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IBM 1130 Synchronous Communications Adapter Subroutines

This publication supplements, and will later be incorporated into, IBM 1130 Subroutine Library (Form C26-5929).

This manual describes the subroutines used in connection with the 1130 Synchronous Communications Adapter, which permits the attachment of the 1130 Computing System to private and commercial common-carrier facilities.

Included in the descriptions are calling sequences for the subroutines and explanations of the parameters involved.

PREFACE

This publication is composed of seven sections. The first section is a brief, general description of the IBM 1130 Synchronous Communications Adapter and the Synchronous Transmit-Receive and Binary Synchronous modes of communication. The second section provides a description of the calling sequences, control parameters, error handling, and functional operation of the SCAT1 subroutine, used for point-to-point communications in Synchronous Transmit-Receive mode. Sections three and four provide descriptions of the calling sequences, control parameters, error handling, and functional operation of the SCAT2 and SCAT3 subroutines, used for point-to-point and multi-point communications, respectively, in Binary Synchronous mode. The fifth and sixth sections are descriptions of the calling sequences, control parameters, and error handling for the printer subroutine PRNT2 and the subroutines that convert IBM card code and EBCDIC to 4-of-8 code and vice versa, HOL48 and EBC48. The seventh section is a sample program showing the use of the SCAT1 subroutine.

Also included in this publication are the procedures for operation of the 1130 Synchronous

Communications Adapter and notes to the programmer using the Synchronous Communications Adapter subroutines.

The reader should be familiar with the following publications:

IBM 1130 Functional Characteristics (Form A26-5881) with Technical Newsletters N26-0143, N26-0156, and N26-0168.

IBM 1130 Computing System Input/Output Units (Form A26-5890).

IBM 1130 Assembler Language (Form C26-5927).

IBM 1130 Subroutine Library (Form C26-5929).

Data Communications Concepts and Communications Facilities (Form E20-8158).

General Information - Binary Synchronous Communications (Form A27-3004).

Third Edition (April 1967)

This publication (Form C26-3706-2) is a major revision of and makes obsolete the previous edition (Form C26-3706-1). Changes are designated as follows:

1. A vertical line appears to the left of affected text where only a part of the page has been changed.
2. A dot (●) appears to the left of the page number of a page that has been changed throughout.
3. A dot appears to the left of the title of a changed illustration.

The major changes in this publication are concerned with the inclusion of general information on Binary Synchronous Communications and the addition of the descriptions of the subroutines used to perform communications in Binary Synchronous mode.

Specifications contained herein are subject to change from time to time. Any such change will be reported in subsequent revisions or Technical Newsletters.

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A form is provided at the back of this publication for reader's comments. If the form has been removed, comments may be addressed to IBM Corporation, Programming Publications, Department 232, San Jose, California 95114.

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THE SYNCHRONOUS COMMUNICATIONS ADAPTER

The Synchronous Communications Adapter enables the IBM 1130 Computing System to function as a data transmission station, using either private or commercial common-carrier line transmission facilities. The Adapter sends data to or receives data from the line transmission facilities under control of the stored program in the 1130. It operates on an interrupt-request basis similar to that used by the other input/output devices in the IBM 1130 Computing System.

SYNCHRONOUS TRANSMIT-RECEIVE MODE

Synchronous Transmit-Receive (STR) communication is a control procedure for carrying out half-duplex, digital, serial-synchronous (by bit and by character) communication between two stations on point-to-point communication lines. The SCAT1 subroutine controls the 1130 Synchronous Communications Adapter (SCA) during operation in STR mode.

In STR mode, data may not have the same bit configurations as control characters. In addition, all data must be in 4-of-8 code; characters other than 4-of-8 code characters and STR control characters are treated as errors.

Error checking performed by the SCAT1 subroutine consists of an 8-bit Longitudinal Redundancy Check (LRC) accumulated from data characters. This subroutine also uses the alternating acknowledgement method for protection against the loss of blocks of data.

STR Control Characters and Sequences

The STR control characters recognized by the SCAT1 subroutine are listed in Table 1.

The LRC character is exceptional:

1. The character may have any bit configuration. It is formed by performing an Exclusive OR of all the data characters in a record as each character is transmitted or received.
2. The character is not tested for validity. It is used in the LRC (Longitudinal Redundancy Check) performed at the receiving station, comparing

Table 1. STR Control Characters

Character	Bit Configuration								Hex
	N	X	O	R	8	4	2	1	
IDLE	0	0	1	1	1	0	0	1	39
TL	0	0	1	1	0	1	0	1	35
CL	0	1	0	1	0	1	0	1	55
INQ/ERR	0	1	0	1	1	0	0	1	59
SOR1/ACK1	0	1	0	1	0	0	1	1	53
SOR2/ACK2	0	0	1	1	0	0	1	1	33
*EOT	0	1	0	1	1	0	1	0	5A
*TEL	0	1	0	1	1	1	0	0	5C
LRC	-	-	-	-	-	-	-	-	-

*Also may be used as data character

the LRC character formed with the LRC character received at the end of the data record. Thus, the character is used as a checksum and is not tested.

The STR control characters, when combined into the control sequences shown in Table 2, are used to control line functions; e.g., to acknowledge receipt of a message, to acknowledge synchronization, to signal the start of a message or the end of a transmission.

Table 2. STR Control Sequences

	Leader	Trailer
End of Idle	CL	IDLE
Inquiry	TL	INQ
Start of Odd Record	TL	SOR1
Start of Even Record	TL	SOR2
End of Record	TL	LRC
Acknowledgment of Odd Record	CL	ACK1
Acknowledgment of Even Record	CL	ACK2
Error Received	CL	ERR
End of Transmission	CL	EOT
Telephone	CL	TEL

BINARY SYNCHRONOUS MODE

Binary Synchronous Communication (BSC) is a control procedure for carrying out half-duplex,

digital, serial-synchronous (by bit and by character) communication between two or more stations on point-to-point and multi-point communication lines. The SCAT2 subroutine controls the 1130 Synchronous Communications Adapter (SCA) during point-to-point operation in BSC mode; the SCAT3 subroutine controls the 1130 Synchronous Communications Adapter (SCA) during multi-point operation in BSC mode.

In the 1130 BSC mode, two types of text may be transmitted: Normal EBCDIC text and Full-Transparent text. In Normal EBCDIC text, data may not have the same bit configurations as control characters. In Full-Transparent text, data may have the same bit configurations as control characters since control character recognition is handled by a special procedure. This permits unrestricted coding of data within messages and is useful for sending binary data, decimal data, and the like.

In multi-point, centralized operation, the SCAT3 subroutine permits the 1130 to operate only as a slave station. Initialization is performed when the master station sends polling or selection addresses. A particular polling address gives a unique station on the line an opportunity to transmit to the master station. The polled station responds with a positive response (data transmission) or a negative response (EOT). Selection addresses are used to request a particular station to receive an ensuing data transmission. A selected station responds with its status: ready to receive (ACK0), or not ready to receive (NAK).

Error checking performed by the SCAT2 and SCAT3 subroutines consists of a 16-bit Cyclic Redundancy Check (CRC-16), accumulated from text and heading data. These subroutines also use the alternating acknowledgement method of protection against the loss of blocks of data.

BSC Control Characters and Sequences

The BSC control characters recognized by the SCAT2 and SCAT3 subroutines when the 1130 is operating in Normal text mode, are listed in Table 3. The recognized control sequences appear in Table 4.

Table 3. BSC Control Characters

Character	Meaning	Bit Configuration								Hex
		0	1	2	3	4	5	6	7	
SYN	Synchronous Idle	0	0	1	1	0	0	1	0	32
DLE	Data Link Escape	0	0	0	1	0	0	0	0	10
ENQ	Enquiry	0	0	1	0	1	1	0	1	2D
SOH	Start of Heading	0	0	0	0	0	0	0	1	01
STX	Start of Text	0	0	0	0	0	0	1	0	02
ETB	End of Block	0	0	1	0	0	1	1	0	26
ETX	End of Text	0	0	0	0	0	1	1	03	
EOT	End of Transmission	0	0	1	1	0	1	1	37	
NAK	Negative Acknowledgement	0	0	1	1	1	0	1	3D	
ACK0*	Positive Acknowledgement, Even Record	0	1	1	0	0	0	0	70	
ACK1*	Positive Acknowledgement, Odd Record	0	1	1	0	0	0	1	61	

*Not control characters unless used in control sequence as shown in Table 5.

Table 4. BSC Control Sequences

Enquiry	ENQ
Start of Heading	SOH
Start of Text	STX
Start of Transparent Text	DLE STX
End of Block	ETB CRC-16
End of Transparent Block	DLE ETB CRC-16
End of Text	ETX CRC-16
End of Transparent Text	DLE ETX CRC-16
Acknowledgement of Odd Record	DLE ACK1
Acknowledgement of Even Record	DLE ACK0
Negative Acknowledgement	NAK
End of Transmission	EOT
Disconnect Signal	DLE EOT
Synchronous Idle (Normal)	SYN
Synchronous Idle (Transparent Text)	DLE SYN

SYNCHRONOUS COMMUNICATIONS ADAPTER SUBROUTINE - SCAT1

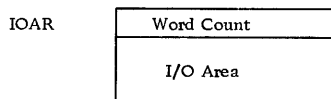
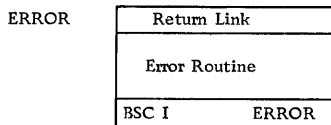
The SCAT1 Interrupt Service Subroutine controls the 1130 SCA during point-to-point operation in STR mode and performs error checking on the data transmitted and received. A four digit control parameter directs the subroutine in the following:

- Testing to determine if the previous operation has been completed
- Establishing synchronism
- Transmitting
- Receiving
- Transmitting the appropriate type of acknowledgement
- Enabling/disabling the Auto Answer Interrupt feature
- Turning the audible alarm on and off
- Disconnecting the station from the line

Calling Sequence

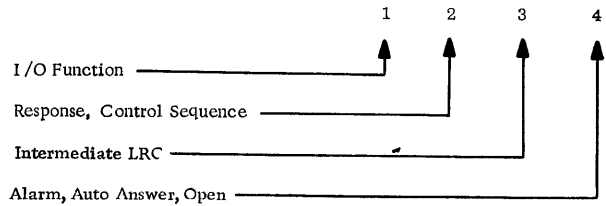
```

LIBF      SCAT1
DC        /XXXX (Control Parameter)
DC        IOAR  (I/O Area Address)
DC        ERROR (Error Routine Address)
.         .
.         .
.         .
    
```



Control Parameter

The control parameter consists of four hexadecimal digits which are used as shown below:



I/O Function

The I/O function digit specifies the operation to be performed by SCAT1 on the SCA. The functions, their associated digital values, and the required parameters are listed and described below.

<u>Function</u>	<u>Digital Value</u>	<u>Required Parameters*</u>
Test	0	Control
Auto Answer	1	Control, I/O Area**
Alarm	2	Control
Close	3	Control
Open	4	Control, I/O Area, Error
Transmit	5	Control, I/O Area, Error
Acknowledge and Receive	6	Control, I/O Area, Error

*Any parameter not required for a particular function must be omitted.
 **I/O area parameter needed if function is Enable Auto Answer.

Test. Tests the Device Routine Busy indicator and branches to LIBF+2 if the previous operation has not been completed, or to LIBF+3 if the previous operation has been completed.

It is possible to initiate an Auto Answer, Alarm, or Close operation while any Open, Transmit, or Receive operation is in progress.

Auto Answer. Enables the automatic answer interrupt if digit 4 of the control parameter is zero; disables the automatic answer interrupt if digit 4 of the control parameter is non-zero.

When an Auto Answer Request interrupt occurs, the location specified by the I/O area address is set to a non-zero value and the automatic answer interrupt is disabled.

Alarm. Turns on the audible alarm in the local system if digit 4 of the control parameter is zero; turns off the audible alarm if digit 4 is non-zero.

Close. Ends all operations on the SCA and disconnects the station from the line.

On carrier lines that require a station to disconnect from the line automatically at the end of message transmission, the user must perform a Close operation within two minutes of the transmission of EOT.

Open. Establishes synchronization. Digit 4 of the control parameter indicates whether the user plans to receive (Data In condition) or transmit (Data Out condition).

If digit 4 of the control parameter is zero (Data In), "handshaking" (exchanging IDLEs) continues until the INQ sequence is received. At this time, the Device Routine Busy indicator is cleared. When an INQ sequence is received, the user must initiate some Receive operation within 1.5 seconds in order to avoid any unnecessary line delay.

If digit 4 of the control parameter is non-zero (Data Out), the INQ sequence is transmitted after synchronization has been established. When the INQ acknowledgement sequence is received, the Device Routine Busy indicator is cleared. The user must initiate some Transmit operation within 1.5 seconds in order to avoid any unnecessary line delay.

When a station in the Open, Data Out condition receives an INQ sequence, a code (4000₁₆) is placed in the accumulator and a branch occurs to the error routine specified by the error routine address. If the user returns from the error routine with a non-zero accumulator, the INQ sequence is transmitted. Otherwise, SCAT1 performs a Close operation.

If the user attempts to synchronize but a Write Response does not occur (indicating that the data

set is not ready), a code (8000₁₆) is placed in the accumulator and a branch occurs to the error routine. If the user returns from the error routine with a non-zero accumulator, SCAT1 attempts to synchronize again. Otherwise, SCAT1 performs a Close operation.

If the TEL sequence is received, a code (1000₁₆) is placed in the accumulator and a branch occurs to the error routine. Upon return from the error routine, SCAT1 transmits the TEL sequence, then resumes the synchronizing procedure.

If synchronization is not established after seven attempts, a code (2000₁₆) is placed in the accumulator and a branch occurs to the error routine. If the user returns from the error routine with a non-zero accumulator, SCAT1 makes seven more attempts to synchronize. If the user returns from the error routine with a zero accumulator, SCAT1 performs a Close operation.

Transmit. To transmit a data record, EOT sequence, or TEL sequence, digit 2 of the control parameter must be set to 0, 1, or 2, respectively. In addition, if ILRCs (Intermediate LRCs of groups of characters within a record) are to be provided with data record transmission, digit 3 of the control parameter must be non-zero. The Record Marks and Group Marks, which indicate the positions of the ILRCs, must be in the I/O area.

In a transmitted data record, the first word in the I/O area contains the word count for the data record. This word count represents the number of unpacked, left-justified, 4-of-8 characters in the data, including any Record Marks or Group Marks. If a non-data character or a 4-of-8 error is detected, SCAT1 transmits hexadecimal 1F, which forces an error at the receiving station. The hexadecimal 1F is not included in the LRC. Upon receiving the ERR sequence, SCAT1 places an error code (0100₁₆) in the accumulator and branches to the error routine. If the user returns from the error routine with a positive accumulator, the record is re-transmitted. If the accumulator is negative, SCAT1 continues as if the proper ACK sequence was received. If the accumulator is zero, SCAT1 performs a Close operation.

When the proper ACK sequence is received, SCAT1 transmits IDLEs and returns to the user. The user should initiate some Transmit or a Close operation within 1.5 seconds in order to avoid any unnecessary line delay.

If the ERR sequence is received in reply to a data record, the data record is re-transmitted. After seven unsuccessful tries, SCAT1 places an error code (0400₁₆) in the accumulator and branches to the error routine. If the user returns from the error routine with a positive accumulator, another series of seven tries is initiated. If the accumulator is negative, SCAT1 continues as if the proper ACK sequence was received. If the accumulator is zero, SCAT1 performs a Close operation.

If an incorrect control sequence is received on seven successive attempts, an error code (0200₁₆) is placed in the accumulator and a branch occurs to the error routine. If the user returns from the error routine with a positive accumulator, another series of seven tries is initiated. If the accumulator is negative, SCAT1 continues as if the proper ACK sequence was received. If the accumulator is zero, SCAT1 performs a Close operation.

If any sequence other than the proper ACK or ERR is received, the INQ sequence is transmitted.

Transmitting EOT and receiving the EOT sequence in reply causes SCAT1 to transmit IDLEs and return to the user program. The user should perform some Open or a Close operation within 1.5 seconds in order to avoid any unnecessary line delay. Any other sequence received in reply to a transmitted EOT results in the EOT sequence being re-transmitted.

Transmitting TEL and receiving the TEL sequence causes SCAT1 to transmit IDLEs and return to the user. The user should initiate some Open or Transmit or a Close operation within 1.5 seconds in order to avoid any unnecessary line delay. If any sequence other than TEL is received, the TEL sequence is re-transmitted.

Acknowledge and Receive. Acknowledges the previous record or INQ sequence and receives the next record.

If the user wishes to respond to the previous record or INQ sequence with a positive acknowledgement (ACK1 or ACK2 sequence), he must set digit 2 of the control parameter to zero. Otherwise, a negative acknowledgement (ERR sequence) is transmitted.

If the user expects Intermediate LRCs in the data, he must set digit 3 of the control parameter to any non-zero value.

The first word in the I/O area specifies the maximum word count for that area.

After the entire data record is received, the number of characters received in the record, including any Record Marks or Group Marks, is stored into the first word of the I/O area. If there were no errors in the record, SCAT1 transmits IDLEs, clears the Device Routine Busy indicator, and returns to the user program. The user should initiate some Acknowledge and Receive operation or a Close operation within 1.5 seconds in order to avoid any unnecessary line delay. The data is stored in the I/O area unpacked and left-justified.

If an error is detected in receiving the record (for example, an incorrect Start of Record, an invalid character, an incorrect LRC or ILRC, or an I/O area overflow), the ERR sequence is transmitted and SCAT1 tries to receive the record again. After seven attempts, an error code (0800₁₆) is placed in the accumulator and a branch occurs to the error routine. If the user returns from the error routine with a positive accumulator, another series of seven tries is initiated. If the accumulator is negative, SCAT1 continues as if there were no errors detected in receiving the record. If the accumulator is zero, SCAT1 performs a Close operation.

If an invalid character is received in the data, it is replaced by a blank character (F0₁₆).

If the EOT sequence is received, SCAT1 sets the first word of the I/O area to zero, transmits the EOT sequence, and returns to the Open, Data In condition.

If the TEL sequence is received, a code (1000₁₆) is placed in the accumulator and a branch occurs to the error routine. Upon return from the error routine, SCAT1 transmits the TEL sequence, then returns to the receive mode of operation.

Response, Control Sequence

Interpretation of control parameter digit 2 varies, depending on the setting of digit 1.

Digit 1		Digit 2	
Value	Meaning	Value	Meaning
5	Transmit	0	Transmit data record
5	Transmit	1	Transmit EOT sequence
5	Transmit	2	Transmit TEL sequence
6	Acknowledge and Receive	0	Transmit positive acknowledgement
6	Acknowledge and Receive	non-zero	Transmit negative acknowledgement

Intermediate LRC

Control parameter digit 3 must be non-zero if the user desires to transmit or receive ILRCs.

Alarm, Auto Answer, Open

Interpretation of control parameter digit 4 varies, depending on the setting of digit 1.

Digit 1		Digit 4	
Value	Meaning	Value	Meaning
1	Auto Answer	0	Enable Auto Answer
1	Auto Answer	non-zero	Disable Auto Answer
2	Alarm	0	Turn on audible alarm
2	Alarm	non-zero	Turn off audible alarm
4	Open	0	Data In - user plans to receive
4	Open	non-zero	Data Out - user plans to transmit

Error Handling

For a description of error handling procedures, refer to General Error Handling Procedures in the publication IBM 1130 Subroutine Library.

The user should bear in mind that he must return from his error routine to SCAT1 within 1.5 seconds or unnecessary line delay is incurred.

Pre-operation Error Detection

The following conditions result in pre-operation error action (accumulator settings are shown in parentheses):

- Invalid function code (8001_{16})
- Invalid word count (8001_{16})
- Receive operation not completed (8002_{16})

- Transmit operation not completed (8002_{16})
- Failure to establish synchronization before attempting to perform some Transmit or Receive operation (8003_{16})
- Attempting to receive before receiving INQ sequence (8003_{16})

Post-operation Error Detection

The following conditions result in a branch to the user's error routine (accumulator settings are shown in parentheses):

- Failure to establish synchronization after seven attempts while trying to perform some Open operation, or INQ received in response to INQ (2000_{16})
- Data set not ready (8000_{16})
- Transmit error on seven tries (0400_{16})
- Receive error, including I/O area overflow, on seven tries (0800_{16})
- Error in data to be transmitted (0100_{16})
- Incorrect control sequence received seven times (0200_{16})

Other Branches to Error Routine

The following conditions, although not classed as errors, result in a branch to the user's error routine (accumulator settings are shown in parentheses):

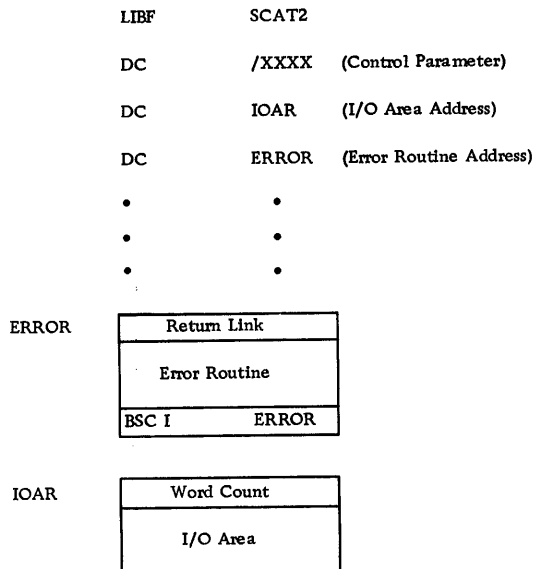
- Receiving a TEL sequence (1000_{16})
- Receiving an INQ sequence while in Open, Data Out condition (4000_{16})

SYNCHRONOUS COMMUNICATIONS ADAPTER SUBROUTINE - SCAT2

The SCAT2 Interrupt Service Subroutine controls the 1130 SCA during point-to-point operation in BSC mode and performs error checking on the data transmitted and received. A four digit control parameter directs the subroutine in the following:

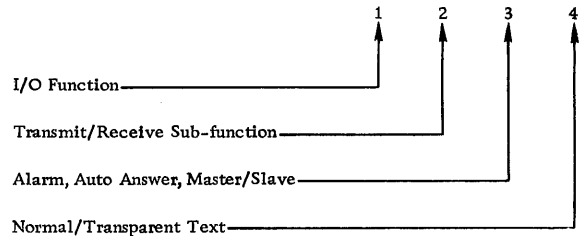
- Testing to determine if the previous operation has been completed
- Transmitting
- Receiving
- Turning the audible alarm on and off
- Enabling/disabling the Auto Answer Interrupt feature
- Disconnecting the station from the line

Calling Sequence



Control Parameter

The control parameter consists of four hexadecimal digits which are used as shown below:



I/O Function

The I/O function digit specifies the operation to be performed by SCAT2 on the SCA. The functions, their associated digital values, and the required parameters are listed and described below.

<u>Function</u>	<u>Digital Value</u>	<u>Required Parameters*</u>
Test	0	Control
Auto Answer	1	Control, I/O Area**
Alarm	2	Control
Close	3	Control
Receive	4	Control, I/O Area, Error
Transmit Block	5	Control, I/O Area, Error
Transmit Text	6	Control, I/O Area, Error
Transmit End	7	Control, I/O Area, Error

*Any parameter not required for a particular function must be omitted.
 **I/O Area parameter required only if function is Enable Auto Answer.

Test. Tests the Device Routine Busy indicator and branches to LIBF+2 if the previous operation has not been completed, or to LIBF+3 if the previous operation has been completed.

It is possible to initiate a Test, Auto Answer, Alarm, or Close operation while any Transmit or Receive operation is in progress.

Auto Answer. Enables the automatic answer interrupt if digit 3 of the control parameter is zero; disables the automatic answer interrupt if digit 3 of the control parameter is non-zero.

When an Auto Answer Request interrupt occurs, the location specified by the I/O area address is set to a non-zero value and the automatic answer interrupt is disabled.

Alarm. Turns on the audible alarm in the local system if digit 3 of the control parameter is zero; turns off the audible alarm if digit 3 of the control parameter is non-zero.

Close. Ends all operations on the SCA and disconnects the station from the line.

On carrier lines that require a station to disconnect from the line automatically at the end of message transmission, the user must perform a Close operation within two minutes of the transmission of EOT.

Receive. A Receive operation can be one of three types. Digit 2 of the control parameter is used to specify which sub-function of Receive is requested.

Digit 2	Digital Value	Sub-function
	0	Receive Initial
	1	Receive Continue
	2	Receive Repeat

- Receive Initial--Monitors the line for ENQ; upon receiving ENQ, transmits ACK0 and receives the message.
- Receive Continue--Transmits the correct positive acknowledgement for the current message and receives the next message.
- Receive Repeat--Transmits NAK for the current message and receives the next message.

When performing a Receive operation, the first word of the I/O area contains the maximum number of unpacked characters (word count) that can be read into that area.

The entire message that is received is stored in the I/O area, including the SOH character and/or the STX character (DLE STX, if Transparent text), the ETB character (DLE ETB, if Transparent text), or the ETX character (DLE ETX, if Transparent text). After the message has been received, the number of characters received, including control characters, is stored in the first word of the I/O area.

All characters in the I/O area are unpacked and left-justified.

If the record is received in Transparent text mode, SCAT2 deletes the second DLE character (inserted at the transmitting station) in each pair of DLE characters received.

If there were no errors in the message, SCAT2 clears the Device Routine Busy indicator and starts the 3-second timer. The user should initiate some Receive or a Close operation within 3 seconds in order to avoid any unnecessary line delay.

If the block check character (CRC-16) is found to be incorrect, if the message overflows the I/O area, or if a Receive timeout occurs while receiving the message, SCAT2 transmits NAK and attempts to receive the message again. After eight unsuccessful attempts, SCAT2 branches to the user's error routine with an error code in the accumulator (see Post-operation Error Detection). If the user returns with a positive accumulator, SCAT2 transmits NAK and attempts to receive the message again (up to seven more attempts before branching to the user's error routine). If the user returns with a zero accumulator, SCAT2 performs a Close operation. If the user returns with a negative accumulator, SCAT2 clears the Device Routine Busy indicator and stores the number of characters, including control characters, received in the message in the first word of the I/O area, allowing the user to initiate a Receive Repeat or Receive Continue operation.

If a timeout occurs while receiving a message, SCAT2 monitors for ENQ and, when ENQ is received, transmits the last acknowledgement.

If the EOT character is received, SCAT2 clears the first word of the I/O area to zero and clears the Device Routine Busy indicator. The user should then initiate a Receive Initial, Transmit Initial, Transmit EOT, Transmit DLE EOT (Dial line only), or Close operation.

If DLE EOT (Disconnect Signal) is received, SCAT2 sets the first word of the I/O area to FFFF₁₆ and performs a Close operation.

Transmit Block/Text. There are four types of Transmit Block and Transmit Text operations. Digits 2 and 4 of the control parameter are used to specify which sub-function of Transmit Block/Text is requested.

Digit 2	Digital Value	Sub-function
	0	Transmit Initial
	1	Transmit Continue

<u>Digit 4</u>	<u>Digital Value</u>	<u>Sub-function</u>
	0	Normal EBCDIC text
	non-zero	Full-Transparent text

- Transmit Initial Block/Text--Transmits ENQ, receives the acknowledgement (ACK0), transmits the message from the I/O area, transmits the CRC-16, and receives the acknowledgement (ACK1).
- Transmit Initial Transparent Block/Text--Transmits ENQ, receives the acknowledgement (ACK0), transmits the message from the I/O area, transmits DLE ETB/DLE ETX, transmits the CRC-16, and receives the acknowledgement (ACK1).
- Transmit Continue Block/Text--Transmits the message from the I/O area, transmits the CRC-16, and receives the acknowledgement.
- Transmit Continue Transparent Block/Text--Transmits the message from the I/O area, transmits DLE ETB/DLE ETX, transmits the CRC-16, and receives the acknowledgement.

Contention exists when the two stations on a line simultaneously bid for control of the line by performing the Transmit Initial operation at the same time. In a 4-wire system, each station receives ENQ in response to its ENQ. In a 2-wire system, neither station receives a response and a timeout occurs at both stations. The two contending stations should have slightly different timeout periods such that, in re-transmitting ENQ, the contending station having the longer timeout period eventually receives ENQ in response to its ENQ.

SCAT2 provides a means to break contention. If the user wishes to be the master station in the event of contention, digit 3 of the control parameter must be zero. If the user wishes to be the slave station, digit 3 of the control parameter must be non-zero.

In a master station, when contention exists, SCAT2 re-transmits ENQ. After eight attempts, SCAT2 branches to the user's error routine with an error code (4000₁₆) in the accumulator. If the user returns from the error routine with a non-zero accumulator, SCAT2 attempts to break contention seven more times. If the user returns with a zero accumulator, SCAT2 performs a Close operation.

In a slave station, when contention exits, SCAT2 branches to the user's error routine with an error code (4000₁₆) in the accumulator and, upon return from the error routine, performs a Close operation, allowing the user to initiate a Receive Initial operation.

When performing a Transmit Block/Text operation, the first word of the I/O area contains the number of characters in the message. The character count includes the control characters in the message. All characters in the I/O area are unpacked and left-justified. If the user wishes to start the message with a heading (optional), he must supply the SOH character as the first character of the message.

If there is text in the message, the text portion of the message follows the heading. When digit 4 of the control parameter is zero, the text is Normal EBCDIC text and must begin with STX and end with ETB/ETX. The user must supply these characters. When digit 4 of the control parameter is non-zero, the text is Full-Transparent text and must begin with DLE STX. The user must supply these characters. The ending characters, DLE ETB/ETX, are supplied by SCAT2. SCAT2 transmits a second DLE character after each DLE that is found in the Transparent text.

If a redundancy check of the heading separate from the text is desired, the heading must end with ETB. The ETB is supplied by the user.

The I/O area is not checked for misplaced or incorrect control characters.

SCAT2 transmits the 16-bit block check character (CRC-16) after the ETB/ETX is transmitted. The CRC-16 is generated by SCAT2.

When the proper acknowledgement is received, SCAT2 clears the Device Routine Busy indicator and starts the 3-second timer. The user should initiate some Transmit operation (except Transmit Initial) or a Close operation within 3 seconds in order to avoid any unnecessary line delay.

If ACK0 is not received in response to the initial ENQ, ENQ is re-transmitted, except when contention exists and the station is a slave station.

If NAK is received in response to a message, the message is re-transmitted.

If EOT is received in response to ENQ or to a message, SCAT2 clears the first word of the I/O area to zero and clears the Device Routine Busy indicator, allowing the user to initiate a Receive Initial, Transmit Initial, Transmit End, or Close operation.

If DLE EOT is received in response to ENQ or to a message, SCAT2 sets the first word of the I/O area to FFFF₁₆ and performs a Close operation.

If anything other than EOT, DLE EOT, NAK, or a positive acknowledgement is received in response to a message, ENQ is transmitted. If the incorrect positive acknowledgement is received, SCAT2 re-transmits the message if a Receive timeout occurred after the message was transmitted; SCAT2 transmits ENQ if no Receive timeout occurred.

If, after eight attempts, the proper positive acknowledgement is not received, SCAT2 branches to the user's error routine with an error code in the accumulator (see Post-operation Error Detection). If the user returns from the error routine with a positive accumulator, the transmission is attempted seven more times. If the user returns with a zero accumulator, SCAT2 performs a Close operation. If the user returns with a negative accumulator, SCAT2 continues as if the proper positive acknowledgement had been received.

Transmit End. The Transmit End operation can be one of two types. Digit 2 of the control parameter is used to specify which sub-function of Transmit End is requested.

Digit 2	Digital Value	Sub-function
	0	Transmit EOT
	1	Transmit DLE EOT

- Transmit EOT--Transmits EOT, then reacts according to the reply received.
- Transmit DLE EOT--Transmits DLE EOT, then performs a Close operation.

On a Transmit EOT operation, SCAT2 transmits EOT and receives the response. If the response is DLE EOT, SCAT2 performs a Close operation. If there is no response (a Receive timeout occurs), SCAT2 performs a Close operation. If the response is EOT, SCAT2 stores an EOT character in the location specified by the I/O area address and clears the Device Routine Busy indicator, allowing the user to initiate a Transmit Initial, Transmit DLE EOT, or Close operation. If the response is ENQ, SCAT2 stores ENQ in the location specified by the I/O area address and clears the Device Routine Busy indicator, allowing the user to initiate a Receive Continue or Receive Repeat operation.

If a response other than DLE EOT, EOT, or ENQ is received, SCAT2 re-transmits EOT. After eight unsuccessful attempts, SCAT2 branches to the user's error routine. If the user returns with a non-zero accumulator, transmission is attempted seven more times. If the user returns with a zero accumulator, SCAT2 performs a Close operation.

Transmit/Receive Sub-function

The interpretation of digit 2 of the control parameter varies, depending on the setting of digit 1.

Digit 1		Digit 2	
Value	Meaning	Value	Meaning
4	Receive	0	Receive Initial
4	Receive	1	Receive Continue
4	Receive	2	Receive Repeat
5	Transmit Block	0	Transmit Initial Block
5	Transmit Block	1	Transmit Continue Block
6	Transmit Text	0	Transmit Initial Text
6	Transmit Text	1	Transmit Continue Text
7	Transmit End	0	Transmit EOT
7	Transmit End	1	Transmit DLE EOT

Alarm, Auto Answer, Master/Slave

The interpretation of digit 3 of the control parameter varies, depending on the setting of digit 1 and digit 2.

Digit 1		Digit 2		Digit 3	
Value	Meaning	Value	Meaning	Value	Meaning
1	Auto Answer	*	*	0	Enable Auto Answer
1	Auto Answer	*	*	non-zero	Disable Auto Answer
2	Alarm	*	*	0	Alarm on
2	Alarm	*	*	non-zero	Alarm off
5	Transmit Block	0	Initial	0	Master station, if contention
5	Transmit Block	0	Initial	non-zero	Slave station, if contention
5	Transmit Block	1	Continue	*	*
6	Transmit Text	0	Initial	0	Master station, if contention
6	Transmit Text	0	Initial	non-zero	Slave station, if contention
6	Transmit Text	1	Continue	*	*

*Not applicable

Normal/Transparent Text

Digit 4 of the control parameter specifies the text mode for the data to be transmitted.

Digit 4	<u>Digital Value</u>	<u>Text Mode</u>
	0	Normal EBCDIC text
	non-zero	Full-Transparent text

Error Handling

For a description of error handling procedures, refer to General Error Handling Procedures in the publication IBM 1130 Subroutine Library.

Pre-operation Error Detection

The following conditions result in pre-operation error action (accumulator settings are shown in parentheses):

- Invalid function code (8001_{16})
- Invalid sub-function code for some Transmit or Receive operation (8001_{16})

- Invalid word count (8001_{16}).

Post-operation Error Detection

The following conditions result in a branch to the user's error routine (accumulator settings are shown in parentheses):

- Data set not ready (8000_{16})
- Contention exists (4000_{16})
- 3-second timeout occurred while receiving a message or monitoring for ENQ, or ENQ not received while monitoring for ENQ (2000_{16})
- I/O area overflow (1000_{16})
- Block check character (CRC-16) in error (0800_{16})
- Receive timeout occurred after transmitting a message or ENQ, or invalid sequence received in response to a message or ENQ (0200_{16})
- NAK received, or the incorrect acknowledgement received following a Receive timeout (0400_{16})
- Incorrect acknowledgement received with no Receive timeout (0100_{16})

SYNCHRONOUS COMMUNICATIONS ADAPTER SUBROUTINE - SCAT3

The SCAT3 Interrupt Service Subroutine controls the 1130 SCA during multi-point operation and performs error checking on the data transmitted and received. A four digit control parameter directs the subroutine in the following:

- Testing to determine if the previous operation has been completed
- Monitoring the line for the specified polling address and selection address
- Transmitting
- Receiving
- Turning the audible alarm on and off
- Disconnecting the station from the line

Calling Sequence

The calling sequence for all I/O functions except Monitor (see I/O Function) is as follows:

```

LIBF      SCAT3
DC        /XXXX (Control Parameter)
DC        IOAR  (I/O Area Address)
DC        ERROR (Error Routine Address)
.         .
.         .
.         .
    
```

ERROR	Return Link
	Error Routine
	BSC I ERROR

IOAR	Word Count
	I/O Area

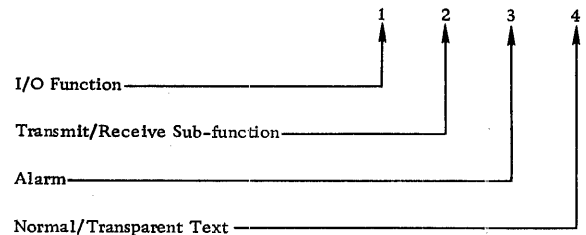
The calling sequence for the Monitor I/O function (see I/O Function) is as follows:

```

LIBF      SCAT3
DC        /1000 (Control Parameter)
DC        POLL  (Polling Address Parameter)
DC        SELCT (Selection Address Parameter)
.         .
.         .
.         .
POLL     DC    /XX00 (Polling Address)
DC        0
.         .
.         .
.         .
SELCT    DC    /YY00 (Selection Address)
DC        0
    
```

Control Parameter

The control parameter consists of four hexadecimal digits which are used as shown below:



I/O Function

The I/O function digit specifies the operation to be performed by SCAT3 on the SCA. The functions, their associated digital values, and the required parameters are listed and described below.

<u>Function</u>	<u>Digital Value</u>	<u>Required Parameters*</u>
Test	0	Control
Monitor	1	Control, I/O Area, Error
Alarm	2	Control
Close	3	Control
Receive	4	Control, I/O Area, Error
Transmit Block	5	Control, I/O Area, Error
Transmit Text	6	Control, I/O Area, Error
Transmit EOT	7	Control

*Any parameter not required for a particular function must be omitted.

Test. Tests the Device Routine Busy indicator and branches to LIBF+2 if the previous operation has not been completed, or to LIFB+3 if the previous operation has been completed.

It is possible to initiate a Test, Alarm, or Close operation while a Monitor, any Transmit, or any Receive operation is in progress.

Monitor. Monitors the line for the specified polling address and selection address.

The polling address and the selection address are limited to one character each; this character must not be a control character.

The polling address parameter specifies the location of the polling address. The polling address must be left-justified. The word following the polling address is used for storing a non-zero indication that the polling address was received on the line.

The selection address parameter specifies the location of the selection address. The selection address must be left-justified. The word following the selection address is used for storing a non-zero indication that the selection address was received on the line.

If the polling address is received, EOT is transmitted, a non-zero indication is stored in the word following the polling address, and SCAT3 continues monitoring.

If the selection address is received, NAK is transmitted, a non-zero indication is stored in the word following the selection address, and SCAT3 continues monitoring.

A Monitor operation must be initiated before the first Transmit Initial or Receive Initial. The Monitor operation does not turn on the Device Routine Busy indicator.

Alarm. Turns on the audible alarm in the local system if digit 3 of the control parameter is zero; turns off the audible alarm if digit 3 of the control parameter is non-zero.

Close. Ends all operations on the SCA and disconnects the station from the line.

Receive. A Receive operation can be one of three types. Digit 2 of the control parameter is used to specify which sub-function of Receive is requested.

<u>Digit 2</u>	<u>Digital Value</u>	<u>Sub-function</u>
	0	Receive Initial
	1	Receive Continue
	2	Receive Repeat

- Receive Initial--Monitors the line for the specified selection address followed by ENQ; upon receiving the selection address and ENQ, transmits ACK0 and receives the message.
- Receive Continue--Transmits the correct positive acknowledgement for the current message and receives the next message.
- Receive Repeat--Transmits NAK for the current message and receives the next message.

When performing a Receive operation, the first word of the I/O area contains the maximum number of unpacked characters (word count) that can be read into that area.

The entire message that is received is stored in the I/O area, including the SOH character and/or the STX character (DLE STX, if Transparent text), the ETB character (DLE ETB, if Transparent text), or the ETX character (DLE ETX, if Transparent text). After the message has been received, the number of characters received, including control characters, is stored in the first word of the I/O area.

All characters in the I/O area are unpacked and left-justified.

If the record is received in Transparent text mode, SCAT3 deletes the second DLE character (inserted at the transmitting station) in each pair of DLE characters received.

If there were no errors in the message, SCAT3 clears the Device Routine Busy indicator and starts the 3-second timer. The user should initiate some Receive operation within 3 seconds in order to avoid any unnecessary line delay.

If the block check character (CRC-16) is found to be incorrect, if the message overflows the I/O area, or if a Receive timeout occurs while receiving the message, SCAT3 transmits NAK and attempts to receive the message again. After eight unsuccessful attempts, the subroutine branches to the user's error routine with an error code in the accumulator (see Post-operation Error Detection). If the user returns with a positive accumulator, the subroutine transmits NAK and attempts to receive the message again (up to seven more attempts before branching to the user's error routine). If the user returns with a zero accumulator, SCAT3 returns to the monitoring operation. If the user returns with a negative accumulator, SCAT3 clears the Device Routine Busy indicator and stores the number of characters, including control characters, received in the message in the first word of the I/O area, allowing the user to initiate a Monitor, Receive Continue, Receive Repeat, Transmit Initial, or Close operation.

If the EOT character is received, SCAT3 clears the first word of the I/O area to zero, clears the Device Routine Busy indicator, and returns to the monitoring operation. The user may then initiate a Transmit Initial, Receive Initial, or Close operation. If no operation is initiated, SCAT3 continues monitoring.

If, while monitoring for the selection address, the polling address is received, SCAT3 transmits EOT, stores a non-zero indication in the location following the polling address specified in the last Monitor operation initiated (see Monitor), and continues monitoring for the selection address.

Transmit Block/Text. There are four types of Transmit Block and Transmit Text operations. Digits 2 and 4 of the control parameter are used to specify which sub-function of Transmit Block/Text is requested.

Digit 2	Digital Value	Sub-function
	0	Transmit Initial
	1	Transmit Continue
Digit 4	Digital Value	Sub-function
	0	Normal EBCDIC text
	non-zero	Full-Transparent text

- Transmit Initial Block/Text--Monitors the line for the specified polling address followed by ENQ; upon receiving the polling address and ENQ, transmits the message from the I/O area, transmits the CRC-16, and receives the acknowledgement (ACK1).
- Transmit Initial Transparent Block/Text--Monitors the line for the specified polling address followed by ENQ; upon receiving the polling address and ENQ, transmits the message from the I/O area, transmits DLE ETB/DLE ETX, transmits the CRC-16, and receives the acknowledgement (ACK1).
- Transmit Continue Block/Text--Transmits the message from the I/O area, transmits the CRC-16, and receives the acknowledgement.
- Transmit Continue Transparent Block/Text--Transmits the message from the I/O area, transmits DLE ETB/DLE ETX, transmits the CRC-16, and receives the acknowledgement.

When performing a Transmit Block/Text operation, the first word of the I/O area contains the number of characters in the message. The character count includes the control characters in the message. All characters in the I/O area are unpacked and left-justified. If the user wishes to start the message with a heading (optional), he must supply the SOH character as the first character of the message.

If there is text in the message, the text portion of the message follows the heading. When digit 4 of the control parameter is zero, the text is Normal EBCDIC text and must begin with STX and end with ETB/ETX. The user must supply these characters. When digit 4 of the control parameter is non-zero, the text is Full-Transparent text and must begin with DLE STX. The user must supply these characters. The ending characters, DLE ETB/DLE ETX are supplied by SCAT3. SCAT3 transmits a second DLE character after each DLE that is found in the Transparent text.

If a redundancy check of the heading separate from the text is desired, the heading must end with ETB. The ETB is supplied by the user.

The I/O area is not checked for misplaced or incorrect control characters.

SCAT3 transmits the 16-bit block check character (CRC-16) after the ETB/ETX is transmitted. The CRC-16 is generated by SCAT3.

If NAK is received in response to a message, the message is re-transmitted.

If EOT is received in response to ENQ or to a message, SCAT3 clears the first word of the I/O area to zero, clears the Device Routine Busy indicator, and returns to the monitoring operation. The user may then initiate a Receive Initial, Transmit Initial, or Close operation. If no operation is initiated, SCAT3 continues monitoring.

If anything other than EOT, NAK, or a positive acknowledgement is received in response to a message, ENQ is transmitted. If the incorrect positive acknowledgement is received, SCAT3 re-transmits the message if a Receive timeout occurred after the message was transmitted; SCAT3 transmits ENQ if no Receive timeout occurred.

If, after eight attempts, the proper positive acknowledgement is not received, SCAT3 branches to the user's error routine with an error code in the accumulator (see Post-operation Error Detection). If the user returns from the error routine with a positive accumulator, the transmission is attempted seven more times. If the user returns with a zero accumulator, SCAT3 returns to the monitoring operation. If the user returns with a negative accumulator, SCAT3 continues as if the proper positive acknowledgement was received.

When the proper acknowledgement is received, SCAT3 clears the Device Routine Busy indicator and starts the 3-second timer. The user should initiate some Transmit operation within 3 seconds in order to avoid any unnecessary line delay.

If, while monitoring for the polling address, the selection address is received, SCAT3 transmits NAK, stores a non-zero indication in the location following the selection address specified in the last Monitor operation initiated (see Monitor), and continues monitoring for the polling address.

Transmit EOT. Transmits EOT and returns to the monitoring operation.

Transmit/Receive Sub-function

The interpretation of digit 2 of the control parameter varies, depending on the setting of digit 1.

Digit 1		Digit 2	
Value	Meaning	Value	Meaning
4	Receive	0	Receive Initial
4	Receive	1	Receive Continue
4	Receive	2	Receive Repeat
5	Transmit Block	0	Transmit Initial Block
5	Transmit Block	1	Transmit Continue Block
6	Transmit Text	0	Transmit Initial Text
6	Transmit Text	1	Transmit Continue Text

Alarm

Digit 3 of the control parameter specifies the requested condition of the Audible Alarm.

Digit 3	Digital Value	Alarm Condition
	0	on
	non-zero	off

Normal/Transparent Text

Digit 4 of the control parameter specifies the text mode for the data being transmitted.

Digit 4	Digital Value	Text Mode
	0	Normal EBCDIC text
	non-zero	Full-Transparent text

Error Handling

For a description of error handling procedures, refer to General Error Handling Procedures in the publication IBM 1130 Subroutine Library.

Pre-operation Error Detection

The following conditions result in pre-operation error action (accumulator settings are shown in parentheses):

- Invalid function code (8001_{16})
- Invalid sub-function code for some Transmit or Receive operation (8001_{16})
- Invalid word count (8001_{16})

Post-operation Error Detection

The following conditions result in a branch to the user's error routine (accumulator settings are shown in parentheses):

- Data set not ready (8000₁₆)
- 3-second timeout occurred while receiving a message (2000₁₆)
- I/O area overflow (1000₁₆)
- Block check character (CRC-16) in error (0800₁₆)
- Receive timeout occurred after transmitting a message or ENQ, or invalid sequence received in response to a message or ENQ (0200₁₆)
- NAK received, or the incorrect acknowledgement received following a Receive timeout (0400₁₆)
- Incorrect acknowledgement received with no Receive timeout (0100₁₆)

PRINTER SUBROUTINE - PRNT2

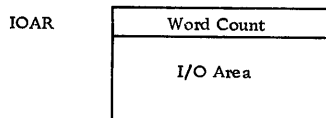
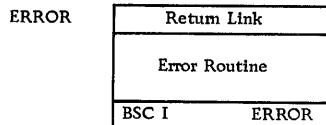
The printer subroutine PRNT2 is an additional printer subroutine for the IBM 1132 Printer, specifically provided to permit concurrent operation of the 1132 and the Synchronous Communications Adapter. PRNT2 handles all print and carriage control functions related to the 1132.

Only one line of data can be printed, or one carriage operation executed, with each call to the printer subroutine. The data in the output area must be in EBCDIC form, packed two characters per word.

Restriction. The PRNT1 and PRNT2 subroutines are mutually exclusive; i.e., both subroutines may not be in core at the same time. Thus, if the Synchronous Communications Adapter is in operation, the PRNT2 subroutine must be used for concurrent operation of the 1132 Printer. If the PRNT2 subroutine is required in a coreload for the concurrent operation of the 1132 Printer and the Adapter, all IBM- and user-written programs in that coreload using the PRNT1 subroutine must be modified to use the PRNT2 subroutine.

Calling Sequence

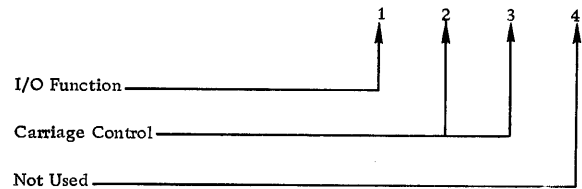
LIBF	PRNT2	
DC	/XXXX	(Control Parameter)
DC	IOAR	(I/O Area Address)
DC	ERROR	(Error Routine Address)
•	•	
•	•	
•	•	



The calling sequence parameters are described in the following paragraphs.

Control Parameter

The control parameter consists of four hexadecimal digits which are used as shown below:



I/O Function

The I/O function digit specifies the operation to be performed on an 1132 Printer. The functions, their associated digital values, and the required parameters are listed and described below.

<u>Function</u>	<u>Digital Value</u>	<u>Required Parameters*</u>
Test	0	Control
Print	2	Control, I/O Area, Error
Control Carriage	3	Control
Print Numerical	4	Control, I/O Area, Error

*Any parameter not required for a particular function must be omitted.

Test. Branches to LIBF+2 if the previous operation has not been completed or to LIBF+3 if the previous operation has been completed.

Print. Prints characters from the user's I/O area; checks for channel 9 and 12 indications. If either of these conditions is detected, the subroutine branches to the user's error routine after the line of data has been printed. Upon return from this

error routine, a skip to channel 1 is initiated or the operation is terminated, depending upon whether the accumulator is non-zero or zero.

Control Carriage. Controls the carriage as specified by the carriage control digits listed in Table 5.

Print Numerical. Prints only numerals and special characters from the user's I/O area and checks for channel 9 and channel 12 indications. See Print above.

Carriage Control

Digits 2 and 3 specify the carriage control operations listed in Table 5. An immediate request is executed before the next print operation; an after-print request is executed after the next print operation and replaces the normal space operation.

If the I/O function is Print, only digit 3 is examined; if the I/O function is Control Carriage, and digits 2 and 3 both specify carriage operations, only digit 2 is used.

I/O Area Parameter

The I/O area parameter is the label of the control word that precedes the user's I/O area. The control word consists of a word count that specifies the number of words of data to be printed. The data must be in EBCDIC format, packed two characters per word.

Error Parameter

See Calling Sequence for format.

Error Handling

For a description of error handling procedures, refer to General Error Handling Procedures in the publication IBM 1130 Subroutine Library.

Pre-operation Error Detection

The following conditions result in pre-operation error action (accumulator settings are shown in parentheses):

Table 5. Carriage Control Operations

Digit #2: Immediate Carriage Operations
<u>Print Functions</u> Not Used
<u>Control Function</u> 1 - Immediate Skip To Channel 1 2 - Immediate Skip To Channel 2 3 - Immediate Skip To Channel 3 4 - Immediate Skip To Channel 4 5 - Immediate Skip To Channel 5 6 - Immediate Skip To Channel 6 9 - Immediate Skip To Channel 9 C - Immediate Skip To Channel 12 D - Immediate Space Of 1 E - Immediate Space Of 2 F - Immediate Space Of 3
Digit #3: After-Print Carriage Operations
<u>Print Functions</u> 0 - Space One Line After Printing 1 - Suppress Space After Printing
<u>Control Function</u> 1 - Skip After Print To Channel 1 2 - Skip After Print To Channel 2 3 - Skip After Print To Channel 3 4 - Skip After Print To Channel 4 5 - Skip After Print To Channel 5 6 - Skip After Print To Channel 6 9 - Skip After Print To Channel 9 C - Skip After Print To Channel 12 D - Space 1 After Print E - Space 2 After Print F - Space 3 After Print

- 1132 not ready (6000₁₆)
- End of forms (6000₁₆)
- Invalid control parameter (6001₁₆)
- Invalid word count (6001₁₆)

Post-operation Error Detection

The following conditions result in a branch to the user's error routine (accumulator settings are shown in parentheses):

- Channel 9 detected (0003₁₆)
- Channel 12 detected (0004₁₆)

HOL48

This subroutine converts IBM card code to the 4-of-8 code or converts the 4-of-8 code to IBM card code (see Appendix A). Only the 64 data characters specified in 4-of-8 code are recognized and converted. Any others are converted to the blank character.

Calling Sequence

LIBF	HOL48
DC	/XXXX (Control Parameter)
DC	INPUT (Input Area Address)
DC	OTPUT (Output Area Address)
DC	NNNN (Character count)

Control Parameter

The control parameter consists of four hexadecimal digits. Digits 1-3 are not used and must be zero. The fourth digit specifies the direction of conversion:

- 0 - IBM card code to 4-of-8 code
- 1 - 4-of-8 code to IBM card code.

Input

Input is either IBM card code or 4-of-8 code (as specified by the control parameter), starting at location INPUT. IBM card code characters are stored one character per word. 4-of-8 characters are stored one character per word, left-justified.

Output

Output is either IBM card code or 4-of-8 code, starting at location OTPUT. Characters are stored as

described under Input. The address INPUT must be equal to or greater than the address OTPUT. The subroutine starts processing at location INPUT.

Character Count

This number specifies the number of characters to be converted and is equal to the number of words required for INPUT and OTPUT.

Errors Detected

No errors are detected during conversion of 4-of-8 code to IBM card code. The SCAT1 subroutine detects any invalid characters in the data being transmitted or received and causes an exit to the error routine upon detection. Hence, only valid 4-of-8 characters reach the I/O area.

In the conversion of IBM card code to 4-of-8 code, any input character that does not conform to one of the 64 4-of-8 characters is replaced in the output buffer by the blank character.

Conversion is not terminated when an error is detected; the Carry indicator is turned off and the Overflow indicator is turned on before returning control to the user. Otherwise, the Carry and Overflow indicators are not changed by the conversion subroutines.

Additional Subroutines and Tables

HOL48 uses a conversion subroutine (HXCVC) and two tables (STRTB, HOLCA), all three of which reside in the subroutine library.

HXCVC. Converts 4-of-8 code to a table of displacements.

STRTB. A table consisting of 4-of-8 and EBCDIC codes.

HOLCA. A table consisting of IBM card codes.

EBC48

This subroutine converts EBCDIC characters to the 4-of-8 code or converts the 4-of-8 code to EBCDIC code (see Appendix A). Only the 64 data characters available in the 4-of-8 code are recognized and converted. Any others are converted to the blank character.

Calling Sequence

LIBF	EBC48	
DC	/XXXX	(Control Parameter)
DC	INPUT	(Input Area Address)
DC	OTPUT	(Output Area Address)
DC	NNNN	(Character count)

Control Parameter

The control parameter consists of four hexadecimal digits. Digits 1-3 are not used and must be zero. The fourth digit specifies the direction of conversion:

- 0 - EBCDIC to 4-of-8 code
- 1 - 4-of-8 code to EBCDIC.

Input

Input is either EBCDIC characters or 4-of-8 characters (as specified by the control parameter), starting at location INPUT. EBCDIC characters must be packed two characters per word; 4-of-8 characters are stored one character per word, left-justified.

Output

Output is either EBCDIC characters or 4-of-8 characters, starting at location OTPUT. Characters are packed as described in Input.

If the direction of the conversion is 4-of-8 code to EBCDIC output, the input area can overlap the output area if the address INPUT is equal to or greater than the address OTPUT. If the direction of the conversion is EBCDIC input to 4-of-8 output, the input area can overlap the output area if the address INPUT+n/2 is equal to or greater than the address OTPUT+n, when n is the character count specified. The subroutine starts processing at location INPUT.

Character Count

This number specifies the number of EBCDIC characters (packed two per word) or the number of 4-of-8 characters (one per word) to be converted. If an odd count is specified for EBCDIC output, bits 8 through 15 of the last word in the output area are set to an indeterminate value.

Errors Detected

No errors are detected during conversion of 4-of-8 code to EBCDIC. The SCAT1 subroutine detects any invalid characters in the data being transmitted or received and causes an exit to the error routine upon detection. Hence, only valid 4-of-8 characters reach the I/O area.

In the conversion of EBCDIC to 4-of-8 code, any input character that does not conform to one of the 64 4-of-8 characters is replaced in the output buffer by the blank character.

Conversion is not terminated when an error is detected; the Carry indicator is turned off and the Overflow indicator is turned on before returning control to the user. Otherwise, the Carry and Overflow indicators are not changed by the conversion subroutines.

Additional Subroutines and Tables

EBC48 uses a conversion subroutine (HXCVC) and a table (STRTB), both of which reside in the subroutine library.

HXCVC. Converts 4-of-8 code to a table of displacements.

STRTB. A table consisting of 4-of-8 and EBCDIC codes.

The following is a sample program showing the use of the SCAT1 subroutine to perform data transmission and reception in STR mode.

```

// JOB
// ASM
*LIST
*PRINT SYMBOL TABLE
0438          ABS
              ORG      /0300
              * IBM 1130 MONITOR SCAT SAMPLE PROGRAM
              * OPEN, DATA IN
              * RECEIVE
              * CONVERT TO EBC
              * PRINT
              * LOOP TO RECEIVE UNTIL
              * EOT
0300 0 3000   PART1 WAIT
0301 20 176558F2 LIBF PRNT2 SKIP TO CHANNEL 1
0302 0 3100     DC      /3100
*
0303 20 220C18F1 LIBF SCAT1
0304 0 4000     DC      /4000 OPEN, DATA IN
0305 0 0000     DC      0
0306 0 03B4     DC      OPENX
*
0307 20 220C18F1 LIBF SCAT1
0308 0 0000     DC      /0000 LOOP UNTIL NOT BUSY
0309 0 70FD     MDX     *-3
*
030A 00 C40003B4 LD L OPENX
030C 00 4C2003BA BSC L ER1,Z BR, IF ERROR IN OPEN
*
030E 0 C029     LOOPA LD D81 RESTORE WORD COUNT
030F 0 D029     STO A
0310 20 220C18F1 LIBF SCAT1
0311 0 6000     DC      /6000 RECEIVE
0312 0 0339     DC      A
0313 0 03C6     DC      RCVX
*
0314 20 220C18F1 LIBF SCAT1
0315 0 0000     DC      /0000 LOOP UNTIL NOT BUSY
0316 0 70FD     MDX     *-3
*
0317 00 C40003C6 LD L RCVX
0319 00 4C2003CD BSC L ER2,Z BR, IF ERROR IN RECEIVE
*
031B 0 C01D     CONT LD A
031C 00 4C1803E0 BSC L EOT,Z- BR IF END OF TRANSMISSION
031E 00 C40003C6 LD L RCVX
0320 00 4C180326 BSC L PNTR,Z-
0322 0 1010     SLA 16
0323 00 D40003C6 STO L RCVX
0325 0 70E8     MDX     LOOPA
*
0326 0 C012     PNTR LD A
0327 0 D007     STO COUNT NUMBER OF CHARACTERS RCVD
0328 0 1801     SRA 1
0329 00 D400038B STO L PRNT NUMBER OF WORDS TO PRINT
*
032B 20 05083D38 LIBF ERC48
032C 0 0001     DC      /0001 CONVERT 4/8 TO EBCDIC
032D 0 033A     DC      A&1 4/8 AREA
032E 0 038C     DC      PRNT&1 EBCDIC AREA
032F 0 0000     COUNT DC *-* CHARACTER COUNT
*
0330 20 176558F2 LIBF PRNT2
0331 0 0000     DC      /0000 LOOP UNTIL NOT BUSY
0332 0 70FD     MDX     *-3
*
0333 20 176558F2 LIBF PRNT2
0334 0 2000     DC      /2000 PRINT 1 RECORD
0335 0 0388     DC      PRNT
0336 0 03DD     DC      PRNTX
*
0337 0 70D6     MDX     LOOPA GO TO RECEIVE
*
0338 0 0051     D81 DC 681

```

SMSTR001
SMSTR002
SMSTR003
SMSTR004
SMSTR005
SMSTR006
SMSTR007
SMSTR008
SMSTR009
SMSTR010
SMSTR011
SMSTR012
SMSTR013
SMSTR014
SMSTR015
SMSTR016
SMSTR017
SMSTR018
SMSTR019
SMSTR020
SMSTR021
SMSTR022
SMSTR023
SMSTR024
SMSTR025
SMSTR026
SMSTR027
SMSTR028
SMSTR029
SMSTR030
SMSTR031
SMSTR032
SMSTR033
SMSTR034
SMSTR035
SMSTR036
SMSTR037
SMSTR038
SMSTR039
SMSTR040
SMSTR041
SMSTR042
SMSTR043
SMSTR044
SMSTR045
SMSTR046
SMSTR047
SMSTR048
SMSTR049
SMSTR050
SMSTR051
SMSTR052
SMSTR053
SMSTR054
SMSTR055
SMSTR056
SMSTR057
SMSTR058
SMSTR059
SMSTR060
SMSTR061
SMSTR062
SMSTR063
SMSTR064
SMSTR065
SMSTR066
SMSTR067
SMSTR068
SMSTR069
SMSTR070
SMSTR071
SMSTR072
SMSTR073
SMSTR074
SMSTR075
SMSTR076

0339 0 0051	A	DC	681		SMSTR077
033A 0051		BSS	81		SMSTR078
	*				SMSTR079
038B 0 0000	PRNT	DC	**		SMSTR080
038C 0028		BSS	40		SMSTR081
	*				SMSTR082
03B4 0 0000	OPENX	DC	0	ERROR ROUTINE FOR OPEN	SMSTR083
03B5 0 D023		STO	CODE		SMSTR084
03B6 00 440005A4		BSI L	TYPIT	GO TYPE ERROR CODE	SMSTR085
03B8 00 4C8003R4		BSC I	OPENX		SMSTR086
	*				SMSTR087
03BA 0 C01E	ER1	LD	CODE		SMSTR088
03BB 0 901E		S	H1000		SMSTR089
03BC 00 4C20030E		BSC L	LOOPA,Z		SMSTR090
	*				SMSTR091
03BE 20 220C18F1	TEL	LIBF	SCAT1	CLOSE OPERATION	SMSTR092
03BF 0 3000		DC	/3000	OPEN - TEL	SMSTR093
03C0 0 C01A		LD	HCCCC		SMSTR094
03C1 0 3000	WAIT	WAIT			SMSTR095
03C2 0 1010		SLA	16		SMSTR096
03C3 0 D0F0		STO	OPENX		SMSTR097
03C4 00 4C000300		BSC L	PART1		SMSTR098
	*				SMSTR099
03C6 0 0000	RCVX	DC	0	ERROR ROUTINE FOR RECEIVE	SMSTR100
03C7 0 D011		STO	CODE		SMSTR101
03C8 00 440005A4		BSI L	TYPIT	GO TYPE ERROR CODE	SMSTR102
03CA 0 C010		LD	HCCCC	ACCEPT BAD RECORD	SMSTR103
03CB 00 4C8003C6		BSC I	RCVX		SMSTR104
	*				SMSTR105
03CD 0 C00B	ER2	LD	CODE		SMSTR106
03CE 0 900B		S	H1000		SMSTR107
03CF 00 4C20031R		BSC L	CONT,Z		SMSTR108
	*				SMSTR109
03D1 20 220C18F1	TEL2	LIBF	SCAT1	CLOSE OPERATION	SMSTR110
03D2 0 3000		DC	/3000	RCV - TEL	SMSTR111
03D3 0 C00B		LD	HEEEE		SMSTR112
03D4 0 3000	WAIT2	WAIT			SMSTR113
03D5 0 1010		SLA	16		SMSTR114
03D6 0 D0EF		STO	RCVX		SMSTR115
03D7 00 4C000300		BSC L	PART1		SMSTR116
	*				SMSTR117
03D9 0 0000	CODE	DC	0		SMSTR118
03DA 0 1000	H1000	DC	/1000		SMSTR119
03DB 0 CCCC	HCCCC	DC	/CCCC		SMSTR120
03DC 0 EEEE	HEEEE	DC	/EEEE		SMSTR121
03DD 0 0000	PRNTX	DC	0		SMSTR122
03DE 00 4C8003DD		BSC I	PRNTX		SMSTR123
	*				SMSTR124
03E0 20 176558F2	EOT	LIBF	PRNT2	PRINT END OF JOB	SMSTR125
03E1 0 2000		DC	/2000		SMSTR126
03E2 0 03E6		DC	END		SMSTR127
03E3 0 03DD		DC	PRNTX		SMSTR128
03E4 00 4C0003F9		BSC L	PART2		SMSTR129
03E6 0 0011	END	DC	END1-END-1		SMSTR130
03E7 0021		EBC	.THIS IS THE END OF THIS TEST CASE.		SMSTR131
03F8 0 0000	END1	DC	0		SMSTR132
	*				SMSTR133
	*			1. OPEN FUNCTION	SMSTR134
	*			DATA OUT ONLY	SMSTR135
	*			2. TEST FUNCTION	SMSTR136
	*			3. TRANSMIT FUNCTION	SMSTR137
	*			DATA	SMSTR138
	*			4. TRANSMIT FUNCTION	SMSTR139
	*			EOT	SMSTR140
	*			5. CLOSE FUNCTION	SMSTR141
	*				SMSTR142
03F9 20 03059131	PART2	LIBF	CARD1	READ CARD INTO BUFFER 1	SMSTR143
03FA 0 1000		DC	/1000		SMSTR144
03FB 0 044B		DC	BUF1		SMSTR145
03FC 0 058F		DC	CDERR		SMSTR146
	*				SMSTR147
03FD 20 220C18F1		LIBF	SCAT1		SMSTR148
03FE 0 4001		DC	/4001	OPEN, DATA OUT	SMSTR149
03FF 0 0000		DC	0		SMSTR150
0400 0 038A		DC	OPENX		SMSTR151
	*				SMSTR152
0401 20 03059131	LOOP	LIBF	CARD1	LOOP UNTIL CARD HAS	SMSTR153
0402 0 0000		DC	/0000	BEEN READ	SMSTR154
0403 0 70FD		MDX	*-3		SMSTR155
	*				SMSTR156
0404 20 08593D38		LIBF	H0L48		SMSTR157
0405 0 0000		DC	/0000	CONVERT BUF1 TO 4 OF 8	SMSTR158
0406 0 044C		DC	BUF1&1	IN XMIT1	SMSTR159
0407 0 04EE		DC	XMIT1&1		SMSTR160
0408 0 0050		DC	880		SMSTR161
	*				SMSTR162
0409 00 44010444		BSI L	CONVT,0	BRANCH IF ERROR IN CONVERT	SMSTR163

040B 20	220C18F1	*	LIBF	SCAT1	LOOP UNTIL SYNCHRONIZATION	SMSTR164
040C 0	0000		DC	/0000	IS ESTABLISHED OR	SMSTR165
040D 0	70FD		MDX	*-3	TRANSMISSION IS COMPLETE	SMSTR166
040E 0	C03B	*	LD	LAST		SMSTR167
040F 00	4C200415		BSC L	X1,Z	BRANCH ON LAST CARD	SMSTR168
0411 20	03059131	*	LIBF	CARD1	READ CARD INTO BUFFER 2	SMSTR169
0412 0	1000		DC	/1000		SMSTR170
0413 0	049C		DC	BUF2		SMSTR171
0414 0	058F		DC	CDERR		SMSTR172
0415 20	220C18F1	X1	LIBF	SCAT1	TRANSMIT DATA FROM XMIT1	SMSTR173
0416 0	5000		DC	/5000		SMSTR174
0417 0	04ED		DC	XMIT1		SMSTR175
0418 0	0597		DC	XMITX		SMSTR176
0419 0	C030	*	LD	LAST		SMSTR177
041A 00	4C200437		BSC L	END2,Z	LAST CARD, SEND EOT	SMSTR178
041C 20	03059131	*	LIBF	CARD1	LOOP UNTIL CARD HAS	SMSTR179
041D 0	0000		DC	/0000	BEEN READ	SMSTR180
041E 0	70FD		MDX	*-3		SMSTR181
041F 20	08593D38	*	LIBF	HOL48		SMSTR182
0420 0	0000		DC	/0000		SMSTR183
0421 0	049D		DC	BUF2&1	CONVERT BUF2 TO 4 OF 8	SMSTR184
0422 0	053F		DC	XMIT2&1	IN XMIT2	SMSTR185
0423 0	0050		DC	680		SMSTR186
0424 00	44010444	*	BSI L	CONVT,0	BRANCH IF ERROR IN CONVERT	SMSTR187
0426 20	220C18F1	*	LIBF	SCAT1	LOOP UNTIL TRANSMISSION	SMSTR188
0427 0	0000		DC	/0000	IS COMPLETE	SMSTR189
0428 0	70FD		MDX	*-3		SMSTR190
0429 0	C020	*	LD	LAST		SMSTR191
042A 00	4C200430		BSC L	X2,Z	BRANCH ON LAST CARD	SMSTR192
042C 20	03059131	*	LIBF	CARD1	READ CARD INTO BUFFER 1	SMSTR193
042D 0	1000		DC	/1000		SMSTR194
042E 0	044B		DC	BUF1		SMSTR195
042F 0	058F		DC	CDERR		SMSTR196
0430 20	220C18F1	X2	LIBF	SCAT1	TRANSMIT DATA FROM XMIT2	SMSTR197
0431 0	5000		DC	/5000		SMSTR198
0432 0	053E		DC	XMIT2		SMSTR199
0433 0	0597		DC	XMITX		SMSTR200
0434 0	C015	*	LD	LAST		SMSTR201
0435 00	4C180401		BSC L	LOOP,6-	NOT LAST CARD SO CONTINUE	SMSTR202
0437 20	220C18F1	END2	LIBF	SCAT1	LOOP UNTIL TRANSMIT IS	SMSTR203
0438 0	0000		DC	/0000	COMPLETE	SMSTR204
0439 0	70FD		MDX	END2		SMSTR205
043A 20	220C18F1	*	LIBF	SCAT1	TRANSMIT EOT	SMSTR206
043B 0	5100		DC	/5100		SMSTR207
043C 0	0000		DC	0		SMSTR208
043D 0	059E		DC	EOTX		SMSTR209
043E 20	220C18F1	*	LIBF	SCAT1	LOOP UNTIL TRANSMIT IS	SMSTR210
043F 0	0000		DC	/0000	COMPLETE	SMSTR211
0440 0	70FD		MDX	*-3		SMSTR212
0441 20	220C18F1	*	LIBF	SCAT1	CLOSE UP SHOP.	SMSTR213
0442 0	3000		DC	/3000		SMSTR214
0443 0	3000	*	WAIT		END OF JOB	SMSTR215
0444 0	0000	CONVT	DC	0		SMSTR216
0445 00	74010449		MDX L	ERCNT,61	ADD TO CONVERSION ERRORS	SMSTR217
0447 00	4C800444		BSC I	CONVT		SMSTR218
0449 0	0000	*	ERCNT	DC	0	SMSTR219
044A 0	0000		LAST	DC	0	SMSTR220
044B 0	0050	*	BUF1	DC	680	SMSTR221
044C	0050		BSS	80	CARD BUFFER 1	SMSTR222
049C 0	0050	*	BUF2	DC	680	SMSTR223
049D	0050		BSS	80	CARD BUFFER 2	SMSTR224
04ED 0	0050	*	XMIT1	DC	680	SMSTR225
04EE	0050		BSS	80	CAT BUFFER 1	SMSTR226
						SMSTR227
						SMSTR228
						SMSTR229
						SMSTR230
						SMSTR231
						SMSTR232
						SMSTR233
						SMSTR234
						SMSTR235
						SMSTR236
						SMSTR237
						SMSTR238
						SMSTR239
						SMSTR240
						SMSTR241
						SMSTR242
						SMSTR243
						SMSTR244
						SMSTR245
						SMSTR246
						SMSTR247
						SMSTR248
						SMSTR249

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053E 0 0050      * XMIT2 DC      800      CAT BUFFER 2
053F 0 0050      *      BSS      80
                                *
058F 0 0000      * CDERR DC      0
0590 00 4CA0058F BSC I CDERR,Z
0592 0 C000      *      LD      *      LAST CARD WAS READ
0593 00 D400044A      *      STO L LAST
0595 00 4C80058F      *      BSC I CDERR
                                *
0597 0 0000      * XMITX DC      0
0598 0 D00A      *      STO CODE1
0599 00 440005A4      *      BSI L TYPIT      GO TYPE ERROR CODE
059B 0 C006      *      LD      H8000      GET NEXT RECORD
059C 00 4C800597      *      BSC I XMITX
                                *
059E 0 0000      * EOTX DC      0
059F 0 D003      *      STO CODE1
05A0 00 4C80059E      *      BSC I ECTX
                                *
05A2 0 8000      * H8000 DC      /8000
05A3 0 0000      * CODE1 DC      0
                                *
05A4 0 0000      * TYPIT DC      *--*      TYPE ERROR CODE
05A5 0 6108      *      LDX 1 B      FIND WHICH CODE IT IS
05A6 0 1140      *      SLCA 1      PUT TILT-ROTATE
05A7 00 C50005B3      *      LD L1 CATTB      CODE IN BUFFER
05A9 0 D007      *      STO CATAR&2      TYPE
05AA 20 26663A30      *      LIBF WRTYO
05AB 0 2000      *      DC /2000
05AC 0 05AF      *      DC CATAR
05AD 00 4C8005A4      *      BSC I TYPIT      RETURN
05AF 0 0003      * CATAR DC 3      TYPEWRITER BUFFER
05B0 0 81BC      *      DC /81BC      NL,/
05B1 0 0000      *      DC *--*      WORD FROM CATTB
05B2 0 C4C4      *      DC /C4C4      /00
05B3      * CATTB EQU      *      TILT-ROTATE CODES
05B3 0 C4C4      *      DC /C4C4      /00
05B4 0 C4FC      *      DC /C4FC      /01
05B5 0 C4D8      *      DC /C4D8      /02
05B6 0 C4F0      *      DC /C4F0      /04
05B7 0 C4E4      *      DC /C4E4      /08
05B8 0 FCC4      *      DC /FCC4      /10
05B9 0 D8C4      *      DC /D8C4      /20
05BA 0 F0C4      *      DC /F0C4      /40
05BB 0 E4C4      *      DC /E4C4      /80
                                *
05BC 0300      *      *
                                *      END      PART1

```

```

SMSTR250
SMSTR251
SMSTR252
SMSTR253
SMSTR254
SMSTR255
SMSTR256
SMSTR257
SMSTR258
SMSTR259
SMSTR260
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SMSTR291
SMSTR292
SMSTR293
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SMSTR295
SMSTR296
SMSTR297
SMSTR298

```

SYMBOL TABLE

A	0339	BUF1	044B	BUF2	049C	CATAR	05AF	CATTB	05B3
CDERR	058F	CODE	03D9	CODE1	05A3	CONT	031B	CONVT	0444
COUNT	032F	D81	0338	END	03E6	END1	03F8	END2	0437
EOT	03E0	EOTX	059E	ERCNT	0449	ER1	038A	ER2	03CD
HCCCC	03DB	HEEEE	03DC	H1000	03DA	H8000	05A2	LAST	044A
LOOP	0401	LOOPA	030E	OPENX	03B4	PART1	0300	PART2	03F9
PNTR	0326	PRNT	038B	PRNTX	03DD	RCVX	03C6	TEL	03BE
TEL2	03D1	TYPIT	05A4	WAIT	03C1	WAIT2	03D4	XMITX	0597
XMIT1	04ED	XMIT2	053E	X1	0415	X2	0430		

NO ERRORS IN ABOVE ASSEMBLY.

APPENDIX A. CODE CONVERSION CHART

Graphics and Control Names	EBCDIC			IBM Card Code						4 - of - 8 Code											
	Binary		Hex	Rows						Hex											
	0213	4567		12	11	0	9	8	7-1		N	X	O	R	8	4	2	1	Hex		
(space)	0100	0000	40																F0		
␣	↓	1010	4A							no punches	0000	1	1	1	1	0	0	0	0	6A	
. (period)		1011	4B	12						8	2	8820	0	1	1	0	0	1	0	8B	
<		1100	4C	12						8	3	8420	1	0	0	0	1	0	1	1	8C
(1101	4D	12						8	4	8220	0	1	1	0	1	1	0	0	6C
+		1110	4E	12						8	5	8120	0	1	0	1	0	1	1	0	56
(logical OR) (Group Mark)		1111	4F	12						8	6	80A0	0	0	1	1	0	1	1	0	36
&	0101	0000	50	12						8	7	8060	1	0	0	0	1	1	0	1	8D
!	↓	1010	5A		11					8	2	8000	1	0	0	0	1	1	1	0	8E
\$		1011	5B		11					8	3	4820	1	1	0	0	1	0	1	0	CA
*		1100	5C		11					8	4	4420	0	1	0	0	1	0	1	1	4B
) (TEL)		1101	5D		11					8	5	4220	1	1	0	0	1	1	0	0	CC
;		1110	5E		11					8	6	4120	0	1	0	1	1	1	0	0	5C
¬ (logical NOT)		1111	5F		11					8	7	40A0	0	0	1	1	1	1	0	0	3C
- (dash)	0110	0000	60	11								4000	0	1	0	0	1	1	1	0	4E
/	↓	0001	61			0					1	3000	1	0	1	1	0	0	0	1	B1
, (comma)		1011	6B			0				8	3	2420	0	0	1	0	1	0	1	1	2B
%		1100	6C			0				8	4	2220	1	0	1	0	1	1	0	0	AC
_ (underscore) (EOT)		1101	6D			0				8	5	2120	0	1	0	1	1	0	1	0	5A
∨		1110	6E			0				8	6	20A0	0	0	1	1	1	0	1	0	3A
?		1111	6F			0				8	7	2060	0	0	1	0	1	1	0	1	2D
:	0111	1010	7A							8	2	0820	0	0	1	0	1	1	1	0	2E
#	↓	1011	7B							8	3	0420	0	0	0	1	1	0	1	0	1B
@		1100	7C							8	4	0220	1	0	0	1	1	1	0	0	9C
' (apostrophe)		1101	7D							8	5	0120	0	0	0	0	1	1	1	1	0F
=		1110	7E							8	6	00A0	0	0	0	1	1	1	1	0	1E
=	↓	1111	7F							8	7	0060	0	0	0	1	1	1	0	1	1D
A	1100	0001	C1	12						1		9000	0	1	1	1	0	0	0	1	71
B	↓	0010	C2	12						2		8800	0	1	1	1	0	0	0	1	72
C		0011	C3	12						3		8400	0	1	1	0	0	0	1	0	63
D		0100	C4	12						4		8200	0	1	1	1	0	1	0	0	74
E		0101	C5	12						5		8100	0	1	1	0	0	1	0	1	65
F		0110	C6	12						6		8080	0	1	1	0	0	1	1	0	66
G		0111	C7	12						7		8040	1	0	0	0	0	1	1	1	87
H		1000	C8	12						8		8020	0	1	1	1	1	0	0	0	78
I		1001	C9	12						9		8010	0	1	1	0	1	1	0	0	69
J	1101	0001	D1		11					1		5000	1	1	0	1	0	0	0	1	D1
K	↓	0010	D2		11					2		4800	1	1	0	1	0	0	1	0	D2
L		0011	D3		11					3		4400	1	1	0	0	0	0	1	1	C3
M		0100	D4		11					4		4200	1	1	0	1	0	1	0	0	D4
N		0101	D5		11					5		4100	1	1	0	0	0	1	0	1	C5
O		0110	D6		11					6		4080	1	1	0	0	0	1	1	0	C6
P		0111	D7		11					7		4040	0	1	0	0	0	1	1	1	47
Q		1000	D8		11					8		4020	1	1	0	1	1	0	0	0	D8
R	↓	1001	D9		11					9		4010	1	1	0	0	1	1	0	0	C9
(Record Mark)	1110	0000	E0			0				8	2	2820	1	0	1	0	1	0	1	0	AA
S	↓	0010	E2			0				2		2800	1	0	1	1	0	0	1	0	B2
T		0011	E3			0				3		2400	1	0	1	0	0	0	1	1	A3
U		0100	E4			0				4		2200	1	0	1	1	0	0	1	0	B4
V		0101	E5			0				5		2100	1	0	1	0	0	1	0	1	A5
W		0110	E6			0				6		2080	1	0	1	0	0	1	1	0	A6
X		0111	E7			0				7		2040	0	0	1	0	0	1	1	1	27
Y		1000	E8			0				8		2020	1	0	1	1	1	1	0	0	B8
Z	↓	1001	E9			0				9		2010	1	0	1	0	1	1	0	0	A9
0	1111	0000	F0			0						2000	1	0	0	1	1	0	1	0	9A
1	↓	0001	F1							1		1000	1	1	1	0	0	0	0	1	E1
2		0010	F2							2		0800	1	1	1	0	0	0	1	0	E2
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4		0100	F4							4		0200	1	1	1	0	0	1	0	0	E4
5		0101	F5							5		0100	1	0	0	1	0	1	0	1	95
6		0110	F6							6		0080	1	0	0	1	0	1	1	0	96
7		0111	F7							7		0040	0	0	0	1	0	1	1	1	17
8		1000	F8							8		0020	1	1	1	0	1	0	0	0	E8
9	↓	1001	F9							9		0010	1	0	0	1	1	0	0	1	99

APPENDIX B. OPERATING PROCEDURES

To prepare for the execution of a communications program, the user must:

1. Prepare the program for execution.
2. Prepare the 1130 Console and Operator Panel.
 - a. Turn the Speed Selection switch to the desired Baud rate
 - b. Set the STR-BSC switch to the STR position for communication in Synchronous Transmit-Receive mode, to the BSC position for communication in Binary Synchronous mode.
 - c. Set the CE Mode switch to the OFF position.
 - d. Set the Audible Alarm switch to the ON position.
3. Prepare the Data Set.
 - a. Check to ensure that the Data Set is connected to the power supply (the AC Input is plugged in).
 - b. Check to ensure that the OPER/TEST switch on the plug in the back of the Data Set is set to the OPER position.
 - c. Establish communication (required in point-to-point operation only).
 1. If this is the calling station,
 - a. Lift the receiver and press the TALK button.
 - b. Dial the other station.
 - c. When the Data-tone (a continuous, high-pitched buzz) is heard, press the DATA button. When the DATA button is lighted, communication is established.
 2. If this is the station to be called
 - a. and Auto Answer is desired, press the AUTO button. When this station is dialed, the DATA button is lighted (communication is established).
 - b. and Auto Answer is not desired, press the TALK button. When this station is dialed, answer the phone and press the DATA button. When the DATA button is lighted, communication is established.
4. Start program execution.

Operating Notes

1. Check to ensure that the same Data Set model is being used at both stations.
2. Check to ensure that the Speed Selection switch on both stations is turned to the same Baud rate.
3. Before starting program execution, check to ensure that the READY light on the 1130 Console is on.

The following considerations should be kept in mind by the user when programming using SCAT1.

1. The 4-of-8 code contains 64 valid data characters; however, some STR devices do not utilize all of the 64 data characters. The 1130 Computing System can recognize any or all of the 64 data characters as directed by the stored program, but the programmer should determine the character set recognized by the remote STR devices to avoid sending invalid characters.
2. If the user's error routine returns to SCAT1 with a zero accumulator, SCAT1 performs a Close operation. Before another Transmit or Receive operation can be performed, an Open operation must be performed. Otherwise, pre-operative errors result on subsequent attempts to Transmit or Receive.
3. After the completion of one Receive operation and before the initiation of another Receive operation, the user should check to determine if EOT was received, i. e. , the word count preceding the I/O area has been set to zero.
4. For maximum throughput, double buffering of the I/O area is recommended.
5. The user must be conscious of any special characteristics of the stations communicating with the 1130, e. g. , record sizes, valid character sets, and ILRC requirements.
6. The user should avoid reverting to handshaking between data records. Handshaking between data records results in the inefficiencies illustrated in Figures 2 and 3. In the illustrations below, both stations, A and B, are 1130 Computing Systems. The Sync-Reg shown is the idle register in the 1130 SCA that contains the character that must be received by the SCA before a read response interrupt is issued. This register is manipulated by SCAT1.

Figure 1 shows the initial handshaking, the normal sequence of communication when handshaking does not occur between data records, and the normal end of transmission.

Figure 2 shows the sequence of communication when the transmitting station, A, reverts to one handshaking sequence between data records.

Figure 3 shows the sequence of communication when the transmitting station, A, reverts to more than one handshaking sequence between data records. Note that, if the transmitting station, A, continues handshaking at POINT C, the receiving station, B, does not time out again until A transmits the data record.

The following considerations should be kept in mind by the user when programming using SCAT2.

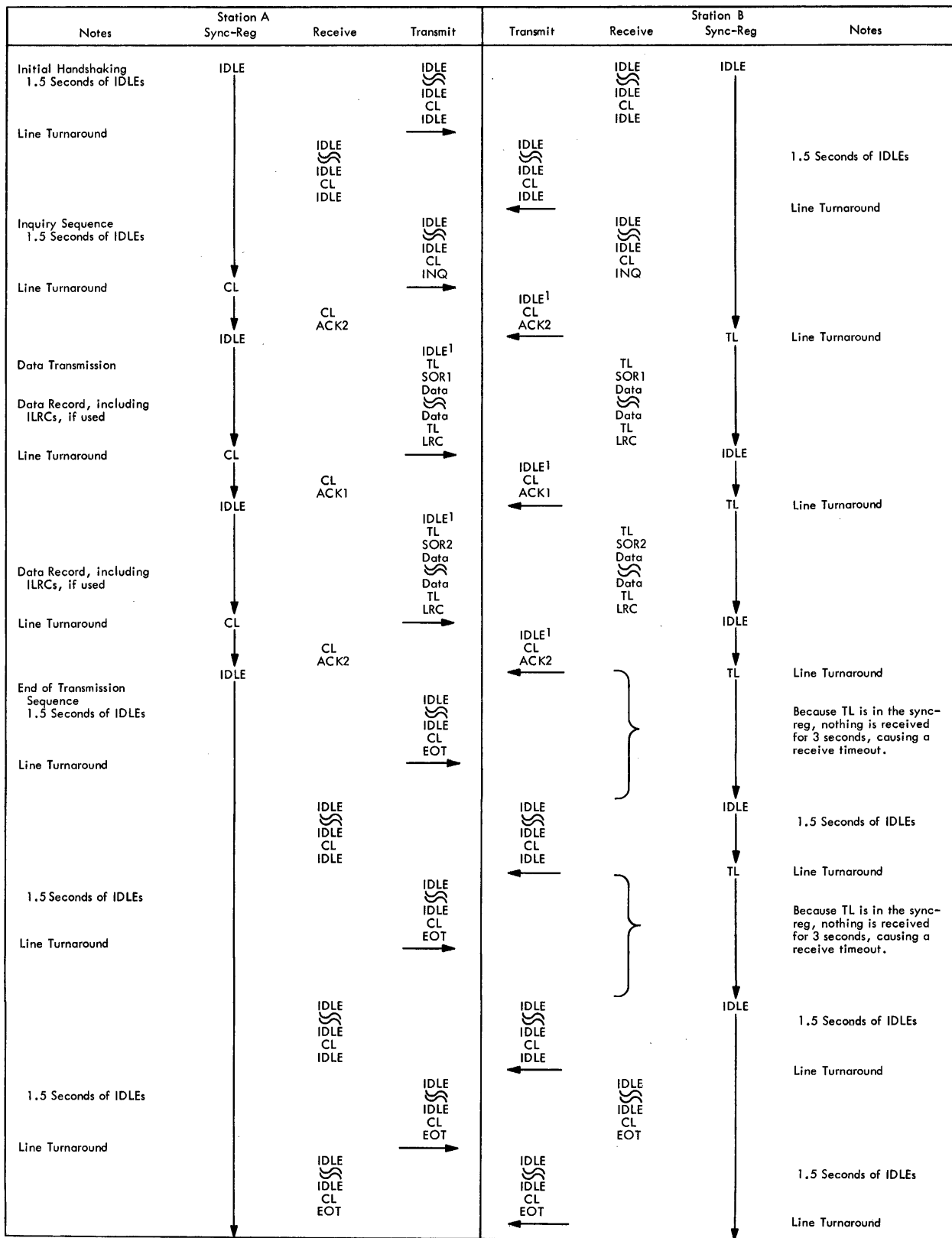
1. If the user's error routine returns to SCAT2 with a zero accumulator, SCAT2 performs a Close operation. Before making subsequent attempts to transmit or receive, the user should check to determine if a Close operation has been performed by SCAT2 as directed by the error routine.
2. After the completion of one Receive operation and before the initiation of another Receive operation, the user should check to determine if EOT or the DLE EOT sequence was received, i. e. , the word count preceding the I/O area has been set to zero or FFFF₁₆, respectively.
3. For maximum throughput, double buffering of the I/O area is recommended.
4. The user must be conscious of any special characteristics of the stations communicating with the 1130, e. g. , record sizes and valid character sets.

The following considerations should be kept in mind by the user when programming using SCAT3.

1. After the completion of one Receive operation and before the initiation of another Receive operation, the user should check to determine if EOT was received, i. e. , the word count preceding the I/O area has been set to zero.
2. The user must initiate a Receive Initial or Transmit Initial before initiating any other Receive or Transmit operation. In addition, the user should check, before initiating a Receive Continue, Receive Repeat, Transmit Continue, or Transmit End operation, to ensure that SCAT3 has not returned to the monitoring operation.

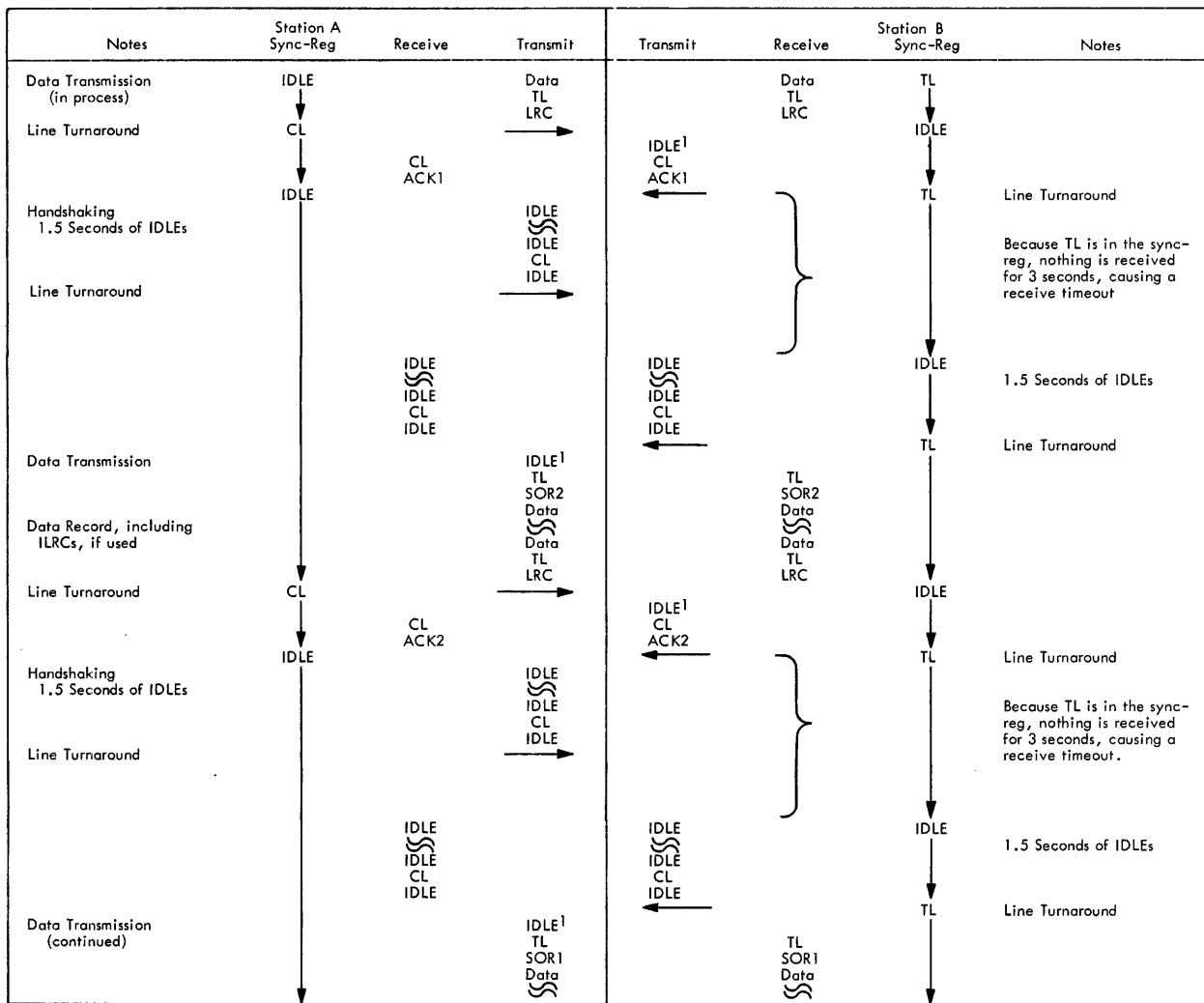
3. Once a Monitor operation has been initiated, another Monitor operation must be initiated only if a Close operation has been performed since the last Monitor operation was initiated.
4. For maximum throughput, double buffering of the I/O area is recommended.
5. The user must be conscious of any special characteristics of the station(s) communicating with the 1130, e. g. , record sizes and valid character sets.

In programming error routines to be used by SCAT1, SCAT2, and SCAT3, the user must keep in mind that (1) if an ISS is called in the error routine and the device serviced by that ISS is on an interrupt level having a priority lower than the SCA (level 1) and (2) if, before the operation of the ISS called in the error routine is completed, the error routine is re-entered, then an endless loop occurs in the error routine waiting for the called ISS to be "not busy".



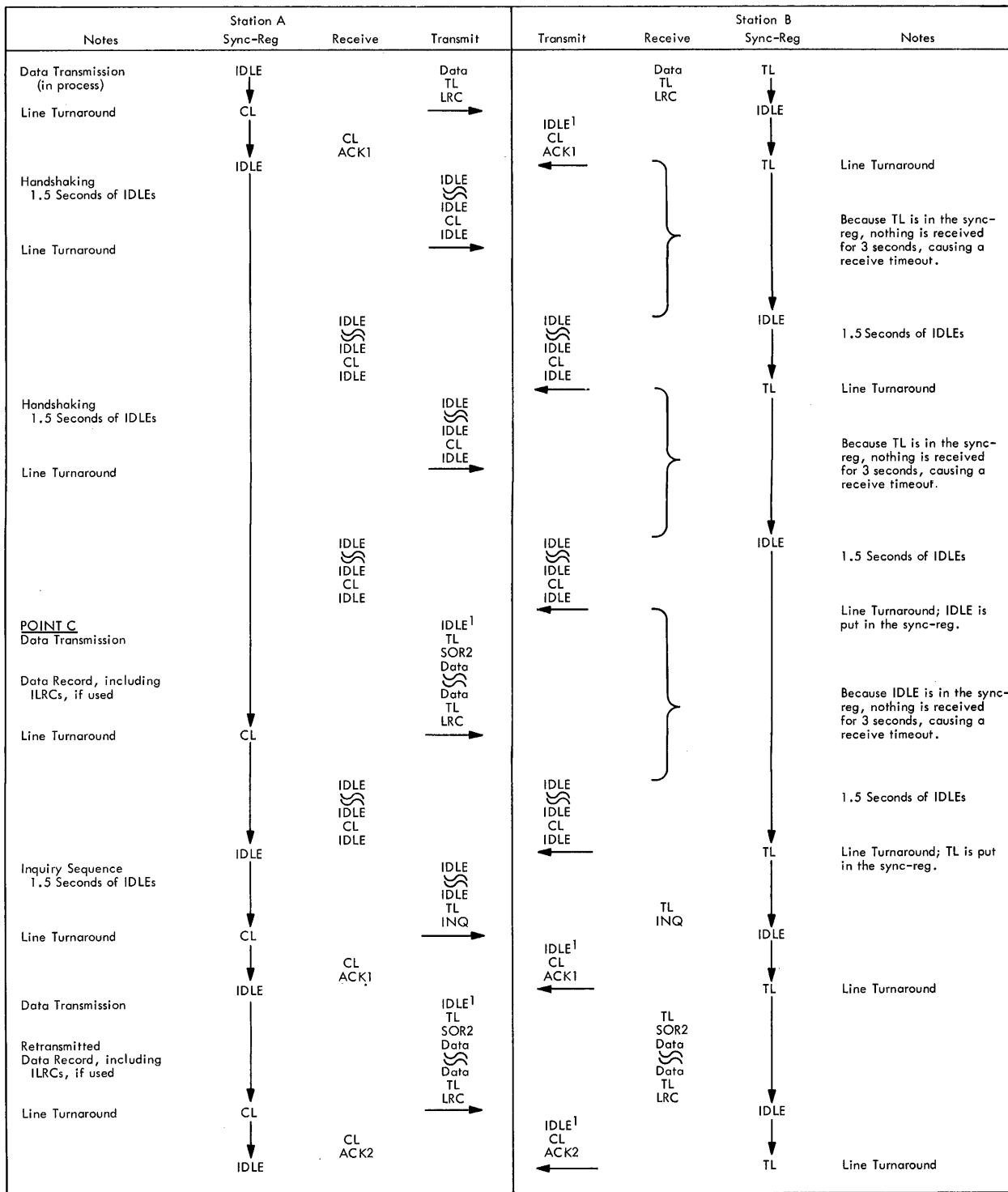
1. Not transmitted by all STR devices

Figure 1. Communication Sequence, Normal Operation



1. Not transmitted by all STR devices

Figure 2. Communication Sequence, One Handshaking Sequence Occurring Between Data Records



1. Not transmitted by all STR devices

Figure 3. Communication Sequence, More Than One Handshaking Sequence Occurring Between Data Records

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