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File Number 1130-30

Re: Form No. C26-3706-4

This Newsletter No. N33-8025

Date November 20, 1968

Previous Newsletter Nos. None.

IBM 1130 Synchronous Communications Adapter Subroutines.

This Technical Newsletter provides replacement pages for IBM 1130 Synchronous Communications Adapter Subroutines, Form No. C26-3706-4. Pages to be inserted and/or removed are lisa ted below.

III	-	IV
7	-	8
		8.1 (added)
9	-	11
		11.1 (added)
12	-	18
21	-	22
43	-	48

A change to the text or a small change to an illustration is indicated by a vertical line to the left of the change; a changed or added illustration is denoted by the symbol • to the left of the caption.

Summary of Amendments

This Technical Newsletter includes information on Error Statistics, on the options for performing in packed data mode and corrects minor errors and omissions throughout the manual.

File this cover letter at the back of the manual to provide a record of changes.

IBM Nordic Laboratory, Technical Communications, Box 962, Lidingö 9, Sweden

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IBM Systems Reference Library

IBM 1130 Synchronous Communications Adapter Subroutines

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 suroutines and explanations of the parameters involved.

The following publications constitute prerequisite information required for effective use of this publication: Data Communications Primer (Form C20-1668) and General Information- Binary Synchronous Communications (Form A27-3004).

Fifth Edition (September 1968)

This is a major revision of and makes obsolete C26-3706-3 and Technical Newsletter N26-0577. The entire section "Error Statistics and Logging Facility" has been added. Other changes to the text, and small changes to illustrations are indicated by a vertical line to the left of the change; changed or added illustrations are denoted by the symbol • to the left of the caption.

This edition applies to version 1, modification 2, of IBM 1130 Synchronous Communication Adapter Subroutines, and to all subsequent versions and modifications until otherwise indicated in new editions or Technical Newsletters. Changes are continually made to the specifications herein; any such changes will be reported in subsequent revisions or Technical Newsletters.

Requests for copies of IBM publications should be made to your IBM representative or to the IBM branch office serving your locality.

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 Nordic Laboratory, Technical Communications, Box 962, 181 09 Lidingö, Sweden

Form C26-3706-4
Revised page 11/20/68
By TNL N33-8025

This publication is composed of eight 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 describes the error statistics and logging facilities of the SCAT1, SCAT2 and SCAT3 subroutines. The eighth section contains sample programs showing the use of the Synchronous Communications Adapter subroutines.

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).
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 Primer (Form C20-1668).

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

IBM System/360 Disk Operating System Basic Telecommunications Access Method (Form C30-5001).

SUPPORTED DEVICES

STR Terminals and Systems

The SCAT1 subroutine supports the devices listed below in point-to-point communication in Synchronous Transmit-Receive (STR) mode on a switched or non-switched network.

IBM System/360, Model 30, 40, 44, 50, 65, 67, or 75 with the IBM 2701 Data Adapter Unit with Synchronous Data Adapter - Type I (SDA-I)

IBM System/360, Model 20 with the Communication Adapter (#2073)

IBM 1130 Computing System with the Synchronous Communications Adapter
IBM 1009 Data Transmission Unit
IBM 1013 Card Transmission Terminal
IBM 7701 and 7702 Magnetic Tape Transmission Terminals
IBM 7710 and 7711 Data Communication Units

Note: For some of these Terminals the character set may be slightly different from that of the IBM 1130 SCA. These differences are not supported in the 1130 subroutines.

BSC Terminals and Systems

The SCAT2 subroutine supports the devices listed below in point-to-point communication in Binary Synchronous (BSC) mode on a switched or nonswitched network.

The SCAT3 subroutine supports the devices listed below in multi-point communication in BSC mode on a nonswitched network.

IBM System/360, Model 30, 40, 50, 65, or 75 with the IBM 2701 Data Adapter Unit with Synchronous Data Adapter — Type II (SDA-II) or with the IBM 2703 Transmission Control Unit with Synchronous Base I.

IBM 1130 Computing System with the Synchronous Communications Adapter

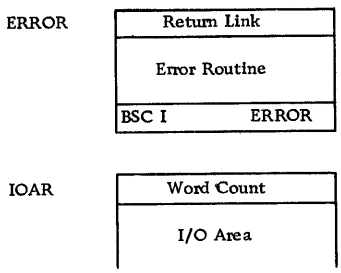
SYNCHRONOUS COMMUNICATIONS ADAPTER SUBROUTINE - SCAT2

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

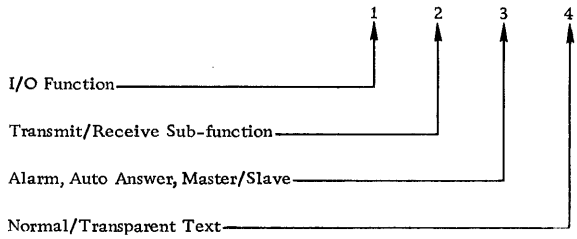
Calling Sequence

```
        LIBF    SCAT2
        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 SCAT2 on the SCA. The functions, their associated digital values, and the required parameters are listed and described below.

Function	Digital Value	Required Parameters*
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
Error Statistics/Options	8	Control, I/O Area***

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

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.

The message to be received in the I/O area can be specified to be stored as either unpacked and left-justified or packed (two characters per word).

To specify the message as unpacked and left-justified, the following values are specified in digit 2 of the control parameter.

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

To specify the message as packed, the following values are specified in digit 2 of the control parameter.

Digit 2	Digital Value	Sub-function
	3	Receive Initial
	4	Receive Continue
	5	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 either:

1. the word count
2. the character count

where

the word count equals the maximum number of unpacked characters that can be read into that area if unpacked data is specified,

the character count equals the maximum number of packed characters that can be read into that area if packed data is specified.

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 unpacked data is specified or packed (two characters per word) if packed data is specified.

If an odd number of characters is received and packed data is specified, bits 8 through 15 of the last word are set to zeroes.

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 or if the message overflows the I/O area, 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 3-second timeout occurs while receiving a message, or monitoring for ENQ or ENQ not received when monitoring for ENQ, SCAT2 attempts to receive the message or ENQ again. After eight unsuccessful attempts, SCAT2 branches to the user's error routine with an error code (2000_{16}) in the accumulator. If the user returns with a positive accumulator, SCAT2 attempts to receive the message or ENQ seven more times 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. This allows the user to initiate a Receive Continue or Receive Repeat.

If an ENQ is received after a timeout has occurred while receiving a message, SCAT2 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 $FFFF_{16}$ and performs a Close operation.

If the data set is not ready, SCAT2 attempts the operation again. After eight unsuccessful attempts, SCAT2 branches to the user's error routine with an error code in the accumulator (8000_{16}). If the user returns with a positive accumulator, SCAT2 attempts the operation 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 starts the 3-second timer.

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.

The message to be transmitted from the I/O area can be specified as either unpacked and left-justified or packed (two characters per word).

To specify the message as unpacked and left-justified, the following values are specified in digit 2 of the control parameter.

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

To specify the message as packed, the following values are specified in digit 2 of the control parameter.

Digit 2	Digital Value	Sub-function
	3	Transmit Initial
	4	Transmit Continue

Digital Value	Sub-function
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 (4000_{16}) in the accumulator. If the user returns from the error routine with a positive accumulator, SCAT2 attempts to break contention 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 clears the Device Routine Busy indicator and starts the 3-second timer.

In a slave station, when contention exists, SCAT2 branches to the user's error routine with an error code (4000_{16}) in the accumulator. If the user returns with a zero or positive accumulator, SCAT2 performs a Close operation, allowing the user to initiate a Receive Initial operation. If the user returns with a negative accumulator, SCAT2 clears the Device Routine Busy indicator and starts the 3-second timer.

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 unpacked data is specified or packed (two characters per word) if packed data is specified. 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 checked for the valid start characters SOH, STX and DLE STX. If none of these characters is present a preoperative error will occur.

The 16-bit block check character (CRC-16) is generated by SCAT2 and is transmitted following the end of the message.

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 $FFFF_{16}$ 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.

If the data set is not ready, SCAT2 attempts the operation again. After eight unsuccessful attempts, SCAT2 branches to the user's error routine with an error code in the accumulator (8000_{16}). If the user returns with a positive accumulator, SCAT2 attempts the operation 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 starts the 3-second timer.

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

Digit 3 of the control parameter is used to specify whether or not a read response should be issued on a Transmit EOT operation.

Digit 3	Digital Value	Sub-function
	0	Read Response
	non-zero	Do NOT Read Response

If digit 3 of the control parameter is non-zero on a Transmit EOT operation, SCAT2 transmits EOT, clears the Device Routine Busy indicator and starts the 3-second timer, allowing the user to initiate a Receive Initial, Transmit Initial or Close operation.

If digit 3 of the control parameter is zero on a Transmit EOT operation, digit 4 of the control operation is used to specify the action to be taken on a no response condition.

Digit 4	Digital Value	Sub-function
	0	Close
	non-zero	Do NOT Close

If digit 3 of the control parameter is zero on a Transmit EOT operation, SCAT2 transmits EOT and receives the response. If there is no response (i.e., a Receive timeout occurs), SCAT2 performs a Close operation if digit 4 of the control parameter is zero. If digit 4 of the control parameter is non-zero, SCAT2 clears the Device Routine Busy indicator and starts the 3-second timer, allowing the user to initiate a Receive Initial, Transmit Initial, or Close operation.

If the response is DLE EOT, SCAT2 sets the first word of the I/O area to $FFFF_{16}$ and 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 positive accumulator, 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 clears the Device Routine Busy indicator and starts the 3-second timer.

If the data set is not ready, SCAT2 attempts the operation again. After eight unsuccessful attempts, SCAT2 branches to the user's error routine with an error code in the accumulator (8000_{16}). If the user returns with a positive accumulator, SCAT2 attempts the operation 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 starts the 3-second timer.

Error Statistics/Options. Digit 2 of the control parameter is used to specify which sub-function is requested.

Digit 2	Digital Value	Sub-function
	0	Error Statistics
	1	Enable User options
	2	Disable User options

If digit 2 of the control parameter is zero, the address to an error statistics log is provided.

An 8-word log of error statistics is maintained within the SCAT2 subroutine during program execution. The location specified by the I/O area address is set to the base (low core) address of the 8-word log. See "Error Statistics and Logging Facility" for a detailed description.

Certain user options can also be provided with the call. If digit 2 of the control parameter is 1, the options specified in digit 4 are enabled and if digit 2 of the control parameter is 2, the options specified in digit 4 are disabled. The second parameter specifies an address to a user's error routine, which will take care of the optional exits. Note that the Disable option function does not require this parameter.

Options 1 and 2

An immediate exit to the user's error routine is provided if a timeout occurs before receiving an ENQ on a Receive Initial operation with an error code (0020_{16}) in the accumulator. Two options are provided with this exit:

Option 1. The normal 3-second timer is used.
Option 2. The third (program) timer is used. The timeout varies between 0.25 and 0.45 seconds depending on the baud rate.

If the user returns from his error routine with a positive accumulator, SCAT2 attempts to receive the ENQ again one more time 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 starts the 3-second timer allowing the user to initiate a Receive Initial, Transmit Initial,

Transmit EOT, Transmit DLE EOT or Close operation.

Option 3

A no-error exit to the user's error routine after the last interrupt of an operation with a zero value in the accumulator is provided as an option in SCAT2. Note that if an Auto-Answer Request interrupt occurs when the automatic answer interrupt is enabled, SCAT2 will take this no-error exit (in addition to notifying the user of the interrupt by setting the location specified by the I/O area address in the Auto Answer function to a non-zero value) if this option is specified.

Digit 4 of the control parameter is used to specify these options.

Digit 4	Digital Value	Options Specified
	1	Option 1
	3	Option 2
	4	Option 3
	5	Options 1 and 3
	7	Options 2 and 3

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, 3[1.]	Receive Initial
4	Receive	1, 4[1.]	Receive Continue
4	Receive	2, 5[1.]	Receive Repeat
5	Transmit Block	0, 3[1.]	Transmit Initial Block
5	Transmit Block	1, 4[1.]	Transmit Continue Block
6	Transmit Text	0, 3[1.]	Transmit Initial Text
6	Transmit Text	1, 4[1.]	Transmit Continue Text
7	Transmit End	0	Transmit EOT
7	Transmit End	1	Transmit DLE EOT

1. 3, 4, 5 also specifies packed data

Alarm, Auto Answer, Master/Slave, Read/Response/Do NOT Read Response.

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, 3[1.]	Initial	0	Master station, if contention
5	Transmit Block	0, 3[1.]	Initial	non-zero	Slave station, if contention
5	Transmit Block	1, 4[1.]	Continue	*	*
6	Transmit Text	0, 3[1.]	Initial	0	Master station, if contention
6	Transmit Text	0, 3[1.]	Initial	non-zero	Slave station, if contention
6	Transmit Text	1, 4[1.]	Continue	*	*
7	Transmit End	0	Transmit EOT	0	Read response
7	Transmit End	0	Transmit EOT	non-zero	Dot NOT read response
7	Transmit End	1	Transmit DLE EOT	*	*

* Not applicable
1. 3, 4 also specifies packed data

Normal/Transparent Text, Close/Do NOT Close

The interpretation of digit 4 of the control parameter varies, depending on the setting of digit 1 and 2.

Digit 1		Digit 2		Digit 4	
Value	Meaning	Value	Meaning	Value	Meaning
5	Transmit Block	0, 3[1.]	Initial	0	Normal EBCDIC Text
5	Transmit Block	0, 3[1.]	Initial	non-zero	Full-Transparent Text
5	Transmit Block	1, 4[1.]	Continue	0	Normal EBCDIC Text
5	Transmit Block	1, 4[1.]	Continue	non-zero	Full-Transparent Text
6	Transmit Text	0, 3[1.]	Initial	0	Normal EBCDIC Text
6	Transmit Text	0, 3[1.]	Initial	non-zero	Full-Transparent Text
6	Transmit Text	1, 4[1.]	Continue	0	Normal EBCDIC Text
6	Transmit Text	1, 4[1.]	Continue	non-zero	Full-Transparent Text
7	Transmit EOT	0	Transmit EOT	0	Close on no response
7	Transmit EOT	0	Transmit EOT	non-zero	Do NOT Close on no response
7	Transmit EOT	1	Transmit DLE EOT	*	*

* Not applicable
1. 3, 4 also specifies packed data

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})
- Invalid start characters in the I/O area (8001_{16}). The only valid start characters are SOH, STX or DLE STX.

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, ENQ, or EOT (0200_{16})
- NAK received, or the incorrect acknowledgement received following a Receive timeout (0400_{16})
- Incorrect acknowledgement received with no Receive timeout (0100_{16})
- Receive timeout occurred prior to receiving an ENQ on a Receive Initial operation (0020_{16}). This error exit is taken only if the option is specified in a call to SCAT2 (see Error Statistics/Options).
- The last interrupt for an operation has been serviced (0000). This no-error exit to the users error routine is taken only if the option is specified in a call to SCAT2 (see Error Statistics/Options).

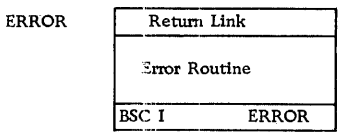
The SCAT3 Interrupt Service Subroutine controls the 1130 SCA during multi-point operation and performs error checking on the data transmitted and received. A four digit control parameter directs the subroutine in the following:

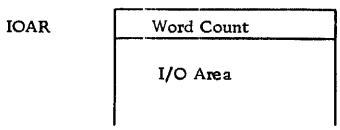
- Testing to determine if the previous operation has been completed
- Monitoring the line for the specified polling address and selection address
- Transmitting
- Receiving
- Turning the audible alarm on and off
- Disconnecting the station from the line

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)
        •       •
        •       •
        •       •
```



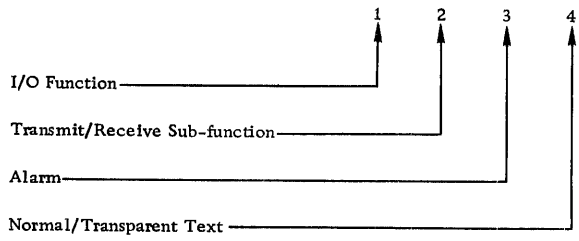


The calling sequence for the Monitor I/O function (see I/O Function) is as follows:

```
        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.

Function	Digital Value	Required Parameters*
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
Error Statistics	8	Control, I/O Area

*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 LIBF+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, the word following the polling address is incremented by 1, and SCAT3 continues monitoring.

If the selection address is received, NAK is transmitted, the word following the selection address is incremented by 1, and SCAT3 continues monitoring.

NOTE: 1. A Monitor operation must be initiated before the first Transmit Initial or Receive Initial.
2. The Monitor operation does not turn on the Device Routine Busy Indicator.
3. A negative reply (NAK or EOT) will not be transmitted if the Monitor operation is followed immediately be a Receive Initial or Transmit Initial operation.

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.

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.

The message to be received in the I/O area can be specified to be stored as either unpacked and left-justified or packed (two characters per word).

To specify the message as unpacked and left-justified, the following values are specified in digit 2 of the control parameter.

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

To specify the message as packed, the following values are specified in digit 2 of the control parameter.

Digit 2	Digital Value	Sub-function
	3	Receive Initial
	4	Receive Continue
	5	Receive Repeat

- Receive Initial--Monitors the line for the selection address specified in the last Monitor operation initiated followed by ENQ; when the selection address is received, increments by 1 the word following that selection address; when ENQ is received, 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 either:

1. the word count
2. the character count

where

the word count equals the maximum number of unpacked characters that can be read into that area if unpacked data is specified.

the character count equals the maximum number of packed characters that can be read into that area if packed data is specified.

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 unpacked data is specified or packed (two characters per word) if packed data is specified.

If an odd number of characters is received and packed data is specified, bits 8 through 15 of the last word are set to zeroes.

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, SCAT 3 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, increments by 1 the word 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.

The message to be transmitted from the I/O area can be specified as either unpacked and left-justified or packed (two characters per word).

To specify the message as unpacked and left-justified, the following values are specified in digit 2 of the control parameter.

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

To specify the message as packed, the following values are specified in digit 2 of the control parameter.

Digit 2	Digital Value	Sub-function
	3	Transmit Initial
	4	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 polling address specified in the last Monitor operation initiated followed by ENQ; when the polling address is received, increments by 1 the word following the polling address; when ENQ is received, 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 polling address specified in the last Monitor operation initiated followed by

ENQ; when the polling address is received, increments by 1 the word following the polling address; when ENQ is received, 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 unpacked data is specified or packed (two characters per word) if packed data is specified. 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 checked for the valid start characters SOH, STX and DLE STX. If none of these characters is present a preoperative error will occur.

The 16-bit block check character (CRC-16) is generated by SCAT3 and is transmitted following the end of the message.

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, increments by 1 the word 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.

Error Statistics

A 9-word log of error statistics is maintained within the SCAT3 subroutine during program execution. The location specified by the I/O area address is set to the base (low core) address of the 9-word log. See "Error Statistics and Logging Facility" for a detailed description.

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, 3[1]	Receive Initial
4	Receive	0, 4[1]	Receive Continue
4	Receive	0, 5[1]	Receive Repeat
5	Transmit Block	0, 3[1]	Transmit Initial Block
5	Transmit Block	0, 4[1]	Transmit Continue Block
6	Transmit Text	0, 3[1]	Transmit Initial Text
6	Transmit Text	0, 4[1]	Transmit Continue Text

1. 3, 4, 5 also specifies packed data

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})
- Invalid start characters in the I/O area (8001_{16})

  The only valid start characters are SOH, STX or DLE STX.

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})
- 3-second timeout occurred while receiving a message (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})

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. If the Synchronous Communications Adapter is in operation, the PRNT2 subroutine must be used for concurrent operation of the 1132 Printer. The PRNT1 or PRNTZ and PRNT2 subroutines are mutually exclusive; i.e., both subroutines may not be in core at the same time. If the PRNT2 subroutine is in a core load for the concurrent operation of the 1132 Printer and the SCA, all IBM-and user-written programs in that core load using the PRNT1 of PRNTZ subroutine must be modified to use the PRNT2 subroutine. For DMV2 users (1130-OS-005/6) a special conversion subroutine has been designed to convert a call to PRNTZ to a call to PRNT2. This subroutine is called PRTZ2 and is used by means of a *EQUAT control record. (See SRL C26-3717, SUPERVISOR CONTROL RECORDS) PRTZ2 enables FORTRAN output on 1132 to be overlapped with SCA operations although that is not normally possible according to the restriction above.

Calling Sequence

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

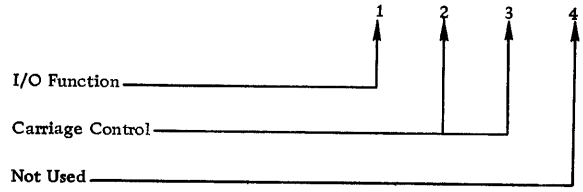
```
ERROR   +-------------------+
        |    Return Link    |
        +-------------------+
        |                   |
        |   Error Routine   |
        |                   |
        +-------------------+
        | BSC I     ERROR   |
        +-------------------+
```

```
IOAR    +-------------------+
        |    Word Count     |
        +-------------------+
        |                   |
        |     I/O Area      |
        |                   |
```

The calling sequence 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.

Function	Digital Value	Required Parameters*
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.

During the execution of carriage control operations, no checks are made for channel 9 and channel 12 indications.

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
Print Functions Not Used Control Function 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
Print Functions 0 - Space One Line After Printing 1 - Suppress Space After Printing Control Function 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 (6000_{16})
- End of forms (6000_{16})
- Invalid control parameter (6001_{16})
- Invalid word count (6001_{16})

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 (0003_{16})
- Channel 12 detected (0004_{16})

ERROR STATISTICS

A log of error statistics is maintained within the SCAT1/2/3 subroutines during program execution. This log is comprised of counters initially set to zero and incremented individually for any of the error conditions listed below:

1. CRC - 16 errors (LRC Errors in SCAT 1)
2. Retransmission Requests
3. Master Receive Timeouts
4. Slave Receive Timeouts
5. Transmit Check Errors
6. Receive Check Errors
7. Invalid Control Sequence Received as Master
8. Invalid Control Sequence Received as Slave
9. Monitor Timeouts

Description of Errors

1. CRC - 16 (or LRC) Errors occur when the CRC - 16 (LRC) calculated by the Slave station is not identical to that received after the message.
2. Retransmission Requests occur when the Master station receives a NAK as response to a message or ENQ, or when the wrong positive acknowledgement is received following a receive timeout (Slave did not receive last message). In STR-mode (SCAT 1) this error occurs when the ERR character is received.
3. Master Receive Timeout would occur when the Master Station is attempting to receive a response from the Slave station.
4. Slave Receive Timeout would occur when the Slave station is attempting to receive an Enquiry or a message from the Master Station.
5. Transmit Check Errors would occur when a Character Gap or Overrun error occurs while transmitting as either the Master or the Slave station.
6. Receive Check Errors would occur when a Character Gap or Overrun error occurs while receiving as either the Master or the Slave station.
7. Invalid Control Sequence Received as Master would occur when the Master station did not recognize a reponse from the Slave station.
8. Invalid Control Sequence Received as Slave would occur when the Slave station did not recognize a control sequence or a message starting character from the Master station.
9. Monitor Timeouts occur when a slave station in a multipoint network is attempting to receive its polling or selection address (SCAT3 only).

The following is an example of how a user could "dump" the contents of the Error Statistics Table at the end of a program execution:

(USER PROGRAM)

```
        LIBF    SCAT 1 (SCAT 2)     Call SCAT
        DC      /7000 (/8000)       Request EST address
        DC      STATS
        LDX L1  * - *               Put EST base in XR-1
STATS   EQU     *-1
        STX  1  PDUMP + 3           Set up dump parameter
        MDX  1  8                   Add several words
        STX  1  PDUMP + 4           Store other parameter
PDUMP   PDMP    * - *, *- *, 0      Dump EST
        CALL    EXIT
        END     XXX                 Beginning of user's program
```

LOGGING FACILITY

Several CALLs to a subroutine named IOLOG have been placed within the SCAT 1/2/3 subroutines when characters to be transmitted or received are in the accumulator. The subroutine IOLOG may be either the IBM-supplied "dummy" routine (which simply returns control without action) or a user-written subroutine in which the accumulator's content are logged or selectively logged.

Two examples of IOLOG routines are included with this description. The first of these is an example of the "dummy" routine and the second will log the contents of the accumulator each time it is entered. The second routine has a "wrap-around" feature and transmits a "flag" of all bits into the next word to be used for logging. Testing for special values could be added to allow selective logging. Data characters received might not be logged, for example.

Note that the trace routine must have a second entry labeled CPLOG to allow logging of the control parameter following the calls to SCAT 1/2/3. The second entry is necessary to prevent re-entry problems caused by SCA interrupt servicing.

The IOLOG subroutine has the facility to log as follows:

1. All received control characters and data (these characters will be logged one character per word, right justified).

2. All control characters and data transmitted (logged one character per word, left justified).

3. Time-outs (logged as a hexadecimal 1111).

4. The control parameter (logged in hex) following each LIBF to SCAT 1/2 in the user program.

NOTE: 1. The SCAT 1/2/3 subroutines assume that the accumulator is saved and restored in the IOLOG subroutine.

2. In Card/Paper Tape Programming System the subroutine IOLOG is called by LIBF statements. The user must take that fact into consideration when writing his own logging subroutine in that system.

3. A time restriction exists for the IOLOG subroutine if the 1132 Printer and the Synchronous Communications Adapter are used concurrently. A read emitter interrupt from the 1132 Printer must be honored within 1.5 ms leaving approximately 0.4 ms for the IOLOG subroutine. This applies to a memory cycle of 3.6 microseconds and is also dependent on the Baud rate.

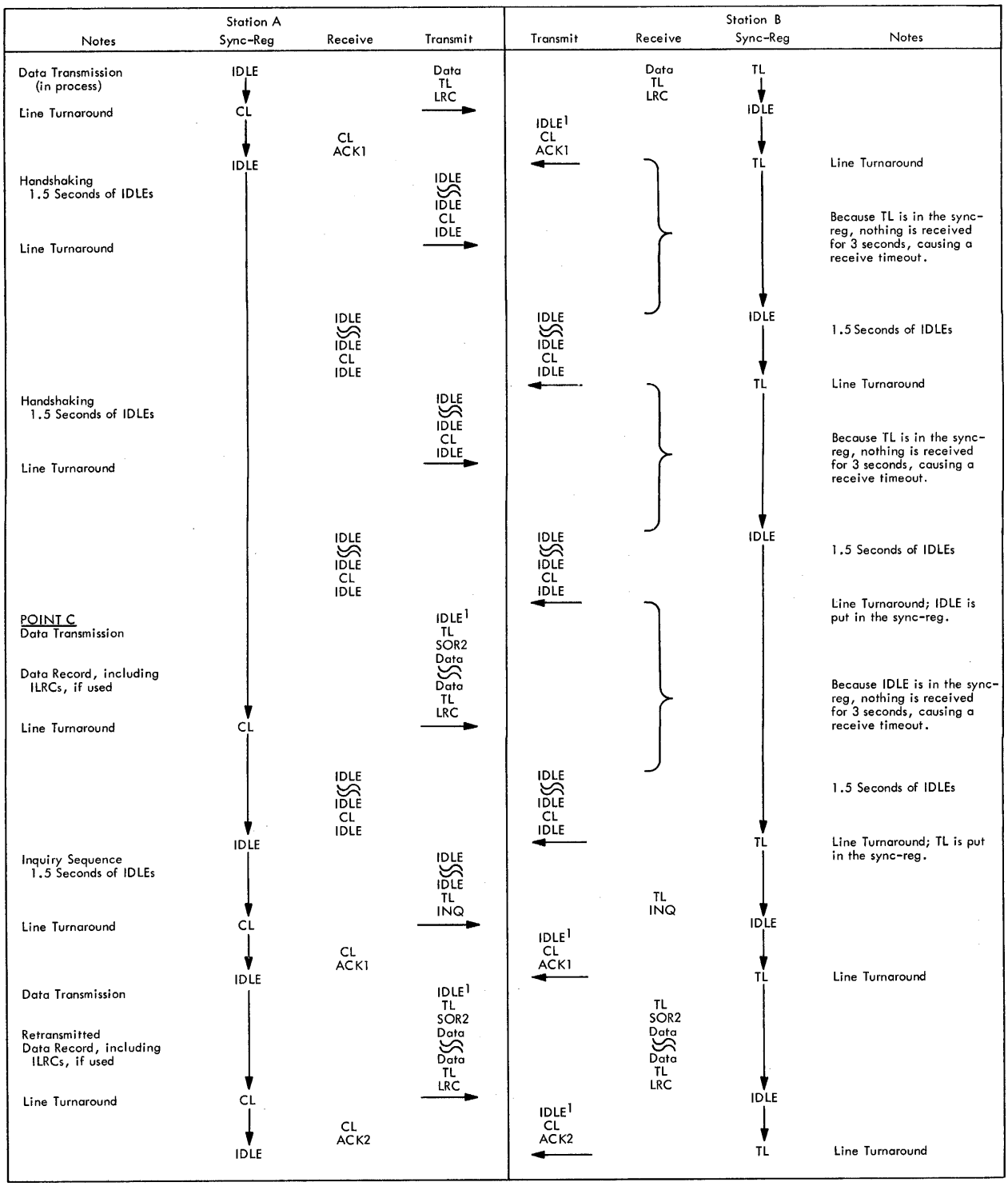
Example of "Dummy" Subroutine

```
// JOB

LOG DRIVE   CART SPEC   CART AVAIL  PHY DRIVE
  0000        5555        5555        0002

// ASM
*LIST
                       *             DUMMY IOLOG SUBROUTINE                IOL00000
                       *                                                   IOL00010
0000     09593587             ENT     IOLOG                                IOL00020
0003     035D3587             ENT     CPLOG                                IOL00030
0000 0   0000         IOLOG   DC      *-*         PRIMARY ENTRY            IOL00040
0001 01  4C800000             BSC  I  IOLOG       RETURN                   IOL00050
0003 0   0000         CPLOG   DC      *-*         SECONDARY ENTRY          IOL00060
0004 01  4C800003             BSC  I  CPLOG       RETURN                   IOL00070
0006                          END                                          IOL00080

   000 OVERFLOW SECTORS SPECIFIED
   000 OVERFLOW SECTORS REQUIRED
   002 SYMBOLS DEFINED
    NO ERRORS□  FLAGGED IN ABOVE ASSEMBLY
```



1. Not transmitted by all STR devices

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

APPENDIX D. CORE STORAGE REQUIREMENTS

Subroutine	Function	Core Size (words)
SCAT1	Communication in STR mode	1078
SCAT2	Communication in BSC point-to-point mode	1372
SCAT3	Communication in BSC multi-point mode	1464
PRNT2	Concurrent operation of the SCA and the 1132 Printer	670
EBC48 with STRTB and HXCV without STRTB and HXCV	Conversion of 4-of-8 code to EBCDIC and EBCDIC to 4-of-8 code	 260* 142
HOL48 with STRTB, HOLCA, and HXCV without STRTB, HOLCA, and HXCV	Conversion of 4-of-8 code to IBM card code and IBM card code to 4-of-8 code	 312* 120
HXCV	Conversion of 4-of-8 code characters to conversion table displacements	44
STRTB	Table of equivalent 4-of-8 code and EBCDIC characters	74
HOLCA	Table of IBM card code characters convertible to 4-of-8 code characters	74
IOLOG	"Dummy" logging	6

* If EBC48 amd HOL48 are in core simultaneously, only 454 words are required for both, since a single copy of HXCV and STRTB are shared.

APPENDIX E. SUBROUTINE TIMINGS

The following table provides timings for the execution of the various functions of the subroutines used in connection with the SCA. These are approximate average timings and are based on a memory cycle of 3.6 microseconds.

Subroutine	Function	Time (microseconds)
ILS01	Transfer to SCAT1	97
	Transfer to SCAT2	97
	Transfer to SCAT3	97
	Transfer to PRNT2	105
SCAT1		
Call Processing	Acknowledge and Receive	630
	Audible Alarm	260
	Auto Answer	290
	Close	750
	Open	705
	Test	160
	Transmit	560
Interrupt Processing	Auto Answer	138
	Read Response (control character)	305
	Read Response (data character)	355
	Timeout	310
	Write Response (control character)	270
	Write Response (data character)	660
SCAT2		
Call Processing	Audible Alarm	263
	Auto Answer	293
	Close	863
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	Receive Initial	682
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	Transmit Block/Text Continue	682
	Transmit Block/Text Initial	783
	Transmit End	607
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	Read Response (control character)	323
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	Write Reponse (control character)	272
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Call Processing	Audible Alarm	263
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	Receive Repeat	690
	Test	189
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	Transmit EOT	602
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	Read Response (data character)	630
	Timeout	292
	Write Response (control character)	216
	Write Response (data character)	583
PRNT2	Double Space	998
	Print	
	Character Interrupt	1000
	Idle Interrupt	515
	Pre-scan	9800 + 640 per character to be printed
	Single Space	708
	Skip to Channel 1	936 + 208 per channel crossed
	Skip to Channel 12	678 + 208 per channel crossed
	Test	188
	Triple Space	1288
EBC48	Conversion of EBCDIC to 4-of-8 code	410 per character
	Conversion of 4-of-8 code to EBCDIC	500 per character
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HOL48	Conversion of IBM card code to 4-of-8 code	260 per character
	Conversion of 4-of-8 code to IBM card code	390 per character
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