53A-121 COMMUNICATIONS CARD, EIA RS-232C

OPERATING MANUAL

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DESCRIPTION

The 53A-121 Communications Card is a printed circuit board assembly for use in a CDS 53/63 Series System. The card is installed in the Communications slot of the 53/63 Series Card Cage. The card provides an optically-isolated EIA RS-232C interface between the system controller and the 53/63 Series System. The communications protocol is asynchronous with a wide variety of switch-selectable speed and format characteristics. The Clear-to-Send and Data-Set-Ready signals are used as unidirectional hold-off signals so that the system controller and the 53/63 Series System will automatically be prevented from overwriting each other. Communications over distances up to one mile is possible using twisted pairs comprised of 22-gauge wire. Operating with modems is not recommended since the hold-off signals typically aren't transmitted with modems.

CONTROLS AND INDICATORS

The following controls and indicators are provided to select and display the functions of the 53A-121 Card's operating environment.

Power LED

The Power LED provides a valuable diagnostic tool by giving the system programmer a visual indication of the action which the system is currently taking. Whenever the 53A-121 Card is addressed by the system controller, the Power LED goes out. The LED remains out until another function card is addressed. Since only one function card can be addressed at a time, an unlit Power LED indicates the function card with which the system controller is currently communicating. The Power LED being lit not only indicates that the 53A-121 Card is unaddressed, but that all required dc power (5V dc, ±15V dc) is being supplied. Whenever mark/space transitions are present on either the input or output data lines, this LED will blink.

Fuse

The 5 Volt dc power bus has a fuse that protects the system from overloads. If the fuse has blown, the Power LED will not light.

Function LEDS and Switches

LEDs
The following LEDs are provided at the top front edge of the 53A-121 Card to indicate the status of the card's operation:

Input/Output LED (I/O)
The Input/Output (I/O) LED will be lit when the system controller is in input and out when the system controller is in output.

As a matter of convention, input and output data will be referenced to the system controller - i.e., when the Communications Card is in input it is sending data to the system controller.

Controller Busy LED (CBY)

The Controller Busy (CBY) LED will be lit when the system controller is busy - i.e., the system controller can't accept data.

The CBY LED represents the state of the system controller busy line, which is a line from the system controller to the Communications Card, and is used as a hold-off signal. System controllers will typically refer to this line as "clear-to-send".

When the system controller is busy the CBY line will be true (low, -3 to -25 volts). When the system controller can accept data the (CBY) line will be false (high, +3 to +25 volts).

If the CBY line (White/Black/Yellow [F.E. 21]) is unused it must be tied high to +12 volts (Yellow [F.E. 1]) or the CBY LED will be lit and the Communications Card won't be able to input data to the system controller.

System Busy LED (SBY)

The Communications Card produces a "53/63 Series System Busy" (SBY) signal which must be used by the system controller. The SBY LED will be lit when the Communications Card is busy - i.e., the receiver buffer is full and the card can't accept data from the system controller.

The SBY LED represents the state of the SBY line which is a line from the Communications Card to the system controller. System controllers will typically refer to this line as "data-set ready."

When the Communications Card is busy the SBY line will be true (low, -9V nominal). When the Communications Card can accept data the SBY line will be false (high, +9V nominal).

Communications Error Status LEDs (CES)

The Communications Error Status (CES) LEDs display the condition of the three error status registers on the Communications Card. These LEDs will always display the status of the last character either input or output.

There is an LED associated with each of the following error conditions:

Receiver Over-Run (ROR)

This LED lights when a second character has been received and transferred to the received data-holding buffer before the previous character was accepted by the 53/63 Series System. This indicates that the previous character has been overwritten and lost. This error can be caused by an improperly connected SBY line.

Receiver Framing Error (RFE)

This LED lights when a stop bit is not received following the start bit and correct number of data bits and indicates a communications failure resulting in a lost character. This error can be caused by an incorrect received setting of the Data Format Switch.

Receiver Parity Error (RPE)

This LED lights when the parity on the received character does not compare with the parity mode selected and indicates a communications failure resulting in an incorrect received character. This error can be caused by an incorrect setting of the Data Parity Switch.

Switches

The following switches are provided to select the proper functions for the 53A-121 Card's operating environment.

NOTES: A "*" following a signal name means the signal is <u>active low</u>.

"B.P. n" refers to a <u>backplane</u> pin number or group of backplane pin numbers defined by "n". For example, "B.P. 11" means pin number 11 on the backplane; "B.P. 65-74" means pin numbers 65 through 74 on the backplane. Likewise, "F.E. n" refers to a front-edge connector pin number or group of front-edge connector pin numbers defined by "n".

Switches For Command Characters (RIC & RIL)

Because of the hand-shake protocol that has been established by the industry, it is necessary for the system controller to tell the 53/63 Series System when to input data to the system controller. The system controller communicates this request for input by first outputting an ASCII character to the 53/63 Series System. This character is of two types:

1.   Request for Input Character (RIC).
2.   Request for Input Line (RIL).

The Communications Card will interpret either character (RIC or RIL) as a command and will not pass the character through the Communications Card to the 53/63 Series System.

The RIC Switch and the RIL Switch allow the user to pick an ASCII character for each command. These characters must be chosen such that they will never need to be output by the system controller as data to the 53/63 Series System. The one exception to this rule is that the RIC and RIL characters may be output as part of a binary data stream sent to a function card designed to handle binary data, such as the 53A-421 ARINC-429 Transmitter Card, the 53A-488 IEEE-488 Bus Controller Card, or the 53A-430 RS-232 UART Card.

The following characters should never be used for RIL or RIC:

    Upper-case alphabet.
    @, 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9
    :, ;, <, =, or >
    <CR> or <LF>
    NULL
    SPACE
    DEL

The 53A-121 Card is shipped from the factory with the RIC and RIL Switches set as in the following example:

The two switches, RIC and RIL, are identical and have seven rockers each. The rockers are labeled from left to right: 1, 2, 3, 4, 5, 6, and 7 and correspond to ASCII bits 0, 1, 2, 3, 4, 5, and 6 respectively.

A zero is achieved by closing the switch pole and a one is achieved by opening the switch pole.

Example: From the ASCII Table in Appendix A, we chose # and $ for the ASCII characters.

\# 00100011 (Octal 043) (Decimal 35)
\$ 00100100 (Octal 044) (Decimal 36)

RIC (#) Rocker		RIL ($) Rocker	
1 OPEN	1	1 CLOSED	0
2 OPEN	1	2 CLOSED	0
3 CLOSED	0	3 OPEN	1
4 CLOSED	0	4 CLOSED	0
5 CLOSED	0	5 CLOSED	0
6 OPEN	1	6 OPEN	1
7 CLOSED	0	7 CLOSED	0

NOTE: For more details, see the Operation section of this manual.

Baud Rate Switch

The Communications Card has a miniature 4-pole rocker switch labeled BAUD RATE. The following table indicates the switch settings necessary to select a given baud rate. An open rocker is indicated by an "O", and a closed rocker by a "C".

BAUD RATE	ROCKER SETTINGS			
	1	2	3	4
75	C	C	C	C
110	O	C	C	C
130	C	O	C	C
150	O	O	C	C
200	C	C	O	C
300	O	C	O	C
600	C	O	O	C
1200	O	O	O	C
1800	C	C	C	O
2400	O	C	C	O
3600	C	O	C	O
4800	O	O	C	O
7200	C	C	O	O
9600	O	C	O	O

Data Format Switch

The Communications Switch has a 3-pole rocker switch labeled FORMAT. The switch can be used to select data formats of 5 through 8 bits per character. However, 5 and 6 bits per character would not allow the user to send the complete ASCII character set

required to program the 53/63 Series System. It is for this reason that the following table is only for 7 and 8 bits per character.

ROCKER SETTING			BITS / CHARACTER	STOP BITS
1	2	3		
CLOSED	OPEN	CLOSED	7	1
OPEN	OPEN	CLOSED	8	1
CLOSED	OPEN	OPEN	7	2
OPEN	OPEN	OPEN	8	2

Data Parity Switch

The Communications Card has a 2-pole rocker switch labeled PARITY that allows odd, even or no parity to be selected. If parity is disabled, no parity bit will be transmitted, causing the Stop bit(s) to immediately follow the last data bit and the receiver to assume the bit(s) following the last data bit to be Stop bits(s). This condition also disables the Receiver Parity Error circuits.

Example: Assume that parity is disabled and that the data format switch is set for 7 bits per character and 2 stop bits. The total bits per character would be:

Start bit	1
Data bits	7
Parity bit	0
Stop bits	2
Total	10

If parity was "on" there would be 11 bits per character.

Rocker Setting		Parity
1	2	
OPEN ----		No Parity
CLOSED	CLOSED	Odd Parity
CLOSED	OPEN	Even Parity

Echo Switch

For most applications this switch is left in the OFF position. The ON position causes each character sent from the system controller to the 53/63 Series System to be echoed back to the system controller.

STOP*

STOP* can be used to clear a system that has hung up from an illegal operation -i.e., a request for input from a nonexistent function card.

STOP* (F.E. 22) can be left unterminated if unused. To cause a STOP* condition,the user need only supply a contact closure to ground. STOP* can also be driven by EIA RS-232C levels, wherein, STOP* is (-3 to -25 volts) and not-STOP* is (+3 to +25 volts).

INTERRUPT*

INTERRUPT* can be input by the system controller to detect when a CDS function card is interrupting. Handling of interrupts can be found in the Operation section of the 53A-171 Control Card Operating Manual. An explanation of when a specific function card will issue an interrupt will be found in the function card's operating manual.

When there is an interrupt, INTERRUPT* will be true (low, -9V nominal). When there isn't an interrupt, INTERRUPT* will be false (high, +9V nominal).

This line may be left unterminated when not in use.

SPECIFICATIONS

Interchange Circuit: From the EIA RS-232-C Standard, the 53A-121 Communications Card provides the following:

>   AA Protective Ground
>   AB Signal Ground - Isolated.
>   BA Transmitted Data - Isolated.
>   BB Received Data - Isolated.
>   CB Clear to Send - Isolated.
>   CC Data Set Ready - Isolated.

Interface Type: From the EIA RS-232-C Standard, the 53A-121 Card provides interface types A, C, and E.

UART Module Manufacturer: American Microsystems, Inc., Model: S1883 or equivalent.

Line Driver Manufacturer: Motorola, Inc., Model: MC1488.

Line Receiver Manufacturer: Motorola, Inc., Model: MC1489.

Logic Levels for Data: EIA RS-232-C.

    Mark (logic "1"):   -25V to -3V.

    Space (logic "0"):   +3V to +25V.

Logic Levels for Functions: EIA RS-232-C.

    OFF (logic "1"):   -3V to -25V; 53/63 Series System or System Controller Busy.

    ON (logic "0"):   +3V to +25V; Not Busy, such as in Clear-to-Send or Data-Set-Ready.

Mode of Operation: Asynchronous.

Data Buffer Transmitter: One character.

Receiver: One character.

Baud Rates: Switch Selectable: 75, 110, 130, 150, 200, 300, 600, 1200, 1800, 2400, 3600, 4800, 7200, or 9600.

Word Lengths: Switch Selectable: 5, 6, 7, or 8 bits with 1 or 2 stop bits.

Parity Generation/Checking: Switch Selectable: Odd, Even or None.

Error Detection: Parity, Framing, and Overflow errors detected.

Start Bit Detection: Circuit for detecting in coming characters allows errorless recovery of data having up to 42% distortion.

Clock Output: Square wave with a frequency of 16 times the selected baud rate.

Optical Isolation: DC: 300V
AC: 100 VRMS

Power-Up: When power is turned on, the card will go to the following known states:
     Power LED - lit
     SBY LED - out
     Mode -   waiting for output from system controller.

Power Requirements: 5V dc power is provided by the internal Power Supply in the 53/63 Series Card Cage.
     Voltage: 4.75V to 5.25V DC.
     Current: 1.1 amperes, maximum, quiescent.
     1.3 amperes, peak.

Cooling: Provided by the fan in the 53/63 Card Cage.

Temperature: -10°C to +65°C, operating (assumes ambient temperature of 55° and airflow to assure less than 10°C temperature rise).
-40°C to +85°C, storage.

Humidity: Less than 95% R.H. non-condensing, -10°C to +30°C.
Less than 75% R.H. non-condensing, +31°C to +40°C.
Less than 45% R.H. non-condensing, +41°C to +55°C.

Dimensions: 197mm High, 220mm Deep, 13mm Wide
     (7.75" x 8.66" x 0.5")

Dimensions, Shipping: When ordered with a 53/63 Card Cage, this card will be installed in the Communications slot.

When ordered alone, the shipping dimensions are:
     254mm X 254mm X 127mm   (10" X 10" X 5")

Weight: 0.23 kg. (0.5 lbs.)

Weight, Shipping: When ordered with a 53/63 Card Cage, this card will be installed in the Communications slot.

When ordered alone, the shipping weight is:

0.64 kg.   (1.4 lbs.)

Mounting Position: Any orientation.

Mounting Location: Plugs into the Communications Slot of the 53A-002
                            or 63A-012 Card Cage.

Output Connections:
(Not supplied)   A 48-pin printed circuit type, hooded connector
                            (53A-780), provides a connection for all 53A-121
                            signals.

Required Equipment: Either a 53A-780 Hooded Connector or 53A-738
                            Data Cable is required with this card.

Equipment Supplied: 53A-121 Communications Card.
                            Spare Fuse (Part #42202-52001)
                            Operating Manual (Part #00000-11210)
                            Service Manual (Part #00000-21210)

OPERATION

Output Data

In output, the 53A-121 will accept serial data, with the baud rate and format selected, a character at a time. All characters except the selected RIC and RIL will be communicated to the 53/63 Series System.

Request For Input - Character (RIC)

When the 53A-121 detects the selected RIC, it will put the 53/63 Series System in the input mode, take one character of input from the presently selected function card and input that character to the system controller. The 53A-121 will then wait for the next output character from the system controller, which may or may not be another RIC character.

The RIC command requires that the system controller output an RIC character for every character of input. This results in a high communications overhead and should only be used when the input data will not be terminated by carriage-return line-feed <CR/LF>.

Request For Input - Line (RIL)

When the 53A-121 detects the selected RIL, it will put the 53/63 Series System in the input mode, take one character of input from the presently selected function card, and input that character to the system controller. The 53A-121 will repeat the operation for a new input character automatically. This process will continue until the 53A-121 detects a line-feed <LF> character from the function card. The 53A-121 will input the line-feed <LF> to the system controller and then wait for the next output character from the system controller which may or may not be another RIL character.

The RIL command allows input in line length blocks with relatively little communications overhead and should be used whenever the input data will be terminated with a carriage-return line-feed <CR/LF>.

NOTE: After the Communications Card receives a RIC or RIL character from the system controller, it will immediately try to return the data requested. For this reason, the RIC and RIL characters must not be followed by any other characters from the system controller, including carriage-return <CR> and line-feed <LF>.

Binary Data Transfer

The 53A-121 Communications Card is designed to transfer either ASCII characters or binary data between the system controller and the 53/63 Series System. When binary data is being transferred to the system controller by the 53/63 Series System, line-feed <LF> characters may appear as valid data in the binary data stream. To prevent the communications card from automatically terminating input to the system controller when a line-feed character is detected in the binary data stream, the function card returning the binary data disables the line-feed detection circuitry of the communications card until the binary transfer is completed.

When the system controller is transferring binary data to the 53/63 Series System, the function card receiving the binary data disables the RIC and RIL detection circuitry on the communications card until the binary transfer is completed, so that RIC and RIL characters may be included in the binary data stream.

INSTALLATION

The 53A-121 Communications Card must be plugged into the GREEN card cage slot marked "COMM.".

CAUTION:
To avoid plugging the card in backwards, observe the following:

a. Match the keyed slot on the card to the key in the backplane connector. The component side should be to the right for a 53 Series Chassis and to the top for a 63 Series Chassis.

b. There are two ejectors on the card. Make sure the ejector marked "53A-121" is at the top for a 53 Series Chassis and to the left for a 63 Series Chassis.

CAUTION:
The 53A-121 Card is a piece of electronic equipment and therefore has some susceptibility to electrostatic damage (ESD). ESD precautions must be taken whenever the module is handled.

LED ASSIGNMENTS I/O

Input/Output   - lit when system controller is in input.

CBY   Controller Busy   - lit when system controller is busy.

SBY   System Busy   - lit when 53/63 Series System is busy.

ROR   Receiver Over-Run   - lit when receiver is over-run.

RFE   Receiver Framing Error   - lit for framing error.

RPE   Receiver Parity Error   - lit for receiver parity error.

EIA INTERFACE CONNECTOR PIN ASSIGNMENTS

(From EIA RS-232-C)

EIA Connector Pin Number	Circuit	Description
1	AA	Protective Ground
2*	BA	Transmitted Data
3*	BB	Received Data
4	CA	Request to Send
5*	CB	Clear to Send
6*	CC	Data Set Ready
7**	AB	Signal Ground (Common Return)
8	CF	Received Line Signal Detector
9	-	(Reserved for Data Set Testing)
10	-	(Reserved for Data Set Testing)
11		Unassigned
12	SCF	Sec. Received Line Signal Detector
13	SCB	Sec. Clear to Send
14	SBA	Secondary Transmitted Data
15	DB	Transmission Signal Element Timing (DCE Source)
16	SBB	Secondary Received Data
17	DD	Receiver Signal Element Timing (DCE Source)
18		Unassigned
19	SCA	Secondary Request to Send
20	CD	Data Terminal Ready
21	CG	Signal Quality Detector
22	CE	Ring Indicator
23	CH/CI	Data Signal Rate Selector (DTE/DCE Source)
24	DA	Transmit Signal Element Timing (DTE Source)
25		Unassigned

* These four signals are minimal requirements for most systems.

** Required for all systems.

53A-121 SIGNAL CONNECTIONS

The signals produced and received by the Communications Card can be accessed by either the 53A-780 Hooded Connector or by the 53A-738 EIA Data Cable. The signal assignments are listed below.

	SIGNAL	53A-780 Pin Number/Letter	53A-738 Wire Color
	+12 Volts	1	Gray
	RS-232C Input Data (From 53A-121)	20	Brown
	Signal Ground	X	White (twisted pair)
	RS-232C Output Data (To 53A-121)	19	Black
	Signal Ground	X	White (twisted pair)
	RS-232C 53/63 Series System Busy (From 53A-121)	17	Red
*	RS-232C System Controller Busy (To 53A-121)	21	White (twisted pair)
**	RS-232C I/O Lock	10	Purple
	RS-232C STOP	22	Orange
	RS-232C Clock Output	23	White (twisted pair)
	53/63 Series System Interrupt	5	Yellow
	Protective Ground	24, BB	Shield

*   If unused, it must tied to F.E. 1 (+12 Volts).

**   When the I/O Lock Line is pulled high by an external device, the 53A-121 RIC, RIL, and line-feed detection circuitry is disabled. For most applications, this line will be unused and can be left unterminated.

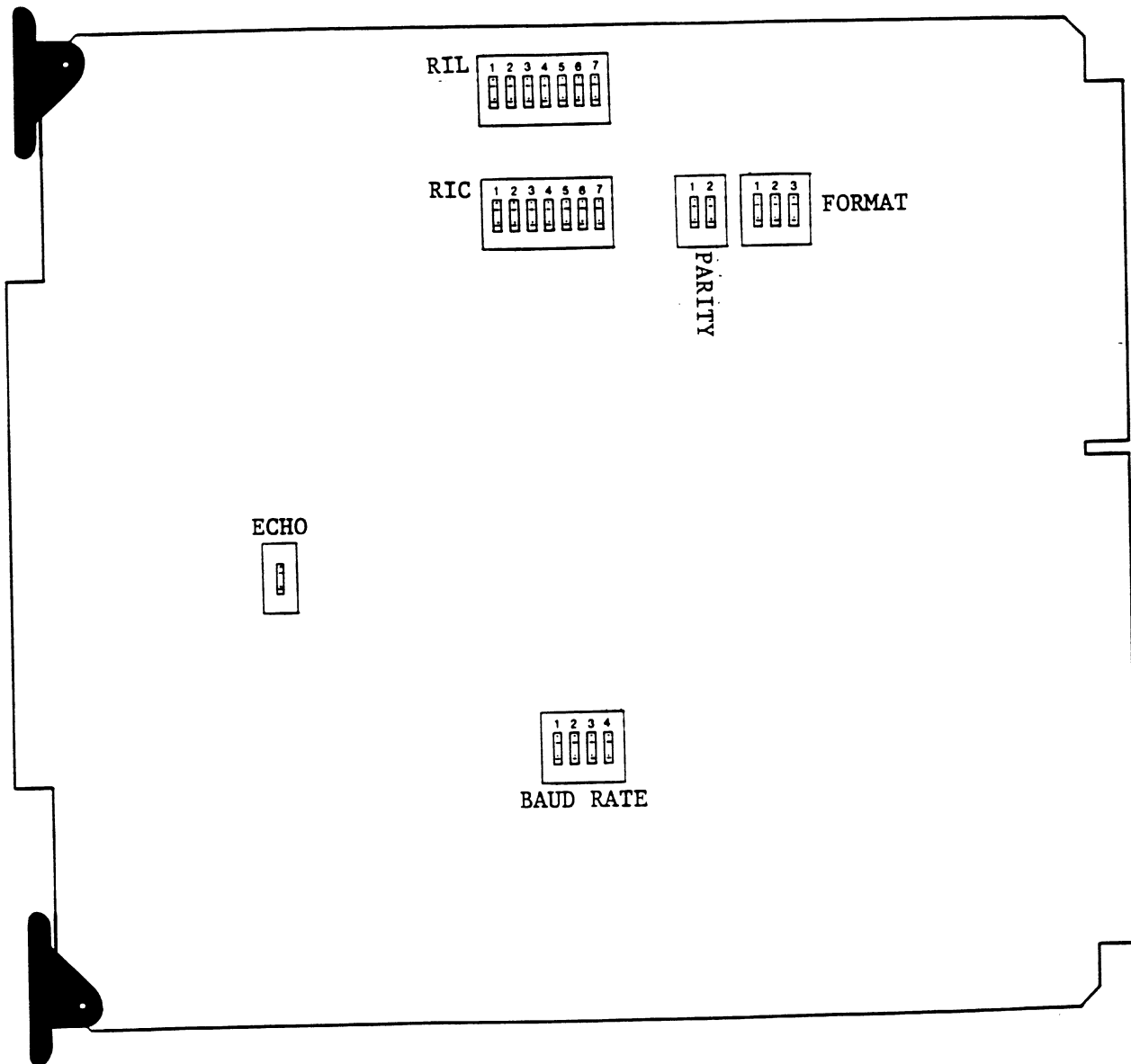*NOTE:*   All Signals except Protective Ground are optically isolated from the 53/63 Series System.

Figure 121-1: 53A-121 Switch Locations