REFERENCE MANUAL

ASYNCHRONOUS COMMUNICATIONS ADAPTER (ACA)

SYSTEM TEN COMPUTER BY SINGER

SINGER
BUSINESS MACHINES

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PREFACE

This manual describes the Asynchronous Communication Adapter (ACA) used with a Model 20 Processor of the System Ten* computer and various communication Modulator/Demodulators (Modems) for telecommunication. Included in the manual are descriptions of the adapter operation, software instructions, and programming information.

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INTRODUCTION

The Asynchronous Communications Adapter (ACA) manufactured by Singer Business Machines provides an interface between the Model 20 Processor and the general class of modulator/demodulators (modems) which conform to the following description:

1. Interface conforms to the requirements of Electronic Industries Association specifications EIA RS-232-B and RS-232-C and/or Comite Consultatif International Telegraphique et Telephonique specification CCITT V 24.
2. Data transmission mode is asynchronous (start/stop).
3. Data transmission rate is software-selectable at 150, 300, 600, 1200, and 1800 bits per second.
4. Character length is 10 bits at various bit rates.
5. Character set is 64-character subset of ASCII code.
6. Character format is Start bit, seven data bits, odd or even parity bit, and one Stop bit.
7. Bit sequence is least significant bit first.

In the United States, The ACA enables the Model 20 Processor to communicate with remotely located peripheral equipment through Bell System Series 202 (or equivalent) modems. In other countries, similar modems approved by the country in which The ACA is located are used for communication with remote terminals. The term 'modems' when used in other parts of this manual, will be understood to refer to data sets which conform to these specifications. Communications are conducted over direct-connected leased lines or dial telephone lines connecting other ACA's, Individual Store and Forward (ISF) units, or other remote peripheral devices to the processor. Using the ACA, the Model 20 Processor may transmit and receive data at a selectable rate of 150, 300, 600, 1200, or 1800 bits per second. If dialed calls are to be originated by the Model 20 Processor, an optional dial-out printed circuit card (CH 7) is available for use with an Automatic Calling Unit (Bell System Series 801A or 801C, for example). The ACA can, however, answer incoming calls from dial system lines without requiring the dial-out option. An ACA without dial-out capability can be used for manually dialed calls.

The ACA is specifically designed to be compatible with three system configurations shown in Figure 1.

In the Individual Store and Forward (ISF) configuration, the ACA, CH 7 card and an Automatic Calling Unit are used to collect point of sale information from remote terminals. ISF station numbers are individually dialed through the Automatic Calling

Unit. After completing the connection, the ISF transmits accumulated data to the ACA. In this application, the ACA operates in a receive-only, simplex mode,except for reverse (back) channel control signals, also called Supervisory channel signals.

In the switched line application, the ACA is shown in a half duplex configuration using general ASCII communication procedures. Line control, error control, and data messages are transmitted over the switched data channel as control character and data character sequences combined in any given message. In this application the ACA can automatically answer incoming calls. To prevent premature termination of any call due to line noise or data error, telephone connections are terminated only by software command.

In the leased line configuration, the ACA is shown in half duplex mode, using either point-to-point or multi-point centralized ASCII communication procedures.

When used in point-to-point communication, either station may initially have control (master) status, using software administration of contention problems.

In a multi-point centralized configuration, the ACA may be used either as a control (master) or tributary (slave) station. Data transfer is initiated by the control station which addresses associated tributary stations.

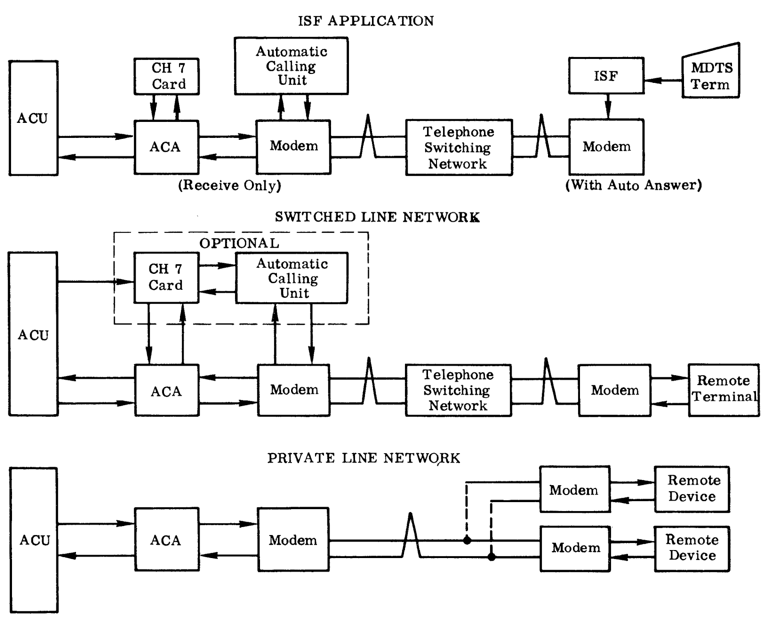

Figure 1 ACA System Applications

1 GENERAL DESCRIPTION

PHYSICAL DESCRIPTION

The Asynchronous Communication Adapter (ACA) consists of three printed circuit cards, designated AC1, AC2, and AC4. The optional dial-out card used with the ACA is designated CH7. AC1 and AC2 must occupy one input/output position in the Model 20 Processor and are always placed as a pair. The partition designator number for the Asynchronous Communication Adapter is determined by the position of the AC1 card. Memory partitions and input/output channel (IOC) configurations of the System Ten Model 20 Processor are described in Singer Publication 40-330.

OPERATIONAL CHARACTERISTICS

ACA operation is fully automatic, without manual controls. The unit responds to normal processor machine instructions, and does not require any special operating procedures for the ACA itself.

Operating Modes

The ACA has four general modes of operation: start idle, transmit, and receive, as shown in Figure 2.

Start

When power is turned on, the ACA is in the start mode, and remains in the start mode until the processor executes a WRITE CONTROL command for initialization. Any previously set operating parameters, such as bit rate (speed), odd or even parity, or ISF mode are cancelled and new parameters for current operation are established. Unless the ACA is properly initialized, all input/output instructions are terminated with FLAG status. Initialization puts the ACA into Idle mode.

Idle

In the Idle mode the ACA accepts all input/output instructions, keeps track of the number of control characters to be transferred, and branches to Transmit or Receive mode in accordance with current instructions. If a RING indication is received from the modem while the ACA is in the Idle mode, the ACA notifies the processor by setting a Service Request signal.

Transmit

In the transmit mode, the ACA obtains characters, one at a time, from the processor core memory, formats each character into a control or data character, adds the required START-STOP, and parity bits, then serially shifts each character to the modem (data set).

Receive

In the receive mode, the ACA detects incoming START bits, samples the data bits at the selected speed, processes all control characters as required, and shifts the data bits to a data register. The ACA then transfers each data character to the storage buffer established in core memory. ACA remains in Receive mode until a terminating character is received, a malfunction is detected, or a 14-second timeout occurs. (In the event of a 14-second timeout, a new READ or READ CONTROL command may be issued by the program to re-establish the receive mode.)

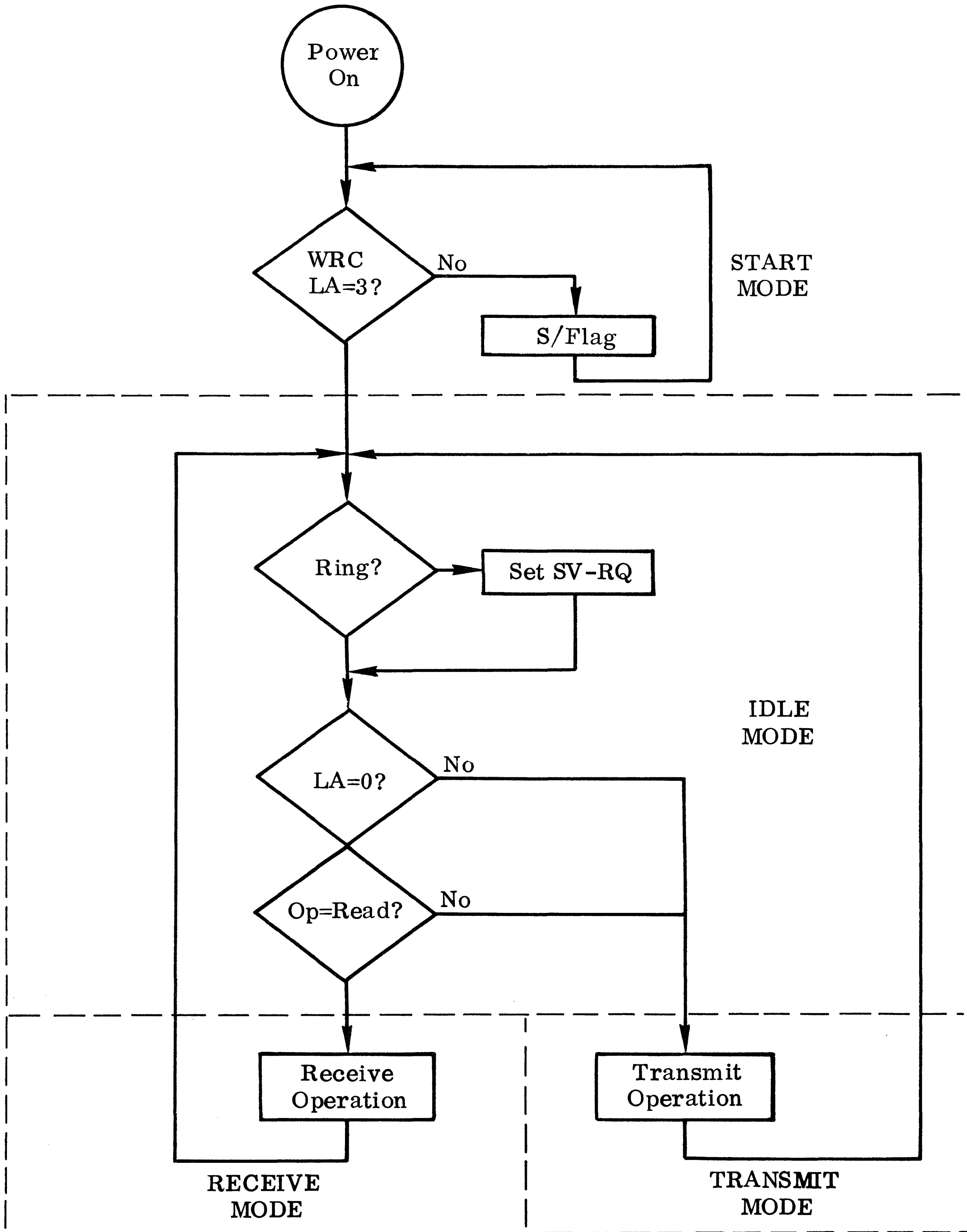

Figure 2 Simplified Diagram of Operating Modes

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2 DIAL OPERATIONS

When the ACA is used with modems in a switched line configuration, remote stations may be called by manual dialing, or by automatic dialing through a CH7 board and an Automatic Calling Unit (such as Bell System Series 801A or 801C).

Manual Dialing

In manual dialing, the program initializes the ACA before the operator dials the desired number. The operator stops the program, dials the number, and upon hearing the answer tone, presses the DATA button on the modem. The operator then allows the program to continue. Under normal program control, the ACA is executing a READ or READ CONTROL instruction before data is received.

Automatic Dialing

Automatic dialing is initiated by a WRITE CONTROL instruction with a device number (LA) of 1. The dialing digits are called from memory in the normal interrupt manner and the instruction is ended when the processor sets a LAST condition as the last digit is transferred through the CH7 card to the Automatic Calling Unit. Dialing can also be terminated by the Automatic Calling Unit because of some excessive delay in the dialing procedure. An Automatic Calling Unit timeout gives the ACA an Abandon Call and Retry (ACR) signal, resulting in ERROR status. The number is redialed by command of the software program (not an automatic procedure). ASCII communication standards require that the calling station transmit first, except when calling an ISF. Upon completing the dialing operation, therefore, the ACA should receive and commence execution of a READ or WRITE instruction. The Automatic Calling Unit terminates the WRITE CONTROL dialing instruction, and returns control to the program at the end of the answer tone. By returning control to the program at the end of the answer tone, the probability of telephone line noise and switching noise entering the ACA while it is in a READ instruction is greatly reduced. Because of normal operating time of the modem, there is enough time between the end of the answer tone and the readiness of the modems to handle data for the instruction to become active. Other timing options are available, however.

Automatic Dial Options

The Automatic Calling Unit may be required to transfer control to the program at the end of the dial number, or at the beginning of the answer tone.

End of Number Option

This option may be requested by the customer. In operation the following criteria apply:

1. The WRITE CONTROL instruction supplies digits to the Automatic Calling Unit in which 'L' is the last digit. The dial number may or may not include the area code; examples are:

   3535480L|XXXXXXXXXXXX
   4153535480L|XXXXXXXXX

   where X is any number

2. The WRITE CONTROL instruction is released just as the dialing is complete.

NOTE: If the program next goes into a READ instruction, there is a great probability that noise will be received in the ACA.

Beginning of Answer Tone Option

This option may be requested by the customer. In operation, the following criteria apply:

1. The dial number transferred to the Automatic Calling Unit during execution of the WRITE CONTROL instruction must have the exact number of digits to be dialed; for example:

   3535480 (no others) or
   4153535480 (no others)

2. The WRITE CONTROL instruction is released just as the answer tone is detected.

NOTE: If the program next goes into a READ instruction, there is a probability that noise will be received by the ACA. Noise may be reduced by delaying the first READ instruction by 3-1/2 seconds, but by no greater time than 4-1/2 seconds.

Telephone Hang Up Function

The ACA does not automatically hang up when an instruction ends, either normally or in bad status. A separate software instruction (WRITE CONTROL, LA=2) is required to tell the ACA to terminate a call, and disconnect.

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3 OPERATION IN ISF MODE

INTRODUCTION

While most ACA functions are common to both ISF and non-ISF operations, there are several special functions unique to the ISF mode; this mode is therefore described as a separate configuration. For all functions, the ACA must first be initialized, as described in the Program Information section of this manual. When initializing in the ISF mode, bit speed and parity must also be set. Although various functions of the Singer Model 800 Individual Store and Forward (ISF) are mentioned as they affect the operation of the ACA, a detailed description of the ISF logic and operation is not included in this manual. For ISF information, refer to the ISF Reference Manual, Singer Publication 40-118.

TIMEOUT PERIODS

In the ISF mode, the ACA provides two timeout periods; (1) a 4-1/2 character-time period of approximately 37-1/2 milliseconds, and (2) a 14-second time period. If, during an active READ instruction, one or more characters are received and then 4-1/2 character-times pass without any characters being received, the ACA times out, ending the READ instruction. If an ERROR condition exists, as for example no ETB, ETX, or EOT as the last character of the message, or less than eight characters received, a Transmission Status Character (TSC) is prepared and transferred to the Model 20 Processor. After a 4-1/2 character-time timeout, another READ instruction may be initiated by the program. The timer is reset each time a character is transferred to the processor memory.

The 4-1/2 character-time timeout allows the ACA to recognize inter-record gaps(IRG) in data transmissions from the ISF. When an inter-record gap occurs in the ISF tape (250 ms. time period), the System Ten processor continues to service other partitions in the system in sequence. At the end of the IRG, if the Service Request raised by the ACA has not been answered by the time the second character after the IRG is received, the ACA drops the reverse channel to the ISF and sets ERROR status. When the reverse channel is dropped, the ISF rewinds to the start of the current record and waits.

The 14-second time period allows the ACA to reamin in a receive mode during the time required for the ISF to start transmitting data, which may require up to 32 seconds. After each successive timeout, another READ instruction is initiated by the program a planned number of times, (generally five or more). If no data is received during the repeated READ instructions, the program terminates the connection with a disconnect instruction (WRITE CONTROL, LA=2).

OPERATION IN ISF MODE

MANUAL DIALING IN ISF MODE

In the ISF mode, manual dialing starts by initializing the ACA:

1. Program initializes the ACA and stops (initialization turns OFF the reverse -- back -- channel).
2. Operator dials the number and upon hearing the answer tone, presses the DATA button on the modem.
3. Pressing the DATA button allows the program to resume.
4. The program issues a READ instruction which turns on the reverse (back) channel.

NOTE: It is important that the READ instruction is issued before the ISF has a chance to time out (800 milliseconds).

AUTOMATIC DIALING IN ISF MODE

When automatic dialing is used in the ISF mode, the following sequence of events occurs:

1. The program initializes the ACA (WRITE CONTROL, LA=3).
2. The program issues a dial instruction (WRITE CONTROL, LA=1).
3. Upon successful completion of the dialing operation, the program issues a READ instruction which turns on the reverse (back) channel.
4. The ACA is executing a READ instruction before a Start of Heading (SOH) is transmitted by the ISF.

When the ISF modem is called, either by the Automatic Calling Unit or by manual dialing, and control is returned to the program, the ACA should immediately start executing a valid READ instruction. A valid READ instruction in the ISF mode is one in which the LA field is zero. When the READ instruction becomes active, the ACA turns on the Supervisory (reverse) channel, required for ISF operation.

TRANSMISSION STATUS CHARACTER

Any error occurring while the ACA is in the ISF mode causes the ACA to generate a Transmission Status Character (TSC). This is an extra 6-bit character transferred to the processor memory immediately following, and as part of, the message in error. The TSC describes the error conditions encountered while receiving the data. The meaning of each bit in the TSC character is described in Table 1. The meaning of various bit combinations explained in Table 2.

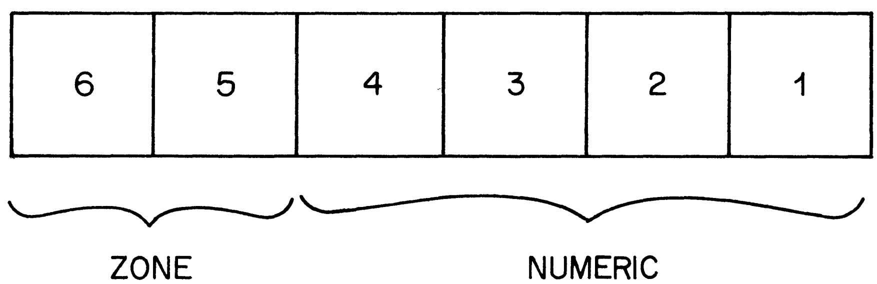


Figure 3 Transmission Status Character

Table 1 Interpreting the Transmission Status Character

Bit 1 Message Indicator (normally ON)

0 A legitimate message has not arrived, but a few characters, (less than eight) have been received. (This condition is true provided that Bit 6 is OFF.)

1 A message of proper length (eight or more characters). has been received.

Bit 2 Data Set Error Indicator (normally OFF)

0 The data set (modem) was operating properly during the message.

1 The Carrier On (CO) or Data Set Ready (DSR) lines dropped, indicating a data set error. (Noisy lines upon dial-up will cause this condition, and may be normal.)

Bit 3 Ending Indicator (normally ON)

0 A message was received but no ending character (ETB, ETX, or EOT) was included at the end of the message.

1 The ending character was present.

Bit 4 Parity Error Indicator (normally OFF)

0 The data had good parity, good START bits and good STOP bits.

1 One or more characters in the data stream had any or all of the following errors:

Parity Error
Wrong START Bit
Wrong STOP Bit

Bit 5 Character Overrun Indicator (normally OFF)

0 All characters received were transferred to the processor.

1 One or more characters were lost because the processor interrupt time was too slow. (This error is extremely serious.)

Bit 6 Record Overrun (Lockout) Indicator (normally off)

0 The programmer's READ instruction preceded data arrival.

1 The programmer's READ instruction arrived late, resulting in loss of data. Automatic retry is executed provided the data consists of eight or more characters, and provided also that the instruction is a READ, not a READ CONTROL.

Note: Bit 6 of the TSC is the dominant bit whenever it is ON (1), indicating a data lockout condition. When Bit 6 is 1 (ON), the condition of the other bits in the character is undefined.

The individual bit indicators in the transmission status character are not mutually exclusive. However, there is a logical precedence that dictates the order of testing the individual bits. TSC(6), the message overrun indicator, pre-empts all other indicators and, therefore, has the highest testing precedence. TSC(1), the short message indicator, is next in precedence. TSC(2,3,4,&5) have no logical precedence, therefor, should be tested in order of probability of occurrence, TSC(4)--parity, TSC(5)--character overrun, TSC(3)--no ending, and finally TSC(2)--data set error.

Table 2 Error Combinations

BIT CONSIDERED	COMBINATIONS 654321	AUTOMATIC REVERSE CHANNEL	PROBABLE CAUSE/COMMENTS
1	0XXXX0	NO	NOISE, OR GOOD SOH
MESSAGE INDICATOR	100000	UNCERTAIN - HOWEVER ALL LEGITIMATE MESSAGES WILL BE RETRIED	PROGRAM TIMING RANDOM NOISE SYSTEM TIMING ISF LEADER VARIATIONS OVERLOADED SYSTEM
2	0XXX10	NO	NOISE, OR BAD SOH
DATA SET ERROR	0XXX11	YES	BAD MESSAGE
3	0XX1X0	NO	ACA WILL NEVER GENERATE THIS COMBINATION
	0XX0X0	NO	NOISE, OR GOOD SOH
ENDING INDICATOR	0XX0X1	YES	MISSING ENDING CHARACTER
4	0X1XX0	NO	NOISE, OR BAD SOH
PARITY ERROR	0X1XX1	YES	BAD MESSAGE
5	01XXX0	NO	NOISE, OR SOH, BUT SYSTEM IS OVERLOADED!
CHARACTER OVERRUN	01XXX1	YES	SYSTEM OVERLOADED, NOTIFY FIELD SYSTEMS ENGINEER
6 RECORD OVERRUN (LOCKOUT)	100000	UNCERTAIN - HOWEVER ALL LEGITIMATE MESSAGES WILL BE RETRIED	PROGRAM TIMING RANDOM NOISE SYSTEM TIMING ISF LEADER VARIATIONS OVERLOADED SYSTEM
	1XXXXX	(SAME)	SAME AS ABOVE, IGNORE X BITS

REVERSE (BACK) CHANNEL COMMUNICATION

The reverse (back) channel provides a means of simultaneous communication from the ACA to the ISF, to facilitate certain forms of error correction (retransmission) functions. Signals are sent from the ACA to the modem as dc voltage levels, transported over the telephone lines as a 387 cps tone, and applied to the ISF as restored dc voltage levels.

The Supervisory voltage signal is a separate signal applied to the modem, similar to other contral signals such as Data Set Ready (DSR) or Data Terminal Ready (DTR) signals. The modem used with the ISF must be able to receive reverse channel signals, but is not required to send any signals.

RECEIVING DATA FROM ISF

If the ISF activity counter is not at zero when the unit is called, indicating that it has data to be transmitted, the ISF responds to a call with a hardware-generated Start Of Heading (SOH) character. The ISF then starts the tape and performs various internal functions that may require four or five seconds, but can be as long as 32 seconds, before transmitting recorded data.

If the ISF activity counter is at zero, indicating that the ISF has no data to be transmitted, a string of EOT signals are transmitted to the ACA. (The EOT signals are remapped into Ds by the ACA.)

Start of Heading (SOH) Signal

The Start of Heading (SOH) signal indicates that a proper connection has been made with the ISF and that data is available. Absence of the SOH could indicate a noisy telephone line, a malfunction in the ISF, or a malfunction in the ACA. An SOH signal, converted into an A by the ACA, results in an error condition because only one character is received; 4-1/2 character-times later (approximately 37-1/2 milliseconds), the ACA times out, ending the READ instruction with an ERROR status. Bit 1 of the TSC is off, indicating a short message (less than eight characters). Because only one character was received, automatic retry logic is not activated. The telephone connection and ACA initialization are not lost when the timeout occurs, and another READ instruction should be immediately initiated by the program.

With no data coming in while the ISF prepares to transmit, and while the tape leader is passing over the ISF read head, another timeout will occur after each 14-second time period. The read instruction is re-established by the program after each timeout, for a system-planned number of repetitions (at least five or more). At some time between reception of SOH and the last programmed READ instruction repetition, the data should be received.

OPERATION IN ISF MODE

EOT Signals

Multiple EOT signals received when an ISF is called indicate that the ISF has no data to send (activity counter is at zero). The EOT signals result in a FLAG status (code condition 3) corresponding to the received data exceeding the memory capacity specified in the READ instruction. The program should verify that at least four of the first five characters received are EOTs, then issue a disconnect instruction (WRITE CONTROL, LA=2) and terminate data handling with that ISF.

Multiple EOT signals received after data has been received from an ISF indicate that all the data recorded on the ISF tape has been transmitted (activity counter has returned to a count of zero).

Receiving Data

Data from the ISF is received in blocks, separated by inter-record gaps (302 milliseconds) or by large gaps (9 seconds) corresponding to end of day leaders and the tape splice. The normal size of the data storage area for ISF data blocks, as specified by the B field in a READ instruction, should be about 250 characters since the maximum ISF data block has 226 characters. Because the ISF is a unique device with a specialized format, READ instructions in the ISF mode are not terminated by an ASCII ending code, but by either a 4-1/2 character-time timeout following the end of a data block, or a 14-second timeout occurring when no data is received, or by multiple EOTs filling the data storage area. If, EOT, ETB, or ETX is not received as the last character in a message, however, the fact is recorded as an error and reported by a zero as Bit 3 of the Transmission Status Character.

When called, an ISF with data transmits an SOH, then starts the tape. During the time required to start the tape and pass the first leader over the ISF read head the ACA may time out several times. After each time out, the ACA receives another READ instruction from the program. While the ISF is transmitting, the ACA times out at each inter-record gap and each end-of-day leader; after each timeout another READ instruction is initiated by the program. Upon completing transmission of all its data, the ISF sends a string of EOTs which fill the designated data storage area in the processor, thereby terminating the last READ instruction.

Data From Multiple ISF Configurations

Multiple ISF units can be connected in series to transmit data through one modem. In this configuration, the ISF connected directly to the modem is called the master and the other ISFs are called slaves. During data transmission, the master transmits all of its data until its activity counter is zero, then transfers control to the first slave in the series. If the activity counter is in the master is zero when called by the remote computer, control is passed immediately to the first slave. EOTs are not transmitted in this case. Each slave transmits its data until its activity counter reaches zero, then passes control to the next slave in the series. At the end of the entire transmission, the last ISF sends the EOTs to the remote computer. Each ISF with data transmits an SOH signal, then starts the tape and locates its data blocks. There is the usual four of five seconds of delay (which can extend to more than 32 seconds) during which the ACA, having received data from the previous unit, times out after 4-1/2 character-times without data. When the ACA times out, it receives another READ instruction from the program and is ready to accept data from the ISF that is just getting started.

AUTOMATIC ERROR CORRECTION

An error occurring during an ISF READ operation causes the voltage level of the Supervisory lead to be lowered for 300 milliseconds at the end of the instruction, thereby turning the reverse channel off for that period of time. This instructs the ISF to rewind the tape to the last inter-record gap and repeat the data message from that point. Automatic operation of the Supervisory lead suspends execution of another ISF READ instruction for the duration of the 300 millisecond period. The ACA drops the voltage to the reverse channel whenever either of the following conditions occur:

1. A transmission greater than eight start bits is received after the program READ instruction became active, but an ERROR status (of any nature) exists when the READ instruction ends.

2. A transmission greater than eight start bits is received but the transmission started before the program READ instruction became active (Record Overrun).

The first condition (number 1 above) causing automatic error correction procedures in the ACA may be due to a lack of a START or STOP bit in a character, or a parity bit error, or reception of the end of a message without an ending character (ETB†ETX† or EOT).

The second condition (number 2 above) is termed a Record Overrun, causing bit 6 of the TSC to be set (1). This error can occur in the following manner. In ISF mode, the ACA continually monitors the modem Receive Data (RD) line, even without an active READ instruction. If data is received before a READ instruction, the ACA stores the first bit, and goes into a lockout condition until the transmission is completed. The first character received is then passed to the processor along with a TSC indicating the malfunction. The READ instruction is terminated in an ERROR status and the automatic reverse channel signal is sent to the ISF to retransmit the message. A Record Overrun is quite common, and could be due to any of the following normal events:

1. Random noise received by the ACA before the programmed READ instruction becomes active.

2. The ACA times out between ISF leaders, just before the ISF continues sending data.

3. Noisy lines after a dial-up operation.

4. Unforeseen program delays, for example, printer top of form delay, or partition switching delays.

When an error status occurs during execution of a READ operation in the ISF mode, the automatic reverse channel signal is sent to the ISF. The ISF rewinds the tape to the last inter-record gap and repeats the portion of the message containing the error. If the error is repeated, the whole cycle of rewind and retransmit is repeated. After a programmed number of repetitions, it is assumed that this is an error actually recorded on the tape and not something due to transmission noise. Such errors are termed 'hard' errors. To avoid further repetitions and to save the data, the software issues a READ CONTROL, LA=0 instruction. This instruction is the same as a READ instruction except that the automatic reverse channel signal is inhibited. The READ CONTROL instruction is used to accept messages which contain hard errors. The data message is accepted and stored in the processor memory where future processing may eliminate the error. Although the automatic reverse channel signal is inhibited, the Transmission Status Character is sent to the processor, as in a READ operation.

Parity Error Indications

The ISF operates with even parity for each character. If a parity error is detected by the ACA, the character in error is transferred to the processor as '^' (circumflex), and a Transmission Status Character is generated to indicate the parity error. The ERROR status causes an automatic reverse channel signal and the transmission is repeated.

4 PROGRAMMING INFORMATION

COMMUNICATING WITH THE ACA

The ACA is operated with standard System Ten computer machine instructions: READ, READ CONTROL, WRITE, and WRITE CONTROL.

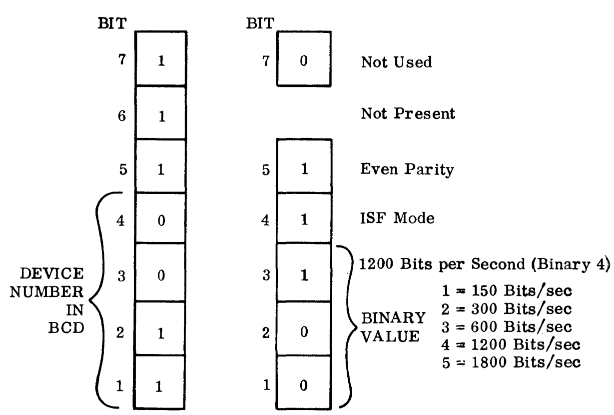
INITIALIZATION

After any power-down, power-up sequence, power failure, or after a system or input/output reset, the ACA requires initializing to set the parity (odd or even), bit speed, and operating mode (ISF or non-ISF). Initialization must precede any other instruction, and should also be repeated before every telephone dialing instruction. Parameters set by initialization remain in force throughot all following instructions until a new initialization is made, or until initialization is lost because of unusual line noise, power failure, or reset.

Initialization consists of a WRITE CONTROL instruction (WRITE CONTROL, LA=3) followed by an initializing character taken from memory. The initializing character, as shown in Figure 4, sets the bit rate, parity, and operating mode.

NOTE: When initializing for ISF operation (receiving) the bit rate and parity must set, as well as the ISF mode (Figure 4). Proper initializing for ISF operation is a WRITE CONTROL, LA=3 instruction followed by a < symbol (less than).

Since the System Ten computer may have just powered up when initialization is first attempted it is possible to get a FAULT condition on the first attempt. It is good practice, therefore, to repeat initialization twice. If an instruction other than WRITE CONTROL, LA = 3 is given to the ACA before proper initialization, the instruction will be terminated and FLAG status (condition code 3) will be posted.



ISF Initializing Character ( )

Figure 4 Initialization Character

PROGRAMMING INFORMATION

ACA INSTRUCTIONS

Any System Ten computer input/output instruction can be executed by the ACA following proper initialization, provided the parameters of the instruction are compatible with the bit rate, parity, and ISF, non-ISF mode specified by the initialization instruction. The binary value of the device number (LA field) used in READ, READ CONTROL, and WRITE instructions is interpreted by the ACA as the number of control characters to be transmitted to the remote device. (In the ISF mode, the LA field of READ and READ CONTROL instructions must be zero.) The ACA activates an OUT REQuest line to the processor which forces a temporary WRITE condition in the processor logic, thereby enabling the ACA to retrieve the required control characters from memory. The ACA converts each character into control character format, adds the START and STOP bits, generates the required odd even parity, and tranmits each control character to the modem. Transmission is in accordance with ASCII rules of communication. When the specified number of control characters have been transmitted, the OUT REQuest line is returned to normal and the rest of the instruction is executed in the usual way.

READ and READ CONTROL Instruction

READ and READ CONTROL instructions executed by the ACA cause it to transmit any required control characters, then start accepting input characters from the modem, moving data from a remote device to sequential locations in the processor memory.

READ and READ CONTROL operations are normally terminated by receipt of a terminator control character. If an ACA READ operation is terminated by exhausting the count (B field) of the READ instruction, then the Error Condition Indicator (condition code 1) in the central processor is set ON. Any further character transfers attempted by the ACA result in FLAG status (condition code 3). FLAG status disables all other status indications and, when it occurs, will be the only status indication posted, even though other errors may be detected.

When a block of data has been received, a Block Check Character (BCC) is generated in the ACA. BCC is a longitudinal redundancy check character which is compared with the received redundancy check character. If the comparison shows that no error exists, the BCC is stored with the data in memory.

When executing a READ or READ CONTROL instruction, the program maps out a section of memory to include storage for any control characters required, storage for the data to be received, and storage for the BCC. To avoid exhausting the count of the READ instruction, every ACA READ instruction should normally specify storage for more data characters than are actually expected, as shown in Figure 5, a simplified diagram of a READ instruction storage area. In the diagram a message of five characters, including starting and ending characters, is expected.

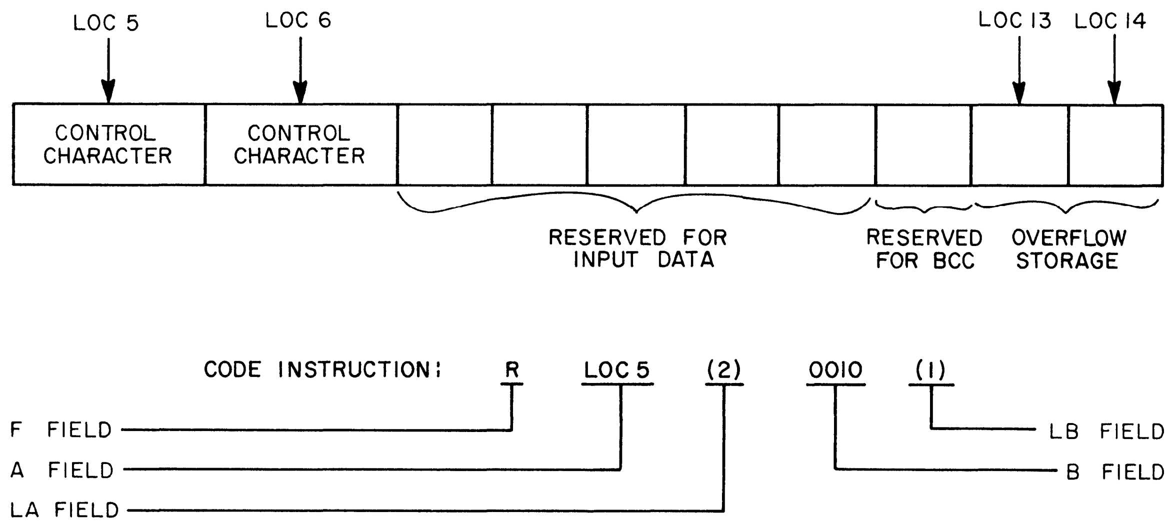


Figure 5 Simplified Diagram of READ Instruction Storage Area

NOTE: LB = 1 indicates a normal READ instruction, not a READ CONTROL.

In the figure, the beginning address of the storage area (LOC 5) is indicated by the A field of the instruction, and the length of the storage area (10 characters) is specified in the B field. This storage area is used in the following manner:

1. Two control characters are stored in LOC5 and LOC6 by the program. These control characters are retrieved and transmitted by the ACA at the start of the READ operation.

2. One storage space is reserved for the BCC.

3. Although only five characters are expected in the message, a maximum of seven data characters can be read by the instruction.
   - if six characters are received, the BCC will be placed in LOC 13
   - if seven characters are received, the BCC will be placed in LOC 14
   - if more than seven characters are received, the eighth character will be placed in LOC 14. The instruction will be terminated and the error condition Indicator (condition code 1) will be set ON.

Normal READ and READ CONTROL instructions are ended by receiving one of the ASCII ending codes, such as ETB, ETX, ENQ, ACK, NAK, EOT, or DLE with one character (0,1,?,;) following. A READ instruction which is terminated without one of these ending characters will cause FLAG status. (A READ instruction is terminated without an ending character when received data exceeds the storage area established by the program.)

A READ or READ CONTROL instruction will remain active in the receive mode for about ten seconds without data. After fourteen seconds without receiving data, the ACA times out and posts FAULT status (condition code 4). The instruction is ended. While receiving data, the 14-second timer is restarted each time a character is transferred to memory.

The fields of an ACA READ instruction are as follows:

F	=	0000
LA	=	0 thru 9 (Number of leading control characters). This field must be zero in the ISF mode.
LB	=	1 or 5
A	=	memory address of start of input data storage area
B	=	maximum number of characters to be transferred, including initial control characters. B must be at least one greater than the combined count of LA plus expected number of received characters in order to obtain good status at the end of the instruction
AC	=	designator that A address is in the common area
BC	=	not used
1A,1B	=	index control for A and B

CONDITION CODE DIAGNOSTICS:

ERROR (condition code 1)	no start bit detected; no stop bit detected; parity error; longitudinal redundancy check error; instruction terminated by Record Overrun.
FLAG (condition code 3)	ACA not initialized; instruction terminated by LAST condition.
FAULT (condition code 4)	Instruction terminated by ACA time out.

The READ CONTROL instruction is used in ISF mode to accept a message containing a hard (uncorrectable) error (see Operation in ISF Mode). In the non ISF mode, a READ CONTROL instruction is used to identify data received from slave stations in a multi-point centralized private line configuration. For this function, the number of control characters specified by LA are transferred from memory to the ACA, but the first character, called the station identifier code, is stored in the ACA while the remaining (LA − 1) characters are transmitted to the local modem. Following this initial transmission, the ACA goes into a special receive mode in which it must match the first character received with the station identifier code stored in the ACA before it will accept further data from the modem. The operation continues until a terminating character is received or until a timeout occurs.

The fields of an ACA READ CONTROL instruction are as follows:

F	=	0000
LA	=	0 This field must be zero in ISF mode.
LA	=	1 thru 9 (Number of leading control characters, including a station identifier code to be stored in the ACA)
LB	=	3
A	=	memory address of start of input data storage area
B	=	maximum number of characters involved in the instruction (local station identifier code, transmitted characters, and received characters).
AC	=	designator for A address in common area
BC	=	not used
1A,1B	=	index control of A and B

CONDITION CODE DIAGNOSTICS:	
ERROR (condition code 1)	no start bit detected; no stop bit detected; parity error; longitudinal redundancy check error; instruction terminated by Record Overrun.
FLAG (condition code 3)	ACA not initialized or operation terminated by setting LAST condition
FAULT (condition code 4)	Instruction terminated by ACA time out

WRITE and WRITE CONTROL Instructions

A WRITE instruction causes the ACA to transmit characters until the instruction is terminated by the System Ten computer processor. The ACA interprets the LA field of the instruction as specifying the number of initial characters that are to be transmitted as control characters.

The fields of an ACA WRITE instruction are as follows:

F	=	0001
LA	=	0 thru 9 (Number of control characters to be transmitted)
LB	=	1
A	=	memory address of start of record to be transmitted
B	=	number of characters to be transmitted
AC	=	designator for A address in common area
BC	=	not used
1A,1B	=	index control for A and B

CONDITION CODE DIAGNOSTICS:

ERROR (condition code 1)	Not used
FLAG (condition code 3)	ACA not initialized.
FAULT (condition code 4)	Time out due to modem not functioning or power failure.

While executing a WRITE instruction, the ACA generates odd or even parity (software selected) for each character, and develops a longitudinal redundancy check (BCC) character which is transmitted at the end of the message block.

A WRITE CONTROL instruction is used to initialize the ACA. The instruction is followed by a character from memory which establishes bit rate, odd or even parity, and normal or ISF mode. WRITE CONTROL instructions are also used to establish a DIAL OUT operation and a HANG UP operation.

The fields of an ACA WRITE CONTROL instruction are as follows:

F	=	0001
LA	=	1 DIAL OUT sequence. Data characters in the instruction are the dial digits
LA	=	2 HANG UP sequence
LA	=	3 Required instruction to initialize the ACA before any other operation can take place
LA	=	4 through 9 not used
LB	=	3
A	=	memory address of record (used for dial out digits and for initialization character).
B	=	number of characters in record. Always equal to 1 for initialization
AC	=	designated for address in common area
1A,1B	=	index control for A and B

CONDITION CODE
DIAGNOSTICS:

ERROR	Set by Abandon Call and Retry (ACR) signal during dial out operation
FLAG	Set if ACA has not been initialized, or if an incoming call occurs during a dial out operation
FAULT	Timeout during a dial out operation caused by an inoperative modem or inoperative Automatic Calling Unit.

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