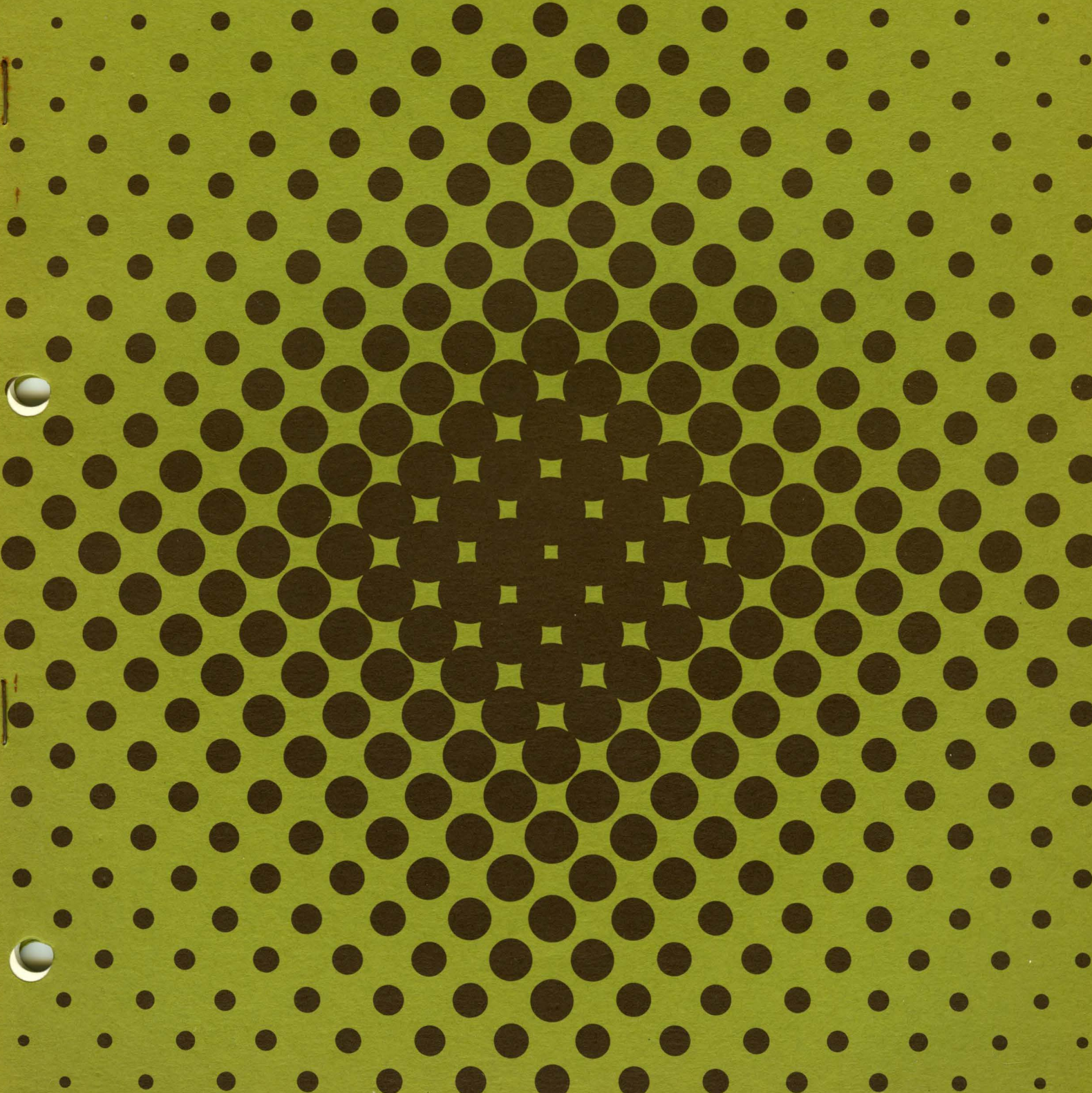


# SYSTEM TEN BY SINGER

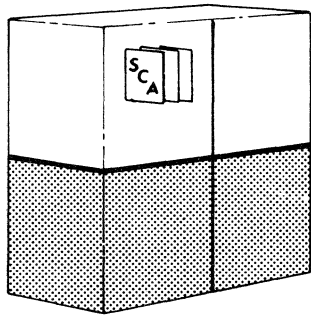
SYNCHRONOUS COMMUNICATIONS ADAPTER  
REFERENCE MANUAL



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**SINGER**  
FRIDEN DIVISION

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

## ORDER OF PRESENTATION

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# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

## INTRODUCTION

The SCA enables programs within a System Ten to transmit data to, and receive data from, remote computers. There are two versions. One (referred to as SCA-2) has "dial out" capability\*, while the other (referred to as SCA-1) does not. Otherwise, they are, for all practical purposes, identical.

\* Both versions of the SCA may receive and transmit data over dial lines once the connection has been initiated. However, only the SCA-2 is capable of initiating the connection. This is referred to as "dial out" capability.

The SCA is connected to the communications adapter of the remote computer by telephone lines and a pair of MODEMS. The SCA replaces two consecutive, physically adjacent IOCs\*\*, and has one partition associated with it. The SCA partition has the partition number associated with the lower of the two replaced IOCs. No peripheral devices may be attached to an SCA partition. Other partitions cannot address the SCA directly. Data to be sent or received via the SCA must either be passed through Common or via an FAC device.

\*\* If installed such that it replaces IOC 19, an SCA-1 may replace only one IOC.

For the most part, an SCA partition is like any other partition. It receives and loses control of the central processor by the same rules as does any other partition, and the program which resides in it may contain any valid System Ten machine instruction. Input and output (i.e., receiving and transmitting) is carried out in the same way as for normal IOCs: that is, the SCA I/O instruction is fulfilled while execution continues in other partitions. An SCA partition differs from a normal partition in the following two respects:

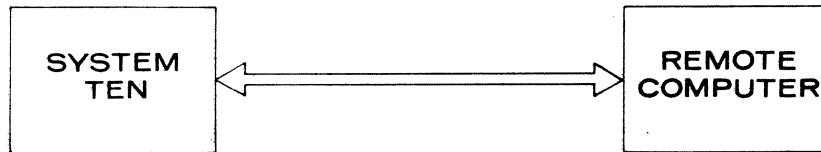
1---Since the SCA partition cannot have attached to it any input devices capable of generating a load sequence, the program which is to reside in it must be loaded in a special way (the loading process is the same as for MDTs partitions).

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

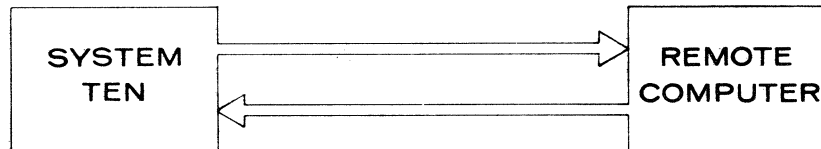
2---The device number (LA) of input/output instructions is interpreted in an unusual manner. Namely, the device number (LA) of a Read or Write instruction, or the device number minus one (LA - 1) of a Read Control instruction, is taken as specifying the number of control characters to be transmitted before proceeding with the operation. Thus, besides the receiving of data, a Read or Read Control instruction may also involve the transmitting of data.

There are two basic configurations in which it is expected the SCA will be used: point-to-point and centralized, multi-point.

1---Point-to-Point (2 wire, private line).

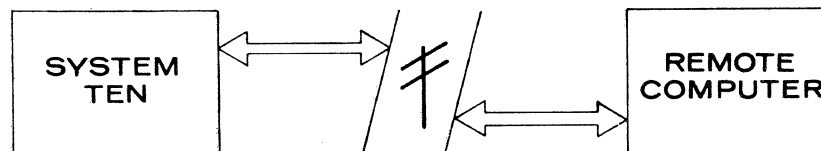


2---Point-to-Point (4 wire, private line).



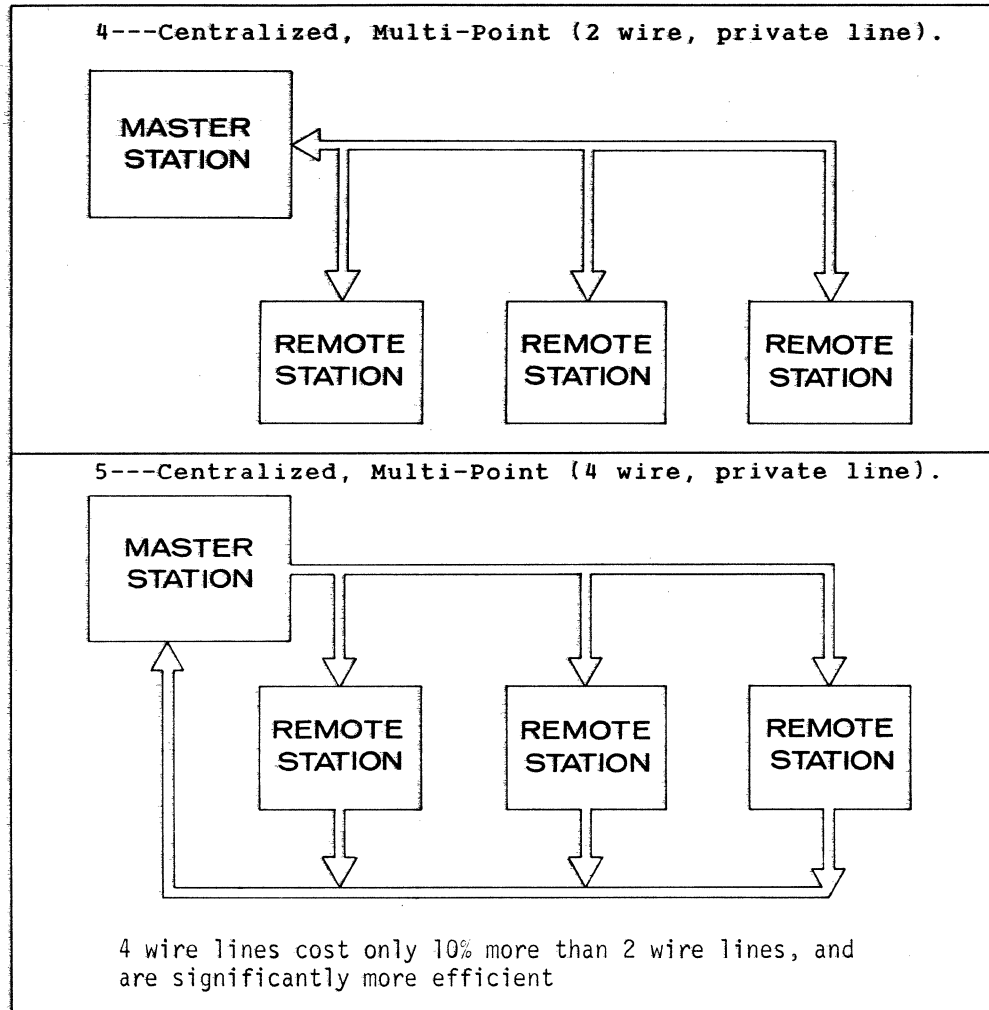
4 wire lines cost only 10% more than 2 wire lines, and are significantly more efficient.

3---Point-to-Point (dial lines, 2 wire only).



If the System Ten is to be permitted to "dial out", then an SCA-2 with an Automatic Calling Unit is required (else an SCA-1 will do).

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)



A centralized, multi-point configuration may, in one sense, be thought of as a "party line". All remote stations "listen in" to everything which the master station transmits, although each actually accepts only those messages which are specifically addressed to it. In a 2 wire configuration, all stations "listen in" to everything which is transmitted by anybody, and one remote station can transmit directly to another (in such a configuration, any of the stations could usurp the role of master). In a 4 wire configuration, one remote station cannot "listen in" to what another transmits to the master, and one remote station cannot transmit directly to another.

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

## MODEM REQUIREMENTS

The MODEMs could be Western Electric Type 201A (for dial lines) or Type 201B (for private lines). They should be wired for the following:

- 1) internal timing.
- 2) EIA option (RS232 interface).
- 3) non-continuous carrier.
- 4) no alternate voice.

From the standpoint of interfacing with the SCA, it makes no difference whether they have the "new sync" feature or not. In ordering the MODEMs, it must be specified whether they are going to be used with 4 wire (full duplex) or 2 wire (half duplex) lines. The Western Electric MODEMs have fixed transfer rates of 2400 BPS (201B) and 2000 BPS (201A). The SCA, however, can accommodate MODEMs with transfer rates of up to 9600 BPS. To achieve these higher transfer rates (e.g., 4800 BPS or 9600 BPS), one must obtain MODEMs which are made by a manufacturer other than Western Electric. In this case, the MODEM should be comparable to the Western Electric 201 with the above mentioned features.

For "dial out" capability, order a Western Electric Model 801A6 Automatic Calling Unit with the "Z" option (terminate calls through data set), and the EIA option. The Automatic Calling Unit has an adjustable timer switch with settings of 7, 10, 15, 25, and 40 seconds. This switch is made accessible by sliding the DATA-PHONE nameplate upward. Once exposed, the timer may be set by the customer with a screwdriver. The timer should be set to the amount of time needed to complete a connection (long distance calls require more time than local calls).

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

## CONTROL CHARACTERS

Up to nine control characters may be transmitted at the start of an SCA Read or Write operation, and up to eight may be transmitted at the start of an SCA Read Control operation. Details regarding how control characters are sent are presented under SCA INPUT/OUTPUT INSTRUCTIONS, further below. The meaningful control characters are as follows:

System Ten Internal Character	External Control Character	Definition
V	SYN	Synchronous idle.
A	SOH	Start of heading block.
B	STX	Start of text block.
W	ETB	End of an intermediate text block within a message.
C	ETX	End of the final, or only, text block in a message.
F	ACK	Affirmative acknowledgement.
U	NAK	Negative acknowledgement.
E	ENQ	End of poll/select sequence (also used for signalling "disregard the last block").
D	EOT	End of transmission (also used by the master station in a centralized, multi-point configuration to tell all the remote stations that it is about to poll or select someone).

### DLE Pairs

In addition, there are four pairs of characters which each act as a control character.

The control character DLE (System Ten internal character P) immediately followed by the control character EOT (System Ten internal character D) is defined as "mandatory disconnect". This is used in a dial line configuration to notify the remote station that you are "hanging up".



# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

The other three pairs consist of the control character DLE immediately followed by the non-control character zero, one, or question mark. These pairs are defined as follows:

DLE 0	Affirmative acknowledgement (ACK 0)
DLE 1	Affirmative acknowledgement (ACK 1)
DLE ?	Wait before transmitting (WABT)

If the SCA detects any of these four pairs while receiving data from the remote computer, it drops the DLE, passes the second character to the central processor, turns ON the Flag Condition Indicator (Condition Code 3) in the central processor, and terminates the Read operation. For example, if the SCA is listening for a one character response from the remote computer, and if the remote computer sends a DLE 0, then the zero is passed to the central processor, the Flag Condition Indicator (Condition Code 3) in the central processor is set ON, and the Read operation is terminated.

## Terminator Control Characters

If the SCA detects any of the following control characters amongst data it is receiving from the remote computer, then it automatically terminates the Read or Read Control operation:

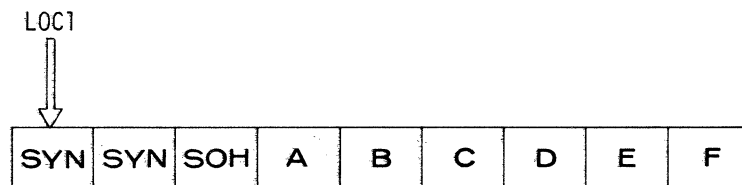
ETB	ETX	EOT	ACK
NAK	ENQ	a DLE pair	

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

## SCA INPUT/OUTPUT INSTRUCTIONS

### Write

This instruction transmits control characters and data to the remote computer. The control characters and data characters must be accessed from a single output area. For example, if the control characters SYN, SYN, and SOH, plus the data characters A, B, C, D, E, and F are to be transmitted by one Write instruction, then they must be accessed from a single output area, as follows (where LOC1 is the location pointed to by the A field of the instruction):



The fields of an SCA Write instruction are as follows:

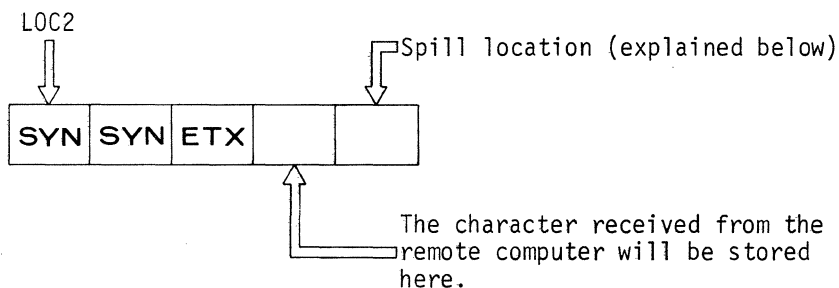
- F: Binary 0001 (1).
- A: Address of output area.
- IA: Index register for A.
- AC: Common flag for A.
- LA: Number of leading control characters.
- B: Count (includes the number of leading control characters).
- IB: Index register for B.
- BC: Ignored.
- LB: Must be 1.

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

## Read

This instruction transmits control characters, and then starts the SCA listening immediately for characters from the remote computer. The control characters to be transmitted, and the locations reserved for receiving the characters from the remote computer must together constitute the input area. For example, if the control characters SYN, SYN, and ETX are to be transmitted, and if a one character response (e.g., an ACK or a NAK) is expected from the remote computer, then the input area pointed to by the Read instruction should be as follows (where LOC2 is the location pointed to by the A field of the instruction):

(NOTE: The count (B) of the instruction is 5).



It is intended that SCA Read operations normally be terminated by the receipt of a terminator control character. If an SCA Read operation is terminated by exhausting the count (B) of the Read instruction, then the Error Condition Indicator (Condition Code 1) in the central processor is set ON. Therefore, every SCA Read instruction should normally ask for more characters than are actually expected.

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

Accordingly, the above sample input area contains an extra location (referred to as "spill location"). If, as expected, the remote computer sends an ACK or a NAK (both of which are terminator control characters), then, after the F or U has been stored in the fourth location of the input area, the operation is terminated with nothing having been stored in the "spill location". If, on the other hand, the remote computer sends 25 characters of data, then, after the first two characters have been received and stored in the fourth and fifth locations of the input area, the operation is terminated, and the Error Condition Indicator (Condition Code 1) is set ON.

SYN control characters sent by the remote computer are neither counted (when received) nor passed on to the input area.

If, at any time during the operation, ten seconds elapse with no data (excluding SYNs) received, then the Fault Condition Indicator (Condition Code 4) in the central processor is set ON, and the operation is terminated. This method of terminating an SCA Read operation is referred to as "time-out".

The fields of an SCA Read instruction are as follows:

- F: Binary 0000 (0)
- A: Address of input area.
- IA: Index register for A.
- AC: Common flag for A.
- LA: Number of leading control characters.
- B: Count (includes the number of leading control characters).
- IB: Index register for B.
- BC: Ignored.
- LB: Must be 1.

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

## Write Control

This instruction is of use only in dial line configurations and 4 wire, centralized, multi-point configurations. In a dial line configuration, it is used to "dial out" and to "hang up". In a 4 wire, centralized, multi-point configuration, it is used to eliminate some of the overhead from "line turnaround".

## 'Dialing Out'

The fields of the SCA Write Control instruction for "dialing out" are as follows:

F: Binary 0001 (1)

A: Address of an output area which contains a 10 or 7 digit telephone number (10 if the number includes an Area Code, 7 if it doesn't).

IA: Index register for A.

AC: Common flag for A.

LA: Must be 1.

B: Count (either 7 or 10).

IB: Index register for B.

BC: Ignored.

LB: Must be 3.

When executed, this instruction initiates the connection with the specified telephone number (analogous to a person dialing a number on a telephone). It has no effect if executed in an SCA-1 partition, or in an SCA-2 partition with no Automatic Calling Unit.

If there is no answer, or if the wrong party answers, then the instruction is terminated and the Error Condition Indicator (Condition Code 1) in the central processor is set ON. It should be noted that when either of these events happens, the programmer need not execute a Write Control instruction for "hanging up".

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

## *'Hanging Up'*

The fields of an SCA Write Control instruction for "hanging up" are as follows:

F: Binary 0001 (1)

A: }  
IA: } Ignored.  
AC: }

LA: Must be 2.

B: }  
IB: } Ignored.  
BC: }

LB: Must be 3.

This instruction (whether executed in a partition attached to an SCA-1 or an SCA-2) terminates the connection with the remote computer. It has no effect if no connection exists, or if used in something other than a dial line configuration.

## *'Constant Carrier'*

"Line turnaround" means that one computer stops transmitting and starts listening, and the other computer starts transmitting. Normally, every "line turnaround" involves approximately 200 ms. of overhead. "Constant carrier" eliminates this overhead. In order to be established, "constant carrier" must be specified at both ends of the connection.

In 4 wire, point-to-point configurations, both computers will normally have "constant carrier" permanently wired into them.

In 4 wire, centralized, multi-point configurations, the master station will normally have "constant carrier" permanently wired into it. To establish "constant carrier" between the master station and a remote station, the remote station would execute a Write Control instruction.

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

The fields of an SCA Write Control instruction for establishing "constant carrier" are as follows:

F: Binary 0001 (1)

A: }  
IA: } Ignored.  
AC: }

LA: Must be 0 (zero).

B: }  
IB: } Ignored.  
BC: }

LB: Must be 3.

Once "constant carrier" has been established, the master station and the remote station may exchange heading blocks, text blocks, and responses without the 200 ms. of overhead at each "line turnaround".

"Constant carrier" is lost whenever either station transmits an EOT control character.

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

## Read Control

This instruction is meant to be used in the SCA partition of a System Ten which is serving as a remote station in a centralized, multi-point configuration. In such a configuration, communication between the master station and any of the remote stations is initiated by either polling or selecting. In polling, the master station queries a remote station to see if it (the remote station) has anything to transmit. In selecting, the master station signals a remote station that it (the master) has something to transmit to that remote station. A System Ten which is serving as a remote station in a centralized, multi-point configuration is assigned a one character remote station address. The primary functions of the Read Control instruction are to assign a remote station an address, and to start that station listening to the master station's transmission line for that address.

## *Remote Station Addresses*

A System Ten's remote station address may be any System Ten internal character. The first character in the input area pointed to by the A field of the Read Control instruction is moved to the SCA's Address Compare Register. Only bits 1 through 5 of this character are used in address comparisons. Consequently, there are, in fact only 32 possible remote station addresses (in assigning addresses, the characters in columns 2 and 3 of the USASCII code chart represent the same addresses as the corresponding characters in columns 4 and 5).

## *Poll/Select Sequence*

Minimally, the poll/select sequence transmitted by the master station consists of two characters: a remote station's address followed by an ENQ control character. Optionally (as determined by the programming conventions for each individual configuration), up to 9 additional characters may be included between the address and the ENQ. Bit 7 of the remote station address (i.e., the first character) in a poll/select sequence is meant to be used for signifying whether the station is being polled or selected. What it means when ON or OFF is determined by the programming conventions for each individual configuration. However, if it is ON (i.e., the first character of the poll/select sequence is one from columns 4 or 5 of the USASCII code chart), then the Flag Condition Indicator (Condition Code 3) in the remote station's central processor is set ON.



# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

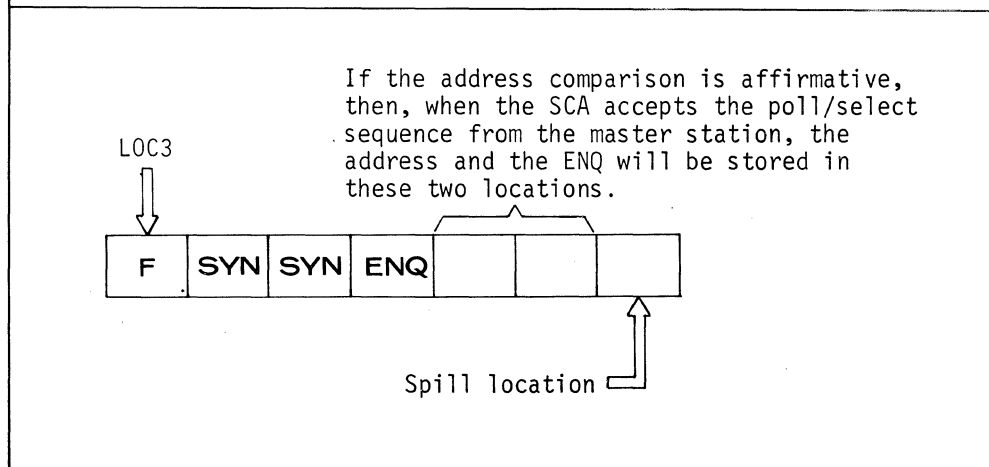
## *Polling and Selecting*

Before transmitting a poll/select sequence, the master station forces a line break by transmitting the control character EOT.

All remote stations listen (via Read Control instructions) to the master station's transmission line. Whenever a line break occurs, each station examines the next non-SYN character. If the character is a control character, then all the remote stations merely continue listening for the next line break. If the character is not a control character, then each station automatically compares bits 1 through 5 of that character with the corresponding bits in its Address Compare Register. If a station's address compares affirmatively with the address transmitted by the master station, then that station accepts the poll/select sequence, and the program in the remote station's SCA partition responds appropriately. Meanwhile, the other remote stations continue listening for the next line break.

## *Instruction Format*

The one character address, plus whatever control characters are to be transmitted, plus the locations reserved for accepting the poll/select sequence must together constitute the input area. For example, if the remote station's address is to be F, and if the control characters SYN, SYN, and ENQ are to be transmitted, and if the master station is transmitting the minimal poll/select sequence, then the input area pointed to by the Read Control instruction would be as follows (where LOC3 is the location pointed to by the A field of the instruction):



# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

The fields of an SCA Read Control instruction are as follows:

F: Binary 0000 (0)

A: Address of input area.

IA: Index register for A.

AC: Common flag for A.

LA: Number of leading control characters + 1.

B: Count (includes the number of leading control characters + 1).

IB: Index register for B.

BC: Ignored.

LB: Must be 3.

*'Time-out'*

After transmitting the specified number of control characters, the SCA starts listening to the master station's transmission line. If, within ten seconds after it starts listening, the SCA does not sense an affirmative address comparison, then the Fault Condition Indicator (Condition Code 4) is set ON, and the Read Control operation is terminated. This method of terminating an SCA Read Control operation is referred to as "time-out".

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

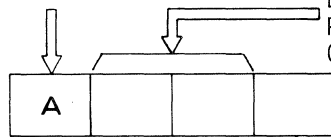
## Sample Instruction Sequence

A typical instruction sequence executed by the program in a remote section's SCA partition might be as follows (assuming that the master station, when polling or selecting, sends a minimal poll/select sequence):

- 1) Execute a Read Control instruction which assigns an address, does not transmit any control characters, and which (in case of an affirmative address comparison) expects to receive two characters.

<u>A</u> :	0010 (in common)	<u>B</u> :	4
<u>IA</u> :	0	<u>IB</u> :	0
<u>AC</u> :	1	<u>BC</u> :	0
<u>LA</u> :	1	<u>LB</u> :	4

Location 0010  
in Common



If an address comparison is affirmative, then the one character address and the ENQ are stored in these two locations. Receipt of the ENQ terminates the Read Control operation.

Spill location.

Remote station's address: A

- 2---Test the Error Condition Indicator (Condition Code 1).

If ON, then either something was wrong with the transmission, or the operation was terminated due to "time-out". In either case, branch back to 1, and execute the Read Control instruction again.

If OFF, then the Read Control operation was terminated by something other than "time-out" (presumably by the ENQ of a poll/select sequence), and there was nothing wrong with the transmission. Proceed with 3.

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

3---Test the Flag Condition Indicator (Condition Code 3) to determine whether the station was polled or selected.

ON---(the station address in the poll/select sequence is a character from columns 4 or 5 of the USASCII code chart).

OFF--(the station address in the poll/select sequence is a character from columns 2 or 3 of the USASCII code chart).

What this Condition Code means when ON or OFF is determined by the programming conventions for each individual configuration.

4---Reply (the USA Standard replies to polling and selecting are presented further below).

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

## SOME PROGRAMMING CONVENTIONS

There are certain conventions (most of which are USA Standards) which should be adhered to in using the SCA. They are presented on the following pages.

### Leading SYNs

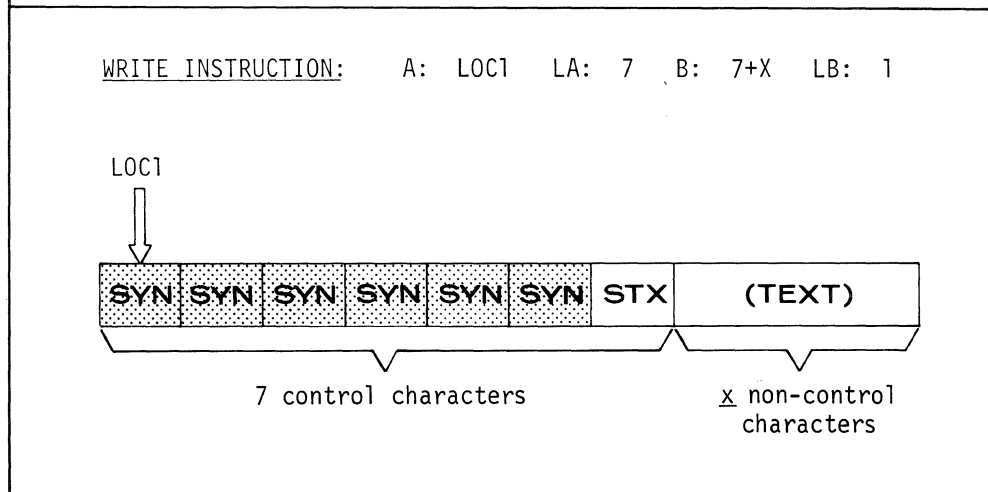
To establish character synchronization between itself and the remote computer, the SCA automatically transmits a pair of SYN control characters at the start of every transmission (i.e., at the start of every Read or Read Control operation which involves the sending of control characters, and at the start of every Write operation). However, under certain circumstances this may not be sufficient. Therefore, it is advised (though not required) that the programmer transmit up to a half dozen SYN control characters at the start of every transmission.

### Transmitting Messages

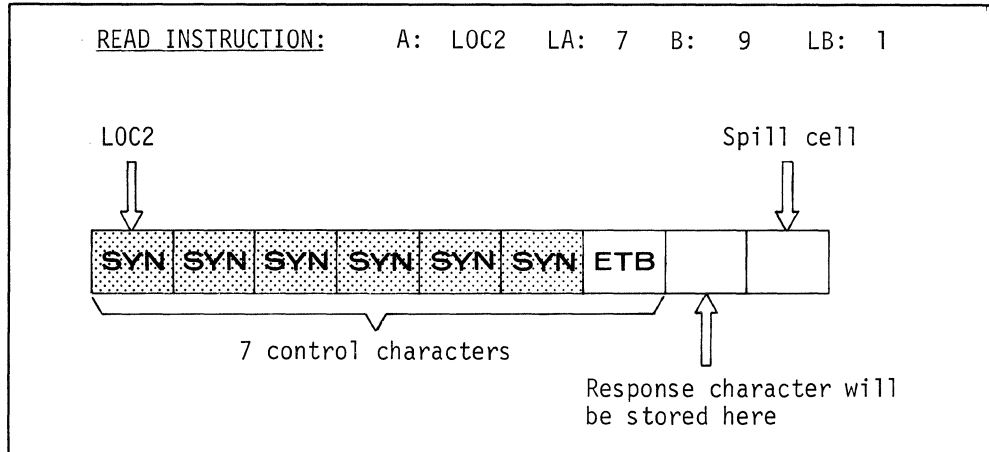
A transmission may consist of a single character such as an ACK or a NAK. It may also consist of one or more messages. Minimally, a message consists of one text block. It may, however, comprise a heading block followed by one or more text blocks.

### Text Blocks

A text block begins with the control character STX and ends with the control character ETB or ETX (an ETB signals the end of an intermediate text block in a message, while an ETX signals the end of the final, or only, text block in a message). Since control characters can only be transmitted at the start of a Write, Read, or Read Control operation, every text block requires two instructions:



# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)



The second instruction must be a Read or Read Control instruction for reasons which will be made clear in the following paragraphs.

At the end of each text block, the SCA transmits a longitudinal parity character. In response to the ETB (or ETX) and the longitudinal parity character, the program in the remote computer should transmit one of the following:

EXTERNAL CONTROL CHARACTER	INTERNAL CHARACTER RECEIVED	MEANING
ACK	F	Everything OK.
DLE 0 (ACK 0)	0	
DLE 1 (ACK 1)	1	
NAK	U	Something (parity?) was wrong. Transmit the block over again.

If the ETB or ETX which terminates a text block is sent by a Write instruction, then, after it has been sent, the SCA proceeds to send either a string of SYNs (until "timeout" occurs) or whatever additional characters the instruction specified be sent. In either case, because it is busy transmitting, the SCA will miss the response.

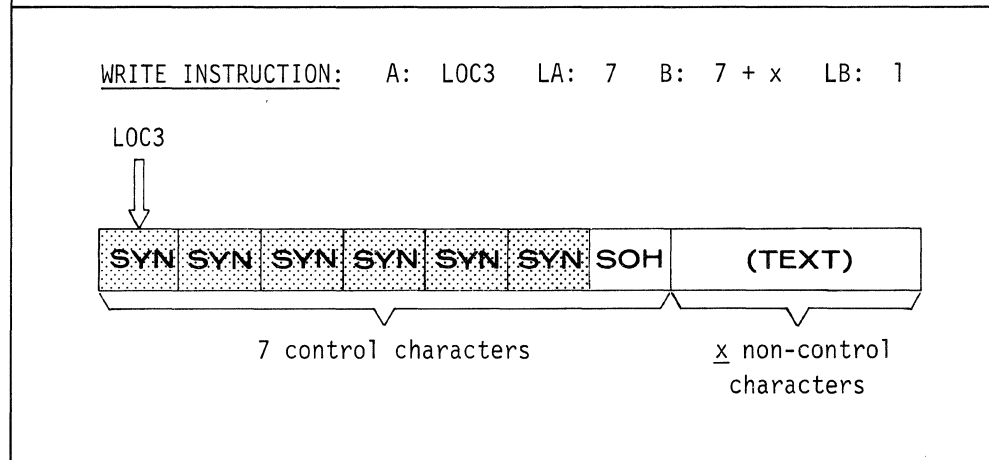
If, on the other hand, the ETB or ETX is sent by a Read or Read Control instruction, then, after it is sent, the SCA immediately begins listening for the response.

The end of a transmission is signalled by the control character EOT.

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

## Heading Blocks

A heading block begins with the control character SOH and is terminated by the STX of the first text block. Thus, a heading block requires only one instruction (this instruction must, however, be immediately followed by the pair of instructions which transmits the first text block):



## Responses to Polling and Selecting

In a centralized, multi-point configuration, communication between the master station and any of the remote stations is initiated by polling and selecting (this is discussed in detail in the description of the Read Control instruction, above).

When polled, a remote station should respond in either of two ways:

<u>External Control Character</u>	<u>Meaning</u>
EOT	The remote station has nothing to transmit to the master.
SOH or STX	The remote station has a message to transmit (the SOH or STX is the initial character of the message).

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

When selected, a remote station should respond in one of three ways:

External Control Character	Meaning
NAK	The remote station is <u>not</u> ready to receive the message from the master.
DLE ?	(WABT) The remote station is not yet ready to receive the message, but will be momentarily. The master station should wait a moment, and then select the remote station again.
DLE 0	The remote station is ready to receive the message from the master station.

## Answering Calls in Dial Line Configurations

Whenever a station in a dial line configuration is called, the "service request signal" in the central processor is set ON. Thus, stations in dial line configurations should periodically test for this signal by executing the Branch On Service Request variant of the Branch instruction. If the signal is ON, then zero is stored in the numeric portion of the location pointed to by the A field, and control passes to the location pointed to by the B field. If the signal is OFF, then execution proceeds with the next sequential instruction.



# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

## CONDITION CODES AFTER SCA OPERATIONS

### Condition Code 1 (ERROR)

It should be noted that whenever Condition Code 4 (FAULT) is set ON, Condition Code 1 (ERROR) is also set ON automatically.

#### *Read or Read Control:*

Operation terminated by exhausting the count (B) rather than by the receipt of a terminator control character.

Character received before the first of the preceding two characters could be passed on to the central processor (the SCA has a two character buffer). It is very unlikely that this will happen.

EOT detected within the text of a message.

Parity error (either vertical or longitudinal).

Loss of carrier, or receipt of 15 consecutive one bits.

#### *Write Control:*

No answer, or wrong party answered.

### Condition Code 3 (FLAG)

#### *Read:*

DLE pair received.

#### *Read Control:*

Bit-7 of the first character of poll/select sequence is ON (signifying that the station was either polled or selected, as decided upon for each individual configuration).

# SYNCHRONOUS COMMUNICATIONS ADAPTER (SCA)

*Write Control:*

Incoming call received just as the SCA was about to initiate a call. In this case, the Write Control instruction for initiating the call is terminated immediately.

## Condition Code 4 (FAULT)

*Write:*

MODEM's power off.

*Read:*

MODEM's power off.

10 seconds elapsed without receiving any non-SYN characters (time-out).

*Write Control:*

MODEM's power off.

Automatic Calling Unit's power off.

*Read Control:*

MODEM's power off.

10 seconds elapsed without an affirmative address comparison (time-out).

**SINGER**  
FRIDEN DIVISION

FORM 40-071