AUERBACH DATA COMMUNICATIONS REPORTS

Prepared and Published by

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WHAT IT IS – HOW TO USE IT

.1 WHAT IT IS

AUERBACH Data Communications Reports is an analytical reference service that provides the information you need in order to understand and apply the current technology and new developments in the most rapidly expanding area of the information processing field — data communications. The facts and objective appraisals in this service will help you to select and operate the facilities that will most effectively meet your data communications requirements. All of the information is arranged in standardized formats to permit rapid references and facilitate comparisons. Regular supplements keep you informed of significant new developments in the field.

AUERBACH Data Communications Reports is an extremely useful tool for every user and potential user of data communications systems. Like most tools, it can be used effectively or ineffectively, depending upon the user's understanding of the techniques involved. To ensure that all of the information in AUERBACH Data Communications Reports can be effectively employed in solving your data communications problems, we strongly recommend a thorough reading of the remaining material in this "What It Is — How To Use It" section.

.2 STRUCTURE AND CONTENTS

AUERBACH Data Communications Reports is arranged in a looseleaf format with an open-ended numbering system to facilitate additions and revisions. The service currently consists of six major sections, identified by the divider tabs. Each section is subdivided into a series of reports on closely-related subjects, and most of the reports are further divided into numbered paragraphs. Brief explanations of the contents and purpose of each major section follow.

.21 Reference Guides

The Reference Guides section includes the report you are now reading and a detailed Index. This material is designed to help you to utilize, as effectively as possible, all of the valuable information and advice that AUERBACH Data Communications Reports contains. The Index, arranged in straightforward alphabetical order, will guide you quickly to all the pertinent information about any specific device or general concept.

.22 System Design

The System Design section presents clear-cut explanations of all of the basic concepts and techniques that must be understood by the designer (or informed user) of a data communications system, plus expert guidance in the procedure for defining system requirements and selecting communications facilities, terminal equipment, and processing equipment. Emphasis is placed upon the numerous possibilities for design "trade-offs," and upon the many ways in which the information in AUERBACH Data Communications Reports can be profitably applied throughout the system design process.

.23 Common-Carrier Communications Facilities

This unique section contains detailed, quantitative information about one of the most important yet least understood aspects of the data communications field: the wide variety of communications facilities and services offered by the common carriers such as the Bell System and Western Union. Because of the numerous types of available facilities and the complexity of the applicable tariffs, definitive information about the capabilities and costs of these facilities is extremely difficult to obtain. The Common-Carrier Facilities section of AUERBACH Data Communications Reports — the product of an intensive study of the available facilities and the pertinent tariffs — overcomes this problem by defining the important characteristics, including illustrative costs, of each type of facility. To systematize and clarify the presentation, common-carrier facilities are divided into three major classes: narrow-band, voice-band, and broad-band. Each class is further divided into leased facilities, public switched services, and "packaged" multistation systems.

.24 Comparison Charts

These charts summarize, in formats designed to facilitate objective comparisons, the principal characteristics of commercially-available data communications equipment. The Comparison Chart entries describing Communications Terminal Equipment (page 4200:01) and Communications Processing Equipment (page 4400:01) have been extracted directly from the detailed Equipment Reports in the last two major sections of AUERBACH Data Communications Reports. The entries in these charts are quite comprehensive and largely self-explanatory, but the serious user is urged to turn to the detailed Equipment Reports to ensure that no important characteristic which could not be included in the Comparison Charts section is overlooked. Also included in the Comparison Charts section are summaries of the data sets available for use with common-carrier facilities (page 4600:01) and of the versatile line of data communications equipment manufactured by Teletype Corporation (page 4800:01).

.25 Communications Terminal Equipment

The reports in this section provide detailed information on the characteristics, performance, features, limitations, and costs of individual commercially-available data communications terminal devices. This category of equipment includes:

- Input/output devices that can serve as an interface between human operators and a communications line.
- Single-line communications terminals for general-purpose computers.
- Small general-purpose computers than can function efficiently as remote terminals for larger computer systems.

The Communications Terminal Equipment Reports are arranged in alphabetical order by manufacturer. Each report has the same standardized format to facilitate comparisons and ensure that no important characteristic will be overlooked. A Users' Guide (Report 6000), keyed to the Equipment Reports by means of corresponding paragraph numbers, explains the meaning and significance of each of the standardized report entries. Regular references to the appropriate Users' Guide entries will help you get the most out of the detailed information in the individual Equipment Reports.

.26 Communications Processing Equipment

This section contains a series of reports that provide detailed information on the characteristics, configurations, performance, limitations, and costs of individual U.S.-manufactured communications processing devices. This category of equipment includes:

- Freestanding communications processing systems with self-contained memory, processing, and input/output facilities.
- Multi-line controllers that enable multiple communications lines to be connected to a general-purpose computer system.

The Communications Processing Equipment Reports are arranged in alphabetical order by manufacturer. To facilitate comparisons and ensure that no important factor is overlooked, each report has the same standardized format. (Note, however, that the format of the Processing Equipment Reports is quite different from that of the Terminal Equipment Reports, as it must be to reflect the different functions and degrees of complexity of the two categories of equipment.) A Users' Guide (Report 8000), keyed to the Equipment Reports by means of corresponding paragraph numbers, explains the meaning and significance of each of the standardized report entries.

(Contd.)

.3 REGULAR SUPPLEMENTS

Your copy of AUERBACH Data Communications Reports will be kept comprehensive and up to date by means of quarterly supplements. Each supplement will contain new reports on recently-announced data communications equipment, services, or techniques, and/or revised versions of previously-published reports to reflect changes in equipment characteristics and in the state of the art. A summary of the important new information and easy-to-follow filing instructions accompany each supplement. We recommend that you set up a standard procedure to ensure that each new supplement will be filed promptly and accurately.

.4 THE NUMBERING SYSTEM

Throughout AUERBACH Data Communications Reports, each report is identified by a unique four-digit report number. The report number constitutes the first four digits of the page number at the top of every page within a given report. For example, the pages of Report 3200, Voice-Band Facilities, are numbered 3200:01, 3200:02, 3200:03, etc.

The basic unit of reference for material in AUERBACH Data Communications Reports, however, is not the page, but the paragraph. Referencing by paragraph number rather than by page number permits standardized report structures, ease of cross-referencing, simplicity of indexing, and convenient supplementation.

Every paragraph number consists of one, two, or three digits preceded by a decimal point. For example, Paragraph .3 of every Communications Terminal Equipment Report is titled "Input" and contains a description of the equipment's data input facilities; Paragraph .31 (a subdivision of Paragraph .3) is titled "Prepared Input" and describes the facilities for accepting input from previously-prepared media such as punched cards or tape. To look up the IBM 1050 Data Communications System's facilities for Prepared Input, you simply turn to Paragraph 6447.31; i.e., Paragraph .31 of Report 6447. (The proper report number for any specific equipment can be quickly located in either the sequentially-arranged Table of Contents on page 0100:01 or the alphabetically-arranged Index on page 1400:01.)

All report numbers, paragraph numbers, and page numbers throughout AUERBACH Data Communications Reports are strictly sequential, although there are many "gaps," or omitted numbers. These gaps help to keep the service "open-ended" by facilitating the insertion of new material in the most appropriate places.

.5 DERIVATION AND RELIABILITY

AUERBACH Data Communications Reports is prepared and edited by experienced technical personnel, all of whom are members of the Technical Staff of AUERBACH Corporation.

In gathering, analyzing, and evaluating material for these reports, our staff starts with the specifications and manuals issued by the equipment manufacturers and other reliable sources. Extensive amplification and clarification of the generally-available specifications are usually obtained through visits to or correspondence with the manufacturers. The procedures that are involved in deriving certain standardized report entries from the manufacturers' specifications are clearly explained in the corresponding Users' Guide entries. Every effort is made to adhere to consistent terminology throughout AUERBACH Data Communications Reports; therefore, some of the terms used in our reports on a given manufacturer's equipment may, of necessity, differ from the terms used in the manufacturer's own literature.

Every report describing a specific manufacturer's equipment or services is sent to the manufacturer for review prior to publication. We invite the manufacturer's comments regarding the completeness and accuracy of the report. Where differences of opinion exist between a manufacturer and our staff, however, AUERBACH Data Communications Reports always reflects the opinion of our staff.

Where insufficient specific data is available, estimates may be used. All estimates or approximations are clearly identified as such. Where specific data is unavailable and an estimate is considered impractical, a question mark (?) is inserted in the published report to indicate that the manufacturer was unable or unwilling to supply the requested data.

.6 HOW TO USE THIS SERVICE EFFECTIVELY

The information in AUERBACH Data Communications Reports can meet many different needs, and you are likely to find new applications nearly every time you open it. A thorough reading of the System Design and Common-Carrier Facilities sections and of the two Users' Guides amounts to a concentrated course in data communications technology. The possibilities for casual yet rewarding "browsing" are virtually unlimited. Most of your data communications information needs, however, will probably fall within one of three classes:

(1) Information about a specific device or concept is needed. How can it be located quickly?

(2) Suitable data communications equipment must be selected for a particular application. How can the relevant equipment characteristics be determined and compared?

(3) A data communications system must be designed or modified. What are the recommended design procedures, and how can the necessary information be obtained?

The recommended procedures for using AUERBACH Data Communications Reports to help you solve each of these three types of problems are outlined in the following paragraphs.

.61 Locating Specific Information

To locate the information pertaining to any specific device or concept, the Index (page 1400:01) should always be your starting point. Arranged in straightforward alphabetical order, the Index will guide you quickly to the exact report and paragraph that contains the information you need.

.62 Selecting Data Communications Equipment

The standardized format of AUERBACH Data Communications Reports is particularly valuable in the selection of equipment. First, turn to the Equipment Selection report (page 2300:01) for recommended selection procedures that will help you relate the equipment characteristics reported in AUERBACH Data Communications Reports to your specific requirements. Second, refer to the Comparison Charts of Communications Terminal Equipment (page 4200:01) or Communications Processing Equipment (page 4400:01) for summaries of the important characteristics of individual devices. The Comparison Charts will help you to determine quickly which of the numerous available devices are potentially suitable for your needs.

The devices that survive this "screening" process should now be studied in greater detail by turning to the appropriate Equipment Reports. The number of the Equipment Report describing any specific terminal or processing device can be quickly located in any of three places: the Comparison Charts, the Table of Contents, or the Index. Whenever you use the Equipment Reports, remember that the meaning and significance of every standardized report entry are explained in the correspondingly-numbered paragraph of the appropriate Users' Guide (page 6000:01 for Communications Terminal Equipment or page 8000:01 for Communications Processing Equipment).

.63 Designing a Data Communications System

When a new system must be designed or an existing system modified, the System Design section, beginning on page 2000:01, should be your starting point and your constant guide. The System Design section explains the basic concepts and techniques involved in data communications. It also furnishes clear-cut procedures for defining system requirements, selecting communications facilities, evaluating error control techniques, and selecting both terminal and processing equipment. The manner in which other information in AUERBACH Data Communications Reports can be effectively employed in all phases of the system design process is clearly explained.

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This Index, arranged in straightforward alphabetical order, is designed to guide you quickly to the information pertaining to any specific device or concept described in AUERBACH Data Communications Reports. Please note that all index entries are expressed in terms of report numbers (the first four digits) and paragraph numbers (the digits, if any, to the right of the decimal point). Where no paragraph number is included in an index entry, the entire indicated report is devoted to the subject device or concept. Although page numbers are not directly shown in the index entries, you will find it easy to locate specific material because the report number constitutes the first four digits of every page number.

Index entries that reference Report 6000 (Users' Guide to Communications Terminal Equipment) or Report 8000 (Users' Guide to Communications Processing Equipment) have a special significance. Each reference to Report 6000 or Report 8000 indicates that: (1) a general discussion of the concept will be found in the indicated Users' Guide paragraph, and (2) the manner in which the concept is implemented in individual data communications devices is discussed in the correspondingly-numbered paragraph of the appropriate Communications Terminal Equipment or Communications Processing Equipment Reports.

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Norwood, Mass. 02062

Redcor Corp.
P.O. Box 1031
7800 Deering Ave.
Canoga Park, Calif. 91304

Remcom Systems, Inc.
2705 National Dr.
Garland, Tex. 75040

Rixon-Electronics, Inc.
2120 Industrial Pkwy.
Silver Spring, Md. 20904

Sanders Associates, Inc.
Daniel Webster Hwy., S.
Nashua, N.H. 03060

Sangamo Electric Co.
P.O. Box 359
Springfield, Ill. 62705

Scientific Control Corp.
14008 Distribution Way
Dallas, Tex. 75234

Shintron Co., Inc.
144 Rogers St.
Cambridge, Mass. 02142

Singer Tele-Signal Corp.
250 Crossways Park Dr.
Woodbury, L.I., N.Y. 11797

Sonex, Inc.
20 E. Herman St.
Philadelphia, Pa. 19144

Spiras Systems, Inc.
332 Second Ave.
Waltham, Mass. 02154

Stelma, Inc.
17 Amelia Pl.
Stamford, Conn. 06902

Stewart-Warner Corp.
1300 N. Kostner Ave.
Chicago, Ill. 60651

Stromberg Carlson Corp.
100 Carlson Rd.
Rochester, N.Y. 14603

Stromberg DatagraphiX, Inc.
P.O. Box 2449
San Diego, Calif. 92112

Sugarman Laboratories
295 Northern Blvd.
Great Neck, N.Y. 11020

Sycor, Inc.
100 Phoenix Dr.
Ann Arbor, Mich. 48104

Syner-Data Inc.
133 Brimbal Ave.
Rte. 128
Beverley, Mass. 01915

TEC, Inc.
6700 S. Washington Ave.
Eden Prairie, Minn. 55343

Tally Corp.
8301 S. 180th St.
Kent, Wash. 98031

Technical Communications Corp.
442 Marrett Rd.
Lexington, Mass. 02173

Technitrend, Inc.
7300 N. Crescent Blvd.
Pennsauken, N.J. 08110

Tel-Tech Corp.
9170 Brookville Rd.
Silver Spring, Md. 20910

Telautograph Corp.
8700 Bellanca Ave.
Los Angeles, Calif. 90045

Tele-Dynamics Corp.
525 Virginia Dr.
Fort Washington Park, Pa. 19034

Telematics, Inc.
1431 Broadway
New York, N.Y. 10018

Teletype Corp.
555 Touhy Ave.
Skokie, Ill. 60676

Tempo Computers, Inc.
1550 S. State College Blvd.
Anaheim, Calif. 92806

Terminal Communications, Inc.
P.O. Box 9363
Raleigh, N.C. 27603

Terminal/Computer Systems, Inc.
581 West Putnam Ave.
Greenwich, Conn. 06830

Texas Instruments
P.O. Box 66027
Houston, Tex. 77006

Time-Sharing Terminals, Inc.
2351 Shady Grove Rd.
Rockville, Md. 20850

Tracor Computing Corp.
1705 Guadalupe St.
Austin, Tex. 78701

Transcom, Inc.
12 Tobey Rd.
Bloomfield, Conn. 06002

Tuck Electronics
235 Market Ave.
New Cumberland, Pa. 17070

Tymshare, Inc.
464 Hudson Ter.
Englewood Cliffs, N.J. 07632

Typagraph Corp.
7525 Convoy Ct.
San Diego, Calif. 92111

Ultronic Systems Corp.
Mount Laurel Industrial Pk.
Moorestown, N.J. 08057

Univac
Data Processing Div.
Sperry Rand Corp.
P.O. Box 8100
Philadelphia, Pa. 19101

Universal Data Acquisition Co., Inc.
P.O. Box 36166
3928 Hartsdale Dr.
Houston, Tex. 77036

University Computing Co.
Computer Industries, Inc.
2659 Nova Dr.
Dallas, Tex. 75229

Vadic Corp.
918 Industrial Ave.
Palo Alto, Calif. 94303

Vanguard Data Systems
P.O. Box 1820
1642 Kaiser St.
Irvine, Calif. 92664

Varian Data Machines
2722 Michelson Dr.
Irvine, Calif. 92664

Vernitron Corp.
176 Central Ave.
Farmingdale, N.Y. 11735

Viatron Computer Systems Corp.
Rte. 62
Bedford, Mass. 01730

Victor Comptometer Corp.
3900 N. Rockwell St.
Chicago, Ill. 60618

Video Systems Corp.
7300 N. Crescent Blvd.
Pennsauken, N.J. 08110

Vogue Instrument Corp.
Shepard Div.
480 Morris Ave.
Summit, N.J. 07901

Wescal Industries, Inc.
Division of CCI
2550 E. Imperial Hwy.
El Segundo, Calif. 90245

Western Telematic, Inc.
5507 Peck Rd.
Arcadia, Calif. 91006

Western Union
82 McKee Dr.
Mahwah, N.J. 07430

Wyle Computer Products
128 Maryland St.
El Segundo, Calif. 90245

Xerox Corp.
Midtown Tower
Rochester, N.Y. 14604

Xerox Data Systems
701 S. Aviation Blvd.
El Segundo, Calif. 90245

SYSTEM DESIGN

AUERBACH
DATA
COMMUNICATIONS
REPORTS

SYSTEM DESIGN: BASIC CONCEPTS

.1 INTRODUCTION

Electrical data communications systems have been in existence for more than 120 years, since Samuel Morse invented the telegraph in 1844. Torn-tape telegraph systems, which transmit data at the rate of around 10 characters per second, have been used for many years and are still appropriate for certain applications. This type of data communications system, however, fails to meet many of the requirements of modern industry. The effectiveness of data communications systems in meeting industry requirements has been greatly enhanced during the last few years by the development of reliable medium- and high-speed terminal equipment and communications processing equipment, in conjunction with the availability of reasonably priced standard communications facilities and flexible common-carrier services.

A data communications system can be considered to consist of a group of functional units whose primary purpose is to transfer digital data between two or more terminals in a reliable manner. Each unit has a specific set of functions to perform; the exact functions and the sequence and manner in which they are enacted are determined by the overall system requirements. Because system requirements vary from business to business and from application to application, the data communications systems in use today vary widely in their functions, their structures, and their degree of complexity. Some systems transfer messages between remote terminals via one or more switching centers where communications processors are located; other systems transmit inquiries from numerous remote terminals to a central data processing facility, which generates responses and routes them back to the inquiring terminals. The design of systems such as these demands a thorough knowledge of both data communications and data processing technology.

.2 FACTORS TO BE EVALUATED

In order to determine the most suitable structure for a specific data communications system, a number of basic factors must be evaluated. These can generally be described as the information flow requirements, and they include the following:

- The number of data sources and points of distribution and their locations.
- The volumes of information (in terms of number of messages and lengths of messages) that must flow among these locations.
- The intervals at which messages will be transmitted. Are these intervals fixed or random? What are the peak rates, and at what times of day will they occur?
- The form of the data to be transmitted.
- The form in which the data must be when received.
- How soon the information must arrive at its destination to be useful. How much delay is permissible, and what are the penalties for delay?
- The reliability requirements. What degree of accuracy must be maintained in the transmitted data? What is the penalty for system failure?

The installation of a data communications system should always be preceded by a thorough study and reevaluation of the patterns of information flow throughout the organization. Money spent in simply mechanizing the existing procedures for collecting, transmitting, and disseminating information is likely to be largely wasted. The real purpose and need for every type of information that is currently being transmitted should be questioned. It is likely that most executives are regularly receiving some information that is of little or no value to them, while failing to receive other information that could aid significantly in decision-making and cost control and that could easily be provided if the need were recognized. In

some cases, the improved flow of information resulting from such a thorough study of information needs will provide far greater benefits than the data communications equipment itself and may even preclude or postpone the need for mechanization of the information system.

Usually, by the time the need for data communications develops, a company has established extensive voice communication facilities, in addition to those offered by the public telephone system. The locations served by these existing facilities frequently include the locations to be served by the proposed data communications network. A serious study of the implementation of a data communications system must include an analysis of the company's present communications facilities and the ways in which they can be employed. For example, leased lines may currently carry little or no traffic at night; these lines could be used for the transfer of data during the slack hours at no increase in the present cost of communications facilities other than for switching, termination, and terminal devices. Use of present facilities requires close coordination between the company personnel responsible for general communications and the personnel responsible for data communications. The local common-carrier communications consultants should be contacted for help in determining the ways in which existing facilities can best be used or modified for data communications.

The design of a data communications system requires a careful analysis of each of the foregoing factors. It also demands satisfactory solutions to a wide variety of potential problems, many of which are interrelated in complex ways. These problem areas include the following:

- Estimating the volumes of data to be transmitted, now and in the future, and the associated traffic statistics
- Providing for traffic overloads
- Distributing the storage and computer capabilities to best fulfill the system requirements and balancing these capabilities with the capacities and speeds of the transmission facilities to minimize the overall cost
- Optimizing the system configuration in terms of fulfilling reliability and backup requirements and maintaining continuous, efficient operation
- Selecting adequate yet economical error detection and correction techniques
- Establishing the programming requirements for any communications processors and specifying the necessary storage and processing capabilities
- Formulating a training program for operating and maintenance personnel and an indoctrination program to help all employees understand the purpose of the system and its effects upon their jobs

A design problem of a slightly different character, but one that deserves considerable emphasis, is the development of a system that is open-ended, i.e., one that is capable of expansion to handle new plants or offices, higher volumes of traffic, new applications, and other difficult-to-foresee developments associated with the growth of the business. The design and implementation of a data communication system is a major investment; proper planning at design time to provide for future growth will safeguard this investment.

These design problems cannot be treated separately; they are interrelated through the various system parameters, so that a decision that solves one problem may lead to a variety of others. Tradeoffs become necessary between equipment, programming systems, communications facilities, and the operating requirements. In the remainder of this system design section, considerable attention is devoted to the nature and implications of these tradeoffs.

.3 SYSTEM COMPONENTS

Figure 1 illustrates the data flow between two terminals in a typical data communications system. An input device at the transmitting terminal wishes to communicate with an output device at the receiving terminal. The input device may be a keyboard, paper tape reader, card reader, magnetic tape unit, or computer. The output device may be a tape punch, card punch, printer, magnetic tape unit, display device, or computer. Other units included in the typical system shown in Figure 1 are the communications facility, input/output control units, error control units, synchronization units, and modulator-demodulators. In most cases, several of these functional units are housed in one cabinet and marketed as a single communications terminal device. Each of these functional units is briefly discussed in the following paragraphs and described in greater detail in subsequent sections of AUERBACH Data Communications Reports.

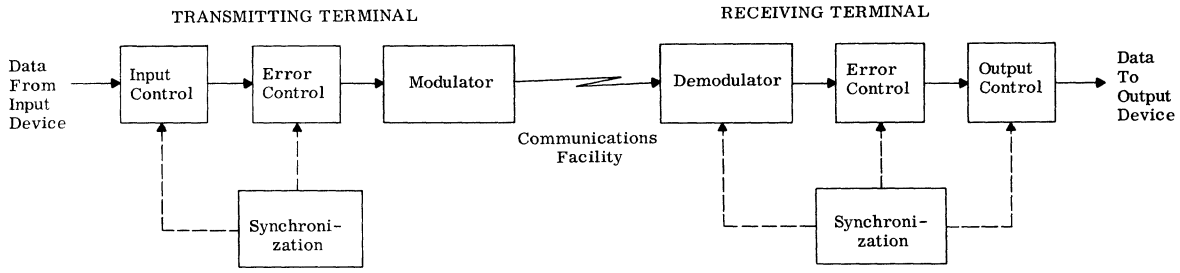


Figure 1. Data Flow in a Typical Data Communications System

.31 Communications Facilities

A communications facility, in the broadest sense, is a means by which data can be transmitted between two or more points. Some of the common types of communications facilities are telephone and telegraph cables, high-frequency radio, and line-of-sight microwave. Although there are many types of communications facilities, the types most commonly used for data transmission at present, because of their wide availability and economy, are the standard public telephone and telegraph line facilities. Telephone line facilities, though designed specifically for voice communications, can be employed for transferring digital data at higher rates than are possible with telegraph facilities.

Communications facilities, in conjunction with the appropriate terminal and/or processing equipment, can be employed for operation in one or more of the following basic modes:

- Simplex - communications in one direction only
- Half-duplex — communications in both directions, but in only one direction at a time
- Full-duplex — communications in both directions simultaneously

For more detailed discussions of the available communications facilities, please see Page 2100:01 of this report section and the entire Common-Carrier Communications Facilities section, beginning on Page 3000:01.

.32 Input/Output Control Units

The input control unit at the transmitting terminal, when present, controls and accepts data from the input device at a rate that is usually dictated by the input device's speed. The control unit stores the data temporarily and transmits it at a rate compatible with that of the communications facility. At the receiving terminal, the output control unit, when present, accepts the received data, stores it temporarily, and supplies it to the output devices at the appropriate rate. In real-time data communications systems, the type and capacity of the

buffer storage within the input and output control units is one of the main concerns because it determines the frequency at which servicing by the processor will be required. Various types of buffers are available, such as magnetic core memories, magnetic drums, transistorized shift registers, and delay lines.

It should be noted that not all data communications terminals employ buffered input/output control units. When no buffers are used, the input, data transmission, and output functions must proceed simultaneously and at the same speed.

In data communications systems that are more complex than the basic point-to-point hookup shown in Figure 1, the input/output control units at the processing or switching centers are likely to be multiline controllers, or even stored-program communications processors, which are capable of buffering and controlling simultaneous input/output transmissions on many different lines.

.33 Error Control Units

In transferring data over a communications link, errors can be expected to occur as a result of: (1) noise and other disturbances introduced into the link, (2) the inherent characteristics of the link, and (3) the environmental characteristics of the link. Error control techniques can be used in data communications systems to detect and/or correct certain types of errors. Techniques that merely detect and indicate errors are generally less complex and expensive than techniques that detect errors and then correct them. In most error control schemes, the digital data at the transmitting terminal is encoded to conform to some set pattern. At the receiver, the data is decoded and checked to see whether the received data pattern conforms to the prescribed rules. For a detailed discussion of the subject of Error Control, see Page 2200:01.

.34 Synchronization Units

Because the transmitted data signals are time-dependent (i.e., the bits are transmitted at precise time intervals), synchronization between the transmitting and receiving stations must be ensured. Special equipment must be provided to accomplish the synchronization. Its type and cost depend on the method used to establish synchronization. Two commonly employed techniques are referred to as "start/stop synchronization" and "synchronous transmission."

In the start/stop technique, additional signals are transmitted with each unit of data (typically, with each character) to identify the beginning and the end of the group of data bits. The data bits within each data unit are transmitted in a strict time sequence, but consecutive data bits are transmitted asynchronously; i.e., there is no definite time relationship between the transmission of successive characters. Upon recognition of a start signal, internal circuitry or other means at the receiving station is actuated to time the arrival of the data signals constituting the transmitted data unit. The advantages of this method are that it allows data transmission from sources with highly irregular data input rates (such as a manual keyboard) and that the probability of cumulative errors in synchronization is minimized. However, the extra start and stop bits that need to be transmitted along with the data bits increase the required line capacity.

In the synchronous transmission technique, which is sometimes referred to as "bit stream synchronization," a specific character is transmitted to the receiving terminal. The bit configuration of this character is used to adjust the synchronizing circuitry to conform with the transmitted bit rate. Usually the synchronizing character must be transmitted several times to enable the transmitting and receiving stations to establish synchronization. During the transmission of data signals, the receiving terminal is kept in step with the transmitter by a high-precision oscillating circuit or other means. Often the synchronizing character is transmitted during idle periods to maintain synchronization and minimize the delay involved in

initiating a transmission. The advantage of this type of synchronization is that it permits higher data transmission rates than the start/stop method; the disadvantage is that it requires highly precise and relatively expensive circuitry to maintain synchronization throughout the transmission of long messages.

.35 Modulation-Demodulation Units

In the early days of digital data communications, telegraphy was the sole transmission technique employed. In this technique, voltage levels are used to represent the different data signals or bits. For example, a positive voltage may represent a "1" bit or "mark" condition and a zero or negative voltage may represent a "0" bit or "space" condition. The communications lines using this type of transmission are referred to as "telegraph-grade" lines. This type of transmission is still in widespread use for teleprinter communications at speeds up to 75 bits per second. The disadvantages of the telegraph transmission technique are that only one conversation or data path is conveniently available and that a large bandwidth is required relative to the transmission rate.

A newer technique, which is called the "carrier" technique throughout these reports, was developed to take advantage of the communications facilities that were being developed with larger bandwidths than those of telegraph-grade lines. In the carrier technique, constant-level (DC) pulses, such as those used with telegraph-grade lines, are not transmitted; instead, the data signal varies regularly with time, establishing a transmission frequency. The significance of the carrier technique is: (1) that a higher transmission rate can be more safely accommodated than with the telegraphy method, and (2) that equipment can be designed to isolate different frequencies, which allows multiple independent data paths to be in existence on the same line at the same time. The common carriers are making extensive use of the latter feature to pack many voice channels and/or data channels into a single broadband communications facility.

Many techniques are used to modify or alter the basic frequency signal to provide the capability for sending digital data. Some of the more common methods include:

- On/Off: The signal is keyed on and off much in the same manner as in telegraphy.
- Frequency Shift Keying: Signals of two different frequencies are transmitted to indicate the "0" and "1" bits.
- Amplitude Modulation: The amplitude (or strength) of the signal is varied to indicate the different levels.
- Frequency Modulation: The frequency of the signal is varied to indicate the different levels.
- Phase Modulation: The phase, or time relationship between the parts of a signal, is varied to indicate the various levels.

One characteristic of all the methods mentioned is that to transmit a composite signal with sufficient accuracy to enable the signal to be correctly interpreted at the receiving terminal, a bandwidth, rather than a single frequency, is required. When transmitting multiple independent signals over the same line, the assignment of a specific bandwidth for each signal is required to prevent one signal from interfering with another.

There is a definite relationship between the allocated bandwidth and the maximum data transmission rate that can be reliably handled. Current theory indicates that a transmission rate in bits per second of twice the bandwidth in cycles per second is possible. Thus, a voiceband line with a bandwidth of 3000 cycles per second could theoretically accommodate a transmission rate of 6000 bits per second, although the actual rates employed in most current applications of voiceband lines are much lower.

The importance of the foregoing information on the carrier technique to a user of data communications equipment is that:

- All standard communications facilities for transmitting data at rates above 75 bits per second (as well as certain lower-speed facilities) employ some variation of the carrier technique.
- Additional equipment is required to convert the constant-level (DC) pulses generated by most data communications terminal and processing equipment into signals suitable for transmission.

The additional equipment mentioned previously is a modulation-demodulation unit, frequently referred to as a modem or data set. Data sets are available from the common carriers for use with a wide range of standard communications facilities; see the Common-Carrier Data Sets Comparison Chart, Page 4600:01. In addition, several companies (such as Collins Radio Co. and Lenkurt Electric Co.) manufacture data sets for use on private communications facilities or, in some cases, leased common-carrier facilities. The data sets manufactured by these companies can provide significantly higher data rates than those furnished by a common carrier for use on the same type of communications line, but they are likely to be more expensive than the common-carrier data sets and may require special conditioning of the lines.

.4 APPLICATIONS

The specific applications for which data communications systems are currently being employed are widely variable in their functions, their scope, and their equipment and programming requirements. New applications are being developed every day, and it would clearly be impossible to describe, or even list, all of the specific applications in which data communications equipment is being used. A more rational approach is to divide the total spectrum of data communications applications into a few fundamental application classes, each of which performs a certain general function and involves a certain type of data flow pattern. Most specific applications will then be found to fall neatly into one application class or to combine the functions of two or more classes.

Although either coarser or finer breakdowns could be justified, it seems reasonable to consider six fundamental application classes:

- Data collection
- Data distribution
- Inquiry processing
- Computer load balancing
- Computer time sharing
- Message switching

The function and data flow pattern of each of these basic applications of data communications equipment and techniques are described in the paragraphs that follow.

.41 Data Collection

The function of this class of applications is the collection and transmission to a central processing point of information concerning the operations of geographically separated manufacturing plants, warehouses, branch and regional sales offices, and other outlying facilities.

The basic data flow pattern is unidirectional, from multiple remote (and/or local) terminals to the central processing facility. This type of system can: (1) provide the complete, timely information about a firm's overall operations that is required for accurate cost control and informed management decisions, and (2) reduce the number of times and places at which data must be manually handled and transcribed, thereby cutting clerical costs and error rates.

.42 Data Distribution

In this class of applications, the principal function is the distribution of data generated and/or processed at a central facility to one or more outlying locations. Again the basic data flow pattern is unidirectional, from the central facility to the remote (and/or local) terminals. This function, of course, is the complement of the data collection function described in Paragraph .41, and many data communications systems combine the collection and distribution functions. To appreciate the potential value of a data distribution system, it is necessary to realize that data has no real value until it has reached the actual point of application in a useful form. Significant financial benefits can frequently be realized through cutting down the elapsed time and improving the accuracy of the data dissemination process.

.43 Inquiry Processing

To meet the competitive demands of modern business, many firms are finding it desirable (and in some cases essential) to "go on-line" by establishing central data files that can be randomly accessed to provide prompt responses to inquiries from outlying locations. In this class of applications, the basic data flow pattern is bidirectional; inquiry messages are transmitted from a network of remote terminals to the central processing facility, and appropriate response messages are generated and transmitted back to the inquiring terminals.

The inquiry processing function is frequently combined with real-time file updating, in which case the appropriate entries in the central data files are modified each time a transaction occurs so that the central files always reflect the true current status of the business. Although inquiry processing and real-time file updating systems promise great potential benefits for nearly every type of business organization, their advantages in terms of faster response and centralized control should be carefully weighed against their costs to ensure that the higher direct cost of a real-time system, as compared with that of a more conventional batch-type data processing system, is worthwhile. Real-time inquiry systems are especially beneficial for organizations such as banks, brokerage firms, airlines, and hotels, where prompt servicing of customer inquiries is of critical importance.

.44 Computer Load Balancing

Organizations that have two or more computers in geographically separated locations may find it advantageous to connect them by means of communications links. This permits more effective use of each of the interconnected computers because the slack time in one computer's schedule can be used to help smooth out the peaks in another's. Reliability is greatly enhanced by the fact that the communications links make it easy for one or more computers to take over another computer's workload when a breakdown occurs. The data flow pattern in this class of application is bidirectional; input data and results are transmitted between each pair of interconnected computers, and the volume of data flow depends upon their relative workloads at any given time.

.45 Computer Time Sharing

Time sharing is the simultaneous operation on a computational facility by more than one person, each situated in a remote location. Two basic types of systems are in use today: conversational time sharing and remote batch processing. Both types have the same fundamental characteristics: multiple consoles, appropriate input/output facilities, and consoles connected to the central computer facility by communications links. Conversational systems consist of remote terminal devices, which are usually of the keyboard type, employing voiceband transmission facilities. Short turnaround time is characteristic of these systems and allows for close man-machine interaction.

Remote batch processing systems find application where a large program or a large number of programs are required to be run to completion. They are usually used with higher-speed terminals, sometimes employing a computer as a terminal.

The basic data flow pattern in a time sharing system is bidirectional and similar to the pattern for the inquiry processing class of applications; input data and operating instructions are transmitted from the consoles to the central computer facility, and the results of computations are transmitted back to the appropriate consoles. The widely discussed "public utility" computer concept, in which multiple subscribers would share the facilities of a giant centralized computer complex on a toll basis, is a logical extension of the computer time sharing class of applications.

.46 Message Switching

Activities of a modern corporation tend to be spread out over a large number of widely separated locations, and an efficient system for handling communications among all these locations is vitally necessary. Where communications traffic is high, a computer-controlled message-switching system is likely to be the best overall choice. In this type of application, the data flow pattern involves two-way message traffic between a number of terminals and a central switching center. The sending terminal transmits each message to the center, which stores it temporarily, performs any processing or code conversion functions that may be required, and then retransmits the message to one or more designated receiving terminals. Large networks may use two or more switching centers that are interconnected by high-speed communications links.

Many of the principles and considerations involved in the design of a message-switching system are equally important in the design of data communications systems for applications in the previously described classes. A relatively large amount of experience has already been accumulated in the design and operation of message-switching systems; therefore, a detailed account of the principles, operations, and inherent advantages of computer-controlled message switching systems is included in AUERBACH Data Communications Reports, beginning on Page 2400:01.

SYSTEM DESIGN: COMMUNICATIONS FACILITIES

.1 DATA TRANSMISSION BY ELECTRICAL MEANS

Several basic concepts and definitions should be understood prior to a discussion of data transmission by electrical or electronic means.

The amplitude of an electrical signal refers to the strength of that signal. An electrical signal or wave-form can be completely defined by using only two parameters, amplitude and time; i.e., given the relationship (which may be quite complex) between the amplitude of a signal and time, the signal is completely known and can be faithfully reproduced.

If the form of the signal is repeated periodically, the signal is said to possess a frequency; i.e., the frequency is the number of times the form is repeated in a specified length of time. One important fact concerning periodic wave-forms is that if the type, or basic shape, of a wave-form is known, only a few measurements at specific time intervals will suffice to precisely identify the wave-form. This fact simplifies the hardware required to interpret transmitted signals.

An important characteristic of a periodic wave-form is phase, or the time relationship of one part of the wave-form with another. If the basic form of the signal is not changed but is merely shifted with regard to the preceding part of the signal, a phase shift has occurred. Thus, the basic characteristics of a periodic wave-form are its amplitude, frequency, and phase.

To facilitate mathematical analysis, a complex wave-form can be regarded as the sum of several simpler wave-forms, each having its own characteristic amplitude, frequency, and phase. In addition, phase or time relationships exist between the various component wave-forms. For a given wave-form there is a minimum frequency component and a maximum frequency component required to define the signal. The range of frequencies between these two limits defines the bandwidth necessary for transmission of the original signal.

At a given instant in time, it is convenient to think of a transmitted signal as having fixed characteristics; i.e., a particular frequency, amplitude, and phase. When these characteristics remain constant for a period of time, they can be called "states." The length of time that a signal must remain in a particular state before it can be identified is a function of the technique used to interpret the signal. For example, a high-frequency state must exist for only a short time before enough information can be determined in order to identify that frequency; the rate and technique of sampling, however, may require a considerably longer time before the identification can be made.

Digital data communications devices generate or receive signals via communications lines for the purpose of transmitting data that has been digitally encoded. The pulses generated are typically DC pulses with constant voltage levels (amplitude). These discrete signals can be transmitted over an essentially continuous medium (the transmission line) by transmitting a signal in which a particular state (amplitude, frequency, or phase) is associated with each pulse. That is to say, the pulse representing a "1" bit could be represented by a signal having one frequency, and the "0" bit pulse by a signal having a second frequency. The signal representing the complete transmission will have many changes of state to represent the many bits that are being transmitted. The signal changes characteristics whenever it changes from one state to the next, so samples of the signal must be taken within each "bit time." Some means of synchronization must be established between the transmitting terminal and the receiving terminal to ensure that the sampling process will be performed accurately. A discussion of various synchronization techniques can be found in Paragraph 2000.34.

The transmitted signal can never perfectly represent the desired input pulses because of: (1) the finite time period required to change states, and (2) various distortions due to inherent characteristics of the transmission medium or to external causes. A discussion of the causes of distortion in transmission media is presented in Paragraph 2200.2. The distortions introduce components having characteristics that differ from the basic components representing the ideal signal. When interpreting the state of a signal, these components alter the value that will be obtained.

Thus, the condition representing a particular data bit actually consists of a range of state values. States representing the different bit values must be separated widely enough so that there is no overlapping of the ranges, which could result in ambiguity and, hence, errors. The total bandwidth is the sum of the bandwidths corresponding to each state that the signal must assume and includes the spreading effect due to distortion. It is not feasible, in general, to provide a bandwidth sufficient for accommodating all of the types of distortion that might develop, so there is a high probability that errors will occur at some time. A detailed discussion of error control is presented in Report 2300.

The foregoing discussion is equally applicable whether the transmission medium is a pair of wires or a high-frequency radio signal. When transmitting via radio, the transmission medium itself is a periodic wave-form; the modulated data signal is not transmitted as such but is used to modify the basic characteristics of the "carrier wave." The concept of bandwidth applies here in determining the spacing of the frequencies of the carrier waves required to eliminate or reduce interference between independent signals. Similar techniques can be used to miltiplex several independent data signals over the same pair of wires; the receiving equipment separates the signals on the basis of the carrier frequencies and relative bandwidths.

.2 SELECTION OF COMMUNICATIONS FACILITIES

Once the information flow requirements for a data communications system (see Paragraph 2000.2) have been determined, the parallel, interrelated problems of line and equipment selection can be attacked. (Factors to be considered in equipment selection are discussed in Report 2300.)

The types of communications facilities that are currently available can be logically divided into three classes:

- Narrowband Facilities: provide capabilities for data communications at up to 300 bits per second.
- Voiceband Facilities: make use of communications channels having bandwidths of about 3000 to 4000 cycles per second. The public telephone network uses channels with a bandwidth of about 3000 cycles per second. Leased lines usually have bandwidths of about 4000 cycles per second. Equipment is currently available from the common carriers for data transmission at up to 2400 bits per second over the leased facilities.
- Broadband Facilities: provide data communications at rates higher than voiceband facilities. Current facilities can provide transmission rates up to several million bits per second.

The facilities offered by the common carriers within these three classes are discussed in detail in the section on Common-Carrier Communications Facilities; see Reports 3000 through 3300. Throughout the communications industry, all types of communications facilities are commonly referred to as "lines," even though they may actually consist of coaxial cables or microwave or high-frequency radio links.

The primary consideration in selecting the types and numbers of lines to be used in a specific application is the provision of adequate service at minimum total cost. In determining the relative costs of various facilities, the analyst should consider all pertinent charges, including channel terminals, local channels, data sets, conditioning charges, and so forth, in addition to the basic mileage charges or message rates.

.21 Effective Transmission Speed

Determination of the most economical communications facilities depends to a large extent on the system requirements and on the characteristics of the terminal equipment to be used. The effective rate, or long-term average rate, at which data can be transferred over a communications link will usually be significantly lower than the peak rate of the transmitting and receiving terminals. The peak rate determines the needed capacity of the transmission line; the effective rate determines the throughput, or the rate at which information can be accurately delivered

when averaged over a long period of time. The selected terminal equipment and communications facilities, in combination, must be fast enough to ensure that the system throughput requirements can be met.

Factors involving the communications line that can influence the effective rate include the occurrence of errors and the turnaround time. The error detection and correction technique selected may require the transmission of redundant information with each data character or each message, or it may require the retransmission of parts or the whole of a message when errors are detected. Both of these techniques essentially require the transmission of the same information more than once. At a given transmission rate, this redundancy reduces the effective amount of information that can be transferred; its purpose, of course, is to increase the accuracy of the data transmission process.

To reduce the effect that errors have on the effective rate of transmission, the data can be transmitted in shorter blocks, which reduces the number of errors likely to occur during the transmission of a single block; this in turn lowers the requirements for error detection and correction. But the performance of the terminal equipment is usually affected by the size of the transmitted data block; in general, the shorter the data block, the slower the effective transmission rate of the terminal, due to turnaround time, equipment start/stop time, etc. These factors must be balanced to arrive at the most economical solution for a given communications line.

A second technique for reducing the effects of transmission errors is to use the transmission line at only partial capacity. This usually serves to reduce the number of errors that occur. The increase in transmission efficiency due to lessening the requirements for redundant transmission may well be negated by the reduction in peak transmission speed, so a careful analysis must be made to determine the advisability of reducing the data transmission rate on a given line.

Some terminal equipment requires an answerback transmission from the remote terminal prior to initiating the next transmission. This return message is usually required as a signal that the data block just transmitted was in error or was without error; the terminal can then either retransmit the current data block or transmit the next one. When transmitting in a half-duplex mode, the time required to condition the communications link and the terminal for the changes of direction of transmission (i.e., the turnaround time) can take as long as one-half a second per change. At a transmission rate of 300 characters per second, this would have the same effect as adding 300 characters to each data block transmitted.

Long turnaround times are usually associated with terminal equipment using synchronous transmission; the extra time is needed to establish synchronization in the reverse direction. Frequently, such terminals can transmit data only in a half-duplex mode, but can maintain synchronization in both directions at once through the use of a full-duplex transmission line.

Such usage can materially increase the throughput for short data blocks, and it can thereby provide the secondary benefit of reducing the effect of transmission errors by permitting more efficient transmission of short data blocks. Again, these factors are interrelated, and a careful study must be made to arrive at the most efficient manner for using a particular communications facility.

.22 Leased Versus Switched Facilities

Another type of analysis that must often be made to arrive at the most economical method for transmitting data involves the cost tradeoffs between the use of switched facilities that are charged on a per-call basis and leased facilities that are charged at a flat rate regardless of the volume of usage.

When trying to determine which of the two types to use, keep in mind that different considerations are involved in obtaining the most efficient use of each type. Two objectives to strive for in designing and regulating the data flow pattern over message-rate (switched) facilities are:

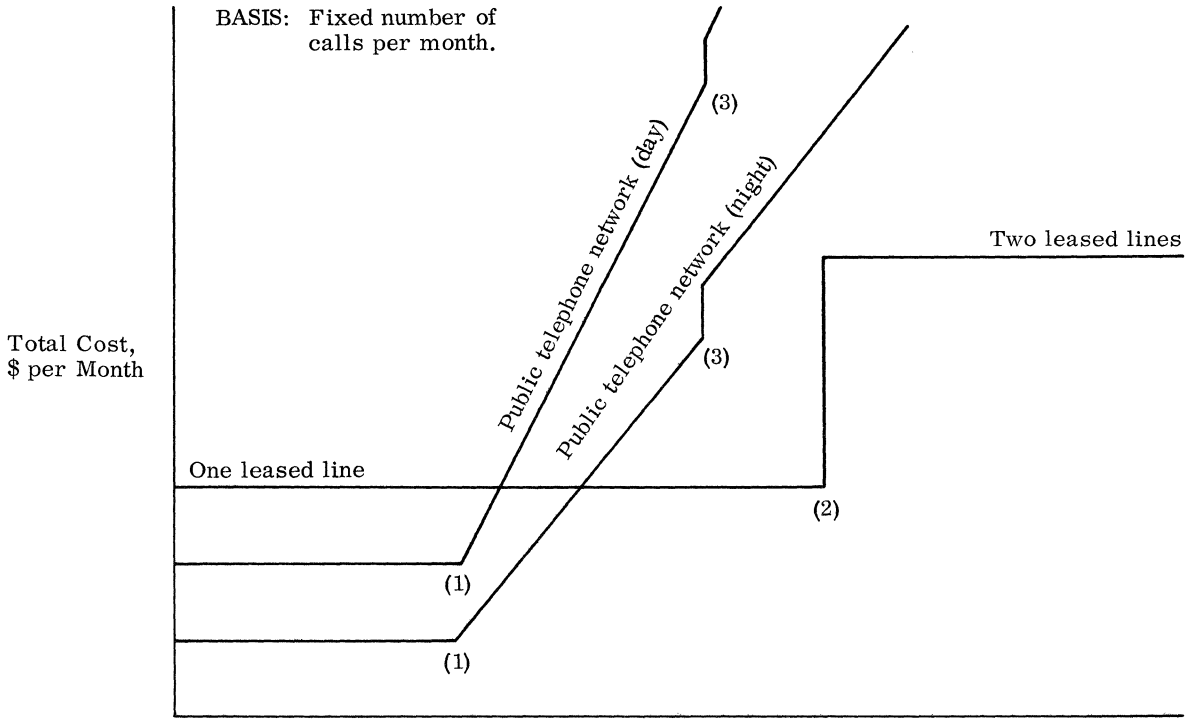
- To minimize the number of calls;
- To optimize the length of each call with respect to the rate structure; e.g., one-minute calls over a service with a minimum charge based on three minutes' use will generally be inefficient.

The primary consideration for optimizing the use of a leased facility is to keep the line as busy as possible, thereby reducing the cost per message. Needless to say, loading up a line with nonpertinent data does not constitute efficient usage under any conditions.

One type of graphical analysis that can be used to study the tradeoffs between a message-rate facility and a leased facility is presented in Figure 1. The points where the lines representing the different communication facilities cross are the break-even points. In some cases, the cost for the switched network may never be lower than for a leased line (e.g., for a large number of calls per day, each consisting of a relatively small number of characters).

If a cost analysis of the type shown in Figure 1 does not favor either type of service to a great extent, other factors can be used to make the decision. For example, leased lines can be specially conditioned to reduce the probability of transmission errors, while the public telephone network offers greater flexibility and guards against catastrophic line failure because many alternate data paths are available through the various exchanges.

The foregoing type of analysis can just as easily be applied to narrowband service, e.g., comparing the use of Bell System TWX Service or Western Union TELEX Service with the use of leased lines.



Notes:

(1) Cost per call remains constant for short calls up to the 3-minute minimum.
(2) At this point the required capacity exceeds the capacity of one leased line.
(3) At this point the required capacity exceeds the capacity of one line; additional lines to the exchange and data sets are required.

Figure 1. Cost Relationships between Message-rate and Flat-rate Facilities

When the application calls for communication between only two points, a straighforward application of the preceding ideas will usually provide the information necessary to determine the type of communications facility that will be the most economical. Other considerations that can affect the decision include the availability of the particular service selected in the areas where data communications may be needed in the future, and the ease with which the selected service will fit into future networks that may be included in the organization's long-term plans.

.23 Planning Complex Networks

Added complexities arise when the application involves interconnection of a number of locations. Often the information flow requirements vary widely between the various pairs of locations, necessitating the use of different types of communications facilities and terminal equipment for maximum economy. Careful consideration must be given to the compatibility relationships among the various types of equipment selected, particularly where data must be extracted and reentered at several different points in the network. Again, future plans should be considered to ease the problems of expansion at a later date.

When the number of locations to be connected is large, consideration should be given to establishing concentrators, or switching centers. A concentrator is a device that combines or multiplexes multiple messages from a number of lines for simultaneous transmission over a single high-capacity line to a remote distribution center where the reverse procedure is performed. Alternatively, all points in a network can be connected to a single switching center. A switching center eliminates the necessity for interconnecting each pair of locations by means of individual communications lines, while maintaining the capability for communication between any two points in the network. Many combinations of these two basic concepts can be devised, and one of these may prove to be the most economical solution for a specific application.

The complexities involved in selecting the most economical communications facilities for an application involving a large number of locations necessitate the expenditure of a considerable amount of technical effort. The local common-carrier communications consultants should be consulted early in the planning stage for a data communications system that will use common-carrier facilities. Other possible sources of help in planning a data communications system are the equipment manufacturers' representatives and private consultants. For best results when dealing with any type of consultant or manufacturer's representative, the information flow requirements and all known problem areas should be well defined prior to requesting their assistance.

.24 Reliability Considerations

Because the day-to-day operations of a business will usually become heavily dependent upon the proper functioning of a data communications system once it has been installed, adequate provisions must be made for reliable operation and for backup in the event of failure. Provisions should be made to ensure that vital information, at least, can be transmitted even in the event of a catastrophic malfunction, such as complete failure of a major item of equipment or a communications line. If a public switched network is being used, service can usually be restored simply by redialing the connection; the multiplicity of data paths in the network provides an abundance of alternate routings. In the case of leased facilities, however, such alternate routings will not normally be available. If multiple lines are being used to carry the communications load between a particular pair of locations, loss of one line will naturally impair communications but will not hopelessly cripple the system's operation.

In any communications link that is implemented by only a single leased line, some thought should be devoted to the provision of backup facilities. If the transmitted information is so vital that delay of any of the information for any significant period of time cannot be tolerated, serious consideration should be given to the provisions of duplicate line facilities. In a less stringent environment, the public telephone network, TWX, or TELEX service may provide adequate backup capability by enabling the transmission of urgent information to continue while the malfunction in the normally used facilities is being located and repaired.

SYSTEM DESIGN: ERROR CONTROL

.1 BASIC FACTORS

Errors will occur in every data communications system. This basic truth must be kept in mind throughout the design of every system. Important criteria for evaluating the performance of any communications system are its degree of freedom from data errors, its probability of detecting the errors that do occur, and its efficiency in overcoming the effects of these errors.

Data errors occur primarily as a result of: (1) data transmission inaccuracies resulting from the inherent characteristics of the communications links, and (2) equipment failures. As a general rule, any error control technique that increases the reliability of the data transfer also increases the system's complexity and cost. Thus, it is essential to weigh the type and amount of error control required.

The degree of error control implemented in the design of a data communications system is normally dependent upon the following factors:

- The Nature of the Data. If the type of data to be transferred via the data communications system is of a critical nature, then sophisticated techniques must be employed to overcome data transmission inaccuracies. As an example, if data relating to invoices or space vehicle check-out is being transferred, then a change in a single digit can cause an embarrassing or dangerous situation. However, if administrative-type messages are being transferred, then transmission errors may not cause enough problems to warrant the cost and complexity of special error control measures.

  Regardless of the general nature of the data, one type of information that must always be transmitted accurately is the control information that is exchanged between terminals to control synchronization, retransmission, or other functional operations. This control information is, of course, subject to the same errors as the content of the messages. Techniques for ensuring that control information is transmitted accurately include using rigid formats to facilitate error detection and requiring that transmission of each control code be repeated a certain number of times. Since the effectiveness of most error control techniques increases as message length decreases, the exchange of control information is frequently restricted to short transmissions which are logically independent of the main data transmissions.

- The Type of Transmission Medium. The common types of transmission media include open wires, cables, coaxial cables, high-frequency radio, and line-of-sight microwave. When using common-carrier facilities, a system designer usually has little control over the actual medium used; frequently, several types are used to form a single connection between two locations. In many parts of the world, a designer has little choice and must make the best of the media that happen to be available. Different types of transmission media are subject to different types of distortion and different error rates.

- The Transmission Medium's Environment. One communications facility may introduce more errors into a data stream than another as a result of its environment. A telephone cable exposed to continuous icy and stormy weather conditions is likely to produce more data errors than a telephone cable in a more moderate environment. Thus, the environment can significantly affect the type of error control required.

- The Data Rate. An error control technique that has been found adequate for data transferred at a low rate may need to be improved if the same data is transferred at a higher rate because noise that can cause errors in a link frequently occurs in bursts. More bits will naturally be obliterated by each burst of noise at high data rates than at lower data rates, and compensation for this effect may be necessary.

Errors occurring as a result of equipment failures are not normally compensated for by the error control techniques employed to guard against transmission inaccuracies. The concept of equipment reliability is a major item for concern, and is by no means unique to data communications systems. Unfortunately, meaningful quantitative data regarding the reliability of individual data communications devices is extremely difficult to collect and correlate. Briefly, the following steps can be taken to enhance the reliability of data communications equipment:

- Use high-quality components with long mean-time-between-failures (MTBF) ratings.
- Provide equipment redundancy where justifiable; i.e., provide each critical system component in duplicate or triplicate. (Where three or more components are used on-line to perform the same function, automatic "majority voting" logic can be used to detect and overrule errors in any one component.)
- Provide appropriate sensors and alarms to ensure prompt detection of equipment failures.
- Provide for ease of maintenance to minimize downtime due to equipment failures.

Having recognized the factors that determine the degree of sophistication required in the error control provisions, one should then acquire a knowledge of the common causes of data transmission errors and the error rates that can be expected.

.2 CAUSES OF ERRORS

Several common causes of data transmission errors are explained in the paragraphs that follow.

.21 Noise

Errors can occur in a communications link because of random fluctuations which interfere with the transmitted signal. These random fluctuations are classified as "noise." The following two types of noise are generally of interest:

- Steady Line (Gaussian) Noise. This type of steady "background" noise frequently interferes with speech transmission, but its effect upon digital data transmission is usually not very significant if the signal-to-noise ratio is maintained at an adequately high level through the use of repeaters (amplifying devices).
- Impulse Noise. Impulse noise is the type of noise which causes most errors in the transmission of digital data. It is characterized by relatively high-amplitude peaks or "bursts" of short-duration pulses. These disturbances can be caused by lightning, switching transients, electrical machinery, and other natural and man-made phenomena.

Problems resulting from noise in a specific communications link can, in some cases, be alleviated by having the common carrier add repeaters to improve the signal-to-noise power ratio or bypass the areas where noise is found to be excessive.

.22 Fading

When using line-of-sight microwave links, fading is a frequent cause of errors. The fading seems to follow a random distribution in which there are periods of relatively constant signal level followed by periods of considerable fading. Maximum fading is normally observed at night during the summer months. During these periods, nonuniform distributions of temperature and humidity can create steep dielectric-constant gradients in the lower atmosphere; these gradients cause periods of fading.

.23 Multipath Distortion

Multipath distortion occurs because of the differences in time of arrival of signals which travel along different paths from a transmitter to a receiver. This situation is especially noticeable at the radio frequencies at which long-range propagation is affected by reflections from the ionosphere. The first and strongest signal to arrive is the one that takes the shortest path; this signal is followed by signals of progressively lesser amplitude, with the result that the duration of a transmitted pulse can appear to the receiver to be "stretched." If the start of a second pulse is received before the first pulse has ended, interference will result.

The multipath distortion effect is especially troublesome on high-frequency (HF) radio channels. As a result, data rates of approximately 50 to 100 bits per second are about the highest rates that can be accurately transmitted over a single HF channel. Equipment is available which overcomes this multipath problem to some extent by taking incoming serial data, converting it to parallel streams, and transmitting these bit streams simultaneously over multiple HF channels.

.24 Amplitude and Phase Distortion

Amplitude distortion occurs when some frequency components of the digital signal are severely attenuated by the communications medium; such distortion may render the received signal unusable.

Phase distortion, often called "envelope delay," is caused by the fact that unequal transmission times are required for signals at different portions of the frequency spectrum. Signal components near the upper and lower edges of the signal frequency band spend a longer time in transit than those in the center of the band. This effect can destroy the carefully balanced phase relationship which must exist between all the frequency components of a digital data pulse to get a true representation of the pulse.

By providing delay and amplitude compensation at the receiving terminal, a system designer can often overcome both of these types of signal distortion and thereby increase the usable bandwidth of a specific communications facility. Both fixed and adjustable means of compensation are available.

.3 ERROR RATES

Having considered the various sources of transmission errors in data communications systems, the system designer's next logical question is: How often will errors occur? The answer to this question is usually far from straightforward; it necessitates a discussion of the subject of error rates in communications facilities.

In most of the commonly used types of communications facilities, there are many error-free periods followed by relatively short periods during which many errors may occur. The mean error rate is highly sensitive to the averaging period, so it is not uncommon for error rates averaged over 24-hour periods to differ by many orders of magnitude on successive days.

For some types of communications media, including microwave and high-frequency radio, very little systematic data on error rates has been compiled and correlated to date. A designer using one of these media must therefore estimate the frequency of occurrence and the distribution patterns of transmission errors on the basis of his knowledge of the characteristics of the medium and its performance in previous applications. In many specific cases, the number and types of errors can be accurately determined only by means of a well-designed test program and a detailed evaluation of its results.

.31 The Public Telephone Network

Even for voice-band telephone facilities — despite their already widespread use for data communications — the available data on error rates is quite limited. The most useful

data on the subject is contained in three papers published in the Bell System Technical Journal:

(1) Alexander, A. A., Gryb, R. M., and Nast, D. W., "Compatibilities of the Telephone Network for Data Transmission," BSTJ, 39, p. 431 (May 1960).

(2) Morris, R., "Further Analysis of Errors Reported in Capabilities of the Telephone Network for Data Transmission," BSTJ, 41, p. 1399 (July 1962).

(3) Elliott, E. O., "Estimates of Error Rates for Codes on Burst-Noise Channels," BSTJ, 42, p. 1977 (September 1963).

The public switched telephone network is far from optimum as a means for data communications because it was designed primarily to handle voice communications. According to reference (1), "the connections that are established in completing telephone calls show a very large variation in characteristics that are of importance to the transmission of data signals." This situation is due to the fact that a variety of different types of transmission facilities are used within the public telephone network (open wires, cables, coaxial cables, radio links, etc.), and the number and types of switched links, or trunks, that are used to make up a given connection are likely to vary widely from one call to the next. These variations in connections, coupled with all of the potential causes of errors discussed in the preceding paragraphs, mean that it is extremely difficult to predict the frequency of errors that will be encountered during any given call on the public telephone network. Therefore, it is especially important to provide adequate means to detect and correct, or compensate for, the errors that do occur.

Reference (1) describes an extensive field testing program that was carried out by the Bell System to determine:

- The basic data transmission characteristics of the public switched telephone network
- The frequency of error occurrence at different transmission speeds (600 and 1200 bits per second) and different distances (local exchange, "short hauls" of up to 400 miles, and "long hauls" of 400 to 3000 miles)
- The factors that cause errors to occur

A total of about 1100 test calls were made between a wide variety of locations, using experimental data sets that employed frequency-shift modulation. Statistics on the occurrence of errors were accumulated, and a detailed analysis of the results was carried out by both the original investigators (1) and Morris (2). A brief summary of some of the principal results is presented in Tables I and II. Table I shows the approximate percentage of total calls of each type and transmission speed in which the error rate was found to be higher than one bit in error per 100,000 bits transmitted. Table II shows the approximate percentage of calls in which the error rate was found to exceed one bit per 10,000 bits transmitted. Since a wide variety of other significant findings regarding error rates, error burst patterns, and circuit quality were reported, the reader is urged to refer to the original papers.

.32 Leased Voiceband Lines

Leased voiceband lines generally provide a higher degree of freedom from transmission errors than the switched telephone network because: (1) leased lines are not subject to the highly variable connections that can occur from call to call in the switched network, and (2) leased lines can be specially conditioned to permit higher data rates with lower error rates. A number of different classes of leased voiceband facilities are available from the common carriers, as described in Paragraph 3200.2; they differ primarily in the type of conditioning employed to achieve different envelope delay and frequency response characteristics.

TABLE I. FREQUENCY OF CALLS WITH ERROR RATES OF MORE THAN 1 BIT PER 100,000 BITS TRANSMITTED (1)

Type of Call	Transmission Speed	Percent of Calls
Local exchange	600 bps	15%
	1200 bps	30%
Short haul (to 400 miles)	600 bps	18%
	1200 bps	35%
Long haul (400-2500 miles)	600 bps	26%
	1200 bps	42%

TABLE II. FREQUENCY OF CALLS WITH ERROR RATES OF MORE THAN 1 BIT PER 10,000 BITS TRANSMITTED (1)

Type of Call	Transmission Speed	Percent of Calls
Local exchange	600 bps	2%
	1200 bps	4%
Short haul (to 400 miles)	600 bps	2%
	1200 bps	6%
Long haul (400-2500 miles)	600 bps	10%
	1200 bps	10%

.33 Error Distribution

In addition to the overall average error rate, another important factor to consider in planning an error control scheme is the probability that successive errors will occur within various time intervals after the occurrence of an initial error. The probability of errors occurring in "bursts" varies with the data rate; a noise pulse of short duration may obliterate only one bit of data at a low data rate, while the same noise pulse may affect two or more bits of data transmitted at a higher rate. Information about the error distribution pattern, in terms of the lengths of error bursts and the number of good bits transmitted between error bursts, is highly important in planning and implementing techniques for the detection and correction of data transmission errors. Here again, the available data on the subject is quite limited, so an experimental test program may be called for in specific cases. With respect to the public telephone network, all three of the references cited in Paragraph .31 deal with the subject of error distribution, although there appear to be some anomalies in the reported findings.

.4 ERROR DETECTION AND CORRECTION TECHNIQUES

Realizing that errors will occur in every data communications system, a system designer must provide adequate means for detecting and correcting enough of these errors to enable the system to perform its primary function of transmitting useful information from one location to another. "Error detection" implies determination of the fact that one or more errors have occurred. "Error correction" implies taking measures to overcome the effects of detected errors and ensures that the correct information is ultimately received. Error detection, therefore, is a prerequisite for error correction, since no error can be corrected without positive knowledge that it has occurred.

Numerous techniques are available both for detecting and correcting data transmission errors. The system designer, recognizing that nearly every measure that increases the reliability of a system will also increase its complexity and cost, must decide upon the type and degree of error control to be used. Please refer back to Page 2200:01 for a discussion of the factors that influence this choice. A number of important specific techniques for detecting and/or

correcting errors in data communications systems are individually discussed in the following paragraphs. (See also Users' Guide, Paragraphs 6000.5 and 8000.5 for explanations of the manner in which AUERBACH Data Communications Reports describes the error detection and correction techniques used in specific types of communications terminal equipment and communications processing equipment, respectively.)

.41 Validity Checking

A validity check simply determines whether a received data code is one of a number of permissible bit configurations. This type of checking is usually performed on each character, and any bit configuration that does not represent a legitimate member of the character set is considered an error. Validity checking, in most cases, is of limited value in detecting errors and of no value in correcting them automatically.

.42 Constant-Ratio Codes

A constant-ratio (or fixed-ratio) code is one in which every member of the character set is represented by the same number of 1 bits and the same number of 0 bits as every other member. When this specialized form of validity checking is used, the receiving terminal can ascertain the validity of each received code pattern by simply counting the number of 1 bits it contains. A constant-ratio code will detect all single-bit errors and all errors in which the total number of erroneous bits within a character code is odd. Many 2-bit, 4-bit, and 6-bit errors will also be detected; in order for a 2-bit error to remain undetected, it would be necessary for a 0 bit to be changed to a 1 and a 1 bit to a 0, and such double inversions are uncommon.

Constant-ratio codes are simple to generate and to check, and they provide a fairly high degree of assurance that errors will be detected. They do not permit automatic error correction because there is no way to tell which of the individual bits is erroneous in a code configuration that is found to be invalid. A further disadvantage of constant-ratio codes is the increased number of bits they require in order to transmit a given amount of data. A 4-of-8 constant-ratio code (in which each 8-bit code contains four 1 bits and four 0 bits), for example, permits only 70 valid bit configurations and therefore limits the character set to 70 distinct members; using pure binary codes, in which all of the bit configurations are valid and no error-control information is transmitted, a 6-bit, 7-bit, or 8-bit code will accommodate 64, 128, or 256 distinct character codes, respectively. Thus, the use of a constant-ratio code necessitates the transmission of more bits per character and/or a reduction in the size of the character set.

.43 One-Dimensional Parity Checking

There are numerous types of "redundancy checking," in which one or more additional bits are added to each group of data bits in accordance with a specific formulation rule. Among these, the simplest and most commonly used type is parity checking, in which one additional bit, a "parity bit," is added to each group of data bits (usually to each character). The added bit will be either a 0 bit or 1 bit, whichever value is required to make the total number of 1 bits in each character either even (in even parity checking) or odd (in odd parity checking). Checking is accomplished by determining whether the received data still conforms to the parity formulation rule.

One-dimensional parity checking, because of its simplicity and relatively low cost, is widely used in data transmission, in data recording on punched tape and magnetic tape, and in internal storage devices. Only one additional checking bit needs to be transmitted with each group of data bits, and all single-bit errors are detected. On the other hand, simple parity checks are of no assistance in error correction, and errors involving an even number of bits cannot be detected (i.e., if two, four, or six 1 bits are "dropped" from the transmitted code for a single character, the parity rule will still be satisfied).

In addition to the character parity checking scheme described in the preceding paragraphs, there is another type of one-dimensional parity checking, called longitudinal or message

parity checking. This type involves accumulating a separate parity count for each code level, or bit position, in the transmitted character codes, and appending a single "check character" at the end of the message or block. Each bit of the check character will be a 0 or a 1, whichever is required to establish the proper message parity for the corresponding code level. Longitudinal parity checks have the same basic limitations as character parity checks, and their generation usually requires more complicated circuitry. Therefore, longitudinal checking is not often used alone; more often it is combined with character parity checking to form the two-dimensional scheme described in the following paragraphs.

.44 Two-Dimensional Parity Checking

A two-dimensional parity check combines the character and longitudinal parity checking techniques described above; a parity bit is added to each character, and a check character is appended to each message or block. The check character contains a bit corresponding to each level of the transmitted codes, including the parity-bit level. Figure 1 illustrates the implementation of a two-dimensional odd parity check for a message consisting of seven characters in a code with six data bits per character.

A two-dimensional parity check ensures the detection of all bit errors up to a total of three in any one message or data block. When more than three errors occur, it is possible that they will be arranged in such a way as to be undetectable. For example, if the four 1 bits within the box in Figure 1 were all erroneously converted to 0 bits during transmission, both the character and longitudinal parity checks would still be satisfied and the errors would not be recognized.

Code Level:	1	2	3	4	5	6	P
	0	1	0	1	0	1	0
	0	0	1	1	0	0	1
	1	0	0	1	0	0	1
Data Characters	0	1	0	0	0	0	0
	1	1	1	0	0	0	0
	1	1	0	0	1	1	1
	0	0	0	0	1	1	1
Check Character:	0	1	1	0	1	0	1

Figure 1. Two-Dimensional Odd Parity Checking

Unlike the previously discussed techniques, two-dimensional parity checking also provides a limited capability for error correction. This capability is limited to the correction of errors involving an odd number of bits (1, 3, 5, etc.) within a single character. The character parity check shows which character was erroneously received, and the longitudinal parity check shows the code level or levels in which an error has occurred. Thus, by cross-checking the parity indications, the erroneous bit(s) can be located and corrected. Not all equipment that employs two-dimensional parity checking for error detection includes the additional hardware that is required to take advantage of its error-correcting capabilities; retransmission of the data and rechecking of the parities are often performed instead.

.45 Error-Correcting Codes

Considerable theoretical work has been carried out on the development of high-level codes designed for efficient detection and correction of data transmission errors. Codes of this type include the Hamming codes, cyclic codes, Bose-Chaudhuri codes (a specific family of cyclic codes), and dual-pulse codes. All of these codes tend to require: (1) the transmission of a relatively large number of checking bits in addition to the data bits that comprise the message itself, in order to provide the degree of redundancy required for reliable error detection and correction; and (2) fairly complex and expensive error control equipment, particularly at the receiving terminal. Both the amount of redundant information required

and the cost of the associated equipment generally increase with increases in the "burst length," or number of consecutive errors, that the error control scheme is designed to be capable of detecting.

Because of their complexity and cost, these high-level error-correcting codes have not been widely employed in business data communications to date. For a definitive discussion of these codes, the recommended reference is Error Correcting Codes, by W. W. Peterson, MIT Press, 1961.

.46 Automatic Retransmission

As the preceding paragraphs indicate, a number of fairly simple yet effective techniques are available for detecting data transmission errors. The codes and techniques required to correct the detected errors tend to be much more complex and expensive. As a result, most of the data communications equipment in use today relies upon retransmission of all erroneously received messages (or segments thereof) rather than upon equipment that can automatically regenerate the correct data from the erroneously received message and appropriate redundant information. Frequently the data communication terminals are capable of initiating and carrying out the retransmission process automatically, with no need for human intervention at either end of the communications link. The retransmission process may be repeated indefinitely until the message is correctly received or an operator intervenes; or the process may be halted, with an appropriate indication, after a fixed number of unsuccessful transmissions.

ARQ (Automatic Request for Repeat) is a frequently employed "feedback" technique in which the receiving terminal, upon reception and checking of data, instructs the sending terminal whether or not to retransmit the same data. The command to retransmit is called an "RQ"; the alternate command, which results in the continuation of transmission, is an "OK." Checking, and transmission of the appropriate ARQ signal, can be performed on each character or on each block or message.

.47 Programmed Detection and Correction

All of the previously discussed error control techniques require special hardware. If the communications network includes a stored-program computer as a switching or processing element, additional error control techniques can be utilized. The logical and arithmetic capabilities of the computer can be used to perform a variety of error detection and correction functions. Validity and redundancy checks can be performed by programmed routines. The redundant information can be in the form of additional bits added to the transmitted characters (e.g., parity checks) or additional characters added to the transmitted messages (e.g., hash totals). The computer's flexibility also permits checks upon the format of received messages and the reasonableness of received data values.

When a stored-program computer is used to perform programmed error control functions, the computer time available for handling communications data and for other processing functions is decreased. A careful analysis should be made to ensure that the additional computer time required for checking and correction functions does not reduce the computer's processing capacity to a point where it will be unable to meet the system requirements for other functions.

SYSTEM DESIGN: EQUIPMENT SELECTION

.1 TERMINAL EQUIPMENT

The numerous communications terminals on the market today differ widely with respect to input/output media, speed, flexibility, operating convenience, error control, compatibility with other equipment, and cost. The system designer, faced with such a multiplicity of possible equipment choices and of factors influencing the decision, must approach the selection of terminal equipment in a systematic, objective manner.

A suggested systematic procedure for terminal equipment selection follows; it consists of a series of questions to be answered for each of the terminal devices whose suitability for a specific application is being studied. These questions are designed to pinpoint quickly those devices that are clearly unsuitable because of inadequate speed, incompatibility with other equipment, excessive cost, etc., and to present a clear-cut comparison of the relative advantages and drawbacks of the remaining candidates. Furthermore, each of the questions can be answered by simply turning to the indicated paragraph of the appropriate communications terminal equipment report and relating the information there to one's own specific requirements. The meaning and significance of each specific report entry can be found in the correspondingly numbered paragraph of the Users' Guide, which begins on Page 6000:01.

General Considerations

- What is the basic function of this terminal device? Are the types of communications facilities and input/output media it can utilize compatible with your needs? (Paragraph .13)
- Will the equipment be available in time to meet your needs? (Paragraphs .16 and .17)

Configuration

- Can each terminal configuration include a sufficient complement of equipment to perform all of the required functions? (Paragraph .2)

Input

- Are the facilities for accepting previously prepared input (cards, tape, etc.) suitable with respect to type and size of medium, code, character set, and message length? (Paragraph .31)
- Is the input speed sufficiently high to handle peak traffic loads? (Paragraph .31)
- Are there adequate facilities for inserting manually entered data at transmission time? (Paragraph .32)
- Are there any limitations on message configuration that will affect the equipment's suitability for the planned application? (Paragraph .35)
- Is the transmission process automatic, or will excessive operator attention be required? (Paragraph .36)

Output

- Are the output facilities suitable with respect to type and size of medium, code, character set, and message length? (Paragraph .4)
- Is the output speed adequate to handle peak loads? (Paragraph .4)

Error Detection and Correction

- Are the facilities for detecting errors in data entry, data transmission, and data recording adequate to meet your reliability requirements without being excessively sophisticated (and therefore costly)? (Paragraph .5 — also see the Error Control section on Page 2200:01)

- Is the process for correcting errors automatic, or will excessive operator attention be required? (Paragraph .5)

Condition Indicators

- Are adequate indicators provided to keep the operator informed of the device's status at all times? (Paragraph .6)

Data Transmission

- Is the data transmission speed sufficiently high? Does the rated speed differ when different communications facilities are used? Is the line's transmission capacity fully utilized? (Paragraph .71)

- Are the transmission code, mode (simplex, half-duplex, or full-duplex), order of bit transmission, and synchronization technique compatible with the requirements of other existing and planned equipment? (Paragraph .71)

- Can the device be used with your existing or proposed communications facilities? What are the data set requirements, if any? (Paragraph .72)

- Can calls be initiated and/or received automatically? Is unattended operation feasible? (Paragraph .73)

- What functional operations (line spacing, feeding blank tape, etc.) can the device perform in response to remotely issued commands? (Paragraph .73)

- Are there any provisions for multistation operations on "party line" circuits? (Paragraph .74)

Physical Specifications

- Will the device fit into the available space? Can it utilize the available source of electrical power? Are there any special, hard-to-satisfy environmental requirements? (Paragraph .8)

Price Data

- What is the rental (or purchase plus maintenance) cost for the basic component(s) plus any required optional features? (Paragraph .9)

.2 PROCESSING EQUIPMENT

The currently available communications processing equipment spans a wide range of configuration possibilities, speeds, processing capabilities, storage capacities, and costs. Because of the greater complexity and cost of most communications processing equipment, its selection presents an even greater problem for the system designer than does the selection of terminal equipment.

Our suggested procedure for the selection of processing equipment, like the one for terminal equipment, consists of a series of questions to be answered for each of the communications processors whose suitability for a specific application is being investigated. The questions

are designed to point out clearly the relative advantages and disadvantages of each candidate and to indicate the ones that are worthy of more detailed investigation. This further investigation might take the form of a request for detailed proposals, coding and timing of a specific "benchmark" application, visits to existing installations, studies by a consulting firm, etc. In conducting or monitoring any of these activities, the information in AUERBACH Data Communications Reports will continue to be of great value.

Each of the following questions can be answered by simply turning to the indicated paragraph of the appropriate communications processing equipment report and relating the information there to one's own specific requirements. The meaning and significance of each report entry are explained in the correspondingly numbered paragraph of the Users' Guide, which begins on Page 8000:01.

General Considerations

- What is the basic form and function of this equipment? Can it stand alone, or is it always used in connection with an associated general-purpose computer system? (Paragraph .13)
- Will the equipment be available in time to meet your needs? (Paragraphs .16 and .17)

Configuration

- Can the equipment accommodate an adequately large number of communications lines of the proper type(s)? Are special adapters required? (Paragraph .21)
- Is the directly accessible internal storage (if any) adequate with respect to capacity, word length, and speed? (Paragraph .221)
- Will the directly accessible mass storage facilities (if any) provide the required storage capacity, speed of access, and data format? (Paragraph .222)
- Can the available directly accessible input/output devices perform the required functions at the required speeds? (Paragraphs .223 and .224)
- Is there a sufficient capability for simultaneous operations to permit maximum utilization of the processor's power? (Paragraph .225)
- What are the characteristics of the associated general-purpose computer systems (if any)? Can the subject communications processor be used in conjunction with an existing or planned general-purpose computer in your installation? (Paragraph .23)
- Which remote terminal devices can communicate with the subject processing equipment? What are their basic characteristics? What adapters are required? (Paragraph .24)

Central Control

- What provisions are available for automatic initiation and/or reception of calls? (Paragraph .31)
- What are the sizes and locations of the message input/output areas? (Paragraph .31)
- What facilities are available for performing arithmetic computation, editing, and code translation? Are these facilities located in the subject equipment or in an associated general-purpose computer? (Paragraph .32)

- Is there a program interrupt system? How many distinct levels of interrupt conditions are recognized? (Paragraph .32)

- What are the values of the basic processor performance factors: data transfer time, scan time, communications data rate, and processor demand ? (Paragraph .33)

- Are there any special provisions for circuit and/or message switching ? (Paragraph .34)

Software

- What standard applications packages and subroutines are available to facilitate the programming task? (Paragraphs .41 and .42)

- What communications-oriented programming languages are offered? What are their capabilities and the equipment requirements for utilizing them? (Paragraph .42)

Error Detection and Correction

- Are the facilities for detecting and correcting errors in input/output, data transmission, and timing adequate to meet your requirements? Are these facilities automatic, or must they be programmed? (Paragraph .5 — also see the Error Control section on Page 2200:01)

Console Facilities

- Is adequate information provided to keep the operator informed of the equipment's status and any required operator actions? What is the form of this information? (Paragraph .6)

Data Transmission

- Can this equipment be used with your existing or proposed communications facilities? What are the data set requirements, if any? (Paragraph .74)

- What are the characteristics of the available communications adapters: buffer size, transmission speed, transmission code, transmission mode (simplex, half-duplex, or full-duplex), order of bit transmission, and synchronization technique? Are these characteristics compatible with the requirements of other existing and planned equipment ? (Paragraph .7)

Physical Specifications

- Will this equipment fit into the available space? Can it utilize the available sources of electrical power? Are there any prohibitively severe environmental requirements? (Paragraph .8)

Price Data

- What is the rental (or purchase plus maintenance) cost for the basic components plus any required adapters and optional features? (Paragraph .9)

SYSTEM DESIGN: MESSAGE-SWITCHING SYSTEMS *

.1 SUMMARY

This paper presents a tutorial discussion of message-switching systems. The emphasis is on utility and operational aspects, although design considerations for an individual message-switching center are also covered. A message-switching network is described, and the differences between its operation and that of a circuit-switching network are pointed out. A message is traced through the system, from a sender to a receiver. Multiaddress messages, exchanges between different types of terminal equipment, and the use of high-speed trunks are discussed.

The interrelationships among messages being processed are discussed, with special attention being given to the queuing of messages, including the complexities of message priorities and message preemption. Message protection measures are briefly discussed, along with the necessity for virtually continuous operation. The paper concludes with a presentation of a typical configuration of a message-switching center, with a discussion of both hardware and software implications.

2 MESSAGE SWITCHING AND CIRCUIT SWITCHING

The two principal types of communications networks, circuit switching and message switching, have the same general function. In a system of either type (Figure 1), one or more switching centers communicate with a number of terminals and transmit messages among them. When terminals connected with different centers communicate, they do so by means of a routing through two or more centers.

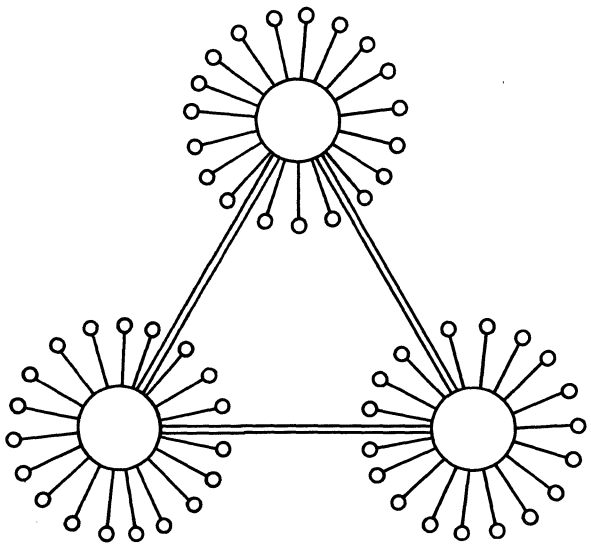


Figure 1. Communications Network Including Three Interconnected Switching Centers

* This portion of the system design section is an adaptation of a tutorial paper, "The Use of Computers in Message Switching Networks," presented at the 19th National Conference of the Association for Computing Machinery, August 1964, by Arnold B. Shafritz, Vice President and Technical Director of AUERBACH Corporation.

In a circuit-switching network, the role of the switching centers is to establish a direct connection from one terminal to another. After the connection is set up, the terminals carry on their communication, one-way or two-way. When the terminals are finished communicating, the switching centers disconnect the circuit, restoring the system to readiness for other connections.

The distinguishing characteristic of a message-switching network is that messages are stored and forwarded. The originator transmits a message into the switching center at his own speed, without waiting for a direct connection. As soon as this input transmission has been completed, the sender is free to send other messages, thus realizing maximum utilization of his input channel. Meanwhile, the network takes on the responsibility of relaying the message to its destination when channels become available.

Such a system utilizes electronic data processing equipment in an entirely different way than does a circuit-switching system. While the communication is necessarily one-way, there are opportunities for processing the contents of the messages as well as for establishing connections. In many ways, message switching achieves greater versatility than does circuit switching.

A message with a multiple address can be handled very efficiently. The transmissions to the various addressees are independent of each other and can take place simultaneously or successively, with no delay in any one transmission affecting any of the others. Also, the terminal equipment of the sender and the receiver need not match. The equipment can operate at different speeds, or can even use entirely different formats, with the required translations being made by the central processor.

.3 TRACING A MESSAGE THROUGH THE SYSTEM

Some of the details of the complex operation of a message-switching network can best be illustrated by tracing the history of a message as it passes through the system. The steps in the process can vary a great deal, according to the length of the message, the kind of equipment used by the sender and the receiver, and many other factors. Some of these variations will be mentioned along the way, but a complete treatment of all possibilities would amount to a description of the whole message-processing program.

The process begins with the transmission of a message from the sender into the message-switching center. He uses a format that is acceptable to the system, beginning with a header including a list of addressees and other pertinent information such as security classification and priority. The header is followed by the text and an ending, and all are transmitted into the system just as they would be transmitted to an individual receiver, using whatever channel-coordination procedures are appropriate to the system.

At the message-switching center, the incoming message is accepted into buffer storage, where it is collected into blocks of some standard length. The center serves many input lines and processes incoming message blocks cyclically. Upon receipt of the header, the data processor begins input-processing the message. This may involve a conversion to a universal code designed to accommodate the various kinds of equipment in the system. Some interpretation of the message header may also be necessary. The addresses used by senders may include group indicators for distribution to lists of several receiving terminals, and these must be broken down into individual addresses. Distinctions are made between addresses served by the center that initially received the message and those that call for routing through other centers.

Transmissions do not begin immediately upon receipt of the header. For reasons that will become clearer in the ensuing discussion, the entire message is first stored in the switching center's message store. In the case of multiple addresses, the message may be stored in

duplicate for each of its transmissions; or else it is stored once, and a system of message bookkeeping is maintained to keep track of all its transmissions. The tables used for such bookkeeping include information on priority and time of arrival, to be used in determining when each message should be sent out.

Input processing entails many other details of bookkeeping, even for single-address messages. The center makes a permanent copy of each message it transmits, and it maintains records of its throughput for protection from error and to permit statistical analysis of the system's operation.

Once the message has been completely stored in the message-switching center, the input line and buffer are released for subsequent use. The system continues to operate with the message, carrying out further processing and making all necessary transmissions, after the input transmission is finished.

If the output line to one of the addressees is available, the output phase can begin as soon as input processing and message storage have been completed. The actual transmission of the message is preceded by output processing. This may involve changes of code and format according to the type of receiver, along with updating of bookkeeping tables. The transmission itself is carried out by an inversion of the input procedure. The data processor retrieves the beginning of the message text from its message store, loads it into the buffer, and begins output transmission. Subsequent message blocks are transferred to the buffer at a rate sufficient to keep it full, so that the output transmission can proceed at the rate adapted to the receiving equipment. Transmission between the major switching centers is over high-speed trunks, often with several independent channels, to minimize delays in message delivery.

In a busy system, output lines will often be found occupied. The presence of multiaddress messages, in fact, keeps outgoing lines even busier than incoming lines. A measure of the effectiveness of a system is the degree of utilization of its lines, and when this is high, the output lines may operate continuously over long periods.

Accordingly, outgoing messages will generally be placed in queues for transmission, and will wait there for some time. Thus the output program will usually be deciding which message is next for an output channel after it finishes a transmission rather than deciding whether output channels are available for a newly-arrived message. It is quite possible for extensive backlogs to build up for individual output lines, and this calls for a program of queuing and selection.

.4 A CLOSER LOOK AT QUEUING

The storage, queuing, and retrieval of messages constitute a large part of the operation of a message-switching center. It is quite unlike the operation of a circuit-switching center, and a closer look at this phase of the problem can show the nature of this application of computers to data communications.

The queue generally consists not of the message texts themselves, but of a substantial amount of information about the messages. This includes the information from the message headers, and also a number of auxiliary tables. These may be kept in a different storage medium, which calls for additional coordination of hardware and software.

The function of the queue is to select the next message for any output line that completes a transmission. One way to accomplish this is to maintain separate lists for all the channels, or possibly even to store separate copies of the message. Either technique gives the output channel material to transmit continuously, as if it were all one message. But if the system makes extensive use of multiaddresses, such duplication results in inefficient use of storage space. It is then more practical to maintain one message store, governed by one master queue.

The arrangement of messages is no small problem in itself. Incoming messages are usually handled in increments, as the input program serves all input lines cyclically. To

assemble the increments contiguously calls for a lot of manipulation and may waste storage space by reserving room for the parts not yet arrived. The alternative is to scatter the message increments as convenience dictates, with the parts linked together by means of information stored with them or in auxiliary tables.

The arrangement of the message queue in memory also presents a problem. Messages may be listed in the order of their arrival, but they are generally not removed in the same order. The first message to arrive may need to wait for an output channel to be freed; and even after a message has been transmitted, it may need to be retained for other transmissions if it is multiaddressed.

An added complication may be introduced in the form of a hierarchy of precedence (priority) classifications. This can be a very useful feature of the communications system, allowing important messages to avoid delay by bypassing a string of messages of relatively low urgency. But it adds an extra dimension to the message queue, requiring separate listings for each precedence. This system can go beyond governing of the order of transmission, and can allow high-priority messages to interrupt others during their transmission. In such a system, message switching has an advantage over circuit switching in that an interrupted message can be automatically retransmitted as soon as possible, with no further action by the sender. But the possibility of interruption necessitates that the entire contents of a message be retained in storage until its last transmission has been completed.

So it can be seen that an output transmission must be preceded by a considerable routine of decisions and updating of information. The end of a transmission triggers the process. The queue entry for the message just completed includes information of all transmissions that are in progress, and the completion calls for revision of this information. If there are no more destinations for the message, the queue entry is removed, and linking information in the queue table is adjusted accordingly.

The next message for the output channel may be selected from the queue in advance of the time when it is actually needed to minimize the elapsed time between messages. It is important to keep output lines busy whenever possible, particularly when a backlog of messages is occupying the message store. Every output transmission relieves the computer's store, not only of the storage of the text, but also of the attendant bookkeeping data. Therefore, as little time as possible should be spent between transmissions. Message selection should not, however, be done too far in advance, because later messages of higher precedence may be better choices.

The selection is made by examination of queue entries, beginning with the highest precedence and proceeding in order of the arrival of the messages in the system. When a suitable entry is found, queue entries are revised appropriately, and the message is made ready for sending out.

The mathematical theory of queuing shows that, under the circumstances encountered in message switching, a memory of any finite capacity has some probability of being filled. The system must provide some way to cope with overflow, either through the use of additional storage or the control of inputs. This should be done in such a way as to minimize interference with the utilization of output lines. Messages nearly ready for output transmission should be available in moderately fast-access memory (core, high-speed drums); but overflow storage can utilize a less accessible store (discs, tapes). Similarly, messages destined for inoperable output lines can be removed to a slow-access intercept storage, or even off-line (tapes).

.5 MESSAGE PROTECTION

Even more important than overflow storage is the system's safeguards against internal malfunctions. In a message-switching system, "down times" of the data processor cannot be tolerated as they might be in other applications. In store-and-forward service, the switching

center takes on the responsibility for every message from the end of its input transmission to the completion of its last delivery. The center must guard against distortion or loss, and in cases where correct transmission becomes impossible, there should be feedback to the sender to request retransmission.

Elaborate measures are called for to guarantee message protection. At any given moment, a switching center may be in the middle of processing many different messages in both directions. If a malfunction occurs in any storage or processing device, there must be enough information stored elsewhere in the center to enable it to analyze the situation and to repeat whatever steps are necessary. This means that any item of information must be stored in at least two independent places, and that the updating of queue tables and other auxiliary data must be carefully synchronized so that operation can continue smoothly after correction of a malfunction. If it is impossible to determine exactly where a transmission was interrupted, procedures should lean toward pessimism. Repetition of part of a message is far less grievous than a loss of part of it.

In the case of catastrophic errors, the rollback procedure need not be fully automatic. Manual reinsertion of messages or other off-line procedures may be called for. The most important thing to be avoided is the loss of a message, or part of one, without any indication that the loss has occurred.

To accomplish such message protection, the system uses additional equipment beside its output, input, and storage. Some of these features will be described in the following description of a typical configuration, including the equipment for duplicate storage.

.6 A TYPICAL CONFIGURATION

Figure 2 pictures a single message-switching center, with input/output lines to a number of terminals and to the other centers in the network. The figure shows the communications processor (CP) together with the major items of equipment it uses to store and forward messages. The I/O processor may be a special-purpose computer itself, with provisions for code conversion as well as for the arrangement of messages in buffer storage. The CP's in

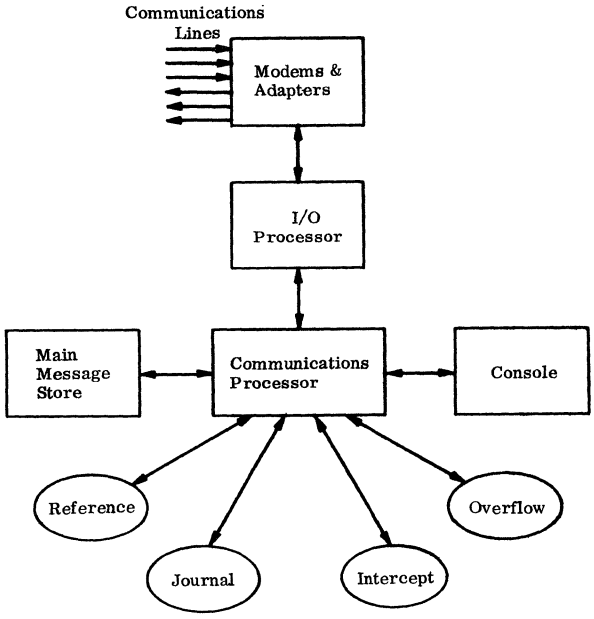


Figure 2. A Typical Message-Switching Center

the system use one universal code during the handling of messages, and this code can be converted for compatibility with any of several output media, regardless of whether they match the input device.

Beside the main message store, the CP uses four memories of slower access and greater capacity: a reference store to preserve a copy of each message segment as it comes into the system; a journal that maintains current information on messages being processed; and an intercept and overflow storage to relieve the main store of messages that cannot be transmitted promptly. The reference and journal stores can be used in connection with manual or automatic procedures to resume message handling, with no loss and a minimum of duplication, after a malfunction in the system.

Figure 3 is a very general diagram of the procedures in the CP program, to convey some idea of the software requirements of a message-switching center. The data processor cycles among the indicated functions, performing some regularly, others intermittently. One message may require a number of cycles to go through the steps described earlier.

Input and output buffers are separate, but they are utilized similarly. The input/output equipment includes indicators that can be sampled by the CP to determine the status of messages in transit. The effects of circuit switching can be achieved in a message-switching center by means of a "virtual cut-through," in which the input buffer for one channel is connected with the output buffer for another.

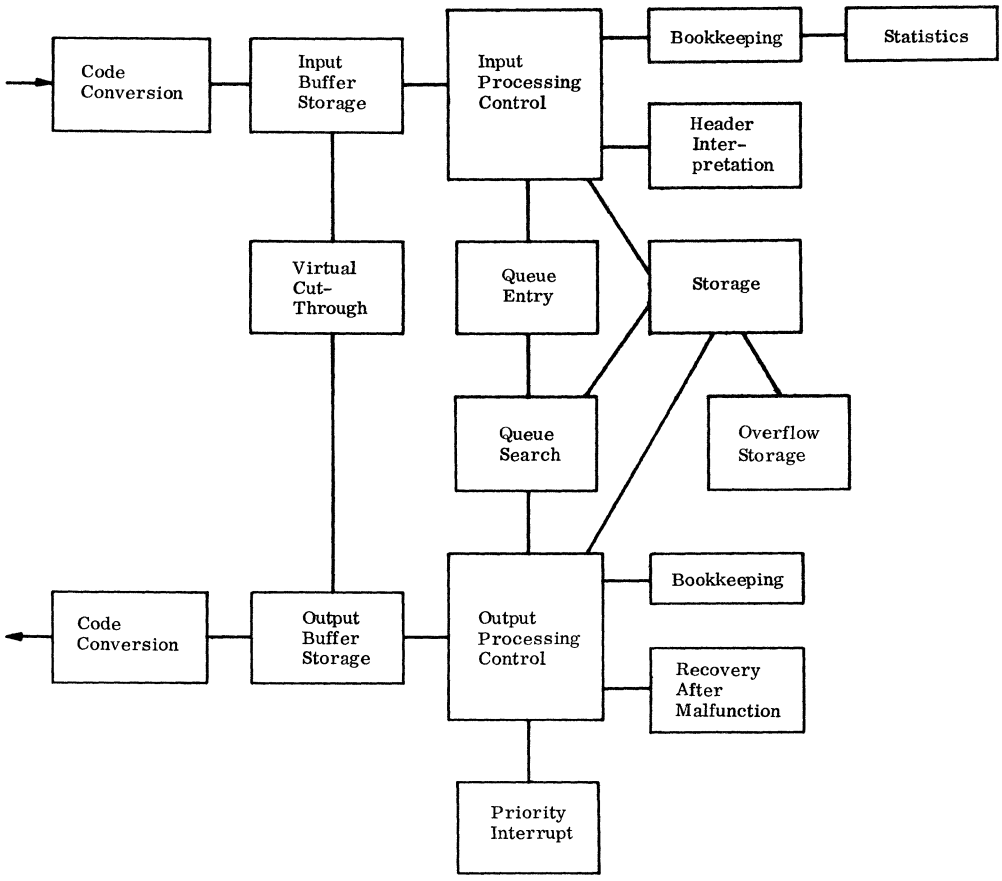


Figure 3. Procedures in the Communications Processor's Program

The execution of this program calls for a fast processor with a large random access memory. It needs a strong complement of instructions for character handling and logical decisions, but comparatively little in the way of mathematical computation. Comprehensive input/output facilities are required to adapt the processor to a variety of communications and storage equipment, and a flexible system of program control is called for to handle a variable operating cycle. These features make the communications processor the heart of an efficient and useful communications network that can serve a variety of terminals with message transmissions as rapid and reliable as the terminal equipment can handle.

.7 CONCLUSION

This brief survey has touched upon a number of advantages realized by the store-and-forward technique. It provides very high line utilization because inputs proceed at the sender's pace, and outputs are expedited by advance queue searches. At the same time, it allows the versatility afforded by the multiprecedence queue.

The ability to handle several kinds of terminal equipment makes message switching particularly valuable in the integration of existing systems into major networks. Individual terminals are not limited in their choice of communications equipment, nor is a high-speed device ever forced to slow down to keep in step with a slower one. Finally, the techniques of store-and-forward service ensure against interruption of service or loss of messages, and facilitate monitoring of the switching service and evaluation of its operation.

COMMON-CARRIER COMMUNICATIONS FACILITIES

AUERBACH
DATA
COMMUNICATIONS
REPORTS

COMMON-CARRIER COMMUNICATIONS FACILITIES

1. COMMON CARRIERS

A communications common carrier is a company whose services are offered for public hire for handling interstate or foreign communications by electrical means. All interstate (across state lines) traffice is regulated by the Federal Communications Commission. Intrastate (within a state) traffic is regulated by a state utility board. In some large cities, intracity traffic is regulated by a city agency.

The major common carriers providing interstate communications services are the Bell System and the Western Union Telegraph Company. The American Telephone and Telegraph Company (AT&T) heads the Bell System and coordinates the operations of its wholly or partly owned operating companies. In addition, there are a number of independent telephone companies, the largest of which is the General Telephone and Electronics Company. In general, the independent telephone companies offer the same types of services as the Bell System, although rates and exact services vary to some extent. Some of the smaller companies have limited capabilities, and care must be taken when planning data communications facilities within their areas. It is important to check with the local telephone company representative to determine the exact services available.

For these reasons, rates and sometimes services vary from location to location depending on the common-carrier companies and the regulating agencies. In general, the material presented in this report section refers to interstate data communications facilities and rates; exceptions are noted:

2. CLASSES AND TYPES OF FACILITIES

The facilities offered by the common carriers can logically be divided into three classes: narrowband, voiceband, and broadband. AUERBACH Data Communications Reports contains a separate report on each of these three classes of facilities. A brief definition of each class follows:

- Narrowband Facilities (Report 3100): These facilities provide data communications capabilities at up to 300 bits per second.

- Voiceband Facilities (Report 3200): These facilities make use of communications channels having effective bandwidths of about 3,000 Hz. Equipment is currently available from the common carriers for data transmission at up to 7,200 bits per second over leased voiceband facilities, and from independent manufacturers for transmission at up to 9,600 bits per second. Equipment is available from the Bell System for transmission at up to 3,600 bits per second over the public telephone network.

- Broadband Facilities (Report 3300): These facilities provide data communication at rates higher than voiceband facilities. Current facilities can provide transmission rates up to several million bits per second.

Within a particular class of common-carrier communications facilities, a number of different types of service can be obtained. The three general types of service include:

- Leased Service: provides the user with exclusive use of a communications line. In general, service is provided on a 24-hour-a-day, 7-day-a-week basis and billed at a flat monthly rate.

- Public Switched Service: provides the user with access to a communications network. Access to this network is available to the general public. In general, charges are based on usage.

- Multistation Leased Systems: provide the user with a private communications network accessible only by stations installed by that user. The majority of the multistation leased systems offered are for narrowband communications networks. In general, such

a system is a packaged plan designed to provide a specific type of service, but the package is variable within certain limits to meet the needs of individual applications.

The types of data communications service offered by the major common carriers are described within the reports on each class of service, under the headings listed above. Services that do not logically fall within any of these type classifications are described in a separate paragraph under the heading "Other Facilities."

A list of the common-carrier data communications facilities described in these reports, and the paragraphs where their descriptions can be found, is as follows:

3. ILLUSTRATIVE COSTS

ALL COSTS SHOWN FOR COMMON-CARRIER FACILITIES ARE ILLUSTRATIVE ONLY. THEY HAVE BEEN TAKEN FROM TARIFFS AVAILABLE TO THE PUBLIC, BUT ARE SUBJECT TO CHANGE AND OFTEN VARY FOR SPECIAL SITUATIONS. THE ACTUAL TARIFF SHOULD ALWAYS BE EXAMINED. FOR INTERPRETATION OF THE LEGAL EFFECTS, MEANING, OR APPLICATION OF A TARIFF, COUNSEL SHOULD BE CONSULTED.

All costs shown in this service are exclusive of any local, state, or federal taxes.

In analyzing a particular situation, estimates of the cost of communications facilities should be obtained from the common carriers. The major common carriers are the Bell System, the Western Union Telegraph Company, and the independent telephone companies. Communications consultants from these companies can recommend the lowest-cost system that will satisfy the overall system requirements. Investigation should include the subjects of lease, purchase, and maintenance.

COMMON-CARRIER NARROWBAND FACILITIES

1. NARROWBAND

Throughout AUERBACH Data Communications Reports, all communications facilities capable of transmitting data at speeds no higher than 300 bits per second are classed as narrowband facilities. This distinct class of facilities should not be confused with wider-band facilities used for data transmission at considerably lower speeds than their bandwidths would permit (e.g., the use of a voiceband line for transmission at only 150 bits per second).

Available narrowband facilities fall into two major types, which differ in the method of transmission. These two types are:

- Telegraph-Grade — With this type of facility, the pulses from business machines are transmitted directly over the transmission lines in direct current (dc) form.

- Carrier — With this type of facility, the pulses or voltage levels from business machines are converted (modulated) into signals which vary regularly with time. The rate with which the signal varies with time determines the frequency of the signal. When data is being received, the signals must be converted (demodulated) into pulses acceptable to another business machine. The unit of equipment that accomplishes this conversion is called a modulator-demodulator, or "modem" for short. Commercial units are frequently referred to as "data sets." Two methods are commonly used for transmitting the frequency signals: keying the signal on and off, or transmitting signals of two different frequencies for the on and off conditions. The latter method is known as "frequency shift keying." More complex modulation methods are used to achieve higher transmission rates.

2. LEASED NARROWBAND FACILITIES

2.1 Leased Private-Line Teletypewriter and Data Channels

The leased narrowband facilities offered by the major common carriers are summarized in Table I. The cost data is for illustrative purposes only and is subject to change. The rates shown are exclusive of any terminal equipment.

In general, the basic charges for a leased line include the following items:

- Service Terminal — A recurring charge applied for each city in which one or more terminal stations are located. This change includes the local channel from the local common-carrier exchange office to each customer main station.

- Inter-Exchange Mileage Charge — A recurring charge for the communications line itself, based on the distance between exchanges.

- Installation — A one-time charge usually applied to the termination. A rule of thumb is that the installation charge is roughly equivalent to one month's termination charge.

3. PUBLIC SWITCHED NARROWBAND SERVICES

3.1 Bell System Teletypewriter Exchange Service (TWX)

Description

AT&T has agreed to the sale of TWX service to Western Union for the sum of $85 million ending on and off negotiations that date back to 1943. The sale, when finalized, will include approximately 40,000 teletypewriters in the United States and Canada. TWX will eventually be integrated within Western Union's Telex service. The agreement between Western Union and AT&T stipulates that for a five-year period after completion of sale AT&T will not market Dataphone terminals (see Paragraph 3.1 of Report 3200) for use under 300 bits per second;

TABLE I. LEASED PRIVATE-LINE TELETYPEWRITER AND DATA CHANNELS

Service	Approx. Max. Data Rate, bits/sec	Type (1)	Available From (2)	Illustrative Rates (3)			
				Mileage Charge, $/mile/month (4)		Service Terminal (5)	
				Half-Duplex	Full-Duplex	Half-Duplex, $/month	Full-Duplex, $/month
Private-Line Teletypewriter Services and Channels	55	DC	WU	Base Rate	Base Rate + 10%	25.00	27.50
	75	DC	WU	Base Rate + 10%	Base Rate + 21%	27.50	30.25
	180	Carrier (6)	WU	Base Rate + 25%	Base Rate + 37.5%	31.25	34.38
Channels for Data Transmission —							
Type 1002	55	Carrier	AT&T & WU	Base Rate	Base Rate + 10%	25.00	27.50
Type 1005	75	Carrier	AT&T & WU	Base Rate + 10%	Base Rate + 21%	27.50	30.25
Type 1006	150	Carrier	AT&T & WU	Base Rate + 25%	Base Rate + 37.5%	31.25	34.38

	First 100 Miles, $/mile/month	Next 150 Miles, $/mile/month	Next 250 Miles, $/mile/month	Next 500 Miles, $/mile/month	Additional Mileage, $/mile/month
Base Rate	1.40	0.98	0.56	0.42	0.28

Notes:

(1) DC refers to a telegraph-grade line as defined in the text. A carrier line requires data sets; see the Common-Carrier Data Set Comparison Charts, Report 4600, for the data sets offered by the common carriers.

(2) WU refers to Western Union Telegraph Company. AT&T refers to the American Telephone and Telegraph Company and includes the various operating companies within the Bell System. Many of the independent telephone companies offer services similar to those offered by the Bell System. Western Union has redesigned its channels for data transmission to conform with those offered by AT&T effective April 1, 1969.

(3) These rates were in effect April 1, 1970, and are subject to change. The rates are based on a usage of 24 hours per day, 7 days per week. Partial usage is not available. All costs shown are illustrative only. Western Union charges are for channels other than Washington, D.C. metropolitan area channels.

(4) See supplementary table for Base Rate charge.

(5) A service terminal charge is applied for each city in which one or more terminal stations are located. Additional terminals connected to the same line at the same point are charged for at a considerably lower rate than the initial terminal.

(6) Western Union states that in some applications a data set is not required; transmission between the customer's station and the exchange office is in dc pulse form.

i.e., no terminals such as Teletype models 28 to 37 will be marketed for use at speeds below 300 bits per second on the switched network. At present, Western Union has not yet defined the TWX service in its tariffs. The service, as described here, reflects operation under the Bell System.

The Bell System TWX network provides subscribers with facilities for two-way manually keyed or paper tape communication. There are two basic classes of TWX service.

- TWX 60-Speed — provides 60-words-per-minute (45-bit-per-second) service via 5-level teleprinter equipment provided by the Bell System.

- TWX 100-Speed — provides 100-word-per-minute (110-bit-per-second) service via 8-level (USASCII) teleprinter equipment provided by the Bell System.

If desired, a TWX station can be arranged to interface a customer-supplied business machine, typically a computer, via the Bell System Data Set 811B. This arrangement is called a TWX CPE (Customer Provided Equipment) station and is functionally identical to a basic

TWX 60-Speed or TWX 100-Speed station, with the computer replacing the teleprinter normally supplied by the Bell System. The computer can communicate with any other station in the TWX network.

TWX 60-Speed and TWX 100-Speed stations can freely intercommunicate via speed conversion and code conversion equipment located at telephone company switching offices. Such intercommunication, however, is limited to 60 words per minute.

In addition, a subscriber can utilize the TWX network circuits for two-way communication between customer-supplied business machines via a Bell System Data Set 103A1. This arrangement is called TWX CE. Two TWX CE services are available:

- TWX CE (60-Speed) — provides service at up to 45 bits per second, with no code restrictions; can alternate with TWX 60-Speed service.
- TWX CE (100-Speed) — provides service at up to 150 bits per second, with no code restrictions; can alternate with TWX 100-Speed service.

A TWX CE station can be used for alternate types of service through a manual switching arrangement. Alternate service possibilities include TWX 60-Speed/TWX CE (60-Speed) and TWX 100-Speed/TWX CE (100-Speed). TWX CE stations are restricted to communication with other TWX CE stations of like speed rating; e.g., a TWX CE (100-Speed) station cannot communicate with a TWX CE (60-Speed) station or any regular TWX station. Stations equipped for alternate modes operate in one mode at a time and are subject to the same restrictions mentioned above for each mode.

The equipment most commonly used with TWX 60-Speed service is the Teletype Model 28 KSR (Keyboard Send-Receive) or ASR (Automatic Send-Receive) set. An RO (Receive-Only) set can be supplied in addition to the other equipment, but not by itself. The characteristics of the Teletype Model 28 line are described in the Communications Terminal Equipment reports; see Report 6802.

The equipment furnished with TWX 100-Speed service is the Teletype Model 33 or Model 35 line (see Reports 6804 and 6805). ASR and KSR sets are available in both lines. When supplied for TWX operation, the Model 33 or 35 units include touch-tone dialing and built-in loudspeakers for dial and call progress indication. The "HERE IS" and the "WRU" keys are part of an automatic station identification feature, which is a relatively new concept for faster and more accurate message handling and control. Both keys are standard features of TWX 100-Speed service.

Card Dialers, which use prepunched cards to dial station numbers automatically, are available for both TWX 60-Speed and TWX 100-Speed service. Unattended service is optional on 60-Speed service and standard on 100-Speed service. Unattended station equipment is arranged to receive incoming communications automatically. Stations with capabilities for unattended operation are so designated in the TWX Directory.

Applications

TWX service finds its major market in companies that have relatively low-volume communications requirements with many separate locations. Examples are found in business firms that are decentralized, having branch offices, suppliers, and distributors scattered over a wide area; or chain organizations such as hotels and motels, department stores, and brokerage houses. TWX also has great appeal to single-unit business organizations that have common interests with other companies.

TWX service provides two-way communications connections, via telephone company switching offices, to approximately 50,000 other TWX stations listed in the US/Canada TWX Directory. Conference and collect calls can also be initiated. Business forms can be used in the machines in place of standard roll paper; this can expedite internal clerical operations and speed order

processing and delivery. Multiple-copy paper with interleaved carbon paper is available for page-copy messages. The most basic choice in TWX service selection is between a manual (KSR) machine for page copy only and an automatic (ASR) machine that provides both page copy and paper tape operation.

A Bell System Communications Consultant can present information on all TWX features and should be consulted early in any proposed TWX application.

How TWX Operates

When idle, the teleprinter motor is turned off and the dial on the control unit is inoperative. A call is initiated by depressing the ORIG key, which corresponds to picking up a telephone handset. This signals the TWX exchange, which automatically recognizes the calling line and transmits a proceed-to-dial signal corresponding to the dial tone.

The subscriber now dials a distant subscriber listed in the TWX directory, usually by dialing a 10-digit number.

Within a second or so after the last digit has been dialed, the direct connection is established; completion of the connection is indicated by a short tone and a typed answer-back code or firm name. Stations equipped with automatic answering respond to a call by transmitting an answer-back code (single letter V) or an answer-back identification (firm name or code). These stations can be called on an unattended basis and are identified in the TWX listings by a special symbol.

If a station is not equipped for automatic answering, the operator must press the ANSWER button and type the firm name in response to a call, or press the "here is" key.

Transmitting and Disconnecting

The message is terminated by the calling station operator by typing END and depressing the CLR (clear) key. When the called station receives an END from the calling station, the called station can respond by typing END or by sending a message and then typing END. If data is transmitted from paper tape, an EOT code perforated in the tape is used to terminate the call.

If the called subscriber is busy, or if the call cannot be completed because the trunk circuits in a particular section of the TWX network are busy, or if the called station is low on paper, or faulty, an audible indication will be returned. In such cases, the subscriber depresses the CLR key, which cancels the call.

When transmitting from a 100-Speed station to a 60-Speed station, special consideration is required to avoid exceeding the transmission speed limit of the 60-Speed station. Transmission from both the keyboard and paper tape reader is regulated by the TWX exchange. An indicator lamp is provided on the 100-Speed equipment to indicate excessive transmission speed. If transmission continues at an excessive speed, the keyboard is locked and transmission may be terminated.

Certain characters cannot be sent between 60-Speed and 100-Speed stations. When one of these characters is transmitted, the receiving terminal will receive a reverse slant (\).

Rates

TWX service is provided on a 24-hour-per-day, 7-day-per-week basis, with message charges on a per-minute basis. Calls are charged on the basis of a minimum of one minute, with each additional minute charged at the same rate as the initial period; see Table II.

TABLE II. BELL SYSTEM TWX AND TWX CPE MESSAGE CHARGES — TWO-POINT CONNECTION*

Distance in Airline Miles		Each Minute or Fraction Thereof,** $
Over	Up to and Including	
0	50	0.20
50	110	0.25
110	185	0.30
185	280	0.35
280	400	0.40
400	550	0.45
550	750	0.50
750	1,030	0.55
1,030	1,430	0.60
1,430	2,000	0.65
2,000	—	0.70

*These rates were in effect April 1, 1970, and are subject to change.

**On collect calls, add $0.25 per call to the total charge.

In addition to the message charges, there is a monthly charge based on the terminal equipment supplied; see Table III. The equipment charge for a TWX CPE station is $30 per month, which includes subscriber access to the appropriate exchange and connecting equipment, but no input/output equipment. Teleprinters can be leased from the Bell System and used at the TWX CPE station, in which case the total monthly equipment charge will be the same as the charge for the equivalent TWX station.

3.2 Western Union Telex Service

Description

Western Union offers a subscriber-dialing service, called Telex, that permits intercity written or punched paper tape communication between subscribers in major cities throughout the United States, Canada, and Mexico. Messages can be transmitted at a maximum speed of 66 words per minute (50 bits per second). Provisions are available to connect a subscriber's business machines into the Telex network with no restrictions on intercommunication.

Telex service operates in a manner similar to TWX, except that the transmission speed is 50 bits per second. Charges are based only on time used; there is no minimum. Unattended operation of the station equipment and self-identification of all units on the network are provided.

How Telex Operates

When idle, the printer of the subscriber set is turned off and the dial on the control unit is inactive. A call is initiated by depressing the START key, which corresponds to picking up a telephone handset. This signals the Telex exchange, which automatically recognizes the calling line and transmits a proceed-to-dial signal corresponding to the dial tone, thereby lighting the dial lamp at the subscriber station.

The subscriber now dials a distant subscriber listed in the Telex directory, usually by dialing a 6- or 7-digit number.

TABLE III. TWX APPROXIMATE SERVICE AND EQUIPMENT CHARGES (1)

Terminal Equipment (2)	Monthly Service and Equipment Charge, $/month (3)	
	Basic Equipment	Additional Equipment
60-Speed service with:		
15 KSR	45	—
19 ASR	65	65
28 KSR	60	55
28 ASR (4)	95	90
28 ASR (5)	105	—
28 RO	—	50
100-Speed service with:		
33 KSR	50	45
33 ASR	65	55
33 RO	—	30
35 KSR	85	80
35 ASR	120	115
35 RO	—	55

Notes:

(1) There is an installation charge of $50, which applies to the basic service and to additional teleprinters.

(2) Many special features and arrangements are available in addition to the basic equipment listed here.

(3) These rates were in effect April 1, 1970 and are subject to change.

(4) Single contact distributor.

(5) Multiple contact distributor.

Within a few seconds after the last digit has been dialed, the direct connection is established; completion of the connection is indicated when the teleprinter motors and Operate lamps of both the calling and called subscribers are turned on.

The operating procedure now requires the calling subscriber to initiate an exchange of answer-back to identify the two subscriber stations to each other. These two functions occur in turn, as the calling subscriber first transmits the "who-are-you" (uppercase D) signal, which triggers the answer-back of the called subscriber. After receiving the identification on the page copy, the calling subscriber depresses an auxiliary "here is" key, which triggers his own answer-back device and thereby identifies him to the called subscriber. A typical exchange of answer-backs, as it would appear on the page copy of both subscribers, is:

CONTLCOFFE NYK (called subscriber)

CONTLCOFFE CGO (calling subscriber)

Transmitting and Disconnecting

Just prior to terminating the connection, or at any time during transmission, either subscriber can trigger the answer-back on the distant printer. This will verify circuit continuity and reception of the transmitted signals. Either the calling or called subscriber can terminate the connection by depressing the STOP key on the control unit. When this occurs, the connection is released sequentially through one or more Telex exchanges, beginning at the calling-subscriber end.

If the called subscriber's line is in use, or if the call cannot be completed because there is a shortage of trunk circuits in a particular section of the Telex network, a busy signal will be returned; this will momentarily turn on the teleprinter motor and Operate lamp of the calling subscriber. If a call is made to a subscriber whose line or equipment is faulty, or if the paper supply is too low and needs replacing, the calling subscriber receives a busy signal. In such cases, the subscriber depresses the STOP key, which cancels the call and enables him to redial and report the condition to a local supervisory position.

Western Union Local Positions

Subscribers may communicate directly with the Telegraph Company's local positions in their own city for the purpose of sending and receiving public message traffic or for obtaining supervisory assistance in using the Telex service. By dialing 111, the subscriber is connected to one of a group of page receiving-only positions in the tie-line message section. Dialing 119 connects the subscriber to an information center which is equipped to furnish current changes in the Telex directory or to handle any subscriber's operating difficulties.

Rates

Telex message charges are based on 12 rate areas bounded by state lines. Table IV is a schedule of the usage charges for Telex calls. The rates are shown in terms of cost per minute, but fractions of minutes are charged to the nearest 2.5 cents; there is no minimum.

In addition to the Telex message charges, the following equipment charges apply:

- Teleprinter sending and receiving station (Teletype Model 32 KSR) — $40.00 per month.
- Automatic punched paper tape sending and receiving equipment — $15.00 per month additional.
- Adapter for interfacing with customer's business machine — $5.75 to $40.50 per month plus installation charges.

Teletype Model 28 KSR and ASR sets are available at higher rates for heavy-duty service.

Telex Computer Communications Service (TCCS)

Western Union Telex Computer Communications Service (TCCS) is a computer service linked with the Telex system which permits the transmission of messages from a Telex station to another Telex station or to a Bell System TWX 60-Speed or 100-Speed station on a torn-tape basis.

Connection to the TCCS system is established by the standard Telex operating procedures, including automatically exchanged answer-backs between the computer and the Telex subscriber station. The transmission consists of the appropriate address, routing, and control function information, in a prescribed format, followed by the message and sending-terminal identification. An acknowledgment is automatically transmitted by the computer following an end-of-message transmission from the subscriber. The acknowledgment indicates that the message was received and accepted for processing and forwarding. The text and sending-terminal identification of multiple-address messages are transmitted only one time by the subscriber. Certain characters cannot be transmitted from a Telex station to a TWX station.

TCCS messages are normally handled in the order of their receipt. In the case of nondelivery, the Telex subscriber is notified and an explanation is provided. No charge is made for a non-delivered message.

TABLE IV. TELEX USAGE CHARGES*

BETWEEN AREAS	1	2	3	4	5	6	7	8	9	10	11	12
1	17-1/2											
2	30	17-1/2										
3	30	30	17-1/2									
4	45	30	30	17-1/2								
5	45	45	30	45	17-1/2							
6	45	45	30	30	30	17-1/2						
7	45	45	45	30	45	30	17-1/2					
8	60	60	45	45	30	30	45	17-1/2				
9	60	60	45	45	30	30	30	30	17-1/2			
10	60	60	45	45	45	45	30	45	30	17-1/2		
11	60	60	60	60	45	45	45	30	30	45	17-1/2	
12	60	60	60	60	45	45	45	30	30	30	30	17-1/2

*Rates are expressed in cents per minute between rate areas. No minimum applies. Fractions of minutes are proportionately charged for. A 28% discount applies for usage in excess of $137.50 recorded during any monthly billing period. These rates were in effect July 1, 1970, and are subject to change.

STATE	RATE AREA
Alabama	4
Arizona	10
Arkansas	4
California	12
Colorado	9
Connecticut	1
Delaware	1
District of Columbia	1
Florida	2
Georgia	2
Idaho	11
Illinois	3
Indiana	3
Iowa	6
Kansas	6
Kentucky	3
Louisiana	4
Maine	1
Maryland	1
Massachusetts	1
Michigan	3
Minnesota	5
Mississippi	4
Missouri	6
Montana	8

STATE	RATE AREA
Nebraska	6
Nevada	12
New Hampshire	1
New Jersey	1
New Mexico	10
New York	1
North Carolina	2
North Dakota	5
Ohio	3
Oklahoma	7
Oregon	11
Pennsylvania	1
Rhode Island	1
South Carolina	2
South Dakota	5
Tennessee	4
Texas	7
Utah	9
Vermont	1
Virginia	1
Washington	11
West Virginia	1
Wisconsin	5
Wyoming	8

TCCS message charges for transmission between two Telex subscribers are the same as regular Telex subscriber charges (see Table IV) and are applied against each message forwarded to a subscriber station. A nominal service charge is added to the message charge for each forwarded message.

TCCS single-message charges for message forwarding between Telex and TWX stations are based on the distance between the communicating terminals and the length of the call. A nominal service charge is also applied against each forwarded message. Table V is a schedule of the usage charges for single-message Telex-to-TWX calls. The rates are shown in terms of cost per minute; there is no minimum charge.

TABLE V. TCCS USAGE CHARGES* FOR TELEX-TO-TWX CALLS

BETWEEN AREAS	1	2	3	4	5	6	7	8	9	10	11	12
1	35											
2	65	35										
3	65	65	35									
4	85	65	65	35								
5	85	85	65	85	35							
6	85	85	65	65	65	35						
7	85	85	85	65	85	65	35					
8	115	115	85	85	65	65	85	35				
9	115	115	85	85	65	65	65	65	35			
10	115	115	85	85	85	85	65	85	65	35		
11	115	115	115	115	85	85	85	65	65	85	35	
12	115	115	115	115	85	85	85	65	65	65	65	35

*Rates are expressed in cents for each minute or fraction thereof between rate areas. The rate area for the TWX station is the Telex rate area within which the TWX station is located. These rates were in effect July 1, 1970, for TCCS usage within the continental United States (except Alaska), and are subject to change.

Western Union offers TCCS service between the hours of 8:00 a.m. and 11:00 p.m. Eastern Time, except on Saturdays, Sundays, and certain holidays. Consult the local Western Union office for further details.

Charges for each delivery of a multiple-address message transmitted from one Telex station to several other Telex or TWX stations are as described previously, depending on whether TWX or Telex is used for delivery. The amount of time used to calculate usage charges for each individual message is made up of two segments: (a) a pro rata share of the elapsed time from beginning of connection to beginning of text, and (b) the time elapsed in transmitting the text, signature, and end-of-message sequence.

3.3 Public Telegraph Message Network

The public telegraph network is a store-and-forward message switching service operated by Western Union. There are no connections between the Western Union Telex network and the public network. Western Union states that there are no present plans to provide private subscriber facilities to permit private data communications via the public network.

4. MULTISTATION LEASED NARROWBAND SYSTEMS

A number of "packaged" multistation systems are available for lease from the common carriers. The available systems vary in the degree of control and type of intercommunication provided among the stations in the network. Generally, these systems are oriented toward providing written message communications via teleprinters. A few of these packaged systems are briefly described in the following paragraphs to illustrate the range of facilities available in systems of this type. No price information is presented because each installation is tailored for a particular application; details can be obtained from the common-carrier communications consultants.

4.1 Selective Calling Systems

This type of system permits any one point in the network to call any other point; other stations in the network do not receive the message. Usually this type of system uses a single line with multiple stations, sometimes called "way stations," connected to it. In addition to the teleprinters at each station, a special device is required that can recognize and respond to a specific address code for that station. This device is frequently referred to as a "stunt box." Some stunt boxes can control tabulation or other functions as well as performing address recognition.

The usual method of controlling the transmissions of multiple stations over one line involves equipping each station with a timer. When a station is ready to transmit, the operator presses the start button; as soon as the line becomes free, the timer starts and the station begins to "time out." When the specified time period has elapsed, transmission beings, provided that no other station has started transmission. In that case, the timer is reset and the station waits for the line to become free again. Setting the timer at each station for a different time interval eliminates the possibility of two stations attempting to transmit simultaneously.

The Western Union Way Operated Circuit System is an example of a selective calling system. It utilizes Teletype Model 28 equipment and is designed for use with one half-duplex circuit.

4.2 Polling Systems

A further degree of sophistication in the control of multiple stations on a single circuit is provided by polling systems. In this type of system, one station is designated as the control station and is equipped with additional hardware. The control station periodically addresses (polls) each station, inviting the remote station to transmit message traffic. If the remote station has a message to transmit, it does so; usually any remote station is permitted to address any other station on the circuit. If the polled remote station does not have a message to transmit, it transmits a specific code to the control station, usually the letter "V." The control station then polls the next station on the circuit.

Special features usually incorporated in polling systems include facilities for handling priority messages, conference calls, and messages to be sent to multiple points (multiple-address messages).

Some of the packaged plans offered by the Bell System and Western Union, and their distinguishing characteristics, are as follows:

- Bell System 83A1 — uses Teletype Model 28 equipment and stunt box selection; operates over a manual half-duplex multipoint line.
- Bell System 83B2 — uses Teletype Model 28 equipment and operates over an automatic half-duplex multipoint line; up to 400 stations can be accommodated.
- Bell System 83B3 — similar to 83B2, but features a higher polling rate.

- Bell System 8A1* — similar to 83B2, but uses Teletype Model 35 equipment; allows for automatic and/or keyboard transmission. This offering is being replaced by 85A1.

- Bell System 8B1* — similar to 8A1, but operates over a full-duplex line. This offering is being replaced by 86B1.

- 85A1 — 100 speed, half-duplex tape system using Teletype Model 33 and 35 equipment; replaces System 8A1.

- 85A2 — 150 speed, half-duplex tape system using Teletype Model 37 equipment.

- 86B1 — 100 speed, full-duplex tape system using Teletype Model 33 and 35 equipment; replaces System 8B1.

- 86B2 — 150 speed, full-duplex tape system using Teletype Model 37 equipment.

- Western Union Plans 115A and 115B** — utilize Teletype Model 28 equipment and operate over a half-duplex line. The 115A system uses electromechanical control equipment, and the 115B uses solid-state control equipment. Either system can accommodate up to 20 transmitting stations.

- Western Union Plan 116 — utilizes Teletype Model 28 ASR equipment and operates over a full-duplex line. This system has been replaced by Plan 117.

- Western Union Plans 117A and 117B** — similar to Plans 115A and 115B, but operate over a full-duplex line. The A and B versions differ as described under Plan 115.

- Western Union Plan 135** — similar to Plan 115B except that it utilizes Teletype Model 35 equipment.

- Western Union Plan 137** — similar to Plan 117B except that it utilizes Teletype Model 35 equipment.

- Western Union Plan 1215A — utilizes Teletype Telespeed 1050 equipment or Mohawk Model 1103 Data Recorders for tape-to-tape data transmission at 1,050 or 1,200 bits per second, respectively. Plan 1215A can accommodate up to eight stations on a half-duplex line.

4.3 Store-and-Forward Message-Switching Systems

When the traffic load becomes too large to handle by means of a single-line way-station arrangement, multiple circuits must be employed. One important technique for controlling the communications between two points in a network is called "store-and-forward message switching."

The basic idea in a store-and-forward message-switching system is that all circuits shall terminate in a single central control center. (Large, complex networks may include two or more control centers, which are usually linked together by high-speed communications lines.) All messages are transmitted to a control center, where they are temporarily stored (usually on punched tape) and then retransmitted to the addressed station or stations (or to another control center) when the appropriate outgoing line becomes free. The common carriers offer a number of store-and-forward systems for punched tape operation, with varying degrees of automated handling of traffic.***

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*Bell Systems 8A1 and 8B1 employ 8-level USASCII transmission code. System 8A1 can be controlled by a computer; Systems 8B1, 85 and 86 must be computer controlled.

**Plan 115B, 117B, 135, or 137 systems can be controlled by a computer.

***Refer to Report 2400 for a detailed discussion of computer-controlled message-switching systems.

There are three basic types:

- Manual Torn-Tape Switching Systems — Incoming messages are reperforated at the control center, where an operator tears the tape from the receiver, reads the address header, and physically carries it across the office to the appropriate sending station. If traffic on a particular outgoing line is heavy, a message queue will need to be maintained, or alternate sending units can be used. Once the tape has been inserted in a sending unit, the message will be transmitted automatically when the line becomes free. Complex message numbering plans are usually needed in busy control centers to ensure that no message will be discarded before it has been transmitted.

- Semiautomatic Switching Systems — Incoming messages are reperforated at the control center, but may or may not be torn off. The sending station is located near the receiving station. The operator reads the address and inserts the message tape into the sending unit. The message's destination is selected by pushbuttons on the sending unit, or "transmitter-distributor."

- Automatic Switching Systems — Incoming messages are reperforated at the control center, where control equipment interprets the address header and retransmits the message to the proper destination(s). In some systems, the message is transmitted across the office to the sending station, where it is reperforated again and then transmitted; these are called "double-storage" systems.

The primary advantage of a store-and-forward message-switching system is that it promotes efficient utilization of the communications lines. This is done at the expense of delays in the delivery of messages. Various priority plans are used to ensure rapid delivery of important messages.

The packaged store-and-forward message-switching systems currently offered by the common carriers all utilize 5-level transmission codes, and include:

- Western Union Plan 111 — a manual torn-tape system for up to three receive and six send circuits; up to 8 or 16 stations can share each circuit on a party-line basis. This system uses Teletype Model 19 or Model 28 ASR equipment and full-duplex communications lines. Operation can be at 60 or 75 words per minute.

- Western Union Plan 55A — a double-storage automatic switching system, originally built by Western Union for the U.S. Air Force, that operates at 100 words per minute over full-duplex lines. Plan 55A is being replaced by AUTODIN, a Department of Defense communications network.

- Western Union Plan 56 — an automatic switching system for up to 20 (56A) or 40 (56B) half-duplex or full-duplex circuits operating at 75 words per minute (56A) or at 60, 75, or 100 words per minute (56B).

- Bell System 81D1 — a double-storage automatic switching system for operation at 60, 75, or 100 words per minute over full-duplex communications lines. Remote stations utilize Teletype Model 28 ASR and RO sets.

- Bell System 82B1 — an automatic switching system similar to Western Union Plan 55A, originally built by the Bell System for the U.S. Navy.

4.4 Circuit-Switching Systems

Another approach to controlling multiple communications lines is the use of a circuit-switching system. In this type of system, a direct electrical connection is established between two points wishing to communicate. The chief advantage of circuit-switching systems is the speed at which messages can be delivered as compared with the store-and-forward systems. However, to

prevent an excessive number of "busy line" conditions, which defeats the idea of quick, direct connections, more lines will be needed in a circuit-switching system than in an equivalent store-and-forward system.

One such circuit-switching system offered by Western Union is Private Wire Service (PWS) Telex. This service operates in a manner similar to the general switched Telex service offered by Western Union (see Paragraph 3.2), and actually uses some of the same circuitry. PWS Telex provides intercommunication at 50 bits per second on a switched-circuit basis among a number of stations; in general, no intercommunication is permitted between a PWS Telex system and the general switched Telex network.

1. VOICEBAND

The channel bandwidth traditionally used to transmit human-voice communications is approximately 3,000 Hz; this bandwidth represents a reasonable balance between transmission quality and cost.

As the need for communications facilities has increased, it has become practical — and in many cases an economic necessity — to use communications channels of very large bandwidths and to divide these channels into a number of independent voiceband paths. The channel separation of these "derived channels" is about 4,000 Hz, and the effective bandwidth of each voiceband path corresponds to the traditional 3,000 Hz. In general, the common carriers make no distinction between the physical facilities used for voice transmission and those for data transmission; the same facility can be used in a voice, data, or alternate voice/data arrangement. Specially conditioned leased lines are available to enhance data transmission.

The method of transmission used for nearly all voiceband data communications is the carrier method, as described in Paragraph 1 of Report 3100. Data sets are required at each end of the line to modulate and demodulate the data signals.

Data sets currently available with common-carrier facilities permit data transmission at up to 3,600 bits per second over the public switched telephone network and up to 7,200 bits per second over leased lines. A comprehensive list of the common-carrier data sets is presented in the Data Set Comparison Charts, Report 4600.

Telephone coupler data sets can be used in conjunction with a conventional office telephone (Bell System Series 500) when portable operation of a data communications terminal over the public telephone network is desired. Telephone coupler data sets are presented in the Telephone Coupler Data Set Comparison Charts, Report 4640.

Data sets directly available from manufacturers, referred to as noncommon-carrier data sets provide the user with a broad spectrum of operating characteristics to meet a variety of applications. These data sets or modems (modulator-demodulator) permit data transmission rates of up to 9,600 bits per second over leased voiceband facilities. A comprehensive list of the noncommon-carrier sets is presented in the Noncommon-Carrier Data Set Comparison Charts, Report 4620. Most independent telephone companies supply these same data sets for use on their own facilities. Regulations governing the use of these data sets vary among the various Bell System operating companies and independent telephone companies; it is advisable to check with the local telephone company communications consultant.

Previously, the use of noncommon-carrier data sets was restricted to leased or privately owned voiceband lines; i.e., telephone companies did not authorize their use on the public telephone network prior to January 1, 1969. This restriction was altered in the recent AT& T tariff concerning foreign attachments. The new tariff permits noncommon-carrier data sets to be connected to the public telephone network via a protective connecting device, referred to by AT& T as a Data Access Arrangement. This device, furnished by the telephone company at a nominal charge, ensures that the electrical signals from the noncommon-carrier data set do not exceed the power level restrictions of the public telephone network to prevent interference with other telephone services.

The Data Access Arrangement is furnished with a conventional Bell System Series 500 Telephone Set, which provides the ncessary network control signaling functions, i.e., the hook switch, data key, and dialing mechanism (Touch-Tone or rotary dialing). With this arrangement, a call is placed in the conventional manner using the telephone set. Following operator coordination, the transmitting operator switches to the data mode by depressing the data key on the telephone set, and data transmission begins. The call is completed by returning the data key to the normal position and hanging up. Received calls are also handled in the conventional manner with the additional operation of the data key to switch to the data mode.

Telephone companies maintain the exclusive right to provide all network control signaling functions required for the public telephone network. A T& T presently offers three versions of the Data Access Arrangement: manual, automatic (unattended answering and calling), and automatic with customer-provided dial pulsing equipment. The latter version can be supplied with or without integral power supply. This protective connecting device is not required for the telephone coupler data sets described under Paragraph 1.

2. LEASED VOICEBAND SERVICES

2.1 Data Channels

The leased voiceband facilities offered by the major common carriers are summarized in Table I. All of the data channels listed have a nominal bandwidth of 4,000 Hz. The primary differences between the various channels are in the conditioning to meet different requirements for envelope delay and frequency response characteristics.

The Type 4001 data channel offered by A T& T was developed for the SAGE system; the tariff specifies that this channel shall be capable of transmitting data at 1,300 or 1,600 bits per second at an error rate of no higher than 1 bit in 100,000. A T& T states that Type 4001 channels have not found many commercial applications, due primarily to their high cost.

The Type 4002 telephoto channel offered by A T& T and Western Union provides for facsimile transmission between the frequencies of 1,200 Hz and 2,600 Hz. The Type 4002 channel effective bandwidth can be increased to provide facsimile transmission between frequencies of 800 Hz and 2,800 Hz by applying special conditioning to the channel at extra cost.

Check with your local common-carrier communications consultant for recommendations as to the most suitable type of data channel for specific application.

In general the basic charges for a leased line include the following items:

- Service Terminal — recurring and installation charges applied for terminating and connecting an interstate interchange channel to stations.
- Inter-Exchange Mileage Charge — a recurring charge for the communications line itself, based on the distance between exchanges.
- Conditioning Arrangement — a recurring charge for special conditioning of the line characteristics to meet specific envelope delay and frequency response requirements.
- Installation — a one-time charge usually applied for each terminal; a rule of thumb is that the installation charge is roughly equivalent to one month's recurring terminal charge.

The service terminal charge is applied only to interstate services and replaces the combined channel terminal and local channel charges in effect prior to August 1, 1967. The old rate structure is maintained for Bell's intrastate services.

In addition, the common carriers offer a wide range of switching configurations to permit flexible arrangements; check with your local common-carrier communications consultant.

3. PUBLIC SWITCHED VOICEBAND SERVICES

3.1 Public Switched Telephone Network

Description

The public switched telephone network, which is operated by the operating companies of the Bell System and by independent telephone companies, is available for the transmission of digital data, currently at practical rates of up to 3,600 bits per second. In the Bell System this type of service is called Data-Phone Service. Many of the independent telephone companies provide similar services and often use Bell System components. Included among the many facilities available through use of the public telephone network are:

- Direct Distance Dialing (DDD) — allows direct dialing of most points in the public system; additional exchanges are continually being added to the list of dialable points.

- Foreign Exchange — provides a permanent leased connection between a subscriber and an exchange other than his local exchange. This facility allows calls to or from the point serviced by the "foreign" exchange to be made at the local message rate for that exchange, and becomes economical if such traffic is heavy.

- Private Branch Exchange (PBX) — provides a local private exchange for a subscriber, typically a company with many extension phones. This permits intercommunication among extension phones and outside calling facilities. PBX facilities can range from operator-connected lines to completely automtic exchanges.

Business machines can be connected to any of the public telephone network facilities via common-carrier-supplied data sets (modems) or by a noncommon-carrier data set via the Data Access Arrangement described under Paragraph 1 of this section. The line of Data-Phone Data Sets offered by the Bell System is summarized in the Data Set Comparison Charts, Report 4600. Most of the independent telephone companies offer equivalent facilities.

Several new facilities are being developed by the Bell System for the public switched telephone network. Included among these is Electronic Switching Service (ESS), which will reduce the time needed to make connections and offer a variety of new services to telephone subscribers. Touch-Tone data transmission, which permits a subscriber to use the ordinary Touch-Tone telephone handset for digital data input, is now widely available.

Other interesting developments for use with the public telephone network include acoustical coupling devices which are being produced by several manufacturers; see Report 4640.

These devices provide a nonphysical coupling between a business machine and the public telephone network via an ordinary telephone set, which opens the way for truly portable data communications terminals. The use of these devices is subject to restrictions imposed by the various regulatory agencies.

Applications

The primary advantage offered by the public telephone network for data communications is the ease with which a widespread data communications network can be implemented. Virtually every area of the United States is served by the Bell System or an independent telephone company with connections to the Bell System, and hence is a potential location for a data communications terminal. Another advantage of the public telephone system is the multiple paths which are usually available between any two points; a line malfunction usually results in the loss of only the time required to reinitiate the call.

(continued on page 5)

TABLE I. LEASED VOICEBAND DATA CHANNELS

Data Channel (2)	Approx. Max. Data Rate bits/sec (3)	Available From	Illustrative Rates (1)				Channel Conditioning Charge, $/month
			Mileage Charge, $/mile/month		Service Terminal Charge, $/month		
			Half-Duplex	Full-Duplex	Half-Duplex	Full-Duplex	
Type 3002 —							
Unconditioned	2,400	AT&T & WU	Base Rate A	Base Rate A+10%	12.50	13.75	—
Conditioned:							
Type C1	2,400	AT&T & WU	Base Rate A	Base Rate A+10%	12.50	13.75	5.00
Type C2	2,400	AT&T & WU	Base Rate A	Base Rate A+10%	12.50	13.75	19.00
Type C3	2,400	AT&T & WU	Base Rate A	Base Rate A+10%	(4)	—	(4)
Type C4	2,400	AT&T & WU	Base Rate A	Base Rate A+10%	12.50	13.75	30.00
Type 4001	1,600	AT&T	Base Rate B	Base Rate B+25%	25.00	30.00	—
Type 4002							
Unconditioned	1,200 to 2,600 Hz(5)	AT&T & WU	Base Rate C	Base Rate C+10%	60.00	60.00	—
Conditioned	800 to 2,800 Hz(5)	AT&T & WU	Base Rate C	Base Rate C+10%	60.00	60.00	(5)

Base Rate	First 25 Miles, $/mile/month	Next 75 Miles, $/mile/month	Next 150 Miles, $/mile/month	Next 250 Miles, $/mile/month	Next 500 Miles, $/mile/month	Next 500 Miles, $/mile/month	Additional Mileage, $/mile/month
Base Rate A	3.00	2.10	1.50	1.05	0.75	0.75	0.75
Base Rate B	4.00	4.00	4.00	3.00	2.35	1.65	1.40
Base Rate C	4.00	2.80	2.00	1.40	1.00	1.00	1.00

Notes:

(1) These rates are for interstate service. The rates for AT&T were in effect April 1, 1970; those for Western Union were in effect July 5, 1970. All rates are subject to change and are illustrative only. The rates presented are for two-point service not arranged for switching and include only the initial terminal connection to a service point. Additional terminals connected to the same line at the same point, including additional channel conditioning, are charged for at a considerably lower rate than the initial terminal connection. Western Union rates are for channels other than Washington Metropolitan Area channels.

(Notes continued on page 5)

Notes for Table I (continued)

(2) AT&T has redesignated its leased voiceband data channel for interstate service. Previous designations still apply to Bell's intrastate service; see Table II. Western Union has redesignated its voiceband data channels to correspond to AT&T designations, effective April 1, 1969.

(3) Maximum data rate is influenced by the data used and can be appreciably different from the rates shown in this column; see also the Common-Carrier and the Noncommon-Carrier Data Set Comparison Charts, Reports 4600 and 4620, respectively.

(4) These rates are complex; see your local Common Carrier communications consultant for exact information.

(5) These channels are intended for facsimile use. Installation charges for AT&T and Western Union Type 4002 unconditioned data channel is $10.00; for conditioned data channels, installation charges are $150.00 (full-duplex and half-duplex), and $75.00 (simplex); simplex service terminal charge is $50.00 per month. The channel conditioning charge for a Type 4002 data channel is $34.00 (full-duplex), $30.00 (half-duplex), and $17.00 (simplex).

TABLE II. BELL SYSTEM INTERSTATE CHANNEL TRANSLATION FOR VOICEBAND CHANNELS

New Designation*	Previous Designation
Type 3002 —	Schedule 4 —
Unconditioned	Type 4
Type C1	Type 4A
Type C2	Type 4B
Type C4	Type 4C

*Type C3 conditioning is a new conditioning arrangement for certain types of switched services; it is not available for point-to-point service.

(Continued from page 3)

The transmission path from one point to another via the public system will seldom be the same for two successive calls. Since the local exchanges throughout the system vary considerably in the types of switching and transmission equipment installed, the characteristics of a particular connection are likely to vary from one call to the next. These variations can affect the efficiency of error detection and correction plans.

In general, the public telephone network can be used effectively by companies needing widespread but relatively low-volume data communications.

Rates

Message rates for data communications are the same as for normal voice communications over the public telephone network. The charge per message varies widely with the location called, type of call, time of day, and day of the week. Most local telephone directories contain lists showing representative rates for various calls, and these rates are equally applicable for data communications calls.

Approximate rental rates for the Bell System Data-Phone Data Sets are shown in the Data Set Comparison Charts, Report 4600.

3.2 Bell System Wide Area Telecommunications Service (WATS)

Description

Bell System Wide Area Telecommunications Service (WATS) is a form of long distance telephone service that provides voice or nonvoice (by means of Data-Phone Service or a customer-provided modem via the Data Access Arrangement) communications to meet the needs of customers who originate or receive a relatively large number of calls to or from widely scattered and distant locations. The customer dials a call in the same way that he would dial an ordinary long distance call. The service is offered at a flat monthly rate or on a measured-time plus overtime basis.

The WATS customer is furnished with an access line from his location to a telephone company central office over which he may make as many calls as he desires. Each WATS access line is arranged for either inward or outward service, but not both over the same line. The charge for this access line varies directly with the size of the geographic area to which calls can be made. Inward and outward service rates are identical. The sizes of the areas range from Area 1, which usually includes the states bordering the customer's origination location (home state excluded), to Area 6, which includes all of the 47 other states (home state excluded) comprising the continental United States. Areas 2 through 6 are comprised of progressively larger areas, with each area including the states covered by the preceding area. Within the subscriber's state, WATS is offered on an intrastate basis and is regulated by the state regulatory body. Many, but not all states, currently offer intrastate inward WATS.

To obtain the WATS rates, all calls must originate at or terminate at one common location. After the connection has been established, data flow can be in either direction. Flexibility is afforded by means of access line bridged extensions. This allows the customer to use extensions at locations both in and out of the exchange area of the originating or terminating location. Calls may be originated from these locations providing the access line is not in use.

One access line is limited to one call at a time; simultaneous calling can be arranged by the installation of two or more access lines.

Applications

Wide Area Telecommunications Service is particularly well suited for customers having a large volume of widespread one-way traffic and for customers who can poll outlying locations for voice or data input. The volume at which WATS becomes economical can be determined from an analysis of the customer's existing long distance servie arrangements. A Bell System communications consultant can make this analysis.

Rates

There are two types of rate schedules for WATS. the measured-time rate covers the first 10 hours of use within a month. Additional use beyond 10 hours is charged by the hour; fractions of hours are charged in increments of 0.1 hour. The full-time rate covers service for 24 hours a day, every day in the month.

Table III shows monthly interstate WATS rates that apply to service areas based on a center in New York City. The "crossover point" indicates the number of hours of monthly use beyond which the full-time rate becomes more economical than the measured-time rate.

TABLE III. WATS RATES FOR A CENTER IN NEW YORK CITY**

Zone	Full-Time*	10 Hours Measured-Time*	Overtime Rate per Hour or Fraction of Hour*	Crossover Point, hours
1	$ 500	$130	$10.00	47
2	950	200	15.00	50
3	1,250	230	17.30	59
4	1,550	270	20.20	64
5	1,700	295	22.00	64
6	1,900	315	23.60	68

* These rates were in effect April 1, 1970, and are subject to change; this data is illustrative only.
** Inward and outward WATS rates are identical.

3.3 Western Union Broadband Exchange Service

Description

The Broadband Exchange Service is a general switched service that provides subcribers with alternate voice/data communications over full-duplex facilities of selectable bandwidth. Subscribers currently have a choice of two bandwidths: 2 or 4 kHz. The service will eventually include a 48-kHz bandwidth, which will make it a truly broadband service as its name implies.

Data can be transmitted at up to 600 bits per second on a "2 KHz" call and at up to 1,200 at 2,400 bits per second on a "4 kHz" call. All stations in the service can be directly dialed by any subscriber. The bandwidth desired is specified in the dialed number. The associated telephone instrument features "pushbutton" dialing. Subscribers attempting to dial a bandwidth higher than the service to which they or the remote party subscribe are automatically informed of this by a recorded message. Usage charges are automatically charged to the calling party; collect calls and person-to-person calls are not permitted. Eventually, facilities for conference calls including up to five subscribers will be provided through a special operator.

At the present time, Western Union Broadband Exchange Service is available in major U.S. cities. Western Union indicates that these services will be expanded as the demand arises.

Western Union Broadband Exchange Service interconnects with various international carriers to provide service between the United States, Canada, most European countries, and Hawaii.

Subscribers to Western Union Broadband Exchange Service can supply their own terminal devices or lease equipment from Western Union. Customer-supplied equipment must be compatible with the Western Union data sets listed in Table IV.

Terminal equipment offered by Western Union to be used with Schedule 1 Service (2kHz) consists of punched card transmitters and 5- and 8-level teleprinters. For Schedule 2 Service (4 kHz), Terminal 311, which transmits and receives data from 5-, 6-, 7-, or 8-level punched tape at 120 characters per second.

Optional features available with the Western Union Broadband Exchange Service include automatic answering and calling equipment.

TABLE IV: TYPICAL BROADBAND EXCHANGE SERVICE USAGE CHARGES*

(Usage Charges By Zones)

BETWEEN / AND	Akron	Atlanta	Baltimore	Boston	Buffalo	Charlotte	Chicago	Cincinnati	Cleveland	Dallas	Denver	Detroit	Grand Rapids	Hartford	Houston	Indianapolis	Jackson	Joplin	Kansas City	Los Angeles	Louisville	Memphis	Milwaukee	Minneapolis	Nashville	New Orleans	New York	Oklahoma City	Omaha	Philadelphia	Pittsburgh	Portland	Providence	Rochester	Rockford	Sacramento	St. Louis	St. Paul	San Francisco	Seattle	Syracuse	Tulsa	Washington	Wichita
Akron, Ohio	1																																										
Atlanta, Ga.	4	1																																									
Baltimore, Md.	4	4	1																																								
Boston, Mass.	4	5	4	1																																							
Buffalo, N.Y.	2	5	4	4	1																																						
Charlotte, N.C.	4	3	4	5	4	1																																				
Chicago, Ill.	4	5	5	5	4	5	1																																			
Cincinnati, Ohio	2	4	4	5	4	4	3	1																																	
Cleveland, Ohio	1	4	4	4	2	4	4	2	1																																
Dallas, Texas	6	5	6	6	6	5	5	5	6	1																															
Denver, Colo.	6	6	6	7	6	6	5	6	6	5	1																														
Detroit, Mich.	1	4	4	4	3	4	3	3	1	6	6	1																													
Grand Rapids, Mich.	3	5	4	5	4	5	2	3	3	5	6	2	1																												
Hartford, Conn.	4	5	3	1	3	5	5	5	4	6	7	4	5	1																											
Houston, Texas	6	5	6	7	6	5	5	5	6	3	5	6	6	6	1																										
Indianapolis, Ind.	3	4	4	5	4	4	2	1	3	5	6	3	3	5	5	1																									
Jackson, Miss.	5	4	5	6	5	4	5	4	5	4	5	5	5	6	4	4	1																								
Joplin, Mo.	5	5	6	6	5	5	4	4	5	4	5	5	5	6	4	4	4	1																							
Kansas City, Mo.	5	5	6	6	5	5	4	4	5	4	4	5	4	6	5	4	4	2	1																						
Los Angeles, Calif.	7	7	8	8	7	7	7	7	7	6	5	7	7	8	6	7	7	6	6	1																					
Louisville, Ky.	4	4	4	5	4	4	3	2	4	5	6	4	4	5	5	1	4	4	4	7	1																				
Memphis, Tenn.	5	4	5	6	5	4	4	4	5	4	5	5	4	6	4	4	2	3	4	7	3	1																			
Milwaukee, Wis.	4	5	5	5	4	5	1	4	4	5	5	3	1	5	6	3	5	4	4	7	4	4	1																		
Minneapolis, Minn.	5	5	5	6	5	5	4	5	5	5	5	4	4	6	6	4	5	4	4	6	5	5	4	1																	
Nashville, Tenn.	4	3	5	5	5	4	4	3	4	5	6	4	4	5	5	3	4	4	4	7	2	2	4	5	1																
New Orleans, La.	5	4	6	6	6	5	5	5	5	4	6	5	5	6	3	5	2	4	5	7	5	4	5	6	4	1															
New York, N.Y.	4	5	2	2	3	4	5	4	4	6	7	4	5	2	6	5	6	6	6	8	5	5	5	6	5	6	1														
Oklahoma City, Okla.	5	5	6	6	6	5	5	5	5	3	4	5	5	6	4	5	4	3	4	6	5	4	5	5	5	5	6	1													
Omaha, Nebr.	5	5	6	6	5	5	4	5	5	5	4	5	4	6	5	4	5	4	2	6	4	4	4	3	5	5	6	4	1												
Philadelphia, Pa.	4	5	1	4	3	4	5	4	4	6	7	4	4	3	6	4	5	6	6	8	4	5	5	6	5	6	2	6	6	1											
Pittsburgh, Pa.	1	4	3	4	3	4	4	3	1	6	6	2	4	4	6	4	5	5	5	7	4	5	4	5	4	5	4	6	5	3	1										
Portland, Ore.	7	7	8	8	7	8	7	7	7	7	5	7	7	8	7	7	7	7	6	5	7	7	7	6	7	7	8	6	6	8	7	1									
Providence, R.I.	4	5	4	1	4	5	5	5	4	6	7	5	5	1	7	5	6	6	6	8	5	6	5	6	5	6	2	6	6	3	4	8	1								
Rochester, N.Y.	3	5	3	4	1	4	4	4	3	6	6	3	4	3	6	4	5	5	5	7	4	5	4	5	5	6	3	6	5	3	3	7	4	1							
Rockford, Ill.	4	5	5	5	4	5	1	4	4	5	5	4	2	5	5	3	5	4	4	7	4	4	2	4	4	5	5	5	4	5	4	7	5	4	1						
Sacramento, Calif.	7	7	8	8	7	7	7	7	6	5	7	7	8	7	7	7	6	6	4	7	7	7	6	7	7	8	6	6	8	7	4	8	8	7	1						
St. Louis, Mo.	4	4	5	6	5	4	3	4	4	4	5	4	4	5	5	3	4	3	3	6	3	3	4	4	3	5	5	4	4	5	4	7	6	5	3	7	1				
St. Paul, Minn.	5	5	5	6	5	5	4	4	5	5	5	4	4	6	6	4	5	4	4	6	4	5	3	1	5	6	5	5	4	5	5	6	6	5	3	6	4	1			
San Francisco, Calif.	7	7	8	8	8	8	7	7	7	6	5	7	7	8	7	7	7	6	6	4	7	7	7	6	7	7	8	6	6	8	7	4	8	8	7	1	7	7	1		
Seattle, Wash.	7	7	8	8	7	8	7	7	7	6	7	7	8	7	7	7	7	6	5	7	7	7	6	7	7	8	6	6	8	7	2	8	7	7	5	7	6	5	1		
Syracuse, N.Y.	3	5	3	3	1	4	4	4	3	6	6	4	4	2	6	4	6	6	5	8	5	5	4	5	5	6	2	6	6	3	3	8	3	1	5	8	5	5	8	7	1	
Tulsa, Okla.	5	5	6	6	6	5	4	5	5	3	4	5	5	6	4	4	4	1	3	6	4	4	5	5	4	4	6	2	4	6	5	6	6	6	4	6	4	5	6	6	6	1	
Washington, D.C.	3	4	1	4	3	4	5	4	3	6	6	4	4	4	6	4	5	5	5	8	4	5	5	5	4	6	2	6	6	1	2	8	4	3	5	8	5	5	8	8	3	6	1	
Wichita, Kans.	5	5	6	6	6	5	4	5	5	4	4	5	5	6	4	5	4	2	2	6	5	4	5	4	5	5	6	2	3	6	5	6	6	6	4	6	4	4	6	6	6	2	6	1

Charge Per Minute of Usage

Zone	2 kHz	4 kHz
1	$.15	$.20
2	.20	.25
3	.25	.30
4	.30	.35
5	.35	.45
6	.45	.55
7	.55	.65
8	.65	.75

Indicated charge applies for first minute or fraction thereof. Fractional minutes beyond the first minute on each call are charged for in tenths of minutes.

*If during any monthly billing period, the usage charges exceed $300 for a Schedule 1 (2 kHz) subscriber station or $50 for a Schedule 2 (4 kHz) subscriber station, then the amount by which such usage charges exceed $300 or $500 respectively, will be reduced by 40%. These rates were in effect July 1, 1970, and are subject to change; they are shown for illustrative purpose only.

Rates

The charges to a subscriber consist of a nonrecurring installation charge, a usage charge for each call, a monthly service charge, and a monthly equipment charge for a data set. The equipment and message charges for 2 kHz and 4 kHz service are summarized in Tables IV and V.

TABLE V. SERVICE AND EQUIPMENT CHARGES FOR BROADBAND EXCHANGE SERVICE (1)

Service or Equipment	Fixed Charge, $/month	Installation, $
Broadband Exchange Service —		
Schedule 1 (2 kHz) (2)	15.00	25
Schedule 2 (4 kHz) (2)	30.00	25
Data Sets —		
0 to 600 bits/sec, asynchronous	27.00	25
0 to 1,200 bits/sec, asynchronous	27.00	25
600 bits/sec, synchronous	88.00	50
1,200 bits/sec, synchronous	88.00	50
2,400 bits/sec, synchronous	72.00	100
Automatic Calling Unit	32.00	50
Automatic Answering Unit	3.75	10
Audible and/or Visual Signal Device (for incoming calls)	1.75	10
International Data Set (DATEL) —		
0 to 1,200 bits/sec, asynchronous	68.00	50
Teleprinter (3) —		
Type 33 KSR	33.00	50
Type 33 ASR	44.00	50
Type 33 RO	31.00	50
Type 35 KSR	70.00	50
Type 35 ASR	110.00	50
Info-Terminal 311 (4) —		
5- through 8-level code:		
Transmitter	100.00	100
Receiver	190.00	100
Combined Transmitter-Receiver	260.00	100
Info-Fax 100 Facsimile Transceiver	115.00	100

Notes:

(1) These changes were in effect July 1, 1970, and are subject to change.
(2) Includes local loop and telephone instrument.
(3) Used with a 0 to 600 bit-per-second asynchronous data set.
(4) Used with a 0 to 1,200 bit-per-second synchronous data set.

4. MULTISTATION VOICEBAND LEASED SYSTEMS

4.1 Bell System 1A System

The Bell System 1A Selective Calling System provides for the operation of multiple 5-level punched paper tape terminals over a single leased, half-duplex, voiceband line. Control circuitry located at the master station permits automatic polling or selective calling of remote way stations. Teletype Telespeed 1050 equipment (see Report 6800), which operates at a transmission speed of 105 characters per second, is used. Optional speed conversion equipment permits a remote way station to be connected to 8-level teleprinter circuits on a store-and-forward basis.

4.2 Western Union Private Automatic Telephone System (PATS)

PATS is a private telephone system available with up to 450 stations. This system features pushbutton-dialing telephones for faster operation, and can include such optional features as the ability to signal an employee anywhere on the premises, to signal a busy line that another station is trying to call, and to arrange conference calls. Western Union states that no provisions for data transmission are currently being planned for PATS.

5. OTHER VOICEBAND SERVICE

5.1 Bell System DATASPEED Service

DATASPEED Service provides transmission and/or reception of punched paper tape data and reception by page equipment over leased voiceband lines or over the public switched telephone network.

DATASPEED Service (Type 1) utilizes 5-level tape equipment operating at a transmission speed of 1,050 words per minute.

DATASPEED Service (Type 2) utilizes the Teletype Telespeed 1050 equipment, which can handle 5-, 6-, 7-, or 8-level fully punched paper tape and operates at a transmission speed of 1,050 words per minute (105 characters per second). This equipment is described in detail in Report 6800.

DATASPEED Service (Type 4) utilizes equipment which can handle 5-, 6-, 7-, or 8-level paper tape and operates at a transmission speed of up to 2,400 words per minute. This equipment includes error detection and correction capabilities.

DATASPEED Service (Type 5) utilizes Teletype Telespeed 750 equipment. This equipment can also handle 5- through 8-level paper tape, but it operates at a lower transmission speed of 750 words per minute (75 characters per second). Telespeed 750 equipment transmits data bits in parallel by character and utilizes the Bell System 402-C and 402-D Data Sets. Telespeed 750 equipment is described in detail in Report 6801.

DATASPEED read-only page equipment is available for use with each service mentioned. Also, a new 8-level magnetic tape terminal is available for send and receive operation presently at transmission speeds up to 1,200 words per minute.

The line usage charges for DATASPEED Service depend upon the particular type of line used. Rate information on the various types of voiceband lines is summarized in Tables I and III. The terminal equipment is leased from the Bell System at the approximate rates shown in Table VI.

TABLE VI. DATASPEED TERMINAL EQUIPMENT COSTS

DATASPEED Equipment	Approximate Rental, $/month*	Installation, $
Paper Tape Equipment		
Type 1 (1,050 wpm)		
Transmitter	100	50
Receiver	125	50
Type 2 (1,050 wpm)		
Transmitter	105	50
Receiver	135	50
Type 4 (2,400 wpm)		
Transmitter	175	150
Receiver	225	150
Type 5 (750 wpm)		
Transmitter —		
Table-mounted	40	75
Console	60	75
Receiver	94	75
RO Page Equipment		
750-wpm Printer (5-8 level)	240	100
1,050-wpm Printer (5- level)	245	100
1,200-wpm Printer	245	100
Magnetic Tape Equipment (1,200 wpm)	100	50

* These prices were in effect April 1, 1970 and are subject to change. Prices do not include a data set or any optional features.

COMMON-CARRIER BROADBAND FACILITIES

1. BROADBAND

Communications facilities having higher bandwidth capabilities than voiceband facilities are termed "broadband" or "wideband" services. Wherever data must be transmitted at speeds substantially higher than 2,400 bits per second, broadband facilities will generally need to be used.

A broadband communications facility can usually be divided, by the common-carrier, into a number of independent channels of lower bandwidth ("derived" channels). A voiceband channel, derived from the basic broadband channel, is frequently used to coordinate data communications.

2. LEASED BROADBAND FACILITIES

2.1 Telpak Service

Telpak is a general name for a service which provides the capacity and felxibility required to meet bulk communication needs and is offered by both the Bell System and Western Union. Telpak Service is designated as Series 5000 channels. The information presented in this section is illustrative only, and is based upon information in the current tariff. At the present time there are some restrictions on the facilities that can be offered; the local common-carrier communications consultant should be contacted for exact information as to the status of the various offerings.

Two classifications of interstate Tekpak Service are currently offered, and these are summarized in Table I.

TABLE I. CLASSES OF INTERSTATE TEKPAK SERVICE

Type	Class	Maximum Equivalent Carrier Spectrum Assignment, kHz	Base Capacity, Number of Equivalent Voice Channels	Inter-Exchange Line Charge, $/mile/month*
5700	C	240	60	30
5800	D	1000	240	85

Table II summarizes the currently available Telpak terminals. Unless otherwise specified, these terminals are available from both the Bell System (AT&T) and Western Union.

In general, the full base capacity of a Telpak channel must be leased, with the common carrier furnishing the derived channels in accordance with the customer's specifications. The full capacity need not be terminated, but the full Telpak line charge applies in any case. In a manner consistent with the arrangements approved by the FCC for private microwave systems, a Telpak channel may be shared among several users. Such users must be in the same business, and this business must be regulated by a federal, state, or local agency; examples of such businesses include companies and railroads. Sharing of Telpak facilities is limited to division of the base capacity among the sharing users; the same derived channel may not be used by two different users.

* These rates were in effect April 1, 1970, and are subject to change. The full bandwidth of Telpak C can be utilized as a single channel for high-speed data transmission. The base capacity of all classifications can be divided into a number of independent channels for simultaneous data transfers at various rates. The full bandwidth of Telpak D cannot be utilized as a single channel.

The major charges for Telpak Service consist of two components:

- Line charges, which are proportional to the distance spanned; see Table I.
- Service terminal charges, which apply at each end of the channels for each derived facility; see Table II.

All costs shown are illustrative only and are subject to change.

2.2 Wideband Data Channels

Both AT&T and Western Union now provide a wideband data channel service that effectively replaces the discontinued Telpak A Service. This service is designated as Series 8000 wideband data channels.

Wideband Service is essentially a 48-kHz facility embracing 12 voiceband channels. The service offers various arrangements that include one of the following:

- A single 48-kHz data channel
- Two 24-kHz data channels
- Twelve voiceband channels
- Combinations of the above not exceeding the 48-kHz channel bandwidth.

The service can be used for data, facsimile, or voice transmission. Alternate use of a wideband channel as individual voiceband channels is allowed when the wideband channel is not being used for data or facsimile transmission.

Wideband channels can be connected to equivalent Telpak terminals provided that all channels so connected terminate at the same locations. Within limits, the user can subdivide each voiceband channel to provide narrowband facilities.

The major charges for Wideband Service include:

- Line charges, which are proportional to the distance spanned; see Table III.
- Service terminal charges, which apply at each end of the channels for each derived facility; see Table IV.
- Installation charges, a one-time charge applied for each terminal; this is treated as part of the service terminal charge; see Table IV.

All costs shown are illustrative only and are subject to change.

2.3 Bell System Series 11000 Channels

AT&T now offers, on an experimental basis, high-capacity broadband channels classified as Series 11000 channels. The service is for a three-year period expiring November 1, 1972 unless cancelled, changed, or extended. Usage is confined to points in the states of Illinois, Indiana, Michigan, New Jersey, New York, Ohio, and Pennsylvania.

AT&T states that the selected seven-state trial territory was chosen in order to obtain a representative market study over a range of densities and lengths of haul.

TABLE II. TELPAK TERMINALS

Service Terminal Type (2)	Bandwidth in kHz or Data Rate in bits/sec	Equivalent Voice Channels	Charge per Service Terminal (1)		Remarks
			Installation, $	Monthly, $	
5701	10 Hz to 20 kHz	—	200	425	Does not include a voice coordination channel
	or				
	40,800 bits/sec	12	200	425	Includes 1 voice channel for coordination
	or				
	50,000 bits/sec	12	200	425	Asynchronous or synchronous operation; includes 1 voice channel for coordination
			100(3)	65(3)	Optional supplementary control arrangement
5703	29 to 44 kHz	—	200	425	Designed for 2-level facsimile transmission; includes 1 voice channel for coordination
	or				
	19,200 bits/sec	6	200	425	Synchronous operation; includes 1 voice channel for coordination
5706(4)	50,000 bits/sec	12	200	425	Designed for the transmission of secure communications and furnished to a department or agency of the U.S. Government; a supervisory signal arrangement is included
5707(4)	18,750 bits/sec	6	400	560	Designed for the transmission of secure communications and furnished to a department or agency of the U.S. Government; includes 1 channel for alternate voice transmission
5708(4)	50,000 bits/sec	12	100	150	Asynchronous or synchronous operation; designed for use with 50 Kilobit switched foreign exchange service; includes one voice channel for coordination
5751	200 Hz to 100 kHz	—	200	650	Does not include a voice coordination channel
	or				
	230,400 bits/sec	60	200	650	Asynchronous or synchronous operation; includes 1 voice channel for coordination
			100(3)	65(3)	Optional supplementary control arrangement
Narrowband or voiceband terminals equivalent to those specified in Paragraph 2.1 of Reports 3100 and 3200	Up to 180 bits/sec for narrowband and up to 2,400 bits/sec for voiceband terminals, depending on the specific service	Each narrowband channel requires the equivalent of 1/12 voice channel.	20	35	Normal voice channel data sets are required and are not included in the terminal charge
		Each voiceband channel requires 1 equivalent voice channel	20	35-255	Normal voice channel used for facsimile operation

Notes:

(1) These charges were in effect April 1, 1970 and are subject to change.

(2) The charges for these terminals include a data set or suitable terminating facility; the data channels can be derived from a Telpak C or D Service. Western Union has redesignated its Telpak Service terminals to conform with the AT&T 5000 Series designation. Previous designations, enclosed by parentheses, were: 5701 (A1), 5703 (A3), 5703 (A3), 5751 (C1).

(3) Supplementary control arrangement allows voice channel to be used solely or alternately for transmission of restricted 3-of-14 code at up to 20 code combinations per second.

(4) These service terminals are supplied by AT&T only.

TABLE III. WIDEBAND SERVICE INTER-EXCHANGE MILEAGE CHARGES

Type	Maximum Equivalent Carrier Spectrum Assignment, kHz	Base Capacity, Number of Equivalent Voice Channels	Channel Charge, $/mile/month		
			First 250 Miles	Next 250 Miles	Additional Miles
8800	48	12	15.00	10.50	7.50

Two types of Series 11000 channels are available: Type 11240 and Type 11048. Both are furnished on a point-to-point basis only. The service offerings of these two channel types are outlined in Table V.

2.4 Other leased Broadband Facilities

Several high-speed facilities are available from both the Bell System and Western Union for special applications. A summary of these facilities is presented in Table VI. Only illustrative line charges are shown, because the terminals are usually custom-engineered for specific applications. These facilities can usually be subdivided to provide multiple voiceband channels.

3. PUBLIC SWITCHED BROADBAND SERVICES

3.1 Western Union Broadband Exchange Service

The Broadband Exchange Service is a general switched service that provides subscribers with alternate voice/data communications over full-duplex facilities of selectable bandwidth. The bandwidths in current use are 2 and 4 kHz. A 48-kHz extension of this service is planned for the near futrue. A more complete description of the existing service is presented in Paragraph 3.3 of Report 3200.

3.2 Bell System Data-Phone 50 Service

AT&T introduced Data-Phone 50 Service on April 1, 1968 on a trial basis. It provides high speed (50 kilobit-per-second) switched, message rate service for data and facsimile. The trial period for this service is three years (to March 31, 1971).

Data-Phone 50 became fully automatic, allowing customer dialing on all calls, on November 15, 1969. Prior to that date only calls within an exchange could be dialed by subscribers, with intercity calls requiring operator intervention.

The service is offered within and between switching centers in four cities: New York, Chicago, Los Angeles, and Washington, D. C. Subscribers located in the same exchange as a switching center are connected to that center by a local access line. Other areas desiring service can request interconnecting interstate private lines thus establishing Foreign Exchange Service. Charges for such a Foreign Exchange Service would consist of:

(1) Series 5000 or 8000 inter-exchange charges as shown in Tables I and III, respectively

(2) Service terminal charges at each end of the Foreign Exchange Channel of Type 5708 or Type 8802 as shown in Tables II and IV, respectively

(3) Data-Phone 50 charges between switching centers as shown in Tables VII and VIII.

TABLE IV. WIDEBAND SERVICE TERMINALS

Type	Bandwidth in kHz or Data Rate in bits/sec	Equivalent Voice Channels	Charge per Service Terminal (1)		Remarks
			Installation, $	Monthly, $	
8801	10 to 20 kHz	12	200	425	Does not include a voice coordination channel
	40,800 bits/sec	12	200	425	Includes 1 voice channel for coordination
	50,000 bits/sec	12	200	425	Asynchronous or synchronous operation; includes 1 voice channel for coordination; supplementary control arrangement allows voice channel to be used solely or alternately for transmission of restricted 3-of-14 code at up to 20 code combinations per second
			100	65	Optional supplementary control arrangement
8802(2)	50,000 bits/sec	12	100	150	Asynchronous or synchronous operation; includes 1 channel for coordination; furnished in connection with 50 kilobit switched foreign exchange service
8803	29 to 44 kHz	6	200	425	Designed for 2-level facsimile transmission; includes 1 voice channel for coordination
	19,200 bits/sec	6	200	425	Synchronous transmission; includes 1 voice channel for coordination
Voiceband terminals equivalent to those specified in Paragraph 2.1 of Report 3200	up to 2,400 bits/sec	up to 12	10	250 plus 12.50(3)	Normal voice channel for data transmission; data sets, if required, are not included in the service terminal charge
	3,000 Hz	up to 12	10	250 plus 60(3)	Normal voice channel for facsimile transmission; data sets, if required, are not included in the service terminal charge
	3,000 Hz	up to 12	10	250 plus 12.50(3)	Normal voice channel for voice transmission

Notes:

(1) These charges were in effect April 1, 1970 and are subject to change.

(2) This channel is not available from Western Union.

(3) The additional charge is for the first service terminal; each additional service terminal is charged at $7.50 per month (voice or data use) and $20 per month (facsimile use).

TABLE V. TYPES OF SERIES 11000 CHANNELS

Type	Maximum Equivalent Carrier Spectrum Assignment, kHz	Base Capacity, Number of Equivalent Voice Channels	Channel Charge, $/mile/month (1)		
			First 250 Miles	Next 250 Miles	Additional Miles
11240	240	60	(2)	(2)	18.00 (2)
11048	48	12	15.00	10.50	7.50

Notes:

(1) These rates were in effect April 1, 1970, and are subject to change.

(2) Type 11240 channels will be furnished only between selected points in the seven-state trial territory. Contact the local Bell communications consultant for exact listings in a particular area of interest.

TABLE VI. BROADBAND FACILITIES FOR SPECIAL APPLICATIONS

Type	Channel Bandwidth, kHz	Approximate Maximum Data Rate, bits/sec	Line Charge, $/mile/month
Single Channel	8 16	5,000 10,000	6.00 11.70
Video Channel	2,800 4,000 6,000	1,500,000 1,900,000 2,900,000	67.00 67.00 67.00

TABLE VII. DATAPHONE 50 INTER-EXCHANGE CHARGES
(Dollars Per Minute or Fraction Thereof)

From/To	Chicago	New York	Washington, D.C.	Los Angeles
Chicago	—	2.25	1.75	2.75
New York	2.25	—	1.25	3.25
Washington, D.C.	1.75	1.25	—	3.25
Los Angeles	2.75	3.25	3.25	—

TABLE VIII. DATAPHONE 50 STATION TERMINAL CHARGES*

Terminal Type	Installation, $	Service and Equipment, $/Month
50 kilobit, nonsynchronous or 50 kilobit, synchronous	125	275
Alternate, 50 kilobit nonsynchronous and 50 kilobit, synchronous	125	300

* Includes a local voice coordinated 50 kilobit-per-second access line, termination in a switching center, and appropriate data sets at subscriber's premise.

Certain switching centers provide "extended area" coverage so that subscribers located in surrounding areas can have Data-Phone 50 service, at an additional charge. Consult the local Bell communications consultant for exact offerings in a particular area of interest.

All wideband circuits are four-wire, full duplex. An end-to-end, two-wire, half-duplex voice coordination channel is also provided.

Data-Phone 50 calls can be initiated manually with a Touch-Tone telephone (see Report 6040) or with an optional Automatic Calling Unit used in conjunction with the appropriate customer-provided terminal equipment. Transmission can be for 50 kilobit-per-second synchronous data, for facsimile at a nonsynchronous rate of approximately 50 kilobit per second, or for alternate synchronous/nonsynchronous transmission.

COMPARISON CHARTS

AUERBACH
DATA
COMMUNICATIONS
REPORTS

COMMUNICATIONS TERMINAL EQUIPMENT

AUERBACH
DATA
COMMUNICATIONS
REPORTS

Printed in U.S.A.

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MARCH 1970

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AUERBACH DATA COMMUNICATION REPORTS

The following pages complete the two-part March supplement of AUERBACH Data Communications Reports. The information contained herein outlines, in comparison chart form, the salient characteristics of well over 200 communications terminal equipment systems and devices.

A Users' Guide for Communications Terminal Equipment is included. The Users' Guide defines each comparison chart entry.

Please file these pages promptly in your binders according to the following filing instructions. We then suggest routing this cover sheet to those who should be informed of the significant new information now available in AUERBACH Data Communications Reports. This cover sheet may then be discarded.

FILING INSTRUCTIONS

Binder	Behind Tab	Remove Old Pages	Filing Instructions For New Pages in This Issue			
			Section Name	First Page	Last Page	Follows Page
1	COMPARISON CHARTS					
	TERMINAL EQUIPMENT	4200:01-4200:40	Terminal Equipment	4200:01	4200:77	Tab

USERS' GUIDE TO COMPARISON CHARTS: COMMUNICATIONS TERMINAL EQUIPMENT

This section briefly explains the meaning of the entries found in the comparison charts for communications terminal equipment

IDENTITY

Both the formal name and model number of the subject equipment are stated, as well as any acronym by which the unit is commonly known.

REPORT NUMBER

The four-digit number that uniquely identifies the detailed equipment report in AUERBACH Data Communications Reports, which covers the subject device. Information in the comparison chart has been extracted from this report.

FUNCTION

A brief statement of the general purpose and characteristics of the subject equipment, usually including the types of transmission facilities to which the equipment can be connected and the types of input and output it can employ.

PREPARED INPUT

Medium

Types of previously prepared input data (e.g., punched paper tape, punched cards) accepted by the subject equipment.

Code

The set of symbols and rules by which characters are represented (e.g., USASCII and Baudot codes) at the input to the subject equipment.

Speed

Peak speed of the input unit, without regard to any restrictions imposed by the communications facilities or the receiving terminal. Units of characters/second or cards/minute are noted as appropriate.

MANUAL INPUT

Method of Entry

Provision(s) for entering variable data at transmission time; usually by either a keyboard or a set of dials, switches, slides, or levers.

Number of Characters

Refers to the characters the subject equipment can transmit for each message. Indicates the character capacity of the buffer for those devices which store all or part of a message for bulk-type transmission.

OUTPUT

Medium

The means by which the data can appear at the output (e.g., punched paper tape, punched cards, or printed copy).

Code

A set of characters or symbols and rules by which characters are represented at the output of the subject equipment. For page printers and display devices the number of printable/displayable characters is indicated.

Speed

The peak speed of the output unit, without regard to any restrictions imposed by the communications facilities.

DATA TRANSMISSION

Line Type

Capabilities of the communication line facilities. The type(s) will be one (or more) of three classes: narrowband, voiceband, or broadband.

Speed, bps

Output data rate(s) of the subject equipment, measured in bits per second.

Mode

The subject equipment's method of communication between two points. Operation will be in one or more of the following basic modes: simplex, communications in one direction only; half-duplex, communications in both directions but in only one direction at a time; or full-duplex, communications in both directions simultaneously.

Code

A specific set of symbols and rules by which characters to be transmitted are represented.

Timing

The method used to establish synchronization. Two commonly employed techniques are start/stop or asynchronous synchronization and synchronous transmission.

ERROR CONTROL

The method provided for detecting errors and the procedures used for correcting or overcoming them are indicated.

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		American Data Systems ADS-715 Data Communications Terminal	American Regitel Model 701 Data Communications Terminal Controller	American Regitel Model 4440C Console Printer	American Regitel Model 12212 Boarding Pass Printer	AT&T Touch-Tone Handset
REPORT NUMBER		—	—	—	—	6040
FUNCTION		Transmission/reception of alphanumeric data over voiceband line; keyboard input; printed copy output	Transmission/reception of data over public telephone network; numeric keyboard data entry; alphanumeric printed copy output	Printed copy output of alphanumeric data received over voiceband line	High-speed std format printout of alphanumeric data on single line	Remote keyboard entry of digital data over public telephone network
PREPARED INPUT	Medium	No provision	Credit cards, merchandise tickets	No provision	No provision	Dial card
	Code	—	—	—	—	2-of-8
	Speed:					
	Char/sec	—	—	—	—	10
	Cards/min	—	—	—	—	—
MANUAL INPUT	Method of Entry	50-key keyboard	23-key keyboard	No provision	No provision	10/12-key keyboard
	No. of Char	Variable	Variable	—	—	1-14
OUTPUT	Medium	Printer	Printer	Printer	Printer (dual print heads)	Voice response output
	Code	88 char	44 char	44 char	44 char	—
	Speed:					
	Char/sec	10/15	40	40	30 (each print head)	—
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband	Voiceband	Voiceband
	Speed, bps	100-134.5	Up to 300	Up to 300	Up to 300	Approx 80
	Mode	Half-duplex	Half-duplex	Half-duplex (receive only)	Half-duplex (receive only)	Half-duplex
	Code	8-level USASCII; 6-level CDR/EBCD	USASCII	USASCII	USASCII	2-of-8
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Receiver activated by each data group
ERROR CONTROL		Char parity checking	Char parity/longitudinal redundancy checking	No provision	No provision	No provision
MONTHLY RENTAL, $		2800 (purchase price)	85-100 (terminal); 450 (controller)	35	75	Included in telephone bill
COMMENTS		Remote I/O terminal consisting of std IBM Selectric typewriter; control equipment permits operation as replacement for IBM 2741 Correspondence/EBCD code or TTY 33 KSR (switch-controlled); acoustic coupler line interface; parity error light	Controller capable of multiplexing up to 120 terminal communications channels; limited processing capability; 4000- to 8000-bit storage capacity	Printer uses any single/multiple ply paper; available in 30-, 40-, or 80-col units with full electronics or basic mechanism only; impact printing up to 5 copies; 10 char/in., 6 lines/in. spacing; friction-feed platen; data rate up to 8KHz optional; versions available for ticket-printing, validation, mobile applications	Printer prints two formatted messages simultaneously each with 30 char max on 1 line; document is hand inserted for printing; data rate up to 8KHz optional	Auxiliary Touch-Tone pushbutton dialers/ card dialers available for use with rotary-dial handsets

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Anderson Jacobson ADT 233 Acoustic Data Terminal		Applied Peripheral Systems Model DG-4 Data Entry Terminal	Applied System ASC 1170 Communications Terminal	
REPORT NUMBER		6050		—	—	
FUNCTION		Transmission/reception of data over public telephone network via acoustic coupler; keyboard/paper tape input; paper tape/printed copy output		Transmission of numeric/mag tape cassette data over voiceband line to computer/off-line mag tape recorder	Remote transmission of punched card/paper tape data over voiceband line to central computer system; reception of data to punched cards/printed copy output	
PREPARED INPUT	**Medium**	Punched tape (ASR)		Magnetic tape	Punched cards	Punched tape
	Code	8-level USASCII		11-level USASCII	Hollerith	8-level
	Speed:					
	Char/sec	10		—	—	400
	Cards/min	—		—	225-500	—
MANUAL INPUT	**Method of Entry**	45-key keyboard (ASR/KSR)		No provision	Keyboard	
	No. of Char	Variable		—	Variable	
OUTPUT	**Medium**	Punched tape (ASR)	Printer (ASR/KSR)	No provision	Punched cards	Printer
	Code	8-level USASCII	64 char	—	Hollerith	64 char
	Speed:					
	Char/sec	10	10	—	—	—
	Cards/min	—	—	—	100	300-600 lpm
DATA TRANSMISSION	**Line Type**	Voiceband		Voiceband	Voiceband	
	Speed, bps	Up to 300		110, 300, 1200	2000-4800	
	Mode	Half-/full-duplex		Half-/full-duplex	Half-/full-duplex	
	Code	8-level USASCII		7-level USASCII	USASCII/EBCDIC	
	Timing	Asynchronous		Asynchronous	Synchronous	
ERROR CONTROL		Even parity generation		Char parity checking; automatic retransmission	Char parity checking; communications support software (optional)	
MONTHLY RENTAL, $		88 (mobile KSR); 99 (mobile ASR); 107 (portable KSR); 128 (portable ASR)		50; 2200 (purchase)	500-1600	
COMMENTS		Modified TTY 33; ASR/KSR units available as ADT 233/integral acoustic coupler or as TTY 33/separate coupler; couplers provide originate, originate/dual input interface, or originate/answer modes; portable or mobile facilities available; KSR includes keyboard/printer; ASR adds paper tape I/O		DG-4 transmits to DG-5 (off-line, 9-track, 800-bpi, mag tape recorder) or directly to computer communication device; can be polled or operate in originate mode; provisions for other input (badges, cards) available; compatible with Bell System 103A Data Set via acoustic coupling/DAA; keyboard generates digits 0-9 plus special function char; 132,000-char storage/mag tape cassette; 15-key adding machine keyboard enters data onto mag tape	Used as on-line system/optionally as stand-alone, off-line computer; programmable processor includes 4096-char core memory; compatibility, formatting, data compression under program control; expandable to include 500-cpm card reader, 1000-lpm printer, 400-cpm card punch; optional software compatibility with IBM 360/20, 1050, 2270, 2780, Burroughs TC-500/remote operation with IBM 360, Univac 1108, CDC 6600; synchronous/asynchronous modem controllers compatible with Bell System Data Sets 201/202 (up to 1800 bps) or 103 (110, 150, 300 bps); 80-/132-char print line; remote TTY 33/35 ASR, IBM 2741, GE 300 keyboard/printers, 8-level, 50-cps paper tape punch available	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Badger Meter Noller Control System DTS-112 Remote Batch Terminal		Badger Meter Noller Control System DTS-114 Remote Batch Terminal		Berkeley Scientific Laboratories GP-30 Data Terminal
REPORT NUMBER		—		—		—
FUNCTION		Remote, programmable, communications terminal for transmission/reception of batched data over voiceband line; keyboard data entry; punched card I/O; printed copy output		Remote, programmable, communications terminal for transmission/reception of batched data over voiceband line; keyboard data entry; punched card I/O; printed copy output		Remote keyboard entry/visual display via nixie tubes of numeric data transmitted to/received from remote computer over voiceband line
PREPARED INPUT	Medium	Punched cards		Punched cards		No provision
	Code	Hollerith/binary		Hollerith/binary		—
	Speed: Char/sec Cards/min	— 400		— 600		— —
MANUAL INPUT	Method of Entry	TTY 33 ASR		TTY 33 ASR		19-key keyboard
	No. of Char	Variable		Variable		Up to 11
OUTPUT	Medium	Printer	Punched cards	Printer	Punched cards	Nixie tubes
	Code	64 char	Hollerith/binary	64 char	Hollerith/binary	10 digits; 1 special char (decimal)
	Speed: Char/sec Cards/min	— 300 lpm	— 120	— 1000 lpm	— 120	50,000 —
DATA TRANSMISSION	Line Type	Voiceband		Voiceband		Voiceband
	Speed, bps	2000, 2400, 4800, 9600		2000, 2400, 4800, 9600		110, 2000, 2400
	Mode	Half-/full-duplex		Half-/full-duplex		Half-duplex
	Code	Any 6- to 9-level code		Any 6- to 9-level code		7-level USASCII
	Timing	Synchronous		Synchronous		Synchronous
ERROR CONTROL		As programmed		As programmed		No provision
MONTHLY RENTAL, $		1095 (basic system includes line printer, card reader, TTY 33 ASR, 4K-memory computer); 49,529 (purchase)		1585 (basic system includes line printer, card reader, TTY 33 ASR, 4K-memory computer); 71,886 (purchase)		Purchase price: 4300 (serial, USASCII); 3700 (parallel, BCD)
COMMENTS		Computer-based terminal; additional 4K storage/peripherals expand stand-alone processing capabilities; card punch/mag tape units optional; monthly rental applies to 5-yr lease		Computer-based terminal; additional 4K storage/peripherals expand stand-alone processing capabilities; card punch/mag tape units optional; monthly rental applies to 5-yr lease		Operates stand-alone or under remote program control; asynchronous, 4-bit parallel, BCD model also available up to 50,000 cps; max of 14 nixie tubes (10 digits/tube); 4 control keys; compatible with Bell System Data-Phone Data Sets 201A (switched, 2000 bps) and 201B (leased, 2400 bps)

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Burroughs Series TC500 Terminal Computer			Burroughs 2531/3351 Single-Line Controls	Burroughs 3353 Multi-Line Control
REPORT NUMBER		6072			6070	—
FUNCTION		Stored program terminal with arithmetic computation capability; can transmit/receive data over voiceband line to most Burroughs/non-Burroughs computer systems			Connects Burroughs B2500/B3500 computer to a single narrow/voiceband line	Connects up to 36 narrow/voiceband communication lines to Burroughs B3500 computer system
PREPARED INPUT	Medium	Punched tape	Punched cards		Computer	Computer
	Code	5-level TTY/any 6- or 7-level	Any code with internal translation for 64 char		8 bit USASCII, EBCDIC, 6 bit BCL, 5 bit Baudot	8 bit USASCII, EBCDIC, 6 bit BCL, 5 bit Baudot
	Speed: Char/sec	Up to 40	—		Up to 600	Up to 600/line
	Cards/min	—	Up to 100		—	—
MANUAL INPUT	Method of Entry	74-key keyboard			No provision	No provision
	No. of Char	Variable			—	—
OUTPUT	Medium	Punched tape	Printer	Punched cards	Computer	Computer
	Code	5-level TTY/any 6- or 7-level	64 char	Same as card input	8 bit USASCII, EBCDIC, 6 BCL, bit 5 bit Baudot	8 bit USASCII, EBCDIC, 6 bit BCL, 5 bit Baudot
	Speed: Char/sec	40	20	Up to 25	Up to 300	Up to 600/line
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband			Narrow/voiceband	Narrow/voiceband
	Speed, bps	1200			Up to 4800	Up to 4800
	Mode	Half-duplex			Half-/full-duplex	Half-/full-duplex
	Code	8-level USASCII			Any code up to 8-levels	Any, up to 8 levels
	Timing	Asynchronous			Synchronous/asynchronous	Synchronous/asynchronous
ERROR CONTROL		Char/longitudinal parity checking; automatic retransmission			Char/message parity checking (depending on code)	Char/message parity checking (depending on code)
MONTHLY RENTAL, $		295-645			155-238 (depending on line adapter used)	400
COMMENTS		Features integrated circuit logic, flexible internally-stored firmware, up to 1280 64-bit words of disc storage; programs loaded via line from computer or integral paper tape loader; all I/O functions controlled by stored program			Various adapters available for connection to wide range of std communications facilities/remote terminals	Various adapters available for connection to wide range of std communication facilities/remote terminals

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Burroughs TC-700 Teller Terminal				Burroughs B9351 Input and Display System	
REPORT NUMBER		—				6071	
FUNCTION		Stored-program teller terminal with arithmetic computation capability; can transmit/receive data over voiceband line to most Burroughs/non-Burroughs computer systems				Video display of alphanumeric data transmitted to/received from remote computer; printed copy output	
PREPARED INPUT	**Medium**	Punched tape		Punched cards		No provision	
	Code	5-level TTY/6- or 7-level code		Any code with internal translation for 64 char		—	
	Speed:						
	Char/sec	Up to 40		Up to 100		—	
	Cards/min	—		—		—	
MANUAL INPUT	**Method of Entry**	74-key keyboard				67-key keyboard	
	No. of Char	Variable				Up to 250, 506, or 1018	
OUTPUT	**Medium**	Punched tape	Printer	Punched cards		Cathode ray tube	Printer
	Code	5-level TTY/6- or 7-level code	64 char	Same as card input		67 char	64 char
	Speed:						
	Char/sec	Up to 40	Up to 20	Up to 25		2400	10
	Cards/min	—	—	—		—	—
DATA TRANSMISSION	**Line Type**	Voiceband				Narrow/voiceband	
	Speed, bps	1200				150, 1200, 1800, 2000, 2400	
	Mode	Half-duplex				Half-duplex	
	Code	8-level USASCII				8-level USASCII	
	Timing	Asynchronous				Synchronous/asynchronous	
ERROR CONTROL		Char/longitudinal parity checking; automatic retransmission				Char/longitudinal parity checking; manual/automatic retransmission	
MONTHLY RENTAL, $		260 to 431				100-325 (control); 60 (display); 20 (keyboard); 75 (printer/adapter)	
COMMENTS		Features integrated circuit logic, flexible internally-stored firmware, up to 1280 64-bit words of disc storage; programs loaded via line from central computer/through integral paper tape loader; all I/O functions controlled by stored program				Multiple display stations can be connected to central controller; multiple controllers can share 1 data set; printed copy output via TTY 33 RO (1/controller); includes 1024-char core memory; screen format is 25 80-char lines; 250, 506, 1018 total displayable char	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Burroughs B9352 Input and Display Terminal	Bonnar-Vawter Expedata 600 Tape Reader/ Transmitter Unit	Bunker-Ramo Series 200 Data Display System		
REPORT NUMBER		—	—	6060		
FUNCTION		Video display of alphanumeric data transmitted to/received from remote computer	Transmission/reception of paper tape data over voiceband line	Video display of alphanumeric data transmitted to/received from remote computer; keyboard/punched tape input; display/punched tape/printed copy output		
PREPARED INPUT	Medium	No provision	Punched tape	Punched tape		
	Code	—	Any 5- to 8-level code	8-level USASCII		
	Speed:					
	Char/sec	—	60	10		
	Cards/min	—	—	—		
MANUAL INPUT	Method of Entry	68-key keyboard	No provision	15-/42-key keyboard		
	No. of Char	Up to 960	—	Up to 384/768 char/unit (depending on model/arrangement)		
OUTPUT	Medium	Cathode ray tube	Punched tape	Cathode ray tube	Punched tape	Printer
	Code	69 char	Any 5- to 8-level code	14-64 char	Any 5- to 8-level code	64 char
	Speed:					
	Char/sec	2400 bps	60	41,600	10	10
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Narrow/voiceband	Voiceband	Voiceband		
	Speed, bps	150, 1200, 1800, 2000, 2400	600	600-2400; typically 1200, 1800, 2000, 2400		
	Mode	Half-duplex	Simplex	Half-duplex		
	Code	8-level USASCII	Any 5- to 8-level code	8-level USASCII		
	Timing	Asynchronous/synchronous	Synchronous	Synchronous/asynchronous		
ERROR CONTROL		Char/longitudinal parity checking; automatic/manual retransmission	No provision	Char/longitudinal parity checking; manual retransmission from display units; automatic retransmission from auxiliary units		
MONTHLY RENTAL, $		195	38; 900 (purchase)	56-88/display unit; 331 to over 900/central controller; approx 53/non-display device control; nondisplay devices extra		
COMMENTS		Multiple displays can be connected: 9 per direct cable connection/16 per modem per multi-drop	Basic configuration includes paper tape reader/punch, integral data set; compatible with Bell System Data Set 402C; automatic answer optional	Multiple display/punched tape/printer units connected to central controller; 14 or 15 additional keys generate special function codes		

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Bunker-Ramo Series 2200 Data Display System			ComData Series 33 Portable Terminal		
REPORT NUMBER		—			—		
FUNCTION		Video display of alphanumeric data transmitted to/received from remote computer; keyboard/punched tape input; display/punched tape/printed copy output			Portable transmission of manually-keyed/punched tape data over voiceband/telegraph-grade lines via acoustic coupler; paper tape/printed copy output		
PREPARED INPUT	Medium	Punched tape			Punched tape		
	Code	8-level USASCII			8-level USASCII		
	Speed: Char/sec Cards/min	 110 —			 10 —		
MANUAL INPUT	Method of Entry	58-/71-key keyboard			53-key keyboard		
	No. of Char	Up to 960 char/unit (depending on model/arrangement)			Variable		
OUTPUT	Medium	Cathode ray tube	Punched tape	Printer	Punched tape	Printer	
	Code	62/92 char	Any 5- to 8-level code	64 char	8-level USASCII	80 char	
	Speed: Char/sec Cards/min	 55,000 —	 100 —	 10 —	 10 —	 10 —	
DATA TRANSMISSION	Line Type	Voiceband			Narrow/voiceband		
	Speed, bps	600-2400; typically 1200, 1800, 2000, 2400			Up to 110		
	Mode	Half-duplex			Half-/full-duplex		
	Code	8-level USASCII			8-level, 11-unit USASCII		
	Timing	Synchronous/asynchronous			Asynchronous		
ERROR CONTROL		Char/longitudinal parity checking; manual retransmission from display units; automatic retransmission from auxiliary units			Char parity generation		
MONTHLY RENTAL, $		60-83 (display unit); 250 to over 800 (central controller); approx 50 (non-display device control); nondisplay devices extra			23 (KSR); 37 (ASR)		
COMMENTS		Multiple display/punched tape/printer units connected to a central controller; approx rental for single-station configuration is $216 (display station/control unit); 12 or 16 additional keys generate special function codes			TTY 33 KSR/ASR modified for time sharing applications; interfaces ComData 301A Acoustic Coupler/301F Data Set; 74-char print line; KSR includes keyboard/printer; ASR adds paper tape I/O; fixed 21-char WRU answerback message; acoustic coupler operates in originate/answer modes		

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Clary Datacomp System 4000 Series Intelligent Terminals				
REPORT NUMBER		—				
FUNCTION		Remote programmed processing, pre-processing, report generation of data transmitted/received over voice/broadband facilities; can be used as stand-alone computer system				
PREPARED INPUT	**Medium**	Punched tape		Magnetic card		Magnetic tape
	Code	Any 5- to 8-level		Any 5- to 9-level		Any 8-level code
	Speed:					
	Char/sec	60-300		Up to 1000		Up to 1000
	Cards/min	—		Up to 60		—
MANUAL INPUT	**Method of Entry**	IBM Selectric		TTY 33/35 ASR		49-key CRT keyboard
	No. of Char	Variable		Variable		Variable
OUTPUT	**Medium**	Punched tape	Magnetic card	Magnetic tape	Printer	Cathode ray tube
	Code	Any 5- to 9-level	Any 5- to 9-level	Any 8-level code	64 char	64 char
	Speed:					
	Char/sec	60-300	Up to 1000	Up to 1000	—	TTY-compatible
	Cards/min	—	Up to 60	—	100-600 lpm	—
DATA TRANSMISSION	**Line Type**	Voiceband/broadband				
	Speed, bps	Up to 3,800,000				
	Mode	Half-/full-duplex				
	Code	Same as input				
	Timing	Asynchronous				
ERROR CONTROL		Program-controlled character/longitudinal/cyclical parity checking, automatic retransmission				
MONTHLY RENTAL, $		300-1000 (depending on peripheral equipment/memory options)				
COMMENTS		4000 Series is an extension of Datacomp 404 general-purpose digital computer product line; available in wide variety of system configurations incorporating extensive selection of peripheral equipment; up to 16 multiple I/O stations may be time-shared by Datacomp 404; max data rate restricted only by data set used; 2-μsec memory speed per 16-bit word; 4 program-selected word length modes of 16, 32, 48, 64 bits; memory capacity of 1024/4096 16-bit words, expandable to 65,536 in 4096-word increments; 120 (Selectric), 72 (TTY), or 64 (CRT) keyboard-generated char; up to 132-char print line; decimal arithmetic unit using 16-bit words; 16 addressing modes; 2 hardware index registers; 4 addressable registers (1 is 64-bit) can be subdivided and individually addressable; 64-bit addressable accumulator; complete editing/formatting via single I/O instruction				

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Clary Datacomp Systems SP20 Digital Strip Printer	Communitype Data Communication System		Communitype 550 and 850 Magnetic Tape Transmission/Conversion Systems	Compat 88-03 Conversational Terminal
REPORT NUMBER		6110	6120		6121	—
FUNCTION		Prints binary coded input data received from computer keyboard/TTY source onto single-copy strip paper	Mag tape cartridge records data from keyboard/communications line; output from mag tape to printer/communications line		Transmission/reception of mag tape data over voiceband line; off-line transcription/code translation	Transmission/reception of inquiry data over voiceband line to remote computer
PREPARED INPUT	Medium	No provision	Mag tape	Punched cards (optional)	Magnetic tape	No provision
	Code	—	7-level IBM Selectric	Hollerith	Any 7-level (550)/9-level (850) code	—
	Speed:					
	Char/sec	—	150	—	100	—
	Cards/min	—	—	75	—	—
MANUAL INPUT	Method of Entry	No provision	55-key keyboard		No provision	44-key IBM Selectric keyboard
	No. of Char	—	Variable up to 200,000		—	Variable
OUTPUT	Medium	Strip printer (single line)	Mag tape	Printer	Magnetic tape	Printer
	Code	64 char	7-level IBM Selectric	88 char	IBM BCD (550); EBCDIC (850)	88
	Speed:					
	Char/sec	20	150	14.8	100	15
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband		Voiceband	Voiceband
	Speed, bps	20 cps	1200		Up to 1200 (switched)/1800 (leased)	Up to 134.5
	Mode	Half-duplex	Half-duplex		Half-duplex	Half-duplex
	Code	8-level USASCII/5-level Baudot	6-level IBM Selectric		IBM 7-level BCD	7-level IBM correspondence
	Timing	Synchronous/asynchronous	Synchronous		Asynchronous	Asynchronous
ERROR CONTROL		No provisions	Char/longitudinal parity checking; automatic retransmission		Char/longitudinal parity checking; retransmission initiated via reverse channel	Char parity checking
MONTHLY RENTAL, $		Purchase price: 690 (rack mount); 700 (desk mount)	295-460		395 (550); 535 (850)	105
COMMENTS		Parallel data entry std; serial entry optional; prints 64-symbol USASCII char set; min paper supply is 160 ft with 19,000-char capacity; print speed increases with smaller char set	Optional program and data memory (PAD) provides storage for up to 80,000 char (1000 lines at 80 char/line); card reader optional		Transmit/receive operation switch-selectable at sending/receiving station; record density of 556 bpi (550)/800 bpi (850); includes 160-char MOS/FET buffer	Standard features include Selectric keyboard, simultaneous printed copy I/O, bi-directional inquiry mode; oversize print carriage optional

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Compat 88-13 Batch Terminal	Compat 88-23 Batch Terminal	Compat CDT-100 Magnetic Tape Terminal	Compat CDT-200 Printer Terminal	Computer Terminals UT-100 Utility Terminal
REPORT NUMBER		—	—	—	—	—
FUNCTION		Remote, programmed transmission/reception, batch processing of alphanumeric data over voiceband line	Transmission/reception, batch processing of data over voiceband line	High-speed code translation, transmission/reception of mag tape data over voiceband line	High-speed, on-line/off-line printed copy output of data received over voiceband line	On-line remote conversation/batch processing of data transmitted/received over voiceband line; keyboard/punched card input; printed copy output
PREPARED INPUT	Medium	No provision	No provision	Magnetic tape	No provision	Punched cards
	Code	—	—	Any 7-/9-level code	—	Hollerith
	Speed:					
	Char/sec	—	—	Up to 48,000	—	—
	Cards/min	—	—	—	—	—
MANUAL INPUT	Method of Entry	44-key IBM Selectric keyboard	44-key IBM Selectric keyboard	TTY 33 ASR keyboard	TTY 33 ASR keyboard	—
	No. of Char	Variable	Variable	Variable	Variable	—
OUTPUT	Medium	Printer	Printer	Magnetic tape	Printer	Printer (nonimpact)
	Code	88 char	88 char	Any 7-/9-level code	64 char	—
	Speed:					
	Char/sec	15	15	Up to 48,000	136,150, 212, 425 lpm	250
	Cards/min	—	—	—		—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband	Voiceband	Voiceband
	Speed, bps	1200/2000 bps	1200 or 2000 bps	Up to 300/48,000 cps	1200/2400	1200 (async); 2400/4800 (sync)
	Mode	Half-duplex	Half-duplex	Half-duplex	Half-duplex	Half-duplex (full-duplex optional)
	Code	8-level USASCII; any 8-level code (optional)	8-level USASCII; any 8-level code (optional)	7-/9-level EBCDIC	Any code up to 8 level	USASCII/EBCDIC
	Timing	Synchronous	Synchronous	Synchronous	Synchronous	Asynchronous/synchronous
ERROR CONTROL		Horizontal/vertical parity checking; automatic retransmission	Horizontal/vertical parity checking; automatic retransmission	Vertical/horizontal parity checking; programmed automatic retransmission by block	Vertical/horizontal parity checking; automatic retransmission by block	Lateral/longitudinal parity checking; automatic retransmission
MONTHLY RENTAL, $		210	315	630 (7-track); 680 (9-track)	—	29,750 (purchase price)
COMMENTS		Contains stored-program controller with 4K, 16-bit word core memory; 50,000-char mag tape storage capacity; unattended send/receive; format control; compatible with Bell System Data Sets 201A3, 202C, 202E; printed copy I/O; bidirectional batch transmission/inquiry mode; oversize print carriage optional	Contains stored-program controller with 4K, 16-bit word core memory; 50,000-char mag tape storage capacity; can be reprogrammed; unattended send/receive; format control; compatible with Bell System Data Sets 201A3, 202C, 202E; printed copy I/O; bidirectional batch transmission/inquiry mode; anytime edit mode	TTY 33 ASR enables keyboard/paper tape entry of special control char/block data; printout of block, char, or message count under program control; dual density recording at 200/800, 556/800, 200/556 bpi; variable/fixed length block transmission; includes stored-program central controller; mag tape 7-channel-compatible with IBM 729/7330 transports, 9-channel-compatible with IBM 360/USASCII; compatible with Bell System Data Set 201A/201B (300 cps) or 300 Series (48,000 cps); programmed record formatting; automatic answering; 4K (16-bit) storage	TTY 33 ASR provides keyboard/paper tape entry of control data; printout of block, char, message count under program control; vert/horiz tab; automatic answering; 40, 80, 120, 132 char/line available; printing up to 1000-lpm off-line; includes code translation facilities; optional card, paper tape, mag tape input devices; programmed record formatting; compatible with Bell System Data Set 201A/201B, 202C and 300 Series; expandable to include data conversion; no longer in production	Std configuration includes card reader/nonimpact printer, 1200 bps data rate; impact printer to be announced; includes programmable control unit; 2400/4800-bps data rates optional; fundamental report generation/tabulating capabilities

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Compace Versicom 300 System			Compucord Data Sense 5000 Video Display/Mag Tape Terminal	
REPORT NUMBER		—			—	
FUNCTION		Transmission of keyboard/punched card/paper tape data; reception of data from remote computer to punched card/paper tape/printed copy output over voiceband line			Video display and mag tape read/record of data transmitted to/received from remote computer over voiceband line	
PREPARED INPUT	**Medium**	Punched cards	Punched tape		Magnetic tape (cassette)	
	Code	Hollerith	Any 6- to 8-level code		8-level USASCII	
	Speed:					
	Char/sec	—	10, 15, 30		6000	
	Cards/min	20	—		—	
MANUAL INPUT	**Method of Entry**	65-key keyboard			56-key keyboard	
	No. of Char	Variable			Up to 400	
OUTPUT	**Medium**	Printer	Punched cards	Punched tape	Cathode ray tube	Magnetic tape (cassette)
	Code	64 char	Hollerith	Any 6- to 8-level code	64 char	8-level USASCII
	Speed:					
	Char/sec	10, 15, 30	10, 15, 30	10, 15, 30	Up to 180,000	500
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	**Line Type**	Voiceband			Voiceband	
	Speed, bps	Up to 300			2400	
	Mode	Half-/full-duplex			Half-duplex	
	Code	8-level USASCII			8-level USASCII	
	Timing	Asynchronous			Synchronous/asynchronous	
ERROR CONTROL		Parity checking/generation (optional)			Char parity checking	
MONTHLY RENTAL, $		113 (RO printer); 120 (RO printer, data set); 158 (keyboard/printer, data set); 55 (paper tape reader/punch); 100 (card reader); 66 (card punch); 55 (mag tape read/write unit)			98.50	
COMMENTS		Central controller provides interface/control facilities for I/O devices; USASCII/TTY-compatible; EBCDIC/IBM-compatibility, parallel interface, incremental mag tape cassette transport optional; can execute on-line I/O operations while creating input/reading out locally; adjustable print spacing at 26-132 char/line (10 char/in.); built-in modem is compatible with Bell System Data Set 103A; external acoustic coupler (originate-only or originate/answer) optional; 2- to 12-channel multiplexer optional; high-speed multiplexer interface operates with Bell System Data Set 201; switch-selectable operating speeds/modes; full USASCII keyboard; TTY/USASCII printer std; IBM/EBCDIC printer optional; impact printing up to 6 copies; pin-feed std; basic unit consists of keyboard/printer, controller; incremental punched card, punched tape I/O optional; mag tape unit reads/records at 10, 15, 30 cps (capacities of 17,000, 25,000, 50,000 char, respectively); card punch processes 1 card at a time			2 integrated Compudette 1100 recorders enable off-line key-to-tape/tape-to-screen operations; display format is 16 25-char lines; variable record lengths up to 400 char; 500-/1000-bpi mag tape recording density; read/write tape speed is 5 in./sec; optional 100-lpm page printer	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Computer Communications Wescal Industries CAL 30/30 Remote Data Terminal		Computer Communications CC-30 Communications Station		
REPORT NUMBER		—		6125		
FUNCTION		Transmission of mag tape data to remote computer over voiceband line; typewriter/adding machine data entry; printed copy output		Portable, video display of alphanumeric/graphic data transmitted to/received from remote computer; keyboard data entry; optional punched card I/O, printed copy output		
PREPARED INPUT	Medium	Magnetic tape		Punched cards		
	Code	8-level IBM Correspondence		Hollerith		
	Speed: Char/sec Cards/min	 10 —		 — 100		
MANUAL INPUT	Method of Entry	IBM 731 Selectric Keyboard; auxiliary numeric keyboard		61-key keyboard		
	No. of Char	Variable		800; 960 optional		
OUTPUT	Medium	Printer	Printed paper tape	Cathode ray tube	Punched cards	Printer
	Code	88 char	18 char	69 char; 96 optional	Hollerith	64 char
	Speed: Char/sec Cards/min	 10 —	 10 —	 500,000 —	 — 100	 300 lpm —
DATA TRANSMISSION	Line Type	Voiceband		Voiceband	Broadband	
	Speed, bps	75 cps (parallel)		110-9600	50,000	
	Mode	Half-duplex		Half-duplex	Full-duplex	
	Code	8-level IBM Correspondence		8-level USASCII	8-level USASCII	
	Timing	Asynchronous		Asynchronous	Modified synchronous	
ERROR CONTROL		Manual retransmission std; char/longitudinal parity checking, automatic retransmission optional		Char parity checking; manual retransmission		
MONTHLY RENTAL, $		5900-8500 (purchase price)		Purchase price: 195-490 (display); 6300 (controller); 500 (serial interface); 550 (keyboard); 7500 (printer); 4700 (card reader)		
COMMENTS		Optional system intertie unit allows remote computer to receive data from several CAL 30/30 terminals, record it on standard IBM-compatible mag tape for off-line applications; CAL 30/30 terminals can be used with CCI CC-70 programmed buffered multiplexor; optional Hermes Adder/Printer provides auxiliary numeric keyboard entry/printed paper tape output; switch-selectable modes include record, print, transmit, receive; bit parallel, 75-cps data rate compatible with Bell System Data Sets 402C/402D; rates up to 200 cps optional; 100,000-char mag tape cassette recording capacity		Up to 7 I/O devices, including TTY 33 RO/ASR, can be connected to Control Unit; 300 bps acoustic coupler, IBM Selectric Typewriter, mag tape I/O, paper tape I/O, light pen optional; channel adapters available to interface IBM 360/1130, CDC 3000 Series, SDS Sigma Series, DEC PDP-8/PDP-12; controller contains 1024-word (9-bit) buffer, char generator, I/O control, communications interface; 8-, 12-, 14-, 17-in. monitors available; up to 32 terminals can be connected to computer I/O channel via optional multiplexer; 800 displayable char positions; includes graphics mode; 960-char display format optional; switch-selectable char/block transmission modes.		

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Computer Communications CC-36 Televideo Conversational/Batch Station			Computer Transceiver Systems Execuport 300 Printer Terminal	Computone Systems CT-14M Computer Terminal
REPORT NUMBER		6127			—	—
FUNCTION		Remote conversational/batch processing terminal; displays/prints data received over voice-/broadband line; data to be transmitted entered via keyboard/punched cards			Portable transmission/ reception of alpha-numeric data over voiceband line to remote computer via integral acoustic coupler	Transmission of manually prepared data over public telephone network to remote computer via acoustic coupler
PREPARED INPUT	Medium	Punched cards			No provision	No provision
	Code	Hollerith/binary			—	—
	Speed:					
	Char/sec	—			—	—
	Cards/min	300			—	—
MANUAL INPUT	Method of Entry	65-key keyboard			81-key keyboard	10-position thumbwheel switches
	No. of Char	800; 960 optional			Variable	14 (up to 18 optional)
OUTPUT	Medium	Cathode ray tube	Printer (impact)	Printer (nonimpact)	Printer	Voice response
	Code	64 char; 96 (optional)	64 char	63 char	96 char	—
	Speed:					
	Char/sec	500,000	—	300	10, 15, 30	1.7-2 words/sec
	Cards/min	—	300 lpm	225 lpm	—	—
DATA TRANSMISSION	Line Type	Voiceband	Broadband		Voiceband	Voiceband
	Speed, bps	110-9600	50,00		Up to 110, 165, 300	40 (based on 10 cps)
	Mode	Half-duplex	Full-duplex		Half-/full-duplex	Half-duplex
	Code	8-level USASCII	8-level USASCII		8-level, 10-/11-unit USASCII	2-of-8 (equivalent to 4 parallel bits)
	Timing	Asynchronous	Modified synchronous		Asynchronous	Receiver activated by each data group
ERROR CONTROL		Char parity checking; manual retransmission			Even/odd parity generation	Tone count within each char; char count per message
MONTHLY RENTAL, $		875-1175 (basic unit includes display, controller, keyboard, card reader, impact/nonimpact printer); 23,900-39,900 (purchase)			150; 3800 (purchase)	300 (purchase); 350 (with electronic scan)
COMMENTS		Off-line, key-to-print, and card-to-print operations possible; can execute up to 8 consecutive stored control sequences; direct connection data rate 50,000 bps; 2 basic onfigurations are Model I (nonimpact printer), Model II (impact printer); configuration is consolidation of modular components available with CCI CC-30 Station; serial interface compatible with Bell System Data Set Series 100, 200, 300 optional; channel adapters available to interface IBM 1130/360, CDC 3000 Series, SDS Sigma Series, DEC PDP-8/PDP-12; switch-selectable char/block transmission modes; controller buffer memory has capacity of 1024 9-bit words; 800 display position format std (20 40-char lines); 80-char std print line; impact printer includes 132-char buffer			Portable unit with acoustic coupler; switch-selectable transmission mode, print speed, even/odd parity generation; nonimpact printing; keyboard interlock; selectable upper-/lowercase modes, off-line operation; 80-char print line; compatible with Bell System Data Set 103 Series; optional answerback; keyboard generates full USASCII set; integral interface for Execuport 200 CRT, 415 mag tape memory unit	Portable, 8-lb, battery/ac-powered unit; front panels custom-labeled for each application; provision for wired-in security/program entry digits; contains integral acoustic coupler; 14 manually generated char std

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Computone Systems CT-16 Series Computer Terminal	Computone Systems CT-23 Computer Terminal	Computone Systems CT-60 Computer Terminal	Connecticut Technical Data Terminal	
REPORT NUMBER		—	—	—	—	
FUNCTION		Transmission of manually prepared data over public telephone network to remote computer via acoustic coupler	Transmission of manually prepared data over public telephone network to remote computer via acoustic coupler	Transmission of manually prepared data over public telephone network to remote computer via acoustic coupler	Transmission/reception of alphanumeric data over narrow/voiceband line; keyboard/punched tape data entry; punched tape/printed copy output	
PREPARED INPUT	Medium	No provision	No provision	No provision	Punched tape	
	Code	—	—	—	Any 5- to 8-level code	
	Speed:					
	Char/sec	—	—	—	50	
	Cards/min	—	—	—	—	
MANUAL INPUT	Method of Entry	10-/12-pos levers; 42-key keyboard	10-pos thumbwheel/15-pos slide switches	10-pos thumbwheel/ lever switches	44-key keyboard	
	No. of Char	16 (lever switches); variable (keyboard)	23 (up to 27 optional)	60 (up to 80 optional)	Variable	
OUTPUT	Medium	Voice response/tone detector	Voice response	Voice response	Punched tape	Printer
	Code	—	—	—	Any 5- to 8-level code	88 char
	Speed:					
	Char/sec	1.7-2 words/sec	1.7-2 words/sec	1.7-2 words/sec	50	14.5
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband	Narrow/voiceband	
	Speed, bps	40 (based on 10 cps); 60 (alphanumeric set)	40 (based on 10 cps)	40 (based on 10 cps)	Up to 400	
	Mode	Half-duplex	Half-duplex	Half-duplex	Full-duplex	
	Code	2-of-8; extended 2-of-8	2-of-8 (equivalent to 4 parallel bits)	2-of-8 (equivalent to 4 parallel bits)	Any 5- to 8-level code	
	Timing	Receiver activated by each data group	Receiver activated by each data group	Receiver activated by each data group	Asynchronous	
ERROR CONTROL		Tone count within each char; char count for scanned data	Tone count within each char; char count per message	Tone count within each char; char count per block/message	Parity checking optional	
MONTHLY RENTAL, $		250-500 (purchase, depending on options)	500 (purchase)	850 (purchase)	150	
COMMENTS		Low-cost, desk-top version intended for credit checking/other large volume applications; provision for wired-in security/ program entry digits; contains integral acoustic coupler; voice/tones activate speaker; status lights activated for confidential replies; 2-of-8 equivalent to 4 parallel bits; extended 2-of-8 equivalent to 6 parallel bits	Portable, 8.5-lb, battery/ac-powered unit; front panels custom-labeled for each application; multipurpose program card overlays, lever-operated switches available; provision for wired-in security/program entry digits; contains integral acoustic coupler; 23 manually generated char std	Portable, battery-powered unit in attache case; contains integral acoustic coupler; modular integrated-circuit scanner; provision for wired-in security or program entry digits/ plug-in card for source identity digits; 60 manually generated char std	Electronic keyboard operates independent of typewriter printing action; parallel bit I/O available; additional special function keys, interlock/2-key roll-over, 1- to 3-char memory, key overlays, keyboard lock-out optional; std keyboard generates 86 char	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Control Data 200 User Terminal			Control Data 210 Inquiry/Retrieval System	
REPORT NUMBER		6160			—	
FUNCTION		Visual display via CRT/remote batch processing of data received over voiceband line; data entry manual from keyboard/automatic under program control			Video display/printed copy of alphanumeric data transmitted to/received from remote computer over voiceband line	
PREPARED INPUT	**Medium**	Punched cards			No provision	
	Code	Hollerith			—	
	Speed:					
	Char/sec	—			—	
	Cards/min	330			—	
MANUAL INPUT	**Method of Entry**	58-key keyboard			Display station keyboard	
	No. of Char	1000 or 1040			Up to 1000	
OUTPUT	**Medium**	Cathode ray tube	Line printer	Page printer	Cathode ray tube	Printer
	Code	64 char	64 char	64 char	64 char	64 char
	Speed:					
	Char/sec	250	400-680	15.5	50,000	15.5
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	**Line Type**	Voiceband (leased/switched)			Voiceband	
	Speed, bps	2400 (switched); 2400 (leased)			2000/2400	
	Mode	Half-duplex			Half-duplex	
	Code	7-level BCD			6-bit BCD (data); USASCII (control)	
	Timing	Synchronous			Synchronous	
ERROR CONTROL		Char/longitudinal parity checking; automatic retransmission			Char/longitudinal parity checking; manual retransmission	
MONTHLY RENTAL, $		350 (display station); 255 (typewriter printer); 465 (80-col line printer); 545 (136-col line printer); 140 (card reader)			135 (display unit); 725 (controller); 270 (printer)	
COMMENTS		Rental charges apply to 1-yr lease; basic unit includes keyboard/display; card input/printed output optional; display format 50 20-char/80 13-char lines; includes 1000-/1040-char delay line buffer; equipment controller provides selection of auxiliary I/O devices			Multiple display/printer devices connected to central controller; 50-char/20-line display format std; 1000 total displayable char positions; 80-char/13-line format optional; max of 12 displays/printer can interface controller (6 printers max); 1000-char buffer capacity/display; printed copy output via IBM Selectric Typewriter; interfaces available for direct connection to computer I/O channel	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Control Data 212 Inquiry/Retrieval System	Daedalus Computer Products 711 PDT Programmable Data Terminal		Data 100 Model 70-1 Remote Batch Terminal	Data 100 Model 70-2 Remote Line Printer Terminal
REPORT NUMBER		—	—		—	—
FUNCTION		Video display of alphanumeric data transmitted to/received from remote computer over voiceband line	Batch processing, editing, voiceband transmission/reception of data under control of stored program; data entered from keyboard/mag tape; can be programmed for printed copy/mag tape output		Transmits data from punched cards/records, via line printer, data received over voiceband line	Records, via line printer, data received over voiceband line
PREPARED INPUT	Medium	No provision	Magnetic tape		Punched cards	No provision
	Code	—	7-level USASCII plus parity		Hollerith	—
	Speed:					
	Char/sec	—	20 ips		—	—
	Cards/min	—	—		300	—
MANUAL INPUT	Method of Entry	Display station keyboard	71-key keyboard		No provision	
	No. of Char	Up to 1000	Up to 256		—	
OUTPUT	Medium	Cathode ray tube	Printer	Magnetic tape	Printer	
	Code	64 char	64 char	USASCII	39 (EBCDIC/SBT), 47 (SBT), 52 (EBCDIC), 63 char (USASCII/EBCDIC)	
	Speed:					
	Char/sec	—	30	20 ips	—	
	Cards/min	—	—	—	300 lpm	
DATA TRANSMISSION	Line Type	Voiceband	Voiceband		Voiceband	
	Speed, bps	2000/2400	800		2000, 2400; 4800 optional	
	Mode	Half-duplex	Half-duplex		Half-duplex	
	Code	6-bit BCD (data); USASCII (control)	8-level USASCII		6-bit SBT, 8-bit USASCII, 8-bit EBCDIC	
	Timing	Synchronous	Synchronous		Synchronous	
ERROR CONTROL		Char/longitudinal parity checking; manual retransmission	Char parity checking on read; echo checking on write		Cyclical redundancy checking (EBCDIC/SBT); vertical/longitudinal redundancy checking (USASCII); automatic retransmission	
MONTHLY RENTAL, $		380	11,000 (purchase)		780 (3-yr lease); 32,000 (purchase)	690 (3-yr lease); 26,950 (purchase)
COMMENTS		Each display device contains internal controller	Over 45 instructions can be used to program std 4K memory; software support also available via Daedatran translator, executive routine; poll/address environment; separate read-only memory; 3-pad keyboard includes 51 alphanumeric, 12 numeric, 8 function keys; 132-col print line; pin-feed platen; adjustable printing to 26 char/line; mag tape recorded at 1500 bpi; mag tape cassette capacity 460,000 char (128 char/block); manual (attended) or automatic (unattended) call initiation/reception; basic configuration includes keyboard, processor, modem, mag tape cassette, printer		Capable of operating off-line for maintenance/card-to-print functions; custom I/O devices available; includes terminal control unit; plug compatible with IBM 2780, Model 1; point-to-point/multipoint operation over switched/leased lines; 7 (400 char)/31 (1000 char) records per block message length; vertical format control; 80-col print line std; 120-/132-col print line optional; options include read/write speed adapters, compression/decompression, horiz tab; 2 records (200 char) per block message length std; compatible with Bell System Data Sets 201A (2000)/201B (2400)	Custom output devices available; 4800 bps not available for SBT code or in conjunction with compression/decompression; includes terminal control unit; plug compatible with IBM 2780, Model 3; point-to-point/multipoint operation over switched/leased lines; 7 (400 char)/31 (1000 char) records per block message length; vertical format control; 80-col print line std.; 120-/132-col print line optional; options include read/write speed adapters, compression/decompression, horiz tab; 2 records (200 char) per block message length std; compatible with Bell System Data Sets 201A (2000)/ 201B (2400)

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Data Computer Systems CP-4 Remote Communication Terminal			DatagraphiX S-D 1100 Inquiry-Display System	
		Model I	Model II	Model III		
REPORT NUMBER		—			—	
FUNCTION		High-speed transmission/reception of alphanumeric data over voiceband line; punched card input; printed copy output			Video display/printed copy of alphanumeric data transmitted to/received from remote computer over voiceband line	
PREPARED INPUT	Medium	Punched cards			No provision	
	Code	Hollerith			—	
	Speed:					
	Char/sec	—			—	
	Cards/min	300			—	
MANUAL INPUT	Method of Entry	No provision			42-key keyboard	
	No. of Char	—			Up to 500	
OUTPUT	Medium	Printer (132-col; impact)	Printer (80-col; nonimpact)	Printer (80-col; impact)	Cathode ray tube	Printer
	Code	64 char	64 char	64 char	61 char	61 char
	Speed:					
	Char/sec	—	120	—	25,000	10
	Cards/min	300 lpm	90 lpm	300 lpm	—	—
DATA TRANSMISSION	Line Type	Voiceband			Voiceband	
	Speed, bps	2000/2400/4800 bps			800-1300; 2000/2400	
	Mode	Full-duplex (half-duplex optional)			Half-/full-duplex	
	Code	8-level EBCDIC (7-/8-level USASCII			8-level USASCII	
	Timing	Synchronous			Synchronous/asynchronous	
ERROR CONTROL		Cyclic redundancy checking; vertical/longitudinal parity checking (optional); automatic retransmission			Char parity checking; automatic retransmission	
MONTHLY RENTAL, $		1100 (basic unit); 42,500 (purchase)	852 (basic unit); 29,000 (purchase)	975 (basic unit); 34,100 (purchase)	98 (display unit); 320-555 (controller); 92-101 (printer)	
COMMENTS		Compatible with IBM 2780; basic unit includes card reader/line printer, communication processor, 400-char MOS memory, operator control console; options include paper tape/mag tape I/O, CRT, keyboard, disc file, TTY 33 ASR, additional memory modules up to 800 8-bit words, auto answer, horiz tab; nonimpact printer is TTY Inktronic; compatible with Bell System Data Set 201 Series; processor memory expandable up to 3200 char; can interface up to 15 simultaneous I/O devices			Multiple; display/printer units connected to central controller; up to 24 displays/4 printers per controller; 61-char user selected char set from possible 78; 50-char line/10 lines std display format; 500 total displayable char/buffer capacity; delay line buffer storage	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Data Access Systems DF33ASR-O Data Terminal		Data Access Systems DF33KSR-O Data Terminal	Data Access Systems DF35ASR-O Data Terminal	
REPORT NUMBER		—		—	—	
FUNCTION		Transmission of manually-keyed/punched tape data over voiceband line; punched tape/printed copy output		Transmission of manually-keyed data over voiceband line; printed copy output	Transmission of manually-keyed/punched tape data over voiceband line; punched tape/printed copy output	
PREPARED INPUT	Medium	Punched tape		No provision	Punched tape	
	Code	8-level USASCII		—	8-level USASCII	
	Speed:					
	Char/sec	10		—	10	
	Cards/min	—		—	—	
MANUAL INPUT	Method of Entry	45-key keyboard		45-key keyboard	45-key keyboard	
	No. of Char	Variable		Variable	Variable	
OUTPUT	Medium	Punched tape	Printer	Printer	Punched tape	Printer
	Code	8-level USASCII	80 char	62 char	8-level USASCII	80 char
	Speed:					
	Char/sec	10	10	10	10	10
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Narrow/voiceband		Narrow/voiceband	Narrow/voiceband	
	Speed, bps	Up to 110		Up to 110	Up to 110	
	Mode	Half-/full-duplex		Half-/full-duplex	Half-/full-duplex	
	Code	8-level USASCII		8-level USASCII	8-level USASCII	
	Timing	Asynchronous		Asynchronous	Asynchronous	
ERROR CONTROL		No provision		No provision	No provision	
MONTHLY RENTAL, $		80; 1650 (purchase)		70; 1460 (purchase)	179; 4495 (purchase)	
COMMENTS		Modified TTY 33 ASR; includes direct-connected (DAA)/acoustic-coupled data set line interface; available in mobile, portable, auto-answer configurations; options include originate, answer, originate/answer modes		Modified TTY 33 KSR; includes direct connected (DAA)/acoustic-coupled data set line interface; available in mobile, portable, auto-answer configurations; options include originate, answer, originate/answer modes	Modified TTY 35 ASR; includes direct-connected (DAA)/acoustic-coupled data set line interface; available in mobile, portable, auto-answer configurations; options include originate, answer, originate/answer modes; designed for heavy-duty usage	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		DataNetics Model 33 Secretarial Terminal	Data Systems Design DSD-8 Batching Processing Terminal			
REPORT NUMBER		—	—			
FUNCTION		Remote keyboard entry of parallel alphanumeric data over voiceband line to remote computer	Processes data from multiple peripheral data handling devices/concentrates data for high-speed transmission to/from large-scale computers over voice-/broadband lines			
PREPARED INPUT	**Medium**	No provision	Punched cards	Punched tape	Magnetic tape	
	Code	—	Hollerith	USASCII	IBM BCD, binary, USASCII	
	Speed:					
	Char/sec	—	—	Up to 200	Up to 10,000	
	Cards/min	—	Up to 300	—	—	
MANUAL INPUT	**Method of Entry**	61-key keyboard	Keyboard (i.e., Teletype)			
	No. of Char	Variable	Full USASCII set			
OUTPUT	**Medium**	No provision	Printer	Teletypewriter	Cathode ray tube	Magnetic tape
	Code	—	64 char	64 char	64 char	IBM BCD, binary, USASCII
	Speed:					
	Char/sec	—	—	10	Variable	Up to 10,000
	Cards/min	—	300 lpm	—	—	—
DATA TRANSMISSION	**Line Type**	Voiceband	Voice/broadband			
	Speed, bps	Up to 75 cps	2400/4800			
	Mode	Simplex; send only	Half-/full-duplex			
	Code	Any 8-level code	8-level USASCII (standard)			
	Timing	Asynchronous	Synchronous			
ERROR CONTROL		Via reverse channel	Validity checking; automatic retransmission			
MONTHLY RENTAL, $		750 (purchase)	1500 (depending on data handling devices selected)			
COMMENTS		Designed for transmission of fixed record-length data (by line/block) to be restructured in formatted text under program control; Bell System Data Set 402C transmits 8 data channels in parallel, serial by char, plus timing channel; answerback mode allows receiving 2 data channels at 20 cps for data entry error indication	Modular, batch-processing terminal designed to select among various peripheral modules for data I/O, storage, editing; minimum system can be expanded; up to 128 low-speed data inputs can be concentrated into 1 high-speed synchronous line at 2400/4800 bps; front-end interfaces to any major computer system available; internally programmed for fundamental instruction formats; memory protection system, off-line data conversion std.			

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Data Products PC-8110 Portable Communications Terminal	Data Products DT-8280 Data Transmission Terminal		Datel Model 30 Conversational Data Terminal	Datron Systems Model 102 Data Transmission Card Reader
REPORT NUMBER		—	—		—	—
FUNCTION		Portable, transmission/reception of data over public telephone network; keyboard input; printer output	Transmits data from punched cards/receives data to punched card/printed copy output over voiceband line		Print-to-point reception of data to printed copy output/transmission of keyboard entry data over narrow-/voiceband lines	Transmission of punched card data over voiceband line via Bell Sysem 401E Data-Phone Data Set
PREPARED INPUT	Medium	No provision	Punched cards		No provision	Punched cards
	Code	—	Hollerith		—	Hollerith
	Speed:					
	Char/sec	—	300		—	10
	Cards/min	—	—		—	—
MANUAL INPUT	Method of Entry	51-key keyboard	No provision		44-key keyboard	16-key keyboard (optional)
	No. of Char	Variable	—		Variable	Variable
OUTPUT	Medium	Printer	Punched cards	Printer	Printer (IBM Selectric)	No provision
	Code	64 char	Hollerith	64 char	88 char (EBCD/Correspondence)	—
	Speed:					
	Char/sec	10	—	356-1110 lpm	14.8	—
	Cards/min	—	100-275	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband		Narrow/voiceband	Voiceband
	Speed, bps	110	1200, 2000, 2400, 4800		134.5	10 cps
	Mode	Half-/full-duplex	Half-duplex		Half-duplex	Half-duplex
	Code	8-level USASCII	IBM 6-bit SBT, 8-bit USASCII, 8-bit EBCDIC		1 of 3 IBM, 6-level, 9-unit codes	3-of-14
	Timing	Asynchronous	Synchronous		Asynchronous	Asynchronous
ERROR CONTROL		Char parity generation/transmission optional; print error char	Cyclic redundancy checking (SBT/EBCDIC); char/longitudinal parity checking (USASCII); automatic retransmission by block		Bidirectional parity checking; reverse break; manual retransmission	No provision
MONTHLY RENTAL, $		80-90 (depending on lease plan)	475 to 1040 (depending on model/options)		113.50-125; 133.50-150 (with integral acoustic interface)	28.65
COMMENTS		Unit is fully TTY-compatible; external acoustic coupler interfaces conventional telephone handset; direct connection through access plate optional; compatible with Bell System Data Set 103; std 4-row typewriter keyboard generates full 128-char USASCII set; can be configured to print any char, check odd/even parity, print error char on detection; operates in originate/answer modes; key interlock; options includes numeric key cluster, fixed 20-char WRU answerback message	Model I (basic unit) includes RO buffered printer; Model II adds punched card input; Model III adds punched card output; compatible with IBM BSC equipment, plug-to-plug with IBM 2780 (via IBM 2701/2703); print speeds at 356 (80-col), 460 (60-col), 650 (40-col), 1110 (20-col) lpm via 4-segment printer; up to 6 copies; point-to-point/binary-sync (BSC) communications std; includes 80-char print line (std), 400-char (7 records) data buffer 20-char peripheral buffer, auto-answer; options include horiz/vert tab, block/record count display, multipoint line control, data compression, 6-bit TransCode (SBT)/8-level EBCDIC data codes		Portable unit intended for remote inquiry/time sharing with various computer systems; can interrupt computer; optional acoustic coupler for communication over public telephone network; plug-to-plug compatible with IBM 2741; local/remote (switch-selectable) operating modes; options include pin feed platen, 130-/156-char print line	Requires single card/manual insertion operation; optional keyboard provides variable data entry; 80-/51-col cards read interchangeably; audible speaker signals status of receiving unit

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Datron Systems Model 107 CRT Data Transmitter	A. B. Dick M960 Videojet Printer	Digitronics Reverse-Channel Dial-o-verter 507 Paper Tape Transmitter	Digitronics Reverse-Channel Dial-o-verter 522 Magnetic Tape Terminal	
REPORT NUMBER		—	—	6221	6221	
FUNCTION		Visual display/transmission of keyed-in numeric data over voiceband line via Bell System 401E Data-Phone Data Set	High-speed, RO, non-impact printing of alphanumeric data received over voiceband line	Transmission of punched tape data over voiceband line	Transmission of mag tape data over voiceband line; optional punched tape output, local conversion between mag paper tape	
PREPARED INPUT	Medium	No provision	No provision	Punched tape	Magnetic tape	Punched tape
	Code	—	—	Any 5- to 8-level code	Any 5- to 8-level code	Any 5- to 8-level code
	Speed:					
	Char/sec	—	—	300	Up to 24,000	700
	Cards/min	—	—	—	—	—
MANUAL INPUT	Method of Entry	19-key keyboard	No provision	No provision	No provision	
	No. of Char	Variable	—	—	—	
OUTPUT	Medium	No provision	Printer	No provision	Magnetic tape	Punched tape
	Code	—	—	—	Any 5- to 8-level code	Any 5- to 8-level code
	Speed:					
	Char/sec	—	250	—	Up to 24,000	100
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband	Voiceband	
	Speed, bps	10 cps	2000	800, 1200, 2400	800, 1200, 2400	
	Mode	Half-duplex	Half-/full-duplex	Simplex	Simplex	
	Code	3-of-14	8-level USASCII	Any 5- to 8-level code	Any 5- to 8-level code (8-unit)	
	Timing	Asynchronous	Synchronous	Synchronous	Synchronous	
ERROR CONTROL		No provision	Char/longitudinal parity checking	Char/longitudinal parity generation; automatic retransmission	Char/longitudinal parity checking; automatic retransmission	
MONTHLY RENTAL, $		62.50	7000 (purchase price)	152-198	1302-2779	
COMMENTS		16 numeric char can be displayed, visually verified, transmitted to receiving card punch; automatic provision for time/date data; audible speaker signals status of receiving unit	Prints up to 13.6-in. line; can compress char size to 204 char/line; low noise level; 136-char print line std; adjustable 5- to 15-char/in. spacing (nominally 10 char/in.); 6 lines/in. vertical spacing; pin feed platen std	Not compatible with Turn-Around equipment; reverse-channel error indication; unbuffered	Reverse-Channel equipment not compatible with Turn-Around equipment; contains 1020-char buffer; mag tape format IBM 729-compatible	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Digitronics Reverse-Channel Dial-o-verter 509 Paper Tape Receiver	Digitronics Turn-Around Dial-o-verter 524 Magnetic Tape Terminal		Digitronics Reverse-Channel Dial-o-verter 4021 Printer Terminal	Digitronics Reverse-Channel Dial-o-verter 5072 Printer/Paper Tape Transmitter
REPORT NUMBER		6221	6220		6221	—
FUNCTION		Punches data, received over voiceband line, into paper tape	Transmission/reception of mag/paper tape data over voiceband line; optional punched tape output, local conversion between mag/paper tape		Prints data received over voiceband line	Transmits data from punched tape input/prints data received over voiceband line
PREPARED INPUT	Medium	No provision	Magnetic tape	Punched tape	No provision	Paper tape
	Code	—	IBM BCD, 6 bits plus parity	Any 5- to 8-level code	—	Any 5- to 8-level code
	Speed:					
	Char/sec	—	Up to 24,000	500		300
	Cards/min	—	—	—	—	—
MANUAL INPUT	Method of Entry	No provision	No provision		No provision	No provision
	No. of Char	—	—		—	—
OUTPUT	Medium	Punched tape	Magnetic tape	Punched tape	Printer	Printer
	Code	Any 5- to 8-level code	IBM BCD, 6 bits plus parity	Any 5- to 8-level code	64 char	64 char
	Speed:					
	Char/sec	100	Up to 24,000	107	300	300
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband		Voiceband	Voiceband
	Speed, bps	800	1200, 2000, 2400		800, 1200, 2400, 3600	800, 1200, 2400, 3600
	Mode	Simplex	Half-duplex		Simplex	Simplex
	Code	Any 5- to 8-level code	Same as input plus sync bit (8-/9-unit)		Any 5- to 8-level code	Any 5- to 8-level code
	Timing	Synchronous	Synchronous		Synchronous	Synchronous
ERROR CONTROL		Char/longitudinal parity checking; automatic retransmission	Char/longitudinal parity checking; automatic retransmission		Char/longitudinal parity checking; automatic retransmission	Char/longitudinal parity checking; automatic retransmission
MONTHLY RENTAL, $		189-228	1325-2950		650-782	750-892
COMMENTS		Error indication returned via reverse channel; unbuffered	Turn-Around equipment not compatible with Reverse-Channel equipment; tape format IBM 729-compatible; other tape formats, code translation optional; 524 supersedes D520		Error indication returned via reverse channel; contains 2 alternating 132-char buffers; formerly D401 model	Reverse-channel equipment not compatible with Turn-Around equipment; error indication returned via reverse channel

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Digitronics Reverse Channel Dial-o-verter 5079 Paper Tape Transmitter/Receiver	Digitronics Reverse-Channel Dial-o-verter 5122 Printer/Card Reader Terminal	Digitronics Reverse-Channel Dial-o-verter 5225 Magnetic Tape Terminal	Dura 1021/1051 Data Terminals	
REPORT NUMBER		6221	—	6221	—	
FUNCTION		Transmits punched tape data over voiceband line; receives data from voiceband line, punches into paper tape	Transmits data from punched/mark-sense cards; prints data received over voiceband line	Transmission/reception of mag tape data over voiceband line	Transmission/reception of data over narrow/voiceband line; keyboard/paper tape data entry; paper tape/printed copy output	
PREPARED INPUT	**Medium**	Punched tape	Punched/mark-sense cards	Magnetic tape	Punched tape (ASR)	
	Code	Any 5- to 8-level code	Hollerith/BCD	Any 5- to 8-level code	Any 6-level code	
	Speed:					
	Char/sec	300	—	Up to 24,000	30	
	Cards/min	—	200	—	—	
MANUAL INPUT	**Method of Entry**	No provision	No provision	No provision	44-key keyboard	
	No. of Char	—	—	—	Variable	
OUTPUT	**Medium**	Punched tape	Printer	Magnetic tape	Printer	Punched tape (ASR)
	Code	Any 5- to 8-level code	64 char	Any 5- to 8-level code	88 char	Any 6-level code
	Speed:					
	Char/sec	100	300	Up to 24,000	14.8	18
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	**Line Type**	Voiceband	Voiceband	Voiceband	Narrow/voiceband	
	Speed, bps	800, 1200, 2400	800, 1200, 2400, 3600	800, 1200, 2400	134.5	
	Mode	Simplex	Simplex	Simplex	Half-duplex	
	Code	Any 5-/8-level code	Any 5- to 8-level code	Any 5- to 8-level code	Any 6-level code	
	Timing	Synchronous	Synchronous	Synchronous	Asynchronous	
ERROR CONTROL		Char/longitudinal parity checking; automatic retransmission	Char/longitudinal parity checking; automatic retransmission	Char/longitudinal parity checking; automatic retransmission	Char parity checking	
MONTHLY RENTAL, $		300-399	850-992	600-1115	98 (1021); 190 (1051)	
COMMENTS		Reverse-Channel equipment not compatible with Turn-Around equipment; error indication returned via reverse channel	Reverse-channel equipment not compatible with Turn-Around equipment; error indication returned via reverse channel	Reverse-Channel equipment not compatible with Turn-Around equipment; has 512-char buffer; mag tape format IBM 729-compatible	Model 1021 includes keyboard/printer (KSR); Model 1051 adds paper tape I/O (ASR); up to 2 readers, 2 punches can be included; paper tape reader/punch also accepts edge-punched cards; supersedes Dura 1041/1015 Data Terminal	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Dura 1041/1015 Data Terminals		Dynatronics EDX-1901 Data Communications Terminal		Electronic Information Systems ET-39 Telewriter
REPORT NUMBER		6240		—		—
FUNCTION		Transmission/reception of data over narrow/voiceband line; input from punched tape/keyboard; output to punched tape/printer		Transmission/reception of alphanumeric data over voiceband line; keyboard/paper tape input; paper tape/printed copy output		Remote printed copy output/transmission of manually-keyed data over narrow-/voice band line
PREPARED INPUT	Medium	Punched tape		Punched tape		No provision
	Code	6-level		8-level USASCII		—
	Speed:					
	Char/sec	30		25		—
	Cards/min	—		—		—
MANUAL INPUT	Method of Entry	44-keyboard; 12 additional function keys		65-key keyboard		52-key keyboard
	No. of Char	Variable		Variable		Variable
OUTPUT	Medium	Punched tape	Printer	Punched tape	Printer	Printer
	Code	6-level	88 char	8-level USASCII	94	63 char
	Speed:					
	Char/sec	18	14.8	25	25	10
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Narrow/voiceband		Voiceband		Narrow/voiceband
	Speed, bps	134.5		250		110
	Mode	Half-duplex		Half-/full-duplex		Half-/full-duplex
	Code	6-level		8-level USASCII		8-level USASCII
	Timing	Asynchronous		Asynchronous; (synchronous optional)		Asynchronous
ERROR CONTROL		Char parity checking; manual correction		Odd/even char parity checking		Parity checking
MONTHLY RENTAL, $		304-643		180		29; 835 (purchase)
COMMENTS		Up to 2 readers/2 punches can be included; paper tape reader/punch also accepts edge-punched cards; no longer in production		Basic EDX-1901 includes keyboard, page printer, paper tape reader/punch; designed for asynchronous operation using USASCII code at 15/25 cps; modular electronics allows code/timing conversion for compatibility with ITA-2, Baudot, other codes at various synchronous/asynchronous speeds; keyboard generates full 128-char USASCII set; printed copy via communications line, keyboard, paper tape reader, read/punch any 5- to 7-level code optional; std typewriter keyboard with interlock; up to 120-char print line (10 char/in.); print position indicator; automatic CR/LF; prints up to 5 copies; horiz/vert tab; pin feed platen		Direct TTY 33 KSR-compatibility; available as RO unit; compatible with Bell System Data Set 101C; keyboard interlock; various interfaces available; 72-char print line (12 char/in.); prints 3 copies; friction feed platen

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Electronic Engineering 1650/51 Terminal		Foto-Mem Foto-Print 30 Data Printing Terminal		Friden Teledata Line
REPORT NUMBER		—		—		6270
FUNCTION		Transmission/reception of alphanumeric data over voice/narrowband lines; keyboard entry/printed copy output std; paper tape I/O optional		Transmission/reception of alphanumeric data over voiceband line; punched tape/keyboard input; output to punched tape/nonimpact printer		Transmission/reception of punched paper tape data over narrow/voiceband line
PREPARED INPUT	Medium	Punched tape		Punched tape		Punched tape
	Code	Any 8-level code		8-level USASCII		Any 5-, 6-, or 8-level code
	Speed:					
	Char/sec	15.3		10, 15, 30		Up to 7.9; (14.2 Dual Teledata)
	Cards/min	—				
MANUAL INPUT	Method of Entry	44-key keyboard		53-key keyboard		No provision
	No. of Char	Variable/up to 100		Variable		—
OUTPUT	Medium	Printer	Punched tape	Printer	Punched tape	Punched tape
	Code	88 char	Any 8-level code	64 char	8-level USASCII	Any 5- to 8-level code
	Speed:					
	Char/sec	15.3	15.3	10, 15, 30	10, 15, 30	Up to 7.9; (14.2, Dual Teledata)
	Cards/min	—	—	—	—	
DATA TRANSMISSION	Line Type	Voice/narrowband		Voice/narrowband		Narrow/voiceband
	Speed, bps	Up to 4800 bps		Up to 300		45, 56, 75; 150 (Dual Teledata)
	Mode	Half-duplex		Half-/full-duplex		Half-/full-duplex
	Code	Any 8-level code		8-level USASCII		Any 5-, 6-, or 8-level code
	Timing	Asynchronous		Asynchronous		Asynchronous
ERROR CONTROL		No provision		Parity checking optional		1 or 2 parity bits/char, depending on model; when receiving, parity is accumulated mechanically by activation of punches
MONTHLY RENTAL, $		Purchase price: 2500 (KSR); 3200 (ASR)		Purchase price: 940 (printer); 295 (keyboard); 200 (tape reader); 315 (tape punch)		165-179; 500 (Dual Teledata)
COMMENTS		Up to 130-char print line; optional 100-char buffer enables transmission bursts of fixed-length records; KSR provides keyboard/printer only; ASR option adds paper tape I/O; internal code conversion to USASCII; EBCDIC model available		Acoustic coupler option ($320) requires TTY communications interface ($215); modular keyboard interchangeable with Foto-Vision Display; switch-selectable operating speeds; 80-char print line; off-line key-to-print/tape-to-print applications; bit-parallel interface available; nonimpact printing std; up to 70-key keyboard optional		Dual Teledata requires 2 communications channels; can be connected to single voiceband line via suitable channel-deriving equipment

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Friden Model 7102 Communications Terminal		Friden Model 7311/7331 Communications Terminal	GE Terminet 300 Data Communication Terminal	
REPORT NUMBER		6272		—	—	
FUNCTION		Transmission/reception of data over narrow/voiceband line; keyboard/punched tape data entry; punched tape/printed copy output		Transmission/reception of data over voiceband line; keyboard/punched card entry; printed copy output	Transmission of keyboard/paper tape input data; reception of data to paper tape/printed copy output over voiceband line	
PREPARED INPUT	Medium	Punched tape		Punched cards (7331)	Punched tape (ASR)	
	Code	8-level USASCII		Hollerith	7-level USASCII	
	Speed:					
	Char/sec	10		10	10, 15, 30	
	Cards/min	—		—	—	
MANUAL INPUT	Method of Entry	53-key keyboard		56-key keyboard (7311)	61-key keyboard	
	No. of Char	Variable		Variable	Variable	
OUTPUT	Medium	Punched tape	Printer	Printer (7311)	Printer	Punched tape (ASR)
	Code	Any 8-level code	89 char	91 char	94 char	7-level USASCII
	Speed:					
	Char/sec	10	10	12	10, 15, 30	10, 15, 30
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Narrow/voiceband		Voiceband (leased)	Voiceband	
	Speed, bps	Up to 110		Up to 150	110, 150, 300	
	Mode	Half-duplex		Half-duplex	Half-/full-duplex	
	Code	8-level USASCII		8-level USASCII	7-level USASCII	
	Timing	Asynchronous		Asynchronous	Asynchronous	
ERROR CONTROL		Char parity checking; manual retransmission		Char parity checking; automatic block retransmission up to 3 times	Char parity checking optional; manual retransmission	
MONTHLY RENTAL, $		148		240 (7311 Keyboard/Printer); 90 (7331 Card Reader)	150 (KSR); 225 (ASR); Purchase price: 3080 (RO); 3625 (KSR); 5860 (ASR)	
COMMENTS		Optional edge-punched/paper tape reader, punch can be substituted for paper tape reader/punch; can transmit/receive entire 128-char USASCII set; 16-/20-in. printer carriage available		Model 7331 Card Reader normally incorporated in basic 7311 configuration; includes full USASCII char set; 16-/20-inch printer carriage available; 135-char print line (10 char/in.) std; options include 175-char print line, pin feed platen, vertical tab	75-char print line std; options include pin feed platen, paper tape I/O, 118-char print line, code transparency, 120-cps (1200-bps) operating speed, horiz/vert tab, 20-char programmable answerback, parallel interface; available as RO unit; switch-selectable operating speeds std	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		GE Datanet 600/601	GE Datanet 730 Acoustically Coupled Terminal		GE Datanet 760 Keyboard/Display Subsystem	
REPORT NUMBER		6320	6322		6321	
FUNCTION		Transmission/reception of punched tape data over voiceband line	Transmission/reception of data over voiceband line via acoustic coupler; paper tape/keyboard entry; paper tape/printed copy output		Video display/printed copy of alphanumeric data transmitted to/received from remote computer over voiceband line	
PREPARED INPUT	Medium	Punched tape	Punched tape (ASR)		No provision	
	Code	Any 5- to 8-level code	7-level USASCII		—	
	Speed:					
	Char/sec	50	10		—	
	Cards/min	—	—		—	
MANUAL INPUT	Method of Entry	No provision	45-key keyboard		53-key keyboard	
	No. of Char	—	Variable		Up to 184, 368, 736, 1196	
OUTPUT	Medium	Punched tape	Printer	Punched tape (ASR)	Cathode ray tube	Printer
	Code	Any 5- to 8-level code	64 characters	7-level USASCII	63 char	63 char
	Speed:					
	Char/sec	50	10	10	150-300	10
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband		Voiceband	Voiceband
	Speed, bps	850	Up to 110		Up to 1200	2000/2400
	Mode	Half-duplex	Half-/full-duplex		Half-duplex	Half-duplex
	Code	Same as input plus inverse	7-level USASCII		8-level USASCII	8-level USASCII
	Timing	Asynchronous	Asynchronous		Asynchronous	Synchronous
ERROR CONTROL		Complete redundancy; inverse of each char transmitted; automatic retransmission	Even parity generation		Char/longitudinal (optional) parity checking; automatic retransmission	
MONTHLY RENTAL, $		275 (600); 300 (601)	110 (ASR); Purchase price: 2100 (portable KSR/mobile ASR); 2200 (portable ASR)		83/terminal (32-terminal configuration)	
COMMENTS		8-level data transmitted at 25 cps; 601 can operate on-line to a GE 200 Series computer via Datanet-15	Basic unit consists of a TTY ASR 35 connected to a GE Model TDM-114 acoustic coupler; modified TTY 33 units connected to GE TDM-114 acoustic coupler; ACT 731 includes portable KSR/coupler; ACT 733, portable ASR/coupler; ACT 735, mobile ASR/coupler; originate-only mode; compatible with Bell System Data Set 103A2		Max of 32 display/printer units connected to central controller; multiple keyboard configurations available	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		GE Datanet 765 CRT Communication Terminal		GDI CT-300 Card Transmitter	Gulton Industries LG 10/30 Remote Computer Terminal	
REPORT NUMBER		—		—	—	
FUNCTION		Provides communication between 1 or 2 keyboard/video display terminals and data processor over voiceband line		Transmission of punched card data over voiceband line via Bell System Data-Phone Data Set	Remote conversational terminal for transmission/reception of alphanumeric data over voiceband line; mag tape I/O; keyboard entry; printed copy output	
PREPARED INPUT	Medium	No provision		Punched cards	Magnetic tape	
	Code	—		Hollerith	8-level USASCII	
	Speed:					
	Char/sec	—		—	10, 15, 30	
	Cards/min	—		300	—	
MANUAL INPUT	Method of Entry	Various keyboards		No provision	63-key keyboard	
	No. of Char	Variable		—	Variable	
OUTPUT	Medium	Cathode ray tube	Printer	No provision	Magnetic tape	Printer
	Code	64 char	64 char	—	8-level USASCII	64 char
	Speed:					
	Char/sec	12-60	10, 15, 30	—	10, 15, 30	10, 15, 30
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband		Voiceband	Voiceband	
	Speed, bps	1200, 2000, 2400, 4800		1200/2400	Up to 300	
	Mode	Half-duplex		Simplex	Half-/full-duplex	
	Code	8-level, 11-unit, USASCII		6-level, 8-unit BCD	8-level USASCII	
	Timing	Synchronous/asynchronous		Asynchronous	Asynchronous	
ERROR CONTROL		Char/longitudinal parity checking; automatic retransmission		Char parity checking; automatic retransmission by block	Char parity checking	
MONTHLY RENTAL, $		170 (2-terminal configuration)		175; 5200-6400 (purchase)	150 (includes acoustic coupler)	
COMMENTS		Available in 3 basic configurations; can be located up to 5000 ft from terminal controller via coaxial cable; up to 64 terminals can be accommodated on single polled communication network; multiple keyboard configurations available; displayable characters range from 22 lines/46 char to 22 lines/92 char; optional Terminet 300 or TTY 33 KSR		Compatible with Mohawk Data Sciences 1103/6403 Data Recorders; error indication via reverse channel; interfaces directly Bell System Data Sets 202C/202E2; automatic retransmission via core memory buffer; 400-card I/O hopper capacities; available with 32-, 64-, 96-, 128-char USASCII interface	TTY 33-compatible; rated for continuous operation; options include mag tape cassette, 16-key numeric entry keyboard, line buffer, acoustic coupler; tape cassette stores 100,000 char; switch-selectable operating speeds; up to 132-char adjustable print line std; prints 5 copies; basic unit is KSR; ASR adds mag tape I/O; 26 keyboard control char; compatible with Bell System Data Set 103A	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Honeywell Data Station		Honeywell Series 200 Visual Information Projection System		Honeywell 281 Single Channel Communications Control
REPORT NUMBER		6383		6384		6382
FUNCTION		Transmission/reception of data over voiceband line with Honeywell Series 200 computer; punched tape I/O; keyboard entry; printed copy output		Video display/printed copy of alphanumeric data transmitted to/received from remote computer; keyboard entry		Connects Honeywell Series 200 computer to single narrow/voice/broadband line
PREPARED INPUT	Medium	Punched tape	Bar-coded cards	No provision		Computer
	Code	8-level USASCII	4-bit bar/2-bit mark-sense	—		5- to 8-level, depending on model
	Speed:					
	Char/sec	120	50/25	—		1-6250
	Cards/min	—	—	—		—
MANUAL INPUT	Method of Entry	48-key keyboard		15-/42-key keyboard		No provision
	No. of Char	Variable/up to 132		Up to 384/768 char/unit		—
OUTPUT	Medium	Punched tape	Printer	Cathode ray tube	Printer	Computer
	Code	8-level USASCII	59 char	14 to 64 char	64 char	5- to 8-level (depending on model)
	Speed:					
	Char/sec	120	10	41,600	10	10-6250
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband		Voiceband		Narrow/voice/broadband
	Speed, bps	Up to 1200		1200, 2000, 2400		Up to 134.5, 2400, 50,000
	Mode	Half-duplex		Half-duplex		Half-duplex
	Code	8-level USASCII		8-level USASCII		5- to 8-level (depending on model)
	Timing	Asynchronous		Synchronous/asynchronous		Synchronous/asynchronous
ERROR CONTROL		Char/message parity checking; automatic retransmission with buffer option		Char/longitudinal parity checking; manual retransmission from display units; automatic retransmission from auxiliary units		Char/message parity checking on some models; error sets testable indicator
MONTHLY RENTAL, $		217-730 (depending on selection of I/O components); 42-288 (per component)		50-92 (display unit); 293 to over 1000 (central controller); 23-60 (nondisplay unit control); 28-81 (nondisplay unit)		122-263 (depending on model/special features)
COMMENTS		Transmission can be initiated only by remote Series 200 computer; option permits selective addressing/polling operations (controlled by remote computer); each data station consists of control unit/1-4 I/O components; 128-char keyboard; bar-coded card reader optional		Multiple display/printer units connected to central controller; equipment manufactured/marketed by Bunker-Ramo; keyboard entry via auxiliary TTY 33/35 KSR available; max keyboard-generated message length depends on model/configuration		Various models available for connection to wide range of std communications facilities/remote terminals

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Honeywell 481 Single Channel Communications Control	Honeywell K-700 Series Keytape Communicators		Honeywell K-900 Series Keytape Communicators	
REPORT NUMBER		6381	6385		6385	
FUNCTION		Connects Honeywell 400/1400 computer to single narrow/voiceband line	Transmission/reception of mag tape data over voiceband line; many I/O options available; preparation of tape for direct entry to computer		Transmission/reception of mag tape data over voiceband line; many I/O options available; preparation of tape for direct entry to computer	
PREPARED INPUT	Medium	Computer	Magnetic tape	Punched cards (K-731)	Magnetic tape	Punched cards (K-931)
	Code	6-bit BCD	6-level BCD	Hollerith	8-level EBCDIC	Hollerith
	Speed:					
	Char/sec	6-105	13,344 (556 bpi); 19,200 (800 bpi)	—	19,200	—
	Cards/min	—		100	—	100
MANUAL INPUT	Method of Entry	No provision	49-key keyboard		49-key keyboard	
	No. of Char	—	Up to 80/120		Up to 80, 90, 100, 110, 120	
OUTPUT	Medium	Computer	Magnetic tape	Printer (K-735)	Magnetic tape	Printer (K-935)
	Code	6-bit BCD	6-level BCD	64 char	8-level EBCDIC	64 char
	Speed:					
	Char/sec	6-105	13,344 (556 bpi); 19,200 (800 bpi)	—	19,200	—
	Cards/min	—		300 lpm	—	300 lpm
DATA TRANSMISSION	Line Type	Narrow/voiceband	Voiceband		Voiceband	
	Speed, bps	Up to 75 (narrow)/ 1050 (voice)	1200/1800		1200/1800	
	Mode	Simplex/half-duplex	Half-duplex		Half-duplex	
	Code	Any code up to 8-levels	6-level BCD		8-level EBCDIC	
	Timing	Asynchronous	Asynchronous		Asynchronous	
ERROR CONTROL		As programmed; no automatic checking	Char/longitudinal parity checking during transmission; complete bit-for-bit checks of all tape recording; automatic retransmission		Char/longitudinal parity checking during transmission; complete bit-for-bit checks of all tape recording	
MONTHLY RENTAL, $		300	245-750		270-775	
COMMENTS		Two alternating 2-char buffers when receiving; one 4-char buffer when transmitting; available to present users on as-returned basis only	Various models provide different auxiliary I/O devices		Various models provide different auxiliary I/O devices	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Honeywell Series 2440/RTT Remote Transmission Terminal		Hewlett-Packard Model 2761A Optical Mark Reader	IBM Magnetic Tape Selectric Typewriter	
REPORT NUMBER		—		—	6458	
FUNCTION		Remote transmission/reception of data with Honeywell Series 200 Computers over voiceband line; punched card I/O; printed copy output		Remote punched card reader terminal; accepts input from 40-/80-col punched/bar-coded cards; transmits data over voiceband line	Transmission/reception of data over public telephone network; input keyboard/mag tape cartridge; output printer/magnetic tape cartridge	
PREPARED INPUT	Medium	Punched cards		Punched cards; bar-coded cards (optional)	Magnetic tape	
	Code	Hollerith		Hollerith; dial mark-sense (bar-coded)	IBM MT/ST	
	Speed:					
	Char/sec	—		10/105	14.8	
	Cards/min	400		—	—	
MANUAL INPUT	Method of Entry	No provision		No provision	44-key keyboard	
	No. of Char	—		—	Up to 23,240/tape cartridge	
OUTPUT	Medium	Punched cards	Printer	No provision	Printer	Magnetic tape
	Code	Hollerith	63 char	—	88 char	IBM MT/ST
	Speed:					
	Char/sec	—	—	—	14.8	14.8
	Cards/min	100-400	270 lpm	—	—	—
DATA TRANSMISSION	Line Type	Voiceband		Voiceband	Public telephone network	
	Speed, bps	2000 (switched); 2400 (leased)		Up to 110/1050	Up to 134.5	
	Mode	Half-duplex		Half-/full-duplex	Half-duplex	
	Code	8-level USASCII		USASCII	IBM MT/ST	
	Timing	Synchronous		Asynchronous	Asynchronous	
ERROR CONTROL		Message parity checking; automatic retransmission		Parity generation	Char parity checking; manual retransmission	
MONTHLY RENTAL, $		675-1055 (depending on selection of I/O components)		2950-3150 (purchase price)	265 (1 tape); 323 (2 tapes)	
COMMENTS		Transmission can be initiated by Series 200 computer or another 2440 terminal; automatic blocking feature provides for transmission of full buffers, does not limit transmission to size of I/O media; double buffer provides transmission of data while reading, punching, printing; 132-char print line std		Adds card entry capabilities to TTY 33 on time sharing networks; card feeding controlled by supervisory return line/X-ON facility; automatic input hopper capacity 300 cards; available with 52-/64-char Hollerith or dial code recognition for 40-/80-col cards	With optional second tape unit, MT/ST can be used for producing edited copy of previous tape; Model II is single-tape station; Model IV, double-tape station	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		IBM 65/66 Data Transceiver	IBM 1013 Card Transmission Terminal	IBM 1050 Data Communications System		
REPORT NUMBER		6440	6444	6447		
FUNCTION		Transmission of punched card data over telegraph-grade/voice-band line	Transmission/reception of punched card dat data over voiceband line	Transmission of data over narrow/voiceband lines; remote terminal for most IBM computers; off-line data preparation		
PREPARED INPUT	Medium	Punched cards	Punched cards	Punched tape	Punched cards	
	Code	Hollerith	Hollerith	8-level IBM PTT	Hollerith	
	Speed: Char/sec	16 col/sec (65);	1000 col/sec	14.8/8.33	14.8/8.33	
	Cards/min	14 col/sec (66)	—	—	10	
MANUAL INPUT	Method of Entry	No provision	No provision	53-key keyboard	15-/16-col keyboard	
	No. of Char	—	—	Variable	15, 16, 26 digits	
OUTPUT	Medium	Punched cards	Punched cards	Punched tape	Punched cards	Printer
	Code	Hollerith	Hollerith	8-level IBM PPT	Hollerith	88 char
	Speed: Char/sec	140 (65); 160 (66)	160 col/sec	14.8/8.33	14.8/8.33	14.8/8.33
	Cards/min	3-11	40-400	—	10	—
DATA TRANSMISSION	Line Type	Voiceband/telegraph-grade	Voiceband	Voiceband/telegraph-grade		
	Speed, bps	1400/1600 (voice); 75 (telegraph)	1200, 2000, 2400	Up to 133.2 (voice); 75 (telegraph)		
	Mode	Half-duplex	Half-duplex	Half-duplex		
	Code	IBM Transceiver 4-of-8	IBM High-Speed 4-of-8	9-bit IBM PTT		
	Timing	Asynchronous	Synchronous	Asynchronous		
ERROR CONTROL		Char validity; manual retransmission	Char validity/message parity checking; automatic retransmission	Char/message parity; automatic retransmission optional		
MONTHLY RENTAL, $		170-220	775	110-500; 30-100 (per component used)		
COMMENTS		65 and 66 are based on IBM 024 and 026 Key Punches, respectively; 66 can print data on card as it is punched	Extensive format control; compatible with other IBM STR terminals	Master Station feature permits multistation polling/addressing; each 1050 terminal consists of control unit/1-7 I/O units		

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		IBM 1978 Print Read Punch Terminal		IBM 2260 Display Station		IBM 2721 Portable Audio Terminal
REPORT NUMBER		6445		6456		—
FUNCTION		Transmits data from punched cards; prints/punches into cards data received over voiceband line		Video display/printed copy of alphanumeric data transmitted to/received from remote computer over voiceband line		Remote keyboard entry of alphanumeric inquiry data to central computer over voiceband line via integral acoustic coupler
PREPARED INPUT	**Medium**	Punched cards		No provision		No provision
	Code	Hollerith		—		—
	Speed:					
	Char/sec	—		—		—
	Cards/min	190		—		—
MANUAL INPUT	**Method of Entry**	No provision		26-/50-key keyboard		60-key keyboard
	No. of Char	—		Up to 240, 480, 960		Variable
OUTPUT	**Medium**	Punched cards	Printer	Cathode ray tube	Printer	Voice response
	Code	Hollerith	13, 39, 52, 63 char	64 char	64 char	—
	Speed:					
	Char/sec	—	—	2560	14.8	—
	Cards/min	91-190	475-160 lpm	—	—	—
DATA TRANSMISSION	**Line Type**	Voiceband		Voiceband		Voiceband
	Speed, bps	600, 1200, 2000, 2400		Up to 1200/2400		12cps (two 0.5-sec words)
	Mode	Half-duplex		Half-duplex		Half-duplex
	Code	IBM High-Speed 4-of-8		8-level USASCII		3-of-14 inquiry code
	Timing	Synchronous		Asynchronous		Receiver activated by each data group
ERROR CONTROL		Char validity/block parity checking; automatic retransmission by block		Char/longitudinal parity checking; automatic retransmission		No provision except tone response to message entry error
MONTHLY RENTAL, $		850 (RO) to 1350		30-50 (display); 390-1050 (central control); 49 (printer)		20; 600 (purchase)
COMMENTS		Model 1 provides punched card input/printed output; Model 2 adds punched card output; Model 3 provides printed output only; compatible with other IBM STR terminals		Multiple display/printer units connected to central controller (2848); up to 24 displays/1 IBM 1053 Printer per controller; buffer capacity up to 7680 char		Connects remotely to IBM 7770/Model 3 Audio Response Unit; keyboard generates 26 alpha, 10 numeric, 14 special, 5 function, and 5 control char; overlays available; audio reception via speaker or ear plug; 3-char, hard-wired, terminal ID code is user-specified; 30-sec timeout will disconnect/request more terminal data

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		IBM 2265 Display Station		IBM 2740 Communication Terminal	IBM 2741 Communication Terminal	IBM 7702 Magnetic Tape Transmission Terminal
REPORT NUMBER		6459		6454	6455	6450
FUNCTION		Video display/printed copy of data transmitted between 2265 and remote IBM System/360 computer over voiceband line		Typed-message data communication over narrow/voiceband line	Typed-message data communication over narrow/voiceband line with IBM System/360 computer	Transmission of mag tape data over voiceband line
PREPARED INPUT	Medium	No provision		No provision	No provision	Magnetic tape
	Code	—		—	—	IBM BCD/binary
	Speed:					
	Char/sec	—		—	—	—
	Cards/min	—		—	—	150, 250, 300
MANUAL INPUT	Method of Entry	50-key keyboard		44-key keyboard	44-key keyboard	No provision
	No. of Char	Up to 960		Variable	Variable	—
OUTPUT	Medium	Cathode ray tube	Printer	Printer	Printer	Magnetic tape
	Code	64 char	64 char	1 of 3 IBM 6-level codes	1 of 3 IBM 6-level codes	IBM BCD/binary
	Speed:					
	Char/sec	2560	14.8	14.8	14.8	150, 250, 300
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband		Narrowband	Narrowband	Voiceband
	Speed, bps	Up to 1200/2400		134.5	134.5	1200, 2000, 2400
	Mode	Half-duplex		Half-duplex	Half-duplex	Half-duplex
	Code	8-level USASCII		1 of 3 IBM 6-level, 9-unit, codes	1 of 3 IBM 6-level, 9-unit, codes	IBM High-Speed 4-of-8
	Timing	Asynchronous		Asynchronous	Asynchronous	Synchronous
ERROR CONTROL		Char/longitudinal parity checking; automatic retransmission		Char/message parity checking optional	No provision	Char validity/message parity checking; automatic retransmission
MONTHLY RENTAL, $		360-445 (display/control); 49 (printer)		95-145	95 to 105	1260
COMMENTS		IBM 2845 controller interfaces 1 display/1 IBM 1053 Printer; 960-char buffer capacity; display formats are 15 64-char/12 80-char lines		Can be used as remote input for IBM System/360 computer; can be polled/addressed by computer	Intended as remote inquiry terminal for IBM System/360 computer; can interrupt computer (optional)	Tape format compatible with IBM 729 Series Magnetic Tape Units; compatible with other IBM STR terminals

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		IBM 2770 Data Communications System				IBM 7710 Data Communication Unit
REPORT NUMBER		—				6451
FUNCTION		Remote, programmed batch processing of alphanumeric data transmitted/received over voiceband line to another 2770 or System/360 computer				Connects IBM 1401 computer to single voice/broadband line
PREPARED INPUT	**Medium**	Punched cards	Magnetic tape	Punched tape	Magnetic char reader	Computer
	Code	Hollerith	EBCDIC	5- to 8-level EBCDIC/ USASCII	EBCDIC/USASCII	6-bit BCD
	Speed:					
	Char/sec	—	117	120	—	250 or 300
	Cards/min	150(A1); 300 (A2)	—	—	Up to 500 6-in. doc/min.	—
MANUAL INPUT	**Method of Entry**	Keyboard (IBM 2772 Control Unit)				No provision
	No. of Char	Variable				—
OUTPUT	**Medium**	Punched cards	Printer	Punched tape	Cathode ray tube	Computer
	Code	Hollerith	63 (EBCDIC); 64 (USASCII)	5- to 8-level EBCDIC/ USASCII	63 (EBCDIC); 64 (USASCII)	6-bit BCD
	Speed:					
	Char/sec	Up to 20	Up to 66	120	Up to 300	250/300
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	**Line Type**	Voiceband				Voice/broadband
	Speed, bps	1200, 2000, 2400				2000/2400 (voice); 40,800 (broad)
	Mode	Half-duplex				Half-duplex
	Code	EBCDIC/USASCII				IBM High-Speed 4-of-8
	Timing	Synchronous				Synchronous
ERROR CONTROL		Parity/cyclic redundancy checking; automatic retransmission by block				Char validity/message parity checking; programmed retransmission
MONTHLY RENTAL, $		265 (control unit); 130-170 (printer); 170 (2265 display); 112-145 (card reader); 112-131 (card punch); 49 (paper tape reader); 121 (paper tape punch); 175 (mag tape inscriber)				1575
COMMENTS		Can communicate with another 2770 or IBM System/360 (Models 25-85) via binary synchronous communications; functions as batch/conversational terminal; all configurations employ keyboard; printer/any 2 of 5 I/O devices can be attached; optional features available on 2772 multipurpose control unit include automatic answering, buffer expansion, conversational mode, EBCDIC transparency, identification, keyboard correction, multipoint data link control, synchronous clock, display format control; interlocked keyboard generates EBCDIC/USASCII char; friction/pin feed printer platen; 132-char print line (10 char/in.); 6-part forms; 2265 displays 960 char max via 12 80-char/15 64-char line format; card punch can print punched data; mag char reader reads MICR encoded data in 4, 6, 8, 10, 12 records per buffer block				Compatible with other IBM STR terminals; can be connected to other IBM computers RPQ

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		IBM 7711 Data Communication Unit	IBM 2780 Data Transmission Terminal		Infotec DS-20 Data Station	Interface Mechanisms Series 3 Dual Image Remote Data Entry Terminal
REPORT NUMBER		6452	6457		—	—
FUNCTION		Transmission of mag tape data over voice/ broadband line	Transmission/reception of alphanumeric data over voiceband line; punched card I/O; printed copy output		Programmed, high-speed transmission/ reception of mag tape data over voice/broad-band line	Keyboard to printed tape data conversion/ transmission to remote computer; reception of data from remote com-puter to printed tape
PREPARED INPUT	Medium	Magnetic tape	Punched cards		Magnetic tape	Printed paper tape
	Code	IBM 6-bit BCD/binary	Hollerith		8-level BCD/EBCDIC	Any 5- to 8-level code
	Speed:					
	Char/sec	Up to 90,000	—		4000/30,000 (7-/9-track)	Up to 150
	Cards/min	—	400		—	—
MANUAL INPUT	Method of Entry	No provision	No provision		TTY 33 ASR keyboard	Keyboard
	No. of Char	—	—		Variable	Variable
OUTPUT	Medium	Magnetic tape	Punched cards	Printer	Magnetic tape	Printed paper tape
	Code	IBM 6-bit BCD/binary	Hollerith	39, 47, 52, 63 char	8-level BCD/EBCDIC	Any 5- to 8-level code
	Speed:					
	Char/sec	Up to 90,000	91-355	—	4000/30,000 (7-/9-track)	Up to 90
	Cards/min	—	—	200-300 lpm	—	—
DATA TRANSMISSION	Line Type	Voice/broadband	Voiceband		Voice/broadband	Voiceband
	Speed, bps	Up to 2400 (voice); 40,800 (broad)	1200, 2000, 2400		3600 (public); 9600 (leased); 40,800 (broad)	Up to 9600
	Mode	Half-duplex	Half-duplex		Half-/full-duplex	Half-duplex
	Code	IBM High-Speed 4-of-8	IBM 6-bit SBT, 8-bit USASCII/EBCDIC		4-of-8 SBT/bisynchro-nous	Any 5- to 8-level code
	Timing	Synchronous	Synchronous		Synchronous/asynchro-nous	Asynchronous/synchro-nous
ERROR CONTROL		Char validity/message parity checking; auto-matic retransmission	Cyclic redundancy checking (SBT/EBCDIC); char/longitudinal parity checking (USASCII); automatic retransmission		Block parity checking; programmed retrans-mission	Char/longitudinal parity checking; automatic re-transmission
MONTHLY RENTAL, $		1065; 46,755 (purchase)	680 (card read/punch) to 1200		1670 (controller/7-tr mag tape/async data-phone interface/TTY 33 ASR/software); 28,625 (purchase)	165
COMMENTS		Up to 2400 char of buffering available; uses IBM 729 II, IV, V, or VI, or 7330 Ma Magnetic Tape Units	Model 1 provides punched card input/printed output; Model 2 adds punched card output; Model 3, printed output only (RO); Model 4, punched card I/O only; compatible with IBM BSC equipment		Contains 4096/8192, 12-bit word, PDP-8 processor; can inter-face up to 32 low-speed, half-duplex, voiceband lines (async)/ up to 8 high-speed, voiceband lines (sync)/ up to 32 parallel lines/up to 2 broadband lines; in-cludes data break; op-tional auto dial-up (100/channel); com-patible with Bell System Data Sets 103A/103B/ 103E/103G/103H/202C/ 202D/811B/303B (async), 201A/201B/ 202C/202D/301B/303B/ 303C/303D (sync), 401J/403J (parallel)	Operates via various data sets at 300, 600, 1200, 2400, 4800, 9600 bps; std version up to 2400 bps; higher speed modems available; printed output speed de-pends on char set; printing speed at 27 (128-char), 60 (64-char), 80 cps (15-char set); up to 50,000-char storage per 5-in. reel; prints alphanumeric char/ machine code simul-taneously on same tape for entry verification; 300-/1000-cps read speed optional; numeric/ alphanumeric keyboards available; USASCII/ EBCDIC codes std; par-allel interface available

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		ITT Data Equipment and Systems Model 3010 Envoy Electronic Dataprinter		Kleinschmidt Model 311 Electronic Data Printer	Kleinschmidt Model 321 High-Speed Automatic Data Set	
REPORT NUMBER		—		6520	6520	
FUNCTION		Transmission/reception of data over narrow/voiceband line; punched tape/keyboard input; output to punched tape/printer		Transmission of manually keyed data over narrow/voiceband line; printed copy output of data received	Transmission of manually-keyed/punched tape data over narrow-/voiceband line; output to punched tape/printer	
PREPARED INPUT	Medium	Punched tape		No provision	Punched tape	
	Code	Any 8-level code		—	See Comments	
	Speed: Char/sec Cards/min	 10 —		 — —	 Up to 37.5 —	
MANUAL INPUT	Method of Entry	62-key keyboard		33, 52, 53-key keyboard	33, 52, 53-key keyboard	
	No. of Char	Variable		Variable	Variable	
OUTPUT	Medium	Punched tape	Printer	Printer	Printer	Punched tape
	Code	Any 8-level code	96 char	51/63 char	51/63 char	See Comments
	Speed: Char/sec Cards/min	 10 —	 10 —	 Up to 37.5 —	 Up to 37.5 —	 Up to 37.5 —
DATA TRANSMISSION	Line Type	Narrow/voiceband		Narrow/voiceband	Narrow/voiceband	
	Speed, bps	50, 75, 110		110, 150, 300	110, 150, 300	
	Mode	Half-/full-duplex		Half-/full-duplex	Half-/full-duplex	
	Code	8-level, 11-unit USASCII		8-/11-unit code	8-/11-unit code	
	Timing	Asynchronous		Asynchronous	Asynchronous	
ERROR CONTROL		Char parity checking; automatic substitute error symbol printed; manual retransmission		Char parity generation (USASCII keyboards only); char parity checking (USASCII) optional	Char parity generation (USASCII keyboards only); char parity checking (USASCII) optional	
MONTHLY RENTAL, $		83; 2750 (purchase)		2370-4000 (purchase price)	5750-7000 (purchase price)	
COMMENTS		Options include 2-color printing, 30-char answer bank, horizontal/vertical tab, remote control facilities; parallel transfer capability for direct connection to computer; prints up to 6 copies; 72-char print line; friction/pin-feed platen; 3 or 6 lines/in. spacing; includes 15-cps burst buffer; RO/KSR versions available; compatible with Bell System Data Set 103B		Can be equipped for 5-level Baudot or 6-/8-level USASCII; 5- to 8-level codes can be used; 5-/6-level codes have 8-unit structure; 7-/8-level codes, 11-unit structure	Can be equipped for 5-level Baudot or 6-/8-level USASCII; 5- to 8-level codes can be used; 5-/6-level codes have 8-unit structure; 7-/8-level codes, 11-unit structure	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		KSW Controls Series 600 Input Terminals	Maxson Electronics M 1389 Digital Message Terminal	Mohawk Data Sciences 1100 Series Data-Recorders		
REPORT NUMBER		—	—	6540		
FUNCTION		Remote keyboard entry of variable numeric data for transmission over narrow/voiceband line	Storage/transmission of manually-keyed, formatted/unformatted, data messages over narrow/voiceband line; printed copy output	Transmission/receiption of mag tape data over voiceband line; keyboard data entry; punched card/paper tape input; printed copy output		
PREPARED INPUT	Medium	No provision	No provision	Magnetic tape (all)	Punched cards (1109)	Punched tape (1115)
	Code	—	—	IBM 6-bit BCD	Hollerith	Any 5- to 8-level code
	Speed:					
	Char/sec	—	—	6250	—	133.3
	Cards/min	—	—	—	75	—
MANUAL INPUT	Method of Entry	10 to 25-key keyboard	53-key keyboard	47-/64-key keyboard		
	No. of Char	Variable	512	Up to 80, 84, 90, 100, 120, 140, 160, 180 char		
OUTPUT	Medium	No provision	TTY 32/33 RO	Magnetic tape (all)	Printer (1183)	1320 Printer (all)
	Code	—	80 char	IBM 6-bit BCD	64 char	64 char
	Speed:					
	Char/sec	—	10	6250	15	—
	Cards/min	—	—	—	—	375 lpm
DATA TRANSMISSION	Line Type	Narrow/voiceband	Narrow/voiceband	Voiceband		
	Speed, bps	100-400	10 cps (narrow); 150 cps (voice)	1200, 1600, 2400		
	Mode	Half-/full-duplex	Half-duplex	Half-/full-duplex		
	Code	Any code	5-level Baudot; 8-level USASCII	Modified BCD (4 bits/numeric; 8 bits/nonnumeric)		
	Timing	Asynchronous	Asynchronous	Synchronous/asynchronous		
ERROR CONTROL		Automatic parity generation; automatic multi-key contention	Parity checking optional	Char validity/longitudinal parity checking during transmission; complete bit-for-bit checks of all mag tape recording; automatic retransmission		
MONTHLY RENTAL, $		10 to 40 (depends on keyboard configuration) 350 to 485 (purchase price)	4500 (purchase)	232		
COMMENTS		Intended primarily for file preparation operations; normally used with TTY or other terminal for printout; std configuration includes 19-key keyboard	Basic, low-speed unit includes 512-char transmit memory, TTY RO, line interface; field keys facilitate formatted message composition; operates on polled/contention basis in monomode (conversational) or duomode (program control); 72-char print line; fixed machine-generated ID char; optional 1024-char memory with low-speed system	Various models have different auxiliary I/O devices; 1320 printer can be used with all models; input, transmission, output performed separately via internal mag tape unit; 1320 printer can receive/print directly; tape format is IBM 729-compatible		

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Mohawk Data Sciences Model 6403 Data-Recorder	Mohawk Data Sciences System 7500 Data Communications Terminal			
REPORT NUMBER		6543	—			
FUNCTION		Transmission/reception of mag tape data over voiceband line; keyboard data entry	Transmission/reception of alphanumeric data over switch/leased voiceband lines; I/O options include paper tape, mag tape, punched card, high-speed printer			
PREPARED INPUT	**Medium**	Magnetic tape	Magnetic tape	Punched cards	Punched tape	
	Code	8-level EBCDIC	6-level BCD, 8-level IBM EBCDIC, or 7-level USASCII	Hollerith	Any 5- to 8-level code	
	Speed:					
	Char/sec	6250	6250	—	400	
	Cards/min	—	—	400/1000	—	
MANUAL INPUT	**Method of Entry**	48-key keyboard	64-char keyboard			
	No. of Char	Variable	10-190 char (selectable record length in increments of 10)			
OUTPUT	**Medium**	Magnetic tape	Magnetic tape	Punched cards (7256)	Punched tape	Printer
	Code	8-level EBCDIC	same as input	Hollerith	Any 5-, 7-, or 8-level code	64 char
	Speed:					
	Char/sec	6250	6250	—	300	—
	Cards/min	—	—	300	—	300 lpm
DATA TRANSMISSION	**Line Type**	Voiceband	Voiceband			
	Speed, bps	1200, 1600, 2400	1200, 1600, 2400			
	Mode	Half-duplex	Half-/full-duplex			
	Code	Modified BCD	Modified BCD (4 bits/numeric; 8 bits/nonnumeric)			
	Timing	Asynchronous	Asynchronous			
ERROR CONTROL		Char validity/longitudinal parity checking; automatic retransmission	Char validity/longitudinal parity checking; automatic retransmission			
MONTHLY RENTAL, $		259	280 to 1886			
COMMENTS		Tape format compatible with 9-channel IBM 2400 series units; can transmit to/receive from Mohawk 1103; BCD code structure 4 bits/numeric, 8 bits/nonnumeric	Mag tape drive included as part of controller; 1 input device can be selected at sending terminal; high-speed printer plus 1 other output device can be selected at receiving terminal; system can communicate with any MDS 1103/6403; mag tape read/write density 200/800 bpi; punched card I/O compatible with mag tape BCD code; dial-selectable record length pertains to all I/O media			

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Metroprocessing Spartan Fone-Tone Models FT-1240/ 1241 and FT-1200/1248	Mite Model 123 Printer Terminal	NCR 735 Series Data-Encoders		
REPORT NUMBER		—	—	—		
FUNCTION		Portable remote keyboard entry of alphanumeric/digital data over public telephone network via acoustic coupler	Portable, low-speed transmission/reception of alphanumeric data over voiceband line to remote computer; keyboard entry; printed copy output	Basic data encoding, transmission/reception of magnetic tape data over voiceband line; punched card/paper tape input; keyboard entry; printed copy output		
PREPARED INPUT	Medium	No provision	No provision	Magnetic tape (200 bpi 7-channel)	Punched cards (601/701)	Punched tape (501)
	Code	—	—	6-bit IBM BCD	Hollerith	Any 5- to 8-level
	Speed:					
	Char/sec	—	—	6250	—	133.3
	Cards/min	—	—	—	75-200	—
MANUAL INPUT	Method of Entry	12-key Touch-Tone keyboard	50-key keyboard	47-1/64-character keyboard		
	No. of Char	Variable	Variable	80, 84, 90, 100, 120, 140, 160, 180		
OUTPUT	Medium	Voice/tone response	Printer	Magnetic tape (200 bpi, 7-channel)	Printer (801)	Printer (745)
	Code	—	Up to 128 char	6-bit IBM BCD	64 char	64 char
	Speed:					
	Char/sec	—	10	6250	15	
	Cards/min	—	—	—	—	375 lpm
DATA TRANSMISSION	Line Type	Public telephone network	Voiceband	Voiceband		
	Speed, bps	12, 16 (2-3 digits/1-2 alpha cps)	110 (serial)	1200, 1600, 2000, 2400		
	Mode	Half-duplex	Half-/full-duplex	Half-duplex		
	Code	2-of-8 Touch-Tone code	7-level, 11-unit USASCII	Modified BCD (4 bits/numeric; 8 bits/alpha)		
	Timing	Receiver activated by each data group	5-level Baudot Asynchronous	Synchronous		
ERROR CONTROL		No provision	Even/odd parity generation	Character validity/longitudinal parity checking; bit-for-bit checks of mag tape recording; automatic retransmission		
MONTHLY RENTAL, $		5-10; 195-250 (purchase)	Purchase price: 414 (printer); 487 (printer/keyboard)	231.50-356.50 (depending on model/options)		
COMMENTS		Acoustic device is coupled to handset mouthpiece; accepts voice/tone replies from audio response equipment/data sets; Model FT-1200 includes speaker/amplifier; battery-powered with no electrical connection; char transmission requires depression of 2/3 keys; provides audio readback of input, format checking; field length control	Portable unit; 80 char/line; 10.8 char/in. 6 line/in. spacing; pin/friction feed platen; key interlock; 1-char mechanical memory; keyboard roll-over capability; parallel interface std; serial interface not available to date; keyboard/printer modules available separately; acoustic coupler optional; prints 5-part forms; printer weights 9lb; keyboard 2.5 lb	Various models have different auxiliary devices; 745 printer can be used with all models; input, transmission, output are performed separately via internal magnetic tape unit; tape format is IBM 729-compatible		

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		NCR 736 Series Data-Encoders			NCR 760/765 Class Parallel Data Communications Equipment
REPORT NUMBER		—			—
FUNCTION		Transmission/reception of mag tape data over voiceband line; punched card/paper tape input; keyboard entry; printed copy output			Transmission/reception of paper tape data over voiceband line
PREPARED INPUT	**Medium**	Magnetic tape (800 bpi, 9-channel)	Punched cards	Punched tape	Punched tape
	Code	EBCDIC/USASCII	Hollerith	Any 5- to 8-level	Any 5- to 8-level code
	Speed:				
	Char/sec	13,200	—	133.3	72
	Cards/min	—	200	—	—
MANUAL INPUT	**Method of Entry**	64-char keyboard			No provision
	No. of Char	100; variable 10-180			—
OUTPUT	**Medium**	Magnetic tape (800 bpi, 9-channel)	Printer (745)		Punched tape
	Code	EBCDIC/USASCII	64 char		Any 5- to 8-level code
	Speed:				
	Char/sec	13,200	—		120
	Cards/min	—	375 lpm		—
DATA TRANSMISSION	**Line Type**	Voiceband			Voiceband (leased/switched)
	Speed, bps	1200, 1600, 2000, 2400			576 (72 cps)
	Mode	Half-duplex			Simplex (sender/receiver)
	Code	Modified BCD (4, 8 bits); EBCDIC/USASCII (12 bits)			Any 5- to 8-level code
	Timing	Synchronous			Receiver activated by each data group
ERROR CONTROL		Character validity/longitudinal parity checking; bit-for-bit checks of mag tape recording; automatic retransmission			Error signaling via reverse channel/automatic retransmission (760-128); char parity checking/ retransmission request via reverse channel (765-228)
MONTHLY RENTAL, $		253.50-387.50 (depending on model/options)			Punched tape transmitters: 35 (760-120); 44 (760-122); 55 (760-128) — Punched tape receiver: 205 (765-228)
COMMENTS		Various models have different auxiliary I/O devices; 745 printer can be used with all models; input, transmission, output performed separately via internal mag tape unit; 745 printer can receive/print directly			760-128 is capable of unattended operation; 765-228 can receive unattended/activate remote unattended sender; transmission/reception is 8-bit parallel; effective tape output speed up to 72 cps; 5-, 6-, 7-level codes are zero filled on transmission

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Motorola MTP30 High-Speed Line	Motorola MTP 6000 Teleprinter Terminal	Novar Model 5-41 Data Communications Terminal	Novar Model 5-50 Data Communications Terminal	
REPORT NUMBER		—	—	—	—	
FUNCTION		High-speed, dry-process line printer for computer readout/remote printed copy over voiceband line	High-speed, nonimpact, receive-only page printer accepts remote input over voiceband line	Transmission/reception of data to/from computer or another terminal; keyboard entry output to printed copy, multiple-part business forms	High-speed transmission/reception of mag tape data to/from computer or another terminal; keyboard entry; output to printed copy, multiple-part business forms; prints on-/off-line from tape cartridge	
PREPARED INPUT	Medium	No provision	No provision	No provision	Magnetic tape	
	Code	—	—	—	IBM Selectric; BCD, EBCDIC, USASCII (optional)	
	Speed:					
	Char/sec	—	—	—	15, 30, 60, 90, 120 cps (asynchronous);	
	Cards/min	—	—	—	120, 140, 180, 200, 240 cps (synchronous)	
MANUAL INPUT	Method of Entry	No provision	No provision	54-key Selectric keyboard	54-key Selectric keyboard	
	No. of Char	—	—	Variable	Variable up to 350	
OUTPUT	Medium	Printer	Printer	Printer	Printer	Magnetic tape
	Code	63 char	95 char	88 char	88 char	IBM Selectric; BCD, EBCDIC, USASCII
	Speed:					
	Char/sec	400	400	15	15-240	15-240
	Cards/min	—	240 lpm	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband	Voiceband	
	Speed, bps	1200	Up to 1200/2000	Up to 135	135-2400	
	Mode	Half-/full-duplex	Half-/full-duplex	Half-duplex	Half-duplex	
	Code	7-level USASCII	7-level USASCII	IBM Selectric	IBM Selectric; BCD, EBCDIC, USASCII (optional)	
	Timing	Asynchronous	Asynchronous	Asynchronous	Synchronous/asynchronous	
ERROR CONTROL		No provision	No provision	Vertical parity checking	Vertical parity checking; longitudinal/char redundancy check characters; automatic retransmission	
MONTHLY RENTAL, $		264 (3-yr lease); 3850 (purchase)	3800 (purchase price)	99	165; 5950 (purchase)	
COMMENTS		Basic configuration includes nonimpact printer, 7-bit serial USASCII code converter, 200-char buffer, Bell System Data Set 202C series interface; prints on 8.5-in. forms	Nonimpact printing; optional keyboard facility for local data entry; contains programmable 4K-memory controller; options include parallel input, BCD/EBCDIC codes, 100-char print line, 240-cps (2400-bps) operating speed; 80-char print line std; 6 lines/in. spacing; compatible with Bell System Data-Phone Data Sets 202C2/202D2	Incorporates 2-char line buffer for intermediate storage; options include built-in data set for DAA, carrying case, BCD/EBCDIC operating codes; Correspondence code std; keyboard generates 88 char set; compatible with IBM 2741; 130-char print line max; 9.5-, 9.9-, 10.4-, 10.7-, 11.8-, 13.7-in. pin feed platens available; horiz/vert tab optional; unattended, automatic answering optional	Options include operating speed above 15 cps (135 bps), BCD/EBCDIC/USASCII operating codes, LRCC/CRCC, automatic retransmission, built-in data set for DAA, polling/addressing, unattended/automatic answer, numeric input attachment; IBM Correspondence code std; asynchronous operation std; binary sync optional; keyboard editing includes delete char, word, line via 350-char buffer; keyboard generates 88-char set; compatible with IBM 2740/2741 (BTAM/QTAM); operates in conversation/batch modes; pin feed platen; 24,000-/48,000-char mag tape cartridge capacity; Bell System Data Sets 103/202 available; 130-char print line, 4-record buffer, dial-up/interrupt capability std; vertical tab optional; horizontal tab std	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Novar Model 5-51 Data Communications Terminal		Olivetti TC 380 Computer Terminal		
REPORT NUMBER		—		—		
FUNCTION		High-speed data transmission/reception of mag tape data to/from remote computer; dual tape units for letter composition/editing; keyboard entry; prints multiple-part business forms on/off-line from tape cartridge		Stored program buffered terminal with 256-character message buffer; transmits/receives mag tape/paper tape data in multidrop connection over voiceband line; keyboard data entry; printed copy output		
PREPARED INPUT	Medium	Magnetic tape (dual)		Punched tape	Magnetic tape	
	Code	IBM Selectric; BCD, EBCDIC, USASCII (optional)		8-level USASCII	8-level USASCII	
	Speed: Char/sec Cards/min	15, 30, 60, 90, 120 cps (asynchronous); 120, 140, 180, 200, 240 cps (synchronous)		15 —	120 —	
MANUAL INPUT	Method of Entry	54-key Selectric keyboard		48-key alphanumeric keyboard; 10-key numeric keyboard		
	No. of Char	Variable up to 350		Variable		
OUTPUT	Medium	Printer	Magnetic tape (dual)	Printer	Punched tape	Magnetic tape
	Code	88 char	IBM Selectric; BCD EBCDIC, USASCII	84 char	8-level USASCII	8-level USASCII
	Speed: Char/sec Cards/min	15-240 —	15-240 —	15 —	15 —	120 —
DATA TRANSMISSION	Line Type	Voiceband		Voice		
	Speed, bps	135 to 2400		1200/2400		
	Mode	Half-duplex		Half-duplex		
	Code	IBM Selectric; BCD, EBCDIC, USASCII (optional)		8-level USASCII		
	Timing	Synchronous/asynchronous		Synchronous/asynchronous		
ERROR CONTROL		Vertical parity checking; longitudinal/char redundancy check characters; automatic retransmission		Char/longitudinal parity checking; automatic retransmission		
MONTHLY RENTAL, $		205		206-292		
COMMENTS		Options include operating speed above 15 cps (135 bps), BCD/EBCDIC/USASCII operating codes, LRCC/CRCC, automatic retransmission, built-in data set for DAA, polling/addressing, unattended/automatic answer, numeric input attachment/ vertical tab, binary sync operation; same as Model 5-50 with dual cartridge mag tape system for editing, formatting; IBM correspondence code, asynchronous operation, pin feed platen, 130-char print line, 4-record buffer, horizontal tab, dial-up/interrupt capability std; compatible with IBM 2740/2741 (BTAM/QTAM); operates in conversation/batch modes; 88-char keyboard can delete char, word, line via 350-char buffer; Bell System Data Sets 103/202 available; 24,000-48,000-char mag tape cartridge capacity		Stand-alone terminal not requiring controller; can operate with local scanner to control 16 terminals on 1 drop; stored program controls I/O operations, arithmetic calculation, check digit verification, logical tests; mag tape cartridge provides 39,000-char storage; prints 120 char/line		

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Olivetti TC 308SH Time Sharing Terminal		Olivetti TC 349BI Buffered General Purpose Terminal		Omnitec Model 800 Portable Data Terminal
REPORT NUMBER		—		—		—
FUNCTION		Transmission/reception of alphanumeric data over public telephone network; keyboard/paper tape input; printer/punched tape output		Buffered terminal with 500-char message storage transmits/receives paper tape data in multidrop connection over voiceband line; keyboard data entry; printed copy output		Transmission/reception of alphanumeric data over voiceband line via acoustic coupler; keyboard entry; strip printer output
PREPARED INPUT	Medium	Punched tape		Punched tape		No provision
	Code	8-level USASCII		8-level USASCII		—
	Speed:					
	Char/sec	10		15		—
	Cards/min	—		—		—
MANUAL INPUT	Method of Entry	67-key keyboard		48-key alphanumeric keyboard; 10-key numeric keyboard		51-key keyboard
	No. of Char	Variable		Variable		Variable
OUTPUT	Medium	Printer	Punched tape	Printer	Punched tape	Strip printer
	Code	64 char	8-level USASCII	96 char	8-level USASCII	63 char
	Speed:					
	Char/sec	10	10	15	15	10
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Public telephone network		Voiceband		Voiceband
	Speed, bps	Up to 110		1200/2400		Up to 110
	Mode	Half-/full-duplex		Half-duplex		Half-/full-duplex
	Code	8-level USASCII		8-level USASCII		USASCII
	Timing	Asynchronous		Synchronous/asynchronous		Asynchronous
ERROR CONTROL		No provision		Char/longitudinal parity checking; automatic retransmission		Odd parity generation
MONTHLY RENTAL, $		75		188		49
COMMENTS		Standard features include off-line operation, keyboard interlock, automatic start/stop, 3/4/6 lines/in., 10 char/in. spacing, friction/pin feed; options include uppercase only, answer back, 80-char print line, numeric keyboard		Stand-alone terminal not requiring controller; can operate with local scanner to control 16 terminals on 1 drop; prints 120 char/line		Built-in coupler compatible with Bell System Data-Phone Data Set 103A2, Omnitec 703 Acoustic Coupler; originate only mode; prints on 0.5-in. paper strip; TTY 33/35-compatible; weighs 25 lb.; switch-selectable transmission modes

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Omnitec Model 800A Portable Data Terminal	Omnitec Model 805 Coupler-to-Tape Communications Subsystem	Omnitec Model 807 Tape-to-Coupler Communications Subsystem	Omnitec Model 812 Key-to-Tape/Coupler-to-Tape/Tape-to-Coupler Communications Subsystem	
REPORT NUMBER		—	—	—	—	
FUNCTION		Transmission/reception of alphanumeric data over voiceband line via acoustic coupler; keyboard entry; strip printer output	Reception of alphanumeric data to mag tape output over voiceband line via acoustic coupler	Transmission of mag tape data over voiceband line via acoustic coupler	Transmission/reception of keyboard/mag tape data over voiceband line via acoustic coupler; keyboard/mag tape entry; strip printer/mag tape output	
PREPARED INPUT	Medium	No provision	No provision	Magnetic Tape	Magnetic tape	
	Code	—	—	11-bit USASCII	11-bit USASCII	
	Speed:					
	Char/sec	—	—	10	10	
	Cards/min	—	—	—	—	
MANUAL INPUT	Method of Entry	51-key keyboard	No provision	No provision	52-key keyboard	
	No. of Char	Variable	—		Variable	
OUTPUT	Medium	Strip printer	Magnetic tape	No provision	Magnetic tape	Strip printer
	Code	88 char	11-bit USASCII	—	11-bit USASCII	63 char
	Speed:					
	Char/sec	15	10	—	10	10
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband	Voiceband	
	Speed, bps	134.5	Up to 300	Up to 300	Up to 300	
	Mode	Half-/full-duplex	Half-duplex	Half-duplex	Half-/full-duplex	
	Code	IBM Correspondence	7-level, 11-unit USASCII	7-level, 11-unit USASCII	7-level, 11-unit USASCII	
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous	
ERROR CONTROL		Odd parity generation	—	—	—	
MONTHLY RENTAL, $		58	69 (2-yr lease); 1490 (purchase)	69 (2-yr lease); 1490 (purchase)	163 (2-yr lease); 3500 (purchase)	
COMMENTS		Built-in coupler compatible with Bell System Data-Phone Data Set 103A2, Omnitec 703 Acoustic Coupler; originate/answer modes; prints on 0.5-in. strip paper; compatible with IBM 2741; switch-selectable transmission modes	Storage capacity of 36,000 char; originate only mode; compatible with Bell System Data Set 103A2; accepts data transmitted from Omnitec 807	Accepts mag tape cartridges prepared on Omnitec 805; originate-only mode; compatible with Bell System Data Set 103A2	Storage capacity of 36,000 char; on-/off-line mag tape recording capability; TTY 33/35-compatible; originate/answer modes; compatible with Bell System Data Set 103A; simultaneous printer/tape recording	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Omnitec Model 900 Conversational Data Terminal	Oneida Electronics Acousticom Series 33 Data Terminal		Peripheral Data Machines Magnyx 6600 Data Terminal	
REPORT NUMBER		—	—		—	
FUNCTION		Transmission/reception of alphanumeric data over voiceband line; keyboard entry; printed copy output	Transmission/reception of alphanumeric data over public telephone network via acoustic coupler; keyboard/paper tape input; paper tape/printed copy output		Transmission/reception of alphanumeric data over narrow-/voiceband line; keyboard/paper tape entry; printer/paper tape output	
PREPARED INPUT	Medium	No provision	Punched tape (ASR)		Punched tape	
	Code	—	8-level USASCII		8-level USASCII	
	Speed: Char/sec Cards/min	— —	10 —		10, 15, 30 —	
MANUAL INPUT	Method of Entry	58-key keyboard	45-key keyboard		63-key keyboard	
	No. of Char	Variable	Variable		Variable	
OUTPUT	Medium	Printer	Punched tape (ASR)	Printer	Punched tape	Printer
	Code	88 char	8-level USASCII	64 char	8-level USASCII	94 char
	Speed: Char/sec Cards/min	15 —	10 —	10 —	10, 15, 30 —	10, 15, 30 —
DATA TRANSMISSION	Line Type	Voiceband	Voiceband		Narrow-/voiceband	
	Speed, bps	134.5	Up to 300		Up to 110, 150, 300	
	Mode	Half-duplex	Half-/full-duplex		Half-/full-duplex	
	Code	7-level IBM Selectric	8-level USASCII		8-level USASCII	
	Timing	Asynchronous	Asynchronous		Asynchronous	
ERROR CONTROL		Parity checking	Even parity generation		Even char parity generation	
MONTHLY RENTAL, $		—	Purchase price; 1726-1919 (KSR) 1985-2655 (ASR)		Purchase price: 1020 (KSR) 1415 (ASR)	
COMMENTS		Compatible with IBM 735 Selectric Typewriter; programmed automatic terminal checking; interrupt capability; no longer in production	Modified TTY 33 KSR/ASR units with integral acoustic coupler; KSR includes keyboard/printer; ASR adds paper tape I/O; mobile/portable facilities available; operating modes are originate (260), originate/alternate transmission via dual input interface (262), originate/answer (300); pin feed, X-on/X-off optional; one 20-char answerback drum std		KSR includes keyboard/printer; ASR adds paper tape I/O wide carriage, 132-char print line, fixed 20-char WRU answerback message std; options include 10-key numeric cluster, pin feed, integral hard-wire data set, parallel interface; switch-selectable operating speeds, transmission modes	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Plessey PT200PT Data Transmission System	Plessey PT600/1200PT Mark III Data Transmission Terminal	Qantel V Terminal Processor		Philco-Ford Model D-20 Alphanumeric Color Display Unit
REPORT NUMBER		—	—	—		6650
FUNCTION		Low-speed transmission/reception of paper tape data over voiceband line	Medium-speed transmission/reception of paper tape data over voiceband line	Functions as stand-alone, small computer/remote data terminal; keyboard entry; paper tape I/O; printed copy output		4-color video display of data transmitted between D-20 and remote computer over voiceband line
PREPARED INPUT	Medium	Punched tape	Punched tape	Punched tape		No provision
	Code	Any 5- to 8-level code	Any 5- to 8-level code	Any 5-, 7-, 8-level code		—
	Speed:					
	Char/sec	18.2	50/100	50		—
	Cards/min	—		—		—
MANUAL INPUT	Method of Entry	No provision	No provision	IBM Selectric keyboard		53-key keyboard
	No. of Char	—	—	Variable up to 128		Up to 768
OUTPUT	Medium	Punched tape	Punched tape	Punched tape	Printer	Cathode ray tube
	Code	Any 5- to 8-level code	Any 5- to 8-level	Any 5-, 7-, 8-level code	88 char	60 char
	Speed:					
	Char/sec	18.2	50/100	50	15	10
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband		Voiceband
	Speed, bps	Up to 200	600 (50 cps); 1200 (100 cps)	75 to 4800		Up to 110
	Mode	Simplex/full-duplex	Simplex/full-duplex	Half-duplex		Half-duplex
	Code	Any 5- to 8-level code	Any 5- to 8-level code	Depends on adapter in central computer		8-level USASCII
	Timing	Asynchronous	Asynchronous	Synchronous/asynchronous		Asynchronous
ERROR CONTROL		Char parity checking; automatic retransmission	Char parity checking; automatic transmission	Vertical/longitudinal redundancy checking		Char/longitudinal parity checking manual correction
MONTHLY RENTAL, $		Purchases price: 2400 (transmitter); 3480 (receiver); 4925 (transmitter/ receiver)	Purchase Price: 3600 (transmitter); 4450 (receiver); 8050 (transmitter/receiver)	275 (per system); 85 (per additional work station)		7200 (purchase price)
COMMENTS		Automatic backspacing; tape copying in full-duplex mode; optional unattended operation with additional controller feature; can interface any processor via special adapter	Automatic answering unattended operation optional; Tally-compatible paper tape reader; TTY-compatible paper tape punch; switch-selectable odd/even parity checking	Transmission codes handled by microprograms supplied for most communications adapters; any modem up to 4800 bps can be used; can operate using most transmission codes available; switch-selectable timing; employs buffered, heavy duty IBM Selectric keyboard/printer; includes 128-char buffer; control via 1-μsec, MOS, 1024-word, read-only memory; additional 1024 char optional; 128-char print line; main magnetic core memory (3-μsec cycle) contains 4096 8-bit words, expandable to 8192 words		Single-station or rack-mounted unit; capable of intermixed display of data in red, green, blue, or white; optional 8-bit parallel I/O; compatible with Bell System Data-Phone Data Set 103A

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Philco-Ford Model D-21 Alphanumeric Display Unit	Raytheon DIDS-400 Digital Information Display System		Remcom Systems Model 2780 Remote Batch Terminal	
REPORT NUMBER		6651	6735		—	
FUNCTION		Video display of data transmitted between D-21 and remote computer over voiceband line	Video display/printed copy of alphanumeric data transmitted to/received from remote computer over voiceband line		Transmits data read from punched cards/prints data received from another terminal or remote computer over voiceband line	
PREPARED INPUT	Medium	No provision	No provision		Punched cards	
	Code	—	—		Hollerith	
	Speed:					
	Char/sec	—	—		—	—
	Cards/min	—	—		300 (2780-01)	600 (2780-02)
MANUAL INPUT	Method of Entry	65-key keyboard	60-key keyboard		No provision	
	No. of Char	Up to 1536	Up to 520, 1040, 1472		—	
OUTPUT	Medium	Cathode ray tube	Cathode ray tube	Printer	Printer	
	Code	62 char	64 char	64 char	63 char	
	Speed:					
	Char/sec	120	100,000	10	—	—
	Cards/min	—	—	—	400 lpm (2780-01)	600 lpm (2780-02)
DATA TRANSMISSION	Line Type	Voiceband	Voiceband (402)	Voiceband (401)	Voiceband	
	Speed, bps	Up to 1200	Up to 1200	2000/2400	2000-9600	
	Mode	Half-duplex	Half-duplex	Half-duplex	Half-/full-duplex	
	Code	8-level USASCII	8-level USASCII	8-level USASCII	8-level EBCDIC/USASCII	
	Timing	Asynchronous	Asynchronous	Synchronous/asynchronous	Synchronous	
ERROR CONTROL		Char/longitudinal parity checking; automatic retransmission	Optional char/longitudinal parity checking, automatic retransmission		Cyclic redundancy checking (EBCDIC) vertical/longitudinal redundancy checking (USASCII); automatic retransmission	
MONTHLY RENTAL, $		9200 (purchase price)	120-200 (display); 285-500 (controller); 100 (printer control); 30 or 52 (printer)		675 (2780-01)	1045 (2780-02)
COMMENTS		Single-station or rack-mounted unit developed from/compatible with IBM 2260; optional 8-bit parallel I/O; compatible with Bell System Data-Phone Data Set 103A	Multiple display/printer units are connected to central controller; independent display units with internal controller also available		Compatible with IBM 2780; basic system includes 400-char buffer, multiple record transmission, EBCDIC transparency, 132-position print line, 12-channel of vertical forms control; options include 1200-char buffer, horizontal tab, auto answer, multipoint line control	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		RCA 70/740 Data Terminal	RCA 70/750 Modular Video Data System		RCA 70/752 Video Data Terminal	
REPORT NUMBER		6704	6703		6702	
FUNCTION		Transmits data read from punched cards, prints data received over voiceband line	Video display/printed copy of alphanumeric data transmitted to/received from remote computer over voiceband line		Video display/printed copy of alphanumeric data transmitted to/received from remote computer over voiceband line	
PREPARED INPUT	Medium	Punched cards	No provision		No provision	
	Code	Hollerith	—		—	
	Speed:					
	Char/sec	—	—		—	
	Cards/min	300	—		—	
MANUAL INPUT	Method of Entry	No provision	66-key keyboard		48-key keyboard	
	No. of Char	—	Up to 1080		Up to 1134	
OUTPUT	Medium	Printer	Cathode ray tube	Printer	Printer	Cathode ray tube
	Code	64 char	96 char	96 char	64 char	64 char
	Speed:					
	Char/sec	300 lpm	4800	108	10	120
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband		Voiceband	
	Speed, bps	Up to 9600	2400		1200	
	Mode	Half-duplex	Full-duplex		Half-duplex	
	Code	8-level USASCII	8-level USASCII		8-level USASCII	
	Timing	Synchronous	Synchronous		Asynchronous	
ERROR CONTROL		Char/longitudinal parity checking; special block-count checking; validity checking; automatic retransmission	Char parity checking; manual retransmission		Char parity checking; manual retransmission	
MONTHLY RENTAL, $		695-760 (basic unit); 190 (card reader plus adapter)	97-179		110-170	
COMMENTS		2 models provide 80-/132-char print line; can operate in card-to-print, off-line mode; designed for operation with RCA Spectra 70 Series computers	Up to 8 display units connected to central controller		Each display unit independent, contains own control logic; up to 8 displays can be multiplexed on 1 line; 1 printer per display; replaces RCA 6051 Video Data Interrogator	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		RCA 70/653 Communication Control	Sangamo DS-7000 Series Data Station	Sangamo DS-9000 Series Data Station	Sycor 301/302 Key-Cassette Terminal	
REPORT NUMBER		6700	6750	6750	—	
FUNCTION		Connects RCA Spectra 70/15, 25, 35, 45, 55 computer to single voice/broadband line	Transmission/reception of mag tape data over voiceband line; keyboard entry	Transmission/reception of mag tape data over voiceband line; keyboard entry	Visual display, transmission/reception of mag tape cassette data over voiceband line; off-line key-to-tape data preparation	
PREPARED INPUT	Medium	Computer	Magnetic tape	Magnetic tape	Magnetic tape	
	Code	6-bit/ 8-bit	6-level BCD	8-level EBCDIC	8-level USASCII	
	Speed:					
	Char/sec	222-5100	6000-24, 000	24, 000	120 (asynchronous); 120/150 (synchronous)	
	Cards/min	—	—	—	—	
MANUAL INPUT	Method of Entry	No provision	49-key keyboard	49-key keyboard	85-key keyboard	
	No. of Char	—	Up to 80, 100, 240	Up to 80, 100, 120, 240	Variable up to 216 (read/write memory)	
OUTPUT	Medium	Computer	Magnetic tape	Magnetic tape	Magnetic tape	Cathode ray tube
	Code	6-bit/8-bit	6-level BCD	8-level EBCDIC	8-level USASCII	62 char
	Speed:					
	Char/sec	222-5100	6000-24, 000	24, 000	120/150	120/150
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voice/broadband	Voiceband	Voiceband	Voiceband	
	Speed, bps	2000, 2400, 40, 800	1200/1600	1200/1600	1200	
	Mode	Half-duplex	Half-duplex	Half-duplex	Half-duplex	
	Code	8-level/9-level	Modified BCD	Modified BCD	8-level USASCII	
	Timing	Synchronous	Synchronous	Synchronous	Asynchronous/synchronous	
ERROR CONTROL		Char/message parity checking; programmed retransmission	Char parity checking (validity/longitudinal); automatic retransmission	Char parity checking (validity/longitudinal); automatic retransmission	Char/message parity checking; automatic retransmission	
MONTHLY RENTAL, $		285	232-302	255-315	175-195	
COMMENTS		8-level transmission permits communication with RCA 301/3301 computers	100-char basic core storage; 7-channel mag tape I/O is IBM 729-compatible; off-line modes include data entry/verify, search, and program entry/verify; code employs 4 bits/numeric, 8 bits/nonnumeric; bit-by bit mag tape recording check	120-char basic core storage; 9-channel mag tape I/O is IBM 2400-compatible; off-line modes include data entry/verify, search, and program entry/verify; code employs 4 bits/numeric, 8 bits/nonnumeric; bit-by-bit mag tape recording check	Communications procedure uses IBM synchronous transmission procedure; unattended operation optional; master communications station interfaces remote terminals via manual dialing/recording or reading from 9- or 7-track tape; Model 302 includes second tape recorder (copying/pooling); cassette stores up to 180, 000 char (800 bpi); 350-char display capacity	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Sanders 620 Stand-Alone Data Display System		Sanders 720 Data Display System		
REPORT NUMBER		6744		6745		
FUNCTION		Video display/printed copy of alphanumeric data transmitted to/received from remote computer over voiceband line		Video display/printed copy of alphanumeric data transmitted to/received from remote computer over voiceband line; auxiliary paper tape I/O		
PREPARED INPUT	Medium	No provision		Punched tape		
	Code	—		8-level USASCII		
	Speed: Char/sec	—		10		
	Cards/min	—		—		
MANUAL INPUT	Method of Entry	51-key keyboard		42-key keyboard		
	No. of Char	Up to 768		Up to 256, 512, 1024		
OUTPUT	Medium	Cathode ray tube	Printer	Cathode ray tube	Punched tape	Printer
	Code	64 char	64 char	64 char	Any 5- to 8-level code	64 char
	Speed: Char/sec	300	10	47,500	10	10
	Cards/min	—	—			
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband	Voiceband	
	Speed, bps	Up to 100-1800	Up to 200/2400	Up to 110, 1000, 1200, 1800	2000/2400	
	Mode	Half-duplex	Half-duplex	Half-/full-duplex	Half-/full-duplex	
	Code	8-level USASCII	8-level USASCII	8-level USASCII	8-level USASCII	
	Timing	Asynchronous	Synchronous	Asynchronous	Synchronous	
ERROR CONTROL		Char/longitudinal parity checking automatic retransmission		Char/longitudinal parity checking; automatic retransmission		
MONTHLY RENTAL, $		180-301		100 (display); 20 (keyboard); 238-339 (control)		
COMMENTS		Printed copy via TTY 33/35 RO; controller interfaces max 1 display and 1 printer; up to 20 terminals can be multidropped on 1 line		Multiple display/auxiliary units connected to central controller; printed copy via TTY 33/35 RO; auxiliary units include TTY paper tape CX Reader/DRPE Punch; max 12 displays per controller; various multi-purpose keyboard configurations available; buffer capacity up to 1024, 2048, 3072 char		

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Scientific Control DCT-132 Programmable Remote Batch Terminal			Tally Parallel System 100, 102, 108 Senders	Tally Serial System 111 Sender
REPORT NUMBER		—			6760	6761
FUNCTION		High-speed transmission/reception, batch processing of data over voiceband line under control of stored program; punched card input/printed copy output std			Transmission of punched tape data over voiceband line	Transmission of punched tape data over voiceband line
PREPARED INPUT	Medium	Punched cards	Punched tape		Punched tape	Punched tape
	Code	Hollerith	8-level USASCII		Any 5- to 8-level code	Any 5- to 8-level code
	Speed:					
	Char/sec	—	10		60	120
	Cards/min	200	—		—	—
MANUAL INPUT	Method of Entry	53-key keyboard (TTY 33 ASR)			No provision	No provision
	No. of Char	Variable			—	—
OUTPUT	Medium	Printer	Punched	Punched tape	No provision	No provision
	Code	64 char	Hollerith	8-level USASCII	—	—
	Speed:					
	Char/sec	—	—	10	—	—
	Cards/min	300 lpm	100	—	—	—
DATA TRANSMISSION	Line Type	Voiceband			Voiceband	Voiceband
	Speed, bps	2000/2400/4800/9600 bps			480 (60 cps)	Up to 1200
	Mode	Half-/full-duplex			Simplex	Half-duplex
	Code	Any 8-level code			Any 5- to 8-level code	Any 5- to 8-level code
	Timing	Synchronous			Receiver activated by each data group	Asynchronous
ERROR CONTROL		Longitudinal parity/cyclic redundancy checking			Error signaling via reverse channel 108; automatic retransmission (108)	Automatic retransmission
MONTHLY RENTAL, $		Purchase price: 21,000 (basic unit); 1900 (TTY33 ASR); 6200 (paper tape reader/punch); 10,000 (card punch)			27-80 (depending on model/options)	160-260 (depending on special features)
COMMENTS		Basic unit includes line printer, card reader, 2000/2400/4800-bps data set interface; off-line capability includes data conversion between any combination of I/O media; stored program can emulate CDC 200, Univac DCT 2000/1004/9200, IBM 2780 (USASCII/EBCDIC); terminal controller includes 21-instruction set, 2K/4K-byte core storage, 32-byte read-only memory; basic memory of 2048 8-bit core locations expandable to 4096; can be configured as data concentrator/data set to terminate up to 32 low-speed (110-bps) lines; prints 132 char/line; operates in edit/list modes			Systems 102 and 108 capable of unattended operation; transmission is 8-bit parallel	Capable of unattended operation; compatible with Tally 211, 311, 1021, 4031 terminals

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Tally Parallel System 120, 122, 128 Senders	Tally Parallel System 200 and 228 Receivers	Tally Serial System 211 Receiver	Tally 1021 Data Terminal	
REPORT NUMBER		6760	6760	6761	6762	
FUNCTION		Transmission of punched tape data over voiceband line	Reception of punched tape data over voiceband line	Reception of punched tape data over voiceband line	Transmission/reception of alphanumeric data over voiceband line; mag tape/paper tape input; mag tape/printer output; keyboard data entry	
PREPARED INPUT	Medium	Punched tape	No provision	No provision	Magnetic tape	Punched tape
	Code	Any 5- to 8-level code	—	—	Any 5- to 8-level code	Any 5- to 8-level code
	Speed: Char/sec	72	—	—	120/1600	120
	Cards/min	—	—	—	—	—
MANUAL INPUT	Method of Entry	No provision	No provision	No provision	53-key keyboard	
	No. of Char	—	—	—	Variable	
OUTPUT	Medium	No provision	Punched tape	Punched tape	Magnetic tape	Printer
	Code	—	Any 5- to 8-level code	Any 5- to 8-level code	Any 5- to 8-level code	64 or 88 char
	Speed: Char/sec	—	60 (200)/72 (228)	120	120/1600	15.5
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband	Voiceband	
	Speed, bps	576 (72 cps)	Up to 480 (200)/576 (228)	1200	Up to 1200	
	Mode	Simplex	Simplex	Half-duplex	Half-duplex	
	Code	Any 5- to 8-level code	Any 5- to 8-level code	Any 5- to 8-level code	Any 5- to 8-level, 10-unit code	
	Timing	Receiver is activated by each data group	Receiver activated by each data group	Asynchronous	Asynchronous	
ERROR CONTROL		Error signaling via reverse channel (128); automatic retransmission (128)	Char parity checking; request retransmission via reverse channel (228)	Char parity checking; request retransmission	Char parity checking; automatic retransmission	
MONTHLY RENTAL, $		27-80 (depending on model/options)	105-240 (depending on model/options)	280-370 (depending on special features)	200 (basic unit); 75-90 (communications adapters); 60-120 (I/O options)	
COMMENTS		Systems 122 and 128 capable of unattended operation; transmission is 8-bit parallel	System 228 can receive unattended/start remote unattended sender; reception is 8-bit parallel	Can receive unattended/start a remote unattended sender; option permits data reception from Tally parallel sender	Input, transmission, output operations performed separately via a removable internal mag tape buffer; optional 360 communications buffer provides direct computer interface for Model 1021 Terminal, all options	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Tally Serial System 311 Sender/Receiver	Tally System 4031 Data Terminal	Technitrend RP 2800 Transmitter/Printer Terminal		Technitrend TT 3100 Portable Data Terminal
REPORT NUMBER		6761	—	—		—
FUNCTION		Transmission/reception of punched tape data over voiceband line	Receives/records data on mag tape, reads/transmits mag tape data over voiceband line	Keyboard entry of variable numeric/control data over voiceband line to remote voice response/computer system; audio reply/printed alphanumeric output		Remote, portable, keyboard entry of variable numeric/control data to voice response/computer system over voiceband line via acoustic coupler
PREPARED INPUT	Medium	Punched tape	Magnetic tape	No provision		No provision
	Code	Any 5- to 8-level code	Any 5- to 8-level code	—		—
	Speed:					
	Char/sec	120	72/120	—		—
	Cards/min	—	—	—		—
MANUAL INPUT	Method of Entry	No provision	No provision	16-key Touch-Tone keyboard		16-key Touch-Tone keyboard
	No. of Char	—	—	Variable		Variable
OUTPUT	Medium	Punched tape	Magnetic tape	Voice/tone response	Printer	Voice/tone response
	Code	Any 5- to 8-level code	Any 5- to 8-level code	—	64 char	—
	Speed:					
	Char/sec	120	72/120	—	10	—
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband	Voiceband	Voiceband
	Speed, bps	1200	1200	80	110	80
	Mode	Half-duplex	Half-duplex	Half-duplex	Half-duplex	Half-duplex
	Code	Any 5- to 8-level code	Any 5- to 8-level, 10-unit, code	2-of-8	11-unit USASCII	2-of-8
	Timing	Asynchronous	Asynchronous	Receiver activated by each data group	Asynchronous	Receiver activated by each data group
ERROR CONTROL		Char parity checking when receiving; automatic retransmission	Char/longitudinal parity checking; automatic retransmission	No provision		No provision
MONTHLY RENTAL, $		400-675 (depending on special features)	900 (basic unit); 1020 (includes all options)	65; 1600 (purchase price)		350 (purchase only)
COMMENTS		Can receive unattended/start a remote unattended sender; option permits data reception from Tally parallel sender	Recording density can be selected at 200, 556, 800 bpi on 7-track tape, or 800 bpi on 9-track tape; read/record rates determined by data set interface	Designed to operated with computer-controlled voice response system; Touch-Tone pad generates 10-digit numeric data plus 6 special function codes; line interface compatible with Bell System Data Sets 401A/401E; TTY 33 RO prints 72-char line; operates over leased line/public switched network; basic unit includes keyboard/printer, integral speaker, data set interface		AC operated, portable unit designed to operate with computer-controlled voice response system; weighs 7.5 lb; consists of keyboard, integral acoustic coupler, speaker, carrying case; Touch-Tone pad generates 10-digit numeric data plus 6 special function codes; 2-of-8 tones compatible with Bell System 403 Data Set

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Teletype Telespeed 750 Equipment	Teletype Telespeed 1050 Equipment	Teletype Telespeed 1200 EDC Equipment	Teletype Model 28	
REPORT NUMBER		6801	6800	6799	6802	
FUNCTION		Transmission/ reception of punched tape data over voiceband line	Transmission/reception of punched data over voiceband line	Transmission/reception of punched tape data over voiceband line	Transmission of manually keyed/punched tape data over telegraph-grade line; paper tape/ printed copy output	
PREPARED INPUT	**Medium**	Punched tape	Punched tape	Punched tape	Punched tape	
	Code	Any 5- to 8-level code	Any 5- to 8-level code	Any 5- to 8-level code	5-level Baudot	
	Speed:					
	Char/sec	75	105	120	10	
	Cards/min	—	—	—	—	
MANUAL INPUT	**Method of Entry**	No provision	No provision	No provision	32-key keyboard	
	No. of Char	—	—	—	Variable	
OUTPUT	**Medium**	Punched tape	Punched tape	Punched tape	Punched tape	Printer
	Code	Any 5- to 8-level code	Any 5- to 8-level code	Any 5- to 8-level code	5-level Baudot	62 char
	Speed:					
	Char/sec	75	105	120	10	10
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	**Line Type**	Voiceband	Voiceband	Voiceband	Telegraph-grade	
	Speed, bps	600	Up to 1050	Up to 1200	Up to 45, 56, 75	
	Mode	Half-duplex	Half-/full-duplex	Half-duplex	Half-/full-duplex	
	Code	Any 5- to 8-level code	Any 5- to 8-level code	Any 5- to 8-level code	5-level Baudot	
	Timing	Receiver activated by each data group	Asynchronous	Asynchronous	Asynchronous	
ERROR CONTROL		No provision except detection of line break	No provision except detection of line break	2 check char per block; read-after-punch check; automatic retransmission	No provision	
MONTHLY RENTAL, $		See Comments/TTY Comparison Chart, Page 4210:02	See Comments/TTY Comparison Chart, Page 4210:02	See Comments/TTY Comparison Chart Page 4210:02	See Comments/TTY Comparison Chart, Page 4210:01	
COMMENTS		Available for lease from the Bell System as Data-Speed Type 5 Service; available from Teletype on purchase basis only	Available for lease from Bell System as Data-Speed Type 2 Service; available from Teletype on purchase basis only	Available for lease from the Bell System as Data-Speed Type 4 Service; available from Teletype on purchase basis only	RO set has printer; KSR set adds keyboard; ASR set adds punched tape I/O; leased from common carrier; purchased from Teletype; designed for heavy-duty use	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Teletype Model 32		Teletype Model 33		Teletype Model 37
REPORT NUMBER		6803		6804		6806
FUNCTION		Transmission of manually-keyed/punched tape data over telegraph-grade line; paper tape/ printed copy output		Transmission of manually-keyed/punched tape data over telegraph-grade line; paper tape/ printed copy output		Transmission of manually-keyed data over narrowband line
PREPARED INPUT	Medium	Punched tape		Punched tape		No provision
	Code	5-level Baudot		8-level USASCII		—
	Speed:					
	Char/sec	10		10		—
	Cards/min	—		—		—
MANUAL INPUT	Method of Entry	32-key keyboard		45-key keyboard		Keyboard
	No. of Char	Variable		Variable		Variable
OUTPUT	Medium	Punched tape	Printer	Punched tape	Printer	Printer
	Code	5-level Baudot	62 char	8-level USASCII	80 char	128 char
	Speed:					
	Char/sec	10	10	10	10	15
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Telegraph-grade		Narrowband		Narrowband
	Speed, bps	Up to 45, 56, 75		Up to 110		Up to 15 cps
	Mode	Half-/full-duplex		Half-/full-duplex		Half-duplex
	Code	5-level Baudot		8-level USASCII		8-level USASCII
	Timing	Asynchronous		Asynchronous		Asynchronous
ERROR CONTROL		No provision		No provision		Char parity checking optional
MONTHLY RENTAL, $		See Comments/TTY Comparison Chart, Page 4210:01		See Comments/TTY Comparison Chart, Page 4210:01		1646-2057 (RO); 1900-2268 (KSR); 3300-3818 (ASR)
COMMENTS		RO set has printer; KSR set adds keyboard; ASR set adds punched tape I/O; leased from common carrier; purchased from Teletype; designed for light-duty use		RO set has printer; KSR set adds keyboard; ASR set adds punched tape I/O; leased from common carrier; purchased from Teletype; designed for light-duty use		Purchase-only from Teletype; leased from common carrier; RO set has printed; KSR set adds keyboard; ASR set adds punched tape I/O; designed for heavy-duty use

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Teletype Model 35		Teletype Inktronic RO/KSR Set	Terminal Communications TC Model 10 Data Terminal	Terminal Communications TC Model 22 Mark Read Card Terminal
REPORT NUMBER		6805		6808	—	—
FUNCTION		Transmission of manually-keyed/punched tape data over telegraph-grade line; paper tape/printed copy output		Nonimpact printing of data received from computer/entered at keyboard while transmitting (KSR)	Transmission of keyed numeric data from Touch-Tone-type keyboard over voiceband line via acoustic coupler	Transmission of punched/mark-sense card data over voiceband line to any BCD-compatible receiver
PREPARED INPUT	Medium	Punched tape		No provision	No provision	Punched/bar-coded cards
	Code	8-level USASCII		—	—	Hollerith (numeric/special char)
	Speed:					
	Char/sec	10		—	—	15 or 30
	Cards/min	—		—	—	—
MANUAL INPUT	Method of Entry	45-key keyboard		64-key keyboard	12-key Touch-Tone keyboard	No provision
	No. of Char	Variable		Variable	Variable	—
OUTPUT	Medium	Punched tape	Printer	Printer	Audio response via telephone handset	No provision
	Code	8-level USASCII	80 char	10-unit Baudot (RO); 10-unit USASCII (RO/KSR)	—	—
	Speed:					
	Char/sec	10	10	Up to 120	—	—
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Narrowband		Voiceband	Public telephone network	Voiceband
	Speed, bps	Up to 110		Up to 1200 (depends on data set)	12-20 cps (depends on receiving modem)	Up to 300
	Mode	Half-/full-duplex		Simplex (RO); half-duplex (KSR)	Half-duplex	Half-duplex
	Code	8-level USASCII		10-unit Baudot (RO); 10-unit USASCII (RO/KSR)	2-of-8	IBM BCD
	Timing	Asynchronous		Asynchronous	Receiver activated by each data group	Asynchronous
ERROR CONTROL		No provision		Even char parity generation (KSR)	No provision	Parity generation
MONTHLY RENTAL, $		See Comments/TTY Comparison Chart, Page 4210:02		Purchase price: 5450 (RO, serial); 5300 (RO, parallel); 5800 (KSR)	165 (purchase)	Purchase price: 1275 (external modem); 1525 (internal modem)
COMMENTS		RO set has printer; KSR set adds keyboard; ASR set adds punched tape I/O; leased from common carrier; purchased from Teletype; designed for heavy-duty use		80 char/line std; 70 char/line optional; char repertoire stored in memory, can be replaced in field; unrestricted message format; each char printed as received	Portable, battery-powered unit; designed for numeric order entry/status, inquiry applications; data entry via acoustic coupling; handset audio response output	Can be used in conjunction with IBM 2740/41 Systems; 40-char per card max; interfaces Bell System Data Set 103

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Texas Instruments Series 720 Electronic Data Terminal Model 10		Texas Instruments Series 720 Electronic Data Terminal Model 15	Texas Instruments Series 720 Electronic Data Terminal Model 20	
REPORT NUMBER		—		—	—	
FUNCTION		IBM-compatible, inquiry/response, nonimpact, PTT/BCD printer with buffer memory and serial data set interface; optional paper tape I/O		IBM-compatible, I/O nonimpact PTT/BCD printer with serial data set interface	Keyboard, send/receive, nonimpact USASCII printer with serial data set interface; optional paper tape I/O	
PREPARED INPUT	**Medium**	Punched tape		No provision	Punched tape	
	Code	6-level PTT/BCD		—	7-level USASCII	
	Speed:					
	Char/sec	10, 15, 30		—	10, 15, 30	
	Cards/min	—		—	—	
MANUAL INPUT	**Method of Entry**	54-key keyboard		53-key keyboard	60-key keyboard	
	No. of Char	25, 32, 100		Variable	Variable/up to 21	
OUTPUT	**Medium**	Printer	Punched	Printer	Printer	Punched tape
	Code	86 char	6-level PTT/BCD	86 char	95 char	7-level USASCII
	Speed:					
	Char/sec	14.8	10, 15, 30	14.8	10, 15, 30	10, 15, 30
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	**Line Type**	Voiceband		Voiceband	Voiceband	
	Speed, bps	Up to 300		Up to 300	110, 150, 300	
	Mode	Half-duplex		Half-duplex	Simplex	
	Code	6-level PTT/BCD		6-level PTT/BCD	7-level, 10-/11-unit USASCII	
	Timing	Asynchronous		Asynchronous	Asynchronous	
ERROR CONTROL		Char/message parity checking		Odd char parity generation	No provision	
MONTHLY RENTAL, $		141 (KSR); 62 (paper tape) Purchase: 2984 (KSR); 1175 (paper tape)		2020 (purchase); 107 (lease)	(109 KSR); 62 (paper tape) Purchase: 2275 (KSR) 1175 (paper tape)	
COMMENTS		Auxiliary parallel input printing at 30/40 cps; 80-char print line; modular paper tape I/O unit; compatible with IBM 1050; poll/address environment; plug-in data set cards		Line interrupt capability; plug-in data set cards; optional 30-/40-cps transmission/printing; comparable to IBM 2741; initiates transmission only; time sharing applications	Switch-selectable operating speeds; optional 40-cps transmission/printing; plug-in data set cards; 80-char print line; EIA std interface; uses 10-unit char code above 10 cps	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Texas Instruments Series 720 Electronics Data Terminal Model 21	Texas Instruments Series 720 Electronic Data Terminal Model 22	Texas Instruments Series 720 Electronic Data Terminal Model 23	Texas Instruments Series 720 Electronic Data Terminal Model 30	
REPORT NUMBER		—	—	—	—	
FUNCTION		Receive-only, non-impact USASCII printer with serial data set interface	Receive-only, non-impact USASCII printer with parallel data interface	Keyboard, send/receive, nonimpact USASCII printer with parallel data interface	Keyboard, send/receive, nonimpact USASCII printer with serial dc-signal interface	
PREPARED INPUT	Medium	No provision	No provision	No provision	Punched tape	
	Code	—	—	—	7-level USASCII	
	Speed:					
	Char/sec	—	—	—	10, 15, 30	
	Cards/min	—	—	—	—	
MANUAL INPUT	Method of Entry	No provision	No provision	60-key keyboard	60-key keyboard	
	No. of Char	—	—	Variable/up to 21	Variable/up to 21	
OUTPUT	Medium	Printer	Printer	Printer	Printer	Punched tape
	Code	95 char	95 char	95 char	95 char	7-level USASCII
	Speed:					
	Char/sec	10, 15, 30	Up to 40	Up to 40	10, 15, 30	10, 15, 30
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband	Narrow/voiceband	
	Speed, bps	110, 150, 300	Up to 400	Up to 400	Up to 110, 150, 300	
	Mode	Simplex	Simplex; receive only	Simplex	Half-/full-duplex	
	Code	7-level, 10-/11-unit USASCII	7-level USASCII	7-level USASCII	7-level, 11-unit USASCII	
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous	
ERROR CONTROL		No provision	No provision	No provision	Even char parity generation	
MONTHLY RENTAL, $		109; 2275 (purchase)	106; 2188 (purchase)	111; 2317 (purchase)	120 (KSR); 62 (paper tape) Purchase: 2580 (KSR); 1175 (paper tape)	
COMMENTS		Switch-selectable operating speeds; optional 40-cps transmission/printing; plug-in data set cards; 80-char line; EIA std interface; uses 10-unit char code above 10 cps	Data format parallel by bit, serial by char; lowercase optional; 80-char print line; vertical spacing 6 lines/in.; similar in operation to Model 21	Data format parallel by bit, serial by char; lowercase optional; 80-char print line; 21-char memory optional; KSR version of Model 22	Auxiliary I/O, parallel by bit, serial by char; 15-/30-cps speeds optional; includes TTY interface; full-duplex and 21-char memory optional; line interrupt capability	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Texas Instruments Series 720 Electronic Data Terminal Model 31	Time-Sharing Terminals TST 33 Data Terminal		Time-Sharing Terminals TST Terminet 300 Data Terminal	
REPORT NUMBER		—	—		—	
FUNCTION		Receive-only, non-impact USASCII printer with serial dc-signal interface	Transmission/reception of alphanumeric data over narrow/voiceband line to remote computer		Transmission of keyboard/paper tape input; reception of data to paper tape/printed copy output over voiceband line	
PREPARED INPUT	Medium	No provision	Punched tape		Punched tape (ASR)	
	Code	—	8-level USASCII		7-level USASCII	
	Speed:					
	Char/sec	—	10		10, 15, or 30	
	Cards/min	—	—		—	
MANUAL INPUT	Method of Entry	No provision	45-key keyboard		61-key keyboard	
	No. of Char	—	Variable		Variable	
OUTPUT	Medium	Printer	Printer	Punched tape	Printer	Punched tape (ASR)
	Code	95 char	80 char	8-level USASCII	94 char	7-level USASCII
	Speed:					
	Char/sec	10, 15, 30	10	10	10, 15, 30	10, 15, 30
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Narrow/voiceband	Narrow/voiceband		Voiceband	
	Speed, bps	Up to 110, 150, 300	Up to 110		Up to 110, 150, 300	
	Mode	Simplex	Half-/full-duplex		Half-/full-duplex	
	Code	7-level, 11-unit USASCII	8-level USASCII		7-level USASCII	
	Timing	Asynchronous	Asynchronous		Asynchronous	
ERROR CONTROL		No provision	No provision		Char parity checking; manual retransmission	
MONTHLY RENTAL, $		111; 2306 (purchase);	60 (KSR); 70 (ASR); 20 (coupler)		155 (KSR)	
COMMENTS		TTY, type II interface; 15-/30-cps operation optional; plug-in data set cards; compatible with Bell System Data Set 103F2; 80-char print line; lowercase optional	Modified TTY 33 KSR/ASR; paper tape reader/punch optional; automatic X-on/X-off control codes; prints 72 char/line (10 char/in.); includes 21-char WRU answerback message; automatic CR/LF; KSR includes keyboard/printer; ASR adds paper tape I/O; acoustic coupler, pin feed platen optional		Modified GE Terminet 300; switch-selectable operating speeds; includes fixed 20-char WRU answerback message; prints 118 char/line; switch-selectable uppercase/full USASCII char modes; local/remote horizontal tab; rollover keyboard; KSR includes keyboard/printer; ASR option no longer available	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Tracor Computing TCC-1601 Character Printer	TransCom CPI-203 Card Punch	TransCom PTP-203 Paper Tape Punch	TransCom PTR-203 Paper Tape Reader	TransCom RCT-203 Strip Printer
REPORT NUMBER		—	—	—	—	—
FUNCTION		Transmission/reception of alphanumeric data over narrow/voiceband line; keyboard entry; printed copy output	Reception of Touch-Tone-coded data over voiceband line to punched card output	Reception of Touch-Tone-coded data over voiceband line to paper tape output	Transmission of paper tape data over voiceband line	Verified transmission/reception of digital data over public telephone network
PREPARED INPUT	Medium	No provision	No provision	No provision	Punched tape	No provision
	Code	—	—	—	8-level USASCII	—
	Speed:					
	Char/sec	—	—	—	10 or 20	—
	Cards/min	—	—	—	—	—
MANUAL INPUT	Method of Entry	64-/53-key keyboard	No provision	No provision	No provision	16-key numeric keyboard
	No. of Char	Variable	—	—	—	Variable
OUTPUT	Medium	Printer	Punched cards	Punched tape	No provision	Strip printer
	Code	64 char	Hollerith	8-level USASCII	—	16 char
	Speed:					
	Char/sec	10 or 15	15	20	—	10
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Narrowband/voiceband	Voiceband	Voiceband	Voiceband	Voiceband
	Speed, bps	Up to 110 or 150	15 cps	20 cps	80 or 160	10 cps
	Mode	Half-/full-duplex	Half-duplex	Simplex; receive only	Simplex; send only	Half-duplex
	Code	8-level, 11-unit USASCII	2-of-8	2-of-8	2-of-8	2-of-8
	Timing	Asynchronous	—	—	—	—
ERROR CONTROL		Parity generation/checking	Undetected signal character; audible answerback	No provision	No provision	Undetectable signal char; manual retransmission
MONTHLY RENTAL, $		2000 (purchase price)	30	30	33	30
COMMENTS		Parallel I/O interface std; serial interface optional; 80-char print line; TTY 33/35 KSR-compatible; typewriter keyboard; 12 char/in., 6 lines/in. spacing; options include horiz/vert tab, fixed 21-char WRU answerback message	Can be driven by Touch-Tone phone/RCT-203 Strip Printer; uses IBM 029 Card Punch	Can be driven by Touch-Tone phone/RCT-203 Strip Printer	Can drive paper tape punch/RCT-203 Strip Printer; uses GE photoelectric tape reader	Can drive/receive from other Touch-Tone-compatible equipment

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Univac DCS-1 Data Communications Subsystem	Univac DCS-1C Binary Synchronous Data Communication Subsystem	Univac DCS-4/DCS-16 Data Communication Subsystem		
REPORT NUMBER		6865	—	—		
FUNCTION		Connects a Univac 9200/9300 computer system to single voice/broadband line	Permits UNIVAC 9000 Series processors to communicate with IBM Binary Synchronous Communication equipment	Connects Univac 9000 Series processors to multiple narrow/voice/broadband lines		
PREPARED INPUT	Medium	No provision	9000 Series processors	No provision		
	Code	—	—	—		
	Speed: Char/sec	—	—	—		
	Cards/min	—	—			
MANUAL INPUT	Method of Entry	No provision	9000 Series processors	No provision		
	No. of Char	—	—	—		
OUTPUT	Medium	No provision	9000 Series processors	No provision		
	Code	—	—	—		
	Speed: Char/sec	—	—	—		
	Cards/min	—	—	—		
DATA TRANSMISSION	Line Type	Voice/broadband	Voice/broadband	Narrowband	Voiceband	Broadband
	Speed, bps	2000/2400 (voiceband) 50,000 (broadband)	1200-230,400	50; 45-300; 110/150	300-1800; 1200-4800	18,750-250,000
	Mode	Half-duplex	—	Full-duplex	Full-duplex	Full-duplex
	Code	Any 5- to 8-level code	EBCDIC/USASCII	5- to 8-level; Baudot; USASCII	5- to 8-level	5- to 8-level
	Timing	Synchronous	Synchronous	Asynchronous	Synchronous/asynchronous	Synchronous
ERROR CONTROL		Char parity checking; automatic retransmission	Operator/message parity; character recognition; programmed message coding/retransmission	Char/message parity checking; programmed retransmission		
MONTHLY RENTAL, $		212 (1-yr lease); 184 (5-yr lease)	300 (does not include 9000 Processor)	370-660 (DCS-4); 1115-1990 (DCS-16)		
COMMENTS		Up to 2 DCS-1's can be incorporated in Univac 9200/9300 computer system; internally connected to optional multiplexor channel	Includes programmable transmission code selection automatic dialing; station selection/polling capability; automatic answering	DCS-4 connects up to 4 lines; DCS-16 connects up to 16 lines; any combination of speeds/codes can be used; DCS-4 provides interface for up to 8 full-duplex lines to Univac 9200/9300 Systems; Univac 9400 system can accommodate up to 64 full-duplex lines via multiple DCS-4/DCS-16 subsystems; DCS contains line terminal controller, line terminal for each line, communications interface; DCS connects to central processor via multiplexor channel		

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Univac DCT-500		Univac DCT-1000		
REPORT NUMBER		—		—		
FUNCTION		Remote I/O Terminal receives/data from/transmits data to computer/another I/O terminal; multipoint terminal-to-computer/terminal-to-terminal operation; keyboard/punched tape input; punched tape/printed copy output		Remote, buffered I/O terminal receives data from/transmits data to remote/local computer in batch/conversational mode keyboard/punched card/punched tape input; punched card/punched tape/printed copy output		
PREPARED INPUT	**Medium**	Punched tape		Punched cards	Punched tape	
	Code	5-, 6-, or 8-level USASCII		Hollerith/binary	5-, 6-, or 8-level USASCII	
	Speed:					
	Char/sec	30		—	50	
	Cards/min	—		35	—	
MANUAL INPUT	**Method of Entry**	Keyboard		Keyboard		
	No. of Char	On demand		On demand		
OUTPUT	**Medium**	Punched tape	Printer	Punched cards	Punched tape	Printer
	Code	5-, 6-, or 8-level USASCII	63 char	Hollerith/binary	5-, 6-, or 8-level USASCII	63 char
	Speed:					
	Char/sec	30	30	—	50	30
	Cards/min	—	—	40	—	—
DATA TRANSMISSION	**Line Type**	Voiceband		Voiceband		
	Speed, bps	100, 150, or 300		300, 1200, 1800 (async); 2000, 2400, 4800 (sync)		
	Mode	Half-/full-duplex		Half-/full-duplex		
	Code	8-level USASCII		8-level USASCII		
	Timing	Asynchronous		Asynchronous/synchronous		
ERROR CONTROL		Even char parity checking		char/message parity checking; automatic retransmission; even char parity (asynchronous)/odd char parity (synchronous)		
MONTHLY RENTAL, $		80-90 (RD); 90-100 (KSR); 174-180 (ASR)		140 (KSR); 35 (multiplexor)		
COMMENTS		No charge for selection of print wheels; internal 300 bps modem optional; keyboard control keys provided; keyboard generates full 128-char USASCII set; prints 132 char positions; switch-selectable data rates		Multiplexor accommodates up to 31 terminals with I/O devices; interfaces for data sets, direct connection, or computer via I/O or multiplex channel; operates in point-to-point/multipoint configurations; prints 132 char positions; keyboard generates full 128-char USASCII set		

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Univac Uniscope 300 Visual Communication Terminal	Univac 1004 Card Processor			
REPORT NUMBER		6864	6860			
FUNCTION		Video display of alphanumeric data transmitted to/received from computer	Compact, plugboard-programmed computer; transmits/receives data over single voiceband line; can be used as remote terminal with most Univac computer systems; punched card/punched tape/mag tape I/O; printed copy output			
PREPARED INPUT	**Medium**	No provision	Punched tape	Punched cards	Magnetic tape	
	Code	—	Any 5- to 8-level code	Hollerith/90-col code	Any 6-bit code	
	Speed:					
	Char/sec	—	400	—	Up to 33, 664	
	Cards/min	—	—	400 or 615	—	
MANUAL INPUT	**Method of Entry**	51-key keyboard; 5/40 optional keys	Console switches			
	No. of Char	Up to 512/1024	Limited			
OUTPUT	**Medium**	Cathode ray tube	Punched tape	Punched cards	Magnetic tape	Printer
	Code	56 char; 61/96 optional	Any 5- to 8-level code	Hollerith/90-col code	Any 6-bit code	63 char
	Speed:					
	Char/sec	250 or 300	110	—	Up to 33, 664	600 lpm
	Cards/min	—	—	200	—	—
DATA TRANSMISSION	**Line Type**	Voiceband	Voiceband (switched/leased)			
	Speed, bps	2000; other rates on request	2000 (switched); 2400 (leased)			
	Mode	Half-/full-duplex	Half-duplex			
	Code	Modified 8-level USASCII	6-bit image of memory plus 1 or 2 bits (depending on model)			
	Timing	Synchronous	Synchronous			
ERROR CONTROL		Char/longitudinal parity checking; automatic retransmission	Char validity on card input; hole-count check on card output; char/longitudinal parity checking on mag tape I/O; char/message parity on transmissions; programmed retransmission			
MONTHLY RENTAL, $		410-490 (single station); 135-215 (display); 850-1155 (controller)	1350-1475 (including card reader, printer, communications adapter); additional peripheral devices rent for 150 to 500 each			
COMMENTS		Up to 4 multiple display stations can be connected to central controller; polled environment; 4 control expansion units accommodate 20 additional displays	Different models have varying numbers of program steps, plugboard facilities, I/O capabilities; adapters for connection to broadband line available on special request; limited production equipment subject to availability; supplied on purchase or long-term lease agreement only			

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Univac DCT-2000			Univac Communication Terminal Synchronous	Univac Word Terminal Synchronous
REPORT NUMBER		6863			6862	6861
FUNCTION		Remote terminal for many Univac computers; transmission of data over voiceband line; punched card/punched tape input; punched card/ punched tape/printer output			Connects wide range of Univac computers to single voice/broadband line	Connects wide range of Univac computers to single voice/broadband line
PREPARED INPUT	Medium	Punched cards	'Punched tape		Computer	Computer
	Code	Hollerith	Any 5- to 8-level code		Any 5- to 8-level code plus parity	Any 6-level code plus parity
	Speed: Char/sec	—	300		222-6800	285-5800
	Cards/min	200	—		—	—
MANUAL INPUT	Method of Entry	No provision			No provision	No provision
	No. of Char	—			—	—
OUTPUT	Medium	Punched cards	Punched tape	Printer	Computer	Computer
	Code	Hollerith	Any 5- to 8-level code	63 char	Any 5- to 8-level code plus parity	Any 6-level code plus parity
	Speed: Char/sec	—	110	250 lpm	222-6800	285-5800
	Cards/min	75 to 200	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband			Voice/broadband	Voice/broadband
	Speed, bps	2000/2400			2000/2400 (voice); 40, 800 (broad)	2000/2400 (voice); 40, 800 (broad)
	Mode	Half-duplex			Half-duplex	Half-duplex
	Code	8-level USASCII/7-level XS-3			Any 5- to 8-level code plus parity	Any 6-level code plus parity
	Timing	Synchronous			Synchronous	Synchronous
ERROR CONTROL		Control char validity checking; char/message parity checking; automatic retransmission			Char parity checking; programmed retransmission	Char/message parity checking; programmed retransmission
MONTHLY RENTAL, $		390-1246 (depending on control unit model, I/O devices, optional features			600 to 710 (depending on special features)	700-855 (depending on computer/special features)
COMMENTS		Basic terminal does not include card read/punch or error control features; available with USASCII Control Unit; control unit contains two 128-char buffers; message lengths selectable at 80/128 char; options include 128-char print line, printer form control, card code translator/print bar, select remote output device, peripheral I/O channel (up to 4 additional devices), unattended answering, off-line listing, transmit/receive monitor via simultaneous printing			Options permit unattended operation/automatic dialing; places higher demand on processor than the Word Terminal Synchronous model	Options permit unattended operation/programmed automatic dialing over public telephone network

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Universal Data Acquisition Model 5400 Data Transmitter	Universal Data Acquisition Model 5450 Data Transmitter	Universal Data Acquisition Model 5800 Twindek Batch Terminal	Typagraph Model 0 Printer Terminal	
REPORT NUMBER		—	—	—	—	
FUNCTION		Reads/transmits mag tape data over voice-band lines	Reads/transmits mag tape data over voice-band lines	Adds high-speed I/O batch processing capability to TTY 33/35 ASR/KSR	Transmission/reception of alphanumeric data over voiceband lines; keyboard/paper tape entry; printer/paper tape output	
PREPARED INPUT	Medium	Magnetic tape	Magnetic tape	Magnetic tape	Punched tape	
	Code	BCD	BCD	USASCII	8-level USASCII	
	Speed: Char/sec	30, 75, 110	30, 75, or 110	110	10	
	Cards/min	—	—	—	—	
MANUAL INPUT	Method of Entry	No provision	No provision	45-key keyboard (TTY)	52-key keyboard	
	No. of Char	—	—	Variable	Variable	
OUTPUT	Medium	No provision	No provision	Magnetic tape	Punched tape	Printer
	Code	—	—	USASCII	8-level USASCII	64 char
	Speed: Char/sec	—	—	110	10	10
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband	Voiceband	
	Speed, bps	65 cps	65 cps	1200	Up to 110	
	Mode	Half-duplex	Half-duplex	Half-duplex	Half-/full-duplex	
	Code	—	3-of-14	8-level, 11 unit code	8-level, 11-unit USASCII	
	Timing	Synchronous	Asynchronous	Asynchronous	Asynchronous	
ERROR CONTROL		Char parity checking	Char parity checking	Char parity checking; automatic error code printout	No provision	
MONTHLY RENTAL, $		1200 (purchase price)	1100 (purchase price)	Purchase price: 2450 (Twindex only); 3230 (Twindek/TTY 33 KSR)	130; 105 (3-yr lease); 2350 (purchase)	
COMMENTS		Accepts 0.25-inch mag tape cartridges generated on UDAC 5200, 5300, 5120 Recorders; data rates determined by data set interface; compatible with Bell System 202C, 401H, 402C Data Sets; unattended polling; automatic rewind/repoll	Accepts 0.25-inch mag tape cassettes generated on UDAC 5021 Alphanumeric Portable Recorder; data rates determined by data set interface; compatible with Bell System 202, 401, 402 Data Sets; unattended polling; acoustic coupler optional	Batch I/O is automatic, unattended at terminal; total repoll capability; 110-cps output via Bell System 202C Data Set in batch mode; 10-cps keyboard data entry	ASR capabilities std; TTY 33/35 ASR-compatible; 72-char print line; includes fixed, 21-char WRU answerback message; full TTY format functions under program control; prints on 8.5-in., friction-fed paper; interfaces Bell System Data Set 103 Series; capable of unattended operation; 26 control codes	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Typagraph Model 2 Printer Terminal		Typagraph Model 3 Plotter/Printer Terminal		Ultronic Systems MT 3000-7 Magnetic Tape Terminal
REPORT NUMBER		—		—		6850
FUNCTION		Transmission/reception of alphanumeric data over voiceband line; keyboard/paper tape entry; printer/paper tape output		Transmission/reception of graphic/alphanumeric data over voiceband line; full X, Y incremental plotter with text printing capability		Transmission/reception of mag tape data over voice/broadband line
PREPARED INPUT	Medium	Punched tape		Punched tape		Magnetic tape
	Code	8-level USASCII		8-level USASCII		Any 6-level code plus parity
	Speed: Char/sec	10		10		7200-36,000
	Cards/min	—		—		—
MANUAL INPUT	Method of Entry	52-key alphanumeric/18-key auxiliary numeric keyboard		52-key alphanumeric/18-key auxiliary numeric keyboard		No provision
	No. of Char	Variable		Variable		—
OUTPUT	Medium	Punched tape	Printer	Punched tape	Printer	Magnetic tape
	Code	8-level USASCII	64 char	8-level USASCII	64 char	Any 6-level code plus parity
	Speed: Char/sec	10	10	10	10	7200-36,000
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband		Voiceband		Voice/broadband
	Speed, bps	Up to 110		Up to 110		1200, 2000, 2400, or up to 40,800
	Mode	Half-/full-duplex		Half-/full-duplex		Half-duplex
	Code	8-level, 11-unit USASCII		8-level, 11-unit USASCII		Same as input plus parity bit
	Timing	Asynchronous		Asynchronous		Synchronous
ERROR CONTROL		No provision		No provision		Char/longitudinal parity checking; automatic retransmission
MONTHLY RENTAL, $		150; 120 (3-yr lease); 2700 (purchase)		240; 195 (3-yr lease); 6000 (purchase)		1400
COMMENTS		ASR capabilities std; TTY 33/35 ASR-compatible; 86-char print line; includes fixed 21-char WRU answerback message; full TTY format functions under program control; prints on 8.5-in., friction-fed paper; interfaces Bell System Data Set 103 Series; capable of unattended operation; 26 control codes		Plots on pin-fed paper with 0.02 resolution/0.01 accuracy; 10-pt/sec plotting speed; 4-in-/sec plotting slew rate; 90 char/line std, variable 20-120 char/line via software; full TTY format functions; capable of unattended operation; interface Bell System Data Set 103 Series; TTY 33/35 ASR-compatible; includes fixed 21-char WRU answerback message; 26 control codes		Tape format compatible with IBM 729 tape units; 200-, 556-, or 800-bpi recording density; 36- or 45-ips tape drive available

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Ultronic Systems MT 3000-9 Magnetic Tape Terminal	University Computing Cope . 30 Remote Terminal		University Computing Cope . 32 Remote Terminal	
REPORT NUMBER		6850	—		—	
FUNCTION		Transmission/reception of mag tape data over voice/broadband line	High-speed transmission of punched card/ keyboard input, reception of data to punched card/ printed copy output in half-duplex mode		High-speed transmission of punched card/keyboard input, reception of data to punched card/ printed copy output in full-duplex mode	
PREPARED INPUT	Medium	Magnetic tape	Punched cards		Punched cards	
	Code	Any 8-level code plus parity	Hollerith		Hollerith	
	Speed:					
	Char/sec	7200-36, 000	—		—	
	Cards/min	—	200		200	
MANUAL INPUT	Method of Entry	No provision	53-key keyboard		53-key keyboard	
	No. of Char	—	Variable		Variable	
OUTPUT	Medium	Magnetic tape	Printer	Punched cards	Printer	Punched cards
	Code	Any 8-level code plus parity	63 char	Hollerith	63 char	Hollerith
	Speed:					
	Char/sec	7200-36, 000	—	—	—	—
	Cards/min	—	240 lpm	75-200	360 lpm	75-200
DATA TRANSMISSION	Line Type	Voice/broadband	Voiceband/coaxial cable		Voiceband/coaxial cable	
	Speed, bps	1200, 2000, 2400, or up to 40, 800	2000/2400/4800/9600 (voice); 10, 000/14, 000/20, 000 (cable)		2000/2400/4800/9600 (voice); 10, 000/14, 000/20, 000 (cable)	
	Mode	Half-duplex	Half-duplex		Full-duplex	
	Code	Same as input plus parity bit	Any 6-level code		Any 6-level code	
	Timing	Synchronous	Synchronous/asynchronous		Synchronous/asynchronous	
ERROR CONTROL		Char/longitudinal parity checking; automatic retransmission	Cyclic redundancy checking; automatic retransmission		Cyclic redundancy checking; automatic retransmission	
MONTHLY RENTAL, $		1700	1070 (basic configuration); 41, 060 (purchase)		1180 (basic configuration); 44, 475 (purchase)	
COMMENTS		Tape format compatible with IBM 2400 Series tape units; 200-556-, or 800-bpi recording density; 36- or 45-ips tape drive available	Designed for remote inquiry/batch processing; controller contains 4K (12-bit) core memory; options include paper tape reader (450 cps), mylar tape punch (150 cps), and mag tape (IBM-compatible); requires Bell System Data Set 201A/ 201B for dial-up mode to various CPU systems; compatible with IBM 360, Univac 490/1100 Series, CDC 6000; optional memory expansion set		Designed for remote batch processing; controller contains 4K (12-bit) core memory; operates over leased lines to central computer; optional memory expansion set; compatible with IBM 360, Univac 490/1100 series, CDC 6000; optional I/O devices include paper tape reader (450 cps), mylar tape punch (150 cps), and mag tape (IBM-compatible)	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		University Computing Cope .34 Remote Terminal		University Computing Cope .36 Remote Terminal		Vanguard Data Systems KC 620/KC 820 Datascribe/Communicators
REPORT NUMBER		—		—		—
FUNCTION		High-speed transmission of punched card/keyboard input, reception of data to punched card printed copy output in half-/full-duplex mode		High-speed transmission of punched card/keyboard input, reception of data to punched card/printed copy output in half-/full-duplex mode		Transmission/reception of mag tape data to Datascribe/Communicator/computer over voiceband line
PREPARED INPUT	Medium	Punched cards		Punched cards		7-track mag tape (620); 9-track mag tape (820)
	Code	Hollerith		Hollerith		7-level BCD (KC 620); 9-level EBCDIC (KC 820)
	Speed: Char/sec	—		—		10-240 (95 to 122 80-char records/min.)
	Cards/min	300		300		
MANUAL INPUT	Method of Entry	53-key keyboard		53-key keyboard		50-key keyboard
	No. of Char	Variable		Variable		Variable
OUTPUT	Medium	Printer	Punched cards	Printer	Punched cards	7-track mag tape (620); 9-track mag tape (820)
	Code	63 char	Hollerith	63 char	Hollerith	7-level BCD (KC 620); 9-level EBCDIC (KC 820)
	Speed: Char/sec	—	—	—	—	10-240 (95 to 122 80-char records/min)
	Cards/min	360	75-200	480 lpm	75-200	
DATA TRANSMISSION	Line Type	Voiceband/coaxial cable		Voiceband/coaxial cable		Voice-band
	Speed, bps	200/2400/4800/9600 (voice); 10,000/14,000/20,000 (cable)		2000/2400/4800/9600 (voice); 10,000/14,000/20,000 (cable)		Up to 1200
	Mode	Full-duplex (half-duplex optional)		Full-duplex (half-duplex optional)		Half-duplex
	Code	Any 6-level code		Any 6-level code		5-level BCD (numeric); 7-level BCD (alpha)
	Timing	Synchronous/asynchronous		Synchronous/asynchronous		Asynchronous
ERROR CONTROL		Cyclic redundancy checking; automatic retransmission		Cyclic redundancy checking; automatic retransmission		2 check char/record; parity check; automatic retransmission; read-after-write check with bit-for-bit comparison
MONTHLY RENTAL, $		1235 (basic configuration); 46,750 (purchase)		1385 (basic configuration); 52,125 (purchase)		240 (KC 620); 265 (KC 820)
COMMENTS		Controller contains 8K (12-bit) core memory; optional memory expansion set; operates in dial-up mode/over leased lines to central processor; compatible with IBM 360, Univac 490/1100 Series, CDC 6000; optional I/O devices include paper tape reader (450 cps), mylar tape punch (150 cps), and mag tape (IBM-compatible); designed for remote batch processing		Controller contains 8K (12-bit) core memory; optional memory expansion set; operates in dial-up mode/over leased lines to central processor; compatible with IBM 360, Univac 490/1100 Series CDC 6000; optional I/O devices include paper tape reader (450 cps), mylar tape punch (150 cps); and mag tape (IBM-compatible); designed for remote batch processing		Processes data at 122 80-char numeric/95 80-char alpha records per min; operates with Bell System 202C Data Set over public switched network; communicates with another KC 820/KC 620, or operates as remote terminal to time-shared computer

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Vernitron Type VDT-2 Dataport Portable Terminal	University Computing Cope .38 Remote Terminal		University Computing Cope .41 Remote Terminal	
REPORT NUMBER		6910	—		—	
FUNCTION		Portable transmission/ reception of data over public telephone network; keyboard input; printer output	High-speed transmission of punched card/ keyboard input, reception of data to punched card/printed copy output in half-/full-duplex mode		High-speed transmission of punched card/keyboard input, reception of data to punched card/ printed copy output in half-/full-duplex mode	
PREPARED INPUT	Medium	No provision	Punched cards		Punched cards	
	Code	—	Hollerith		Hollerith	
	Speed:					
	Char/sec	—	—		—	
	Cards/min	—	600		600	
MANUAL INPUT	Method of Entry	53-key keyboard	53-key keyboard		53-key keyboard	
	No. of Char	Variable	Variable		Variable	
OUTPUT	Medium	Printer	Printer	Punched cards	Printer	Punched cards
	Code	64 char	63 char	Hollerith	63 char	Hollerith
	Speed:					
	Char/sec	10	—	—	—	—
	Cards/min	—	480 lpm	75-200	1250 lpm	75-200
DATA TRANSMISSION	Line Type	Public telephone network	Voiceband/coaxial cable		Voiceband/coaxial cable	
	Speed, bps	Up to 110	2000/2400/4800/9600 (voice); 10, 000/14, 000/20, 000 (cable)		2000/2400/4800/9600 (voice); 10, 000/14, 000/20, 000 (cable)	
	Mode	Half-/full-duplex	Full-duplex (half-duplex optional)		Full-duplex (half-duplex optional)	
	Code	8-level USASCII	Any 6-level code		Any 6-level code	
	Timing	Asynchronous	Synchronous/asynchronous		Synchronous/asynchronous	
ERROR CONTROL		Char parity generation/ transmission optional; no checking	Cyclic redundancy checking; automatic retransmission		Cycle redundancy checking; automatic retransmission	
MONTHLY RENTAL, $		100	1520 (basic configuration); 56, 850 (purchase)		2150 (basic configuration); 80, 050 (purchase)	
COMMENTS		Modified TTY Model 33 KSR control circuitry/ modular acoustic coupler; portable carrying cases; up to 74-char print line; compatible with Bell System DataPhone Data Set 103A	Designed for remote batch processing; controller contains 8K (12-bit) core memory; optional memory expansion set; operates in dial-up mode/over leased lines to central processor; compatible with IBM 360, Univac 490/1100 Series, CDC 6000; optional I/O devices include paper tape reader (450 cps), mylar tape punch (150 cps), mag tape (IBM-compatible)		Controller contains 12K memory; batch processes data in dial-up (half-duplex) mode/over leased lines (full-duplex); compatible with IBM 360; Univac 490/1100 Series, CDC 6000; optional I/O devices include paper tape reader (450 cps), mylar tape punch (150 cps), mag tape (IBM-compatible)	

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		University Computing Cope .45 Remote Terminal		Vogue Instrument Shepard 500A Communication Terminal Page Printer	Vogue Instrument Shepard 880 Digital Printer	Vogue Instrument Shepard 880C Telecommunications Printer
REPORT NUMBER		6145		—	—	—
FUNCTION		High-speed transmission of punched card/keyboard input, reception of data to punched card/printed copy output in half-/full-duplex mode		Remote, high-speed printed copy output of alphanumeric data received over voiceband line	Remote, rack-mounted printed copy output of alphanumeric data received over voiceband line	Remote, high-speed printed copy output of alphanumeric data received over voiceband line
PREPARED INPUT	Medium	Punched cards		No provision	No provision	No provision
	Code	Hollerith		—	—	—
	Speed:					
	Char/sec	—		—	—	—
	Cards/min	1500		—	—	—
MANUAL INPUT	Method of Entry	53-key keyboard		No provision	No provision	No provision
	No. of Char	Variable		—	—	—
OUTPUT	Medium	Punched cards	Printer	Printer	Printer	Printer
	Code	Hollerith	64 char	64 or 128 char	64 char	64 char
	Speed:					
	Char/sec	—	—	—	—	—
	Cards/min	200	1250 lpm	Up to 1200 lpm	600 lpm	600 lpm
DATA TRANSMISSION	Line Type	Voice/broadband/coaxial cable		Voiceband	Voiceband	Voiceband
	Speed, bps	2000/2400/4800/9600 (voice); 10,000/14,000/20,000 (cable)		Up to 4800 bps	1200/2400 bps	1200/2400 bps
	Mode	Full-duplex (half-duplex optional)		Half-/full-duplex	half-/full-duplex	Half-/full-duplex
	Code	Any 6-level code		7-level USASCII	7-level USASCII	8-level USASCII
	Timing	Synchronous/asynchronous		Synchronous/asynchronous	Synchronous	Synchronous
ERROR CONTROL		Cyclic redundancy checking; automatic retransmission		Even/odd parity checking	No provision	No provision
MONTHLY RENTAL, $		3380 (basic configuration); 128,250 (purchase)		17,100 (purchase price)	10,550-10,950 (purchase price)	11,200-11,600 (purchase price)
COMMENTS		Designed for remote batch processing; controller contains 12K (12-bit) core memory; options include paper tape reader (450 cps), mylar tape punch (150 cps), 2 IBM-compatible mag tape I/O units; core memory is expandable to 65K; compatible with IBM 360, Univac 490/1100 Series, CDC 6000		Impact printing up to 6 copies; includes 500-char buffer memory; 72 or 80 char/line; 10 char/in. and 3 or 6 line/in. spacing; programmed or message forms control; transmission units/char selectable up to 16	Separate printer mechanism /electronics modules; 40-char overflow buffer accommodates up to 1200 bps; 500-char buffer, up to 2400 bps; impact or ink roller printing technique (1/2-part forms); 80 char/line; adjustable line spacing; pin feed, optional	Incorporates rotating drum/line printing technique; 40-char overflow buffer accommodates up to 1200 bps; 500-char buffer, up to 2400 bps; 80 char/line includes control panel; 10 char/in. and 6 line/in. spacing; pin feed, optional

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Viatron System 21				
REPORT NUMBER		6920				
FUNCTION		Transmission of data entered from keyboard/punched cards/mag tape (computer-compatible reels/in compatible cartridges) over voiceband line; reception of data from voiceband line to printer/video display/mag tape/punched cards				
PREPARED INPUT	**Medium**	Magnetic tape (cartridge)		Magnetic tape (7-/9-track)		Punched cards
	Code	USASCII		USASCII		Hollerith
	Speed:					
	Char/sec	109		2200		—
	Cards/min	—		—		Function of keypunch
MANUAL INPUT	**Method of Entry**	73-key keyboard				
	No. of Char	80				
OUTPUT	**Medium**	Magnetic tape (cartridge)	Magnetic tape (7-/9-track)	Punched card	Printer	Cathode ray tube
	Code	USASCII	USASCII	Hollerith	88 char	64 char
	Speed:					
	Char/sec	109	2200	—	12	—
	Cards/min	—	—	20 (nonprint); 18 (print)	—	—
DATA TRANSMISSION	**Line Type**	Narrow/voiceband				
	Speed, bps	110/247.5 (with Model 6003 Adapter); 600/1200 (Model 6004); up to 1200 (Model 6005)				
	Mode	Half-duplex				
	Code	7-level, 11-unit USASCII				
	Timing	Asynchronous				
ERROR CONTROL		Parity checking optional				
MONTHLY RENTAL, $		20-36 (microprocessor); 5 (video display adapter); 4-13 (keyboard); 4 (Viatape recorder); 60 (7-track recorder); 60 (9-track recorder); 37 (card punch/reader adapter); 25 printing robot; 18 USASCII device attachment); 23 (Hollerith device attachment); 25 (unit card reader); 12 (computer adapter)				
COMMENTS		Read/write display verification; upper-and lowercase with Model 3001/304 (color) display; Viatron 2140/2150 computer can serve as I/O device; optional foreign device attachment permits interface of additional peripheral devices; accommodation of up to 24 multistation displays available; Model 6001 Card Reader/ Punch Adapter interfaces IBM 29 Card Punch; Model 6002 Printing Robot interfaces IBM Selectric typewriter; provides facilities for time sharing, shared-processor entry, data collection, media conversion; completely modular mag tape encoding system configured with microprocessor, video display subsystem, 2 tape units; 1 or 2 I/O devices or controllers can be added including buffered/unbuffered card reader/punch controller (IBM 29 Punch), buffered/unbuffered printing robot (IBM Selectric communications adapters, unit card reader, Hollerith-/USASCII-coded device adapters, on-line adapter to Viatron 2140/2150 computer; basic components selectable from 3 keyboards, 2 microprocessors, 3 tape handlers (cartridge 7-track, 9-track), various display systems (color/up to 32 monochrome); basic system includes 128-char keyboard 320-char (4-record) monochrome display, 2 Viatape cartridge recorders, 2101 microprocessor; up to 8 System 21 terminals can be connected to 2140 computer/ 24 terminals to 2150 computer; 2 basic operational modes: data entry, data process; data is stored in Write, Read, Master, or Program areas of memory (80 8-bit char/area); all systems can store 2 programs (main/alternate); any Viatape cartridge/7-or 9-track tape recorder can be used as input device; output controlled automatically via control record/manually via keyboard; Viatape cartridges contain 300 ft of 1-track USASCII-coded may tape data at 2500 bpi (32 bits/char); 9-in. CRT (connected to microprocessor) std; optional RF modulators interface 1-16 displays; color-coded displays optional; CRT displays four 80-char records; nonstandard 8-level Viatape records at 125 cps with 600 80-char record capacity (2500 bpi); 7-track (556 bpi)/9-track (800 bpi) computer-compatible USASCII-coded mag tape drives can replace Viatape recorders; pin/friction feed printer platen; 80-char print line std (program-controlled)				

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Western Telematic CT41 Punched Card Reader Terminal	Victor Comptometer Model 820/03 Alphanumeric Terminal			
REPORT NUMBER		—	—			
FUNCTION		Interactive transmission with IBM 2741 for time shared computers requiring card/keyboard I/O terminals	Stored-program terminal with arithmetic computation capability; can transmit/receive data over narrow-/voiceband lines to computer			
PREPARED INPUT	**Medium**	Punched cards	Punched cards	Punched tape	Magnetic tape	
	Code	Hollerith	Hollerith	Any 5- to 8-level code	Internal	
	Speed:					
	Char/sec	—	—	200	200	
	Cards/min	25-40	150	—	—	
MANUAL INPUT	**Method of Entry**	44-key keyboard	84-key keyboard (50 alphanumeric, 10 numeric, 24 function keys)			
	No. of Char	Variable	Variable			
OUTPUT	**Medium**	No provision	Punched cards	Punched tape	Magnetic tape	Printer
	Code	—	Hollerith	Any 5- to 8-level code	Internal	64 char
	Speed:					
	Char/sec	—	—	25	200	15.5
	Cards/min	—	Up to 150	—	—	—
DATA TRANSMISSION	**Line Type**	Voiceband	Voice/narrowband			
	Speed, bps	Up to 110/1200	50-2400			
	Mode	Half-duplex	Half-duplex			
	Code	7-level IBM Correspondence/BCD	Any 5- to 9-level code			
	Timing	Asynchronous	Synchronous/asynchronous			
ERROR CONTROL		No provision	Horizontal/vertical parity checking; automatic retransmission up to 14 times			
MONTHLY RENTAL, $		125-165	200-650			
COMMENTS		Intended for interactive program/data input from punched cards on systems using unmodified IBM 2741 Selectric terminals; can also be used off-line for local list operations	Small-scale computer with set of 300 instructions, indexing; memory capacity to 120 64-bit words plus 4096 18-bit words for data/instructions; usable as on-line terminal/off-line processor on point-to-point/multipoint basis; operates in contention/polling environment; communicates with another 820/03 Terminal or any processor/terminal; central unit consists of 5 functional modules: processor, I/O interface, core memory, microprogram read-only memory, macroprogram read-only memory; processor includes 6-bit control unit, 12-bit parallel arithmetic unit; 16-, 32-, 64-, 128-word core sizes available; core divided into 60-bit words (15 individually-addressable core locations); 5-μsec cycle time per location; microprogram step is one 18-bit word (2 μsec); macroprogram memory expandable to 2048 instructions (18-bit words); printer produces up to 8 copies; 131-char print line (10 char/in.); 6 lines/in. spacing; data message retransmission up to 14 times upon receipt of computer NAK			

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Victor Comptometer Model 820/04 Teller Terminal				Datamark Series 200 Oscillating Bar Printer
REPORT NUMBER		—				—
FUNCTION		Stored-program banking terminal with arithmetic computation capabilities to process banking passbooks; can transmit/receive data over narrow/voice-band lines to remote computer				Prints data received from Bell System 201/202 Data-Phone Data Set or equivalent over voiceband line
PREPARED INPUT	**Medium**	No provision				No provision
	Code	—				—
	Speed:					
	Char/sec	—				—
	Cards/min	—				—
MANUAL INPUT	**Method of Entry**	84-key keyboard				No provision
	No. of Char	Variable				—
OUTPUT	**Medium**	Bank passbook	Punched tape	Printer	Punched cards	Printer
	Code	—	Any 5- to 8-level code	64 char	Hollerith	64/96 (USASCII)
	Speed:					
	Char/sec	16	25	15.5	—	Up to 600
	Cards/min	—	—	—	Up to 150	—
DATA TRANSMISSION	**Line Type**	Voice-/narrowband				Voiceband
	Speed, bps	50-2400				Up to 4800
	Mode	Half-duplex				Half-/full-duplex
	Code	Any 5- to 9-level code				8-level
	Timing	Synchronous/asynchronous				Synchronous/asynchronous
ERROR CONTROL		Horizontal/vertical parity checking; automatic retransmission up to 14 times; provisions for detecting line breaks				Parity checking
MONTHLY RENTAL, $		300				15,000 (purchase price)
COMMENTS		Small-scale computer usable as on-/off-line passbook processor; can be used with any processor or as data collection terminal; central unit includes 5 functional modules: processor, I/O interface, core memory, microprogram read-only memory, macroprogram read-only memory; processor consists of 6-bit control unit, 12-bit parallel arithmetic unit; 16-, 32-, 64-, 128-word core sizes available; core divided into 60-bit words (15 individually-addressable core locations); 5 μsec cycle time per location; microprogram step is one 18-bit word (2 μsec); macroprogram memory expandable to 2048 instructions (18-bit words); keyboard includes 10 numeric, 50 alphanumeric, 24 function keys; prints 131-char line; 10 char/in., 6 lines/in. spacing; produces up to 8 copies; front feed device provides 70-position passbook handling; terminal operates via poll/select message transmission from remote computer; data message retransmission up to 14 times upon receipt of NAK from computer; communicates with another terminal or in point-to-point or multipoint configuration				128-char USASCII set optional; stand-alone line-printer unit receiving data from modem/intermediate data handling device; 10 char/in. spacing std; nonstandard spacing available; 132-col print line std; 80-, 120-, 160-col print lines optional; all std direct channel interfaces available; RO unit generates return signals to acknowledge receipt of correct data, identify status, indicate ready-to-receive

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Xerox Data Systems Model 7670 Remote Batch Terminal		Addressograph Multigraph AM 9650 Series CODE Scanner (Computer Oriented Data Entry) Models 9652/9654			Audac Data Terminal
REPORT NUMBER		—		—			—
FUNCTION		Remote batch job entry/transmission of punched card data; punched card/printed copy output of data received from another 7670 Terminal computer over voiceband line		Transmission/reception of mag tape data over voiceband line; records data read from punched/bar coded cards, entered from keyboard, received from line; printed copy record of data read from memory			Low speed transmission/reception of fixed and variable numeric data over public telephone network to remote computer
PREPARED INPUT	Medium	Punched cards		Punched/mark sensed cards	7-trk mag tape (9652); 9-trk mag tape (9654)		Credit card
	Code	Hollerith		Hollerith/2-of-5 level AM bar code	6-level BCD (9652); 8-level EBCDIC (9653)		4-level binary
	Speed:						
	Char/sec	—		—	Up to 730		10
	Cards/min	200		300	—		—
MANUAL INPUT	Method of Entry	No provision		64-char keyboard			12-key keyboard; 4 leverwheel switches
	No. of Char	—		80 std/140 optional (9652); 100 std/selectable 10-180 optional (9654)			Variable (keyboard); 4 (switches)
OUTPUT	Medium	Punched cards	Printer	7-trk mag tape (9652); 9-trk mag tape (9654)	Page printer; line printer		Voice reply only
	Code	Hollerith	63 char	6-level BCD (9652); 8-level EBCDIC (9654)	44 char (page); 64 char (line)		—
	Speed:						
	Char/sec	—	—	Up to 730	15 cps (page);		—
	Cards/min	75	250 lpm	—	300 lpm (line)		—
DATA TRANSMISSION	Line Type	Voiceband		Voiceband			Voiceband
	Speed, bps	2000/2400		1,200, 2,000 bps (public); 1,200-4,800 bps (leased)			Approx 80
	Mode	Half-/full-duplex		Half-/full-duplex			Half-duplex
	Code	USASCII		Modified BCD plus parity			2-of-8
	Timing	Synchronous		Asynchronous			Receiver activated by each data group
ERROR CONTROL		Block parity checking; automatic retransmission		Vertical/longitudinal parity checking; bit count check on transmitted data; read-after-write check on received data; CRC checking on 9-channel units; odd/even message ID checking; automatic retransmission			Partial char checking
MONTHLY RENTAL, $		810		1,005 (9652/page printer); 1,040 (9654/page printer); 1,620 (9652/line printer); 1,660 (9654/line printer)			Approx 10
COMMENTS		Basic unit is modified Univac DCT 2000; printer can monitor card input/output; 80-/128-char print lines available		Communicating mag tape units alone available for purchase at $12,825 (7-track), $13,805 (9-track); basic configuration contains scanner, buffered mag tape unit, off-line typewriter printer, Data-Phone interface; line printer optional; scanner unit includes optical code reader, code converter, printer, controls for field definition/parity checking; printer records data from memory in same sequence with auto CR/LF, formatting via edit codes; buffered mag tape unit includes core memory (programs/data), keyboard, mag tape deck, line interface; records on tape/stores in memory data read from cards, entered from keyboard, received from line; avg alpha transmission rate 70 80-char messages/min, numeric at 100/min; card reader accepts punched/bar coded data on same 80-col card; mag tape unit operates in read, write, search modes; line printer operates on-/off-line with 132 char/line; switched operation via Bell System Data Sets 202C (1,200 bps)/201A (2,000 bps); private line, 4-wire operation at 1200, 2400, 3600, 4800 bps; IBM-compatible mag tape record formats: 6-bit + parity, 200 bpi (9652)/ 8-bit + parity, 800 bpi (9654)			Automatically sends sequence of data upon depression of activating button; can send data from card only; automatically dials prestored telephone numbers; 11-digit automatic dialing via 1-pulse dial button std; additional buttons up to 4 optional; stored numbers, station ID (10 digits max) are hard-wired, field changeable; includes std Touch-Tone pad, 4 rotary switches for sale data entry (6 digits optional), 20-digit credit card reader (60 digits optional), hand-set for bidirectional voice communication; SEND button transmits station ID, card data, sale data; optional 20-digit card dialing limits max pulse dial buttons to 3; automatic EOT signal follows sale data

COMMUNICATIONS TERMINAL EQUIPMENT

IDENTITY		Colorado Instruments C-Dek 213 Data Input Station	Computone Systems CT-32LR Computer Terminal	Customized Data Systems Adapta-Data N3 Series Terminal System	Dataterm Model 44 Teletypewriter	RCA Model 6741-11/-21 Teletypewriter
REPORT NUMBER		—	—	—	—	—
FUNCTION		Remote, polled transmission of fixed/variable input data to central data collection system over voiceband line	Transmission of manually prepared/card data over public telephone network to remote computer via acoustic coupler	Transmission of manually keyed, numeric data to remote keypunch receiver over voiceband line	Transmission/reception of alphanumeric data over public telephone network via acoustic coupler; keyboard input; printer output	Low-speed transmission of manually keyed data/reception of data to printed copy output over narrow-/voiceband line
PREPARED INPUT	Medium	Punched cards; 22-col ID badges	Punched cards (credit card size)	No provision	No provision	No provision
	Code	Hollerith	Hollerith	—	—	—
	Speed:					
	Char/sec	120	—	—	—	—
	Cards/min	—	—	—	—	—
MANUAL INPUT	Method of Entry	13-col numeric keyboard	10-/12-pos levers; 4 special switches	10-key adder keyboard; up to 6 function keys	Typewriter keyboard	53-key keyboard
	No. of Char	13	32 (16-48 optional)	80 (increments of 10-col data fields)	Variable	Variable
OUTPUT	Medium	No provision	Voice response	Punched cards	Printer	Printer
	Code	—	—	Hollerith	128 char	63 char
	Speed:					
	Char/sec	—	1.7-2 words/sec	14 max (rated)	10-15	10
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband (switched/leased)	Voiceband	Narrow-/voiceband
	Speed, bps	Up to 1,200	40 (based on 10 cps)	20 cps max (rated)	110	110
	Mode	Half-duplex	Half-duplex	Half-duplex	Half-/full-duplex	Half-duplex
	Code	6-level, 9-unit BCD	2-of-8 (equivalent to 4 parallel bits)	2-of-8 (using 3-of-14 channel)	8-level USASCII/EBCDIC	8-level, 11-unit USASCII
	Timing	Asynchronous	Receiver activated by each data group	Receiver activated by each data group	Asynchronous	Asynchronous
ERROR CONTROL		Card/badge char validity; parity checking	Tone count within each char; char count per message	Char parity checking; manual retransmission by 80-char block	Char parity checking optional	Even parity generation
MONTHLY RENTAL, $		79-102	—	30 (transmitter); 87 (receiver) Purchase: 750 (transmitter); 3700 (receiver)	90-100	72-76, plus maintenance charges: 23 (local), 36 (remote)
COMMENTS		Facilities for 10 different transactions, corresponding entry formats available; preprogrammed logic cards illuminate console lamps indicating proper data fields for manual entry; erroneously entered data also indicated via console lamps; 16 input stations max/1 buffer unit; 8 buffer units max/central line controller; buffer unit provides polling, message storage, error checking, central controller polls buffer units, provides interface to output media (mag tape/paper tape); keyboard over 124 char designed according to application; std preset 64-char message length expandable to 96 (optional); bit-parallel transmission over 10,000-ft trunk cable at 1,000 cps	Desktop unit accommodates acoustic coupling or direct-wired line interface; includes automatic dialing (contingent on tariff); modular integrated-circuit scanner; 15-position slide switches available; plug-in card provides program security, source identification digits; senses removable edge-coded programs card overlays to provide computer with appropriate query data (includes tabs for custom switch labeling); wired-in security/program entry digits reader accepts IBM-type, credit card-size input card	Following transmission of data block, interrupted validity tone via reverse channel signals request for retransmission; adding machine tape provides local hard copy verification of data transmitted to remote card receiver; reception of valid card data returns special char to transmitter, printed on tape; transmitter interfaces Bell System 401E Series Data Set/receiver, 401J Series; keypunch receiver compatible with IBM 024 Model 5; units accommodate local back-to-back operation for discrete wiring; keypunch options include card printing, manual/automatic skipping, duplicating, spacing	Includes built-in acoustic coupler; full upper-lowercase capability; electric typewriter has switch encoding; keyboard includes 2-key rollover, generates 128 symbol char set	Friction-feed (-11)/pin-feed (-21) platens available; optional features available for Spectra 70 systems only include: data set coupler, 9.5-in. (84-char) wide carriage (-21), forms supply box (-21); requires connection to RCA 70/710 Telegraph Buffer/6020-11 Communications Buffer when used with local 2-wire user-supplied line circuit; other type facilities connect to RCA 70/720-22, 70/720-23 Telegraph Buffer/6020-11, 6020-12 Communications Buffer; includes answerback, CR/LF, horiz/vert tab (-21), form feed (-21); std 72-char print line, 7 copies

IDENTITY		RCA Model 6740-11/-21 Teletypewriter		RCA Model 6742-11/-21 Teletypewriter	Syner-Data Beta Serial Printer System	
REPORT NUMBER		—		—	—	
FUNCTION		Low-speed transmission/reception of data over narrow-/voiceband line; keyboard/paper tape input; paper tape/printed copy output		Low-speed reception of data to printed copy output over narrow-/voiceband line	Low-speed transmission/reception of alphanumeric data over voiceband line to remote computer; manual keyboard entry; paper tape I/O; printed copy	
PREPARED INPUT	**Medium**	Punched tape		No provision	Punched tape	
	Code	8-level USASCII		—	8-level USASCII	
	Speed:					
	Char/sec	10		—	10, 15, 30 (serial);	
	Cards/min	—		—	300 (parallel)	
MANUAL INPUT	**Method of Entry**	53-key keyboard		No provision	53-key keyboard	
	No. of Char	Variable		—	Variable	
OUTPUT	**Medium**	Printer	Punched tape	Printer	Printer	Punched tape
	Code	63 char	8-level USASCII	63 char	64 char	8-level USASCII
	Speed:					
	Char/sec	10	10	10	10, 15, 30	10, 15, 30
	Cards/min	—	—	—	—	—
DATA TRANSMISSION	**Line Type**	Narrow-/voiceband		Narrow-/voiceband	Voiceband	
	Speed, bps	110		110	110, 150, 300	
	Mode	Half-duplex		Simplex	Half-/full-duplex	
	Code	8-level, 11-unit USASCII		8-level, 11-unit USASCII	7-level, 10-/11-unit USASCII	
	Timing	Asynchronous		Asynchronous	Asynchronous	
ERROR CONTROL		Even parity generation		No provision	Odd/even parity generation	
MONTHLY RENTAL, $		112-117, plus maintenance charges: 35 (local), 48 (remote)		63-67, plus maintenance charges: 21 (local), 34 (remote)	Purchase price: 2,800 (RO); 3,195 (KSR); 4,500 (ASR 30); 4,985 (ASR 300)	
COMMENTS		Friction-feed (-11)/pin-feed (-21) platens available; optional features available for Spectra 70 systems only include: data set coupler, 9.5-in (84-char) wide carriage (-21), forms supply box (-21), X-On/X-Off operation; requires connection to RCA 70/710 Telegraph Buffer/6020-11 Communications Buffer when used with local 2-wire, user-supplied line circuit; other type facilities connect to RCA 70/720-22, 70/720-23 Telegraph Buffer/6020-11, 6020-12 Communications Buffer; includes answerback, CR/LF, horiz/vert tab (-21), form feed (-21); std 72-char print line, 7 copies		Friction-feed (-11)/pin-feed (-21) platens available; optional features available for Spectra 70 systems only include: data set coupler, 9.5-in. (84-char) wide carriage (-21), forms supply box (-21); requires connection to RCA 70/710 Telegraph Buffer/6020-11 Communications Buffer when used with local 2-wire user-supplied line circuit; other type facilities connect to RCA 70/720-22, 70/720-23 Telegraph Buffer/6020-11, 6020-12 Communications Buffer includes CR/LF, horiz/vert tab (-21), form feed (-21); std 72-char print line, 7 copies	TTY 33-compatible; RO includes line printer only; KSR includes keyboard/printer; ASR adds paper tape I/O to KSR; switch-selectable features include: printer/paper tape operating speeds, transmission rate, odd/even parity generation, bits per char frame; impact printing at 26-132 char/line (adjustable); spacing at 10 char/in., 6 lines/in.; pin-feed platen handles 1-6-part forms; 96-char USASCII paper tape coding (64 data, 32 control); Model 30 paper tape reader operates to 30 cps; Model 300 to 300 cps (parallel, stop-on-char); photoelectric tape sensing; available with parallel I/O or EIA RS232B, std TTY interfaces; compatible with acoustic couplers, Bell System Data Set 103A; additional I/O media (punched card, mag tape reel/cassette) accommodated on RPQ basis	

IDENTITY		Centronics Data Computer Mach I Impact Printer Model 3000	Data Computing Cardliner 10 Terminal-Oriented Card Reader	Data Computing Cardliner 15 Terminal-Oriented Card Reader	Data Computing Cardliner 30 Terminal-Oriented Card Reader	Data Computing Typeliner Remote Communications Printer
REPORT NUMBER		—	—	—	—	—
FUNCTION		Receive-only, printed copy output of alphanumeric data transmitted over voiceband line	Remote batch entry of punched card alphanumeric data over voiceband line via stand-alone/peripheral configuration	Remote batch entry of punched card alphanumeric data over voiceband line via stand-alone/peripheral configuration	Remote batch entry of punched card alphanumeric data over voiceband line via stand-alone/peripheral configuration	Remote receive-only printed output of alphanumeric data transmitted over voiceband line
PREPARED INPUT	Medium	No provision	Punched cards	Punched cards	Punched cards	No provision
	Code	—	Hollerith	Hollerith	Hollerith	—
	Speed:					
	Char/sec	—	10	15	30	—
	Cards/min	—	7.5	11.25	22.5	—
MANUAL INPUT	Method of Entry	No provision	No provision	No provision	No provision	No provision
	No. of Char	—	—	—	—	—
OUTPUT	Medium	Printer	No provision	No provision	No provision	Printer
	Code	63 char	—	—	—	64 char; 90 opt
	Speed:					
	Char/sec	165	—	—	—	—
	Cards/min	—	—	—	—	100 lpm
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband	Voiceband	Voiceband
	Speed, bps	Up to 3,000	Up to 300	Up to 300	Up to 300	300; 600; 1,200; 2,400
	Mode	Simplex	Half-/full-duplex	Half-duplex	Half-/full-duplex	Half-duplex
	Code	7-level USASCII	8-level, 11-unit USASCII	IBM Correspondence/ BCD	8-level, 11-unit USASCII	8-level, 11-unit USASCII
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
ERROR CONTROL		No provision	No provision	No provision	No provision	Char parity checking; automatic retransmission
MONTHLY RENTAL, $		2,400 (purchase)	90 (1 yr, min. usage); 3,600 (purchase)	90 (1 yr, min. usage); 3,600 (purchase)	100 (1 yr, min. usage); 3,990 (purchase)	245 (Model I); 285 (Model II); 270 (Model III); 315 (Model IV)
COMMENTS		Rated printer output speed at 60 (132-char print line) to 150 (short print line) lpm; 132-char line buffer; 5 x 7 dot matrix char structure; impact printing up to 4 copies on std paper; accommodates form widths of 6-14.875 in. (adjustable); 132-char max print line; pin-feed platen; 6 lines/in. vertical spacing; accepts parallel transmission up to 25,000 cps	Transmits data via data set/terminal line interface; TTY 33/35-compatible; Hollerith-to-USASCII code conversion; serial photo optic read mechanism; 500-card input hopper/ 600-card output stacker capacity; attended/ unattended operation	Transmits data via data set/terminal line interface; compatible with IBM 2741, Datel, Dura terminals; Hollerith-to-IBM Correspondence/BCD code conversion; serial photo optic read mechanism; 500-card input hopper/600-card output stacker capacity; attended/unattended operation	Transmits data via data set/terminal line interface; compatible with GE Terminet 300, Beta, Gulton, CRT terminals; Hollerith-to-USASCII code conversion; serial photo optic read mechanism; 500-card input hopper/600-card output stacker capacity; attended/ unattended operation	Model I: 80-col, upercase only; Model II: 132-col, uppercase only; Model III; 80-col, upper-/lowercase; Model IV: 132-col, upper-/lowercase; impact printing up to 6 copies; includes CRT/ modem interface; 100-lpm speed rated for 72-col printing; 10 char/in. horizontal spacing; 6 lines/in. vertical spacing; pin-feed platen std; 24 lines/sec skip; in parity check mode 80-/132-char buffer retains error data block, generates error signal for retransmission via 5-bps reverse channel; compatible with Bell System Data Sets 103, 201, 202C

IDENTITY		Dataterm Model 135 Send Only Typewriter	Datel Model 31 Cartridge Magnetic Tape Data Terminal		Friden 7100 Conversational Terminal	Litton Systems Datalog MC 1000 Military Strip Printer
REPORT NUMBER		—	—		6271	—
FUNCTION		Low-speed keyboard entry/transmission of alphanumeric data to remote computer over narrow-/voiceband line; input printed copy	Conversational/remote batch transmission/ reception of mag tape data over voiceband line; keyboard entry; printed copy output		Transmission/reception of data point to point over narrow-/ voiceband line; keyboard input; printed copy output	Receive-only high-speed printed copy of alphanumeric data over voice-/broadband facility
PREPARED INPUT	Medium	No provision	Magnetic Tape		No provision	No provision
	Code	—	IBM Correspondence, BCD, EBCD		—	—
	Speed:					
	Char/sec	—	14.8-120		—	—
	Cards/min	—	—		—	—
MANUAL INPUT	Method of Entry	49-key keyboard	54-key Selectric keyboard (plus control keys)		52-key keyboard	No provision
	No. of Char	Variable	Variable		Variable	—
OUTPUT	Medium	Printer	Printer	Magnetic tape	Printer	Printer
	Code	84 char	88 char	IBM Correspondence, BCD, EBCD	91 char	64 char
	Speed:					
	Char/sec	Up to 30	14.8	14.8-120	10/12.2	65 std
	Cards/min	—	—		—	—
DATA TRANSMISSION	Line Type	Narrow-/voiceband	Voiceband		Narrow-/voiceband	Voice-/broadband
	Speed, bps	Up to 110 (10 cps)	134-1,200		100-134.2	Up to 1,320
	Mode	Half-duplex	Half-duplex		Half-duplex	Simplex/half-/full-duplex
	Code	8-bit parallel std	IBM Correspondence, BCD, EBCD		8-level, 10-/11-unit USASCII	8-level USASCII std
	Timing	Asynchronous	Asynchronous		Asynchronous	Asynchronous/synchronous
ERROR CONTROL		Char parity generation	Vertical parity checking; read-after-write check; remote status check		Char parity checking opt; manual retransmission	Parity checking opt
MONTHLY RENTAL, $		Purchase: 450 (basic); 100 (parallel-to-serial converter); 400 (acoustic coupler)	175; 7,490 (purchase)		90-100 3,200-3,475 (purchase)	2,250 (purchase)
COMMENTS		Basic configuration provides direct parallel input to computer I/O channel; serial (8-level, 11-unit USASCII) communications opt; TTY speed-compatible; Bell System 401H equivalent data set interface; connects to mag tape/ paper tape recorders for temporary media storage; facilitates voice answerback applications; manual keyboard generates 117 USASCII code combinations including control char; acoustic coupler opt; 82-char print line	Dialup, full-duplex interrupt, reverse break, full keyboard repeat, forward/reverse search, off-line editing, remote status checking, Correspondence/BCD/EBCD code-controlled tape functions std; IBM 2741 software compatible; built-in modem, terminal-to-terminal operation, carrying cases, Basic/APL typespheres/keyboards, 90,000-char mag tape cartridge, high-speed operation opt; 130-/156-char print line; compatible with Bell System Data Set 103A; Datel 90 Acoustic Coupler incorporated; operating modes; tape-to-print/-line, line-to-tape/-print, key-to-tape/-print		Can transmit/receive 128-char USASCII; multistation operation opt; compatible with Bell System Data Set 103F (leased line)/ Data-Phone Data Set 103A2 (switched); auto answer capability; 135-char print line std (14-in. forms); case shift, CR/LF controls; 10 char/in. horizontal spacing; 6 lines/in. vertical; full-duplex required for Break feature; switch-selectable Mechanical Nonprint option disables printing transmitted/ received data	Nonimpact printing; full military/commercial models; 12,000-hr MTBF; weighs 4 lb; options include up to 120-cps rated print speed, any 8-level transmission code

IDENTITY		Litton Systems Datalog MC 3000 Digital Page Teleprinter	Litton Systems Datalog MC 3434 High-Speed Military Printer	Litton Systems Datalog MC 4600 High-Speed Printer	Litton Systems Datalog MC 8800 High-Speed Printer	Memorex MRX 1240 Communication Terminal
REPORT NUMBER		—	—	—	—	—
FUNCTION		Receive-only high-speed printed copy of alphanumeric data over voice-/broadband facility	Receive-only high-speed printed copy of numeric/alphanumeric data over voice-/broadband facility	Receive-only high-speed printed copy of numeric/alphanumeric data over voice-/broadband facility	Receive-only high-speed printed copy of numeric/alphanumeric data over voice-/broadband facility	Transmission/reception of alphanumeric data over public network/leased voiceband line; keyboard entry; printed output
PREPARED INPUT	Medium	No provision	No provision	No provision	No provision	No provision
	Code	—	—	—	—	—
	Speed:					
	Char/sec	—	—	—	—	—
	Cards/min	—	—	—	—	—
MANUAL INPUT	Method of Entry	No provision	No provision	No provision	No provision	60-key keyboard
	No. of Char	—	—	—	—	Variable
OUTPUT	Medium	Printer	Printer	Printer	Printer	Printer
	Code	64 char	64 char	64 char	64 char	94 char
	Speed:					
	Char/sec	—	Up to 3,200	Up to 3,200	Up to 8,800	10, 15, 30, 60
	Cards/min	800 lpm std	—	—	—	—
DATA TRANSMISSION	Line Type	Voice-/broadband	Voice-/broadband	Voice-/broadband	Voice-/broadband	Voiceband
	Speed, bps	Up to 44,000	Up to 35,200	Up to 35,200	Up to 96,800	110, 150, 300, 600
	Mode	Simplex/half-/full-duplex	Simplex/half-/full-duplex	Simplex/half-/full-duplex	Simplex/half-/full-duplex	Full-/half-duplex
	Code	8-level USASCII std	8-level USASCII std	8-level USASCII std	8-level USASCII std	7-level, 10-/11-unit USASCII
	Timing	Asynchronous/synchronous	Asynchronous/synchronous	Asynchronous/synchronous	Asynchronous/synchronous	Asynchronous
ERROR CONTROL		Parity checking opt	Parity checking opt	Parity checking opt	Parity checking opt	Char parity (opt); manual retransmission
MONTHLY RENTAL, $		12,650 (purchase)	12,900 (purchase)	Purchase price: 6,575 (numeric); 6,950 (alphanumeric)	12,900 (purchase)	115; 4,200 (purchase)
COMMENTS		Nonimpact printing; full military/commercial models; 8,000-hr MTBF; weighs 40 lb; 80-char print line; options include up to 3000-lpm rated print speed, any 8-level transmission code	Nonimpact printing; 4,000-hr MTBF; 32-char print line; numeric only/alphanumeric char sets available; weighs 42 lb; options include any 8-8-level transmission code	Nonimpact printing; 4,000-hr MTBF; 32-char print line; weighs 58 lb; numeric only/alphanumeric char sets available; options include any 8-level transmission code	Nonimpact printing; 4,000-hr MTBF; 88-char print line; numeric only/alphanumeric char sets available; weighs 85 lb; options include any 8-level transmission code	Std configuration includes 30-cps rated print speed, 128-char keyboard generation (USASCII), 120-char print line, forms tractor-/friction-feed platen, interchangeable print cartridge (94 graphics), positional electronic cursor, switch-selectable transmission modes; options include 60-cps print speed, output rate selection (10, 15, 30, 60 cps), horizontal tab (electronic), char parity checking, integral modems Model 1220 (Bell System 103A), Model 1224 (Bell System 202C)

IDENTITY		Mohawk Data Sciences Model 7201 Binary Synchronous Communication Adapter		Potter Instrument KDR 3100 Communications Terminal		TEC Model 520-40 Remote Batch Terminal
REPORT NUMBER		—		—		—
FUNCTION		Transmission/reception of alphanumeric data over switched network/leased line; enables Mohawk Data-Recorder compatibility with IBM System/360 via 2701/2703 Transmission Adapters in IBM 2780 EBCDIC mode		Transmission/reception of mag tape data over voiceband line; keyboard entry; line printer output		Programmed, high-speed batch processing of data transmitted over voiceband line; punched card input; printed output
PREPARED INPUT	Medium	Magnetic tape (6401/1101)	Punched cards (1116/6406)	Magnetic tape		Punched cards
	Code	8-level EBCDIC; IBM/NCR BCD	Hollerith	6-level BCD		Hollerith
	Speed: Char/sec Cards/min	 6,250 —	 — 220	 10,000 —		 — 400
MANUAL INPUT	Method of Entry	64-char keyboard		51-key keyboard		TTY (opt)
	No. of Char	10-190 (selectable record length in increments of 10)		Up to 160 (variable block length)		Variable
OUTPUT	Medium	Magnetic tape (6401/1101)	Printer (7520)	Magnetic tape	Printer	Printer
	Code	8-level EBCDIC; IBM/NCR BCD	64 char	6-level BCD	64 char	64 char std
	Speed: Char/sec Cards/min	 6,260 —	 — 300	 10,000 —	 — 135 lpm	 — 300 lpm
DATA TRANSMISSION	Line Type	Voiceband		Voiceband		Voiceband
	Speed, bps	2,000 bps (switched); 2,400 bps (leased)		1,200/1,600		Up to 4,800 std
	Mode	Half-/full-duplex		Half-duplex		Full-duplex
	Code	8-level EBCDIC; transparency		6-level BCD		7-level USASCII std
	Timing	Synchronous		Synchronous		Synchronous std
ERROR CONTROL		Cyclic redundancy checking (CRC)		Cyclic redundancy checking via BCC; automatic retransmission		As programmed
MONTHLY RENTAL, $		350-960 (depending on equipment/options)		472; 15,280 (purchase)		29,400 (purchase)
COMMENTS		Accommodates 2 Mohawk Data-Recorders, each with 300-lpm printer; reverse interrupt/escape option allows I/O device selection; 9,600-bps transmission rate potential; 132-char/line buffered line printer (7520)		Incorporates programmable data compression techniques; price data includes printer, communications interface; 132-char print line std; enables transmission/printed copy of on-line computer-compatible tape data without editing/reformatting		Basic configuration includes card reader, line printer; peripheral options include 35-cpm card punch, CRT displays, keyboards, TTY, paper tape reader/punch; 132-char print line std; functional/format controls included; serial rates of 110-9,600 bps, sync/async timing available; Autodial (auto answer) feature opt; EBCDIC/Transcode (SBT) available; 500-card reader hopper capacity; basic system includes IBM 2780 simulator software; interfaces TEC 520 Programmable Communications Processor

IDENTITY		Potter Instrument KDR 4100 Communications Terminal		Versatec Matrix 300 Printer	Versatec Matrix 600 Printer	Versatec Matrix 100 Plotter
REPORT NUMBER		—		—	—	—
FUNCTION		Transmission/reception of mag tape data over voiceband line; keyboard entry; line printer output		High-speed, receive-only printed output of alphanumeric data transmitted over voiceband line	High-speed, receive-only printed output of alphanumeric data transmitted over voiceband line	High-speed, receive-only plotted output of graphic data transmitted over voiceband line
PREPARED INPUT	Medium	Magnetic tape		No provision	No provision	No provision
	Code	8-level USASCII/EBCDIC		—	—	—
	Speed:					
	Char/sec	10,000		—	—	—
	Cards/min	—		—	—	—
MANUAL INPUT	Method of Entry	51-key keyboard		No provision	No provision	No provision
	No. of Char	Up to 160 (variable block length)		—	—	—
OUTPUT	Medium	Magnetic tape	Printer	Printer	Printer	Plotter
	Code	8-level USASCII	64 char	64 char	64 char	—
	Speed:					
	Char/sec	10,000	—	400;	800;	0.828 in./sec;
	Cards/min	—	135 lpm	300 lpm	600 lpm	120 steps/sec
DATA TRANSMISSION	Line Type	Voiceband		Voiceband	Voiceband	Voiceband
	Speed, bps	1,200/1,600		Up to 4,800	Up to 9,600	Up to 4,800
	Mode	Half-duplex		Simplex; receive only (output status line)	Simplex; receive only (output status line)	Simplex; receive only (output status line)
	Code	8-level USASCII/EBCDIC		8-level, 11-unit USASCII	8-level, 11-unit USASCII	8-bit parallel
	Timing	Synchronous		Synchronous/asynchronous	Synchronous/asynchronous	Asynchronous by scan
ERROR CONTROL		Cyclic redundancy checking via BCC; automatic retransmission		No provision	No provision	No provision
MONTHLY RENTAL, $		472; 15,280 (purchase)		5,500 (purchase); 2-, 3-, 4-, 5-yr leasing	6,700 (purchase); 2-, 3-, 4-, 5-yr leasing	5,900 (purchase); 2-, 3-, 4-, 5-yr leasing
COMMENTS		Incorporates programmable data compression techniques; price data includes printer, communications interface; 132-char print line std; enables transmission/printed copy of on-line computer-compatible tape data without editing/reformatting		Nonimpact electrostatic printing; 80-char print line; 5 x 7 dot matrix char generation; std 80-char/1-line buffer; opt 2-line buffer; accepts serial/parallel line input; 10.3 char/in. horizontal spacing; 6 lines/in. vertical spacing; peripheral interface available	Nonimpact electrostatic printing; 80-char print line; 5 x 7 dot matrix char generation; std 80-char/1-line buffer; opt 2-line buffer; accepts serial/parallel line input; 10.3 char/in. horizontal spacing; 6 lines/in. vertical spacing; peripheral interface available	Electrostatic plotting; digital electronic raster scan; 8.5-in. paper width; 7.75-in. plotting area; 560 stationary writing nibs; 13.8 mils nib spacing (72.5/in.); 8-bit bytes parallel input (70 bytes/1scan); 60 scans/sec; 13.8 mils incremental paper drive; peripheral interface available; plots 8.5 x 11-in. page in 14 sec.

IDENTITY		Versatec Matrix 200 Plotter	Versatec Matrix 100A Printer/Plotter		Versatec Matrix 200A Printer/Plotter	
REPORT NUMBER		—	—		—	
FUNCTION		High-speed, receive-only plotted output of graphic data transmitted over voiceband line	High-speed, receive-only printed/plotted output of alphanumeric/graphic data transmitted over voiceband line		High-speed, receive-only printed/plotted output of alphanumeric/graphic data transmitted over voiceband line	
PREPARED INPUT	Medium	No provision	No provision		No provision	
	Code	—	—		—	
	Speed:					
	Char/sec	—	—		—	
	Cards/min	—	—		—	
MANUAL INPUT	Method of Entry	No provision	No provision		No provision	
	No. of Char	—	—		—	
OUTPUT	Medium	Plotter	Printer	Plotter	Printer	Plotter
	Code	—	64 char	—	64 char	—
	Speed:					
	Char/sec	1.656 in./sec;	400;	0.828 in./sec;	800;	1.656 in./sec;
	Cards/min	240 steps/sec	300 lpm	120 steps/sec	600 lpm	240 steps/sec
DATA TRANSMISSION	Line Type	Voiceband	Voiceband	Voiceband	Voiceband	Voiceband
	Speed, bps	Up to 9,600	Up to 4,800	Up to 4,800	Up to 9,600	Up to 9,600
	Mode	Simplex; receive-only (output status only)	Simplex; receive-only (output status line)	Simplex; receive-only (output status line)	Simplex; receive-only (output status line)	Simplex; receive-only (output status line)
	Code	8-bit parallel	8-level, 11-unit USASCII	8-bit parallel	8-level, 11-unit USASCII	8-bit parallel
	Timing	Asynchronous by scan	Synchronous/asynchronous	Asynchronous by scan	Synchronous/asynchronous	Asynchronous by scan
ERROR CONTROL		No provison	No provision		No provision	
MONTHLY RENTAL, $		6,500 (purchase); 2-, 3-, 4-, 5-yr leasing	7,300 (purchase); 2-, 3-, 4-, 5-yr leasing		7,900 (purchase) 2-, 3-, 4-, 5-yr leasing	
COMMENTS		Electrostatic plotting; digital electronic raster scan; 8.5-in. paper width; 7.75-in. plotting area; 560 stationary writing nibs; 13.8 mils nib spacing (72.5/in.); 8-bit bytes parallel input (70 bytes/1 scan); 120 scans/sec; 13.8 mils incremental paper drive; peripheral interface available; plots 8.5 x 11-in. page in 7 sec	Nonimpact electrostatic printing; 80-char print line; 5 x 7 dot matrix char generation; std 80-char/1-line buffer; opt 2-line buffer; accepts serial/parallel line input; 10.3 char/in. horizontal spacing; 6 lines/in. vertical spacing; peripheral interface available	Electrostatic plotting; digital electronic raster scan; 8.5-in. paper width; 7.75-in. plotting area; 560 stationary writing nibs; 13.8 mils nib spacing (72.5/in.); 8-bit bytes parallel input (70 bytes/1scan); 60 scans/sec; 13.8 mils incremental paper drive; peripheral interface available; plots 8.5 x 11-in. page in 14 sec	Nonimpact electrostatic printing; 80-char print line; 5 x 7 dot matrix char generation; std 80-char/1-line buffer; accepts serial/parallel line input; 10.3 char/in. horizontal spacing; 6 lines/in. vertical spacing; peripheral interface available	Electrostatic plotting; digital electronic raster scan; 8.5-in. paper width; 7.75-in. plotting area; 560 stationary writing nibs; 13.8 mils nib spacing (72.5/in.); 8-bit bytes parallel input (70 bytes/1 scan); 120 scans/sec; 13.8 mils incremental paper drive; peripheral interface available; plots 8.5 x 11-in. page in 7 sec

ALPHANUMERIC DISPLAY TERMINALS

AUERBACH
DATA
COMMUNICATIONS
REPORTS

Printed in U.S.A.

COMPARISON CHART: ALPHANUMERIC DISPLAY TERMINALS

An alphanumeric display terminal is typically a compact unit that looks — and actually is — much like a small television set equipped with a keyboard. These terminals display data on the face of a cathode ray tube. The data can be entered from a keyboard or received from a computer.

The data displayed by an alphanumeric display terminal can be in the form of alphabetic letters, numeric digits, punctuation marks, and specialized symbols. Some units can display only a subset, such as numeric digits, of the character set mentioned. In this report, any displayed symbol is referred to as a character. Other, more sophisticated display devices used to display graphs and other complex shapes are commonly referred to as "line drawing units."

Most commercially available alphanumeric terminals can either be connected directly to a computer input/output channel or connected remotely, via an appropriate controller or adapter at the computer site and a communications line.

All of the display devices covered in AUERBACH Data Communications Reports are alphanumeric terminals that can transmit and receive data over communications lines.

The basic function of alphanumeric terminals is to provide rapid, easy access to data stored in a computer system or to the computational facilities of the computer. Two types of applications for which alphanumeric display terminals are well suited are:

- Obtaining information pertaining to a particular account or subject, such as credit, bank balance, inventory, seating availability, and countless others. Data files maintained at the central computer site serve as the source of information. These files can be quickly updated from the remote display stations as events and transactions take place.
- Providing convenient man-machine "conversations" which permit the operator of the remote display station to base his inquiries upon prior results calculated by the computer and displayed on the screen. This type of application allows programmers, engineers, designers, etc. to create and execute programs in step-by-step fashion while being informed of programming errors and intermediate results at each step.

Programming of the computer at the central site will be a major portion of the implementation task for nearly every display system. Manufacturers of commercial computers are beginning to provide software support for the types of applications described above.

The operations described could be — and have been — implemented with communications terminals other than display units. The principal advantages of the display terminals are their speed, ease, and convenience of operation.

The important characteristics of alphanumeric display terminals which transmit and receive data from remote computers over communications lines include:

- Transmission characteristics such as speed, code, and synchronization technique;
- General input/output capabilities of the display device and any auxiliary equipment;
- Cost;
- Display characteristics;
- Editing capabilities; and
- Control, including buffering and configuration limitations.

The transmission characteristics, general input/output capabilities, and costs are summarized in the Communications Terminal Equipment Comparison Charts (page 4200:01). Important characteristics unique to display terminals are summarized in the special comparison chart on the following pages. Explanations of specific comparison chart entries follow.

DISPLAY UNITS

The distinguishing features of the display units are: the actual size of the display area, the display arrangement (i.e., the number of characters per line and the number of lines per display), the total number of characters per display, the number of different characters or symbols that can be displayed, and the technique for character generation.

The three common techniques for generating the characters to be displayed are: dot matrix, stroke, and monoscope. With the dot matrix technique, points within a specified point matrix (usually 5 points wide by 7 points high) are intensified to form the displayed symbol. The characters so formed are actually composed of small, overlapping circles. The stroke method is used to form symbols by drawing short straight lines between specified points.

DISPLAY UNITS (Contd.)

Different units may use different combinations of lines, which lead to differences in the appearance of the symbols on the screen. The monoscope technique utilizes a separate scanning tube which contains a plate with all of the displayable characters etched into it. The scan generates signals which control the movement of the electron beam in the display tube. Any symbol shape or type style can be generated with this technique.

EDITING FACILITIES

The editing facilities provided for the operator's use govern the ease and flexibility of entering data and modifying or correcting previously displayed data. All currently available commercial display units use a visible cursor or entry marker to indicate to the operator the position where the next character will be displayed when entered. Normally, control keys are included within the keyboard layout to allow the operator to position the cursor for data entry at specified locations.

Editing facilities that are provided in some display units include:

- Horizontal tabulation — allows the operator to set specified "stops" within a display and later skip to these stops in the same manner as on a typewriter.
- Line erase — allows the operator to erase a whole line or selected portion of a line with a single key depression.
- Line insertion — allows the operator to insert data within a line, with the previously displayed data being automatically shifted over.
- Transmission of partial display — allows transmission of a selected portion of the total display, in contrast to having to transmit the full display each time.
- Split screen — allows retention of previously displayed data while new data is being entered or received. In practice, this may take the form of filling in a displayed format or displaying a series of operator inquiries and computer responses. With some units the operator can be prevented from modifying the previous data.

CONTROL UNIT

Depending on the particular equipment, multiple display units may be connected to a central controller, or each display unit may be independent and contain its own control logic. In the former configuration, the controller interfaces with the communications line; individual display units can usually be located up to 1,000 to 2,000 feet from the central controller.

The types of phosphors used in all currently available alphanumeric display terminals are of relatively low persistence. To present a display that is adequate for viewing, and free from flickering, the display must be continually regenerated. Buffer storage is provided within the central controller or within each display unit to store data entered locally or received from the remote computer. Logic circuitry within the central controller or individual display unit utilizes the buffer storage to regenerate the display, usually 30 to 40 times per second.

The amount of buffer storage determines the maximum amount of data that can be displayed at any one time. The capacity of the buffer is of concern primarily in multi-unit display systems where the buffer storage is contained in a central controller. The total buffer size is one factor that determines the number of display units that can be accommodated and the maximum amount of data that can be displayed by each unit.

"Multi-drop" is the capability for connecting more than one controller (multi-unit or independent) to a single communications line. This capability requires that control logic be provided for controller address recognition to enable selective transmission to individual display units. This capability can be used to expand the number of display units at a single location or to permit units located at geographically separate locations to share the same line. The object of either arrangement is to reduce line costs. Careful analysis should be made when planning multi-drop configurations to ensure that one line will provide adequate transmission capacity.

AUXILIARY EQUIPMENT

The alphanumeric display terminal does not of itself provide a permanent, hard-copy record of transmitted and received data. In many cases, an optional auxiliary printer can provide a permanent record of this data. Such units are typically low-speed teleprinter or typewriter devices and are used to provide occasional copies rather than a complete record of all transmissions.

In some cases, other auxiliary units, such as punched paper tape readers and punches or keyboard teleprinters, are also available. These units extend the flexibility of the display system and permit more conventional data communications tasks to be performed within the overall display system.

(Contd.)

COMPARISON CHART: ALPHANUMERIC DISPLAY TERMINALS

IDENTITY		Bunker-Ramo Series 200 Data Display System			Burroughs Input and Display System
REPORT NUMBER		6060			6071
DISPLAY UNITS	Identity	203/204	211	212	9351-4 Monitor
	Display Size, inches	7.75 wide; 5.50 high	4.75 wide; 3.75 high	4.75 wide; 3.75 high	12 wide; 9 high
	Char/Line	8 to 64	8 to 42	8 to 42	80
	Lines/Display	2 to 12	2 to 12	2 to 12	25
	Number of Displayable Characters	39 plus 15 optional	14 plus up to 12 optional	40 plus up to 12 optional	66
	Total Char/Display	32 to 768	32 to 384	32 to 384	1020, 508, or 252; 2000 display positions
	Character Generation Technique	5-by-7 dot matrix	5-by-7 dot matrix	5-by-7 dot matrix	Stroke
EDITING FACILITIES	Horizontal Tab	No			Yes
	Line Erase	Yes			Optional
	Line Insert	No			Optional
	Transmit Partial Display	Yes			Yes
	Split Screen	Optional			Yes
	Other	Full range of cursor movement controls			Full range of cursor movement controls
CONTROL UNIT	Identity	222	223 and 224		Control I, II, or IIA
	Type of Buffer Storage	Delay line	Delay line		Magnetic core
	Buffer Capacity, Characters	768 to 2304	768 to 6912		1024
	Maximum Number of Devices per Controller	Up to 36 depending on display size and physical space and power requirements	Up to 96 depending on display size and physical space and power requirements		1 display per Control I; 4 displays per Control II or IIA
	Multi-Drop	Optional	Optional		Yes
AUXILIARY EQUIPMENT	Printer	Teletype Model 33 or 35 KSR or RO			Teletype Model 33 RO; one per Control
	Other	Teletype CX Paper Tape Reader and DRPE Paper Tape Punch			None
COMMENTS		Many different arrangements of number of lines/display and characters/line are available; all displays must have the same arrangement. Different models of the display units and auxiliary devices can be intermixed on the same control unit			Up to 4 Control II's and 12 Control IIA's can be multiplexed to one data set

COMPARISON CHART: ALPHANUMERIC DISPLAY TERMINALS

IDENTITY		Computer Communications CC-30 Communications Station	CDC 210 Entry Display System	217 Video Display Station
REPORT NUMBER		6125	6140	6140
DISPLAY UNITS	Identity	CC-300 Model II TV Receiver	211F Entry/Display Station	217 Station Display
	Display Size, inches	8 wide; 6.5 high	8.0 wide; 6.0 high	8 wide; 6 high
	Char/Line	40	50; see Comments	50; see Comments
	Lines/Display	20; 24 (optional)	20; see Comments	20; see Comments
	Number of Displayable Characters	64; 96 (optional)	64	64
	Total Char/Display	800; 960 (optional)	1000	1000
	Character Generation Technique	5-by-7 dot matrix	5-by-7 dot matrix	5-by-7 dot matrix
EDITING FACILITIES	Horizontal Tab	Yes; one fixed position	No	No
	Line Erase	No	No	No
	Line Insert	No	No	No
	Transmit Partial Display	Yes	Yes	Yes
	Split Screen	Yes	No	No
	Other	Full range of cursor movement controls	Full range of cursor movement controls	Full range of cursor movement controls
CONTROL UNIT	Identity	CC-301 Model II TV Display Controller (portable)	216 Remote Controller	Contained in display unit
	Type of Buffer Storage	Magnetic Core	Delay line	Delay line
	Buffer Capacity, Characters	1024	1000 char/display	1000
	Maximum Number of Devices per Controller	1 display unit plus up to 16 slave displays; up to 7 auxiliary units in any combination	Up to 12 display units and printers; 6 printers maximum	1; up to 5 display units can be multiplexed into one data set
	Multi-Drop	Yes	Yes	Yes
AUXILIARY EQUIPMENT	Printer	Motorola; Teletype 33 or 35 RO or ASR	IBM Selectric Typewriter	None
	Other	Card reader; other devices on request	None	None
COMMENTS		There are six display models ranging in size from 8 to 18 inches; Model II is the most popular	80 char/line, 13-line display arrangement available; interfaces available for direct connection to a computer I/O channel	80 char/line, 13-line display arrangement available

COMPARISON CHART: ALPHANUMERIC DISPLAY TERMINALS

IDENTITY		GE Datanet-760 Keyboard/Display Subsystem	Honeywell Series 200 Visual Information Projection System		
REPORT NUMBER		6321	6384		
DISPLAY UNITS	Identity	DMU761 Display Monitor Unit	303/304/317	311	312
	Display Size, inches	8.0 wide; 6.3 high	7.75 wide; 5.50 high	4.75 wide; 3.75 high	4.75 wide; 3.75 high
	Char/Line	46	8 to 64	8 to 42	8 to 42
	Lines/Display	4, 8, 16, or 26	2 to 12	2 to 12	2 to 12
	Number of Displayable Characters	64	39 plus 15 optional	14 plus up to 12 optional	40 plus up to 12 optional
	Total Char/Display	184, 368, 736, or 1196	32 to 768	32 to 384	32 to 384
	Character Generation Technique	5-by-7 dot matrix	5-by-7 dot matrix	5-by-7 dot matrix	5-by-7 dot matrix
EDITING FACILITIES	Horizontal Tab	Yes	No		
	Line Erase	No	Yes		
	Line Insert	No	No		
	Transmit Partial Display	Yes	Yes		
	Split Screen	No	Optional		
	Other	Full range of cursor movement controls; special symbols facilitate tables	Full range of cursor movement controls		
CONTROL UNIT	Identity	DCU760 Display Controller Unit	323		
	Type of Buffer Storage	Delay line	Delay line		
	Buffer Capacity, Characters	Up to 5888 in units of 1472	768 to 6912		
	Maximum Number of Devices per Controller	32 display units and printers; max. of 4 printers	Up to 96; maximum actual number depends on display size and physical space and power requirements		
	Multi-Drop	No	Optional		
AUXILIARY EQUIPMENT	Printer	Teletype Model 33 or 35 RO	Teletype Model 33 or 35 KSR or RO		
	Other	None	Teletype CX Paper Tape Reader and DRPE Paper Tape Punch		
COMMENTS		The DMU761 and Electronic Keyboard (EKB 761) replace the DTU 760 Display Terminal Unit; slaved display and printer monitors are available	Many different arrangements of number of lines/display and char/line are available; all displays must have the same arrangement. Different models of display units and auxiliary devices can be intermixed on the same Control Unit. This equipment is manufactured by Bunker-Ramo		

COMPARISON CHART: ALPHANUMERIC DISPLAY TERMINALS

IDENTITY		IBM 2260 Display Station	RCA 6051 Video Data Interrogator	RCA 70/752 Video Data Terminal
REPORT NUMBER		6456	6701	6702
DISPLAY UNITS	Identity	2260 Display Station	6051 Video Data Interrogator	70/752 Display Terminal
	Display Size, inches	9 wide; 4 high	8.0, 8.16, or 8.0 wide; 6.0, 4.0, or 4.8 high	8.0 wide; 5.6 high
	Char/Line	40 or 80	32, 48, or 40	54
	Lines/Display	6 or 12	15, 10, or 12	20
	Number of Displayable Characters	64	64	64
	Total Char/Display	240, 480, or 960	480	1080
	Character Generation Technique	5-by-7 dot matrix	Monoscope	Stroke
EDITING FACILITIES	Horizontal Tab	No	No	No
	Line Erase	No	No	Yes
	Line Insert	No	No	Yes
	Transmit Partial Display	Yes	Yes	Yes
	Split Screen	Yes	Yes	Yes
	Other	Limited cursor control with basic unit; full range of controls optional	Full range of cursor movement controls; can use preset formats	Full range of cursor movement controls
CONTROL UNIT	Identity	2848 Display Control	6077 Interrogator Control Terminal	Contained in terminal
	Type of Buffer Storage	Delay line	Magnetic disc	Delay line
	Buffer Capacity, Characters	7680	480 char per Display unit	1080
	Maximum Number of Devices per Controller	24 display units and 1 printer	8	Up to 8 displays can be multiplexed onto one line via 70/755 Switch; 1 printer per display
	Multi-Drop	No	No	Yes
AUXILIARY EQUIPMENT	Printer	IBM 1053 Model 4	None	Teletype 33 or 35 RO
	Other	None	None	None
COMMENTS			No longer in production; available on "as returned" basis only	Replaces RCA 6051 Video Data Interrogator

COMPARISON CHART: ALPHANUMERIC DISPLAY TERMINALS

IDENTITY		Raytheon DIDS-400		Sanders 720 Data Display System
REPORT NUMBER		6735		6745
DISPLAY UNITS	Identity	401 Display Console	402 Display Console	708 Display Unit
	Display Size, inches	8.5 wide; 6.5 high	8.5 wide; 6.5 high	7.5 wide, 9.5 high; see Comments
	Char/Line	40 to 80	40 to 80	52; see Comments
	Lines/Display	13	13	40; see Comments
	Number of Displayable Characters	64	64	64
	Total Char/Display	520 or 1040	520 or 1040	256, 512, or 1024; total of 2080 display positions
	Character Generation Technique	Monoscope	Monoscope	Stroke
EDITING FACILITIES	Horizontal Tab	Optional	No	Yes
	Line Erase	Yes	Yes	Yes
	Line Insert	No	No	Yes
	Transmit Partial Display	Yes	Yes	Yes
	Split Screen	Optional	No	Yes
	Other	See Comments	See Comments	Vertical tab; full range of cursor movement controls
CONTROL UNIT	Identity	425 Control Unit	Contained in Console	701 Control Unit
	Type of Buffer Storage	Delay line (in each display)	Delay line	Delay line
	Buffer Capacity, Characters	520 or 1040 per display unit	520 or 1040	1024, 2048, or 3072
	Maximum Number of Devices per Controller	64 Display Consoles and printers	1; up to 5 Display Consoles can share one data set	12 Display Units; one printer can share each display buffer segment
	Multi-Drop	Yes	Optional	Yes
AUXILIARY EQUIPMENT	Printer	Teletype 33 or 35 RO	Teletype 33 or 35 RO	Teletype 33 or 35 RO
	Other	None	None	Teletype CX Paper Tape Reader and DRPE Paper Tape Punch
COMMENTS		Other editing facilities include character insert and delete with expansion or contraction of text, and full range of cursor movement controls		Several different keyboard arrangements are available; 9.5-by-7.5 display is available, with 64 char/line and 32 lines/display (2048 positions total)

COMPARISON CHART: ALPHANUMERIC DISPLAY TERMINALS

IDENTITY		Stromberg-Carlson S-C 1100 Inquiry Display System	UNIVAC Uniscope 300 Visual Communication Terminal
REPORT NUMBER		—	6864
DISPLAY UNITS	Identity	C560 Inquiry Display Station	Display unit
	Display Size, inches	Nominally 5.0 wide, 3.0 high; see Comments	10 wide by 5 high
	Char/Line	50	64
	Lines/Display	10	8 or 16
	Number of Displayable Characters	61 (selected by user from 78 when ordered)	56, 61, or 96
	Total Char/Display	500	1024 or 512
	Character Generation Technique	5-by-7 dot matrix	Stroke
EDITING FACILITIES	Horizontal Tab	No	Yes
	Line Erase	No	Yes
	Line Insert	No	Yes
	Transmit Partial Display	Yes	Yes
	Split Screen	No	Yes
	Other	Full range of cursor movement controls	Full range of cursor movement controls
CONTROL UNIT	Identity	C310 Station Controller	300M Multi-Station Control Unit
	Type of Buffer Storage	Delay line (located in each Display Station)	Magnetic core
	Buffer Capacity, Characters	500 per Display Station	8,192, 16,384, or 24,576
	Maximum Number of Devices per Controller	24 Display Stations and 4 printers	24 or 48
	Multi-Drop	No	Yes
AUXILIARY EQUIPMENT	Printer	Yes	None
	Other	None	None
COMMENTS		Display width can be adjusted from 3.0 to 6.5 inches; height from 1.0 to 3.5 inches	300S Terminal contains one display station and an integral control unit; 122 overlays for the optional 35 function keys can be automatically identified.

COMPARISON CHART: ALPHANUMERIC DISPLAY TERMINALS SUPPLEMENT 1

IDENTITY		Computer Communications CC-33 Teletype Oriented Display Station	IBM 2265 Display Station	Sanders 620 Stand-Alone Data Display System
REPORT NUMBER		6126	6459	6744
DISPLAY UNITS	Identity	CC-300 Model II TV Receiver	2265 Display Station	6220 Display Unit
	Display Size, inches	8 wide; 6.5 high	10.4 wide; 4.8 or 3.12 high	7.5 wide; 9.5 high; see Comments
	Char/Line	40	64; 80	52
	Lines/Display	20; 24 (optional)	15; 12	40
	Number of Displayable Characters	64; 96 (optional)	64	64
	Total Char/Display	800; (960 optional)	960	768; 2080 display positions
	Character Generation Technique	5-by-7 dot matrix	Stroke	Stroke
EDITING FACILITIES	Horizontal Tab	Yes; one fixed position	No	Optional
	Line Erase	No	No	No
	Line Insert	No	No	No
	Transmit Partial Display	Yes	Yes	Yes
	Split Screen	Yes	Yes	Yes
	Other	Full range of cursor movement controls	Full range of cursor movement controls	Full range of cursor movement controls
CONTROL UNIT	Identity	CC-301 Model III TV Display Controller	2845 Display Control	Self-contained
	Type of Buffer Storage	Magnetic core	?	?
	Buffer Capacity, Characters	1024	960	781
	Maximum Number of Devices per Controller	1 display; up to 16 monitors; up to 7 auxiliary units in any combination	1 display unit and 1 printer	1 display unit and 1 printer; see Comments
	Multi-Drop	Yes	Yes	Yes
AUXILIARY EQUIPMENT	Printer	Motorola TP; see Comments	1053 Model 4	Teletype Model 33 or 35 RO
	Other	Card reader; other devices on request	None	None
COMMENTS		Teletype Model 33 or 35 RO or KSR can be attached as an auxiliary unit; switch-selectable transmission rates at 110, 600, and 1200 bits/sec	Two format arrangements are available as shown	Horizontal format is also available with 64 or 84 char/line and 32 lines/display; up to 20 terminals can share a line

COMPARISON CHART: ALPHANUMERIC DISPLAY TERMINALS SUPPLEMENT 1 (CONTD.)

IDENTITY		Philco-Ford Alphanumeric Color Display Unit Model D-20	Philco-Ford Alphanumeric Display Unit Model D-21
REPORT NUMBER		6650	6651
DISPLAY UNITS	Identity	Model D-20 Display Unit	Model D-21 Display Unit
	Display Size, inches	10.4 wide; 7.4 high	10.7 wide; 9 high
	Char/Line	32	64
	Lines/Display	24	24
	Number of Displayable Characters	60	62
	Total Char/Display	768	1536
	Character Generation Technique	5-by-7 dot matrix	5-by-7 dot matrix
EDITING FACILITIES	Horizontal Tab	No	No
	Line Erase	No	No
	Line Insert	No	No
	Transmit Partial Display	No	Yes
	Split Screen	No	Yes
	Other	Full range of cursor movement controls	Full range of cursor movement controls
CONTROL UNIT	Identity	Self-contained	Self-contained
	Type of Buffer Storage	Magneto-strictive delay lines	Magneto-strictive delay lines
	Buffer Capacity, Characters	768	1536
	Maximum Number of Devices per Controller	1	1
	Multi-Drop	No	Yes
AUXILIARY EQUIPMENT	Printer	None	None
	Other	None	None
COMMENTS		D-20 can display data in red, green, blue, or white; colors can be intermixed	D-21 is compatible with IBM 2260 message format

COMPARISON CHART: ALPHANUMERIC DISPLAY TERMINALS
SUPPLEMENT 2

IDENTITY		RCA 70/750 Modular Video Data System						
REPORT NUMBER		6703						
DISPLAY UNITS	Identity	70/751-10, -11, -12 Video Data Terminal						
	Display Size, inches	4.0w; 2.8h	8.0w; 1.4h	4.0w; 5.6h	8.0w; 2.8h	8.4w; 1.7h	8.0w; 5.6h	8.4w; 3.4h
	Char/Line	27	5.4	27	54	80	54	80
	Lines/Display	10	5	20	10	6	20	12
	Number of Displayable Characters	96	96	96	96	96	96	96
	Total Char/Display	270	270	540	540	480	1080	960
	Character Generation Technique	Monoscope						
EDITING FACILITIES	Horizontal Tab	Optional						
	Line Erase	Yes						
	Line Insert	Yes						
	Transmit Partial Display	Yes						
	Split Screen	Yes						
	Other	Full range of cursor movement controls						
CONTROL UNIT	Identity	70/759 Video Data Controller; contains up to four Video Data Generators						
	Type of Buffer Storage	Magneto-strictive delay lines contained in Video Data Generator						
	Buffer Capacity, Characters	2160 per Video Data Generator; up to four VDG's per Video Data Controller						
	Maximum Number of Devices per Controller	8 per 70/756-11 VDG; 4 per 70/756-21 VDG; 2 per 70/756-31 VDG						
	Multi-Drop	Optional						
AUXILIARY EQUIPMENT	Printer	None						
	Other	None						
COMMENTS		A 70/750 System includes a 70/759 Controller, up to four 70/756 Video Data Generators, and up to eight 70/751 Video Data Terminals per VDG; the display arrangement and number of Terminals is a function of the 70/756 VDG model employed						

IDENTITY		Wyle Model 600 Computerminal	Xerox Data Systems 7550/7555 Multi-purpose Keyboard Display	Delta Data Systems Telterm I	Delta Data Systems Telterm II	Delta Data Systems Telterm III
REPORT NUMBER		—	—	—	—	—
DISPLAY UNIT	Identity	600 Display	7550/7555 Display	Telterm I	Telterm II	Telterm III
	Viewing Area, in.	6 wide; 4.5 high	10 wide; 7 high	10 wide; 6 high	10 wide; 6 high	10 wide; 6 high
	Char/Line	32	86	80	80	80
	Lines/Display	8	32	27	27	27
	Char Set	64	96	64; 96 optional	64; 96 optional	64; 96 optional
	Total Char/Display	1024	2048; 2752 char positions	2160	2160	2160
	Char Generation Technique	Stroke	Monoscope	7 X 9 dot matrix	7 X 9 dot matrix	7 X 9 dot matrix
EDITING FACILITIES	Horizontal Tab	Yes	No	Yes	Yes	Yes
	Line Erase	Yes	Yes	No	Yes	Yes
	Line Insert	Yes	Yes	No	Yes	Yes
	Partial Display Transmit	Yes	Yes	No	Yes	Yes
	Split Screen	Yes	No	Yes	Yes	Yes
	Other	Char insert/delete; erase display	Char insert/delete; erase display; scrolling	Blink; format; paging	Edit; format; blink; margin set; paging	Edit; format; blink; margin set; paging
CONTROL UNIT	Identity	Self-contained	Self-contained	Self-contained	Self-contained	Self-contained
	Type of Buffer Storage	Magnetic core	Magnetostrictive delay line	MOS	MOS	MOS
	Buffer Capacity Char	1024	2285	2500	2500	2500
	Max Devices/ Controller	1 display; 1 printer	1	Unlimited slaves	Unlimited slaves	Unlimited slaves
	Multi-Drop	Yes	No	Optional	Optional	Optional
PERIPHERY	Printer	TTY 33/35	TTY 35/37 RO	10 cps, 30 cps, 400 cps	10 cps, 30 cps, 400 cps	10 cps, 30 cps, 400 cps
	Other	Mag tape cassette recorder	7553 Hard Copy Output (optional)	Cassette tape; punch/mark sense card; paper tape	Cassette tape; punch/mark sense card; paper tape	Cassette tape; punch/mark sense card; paper tape
PURCHASE PRICE, $		4700	10,000 (7550); 12,500 (7555)	3000	3500	4500
MONTHLY RENTAL, $		—	265 (7550); 330 (7555)	90	100	120
COMMENTS		Operates in full-duplex; asynchronous up to 1200 bps; 8-level USASCII; up to 23 units can be multidropped on 1 line; vertical/longitudinal parity checking; compatible with Bell System Data Set 202D; addressable memory; polled transmission; parallel interface optional; serial rates up to 2400/4800 bps available	Compatible with TTY 37; operates in full-duplex mode at 150 bps (Model 7750)/optionally at 1800 bps (Model 7555); operates in char/echo or message mode modes; half-duplex optional; compatible with Bell System Data Set 202	Plug-to-plug TTY replacement; separate numeric pad; 4,000,000-bps parallel data rate; paging enables storage capacity in excess of selected display data	Block mode transmission; plug-to-plug TTY replacement; separate numeric pad; 4,000,000-bps parallel data rate; paging enables storage capacity in excess of selected display data	IBM 2260/2265 replacement; block mode transmission; separate numeric pad; 4,000,000-bps parallel data rate; paging enables storage capacity in excess of selected display data

IDENTITY		American Terminal Systems Series 765 Video Communication Terminal	American Terminal Systems Series 766 Video Communication Terminal	American Terminal Systems Series 767 Video Communication Terminal	Applied Digital Data Systems Envoy 600 Portable CRT Terminal	Applied Digital Data Systems Envoy 640 Portable CRT Terminal
REPORT NUMBER		—	—	—	—	—
DISPLAY UNIT	Identity	765-10/-20/-30/-40	766-10/-20/-30/-40	767-10/-20/-30/-40	Envoy 600	Envoy 640
	Viewing Area, in.	9 (tube diagonal)	9 (tube diagonal)	12 (tube diagonal)	3.5 wide; 2.25 high	3.5 wide; 2.25 high
	Char/Line	32	64	80	32	64
	Lines/Display	4; 8; 15; 16; 30	4; 8; 16; 30	4; 8; 16; 30	16	16
	Char Set	64; 96 opt	64; 96 opt	64; 96 opt	64	64
	Total Char/Display	128; 256; 480; 512; 960	256; 512; 1024; 1920	320; 640; 1280; 2400	256	512
	Char Generation Technique	9 x 14 filled stroke matrix	9 x 14 filled stroke matrix	9 x 14 filled stroke matrix	5 x 7 dot matrix	5 x 7 dot matrix
EDITING FACILITIES	Horizontal Tab	Yes	Yes	Yes	Yes (fixed stop at each 8th position)	Yes (fixed stop at each 8th position)
	Line Erase	Optional	Optional	Optional	No	No
	Line Insert	Optional	Optional	Optional	No	No
	Partial Display Transmit	Optional	Optional	Optional	No	Yes
	Split Screen	Optional	Optional	Optional	No	Yes
	Other	Char/page erase; CR/LF; scroll; full cursor controls	Char/page erase; CR/LF; scroll; full cursor controls	Char/page erase; CR/LF; scroll; full cursor controls	Full cursor controls; CR; home; screen erase	Full cursor controls; CR; home; screen erase; char insert/delete; fixed format; blink
CONTROL UNIT	Identity	Self-contained	Self-contained	Self-contained	Self-contained	Self-contained
	Type of Buffer Storage	MOS	MOS	MOS	MOS semiconductor	MOS semiconductor
	Buffer Capacity Char	128; 256; 480; 512; 960	256; 512; 1024; 1920	320; 640; 1280; 2400	256	512
	Max Devices/ Controller	4, 8, 12, or 16 (15 if printer interface required) displays per Polling Adapter	4, 8, 12, or 16 (15 if printer interface required) displays per Polling Adapter	4, 8, 12, or 16 (15 if printer interface required) displays per Polling Adapter	1 display	1 display
	Multi-Drop	Optional	Optional	Optional	No	No
PERIPHERY	Printer	ADS Series 715 Printer	ADS Series 715 Printer	ADS Series 715 Printer	No	No
	Other	ADS Mag Tape Cassette	ADS Mag Tape Cassette	ADS Mag Tape Cassette	—	—
PURCHASE PRICE, $		1,900-2,400	2,500-3,500	2,700-3,900	3,195	3,695
MONTHLY RENTAL, $		125 max	175 max	200 max	—	—
COMMENTS		IBM 2845/2265 replacement via 360/2701; half-/full-duplex; sync/async; serial up to 75, 110, 150, 300, 600, 1200, 2400, 4800, 9600 bps; 15,000 cps parallel; char-/line-blink, char-/line-insert, char-/line-delete, polling, lower case opt	IBM 2845/2265 replacement via 360/2701; half-/full-duplex; sync/async; serial up to 75, 110, 150, 300, 600, 1,200, 2,400, 4,800, 9,600 bps; 15,000 cps parallel; char-/line-blink, char-/line-insert, char-/line-delete, polling, lower case opt	IBM 2845/2265 replacement via 360/2701; half-/full-duplex; sync/async; serial up to 75, 110, 150, 300, 600, 1,200, 2,400, 4,800, 9,600 bps; 15,00 cps parallel; char-/line-blink, char-/line-insert, char-/line-delete, polling, lower case opt	Portable; built-in acoustic coupler; TTY compatible; data compression; local edit in conversation mode; async; USASCII; half-duplex; 110/300 bps (selectable)	Portable; built-in acoustic coupler; TTY compatible; data compression; local edit in conversation mode; async; USASCII; half-duplex; 110/300 bps (selectable)

IDENTITY		Applied Digital Data Systems Consul 800 Stand-Alone CRT Terminal	Applied Digital Data Systems Consul 840 Stand-Alone CRT Terminal	Applied Digital Data Systems Consul 880 Stand-Alone CRT Terminal	Hazeltine 1760 Desk-Top Video Display Terminal	Hazeltine 2000 Desk-Top Video Display Terminal
REPORT NUMBER		—	—	—	—	—
DISPLAY UNIT	Identity	Consul 800	Consul 840	Consul 880	1760	2000
	Viewing Area, in.	6 wide; 4 high	6 wide; 4 high	—	6.48 wide; 6.48 high	10 wide; 5.5 high
	Char/Line	32	64	80	55	74
	Lines/Display	16	16	20-24	32	27
	Char Set	64	64	64	64	64
	Total Char/Display	256	512	1,600-1,920	1,760	1,998
	Char Generation Technique	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
EDITING FACILITIES	Horizontal Tab	Yes (fixed stop at each 8th position)	Yes (fixed stop at each 8th position)	Yes (fixed stop at each 8th position)	Yes (also vertical/diagonal)	Yes
	Line Erase	No	No	No	Yes	Yes
	Line Insert	No	No	No	Yes	Yes
	Partial Display Transmit	No	Yes	Yes	Yes	Yes
	Split Screen	No	Yes	Yes	As programmed	As programmed
	Other	Full cursor controls; CR; home; screen erase	Full cursor controls; CR; home; screen erase; char insert/delete; fixed format; blink	Full cursor controls; CR; home; screen erase; char insert/delete; fixed format; blink	Full cursor controls; char insert/delete; fixed format; variable roll-up	Full cursor controls; char insert/delete; fixed format; variable roll-up
CONTROL UNIT	Identity	Self-contained	Self-contained	Self-contained	Self-contained	Self-contained
	Type of Buffer Storage	MOS semiconductor	MOS semiconductor	MOS semiconductor	Magnetic core	Magnetic core
	Buffer Capacity Char	256	512	1,600-1,920	2,048	2,048
	Max Devices/ Controller	1 display/printer/ cassette unit	1 display/printer/ cassette unit	1 display/printer/ cassette unit	1 display, printer/ cassette; slave monitors	1 display, printer/ cassette; slave monitors
	Multi-Drop	No	No	No	Yes	Yes
PERIPHERY	Printer	Yes	Yes	Yes	Yes	Yes
	Other	Mag tape cassettes	Mag tape cassettes	Mag tape cassettes	Mag tape cassette; remote monitors	Mag tape cassette; remote monitors
PURCHASE PRICE, $		2,995	3,495	3,995	2,995 (1-24 units)	2,995 (1-24 units)
MONTHLY RENTAL, $		—	—	—	108	108
COMMENTS		Desk-top verion of ADDS Envoy 600; hard copy interface; built-in acoustic/hardwired modem (Bell System 103 equivalent); TTY compatible; data compression; local edit in conversation mode; async; USASCII; half-duplex; 110/300 bps (selectable)	Desk-top verion of ADDS Envoy 640; hard copy interface; built-in acoustic/hardwired modem (Bell System 103 equivalent); TTY compatible; data compression; local edit in conversation mode; async; USASCII; half-duplex; 110/300 bps (selectable)	Desk-top version of ADDS Envoy 640 with increased char capacity; hard copy interface; built-in acoustic/hard-wired modem (Bell System 103 equivalent) TTY compatible; data compression; local edit in conversation mode; async; USASCII; half-duplex; 110/300 bps (selectable)	Asynchronous; serial rates to 110, 150, 300, 600, 1,200 bps (switchable); adjustable to 9,600 bps plus; half-duplex; solid state removable keyboard; 8-level USASCII; 32 control codes; modular CRT can be remoted; computer addressable cursor	TTY compatible; asynchronous; serial rates to 110, 150, 300, 600, 1,200 bps (switchable); adjustable to 9,600 bps plus; half-/full-duplex; solid state TTY removable keyboard; 8-level USASCII; 32 control codes; computer addressable cursor; all keyboard functions fully program controllable

IDENTITY		Honeywell CCD Series 16 Alphanumeric Display Terminal Model 316/516-7210	Imlac PDS-1 Programmable Display System	International Computer Terminals SPD 10/20 Stored Program Display	Mark Computer Systems DD-70 Data Display Terminal	
REPORT NUMBER		—	—	—	—	
DISPLAY UNIT	**Identity**	7215; 7216	PDS-1	SPD 10/20	DD-70M	DD-70L
	Viewing Area, in.	10.0 wide; 5.0 high	8.5 wide; 7.5 high	9.5 wide; 7.0 high	7.0 wide; 4.5 high	8.3 wide; 6.0 high
	Char/Line	64	Up to 128	64	32	32/64
	Lines/Display	16	Up to 64	1-30 (programmable)	8	16/32
	Char Set	64	As programmed; see Comments	64	64	64
	Total Char/Display	1,024	1,200 (40 frames/sec)	1,920	256	1,024
	Char Generation Technique	Closed stroke	Vector stroke	7 x 10 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
EDITING FACILITIES	**Horizontal Tab**	Yes	Yes	Yes (any combination)	Yes	Yes
	Line Erase	Yes	Yes	Yes	Repeat char erase	Repeat char erase
	Line Insert	Yes	Yes	Yes	Repeat char insert	Repeat char insert
	Partial Display Transmit	Yes	Yes	Yes (including fields)	Yes	Yes
	Split Screen	No	Yes	Yes (horizontally/ vertically)	No	No
	Other	Data protect/tab; full cursor controls; char insert/delete	Full cursor controls; keyboard graphics editing	Programmed for application oriented functions; full cursor controls	Full cursor controls; char insert/delete	Full cursor controls; char insert/delete
CONTROL UNIT	**Identity**	Self-contained	PDS-1	Self-contained	Self-contained	Self-contained
	Type of Buffer Storage	Magnetic core	Magnetic core	Magnetic core	MSI	MSI
	Buffer Capacity Char	1,048	1,440	1,920	256	1,024
	Max Devices/ Controller	1	No hardware limit; software-limited by function of application	1 display, printer	1 display/printer	1 display/printer
	Multi-Drop	—	Optional	Yes	—	—
PERIPHERY	**Printer**	Optional (via 7217 interface)	Optional	Yes (30 cps, 132-char line)	TTY ASR 33; Inktronic 2101	TTY ASR 33; Inktronic 2101
	Other	7217 interface accommodates badge reader/other devices	Paper/mag tape; discs (opt)	Tape cassette; TTY; microfilm viewer	—	—
PURCHASE PRICE, $		4,950 (display/control); 500 (serial interface); 300 (keyboard)	8,845 (basic)	5,300 (51-unit quantity)	3,500	4,400
MONTHLY RENTAL, $		134 (display/control); 14 (serial interface); 8 (keyboard)	300	96 (51-unit quantity, 5-yr lease)	80.50 — 107.75 (depending on options)	101.20 — 118.45 (depending on options)
COMMENTS		Displays operate with any Series 16 communication options (asynchronous/synchronous, up to 9,600 bps); can be driven from multiline controllers/in polled environment	91 alphanumeric, 36 graphic char generation subroutines in std text/ graphics editing program; any software-defined char/symbols can be programmed/ controlled by any key; includes 16-bit processor; 4K core; opt horizontal orientation; serial rates to 9,600 bps; any 5- to 8-level code	Contains small programmable 2,048-word core memory computer; multiplexor available to connect/address 16 displays on 1 line; 75-4,800 bps serial rate; sync/async; USASCII; half-/full-duplex; 16 special function keys	Various arrangements include horizontal/vertical CRT, hardwired/keyboard-variable format, auxiliary files, insert/delete edit, blink/intensity called-up char, attached/separate keyboard, internal 2-wire modem, RS232B/TTY interface; 5,000-cps display output; 19 max control keys; parity checking; recognize reverse error code; 1,000-50,000 bps line speed (voice-/broadband); modified USASCII; 2-wire half-duplex (voice)/simplex (broad); asynchronous	

IDENTITY		Photophysics Model 45 B CRT Data Terminal (with integral printer)	Spiras Systems Irascope Series UL	Spiras Systems Irascope Series UL	Spiras Systems Irascope Series TY	Spiras Systems Irascope Series TY
REPORT NUMBER		—	—	—	—	—
DISPLAY UNIT	Identity	45 B std TV monitor	DBEC-A/N-UL	DBEC-A/N-UL-360	DBEC-A/N-TY	DBEC-A/N-TY-360
	Viewing Area, in.	8.5 wide; 6.25 high	9.5 wide; 7 high	9.5 wide; 7 high	9.5 wide; 7 high	9.5 wide; 7 high
	Char/Line	40	64	64	64	64
	Lines/Display	25	32	32	32	32
	Char Set	96	64	64	64	64
	Total Char/Display	1,000	1,028 (less 6 char/line	1,028 (less 6 char/line)	1,028 (less 5 char/line	1,028 (less 5 char/line)
	Char Generation Technique	5 x 7 dot matrix	Monoscope	Monoscope	Monoscope	Monoscope
EDITING FACILITIES	Horizontal Tab	Yes	Yes	Yes	Yes	Yes
	Line Erase	Yes	Yes	Yes	Yes	Yes
	Line Insert	Optional	Yes	Yes	Yes	Yes
	Partial Display Transmit	Yes	Yes	Yes	Yes	Yes
	Split Screen	Yes	Yes	Yes	Yes	Yes
	Other	Full cursor controls; CR/LF; clear page; char insert/delete; double space; recall line; char blink	Char insert/delete; format protect; full cursor controls	Char insert/delete; format protect; full cursor controls	Char insert/delete; format protect; full cursor controls; page roll	Char insert/delete; format protect; full cursor controls; page roll
CONTROL UNIT	Identity	Self-contained	Self-contained	Self-contained	Self-contained	Self-contained
	Type of Buffer Storage	MOS semiconductor	Magnetostrictive delay line	Magnetostrictive delay line	Magnetostrictive delay line	Magnetostrictive delay line
	Buffer Capacity Char	1,000	1,028	1,028	1,028	1,028
	Max Devices/ Controller	—	1 display (plus peripherals)	1 display (plus peripherals)	1 display (plus peripherals)	1 display (plus peripherals)
	Multi-Drop	Optional	Yes	Yes	Yes	Yes
PERIPHERY	Printer	Integral Quantafax Copier	Yes	Yes	Yes	Yes
	Other	Mag tape cassette systems	Mag tape, paper tape, cassette	Mag tape, paper tape, cassette	Mag tape, paper tape, cassette	Mag tape, paper tape, cassette
PURCHASE PRICE, $		9,900	5,745	7,245	4,995	6,495
MONTHLY RENTAL, $		340	—	—	—	—
COMMENTS		IBM 360-compatible; sync/async; polled/ nonpolled; 8-level USASCII; limited graphics; 110, 150, 300, 600, 1,200 bps serial; 2,400 bps opt; 60,000 cps parallel; integral electrophotographic printer for 5x5-in. hard copy of displayed data in 5 sec (add. Copies at 2-sec intervals); echoplex/ half-/full-duplex	Char/line field adjustable from 40 to 80; half-duplex; optional parallel interface; serial data rate up to 1,200 bps; modified 7-level USASCII	Char/line field adjustable from 40 to 80; half-duplex optional parallel interace; serial data rate up to 1,200 bps; modified 7-level USASCII; IBM 360 remote capability via 2701 Data Adapter Unit	Max 80 char/line; double-key rollover/ lock-out; page roll starts at 833rd char/ 33rd line; Message mode permits editing (block transfer from cursor to EOM); TTY-compatible (char-key transfer); USASCII; half-duplex	Max 80 char/line; double-key rollover/ lock-out; Message mode permits editing (block transfer); TTY-compatible (char-key transfer); USASCII; half-duplex; IBM 360 remote capability via 2701; CC-1 Cluster Controller polls/ multiplexes up to 31 displays (groups of 8), 1 printer

IDENTITY		Spiras Systems Irascope Series TY	Spiras Systems Irascope Series TY	TEC Series 400 Model 430 Data-Screen Terminal	TEC Series 400 Model 440 Data-Screen Terminal	TEC Series 400 Model 450 Data-Screen Terminal
REPORT NUMBER		—	—	—	—	—
DISPLAY UNIT	Identity	DBC-A/N-TY	DBC-A/N-TY-360	430	440	450
	Viewing Area, in.	9.5 wide; 7 high	9.5 wide; 7 high	9 wide; 6.5 high	9 wide; 6.5 high	9 wide; 6.5 high
	Char/Line	64	64	32	40	50
	Lines/Display	32	32	Up to 24	Up to 24	Up to 24
	Char Set	64	64	64	64	64
	Total Char/Display	1,028 (less 5 char/line)	1,028 (less 5 char/line)	768	900	1,200
	Char Generation Technique	Monoscope	Monoscope	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
EDITING FACILITIES	Horizontal Tab	No	No	Yes	Yes	Yes
	Line Erase	No	No	Yes	Yes	Yes
	Line Insert	No	No	Yes	Yes	Yes
	Partial Display Transmit	No	No	Yes	Yes	Yes
	Split Screen	No	No	Yes	Yes	Yes
	Other	Without Message/Edit logic assembly	Without Message/Edit logic assembly	Full cursor controls; char insert/delete; blink; protected format; roll up/down	Full cursor controls; char insert/delete; blink; protected format; roll up/down	Full cursor controls; char insert/delete; blink; protected format; roll up/down
CONTROL UNIT	Identity	Self-contained	Self-contained	410 Controller	410 Controller	410 Controller
	Type of Buffer Storage	Magnetostrictive delay line	Magnetostrictive delay line	MOS	MOS	MOS
	Buffer Capacity Char	1,028	1,028	As required	As required	As required
	Max Devices/ Controller	1 display (plus peripherals)	1 display (plus peripherals)	31	31	31
	Multi-Drop	Yes	Yes	—	—	—
PERIPHERY	Printer	Yes	Yes	TTY	TTY	TTY
	Other	Mag tape, paper tape, cassette	Mag tape, paper tape, cassette	—	—	—
PURCHASE PRICE, $		4,495	5,995	1,486 (basic)	1,486 (basic)	1,769 (basic)
MONTHLY RENTAL, $		—	—	—	—	—
COMMENTS		Max 80 char/line; double-key rollover/ lock-out; char-key transfer only; TTY-compatible; USASCII; half-duplex; opt Model E-1 Message/Edit logic assembly costs $650, converts unit to Model DBEC-A/N-TY	Max 80 char/line; double-key rollover/ lock-out; char-key transfer only; TTY-compatible; USASCII; half-duplex; IBM 360 remote capability via 2701; CC-1 Cluster Controller polls/ multiplexes up to 31 displays (groups of 8), 1 printer;	Options include I/O adapters (sync/async/ parallel/TTY), editing, printer adapter, 96-char set, edit/ non-edit keyboards; stand-alone/multistation models available; char/line addressing; modified USASCII; 75-9,600 bps serial; half-/full-duplex	Options include I/O adapters (sync/async/ parallel/TTY), editing, printer adapter, 96-char set, edit/ non-edit keyboards; stand-alone/multistation models available; char/line addressing; modified USASCII; 75-9,600 bps serial; half-/full-duplex	Options include I/O adapters (sync/async/ parallel/TTY), editing, printer adapter, 96-char set, edit/ non-edit keyboards; stand-alone/multistation models available; char/line addressing; modified USASCII; 75-9,600 bps serial; half-/full-duplex

IDENTITY		TEC Series 400 Model 460 Data-Screen Terminal	Video Systems VST 1200 Video Data Terminal	Video Systems VST 2000 Video Data Terminal	Video Systems VST 5000 Video Data Terminal	Video Systems VST 7000 Video Data Terminal
REPORT NUMBER		—	—	—	—	—
DISPLAY UNIT	Identity	460	VST 1200	VST 2000	VST 5000	VST 7000
	Viewing Area, in.	9 wide; 6.5 high	10.5 wide; 8.0 high	10.5 wide; 8.0 high	10.5 wide; 8.0 high	10.5 wide; 8.0 high
	Char/Line	64	72	72	72	72
	Lines/Display	Up to 24	18 (1 page)	18 (2 pages)	18 (4 pages)	18 (6 pages)
	Char Set	64	64	64	64	64
	Total Char/Display	1,536	1,296	2,592	5,184	7,776
	Char Generation Technique	7 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix	5 x 7 dot matrix
EDITING FACILITIES	Horizontal Tab	Yes	No	No	No	No
	Line Erase	Yes	Yes	Yes	Yes	Yes
	Line Insert	Yes	No	No	No	No
	Partial Display Transmit	Yes	Yes	Yes	Yes	Yes
	Split Screen	Yes	Yes	Yes	Yes	Yes
	Other	Full cursor controls; char insert/delete; blink; protected format; roll up/down	Full cursor controls; selective transmit; page erase; page flip; home	Full cursor controls; selective transmit; page erase; page flip; home	Full cursor controls; selective transmit; page erase; page flip; home	Full cursor controls; selective transmit; page erase; page flip; home
CONTROL UNIT	Identity	410 Controller	Self-contained	Self-contained	Self-contained	Self-contained
	Type of Buffer Storage	MOS	Delay line	Delay line	Delay line	Delay line
	Buffer Capacity Char	As required	1,296	2,592	5,184	7,776
	Max Devices/ Controller	31	4 printers; multiple monitors	4 printers; multiple monitors	4 printers; multiple monitors	4 printers; multiple monitors
	Multi-Drop	—	No	No	No	No
PERIPHERY	Printer	TTY	Any USASCII serial input printer	Any USASCII serial input printer	Any USASCII serial input printer	Any USASCII serial input printer
	Other	—	Any serial incremental mag tape unit	Any serial incremental mag tape unit	Any serial incremental mag tape unit	Any serial incremental mag tape unit
PURCHASE PRICE, $		2,051 (basic)	3,990	4,590	4,990	5,790
MONTHLY RENTAL, $		—	77-145	79-155	119-185	149-215
COMMENTS		Options include I/O adapters (sync/async/ parallel/TTY), editing printer adapter, 96-char set, edit/non-edit keyboards; stand-alone/multistation models available; char/line addressing; modified USASCII; 75-9,600 bps serial; half-/full-duplex	TTY-compatible (opt); built-in coupler (hard-wired); any USASCII coding of function switches for remote positioning of cursor; parity checking; full-/ half-duplex; up to 1,200 bps (2,400 opt; TV-compatible	TTY-compatible (opt); built-in coupler (hard-wired); any USASCII coding of function switches for remote positioning of cursor; parity checking; full-/ half-duplex; up to 1,200 bps (2,400 opt); TV-compatible	TTY-compatible (opt); built-in coupler (hard-wired); any USASCII coding of function switches for remote positioning of cursor; parity checking; full-/ half-duplex; up to 1,200 bps (2,400 opt); TV-compatible	TTY-compatible (opt); built-in coupler (hard-wired); any USASCII coding of function switches for remote positioning of cursor; parity checking; full-/ half-duplex; up to 1,200 bps (2,400 opt); TV-compatible

COMPARISON CHARTS: TELETYPE EQUIPMENT

TRADE NAME OR MODEL	FUNCTION	INPUT (1)	OUTPUT (1)	CODE LEVELS	SPEED, char/sec (2)	APPROX. PURCHASE PRICE (U.S.), $
MODEL 28 EQUIPMENT						
KSR**	Send/receive	Keyboard, signal line	Printed page, signal line	5	6, 6.6, 7.5, or 10	1,300
ASR**	Send/receive with tape perforator and reader	Keyboard, punched tape signal line	Printed page, punched tape, signal line	5	6, 6.6, 7.5, or 10	2,200
R/O**	Receive only	Signal line	Printed page	5	6, 6.6, 7.5, or 10	1,100
Compact Page Printer	Desk-top send/receive	Keyboard, signal line	Printed page, signal line	5	6, 7.5, or 10	1,150
Wall Mounted Page Printer	Send/receive	Keyboard, signal line	Printed page, signal line	5	6, 7.5, or 10	1,250
ROTR (Reperforator)	Tape output, punched and printed	Signal line	Punched tape	5	6, 7.5, or 10	900
RT (Reperforator/ Transmitter)	Receiver, tape perforator, and transmitter; tape can be printed	Signal line (parallel or serial)	Signal line (parallel or serial)	5	6, 7.5, 10, or 20	3,400
LD (Distributor)	Converts parallel transmission to serial stop/ start transmission	Signal line	Signal line	5	6, 7.5, or 10	250
Model 28 LXD	Tape reader	Punched tape	Signal line	5 to 8	10	300
Model 28 LXD Multiple Tape Reader	Can read three tapes simultaneously and transmit to three stations, or can read three tapes alternately and transmit to one station	Punched tape	Signal line	5	6, 7.5, or 10	800
Model 28 LBXD	Tape reader	Punched tape	Electrical impulse	5 to 8	10	600
Model 28 LX	Tape reader	Punched tape	Electrical impulse	5 to 8	6 to 20	350
Model 28 LEXD Edge-Punched Card Reader	Reads edge-punched cards	Punched cards	Electrical impulse	5	6, 7.5, or 10	400
Model 28 LARP Multi-Magnet Tape Punch	Tape punch	Electrical impulse	Punched tape	5 to 8	20	500
MODEL 32 EQUIPMENT						
KSR*	Send/receive	Keyboard, signal line	Printed page, signal line	5	6, 6.6, or 10	425
ASR*	Send/receive with tape perforator and reader	Keyboard, punched tape, signal line	Printed page, punched tape, signal line	5	6, 6.6, or 10	580
R/O*	Receive only	Signal line	Printed page	5	6, 6.6, or 10	385
MODEL 33 EQUIPMENT						
KSR*	Send/receive	Keyboard, signal line	Printed page, signal line	8	10	500
ASR*	Send/receive with tape perforator and reader	Keyboard, punched tape, signal line	Printed page, punched tape, signal line	8	10	650
R/O*	Receive only	Signal line	Printed page	8	10	425
ASR*	Send/receive with tape perforator and reader; equipped with numeric keyboard	Keyboard (numeric only), punched tape, signal line	Printed page, punched tape, signal line	8	10	650

(1) Can be used directly on communications line (signal line), or as a peripheral device for data processing equipment (electrical impulse).

(2) To obtain WPM (words/min), multiply char/sec by 10.

NA Information not available from Teletype Corp.

* Designed for standard-duty usage.

** Designed for heavy-duty usage.

COMPARISON CHARTS: TELETYPE EQUIPMENT (CONTD.)

TRADE NAME OR MODEL	FUNCTION	INPUT (1)	OUTPUT (1)	CODE LEVELS	SPEED, char/sec (2)	APPROX. PURCHASE PRICE (U.S.), $
Remote Keyboard	Send only	Keyboard	Signal line	8	10	125
MODEL 35 EQUIPMENT						
KSR**	Send/receive	Keyboard, signal line	Printed page, signal line	8	10	1,400
ASR**	Send/receive with tape perforator and reader	Keyboard, punched tape, signal line	Printed page, punched tape, signal line	8	10	2,500
R/O**	Receive only	Signal line	Printed page	8	10	1,300
ACS**	Send/receive with tape perforator and two readers; extensive format control	Keyboard, punched tape, signal line	Printed page, punched tape, signal line	8	10	3,550
ROTR (Reperforator)	Tape output, punched and printed; backspace option for error correction	Signal line	Punched tape	8	6, 7.5, or 10	900
MODEL 37 EQUIPMENT						
KSR	Send/receive; 8th bit parity check	Keyboard, signal line	Printed page, signal line	5 to 8	15	NA
TELESPEED EQUIPMENT						
100 EDC — Send Set	Send only; generates one check character per 75-char block; character parity optional	Punched tape	Signal line	8	10	NA
100 EDC — Receive Set	Receive only; second punch deletes error blocks	Signal line	Punched tape	8	10	NA
1200 EDC — Send Set	Send only; generates two check characters per 80-char block; unattended operation optional	Punched tape	Signal line	5 to 8	105 or 120	4,150
1200 EDC — Receive Set	Receive only; performs read-after-write check; errors are over-punched; unattended operation optional	Signal line	Punched tape	5 to 8	105 or 120	5,350
1050 — Send Set	Send only; unattended operation optional	Punched tape	Signal line	5 to 8	105	1,800
1050 — Receive Set	Receive only; unattended operation optional	Signal line	Punched tape	5 to 8	105	2,420
750 — Send Set	Send only; unattended operation optional	Punched tape	Signal line	5 to 8	75	800 (table-top); 1,250 (cabinet)
750 — Receive Set	Receive only; unattended operation optional	Signal line	Punched tape	5 to 8	75	2,300
OTHER EQUIPMENT						
CARData Keyboard Punch	Edge-punched card output, punched and printed	Keyboard	Punched card	8	10	1,200
CARData Reader	Send only	Edge-punched cards	Electrical impulse	8	10	600
Tape Reader (Type CX)	Send only	Punched tape	Signal line	5 to 8	105	400
BRPE Punch	Receive only	Signal line	Punched tape	5 to 8	60, 75, or 105	750

(1) Can be used directly on communications line (signal line), or as a peripheral device for data processing equipment (electrical impulse).

(2) To obtain WPM (words/min), multiply char/sec by 10.

NA Information not available from Teletype Corp.

* Designed for standard-duty usage.

** Designed for heavy-duty usage.

COMMUNICATIONS PROCESSING EQUIPMENT

AUERBACH
DATA
COMMUNICATIONS
REPORTS

Printed in U.S.A.

COMPARISON CHARTS: COMMUNICATIONS PROCESSING EQUIPMENT

IDENTITY		Burroughs B 487 Data Transmission Terminal Unit	Burroughs 3353 Multi-Line Control	Burroughs 2350-1 and 3350-1 Terminal Unit Control
REPORT NUMBER		8070	8071	8071
FUNCTION		Multi-line controller for connecting multiple narrow- and/or voice-band lines to a B 300 or B 5500 computer	Multi-line controller for connecting Burroughs B 3500 computer to multiple narrow- or voice-band lines	Multi-line controller for connecting Burroughs B 2500 or B 3500 computer to multiple voice-band lines for on-line banking applications
ASSOCIATED COMPUTER SYSTEM (ACS)		Burroughs B 300, B 5500, or B 6500	Burroughs B 3500	Burroughs B 2500 or B 3500
MAXIMUM NUMBER OF LINES	Narrow-Band	16	36	None
	Voice-Band	16	36	6
	Broad-Band	None	None	None
INTERNAL STORAGE	Type of Storage	Magnetic core	Magnetic core (in ACS)	Magnetic core (in ACS)
	Word Size in Bits	6 (B 300); 48 (B 5500)	8	8
	Capacity in Words	4800 to 19,200 (B 300); 4096 to 32,768 (B 5500)	500,000	60,000 (B 2500); 500,000 (B 3500)
	Cycle Time in μsec	6 (B 300); 4 (B 5500)	1.0	2.0 (B 2500); 1.0 (B 3500)
ON-LINE PERIPHERAL EQUIPMENT	Mass Storage	Via ACS	Via ACS	Via ACS
	Magnetic Tape	Via ACS	Via ACS	Via ACS
	Punched Card I/O	Via ACS	Via ACS	Via ACS
	Punched Tape I/O	Via ACS	Via ACS	Via ACS
	Line Printer	Via ACS	Via ACS	Via ACS
	Typewriter	Via ACS	Via ACS	Via ACS
AUTOMATIC TRANSMISSION CONTROL FACILITIES	Call Initiation (on switched lines)	Yes	Yes	No (operates on dedicated line)
	Call Reception	Yes	Yes	No (operates on dedicated line)
	Line Identification	Yes	Yes	Yes
	Polling of Remotes	No	No	Yes
AUTOMATIC PROCESSING FACILITIES	Add/Subtract	Via ACS	Via ACS	Via ACS
	Multiply/Divide	Via ACS	Via ACS	Via ACS
	Editing	Via ACS	Via ACS	Via ACS
	Code Translation	Via ACS	Via ACS	Via ACS
	Program Interrupts	Yes	Yes	Yes
PERFORMANCE	Maximum Total Communications Data Rate	30,000 char/sec	?	?
	Processor Demand at Max. Data Rate	100% (B 300); 1.5% (B 5500 core memory)	?	?
ERROR CONTROL		Automatic character and longitudinal parity checking, depending on remote terminal; otherwise as programmed	Automatic character and message parity checking, depending on code	Automatic message parity checking
COMMENTS		B 487 provides 16 buffer segments; different remote terminals use from 1 to 7 segments, thus limiting the number of lines that can be connected	Maximum of one 3353 Multi-Line Control per B 3500 system	The 2350-1 Control is used with a B 2500 system; the 3350-1, with a B 3500 system; up to 16 remote teller consoles can be accommodated per line; a maximum of 10 Controls can be accommodated per computer system

* — No automatic facility, but can be programmed.

ACS — Associated Computer System.

COMPARISON CHARTS: COMMUNICATIONS PROCESSING EQUIPMENT (Contd.)

IDENTITY		Collins Data Central System	CDC 8090/8050 Information Control System	GE DATANET-30
REPORT NUMBER		8100	8140	8320
FUNCTION		Communications processing system; terminates multiple telegraph-grade and/or voice-band lines; oriented toward message switching.	Communications processing system; terminates multiple narrow-band and/or voice-band lines.	Stored program processor; terminates multiple telegraph-grade, voice-band, and/or broad-band lines; connects directly to many GE computers
ASSOCIATED COMPUTER SYSTEM (ACS)		None	None	GE 200, 400, 600 Series (optional)
MAXIMUM NUMBER OF LINES	Narrow-Band	256 half- or full-duplex	128 simplex (half each way) or 64 half- or full-duplex	240 simplex (half each way) or 120 half- or full-duplex
	Voice-Band	16 half- or full-duplex	32 half- or full duplex	24 half-duplex
	Broad-Band	RPQ	10	7 half-duplex
INTERNAL STORAGE	Type of Storage	Magnetic core	Magnetic core	Magnetic core
	Word Size in Bits	16	12	18
	Capacity in Words	4,096 to 65,536	8,192 to 32,768	2,096 to 16,384
	Cycle Time in μsec	5	6.4	6.94
ON-LINE PERIPHERAL EQUIPMENT	Mass Storage	Yes	Yes	Yes; also via ACS
	Magnetic Tape	Yes	Yes	Yes; also via ACS
	Punched Card I/O	Yes	Yes	Yes; also via ACS
	Punched Tape I/O	Yes	Yes	Yes; also via ACS
	Line Printer	Yes	Yes	Yes; also via ACS
	Typewriter	Yes	Yes	Via ACS
AUTOMATIC TRANSMISSION CONTROL FACILITIES	Call Initiation (on switched lines)	*	Yes	Yes
	Call Reception	*	*	*
	Line Identification	*	Yes	Yes
	Polling of Remotes	*	*	*
AUTOMATIC PROCESSING FACILITIES	Add/Subtract	Yes	Yes	Yes
	Multiple/Divide	*	Yes	*; also via ACS
	Editing	*	*	*; also via ACS
	Code Translation	*	*	*; also via ACS
	Program Interrupts	No	Yes	No
PERFORMANCE	Maximum Total Communications Data Rate	26,700 char/sec for telegraph-grade lines	50,000 char/sec	appx 6,000 char/sec for telegraph-grade lines
	Processor Demand at Max. Data Rate	100%	100%	100%
ERROR CONTROL		As programmed; no automatic checking except on direct I/O	As programmed; no automatic checking except on direct I/O	As programmed; no automatic checking except on direct I/O
COMMENTS		Stored-logic memory permits processor's command structure and I/O control to be tailored for specific applications	Other CDC computers can be used in different 8050 systems; most installations use dual processors	Frequently used as switching facility for GE computers

* - No automatic facility, but can be programmed.

ACS — Associated Computer System.

RPQ — "Request Price Quotation"; indicates that the facility is available on special request.

(Contd.)

COMPARISON CHARTS: COMMUNICATIONS PROCESSING EQUIPMENT (CONTD.)

IDENTITY		Honeywell 484 Multi-Channel Communications Control	Honeywell Type 286 Multi-Channel Communications Control	IBM 7740 Communication Control System
REPORT NUMBER		8380	8381	8440
FUNCTION		Multi-line controller for connecting Honeywell 400 or 1400 computer to multiple telegraph-grade or voice-band lines	Multi-line controller for connecting Honeywell Series 200 computer to multiple narrow- or voice-band lines	Stored-program processor; terminates multiple narrow-band and voice-band lines; connects directly to many IBM computers
ASSOCIATED COMPUTER SYSTEM (ACS)		Honeywell 400 or 1400	Honeywell Series 200 (all models except Model 110)	IBM 1400 or 700 Series (optional)
MAXIMUM NUMBER OF LINES	Narrow-Band	28 simplex or half-duplex	63 half-duplex	84 half-duplex or 42 full-duplex
	Voice-Band	28 simplex or half-duplex	63 half-duplex	4 half-duplex or 2 full-duplex
	Broad-Band	None	None	None
INTERNAL STORAGE	Type of Storage	Magnetic core (in ACS)	Magnetic core (in ACS)	Magnetic core
	Word Size in Bits	48	6	32
	Capacity in Words	1,024 to 4,096 (H-400); 4,096 to 32,768 (H-1400)	2,048 to 1,048,576	4,096 to 16,384
	Cycle Time in μsec	9.25 (H-400, half word); 6.5 (H-1400, half word)	4.0 to 0.188	10
ON-LINE PERIPHERAL EQUIPMENT	Mass Storage	Via ACS	Via ACS	Yes (also via ACS)
	Magnetic Tape	Via ACS	Via ACS	Via ACS
	Punched Card I/O	Via ACS	Via ACS	Via ACS or IBM 1050
	Punched Tape I/O	Via ACS	Via ACS	Via ACS
	Line Printer	Via ACS	Via ACS	Via ACS
	Typewriter	Via ACS	Via ACS	Yes (IBM 1050)
AUTOMATIC TRANSMISSION CONTROL FACILITIES	Call Initiation (on switched lines)	No	Yes	Narrow-band lines only
	Call Reception	Yes	Yes	Yes
	Line Identification	Yes	Yes	Yes
	Polling of Remotes	*	*	*
AUTOMATIC PROCESSING FACILITIES	Add/Subtract	Via ACS	Via ACS	Yes
	Multiple/Divide	Via ACS	Via ACS	* (also via ACS)
	Editing	Via ACS	Via ACS	* (also via ACS)
	Code Translation	Via ACS	Via ACS	* (also via ACS)
	Program Interrupts	Yes	Yes	Yes
PERFORMANCE	Maximum Total Communications Data Rate	100,000 char/sec (H-400); 154,000 char/sec (H-1400)	7,000 char/sec (message mode); approx. 700 char/sec (character mode)	24,200 char/sec
	Processor Demand at Max. Data Rate	100%	Up to 4.2% (message mode); 100% (character mode)	100%
ERROR CONTROL		Automatic character parity checking, depending on code; otherwise, as programmed	Automatic reception and generation of character and block parity; actual error detection must be programmed	As programmed; no automatic checking, except on direct I/O
COMMENTS		Two 484's can be connected to an H-400; four to an H-1400; the maximum number of lines that can be connected to the 484 is 28, in any combination	Various models permit connection of different numbers of lines; character mode models process one message character at a time; message mode models generate interrupt only at end of message	Can stand alone, but is usually used as switching facility for IBM computer; peak data transfer rate between 7740 and ACS is 50,000 char/sec

* — No automatic facility, but can be programmed.

ACS — Associated Computer System.

COMPARISON CHARTS: COMMUNICATIONS PROCESSING EQUIPMENT (CONTD.)

IDENTITY		IBM 7750 Programmed Transmission Control	IBM 2701 Data Adapter Unit	IBM 2702 Transmission Control
REPORT NUMBER		8441	8442	8443
FUNCTION		Stored-program processor; switching facility for IBM computer; connects to multiple narrow- or voice-band lines	Multi-line controller for connecting IBM System/360 computer to multiple narrow-, voice-, or broad-band lines	Multi-line controller for connecting IBM System/360 computer to multiple narrow- or voice-band lines
ASSOCIATED COMPUTER SYSTEM (ACS)		IBM 1410 or 7000 Series	IBM System/360 (Model 30, 40, 50, 65 or 75)	IBM System/360 (Model 30, 40, 44, 50, 65, 67, or 75)
MAXIMUM NUMBER OF LINES	Narrow-Band	112 half-duplex or 56 full-duplex	4 half-duplex	31 half-duplex
	Voice-Band	16 half-duplex or 8 full-duplex	4 half-duplex	15 half-duplex
	Broad-Band	None	2 half-duplex	None
INTERNAL STORAGE	Type of Storage	Magnetic core	Magnetic core (in ACS)	Magnetic core (in ACS)
	Word Size in Bits	48	8	8
	Capacity in Words	4,096 to 16,384	8,192 to 1,048,576	8,192 to 1,048,576
	Cycle Time in μsec	28	0.094 to 1.5	0.094 to 1.5
ON-LINE PERIPHERAL EQUIPMENT	Mass Storage	Via ACS	Via ACS	Via ACS
	Magnetic Tape	Via ACS	Via ACS	Via ACS
	Punched Card I/O	Via ACS	Via ACS	Via ACS
	Punched Tape I/O	Via ACS	Via ACS	Via ACS
	Line Printer	Via ACS	Via ACS	Via ACS
	Typewriter	Via ACS	Via ACS	Via ACS
AUTOMATIC TRANSMISSION CONTROL FACILITIES	Call Initiation (on switched lines)	No	Voice- or narrow-band lines only	Yes
	Call Reception	Yes	Yes	Yes
	Line Identification	Yes	Yes	Yes
	Polling of Remotes	*	Semi-automatic	Yes (optional)
AUTOMATIC PROCESSING FACILITIES	Add/Subtract	Yes	Via ACS	Via ACS
	Multiply/Divide	* (also via ACS)	Via ACS	Via ACS
	Editing	* (also via ACS)	Via ACS	Via ACS
	Code Translation	* (also via ACS)	Via ACS	Via ACS
	Program Interrupts	Yes	Yes	Yes
PERFORMANCE	Maximum Total Communications Data Rate	35,700 bits/sec	31,000 to 1,300,000 char/sec, depending on computer model	31,000 to 110,000 char/sec, depending on computer model
	Processor Demand at Max. Data Rate	100%	Varies widely	Varies widely
ERROR CONTROL		As programmed; no automatic checking	Automatic character and message parity checking; cyclic redundancy checking; hardware diagnostic checking	Automatic character and message parity checking; hardware diagnostic checking
COMMENTS		Has no capability for directly connecting mass storage or I/O devices	Connected to a System/360 computer via one control unit position of a Multiplexor or Selector Channel; can communicate with virtually the entire line of IBM data communications terminals, including BSC terminals	Connected to a System/360 computer via one control unit position of a Multiplexor Channel; communicates with remote terminals at up to 600 bits/sec

* — No automatic facility, but can be programmed.

ACS — Associated Computer System.

(Contd.)

COMPARISON CHARTS: COMMUNICATIONS PROCESSING EQUIPMENT (CONTD.)

IDENTITY		IBM 2703 Transmission Control	IBM 7770 Audio Response Unit	IBM 7772 Audio Response Unit
REPORT NUMBER		8444	8445	8446
FUNCTION		Multi-line controller for connecting IBM System/360 computer to multiple narrow- or voice-band lines	Receives digital inputs from telephones or certain IBM terminals and transmits machine-generated human voice responses	Receives digital inputs from telephones or certain IBM terminals and transmits machine-generated human voice responses
ASSOCIATED COMPUTER SYSTEM (ACS)		IBM System/360 (Model 30, 40, 50, 65, or 75)	IBM 1400 Series, 7010, or System/360 Model 30, 40, 50, 65, or 75	IBM System/360 Model 30, 40, 50, 65, or 75
MAXIMUM NUMBER OF LINES	Narrow-Band	176 half-duplex	None	None
	Voice-Band	72 (600 bps) or 48 (2400 bps) half-duplex	48	8
	Broad-Band	None	None	None
INTERNAL STORAGE	Type of Storage	Magnetic core (in ACS)	Magnetic core (in ACS)	Magnetic core (in ACS)
	Word Size in Bits	8	6 or 8	8
	Capacity in Words	8,192 to 1,048,576	1,400 to 1,048,576	8,192 to 1,048,576
	Cycle Time in μsec	0.094 to 1.5	0.094 to 11.5 per byte or character	0.094 to 1.5 per 8-bit byte
ON-LINE PERIPHERAL EQUIPMENT	Mass Storage	Via ACS	Via ACS	Via ACS
	Magnetic Tape	Via ACS	Via ACS	Via ACS
	Punched Card I/O	Via ACS	Via ACS	Via ACS
	Punched Tape I/O	Via ACS	Via ACS	Via ACS
	Line Printer	Via ACS	Via ACS	Via ACS
	Typewriter	Via ACS	Via ACS	Via ACS
AUTOMATIC TRANSMISSION CONTROL FACILITIES	Call Initiation (on switched lines)	Yes	No	No
	Call Reception	Yes	Depends on Model	Yes
	Line Identification	Yes	Yes	Yes
	Polling of Remotes	Yes	No	No
AUTOMATIC PROCESSING FACILITIES	Add/Subtract	Via ACS	Via ACS	Via ACS
	Multiply/Divide	Via ACS	Via ACS	Via ACS
	Editing	Via ACS	Via ACS	Via ACS
	Code Translation	Via ACS	Via ACS	Via ACS
	Program Interrupts	Yes	Yes (1410, 7010, System/360 only)	Yes
PERFORMANCE	Maximum Total Communications Data Rate	Significantly higher than 2702 Control	Variable, depending on number of lines, length of calls, etc.	Variable, depending on number of lines, length of calls, etc.
	Processor Demand at Max. Data Rate	Varies widely	Varies widely	Varies widely
ERROR CONTROL		Automatic character and message parity checking; cyclic redundancy checking; hardware diagnostic checking	As programmed; no automatic checking.	As programmed; no automatic checking
COMMENTS		Connected to a System/360 computer via one control unit position of a Multiplexor Channel; communicates with remote terminals at up to 2400 bits/sec; can communicate with IBM BSC terminals	See Comparison Chart on page 4410:01 for additional characteristics	See Comparison Chart on page 4410:01 for additional characteristics

* - No automatic facility, but can be programmed.

ACS - Associated computer system.

COMPARISON CHARTS: COMMUNICATIONS PROCESSING EQUIPMENT (CONTD.)

IDENTITY		NCR 321 Central Communications Controller	RCA 378 Communications Mode Control	RCA 3378 Communications Mode Control
REPORT NUMBER		8560	8700	8701
FUNCTION		Multi-line controller for connecting NCR 315 Line computer to multiple narrow-, voice-, or broad-band lines	Multi-line communications controller for connecting RCA 301 computer to multiple narrow-band and/or voice-band lines	Multi-line communications controller for connecting RCA 3301 computer to multiple narrow-band and/or voice-band lines
ASSOCIATED COMPUTER SYSTEM (ACS)		NCR 315, 315-100, or 315 RMC	RCA 301	RCA 3301
MAXIMUM NUMBER OF LINES	Narrow-Band	99 half-duplex	80 half-duplex or 40 full-duplex	160 half-duplex or 80 full-duplex
	Voice-Band	99 half-duplex	80 half-duplex or 40 full-duplex	160 half-duplex or 80 full-duplex
	Broad-Band	99 half-duplex	None	None
INTERNAL STORAGE	Type of Storage	Magnetic core or thin film (in ACS)	Magnetic core (in ACS)	Magnetic core (in ACS)
	Word Size in Bits	12	6	6
	Capacity in Words	up to 40,000 (315 or 315-100) or 80,000 (315 RMC)	10,000 to 40,000	40,000 to 160,000
	Cycle Time in μsec	6.0 (315 or 315-100) or 0.80 (315 RMC)	7.0 (4.8 optional)	1.9
ON-LINE PERIPHERAL EQUIPMENT	Mass Storage	Via ACS	Via ACS	Via ACS
	Magnetic Tape	Via ACS	Via ACS	Via ACS
	Punched Card I/O	Via ACS	Via ACS	Via ACS
	Punched Tape I/O	Via ACS	Via ACS	Via ACS
	Line Printer	Via ACS	Via ACS	Via ACS
	Typewriter	Via ACS	Via ACS	Via ACS
AUTOMATIC TRANSMISSION CONTROL FACILITIES	Call Initiation (on switched lines)	No	Yes	Yes
	Call Reception	Yes	Yes	Yes
	Line Identification	Yes	Yes	Yes
	Polling of Remotes	* (automatic with certain remote terminals)	*	*
AUTOMATIC PROCESSING FACILITIES	Add/Subtract	Via ACS	Via ACS	Via ACS
	Multiply/Divide	Via ACS	Via ACS	Via ACS
	Editing	Via ACS	Via ACS	Via ACS
	Code Translation	Via ACS	Via ACS	Via ACS
	Program Interrupts	Yes	None	Yes (in ACS)
PERFORMANCE	Maximum Total Communications Data Rate	12,000 bits/sec or char/sec (315 or 315-100); 24,000 bits/sec or char/sec (315 RMC)	7,130 char/sec	21,900 char/sec
	Processor Demand at Max. Data Rate	36% (315 or 315-100); 9.6% (315 RMC)	25%	16%
ERROR CONTROL		Automatic character and message parity checking, depending on transmission code	Character and message parity checking on data received over a voice-band line; otherwise as programmed	Character and message parity checking on data received over a voice-band line; otherwise as programmed
COMMENTS		Only one 321 can be connected to an NCR 315 Line computer	Scan rate is variable; some models permit servicing a selected group of lines more frequently than the rest	Scan rate is variable; some models permit servicing a selected group of lines more frequently then the rest

* — No automatic facility, but can be programmed.

ACS — Associated Computer System.

(Contd.)

COMPARISON CHARTS: COMMUNICATIONS PROCESSING EQUIPMENT (CONTD.)

IDENTITY		RCA 70/510 Voice Response Unit	RCA 70/688 Communication Controller — Multichannel	UNIVAC Communications Terminal Module Controller
REPORT NUMBER		8703	8702	8860
FUNCTION		Receives digital inputs from telephones and transmits machine-generated human voice responses	Multi-line controller for connecting RCA Spectra 70 computer to multiple narrow- or voice-band lines	Multi-line controller for connecting various UNIVAC computers to multiple narrow- or voice-band lines
ASSOCIATED COMPUTER SYSTEM (ACS)		RCA Spectra 70/35, 70/45, or 70/55	RCA Spectra 70/35, 70/45, or 70/55	UNIVAC 418, 1050, 490 Series, or 1108
MAXIMUM NUMBER OF LINES	Narrow-Band	None	48 half-duplex	64 simplex or 32 half- or full-duplex
	Voice-Band	50	48 half-duplex	64 simplex or 32 half- or full-duplex
	Broad-Band	None	None	None
INTERNAL STORAGE	Type of Storage	Magnetic core (in ACS)	Magnetic core (in ACS)	Magnetic core (in ACS)
	Word Size in Bits	8	8	6 to 36
	Capacity in Words	16,384 to 524,288	16,384 to 524,288	4,096 to 262,144
	Cycle Time in μsec	0.72 to 0.21 per 8-bit byte	0.72 to 0.21 per 8-bit byte	4.5 to 0.75
ON-LINE PERIPHERAL EQUIPMENT	Mass Storage	Via ACS	Via ACS	Via ACS
	Magnetic Tape	Via ACS	Via ACS	Via ACS
	Punched Card I/O	Via ACS	Via ACS	Via ACS
	Punched Tape I/O	Via ACS	Via ACS	Via ACS
	Line Printer	Via ACS	Via ACS	Via ACS
	Typewriter	Via ACS	Via ACS	Via ACS
AUTOMATIC TRANSMISSION CONTROL FACILITIES	Call Initiation (on switched lines)	No	Yes	Yes
	Call Reception	Yes	Yes	Yes
	Line Identification	Yes	Yes	Yes
	Polling of Remotes	No	*	*
AUTOMATIC PROCESSING FACILITIES	Add/Subtract	Via ACS	Via ACS	Via ACS
	Multiply/Divide	Via ACS	Via ACS	Via ACS
	Editing	Via ACS	Via ACS	Via ACS
	Code Translation	Via ACS	Via ACS	Via ACS
	Program Interrupts	Yes	Yes	Yes
PERFORMANCE	Maximum Total Communications Data Rate	Variable, depending on number of lines, length of calls, etc.	6,000 char/sec	Up to 51,000 char/sec, depending on computer model
	Processor Demand at Max. Data Rate	Varies widely	Varies widely, depending on computer model	Variable, depending on computer model
ERROR CONTROL		As programmed; no automatic checking	Automatic character and message parity checking depending on transmission code	As programmed; no automatic checking
COMMENTS		See Comparison Chart on page 4410:02 for additional characteristics	Connected to a Spectra 70 computer via one trunk of a Multiplexor Channel	Central processor is interrupted only at end of message

* — No automatic facility, but can be programmed.

ACS — Associated Computer System

COMPARISON CHARTS: COMMUNICATIONS PROCESSING EQUIPMENT (CONTD.)
SUPPLEMENT 1

IDENTITY		Honeywell 285-8 Audio Response System
REPORT NUMBER		8382
FUNCTION		Receives digital inputs from telephones and transmits machine-generated human voice responses and tones
ASSOCIATED COMPUTER SYSTEM (ACS)		Honeywell Series 200 (all models except 110)
MAXIMUM NUMBER OF LINES	Narrow-Band	None
	Voice-Band	50
	Broad-Band	None
INTERNAL STORAGE	Type of Storage	Magnetic core (in ACS)
	Word Size in Bits	6
	Capacity in Words	2,048 to 1,048,576
	Cycle Time in μsec	4.0 to 0.188
ON-LINE PERIPHERAL EQUIPMENT	Mass Storage	Via ACS
	Magnetic Tape	Via ACS
	Punched Card I/O	Via ACS
	Punched Tape I/O	Via ACS
	Line Printer	Via ACS
	Typewriter	Via ACS
AUTOMATIC TRANSMISSION CONTROL FACILITIES	Call Initiation (on switched lines)	Yes
	Call Reception	Yes
	Line Identification	Yes
	Polling of Remotes	No
AUTOMATIC PROCESSING FACILITIES	Add/Subtract	Via ACS
	Multiple/Divide	Via ACS
	Editing	Via ACS
	Code Translation	Via ACS
	Program Interrupts	Yes
PERFORMANCE	Maximum Total Communications Data Rate	Variable, depending on number of lines, length of calls, etc.
	Processor Demand at Max. Data Rate	Varies widely
ERROR CONTROL		As programmed; no automatic checking
COMMENTS		See Comparison Chart on page 4410:03 for additional characteristics

* — No automatic facility, but can be programmed

ACS — Associated Computer System

COMMUNICATIONS PROCESSING EQUIPMENT

IDENTITY		Texas Instruments 980/EMS Electronic Message Switching System	Ultronic Systems Communications Interface Processor	Univac Communications Terminal Module Controller	Varian 520/DC Data Communication System
REPORT NUMBER		—	—	8860	—
FUNCTION		Stored-program, store-and-forward, message switching system for mixed narrow-/voice-/broadband lines	Multiline controller for connecting IBM System/360 to multiple narrow-/voice-band lines	Multiline controller for connecting various Univac computers to multiple narrow-/voiceband lines	Stored-program processor for connecting multiple narrow-/voiceband lines to computer (preprocessor)/high-speed line (concentrator)
ASSOCIATED COMPUTER SYSTEM (ACS)		TI 980 CPU	IBM System/360, Model 30, 40, 50, 65, 75	UNIVAC 418, 1050, 490 Series or 1108	IBM System/360; NCR 200
MAX NO. OF LINES	Narrow band	127 half-duplex; 63 full-duplex	176 half-duplex	64 simplex; 32 half-/full-duplex	64 half-/full-duplex
	Voice band	127 half-duplex; 63 full-duplex	12	64 simplex; 32 half-/full-duplex	64 half-/full-duplex
	Broad band	127 half-duplex; 63 full-duplex	No	No	Special interface
INTERNAL STORAGE	Storage Type	Magnetic core	Magnetic core	Magnetic core (in ACS)	Magnetic core
	Word Size, bits	16	8	6-36	8
	Capacity, words	8192-65,536	64,000	4096-262,144	4096-32,768
	Cycle Time, μsec	1.0	1.0	4.5-0.75	1.5
ON-LINE PERIPHERY	Mass Storage	Yes (disc)	Via ACS	Via ACS	Yes
	Magnetic Tape	Optional	Via ACS	Via ACS	Yes
	Punched Card I/O	Optional	Via ACS	Via ACS	Yes
	Punched Tape I/O	Optional	Via ACS	Via ACS	Yes
	Line Printer	Optional	Via ACS	Via ACS	Yes
	Typewriter	Yes	Via ACS	Via ACS	Yes (TTY ASR 33/35)
AUTOMATIC TRANSMISSION CONTROLS	Call Initiation (switched lines)	Yes	No	Yes	Yes
	Call Reception	Yes	Yes	Yes	Yes
	Line Identification	Yes	Yes	Yes	Yes
	Polling of Remotes	Yes	Yes	As programmed	As programmed
AUTOMATIC PROCESSING FACILITIES	Add/Subtract	Yes	Yes	Via ACS	Yes
	Multiply/Divide	Yes	Yes (not normally used)	Via ACS	As programmed
	Editing	Yes	Yes	Via ACS	As programmed
	Code Translation	Yes	Yes (up to 3 code sets)	Via ACS	As programmed
	Program Interrupts	Yes	Yes	Yes	Yes
PERFORMANCE	Maximum Total Transmission Data Rate	1600-1,000,000 cps	105,600 bps	Up to 51,000 cps (depending on computer model)	4000 cps
	Processor Demand at Max Data Rate	1007	Varies widely	Variable (depending on computer model)	60%
ERROR CONTROL		As programmed	Char parity/longitudinal redundancy checking; block parity checking	Automatic char/block parity checking optional; otherwise as programmed	Automatic char parity checking; otherwise as programmed
PURCHASE PRICE, $		115,000	59,800; 3000 (high-speed line controller)	24,700	32,000 (32 full-duplex lines)
MONTHLY RENTAL, $		2500	—	570	1056 (32 full-duplex lines)
COMMENTS		Transmits/receives data on any combination of speeds at 60, 75, 100, 150 wpm; adjustable frequency of polling sequence; processes 5-/8-level USASCII; messages can be routed on priority basis	Connects to multiplexor channel of any IBM System/360 computer; designed to interface Ultronic multiplexing equipment for up to 176 remote/local terminals; CIP is subset of IBM 2702/03; up to 600 bps/terminal	Central processor interrupted only at end of message	I/O lines can be half-/full-duplex, synchronous/asynchronous; 5-, 6-, 7-, or 8-bit char with odd/even parity; 4 asynchronous line speeds; all options can be selected by software

COMMUNICATIONS PROCESSING EQUIPMENT

IDENTITY		Western Telematic Model TM150 Tramsmission Controller	American Data Systems ADS-945 Communication Control System	Colorado Instruments CLC816 Central Line Controller	Micro Systems Micro 812 Data Communications Processor	
REPORT NUMBER		—		—	—	
FUNCTION		Multiline controller for IBM 1130 computing system	Data communications controller provides full computer port contention, baud rate discrimination on multiple low-speed lines	Data collection system control unit interfaces multiple remote input terminals to output media/ central processor	Microprogrammed, general-purpose, digital minicomputer; operates as data concentrator, preprocessor, stand-alone interactive terminal	
ASSOCIATED COMPUTER SYSTEM (ACS)		IBM 1130 Models 2 or 3 (8000 to 32,000)	IBM 360 Series via 2702/3; GE via Datanet-30	Burroughs 2500-5500; GE 635; Honeywell 200/4200; IBM 360; Univac 1108	Micro 800 Mini Computer	
MAX NO. OF LINES	Narrow band	15 (300 bps)	200	—	32 (50-300 bps; async; processed in groups of 8)	
	Voice band	15 (1200 bps)	—	128 half-duplex	8	
	Broad band	No	—	—	—	
INTERNAL STORAGE	Storage Type	Magnetic core (in ACS)	Magnetic core	MOS/FET	Magnetic core	Read-only memory
	Word Size, bits	8	8	7	8	16
	Capacity, words	8000-512,000 (16-bit)	4096 (expandable to 16K)	1024	4096-32,768	1024 (256-word modules)
	Cycle Time, μsec	2.2-3.6	—	—	1.1	220 μsec
ON-LINE PERIPHERY	Mass Storage	Via ACS	Via ACS	Via ACS	Yes (disc; 256K bytes)	
	Magnetic Tape	Via ACS	Yes	Optional (7-/9-track)	Yes (9-track, IBM-compatible)	
	Punched Card I/O	Via ACS	Yes	Via ACS	Yes (300 cpm)	
	Punched Tape I/O	Via ACS	Yes	Optional	Yes (75 cps)	
	Line Printer	Via ACS	Yes	Via ACS	No	
	Typewriter	Yes (IBM 2741; TTY 33)	Yes	Via ACS	Yes (TTY 33/35 ASR)	
AUTOMATIC TRANSMISSION CONTROLS	Call Initiation (switched lines)	No	Yes	No	Yes	
	Call Reception	Yes	Yes	No	Yes	
	Line Identification	Yes	Yes	No	Yes	
	Polling of Remotes	Yes	Yes	Yes	Yes (async lines)	
AUTOMATIC PROCESSING FACILITIES	Add/Subtract	Via ACS	Yes	Via ACS	Yes	
	Multiply/Divide	Via ACS	Yes	Via ACS	No	
	Editing	Via ACS	Yes	Via ACS	Yes	
	Code Translation	Via ACS	Via ACS	Yes	Yes	
	Program Interrupts	Yes	Yes	No	Yes	
PERFORMANCE	Maximum Total Transmission Data Rate	Depends on application	1800 bytes/sec	1000 cps	4000 bytes/sec (909,000 bytes/sec via optional Direct Memory Access Channel)	
	Processor Demand at Max Data Rate	Depends on application	100%	—	—	
ERROR CONTROL		Vertical/longitudinal redundancy checking via ACS optional	Parity checking	Message parity/record length checking	Char parity/cyclic redundancy checking	
PURCHASE PRICE, $		—	13,500	7000	10,000 (includes 4K core, console, power supply)	
MONTHLY RENTAL, $		400-800	—	121-157	—	
COMMENTS		Multiplexes up to 15 simultaneous lines through storage access channel; includes control software compatible with disc monitor 2	Provides large inward watts dial group; transmits/receives 1800 bytes/sec simultaneously; options to 2,400 available; operates with all low-speed EIA interfaces comparable to stated ACS	Polls, checks messages in bit parallel from 8 buffer units; each buffer polls, stores data from up to 16 remote input stations; reformats data, adapts speed to output devices	Different code/bit rate accommodated per 8-line group; 7.5-11-unit codes; byte-addressable memory; 6 16-bit operational registers; 105 instructions; 8 addressing modes	

		Miller-Ellis Computer Systems Series 2000 Computer System		RCA 70/656 Communication Controller-Single Channel	Computer Machinery DataCentral
		Basic Configuration	Standard Configuration		
REPORT NUMBER		—		—	—
FUNCTION		Internally stored program processor/terminal system for remote data processing, communications, real-time applications; selectable transmission methods		Single-line controller for connecting RCA Spectra 70 computer to voiceband/ broadband facility	Receives, validates, stores data records for processor; transmits records, computer output; terminal message switching
ASSOCIATED COMPUTER SYSTEM (ACS)		Hardware adaptable to any larger standard computer system		RCA Spectra 70/35, 70/45, 70/46, 70/55, 70/60, 70/61	Stand-alone
MAX NO. OF LINES	**Narrow band**	20 full-duplex	20 full-duplex	—	64 half-/full-duplex
	Voice band	20 full-duplex	20 full-duplex	1 simplex/half-duplex	64 half-/full-duplex
	Broad band	Up to 2 (40.8 kb)	Up to 2 (40.8 kb)	1 simplex/half-duplex	None
INTERNAL STORAGE	**Storage Type**	Magnetic core	Magnetic core	Via ACS	Magnetic core
	Word Size, bits	16	16	Via ACS	16
	Capacity, words	4,096 - 32,768 (4K increments)	8,192 - 32,768 (4K increments)	Via ACS	8,192-32,768 (4K increments)
	Cycle Time, μsec	2.6; 0.8 optional	2.6; 0.8 optional	Via ACS	1.2 per word
ON-LINE PERIPHERY	**Mass Storage**	Optional (disc, drum)	Optional (disc, drum)	Via ACS	Yes (disc)
	Magnetic Tape	Yes (3 cassettes; 500 cps)	Yes (6 cassettes; 500 cps on each of 2 channels)	Via ACS	Yes
	Punched Card I/O	Optional	Optional	Via ACS	No
	Punched Tape I/O	Yes (7-level USASCII)	Optional	Via ACS	Yes
	Line Printer	Yes (TTY 33 ASR)	Yes (356 80-col lpm)	Via ACS	No
	Typewriter	Yes (IBM Selectric)	Yes	Via ACS	Yes
AUTOMATIC TRANSMISSION CONTROLS	**Call Initiation (switched lines)**	As programmed	As programmed	Yes	Yes
	Call Reception	Yes (autointerrupt)	Yes (autointerrupt)	Yes	Yes
	Line Identification	Yes (device code)	Yes (device code)	Yes	Yes
	Polling of Remotes	Yes (device code)	Yes (device code)	Yes	Yes
AUTOMATIC PROCESSING FACILITIES	**Add/Subtract**	Yes	Yes	Via ACS	Yes
	Multiply/Divide	As programmed	As programmed	Via ACS	As programmed
	Editing	As programmed	As programmed	Via ACS	Yes
	Code Translation	As programmed	As programmed	Via ACS	Yes
	Program Interrupts	Yes (including power failure, restart)	Yes (including power failure, restart)	Yes	Yes
PERFORMANCE	**Maximum Total Transmission Data Rate**	400,000 cps	400,000 cps	230,400 bps (28,800 cps)	31,000 cps
	Processor Demand at Max Data Rate	40%	40%	Varies widely	13.8-29% (depends on communications/editing criteria)
ERROR CONTROL		As programmed	As programmed	Char/block parity checking (depends on mode of operation)	Automatic char/block parity checking; programmed text/ record validation
PURCHASE PRICE, $		34,950	46,950	20,700	—
MONTHLY RENTAL, $		1,000	1,300	394	—
COMMENTS		Includes: general-purpose computer, basic console/ control panel, CRT display, data set (110, 150, 300 bps), program-controlled 10-/11-unit codes, auto dialing, internal real-time clock	Includes: general-purpose computer, std console/ control panel, CRT display, light pen, data set (110, 150, 300, 1,200, 2,000, 2,400 bps), 9-, 10-, 11-unit codes, async/bisync, auto dialing, internal real-time clock	Establishes, maintains sync; operates point-to-point/multipoint; rates also at 2,000 (201A3), 2,400 (201B1), 19,200 (303B5), 40,800 (301B), 50,000 (303C5) bps; selectable: auto/manual dial/answer	Can be interfaced to other processors as stand-alone system; available in single/ redundant configurations; 4K storage bank reserved in configurations over 16K

IDENTITY		EMR Computer 6116 Series Data Communication System	General Electric Datanet-355 Communications Processor	General Electric Datanet-500 Communications Processor	Honeywell Series 15 Model 1530 Communications Processor
REPORT NUMBER		—	—	—	—
FUNCTION		Stand-alone/front-end multiline controller/stored-program processor for narrow-/voice-/broadband lines	Stored-program computer provides front-end communication functions for GE-600 line computers	Stored-program processor terminates multiple narrow-/voice-/broadband lines for network processing, remote concentration	Stored-program processor for peripheral control, synchronous single-channel communications
ASSOCIATED COMPUTER SYSTEM (ACS)		EMR 6130, 6135, 6154, or 6155	GE 600 line	None	Honeywell Series 15
MAX NO. OF LINES	**Narrow band**	63 half-duplex	200 half-/full-duplex	250 full-duplex	None
	Voice band	63 half-duplex	32 half-/full-duplex	125 full-duplex	4 sync
	Broad band	8 per controller	16 half-/full-duplex	24 half-duplex	2,000-40,800 bps
INTERNAL STORAGE	**Storage Type**	Magnetic core	Magnetic core	Magnetic core	Magnetic core
	Word Size, bits	16 (plus parity, protect)	18	18	16
	Capacity, words	32K per processor (multiprocessor configurations)	16,834-32,768	8,192-65,536	8,192-16,384
	Cycle Time, μsec	0.775; 0.500	1.0	1.0	1.6
ON-LINE PERIPHERY	**Mass Storage**	Yes (fixed-head disc)	Optional	Yes	Yes
	Magnetic Tape	Yes	Optional	Yes	No
	Punched Card I/O	Yes	Optional	Yes	Yes
	Punched Tape I/O	Yes	Optional	Yes	No
	Line Printer	Yes	Optional	Yes	Yes
	Typewriter	Yes	Yes	Yes	Yes
AUTOMATIC TRANSMISSION CONTROLS	**Call Initiation (switched lines)**	Yes	Optional	Yes	Optional
	Call Reception	Yes	Yes	Yes	As programmed
	Line Identification	Yes	Yes	Yes	As programmed
	Polling of Remotes	Yes	As programmed	As programmed	No
AUTOMATIC PROCESSING FACILITIES	**Add/Subtract**	Yes	Yes	Yes	Yes (3.2 μsec)
	Multiply/Divide	Yes	Yes	Yes	Yes (8.8/17.6 μsec)
	Editing	Yes	As programmed	As programmed	As programmed
	Code Translation	Yes	As programmed	As programmed	As programmed
	Program Interrupts	Yes	Yes	Yes	Yes
PERFORMANCE	**Maximum Total Transmission Data Rate**	Over 450,000 bps (per controller)	100,000 cps (Telpak speed); 3,000 cps (TTY speed)	15,000 cps (telegraph-grade lines); 2.9 M cps (Telpak-grade lines)	40,800 bps (4 lines)
	Processor Demand at Max Data Rate	Varies per application	Varies widely (Telpak); <10% (TTY)	Varies widely	13%
ERROR CONTROL		Char parity checking; LRC; CRC	Char parity checking; automatic transfer timing error detection	Unique error storage unit; dual arithmetic units; full memory parity	Processor parity; char parity checking
PURCHASE PRICE, $		63,000 (basic; includes processor/controller)	—	—	50,450 (basic)
MONTHLY RENTAL, $		1,720 (basic; includes processor/controller)	—	—	1,120 (basic)
COMMENTS		Accommodates mixed line speeds/codes; operational reliability via redundant connections/Fail-Soft software; EMR provides full system software; max line capacities shown apply to multicontroller configurations	Completely programmed to perform std front-end remote batch, remote access, time sharing functions for GE-600 line computers	Specifically designed for communications applications: time share/batch remote concentration, network processing	72-instruction set; includes .72M-word disc drive, 8K core, parity, multiplexor channel, printer/card reader/punch/disc pack drive controls, desk-type cabinet, control panel

IDENTITY		Honeywell Series 15 Model 1540 Communications Processors	Interactive Data Systems L-64 Communication Controller	Interactive Data Systems U-64 Communication Controller	Interactive Data Systems DSLA Dedicated Synchronous Line Adapter
REPORT NUMBER		—	—	—	—
FUNCTION		Stored-program processor for peripheral control, multichannel communications	Multiline controller for connecting multiple narrow-/voiceband lines to larger computer system; for remote data concentration	Multiline controller for connecting multiple narrow-/voiceband lines to larger computer system; for remote data concentration	Single-line controller unit for connecting voice-/broadband line to larger computer system; for remote data concentration
ASSOCIATED COMPUTER SYSTEM (ACS)		Honeywell Series 15	IBM System/360; Univac 1108; Burroughs B 5500; CDC 6600	IBM System/360; Univac 1108; Burroughs B 5500; CDC 6600	IBM System/360; Univac 1108; Burroughs B 5500; CDC 6600
MAX NO. OF LINES	Narrow band	32 (150 bps max)	64 half-/full-duplex	64 half-/full-duplex	1
	Voice band	4 sync/async	64	64	1
	Broad band	45-40,800 bps	None	None	1
INTERNAL STORAGE	Storage Type	Magnetic core	Magnetic core (in ACS)	Magnetic core (in ACS)	Magnetic core (in ACS)
	Word Size, bits	16	16	16	16
	Capacity, words	4,096-16,384	4-32K	4-32K	4-32K
	Cycle Time, μsec	1.6	1.0	1.0	1.0
ON-LINE PERIPHERY	Mass Storage	Yes	Via ACS	Via ACS	Via ACS
	Magnetic Tape	Yes (7-/9-channel)	Via ACS	Via ACS	Via ACS
	Punched Card I/O	Yes	Via ACS	Via ACS	Via ACS
	Punched Tape I/O	Yes	Via ACS	Via ACS	Via ACS
	Line Printer	Yes	Via ACS	Via ACS	Via ACS
	Typewriter	Yes	Via ACS	Via ACS	Via ACS
AUTOMATIC TRANSMISSION CONTROLS	Call Initiation (switched lines)	Optional	Yes	Yes	Yes
	Call Reception	As programmed	Yes	Yes	Yes
	Line Identification	As programmed	Yes	Yes	Yes
	Polling of Remotes	As programmed	Yes	Yes	Yes
AUTOMATIC PROCESSING FACILITIES	Add/Subtract	Yes (3.2 μsec)	Via ACS	Via ACS	Via ACS
	Multiply/Divide	Optional	Via ACS	Via ACS	Via ACS
	Editing	As programmed	Via ACS	Via ACS	Via ACS
	Code Translation	As programmed	Yes	Yes	Yes
	Program Interrupts	Yes	Yes	Yes	Yes
PERFORMANCE	Maximum Total Transmission Data Rate	40,800 bps (4 lines); 150 bps (32 lines)	60,000 cps	Varies	Varies
	Processor Demand at Max Data Rate	63%	Varies widely	Varies widely	Varies widely
ERROR CONTROL		Processor parity (opt); char parity checking (single-channel); programmable (multichannel)	Vertical redundancy checking (VRC) opt	Vertical redundancy checking (VRC)	Vertical/longitudinal/cyclical redundancy checking (VRC, LRC, CRC)
PURCHASE PRICE, $		13,720 (basic)	28,000 (32 low-speed lines, 45-2,000 bps, processor, 1 dedicated high-speed line up to Telpak rate)	28,000 (16 high-speed lines, 2,000-9,600 bps, processor, 1 dedicated Telpak-speed line)	1,500-3,500 (depending on code conversion options)
MONTHLY RENTAL, $		360 (basic)			
COMMENTS		Multichannel control feature intended for line concentration applications; 72-instruction set; includes 4K core, desk-type cabinet, control panel	Communicates with remote terminals at 45-2,000 bps (async)/2,000-9,600 bps (sync); char-(async)/double char-buffered (sync) lines; echoplexing, 4 selectable rates, auto call/dual-processor interfaces opt	Communicates with remote terminals at 45-9,600 bps; options include modem control, 4 selectable rates, variable code lengths, line echo, dual-processor interface, hardware code translation	Handles Telpak speeds; 4 selectable code conversion options

IDENTITY		Interdata 270X Communications Controller	Varian Data Machines 620/i-60 Communications Controller		
REPORT NUMBER		—	—		
FUNCTION		Multiline controller for connecting IBM System/360 computer to multiple narrow-/voiceband lines	Front-end multiline controller to larger computer system for sampling low-speed asynchronous lines		
ASSOCIATED COMPUTER SYSTEM (ACS)		IBM System/360 Model 30, 40, 44, 50, 65, 67, 75	VDM 620/i; VDM 620/f		
MAX NO. OF LINES	Narrow band	176 half-duplex	16 half-/full-duplex (up to 50 bps)		
	Voice band	72 (500 bps)	16 half-/full-duplex (up to 150 bps)		
	Broad band	None	None		
INTERNAL STORAGE	Storage Type	Magnetic core; also via ACS	—		
	Word Size, bits	16	—		
	Capacity, words	8,192 bytes	—		
	Cycle Time, μsec	1.0	—		
ON-LINE PERIPHERY	Mass Storage	Via ACS	Via ACS		
	Magnetic Tape	Via ACS	Via ACS		
	Punched Card I/O	Via ACS	Via ACS		
	Punched Tape I/O	Via ACS	Via ACS		
	Line Printer	Via ACS	Via ACS		
	Typewriter	Console TTY	Via ACS		
AUTOMATIC TRANSMISSION CONTROLS	Call Initiation (switched lines)	No	No		
	Call Reception	Yes	Yes		
	Line Identification	Yes	Yes		
	Polling of Remotes	Yes	As programmed		
AUTOMATIC PROCESSING FACILITIES	Add/Subtract	Yes	Via ACS		
	Multiply/Divide	Via ACS	Via ACS		
	Editing	Yes	Via ACS		
	Code Translation	Yes (4 tables)	Via ACS		
	Program Interrupts	Yes	For clocking samples		
PERFORMANCE	Maximum Total Transmission Data Rate	14,400 cps	500 cps		
	Processor Demand at Max Data Rate	100%	40% (620/i ACS); 16% (620/f ACS)		
ERROR CONTROL		Automatic char/message clearing; hardware diagnostic clearing	As programmed (no automatic checking)		
PURCHASE PRICE, $		40,000-120,000	4,200-6,000		
MONTHLY RENTAL, $		—			
COMMENTS		Incorporates specially microcoded Interdata Model 3 computer with Ultronics Corp char interlaced TDM; console program allows code conversion/monitoring of any line; IBM 2702-compatible	Char sync/assembly, message assembly, error control, control char recognition, message delimiting, message buffering performed by ACS software		

VOICE RESPONSE EQUIPMENT

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COMPARISON CHARTS: VOICE RESPONSE EQUIPMENT

IDENTITY		IBM 7770 Audio Response Unit			IBM 7772 Audio Response Unit
		Model 1	Model 2	Model 3	
REPORT NUMBER		8445			8446
ASSOCIATED COMPUTER SYSTEM (ACS)		IBM 1401, 1440, or 1460	IBM 1410 or 7010	IBM System/360 Model 30, 40, 50, 65, or 75	IBM System/360 Model 30, 40, 50, 65, or 75
CONNECTION TO ACS		Replaces one 1311 Disk File Unit; maximum of one 7770	Connects to Channel 1 or 2; maximum of one 7770	Connects via one control unit position on Multiplexor Channel	Connects via one control unit position on Multiplexor Channel
VOCABULARY SIZE	Minimum words	32	32	32	No minimum
	Maximum words	126	127	128	No maximum; see Comments below
	Length of word	0.5 second	0.5 second	0.5 second	0.5 second
VOCABULARY SELECTION		Words can be chosen from an ordinary English language dictionary, and can include numbers and letters of the alphabet			Basic library contains 1,000 common words; other words available optionally
VOCABULARY STORAGE		On drum in 7770			On random access device with ACS
VOICE GENERATION TECHNIQUE		Words are recorded in analog form on removable magnetic sleeve which fits over drum			Words are stored in digitally coded form which governs the output of a series of band filters
NUMBER OF LINES		4 to 48 in groups of 4			2 to 8 in groups of 2
REMOTE TERMINALS		IBM 1001 Data Transmission Terminal, 1092/1093 or 1093 Programmed Keyboard, 1094 Line Entry Keyboard, or Touch-Tone telephone			Same as IBM 7770 (left)
THROUGHPUT, maximum number of 30-second calls per hour		Approximately 240 (4 lines) to 3,600 (48 lines)			Approximately 180 (2 lines) to 430 (8 lines)
COMMENTS		A 0.5-second word corresponds approximately to the pronunciation of the name of a letter, numeral, or to a short word; polysyllabic words can be recorded as two or more 7770 words			Storage of one second of verbal information requires about 300 bytes of disc storage; see also 7770 Comments

COMPARISON CHARTS: VOICE RESPONSE EQUIPMENT (CONTD.)

IDENTITY	RCA 70/510 Voice Response Unit		
	70/510-11	70/510-21	70/510-26
REPORT NUMBER	8703		
ASSOCIATED COMPUTER SYSTEM (ACS)	RCA Spectra 70/35, 70/45, or 70/55		
CONNECTION TO ACS	Connects via 70/668 Communications Control—Multichannel		
VOCABULARY SIZE — Minimum words	31 words and phrases	63 words and phrases	189 words
VOCABULARY SIZE — Maximum words	31 words and phrases	63 words and phrases	189 words
Length of words	0.5 second (word); 1.55 seconds (phrase)		
VOCABULARY SELECTION	Vocabulary master is individually prepared for each unit; not limitation other than length of word or phrase		
VOCABULARY STORAGE	On drum in 70/510		
VOICE GENERATION TECHNIQUE	Words and phrases are recorded in analog form on film strips from which a master film is produced; technique is similar to that used to produce a sound track for a motion picture		
NUMBER OF LINES	10 to 50 in groups of 10		
REMOTE TERMINALS	Touch-Tone telephone		
THROUGHPUT, maximum number of 30-second calls per hour	Approximately 1150 (10 lines) See Comments		
COMMENTS	A 0.5-second word corresponds approximately to the pronunciation of the name of a letter or numeral, or to a short word; throughput is contingent on system configuration, file arrangement, and format routine.		

COMPARISON CHARTS: VOICE RESPONSE EQUIPMENT

IDENTITY		Honeywell Audio Response System		
		31 elements	63 elements	189 elements
REPORT NUMBER		8382		
ASSOCIATED COMPUTER SYSTEM (ACS)		Honeywell Series 200; Model 120, 125, 200, 1200, 1250, 2200, 4200 or 8200		
CONNECTION TO ACS		Connects via a Model 286-2, -3, -4, or -5 Multichannel Communication Control		
VOCAB-ULARY SIZE	Minimum words	31 words and phrases	63 words and phrases	189 words
	Maximum words	31 words and phrases	63 words and phrases	189 words
	Length of word	0.53 second (word); 1.6 second (phrase)		
VOCABULARY SELECTION		Vocabulary master is individually prepared for each unit; no limitation other than length of word or phrase		
VOCABULARY STORAGE		On individual voice cylinders 083-1, -2, -3, -4, or -5		
VOICE GENERATION TECHNIQUE		Words and phrases are recorded in analog form on film strips from which a master film is produced; technique is similar to that used to produce a sound track for a motion picture		
NUMBER OF LINES		2 to 60 in groups of 2		
REMOTE TERMINALS		Touch-Tone telephone		
THROUGHPUT, maximum number of 30-second calls per hour		Approximately 2500 (24 lines)		
COMMENTS		A 0.5-second word corresponds approximately to the pronunciation of the name of a letter or numeral, or to a short word; a tone-only response unit is available that can issue three different tone responses		

IDENTITY		RCA 70/510-26 Voice Response Unit	Technitrend VM-1400 Voice Response System	Periphonics Voice PAC-2000 Voice Response Systems		
REPORT NUMBER		—	—	—		
ASSOCIATED COMPUTER SYSTEM (ACS)		RCA Spectra 70/35, 70/45, 70/55, or 70/60	IBM System/360 Models 30, 40, 50, 65, 70	IBM System/360; minicomputers (PDP Series)		
CONNECTION TO ASSOCIATED COMPUTER SYSTEM		Connects via 70/668 Communications Control-Multichannel	Connects via 1 control unit position on multiplexor channel	Via minicomputer interface; other interface arrangements available at user's option		
VOCABULARY SIZE	**Minimum Words**	—	32	No min		
	Maximum Words	Up to 189 words	700	No max (std system up to 2,000 words)		
	Word Length	0.5 sec	0.5-0.6 sec; 1.8 sec (phrase)	Unrestricted		
VOCABULARY SELECTION		Vocabulary master individually prepared for each application; no limit other than length of word/phrase	Words can be chosen from any dictionary; can include numbers/letters of alphabet with no limit other than length of word/phrase	Customer selection to meet user requirements; male/female voice available; no limitation on length of word		
VOCABULARY STORAGE		Drum in 70/510	Drum in VM-1400	Unique encoding technique via high-speed disc		
VOICE GENERATION TECHNIQUE		Words recorded in analog form from which memory drum is produced	Words recorded in analog form on magnetic drum	Unique encoding technique via high-speed disc		
NUMBER OF LINES		10-50 in groups of 10	2-256 in groups of 2	Unrestricted (dependent upon CPU capability)		
REMOTE TERMINALS		Touch-Tone telephone	Technitrend RP-2800 Voice/Print Terminal; Technitrend TT-3100 Portable Data Terminal; Touch-Tone telephone	Pushbutton telephones, card dialers, auxiliary units, special-purpose terminals as required by user applications		
THROUGHPUT, maximum number of 30-second calls/hour		1150 (10 lines)	84 (2 lines) to 49,000 (256 lines)	Dependent upon associated computer system		
PURCHASE PRICE, $		38,800	36,000 (basic configuration)	38,000 (40 words); 54,000 (240 words); 65,500 (960 words); 600 (cost/additional line)		
MONTHLY RENTAL, $		743	—			
COMMENTS		0.5-sec word corresponds approx to pronunciation of name of letter/numeral or to short word; throughput contingent on system configuration, file arrangement, format routine; internal storage capacity of 16,384-524,288 8-bit words; special feature 5518 is custom vocabulary	Can be remotely located from CPU; many lines can be multiplexed over a single, voice-band, leased line; system can provide print answerback in addition to voice	Unique recording/storage technique allows max flexibility/system utilization; vocabulary can be revised at user computer site; stored vocabulary can be fractionated to produce additional byproduct words (information can provide in/inform/form/formation); program-controlled interval between words; desired word inflection designed into system		

DATA SETS (MODEMS)

AUERBACH
DATA
COMMUNICATIONS
REPORTS

Printed in U.S.A.

COMPARISON CHARTS: COMMON-CARRIER DATA SETS

IDENTITY		Bell System Data Set 103A	Bell System Data Set 103F	Bell System Auxiliary Data Set 811B
APPLICATION		Low-speed operation over the public telephone network (Data-Phone Service) or TWX CE Service	Low-speed operation over a leased narrow-band or voice-band line	Permits connection of customer-provided terminal to regular TWX network
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex
	Method	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	None; see Comments
	Timing	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	See Comments
	Turn-Around Time, msec	See Comments	265	—
TRANSMISSION SPEED	Public Switched Network	Up to 300 bps or 150 bps (TWX CE)	—	45.5 or 110 bps (TWX network)
	Leased Line	—	Up to 300 bps	—
ELECTRICAL INTERFACE		EIA Standard RS232A or B	EIA Standard RS232A or B	EIA Standard RS232B
FEATURES	Telephone Set	Separate (804B)	None	None
	Unattended Operation	Yes	Yes	Yes
	Other	—	—	—
PHYSICAL SPECIFICATIONS	Depth, inches	10	10	10.5
	Width, inches	11	11	11
	Height, inches	5.5	5.5	5.5
	Weight, pounds	18	15	?
COST	Rental, $/month	25*	25*	22*; see Comments
	Installation, $	25*	25*	15*; see Comments
COMMENTS		Capable of automatic answering; compatible with automatic calling units; transmitter and receiver operate simultaneously	Can operate alternately in originate or answer mode, or permanently in either mode	811B is connected to regular TWX 60- or 100-speed station; TWX station data set provides frequency shift modulation; TWX stations use 5-level Baudot or 8-level USASCII codes; above costs are based on a single-station arrangement

* This data is approximate; prices vary with the various Bell System operating companies. Check with your local Bell System Communications Consultant.

COMPARISON CHARTS: COMMON–CARRIER DATA SETS (CONTD.)

IDENTITY		Bell System Data Set 201A	Bell System Data Set 201B	Bell System Data Set 202C	Bell System Data Set 202D
APPLICATION		Operation over the public telephone network (Data-Phone Service) or over a leased voice-band line	Operation over a leased voice-band line	Operation over the public telephone network (Data-Phone Service) or over a leased voice-band line	Operation over a leased voice-band line
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex or full-duplex (leased only)	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Phase shift; see Comments	Phase shift; see Comments	Frequency shift	Frequency shift
	Timing	Synchronous	Synchronous	Asynchronous	Asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	150	9	200 ± 25	200 ± 25
TRANSMISSION SPEED	Public Switched Network	2,000 bps (fixed)	—	Up to 1,200 bps	Up to 1,200 bps
	Leased Line	Type 3002-C2 — 2,000 bps (fixed)	Type 3002-C2 — 2,400 bps (fixed)	Type 3002 — Up to 1,000 bps (Unconditioned); Up to 1,400 bps (Type C1); Up to 1,800 bps (Type C2)	Type 3002 — Up to 1,000 bps (Unconditioned); Up to 1,400 bps (Type C1); Up to 1,800 bps (Type C2)
ELECTRICAL INTERFACE		EIA Standard RS232A or B	See Comments	EIA Standard RS232A or B	EIA Standard RS232A or B
FEATURES	Telephone Set	Separate; see Comments	Separate; see Comments	Integral	Separate (804A or M)
	Unattended Operation	Yes	Yes	Yes	Yes, with 804A
	Other	—	—	See Comments	See Comments
PHYSICAL SPECIFICATIONS	Depth, inches	11.6	11.6	14	8.75
	Width, inches	17.5	17.5	10.5	10.5
	Height, inches	7.75	7.75	5.5	5.5
	Weight, pounds	35	35	15	14
COST	Rental, $/month	70*	70*	40*	40*
	Installation, $	100*	100*	50*	50*
COMMENTS		Bit pairs are encoded as a phase shift which is an odd multiple of 45°; 201A1 and A3 have internal clock; 201A2 and A4 use external clock; separate telephone sets such as 804A, 569NB, or 568HT can be used depending upon options	Bit pairs are encoded as a phase shift which is an odd multiple of 45°; 201B1 has internal clock; 201B2 has external clock; uses telephone sets 569NB or 568HT depending on options; EIA Standard RS232A or B or contact closure electrical interface	Capable of reverse-channel operation on two-wire half-duplex service only; supersedes 202A; compatible with automatic calling units	Capable of reverse channel operation on two-wire half-duplex service only; compatible with automatic calling units

* This data is approximate; prices vary with the various Bell System operating companies. Check with your local Bell System Communications Consultant.

(Contd.)

COMPARISON CHARTS: COMMON—CARRIER DATA SETS (CONTD.)

IDENTITY		Bell System Data Set 301B	Bell System Data Set 303B	Bell System Data Set 303C	Bell System Data Set 303D
APPLICATION		High-speed operation over a leased broad-band facility	High-speed operation over a leased broad-band facility	High-speed operation over a leased broad-band facility	High-speed operation over a leased broad-band facility
TRANSMISSION CHARACTER-ISTICS	Mode	Full-duplex	Full-duplex	Full-duplex	Full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Phase modulation	AM vestigial sideband	Restored polar	Restored polar
	Timing	Synchronous	Synchronous	Synchronous or Asynchronous	Asynchronous
	Code	Any code; see Comments	Any code; see Comments	Any code; see Comments	Any code; see Comments
	Turn-Around Time, msec	—	—	—	—
TRANSMISSION SPEED	Public Switched Network	—	—	—	—
	Leased Line	Group (12 voice-band lines) — 40,800 bps	Half-group (6 voice-band lines) — 19,200 bps	Group (12 voice-band lines) — 50,000 bps	Super-group (60 voice-band lines) — 230,400 bps
ELECTRICAL INTERFACE		Low impedance, current switching	Low impedance, current switching	Low impedance, current switching	Low impedance, current switching
FEATURES	Telephone Set	Separate (803A)	Separate (809B)	Separate (806B)	Separate (806B)
	Unattended Operation	Yes	Yes	Yes	Yes
	Other	—	—	—	—
PHYSICAL SPECIFICATIONS	Depth, inches	11.6	12	12	12
	Width, inches	17.5	24	24	24
	Height, inches	7.75	24	24	24
	Weight, pounds	35.5	105	105	105
COST	Rental, $/month	See Comments	See Comments	See Comments	See Comments
	Installation, $				
COMMENTS		There are some restrictions on the code structure that can be used with these data sets (check with your local telephone company communications consultant). The cost of these data sets is normally included in the terminal charges for the broad-band facility. Reverse channel capability can be implemented.			

COMPARISON CHARTS: COMMON–CARRIER DATA SETS (CONTD.)

IDENTITY		Bell System Data Set 401A	Bell System Data Set 401E	Bell System Data Set 401H
APPLICATION		Parallel transmission of data over the public telephone network (Data-Phone Service)	Parallel transmission of data over the public telephone network (Data-Phone Service)	Parallel or serial transmission of data over the public telephone network
TRANSMISSION CHARACTERISTICS	Mode	Simplex; send only	Simplex; send only	Simplex; send only
	Method	Parallel by bit; serial by character	Parallel by bit; serial by character	Parallel by bit or serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous
	Code	Restricted 2-of-8 code	Restricted 3-of-14 code	See Comments
	Turn-Around Time, msec	—	—	—
TRANSMISSION SPEED	Public Switched Network	Up to 20 char/sec	Up to 20 char/sec	Up to 20 char/sec, parallel, or up to 150 bits/sec, serial
	Leased Line	—	—	—
ELECTRICAL INTERFACE		Contact closure	Contact closure	Contact closure
FEATURES	Telephone Set	Integral	Integral	Separate
	Unattended Operation	No	No	Yes
	Other	—	Voice answer-back channel with 401E3	—
PHYSICAL SPECIFICATIONS	Depth, inches	9	9	3.25
	Width, inches	9	9	6
	Height, inches	4.5	3.75	8
	Weight, pounds	6	6	3
COST	Rental, $/month	5*	7.50*	10*
	Installation, $	15*	20*	20*
COMMENTS		Transmits 12 discrete code combinations	Transmits 99 discrete code combinations	Parallel operation provides transmission of 99 discrete code combinations using the restricted 3-of-14 code; compatible with 401J Serial operation permits use of any code, with no restrictions on code length; compatible with 103A

* This data is approximate; prices vary with the various Bell System operating companies. Check with your local Bell System Communications Consultant.

(Contd.)

COMPARISON CHARTS: COMMON–CARRIER DATA SETS (CONTD.)

IDENTITY		Bell System Data Set 401J	Bell System Data Set 402C	Bell System Data Set 402D
APPLICATION		Parallel reception of data transmitted over the public telephone network	Parallel transmission of data over a voice-band line	Parallel reception of data transmitted over a voice-band line
TRANSMISSION CHARACTERISTICS	Mode	Simplex; receive only	Simplex; send only	Simplex; receive only
	Method	Parallel by bit; serial by character	Parallel by bit; serial by character	Parallel by bit; serial by character
	Modulation	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous
	Code	Restricted 3-of-14 code	Any 8-level code	Any 8-level code
	Turn-Around Time, msec	—	—	—
TRANSMISSION SPEED	Public Switched Network	Up to 20 char/sec	Up to 75 char/sec	Up to 75 char/sec
	Leased Line	—	Up to 75 char/sec	Up to 75 char/sec
ELECTRICAL INTERFACE		Contact closure	Contact closure	Contact closure
FEATURES	Telephone Set	Integral	Integral	Separate (804A)
	Unattended Operation	Yes	Yes	Yes
	Other	See Comments	Reverse channel with 402C2	Reverse channel with 402D2
PHYSICAL SPECIFICATIONS	Depth, inches	14.5	14.75	11.6
	Width, inches	10.75	11	17.5
	Height, inches	5.5	5.5	7.75
	Weight, pounds	22	25	45
COST	Rental, $/month	35*	25*	75*
	Installation, $	50*	40*	100*
COMMENTS		Receives 99 discrete code combinations; 401J3 and J5 provide voice answer-back channel; 401J2 and J4 provide tone answer-back; compatible with 401H	Transmits 8 data channels in parallel plus a timing channel; answer-back mode allows receiving two data channels at 20 char/sec. compatible with automatic calling units	Receives 8 data channels in parallel plus a timing channel; answer-back mode allows transmission of three control codes, capable of automatic answering; compatible with automatic calling units when using 804A

* This data is approximate; prices vary with the various Bell System operating companies. Check with your local Bell System Communications Consultant.

COMPARISON CHARTS: COMMON—CARRIER DATA SETS (CONTD.)

IDENTITY		Bell System Data Set 602C	Bell System Data Set 603A	Bell System Data Set 603B
APPLICATION		Transmission of facsimile data over the public telephone network (Data-Phone Service); see Comments	Transmission of medical data over the public telephone network (Data-Phone Service); see Comments	Reception of medical data over the public telephone network (Data-Phone Service); see Comments
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex	Simplex; send only	Simplex; receive only
	Method	Analog	Analog	Analog
	Modulation	FM	FM	FM
	Timing	—	—	—
	Code	—	—	—
	Turn-Around Time, msec	200 + 25	—	—
TRANSMISSION SPEED	Public Switched Network	0 to 900 Hz baseband	0 to 100 Hz baseband	0 to 100 Hz baseband
	Leased Line	—	—	—
ELECTRICAL INTERFACE		EIA	EIA	EIA
FEATURES	Telephone Set	Integral	Integral	Integral
	Unattended Operation	Yes	No	Yes
	Other	Reverse-Channel (optional)	Reverse-Channel	Reverse-Channel
PHYSICAL SPECIFICATIONS	Depth, inches	14.7	11.5	14.75
	Width, inches	11	9	11
	Height, inches	5.6	4	5.5
	Weight, pounds	15	10	18
COST	Rental, $/month	Check with local Bell System Co.	12*	25*
	Installation, $		25*	50*
COMMENTS		The 602C is primarily designed to interface with facsimile equipment operating at speeds of 100 to 180 lines per minute; can also be used on a leased voice-band line	The 603A and 603B are designed to meet the data communications requirements of the medical profession for connection of customer owned medical electronic equipment such as electrocardiogram (ECG) devices to a voice-band line. The 603B is compatible with the 603A or 603D and includes automatic answering.	

* This data is approximate; prices vary with the various Bell System operating companies. Check with your local Bell System Communications Consultant.

(Contd.)

IDENTITY		Bell System Data Set 403E	Bell System Data Set 602C	Bell System Data Set 602D	Bell System Data Set 603A	Bell System Data Set 603B
APPLICATION		Parallel reception of data over public telephone network or leased voiceband line	Transmission of facsimile data over public telephone network (Data-Phone Service)	Transmission of facsimile data over public telephone network (Data-Phone service) or leased voiceband line	Transmission of medical data over public telephone network (Data-Phone service)	Reception of medical data over public telephone network (Data-Phone service)
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex	Half-duplex	Half-duplex	Simplex; send only	Simplex; receive only
	Method	Serial by char	Analog	Analog	Analog	Analog
	Modulation	Frequency shift	Frequency modulation	Frequency modulation	Frequency modulation	Frequency modulation
	Timing	Asynchronous	—	—	—	—
	Code	Restricted 2-of-8; restricted 2-of-7	—	—	—	—
	Turnaround Time, msec	—	200 to 225	200 to 225	—	—
TRANSMISSION DATA RATE	Public Switched Network	Up to 10 cps	0-900 Hz baseband	0-900 Hz baseband	0-100 Hz baseband	0-100 Hz baseband
	Leased Line	Type 2001: alternate voice/data Type 3001: data only	—	Type 2001: alternate voice/data Type 3001: data only	—	—
	Coaxial Cable or Twisted Pair Line		—	—	—	—
ELECTRICAL INTERFACE		EIA RS232A or B; contact closure	EIA	EIA	EIA	EIA
FEATURES	Telephone Set	Integral	Integral	Integral	Integral	Integral
	Unattended Operation	Yes	Yes	No	No	Yes
	Reverse Channel	—	—	—	—	—
	Line Equalization	—	—	—	—	—
PHYSICAL SPECS	Depth, in.	12	14.7	11.5	11.5	14.75
	Width, in.	12.25	11	9	9	11
	Height, in.	11.75	5.6	4.5	4	5.5
	Weight, lb	—	15	—	10	18
MONTHLY RENTAL, $		53 or 64 (USASCII)	—	16	12	25
INSTALLATION, $		—	—	30	25	50
COMMENTS			Designed primarily to interface facsimile equipment operating at 100 - 180 lines/min; can also be used on leased voiceband line	Designed primarily to interface facsimile equipment	Designed to meet data communications requirements of medical profession for connection of customer-owned medical electronic equipment, such as electrocardiogram (ECG) devices, to voiceband line; compatible with 603B or 603D	Designed to meet data communications requirements of medical profession for connection of customer-owned medical electronic equipment, such as electrocardiogram (ECG) devices, to voiceband line; compatible with 603A or 603D; includes automatic answering

IDENTITY		Bell System Data Set 603D	Bell System Data Set 604A	Bell System Data Set 604B	Bell System Auxiliary Data Set 811B	Bell System Data Set 113A
APPLICATION		Portable transmission of medical data over public telephone network via acoustic coupling	Multichannel transmission of medical data over public telephone network (Data-Phone service)	Multichannel reception of medical data over public telephone network (Data-Phone service)	Permits connection of customer-provided terminal to regular TWX network	Low-speed operations over public telephone network (Data-Phone Service)
TRANSMISSION CHARACTERISTICS	Mode	Simplex; send only	Simplex; send only	Simplex; receive only	Half-duplex	Half-/full-duplex
	Method	Analog	Analog	Analog	Serial by bit	Serial by bit
	Modulation	Frequency modulation	Frequency modulation	Frequency modulation	None; see Comments	Frequency shift
	Timing	—	—	—	Asynchronous	Asynchronous
	Code	—	—	—	See Comments	Any code; any length
	Turnaround Time, msec	—	—	—	—	See Comments
TRANSMISSION DATA RATE	Public Switched Network	0-100 Hz baseband	0-105 Hz baseband per channel	0-105 Hz baseband per channel	45.5 or ±10 bps (TWX network)	Up to 300 bps
	Leased Line	—	—	—	—	—
	Coaxial Cable or Twisted Pair Line	—	—	—	—	—
ELECTRICAL INTERFACE		EIA	EIA	EIA	EIA RS232B	EIA RS232C
FEATURES	Telephone Set	No	Integral	Integral	No	Yes
	Unattended Operation	No	Yes	Yes	Yes	No
	Reverse Channel	—	—	—	—	No
	Line Equalization	—	—	—	—	None
PHYSICAL SPECS	Depth, in.	4.4	14.75	14.75	10.5	11.5
	Width, in.	9.4	11	11	11	8.75
	Height, in.	12.9	5.5	5.5	5.5	3.75
	Weight, lb	6	16.5	18	—	8
MONTHLY RENTAL, $		12	—	—	22	10
INSTALLATION, $		10	—	—	15	25
COMMENTS		Battery-powered, acoustic telephone coupler; compatible with 603B; designed for electrocardiogram (ECG) equipment; connects to std telephone handset	Contains 3 data channels; designed for electrocardiogram (ECG) equipment; compatible with 604B	Contains 3 data channels; designed for electrocardiogram (ECG) equipment; compatible with 604A	Connected to regular TWX 60- or 100-speed satation; TWX station data set provides frequency shift modulation; TWX stations use 5-level Baudot/8-level USASCII codes; above costs based on single-station arrangement	Designed for Originate-Only service; transmitter/receiver operate simultaneously, compatible with/replacement for Bell System Data Set 103A with Data-Phone Service; intended for time sharing applications

IDENTITY		Western Union 180 Baud Data Modem No. 1181.1A	Western Union Data Set 1601B	Western Union Data Set 2121B	Western Union Data Set 2247B	Western Union Data Set 2481A
APPLICATION		Low-speed operation over leased narrow band line	Operation over leased voiceband line	Operation over leased voiceband line	Operation over leased voiceband line	High-speed operation over leased voiceband line
TRANSMISSION CHARACTERISTICS	Mode	Full-duplex	Simplex/half-/full-duplex	Simplex/half-/full-duplex	Simplex/half-/full-duplex	Simplex/half-/full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Phase shift (8-phase)	Phase shift (8-phase)
	Timing	Asynchronous	Asynchronous	Asynchronous	Synchronous	Synchronous
	Code	Any code; any length	Any code; any length	Any code; any length	Any code; any length	Any code; any length
	Turnaround Time, msec	—	20 (fast); 40 (norm)	20 (fast); 60 (norm)	12 (fast); 50 (norm)	12 (fast); 50 (norm)
TRANSMISSION DATA RATE	Public Switched Network	—	—	—	—	—
	Leased Line	Class D Data Channel: up to 180 bps	Type 3002: up to 600 bps	Type 3002: up to 1,200 bps	Type 3002: 2,400 bps	Type 3002 (C2): 4,800 bps
	Coaxial Cable or Twisted Pair Line	—	—	—	—	—
ELECTRICAL INTERFACE		EIA RS232A	EIA RS232B	EIA RS232B	EIA RS232B	EIA RS232B
FEATURES	Telephone Set	No	Optional	Optional	Optional	Optional
	Unattended Operation	No	Yes	Yes	Yes	Yes
	Reverse Channel	—	Optional	Optional	Optional	Optional
	Line Equalization	—	—	—	Fixed	Adjustable
PHYSICAL SPECS	Depth, in.	10	9	9	18	18
	Width, in.	11	11	11	18	18
	Height, in.	6	5	5	6.5	6.5
	Weight, lb	22	12	12	49	49
MONTHLY RENTAL, $		13.75; see Comments	30	30	108	145
INSTALLATION, $		No charge	50	50	50	250
COMMENTS		Cost figure refers to station arrangement charge	Telephone set provided separately; reverse channel requires adapter; 4-wire operation; compatible with Western Union 11774-A/13182-A Automatic Answering Units, 12405-B Automatic Calling Unit; forward operating frequencies 850 Hz (mark)/1,350 Hz (space)	Telephone set provided separately; reverse channel requires adapter; 4-wire operation; compatible with Western Union 11774-A/13182-A Automatic Answering Units, 12405-B Automatic Calling Unit; forward operating frequencies 1,400 Hz (mark)/2,200 Hz (space)	Telephone set provided separately; reverse channel requires adapter; 4-wire operation; groups of 3 bits encoded as 1 of 8 phase shifts (multiple of 45°); 1,300-2,100 Hz frequency range (480-570 Hz, secondary); full-duplex 75-bps FSK secondary auxiliary channel opt; compatible with Western Union 11774-A/13182-A Automatic Answering Units, 12405-B Automatic Calling Unit; contact closure interface optional	Telephone set provided separately; reverse channel requires adapter; 4-wire operation; groups of 3 bits encoded as 1 of 8 phase shifts (multiple of 45°); 900-2,500 Hz frequency range; switch provision to regenerative mode for remote testing; compatible with Western Union 11774-A/13182-A Automatic Answering Units, 12405-B Automatic Calling Unit

IDENTITY		Western Union Data Set 2200/24				
APPLICATION		Operation over leased voiceband line				
TRANSMISSION CHARACTERISTICS	**Mode**	Simplex/half-/full-duplex				
	Method	Serial by bit				
	Modulation	Phase shift (4-phase)				
	Timing	Synchronous				
	Code	Any code; any length				
	Turnaround Time, msec	12 (fast); 50 (norm)				
TRANSMISSION DATA RATE	**Public Switched Network**	2,400 bps				
	Leased Line	Type 3002: 2,400 bps				
	Coaxial Cable or Twisted Pair Line	—				
ELECTRICAL INTERFACE		EIA RS232B or C				
FEATURES	**Telephone Set**	Optional				
	Unattended Operation	Yes				
	Reverse Channel	—				
	Line Equalization	Fixed				
PHYSICAL SPECS	**Depth, in.**	15.6				
	Width, in.	16.75				
	Height, in.	3.5				
	Weight, lb	25				
MONTHLY RENTAL, $		72				
INSTALLATION, $		100				
COMMENTS		Telephone set provided separately; compatible with Bell System 201B Data Set; unit manufactured by ICC; alternate voice/data over leased line via ICC Model 12 Voice Adapter; alternate voice/data over switched network via manual coupler/automatic answer DAA; groups of 2 bits encoded as 2 of 4 phase shifts (multiple of 90°); field-switchable to 2-phase (1,200 bps); operates within 800-Hz bandwidth				

COMPARISON CHARTS: NON—COMMON—CARRIER DATA SETS

The characteristics of data sets produced for independent sale are presented in this set of charts beginning on page 4620:02. These data sets are typically used on private or leased facilities, but can also be connected to the public telephone network via a Bell System Data Access Arrangement (see Report 3200, Paragraph .1) when line conditioning is not required. The addresses of the manufacturers represented in the charts are listed below.

American Data Systems
20747 Dearborn Street
Chatsworth, California 91311

Astrocom Corporation
293 Commercial Street
St. Paul, Minnesota 55106

Automatic Electric Company
Subsidiary of
General Telephone and Electronics (GT&E)
400 N. Wolf Road
North Lake, Illinois 60164

Codex Corporation
222 Arsenal Street
Watertown, Massachusetts 02172

Collins Radio Company
19700 Jamboree Road
Newport Beach, California 92663

Datamax Corporation
3941 Research Park Drive
Ann Arbor, Michigan 48104

General Dynamics
P. O. Box 2566
Orlando, Florida 32802

General Electric Company
Mountain View Road
Lynchburg, Virginia 24505

International Communications Corporation
7620 N. W. 36th Avenue
Miami, Florida 33147

Lenkurt Electric
Subsidiary of
General Telephone and Electronics (GT&E)
1105 County Road
San Carlos, California 94070

Lynch Communications Systems
695 Bryant Street
San Francisco, California 94107

RFL industries, Inc.
Communications Division
Boonton, New Jersey 67005

Rixon Electronics, Inc.
2120 Industrial Parkway
Silver Spring, Maryland 20904

Sangamo Electric Company
P. O. Box 359
Springfield, Illinois 62705

Singer Tele-Signal Corporation
250 Crossways Park Drive
Woodbury, Long Island, New York 11797

Tele-Dynamics
Division of
American Bosch Arma Corporation
5000 Parkside Avenue
Philadelphia, Pennsylvania 19131

Tel-Tech Corporation
9170 Brookville Road
Silver Spring, Maryland 20910

Ultronic Systems Corporation
Subsidiary of
Sylvania Electric Products
Mount Laurel Industrial Park
Moorestown, New Jersey 08057

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		Automatic Electric Company AE2024 Data Set	Automatic Electric Company AE2025 Data Set	Automatic Electric Company AE2026 Duobinary Data Set
APPLICATION		Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line
TRANSMISSION CHARACTER-ISTICS	Mode	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift; see Comments
	Timing	Asynchronous	Synchronous	Synchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	15 (receive to transmit); 2 (transmit to receive)	15 (receive to transmit); 2 (transmit to receive)	15 (receive to transmit); 2 (transmit to receive)
TRANSMISSION SPEED	Public Switched Network	Up to 1600 bps	Up to 1200 bps	—
	Leased Line	Type 3002 Up to 1600 bps	Type 3002 600 bps or 1200 bps	Type 3002 2400 bps
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B
FEATURES	Telephone Set	None	None	None
	Unattended Operation	—	—	—
	Other	See Comments	See Comments	See Comments
PHYSICAL SPECIFICATIONS	Depth, inches	6	6	6
	Width, inches	18.4	18.4	18.4
	Height, inches	9.5	9.5	9.5
	Weight, pounds	20	20	20
COST	Purchase Price, $	865 to 904	1015 to 1174	1015 to 1270
COMMENTS		Optional Delay Equalizer permits turn-around delay time to be set to customer requirements	Optional Delay Equalizer permits turn-around delay time to be set to customer requirements	Duobinary modulation; center frequency represents a space; a mark is transmitted as the upper or lower frequency, depending upon whether an even or odd number of spaces occur between marks and on the previous mark frequency; optional Duobinary Error, Detector, Receive Clock, and Delay Equalizer for customer-specified turn-around delay

(Contd.)

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		Codex AE-96 High Speed Data Modem	Collins TMX-201 Data Modem	Collins TMX-202 Data Modem
APPLICATION		High speed operation over a voice-band line	Multiple channel operation over a voice-band line	Multiple channel operation over a voice-band line
TRANSMISSION CHARACTERISTICS	Mode	Full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex
	Method	See comments	Serial by bit	Serial by bit
	Modulation	Multi-level single-sideband AM; see Comments	Frequency shift	Frequency shift
	Timing	Synchronous	Asynchronous	Asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	—	?	?
TRANSMISSION SPEED	Public Switched Network	—	75 bps, 110 bps, or 150 bps	Up to 1800 bps
	Leased Line	Type 3002 9600 bps or 4800 bps (Type C2) 7200 bps or 3600 bps (Type C1) 4800 bps or 2400 bps (Unconditioned)	Type 3002 75 bps, 110 bps, or 150 bps	Type 3002 Up to 1800 bps
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B; standard Teletype interface	EIA Standard RS232B; standard Teletype interface
FEATURES	Telephone Set	Optional	None	None
	Unattended Operation	No	Yes	Yes
	Other	—	—	—
PHYSICAL SPECIFICATIONS	Depth, inches	24	10.375	21
	Width, inches	19	19	19
	Height, inches	8.75	5.25	8.75
	Weight, pounds	75	17	7.5
COST	Purchase Price, $	13,975	575 to 650	575 to 650
COMMENTS		The Codex modulation technique encodes a two-bit group as one of four amplitude levels; various transmission speed pairs can be implemented as shown by changing circuit boards; speed selection between the two rates is by manual switch and transmission and receiving rates can be different	Several different transmitting and receiving units can be incorporated to provide 25 channels (75 bps), 18 channels (110 bps), or 8 channels (150 bps)	Several different transmitting and receiving units can be incorporated to provide 24 channels (50 to 75 bps), 18 channels (75 to 110 bps), 8 or 9 channels (150 bps), 4 channels (300 bps), 2 channels (600 bps), or 1 channel (1200 bps)

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		Collins TE-216A-2D-2400 Data Modem	Collins TE-216A-3D-3600 Data Modem	Collins TE-216A-4D-4800 Data Modem
APPLICATION		Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line
TRANSMISSION CHARACTER-ISTICS	Mode	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex
	Method	See Comments	See Comments	See Comments
	Modulation	Phase shift/AM; see Comments	Phase shift/AM; see Comments	Phase shift/AM; see Comments
	Timing	Synchronous	Synchronous	Synchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	50 with options	50 with options	50 with options
TRANSMISSION SPEED	Public Switched Network	—	—	—
	Leased Line	Type 3002 (C1) 1200 bps (optional) or 2400 bps	Type 3002 (C2) 2400 bps (optional) or 3600 bps	Type 3002 (C3) 2400 bps (optional) or 4800 bps
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B
FEATURES	Telephone Set	TE-814	None	None
	Unattended Operation	Yes	Yes	Yes
	Other	See Comments	See Comments	See Comments
PHYSICAL SPECIFICATIONS	Depth, inches	22.5	22.5	22.5
	Width, inches	17.5	17.5	17.5
	Height, inches	8.75	8.75	8.75
	Weight, pounds	72	72	72
COST	Purchase Price, $	5170	5920	6390
COMMENTS		These data sets use the Collins Kineplex modulation technique; for each tone transmitted, a group of three bits is encoded as a phase shift which is an odd multiple of 45° and one of two amplitude levels; these data sets transmit four discrete frequencies (tones) for 4800 bps, three tones for 3600 bps, two tones for 2400 bps, and one tone for 1200 bps; data rate selection by remote station is optional; other options include various electrical interfaces and plug-in test unit. The TE-814 includes alternate data voice selection and is capable of transmission rates at up to 4800 bps		

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		General Electric TDM-111 Data Set	General Electric TDM-211 Data Set	General Electric TDM-110 Data Set	General Electric TDM-210 Data Set
APPLICATION		Low-speed operation over the public telephone network	High-speed operation over the public telephone network	Operation over a voice-band line	Operation over a voice-band line
TRANSMISSION CHARACTERISTICS	Mode	Full-duplex	Half-duplex	Full-duplex	Half-duplex or full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	—	200	—	See Comments
TRANSMISSION SPEED	Public Switched Network	Up to 300 bps	Up to 1200 bps	Up to 300 bps	Up to 1000 bps
	Leased Line	—	—	Type 3002 Up to 300 bps	Type 3002 Up to 1000 bps Type 3002(C1) Up to 1400 bps Type 3002(C2) Up to 1800 bps
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B
FEATURES	Telephone Set	Optional	Optional	None	None
	Unattended Operation	Yes	Yes	No	No
	Other	—	Optional reverse channel	—	See Comments
PHYSICAL SPECIFICATIONS	Depth, inches	9	9	9	9
	Width, inches	19	19	13.75	13.75
	Height, inches	6.5	6.5	6	6
	Weight, pounds	15	15	14.5	14.5
COST	Purchase Price, $	875 to 970	850 to 1145	625	815 to 1015
COMMENTS		These data sets are marketed to telephone (common-carrier) companies only. TDM-111 is compatible with Bell System Data Phone Data Set 103A2; TDM-211 is compatible with 202C. Six-button telephone set (optional) provides voice, data, and answer modes. Both data sets provide automatic disconnect		Compatible with Bell System Data Set 103F	Compatible with Bell System Data Set 202D; has optional reverse channel capability; a turn-around time of 10, 60, 120, or 200 milliseconds can be specified

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		General Electric TDM-220 Data Set	ICC Modem 4400/20H and 4400/20L	ICC Modem 4400/20 PB	ICC Modem 4400/24PB
APPLICATION		Operation over a leased voice-band line	Double high-speed channel and multiple low-speed channels over a leased voice-band line	Single high-speed channel and multiple low-speed channels/ voice over a leased voice-band line	Single high-speed channel and multiple low-speed channels/ voice over a leased voice-band line
TRANSMISSION CHARACTER-ISTICS	Mode	Half-duplex or full-duplex	Simplex, half-duplex, or full-duplex	Simplex, half-duplex, or full-duplex	Simplex, half-duplex, or full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	AM vestigial side-band	Phase shift (8 phase); see Comments	Phase shift (8 phase); see Comments	Phase shift (8 phase); see Comments
	Timing	Asynchronous; see Comments	Synchronous	Synchronous	Synchronous
	Code	Any code; unre-stricted code length	Any code; unre-stricted code length	Any code; unre-stricted code length	Any code; unre-stricted code length
	Turn-Around Time, msec	500	150	150	50 or 12 (optional)
TRANSMISSION SPEED	Public Switched Network	—	—	—	—
	Leased Line	Type 3002 Asynchronous operation at speeds up to 2400 bps; synchronous operation at 2400 bps	Type 3002 (C2) 2000 bps per high-speed channel; 75 bps per low-speed channel	Type 3002 (C2) 2000 bps plus 75 bps per low-speed channel	Type 3002 (C2) 2400 bps plus 75 bps per low-speed channel
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B
FEATURES	Telephone Set	None	None	Model 10	Model 10
	Unattended Operation	No	No	No	No
	Other	—	—	—	—
PHYSICAL SPECIFICATIONS	Depth, inches	9	18.6	18.6	18.6
	Width, inches	13.75	18	18	18
	Height, inches	6	6.5	6.5	6.5
	Weight, pounds	14.5	47	47	47
COST	Purchase Price, $	990 (asynchronous) 1360 (synchronous)	5050 each unit	5050	5050
COMMENTS		Internal clocking at a 2400 bps rate is included in synchronous model	Groups of three bits are encoded as one of eight phase shifts which is a multiple of 45°; two independent data sets (20L and 20H) each provide a separate 2000 bps channel on a single voice line; up to twelve 75 bps channels can be substituted for one 2000 bps channel	Groups of three bits are encoded as one of eight phase shifts which is a multiple of 45°; alternate operation of voice (with optional Model 10 Voice Adapter) or up to twelve 75 bps channels is provided in addition to the 2000 bps channel	Groups of three bits are encoded as one of eight phase shifts which is a multiple of 45°; alternate operation of voice (with optional Model 10 Voice Adapter) or up to eight 75 bps channels is provided in addition to the 2000 bps channel

(Contd.)

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		ICC Modem 4400/48	ICC Modem 2200/24	ICC Modem 1100 Series	ICC Modem 5500
APPLICATION		Single high-speed channel and two low-speed channels over a leased voice-band line	High-speed operation over a voice-band line	Ultra-high-speed operation over a coaxial cable or twisted pair line	High-speed operation over a leased voice-band line
TRANSMISSION CHARACTERISTICS	Mode	Simplex, half-duplex, or full-duplex	Simplex, half-duplex, or full-duplex	Simplex, half-duplex, or full-duplex	Simplex, half-duplex, or full duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Phase shift (8 phase); see Comments	Phase shift (4 phase); see Comments	Phase shift (2 phase); see Comments	Not specified
	Timing	Synchronous	Synchronous	Synchronous	Synchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	50 or 12 (optional)	150	12	150
TRANSMISSION SPEED	Public Switched Network	—	—	—	—
	Leased Line	Type 3002 4800 bps	Type 3002 2400 bps	—	Type 3002 (C2) 9600 bps
				Up to 1,000,000 bps; See Comments	
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B
FEATURES	Telephone Set	Model 11	Model 12	None	None
	Unattended Operation	Yes	Yes	No	No
	Other	—	—	—	—
PHYSICAL SPECIFICATIONS	Depth, inches	18.6	16.25	8	18.63
	Width, inches	18	15.625	8	18
	Height, inches	5.7	3.5	3.25	6.5
	Weight, pounds	45	20	7.5	50
COST	Purchase Price, $	5,885	2350	2725 to 3925	11,500
COMMENTS		Groups of three bits are encoded as one of eight phase shifts which is a multiple of 45°; bandwidth used is 1600 (Hz); optional alternate voice/data operation is provided by Model 11 Voice Adapter	Groups of two bits are encoded as one of four phase shifts which is a multiple of 90°; bandwidth used is 800 Hz; optional alternate voice/data operation is provided by Model 12 Voice Adapter	Designed for limited-distance operation over a twisted-pair line or coaxial cable. ICC states range at 1M bps is 0.6 miles (twisted pair) and 2.4 miles (coaxial cables); range is greatly extended at lower speeds	

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		Lenkurt 25B Data Transmission System	Lenkurt 26C Duobinary Datatel Data Set	Lenkurt 26C-40.8 Duobinary Datatel Data Set
APPLICATION		Multiple low-speed channel operation over a voice-band line	Operation over a voice-band line	High-speed operation over a broad-band line
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex or full-duplex	Simplex or full-duplex	Full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift; see Comments	Frequency shift
	Timing	Asynchronous	See Comments	Synchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	100	—	—
TRANSMISSION SPEED	Public Switched Network	75 bps, 110 bps, 150 bps, 200 bps, or 600 bps	Up to 1800 bps	—
	Leased Line	Type 3002- 75 bps, 110 bps, 150 bps, 200 bps, or 600 bps (each channel); see Comments	Type 3002 asynchronous operation at speeds up to 1800 bps; synchronous operation at 150 bps, 300 bps, 600 bps, 1200 bps, or 2400 bps	Broad-band (group) 20,400 bps or 40,800 bps
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B
FEATURES	Telephone Set	None	None	None
	Unattended Operation	Yes	No	No
	Other	—	—	—
PHYSICAL SPECIFICATIONS	Depth, inches	12(1)	10	10
	Width, inches	19	19	17
	Height, inches	5.25	3.5	3.5
	Weight, pounds	varies with size	20	16
		10.75(2)		
		14		
		3		
		9		
COST	Purchase Price, $	600 per channel	1600 to 2400	2000
COMMENTS		Desk-top modems are restricted to single-channel operation at one of the designated speeds; rack-mounted modems incorporate several transmit and receive units to provide 25 channels (75 bps), 18 channels (110 bps) 12 channels (150 bps) 7 channels (200 bps), 1-channel (600 bps) or combinations of the above. Multi-channel operation requires Type C4 conditioning	Duobinary modulation; center frequency represents a space; a mark is transmitted as the upper or lower frequency depending upon whether an even or odd number of spaces occur between marks and on the previous mark frequency	Transmission speeds are switch selected; Duobinary modulation; compatible with Bell System Data Set 301B

(Contd.)

(1) Rack-mounted multi-channel modem.
(2) Desk-top single-channel modem.

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		Lynch Communications Systems L2103A Data Set	Lynch Communications Systems L2103F Data Set	RFL Industries Series 2056 Model 13AO/TTY Data Set	RFL Industries Series 2056 Model 13AO/EIA Data Set
APPLICATION		Low-speed operation over the public telephone network	Low-speed operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex	Full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	See Comments	265	10	—
TRANSMISSION SPEED	Public Switched Network	Up to 300 bps	—	Up to 300 bps	Up to 300 bps
	Leased Line	—	Type 3002 Up to 300 bps or 150 bps (TWX-CE)	Type 3002 Up to 300 bps	Type 3002 Up to 300 bps
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B	Teletype or contact closure (optional)	EIA Standard RS232B
FEATURES	Telephone Set	See Comments	—	None	None
	Unattended Operation	Optional	Optional	Yes	Yes
	Other	—	—	—	—
PHYSICAL SPECIFICATIONS	Depth, inches	9.25	9.25	3.95	9.875
	Width, inches	9.75	9.75	12	18
	Height, inches	5.63	5.63	5.12	4.75
	Weight, pounds	8	8	10	30
COST	Purchase Price, $	570	520	384	670
COMMENTS		The L2103A and L2103F are compatible with the Bell System 100 Series Data Sets; a Bell System 804BWI Auxiliary Set is required for alternate voice operation and dialing over the public telephone network. The L2103A transmitter and receiver operate simultaneously		Models 13AO/TTY and 13AO/EIA are compatible with the Bell System 100 Series Data Sets; both operate in originate mode only; answer mode is optional	

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		RFL Industries Series 2056 Model 13AF/EIA Data Set	RFL Industries Series 2056 Model 22DB/EIA Data Set	RFL Industries Series 2056 Model 32DT/EIA and 32DR/EIA Data Set	RFL Industries Model 3227 High Speed Data Set
APPLICATION		Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line
TRANSMISSION CHARACTERISTICS	Mode	Full-duplex	Half-duplex or full-duplex	Full-duplex	Half-duplex or full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Synchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	—	—	—	15, minimum
TRANSMISSION SPEED	Public Switched Network	Up to 300 bps	Up to 1200 bps	Up to 1200 bps	1000 bps
	Leased Line	Type 3002 Up to 300 bps	Type 3002 Up to 1200 bps	Type 3002 Up to 120 bps and Up to 1200 bps	Type 3002 1200 bps
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B; Teletype interface optional	EIA Standard RS232B
FEATURES	Telephone Set	None	None	None	None
	Unattended Operation	Yes	Yes	Yes	Yes
	Other	—	—	—	—
PHYSICAL SPECIFICATIONS	Depth, inches	9.875	9.875	9.875	8.5
	Width, inches	18	18	18	19
	Height, inches	4.75	4.75	4.75	3.5
	Weight, pounds	30	30	30	20
COST	Purchase Price, $	849*	868*	32DT/EIA: 814* 32DR/EIA: 956*	850
COMMENTS		Operates in both originate and answer modes; compatible with Bell System 100 Series Data Sets; provides data set checking features	Compatible with Bell System 202C and 202D Data Sets; provides optional reverse-channel capability; includes data set checking features	Complimentary data sets having one 1200 bps channel and one 120 bps channel for use at opposite ends of the line; both channels can be operated simultaneously; optional Teletype interface on 120 bps channel	Physical dimensions are for rack mounting; desk set and other mountings are available

* This data is approximate; prices vary with configuration and options.

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		Rixon Electronics Sebit-12M Data Set	Rixon Electronics Sebit-24M Data Set	Rixon Electronics Sebit-36M Data Set	Rixon Electronics Sebit-48M Data Set
APPLICATION		Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line
TRANSMISSION CHARACTER-ISTICS	Mode	Full-duplex	Full-duplex	Full-duplex	Full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	AM vestigial sideband	AM vestigial sideband	AM vestigial sideband	AM vestigial sideband
	Timing	Synchronous	Synchronous	Synchronous	Synchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	See Comments	See Comments	See Comments	See Comments
TRANSMISSION SPEED	Public Switched Network	Up to 1200 bps	Up to 1200 bps	—	—
	Leased Line	Type 3002 150 bps, 300 bps, 600 bps, or 1200 bps	Type 3002 150 bps, 300 bps, 600 bps, 1200 bps, or 2400 bps	Type 3002 fixed data rates at up to 3600 bps; see Comments	Type 3002 fixed data rates at up to 4800 bps; see Comments
ELECTRICAL INTERFACE		EIA Standard RS232A or B	EIA Standard RS232A or B	EIA Standard RS232A or B	EIA Standard RS232A or B
FEATURES	Telephone Set	Optional	Optional	Optional	Optional
	Unattended Operation	Optional	Optional	Optional	Optional
	Other	—	—	—	—
PHYSICAL SPECIFICATIONS	Depth, inches	16	16	16	16
	Width, inches	19	19	19	19
	Height, inches	5.25	5.25	15.75	21
	Weight, pounds	25	25	100	125
COST	Purchase Price, $	2,000*	2,500*	5,800*	6,000*
COMMENTS		Transmission speeds can be switch-selected; will operate in half-duplex mode but requires 10-second turn-around time; Rixon does not recommend half-duplex operation; AM vestigial sideband transmission favorably concentrates the transmission power into a restricted frequency spectrum		A wide range of transmission speeds can be obtained via two front-panel selector switches; will operate in half-duplex mode but requires 10-second turn-around time; Rixon does not recommend half-duplex operation; AM vestigial sideband transmission favorably concentrates the transmission power into a restricted frequency spectrum	

* This data is approximate; prices vary with configuration and options.

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		Rixon Electronics Sebit-24B Data Set	Rixon Electronics Sebit-48C Data Set	Rixon Electronics Sebit-72 Data Set	Rixon Electronics Sebit-96 Data Set
APPLICATION		Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line
TRANSMISSION CHARACTER-ISTICS	Mode	Full-duplex	Half-duplex, full-duplex, or simplex	Simplex, Half-duplex, or full-duplex	Simplex, half-duplex, or full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	AM vestigial side-band	AM vestigial side-band	4-level AM vestigial sideband	4-level AM vestigial sideband
	Timing	Synchronous	Synchronous	Synchronous	Synchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	See Comments	—	See Comments	See Comments
TRANSMISSION SPEED	Public Switched Network	Up to 1200 bps	—	—	—
	Leased Line	Type 3002 600 bps, 1200 bps, or 2400 bps	Type 3002 (C4) 4800 bps	Type 3002 (C2) 3600 bps, 4800 bps, or 7200 bps	Type 3002 (C4) 4800 bps, 6400 bps, or 9600 bps
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B
FEATURES	Telephone Set	Optional	None	None	None
	Unattended Operation	Optional	None	Yes	Yes
	Other	—	—	—	—
PHYSICAL SPECIFICATIONS	Depth, inches	16	16	12	12
	Width, inches	19	19	23	23
	Height, inches	10.5	10.5	17	17
	Weight, pounds	117	50	60	60
COST	Purchase Price, $	6,000*	2900	9950	9950
COMMENTS		Transmission speeds can be selected by interchanging circuit boards; will operate in half-duplex mode but requires 10-second turn-around time; Rixon does not recommend half-duplex operation	Lower speeds of 4400 bps or 4000 bps can be manually selected	Transmission speeds are switch selected; 1800 Hz bandwidth; requires 15-second turn-around time in half-duplex mode	Transmission speeds are switch selected; 2400 Hz bandwidth; requires 15-second turn-around time in half-duplex mode

* This data is approximate; prices vary with configuration and options.

(Contd.)

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		Rixon Electronics Sebit Dual-12M Data Set	Rixon Electronics FM-300 Data Set	Rixon Electronics FM-12 Data Set	Rixon Electronics FM-18 Data Set
APPLICATION		Dual channel operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line
TRANSMISSION CHARACTERISTICS	Mode	Full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex, full-duplex, or simplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	AM vestigial sideband	Frequency shift	Frequency shift	Frequency shift
	Timing	Synchronous	Asynchronous	Asynchronous	Synchronous or asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	See Comments	265 ± 65	200 ± 20	8.5 or 70; 8.5 or 200
TRANSMISSION SPEED	Public Switched Network	Up to 1200 bps	Up to 300 bps	—	1200 or 1800 bps (synch) or up to 1800 bps (asynch)
	Leased Line	Type 3002 150 bps, 300 bps, 600 bps, or 1200 bps Data rates are for each channel	Type 3002 Up to 300 bps	Type 2002 (C1) Up to 1200 bps Type 3002 (C2) Up to 1800 bps	Type 3002 (C1) Up to 1200 bps Type 3002 (C2) Up to 1800 bps
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B
FEATURES	Telephone Set	Optional	None	Optional	None
	Unattended Operation	Optional	None	Optional	None
	Other	—	—	—	Reverse channel capability
PHYSICAL SPECIFICATIONS	Depth, inches	16	9.5	Physical dimensions depend on configuration; see Comments	9.5
	Width, inches	19	6.5		6.5
	Height, inches	10.5	6.5		6.5
	Weight, pounds	50	8		8
COST	Purchase Price, $	5,000*	435	450*	445
COMMENTS		Transmission speeds can be switch-selected (channels operate independently and can operate concurrently at different speeds); will operate in half-duplex mode but requires 10-second turn-around time; Rixon does not recommend half-duplex operation	Compatible with the Bell System Series 100 Data Set; available as a rack-mounted modem: four modems to a single rack-mounted enclosure	Clock option is available; desk, shelf, or rack mounting is available	Compatible with the Bell System Series 202 Data Set; available as a rack-mounted modem: four modems to a single rack-mounted enclosure; operates synchronously with optional clock

* This data is approximate; prices vary with configuration and options.

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		Rixon Electronics PM-24A and PM-24B Data Sets	Sangamo Transidata T103A Data Set	Sangamo Transidata T103F Data Set	Sangamo Transidata T201A Data Set
APPLICATION		Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Phase shift	Frequency shift	Frequency shift	Phase shift; see Comments
	Timing	Synchronous	Asynchronous	Asynchronous	Synchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	7.5	—	—	150
TRANSMISSION SPEED	Public Switched Network	—	Up to 300 bps	Up to 300 bps	2000 bps
	Leased Line	Type 3002 1200 bps (PM-24A) Type 3002 (C2) — 2400 bps (PM-24B); see Comments	Type 3002 Up to 300 bps	Type 3002 Up to 300 bps	Type 3002 (C2) 2000 bps
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B
FEATURES	Telephone Set	Optional	Separate (804B; 567PB)	Separate	Separate
	Unattended Operation	Optional	Yes	Optional	Optional
	Other	—	—	—	—
PHYSICAL SPECIFICATIONS	Depth, inches	10.5	11	11	10
	Width, inches	19	11.5	11.5	17.75
	Height, inches	14	4.8	4.8	11
	Weight, pounds	40	33	33	33
COST	Purchase Price, $	2400	580	535	2110 (A1) 2075 (A2)
COMMENTS		Transmission speeds can be switch-selected; PM-243 has higher carrier frequency and requires line conditioning	T103A1 and T103A2 provide compatibility with Bell System Models 103A1 and 103A2; provides data set checking features	Compatible with Bell System Data Set 103F	Bit pairs are encoded as a phase shift which is an odd multiple of 45°; T201A1 has internal clock; T201A2 uses external clock; separate telephone sets such as Bell System 804A, 569NB, or 568HT can be used depending upon options

(Contd.)

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		Sangamo Transidata T201B Data Set	Sangamo Transidata T202C Data Set	Sangamo Transidata T202D Data Set	Sangamo Transidata T401E Data Set
APPLICATION		Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line	Parallel transmission of data over the public telephone network
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex	Simplex; send only
	Method	Serial by bit	Serial by bit	Serial by bit	Parallel by bit; serial by character
	Modulation	Phase shift; see Comments	Frequency shift	Frequency shift	Frequency shift
	Timing	Synchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length	Restricted 3-of-14 code
	Turn-Around Time, msec	8	8.5 to 200	200 ± 25	—
TRANSMISSION SPEED	Public Switched Network	—	Up to 1200 bps	Up to 1200 bps	Up to 20 char/sec
	Leased Line	Type 3002 (C2) 2400 bps	Type 3002 (C1) Up to 1400 bps Type 3002 (C2) Up to 1800 bps	Type 3002 Up to 1000 bps Type 3002 (C1) Up to 1400 bps Type 3002 (C2) Up to 1800 bps	—
ELECTRICAL INTERFACE		EIA Standard RS232B or contact closure	EIA Standard RS232B or contact closure	EIA Standard RS232B	Contact closure
FEATURES	Telephone Set	Separate	Separate (569)	Separate (804A)	Integral
	Unattended Operation	Optional	Optional	Yes, with 804A	No
	Other	—	Reverse channel	—	See Comments
PHYSICAL SPECIFICATIONS	Depth, inches	10	10.5	10.5	12
	Width, inches	17.75	19	17.5	8.5
	Height, inches	11	5.25	5.25	4.25
	Weight, pounds	33	22	22	6.8
COST	Purchase Price, $	2200 to 2158	1035 to 1320	790 to 1015	234 to 254
COMMENTS		Bit pairs are encoded as a phase shift which is an odd multiple of 45°; T201B1 has internal clock; T201B2 has external clock; uses Bell System telephone sets 569NB or 568HT depending on options	Options include reverse channel capability, automatic answer, and auxiliary telephone set; compatible with Bell System 202 Series Data Sets and Bell System 801A and 801C Auto Call Units	T202D2 is capable of reverse channel operation on two-wire half-duplex service only; compatible with Bell System Data Auxiliary Set 804A and Automatic Calling Unit 801A and 801C	Transmits 99 discrete code combinations; audible answer-back monitor via handset and business machine speaker; converts to T401A (Bell System compatible); provides a wide variety of transmission frequencies

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		Sangamo Transidata T401H Data Set	Singer Tele-Signal 888A Data Modem	Singer Tele-Signal 888F Data Modem
APPLICATION		Parallel or serial transmission of data over the public telephone network	Operation over a voice-band line	Operation over a voice-band line
TRANSMISSION CHARACTERISTICS	Mode	Simplex; send only	Half-duplex or full-duplex	Half-duplex or full-duplex
	Method	Parallel by bit or serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous
	Code	See Comments	any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	—	—	—
TRANSMISSION SPEED	Public Switched Network	Up to 20 char/sec, parallel, or up to 150 bits/sec, serial	Up to 200 bps	Up to 200 bps
	Leased Line	—	Type 3002 Up to 200 bps	Type 3002 Up to 200 bps
ELECTRICAL INTERFACE		Contact closure	EIA Standard RS232B	EIA Standard RS232B
FEATURES	Telephone Set	—	Yes	Yes
	Unattended Operation	Yes	Yes	Yes
	Other	—	—	—
PHYSICAL SPECIFICATIONS	Depth, inches	4	12.25	12.25
	Width, inches	6	13	13
	Height, inches	9	6	6
	Weight, pounds	8	50	50
COST	Purchase Price, $	230	Not specified	Not specified
COMMENTS		Parallel operation provides transmission of 99 discrete code combinations using the restricted 3-of-14 code; compatible with Bell System Data Set 401J. Serial operation permits use of any code, with no restrictions on code length; compatible with Bell System Data Set 103A		

(Contd.)

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS (Contd.)

IDENTITY		Singer Tele-Signal 888R Data Modem	Singer Tele-Signal 898A Data Modem	Ultronic Systems Series 1200 Data Set	Ultronic Systems Series 2400 Data Set
APPLICATION		Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line	Operation over a voice-band line
TRANSMISSION CHARACTERISTICS	Mode	Simplex, half-duplex, or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex, full-duplex, or simplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Synchronous	Synchronous or asynchronous	Asynchronous	Synchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	—	—	200 ± 25	8.5 or 150
TRANSMISSION SPEED	Public Switched Network	—	Up to 1200 bps	Up to 1200 bps	2400 bps
	Leased Line	Type 3002 2400 bps	Type 3002 600 bps or 1200 bps	Type 3002 Up to 1200 bps	Type 3002 2400 bps
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B
FEATURES	Telephone Set	Yes	Yes	None	—
	Unattended Operation	Yes	Yes	Yes	—
	Other	—	—	—	Reverse channel capability
PHYSICAL SPECIFICATIONS	Depth, inches	13	12.25	10.75	12
	Width, inches	19	13	7	15
	Height, inches	7	6	5.5	5.25
	Weight, pounds	50	25	11.75	30
COST	Purchase Price, $	Not specified	Not specified	460; see Comments	1495
COMMENTS				This data set can also be leased for $35 to $65 per month depending on quantity and negotiations; purchase price is also negotiable	Functionally compatible with the Bell System 201B Data Set; can be clocked by external timing; can be rack-mounted

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS
SUPPLEMENT 1

IDENTITY		American Data Systems ADS-448 Data Modem	Astrocom Astroset 220 Data Set		Astrocom Astroset 224 Data Set	
APPLICATION		Single and multiple channel operation over a voice-band line	Medium-speed operation over a coaxial cable or twisted pair line		Medium-speed operation over a coaxial cable or twisted pair line	
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex or full-duplex	Simplex, half-duplex, or full-duplex		Simplex, half-duplex, or full-duplex	
	Method	Serial by bit	Serial by bit		Serial by bit	
	Modulation	Phase shift (4 phase); see Comments	Phase shift (2 phase)		Phase shift (2 phase)	
	Timing	Synchronous; see Comments	Synchronous		Synchronous	
	Code	Any code; unrestricted code length	Any code; unrestricted code length		Any code; unrestricted code length	
	Turn-Around Time, msec	—	—		—	
TRANSMISSION SPEED	Public Switched Network	—	—		—	
	Leased Line	Type 3002 1200 bps Type 3002 (C1) 2400 bps Type 3002 (C2) 3600 bps Type 3002 (C4) 4800 bps	— 2000 bps; see Comments		— 2400 bps; see Comments	
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B		EIA Standard RS232B	
FEATURES	Telephone Set	None	None		None	
	Unattended Operation	Yes	Yes		Yes	
	Other	Automatic equalization	—		—	
PHYSICAL SPECIFICATIONS	Depth, inches	18	10 (1)	10 (2)	10 (1)	10 (2)
	Width, inches	20	11.63	17	11.63	17
	Height, inches	7	7.06	7	7.06	7
	Weight, pounds	50	25	25	25	25
COST	Purchase Price, $	6000 (single-channel) 6400 (multi-channel)	1730		1825	
COMMENTS		Groups of two bits are encoded as one of four phase shifts which is a multiple of 90°; bandwidth used is 1800 Hz; optional multiple channel operation provides 1 channel (4800 bps), 1 channel (3600 bps), 2 channels (2400 bps), 4 channels (1200 bps), or any combination of the above; multi-channel timing is asynchronous	Designed for limited-distance operation over a twisted pair line or coaxial cable; Astrocom states range at 2000 bps is 9 to 13 miles (twisted pair) and 16 miles (coaxial cable)		Designed for limited distance operation over a twisted pair line or coaxial cable; Astrocom states range at 2400 bps is 7.5 to 11.5 miles (twisted pair) and 14 miles (coaxial cable)	

(1) Cabinet-mounted single data set unit.
(2) Rack-mounted dual data sets unit.

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS
SUPPLEMENT 1 (Contd.)

IDENTITY		Astrocom Astroset 236 Data Set		Astrocom Astroset 248 Data Set		Astrocom Astroset 272 Data Set	
APPLICATION		Medium-speed operation over a coaxial cable or twisted pair line		High-speed operation over a coaxial cable or twisted pair line		High-speed operation over a coaxial cable or twisted pair line	
TRANSMISSION CHARACTER-ISTICS	Mode	Simplex, half-duplex, or full-duplex		Simplex, half-duplex, or full-duplex		Simplex, half-duplex, or full-duplex	
	Method	Serial by bit		Serial by bit		Serial by bit	
	Modulation	Phase shift (2 phase)		Phase shift (2 phase)		Phase shift (2 phase)	
	Timing	Synchronous		Synchronous		Synchronous	
	Code	Any code; unrestricted code length		Any code; unrestricted code length		Any code; unrestricted code length	
	Turn-Around Time, msec	—		—		—	
TRANSMISSION SPEED	Public Switched Network	—		—		—	
	Leased Line	—		—		—	
		3600 bps see Comments		4800 bps see Comments		7200 bps see Comments	
ELECTRICAL INTERFACE		EIA Standard RS232B		EIA Standard RS232B		EIA Standard RS232B	
FEATURES	Telephone Set	None		None		None	
	Unattended Operation	Yes		Yes		Yes	
	Other	—		—		—	
PHYSICAL SPECIFICATIONS	Depth, inches	10 (1)	10 (2)	10 (1)	10 (2)	10 (1)	10 (2)
	Width, inches	11.63	17	11.63	17	11.63	17
	Height, inches	7.06	7	7.06	7	7.06	7
	Weight, pounds	25	25	25	25	25	25
COST	Purchase Price, $	2460		2910		4800	
COMMENTS		Designed for limited distance operation over a twisted pair line or coaxial cable; Astrocom states range at 3600 bps is 6 to 9.5 miles (twisted pair) and 11.5 miles (coaxial cable)		Designed for limited distance operation over a twisted pair line or coaxial cable; Astrocom states range at 4800 bps is 4.5 to 7.5 miles (twisted pair) and 10 miles (coaxial cable)		Designed for limited distance operation over a twisted pair line or coaxial cable; Astrocom states range at 7200 bps is 4 to 6 miles (twisted pair) and 8 miles (coaxial cable)	

(1) Cabinet-mounted single data set unit.
(2) Rack-mounted dual data sets unit.

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS
SUPPLEMENT 1 (Contd.)

IDENTITY		Astrocom Astroset 296 Data Set	Datamax QB34 Modem	Datamax QB48 Modem
APPLICATION		High-speed operation over a coaxial cable or twisted pair line	High-speed operation over a voice-band line	High-speed operation over a voice-band line
TRANSMISSION CHARACTER-ISTICS	Mode	Simplex, half-duplex, or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit
	Modulation	Phase shift (2 phase)	AM vestigial sideband	AM vestigial sideband
	Timing	Synchronous	Synchronous	Synchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	—	—	—
TRANSMISSION SPEED	Public Switched Network	—	2400 bps	4800 bps
	Leased Line	—	Type 3002 2400 bps	Type 3002 4800 bps
		9600 bps see Comments		
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B (options available)
FEATURES	Telephone Set	None	None	None
	Unattended Operation	Yes	Yes	Yes
	Other	—	Automatic equalization; reverse channel capability	Automatic equalization
PHYSICAL SPECIFICATIONS	Depth, inches	10 (1) / 10 (2)	14	14
	Width, inches	11.63 / 17	14	14
	Height, inches	7.06 / 7	4.5	4.5
	Weight, pounds	25 / 25	35	37.5
COST	Purchase Price, $	4920	See Comments	See Comments
COMMENTS		Designed for limited distance operation over a twisted pair line or coaxial cable; Astrocom states range at 9600 bps is 3 to 5 miles (twisted pair) and 7 miles (coaxial cable)	Incorporates error control system to eliminate most retransmissions: transmission rates are actually 3600 bps and 7200 bps including 1/3 redundancy data; designed for high-speed transmission over the public telephone network; reverse channel operates asynchronously at 150 bps; QB24 Modem can be acoustically coupled; multichannel operation in multiples of 600 bps is optional; includes 8-bit parallel interface; external synchronization capability is optional; price range information is available from Datamax upon quotation.	

(1) Cabinet-mounted single data set unit.
(2) Rack-mounted dual data sets unit.

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS SUPPLEMENT 1 (Contd.)

IDENTITY		General Dynamics Dynatronics Model EDX-1403 Data Modem	Rixon Electronics PM-48 Data Set	Rixon Electronics FDM-8 Frequency Division Multiplex Modem
APPLICATION		High-speed operation over a voice-band line	High-speed operation over a voice-band line	Multiple low-speed channel operation over a voice-band line
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex or full-duplex	Half-duplex or full-duplex	Simplex, half-duplex, or full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit
	Modulation	AM vestigial sideband	Phase shift (8 phase); see Comments	Frequency shift
	Timing	Synchronous	Synchronous	Asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	—	12	265 ±65
TRANSMISSION SPEED	Public Switched Network	—	—	—
	Leased Line	Type 3002 (C2) 4800 bps	Type 3002 (C2) 4800 bps	Type 3002 (C2) up to 150 bps (each channel); see Comments
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232C	EIA Standard RS232B
FEATURES	Telephone Set	Yes	None	None
	Unattended Operation	Yes	Yes	
	Other	Automatic equalization	Automatic equalization	—
PHYSICAL SPECIFICATIONS	Depth, inches	18	12 (1) / 12 (2)	11.9 (3) / 11.9 (4) / 9.5 (5)
	Width, inches	19	23 / 19	17.4 / 19 / 6.5
	Height, inches	7	10 / 7	14.4 / 14.4 / 6.5
	Weight, pounds	20	35 / 20	36 / 34 / 3
COST	Purchase Price, $	6150	5650	5300 (8-channel) 3100 (4-channel) 820 (single-channel)
COMMENTS		Bandwidth used is 2400 Hz; accepts external synchronization; selectable alternate voice and data transmission	Groups of three bits are encoded as one of eight phase shifts which is a multiple of 45°; bandwidth used is 1700 Hz	Modular transmit and receive card units can provide up to eight channels within one rack-mounted or desk-top cabinet; each channel operates at up to 150 bps; compatible with Bell System 100 Series Data Sets

(1) Free-standing cabinet unit.
(2) Rack-mounted unit.
(3) Free-standing cabinet unit (up to eight channels).
(4) Rack-mounted cabinet unit (up to eight channels).
(5) Extended housing unit (one channel).

COMPARISON CHARTS: NON-COMMON-CARRIER DATA SETS
SUPPLEMENT 1 (Contd.)

IDENTITY		Tele-Dynamics Type 7260 Multi-channel FSK Modem	Tel-Tech TT-103 Data Set	Tel-Tech TT-202 Data Set
APPLICATION		Multiple low-speed channel operation over a voice-band line	Low-speed operation over a voice-band line	Low-speed operation over a voice-band line
TRANSMISSION CHARACTER-ISTICS	Mode	Full-duplex	Full-duplex	Full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift
	Timing	Synchronous or asynchronous	Synchronous	Synchronous or asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Turn-Around Time, msec	—	—	—
TRANSMISSION SPEED	Public Switched Network	Up to 1200 bps	300 bps	1200 bps (synch) or up to 1200 bps (asynch)
	Leased Line	Type 3002 75 bps, 150 bps, 300 bps, 600 bps, or 1200 bps Data rates are for each channel	Type 3002 300 bps	Type 3002 (C1) up to 1200 bps Type 3002 (C2) up to 1800 bps
ELECTRICAL INTERFACE		MIL-STD-188B (options available)	EIA Standard RS232B	EIA Standard RS232B
FEATURES	Telephone Set	None	None	None
	Unattended Operation	Yes	None	None
	Other	—	Optional acoustic coupler	Reverse channel capability
PHYSICAL SPECIFICATIONS	Depth, inches	17.5	10	12.5
	Width, inches	19	4.5	6.25
	Height, inches	7	1.12	1.12
	Weight, pounds	50	0.5	1
COST	Purchase Price, $	2800 (8-channel) 400 (per channel)	200	300
COMMENTS		Single channel or up to eight channels can operate in any combination of listed speeds totaling up to 1200 bps per modem; synchronous or asynchronous timing is optionally available for single- or multi-channel operation	Physical specifications refer to modular card components excluding power supplies; rack-mounted or free-standing cabinet units are available	Physical specifications refer to modular card components excluding power supplies; rack-mounted or free-standing cabinet units are available; optional synchronous or asynchronous operation

NON-COMMON-CARRIER DATA SETS

IDENTITY		Ultronic Systems Series 2400 Data Pump	Vadic VA300 Data Set	Vadic VA300E Data Set	Vadic VA1200 Data Set	American Data Systems ADS-448 Data Modem
APPLICATION		Operation over a voiceband line	Low-speed operation over voiceband line	Low-speed operation over voiceband line	Low-speed operation over voiceband line	Single-/multiple-channel operation over voiceband line
TRANSMISSION CHARACTERISTICS	Mode	Half-/full-duplex/ simplex	Full-duplex	Full-duplex	Half-/full-duplex	Half-/full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency modulation	Frequency modulation	Frequency modulation	Phase shift (4-phase)
	Timing	Synchronous	Asynchronous	Asynchronous	Asynchronous	Synchronous (single-channel)
	Code	Any code; any length	Any code; any length	Any code; any length	Any code; any length	Any code; any length
	Turnaround Time, msec	8.5 or 150	—	—	—	—
TRANSMISSION DATA RATE	Public Switched Network	2400 bps	Up to 300 bps	Up to 300 bps	Up to 1200 bps	—
	Leased Line	Type 3002: 2400 bps	Type 3002: up to 300 bps	Type 3002: up to 300 bps	Type 3002 (C2): up to 1800 bps	Type 3002: 1200 bps; 2400 bps (C1); 3600 bps (C2); 4800 bps (C4)
	Coaxial Cable or Twisted Pair Line	—	—	—	—	—
ELECTRICAL INTERFACE		EIA RS232B	EIA RS232B; std TTY	EIA RS232B	EIA RS232B	EIA RS232B
FEATURES	Telephone Set	No	No	No	No	No
	Unattended Operation	Yes	Yes	Yes	Yes	Yes
	Reverse Channel	—	—	—	5/150 bps (optional)	—
	Line Equalization	Manual	—	—	—	Automatic
PHYSICAL SPECS	Depth, in.	12	6	6	6	18
	Width, in.	15	6	7	6	20
	Height, in.	5.25	0.5	0.5	0.5	7
	Weight, lb	30	—	—	—	50
PURCHASE PRICE, $		1695	175	185	250	6000 (single-channel); 6400 (multichannel)
COMMENTS		Functionally compatible with the Bell System 201B Data Set; can be clocked by external timing (switch-selectable); optional manual equalization allows up to 1200/2400 bps operation on unconditioned line	Designed for installation within terminal; rack-mounted version available with 16 data sets in 19-in. chassis with common power supply/multiline dialer; compatible with Bell System Data Sets 103A/103F	Rack-mounted version contains 16 data sets in 19-in. chassis with common power supply/ multiline dialer; compatible with/includes all options of Bell System Data Set 103E	Designed for installation within terminal; compatible with Bell System Data Set 202C6	Groups of 2 bits are encoded as 1 of 4 phase shifts, which is multiple of 90°; bandwidth used is 1800 Hz; optional multiple-channel operation provides 1 channel at 4800 bps, 1 channel at 3600 bps, 2 channels at 2400 bps, 4 channels at 1200 bps, or any combination of these; multichannel timing asynchronous

NON-COMMON-CARRIER DATA SETS

IDENTITY		Design Elements Design 80 Hardwire Coupler	Dynatronics EDX-1402 International Modem	General Electric Diginet 400 Series TDM-401/402 Wideband Data Sets	General Electric Diginet 400 Series TDM-422/423 Wideband Data Sets	General Electric Diginet 500 Series TDM-501 Wideband Data Set
APPLICATION		Low-speed operation over public telephone network	Low-speed operation over voiceband line	High-speed operation over leased broadband facility	High-speed operation over leased broadband facility	High-speed operation over leased broadband facility
TRANSMISSION CHARACTERISTICS	Mode	Half-/full-duplex	Simplex/half-/full-duplex	Full-duplex (4-wire)	Full-duplex (4-wire)	Full-duplex (4-wire)
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Restored polar	AM vestigial sideband	Restored polar
	Timing	Asynchronous	Asynchronous	Synchronous/asynchronous	Synchronous/asynchronous	Synchronous/asynchronous
	Code	Any code; any length	Any code; any length			
	Turnaround Time, msec	—	—	—	—	—
TRANSMISSION DATA RATE	Public Switched Network	Up to 300 bps	Up to 600/1,200 bps	—	—	—
	Leased Line	—	Type 3002: up to 600/1,200 bps	Group (12 voiceband lines): 50,000 bps (401); 40,800 bps (402)	Group (12 voiceband lines): 50,000 bps (422); 40,800 bps (423)	Supergroup (60 voiceband lines): 230,400 bps
	Coaxial Cable or Twisted Pair Line	—	—	—	—	—
ELECTRICAL INTERFACE		EIA RS232B; std TTY	EIA RS232B	Low impedance, current switching	Low impedance, current switching	Low impedance, current switching
FEATURES	Telephone Set	Separate	Optional	Separate (4004)	No	Separate (4004)
	Unattended Operation	Yes	Yes	Yes	Yes	Yes
	Reverse Channel	—	75 bps, async	—	—	—
	Line Equalization	—	—	Adjustable, 6-stage	Adjustable, 6-stage	Adjustable, 6-stage
PHYSICAL SPECS	Depth, in.	11	14.25	10.5	10.5	10.5
	Width, in.	8	19	20.5	20.5	20.5
	Height, in.	2	5.25	11	11	11
	Weight, lb	7	25	34	38	34
PURCHASE PRICE, $		495	—	3,100	4,850	3,100
COMMENTS		Capable of automatic answer; compatible with Bell System Data Set 103A	Compatible with international and domestic data transmission systems in accordance with CCITT V. 23; provisions for telephone control unit via optional printed circuit cards; operates over 2-wire (simplex/half-duplex) or 4-wire (simplex/half-/full-duplex) lines; forward operating frequencies of 1300 Hz (mark)/2100 Hz (space) at 1,200 bps, or 1300 Hz (mark)/1700 Hz (space) at 600 bps; switch-selectable transmission speeds	Baseband data sets designed to interface data terminal with unloaded exchange-grade cables; intended for point-to-point, multipoint, 2-level facsimile, secure voice transmission systems; 4-12 mile range depending on wire gauge (extended via repeaters); digital interface compatible with Bell System Series 303 Data Sets; capable of automatic operation in switched broadband systems	VSB data sets designed as interface between data terminal and multiplex system over 60-108 kHz std CCITT primary group channel; intended for point-to-point, multipoint, 2-level facsimile, secure voice transmission systems; auxiliary voice channel can be multiplexed into frequency band; digital interface compatible with Bell System Series 303 Data Sets; capable of automatic operation in switched broadband systems	Baseband data set designed to interface data terminal with unloaded exchange-grade cables; intended for point-to-point, multipoint, 2-level facsimile, secure voice transmission systems; 2-6 mile range depending on wire gauge (extended via repeaters); digital interface compatible with Bell System Series 303 Data Sets; capable of automatic operation in switched broadband systems

IDENTITY		General Electric Diginet 500 Series TDM-522 Wideband Data Set	Northern Radio Type 500 Model 1 Data Sub-Set	RCA Computer Systems Div. Model 6711 Data Set	Technical Communications DM-150 (A) Data Set	Technical Communications DM-100(A) Data Set
APPLICATION		High-speed operation over leased broadband facility	Multiple low-speed channel operation over voiceband line	Operation over voiceband line	Low-speed operation over voiceband line	Low-speed operation over voiceband line
TRANSMISSION CHARACTERISTICS	Mode	Full-duplex (4-wire)	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	AM vestigial sideband	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Synchronous/asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code		Any code; any length	Any code; any length	Any code; any length	Any code; any length
	Turnaround Time, msec	—	—	10, 60, 200	—	—
TRANSMISSION DATA RATE	Public Switched Network	—	75 bps, 110 bps, 150 bps, 200 bps, or 600 bps	Up to 1,200 bps	Up to 150 bps	Up to 100 wpm
	Leased Line	Supergroup (60 voiceband lines): 230,400 bps	Type 3002: 75 bps, 110 bps, 150 bps, 200 bps, 600 bps (each channel)	Type 3002: up to 1,800 bps	Type 3002: up to 150 bps	Type 3002: up to 100 wpm
	Coaxial Cable or Twisted Pair Line	—	—	—	Up to 150 bps	Up to 100 wpm
ELECTRICAL INTERFACE		Low impedance, current switching	EIA RS232C; high-level telegraph	EIA RS232B	EIA RS232B; std TTY	EIA RS232B; std TTY
FEATURES	Telephone Set	No	—	—	No	No
	Unattended Operation	Yes	—	Yes	Yes	Yes
	Reverse Channel	—	—	Yes	—	—
	Line Equalization	Adjustable, 6-stage	—	—	Not required	Not required
PHYSICAL SPECS	Depth, in.	10.5	13	10.25	10	10
	Width, in.	20.5	15.75	9.75	8	8
	Height, in.	11	6	3.5	6	6
	Weight, lb	38	Varies with no. of channels	8.5	8	8
PURCHASE PRICE, $		4,850	700/channel	800; 22/mo (rental)	450	450
COMMENTS		VSB data set designed as interface between data terminal and multiplex system over 312-552 kHz std CCITT secondary group channel; intended for point-to-point, multipoint, 2-level facsimile, secure voice transmission systems; auxiliary voice channel can be multiplexed into frequency band; digital interface compatible with Bell System Series 303 Data Sets; capable of automatic operation in switched broadband systems	Desk-top modems accommodate 1-4 multiplexed channels for total speeds not exceeding 1,200 bps	Monthly maintenance $4.75 (local), $9.50 (remote); compatible with Bell System 202 Series Data Set; line conditioning advisable as planning consideration for leased line rates over 1,000 bps	Acoustic coupler available for interface with Type 500 telephones; can be used as its own multiplexor; not compatible with Bell System data sets	Acoustic coupler available for interface with Type 500 telephones; can be used as its own multiplexor; not compatible with Bell System data sets

IDENTITY		Stromberg-Carlson SC835 Data Modem	Astrocom Model 120 C1 Astroset	Astrocom Model 120 C2 Astroset	Astrocom Model 120 C3 Astroset	Astrocom Model 120 C4 Astroset
APPLICATION		Low-speed, multi-channel operation over voiceband line	Medium-speed operation over public telephone network	Medium-speed operation over public telephone network	Medium-speed operation over private line	Medium-speed operation over public telephone network
TRANSMISSION CHARACTERISTICS	Mode	Simplex/half-/full-duplex	Half-duplex	Half-duplex	Half-duplex	Full-duplex (4-wire)
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; any length	Any code; any length	Any code; any length	Any code; any length	Any code; any length
	Turnaround Time, msec	60 minimum	200	200	200	—
TRANSMISSION DATA RATE	Public Switched Network	75 bps, 110 bps, 150 bps (each channel)	Up to 1,200 bps	Up to 1,200 bps	—	Up to 1,200 bps
	Leased Line	Type 3002: 75 bps, 110 bps, 150 bps (each channel)	—	—	Type 3002: up to 1,400 bps (C1); up to 1,800 bps (C2)	—
	Coaxial Cable or Twisted Pair Line	75 bps, 110 bps, 150 bps (each channel)	—	—	—	—
ELECTRICAL INTERFACE		EIA RS232C; std TTY	EIA RS232C	EIA RS232C	EIA RS232C	EIA RS232C
FEATURES	Telephone Set	No	No	No	No	No
	Unattended Operation	—	Yes	No	Yes	Yes
	Reverse Channel	—	No	No	No	No
	Line Equalization	—	None	None	Fixed	None
PHYSICAL SPECS	Depth, in.	15.875	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)
	Width, in.	19	12 / 17	12 / 17	12 / 17	12 / 17
	Height, in.	5.25	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25
	Weight, lb	34	12 / —	12 / —	13 / —	12 / —
PURCHASE PRICE, $		400-650/channel	450	450	450	450
COMMENTS		Various combinations of transmitters/receivers can be configured with the following multichannel capacities per line: 18 75-bps channels, 9 150-bps channels; operates within 300-3400 Hz frequency band; channel spacing is 170 Hz (75/110 bps), 340 Hz (150 bps); self-contained subsets each accommodate 4 simplex or 2 complete channels; opt speech-plus-data assembly provides simultaneous voice/data transmission	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent

IDENTITY		Astrocom Model 120 C5 Astroset	Astrocom Model 120 C6 Astroset	Astrocom Model 120 D1 Astroset	Astrocom Model 120 D2 Astroset	Astrocom Model 120 D3 Astroset
APPLICATION		Medium-speed operation over public telephone network	Medium-speed operation over private line	Medium-speed operation over public telephone network	Medium-speed operation over public telephone network	Medium-speed operation over private line
TRANSMISSION CHARACTERISTICS	**Mode**	Full-duplex (4-wire)	Full-duplex (4-wire)	Half-duplex	Half-duplex	Half-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; any length	Any code; any length	Any code; any length	Any code; any length	Any code; any length
	Turnaround Time, msec	—	—	200	200	200
TRANSMISSION DATA RATE	**Public Switched Network**	Up to 1,200 bps	—	Up to 1,200 bps	Up to 1,200 bps	—
	Leased Line	—	Type 3002: up to 1,400 bps (C1); up to 1,800 bps (C2)	—	—	Type 3002: up to 1,400 bps (C1); up to 1,800 bps (C2)
	Coaxial Cable or Twisted Pair Line	—	—	—	—	—
ELECTRICAL INTERFACE		EIA RS232C	EIA RS232C	EIA RS232C	EIA RS232C	EIA RS232C
FEATURES	**Telephone Set**	No	No	No	No	No
	Unattended Operation	No	Yes	Yes	No	Yes
	Reverse Channel	No	No	Up to 5 bps	Up to 5 bps	Up to 5 bps
	Line Equalization	None	Fixed	None	None	Fixed
PHYSICAL SPECS	**Depth, in.**	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)
	Width, in.	12 / 17	12 / 17	12 / 17	12 / 17	12 / 17
	Height, in.	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25
	Weight, lb	12 / —	13 / —	13 / —	13 / —	14 / —
PURCHASE PRICE, $		450	450	600	600	600
COMMENTS		(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent

IDENTITY		Astrocom Model 120 D4 Astroset	Astrocom Model 120 D5 Astroset	Astrocom Model 120 D6 Astroset	Astrocom Model 120 E1 Astroset	Astrocom Model 120 E2 Astroset
APPLICATION		Medium-speed operation over public telephone network	Medium-speed operation over public telephone network	Medium-speed operation over private line	Medium-speed operation over public telephone network	Medium-speed operation over public telephone network
TRANSMISSION CHARACTERISTICS	**Mode**	Full-duplex (4-wire)	Full-duplex (4-wire)	Full-duplex (4-wire)	Simplex (transmit-only)	Simplex (transmit-only)
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; any length	Any code; any length	Any code; any length	Any code; any length	Any code; any length
	Turnaround Time, msec	—	—	—	—	—
TRANSMISSION DATA RATE	**Public Switched Network**	Up to 1,200 bps	Up to 1,200 bps	—	Up to 1,200 bps	Up to 1,200 bps
	Leased Line	—	—	Type 3002: up to 1,400 bps (C1); up to 1,800 bps (C2)	—	—
	Coaxial Cable or Twisted Pair Line	—	—	—	—	—
ELECTRICAL INTERFACE		EIA RS232C	EIA RS232C	EIA RS232C	EIA RS232C	EIA RS232C
FEATURES	**Telephone Set**	No	No	No	No	No
	Unattended Operation	Yes	No	Yes	Yes	No
	Reverse Channel	Up to 5 bps	Up to 5 bps	Up to 5 bps	No	No
	Line Equalization	None	None	Fixed	—	—
PHYSICAL SPECS	**Depth, in.**	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)
	Width, in.	12 / 17	12 / 17	12 / 17	12 / 17	12 / 17
	Height, in.	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25
	Weight, lb	13 / —	13 / —	14 / —	11 / —	11 / —
PURCHASE PRICE, $		600	600	600	405	405
COMMENTS		(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent

IDENTITY		Astrocom Model 120 E3 Astroset	Astrocom Model 120 E4 Astroset	Astrocom Model 120 E5 Astroset	Astrocom Model 120 E6 Astroset	Astrocom Model 120 F1 Astroset
APPLICATION		Medium-speed operation over private line	Medium-speed operation over public telephone network	Medium-speed operation over public telephone network	Medium-speed operation over private line	Medium-speed operation over public telephone network
TRANSMISSION CHARACTERISTICS	Mode	Simplex (transmit-only)	Simplex (transmit-only)	Simplex (transmit-only)	Simplex (transmit-only)	Simplex (receive-only)
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; any length	Any code; any length	Any code; any length	Any code; any length	Any code; any length
	Turnaround Time, msec	—	—	—	—	—
TRANSMISSION DATA RATE	Public Switched Network	—	Up to 1,200 bps	Up to 1,200 bps	—	Up to 1,200 bps
	Leased Line	Type 3002: up to 1,400 bps (C1); up to 1,800 bps (C2)	—	—	Type 3002: up to 1,400 bps (C1); up to 1,800 bps (C2)	—
	Coaxial Cable or Twisted Pair Line	—	—	—	—	—
ELECTRICAL INTERFACE		EIA RS232C	EIA RS232C	EIA RS232C	EIA RS232C	EIA RS232C
FEATURES	Telephone Set	No	No	No	No	No
	Unattended Operation	Yes	Yes	No	Yes	Yes
	Reverse Channel	No	Up to 5 bps (receive-only)	Up to 5 bps (receive-only)	Up to 5 bps (receive-only)	No
	Line Equalization	—	—	—	—	None
PHYSICAL SPECS	Depth, in.	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)
	Width, in.	12 / 17	12 / 17	12 / 17	12 / 17	12 / 17
	Height, in.	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25
	Weight, lb	11 / —	12 / —	12 / —	12 / —	12 / —
PURCHASE PRICE, $		405	405	405	405	405
COMMENTS		(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent

IDENTITY		Astrocom Model 120 F2 Astroset	Astrocom Model 120 F3 Astroset	Astrocom Model 120 F4 Astroset	Astrocom Model 120 F5 Astroset	Astrocom Model 120 F6 Astroset
APPLICATION		Medium-speed operation over public telephone network	Medium-speed operation over private line	Medium-speed operation over public telephone network	Medium-speed operation over public telephone network	Medium-speed operation over private line
TRANSMISSION CHARACTERISTICS	Mode	Simplex (receive-only)	Simplex (receive-only)	Simplex (receive-only)	Simplex (receive-only)	Simplex (receive-only)
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; any length	Any code; any length	Any code; any length	Any code; any length	Any code; any length
	Turnaround Time, msec	—	—	—	—	—
TRANSMISSION DATA RATE	Public Switched Network	Up to 1,200 bps	—	Up to 1,200 bps	Up to 1,200 bps	—
	Leased Line	—	Type 3002: up to 1,400 bps (C1); up to 1,800 bps (C2)	—	—	Type 3002: up to 1,400 bps (C1); up to 1,800 bps (C2)
	Coaxial Cable or Twisted Pair Line	—	—	—	—	—
ELECTRICAL INTERFACE		EIA RS232C	EIA RS232C	EIA RS232C	EIA RS232C	EIA RS232C
FEATURES	Telephone Set	No	No	No	No	No
	Unattended Operation	No	Yes	Yes	No	Yes
	Reverse Channel	No	No	Up to 5 bps (transmit-only)	Up to 5 bps (transmit-only)	Up to 5 bps (transmit-only)
	Line Equalization	None	Fixed	None	None	Fixed
PHYSICAL SPECS	Depth, in.	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)	10.5 (1) / 12 (2)
	Width, in.	12 / 17	12 / 17	12 / 17	12 / 17	12 / 17
	Height, in.	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25	5.75 / 5.25
	Weight, lb	12 / —	13 / —	13 / —	13 / —	14 / —
PURCHASE PRICE, $		405	405	405	405	405
COMMENTS		(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent	(1) Cabinet mounting (2) Rack mounting; Bell System 202 Data Set equivalent

IDENTITY		Lenkurt Electric Model 25B/108 Data Line Extender	Lenkurt Electric Model 9003A/9005A PCM Wideband Data Terminals	Novation DM-102D Data Modem	Singer Tele-Signal Teletypewriter Subset 606D	Singer Tele-Signal 2503 Frequency Division Multiplex
APPLICATION		Single-channel, low-speed operation over public switched network/leased voiceband line	High-speed operation over broadband PCM repeatered line	Low-speed operation over voiceband line	Low-speed operation over leased voiceband line	Multiple, low-speed channel operation over leased voiceband line
TRANSMISSION CHARACTERISTICS	**Mode**	Simplex/half-/full-duplex	Simplex/half-/full-duplex	Half-/full-duplex	Full-/half-duplex	Full-/half-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Pulse code modulation (PCM)	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Synchronous/asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; any length	Any code; any length	Any code; any length	Any code; any length	Any code; any length
	Turnaround Time, msec	85	—	—	—	—
TRANSMISSION DATA RATE	**Public Switched Network**	Up to 300 bps	—	Up to 400 bps	—	—
	Leased Line	Type 3002: up to 300 bps	Model 9003A: 8/4 50-kbps channels; 2/1 250-kbps channels Model 9005A: 1 50-kbps channel; 1 250-kbps channel	Type 3002: up to 400 bps	Type 3002: all std TTY speeds	Type 3002: 24 75-bps channels; 18 110-bps channels; 12 150-bps channels
	Coaxial Cable or Twisted Pair Line	—	—	—	—	—
ELECTRICAL INTERFACE		EIA RS232C	Shielded twisted-pair line	EIA RS232B/std TTY	High-level: 60 ma neutral 20 ma neutral/polar	EIA RS232B
FEATURES	**Telephone Set**	Optional	—	No	—	—
	Unattended Operation	Yes	Yes	No	—	—
	Reverse Channel	—	—	No	—	—
	Line Equalization	—	—	Adjustable	—	—
PHYSICAL SPECS	**Depth, in.**	10.5 (1) / 10 (2)	12	11	14	Dependent on number of channels included
	Width, in.	9 / 19	19	8	5.75	
	Height, in.	3 / 5.25	7	3	6.25	
	Weight, lb	7 / —	—	5	9	
PURCHASE PRICE, $		300	—	335	750	Dependent on number of channels included
COMMENTS		(1) Desk-top, designed for single channel operations (2) Rack-mounted, incorporates up to 3 duplex channels	9003A end-to-end compatible with Bell System T1-WB1/T1-WB2; 9005A end-to-end compatible with Bell System T1-WM1	Operates in Originate-only mode; includes carrier detection; dual interface allows EIA, TTY equipment to operate simultaneously	Operating frequencies can be specified for compatibility with Tele-Signal std multichannel VFTG equipment	Can be used in multipoint network configuration with Tele-Signal 833-type modems; available with high-level electrical interface

IDENTITY		Ultronic Systems Series 4800 Data Pump				
APPLICATION		Operation over voiceband line				
TRANSMISSION CHARACTERISTICS	Mode	Half-/full-duplex				
	Method	Serial by bit				
	Modulation	Modified duobinary single sideband AM				
	Timing	Synchronous				
	Code	Any code; any length				
	Turnaround Time, msec	20				
TRANSMISSION DATA RATE	Public Switched Network	—				
	Leased Line	Type 3002 (C2): 4,800 bps				
	Coaxial Cable or Twisted Pair Line	—				
ELECTRICAL INTERFACE		EIA RS232B				
FEATURES	Telephone Set	No				
	Unattended Operation	Yes				
	Reverse Channel	150 bps (opt)				
	Line Equalization	Manual				
PHYSICAL SPECS	Depth, in.	12				
	Width, in.	18				
	Height, in.	7				
	Weight, lb	35				
PURCHASE PRICE, $		3,175				
COMMENTS		Automatic error detection; built-in test facilities				

COMPARISON CHARTS: TELEPHONE COUPLER DATA SETS

The characteristics of data sets designed for portable operation over the public telephone network are presented in this set of charts, beginning on page 4640:02. These data sets inductively and/or acoustically couple the data terminal to the public telephone network via a conventional telephone set such as the Bell System Series 500 Telephone Set or equivalent.

Data to be transmitted is converted by the coupler from a serial stream of binary digits to a sequence of tones (mark and space frequencies) similar to the familiar Touch-Tone sounds. At the receive end, the tones are converted to a stream of binary digits, corresponding to the original input data.

Data is transmitted after the operator places the call in the conventional manner, places the telephone handset in the telephone-coupler cradle and activates the data terminal. The call is terminated by simply removing the handset from the cradle and "hanging-up" in the conventional manner.

There are two modes in which a data set can operate: originate and answer. The originate mode is the operating state of the calling station; the answer mode is the operating state of the called station. A data set operating in the answer mode receives the transmission from the originating data set.

Most telephone coupler data sets at present operate in the originate mode only and claim compatibility with a Bell System Data-Phone Data Set 103A2 operating in the answer mode. Some telephone coupler data sets provide manual selection of "upright" or "inverted" transmission frequencies. (Transmission frequencies of the Bell System Data-Phone Data Set 103A2 are commonly referred to as upright. The mark and space frequencies of the 103A1 are the inverse of those of the 103A2 and are thus called inverted.)

Many of the telephone couplers presently on the market operate only in the full-duplex mode; however, some manufacturers incorporate a full-duplex/half-duplex mode switch. Essentially, this switch connects the data-terminal output to the data-terminal input when the switch is set to half-duplex. In this position, any data present on the telephone-coupler receive input would be mixed with the data-terminal output. Because the switch is intended mainly for teleprinter usage, "local-copy-mode switch" would be a more appropriate name.

The addresses of the manufacturers represented in the charts are listed below:

Anderson-Jacobson, Inc.
2235 Mora Drive
Mountain View, California 94040

ComData Corporation
7544 W. Oakton Street
Niles, Illinois 60648

Communications Logic, Inc.
6400 Westpark
Houston, Texas 77027

Data Communications Systems, Inc.
4230 Central Avenue, N.E.
Minneapolis, Minnesota 55421

Direct Access Computing Corporation
24175 Northwestern Highway
Southfield, Michigan 48075

Electronic Voice, Inc.
2059 East 223rd Street
Long Beach, California 90810

Ford Industries, Inc.
5001 S.E Johnson Creek Blvd.
Portland, Oregon 97206

General Electric Company
Mountain View Road
Lynchburg, Virginia 24502

Novation, Inc.
18664 Topham Street
Tarzana, California 91356

Omnitec
Electronic Products Division
Subsidiary of
Nytronics, Inc.
903 North Second Street
Phoenix, Arizona 85004

Tymshare
464 Hudson Terrace
Englewood Cliffs, New Jersey 07632

COMPARISON CHARTS: TELEPHONE COUPLER DATA SETS

IDENTITY		Anderson-Jacobson Acoustic Data Coupler Model ADC 260 and ADC 262	Anderson-Jacobson Acoustic Data Coupler Model ADC 300	Bell System Data Set 603D	ComData Model 301A Acoustic Data Set
APPLICATION		Portable, low-speed operation over the public telephone network	Portable, low-speed operation over the public telephone network	Portable transmission of medical data over the public telephone network	Portable, low-speed operation over the public telephone network
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex or full-duplex	Half-duplex or full-duplex	Simplex; send only	Half-duplex or full-duplex
	Method	Serial by bit	Serial by bit	Analog	Serial by bit
	Modulation	Frequency shift	Frequency shift	FM	Frequency shift
	Timing	Asynchronous	Asynchronous	—	Asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	—	Any code; unrestricted code length
	Operating mode	Originate only	Originate or answer	Originate only	Originate or answer
	Speed	Up to 300 bps	Up to 300 bps	0 to 100 Hz baseband	Up to 300 bps
OPERATING FREQUENCIES	Transmit, Hz	1270 (mark); 1070 (space)	2225 (mark); 2025 (space) see Comments	0 to 100	2225 (mark); 2025 (space) see Comments
	Receive, Hz	2225 (mark); 2025 (space)	1270 (mark); 1070 (space) see Comments	—	1270 (mark); 1070 (space) see Comments
COUPLING	Transmit	Acoustic	Acoustic	Acoustic	Acoustic
	Receive	Acoustic	Acoustic	Acoustic	Acoustic
ELECTRICAL INTERFACE		EIA Standard RS232B and Standard Teletype Interface	EIA Standard RS232B	EIA Standard RS232B	EIA Standard RS232B; Standard Teletype Interface
PHYSICAL SPECIFICATIONS	Depth, inches	12	12	4.4	6
	Width, inches	12	12	9.4	12
	Height, inches	5.75	5.75	12.9	4
	Weight, pounds	9	9	6	5
COST	Purchase Price, $	570 (ADC 260) 595 (ADC 262)	695	12/month (rental) 10 (installation)	395 to 545
COMMENTS		Offers manual selection of upright or inverted transmission frequencies, compatible with Anderson-Jacobson ADC 300 Acoustic Data Coupler or Bell System DataPhone Data Set 103A1 or 103A2; Model 262 provides a second interface for both on- and off-line operation	Operating frequencies are shown for answer mode; frequencies for originate mode are the inverse of those shown	Battery powered telephone coupler compatible with the Bell System Data Set 603B; designed for electrocardiogram (ECG) equipment	Operating frequencies are shown for answer mode; frequencies for originate mode are the inverse of those shown

(Contd.)

COMPARISON CHARTS: TELEPHONE COUPLER DATA SETS (CONTD.)

IDENTITY		Communications Logic The Coupler	Data Communications Systems, Inc. Digital Acoustic Coupler DAC 337 and DAC 347	Direct Access Computing Telemate 300 Acoustical Coupler
APPLICATION		Portable, low-speed operation over the public telephone network	Portable low-speed operation over the public telephone network	Portable, low-speed operation over the public telephone network
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Operating mode	Originate only	Originate only (337); originate or answer (347)	Originate only; see Comments
	Speed	Up to 300 bps	Up to 165 bps; see Comments	Up to 300 bps
OPERATING FREQUENCIES	Transmit, Hz	1270 (mark); 1070 (space)	1270 (mark); 1070 (space); see Comments	1270 (mark); 1070 (space)
	Receive, Hz	2225 (mark); 2025 (space)	2225 (mark); 2025 (space); see Comments	2225 (mark); 2025 (space)
COUPLING	Transmit	Acoustic or inductive	Acoustic	Acoustic
	Receive	Acoustic or inductive	Acoustic	Acoustic or inductive
ELECTRICAL INTERFACE		EIA Standard RS232B	EIA Standard RS232B and standard Teletype interface	Model 33 Teletype standard; EIA Standard RS232B optional
PHYSICAL SPECIFICATIONS	Depth, inches	12.375	6.37	10.5
	Width, inches	12.375	11.75	9.5
	Height, inches	4.5	6.63	3.5
	Weight, pounds	9	6.25	5.5
COST	Purchase Price, $	495	495 (DAC 337) 560 (DAC 347)	395
COMMENTS		The Coupler provides acoustic shielding for the telephone handset and is compatible with the Bell System Data-Phone Data Set 103A2	DAC 347 is compatible with DAC 337 or DAC 347 or Bell System Data-Phone Data Set 103A2. Operating frequencies are shown for answer mode; frequencies for originate mode are the inverse of those shown; DAC states that higher transmission speeds up to 300 bps can be provided on special order; both models include sound-proof case with cover and speaker for audible circuit-assurance	Originate mode is standard; answer only and answer/originate modes are optional

COMPARISON CHARTS: TELEPHONE COUPLER DATA SETS (CONTD.)

IDENTITY		Ford Industries ForData 1200 Data Coupler	General Electric TDM-114 Data Set	General Electric TDM-115 Data Set
APPLICATION		Portable, low-speed operation over the public telephone network	Portable, low-speed operation over the public telephone network	Portable, low-speed operation over the public telephone network
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Operating mode	Originate only	Originate only	Originate or answer
	Speed	Up to 150 bps	Up to 300 bps	Up to 300 bps
OPERATING FREQUENCIES	Transmit, Hz	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)	2225 (mark); 2025 (space) see Comments
	Receive, Hz	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)	1270 (mark); 1070 (space) see Comments
COUPLING	Transmit	Acoustic	Acoustic	Acoustic
	Receive	Inductive	Acoustic	Acoustic
ELECTRICAL INTERFACE		Teletype 33, 35 or 37 standard; EIA RS232B optional	EIA Standard RS232B; optional Teletype interface	EIA Standard RS232B; optional Teletype interface
PHYSICAL SPECIFICATIONS	Depth, inches	6 } see Comments	9.5	9.5
	Width, inches	2.375 } see Comments	7.5	7.5
	Height, inches	6.5 } see Comments	4	4
	Weight, pounds	3 } see Comments	6	6
COST	Purchase Price, $	245	495	595
COMMENTS		Composed of two units: Modem Unit (see Phys. Specs.) and Telephone Coupler, which is cradled by desk telephone. Telephone handset lays in Coupler	Compatible with General Electric TDM-115 Data Set or Bell System Data-Phone Data Set 103A2	Compatible with General Electric TDM-114 Data Set or Bell System Data-Phone Data Set 103A2. Operating frequencies are shown for answer mode; frequencies for originate mode are the inverse of those shown

(Contd.)

COMPARISON CHARTS: TELEPHONE COUPLER DATA SETS
SUPPLEMENT 1

IDENTITY		Omnitec Models 701 and 701A Telephone Coupler	Omnitec Model 702 Telephone Coupler	Omnitec Model 703 Telephone Coupler	Tymshare Data Transceiver Mark V
APPLICATION		Portable, low-speed operation over the public telephone network	Portable, low-speed operation over the public telephone network	Portable, low-speed operation over the public telephone network	Portable low-speed operation over the public telephone network
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Operating mode	Originate only	Originate or answer	Originate or answer	Originate only
	Speed	Up to 300 bps	Up to 300 bps	Up to 300 bps	Up to 300 bps
OPERATING FREQUENCIES	Transmit, Hz	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)
	Receive, Hz	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)
COUPLING	Transmit	Acoustic or inductive	Acoustic	Acoustic; see Comments	Inductive
	Receive	Acoustic or inductive	Acoustic	Acoustic; see Comments	Acoustic
ELECTRICAL INTERFACE		EIA Standard RS232B; standard Teletype interface	EIA Standard RS232B; standard Teletype interface	EIA Standard RS232B; standard Teletype interface	EIA Standard RS232B optional
PHYSICAL SPECIFICATIONS	Depth, inches	11	11	12	8
	Width, inches	6	8	14	11
	Height, inches	4	4	7	3.7
	Weight, pounds	7	8	12	5
COST	Purchase Price, $	425	550	900	475; 95 (RS232B interface)
COMMENTS		Compatible with Omnitec Model 703 or Bell System Data-Phone Data Set 103A2; Model 701A is capable of inverted frequency operation and provides compatibility with the Bell System Data-Phone Data Set 103A1 or Data Set 103A2	Operating modes are manually selected; compatible with Omnitec Models 701, 701A or 703 or the Bell System Data-Phone Data Set 103A2. Operating frequencies are shown for originate mode; frequencies for answer mode are inverse of those shown	Operating modes are automatically or manually selected; incorporates automatic answer capability; compatible with Omnitec Models 701, 701A or 702 or the Bell System Data-Phone Data Set 103A1 or 103A2	Compatible with Bell System Data-Phone Data Set 103A2

COMPARISON CHARTS: TELEPHONE COUPLER DATA SETS SUPPLEMENT

IDENTITY		Electronic Voice Model 101A Data Set Acoustic Telephone Coupler	Electronic Voice Model 102A Data Set Acoustic Telephone Coupler	Novation Model DC/100 Acoustic Coupler	Novation Model DC/101 Acoustic Coupler
APPLICATION		Portable low-speed operation over the public telephone network	Portable low-speed operation over the public telephone network	Portable low-speed operation over the public telephone network	Portable low-speed operation over the public telephone network
TRANSMISSION CHARACTERISTICS	Mode	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex	Half-duplex or full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length	Any code; unrestricted code length
	Operating mode	Originate only	Originate or answer	Originate or answer	Originate only
	Speed	Up to 300 bps	Up to 300 bps	Up to 300 bps	Up to 300 bps
OPERATING FREQUENCIES	Transmit, Hz	1270 (mark); 1070 (space)	2225 (mark); 2025 (space) see Comments	2225 (mark); 2025 (space) see Comments	1270 (mark); 1070 (space)
	Receive, Hz	2225 (mark); 2025 (space)	1270 (mark); 1070 (space) see Comments	1270 (mark); 1070 (space) see Comments	2225 (mark); 2025 (space)
COUPLING	Transmit	Acoustic	Acoustic	Acoustic	Acoustic
	Receive	Inductive	Inductive	Inductive	Inductive
ELECTRICAL INTERFACE		EIA Standard RS232B; Standard Teletype Interface	EIA Standard RS232B; Standard Teletype Interface	EIA Standard RS232B; Standard Teletype Interface	EIA Standard RS232B; Standard Teletype Interface
PHYSICAL SPECIFICATIONS	Depth, inches	10	10	11	11
	Width, inches	7.75	7.75	11	11
	Height, inches	3.75	3.75	3	3
	Weight, pounds	6.5	6.5	6	6
COST	Purchase Price, $	520	585	650	550
COMMENTS		Compatible with Bell System Data-Phone Data Set 103A2 and 804B1, and Electronic Voice Model 102A	Operating frequencies are shown for answer mode; frequencies for originate mode are the inverse of those shown; compatible with Bell System Data-Phone Data Set 103A1, 103A2, and 804B1, and Electronic Voice Model 101A	Operating frequencies are shown for answer mode; frequencies for originate mode are the inverse of those shown; compatible with Bell System Data-Phone Data Set 103A2 and Novation Model DC/101	Compatible with Bell System Data-Phone Data Set 103A2 and Novation Model DC/100

TELEPHONE COUPLER DATA SETS

IDENTITY		Sonex I/Onex 30 Acoustic Coupler	Stelma Model 703 Acoustic Coupler Data Set	Time-Sharing Terminals TST 701A Acoustical Coupler	Tymshare Mark V Data Transceiver	Vanguard Data Systems VDC 300 Acoustic Coupler
APPLICATION		Portable, low-speed operation over public telephone network	Portable/fixed low-speed operation over public telephone network	Portable, low-speed operation over public telephone network	Portable, low-speed operation over public telephone network	Portable, low-speed operation over public telephone network
TRANSMISSION CHARACTERISTICS	Mode	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; any length	Any code; any length	Any code; any length	Any code; any length	Any code; any length
	Operating Mode	Originate only	Originate/answer	Answer only	Originate only	Originate only
	Data Rate	Up to 300 bps	Up to 300 bps	Up to 500 bps	Up to 300 bps	Up to 300 bps
OPERATING FREQUENCY	Transmit, Hz	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)	2225 (mark); 2025 (space)	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)
	Receive, Hz	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)	1270 (mark); 1070 (space)	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)
COUPLING	Transmit	Acoustic	Acoustic/DAA	Acoustic/DAA	Inductive	Acoustic
	Receive	Inductive	Inductive/DAA	Acoustic/DAA	Acoustic	Acoustic
ELECTRICAL INTERFACE		EIA RS232B; std TTY	EIA RS232B	EIA RS232B; std TTY	EIA RS232B optional	EIA RS232B; std TTY
PHYSICAL SPECS	Depth, in.	11	11	11	8	5.5
	Width, in.	5	11	6	11	11
	Height, in.	4.25	2.75	4	3.7	5.5
	Weight, lb	3.25	—	7	5	5
PURCHASE PRICE, $		295	385	375	475; 95 (RS232B interface)	500
COMMENTS		Compatible with Bell System Data Set 103A; half-/full-duplex mode switch-selectable; operates at 10-watt power consumption; inhibits transmission until carrier detected; includes carrier detection indicator and phase lock loop feature	Operating frequencies shown for originate mode; frequencies for answer mode are inverse; alternate direct connection to public telephone network via Bell System DAA; includes automatic answer, long-space disconnect, test mode; compatible with Bell System Data Set 103 Series	Alternate direct hardwire interface to Bell System DAA; switch-selectable transmission modes	Compatible with Bell System Data-Phone Data Set 103A2	Provides manual selection of upright/inverted transmission frequencies; loopback test feature available as option; accommodates cabinet or TTY mounting

TELEPHONE COUPLER DATA SETS

IDENTITY		Vanguard Data Systems VDC 300A Acoustic Coupler	Applied Digital Data Systems COM-110 Data Coupler	Applied Digital Data Systems COM-120 Data Coupler	Applied Digital Data Systems COM-130 Data Coupler	Design Elements Design 79-O Acoustic Data Coupler
APPLICATION		Portable, low-speed operation over public telephone network	Portable, low-speed operation over public telephone network	Portable, low-speed operation over public telephone network	Portable, low-speed operation over public telephone network	Portable, low-speed operation over public telephone network
TRANSMISSION CHARACTERISTICS	Mode	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; any length	Any code; any length	Any code; any length	Any code; any length	Any code; any length
	Operating Mode	Originate/ answer	Originate only	Originate only	Originate only	Originate only
	Data Rate	Up to 300 bps	Up to 300 bps	Up to 300 bps	Up to 300 bps	Up to 300 bps
OPERATING FREQUENCY	Transmit, Hz	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)
	Receive, Hz	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)
COUPLING	Transmit	Acoustic	Acoustic	DAA	Acoustic/DAA	Acoustic
	Receive	Acoustic	Acoustic	DAA	Acoustic/DAA	Acoustic/inductive
ELECTRICAL INTERFACE		EIA RS232B; std TTY	EIA RS232B; std TTY	EIA RS232B; std TTY	EIA RS232B; sts TTY	EIA RS232B; std TTY
PHYSICAL SPECS	Depth, in.	5.5	13.5	13.5	13.5	10
	Width, in.	11	10	10	10	5.625
	Height, in.	5.5	5	5	5	3.75
	Weight, lb	5	8	8	8	3.5
PURCHACE PRICE, $		600	480	410	495	345
COMMENTS		Provides manual selection of upright/inverted transmission frequencies; loopback test feature available as option; operating frequencies shown for originate mode; frequencies for answer made are inverse; accommodates cabinet or TTY mouting	Special feature eliminates second harmonic, accepts 10-d B-weaker signals; optional parallel I/O; enclosed acoustic chamber minimizes ambient noise; remote echo option permits automatic transmission (can be switched on/off via user-specified control char); user specifies speed, format for parallel interface/remote echo options; filter can be optimized for 0-150 bps operation; compatible with Bell System 103 Data Set	Remote echo option permits retransmission of received char (can be switched on/off via user-specified control char); optional parallel I/O; user specifies speed, format for parallel interface/remote echo options; filter can be optimized for 0-150 bps operation; compatible with Bell System 103 Data Set	Special feature eliminates second harmonic, accepts 10-dB-weaker signals; optional parallel I/O; enclosed acoustic chamber minimizes ambient noise; remote echo option permits automatic retransmission of received char (can be switched on/off via user-specified control char); user specifies speed, format for parallel interface/remote echo options; filter can be optimized for 0-150 bps operation; compatible with Bell System 103 Data Set	Compatible with Bell System Data-Phone Data Set 103A1, Data Set 103A2, Design Elements Design 80 Data Set; upright/ inverted code polarity selection std

IDENTITY		Design Elements Design 79-A Acoustic Data Coupler	Design Elements Design 70-O/A Acoustic Data Coupler	Info-Max Model 311 Acoustic Coupler	Info-Max Model 315 Acoustic Coupler	Info-Max Model 316 Acoustic Coupler
APPLICATION		Portable, low-speed operation over public telephone network	Portable, low-speed operation over public telephone network	Portable, low-speed operation over public telephone network	Portable, low-speed operation over public telephone network	Portable, low-speed operation over public telephone network
TRANSMISSION CHARACTERISTICS	Mode	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; any length	Any code; any length	Any code; any length	Any code; any length	Any code; any length
	Operating Mode	Answer only	Originate/answer	Originate only	Originate only	Answer only
	Data Rate	Up to 300 bps	Up to 300 bps	Up to 300 bps	Up to 300 bps	Up to 300 bps
OPERATING FREQUENCY	Transmit, Hz	2,225 (mark); 2,025 (space)	1,270 (mark); 1,070 (space)	1,270 (mark); 1,070 (space)	1,270 (mark); 1,070 (space)	2,225 (mark); 2,025 (space)
	Receive, Hz	1,270 (mark); 1,070 (space)	2,225 (mark); 2,025 (space)	2,225 (mark); 2,025 (space)	2,225 (mark) 2,025 (space)	1,270 (mark) 1,070 (space)
COUPLING	Transmit	Acoustic	Acoustic	Acoustic	Acoustic	Acoustic
	Receive	Acoustic/inductive	Acoustic/inductive	Inductive	Acoustic	Inductive
ELECTRICAL INTERFACE		EIA RS232B; std TTY	EIA RS232B; std TTY	EIA RS232B; std TTY	EIA RS232B; std TTY	EIA RS232B; std TTY
PHYSICAL SPECS	Depth, in.	10	10	7	7	7
	Width, in.	5.625	5.625	12.875	12.875	12.875
	Height, in.	3.75	3.75	4.5	4.5	4.5
	Weight, lb	3.5	3.5	4	4	4
PURCHACE PRICE, $		345	435	395	395	395
COMMENTS		Compatible with Bell System Data-Phone Data Set 103A1, Data Set 103A2, Design Elements Design 80 Data Set; upright/inverted code polarity selection std	Compatible with Bell System Data-Phone Data Set 103A1, Data Set 103A2, Design Elements Design 80 Data Set; upright/inverted code polarity selection std; operating frequencies shown for originate mode; frequencies for answer mode are inverse	Compatible with Bell System Data-Phone Data Set 103A2, Info-Max 316,317; switch-selectable transmission modes	Compatible with Bell System Data-Phone Data Set 103A2, Info-Max 316, 317; switch-selectable transmission modes	Compatible with Bell System Data-Phone Data Set 103A2, Info-Max 311,315; switch-selectable transmission modes

TELEPHONE COUPLER DATA SETS

IDENTITY		Info-Max Model 317 Acoustic Coupler	Applied Peripheral Systems DG-103 Telephone Coupler	Novation DC-101A Data Coupler	Novation DC-102AD Data Coupler	Novation TM-102AD Data Coupler
APPLICATION		Portable, low-speed operation over public telephone network	Portable, low-speed operation over public telephone network	Portable low-speed operation over public telephone network	Portable/fixed low-speed operation over public telephone network	TTY-mounted, low-speed operation over public telephone network
TRANSMISSION CHARACTERISTICS	**Mode**	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex	Half-/full-duplex
	Method	Serial by bit	Serial by bit	Serial by bit	Serial by bit	Serial by bit
	Modulation	Frequency shift	Frequency shift	Frequency shift	Frequency shift	Frequency shift
	Timing	Asynchronous	Asynchronous	Asynchronous	Asynchronous	Asynchronous
	Code	Any code; any length	Any code; any length	Any code; any length	Any code; any length	Any code; any length
	Operating Mode	Answer only	Originate only	Originate only	Originate only	Originate only
	Data Rate	Up to 300 bps	Up to 300 bps	Up to 440 bps	Up to 400 bps	Up to 400 bps
OPERATING FREQUENCY	**Transmit, Hz**	2,225 (mark); 2,025 (space)	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)
	Receive, Hz	1,270 (mark); 1,070 (space)	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)
COUPLING	**Transmit**	Acoustic	Acoustic	Acoustic	Acoustic/DAA	Acoustic/DAA
	Receive	Acoustic	Acoustic	Acoustic	Acoustic/DAA	Acoustic/DAA
ELECTRICAL INTERFACE		EIA RS232B; std TTY	EIA RS232B; std TTY	EIA RS232B	EIA RS232B/std TTY	Std TTY
PHYSICAL SPECS	**Depth, in.**	7	10	11	11	Integral TTY rack mounting
	Width, in.	12.875	7	11	11	
	Height, in.	4.5	5	3	3	
	Weight, lb	4	9	6	6	
PURCHASE PRICE, $		395	395	315	350	350
COMMENTS		Compatible with Bell System Data-Phone Data Set 103A2, Info-Max 311, 315; switch-selectable transmission modes	Compatible with Bell System Data-Phone Data Set 103A2	Compatible with Bell System Data Set 103A2; -40 dbm receiver sensitivity via selective amplification/multisampling techniques	Compatible with Bell System Data Set 103A2; dual interface allows EIA, TTY equipment to operate simultaneously; alternate direct connection to public telephone network via Bell System DAA (switch-selectable); -50 dbm (acoustic), -57 dbm (direct) receiver sensitivity via selective amplification/multisampling techniques	Compatible with Bell System Data Set 103A2; designed for integral mounting within std TTY unit enclosure; alternate direct connection to public telephone network via Bell System DAA (switch-selectable); -50 dbm (acoustic), -57 dbm (direct) receiver sensitivity via selective amplification multisampling techniques

TELEPHONE COUPLER DATA SETS

IDENTITY		Prentice Electronics DC-22 Universal Data Coupler				
APPLICATION		Portable/fixed, low-speed operation over public telephone network				
TRANSMISSION CHARACTERISTICS	**Mode**	Half-/full-duplex				
	Method	Serial by bit				
	Modulation	Frequency shift				
	Timing	Asynchronous				
	Code	Any code; any length				
	Operating Mode	Originate/answer				
	Data Rate	Up to 300 bps				
OPERATING FREQUENCY	**Transmit, Hz**	2225 (mark); 2025 (space)				
	Receive, Hz	1270 (mark); 1070 (space)				
COUPLING	**Transmit**	Acoustic/DAA				
	Receive	Accoustic/DAA/ inductive				
ELECTRICAL INTERFACE		EIA RS232C/inverted; std TTY				
PHYSICAL SPECS	**Depth, in.**	10.6				
	Width, in.	4.1				
	Height, in.	4.9				
	Weight, lb	4.25				
PURCHASE PRICE, $		298				
COMMENTS		Switch-selectable Originate/Answer modes; TTY, EIA/ EIA-inverted interconnection selectable by straps in base of unit; carrier detection, power indicator lights; compatible with Bell System 103 Series Data Sets/other couplers operating up to 300 bps; operating frequencies shown for Answer mode; frequencies for Originate mode are inverse				

FACSIMILE EQUIPMENT

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COMPARISON CHARTS: FACSIMILE EQUIPMENT

The following is a thumb-nail sketch to acquaint the reader with the historical background of facsimile. Since its birth, facsimile communication has not been exploited to any great degree. Early development of facsimile was hindered by more successful means for communication and by the lack of techniques that were not to be made available until after World War II. Facsimile communications today are still secondary to digital communications — a spinoff from the computer revolution. Knowledgeable people in the communications field have referred to facsimile as a sleeping giant.

Facsimile was originated in 1842 when Alexander Bain, a Scottish physicist, developed an electrochemical recording telegraph. This rudimentary facsimile system functioned by swinging a pendulum across metallic type; contact with the type caused an electric current to flow over wires to a remotely swinging pendulum that was synchronized with the first. Chemically treated paper, positioned beneath the pendulum, produced a brown stain when an electric current passed from the pendulum to the paper. Bain's facsimile was widely used in the United States, but was abandoned because of the rising demand for electro-mechanical printers, which were operated faster and were simpler to operate. Telegraph equipment also decreased the popularity of facsimile.

Facsimile became active again in the 1920's with experimental AM radio facsimile broadcasts. In 1924 AT&T established the first commercial facsimile system when it inaugurated facsimile communication by cable between New York and London. Western Union, in the same year, established a wirephoto service (Telepix) for newspapers over its domestic telegraph system. This service lacked support and was shortly discontinued. AT&T inaugurated a domestic wirephoto service in 1925 and later sold it to the Associated Press. AT&T has since developed facsimile equipment for picture transmission over its own intrastate and interstate facsimile channels. Western Union has also developed its own facsimile equipment employing a special dry recording paper called Teledeltos. Teledeltos paper resulted from Western Union investigations to produce a recording paper that did not require processing after recording. In addition to AT&T's facsimile channels, Western Union inaugurated facsimile service for photographs and telegrams over its own circuits. Both common carriers, at present, offer wirephoto service for the press in addition to voice-band and broad-band facsimile channels.

RCA had been investigating commercial short-wave facsimile and in 1926 inaugurated such a service between New York and London. Based on its success, RCA expanded its radiophoto service to world-wide dimensions.

Many endeavors to promote commercial facsimile were pursued in the ensuing years until the beginning of World War II. These endeavors included broadcasting news media to home facsimile receivers produced by several manufacturers.

With the onslaught of World War II, commercial facsimile activity dwindled. Facsimile was directed toward the military who used facsimile extensively for transmission of maps, orders, photographs, weather charts, etc.

Several improvements in facsimile equipment resulted from technical gains made during the war-time period. The electrolytic recording technique proved to be highly successful in producing well-defined photographic images containing fine tonal gradations of black and white. Other improvements included increased page size, high-speed operation, automatic synchronization, and established standards.

Toward the end of the war, several newspapers and radio broadcasters formed an organization to promote facsimile broadcast service to the public over FM channels that would provide static-free reception. The organization established equipment and broadcasting standards, and in 1947 facsimile was introduced to the public through a Miami, Florida commercial FM radio station. The impact of commercial television, which began at about the same time, undoubtedly killed growth in this area.

In recent years, facsimile has been directed toward business applications as an important alternative to data communications. A key to the success of facsimile in the business world was AT&T's introduction of the 602 Series Data-Phone Data Set in late 1962, enabling the public telephone network to be used for low-speed facsimile communication.

The characteristics of facsimile equipment designed for operation over a common-carrier communications facility are presented in this set of charts, beginning on page 4800:03. A facsimile system includes a facsimile transmitter (scanner) and a facsimile receiver (recorder). The facsimile transmitter and receiver are sometimes combined to perform as a transceiver providing two-way communication. Unless otherwise stated, each facsimile system presented in these charts includes separate transmitter and receiver units. The transmitter characteristics are presented in the Input portion of the chart; the receiver characteristics are presented in the Output portion of the chart. Both transmitter and receiver characteristics are combined in the Data Transmission and Error Control portions of the chart.

The facsimile equipment is identified by the manufacturer's name, the formal name of the equipment and its model number (if a model number is specified by the manufacturer). The Report Number provides a rapid index to the detailed report covering the equipment.

A brief statement of the general purpose of the subject equipment is presented under the heading Function. The types of transmission facilities to which the equipment can be connected are usually stated.

The important characteristics of the facsimile transmitter are described under Input. These characteristics include:

- Document size — states the maximum acceptable size of a document to be scanned; the minimum size is also stated where applicable.
- Scanner type — classifies the scanner as either a drum or flat-bed scanner.
- Scanning technique — a succinct description of the scanning technique employed by the transmitter.
- Vertical resolution — states the scanning density along the axis of scanning, stated in lines per inch.
- Scanning rate — states the scanning speed in lines per minute.
- Line length — states the scanning line length in inches.

The important characteristics of the facsimile receiver are described under Output. These characteristics include:

- Copy size — states the maximum size of the recorded copy.
- Recorder type — classifies the recorder as electrolytic, impression, electrothermal, xerographic, etc.
- Recording technique — a succinct description of the recording technique employed by the receiver.
- Vertical resolution — states the recording density along the axis of recording, stated in lines per inch.
- Line length — states the recording line length in inches.

Data transmission characteristics, common to both facsimile transmitter and receiver, are stated under Data Transmission. These characteristics include:

- Transmission speed — states the rated transmission speed of the facsimile equipment in lines per inch.
- Modulation technique — states the method employed to control the carrier signal. (See Users' Guide to Facsimile Reports, Paragraph .1.)
- Modulation frequencies — states the upper and lower modulating frequencies, that define the modulation bandwidth.
- Transmission facilities — states the common-carrier communications facility that is compatible with the transmission characteristics.

Techniques for controlling errors in the received image that forms the output from a facsimile system are listed under Error Control. In some cases, an answer-back circuit is used to alert the operator at the facsimile transmitter that the transmission was improperly received. In general, conventional facsimile equipment does not include error detection and correction capabilities. When error control is not incorporated in the equipment, the entry is marked "no provision."

The purchase price and monthly rental are listed for both transmitter and receiver units.

The addresses of the manufacturers represented in the charts are listed below.

Alden Electronic and Impulse Recording Equipment Co., Inc.
Alden Research Center
1 Washington Avenue
Westboro, Massachusetts 01581

Graphic Sciences, Inc.
Corporate Drive - Commerce Park
Danbury, Connecticut 06810

Muirhead Instruments, Inc.
1101 Bristol Road
Mountainside, New Jersey

Stewart-Warner Electronics
Division of Stewart-Warner Corp.
1300 N. Kostner Avenue
Chicago, Illinois 60651

Telautograph Corporation
8700 Bellanca Avenue
Los Angeles, California 90045

Xerox Corporation
Midtown Tower
Rochester, New York 14604

COMPARISON CHARTS: FACSIMILE EQUIPMENT

IDENTITY		Alden 2 Signature Verification Facsimile System	Alden 11 Docufax Facsimile System	Alden 18 Alpurfax Facsimile System	Alden 18 Alspeed Alpurfax Facsimile System
REPORT NUMBER		9030	9031	9032	9033
FUNCTION		Transmission and reception of graphic data over a broad-band facility restricted to handling narrow copy	Transmission and reception of graphic data over a voice-band line	Transmission and reception of graphic data over a voice-band line	Transmission and reception of graphic data over a broad-band facility
INPUT	Document size, inches	Up to 7 wide; see Comments	Up to 28 wide; see Comments	Up to 60 wide; see Comments	Up to 60 wide; see Comments
	Scanner type	Flat bed	Flat bed	Flat bed	Flat bed
	Scanning technique	Rotating single-turn helical aperture in respect to a fixed aperture	Rotating single-turn helical aperture in respect to a fixed aperture	Rotating single-turn helical aperture in respect to a fixed aperture	Rotating single-turn helical aperture in respect to a fixed aperture
	Vertical resolution, lines/inch	100	96 or 166	48 or 96	48 or 96
	Scanning rate, lines/min	3600	120 or 240	60 or 120	120, 240, 480, or 960
	Line length, inches	2.250	10.2	18.125	18.125
OUTPUT	Copy size, inches	2,687 by up to 150 ft	11 by up to 120 ft	19 by up to 120 ft	19 by up to 170 ft
	Recorder type	Electrolytic	Electrolytic	Electrolytic	Electrolytic
	Recording technique	Rotating raised-wire helix in respect to a fixed printing blade	Rotating raised-wire helix in respect to a fixed printing blade	Rotating raised-wire helix in respect to a fixed printing blade	Rotating raised-wire helix in respect to a fixed printing blade
	Vertical resolution, lines/inch	100	96 or 166	48 or 96	48 or 96
	Recording rate, lines/min	3600	120 or 240	60 or 120	120, 240, 480, or 960
	Line length, inches	2.250	10.2	18.125	18.125
DATA TRANSMISSION	Transmission speed, lines/min	3600	120 or 240	60 or 120	120, 240, 480, or 960
	Modulation technique	Double sideband amplitude modulation	Double sideband amplitude modulation	Double sideband amplitude modulation	Double sideband amplitude modulation
	Modulation frequencies, KHz	0 to 7.5	0 to 1, 0 to 1.6, or 0 to 2.0	0 to 0.9 or 9 to 1.8	Ranges up to 0 to 14.0
	Transmission facilities	15.5 KHz broad-band facility	Bell System Type 4002 Data channel or equivalent	Bell System Type 4002 Data channel or equivalent	Telpak 5702 (A2) or 5703 (A3) service
ERROR CONTROL		No provision	No provision	No provision	No provision
PRICE DATA	Purchase price, $	5000 (transmitter); 3000 (receiver)	6500 (transmitter); 3440 (receiver)	6500 (transmitter); 3450 (receiver)	8000 (transmitter); 9500 (receiver)
	Monthly rental, $	—	150 (transmitter); 120 (receiver)	220 (transmitter); 140 (receiver)	390 (transmitter); 464 (receiver)
COMMENTS		Alden transmitters are capable of selectively scanning any portion of the input document up to the scanning line length. Alden also produces 16 mm and 35 mm microfilm facsimile equipment; document length is restricted only by paper supply at receiver.			

COMPARISON CHARTS: FACSIMILE EQUIPMENT

IDENTITY		Muirhead D-900/D-901 Mufax Business Machines		
		FM/B	FM/DG	AM/B
REPORT NUMBER		—	—	—
FUNCTION		Transmission and reception of graphic data over a voice-band line	Transmission and reception of graphic data over a voice-band line	Transmission and reception of graphic data over a voice-band line
INPUT	Document size, inches	14 by 8.625	14 by 8.625	19 by 8.625
	Scanner type	Drum	Drum	Drum
	Scanning technique	Copy attached to rotating cylinder; light source, aperture, and photocell scan across copy	Copy attached to rotating cylinder; light source, aperture, and photocell scan across copy	Copy attached to rotating cylinder; light source, aperture, and photocell scan across copy
	Vertical resolution, lines/inch	90	90	90
	Scanning rate, lines/min	444	360	444
	Line length, inches	8.625	8.325	8.625
OUTPUT	Copy size, inches	14 by 8.625	14 by 8.625	14 by 8.625
	Recorder type	Electrolytic	Electrolytic	Electrolytic
	Recording technique	Rotating raised-wire helix in respect to a fixed printing blade	Rotating raised-wire helix in respect to a fixed printing blade	Rotating raised-wire helix in respect to a fixed printing blade
	Vertical resolution, lines/inch	90	90	90
	Recording rate, inches/min	444	360	444
	Line length, inches	8.625	8.625	8.625
DATA TRANS-MISSION	Transmission speed, lines/min	444	360	444
	Modulation technique	Frequency modulation	Frequency modulation	Amplitude modulation
	Modulation frequencies, KHz	0 to 0.6	0 to 0.6	0 to 0.6
	Transmission facilities	?	?	?
ERROR CONTROL		No provision	No provision	No provision
PRICE DATA	Purchase price, $	?	?	?
	Monthly rental, $	?	?	?
COMMENTS		These units can be used over a radio link; Muirhead also produces specialized facsimile devices for transmission of photographs (high resolution), newspapers, and weather charts		

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COMPARISON CHARTS: FACSIMILE EQUIPMENT

IDENTITY		Stewart-Warner Private Line Datafax Facsimile Model 1824	Stewart-Warner Private Line Datafax Facsimile Model 2828	Stewart-Warner Private Line Datafax Facsimile Model 3628	Stewart-Warner Private Line Datafax Facsimile Model 9095
REPORT NUMBER		9281	9281	9281	9281
FUNCTION		Transmission and reception of graphic data over a voice-band line	Transmission and reception of graphic data over a voice-band line	Transmission and reception of graphic data over a voice-band line	Transmission and reception of graphic data over a broad-band facility
INPUT	Document size, inches	Up to 9 wide; see Comments	Up to 9 wide; see Comments	Up to 9 wide; see Comments	Up to 9 wide; see Comments
	Scanner type	Flat bed	Flat bed	Flat bed	Flat bed
	Scanning technique	Individually rotating multi-turn and single-turn helical apertures	Individually rotating multi-turn and single-turn helical apertures	Individually rotating multi-turn and single-turn helical apertures	Individually rotating multi-turn and single-turn helical apertures
	Vertical resolution, lines/inch	100	133	100	100
	Scanning rate, lines/min	180	280	360	900
	Line length, inches	8.3	8.3	8.3	8.3
OUTPUT	Copy size, inches	9.375 by up to 400 ft	9.375 by up to 400 ft	9.375 by up to 400 ft	9.375 by up to 400 ft
	Recorder type	Electrolytic	Electrolytic	Electrolytic	Electrolytic
	Recording technique	Rotating raised-wire helix and printing blade	Rotating raised-wire helix and printing blade	Rotating raised-wire helix and printing blade	Rotating raised-wire helix and printing blade
	Vertical resolution, lines/inch	100	133	100	100
	Recording rate, lines/min	180	280	360	900
	Line length, inches	8.3	8.3	8.3	8.3
DATA TRANSMISSION	Transmission speed, lines/min	180	280	360	900
	Modulation technique	Vestigial sideband amp. modulation	Vestigial sideband amp. modulation	Vestigial sideband amp. modulation	Vestigial sideband amp. modulation
	Modulation frequencies, KHz	0.8 to 2.4	0.5 to 2.8	0.5 to 2.8	1.2 to 9.5
	Transmission facilities	Bell System Type 4002 Data channel or equivalent	Bell System Type 4002 Data channel or equivalent	Bell System Type 4002 Data channel or equivalent	10 KHz broad-band facility
ERROR CONTROL		No provisions	No provisions	No provisions	No provisions
PRICE DATA	Purchase price, $	2850 (transmitter); 2450 (receiver)	2950 (transmitter); 2950 (receiver)	2850 (transmitter); 2450 (receiver)	3100 (transmitter); 2650 (receiver)
	Monthly rental, $	109 (transmitter); 48 (receiver)	109 (transmitter); 98 (receiver)	109 (transmitter); 98 (receiver)	120 (transmitter); 118 (receiver)
COMMENTS		Stewart-Warner facsimile equipment is distributed and serviced by Datafax Corporation, a leasing subsidiary of Stewart-Warner Electronics; Dictaphone Corporation and Western Union Telegraph Company also market the Datafax product line; document length is restricted only by paper supply at receiver.			

COMPARISON CHARTS: FACSIMILE EQUIPMENT

IDENTITY		Stewart-Warner Dial Datafax Facsimile System	Telautograph Quikfax Facsimile Model 180	Telautograph Quikfax Facsimile Model 300	Telautograph Quikfax Facsimile Model 900
REPORT NUMBER		9280	9320	9320	9320
FUNCTION		Transmission and reception of graphic data over the public telephone network	Transmission and reception of graphic data over a voice-band line	Transmission and reception of graphic data over a voice-band or broad-band facility	Transmission and reception of graphic data over a broad-band facility
INPUT	Document size, inches	Up to 9 wide; see Comments	Up to 8.5 wide; see Comments	Up to 8.5 wide; see Comments	Up to 8.5 wide; see Comments
	Scanner type	Flat bed	Flat bed	Flat bed	Flat bed
	Scanning technique	Individually rotating multi-turn and single-turn helical apertures	Slitted, rotating scanning disk and photomultiplier arrangement	Slitted, rotating scanning disk and photomultiplier arrangement	Slitted, rotating scanning disk and photomultiplier arrangement
	Vertical resolution, lines/inch	100	100	85 or 100	100
	Scanning rate, lines/min	180	180	300 or 360	900
	Line length, inches	8.3	8.3	8.3	8.3
OUTPUT	Copy size, inches	9.375 by up to 400 ft	8.5 by up to 400 ft	8.5 by up to 400 ft	8.5 by up to 400 ft
	Recorder type	Electrolytic	Electrolytic	Electrolytic	Electrolytic
	Recording technique	Rotating raised-wire helix and printing blade	Rotating raised-wire helix and printing blade	Rotating raised-wire helix and printing blade	Rotating raised-wire helix and printing blade
	Recording rate, lines/min	180	180	300 or 360	900
	Line length, inches	8.3	8.3	8.3	8.3
DATA TRANSMISSION	Transmission speed, lines/min	180	180	300 or 360	900
	Modulation technique	Frequency modulation	Vestigial sideband amp. modulation	Vestigial sideband amp. modulation	Vestigial sideband amp. modulation
	Modulation frequencies, KHz	1.5 to 2.8	0 to 1.3	0 to 1.8 or 0 to 2.6	0 to 6.6
	Transmission facilities	Public telephone network	Bell System Type 4002 Data channel or equivalent	Bell System Type 4002 Data channel (lower scan rate) or 5 KHz broad band facility (higher scan rate)	48 KHz wideband channel
ERROR CONTROL		No provision	Optional answer-back circuit	Optional answer-back circuit	Optional answer-back circuit
PRICE DATA	Purchase price, $	3160 (transmitter); 3860 (receiver)	2700 (transmitter or receiver)	2700 (transmitter or receiver)	3008 (transmitter or receiver)
	Monthly rental, $	112 (transmitter); 124 (receiver)	105 (transmitter or receiver)	105 (transmitter or receiver)	115 (transmitter or receiver)
COMMENTS		Data-Phone Data Set 602C; see Comments under Stewart-Warner Private Line Datafax Facsimile; document length is restricted only by paper supply at receiver.	A Motor Drive Amplifier is required at both transmitter and receiver when the units are not operating from a common power network; document length is restricted only by paper supply at receiver.		

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COMPARISON CHARTS: FACSIMILE EQUIPMENT

IDENTITY		Xerox LDX Scanner and Printer		Xerox Telecopier II
REPORT NUMBER		9390		9391
FUNCTION		High speed transmission and reception of graphic data over a broad-band facility		Transmission and reception of graphic data over the public telephone network; scanner and recorder are integrated into a single transceiver
INPUT	Copy size, inches	Up to 9.5 wide; see Comments		Up to 8.5 wide; see Comments
	Scanner type	Flat bed		Flat bed
	Scanning technique	Cathode ray tube (CRT), lens and photo-multiplier arrangement		Revolving parabolic mirror and fixed aperature arrangement
	Vertical resolution, lines/inch	135	190	96
	Scanning rate, lines/min	2520 or 12,600	1800 or 9000	180
	Line length, inches	8.25	8.25	8.3
OUTPUT	Copy size, inches	8.5 by up to 2000 ft		Up to 8.5 by up to 14 or up to 200 ft with Roll Feed option
	Recorder type	Xerographic		Impression
	Recording technique	Xerographic using cathode ray tube to form latent image		Carbon paper impressed against paper
	Vertical resolution, lines/inch	135	190	96
	Recording rate, lines/min	2520 or 12,600	1800 or 9000	180
	Line length, inches	8.25	8.25	8.3
DATA TRANS-MISSION	Transmission speed, lines/min	1800, 2520, 9000, or 12,600		180
	Modulation technique	See Comments		Frequency modulation
	Modulation frequencies, KHz	See Comments		1.5 to 2.4
	Transmission facilities	48 KHz wideband channel (lower scan rate) or Telpak C facility (higher scan rate)		Public telephone network via Xerox Telecoupler II telephone coupler data set
ERROR CONTROL		No provision		No provision
PRICE DATA	Purchase price, $	—		2500 to 3000
	Monthly rental, $	550 (scanner); 650 (Printer)		65 to 80
COMMENTS		Picture signal is digitized for transmission at 50,000 bits/sec (lower scan rate) or 250,000 bits/sec (higher scan rate). The LDX Scanner and Printer can be used over a 48 KHz Wideband Channel via a Bell System Data Set 303C or over a Telpak C Facility via a Bell System Data Set 303D; document length is restricted only by paper supply at receiver		Xerox Telecoupler II telephone coupler data set is compatible with the Bell System Data-Phone Data Set 602C; document length is restricted only by paper supply at receiving Telecopier; capable of unattended operation

COMPARISON CHARTS: FACSIMILE EQUIPMENT SUPPLEMENT 1

IDENTITY		Stewart-Warner Electronic Mailbox Facsimile Transceiver
REPORT NUMBER		9282
FUNCTION		Transmission and reception of graphic data over the public telephone network
INPUT	Copy size, inches	up to 9 wide; see Comments
	Scanner type	Flat bed
	Scanning technique	Three equally spaced scanning heads attached to a continuous belt scan across moving document
	Vertical resolution, lines/inch	96
	Scanning rate, lines/min	240
	Line length, inches	8.5
OUTPUT	Copy size, inches	9.5 by up to 200 feet
	Recorder type	Electrolytic
	Recording technique	Three equally spaced recording styli attached to a continuous belt scan across moving paper
	Vertical resolution, lines/inch	96
	Recording rate, lines/min	240
	Line length, inches	8.5
DATA TRANS-MISSION	Transmission speed, lines/min	240
	Modulation technique	Frequency modulation
	Modulation frequencies, KHz	0.5 to 2.4
	Transmission facilities	Public telephone network
ERROR CONTROL		No provision
PRICE DATA	Purchase price, $	—
	Monthly rental, $	$125 to $147
COMMENTS		Employs Bell System Data-Phone Data Set 602C; document length is restricted only by paper supply at receiving transceiver; optional automatic Document Loader accommodates up to 50 documents; capable of unattended operation

COMPARISON CHARTS: FACSIMILE EQUIPMENT

SUPPLEMENT 2

IDENTITY		Graphic Sciences dex I Facsimile Transceiver
REPORT NUMBER		9078
FUNCTION		Transmission and reception of graphic data over the public telephone network via an acoustic telephone coupler
INPUT	Document size, inches	Up to 9 wide by 14 long
	Scanner type	Drum
	Scanning technique	Photocell and light source/lens arrangement scan the length of the document fixed to the rotating drum
	Vertical resolution, lines/inch	88
	Scanning rate, lines/min	150
	Line length, inches	9
OUTPUT	Copy size, inches	8.5 by 11 or 9 by 14
	Recorder type	Electrothermal
	Recording technique	Recording stylus moves laterally across recording paper attached to the rotating drum
	Vertical resolution, lines/inch	88
	Recording rate, lines/min	150
	Line length, inches	9
DATA TRANS-MISSION	Transmission speed, lines/min	150
	Modulation technique	Vestigial sideband amplitude modulation
	Modulation frequencies, KHz	0 to 2.0
	Transmission facilities	Public telephone network via an integral acoustic telephone coupler
ERROR CONTROL		No provision
PRICE DATA	Purchase price, $	—
	Monthly rental, $	75
COMMENTS		The Transceiver does not include a data set interface; operation must be attended; integral telephone coupler is acoustically shielded.

IDENTITY		Western Union Letter-Fax	Western Union Info-Fax 100 Facsimile System	Xerox LDX Scanner/Printer		Xerox Telecopier II
REPORT NUMBER		—	—	9390		9391
FUNCTION		Transmission/reception of graphic data over voiceband line	Transmission/reception of graphic data over a voiceband/ broadband line	High-speed transmission/reception of graphic data over broadband facility		Transmission/reception of graphic data over public telephone network
INPUT	Document Size, in.	0.5 x 11	8.5 wide; see Comments	Up to 9.5 wide; see Comments		Up to 8.5 wide; see Comments
	Type of Scanner	Drum	Flatbed	Flatbed		Flatbed
	Scanning Technique	Photocell and light source/lens arrangement scan length of document fixed to rotating drum	3 equally speced scanning heads attached to continuous belt scan across moving document	Cathode ray tube, lens/photomultiplier arrangement		Revolving parabolic mirror/fixed aperture arrangement
	Vertical Resolution, lines/in.	100	96	135	190	96
	Scanning Rate, lines/min	180 or 360	300	2520 or 12,600	1800 or 9000	180
	Line Length , in.	10	9	8.25	8.25	8.3
OUTPUT	Copy Size, in.	7.87 x 10	8.5 by up to 200 ft	8.5 by up to 2000 ft		Up to 8.5 by up to 14 (up to 200 ft with Roll Feed option)
	Type of Recorder	Electrolytic	Electrolytic	Xerographic		Impression
	Recording Technique	3 equally spaced recording styli attached to continuous belt scan across moving document	Rotating raised-wire helix in respect to a fixed printing blade	Xerographic using cathode ray tube to form latent image		Carbon paper impressed against copy
	Vertical Resolution, lines/in.	100	96	135	190	96
	Recording Rate, lines/min	180 or 360	300	2520 or 12,600	1800 or 9000	180
	Line Length, in.	10	9	8.25	8.25	8.3
DATA TRANSMISSION	Data Rate, lines/min	180 or 360	300	1800, 2520, 9000, or 12,600		180
	Modulation Technique	Double sideband amplitude modulation	Vestigial sideband amplitude modulation	See Comments		Frequency modulation
	Modulation Frequencies, kHz	0.3-3.3	0.3-3.3	See Comments		1.5-2.4
	Line Facility	Western Union Type 4002 Data Channel or equivalent	Western Union Type 4002 Data Channel or Broadband Exchange Service	48 KHz wideband channel (low scan rate) or Telpack C facility (high scan rate)		Public telephone network via Xerox Telecoupler II telephone data set
ERROR CONTROL		No provision	No provision	No provision		No provision
PURCHASE PRICE, $		—	—	—		2500-3000
MONTHLY RENTAL, $		60 (transmitter) 80 (recorder)	125	550 (scanner); 650 (printer)		65-80
COMMENTS		Document length restricted only by receiver paper supply; available for lease only	Document length restricted only by receiver paper supply; available for lease only	Picture signal digitized for transmission at 50,000 bps (lower scan rate) or 250,000 bps (higher scan rate); LDX Scanner/Printer can be used over 48-KHz wideband channel via Bell System Data Set 303C or over Telpak C Facility via Bell System Data Set 303D; document length restricted only by paper supply at receiver		Xerox Telecoupler II telephone coupler data set compatible with Bell System Data-Phone Data Set 602C; document length restricted only by paper supply at receiver; capable of attended operation; scanner/recorder integrated into single transceiver

IDENTITY		Graphic Transmission Systems Bandcom-1000 Business Facsimile System	Alden 2 Signature Verification Facsimile System	Alden 18 Alspeed Alpurfax Facsimile System	Dacom D111 One Minute Facsimile System	Graphic Sciences dex V Graphic Transceiver
REPORT NUMBER		—	9030	9033	—	—
FUNCTION		High-speed transmission/reception of graphic data over voiceband line	Transmission/reception of graphic data over broadband facility; restricted to handling narrow copy	Transmission/reception of graphic data over voice-/broadband facility	Transmission/reception of graphic data over public telephone network/private voiceband line	Transmission/reception of graphic data over public telephone network via Data Access Arrangement (DAA)
INPUT	Document Size, in.	Up to 8.5 wide; see Comments	Up to 7 wide; see Comments	Up to 60 wide; see Comments	Up to 8.5 wide; see comments	Up to 9 x 14
	Type of Scanner	Flatbed	Flatbed	Flatbed	Flatbed	Drum
	Scanning Technique	Rotating single-turn helical aperture in respect to fixed aperture	Rotating single-turn helical aperture in respect to fixed aperture	Rotating single-turn helical aperture in respect to fixed aperture	Individually rotating multi-turn/single-turn helical apertures	Photocell, light source/lens arrangement laterally scan document fixed to rotating drum
	Vertical Resolution, lines/in.	96	100	48/96	80 (D111A); 96 (D111B)	176
	Scanning Rate, lines/min	450	3,600	120, 240, 480, 960	900 max; 700 nominal	112.5
	Line Length , in.	8.5	2.250	18.125	8.3	9
OUTPUT	Copy Size, in.	8.5 wide by up to 360 ft long	2.687 by up to 150 ft	19 by up to 170 ft	8.5 by up to 400 ft	8.5 x 11/9 x 14
	Type of Recorder	Electrostatic (xerographic)	Electrolytic	Electrolytic	Electrolytic	Electrothermal
	Recording Technique	3 recording styli on continuous belt scan electrostatic paper to produce image fused by heat	Rotating raised-wire helix in respect to fixed printing blade	Rotating raised-wire helix in respect to fixed printing blade	Rotating raised-wire helix in respect to fixed printing blade	Recording stylus moves laterally across recording paper fixed to rotating drum
	Vertical Resolution, lines/in.	96	100	48/96	80 (D111A); 96 (D111B)	176
	Recording Rate, lines/min	450	3,600	120, 240, 480, 960	900 max; 550 nominal	112.5
	Line Length, in.	8.5	2.250	18.125	8.3	9
DATA TRANSMISSION	Data Rate, lines/min	450	3,600	120, 240, 480, 960	900 max; 700 nominal	112.5
	Modulation Technique	Frequency modulation	Double sideband amplitude modulation	Double sideband amplitude modulation	Frequency shift keying	Vestigial sideband amplitude modulation
	Modulation Frequencies, kHz	1.7-2.1	0-7.5	0-14.0	1.2/2.4 (1200 bps); 1.2/1.8/2.4 (2400 bps)	0-2.0
	Line Facility	Public switched network, Bell System Type 3002 or 4002 Data Channel	15.5 kHz broadband facility	Telpak 5702 (A2)/5703 (A3) service; 3kHz voiceband unconditioned line	Public telephone network, voiceband leased line; equivalent voicegrade radio channel	Public telephone network via hardwire DAA
ERROR CONTROL		No provision	No provision	No provision	No provision	No provision
PURCHASE PRICE, $		2,550 (transmitter or receiver)	5,000 (transmitter); 3,000 (receiver)	8,000 (transmitter); 9,500 (receiver)	9,195 (transmitter); 8,725 (receiver)	3,900
MONTHLY RENTAL, $		90 (transmitter or receiver)	—	390 (transmitter); 464 (receiver)	225 (transmitter); 225 (receiver)	—
COMMENTS		Can transmit and record copy of std 8.5 x 11-in. document in 2.33 min; bandwidth compression techniques (self-contained circuitry) provide high-speed transmission of concentrated data to reduce recording time, line costs; automatic control signals transmitted behind data on each scanner backstroke to keep receiver in sync; capable of manual (DAA) or automatic (602C) operation; document length restricted only by receiver paper supply	Transmitter can selectively scan any 2.25-in. portion of 7-in. wide document; document length restricted only by receiver paper supply	Manually selectable scanning rates; transmitter can selectively scan any 18-in. portion of 60-in. wide document; document length restricted only by receiver paper supply	Document length restricted only by receiver paper supply; can operate over radio/TTY facilities at reduced speeds; price includes opt Bell System 201 Data Set; cassette tape recorder enables recording/playback of approx 100 8.5x11-in. documents; avg transmission per 8.5x11-in. copy in 1 min (D111A)/1.5 min (D111B); includes digital bandwidth compression; scanning/recording, transmission rates vary with page content; FSK via duobinary coding	Includes DAA interface; operation must be attended; adjustable margin indices enable selective scanning to reduce transmission time; concurrent halt of transmit/receive units; records 8.5 x 11-in. document in approx 17 min

IDENTITY		International Scanatron Systems Document Facsimile System Model 391/392-ID	International Scanatron Systems Document Facsimile System Model 391/392-2D	International Scanatron Systems Document Facsimile System Model 391/392-3D	International Scanatron Systems Document Facsimile System Model 391/392-4D	International Scanatron Systems Document Facsimile System Model 391/392-5D
REPORT NUMBER		—	—	—	—	—
FUNCTION		Transmission/reception of graphic data over public telephone network via Data Access Arrangement (DAA)	Transmission/reception of graphic data over public telephone network via Data Access Arrangement (DAA)	Transmission/reception of graphic data over public telephone network via Data Access Arrangement (DAA)	Transmission/reception of graphic data over voiceband line	Transmission/reception of graphic data over voiceband line
INPUT	**Document Size, in.**	Up to 9.125 wide; see Comments	Up to 9.125 wide; see Comments	Up to 9.125 wide; see Comments	Up to 9.125 wide; see Comments	Up to 9.125 wide; see Comments
	Type of Scanner	Flatbed	Flatbed	Flatbed	Flatbed	Flatbed
	Scanning Technique	Multiple rotating optical heads	Multiple rotating optical heads	Multiple rotating optical heads	Multiple rotating optical heads	Multiple rotating optical heads
	Vertical Resolution, lines/in.	100	100	100	100	100
	Scanning Rate, lines/min	240/120	360/180	480/240	600/300	960/480
	Line Length , in.	8.5	8.5	8.5	8.5	8.5
OUTPUT	**Copy Size, in.**	9.125 up to 400 ft	9.125 up to 400 ft	9.125 up to 400 ft	9.125 up to 400 ft	9.125 up to 400 ft
	Type of Recorder	Electrolytic	Electrolytic	Electrolytic	Electrolytic	Electrolytic
	Recording Technique	Rotating raised wire helix in respect to fixed electrode printing blade	Rotating raised wire helix in respect to fixed electrode printing blade	Rotating raised wire helix in respect to fixed electrode printing blade	Rotating raised wire helix in respect to fixed electrode printing blade	Rotating raised wire helix in respect to fixed electrode printing blade
	Vertical Resolution, lines/in.	100	100	100	100	100
	Recording Rate, lines/min	240/120	360/180	480/240	600/300	960/480
	Line Length, in.	8.5	8.5	8.5	8.5	8.5
DATA TRANSMISSION	**Data Rate, lines/min**	240/120	360/180	480/240	600/300	960/480
	Modulation Technique	AM/AM-VSB/FSK; see Comments	AM/AM-VSB/FSK; see Comments	AM/AM-VSB/FSK; see Comments	AM/AM-VSB/FSK; see Comments	AM/AM-VSB/FSK; see Comments
	Modulation Frequencies, kHz	—	—	—	—	—
	Line Facility	Public telephone network via DAA	Public telephone network via DAA	Public telephone network via DAA	Bell System Type 4002 Data Channel	Bell System Type 4002 C2/C4 Telephoto Channel
ERROR CONTROL		No provision	No provision	No provision	No provision	No provision
PURCHASE PRICE, $ / **MONTHLY RENTAL, $**		2,800 per pair (OEM only; quantities of 300 pairs or more)	2,800 per pair (OEM only; quantities of 300 pairs or more)	2,800 per pair (OEM only; quantities of 300 pairs or more)	2,800 per pair (OEM only; quantities of 300 pairs or more)	2,800 per pair (OEM only; quantities of 300 pairs or more)
COMMENTS		Frequency standard provided; bandwidth compression, automatic speed recognition included in each unit; other indices/speeds available; document length restricted only by receiver paper supply; modulation technique dependent upon facility selected	Frequency standard provided; bandwidth compression, automatic speed recognition included in each unit; other indices/speeds available; document length restricted only by receiver paper supply; modulation technique dependent upon facility selected	Frequency standard provided; bandwidth compression, automatic speed recognition included in each unit; other indices/speeds available; document length restricted only by receiver paper supply; modulation technique dependent upon facility selected	Frequency standard provided; bandwidth compression, automatic speed recognition included in each unit; other indices/speeds available; document length restricted only by receiver paper supply; modulation technique dependent upon facility selected	Frequency standard provided; bandwidth compression, automatic speed recognition included in each unit; other indices/speeds available; document length restricted only by receiver paper supply; modulation technique dependent upon facility selected

COMMUNICATIONS TERMINAL EQUIPMENT

AUERBACH
DATA
COMMUNICATIONS
REPORTS

USERS' GUIDE TO COMMUNICATIONS TERMINAL EQUIPMENT REPORTS

.1 GENERAL

The types of data communications equipment that are described in the detailed reports on Communications Terminal Equipment include:

(1) Equipment that serves as an interface between human operators and a communications line. Examples of this type of equipment include:

- Devices for inputting data to a communications line either by manual keying or by reading data recorded on punched tape, punched cards, or magnetic tape and transmitting this data over a communications line;
- Devices for receiving data from a communications line and outputting it via printed copy, punched tape, punched cards, or magnetic tape;
- Devices having both input and output capabilities as defined above.

(2) Equipment that allows connection of a general-purpose computer to a single communications line, usually for the purpose of exchanging large amounts of data between two computer systems via a communications link.

(3) Small general-purpose computer systems with the capability for connection to a single communications line. This type of equipment can function as a multipurpose remote communications terminal for a larger computer system.

.11 Identity

The formal name and model number(s) of the subject equipment are stated, as well as any acronym or nickname by which it is commonly known. Where several versions or models of a device have similar characteristics, they are described in a single report, with the differences noted.

.12 Manufacturer

The corporate name, division, and full mailing address are stated.

.13 Basic Function

A brief statement of the general purpose and characteristics of the subject equipment is presented, usually including the types of transmission facilities to which the equipment can be connected and the types of input and output it can utilize.

.14 Basic Components

If the subject equipment is composed of a number of separate components (some of which may be optional), a list is presented which states the name, model number, and function of each of the major components or features.

.15 Description

These paragraphs provide a concise "word picture" of the functions, characteristics, and applications of the subject equipment. A summary is presented of the components, input-output media, configurations, speeds, usable communications facilities, operating procedures,

.15 Description (Contd.)

optional features, and costs. Strong points and drawbacks relative to competitive equipment are emphasized.

.16 First Delivery

The date of the first successful customer installation of the subject device is stated.

.17 Availability

The current time lag between placement of an order and delivery of the equipment is stated. Occasionally equipment will be covered which is no longer being manufactured but which is still being marketed on an "as available" basis. The availability of such equipment usually depends upon the rate of returns to the manufacturer.

.2 CONFIGURATION

The configuration rules for a remote terminal utilizing the subject equipment are described. Labeled diagrams are used wherever they help to clarify the presentation. The maximum and minimum number of each component and its rated speeds are indicated. Data sets, when required for connection to communications lines, are also indicated. Where the configuration possibilities are complex, one or more representative configurations are shown. Because a given terminal device can usually communicate with a wide variety of remote units, no attempt is made to show the terminals at the other end of the communications links.

3. INPUT

An important factor in determining the success of a data communications installation is the speed, convenience, and flexibility of data entry. Input data can be broadly classified as either "prepared" or "manually entered." Prepared data is defined as data read from previously-prepared punched paper tape, punched cards, or other semi-permanent, machine-readable data storage media. Manually-entered data is data entered manually by the operator at transmission time, usually by means of a keyboard, but occasionally by dial, switch, or lever settings.

.31 Prepared Input

Each component, if any, that can accept previously-prepared input data is identified. The type and size of the input medium, the input code, and the character set (when applicable) are indicated. The quantity of data that can be entered in each message or transaction is specified. Sometimes, for devices such as paper tape or magnetic tape readers, there is no practical limit on the quantity of data that can be entered. In other equipment, the quantity of data may be limited by the capacity of a buffer.

The peak speed of the input unit, without regard to any restrictions imposed by the communications facilities or the receiving terminal, is indicated as the "rated input speed." The "effective speed" is the average rate at which data can be transmitted over a long period of time; it may depend upon the grade of the communications line, the start and stop times of the input unit, the amount of data transmitted per message, and the presence or absence of redundancy checking data and control codes.

Any unusual or particularly useful features of each input unit are noted.

.32 Manual Input

The provisions for entering variable data at transmission time are identified. The method of entry will usually be either a keyboard or a set of dials, switches, slides, or levers. Human engineering aspects are particularly important here, and any significantly good or bad features that tend to affect the convenience, speed, and accuracy of manual input are emphasized. The quantity of manual data that can be entered for a single message and the available character set are stated. While some devices can accept only numeric manual input data, the ability to enter alphanumeric data manually is vital in many applications.

(Contd.)

After the manual data has been entered, it is important to note whether the settings are visible to the user so that he can verify that the data has been entered correctly — preferably before the message is transmitted. Typewriter-like input devices usually produce a printed record of the input data at the same time as it is being typed and transmitted. Keyboard input units that produce no permanent record of the transmitted data can lead to obvious problems in accuracy control. In systems that employ dials, levers, or slides for manual input, the settings will generally be visible, though it may not be easy to read them quickly and reliably. Input units that incorporate a direct display of the data about to be transmitted are desirable if accuracy of input is critical.

.33 Fixed Input

In some applications, certain semi-permanent data will be a part of all or most messages from a given input station. The quantity and method of inserting this type of data are noted.

.34 Transaction Code Input

A transaction code can be utilized to specify the nature and, in some cases, the message format of each message. This type of data can be entered in the same manner as other variable data, but in some systems special provisions are included for inserting a transaction code into each message. Usually such codes are unique code symbols or combinations of symbols, or else they are located in a specific place in the message format (e.g., the first two characters of each message). If the subject equipment includes specific provisions for transaction code input, the method and the number of available transaction codes are specified.

.35 Message Configuration

The range and flexibility of message configurations is of great importance in data communications systems. The maximum and minimum amounts of each type of input data that can be accommodated are specified. Any required control codes, such as start of message, station identification, and end of message, are specified. The manner in which the control codes are generated is also stated; frequently, these codes are generated automatically by the input unit.

.36 Operating Procedure

The steps involved in a normal transmission are listed to permit comparisons of relative operating convenience and speed. The usual steps to be performed (either manually by the operator or automatically by the hardware) include: verifying that the system is ready, entering all prepared and manual data, actuating the data transmission, verifying that no detectable error has occurred, and retransmitting if necessary.

.37 Entry of Time and Date

The time of day and/or the day of the week or month form an important part of the record of each transmission in certain data communications applications. Any special provisions to supply this information automatically are noted.

.4 OUTPUT

The types and speeds of data output are also important factors in every data communications installation. The most common media for data output are punched paper tape, punched cards, magnetic tape, and printed copy. Another type of output that is coming into more frequent use is visual output via a cathode-ray-tube display device. Sometimes a single terminal device can have a combination of two or more of these output capabilities.

Separate entries are presented for each output component, and the components are grouped by type of output; e.g., output to punched tape, punched cards, magnetic tape, printer, etc. For each component, the type and size of the output medium and the output code are indicated. The peak speed of the output unit, without regard to any restrictions imposed by the communications facilities, is indicated as the "rated output speed." The "effective speed" is the

.4 OUTPUT (Contd.)

average rate at which data can be transmitted over a long period of time; it may depend upon the grade of the communications line, the start and stop times of the output unit, the amount of data received per message, and the presence or absence of redundancy checking data and control codes.

Any special provisions for controlling the format of the output, such as plugboard wiring or special control codes in the received data, are indicated.

Any unusual or particularly useful features of each output unit are noted.

.5 ERROR DETECTION AND CORRECTION

The primary purpose of a data communications system is to transmit useful information from one location to another. To be useful, the received copy of the transmitted data must constitute an accurate representation of the original input data, within the accuracy limits dictated by the application requirements and the necessary economic tradeoffs.

A general discussion of error control from a systems standpoint is presented on page 2300:01, in the System Design section. The specific facilities for error detection and correction provided by the subject terminal equipment are described in Paragraph .5 of the appropriate Communications Terminal Equipment Report.

Errors in the received messages which form the output from a data communications system can result from:

- Operator errors in preparing the input or in operating the transmitting terminal.
- Malfunctioning of the communications lines, due either to random pulses interfering with data transmission or to a more permanent condition, such as complete failure of the line.
- Malfunctioning of the receiving terminal equipment in preparing the output copy.

The types of checking, the methods of indicating errors, and the procedures for correcting or overcoming errors are the principal topics to be considered in describing the error control facilities of data communications equipment.

There are two commonly-used methods for automatic checking of data: validity and redundancy. A validity check ascertains whether each data code is one of a number of permitted bit configurations; this checking is usually performed on a character basis, and any code configuration which does not represent a legitimate member of the character set is considered an error. In redundancy checking, one or more additional bits are added to each data configuration in accordance with a specific formulation rule. Checking is accomplished by testing the additional bits to see whether they still conform to the formulation rule.

The most common form of redundancy checking is parity checking, in which the total number of "1" bits in a data configuration of some arbitrary length is required to be either even or odd. One additional bit per data configuration is added; the added bit will be either a "1" or "0" bit — whichever is required to satisfy the parity formulation rule. Parity checking can be performed on a character basis, on a message basis, or both. Message (longitudinal) parity checking involves accumulating a parity count for each code level and appending a single "check character" at the end of the message; each bit of the check character will be a "1" or "0" bit, as required to establish the proper message parity for the corresponding code level.

Detected errors are commonly indicated by lights, audible alarms (buzzers), machine halts, presence or absence of special characters in transmitted or output data, or by combinations of these indications.

(Contd.)

Error correction procedures may be fully automatic, or they may require extensive manual intervention by the operator(s). The most common method of error correction is retransmission of either the complete message or individual segments of it until the entire message has been received with no detected errors.

Paragraph 2300.4 of the System Design section contains a discussion of the value of various error detection and correction methods.

In the Communications Terminal Equipment Reports, the types of checking, methods of error indication, and corrective procedures (manual and/or automatic) are listed for each major potential source of errors.

.51 Data Entry Errors

The facilities for error control in the data entered at the transmitting terminal are described. These can include provisions for ensuring that the correct amount of data is entered from the correct type of input medium in the proper manner. Corrective procedures usually require that the input message be reread (or rekeyed) a specified number of times, or that the input medium be manually corrected.

.52 Data Transmission Errors

The facilities provided for checking the accuracy of data transmitted to and from the subject equipment are stated. The corrective procedure is usually retransmission of part or all of the message. Retransmission may need to be manually initiated by the operator at the transmitting station in response to a request from the receiving station operator, or it may occur automatically in response to a signal from the receiving station.

.53 Data Recording Errors

The facilities provided for checking the accuracy with which the received data is recorded on an output medium are stated. The most effective check upon recording accuracy is to read back the data immediately after recording it and compare the recorded information with the contents of the output buffer, if any; unfortunately, such "read-after-write" checks are expensive to implement and are relatively rare in current data communications equipment. It should be noted that many of the output devices in widespread use in data communications provide no check upon recording accuracy (as distinguished from data transmission accuracy).

Correction of detected recording errors can be accomplished by rerecording the output message from the receiving station's buffer (provided that there is a buffer and that the incorrectly recorded message has been retained in it) or by retransmitting the message from the transmitting terminal.

.54 Other Errors

Any facilities provided by the subject equipment for detecting and correcting types of errors other than those occurring during data entry, data transmission, or data recording are stated. These additional checking provisions might include facilities for testing various components to ensure that they are functioning properly.

.55 Line Malfunctions

The facilities for detecting a long-term line malfunction, such as an open circuit, are stated, along with the resulting indication or automatic action.

.6 CONDITION INDICATORS

The facilities provided in each system component to indicate to the operator various conditions, both normal and abnormal, are described. Conditions are usually indicated by lamps, visible switch settings, audible alarms (buzzers), or by a combination of these means. The operator should receive a clear indication that the components are ready (or

.6 CONDITION INDICATORS (Contd.)

not ready) to transmit or receive data, or that some difficulty has occurred (e.g., the station is not ready, or an error has been detected). In simple systems having one input or output device at each end of the communications line, the operator can merely note whether or not the device is operating (reading or punching tape, perhaps).

.7 DATA TRANSMISSION

There are many factors to consider when selecting an item of data communications equipment. Paramount among these are the basic transmission and control characteristics, which determine the communications facilities required, the speed of transmission, the flexibility of operation, and the degree of compatibility with other data communications equipment.

.71 Basic Characteristics

The important transmission characteristics include the transmission speed, transmission method, transmission code, transmission mode, the order in which the bits forming each character or word are transmitted (when transmission is serial), and the synchronization technique.

The rated transmission speed is often dependent upon the type of communications line used; the rated speed is stated for each standard type of communications line or facility with which the subject equipment is known to be compatible.

The current techniques of data transmission employ relatively few line signals (normally two). In two-level (binary) transmission, each signal is referred to as a "bit", and its two possible states are commonly called "0" and "1".

In digital data communications, specific bit patterns are assigned particular meanings. The group of bit configuration patterns which defines all of the transmitted characters in a particular character set is termed a transmission code. The transmission code used by the subject terminal device is usually shown by means of a code table.

Some data communications devices are relatively insensitive to the transmission codes used because they simply "pass along" the data in the form in which they receive it; but the particular transmission codes used can be of great importance when considering devices that:

- Perform some kind of checking on the received data,
- Generate checking information which is appended to the transmitted data,
- Convert the input code to another code for transmission,
- Alter the received code for recording the data, or
- Record the received data directly in printed form.

Data can be transmitted in one of three basic transmission modes: simplex, half-duplex or full-duplex. In simplex transmission, data can be transmitted in one direction only. Simplex transmission is a function of the terminal equipment, as all standard communications lines permit bidirectional transmission. Half-duplex transmission permits a device to transmit or receive data, but not both at the same time. A short delay is usually required to condition half-duplex equipment for transmission in the opposite directions; this time is referred to as "turnaround time." Full-duplex transmission allows data to be simultaneously transmitted in both directions by means of two independent data paths. The cost of full-duplex line facilities is usually only slightly higher (10 to 25 percent) than that of half-duplex facilities.

(Contd.)

The order of bit transmission (i.e., the sequence in which the data signals, or bits, are transmitted) is of importance for much the same reason as the transmission code: devices that interpret the data signals to control specific functions expect the signals to be in a certain code and transmission sequence. If these format requirements are not observed, the equipment will probably interpret the signals incorrectly.

Because the data signals are also time-dependent (i.e., the bits are transmitted at precise time intervals), some means must be provided to ensure synchronization between the transmitting and receiving stations. Two commonly-employed techniques are referred to as "start/stop synchronization" and "synchronous transmission."

In the start/stop technique, extra signals are transmitted with each character of data to identify the beginning and the end of the character. The data bits within each character are transmitted in a strict time sequence, but characters are transmitted asynchronously; i.e., there is no definite time relationship between the transmission of successive characters. The advantages of this method are that it allows data transmission from sources with highly irregular data input rates (such as a manual keyboard), and that the probability of cumulative errors in synchronization is minimized. The disadvantages of start/stop synchronization is that it increases the required line capacity due to the extra start and stop bits that need to be transmitted along with the data bits.

In the synchronous transmission technique, a specific character is transmitted to the receiving terminal, which interprets the character and adjusts its synchronizing circuitry to conform with the transmitted bit rate. Usually the synchronizing character must be transmitted several times to enable the transmitting and receiving stations to establish synchronization. During the transmission of data signals, the receiving terminal is kept in step with the transmitter by a high-precision oscillating circuit or other means. Often the synchronizing character is transmitted during idle periods to maintain synchronization and minimize the delay involved in initiating a transmission. The advantage of this type of synchronization is that it permits higher data transmission rates than the start/stop method; the disadvantage is that it requires highly precise and relatively expensive circuitry to maintain synchronization throughout the transmission of long messages. The synchronous method is sometimes referred to as "bit stream synchronization."

In each Communications Terminal Equipment report, the transmission method, possible transmission modes, and synchronization technique are stated. The transmission code and order of bit transmission are clearly defined; where possible, a standard transmission code is referenced and a code table that shows the transmitted bit pattern for each character is included.

.72 Connection to Communications Lines

Each standard communications facility with which the subject terminal equipment is known to be compatible is listed, along with the common-carrier data set required, if any. For some services and in some localities, data sets of non-common-carrier manufacture are permitted. The applicable regulations vary among local common carriers, so the local common-carrier communications consultant should be contacted for information as to the equipment permitted.

.73 Transmission Control

The technique for establishing a communications connection originating with the subject device is stated. The methods used for call initiation can range from manual dialing or signaling that requires operator attention to automatic calling initiated by one of the hardware comments.

Next, the manner of answering calls originated by remote stations is stated. The method of call reception may be manual, requiring operator attention, or automatic, in which case the terminal equipment will usually be capable of unattended operation.

The number and type of functional operations of the subject device that can be controlled by a remote station are stated, along with the method used to initiate these operations. Functional operations can include line spacing (line feed), tabulating, feeding blank tape, ringing a bell,

.73 Transmission Control (Contd.)

or selecting which component in a complex terminal is to transmit or receive. The usual method of initiating such operations is to transmit special, unique code characters or combinations of characters.

.74 Multistation Operation

When the volume of data communications traffic among several points does not warrant the use of individual communications circuits interconnecting each pair of points, it may be desirable to operate more than two stations over the same line. In this type of "party line" situation, some control measures are desirable to coordinate the individual transmissions and to prevent messages from becoming garbled as a result of two stations attempting to transmit simultaneously. Two general techniques are available: polling and addressing.

Polling is a technique in which one central station periodically invites each of the other stations sharing the line to use the line to transmit the messages, if any, that are awaiting transmission there. Many refinements of this basic technique are possible, including the capability to adjust the polling rate or sequence to balance the traffic on the line.

Addressing, which is sometimes called "selective calling," is a method that permits transmission between selected stations in the network; stations not specifically addressed do not produce a copy of the transmitted message. The provisions included in the subject device for multistation operations are stated. This type of operation usually requires some means of interpreting unique characters or combinations of characters used as control codes.

.8 PHYSICAL SPECIFICATIONS

The physical characteristics of each component are summarized in a table that facilitates estimates of the site requirements for installation of the subject equipment. The overall dimensions in inches and the weight in pounds are stated. The electrical requirements, including power consumption, are also stated for each component. In addition, the recommended operating temperature and humidity ranges and the amount of heat generated by each component are stated to allow the air conditioning requirements to be determined.

.9 PRICE DATA

The prime-shift monthly rental, purchase price, and monthly maintenance charge on purchased equipment are listed for each component and each optional feature. Unless otherwise noted, monthly rental charges generally include normal maintenance. Any other significant information about pricing or contract terms, such as extra-shift or around-the-clock rental and maintenance rates, is summarized where available.

AT & T TOUCH—TONE TELEPHONE HANDSET

.1 GENERAL

.11	Identity:	Touch-Tone* Series 1500, Princess*, Call Director*, or Trimline* telephone handsets. Touch-Tone Auxiliary Dial (for use with rotary-dial telephones) Touch-Tone Card Dialer Touch-Tone Auxiliary Card Dialer (for use with rotary-dial telephones)
.12	Manufacturer	
	Manufactured by:	Western Electric Company 222 Broadway New York, New York 10038
	Distributed by:	Bell System operating companies and some independent telephone companies
.13	Basic Function:	provides a subscriber with access to the public telephone network for placing a voice or data call, and permits input of digital data

.15 Description

The Bell System pushbutton telephone handsets can be effectively used as simple data input devices in a data communications system. Touch-Tone is the Bell System trademark for these units. Not all areas served by the Bell System are equipped with central exchanges that permit the use of pushbutton dialing. In areas where pushbutton dialing is not offered, rotary-dial telephone handsets can be equipped to transmit digital data in the same manner as the Touch-Tone handsets, by the installation of an auxiliary Touch-Tone dialer or pad; the connection must be established by means of the rotary dial.

Some independent telephone companies offer a similar service under a different name. For example, the operating companies of the General Telephone and Electronics system will offer the service as Touch-Calling when the necessary central exchanges are installed; they currently offer an integrated handset having a rotary dial for establishing a call and a pushbutton arrangement for data input. Only the Bell System Touch-Tone devices are discussed in this report.

Use of an ordinary telephone handset as an input device in a data communications system has several attractive advantages:

- Wide availability
- Simplicity and ease of use
- Low cost

The simplicity can also be a severe disadvantage in some applications; procedures and techniques required to implement more sophisticated operations become complex and cumbersome for the user, as compared to implementing the same operations with terminal equipment having greater capabilities (and higher cost).

In some applications, the ordinary rotary-dial telephone has been used as a data input device. The chief drawback is the difficulty of interpreting the signals transmitted to the remote terminal. The rotary dial is basically a circuit interrupting device, operating in much the same manner as a telegraph. Each digit is represented by a chain of pulses, and the pulse chain for each digit is of different length. Special equipment is required at the remote end to interpret the signals; this equipment is not universally available.

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* These names are registered trade marks of the Bell System.

Figure 1. 12-Button Touch-Tone Card Dialer Handset

(The markings on the two extra buttons are now
* and # instead of ☆ and ◇)

The development of the pushbutton telephone handset has made it practical to consider the telephone as a data input device. This unit generates and transmits particular frequencies or tones in response to the depressing of its buttons. Each digit is represented by a combination of two characteristic tones. The length of each tone pulse is constant, regardless of how long a button is held down. A standard handset provides 12 buttons, corresponding to the digits zero through nine, plus two special function buttons. A 10-button model is also in service.

A limited amount of data prepunched into a dial card can be transmitted at a speed of approximately 10 characters per second. The dial card is perforated so that the punches can easily be pushed out by hand and is read by the Card Dialer, which is normally used for semiautomatic dialing. After the dial card has been inserted into the dialer, it will rise until a stop punch is detected. Depressing the Start key causes the dial card to be read for transmission. Multiple stop punches permit separate data fields in the dial card. Variable data, entered by means of the pushbuttons, can be transmitted between each of the fixed data fields; blanks are not transmitted.

An integrated Touch-Tone Card Dialer handset is available (see Figure 1). A similar unit without the handpiece is available for use with a rotary-dial handset.

Figure 2 illustrates the arrangement of a 12-button set. Depression of a button results in the generation and transmission of two distinct tones, as indicated in the figure; e.g., when the button marked 1 is pushed, frequencies A and E are transmitted. The tones A through G correspond to dial card rows 1 through 7; see Figure 3. The two buttons marked * and # are present only on a 12-button handset or auxiliary dialer.

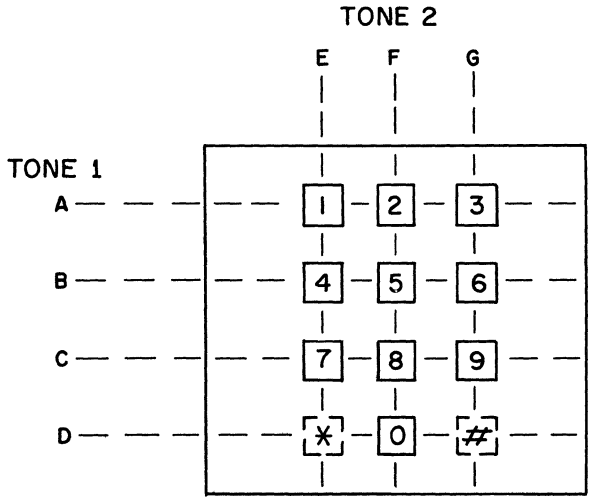


Figure 2. Touch-Tone Push Button Arrangement

The following steps represent a typical usage of the Touch-Tone handset in a data communications system:

- The local agent or representative establishes a connection with the central office, using the telephone in the normal manner.
- The local representative receives permission to transmit; the go-ahead signal can be verbal if the remote site is operating as an attended terminal or can be a distinct, audible tone if the remote site is operating as an unattended terminal.
- The local representative transmits an identification code to allow the remote site to verify that a properly authorized person has placed the call; the remote site again transmits a go-ahead signal or disconnects depending on the validity of the authorization code.
- If authorized, the local representative transmits the data; this may consist of fixed data such as account number, etc., prepunched into a dial card, plus variable data such as charge, or order quantity.
- The local representative transmits an end-of-message code.

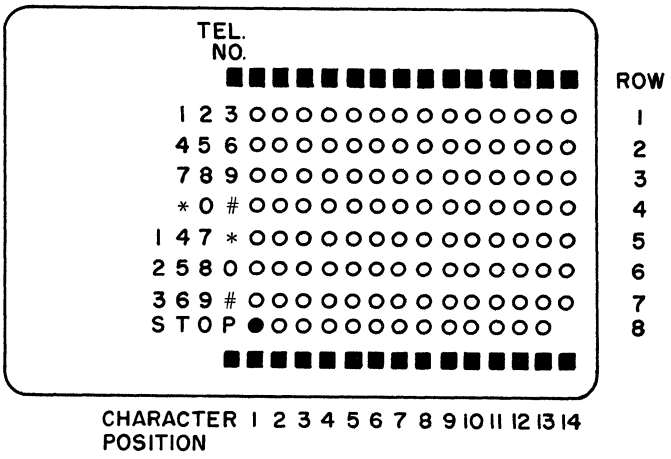


Figure 3. Dial Card

- Depending on the application and the facilities of the remote terminal, the local representative may receive a verbal reply or audible signal indicating that the message was received in the proper format.
- The transaction completed, the local representative hangs up; the remote terminal hangs up after a predetermined period of time elapses or in response to a special combination of codes transmitted before the local representative hangs up; see Table I.

The range of applications is limited only by the imagination of the user. A few of the installed or planned applications include:

- Teller operations in a bank, including entering information into checking, mortgage, and loan accounts or checking the status of accounts.
- Entering labor time and charge, material dispatching, production scheduling, or status reporting information in a manufacturing operation.
- Central processing of sales orders entered directly from the salesman's home.
- Central reply to inquiries entered from outlying business offices.
- Central billing service for doctors.

The communications consultant from the local telephone company should be contacted early in an application using Touch-Tone handsets as data input devices.

.16 First Delivery: . . . . . February 1965

.17 Availability: . . . . . 2 weeks (varies depending on demand)

.2 CONFIGURATION

A Touch-Tone calling station consists of an ordinary telephone handset; no data set is required. In areas where telephone central exchanges have been modified for Touch-Tone service, the calling station is a Touch-Tone handset or a Touch-Tone Card Dialer. The card-dialer permits automatic dialing to establish a connection and also automatic data input (see Paragraph .3). In areas where exchanges have not yet been modified for Touch-Tone service, an auxiliary Touch-Tone dialer (pad) is connected to the rotary-dial handset; an integrated pushbutton dialer (pad) and card dialer unit is available to furnish the same service as the Touch-Tone Card Dialer. The data set required at the receiving end of the telephone line is stated in Paragraph .72.

TABLE I. TOUCH-TONE DATA CODES

Character	Dial Card Rows Punched (1)	Tones Transmitted (2)
1	1, 5	A, E
2	1, 6	A, F
3	1, 7	A, G
4	2, 5	B, E
5	2, 6	B, F
6	2, 7	B, G
7	3, 5	C, E
8	3, 6	C, F
9	3, 7	C, G
*	4, 5	D, E
0	4, 6	D, F
#	4, 7	D, G
Stop (3)	8	—

Notes: (1) See Figure 3.
(2) See Figure 2.
(3) The stop code is used to stop the dial card reader at the beginning of a telephone number or data field and is not transmitted.

.3 INPUT

.31 Prepared Input

Touch-Tone Card Dialer or Auxiliary Card Dialer —

Input medium:	dial card; approximately 2.2 inches wide, 3.4 inches long, and 0.03 inch thick.
Input code:	2-of-7; see Table I.
Quantity of data:	1 or more fields totaling 1 to 14 digits.
Character set:	10 or 12 codes, depending on handset; normally these are used as the digits 0-9 and 2 control codes.
Rated input speed:	10 char/sec.
Effective speed:	varies greatly depending on application and speed with which the cards are replaced.

.32 Manual Input

Touch-Tone Handset or Auxiliary Dial (Pad) —

Method of entry:	via a 10- or 12-key keyboard.
Quantity of data:	variable.
Character set:	digits 0-9 and 2 control codes (12-button handsets only).

.33	Fixed Input:	no provision.
.34	Transaction Code Input:	no provision.
.35	Message Configuration:	from 1 to N data characters; fixed data can be interspersed with variable data.

.36 Operating Procedure

The person placing the call establishes the connection in the normal manner by dialing. With a rotary-dial handset equipped with an Auxiliary Dial (pad), the pushbutton auxiliary pad cannot be used to dial the remote terminal. Semiautomatic dialing is available through use of the card dialer or auxiliary card dialer. Data is then transmitted by inserting a dial card

in the card dialer and/or by depressing the pushbuttons in the desired sequence. The connection is normally terminated in one of two ways:

- The remote terminal responds to a certain combination of transmitted codes and signals the data set at the remote end to disconnect, or
- The remote terminal disconnects automatically if it does not receive any data for a predetermined period of time; the absence of data could be due to a long pause by the sender or to the sender's hanging up.

.4 OUTPUT

All output from the handset is in the form of verbal replies or audible tones generated at the remote end.

.5 ERROR DETECTION AND CORRECTION

There are no provisions within the telephone handset for detecting errors due to incorrect keying of input data. The nature of the transmission code (see Table I) does permit a remote terminal to verify that a valid character code was received. An important consideration when using the telephone handset for data transmission is the fact that there is no permanent record of the transmitted data (except for data entered via dial cards).

In general, many standard techniques, such as check digits, hash totals, and format checks, can be used to verify correct input and transmission. These checks are performed at the remote end; the nature and extent of the checks will depend on the capabilities of the remote terminal equipment. One technique that can be used if the remote terminal is an audio response unit is to have the remote terminal respond with a verbal repetition of the input data. The sending station can be notified of an error only by an audible signal. The Bell System Data-Phone Data Set 403, which is normally used at the remote site for reception of Touch-Tone calls, provides a three-tone answerback channel. These tones are under the control of the remote terminal and could be used to signal the sender of various conditions.

.6 CONDITION INDICATORS: . . . . . none.

.7 DATA TRANSMISSION

.71 Basic Characteristics

Rated transmission speed:	up to 10 char/sec.
Transmission method:	serial by character.
Transmission code:	2-of-7; see Table I.
Transmission mode:	half-duplex.

.72 Connection to Communications Lines

Communications Line	Data Set*
Public telephone network:	none required.
Bell System leased voiceband data channel**:	none required.

.73 Transmission Control

Call initiation:	manual or semiautomatic with card dialer.
Call reception:	manual.

.74 Multistation Operation: . . . . . the nature of the public switched telephone network permits the calling station to select, by dialing, the remote station desired.

---

* A Bell System Data Set 403A is required at the receiving end.

** AT&T states that a Touch-Tone Handset or Auxiliary Dialer (Pad) will not be provided for a leased line unless a dialing function is required in the normal operation of that line.

.8 PHYSICAL SPECIFICATIONS

Component	Touch-Tone Handset*	Touch-Tone Card Dialer	Auxiliary Touch-Tone Dialer	Auxiliary Touch-Tone Card Dialer
Width (inches)	5.38**	9.65	3.94	7.08
Depth (inches)	9.50	9.00	4.08	9.00
Height (inches)	4.91	4.38	2.67	4.38

* The basic Touch-Tone or rotary-dial handset is available in several different shapes to meet particular requirements for location or appearance; consult your local telephone company for the handsets available in your area. The data shown in this column is for the common desk-model telephone.

** 8.30 inches, including handpiece.

.9 PRICE DATA

Component or Feature	Monthly Rental, $
Basic Touch-Tone Telephone Handset	*
Touch-Tone Card Dialer	3.50*
Auxiliary Touch-Tone Dialer (Pad)	2.50*
Auxiliary Touch-Tone Card Dialer	5.00*

* The rates for a basic telephone handset vary with the geographical location and the exact service desired; contact your local telephone company for the rates in your area. The rates presented in this table are illustrative only and represent the approximate increase in the monthly rate, above the basic service, for the components indicated.

ANDERSON JACOBSON ADT 233 ACOUSTIC DATA TERMINAL

.1 GENERAL

.11 Identity: . . . . . Anderson Jacobson ADT 233 Acoustic Data Terminal

.12 Manufacturer: . . . . . Anderson Jacobson, Inc.
2235 Mora Drive
Mountain View, California 94040

.13 Basic Function: . . . . . transmits and receives data over the public telephone network via an acoustic telephone coupler

.14 Basic Components

Name: . . . . . Keyboard Send-Receive Acoustic Data Terminal
Model number: . . . . . ADT 233 KSR
Function: . . . . . transmits data from keyboard input and prints data received via an integral acoustic telephone coupler

Name: . . . . . Automatic Send-Receive Acoustic Data Terminal
Model number: . . . . . ADT 233ASR
Function: . . . . . transmits data from keyboard or punched paper tape input and prints or punches into paper tape data received via an integral acoustic telephone coupler

Name: . . . . . Acoustic Data Coupler
Model number: . . . . . ADC 260, 262, and 300
Function: . . . . . provides low-speed transmission and reception of data over the public telephone network via cable connection to a Teletype Model 33 terminal

.15 Description

The Anderson Jacobson Acoustic Data Terminal Model ADT 233 is an acoustically-coupled Teletype Model 33 designed primarily for time sharing operations over the public telephone network. The ADT 233 is available in two basic terminal configurations:

- A Keyboard Send-Receive Set (KSR)
- An Automatic Send-Receive Set (ASR)

Both ADT 233 units incorporate an Anderson Jacobson telephone coupler, which is integrated into the equipment housing designed specifically for this purpose. Facilities are also provided for operation of a Teletype Model 33 KSR or ASR unit with cable connection to an external Anderson Jacobson Acoustic Data Coupler, available in three models:

- ADC 260 — originate only
- ADC 262 — originate only
- ADC 300 — originate or answer

All telephone coupler units provide low-speed asynchronous operation over a voice-band line in the half- or full-duplex mode at 300 bits per second. Transmission characteristics of the Acoustic Data Coupler series are summarized in Table III.

Teletype Model 33 units are designed for standard-duty operation at speeds of 60, 66, or 100 words per minute using an 8-level, 11-unit USASCII code; see Table I. The Model 33 Keyboard Send-Receive Set (KSR) consists of a standard 4-row, typewriter-compatible keyboard for originating messages and a paper printer that produces a record, on continuous paper forms, of both incoming and outgoing messages. The Model 33 Automatic Send-Receive Set (ASR) combines the keyboard and printing facilities of the KSR with a paper tape reader and punch that accommodate standard 8-level, 1-inch tape. The punch has a Tape Release key to

Figure 1. Anderson Jacobson Portable Model ADT 233 Automatic Send-Receive (ASR) Acoustic Data Terminal

.15 Description (Contd.)

facilitate tape insertion and removal and a Backspace key to provide error deletion capabilities. The punch can be used on-line to produce a tape record of incoming messages, or off-line as a keyboard-actuated preparation unit.

Model 33 units can communicate with unattended remote stations by turning them on, transmitting messages to them, and then turning them off. An automatic answerback mechanism enables unattended receivers to identify themselves and notify the transmitting station that they are ready to receive messages. To transmit data to a remote computer, the operator dials the call to establish connection, positions the telephone handset in the telephone-coupler cradle, and activates the terminal. The connection is terminated by removing the handset from the cradle and hanging up in the conventional manner. Data transmissions can be initiated from the computer via special control codes. Keyboard generation of control codes is explained in Table II.

.16 First Delivery: . . . . . December 1968

.17 Availability: . . . . . from stock

.2 CONFIGURATION

The Anderson Jacobson Model ADT 233 KSR consists of:

- A page printer
- A keyboard
- An integral acoustic coupler

The Model ADT 233 ASR consists of:

- A page printer
- A keyboard
- A punched paper tape reader
- A paper tape punch
- An integral acoustic coupler

TABLE I. USASCII (UNITED STATES OF AMERICA STANDARD CODE FOR INFORMATION INTERCHANGE)

Bits 4, 3, 2, 1	Bits 7, 6, 5							
	000	001	010	011	100	101	110	111
0000	NUL	DLE	SP	0	@	P	UNUSED	
0001	SOH	DC_1	!	1	A	Q		
0010	STX	DC_2	"	2	B	R		
0011	ETX	DC_3	#	3	C	S		
0100	EOT	DC_4	$	4	D	T		
0101	ENQ	NAK	%	5	E	U		
0110	ACK	SYN	&	6	F	V		
0111	BEL	ETB	'	7	G	W		
1000	BS	CAN	(	8	H	X		
1001	HT	EM	)	9	I	Y		
1010	LF	SUB	*	:	J	Z		
1011	VT	ESC	+	;	K	[		
1100	FF	FS	,	<	L	\		¦
1101	CR	GS	-	=	M	]		}
1110	SO	RS	.	>	N	^		~
1111	SI	US	/	?	O	—		DEL

Note: The eighth bit (not shown) is transmitted as even parity.

Model 33 Teletype units with external Anderson Jacobson telephone couplers can be configured via cable connection according to one of the following combinations:

- A Model 33 KSR and a Model ADC 260, 262, or 300 Acoustic Data Coupler
- A Model 33 ASR and a Model ADC 260, 262, or 300 Acoustic Data Coupler

All KSR and ASR ADT 233 models and Teletype 33 models with external telephone couplers are available as mobile or portable units with accompanying cart attachments or carrying cases; see Paragraph .9.

.3 INPUT

.31 Prepared Input

ADT 233 Paper Tape Reader (ASR) —

Input medium:	1-inch, fully-punched, 8-level paper tape
Input code:	USASCII; see Table I.
Quantity of data:	variable
Character set:	63 characters, including upper-case alphabetics, digits 0-9, punctuation, and special symbols; see Table I.

TABLE II. USASCII CONTROL CODE IDENTIFICATION AND GENERATION (1)

Code	Identity	Generation (2)		
		S	C	L
ACK	Acknowledge		*	F
BEL	Bell		*	G
BS	Backspace		*	H
CAN	Cancel		*	X
CR	Carriage Return		*	M
DC_1	Device Control		*	Q
DC_2	Device Control		*	R
DC_3	Device Control		*	S
DC_4	Device Control (Stop)		*	T
DEL	Delete		Rub-Out	
DLE	Data Link Escape		*	P
EM	End of Medium		*	Y
ENQ	Enquiry		*	E
EOT	End of Transmission		*	D
ESC	Escape	*	*	K
ETB	End of Transmission Block		*	W
ETX	End of Text		*	C
FF	Form Feed		*	L
FS	File Separator	*	*	L
GS	Group Separator	*	*	M
HT	Horizontal Tab		*	I
LF	Line Feed		*	J
NAK	Negative Acknowledge		*	U
NUL	Null	*	*	P
RS	Record Separator	*	*	N
SI	Shift In		*	O
SO	Shift Out		*	N
SOH	Start of Heading		*	A
STX	Start of Text		*	B
SUB	Substitute		*	Z
SYN	Synchronous Idle		*	V
US	Unit Separator	*	*	O
VT	Vertical Tab		*	K

(1) These control codes are presently generated and interpreted by Model 33 and 35 Teletype equipment.

(2) Control character generation, in most cases, is performed by simultaneously depressing the Control (C) key and the appropriate letter (L) key; the Shift (S) key must be depressed in addition to the control and letter keys where specified. Separate keys are also provided for Carriage Return, Escape, and Line Feed codes.

.31 Prepared Input (Contd.)

Rated input speed: . . . . . 10 char/sec (110 bits/sec), max
Effective speed: . . . . . less than rated speed, depending on block length

.32 Manual Input

ADT 233 Keyboard (ASR and KSR) —
Method of entry: . . . . . via standard typewriter-styled, 45-key keyboard
Quantity of data: . . . . . variable

TABLE III. ACOUSTIC DATA COUPLER TRANSMISSION CHARACTERISTICS

Component / Feature	Model ADC 260	Model ADC 262	Model ADC 300
Mode	Half-duplex; full-duplex	Half-duplex; full-duplex	Half-duplex; full-duplex
Method	Serial by bit	Serial by bit	Serial by bit
Modulation	Frequency shift	Frequency shift	Frequency shift
Timing	Asynchronous	Asynchronous	Asynchronous
Code	Any code; any length	Any code; any length	Any code; any length
Operating Mode	Originate only	Originate only	Originate or answer
Speed	Up to 300 bps	Up to 300 bps	Up to 300 bps
Operating Frequency:			
Transmit (Hz)	1270 (mark); 1070 (space)	1270 (mark); 1070 (space)	2225 (mark); 2025 (space)
Receive (Hz)	2225 (mark); 2025 (space)	2225 (mark); 2025 (space)	1270 (mark); 1070 (space)
Coupling:			
Transmit	Acoustic	Acoustic	Acoustic
Receive	Acoustic	Acoustic	Acoustic
Interface	EIA RS232B; Std. Teletype	EIA RS232B; Std. Teletype	EIA RS232B
Comments	Offers manual selection of upright or inverted transmission frequencies; compatible with ADC 300 or Bell System Data-Phone Data Sets 103A1, 103A2, or 101C; Model 262 provides a second interface for both on- and off-line operation.		Operating frequencies are shown for answer mode; frequencies for originate mode are the inverse.

Note: Bell System Data Sets are described in the Comparison Chart Section 4600: Common-Carrier Data Sets.

Character set: . . . . . 96 characters: upper-case alphabetics, digits 0-9, punctuation, special characters, and control codes; see Tables I and II.

Comments: . . . . . additional keys provide special functions.

.33 Fixed Input: . . . . . no provision, except for a 20-character reply to an ENQ (WRU) inquiry; these characters are set up in the answerback mechanism and are usually used to identify the station.

.35 Message Configuration: . . . . . 1 to N characters with control characters interspersed; control characters are keyed in or contained in the paper tape input.

.36 Operating Procedure

The operating procedure can vary greatly depending on the optional control features installed and the application. See Paragraphs 3100.31, 3100.32, 3100.41, 3100.42, and 3100.43 for the manner in which Teletype units are being used in services offered by the common carriers.

.4 OUTPUT

.41 Output to Punched Tape

ADT 233 Paper Tape Punch (ASR) —

Tape size:	1-inch, fully-punched, 8-level paper tape
Tape code:	8-level USASCII; see Table I.
Rated punching speed:	10 char/sec, max
Effective speed:	less than rated speed, depending on block length
Format control:	none

.44 Output to Printer

ADT 233 Page Printer (ASR and KSR) —

Output medium:	friction-fed forms, 72 char/line, max; pin-fed forms, 72 char/line, max
Character set:	64 printable characters; upper-case alphabetics digits 0-9, punctuation, special symbols, and control codes
Rated printing speed:	10 char/sec (110 bits/sec), max
Effective speed:	less than rated speed due to operations such as carriage return/line feed
Format control:	via special control codes contained in the received data

.5 ERROR DETECTION AND CORRECTION

Even parity is generated and transmitted; no detection facilities exist except for visual verification of manual input.

.6 CONDITION INDICATORS: . . . . . various facilities, such as the Received Carrier lamp indicator, can be supplied, depending upon the application.

.7 DATA TRANSMISSION

.71 Basic Characteristics

Rated transmission speed:	up to 300 bits/sec
Transmission method:	serial by bit
Transmission code:	8-level, 11-unit USASCII including start and stop bits for each character
Transmission mode:	half-duplex or full-duplex
Order of bit transmission:	start bit followed by data bits, low-order bit first, and stop bits
Synchronization:	asynchronous; start pulse is one bit-time in length and stop pulse is two bit-times in length.

.72 Connection to Communications Lines: . . . . . see Table III.

.73 Transmission Control

Call initiation:	manual dialing
Call reception:	operator intervention
Functional operations:	carriage return, line feed, bell, horizontal tab, vertical tab, etc., are initiated by special control codes.

.74 Multistation Operation: . . . . . no provision

.8 PHYSICAL SPECIFICATIONS

Component / Characteristic	Model ADT 233 KSR	Model ADT 233 ASR	Teletype Model 33 KSR	Teletype Model 33 ASR	ADC 260, 262, 300 Couplers
Width (inches)	18.625	22.0	18.625	22	12
Depth (inches)	18.5	18.5	18.5	18.5	12
Height (inches)	32.875	32.875	32.875	32.875	5.75
Weight (pounds)	—	—	56	56	9
Power (KVA)	0.119	0.119	0.110	0.110	Supplied by Teletype unit or External Power Source
Voltage	115	115	115	115	
Frequency (Hz)	60	60	60	60	
Phase	1	1	1	1	
Temperature Range (°F)	40-120	40-120	40-120	40-120	40-120
Humidity Range (%)	0-90	0-90	0-90	0-90	0-90
Heat (BTU/hr)	430	703	409	682	10

.9 PRICE DATA

Component or Feature	Monthly (1) Rental, $	Purchase Price, $
Mobile KSR Units (2)		
ADT 233 (5)	88	1773
Teletype 33 with coupler: (6)		
ADC 260	83	1673
ADC 262	N/A	1726
ADC 300	N/A	1823
Mobile ASR Units (2)		
ADT 233 (5)	99	2085
Teletype 33 with coupler: (6)		
ADC 260	92	1985
ADC 262	N/A	2048
ADC 300	N/A	2145
Portable KSR Units (3)		
ADT 233 (5)	107	1869
Teletype 33 with coupler: (6)		
ADC 260	N/A	1769
ADC 262	N/A	1822
ADC 300	N/A	1919
Portable ASR Units (4)		
ADT 233 (5)	128	2196
Teletype 33 with coupler: (6)		
ADC 260	N/A	2095
ADC 262	N/A	2158
ADC 300	N/A	2258

.9 PRICE DATA (Contd.)

Component or Feature	Monthly[1] Rental, $	Purchase Price, $
Acoustic Data Couplers [6]		
ADC 260	25	570
ADC 262	27	598
ADC 300	31	695
Teletype Options		
X-On, X-Off (computer control of paper tape reader) and Even Parity [7]	*	98
Elasped Time Meter[7]	N/A	38
KSR Sprocket Paper Feed	14	160
ASR Sprocket Paper Feed and Automatic Control of Paper Tape Punch	14	248
Additional Answerback Drum [8]	N/A	8
Coding of Answerback Drum	N/A	14
Additional Accessories [9]		
TC-1 KSR Carrying Case (includes 4 wheels, shock mounting, and printer carriage lock)	N/A	244
TC-2 ASR Carrying Case (includes 4 wheels, shock mounting, reader guide, printer carriage lock, and built-in chad receptacle)	N/A	286
TC-3 Cart Attachment	4	79
TC-4 Shelf Rack	*	68
TC-5 Coupler Carrying Case	N/A	24
Coupler Connection Cable (8 feet)	N/A	20

(1) Other rental plans available, including purchase options and leases.

(2) Includes accessories TC-3 and TC-4.

(3) Includes accessory TC-1.

(4) Includes accessory TC-2.

(5) Contains integrated coupler.

(6) Includes coupler connection cable.

(7) Installed charge.

(8) One drum included in each terminal at no charge.

(9) Additional accessories not shown are available upon request.

N/A — Not applicable.

*Included in rental units.

BUNKER—RAMO SERIES 200 DATA DISPLAY SYSTEM

.1 GENERAL

.11 Identity: . . . . . Series 200 Data Display System:
Models 203, 204, 211, and 212 Display Stations;
Models 222 and 223 Universal Control Units.

.12 Manufacturer: . . . . . Bunker-Ramo Corporation
445 Fairfield Avenue
Stamford, Connecticut 06904

.13 Basic Function: . . . . . transmit data to a computer; display data received from a computer or entered via a keyboard; input can be from a keyboard, paper tape reader or teleprinter keyboard; output can be to a video display device, paper tape punch, or teleprinter.

.14 Basic Components

Name: . . . . . Display Station.
Model number: . . . . . 203, 204, 211, and 212.
Function: . . . . . video display of data and keyboard data entry; different models have different keyboards.

Name: . . . . . Universal Control Unit.
Model number: . . . . . 222, 223, and 224.
Function: . . . . . provides control logic, character generation, buffer storage, and display regeneration.

Name: . . . . . Communications Interface.
Model number: . . . . . 231 and 232.
Function: . . . . . provides EIA RS-232A interface to communications line; different models permit transmission using different synchronization techniques and transmission speeds.

Name: . . . . . Expansion Module.
Model number: . . . . . 241, 242, 243, and 246.
Function: . . . . . provides additional buffer storage for display and non-display units.

Name: . . . . . Control Modules.
Model number: . . . . . 253, 254, 256, 257, and 258.
Function: . . . . . provides control logic for non-display devices.

.15 Description

The Bunker-Ramo Series 200 Data Display System is designed to facilitate the rapid exchange of data between a computer and one or more remote locations under control of a stored program in the computer. A large number of cathode ray tube Display Stations and non-display devices can be connected to a Universal Control Unit, which contains the interface for the communications line. Each display or non-display device can be located up to 1,000 cable-feet away from the Control Unit. The non-display devices that can be incorporated include Teletype paper tape readers and punches, Teletype Model 33 or 35 Receive-Only Printers, and Teletype Model 33 or 35 Keyboard Send-Receive units. Bunker-Ramo will supply the Teletype equipment if desired by the customer.

Bunker-Ramo has produced a number of special designs for customers; the Series 200 system is the current standard product line. Bunker-Ramo display equipment is also known under the registered trademark Teleregister.

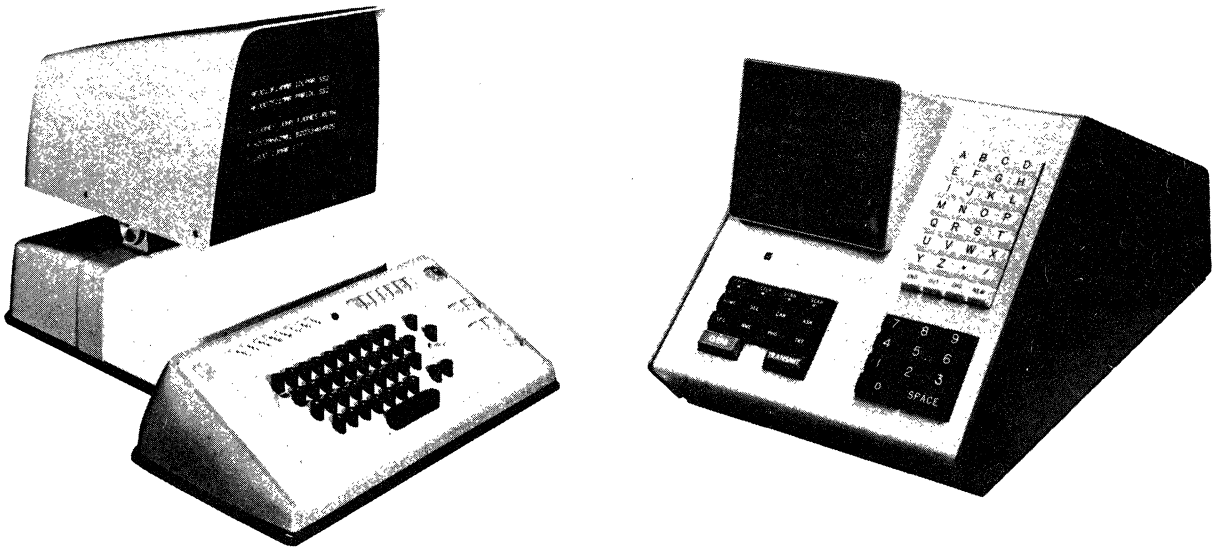


Figure 1: Bunker-Ramo Model 203 Display Station (Left)
and 212 Display Station (Right)

.15 Description (Contd.)

The Bunker-Ramo Series 200 Data Display System is also offered by Honeywell under the name Honeywell Series 200 Visual Information Projection (VIP); see Report 6384.

In a data communications environment, A Series 200 Display System can be arranged in two functionally different ways. In a non-polling arrangement only one Control Unit can be operated on one communications line, and all communications between the remote computer and the Display Stations are initiated by the Display Station operators. In a polling arrangement up to 32 Control Units can be connected to one line, and all communications are initiated by the remote computer under stored program control or by special hardware.

The Universal Control Unit is connected to a remote computer via the public telephone network or a common-carrier leased voice-band line, appropriate data sets, and the appropriate communications controller at the computer site.

The Control Unit performs a scan of associated devices periodically (non-polling) or when a request is received (polling). The connected devices are tested sequentially for a pending message; if one is found, it is transmitted to the computer. Scanning of the other units is resumed only after a computer response is received or after a predetermined period of time has elapsed.

Communications between the computer and a particular Control Unit are done in a half-duplex mode. In the polling arrangement, full-duplex communications facilities are used to permit simultaneous transmission from the computer to one Control Unit and reception from another. Communication Interface features are available for transmission at from 600 to 2,400 bits per second. The most commonly-used speeds are 1,200, 1,800, 2,000, or 2,400 bits per second.

The 7-level ASCII transmission code is employed, with an eighth bit added for character parity. Start/stop synchronization is generally employed at 1,200 or 1,800 bits per second; a total of 10 bits, including start and stop bits, are transmitted for each character. Synchronous transmission is generally used at 2,000 or 2,400 bits per second; in this case, sync characters are transmitted prior to each message, and a total of eight bits per character are transmitted.

(Contd.)

There are four models of the Display Station:

- Model 203 Display Station — provides a removable alphanumeric keyboard with mechanical key linkages and a 10-inch rectangular cathode ray display tube; see Figure 1.
- Model 204 Display Station — similar to Model 203 except that electronic switches replace the mechanical key linkages.
- Model 211 Display Station — provides an integral numeric keyboard and a 7-inch rectangular cathode ray display tube.
- Model 212 Display Station — similar to Model 211 except that it provides an alphanumeric keyboard arranged in two separate blocks containing numerics and alphabetics; see Figure 1.

Models can be intermixed on the same Universal Control Unit. The display capacity ranges from a total of 32 to 384 (Model 211 or 212) or 768 (Model 203 or 204) characters. The display size is a function of the number of devices connected to the Control Unit. A display-only device (no keyboard) is available on special request; this device (Model 217) is the display unit of the Model 203 Display Station.

Paragraph .2, Configuration, contains detailed configuration rules governing the number of display and non-display devices that can be connected to a Control Unit and the resulting display size.

Editing facilities available to a Display Station operator include movement of the cursor to the right one position at a time or repetitively, to the first position of the next line, and to the first display position. Movement of the cursor to the left is possible with the 251 Message Editing Module. Control keys are also provided to erase one character or an entire line. The cursor is non-destructive; i.e., it does not erase the character displayed in the position the cursor occupies.

A number of special function keys are provided which can be conveniently used for transaction code input. These keys generate unique code patterns, but the user can select the character or symbol to be displayed and the keytop markings.

If the Model 252 Multi-Message Transaction feature is incorporated, only the last Display Station inquiry or computer response is transmitted, but the previous inquiries and responses continue to be displayed. The operator can position the cursor and hence enter or alter data only in the last response. A special character code transmitted from the computer can enable the operator to access any portion of the displayed data. Without the Multi-Message Feature, all displayed data is transmitted each time.

The Model 261 Blink Feature permits the computer to blink selectively all data on the screen or portions of the data at a rate of once per second. Two non-displayable special characters (Start Blink and End of Blink) bracket the data to be blinked.

The Model 262 Tab Control Module allows the operator to tab to a predetermined position on the screen. The tab positions are identified by special, displayable characters included in the message. The Model 251 Message Editing Module is a prerequisite for the Model 262 Tab Control Module.

Character and longitudinal parity checking are performed on all data received by a Control Unit from the remote computer; character parity bits and longitudinal check characters are generated and transferred with all data transmitted from the Control Unit. A "T" (Transmit mode) or an "E" (Error condition) is displayed in the last displayable position to indicate the status of a Display Station. The detection of an error by the remote computer is indicated by failure of the Control Unit to receive a response within a predetermined period of time. Retransmissions must be initiated manually, but the data need not be rekeyed. For non-display devices, positive and negative acknowledgment messages are used to indicate successful or unsuccessful transmission; the control unit can automatically retransmit a message in response to a negative acknowledgment.

The Bunker-Ramo Series 200 Data Display System can also be connected directly to a variety of computer systems via special interfaces. Interfaces are available for direct connection to IBM 1400, 7000 Series, and System/360 computers. Other interfaces are available on special request. The data transfer rate when connected directly can be up to 41,600 characters per second. The remainder of this report discusses the Series 200 Display System as used in a data communications environment unless otherwise specified.

.16 First Delivery: . . . . . April 1965.

.17 Availability: . . . . . 4 months.

.2 CONFIGURATION

In a data communications environment, Bunker-Ramo Series 200 Data Display Systems can be arranged in two functionally different ways. In a non-polling arrangement, all communications between the computer and the Display Stations are initiated by the Display Station operators. In a polling arrangement, all communications are initiated by the computer under control of the program stored in the computer or special hardware devices.

A non-polling arrangement consists of the following components:

- One Model 222, 223, or 224 Universal Control Unit and appropriate Model 241, 242, 243, or 246 Expansion Modules as needed;
- A number of associated display and non-display devices; and
- A Model 231 or 232 Communications Interface and a data set.

A polling arrangement consists of the following components:

- Up to 32 Model 222, 223, or 224 Universal Control Units and appropriate Model 241, 242, 243, and 246 Expansion Modules as needed;
- One 255 Polling Control Feature for each Control Unit;
- A number of associated display and non-display devices for each Control Unit; and
- One Model 232 Communications Interface and corresponding data set for each Control Unit.

The devices connected to each Control Unit can be located up to 1,000 cable-feet away from the Control Unit.

The Model 231 Communications Interface permits data communications at 600 to 2400 bits per second using an asynchronous (start/stop) technique. The Model 232 Communications Interface permits data communications at 600 to 2400 bits per second using either an asynchronous (start/stop) or synchronous technique. The Model 231 can be used in non-polling networks only; the Model 232 can be used in either polling or non-polling networks. The characteristics of each Interface are specified in Table V. The standard communications facilities that can be used and the data sets required are listed in Paragraph .72.

There are four different Display Stations that can be incorporated in a Series 200 Data Display System. The characteristics of each model are described in Paragraphs .32 and .46. Each Display Station includes a keyboard for manual data entry. The Model 211 and Model 212 Display Stations contain provisions for including 12 editing control/special function keys. There are six standard and two optional editing control keys. Any of the standard editing control keys can be deleted if desired and replaced with special function keys. Care should be taken before dropping any of the standard editing functions to ensure that adequate cursor positioning control will be provided for the planned application. The Model 203 and 204 Display Stations contain provisions for 15 special function keys; editing control keys cannot be replaced by additional special function keys.

Control modules are available for connecting the following non-display devices:

- Teletype CX Paper Tape Reader,
- Teletype BRPE Paper Tape Punch,
- Teletype Model 33 or 35 Receive-Only Printer, and
- Teletype Model 33 or 35 Keyboard Send-Receive Unit.

A Control module is required for each non-display device incorporated.

The basic Model 222, 223, or 224 Universal Control Unit contains the basic control logic for all devices connected to the Control Unit and contains 768 characters of buffer storage. Four models of Expansion Modules are available, each of which also contains 768 characters of storage. The buffer storage of the basic Control Unit and the Expansion Modules can be segmented to allow the connection of multiple devices. The basic Model 222, 223, or 224 Universal Control Unit can accommodate up to 12 Display Stations (any model) and non-display

(Contd.)

devices in any combination. The Model 241 Expansion Module can accommodate up to 12 Display Stations. The Model 242 Expansion Module can accommodate up to 12 Display Stations and non-display devices. The Model 243 and 246 Expansion Modules can accommodate up to 12 non-display devices. As the number of devices connected to the basic Control Unit or to an Expansion Module increases, the display size or size of buffer storage allocation decreases accordingly. Table I shows the maximum number of devices allowed for each of the possible display capacities.

The only significant difference among the three models of the Universal Control Unit is the number of Expansion Modules that can be incorporated. The Model 222 Control Unit can accommodate up to two Model 241 and 243 Expansion Modules in any combination. Models 223 and 224 Control Units can incorporate up to eight Expansion Modules in the sequence shown in the following table:

Control Unit	Control Unit Positions				
	1 and 2	3	4 and 5	6	7 and 8
223	241 or 242	242	241 or 243*	242	241 or 243*
or	241 or 242	246*	243*	246*	243*
224	241 or 242	242	241 or 243*	246*	243*

* Non-display Expansion Modules.

There are four editing options: the 251 Message Editing Module, the 252 Multi-Message Transaction Feature, the 261 Blink Feature, and the 262 Tab Control Module. One 251 or 261 option is required in each basic Control Unit or Expansion Module whose associated Display Stations utilize this feature. Only one 252 option is required in each Control Unit to provide this feature for all Display Stations. One 262 option is required for each Control Unit and each Model 242 Expansion Module whose associated Display Stations utilize this feature. The 251 Module is a prerequisite for the 262 Module.

.3 INPUT

.31 Prepared Input

Teletype Model CX Reader —

Input medium:	punched paper tape; chad or chadless; 7/8- or 1-inch tape, as specified when ordered.
Input code:	any 5-, 6-, or 7-level code, as specified when ordered.
Quantity of data:	up to maximum size of associated buffer segment; see Paragraph .2.
Rated input speed:	100 char/sec.
Effective speed:	limited by transmission speed, turnaround time, etc.
Comments:	requires the 254 Reader Control.

.32 Manual Input

203 Display Station Keyboard —

Method of entry:	via 42-key keyboard; 15 additional special function keys provide special data codes and display symbols; 8 additional keys provide editing and functional control.
Quantity of data:	up to 768 characters per display, depending on maximum display size; see Table I.
Character set:	see Table IV.
Comments:	keyboard is separated from display unit; keyboard is modified Teletype keyboard with mechanical key linkages; see Figure 1.

TABLE I: BUNKER-RAMO SERIES 200 DISPLAY ARRANGEMENTS

Display Capacity, Characters (1)	Number of Lines per Display	Number of Characters per Line	Maximum Number of Devices per Basic Control Unit or Expansion Module (2)	Maximum Number of Devices per Control Unit (2)		
				Model 222	Model 223	Model 224
32	2	16	18	*	*	*
32	4	8	15	*	*	*
64	2	32	12	*	*	*
64	4	16	9	*	*	*
128	4	32	6	*	*	*
256	8	32	3	9	27	27
378	9	42	2	6	18	18
384	12	32	2	6	18	18
768	12	64	1	3	9	9

(1) The Model 211 or 212 Display Station cannot display 768 characters. All Display Stations connected to the same Control Unit have the same display arrangement, i.e., the same number of lines and characters per line. For non-display devices, the "display capacity" represents the buffer size.

(2) See Paragraph .2, Configuration, for the rules for combining various numbers of display and non-display devices in the same configuration.

* The maximum number of devices per Control Unit at these display capacities is not entirely a function of the overall buffer capacity; it depends, in addition, on such considerations as physical space and power available. The manufacturer should be consulted for information on individual cases.

.32 Manual Input (Contd.)

204 Display Station Keyboard —

Comments: . . . . . same as 203 Display Station Keyboard except electronic switches are used in place of the mechanical linkages.

211 Display Station Keyboard —

Method of entry: . . . . . via 15-key numeric keyboard; 14 additional keys provide special function codes and editing and functional control.

Quantity of data: . . . . . up to 384 characters per display, depending on maximum display size; see Table I.

Character set: . . . . . see Table IV.

Comments: . . . . . keyboard is integral with display unit; numeric keys are laid out in block fashion.

212 Display Station Keyboard —

Method of entry: . . . . . via 43-key keyboard; 14 additional keys provide special function codes and editing and functional control.

Quantity of data: . . . . . up to 384 characters per display, depending on maximum display size; see Table I.

Character set: . . . . . see Table IV.

Comments: . . . . . keyboard is integral with display unit; alphabetic and numeric keys are laid out in two separate blocks; see Figure 1.

Teletype Model 33 or 35 KSR Keyboard —

A Teletype Model 33 or 35 Keyboard Send-Receive Set can be connected to a Control Unit via a 257 KSR Control. Manual input can be accepted from the keyboard of one of these units in the same fashion as from a Display Station Keyboard. See Paragraph .44 for additional details.

(Contd.)

TABLE II: BUNKER-RAMO SERIES 200 USASCII DATA TRANSMISSION CODE (1)

B7 → B6 → B5 →				0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0
B4 ↓	B3 ↓	B2 ↓	B1 ↓							
0	0	0	0	NUL		SP	0	@	P	Special Function Codes (2)
0	0	0	1	SOH	DC1	!	1	A	Q	
0	0	1	0		DC2	"	2	B	R	
0	0	1	1	ETX	DC3	#	3	C	S	
0	1	0	0	EOT	DC4	$	4	D	T	
0	1	0	1	ENQ	NAK	%	5	E	U	
0	1	1	0	ACK	SYN	&	6	F	V	
0	1	1	1			'	7	G	W	
1	0	0	0			(	8	H	X	
1	0	0	1		EM	)	9	I	Y	
1	0	1	0			*	:	J	Z	
1	0	1	1			+	;	K	[	
1	1	0	0			,	<	L	\	
1	1	0	1			-	=	M	]	
1	1	1	0			.	>	N	^	
1	1	1	1			/	?	O	—	

(1) See Table IV for the displayable character set for each model.

(2) Each special function key generates a unique code pattern within this group; the displayed character is selectable, when ordered, from among a wide array of character and symbol patterns.

.33 Fixed Input: . . . . . no provision.

.34 Transaction Code Input: . . . . . with appropriate programming of the remote computer, the special function keys can be used for transaction code input; any keytop markings can be supplied for the special function keys when ordered.

.35 Message Configuration

The basic message format for all messages transmitted to or from a Series 200 Display System is as follows: SOH, AO, A1, A2, Text, ETX, LPC. The AO character is an address of a Control Unit; it is deleted for non-polling arrangements. The two characters A1 and A2 are an address of a specific display or nondisplay device. The LPC character contains the longitudinal parity checking information.

The number of data characters in the text portion of a message to or from a Display Station is the actual number of characters entered, including spaces but not blanks. When the Clear and Home keys are depressed, the buffer segment is cleared to all blanks. Movement of the cursor by use of the cursor movement keys leaves blanks in those positions skipped. A space is entered via the Space key. The size of the text portion of a message to or from a non-display device is the same as the size of the buffer segment. When the 252 Multi-Message Transaction Feature is incorporated, only the most recent inquiry or response is

.35 Message Configuration (Contd.)

transmitted. Table I shows the display size for each Display Station when multiple devices are connected to a Control Unit.

Also contained in the text portion of the message are certain control characters. Table III lists these characters and their functions.

TABLE III: BUNKER-RAMO SERIES 200 DISPLAY SYSTEM CONTROL CHARACTERS

ASCII Character	Function — When Transmitted by:	
	Control Unit	Computer
DC1	Never transmitted	Clears the display screen, causes the memory buffer associated with the addressed device to clear, and returns the entry marker to the HOME position. When transmitted to a non-display device as the only character, it initiates a pre-set timer for periodic service requests. Must always be transmitted as the first text character of an unsolicited response message.
DC2	Acts as a request for service for a non-display device.	In systems equipped with Multi-Message Transaction features, access to all areas of the display screen is made available to the operator. At this time, operation of the Transmit key causes the display station to transmit the entire content of its associated memory.
DC3	Automatically generated and transmitted after the last valid character of each line of a message.	Causes the next character received to be placed in Character Position 1 of the following line. Used for formatting display station text; should not be used for non-display devices.
DC4	Notifies the computer that a non-display device is out-of-service.	Never transmitted.
ACK	Transmitted as the first text character for each data burst, except the last, from a non-display device.	Transmitted as the only text character to a non-display device to acknowledge receipt of a message and request another data burst.
NAK	Requests repeat of last reply received by a non-display device.	Notifies non-display device that the last query received was in error and requests repeat of message. Causes last data burst to be retransmitted.
EM	Transmitted as the first text character, whenever the text is the last burst in a sequence of bursts from a non-display device.	Never transmitted.
ENQ	Never transmitted.	Requests transmission from a control unit.
EOT	Notifies the computer that the control unit polled has no message to transmit.	Never transmitted.

(Contd.)

TABLE IV: BUNKER-RAMO SERIES 200 DISPLAYABLE CHARACTER SETS (1)

	Display Station Model		
	203/204	211	212
Numeric digits	0-9	0-9	0-9
Upper-case alphabetic letters	A-Z	None	A-Z
Punctuation marks	./—	None (basic); choice of up to 4 optional	./ (basic); choice of up to 4 optional
Special Symbols	Space 15 function codes (2)	Space Up to 12 function codes (2)	Space Up to 12 function codes (2)
Displayable symbols generated by keyboard	55	27	55
Additional symbols displayable when received from computer	10	38	10
Total number of displayable symbols	65 (including space)	65 (including space)	65 (including space)

(1) See Table II for data transmission codes.

(2) Each special function key generates a unique code. The character displayed for each special function key is selectable by the user, when ordered, from among hundreds of character or symbol patterns. The number of special function keys provided with a 211 or 212 Display Station depends on the number of editing features incorporated; see Paragraph .2, Configuration.

.36 Operating Procedure

A message is composed on the display unit by positioning the cursor and keying in the data. The special function keys can be used in a variety of ways. They are, essentially, additional character keys that can display special symbols selected by the user when the equipment is ordered.

Control keys are provided to move the cursor: to the right one position at a time (Step Right), continuously to the right (Scan Right), to the first display position (Home), or to the first position of the next line (CR/LF). Step Left and Scan Left functions are provided by the optional Message Editing Feature. Character Erase and Line Erase control keys can be provided in the standard arrangement if desired. Errors detected by visual inspection can be corrected by positioning the cursor and rekeying the data.

After the message is composed, the Transmit key is depressed. The message is transmitted the next time the Control Unit scans the Display Station. When the Transmit key is depressed, the letter "T" appears in the last displayable position, and the keyboard is locked. An answering response from the remote computer is displayed on the display unit, and the keyboard is unlocked. If the transmission was not successful, an "E" will be displayed in the last displayable position and the response, if any, will not be displayed. The operator can retransmit the message without rekeying the data by depressing the Transmit key again.

.36 Operating Procedure (Contd.)

Transmission of data from non-display devices is performed in a manner similar to that for display devices. The device is prepared for operation and placed in a ready condition. The device will be serviced during the next Control Unit cycle. Transmissions to and from the non-display devices take place as a series of "bursts," each the size of the buffer segment. Each burst is acknowledged. If the Control Unit receives a negative acknowledgment in response to a segment of data from a non-display device, the contents of the buffer are automatically retransmitted. The Control Unit controls the starting and stopping of each non-display device; once such a device is placed in the ready condition, it will operate unattended.

.37 Entry of Time and Date: . . . . . no provisions.

.4 OUTPUT

.41 Output to Punched Tape

Teletype BRPE Punch —

Tape size:	5-, 6-, or 7-level; 11/16-, 7/8-, or 1-inch as specified when ordered.
Tape code:	any 5-, 6-, or 7-level code, as specified when ordered.
Rated punching speed:	110 char/sec.
Effective speed:	limited by transmission speed, turnaround time, etc.
Format control:	none.
Comments:	requires 256 Punch Control.

.44 Output to Printer

Teletype Model 33 or 35 Receive-Only (RO) or Keyboard Send-Receive (KSR) sets can be used for printed output at 10 characters per second. Each RO set requires a 253 RO Control; each KSR set requires a 257 KSR Control. Both the 253 and 257 Controls include buffering and can receive computer messages only. Displayed messages cannot be printed unless they are transmitted to the computer and retransmitted from the computer to the specific RO or KSR Control. The 258 RO Control shares the display buffer and permits printing a displayed message composed via the keyboard or received from the computer. Printing can be formatted through the use of format characters in the displayed message. The Teletype equipment is fully described in Reports 6804 and 6805. See Paragraph .2, Configuration, for the configuration rules governing the number of RO and KSR sets that can be incorporated.

.46 Output to Visual Display Device

203, 204, 211, and 212 Display Stations —

Output medium:	cathode ray tube; displays green characters on dark grey background.
Character set:	see Table IV.
Character size:	characters are formed by 5-by-7 dot matrix; character height is adjustable from 0.125 to 0.25 inches; width is 75% of height; line spacing is 0.31 to 1.0 inch, depending on size of display.
Display size:	
203 or 204 Display Station:	7.75 inches wide by 5.50 inches high on 10-inch-diagonal rectangular tube.
211 or 212 Display Station:	4.75 inches wide by 3.75 inches high on 7-inch-diagonal rectangular tube.
Characters per line:	see Table I.
Lines per display:	see Table I.
Characters per display:	see Table I.
Buffer capacity:	768 to 2304 characters (222 Control) or 768 to 6144 characters (223 Control) in modules of 768 characters.

(Contd.)

	Format control:	space codes entered via Space key occupy a character position in the buffer and are transmitted; blanks skipped over by cursor are not transmitted. Cursor can be moved right one position at a time or repetitively via Step Right and Scan Right keys; Step Left and Scan Left are optional (251 Message Editing Module); cursor can be positioned at the beginning of the next line (CR/LF key) or to the first displayable position (Home). Individual characters or lines can be erased. Multiple inquiry-response sequences can be displayed with operator access only to latest entry (optional; requires 252 Multi-Message Transaction Feature). Portions or all of displayed data can be blinked (optional; requires 261 Blink Feature). Tabbing capabilities are provided by the 262 Tab Control Feature.
	Rated output speed:	up to 42,000 char/sec when connected on-line; up to 300 char/sec over a voice-band line.
	Effective output speed:	limited by transmission speed, turnaround time, etc.
.5	ERROR DETECTION AND CORRECTION	
.51	Data Entry Errors:	no provisions for checking other than visual verification of displayed data. Errors are corrected by positioning the cursor and re-keying the data.
.52	Data Transmission Errors	
	Type of checking:	character and longitudinal parity are checked by Control Unit.
	Error indication:	failure of computer to respond within a predetermined period of time; an "E" is displayed in the lower right display position. Data containing a detected error is not displayed.
	Correction procedure:	operator depresses Transmit key to retransmit; contents of a non-display device buffer are retransmitted automatically in response to a negative acknowledgment.
.53	Data Recording Errors:	no provision for checking other than visual verification.
.55	Line Malfunctions	
	Detection:	no data is received from remote computer within a predetermined period of time.
	Action:	display an "E" in lower right display position.
.6	CONDITION INDICATORS:	a minimum of indicators are provided in a Series 200 Display System. A "T" or "E" is displayed to indicate status. Lamps on the Control Unit indicate that power is on and indicate a time-out condition.

.7 DATA TRANSMISSION

A group of Bunker-Ramo Series 200 Display Stations can be arranged for non-polling or polling operations; see Paragraphs .73 and .74. The primary difference between the two arrangements is that the Control Unit initiates all communications in the non-polling arrangement, while the remote computer initiates all communications in the polling arrangement. The Control Unit performs a scan of associated devices periodically (non-polling) or when a request is received (polling). The connected devices are tested sequentially for a pending message. If one is found, it is transmitted to the computer. Scanning of the other

.7 DATA TRANSMISSION (Contd.)

units is resumed only after a computer response is received or after a predetermined period of time has elapsed.

In the non-polling arrangement, the computer normally communicates with a particular display station or non-display device only in response to a message transmitted to the computer by that device. The computer, however, can selectively address a remote device by "tacking on" an addressed message to a normal response to an inquiry from a different device. In the polling arrangement, the computer can request transmission from all active devices connected to a Control Unit and can selectively address individual devices.

A message which is not transmitted as a response to an inquiry by a particular terminal device is called an "unsolicited response" by Bunker-Ramo. Careful planning should precede the use of unsolicited responses, because the Control Units do not indicate a busy status for the associated devices, and data can be lost or garbled should the addressed device have a message pending transmission.

.71 Basic Characteristics: . . . . . see Table V.

.72 Connection to Communications Lines

Communications Line or Service*	Data Set**
Public telephone network operating at the following speeds —	
1200 bits/sec (120 char/sec):	Bell System Data-Phone Data Set 202C.
2000 bits/sec (250 char/sec):	Bell System Data-Phone Data Set 201A.
Common-carrier leased voice-band line operating at the following speeds —	
1800 bits/sec (180 char/sec):	Bell System Data Set 202D.
2400 bits/sec (300 char/sec):	Bell System Data Set 201B or Western Union 2400 Baud Data Modem.

* Full-duplex facilities are required if Display Stations arranged for polling; see Paragraph .7. The speeds listed are the speeds commonly used for a Series 200 System.

** In some cases, equivalent data sets can be used; check with your local common-carrier communications consultant.

TABLE V: BASIC DATA TRANSMISSION CHARACTERISTICS

Characteristic	Communications Interface	
	231	232
Rated transmission speed (1)	1,200 or 1,800 bits/sec (120 or 180 char/sec), as specified when ordered.	2,000 or 2,400 bits/sec (250 or 300 char/sec)
Transmission method	Serial by bit	Serial by bit
Transmission code (1)	7-level ASCII plus parity; see Table II; a total of 10 bits, including start and stop bits, are transmitted for each character	7-level ASCII plus parity; see Table II; a total of 8 bits are transmitted for each character
Transmission mode	Half-duplex	Half-duplex; see Comments
Order of bit transmission	Low-order bit first, parity bit last	Low-order bit first, parity bit last
Synchronization (1)	Start/stop	Synchronous; Sync characters are transmitted prior to each message
Comments	Timing by internal clock	Timing is external, from data set; full-duplex communications facilities are required if Display Stations are arranged for polling (see Paragraph .7)

(1) The speeds, synchronization techniques, and code structures shown here are the ones commonly employed by the respective Communications Interfaces; see also Paragraph .2, Configuration.

(Contd.)

.73 Transmission Control

Non-Polling Arrangement —

Call initiation:	manual dialing over switched network; direct transmission over dedicated line; computer cannot initiate a call.
Call reception:	manual.
Functional operations:	carriage return/line feed can be initiated for Display Station; wide range of operations is possible with Teletype 33 and 35 RO and KSR sets (see Reports 6804 and 6805); operations are initiated by control characters contained in text portion of message; automatic retransmission of buffer contents in response to a negative acknowledgment to a non-display device message.

Polling Arrangement —

Call initiation:	only when polled by remote computer; display stations cannot initiate a call, but can request service the next time the Control Unit is polled.
Call reception:	capable of unattended operation.
Functional operations:	same as non-polling arrangement.

.74 Multistation Operation

Without optional features, only one Control Unit can be connected to a communications line. Multiple devices connected to one Control Unit are handled sequentially as the operators signal that messages are ready for transmission; see Paragraph .7. The optional 255 Polling Control Feature provides the Universal Control Unit with the capability for address recognition. Up to 32 Model 222, 223, and 224 Universal Control Units, in any combination, can be connected to a single communications line; each Control Unit requires a 255 Polling Control Feature. The 255 Feature can be used only with the Model 232 Communications Interface. In a network arranged for polling, the central computer initiates all communications. A poll request is directed to a specific Control Unit. The Control Unit responds with a message pending from a display station or other device connected to the Control Unit.

The polling arrangement requires the use of a full-duplex communications facility. Communications between an individual Control Unit and the computer are still half-duplex. Communications between the Control Units and the computer are full-duplex; i.e., the computer can receive a message from one Control Unit and simultaneously transmit a message to another.

Individual display stations cannot communicate directly with one another. With appropriate programming of the computer, such communication could be handled on a store-and-forward basis.

.8 PHYSICAL SPECIFICATIONS

Component	203 or 204 Display Station		211 or 212 Display Station	222 Control Unit (1)	223 Control Unit (1)	224 Control Unit (1)
	Display Unit	Keyboard				
Width (inches)	14.06	17.81	11	30	59	90
Depth (inches)	14.25	8.87	22.5	20	20	20
Height (inches)	16.25	6.12	11.3	59	59	59
Weight (pounds)	35	18 (203);10(204)	32	260 max	425 max	575 max
Power (KVA) (2)	0.17	—	0.11	1.0 max	1.8 max	3.0 max
Voltage (3)	115 ± 10%	115 ± 10%	115 ± 10%	115 ± 10%	115 ± 10%	115 ± 10%
Frequency (cps) (s)	60	60	60	60	60	60
Phases	1	1	1	1	1	1
Temperature Range (°F)	32 to 131	32 to 131	32 to 131	40 to 95	40 to 95	40 to 95
Heat (BTU/hr)	?	—	375	3,400	6,150	10,200

(1) Includes all Expansion Modules, control for non-display devices, and Communication Interface.

(2) Figures are approximate.

(3) Capability for operation on a 220-volt, 50 cps power supply is available on special request.

.9 PRICE DATA

Component or Feature	Monthly Rental, $ (1)	Purchase Price, $	Monthly Maintenance, $
Display Stations			
Model 203 (separable alphanumeric keyboard)	77	2,310	22
Model 204 (separable alphanumeric keyboard)	88	2,815	23
Model 211 (integral block numeric keyboard)	56	1,300	21
Model 212 (integral block alphabetic and numeric keyboard)	58	1,370	21
Control Units			
Model 222 Universal Control Unit	243	8,950	50
Model 223 Universal Control Unit	270	10,800	53
Model 224 Universal Control Unit	318	12,900	57
Expansion Modules			
Model 241	68	2,500	14
Model 242	107	4,000	22
Model 243	26	850	7
Model 246	39	1,450	7
Editing Options			
Model 251 Message Editing Module	6	250	2
Model 252 Multi-Message Transaction Feature	NC	NC	NC
Model 261 Blink Feature	—	POR	—
Model 262 Tab Control Module	—	POR	—
Communications Interfaces			
Model 231 (asynchronous)	88	3,720	19
Model 232 (synchronous)	116	5,050	24
Model 255 Polling Control Feature	13	530	3
Controls for Non-Display Devices			
Model 253 RO Printer Control	54	1,950	9
Model 254 Paper Tape Reader Control	54	1,950	9
Model 256 Paper Tape Punch Control	46	1,920	8
Model 257 KSR Control	59	2,020	9
Model 258 Local Print Module	62	2,320	11

(1) Based on 2-year lease; 3-year and 5-year leases are also available at reduced rentals.

NC — No Charge.

POR — Price on Request.

BURROUGHS SINGLE–LINE CONTROL
(WITH BURROUGHS B 2500 AND B 3500 COMPUTERS)

.1 GENERAL

.11	Identity:	2351 and 3351 Single-Line Controls and related adapters.
.12	Manufacturer:	Burroughs Corporation 6071 Second Avenue Detroit, Michigan 48232.
.13	Basic Function:	single-line controller for connecting one narrow-or voice-band line to a Burroughs B 2500 or B 3500 computer.

.15 Description

A data communications subsystem for a Burroughs B 2500 or B 3500 computer consists of a peripheral control unit, the necessary adapters for control functions and line interfaces, and one or more remote terminal devices. Burroughs currently offers three different peripheral control units: the Single-Line Control, the Multi-Line Control, and the Terminal Unit Control. The Multi-Line Control cannot be used in a B 2500 system.

The Single-Line Control is described in this report; see page 8071:01 for a discussion of the Multi-Line and Terminal Unit Controls and a brief description of the Burroughs B 2500 and B 3500 computer systems.

Detailed specifications on the Single-Line Control have not been released by Burroughs to date. This summary report was prepared from preliminary specifications to provide our subscribers with timely, useful information.

The 2351 Single-Line Control is used with B 2500 systems; the 3351 Single-Line Control is used with B 3500 systems. A Single-Line Control occupies one Type B I/O Channel and accommodates one narrow-band or voice-band communications line. One Single-Line Control can be connected to each available Type B I/O Channel. The Single-Line Control can communicate with various remote terminals at up to 2,400 bits per second.

A data communications subsystem built around a Single-Line Control includes the following components:

- One 2351 or 3351 Single-Line Control;
- One Line Adapter;
- One communications link; and
- One or more remote terminal devices, all operating over a single line.

The Single-Line Control includes a code adapter and a station parameter adapter. The code adapter provides the logic for recognition of control characters transmitted from the selected remote terminal. The station parameter adapter determines the control functions that the Single-Line Control must perform for the selected remote terminal. Table I lists the various remote terminals that can be used with the Single-Line Control. A wide range of adapters is available for use with these remote terminal devices, and these adapters are also listed in Table I.

The Single-Line Control does not perform any code translation. If codes of less than eight levels are used, the Control transfers zeros to core memory for unused high-order bits.

The Single-Line Control provides one character of buffering. Data is transferred one character at a time between B 2500 or B 3500 core memory and the Single-Line Control. The Single-Line Control contains the logic required for disassembling each character transmission serially by bit and for assembling characters received in bit-serial form.

Line Adapters provide the interface for connecting a Single-Line Control to a half- or full-duplex communications line and define such characteristics as character length, type of synchronization, type of line control, type of error control, and control code sensitivity. The Line Adapters currently available are shown in Table I.

.15 Description (Contd.)

The communications link can be a leased line or a public switched network with appropriate data sets, or it can be a direct cable connection. Table I shows the communications facilities used with each Line Adapter and remote terminal device.

TABLE I: LINE ADAPTERS FOR BURROUGHS SINGLE-LINE CONTROL

Line Adapter**	Remote Terminal	Communications Facility	Data Set Required
2651 or 3651 Typewriter Inquiry Station	9351 Typewriter Inquiry Station	Direct Cable; Public Telephone Network	— Bell System Data Set 103A
2652-1, 3652-1, 2652-2*, or 3652-2* TWX/ Remote Typewriter	Bell System TWX station	Bell System TWX Service	Bell System Data Set 811B
2653-1, 3653-1, 2653-2* or 3653-2* B 2500/B 3500	Burroughs B 2500 or B 3500 computer	Bell System Schedule 4 Type 4C Leased Voice-Band Line; Public Telephone Network	Bell System Data Set 201B1 Bell System Data Set 201A3
2655-1 or 3655-1 U1004	UNIVAC 1004 Card Processor	Bell System Schedule 4 Type 4 Leased Voice-Band Line; Public Telephone Network	Bell System Data Set 201B1 Bell System Data Set 201A3
2655-1, 3655-1, 2655-2* or 3655-2* IBM 1050	IBM 1050 Data Communication System	Bell System Schedule 4 Type 4 Leased Voice-Band Line; Public Telephone Network	Bell System Data Set 103F Bell System Data Set 103A
2657 or 3657 Model 35 8A1 Selective Calling Stations	Teletype Model 33 or 35 Teletypewriters	Bell System Schedule 3A Leased Data Channel	Bell System Data Set 816A
2658-1, 3658-1, 2658-2*, or 3658-2* Digitronics	Digitronics D507 Paper Tape Reader and/or D509	Bell System Schedule 4 Type 4C Leased Voice-Band Line; Public Telephone Network	Bell System Data Set 201B Bell System Data Set 202C

*These Line Adapters are equipped with the Automatic Dial Out (ADO) feature. This feature permits the computer to initiate the dialing of a remote station over a public switched network in conjunction with the Bell System 801A Automatic Calling Unit.

**The 2000 series models are used with B 2500 systems; the 3000 series models are used with B 3500 systems.

.9 PRICE DATA

Component or Feature (1)	One-Time Charge, $ (2)	Monthly Rental, $	Purchase Price, $	Monthly Maintenance, $ (3)
2351 or 3351 Single-Line Control	90	125	6,000	17
Line Adapters				
3651 or 2651 Typewriter Inquiry Station	15	30	1,440	6
3652-1 or 2652-1 TWX/Remote Typewriter	15	30	1,440	6
3652-2 or 2652-2 TWX/Remote Typewriter with Automatic Dial Out	15	45	2,160	12
3653-1 or 2653-1 B 2500/B 3500	15	50	2,400	6
3653-2 or 2653-2 B 2500/B 3500 w/ADO	15	65	3,120	12
3654 or 2654 U1004	15	85	4,080	6
3655-1 or 2655-1 IBM 1050	15	60	2,880	6
3655-2 or 2655-2 IBM 1050 w/ADO	15	75	3,600	12
3657 or 2657 Model 35 on 8A1 Selective Calling Service	15	30	1,440	6
3658-1 or 2658-1 Digitronics D507 & D509	15	30	1,440	6
3658-2 or 2658-2 Digitronics D507 & D509 w/ADO	15	45	2,160	12

(1) The 2000 series models are used with B 2500 systems; the 3000 series models are used with B 3500 systems.
(2) One-time charge is applicable when certain features are added to an existing installation.
(3) Maintenance charges are approximately 20% lower in metropolitan areas.

BURROUGHS INPUT AND DISPLAY SYSTEM

.1 GENERAL

.11 Identity: . . . . . Input and Display System.

.12 Manufacturer: . . . . . Burroughs Corporation
6071 Second Avenue
Detroit, Michigan 48232

.13 Basic Functions: . . . . . displays, via cathode ray tube, data received from a remote computer or entered via keyboard; transmits data to a remote computer over the public telephone network or a leased voice-band line.

.15 Description

The Burroughs Input and Display System is a visual communications terminal designed to permit rapid exchange of data between a Burroughs computer (B 8500, B 7500, B 6500, B 5500, B 3500, B 2500, or B 300) and a remote operator. Communication is under the control of a stored program in the computer. Multistation or single-station operation in a polling or non-polling environment is available. A station can contain a single display terminal or up to 64 display terminals. An adapter is also available for connecting a printer to the station.

Configuration

The basic Burroughs Input and Display System includes a keyboard, a display unit (monitor), and a control unit. The control unit contains a core memory, a character generator, control circuits, and a power supply. Three control units are available: Control I provides control for one keyboard and one display unit; Control II provides control for up to four keyboard/display units. Control IIA expands the Control II unit for connecting more than four keyboard/display units.

An expanded Display System requires a Multiplexor, which can accommodate up to four control units (one Control II unit and up to three Control IIA units). Each Control IIA can accommodate up to four keyboard/display units. The station is further expanded by adding a Multiplexor Extension, which can accommodate one Control II unit and three IIA associated Control units. The Multiplexor can incorporate up to three Multiplexor Extensions to accommodate a maximum of 64 keyboard/display units. Each Control II or IIA in the station configuration can include an optional Input and Display Printer Adapter to connect to a Teletype Model 33 Receive-Only unit.

Multistation operation requires a Multiplexor or a Simplexor. The Simplexor can accommodate one Control I or II.

A Remote Communications Adapter is required to connect the display terminal to a data set. The Adapter can accommodate a Multiplexor, a Simplexor, or a single control unit. A Burroughs Input and Display System can also be used for local operation with any Burroughs computer. A Display System can be connected directly to a B 2500, B 3500, B 6500, or B 7500 computer. The Remote Communications Adapter connects a local Display System to a B 300 or B 5500 computer via a B 487 Data Transmission Terminal Unit and the appropriate adapter. The remainder of this report discusses the Input and Display System in a data communications environment unless otherwise noted.

Transmission Characteristics

Transmission rates for the Burroughs Input and Display System are 150, 300, 1200, 1800, 2000, or 2400 bits per second. Data is transmitted asynchronously at rates below 2000 bits per second and synchronously at transmission rates of 2000 or 2400 bits per second. Data transmission is in the half-duplex mode. A line adapter is required at the Burroughs computer to interface with the communications controller; see Table IV.

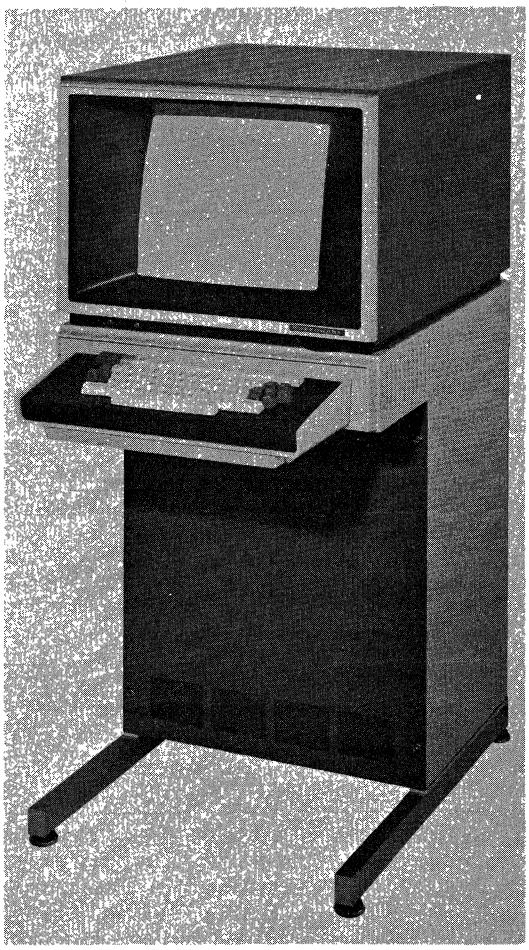


Figure 1. Burroughs Input and Display System.

Transmission Characteristics (Contd.)

The Burroughs Input and Display System is compatible with the Bell System Data-Phone Data Sets 103A (up to 300 bits per second), 202C (up to 1800 bits per second), and 201A (at 2000 bits per second) for transmission over the public telephone network. The Display System is also compatible with the Bell System Data Sets 103F (up to 300 bits per second), 202D (up to 1800 bits per second), and 201B (up to 2400 bits per second) for transmission over a leased voice-band line.

The Burroughs Input and Display System employs a modified 7-level USASCII code with an even parity bit added; see Table I. When asynchronous transmission is employed, a start and a stop bit are added; thus, a total of eight or ten bits are transmitted per character. A longitudinal parity check character terminates each message.

Memory Configuration

A 1024-character nonspatial core memory is contained in each of the three control units. Control I provides 1019 locations for storing displayed symbols and control codes. Five locations are reserved for special use: two are used to hold the cursor address, two are used with the fixed horizontal tab feature, and one is used with the Variable Horizontal Tab option. These locations are reserved whether or not the options are included. Controls II and IIA divide memory into 256-character quadrants with a keyboard/display unit connection for each quadrant. When less than four keyboard/display units are attached, unused memory quadrants are automatically linked with other quadrants; see Table II. The number of active storage locations is reduced by five for each keyboard/display unit attached.

(Contd.)

TABLE I: BURROUGHS INPUT AND DISPLAY USASCII TRANSMISSION CODE

Bit Position				7 6 5	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
4	3	2	1	Row ↓ Column →	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL		SP	0	@	P	\	p
0	0	0	1	1	SOH	DC1	≥	1	A	Q	a	q
0	0	1	0	2	STX		"	2	B	R	b	r
0	0	1	1	3	ETX		#	3	C	S	c	s
0	1	0	0	4			$	4	D	T	d	t
0	1	0	1	5	ENQ		%	5	E	U	e	u
0	1	1	0	6		SYN	&	6	F	V	f	v
0	1	1	1	7			≤	7	G	W	g	w
1	0	0	0	8			(	8	H	X	h	x
1	0	0	1	9	HT		)	9	I	Y	i	y
1	0	1	0	10	LF		*	:	J	Z	j	z
1	0	1	1	11	VT	ESC	+	;	K	[	k	{
1	1	0	0	12	FF		,	<	L	↑	l	|
1	1	0	1	13	CR	GS	-	=	M	]	m	}
1	1	1	0	14	SO	RS	.	>	N	≠	n	¬
1	1	1	1	15	SI	US	/	?	O	←	o	DEL

Control Code Identification

NUL	Null	SO	Shift Out
SOH	Start of Header	SI	Shift In
STX	Start of Text	DC1	Device Control 1
ETX	End of Text	SYN	Synchronous Idle
ENQ	Enquiry	ESC	Escape
HT	Horizontal Tabulation	GS	Group Separator (△)
LF	Line Feed	RS	Record Separator (◁)
VT	Vertical Tabulation	US	Unit Separator (▷)
FF	Form Feed	DEL	Delete
CR	Carriage Return		

NOTE: All characters in columns 2, 3, 4, and 5 are displayable; columns 6 and 7 can be received, but are displayed as their upper-case equivalents. The control codes FF and DC1 are received but not displayed.

TABLE II: BURROUGHS DISPLAY COMBINATIONS*

Number of Display Units	Total Storage per Display, characters	Total Reserved Storage, characters
1	1019	5
2	251; 763	10
2	507; 507	10
3	251; 251; 507	15
4	251 each	20

* The memory in each Control II and IIA is automatically segmented as shown when 1, 2, 3, or 4 display units are connected.

Display Unit

The display unit contains a 17-inch rectangular CRT with a 9-inch-high by 12-inch-wide viewing area. The display provides 2000 display positions arranged in 25 lines of 80 characters per line. The maximum amount of data that can be displayed depends on the amount of memory (see Table II), and the number of control codes used. Eight symbols require two memory storage locations but occupy only one display position on the screen. These symbols include dollar sign, percent sign, ampersand, less-than-or-equal-to sign, left and right parentheses, asterisk, and plus sign. Efficient use of the memory is obtained by eliminating the need to store long sequences of blank spaces, as explained under Editing Facilities. The characteristics of the display unit are summarized in Table III. The display is regenerated 60 times per second.

TABLE III: INPUT AND DISPLAY SYSTEM CHARACTERISTICS

Characteristic	Description
Output medium	Cathode ray tube; displays white characters against black background.
Character set	64 characters, including upper-case alphabetics, numerics, punctuation marks, and special symbols.
Character size	Nominally, 0.115 inch wide and 0.150 inch high.
Display size	12 inches wide by 9 inches high.
Characters per line	80 characters.
Lines per display	25 lines.
Characters per display	1019, 763, 507 or 251 characters depending upon number of display units per Control II or IIA.
Buffer capacity	1024 characters.
Format control	Fixed or variable horizontal tab; Controlled Format option; line and character insert and delete functions; flexible cursor movement controls.
Rated output speed	Up to 2400 bits per second over a communication's line; up to 9600 bits per second operating locally.
Effective output speed	Limited by message length and communications facility.

Keyboard

The keyboard included with the display unit contains 67 active keys (including cursor movement, editing, and control keys) arranged in conventional typewriter style. Eight additional keys are unassigned. The keyboard is independent of the display unit and can be located up to 600 cable-feet from the display. Keys are interlocked to prevent simultaneous keying.

Cursor controls provide for positioning the cursor (displayed as a bracket above and below the character position) to:

- The first character position of the next line (or to the first character position of the first line if the cursor is positioned on the last line),
- The first character position of the same line (or to the first character position of the preceding line if the cursor occupies the first position of a line),

(Contd.)

TABLE IV: LINE ADAPTERS REQUIRED BY REMOTE BURROUGHS COMPUTER

Burroughs Computer	Data Communications Controller	Line Adapter*	Speed, bits/sec	Connection	Reference, Page
B 300 or B 5500	B 487 DTTU	989-1	2400	Direct	8070:01
		989-2	300	Data set	
		989-3	1200	Data set	
B 2500, B 3500,	Single-Line Control	3659-1	9600	Direct	6070:01
		3659-2	1200	Data set	
B 6500, or B 7500	Multi-Line Control	3659-3	2400	Data set	8071:01

* The Line Adapter model numbers shown for the B 2500/3500/6500/7500 computers are those used with the B 3500 computer. For the other computers, the first digit of the Line Adapter model number is the same as the number of the computer; e.g., the corresponding numbers for a B 2500 system would be 2659-1, 2659-2, and 2659-3.

- The first character position of the first line,
- The next tab stop on the same line or on the following line,
- One position to the left (or to the first character position of the preceding line if the cursor occupies the first position of a line), or
- One position to the right.

Cursor positioning can also be accomplished through the use of control characters in the computer message. Any keyboard operation can be automatically repeated at the rate of 10 positions per second when the Repeat key is depressed in conjunction with any other key.

Editing Facilities

The basic editing facilities are limited; they include the ability to replace a character with another character or space and to erase the screen. In addition, there are ten fixed tab stops per line, spaced every eighth character position.

Optional editing facilities significantly extend the editing capability; they include character and line insert and delete functions, Variable Tab Positioning, computer-controlled formatting, and Programmatic Cursor Positioning. These optional editing facilities are fully described in the paragraph under Options.

Message Configuration

The message configuration for the basic Burroughs Input and Display System is: a Start-of-Text (STX) character, A2, the text, and an End-of-Text (ETX) character. The A2 character identifies a display unit. The message configuration is expanded by the addition of a Multiplexor or Simplexor Unit to: Start-of Header (SOH), AO, INS, A1, STX, A2, text, ETX, and LPC. The AO character identifies one of the Simplexors or Multiplexors (up to 16 possible); Ins specifies a type of command or message; A1 identifies the display control unit; LPC is the longitudinal parity-check character.

When the message is destined for the computer, the STX, ETX, and address characters are automatically inserted by the Control, Multiplexor, or Simplexor. The Control unit automatically interprets and strips the addressing information from the messages received from the computer.

Operating Procedure

The Burroughs Input and Display System operates in one of five modes: Keyboard, Send, Wait, Receive, and Error. Message composition and editing are performed in the Keyboard mode. Data can be entered at any point on the screen by positioning the cursor to that point and typing the data. The cursor is advanced one character position for each displayable character entered.

The Send mode is entered when a message is ready for transmission. The operator or the computer can request the transmission. A selected portion of the message on the screen can be transmitted by bracketing that portion with the cursor and a group-separator character.

Operating Procedure (Contd.)

The Wait mode is entered at the end of the transmission; the display unit is inactive until a response is received from the computer. The Wait mode can be interrupted by the operator if necessary.

The Receive mode is entered when a computer response is received. The computer message can override all operations to display an urgent message. The Receive mode is terminated at the end of the computer message. An unwanted computer message can be terminated by the operator at the keyboard without causing a line disconnect. If the message from the computer is received in error or if an operator response is desired, the Error mode is initiated. The Error mode can be terminated from the keyboard and a message acknowledgement returned to the computer.

When an optional Teletype Model 33 Receive-Only unit is connected to the controller, data contained in the memory area associated with a specific display unit can be printed. Printing can be initiated by a computer command or by the operator at the keyboard. If the teleprinter is occupied when a print order is issued, the order is executed immediately following an idle condition.

Multistation Operation

Multistation operation is possible with the inclusion of a Multiplexor or Simplexor into an Input and Display System. The Multiplexor and Simplexor remain in the Receive mode until a poll message or a "contention-mode-enable" message is received. The poll message causes the Display System to respond with one of several different messages. A contention-mode-enable message causes the Display System to transmit a "request-for-poll" message to the computer if a message is waiting at a display unit. The contention mode is disabled by any other message from the computer. Up to 16 Display Systems can operate over the same line. A group-addressed computer message can be used to access multiple display units, Multiplexors or Simplexors.

Error Detection and Correction

An even parity bit is generated and transferred with each character transmitted from the terminal. A longitudinal parity-check character is generated by each message and transmitted at the end of the message. A computer message received in error at the terminal causes automatic entry into the Error mode, alerting the operator to the condition. The operator has the option of responding to the computer or of terminating the Error mode.

Options

The options available with the Input and Display System include a printer adapter, a B 5500 computer remote-console feature, and several editing features. These options are described in the following paragraphs.

The Input and Display Printer Adapter provides the capability to print a displayed message via a Teletype Model 33 Receive-Only teleprinter. The 80-character line of the display unit corresponds to the 80-character teleprinter line. Configuration rules allow only one Printer Adapter per Control I, II, or IIA.

The B 5500 Console Modification Switch provides the capability to use the Input and Display System as a remote console for a Burroughs B 5500 computer system. The switch modifies the character set to that used by the B 5500 Master Control Program. This feature is restricted to use with a Control I unit and a single keyboard/display unit.

The Insert and Delete function provides the capability to insert or delete a number of characters or a whole line; the text is automatically expanded to permit insertion or contracted to permit deletion. Text expanded beyond the line capacity automatically overflows to the next line. Partial line deletion causes data to be erased without storing space or blank characters. Control characters are not erased by the delete function.

The Variable Tab Positioning option provides the capability to set one tab stop at any character position on a line by positioning the cursor and then depressing the Tab Set key on the keyboard. The tab stop can also be set by a computer message. Once the tab stop is set, the cursor is positioned to this stop when the Shift key and Tab key are depressed together. If the cursor is located to the right of a stop when this action is initiated, the cursor will be positioned at the tab stop on the next line.

(Contd.)

The Controlled Format option provides the capability for displaying fixed data in a specific format and for restricting data entry to specified fields in the displayed format. The format is transmitted from the remote computer. Cursor operation is restricted to the data-entry areas. The format can be altered from the keyboard only by setting a switch at the Control. Only the entered data is returned to the computer during a transmit operation. When the Controlled Format option is in use, the Insert, Delete, and fixed Tab functions are inoperative. Variable tabulation is possible through proper insertion of unit separator (US) codes.

The Programmatic Cursor Positioning option provides the capability of controlling the cursor position by a computer message specifying a line and character position.

.9 PRICE DATA

Component or Feature	Monthly Rental, $	Purchase Price, $	Monthly Maintenance, $ *
Control I (single terminal control)	215	9,460	27
Control II (controls up to 4 terminals)	325	14,300	27
Control IIA (controls up to 4 terminals)	100	4,400	20
Monitor (display unit)	60	2,640	10
Alphanumeric Keyboard	20	880	3
Printer (Teletype Model 33 RO)	45	1,980	10
Simplexor (for a single Control)	15	660	7
Multiplexor (for up to four Controls)	50	2,200	11
Multiplexor Extension (for up to four additional Controls)	50	2,200	7
Remote Communications Adapter	35	1,540	3
Line Adapters** —			
Type 989-1 (Direct Connect — 2400 bits/sec)	60	2,700	7
Type 989-2 (Data Set Connect — 300 bits/sec)	60	2,700	7
Type 989-3 (Data Set Connect — 1200 bits/sec)	120	5,400	12
Type 3659-1 (Direct Connect — 9600 bits/sec)	50	2,400	5
Type 3659-2 (Data Set Connect — 1200 bits/sec)	50	2,400	5
Type 3659-3 (Data Set Connect — 2400 bits/sec)	50	2,400	5
Options			
Printer Adapter	30	1,320	3
Insert/Delete (Editing function)	15	660	3
Controlled Format	20	880	3
Variable Tab Position	5	220	1
Programmatic Cursor Positioning	5	220	1
B 5500 Console Modification Switch	2	88	0

* The monthly maintenance charges shown are for areas close to Burroughs service points. Slightly higher charges are in effect for outlying areas. There is a one-time field installation charge of $45 for the Multiplexor Extension and the Control IIA; a one-time charge of $15 is made for every other component except Controls I and II, Printer, Simplexor, and Multiplexor.

** See Table IV.

BURROUGHS TC 500 TERMINAL COMPUTER

.1 GENERAL

.11	Identity:	TC 500 Terminal Computer.
.12	Manufacturer:	Burroughs Corporation 6071 Second Avenue Detroit, Michigan 48232
.13	Basic Functions:	performs processing and control functions, under control of a stored program, on data entered via keyboard, punched paper tape, 80-column punched cards, or received from a voice-band line; can print on two independently controlled forms and can punch data into paper tape or cards; transmits data over a voice-band line to a remote computer.

.14 Basic Components:

Name:	Punched Paper Tape/Edge Punched Card Reader.
Model number:	A 581.
Function:	reads data from punched paper tape or edge punched cards, stores it in memory, punches it into paper tape, and/or prints it under program control.
Name:	Punched Paper Tape/Edge Punched Card Perforator.
Model number:	A 562.
Function:	receives data from memory, punched paper tape, or cards and punches it into paper tape or edge punched cards under program control.
Name:	80-Column Card Reader.
Model number:	A 595.
Function:	reads data from 80 column cards, stores it in memory, punches it into paper tape, and/or prints it under program control.
Name:	Keypunch.
Model number:	A 149.
Function:	receives data from memory, punched paper tape, or cards and punches it into 80-column punched cards under program control.

.15 Description

The Burroughs TC 500 is a stored-program communications terminal. It consists of a keyboard, a processing unit, a printer capable of several form-feed arrangements, and optional peripheral devices that include a separate punched paper tape/edge punched card reader and punch, an 80-column card reader and a card punch.

The TC 500 operates in a polling and addressing environment and can communicate with a Burroughs B 8500, B 7500, B 6500, B 5500, B 3500, B 2500, B 500, or B 300 computer at 1200 bits per second over the public telephone network or in a single-station or multi-station arrangement over a leased voice-band line. The TC 500 is designed to provide buffered, asynchronous communications in a half-duplex mode.

The data transmission code is 7-level USASCII, see Table I. Each character transmitted contains 10 bits composed of 7 data bits, an even parity bit, and unity start and stop bits.

Data communications, processing, and control functions are performed by two independently operating, integral computing units: the Data Communications Processor and the Main Memory Processor. The working storage for the two processors is provided by separate sections of magnetic-disk memory.

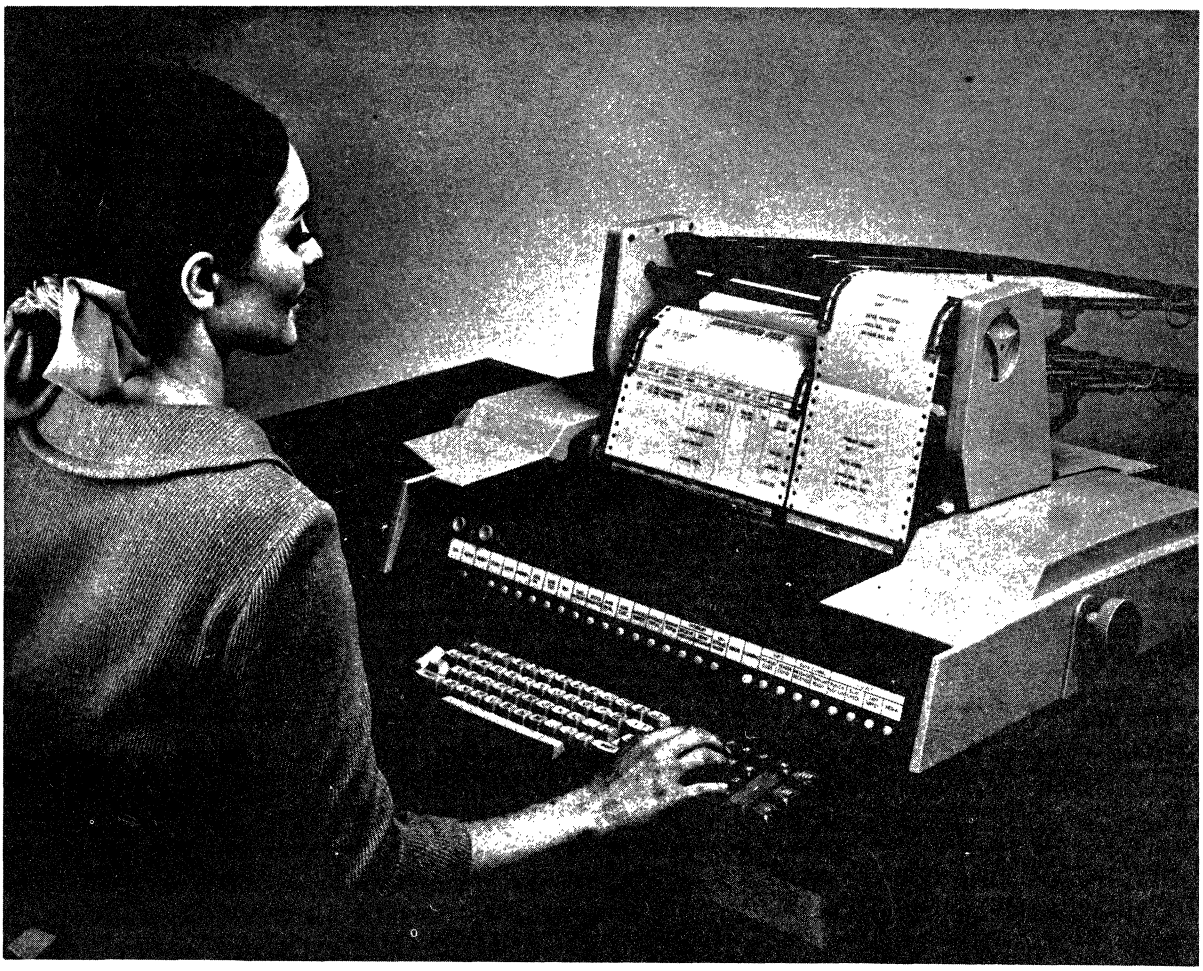


Figure 1. Burroughs TC 500 Terminal Computer shown with the Continuous Forms Pin Feed Device.

.15 Description (Contd.)

The main memory is subdivided into a control area and a normal area. The control area contains a composite of microprograms, each composed of a sequence or string of microinstructions required to execute one "macroinstruction" (a single instruction contained in the instruction repertoire). This composite of microprograms is referred to by Burroughs as system firmware and is supplied with the TC 500 by Burroughs. The control area is not accessible to the programmer. The normal area is accessible to the user and provides from 128 to 448 words of program and data storage depending upon the TC 500 model; see Paragraph .2.

The data communications memory includes two 256-character buffers: the transmit buffer and the receive buffer. Messages received from the remote computer are intermediately stored in the receive buffer, checked for accuracy, and transferred to a "receive-record" area in the normal memory and/or the accumulator under program control. Messages to be transmitted to the remote computer can be constructed in the transmit buffer or in a "send-record" area in the normal memory and then transferred to the transmit buffer to be transmitted. "Send- and "receive-record" areas are assigned by the programmer; instructions are provided to transfer a 255-character message block between the transmit/receive buffers and the send/receive-record areas in normal memory.

TABLE I: TC 500 USASCII TRANSMISSION CODE

Bits b_7 b_6 b_5					0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b_4	b_3	b_2	b_1	Row ↓ Column →	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
1	0	1	1	11	VT	ESC	+	;	K	[	k	{
1	1	0	0	12	FF	FS	,	<	L	\	l	|
1	1	0	1	13	CR	GS	-	=	M	]	m	}
1	1	1	0	14	SO	RS	.	>	N	^	n	~
1	1	1	1	15	SI	US	/	?	O	—	o	DEL

Because the data communications processor functions independently of and concurrently with the main memory, the firmware required to implement data communications instructions is stored in the data communications memory; the memory area is also inaccessible to the programmer.

The accumulator, a fixed-storage, 16-digit field within the normal area of memory serves as a working register with 15 digit positions allocated to data storage; the sixteenth is reserved for special indicators. Shift, comparison, and arithmetic operations manipulate data contained in the accumulator. Access to the accumulator is established through instructions that control numeric data entered via the numeric keygroup or the numeric keys of the typewriter keygroup or data that has been transferred between memory and the accumulator.

The keyboard incorporates a separate typewriter-style keygroup of 53 keys and a numeric keygroup of 21 keys. Data entered via either keygroup is intermediately stored in a keyboard buffer with a storage capacity of from seven to 35 characters. Data transferred from the buffer is under control of the stored program.

Because the type of data (numeric or alpha) to be entered via keyboard is anticipated by the controlling program, the operator must be cognizant of the program sequence. The TC 500 alerts the operator, via indicator lamps, to enter data from the alphanumeric keys or the numeric keys; data entered from keys not specified by the indicator lamps results in an error and the error indicator is illuminated.

Numeric data, entered via either keygroup, is transferred from the keyboard buffer to the accumulator. A single numeric instruction permits up to fifteen digits to be entered and stored in the accumulator. Numeric data can be printed from the accumulator under program control.

Alphanumeric data, transferred from the keyboard buffer, can be: (1) printed and stored in memory, (2) printed only, or (3) stored only by a typewriter instruction. Up to 150 characters (one print line) can be entered via the keyboard and transferred by a single typewriter instruction.

.15 Description (Contd.)

A single row of 16 program-select keys, logically divided into two groups of eight keys each, are positioned across the top of the keyboard. These keys add extensive program/operator flexibility to the TC 500. The key functions are assigned by the stored program and functions can be reassigned during program execution. Any combination of keys can be enabled by instruction. A row of indicator lights, positioned above the program-select keys keys alert the operator to the enabled keys. After having entered data via the keyboard, the operator depresses the program-select key corresponding to the identity of the data field entered; the keyboard instruction is terminated and execution of the appropriate program subroutine is initiated. This is implemented via a table in normal memory containing one instruction for each program-select key. Multiple tables can be set up; the active table is selected via a register holding the base address.

Programs can be entered into the TC 500 memory via the integral memory loader, an 8-level paper tape reader designed to automatically load programs into memory at the rate of 15. 5 rows per second. A special program tape cartridge, Style PC1, is available to accommodate an endless loop program tape. The PC1 cartridge is normally used when cycling through a series of programs for different applications.

Programs can also be entered from the peripheral devices connected to the TC 500 or accessed from the remote computer via the communications interface. Program generation can be performed manually from the TC 500 keyboard using the TC 500 Basic Assembler Language.

The TC 500 Printer prints up to 150 characters per line; peak printing rate is 20 characters per second. The Printer employs a 64-element removable type ball; a two-color (red and black) printer ribbon is contained in a removable cartridge attached to the printer carrier. Printing and positioning as performed under program control. The Printer is equipped with a friction-feed platen that can be split to accommodate printing two independent forms. An optional Continuous Forms Pin Feed Device, available in three styles, provides flexible forms-feed arrangements; see Table II.

The systems firmware, pre-recorded on the magnetic disc memory by Burroughs, implements the TC 500 instruction repertoire identified by Burroughs as General Purpose Language 300 (G. P. 300). The systems firmware is composed of firmware subsets; each subset implements a specific category of instructions such as internal operations, punched paper tape I/O, data communications, etc. Firmware subsets are combined to provide nine standard G. P. 300 firmware sets; these standard combinations are presented in Table III. At present, firmware sets can be interchanged by enabling the read/write heads in the control area of memory via jumper wires on the backboard and loading control memory with the new firmware set through the integral memory loader. Burroughs states that it plans to simplify this operation.

The TC 500 Basic Assembler Language is a symbolic programming language for writing programs that are to be run on TC 500 systems employing GP 300 firmware. Programs written in this language can be assembled on a TC 500, B 2500/3500, or a B 5500 system.

The A 595 Card Reader employs a modified form of column binary reading. Data read from one card column is stored in one eight-bit location in memory. The high-order 5 bits in the memory location are set to correspond to punches in the upper 5 card rows (12 through 8); the low-order 3 bits in the memory location are set to the binary value of a single punch in the lower seven card rows (1 through 7). Translation into a usable code is by programmed table look-up. This technique permits the TC 500 to accept data from cards punched in any conventional card code. (Card codes that use multiple punches in rows one through seven would not be acceptable.)

The TC 500 magnetic disc memory is organized into five blocks of eight tracks each to total 40 tracks. Each track contains 32 words (64 bits per word). Each implemented track (determined by the TC 500 model) possess a discrete read/write head. Only one side of the disc is utilized. Disc rotation is maintained at 6000 revolutions per second (10 milliseconds per revolution). There are three general types of TC 500 words: numeric, alpha, and instruction word. A numeric word contains 16 digit (4 bits per digit) positions; the sixteenth digit position is reserved for program indicators. An alpha word contains eight bytes, an instruction word, four instructions (4 bits per instruction).

TABLE II: FORMS FEED CHARACTERISTICS

Style	Platen	Pin Feed	Form Advance Key Action
Standard	Normal	None; friction feed	Left: Platen advances Right: No action
	Split	None; friction feed	Left: Left platen advances Right: Right platen advances
PF-1	Normal	Single shaft	Left: Platen and pin-feed shaft advance in synchronization Right: No action
	Split	Single shaft	Left: Left platen and pin-feed shaft advance in synchronization Right: Advances right platen only
PF-2	Normal	Single shaft	Left: Advances platen only Right: Advances pin-feed shaft only
	Split	Single shaft	Left: Advances left platen Right: Advances right platen in sync with pin feed
PF-3	Normal	Double shaft (synchronous and independent spacing)	Left: Advances platen in sync with lower pin-feed shaft Right: Advances upper pin-feed shaft only
	Split	Double shaft (synchronous and independent spacing)	Left: Advances left platen in sync with lower pin-feed shaft

TABLE III. TC 500 FIRMWARE FOR G.P. 300

G.P. 300 Firmware Sets	Basic Instruction Repertoire	Data Communication Firmware	Paper Tape I/O Firmware*	80 Col. Card I/O Firmware	Normal Memory (User Storage) Available, in Words
a	yes	yes	USASCII (without table)	—	416
b	yes	yes	8 channel table look up	—	416
c	yes	yes	8 channel table look up	—	256
d	yes	yes	5 channel table look up	—	416
e	yes	yes	5 channel table look up	—	256
f	yes	yes	—	yes	416
g	yes	yes	—	yes	256
h	yes	yes	—	—	448
i	Partial	Partial	—	—	128

*Code translation is performed where specified by the table-look-up technique via the employment of firmware for the Table of Code Assignments.

.15 Description (Contd.)

The internal coding of the TC 500 is USASCII, therefore, translation between the TC 500 transmission code and internal code is not required. Translation between codes read from paper tape or 80-column cards to the internal code as performed by the "table-look-up" technique. The G.P. 300 firmware implements the required translation by a stored Table of Input Code Assignments. The conversion table, where required, is stored in the normal (user) area of memory and occupies up to 16 words.

.16 First Delivery: . . . . . September 1968 (with communications interface).

.17 Availability: . . . . . 3 months.

.2 CONFIGURATION

The Burroughs TC 500 Terminal Computer is available in five models with user memory capacity and different combinations of features as follows:

- Model TC 525 — provides 416 words (3328 bytes) of user storage, PF-3 Dual Pin Feed Attachment, Split Platen, 16 Program Select keys, peripheral I/O capability, and data set interface.
- Model TC 522 — identical to Model TC 525 except it contains 256 words (2048 bytes) of user storage and 12 Program Select keys.
- Model TC 535 — identical to TC 525 except no peripheral I/O capability; contains 448 words (3584 bytes) of user storage.
- Model TC 532 — identical to Model TC 525 except no peripheral I/O capability, contains 288 words (2304 bytes) of user storage, and 12 Program Select keys.
- Model TC 531 — identical to Model TC 525 except no peripheral I/O capability, contains 128 words (1024 bytes) of user storage, 4 Program Select keys, no split platen and a significant decrease in size of the instruction repertoire producing a limited processing capability.

Peripheral devices available for the TC 500 include:

- Model A 581 Paper Tape/Edge Punched Card Reader,
- Model A 562 Paper Tape/Edge Punched Card Perforator,
- Model A 595 Card Reader with adapter, and
- Model A 149 Keypunch with adapter.

.3 INPUT

.31 Prepared Input

TC 500 Memory Loader (program entry only) —

Input medium:	fully-punched 1-inch, 8-level paper-Mylar-paper tape.
Input code:	8-level.
Quantity of data:	limited by user storage capacity; see Paragraph .2.
Rated input speed:	15.5 rows/sec.
Effective speed:	dependent upon controlling program.
Comments:	an optional program tape cartridge, Style PC1, will accommodate an endless loop program tape (tape length can be from 10 to 40 feet).

A 581 Punched Paper Tape/Edge Punched Card Reader —

Input medium:	fully-punched 11/16- or 1-inch 5-, 6-, 7-, or 8-level one- or two-ply Mylar or Aluminized Mylar tape; individual or fanfold 3- to 5-inch wide edge-punched cards.
Input code:	any 5-, 6-, 7-, or 8-level code, input codes compared to codes in stored translation table.

.31 Prepared Input (Contd.)

Quantity of data:	limited by user storage capacity; see Paragraph 2.
Rated input speed:	40 char/sec.
Effective speed:	dependent upon controlling program.
Comments:	reeled, strip, or fanfold oily or dry tape is acceptable; cards up to 11-inches wide can be accommodated as an option; holes are sensed photoelectrically.

A 595 80-Column Card Reader —

Input medium:	80-column cards.
Input code:	see Paragraph .15.
Quantity of data:	limited by user storage capacity; see Paragraph .2.
Rated input speed:	100 cards/min.
Effective speed:	dependent upon controlling program.
Comments:	cards are photoelectrically sensed serially by column.

.32 Manual Input

Numeric Keygroup —

Method of entry:	via 21-key Keygroup.
Quantity of data:	up to 15 digits can be entered under control of a single numeric instruction; entry is limited by user storage capacity; see Paragraph .2.
Character set:	21 distinct character codes including 12 numerics, a decimal point, 3 accumulator flag keys, reset, and four operation control keys.
Comments:	a keyboard buffer provides intermediate storage of from seven to 35 characters.

Typewriter Keygroup —

Method of entry:	via 53-key Keygroup.
Quantity of data:	up to 150 alphanumeric characters (one print line) can be entered under control of a single keyboard instruction; entry is limited by user storage capacity; see Paragraph .2.
Character set:	66 distinct character codes including numeric, upper-case alphabetics, punctuation; and special symbols.
Comments:	a keyboard buffer provides intermediate storage of from seven to 35 characters.

.33 Fixed Input: . . . . . via stored program.

.34 Transaction Code Input: . . . . . via stored program.

.35 Message Configuration

Three message formats are employed: Poll messages, Select messages, and Data messages. Poll and Select messages are only transmitted from the remote computer. The Poll message interrogates the TC 500 for a waiting message; the Select message interrogates the TC 500 for a ready-to-receive status. Both Poll and Select messages are identical except for the single character, p (Poll) or q (Select) that identifies the message and are configured as: EOT, AD1, AD2 (a two-character terminal identification adhesive), p/q, and ENQ. Data messages are configured as: SOH, AD1, AD2, TR# (a message transmission number consisting of one to three characters), STX, the Text, ETX, and an even Block Check Character (longitudinal parity character). The message transmission number identifies the message sequence. The text portion of the message can contain from one to 255 data characters.

.35 Message Configuration (Contd.)

All messages are acknowledged by a positive (ACK), negative (NAK), or an EOT response. The TC 500 responds to a received Poll message with EOT, when a message is not ready to be transmitted, or with a Data message. The remote computer acknowledges the received Data message with an ACK or NAK. A NAK response initiates automatic retransmission from the TC 500; retransmission will occur each time a NAK is received (i.e., no time-out). A received ACK response permits the application program to begin storing the next message to be transmitted in the transmit buffer and is followed by an EOT character transmitted from the TC 500; the received EOT causes the remote computer to return an EOT and re-initiate the polling/selection routine.

Response to a Selection message is determined by the stored program. No response indicates that the TC 500 requires a Poll. A NAK response indicates that the TC 500 is not ready to receive; an ACK response indicates a receive-ready status. Data messages received by the TC 500 are acknowledged by the TC 500 with an ACK or NAK response. The ACK response causes the remote computer to transmit an EOT and to continue with its polling/selection routine; a NAK indicates a retransmission request.

.36 Operating Procedure

All transmission and reception is under control of the stored program in response to polling and addressing messages from the remote computer. The operator is concerned only with data entry as required by the stored program and replenishing forms, tape, and cards.

.37 Entry of time and Date: . . . . . no provision.

.4 OUTPUT

.41 Output to Punched Tape
A 562 Punched Paper Tape/Edge Punched Card Perforator —

Tape size:	11/15 or 1-inch 5-, 6-, 7-, or 8-level one- or two-ply Mylar or Aluminized Mylar tape; individual or fanfold 3- to 5-inch wide edge-punched cards.
Tape code:	any 5-, 6-, 7-, or 8-level code. Codes can be generated through-stored, translation table.
Rated punched speed:	40 char/min.
Effective speed:	dependent upon controlling program.
Format control:	punches under program control; fixed and/or variable field punching by character oriented instructions.
Comments:	reeled, strip, or fanfold, oily or dry tape is acceptable; supply spindle accommodates up to 8-inch tape reel; take-up reel can be from 5.5 to 8 inches; optional 5.5- or 7-inch take-up reels for rewind; optional supply and stacker tray for automatic feeding and punching of continuous edge-punched cards.

.42 Output to Punched Cards
A 149 Keypunch —

Card type and size:	standard IBM 80-column cards.
Card code:	any code; internal USASCII code can be translated to card code via stored translation table.
Rated punching speed:	25 characters (columns) per second.
Effective speed:	dependent on controlling program.
Format control:	under control of the stored program.

.42 Output to Punched Cards (Contd.)

Comments:	the A 149 Keypunch is manufactured by Bull-G. E.; it can be used as a free-standing keypunch or it can be operated by the TC 500 under control of the stored program; interpreting can be performed concurrent with punching at the rated speed; stacker-selection for normal and reject stackers is provided.

.44 Output to Printer

Output medium:	friction-fed fanfold forms up to 15.5 inches wide (15-inch printing width); optional Continuous Forms Pin Feed Device, available in three models; see Table II.
Character set:	64 printable characters; see Table I.
Rated printing speed:	20 char/sec.
Effective speed:	dependent upon controlling program; less than rated speed due to carriage return, line advance and other format operations.
Format control:	controlled by stored program.
Comments:	horizontal spacing is 10 char/inch; vertical spacing is 6 line/inch; horizontal positioning is 20 inches/sec; vertical advance is 20 lines/sec.

.5 ERROR DETECTION AND CORRECTION

.51 Data Entry Errors

Type of checking:	character parity (paper tape) and character validity (paper tape and punched cards); input code compared to codes in stored translation table unless paper tape is punched in USASCII code.
Error indication:	indicator lamp is lighted; testable indicator is set alerting program.
Correction procedure:	determined by stored program, except when operator intervention is required.

.52 Data Transmission Errors

Type of checking:	character and longitudinal parity; optional transmission number check.
Error indication:	a negative acknowledge (NAK) is returned to the remote computer.
Correction procedure:	automatic retransmission of message received in error.

.53 Data Recording Errors

Type of checking:	echo check to verify correct dies have been activated in A562 Paper Tape Perforator.
Error indication:	indicator lamp is lighted; testable indicator is set alerting program.
Correction procedure:	determined by stored program except when operator intervention is required.

.55 Line Malfunctions: no special provisions for checking.

.6 CONDITION INDICATORS

Numerous indicator lamps are provided on the TC 500 operator panel for monitoring the internal functions of the TC 500. Two indicator lamps: Message Received and Transmit Ready provide the operator with an indication to the communications status of the TC 500.

.7 DATA TRANSMISSION

Data communications control procedures are implemented by special instructions recorded in the Data Communications Processor portion of memory (eight tracks — 256 words). The Data Communications Processor functions independently to and concurrently with the Main Memory Processor. The TC 500 can operate with a remotely connected Burroughs B 8500, B 7500, B 6500, B 5500, B 3500, B 2500, B 500, or B 300 computer.

.71 Basic Characteristics

Rated transmission speed:	1200 bits/sec.
Transmission method:	serial by bit.
Transmission code:	7-level USASCII plus an even parity bit, and unity start and stop bits which total 10 bits/char.
Transmission mode:	half-duplex
Order of bit transmission:	low order bit (62) of each character is transmitted first.
Synchronization:	asynchronous; unity start and stop bits are transmitted with each character.

.72 Connection to Communications Lines

Communication Line	Data Set*
Common-carrier leased voice-band line operating at 1200 bits/sec:	Bell System Data Set 202C or 202D or Western Union 1200 Baud Data Modem.
Public telephone network operating at 1200 bits/sec:	Bell System Data-Phone Data Set 202C.

.73 Transmission Control

Call initiation:	only when polled by the remote computer
Call reception:	capable of unattended operation.
Functional operations:	no direct control, but incoming data could be used to control operations through appropriate programming.

.74 Multistation Operation

All communications are initiated by the remote computer. The TC 500 responds to a Poll message containing the two-character address of the polled unit by transmitting an awaiting message or a negative acknowledgment.

A Select message containing the address of the unit to be selected, is transmitted by the remote computer prior to transmitting a message to the selected or addressed unit. The selected TC 500 responds with a positive or negative acknowledgment to the remote computer.

*In some cases, equivalent data sets can be used; check with your local common-carrier communications consultant.

.8 PHYSICAL SPECIFICATIONS

Component	TC 500 (any model)	Model A 581 Paper Tape Reader	Model A 562 Paper Tape Perforator
Width (inches)	44	9.2	11.62
Depth (inches)	28.5	11	15.25
Height (inches)	30	7	6
Weight (pounds)	400	15	21
Power (KVA)	1.0*	Power derived	Power derived
Voltage	115	from TC 500	from TC 500
Frequency (Hz)	60		
Phases	1		
Temperature Range (°F)	50 to 105	50 to 105	50 to 105
Humidity Range (%)	5 to 95	5 to 95	5 to 95
Heat (BTU/hr)	?	?	?

* Maximum system requirements.

Component	Model A 595 Card Reader	Model A 149 Keypunch
Width (inches)	24.5	39
Depth (inches)	10.5	26.5
Height (inches)	10/37	44
Weight (pounds)	45	?
Power (KVA)	Power derived	0.5
Voltage	from TC-500	95 to 240
Frequency (Hz)		50 or 60
Phases		1
Temperature Range (°F)	50 to 105	66 to 87
Humidity Range (%)	5 to 95	35 to 65
Heat (BTU/hr)	?	?

.9 PRICE DATA

Component or Feature	Monthly Rental, $	Purchase Price, $	Monthly Maintenance, $*
Terminal Computer Model -**			
TC 525	360	14,400	48
TC 522	310	12,400	43
TC 535	335	13,400	45
TC 532	285	11,400	42
TC 531	250	9,900	40
Peripheral Model -			
A 581 Paper Tape/ Edge Punch Card Reader	30	1,200	8
A 562 Paper Tape/Edge Punch Card Perforator	40	1,500	10
A 595 80-column Card Reader (with interface adapter)	120	4,690	18
A 149 Keypunch (with interface adapter)	150	7,100	25
PC1 Program Tape Cartridge	-	15	-

* The monthly maintenance charges shown are for areas close to Burroughs service points. Slightly higher charges are in effect for outlying areas.

** All TC 500 models include the PF3 Dual Pin Feed Attachment as a standard feature; the PF1 or PF2 Pin Feed Attachments can be substituted for the PF3 at no extra cost.

CLARY SP20 STRIP PRINTER

.1 GENERAL

.11 Identity: . . . . . Clary SP20 Informer
Digital Strip Printer.

.12 Manufacturer: . . . . . Clary Corporation
Precision Instrument Division
320 W. Clary Avenue
San Gabriel, California 91776

.13 Basic Function: . . . . . prints binary coded data input received from a remote computer keyboard or Teletype source onto single-copy strip paper.

.15 Description

The Clary Model SP20 Alphanumeric Strip Printer is a lightweight, compact, parallel/serial entry device using the simplest method of data reproduction, i.e., pressure-sensitive paper impacted between a hammer and character wheel. This technique minimizes the mechanical complexity and the number of mechanical components, and maximizes the reliability of the printer.

The Model SP20 Printer converts parallel binary coded input data into a printed record on a strip of paper 5/16 inch wide. Normally, the input code is in six-bit format which accommodates the standard 64-symbol USASCII character sub-set; included are upper-case alphabetics, numerics, punctuation, and special symbols; see Table I. Serial data entry is available as an option using eight-level USASCII, five-level Baudot, or other non-standard codes. The rated printing speed of 20 characters per second can be increased by using less than one-half the maximum 64-symbol character set. Printed character size is 0.06 inch wide by 0.10 inch high with nominal character spacing at 10 characters per inch.

The Clary SP20 Strip Printer is available in five basic configurations:

- Model SP20-1A — rack-mounted printer and electronics;
- Model SP20-2A — desk-mounted printer and electronics;
- Model SP20-3A — rack-mounted printer, electronics, and power supply;
- Model SP20-4A — desk-mounted printer, electronics, and power supply;
- Model SP20-5A — printing head mechanism.

The printing head and the electronic components are mounted on two assemblies. The printing head assembly provides mounting for the mechanical section of the printer and includes a character motor, stepper motor, hammer, timing disc, control switches, strip paper guide, and storage reel. The electronic chassis assembly provides mounting for the control and logic electronics (plug-in printed circuit cards) in the SP20-1A and 2A configurations, and mounting for the control and logic electronics plus a power supply in the SP20-3A and 4A configurations.

The Model SP20 printing mechanism consists of a rotating character wheel, with the 64-symbol (standard) character set engraved in its perimeter (at 360°/64), a paper space stepping motor, and a solenoid-actuated print hammer. The "on the fly" method of printing requires a constant hammer pull-in time which is synchronized with the character wheel rotating at 1200 revolutions per minute. The constant character wheel speed is maintained by a synchronous motor driven by the input power line voltage. For each print cycle, a reset pulse is generated; a count pulse is generated at the same time for each of the 64 characters and translated into binary code, which is then compared to the coded input data signal. Coincidence causes the print hammer to impact the pressure-sensitive paper against the character wheel at the instant the desired character is opposite the hammer.

The paper supply is a minimum of 160 feet (19,000-character capacity) with a red-tinted strip near the end of the spool to indicate impending paper deletion. The movement of paper is rated at approximately 2.0 inches/second, controlled by a stepping motor; this function is

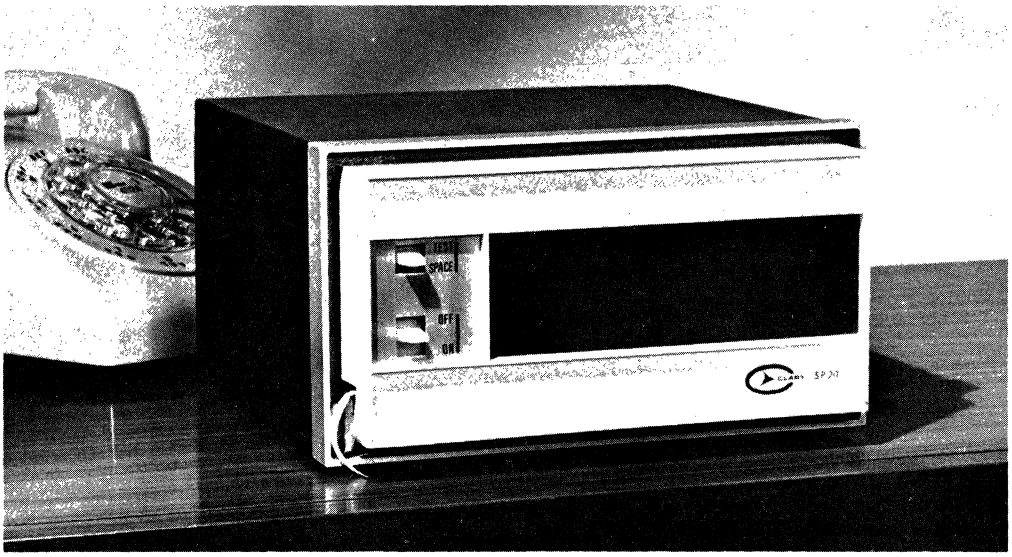


Figure 1. Clary Model SP20 Desk-Mounted Digital Strip Printer

.15 Description (Contd.)

independent of print hammer operation. The strip paper is automatically advanced four spaces when the ON-OFF power switch is turned on to ensure adequate spacing between messages.

.16 First Delivery: . . . . . August 1969.

.17 Availability: . . . . . immediate delivery from stock.

TABLE I. CLARY SP20 PRINTER STANDARD USASCII CHARACTER SUB-SET

Binary Coded Decimal	Character Wheel Position	Printed USASCII Symbol	Binary Coded Decimal	Character Wheel Position	Printed USASCII Symbol
000000	1		010101	22	U
000001	2	A	010110	23	V
000010	3	B	010111	24	W
000011	4	C	011000	25	X
000100	5	D	011001	26	Y
000101	6	E	011010	27	Z
000110	7	F	011011	28	[
000111	8	G	011100	29	/
001000	9	H	011101	30	]
001001	10	I	011110	31	↑
001010	11	J	011111	32	←
001011	12	K	100000	33	■
001100	13	L	100001	34	!
001101	14	M	100010	35	"
001110	15	N	100011	36	#
001111	16	O	100100	37	$
010000	17	P	100101	38	%
010001	18	Q	100110	39	&
010010	19	R	100111	40	'
010011	20	S	101000	41	(
010100	21	T	101001	42	)

TABLE I. CLARY SP20 PRINTER STANDARD USASCII CHARACTER SUB-SET (Contd.)

Binary Coded Decimal	Character Wheel Position	Printed USASCII Symbol	Binary Coded Decimal	Character Wheel Position	Printed USASCII Symbol
101010	43	*	110101	54	5
101011	44	+	110110	55	6
101100	45	,	110111	56	7
101101	46	-	111000	57	8
101110	47	.	111001	58	9
101111	48	/	111010	59	:
110000	49	0	111011	60	;
110001	50	1	111100	61	<
110010	51	2	111101	62	=
110011	52	3	111110	63	>
110100	53	4	111111	64	?

.8 PHYSICAL SPECIFICATIONS

Component	Model SP20-1A	Model SP20-2A	Model SP20-3A	Model SP20-4A	Model SP20-5A
Width (inches)	8.75	8.75	8.75	8.75	8.75
Depth (inches)	4.5	4.5	4.5	8.31	2.5
Height (inches)	4.6	4.6	4.6	4.6	4.6
Weight (pounds)	6	6	9	9	4
Power (watts)	15	15	60	60	60
Voltage	115	115	115	115	115
Frequency (Hz)	60	60	60	60	60
Phase	1	1	1	1	1
Temperature Range (°F)	--	--	--	--	--
Humidity Range (%)	--	--	--	--	--
Heat (BTU/hr)	--	--	--	--	--

Note: DC power requirements are also accommodated.

.9 PRICE DATA

Component or Feature	Purchase Price, * $
Model SP20-1A	610
Model SP20-2A	620
Model SP20-3A	690
Model SP20-4A	700
Model SP20-5A	265
Option	
Serial Entry	100

* All configurations and optional features of the Clary Model SP20 Strip Printer are available on a Purchase-Only basis.

COMMUNITYPE DATA COMMUNICATION SYSTEM

.1 GENERAL

.11	Identity:	Communitype Data Communication System.
.12	Manufacturer:	Communitype Corporation GM Building 767 Fifth Avenue New York, New York 10022
.13	Basic Function:	data entered from keyboard or received from communications line is recorded on a magnetic tape and printed; recorded data is transmitted at 1200 bits per second over the public telephone network or at 1800 bits per second over a leased voice-band line.

.15 Description

The Communitype approach to data communications was conceived almost 40 years ago by the late Walter S. Lemmon, a prominent inventor and radio engineer during the early years of radio communications. Lemmon's Radiotype, forerunner of the Communitype system, was demonstrated at the 1939 New York World's Fair. The Radiotype consisted of an electric typewriter, a paper tape reader, and a paper tape punch; radio transmission was used as a vehicle for communication with the terminal.

Lemmon founded Communitype Corporation in September 1961 under the name Radio Electronics Corporation, which was given its present corporate name in June 1967. Inspired by the Bell System's introduction of the Data-Phone in 1960, Lemmon decided to upgrade the Radiotype with solid state electronics, magnetic tape, and the Data Set. Development work was accomplished in a small laboratory in Trenton, New Jersey. Learning of his progress, the U. S. Navy ordered a specially designed model in 1962. From 1961 to 1967, the system underwent further development, testing, and refinement and was finally introduced to the market in November 1967. First deliveries of the production model took place in January 1968. In July of that year, the company acquired a 15,000-square-foot manufacturing, research, and development facility in Stirling, New Jersey. Communitype states that, in conjunction with its marketing efforts, it is establishing a nationwide sales organization.

The Communitype Data Communication System is a keyboard-to-magnetic tape terminal designed to capture data at the point where information originates for two-way communication with a computer or another Communitype terminal. The basic system incorporates an IBM Selectric typewriter, an incremental magnetic tape recorder, and the necessary control logic in a standard office desk.

Four models of the system are manufactured: 94, 95, 100, and 105. The 100 and 105 have five operating modes: Record, Non-Record, Printout, Transmit, and Receive. Models 94 and 95 have three operating modes: Record, Non-Record, and Printout. Basic equipment design for all four models is the same.

In addition, Communitype's product line includes its recently announced Data-Jotter (the Model 90 system), a Record and Non-Record device that is scheduled for production in late 1969.

Data entered from the keyboard (in all models) produces a printed copy and is simultaneously recorded on magnetic tape when the system is in the Record mode. The Non-Record mode permits certain information, as required, to be typed out as hard copy without being recorded on the magnetic tape. In all models except the 90, the recorded data can be printed any number of times in the Printout mode.

Figure 1. The Communitype 105 Communications System showing the removable tape cartridge, IBM Selectric typewriter, and the PAD (Program and Data) Memory Unit to the right of the typewriter.

.15 Description (Contd.)

When operating as data communications terminals, Models 100 and 105 can transmit the recorded data to or record the received data from the corresponding remote device (another remote Communitype terminal, tape converter, or computer interface) via the public telephone network or a leased voice-band line. Data is transmitted synchronously in the half-duplex mode at a fixed rate of 1200 bits per second.

The Communitype system employs the IBM Selectric typewriter BCD code, a 7-level code with odd parity, as an internal code and as a data transmission code; i.e., the system does not translate between internal and transmission codes.

Magnetic tape recorded on the Communitype system is not computer compatible; data recorded on tape must be converted to a computer-compatible form prior to entering the data into a computer system. This data conversion is accomplished automatically and instantly as the data is transmitted via telephone from the 100 or 105 Data Communication System to a Communitype magnetic tape transmission and conversion device (available in two models: 550 and 850; the former converts to 7-track, 556 bpi magnetic tape; the latter to 9-track, 800 bpi magnetic tape). Both models are also capable of sending computer-prepared data back to the 100 or 105.

In addition, versions of these tape units (Models 500 and 800) are available without a communications interface but with a cartridge tape drive for local on-site data conversions.

.15 Description (Contd.)

Models 500 and 800, however, convert only from Communitype magnetic tape cartridges to computer-compatible magnetic tape; they do not convert in the opposite direction as do Models 550 and 850.

An incremental magnetic tape recorder is built into one of the desk drawers and is designed to handle a magnetic tape cartridge; see Figure 1. The tape cartridge available only from Communitype, includes both supply and takeup reels and contains sprocketed, 16mm film with magnetic oxide coating. It has the capacity for 200,000 characters of data.

The Selectric code is recorded serially by character, parallel by bit on the 7-channel tape at a density of 83 characters per inch. Data is recorded in variable-length records separated by a customer-initiated interrecord gap (IRG) code. Normally, the IRG code is entered manually but can be entered automatically from the PAD Memory Unit as an option. The operator records an End-of-File (EOF) code at the end of the final record. When this EOF code is detected, it causes the tape to halt at the end of a message.

Character parity is checked for each character recorded on tape when the system is operating in the Record mode. Data recording errors are detected by read-after-write error checking (an optional feature available at additional cost). The error checking operation is performed automatically by backing up the tape one character position after recording a character, then reading forward one position. A detected error causes the keyboard to lock and an error indicator to light. The error condition can be corrected by backspacing one position and re-keying the correct character.

Error signaling in response to data transmission errors is performed via the reverse-channel technique. The inherent value of this method is that it eliminates the time required for line turnaround to allow the receiver to transmit an acknowledge code. A description of the reverse-channel technique appears in Report 6220, Paragraph .15.

An interrupted signal on the reverse channel during data transmission is interpreted by the sending terminal as a request for retransmission. (The transmit mode remains active for approximately one-half second following transmission of the last character in the record; this additional period allows for propagation delay over the communications facility.) Assuming a Model 100 or 105 is communicating with another 100 or 105, both transmitting and receiving terminal tapes are automatically reversed to the beginning of the incorrectly received record, and the record is again read and retransmitted. After the first retransmission of the same record, should an error still exist the receiving terminal will write a special character (customer-specified) in place of the character received in error, and transmission continues.

The signal on the reverse channel is normally interrupted at the end of a transmission, that is, after the last character is correctly received. This interruption is interpreted as a positive acknowledgment by the transmitting terminal and initiates transmission of the next record.

The PAD (Program And Data) Memory Unit, a desk-top device approximately the size of a Data-Phone Data Set, provides a storage capacity of 80,000 characters for fixed, formatted data such as customer names, addresses, stock numbers, and so on. It is included as standard equipment with Models 95 and 105. The PAD contains an easily removable magnetic tape cartridge with a magnetic tape whose front surface may be used to type or write descriptive information relating to each of the 1,000 lines of recorded data; up to 80 characters can be recorded on each line. With the cartridge positioned in the PAD, a portion of the typed or written data is visible to the operator. Controls are provided for quick location of any line or part of a line, to record data on the PAD tape from the system's magnetic tape cartridge, or to read data from the PAD tape and write it on the cartridge magnetic tape in the system. Editing operations can be performed when preparing the buffer tape from variable data entered via the keyboard and fixed data received from the PAD. The PAD cartridge can be manually advanced one line at a time, or rapidly slewed in either direction. Character advance is continuous at 10 characters per second, with automatic return and stepping to

.15 Description (Contd.)

the next line. Additional PAD Memory Units can be attached in parallel to expand the capacity of instantly available fixed and formatted data.

.16 First Delivery: . . . . . January 1968.

.17 Availability: . . . . . 3 to 6 months.

.2 CONFIGURATION

The basic Communitype Data Communication System consists of a manual input keyboard, a printer, an incremental magnetic tape recorder used as a buffer, and control logic (including a communications interface in two of the models available). A PAD (Program And Data) Memory Unit is a standard feature with two of the models. A Program and Data Memory (PAD) can be added to the system at additional cost. A card reader for standard 80-column cards can also be added. A data set is required to connect Models 100 or 105 to a communications line; see Paragraph .72.

.3 INPUT

.31 Prepared Input

Magnetic tape buffer —

Input medium:	16-mm sprocketed magnetic oxide coated film recorded at 83 char/inch; 200-foot tape is contained in a removable cartridge.
Input code:	IBM Selectric code, six data bits plus odd parity; see Table I.
Quantity of data:	variable up to tape capacity of 200,000 characters.
Character set:	88 characters, plus seven function codes.
Rated input speed:	up to 14.8 char/sec (printer) or 1200 bits/sec (communications facility).
Effective speed:	limited by record length and transmission speed.
Comments:	this unit serves as a data buffer; all transmission and transcription operations are performed via this unit.

Card Reader Option —

Input medium:	standard IBM 80-column punched cards.
Input code:	standard Hollerith card code.
Quantity of data:	up to 80 characters per card.
Character set:	64 characters.
Rated input speed:	75 cards per minute.
Effective speed:	limited by number of characters per card (14.8 char/sec, maximum).
Comments:	Hollerith card code is translated to IBM Selectric code when data is transcribed to the magnetic tape buffer.

.32 Manual Input

Keyboard —

Method of entry:	via a 55-key keyboard.
Quantity of data:	variable up to 200,000 characters.
Character set:	44 distinct character codes, in conjunction with upper and lower case control codes, provide 88 upper and lower case alphabetic, numeric, and special characters, plus six additional standard function codes; see Table I.

.32 Manual Input (Contd.)

Comments: . . . . . keyboard data is entered directly on the magnetic tape. A separate key-pad (optional) provides entry of up to 10 additional nonprinting codes; see Table I.

.33 Fixed Input: . . . . . up to 80,000 characters per cartridge with the PAD (Program And Data) Memory Unit (Models 95 and 105); see Paragraph .15.

.34 Transaction Code Input: . . . . . no provision.

.35 Message Configuration: . . . . . data is transmitted in variable-length records; each data record begins and ends with an IRG character; an EOF (End-of-File) character follows the IRG character at the end of a message; longitudinal parity can be located just prior to or following the IRG character.

.36 Operating Procedure

To send or receive a message on the Communitype 100 or 105, the operator:

- Mounts the tape cartridge on the magnetic tape handler (an erased tape is used for receiving data) and positions the tape at the starting point
- Places the terminal in the Transmit or Receive mode
- Establishes connection by dialing or signaling
- Ensures that the called terminal is ready
- Depresses data set Data button
- Starts the send or receive operation by depressing the Send or Receive button on the Communitype 100 or 105 system

The subsequent operation, including retransmission, is completely automatic. Operator attention is required only to break the connection. The Error Substitution Feature insures that an error substitute character is recorded in place of the error character after one retransmission and the operation continues.

.37 Entry of Time and Date: . . . . . a special button enables automatic printout of the date (optional feature available at extra cost on an RPQ basis).

.4 OUTPUT

.43 Output to Magnetic Tape

Magnetic tape buffer —

Tape size: . . . . . 16mm sprocketed magnetic oxide coated film recorded at 83 char/inch; 200-foot tape is contained in a removable cartridge.

Tape code: . . . . . IBM Selectric code; six bits plus odd parity; see Table I.

Rated output speed: . . . . . 14.8 char/sec (keyboard) or 133 char/sec (communications facility).

Effective speed: . . . . . limited by block length and transmission speed.

Format control: . . . . . via PAD Memory Unit on Models 95 and 105.

TABLE I. COMMUNITYPE TRANSMISSION CODE

Lower Case*	Bit Position							Upper Case*
	1	2	3	4	5	6	7	
A	1	1	1	1	0	0	1	
B	0	1	1	0	0	0	1	
C	0	1	1	1	0	0	0	
D	1	0	1	0	0	0	1	
E	1	0	1	1	0	0	0	
F	0	0	1	0	0	0	0	
G	0	0	1	1	0	0	1	?
H	1	0	0	1	0	0	1	¤
I	1	0	0	0	0	0	0	[
J	1	1	1	1	1	0	0	
K	0	1	1	0	1	0	0	
L	0	1	1	1	1	0	1	
M	1	0	1	0	1	0	0	
N	1	0	1	1	1	0	1	
O	0	0	1	0	1	0	1	
P	0	0	1	1	1	0	0	!
Q	1	0	0	1	1	0	0	*
R	1	0	0	0	1	0	1	]
S	0	1	1	0	0	1	0	
T	0	1	1	1	0	1	1	
U	1	0	1	0	0	1	0	
V	1	0	1	1	0	1	1	
W	0	0	1	0	0	1	1	
X	0	0	1	1	0	1	0	†
Y	1	0	0	1	0	1	0	%
Z	1	0	0	0	0	1	1	‿
1	1	1	1	1	1	1	1	
2	0	1	1	0	1	1	1	
3	0	1	1	1	1	1	0	
4	1	0	1	0	1	1	1	
5	1	0	1	1	1	1	0	
6	0	0	1	0	1	1	0	
7	0	0	1	1	1	1	1	
8	1	0	0	1	1	1	1	@
9	1	0	0	0	1	1	0	:
0	0	0	0	1	1	1	0	>

.44 Output to Printer

Output medium:	friction-fed or pin-fed (optional) fanfold forms up to 15.5 inches wide (13-inch writing width).
Character set:	88 printable characters; see Table I.
Rated printing speed:	14.8 char/sec.
Effective speed:	less than rated speed due to carriage return, line feed, or other format operations.
Format control:	controlled by function codes in incoming data, or manually. Controls include line feed, carriage return, case shift, backspace, and horizontal tab.
Comments:	horizontal spacing is 10 char/inch (12 char/inch optional); vertical spacing is six lines/inch (eight lines/inch optional).

TABLE I. COMMUNITYPE TRANSMISSION CODE (Contd.)

Lower Case*	Bit Position							Upper Case*
	1	2	3	4	5	6	7	
—	1	1	1	0	1	0	1	;
#	0	0	0	0	1	1	1	✓
₺	1	1	1	0	0	1	1	\
&	1	1	1	0	0	0	0	<
$	0	0	0	0	1	0	0	Δ
,	0	0	0	0	0	1	0	⧺
.	0	0	0	0	0	0	1	⧻
/	1	1	1	1	0	1	0	
Function Codes (non-printing)								Meaning
	1	1	0	0	1	1	1	Space
	1	1	0	0	0	1	0	Horizontal Tab
	1	1	0	0	1	0	0	Carriage Return
	1	1	0	0	0	0	1	Line Feed
	0	1	0	1	1	1	1	Upper Case
	0	1	0	1	0	0	1	Lower Case
	0	1	0	1	1	0	0	Backspace
	0	0	0	1	0	1	1	IRG Code
	0	1	0	0	1	1	0	End of File
Optical Codes (non-printing)**								
	0	0	0	1	0	0	0	
	1	1	0	1	0	0	0	
	0	0	0	1	1	0	1	
	1	1	0	1	1	0	1	
	1	1	0	1	1	1	0	
	1	1	0	1	0	1	1	
	0	1	0	1	0	1	0	
	0	1	0	1	1	0	1	
	0	1	0	0	0	1	1	
	0	1	0	0	0	0	0	

* Codes having no symbol in the lower or upper case column do not have any corresponding graphic or control character associated with them. All codes can be generated from keyboard except optional codes, which requires keypad.

** These codes are available at additional cost; error substitution character can be selected from these codes.

.5 ERROR DETECTION AND CORRECTION

.51 Data Entry Errors

Type of checking: . . . . . tape character parity is checked in Printout mode.

Error indication: . . . . . lamp is lighted; (keyboard locks with Read-After-Write option).

Correction procedure: . . . . . operator intervention is required to reverse tape and reread error character; incorrect data can be corrected from the keyboard by backspacing with the Error-Correct button depressed, and then keying in new characters.

.52 Data Transmission Errors

Type of checking:	character parity and longitudinal parity.
Error indication:	lamp is lighted; request for retransmission is initiated via the reverse channel.
Correction procedure:	sending and receiving tapes automatically reverse to interrecord gap, and incorrectly received record is retransmitted.
Comments:	operation halts or a special symbol is substituted for error character after one retransmission without halting transmission.

.53 Data Recording Errors

Type of checking:	read-after-write check on character and longitudinal parity.
Error indication:	keyboard locks, error lamp lights.
Correction procedure:	operator intervention is required to extinguish error lamp and re-key data.

.55 Line Malfunctions

Detection:	reverse channel is interrupted for a specified period of time.
Action:	automatic disconnect.

.7 DATA TRANSMISSION

.71 Basic Characteristics

Rated transmission speed:	133 char/sec (1,200 bits/sec).
Transmission method:	serial by bit.
Transmission code:	7-level IBM Selectric Typewriter Code (six bits plus parity); characters are separated by one bit position).
Transmission mode:	half-duplex.
Order of bit transmission:	low order bit first.
Synchronization:	synchronous; terminal is synchronized by first character transmitted.

.72 Connection to Communications Lines

Communications Line or Service	Data Set*
Public telephone network:	Bell System Data-Phone Data Set 202C.**
Bell System leased voice-band (Type 3002-C1 Data Channel):	Bell System Data Set 202C or 202D or Western Union 1200 Baud Data Modem.**

.73 Transmission Control

Call initiation:	manual dialing or signaling.
Call reception:	manual (can be unattended in the Receive mode).
Functional operations:	different control codes perform a variety of functions such as line feed, carriage return, case shaft, horizontal tab, backspace, etc.

* In some cases, equivalent data sets and telephone couplers can be used; see Sections 4620 and 4640 for a current list of modems available from independent manufacturers of telephone equipment.

** Bell System 202C2 and 202D2 Data Sets provide reverse-channel capability.

.74 Multistation Operation: . . . . . no provision.

.8 PHYSICAL SPECIFICATIONS

Component	Communitype Models 94, 95, 100, and 105	Model 90 Data-Jotter
Width (inches)	60	45
Depth (inches)	30	30
Height (inches)	29	30
Weight (pounds)	300	250
Power (KVA)	1.7	1.7
Voltage	105 to 125	110
Frequency (Hz)	60	60
Phases	1	1
Temperature Range (°F)	55 to 100	55 to 100
Humidity Range (%)	0 to 85	0 to 85
Heat (BTU/hr)	450	450

.9 PRICE DATA

Component or Feature	Monthly Rental $	Purchase Price $	Monthly Maintenance $
Data Communication System			
Model 90 (Data-Jotter)	160	6950	35
Model 94	295	10,600	55
Model 95	325	12,600	65
Model 100	340	11,600	55
Model 105	370	14,000	65
Magnetic Tape Transmission/ Conversion System			
Model 500	395	18,000	55
Model 550	395	18,000	55
Model 800	535	24,000	65
Model 850	535	24,000	65
Features			
Card Reader	70	2000	11
Automatic Retransmission	10	450	2
Read-After-Write	10	450	2
Additional Tape Cartridge	–	25	–
Additional PAD Cartridge	–	45	–

COMMUNITYPE 550 AND 850 MAGNETIC TAPE TRANSMISSION/CONVERSION SYSTEMS

.1 GENERAL

.11	Identity:	Communitype Model 550 and Model 850.
.12	Manufacturer:	Communitype Corporation GM Building 767 Fifth Avenue New York, New York 10022
.13	Basic Function:	off-line magnetic tape recording of data received or off-line transmission of data read from magnetic tape via a voice-band communications facility.

.15 Description

The Communitype Magnetic Tape Transmission/Conversion System is an off-line data receiving and sending station designed to provide transcription, computer code translation, and exchange of magnetic tape data transmitted to and from the Communitype Data Communication System, an input/output source data terminal; see Report 6120. Two basic single-unit terminal configurations of the Magnetic Tape Transmission/Conversion System are available:

- Model 550 — writes data on 7-channel IBM System/360-compatible magnetic tape at 556 bits per inch;
- Model 850 — writes data on 9-channel IBM System/360-compatible magnetic tape at 800 bits per inch.

Data is transmitted asynchronously over the public telephone network at 1200 bits per second or over a leased voice-band line at up to 1800 bits per second using Bell System 202 Series Data Sets; see Paragraph .72. A 7-level (6 bits plus parity) IBM BCD Selectric transmission code is employed in the half-duplex mode; see Report 6120, Table I.

The Magnetic Tape Transmission/Conversion System has two operating modes:

- Receive (Write) Mode — data transmitted from a Communitype Model 100 or 105 Data Communication System or other send/receive terminal at 1200 bits per second (100 characters per second) is recorded immediately character-by-character in computer-compatible code (Model 550: IBM BCD; Model 850: EBCDIC) as it is received; each character is checked for vertical parity, and inter-record gaps (IRG) and longitudinal and cyclic redundancy checks are generated internally.
- Send (Read) Mode — data from standard computer-prepared magnetic tape (Model 550: 7-level; Model 850: 9-level) is read into a 160-character MOS/FET (Metal Oxide Semi-conductor Field Effect Transistor) buffer memory at 1200 bits per second for transmission to a Model 100 or 105 Data Communication System or for tape-to-tape transmission to another Model 550 or 850 unit.

The direction of data transmission is switch-selectable at the sending or receiving station; see Paragraph .36.

Error detection is provided by parity verification of each character received. Upon detection of a character received in error, the receiving terminal will halt the write operation and transmit a reverse channel signal to the sending station; upon receipt of the signal, the sending station will retransmit the entire data block in which the error occurred. This automatic retransmission feature operates in both Send and Receive Modes. In the Send Mode, the affected data is retransmitted; the MOS/FET buffer has nondestructive readout and destructive readin. In the Receive Mode, a special character of the user's choice is recorded immediately following the incorrect record, and the data block is recorded a second time.

Figure 1. Communitype Model 550 or 850 Magnetic Tape Transmission/Conversion System

.16 First Delivery: . . . . . December, 1968 (Model 550); none to date (Model 850)

.17 Availability: . . . . . 3 to 6 months.

.2 CONFIGURATION

The basic Communitype Transmission/Conversion System consists of a Model 550 or Model 850 buffered reader/recorder magnetic tape unit. A data set is required to connect the system to a communications line; see Paragraph .72.

.3 INPUT

.31 Prepared Input

Input medium:	standard 0.5-inch computer magnetic tape; 556 bits/inch (Model 550) or 800 bits/inch (Model 850).
Input code:	any 7-level (Model 550) or 9-level (Model 850) code.
Quantity of data:	variable up to tape capacity of 14 million (Model 550) or 20 million (Model 850) characters.
Character set:	any standard character set with maximum of 44 characters plus 9 function codes.
Rates input speed:	1200 bits/sec.
Effective speed:	limited by record length and transmission speed.
Comments:	data is read block-by-block into a 160-character (minimum) MOS/FET buffer memory; larger capacity buffer memories are available; tape handler accommodates 5-, 8.5-, and 10.5-inch tape reels.

.35 Message Configuration: . . . . . data is transmitted in variable-length records; each data record begins and ends with an IRG character; an EOF (End-of-File) character follows the IRG character at the end of a message; longitudinal parity is recorded before the IRG is generated.

.36 Operating Procedure

To send or receive a data transmission, the operator:

- Mounts the tape reel on the magnetic tape handler unit and positions the tape at the starting point;
- Establishes connection by dialing or answering the Data-Phone;
- Depresses the data set Data button;
- Switches the terminal to Transmit or Receive mode;
- Starts the send or receive operation by depressing the Send or Receive button.

Depressing the BOT button automatically advances the tape to a reflective marker where the data begins. Subsequent operation, including retransmission, is automatic. Operator intervention is required only to break the connection.

.4 OUTPUT

.43 Output to Magnetic Tape

Tape size:	7-channel, 0.5-inch IBM 360-compatible at 556 bits/inch (Model 550); 9-channel 0.5-inch IBM 360-compatible at 800 bits/inch (Model 850).
Tape code:	IBM BCD (Model 550); EBCDIC (Model 850).
Rated output speed:	1200 bits/sec (100 char/sec).
Effective speed:	limited by block length and retransmit check at the end of each record.
Format control:	function of software control; variable length records.
Comments:	accommodates Series 729 (Model 550) and Series 2400 (Model 850) tape drives using 5-, 8.5-, or 10.5-inch tape reels.

.5 ERROR DETECTION AND CORRECTION

.51 Data Entry Errors:	no provision.

.52 Data Transmission Errors

Type of checking:	character parity and longitudinal parity; longitudinal redundancy check character is recorded before each IRG.
Error indication:	parity lamp is lighted; request for retransmission is initiated via the reverse channel.
Correction procedure:	sending tape reverses automatically to IRG and incorrectly-received record block is retransmitted.
Comments:	receiving tape does not reverse; a user-selected record delete code is entered on the tape and retransmitted data follows.

.53 Data Recording Errors:	no provision.

.55 Line Malfunction

Detection:	reverse channel is interrupted by the receiving terminal for a specified period of time.
Action:	automatic retransmission.

.6 CONDITION INDICATORS

Indicators located on the Model 550 or 850 console signify the following conditions when lighted:

- DATA — data is being transmitted or received.
- SEND — unit is in send mode.
- RECEIVE — unit is in receive mode.
- PARITY RESET — erroneous data has been transmitted or received.
- OVERLOAD — sending unit attempted to transmit a data record larger than the buffer capacity of 160 characters.
- NON-RECORD — unit is in a neutral state, i.e. not sending or receiving.
- END-OF-TAPE — magnetic tape supply is depleted.

.7 DATA TRANSMISSION

.71 Basic Characteristics

Rated transmission speed:	1200 or 1800 bits/sec over a voice-band line.
Transmission method:	serial by bit.
Transmission code:	7-level, IBM Selectric BCD (6 bits plus parity).
Transmission mode:	half-duplex.
Order of bit transmission:	low-order bit first.
Synchronization:	asynchronous; start/stop bits transmitted with each character.

.72 Connection to Communications Lines

Communications Line or Service	Data Set*
Public telephone network (1200 bits/sec):	Bell System Data-Phone Data Set 202C or Data Set 202D. **
Leased common-carrier voice-band line (1800 bits/sec):	Bell System Data-Phone Data Set 202C, Data Set 202D, or Western Union 2400 Band Data Modem.

.73 Transmission Control

Call initiation:	manual dialing.
Call reception:	operator must establish voice communication and then switch to data mode.
Functional operations:	initiated by control characters contained in the data portion of incoming messages.

.74 Multistation Operation: no provision.

* In some cases, equivalent data sets and telephone couplers can be used; see Sections 4620 and 4640 for a current list of modems available from independent manufacturers of telephone equipment.

** Bell System 202C2 and 202D2 Data Sets provide reverse-channel capability.

.8 PHYSICAL SPECIFICATIONS

Component	Model 550	Model 850
Width (inches)	22	22
Depth (inches)	25	25
Height (inches)	47	47
Weight (pounds)	200	200
Power (KVA)	(?)	(?)
Voltage	105 to 125	105 to 125
Frequency (Hz)	60	60
Phases	1	1
Temperature Range (°F)	55 to 100	55 to 100
Humidity Range (%)	(?)	(?)
Heat (BTU/hr.)	(?)	(?)

.9 PRICE DATA

Component	Monthly Rental, $	Purchase Price, $	Monthly Maintenance, $
Model 550	395	18, 000	55
Model 850	535	24, 000	65

COMPUTER COMMUNICATIONS CC—30 COMMUNICATIONS STATION

.1 GENERAL

.11 Identity: . . . . . CC-30 Communications Station.

.12 Manufacturer: . . . . . Computer Communications, Inc.
701 W. Manchester Blvd.
Inglewood, California 90301

.13 Basic Function: . . . . . displays, via cathode ray tube, data received from a remote computer or entered via keyboard; transmits data to a remote computer over the public telephone network, a leased voice-band line, or a broad-band facility; portable or fixed-location components.

.15 Description

The Computer Communications CC-30 Communications Station is a visual communications terminal designed for fixed-location or portable operation; it can use any standard television receiver as a display device. The terminal can be coupled to a standard telephone set, connected to a Bell System 100, 200, or 300 Series Data Set, or equivalent data sets, or connected directly to a computer input/output channel. Both alphanumeric and graphic data can be displayed.

Configuration

The CC-301 TV Display Controller is the heart of the CC-30 Communications Station. The CC-301 contains a 1024-word buffer (9 bits per word), a character/graph generator, input-output control section (for local devices), and a parallel or serial interface.

The CC-300 Model II TV Receiver, a 12-inch solid-state portable television receiver, is the standard display device connected to the CC-301 Controller. Other models are available from CCI; they differ from one another in screen size and the use of tube-type or solid-state circuitry; see Paragraph .9.

Up to 16 CC-300 TV Receivers can be attached to a single CC-301 Controller; the same image is displayed by all receivers. In addition, any conventional monochrome television receiver can be adapted by CCI to operate with the CC-301 Controller; the required modification is slight.

Data can be manually entered via the CC-303 Alphanumeric Keyboard.

Several input-output devices are available with the CC-30 Communications Station:

- A 300 character-per-second CC-305 Line Printer (Motorola);
- A 100 card-per-minute portable CC-306 Card Reader;
- A CC-307 Typewriter (IBM Selectric); and
- A CC-308 Teletypewriter Adapter (Teletype Model 33 or 35 RO or ASR).

Any combination up to seven I/O devices can be connected to a CC-301 Controller when the optional Input Channel (Option 3) and Output Channel (Option 4) are incorporated.

Additional devices, including magnetic tape units, magnetic disc units, paper tape units, and others, can be connected to the CC-301 Controller; prices for these options are individually negotiable with CCI.

The CC-304 Light Pen is a narrow aperture, low-resolution photocell capable of locating a single character position (alpha mode) or any three horizontally sequential dots (graphic mode). When activated, the Light Pen can be used to select specific data displayed on the screen; the address (coordinates) of the selected data is stored for later access by the computer. After selecting the data, the operator can alert the computer by transmitting an interrupt signal.

Figure 1. CC-30 Communications Station including CC-300 Model II Television Receiver, CC-303 Model III Alphanumeric Keyboard, and CC-301 Model II TV Display Controller.

Configuration

The CC-301 Controller contains a parallel interface for direct connection to a computer via a Channel Adapter (computer interface). In this configuration, data can be transferred at rates up to 500,000 characters per second.

A serial interface (Option 1) is required when the CC-30 Communications Station is connected to a communications line. The serial communications interface, also contained in the CC-301 Controller, can interface with a Bell System 100, 200, or 300 Series Data Set or equivalent for fixed-location operation. Alternatively, the CC-302 Telephone Coupler can acoustically couple the CC-301 Controller to a conventional telephone set where portable operation is desired. The CC-302 coupler is compatible with the Bell System Data-Phone Data Set 103A1 or 103A2.

Up to 32 remote CC-30 Communications Stations, each operating over a separate line, can be connected to a single computer input-output channel via the CC-72 Communications Multiplexor located at the computer site. A CC-721 Line Adapter, contained in the CC-72 cabinet, is required for every two communications lines.

A Channel Adapter is required to match the CC-72 Multiplexor to the computer input-output channel. The Channel Adapters are designed to provide a direct parallel connection between the computer and a CC-30 Communications Station; an optional serial interface is required when the Channel Adapter is to be connected to a remote CC-30.

A family of Channel Adapters is available to meet the interface requirements of some of the major computer manufacturers. The Channel Adapters presently available from CCI are presented below.

- CC-7011 — connects to storage access channel of an IBM 1130 computer.
- CC-7012 — connects to one or two Multiplexor or Selector channels of an IBM System/360 computer.
- CC-7013 — connects to data channel of a CDC 3000 Series computer.
- CC-7014 — connects to SDS Sigma Series computer.
- CC-7015 — connects to I/O bus of DEC PDP-8, Line-8, and PDP-12 computers.

.15 Description (Contd.)

The CC-72 Remote Master Controller enables the computer to address up to 32 CC-301 Controllers and related devices, all operating over the same line. Each CC-301 Controller can be located up to 5000 cable-feet from the Master Controller. A CC-721 Line Adapter, contained in the Master Controller cabinet, is required for every two CC-301 Controllers. A party line serial interface is available which permits up to 62 terminals to be multidropped on a single communications line (Option 7).

Transmission Characteristics

The CC-301 Display Controller operates in a half-duplex mode over the public telephone network at up to 2000 bits per second or over a leased voice-band line at up to 2400 bits per second. The Bell System 100 and 200 Series Data Sets span this speed range. The CC-301 can also operate in a half-duplex mode over broad-band facilities at up to 50,000 bits per second using a Bell System 300 Series Data Set or its equivalent. The CC-302 Telephone Coupler enables station portability but limits the transmission speed to 300 bits per second. The CC-302 Coupler provides full-duplex operation using frequency-shift modulation.

The CC-30 Communications Station employs the 7-level USASCII transmission code, presented in Table II. An even parity bit is appended to each transmitted character.

When operating as a stand-alone display station; i.e., a single CC-301 Controller and CC-300 TV Receiver, an asynchronous transmission technique is employed. A total of 10 bits including unity start and stop bits, seven data bits, and an even parity bit are transmitted.

When the CC-72 Remote Master Multiplexor is employed in a multistation environment, a synchronous transmission technique is used. Each character totals eight bits, including an even parity bit. A SYN character precedes each transmission.

Display Unit

The display characteristics of the CC-300 Model II Receiver are summarized in Table I. Any conventional television receiver ranging from a 5-inch screen to a 23-inch screen will display the same format when connected to the CC-301 Controller. When operating in the graphic mode, the display image is formed by a pattern of dots arranged in a 108-by-85 dot matrix; the viewing area on a 12-inch receiver measures 5.5 by 8 inches.

The buffer memory included in the CC-301 Controller has a capacity of 1024 9-bit words; the first 800 word-locations correspond to the 800-position alphanumeric display format. The remaining 224 memory locations are accessible to the computer for storing and retrieving terminal identification and other information.

Each displayed character is formed within a 5-by-7 dot matrix. The 64-symbol character set includes upper-case alphabetics, numerics, and special symbols (including the cursor symbol). A Nonstandard Character Set (Option 2) allows the user to define a character set of up to 96 characters or symbols, employing bit configurations in columns 2 through 7 of the USASCII code chart; see Table II. The display is regenerated 60 times per second.

Keyboard

The CC-303 Model III Alphanumeric Keyboard operates electromechanically (each key-switch contains gold-plated contacts). The keyboard is portable and is interlocked to prevent more than one key depression at a time.

The Model III keyboard contains 65 keys including control and cursor keys which are separated (for ease of identification) from the data entry keys; see Figure 2. This keyboard is capable of generating the complete 127-character USASCII character set (all except NUL). Control functions can be generated by depressing only the control function key. Control codes other than those specified as functions can be generated by depressing the special code key concurrently with the designated control code key. Repetitive data entry is performed by holding a key in a depressed position.

Figure 2: CC-303 Model III Alphanumeric Keyboard

.15 Description (Contd.)

Cursor controls permit positioning the cursor (an underscore symbol) to:

- The first character position of the first line (Reset key),
- The first character position of the current line (Return key),
- The first character position of the next line (New Line key),
- The current position on the next line (down arrow),
- The current position on the preceding line (up arrow),
- One space to the right (right arrow), or
- One space to the left (left arrow).

When the cursor controls marked by arrows are held in a depressed position, the cursor continues to step in the specified direction and will wrap-around the screen in any of the four directions. The current cursor location is contained in a cursor address register within the CC-301 Controller. The cursor address can be accessed and altered by the computer.

Editing Facilities

Data can be altered by positioning the cursor to the desired character-location and typing new data over the existing data; no expansion or contraction of data takes place. The entire screen can be erased by using the Clear key. When it is desired to retain fixed data, as in a fixed format, a New Line symbol is used at the end of each entry. The New Line symbol causes the cursor to skip all succeeding characters in the line and move to the beginning of the next line. The Tab key positions the cursor forward or backward to a fixed tab stop located at the center position of each line.

(Contd.)

TABLE I: CC-300 MODEL II DISPLAY OUTPUT CHARACTERISTICS

Characteristic	Description
Output Medium	Cathode ray tube; displays white characters against black background.
Character Set	64 characters, including upper-case alphabetics, numerics, punctuation marks, and special symbols; 96 customer-specified characters or symbols with the Nonstandard Character Set (Option 2).
Character size	0.156 inch wide and 0.187 inch high when using a 12-inch TV receiver.
Display Size	6.5-by 8-inch viewing area (standard 12-inch CRT); CRT sizes range from 8 inches to 27 inches (diagonal measurement).
Character Generation	5- by 7-dot matrix.
Characters per Line	40.
Lines per Display	20 or 24 (option 5).
Characters per Display	800 or 960 (option 5).
Buffer Capacity	1024 characters.
Format Control	Carriage return/line feed; split screen capability; flexible cursor movement controls; fixed tab positioning.
Rated Output Speed	Up to 500,000 char/sec on-line; up to 200 or 240 char/sec over public telephone network or leased voice-band line respectively; up to 50,000 char/sec over a broad-band facility.
Effective Output Speed	Limited by message length and communications facility.
Comments	The CC-300 can also be used in the graphic mode to display data within a matrix of 108 by 85 dots; the viewing area in the graphic mode is 7.5 inches wide by 4.75 inches high with the 12 inch TV receiver.

Operating Procedure

Data is entered at any location of the display by positioning the cursor to that location and keying in the data. The cursor advances one character-position as each character enters. Any editing that may be necessary is performed prior to transmitting the message. The End-of-Text character is entered at the end of the message by depressing the END key; the cursor returns to the beginning of the message. Transmission of the message follows.

The station can operate in one of two operator-selectable transmission modes: Character mode or Block mode.

In the Character mode of operation, each character entered from the keyboard is immediately transmitted but not displayed. The station waits for a response from the computer and displays the returned character or message. The computer can respond to a detected character-parity error by returning a special parity symbol, which is displayed in the current cursor position on the screen. The keyboard is locked while the station is waiting for the response from the computer. Data can be transmitted from any input device in the system. In this mode of operation, errors can be detected and corrected on a character-by-character basis.

TABLE II: CC-30 USASCII TRANSMISSION CODE (3)

Bit Position				7 6 5	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1
4	3	2	1	Column → / Row ↓	(2) 0	(2) 1	2	3	4	5
0	0	0	0	0			Space	0	@	P
0	0	0	1	1	SOH		!	1	A	Q
0	0	1	0	2	TRANS		"	2	B	R
0	0	1	1	3	END(1)		#	3	C	S
0	1	0	0	4	EOT		$	4	D	T
0	1	0	1	5	INT	PARITY(1)	%	5	E	U
0	1	1	0	6			&	6	F	V
0	1	1	1	7			'	7	G	W
1	0	0	0	8	←		(	8	H	X
1	0	0	1	9	→	CLEAR	)	9	I	Y
1	0	1	0	10	LINE(1)	↑	*	:	J	Z
1	0	1	1	11	↓		+	;	K	[
1	1	0	0	12	RESET	TAB	,	<	L	\
1	1	0	1	13	RETURN		-	=	M	]
1	1	1	0	14	OUT		.	>	N	^
1	1	1	1	15	IN		/	?	O	_

(1) The only displayable codes in columns 0 and 1 are END (◣), LINE (◢) and PARITY (■).

(2) The designated control functions in columns 0 and 1, except for SOH, EOT, and PARITY, are keyboard functions and are identified by the corresponding keytops.

(3) All codes received with a "110" or "111" configuration for bits 7, 6, and 5 (columns 6 and 7, not shown) are displayed as ≡ unless the Nonstandard Character Set (Option 2) is employed.

.15 Description (Contd.)

In the Block mode, the complete message is composed prior to transmission. When the message is to be transmitted, the Transmit key is depressed. The CC-301 Controller functions in one of two sub-modes of operation when placed in the Block mode. These sub-modes, Transmit Enabled and Transmit Disabled, are established by the computer. The Controller must be placed in the Transmit Enabled sub-mode to accept a message. If it is already in this mode when the Transmit key is depressed, the message is immediately sent to the computer. Depressing the Transmit key, when the controller is in the Transmit Disabled sub-mode, locks the keyboard until the computer polls for the message.

When operating with the CC-72 Remote Master Controller, depressing the Transmit key sets a status indicator within the Master Controller. The computer can sample the status indicators and selectively initiate transmission from a waiting display terminal. The Master Controller can also alert the computer to a waiting message by sending an interrupt signal when a status indicator is set.

(Contd.)

Message Configuration

The message transmitted from the CC-30 Communications Station includes a Start-of-Text (STX) character, the message, and an End-of-Text (EXT) character. A message is transmitted in sequence beginning at the cursor position and ending with the ETX character. Messages received from the computer can completely override any local operations. Commands received from the computer are preceded by a Start-of-Header (SOH) character which conditions the Controller to interpret the following character as a function code. Bit positions seven through five of the function code select a specific input or output device (including the display unit); bit positions four through one specify one of several commands, such as, select graphic or alphanumeric mode, load or read cursor address register, read Light Pen address, halt local input-output operations, and others. The computer can also request the status of the station, defined in a single character. When it is desired to unlock the keyboard, the computer message is terminated with an End-of-Transmission (EOT) signal, which releases the keyboard to the operator.

When the CC-72 Remote Master Controller is included, computer messages are prefixed by an SOH and a single address character; the address character specifies which of the CC-301 Controllers is to receive the message.

Error Detection and Correction

Errors that occur during off-line composition are corrected by positioning the cursor under the character in error and rekeying the correct character. When transmitting a message to the computer in the Character mode, the computer responds to a detected character-parity error by returning a special parity symbol, which is displayed in the position of the character received in error. The operator corrects the error by retyping the character.

Computer response to errors received in the Block mode is dependent upon the controlling software. When parity errors are detected at the display station, a status bit is set and a special parity-character is displayed on the screen in place of the character in error. The operator can request retransmission or can repeat the interrogation message.

.16 First Delivery: . . . . . August 1967.

.17 Availability: . . . . . 3 months.

.8 PHYSICAL SPECIFICATIONS

Component	CC-301 Model II Controller	CC-303 Model III Keyboard	CC-305 Line Printer	CC-306 Card Reader
Width (inches)	9.0	8.5	16.0	18.1
Depth (inches)	21.0	13.5	14.0	22.9
Height (inches)	10.1	3.0	9.0	10.0
Weight (pounds)	40.0	6.25	40.0	108.0
Power (KVA)	—	—	0.115	0.360
Voltage	115	115	115	115
Frequency (Hz)	60	60	60	60
Phases	1	-	1	1
Temperature Range (°F)	50 to 120	50 to 120	65 to 85	65 to 90
Humidity Range (%)	10 to 80	10 to 80	10 to 80	30 to 75
Heat (BTU/hr)	—	—	—	—

.9 PRICE DATA

Component or Feature	Purchase Price,* $
CC-300 TV Receiver —	
Model II (12-inch)	195
Model IV (8-inch)	465
Model V (14-inch)	485
Model VI (17-inch)	490
CC-301 Model II TV Display Controller (1) (includes parallel interface)	6300
Option 1 — Serial communications interface compatible with Bell System 100, 200, or 300 Series Data Sets	500
Option 2 — Nonstandard Character Set (2)	400
Option 3 — Input Channel (3)	500
Option 4 — Output Channel (3)	500
Option 5 — 960 Character Display (4)	300
Option 7 — Party Line Serial Interface	800
Option 8 — Blinking Cursor	100
Option 9 — External Synchronization	500
Option 14 — Composite Sync-Video Generator	150
CC-302 Telephone Coupler	600
CC-303 Model III Alphanumeric Keyboard	550
CC-304 Light Pen (includes control logic contained in CC-301 Controller)	1500
CC-305 Line Printer (Motorola)	7500
CC-306 Card Reader	4700
CC-308 Teletypewriter Adapter	1600
CC-72 Remote Multiplexor	5500
CC-721 Line Adapter	700
Channel Adapters —	
CC-7011 (IBM 1130)	5500
CC-7012 (IBM System/360)	5500
Dual Channel Option	2000
CC-7013 (CDC 3000 Series)	5500
CC-7014 (SDS Sigma Series)	5500
CC-7015 (DEC PDP-8, Line-8, or PDP-12)	
Model II (integrated into CC-301 Controller for direct connection; cannot include Option 1)	1500

(1) All options are contained in the CC-301 Controller.

(2) Includes up to 96 customer-specified characters or symbols.

(3) These options provide connection for any combination of up to seven I/O devices, excluding Keyboard and Light Pen.

(4) Expands the display arrangement to 24 lines of 40 characters per line.

*CCI provides standard leasing and maintenance arrangments upon request.

COMPUTER COMMUNICATIONS CC—33
TELETYPE—ORIENTED DISPLAY STATION

.1 General

.11 Identity: . . . . . CC-33 Teletype-Oriented Display Station.

.12 Manufacturer: . . . . . Computer Communications, Inc.
701 W. Manchester Boulevard
Inglewood, California 90301

.13 Basic Function: . . . . . visual display, via cathode ray tube (CRT), of alphanumeric and graphic data transmitted at 110, 600, or 1200 bits per second between the display terminal and a remote computer over the public telephone network or over a narrow-band or voice-band line; data entry is provided via keyboad or program control; printed copy is optional.

.15 Description

The CC-33 Teletype-Oriented Display Station incorporates the same basic components found in the CC-30 Communications Station, excluding the CC-301 Model III Display Controller.

Basic Operation

The basic CC-33 Teletype Compatible Display Station consists of a CRT/keyboard and control unit which operates into computer systems using the existing Teletype hardware and software without modification. Designed for fixed-location or portable operation the CC-33 can incorporate, with slight modification, any standard television receiver as a display device. Both alphanumeric and graphic data can be displayed. An alphanumeric keyboard provides manual data entry.

Configuration

The basic CC-33 Display Station configuration includes the following components:

- a CC-301 Model III Display Controller;
- a CC-300 Model II TV Display; and
- a CC-303 Model III Alphanumeric Keyboard.

The CC-301 Model III TV Display Controller contains a 1024-word buffer (9 bits per word), a character/graph generator, input-output control section (for local devices), and a serial interface.

The CC-300 Model II TV Receiver, a 12-inch solid-state portable television receiver, is the standard display device connected to the CC-301 Controller. Other models are available from CCI; they differ from one another in screen size and the use of tube-type or solid-state circuitry; see Paragraph .9.

Up to 16 CC-300 TV Receivers can be attached to a single CC-301 Controller; the same image is displayed by all receivers. In addition, any conventional monochrome television receiver can be adapted by CCI to operate with the CC-301 Controller; the required modification is slight.

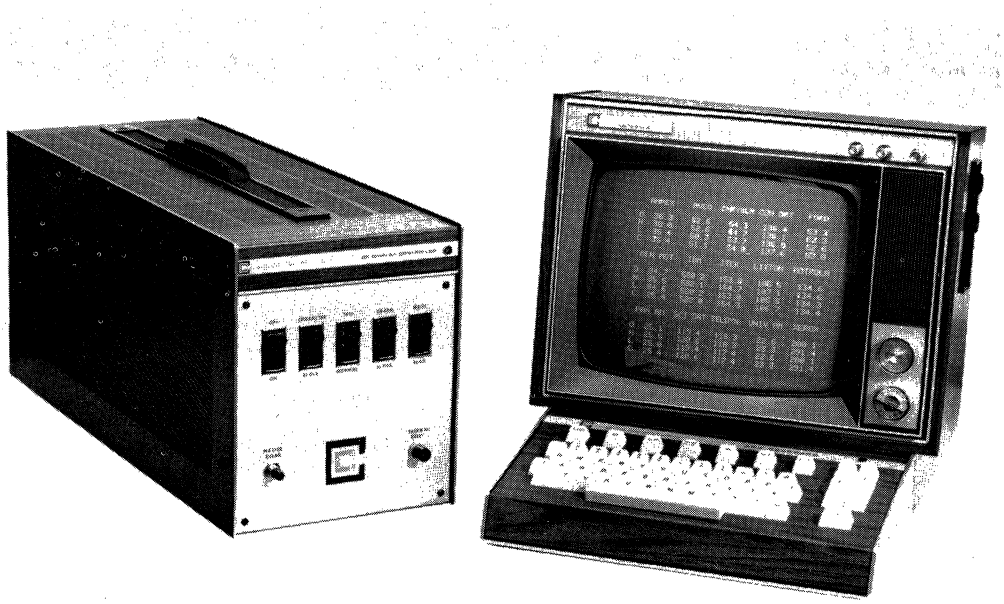


Figure 1. CC-33 Teletype-Oriented Display Station including CC-301 Model III TV Display Controller, CC-300 Model II Television Receiver, and CC-303 Model III Alphanumeric Keyboard.

.15 Description (Contd.)

Data can be manually entered via the CC-303 Alphanumeric Keyboard.

Several input-output devices are available with the CC-30 Communications Station:

- a CC-304 Light Pen;
- a 300 character-per-second portable CC-305 Line Printer (Motorola);
- a 300 card-per-minute portable CC-306 Card Reader; and
- a CC-308 Teletypewriter Adapter (connects all Teletype models).

Any combination up to seven I/O devices can be connected to a CC-301 Controller when the optional Input Channel (Option 3) and Output Channel (Option 4) are incorporated.

Additional devices, including magnetic tape units, magnetic disc units, paper tape units, and others, can be connected to the CC-301 Controller; prices for these options are individually negotiable with CCI.

Display Controller

A serial interface (Option 1) is required when the CC-33 Display Station is connected to a communications line. The serial communications interface contained in the CC-301 Controller can interface with a Bell System 100 or 200 Series Data Set for fixed-location operation. Alternatively, the CC-302 Telephone Coupler can acoustically couple the CC-301 Controller to a conventional telephone set where portable operation is desired. The CC-302 coupler is compatible with the Bell System Data-Phone Data Set 103A1 or 103A2.

Display Unit

The output characteristics of the CC-300 Model II Receiver are summarized in Table II. Any conventional television receiver ranging from a 5-inch screen to a 23-inch screen will

display the same format when connected to the CC-301 Controller. When operating in the graphic mode, the display image is formed by a pattern of dots arranged in a 108-by-85 dot matrix; the viewing area on a 12-inch receiver measures 5.5 by 8 inches.

The buffer memory included in the CC-301 Controller has a capacity of 1024 9-bit words; the first 800 word-locations correspond to the 800-position alphanumeric display format (960-character option available). The remaining 224 memory locations are accessible to the computer for storing and retrieving terminal identification and other information.

Each display character is formed within a 5-by-7 dot matrix. The 64-symbol character set includes upper-case alphabetics, numerics, and special symbols (including the cursor symbols. A Nonstandard Character Set (Option 2) allows the user to define a character set of up to 96 characters or symbols, employing bit configurations in columns 2 through 7 of the USASCII code chart; see Report 6125 Table II. The display is regenerated 60 times per second.

Each character display location has an absolute memory address; the memory contents is displayed continuously and can be transmitted to the computer or output device at any time via keyboard or program control. The non-destructive cursor, displayed as a horizontal underline, indicates the location to be occupied by the next character entered into or read from the memory buffer. TV receivers varying in size from 8 inches to 27 inches (measured diagonally) are available. The maximum display format consists of 20 lines of data with 40 characters to a line; a 24 line arrangement is available as an option. The display characteristics of three typical CRT models are represented in Table I.

TABLE I: REPRESENTATIVE DISPLAY CHARACTERISTICS OF THREE STANDARD CC-300 SCREEN SIZES

CRT Size (inches)	Display Area		Character Size	
	Alphanumeric (inches)	Graphic (inches)	Height (inches)	Width (inches)
8	5.5 x 4.5	5.0 x 3.25	.125	.094
12	8.0 x 6.5	7.25 x 4.75	.219	.156
18	12.0 x 10.0	11.25 x 7.00	.313	.219

Keyboard

The CC-303 Model III Keyboard is interlocked to prevent more than one key depression at a time. A cable connection provides keyboard operations up to 150 feet from the display controller.

The Model III keyboard contains 65 keys including control and cursor keys which are separated (for ease of identification) from the data entry keys. This keyboard is capable of generating a 127-character USASCII character set (except NUL); see Report 6125, Table II. Control codes can be generated by depressing the special code key concurrently with the designated control code key. Repetitive data entry is performed by holding a key in a depressed position.

Cursor controls permit positioning the cursor (an underscore symbol) to:

- The first character position of the first line (Reset key),
- The first character position of the current line (Return key),
- The same character position of the next line (New Line key),

.15 Description (Contd.)

- The current position on the next line (down arrow),
- The current position on the preceding line (up arrow),
- One space to the right (right arrow), or
- One space to the left (left arrow).

When the cursor controls marked by arrows are held in a depressed position, the cursor continues to step in the specified direction and will wrap-around the screen in any of the four directions. The current cursor location is contained in a cursor address register within the CC-301 Controller. The cursor address can be accessed and altered by the computer.

TABLE II: CC-300 DISPLAY OUTPUT CHARACTERISTICS

Characteristic	Description
Output Medium	Cathode ray tube; displays white characters on black background.
Character Set	64 characters, including upper-case alphabetics, numberics, punctuation marks, and special symbols; 96 customer-specified characters or symbols with the Nonstandard Character Set (Option 2).
Character size	0.156 inches wide and 0.187 inches high when using a 12-inch TV receiver.
Display size	6.5-by 8-inch viewing area (standard 12-inch CRT); CRT sizes range from 8 inches to 27 inches (diagonal measurement)
Character generation	5-by 7-dot matrix
Characters per Line	40.
Lines per Display	20 or 24 (option 5).
Characters per Display	800 or 960 (option 5).
Buffer Capacity	1024 characters.
Format Control	New line character; flexible cursor movement controls; fixed tab positioning.
Rated Output Speed	Up to 110, 600, or 1200 bits/sec over public telephone network or leased voice-band or narrow-band line.
Effective Output Speed	Limited by message length and communications facility.
Comments	The CC-300 can also be used in the graphic mode to display data within a matrix of 108 by 85 dots; the viewing area in the graphic mode is 7.5 inches wide by 4.75 inches high with the 12-inch TV receiver; higher transmission speeds available upon request.

Optional Features

The CC-304 Light Pen is a narrow aperture, low-resolution photocell capable of locating a single character position (alpha mode) or any three horizontally sequential dots (graphic mode). When activated, the Light Pen can be used to select specific data displayed on the screen; the address (coordinates) of the selected data is stored for later access by the computer. After selecting the data, the operator can alert the computer by transmitting an interrupt signal.

The portable CC-305 Line Printer provides high-speed non-impact printing capabilities at 300 characters per second which can be executed locally for off-line operations or remotely under computer program control. Any selected portion of a displayed text can be printed; the printing operation incorporates an electrothermal printing technique with a continuously moving 8.5-inch roll of paper and four separate rotating printheads Data is printed from the buffer sequentially by character and line position in the 80-character line format made. A display image format mode can also be employed where characters are printed only in the middle 40 page columns (positions 20 through 60), arranged identical to the displayed data configuration. See Report 6550 for additional information about the Motorola TP-4000 Series Teleprinters.

The portable CC-306 Card Reader reads standard 80-column punched cards photoelectrically at a rate of 300 cards per minute. The CC-306 is capable of two separate operating modes selected under computer control: the binary image mode and the Hollerith mode. In the binary image mode, each card column is interpreted as two separate 6-bit characters of data as it is read into the buffer-memory. Parity is generated and bit 7 of each work is set to avoid confusion with USASCII code characters. The card reader generates EOT after five cards (800 bytes) have been read into the buffer. In the Hollerith mode, each card column is translated into its 7-bit USASCII code equivalent; parity is generated and the characters are read into consecutive buffer locations following the movement of the cursor. Data transmission is terminated when an EOT, INT, or TRANS character is read, or when data from ten cards (800 characters) has been transmitted, generating EOT. The CC-306 will function accordingly upon reading any USASCII control characters.

Data Transmission

The CC-301 Model III Display Controller operates in a full-duplex mode over the public telephone network or a narrow-band facility using a Bell System Series 103 or 202 Data-Phone Data Set or the CC-302 Telephone Coupler. (Equivalent data sets and telephone couplers can be used; see Sections 4620 and 4640 for a current list of modems available from independent manufacturers of telephone equipment.) Data is transmitted serial by bit at 110, 600, or 1200 bits per second; transmission rates are switch-selectable (Option 13). The CC-301 Controller accomodates serial transmission at increased rates using higher speed serial interfaces which are available on special request.

The CC-33 Communications Station employs the 7-level USASCII transmission code, presented in Report 6125 Table II. An even parity bit is appended to each transmitted character.

When operating as a stand-alone display station; i.e., a single CC-301 Controller and CC-300 TV Receiver, an asynchronous transmission technique is employed. A total of 11 bits including unity start and two stop bits, seven data bits, and an even parity bit are transmitted.

Editing Facilities

Data can be altered by positioning the cursor to the desired character-location and typing new data over the existing data; no expansion or contraction of data takes place. The entire screen can be erased by using the Clear key. The Tab key positions the cursor forward or backward to a fixed tab stop location at the center position of each line. After the bottom

.15 Description (Contd.)

line is displayed, the cursor automatically wrapsaround to the first display line. Each succeeding Line Feed automatically erases all characters from the next line before data entry continues.

Operating Procedure

Data is entered at any location of the display by positioning the cursor to that location and keying in the data. The cursor advances one character position as each character enters. Any editing that may be necessary is performed prior to transmitting the message in the Block mode. The End-of-Text character is entered at the end of the message by depressing the END key. Transmission of the message follows.

The station can operate in one of two operator-selectable transmission modes: Character mode or Block mode.

In the Character mode of operation, each character entered from the keyboard is immediately transmitted. In a full-duplex system the station waits for a response from the computer and displays the returned character or message. In a half-duplex system the character is displayed locally immediately.

The computer can respond to a detected character-parity error by returning a special parity symbol, which is displayed in the current cursor position on the screen. Data can be transmitted from any input device in the system. In this mode of operation, errors can be detected and corrected on a character-by-character basis.

In the Block mode, the complete message is composed prior to transmission. When the message is to be transmitted, the Transmit key is depressed. The CC-301 Controller functions in one of two sub-modes of operation when placed in the Block mode. These sub-modes, Transmit Enabled and Transmit Disabled, are established by the computer. The Controller must be placed in the Transmit Enabled sub-mode to accept a message. If it is already in this mode when the Transmit key is depressed, the message is immediately sent to the computer. Depressing the Transmit key, when the controller is in the Transmit Disabled sub-mode, locks the keyboard until the computer polls for the message.

Message Configuration

Commands received from the computer are preceded by a Start-of-Header (SOH) character which conditions the Controller to interpret the following character as a function code. Bit positions seven through five of the function code select a specific input or output device (including the display unit); bit positions four through one specify one of several commands, such as, select graphic or alphanumeric mode, load or read cursor address register, read Light Pen address, halt local input-output operations, and others. The computer can also request the status of the station, defined in a single character. When it is desired to unlock the keyboard, the computer message is terminated with an End-of-Transmission (EOT) signal, which releases the keyboard to the operator.

Error Detection and Correction

Errors that occur during off-line composition are corrected by positioning the cursor under the character in error and rekeying the correct character. When transmitting a message to the computer in the Character mode, the computer responds to a detected character-parity error by returning a special parity symbol, which is displayed in the position of the character received in error. The operator corrects the error by retyping the character.

Computer response to errors received in the Block mode is dependent upon the controlling software. When parity errors are detected at the display station, a status bit is set and a

special parity-character is displayed on the screen in place of the character in error. The operator can request retransmission or can repeat the interrogation message.

.8 PHYSICAL SPECIFICATIONS: ..... See Report 6125, Paragraph .8.

.9 PRICE DATA

Component or Feature	Purchase Price,* $
CC-300 TV Receiver	
Model II (12-inch)	195
Model IV (8-inch)	465
Model V (14-inch)	485
Model VI (17-inch)	490
CC-301 Model III TV Display Controller (1) (includes serial interface)	7200
Option 2 – Nonstandard Character Set (2)	400
Option 3 – Input Channel (3)	500
Option 4 – Output Channel (3)	500
Option 5 – 960 Character Display (4)	300
Option 13 – Three-Speed Switch	750
CC-302 Telephone Coupler	600
CC-303 Model III Alphanumeric Keyboard	550
CC-304 Light Pen (includes control logic contained in CC-301 Controller)	1500
CC-305 Line Printer (Motorola)	7500
CC-306 Card Reader	4700
CC-308 Teletypewriter Adapter	1600

(1) All options are contained in the CC-301 Controller.

(2) Includes up to 96 customer-specified characters or symbols.

(3) These options provide connection for any combination of up to seven I/O devices, excluding Keyboard and Light Pen.

(4) Expands the display arrangement to 24 lines of 40 characters per line.

* CCI provides standard leasing and maintenance arrangements upon request.

COMPUTER COMMUNICATIONS CC—36 TELEVIDEO CONVERSATIONAL/BATCH STATION

.1 GENERAL

.11 Identity: . . . . . CC-36 Televideo Conversational/Batch station.

.12 Manufacturer: . . . . . Computer Communications, Inc.
701 W. Manchester Boulevard
Inglewood, California 90301

.13 Basic Function: . . . . . displays and/or prints data received from a remote computer over a voice-band or broad-band facility; data to be transmitted can be entered via keyboard and/or punched cards.

.15 Description

Basic Operation

The CC-36 is an integrated communications terminal designed to accommodate remote batching operations, on-line transmission and reception of data in a conversation mode, and off-line operations using local peripheral equipment. The modular input/output components of the CC-30 Communications Station are consolidated into one of two basic CC-36 terminal configurations with the addition of a high-speed impact printer. Communications with a remote computer can be provided over the public telephone network or a leased voice-band or broad-band facility. The terminal can be coupled to a standard telephone set, connected to a Bell System 100, 200, or 300 Series Data Set, or connected directly to the computer input/output channel.

Station controls covering input-output operations and data transmission can be initiated manually by keyboard or remotely by the computer using the appropriate set of USASCII control codes. The CC-36 station can store and execute up to eight consecutive control code sequences using any combination of the 17 available control codes provided in the CC-301 Controller. Once initiated, the stored set of control operations is executed in the order specified without additional operator or computer intervention.

Configuration

The CC-36 Televideo Conversational/Batch Station is available in two basic configurations: Model I and Model II. Excluding the type of printing device used, which is the only distinguishing feature between the two models, both configurations incorporate the same basic components in an integrated console. Model I includes a non-impact printer; Model II includes an impact printer. The remaining components common to both models include the following devices:

- CC-301 Model II TV Display Controller;
- CC-300 Model II TV Display;
- CC-303 Model III Alphanumeric Keyboard; and
- CC-306 Card Reader.

The CC-300 Model II TV Receiver, a 12-inch solid-state portable television receiver, is the standard display device connected to the CC-301 Controller. Other models are available from CCI; they differ from one another in screen size and the use of tube-type or solid-state circuitry; see Report 6125, Paragraph .9.

Up to 16 CC-300 TV Receivers can be attached to a single CC-301 Controller; the same image is displayed by all receivers. In addition, any conventional monochrome television receiver can be adapted by CCI to operate with the CC-301 Controller; the required modification is slight.

Display Controller

The CC-301 Model II TV Display Controller contains a 1024-word buffer (9 bits per word), a character/graph generator, an input-output control section (for local devices), and a serial interface. A parallel interface is also included to provide direct connection to a computer via a Channel Adapter (computer interface). In this configuration, data can be transferred at rates up to 500,000 characters per second.

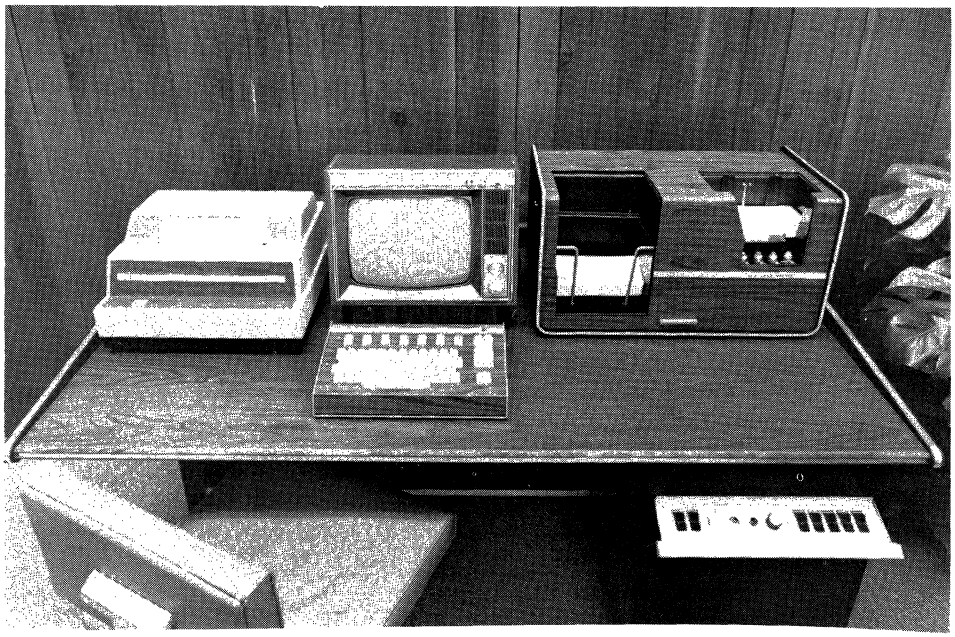


Figure 1. CC-36 Televideo Conversational/Batch Station Model I including CC-305 Line Printer, CC-300 Model II Television Receiver, CC-303 Model III Alphanumeric Keyboard, CC-306 Card Reader, and CC-301 Model II TV Display Controller.

.15 Description (Contd.)

A serial interface (Option 1) is required when the CC-36 Station is connected to a communications line. The serial communications interface can operate using also data sets or over direct connection at rates up to 50,000 bits per second.

Up to 32 remote CC-36 Stations, each operating over a separate line, can be connected to a single computer input-output channel via the CC-72 Communications Multiplexor located at the computer site. A CC-72 Line Adapter, contained in the CC-72 cabinet, is required for every two communications lines. A Channel Adapter is required to match the CC-72 Multiplexor to the computer input-output channel. The Channel Adapters are designed to provide a direct parallel connection between the computer and a CC-36 Station; an optional serial interface is required when the Channel Adapter is to be connected to a remote CC-36.

A family of Channel Adapters is available to meet the interface requirements of some of the major computer manufacturers. The Channel Adapters presently available from CCI are presented below.

- CC-7011 — connects to storage access channel of an IBM 1130 computer.
- CC-7012 — connects to selector or multiplexor channels of an IBM System/360 computer.
- CC-7013 — connects to data channel of a CDC 3000 Series computer.
- CC-7014 — connects to SDS Sigma Series computer.
- CC-7015 — connects to I/O bus of a DEC PDP-8, Linc-8, or PDP-12 computer.

The CC-72 Remote Master Controller enables the computer to address up to 32 CC-301 Controllers and related devices, all operating over the same line. Each CC-301 Controller can be located up to 5000 cable-feet from the Master Controller. A CC-721 Line Adapter, contained in the Master Control cabinet, is required for every two CC-301 Controllers.

Display Unit

The output characteristics of the CC-300 Model II Receiver are summarized in Report 6125, Table I. Any conventional television receiver ranging from a 5-inch screen to a 23-inch screen will display the same format when connected to the CC-301 Controller. When operating in the graphic mode, the display image is formed by a pattern of dots arranged in a 108-by-85 dot matrix; the viewing area on a 12-inch receiver measures 5.5 by 8 inches.

The buffer memory included in the CC-301 Controller has a capacity of 1024 9-bit words; the first 800 word-locations correspond to the 800-position alphanumeric display format (960-character option available). The remaining 224 memory locations are accessible to the computer for storing and retrieving terminal identification and other information.

Each display character is formed within a 5-by-7 dot matrix. The 69-symbol character set includes upper-case alphabetics, numerics, and special symbols (including the cursor symbol); see Report 6125, Table II. The display is regenerated 60 times per second.

Each character display location has an absolute memory address; the memory contents is displayed continuously and can be transmitted to the computer or output device at any time via keyboard or program control. The non-destructive cursor, displayed as a horizontal underline, indicates the location to be occupied by the next character entered into or read from the memory buffer. TV receivers varying in size from 8 inches to 27 inches (measured diagonally) are available. The maximum display format consists of 20 lines of data with 40 characters to a line; a 24 line arrangement is available as an option. The display characteristics of three typical CRT models are represented in Report 6126, Table I.

Keyboard

The CC-303 Model III keyboard operates electromechanically and is interlocked to prevent more than one key depression at a time. A cable connection provides keyboard operations up to 150 feet from the display controller.

The Model III keyboard contains 65 keys including control and cursor keys which are separated (for ease of identification) from the data entry keys. This keyboard is capable of generating a 127-character USASCII character set (except NUL); see Report 6125, Table II. Control functions can be generated by depressing only the control function key. Control codes other than those specified by the control function keys can be generated by depressing the control key concurrently with the designated control code key. Repetitive data entry is performed by holding a key in a depressed position.

Cursor controls permit positioning the cursor (an underscore symbol) to:

- The first character position of the first line (Reset key),
- The first character position of the current line (Return key),
- The same character position of the next line (New Line key),
- The current position on the next line (down arrow),
- The current position on the preceding line (up arrow),
- One space to the right (right arrow), or
- One space to the left (left arrow).

When the cursor controls marked by arrows are held in a depressed position, the cursor continues to step in the specified direction and will wrap-around the screen in any of the four directions. The current cursor location is contained in a cursor address register within the CC-301 Controller. The cursor address can be accessed and altered by the computer.

Line Printer

The basic CC-36 Terminal provides high-speed printing devices to produce printed copy of any selected portion of a displayed text initiated locally via keyboard or by remote program control. This system also facilitates on-line computer-to-print and off-line key-to-print operations. Two basic terminal configurations are available incorporating different printing devices.

.15 Description (Contd.)

The CC-36 Model I includes the CC-305 Line Printer for non-impact printing capability at 300 characters per second. The printing operation employs an electrothermal printing technique with a continuously moving 8.5-inch roll of paper and four separate rotating printheads. Data is printed from the buffer sequentially by character and line position in the 80-character line format mode. A display image format mode can also be employed where characters are printed only in the middle 40 page columns (positions 20 through 60), arranged identical to the displayed data configuration. See Report 6550 for additional information about the Motorola TP-4000 Series Teleprinters.

The CC-36 Model II includes an impact line printer with a 132-character buffer (Mohawk 4000 Series). Printing is executed via rotating drum and a shuttle-type print mechanism at 300 lines per minute. Up to 80 characters per line can be printed using a standard 64-character set. Single spacing provides 6 to 8 lines per inch. Data is printed from the buffer sequentially by character and line position.

Card Reader

The CC-306 Card Reader reads standard 80-column punched cards photoelectrically at a rate of 300 cards per minute. The CC-306 is capable of two separate operating modes selected under computer control: the binary image mode and the Hollerith mode. In the binary image mode, each card column is interpreted as two separate 6-bit characters of data as it is read into the buffer-memory. Parity is generated and bit 7 of each word is set to avoid confusion with USASCII code characters. The card reader generates EOT after five cards (800 bytes) have been read into the buffer. In the Hollerith mode, each card column is translated into its 7-bit USASCII code equivalent; parity is generated and the characters are read into consecutive buffer locations following the movement of the cursor. Data transmission is terminated when an EOT, INT, or TRANS character is read, or when data from ten cards (800 characters) has been transmitted, generating EOT. The CC-306 will function accordingly upon reading any USASCII control characters.

Data Transmission

The CC-301 Display Controller operates in a half-duplex mode over the public telephone network at up to 2000 bits per second or over a leased voice-band line at up to 2400 bits per second. The CC-301 can also operate in a half-duplex mode over broad-band facilities at up to 50,000 bits per second using a Bell System 300 Series Data Set or its equivalent.

The CC-36 Station employs the 7-level USASCII transmission code, presented in Report 6125, Table II. An even parity bit is appended to each transmitted character.

When operating as a stand-alone display station; i.e., a single CC-301 Controller and CC-300 TV Receiver, an asynchronous transmission technique is employed. A total of 10 bits including unity start and stop bits, seven data bits, and an even parity bit are transmitted.

When the CC-72 Remote Master Multiplexor is employed in a multistation environment, a synchronous transmission technique is used. Each character totals eight bits, including an even parity bit. A SYN character precedes each transmission.

Editing Facilities

Data can be altered by positioning the cursor to the desired character-location and typing new data over the existing data; no expansion or contraction of data takes place. The entire screen can be erased by using the Clear key. When it is desired to retain fixed data, as in a fixed format, a New Line symbol is used at the end of each entry. The New Line symbol causes the cursor to skip all succeeding characters in the line and move to the beginning of the next line. The Tab key positions the cursor forward or backward to a fixed tab stop location at the center position of each line.

Operating Procedure

Data is entered at any location of the display by positioning the cursor to that location and keying in the data or reading cards. The cursor advances one character position as each character enters. Any editing that may be necessary is performed prior to transmitting the message. The End-of-Text character is entered at the end of the message by depressing the END key; transmission of the message follows.

The complete message is composed on the display or read in from cards prior to transmission. When the message is to be transmitted, the Transmit key is depressed, or the transmit function is provided by the stored control sequence. The CC-301 Controller functions in one of two sub-modes of operation when placed in the Block mode. These sub-modes, Transmit Enabled and Transmit Disabled, are established by the computer. The Controller must be placed in the Transmit Enabled sub-mode to accept a message. If it is already in this mode when the Transmit key is depressed, the message is immediately sent to the computer.

When operating with the CC-72 Remote Master Controller, depressing the Transmit key sets a status indicator within the Master Controller. The computer can sample the status indicators and selectively initiate transmission from a waiting display terminal. The Master Controller can also alert the computer to a waiting message by sending an interrupt signal when a status indicator is set.

Message Configuration

The message transmitted from the CC-36 Station includes a Start-of-Text (STX) character, the message, and an End-of-Text (EXT) character. A message is transmitted in sequence beginning at the cursor position and ending with the ETX character. Messages received from the computer can completely override any local operations. Commands received from the computer are preceded by a Start-of-Header (SOH) character which conditions the Controller to interpret the following character as a function code. Bit positions seven through five of the function code select a specific input or output device (including the display unit); bit positions four through one specify one of several commands, such as, select graphic or alphanumeric mode, load or read cursor address register, read Light Pen address, halt local input-output operations, and others. The computer can also request the status of the station, defined in a single character. When it is desired to unlock the keyboard, the computer message is terminated with an End-of-Transmission (EOT) signal, which releases the keyboard to the operator.

When the CC-72 Remote Master Controller is included, computer messages are prefixed by an SOH and a single address character; the address character specifies which of the CC-301 Controllers is to receive the message.

Error Detection and Correction

Errors that occur during off-line composition are corrected by positioning the cursor under the character in error and rekeying the correct character. When transmitting a message to the computer in the Character mode, the computer responds to a detected character-parity error by returning a special parity symbol, which is displayed in the position of the character received in error. The operator corrects the error by retyping the character.

Computer response to errors received in the Block mode is dependent upon the controlling software. When parity errors are detected at the display station, a status bit is set and a special parity-character is displayed on the screen in place of the character in error. The operator can request retransmission or can repeat the interrogation message.

.8 PHYSICAL SPECIFICATIONS

Component	CC-36 Televideo Conversational/Batch Station Console (includes table)*
Width (inches)	62.5
Depth (inches)	31.0
Height (inches)	28.0
Weight (pounds)	300.0
Power (KVA)	1.2
Voltage	115
Frequency (Hz)	60
Phases	1
Temperature Range (°F.)	50 to 90
Humidity Range (%)	10 to 80
Heat (BTU/hr)	-

* Refer to Report 6125, Paragraph .8 for physical characteristics of individual components.

.9 PRICE DATA

Component or Feature	Monthly Rental, $	Purchase Price,** $
CC-36 Model I (non-impact printer)	875	23,900
CC-36 Model II (impact printer)	1175	39,900
Option 5 — 960-character Display *		300
CC-304 Light Pen	—	1500
CC-72 Remote Multiplexor	—	5500
CC-721 Line Adapter	—	700
Channel Adapters —		
CC-7011 (IBM 1130)	—	5500
CC-7012 (IBM System/360)	—	5500
Dual Channel Option	—	2000
CC-7013 (CDC 3000 Series)	—	5500
CC-7014 (SDS Sigma Series)	—	5500
CC-7015 (DEC PDP-8, Linc-8, or PDP-12) Model II (integrated into CC-301 Controller for direct connection; cannot include Option 1)	—	1500
Option 1 — Serial communications interface compatible with Bell System 100, 200, or 300 Series Data Sets for any of the Channel Adapters	—	500

* Expands the display arrangement to 24 lines of 40 characters per line.

** CCI provides standard leasing and maintenance arrangements upon request.

ADVANCE REPORT
COMPUTER INDUSTRIES COPE .45
(COMMUNICATION ORIENTED PROCESSING EQUIPMENT)

.1 GENERAL

.11 Identity: . . . . . COPE .45 Remote Communications Terminal.

.12 Manufacturer: . . . . . Computer Industries, Inc.
Data Communications Systems Division
2659 Nova Drive
Dallas, Texas 75229

.13 Basic Function: . . . . . high-speed remote batch processing of data transmitted over a voice-band communications line; standard input/output facilities provide punched card data entry and printed copy.

.15 Description

The COPE .45 Remote Communications Terminal, announced in early 1968 by Computer Industries, a subsidiary of University Computing Company, is the top of the line in a series of seven COPE terminals designed to operate at computer-compatible speeds over voice-grade telephone lines. The basic COPE .45 configuration comprises the following components:

- Remote Controller with Operator Console;
- Keyboard/Printer Teletypewriter;
- High-Speed Printer;
- High-Speed Card Reader;
- Communications Modem.

The COPE .45 Remote Controller is a fixed-address, parallel system using a random-address magnetic core memory of 4096 or 8192 12-bit words with a cycle time of 1.5 microseconds/word. Operating in the full-duplex mode, this unit coordinates the card reader, printer, and data set on-line to the computer system with facilities for indirect addressing, program interrupt for I/O conditions, and transfer of data with peripheral equipment. Both card input and printer output data is compressed and packed in 254 12-bit data word messages for a total of 508 characters. Data is transmitted to the COPE Communications Controller at the central computer site where it is unpacked and transferred to a UNIVAC 1108 for further processing. Keys and switches on the Operator Console provide manual control of the Remote Controller for data transmission and reception, peripheral device operations, and Teletype communications.

A Teletype Model 33 Automatic Send-Receive (ASR) with a 53-key input keyboard and 600-character/minute printer provides diagnostic information, with facilities for operator control and intervention and status media. This unit generates and interprets a modified 8-level USASCII code from keyboard or paper tape input.

The COPE .45 printer is a high-speed rotating drum impact printer which operates at a rated speed of 1000 lines/minute for any combination of alphanumeric and special characters, or up to 1250 lines/minute for alphanumeric characters. A standard print line of 132 characters/line is provided, with maximum printed symbol capability of 63 characters (26 alpha, 10 numeric, and 27 special). Two pin-type tractor guide sets can be adjusted to accommodate 4- to 20-inch fan-fold paper forms. A vertical format unit employs a 12-channel punched paper tape loop to provide program-controlled paper form spacing.

.15 Description (Contd.)

The high-speed COPE .45 Card Reader operates at a rated speed of 1500 cards/minute on a single card demand basis using a photo-diode reader station. The single input hopper has a 2500-card capacity and the receiver output stacker, a 2000-card capacity; concurrent loading of additional card data and removal of processed cards during operation is permitted.

The Communications Modem is a high-speed data set mounted internally and designed to accommodate the COPE .45 Remote Controller communications interface. Operating in the full-duplex mode, this unit transmits serial data at 4800 bits/second over a C4-conditioned voice-band line. The system can be modified to operate in the half-duplex mode over dial-up or broad-band lines. An optional 10,000 bits/second data set is available for a system requiring limited-distance communications over coaxial cable.

The COPE .45 Terminal is fully modular and can be expanded to include any combination of the following optional I/O devices:

- Model 8001-00 Magnetic Tape Master — processes IBM-compatible 6- or 8-level magnetic tape at 28,000 characters/second; accommodates a 200-, 556-, or 800-bits/inch read/write unit.
- Model 8002-00 Magnetic Tape Slave — operates as a backup device in a two-unit magnetic tape configuration; records card data on standard tape and can be used to transmit plotter data.
- Model 200 Card Punch — punches standard 80-column cards at 200 cards/minute; incorporates an echo-check feature for automatic repunching of erroneous card data.
- Model P120 Tally Paper Tape Punch — punches mylar or paper tape data from cards read on the COPE .45 Card Reader.
- Model 500 Tally Paper Tape Reader — reads mylar or paper tape data at 450 characters/second.

Computer Industries states that the basic COPE .45 Remote Communications Terminal currently rents for $3380/month, with an availability of three months.

CDC 200 USER TERMINAL

.1 GENERAL

.11 Identity: . . . . . CDC 200 User Terminal

.12 Manufacturer: . . . . . Control Data Corporation
8100 34th Avenue South
Minneapolis, Minnesota 55440

.13 Basic Function: . . . . . visual display, via cathode ray tube, of alphanumeric data transmitted between the display station and a remote computer over a voice-band line; data entry can be executed manually from keyboard or automatically under computer program control; facilities for card input and printed copy are optional.

.14 Basic Components

Name:	Single-Station Entry/Display
Model number:	217-2
Function:	displays data entered from keyboard or data received from the computer; keyboard includes features for display control, edit functions, and message transmission; equipment controller provides line control functions, selection of off-line operations, and buffer storage for transmission and reception of data.
Name:	Typewriter Printer (optional)
Model number:	218-1
Function:	prints copy of displayed data for data received from the computer using an IBM Selectric Typewriter; prints data entered from punched cards in off-line list operations.
Name:	Line Printer (optional)
Model number:	222-1 or 222-2
Function:	provides 80-column (222-1) or 136-column (222-2) printed copy of display data at 300 lines/min; also accepts card data entry for off-line printing.
Name:	Card Reader (optional)
Model number:	224-2
Function:	reads punched card data to be displayed or printed, and/or transmitted to the computer at 330 cards/min.

.15 Description

The Control Data 200 User Terminal is a visual communications terminal designed to facilitate rapid access and exchange of alphanumeric data between a Control Data 3000, 6000, or 7000 Series computer and one or more remote single-station terminals under control of a stored computer program. While it functions best with a Control Data computer, this display station can operate efficiently in any commercial-oriented computer system; communications software packages or required program modifications are not a standard provision with the 200 User Terminal.

Basic Operation

The 200 User Terminal is designed to operate in a poll/address environment; all communications between the remote computer and the display station are initiated by the computer. Messages transmitted in either direction must be acknowledged by the recipient. The basic terminal can be expanded to provide both conversational and batch processing capabilities through

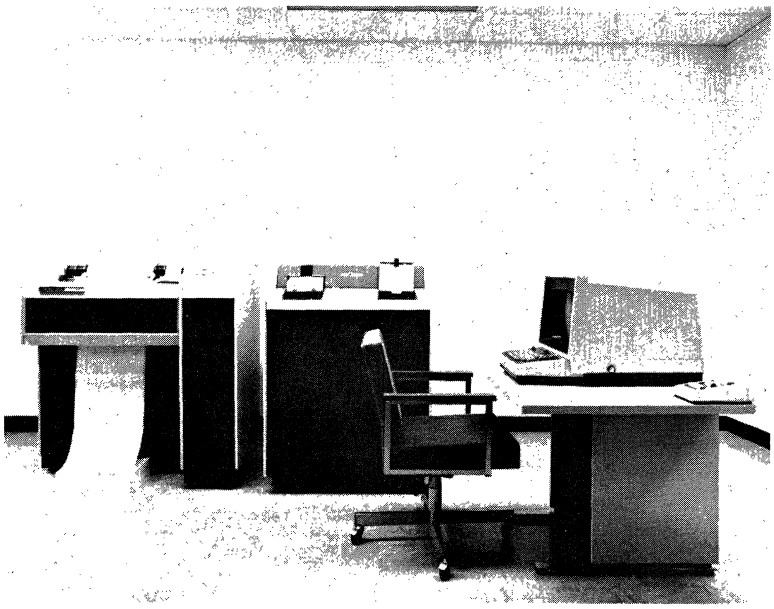


Figure 1. Control Data 200 User Terminal Including the Model 217-2 Entry/Display Station, Model 222-1 Line Printer, and Model 224-2 Card Reader

.15 Description (Contd.)

the addition of a card reader and printer; off-line key-to-print and card-to-print operations can be executed by the terminal operator. The 200 User Terminal is available only in single-station terminal arrangements, which can be multidropped in several locations via voice-band communications facilities.

Display Unit

The 217-2 Remote Entry/Display Station is a single-station CRT/keyboard unit connected to a display controller to comprise the basic 200 User Terminal configuration. The display incorporates a 14-inch (diagonal) rectangular CRT oriented horizontally to present a viewing area six inches high by eight inches wide. A 64-symbol alphanumeric character set including upper-case alphabetics, numerics, punctuation, and special symbols can be generated via keyboard or computer program; each displayed character is constructed within a 5- by 7-dot matrix. A total character capacity of 1000 or 1040 8-bit word positions in the controller's delay line memory provides maximum display formats of 20 50-character lines or 13 80-character lines, respectively. A chain of markers (underlines of character positions) facilitates keyboard data entry; the leftmost symbol in the chain, called the entry marker (cursor), indicates the position of the next entered character to be displayed. Table I summarizes the entry marker control functions.

Data Transmission

The 200 User Terminal operates synchronously in the half-duplex mode over a leased voice-band line at 300 characters per second (2400 bits per second) or over the public telephone network at 250 characters per second (2000 bits per second). A 7-level transmission is employed; each transmitted character includes seven data bits plus parity. One of two transmission codes, Modified External BCD or Modified Internal BCD can be switch-selected at time of installation; see Table V. A 128-character code set includes 64 characters to initiate control functions. A precedence code (ESCAPE) is required to designate each control code. Table II presents the control code repertoire.

.16 First Delivery: . . . . . second quarter, 1968

.17 Availability: . . . . . 60 days maximum

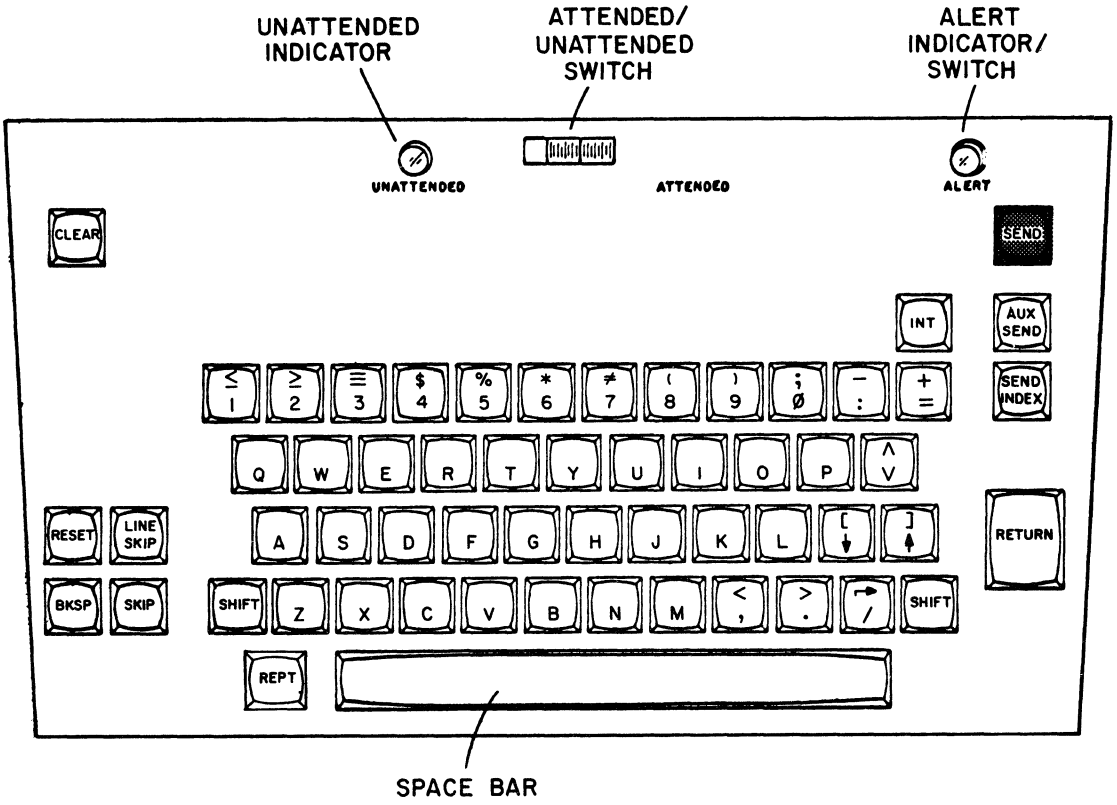


Figure 2. CDC 217-2 Entry/Display Station Keyboard

TABLE I. CDC 217-2 DISPLAY ENTRY MARKER (CURSOR) CONTROLS

Key	Control Function
Space	Stores a space code in the entry marker position of memory; advances entry marker one position.
Return	Stores a carriage return code in the entry marker position; advances the entry marker to the first display position of the next line.
Skip	Advances the entry marker one position; data is not affected.
Slew	Causes repeated advance during key depression.
Clear	Erases all data from memory and CRT screen; the entry marker is repositioned to the home display location (upper left corner).
Backspace	Returns the entry marker one position to the left; data is not affected.
Reset	Positions the entry marker to the home display location (upper left corner).
Line Skip	Advances the entry marker to the first display position of the next line; data is not affected.

.2 CONFIGURATION

The basic 200 User Terminal consists of an Entry/Display Station fixed upon a cabinet-mounted Equipment Controller. Optional input/output devices incorporated into the basic terminal arrangement can be configured according to one of the following combinations:

- A 224-2 Card Reader and a 222-1 or 222-2 Line Printer
- A 224-2 Card Reader and a 218-1 Typewriter Printer
- A 224-2 Card Reader
- A 222-1 or 222-2 Line Printer
- A 218-1 Typewriter Printer

The available 200 User Terminal configurations including basic components and optional equipment are represented in Figure 3.

TABLE II. CDC 200 USER TERMINAL FUNCTION REPERTOIRE

Function Code	Display Symbol*	Delay-Line Code	BCD		Hollerith Code	Line Printer Code
			INT	EXT		
End of Line	None	100	060	120	None	100
Carriage Return	—	101	101	101	None	101
E1	Δ	102	102	102	None	102
Escape	None	None	136	076	None	None
E2	'	140	040	040	None	140
E3	:	141	041	041	None	141
End of Record	None	127	067	127	7, 8, 9	None
End of File	None	126	066	126	6, 7, 8, 9	None
Compress 3 Zeros	None	103	103	103	None	103
Compress 4 Zeros	None	104	104	104	None	104
Compress 5 Zeros	None	105	105	105	None	105
Compress 6 Zeros	None	106	106	106	None	106
Compress 7 Zeros	None	107	107	107	None	107
Compress 8 Zeros	None	110	110	110	None	110
Compress 9 Zeros	None	111	111	111	None	111
Compress 10 Zeros	None	112	100	112	None	112
Compress 11 Zeros	None	113	113	113	None	113
Compress 12 Zeros	None	114	114	114	None	114
Compress 13 Zeros	None	115	115	115	None	115
Compress 14 Zeros	None	116	116	116	None	116
Compress 15 Zeros	None	117	117	117	None	117
Compress 3 Spaces	None	143	043	043	None	143
Compress 4 Spaces	None	144	044	044	None	144
Compress 5 Spaces	None	145	045	045	None	145
Compress 6 Spaces	None	146	046	046	None	146
Compress 7 Spaces	None	147	047	047	None	147
Compress 8 Spaces	None	150	050	050	None	150
Compress 9 Spaces	None	151	051	051	None	151
Compress 10 Spaces	None	152	052	052	None	152
Compress 11 Spaces	None	153	053	053	None	153
Compress 12 Spaces	None	154	054	054	None	154
Compress 13 Spaces	None	155	055	055	None	155
Compress 14 Spaces	None	156	056	056	None	156
Compress 15 Spaces	None	157	057	057	None	157
Compress 16 Spaces	None	160	120	060	None	160
Compress 17 Spaces	None	161	121	061	None	161
Compress 18 Spaces	None	162	122	062	None	162
Compress 19 Spaces	None	163	123	063	None	163
Compress 20 Spaces	None	164	124	064	None	164
Compress 21 Spaces	None	165	125	065	None	165
Compress 22 Spaces	None	166	126	066	None	166
Compress 23 Spaces	None	167	127	067	None	167
Compress 24 Spaces	None	170	130	070	None	170
Compress 25 Spaces	None	171	131	071	None	171
Compress 26 Spaces	None	172	132	072	None	172
Compress 27 Spaces	None	173	133	073	None	173
Compress 28 Spaces	None	174	134	074	None	174
Compress 29 Spaces	None	175	135	075	None	175
Compress 30 Spaces	None	176	136	076	None	176
Compress 31 Spaces	None	177	137	077	None	177
Backspace	None	120	None		None	None
Line Skip	None	122	None		None	None
Skip	None	131	None		None	None
Reset	None	132	None		None	None

* In the case of "None", a meaningless image may be present.

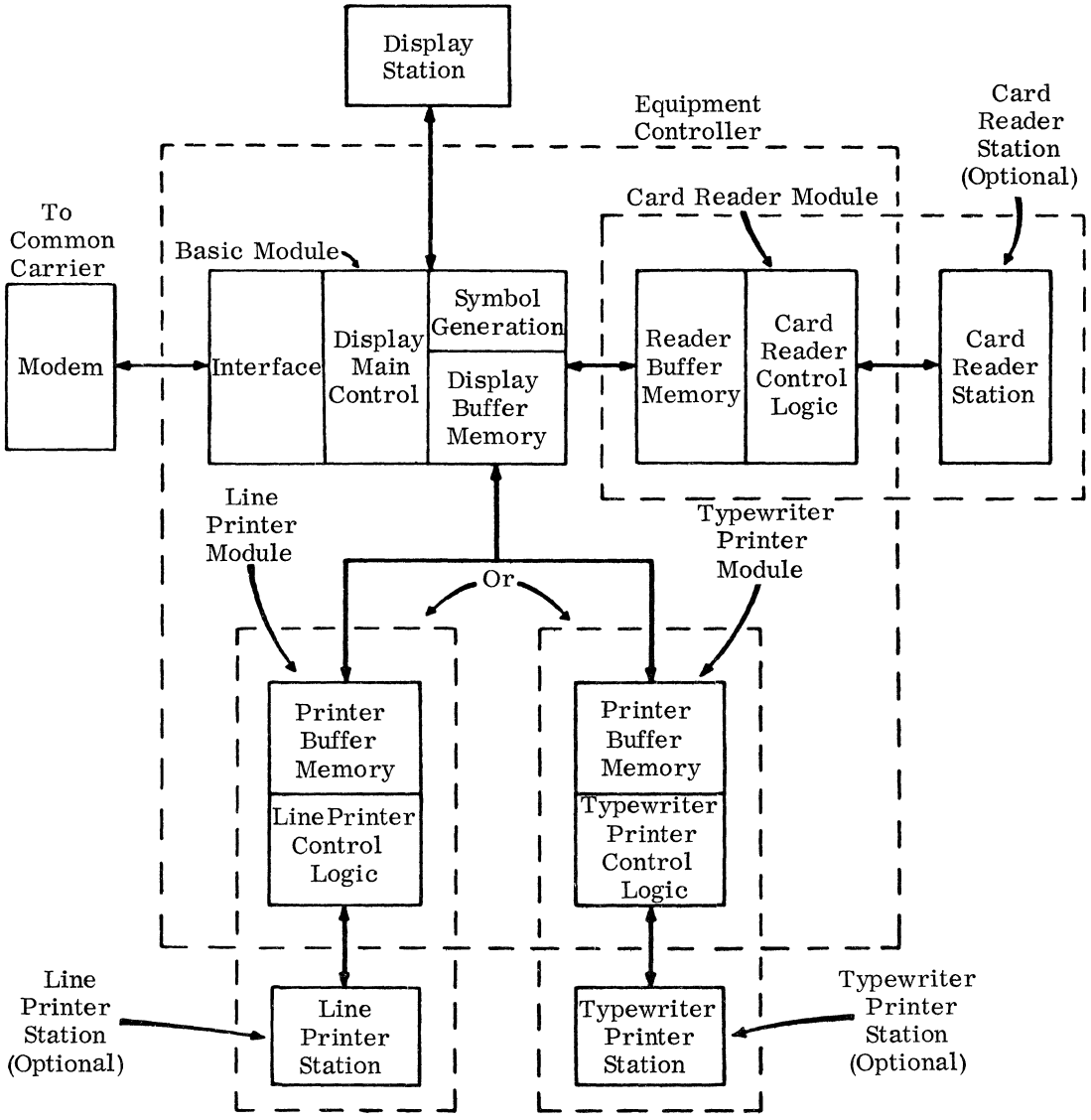


Figure 3. Basic CDC 200 User Terminal Configuration Including Optional Features

.3 INPUT

.31 Prepared Input

Model 224-2 Card Reader —

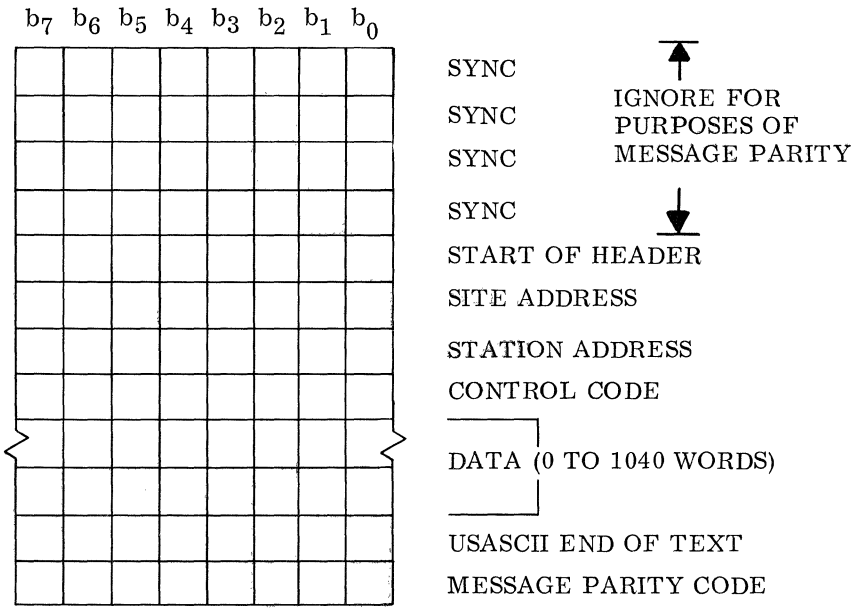
Input medium:	standard 80-column punched cards
Input code:	standard Hollerith card code (see Table V)
Quantity of data:	960 characters; 12 cards
Character set:	64 characters, including upper-case alphabetic, numeric, punctuation, and special symbols
Rated input speed:	330 cards per minute
Effective speed:	limited by transmission rate
Comments:	card input hopper capacity is 1200 cards; card output stacker capacity is 1300 cards; includes a 1000- or 1040-character buffer

.32 Manual Input

Method of entry:	via 58-key keyboard, including entry marker (cursor), edit, and display control keys.
Quantity of data:	up to 1000 or 1040 characters (depends on display format).
Character set:	64 characters including upper-case alphabetic, numeric, punctuation, and special symbols (see Table V)
Comments:	keys are arranged in conventional typewriter keyboard configuration; keyboard is fixed to display unit.

.33 Fixed Input: . . . . . no provision

.34 Transaction Code Input: . . . . . no provision



Note: Sequence must be maintained. Sync codes may not be inserted between start of header and control code.

Figure 4. CDC 200 User Terminal Basic Message Configuration

.35 Message Configuration

A total of 10 different types of messages are transmitted between a CDC 200 User Terminal and the remote computer; Table III summarizes these messages. The message format consists of an 8-character message header followed by a maximum of 1000 or 1040 data characters (read or write messages only) and a 2-character message trailer. Included in the message header are four sync (SYN) characters followed by a Start-of-Header (SOH) character, two address characters, and a message identification code. The initial address character identifies one of up to 16 stations; the second address character is employed for program compatibility with multiterminal configurations but is ignored by the 200 User Terminal. The message identification code specifies the type of message as defined in Table IV. The two-character message trailer includes an End-of-Text (ETX) character and a longitudinal parity character, which reflects longitudinal parity from the SOH to the ETX characters. The USASCII code provides all control codes in the message header and trailer; these codes are automatically inserted during message composition and transmission.

TABLE III. CDC 200 USER TERMINAL MESSAGE FORMATS

Type of Message	Origin of Transmission	Code Sequence	Purpose of Command
Poll	Computer	Sync (4 total) SOH Site Address Station Address Poll ETX Parity	Requests transmission of data contained in the addressed display station memory
Alert	Computer	Sync (4 total) SOH Site Address Station Address Alert ETX Parity	Illuminates the Alert indicator and sounds an alarm to inform the terminal operator that the computer has a message waiting to be transmitted
Write	Computer	Sync (4 total) SOH Site Address Station Address Write Date Escape E1, E2, or E3 ETX Parity	Designates a message to be stored in the display buffer and to be displayed beginning at the entry marker position and terminating at the ETX character or end of screen
Write-Print	Computer	Sync (4 total) SOH Site Address Station Address Write-Print Sync (7 total) Data Escape E1, E2, or E3 ETX Parity	Designates a message to be stored in the display and printer buffers; the message is both displayed and printed
Clear-Write	Computer	Sync (4 total) SOH Site Address Station Address Clear-Write Sync (7 total) Data Escape E1, E2, or E3 ETX Parity	Operates same as Write command except the display buffer is cleared and the message begins at the first character position on the display

TABLE III. CDC 200 USER TERMINAL MESSAGE FORMATS (Contd.)

Type of Message	Origin of Transmission	Code Sequence	Purpose of Command
Reset-Write	Computer	Sync (4 total) SOH Site Address Station Address Reset-Write Sync (7 total) Data Escape E1, E2, or E3 ETX Parity	Operates same as Write command except the message begins at the first character position on the display
Read	Terminal	Sync (4 total) SOH Site Address Station Address Read Data Escape E1, E2, or E3 ETX Parity	Designates a message to be transmitted to the computer; the message can originate from the keyboard/display or from punched cards
Acknowledge	Terminal	Sync (4 total) SOH Site Address Station Address Acknowledge ETX Parity	Indicates that a message transmitted from the computer was received without error
Error	Terminal	Sync (4 total) SOH Site Address Station Address Error ETX Parity	Indicates that a message transmitted from the computer was received in error
Reject	Terminal	Sync (4 total) SOH Site Address Station Address Reject ETX Parity	Indicates that the terminal is not in the receive mode; i.e., the Memory Guard is enabled and the terminal is in the process of message composition

TABLE IV. CDC 200 USER TERMINAL USASCII CODE

			b6	0	0	1	1
			b5	0	0	1	1
b3	b2	b1	b4 / b0	0	1	0	1
0	0	0	0		DIAGNOSTIC WRITE	STATION ADDRESS ON POLL*	0
0	0	0	1	SOH	WRITE	STATION ADDRESS ANY MESSAGE EXCEPT POLL	S 1
0	0	1	0		CLEAR WRITE		E 2
0	0	1	1	ETX	READ		S 3
0	1	0	0				S 4
0	1	0	1	POLL	ERR		E 5
0	1	1	0	ACK	SYNC		R 6
0	1	1	1	ALERT			D 7
1	0	0	0		REJECT		D 8
1	0	0	1				A 9
1	0	1	0				10
1	0	1	1				E 11
1	1	0	0	RESET WRITE			T 12
1	1	0	1				I 13
1	1	1	0				S 14
1	1	1	1				15

*Includes reset response to a poll message.

.36 Operating Procedure

A message to be transmitted from the 200 User Terminal to the remote computer is composed by:

- Positioning the entry marker (cursor)
- Entering the desired text data from the keyboard

The operator then depresses the Send key and waits for a Poll message; the display data is transmitted to the computer when the terminal is polled. Interim delay is a function of the programming and activity status of the remote computer.

If a computer message alert is sent to the terminal while display data is being keyed in, the operator is alerted but continues composing the message to be transmitted. The computer can override any operations by the terminal operator and can command a write message to be displayed immediately, unless the Memory Guard switch has been enabled. This memory protection feature inhibits the terminal from accepting any of the listed write messages until the Send key has been depressed.

Additional on-line data entry capabilities are provided by the 224-2 Card Reader, which can be optionally incorporated into the 200 User Terminal. Messages composed on punched cards are loaded into the card reader hopper and are accessed by the remote computer via a polled transmission following depression of the Load key. Off-line key-to-print (displayed data) and card-to-print (punched card data) operations can also be enabled at the terminal site by depression of the Aux Send and List keys, respectively. Typical operation sequences executed by the CDC 200 User Terminal are summarized by the flow diagram presented in Figure 5.

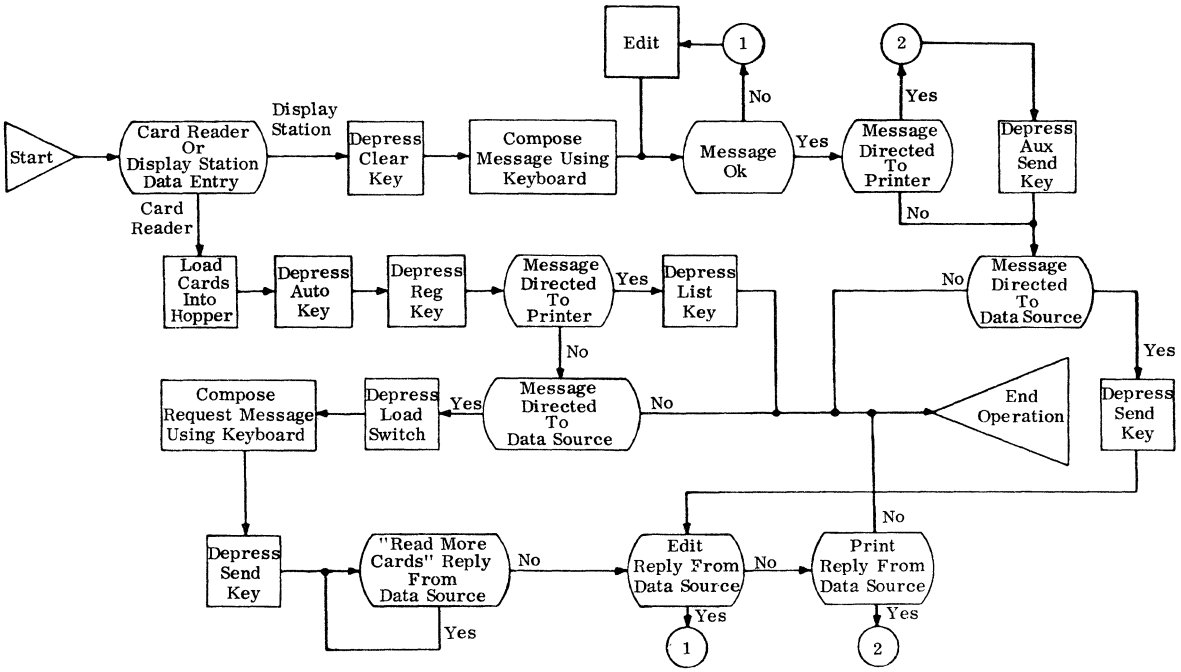


Figure 5. CDC 200 User Terminal Basic Operating Sequence

.4 OUTPUT

.44 Output to Printer

Line Printer Models 222-1 and 222-2 —

Output medium —	
Model 222-1:	pin-fed fanfold forms up to 9.875 inches wide; 80 characters per line
Model 222-2:	pin-fed fanfold forms up to 14.875 inches wide; 136 characters per line
Character set:	64 characters (see Table V)
Rated printing speed:	300 lines/min
Effective speed:	less than rated speed due to line length and carriage return/line feed operations
Format control:	controlled by function codes in the data message; controls include carriage return/line feed, and vertical and horizontal tab.
Comments:	includes a 1000- or 1040-character buffer

Typewriter Printer Model 218-1 —

Output medium:	pin-fed fanfold forms up to 9.875 inches wide; 85 char/line
Character set:	64 characters (see Table V)
Rated printing speed:	15.5 char/sec
Effective speed:	less than rated speed due to carriage return/line feed, or other format operations
Format control:	controlled by function codes in incoming data, or manually by operator; controls include line feed/carriage return, case shift, backspace, and horizontal tab.
Comments:	horizontal spacing is 10 char/inch; vertical spacing is 6 lines/inch.

.46 Output to Visual Display Device

Model 217-2 Display Station —

Output medium:	cathode-ray tube; displays white characters against gray background.
Character set:	64 characters: digits, upper-case letters, punctuation marks, and special symbols; see Table V.
Character size:	nominally 0.124 inch wide and 0.250 inch high.
Character generation:	5-by 7-dot matrix
Display size:	8 inches wide by 6 inches high on a 14-inch (measured diagonally) rectangular CRT
Characters per line:	50 (1000-character buffer) or 80 (1040-character buffer)
Lines per display:	20 (1000-character buffer) or 13 (1040-character buffer)
Characters per display:	1000 or 1040 (depends on display format)
Buffer capacity:	1000 or 1040 (depends on display format)
Format control:	horizontal tab; carriage return/line feed; entry marker (cursor) movement controls; split screen and partial display transmission
Rated output speed:	250 char/sec (2000 bits/sec) or 300 char/sec (2400 bits/sec) over a voice-band line
Effective output speed:	lower than rated speed due to exchange of control messages and presence of header characters

TABLE V. CDC 200 USER TERMINAL CHARACTER SET

BCD		DELAY-LINE	DISPLAY	TYPEWRITER		LINE PRINTER		HOLLERITH
INT	EXT	CODE	SYMBOL	SYMBOL	CODE	SYMBOL	CODE	CODE
121	061	61	A	A	R1, R2, R2A, R5, CK (LC)	A	61	12, 1
122	062	62	B	B	R2, R2A, CK (LC)	B	62	12, 2
123	063	63	C	C	R5, R2, R2A (LC)	C	63	12, 3
124	064	64	D	D	R1, R2A, CK (LC)	D	64	12, 4
125	065	65	E	E	R1, R2A, R5 (LC)	E	65	12, 5
126	066	66	F	F	R2A (LC)	F	66	12, 6
127	067	67	G	G	R2A, R5, CK (LC)	G	67	12, 7
130	070	70	H	H	R1, R5, CK, (LC)	H	70	12, 8
131	071	71	I	I	R1 (LC)	I	71	12, 9
041	041	41	J	J	R1, R2, R2A, R5, T1 (LC)	J	41	11, 1
042	042	42	K	K	R2, R2A, T1 (LC)	K	42	11, 2
043	043	43	L	L	R2, R2A, R5, T1, CK (LC)	L	43	11, 3
044	044	44	M	M	R1, R2A, T1 (LC)	M	44	11, 4
045	045	45	N	N	R1, R2A, R5, T1, CK (LC)	N	45	11, 5
046	046	46	O	O	R2A, T1, CK (LC)	O	46	11, 6
047	047	47	P	P	R2A, R5, T1 (LC)	P	47	11, 7
050	050	50	Q	Q	R1, R5, T1 (LC)	Q	50	11, 8
051	051	51	R	R	R1, T1, CK (LC)	R	51	11, 9
062	122	22	S	S	R2, R2A, T2 (LC)	S	22	0, 2
063	123	23	T	T	R2, R2A, R5, T2, CK (LC)	T	23	0, 3
064	124	24	U	U	R1, R2A, T2 (LC)	U	24	0, 4
065	125	25	V	V	R1, R2A, R5, T2, CK (LC)	V	25	0, 5
066	126	26	W	W	R2A, T2, CK (LC)	W	26	0, 6
067	127	27	X	X	R2A, R5, T2 (LC)	X	27	0, 7
070	130	30	Y	Y	R1, R5, T2 (LC)	Y	30	0, 8
071	131	31	Z	Z	R1, T2, CK (LC)	Z	31	0, 9
101	101	01	1	1	R1, R2, R2A, R5, T1, T2, CK (LC)	1	01	1
102	102	02	2	2	R2, R2A, T1, T2, CK (LC)	2	02	2
103	103	03	3	3	R2, R2A, R5, T1, T2 (LC)	3	03	3
104	104	04	4	4	R1, R2A, T1, T2, CK (LC)	4	04	4
105	105	05	5	5	R1, R2A, R5, T1, T2 (LC)	5	05	5
106	106	06	6	6	R2A, T1, T2 (LC)	6	06	6
107	107	07	7	7	R2A, R5, T1, T2, CK (LC)	7	07	7
110	110	10	8	8	R1, R5, T1, T2, CK (LC)	8	10	8
111	111	11	9	9	R1, T1, T2 (LC)	9	11	9
100	112	12	ø zero	0	R1, R2, R2A, T1, T2 (LC)	0	12	0
113	113	13	=	=	T1, T2, CK (LC)	=	13	8, 3
114	114	14	≠	≠	R1, R5, T1, T2, CK (UC)	≠	14	8, 4
115	115	15	≤	≤	R1, T1, T2 (UC)	≤	15	8, 5
116	116	16	%	%	R1, R2, R2A, T1, T2 (UC)	%	16	8, 6
117	117	17	[	[	T1, T2, CK (UC)	[	17	8, 7
060	120	00	BLANK	SPACE	None	SPACE	00	BLANK
061	121	21	/	/	R1, R2, R2A, R5, T2 (LC)	/	21	0, 1
072	132	32	]	]	R2A, R5, T2 (UC)	]	32	0, 8, 2
073	133	33	, comma	,	T2 (LC)	,	33	0, 8, 3
074	134	34	(	(	R1, R5, T2 (UC)	(	34	0, 8, 4
075	135	35	↱	↱	R1,T2, CK (UC)	↱	35	0, 8, 5
076	136	36	≡	≡	R1, R2, R2A, T2, CK (UC)	≡	36	0, 8, 6
040	040	40	- minus	-	R1, R2, R2A, T1, CK (LC)	-	40	11
077	137	37	∧	∧	T2 (UC)	∧	37	0, 8, 7
052	052	52	∨	∨	R2A, R5, T1 (UC)	∨	52	11, 0
053	053	53	$	$	T1 (LC)	$	53	11, 8, 3
054	054	54	*	*	R1, R5, T1 (UC)	*	54	11, 8, 4
055	055	55	↟	↟	R1, T1, CK (UC)	↟	55	11, 8, 5
056	056	56	↟	↟	R1, R2, R2A, T1, CK (UC)	↟	56	11, 8, 6
057	057	57	>	>	T1 (UC)	>	57	11, 8, 7
120	060	60	+	+	R1, R2, R2A (LC)	+	60	12
132	072	72	<	<	R2A, R5, CK (UC)	<	72	12, 0
133	073	73	. period	.	CK (LC)	.	73	12, 8, 3
134	074	74	)	)	R1, R5, CK (UC)	)	74	12, 8, 4
135	075	75	≥	≥	R1 (UC)	≥	75	12, 8, 5
None	None	76	■ parity error	■	R1, R2, R2A (UC)	⌐—	76	None
137	077	77	;	;	CK (UC)	;	77	12, 8, 7
112	100	20	:	:	R1, R2, R2A, T2, CK (LC)	:	20	8, 2

.5 ERROR DETECTION AND CORRECTION

.51 Data Entry Errors

Model 224-2 Card Reader —

Type of checking:	character validity; cards are read by two independent read stations and data is compared bit by bit.
Error indication:	computer is alerted to error; read operation halts.
Correction procedure:	manual intervention

.52 Data Transmission Errors

Type of checking:	character parity, longitudinal parity, and control code recognition
Error indication:	an error message is transmitted; character received in error is displayed as a solid square (■).
Correction procedure:	automatic retransmission in response to a poll message; the number of retransmissions is under control of the computer.
Comments:	data entry from the keyboard or card reader is inhibited after the Send key or Load key has been depressed; data entry remains inhibited until the completion of a correct Write, Write Reset, or Clear Write message. See Table VI.

.53 Data Recording Errors: ..... no provisions other than visual verification of displayed data

.55 Line Malfunction

Detection:	only for carrier on signal interruption during data transmission
Action:	terminal responds with an error message.

.6 CONDITION INDICATORS

Indicators located on the Model 217-2 Display keyboard panel signify the following conditions when lighted:

- Alert — indicates that the remote computer has a message waiting to be transmitted; an audible alarm is also sounded to inform the operator.
- Unattended — indicates that the terminal is in the unattended mode to enable a write operation without operator intervention.

.7 DATA TRANSMISSION

.71 Basic Characteristics

Rated transmission speed:	2000 bits/sec (250 char/sec) or 2400 bits/sec (300 char/sec)
Transmission method:	serial by bit
Transmission code:	7-level plus parity; see Table II.
Transmission mode:	half-duplex
Order of bit transmission:	low-order bit first
Synchronization:	synchronous

.72 Connection to Communication Lines

Communications Line or Service	Data Set*
Public telephone network (2000 bits/sec):	Bell System Data-Phone Data Set 201A
Leased common-carrier voice-band line (2400 bits/sec):	Bell System Data Set 201B or Western Union 2400 Baud Data Modem.

* In some cases, equivalent data sets can be used; see Sections 4620 and 4640 for a current list of modems available from independent manufacturers of telephone equipment.

TABLE VI. CDC 200 USER TERMINAL ERROR CONDITIONS

Error Condition	Error Message Switch*	
	Enable	Disable
Word Parity Error	Store message in memory; insert parity error symbol for symbol in error; transmit error message instead of acknowledge message; no data transfer to the printer or from the card reader	Store message in memory; insert parity error symbol for symbol in error; no data transfer to the printer or from the card reader
Message Parity Error	Store message in memory; transmit error message instead of acknowledge message; no data transfer to the printer or from the card reader	Store message in memory; receive sequence aborts on end of message; no data transfer to the printer or from the card reader
Unrecognized Control Code	Transmit error message on end of message; receive sequence aborts on end of message; no data transfer to the printer or from the card reader	Receive sequence aborts on end of message; no data transfer to the printer or from the card reader
Nonexistent Station Address	Transmit error message instead of acknowledge message; no data transfer to the printer or from the card reader	Receive sequence aborts on end of message; no data transfer to the printer or from the card reader
Write Message not ending with escape code and E1, E2, or E3	Store message in memory; transmit error message instead of acknowledge message; no data transfer to the printer or from the card reader	Store message in memory; receive sequence aborts on end of message; store message in memory; no data transfer to the printer or from the card reader
Carrier On Signal drops before USASCII End of Text Recognized	Allow receive sequence to complete; transmit error message instead of acknowledge message; no data transfer to the printer or from the card reader	Receive sequence aborts on end of message; store message in memory; no data transfer to the printer or from the card reader

* The error message is generated by the terminal and transmitted only if the error Message Enable/Disable switch is in the Enable position in the Equipment Controller.

.73 Transmission Control

Call initiation: . . . . . only when polled by the remote computer
Call reception: . . . . . capable of unattended operation
Functional operations: . . . . . format of displayed and/or printed messages can be controlled by control characters in the incoming data

.74 Multistation operation: . . . . . no provision

.8 PHYSICAL SPECIFICATIONS

Component	217-2 Entry/Display		218-1 Typewriter Printer*	222-1 or 222-2 Line Printer	224-2 Card Reader
	Display Unit	Control Unit			
Width (inches)	17.75	30.0	17.25	46.0	33.0
Depth (inches)	28.75	30.0	15.34	25.0	27.5
Height (inches)	17.0	26.5	9.63	44.0	48.0
Weight (pounds)	85.0	125.0	161.0	675.0	500.0
Power (KVA)	0.6 or 1.2	0.5 or 1.0	0.5 or 12.0	7.0 or 12.0	4.5 or 7.0
Voltage	220 or 120	220 or 120	220 or 120	220 or 120	220 or 120
Frequency (Hz)	50 or 60	50 or 60	50 or 60	50 or 60	50 or 60
Phases	1	1	1	1	1
Temperature Range(°F)	60 to 100	60 to 85	60 to 100	60 to 90	55 to 90
Humidity Range (%)	10 to 90	10 to 90	10 to 90	30 to 80	25 to 75
Heat (BTU/hr)	410	440	270	1910	990

* Typewriter stand measures 24.63 (w) by 28.0 (d) by 26.5 (h) inches.

.9 PRICE DATA

Component or Feature	Monthly Rental				Purchase Price $	Monthly Maintenance $
	1-year Lease $	3-year Lease $	4-year Lease $	5-year Lease $		
217-2 Entry/Display Station	305	290	285	275	12,720	44
218-1 Typewriter Printer	255	245	240	230	8,480	27
222-1 Line Printer (80 Col)	465	445	435	420	25,440	168
222-2 Line Printer (136 Col)	545	520	510	495	29,150	195
224-2 Card Reader	140	135	135	130	6,890	38

DATA 100 MODEL 70 REMOTE BATCH TERMINAL

1. GENERAL

1.1 Identity ..... Model 70-1 Remote Batch Terminal; Model 70-3 Remote Printer Terminal.

1.2 Manufacturer ..... Data 100 Corporation
7450 France Avenue South
Minneapolis, Minnesota 55435

1.3 Basic Function ..... high-speed transmission of data read from punched cards and reception of data to printed copy output; operates over a voice-band line at synchronous speeds of 2,000 to 4,800 bits/sec.

1.4 Basic Components

Name ..... Line Printer.

Function ..... provides printed copy output via drum-type printer mechanism; includes function controls, line buffers, code translation facilities, and interface circuitry to connect line printer control unit with Terminal Control Unit (TCU); printer is available in Models 70-1 and 70-3.

Name ..... Card Reader.

Function ..... provides punched card input via photoelectric read mechanism; includes code and message formatting controls, and interface circuitry to connect card reader with Terminal Control Unit (TCU); card reader is available in Model 70-1 only.

Name ..... Terminal Control Unit (TCU).

Function ..... provides selection of operating modes and terminal unit functions via operator control panel; includes message formatting and error control facilities, and maintains synchronization; controls flow of data over the line between transmitting and receiving terminals.

1.5 Description

The Data 100 Model 70 Series consists basically of two general-purpose remote batch terminals designed to operate in both computer-to-station and station-to-station communications systems. Models 70-1 and 70-3 are directly compatible with the IBM 2780 Data Transmission Terminal Models 1 and 3, respectively.

The Data 100 Model 70-1 can operate as either a transmitting or a receiving terminal. The Model 70-3 operates as a receiving terminal only. Various terminal systems using the Data 100 Model 70 Series can be configured according to any of the following communications techniques:

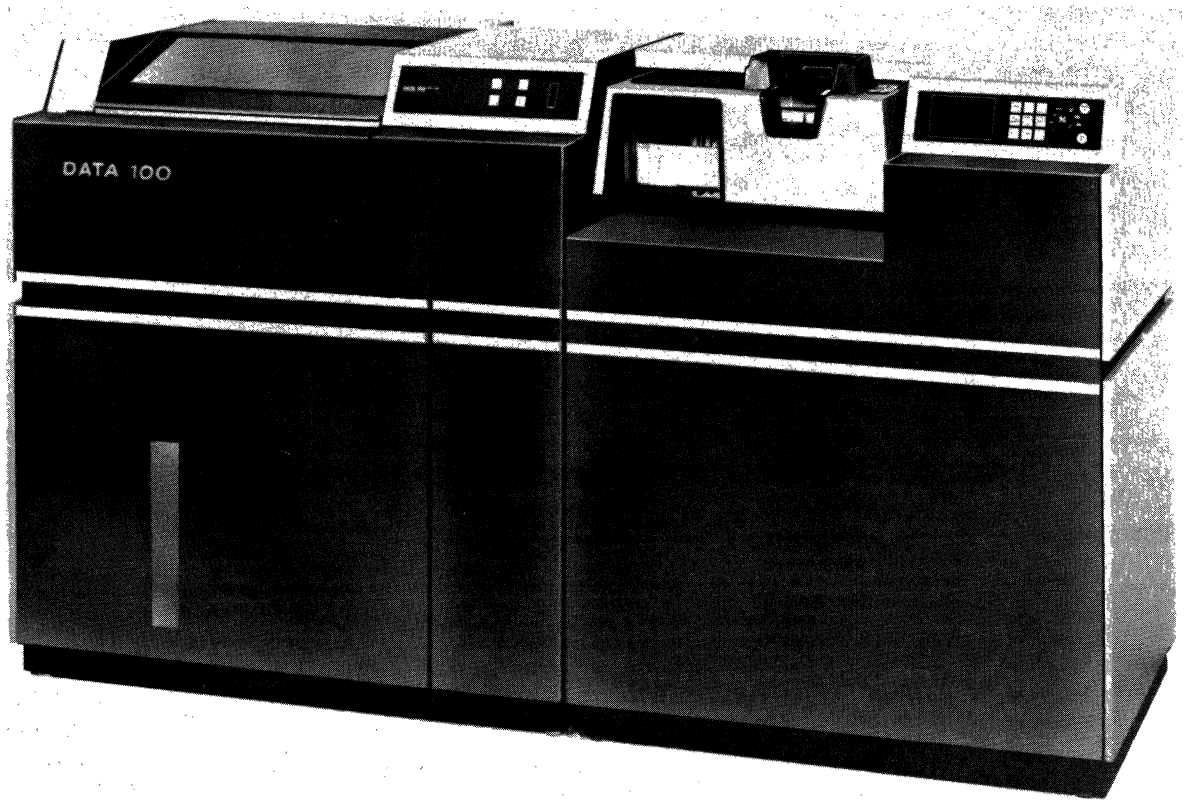


Figure 1. Data 100 Model 70-1 Remote Batch Terminal including Line Printer (left) and Card Reader (right)

- Point to point with another Data 100 Terminal or an IBM 2780 Data Transmission Terminal.
- Point to point with an IBM System/360 Model 25, 30, 40, 50, 65, 67 (in the 65 mode), 75 or 85 computer equipped with the appropriate multiline controller and transmission adapters (see Reports 8442 and 8444 in the IBM 2701 Data Adapter Unit and the IBM 2703 Transmission Control); adapters using the IBM Binary Synchronous Communications (BSC) technique.
- Multipoint to any of the computer systems stated using the required control units and communications adapters.

The Model 70 Terminal is designed to use the IBM Binary Synchronous Communications (BSC) technique for transmitting and receiving data in a half-duplex mode. BSC accommodates the synchronous transmission of a continuous stream of data with all error checking information provided at the end of a record. Alternatively, the USASCII code can be used with conventional character and message parity checking provisions. See Paragraph 5.

Through the exercise of various available options, Models 70-1 and 70-3 can operate using one of three different character code sets: 8-level USASCII, 8-level EBCDIC, or 6-level Six-Bit Transcode (SBT); see Tables II, III, and IV. All three codes use the same BSC data-link control characters and procedures as described in Paragraph 3.5. This design flexibility permits

configuration of the Model 70 Terminal into existing or predefined communications systems without the need for data source driver reprogramming. Table V illustrates the special characters provided with each transmission code.

Operating with the appropriate data set, the Data 100 Terminal can transmit and receive data at rates of 2,000, 2,400, or 3,600 bits per second over the public telephone network and 2,000, 2,400, 3,600 or 4,800 bits per second over a leased voiceband line. Although the terminal operates internally in a half-duplex mode, connection to a four-wire, full-duplex communications facility results in a significantly reduced turnaround time during the exchange of data and acknowledgment messages.

Of the seven switch-selectable modes of operation provided by the Data 100 Terminal, the following can be initiated by the operator to perform primary data transfer functions:

- Receive Mode — allows a transmitting device to select the terminal and one of its peripheral units for a write operation.

- Transmit Mode — initiates a read operation by causing a predesignated read device to be enabled/selected in a point-to-point terminal system. When the receiving unit returns a positive response to an Enquiry (ENQ) control code message, the transmitting terminal initiates data transfer from the read device to the communications line. While in this mode, the terminal can also receive data if it is not transmitting and a write device is ready. In a multipoint system, the write devices can be selected or the read devices can be polled by a CPU.

- Print Mode — activates the printer of the receiving terminal in a point-to-point write operation. All write messages received over the data link are automatically transferred to this device.

- List Mode — enables the selected read/write devices to perform a local list operation, i.e., data transfer from card reader to line printer.

Designed for half-duplex communications, the Data 100 Model 70 Terminal incorporates both a read buffer and a write buffer to provide double storage capacity for incoming and outgoing data.

When a read (Transmit mode) operation is activated, data from the input device is assembled into the read buffer memory. Once this buffer is full or the message block is completely assembled, the data is transferred to the write buffer memory for transmission and the read buffer again is free to assemble the next block of data from the input device. See Figures 2A and 2B.

When a write (Receive mode) operation is activated, the incoming message from the communications facility is checked for validity (message format, parity, etc.) and assembled into the read buffer memory. Once this buffer is full or the transmission is complete, the data is transferred to the write buffer memory, which subsequently transfers it to the selected output peripheral device. The write buffer remains assigned to this output device until the message processing is completed, while the read buffer memory is free to assemble more data from the communications line. See Figure 3.

The interface and synchronization circuits illustrated in Figure 4 implement such functions as automatic answering and serial-to-parallel and parallel-to-serial conversions for message transmission and decoding, as well as all control functions necessary to operate the data set.

The degree of operational flexibility within the basic Model 70 Terminal design is demonstrated by the following set of standard features:

- Automatic Answer/Disconnect — allows the terminal to automatically answer and/or disconnect incoming calls from the remote computer system or from another terminal over switched networks. It does not allow the terminal to perform automatic dialup.

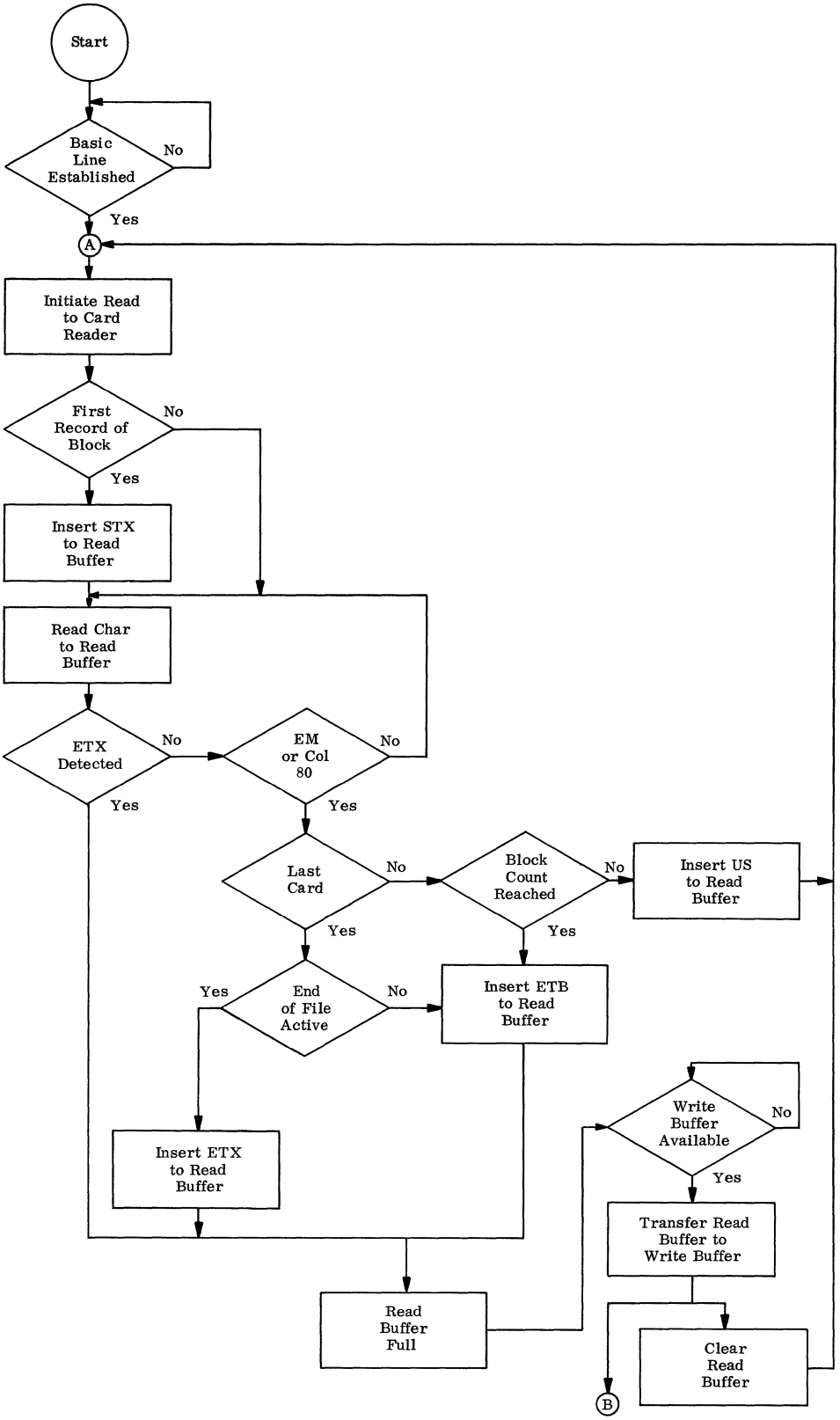
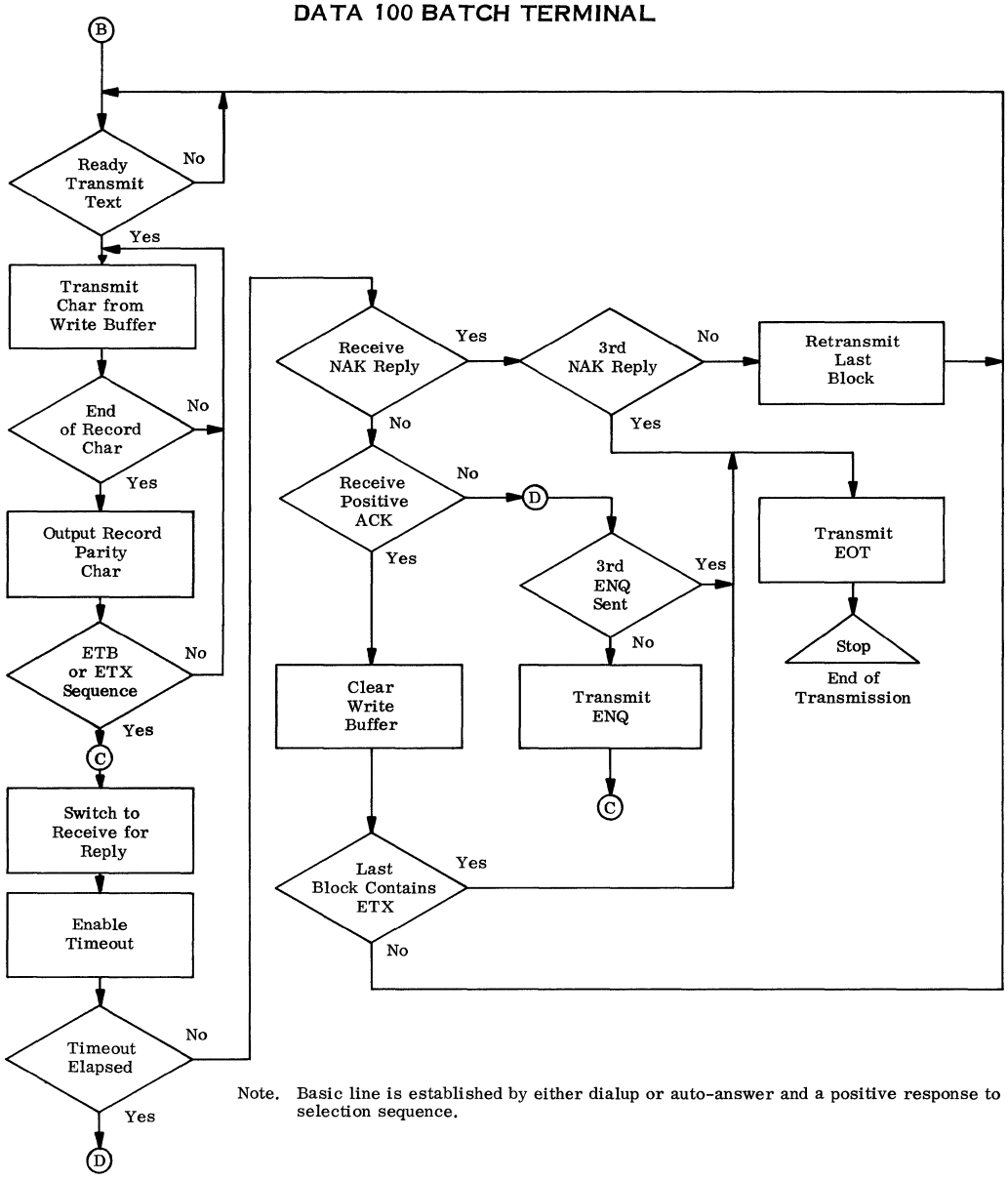


Figure 2A. Read Card and Message Block Generation



Note. Basic line is established by either dialup or auto-answer and a positive response to selection sequence.

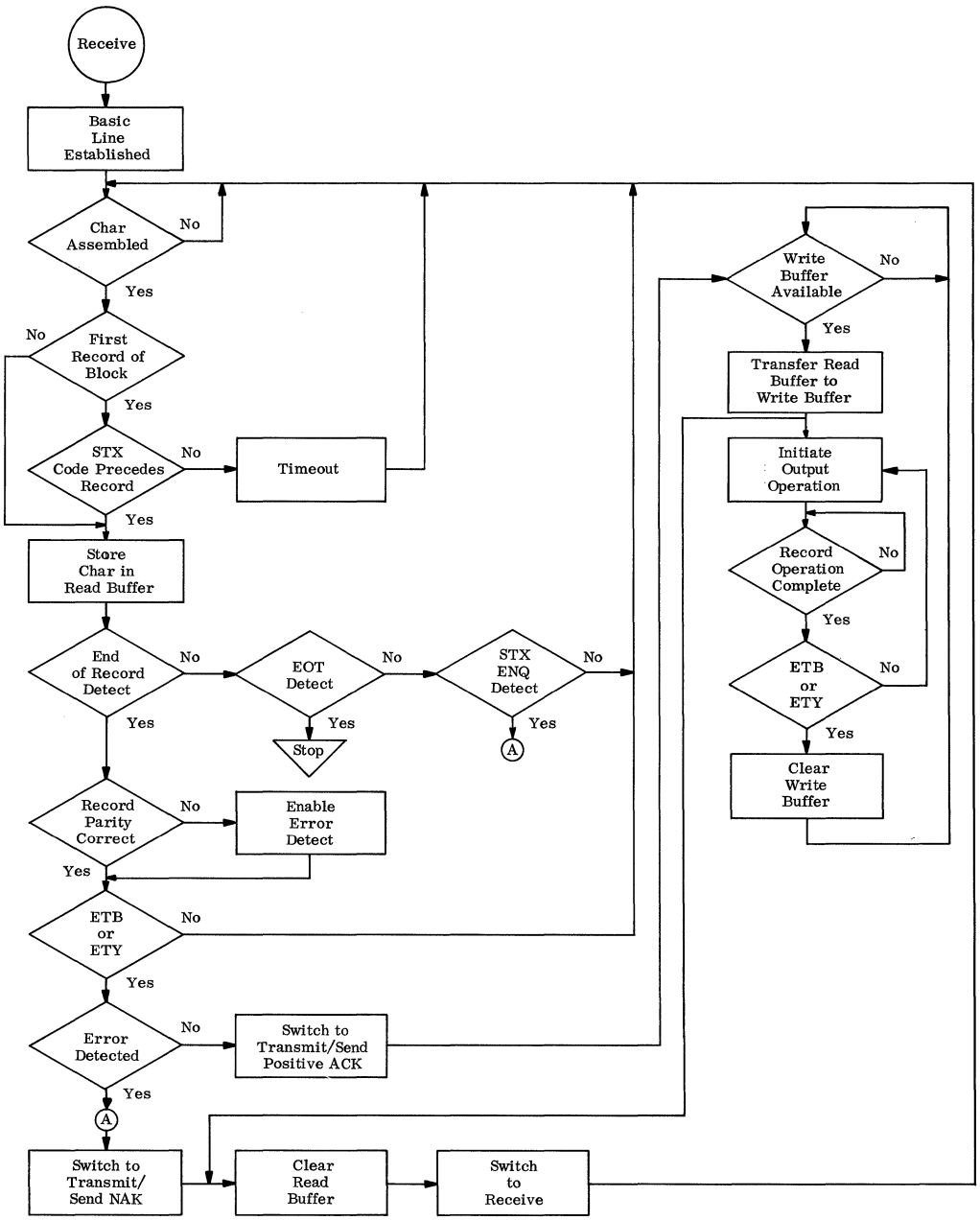
Figure 2B. Message Transmission, Acknowledgment, and Termination

A 20-second timeout is started when a call is answered. If no data is received during this period, the terminal automatically disconnects. A timed-out call is not considered an error condition. A completed call is ended when the calling terminal sends an End-Of-Transmission (EOT) sequence, which causes the called terminal to automatically disconnect after a 20-second timeout. This feature enables unattended operation of the Data 100 Terminal.

- Auto Turnaround — allows the terminal to switch automatically from a read operation (Transmit mode) to a write operation (Receive mode), following the receipt of an RVI acknowledge to a data block.

- Two-Wire/Four-Wire Operation — allows the terminal to transmit and receive data using synchronous data sets interfaced for four-wire as well as two-wire operation. In a four-wire operation, the receiver and transmitter remain on, minimizing the time delay in switching from a Transmit to a Receive mode.

- EBCDIC Transparency — allows unrestricted transfer of all possible bit combinations within the 256-character EBCDIC code, including those otherwise reserved for control sequence functions; see Paragraph 3.5. The optional Multiple Record feature can be used with Transparency, but record length is fixed at 80 data characters coming from the card reader



Note. Basic line is established by either dial-up or auto-answer and positive response to selection sequence.

Figure 3. Receive Mode

and can be variable when going to the line printer. This restriction, in turn, eliminates exercise of the card reader Line Truncation feature. Programming in Transparency mode requires that a DLE control character precede each control character in a record. DLE is inserted automatically by the terminal for control characters originating from the transmitting station hardware.

- Off-Line List — allows the terminal to perform local card-to-print listing and maintenance operations without communicating with the central site.

- Invalid Character/Multiple Punch Check — allows the card reader (Model 70-1) to detect multiple punches in card columns 1 to 7 (all others are valid) and the five data-link control characters which are not to be punched in cards (unless the EBCDIC Transparency feature is enabled).

- Line Truncation — allows the terminal to accommodate card records of less than maximum length by the suppression of trailing spaces. This feature is activated by an End-of-Medium (EM) character read from the card, after which all subsequent columns in that card are ignored.

- Multipoint Line Control — allows a number of terminals to communicate in a multistation arrangement over a single leased line with the computer system. All communications are initiated and controlled at the computer site by polling or selecting the terminals. Individuals terminals cannot communicate directly with one another. (The standard point-to-point configuration enables the transmitting terminal to initiate the calling sequence over a line connected directly to another terminal or computer system.) The Data 100 Terminal can operate in a multipoint fashion over switched networks. See Paragraph 3.5 for additional information regarding the control character sequences used in this arrangement.

The basic functions of the Data 100 Terminal can be further expanded with the selection of various available options:

- Multiple Record Transmission — allows the terminal buffer to accommodate message lengths up to 600 characters or 15 records per block, or 1,000 characters or 31 records per block (requires software modification).

- Extended Print Line — permits the line printer to record characters in an additional 40 or 52 print positions (80-position print line is standard); the length of the affected carriage area is expanded to accommodate 120 characters (12.0 inches) or 132 characters (13.2 inches) with the horizontal density at 10 print positions per inch. This feature provides that any data character in the code set used can be printed in any line position.

- Read/Write Speed Adapters — allow the terminal to operate at synchronous transmission rates up to 4,800 bits per second. Intended to facilitate transmission of maximum character length records, this feature adds line speed adapters (buffers) that accumulate a block of read data or output a block of write data on a character basis at the rated speed of the peripheral devices or of the 4,800-bit-per-second transmission facility. This additional buffering capacity does not, however, restrict the use of slower 2,000 or 2,400-bit-per-second lines.

- Compression/Decompression — enables the terminal to compress or decompress strings of three or more identical characters within a record, i.e., suppression of repetitive zeros or elimination of spaces between data columns on punched cards. This feature may require software modification and is inoperable for the SBT code set and EBCDIC Transparency mode.

- Horizontal Format Control — allows the terminal to store a horizontal format record containing horizontal tab (HT) characters in specified positions; remaining data positions are filled with space characters. The HT characters in the format record identify the beginning of printed data fields. When an HT character is received in an incoming message, the data field immediately following will be printed beginning with the next horizontal tab position as defined by the HT character in the stored format record. The format record remains stored until a new format record is received, a manual reset is performed, or the power is removed from the terminal. A format record is identified by the prefix ESC HT. This feature cannot be used in the EBCDIC Transparency mode. When used in conjunction with the 132-column print line, it allows formatting over the entire carriage length in terminal-to-terminal operations, even though the transmitted record length is restricted to 80 data characters.

- High-Speed Line Printer — provides a terminal line printer mechanism with a rated speed of 400 lines per minute; the standard line printer operates at a rated speed of 300 lines per minute.

1.6 First Delivery . . . . . February 1970.

1.7 Availability . . . . . 90 days.

2. CONFIGURATION

The basic Model 70-1 Remote Batch Terminal consists of the following components:

- 300 line-per-minute line printer
- 300 card-per-minute card reader
- Terminal Control Unit (TCU).

Model 70-3 has essentially the same hardware configuration minus the card reader. The standard communications facilities that can be interfaced and the associated common carrier data sets are listed in Paragraph 7.2. Optional equipment features available for the Model 70 Terminals are described in Paragraph 1.5. Figure 4 illustrates the basic flow of data through the components of a typical Data 100 Model 70-1 Terminal.

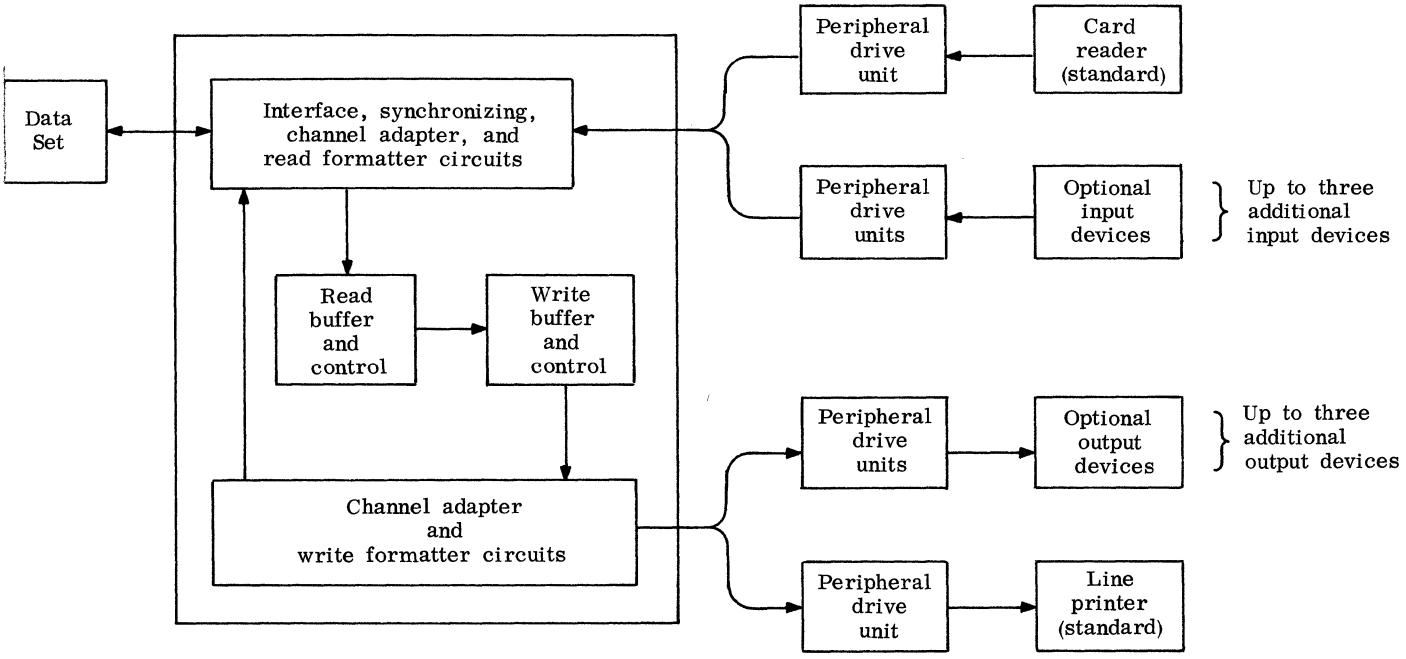


Figure 4. Basic 70-1 Remote Batch Terminal Configuration

3. INPUT

3.1 Prepared Input

Card Reader (Model 70-1 only) —

Input medium	standard 80-column punched cards.
Input code	standard Hollerith card code.
Quantity of data	up to 80 characters per card — dual 400 character (7-record block) buffers standard; dual 600 character (15-record block) buffers optional; dual 1000 character (31-record block) buffers optional.
Character set	64 (SBT), 128 (USASCII), or 256 characters (EBCDIC): see Tables II, III, and IV.
Rated input speed	300 cards/min.
Effective speed	speed of communications facility may limit card reader performance.
Comments	input function employs serial-by-column card sensing via 12-row photoelectric read station; capacity of input hopper or output stacker is 600 cards; hopper and stacker can be loaded/unloaded while reader is in operation.

3.2 Manual Input	no provision.
3.3 Fixed Input	no provision.
3.4 Transaction Code Input	no provision.

3.5 Message Configuration

Data is transmitted and received by the Data 100 Model 70 Terminal in blocks of 400 characters or seven records for a standard configuration. If the optional Multiple-Record Transmission feature is included, a data block can contain up to 600 characters or 15 records, or 1,000 characters or 31 records.

Data-Link Control Characters

Eleven data-link control characters are automatically encoded by the control circuitry in the Data 100 Terminal to determine data-link status and required responses.

Data-link control characters are stripped from the data at the receiving terminal. Table I describes the function of each data-link control character.

TABLE I. DATA 100 MODEL 70 DATA-LINK CONTROL CHARACTERS

Control Designation	Code Function	Character Transmitted
Synchronous Idle	To establish and maintain synchronization of the transmitting device (CPU or TCU) with the receiving device (TCU or GPU); four SYN control codes precede all message transmissions; not considered for purposes of message parity generation except when included as a data character within an EBCDIC transparent record.	SYN
Enquiry	To interrogate a remote terminal for readiness to transmit (poll), alert to a request to receive (select) or indicate status, or to activate a data check when the TCU is transmitting; can request multiple retransmissions on detection of data transmission errors.	ENQ
Start-of-Text/ Start-of-Header	To alert remote terminal to the beginning of a block of text; SOH is recognized by the terminal in lieu of STX when the TCU is in Normal mode; STX required for the first record of a block and optional for all additional records.	STX/SOH
Unit Separator	To end a record and initiate error checking, indicate the end of a record; it is encoded by the Peripheral Drive Unit or CPU and passes through the TCU, without modification, for transmission or receipt; also used to initiate record parity checking; US replaced by ETB following last record in a block and by ETX at the end of a message.	US
End-of-Transmission-Block	To initiate error checking at the end of last record in a block; initiates line turnaround to allow remote terminal to respond with positive or negative reply.	ETB
End-of-Text	To signify the end of a block and initiate error checking at the end of last record in a message; initiates line turnaround to allow remote terminal to respond with positive or negative reply; immediately precedes parity character(s).	ETX
Data-Link Escape	To provide additional line control and end-to-end controls other than those specifically called out in the various code sets; DLE preceding a character code alters the meaning of that character only; DLE is considered for purposes of block check accumulation if it follows a US sequence, an SOH (STX), or DLE code in a transparent record.	DLE
Acknowledgement	To verify proper receipt of the second and subsequent even-numbered message blocks (ACK 0) and of the first and subsequent odd-numbered message blocks (ACK1) transmitted from the remote site; encoded as DLE followed by a specific even character, or as DLE	ACK 0/ACK 1 (DLE 0/DLE 1)

TABLE I. (Contd.)

Control Designation	Code Function	Character Transmitted
Acknowledgement (Contd.)	followed by a specific odd character; ACK 0 is also a positive response to an ENQ (select) character to indicate terminal readiness to receive a WRITE message.	
Negative Acknowledgement	To acknowledge an enquiry from the transmitting terminal and indicate that the receiving terminal is not ready to receive data; transmitted by the TCU already receiving or being selected to receive a message. To inform the transmitting terminal that the last block of data transmitted was received in error; terminal again switches to Receive mode to accept retransmission.	NAK
Reverse Interrupt	To provide a positive response in lieu of ACK 0/ACK 1 and allow the receiving CPU to interrupt a message stream from the terminal, stop receiving, and begin transmitting data; received as a positive acknowledgment by TCU, which transmits remaining blocks of data in TCU buffers; RVI code is comprised of DLE followed by a specific character depending on code set used.	RVI (DLE X)
End-of-Transmission	To inform the receiving terminal that the message is completed and transmission is to be terminated; causes a reset of all TCU's on the link (effective in multipoint operations only) and activates the Terminal Control mode whereby station addressing and selection recognition is enabled in preparation for the next message process. To indicate in response to ENQ that the polled terminal was incorrectly addressed, has no data ready to transmit, or is unable to continue transmission. To indicate receiving terminal's request to terminate transmission and disconnect (in lieu of ACK 0/ACK 1). To indicate receiving terminal's request to terminate transmission and disconnect although previous transmission was unacceptable (in lieu of NAK).	EOT

*The following odd/even block designations are for USASCII, SBT, and EBCDIC codes:

USASCII: 1 (odd), 0 (even)
SBT: T (odd), - (even)
EBCDIC: 61 (odd), 70 (even)

The EBCDIC designations are hexadecimal code representations and have no corresponding graphic characters.

Message Format

A Start-of-Message (STX) character is used at the beginning of each block and optionally at the beginning of each record within the block. The text contained in the record follows immediately or within one character after the STX character. A record can be terminated by a Unit Separator (US), an End-of-Transmission-Block (ETB), or an End-of-Text (ETX) character and is followed by one or two error-checking characters and one sync (SYN) character. US terminates each record of a block except the final record, which is terminated by an ETB character. The final record in the last block of a message is terminated by an ETX character. The receiving terminal will accept a Start-of-Header (SOH) character in place of the STX character; however, the terminal cannot transmit an SOH.

Terminal Status Interrogation

Before transmitting a message to a remote terminal, the transmitting terminal must determine the status of the receiving terminal. The Data 100 Terminal interrogates the receiving terminal by sending an enquiry message consisting of four SYN characters followed by an ENQ character. The receiving terminal must respond to the enquiry with a positive reply indicating that the terminal is ready to receive, or with a negative reply indicating the terminal is not ready because of an existing contingency. If a reply is not received from the remote terminal within a predetermined period of time, a second enquiry message is sent. An End-of-Transmission (EOT) character is sent and the disconnect procedure initiated after four unsuccessful attempts to interrogate the terminal. The data message is transmitted when the initiating terminal receives a positive reply to an enquiry.

End-of-Block Response

The receiving terminal responds to an ETB or ETX character designating the end of a block or end of the final block in a message respectively. The terminal responds to a correctly received block by sending a positive reply to the transmitting terminal; a negative reply is sent in response to an incorrectly received block.

A positive reply to an ETX character causes the transmitting terminal to send an EOT which terminates the transmission.

The transmitting terminal will retransmit an incorrectly received block up to three times (when transmitting point to point) before operator intervention is required. When communication is between a terminal and computer system, the number of retransmissions is specified by the stored program in the CPU. A negative reply to a final retransmission causes the transmitting terminal to send an EOT character preceding disconnection.

Block Sequence Check

The Data 100 Terminal employs an odd/even block count to ensure the correct sequencing of data blocks within a message. The first block in a message is identified as an odd block. Block checking is performed at both the transmitting and receiving terminals. The odd/even count is toggled at the receiving terminal in response to a correctly received block, and a positive reply containing the toggled block count is sent to the transmitting terminal, where it is compared to the transmitter block count. When the compared block counts do not agree, the transmitting terminal sends an ENQ requesting that the receiving terminal retransmit the positive reply. Up to three enquiries can be sent before the transmitting terminal terminates the call with EOT.

Output Selection

Selection of a terminal output device in the Receive mode is used only in point-to-point operations and is controlled by a two-character sequence ESC plus a component-selection code (x). The selection sequence must be the first two characters of a record. Selection is sustained until the next selection code is received. Invalid codes are either ignored or cause an erroneous print operation to be performed.

EBCDIC Transparency

When the EBCDIC Transparency feature is used, message transparency is initiated through a DLE (Data-Link Escape) STX sequence and exited through a DLE followed by a US, ETB, or ETX character. Transparency can be initiated only at the beginning of a record. Record length on a read is fixed at 80 data characters; EM or ETX characters read from the card are not interpreted as control characters. Control character recognition is established by preceding a control character with a DLE character. A second DLE character is automaticaly inserted following a DLE read from a card; the receiving terminal treats this sequence as one DLE data character. When the printer is receiving in Transparency mode from a remote computer system, a two-character vertical forms-control sequence may be used if other than single-line spacing is desired.

Multipoint Line Control

When the DATA 100 Terminal is part of a multistation configuration using the Multipoint Line Control feature, component selection differs from the basic operation. The computer polls or selects one of the remote terminals using a three-character address sequence. Following the four SYN codes, the first character identifies the terminal, the second identifies the component (reader or printer), and the third character is an ENQ, which ends the sequence. The printer or reader is selected by the character "3" or "6", respectively. Any alphabetic character can be selected for terminal identification. An addressing sequence that contains a "3" is defined as a selection sequence; one that contains a "6" is defined as a polling sequence.

The terminal responds to a polling sequence with a negative response (EOT) or a positive response (Data Record). A negative response indicates that the terminal is not ready to transmit. No response is returned if the polled terminal is in the Off-Line mode.

The terminal responds to a selection sequence with a negative response (NAK) if the selected component is not ready to receive, or a positive response (ACK 0) if the selected component is ready to receive. No response is returned if the selected terminal is in the Off-Line mode.

The basic terminal component selection sequence (ESC plus selection code) is inoperative when the Multipoint Line Control feature is installed. All ESC sequence codes, when used in the first two character positions of data, are interpreted as vertical or horizontal format-control sequences. When initially switched on, the terminal remains in a Receive mode until a sync pattern followed by a selection or poll selection sequence is received.

3.6 Operating Procedure

To prepare the Data 100 Model 70 Terminal for operation, the operator must proceed as follows:

(1) Load the input hopper of the card reader with punched cards for transmission of data to another terminal or central computer system.

(2) Load the line printer with the proper vertical format control tape and print forms for reception of data from another terminal or central computer system.

TABLE II. IBM SYSTEM/360 EBCDIC CODE

Bit Position b4 b5 b6 b7	b0	b1	b2	b3														
	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1		
	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1		
	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1		
	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1		
0 0 0 0	NUL	DIE	DS		• SP	• &	•									• 0		
0 0 0 1	SOH	DC1	SOS				• /		a	j			• A	• J		• 1		
0 0 1 0	STX	DC2	FS	SYN					b	k	s		• B	• K	• S	• 2		
0 0 1 1	ETX	DC3							c	l	t		• C	• L	• T	• 3		
0 1 0 0	PF	RES	BYP	PN					d	m	u		• D	• M	• U	• 4		
0 1 0 1	HT	NL	LF	RS					e	n	v		• E	• N	• V	• 5		
0 1 1 0	IC	BS	ETB	UC					f	o	w		• F	• O	• W	• 6		
0 1 1 1	DEI	IL	ESC	EOT					g	p	x		• G	• P	• X	• 7		
1 0 0 0		CAN							h	q	y		• H	• Q	• Y	• 8		
1 0 0 1		EM							i	r	z		• I	• R	• Z	• 9		
1 0 1 0	SMM	CC	SM		• ¢	• !		• :										
1 0 1 1	VT				•	• $	•	• •										
1 1 0 0	FF	IFS		DC4	• <	• *	• %	• @										
1 1 0 1	CR	IGS	ENQ	NAK	• (	•)	• -	• ·										
1 1 1 0	SO	IRS	ACK		• +	• ;	• >	• =										
1 1 1 1	SI	IUS	BEL	SUB	• |	• ¬	• ?	• ·										

• Printable symbol

b0 is most significant bit

(3) Establish line connection by dialing or signaling and coordinate transmission with the remote operator.

(4) Check that the data set is ready for transmission and switch the terminal to Transmit, Receive, or Print mode.

(5) Verify that synchronization between terminals has been established and that all components are in a ready condition according to control panel indicators.

(6) Depress the START key.

Exchanges of data messages and control signals are under the control of the terminals or central computer system. Further intervention by the operator is required only when errors are repeatedly detected in retransmission of the same data block.

Two special control sequences, Bell (BEL) and End-of-File (EOF), can be implemented by the operator by manually depressing a key. A BEL character can be sent at any time between messages. The BEL character lights an indicator and sounds an audible alarm at the receiving terminal. Depressing the EOF key causes an ETX data-link control character to be transmitted after the last card has been read. An STX ENQ sequence is normally sent after the last card when the EOF key is not depressed.

TABLE III. USASCII DATA TRANSMISSION CODE

Bit Position b4	b3	b2	b1	b7→ / b6→ / b5→	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
0	0	0	0		NUL	DLE	• SP	• 0	• @	• P	`	p
0	0	0	1		SOH	DC1	• !	• 1	• A	• Q	a	q
0	0	1	0		STX	DC2	• "	• 2	• B	• R	b	r
0	0	1	1		ETX	DC3	• #	• 3	• C	• S	c	s
0	1	0	0		EOT	DC4	• $	• 4	• D	• T	d	t
0	1	0	1		ENQ	NAK	• %	• 5	• E	• U	e	u
0	1	1	0		ACK	SYN	• &	• 6	• F	• V	f	v
0	1	1	1		BEL	ETB	• '	• 7	• G	• W	g	w
1	0	0	0		BS	CAN	• (	• 8	• H	• X	h	x
1	0	0	1		HT	EM	•)	• 9	• I	• Y	i	y
1	0	1	0		LF	SUB	• *	• :	• J	• Z	j	z
1	0	1	1		VT	ESG	• +	• ;	• K	• [	k	{
1	1	0	0		FF	FS	• ,	• <	• L	• \	l	:
1	1	0	1		CR	GS	• -	• =	• M	•)	m	}
1	1	1	0		SO	RS	• .	• >	• N	• ~	n	~
1	1	1	1		SI	US	• /	• ?	• O	• -	o	DEL

• Printable symbol

b7 is most significant bit

3.7 Entry of Time and Date . . . . . no provision.

4. OUTPUT

4.4 Output to Printer

Output medium: . . . . . pin-fed continuous fanfold forms from 3.5 to 20.625 inches wide; up to 22 inches in length between folds; 80, 120 (optional), or 132 (optional) printing positions; 10-char/in. horizontal spacing; 6- or 8-line/in. vertical spacing.

TABLE IV. SBT DATA TRANSMISSION CODE

Bit Position b2	b3	b4	b5	b0 → / b1 →	0 0	0 1	1 0	1 1
0	0	0	0		SOH	• &	• —	• 0
0	0	0	1		A •	• J	• /	• 1
0	0	1	0		B •	• K	• S	• 2
0	0	1	1		C •	• L	• T	• 3
0	1	0	0		D •	• M	• U	• 4
0	1	0	1		E •	• N	• V	• 5
0	1	1	0		F •	• O	• W	• 6
0	1	1	1		G •	• P	• X	• 7
1	0	0	0		H •	• Q	• Y	• 8
1	0	0	1		I •	• R	• Z	• 9
1	0	1	0		STX	• SP	ESC	SYN
1	0	1	1		. •	• $	• '	• .
1	1	0	0		¤ •	• *	• %	• @
1	1	0	1		BEL	US	ENQ	NAK
1	1	1	0		SUB	EOT	ETX	EM
1	1	1	1		ETB	DLE	HT	DEL

• Printable symbol

b0 is most significant bit

Character set: . . . . . 47 (39 optional) characters (SBT); 52 (39 or 63 optional) characters (EBCDIC); 63 characters (USASCII); see Table V.

Rated printing speed: . . . . . 300 lines/min standard; 400 lines/min optional.

Effective speed: . . . . . speed of communications facility may limit line printer throughput.

Format control: . . . . . vertical forms spacing is initiated by a 2-character control sequence; skips of over 3 lines are controlled by punches in carriage control tape; see Table VI; horizontal tab (optional) is

TABLE V. SPECIAL CHARACTER SETS

CHARACTER SET					
USASCII	EBCDIC			Six-BIT Transcode	
63	63	52	39	47	39
¬ | " :	¬ | " :				
. $;	. $;	. $;	. $;	. $;	. $;
< * % @	< * % @	¤ * % @		¤ * % @	
( ) ¬ '	( ) ¬ '	( ) '			
+ ; = [	+ ; = ¢	+ =			
] ? & -	? & -	& -		& -	
/ > \	/ > |	/		/	

TABLE VI. PRINTER FORMAT CONTROL CODES

USASCII	EBCDIC and Six-Bit Transcode	Carriage Operation after Printing
ESC Q	ESC /	Single Space
ESC R	ESC S	Double Space
ESC S	ESC T	Triple Space
ESC A	ESC A	Skip to Channel 1
ESC B	ESC B	Skip to Channel 2
ESC C	ESC C	Skip to Channel 3
ESC D	ESC D	Skip to Channel 4
ESC E	ESC E	Skip to Channel 5
ESC F	ESC F	Skip to Channel 6
ESC G	ESC G	Skip to Channel 7
ESC H	ESC H	Skip to Channel 8

initiated by HT character in data and controlled by prestored format control record.

Comments: . . . . . Vertical line spacing is switch-selectable within printer cabinet; multiple printed copies possible using up to 6-part forms; printer control facility provides 132-character line-image memory.

5. ERROR DETECTION AND CORRECTION

The Data 100 Model 70 Terminal employs a polynomial checking technique, referred to as Cyclic Redundancy Checking (CRC), for use with Binary Synchronous Communications. The CRC technique uses a checking polynomial to generate a 12-bit (SBT code) or 16-bit (EBCDIC code) block check character, which is appended to each record of data transmitted. The received block check character is compared with a block check character generated from the received data. Comparison of the block check characters determines the validity of the received message block.

Transmissions using USASCII are not checked by the CRC technique, but employ an odd-parity check bit for each character and a longitudinal redundancy check character at the end of each record.

5.1 Data Entry Errors

Type of checking . . . . . character validity checks, card registration, card column count, and photo-transistor check.

Error indication . . . . . terminal is halted, an indicator lamp is lighted, and an audible alarm is sounded.

Correction procedure . . . . . manual intervention.

5.2 Data Transmission Errors

Type of checking . . . . . cyclic redundancy checking (CRC) for EBCDIC and SBT; character parity (odd) and longitudinal redundancy check for USASCII.

Error indication . . . . . receiving terminal returns a negative acknowledgment (NAK) at the end of a block.

Correction procedure . . . . . automatic retransmission of block received in error; terminal halts, an indicator lamp lights, and an audible alarm sounds if 3 retransmissions fail when 2 terminals are communicating; computer controls number of retransmissions when the terminal is transmitting to a computer.

5.3 Data Recording Errors

Type of Checking

- A message parity check by the terminal on each message entering the terminal.
- A check by both the transmitting and receiving terminals on the count of the message blocks transmitted and received.
- An overflow check on the message to ensure that the terminal buffer and line printer line capacity have not been exceeded.
- A check by the receiving terminal on the permissible message formats for a block of data.
- Internal parity checks to prevent loss of data between data set adapter and line printer.
- Printout verified by operator.

Error Indication

If an error indication for any of the above conditions is detected, different actions occur depending on the error condition. In some cases, the transmitting terminal automatically retransmits the message; in other cases, the terminal stops transmitting and provides a visual indication of the error on the operator's control panel.

Correction Procedure

Operator intervention.

5.4 Internal Errors

The discussion of internal errors will be conducted assuming the terminal is receiving data from a remote device. The internal checking procedure for a terminal which is transmitting is basically the same, but in reverse order.

Type of Checking

The terminal data set adapter verifies the CRC character(s) at the end of the data record coming from the transmission line. If a communication error exists, the error recovery procedure, as described in Paragraph 5.2, will be initiated. Assuming the communication checks are verified, the flow of data within the terminal is as follows:

- An LRC character is generated for each record of the data block.
- The data flows through the line speed adapter, the read memory, and the write memory before the LRC character is verified in the outgoing side of the write memory.
- A VRC character is generated and verified by the data channel and the peripheral drive unit.
- The data is printed on the line printer for visual verification.

Error Indication

Should any of the above internal or external checks be in error, operation of the terminal will halt and the appropriate error indicators on the operator's panel will be lighted.

Correction procedure

Operator intervention.

5.5 Line Malfunctions

Detection ..... depending on the operation being performed, transmit or receive, the terminal must receive data or a response within a 1-, 2-, or 3-second period.

Action ..... if an enquiry sequence or a response is not received after the automatic transmission of 3 enquiry sequences, the terminal will halt and operator intervention is required.

6. CONDITION INDICATORS

The Data 100 Terminal is equipped with operator control panels located on the TCU and on each input/output peripheral device employed in the configuration. The main control panel on the TCU provides those pushbuttons, switches, and indicators necessary to operate and maintain the terminal. The individual peripheral control panels are intended primarily for specific device control. The indicators display the mode of operation, status of each component, and error detection conditions.

7. DATA TRANSMISSION

7.1 Basic Characteristics

Rated transmission speed ..... 2,000; 2,400; 3,600; or 4,800 bits/sec.

Transmission method ..... serial by bit.

Transmission code ..... 8-level USASCII, 8-level EBCDIC, or 6 bit SBT; see Tables II, III, and IV.

Transmission mode ..... half-duplex; see Paragraph 1.5.

Order of bit transmission ..... low-order bit first.

Synchronization ..... synchronous; each message transmission begins with a series of 4 consecutive SYN codes followed by the text or appropriate control code(s).

7.2 Connection to Communications Lines

Communications Line	Data Set*
Public telephone network —	
2,000 bits/sec	Bell System Data-Phone Data Set 201A.
3,600 bits/sec	Non-AT&T Modems that conform to EIA RS232C Interface Standard.
Leased common-carrier voiceband line —	
2,000 bits/sec	Bell System Data-Phone Data Set 201A.
2,400 bits/sec	Bell System Data Set 201B.
4,800 bits/sec	Non-AT&T Modems that conform to EIA RS232C Interface Standard.

7.3 Transmission Control

Call initiation	manual dialing or signaling; voice communication on another line.
Call reception	capable of unattended operation with Auto Answer feature; otherwise, operator must establish voice communication before switching the data set to Data mode.
Functional operations	card reader (Model 70-1 only) or line printer can be selected by control codes; vertical form spacing or skipping and horizontal tabulation can be initiated on the printer via various control sequences contained in the incoming data; audible alarm can be activated by the BEL character.
7.4 Multistation Operation	the optional Multipoint Line Control feature enables the Data 100 Terminal to respond to polling or selection by the controlling computer system when a number of terminals are connected in a multistation arrangement; the terminal is capable of interpreting, but unable to generate, the address header, making direct communication with another multipoint terminal impossible; see Paragraph 1.5.

* In some cases, equivalent data sets can be used; see report sections 4620 and 4640 for a current list of modems available from independent manufacturers of telephone equipment.

8. PHYSICAL SPECIFICATIONS

Component / Feature	Model 70-1 Card Reader-TCU Cabinet	Model 70-3 Printer Cabinet
Width (in.)	40	40
Depth (in.)	25	25
Height (in.)	46	46
Weight (lb)	485	735
Power (kVA)	0.796	0.770
Voltage	115	115
Frequency (Hz)	50/60	50/60
Phases	1	1
Temperature Range (°F)	65-80	65-80
Humidity Range (%)	40-60	40-60
Heat (BTU/hr)	2,700	2,640

9. PRICE DATA

Component or Feature	Monthly Rental* $	Purchase Price** $	Monthly Maintenance $
70-1 Batch Terminal (card reader and line printer)	700	29,000	180
70-3 Printer Terminal (line printer only)	625	22,950	160
Optional Features			
Read/Write Speed Adapters (4,800 bits/sec)	10	400	2
Compression/Decompression	20	1,100	3
Extended Print Line —			
120 columns	35	2,150	6
132 columns	50	2,600	20
Printer Horizontal Tab	20	805	1
Multiple Record Transmission —			
Dual 600-character buffers (1-15 records each)	40	1,500	15
Dual 1,000-character buffers (1-31 records each)	80	3,000	25
High-Speed Line Printer (400 lines/min)	50	2,000	10

* Basic monthly lease price for a three-year period.
**Single quantity.

DELTA 1 VIDEO DISPLAY TERMINAL

.1 GENERAL

.11 Identity: . . . . . Delta 1 Video Display Terminal.

.12 Manufacturer: . . . . . Delta Data Systems Corporation
Woodhaven Industrial Park
Cornwells Heights, Pennsylvania 19020

.13 Basic Function: . . . . . visual display, via cathode ray tube (CRT), of alphanumeric data transmitted between the display terminal and a local or remote computer; data entry can be executed manually via keyboard or over the communications facility via program control; printed output is optional.

.14 Basic Components

Name: . . . . . Display Control Unit.
Model number: . . . . . 1010.
Function: . . . . . provides common input/output control, edit and format facilities, and buffer storage for display data.

Name: . . . . . Serial Communications Unit.
Model Number: . . . . . 1014.
Function: . . . . . provides a serial communications interface for remote data transmission over a voice-band line.

Name: . . . . . CRT Display Unit.
Model number: . . . . . 1020.
Function: . . . . . provides display of alphanumeric data received from the computer under program control or transmitted to the computer via keyboard data entry.

Name: . . . . . Keyboard
Model Number: . . . . . 1030.
Function: . . . . . provides manual entry of alphanumeric data to memory buffer for visual display and transmission to the computer.

.15 Description

Delta Data Systems Corporation states that the Delta 1 Video Display Terminal can be interchanged on a plug-to-plug compatibility basis with the IBM 2260/2848 or 2265/2845 Display Systems under local or remote operating conditions. No software modifications are required. Because there is a high degree of similarity to the IBM system pertaining to configuration, message sequence, and transmission characteristics, this report is confined to a summary of the Delta 1. Presented here will be a brief description of the basic operation of this terminal, a statement of the major differences existing between the equipment marketed by Delta Data Systems and IBM, and information pertinent to the inclusion of the Delta 1 into an IBM System/360 system. Refer to Reports 6456 and 6459 for additional information.

Basic Operation

The Delta 1 Video Display is designed primarily to facilitate rapid access and exchange of alphanumeric data with an IBM System/360 computer in a local environment or remotely via a 2701 Data Adapter Unit over a voice-band communications facility. Features including

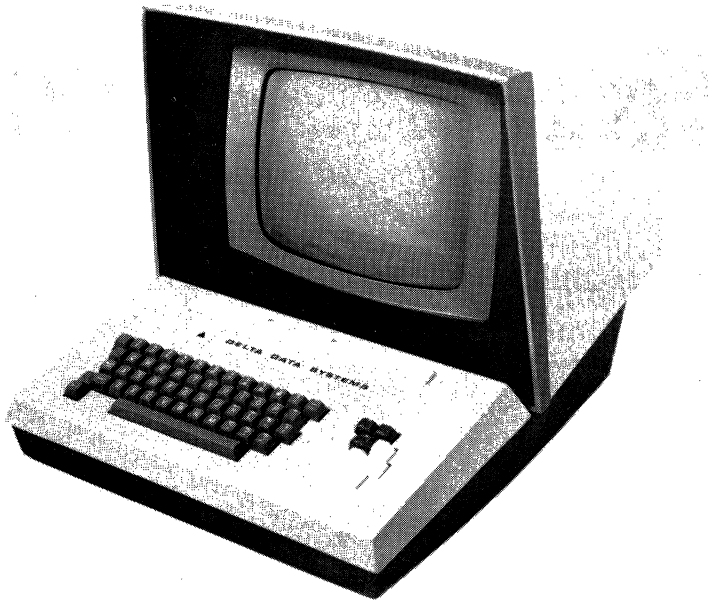


Figure 1. Delta 1 Video Display Terminal.

.15 Description (Contd.)

hardware connection and software packages are available to accommodate operations with various other types of computers. All communications are initiated by the remote computer in a polling arrangement so that coordination of transmitted data is maintained via command sequences under program control. One auxiliary device per controller can be incorporated to provide printed copy.

Five read commands are provided for transmission of data from the display station to the remote computer:

- Transmit Message — transmits data located between the existing cursor position and the End of Message symbol (↟); in the conversation mode the cursor is automatically returned to the first character position following the previous EOM Symbol before the transmission sequence is executed.

- Transmit Display — repositions the cursor to the first display location and initiates transmission of the entire display memory contents; concluding the transmission, the cursor is returned to the starting location.

- Transmit Line — transmits data located between the existing cursor position and the end of the line; cursor advances to the first position of the next line.

- Transmit Y Address Counter — transmits the address contained in the Y address counter; this is the address of the current cursor location and includes all character positions on the same line; the line address can range from zero to 23.

- Transmit X Address Counter — transmits the address contained in the X address counter; this address is the current character position of the cursor on a line; the command is usually preceded by a Y address to designate the current line location of the cursor; the character address can range from zero to 39.

Three write commands are provided for transmission of data from the remote computer to the display station:

- Enter Addressed Display — received data is displayed beginning at the current cursor position; a line feed/carriage return operation is automatically executed when more than 40 characters are entered to a line.

- Enter Addressed Line — received data is displayed beginning at the initial position on the line designated by the first character (Y address) following STX in the message; initiates an automatic line feed/carriage return operation.

- Enter Addressed Position — received data is displayed beginning at the line position designated by the first character (X address) following STX in the message; initiates an automatic line feed/carriage return operation.

All entry commands that advance the cursor include wraparound, i.e., uninterrupted writing from the last display location to the home position.

Editing Facilities

The Delta 1 incorporates an extensive set of edit functions that can be executed in conjunction with cursor manipulation via keyboard or remote program control. Cursor controls include:

- Left — cursor backspaces one position to the left; cursor returns (wraps around) to the last character position on a line when initially located on first position of that line.

- Right — cursor advances one position to the right; cursor returns (wraps around) to the first position on a line when initially located on the last position of that line.

- Up — positions the cursor up one line; cursor occupies same position in the line.

- Down — positions the cursor down one line; cursor occupies same position in the line; wraps around from the last line to the first line.

- Return — cursor advances to the first position of the following line (line feed/carriage return).

- Home — cursor is repositioned to the initial display position of the first line.

- Backspace — cursor returns one position to the left; cursor returns (wraps around) to the last character position of the same line if enabled when initially located on first position of a line.

- Tab — cursor advances to the first position of the next variable data field when in the fixed format mode.

- New Line — displays a New Line symbol (◢) to define the end of a line of data to be transmitted or the end of a variable data field in the fixed format mode.

Edit controls include:

- Insert — permits data characters to be added to an existing text; cursor defines the initial entry location of data to be inserted after shifting the locations initially occupied; the remaining text which follows the inserted data is advanced one position to accommodate each added character.

- Insert Line — permits a line of data to be added to an existing text; cursor defines the initial entry location of the line to be inserted after shifting the line initially occupied; text located below the inserted data is dropped one line to accommodate each added line.

- Delete — permits data characters to be erased from an existing text, which is then closed to maintain continuity; cursor defines the point of deletion; the remaining text following the deleted data is backspaced one position for each character erased.

.15 Description (Contd.)

- Delete Line — permits a line of data to be erased from an existing text which is then closed; cursor defines the initial character position of the line to be deleted; text located below the deleted data is moved up one line for each line erased.

- Clear Message — erases all data between the cursor and the End of Message (EOM) symbol by substituting space characters; cursor is relocated to the position immediately following the EOM symbol.

- Clear Display — erases all displayed data by substituting space characters; cursor is returned to the starting location as defined by the first deleted character position.

- Clear Line — erases all data between the cursor and the end of the line containing the cursor by substituting space characters; cursor is returned to its initial position on the line.

- Set Blink — initiates blinking of data inserted at the location occupied by the cursor; cursor is advanced one position.

- Clear Blink — terminates blinking at the character position occupied by the cursor; cursor is advanced one position.

Delta 1 Features Contrasting IBM 2265 Display Station

- Remote Read Operations — provides commands instructing the display to transmit text beginning at an addressed character position or an addressed line, to transmit selected text framed between the cursor and the end of a line or an EOM symbol, and to transmit the entire display.

- Remote Write Operations — provides commands initiating display of a received message beginning of a specified line or character address as well as at the home position; cursor positioning includes wrap-around.

- Remote Cursor Control — provides exceptionally flexible cursor manipulation via program control as well as manual operation; enables the remote computer to position the cursor at any fixed location on the display by supplying an absolute address to the terminal; all cursor control functions can be executed anywhere within the transmitted text for optimum format capability.

- Remote Edit Control — provides functions to alter or modify the displayed text; includes provision for insertion or deletion of text at addressed locations as specified in the command; also provides for erasure of data framed by the cursor and the end of a line or an EOM symbol, or the entire display.

- Selective Blink (optional) — alternate display/non-display of any character or groups of characters designated by the cursor location under keyboard or program control; reset facilities also selectively terminate the blink; this feature can be enabled for both fixed and variable data when operating in the fixed format mode.

- Graphic Mode (optional) — provides graphic facilities to generate straight and curved vectors under program control; display screen is divided into 8192 points each corresponding to an addressable character position in the refresh memory.

- Refresh memory — incorporates a 1024-byte magnetic core storage; six bits provide character storage, while the remaining two bits can be used to store blink and format data.

- Character Generation — incorporates a read-only memory to provide permanent storage for each of the 64 standard display characters; generates a 5-by 7-dot matrix to display each character.

- Keyboard — includes a conventional typewriter-styled keyboard with provisions for manual data entry, edit control, display control and selection of modes of operation; generates upper-case alphabetics, numerics, and 24 special symbols; up to ten special controls for additional I/O devices are optionally available.

- Display — incorporates a 12-inch (measured diagonally) cathode ray tube (CRT) mounted in a desk-top housing, standard; the maximum display format consists of 960 characters, arranged on 24 lines with 40 characters per line; additional standard or larger-sized display monitors connected to the same control unit are available as options to provide duplicate displays at different locations.

- Teletype Compatible Serial Controller (optional) — provides remote communications at standard teletype speeds of 110 bits per second using a full-duplex facility; one of two modes of operation can be employed:

  When operating in the Normal Mode, data entered via keyboard is immediately displayed and is transmitted by block directly to the remote computer; incoming data is displayed as it is received. The transmitted data is contained within cursor and EOM symbols when in the conversation mode, and within variable data fields when in the fixed format mode; the entire display is transmitted when neither of these modes is selected.

  When operating in the Echoplex Mode, data entered via keyboard is transmitted directly to the remote computer as each character is keyed in; each character entered or an error symbol (CAN), if received incorrectly, is returned for display.

- Options —

  options include a light pen;
  the Selective Blink feature;
  additional display monitors;
  color displays;
  provisions for printed copy;
  a communications interface; and
  a 96-character set that provides either lower-case alphabetics, line-drawing characters, or graphic symbols. (Use of the additional 32 characters for any one of these features excludes the Selective Blink capability.)

.16 First Delivery: . . . . . June, 1969.

.17 Availability: . . . . . 90 days, maximum.

TABLE I. DELTA 1 OUTPUT TO DISPLAY CHARACTERISTICS

Characteristic	Description
Output Medium	cathode ray tube; displays green characters against gray background
Character Set	64 characters, including digits 0-9, upper-case alphabetics, and 28 punctuation and special symbols; basic character set can be expanded to 96 characters to provide additional special symbols as options
Character Size	.25 inches high by .06 inches wide
Character Generation	5-by 7-dot matrix
Display Size	7 inches high by 9 inches wide
Characters Per Line	40
Lines Per Display	24
Characters Per Display	960
Buffer Capacity	960 characters
Format Control	line feed; carriage return; horizontal tab; line addressing; character addressing; remote cursor control; split-screen feature permits fixed format and conversation modes
Rated Output Speed	up to 1200 bits/sec or 2400 bits/sec (120 or 240 char/sec) over a voice-band line; up to 9600 bits/sec using appropriate data sets
Effective Speed	less than rated speed due to message length, exchange of control messages, and communications facility
Comments	optional character set includes either lower case, line drawing characters, or graphic symbols (provided the blink feature is not installed); color displays available on request.

TABLE II. DELTA 1 USASCII TRANSMISSION CODE

b_7 →					0	0	0	0	1	1	1	1
b_6 →					0	0	1	1	0	0	1	1
b_5 →					0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1	COL →	0	1	2	3	4	5	6	7
				ROW ↓								
0	0	0	0	0	NUL	DCO		0	@	P	@	P
0	0	0	1	1	SOH		:	1	A	Q	A	Q
0	0	1	0	2	STX	SET BLINK	"	2	B	R	B	R
0	0	1	1	3	ETX	CLEAR BLINK	#	3	C	S	C	S
0	1	0	0	4	EOT		$	4	D	T	D	T
0	1	0	1	5		NAK	%	5	E	U	E	U
0	1	1	0	6	ACK	↑	&	6	F	V	F	V
0	1	1	1	7		↓	'	7	G	W	G	W
1	0	0	0	8	BS	NORMAL MODE	(	8	H	X	H	X
1	0	0	1	9	TAB	FORMAT MODE	)	9	I	Y	I	Y
1	0	1	0	10	CR/LF		*	:	J	Z	J	Z
1	0	1	1	11		HOME	+	;	K	[	K	[
1	1	0	0	12	HOME	→	,	<	L	\	L	\
1	1	0	1	13			-	=	M	]	M	]
1	1	1	0	14	SO	A/N	.	>	N	↑ EOM	N	↑ EOM
1	1	1	1	15	SI	GR	/	?	O	← CR/LF	O	← CR/LF

TABLE III. DELTA 1 MESSAGE CONFIGURATION

Type of Message	Origin of Transmission	Message Sequence	Purpose of Command
Poll	computer	EOT, terminal address, terminal address, read command	requests transmission of data displayed at the addressed terminal; transmits variable data fields defined by New Line symbols; transmission begins at any addressed character position
Select	computer	SOH, terminal address, terminal address, write command	indicates to the addressed terminal, a message is waiting to be transmitted and displayed; transmitted data begins writing at any addressed character position; cursor commands within transmitted text initiate format controls. provides insertion or deletion of characters and lines of data in an existing text; causes erasure of lines, messages, or all data from a displayed text; commands are executed at any addressed line or character position as defined by cursor
Query	terminal	STX, terminal address, text, ETX, LPC (parity character)	indicates that addressed terminal is in transmit mode with displayed text, in response to a poll command
Acknowledgement (message and terminal status replies)	terminal	ACK	indicates that addressed terminal is in receive mode to display data transmitted from the computer, in response to a select command. indicates data is received without error after transmission of a computer message.
Acknowledgement	terminal	EOT	indicates end of transmission following computer acknowledgement of valid polled message; causes terminal keyboard to unlock. indicates that addressed terminal has no message waiting and is not in transmit mode, in response to a poll command

TABLE III. DELTA 1 MESSAGE CONFIGURATION (Contd.)

Type of Message	Origin of Transmission	Message Sequence	Purpose of Command
Acknowledgement (message status replies)	computer	ACK	indicates data was received without error following terminal transmission of a polled message
		NAK	indicates data contained in a polled message was received in error; causes addressed terminal to retransmit the displayed text until a valid message is received
		EOT	indicates end of transmission following terminal acknowledgement of a valid computer message.

.8 PHYSICAL SPECIFICATIONS

Component	Model 1020 Display	Model 1010 Display Control Unit	Model 1030 Keyboard
Width (inches)	8.75	16.63	16.38
Depth (inches)	13.88	9.75	9.25
Height (inches)	16.25	7.0	4.12
Weight (pounds)	25.0	60.0	9.0
Power (KVA)	—	.35	—
Voltage	—	115	—
Frequency (cps)	—	60	—
Phases	1	1	1
Temperature Range (°F)	40 to 105	40 to 105	40 to 105
Humidity Range (%)	0 to 95	0 to 95	0 to 95
Heat (BTU/hr)	—	—	—

.9 PRICE DATA

Component or Feature	Purchase Price,*
Model 1010 Display Control Unit	300
Model 1014 Serial Communications Unit	4700
Model 1020 Display Unit	500
Model 1030 Keyboard	300
Options	
Model 1011 Selective Blink	—
Model 1012 Edit Control	—
Model 1016 Format Mode	—
Model 1017 96-Character Set	—
Model 1018 Data Set Serial Communications Interface	—
Model 1019 Teletype Serial Communications Interface	—
Model 1022 Display Unit (17-inch)	—
Model 1040 Light Pen	—
Parallel Control Units —	
Model 1101 (DEC PDP-8)	—
Model 1102 (Varion 6201)	—
Model 1103 (SDS Sigma II)	—
Model 1104 (PDC 808/16)	—
Model 1105 (Nova)	—
Model 1106 (Interdata)	—
Model 1201 Teletype Adapter	—
Model 2020 Color Display Unit	—
Model 2110 Color Drive (for Model 1010 Control Unit)	—

*Delta Data Systems provides standard leasing and maintenance arrangements for all components including purchase price information for optional features which are not included in the basic configuration.

DIGITRONICS TURN-AROUND DIAL-O-VERTER LINE

.1 GENERAL

.11 Identity: . . . . . Digitronics Dial-o-Verter Line

.12 Manufacturer: . . . . . Digitronics Corporation
1 Albertson Avenue
Albertson, L.I., New York 11507

.13 Basic Function: . . . . . provides transmission/reception of magnetic tape data over voiceband lines

.14 Basic Unit

Name: . . . . . Magnetic Tape Terminal
Model number: 524
Function: . . . . . reads data from magnetic tape and transmits it over a voiceband line; receives data over a voiceband line and records it on magnetic tape; optional features include local conversion between magnetic tape and paper tape and capability for punching received data into paper tapes

.15 Description

The Digitronics Turn-Around Dial-o-Verter consists of the 524 Magnetic Tape Terminal. This unit is designed to be compatible with the Turn-Around Terminals no longer in production. The Digitronics 507R, 507S, 510, 515, 505, 520, and 521 communication terminals previously contained in this line have been discontinued and are not available. The 524 Magnetic Tape Terminal is a new version of the 520 and provides additional input/output and translation capabilities. Digitronics Turn-Around Dial-o-Verter line is being supplemented with the Digitronics Reverse-Channel Dial-o-Verter line described in Report 6221:01; however, the two Digitronics equipment lines are not compatible. The following paragraphs provide a description of the 524 Magnetic Tape Terminal.

524 Magnetic Tape Terminal

Transmitting speed of the 524 ranges from 150 to 300 characters per second, and the terminal is capable of unattended operation.

The basic seven-channel recording format is IBM 729-compatible at 200, 556, or 800 (optional) bits per inch; tape speed is 30 inches per second. A nine-channel tape handler, which records in a format compatible with the IBM 2400 Series Magnetic Tape Units, is optional.

The basic 524 Terminal handles data in a binary image form with no translation. Various 6-bit to 6-bit code translators are optional, as are translators for conversion between a 6-bit code and the 7-bit USASCII code. Data transmitted between the tape handler and the communications line is intermediately stored in a 1,020-character core memory buffer.

Digitronics' 524 Magnetic Tape Terminal can transmit or receive data over common-carrier leased or switched telephone lines. The terminal operates in a half-duplex mode and can communicate with other terminal equipment in the firm's Turn-Around Dial-o-Verter line.

The 524 has extensive error detection, error identification, and error correction capabilities. Both character parity and block (longitudinal) parity checks are used. If a block of data on

tape contains a parity error, up to three additional attempts are made to read the data block correctly. The operator may elect to force a reading of the block or to pass over the block. If reading of the block is forced, the character in error and the associated block are flagged.

If an error is detected in a block of received data, an automatic request for retransmission is generated. Up to three retransmissions can occur for the same block of data; at the end of the fourth unsuccessful transmission of the same data block, the receiving terminal is automatically disconnected.

All data received is stored in a 1,024-character core memory buffer. If a writing error is detected through a character or block parity check, the data is rewritten from the core buffer. After four unsuccessful attempts to write on tape, the unit halts. The operator can force writing of the block and have special characters inserted on the tape.

Special codes can be manually written on tape in signal-character blocks to identify the end of data. A special-character search can be manually initiated and automatically terminated when the special character is found. An indicator lamp is illuminated when the search is terminated.

A technique for determining the correct sequence of data blocks, called Modulo 8 Block Count, is provided with the basic 524. Modulo 8 Block Count is discussed in the Digitronics Reverse-Channel Dial-o-Verter Report 6221, Paragraph .15.

A wide range of optional features is available, including:

- Fixed Code Translation — provides translation between a six- or seven-bit transmission code and a six-bit magnetic tape code; translation codes are specified by the customer.

- Variable Code Translation — provides the translation ability described under fixed code translation with the addition of suppressed character and translation code selection via a plugboard.

- Paper Tape Output — provides local conversion of magnetic tape data to paper tape data, or paper tape output of received data. A self-contained paper tape punch (Teletype DRPE) and winder are included; they can handle five- or eight-level tape. When the 524 operates as a paper tape receiver, data is checked for correct parity and transferred to the buffer. Only data with correct parity is punched.

- Paper Tape Input — provides local conversion of paper tape data to magnetic tape data. A self-contained paper tape reader capable of reading 500 characters per second and a spooler capable of handling 10-inch reels are included. Paper tape that contains five or eight levels can be read.

- High Density Tape Option — provides tape density selection of either 556 or 800 bits per inch.

- RCA-Compatible Tape Option — permits the use of a customer-supplied RCA Model 581 Tape Handler in place of the standard IBM-compatible tape drive. This option employs an echo check on written data instead of a read-after-write check. Three rewrite attempts are made following an echo-check error before operator intervention is required. A bit density of 333.3 bits per inch is standard with the RCA Model 581.

- Data-Verter Compatibility — provides the magnetic tape terminal with the capability to receive transmissions from a remote Digitronics Data-Verter transmitter. An automatic polling feature is available with this option.

- IBM-Compatible 9-Channel Tape Capability — provides a nine-channel tape drive for recording tape in the IBM System/360 Series format at 800 bits per inch.

- Data Set Select — permits the terminal to share a common data set with any other Digitronics Turn-Around Dial-o-Verter terminal, which also has the Data Set Select option installed. Only one terminal can use the data set at a time. If the two sharing terminals are a transmitter and a receiver, local communication between the two terminals is possible if their data formats are compatible.

- Subset Select — provides for selection of one or two data sets by a control panel switch.

.16 First Delivery: . . . . . April 1966.

.17 Availability: . . . . . 4 months.

.2 CONFIGURATION

The 524 Magnetic Tape Terminal consists of:

- Magnetic tape handler, including read and write circuits
- 1024-character core memory
- Printing counter
- Coupler
- Translator module (optional)
- Paper tape punch (optional)
- Paper tape reader (optional)
- Data-Verter Receive Adapter (optional)

It is used in conjunction with the appropriate data set, as described in Paragraph .72.

.3 INPUT

.31 Prepared Input

524 Magnetic Tape Terminal —

Input medium:	0.5-inch magnetic tape, recorded at 200, 556, or 800 bpi; IBM 729-compatible (IBM System/360 Series compatibility is optional).
Input code:	IBM BCD; 6 data bits plus parity bit per character (or 8 data bits plus parity bit per character using the IBM System/360 Series compatibility option).
Quantity of data:	15 to 1,020 char/block.
Character set:	full alphanumeric plus special symbols.
Rated input speed:	6,000 to 24,000 char/sec.
Effective speed:	up to 300 char/sec, depending on block length and communications facility.
Comments:	uses 2,400-foot reels of tape; tape speed is 30 ips.

524 Magnetic Tape Terminal with Paper Tape Input Option —

Input medium:	standard oil-impregnated paper tape; 11/16-inch 5-level or 1-inch 8-level (factory preset).
Input code:	any 5-, 6-, 7-, or 8-level code.
Quantity of data:	variable.
Rated input speed:	500 char/sec.
Effective speed:	up to 300 char/sec, depending upon block length and transmission speed.
Comments:	optional features include 10-inch reel spooler.

.32 Manual Input: . . . . . no provision.

.33 Fixed Input: . . . . . no provision.

.34 Transaction Code Input: . . . . . no provision.

.35 Message Configuration: . . . . . the data characters are preceded and followed by special control codes automatically supplied by the terminal; Magnetic Tape Terminal is limited to 1,020 characters per block, including the 524 control characters automatically supplied by the terminal.

.36 Operating Procedure

(1) Load magnetic tape or punched paper tape.

(2) Establish connection with remote terminal.

(3) Press button to establish synchronization and start transmission.

.37 Entry of Time and Date: . . . . . no provision.

.4 OUTPUT

.41 Output to Punched Tape

524 Magnetic Tape Terminal with Paper Tape Output Option —

Tape size:	standard oil-impregnated paper tape; 11/16-inch, 5-level or 1-inch 8-level (factory preset).
Tape code:	any 5-, 6-, 7-, or 8-level code.
Rated output speed:	107 char/sec.
Effective speed:	somewhat less than rated speed, depending block length.

.43 Output to Magnetic Tape

524 Magnetic Tape Terminal —

Tape size:	0.5-inch, recorded at 200, 556, or 800 bpi; IBM 729-compatible (IBM 2400 Series compatibility is optional).
Tape code:	IBM BCD; 6 data bits plus parity bit per character (or 8 data bits plus parity bit per character using the IBM 2400 Series compatibility option); various code translations are optional.
Rated output speed:	6,000 to 24,000 char/sec.

Effective speed: . . . . . up to 300 char/sec, depending on block length and communications facilities.
Format control: . . . . . none.

.5 ERROR DETECTION AND CORRECTION

.51 Data Entry Errors

Type of checking: . . . . . character parity.
Error indication: . . . . . indicator lamp is lighted.
Correction procedure: . . . . . magnetic tape terminals automatically reread up to a total of four read operations.

.52 Data Transmission Errors

Type of checking: . . . . . character parity and longitudinal parity.
Error indication: . . . . . indicator lamp is lighted, buzzer is sounded; writing operation halts in magnetic tape units.
Correction procedure: . . . . . automatic retransmission; if four unsuccessful transmissions occur for the same data block, the terminal automatically halts; transmitting operator can force transmission with special error character flag.

.53 Data Recording Errors

Type of checking: . . . . . read-after-write character and longitudinal parity check.
Error indication: . . . . . indicator lamp lights; buzzer is sounded; printing counter prints block number.
Correction procedure: . . . . . data is rewritten from memory; tape unit halts and terminal disconnects after four unsuccessful attempts to write the same data block.

.54 Overflow Errors

Type of checking: . . . . . data received is checked for exceeding buffer core memory capacity.
Error indication: . . . . . lamp, buzzer, automatic disconnect.
Correction procedure: . . . . . operator intervention.

.55 Line Malfunctions

Detection: . . . . . no data received for 10 seconds.
Action: . . . . . automatic disconnect.

.6 CONDITION INDICATORS

Indicator lamps provide visual indications of error status, busy condition, memory-buffer overflow, and power on.

.7 DATA TRANSMISSION

.71 Basic Characteristics

Rated transmission speed: . . . . . 150, 250, or 300 char/sec, depending on communications line and data set; these speeds correspond to 1200, 2000, and 2400 bps, respectively.
Transmission method: . . . . . serial by bit.
Transmission code: . . . . . 6 data bits, one parity bit, and one sync bit per character.

Transmission mode: . . . . . half-duplex.
Order of bit transmission: . . . . . most significant bit first, parity bit last.
Synchronization: . . . . . synchronous; a sync bit is inserted into each character, and resynchronizing characters are inserted during transmission of data.

.72 Connection to Communications Lines

Communications Line	Data Set*
Public switched telephone network at the following speeds —	
1,200 bits/sec (150 char/sec):	Bell System Data-Phone Data Set 202C
2,000 bits/sec (250 char/sec):	Bell System Data-Phone Data Set 201A
Common-carrier leased voiceband line at the following speeds —	
1,200 bits/sec (150 char/sec):	Bell System Data Set 202C, or Western Union 1200 Baud Data Modem
2,000 bits/sec (250 char/sec):	Bell System Data Set 201A
2,400 bits/sec (300 char/sec):	Bell System Data Set 201B, or Western Union 2400 Baud Data Modem

.73 Transmission Control

Call initiation: . . . . . manual dialing or signaling.
Call reception: . . . . . manual or unattended operation.
Functional operations: . . . . . none; except request retransmission.

.74 Multistation Operation: . . . . . no provision.

.8 PHYSICAL SPECIFICATIONS

Component	524 Magnetic Tape Terminal
Width (inches)	56
Depth (inches)	24
Height (inches)	72
Weight (pounds)	1,500
Power (KW)	5.9
Voltage	115
Frequency (cps)	60
Phases	1
Temperature range (°F.)	55 to 95
Humidity Range (%)	40 to 70
Heat (BTU/hr)	18,000

* In some cases, equivalent data sets can be used; see Sections 4620 and 4640 for a current list of modems available form independent manufacturers of telephone equipment.

.9 PRICE DATA

Component or Feature	Monthly Rental $	Purchase Price $	Monthly Maintenance $
524 Magnetic Tape Terminal	1,325	48,900	220
Fixed Code Translator	126	4,515	N/C
Variable Code Translator	134	4,746	N/C
Paper Tape Output	236	8,500	50
Paper Tape Input	210	7,560	30
800 bpi Density	63	2,258	6
RCA 581 Compatibility	N/C	N/C	N/C
9-channel Tape (IBM 2400 Series Compatibility)	95	3,360	19
Data Set Selection	11	378	2.20
Subset Select (202/201)	16	567	3.20
Data-Verter Compatibility	457	17,026	50
Automatic Polling (Data-verter)	509	19,115	30

N/C — No Charge

DIGITRONICS REVERSE-CHANNEL DIAL-O-VERTER LINE

.1 GENERAL

.11 Identity: ..... Digitronics Reverse-Channel, Dial-o-Verter line; see Paragraph .14 for a listing of the current models in the line.

.12 Manufacturer: ..... Digitronics Corporation
1 Albertson Avenue
Albertson, L.I., New York 11507

.13 Basic Function: ..... the Digitronics Reverse-Channel, Dial-o-Verter communication terminals are a group of independent, compatible data transmitting or receiving terminals which provide data communications over voiceband lines, using various input/output media.

.14 Basic Units

Name: ..... Printer Terminal.
Model number: ..... 4021.
Function: ..... receives data from a voiceband line and prints it on paper.

Name: ..... Paper Tape Transmitter.
Model number: ..... 507.
Function: ..... reads data from punched paper tape and transmits it over a voiceband line.

Name: ..... Paper Tape Receiver.
Model number: ..... 509.
Function: ..... receives data from a voiceband line and punches it into paper tape.

Name: ..... Magnetic Tape Terminal.
Model number: ..... 522.
Function: ..... reads data from magnetic tape and transmits it over a voiceband line; receives data from a voiceband line and records it on magnetic tape; optional functions include local conversion between magnetic tape and paper tape, and punching received data into paper tape.

Name: ..... Magnetic Tape Terminal.
Model number: ..... 5225.
Function: ..... reads data from magnetic tape and transmits it over a voiceband line; receives data from a voiceband line and records it on magnetic tape.

Name: ..... Printer/Card Reader Terminal.
Model number: ..... 5122.
Function: ..... transmits data over voiceband line from prepunched or mark-sensed cards; prints data received from a voiceband line on paper.

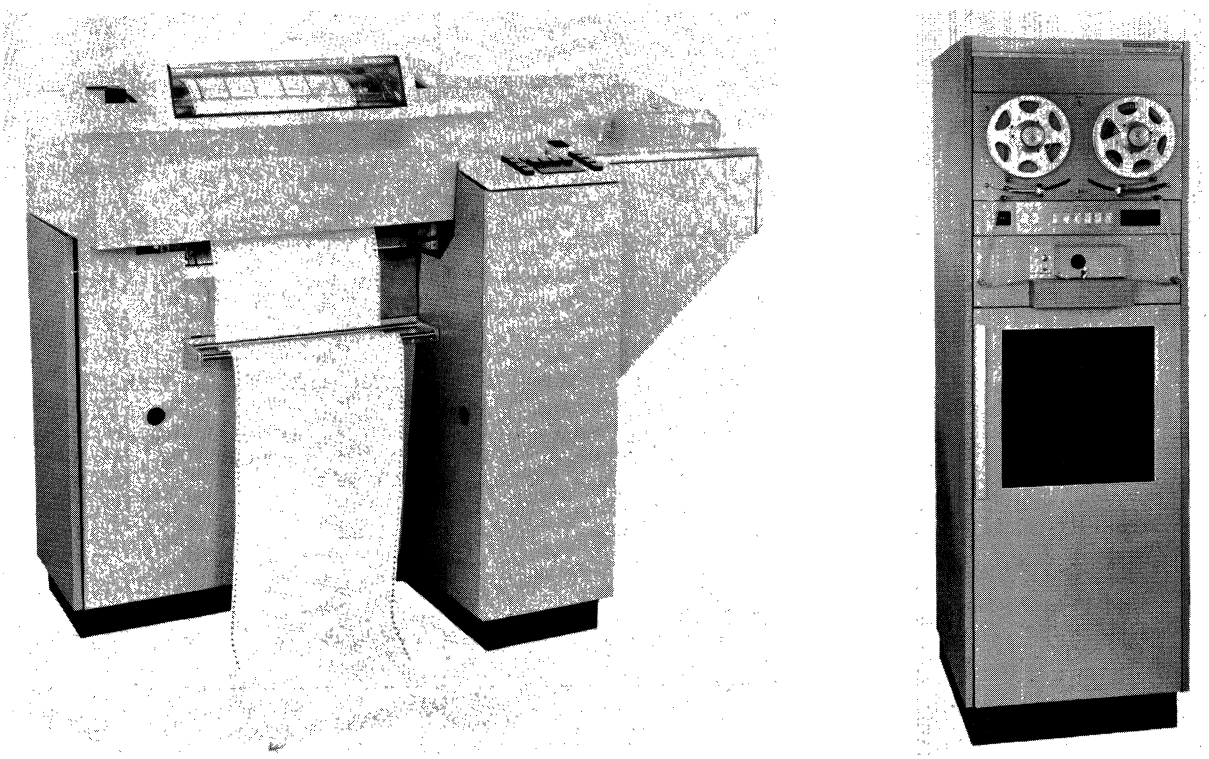


Figure 1. The 5072, a Combined Paper Tape Transmitter/Printer Receiver Terminal (left) and the 5079, a Bidirectional Paper Tape Terminal (right)

Name:	Printer/Paper Tape Transmitter.
Model number:	5072.
Function:	transmits data over voiceband line from prepunched paper tape; prints data received from voiceband line on paper.
Name:	Paper Tape Transmitter/Receiver.
Model number:	5079.
Function:	transmits data from punched paper tape over a voiceband line; prints data received from a voiceband line on paper.

.15 Description

The Digitronics Dial-o-Verter communications terminals described in this report are discrete, self-contained, compatible units which transmit or receive data over a voiceband line. Different units provide facilities for transmitting data recorded in punched cards, punched paper tape, or magnetic tape; or for receiving data and punching it into paper tape, printing it, or recording it on magnetic tape.

Error signaling via a reverse channel characterizes all units in this line. Reverse-channel operation is a monitoring process by which the transmitting device is made immediately cognizant of transmission errors detected at the receiver. This process eliminates the time required for line turn-around to allow the receiver to transmit an acknowledge code. Reverse-channel data sets divide the available bandwidth in a normal voice-grade circuit into a forward data channel and a narrow reverse-signaling channel. Under normal circumstances, when no errors are detected, the receiving terminal allows a continuous tone to be

transmitted on the reverse channel. When an error is detected, the signal on the reverse channel is momentarily interrupted. The momentary interruption is interpreted by the transmitting device as a request for retransmission of a block. If the signal on the reverse channel is interrupted for a period greater than two seconds, the transmitting terminal automatically disconnects and operator intervention is required.

The Modulo 8 Block Count feature is also included with all units. This block identification method is employed by both the transmitting and receiving devices to detect the loss or duplication of a data block within a message. The transmitter and receiver units contain block counters which are preset to 0 at the start of a message. The block count is sampled at the beginning of each data block, and a character containing the current block count is transmitted immediately preceding the corresponding data block. A similar block counter at the receiver is incremented after each successful transmission, and its block count is compared to the transmitted block count preceding the next data block.

A transmitted block count less than the receiver's block count indicates that a successfully received data block has been repeated. The repeated data block is ignored; i.e., the block count is unchanged and the repeated block is not entered on the output media. A transmitted block count greater than the receiver's block count indicates that a retransmission request was missed or the transmitter has failed to synchronize on a previous block. Retransmission is requested via the reverse channel. If a block count error recurs three consecutive times, transmission is interrupted and operator intervention is required.

The characteristics of each unit are described in the following paragraphs.

4021 Printer Terminal

The 4021 Printer Terminal is a buffered, receive-only terminal capable of printing at up to 300 single-spaced lines per minute, using a 64-character set. Printing is spaced at 10 columns per inch horizontally and six lines per inch vertically. Up to six carbon copies can be produced.

The printer terminal assembles data received serially by bit from a voiceband line, performs character parity and longitudinal parity checks, and stores the characters sequentially in a 256-character-capacity buffer segment. When a full line of print has been stored, a print cycle is initiated. Characters are transferred from the buffer, checked for character parity, and printed. During the print cycle, the next print line is received and stored in an alternate buffer segment. A retransmission request is automatically initiated over the reverse channel in response to detected transmission errors. If errors cannot be corrected by automatic retransmission, operator intervention is required.

The 4021 is capable of receiving information at a rate of 100, 150, or 300 characters per second, depending upon the data set and the transmission facility used. The effective printing rate is determined by the vertical output format, the number of characters per line, and the transmission rate. The print mechanism requires 205 msec to print and feed one line. Each additional line feed requires 9 msec. A three-channel punched Mylar tape loop is used to define the vertical format.

The 4021 uses an End-of-Text (ETX) code to terminate each block. This code can be used to specify a print-and-space or a print-only operation. The printing of control characters is automatically suppressed.

Optional features available for the 4021 include:

- Horizontal Tab — provides for controlled-column skipping in a printed line. Up to 12 tab positions may be defined on a pin-board. Data characters following a tab-control character are shifted to the next tab-stop position.

- Vertical Tab — provides the addition of five more channels to the standard three channels on the Mylar tape loop.

- Increased Column Printing Width — provides expansion of the standard 120-column printer to 132 columns in increments of four columns.

- A choice of type styles.

507 Paper Tape Transmitter

The 507 Paper Tape Transmitter is an unbuffered paper tape terminal capable of reading at 100, 150, or 300 characters per second from fully punched 5-, 6-, 7-, or 8-level paper tape.

Data is read from tape serially by character and momentarily stored. A character parity check (odd or even) is performed on the stored character and a longitudinal parity character is generated. The data character is then serialized and transmitted. The longitudinal parity character is transmitted at the end of each block. Error correction is performed by automatic retransmission upon request from the receiving device.

End of block is indicated by an End-of-Text (ETX) code, which is generated upon recognition of a unique item character or a unique arrangement of two item characters (customer-selected). Additional methods for grouping data into blocks are available, as listed below under optional features. Data transmission may be terminated by physically sensing the end of tape, by reading the End-of-Transmission (EOT) code from an USASCII-coded tape, or by activating the EOT switch. One of two characters (customer-selected) may be automatically transmitted upon end-of-tape detection — ETX or EOT. If the ETX code is chosen, the EOT switch must be activated to transmit the EOT code. Transmission of ETX allows additional data to be transmitted without re-establishing a connection.

Every input tape must include a trailer consisting of a number of trailer characters plus an additional 10 inches of tape.

Optional features available for the 507 include:

- Character Counter — establishes block length in one of the following three ways:

  (1) Executes ETX code transmission immediately following the first item code read after a specified number of characters has been transmitted.

  (2) Executes ETX code transmission immediately after a specified number of characters has been transmitted.

  (3) Executes ETX code transmission immediately after a specified number of item codes has been read.

  The character counter is not advanced by FIGS, LTRS, or Delete codes. An ETX code is automatically generated at a character count of 1,020, or a lesser specified number, as a protection against exceeding the memory capacity of a magnetic tape receiver.

- Spoolers — Digitronics Model 4566A Spoolers are available to permit the bi-directional handling of paper tape. The two 8-inch reels included with the spoolers can each accommodate 650 feet of paper tape.

509 Paper Tape Receiver

The 509 Paper Tape Receiver is an unbuffered paper tape terminal capable of punching paper tape at 100 characters per second. The 509 terminal assembles data received serially by bit from a voiceband line, performs character parity and longitudinal parity checks, and punches each assembled 5-, 6-, 7-, or 8-level character into paper tape. A retransmission request is automatically initiated over the reverse channel in response to detected transmission errors. If errors cannot be corrected by automatic retransmission, operator intervention is required.

Block length is determined by the transmitting device, which transmits an ETX character to identify end of block. Correctly and incorrectly received blocks are identified on the paper tape by customer-selected codes immediately following the final data character of the block.

The following listed codes may be deleted, punched directly into the output tape, or translated prior to punching:

(1) Start-of-Text (STX) code.

(2) Modulo 8 Block Count code (only if correct).

(3) End-of-Text (ETX) code.

(4) End-of-Transmission (EOT) code.

Transmission is terminated by detection of the EOT code, and operator intervention is required for confirmation. Optional features available with the 509 include:

- Output Error Control — provides two alternate modes of error control in reference to the normal reverse-channel operation:

  (1) Completion of the error-block operation allows a block to be completed and an ETX code or a sync code to initiate a reverse-channel retransmission request. An error flag character may be inserted in place of the error character if desired, and the normal incorrect block codes punched at the end of a block. The reverse channel is also interrupted at the loss of synchronization, a longitudinal parity error, or the failure to receive an STX code or Modulo 8 Count code.

  (2) Non restraint operation inhibits a retransmission request except for control errors, e.g., STX, Modulo 8, longitudinal parity, or loss of synchronization. Data errors are replaced by flag characters, and control-error blocks are followed by incorrect block codes.

5079 Paper Tape Transmitter/Receiver

The 5079 Paper Tape Transmitter/Receiver is an unbuffered paper tape terminal incorporating a paper tape reader and a paper tape punch. This unit is capable of reading or punching any 5-, 6-, 7-, or 8-level paper tape code.

The transmitter reads data at 100, 150, or 300 characters per second from tape serially by character and stores it momentarily. A character parity check (odd or even) is performed on the stored character, and a longitudinal parity character is generated. The data character is then serialized and transmitted. The longitudinal parity character is transmitted at the end of each block. Error correction is performed by automatic retransmission upon request from the receiving device.

End of block is indicated by an End-of-Text (ETX) code, which is generated upon recognition of a unique item character or a unique arrangement of two item characters (customer-selected). Additional methods for grouping data into blocks are available, as listed under optional features. Data transmission may be terminated by physically sensing the end of tape, by reading the End-of-Transmission (EOT) code from a USASCII-coded tape, or by activating the EOT switch. One of two characters (customer-selected) can be automatically transmitted upon end-of-tape detection (ETX or EOT). If the ETX code is chosen, the EOT switch must be activated to transmit the EOT code. Transmission of ETX allows additional data to be transmitted without re-establishing a connection.

Every input tape must include a trailer consisting of a number of trailer characters plus an additional 10 inches of tape.

The receiver is capable of punching paper tape at a nominal rate of 100 characters per second. The terminal assembles data received serially by bit from a voiceband line, performs character parity and longitudinal parity checks, and punches each assembled 5-, 6-, 7-, or 8-level character into paper tape. A retransmission request is automatically initiated over the reverse channel in response to detected transmission errors. If errors cannot be corrected by automatic retransmission, operator intervention is required.

Block length is determined by the transmitting device, which transmits an ETX character to identify end of block. Correctly and incorrectly received blocks are identified on the paper tape by customer-selected codes immediately following the final data character of the block.

The following listed codes may be deleted, punched directly into the output tape, or translated prior to punching:

(1) Start-of-Text (STX) code.

(2) Modulo 8 Block Count code (only if correct).

(3) End-of-Text (ETX) code.

(4) End-of-Transmission (EOT) code.

Transmission is terminated by detection of the EOT code, and operator intervention is required for confirmation.

The 5079 can be operated locally in the Copy mode if the transmitter is programmed for a speed of 100 characters per second to match the speed of the punch.

Optional features with the 5079 include:

Transmit — Character Counter

(1) Executes ETX code transmission immediately following the first item code read after a specified number of characters has been transmitted.

(2) Executes ETX code transmission immediately after a specified number of characters has been transmitted.

(3) Executes ETX code transmission immediately after a specified number of item codes has been read.

The character counter is not advanced by FIGS, LTRS, or Delete codes. An ETX code is automatically generated at a character count of 1,020, or a lesser specified number, as a protection against exceeding the memory capacity of a magnetic tape receiver.

Receive — Output Error

(1) Completion of the error-block operation allows a block to be completed and an ETX code or a sync code to initiate a reverse-channel retransmission request. An error flag character may be inserted in place of the error character, if desired, and the normal incorrect block codes punched at the end of a block. The reverse channel is also interrupted at the loss of synchronization, a longitudinal parity error, or the failure to receive an STX or Modulo 8 Count code.

(2) Nonrestraint operation inhibits a retransmission request except for control error, e.g., STX, Modulo 8, longitudinal parity, or loss of synchronization. Data errors are replaced by flag characters, and control-error blocks are followed by incorrect block codes.

5072 Printer/Paper Tape Transmitter

The 5072 Printer/Paper Tape Transmitter is a buffered terminal consisting of a printer (see 4021) and a Paper Tape Transmitter capable of reading at 100, 150, or 300 characters per second from fully punched 5-, 6-, 7-, or 8-level paper tape.

In addition to the on-line transmit and receive operations, the 5072 is capable of performing off-line printing. In the off-line Printing mode, data is read from fully chadded punched tape and hard copy printout is produced.

When transmitting, data is read parallel by character from the input tape and is stored momentarily in the 5072. Each character is monitored for correct vertical parity (even or odd) and is then serialized onto the transmission line. A longitudinal parity character is transmitted at the end of each data block to enable additional error checking at the receiver.

Detection of an error by the receiver results in an interruption in the transmission and a retransmission of the data block which contained the error. All additional attempts to read and transmit the data correctly are controlled by the receiver. If all attempts fail, transmission halts and the operator is informed of the situation by the appropriate lights on the control panel.

End of block is indicated by an End-of-Text (ETX) code, which is generated upon recognition of a unique item character or a unique arrangement of two item characters (customer-selected). Additional methods for grouping data into blocks are available (see 507). Data transmission may be terminated by physically sensing the end of tape, by reading the End-of-Transmission (EOT) code from a USASCII-coded tape, or by activating the EOT switch. One of two characters (customer-selected) may be automatically transmitted upon end-of-tape detection (ETX or EOT). If the ETX code is chosen, the EOT switch must be activated to transmit the EOT code. Transmission of ETX allows additional data to be transmitted without re-establishing a connection.

Digitronics Model 4566A Spoolers are available to permit the bidirectional handling of paper tape. The two 8-inch reels included with the spoolers can each accommodate 650 feet of paper tape.

5122 Printer/Card Reader

The Digitronics 5122 Printer Card Reader is a buffered terminal consisting of a printer (see 4021) and a card reader which transmits data from punched or mark-sensed cards.

The 5122 can be provided with a modified form of polling and selection, enabling it to perform with a minimum of operator attention. When operating in this mode, the 5122 will respond to an incoming ring signal. The terminal will then either transmit or receive, depending on whether cards are contained in the card reader hopper. If both transmission and reception are required to proceed automatically, operation in the Transmit mode must be completed before operation in the Receive mode.

In addition to the on-line Transmit and Receive mode operations, the 5122 performs off-line printing (local mode). In the Local mode, data is read from punched or mark-sensed cards and hard-copy printout is produced.

When transmitting, data is presented to the 5122 on punched or mark-sensed cards which record two complete characters on each of up to eight columns. The two characters are separated and each is checked for correct vertical parity and then serialized for storage in the core memory. When a complete data block has been assembled, the data is transferred to the coupler module. The data is again checked for correct vertical parity and sent, serially, to the data set for line transmission. A longitudinal parity character is transmitted at the end of each data block to enable additional error checking at the receiver.

Detection of an error by the receiver results in an interruption in the transmission and a retransmission of the data block which contained the error. If four attempts to transmit the

data fail, transmission halts and the operator is warned by the appropriate lights on the master control panel.

The card reader has a nominal rated spped of 200 cards per minute. This speed in conjunction with the Blocking mode, the number of characters per card, and the speed of the data set (Bell System 202C, 201B, or Rixon Sebit 48) determines the effective transmission rate of the 5122 in cards per minute.

522/5225 Magnetic Tape Terminal

The 522/5225 Magnetic Tape Terminal is a buffered terminal consisting of a magnetic tape handler (IBM 729-compatible), a 1020- (522)/512-character (5225) buffer memory, and circuits for both transmitting and receiving data at up to 300 characters per second over a voiceband line. The basic 522/5225 receives or transmits without translation. Data is recorded on tape at a bit density of 200 or 556 bits per inch. The tape speed is 30 inches per second. Several optional features can be incorporated in the 522, including paper tape equipment. These optional features are described in detail at the end of this 522/5225 description.

When the 522/5225 operates as a receiving terminal, it assembles data received serially by bit from a voiceband line, performs character parity and longitudinal parity checks, and stores each character in a buffer memory. Data is transferred from buffer memory to magnetic tape, and a second character parity check is performed. As data is written on tape, a read-after-write check is performed.

When the 522/5225 operates as a transmitting terminal, data is read from magnetic tape, checked for correct character parity, and transferred to the buffer memory. After a full block has been read from tape, data is transferred from the buffer memory, serialized, and transmitted. A second character parity check is performed during the transfer from memory, and longitudinal parity is generated. A longitudinal parity character is transmitted at the end of a data block.

Block length, due to memory limitation, is established at 1020 (522) or 512 (5225) characters, or a lesser number of characters, depending on the communicating terminal. Blocks of less than a specified number of characters (usually 15) are ignored with the exception of two single-character control blocks. The 522 recognizes the end of a block by detecting an interrecord gap. The End of Transmission (EOT) is indicated by a single-character block or two consecutive, identical, single-character blocks. Detection of the End-of-Text (ETX) or EOT character causes transmission of the appropriate USASCII control character to the receiving terminal. When the single-character block indicating the end of tape is read, the block may be transmitted and followed by an EOT block, or suppressed and the EOT block transmitted alone.

The transmitter establishes the end of a block by transmitting an ETX code. Detection of the ETX code from the line causes the 522/5225 to generate an internal End-of-Block code which causes an interrecord gap to be written on tape. The End-of-Block code itself may or may not be written on tape. When an EOT code is received from a remote terminal, one of the following actions can be specified:

(1) A single-character block is written on tape.

(2) Nothing is written.

(3) A manual control may be used to write the single-character block.

The EOT code causes the terminal to halt with illumination of an indicator lamp.

Detection of an EOT code either from the line or from an input tape causes the 522/5225 to terminate transmission. The 522 may, under operator control, write the single-character End-of-Data block on tape.

Optional features available for the 522 include:

- Fixed Translation — provides translation between the transmission code and magnetic tape code. The translator can be bypassed when image transmission is desired. Translation codes are customer-specified. This feature is available with the 5225 terminal.

- Variable Code Translation — provides the translation ability described under Fixed Translation with the addition of suppressed character and translation code selection via a plugboard. Several plugboards with different code translations and different suppressed characters are available.

- Paper Tape Output — provides local conversion of magnetic tape data to paper tape data, or paper tape output of received data. A self-contained paper tape punch and winder are included; they can handle 5-, 6-, 7-, or 8-level tape. When the 522 operates as a paper tape receiver, data is checked for correct parity and transferred to the buffer. Only data with correct parity is punched.

- Paper Tape Input — provides local conversion of paper tape data to magnetic tape data. A self-contained paper tape reader capable of reading 700 characters per second and a spooler capable of handling 10-inch reels are included. Paper tape which contains 5 or 8 levels can be read.

- High-Density Tape Option — provides tape-density selection of either 556 or 800 bits per inch. This feature is available with 5225 terminal.

- RCA-Compatible Tape Option — permits the use of a customer-supplied RCA Model 581 tape handler in place of the standard IBM-compatible tape drive. This option employs an echo check on written data instead of a read-after-write check. Three rewrite attempts are made following an echo-check error before operator intervention is required. A bit density of 333.3 bits per inch is standard with the RCA Model 581.

- IBM-Compatible 9-Channel Tape Capability — provides a 9-channel tape drive for recording tape in the IBM 2400 Series format at 800 bits per inch. An extended USASCII code is used.

- Data-Verter Compatibility — provides the magnetic tape terminal with the capability to receive transmissions from a remote Digitronics Data-Verter transmitter. An automatic polling feature is available with this option. This feature is available with the 5225 terminal.

Other Options

The following optional features are available for each terminal described, except where noted:

- Data Set Select

- Data Set

- Unattended Operation

The Unattended Operation feature provides automatic power control and automatic answering in response to the calling terminal. Terminal power is switched on and the data set switched to the data mode in response to the ring signal from the data set. Detection of the End-of-Transmission block causes an automatic disconnect and removal of power from the terminal.

Data Set Select is an optional feature which permits the terminal to share a common data set with any other Digitronics terminal described in this report if the terminal also has the

Data Set Select option installed. Only one terminal can use the data set at a time. If the two sharing terminals are a transmitter and a receiver, local communication between the two terminals is possible if their data formats are compatible.

The Data Set option provides terminal compatibility with the Bell System 201B Data Set when the terminal is used on a four-wire leased line.

.16 First Delivery

507, 509, and 522:	January 1965.
4021, 5072, 5079, 5122, and 5225: . . .	January 1969.

.17 Availability: . . . . . 3 months.

.2 CONFIGURATION

The 4021 Printer Terminal consists of:

- An Analex Series 4000 line printer.
- A receive-only control unit.
- A 512-character core memory module.

The 507 Paper Tape Transmitter consists of:

- A Digitronics bidirectional photoelectric paper tape reader.
- A control module.
- A coupler.
- A spooler option.

The 509 Paper Tape Receiver consists of:

- A Teletype BRPE punch.
- A control module.
- A coupler.
- A paper tape winder option.

The 5079 Paper Tape Transmitter/Receiver consists of:

- A Digitronics bidirectional photoelectric paper tape reader.
- A control module.
- A Teletype BRPE punch.
- A spooler option.
- A paper tape winder option.

The 5122 Printer/Card Transmitter consists of:

- An Analex Series 4000 line printer.
- A control module.

- A 512-character core memory buffer.
- A card reader.
- A coupler module.

The 5072 Printer/Paper Tape Transmitter consists of:

- An Analex Series 4000 line printer.
- A control module.
- A 512-character core memory buffer.
- A Digitronics bidirectional photoelectric paper tape reader.
- A coupler.
- A spooler option.

The 522/5225 Magnetic Tape Terminal consists of:

- An IBM 729-compatible magnetic tape handler with a recording density of 200 or 556 bits per inch or an optional recording density of 556 or 800 bits per inch. An interface is available for a customer-supplied RCA 581 tape handler with a recording density of 333.3 bits per inch.
- A 1020- (522) or 512-character (5225) core memory buffer.
- A control module.
- A coupler.
- A translator module option.
- A plugboard option (not available with 5225).
- A paper tape punch option (not available with 5225).
- A paper tape reader option (not available with 5225).
- A Data-Verter Receive Adapter option.

.3 INPUT

.31 Prepared Input

522/5225 Magnetic Tape Terminal —

Input medium:	0.5-inch magnetic tape recorded at 200, 556, or 800 bits/in.; IBM 729-compatible.
Input code:	IBM BCD (even parity) or binary (odd parity). Other codes can be accommodated with optional translation features.
Quantity of data:	variable; up to 512 or 1,020 char/block.
Rated input speed:	6,000 char/sec (200 bits/in.), 16,680 char/sec (556 bits/in.), or 24,000 char/sec (800 bits/in.).
Effective input speed:	up to 300 char/sec, limited by block length, transmission speed, and speed of receiving device.

522 Magnetic Tape Terminal with Paper Tape Option —

Input medium:	fully punched 11/16-inch or 1-inch (factory preset) paper tape. Transmissivity must not be more than 40%; color is optional.
Input code:	any 5-, 6-, 7-, or 8-level code.
Quantity of data:	variable.
Rated input speed:	700 char/sec.
Effective speed:	up to 300 char/sec, depending upon block length, transmission speed, and speed of receiving device.
Comments:	optional features include 10-inch reel spooler.

507, 5072, 5079 Paper Tape Transmitters —

Input medium:	fully punched 11/16-, 7/8-, or 1-inch paper tape. Transmissivity must not be more than 40%; color is optional.
Input code:	any 5-, 6-, 7-, or 8-level code.
Quantity of data:	block length is limited only by the receiving device.
Rated input speed:	300 char/sec.
Effective input speed:	up to 300 char/sec, depending upon block length, transmission speed, and speed of receiving device.

5122 Printer/Card Reader —

Input medium:	standard 80-column punched or mark-sensed cards.
Input code:	standard Hollerith card code; see Table I.
Quantity of data:	80 characters (1 card).
Rated input speed:	up to 200 cards/min.
Effective input speed:	limited by transmission speed and speed of receiving device.

.32 Manual Input: ..... no provision.

.33 Fixed Input: ..... no provision.

.34 Transaction Code Input: ..... no provision.

.35 Message Configuration

Data is transmitted in blocks under control of the transmitting device. The data contained in a block is preceded by four sync characters, a Start-of-Text (STX) character, and a Modulo 8 Block Count character. Blocks are terminated by an End-of-Transmission Block (ETB), End-of-Text (ETX), or an End-of-Transmission (EOT) code followed by a longitudinal parity (LP) character. Block length is determined by the limitations of the transmitting and/or receiving devices and by the memory-buffer capacities of the buffered devices (magnetic tape and printer).

There are no limitations on block length when transmitting messages between paper tape terminals (507, 5079, and 509). The 5122, 5072, or 4021 dictates that each data block's length must equal one line of print — a maximum of 120 or 132 characters. The 522 can receive or transmit variable block lengths not to exceed its 1,020-character memory-buffer capacity or the limitations of the receiving device. Magnetic tape blocks can be made uniform in length, if desired, through the addition of customer-specified fill characters.

The 5122 can transmit either the Hollerith code as if it were Friden, or any configuration on cards in a binary manner. When the latter is required, each column on the card is

transmitted as two characters of which the first six bits are the image of the top or bottom half of the card. The last two bits of each character are used to make them appear as a USASCII graphic code and for parity. The transmitted block length is selected from one card per block up to 160 characters per block in set increments. The increments are dependent on the number of characters per card and the mode of transmission (Hollerith to Friden or binary). Control codes are transmitted during intercard time. These codes consist of four synchronization characters followed by an STX code, a Modulo 8 Block Count, and a series of null characters which precede the transmission of data. An ETX, ETB, or EOT code is transmitted at the end of each card or group of cards in a block. Unpunched card columns are interpreted as spaces, translated to a unique character code, and transmitted in sequence with the data.

Data is transmitted in the form of eight-bit character codes by all Digitronics Dial-o-Verter terminals included in this report. The following table illustrates the modification of codes that contain fewer bits per character than the eight-bit format.

Bit Position	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_p
BCD Code	B'	B	A	8	4	2	1	P
Friden (IBM) Code	7'	7	6	4	3	2	1	P
TTY 5-Level	1	0	1	2	3	4	5	P
USASCII Code	B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_p

Notes: The most significant bit, B_7, is transmitted or received first; B_p is last.
The added bits are deleted when received to convert the data to its original configuration.
Bit B_7 is generated as the complement of B_6 (unless full USASCII is the transmitted code).
Bit B_p is the parity bit.

.36 Operating Procedure

(1) Load magnetic tape, paper tape, or cards.

(2) Establish connection with remote terminal.

(3) Press button to establish synchronization and start transmission.

.37 Entry of Time and Date: . . . . . no provisions.

.4 OUTPUT

.41 Output to Punched Tape

509/5079 Paper Tape Receiver —

Tape size: . . . . . 11/16-, 7/8-, or 1-inch oiled paper tape.
Tape code: . . . . . any 5-, 6-, 7-, or 8-level code.
Rated punching speed: . . . . . 100 char/sec.
Effective speed: . . . . . somewhat less than rated speed, limited by block length and transmission speed of sending device.
Comments: . . . . . cannot translate data to another code.

522 Magnetic Tape Terminal with Paper Tape Option —

Tape size:	11/16-, 7/8-, or 1-inch oiled paper tape.
Tape code:	any 5-, 6-, 7-, or 8-level code.
Rated output speed:	100 char/sec.
Effective speed:	somewhat less than rated speed, limited by block length and transmission speed of sending device.
Comments:	tape winder is included.

.43 Output to Magnetic Tape

522/5225 Magnetic Tape Terminal —

Tape size:	0.5-inch, recorded at 200, 556, or 800 bits/inch; IBM 729-compatible.
Tape code:	IBM BCD (even parity) or binary (odd parity). Other codes can be accommodated with optional translation features.
Rated output speed:	6,000 char/sec (200 bits/in.), 16,680 char/sec (556 bits/in.), or 24,000 char/sec (800 bits/in.).
Effective speed:	up to 300 char/sec, limited by block length and transmission speed of sending device.
Comments:	translator and format options are available; see Paragraph .15.

.44 Output to Printer

4021, 5072, or 5122 Printer Terminals —

Output medium:	pin-fed, fanfold forms up to 20 inches wide.
Character set:	64 characters; see Table II.
Rated printing speed:	300 lines/min.
Effective speed:	up to 150 lines/min (300 char/sec), limited by block length and transmission speed of sending device.
Format control:	horizontal and vertical tab options are available.

.5 ERROR DETECTION AND CORRECTION

All terminals in the Reverse-Channel, Dial-o-Verter line are provided with reverse-channel operation and Modulo 8 Block Count capability as standard features. Both features are described in detail under Paragraph .15.

.51 Data Entry Errors

4021 Printer Terminal and 509
Paper Tape Receiver: ..... no provision for checking.

507 Paper Tape Transmitter, 5122 Printer/Card Reader, and 522/5225 Magnetic Tape Terminal —

Type of checking:	522 checks character parity; 5122 has card column check and optional validity check; character parity is checked on the 507 if parity bit is included.
Error indication:	indicator lamp is lighted; 507 inserts flag character in place of incorrect character.

TABLE I. DIGITRONICS 5122 STANDARD HOLLERITH TO FRIDEN TRANSLATION

Punched Card Input Code												Punched Tape Code								Output Character Codes
12	11	0	1	2	3	4	5	6	7	8	9	8	7	6	5	4	FEED	3	2	1	
														•			·				0
																	·			•	1
																	·		•		2
															•		·		•	•	3
																	·	•			4
															•		·	•		•	5
															•		·	•	•		6
																	·	•	•	•	7
																•	·				8
															•	•	·			•	9
													•	•			·			•	A
													•	•			·		•		B
													•	•	•		·		•	•	C
													•	•			·	•			D
													•	•	•		·	•		•	E
													•	•	•		·	•	•		F
													•	•			·	•	•	•	G
													•	•		•	·				H
													•	•	•	•	·			•	I
													•		•		·			•	J
													•		•		·		•		K
													•				·		•	•	L
													•		•		·	•			M
													•				·	•		•	N
													•				·	•	•		O
													•		•		·	•	•	•	P
													•		•	•	·				Q
													•			•	·			•	R
														•	•		·		•		S
														•			·		•	•	T
														•	•		·	•			U
														•			·	•		•	V
														•			·	•	•		W
														•	•		·	•	•	•	X
														•	•	•	·				Y
														•		•	·			•	Z
															•		·				SPACE
													•				·				
														•	•		·			•	
																•	·		•	•	
													•		•	•	·		•	•	%
														•	•	•	·		•	•	
													•	•		•	·		•	•	
															•	•	·	•			NON-PRINT. (AUX. SPACE)
														•		•	·	•			PRINT-RESTR. (AUX. ZERO)
													•			•	·	•			ON—1
													•	•	•	•	·	•			
													•	•	•		·				
														•	•	•	·	•	•		
																•	·	•	•		
														•		•	·	•	•	•	
															•	•	·	•	•	•	CHANGE OF TIME
													•			•	·	•	•	•	CANCEL CODE
																	·				
													•			•	·		•		TRANSACTION 2
																	·				
														•	•	•	·	•		•	TRANSACTION 4
													•	•		•	·	•		•	TRANSACTION 5
													•		•	•	·	•		•	TRANSACTION 6
																•	·	•		•	TRANSACTION CODE, BADGE READ
													•	•	•	•	·		•		TRANSACTION 7
													•	•		•	·	•	•		
													•		•	•	·	•	•		
													•	•	•	•	·	•	•	•	TAPE FEED
												•					·				END OF MESSAGE
12	11	0	1	2	3	4	5	6	7	8	9	EL	X	O	CH	8	FEED	4	2	1	

TABLE II. DIGITRONICS 401 PRINTER TERMINAL CHARACTER SET

Name	Drum Symbol
Word Separator	
Exclamation Mark	!
Quotation Mark	"
Number Sign	#
Dollar Sign	$
Percent	%
Ampersand	&
Apostrophe	'
Open Parenthesis	(
Close Parenthesis	)
Asterisk	*
Plus	+
Comma	,
Minus	-
Period	.
Slash	/
Zero	0
One	1
Two	2
Three	3
Four	4
Five	5
Six	6
Seven	7
Eight	8
Nine	9
Colon	:
Semicolon	;
Less Than	<
Equal	=
Greater Than	>
Question Mark	?

Name	Drum Symbol
At	•
A	A
B	B
C	C
D	D
E	E
F	F
G	G
H	H
I	I
J	J
K	K
L	L
M	M
N	N
O	O
P	P
Q	Q
R	R
S	S
T	T
U	U
V	V
W	W
X	X
Y	Y
Z	Z
Open Bracket	[
Reverse Slash	/
Close Bracket	]
Arrow Up	↑
Arrow Left	←

Correction procedure:	automatic retransmission in response to reverse-channel interruption (507 and 522).
Comments:	507 and 522 require operator intervention after three unsuccessful retransmissions.

.52 Data Transmission Errors

Type of checking:	character parity and longitudinal parity.
Error indication:	indicator lamp is lighted; reverse channel is interrupted; error block is identified by special code.
Correction procedure:	automatic retransmission.

.53 Data Recording Errors

Type of checking:	read-after-write check is performed by 522/5225 Magnetic Tape Terminal.
Error indication:	indicator lamp is lighted.
Correction procedure:	error block is erased, tape is moved to clean area, and block is rewritten.
Comments:	operation halts and operator intervention is required after three unsuccessful rewrite operations.

.54 Internal Transfer Errors

522/5225 Magnetic Tape Terminal —

Type of checking:	character parity is checked when data is read from memory if terminal is in Receive or Transmit mode.
Error indication:	unit halts and an indicator lamp is lighted.
Correction procedure	
Transmit mode:	error block is transmitted and error character is detected at receiver. Receiver requests retransmission, but transmit terminal responds by reversing magnetic tape to beginning of error block. Operator intervention is then required.
Receive mode:	error block is written on output tape. Receiver halts, erasing error block, and operator intervention is required.

4021 Printer Terminal —

Type of checking:	character parity is checked when character is read from memory during print cycle.
Error indication:	unit halts and an indicator lamp is lighted.
Correction procedure:	reverse channel is interrupted, operation is halted, and operator intervention is required.

5122 Printer/Card Reader —

Type of checking:	character parity is checked after character from card is translated to BCD code.
Error indication:	unit halts and an indicator lamp is lighted.
Correction procedure:	operator intervention is required to reinsert and reread card.

.55 Line Malfunctions

Detection:	interrupted transmission is detected by the reverse-channel technique (see Paragraph .15).
Action:	automatic retransmission, automatic disconnect, or operator intervention, depending on transmitting terminal and period of interruption.

.6 CONDITION INDICATORS

A comprehensive array of indicator lamps on each Digitronics Dial-o-Verter terminal provides visual indications of error status, block count, transmission status, memory status, paper depletion, unattended operation, etc.

.7 DATA TRANSMISSION

.71 Basic Characteristics

Rated transmission speed —	
5072, 5079, 5225, and 522:	100, 150, or 300 char/sec.
507:	100 or 150 char/sec.
509:	100 char/sec.
Transmission method:	serial by bit.
Transmission code:	507 and 509 Paper Tape Terminals and 522/5225 Magnetic Tape Terminal are not code-sensitive. See Table I for 5122 card terminal transmission code. 4021 Printer Terminal can be ordered to accommodate any one 5-, 6-, 7-, or 8-level, nonprecedence code; see Paragraph .35.
Transmission mode:	simplex transmission or reception, using reverse-channel acknowledge; see Paragraph .15.
Order of transmission:	high-order data bit first, parity bit last.
Synchronization:	synchronous; i.e., each data block is preceded by a sequential group of special sync characters.

.72 Connection to Communications Lines

Communications Line	Data Set*
Public switched telephone network:	Bell System Data-Phone Data Set 202C.
Common-carrier leased voiceband line:	Bell System Data Set 201B or Western Union 2400 Baud Data Modem.

.73 Transmission Control

Call initiation:	manual dialing or signaling.
Call reception:	manual; unattended operation is optional.
Functional operations	
4021:	line feed, horizontal and vertical tab (optional) initiated by control codes.
All others:	none.

.74 Multistation Operation: no provision:

* In some cases, equivalent data sets can be used; check with your local common-carrier communications consultant.

.8 PHYSICAL SPECIFICATIONS

Component	4021 Printer Terminal	507 Paper Tape Transmitter	509 Paper Tape Receiver	5122 Printer/ Card Reader
Width (inches)	44	22	22	60
Depth (inches)	30	18	18	30
Height (inches)	48	60	60	48
Weight (pounds)	925	500	500	925
Power (KVA)	1.15	0.8	0.8	1.15
Voltage	115	115	115	115
Frequency (cps)	60	60	60	60
Phases	1	1	1	1
Temperature Range (°F)	60-95	50-90	50-90	60-95
Humidity Range (%)	40-80	30-80	30-80	40-80
Heat (BTU/hr)	6,500	2,500	2,500	6,500

Component	522 Magnetic Tape Terminal	5072 Printer/Paper Tape Terminal	5079 Paper Tape Terminal
Width (inches)	56	60	22
Depth (inches)	24	30	18
Height (inches)	60	48	72
Weight (pounds)	1,000	925	500
Power (KVA)	5.8	1.15	1.84
Voltage	115	115	115
Frequency (cps)	60	60	60
Phases	3	1	1
Temperature Range (°F)	55-95	50-95	55-105
Humidity Range (%)	40-70	30-80	20-80
Heat (BTU/hr)	18,000	6,500	1,450

.9 PRICE DATA

Component or Feature	Monthly Rental $	Purchase Price $	Monthly Maintenance $
4021 Printer Terminal (1, 2)	650	42,420	180.00
132-Column Printing Width	74	2,646	14.00
Horizontal Tab Control	26	945	5.20
Vertical Tab Control (automatic)	15	567	3.00
Unattended Operation, Automatic Answering	11	370	2.20
201B Data Set Operation	6	189	NC
Rixon Data Set Operation (3)	6	189	50.00
5072 Printer/Paper Tape Terminal (2)	750	42,950	200.00
Unattended Operation, Automatic Answering —			

Component or Feature	Monthly Rental $	Purchase Price $	Monthly Maintenance $
Unidirectional	11	370	2.20
Bidirectional	21	750	4.20
Horizontal Tab	26	945	5.20
Vertical Tab	15	567	3.00
132-Column Printing Width	74	2,646	15.00
201B Data Set Operation	6	189	NC
Rixon Data Set Operation (3)	6	189	50.00
Spooler —			
8-inch	26	935	NC
10.5-inch	POR	POR	NC
5079 Paper Tape Terminal	300	14,400	90.00
Unattended Operation, Automatic Answering —			
Unidirectional	6	242	1.20
Bidirectional	21	750	4.20
Spooler (reader) —			
8-inch	26	935	5.20
10.5-inch	40	1,400	POR
Winder (punch) —			
8-inch	6	184	NC
10.5-inch	15	460	NC
Supply Reel Winder for punch unit (winds up to 3,000 feet of punched paper tape)	40	1,500	5.00
201B Data Set Operation	6	189	NC
Rixon Data Set Operation (3)	6	189	50.00
5122 Printer/Card Reader (2)	850	54,500	220.00
Unattended Operation, Automatic Answering —			
Unidirectional	11	370	2.20
Bidirectional	21	750	4.20
Horizontal Tab	26	945	5.20
Vertical Tab	15	567	3.00
132-Column Printing	74	2,646	15.00
201B Data Set Operation	6	189	NC
Rixon Data Set Operation	6	189	50.00
507 Paper Tape Transmitter	152	7,875	40.00
Spooler, Bidirectional	26	935	5.20
Character Counter	NC	NC	NC
Data Set Select	6	242	1.20
Unattended Operation, Automatic Power Control	6	242	1.20
Unattended Operation, Automatic Answering	6	242	1.20
201B Data Set Operation	8	312	1.60
509 Paper Tape Receiver	189	10,500	50.00
Unattended Operation, Terminal Power Control	6	184	1.20
Unattended Operation, Punch Power Control	6	184	1.20
Data Set Select	6	184	1.20

Component or Feature	Monthly Rental $	Purchase Price $	Monthly Maintenance $
Winder —			
8-inch	6	184	1.20
10.5-inch	15	460	3
Output Error Control	6	184	1.20
201B Data Set Operation	6	184	1.20
522 Magnetic Tape Terminal	1,302	47,775	200.00
Fixed Code Translator	126	4,515	NC
Variable Code Translator	134	4,746	NC
Paper Tape Punch	236	8,500	50.00
Paper Tape Reader	210	7,560	50.00
800 bpi density	63	2,258	6.00
RCA 581 Compatibility	NC	NC	NC
Data-Verter Compatibility	373	10,185	37.00
Subset Select (202/201)	16	567	3.20
Data Set Select	11	378	2.20
9-Channel Tape (IBM 2400 Series Compatibility)	95	3,360	19.00
Automatic Polling (for Data-Verter)	285	12,200	30.00
5225 Magnetic Tape Terminal	600	29,400	220.00
Fixed Translation	126	4,515	NC
Data-Verter Compatibility	373	10,185	37.00
Data Set Select	11	378	2.20
Alternate Data Set	16	567	3.20

(1) The 401 Printer Terminal has been replaced by the 4021, an integrated circuit version of the 401 with the same capabilities.

(2) Two optional print drums are available: (1) 128-character set; (2) 16-character set repeated four times around the drum circumference. Prices are available on request.

(3) For Rixon Sebit 48 Data Set; data set must be installed by Rixon.

NC — No Charge.

POR — Price on Request.

DURA DATA TERMINAL

.1 GENERAL

.11 Identity: . . . . . Dura Data Terminal.

.12 Manufacturer: . . . . . Dura Business Machines
Division of Intercontinental Systems Incorporated
32220 Stephenson Highway
Madison Heights, Michigan

.13 Basic Function: . . . . . transmission and reception of data over a narrow-band or voice-band line at 14.8 characters per second.

.14 Basic Components

Name: . . . . . Dura 1041.

Function: . . . . . provides data input and output capabilities via typewriter, edge-punched card/tape reader and punch.

Name: . . . . . Dura 1015.

Function: . . . . . provides a communications interface between the Dura 1041 and a communications facility.

.15 Description

The Dura Data Terminal includes the Dura 1041 (typewriter) and the Dura 1015 (communications interface). The standard 1041 incorporates an individual edge-punched card/paper tape reader and punch as integral units positioned at opposite sides of a Selectric typewriter. An auxiliary reader and/or punch can be added to the standard 1041 at additional cost. The 1041 is also available in a typewriter-only configuration.

The Data Terminal can communicate with another Data Terminal or a remote computer system over a narrow-band or voice-band communications facility at up to 14.8 characters per second (up to 15.5 characters per second optionally). Transmission is half-duplex asynchronous. The Data Terminal is compatible with the IBM 2741 Communication Terminal (see Report 6455).

The Data Terminal can operate in any one of six transmit modes or three receive modes as illustrated in the following table.

Function	Mode								
	Transmit						Receive		
Print		X		X	X	X	X		X
Punch			X	X	X			X	X
Read	X	X	X	X					
Key					X	X			

In addition, a local mode is provided for transcribing data from edge-punched cards to paper tape or vice versa; this mode can also be used to punch data entered from the keyboard.

The punch and reader accept 1-inch wide paper tape or edge-punched cards from 3.5 inches to 8.5 inches wide. The punch can operate at up to 18 characters per second; the reader, at 30 characters per second. The reader senses data photoelectrically.

A 56-key Selectric or BCD keyboard (44 keys plus control keys) is provided and is supplemented with control keys strategically located by the reader and punch units.

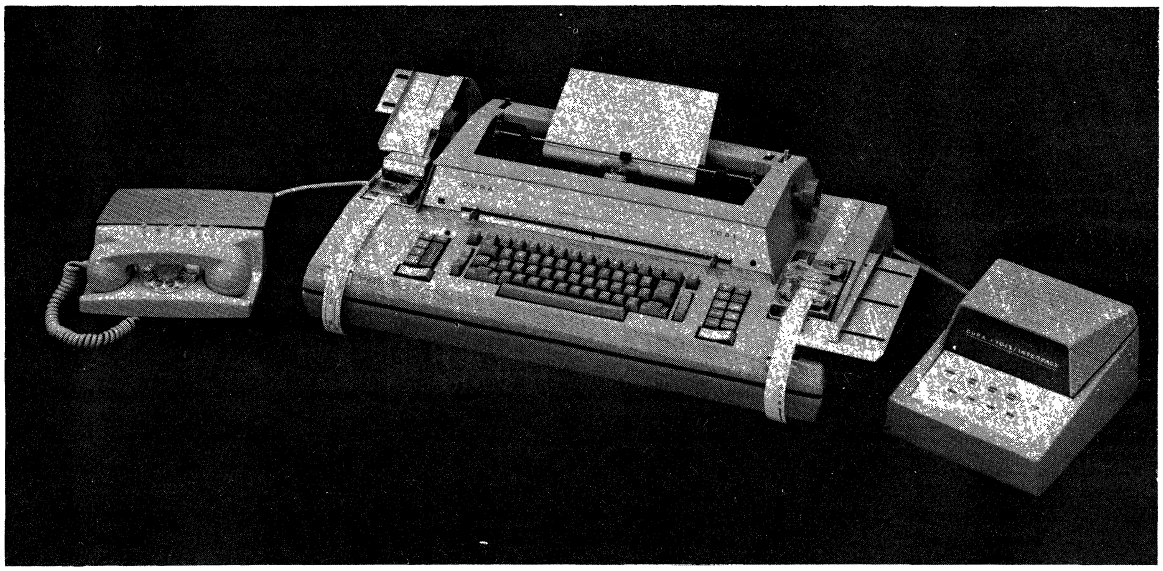


Figure 1. Dura Data Terminal includes the Dura 1041 (center) and the Dura 1015 (right).

.15 Description (Contd.)

The Dura Data Terminal employs the IBM Paper Tape Transmission Code/EBCD; see Table I. Dura states that most 6-bit codes can be accommodated at no extra cost.

The Data Terminal employs odd or even (specified by user) character parity to detect errors when reading from edge punched cards or tape or when receiving data. Character parity is generated and punched; parity checking on punching can be implemented at additional cost.

Several options are available for the 1041 typewriter. The Color Ribbon Shift permits automatic selection of typing color from coded commands entered from the keyboard or in received text. The Reverse Index feature permits half-spacing paper up or down from coded commands entered from the keyboard or in received text; this feature is intended for typing chemical equations containing subscripts using a special typing sphere that incorporates chemical symbols. The Automatic First Line Finder permits automatic line feed from the last printed line on a form to the first printed line on the following form. A Carbon Ribbon Attachment is also available.

.16 First Delivery: . . . . . June 1967.

.17 Availability: . . . . . 4 months.

.2 CONFIGURATION

The Dura Data Terminal consists of an IBM Selectric typewriter, an individual edge-punched card/paper tape reader and punch, and a separate communications interface. A data set is required to connect the communications interface to a communications facility; see Paragraph .72.

.3 INPUT

.31 Prepared Input

Edge-Punched Card/Paper Tape Reader —

Input medium:	fully punched 1-inch, 6-level paper tape or 3.5- to 8.5-inch edge-punched cards.
Input code:	most 6-level codes.
Quantity of data:	any size block length.
Character set:	64 characters.
Rated input speed:	30 char/sec.
Effective speed:	somewhat less than 14.8 char/sec transmission speed depending on block length.
Comments:	holes are sensed photoelectrically; character parity is checked.

(Contd.)

.32 Manual Input

Method of entry:	via 44-key Selectric typewriter keyboard; 12 additional keys provide special functions such as backspace, shift, carriage return, horizontal tab, etc.
Quantity of data:	variable.
Character set:	44 distinct character codes, in conjunction with upper and lower case control codes, provide 88 upper and lower case alphabetic, numeric special characters; see Table I.
Comments:	two keyboard configurations are available that correspond to the IBM EBCD layout or the IBM Standard Selectric layout (optional). Table I corresponds to the IBM EBCD layout.

.33 Fixed Input: . . . . . no provision.

.34 Transaction Code Input: . . . . . no provision.

.35 Message Configuration: . . . . . typically, text of any length is preceded by an EOA code and followed by an EOT code; message configuration is dependent upon the environmental requirements. Control characters are recognized only after receiving an EOA code; recognition is inhibited by an EOT code.

.36 Operating Procedure

To transmit a message to the remote computer, the operator:

(1) Places the terminal in the On-Line mode; this locks the keyboard and inhibits the reader until the connection is established.

(2) Establishes connection by dialing or manually signaling; on a dedicated line, a permanent connection can be maintained.

(3) Depresses the EOA key to indicate the beginning of a message.

(4) Keys in the message or initiates reader operation.

(5) Depresses the Interrupt key to transmit an End-of-Transmission (EOT) code or depresses the automatic EOT key which transmits an EOT following the carriage return function initiated by the Carriage-Return code. The EOT code is automatically transmitted if reading from paper tape or edge punched cards.

The transmitted EOT code places the Terminal in receive mode; locks the keyboard, and inhibits the reader. An EOT code received from the computer causes the Terminal to enter the transmit mode, unlocks the keyboard, and frees the reader.

An End-of-Line (EOL) code is automatically transmitted following the transmission of the control codes: Tab, Carrier Return, Index, Reverse Index, and first line, provided the EOL function is initiated. The keyboard is locked and the reader is inhibited until a Delete code is received from the computer. The reader will continue or the keyboard is unlocked after receiving the Delete code.

To transmit control codes from the keyboard, the Encode switch must be engaged. When receiving, control codes are recognized only after an EOA code has been received.

.37 Entry of Time and Date: . . . . . no provision.

.4 OUTPUT

.41 Output to Punched Tape

Edge-Punched Card and Paper Tape Punch —

Tape size:	1-inch paper tape or 3.5- to 8.5-inch edge-punched cards.
Tape code:	most level codes, see Comments.
Rated punching speed:	18 char/sec.

TABLE I: IBM PAPER TAPE TRANSMISSION CODE/EBCD*

Lower Case		Bit Position							Upper Case	
(1)	(2)	7	6	5	4	3	2	1	(1)	(2)
o	0	0	0	1	1	0	1	0	\\	-)
ı	1	0	0	0	0	0	0	1	/	[
ƨ	2	0	0	0	0	0	1	0	//	@
ȝ	3	0	0	1	0	0	1	1	/	#
4	4	0	0	0	0	1	0	0	||	$
ƽ	5	0	0	1	0	1	0	1	•	%
ϭ	6	0	0	1	0	1	1	0	|	¢
⁊	7	0	0	0	0	1	1	1	-	&
ȣ	8	0	0	0	1	0	0	0	=	*
ƿ	9	0	0	1	1	0	0	1	\	(
a	A	1	1	0	0	0	0	1	A	A
b	B	1	1	0	0	0	1	0	B	B
c	C	1	1	1	0	0	1	1	C	C
d	D	1	1	0	0	1	0	0	D	D
e	E	1	1	1	0	1	0	1	E	E
f	F	1	1	1	0	1	1	0	F	F
g	G	1	1	0	0	1	1	1	G	G
h	H	1	1	0	1	0	0	0	H	H
i	I	1	1	1	1	0	0	1	I	I
j	J	1	0	1	0	0	0	1	J	J
k	K	1	0	1	0	0	1	0	K	K
l	L	1	0	0	0	0	1	1	L	L
m	M	1	0	1	0	1	0	0	M	M
n	N	1	0	0	0	1	0	1	N	N
o	O	1	0	0	0	1	1	0	O	O
p	P	1	0	1	0	1	1	1	P	P
q	Q	1	0	1	1	0	0	0	Q	Q
r	R	1	0	0	1	0	0	1	R	R
s	S	0	1	1	0	0	1	0	S	S
t	T	0	1	0	0	0	1	1	T	T
u	U	0	1	1	0	1	0	0	U	U
v	V	0	1	0	0	1	0	1	V	V
w	W	0	1	0	0	1	1	0	W	W
x	X	0	1	1	0	1	1	1	X	X
y	Y	0	1	1	1	0	0	0	Y	Y
z	Z	0	1	0	1	0	0	1	Z	Z
)	=	1	1	1	0	0	0	0	(	+
•	,	0	1	1	1	0	1	1	*	,
•	.	1	1	0	1	0	1	1	⁄	.
<	;	1	0	1	1	0	1	1	:	:
+	-	1	0	0	0	0	0	0	\	_
®	/	0	1	1	0	0	0	1	⁄	?
>	'	0	0	0	1	0	1	1	•	"
–	!	0	1	0	0	0	0	0	o	°

(1) Camwil 67M Chemical Type Sphere available from Dura.

(2) Standard Selectric Type Sphere used on the basic Dura Data Terminal; the Standard Selectric Type Sphere is also available with lower-case letters.

*Not all symbols are identical to the IBM 2740/2741 Paper Tape Transmission Code/EBCD.

(Contd.)

TABLE I: IBM PAPER TAPE TRANSMISSION CODE/EBCD* (Contd.)

Function Codes**	Bit Position						
	1	2	3	4	5	6	7
Tab	1	1	0	1	1	0	1
Carriage Return/LF	1	0	1	1	1	0	1
Space	0	0	1	0	0	0	0
Upper Case	0	0	0	1	1	1	0
Lower Case	1	1	0	1	1	1	0
Backspace	1	0	1	1	1	1	0
Index	0	1	1	1	1	0	1
Delete/EOL	1	1	1	1	1	1	1
Non-Print	0	1	0	1	1	0	0
Print On	1	0	0	1	1	0	0
Punch Off	1	1	1	1	1	0	0
Punch On	0	0	1	1	1	0	0
Skip Off	0	1	0	1	1	1	1
Skip On	0	0	0	0	0	0	0
Switch Reader	1	1	1	1	0	1	0
Field Control	0	1	0	1	0	1	0
Branch Skip/EOT	0	0	1	1	1	1	1
Aux. Punch On	0	1	1	1	1	1	0
Card Feed	N. A.						
First Line/R. I.	1	0	0	1	0	1	0
Stop/Idle	1	0	0	1	1	1	1
Tape Feed	N. A.						
Reader Start	N. A.						

*Not all Symbols are identical to the IBM 2740/2741 Paper Tape Transmission Code/EBCD.

**These Codes Are Not Printable.
N. A. — Not Applicable.

Effective speed: . . . . . somewhat less than 14.8-char/sec transmission speed depending on block length.
Format control: . . . . . none.
Comments: . . . . . erroneously punched data can be manually deleted; character parity checking is optionally available.

.44 Output to Printer

Selectric Typewriter —

Output medium: . . . . . friction-fed or pin-fed fanfold forms up to 15.5 inches wide (13-inch printing width).
Character set: . . . . . 88 printable characters; see Table I.
Rated Printing speed: . . . . . 14.8 char/sec; optionally 15.5 char/sec.
Effective speed: . . . . . less than rated speed due to carriage return, line feed, or other format options.
Format control: . . . . . controlled by function codes in incoming data or manually by operator.
Comments: . . . . . horizontal spacing is 10 char/inch (12 char/inch optional); vertical spacing is 6 lines/inch (8 or 12 lines/inch optional).

.5 ERROR DETECTION AND CORRECTION

.51 Data Entry Errors

Type of checking: . . . . . character parity checking is performed on data entered from reader.
Error indication: . . . . . lamp is lighted; operation is halted; keyboard is locked.

.51 Data Entry Errors (Contd.)

Correction procedure:	reset error then backspace card or tape and restart; re-enter data from keyboard.
Comments:	operator intervention is required after several unsuccessful attempts to enter data.

.52 Data Transmission Errors

Type of checking:	character parity checking is performed on received data.
Error indication:	lamp is lighted; operation is halted; space codes are transmitted for 2 second interval.
Correction procedure:	operator intervention is required.

.53 Data Recording Errors

Type of checking:	optional character parity checking is performed on punched data (punching pins are electrically sensed); typed data is visually verified.
Error indication:	indicator lamp is lighted.
Correction procedure:	manual deletion of incorrect character.

.55 Line Malfunctions

Detection:	spacing condition lasting over 200 msec.
Action:	indicator lamp on interface is extinguished; operation is halted; keyboard is locked; operator intervention is required.

.7 DATA TRANSMISSION

.71 Rated transmission speed:	14.8 char/sec (134.5 bits/sec); optionally 15.5 char/sec.
Transmission method:	serial by bit.
Transmission code:	IBM Paper Tape Transmission Code/EBCD (6-level); most 6-level codes can be specified at no extra cost; each character includes an odd or even parity bit, a start, and a stop bit totaling 9 bits per character.
Transmission mode:	half-duplex.
Order of bit transmission:	high-order bit is transmitted first.
Synchronization:	start/stop.

.72 Connection to Communications Lines

Communications Line or Service	Data Set*
Bell System leased line Type 1006 Data Channel:	Bell System Data Set 103F.
Western Union Class D Data Channel:	Western Union 180 Baud Data Modem.
Bell System leased line Type 3002 Data Channel:	Bell System Data Set 103F.
Public telephone network:	Bell System Data-Phone Data Set 103A.

*In some cases, equivalent data sets can be used; check with your local common-carrier communications consultant.

.73 Transmission Control

Call initiation:	manual dialing or signaling.
Call reception:	capable of unattended operation; can automatically answer call, print, and/or punch data depending on control characters in received message.
Functional operations:	carriage return, line feed, case shift, horizontal tab, backspace, etc.

.74 Multistation Operation: no provision.

(Contd.)

.8 PHYSICAL SPECIFICATIONS

Component	Dura 1041	Dura 1015
Width (inches)	28	8.75
Depth (inches)	16	11.50
Height (inches)	7.75	6
Weight (pounds)	60	15
Power (KVA)	225*	Power is obtained
Voltage	115	from 1041
Frequency (cps)	60	
Phases	1	
Temperature Range (°F.)	30 to 110	30 to 110
Humidity Range (%)	0 to 95	0 to 95
Heat (BTU/hr)	?	?

*Includes punch and reader.

.9 PRICE DATA

Component or Feature	Monthly* Rental, $	Purchase Price, $	Monthly Maintenance, $
Dura Data Terminal —			
1041 Typewriter (IBM Selectric)	164.50	3290	18.00
Edge-Punched Card/Paper Tape Reader	53.50	1070	6.00
Edge-Punched Card/Paper Tape Punch	53.50	1070	6.00
1015 Communications Interface	109.75	2195	12.00
Auxiliary Edge-Punched Card/ Paper Tape Reader	57.50	1000	6.50
Auxiliary Edge-Punched Card/ Paper Tape Punch	55.00	1000	6.50
1041 Options —			
Color Ribbon Shift	14.00	275	1.50
Reverse Index	50.08	1000	5.50
Automatic First Line	15.00	300	3.00
Carbon Ribbon Attachment	5.00	100	1.00

*Monthly Maintenance costs are not included in the Monthly Rental Price. The Monthly Maintenance costs shown are for points within a 25 mile radius of a service center. Maintenance costs for outlying points are negotiated separately.