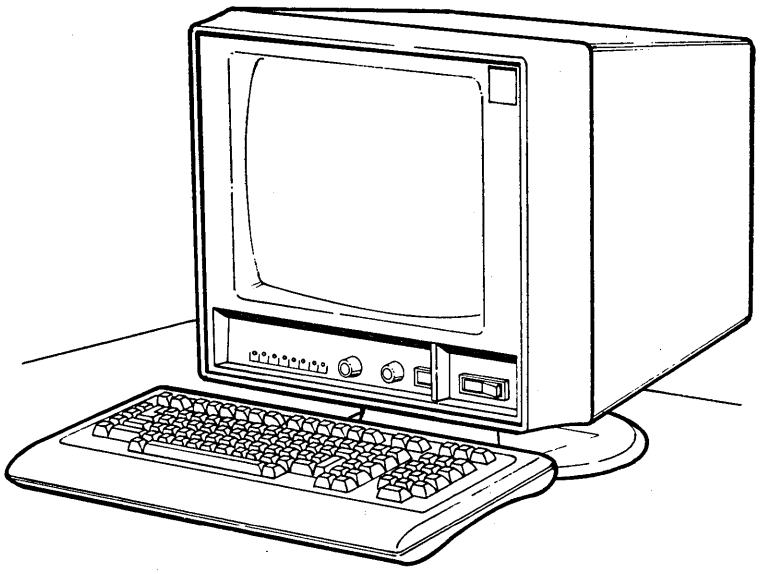
62940020

CONTROL DATA CORPORATION

# CDC® 721 - XO DISPLAY TERMINAL



## REFERENCE MANUAL

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or use Comment Sheet in the back of this manual.

New features, as well as changes, deletions, and additions to information in this manual are indicated by bars in the margins or by a dot near the page number if the entire page is affected. A bar by the page number indicates pagination rather than content has changed.

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This manual contains hardware reference information for the CDC® 721 Display Terminal. This information consists of functional descriptions, parameter and mode selections, as well as a description of operator controls, indicators, and keysets.

This information provides an overview of the terminal and specifically covers its operation in CYBER mode. That mode is for operations with computer systems of the CDC CYBER 120 or 170 series. In addition, an appendix covers a 401X/graphics mode that can be run when the terminal is connected to the Control Data Shared Network.

Other associated manuals include the:

| Title | Publication Number |
|---|---|
| 721 Display Terminal Unpacking/Packing Instructions | 62940038 |
| 721 Display Terminal Operator's Guide Installation Instructions | 62940019 |

All manuals may be ordered from:

Control Data Corporation
Literature and Distribution Services
308 North Dale Street
St. Paul, Minnesota 55103

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The CDC® 721-X0 Display Terminal (figure 1-1) is a locally or remotely located input/output device capable of supporting several modes of operation. This capability is accomplished through use of a microprocessor and common bus based scheme that supports a large, loadable memory (loadable via the communications line, an attached flexible disk, or operator plug-in memory module). The basic resident terminal mode supports CYBER mode (722-10 TTY compatible advanced mode with enhancements and additional edit features) and a Control Data Shared Network (CDSN) downline load capability. Optional modes require optional hardware and include, Tektronix* 401X mode, graphics mode, and IST-III mode (operating controlware loaded from the host network or from a program module).

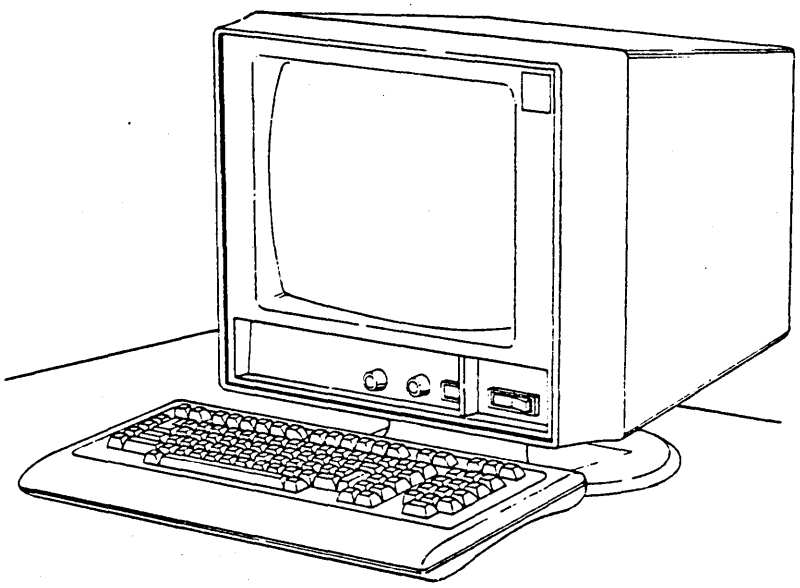

Figure 1-1. 721-X0 Display Terminal

*Tektronix is a registered trademark of Tektronix Inc.

## TERMINAL FEATURES

The following tabulations highlight the basic and optional features of the terminal.

### BASIC TERMINAL FEATURES

The basic terminal features include the following:

- Tiltable display module with a 380 mm (15 in diagonal measurement) cathode-ray tube (CRT) and associated drive electronics
- Symbol generation circuits - 256 symbols in ROM, 64 loadable RAM symbols
- 20K ROM and 64K RAM, 256 x 4K nonvolatile memory (NVM), and 1K character generation RAM
- Nonvolatile memory (NVM) for parameter retention
- Detached alphanumeric keyboard
- Asynchronous RS-232-C/CCITT V.24 interface with selectable transmission speeds up to 19 200 bps (receive and transmit speeds may differ)
- ASCII downline load (CDSN compatible) capability
- 80- or 132-characters per line with up to 30 lines of data entry
- Window scroll, character attributes (inverse, dim, blink, blank, underscore, and protected data)
- Memory module capability (16K maximum)
- Parameter selection performed via keyboard (no selection switches)
- Switch selectable 115/220 V ac operation
- Foreign character ROM

## OPTIONAL TERMINAL FEATURES

Optional terminal features include:

- Full-vector graphic displays within either a 512- by 480-dot array or a 512- by 512-dot array
- 16- by 16-position touchpanel
- 16K memory module
- Peripheral options to support:
  - An alphanumeric character printer (dual asynchronous RS-232-C interface required)
  - An asynchronous RS-232-C peripheral device interface with two ports with transmission speeds up to 19 200 bps
  - Parallel peripheral interface
- Internal modem that transmits and receives data at 1200 bits per second (b/s) in either full- or half-duplex modes (Bell 212A compatible) and that has both auto-dial and auto-answer capabilities. Refer to Appendix E of this manual for more detailed information on the internal 1200/1200 b/s modem.

## TERMINAL CONFIGURATION

The terminal may be configured as a basic terminal as shown in figure 1-2 or as an expanded terminal as shown in figure 1-3. The basic terminal configuration supports CYBER mode operation and CDSN-compatible downline load, while the expanded configuration supports optional modes that allow emulation of other terminal products.

The minimum configuration is a single PC board with 64K bytes of RAM and 20K bytes of ROM. The maximum configuration is limited by PC board space and power requirements. The terminal can be configured with a basic terminal control PC board, two large optional PC board modules, and three small optional PC board modules. The large modules (approximately 515 square centimeters) connect to the basic terminal control PC board via ribbon cables. The large option modules are factory and field service center installable. The small modules (approximately 160 square centimeters) plug directly into a backpanel that connects into the basic terminal. The small option modules are customer installable.

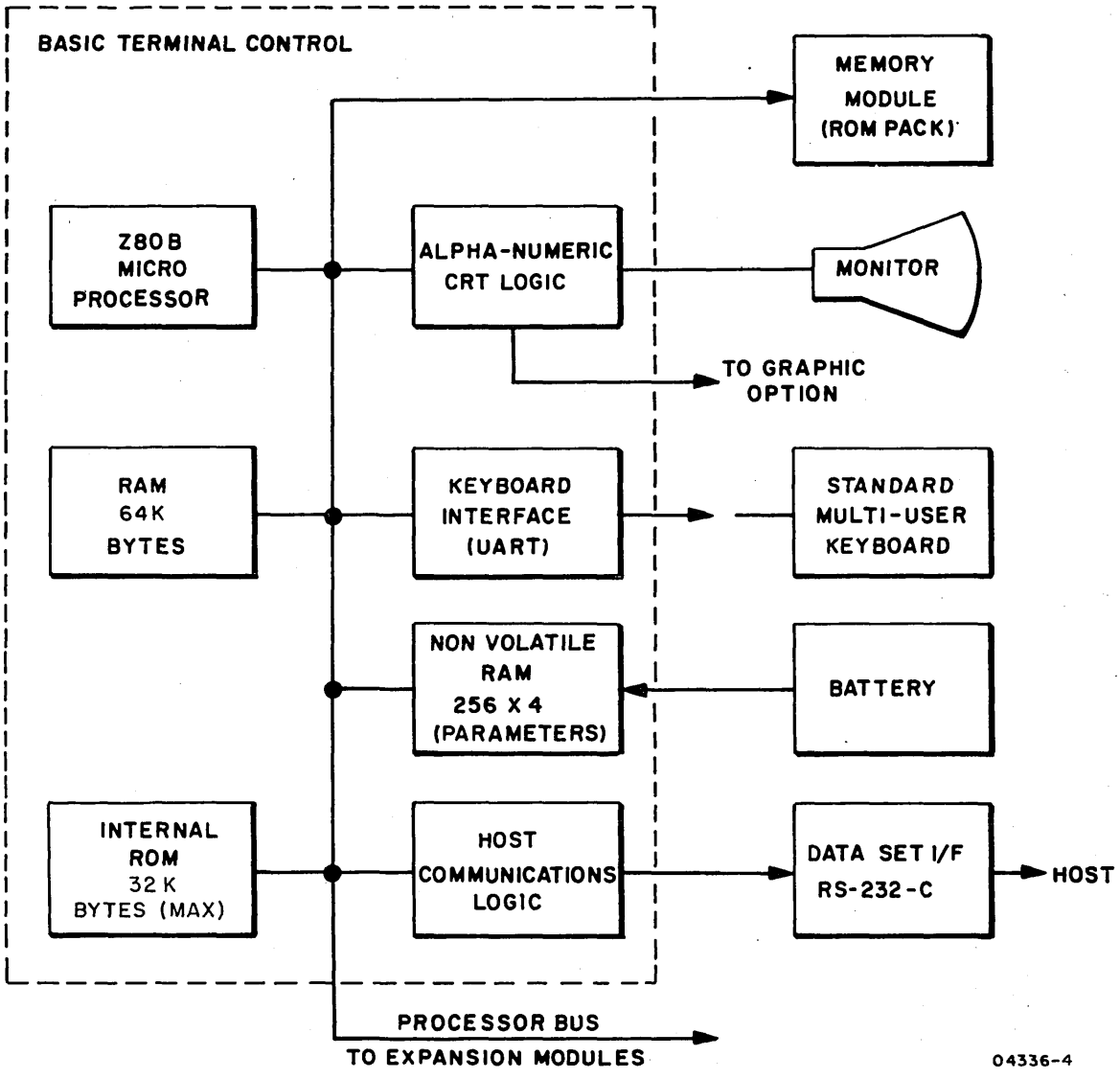


Figure 1-2. Basic Terminal Configuration

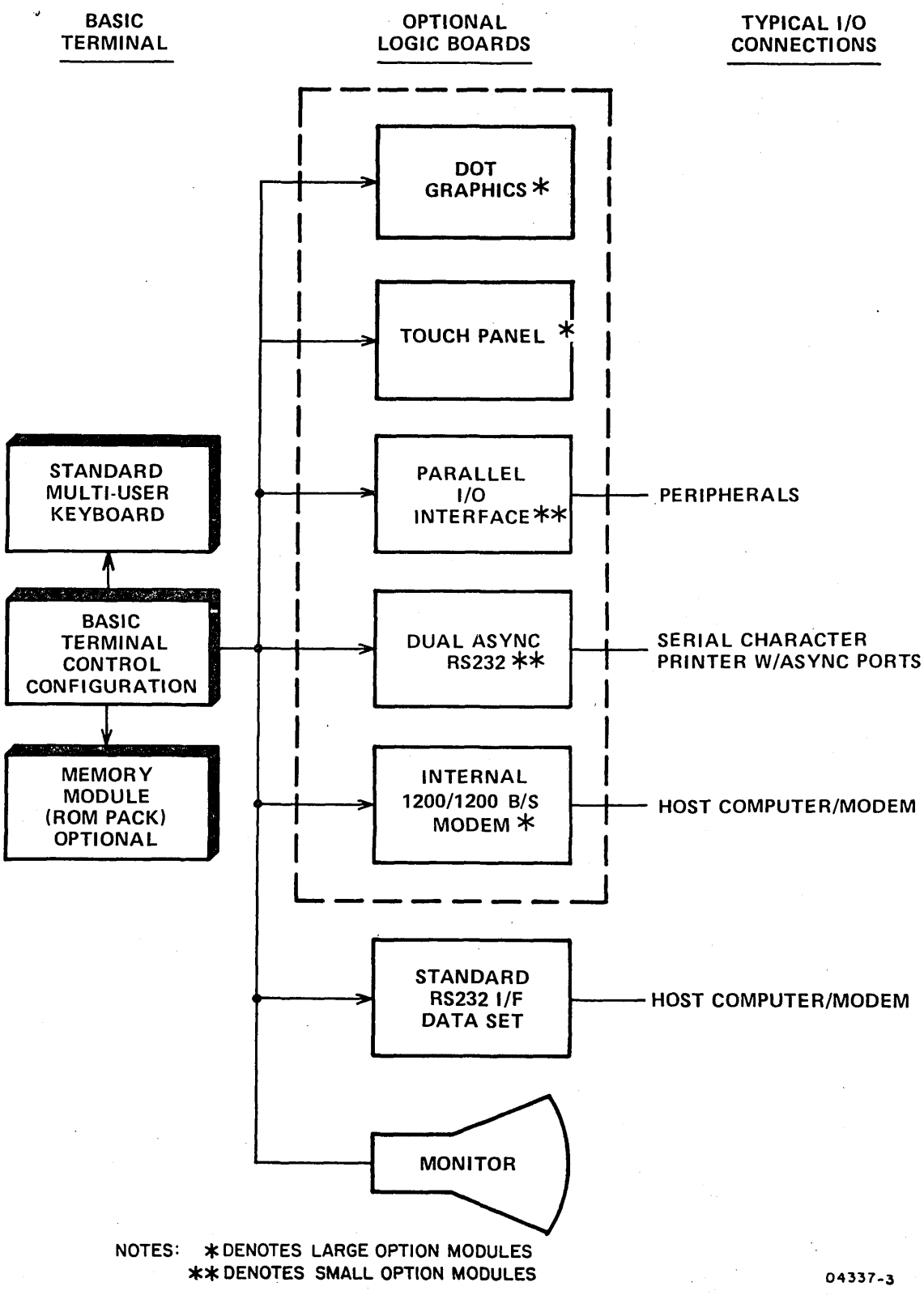


Figure 1-3. Expanded Terminal Configuration

## EQUIPMENT SPECIFICATIONS

The following paragraphs describe the physical, electrical, and environmental specifications for the display terminal.

### PHYSICAL SPECIFICATIONS

The size and weight of the monitor and control module and detached keyboard module are as follows:

- Monitor and control logic module

  Height: 440 mm (17.3 in) nominal position

  Width: 430 mm (16.9 in) maximum

  Depth: 430 mm (17.0 in) maximum

  Weight: 19.5 kg (43 lb) maximum

  Weight (packaged): 22.2 kg (49 lb) maximum

- Keyboard module

  Height: 51 mm (2.0 in) maximum
  80 mm (3.1 in) maximum (raised position)

  Width: 490 mm (19.3 in) maximum

  Depth: 230 mm (9.0 in) maximum

  Weight: 3.0 kg (8 lb)

  Weight (packaged): 4.5 kg (10 lb) maximum

### ELECTRICAL SPECIFICATIONS

The display terminal has the following electrical power requirements:

| | Basic Configuration | Full Configuration |
|---|---|---|
| o | 120V ac, 50/60 Hz, at 1.0 A, nominal; | 1.30 A, maximum |
| o | 220V ac, 50/60 Hz, at 0.5 A, nominal; | 0.71 A, maximum |
| o | 240V ac, 50/60 Hz, at 0.5 A, nominal; | 0.65 A, maximum |
| o | 85 W (290 Btu/hr), heat dissipation configuration without options | |

## ENVIRONMENTAL SPECIFICATIONS

The display terminal has the following environmental requirements:

- OPERATING:

| | |
|---|---|
| Temperature range: | 10°C(50°F) to 40°C(104°F) |
| Temperature change: | 10°C(18°F)/60 minutes |
| Relative humidity range: | 20 to 80 percent |
| Humidity change: | 10 percent/60 minutes |
| Altitude: | 3000m (9850 ft) maximum |

- NONOPERATING:

| | |
|---|---|
| Temperature range: | -40°C(-40°F) to 60°C(140°F) |
| Temperature change: | 20°C(36°F)/60 minutes |
| Relative humidity range: | 5 to 100 percent |
| Humidity change: | 10 percent/60 minutes |

This section provides a brief description of the major functional areas and the optional features that may be configured with the display terminal:

- CRT Monitor
- Microprocessor
- Memory
- Display Refresh logic
- Host Interface
- Keyboard Interface
- Optional Features

## CRT MONITOR

The terminal crt measures 380 mm (15 in) diagonally with an approximate 203 mm (8 in) by 262 mm (10.3 in) viewable area. A green phosphor is used to optimize performance in the interlaced mode of operation. A reduced-glare green faceplate is standard.

## MICROPROCESSOR

The terminal uses a type Z80B programmable microprocessor. It is an 8-bit parallel central processor unit (CPU) contained in one large scale integration (LSI) microcircuit chip. The microprocessor controls all operations inside the terminal as well as directing the operation of associated peripheral equipments, such as printers, disk drives, and modems. See figure 2-1 for a block diagram of primary microprocessor functions.

There are six general purpose registers which are used individually either as 8-bit or 16-bit register-pairs. There are two sets of accumulator and flag registers. A group of exchange instructions designates each of the sets as main or alternate registers. The alternate set allows the programmer to operate in foreground-background mode or it may be reserved for very fast interrupt response. The microprocessor also contains a stack pointer, program counter, two index registers, a refresh counter, and an interrupt register.

The instruction set contains the following categories of operations and the type of action performed by each category.

| Category | Type of Action |
|---|---|
| 8-Bit loads | Miscellaneous |
| 16-Bit loads | Rotates and shifts |
| Exchanges | Bit set, reset and test |
| Memory block moves | Input and output |
| Memory block searches | Jumps |
| 8-Bit arithmetic and logic | Calls |
| 16-Bit arithmetic | Restarts |
| General purpose accumulator and flag operations | Returns |

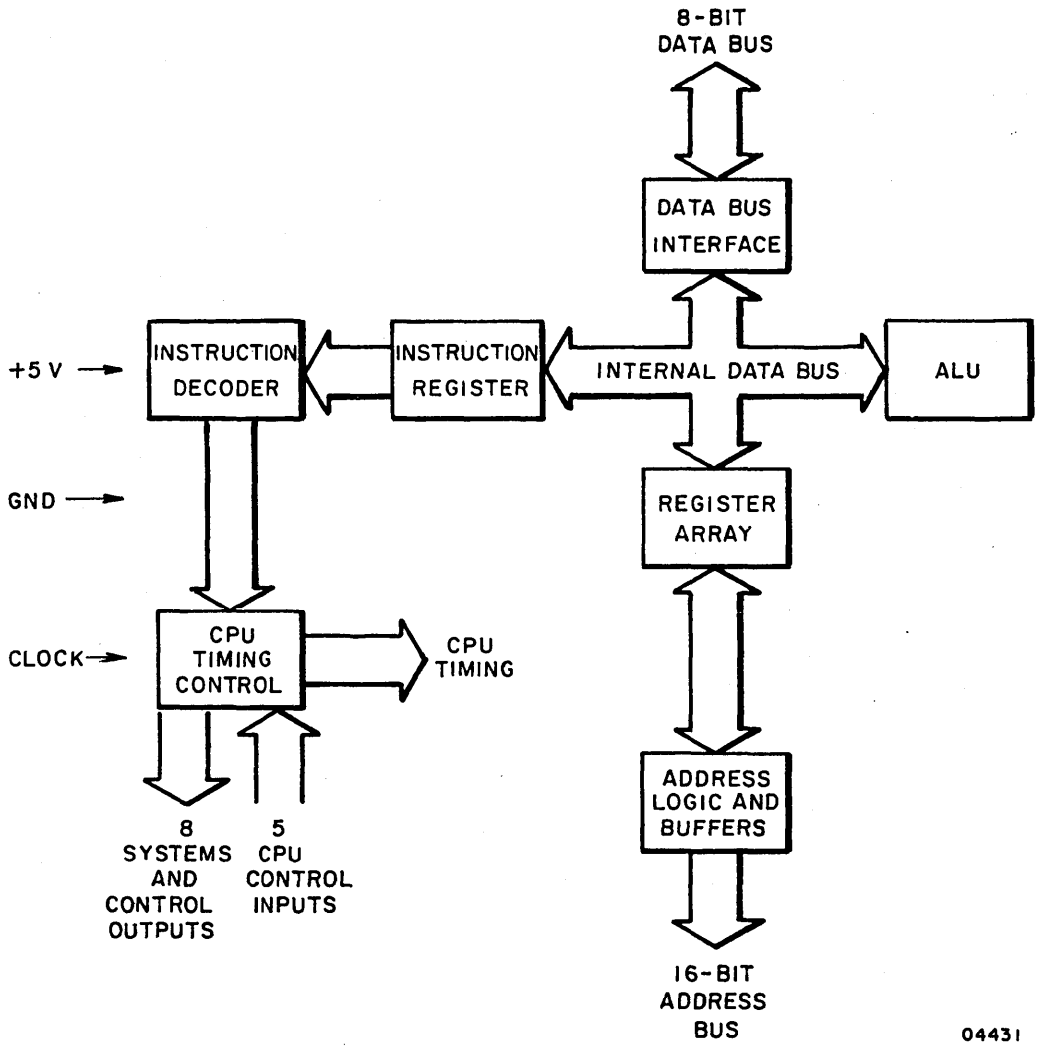


Figure 2-1. Microprocessor CPU Block Diagram

## MEMORY

The terminal uses a 16-bit address bus that allows for a maximum of 64K bytes of direct memory addressing. However, since the terminal has more than 64K bytes of RAM and ROM, memory mapping is required. Refer to figure B-1 (in Appendix B) to see how the memory is divided into 16K banks. The memory mapping scheme used structures these banks into four blocks forming 64K of addressable memory locations as shown in figure B-2 (in Appendix B). Block 0 starts at address 0000, block 4 starts at address 4000, block 8 starts at address 8000, and block C starts at address C000.

## DISPLAY REFRESH LOGIC

A block diagram of the display refresh logic is shown in figure 2-2. The display is refreshed from executable 64K RAM memory via dual-line buffers and a symbol generator. Each line buffer stores one line of displayable characters and character attributes. Line addresses, resident at fixed-byte locations in executable RAM, are read by the refresh hardware and used to define locations in the RAM where the strings of character and attribute codes are stored.

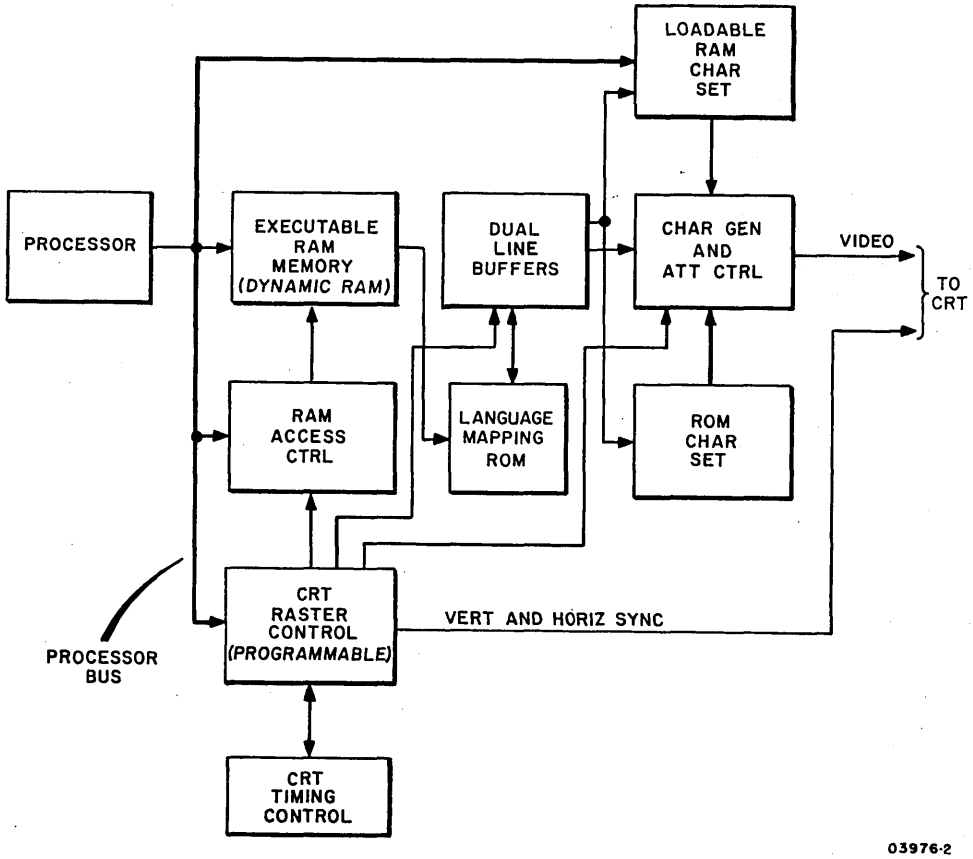


Figure 2-2. Display Refresh Logic - Alphanumeric Mode

The codes received from memory with conversion by foreign character ROM, determine what symbol is to be generated. If the most significant 2 bits are ones, the loadable symbol generator symbols are used. If either of the most significant 2 bits are a zero, the ROM based symbol generator is used.

## ROM-Based Generator

The ROM-based generator provides the following symbols:

- 95 ANSI X3.4 Alphanumeric Characters (tables 2-1 through 2-7).
- 32 ANSI X3.4 Control Code Symbols and one special parity error symbol (table 2-8).
- 32 Line Drawing Symbols (table 2-9).
- 32 Foreign Language Symbols (table 2-10).

A ROM symbol-generator IC allows the terminal to accommodate foreign and special character sets. The 32 foreign language symbols accommodate character sets in British, German, French, Spanish, Swedish/Finnish, and Danish/Norwegian.*

## Loadable Symbol Generator

The loadable symbol generator uses bit patterns that have been loaded into RAM from an external source. A maximum of 64 symbols can be stored. These symbols are host accessed by character codes $40_{16}$ thru $7F_{16}$ when preceded by an extended character command code. The symbol generator addressing scheme is shown in figure 2-3.

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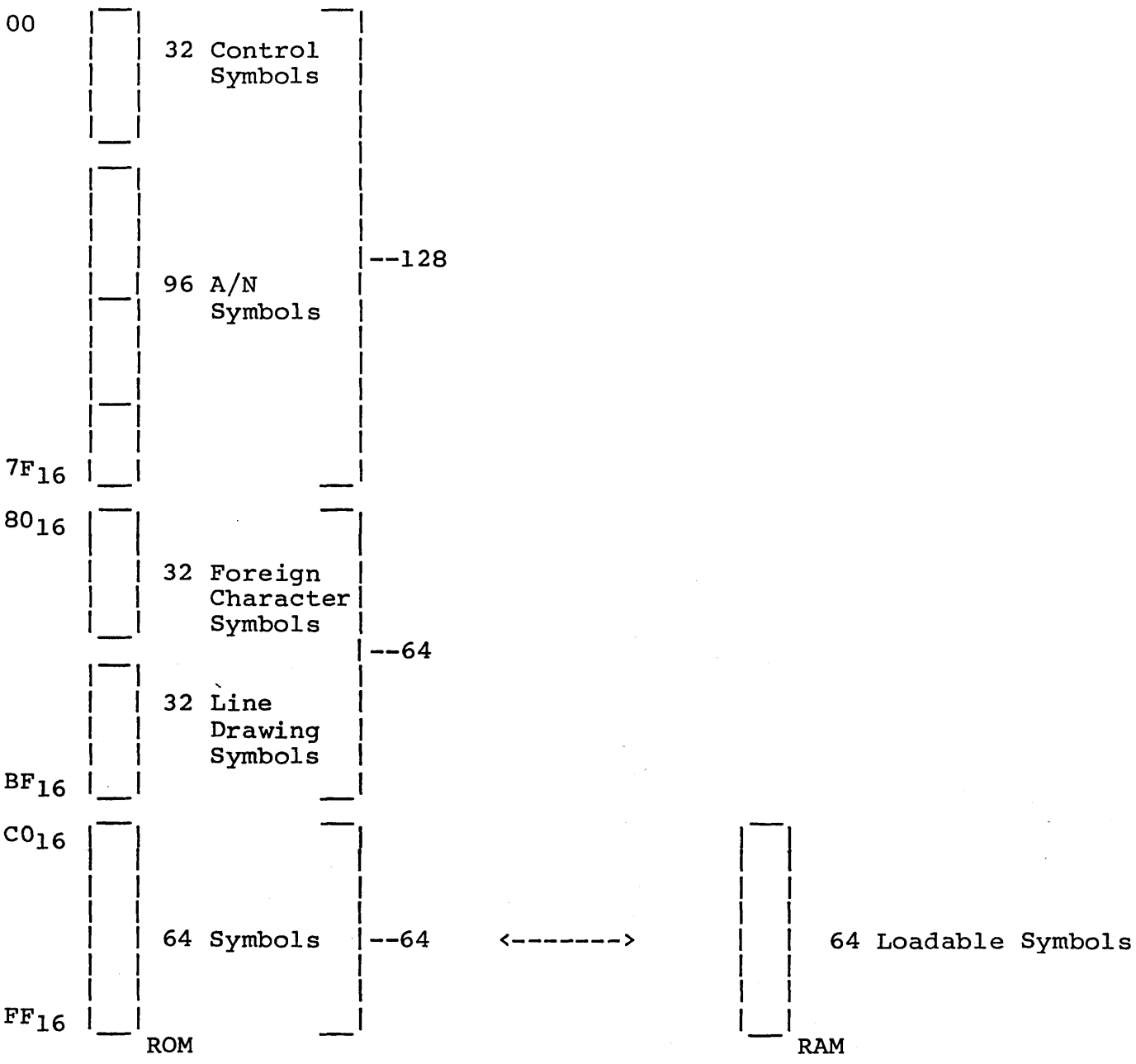
*Requires parameter selection and keycap kit option.




Eight memory bits address 256 symbols in ROM/RAM. An I/O bit controls overlay selection of 64 symbols.

Figure 2-3. Symbol Generator Addressing

## CHARACTER ATTRIBUTES

A character attribute code (background) is loaded into the line buffer for every character display code (foreground). Of the eight bits available, five are used by the hardware. These are:

| Bit No. | Feature |
|---|---|
| 0 | Blank |
| 1 | Underscore |
| 2 | Inverse |
| 3 | Blink |
| 4 | Dim |
| 5 thru 7 | Available for program control (these may be used for marking modified fields, programmed fields, protected field, and so forth). |

## DISPLAY TIMING

A crystal controlled oscillator provides the basic CRT timing. This method of timing, in conjunction with a programmable CRT controller IC allows flexibility in display modes of operation; that is, interlaced, 80- or 132-characters per row. A programmable bit allows this timing to be driven by an external source.

## SYMBOL GENERATION

Two methods of symbol generation are provided. In the first method, used for 80-column display format, the characters are formed via a 8- by 16-dot symbol generator. The dot array for all characters normally occupies a 7 by 12 subset within the generator. In the second method, used for 132-column display format, the characters are formed on the screen in a 5- by 16-dot space with half-dot step positioning. The same character generator bit pattern is used for both methods.

## CURSOR

The cursor indicates the current entry position. This position is represented on the screen in one of the following manners:

- Constant underline
- Blinking underline
- Solid block
- Blinking solid block

The type of cursor is determined by two operator selectable parameter bits.

TABLE 2-1. AMERICAN ALPHANUMERIC CHARACTER CODES

| b7 → b6 → b5 → / BITS | | | | | 0 0 0 | 0 0 1 | 1 0 0 | 1 0 1 | 1 1 0 | 1 1 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| b4 ↓ | b3 ↓ | b2 ↓ | b1 ↓ | COLUMN → / ROW ↓ | 2 | 3 | 4 | 5 | 6 | 7 |
| 0 | 0 | 0 | 0 | 0 | SP | 0 | @ | P | ` | p |
| 0 | 0 | 0 | 1 | 1 | ! | 1 | A | Q | a | q |
| 0 | 0 | 1 | 0 | 2 | " | 2 | B | R | b | r |
| 0 | 0 | 1 | 1 | 3 | # | 3 | C | S | c | s |
| 0 | 1 | 0 | 0 | 4 | $ | 4 | D | T | d | t |
| 0 | 1 | 0 | 1 | 5 | % | 5 | E | U | e | u |
| 0 | 1 | 1 | 0 | 6 | & | 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 | ) | 9 | I | Y | i | y |
| 1 | 0 | 1 | 0 | 10(A) | * | : | J | Z | j | z |
| 1 | 0 | 1 | 1 | 11(B) | + | ; | K | [ | k | { |
| 1 | 1 | 0 | 0 | 12(C) | , | < | L | \ | l | \| |
| 1 | 1 | 0 | 1 | 13(D) | - | = | M | ] | m | } |
| 1 | 1 | 1 | 0 | 14(E) | . | > | N | ^ | n | ~ |
| 1 | 1 | 1 | 1 | 15(F) | / | ? | O | _ | o | |

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TABLE 2-2. BRITISH ALPHANUMERIC CHARACTER CODES

| b7 → / b6 → / b5 → / BITS | | | | | 0 1 0 | 0 1 1 | 1 0 0 | 1 0 1 | 1 1 0 | 1 1 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| b4 ↓ | b3 ↓ | b2 ↓ | b1 ↓ | COLUMN → / ROW ↓ | 2 | 3 | 4 | 5 | 6 | 7 |
| 0 | 0 | 0 | 0 | 0 | SP | 0 | @ | P | ` | p |
| 0 | 0 | 0 | 1 | 1 | ! | 1 | A | Q | a | q |
| 0 | 0 | 1 | 0 | 2 | " | 2 | B | R | b | r |
| 0 | 0 | 1 | 1 | 3 | £ | 3 | C | S | c | s |
| 0 | 1 | 0 | 0 | 4 | $ | 4 | D | T | d | t |
| 0 | 1 | 0 | 1 | 5 | % | 5 | E | U | e | u |
| 0 | 1 | 1 | 0 | 6 | & | 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 | ) | 9 | I | Y | i | y |
| 1 | 0 | 1 | 0 | 10(A) | * | : | J | Z | j | z |
| 1 | 0 | 1 | 1 | 11(B) | + | ; | K | [ | k | { |
| 1 | 1 | 0 | 0 | 12(C) | , | < | L | \ | l | ¦ |
| 1 | 1 | 0 | 1 | 13(D) | - | = | M | ] | m | } |
| 1 | 1 | 1 | 0 | 14(E) | . | > | N | ^ | n | ¯ |
| 1 | 1 | 1 | 1 | 15(F) | / | ? | O | _ | o | |

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TABLE 2-3. SPANISH ALPHANUMERIC CHARACTER CODES

| b7 → / b6 → / b5 → / BITS b4 b3 b2 b1 ↓ | | | | | 0 1 0 | 0 1 1 | 1 0 0 | 1 0 1 | 1 1 0 | 1 1 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | COLUMN → / ROW ↓ | 2 | 3 | 4 | 5 | 6 | 7 |
| 0 | 0 | 0 | 0 | 0 | SP | 0 | § | P | ` | p |
| 0 | 0 | 0 | 1 | 1 | ! | 1 | A | Q | a | q |
| 0 | 0 | 1 | 0 | 2 | " | 2 | B | R | b | r |
| 0 | 0 | 1 | 1 | 3 | £ | 3 | C | S | c | s |
| 0 | 1 | 0 | 0 | 4 | $ | 4 | D | T | d | t |
| 0 | 1 | 0 | 1 | 5 | % | 5 | E | U | e | u |
| 0 | 1 | 1 | 0 | 6 | & | 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 | ) | 9 | I | Y | i | y |
| 1 | 0 | 1 | 0 | 10(A) | * | : | J | Z | j | z |
| 1 | 0 | 1 | 1 | 11(B) | + | ; | K | ¡ | k | ° |
| 1 | 1 | 0 | 0 | 12(C) | , | < | L | Ñ | l | ñ |
| 1 | 1 | 0 | 1 | 13(D) | - | = | M | ç | m | Ç |
| 1 | 1 | 1 | 0 | 14(E) | . | > | N | ^ | n | ~ |
| 1 | 1 | 1 | 1 | 15(F) | / | ? | O | _ | o | |

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TABLE 2-4. GERMAN ALPHANUMERIC CHARACTER CODES

| b7 → / b6 → / b5 → / BITS | | | | | 0 1 0 | 0 1 1 | 1 0 0 | 1 0 1 | 1 1 0 | 1 1 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| b4 ↓ | b3 ↓ | b2 ↓ | b1 ↓ | COLUMN → / ROW ↓ | 2 | 3 | 4 | 5 | 6 | 7 |
| 0 | 0 | 0 | 0 | 0 | SP | 0 | § | P | ` | p |
| 0 | 0 | 0 | 1 | 1 | ! | 1 | A | Q | a | q |
| 0 | 0 | 1 | 0 | 2 | " | 2 | B | R | b | r |
| 0 | 0 | 1 | 1 | 3 | # | 3 | C | S | c | s |
| 0 | 1 | 0 | 0 | 4 | $ | 4 | D | T | d | t |
| 0 | 1 | 0 | 1 | 5 | % | 5 | E | U | e | u |
| 0 | 1 | 1 | 0 | 6 | & | 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 | ) | 9 | I | Y | i | y |
| 1 | 0 | 1 | 0 | 10(A) | * | : | J | Z | j | z |
| 1 | 0 | 1 | 1 | 11(B) | + | ; | K | Ä | k | ä |
| 1 | 1 | 0 | 0 | 12(C) | , | < | L | Ö | l | ö |
| 1 | 1 | 0 | 1 | 13(D) | - | = | M | Ü | m | ü |
| 1 | 1 | 1 | 0 | 14(E) | . | > | N | ^ | n | β |
| 1 | 1 | 1 | 1 | 15(F) | / | ? | O | _ | o | |

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TABLE 2-5. FRENCH ALPHANUMERIC CHARACTER CODES

| b7 → | | | | | 0 | 0 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| b6 → | | | | | 1 | 1 | 0 | 0 | 1 | 1 |
| b5 → | | | | | 0 | 1 | 0 | 1 | 0 | 1 |
| BITS | b4 ↓ | b3 ↓ | b2 ↓ | b1 ↓ | COLUMN → / ROW ↓ | 2 | 3 | 4 | 5 | 6 | 7 |
| | 0 | 0 | 0 | 0 | 0 | SP | 0 | à | P | ` | p |
| | 0 | 0 | 0 | 1 | 1 | ! | 1 | A | Q | a | q |
| | 0 | 0 | 1 | 0 | 2 | " | 2 | B | R | b | r |
| | 0 | 0 | 1 | 1 | 3 | £ | 3 | C | S | c | s |
| | 0 | 1 | 0 | 0 | 4 | $ | 4 | D | T | d | t |
| | 0 | 1 | 0 | 1 | 5 | % | 5 | E | U | e | u |
| | 0 | 1 | 1 | 0 | 6 | & | 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 | ) | 9 | I | Y | i | y |
| | 1 | 0 | 1 | 0 | 10(A) | * | : | J | Z | j | z |
| | 1 | 0 | 1 | 1 | 11(B) | + | ; | K | ° | k | é |
| | 1 | 1 | 0 | 0 | 12(C) | , | < | L | Ç | l | ù |
| | 1 | 1 | 0 | 1 | 13(D) | - | = | M | § | m | è |
| | 1 | 1 | 1 | 0 | 14(E) | . | > | N | ^ | n | ¨ |
| | 1 | 1 | 1 | 1 | 15(F) | / | ? | O | _ | o | |

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TABLE 2-6. SWEDISH/FINNISH ALPHANUMERIC CHARACTER CODES

| b7 → / b6 → / b5 → / BITS | | | | | 0 0 0 | 0 0 1 | 1 0 0 | 1 0 1 | 1 1 0 | 1 1 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| b4 ↓ | b3 ↓ | b2 ↓ | b1 ↓ | COLUMN → / ROW ↓ | 2 | 3 | 4 | 5 | 6 | 7 |
| 0 | 0 | 0 | 0 | 0 | SP | 0 | É | P | é | p |
| 0 | 0 | 0 | 1 | 1 | ! | 1 | A | Q | a | q |
| 0 | 0 | 1 | 0 | 2 | " | 2 | B | R | b | r |
| 0 | 0 | 1 | 1 | 3 | # | 3 | C | S | c | s |
| 0 | 1 | 0 | 0 | 4 | ¤ | 4 | D | T | d | t |
| 0 | 1 | 0 | 1 | 5 | % | 5 | E | U | e | u |
| 0 | 1 | 1 | 0 | 6 | & | 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 | ) | 9 | I | Y | i | y |
| 1 | 0 | 1 | 0 | 10(A) | * | : | J | Z | j | z |
| 1 | 0 | 1 | 1 | 11(B) | + | ; | K | Ä | k | ä |
| 1 | 1 | 0 | 0 | 12(C) | , | < | L | Ö | l | ö |
| 1 | 1 | 0 | 1 | 13(D) | - | = | M | Å | m | å |
| 1 | 1 | 1 | 0 | 14(E) | . | > | N | Ü | n | ü |
| 1 | 1 | 1 | 1 | 15(F) | / | ? | O | _ | o | |

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TABLE 2-7. DANISH/NORWEGIAN ALPHANUMERIC CHARACTER CODES

| b7 → b6 → b5 → BITS b4 ↓ | b3 ↓ | b2 ↓ | b1 ↓ | COLUMN → / ROW ↓ | 0 1 0 | 0 1 1 | 1 0 0 | 1 0 1 | 1 1 0 | 1 1 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2 | 3 | 4 | 5 | 6 | 7 |
| 0 | 0 | 0 | 0 | 0 | SP | 0 | @ | P | ` | p |
| 0 | 0 | 0 | 1 | 1 | ! | 1 | A | Q | a | q |
| 0 | 0 | 1 | 0 | 2 | " | 2 | B | R | b | r |
| 0 | 0 | 1 | 1 | 3 | # | 3 | C | S | c | s |
| 0 | 1 | 0 | 0 | 4 | $ | 4 | D | T | d | t |
| 0 | 1 | 0 | 1 | 5 | % | 5 | E | U | e | u |
| 0 | 1 | 1 | 0 | 6 | & | 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 | ) | 9 | I | Y | i | y |
| 1 | 0 | 1 | 0 | 10(A) | * | : | J | Z | j | z |
| 1 | 0 | 1 | 1 | 11(B) | + | ; | K | Æ | k | æ |
| 1 | 1 | 0 | 0 | 12(C) | , | < | L | Ø | l | ø |
| 1 | 1 | 0 | 1 | 13(D) | - | = | M | Å | m | å |
| 1 | 1 | 1 | 0 | 14(E) | . | > | N | ^ | n | — |
| 1 | 1 | 1 | 1 | 15(F) | / | ? | O | _ | o | |

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TABLE 2-8. CONTROL CHARACTER CODES

| b7 → / b6 → / b5 → / BITS | | | | | 0 0 0 | 0 0 1 | 1 1 1 |
|---|---|---|---|---|---|---|---|
| b4 ↓ | b3 ↓ | b2 ↓ | b1 ↓ | COLUMN → / ROW ↓ | 0 | 1 | 7 |
| 0 | 0 | 0 | 0 | 0 | NUL | DLE | |
| 0 | 0 | 0 | 1 | 1 | SOH | DC1 | |
| 0 | 0 | 1 | 0 | 2 | STX | DC2 | |
| 0 | 0 | 1 | 1 | 3 | ETX | DC3 | |
| 0 | 1 | 0 | 0 | 4 | EOT | DC4 | |
| 0 | 1 | 0 | 1 | 5 | ENQ | NAK | |
| 0 | 1 | 1 | 0 | 6 | ACK | SYN | |
| 0 | 1 | 1 | 1 | 7 | BEL | ETB | |
| 1 | 0 | 0 | 0 | 8 | BS | CAN | |
| 1 | 0 | 0 | 1 | 9 | HT | EM | |
| 1 | 0 | 1 | 0 | 10 (A) | LF | SUB | |
| 1 | 0 | 1 | 1 | 11 (B) | VT | ESC | |
| 1 | 1 | 0 | 0 | 12 (C) | FF | FS | |
| 1 | 1 | 0 | 1 | 13 (D) | CR | GS | |
| 1 | 1 | 1 | 0 | 14 (E) | SO | RS | |
| 1 | 1 | 1 | 1 | 15 (F) | SI | US | DEL(1) |

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(1) This character code is used to denote a parity error.

TABLE 2-9. LINE DRAWING SYMBOL CODES

| b7 → / b6 → / b5 → / BITS: b4 ↓ | b3 ↓ | b2 ↓ | b1 ↓ | COLUMN → / ROW ↓ | 0 1 0 — 2 | 0 1 1 — 3 |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | — | ┘ |
| 0 | 0 | 0 | 1 | 1 | \| | ┐ |
| 0 | 0 | 1 | 0 | 2 | ┌ | ┴ |
| 0 | 0 | 1 | 1 | 3 | ┐ | ├ |
| 0 | 1 | 0 | 0 | 4 | └ | ┤ |
| 0 | 1 | 0 | 1 | 5 | ┘ | ┼ |
| 0 | 1 | 1 | 0 | 6 | ┬ | ▌ |
| 0 | 1 | 1 | 1 | 7 | ┴ | ▐ |
| 1 | 0 | 0 | 0 | 8 | ├ | ▀ |
| 1 | 0 | 0 | 1 | 9 | ┤ | ▄ |
| 1 | 0 | 1 | 0 | 10 (A) | ┼ | ▖ |
| 1 | 0 | 1 | 1 | 11 (B) | — | ▙ |
| 1 | 1 | 0 | 0 | 12 (C) | \| | ■ |
| 1 | 1 | 0 | 1 | 13 (D) | ┌ | ■ |
| 1 | 1 | 1 | 0 | 14 (E) | ┐ | |
| 1 | 1 | 1 | 1 | 15 (F) | └ | ■ |

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TABLE 2-10. FOREIGN CHARACTER CODES

| b7 → / b6 → / b5 → / BITS | | | | | | 0 0 0 | 0 0 1 |
|---|---|---|---|---|---|---|---|
| b4 ↓ | b3 ↓ | b2 ↓ | b1 ↓ | COLUMN → / ROW ↓ | | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | | £ | ¤ |
| 0 | 0 | 0 | 1 | 1 | | `a | É |
| 0 | 0 | 1 | 0 | 2 | | `e | Å |
| 0 | 0 | 1 | 1 | 3 | | `u | å |
| 0 | 1 | 0 | 0 | 4 | | e´ | é |
| 0 | 1 | 0 | 1 | 5 | | ç | \| |
| 0 | 1 | 1 | 0 | 6 | | ° | — |
| 0 | 1 | 1 | 1 | 7 | | § | |
| 1 | 0 | 0 | 0 | 8 | | Ä | O |
| 1 | 0 | 0 | 1 | 9 | | Ö | Æ |
| 1 | 0 | 1 | 0 | 10 (A) | | Ü | Ø |
| 1 | 0 | 1 | 1 | 11 (B) | | ä | æ |
| 1 | 1 | 0 | 0 | 12 (C) | | ö | ø |
| 1 | 1 | 0 | 1 | 13 (D) | | ü | |
| 1 | 1 | 1 | 0 | 14 (E) | | β | Ñ |
| 1 | 1 | 1 | 1 | 15 (F) | | ·· | ñ |

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## HOST INTERFACE

The only method of interfacing to the host system is through the interface conforming to RS-232-C/CCITT V.24 (data set interface). In asynchronous RS-232-C operation, a different send and receive data rate may be provided. The data rate and several other communication parameters are entered via the keyboard. The interface selection is operator program selectable.

The RS-232-C/CCITT V.24 interface is described in Appendix C.

## KEYBOARD INTERFACE

A serial keyboard interface is provided with a single, standard-length cable to allow 1 metre (39.4 in) keyboard to monitor separation.

## OPTIONAL FEATURES

The following paragraphs describe the functions of the optional features that may be configured with the system:

### TOUCHPANEL OPTION

The touchpanel option is part of the graphics display option. The touchpanel array size is 16 by 16 providing a 12.7 mm square grid on the monitor. Each square grid covers 4 characters by 2 lines in 80 character/line mode. Control logic for the touchpanel is located on the graphics option module. Touchpanel operation is used with the graphic-display operation. In modes supporting touchpanel input, pressure applied to the touchpanel surface interrupts an X/Y scanning mechanism. When a touch is detected, the terminal captures the intersecting X/Y coordinates for processing and produces an audible tone, except in CYBER mode. In CYBER mode, the cursor moves to the area touched.

## GRAPHICS DISPLAY OPTION

The standard graphics display capability allows the terminal to display a 512- by 480- full-vector dot array on the monitor. The refresh memory is contained in a separate independent 32K bytes of dynamic RAM. This memory is mapped into processor memory space by the display driver when required. All bit patterns are written under normal processor-to-memory, operations.

A graphics mode selection allows full IST compatibility to display a 512- by 512- full-vector dot array. Both capabilities are provided on the same basic graphics module (program selectable). Refer to appendix D.

## PARALLEL CHANNEL OPTION

In the graphics operations described in appendix D, the parallel channel interface supports a graphics printer. The graphics printer provides a 115 LPM capability. The parallel channel interface control logic is contained on a small customer-installable option module.

## MEMORY MODULE (ROM PACK) OPTION

The ROM pack plugs into the terminal via an external slot accessible on the back of the display cabinet. Each ROM pack provides a maximum of 16K bytes of memory. Firmware in the basic terminal allows the ROM pack code to supersede resident mode and parameter selection. The ROM pack is packaged in a hand-sized module that has its connector contacts protected when not inserted in the terminal.

## DUAL ASYNCHRONOUS INTERFACE OPTION

The dual bidirectional asynchronous interface can connect to two RS-232-C-compatible devices. The dual interface supports the same data rate for both send and receive data on each port. Data rate and other communication parameters can be entered on the keyboard. The interface supports local devices with cable lengths less than 15 metres (50 ft). This interface is provided on a small customer-installable option module.

## FOREIGN KEYCAP OPTIONS

Foreign keycap kits are available for the following languages:

- German
- French
- United Kingdom
- Spanish
- Swedish/Finnish
- Danish/Norwegian

A language selection in the terminal installation parameters (described in section 4) allows displayed characters to be changed to match the installed keycap kit.

## INTERNAL 1200/1200 BIT-PER-SECOND MODEM

The internal 1200/1200 bit-per-second (b/s) modem is an option that mounts in the terminal in large option-board location I/F-4. This option enables the terminal to transmit and receive information over standard dial-up telephone lines at 1200 b/s rates. The modem is Bell 212A compatible and conforms to most industry, national, and international standards for data communications equipment. It incorporates automatic dialing and automatic answering capabilities so that unattended operation of the terminal during communications interchanges with a host computer is possible (with proper applications software). Appendix E of this manual contains a more detailed description of the internal 1200/1200 b/s modem and its special features.

This section describes the operator-accessible controls and indicators of the display terminal including the various keyboard configurations. Refer to section 4 for information on parameter selection and terminal operation.

## CABINET-MOUNTED CONTROLS AND INDICATORS

All of the following items are mounted on the terminal cabinet (figure 3-1).

- POWER 0/1 (off/on) Switch - Allows the operator to control primary power application to the terminal. This switch is located at the front of the terminal.
- CB1 Circuit Breaker - Provides line circuit over-current protection for the terminal. CB1 is located at the rear of the terminal and can be reset when the over-current fault condition is cleared.
- TEST Switch - This slide switch allows maintenance loopback of the resident host interface (RS232C) and keyboard I/F for fault isolation capability. It is in the TEST (looped) position when the actuator is pulled out. This switch is located at the rear of the terminal
- RESET Switch - Allows operator to reset the terminal to a normal restart condition (provides a clear function to the terminal). Terminal activity is program dependent. This switch is located on the front of the terminal.
- BRIGHTNESS (Intensity) Control - Allows the operator to adjust the video intensity to the ambient lighting conditions. This control is located on the front of the terminal.
- CONTRAST Control - Allows the operator to adjust the intensity variation between the normal characters and background. This control is located at the front of the terminal.
- LINE VOLTAGE Switch - Allows for selection of the appropriate line voltage range (115/220 V ac) for terminal operation. This switch is located at the rear of the terminal. CAUTION: This switch must be set to equal line voltage.
- M REL (Manual Release) - This key will perform a firmware manual release. Any print or host operation is aborted.

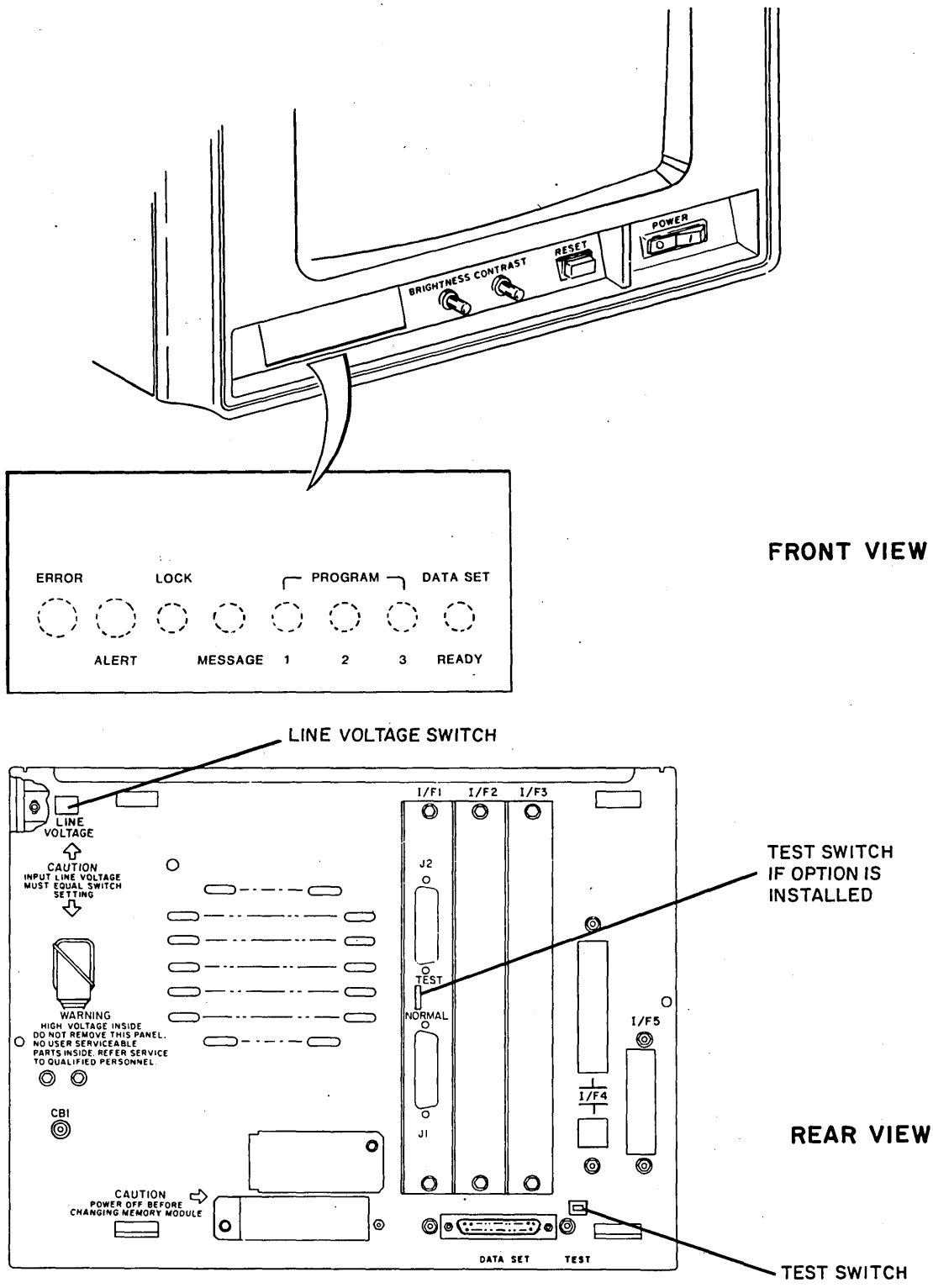



Figure 3-1. Location of Controls and Indicators

- DATA SET READY Indicator - Illuminates if the Data Set Ready signal at the modem (host) interface is present. The DATA SET READY indicator is located at the front of the terminal.

- LOCK (Keyboard Locked) Indicator - Illuminates during a page print operation. The keyboard is also locked and the LOCK indicator is lit if the terminal is unable to transmit data due to loss of modem control signals such as CTS or DATA SET READY while the terminal is online and ready to send, or if the terminal is disabled by host command. Also, the keyboard is locked out during block mode communication with the host or when a disk operation is active. The LOCK indicator is located at the front of the terminal.

- MESSAGE (Message Waiting) Indicator - This indicator is under program control. The MESSAGE indicator is located on the front of the terminal.

- ALERT Indicator - Used as an alternate visible alert when the audible alarm is disabled or cannot be heard. It is controlled by a programmable bit. The Alert indicator is located at the front of the terminal.

- ERROR Indicator - Illuminates when a terminal subsystem or mode dependent error condition is detected. It is controlled by a programmable bit. The Error indicator is located at the front of the terminal.

- PROGRAM 1/PROGRAM 2/PROGRAM 3 (Programmable) Indicators - These three indicators are under programmable control, and are illuminated when certain conditions are present as defined by the program. The Programmable indicator is located at the front of the terminal.

- Audible Alarm - Provides a two-level (loud/soft intensity) audible alarm signal. Operation is under firmware control and is also operator parameter bit controlled. The following conditions cause an audible alarm to occur:

  After power on or RESET has run test 1

  - Improper key depressions during MODE selection.
  - Host code sequence
  - Entry of certain key while the cursor is in a protected position
  - Entry on keyboard while the keyboard is locked
  - Entry of the cursor by the keyboard into the 8th position from end of line or into the last line caused by keyboard entry and margin alert enabled.

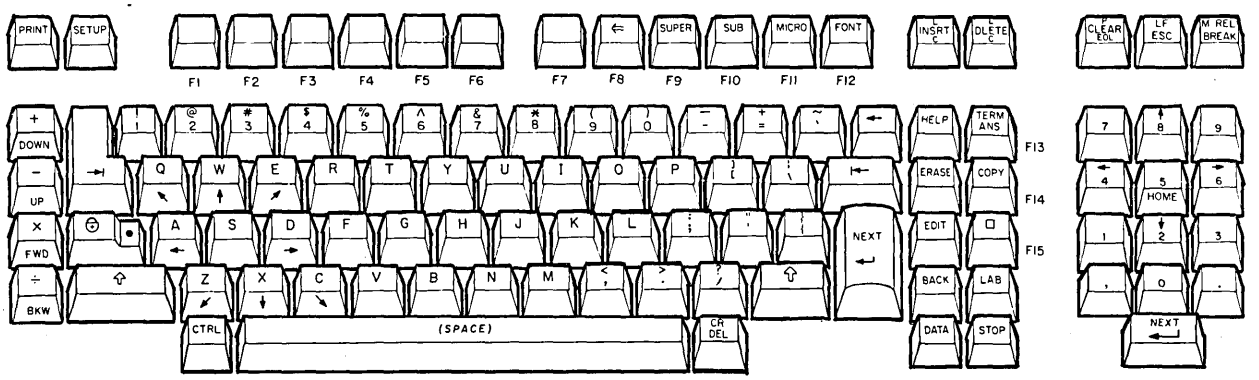
## KEYBOARD CONFIGURATIONS

Figure 3-2 shows the standard keyboard. Figures 3-3 through 3-8 show the keyboard with foreign keycap kits installed. The symbols on the keys support standard alphanumeric requirements and mode dependent special functions. The keyboard function keys can be labeled with application-unique legends through use of special overlay templates.

All keys - including special functions such as Shift and Control - are under firmware control. If a foreign keycap kit is installed, the only change necessary is to specify the language in the terminal installation parameters. The foreign character sets supported are:

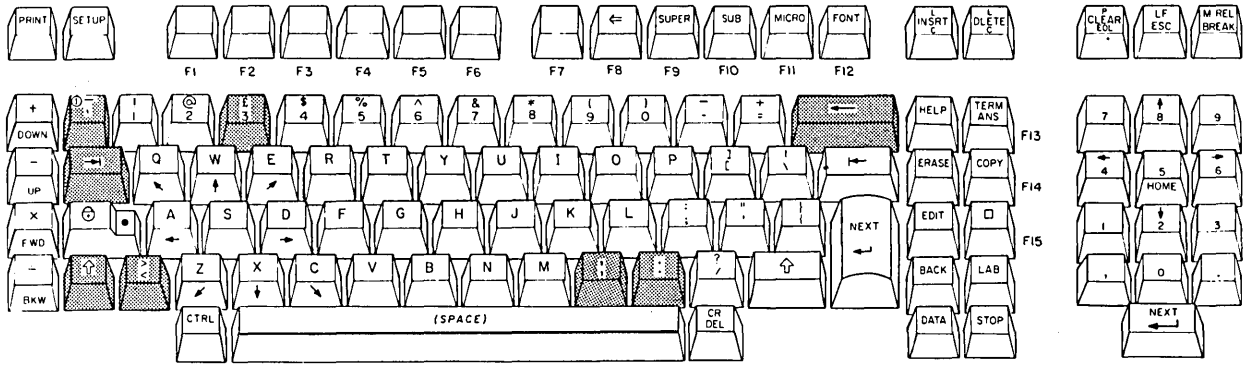
- German
- French
- United Kingdom
- Spanish
- Swedish/Finnish
- Danish/Norwegian

Each keycap option consists of a user-installed keycap kit. The corresponding characters are displayed by changing the factory-set language in the terminal installation parameters. For changing terminal installation parameters, refer to appendix A of the CDC 721 Display Terminal Operator's Guide/Installation Instructions Manual (publication number is listed in preface).




03942-6

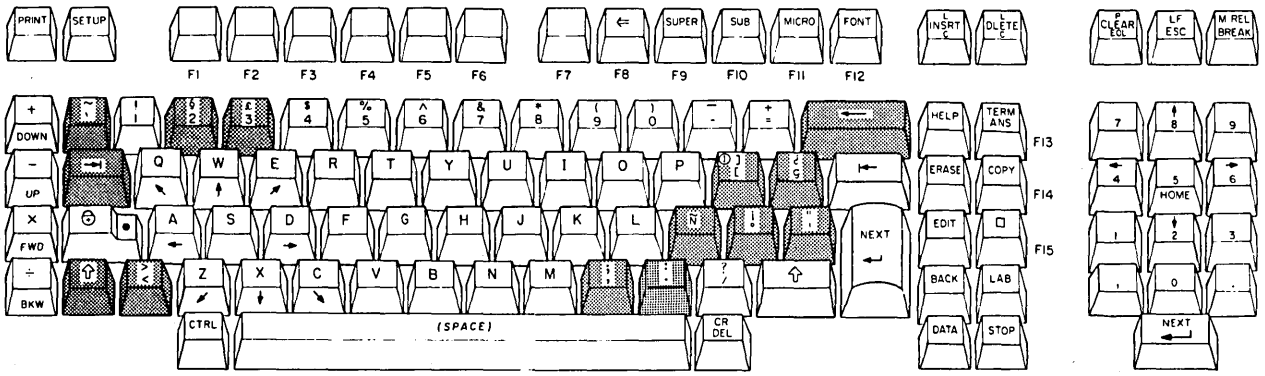
Figure 3-2. Keyboard with Standard (USA) Keycaps




03942-19

(1) UPPER - OVER BAR
LOWER - GRAVE ACCENT

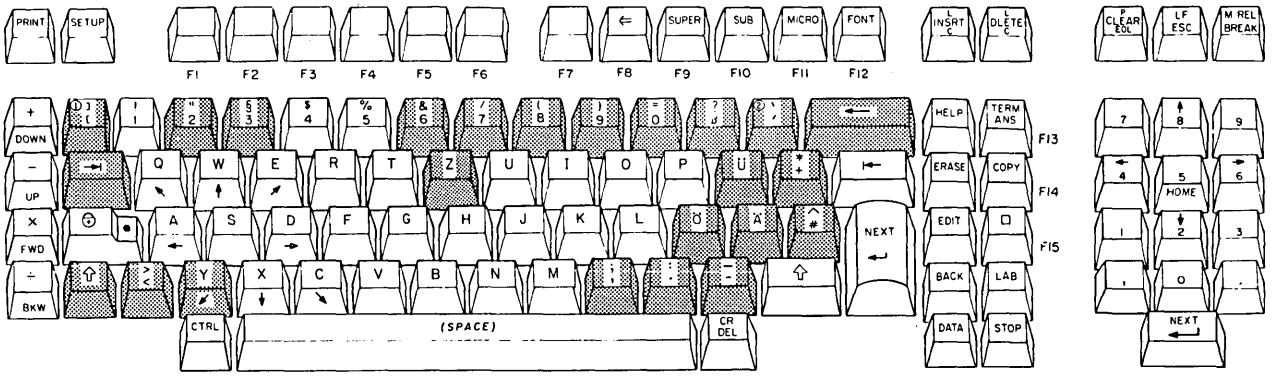
Figure 3-3. Keyboard with United Kingdom Keycap Option




NOTES:
OPTIONAL KEYCAPS ARE SHADED FOR ILLUSTRATING PURPOSES

03942-30

Figure 3-4. Keyboard with Spanish Keycap Option

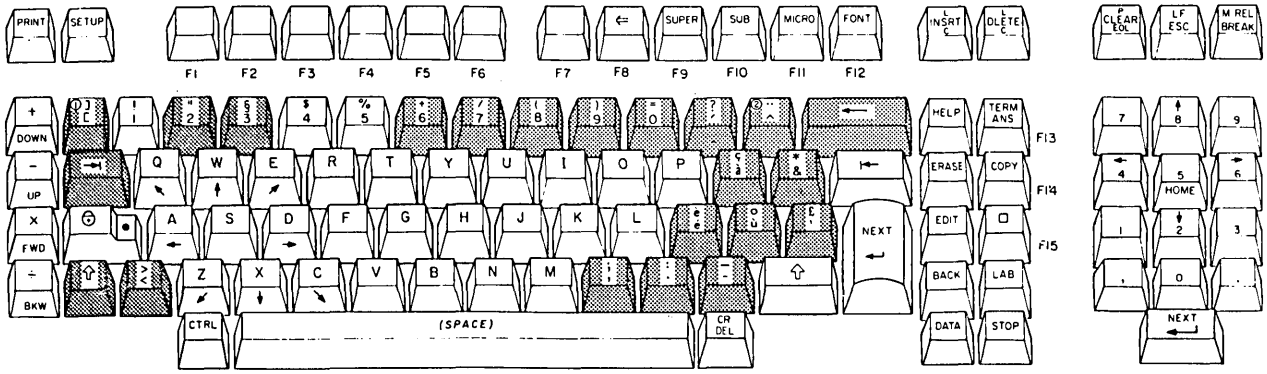



NOTES:
OPTIONAL KEYCAPS ARE SHADED FOR ILLUSTRATING PURPOSES

03942-27

①PROVIDED FOR PLATO USAGE
②UPPER-GRAVE ACCENT
LOWER-APOSTROPHE, ACUTE ACCENT

Figure 3-5. Keyboard with German Keycap Option

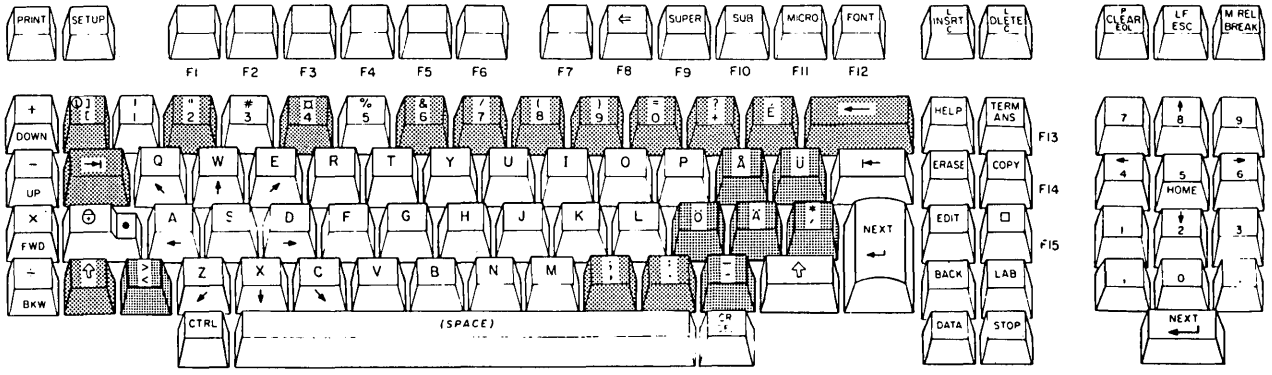



NOTES:
OPTIONAL KEYCAPS ARE SHADED FOR ILLUSTRATING PURPOSES

①PROVIDED FOR PLATO USAGE.
②UPPER-UMLAUT

03942-18

Figure 3-6. Keyboard with French Keycap Option




NOTES:
OPTIONAL KEYCAPS ARE SHADED FOR ILLUSTRATING PURPOSES

03942-28

Figure 3-7. Keyboard with Swedish/Finnish Keycap Option

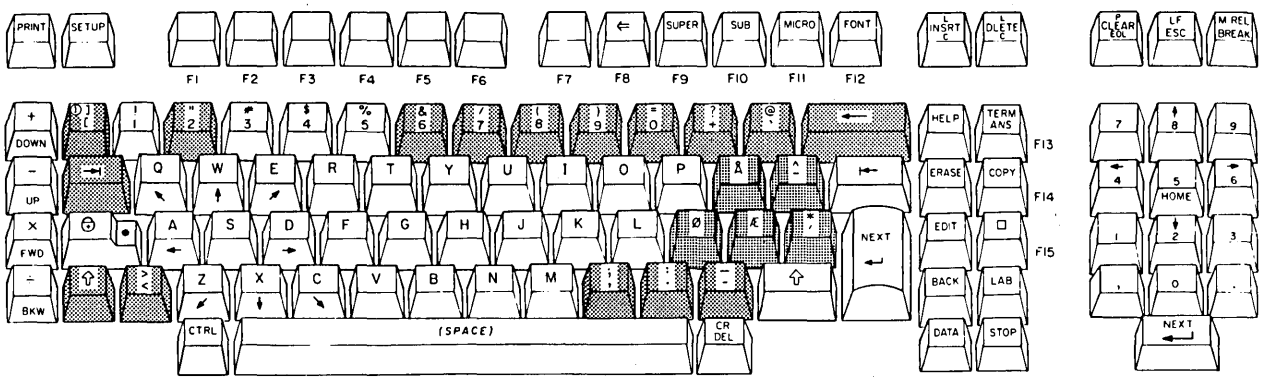



Figure 3-8. Keyboard with Danish/Norwegian Keycap Option

## KEYBOARD OPERATION

The keyboard provides for operator entry of desired symbols/commands. Figure 3-9 shows the keyboard keystation assignments. Each keystation, when pressed, sends an 8-bit serial code and parity to the terminal. A similar code is sent to the terminal when each keystation is released. This allows the terminal program to monitor the exact state of the keyboard and assign/define the resultant activity as desired. Refer to table 3-1 for keystation coding.

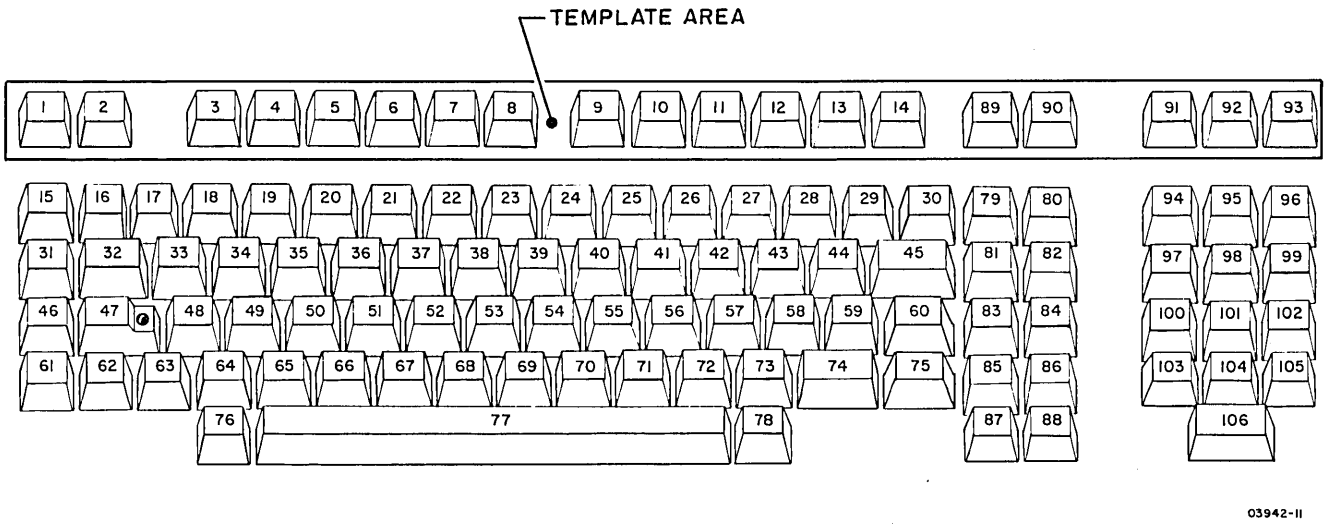



Figure 3-9 Keyboard Keystation Assignments

TABLE 3-1. KEYBOARD KEYSTATION CODING (HEXIDECIMAL)

| KEY STATION NUMBER | OUTPUT CODE | |
|---|---|---|
| | DOWN | UP |
| 1 | 10 | 90 |
| 2 | 18 | 98 |
| 3 | 20 | A0 |
| 4 | 28 | A8 |
| 5 | 30 | B0 |
| 6 | 38 | B8 |
| 7 | 40 | C0 |
| 8 | 48 | C8 |
| 9 | 50 | D0 |
| 10 | 58 | D8 |
| 11 | 60 | E0 |
| 12 | 68 | E8 |
| 13 | 70 | F0 |
| 14 | 78 | F8 |
| 15 | 11 | 91 |
| 16 | 19 | 99 |
| 17 | 21 | A1 |
| 18 | 29 | A9 |
| 19 | 31 | B1 |
| 20 | 39 | B9 |

TABLE 3-1. KEYBOARD KEYSTATION CODING (HEX) (CONTD)

| KEY STATION NUMBER | OUTPUT CODE | |
|---|---|---|
| | DOWN | UP |
| 21 | 41 | C1 |
| 22 | 49 | C9 |
| 23 | 51 | D1 |
| 24 | 59 | D9 |
| 25 | 61 | E1 |
| 26 | 69 | E9 |
| 27 | 71 | F1 |
| 28 | 79 | F9 |
| 29 | 7E | FE |
| 30 | 76 | F6 |
| 31 | 13 | 93 |
| 32 | 1B | 9B |
| 33 | 23 | A3 |
| 34 | 2B | AB |
| 35 | 33 | B3 |
| 36 | 3B | BB |
| 37 | 43 | C3 |
| 38 | 4B | CB |
| 39 | 53 | D3 |
| 40 | 5B | DB |
| 41 | 63 | E3 |
| 42 | 6B | EB |
| 43 | 73 | F3 |
| 44 | 7B | FB |
| 45 | 7F | FF |
| 46 | 12 | 92 |
| 47 | 1A | 9A |
| 48 | 22 | A2 |
| 49 | 2A | AA |
| 50 | 32 | B2 |
| 51 | 3A | BA |
| 52 | 42 | C2 |
| 53 | 4A | CA |
| 54 | 52 | D2 |
| 55 | 5A | DA |
| 56 | 62 | E2 |
| 57 | 6A | EA |
| 58 | 72 | F2 |
| 59 | 7A | FA |
| 60 | 67 | E7 |
| 61 | 14 | 94 |
| 62 | 1C | 9C |
| 63 | 24 | A4 |
| 64 | 2C | AC |
| 65 | 34 | B4 |

TABLE 3-1. KEYBOARD KEYSTATION CODING (HEX) (CONTD)

| KEY STATION NUMBER | OUTPUT CODE | |
|---|---|---|
| | DOWN | UP |
| 66 | 3C | BC |
| 67 | 44 | C4 |
| 68 | 4C | CC |
| 69 | 54 | D4 |
| 70 | 5C | DC |
| 71 | 64 | E4 |
| 72 | 6C | EC |
| 73 | 74 | F4 |
| 74 | 7C | FC |
| 75 | 66 | E6 |
| 76 | 25 | A5 |
| 77 | 2D | AD |
| 78 | 35 | B5 |
| 79 | 6E | EE |
| 80 | 36 | B6 |
| 81 | 77 | F7 |
| 82 | 6F | EF |
| 83 | 5F | DF |
| 84 | 55 | D5 |
| 85 | 5D | DD |
| 86 | 56 | D6 |
| 87 | 45 | C5 |
| 88 | 4D | CD |
| 89 | 7D | FD |
| 90 | 75 | F5 |
| 91 | 6D | ED |
| 92 | 37 | B7 |
| 93 | 1D | 9D |
| 94 | 16 | 96 |
| 95 | 1E | 9E |
| 96 | 26 | A6 |
| 97 | 17 | 97 |
| 98 | 1F | 9F |
| 99 | 27 | A7 |
| 100 | 4F | CF |
| 101 | 47 | C7 |
| 102 | 3F | BF |
| 103 | 4E | CE |
| 104 | 46 | C6 |
| 105 | 3E | BE |
| 106 | 3D | BD |

This section describes the method of parameter selection and operation of the terminal in CYBER mode.

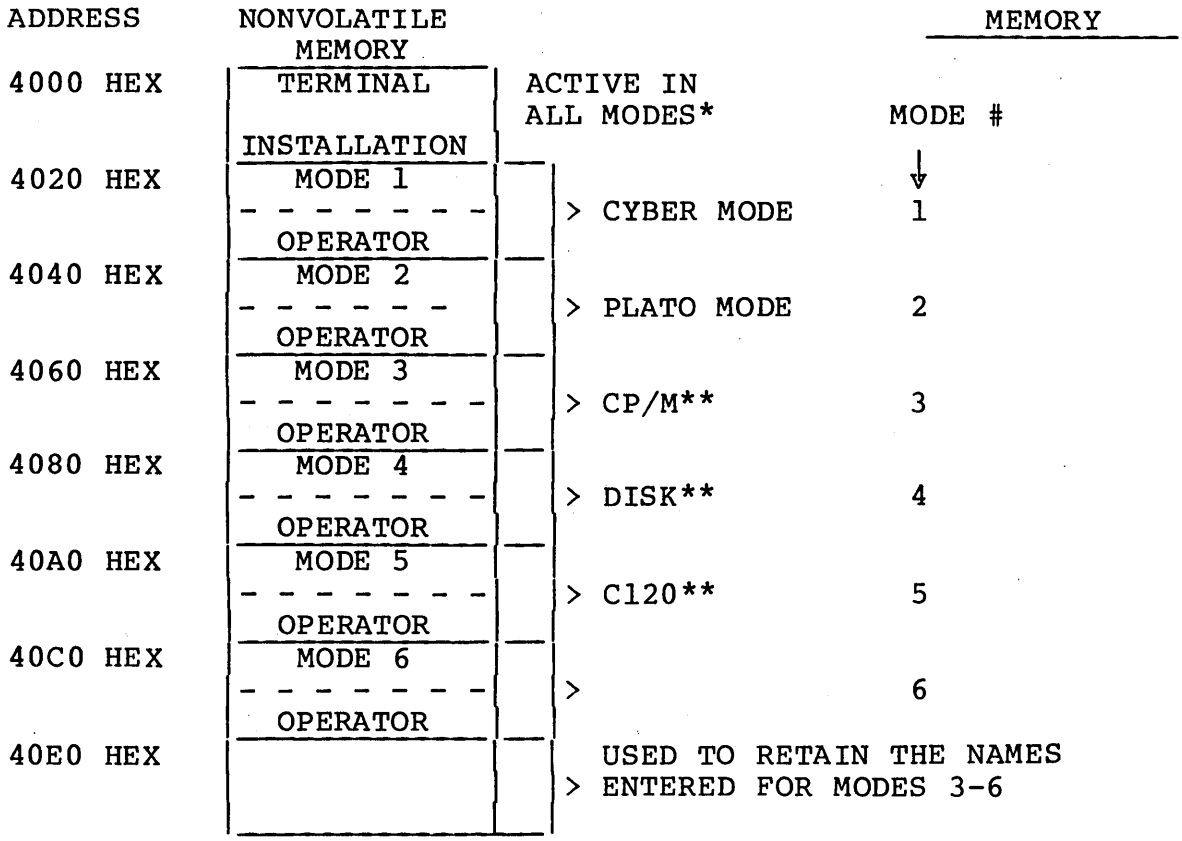
## PARAMETER SELECTION

The terminal has no operator parameter switches that can be sensed by the processor. Instead, parameters are entered into a nonvolatile memory (NVM) and read by the processor. The NVM retains the parameters when power is off via the use of a battery. These parameters should be set/changed only by terminal installation personnel or their equivalent. No provision has been made for a nontechnical operator to have the capability to change the installation parameters.

The parameters consist of the following three groups:

- Terminal Installation Parameters
- Mode Installation Parameters
- Mode Operator Parameters

There is one set of terminal installation parameters, six sets of mode installation and operator parameters (see figure 4-1). The terminal installation parameters are viewed and changed by simultaneously pressing the CTRL and SETUP keys prior to operator mode selection. The mode installation parameters (figure 4-2) can then be viewed and changed by pressing F10 and the desired mode number. Parameters are changed in NVM by making change on screen and pressing COPY. The mode operator parameters are viewed and temporarily changed by pressing SETUP while in an active mode.




*ANY MODE CAN BE ASSIGNED TO ANY BLOCK, EXCEPT 1 IS RESERVED FOR RESIDENT CYBER MODE AND 2 IS RESERVED FOR PLATO MODE.

**DEFAULT NAMES

Figure 4-1. Parameters

CONVENTIONS:

1. LOWERCASE LABELS INDICATE A BRANCHING FUNCTION.

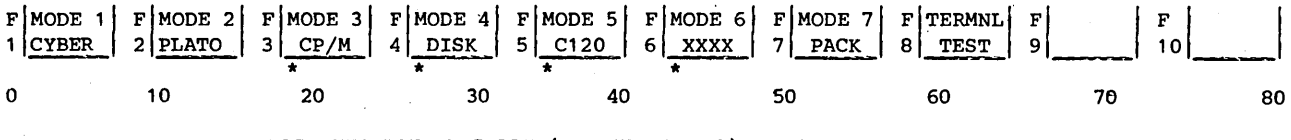
2. ALPHA CAPS LABELS INDICATE A DIRECT FUNCTION SELECTION.

3. "BOXES" ARE DISPLAYED IN INVERSE VIDEO.

4. F1 THROUGH F10 ARE SELECTED BY PRESSING (OPERATOR) FUNCTION KEYS F1 THROUGH F10.

5. AN * WILL APPEAR IN THE LOWER RIGHT CORNER OF THE BOX THAT IS THE AUTO SELECT MODE.

(*A CUSTOMER OR APPLICATION DEFINED 4 ALPHANUMERIC CHARACTER LABEL FOR MODES 3 THROUGH 6 AND OPERATOR DEFINED AT MODE INSTALLATION TIME. THE DEFAULT VALUES ARE SHOWN.)




LAST TWO ROWS DISPLAY (VIRTUAL LINES) AFTER POWER ON OR RESET

Figure 4-2. Mode Selection Menu

## TERMINAL INSTALLATION PARAMETERS

The terminal installation parameters are used in all modes. They can be viewed by simultaneously pressing the CTRL and SETUP keys prior to operator mode selection. To change any installation parameter, the cursor must be positioned under the item to be changed and COPY must be pressed prior to displaying different information. Only the following keys are operable for changing parameters.

- Space - Moves cursor to next changeable parameter. If cursor is under the last changeable parameter, it will wrap around and reposition again under the first changeable parameter.
- Backspace - Moves cursor back to next changeable parameter. If cursor is under the first changeable parameter, it will stop.
- 0 - 7 - Enters 0 or 7 at cursor if field requires an octal value.
- 0 - 1 - Enters 0 or 1 at cursor if field requires a binary value.
- 0 - 9, A - F - Enters 0 to 9 or A to F at cursor if field requires a hexadecimal value.
- COPY - Stores the current line of parameters displayed in NVM (non-volatile memory).
- F1 (Return) - Exits to terminate installation mode (Returns to mode selection menu).
- F2 - F9 - Moves cursor under first changeable parameter in the associated field.
- F10 - Goes to mode installation parameters.

The cursor advances to next changeable location after each data entry. Cursor movement is not limited to the selected function key group; a new function group may be selected as required. See figure 4-3 for terminal installation parameters.

| F | return | F | CONFIG | F | CONFIG | F | CONFIG | F | CONFIG | F | AS X Y | F | L ID | F | PORT A | F | PORT B | F | instl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 2 | 123456 | 3 | 123456 | 4 | 123456 | 5 | 123456 | 6 | O O H | 7 | O HHHH | 8 | H H | 9 | H H | 10 | mode n |

1-6 = BINARY
O = OCTAL
H = HEX

F2 CONFIGURATION (BINARY)

1 1 = SPARE
2 1 = TOUCHPANEL OPTION IN
3 1 = DUAL SERIAL INTERFACE OPTION IN
4 1 = GRAPHIC PRINTER OPTION IN
5 1 = FLEXIBLE DISK OPTION IN
6 1 = SPARE

F3 CONFIGURATION

1 1 = 1200/1200 INTERNAL MODEM OPTION IN
2 1 = A KEYCAP OPTION INSTALLED
3 1 = GRAPHIC OPTION IN
4 1 = PARALLEL PORT OPTION IN
5 1 = SPARE
6 1 = FIXED DISK OPTION IN

F4 CONFIGURATION (BINARY)

1 1 = AUTO SELECT ENABLED 0 = AUTO SELECT DISABLED
2 1 = USE PRINTER SRTS 0 = IGNORE PRINTER SRTS
3 1 = SPARE
4 1 = SPARE
5 1 = SPARE
6 1 = SPARE

F5 CONFIGURATION (BINARY)

1 1 = SPARE
2 1 = SPARE
3 1 = SPARE
4 1 = SPARE
5 1 = SPARE
6 1 = SPARE

F6 AS AUTO SELECT (MODE NUMBER) (OCTAL)

0 = CYBER MODE
1 = CYBER MODE
2 = PLATO MODE
3 = MODE 3
4 = MODE 4
5 = MODE 5
6 = MODE 6
7 = ROM PACK FUNCTION

F6 X DISPLAY DISPLACEMENT RIGHT/LEFT (OCTAL)

| | |
|---|---|
| 0 = NO DISPLACEMENT | 4 = NO DISPLACEMENT |
| 1 = RIGHT 1 CHARACTER | 5 = LEFT 1 CHARACTER |
| 2 = RIGHT 2 CHARACTER | 6 = LEFT 2 CHARACTER |
| 3 = RIGHT 3 CHARACTER | 7 = LEFT 3 CHARACTER |

F6 Y DISPLAY DISPLACEMENT UP/DOWN (HEXADECIMAL)

| | |
|---|---|
| 0 = NO DISPLACEMENT | 8 = NO DISPLACEMENT |
| 1 = UP 1 SCANS | 9 = DOWN 1 SCANS |
| 2 = UP 2 SCANS | A = DOWN 2 SCANS |
| 3 = UP 3 SCANS | B = DOWN 3 SCANS |
| 4 = UP 4 SCANS | C = DOWN 4 SCANS |
| 5 = UP 5 SCANS | D = DOWN 5 SCANS |
| 6 = UP 6 SCANS | E = DOWN 6 SCANS |
| 7 = UP 7 SCANS | F = DOWN 7 SCANS |

Figure 4-3. Terminal Installation Parameters

```
F7 L  LANGUAGE (OCTAL)

   0 = ENGLISH
   1 = ENGLISH
   2 = FRENCH
   3 = GERMAN
   4 = SWEDISH/FINNISH
   5 = BRITISH
   6 = SPANISH
   7 = DANISH/NORWEGIAN

F7 ID TERMINAL IDENTIFICATION

F8 PORT A (HEXADECIMAL)
   1ST VALUE
     B3 0 = PORT A PRINTER                1 = PORT A BI-DIRECTIONAL
     B2 0 = PORT A PARITY ENABLED         1 = PORT A PARITY DISABLE
     B1 0 = PORT A PARITY ODD/SPACE       1 = PORT A PARITY EVEN/MARK
     B0 0 = PORT A STOP BITS 1            1 = A STOP BITS 2

   2ND VALUE - BAUD RATE (HEXADECIMAL)
     0 = 75 BAUD          4 = 300          8 = 2400
     1 = 110              5 = 600          9 = 4800
     2 = 150              6 = 1200         A = 9600
     3 = 200              7 = 1800         B-F = 19.2K

F9 PORT B
   Same as PORT A

F10 INSTALLATION PARAMETERS FOR MODE n

   THE FOLLOWING MESSAGE WILL BE DISPLAYED

     ENTER MODE n |__|

     ENTER MODE NAME |____| (FOR MODES 3-6)
```

Figure 4-3. Terminal Installation Parameters (Contd)

The meaning of the displayed blocks is further described in the following paragraphs.

## F1 Return

Indicates that pressing the F1 key returns control to Mode Selection Menu.

## F2 CONFIG (Configuration)

Each parameter bit in this block must be set to 1 for each option present. If an option is not present or disabled, the corresponding bit must be set to 0.

## F3 CONFIG (Configuration)

Each parameter bit of the F3 block must be set to 1 for each option present or set to 0 if the option is not present or disabled.

## F4 CONFIG (Configuration)

The F4 parameters defines the following:

- F4-1 - AUTO SELECT ENABLE/DISABLE - If this bit is set to a 1, the mode selected in the Auto Select (AS) field (F6) will automatically load if Test 1 detected no errors. If this bit is set to 0, the Mode Selection Menu appears after Test 1 is run.

- F4-2 - USE/IGNORE PRINTER SRTS - If this bit is set to 1, a 200-millisecond delay will follow every carriage return and line feed sent to the serial printer when its Secondary Request To Send (STRS) line is in a marking or open condition. If this bit is set to 0, no delays will be used when sending data to a serial printer.

## F5 CONFIG (Configuration)

All bits in this parameter block are spare at this time.

## F6 AS, X or Y

The F6 parameters are:

- AS (AUTO SELECT) - This parameter allows the entry of a number between 0 and 7. The parameter value is used as the mode number if auto select enable is selected.

  0-1 - Executes CYBER mode.
  2-6 - Executes the appropriate mode.
  7 - Executes function in a ROM pack.

- X (Screen Move in X Direction) - As the CRT ages, the picture raster may drift. This parameter will allow the installer to move the raster left or right up to 3 characters in width. It is set to 0 when aligned at factory.

  To move the raster left or right see the following listing:

| | |
|---|---|
| 0 = No move | 4 = No move |
| 1 = Move right 1 character | 5 = Move left 1 character |
| 2 = Move right 2 characters | 6 = Move left 2 characters |
| 3 = Move right 3 characters | 7 = Move left 3 characters |

- Y-Screen Move in Y Direction - As the CRT ages, the picture raster may drift. This parameter will allow the installer to move the raster up or down, up to 7 scans. It is set to 0 when aligned at factory. To move the raster up or down see the following listing:

| | |
|---|---|
| 0 = No move | 8 = No move |
| 1 = Move up 1 scans | 9 = Move down 1 scans |
| 2 = Move up 2 scans | A = Move down 2 scans |
| 3 = Move up 3 scans | B = Move down 3 scans |
| 4 = Move up 4 scans | C = Move down 4 scans |
| 5 = Move up 5 scans | D = Move down 5 scans |
| 6 = Move up 6 scans | E = Move down 6 scans |
| 7 = Move up 7 scans | F = Move down 7 scans |

F7 L, ID

Allows selection of language characters and the terminal identification code.

- L - Language - This parameter allows the display of special foreign characters; only the numbers 0 through 7 are allowed. The unit must be reset after changing this parameter.

0 = Standard (USA)
1 = Standard (USA)
2 = French
3 = German
4 = Swedish/Finnish
5 = United Kingdom
6 = Spanish
7 = Danish/Norwegian

- ID - (Terminal Identification Code) - The ID code is broken up into 4 codes. Each code can be set between 0 and F. This code can be used as a physical or logical identifier (host defined). They will be sent to the host with the Model Report Request in CYBER mode.

F8 (PORT A)

This block establishes the data transmission parameters for port A of the dual asynchronous interface option..

- 1st Value - This is an encoded value to select different parameters for Port A.

- Bit 3 Printer/Bi-Directional - This parameter is used by the firmware to determine if an ASCII type printer is connected to the terminal. In order to connect an ASCII printer, the Dual Serial RS232/Serial Interface Option must be installed. This option has two serial I/O Ports, A and B. This parameter must be set to 1 if the printer is connected to Port A. Otherwise, it must be set to 0 for a bi-directional port, which is supported by the resident firmware.

NOTE

The firmware tests for a printer on Port A first. If both ports are sent for a printer, Port A will be used.

- Bit 2 (Parity Enabled/Disabled) - If this parameter is set to Parity Enable, even or odd parity is transmitted with each code and tested for on each code received. If this parameter is set to Parity Disabled, the parity checking logic is disabled and the terminal will transmit either a mark or space condition in the parity position of each code. Transmission of either mark or space parity is determined by the setting of the Port A Parity Odd/Even.

- Bit 1 (Parity Odd/Even) - This parameter interacts with Port A Parity Enabled/Disabled. If Channel A Parity Enabled is selected and:

  - This parameter is set to Parity Odd - The terminal will transmit and test for odd parity.

  - This parameter is set to Parity Even - The terminal will transmit and test for even party.

If Port A Parity Disabled is selected and:

  - This parameter is set to Parity Odd - The terminal will transmit a space in place of the parity bit.

  - This parameter is set to Parity Even - The terminal will transmit a mark in place of the parity bit.

- Bit 0 (1/2 Stop Bits) - If this parameter is set to 1 stop bit, only 1 stop bit is transmitted with each code. If this parameter is set to 2 stop bits, 2 stop bits are transmitted with each code. Received data may have one or two stop bits regardless of the parameter setting.

- 2nd Value (PORT A Baud Rate) - This parameter will be used to select the baud rate (send and receive) of PORT A. The value is encoded; 0 through F may be entered. (See figure 4-3).

F9 (PORT B)

This block establishes data transmission parameters for port B of the dual asynchronous interface option.

NOTE

The same descriptions apply, except substitute port B for port A.

- 1st Value - This is an encoded value to select different parameters for PORT B.
  - Bit 3 (Printer/Bidirectional) - Same as described for port A.
  - Bit 2 (Parity Enabled/Disabled) - Same as described for port A.
  - Bit 1 (Parity Odd/Even - Same as described for port A.
  - Bit 0 (1/2 Stop Bits - Same as described for port A.
- 2nd Value (PORT B Baud Rate) - Same as described for A baud rate.

F10 [Instl Mode n (Installation Mode n)]

Mode installation parameters are entered as follows.

When F10 is pressed the following message will be displayed on line 27:

ENTER MODE n (1-6) |__|

The number 1 through 6 must be entered. It will be displayed where the inverse box is, and the inverse will go to normal intensity. If any other key is pressed, the alarm will sound and the key is ignored.

If mode 3 through 6 are selected, the following message will be displayed on line 28:

ENTER MODE NAME |__|__|__|__|

The current mode name will be displayed in the inverse boxes. If no change is desired, the NEXT key can be pressed. A change can be made by entering the new codes. When all four codes are entered (or the NEXT key pressed) control will transfer to mode installation parameter entry

## MODE INSTALLATION PARAMETERS

There are six sets of mode installation parameters, one set for each mode the terminal is to operate in. Modes 1 through 5 have factory-assigned, default, mode installation parameters. These parameters automatically load into NVM when no parameters have been stored (further details are given later in this section under Default Parameters). The default parameters establish mode 3 as CP/M mode, mode 4 as disk mode, and mode 5 as C120 mode. If desired, the names for these mode numbers may be changed (previously covered in this section under F10 Instl Mode n) and new modes assigned by entering new mode installation parameters. The mode installation parameters for mode 1 (CYBER mode) and mode 2 (PLATO mode) may be changed as needed but not the names. Mode 6 is for a user assigned mode.

A set of mode installation parameters is shown in figure 4-4. To make a change, the cursor must be positioned under the item to be changed. The keys that are operable for mode parameter changes are the same as described earlier under Terminal Installation Parameters. To view the set of parameters for another mode, requires that the F1 key be pressed, then the CTRL and SETUP keys. This displays the message ENTER MODE n (1-6) |__|.

The meaning of the displayed blocks is further described in the following paragraphs.

### F1 Return

Return control to Mode Selection Menu.

### F2 CONFIG (Configuration)

- F2-1 Mode Disabled/Enabled - When this parameter is set to 0, the mode is disabled and will not be executed. All the other parameters in the block can be set to perform a given load. This could allow a supervisor to simply disable or enable a mode. When this parameter is set to 1, the mode is enabled and can be executed.

```
ENTER MODE n(1-6)1

F|return| F|CONFIG| F|CONFIG| F|CONFIG| F|CONFIG| F|OPR DF| F|A-DIAL| F|A-DIAL| F|DF T R| F|ACCESS|
1|      | 2|123456| 3|123456| 4|123456| 5|123456| 6| HHHH | 7|HHHHHH| 8|HHHHHH| 9|OH H H| 10| HHHH |

F2 CONFIGURATION (BINARY)

  1 0 = MODE DISABLED                    1 = MODE ENABLED
  2 0 = ACCESS DISABLED                  1 = ACCESS ENABLED
 *3 0 = USE DEFAULT SOURCE/FILE/         1 = OPERATOR SELECT SOURCE/FILE/PHONE NUMBER
       PHONE NUMBER
 *4 0 = RUN INTERNAL                     1 = LOAD EXTERNAL
 *5 0 = LOAD FROM HOST                   1 = LOAD FROM FLEXIBLE DISK
  6 0 = RESIDENT HOST INTERFACE          1 = 1200/1200 INTERNAL MODEM INTERFACE

F3 CONFIGURATION (BINARY)

  1 0 = SPARE                            1 = SPARE
  2 0 = AUTO DIAL DISABLED               1 = AUTO DIAL ENABLED
  3 0 = HOST 7 BITS (DATA)               1 = HOST 8 BITS (DATA)
  4 0 = HOST PARITY DISABLE              1 = HOST PARITY ENABLE
  5 0 = HOST PARITY ODD                  1 = HOST PARITY EVEN
  6 0 = HOST 1 STOP BIT                  1 = HOST 2 STOP BITS

F4 CONFIGURATION (BINARY)

  1 0 = DTR CONSTANT                     1 - DTR SWITCHED
  2 0 = RTS CONSTANT                     1 - RTS SWITCHED
  3 0 = TYPAMATIC ON                     1 = TYPAMATIC OFF
  4 0 = DATA ONLY OFF                    1 = DATA ONLY ON
  5 0 = HOME UPPER LEFT                  1 = HOME LOWER LEFT
  6 0 = AUTO LF OFF                      1 = AUTO LF ON

F5 CONFIGURATION (BINARY)

  1 0 = PACING DISABLED                  1 = PACING ENABLED
  2 0 = BIAS DISABLED                    1 = BIAS ENABLED
  3 0 = SPARE
  4 0 = SPARE
  5 0 = SPARE
  6 0 = CYBER MODE                       1 = LOAD FROM ROM PACK

F6 OPERATOR DEFAULT PARAMETERS (HEXADECIMAL)

  1ST VALUE

    B0 0 = ONLINE                        1 = LOCAL
    B1 0 - PRINTER DESELECTED            1 = PRINTER SELECTED
    B2 0 = MARGIN ALERT OFF              1 = MARGIN ALERT ON
    B3 0 = ALERT SOFT                    1 = ALERT LOUD

  2ND VALUE (HEXADECIMAL)

    B0 0 = ALPHA LOCK                    1 = SHIFT LOCK
    B1 0 = NUMERIC PAD NORMAL            1 = NUMERIC PAD SHIFT
    B2 0 = PAGE SCREEN                   1 = ROLL SCREEN
    B3 0 = ADV. / SMALL CYBER            1 = NATIVE / LARGE CYBER
```

Figure 4-4. Mode Installation Parameters

```
3RD VALUE (HEXADECIMAL)

   B0 0 = BACKGROUND DARK              1 = BACKGROUND LIGHT
   B1 0 = CURSOR LINE                  1 = CURSOR BOX
   B2 0 = CURSOR BLINK                 1 = CURSOR SOLID ON
   B3 0 = NOT USABLE                   1 = NOT USABLE


4TH VALUE (HEXADECIMAL)

   B0 0 = HALF DUPLEX                  1 = FULL DUPLEX
   B1 0 = 80 CHARACTERS/LINE           1 = 132 CHARACTERS/LINE
   B2 0 = 24 LINES                     1 = 30 LINES
   B3 0 = TRANSPARENT OFF              1 = TRANSPARENT ON


F7 A-DIAL AUTO DIAL NUMBER PART 1 (HEXADECIMAL)

F8 A-DIAL AUTO DIAL NUMBER PART 2 (HEXADECIMAL)

F9
  DF DEFAULT FILE NUMBER (HEXADECIMAL)

  T TRANSMIT BAUD RATE (HEXADECIMAL)

  0 =  75          4 = 300          8 = 2400         C = 19.2K
  1 = 110          5   600          9 = 4800         D = 19.2K
  2 = 150          6  1200          A = 9600         E = 19.2K
  3 = 200          7  1800          B = 19.2 K       F = 19.2K

  R RECEIVE BAUD RATE

  SAME AS TRANSMIT BAUD RATE

F10 ACCESS CODE HEXADECIMAL

*THESE PARAMETERS ARE IGNORED IN CYBER MODE.
```

Figure 4-4. Mode Installation Parameters (Contd)

- F2-2 Access Off/On - If this parameter is set to 1 (Access On), the operator will be required to enter the proper access code before the mode is loaded. If this parameter is set to 0 (Access Off), the load will commence immediately after mode selection.

- F2-3 Load Default/Operator Selected Source/File/Phone Number - If the host load has been selected and this parameter is set to 0, the default source and file parameters will be used to select the load source and file. If the parameter is set to 1, the operator will be allowed to select the source and phone number (phone number is to be used with 1200/1200 auto dial modem).

- F2-4 RUN Internal/Load External - This parameter must be set to 0 to execute CYBER mode or a mode from ROM pack. This parameter must be set to 1 to load a mode from host or disk.

- F2-5 Load From Host/Disk - This parameter works in conjunction with the Run Internal/Load External parameter. If the Load External (1) is selected and this parameter is set to 0, a load from host will be initiated. If this parameter is set to 1, a load from disk is initiated.

- F2-6 Use Resident Host/Internal Modem Interface - This parameter works in conjunction with LOAD FROM HOST/DISK. If LOAD FROM HOST is selected and this parameter is set to 0, the Resident Host interface is used. If this parameter is set to 1, the internal 1200/1200 modem is used.

F3 CONFIG (Configuration)

- F3-1 Spare -

- F3-2 Auto Dial Off/On - This parameter is not used by the resident firmware; only the intent is described here. If the host load has been selected, the internal modem option is installed, and this parameter is a 1, the auto dial number will be used. If this parameter is a 0, the operator will be requested to make an external phone connection.

- F3-3 Host 7/8 Bits, F3-4 Host Parity Enabled/Disabled, F3-5 Host Parity Odd/Even, and F3-6 Host 1/2 Stop Bits - These four parameters work together to select the proper word format to the host. If 8 bits are selected, 8 data bits are sent. The parity bit is dependent upon Parity Enabled/ Disabled and Parity Odd/Even. If 7 bits are selected, only 7 data bits are sent.

  If 8 bits are selected and parity is disabled, the Even/Odd parameter is used to select a mark or space in place of the parity bit 8th bit.

  The following example is to aid in selecting the proper word format:

| | 7/8 | Enabled/ Disabled | Odd/ Even | Stop 1/2 |
|---|---|---|---|---|
| 8 data bits with parity | 1 | 1 | X | X |
| 7 data bits with odd parity | 0 | 1 | 0 | X |
| 7 data bits with even parity | 0 | 1 | 1 | X |
| 7 data bits with space parity (bit 8) | 1 | 0 | 0 | X |
| 7 data bits with mark parity (bit 8) | 1 | 0 | 1 | X |
| 7 data bits with no parity | 0 | 0 | X | X |
| Where X can be either 0 or 1. | 0=7<br>1=8 | 0=DIS<br>1=ENA | 0=ODD<br>1=EVEN | 0=1 STOP BIT<br>1=2 STOP BITS |

- F4-1 DTR Constant/Switched - If this parameter is set to 0 (DTR Constant), the DTR (Data Terminal Ready) signal on the host connector will be held on at all times. If this parameter is set to 1 (DTR Switched), the DTR signal on the host connector will be switched off if the mode is in local operation. DTR is maintained in the on condition at all other times. Received data is ignored if DTR is off.

- F4-2 RTS Constant/Switched - If this parameter is set to 0 (RTS Constant), the RTS (Request to Send) signal will be on whenever DSR and DTR are on. If this parameter is set to 1 (RTS Switched), the RTS signal will operate as follows if DSR and DTR are on, and Data Only Off:

  - Half Duplex - RTS is on with the first keystroke and is switched off a minimum of 1 millisecond, maximum of 16 milliseconds following transmission of a CR, LF, ACK, or LF. RTS will be placed to off if a break is received, or local operation is selected. Automatic responses to the host will cause RTS to be on for the duration of the response and switched off 1 to 16 milliseconds following the last word transmitted.

  - Full Duplex - RTS is on until local operation is selected.

- F4-3 TYPAMATIC On/Off - If TYPAMATIC is on, the keys shown in table 4-1 will repeat at a rate of 15 $\pm$3 characters per second if held down longer than 1 second. If TYPAMATIC is off, no keys will repeat when held down.

- F4-4 Data Only Off/On - If this parameter is set to 0 (Data Only Off), the terminal honors the DSR and DTR when sending and CO when receiving. If this parameter is set to 1 (Data Only On), the terminal will disregard the RS-232-C modem control signals. Data is transmitted without regard to the presence of DSR or CTS. Received data is acted upon without regard to CO or DSR. DTR operates normally.

- F4-5 Home Upper/Lower Left - If this parameter is set to 0, the home position for the cursor will be at the upper-left corner of the screen. If this parameter is set to 1, the home position for the cursor will be at the lower left corner. In CYBER mode, Upper-Left selection is applicable if compatibility with a CDC 722-10 (CC628) TTY Display Terminal is desired.

- F4-6 Auto LF Off/On - This parameter may be ignored in some modes. In the resident CYBER mode it is operational. If this parameter is set to a 0 (Auto LF Off), it is intended that a carriage return operation position the cursor to the beginning of the current line. If this parameter is set to a 1 (Auto LF On), it is intended that a line feed operation in addition to a carriage return operation be performed upon actuation of the CR key or receipt of the carriage return code.

F5 CONFIG (Configuration)

- F5-1 Pacing Disabled/Enabled - When this parameter is set to 1, the rate of data being sent to the host will be limited to one code every 8 milliseconds regardless of the baud rate. This gives an effective throughput of 1200 baud. If the parameter is set to 0, no limiting is performed.
- F5-2 Code Bias Off/On - This parameter may be ignored in some modes. In the resident CYBER mode it is operational. If this parameter is set to a 0 (Code Bias Off, no bias is added to the cursor address when sending or receiving X/Y positioning information or set-scroll field information. If this parameter is set to a 1 (Code Bias On), a bias of 20 hex is added to the cursor address when sending or receiving X/Y positioning information or set-scroll field information.
- F5-3 Spare
- F5-4 Spare
- F5-5 Spare
- F5-6 CYBER MODE/ROM PACK - If the Run Internal parameter is selected in F2, this parameter will be tested to determine if control is passed to CYBER mode or to the ROM pack.

F6 OPR DF (Operator Default)

All of the Mode Operator Parameter default values are encoded in hex digits. They are the initial operator parameters when a mode is selected. The initial value is moved from NVM into an active RAM table to allow temporary changes by the operator or host.

- F6 1st Digit

  - Bit 0 Online/Local - This parameter may be ignored in some modes. In the resident advanced mode it determines the initial state. If this parameter is set to 1 (Local), the transmit portion of the terminal is disabled and data originating at the keyboard is displayed. Modem interface circuits are also affected. If this parameter is set to 0 (Online), data originating at the keyboard is transmitted in character mode and block mode transmission is enabled. It is possible to receive data while in local mode if Constant DTR is selected.

  - Bit 1 Printer Off/On - This parameter may be ignored in some modes. In the resident CYBER mode it is operational. If this parameter is set to 1 (Printer On), the initial condition will have the printer interface active. The host can also change the active value. If this parameter is set to 0 (Printer Off), the initial condition will have the printer interface disabled. When the printer is enabled, all data sent or received in character mode will be printed while it is being displayed.

  - Bit 2 Margin Alert Off/On - This parameter may be ignored by some modes. In the resident CYBER mode, it is operational. If this parameter is set to 1 (Margin Alert On), the audible alarm will sound whenever the cursor is advanced into the eighth position from the end of a line during keyboard entry. The audible alarm will also sound when the cursor is moved into the last line from the previous line during keyboard entry. If this parameter is set to 0 (Margin Alert Off), the audible alarm will not sound due to cursor movement from the keyboard.

  - Bit 3 Alert Soft/Loud - This parameter may be ignored in some modes. In the resident CYBER mode, it is operational. If this parameter is set to 0 (Alert Loud), the audible alarm will be at a louder level. If this parameter is set to 1 (Alert Soft), the audible alarm will be at a lower level.

- F6 2nd Digit

  - Bit 0 Shift/Alpha Lock - When this parameter is set to 1, the lock key will be a shift lock (all keys used as shifted). If the parameter is set to 0, the lock key will lock only alphabetical keys.

- Bit 1 Numeric Pad - When this parameter is set to 0 (normal), the 13-key numeric pad group on right side of keyboard operates in both lowercase and uppercase. When the parameter is set to 1 (shift), the 13-key numeric pad group operates in uppercase only.

- Bit 2 Roll/Page Screen - This parameter may be ignored in some modes. In the resident CYBER mode, it is operational. If this parameter is set to 1 (Roll Screen), the scroll feature is enabled; the field scroll feature is unaffected. It is recommended to set this parameter to Roll Screen to be compatible with the CC628 TTY Display Terminal. The host has the capability to switch the active value. If this parameter is set to 0 (Page Screen), the initial value will disable the scroll feature.

- Bit 3 Advanced/Native Operation - This parameter will determine which code is sent as keys are pressed and reaction to received codes (see table 4-1).

- F6 3rd Digit

  - Bit 0 Background Dark/Light - This parameter may be ignored in some modes. In the resident CYBER mode, it is operational. If this parameter is set to 0 (Background Dark), characters will be displayed as light characters on a dark background. If this parameter is set to 1 (Background Light), characters will be displayed as dark characters on a light background (inverse video).

  - Bit 1 Cursor Line/Block - This parameter may be ignored in some modes. In the resident CYBER mode, it is operational. If this parameter is set to 0 (Cursor Line), the cursor will appear as an underline. It may be blinking or solid depending upon the next parameter. If this parameter is set to 1 (Cursor Block), the cursor will appear as a solid box. It may be blinking or solid depending upon the next parameter.

  - Bit 2 Cursor Blink/Solid On - This parameter may be ignored by some modes. In the resident CYBER mode, it is operational. If this parameter is set to 0 (Cursor Blink), the cursor will blink. If this parameter is set to 1 (Cursor Solid On), the cursor will be always on.

  - Bit 3 Not Used

- F6 4th Digit

  - Bit 0 - Half/Full Duplex - This parameter may be ignored in some modes. In the resident CYBER mode, a 0 selects Half Duplex and a 1 selects Full Duplex. In half-duplex operation, data is displayed, printed (if enabled), and sent to the host as it is typed. In full-duplex operation, data is only sent to the host as it is typed. In either operation, data will be displayed and printed (if enabled) as data is received from the host. This parameter is ignored if the terminal is in local or block mode operations.

  - Bit 1 80/132 Characters/Line - Not all modes use this parameter. The resident CYBER mode does, however, and if this parameter is set to 0 (80 Characters/Line), 80 characters will be the maximum number per line. If this parameter is set to 1 (132 Characters/line), 132 characters will be the maximum number per line.

  - Bit 2 24/30 Lines - Some modes ignore this parameter. In resident CYBER mode, however, setting this parameter to 0 (24 Lines) enables a display maximum of 24 lines, and setting this parameter to 1 (30 Lines) enables a display maximum of 30 lines.

  - Bit 3 Transparent - This parameter may be ignored by some modes. In the resident CYBER mode, it is operational. If this parameter is set to 1 (transparent on), all control codes received and entered on the keyboard will be displayed and not acted upon. When set to 0 (off), control functions will be performed.

- F7 A-DIAL Auto Dial number part 1.

- F8 A-DIAL Auto Dial number part 2. - The F7 and F8 fields can hold up to 12 characters (0 through $F_{16}$; where 0 to 9 are numerics, A is not used, B is the * symbol, C the # symbol, D the - symbol, E the / symbol, and F terminates an entry not filling the entire 12-digit area). These fields are used if: 1) the internal modem is available for host communications, 2)the default values for source/file/phone number are selected, and 3) the auto-dial function is selected.

- F9 - DF - Default File Number - This parameter may be used when requesting a downline load (see the Load File Selection section, for when it is used).

- T - Host Transmit Baud Rate - This parameter will be used to select the transmit rate for terminal-to-host communications. It can be set to any value from 0 to F hex, to select transmit rates from 75 to 19.2K b/s (see figure 4-4). If the internal 1200/1200 b/s modem is being used for communications with the host, set this value to 6.

- R - Host Receive Baud Rate - This parameter is used to select the receive rate for terminal-to-host communications. It can be set to any value from 0 to F hex, to select receive rates from 75 to 19.2K b/s (see figure 4-4). If the internal 1200/1200 b/s modem is being used for communications with the host, set this value to 6.

NOTE

The Transmit and Receive baud rate may be set to different rates when selected here. If the operator changes the rate in Operator Parameter Entry mode, the Transmit and Receive rates will be forced to the same rate.

- F10 ACCESS - Access Code - This parameter is used if the Access On parameter is selected. It contains four hexadecimal digits. The operator is required to type in the same four digits before the mode is entered. If the Access Disabled parameter is selected, this parameter is ignored.

MODE OPERATOR PARAMETERS

Operator parameters are mode dependent. The initial state of each operator parameter is set in the mode installation parameters. The operator parameters are moved into an active RAM section and can only be changed temporarily by the operator. The operator cannot change the NVM values.

To change the operator parameters, the SETUP key must be pressed while in an operating mode. Eight parameters will be written on the bottom line. To change any parameter, the operator must press the Function key number that precedes the block. The alternate state will then be displayed. If there are more parameters, F10 will indicate MORE SELECT. Pressing F10 key will display eight new parameters. If there are no more parameters, F10 will say MODE SELECT. Pressing F1 at any time will exit the operation.

If the operator does not change the 80/132 Characters/Line parameter or 24/30 lines parameter, displayed data is not lost. If either parameters are changed, the screen will clear and cursor will return to home.

CYBER mode will interface to a host using the RS-232 interface and to an operator using the keyboard or touchpanel.

If an unallowable key is pressed, the alarm will sound. The only keys operational in this mode are:

- F1 (Return) - Returns to original operating mode.
- F2 to F9 - Except for the printer and baud rate parameters described below, alternates the selected parameters.
- F10 (More Select) - When first set of parameters are on screen, displays second set of parameters.

  (Mode Select) - When second set of parameters are on screen, displays the mode selection menu.

See figure 4-5 for CYBER Mode Operator Parameters.

## Printer

When the first line of CYBER Mode Operator Parameters is being displayed, block F3 shows the printer selection. If both ports on the dual serial interface option are set to bidirectional operation (no printer assigned), the printer parameter field will remain blank and no changes can be made to it.

## Baud Rate

The F5 field in the second line of Operator Parameters shows the selected transmit/receive rate for host communications in bits per second (b/s). Available rates range from 75 to 19.2 K b/s. Toggling the F5 function key on the terminal keyboard steps through each of the available rates, and stepping through the highest rate (19.2) wraps around to the slowest (75) selection. If the internal 1200/1200 b/s modem is being used in the terminal, this parameter field must be set to 1200 (in terminals using the modem, this value is normally set to default to 1200).

## DEFAULT PARAMETERS

If the terminal is ever turned off and the battery removed, default parameters will be forced into NVM. The default values are as follows:

| F 1 | return | F 2 | LINE (OFF) (ON) | F 3 | PRINTR (OFF) (ON) (BLANK) | F 4 | MARGIN (OFF) (ON) | F 5 | ALERT (SOFT) (LOUD) | F 6 | LOCK (ALPHA) (SHIFT) | F 7 | N PAD NORMAL SHIFT | F 8 | SCREEN (ROLL) (PAGE) | F 9 | CYBER (SMALL) (LARGE) | F 10 | MORE SELECT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

0 10 20 30 40 50 60 70 80

SETUP #1

1. OPERATOR SELECTED AFTER MODE ACTIVE BY PRESSING SETUP KEY.

2. F(N) KEY SELECTION ACTIVATES ALTERNATE SPECIFIED FUNCTION.

| F 1 | return | F 2 | BACKGD (DARK) (LIGHT) | F 3 | CURSOR (LINE) (BLOCK) | F 4 | CURSOR (BLINK) (SOLID) | F 5 | BAUD (75-19.2) | F 6 | DUPLEX HALF (FULL) | F 7 | CH/LN (80) (132) | F 8 | LINES (24) (30) | F 9 | XPARNT (OFF) (ON) | F 10 | mode select |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

0 10 20 30 40 50 60 70 80
Character Position

SETUP #2

1. OPERATOR SELECTED VIA F10 = more select IN SETUP #1.

2. F(N) KEY SELECTION ACTIVATES ALTERNATE SPECIFIED FUNCTION.

Figure 4-5. CYBER Mode Operator Parameters

## Default Terminal-Installation Parameters

| Block | 721-20 (CC634-A) Terminals | 721-30 (CC638-A) Terminals |
|---|---|---|
| F2 | 000000 | 010000 |
| F3 | 000000 | 001000 |
| F4 | 000000 | 000000 |
| F5 | 000000 | 000000 |
| F6 | 0 0 0 | 0 0 0 |
| F7 | 0 0000 | 0 0000 |
| F8 | 0 6 | 0 6 |
| F9 | A 6 | A 6 |

## Default Mode-Installation Parameters for Available Modes

| Block | CYBER | PLATO | CP/M | Disk | C120 |
|---|---|---|---|---|---|
| F2 | 100000 | 100100 | 100110 | 100110 | 100000 |
| F3 | 000110 | 000110 | 000100 | 000110 | 001010 |
| F4 | 000000 | 000001 | 000000 | 000001 | 000000 |
| F5 | 010000 | 000000 | 000000 | 000000 | 000000 |
| F6 | 4C04 | 6C24 | 6C25 | 6C24 | 4421 |
| F7 | 000000 | 000000 | 000000 | 000000 | 000000 |
| F8 | 000000 | 000000 | 000000 | 000000 | 000000 |
| F9 | 00 6 6 | 08 6 6 | 00 6 6 | 00 6 6 | 00 9 9 |
| F10 | 0000 | 0000 | 0000 | 0000 | 0000 |

## LOAD SOURCE SELECTION

If the operator selects a mode 2 through 6 and has met the security requirement, or the host selects a mode change, the resident firmware must determine which load source is to be used. This is accomplished through the preset mode installation parameters.

This feature allows automatic selection of the load source. Either of the following load sources can be selected if present:

- Resident Host
- Optional ROM Pack

Automatic selection of the load source is determined by the following mode installation parameters:

- Use-Default/Operator-Select Source/File/Phone Number
- Run Internal/Load External
- Load From Host/Load from Disk*
- Resident Host/1200/1200 Internal Modem
- CYBER Mode/ROM Pack

## INTERFACES

Activity is generated to select the load source if:

- The auto select enable parameter is a 1 and auto select number is 2-6.
- If F2-F6 keys (modes 2 through 6) are pressed while displaying the mode selection menu.

---

*Loading from a disk is not supported in the 721 usage of the terminal.

The USE-DEFAULT/OPERATOR-SELECT parameter will be tested first.

- If USE-DEFAULT SOURCE/FILE is selected, the parameters RUN INTERNAL/LOAD EXTERNAL, CYBER MODE/ROM PACK, and LOAD FROM HOST/LOAD FROM DISK are checked.

- If OPERATOR-SELECT SOURCE/FILE/PHONE NUMBER is selected, the following prompt is displayed:

  SELECT LOAD SOURCE > DISK HOST ROM

  Selection of the source is done from the keyboard by pressing H or R. Pressing the NEXT key results in automatic selection of the default load source specified in the installation parameters.

NOTE

The mode installation parameters must be preset to the desired load source.

If ROM pack is selected as the load source, the ROM pack load is performed (refer to ROM Pack Loader later in this section).

If Load External is selected, the firmware then checks the Load From Host/Disk parameter.* If Load From Host is selected, the firmware checks if communications are to be via the resident host interface or the 1200/1200 internal modem.

## ABORTS AND RECOVERY

If an operator error is made during the number entry, the ERASE key will clear all entries.

## PERFORMANCE

The time required to make entries is operator-dependent.

---

*Loading from a disk is not supported in the 721 usage of the terminal.

ERRORS

If an internal modem is not present but is erroneously specified in the parameters for host communications, the error message FAILURE LOADING MODE appears on the terminal display screen along with the mode selection menu. Other messages than this appear if the modem is present and not able to communicate with the host. For more detail on messages associated with operation of the internal modem, refer to Appendix E of this manual.

INSTALLATION PARAMETERS

Refer to description under Mode Installation Parameters heading.

LOAD FILE SELECTION

When the communications host has been selected, this feature allows selection of a controlware load file to be loaded into the terminal. This can be done either automatically or manually. One default value can be used in the mode installation parameters or one of 64 different files may be selected manually.

NOTE

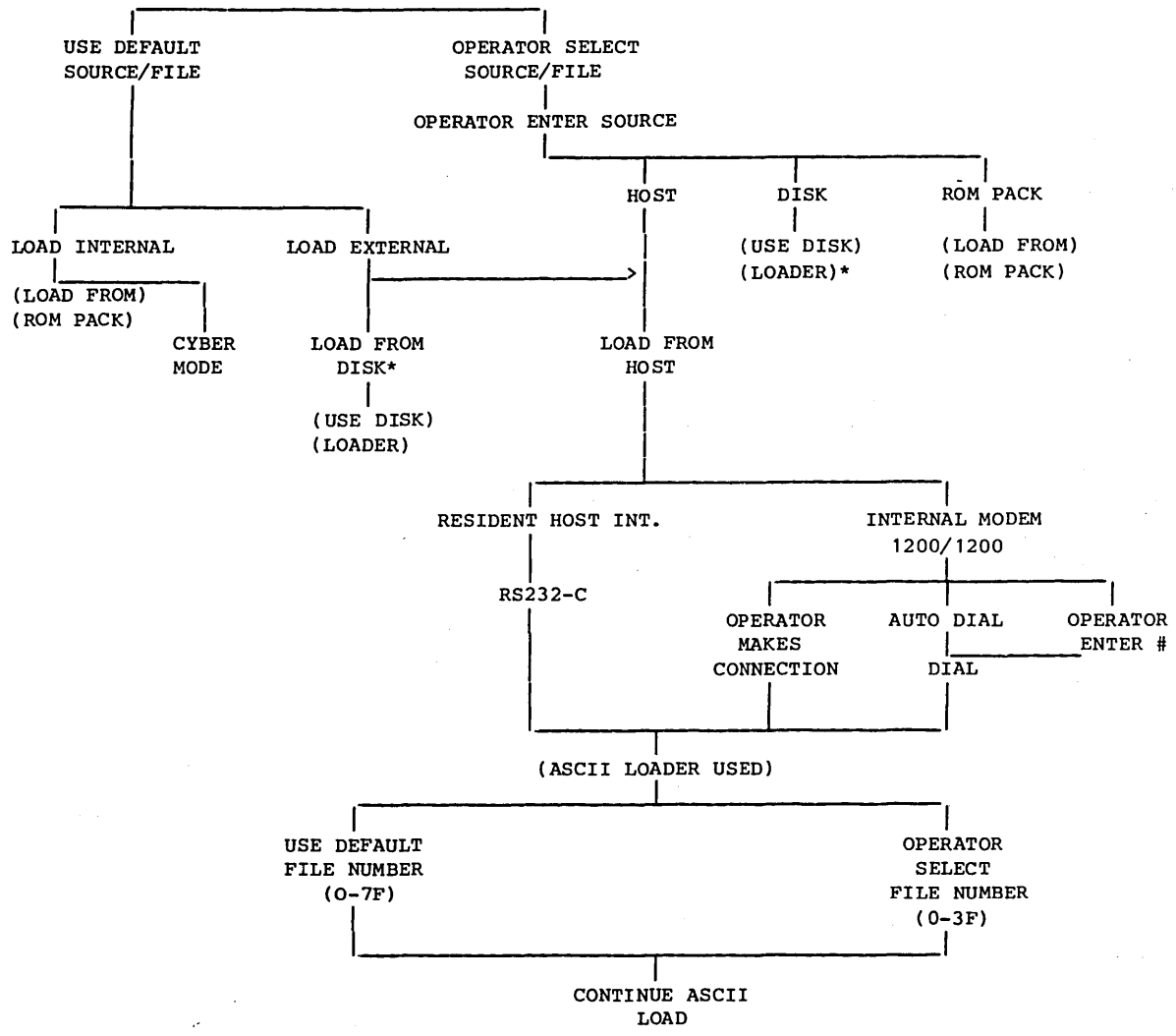
A suggested scheme for setting up Load File Parameters is shown in figure 4-6.

INTERFACES

Automatic selection of a load file is done if the use Default Source/File/Phone Number parameter is selected in the mode installation parameters. Manual selection is done if the operator selected parameter is selected. The terminal requests the load file selection with the following prompt:

SELECT LOAD FILE_

The operator then selects the desired load file by using the keyboard. Entry is done by entering one or two hexadecimal digits followed by pressing the NEXT key. The file number entered must be less than 40 hexadecimal. If an error is made during entry, the ERASE key may be pressed to start over. Other keyboard keys are ignored.




*LOADING FROM A DISK IS NOT SUPPORTED IN THE 721 USAGE OF THE TERMINAL.

Figure 4-6. Load Source/File Selection

If the file number entered is 40 hexadecimal or more, the program will force entry to start over; the same as if ERASE had been pressed.

If the NEXT key is pressed before any other entry is made, the program will select the automatic default file; the same as if the Load Default File parameter were selected.

### ABORTS AND RECOVERY

If an operator error is made during a number entry, the ERASE key will clear all entries.

### PERFORMANCE

The time required to make entries is operator-dependent.

## ASCII NETWORK LOADER

The ASCII network loader allows the terminal to load a selected controlware program from an ASCII communications network that supports the protocol described in the following paragraphs.

### DESCRIPTION

The ASCII communications loader loads a selected controlware file into the RAM of the terminal. Once the load file is selected, the load process proceeds automatically until control is transferred to the loaded controlware or until an unrecoverable error situation occurs. Both the local host interface (data-set connector at rear of terminal) and the internal 1200/1200 b/s modem use the ASCII communications loader to load information from the host computer. This section describes the communications protocol for loading the terminal from the ASCII communications network.

The protocol contains the following features:

- All data transmitted to the terminal from the network is in blocks and a cyclic redundancy check is associated with each block (transmit and receive data is automatically switched to 8 bits of data and no parity).
- The load process generates a memory checksum of the loaded controlware. It is intended that the loaded controlware have a routine that utilizes this checksum for checking the integrity of the loaded controlware during operation.
- The RESET switch can be used to exit from operation on the ASCII network if other techniques are ineffective.
- Automatic error recovery during loading is limited to three attempts. After three unsuccessful load attempts, the terminal aborts the load.
- Partial loading of selected blocks is not supported. A checksum error or an aborted load requires a full reload.
- The maximum number of production load files is 64. Block lengths are variable with a maximum number of 240 data characters per block. The maximum number of host blocks in a file is 65536.
- The first block is loaded starting at a host-defined memory address and all succeeding blocks are loaded contiguously after this block. No auxiliary block loading table is used. The host is restricted from using hexadecimal addresses 0000 through 3FFF and D870 through FFFF.
- If no carrier is detected within 3 seconds after mode selection, the message HOST NOT CONNECTED appears on the display screen. No carrier detection after 40 seconds (time for manual phone number entry) causes HOST LOAD FAILURE and FAILURE LOADING MODE messages to appear along with the redisplay of the mode-selection menu.

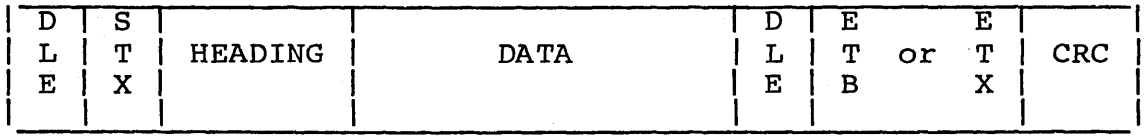
## AUTOLOAD MESSAGE FORMATS

The following message formats are utilized by the host communications line autoload routine (currently supported on the DSN). Unless otherwise specified, communications characters are those in the ASCII character set with even parity.

- Load Block
- Load Request
- NAK Sequence
- Load Complete

## Load Block

Each Load Block received from the host (CDSN-compatible) is formatted as follows:




The heading is formatted as follows:


Each block begins with a DLE STX character sequence and ends with either a DLE ETB or DLE ETX character sequence followed by a block cyclic redundancy check. The DLE ETB sequence is used on all blocks except for the last one. In this case, a DLE ETX sequence is used, signifying to the terminal that this is the last block of the load. The CRC is a 2-character, 16-bit cyclic redundancy check; that is, the remainder after polynomial division modulo two. The polynomial divisor is $X^{16}+X^{15}+X^{2}+1$. The end of the block occurs immediately after the CRC characters. The division is performed on all characters except the initial DLE STX sequence and the first DLE of any DLE DLE sequence in the block.

The heading and data parts of the block can be comprised of any 8-bit character sequences. If any character happens to be a DLE, it is prefixed by another DLE.

SEQ1 SEQ2 is a 2-character, 16-bit binary number which uniquely identifies each load block being transmitted. SEQ1 SEQ2 = 0 for the first load block and is incremented by one for each subsequent load block initially transmitted.

LDN is a single 8-bit character which uniquely identifies the particular load file. The load file can be selected by the operator if desired.

A1 A2 A3 is a three-character, 24-bit binary number which identifies the absolute starting address of the load data in the present block. The address sequence must be in sequential ascending order with all load data being loaded contiguously in memory. Only the lower 16 bits are used.

The data portion of the block may be variable in length from 1 to 240 8-bit load-data characters.

## Load Request

The down-line load operation from the host is initiated by the terminal sending the following character sequence, termed a Load Request.


The sequence begins with an upper case ASCII L and ends with an ASCII CR. The N1 N2 sequence is an ASCII representation of the desired load file. Each N is a hexadecimal number represented by the corresponding ASCII character (upper case for the numbers A through F). N1 N2 corresponds to the LDN binary number in the resulting load blocks. All four ASCII characters have even parity.

## NAK Sequence

If the terminal detects an error during the load process that can be corrected by retransmitting the load block, it sends a 5-character NAK Sequence indicating the block to be retransmitted.


The NAK is the corresponding ASCII NAK character. SEQ1 SEQ2 is a 2-character sequence identifying the load block from which point retransmission is to occur. This sequence corresponds to the SEQ1 SEQ2 16-bit binary number in the load block where the error occurred. (SEQ1) (SEQ2) is a one's complement of SEQ1 SEQ2 and is used for error detection.

The use of NAK does not alter the sequence of alternating acknowledgements. The same positive reply (ACK 0 or ACK 1) is used for successful retransmission as would have been used if the previous transmission of the unaccepted block had been successful.

## Load Complete

Upon successful receipt of the last load block, the terminal sends the following Load Complete message to the CDSN.

| | |
|---|---|
| D | E |
| L | O |
| E | T |

The characters are the corresponding ASCII characters with even parity.

## AUTOLOAD SEQUENCE

After the host autoload routine is initiated, the following sequence occurs:

1. The terminal transmits a Load Request upon detection of the network sign-on message (ASCII "/"). If the default file is not selected, the terminal waits for the operator to select the desired load file from the keyboard before transmitting the load request. The message LOADING FILE MM is also displayed to indicate that file number MM is the selected load file.

2. The network must then send Load Blocks to the terminal. As it receives the load blocks, the terminal checks for valid SEQ1 and SEQ2 characters. If they are too large, a NAK sequence is sent and the terminal waits for successful retransmission of the desired block. If they are too small, the terminal ignores the block. The terminal also checks the LDN and A1 A2 A3 characters to see if they match the values expected by the terminal. If not, the terminal sends a NAK sequence and awaits retransmission of the block. After the header has been verified, the terminal stores data characters at sequentially-increasing RAM addresses. When the end of the block is encountered, the received CRC characters are compared to the CRC calculated by the terminal on the received data. If they do not agree, the terminal sends a NAK sequence to request retransmission of the load block.

3. If the two CRC values agree, the block has been received successfully. If this was not the last load block for CDSN operation, the terminal then updates the expected values for the header and awaits receipt of the next block (no positive acknowledgement is sent). If this was the last load block, the terminal sends a Load Complete message signaling a positive acknowledgement of completing the load process.

4. The network then returns to its sign-on phase and awaits operator action. The loader, upon detection of the sign-on phase, turns control over to the loaded controlware.

5. During the load process, the loader program calculates an 8-bit arithmetic-sum checksum of the loaded RAM controlware and saves it for use by the memory checksum routine.

While each block is being loaded the message LOADING FILE MM BLOCK NN is displayed to indicate that block number NN of load file MM is being loaded.

During the load, various timeout conditions can occur. When this happens, the ERROR light is turned on and error recovery is attempted.

If no response to a NAK sequence has been received, the NAK sequence is resent. After three tries without success, the load is aborted with a load-failure message being displayed.

If no response to a load request has been received, the load request is retried up to three times. If there is still no success, the load is aborted with a load-failure message being displayed.

If the network does not return to the sign-on phase after the load-complete message has been sent, the load-complete message is resent. After three retries without success, the load is aborted with a load-failure message.

## INTERFACES

The operator interface consists of a series of displays on the CRT screen indicating progress of the load operation. The load process is automatic and does not require any operator interaction.

The message LOADING FILE MM is displayed whenever the terminal sends a load request to the network, indicating that a load of controlware file number MM has been initiated.

The message LOADING FILE MM BLOCK NN is displayed to indicate that block NN of controlware load file MM is being loaded. Error messages are listed below in the Errors paragraph.

At the end of a completed ASCII load, the following common variables are present:

LINFO is set to X1 (ASCII loader used)

## ABORTS AND RECOVERY

If the load is unsuccessful due to checksum errors, or no response from the network for 30 seconds, or loss of carrier on the selected RS-232-C communications interface, the ASCII loader displays a HOST LOAD FAIL, FAILURE LOADING MODE message and then returns to the mode selection routine.

Pressing the RESET switch on the terminal front panel results in the terminal aborting the load and running diagnostics again.

## ERRORS

The following error messages can be generated on the CRT screen during the course of the load process.

NO REPLY - Indicates that the load operation has not progressed for 30 seconds due to no response or incorrect response from the network. The terminal then sends a new load request and tries loading again up to three times.

HOST LOAD FAIL - Indicates that the load process has been aborted after three unsuccessful load attempts or that host carrier has been lost. The terminal will return to load file selection after momentarilly displaying this message.

HOST NOT CONNECTED - Indicates no initial carrier signal was detected within 30 seconds of load initialization.

In addition, the ERROR light on the front panel lights whenever a load error has occurred and remains lit until the error has been recovered or the load has been aborted.

PERFORMANCE

The ASCII loader program in the terminal is capable of loading programs from the ASCII network at communication line rates specified by the send and receive parameters in the mode installation parameters. A typical controlware load will take about 3 to 4 minutes at 1200 bps.

INSTALLATION PARAMETERS

Transmit and receive rates are selectable in the mode installation parameters. These rates must be set to the desired value at installation (see Parameter Selection at the beginning of this section). The last transmit and receive is forced to 8 data bits and no parity.

ROM PACK LOADER

The ROM pack loader transfers control to a program in an internal ROM pack option if the option is present. When a ROM pack is selected as the load source, control is transferred to the ROM pack loader. The presence of a ROM pack is tested first by sensing status. If the status check indicates the presence of a ROM pack, a memory read is performed on the ROM pack to verify its presence. If the ROM pack is present, control is then transferred to the ROM pack. If the ROM pack is not present, a loading failure message appears on the CRT screen.

The ROM pack can contain diagnostics or special functions.

DESCRIPTION

The ROM pack has a name, revision level, and three entry points, as follows.

| ADDRESS | DATA | DESCRIPTION |
|---|---|---|
| 8000 | C3 | Entry point to mode |
| 8003 | C3 | Entry point to diagnostic |
| 8006 | C3 | Entry point to function |
| 800A | X X X | 3 ASCII codes of pack name |
| 800D | X X X | 3 ASCII codes of pack version |

- Mode Entry - When ROM pack is selected as the load source (see Load Source Selection section), control will be transferred to address 8000, if that address contains a C3 with mode parameters loaded in RAM. If the C3 is not read, a message FAILURE LOADING MODE will be displayed.

- Diagnostic Entry - When test 1 is complete, it will test address 8003 for a C3. If a C3 is read, control will be transferred to 8003. If a C3 is not read, control is not transferred and test 1 will be completed. The ROM pack should contain a checksum of its own ROM, test any special hardware it uses, and display its name and revision.

- Function Entry - When the terminal is displaying the Mode Selection Menu and the F7 key is pressed, or if Auto Select mode 7 is selected, control will be transferred to address 8006 if it contains a C3. If the C3 is not read, the alarm will sound, the message FAILURE LOADING MODE will be displayed, and control transferred to the Mode Selection Menu.

## ABORTS AND RECOVERY

See ERRORS paragraph that follows.

## PERFORMANCE

The ROM pack load requires the presence of a ROM pack option at address 8000 hexadecimal, bank 5, with the entry table containing a C3 for each entry that is enabled. The operation of the ROM pack load takes less than one second to execute.

INSTALLATION PARAMETERS

A ROM pack option must be installed. See the Load Source Selection section to select the proper parameter for using the ROM as the load source. The ROM pack must contain the proper format (the format is contained in the Description paragraph for the the ROM Pack Loader).

INTERFACES

Selection of the ROM pack is described in the Load Source Selection section. Once selected, loading proceeds automatically without operator intervention. If the ROM pack option is not present, the FAILURE LOADING MODE message is displayed.

The common variables are set as follows before the jump to ROM:

- LINFO is set to a value of X4 hexadecimal (ROM loader used).

ERRORS

If the ROM pack option is not present, the message FAILURE LOADING MODE is displayed on the screen.

CYBER MODE OPERATION

The basic terminal mode is CYBER mode. CYBER mode consists of two operating submodes. Small CYBER mode is referred to as Advanced (ADV) mode and is functional on CYBER-C120 series systems. Large CYBER Mode is referred to as Advanced Native (ADVN) mode and is functional on CYBER C170 series systems. Small CYBER mode emulates an enhanced Advanced Mode operation compatible with the CC628 TTY Display Terminal. Small CYBER and Large CYBER submodes are host and operator selectable. The differences are covered by tables 4-1 and 4-2. See table 4-2 for CYBER control codes and escape sequences.

CYBER mode supports character transmissions and block transmissions and protected and unprotected data operations.

## Cursor

The cursor indicates the current entry position. It is represented on the screen in one of the following manners:

- Constant underline
- Blinking underline
- Solid block
- Blinking solid block

The type of cursor is determined by two operator-selectable parameter bits.

## Character Attributes

A character attribute code (background) is loaded into the display memory for every character display code (foreground). These are:

| Bit No. | Feature | |
|---|---|---|
| 0 | Blank | Used by Hardware |
| 1 | Underscore | |
| 2 | Inverse | |
| 3 | Blink | |
| 4 | Dim | |
| 5 | Modified | |
| 6 | Validate | |
| 7 | Protect | |

The code is stored along with the displayable character in the following manner:

1. The modified bit is always set if displayable character came from the keyboard and cleared if from host (common input).
2. With Protect disabled, the new attribute code will be stored with each keyboard input and common input.

3. With Protect enabled, the old attribute is reused if common input and the modified bits set, if keyboard-input.

4. The validate bit is not changed with keyboard input.

## Parity Errors

If parity errors are received while alphanumeric display information is being received from the keyboard, the code is ignored.

## KEYBOARD OPERATION

In CYBER mode, the keyboard operates all 128 ASCII codes. Table 4-1 contains a listing of the keyboard codes and legends. Refer to section 3 for figures of keycap options and for a figure showing keystation assignments.

All code generation is controlled by the terminal firmware. Also, the terminal firmware provides typamatic action on all keys. This typamatic action provides a repeat rate of 15 $\pm 3$ characters per second after a 1-second delay when the operator holds a key pressed. Typamatic action can be disabled by host command or by mode installation parameter selection. All terminal code generation is controlled by the terminal firmware.

The transmission of keyboard input is governed by the transmission mode being used, which is host controlled. As described later under Character-Transmit Mode and Block-Transmit Mode, transmission may occur immediately as a key is pressed (character mode) or input may be stored until the operator initiates transmission (block mode).

For protected character locations, actuation of any alphanumeric or control code key causes the alarm to sound with no other action taken. The cursor does not move when this condition occurs. Cursor control operation, however, is always allowed when the keyboard is enabled.

The codes of the keyboard can function three different ways:

- Normal - Pressing a key causes the corresponding code in table 4-1 to be sent to the host (immediately in character mode or subsequently in block mode).
- Host-Loaded Code Sequence - If the host has loaded an code sequence for that key (table 4-1 indicates the keys which are loadable), those codes will be sent to the host instead of the codes in the table. If the terminal is in half-duplex routing, the codes will not be acted upon by the terminal.
- Host-Loaded Controlware - If the host has loaded Z80 code controlware for that key, a call will be made to the controlware.

The following paragraphs describe the function of basic keys and basic operations.

##  (Shift) Keys

When two symbols share the same key, the upper symbol or control function is active only while either one of the two Shift keys is actuated.

Actuating the Shift key in conjunction with a key labeled with a single legend causes the transmission of the uppercase code for the symbol shown on the key as indicated in table 4-1.

##  (LOCK) Key/Indicator

The Lock key is operator-parameter selectable to perform a shift-lock or alpha-lock function. In shift-lock mode, all function, control and alpha/numeric keys unconditionally transmit the level two column shifted keycode definition shown in table 4-1. Operator care must be exercised to ensure intended operation of all keys when shift-lock mode is active. Shift lock is provided for single key activation ease of use.

In alpha-lock mode, this key, when pressed, causes all alphabetic keys to transmit only the uppercase code until pressed a second time. The alpha-lock mode is provided to disable the generation of lowercase codes. If this key is in the lock position, uppercase characters are generated in place of the lowercase characters. Special function, control, and numeric keys are unaffected. This key contains an indicator that is illuminated when in lock mode.

## CTRL (Control) Key

Actuation of the CTRL key in conjunction with any data key or combination of data key and Shift key causes the generation of the codes outlined in the level three and level four columns of table 4-1, respectively.

For protected locations and block mode operation, actuation of the CTRL key in conjunction with any data key causes an audible alarm and no action is taken.

## RESET Switch

When the RESET switch is activated, a power-on reset function is executed. This function causes the terminal to reinitialize and perform a self-test routine. At the completion of the self-test routine, the terminal checks terminal installation parameters to determine whether to display the mode menu (manual-mode selection) or to load/enter the designated mode (automatic-mode selection).

Activating the RESET switch halts any data transfer to or from the terminal. This includes display to host and display to printer transfers.

## Validation Bits

The host has the ability to load validation code, (see the Host Specified Code Sequence/Controlware) and start/stop validation.

As the host is entering data on the screen, the start validation will store the validate bit in background memory for each code stored while the start validation is active.

As keys are pressed on the keyboard, the following conditions are tested against the question: Is the key a host-loadable key?

- YES-perform loadable key function
- NO-is current position a validate position?
  - NO-perform normal function
  - YES-has host loaded validation code?
    -- NO-perform normal function
    -- YES-call host loaded validation code. When control is returned, the normal function will be performed if the ZERO flag is clear. Nothing will be done if the ZERO flag is set.

## Host Multiple Code Sequences

There are many host-initiated functions which have multiple-code sequences. (See table 4-2.) These sequences contain either two codes (RS, X) or three codes (RS, DC2, X). When the terminal receives the RS code, keyboard inputs will be ignored until one of the following conditions is met:

- The next code is processed (unless it is a DC2 code).
- The next code is DC2 and keyboard inputs are ignored until one more code is received.

NOTE

If the RS code or RS, DC2 codes are received without another code following, the keyboard may be hung up. The manual release (M REL) function re-enables the keyboard.

## Prologue Code

The user is able to down-load a series of characters to be used as a screen prologue. In block mode, the screen prologue characters, if active, will be sent back to the host prior to sending the unprotected fields on the screen. The primary use of the prologue characters is as a screen or transaction identifier which would be unknown, not modifiable, and not displayable by the terminal operator. Prologue characters are down-loaded using the following command:

RS, HT, (V), (W), (X), (Y), (Z)

where:

V = 5F (the prologue command identifier)
W = 31 (the host code sequence)
X = the address in RAM where the code is to be loaded
Y = the prologue character sequence (same as the host code sequence)
Z = termination code (CR)

To clear the prologue characters, the user sends the following command:

RS, HT, (V), (W), (X), (Y), (Z)

where:

V = 5F (the prologue command identifier)
W = 30 (to clear the function)
X = not required
Y = not required
Z = termination code

## Printer Operation

Both of the CYBER modes support a serial printer which may be connected to either port on the optional dual asynchronous interface board. As data is received from the host, it is sent to the printer port if the Printer-On parameter is selected. As data is entered from the keyboard, it is sent to the printer port only if the Printer-On parameter is selected and half-duplex data routing is in effect (with full-duplex routing, keyboard entered data is echoed back from host for printing).

The printer X-ON/X-OFF condition is supported. If the printer sends an X-OFF signal to the terminal, the terminal will stop taking data from the buffer and sending it to the printer. When the X-ON signal is received from the printer, data transfer is resumed.

When the common input buffer reaches three-quarter capacity, an X-OFF signal is sent to the host. If it is desired to communicate with the host after the printer has sent an X-OFF signal, the manual release operation will send an X-ON signal to the host and will resume sending data to the printer even if it cannot accept it.

TABLE 4-1. KEYCODES AND LEGENDS OF STANDARD KEYBOARD

| KEY NO. | NOTES* | KEY LEGENDS | | | PRESSED WITH KEY ... GENERATE | | | |
|---|---|---|---|---|---|---|---|---|
| | | LOWER | CENTER | UPPER | | ⇧ | CTRL | ⇧ •CTRL |
| 1 | DS,L | | PRINT | | | | | |
| | | | ADV Mode (Small) | | 1E,11 | 1E,01 | 1E,11 | 1E,01 |
| | | | ADV N Mode (Large) | | 1E,02 | 1E,01 | 1E,02 | 1E,01 |
| 2 | | | SETUP | | | | | |
| 3 | D, L | | (F1) | | 1E,71 | 1E,61 | 1E,31 | 1E,21 |
| 4 | D, L | | (F2) | | 1E,72 | 1E,62 | 1E,32 | 1E,22 |
| 5 | D, L | | (F3) | | 1E,73 | 1E,63 | 1E,33 | 1E,23 |
| 6 | D, L | | (F4) | | 1E,74 | 1E,64 | 1E,34 | 1E,24 |
| 7 | D, L | | (F5) | | 1E,75 | 1E,65 | 1E,35 | 1E,25 |
| 8 | D, L | | (F6) | | 1E,76 | 1E,66 | 1E,36 | 1E,26 |
| 9 | D, L | | (F7) | | 1E,77 | 1E,67 | 1E,37 | 1E,27 |
| | | | ⇐ | | | | | |
| 10 | D, L | | (F8) | | 1E,78 | 1E,68 | 1E,38 | 1E,28 |
| | | | SUPER | | | | | |
| 11 | D, L | | (F9) | | 1E,79 | 1E,69 | 1E,39 | 1E,29 |
| | | | SUB | | | | | |
| 12 | D, L | | (F10) | | 1E,7A | 1E,6A | 1E,3A | 1E,2A |
| | | | MICRO | | | | | |
| 13 | D, L | | (F11) | | 1E,7B | 1E,6B | 1E,3B | 1E,2B |
| | | | FONT | | | | | |
| 14 | D, L | | (F12) | | 1E,7C | 1E,6C | 1E,3C | 1E,2C |
| 15 | L,D | | + | DOWN** | 1E,12,20 | 1E,12,21 | 1E,12,22 | 1E,12,23 |
| 16 | R, L | | | | NOT USED | | | |
| 17 | R | 1 | | ! | 31 | 21 | 31 | 21 |
| 18 | R | 2 | | @ | 32 | 40 | 00 | 00 |
| 19 | R | 3 | | # | 33 | 23 | 33 | 23 |
| 20 | R | 4 | | $ | 34 | 24 | 34 | 24 |
| 21 | R | 5 | | % | 35 | 25 | 35 | 25 |
| 22 | R | 6 | | ^ | 36 | 5E | 36 | 5E |
| 23 | R | 7 | | & | 37 | 26 | 37 | 26 |
| 24 | R | 8 | | * | 38 | 2A | 38 | 2A |

TABLE 4-1. KEYCODES AND LEGENDS OF STANDARD KEYBOARD (CONTD)

| KEY NO. | NOTES* | KEY LEGENDS | | | PRESSED WITH KEY ... GENERATE | | | |
|---|---|---|---|---|---|---|---|---|
| | | LOWER | CENTER | UPPER | | ⇧ | CTRL | ⇧ •CTRL |
| 25 | R | 9 | | ( | 39 | 28 | 39 | 28 |
| 26 | R | 0 | | ) | 30 | 29 | 30 | 29 |
| 27 | R | - | | — | 2D | 5F | 1F | 1F |
| 28 | R | = | | + | 3D | 2B | 1E | 1E |
| 29 | R | ` | | ~ | 60 | 7E | 60 | 7E |
| 30 | R | | ← | | | | | |
| | | ADV MODE (Small) | | | 19 | 19 | 19 | 19 |
| | | ADV N MODE (Large) | | | 08 | 08 | 08 | 08 |
| 31 | L, D | | — | UP** | 1E,12,24 | 1E,12,25 | 1E,12,26 | 1E,12,27 |
| 32 | R, L, DS | | → | | 09 | 09 | 1E,12,57 | 1E,12,57 |
| 33 | R | | Q | ↖** | 71 | 51 | 11 | 11 |
| 34 | R | | W | ↑** | 77 | 57 | 17 | 17 |
| 35 | R | | E | ↗** | 65 | 45 | 05 | 05 |
| 36 | R | | R | | 72 | 52 | 12 | 12 |
| 37 | R | | T | | 74 | 54 | 14 | 14 |
| 38 | R | | Y | | 79 | 59 | 19 | 19 |
| 39 | R | | U | | 75 | 55 | 15 | 15 |
| 40 | R | | I | | 69 | 49 | 09 | 09 |
| 41 | R | | O | | 6F | 4F | 0F | 0F |
| 42 | R | | P | | 70 | 50 | 10 | 10 |
| 43 | R | [ | | ] | 5B | 5D | 1D | 1D |
| 44 | R | ` | | ¦ | 5C | 7C | 1C | 1C |
| 45 | R, L, DS | | ← | | 1E,0B | 1E,0B | 1E,12,58 | 1E,12,58 |
| 46 | D, L | | X | FWD** | 1E,12,28 | 1E,12,29 | 1E,12,2A | 1E,12,2B |
| 47 | | | ⊖ | ← | | | | |
| 48 | R | | A | ** | 61 | 41 | 01 | 01 |
| 49 | R | | S | | 73 | 53 | 13 | 13 |
| 50 | R | | D | ** | 64 | 44 | 04 | 04 |
| 51 | R | | F | → | 66 | 46 | 06 | 06 |

TABLE 4-1. KEYCODES AND LEGENDS OF STANDARD KEYBOARD (CONTD)

| KEY NO. | NOTES* | KEY LEGENDS | | | PRESSED WITH KEY ... GENERATE | | | |
|---|---|---|---|---|---|---|---|---|
| | | LOWER | CENTER | UPPER | | ⇧ | CTRL | ⇧ •CTRL |
| 52 | R | | G | | 67 | 47 | 07 | 07 |
| 53 | R | | H | | 68 | 48 | 08 | 08 |
| 54 | R | | J | | 6A | 4A | 0A | 0A |
| 55 | R | | K | | 6B | 4B | 0B | 0B |
| 56 | R | | L | | 6C | 4C | 0C | 0C |
| 57 | R | ; | | : | 3B | 3A | 3B | 3A |
| 58 | R | ' | | " | 27 | 22 | 27 | 22 |
| 59 | R | { | | } | 7B | 7D | 7B | 7D |
| 60 | See Key 75 | | | | - | - | - | - |
| 61 | D, L | | ÷ | BKW** | 1E,12,2C | 1E,12,2D | 1E,12,2E | 1E,12,2F |
| 62 | | | ↑ | | | | | |
| 63 | R | | | | NOT USED | | | |
| 64 | R | | Z | ↙** | 7A | 5A | 1A | 1A |
| 65 | R | | X | ↓ ** | 78 | 58 | 18 | 18 |
| 66 | R | | C | ↘** | 63 | 43 | 03 | 03 |
| 67 | R | | V | | 76 | 56 | 16 | 16 |
| 68 | R | | B | | 62 | 42 | 02 | 02 |
| 69 | R | | N | | 6E | 4E | 0E | 0E |
| 70 | R | | M | | 6D | 4D | 0D | 0D |
| 71 | R | ' | | < | 2C | 3C | 2C | 3C |
| 72 | R | . | | > | 2E | 3E | 2E | 3E |
| 73 | R | / | | ? | 2F | 3F | 2F | 3F |
| 74 | | | ↑ | | | | | |
| 75 | L | ←↵ | | NEXT | | | | |
| | | ADV MODE (Small) | | | 0A | 0A | 0A | 0A |
| | | ADV N MODE (Large) | | | 0D | 0D | 0D | 0D |
| 76 | | | CTRL | | | | | |
| 77 | R | | (Space) | | 20 | 20 | 20 | 20 |
| 78 | | DEL | | CR | 7F | 0D | 7F | 0D |
| 79 | D, L | | HELP | | 1E,5C | 1E,58 | 1E,5C | 1E,58 |
| 80 | D, L | ANS | (F13) | TERM | 1E,7D | 1E,6D | 1E,3D | 1E,2D |

TABLE 4-1. KEYCODES AND LEGENDS OF STANDARD KEYBOARD (CONTD)

| KEY NO. | NOTES* | KEY LEGENDS LOWER | CENTER | UPPER | PRESSED WITH KEY ... GENERATE | ⇧ | CTRL | ⇧ •CTRL |
|---|---|---|---|---|---|---|---|---|
| 81 | DS,L | | ERASE | | | | | |
| | | ADV MODE (Small) | | | 1E,5D | 1E,59 | 1E,5D | 1E,59 |
| | | ADV N MODE (Large) | | | 1F | 1E,5D | 1E,5D | 1E,59 |
| | | | COPY | | | | | |
| 82 | | | (F14) | | 1E,7E | 1E,6E | 1E,3E | 1E,2E |
| 83 | D, L | | EDIT | | 1E,5E | 1E,5A | 1E,5E | 1E,5A |
| | | | □ | | | | | |
| 84 | D, L | | (F15) | | 1E,70 | 1E,60 | 1E,30 | 1E,20 |
| 85 | D, L | | BACK | | 1E,5F | 1E,5B | 1E,5F | 1E,5B |
| 86 | D, L | | LAB | | 1E,12,31 | 1E,12,32 | 1E,12,33 | 1E,12,33 |
| 87 | D, L | | DATA | | 1E,12,35 | 1E,12,36 | | |
| 88 | D, L | | STOP | | 1E,49 | 1E,4A | 1E,49 | 1E,4A |
| 89 | DS, L, R | C | INSRT | L | 1E,4F | 1E,52 | 1E,4F | 1E,52 |
| 90 | DS, L, R | C | DLETE | L | 1E,4E | 1E,51 | 1E,4E | 1E,51 |
| 91 | L | EOL | CLEAR | P | 0B | 0C | 0B | 0C |
| 92 | | ESC | | LF | 1B | 0A | 1B | 0A |
| 93 | | BREAK | | M REL | BREAK | | BREAK | |
| 94 | R, L,N | | 7 | | 37 | | 37 | |
| 95 | R, L,N | 8 | | ↑ | 38 | 17 | 38 | 17 |
| 96 | R, L,N | | 9 | | 39 | | 39 | |
| 97 | R, L,N | 4 | | ← | | | | |
| | D | ADV MODE (Small) | | | 34 | 19 | 19 | 1E,19 |
| | | ADV N MODE (Large) | | | 34 | 08 | 34 | 08 |
| 98 | R, L,N | 5 | | HOME** | | | | |
| | D | ADV MODE (Small) | | | 35 | 08 | 08 | 1E,08 |
| | | ADV N MODE (Large) | | | 35 | 19 | 35 | 19 |
| 99 | R, L,N | 6 | | → | | | | |
| | | ADV MODE (Small) | | | 36 | 18 | 18 | 1E,18 |
| | | ADV N MODE (Large) | | | 36 | 18 | 36 | 18 |
| 100 | R, L,N | 1 | | | 31 | | 31 | |

TABLE 4-1. KEYCODES AND LEGENDS OF STANDARD KEYBOARD (CONTD)

| KEY NO. | NOTES* | KEY LEGENDS LOWER | CENTER | UPPER | PRESSED WITH KEY ... GENERATE | ⇧ | CTRL | ⇧ •CTRL |
|---|---|---|---|---|---|---|---|---|
| 101 | R, L,N | 2 | | ↓ | | | | |
| | D | ADV MODE (Small) | | | 32 | 1A | 1A | 1E,1A |
| | | ADV N MODE (Large) | | | 32 | 1A | 32 | 1A |
| 102 | R, L,N | 3 | | | 33 | | 33 | |
| 103 | R, L,N | , | | | 2C | | 2C | |
| 104 | R, L,N | 0 | | | 30 | | 30 | |
| 105 | R, L,N | . | | | 2E | | 2E | |
| 106 | L, N | ← | | NEXT | | | | |
| | | ADV MODE (Small) | | | 0A | 0A | 0A | 0A |
| | | ADV N MODE (Large) | | | 0D | 0D | 0D | 0D |

*Key to Notes:

N - Modified if the numeric pad parameter set to SHIFT.

R - Auto repeat if TYPAMATIC is on.

L - Host loadable.

D - Delimiter. CR sent when enabled by host.

DS - Delimiter. CR sent when enabled by host in small CYBER mode.

- - No function performed.

** - Labeled on skirt of key cap.

TABLE 4-1.1. KEYCODE AND LEGEND ADDENDUM FOR BRITISH KEYCAP KIT

| KEY NO. | KEY LEGENDS LOWER | CENTER | UPPER | PRESSED WITH KEY ... GENERATE | ⇧ | CTRL | ⇧ •CTRL |
|---|---|---|---|---|---|---|---|
| 16 | ` | | - | 60 | 7E | 60 | 7E |
| 19 | 3 | | £ | 33 | 23 | 33 | 23 |
| 29 | | | | - | - | - | - |
| 63 | < | | > | 3C | 3E | 3C | 3E |
| 71 | , | | , | 2C | 2C | 2C | 2C |
| 72 | . | | . | 2E | 2E | 2E | 2E |

TABLE 4-1.2. KEYCODE AND LEGEND ADDENDUM FOR SPANISH KEYCAP KIT

| KEY NO. | KEY LEGENDS | | | PRESSED WITH KEY ... GENERATE | | | |
|---|---|---|---|---|---|---|---|
| | LOWER | CENTER | UPPER | | ⇧ | CTRL | ⇧ •CTRL |
| 16 | ` | | ~ | 60 | 7E | 60 | 7E |
| 18 | 2 | | § | 32 | 40 | 00 | 00 |
| 19 | 3 | | £ | 33 | 23 | 33 | 23 |
| 29 | | | | - | - | - | - |
| 43 | ] | | [ | 1E, 4B | 1E, 4D | 1D | 1D |
| 44 | ç | | Ç | 7D | 5D | 1C | 1C |
| 57 | | Ñ | | 7C | 5C | 7C | 5C |
| 58 | . | | i | 7B | 5B | 7B | 5B |
| 59 | ' | | " | 27 | 22 | 27 | 22 |
| 63 | < | | > | 3C | 3E | 3C | 3E |
| 71 | , | | ; | 2C | 3B | 2C | 3B |
| 72 | . | | : | 2E | 3A | 2E | 3A |
| | | | | | | | |

TABLE 4-1.3. KEYCODE AND LEGEND ADDENDUM FOR GERMAN KEYCAP KIT

| KEY NO. | KEY LEGENDS | | | PRESSED WITH KEY ... GENERATE | | | |
|---|---|---|---|---|---|---|---|
| | LOWER | CENTER | UPPER | | ⇧ | CTRL | ⇧ •CTRL |
| 16 | [ | | ] | 1E, 4B | 1E, 4D | 1E, 4B | 1E, 4D |
| 18 | 2 | | " | 32 | 22 | 00 | 00 |
| 19 | 3 | | § | 33 | 40 | 33 | 40 |
| 22 | 6 | | & | 36 | 26 | 36 | 26 |
| 23 | 7 | | / | 37 | 2F | 37 | 3F |
| 24 | 8 | | ( | 38 | 28 | 38 | 28 |
| 25 | 9 | | ) | 39 | 29 | 39 | 29 |
| 26 | 0 | | = | 30 | 3D | 30 | 3D |
| 27 | B | | ? | 7E | 3F | 1F | 1F |
| 28 | ' | | ` | 27 | 60 | 1E | 1E |
| 29 | | | | - | - | - | - |
| 38 | | Z | | 7A | 5A | 19 | 19 |
| 43 | | Ü | | 7D | 5D | 1D | 1D |

TABLE 4-1.3. KEYCODE AND LEGEND ADDENDUM FOR GERMAN KEYCAP KIT (CONTD)

| KEY NO. | KEY LEGENDS | | | PRESSED WITH KEY ... GENERATE | | | |
|---|---|---|---|---|---|---|---|
| | LOWER | CENTER | UPPER | | ⇧ | CTRL | ⇧ •CTRL |
| 44 | + | Ü | * | 2B | 2A | 1C | 1C |
| 57 | | Ö | | 7C | 5C | 7C | 5C |
| 58 | | Ä | | 7B | 5B | 7B | 5B |
| 59 | # | | ^ | 23 | 5E | 23 | 5E |
| 63 | < | | > | 3C | 3E | 3C | 3E |
| 64 | | Y | | 79 | 59 | 1A | 1A |
| 71 | , | | ; | 2C | 3B | 2C | 3B |
| 72 | . | | : | 2E | 3A | 2E | 3A |
| 73 | - | | _ | 2D | 5F | 2D | 5F |

TABLE 4-1.4. KEYCODE AND LEGEND ADDENDUM FOR FRENCH KEYCAP KIT

| KEY NO. | KEY LEGENDS | | | PRESSED WITH KEY ... GENERATE | | | |
|---|---|---|---|---|---|---|---|
| | LOWER | CENTER | UPPER | | ⇧ | CTRL | ⇧ •CTRL |
| 16 | [ | | ] | 1E, 4B | 1E, 4D | 1E, 4B | 1E, 4D |
| 18 | 2 | | " | 32 | 22 | 00 | 00 |
| 19 | 3 | | § | 33 | 5D | 33 | 5D |
| 22 | 6 | | + | 36 | 2B | 36 | 2B |
| 23 | 7 | | / | 37 | 2F | 37 | 2F |
| 24 | 8 | | ( | 38 | 28 | 38 | 28 |
| 25 | 9 | | ) | 39 | 29 | 39 | 29 |
| 26 | 0 | | = | 30 | 3D | 30 | 3D |
| 27 | ' | | ? | 27 | 3F | 1F | 1F |
| 28 | ^ | | •• | 5E | 7E | 1E | 1E |
| 29 | | | | - | - | - | - |
| 43 | à | | ç | 40 | 5C | 1D | 1D |
| 44 | & | | * | 26 | 2A | 1C | 1C |
| 57 | é | | è | 7B | 7D | 7B | 7D |
| 58 | ù | | o | 7C | 5B | 7C | 5B |
| 59 | ' | | £ | 60 | 23 | 60 | 23 |

TABLE 4-1.4. KEYCODE AND LEGEND ADDENDUM FOR FRENCH KEYCAP KIT (CONTD)

| KEY NO. | KEY LEGENDS | | | PRESSED WITH KEY ... GENERATE | | | |
|---|---|---|---|---|---|---|---|
| | LOWER | CENTER | UPPER | | ⇧ | CTRL | ⇧ •CTRL |
| 63 | < | | > | 3C | 3E | 3C | 3E |
| 71 | , | | ; | 2C | 3B | 2C | 3B |
| 72 | . | | : | 2E | 3A | 2E | 3A |
| 73 | - | | _ | 2D | 5F | 2D | 5F |

TABLE 4-1.5. KEYCODE AND LEGEND ADDENDUM FOR SWEDISH/FINNISH KEYCAP KIT

| KEY NO. | KEY LEGENDS | | | PRESSED WITH KEY ... GENERATE | | | |
|---|---|---|---|---|---|---|---|
| | LOWER | CENTER | UPPER | | ⇧ | CTRL | ⇧ •CTRL |
| 16 | [ | | ] | 1E, 4B | 1E, 4D | 1E, 4B | 1E, 4D |
| 18 | 2 | | " | 32 | 22 | 00 | 00 |
| 19 | 3 | | # | 33 | 23 | 33 | 23 |
| 20 | 4 | | ¤ | 34 | 24 | 34 | 24 |
| 22 | 6 | | & | 36 | 26 | 36 | 26 |
| 23 | 7 | | / | 37 | 2F | 37 | 2F |
| 24 | 8 | | ( | 38 | 28 | 38 | 28 |
| 25 | 9 | | ) | 39 | 29 | 39 | 29 |
| 26 | 0 | | = | 30 | 3D | 30 | 3D |
| 27 | + | | ? | 2B | 3F | 1F | 1F |
| 28 | | É | | 60 | 40 | 1E | 1E |
| 29 | | | | - | - | - | - |
| 43 | | Å | | 7D | 5D | 1D | 1D |
| 44 | | Ü | | 7E | 5E | 1C | 1C |
| 57 | | Ö | | 7C | 5C | 7C | 5C |
| 58 | | Ä | | 7B | 5B | 7B | 5B |
| 59 | ' | | * | 27 | 2A | 27 | 2A |
| 63 | < | | > | 3C | 3E | 3C | 3E |
| 71 | , | | ; | 2C | 3B | 2C | 3B |
| 72 | . | | : | 2E | 3A | 2E | 3A |
| 73 | - | | _ | 2D | 5F | 2D | 5F |

TABLE 4-1.6. KEYCODE AND LEGEND ADDENDUM FOR DANISH/NORWEGIAN KEYCAP KIT

| KEY NO. | KEY LEGENDS | | | PRESSED WITH KEY ... GENERATE | | | |
|---|---|---|---|---|---|---|---|
| | LOWER | CENTER | UPPER | | ⇧ | CTRL | ⇧ •CTRL |
| 16 | [ | | ] | 1E, 4B | 1E, 4D | 1E, 4B | 1E, 4D |
| 18 | 2 | | " | 32 | 22 | 00 | 00 |
| 22 | 6 | | & | 36 | 26 | 36 | 26 |
| 23 | 7 | | / | 37 | 2F | 37 | 2F |
| 24 | 8 | | ( | 38 | 28 | 38 | 28 |
| 25 | 9 | | ) | 39 | 29 | 39 | 29 |
| 26 | 0 | | = | 30 | 3D | 30 | 3D |
| 27 | + | | ? | 2B | 3F | 1F | 1F |
| 28 | \ | | @ | 60 | 40 | 1E | 1E |
| 29 | | | | - | - | - | - |
| 43 | | A | | 7D | 5D | 1D | 1D |
| 44 | - | | ^ | 7E | 5E | 1C | 1C |
| 57 | | Ø | | 7C | 5C | 7C | 5C |
| 58 | | Æ | | 7B | 5B | 7B | 5B |
| 59 | ' | | * | 27 | 2A | 27 | 2A |
| 63 | < | | > | 3C | 3E | 3C | 3E |
| 71 | , | | ; | 2C | 3B | 2C | 3B |
| 72 | . | | : | 2E | 3A | 2E | 3A |
| 73 | - | | _ | 2D | 5F | 2D | 5F |

CHARACTER-TRANSMIT MODE

The basic type of transmission in CYBER mode is character transmission which emulates the operation of the CC628 TTY Display Terminal. This type of transmission is in effect unless a command to enter block mode is received from the host.

In character mode, the code for a pressed key is transmitted immediately. That is if operations are online and the cursor was in an unprotected position. In addition, the character for the pressed key displays immediately if half-duplex routing is being used or displays when the code is echoed back by the host if full-duplex routing is being used. As characters are displayed, the attribute word is stored in back-ground memory with the modified bit set. If the cursor occupied a protected position, and the key pressed is a displayable code, nothing is sent and the alarm sounds. When a function requiring the clearing of data is performed, the modified attribute bit is cleared for each position cleared.

The following paragraphs describe the operation of keys in character mode.

## PRINT Key

Activation of this key in the unshifted position causes the transmission of a page print code sequence. If half-duplex is selected, the terminal causes all data to be printed as it appears on the screen from the current line to end of page. Preceding the transfer, the terminal issues a form feed. During the transfer, all codes 7F through FF hexadecimal are replaced by spaces and a carriage return/line feed is inserted at the start of the page and at the end of each line. When online, all incoming codes are ignored (not lost) until completion of the print transmission. Print completion is signaled by the terminal transmitting a print complete code (ACK) or if the operation is aborted by actuating SHIFT/M REL; transmission of an abnormal completion sequence (RS, NAK). No response is sent in large CYBER mode.

NOTE

Pressing the Shift and M REL keys sends a X-ON signal (DC1) to the host.

If the PRINT key is actuated in conjunction with the shift key, a print form code sequence is generated. If half-duplex is selected, the terminal sends all data as previously described except dimmed data is replaced with space codes for transfer to the printer.

Any data received during the print operation is ignored. The keyboard is locked during the print operation. A 250-ms delay is inserted after each CR, LF, FF if the SRTS is off and Use Printer SRTS parameter is in effect. If the printer is not ready, DTR off, or goes not ready, nothing will be sent to the printer until DTR goes on.

## SETUP Key

Activating the SETUP key causes the terminal to display the operator mode status (eight parameters) at the bottom two lines of the display. The bottom lines are not lost. When displayed, mode operating parameters can be changed. Activating the F1 (Return) key causes deletion of the status line and returns screen data to its original position. If data is received from the host, it is placed into the 992 character COMM INPUT BUFFER. If the buffer ever reaches 768 characters, an X-OFF is sent to the host (if online).

NOTE

If the mode is exited by pressing F10, F10, the host may be left with the X-OFF active.

## Special Function Keys

Fifteen four-level special function keys (F1 through F15) are contained on the keyboard. When pressed, these keys cause the transmission of a 2-character sequence. The first character is an $1E_{16}$, the second character is unique to the individual function key whether it is shifted, unshifted, or activated in conjunction with the CTRL (Control) key (refer to table 4-1).

The following additional host-defined actions are also available:

- A host-selectable CR ($0D_{16}$) code delimiter added to the code sequence defined in table 4-1.
- A host-specified code sequence or a host defined controlware sequence executed in response to a key activation. The host-specified action includes a key identifier, a code sequence or controlware sequence selector, and the actual code sequence or controlware sequence.

## L/INSRT/C Key

When unshifted, activation of the L/INSRT/C key causes entry of a space code at the current cursor position. The character that occupied that position and all characters to the right of the cursor are moved one position to the right. This character shifting to the right is continued to the end of the line, or to the end of the unprotected field, whichever occurs first. The rightmost character is then lost. This key is ignored and the audible alarm is activated if the cursor currently occupies a protected position.

When shifted, activation of this key causes a line of space codes to be entered into the display line presently occupied by the cursor. The line of data that occupied the cursor line is then moved down one line position. This line shifting continues until either the bottom line, or a line with protected data is encountered. The data in the bottom line, or just above the line with any protected data is lost. This shifted key is ignored and the audible alarm is activated if the cursor currently occupies a line with any protected character positions. For character and protect mode, the modified attribute bit is cleared for all character locations changed.

## ERASE Key

The ERASE key causes entry of a space code into all unprotected display positions in the current unprotected field. This includes all unprotected positions from the current cursor position to the beginning of the field or the beginning of the line, and all unprotected positions from the current cursor position to the end of the field, or end of the line, whichever comes first. The cursor is moved to the beginning of the field. For character or protect mode, the modified attribute bit is cleared for all locations cleared. In half-duplex operation, this key performs a line clear and carriage return or destructive backspace.

If the cursor currently occupies a protected position, an audible alarm is activated, the cursor is left unchanged, and no additional action is taken.

## L/DLETE/C Key

When activated in the unshifted position, the L/DLETE/C key deletes the character code at the present cursor position. The character code to the right of the cursor moves one position to the left and this character shift to the left continues to the end of the unprotected field, or to the end of the line, whichever occurs first. The rightmost position shifted left is then replaced with a space code. If the cursor currently occupies a protected position, the function of this key is ignored and the audible alarm is activated.

When activated in the shifted position, this key deletes the entire line of codes in the line presently occupied by the cursor. The lines below this line are then shifted up one line position. This shifting continues until the bottom line, or until a line with any protected data is encountered. The line position of the last line shifted up is then replaced with space codes. If the cursor currently occupies a line with any protected position, the function of this key is ignored and the audible alarm is activated.

For character and protect mode, the modified attribute bit is cleared for all character locations changed.

## P/CLEAR/EOL (Erase Page/Erase End of Line) Key

When activated in the unshifted position, the P/CLEAR/EOL key causes entry of space codes into all unprotected display positions, from and including the current cursor position to the end of the current unprotected field or to the end of the line, whichever occurs first. The cursor is not moved. The modified attribute bit is cleared for all character locations cleared.

When activated in the shifted position, this key causes the entry of a space code into all unprotected display positions, from the home position to the end of the display position. The cursor is moved to the home position. The modified attribute bit is cleared for all character locations cleared.

## LF/ESC (Line Feed/Escape) Key

When actuated in the unshifted position, this key causes an ESC code to be sent to the host. The LF/ESC key for unprotected character locations performs an escape function. For protected locations, an audible alarm is generated and no action taken. Actuation of this key in the shifted position performs a line feed function and causes an LF code to be sent to the host.

## M REL/BREAK Key

Actuation of the M REL/BREAK key in the unshifted position causes the transmitted data signal to be held to a space (logical 0) condition for approximately 250 milliseconds. If a break is received, a parity error symbol is entered at the cursor position and the audible alarm is actuated.

Actuation of this key in the shifted position causes a manual release operation to be executed. This provides a controlware/firmware break function and sends an X-ON signal to the host. If a print operation is active, it will be aborted and the keyboard unlocked.

## NEXT/ ↵ (New Line/Carriage Return)

Activation of this key causes a new line code ($0A_{16}$) to be transmitted in Advanced mode or a carriage return code ($0D_{16}$) to be transmitted in Advanced native mode.

## →(Tab Forward) Key

Activation of this key causes the transmission of the tab sequence. If pressed in conjunction with the Control key it will set the current column as a tab stop. If protect is not enabled, the key will move the cursor to the first position following the low intensity field or next column tab, whichever comes first. If none are present, the cursor moves to the top of page. If protect is enabled, this key will cause the cursor to move right to the beginning of the next unprotected field or the next column tab that is set. If the cursor is at the beginning of an unprotected field or at a protected character position, the cursor will move to the beginning of the previous unprotected field or upper-left position, if neither is found.

## ← (Tab Backward) Key

Activation of this key causes the transmission of the back tab sequence. See the protect operation section if protect is enabled. If protect is not enabled, the key will move the cursor backwards to the start of the current or next non-dim field or to the next column tab position, whichever comes first. If none are present, the cursor moves to the top of the page. If pressed in conjunction with the CTRL key, it clears the current column as a tab stop.

## Cursor Control Keys (Up ↑, Down ↓, Left ←, Right → and HOME Keys)

Five keys in the numeric cluster are used to enable cursor movement. The cursor control keys must be used in conjunction with the Shift key or the Shift and CTRL keys. The numeric pad keys are also affected by the N PAD NORMAL/SHIFT parameter. Key functions are described as follows:

- Cursor Up - The shifted numeric 8 key moves the cursor up one line. If the cursor up key is activated in the top line, the cursor moves to the current column position in the last line. If the character position that the cursor is to occupy is protected, the cursor moves to the protected position.

- Cursor Down - The shifted numeric 2 key moves the cursor down one line. If the cursor down key is activated and the cursor is in the bottom line, the cursor moves to the current column position in top line. If the character position that the cursor is to occupy is protected, the cursor moves to the protected position.

- Cursor Left - The shifted numeric 4 key or Backspace key moves the cursor left one character position. If the cursor is in column 1 when the key is activated, the cursor moves to the last column position (80 or 132) of the previous line. If the cursor is at upper-left, it will move to the last column of the bottom line. If the position the cursor is to occupy is protected, the cursor moves to the protected position.

- Cursor Right - The shifted numeric 6 key moves the cursor right one character position. If the cursor is in the last column position (80 or 132) when the key is activated, the cursor moves to column 1 of the next line. If the cursor is at the last column of the bottom line, it moves to upper-left if page operation is selected or causes the screen to scroll in roll operation. If the position the cursor is to occupy is protected, the cursor moves to the protected position.

- Home - The shifted numeric 5 key moves the cursor to the home position. If the position the cursor is to occupy is protected, the cursor moves to the protected position following the home position.

CR/DEL (Carriage Return/Delete) Key

Unshifted, the CR/DEL key transmits a delete (DEL) code. Shifted, the CR/DEL key transmits a carriage return (CR) code.

Special Action Keys (+, -, x, ÷, HELP, ERASE, EDIT, BACK, LAB, DATA, STOP)

Eleven special action keys are available on the keyboard. Action keycodes and code sequences as defined by table 4-1 are transmitted to the host.

All keys identified in table 4-1 that are not function keys and support a host-specified optional code sequence or controlware sequence support the additional host defined action:

- A host-specified code sequence or a host-defined controlware sequence is executed in response to a key activation. The host-specified action includes a key identifying a code sequence or controlware sequence selector and the actual code sequence or controlware sequence.
- ERASE - This key performs a LINE CLEAR and carriage return or a destructive backspace in half-duplex. See Protect Operation later in this section.

BLOCK-TRANSMIT MODE

CYBER mode includes the capability to perform operator entry and editing on a page basis offline to the host. When the operator completes an activity, a block transmission is initiated by the operator to the host.

When alphanumeric keys are pressed in block mode, the associated 7-bit code is stored in display memory. Bit $2^7$ in display memory is not modified. Therefore, a graphic, PLATO, RAM generator character will be displayed if the previous code stored there was a graphic, PLATO, or RAM generator character. The attribute word for an alphanumeric entry is stored in background memory with the modified bit set. However, if the cursor occupied a protected position, no action is performed and the alarm will sound. If the operator initiates a function which requires the clearing of data, the modified attribute bit will be set for each position cleared.

If alphanumeric codes are received from the host while in block mode, they will be stored along with new attribute words and the modified bit will be cleared. If protect is enabled, the attributes will not be stored with received data, and if the cursor is at a protected position when data is received, a tab will be performed before storing the data.

## Initiating/Terminating Block Mode

The host uses two commands to initiate and terminate block mode transmission:

- Enter Block Mode - When block mode is active, the operator enters and/or changes data locally at the terminal on a page basis without host intervention. Block transmission is initiated by the operator when the current page activity is completed.
- Exit Block Mode - Terminates local terminal activity.
- Block mode selection can only be activated by host command (not an installation parameter). When the block mode operation is active, the host utilizes the following commands to properly support block mode operation.
  - Enable/Disable Keyboard - Enables/disables operator keyboard entry during block mode transmission activity.
  - Load/Define Function Keys - This allows the host to define any or all function keys to perform desired block mode code sequence or controlware sequence.

## Block Mode Operation

When an enter block mode command is received, the terminal disables immediate communications with the host. It performs all allowed operator actions, such as data-entry and editing functions locally (offline to the host). These actions are performed on a page basis.

The terminal remains in this state until the operator initiates a send function by activating anyone of the 15 function keys or ten special action keys (does not include the ERASE key, the L/INSRT/C key, or the L/DLETE/C key). This indicates to the terminal that the operator has completed the current page activity and requests transmission to the host. The terminal then performs the following:

- Enables communications with the host
- Disables keyboard to the operator
- Saves the current cursor position
- Resets cursor to upper left
- Sends prologue codes if loaded
- Sends all unprotected data in each field. Modified bits are cleared as codes are sent.
- Restores the cursor to original position
- Sends the function code sequence for the key that started transmission
- Sends current cursor XY position
- Sends a page block terminator (CR)
- Disables communications
- Enables the keyboard

## Keyboard Operation in Block Mode

The special-action and function keys and the L/INSRT/C and L/DLETE/C keys generate different operations in block mode than they do in character mode. These differences are described in the following paragraphs. The other keys operate the same as if in character mode but offline from the host.

### Special-Action and Function Keys

Function keys F1 through F15 and special action keys (+, -, X, ÷, HELP, EDIT, BACK, LAB, DATA, STOP) are used by the operator to initiate a block transfer to the host. The significance of any or all function keys is dependent upon the host or host application.

### L/INSRT/C and L/DLETE/C Keys

Unshifted, the insert-character and delete-character actions of these keys perform the same as for character and/or protect mode operations.

Shifted, these keys:

- Send an insert-line or delete-line keycode sequence
- Do not perform the insert-line or delete-line operation until the codes are echoed or sent back by the host

## PROTECT OPERATION

Protect operation in CYBER mode allows areas of the screen to be protected from operator entry. These areas are designated by the protect attribute bit. Each character position has a protect attribute bit which allows the host to select individual character positions for protection. The operator cannot alter these positions, but can move the cursor through them.

As alphanumeric codes are received from the host, they are displayed at the cursor position if protect is disabled. If protect is enabled and the current position is protected, a tab is performed before displaying the data. The host must disable the protect system to perform clear functions. The host can store data over protected positions.

## Host Communications

The host uses two commands to specify desired protect attribute bit conditions:

- Start Protect - Store protect bit for each succeeding character received.
- Clear Protect - Clear protect bit for each succeeding character received.

The state of the protect attribute bit by itself has no effect on normal terminal operation. The protect system active condition must be present before the terminal uses the protect attribute bit. The host uses two additional commands to select desired protect system conditions.

- Enable Protect System - All protected characters (protect attribute set) are protected from operator action and can only be changed by the host. Any operator alphanumeric or Control key entry causes an audible alarm to be generated and no operation is performed.
- Disable Protect System - All character positions can be entered/changed by operator action. If an operator changes a character location with its protect bit set, the character is entered and its associated bit is stored.

## Protect System Disabled

With the protect system off, all character positions can be entered/changed via the terminal keyboard.

## Protect System Enabled (Keyboard Operation)

Keyboard operation with the protect system enabled is described as follows. Operation of the keys is the same as for Character-Transmit Mode unless otherwise specified.

Alphanumeric and Control Code Entry

For unprotected character locations, actuation of the alphanumeric or control code key causes the code for that key to be processed the same as for the current mode operation.

For protected character locations, actuation of any alphanumeric key causes an audible alarm to be generated with no additional terminal action taken. The cursor does not move when this condition occurs.

→|, |← (Forward Tab and Back Tab) Keys

The →| (Forward Tab) key moves the cursor to the beginning of the next unprotected field next column tab that is set or the home position if found.

The |← (Back Tab) key causes the cursor to move left to the beginning of the current unprotected field or next column tab that is set. If the cursor is at the beginning of an unprotected field or at a protected character location, the cursor will move to the beginning of the previous unprotected field or upper-left position if neither is found.

NEXT/ ↵ (New Line) Key

In Advanced mode, the NEXT/New Line key moves the cursor to the first location of the next line.

In Advanced N mode, the NEXT/New Line key moves the cursor to the first location of the current line. If the Auto LF option is enabled, a line feed is also performed.

PRINT Key

Unshifted this key operates the same as standard character mode operation.

Shifted this key operation is the same as previously defined except that dimmed or protected characters are replaced with space codes.

## Protect System Active Display Operation

When the protect system is enabled, all character attributes remain unchanged. Display operation is controlled by the character attributes (blink, protect, underscore, dim, inverse, and blank), and the character set and edit control commands (line drawing, external loadable characters, scroll/page field, line length and format).

The character attribute commands enable the video display characteristic named with the protect system active. The line drawing and extended character commands cause the display to substitute the selected character set for part of the standard ASCII set.

The line length command selects 80- or 132-character line operation. All other functions are not affected.

## TOUCHPANEL OPERATION

CYBER mode supports touchpanel operation. This support is as follows:

- With graphics and touchpanel option installed, an 80-character-per-line display format must be in effect for graphics use. Therefore, only that format is referred to here.
- The touchpanel has 16 vertical and 16 horizontal strips. Each strip is 0.5 inches wide. Where the vertical and horizontal strips intersect is a 0.5-inch square cell. With 80 characters per line, the cell covers two lines by four characters.
- Touchpanel activated selection to a defined single character position located within the activated cell. Normally, this is intended to be the bottom center character located in the touchpanel cell.

## Line Display

When 30 lines are displayed, the top line is under the bottom half of the top strip of the touchpanel, and the last line is under the top half of the bottom strip. When 24 lines are displayed, the top 2 and bottom 2 strips of the touchpanel have no data under them.

NOTE

The displayable area of 30 lines by 80 characters is 7.5-inches high by 10-inches wide. The area covered by the touchpanel is 8 inches by 8 inches. This means 1 inch (8 characters) on each side is not covered by the touchpanel and 0.25-inches on top and bottom are not covered by the touchpanel.

The following charts show the X and Y positions (decimal) used when positioning the cursor.

| Char/ Line | TOUCHPANEL STRIPS LEFT TO RIGHT | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 80 | 11 | 15 | 19 | 23 | 27 | 31 | 35 | 39 | 43 | 47 | 51 | 54 | 58 | 62 | 66 | 70 |

| Lines/ Screen | TOUCHPANEL STRIPS LEFT TO RIGHT | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 24 | 1 | 1 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 24 | 24 |
| 30 | 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 30 |

## Host Communications

The host utilizes two special commands to support touchpanel operation. The host can enable or disable the function. If enabled, it is supported by operator initiated selection input to the host. The host can request terminal configuration status to determine if the touchpanel option is present.

## Terminal Operation

When a touchpanel operation is active, the following occurs:

1. The operator determines desired selection or position.
2. The operator touches the touchpanel at the desired position.

3. The terminal computes X/Y position activated.

4. The terminal moves cursor to X/Y position activated.

5. The terminal sends a Select function (RS, M code sequence) to the host.

6. The terminal sends a Read Cursor Address function to the host to specify the X/Y cursor position. Refer to table 4-2 for a definition. The terminal then sends a CR (OD) termination character.

## CYBER MODE HOST RECEIVED COMMANDS

Table 4-2 summarizes all host-received commands and I/O responses. Table 4-3 provides read parameter data word formats.

**NOTE**

Multiple word responses made by the terminal are subject to the Pacing parameter in mode installation parameters.

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| NOOP | NUL | 00 | No operation performed. |
| Print Form | SOH | 01 | Transfers all nondimmed displayed data to printer from beginning of current line to end of page. Dimmed data is sent as space code (20). Keyboard locks, comm data is received but ignored until end of operation (not lost). Printing may be aborted by actuation of SHIFT/M REL. Print completion is signaled by terminal transmitting an 06 (ACK) or, if the operation is aborted due to actuating SHIFT/M REL, by transmission of an 1E, 15 (RS, NAK) sequence. If there is no printer DTR when the Print Form command is received, an RS,NAK is sent. There is no completion response in large CYBER mode. |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| NOOP<br>ADV Mode (small) | STX | 02 | No operation. |
| Write Cursor Address<br>ADV N Mode (large) | STX | 02 | See Write Cursor Address (DLE). |
| Enable Blink | ETX | 03 | Blinks characters whose blink bit is set to 1 (refer to Start Blink command). Following power up or page erase, blink is automatically enabled. |
| Disable Blink | EOT | 04 | Disables character blinking on display page. |
| Read Cursor Address | ENQ | 05 | Causes terminal to send cursor address header code (1F) followed by codes containing column and row address. Column position transfers first and is numbered from left to right (00 through 4F) for 80-column mode. In 132-column mode, a 7E code preceeds the column position address, producing a code sequence of 7E, 00, 00 through 4F for the first 80 columns: 01, 00 through 34 for columns 81 through 132. The next code is line position numbering from top to bottom (00 through 1D). Row/column addresses may be biased to avoid codes 00 through 1F by enabling code bias parameter selection. When CODE BIAS is enabled, cursor position 00 equals 20. Addressing continues in normal binary progression through 6F for 80-column mode. The 132-column mode sequence is 7E, 20, 20 through 7E, 21, 44 for columns 0 through 132, respectively. The line position address is 20 through 3D for both 80- and 132-column modes. |
| NOOP<br>ADV Mode (small) | ACK | 06 | No operation. |
| Start Underline<br>ADV N Mode (large) | ACK | 06 | Sets the underline attribute bit to 1. |
| Alarm | BEL | 07 | Sounds audible alarm for 250 milliseconds. |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Home<br>ADV Mode (small) | BS | 08 | Moves cursor to home position as defined by parameter setting. |
| Cursor Left<br>ADV N Mode (large) | BS | 08 | Moves cursor left one character position. |
| NOOP<br>ADV Mode (small) | HT | 09 | No operation. |
| TAB<br>ADV N Mode (large) | HT | 09 | Causes cursor to be advanced to the first position following the next low intensity field or next column tab (whichever comes first) if protect is not enabled. Causes cursor to be advanced to the next unprotected field or next column tab (whichever comes first) if protect is enabled. Cursor will move to top of page if none present. Completion response is identical to Read Status response. No response sent in large CYBER mode. |
| New Line<br>ADV Mode (small) | LF | 0A | Moves cursor to first character position in next line. |
| Cursor Down<br>ADV N Mode (large) | LF | 0A | Moves cursor down one line while remaining in the same position. If on the last line, screen will scroll if roll enabled; cursor moves to top line if page enabled. |
| EOL (Erase to End of Line) | VT | 0B | Erases all unprotected characters from and including current cursor position to end of current unprotected field or the end of that line. Enters 20 in affected positions. Modified attribute bit for all cleared character positions are cleared. |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| EP (Erase Page) | FF | 0C | Erases all unprotected characters on screen. Cursor moves to home position. Enters 20 in affected positions. Clears background memory and enables blink if previously disabled. Return to enter normal data (clears enter blink, underscore, reduced intensity, dim, and blank). Modified attribute bits are cleared in character mode, set in block mode. |
| Carriage Return ADV Mode (small) | CR | 0D | Moves cursor to first character position in line that it is on. If the Auto Line Feed parameter is selected, a LF is performed. |
| Start Blink | SO | 0E | Sets blink bit to 1 in those succeeding characters received and stored in terminal memory. |
| Stop Blink | SI | 0F | Sets blink bit to 0 in succeeding characters received. |
| Write Cursor Address ADV Mode (small) | DLE | 10 | Interprets next characters as cursor column and row address. Cursor moves to position defined by addresses. Column address is numbered from left to right (00 through 4F) for 80-column mode. In 132-column mode, a 7E code preceeds the column position address, producing a code sequence of 7E, 20, 00 through 4F for columns 0 through 80, and 7E, 21, 00 through 33 for columns 81 through 132. Line position is numbered from top to bottom (00 through 1D). If column position code is greater than 4F in 80-column mode or 01, 33 in 132-column mode, cursor control logic wraps around. Line position operates in a similar manner (e.g., 1F equals 01). Row and column addresses may be biased in same manner as described for Read Cursor Address. |
| NOOP ADV N Mode (large) | DLE | 10 | No operation. |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Page Print<br>ADV Mode (small) | DC1 | 11 | Transfers to printer all displayed data from current line to end of page. Keyboard is locked and received data ignored until end of operation (not lost). Printing may be aborted by pressing SHIFT/M REL. Print completion is signaled by terminal transmitting an 06, or if the operation is aborted by actuating SHIFT/M REL, transmission of an RS,NAK (1E,15) sequence. If there is no printer DTR when the Page Print command is received, an RS,NAK is sent. No completion response is sent in large CYBER mode. |
| X-On<br>ADV N Mode (large) | DC1 | 11 | Enables transmission to the host or initiates continuation of suspended transmission from the host. |
| Roll Enable | DC2 | 12 | Enables roll mode; screen scrolls up one line each time cursor overflows bottom line or if a new line code is received when cursor is on bottom line, cursor moves to first character position on bottom line. Bottom line clears; top line is lost. Powering on terminal enables scroll feature. |
| Roll Disable<br>ADV Mode (small) | DC3 | 13 | Enables page mode; moves cursor to home position when new line code is received and cursor is on bottom line. |
| X-Off<br>ADV N Mode (large) | DC3 | 13 | Causes the terminal to temporarily halt transmission to the host until the X-On is received. When sent to the host, means data cannot be acted upon.<br><br>NOTE<br><br>This code cannot be placed inside a multiple code sequence. |
| Start Underscore<br>ADV Mode (small) | DC4 | 14 | Sets underscore bit to 1. Each succeeding displayed character received is underlined on the screen. |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| NOOP<br>ADV N Mode (large) | DC4 | 14 | No operation. |
| End Underscore | NAK | 15 | Sets underscore bit to 0. Each succeeding displayed character received is not underlined. |
| NOOP<br>ADV Mode (small) | SYN | 16 | No operation. |
| Roll Disable<br>ADV N Mode (large) | SYN | 16 | Roll disable (see DC3). |
| Cursor Up | ETB | 17 | Moves cursor up one line while remaining in same column (character) position. Stored data is not affected. |
| Skip | CAN | 18 | Moves cursor right one character position. Stored data is not affected. |
| Cursor Left<br>ADV Mode (small) | EM | 19 | Moves cursor left one character position. Stored data is not affected. |
| Home<br>ADV N Mode (large) | EM | 19 | Moves cursor to home as determined by the parameter bit. |
| Cursor Down | SUB | 1A | Moves cursor down one line while remaining in same column (character) position. If cursor is on the last line it will wrap around to the top. Stored data is not affected. |
| NOOP | ESC | 1B | No operation. |
| Start Dim | FS | 1C | Sets dim bit to 1. Each succeeding displayed character received is dimmed on the screen. |
| End Dim | GS | 1D | Sets dim bit to 0. Each succeeding displayed character received is displayed at full intensity on the screen. |
| NOOP<br>ADV Mode (small) | US | 1F | No operation. |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Backspace<br>ADV N Mode (large) | US | 1F | Move data left one position and clears the data. Protected data is not cleared. |
| NOOP | DEL | 7F | No operation. |
| Print Form | RS, SOH | 1E, 01 | See Print Form (SOH) |
| Page Print | RS, STX | 1E, 02 | See Page Print (DC1) |
| Tab<br>ADV Mode (small) | RS, EOT | 1E, 04 | If protect is not active, this will cause the cursor to advance to the first position following next low-intensity field or next column tab (whichever comes first). If none are present, moves to top of page. If protect is active, moves to the next unprotected area or column tab (whichever comes first). If none are present, moves to top of page. Completion response is identical to Read Status response. No response is sent in large CYBER mode. |
| NOOP<br>ADV N Mode (large) | RS, EOT | 1E, 04 | No operation. |
| Enable CR Delimiter | RS, ENQ, | 1E, 05 | Caused a CR delimiter (0D) to be added to certain host responses. |
| Home | RS, BS | 1E, 08 | See Home BS, (08) |
| Define Function or Action Key Code Sequence or Controlware Sequence | RS, HT, (V), (W) (X), (Y...), (Z) | 1E, 09, (V), (W) (X), (Y...), (Z) | Causes a code sequence or controlware sequence to be defined by the host.<br>V = Key identifier and address pointer<br>W = Function<br>X = Address<br>Y = Code sequence or controlware<br>Z = Specified delimiter<br>The terminal will respond with an ACK if all codes are received okay and an RS,NAK if not. No response is sent in large CYBER mode. |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Back Tab | RS, VT | 1E, 0B | Causes the cursor to move back to the first position following a preceding low-intensity field, following a preceding protected field position at preceding column tab or to Home position, if none are encountered. See Back Tab key for more detailed definition. Completion response is identical to Read Status response. No response is sent in large CYBER mode. |
| Read Attribute | RS, SO<br>(X), (Y) | 1E, 0E<br>(X)<br>(Y) | Causes terminal to respond with two words that indicate the attributes of character at cursor position. Cursor is not advanced; stored data is not affected. Data word one bit significance is: $2^0$ - internal program use; $2^1$ - underscore; $2^2$ - blink; $2^3$ - reduced intensity; $2^4$ and $2^5$ - set to logical 1. If data bit $2^6$ is logical 1, character displayed at cursor position is not an alphanumeric or control character. Refer to tables 2-1 through 2-8. If $2^6$ a logical 1 and data word at cursor-position falls in columns 4, 5, 6, or 7, symbol is extended character. If data word falls in columns 2 or 3, symbol is one of line drawing set (table 2-9). Data word two bit significance is: $2^0$ - modified position; $2^1$ - protected position; $2^2$ - blank; $2^3$ - inverse; $2^4$ and $2^5$ - set to logical 1; $2^6$ - set to logical 0. |
| Read Parameter | RS, SI | 1E, 1F | See RS, DC3 |
| Read Data | RS, DLE | 1E, 10 | Causes data word stored in memory at cursor position to be transferred to interface. Cursor is not advanced. Seven data bits are transferred. Determining if the code represents an alphanumeric character, line drawing, extended character, or control code requires that the attribute character be read. Refer to read attribute command and buffer mode operation. |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Page Print<br>ADV Mode (Small) | RS, DC1 | 1E, 11 | See Page Print (DC1). |
| X-ON<br>ADV N Mode (large) | RS, DC1 | 1E, 11 | This is not a normal sequence. If the DC1 is following an RS, the X-ON function will be performed (see DC1) but the next code received will be acted upon as if an RS preceded it. |
| Read Parameter<br>ADV Mode (small) | RS, DC3 | 1E, 13 | Causes terminal to transmit settings of terminal operating parameters. Settings are sent out in data words preceded by sequence 02, 06, 25 and terminated with a Read Status response. See table 4-4. No response sent in large CYBER mode. |
| X-OFF<br>ADV N Mode (large) | RS, DC3 | 1E, 13 | This is not a normal sequence. If the DC1 is following an RS, the X-ON function will be performed (see DC1) but the next code received will be acted upon as if an RS preceded it. |
| Read Status | RS, DC4 | 1E, 14 | Causes terminal to respond 02, 06, 06 (STX, ACK, ACK), if all preceding self-test operations were completed successfully. The response 02, 06, 15 (STX, ACK, NAK) is transferred if any self test failed. |
| Initiate Test | RS, SYN | 1E, 16 | Causes terminal to perform self-test (Test 2) operation; no response to further commands until self test is completed. Terminal signals completion of self test by automatically sending a Read Status response. Refer to Self-Test Routines paragraph for further description. |
| Skip | RS, CAN | 1E, 18 | See Skip (CAN, 18) |
| Backspace | RS, EM | 1E, 19 | See Backspace (EM, 19) |
| Cursor Down | RS, SUB | 1E, 1A | See Cursor Down (SUB, 1A) |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Line Drawing | RS, FS | 1E, 1C | Causes terminal to interpret any following data words received from 20 to 3F as line drawing characters. Refer to table 2-9 for codes. |
| Basic Char | RS, GS | 1E, 1D | Causes terminal to interpret received data as normal characters. |
| NOOP | RS, SP thru RS, . | 1E, 20 thru 1E, 2E | No operation. |
| NOOP | RS, ø thru RS, > | 1E, 3ø thru 1E, 3E | No operation |
| Clear field<br>• Low Intensity<br>• High Intensity<br>• All Data | RS, ?<br>RS, @<br>RS, P | 1E, 3F<br>1E, 40<br>1E, 50 | Causes terminal to clear all unprotected data from cursor position to end of page for all data or only unprotected high- or low-intensity areas as selected. No response is provided to I/O commands during operation. Modified attribute bits for all cleared character positions are cleared. The Read Status is sent back to indicate operation complete. No response is sent in large CYBER mode. |
| Initiate Host DLL | RS, A | 1E, 41 | Initiates a host specified downline load (DLL). The host DLL command is followed by standard load blocks until all load blocks are loaded or an uncorrectable error occurs. If the load completes successfully, control is transferred to the loaded controlware. If unsuccessful, terminal responds with RS, NAK (1E, 05). |
| Exit Host DLL | RS, B | 1E, 42 | Reserved for host command to loaded controlware. |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Model Report Request | RS, C,(n) | 1E, 43, (n) | n = 30 Terminal installation parameters<br>n = 31-36 Requesting that modes NVM only<br>n = 37 Active status from RAM<br>The terminal sends the following code sequence to the host system:<br>1E Header Code<br>6F Header Code<br>23 Indicates model report request data follows<br>21 Indicates a Viking X terminal<br>XXX Configuration Code; See Model Report Request<br>YYY Firmware code<br>ZZZ Termination code<br><br>NOTE<br><br>Terminal and NVM data is only valid while running in CYBER mode (Mode 1). |
| Start Inverse | RS, D | 1E, 44 | Set inverse bit of each succeeding character received to 1. |
| End Inverse | RS, E | 1E, 45 | Clear inverse bit of each succeeding character received. |
| Print I/O | RS, F | 1E, 46 | Causes terminal to direct all received data, and transmitted data in half duplex, or local, to printer interface. Completion response is identical to Read Status. No response is sent in large CYBER mode. |
| Set All Protect Bits | RS, G | 1E, 47 | This command will disable Protect and set the protected bit in the attribute code for every character position.<br><br>NOTE<br><br>If the Protect Enable Command is received before any unprotected data is displayed, the terminal will lock up. |
| NOOP | RS, I thru M | 1E, 49 thru 4D | No operation. |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Delete Character | RS, N | 1E, 4E | Deletes one character. All characters to the right of the cursor are shifted left one position. If protect enable is active, shift occurs only up to protected data. |
| Insert Character | RS, O | 1E, 4F | Inserts one space character. Character in cursor position and all characters to the right of the cursor are shifted right one position. If protect enable is active, shift occurs only up to protected data. |
| Clear All Data | RS, P | 1E, 50 | See Clear Fields. |
| Delete Line | RS, Q | 1E, 51 | Causes all unprotected line data and associated highlight fields below cursor and within the logical page or unprotected area limits to be moved up one position; current line is lost; bottom line is cleared. No response to I/O commands during operation. Completion response is identical to Read Status response. No response is sent in large CYBER mode. Modified attribute bits for all cleared character positions are cleared. |
| Insert Line | RS, R | 1E, 52 | Causes all unprotected line data and associated highlight field on current line to be relocated one line down; bottom line within logical page or unprotected area is lost; current line is cleared. No response to I/O commands is provided during operation. Insert line timing and completion response are identical to delete line. Modified attribute bits for all cleared character positions are cleared. |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Load RAM Extended Character Generator* | RS,S,(W), (X), (Y), (Z) | 1E, 53,(W) (X), (Y), (Z) | Causes the terminal to interpret the characters following the RS, S, [1E, 53 command (W) (X), (Y), (Z)] as information concerning the RAM character generator. Loading the generator requires the character be specified (40 through 7F, six bits, 64 characters). It also requires the starting scan be specified (one of sixteen numbered top to bottom, four bits). The dot patterns may then be specified (eight possible dots); left to right, lowest to highest order bit position. The data words are formatted as follows:<br>• Word 1 (W) - Character Code. Code must be between 40 through 7F. Codes outside this field cause an RS NAK to be sent to the host.<br>• Word 2 (X) - Start Scan Count. Bits $2^0$ through $2^3$ contain the start count. $2^4$ must be 0, $2^5$ must be 1, $2^6$ must be 0.<br>• Word 3 (Y) - Dot Pattern. Dot Patterns are sent in groups of 2. Bits $2^0$ through $2^3$ of the first word are the upper 4 dots and $2^0$ through $2^3$ of the second word are the lower 4 dots. Bit $2^4$ must be 0, $2^5$ must be 1, $2^6$ must be 0 for first word and 1 for the second word. If words have an error, an RS, NAK will be sent to host when the termination code is received.<br>• Word 4 (Z) - Termination Code CR. An ACK will be sent to host if no errors were encountered, otherwise an RS, NAK is returned. No response is sent in large CYBER mode. |

*Resequence per dual hexadecimal code.

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Extended Character* | RS, T,(X) | 1E, 54,(X) | Causes terminal to interpret (X) as character to be displayed from RAM character generator. Code must be in field 40 through 7F. Codes outside of this field cause entry of parity error symbol. |
| Field Scroll Up | RS, U | 1E, 55 | Causes each line to be relocated down one position between upper-and lower-field delimiters. Uppermost line in scroll field is lost; bottom line in scroll field is cleared. If protect enable is active, only lines containing unprotected data will be moved. No response to I/O commands is provided during operation. Completion response is identical to Read Status. No response is sent in large CYBER mode. |
| Field Scroll Down | RS, V | 1E, 56 | Causes each line to be relocated down one position between upper-and lower-field delimiters. Lowest line is lost; uppermost line in scroll field is cleared. If protect enable is active, only lines containing unprotected data will be moved. No response to I/O commands is provided during operation. Completion response is identical to Read Status. No response is sent in large CYBER mode. |
| Set Scroll Field | RS,W,(U,)(L) | 1E, 57, U, L | Causes terminal to store upper- and lower-line addresses of scroll page field. Refer to X/Y position command for line addressing definition. Receipt of line numbers other than 1 through 30 causes entry of line 30 and 1. Address biasing is supported if selected.<br><br>NOTE<br><br>This works in conjunction with Field Scroll Up and Down. |

*Resequence per dual hexadecimal code.

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| NOOP | RS, X | 1E, 58 | No operation. |
| Erase | RS, Y | 1E, 59 | See RS,] 1E, 5D |
| NOOP | RS, Z | 1E, 5A | No operation. |
| NOOP | RS, [ | 1E, 5B | No operation. |
| NOOP | RS, \ | 1E, 5C | No operation. |
| Erase | RS, ] | 1E, 5D | All character locations in the current unprotected field are cleared to spaces and the cursor is moved to the beginning of the unprotected field. |
| NOOP | RS, ^ | 1E, 5E | No operation. |
| NOOP | RS, _ | 1E, 5F | No operation. |
| Blind Printer | RS, DEL | 1E, 7F | Causes terminal to stop transferring received and transmitted data to printer. Initial value selected by parameter. RS, DEL is transmitted to printer. The completion response is identical to Read Status. No response is sent in large CYBER mode. |
| NOOP | RS,DC2,SP thru RS,DC2,? | 1E, 12, 20 thru 1E, 12, 3F | No operation. |
| Enter ADV mode (small) | RS, DC2, A | 1E, 12, 41 | Enter advanced (ADV) mode of operation. |
| Enter ADV N mode (large) | RS, DC2, B | 1E,12, 42 | Enter Advanced Native (ADV N) mode operation. |
| NOOP | RS, DC2, C | 1E, 12, 43 | No operation. |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Start Block Mode Send | RS, DC2, D | 1E, 12, 44 | The terminal sends all unprotected data characters. See Block-Transmit Mode for format of data. A delimiter indicates the end of operation. |
| Reserved | RS, DC2, E | 1E, 12, 45 | No operation. |
| Reserved | RS, DC2, F | 1E, 12, 46 | No operation. |
| Set 132 Character Line | RS, DC2, G | 1E, 12, 47 | Causes the terminal to display 132 characters/line. If the initial line length is 80 characters per line, the display is cleared and cursor is moved to Home. |
| Set 80 Character Line | RS, DC2, H | 1E, 12, 48 | Causes the terminal to display 80 characters/line. If the initial line length is 132 characters per line, the display is cleared and cursor is moved to Home. |
| Start Protect | RS, DC2, I | 1E, 12, 49 | Set Protect bit of each succeeding character received to a 1. |
| Clear Protect | RS, DC2, J | 1E, 12, 4A | Clear Protect bit of each succeeding character received to a 0. |
| Enable Protect | RS, DC2, K | 1E, 12, 4B | Protected characters (with their protect bit set) are protected from operator action and can only be changed by host action. |
| Disable Protect | RS, DC2, L | 1E, 12, 4C | Disables protected characters on the display page. If an operator changes a character location, its protect bit is determined by the state of the start/ clear protect bit flag. |
| Disable Keyboard Display | RS, DC2, M | 1E, 12, 4D | Disable keyboard entry, until reenabled by host or a reset condition. |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Enable Keyboard Display | RS, DC2, N | 1E, 12, 4E | Enable keyboard entry. |
| Disable Display | RS, DC2, O | 1E, 12, 4F | Disables change to display refresh memory for normal terminal operation. All incoming commands are ignored until the Enable Display is received. |
| Enable Display | RS, DC2, P | 1E, 12, 50 | Enables normal display operation. |
| Disable Touchpanel | RS, DC2, Q | 1E, 12, 51 | Disables input from the touchpanel. |
| Enable Touchpanel | RS, DC2, R | 1E, 12, 52 | Enables input from the touchpanel. |
| Mode Select | RS, DC2, S, (n) | 1E, 12, 53, (n) | Selects mode n = 30-37 (0-7) and transfers control to selected mode. Mode enable and mode security are bypassed. See Auto-Select parameter in Terminal Installation parameter. If n is outside of range, an RS, NAK is returned. |
| Select Bidirectional Port N | RS, DC2, U, (N) | 1E, 12, 55, (N) | Selects bidirectional port N where N = 0-1. When selected, the port can transmit transparent bidirectional data until a deselect is issued. See Host Select Bidirectional port. |
| Write New Mode Parameters | RS, DC2, V, (Y), (Z) | 1E, 12, 56, (Y), (Z) | Causes the terminal to write the RAM (dynamic) parameter memory specified. Y = Write data to parameter memory in format specified by Write New Parameters section. Z = CR Delimiter.<br><br>NOTE<br><br>To change NMV, see RS, DC2, 0 |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Set Column Tab | RS,DC2,W, | 1E, 12, 57 | Causes the terminal to set a column tab for the current column. |
| Clear Column Tab | RS,DC2,X, | 1E, 12, 58 | Causes the terminal to clear the column tab position of current column. |
| Clear All Tabs | RS,DC2,Y | 1E, 12, 59 | Clear all column tabs. |
| Disable CR Delimiter | RS, DC2, Z | 1E, 12, 5A | Disables the CR delimiter for multiple code and controlware sequences. |
| Start Blank | RS,DC2,[ | 1E, 12, 5B | Set the blank attribute bit. |
| End Blank | RS,DC2,\ | 1E, 12, 5C | Clear the blank attribute bit. |
| Select 24 lines | RS,DC2,] | 1E, 12, 5D | Set 24 lines. |
| Select 30 lines | RS,DC2,^ | 1E, 12, 5E | Set 30 lines. |
| NOOP | RS,DC2,_ | 1E, 12, 5F | No operation. |
| NOOP | RS,DC2,` | 1E, 12, 60 | No operation. |
| Enter Block Mode | RS, DC2, a | 1E, 12, 61 | Enter block mode operation. |
| Exit Block Mode | RS, DC2, b | 1E, 12, 62 | Exit block mode operation. |
| NOOP | RS, DC2, c | 1E, 12, 63 | No operation. |
| NOOP | RS,DC2, d | 1E, 12, 64 | No operation. |
| Turn On Indicator | RS, DC2, e, (N) | 1E, 12, 65, (N) | Causes terminal to turn on indicator specified by (N).<br>N = 30: Alert indicator<br>N = 31: Programmable indicator 1<br>N = 32: Programmable indicator 2<br>N = 33: Programmable indicator 3<br>N = 34: Message indicator |

TABLE 4-2. CYBER MODE RECEIVE AND I/O RESPONSES (CONTD)

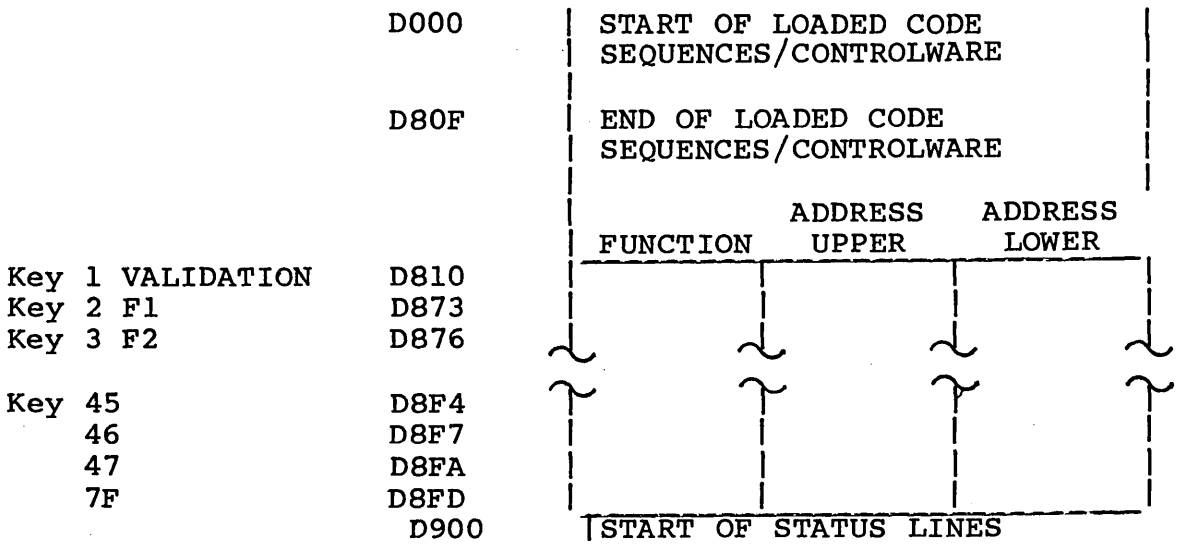
| COMMAND NAME | ASCII MNEMONIC | HEX CODE | TERMINAL RESPONSE |
|---|---|---|---|
| Turn Off Indicator | RS, DC2, f, (N) | 1E, 12, 66, (N) | Causes terminal to turn off indicator specified by (N).<br>N = 30: Alert indicator<br>N = 31: Programmable indicator 1<br>N = 32: Programmable indicator 2<br>N = 33: Programmable indicator 3<br>N = 34: Message indicator |
| NOOP | RS, DC2, g | 1E, 12, 67 | No operation. |
| Driver Request | RS, DC2, h | 1E, 12, 68 | Causes the terminal to test for presence of a driver. A Status response is sent to the host and control is passed to the driver: RS, NAK if transfer not successful. |
| Enable Typamatic | RS, DC2, i | 1E, 12, 69 | Enable typamatic keys defined by table 4-1. |
| Disable Typamatic | RS, DC2, j | 1E, 12, 6A | Disable typamatic keys defined by table 4-1. |
| SHIFT Numeric Pad | RS, DC2, k | 1E, 12, 6B | Causes the numeric keypad to operate as if the Shift key were active. |
| Normal Numeric Pad | RS, DC2, l | 1E, 12, 6C | Returns the numeric keypad to normal operation. |
| Start Validation | RS, DC2, m | 1E, 12, 6D | Sets the character validation attribute bit for each character stored. |
| End Validation | RS, DC2, n | 1E, 12, 6E | Clear the character validation attribute bit for each character stored. |
| Store Mode Parameters in NVM | RS,DC2, o | 1E, 12, 6F | Causes the active mode parameters in RAM to be stored into the NVM memory as the new default parameters. |
| Host Execute Loaded Controlware | RS,DC2, p-DEL | 1E, 12, 70-7F | If the host has loaded controlware for the appropriate function, a call will be made to the starting address. If the host has not loaded any controlware for the appropriate function, this will be a no operation. |

TABLE 4-3. READ PARAMETER DATA WORD FORMAT

| | WORD 1 | WORD 2 | WORD 3 | WORD 4 | WORD 5 |
|---|---|---|---|---|---|
| b0 | 0 = PAGE<br>1 = ROLL | 0 = EOL BELL<br>1 = DISABLE BELL | 0 = PAR ODD<br>1 = PAR EVEN | Baud Rate $2^3$ | 1 |
| b1 | 0 = HALF DUP<br>1 = FULL DUP | 0 = AUTO LF<br>1 = Normal | 0 = 2 STOP BITS<br>1 = 1 STOP BIT | Baud Rate $2^2$ | 1 |
| b2 | Printer DSR (READY) | 1 | 0 = PARITY DISABLE<br>1 = PARITY ENABLE | Baud Rate $2^1$ | 0 = DTR SWITCHED<br>1 = DTR CONSTANT |
| b3 | Bidirec-tional Port DSR (READY) | 1 | 0 = DATA ONLY<br>1 = NORMAL | Baud Rate $2^0$ | 0 = RTS SWITCHED<br>1 = RTS CONSTANT |
| b4 | 1 | 1 | 1 | 1 | 1 |
| b5 | 1 | 1 | 1 | 1 | 1 |
| b6 | 1 | 1 | 1 | 1 | 1 |

## Host-Specified Code Sequence/Controlware

The keyboard has 45 keys that can be redefined by the host. The host can specify if a key is to act as previously defined, send a different code sequence, or execute loaded controlware. A 2K block of RAM is reserved for this function (D000 to D8FF bank 4). If the disk controlware is not going to be used, the next 4K (C000 to CFFF) can be used for defining the keys. The first 240 locations make up a table used by the firmware to determine which operation is to be performed on each key.




- Host Interface - The host can specify keys and load code sequences or controlware in the following manner.

RS, HT, (V), (W), (X), (Y...), Z

V = Key identifier
W = Function
X = Address
Y = Code sequence or controlware code
Z = Terminator code

- V (Key Identifier)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 30 | VALIDATION | | | | | | |
| 31 | F1 | 3E | F14 COPY | 4B | LAB | 58 | 7 |
| 32 | F2 | 3F | F15 □ | 4C | DATA | 59 | 8 ↑ |
| 33 | F3 | 40 | TAB →\| | 4D | STOP | 5A | 9 |
| 34 | F4 | 41 | TAB \|← | 4E | INSRT | 5B | 0 |
| 35 | F5 | 42 | NEXT ↵ | 4F | DLETE | 5C | , |
| 36 | F6 | 43 | + | 50 | CLEAR | 5D | . |
| 37 | F7 | 44 | - | 51 | PRINT | 5E | |
| 38 | F8 ⇦ | 45 | X | 52 | 1 | 5F | PROLOGUE |
| 39 | F9 SUPER | 46 | ÷ | 53 | 2 ↓ | 60-6F | NOT USED |
| 3A | F10 SUB | 47 | HELP | 54 | 3 | 70-7F | HOST |
| 3B | F11 MICRO | 48 | ERASE | 55 | 4 ← | | CONTROL- |
| 3C | F12 FONT | 49 | EDIT | 56 | 5 HOME | | WARE |
| 3D | F13 TERM | 4A | BACK | 57 | 6 → | | FUNCTIONS |

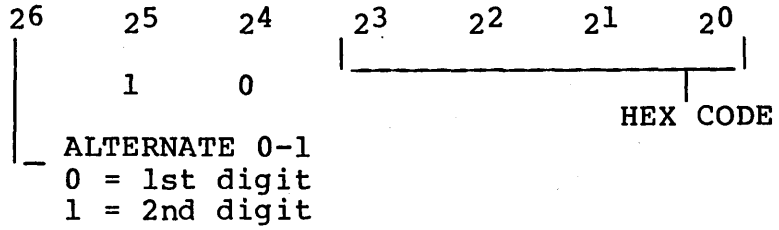
- W (Function)

30 = Disable - send normal code - default value
31 = Host specified code sequence
32 = Host defined controlware
33 = Host validation controlware
Default for all keys is 30.

- X (Address)

NOTE: This parameter is not required if W = 30.

This parameter is four codes wide. It contains the address where the code sequence/controlware starts. The address is converted to a modified hex value for each digit sending the highest digit first. The modified hex value is:

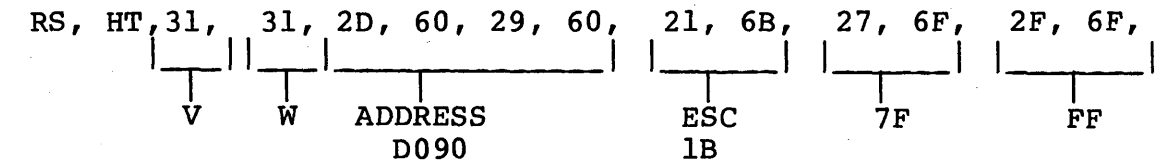



Example: Address D090 - RS, HT, V, W, 2D, 60, 29, 60

- Y (Code Sequence/Controlware Code)

Note: This parameter is not required if W = 30. This is the information that is stored in RAM starting at the address previously loaded. These words are formatted like the address.

- If information being loaded is a code sequence, the first word (two codes) will be FF. The following example indicates how the host would change F1 to send a code of 7F with the ESC key when pressed (store code at D090). The byte count and codes are stored in memory.



- If the information being loaded is controlware, the FF is not needed. Information is stored until the termination code is detected.

  If a parity error, framing error, or improper bit 6 occurs, data will be ignored until the termination code is received at which time an RS, NAK will be sent back to the host. If no error occurred, an ACK will be returned. No response will be returned in CYBER mode.

  -Z (Termination Code)

  CR (0D) is the termination code.

- Keyboard Operation Character Mode

  As each key is pressed, it will be tested first to see if it is a key that the host can modify. If it is, the firmware will next test the function code in the table.

  - If it is a disable code (30), the normal operation will be performed.

  - If it is a host-specified code sequence (31), the controlware will go to the address specified and send codes until the FF is found.

  - If it is a host-defined controlware (32), a call will be made to the address specified.

- Keyboard Operation Block Mode

  As each key is pressed, it will be tested first to see if if it is a key that the host can modify. If it is, the firmware will next test the function code in the table.

  - If it is a disable code (30), the normal operation will be performed.

  - If it is a host-specified code sequence (31), the block send is initiated. The host-specified code sequence will be sent in place of the normal function keycode.

  - If it is a host-defined controlware (32), a call will be made to the address specified.

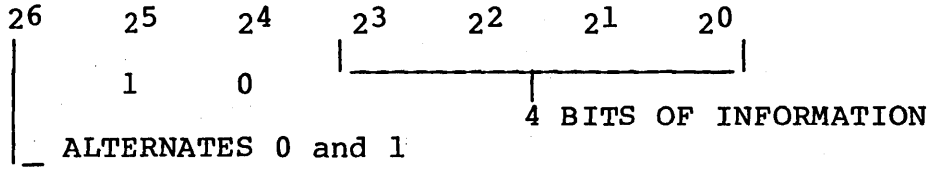
Model Report Request

The host can request the terminals model, configuration, and parameters using this request (RS, C, (n)). The CYBER mode will respond to this request with the following:

```
1E      HEADER CODE
6F      HEADER CODE
23      INDICATES MODEL REPORT REQUEST DATA
21      INDICATES A 721 DISPLAY TERMINAL
XXX
 |
 |      -- CONFIGURATION AND PARAMETERS (See definitions below)
 |
XXX
 Y      FIRMWARE REVISION LEVEL
 Z      TERMINATION CODE
```

Each code sent contains 4 bits of information.

EXAMPLE




Configuration and Parameters

- Word 1

```
20
21      > Current Mode Active
22
23        0
```

- Word 2

```
20 = Not Used
21 = Not Used
22 = Battery Low
23 = ROM PACK Option Installed, 0 = ROM PACK in
```

- Word 3

```
20 = Channel A DSR
21 = Channel A SCTS
22 = Channel B DSR      > If no dual port present
23 = Channel B SCTS       all bits = 0
```

- Word 4

  $2^0$ = Not Used
  $2^1$ = Not Used
  $2^2$ = Not Used
  $2^3$ = Not Used

The next 32 words are determined by the n value.

If n = 30, the Terminal Installation Parameters from NVM are sent.

If n = 31-36, the Mode Installation Parameters from NVM are sent.

If n = 37, the Active Mode Parameters from RAM are sent.

For n = 30, the Terminal Installation Parameters are sent as follows:

- Word 5 - See F2, 1 through 4, of Terminal Installation Parameters
- Word 6 - See F2, 5 and 6, and F3, 1 and 2, of Terminal Installation Parameters
- Word 7 - See F3, 3 through 6, of Terminal Installation Parameters
- Word 8 - See F4, 1 through 4, of Terminal Installation Parameters
- Word 9 - See F4, 5 and 6, and F5, 1 and 2, of Terminal Installation Parameters
- Word 10 - See F5, 3 through 6, of Terminal Installation Parameters
- Word 11 - See AS-AUTO SELECT of Terminal Installation Parameters
- Word 12 - See X - Delta X of Terminal Installation Parameters
- Word 13 - See Y - Delta Y of Terminal Installation Parameters
- Word 14 - See L - Language of Terminal Installation Parameters
- Word 15-18 - See ID = Identification of Terminal Installation Parameters
- Word 19 - See PORT A - Parameters of Terminal Installation Parameters

- Word 20 - See PORT A Baud of Terminal Installation Parameters
- Word 21 - See PORT B - Parameter of Terminal Installation Parameters
- Word 22 - See PORT B - Baud of Terminal Installation Parameters
- Word 23-36 - Not Used

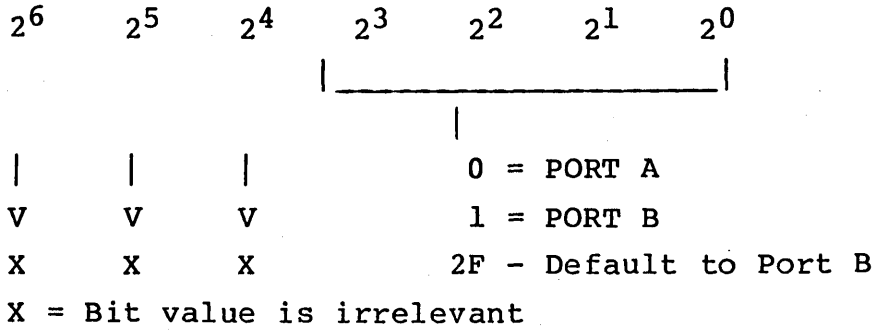
If n = 31 to 36, only that mode's parameters are sent from NVM.
If n = 37, the active Mode Parameters are sent from RAM as follows:.

- Word 5 - See F2, 1 through 4, of Mode Installation Parameter
- Word 6 - See F2, 5 and 6, F3, 1 and 2, of Mode Installation Parameter
- Word 7 - See F3, 3 through 6, of Mode Installation Parameter
- Word 8 - See F4, 1 through 4, of Mode Installation Parameter
- Word 9 - See F4, 5 and 6, F5, 1 and 2, of Mode Installation Parameter
- Word 10 - See F5, 3 through 6, of Mode Installation Parameter
- Word 11-14 - See OPR-DF of Mode Installation Parameter
- Word 15-26 - See A-DIAL of Mode Installation Parameter
- Word 27-28 - See DF of Mode Installation Parameter
- Word 29 - See T of Mode Installation Parameter
- Word 30 - See R of Mode Installation Parameter
- Word 31-34 - See ACCESS of Mode Installation Parameter
- Word 35-36 - Not Used

- Y Firmware Revision Level - Two codes will be sent:
  - 1st code 1 to F = Release level
  - 2nd code 1 to F = Revision level
- Z Termination Code
  - CR (0D)

## Host Select Bidirectional Port

In CYBER mode, the host can select and send or receive information to either Port A or Port B of the optional bidirectional RS-232-C ports. The parameter bits for both ports must be set up before entering CYBER mode. The host must make certain that the transmit buffer is empty by ensuring X-On is active. When the terminal receives the host select bidirectional port sequence, it will interpret the next code (port and word size) as follows:




Ports A and B have no parameters to select word size. The default word size is 7 bits. The terminal will return an ACK to the host to indicate end of terminal data. The keyboard will be locked. DTR, RTS and CO will be sent to the selected port. At this time all data received from the host will be sent to the selected port and will not be acted upon by the display. As data is received from the port, it is placed into the comm output buffer to be sent to the host. The standard host communication protocol is used to send the data as if it came from the keyboard (Full/Half duplex, Constant/Switched RTS, Data Only).

If an RS is received from the host, it is not sent to the port. The next code is examined as follows.

- If it is an RS, a single RS will be sent to the port. This allows the host to send an RS to the port.
- If it is a DC2, the bidirectional port will be deselected and the host interface will be returned to the parameter setting for word size and parity.
- If it is anything except the DC2, the code will be sent to the port and the previous RS ignored.
- If a parity error is received from the host, a 7F is sent to the port.

- Receiving X-OFF/X-ON - Transmit off/Transmit on (X-Off/X-On) is supported by large CYBER mode. Each operating mode is defined in the following text.

- Character mode - When the X-Off is received from the host, all codes being sent to the host will be placed in the comm output buffer until the buffer becomes full. At this time, the keyboard is locked. When the X-On is received, the buffer will send and the keyboard unlocked.

- Block mode - When the X-Off is received from the host, no information will be sent to the host. Keyboard entry is still allowed. If a send function is initiated, the comm output buffer will be filled and no other operations will be performed until the X-On is received. When X-On is received, transmission will continue. The keyboard will remain locked until cleared by the completion of the block send.

- Bidirection Port - When the bidirectional port is selected, X-On must be active. In large CYBER mode, the X-ON and X-OFF can be placed anywhere in the data stream.

- Sending X-OFF/X-ON - This feature is supported in both large and small CYBER modes. The terminal has a receive buffer of 992 characters. If this buffer ever reaches 768 characters, the X-OFF will be sent to the host and the X-ON sent when the count goes down to 256.

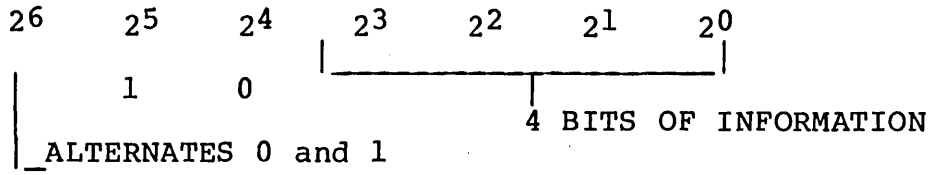
## Write New Mode Parameters

The host can temporarily override the CYBER mode installation parameters by changing them in the active RAM table.

NOTE

The host cannot change the Nonvolatile Memory (NVM) table.

When CYBER mode receives the write new mode parameter command, it will input up to 32 codes and replace the active mode parameter words with them. The 32 words correspond to the 32 groups which are contained in the Mode Installation Parameters section. The 32 codes are received in the following format.




The first code received should have $2^6 = 0$. If an error is received during the 32-code sequence, data will be ignored until the termination code is received. At this time, an RS, NAK is sent to the host. If no errors are detected, an ACK is sent to the host and control will be sent back to cause the new codes to be implemented. This will clear the screen and reset the cursor. Note: No response is sent in large CYBER mode.

The resident diagnostics contain three tests. Test 1 runs after a power up or RESET and requires no operator verification or intervention. It should take less than 6 seconds to run. Test 2 is a host-initiated RAM test. Test 3 contains a setup raster and other tests that require operator verification or intervention. Resident diagnostics test the basic hardware and some options. In test 1, if any failure occurs, a message will be displayed, an error flag will be set and the MODE SELECTION MENU displayed. If no errors are detected, no messages will be displayed and the mode selection process will begin.

## DESCRIPTION

### TEST 1 (QUICKLOOK)

Test 1 runs after power on or by pressing the RESET switch. It is also run if test 2 is run, but the RAM test is replaced by a shifting pattern test. Test 1 contains the following subtests:

- Character RAM Test - A 55 hex and AA hex are written, read and compared throughout the RAM Character Generator memory. A failure of this test results in displaying CHARACTER RAM FAIL on the next line of the CRT. Nothing will be displayed if there is no failure.

- RAM Test - 55 hex and AA hex are written, read, and compared throughout the 64K resident RAM. A failure of this test results in displaying RAM FAIL XXXX AA EE on the next line of the CRT (assuming a failure mode does not prevent display) where: XXXX = failing address; AA = actual data read; EE = expected data read. Nothing will be displayed if there are no failures. Parity error interrupts are enabled during the RAM test, and a failure will be reported if a parity error is detected.

- Graphics RAM Test - If this option is present, the graphics RAM will be selected and a 55 hex and AA hex pattern will be stored and tested. A failure of the test will result in a display of GRAPHICS FAIL XXXX, AA EE on the next line. Nothing will be displayed if there are no failures.

- Graphics Bulk Write Test - If this option is present, a bulk write function will be performed, writing all zeros into the graphics RAM. If the bulk write busy status does not set and clear, the message GRAPHICS FAIL will be displayed. The same message will be displayed if the graphics RAM does not contain all zeros after the completion of the bulk write function.

- ROM Test - A checksum is run on each memory chip of the resident ROM. A failure of this test results in a display of ROM FAIL XX XX XX. The first value is ROM 1, the second is ROM 2, and the third is ROM 3. A value other than 00 indicates a failure. A checksum will be run on the nonvolatile memory (NVM). A failure of this test results in a display of NVM FAIL on the next line of the CRT. Nothing will be displayed if there are no failures.

- Loopback Test - The test transfers 128 characters from the processor to the communications UART which is conditioned to echo rather than transmit all data. The data is tested as it is received. Transmitter speed is fixed at 9600 baud. A failure of the test results in a display of COMM FAIL on the next line of the CRT. The same test is conducted on the UART to the keyboard. A failure of this test results in a display of KEYBOARD FAIL on the next line of the CRT.

- Timer Test - The timer will be started for a 5-millisecond delay with the timer interrupt enabled. If a timer interrupt does not occur before 6 milliseconds, interrupts will be disabled and the message TIMER FAIL displayed.

- Battery Test - This test will sample the battery low status. If the battery voltage level is low, BATTERY LOW will be displayed. This is not an error condition, but indicates the battery should be replaced before NVM is lost.

- Serial Ports - If this option is present, this test will transfer 128 characters to the UART on ports A and B which are conditioned to echo rather than transmit all data. The data is tested as it is received. Transmission speed is fixed at 9600 baud. A failure of the test results in displaying PORT A or PORT B FAIL.

- TEST Switch - The TEST switch on the main logic board is tested. If not enabled, it will go to the next section. If enabled, it will:

  - Keyboard Clock - The keyboard clock is fed into a timer chip, the timer is tested to see if it runs. If not, the message KBD CLOCK FAIL will be displayed.

- Keyboard Loopback - The keyboard UART, transmitter, and receiver will be tested. A total of 128 characters from 00 to 7F hex will be transmitted. They should be looped back through the switch and tested as they are received. The message EXT KBD LOOPBACK FAIL will be displayed if an error occurs.

- The message TEST SWITCH ENABLED will be displayed.

- Internal Modem Test - If the 1200/1200 Baud internal modem option is installed, a call will be made to address 8009 to check for a C3.

- Serial Port Test Switch - If the test switch on the dual serial interface board is in the TEST position, the message SERIAL PORT TEST SWITCH ENABLED will be displayed.

- Diagnostic ROM Pack - If a ROM PACK containing a diagnostic is installed, a call will be made to the ROM PACK diagnostic input. The ROM PACK diagnostic should perform a ROM checksum routine, test any additional hardware used and display any error messages, the ROM pack name, and revision. If an error occurs, the call is returned with NZ condition active, otherwise with Z active.

- Revision Level - The section displays the current revision level of the resident firmware. Note: The release and revision numbers may be different than shown.

```
CHARACTER RAM FAIL
RAM FAIL XXXX XX XX
GRAPHIC FAIL XXXX XX XX
GRAPHIC FAIL
ROM FAIL XX XX XX
NVM FAIL
COMM FAIL
KEYBOARD FAIL
TIMER FAIL
BATTERY LOW
PORT A FAIL
PORT B FAIL
KBD CLOCK FAIL
EXT KBD LOOPBACK FAIL
TEST SWITCH ENABLED
INTERNAL MODEM FAIL
SERIAL PORT TEST SWITCH ENABLED
(DIAGNOSTIC ROM PACK MESSAGES HERE)
RES REV 3.0
```

Figure A-1. Diagnostic Display Test 1 If Everything Failed

- Alarm - Successful completion of test 1 results in the audible alarm sounding for one-quarter second at a soft level, then one-quarter second at a loud level and followed by another one-quarter second at a soft level. See Figure A-1 for the internal diagnostic failure format after test. This figure shows all possible failures. A blank screen indicates there are no failures.

TEST 2

Test 2 can be initiated from the keyboard in local character mode or upon receipt of the Initiate Test command from the host while running in resident CYBER mode (RS, SYN). Test 1 is rerun. If an error occurs, the error flag will be set.

- Host Initiated - At the completion of the test, if the error flag is set, an error response is sent to the host (STX, ACK, NAK). The error message will not remain on the screen. If the error flag is not set, a positive response is sent (STX, ACK, ACK) to the host and the screen will be cleared.

- Locally Initiated - If the operator presses CTRL, =, V (RS, SYN) while in local CYBER mode, the test will be run. As long as no errors are detected, the test will loop and keep running. This can only be cleared by pressing RESET. If an error occurs, the test will halt displaying the failure and the RESET must be pressed to exit.

TEST 3

Test 3 is initiated if the operator presses the F8 key while the Mode Selection Menu is being displayed.

- Graphic Video - If the graphics option is present, the graphics video will be enabled and the graphics RAM will be filled with an alternate dot pattern. This display will switch between 480 and 512 scans at approximately a 1-second rate. Pressing any key will disable the graphics video and continue the test.

- Alignment Raster - This test enters an alignment pattern around the outer edge of the display area.

- ROM Character Generator - Six lines will be displayed as follows:

- 32 Control codes
- 33 Numeric and special characters
- 32 Uppercase alpha and special characters
- 31 Lowercase and special characters
- 32 Foreign character symbols
- 32 Line drawing characters

NOTE

If a foreign character set is selected, they will appear in their assigned locations.

- Attribute Test - A line (BLINK DIM UNDERSCORE INVERSE BLANK) will be displayed with each word having the associated bit set in background. If BLANK is seen on the CRT, the function is not working.

- Keyboard Test - This test displays KEYBOARD TEST on one line on the CRT. As the operator presses a key, the hex code received from the key will be displayed after the words KEYBOARD TEST.

NOTE

The keyboard sends a hex code whenever a key is pressed or released. Bit $2^7$ is clear whenever a key is pressed and the same code with $2^7$ set when the key is released. The code sent by the keyboard are not ASCII codes. The following is an example.

KEYBOARD TEST 55 (when a key is pressed)
KEYBOARD TEST D5 (when key is released)

- Indicator Test - The eight indicators that are controlled by the firmware will be stepped on and off in about one and one-half seconds. After the last indicator has been lit, the cycle will be repeated.

- Touchpanel Test - The touchpanel interrupt will be enabled. When the screen is touched, an interrupt occurs, and the cursor will be moved to the area touched.

- External Loopback - A message displays near the bottom of the screen explaining how to run external loopback. It displays TO RUN EXTERNAL LOOPBACK - ENABLE TEST SWITCHES.

  When the TEST switch at rear of terminal is enabled, the following tests will be looped on:

  - The UART clock for the keyboard I/F will be tested and the message KBD CLOCK OK or KBD CLOCK FAIL will be displayed.

  - PARALLEL PORT - If a graphic printer is installed, it must be powered-on or an error will occur. A 55 hex and AA hex will be sent to the printer which is conditioned to echo data. If incorrect data is received back or no response received, the error message PARALLEL PORT FAIL will be displayed and there will be no further test on this port. If no error is detected, the message PARALLEL PORT OK is displayed.

    If the graphic printer is not installed, a test will be made for the presence of the flexible disk. A read ID will be sent to the disk. If an incorrect status is received, the message PARALLEL PORT FAIL will be displayed. If the correct status is received, the message PARALLEL PORT OK will be displayed.

  - KEYBOARD LOOPBACK - KEYBOARD RUNNING will be displayed. A group of 128 characters from 00 hex to 7F hex will be looped back continuously. If an error occurs, the word RUNNING will change to FAIL.

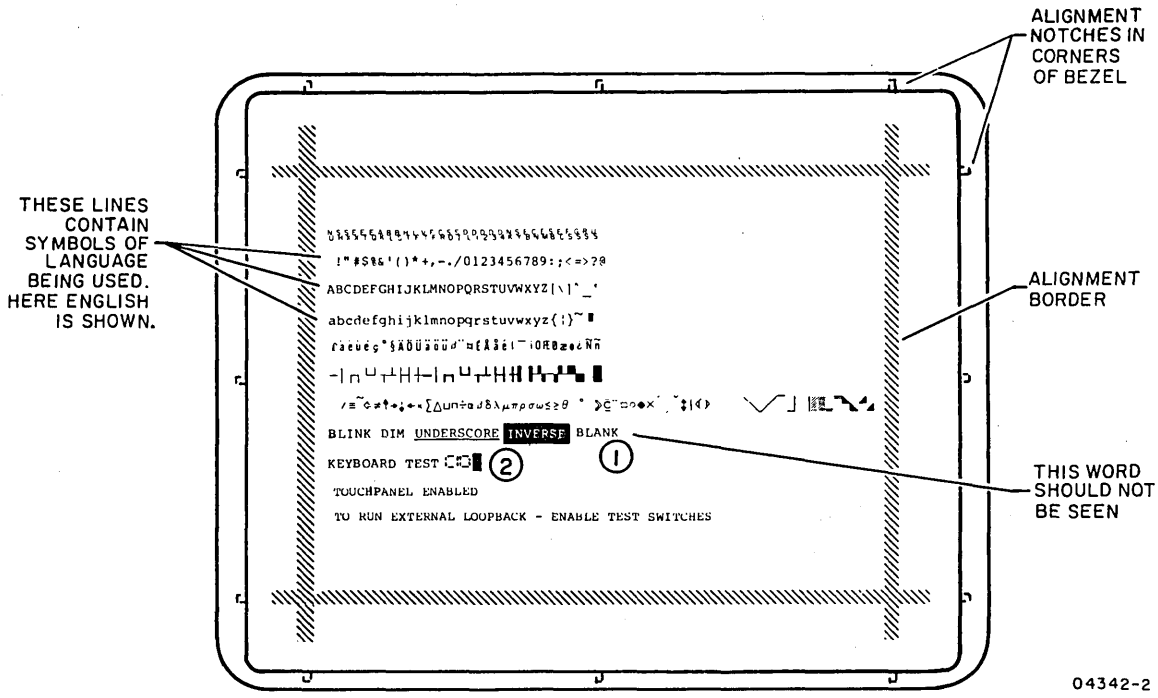
  - COMMUNICATIONS LOOPBACK - COMM RUNNING will be displayed. A group of 128 characters from 00 hex to 7F hex will be looped back continuously. If an error occurs, the word RUNNING will change to FAIL.

  - SERIAL PORT A or B - If the Dual Serial Interface board is installed, the message PORT A (or B) RUNNING will be displayed. The 128 characters from 00 hex to 7F hex will be looped back continuously. If an error occurs, the word RUNNING will change to FAIL.

    NOTE

    The TEST/NORMAL switch on the Dual Serial Interface board must be switched to TEST before starting the test or an invalid error will occur.

  To exit test 3, the operator must press the RESET switch (see Figure A-2 for display format of test).




(1) This space should be empty. If the word BLANK appears here, or any other data, an error has occurred.

(2) The cursor will initially be in this location.

Figure A-2. Diagnostic Display Test 3

## INTERFACES

- Test 1 - The only operator interface required to run test 1 is to power on unit or press RESET. Operator can verify failures by displayed messages.

- Test 2 - Host selectable in CYBER mode only, and operator selectable in local CYBER mode by pressing CTRL, =, V.

- Test 3 - The operator is required to press F8 while the Mode Selection Menu is displayed. The operator can verify all symbol shapes, indicators, and keyboard. Symbols will be displayed according to language selected. Figure A-2 shows English selected. To run external loopback, the operator must pull the TEST switch.

## ABORTS AND RECOVERY

- Test 1 - If an error occurs, the remainder of that section is aborted, an error message is displayed, and the test will continue. Pushing RESET will rerun test 1.
- Test 2 - If initiated while online and an error occurs, test 2 is aborted and a negative response is sent to the host. If initiated while local and an error occurs, Test 2 will halt with message displayed. Operator must press RESET to recover.
- Test 3 - If an error occurs during loopback, the failing section will no longer be run, the test will continue running all good sections. Operator must press RESET or TEST switch to end test.

## ERRORS

- Test 1 - Errors display on the screen. If no error occurs, nothing is displayed.
- Test 2 - An error message is sent back to the host.
- Test 3 - Operator verification required, except during external loopback.

## PERFORMANCE

- Test 1 - Requires less than 6 seconds to run.
- Test 2 - Same as Test 1.
- Test 3 - No time limit, test ends when RESET is pressed.

## MEMORY LAYOUT

The terminal has more than 64K bytes of RAM and ROM in its maximum configuration, since a 16-bit address bus allows only 64K of direct addressing, memory bank controls are added.

Figure B-1 shows all of the present memory broken up into 16K banks. The 64K of addressing is broken up in 4 blocks (see Figure B-2). Block 0 starts at address 0000; block 4 starts at 4000; block 8 starts at 8000; and block C starts at C000. Banks can be selected into certain blocks to achieve the desired mode configuration. See Figure B-3 for some mode configurations.

When the terminal is powered on or reset, banks 0, 6, 5 and 4 are selected in blocks 0, 4, 8, and C, respectively. The following bank selections will take place in the resident firmware depending upon type of load.

- CYBER Mode - No bank selection is performed.
- Load from ROM Pack - No bank selection is performed since ROM pack is selected in block 8.
- Load from Host - When the ASCII loader is selected, banks 2 and 3 are selected in blocks 4 and 8, respectively. This could accommodate a load from 4000 of bank 1, and all of bank 3. At the completion of the load, control is transferred to the first address designated in the load. If the loaded controlware does not want to use the ASCII display (banks 0 and 4), it must select the desired bank configuration.
- Load from Disk - When the disk loader is selected banks 2 and 3 are selected in blocks 4 and 8, respectively. At the completion of the disk load, control is transferred to the address specified by the first 2 words from the disk. If the loaded controlware does not want to use the ASCII display (banks 0 and 4), it must select the desired bank configuration.
- If the controlware being loaded is going to use the Graphic RAM, it must first move the controlware into banks 1 and 2 (block 0, 4), then select the Graphic RAM banks 7, 8 (block 8.C).

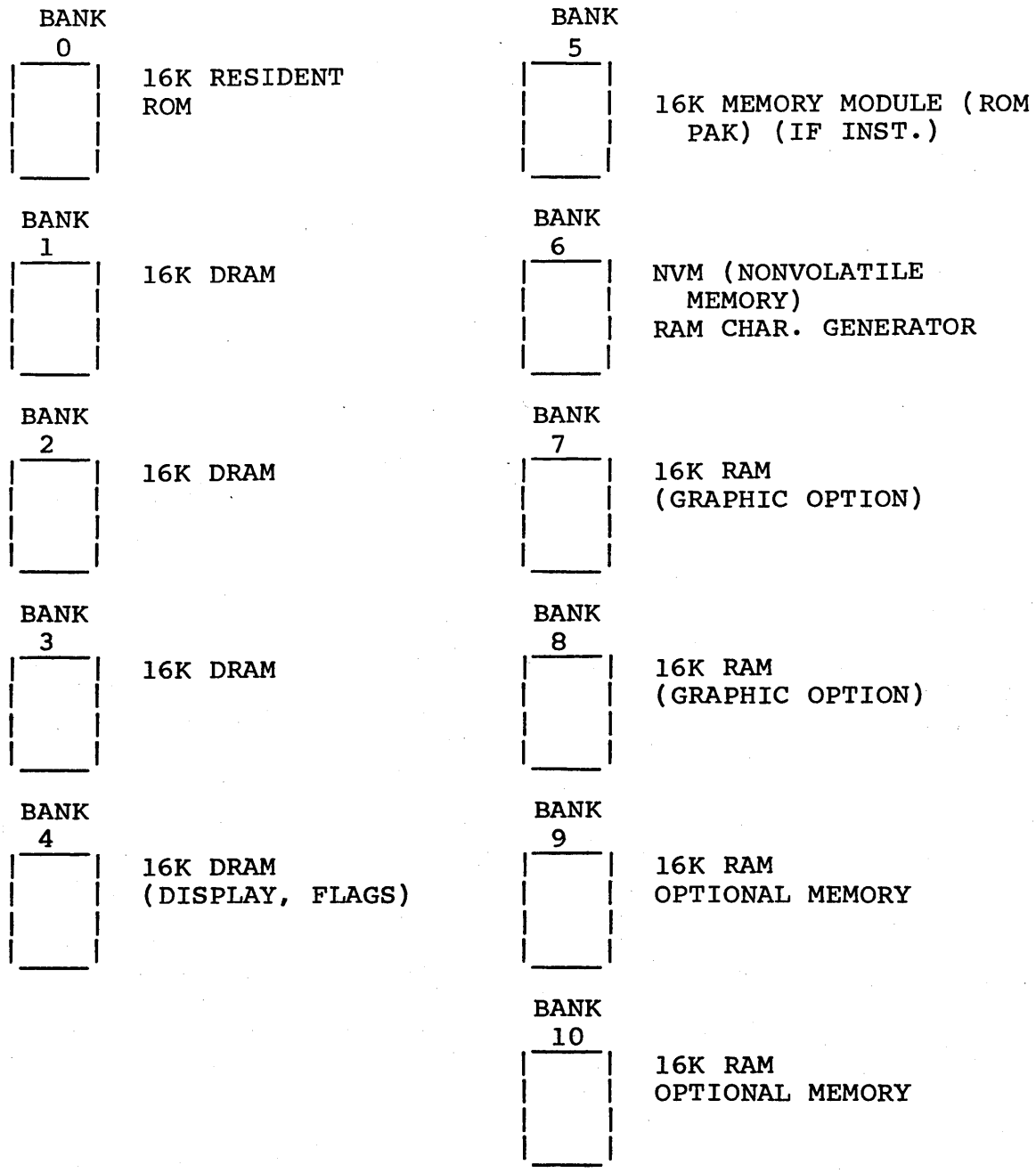



Figure B-1. Bank Configurations

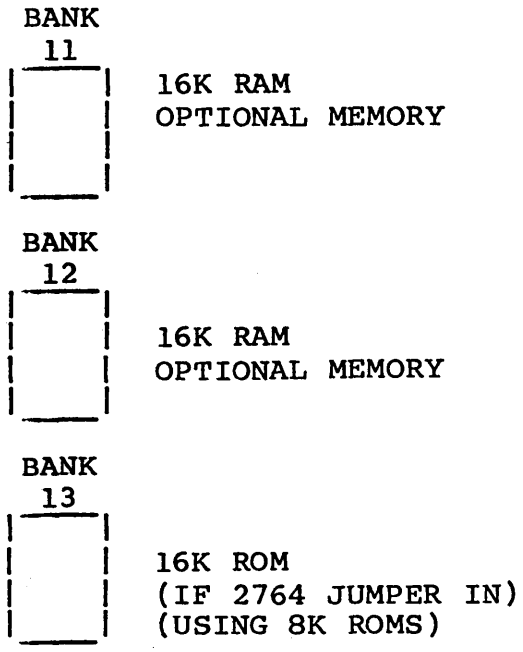



Figure B-1. Bank Configurations (Contd)

| | | POSSIBLE BANK SELECTIONS |
|---|---|---|
| BLOCK 0 | 0000 | 00 BANK 0 RESIDENT ROM<br>01 BANK 7 16K GRAPHIC RAM*<br>02 BANK 1 16K RAM<br>03 NOT USED |
| BLOCK 4 | 4000 | 00 BANK 6 NVM<br>01 BANK 8 16K GRAPHIC RAM**<br>02 BANK 13 16K ROM (8K ROMS IN)<br>03 BANK 2 16K RAM |
| BLOCK 8 | 8000 | 00 BANK 5 MEMORY MODULE (ROM PAK)<br>01 BANK 3 16 RAM<br>02 BANK 11 16K OPTIONAL MEMORY<br>03 BANK 7 16K GRAPHIC RAM |
| BLOCK C | C000 | 00 BANK 4 16K DISPLAY RAM<br>01 BANK 6 NVM<br>02 BANK 12 16K OPTIONAL MEMORY<br>03 BANK 8 16K GRAPHIC RAM |

*DEFAULTS TO BANK 9 IF GRAPHIC OPTION NOT INSTALLED.
**DEFAULTS TO BANK 10 IF GRAPHIC OPTION NOT INSTALLED.

Figure B-2. Block Configuration

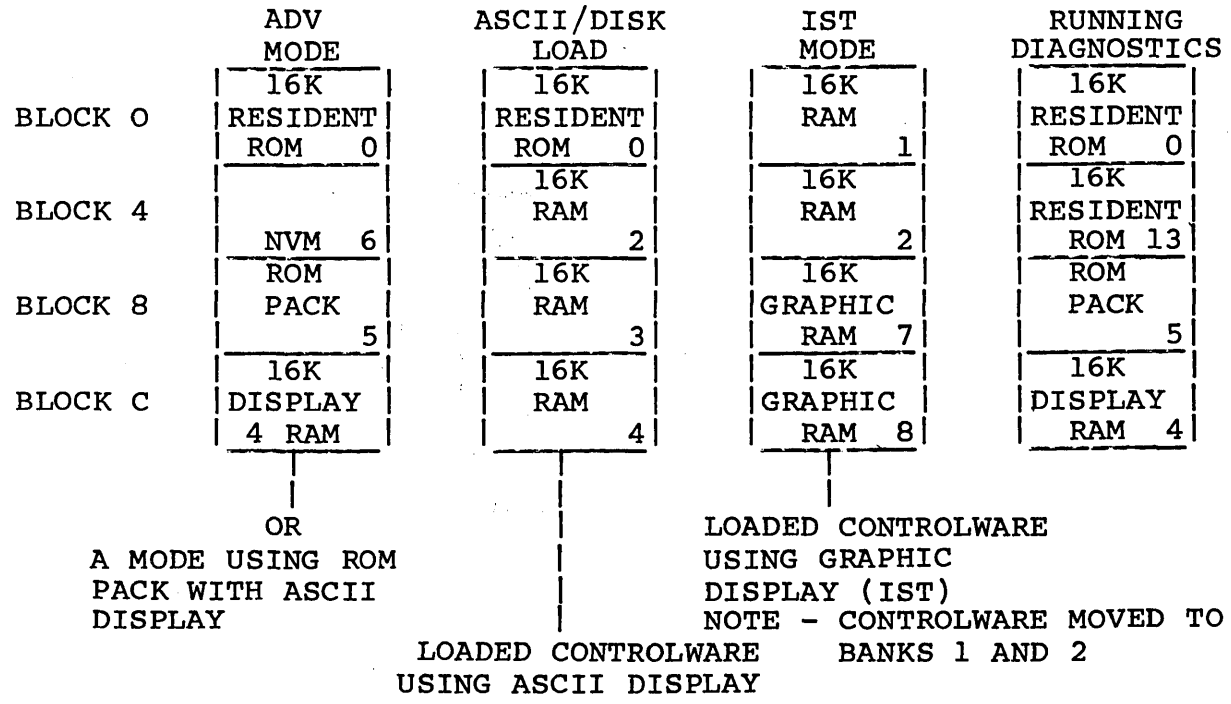



Figure B-3. Memory Configurations

## BANK 4 LAYOUT

Bank 4 contains 16K of dynamic random-access memory (DRAM). The ASCII display hardware uses this bank of memory for display refresh. The CYBER mode uses this bank also for flags, buffers, stack pointer, and interrupt table. Table B-1 shows the layout.

Bank 4 contains 16K of DRAM that is used by CYBER mode to display information. The data is arranged in lines. A line can be anywhere in the 16K area, but must start on an even address. The data is stored at even addresses and the attributes are stored at the next odd addresses.

A table is set up in the middle of the memory that tells the hardware where each line starts. See table B-2 for an example of how the table and display DRAM are set up in CYBER mode.

TABLE B-1. BANK 4 LAYOUT

| ADDRESS | | SIZE |
|---|---|---|
| C000<br>CFFF | DISK OPERATING CONTROLWARE | 4096 |
| D000<br>D80F | HOST LOADABLE CODES/CONTROLWARE | 2064 |
| D810<br>D8FF | HOST LOADABLE AREA TABLE | 240 |
| D900<br>DB0F | 2 STATUS LINES | 528 |
| DB10<br>DB1F | KEYBOARD INPUT BUFFER | 16 |
| DB20<br>DEFF | COMM INPUT BUFFER | 992 |
| DF00<br>DFBF | COMM OUTPUT BUFFER | 192 |
| DFC0<br>DFFF | STACK POINTER | 64 |
| E000<br>E03B | DISPLAY TABLE | 60 |
| E03C<br>E03F | LOAD FLAGS | 4 |
| E040<br>E0FF | ACTIVE RAM AND FLAGS | 192 |
| E100<br>E10F | INTERRUPT TRAPS | 16 |
| E110<br>FFFF | 30 X 132 X 2 DISPLAY DATA | 7920 |

TABLE B-2. INITIAL DISPLAY MEMORY LAYOUT

| ADDR | TABLE | | DISPLAY RAM | |
|---|---|---|---|---|
| E000 | 1 0 | | E110 | |
| E001 | E 1 | LINE 1 | | DATA+ATTRI LINE 1 |
| E002 | 1 8 | | | |
| E003 | E 2 | LINE 2 | E218 | 2 |
| E004 | 20 | | | |
| E005 | E3 | LINE 3 | E320 | 3 |
| E006 | 28 | | | |
| E007 | E4 | LINE 4 | E428 | 4 |
| E008 | 30 | | | |
| E009 | E5 | LINE 5 | E530 | 5 |
| E00A | 38 | | | |
| E00B | E6 | LINE 6 | E638 | 6 |
| E00C | 40 | | | |
| E00D | E7 | LINE 7 | E740 | 7 |
| E00E | 48 | | | |
| E00F | E8 | LINE 8 | E848 | 8 |
| E010 | 50 | | | |
| E011 | E9 | LINE 9 | E950 | 9 |
| E012 | 58 | | | |
| E013 | EA | LINE 10 | EA58 | 10 |
| E014 | 60 | | | |
| E015 | EB | LINE 11 | EB60 | 11 |
| E016 | 68 | | | |
| E017 | EC | LINE 12 | EC68 | 12 |
| E018 | 70 | | | |
| E019 | ED | LINE 13 | ED70 | 13 |
| E01A | 78 | | | |
| E01B | EE | LINE 14 | EE78 | 14 |
| E01C | 80 | | | |
| E01D | EF | LINE 15 | EF80 | 15 |
| E01E | 88 | | | |
| E01F | F0 | LINE 16 | F088 | 16 |
| E020 | 90 | | | |
| E021 | F1 | LINE 17 | F190 | 17 |
| E022 | 98 | | | |
| E023 | F2 | LINE 18 | F298 | 18 |
| E024 | A0 | | | |
| E025 | F3 | LINE 19 | F3A0 | 19 |
| E026 | A8 | | | |
| E027 | F4 | LINE 20 | F4A8 | 20 |
| E028 | B0 | | | |
| E029 | F5 | LINE 21 | F5B0 | 21 |
| E02A | B8 | | | |
| E02B | F6 | LINE 22 | F6B8 | 22 |
| E02C | C0 | | | |
| E02D | F7 | LINE 23 | F7C0 | 23 |
| E02E | C8 | | | |

TABLE B-2. INITIAL DISPLAY MEMORY LAYOUT (CONTD)

| | | | | |
|---|---|---|---|---|
| E02F | F8 | LINE 24 | F8C8 | 24 |
| E030 | D0 | | | |
| E031 | F9 | LINE 25 | F9D0 | 25 |
| E032 | D8 | | | |
| E033 | FA | LINE 26 | FAD8 | 26 |
| E034 | E0 | | | |
| E035 | FB | LINE 27 | FBE0 | 27 |
| E036 | E8 | | | |
| E037 | FC | LINE 28 | FCE8 | 28 |
| E038 | F0 | | | |
| E039 | FD | LINE 29 | FDF0 | 29 |
| E03A | F8 | | | |
| E03B | FE | LINE 30 | FEF8 FFFF | 30 |

USER INTERFACE TO RESIDENT SUBROUTINES

The resident ROM firmware contains routines that can be used by user loaded controlware. A jump table has been placed at the beginning so that changes can be made to the resident firmware without requiring all external users to change their programs. The table in B-3 shows the fixed address that an external user can call. Note: These addresses are to remain fixed and any new jumps are to be added to the end of the list.

TABLE B-3. ENTRY POINT JUMP LISTING

| ADDRESS | NAME | DESCRIPTION |
|---|---|---|
| 0000 | INIT | ; INITIALIZATION |
| 0003 | INIT00 | ; INITIALIZATION 00 |
| 0006 | INIT01 | ; INITIALIZATION 01 |
| 0009 | INIT02 | ; INITIALIZATION 02 |
| 000C | CRT80 | ; SET CRT TO 80 CHR/LINE |
| 000F | CRT132 | ; SET CRT TO 132 CHR/LINE |
| 0012 | CINIT | ; COMM INITIALIZATION |
| 0015 | KINIT | ; KEYBOARD INITIALIZATION |
| 0018 | PINIT | ; PRINTER INITIALIZATION |
| 001B | INTDIS | ; INTERRUPT DISABLE |
| 001E | INTENA | ; INTERRUPT ENABLE |
| 0021 | CMTRAP | ; COMM INTERRUPT TRAP |
| 0024 | KBTRAP | ; KEYBOARD INTERRUPT TRAP |
| 0027 | TMTRAP | ; TIMER INTERRUPT TRAP |
| 002A | TPTRAP | ; TOUCHPANEL INTERRUPT TRAP |
| 002D | ADVCR | ; ADVANCE CURSOR |
| 0030 | ADVMD | ; ADVANCED MODE |
| 0033 | ALARM | ; ALARM |
| 0036 | ALARMI | ; ALARM IF ENABLED |

TABLE B-3. ENTRY POINT JUMP LISTING (CONTD)

| ADDRESS | NAME | DESCRIPTION |
|---|---|---|
| 0039 | BDISPN | ; DISPLAY B - PERFORM FUNCTION |
| 003C | BFTB | ; COMM BUFFER TO B |
| 003F | BLDADD | ; BUILD ADDRESS |
| 0042 | CLEAR | ; CLEAR |
| 0045 | CLREOL | ; CLEAR TO END OF LINE |
| 0048 | CLREOP | ; CLEAR TO END OF PAGE |
| 004B | CRDOWN | ; CURSOR DOWN |
| 004E | CRGRTN | ; CARRIAGE RETURN |
| 0051 | CRLEFT | ; CURSOR LEFT |
| 0054 | CRLNFD | ; CARRIAGE RETURN LINE FEED |
| 0057 | CRUP | ; CURSOR UP |
| 005A | DISPB | ; DISPLAY B - STORE ON SCREEN |
| 005D | DLYEN1 | ; DELAY ENABLE 1 |
| 0060 | DLYEN2 | ; DELAY ENABLE 2 |
| 0063 | DSTRNG | ; DATA STRING |
| 0066 | HASCII | ; HEX TO ASCII |
| 0069 | KBDAS | ; CONVERT NEXT KEYBOARD CODE TO ASCII |
| 006C | KBDASC | ; KEYBOARD TO LOWERCASE ASCII |
| 006F | KINPUT | ; KEYBOARD INPUT |
| 0072 | MODENE | ; DISPLAY MODE NOT ENABLED |
| 0075 | PABI | ; PORT A BI-DIRECTIONAL |
| 0078 | PBBI | ; PORT B BI-DIRECTIONAL |
| 007B | PRINTB | ; PRINT B |
| 007E | RESET | ; RESET |
| 0081 | SCROLL | ; SCROLL |
| 0084 | SEND | ; SEND NEXT CODE FROM COMM BUFFER |
| 0087 | SENDB | ; STORE B IN COMM SEND BUFFER |
| 008A | SETDE | ; SET CURSOR TO DE |
| 008D | SETCR | ; SET CURSOR |
| 0090 | ST TM | ; START DELAY TIMER |
| 0093 | TABBK | ; TAB BACKWARDS |
| 0096 | TABFW | ; TAB FORWARD |
| 0099 | TABCLR | ; TAB CLEAR |
| 009C | TABSET | ; TAB SET |
| 009F | TPINP | ; TOUCHPANEL INPUT |
| 00A2 | SENDB8 | ; STORE B IN COMM SEND BUFFER |
| 00A5 | MNTOR | ; USER ENTRY TO MONITOR |
| 00A8 | ADVINI | ; ADVANCED MODE INITIALIZATION |
| 00AB | KBDINP | ; ADVANCED MODES KEYBOARD INPUT |
| 00AE | CMTRPU | ; COMM INTERRUPT TRAP-USER |
| 00B1 | KBTRPU | ; KEYBOARD INTERRUPT TRAP-USER |
| 00B4 | TMTRPU | ; TIMER INTERRUPT TRAP-USER |
| 00B7 | TPTRPU | ; TOUCHPANEL INTERRUPT TRAP-USER |
| 00BA | TIPRAM | ; MOVE TERMINAL INSTALLATION |
| 00BD | CRTOUT | ; OUTPUT VALUES TO 5037 CRT CONTROLLER |

## Common Variables

Common variables and flags are stored in Bank 4 and can be read or changed by the resident or user programs. They are broken up in terminal parameters, mode parameters and flags (table B-4).

The terminal parameters are moved from NVM to the RAM area during initialization (before any mode is selected). The mode parameters are moved to the RAM area when the mode has been determined (before the mode has been loaded). The flags can be cleared by calling Advanced Mode Initialization (ADVINI).

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE

```
        ;*******************************************************
        ;
        ;       M O D E   I N S T A L L A T I O N   R A M / E Q U
        ;
        ;*******************************************************
E040    RAMST   .EQU    0E040H
E040    MBYTE1  .EQU    RAMST
0001    MODEEN  .EQU    01              ; MODE ENABLED
0002    SECEN   .EQU    02              ; SECURITY ENABLED
0004    OPSLSF  .EQU    04              ; OPERATOR SELECT SOURCE/FILE
0008    LDEN    .EQU    08              ; LOAD ENABLED
E041    MBYTE2  .EQU    MBYTE1+1
0001    LDDISK  .EQU    01              ; LOAD FROM DISK
0002    INTMDM  .EQU    02              ; USE INTERNAL 1200 BAUD MODEM
0004    CLPEN   .EQU    04              ; CURRENT LOOP ENABLED
0008    AUTODL  .EQU    08              ; AUTO DIAL
E042    MBYTE3  .EQU    MBYTE2+1
0001    H8BIT   .EQU    01              ; HOST 8 BITS
0002    HPEN    .EQU    02              ; HOST PARITY ENABLED
0004    HPEVEN  .EQU    04              ; HOST PARITY EVEN
0008    H2STOP  .EQU    08              ; HOST 2 STOP BITS
E043    MBYTE4  .EQU    MBYTE3+1
0001    DTRSW   .EQU    01              ; DTR SWITCHED
0002    RTSSW   .EQU    02              ; RTS SWITCHED
0004    RPTDIS  .EQU    04              ; REPEAT DISABLED
0008    DTONLY  .EQU    08              ; DATA ONLY OPERATION
E044    MBYTE5  .EQU    MBYTE4+1
0001    HOMELL  .EQU    01              ; HOME LOWER LEFT
0002    AUTOLF  .EQU    02              ; AUTO LINE FEED ENABLED
0004    PACEEN  .EQU    04              ; PACING ENABLED
0008    BIASEN  .EQU    08              ; BIAS ENABLED
```

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE

```
E045    MBYTE6  .EQU   MBYTE5+1
        ;               01          ; NOT USED
        ;               02          ; NOT USED
        ;               04          ; NOT USED
0008    RUNPAK  .EQU   08           ; 0=RUN CYBER 1= RUN ROM PAK
        ;*******************************************************
        ;               O P E R A T O R   P A R A M E T E R S
        ;*******************************************************
E046    OBYTE1  .EQU   MBYTE6+1
0001    LOCAL   .EQU   01           ; LOCAL
0002    PTSEL   .EQU   02           ; PRINTER SELECTED
0004    MRGEN   .EQU   04           ; MARGIN ALERT ENABLED
0008    ALERTL  .EQU   08           ; ALERT LOUD
E047    OBYTE2  .EQU   OBYTE1+1
0001    SFLOCK  .EQU   01           ; SHIFT LOCK
        NPADIV  .EQU   02           ; NUMERIC PAD SHIFTED
0004    ROLLSC  .EQU   04           ; ROLL SCREEN
000B    PAGESC  .EQU   0BH          ; .PAGE SCROLL
0008    NATIVE  .EQU   08           ; NATIVE MODE / LARGE CYBER
E048    OBYTE3  .EQU   OBYTE2+1
0001    BGLITE  .EQU   01           ; BACKGROUND LIGHT
0002    CRBOX   .EQU   02           ; CURSOR BOX
0004    CRSLD   .EQU   04           ; CURSOR SOLID ON
        ;       .EQU   08           ; NOT USABLE
E049    OBYTE4  .EQU   OBYTE3+1
0001    FULL    .EQU   01           ; FULL DUPLEX
0002    CL132   .EQU   02           ; 132 CHARACTERS PER LINE
0004    LN30    .EQU   04           ; 30 LINES
0008    TRANS   .EQU   08           ; TRANSPARENT
        ;*******************************************************
        ;       M O R E   M O D E   P A R A M E T E R S
        ;*******************************************************
E04A    ADILE   .EQU   OBYTE4+1     ; AUTO-DIAL NUMBER
E056    DFILE   .EQU   ADILE+12     ; DEFAULT FILE NUMBER
E058    TBAUD   .EQU   DFILE+2      ; TRANSMIT BAUD RATE
E059    RBAUD   .EQU   TBAUD+1      ; RECEIVE BAUD RATE
E05A    SECURE  .EQU   RBAUD+1      ; SECURITY CODE
E060    OEND    .EQU   0E060H       ; END OF OPERATOR PARAMETERS
        ;*******************************************************
        ;       T E R M I N A L   P A R A M E T E R S
        ;*******************************************************
E060    TBYTE1  .EQU   OEND
0001    RAM64K  .EQU   01H          ; 64K RAM OPTION IN
0002    TPOPT   .EQU   02H          ; TOUCH PANEL OPTION IN
0004    DSOPT   .EQU   04H          ; DUAL SERIAL OPTION IN
0008    GPOPT   .EQU   08H          ; GRAPHIC PRINTER OPTION IN
E061    TBYTE2  .EQU   TBYTE1+1
0001    FDOPT   .EQU   01H          ; FLEXIBLE DISK OPTION IN
```

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE (CONTD)

```
0002    PIOPT   .EQU   02H          ;
0004    IMOPT   .EQU   04H          ; INTERNAL 1200 MODEM OPTION IN
0008    ISOKBD  .EQU   08H          ; ISO 3243 KEYBOARD OPTION IN
E062    TBYTE3  .EQU   TBYTE2+1
0001    GOPT    .EQU   01H          ; GRAPHIC OPTION IN
0002    PAROPT  .EQU   02H          ; PARALLEL OPTION IN
0004    R232CL  .EQU   04H          ; RS232/CURRENT LOOP OPTION IN
E063    TBYTE4  .EQU   TBYTE3+1
0001    ASELEN  .EQU   01H          ; AUTO SELECT ENABLE
0002    DLSRTS  .EQU   02H          ; DELAY ON PRINTER SRTS
E064    TBYTE5  .EQU   TBYTE4+1
E065    TBYTE6  .EQU   TBYTE5+1
E066    ASEL    .EQU   TBYTE6+1     ; AUTO SELECT 0-7 (DEFAULT MODE)
E067    XDELTA  .EQU   ASEL+1       ; SCREEN MOVE X DELTA
E068    YDELTA  .EQU   XDELTA+1     ; SCREEN MOVE Y DELTA 0-F
E069    LANG    .EQU   YDELTA+1     ; LANGUAGE 0-7
E06A    ID      .EQU   LANG+1       ; TERMINAL ID NUMBER 0000-FFFF
E06E    CHAPAR  .EQU   ID+4         ; CHANNEL A PARAMETERS
0008    BIDIR   .EQU   08H          ; BI-DIRECTIONAL PORT
0004    PARDIS  .EQU   04H          ; PARITY DISABLED
0002    PAREV   .EQU   02H          ; PARITY EVEN
0001    SB2     .EQU   01H          ; 2 STOP BITS
E06F    CHABD   .EQU   CHAPAR+1     ; CHANNEL A BAUD 0-F
E070    CHBPAR  .EQU   CHABD+1      ; CHANNEL B PARAMETERS
E071    CHBBD   .EQU   CHBPAR+1     ; CHANNEL B BAUD 0-F
E080    TEEND   .EQU   0E080H       ; TERMINAL EQUATE END
        ;*******************************************************
        ;       BI-DIRECTIONAL PORT
        ;*******************************************************
E080    BDATAR  .EQU   TEEND        ; BI-DIR DATA IN/OUT
0001    IER     .EQU   01H          ; INTERRUPT ENABLE REGISTER
0002    IIR     .EQU   02H          ; INTERRUPT ID REGISTER INPUT
0003    LCR     .EQU   03H          ; LINE CONTROL REGISTER OUTPUT
0004    MCR     .EQU   04H          ; MODEM CONTROL REGISTER OUTPUT
0005    LSR     .EQU   05H          ; LINE STATUS REGISTER INPUT
0006    MSR     .EQU   06H          ; MODEM STATUS REGISTER INPUT
        ;
        ;*******************************************************
        ;       COMM I/O STORED IN RAM
        ;*******************************************************
E081    CDATAR  .EQU   BDATAR+1     ; COMM DATA IN/OUT
        ;
        ;*******************************************************
        ;       PRINTER I/O STORED IN RAM
        ;*******************************************************
E082    PDATAR  .EQU   CDATAR+1     ; PRINTER DATA IN/OUT
        ;
```

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE (CONTD)

```
                ;*********************************************************
                ;
                ;       I N P U T   B U F F E R S
                ;
                ;*********************************************************
E083    BFCNT   .EQU    PDATAR+1        ; NUMBER OF CHARACTERS IN COMM BUFFER
E085    BFINAD  .EQU    BFCNT+2         ; ADDRESS OF NEXT OPEN SLOT IN BUFFER
E087    BFOTAD  .EQU    BFINAD+2        ; ADDRESS OF NEXT CHARACTER TO BE TAKEN
                ;                         FROM COMM INPUT BUFFER
E089    KBCNT   .EQU    BFOTAD+2        ; NUMBER OF CHARACTERS IN KEYBOARD
                ;                         BUFFER
E08A    KBINAD  .EQU    KBCNT+1         ; ADDRESS OF NEXT OPEN SLOT IN BUFFER
E08C    KBOTAD  .EQU    KBINAD+2        ; ADDRESS OF NEXT CHARACTER TO BE TAKEN
                ;                         FROM KEYBOARD INPUT BUFFER
E08E    TXCNT   .EQU    KBOTAD+2        ; NUMBER OF CHARACTERS IN TRANSMIT
                ;                         BUFFER
E08F    TXINAD  .EQU    TXCNT+1         ; ADDRESS OF NEXT OPEN SLOT IN BUFFER
E091    TXOTAD  .EQU    TXINAD+2        ; ADDRESS OF NEXT CHARACTER TO BE TAKEN
                ;                         FROM TRANSMIT BUFFER
                ;*********************************************************
                ;
                ;       D E L A Y S
                ;
                ;*********************************************************
E093    ALRACT  .EQU    TXOTAD+2        ; 250 MSEC ALARM DELAY ACTIVE
001F    ALRTM   .EQU    31              ; 31 X 8 = 248
E094    BRKACT  .EQU    ALRACT+1        ; 250MSEC. BREAK DELAY ACTIVE
001F    BRKTM   .EQU    31              ; 31 X 8 = 248
E095    KBDACT  .EQU    BRKACT+1        ; 1 SEC. KEYBOARD DELAY IS ACTIVE
007D    KBDTM   .EQU    125             ; 125 X 8 = 1 SEC
E096    KBRACT  .EQU    KBDACT+1        ; 60MS . KEYBOARD REPEAT IS ACTIVE
0008    KBRTM   .EQU    8               ; 8 X 8 = 64
E097    PCDACT  .EQU    KBRACT+1        ; 8 MS. PACING DELAY ACTIVE
E098    PNTACT  .EQU    PCDACT+1        ; 200MSEC. PRINTER DELAY ACTIVE
0019    PNTTM   .EQU    25              ;
E099    TXDACT  .EQU    PNTACT+1        ; 8MS. TRANSMIT DELAY IS ACTIVE
E09A    UD1ACT  .EQU    TXDACT+1        ; USER DELAY 1 ACTIVE
E09B    UD1ADD  .EQU    UD1ACT+1        ; USER DELAY 1 ADDRESS
E09D    UD2ACT  .EQU    UD1ADD+2        ; USER DELAY 2 ACTIVE
E09E    UD2ADD  .EQU    UD2ACT+1        ; USER DELAY 2 ADDRESS
                ;*********************************************************
                ;
                ;       I N T E R R U P T   M A S K
                ;
                ;*********************************************************
E0A0    INTMSK  .EQU    UD2ADD+2        ; INTERRUPT MASK
                ;
0001    INTCM   .EQU    01H             ; INT. 0 COMM MASK
```

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE (CONTD)

```
0002    INT21   .EQU   02H          ; INT. 1 21 BIT (PCN) MASK
0004    INTDP   .EQU   04H          ; INT. 2 DUAL RS232 PORT MASK
0008    INTPP   .EQU   08H          ; INT. 3 PARALLEL PORT MASK
0010    INTTP   .EQU   10H          ; INT. 4 TOUCHPANEL MASK
0020    INTKB   .EQU   20H          ; INT. 5 KEYBOARD MASK
0040    INTTM   .EQU   40H          ; INT. 6 TIMER MASK
0080    INTPE   .EQU   80H          ; INT. 7 PARITY ERROR
        ;*****************************************************
        ;
        ;       K E Y B O A R D   T A B L E
        ;
        ;*****************************************************
E0A1    KNSNC   .EQU   INTMSK+1     ; ADDRESS OF NO SHIFT, NO CONTROL TABLE
E0A3    KSNC    .EQU   KNSNC+2      ; ADDRESS OF SHIFT, NO CONTROL TABLE
E0A5    KNSC    .EQU   KSNC+2       ; ADDRESS OF NO SHIFT, CONTROL TABLE
E0A7    KSC     .EQU   KNSC+2       ; ADDRESS OF SHIFT, CONTROL TABLE
        ;*****************************************************
        ;
        ;       D I S P L A Y   R A M
        ;
        ;*****************************************************
E0A9    ATTRIB  .EQU   KSC+2        ; ATTRIBUTES WORD
0001    BLANK   .EQU   01H          ;   2**0=BLANK
0002    UNDLN   .EQU   02H          ;   2**1=UNDERSCORE
0004    INVERS  .EQU   04H          ;   2**2=INVERSE
0008    BLINK   .EQU   08H          ;   2**3=BLINK
0010    DIM     .EQU   10H          ;   2**4=DIM
0020    MODIFY  .EQU   20H          ;   2**5=MODIFIED DATA
        VALID   .EQU   40H          ;   2**6=VALIDATE CHARACTER
0080    PROTD   .EQU   80H          ;   2**7=PROTECT
E0AA    ATTSAV  .EQU   ATTRIB+1     ; A PLACE TO SAVE ATTRIB
E0AB    BLKMD   .EQU   ATTSAV+1     ; BLOCK MODE ACTIVE
E0AC    BLKSND  .EQU   BLKMD+1      ; BLOCK SEND ACTIVE
E0AD    BSCRPE  .EQU   BLKSND+1     ; BACKSPACE CURSOR IN PARAMETER ENTRY
        ;                             MODE
E0AE    CCDSR   .EQU   BSCRPE+1     ; CURRENT COMM DSR
E0AF    CEOL    .EQU   CCDSR+1      ; 1= CLEAR TO EOL ACTIVE
E0B0    CHNCHG  .EQU   CEOL+1       ; CHANGE IN NUMBER OF CHARACTERS
E0B1    CHRCNT  .EQU   CHNCHG+1     ; CHARACTER COUNT 0-4F, 0-83
E0B2    CHRSAV  .EQU   CHRCNT+1     ; A PLACE TO SAVE CHARACTER COUNT
E0B3    CLRTYP  .EQU   CHRSAV+1     ; TYPE OF CLEAR
        ;                             00= ALL
        ;                             02= UNDERSCORE
        ;                             08= BLINK
        ;                             10= DIM
        ;                             1F= NORMAL
E0B4    COMPNT  .EQU   CLRTYP+1     ; COMM PRINT ACTIVE
E0B5    CONT    .EQU   COMPNT+1     ; 1=CONTROL KEY ACTIVE
```

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE (CONTD)

```
E0B6    CPSLK   .EQU  CONT+1       ; 0=CAPS LOCK NOT ACTIVE
E0B7    CURSOR  .EQU  CPSLK+1      ; CURSOR ADDRESS
E0B9    DLMENA  .EQU  CURSOR+1     ; DELIMITER ENABLED
E0BA    DRVADD  .EQU  DLMENA+1     ; 0= DRIVER NOT LOADED, ELSE ADDRESS OF
        ;                            DRIVER
E0BC    DSPDIS  .EQU  DRVADD+2     ; DISPLAY DISABLED
E0BD    ERROR   .EQU  DSPDIS+1     ; 2**0 = SECURITY CODE INCORRECT
E0BE    FLDIDS  .EQU  ERROR+1      ; FIELD ID SENT
E0BF    FLDSCR  .EQU  FLDIDS+1     ; 1=FIELD SCROLL ACTIVE
E0C0    GRACHR  .EQU  FLDSCR+1     ; GRAPHIC CHARACTER
E0C1    HDCSER  .EQU  GRACHR+1     ; HOST DEFINED CODE SEQUENCE
E0C2    HMSGA   .EQU  HDCSER+1     ; HOST MESSAGE ACTIVE
E0C3    HMSGSV  .EQU  HMSGA+1      ; HOST MESSAGE STORAGE
E0C7    INDON   .EQU  HMSGSV+4     ; INDICATOR ON ACTIVE
E0C8    KBCODE  .EQU  INDON+1      ; KEYBOARD CODE FROM TABLE
E0C9    KBINP   .EQU  KBCODE+1     ; 1=KEYBOARD INPUT ACTIVE
E0CA    KBLKD   .EQU  KBINP+1      ; 2**0=KEYBOARD LOCKED
        ;                            2**1=COMM LOCKED
E0CB    LASTCD  .EQU  KBLKD+1      ; LAST CODE FROM KEYBOARD
E0CC    LASTKY  .EQU  LASTCD+1     ; LAST KEY FROM KEYBOARD
E0CD    LASTLN  .EQU  LASTKY+1     ; LAST LINE, 23 OR 29
E0CE    LIGHTS  .EQU  LASTLN+1     ; CURRENT LIGHTS, 1=ON 0=OFF
E0CF    LOCK    .EQU  LIGHTS+1     ; 1 = FIRST TIME DOWN, 2 = SECOND TIME
        ;                            DOWN
E0D0    LOCKLT  .EQU  LOCK+1       ; 0 = LOCK LIGHT OFF, 2 = LOCK LIGHT ON
E0D1    LNCNT   .EQU  LOCKLT+1     ; CURRENT LINE COUNT 0-17
E0D2    LNNCHG  .EQU  LNCNT+1      ; CHANGE IN NUMBER OF LINES
E0D3    LNSAV   .EQU  LNNCHG+1     ; A PLACE TO SAVE LINE COUNT
E0D4    LNSIZE  .EQU  LNSAV+1      ; LINE SIZE, 79 OR 131
E0D5    MLTCNT  .EQU  LNSIZE+1     ; THE COUNTER USED WHEN MULTIPLE INPUT-
        ;                            ACTIVE
E0D6    MLTACT  .EQU  MLTCNT+1     ; MULTIPLE CODE SEQUENCE ACTIVE
E0D7    MLTADD  .EQU  MLTACT+1     ; CALL ADDRESS STORED HERE
E0D9    MODEST  .EQU  MLTADD+2     ; MODE START IN CMOS OR RAM
E0DA    PCRLF   .EQU  MODEST+1     ; PRINT CR, LF
E0DB    PNTNXT  .EQU  PCRLF+1      ; THIS CODE IS TO BE PRINTED NEXT
E0DC    POSPRO  .EQU  PNTNXT+1     ; POSITION IS PROTECTED
E0DD    PRINTA  .EQU  POSPRO+1     ; 1= PRINT ALL ACTIVE
        ;                          ; 3= PRINT NORMAL ACTIVE
E0DE    PROTE   .EQU  PRINTA+1     ; PROTECT IS ENABLED
E0DF    RPTACT  .EQU  PROTE+1      ; 1=REPEAT ACTIVE
E0E0    RSRCV   .EQU  RPTACT+1     ; RS LAST CODE RECEIVED
E0E1    RXOFF   .EQU  RSRCV+1      ; RECEIVED X-OFF
E0E2    SAVEA   .EQU  RXOFF+1      ; STORAGE LOCATION A
E0E3    SAVEB   .EQU  SAVEA+1      ; STORAGE LOCATION B
E0E4    SAVEHL  .EQU  SAVEB+1      ; STORAGE LOCATION HL
E0E5    SCRSV   .EQU  SAVEHL+1     ; STORAGE LOCATION FOR SCROLL
```

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE (CONTD)

```
E0E6    SHIFT   .EQU   SCRSV+1      ; 2**0 = SHIFT KEY DOWN
        ;                            2**1 = SHIFT LOCK ACTIVE
E0E7    SPFLAG  .EQU   SHIFT+1      ; 1= LINE TESTED, NOT ALL SPACES TO EOL
E0E8    SRLFST  .EQU   SPFLAG+1     ; 1ST LINE OF SCROLL FIELD . 0-17
E0E9    SRLLST  .EQU   SRLFST+1     ; LAST LINE OF SCROLL FIELD . 1-18
E0EA    STALN   .EQU   SRLLST+1     ; STATUS LINE ACTIVE
E0EB    SXOFF   .EQU   STALN+1      ; SENT X-OFF
E0EC    TABLE   .EQU   SXOFF+1      ; 0 = ADV .TBL, 1=TABLE 1, 2=TABLE 2
E0ED    TABST   .EQU   TABLE+1      ; 1 = TAB SET ACTIVE
E0EE    TIPE    .EQU   TABST+1      ; TERMINAL INSTALLATION PARA . ENTRY
E0EF    TOGAL   .EQU   TIPE+1       ; 2**4=0, 2**5=1, 2**6=TOGAL
E0F0    TXEMPF  .EQU   TOGAL+1      ; TRANSMIT EMPTY
E0F1    XPOS    .EQU   TXEMPF+1     ; X POSITION FROM COMM
E0F2    BANKS   .EQU   XPOS+1       ; CURRENT BANKS SELECTED
E0F3    T3RUN   .EQU   BANKS+1      ; TIMER 3 RUNNING
E0F4    T3TCV   .EQU   T3RUN+1      ; TIMER 3 TIME CONSTANT VARIABLE
E0F5    FNCODE  .EQU   T3TCV+1      ; FUNCTION KEY CODE TO SEND AFTER
        :                            BLOCK SEND
E0F6    BAUDCH  .EQU   FNCODE+1     ; BAUD RATE CHANGED IN OPERATOR ENTRY
E0F7    PTXOFF  .EQU   BAUDCH+1     ; X-OFF RECEIVED FROM PRINTER
E0F8    NOPTR   .EQU   PTXOFF+1     ; NO PRINTER ASSIGNED
        ;*************************************************************
        ;
        ;       L O A D   F L A G S
        ;
        ;*************************************************************
        ;
E0FC    LINFO    .EQU   0E03CH      ; LOAD INFO
0001    ASCIIL   .EQU   01H         ; ASCII LOADER
0002    DISKL    .EQU   02H         ; DISK LOADER
0004    ROML     .EQU   04H         ; ROM PACK
0010    RS/232/C .EQU   10H         ; USING RS/232/C HOST INT.
0020    CLINT    .EQU   20H         ; USING CURRENT LOOP HOST INT.
0040    I1200    .EQU   40H         ; USING INTERNAL 1200/1200
0080    P21 12   .EQU   80H         ;
E0FD    FILEN    .EQU   LINF0+1     ; FILE NUMBER
E0FE    MDACT    .EQU   FILEN+1     ; MODE ACTIVE
0007    MD       .EQU   07H         ; MODE
E0FF    ERRORF   .EQU   MDACT+1     ; ERROR FLAG
0001    DERROR   .EQU   01H         ; DIAGNOSTIC ERROR
0002    BATTL    .EQU   02H         ; BATTERY LOW
FFFF    RAMEND   .EQU   0FFFFH
```

## INIT Initialization

This routine is entered after power-on or depressing of the reset switch.

In general INIT will:

- Set up the 8255 to have all ports as outputs.
- Set the Stack Pointer to E000 hex.
- Select Banks 0, 6, 5, 4.
- Turn off alarm, enable ASCII video with internal clock, disable graphic video.
- Move terminal installation parameters from NVM to active RAM flags.
- Go to Test 1.
- After returning from Test 1.
- Select Bank 0, 6, 5, 4.
- Clear Flags - Except LIGHTS and ERROR F.
- Select Interrupt Mode 2.
- Enable Timer and Keyboard Interrupt.
- Test Error Flag
  - Go to Mode Select without clear if error set (MDSLNC).
- Test Auto Select
  - Go to Mode Select with clear if not enabled (MODESL).
  - Go to Default mode select if set (DFMODE).

## INIT00 Initialization 00

This routine is used to set up for interrupts.

In general INIT00 will:

- Clear timer 3 of interrupts.
- Set (T3TCV) for 8 ms time constant.
- Call enable blink (ABLKE) output in 8255.
- Move the interrupt trap addresses to the interrupt trap table at E100 hex.
- Select Mode 2 interrupts.
- Call keyboard initialization (KINIT).
- Set interrupt mask to allow keyboard and timer interrupts.
- Return.

## INIT01 Initialization 01

This routine is used to set up the 5037 for 30 lines by 80 characters.

In general INIT01 will:

- Turn off keyboard lock light.
- Call CRT80 to select 30 lines by 80 characters.
- Select blinking, box cursor with normal background.
- Calls INIT02 to clear comm send and receive buffers.
- Return.

## INIT02 Initialization 02

This routine is used to reset comm send and receive buffers.

In general INIT02 will:

- Clear comm send and receive buffer counts (BFCNT, TXCNT).
- Set comm send and receive buffer pointers to start (BFINAD, BFOTAD, TXINAD, TXOTAD).
- Return.

## CRT80 Set CRT to 80 Char/Line

This routine is used to set up the 5037 CRT controller chip for 80 characters per line.

In general CRT80 will:

- Select 80 characters in Port C of the 8255.
- Set (LNSIZE) = 4F hex (79).
- Test (OBYTE4) for 24 or 30 lines
  - Output 7 values to the 5037 depending on 24/30 lines, (XDELTA) and (YDELTA).
- Call clear screen (CLEAR).
- Return.

## CRT132 Set CRT to 132 Char/Line

This routine is used to set up the 5037 CRT controller chip for 132 characters per line.

In general CRT132 will:

- Select 132 characters in Port C of 8255.
- Set (LNSIZE) = 83 hex (131).
- Test (OBYTE4) for 24 or 30 lines
  - Output 7 values to the 5037 depending on 24/30 lines, (XDELTA) and (YDELTA).
- Call clear screen (CLEAR).
- Return.

## CINIT Comm Initialization

This routine is used to select and set up the proper 8250 UART for Comm interface. There are two possible Comm interfaces.

1. The Resident Data set.
2. The 1200/1200 Auto-Dial modem.

In general CINIT will:

- First determine which interface is going to be used. If the option card is not installed for the interface selected, control is sent to Mode Not Enabled (MODENE).
- The flag (CDATAR) is set to the device number for the 8250 selected. 40 = Resident Interface, C0 = Internal Modem.
- The interrupt trap table is set to CMTRAP. The transmit baud rate is sent to the 8250. Timers 1 and 2 are set for the receive baud rate. (Needed for resident only.)
- Output to the 8250 line control register LCR to select 7/8 bits, parity enabled/disabled, parity even/odd, and 1/2 stop bits.
- Enable receive data interrupt in the 8250.
- Light or clear the DSR indicator.
- Output to the 8250 modem control register MCR to select proper data terminal ready (DTR).
- Request to send (RTS) and secondary RTS (SRTS).
- Clear interrupts in the 8250.
- Delay about one half second to allow 8250 to settle.
- Return.

## KINIT Keyboard Initialization

The routine is used to set up the 8250 UART to the keyboard.

In general KINIT will:

- Clear keyboard buffer count (KBCNT).
- Set buffer in and out addresses to start (KBINAD) (KBOTAD).
- Set 8250 to 9600 baud.
- Select 8 bits, 1 stop bit, odd parity.
- Select receive data interrupt in 8250.
- Output to the modem control register to select language and alert volumn.
- Call unlock keyboard (KBDUNL).
- Select the residents keyboard tables.
- Clear interrupts.
- Return.

## PINIT Printer Initialization

This routine is used to set up the proper 8250 on the Dual Serial Board to talk to a serial printer.

In general PINIT will:

- Test (CHAPAR) if printer is on Port A
  - Set (PDATAR) = 80 if Port A - Jump over Test B.
- Test (CHBPAR) if printer is on Port B
  - Set (PDATAR) = 90 if Port B.
- If neither have a printer, clear printer selected flag (OBYTE1).
- Output baud rate to selected Port.
- Set up the Line Control Register LCR for 7/8 bits = 7 if parity enabled else 8 bits, parity enabled/disabled, paritiy even/odd and 1/2 stop bits.
- Set up the modem control register MCR with DTR, RTS and Carrier On.

- Disable interrupts in the 8250.
- Delay 1/2 second to settle the 8250.
- Return.

INTDIS Interrupt Disable

This routine will disable the mask for a specified interrupt.

In general INTDIS will:

- Get the current interrupt mask.
- Remove the proper mask bit.
- Save new mask (INTMSK).
- Output new mask to Port B of the 8255.
- Return

INTENA Interrupt Enable

This routine will enable the mask for the device specified and store the address of the trap.

In general INTENA will:

- Store DE in the proper interrupt trap table.
- Get the current interrupt mask (INTMSK).
- Add the proper bit in B.
- Save new mask (INTMSK).
- Output new mask to Port B of the 8255.
- Return.

## CMTRAP Comm Interrupt Trap

This routine will input one character from the Comm 8250, test it for errors, and store the proper code in the receive buffer.

In general, CMTRAP will:

- Input the data from the proper Comm interface (CDATAR).
- Accept the data only if
  - Data only is active
  - DSR and CO are active
  - DSR and Constant RTS are active
  - DSR and Switched RTS and full duplex.
- If a Break is received
  - Sound the alarm
  - Drop RTS if needed
  - Clear send and receive buffers.
- Place a parity error code (FF) in buffer if
  - Overrun error
  - Parity error
  - Framing error
  - Break received.
- Enable interrupts.
- Return.

## KBTRAP Keyboard Interrupt Trap

This routine will input one code from the keyboard 8250 UART and place it into the keyboard buffer. If code has an error status set, the code is not put into the buffer.

## TMTRAP Timer Interrupt Trap

This routine is entered whenever the timer interrupt occurs. It tests to see which delays are active. It will take the appropriate action when a delay has finished. If a delay is not finished, the timer will be started again.

Each delay has a flag indicating the delay is active. The number stored in an active flag is the number of times remaining to go through the timer before the delay is finished.

Example: The alarm is a 250-ms delay. The timer length set by CYBER mode is 8 ms. Therefore 250 divided by 8 equals 32. 32 decimal equals 20 hex. So, to sound the alarm in 250 ms:

- The alarm must be turned on
- 20 stored in the active flag (ALRACT)
- The Start Timer (STTM) called.

The length of the timer can be changed by a user by storing the time constant in location (T3TCV) before calling (STTM).

Here is a list of delays and what happens when each times out.

- User delay 2 (UD2ACT) - A call is made to address stored in (UD2ADD) when finished.
- Keyboard delay (KBDACT) - This is a 1-second delay which starts the Keyboard Repeat delay when finished.
- Keyboard Repeat delay (KBRACT) - A call is made to KBDRPT to process another character, and the Repeat delay is started again.
- Alarm delay (ALRACT) - The alarm will be turned off when finished.
- Transmit delay (TXDACT) - A call is made to SENDTM to drop RTS when finished.
- Printer delay (PNTACT) - The (PNTACT) is cleared when finished.
- Pacing delay (PCDACT) - The (PCDACT) is cleared when finished.
- Break delay (BRKACT) - The Break signal is dropped from the Comm interface when finished.
- User delay 1 (UD1ACT) - A call is made to address stored in (UD1ADD) when finished.

NOTE

A user can call DLYEN1 or DLYEN2 to start user delays 1 or 2.

## TPTRAP Touchpanel Interrupt Trap

This routine will move the cursor under the area touched and send the XY position on the Comm line.

In general TPTRAP will:

- Save all registers.
- Call TPINP.
- Move cursor to DE.
- Send RS, M, X, Y and CR if enabled.
- Restore all registers.
- Return.

NOTE

The user can call TPINP if it is not desired to move the cursor and send the XY position.

## ADVCR Advance Cursor

This routine will advance the cursor to the next position.

- The alarm is sounded when the cursor enters the eighth position from end of line or last line and the margin alert is enabled.
- If cursor is at the end of line it is moved to the start of next line.
- If cursor is at the end of the last line:
  - It is moved to upper left if page mode is selected.
  - The screen is scrolled if scroll mode is selected.

## ADVMD Advanced Mode (CYBER Mode)

This is the entry point to advanced mode (CYBER Mode). It does not return if called. See the definition of CYBER Mode if needed.

ALARM Alarm for 250 ms

This routine will turn on the alarm and start the alarm delay for 250 ms.

ALARMI Alarm if Margin Bell Enabled

This routine will call ALARM if a keyboard input is active and the margin alert parameter flag is active.

BDISPN Display B

This routine will display (or process) the code in the B register. Function code will be processed.

BFTB Buffer to B

This routine will take the next code out of the Comm buffer and return with the code in the B register and interrupt disabled.

BLDADD Build Address

This routine will calculate the starting address of a line.

CLEAR Clear Screen

This routine will clear 30 lines by 132 character per line, enable the blink, and clear the attribute word. The cursor will be reset to home position.

CLREOL Clear to End of Line

This routine will clear data from current position to the end of line.

- If protect is enabled - only unprotected data is cleared.
- The background code is cleared - except in Block mode with keyboard input the modified bit is set.

CLREOP Clear to End of Page

This routine will clear data from current position to the End of Page.

- If protect is enabled - only unprotected data is cleared.
- The background code is cleared - except in Block mode with keyboard input the modified bit is set.

CRDOWN Cursor Down

This routine will move the cursor to the same relative position on the next line. If cursor is on the last line:

- Page mode - move cursor to top line.
- Roll mode - scroll screen and move cursor to start of last line.

CRGRTN Carriage Return

This routine will move the cursor to the beginning of the current line. If the Auto Line Feed parameter is active the cursor is moved to the beginning of the next line.

CRLEFT Cursor Left

This routine will move the cursor left one position. If in the first position of a line it will move to the last position of the line above. If in the first position of top line it will move to last position of last line.

## CRLNFD Carriage Return Line Feed

This routine will move the cursor to the first position of current line and call CRDOWN.

## CRUP Cursor Up

This routine will move the cursor up one line in the same relative position. If on the top line, cursor is moved to same position on bottom line.

## DISPB Display the Code in B

This routine will store the code in the B register at the current cursor position and store the current attributes in the background memory:

- If the current position is protected, a keyboard input alarm will sound and code not stored.
- If the graphic flag is active, 2**7 is added to codes between 20 and 3F hex.
- If keyboard input is active, the modified bit is added to the background code.

The cursor is advanced to next position if code was stored.

NOTE

Function codes are displayed.

## DLTEN1 Delay Enable 1

This routine will save the number of times the user wants to go through the timer (8 ms if not modified) and save the address it will call when the delay is finished. When the delay is finished, a call will be made to the user address and the user must do a return as soon as possible.

DLYEN2 Delay Enable 2

Same as DLYEN1.

DSTRNG Data String

This routine will take data from memory starting at address in HL and call BDISPN. HL is incremented after each call until an FF hex code is found.

HASCII Hex to ASCII Conversion

This routine will convert the lower 4 bits in the A register to its ASCII value.

KBDAS Keyboard to ASCII

This routine will wait for the next keyboard interrupt by calling KINPUT. If the code is not a Shift, Lock, or Control key, the appropriate code will be taken from the keyboard table.

KBDASC Keyboard to Lower Case ASCII

This routine will select the proper code from the No-Shift No-Control Keyboard table and return with code in A.

KINPUT Keyboard Input

This routine will loop waiting for a code in the keyboard buffer. It will input the code to register B and return.

MODENE Mode Not Enabled

This routine will display "MODE NOT ENABLED" on line 27 and display the mode selection menu.

This routine must have 30 lines selected. This can be done by calling INITO1 before jumping to MODENE.

This routine will not return, it requires the operator to fix any problem and select another mode.

PABI Port A Bidirectional

This routine will set up Port A as the bidirectional RS-232-C port. It requires HL to be present to BDATAR.

In general PABI will:

- Store 80 at (HL).
- Output baud rate to the 8250 UART.
- Set up the Line Control (LCR) for
  - 7/8 bits = 7 if parity enabled also 8 bits
  - Parity enabled/disabled
  - Parity even/odd
  - One or two stop bits.
- Set up the Modem Control Register (MCR) with DTR, RTS and Carrier On.

PBBI Port B Bidirectional

Same as PABI except for Port B is initialized.

PRINTB Printer Code in B Register

This routine will send the code in the B register to the printer if printer is selected and the UART has a data ready. It will loop waiting for data ready.

RESET Reset Cursor

This routine will move the cursor to the upper-left or lower-left depending on the cursor home parameter.

## SCROLL Scroll Screen

This routine will scroll a field. The top and bottom lines must be preset.

(SRLFST) = Top line to scroll.
(SRLLST) = Bottom line to scroll.
(FLDSCR) = Direction of Scroll 0 = scroll up, 1 = scroll down. The cursor is moved to lower left if total scroll up.

## SEND Send Next Code From Comm Buffer

This routine will send one byte of data if:

- Pacing delay not active.
- The host has not sent an X-OFF code.
- UART Has a data request.
- Data only parameter active.
- DTR and DSR and RTS and CTS are active.
  - If DSR is not active the keyboard is locked.

The routine will first send data from transmit buffer. If nothing is in the buffer the send is assumed to be a block mode send and the code is then taken from the screen.

## SENDB Send the Code in B Register

This routine will place the code in the B register into the transmit buffer if online is active.

Return with NZ if local.
Return with Z if online and code is in buffer.

Before placing the code in the buffer bit 7 is cleared if space parity selected or set if mark parity selected.

NOTE

This routine will only send a 7-bit code. To send 8-bits see SENDB8.

SETDE Set Cursor to Location in DE

This routine will move the cursor to location specified by DE. D = Character Count, E = Line Count.

SETCR Set Cursor

This routine will move the cursor to the location specified by Character Count (CHRCNT) and Line Count (LNCNT).

STTM Start Timer

This routine will start the delay timer by outputing the variable count stored in (T3TCV). This location is set for 8 ms during initialization. If the timer is currently running it will not be restarted.

TABBK

This routine will move the cursor backwards to the next tab set position or to the start of the next non-dim field if protect is disabled or to the start of the next unprotected field if protect is enabled. The cursor will stop at upper-left if not found. If the cursor is at upper-left it will start search from lower-right corner.

TABFW Tab Forward

This routine will move the cursor forward to the next tab set position or to the next non-dim position following a DIM position of protect is disabled or to the next unprotected position following a protected position if protect is enabled. The cursor will be moved to upper-left if none are found.

TABCLR Tab Clear

This routine will clear the current column as a tab stop.

## TABSET Tab Set

This routine will set the current column as a tab stop.

## TPINP Touchpanel Input

This routine will input touchpanel data and return with the actual data in B, the character count in D and the line count in E.

## SENDB8 Send the 8-Bit Code in B Register

This routine will place the code in the B register into the transmit buffer if online is active.

Return with NZ if local.

Return with Z if online and code in buffer.

## MNTOR User Entry to Monitor

This entry will make one pass through the MDNITOR Routine and return. The monitor will:

- Print one character if print is active.
- Process one character if data in receive buffer.
- Process one keyboard code if data in keyboard buffer.
- Send one code if data in send buffer.
- Send one code if block mode send active.
- Update the DSR indicator.

## ADVINI Advanced Mode Initialization

This routine will do the following initialization before returning:

- Clear RAM flags and host load table.
- Set up to use resident keyboard tables.
- Turn off keyboard lock light.
- Set up the 5037 according to 24/30 lines and 80/132 characters.
- Select cursor type.
- Call INIT00.
- Call INIT02.
- Call PINIT.
- Select keyboard and timer interrupt masks.
- Call CINIT.

KBDINP Keyboard Input (CYBER Mode)

This routine will process the next keyboard code using all of the CYBER mode function table.

In general it will:

- Input the next code.
- Convert code using tables.
- Send the proper CYBER mode code(s) by placing them in the send buffer.
- If half duplex - process code(s) internally.

CMTRPU Comm Interrupt Trap for User

This routine does the same as CMTRAP except it will not enable interrupts before returning.

KBTRPU Keyboard Interrupt Trap for User

The routine is the same as KBTRAP except it will not enable interrupts before returning.

TMTRPU Timer Interrupt Trap for User

This routine does the same as TMTRAP except registers must be saved before calling and it will not enable interrupts before returning.

TPTRPU Touchpanel Interrupt Trap for User

This routine does the same as TPTRAP except it will not enable interrupts before returning.

TIPRAM Move Terminal Installation Parameters to RAM

This routine will move the terminal installation parameters from NVM to there active locations in RAM.

Bank 6 must be selected in Block 4 and Bank 1 must be selected in Block C before calling this routine.

CRTOUT CRT Output

This routine will output seven values to the 5037 CRT controller chips. A register pair is used to point to the starting value in memory.

Programming Considerations

## General Guidelines

1. Refer to table B-3 (earlier in this appendix) for entry points to callable routines.

2. Never read from or write into NVM directly. Always use Bank 4 parameters.

3. All user callable routines will not enable or disable interrupts (except BFTB will return with interrupts disabled).

4. All user callable routines will not change interrupt mask (except interrupt enable and disabled).

5. All user callable routines will not change bank selects (except the initialization routines).

6. Bank 0 must be selected in Block 0 and Bank 4 must be selected in Block C when using any callable routines.

## Position the Cursor

There are many ways to position the cursor to a desired position.

1. SETDE - Place the character count in Register D, the line count in Register E and call SETDE.

2. DSTRNG - In a display string of data the X, Y positioning can be used. Example using a system configured to small CYBER, 80 characters per line, bias off. Move cursor to line 4, character 0 and display HELP.

   ASCII - DLE, X, Y, H, E, L, P
   HEX - 10, 03, 48, 45, 4C, 50, FF

   Load (HL) will starting address of hex codes in memory and call DSTRNG.

3. CRDOWN - Call CRDOWN to do DOWN ARROW.

4. CRGRTN - Call CRGRTN to do carriage return.

5. CRLEFT - Call CRLEFT to backspace.

6. CRLNFD - Call CRLNFD to do carriage return and line feed.

7. CRUP - Call CRUP to do up arrow.

## Displaying One Character

There are two ways to display a character.

1. DISPB - To display the code in B without reacting to control codes call DISPB.

2. BDISPN - To display the code in B while reacting to control codes call BDISPN.

## Display a String of Characters

Store the message in memory, terminating it properly. Call DSTRNG.

## Get one Code From Keyboard

When it has been determined there is something in the keyboard buffer:

1. KINPUT - Call this to get the raw code from the keyboard.

2. KBDAS - Call this to convert the raw code into an ASCII code.

## Transmit Data

Transmitting data is a two step operation.

1. SENDB - Call this routine to place the code in Register B into the transmit buffer.

2. SEND - If there is something in the transmit buffer call this routine to send the next code if conditions are ready.

## Receive Data

The initial set up has the host receive interrupt enabled. The interrupt (CMTRPU) will input one code and put it into the receive buffer.

BFTB - This route can be called to take the next code from the buffer and put it into B.

Delays

There are two user delays. A timer is run that has a user defined time constant. The user defines the number of times through the timer and the address to be called when finished.

1. The timers time constant is initialized to 8 ms. This can be changed by storing a new time constant variable at (T3TCV). Example for a 5 ms time constant: 5000 000 = 42666 · T3TCV

   117 = T3TCV

2. DLYEN1 or DLYEN2 - Call these routines with the proper register set to number of times through the timer and the proper registers set to address to call when finished.

## Restrictions and Limitations

This firmware does not support the graphic option. It is intended to have a ROM pack or external loaded controlware to support the graphic option.

The following paragraphs describe the physical, electrical, and functional requirements of the RS-232-C/CCITT V.24 Interface.

## PHYSICAL AND ELECTRICAL REQUIREMENTS

The interface signals conform to EIA Standard RS-232-C and CCITT Recommendation V.24 as applied to asynchronous telecommunications.

All levels are referenced to Signal Ground and must not exceed ±15 volts.

For the Received Data circuit, a voltage more negative than -3 volts is interpreted as a marking condition; a voltage more positive than +3 volts is interpreted as spacing condition. During periods of no receiver activity, the Received Data circuit is expected to be held to a marking condition.

For control circuits originating at the modem, a voltage more negative than -3 volts open circuit is interpreted as an off condition; a voltage more positive than +3 volts is interpreted as an on condition.

For the Transmitted Data circuit, the terminal provides a voltage equal to, or greater than -5 volts as a marking condition and a voltage equal to or greater than +5 volts as a spacing condition. During periods of no transmission activity, the Transmitted Data circuit is held to a marking condition.

For control signals originating at the terminal, a voltage equal to or greater than -5 volts is provided as an off condition; a voltage equal to or greater than +5 volts is provided as an on condition.

Recommended maximum cable (P/N 61409028-32) length is 15.2 metres (50 feet). The connector is a 25 pin female AMP part 745114-2 or equivalent.

Interface circuit definitions are provided as follows:

- Protective Ground (Pin 1) - Protective ground is electrically connected to the terminal frame and to the power source protective ground through the terminal ac power system.

- Transmitted Data (TXD) (Pin 2) - The Transmitted Data signal transfers data from the terminal to the modem. Data is transmitted as a 10- or 11-bit serial word and supports 7- or 8-bit data. In the order of transmission, the data word contains: a start bit (spacing), data bits $2^0$ through $2^6$ for 7-bit data and $2^0$ through $2^7$ for 8-bit data, a parity bit, and one or two stop bits (marking) for 7-bit data and 1 stop bit for 8-bit data. The number of stop bits is selected by operator parameter bit selection. Within the field created by the start and stop bits, a marking condition is provided for a binary one indication and a spacing condition is provided as binary zero indication. Rate of transmission is determined by the Transmit Data Rate Select parameter setting. Within the field created by the start and stop bits, a marking condition is provided for a binary one indication and a spacing condition is provided as binary zero indication. Rate of transmission is determined by the Transmit Data Rate Select parameter setting. The transmit rate is independent of the receive data rate.

- Received Data (RXD) (Pin 3) - The Receive Data signal transfers data from the modem to the terminal. The received data word contains, in the order of reception: a start bit (spacing), data bits $2^0$ through $2^6$ for 7-bit data or $2^0$ through $2^7$ for 8-bit data a parity bit, and a stop bit(s) (marking) 1 or 2 for 7-bit mode and 1 for 8-bit mode. Rate of reception is determined by the Receive Data Rate select parameter setting. Within the field created by the start and stop bits, a marking condition is interpreted as a binary one and a spacing condition is interpreted as a binary zero.

- Request to Send (RTS) (Pin 4) - This signal is generated by the terminal to condition the modem for data transmission. The transition of this signal from OFF to ON instructs the modem to enter the transmit mode. The transition of this signal from ON to OFF instructs the modem to complete the transmission on the communication channel of all data previously transferred on the terminal/modem interface and then to assume a nontransmit mode.

Once this signal has been turned OFF, it must not be turned ON again until Clear to Send has been turned OFF.

- Clear to Send (CTS) (Pin 5) - This signal is generated by the modem to indicate that the modem is ready to transmit data. The ON state of this signal is a response to the ON state of Request to Send, indicating that the modem is in the transmit mode. The OFF state of this signal is a response to the OFF state of Request To Send, indicating that all information previously transferred on the terminal/modem interface has been transferred to the communication channel and the modem is in the nontransmit mode.

- Data Set Ready (DSR) (Pin 6) - This signal is generated by the modem to indicate its status. The "ON" state signifies that the modem is connected to a communication channel; is not in test, talk or dial mode; and had completed all operations required of it to establish a connection to a remote modem. The ON state does not signify that a connection has actually been established. The OFF state indicates that the terminal must disregard all other interface signals except Ring Indicator. The OFF state of this signal must not impair the operation of the Ring Indicator or Data Terminal Ready Signals.

- Signal Ground (Pin 7) - Signal Ground establishes the common ground reference potential for the control and data signals.

- Received Line Signal Detector (Carrier On) (Pin 8) - This signal is generated by the modem. The ON state indicates that the modem is receiving a signal on the communication channel which meets the "Suitability Criteria" of the modem.

- Secondary Request to Send (Pins 11 & 19) - The modem generates this signal to indicate the condition of the unmodulated carrier on the secondary channel. The ON state indicates that a carrier signal is present. The OFF state indicates the absence of the carrier.

- Data Terminal Ready (DTR) (Pin 20) - This signal is generated by the terminal to indicate to the modem that the terminal is ready to receive or transmit information and that the modem may connect to or remain connected to the communication channel.

- Ring Indicator (Pin 22) - The modem generates this signal. It indicates to the terminal that a ringing signal is being received on the communication channel.

- Data Signal Rate Selector (Pin 23) - The Data Signal Rate Selector circuit is maintained in the on condition when power is applied to the terminal.

This appendix describes the functional characteristics of the Display Terminal when operating as an ASCII graphics terminal using the communications protocol of the Tektronix 401X Terminal. These characteristics come from controlware loaded into the terminal. In this mode, the terminal simulates the operation of the Tektronix 401X terminal series, but is not completely compatible due to certain hardware and controlware constraints.

## EQUIPMENT CONFIGURATION

Equipment configurations for the 401X/graphics mode are listed as follows:

- Minimum Configuration (typical)
  - 721-30 (CC638-A) Terminal (includes touchpanel and graphics feature)
- Maximum Configuration
  - Terminal listed under Minimum Configuration
  - Graphics printer
  - Parallel Interface option
  - Dual asynchronous interface option
  - Matrix printer

## GRAPHICS OPERATION

The following description of graphics operation defines initial conditions upon selection, the bypass condition, and describes the operational modes that can be selected while in graphics operation.

### SELECTION AND DESELECTION OF GRAPHICS OPERATION

Upon completion of a load operation, the terminal controlware is initialized to alphanumeric operation. (All terminals downline loading this controlware from CDSN will automatically receive the latest released version.)

Graphics operation can be selected by receipt of an ESC SOH code sequence from the ASCII host system or by operator selection on the status line.

Graphics operation can be deselected by receipt of an ESC STX code sequence.

## INITIAL CONDITIONS

Certain initial conditions exist when ASCII operation is selected. These initial conditions are:

- The screen is erased.
- The terminal is in alpha mode.
- The alpha cursor is in the home position (upper left corner).
- Normal size characters will be displayed.
- Character writing is overstrike write.
- The terminal is set to LINE mode and CAPS is selected.

## BYPASS CONDITION

The bypass condition inhibits data from being displayed on the screen, thus allowing data to be transmitted to the computer without it being written on the screen. The following program commands set and clear the bypass condition.

- Set bypass

  ESC CAN
  ESC SUB

- Clear Bypass

| | |
|---|---|
| BEL | ESC BEL |
| BS | ESC BS |
| CR | |
| HT | ESC HT |
| LF | |
| VT | ESC VT |
| | ESC FF |
| US | ESC US |

KEYBOARD FOR GRAPHICS OPERATION

The keyboard has a standard Viking X layout with the ASCII graphics-unique characters and certain ASCII control codes on the front surfaces of the keycaps as shown in figures 3-2 and 3-3. Figure 3-10 shows the keystation assignments.

## Alphanumeric Keys

The terminal can generate all 96 of the ASCII alphanumeric codes. These codes are generated as shown in table D-1.

Upper case alphabetic symbols and other shifted symbols are generated by holding down either SHIFT key simultaneously while pressing the desired data key.

TABLE D-1. ASCII KEY CHARACTERS AND CODES

| KEY NO. | CHARTER GENERATED | | ASCI CODE (HEX) | |
|---|---|---|---|---|
| | LOWER | UPPER | LOWER | UPPER |
| 1 | PRINT | PRINT | ** | ** |
| 2 | SET UP | SET UP | ** | ** |
| 3 | | | * | * |
| 4 | | | * | * |
| 5 | | | * | * |
| 6 | | | * | * |
| 7 | | | * | * |
| 8 | | | * | * |
| 9 | | | * | * |
| 10 | | | * | * |
| 11 | | | * | * |
| 12 | ESC | ESC | 1B | 1B |
| 13 | | | * | * |
| 14 | | | * | * |
| 15 | | | * | * |
| 16 | ` (ISO) | ~ (ISO) | 60 | 7E |
| | → (ANSI) | → (ANSI) | 09 | 09 |
| 17 | 1 | ! | 31 | 21 |
| 18 | 2 | @ | 32 | 40 |
| 19 | 3 | # | 33 | 23 |
| 20 | 4 | $ | 34 | 24 |
| 21 | 5 | % | 35 | 25 |
| 22 | 6 | | 36 | 5E |
| 23 | 7 | & | 37 | 26 |
| 24 | 8 | * | 38 | 2A |

TABLE D-1. ASCII KEY CHARACTERS AND CODES (CONTD)

| KEY NO. | CHARTER GENERATED | | ASCI CODE (HEX) | |
|---|---|---|---|---|
| | LOWER | UPPER | LOWER | UPPER |
| 25 | 9 | ( | 39 | 28 |
| 26 | 0 | ) | 30 | 29 |
| 27 | - | | | |
| 28 | = | + | 3D | 2B |
| 29 | (ISO) | (ISO) | 08 | 08 |
| | (ANSI) | (ANSI) | 60 | 7E |
| 30 | | | 08 | 08 |
| 31 | | | * | * |
| 32 | \| | \| | 0A | 0A |
| 33 | q | Q | 71 | 51 |
| 34 | w | W | 77 | 57 |
| 35 | e | E | 65 | 75 |
| 36 | r | R | 72 | 52 |
| 37 | t | T | 74 | 54 |
| 38 | y | Y | 79 | 59 |
| 39 | u | U | 75 | 55 |
| 40 | i | I | 69 | 49 |
| 41 | o | O | 6F | 4F |
| 42 | p | P | 70 | 50 |
| 43 | [ | ] | 5B | 5D |
| 44 | | : | 5C | 7C |
| 45 | | | * | * |
| 46 | | | * | * |
| 47 | | | ** | ** |
| 48 | a | A | 61 | 41 |
| 49 | s | S | 73 | 53 |
| 50 | d | D | 64 | 44 |
| 51 | f | F | 66 | 46 |
| 52 | g | G | 67 | 47 |
| 53 | h | H | 68 | 48 |
| 54 | j | J | 6A | 4A |
| 55 | k | K | 6B | 4B |
| 56 | l | L | 6C | 4C |
| 57 | ; | : | 3B | 3A |
| 58 | ' | " | 27 | 22 |
| 59 | | | 7B | 7D |
| 60 | CR | CR | 0D | 0D |
| 61 | | | * | * |
| 62 | | | ** | ** |
| 63 | (ISO) | (ISO) | | |
| | (ANSI) | (ANSI) | ** | ** |
| 64 | z | Z | 7A | 5A |
| 65 | x | X | 78 | 58 |
| 66 | c | C | 63 | 43 |
| 67 | v | V | 76 | 56 |
| 68 | b | B | 62 | 42 |
| 69 | n | N | 6E | 4E |

TABLE D-1. ASCII KEY CHARACTERS AND CODES (CONTD)

| KEY NO. | CHARTER GENERATED | | ASCI CODE (HEX) | |
|---|---|---|---|---|
| | LOWER | UPPER | LOWER | UPPER |
| 70 | m | M | 6D | 4D |
| 71 | , (ISO) | , (ISO) | 2C | 2C |
| | , (ANSI) | < (ANSI) | 2C | 3C |
| 72 | . (ISO) | . (ISO) | 2E | 2E |
| | . (ANSI) | > (ANSI) | 2E | 3E |
| 73 | / | ? | 2F | 3F |
| 74 | | | ** | ** |
| 75 | CR | CR | 0D | 0D |
| 76 | | | ** | ** |
| 77 | SPACE | SPACE | 20 | 20 |
| 78 | DEL | CR | 7F | 0D |
| 79 | | | * | * |
| 80 | | | * | * |
| 81 | BS | BS | 08 | 08 |
| 82 | | | * | * |
| 83 | LF | LF | 0A | 0A |
| 84 | (PAGE) | (RESET) | ** | ** |
| 85 | B | BS | 08 | 08 |
| 86 | | | * | * |
| 87 | DEL | DEL | 7F | 7F |
| 88 | | | * | * |
| 89 | | | * | * |
| 90 | | | * | * |
| 91 | | | * | * |
| 92 | ESC | LF | 1B | 0A |
| 93 | | | ** | ** |
| 94 | 7 | 7 | 37 | 37 |
| 95 | 8 | 8 | 38 | 38 |
| 96 | 9 | 9 | 39 | 39 |
| 97 | 4 | 4 | 34 | 34 |
| 98 | 5 | 5 | 35 | 35 |
| 99 | 6 | 6 | 36 | 36 |
| 100 | 1 | 1 | 31 | 31 |
| 101 | 2 | 2 | 32 | 32 |
| 102 | 3 | 3 | 33 | 33 |
| 103 | , | , | 2C | 2C |
| 104 | 0 | 0 | 30 | 30 |
| 105 | . | . | 2E | 2E |
| 106 | CR | CR | 0D | 0D |

*Unused
**Local Function

## Control Character Keys

The terminal can generate ASCII control characters as shown in Control Codes and Escape Sequences for Graphics Operation paragraph. This lists the allowable characters, indicates the modes that use them, and describes their functions.

Control characters are generated from the keyboard by holding down the CTRL key (or in some cases, the CTRL and SHIFT keys) simultaneously while pressing the desired data key. Control characters CR, LF, BS and HT may also be generated by pressing the CR, LF, BS or TAB key respectively. The ERASE key also generates a BS character. The ERASE key additionally erases the displayed character when in LOCAL or HALF.

## DEL Key

The DEL key generates a DEL (Rubout) character.

## BREAK Key

Pressing the BREAK key generates a break condition by holding the transmitted data line in a spacing state for 250 milliseconds. This key is also used to recover from error conditions if one of the print options is active.

## Function Select Keys

While operating in Graphics operation, local function select keys may be used to select the various functions internal to the terminal. They do not send any data to the host. Table D-2 lists these keys and indicates their use.

## GRAPHICS OPERATION MODES

When Graphics operation is selected, one of five modes can be chosen. These modes are alpha, graph, point plot, graphics input (GIN), and block mode.

TABLE D-2. FUNCTION SELECT KEYS FOR GRAPHICS OPERATION

| FUNCTION SELECT | DESCRIPTION |
|---|---|
| ⊛ | Alternate depressions cause all letter keys to transmit codes for uppercase ASCII only, or to transmit uppercase or lowercase ASCII depending on the SHIFT keys. |
| □ | Clears display, resets terminal to alpha mode and positions alpha cursor to home position (upper-left corner of display). Does not clear selected character size. |
| M REL | Resets terminal to alpha mode, positions alpha cursor to home position (upper-left corner of display), and selects normal character size. |

The primary use of each mode is:

- Alpha - display characters.
- Graph - draw a line between two sets of coordinates or perform random positioning.
- Point Plot - display one point at the intersection of two coordinates.
- GIN - input coordinates and status to the host computer.
- Block - write or erase rectangular blocks.

Control codes are used to select a mode and to select certain functions within that mode. The Control Codes and Escape Sequences paragraph is a summary of the ASCII operation control codes. Figure D-2 shows those control codes and sequences used to select a mode. The following paragraphs provide detailed descriptions of the operational modes and define the control codes that select functions within the modes. Figure D-1 illustrates character codes for graphics operation.

| B I T S B7 B6 B5 / B4 B3 B2 B1 | Ø Ø Ø | Ø Ø 1 | Ø 1 Ø | Ø 1 1 | 1 Ø Ø | 1 Ø 1 | 1 1 Ø | 1 1 1 |
|---|---|---|---|---|---|---|---|---|
| | CONTROL | | HIGH X & Y GRAPHIC INPUT | | LOW X | | LOW Y | |
| Ø Ø Ø Ø | Ø NUL | 16 DLE | 32 SP | 48 Ø | 64 @ | 8Ø P | 96 ` | 112 p |
| Ø Ø Ø 1 | 1 SOH | 17 DC1 | 33 ! | 49 1 | 65 A | 81 Q | 97 a | 113 q |
| Ø Ø 1 Ø | 2 STX | 18 DC2 | 34 " | 50 2 | 66 B | 82 R | 98 b | 114 r |
| Ø Ø 1 1 | 3 ETX | 19 DC3 | 35 # | 51 3 | 67 C | 83 S | 99 c | 115 s |
| Ø 1 Ø Ø | 4 EOT | 2Ø DC4 | 36 $ | 52 4 | 68 D | 84 T | 1ØØ d | 116 t |
| Ø 1 Ø 1 | 5 ENQ | 21 NAK | 37 % | 53 5 | 69 E | 85 U | 1Ø1 e | 117 u |
| Ø 1 1 Ø | 6 ACK | 22 SYN | 38 & | 54 6 | 7Ø F | 86 V | 1Ø2 f | 118 v |
| Ø 1 1 1 | 7 BEL BELL | 23 ETB | 39 ' | 55 7 | 71 G | 87 W | 1Ø3 g | 119 w |
| 1 Ø Ø Ø | 8 BS BACK SPACE | 24 CAN | 40 ( | 56 8 | 72 H | 88 X | 1Ø4 h | 12Ø x |
| 1 Ø Ø 1 | 9 HT | 25 EM | 41 ) | 57 9 | 73 I | 89 Y | 1Ø5 i | 121 y |
| 1 Ø 1 Ø | 1Ø LF | 26 SUB | 42 * | 58 : | 74 J | 9Ø Z | 1Ø6 j | 122 z |
| 1 Ø 1 1 | 11 VT | 27 ESC | 43 + | 59 ; | 75 K | 91 [ | 1Ø7 k | 123 { |
| 1 1 Ø Ø | 12 FF | 28 FS | 44 , | 60 < | 76 L | 92 \ | 1Ø8 l | 124 ¦ |
| 1 1 Ø 1 | 13 CR RETURN | 29 GS | 45 - | 61 = | 77 M | 93 ] | 1Ø9 m | 125 } |
| 1 1 1 Ø | 14 SO | 3Ø RS | 46 . | 62 > | 78 N | 94 ^ | 11Ø n | 126 ~ |
| 1 1 1 1 | 15 SI | 31 US | 47 / | 63 ? | 79 O | 95 _ | 111 o | 127 RUBOUT (DEL) |

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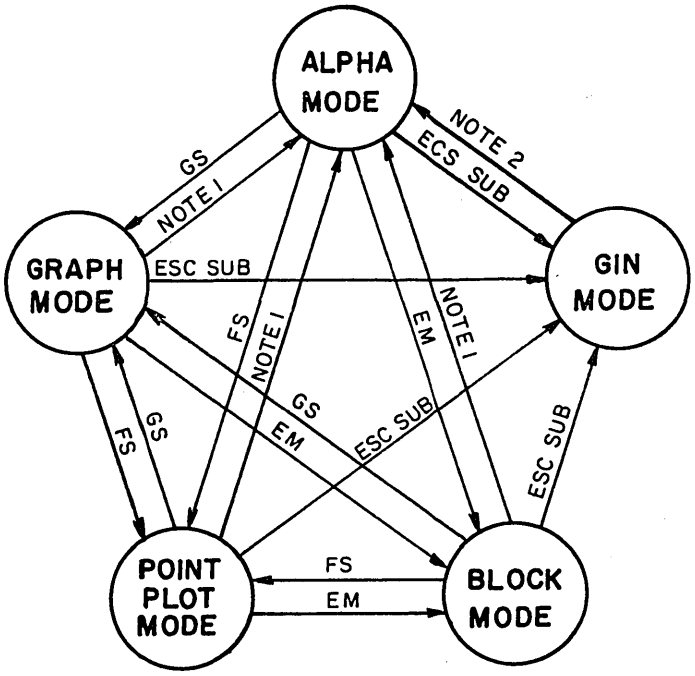
Figure D-1. Character Codes for Graphics Operation




NOTE 1: US, CR, ESC FF, KEYBOARD PAGE, AND KEYBOARD RESET.
NOTE 2: CR, ESC FF, KEYBOARD PAGE, AND KEYBOARD RESET.

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Figure D-2. Permissible Operating Mode Changes

ALPHA MODE

In alpha mode, the terminal displays the 95 displayable ASCII characters. The DEL (rubout) code is ignored in alpha mode.

A blinking cursor occupies the lower dots of the character matrix and marks the position on the display screen where the next character will be entered. After the symbol is entered, the cursor moves one position to the right. When the end of a line is reached, the cursor moves to the leftmost position on the line below. When the bottom line has been completed, the cursor moves to the first position of the top line. The cursor is nondestructive. Cursor home position is at X = 0, Y = 752.

Characters are written on the display screen in an overstrike write mode unless otherwise selected from the host system.

## Transition to Alpha Mode

Control characters and keys that can be used for transition to alpha mode are:

- CR - This control character resets the terminal to alpha mode, positions the alpha cursor to the leftmost position in the current line, and clears the bypass condition.
- ESC FF - This control character sequence resets the terminal to alpha mode, positions the alpha cursor to the leftmost top line (home position), clears the display, and clears the bypass condition.
- US - This control character resets the terminal to alpha mode, leaves the alpha cursor at the last graph-mode address, and clears the bypass condition. This character is nonfunctional in GIN mode, so it cannot be used to transfer from GIN mode to alpha mode.
- □ - Pressing the □ key resets the terminal to alpha mode, positions the alpha cursor to home position, and clears the display. This function operates locally in the terminal.
- M REL - Pressing the M REL key resets the terminal to alpha mode, positions the alpha cursor to home position, and re-establishes initial conditions. This function operates locally in the terminal.

## Alpha-Mode Control Characters

In alpha mode, the following ASCII control characters are operational. All other control characters are ignored.

- Carriage Return (CR) - This character moves the cursor to the leftmost position in the current line and clears the bypass condition.
- Line Feed (LF) - This character moves the cursor down one line and clears the bypass condition. When the cursor reaches the bottom line, the cursor moves to the same column position in the top line.

- Backspace (BS) - This character moves the cursor one position to the left and clears the bypass condition. When the beginning of the line is reached, the cursor moves to the last position of the line above. When the first position of the top line is reached, the cursor moves to the last position of the bottom line.

- Horizontal Tabulation (HT) - This character moves the cursor one position to the right and clears the bypass condition. Spacing past the end of a line causes the cursor to move to the beginning of the next lower line. If the cursor is in the last position of the bottom line, it moves to the home position.

- Vertical Tabulation (VT) - This character moves the cursor up one line and clears the bypass condition. When the top line is reached, the cursor moves to the same column position in the bottom line.

- Bell (BEL) - This character sounds the audible alarm and clears the bypass condition.

## Alpha-Mode Escape Sequences

Escape sequences allow deselection of previously selected functions and transmission of status and cursor position. These sequences begin with an ESC control code which causes the terminal to examine the next character to determine if it is valid in an escape sequence. Valid sequences are:

- ESC DC1 - While in alpha mode, this control code sets inverse video for characters. The inverse of the characters dot pattern represented by the ASCII code is written into display memory.

- ESC DC2 - While in alpha mode, this control code sets character overstrike write. The dot pattern represented by the ASCII code is superimposed in display memory.

- ESC DC3 - While in alpha mode, this control code sets character overstrike erase. The dot pattern represented by the ASCII code is erased from display memory.

- ESC DC4 - While in alpha mode, this control code sets clear write. The dot pattern occupying the display position is first erased and the dot pattern represented by the ASCII code is written into display memory.

- ESC CAN - This sequence selects the bypass condition to inhibit data from being processed by the display.

- ESC ENQ - This sequence causes the terminal to transmit terminal status and the X-Y address of the left end of the alpha cursor to the host system. Bypass is not affected. If a screen-copy operation is active when this sequence is received, the terminal transmission is deferred until the copy operation terminates. The following character sequence is transmitted.

| Byte | Item | Data |
|---|---|---|
| 1 | Terminal Status | 35 hex* |
| 2 | High bits of X address | 5 MSB X + 20 hex |
| 3 | Low bits of X address | 5 LSB X + 20 hex |
| 4 | High bits of Y address | 5 MSB Y + 20 hex |
| 5 | Low bits of Y address | 5 LSB Y + 20 hex |
| 6 | CR | 0D hex |

*25 hex if graphics printer is attached and ready to print and communications-print mode is not selected.

- ESC ETB - This sequence initiates a screen copy operation (see section 3.1.2.8.1). Bypass condition and selected mode are not affected. The alpha cursor is inhibited until the copy operation terminates.

- ESC 7 - Selects large (7 by 9) size characters.

- ESC 8 - Selects normal (5 by 9) size characters.

Transition from Alpha Mode

For required control codes and escape sequences to transfer to other modes, refer to the section describing the mode. Figure D-2 shows permissable mode changes.

GRAPH MODE

In graph mode, the terminal writes and erases vectors in response to ASCII code sequences. To set vector coordinate positions, the 10-bit X coordinate and 10-bit Y coordinate must be converted to ASCII characters as shown in the coordinate conversion chart at the end of this appendix.

These characters are interpreted by the terminal to define a vector. The reception of the low X coordinate initiates a vector operation. The Coordinate Conversion Chart at the end of this appendix shows which coordinates must be sent when coordinate values change.

## Transition to Graph Mode

The control character used for transition to graph mode is Group Separator (GS). It sets the terminal to graph mode and restores any previous graph-mode coordinates.

Initial coordinates set immediately after the GS character, which sets graph mode, do not cause a vector to be written unless GS is immediately followed by a BEL character. This is called a dark or unwritten vector. The GS character can be sent at any time to allow the coordinate base position to be changed without writing a solid-line vector write.

The terminal retains the last high Y, low Y, and high X addresses when switched to another mode. When returning to graph mode, only low X must be received to reset the terminal to its previous coordinates.

## Graph Mode Escape Sequences

Escape sequences begin with an ESC control character. Valid escape sequences for graph mode are:

- ESC DC1 - Causes the terminal to erase the specified vector(s). All other characteristics of graph mode remain the same.
- ESC DC2 - Causes the terminal to write the specified vector(s). All other characteristics of graph mode remain the same.
- ESC DC3 - Causes the terminal to erase the specified vector(s). All other characteristics of graph mode remain the same.
- ESC DC4 - Causes the terminal to write the specified vector(s). All other characteristics of graph mode remain the same.

- ESC ENQ - Causes the terminal to transmit terminal status and graph-mode X-Y beam position. Bypass is not affected. If a screen-copy operation is active when this sequence is received, the terminal transmission is deferred until the copy operation terminates. The following character sequence is transmitted.

| Byte | Item | Data |
|---|---|---|
| 1 | Terminal Status | 39 hex* |
| 2 | High bits of X address | 5 MSB X + 20 hex |
| 3 | Low bits of X address | 5 LSB X + 20 hex |
| 4 | High bits of Y address | 5 MSB Y + 20 hex |
| 5 | Low bits of Y address | 5 LSB Y + 20 hex |
| 6 | CR | 0D hex |

*29 hex if graphics printer is attached and ready to print and communications-print mode is not selected.

- ESC ETB - Initiates a screen copy operation. Bypass condition and selected mode are not affected.

## Transition from Graph Mode

For required control characters and escape sequences to transfer to other modes, refer to the section describing the mode. Figure D-2 shows permissable mode changes.

# POINT-PLOT MODE

In point-plot mode, only a point is written or erased at the specified X,Y coordinate.

## Transition to Point-Plot Mode

Point plot is selected by the File Separator (FS) control character. It sets the terminal to point plot mode and restores any previous point plot mode coordinates.

## Point-Plot-Mode Escape Sequences

Selection of writing or erasing is accomplished by one of four escape sequences:

- ESC DC1 - Erase a point(s)
- ESC DC2 - Write a point(s)
- ESC DC3 - Erase a point(s)
- ESC DC4 - Write a point(s)
- ESC ENQ - Causes the terminal to transmit terminal status and point-plot X-Y beam position. Bypass is not affected. If a screen-copy operation is active when this sequence is received, the terminal transmission is deferred until the copy operation terminates. The following character sequence is transmitted.

| Byte | Item | Data |
|---|---|---|
| 1 | Terminal Status | 31 hex* |
| 2 | High bits of X address | 5 MSB X + 20 hex |
| 3 | Low bits of X address | 5 LSB X + 20 hex |
| 4 | High bits of Y address | 5 MSB Y + 20 hex |
| 5 | Low bits of Y address | 5 LSB Y + 20 hex |
| 6 | CR | 0D hex |

*21 hex if graphics printer is attached and ready to print and communications-print mode is not selected.

- ESC ETB - Initiates a screen copy operation. Bypass condition and selected mode are not affected.

## Transition From Point-Plot Mode

For required control characters and escape sequences to transfer to other modes, refer to the section describing the mode.

# GRAPHICS INPUT (GIN) MODE

The graphics input mode is interactive in that it involves computer requests for information and the terminal's response to the requests.

A crosshair cursor, which appears as a blinking plus sign, is enabled in GIN mode. The intersect address of the crosshair cursor is the position of the X and Y coordinates. The cursor is nondestructive.

During GIN mode, an ESC ETB sequence initiates a screen copy operation. Bypass condition and selected mode are not affected. The crosshair cursor is inhibited until the copy operation terminates.

## Transition to GIN Mode

The ESC SUB sequence selects GIN mode, activates the bypass condition, enables the crosshair cursor, and enables the touchpanel. This sequence should not be entered from the keyboard when online to the ASCII host.

## Cursor Positioning in GIN Mode

The position of the cursor can be moved by three methods:

- Gross Positioning - This method is achieved via the touchpanel. The display screen is sectioned into 256 touch-sensitive areas, each 32 dots by 32 dots, which, when touched, position the cursor to the center of the affected area.
- Coarse Positioning - The shifted arrow keys on the keyboard move the cursor four dots in the direction of the arrow.
- Fine Positioning - The unshifted arrow keys on the keyboard move the cursor one dot in the direction of the arrow.

## GIN Mode Transmission

Each of the following three methods of initiating transmission to the host computer also resets the terminal to alpha mode. Bypass is not cleared until a subsequent character or character sequence which clears bypass is received. Terminal status cannot be transmitted while in GIN mode.

- Character Keys Other than Arrow Keys or CR Key - All character keys other than the arrow keys or CR key cause transmission of the entered character and X-Y position of the crosshair cursor. The following character sequence is transmitted.

| Byte | Item | Data |
|---|---|---|
| 1 | Keyboard Key | Keyboard Character |
| 2 | High bits of X address | 5 MSB X + 20 hex |
| 3 | Low bits of X address | 5 LSB X + 20 hex |
| 4 | High bits of Y address | 5 MSB Y + 20 hex |
| 5 | Low bits of Y address | 5 LSB Y + 20 hex |
| 6 | CR | 0D hex |

- CR Key - The CR key causes transmission of the character corresponding to the arrow key last used to position the crosshair cursor, followed by the X-Y position of the crosshair cursor. The transmitted character sequence is the same as above except that Byte 1 contains the arrow key character rather than the keyboard character.

- ESC ENQ - Causes transmission of the X-Y position of the crosshair cursor. The transmitted character sequence is the same as shown above except that Byte 1 is not transmitted.

## Transition from GIN Mode

ESC FF, ESC ENQ and ESC ETB are the only escape sequences allowed in GIN mode.

## PARAMETER SETTING

There are three types of parameters available. The first two are terminal installation amd mode installation parameters. Refer to section 4. The initial state of each operator parameter is set in the mode installation parameters. The operator parameters are moved into an Activie RAM section and can only be temporarily changed by the operator or host. The operator cannot change the NVM values.

To change the operator parameters, the operator must press SETUP while in an operating mode. An X-Off code will be sent to the host. Eight parameters will be written on the bottom line. To change any parameter, the operator must press the FUNCTION key number that precedes the word. The alternate state will then be displayed. If there are more parameters, F10 will say more select. Pressing F10 will display eight new parameters. If there are no more parameters, F10 will say MODE SELECT. Pressing F1 at any time will exit the operation and send and X-On to the host.

The only keys operational in this mode are:

- F1 return - return to mode.
- F2-F9 - alternate state of that parameter.
- F10 - display next group or go to MODE SELECTION MENU.

All other keys are inoperable. See figure 4-5 for advanced Mode Operator Parameters.

## PRINT OPTIONS

A CL607 (40003-208/209) Graphic Printer is optionally supported by this controlware. Printing may be in a screen-copy mode or in a communications print mode. Both print modes cannot be active at the same time.

## SCREEN-COPY MODE

In screen-copy mode the printer will make a dot-for-dot reproduction of information on the terminal display screen. When present in the resident controlware, the screen-print controlware is available for use at any time during Graphics operation.

### Making a Screen Copy

The operator makes a screen copy by pressing the SHIFT-PRINT keys on the terminal keyboard. Prior to this the printer must have been made ready for operation by pressing the PRINT switch on the printer so that the indicator in that switch is lit. When the copy is complete, the printer will form feed. The printer is then ready to make another copy.

In graphics operation, the host computer system may initiate the screen copy by sending an ESC ETB character sequence to the terminal. Operation of the screen copy is the same as if the operator had started the operation.

## Stopping a Screen Copy Early

A screen copy may be aborted by pressing the BREAK key. The screen copy will be aborted and the printer will form feed. No signal is transmitted to the communications line.

## Printer Errors in Screen-Copy Mode

During a screen-copy operation certain error conditions can occur in the printer. When this occurs, one of the following error messages will flash on and off in the lower righthand corner of the display screen.

- DESELECT - This means that the printer is offline; that is, the indicator is turned off in the PRINT switch on the printer.
- PAPER - This means that the printer has a paper loading problem or that the platen yoke is not closed. This may be corrected by correcting the paper problem, closing the platen yoke, and pressing the FEED switch on the printer to stop it from blinking.
- REJECT - This condition will occur only if a hardware problem exists.

Recovery from these errors is accomplished by correcting the error or by pressing either the STOP key or the SHIFT-STOP keys. The screen copy will immediately terminate and the error message on the screen will be turned off. No signal will be transmitted to the communications line. All other keyboard keys are ignored while an error message is flashing.

## Duty Cycle Protection

The printer duty cycle is kept under 50 percent by a gradual slowdown algorithm built into the screen-copy controlware. In this algorithm, a running average is kept of the density of the screen copy. A separate average is kept for each of the solenoids in the printer. For each solenoid, the following is done when printing each row of data:

a. Count the number of dots on in this row (0 to 42).

b. Add this number to the running average for this solenoid.

c. If the running average is greater than 2560 (greater than 50-percent duty cycle over the last 128 rows), then print at reduced speed.

d. Adjust the running average: new average = old average - (average/128).

This algorithm is not perfect in the sense of checking for exactly 50-percent duty cycle. In general, the slowdown will begin around 40-percent duty cycle.

## Screen-Copy Performance

Nominal time for a screen copy to be made is 35 seconds. High-density (dark) images on paper may cause the printer to slow to 0.3 to 0.5 times its rated speed. This is to prevent the printer solenoids from overheating. The maximum print time for a totally dark image is about 120 seconds. Duty-cycle slowdown should be rarely, if ever, seen by a user. The fastest possible screen-copy time is about 4 seconds.

Screen-copy time depends on the number of horizontal rows of the screen which have dots turned on. If a row has one or more dots turned on, that row will have a print time of 65 milliseconds. If no dots are turned on in a row, that row will be printed in about 5 milliseconds. These times will be slowed if the duty cycle algorithm has slowed down the printer.

## COMMUNICATIONS-PRINT MODE

In communications-print mode, the printer will print alphanumeric data as it is received from the communications line. The data will also be displayed normally on the terminal display screen. When present in the resident controlware, the communications-print controlware is available for use at any time during Graphics operation.

## Selecting Communications-Print Mode

The operator selects communications-print mode by pressing the CTRL-SHIFT-PRINT keys. A PRINT message will appear in the lower right corner of the screen if the Status Display Line is turned on. This message will remain active until the communications-print mode is deselected.

While the mode is active, ASCII characters received from the communications line (and also those generated from the keyboard if in HALF duplex) will be sent to the printer for printing as well as being displayed.

Since the printer is a line printer rather than a character printer, actual printing of a line of characters will not occur until the printer receives a CR or LF character. Once a line of characters is printed, the printer is advanced to the next line, so that overstrike printing of characters is not allowed. Lines may be printed at 6 or 8 lines to the inch as determined by a switch setting in the printer.

## Deselecting Communications-Print Mode

The operator deselects communications-print mode by pressing the CTRL-SHIFT-PRINT keys when no errors are present. The PRINT message at the lower right corner of the screen will turn off, and terminal operation may proceed as if no printer were present.

If an error condition is present in the printer, the mode may be terminated by pressing the STOP key or the SHIFT-STOP keys. See the following section for more information.

## Printer Errors in Communications-Print Mode

During communications-print mode certain error conditions can occur in the printer. When this occurs, one of the following error messages will flash on and off in the lower righthand corner of the display screen. While an error message is displayed, data will be displayed normally on the display screen but will not be sent to the printer.

- DESELECT - This means that the printer is offline; that is, the indicator is turned off in the PRINT switch on the printer.

- PAPER - This means that the printer has a paper loading problem or that the platen yoke is not closed. This may be corrected by correcting the paper problem, closing the platen yoke, and pressing the FEED switch on the printer to stop it from blinking.

- REJECT - This condition will occur only if a hardware problem exists.

Recovery from these errors is accomplished by correcting the error or by pressing the BREAK key.

If the error is corrected, the flashing error message on the screen will turn off and communications printing will resume.

If the BREAK key was pressed, the communications-print mode will immediately terminate and the PRINT message and flashing error message will both turn off. No signal will be transmitted to the communications line. All other keyboard keys operate normally.

## Communications-Print Performance

The printer will print at a maximum of 115 lines per minute regardless of how many printable characters are on a line. Hence the printer should be able to keep up with a 1200-baud transfer rate if there are at least 65 characters per line. It should be able to keep up with a 300 baud line if there are at least 16 characters per line. This limitation is due to the printer and not the controlware. The controlware contains a 256-character receive buffer so that the communications line can get ahead of the printer by up to 256 characters without losing data. If the communications line gets more than 256 characters ahead of the printer, data will be lost.

# INTERFACES

The operator interface is divided into three major parts. These are data entry, data display, and operator control and status monitoring.

## DATA ENTRY INTERFACE

Operator data entry to the terminal is done via the keyboard or the touchpanel.

The keyboard consists of data keys, plus SHIFT and CTRL keys. Pressing a key results in transmission of a character indentifying the key that was pressed. The CTRL and SHIFT keys are used to modify the character generated when held down simultaneously when another key is pressed. A layout of the keyboard is shown in figure 3-2. Key characters generated by various key combinations are shown in table D-1 and table D-2.

The touchpanel consists of 256 touch sensitive areas overlaying the display screen in a 16 by 16 square array. Touching the touchpanel results in transmission of the coordinate touched.

The touchpanel and keyboard keys with arrows on them (a,q,w,e,d,c,x,z) are used for positioning the crosshair cursor when in Graphics Input (GIN) mode.

The touchpanel may also be used by the operator to perform various terminal parameter selections.

## DATA DISPLAY INTERFACE

Data display is performed by the CRT display screen. The screen is divided into a 512 by 512 array of dots or 512 x 480 (dependent on switch setting on graphics PCB), each of which may be on (bright) or off (dark). Data from the ASCII host system or from the terminal keyboard may be displayed as dots, lines or characters.

Normal size characters fit within a 6 by 14 dot matrix, with most characters not exceeding a dot matrix size of 5 by 9 dots and with no character exceeding a dot matrix size of 5 by 12 dots. Screen format for characters is 34 lines with 85 characters per line. The Normal Size Characters and Codes paragraph at the end of this section illustrates the dot matrix format of normal size characters on the display screen.

Large size characters fit within an 8 by 16 dot matrix, with most characters not exceeding a dot matrix size of 7 by 9 dots and with no character exceeding a dot matrix size of 7 by 12 dots. Screen format for characters is 30 lines with 64 characters per line. The Large Size Characters and Codes paragraph at the end of this appendix illustrates the dot matrix format of large size characters on the display screen.

## STATUS MONITORING

The touchpanel may be used by the operator to change various terminal parameter selections. The indicators on the front panel (figure 3-1) show status of the communications line being used. The ERROR light shows that a communications error has occurred and automatic recovery is being attempted by the controlware. The ERROR light will be off when no errors occur or when a successful communication error recovery has been accomplished. The other indicators show the status of the DTR, RTS, DSR, RCV, and XMT data lines between the terminal and the modem or acoustic coupler being used.

## ABORTS AND RECOVERY

The operator may force an exit from the graphics mode of operation to the timeshare mode of operation if there is a timeshare mode in the loaded controlware. This is accomplished by using the GRAPH/TTY field on the status display line.

Pressing RESET causes the terminal to reload controlware. Pressing Manual Release will reinitialize this controlware, except that status line fields will not be changed. If a print option is active, the operator may stop printing at any time.

## ERRORS

If a parity error is detected on receive data in graphics mode, the ERROR light will turn on. The ERROR light will stay on until a character with correct parity is received. Error correction or retransmission is not supported in the graphics mode.

During idle time the controlware performs a checksum operation on the controlware characters. If this checksum should fail, the words BLOCK FAILURE will appear on the right, center part of the display screen. The operator must then press RESET to recover. This will cause the firmware to initiate a controlware reload. Whether or not this is successful will depend on whether or not the network supports terminal controlware loading. Printer errors may occur while one of the print options is active.

## PERFORMANCE

This controlware can communicate with an ASCII host system at an input and output rate of up to 2400 bits per second (240 characters per second) in a half duplex or full duplex mode of operation.

The controlware can generate a straight line vector in less than 17.5 milliseconds and can generate character data at a rate of up to 500 characters per second.

## FIRMWARE COMMON VARIABLES

The firmware common variables constitute the only interface to other software products. The loaded controlware sets the CKSUMTBL variable to the beginning address of the controlware checksum table immediately after control is passed to the controlware after loading is finished. If the RESETFLG variable does not contain a value of 3C hex on entry to the controlware, the controlware returns to the timeshare mode if there is one, and performs a full controlware initialization, after which the RESETFLG variable is set to a value of 3C hex. The controlware does not alter the value of the other firmware variables.

## RESTRICTIONS AND LIMITATIONS

The printer prints at a maximum of 115 lines per minute in communications-print mode. There is a 256-character receiver buffer, but the ASCII host should make provision to prevent overrun of this buffer or data will be lost both on the printout and on the display.

Due to certain hardware and controlware limitations, the following differences exist between the graphics mode of this terminal and that of the Tektronix terminals.

a) The screen resolution of this terminal is 512 by 512 dots while that of the Tektronix terminals is 780 by 1024 dots. Hence coordinates received by the terminal are scaled down by a factor of 2 before being utilized for display purposes. Since the Y coordinate is limited to 780, the bottommost part of the display screen is not used. Y coordinates are biased upward by a value of 122 after scaling but before being used by the display screen.

b) The crosshair cursor in GIN mode on this terminal is displayed as a + sign, rather than as vertical and horizontal lines which extend the full height and width of the screen. This was to make it easier to implement a non-destructive cursor on this terminal. Since there are no thumbwheel controls on this terminal, the method of manually positioning the crosshair is also different. It is accomplished by using the touchpanel and arrow keys on the keyboard.

c) Character sizes are different relative to screen size than on the Tektronix terminals. Only two character sizes are supported.

d) Alternate character set is not supported by this terminal.

e) Margin 2 operation is not supported by this terminal.

f) Operations performed by the enhanced graphics module on the Tektronix terminals are not supported except for point plot mode.

g) Communications data rate is limited to 2400 bps by the controlware.

h) Automatic characters after transmission of status or cursor position can be selected using hardware jumpers on the Tektronix 401X series of terminals. These characters are either:

- CR and EOT - clears bypass via execution of CR if echoed from the host computer.

TABLE D-3. CONTROL CODES AND ESCAPE SEQUENCES FOR GRAPHICS OPERATION

| ASCII CHAR. | HEX CODE | KEYING SEQUENCE | *EFFECT WITH ESC CONDITION CLEAR | *EFFECT WITH ESC CONDITION SET |
|---|---|---|---|---|
| NUL | 00 | CTRL SH P or CTRL @ | No Effect. | Leaves ESC condition set. |
| SOH | 01 | CTRL A | No Effect. | Selects Graphics operation and initializes the terminal |
| STX | 02 | CTRL B | No Effect. | No Effect. |
| ETX | 03 | CTRL C | No Effect. | Selects Timeshare operation and initializes the terminal. |
| EOT | 04 | CTRL D | No Effect. | No Effect. |
| ENQ | 05 | CTRL E | No Effect. | Alpha Mode - Causes the terminal to transmit status and alpha cursor position and selects bypass condition. Graph/Point Plot Mode - Causes terminal to transmit status and beam position and selects bypass condition. GIN Mode - Causes terminal to transmit status and the GIN cursor position and selects bypass condition. |
| ACK | 06 | CTRL F | No Effect. | No Effect. |
| BEL | 07 | CTRL G | Alpha Mode - Clears bypass condition and sounds audible alarm. Graph Mode - Following GS, causes the first vector to be written, clears bypass condition, and sounds audible alarm. | Alpha Mode - Clears bypass condition and sounds audible alarm. Graph Mode - Following GS, causes the first vector to be written, clears bypass condition, and sounds audible alarm. |

TABLE D-3. CONTROL CODES AND ESCAPE SEQUENCES FOR GRAPHICS OPERATION (CONTD)

| ASCII CHAR. | HEX CODE | KEYING SEQUENCE | *EFFECT WITH ESC CONDITION CLEAR | *EFFECT WITH ESC CONDITION SET |
|---|---|---|---|---|
| BS | 08 | or ERASE or CTRL H | Moves the cursor one position to the left and clears bypass condition. If at leftmost position on a line, cursor moves to rightmost position on line above. If at first position of topmost line, cursor moves to last position of bottom line. ERASE additionally erases character. | Moves the cursor one position to the left and clears bypass condition. If at leftmost position on a line, cursor moves to rightmost position on line above. If at first position of topmost line, cursor moves to last position of bottom line. ERASE additionally erases character. |
| HT | 09 | TAB or or CTRL H | Moves the cursor one position to the right and clears bypass condition. If at rightmost position on a line, cursor moves to leftmost position on next lower line. If at last position of bottom line, cursor moves to leftmost position of top line. | Moves the cursor one position to the right and clears bypass condition. If at rightmost position on a line, cursor moves to leftmost position on next lower line. If at last position of bottom line, cursor moves to leftmost position of top line. |
| LF | 0A | LF or or CTRL J | Moves the cursor down one line and clears bypass condition. If at bottom line, cursor moves to bottom line. | No effect. Leaves ESC condition set. |
| VT | 0B | CTRL K or | Moves the cursor up one line and clears bypass condition. If at top line, cursor moves to bottom line. | Moves the cursor up one line and clears bypass condition. If at top line, cursor moves to bottom line. |
| FF | 0C | CLEAR or CTRL L | No Effect. | Clears screen, selects Alpha Mode, moves position to upper-left corner of display, and clears bypass condition. |
| CR | 0D | CR or CTRL M | Moves cursor to leftmost position of current line, resets the terminal to Alpha Mode and clears bypass condition. | Leaves ESC condition set. |
| SO | 0E | CTRL N | No Effect. | No Effect. |
| SI | 0F | CTRL O | No Effect. | No Effect. |
| DLE | 10 | CTRL P | No Effect. | No Effect. |
| DC1 | 11 | CTRL Q | No Effect. | Alpha Mode - Selects inverse video write.<br>Other Modes - Selects erase. |

TABLE D-3. CONTROL CODES AND ESCAPE SEQUENCES FOR GRAPHICS OPERATION (CONTD)

| ASCII CHAR. | HEX CODE | KEYING SEQUENCE | *EFFECT WITH ESC CONDITION CLEAR | *EFFECT WITH ESC CONDITION SET |
|---|---|---|---|---|
| DC2 | 12 | CTRL R | No Effect. | Alpha Mode - Selects overstrike write. Other Modes - Selects write. |
| DC3 | 13 | CTRL S | No Effect. | Alpha Mode - Selects overstrike erase. Other Modes - Selects erase. |
| DC4 | 14 | CTRL T | No Effect. | Alpha Mode - Selects rewrite. Other Modes - Selects write. |
| NAK | 15 | CTRL U | No Effect. | No Effect. |
| SYN | 16 | CTRL V | No Effect. | No Effect. |
| ETB | 17 | CTRL W | No Effect. | Make screen copy. |
| CAN | 18 | CTRL X | No Effect. | Selects bypass condition. |
| EM | 19 | CTRL Y | No Effect. | No Effect. |
| SUB | 1A | CTRL Z | No Effect. | Selects GIN mode and selects bypass condition. |
| ESC | 1B | ESC or CTRL [ or CTRL SH K | Sets ESC condition (Beginning of an ESC sequence). | Leaves ESC condition set. |
| FS | 1C | CTRL or CTRL SH L | Selects point plot mode and clears bypass condition. | Selects point-plot mode and clears bypass condition. |
| GS | 1D | CTRL ] or CTRL SH M | Selects graph mode and clears bypass condition. | Selects graph mode and clears bypass condition. |
| RS | 1E | CTRL or CTRL SH N | No Effect. | No Effect. |
| US | 1F | CTRL _ or CTRL SH-O | GIN Mode - No effect. Other Modes - Selects alpha mode and clears bypass condition. | GIN Mode - No effect. Other Modes - Selects alpha mode and clears bypass condition. |
| 7 | 37 | 7 | See Note 1. | Selects large alpha characters |
| 8 | 38 | 8 | See Note 1. | Selects normal alpha characters |
| 9 | 39 | 9 | See Note 1. | Selects normal alpha characters |
| : | 3A | : | See Note 1. | Selects normal alpha characters |

TABLE D-3. CONTROL CODES AND ESCAPE SEQUENCES FOR GRAPHICS OPERATION (CONTD)

| ASCII CHAR. | HEX CODE | KEYING SEQUENCE | *EFFECT WITH ESC CONDITION CLEAR | *EFFECT WITH ESC CONDITION SET |
|---|---|---|---|---|
| ; | 3B | ; | See Note 1. | Selects normal alpha characters |
| All Others | -- | | See Note 1. | No Effect. |

*ESC Condition is initiated by receipt of an ESC character and terminates following the receipt of the following character unless otherwise shown.

Note 1: Code is displayable character in alpha mode, or part of a coordinate in point-plot and graph modes.

The load coordinate instruction and the point plot, draw line, and block modes all require sets of coordinates. To set coordinate positions, the 10-bit X coordinate and the 10-bit Y coordinate must be converted to ASCII characters as shown below:

| BYTE | BIT 7 | BIT 6 | BITS 5 THROUGH 1* |
|---|---|---|---|
| High Y | 0 | 1 | 5 MSB of Y Coordinate** |
| Low Y | 1 | 1 | 5 LSB of Y Coordinate |
| High X | 0 | 1 | 5 MSB of X Coordinate** |
| Low X | 1 | 0 | 5 LSB of X Coordinate |

*MSB is most significant bit; LSB is least significant bit.

**Since the resolution of this terminal is 512 by 512, the MSB (bit 10) of each coordinate is outside the screen display area. Coordinates exceeding 511 yield unpredictable results. If the scale mode is selected, all X and Y coordinates are scaled down by a factor of two, and the Y coordinate is then biased upward by 122.

The terminal retains the last high Y, low Y, and High X addresses when switched to other operations not requiring coordinate information. When returning to an operation requiring coordinate information, only low X must be received by the terminal to reset to its previous coordinates.

It is not necessary that all four ASCII characters describing the coordinate be transmitted. The following table D-4 shows the coordinate byte transmission requirements.

A coordinate conversion chart is shown in table D-5.

TABLE D-4. BYTE TRANSMISSION REQUIREMENTS

| BYTES WHICH CHANGE | | | | BYTE TRANSMISSION REQUIRED | | | |
|---|---|---|---|---|---|---|---|
| HIGH Y | LOW Y | HIGH X | LOW X | HIGH Y | LOW Y | HIGH X | LOW X |
| | | | X | | | | X |
| | | X | | | X | X | X |
| | X | | | | X | | X |
| X | | | | X | | | X |
| | | X | X | | X | X | X |
| | X | | X | | X | | X |
| X | | | X | X | | | X |
| | X | X | | | X | X | X |
| X | | X | | X | X | X | X |
| X | X | | | X | X | | X |
| | X | X | X | | X | X | X |
| X | | X | X | X | X | X | X |
| X | X | | X | X | X | | X |
| X | X | X | | X | X | X | X |
| X | X | X | X | X | X | X | X |
| Sending to Initial Address | | | | X | X | X | X |
| Returning to Remembered Address | | | | | | | X |

TABLE D-5. COORDINATE CONVERSION CHART (ASCII OPERATIONS)

| LOW ORDER X | | | X or Y COORDINATE | | | | | | | | LOW ORDER Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASCII | DEC. | HEX | | | | | | | | | HEX | DEC. | ASCII |
| @ | 64 | 40 | 0 | 32 | 64 | 96 | 128 | 160 | 192 | 224 | 60 | 96 | |
| A | 65 | 41 | 1 | 33 | 65 | 97 | 129 | 161 | 193 | 225 | 61 | 97 | a |
| B | 66 | 42 | 2 | 34 | 66 | 98 | 130 | 162 | 194 | 226 | 62 | 98 | b |
| C | 67 | 43 | 3 | 35 | 67 | 99 | 131 | 163 | 195 | 227 | 63 | 99 | c |
| D | 68 | 44 | 4 | 36 | 68 | 100 | 132 | 164 | 196 | 228 | 64 | 100 | d |
| E | 69 | 45 | 5 | 37 | 69 | 101 | 133 | 165 | 197 | 229 | 65 | 101 | e |
| F | 70 | 46 | 6 | 38 | 70 | 102 | 134 | 166 | 198 | 230 | 66 | 102 | f |
| G | 71 | 47 | 7 | 39 | 71 | 103 | 135 | 167 | 199 | 231 | 67 | 103 | g |
| H | 72 | 48 | 8 | 40 | 72 | 104 | 136 | 168 | 200 | 232 | 68 | 104 | h |
| I | 73 | 49 | 9 | 41 | 73 | 105 | 137 | 169 | 201 | 233 | 69 | 105 | i |
| J | 74 | 4A | 10 | 42 | 74 | 106 | 138 | 170 | 202 | 234 | 6A | 106 | j |
| K | 75 | 4B | 11 | 43 | 75 | 107 | 139 | 171 | 203 | 235 | 6B | 107 | k |
| L | 76 | 4C | 12 | 44 | 76 | 108 | 140 | 172 | 204 | 236 | 6C | 108 | l |
| M | 77 | 4D | 13 | 45 | 77 | 109 | 141 | 173 | 205 | 237 | 6D | 109 | m |
| N | 78 | 4E | 14 | 46 | 78 | 110 | 142 | 174 | 206 | 238 | 6E | 110 | n |
| O | 79 | 4F | 15 | 47 | 79 | 111 | 143 | 175 | 207 | 239 | 6F | 111 | o |
| P | 80 | 50 | 16 | 48 | 80 | 112 | 144 | 176 | 208 | 240 | 70 | 112 | p |
| Q | 81 | 51 | 17 | 49 | 81 | 113 | 145 | 177 | 209 | 241 | 71 | 113 | q |
| R | 82 | 52 | 18 | 50 | 82 | 114 | 146 | 178 | 210 | 242 | 72 | 114 | r |
| S | 83 | 53 | 19 | 51 | 83 | 115 | 147 | 179 | 211 | 243 | 73 | 115 | s |
| T | 84 | 54 | 20 | 52 | 84 | 116 | 148 | 180 | 212 | 244 | 74 | 116 | t |
| U | 85 | 55 | 21 | 53 | 85 | 117 | 149 | 181 | 213 | 245 | 75 | 117 | u |
| V | 86 | 56 | 22 | 54 | 86 | 118 | 150 | 182 | 214 | 246 | 76 | 118 | v |
| W | 87 | 57 | 23 | 55 | 87 | 119 | 151 | 183 | 215 | 247 | 77 | 119 | w |
| X | 88 | 58 | 24 | 56 | 88 | 120 | 152 | 184 | 216 | 248 | 78 | 120 | x |
| Y | 89 | 59 | 25 | 57 | 89 | 121 | 153 | 185 | 217 | 249 | 79 | 121 | y |
| Z | 90 | 5A | 26 | 58 | 90 | 122 | 154 | 186 | 218 | 250 | 7A | 122 | z |
| [ | 91 | 5B | 27 | 59 | 91 | 123 | 155 | 187 | 219 | 251 | 7B | 123 | |
| \ | 92 | 5C | 28 | 60 | 92 | 124 | 156 | 188 | 220 | 252 | 7C | 124 | |
| ] | 93 | 5D | 29 | 61 | 93 | 125 | 157 | 189 | 221 | 253 | 7D | 125 | |
| ^ | 94 | 5E | 30 | 62 | 94 | 126 | 158 | 190 | 222 | 254 | 7E | 126 | |
| _ | 95 | 5F | 31 | 63 | 95 | 127 | 159 | 191 | 223 | 255 | 7F | 127 | RUBOUT (DEL) |
| DECIMAL | | | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | | | |
| ASCII | | | SP | ! | " | # | $ | % | & | ' | | | |
| HEXADECIMAL | | | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | | | |
| | | | High Order X & Y | | | | | | | | | | |

INSTRUCTIONS: Find coordinate value in body of chart; follow that column to bottom of chart to find decimal value, hex value, or ASCII character which represents the High Y or High X byte; go to the right in the row containing the coordinate value to find the Low Y byte or go to the left to find the Low X byte. EXAMPLE: 200Y, 48 X equals 38 104 33 80 in decimal code equals & h ! P in ASCII code equals 26 68 21 50 in hexadecimal code.

TABLE D-5. COORDINATE CONVERSION CHART (ASCII OPERATIONS) (CONTD)

| LOW ORDER X | | | X or Y COORDINATE | | | | | | | | LOW ORDER Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASCII | DEC. | HEX | | | | | | | | | HEX | DEC. | ASCII |
| @ | 64 | 40 | 256 | 288 | 320 | 352 | 384 | 416 | 448 | 480 | 60 | 96 | |
| A | 65 | 41 | 257 | 289 | 321 | 353 | 385 | 417 | 449 | 481 | 61 | 97 | a |
| B | 66 | 42 | 258 | 290 | 322 | 354 | 386 | 418 | 450 | 482 | 62 | 98 | b |
| C | 67 | 43 | 259 | 291 | 323 | 355 | 387 | 419 | 451 | 483 | 63 | 99 | c |
| D | 68 | 44 | 260 | 292 | 324 | 356 | 388 | 420 | 452 | 484 | 64 | 100 | d |
| E | 69 | 45 | 261 | 293 | 325 | 357 | 389 | 421 | 453 | 485 | 65 | 101 | e |
| F | 70 | 46 | 262 | 294 | 326 | 358 | 390 | 422 | 454 | 486 | 66 | 102 | f |
| G | 71 | 47 | 263 | 295 | 327 | 359 | 391 | 423 | 455 | 487 | 67 | 103 | g |
| H | 72 | 48 | 264 | 296 | 328 | 360 | 392 | 424 | 456 | 488 | 68 | 104 | h |
| I | 73 | 49 | 265 | 297 | 329 | 361 | 393 | 425 | 457 | 489 | 69 | 105 | i |
| J | 74 | 4A | 266 | 298 | 330 | 362 | 394 | 426 | 458 | 490 | 6A | 106 | j |
| K | 75 | 4B | 267 | 299 | 331 | 363 | 395 | 427 | 459 | 491 | 6B | 107 | k |
| L | 76 | 4C | 268 | 300 | 332 | 364 | 396 | 428 | 460 | 492 | 6C | 108 | l |
| M | 77 | 4D | 269 | 301 | 333 | 365 | 397 | 429 | 461 | 493 | 6D | 109 | m |
| N | 78 | 4E | 270 | 302 | 334 | 366 | 398 | 430 | 462 | 494 | 6E | 110 | n |
| O | 79 | 4F | 271 | 303 | 335 | 367 | 399 | 431 | 463 | 495 | 6F | 111 | o |
| P | 80 | 50 | 272 | 304 | 336 | 368 | 400 | 432 | 464 | 496 | 70 | 112 | p |
| Q | 81 | 51 | 273 | 305 | 337 | 369 | 401 | 433 | 465 | 497 | 71 | 113 | q |
| R | 82 | 52 | 274 | 306 | 338 | 370 | 402 | 434 | 466 | 498 | 72 | 114 | r |
| S | 83 | 53 | 275 | 307 | 339 | 371 | 403 | 435 | 467 | 499 | 73 | 115 | s |
| T | 84 | 54 | 276 | 308 | 340 | 372 | 404 | 436 | 468 | 500 | 74 | 116 | t |
| U | 85 | 55 | 277 | 309 | 341 | 373 | 405 | 437 | 469 | 501 | 75 | 117 | u |
| V | 86 | 56 | 278 | 310 | 342 | 374 | 406 | 438 | 470 | 502 | 76 | 118 | v |
| W | 87 | 57 | 279 | 311 | 343 | 375 | 407 | 439 | 471 | 503 | 77 | 119 | w |
| X | 88 | 58 | 280 | 312 | 344 | 376 | 408 | 440 | 472 | 504 | 78 | 120 | x |
| Y | 89 | 59 | 281 | 313 | 345 | 377 | 409 | 441 | 473 | 505 | 79 | 121 | y |
| Z | 90 | 5A | 282 | 314 | 346 | 378 | 410 | 442 | 474 | 506 | 7A | 122 | z |
| [ | 91 | 5B | 283 | 315 | 347 | 379 | 411 | 443 | 475 | 507 | 7B | 123 | |
| \ | 92 | 5C | 284 | 316 | 348 | 380 | 412 | 444 | 476 | 508 | 7C | 124 | |
| ] | 93 | 5D | 285 | 317 | 349 | 381 | 413 | 445 | 477 | 509 | 7D | 125 | |
| ^ | 94 | 5E | 286 | 318 | 350 | 382 | 414 | 446 | 478 | 510 | 7E | 126 | |
| _ | 95 | 5F | 287 | 319 | 351 | 383 | 415 | 447 | 479 | 511 | 7F | 127 | RUBOUT (DEL) |
| DECIMAL | | | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | | | |
| ASCII | | | ( | ) | * | + | , | - | . | / | | | |
| HEXADECIMAL | | | 28 | 29 | 2A | 2B | 2C | 2D | 2E | 2F | | | |
| | | | High Order X and Y | | | | | | | | | | |

TABLE D-5. COORDINATE CONVERSION CHART (ASCII OPERATIONS) (CONTD)

| LOW ORDER X | | | X or Y COORDINATE | | | | | | | | LOW ORDER Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASCII | DEC. | HEX | | | | | | | | | HEX | DEC. | ASCII |
| @ | 64 | 40 | 512 | 544 | 576 | 608 | 640 | 672 | 704 | 736 | 60 | 96 | |
| A | 65 | 41 | 513 | 545 | 577 | 609 | 641 | 673 | 705 | 737 | 61 | 97 | a |
| B | 66 | 42 | 514 | 546 | 578 | 610 | 642 | 674 | 706 | 738 | 62 | 98 | b |
| C | 67 | 43 | 515 | 547 | 579 | 611 | 643 | 675 | 707 | 739 | 63 | 99 | c |
| D | 68 | 44 | 516 | 548 | 580 | 612 | 644 | 676 | 708 | 740 | 64 | 100 | d |
| E | 69 | 45 | 517 | 549 | 581 | 613 | 645 | 677 | 709 | 741 | 65 | 101 | e |
| F | 70 | 46 | 518 | 550 | 582 | 614 | 646 | 678 | 710 | 742 | 66 | 102 | f |
| G | 71 | 47 | 519 | 551 | 583 | 615 | 647 | 679 | 711 | 743 | 67 | 103 | g |
| H | 72 | 48 | 520 | 552 | 584 | 616 | 648 | 680 | 712 | 744 | 68 | 104 | h |
| I | 73 | 49 | 521 | 553 | 585 | 617 | 649 | 681 | 713 | 745 | 69 | 105 | i |
| J | 74 | 4A | 522 | 554 | 586 | 618 | 650 | 682 | 714 | 746 | 6A | 106 | j |
| K | 75 | 4B | 523 | 555 | 587 | 619 | 651 | 683 | 715 | 747 | 6B | 107 | k |
| L | 76 | 4C | 524 | 556 | 588 | 620 | 652 | 684 | 716 | 748 | 6C | 108 | l |
| M | 77 | 4D | 525 | 557 | 589 | 621 | 653 | 685 | 717 | 749 | 6D | 109 | m |
| N | 78 | 4E | 526 | 558 | 590 | 622 | 654 | 686 | 718 | 750 | 6E | 110 | n |
| O | 79 | 4F | 527 | 559 | 591 | 623 | 655 | 687 | 719 | 751 | 6F | 111 | o |
| P | 80 | 50 | 528 | 560 | 592 | 624 | 656 | 688 | 720 | 752 | 70 | 112 | p |
| Q | 81 | 51 | 529 | 561 | 593 | 625 | 657 | 689 | 721 | 753 | 71 | 113 | q |
| R | 82 | 52 | 530 | 562 | 594 | 626 | 658 | 690 | 722 | 754 | 72 | 114 | r |
| S | 83 | 53 | 531 | 563 | 595 | 627 | 659 | 691 | 723 | 755 | 73 | 115 | s |
| T | 84 | 54 | 532 | 564 | 596 | 628 | 660 | 692 | 724 | 756 | 74 | 116 | t |
| U | 85 | 55 | 533 | 565 | 597 | 629 | 661 | 693 | 725 | 757 | 75 | 117 | u |
| V | 86 | 56 | 534 | 566 | 598 | 630 | 662 | 694 | 726 | 758 | 76 | 118 | v |
| W | 87 | 57 | 535 | 567 | 599 | 631 | 663 | 695 | 727 | 759 | 77 | 119 | w |
| X | 88 | 58 | 536 | 568 | 600 | 632 | 664 | 696 | 728 | 760 | 78 | 120 | x |
| Y | 89 | 59 | 537 | 569 | 601 | 633 | 665 | 697 | 729 | 761 | 79 | 121 | y |
| Z | 90 | 5A | 538 | 570 | 602 | 634 | 666 | 698 | 730 | 762 | 7A | 122 | z |
| [ | 91 | 5B | 539 | 571 | 603 | 635 | 667 | 699 | 731 | 763 | 7B | 123 | |
| \ | 92 | 5C | 540 | 572 | 604 | 636 | 668 | 700 | 732 | 764 | 7C | 124 | |
| ] | 93 | 5D | 541 | 573 | 605 | 637 | 669 | 701 | 733 | 765 | 7D | 125 | |
| ^ | 94 | 5E | 542 | 574 | 606 | 638 | 670 | 702 | 734 | 766 | 7E | 126 | |
| _ | 95 | 5F | 543 | 575 | 607 | 639 | 671 | 703 | 735 | 767 | 7F | 127 | RUBOUT (DEL) |
| DECIMAL | | | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | | | |
| ASCII | | | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | |
| HEXADECIMAL | | | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | | | |
| | | | High Order X and Y | | | | | | | | | | |

TABLE D-5. COORDINATE CONVERSION CHART (ASCII OPERATIONS) (CONTD)

| LOW ORDER X | | | X or Y COORDINATE | | | | | | | | LOW ORDER Y | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASCII | DEC. | HEX | | | | | | | | | HEX | DEC. | ASCII |
| @ | 64 | 40 | 768 | 800 | 832 | 864 | 896 | 928 | 960 | 992 | 60 | 96 | |
| A | 65 | 41 | 769 | 801 | 833 | 865 | 897 | 929 | 961 | 993 | 61 | 97 | a |
| B | 66 | 42 | 770 | 802 | 834 | 866 | 898 | 930 | 962 | 994 | 62 | 98 | b |
| C | 67 | 43 | 771 | 803 | 835 | 867 | 899 | 931 | 963 | 995 | 63 | 99 | c |
| D | 68 | 44 | 772 | 804 | 836 | 868 | 900 | 932 | 964 | 996 | 64 | 100 | d |
| E | 69 | 45 | 773 | 805 | 837 | 869 | 901 | 933 | 965 | 997 | 65 | 101 | e |
| F | 70 | 46 | 774 | 806 | 838 | 870 | 902 | 934 | 966 | 998 | 66 | 102 | f |
| G | 71 | 47 | 775 | 807 | 839 | 871 | 903 | 935 | 967 | 999 | 67 | 103 | g |
| H | 72 | 48 | 776 | 808 | 840 | 872 | 904 | 936 | 968 | 1000 | 68 | 104 | h |
| I | 73 | 49 | 777 | 809 | 841 | 873 | 905 | 937 | 969 | 1001 | 69 | 105 | i |
| J | 74 | 4A | 778 | 810 | 842 | 874 | 906 | 938 | 970 | 1002 | 6A | 106 | j |
| K | 75 | 4B | 779 | 811 | 843 | 875 | 907 | 939 | 971 | 1003 | 6B | 107 | k |
| L | 76 | 4C | 780 | 812 | 844 | 876 | 908 | 940 | 972 | 1004 | 6C | 108 | l |
| M | 77 | 4D | 781 | 813 | 845 | 877 | 909 | 941 | 973 | 1005 | 6D | 109 | m |
| N | 78 | 4E | 782 | 814 | 846 | 878 | 910 | 942 | 974 | 1006 | 6E | 110 | n |
| O | 79 | 4F | 783 | 815 | 847 | 879 | 911 | 943 | 975 | 1007 | 6F | 111 | o |
| P | 80 | 50 | 784 | 816 | 848 | 880 | 912 | 944 | 976 | 1008 | 70 | 112 | p |
| Q | 81 | 51 | 785 | 817 | 849 | 881 | 913 | 945 | 977 | 1009 | 71 | 113 | q |
| R | 82 | 52 | 786 | 818 | 850 | 882 | 914 | 946 | 978 | 1010 | 72 | 114 | r |
| S | 83 | 53 | 787 | 819 | 851 | 883 | 915 | 947 | 979 | 1011 | 73 | 115 | s |
| T | 84 | 54 | 788 | 820 | 852 | 884 | 916 | 948 | 980 | 1012 | 74 | 116 | t |
| U | 85 | 55 | 789 | 821 | 853 | 885 | 917 | 949 | 981 | 1013 | 75 | 117 | u |
| V | 86 | 56 | 790 | 822 | 854 | 886 | 918 | 950 | 982 | 1014 | 76 | 118 | v |
| W | 87 | 57 | 791 | 823 | 855 | 887 | 919 | 951 | 983 | 1015 | 77 | 119 | w |
| X | 88 | 58 | 792 | 824 | 856 | 888 | 920 | 952 | 984 | 1016 | 78 | 120 | x |
| Y | 89 | 59 | 793 | 825 | 857 | 889 | 921 | 953 | 985 | 1017 | 79 | 121 | y |
| Z | 90 | 5A | 794 | 826 | 858 | 890 | 922 | 954 | 986 | 1018 | 7A | 122 | z |
| [ | 91 | 5B | 795 | 827 | 859 | 891 | 923 | 955 | 987 | 1019 | 7B | 123 | |
| \ | 92 | 5C | 796 | 828 | 860 | 892 | 924 | 956 | 988 | 1020 | 7C | 124 | |
| ] | 93 | 5D | 797 | 829 | 861 | 893 | 925 | 957 | 989 | 1021 | 7D | 125 | |
| ^ | 94 | 5E | 798 | 830 | 862 | 894 | 926 | 958 | 990 | 1022 | 7E | 126 | |
| _ | 95 | 5F | 799 | 831 | 863 | 895 | 927 | 959 | 991 | 1023 | 7F | 127 | RUBOUT (DEL) |
| DECIMAL | | | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | | | |
| ASCII | | | 8 | 9 | : | ; | < | = | > | ? | | | |
| HEXADECIMAL | | | 38 | 39 | 3A | 3B | 3C | 3D | 3E | 3F | | | |
| | | | High Order X and Y | | | | | | | | | | |

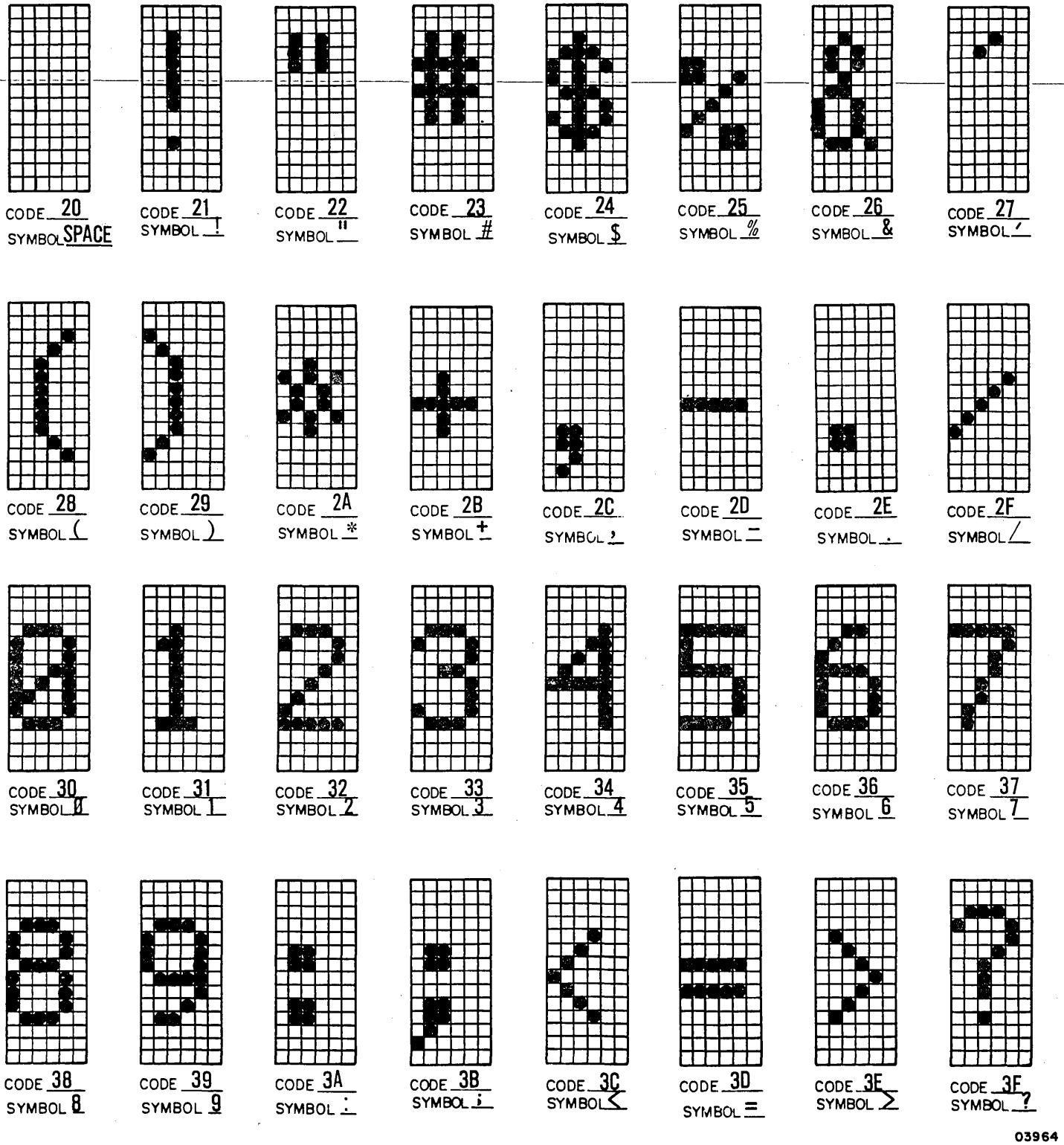


Figure D-3. Normal Size Characters and Codes (Sheet 1 of 3)

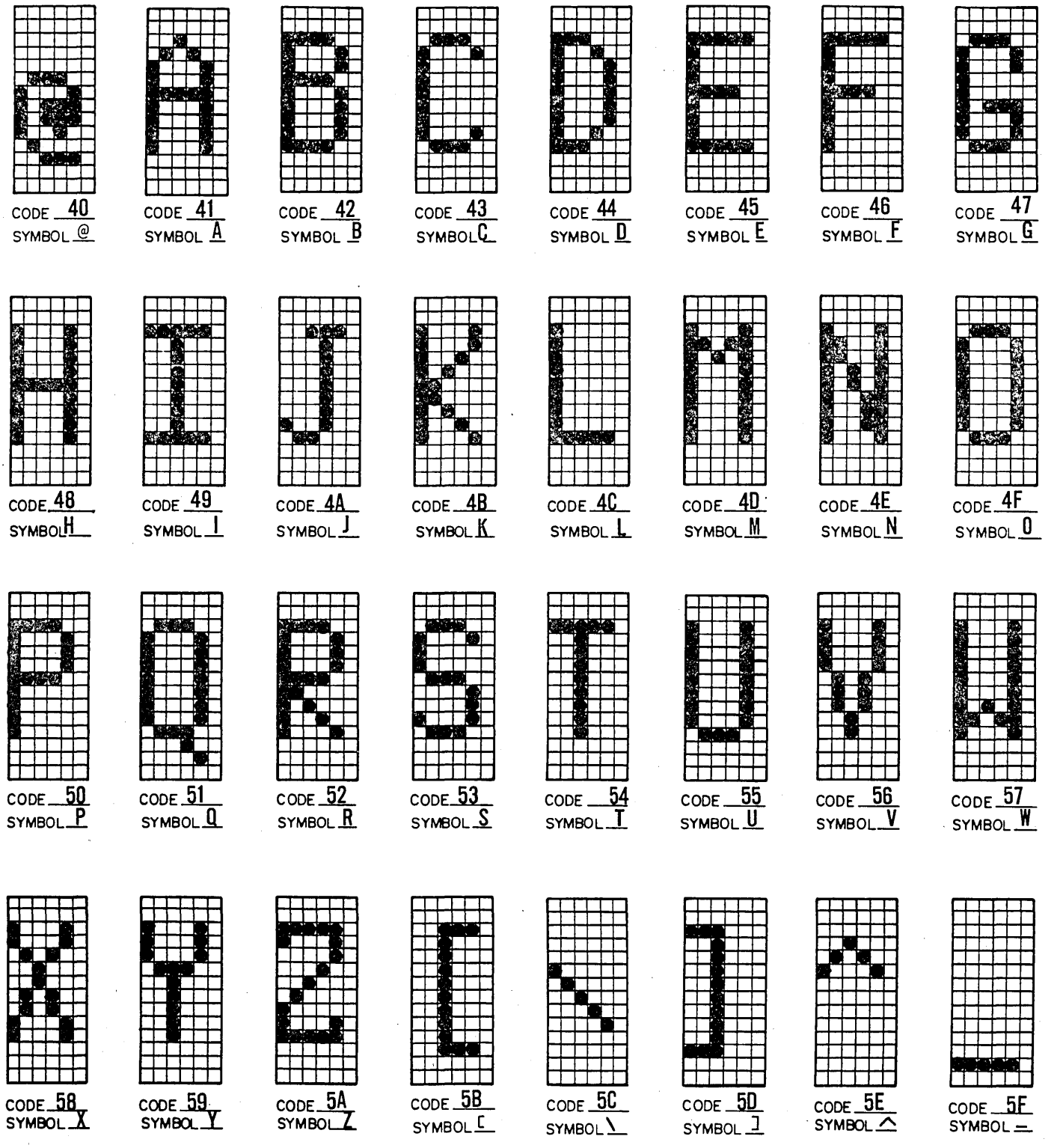


Figure D-3. Normal Size Characters and Codes (Sheet 2 of 3)

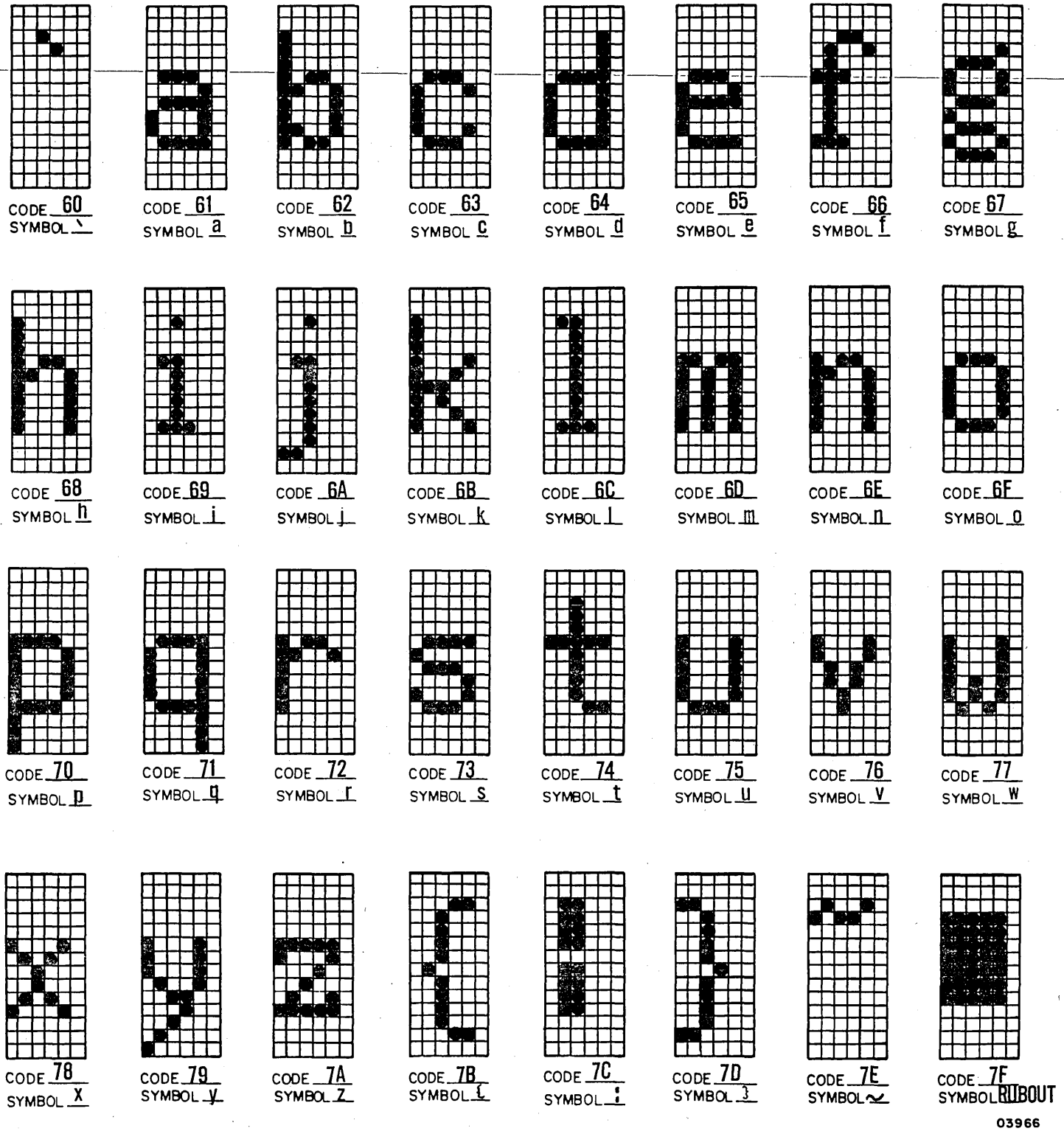


Figure D-3. Normal Size Characters and Codes (Sheet 3 of 3)

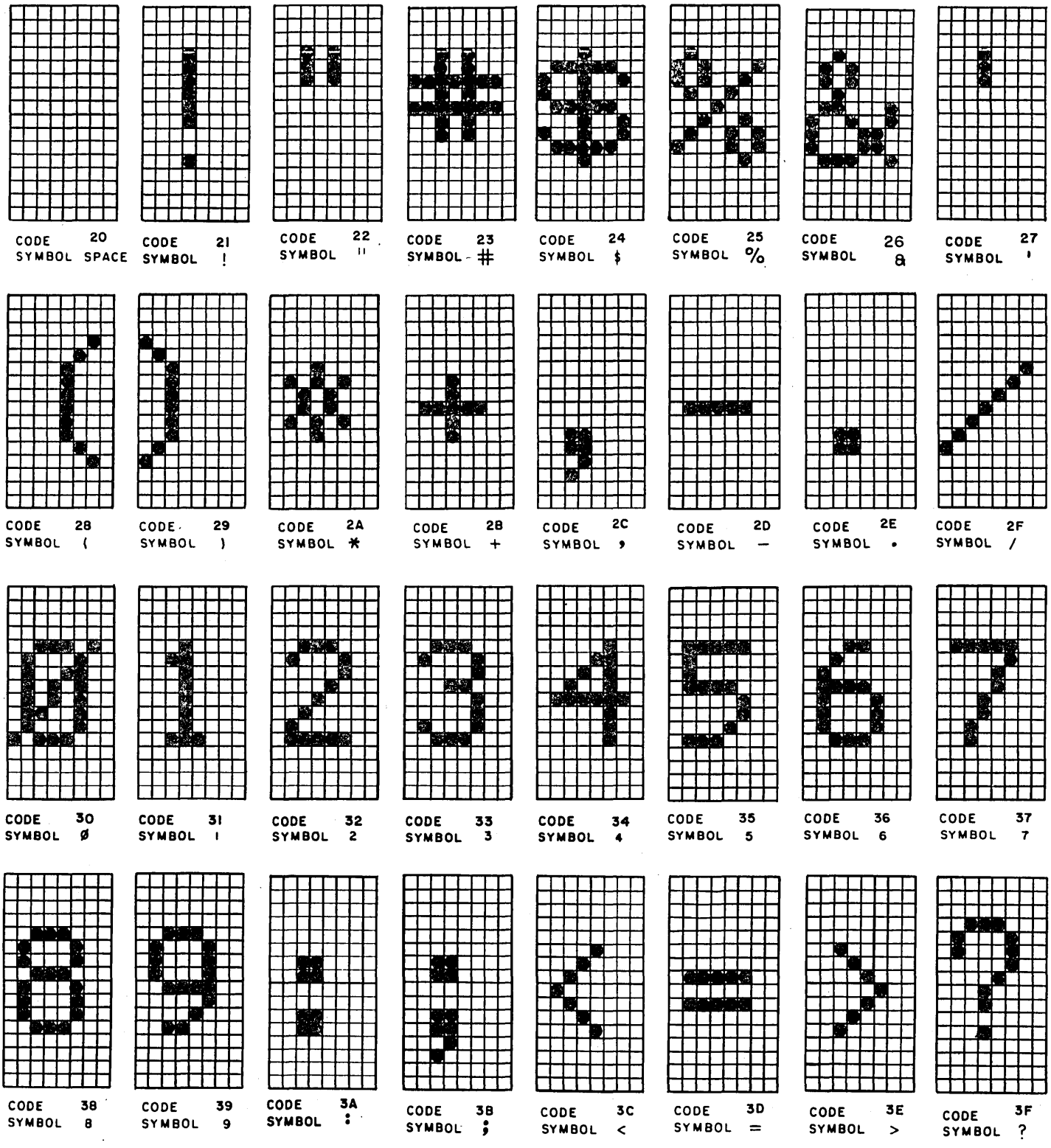


Figure D-4. Large Size Characters and Codes (Sheet 1 of 3)

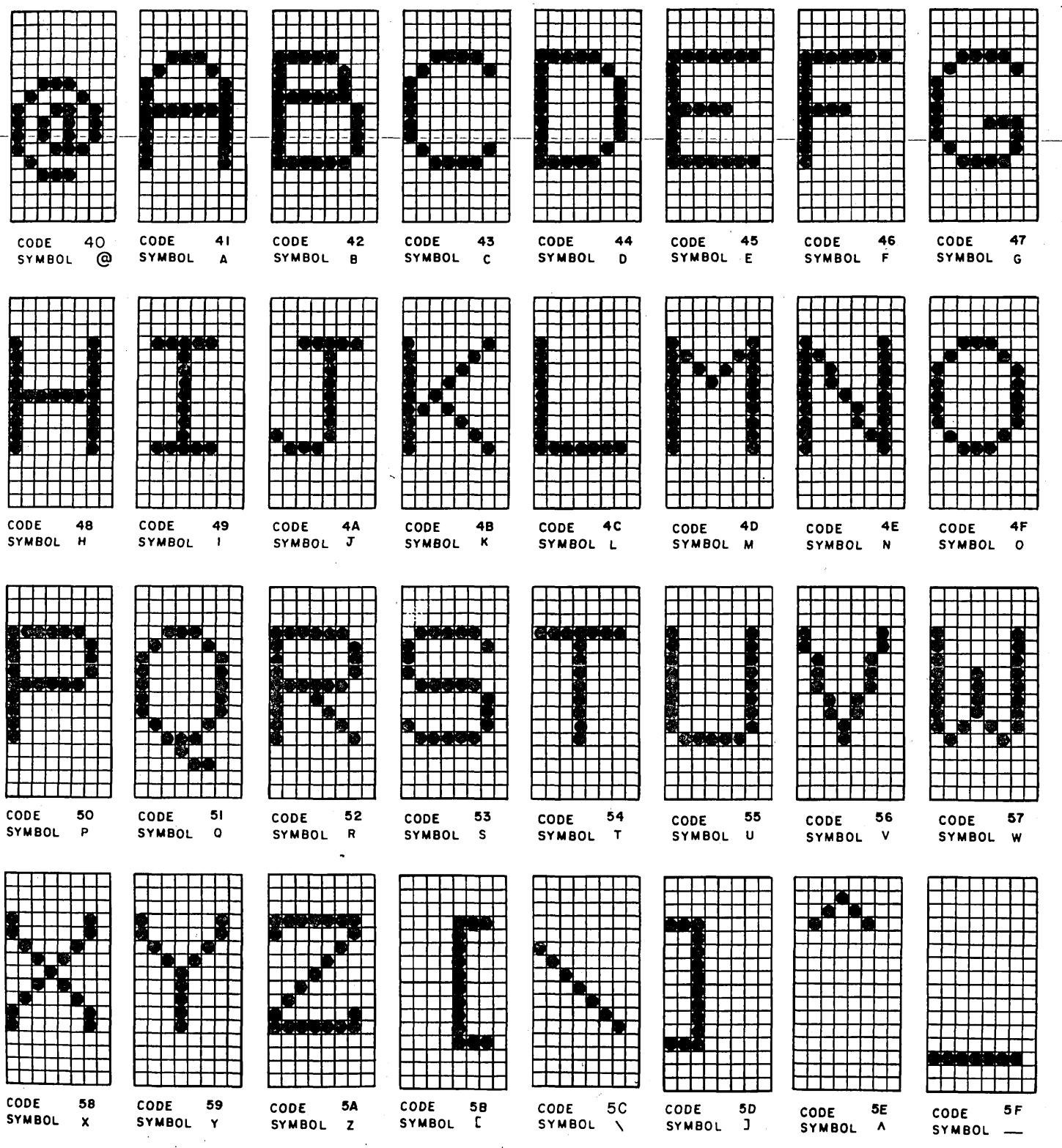


Figure D-4. Large Size Characters and Codes (Sheet 2 of 3)

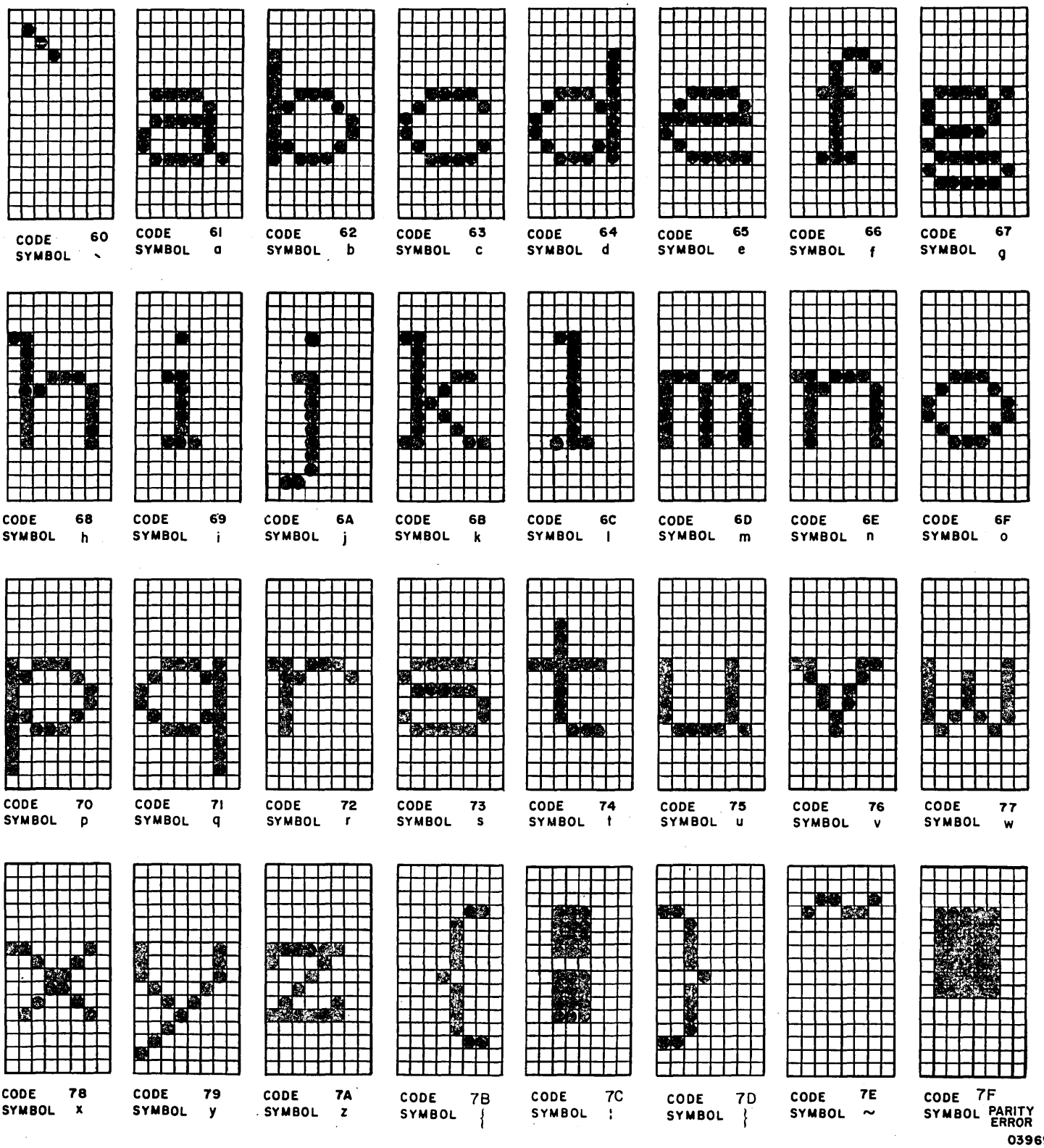


Figure D-4. Large Size Characters and Codes (Sheet 3 of 3)

This appendix provides general description and programming aids information about the internal 1200/1200 bit-per-second modem. The general description portion of this appendix includes the functional and physical characteristics of the modem, a features summary of the capabilities of the modem, and a description of the internal and external interfaces of the modem. The programming aids portion of this appendix lists the code and character sequences that provide modem control or retrieve status information from the modem.

## GENERAL DESCRIPTION

The topics related to the internal 1200/1200 b/s modem that are discussed in this portion of the appendix are as follows:

- Modem identification and physical characteristics
- Summary listing of the more notable modem features
- Fuctional description of the modem and its principal components
- Internal and external interfaces

## MODEM IDENTIFICATION AND PHYSICAL CHARACTERISTICS

The equipment number of the modem assembly is XA360-A, and it is installed in large option-board location I/F-4 at the rear of the Viking X terminal (refer to figure E-1). The presence of this assembly in the terminal is most easily established by checking the I/F-4 location at the rear of the terminal. The rear of the assembly with its Canadian Department of Communications and FCC certification label is prominently visible through a slot in the rear of the terminal at the I/F-4 location. The modem is a field/service-center installed option; it is not installable by the user because installation requires access to the inside of the terminal. Figure E-2 indicates the appearance and physical size of the modem assembly. Notice that the assembly consists of two printed-circuit boards. The larger of the two boards is the actual modem while the smaller board provides a control logic interface between the host terminal and the modem.

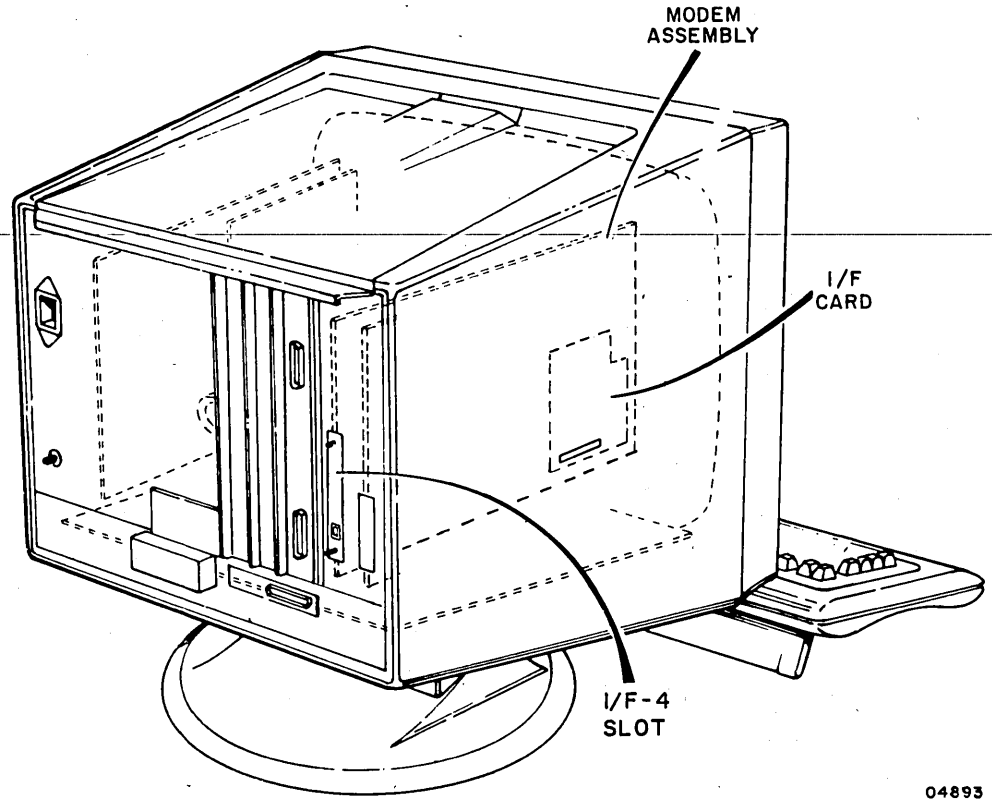


Figure E-1. Location of Modem Assembly in Terminal

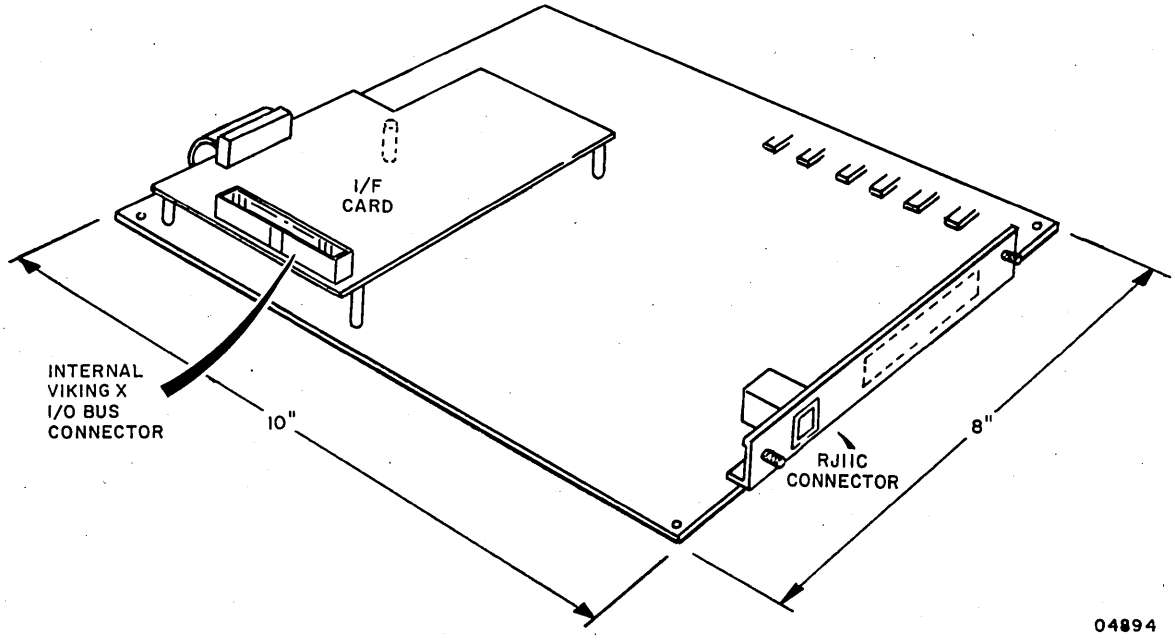


Figure E-2. Physical Appearance and Size of Modem Assembly

## SUMMARY LISTING OF MODEM FEATURES

The 1200/1200 b/s modem provides the Viking X terminal with a telephone line interface capable of data reception and transmission at a rate of 1200 bits per second (approximately 120 characters per second). The modem is compatible with Bell 212A data communication equipment requirements and is capable of full duplex 1200 b/s data transfers on standard telephone transmission lines. The modem has been designed and manufactured for conformance to most of the commonly recognized industry, national, and international standards.* Some of the more notable features and capabilities of the modem are listed below:

- Bell 212A compatible for 1200 b/s data exchange rates only
- Capable of full-duplex transmissions on 2-wire, switched-network local or long-distance telephone lines without special conditioning
- Automatic dual-tone multi-frequency dialing (touch-tone)
- Automatic pulse dialing (standard dial-phone dialing)
- Operation in either call originate or call answer mode
- Operation in both digital and analog loopback test mode
- A firmware-resident self-test feature
- Standard telephone line interface: 1) a RJ11C modular phone-jack connector accessible at rear of terminal, and 2) a 4.3 metre (14 foot) cable with a RJ11 plug at one end and a RJ11 duplex (T) connector at the other end for connecting both the terminal and a telephone to the same line
- A 4k read-only memory containing modem operation-control subroutines

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*Specific standards with which the modem is in conformance include: industry standards UL STD 478, FCC Part 15 (Subpart J), and FCC Part 68; national standards ANSI X3.4, ANSI X3.15, and ANSI X3.16; and international standards CSA STD C22.2-143, VDE 0871, VDE 0730, VDE 875, IEC 380, and Canadian TAPS.

The principal use of the internal modem is to permit its host terminal to communicate over the telephone lines with a host computer system or with other terminals using a compatible interface to the same telecommunications network. The automatic features of the modem permit its use either for automatically downloading an operating mode from the host computer of the system, or for use in communicating with the host computer or other network terminals during typical system applications. Figure E-3 is a block diagram of the terminal that indicates how the modem assembly interfaces with the other functional assemblies within the terminal.

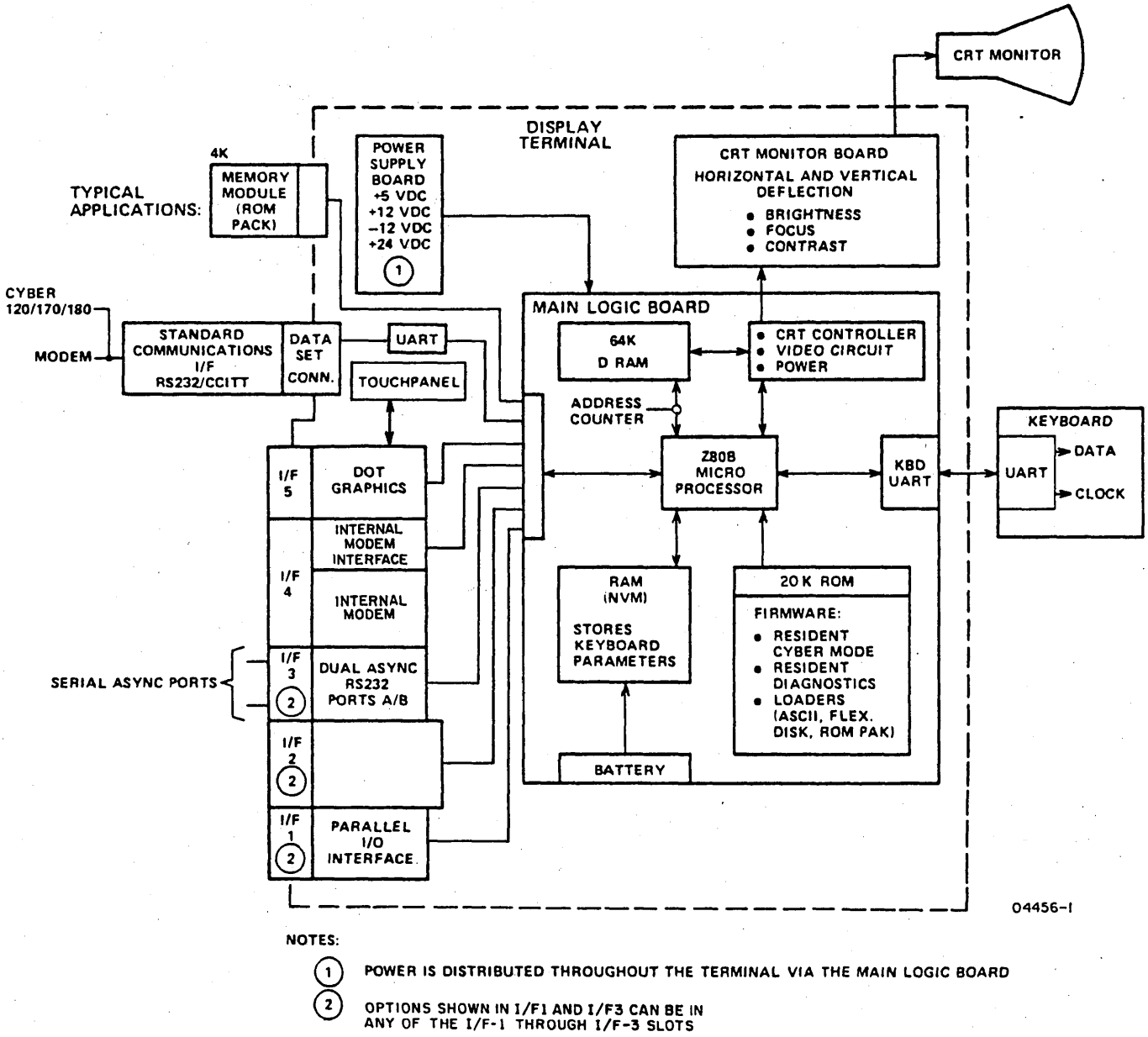


Figure E-3. Block Diagram of Host Terminal

Figure E-4 is a functional block diagram of the modem assembly. The following text briefly summarizes the purpose of each block on the diagram, and includes brief descriptions of the address, data, and control signal buses shown on the diagram.. The blocks labeled buffers, memory, UART, and registers (REGS.) are all mounted on the interface PC board (small PC board) of the modem assembly. The block labeled modem in the figure represents the actual modem printed circuit board (large PC board) of the assembly (also refer to figure E-2).

## Address, Data, and Control Signal Buses

The address buses shown in figure E-4 are 12-bit buses that carry address information from the terminal processor to the modem assembly. As is the case with the terminal processor, the function of the information on the address bus varies with the state of the I/O- and memory-request signal control lines. The memory-request control line gates address information to to the memory bank on the modem assembly; whereas, the I/O-request control line enables addressing modem input/output operations directly. The data bus is an 8-bit bidirectional bus that passes data bytes, including functional control and status information, betweeen the terminal processor and the modem assembly. The control bus carries terminal processor control signals (memory request, I/O request, memory-bank select, etc.) to the modem assembly in order to coordinate modem activity with other terminal operations. Further information on these buses is included later in this appendix under the Internal and External Interfaces heading.

## Buffers

The buffers shown in figure E-4 simply provide a means for temporarily buffering the information carried on the three signal buses described above. The data buffer actually consists of transceivers for passing bidirectional data and status information between the modem assembly and the terminal processor.

## Read-only Memory (4K x 8)

The 4K X 8 ROM holds the control firmware for the modem assembly. The terminal processor accesses this ROM via bank 11 addresses (block 8000 to $8FFF_{16}$). The processor uses jump-table entry addresses to access the particular function (auto-dial, auto-answer, test, etc.) of the ROM that it requires. The actual addresses used to access a particular function depend upon

whether the resident (CYBER) operating mode is making the subroutine call or an applications mode program is making the call. More detailed information regarding the jump-table entry addresses for the various modem functions are provided later in this section under the Programming Aids heading.

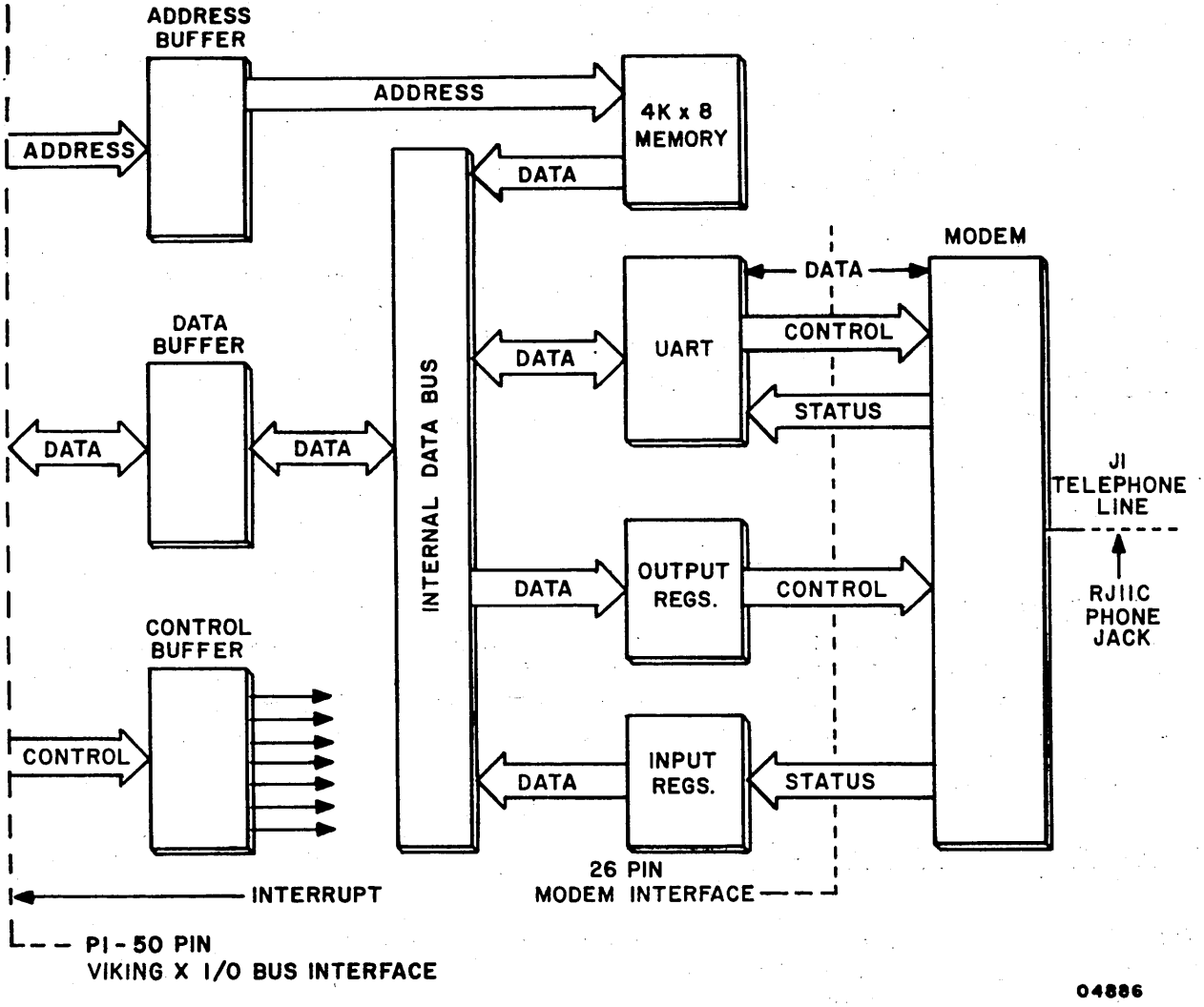


Figure E-4. Functional Block Diagram of Modem Assembly

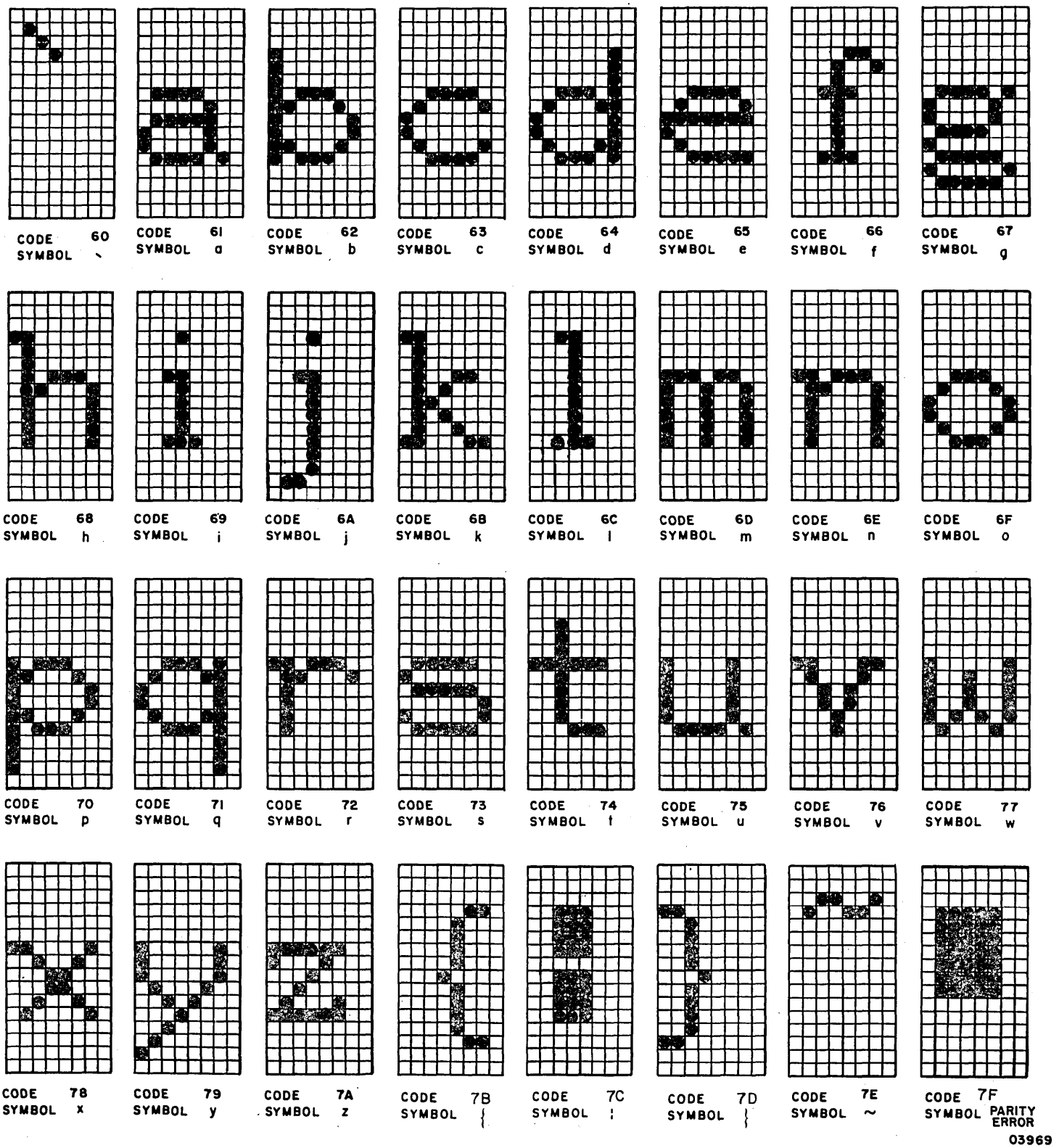


Figure D-4. Large Size Characters and Codes (Sheet 3 of 3)

This appendix provides general description and programming aids information about the internal 1200/1200 bit-per-second modem. The general description portion of this appendix includes the functional and physical characteristics of the modem, a features summary of the capabilities of the modem, and a description of the internal and external interfaces of the modem. The programming aids portion of this appendix lists the code and character sequences that provide modem control or retrieve status information from the modem.

## GENERAL DESCRIPTION

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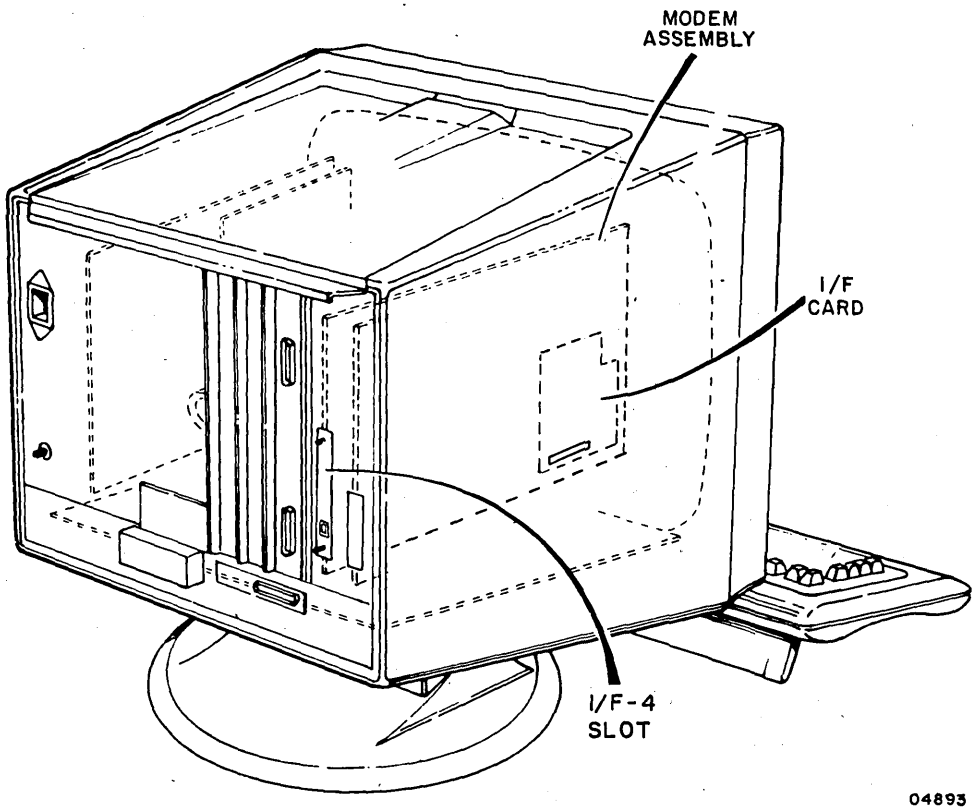


Figure E-1. Location of Modem Assembly in Terminal

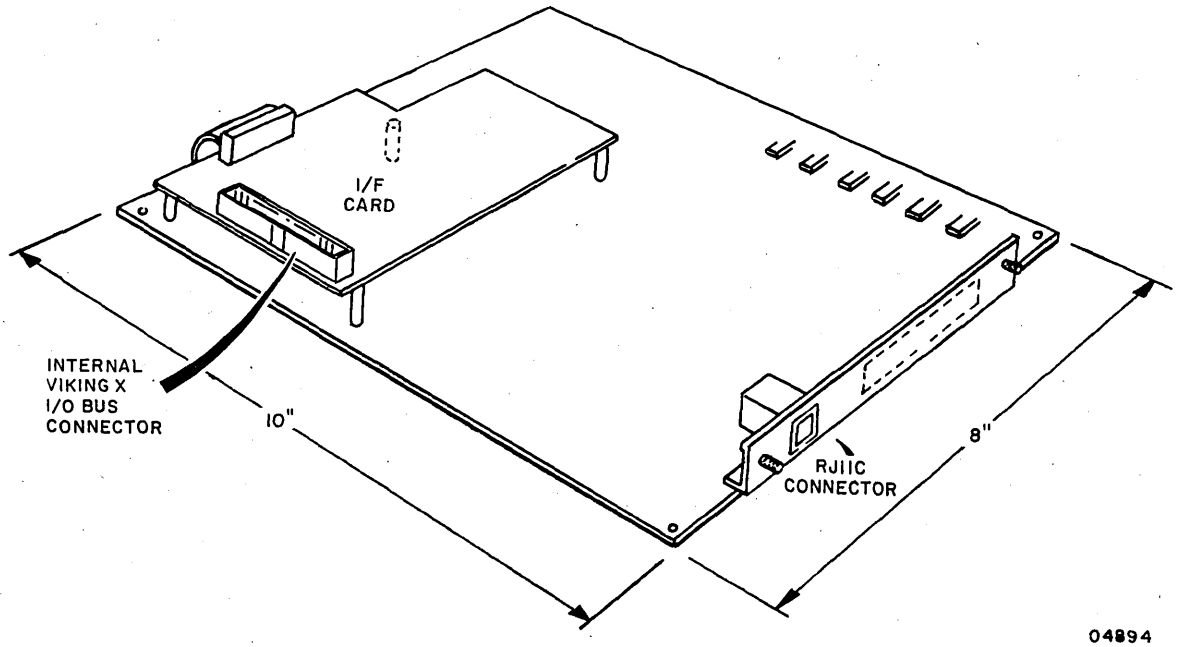


Figure E-2. Physical Appearance and Size of Modem Assembly

## SUMMARY LISTING OF MODEM FEATURES

The 1200/1200 b/s modem provides the Viking X terminal with a telephone line interface capable of data reception and transmission at a rate of 1200 bits per second (approximately 120 characters per second). The modem is compatible with Bell 212A data communication equipment requirements and is capable of full duplex 1200 b/s data transfers on standard telephone transmission lines. The modem has been designed and manufactured for conformance to most of the commonly recognized industry, national, and international standards.* Some of the more notable features and capabilities of the modem are listed below:

- Bell 212A compatible for 1200 b/s data exchange rates only
- Capable of full-duplex transmissions on 2-wire, switched-network local or long-distance telephone lines without special conditioning
- Automatic dual-tone multi-frequency dialing (touch-tone)
- Automatic pulse dialing (standard dial-phone dialing)
- Operation in either call originate or call answer mode
- Operation in both digital and analog loopback test mode
- A firmware-resident self-test feature
- Standard telephone line interface: 1) a RJ11C modular phone-jack connector accessible at rear of terminal, and 2) a 4.3 metre (14 foot) cable with a RJ11 plug at one end and a RJ11 duplex (T) connector at the other end for connecting both the terminal and a telephone to the same line
- A 4k read-only memory containing modem operation-control subroutines

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*Specific standards with which the modem is in conformance include: industry standards UL STD 478, FCC Part 15 (Subpart J), and FCC Part 68; national standards ANSI X3.4, ANSI X3.15, and ANSI X3.16; and international standards CSA STD C22.2-143, VDE 0871, VDE 0730, VDE 875, IEC 380, and Canadian TAPS.

The principal use of the internal modem is to permit its host terminal to communicate over the telephone lines with a host computer system or with other terminals using a compatible interface to the same telecommunications network. The automatic features of the modem permit its use either for automatically downloading an operating mode from the host computer of the system, or for use in communicating with the host computer or other network terminals during typical system applications. Figure E-3 is a block diagram of the terminal that indicates how the modem assembly interfaces with the other functional assemblies within the terminal.

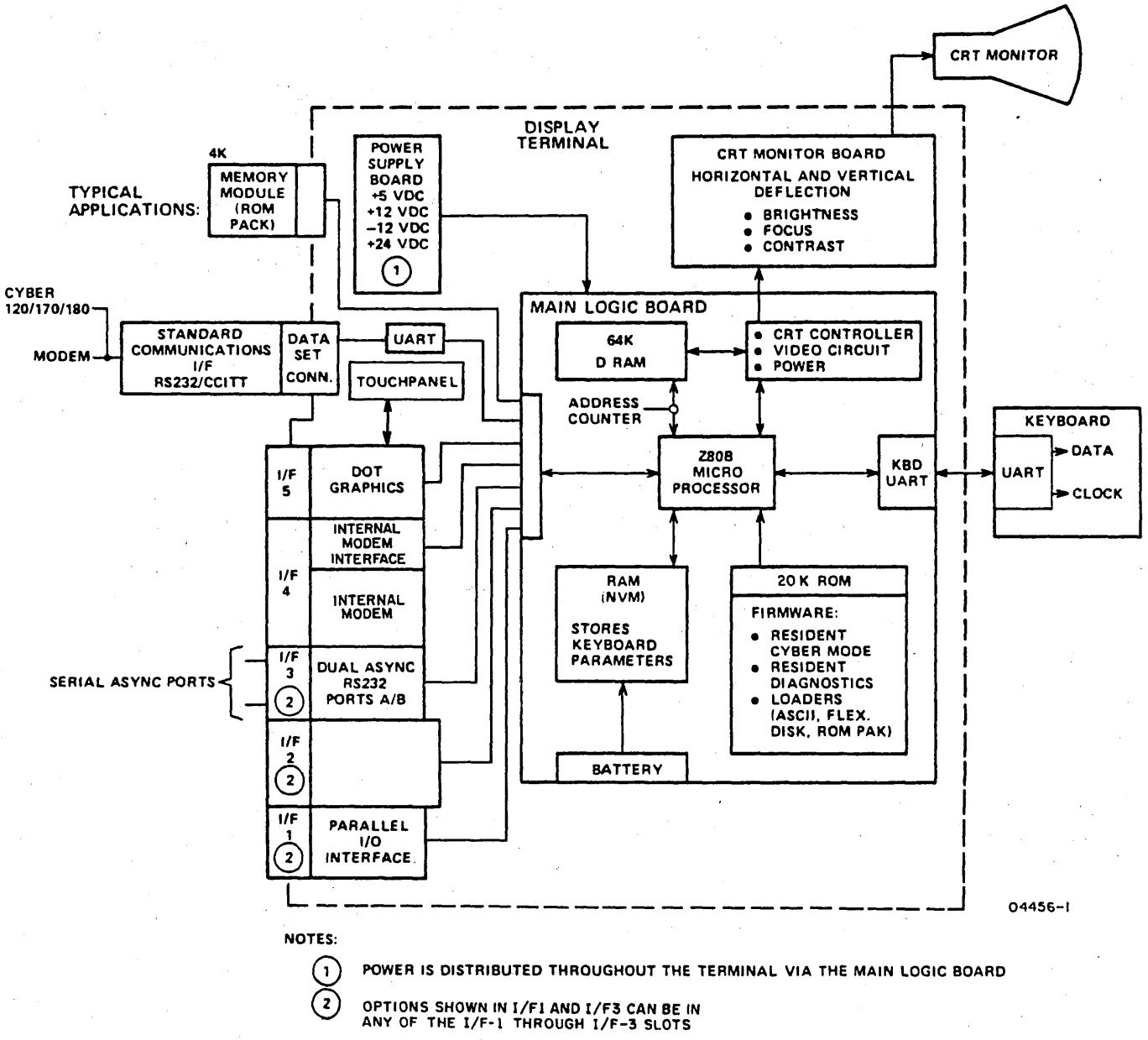



Figure E-3. Block Diagram of Host Terminal

Figure E-4 is a functional block diagram of the modem assembly. The following text briefly summarizes the purpose of each block on the diagram, and includes brief descriptions of the address, data, and control signal buses shown on the diagram.. The blocks labeled buffers, memory, UART, and registers (REGS.) are all mounted on the interface PC board (small PC board) of the modem assembly. The block labeled modem in the figure represents the actual modem printed circuit board (large PC board) of the assembly (also refer to figure E-2).

## Address, Data, and Control Signal Buses

The address buses shown in figure E-4 are 12-bit buses that carry address information from the terminal processor to the modem assembly. As is the case with the terminal processor, the function of the information on the address bus varies with the state of the I/O- and memory-request signal control lines. The memory-request control line gates address information to to the memory bank on the modem assembly; whereas, the I/O-request control line enables addressing modem input/output operations directly. The data bus is an 8-bit bidirectional bus that passes data bytes, including functional control and status information, betweeen the terminal processor and the modem assembly. The control bus carries terminal processor control signals (memory request, I/O request, memory-bank select, etc.) to the modem assembly in order to coordinate modem activity with other terminal operations. Further information on these buses is included later in this appendix under the Internal and External Interfaces heading.

## Buffers

The buffers shown in figure E-4 simply provide a means for temporarily buffering the information carried on the three signal buses described above. The data buffer actually consists of transceivers for passing bidirectional data and status information between the modem assembly and the terminal processor.

## Read-only Memory (4K x 8)

The 4K X 8 ROM holds the control firmware for the modem assembly. The terminal processor accesses this ROM via bank 11 addresses (block 8000 to $8FFF_{16}$). The processor uses jump-table entry addresses to access the particular function (auto-dial, auto-answer, test, etc.) of the ROM that it requires. The actual addresses used to access a particular function depend upon

whether the resident (CYBER) operating mode is making the subroutine call or an applications mode program is making the call. More detailed information regarding the jump-table entry addresses for the various modem functions are provided later in this section under the Programming Aids heading.

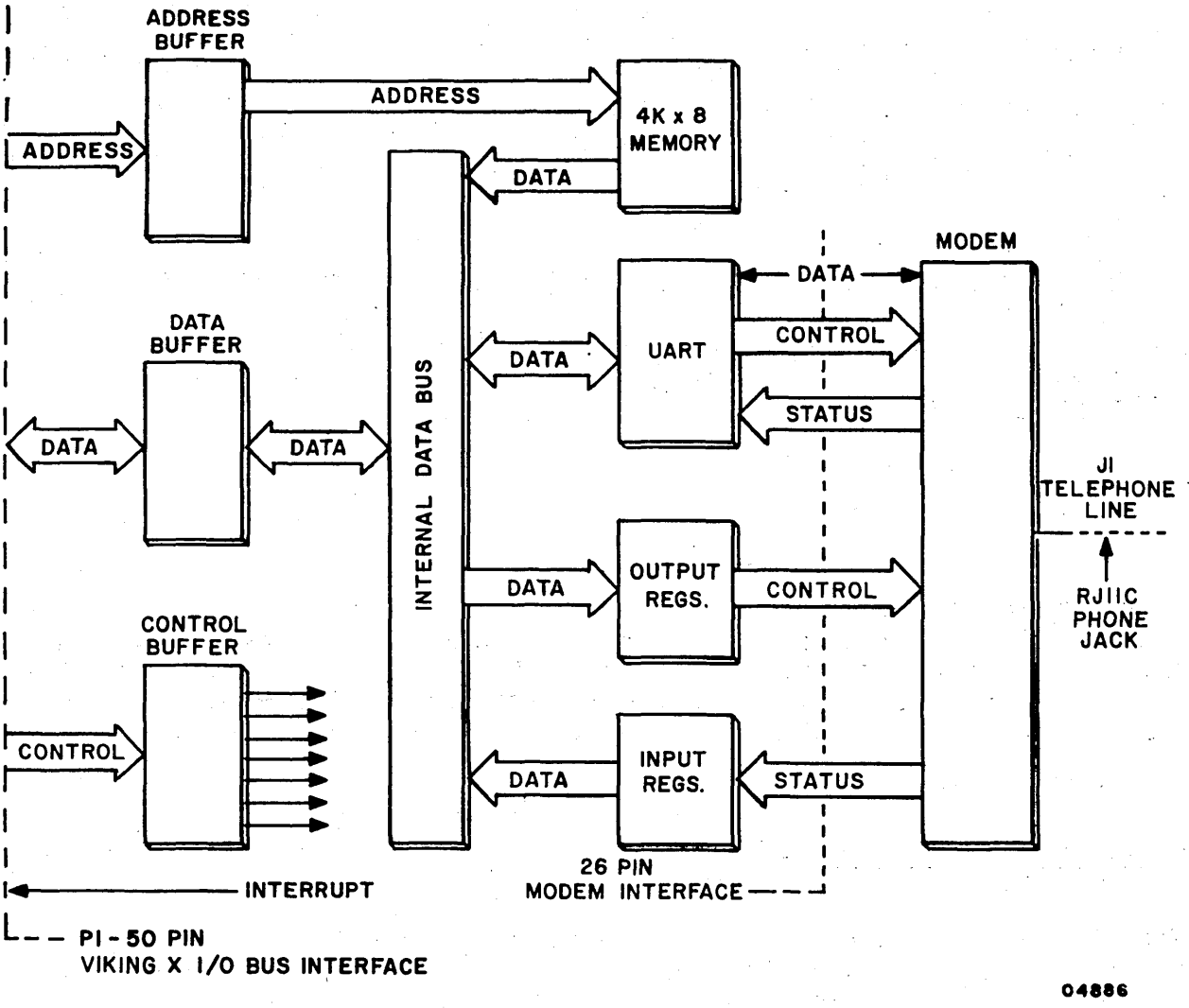



Figure E-4. Functional Block Diagram of Modem Assembly

## Universal Asynchronous Receiver Transmitter (UART)

Besides the usual functions of serializing transmit data and assembling received data into parallel data bytes, this UART contains a number of registers for holding both line and modem control and status information. These internal UART registers are used in conjunction with external registers (identified on the block diagram as output and input registers) to provide control of all modem operations and to enable monitoring modem/line status during the call-placing process. In addition, the modem can be directed to enter a loopback test mode.

The internal registers of the modem are accessed via processor I/O addresses in the $C0_{16}$ through $C6_{16}$ range. By further using the most significant bit of the line control register (address $C3_{16}$) as a function select bit and read/write signals to select between the receive and transmit data buffers, the UART can actually perform ten different control, data and status operations, including read/write data, interrupt enable and identification, modem/line control, read modem/line status, and set transmit/receive data rate (fixed at 1200 b/s in this application). For more detailed information on accessing and using these UART registers during I/O operations (applications program oriented), refer to the Programming Aids portion of this appendix.

## Output and Input Registers

The blocks labeled output and input registers in figure E-4 actually consist of two output registers and a single input register. The output registers are accessed by the terminal processor via I/O addresses $C8_{16}$ and $C9_{16}$, while the input register responds to $CA_{16}$. As with the UART registers, these registers are used for modem control and status operations. The output register accessed by address $C8_{16}$ is the call-control register and the input register accessed by address $CA_{16}$ is the call-status register. The output register associated with address $C9_{16}$ provides control for the dual-tone multi-frequency dialing portion of the modem. For more detailed information on accessing and using these registers during I/O operations (applications program oriented), refer to the Programming Aids portion of this appendix.

## Modem

As noted previously, the modem is compatible with Bell 212A requirements. It is capable of either call originate or auto-answer operation in either full- or half-duplex modes. Call

dialing is possible using either pulse or dual-tone multi-frequency techniques (where available). The modem can monitor and report status (ringing, busy, etc.) while a call is in progress, and it can also be directed to enter an analog-loopback mode for testing purposes. In transmit mode, the internal interface of the modem accepts serial TTL-level signals from the interface board, modulates these signals using phase-shift-encoding techniques, and places these signals on the transmission lines for sending to the distant receiver. In receive mode, the phase-shift encoded signals from the transmission lines are demodulated, converted to TTL-level signals, and passed to the UART on the interface board. The modem uses a four-step phase-shift-modulation technique in which each step represents one of four possible dibit codes on the transmission line. In this application of the modem, its transmit/receive data rate is fixed at 1200 b/s (600 baud). The transmit/receive characteristics of the modem are listed later in this appendix under the External Interface heading.

## MODEM ASSEMBLY INTERFACES

Figure E-4 indicates the internal and external interfaces of the 1200/1200 b/s modem. The following text briefly describes each of these interfaces.

### Internal Interface

The internal modem interface is compatible with control, data, and address signal buses of the terminal processor in the host terminal. The interface is implemented via a 50-pin male connector that mounts on the interface PC board of the modem assembly and connects to a mating ribbon-cable connector of the host terminal. All voltages on the interface are TTL compatible and have levels falling within the following indicated ranges (as referenced to ground pins 1, 2, and 4 of the interface cable).

- A high-level output is defined as having a voltage range between +2.4 and +5.25 volts (minimum to maximum)
- A low-level output is defined as having a voltage range between 0 and +0.5 volts (minimum to maximum)
- A high-level input is defined as having a voltage range between +2.0 and +5.25 volts (minimum to maximum)
- A low-level input is defined as having a voltage range between 0 and +0.8 volts (minimum to maximum)

TABLE E-1. INTERNAL MODEM INTERFACE SIGNALS AND PIN ASSIGNMENTS

| CONN PIN NO. | SIGNAL DESCRIPTION | LOADING (L)/DRIVE (D) | SIGNAL ORIGIN* |
|---|---|---|---|
| 1 | Power Ground | | Power |
| 2 | Power Ground | | Power |
| 3 | 6-MHz Osc | L High: 20 uA, Low: -0.4 mA | Input |
| 4 | Power Ground | | Power |
| 5 | -Interrupt 1 | D High: -0.400 mA, Low: 8 mA | Output |
| 6 | 1.8432-MHz Osc | L High: 20 uA, Low: -0.2 mA | Input |
| 7 | (Not used) | | |
| 8 | (Not used) | | |
| 9 | -Refresh | L High: 50 uA, Low: -0.4 mA | Input |
| 10 | (Not used) | | |
| 11 | (Not used) | | |
| 12 | -Bank 11 | L High: 20 uA, Low: -0.2 mA | Input |
| 13 | -IORQ | L High: 50 uA, Low: -0.4 mA | Input |
| 14 | -Reset | L High: 20 uA, Low: -0.2 mA | Input |
| 15 | -Wait | D Low: -20 mA, Open Collector | Output |
| 16 | -M1 | L High: 50 uA, Low: -0.4 mA | Input |
| 17 | (Not used) | | |
| 18 | (Not used) | | |
| 19 | Data Bus $2^3$ | L High: 20 uA, Low: -0.2 mA<br>D High: -12 mA, Low: 24 mA | Bi-Dir |
| 20 | Data Bus $2^2$ | L High: 20 uA, Low: -0.2 mA<br>D High: -12 mA, Low: 24 mA | Bi-Dir |
| 21 | Data Bus $2^4$ | L High: 20 uA, Low: -0.2 mA<br>D High: -12 mA, Low: 24 mA | Bi-Dir |
| 22 | Data Bus $2^1$ | L High: 20 uA, Low: -0.2 mA<br>D High: -12 mA, Low: 24 mA | Bi-Dir |
| 23 | Data Bus $2^5$ | L High: 20 uA, Low: -0.2 mA<br>D High: -12 mA, Low: 24 mA | Bi-Dir |
| 24 | Data Bus $2^0$ | L High: 20 uA, Low: -0.2 mA<br>D High: -12 mA, Low: 24 mA | Bi-Dir |
| 25 | Data Bus $2^6$ | L High: 20 uA, Low: -0.2 mA<br>D High: -12 mA, Low: 24 mA | Bi-Dir |
| 26 | Address Bus $2^0$ | L High: 20 uA, Low: -0.2 mA | Input |
| 27 | Data Bus $2^7$ | L High: 20 uA, Low: -0.2 mA<br>D High: -12 mA, Low: 24 mA | Bi-Dir |
| 28 | Address Bus $2^1$ | L High: 20 uA, Low: -0.2 mA | Input |
| 29 | | | |
| 30 | Address Bus $2^2$ | L High: 20 uA, Low: -0.2 mA | Input |
| 31 | Addr's Bus $2^{10}$ | L High: 50 uA, Low: -0.4 mA | Input |
| 32 | Address Bus $2^3$ | L High: 20 uA, Low: -0.2 mA | Input |
| 33 | -Read | L High: 20 uA, Low: -0.2 mA | Input |

*Input and output are defined relative to the modem assembly.

TABLE E-1. INTERNAL MODEM INTERFACE SIGNALS, ETC. (CONTD)

| CONN PIN NO. | SIGNAL DESCRIPTION | LOADING (L)/DRIVE (D) | SIGNAL ORIGIN* |
|---|---|---|---|
| 34 | Address Bus $2^4$ | L High: 20 uA, Low: -0.2 mA | Input |
| 35 | Addr's Bus $2^{11}$ | L High: 50 uA, Low: -0.4 mA | Input |
| 36 | Address Bus $2^5$ | L High: 20 uA, Low: -0.2 mA | Input |
| 37 | Address Bus $2^9$ | L HIgh: 50 uA, Low: -0.4 mA | Input |
| 38 | Address Bus $2^6$ | L High: 20 uA, Low: -0.2 mA | Input |
| 39 | Address Bus $2^8$ | L High: 50 uA, Low: -0.4 mA | Input |
| 40 | Address Bus $2^7$ | L High: 20 uA, Low: -0.2 mA | Input |
| 41 | (Not used) | | |
| 42 | (Not used) | | |
| 43 | -MEMREQ | L High: 50 uA, Low: -0.4 mA | Input |
| 44 | (Not used) | | |
| 45 | -12 V dc | L 76 mA max. | Power |
| 46 | -Write | L High: 20 uA, Low: -0.2 mA | Input |
| 47 | +12 V dc | L 80 mA max. | Power |
| 48 | +5 V dc | L 1010 mA | Power |
| 49 | +5 V dc | | Power |
| 50 | +5 V dc | | Power |

*Input and output are defined relative to the modem assembly.

As indicated earlier, the internal modem responds to two different types of requests from the terminal processor. During memory request operations directed to memory bank 11 (the 4K ROM on the modem assembly), the terminal processor performs a data output to buffer a bank 11 select signal and it then uses an address in the $8000_{16}$ to $8FFF_{16}$ range to access the 4K ROM of the modem. The lower 12 bits of the address select a particular memory location in the 4K ROM and places the contents of that location on the data bus for reading by the processor. During an I/O request operation, the processor uses address bits $2^0$ through $2^7$, the I/O request signal, and either the read or write signal to complete the desired input/output operation from/to the modem. To perform input/output operations directed to the modem, the processor sets the address bits as follows:

| $2^7$ | $2^6$ | $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 0 | X | X | X | X |

where XXXX corresponds to the desired modem register-select address (also refer to the information given previously under the Universal Asynchronous Receiver Transmitter and Output and Input Registers headings).

## External Interface

The external interface of the modem consists of single, six-pin, RJ11 female connector (standard modular telephone connector). Pins 3 and 4 of this connector carry the transmit/receive data signals. This interface connects the modem to a two-wire full-duplex (simultaneous transmit and receive) data transmission line. Following are the characteristics for the transmitter and receiver circuits of the internal modem. The modem at the far end of the transmission line should have characteristics compatible with those listed below.

### Transmitter:

Carrier frequency: 1200 Hz ± 0.24 Hz in originate mode
2400 Hz ± 0.48 Hz in answer mode

Level into 600 ohm load: -10 dBm ±1 dBm maximum

Source impedance: 600 ohms ± 6 ohms

Transmit data rate: 1170 to 1212 b/s

### Receiver:

Carrier frequency: 2400 Hz ± 7 Hz in orginate mode
1200 Hz ± 7 Hz in answer mode

Dynamic range: -43 to -10 dBm

Source impedance: 500 to 1700 ohms

Carrier detect level: On is -43 dBm, minimum, between 1800 and 3000 Hz in originate mode or between 600 and 1800 Hz in answer mode.

Off is -50 dBm, maximum, or signal levels outside the 1000-Hz to 5300-Hz band in originate mode or outside the 350-Hz to 3200-Hz band in answer mode

Carrier detect hysteresis: 2 dBm, minimum

Receive-carrier carrier-detect delay: -155 ± 55 ms off/on
-17 ± 7 ms on/off

## PROGRAMMING AIDS

This portion of the appendix provides useful information for writing applications programs that use the internal modem. The following text covers two interrelated aspects of using the modem: using the subroutines in the modem firmware for initiating and terminating communications with a remote device and accessing the modem hardware to provide communications I/O control and status information.

### USING THE MODEM FIRMWARE

The modem firmware contains subroutines for use both by the resident (CYBER) operating mode of the terminal and by the other possible (applications) operating modes. The former operating mode is firmware resident in the host terminal, and it, therefore, has already defined exit and re-entry points for using some of the modem subroutines. The applications operating modes, on the other hand, are flexible with undefined exit or re-entry points for using the modem subroutines. In addition, a portion of the terminal resident firmware can use the modem firmware as a means of loading an applications operating mode. For these reasons, some portions of the modem firmware appear to be redundant (two auto-dial subroutines, for example). This is not in fact the case, however, because each of the similar modem subroutines has a different usage (loader or resident usage versus applications usage).

Despite the undefined nature of the applications mode exit and re-entry points, the modem subroutines (in modem firmware) used by the applications modes are defined and have fixed entry points. The following listing gives the subroutines accessible to both types of operating modes (resident and applications), and it also includes the jump-table entry address (as a hexadecimal number in parentheses) for each subroutine.

| Resident Subroutines | Applications Subroutines |
|---|---|
| Auto-dial ($8000_{16}$) | Auto-dial ($8012_{16}$) |
| Run modem tests ($8009_{16}$) | Get phone-call status ($8015_{16}$) |
| Hang-up phone ($800F_{16}$) | Set control parameters ($8018_{16}$) |
| | Continuous auto-answer ($801B_{16}$) |
| | Normal auto-answer ($801E_{16}$) |
| | Send tone-dial info ($8024_{16}$) |

The following text first describes the modem subroutines accessible by the resident terminal mode. It then provides information, including a series of figures, to indicate how parameter lists are set up for use by the modem subroutines and what status information is furnished by the modem subroutines.

## Resident-Accessible Modem Subroutines

As indicated in the above listing, the current version (3.0) of the terminal-resident firmware supports the following three general functions of the version 1.0 firmware for the 1200/1200 b/s internal modem:

- Modem-assembly quick-look test
- Modem-assembly auto-dial functions
- Modem-assembly hang-up subroutine

These three subroutines are actually pre-mode subroutines. That is, they are normally used prior to actually loading an operating mode into the terminal. The run-modem-tests subroutine normally occurs automatically upon terminal power up or reset as an extension of the terminal quick-look tests. It can, however, be initiated at other times by other means. The normal function of the auto-dial subroutine is to connect a remotely located host computer for the purpose of: 1) operating the terminal in resident mode as a CYBER terminal, or 2) downloading one of the other possible (applications) operating modes from the connected computer. The hang-up subroutine simply places the modem back on hook after the terminal is finished using it. The following paragraphs briefly describe each of resident accessible modem subroutines.

### Modem-assembly Quick-look Test

The resident firmware requests a quick-look test of the terminal hardware upon one of the following occurrences:

- Terminal power on or reset
- An operator request (CTRL = V) while operating in local CYBER mode
- A host-processor initiated request

Just as the resident firmware performs quick-look tests upon the basic terminal hardware following terminal power on or reset, the internal modem firmware incorporates checks of the modem hardware. These checks include a ROM checksum test, a UART loopback test, and a modem loopback test. The modem tests are run as an extension of the resident quick-look test. That is, as the resident quick-look is running, it checks the terminal installation parameters to determine if an internal modem is installed in the terminal (terminal installation parameter F3P1 = 1).*

If the modem is installed, the resident quick-look makes a call to $8009_{16}$ to initiate a checksum test of the modem ROM. When the checksum test is complete and its pass/fail status flag set, a check is made to determine if the terminal is presently operating online (quick-look test was host initiated). If so, the UART and modem loopback tests are bypassed and the pass/ fail status of the quick-look tests (including the modem ROM checksum test) is sent to the host. In this instance, the modem quick-look tests are complete. The UART and modem loopback portions of the modem quick-look test are bypassed because it is necessary to hang up the modem to run either of these tests (disconnect the host computer).

If an operating mode is not selected (power-up/reset) or the terminal is not online (local mode operation selected), the modem quick-look checks continue with the UART loopback test. When this test is complete, terminal-installation parameter bit F4P3 is tested to determine whether the modem quick-look should either continue with the modem loopback test (F4P3 = 1) or bypass it (F4P3 = 0). Running or bypassing this last test is made a terminal installation option because running the modem loopback test takes approximately 6 seconds to complete.

If any of the modem quick-look tests detect an error condition, it causes the display of a corresponding test-failure message.

---

*The FXPY convention is used to indicate an entry position (P) within either terminal- or mode-installation parameter-entry fields F0 through F10. In using this convention, X indicates the parameter field number (for example, F2, F3, etc.) associated with the corresponding function key on the terminal keyboard, and Y indicates a 1 through 6 position number within a field when counting possible positions from left to right.

The test-failure messages associated with the modem quick-look tests are as follows:

- INTERNAL MODEM CHECKSUM FAIL
- INTERNAL MODEM UART FAIL
- INTERNAL MODEM LOOPBACK FAIL

Upon completion of the modem quick-look tests, a return is made to the resident quick-look tests.

## Modem-assembly Auto-dial Functions

Upon terminal power up or reset, the resident firmware examines both the terminal installation and the mode installation parameters (TIPS) and MIPs). If TIP F3P1 is set to 1, the resident firmware knows that the internal modem is installed in the terminal and includes the modem in the terminal quick-look tests. The state of F4P3 determines whether the modem loopback self test is to run at this time (F4P3 = 1 = run; F4P3 = 0 = bypass), and the state of F4P4 decides whether the modem uses either its tone or pulse dial capability on the phone lines (F4P4 = 1 = tone; F4P4 = 0 = pulse). Once the self test operations are completed, an operating mode is either automatically or manually selected (depends on entries in TIPs F4P1 and F6P1). Regardless of how mode selection is initiated, it is at this time that the resident loader examines the mode installation parameters (MIPs) to determine such things as:

- Whether the loader is to use the default source, file, and phone number parameter entries - F2P4 and F2P5 mode installation parameter entries determine the default load source, entries in F9P1 and F9P2 determine the default file number, and mode installation parameter fields F7 and F8 contain the default phone number
- Whether the load is internal (resident) or external (applications) - mode installation parameter F2P4
- Whether, if external, the load is to be from the host computer or another external source (e.g., a disk unit) - mode installation parameter F2P5
- Whether, if from the host, the load is to be from the RS-232-C Data Set interface or from the internal modem - mode installation parameter F2P6
- Whether, if from the host and using the internal modem, the auto-dial feature of that modem is to be used - mode installation parameter F3P2

Assuming the following:

- terminal installation parameter F3P1 = 1, indicating the internal modem is installed
- mode installation parameter F2P3 = 1, indicating that source, file, and phone number parameters are to be manually selected or entered
- mode installation parameter F2P4 = 1, indicating the operating mode is to load from an external source
- mode installation parameter F2P5 = 0, indicating the operating mode is to be loaded from the host computer
- mode installation parameter F2P6 = 1, indicating the internal modem is to be used for the load
- mode installation parameter F3P2 = 1, indicating the auto-dial function of the internal modem is to be used

the operator-action and display-message sequence depicted in figure E-5 would occur.

Setting mode installation parameter F2P3 to 0 while the other parameter entries given above remain the same causes essentially the same sequence to occur. In this instance, however, the boxed-in display messages do not appear because the default phone number, load source, and file values automatically replace the operator entered values.

Setting mode installation parameters F2P3 and F3P2 both to 0's while the other entries remain the same bypasses the entire upper half of figure E-5. That is, selecting a host loaded operating mode with out using either the default-values or auto-dial function drops the user immediately to the following display message on the diagram:

SELECT LOAD SOURCE > DISK HOST ROM

In this instance, the operator keys an H to select the host load, and a short time later, a HOST NOT CONNECTED message appears on the display screen. Assuming that a hand set is connected to the same telephone line as the internal modem (via T or Y line adapter), the terminal operator has approximately 40 seconds to complete the following tasks. Dial the number of the load source (host computer) on the telephone, wait until the phone is answered and an answer tone is heard, and hang up the telephone. The internal modem senses the answer tone at the same time the operator hears it and the terminal to host computer connection is made.

Operator-action/Comments

Operator selects an operating mode that uses internal modem, but does not use default source/file/phone-number values stored in mode parameter entries; F2, for example.

Operator keys in phone number and presses NEXT key. See text for allowable entries.

The next messages appear one at time in sequence. Where more than one message possibility is available, only the message that reflects the actual condition of the phone line appears.

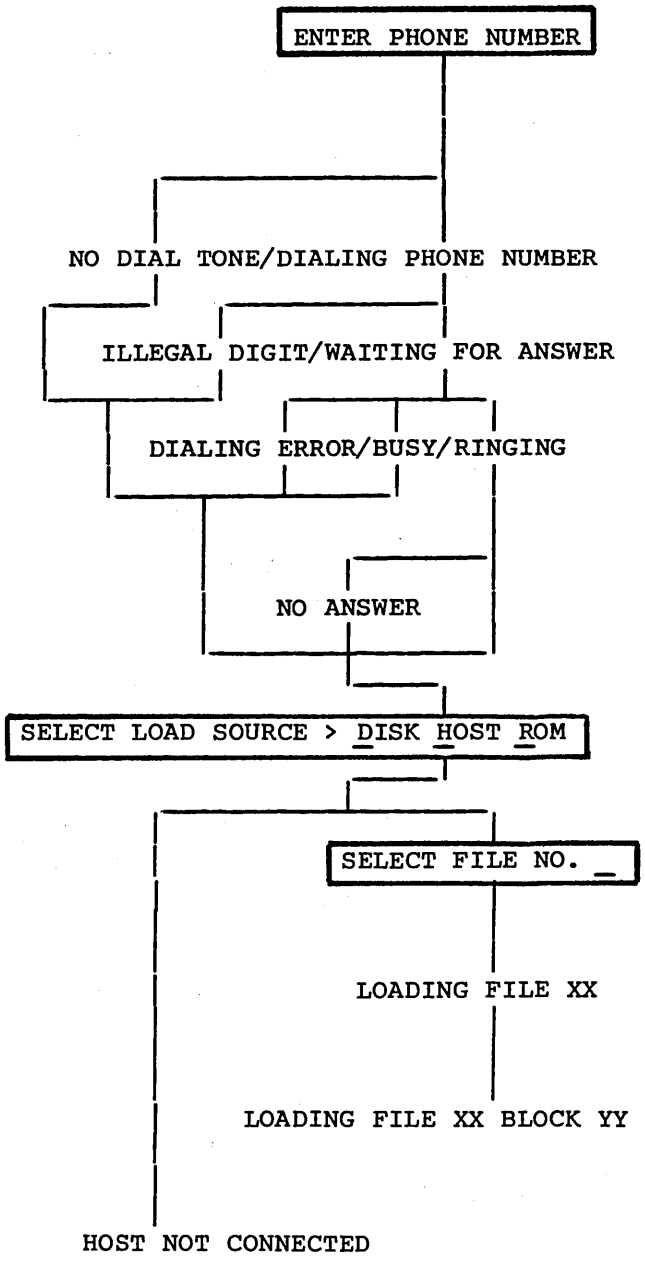
Operator keys in desired load source (H), or default value can be used.

Operator keys in desired file number (00 to $3F_{16}$ range), or default value can be used.

This message reflects loading of file specied by operator (or default value).

The $YY_{16}$ portion of this message increments as each block of the selected file loads.

Possible Display Messages




The last message (HOST NOT CONNECTED) only appears if the source-select message is entered via the no-dial-tone, illegal-digit, dialing-error, busy, or no-answer route. About 40 seconds after this last message appears, a loading failure message appears along with the redisplay of the mode-selection menu. At this time the operator can retry the load, but should first verify proper terminal and mode installation parameter settings. Operator should also double check for correct procedures.

Figure E-5. Auto-dial and Not-default-value Load from Host

Notice that in the three previously described sequences for connecting the host, the auto-dial function is only used in two of them, the first and the second. The third sequence bypasses the auto-dial function completely and allows the internal modem to be used similarly to a modem/handset combination. In the two sequences using the auto-dial subroutine of the modem, however, the resident loader detects the presence of the auto-dial parameter entry and uses jump-table entry address $8000_{16}$ to access the auto-dial subroutine. The auto-dial subroutine consists of the following support subroutines:

- Get phone number - fetches phone number from mode installation parameter fields F7 and F8 (if default values are used) or displays request for operator entered number on the terminal screen and returns number as it is entered.*

- Dial number - takes the modem off hook, determines whether a dial tone is present, and checks whether to use pulse or tone dialing on the line. It then uses the get-phone-number data to dial the telephone number, and then jumps to the connect support subroutine. If a dial tone is not detected, this routine bypasses the connect subroutine and returns to the resident, which displays the select-load-source message.

- Connect - monitors telephone line to determine whether desired phone number is busy, ringing, does not answer, etc. and displays appropriate messages on terminal screen. Returns control to resident along with status information that indicates whether or not connection has been made.

---

*Allowable entries for either the F7/F8 mode-installation parameter fields (default number) or the operator-entered telephone number include 0 through $F_{16}$; where 0 through 9 are standard numeric entries, A is not used, B represents the * symbol (for later use in tone dialing), C represents the # symbol (for later use in tone dialing), D causes a pause in the dialing sequence until a tone is detected, E causes a pause in the dialing sequence until no tone is detected for 3 seconds, and F is only used in the mode-installation parameter-entry fields (F7/F8) to indicate the end of a phone number that does not entirely fill the 12 symbol spaces available.

## Modem-assembly Hang-up-Phone Subroutine

Assuming the download of an operating mode is to occur, the resident ASCII loader is given control of the load operation once the phone-line connection is established. The loader monitors the download operation, and when the load is complete, the loader calls the modem firmware (jump-table entry address $8179_{16}$) to hang up the modem. The modem firmware issues a command to place the modem back on hook, and then returns control to the loader.

## Modem-subroutine Parameter Lists and Status

As noted earlier in this appendix, the undefined nature of the applications operating modes requires the use of modem subroutines that differ from those of the resident mode. The following text and figures indicate how parameter lists are to set up for use by the applications modes and what status information the modem subroutines make available for use by the applications modes. Information is included for the following applications-mode subroutines of the modem:

### Applications-mode Subroutines

Auto-dial ($8012_{16}$)
Get phone-call status ($8015_{16}$)
Set modem-control parameters ($8018_{16}$)
Continuous auto-answer ($801B_{16}$)
Normal auto-answer ($801E_{16}$)
Send tone-dial info ($8024_{16}$)

### Applications Auto-dial (Hex 8012)

The applications program must incorporate a parameter list that conforms to the format indicated in figure E-6. Upon entry to the auto-dial subroutine, the HL registers point to a parameter list containing the information indicated in figure E-6.

| Parameter Number | Address | Byte | Data | | |
|---|---|---|---|---|---|
| 1 | (HL)+0 | 1 | Address of Phone Number (LSB) | | (hex) |
| | (HL)+1 | 2 | Address of Phone Number (MSB) | | (hex) |
| 2 | (HL)+2 | 3 | Misc Control | | (binary) (see chart) |
| 3 | (HL)+3 | 4 | Ring Count | | (ASCII) (0-9) |
| 4 | (HL)+4 | 5 | Redial Attempts | Units Digit | (ASCII) (0-9) |
| | (HL)+5 | 6 | Redial Attempts | Tens Digit | (ASCII) (0-9) |

Figure E-6. Auto-dial Parameters List

The following paragraphs and figures more thoroughly describe the contents of each required parameter.

Auto-dial Parameter 1 (Phone Number Address): The first two bytes of the auto-dial parameters list contain the address of the phone number to be dialed. The LSB of address information is the first entry and the MSB is next. The applications auto-dial subroutine only accepts the following ASCII characters as valid telephone number entries:

- Numeric entries 0 through 9
- Special character entries *, #, -, and /
- Character entries A and F

The * and # special characters are only used when tone dialing is enabled. Using these characters in an other than tone dialing phone number sequence causes a dialing error to occur. The - and / special characters may be included in a dialing sequence to perform the following functions: the - causes the dialing

sequence to pause until a tone is detected on the line (e.g., wait for a dial tone after dialing an outside line), and the / causes a 3 second pause in the dialing sequence provided a tone is not detected on the line. The A character is currently not used, but the F character may be used following the last entry of a phone number as an end-of-number delimiter.

Auto-dial Parameter 2 (Miscellaneous Control): Figure E-7 shows the format and indicates the functions for the second parameter entry of auto-dial parameters list. The text following the figure explains the meaning of some of the bits whose significance may not be immediately apparent from the figure.

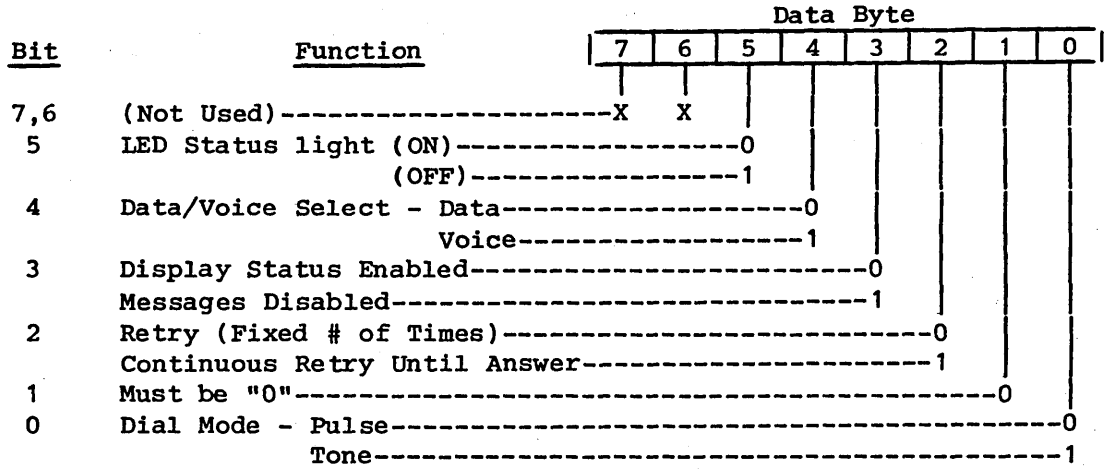



Figure E-7. Auto-dial Parameter 2: Miscellaneous Control

Bit 4 is used to let auto-dial enable voice communications. That is, if this bit is set to a 1, the modem completes an auto-dialing sequence, waits for an answer, and hangs up (goes back on hook) after detecting the first ring. To use this feature properly, the terminal operator should therefore pick up the handset receiver while the WAITING FOR ANSWER message is appearing on the terminal display screen.

Bit 3 enables or disables the display of line and modem status messages on the terminal display screen.

Bit 2 controls whether the modem continuously redials a number until a connection is made, or whether it only redials a specified number of times (refer to Retries entry of parameter 4).

Bit 0 controls the dialing mode. If this bit is a 0, the modem employs its pulse dialing circuits; if this bit is a 1, it uses the tone dial circuits.

Auto-dial Parameter 3 (Ring Count): This parameter entry determines the number of rings the modem detects before assuming a no answer and aborting the call. The entry accepts ASCII numerics 0 through 9, with a 0 entry defaulting to five rings.

Auto-dial Parameter 4 (Retries): This parameter accepts ASCII numeric entries between 00 and 99. It controls the number of times that the modem attempts redialing number before aborting the phone call and returning control to the calling routine. An entry of 99 for this parameter forces continuous retries in a manner similar to setting bit 2 of the parameter entry 2 to a 1.

NOTE

Canadian Department of Communications (DOC) regulations restrict dialing retries made in this manner to a maximum of ten (10).

Applications Get-Phone-Call Status ($8015_{16}$)

A call to this modem subroutine via jump-table address $8015_{16}$ returns modem status information in the following format. Upon return, the HL registers point to the beginning of a 6-byte status table. Figure E-8 indicates the contents and layout of that status table.

Status-table Parameter 1 (Miscellaneous): This status byte reflects the settings of the bits in the miscellaneous control byte of auto-dial parameter 2. Refer figure E-7 and to the preceding text describing that control byte for more detailed information.

| Parameter Number | Address | Byte | Data Type | Entry Type |
|---|---|---|---|---|
| 1 | (HL)+0 | 1 | Misc. Status | (binary) refer to text |
| 2 | (HL)+1 | 2 | Phone Call Status | (binary) refer to figure E-9 |
| 3 | (HL)+2 | 3 | Self-Test Status | (binary) refer to figure E-10 |
| 4 | (HL)+3 | 4 | ROM Revision | (hex) refer to figure E-11 |
| 5 | (HL)+4 | 5 | Redial Attempts Units Digit | (ASCII 0-9) refer to text |
| | (HL)+5 | 6 | Redial Attempts Tens Digit | (ASCII 0-9) refer to text |

*Count wraps around to 00 after count of 99.

Figure E-8. Get-phone-call-status Table

Status-table Parameter 2 (Phone-call Status): The phone-call status byte has the format shown in figure E-9. The figure also indicates the function of each bit in the phone-call status byte.

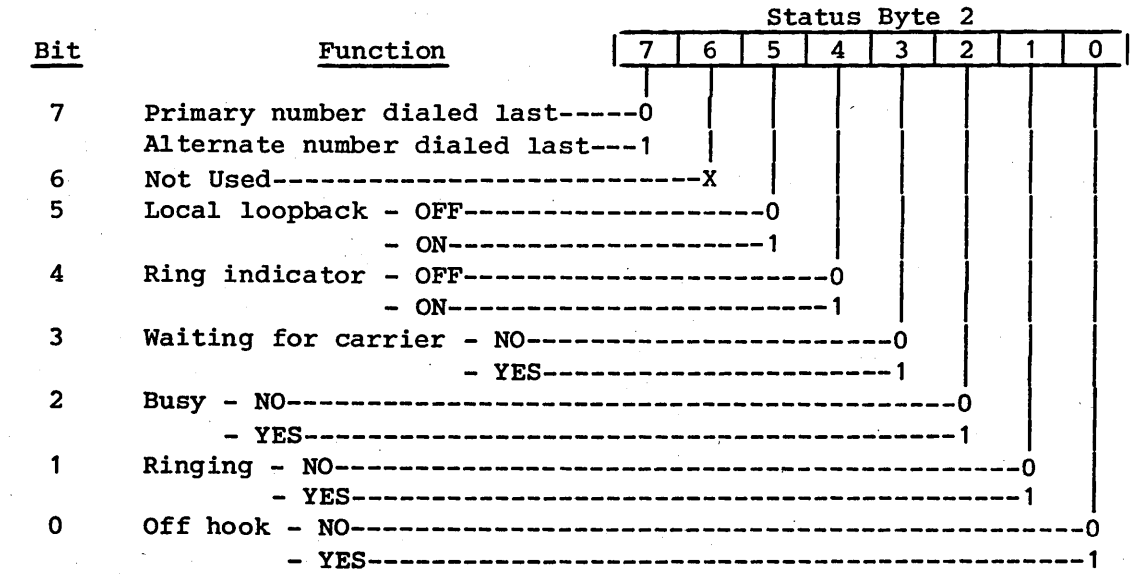



Figure E-9. Status-table Parameter 2: Phone-call Status

Status-table Parameter 3 (Self-Test Status): The self-test status byte has the format shown in figure E-10. The figure also indicates the function of each bit in the self-test status byte.

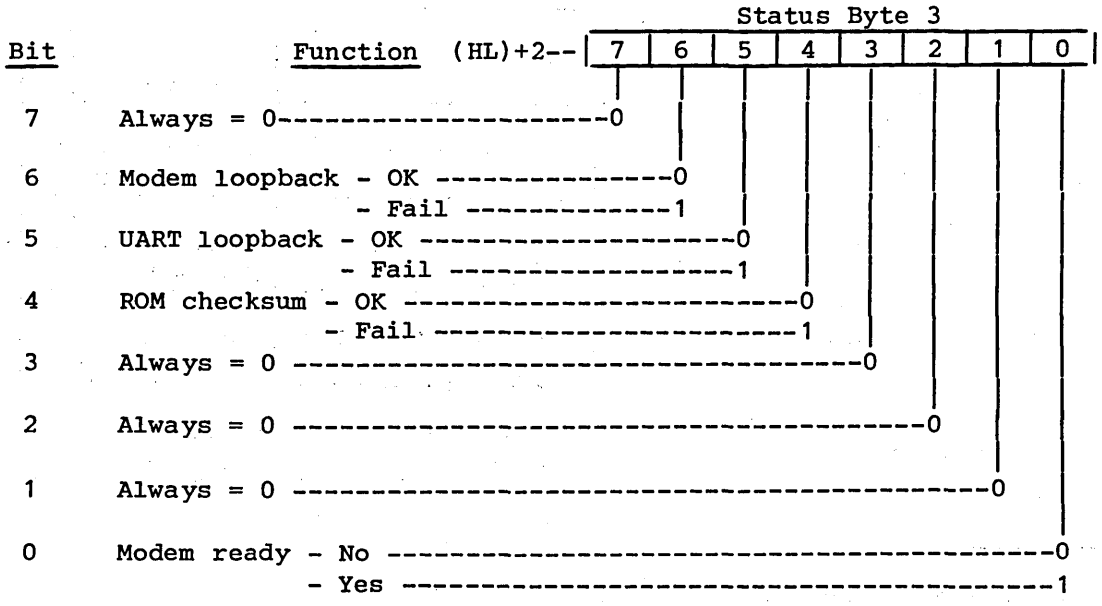
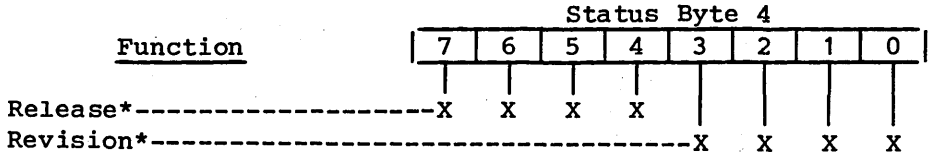



Figure E-10. Status-table Parameter 3: Self-test Status

Status-table Parameter 4 (ROM Revision): Figure E-11 shows the layout of the ROM revison status bit. The upper four bits of the byte contain a hexadecimal code that indicates the release level of the modem firmware. The hexadecimal code in the lower four bits indicates the revision level of the modem firmware.



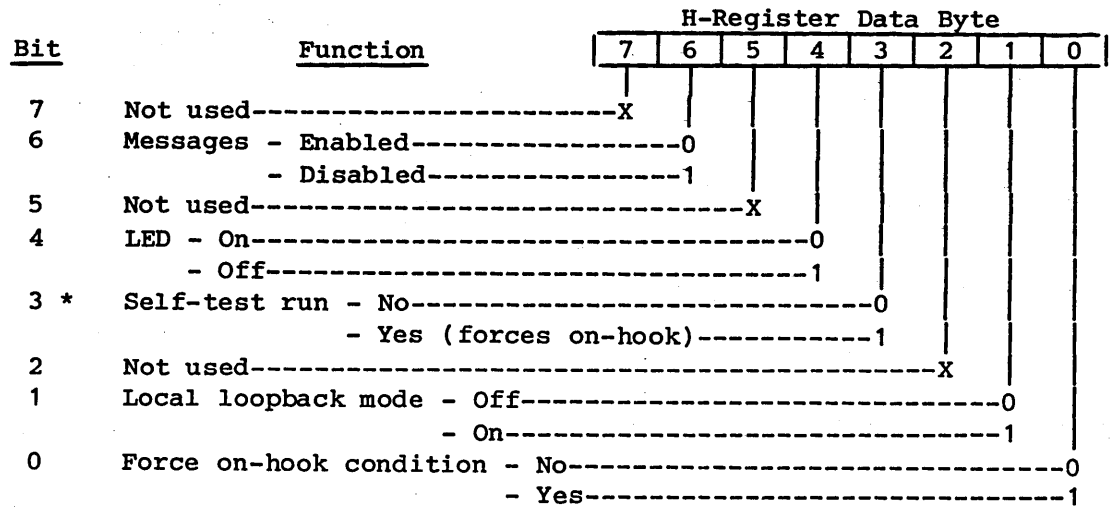

* Release and revision levels are each represented by a single 4-bit hexadecimal code.

Figure E-11. Status-table Parameter 4: ROM Revision

Status-table Parameter 5 (Dial Retries): Bytes 5 and 6 of the status table accessed via jump-table address $80015_{16}$ contain a two-character ASCII numeric that indicates the number of redials the modem is to make in attempting to connect the host computer. That is, these two bytes reflect the settings of auto-dial parameter 4. Byte 5 contains units- place redial-count information, and byte 6 contains tens-place information.

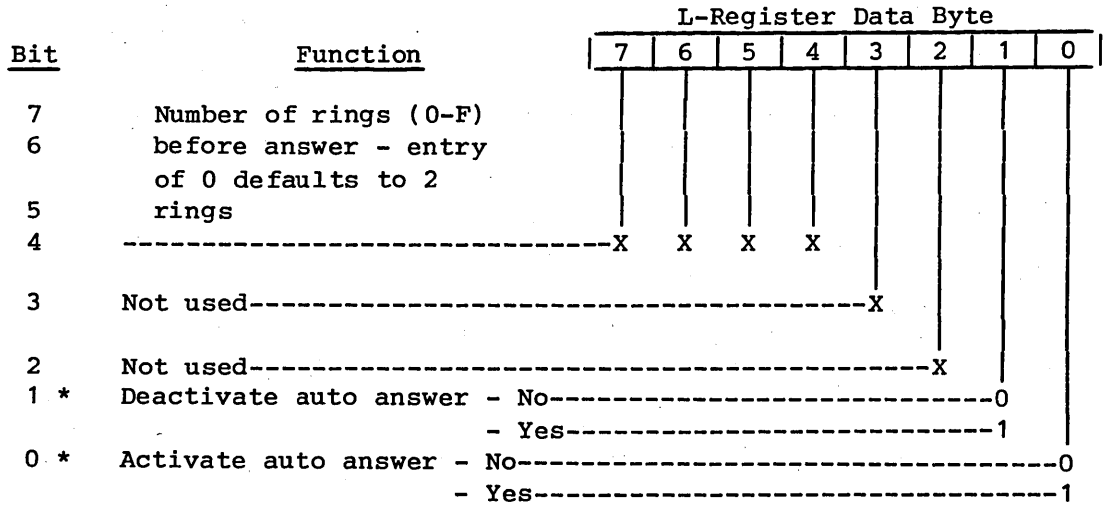
## Set Modem-control Parameters ($8018_{16}$)

Upon entry to this subroutine, the H and the L registers each contain a byte of modem control information. Figures E-12 and E-13 reflect the possible contents of these two control bytes. Each figure indicates the significance and usage of each bit in each register. Upon initialization both of these bytes contain all zeroes.




* Setting bit 3 enables running of the modem self-tests in accordance with the following modifiers. If bit 0 of RAM location $E046_{16}$ is equal to 0, the terminal is online and only the ROM checksum test is run. Running the loopback tests when the terminal is online hangs up on the host computer (places modem on hook). If bit 0 of $E046_{16}$ is equal to 1, the terminal is offline (in local mode) and all of the modem self tests may be run.

Figure E-12. Set Modem-Control Byte 1 (H Register)




* Bit 1 is given priority over bit 0. Setting bit 0 to 1 and bit 1 to 0 causes modem firmware to status the incoming ring indicator. If a ring is present the modem firmware remains in control and connects the call after the specified number of rings. If no ring is detected, the modem firmware returns control to the calling routine. Checking for the presence of a carrier or testing the off-hook status bit of phone-call-status byte 2 provides an indication of whether or not a connection has been made.

Figure E-13. Set Modem-Control Byte 2 (L Register)

### Continuous Auto-answer ($801B_{16}$)

An applications program call to jump-table entry address $801B_{16}$ causes the modem firmware to remain in control until the modem detects a ring status and makes a connection (answers after two rings).

### Normal Auto-answer ($801E_{16}$)

An applications program call to jump-table entry address $801E_{16}$ causes the modem firmware to check the ring indicator status of the modem. If a ring is present, the firmware connects the incoming call after two rings and returns control to the calling routine. If no ring is present, the modem firmware returns control immediately.

## Send Tone-dial Information ($8024_{16}$))

Use of this modem subroutine is restricted to communications lines capable of making tone-dial connections. The subroutine enables the user to send dual-tone multi-frequency (DTMF) information over the phone line at any time. This can be accomplished in the following manner:

1. Defining a table of bytes in memory
2. Loading the HL registers with the address of the first byte in the table
3. Calling this routine

The format of the table is shown in figure E-14, and the following text explains some of the limitations of DTMF data transmissions.

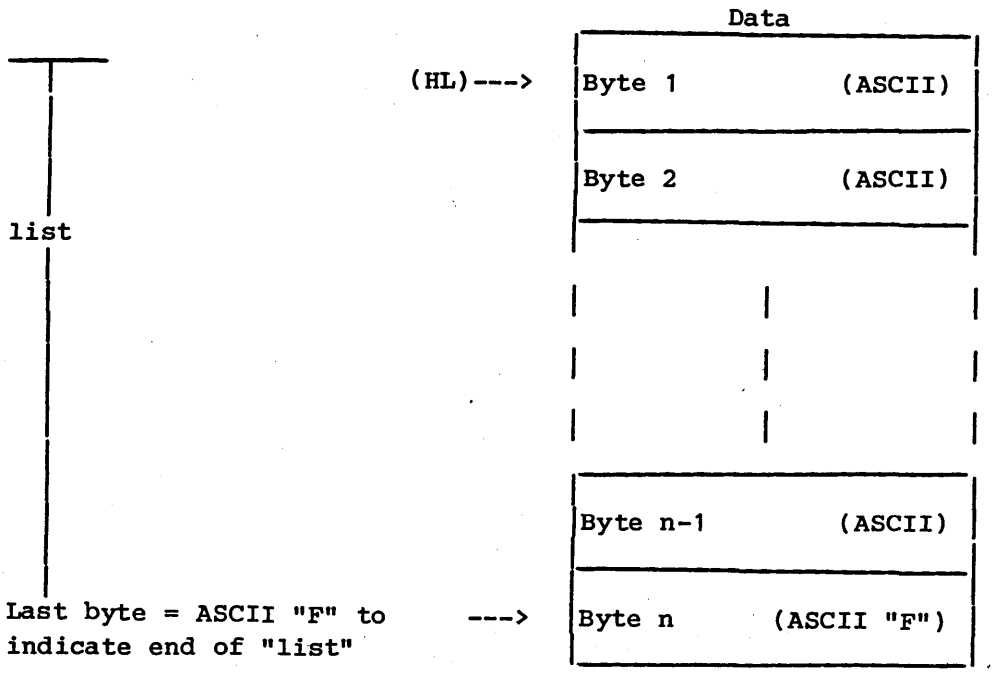



Figure E-14. Data-byte Table for Sending DTMF Information

Data in the table is stored as ASCII characters representing the characters 0-9, *, and # (touch-tone dial characters). An ASCII F ($46_{16}$) must be included as the last byte in the table to indicate the end of the table. This routine does not check any status (e.g., off-hook, carrier detect, etc.) prior to execution. The user must ensure that a connection exists before using this subroutine to send data. Use of the - (dash) or / (slash) characters, which are used on pulse-dial lines, cause a no-op to occur (i.e., no tone information is sent).

## ACCESSING THE MODEM HARDWARE

The preceding portion of this appendix discussed how to use the modem firmware in order to establish communications between the terminal and its host system computer. This portion of the text provides the information necessary for effective use of the communications lines once a terminal-to-host connection has been established. That is, the following paragraphs describe how to access the control and status registers of the internal modem.

The terminal processor uses the lower eight address bits, the I/O request signal line, and either a read or a write signal to perform I/O operations. To access the modem, the terminal processor uses the lower eight address lines as follows:

| $2^7$ | $2^6$ | $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 0 | X | X | X | X |

where XXXX designates a particular modem-interface status or control register.

The addressable entities within the modem assembly include eight UART registers, two UART latches, and three other modem control and status registers - a total of thirteen addressable items. The usable I/O address range for accessing the modem is between $C0_{16}$ and $CF_{16}$. Although it seems there are more than enough addresses allocated for accessing the 13 addressable entities of the modem, access to the ten items within the modem UART is restricted to the address range of $C0_{16}$ to $C6_{16}$. The three addressable modem registers external to the UART use addresses $C8_{16}$, $C9_{16}$, and $CA_{16}$. Addresses $C7_{16}$ and $CB_{16}$ through $CF_{16}$ are not used for addressing the modem.

Obtaining ten functions from seven UART addresses requires using additional information to differentiate between redundant addresses that have different functions. The most significant bit of one of the UART registers is used as a function designator for two redundant addresses (two of the UART addresses become four). In addition, the read and the write control signals from the processor are used to further breakdown one of the already redundant addresses into two functions (the same two UART addresses become five). Figure E-15 and Table E-2 summarize the addressable UART functions. In the table notice that the eighth bit (divisor latch access bit, or DLAB) of the line control register (UART address $C3_{16}$) is the one used to obtain different functions from redundant addresses ($C0_{16}$ and $C1_{16}$). Also notice that this bit only has to be set (DLAB = 1) to enable loading of the divisor latches which determine the transmit/receive rate of the UART. The UART divisor latches are loaded with $0060_{16}$ for 1200 b/s operation. The following text discusses the function of each of the registers and latches listed in table E-2.

| DLAB | A3 | A2 | A1 | A0 | UART Register |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | Receiver Buffer (Read), Transmitter Holding Register (Write) |
| 0 | 0 | 0 | 0 | 1 | Interrupt Enable Register |
| X | 0 | 0 | 1 | 0 | Interrupt ID Register (Read Only) |
| X | 0 | 0 | 1 | 1 | Line Control Register |
| X | 0 | 1 | 0 | 0 | Modem Control Register |
| X | 0 | 1 | 0 | 1 | Line Status Register |
| X | 0 | 1 | 1 | 0 | Modem Status Register |
| X | 0 | 1 | 1 | 1 | None |
| 1 | 0 | 0 | 0 | 0 | Divisor Latch (Least Significant Byte) |
| 1 | 0 | 0 | 0 | 1 | Divisor Latch (Most Significant Byte) |

Figure E-15. UART Register and Latch Addressing

## Receive Buffer Register

To access the receive-buffer register of the UART, bit 7 of the UART line-control register must have previously been set to 0 (DLAB = 0). Once this has been done, an I/O-request operation to address $C0_{16}$, along with the appropriate read signal, enables received data to be read from the receive-buffer register. This UART register presents data received from the telephone interface to the internal interface. The presence of new data in this register is indicated when the data-ready bit (bit 0) of the UART

# TABLE E-2. ADDRESSABLE UART REGISTERS AND LATCHES

| Bit | REGISTER ADDRESSES AND FUNCTIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | C0 DLAB=0 | C0 DLAB=0 | C1 DLAB=0 | C2 | C3 | C4 | C5 | C6 | C0 DLAB=1 | C1 DLAB=1 |
| | Receive Buffer Regular (Read only) | Transmit Holding Register (Write Only) | Interrupt Enable Register | Interrupt Identification Register | Line Control Register | Modem Control Register | Line Status Register | Modem Status Register | Divisor Latch (LS) | Divisor Latch (MS) |
| 0 | Data Bit 0 | Data Bit 0 | Enable Receive Data Available Interrupt | "0" if Interrupt Pending | Word Length Select Bit 0 | Data Terminal Ready DTR | Data Ready DR | Delta Clear to Send DCTS | Bit 0 | Bit 8 |
| 1 | Data Bit 1 | Data Bit 1 | Enable Transmitter Holding Register Empty Interrupt | Interrupt ID Bit (0) | Word Length Select Bit 1 | Request to Send RTS | Overrun Error OE | Delta Data Set Ready DDSR | Bit 1 | Bit 9 |
| 2 | Data Bit 2 | Data Bit 2 | Enable Receiver Line Status Interrupt | Interrupt ID Bit (1) | Number of Stop Bits | Output Bit 1 Not Used OUT1 | Parity Error PE | Trailing Edge Ring Indicator TERI | Bit 2 | Bit 10 |
| 3 | Data Bit 3 | Data Bit 3 | Enable Modem Status Interrupt | 0 | Parity Enable | Output Bit 2 Not Used Out2 | Framing Error FE | Delta Carrier Detect DCD | Bit 3 | Bit 11 |
| 4 | Data Bit 4 | Data Bit 4 | 0 | 0 | Even Parity Select | Loopback | Break Interrupt BI | Clear to Send CTS | Bit 4 | Bit 12 |
| 5 | Data Bit 5 | Data Bit 5 | 0 | 0 | Stick Parity | 0 | Transmitter Holding Register Empty THRE | Data Set Ready DSR | Bit 5 | Bit 13 |
| 6 | Data Bit 6 | Data Bit 6 | 0 | 0 | Set Break | 0 | Transmitter Shift Register Empty TSRE | Ring Indicator RI | Bit 6 | Bit 14 |
| 7 | Data Bit 7 | Data Bit 7 | 0 | 0 | Divisor Latch Access Bit (DLAB) | 0 | 0 | Carrier Detect CARDET | Bit 7 | Bit 15 |

line-status register is set (bit 0 = 1). Data is assembled in an internal receiver shift register, least significant bit first. Data must be read from the receive-buffer register before the next received word is transferred to avoid an overrun error.

## Transmit Holding Register

To access the transmit-holding register of the UART, bit 7 of the UART line-control register must have previously been set to 0 (DLAB = 0). Once this has been done, an I/O-request operation to address $C0_{16}$, along with the appropriate write signal, enables transmit data to be written into the transmit-holding register. This UART register accepts data from the internal interface for sending over the telephone-line interface. Writing to this register initiates the transmission of the 8-bit data word, with its attendant start and stop bits, from the internal transmitter shift register. Data may be written to this register whenever the transmitter holding-register-empty indicator bit (bit 5) of the UART line-status register is set (bit 5 = 1). Data is transmitted least significant bit first.

## Interrupt Enable Register

To access the interrupt-enable register of the UART, bit 7 of the UART line-control register must have previously been set to 0 (DLAB = 0). Once this has been done, an I/O-request operation to address $C1_{16}$, along with the appropriate write signal, enables interrupt enable information to be written into the interrupt-enable register of the UART. This register enables four separate UART interrupt sources to activate the interrupt output signal.

- Bit 0 - This bit enables the received data available interrupt when set to logical 1.
- Bit 1 - This bit enables the transmitter holding register empty interrupt when set to logical 1.
- Bit 2 - This bit enables the receiver line status interrupt when set to logical 1.
- Bit 3 - This bit enables the modem status interrupt when set to logical 1.
- All bits (0-3) are reset to logical 0 upon completion of the associated interrupt service routine.
- Bits 4 through 7 - These bits are permanently set to logical 0.

## Interrupt Identification Register

An I/O-request operation to address $C2_{16}$, along with the appropriate read signal, accesses the interrupt-identification register of the UART. This register contains information that both identifies the source of an interrupt and indicates its priority level. The UART classifies interrupts into one of four priority levels in the following manner: Receiver Line Status (priority 1); Received Data Ready (priority 2); Transmitter Holding Register Empty (priority 3); Modem Status (priority 4). Information indicating that a prioritized interrupt is pending and source of that interrupt are stored in the UART interrupt-identification register (IIR). Following is a brief description of the signicance for each bit position in the IIR (also refer to table E-3).

- Bit 0 - This bit can be used in either a hardwire prioritized or polled environment to indicate when an interrupt is pending. When this bit = 0, an interrupt is pending and the IIR contents may be used as a pointer to the appropriate interrupt service routine. When this bit = 1, no interrupt pending, polling continues.
- Bit 1 and 2 - These two bits are used to identify the highest priority interrupt pending as indicated in table E-3.
- Bits 3 through 7 - These bits permanently set to zero.

## Line Control Register

An I/O-request operation to address $C3_{16}$, along with the appropriate write signal, accesses the line-control register of the UART. This register controls the format of the data communications. The format used is one start bit, eight data bits, no parity, and one stop bit. The contents of this register are described as follows:

- Bits 0 and 1 - These two bits specify the number of bits in each transmitted and received serial character. In this application, eight-bit characters are used, and so the both bit 0 and bit 1 must be set to 1.
- Bit 2 - This bit specifies the number of stop bits in each transmitted or received serial character. A single stop bit must be used. If bit 2 = 0, one stop bit is generated.

- Bit 3 - This bit is parity enable bit. Parity must not be used. When bit 3 = 0, no parity bit is generated or checked.

- Bit 4 - This bit is not used. Either a 0 or a 1 may be programmed.

- Bit 5 - This bit is not used. Either a 0 or a 1 may be programmed.

- Bit 6 - This bit is the set break control bit. When bit 6 = 1, the serial output is forced to the spacing (logical 0) state and remains there (until reset by bit 6 = 0), regardless of other transmitter activity.

- Bit 7 - This bit is the divisor latch access bit (DLAB). It must be set high (bit 7 = 1) to access the divisor latches of the baud rate generator during a read or write operation. It must be set low (bit 7 = 0) to access the Receiver Buffer, Transmitter Holding, or Interrupt Enable register.

TABLE E-3. INTERRUPT CONTROL FUNCTIONS

| INTERRUPT IDENTIFICATION REGISTER | | | INTERRUPT SET AND RESET FUNCTION | | | |
|---|---|---|---|---|---|---|
| BIT 2 | BIT 1 | BIT 0 | PRIORITY LEVEL | INTERRUPT FLAG | INTERRUPT SOURCE | INTERRUPT RESET CONTROL |
| 0 | 0 | 1 | - | None | None | - |
| 1 | 1 | 0 | 1st | Receiver Line Status | Overrun Error<br>Parity Error<br>Framing Error<br>Break Int. | Reading the Line Status Register |
| 1 | 0 | 0 | 2nd | Received Data Available | Receiver Data Available | Reading the Receiver Buffer Register |
| 0 | 1 | 0 | 3rd | Transmitter Holding Register Empty | Transmitter Holding Register Empty | Reading the IIR Register (if source of interrupt) or Writing into Transmitter Holding Register |
| 0 | 0 | 0 | 4th | Serial Interface Status | Clear to Send or Data Set Ready or Ring Indicator or Carrier Detect | Reading the Modem Status Register |

## Modem Control Register

An I/O-request operation to address $C4_{16}$, along with the appropriate write signal, accesses the modem-control register of the UART. This register controls the modem interface in the following manner:

- Bit 0 - This bit controls the DTR output of the UART. Setting this bit to a 1 enables the modem to transmit and receive data. All modem transmitting and receiving is terminated when this bit is set to 0. An 0-to-1 transition (inactive to active condition) initiates one of two handshaking sequences depending on whether the terminal is operating in phone call originate or answer mode.

- Bit 1 - Request to Send (RTS) - Not used.

- Bit 2 - Output bit 1 (Out1) - Not used.

- Bit 3 - Output bit 2 (Out2) - Not used.

- Bit 4 - This bit provides a digital loopback feature for diagnostic testing of the UART. When bit 4 is set to logical 1, the Transmitter Serial Output (SOUT) is set to logical 1, the receiver Serial Input (SIN) is disconnected, the output of the Transmitter Shift Register is looped back into the Receiver Shift register input, the four modem control inputs (CTS, DSR, CARDET, and RI) are disconnected, and the four modem control outputs (DTR, RTS, OUT1, and OUT2) are internally connected to the four modem control inputs as follows: CTS = RTS, CARDET = OUT2, DSR = DTR, and RI = OUT1

- Bits 5 through 7 - These bits are permanently set to logical 0.

## Line Status Register

An I/O-request operation to address $C5_{16}$, along with the appropriate read or write signal, accesses the line-status register of the UART. This register provides status information to the terminal processor concerning a data-transfer operation. The contents of this register provide the following status information.

- Bit 0 - This bit is the receiver data-ready (DR) indicator. It is set to a 1 whenever a complete character has been received and transferred to the receiver buffer register. The terminal processor may set this bit to 0 either by writing a 0 to it or by reading the data in the receiver buffer register.

- Bit 1 - This bit is the overrun-error (OE) indicator. Displacement of an unread data character in the receiver buffer register by an incoming character causes this bit to set to a 1 as an indication that data has been lost. This bit is set to a 0 when the terminal processor reads the contents of the line-status register.

- Bit 2 - This bit is the parity-error (PE) indicator. This bit is set to a 1 when a received data character does not have the correct even or odd parity. It sets to a 1 upon detection of a parity error and clears (sets to 0) when the terminal processor reads the line-status register. Parity is not used.

- Bit 3 - This bit is the framing-error (FE) indicator. It sets to 1 to indicate that a received character did not have a valid stop bit; that is, it sets to 1 when the bit following the last data or parity bit has spacing level (0).

- Bit 4 - This bit is the break-interrupt (BI) indicator. It sets to 1 when the received data input is held at a spacing level (0) for longer than a full word transmission time.

NOTE

Bits 1 through 4 are the error conditions that produce a receiver line status interrupt.

- Bit 5 - This bit is the transmitter-holding-register-empty (THRE) indicator. It is set to a 1 to indicate that the UART is ready to accept a new transmit character. In addition when this bit is high, it causes the UART to issue an interrupt to the terminal processor if the THRE interrupt enable bit is high. The THRE bit sets to a logic 1 when a character is transferred from the transmitter holding register into the transmitter shift register. It clears to a logic 0 as the terminal processor loads the holding register.

- Bit 6 - This bit is the transmitter-shift-register-empty (TSRE) indicator. It is set to a 1 whenever the transmitter shift register is idle. It clears to a 0 upon data transfer from holding register to shift register.

- Bit 7 - This bit is permanently set to zero.

## Modem Status Register

An I/O-request operation to address $C6_{16}$, along with the appropriate read signal, accesses the modem-status register of the UART. This register provides status information regarding the current state of the control lines between the modem and the terminal processor. In addition to this information, four bits of the modem-status register provide status change information. Each of these four bits set to a logic 1 whenever its associated control-input signal from the modem changes state. They clear to logical 0 when the terminal processor reads the modem-status register. Following is a brief description of the function of each of the modem-status register bits:

- Bit 0 - This bit is the delta clear-to-send (DCTS) indicators. Bit 0 indicates that the CTS input has changed state since the last time it was read by the terminal processor.

- Bit 1 - This bit is the delta data-set-ready (DDSR) indicator. Bit 1 indicates that the DSR input has changed state since the last time it was read by the terminal processor.

- Bit 2 - This bit is the trailing-edge-of-ring-indicator (TERI) detector. Bit 2 indicates that the RI input has changed from an On (logical 1) to an Off (logical 0) condition.

- Bit 3 - This bit is the delta carrier-detect (DCD) indicator. Bit 3 indicates that the CARDET input has changed state.

NOTE

When bit 0, 1, 2, or 3 is set to a logic 1, a modem-status interrupt is generated.

- Bit 4 - This bit is the clear-to-send (CTS) input. If bit 4 (loop) of the modem-control register (MCR) is set to a 1, this bit is equivalent to RTS in the MCR.

- Bit 5 - This bit is the data-set-ready (DSR) input. The DSR input is wired to CARDET. If bit 4 of the MCR is set to a 1, this bit is equivalent to DTR in the MCR.

- Bit 6 - This bit is the ring-indicator (RI) input. If bit 4 of the MCR is set to a 1, this bit is equivalent to OUT1 in the MCR.

- Bit 7 - This bit is the carrier-detect (CARDET) input. If bit 4 of the MCR is set to a 1, this bit is equivalent to OUT2 of the MCR.

## Divisor Latches

To access the divisor latches, bit 7 of the UART line-control register must have previously been set to 1 (DLAB = 1). Once this has been done, successive I/O-request operations to addresses $C0_{16}$ and $C1_{16}$ enable setting the least significant and most significant divisor latches, respectively. The contents of these latches acts as a divisor for the UART transmit/receive clock generator. The dividend input for the clock generator is a 1.8432 MHz clock pulse. The output of the clock generator must be 16 times the desired transmit/receive rate of the modem, and therefore the divisor setting for the desired 1200 b/s rate of the internal modem is $0060_{16}$. Once the divisor latches of the UART have been properly set, bit 7 of the UART line-control register (the DLAB bit) should be cleared since none of the other UART functions require that this bit be set.

**NOTE**

The following three registers are modem registers that are external to the UART.

## Call Control Register

An I/O-request operation to address $C8_{16}$, along with the appropriate write signal, accesses the call-control register of the modem. This interface control register provides control for the telephone line interface. The contents of this register are indicated in Table E-4 and are described as follows:

- Bit 0 - This bit is the modem off-hook control (-OH). Setting this bit to zero places the modem in an off hook condition and enables communication through the telephone interface. Setting this bit to a one places the modem on-hook. This bit should be initialized to one after power up.

- Bit 1 - This bit is modem Originate/Answer mode control (-OR). Setting this bit to zero places the modem in originate mode, and setting this bit to a one places the modem in answer mode. This state of this bit must be set before DTR is brought high and must remain in the same state for the duration of DTR active.

TABLE E-4. SUMMARY OF MODEM INTERFACE REGISTERS

| | REGISTER ADDRESS | | |
|---|---|---|---|
| | C8 | C9 | CA |
| BIT | CALL CONTROL | DTMF DIAL | CALL STATUS |
| 0 | -Off Hook | -Row 1 | -Call Progress |
| 1 | -Originate | -Row 2 | -Off Hook |
| 2 | -Analog Loopback | -Row 3 | -Originate |
| 3 | X | -Row 4 | -Analog Loopback |
| 4 | X | -Column 1 | 0 |
| 5 | X | -Column 2 | 0 |
| 6 | X | -Column 3 | 0 |
| 7 | X | X | 0 |

- Bit 2 - This bit is the modem Analog Loopback control (-LL). If -LL is active (low) at the time DTR goes high, the normal telephone interface handshake sequence is disabled. Instead the transmitter and receiver do the following:

  1. The transmitter sends Marking data.

  2. The transmitter reacts as follows depending on the state of the -OR

     a. If -OR is high, the transmitter becomes the answer unit and the receiver becomes the Originate Unit with corresponding carrier frequency of 2400 Hz.

     b. If -OR is low, the transmitter becomes the originate unit and the receiver becomes the answer unit with corresponding carrier frequency of 1200 Hz.

  3. Carrier-detect detects carrier and becomes active within 270 $\pm$40 ms; CTS becomes active at which time the terminal processor sends and receives test data.

  4. All modem transmission and receiving is terminated when DTR is brought low.

- Bit 3 through Bit 7 - Not used.

## DTMF Dial Register

NOTE

Using the following register for its intended purpose is only possible on communications lines supporting tone-dial operation.

An I/O-request operation to address $C9_{16}$, along with the appropriate write signal, accesses the DTMF-dial register of the modem. This register provides control for the dual-tone multi-frequency (DTMF) tones to the telephone interface. Each tone is individually enabled by setting its control bit to a zero. Setting a control bit to a one disables its associated tone. After powering on the terminal, this register should be set to all 1's ($FF_{16}$). The contents of this register are indicated in table E-4 and are described as follows:

- Bit 0 - Row 1 697 Hz
- Bit 1 - Row 2 770 Hz
- Bit 2 - Row 3 852 Hz
- Bit 3 - Row 4 941 Hz
- Bit 4 - Column 1 1209 Hz
- Bit 5 - Column 2 1336 Hz
- Bit 6 - Column 3 1477 Hz
- Bit 7 - Not used.

## Call Status Register

An I/O-request operation to address $CA_{16}$, along with the appropriate read signal, accesses the call-status register of the modem. This interface control register is used to input the status of the telephone line interface. The contents of this register are indicated in figure E-4, and each bit is briefly described as follows:

- Bit 0 - This bit is the modem call-progress status bit (-CP). A low level on this bit indicates that the telephone line is currently receiving a busy signal, a dial tone, or an outgoing ringing signal. This bit is not latched, and timed samples must be taken to determine exact status.

- Bit 1 - This bit is a copy of the off-hook control bit (-OH), which is bit 0 of the call-control register.

- Bit 2 - This bit is a copy of the originate/answer-mode control bit (-OR), which is bit 1 of the call-control register.

- Bit 3 - This bit is a copy of the analog-loopback control bit (-LL), which is bit 2 of the call-control register.

- Bit 4 - Zero.

- Bit 5 - Zero.

- Bit 6 - Zero.

- Bit 7 - Zero.

COMMENT SHEET

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