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CMA01-487

* LL091289-(CKSUM E432) - STD EPROM.

COMMUNICATIONS ADAPTER PLUS (CAP)

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SECTION I

INTRODUCTION

1.1 GENERAL

The Communications Adapter Plus (CAP) is a versatile microprocessor based device which supports a wide variety of data communication applications. The CAP can connect two incompatible devices (using RS-232 interfaces) and allow them to communicate with each other. Internal DIP switches and jumpers are used to program the CAP's two bidirectional ports. The 8K of buffer may be allocated in different amounts for each port.

1.2 SPECIFICATIONS

Power: 115 VAC, 50-60 Hz, .771 ma

Size: 8 3/4"D x 5 1/2"W x 1 7/8"H (22.22 cm x 13.97cm x 4.76cm)

Weight: 1 pound, 1.5 ounces (0.496 Kg)

Enclosure: High Impact Plastic

Connectors: (2) DB25S female

Indicators: RXD, and TXD for each port and Power

Controls: Reset

Leads Supported

Pin		Function
1	PG	Protective Ground
2	TD	Transmit Data
3	RD	Receive Data
4	RTS	(DTE) Request to Send
5	CTS	(DCE) Clear to Send
6	DSR	(DCE) Data Set Ready
7	SG	Signal Ground
8	DCD	(DCE) Data Carrier Detect
20	DTR	Data Terminal Ready
21	SQ	(DCE) Signal Quality Detector
22	RI	(DCE) Ring Indicator
23	DRS	(DCE) Data Signal Rate Selector

SECTION II

INSTALLATION

2.1 EXTERNAL DEVICE REQUIREMENTS

Prior to installation, review the specifications of all the devices in the system to ensure compatibility with the CAP. The CAP can convert differences of two devices in any of the following parameters:

1. Equipment Type - Data Communication Devices are basically divided into two categories; Data Terminal Equipment (DTE) and Data Communications Equipment (DCE). See Figure 1 for the RS-232C Interface chart. For devices to communicate with each other, one device must be DTE and the other DCE. If the device transmits data on pin 2 of the RS-232C interface it is DTE. Otherwise, it is DCE. The CAP supports pins 1 thru 8, 20, 21 22 and 23.

   CAP Equipment Type Options:

   (a) Data Terminal Equipment (DTE)
   (b) Data Communications Equipment (DCE)

Pin	Name	EIA RS-232C	CCITT V.24	Description	Direction To DCE	Direction From DCE
1	FG	AA	101	Frame/Protective Ground	-	-
2	TD	BA	103	Transmitted Data	X	
3	RD	BB	104	Received Data		X
4	RTS	CA	105	Request to Send	X	
5	CTS	CB	106	Clear to Send		X
6	DSR	CC	107	Data Set Ready		X
7	SG	AB	102	Signal Ground	-	-
8	DCD	CF	109	Received Line Signal Detector		X
9	POS	-	-	Reserved For Data Set Testing		X
10	NEG	-	-	Reserved For Data Set Testing		X
11				Unassigned (Handshake Line)		
12	SDCD	SCF	122	Secondary Received Line Signal Detector		X
13	SCTS	SCB	121	Secondary Clear to Send		X
14	STD	SBA	118	Secondary Transmitted Data	X	
15	TC	DB	114	Transmitter Signal Element Timing		X
16	SRD	SBB	119	Secondary Received Data		X
17	RC	DD	115	Receiver Signal Element Timing		X
18				Unassigned		
19	SRTS	SCA	120	Secondary Request to Send	X	
20	DTR	CD	108.2	Data Terminal Ready	X	
21	SQ	CG	110	Signal Quality Detector		X
22	RI	CE	125	Ring Indicator		X
23	-	CH	111	Data Signal Rate Selector (DTE)	X	
23	-	CI	112	Data Signal Rate Selector (DCE)		X
24	SCTE	DA	113	Transmitted Signal Element Timing	X	
25	-	-	-	Unassigned		

Figure 1. RS-232 Interface Chart

2. Word Structure - Defines the structure of the asynchronous characters transmitted and received over the RS-232C interface.

   CAP Word Structure Options:

   1. 5-8 Data Bits

   2. Even, Odd, or No Parity Bit

   3. 1, 1.5, or 2 Stop Bits

3. Buffer Flow Control - The protocol for stopping and starting the transfer of data between two devices.

   CAP Buffer Flow Control Options:

   1. Hardware Flow Control - A pin of the RS-232 interface is used for buffer flow control. If the pin is +12V the device can receive data. If the pin is -12V the device can not receive data. The device attached to the CAP is asked to stop transmitting when only 256 Bytes of unused space remain in the buffer. The CAP will permit the device to transmit again when the buffer has been emptied to a point where 256 bytes of information are remaining.

      A. If CAP is DTE - It will source DTR and monitor CTS.

      B. If CAP is DCE - It will source CTS and monitor DTR.

   2. ENQ/ACK Flow Control - The device attached to the CAP must request for permission to transmit a block of asynchronous data by transmitting an 'ENQ' control code (Ø5H). Only if the device receives an 'ACK' control code (Ø6H) can it transmit the block. The CAP can always transmit data. A block may be anywhere from 1 to 256 bytes. If a larger block size is required, custom programming will have to be done.

   3. X-ON/X-OFF Flow Control - The device attached to the CAP or the CAP is allowed to transmit until they receive an 'X-OFF' control character (13H). After they receive this character they must wait until they receive an 'X-ON' control character (11H) before they transmit again. The device attached to the CAP is asked to stop transmitting when only 256 bytes of unused space remain in the buffer. The CAP will permit the device to transmit again when the

buffer has been emptied to a point where 256 bytes of information are remaining.

4. No Flow Control - The CAP can be configured to always receive and transmit data without any protocol.

4. Baud Rate - A unit of signaling speed equal to the number of signal events per second.

   CAP Baud Rate Options:

   Common Rates between 45.5 and 19,200 bps are available. See the baud rate chart for specific rates available. Some other Baud Rates between 18.75 and 19200 are available with custom programming.

5. Data Code - A set of rules specifying the way in which characters may be represented.

   CAP Data Code Options:

   1. ASCII
   2. EBCDIC
   3. TRANSCODE
   4. BAUDOT
   5. TICKER TAPE
   6. Other - The CAP can pass data in any data code without conversion if both ports are set up for 'OTHER'.

6. Transmission Mode - The protocol defining how information is transmitted over the RS-232C interface.

   CAP Transmission Mode Options:

   1. Full Duplex - Transmission can occur in both directions simultaneously.

   2. Half-Duplex - Transmission can occur in either direction, but not simultaneously.

   3. Simplex - Transmission that occurs in one direction only.

2.1.1 AC POWER

The AC power CAP is supplied with a 115V AC wall mounted power AC power supply. A 220V AC power supply is available.

NOTE
Do not have the AC power turned ON while making switch or jumper selections.

2.1.2 Cable Requirements

Both ports of the CAP are configured as DTE. One special crossover cable is provided with the unit to make one port DCE when the crossover cable is attached. If you require both ports to be configured DCE, you must use an additional crossover cable. The EIA RS-232 cable that interconnects the CAP via either of the two ports must be terminated with a male, DB25 connector. Usually only pins 1-8 and pin 2Ø are needed for most asynchronous applications. The following chart shows all the pins supported by the CAP.

PIN	NAME	DESCRIPTION	SOURCE
1	PG	Protective Ground	DTE and DCE
2	TD	Transmit Data	DTE
3	RD	Receive Data	DCE
4	RTS	Request to Send	DTE
5	CTS	Clear to Send	DCE
6	DSR	Data Set Ready	DCE
7	SG	Signal Ground	DTE and DCE
8	DCD	Data Carrier Detect	DCE
2Ø	DTR	Data Terminal Ready	DTE
21	SQD	Signal Quality Detector	DCE
22	RI	Ring Indicator	DCE
23	DRS	Data Signal Rate Selector	DCE

2.2 PROGRAMMING THE CAP

Before the CAP can be installed it must be programmed to match your specific application. This consists of setting internal DIP switches and positioning jumpers on the inside of the CAP. This is a very simple procedure if you first fill out the questionnaire at the end of this manual. The completed questionnaire can then be used to configure the DIP switches and jumpers in a logical manner.

2.2.1 DIP SWITCH SETTINGS

Figure 2 shows the location of the DIP switches and Table I gives their functions. See Tables II-V for the switch settings.

Positions 1-8 of each DIP switch can be turned ON or OFF with a small instrument such as a ball point pen. A position is ON when it is pushed in the direction of the arrow marked on the

switch. If it is pushed in the direction opposite the arrow, it is in the OFF position. After any switch positions are changed, the CAP should be powered OFF and then powered ON again. If the switches were changed with the CAP powered ON, the reset button has to be pressed.

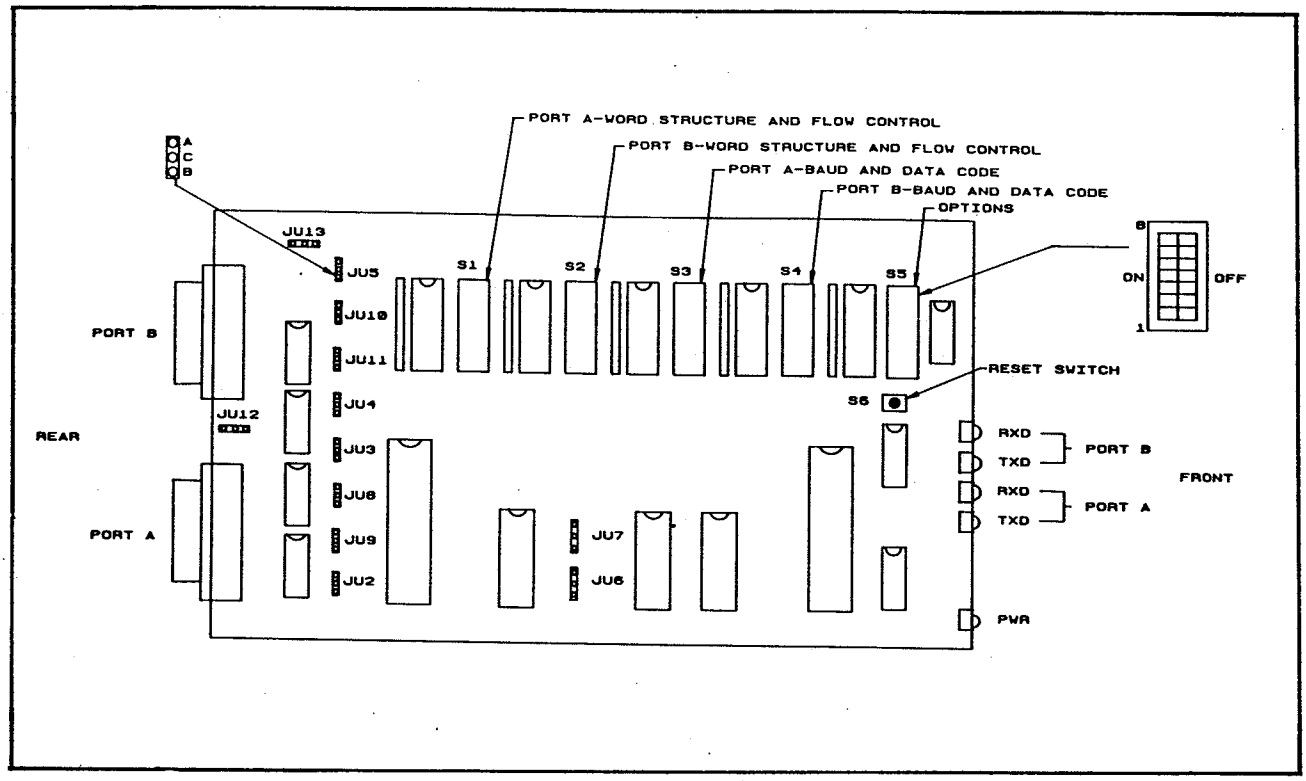

Figure 2. Switches

Table I. Switch Functions

SWITCH	FUNCTION
S1	Port A word structure and buffer flow control
S2	Port B word structure and buffer flow control
S3	Port A baud rate and data code set
S4	Port B baud rate and data code set
S5	Ports A and B RS-232 lead options, equipment type, transmission mode, buffer allocation and self test.
S6	Reset Pushbutton

Table II. Switch S1 (Port A) and Switch S2 (Port B) Settings for Word Structure and Buffer Flow Control.

POSITION	1	2	WORD STRUCTURE
	OFF	OFF	1 stop bit
	ON	OFF	1 1/2 stop bits
	OFF	ON	1 stop bit
	ON	ON	2 stop bit
POSITION	3		
	OFF		Odd parity
	ON		Even parity
POSITION	4		
	OFF		Parity disable (voids position 3)
	ON		Parity enable
POSITION	5	6	
	OFF	OFF	8 data bits
	OFF	ON	7 data bits
	ON	OFF	6 data bits
	ON	ON	5 data bits
POSITION	7	8	BUFFER FLOW CONTROL
	OFF	OFF	Hardware flow control using CTS/DTR or no flow control
	ON	OFF	ENQ/ACK buffer flow control
	OFF	ON	XON/XOFF buffer flow control
	ON	ON	XON/XOFF buffer flow control (Enables XON at reset)

In some cases it is possible to use Mark and Space Parity. A Mark Parity bit is a parity bit used to represent a binary 1. A Space Parity bit is used to represent binary Ø.

To use either mark or space parity, position 4 must be OFF (to disable even or odd parity) and certain other conditions must be met as follows:

Space Parity - Set the data bit switches for, one more data bit than the data code set requires. For example; if your device is using the 7 bit ASCII code set, set position 5 and 6 for 8 bit data (7 + 1 = 8). This extra data bit will appear as the space parity bit.

The data bits required to represent a character in each code set are as follows:

ASCII	7
EBCDIC	8
BAUDOT	5
TICKER TAPE	6
TRANSCODE	6

> NOTE
>
> Space parity cannot be used for 8 bit EBCDIC data because the CAP cannot be configured for 9 bit data.

Mark Parity - Mark parity can only be used if your device is using a word structure containing one stop bit. Set positions 1 and 2 ON (2 stop bits). The first stop bit will appear as a Mark parity bit.

> NOTE
>
> For all options except hardware flow control, the transmit and receive enable jumpers should be set as follows:
>
> 1. Source of RX Enable - Always Receive
> 2. Source of TX Enable - Always Transmit See Section 2.1.2.

Table III. Switch S3 and Switch S4 Settings For Baud Rate and Data Code Set

POSITION				Baud Rate With Position 5 OFF	Baud Rate With Position 5 ON
1	2	3	4		
OFF	OFF	OFF	OFF	9,600	1,371.54
ON	OFF	OFF	OFF	19,200	1,200
OFF	ON	OFF	OFF	9,600	1,037.92
ON	ON	OFF	OFF	4,800	600
OFF	OFF	ON	OFF	4,800	300
ON	OFF	ON	OFF	2,400	200
OFF	ON	ON	OFF	2,400	164.82
ON	ON	ON	OFF	1,828.72	150
OFF	OFF	OFF	ON	1,371.54	134.28
ON	OFF	OFF	ON	1,200	110.35
OFF	ON	OFF	ON	1,037.92	100
ON	ON	OFF	ON	600	74.42
OFF	OFF	ON	ON	300	67.14
ON	OFF	ON	ON	200	55.82
OFF	ON	ON	ON	164.82	50
ON	ON	ON	ON	150	45.5

Table IV. Switch S3 and Switch S4 Settings (Positions 6 thru 8)

POSITION	6	7	8	DATA CODE SET
	OFF	OFF	OFF	ASCII
	ON	OFF	OFF	EBCDIC
	OFF	ON	OFF	TRANSCODE
	ON	ON	OFF	BAUDOT
	OFF	OFF	ON	TICKER TAPE
	ON	OFF	ON	ASCII
	OFF	ON	ON	ASCII
	ON	ON	ON	OTHER may be chosen only if both devices use the same code set

NOTE

Make certain switches S1 and S2 are set for the correct number of data bits for the particular Data Code set chosen (Table II).

Table V. Switch S5 Settings

RS-232 lead options, equipment type, transmission mode and buffer allocation

POSITION	1	RS-232 Lead options for PORT A
	OFF	Normal - DTR/CTS output toggles for buffer flow control and RTS/DCD output raises only when the port has data to transmit. Normal must be used for hardware flow control.
	ON	Active - DTR/CTS and RTS/DCD outputs are always active.
POSITION	2	RS-232 Lead options for PORT B
	OFF	Normal - DTR/CTS output toggles for buffer flow control and RTS/DCD output raises only when the port has data to transmit. Normal must be used for hardware flow control.
	ON	Active - DTR/CTS and RTS/DCD outputs are always active.
POSITION	3	Equipment type of CAP outputs PORT A
	OFF	DCE - Port receives data on pin 2
	ON	DTE - Port transmits data on pin 2
POSITION	4	Transmission mode for PORT A
	OFF	Full duplex
	ON	Half duplex (Hardware flow control configuration must be used with half duplex).
POSITION	5	Equipment type of CAP outputs PORT B
	OFF	DCE - Port receives data on pin 2
	ON	DTE - Port transmits data on pin 2
POSITION	6	Transmission mode for PORT B
	OFF	Full duplex
	ON	Half duplex

Table V. Switch S5 Settings (continued)

POSITION 7	8	Buffer allocation/self test	
		Port A	Port B
OFF	OFF	1/2	1/2
ON	OFF	3/4	1/4
OFF	ON	1/8	7/8
ON	ON	SELF	TEST

2.2.2 JUMPER SETTINGS

Post jumpers are used in the CAP (See Figure 2). A post jumper consists of physical posts extending upward from the PC board for the socket. A rectangular jumper is placed over the posts. The sockets are in arrangements of three posts on the CAP. A post jumper can be changed using your fingers or a small pair of pliers. Pull the jumper straight up off the posts being careful not to crush the jumper. To insert the jumper, line the holes in the jumper with the posts and push the jumper over the posts.

Table VI RS-232 Interface Jumpers

JU1 - When a piece of wire is soldered between these two holes, frame ground is connected to voltage ground.

JU1Ø & JU8 - Source of RX enable for CAP
JU1Ø is for port B, JU8 is for Port A

Receive Enable (RXE) - A ports RXE must be enabled when Receive Data is present, or the data will be ignored. The CAP has two options for RXE. Position B-C will enable the CAP's port receiver at all times. Position A-C allows the DCD/RTS RS-232 input lead to enable the CAP port's receiver. The lead must be active (+12V) to enable the port's receiver. If the lead is not active, the receiver will not be enabled. This will cause the CAP to not recognize any data that comes into the port. It is desirable to use the RS-232 lead as the receiver enable to avoid receiving garbage or noise as data. Normally DCD/RTS input will be active when a device is transmitting to the PCA. If your device does not source DCD/RTS like this, you must position the jumper to always enable the receiver (B-C).

POSITION	RESULT
B-C	Receiver always enabled
A-C	DCD/RTS input active enables receiver

JU4 & JU2 - Source of TX enable for CAP
JU4 is for Port B, JU2 is for Port A

Transmit Enable (TXE) - A port's transmitter must be enabled or the CAP will not transmit any data. The CAP has two options for TXE. Position B-C will enable the CAP port's transmitter at all times. This allows the CAP to always transmit any valid data it receives from the other port. The A-C position selects the CTS/DTR input signal to enable the port's transmitter. The lead must be active (+12V) to enable the transmitter. If the port's transmitter is not enabled, it will buffer the data received from the other port. It is desirable to use CTS/DTR as the transmit enable to avoid transmitting to a device that is powered off. You must use CTS/DTR input as the transmitter enable when using hardware flow control.

POSITION	RESULT
B-C	Transmitter always enabled
A-C	CTS/DTR input active enables transmitter

JU13 & JU12 - DSR output
JU13 is for Port B, JU12 is for Port A

POSITION	RESULT
A-C	DSR output always active (use when Port configured as DCE)
B-C	No connection to DSR (use when port configured as DTE)

JU5 & JU3 - DTR output
JU5 is for Port B, and JU3 is for Port A

POSITION	RESULT
A-C	DTR controlled by software
B-C	DTR always active (Forces DTR up to prevent attached modems from hanging up when using software flow control)

JU11 & JU9 - Ring indicate input (RI)
JU11 is for Port B, and JU9 is for Port A

POSITION	RESULT
A-C	RI/SQD input connected to CAP (use only for custom software that monitors RI of SQD).
B-C	RI/SQD input not connected to CAP. This position must be used for standard CAP program.

Table VIII. Ram Size Jumpers

This jumper is factory set in the proper position for an 8K RAM.

JU6 Position	RAM Size
A-C	8K
B-C	2K

Table IX. Eprom Size Jumpers

This jumper is factory set in the proper position for an 8K EPROM.

Jumper U7	Eprom Size
A-C	4, 8, or 16K
B-C	2K

2.3 CAP TO DEVICE CONNECTION

After the CAP is programmed for your application, connect it to the two external devices using an RS-232 cable. Make sure the port configured for device A is connected to device A and the port configured for device B is connected to device B. Apply AC Power. The CAP is now ready for operation.

SECTION III

PROBLEM SOLVING

3.1 LED INDICATORS

Five diagnostic leds are mounted on the front of the unit. One Led is for POWER Two leds are for Port A and two are for Port B. The two leds for each port are Receive Data and Transmit Data If the CAP does not appear to be communicating with your devices, the following procedure may be used to help solve the problem.

1. Power - The power led should be on when the CAP is plugged into a wall outlet. The CAP can not operate without power.

3. Receive Data - This indicator will flash when the CAP receives data. The CAP cannot pass information between two devices unless it receives data to transmit. Never assume your equipment is transmitting data to the CAP. Monitor this led to verify that the CAP is receiving data. If this led does not flash when your device is transmitting to the CAP check the following:

   A. Verify if your device is DTE or DCE.
   B. DTE/DCE switches & crossover cable (DIP switch #5 positions 3 & 5).

The CAP may receive data, but it will ignore this data unless the receive enable input is active. Check the following to make sure this is not the problem:

A. Receive enable jumpers (JU1Ø & JU8)
B. If the receive enable jumpers are in the correct position for your application, the input signal you have chosen for RXE may not be active. The cable that connects your device to the CAP may be damaged or missing a wire for this input pin. Your device may not output the signal you have chosen. With jumpers JU1Ø and JU8 in the B-C position, the CAP will always receive.

5. Transmit Data

If the CAP receives data when its receive enable is active, it will put the data in its internal buffer. The CAP will attempt to transmit the data out the other port. However, the CAP cannot transmit any data unless its transmit enable is active.

If the TXD LED is not flashing check the following:

A. Transmit Enable Jumpers (W14 & W16)
B. If the transmit enable jumpers are in the correct position for your application, the input signal you have chosen for TXE may not be active. The cable that connects your device to the CAP may be damaged or missing a wire for this input pin. Your device may not output the signal you have chosen. With jumpers JU4 and JU2 in the 'B-C' position, the CAP will always transmit. This option can be used during testing, but it should not be used in normal operation if you are using hardware flow control.

3.2 CABLES AND CONFIGURATION

If the LED indicators for both ports are working properly but the two devices are not communicating with each other, check the following:

1. Check for a good connection between pins 2, 3 and 7 of the cables that attach your equipment to the CAP. These are the pins for TXD, RXD and ground.

2. Recheck all DIP Switches and jumper positions for both ports to verify that the CAP is configured to match both devices it is connecting. For example, if Port A is configured to use two stop bits and your device is only sending one stop bit, the CAP may not recognize the receive data.

SECTION IV

SELF TEST

4.1 INITIAL REQUIREMENTS

The CAP can be set up to run a self test. This self test will determine if the unit is operating properly. A CRT can be connected to determine specific problems and to display status and error messages. To set up the self test, the crossover cable (supplied with the unit) and a male to male cable will have to be used. If a CRT is going to be used to display the test results, an additional break-out box or special cable is required. This cable or break-out box should be able to tap into pins 3 & 7 only on the CAP's RS-232 interface and connect to the CRT interface on the other end.

The self test checks for proper operation of the RAM, DIP switches, RS-232 interface, jumpers TXE and RXE and performs an interrupt test. The CRT will display a status message after every test to indicate if the test was passed or was failed. If an error occurs during the DIP switch test or jumper test, error codes will be displayed. The code can then be used to determine the problem. The CRT will also display instructions to aid in running the test. For example; the DIP switches have to be tested in both positions. The CRT will tell you when to change the settings.

4.2 TEST PROCEDURE

Use the following procedure to set up and run the self test:

1. Connect one end of the crossover cable to Port A of the CAP.

2. Connect the other end of the crossover cable to a male to male cable, then connect the other end of the male to male cable to port B. If you are connecting Port B to a CRT, the type of connection used, will remain up to you. Make sure that only pins 3 and 7 are connected to the interface of the CRT. Other pins connected to CRT could cause incorrect test results.

3. Configure Port A as DCE (switch 5 position 3 OFF).

4. Configure Port B as DTE (switch 5 positions 5 ON).

5. Configure the CAP to run self test by setting switch 5 positions 7 and 8 to the ON position.

6. The other switches should be set to the OFF positions. If a CRT is being used to monitor status messages and error codes, set the switches to match the CRT configuration (only baud rate and word structure). The test

will work with a CRT when the other switches are in the OFF position if the CRT is configured for 9600 Baud, 8 data bits, 1 stop bit and no parity.

7. RI/SQD jumpers (JU11 and JU19) must be set in the B-C position, during the self test and normal operation of the CAP.

8. Set the TX enable jumpers (JU4 and JU2) to the DTR/CTS input position (A-C).

9. Set the RX enable jumpers (JU10 and JU8) to the RTS/DCD input position (A-C).

10. Set jumpers JU5 and JU3 (DTR output) to the A-C position.

11. Turn power on or press the reset button. The Transmit and Receive lights should flash on for approximately one second. If using a CRT, a message should be displayed on the screen. If no message is on the screen or the LEDs did not come on, there may be a cable problem, an initialization problem or a bad board.

12. After the unit is reset or powered on, change switch 5 position 8 to start the test. The first test executed is a RAM test.

    Wait a few seconds to allow the test program to check the RAM and read the DIP switches. If the LEDs continuously flash, the RAM is bad and the test will stop. It is normal for the LEDs to flash occasionally during test.

    If the RAM is working properly the next test will automatically start. This test is the DIP switch test. The CAP will read the current value of all DIP switch positions. The unit now has to read the DIP switches when they are in the exact opposite positions to make sure all the positions can be read (ON and OFF).

13. Set the DIP switches to the opposite positions. Set switch 5 position 8 last. When you change this switch, the CAP will read the switches again to verify if they can be read in both the ON and OFF positions. An error in the DIP switch test will not be shown by the TXD and RXD LEDs flashing until the rest of the self test is completed.

If a CRT is monitoring the test, five error codes will be displayed on the screen (one for each DIP switch) if the test failed. Each error code is a 1 byte number in the hexidecimal number system. Convert this code to the 8 bit binary equivalent. The 8 bit binary pattern indicates the switch positions as shown below.

DATA BIT Column Number	7 6 5 4 3 2 1 Ø
DIP Switch Position Number	8 7 6 5 4 3 2 1

A (Ø) in the DIP switch position indicates a good switch. A (1) indicates a bad switch.

An example of an error code and results is as follows:

ERROR CODES FF 7F Ø4 18 ØØ

DIP Switch 1 = FF - This translates to 1111 1111 in binary. All the DIP switch positions are faulty.

DIP Switch 2 = 7F - This translates to Ø111 1111 in binary DIP switch positions 1 thru 7 are faulty. The 8th position is good.

DIP Switch 3 = Ø4 - This translates to ØØØØ Ø1ØØ in binary. DIP Switch Position 3 is bad. The rest are good.

DIP Switch 4 = 18 - This translates to ØØØ1 1ØØØ in binary DIP switch positions 4 and 5 are bad. The rest are good.

DIP Switch 5 = ØØ - This translates to ØØØØ ØØØØ in binary. All the DIP switch positions are good.

14. After the DIP switch test is completed, the CAP will immediately start the jumper test. The jumper test checks to make sure if the two circuit paths created by the positions of the RXE and TXE jumpers is correct and working properly. The test will check the first circuit path created when the TXE and RXE jumpers are in their initial setting (A-C).

15. Change the TX enable and RX enable jumpers (JU2, JU4, JU8 and JU1Ø) to always receive (position B-C).

16. Invert switch 5 position 8. The jumper test will now be run for the circuit path created by position B-C.

17. If the jumper test does not pass, an error code in HEX will be displayed on the screen for each port. Port A will be on the left and Port B on the right. Translate the 1 byte Hex number into it's 8 bit binary form and compare the binary number to the error code table to find the problem area. A Ø in the Bit Column Number indicates no error and a 1 indicates an error.

An example of a CRT display is as follows:

DIP Switch test passed.

Set TX enable and RX enable jumper to always TX and RX then change position 8 of switch 5 to continue.

RS-232 interface and jumper test failed.
Error Codes: 12 ØØ

Port A = 12 - This translates to ØØØ1 ØØ1Ø in binary. Bits 1 and 4 are set to indicate errors (refer to the Error Code table for error description for these bits).

Port B = ØØ - This translates to ØØØØ ØØØØ in Binary. Port B did not have any error in the jumper test.

ERROR CODE TABLE

Binary Bit Column Number	Meaning
Ø	RX data error (data transmitted out a port is not the same as the data received in the other port)
1	DTR to CTS input is active when DTR is down
2	DTR to CTS input is not active when DTR is up
3	Ground to CTS input is not active when tied to ground
4	RTS to DCD input is active when RTS is down
5	RTS to DCD input is not active when RTS is up
6	Ground to DCD input is not active when tied to ground
7	Interrupt Error

17. After the jumper test is completed, the unit will automatically start an interrupt test. A break will be transmitted out of each port and received by the other port to check the interrupt circuitry of the board. This may cause a Byte of garbage to be displayed on the CRT.

18. After a few seconds the RX Data and TX Data LEDs will do one of the following:

    1. Light steadily - this indicates the test passed.

    2. Flash - this indicates test failed. A CRT connected to the unit is necessary to determine what individual test failed.

    3. Stay off - this indicates a loss of communication between ports A and B. Check cabling for good connections and run the test again. To run the test over again configure the DIP switches and jumpers to their initial settings and press the reset switch.

19. The test is now complete. A brief summary of the test steps is given below.

    1. Configure switches and jumpers to initial positions

    2. Connect the cables and reset box.

    3. Change position 8 of DIP switch 5 to start test.

    4. Invert all DIP switches. Change DIP switches position 8 of switch 5 last.

    5. Change TX enable and RX enable jumpers (JU2, JU4, JU8 and JU1Ø) jumpers to B-C positions, then change position 8 of switch 5 last.

    6. Monitor LEDs for test pass or fail

SECTION V

QUESTIONNAIRE

5.1 GENERAL

If you are having difficulty programming the CAP, this questionnaire may be helpful. After the questionnaire has been completed, refer to Section 2.2.1 for information on setting the switches and jumpers.

> **NOTE**
>
> Device A is the device to be connected to Port A and Device B is the device to be connected to Port B.

5.2 WORD STRUCTURE AND BUFFER FLOW CONTROL

DEVICE A	DEVICE B	DIP SWITCH POSITIONS
--------	--------	STOP BITS (1, 1.5 or 2)
--------	--------	PARITY TYPE (odd, even, mark, space or void)
--------	--------	DATA BITS, (5, 6, 7, OR 8). The number data bits should be equal to or greater than the number of bits required to represent your chosen data code. ASCII - 7 Bit Code EBCDIC - 8 Bit Code TRANSCODE - 6 Bit Code BAUDOT - 5 Bit Code TICKER TAPE - 6 Bit Code
--------	--------	Flow control type - Hardware, ENQ/ACK, XON/XOFF, No flow control

5.3 BAUD RATE AND DATA CODE

DEVICE A	DEVICE B	DIP SWITCH POSITIONS
---------	---------	BAUD RATE (use table III and choose closest rates to your devices). The rate should be within plus or minus 4% of your device's actual baud rate. For example, if your device uses 1050 baud, choose 1037.92 baud. 1037.92/1050 = .99 (99%)
--------	--------	DATA CODE The data code selections are as follows: ASCII EBCDIC TRANSCODE BAUDOT TICKER TAPE OTHER (none of the above)

5.4 RS-232 LEAD OPTIØNS, EQUIPMENT TYPE, TRANSMISSION MODE AND BUFFER ALLOCATION

DEVICE A	DEVICE B	DIP SWITCH POSITIONS
--------	--------	OPERATION OF OUTPUT LEADS NORMAL (If using hardware lead flow control) ACTIVE (If using software flow control ENQ/ACK or XON/XOFF)
--------	--------	Equipment type of CAP (DCE or DTE must be the opposite of your device). DCE - Port receives data on pin 2 DTE - Port transmits data on pin 2
--------	--------	Transmission mode (full duplex, half duplex, or simplex).

DEVICE A	DEVICE B	Buffer Allocation	
		PORT A	PORT B
--------	---------	1/2	1/2
		3/4	1/4
		1/8	7/8

If one of your devices will do most of or all of the transmission. You may assign it a larger portion of the CAP buffer. Otherwise, assign 1/2 the buffer to each port.

5.5 SOURCE OF RX ENABLE

DEVICE A	DEVICE B
-------	-------

Source of RX Enable - The CAP will only accept receive data if it's receiver is enabled.

DCD/RTS Input - RTS input if the CAP is DCE. DCD input if the CAP is DTE. DCD/RTS enables receiver when active. Choose if your device asserts RTS or DCD when transmitting.

Receiver Always Enabled - The CAP can always receive.

5.6 SOURCE OF TX ENABLE

DEVICE A	DEVICE B
--------	--------

Source of TX Enable - The CAP can only transmit when it's transmitter is enabled.

CTS/DTR Input - DTR input if the CAP is DCE or CTS input if the CAP is DTE. CTS/DTR enables transmitter when input is active. Choose if your device asserts DTR or CTS when it is powered on and/or it can receive data. You must use this option if you choose hardware buffer flow control.

Transmitter Always Enabled - The CAP can always transmit

SECTION VI

CODE SET CONVERSION TABLES

6.1 GENERAL

This section contains tables that give the hexadecimal number (followed by "H") for a character in the ASCII, EBCDIC, Transcode, Baudot and Ticker Tape codes. The column labeled "Character or Control" gives the character that the hexadecimal number represents. The characters are in the same order as the codes. Looking at the first listing in Section 6.1 for example, a 061H in ASCII is an "a", a 081H in EBCDIC is an "a", a 001H in Transcode is an A, a 003H in Baudot is an "A" and a 020H in Ticker Tape is special ticker tape conversion character called a special figure five (SF5). A Lower case 'a' in ASCII (061H) would be converted to a capital 'A' in baudot (03H), because Baudot does not support lower case letters. An upper case 'A' in Baudot would be converted to an upper case 'A' in ASCII (See Section 6.3).

6.2 LOWER CASE LETTERS

Only ASCII & EBCDIC support lower case letters. All lower case letters will be converted to upper case letters in the other codes, with the exception of some ticker tape codes.

ASCI	EBCD	TRAN	BAUD	TICK	CHARACTER OR CONTROL
061H,	081H,	001H,	003H,	020H	a,a,A,A,SF5
062H,	082H,	002H,	019H,	03BH	b,b,B,B,2ND B
063H,	083H,	003H,	00EH,	022H	c,c,C,C,c
064H,	084H,	004H,	009H,	027H	d,d,D,D,SF4
065H,	085H,	005H,	001H,	02FH	e,e,E,E,SF3
066H,	086H,	006H,	00DH,	00DH	f,f,F,F,F
067H,	087H,	007H,	01AH,	01AH	g,g,G,G,G
068H,	088H,	008H,	014H,	025H	h,h,H,H,S
069H,	089H,	009H,	006H,	006H	i,i,I,I,I
06AH,	091H,	011H,	00BH,	00BH	j,j,J,J,J
06BH,	092H,	012H,	00FH,	00FH	k,k,K,K,K
06CH,	093H,	013H,	012H,	012H	l,l,L,L,L
06DH,	094H,	014H,	01CH,	01CH	m,m,M,M,M
06EH,	095H,	015H,	00CH,	00CH	n,n,N,N,N
06FH,	096H,	016H,	018H,	018H	o,o,O,O,O
070H,	097H,	017H,	016H,	003H	p,p,P,P,PR
071H,	098H,	018H,	017H,	017H	q,q,Q,Q,Q
072H,	099H,	019H,	00AH,	01FH	r,r,R,R,RT
073H,	0A2H,	022H,	005H,	036H	s,s,S,S,ST
074H,	0A3H,	023H,	010H,	032H	t,t,T,T,SS
075H,	0A4H,	024H,	007H,	007H	u,u,U,U,U
076H,	0A5H,	025H,	01EH,	01EH	v,v,V,V,V
077H,	0A6H,	026H,	013H,	008H	w,w,W,W,WI
078H,	0A7H,	027H,	01DH,	01DH	x,x,X,X,X
079H,	0A8H,	028H,	015H,	02BH	y,y,Y,Y,BEG ANN

ASCI EBCD TRAN BAUD TICK	CHARACTER OR CONTROL
07AH,0A9H,029H,011H,02AH	z,z,Z,Z,END ANN

6.3 UPPER CASE LETTERS

All upper case letters can be converted. Therefore, only one letter is given in the "CHARACTER OR CONTROL" column.

ASCI EBCD TRAN BAUD TICK	CHARACTER OR CONTROL:
041H,0C1H,001H,003H,003H	A
042H,0C2H,002H,019H,019H	B
043H,0C3H,003H,00EH,00EH	C
044H,0C4H,004H,009H,009H	D
045H,0C5H,005H,001H,001H	E
046H,0C6H,006H,00DH,00DH	F
047H,0C7H,007H,01AH,01AH	G
048H,0C8H,008H,014H,014H	H
049H,0C9H,009H,006H,006H	I
04AH,0D1H,011H,00BH,00BH	J
04BH,0D2H,012H,00FH,00FH	K
04CH,0D3H,013H,012H,012H	L
04DH,0D4H,014H,01CH,01CH	M
04EH,0D5H,015H,00CH,00CH	N
04FH,0D6H,016H,018H,018H	O
050H,0D7H,017H,016H,016H	P
051H,0D8H,018H,017H,017H	Q
052H,0D9H,019H,00AH,00AH	R
053H,0E2H,022H,005H,005H	S
054H,0E3H,023H,010H,010H	T
055H,0E4H,024H,007H,007H	U
056H,0E5H,025H,01EH,01EH	V
057H,0E6H,026H,013H,013H	W
058H,0E7H,027H,01DH,01DH	X
059H,0E8H,028H,015H,015H	Y
05AH,0E9H,029H,011H,011H	Z

6.4 NUMBERS

All numbers can be converted. Therefore, only one number is given in the "CHARACTER OR CONTROL" column.

ASCI EBCD TRAN BAUD TICK	CHARACTER OR CONTROL:
030H,0F0H,030H,016H,028H	0
031H,0F1H,031H,017H,023H	1
032H,OF2H,032H,013H,039H	2
033H,0F3H,033H,001H,02EH	3
034H,0F4H,034H,00AH,029H	4
035H,0F5H,035H,010H,021H	5
036H,0F6H,036H,015H,02DH	6

```
ASCI EBCD TRAN BAUD TICK    CHARACTER OR CONTROL:

037H,0F7H,037H,007H,03AH    7
038H,0F8H,038H,006H,034H    8
039H,0F9H,039H,018H,026H    9
```

6.5 SPECIAL PRINTABLE CHARACTERS

Any special printable character that can not be converted will be changed to another character that is a valid member of the code set. The common character dash (-) is used, except for ticker tape codes that can't be converted.

```
ASCI EBCD TRAN BAUD TICK    CHARACTER OR CONTROL:

020H,040H,01AH,004H,02CH    SP (BAUDOT SP, SET 1B)
021H,05AH,020H,003H,038H    !,!,-,-,-
022H,07FH,020H,011H,038H    ",",-,",-
023H,07BH,03BH,014H,038H    #,#,#,#,-
024H,05BH,01BH,00DH,03CH    $
025H,06CH,02CH,003H,038H    %,%,%,-,-
026H,050H,010H,01AH,01BH    &
027H,07DH,020H,005H,038H    ',',-,',-
028H,04DH,020H,00FH,038H    (,(,-,(,-
029H,05DH,020H,012H,038H    ),),-,),-
02AH,05CH,01CH,003H,038H    *,*,*,-,-
02BH,04EH,020H,009H,038H    +,+,-,+,-
02CH,06BH,02BH,00CH,038H    , , , , -
02EH,04BH,00BH,01CH,024H    .,.,.,.,FIGURE DOT
02FH,061H,021H,01DH,002H    /,/,/,/,LETTER DOT
03AH,07AH,020H,00EH,038H    :,:,-,:,-
03BH,05EH,020H,01EH,038H    ;,;,-,;,-
03CH,04CH,00CH,003H,038H    <,<,<,-.-
03DH,07EH,020H,003H,038H    =,=,-,-,-
03EH,06EH,020H,003H,03EH    >,>,-,-,3/8
03FH,06FH,020H,019H,038H    ?,?,-,?,-
040H,07CH,03CH,003H,038H    @,@,@,-,-
05BH,0ADH,020H,003H,037H    [,[,-,-,1/4
05CH,0E0H,020H,003H,038H    \,\,-,-,-
05DH,0BDH,020H,003H,035H    ],],-,-,3/4
05EH,060H,020H,003H,038H    ^,-,-,-,
05FH,06DH,020H,003H,038H    ←,←,-,-,-
060H,079H,020H,003H,038H    `,`,-,`,-
07BH,0C0H,020H,003H,033H    {,{,-,-,1/2
07CH,06AH,020H,003H,030H    |,|,-,-,1/8
07DH,0D0H,020H,003H,031H    },},-,-,7/8
07EH,0A1H,020H,003H,03DH    ~,~,-,-,5/8
```

6.6 CONTROL CODES

Any control code that can not be converted is discarded and shown as an OFFH in the column for that code set.

ASCI	EBCD	TRAN	BAUD	TICK	CHARACTER OR CONTROL:
006H	02EH	0FFH	0FFH	0FFH	ACK
007H	02FH	00DH	00BH	0FFH	BEL
008H	016H	0FFH	0FFH	0FFH	BS
0FFH	024H	0FFH	0FFH	0FFH	BYP
018H	018H	0FFH	0FFH	0FFH	CAN
0FFH	01AH	0FFH	0FFH	0FFH	CC
00DH	00DH	0FFH	008H	0FFH	CR (BAUDOT CR, SET 1B)
011H	011H	0FFH	0FFH	0FFH	DC1
012H	012H	0FFH	0FFH	0FFH	DC2
013H	013H	0FFH	0FFH	0FFH	DC3
014H	03CH	0FFH	0FFH	0FFH	DC4
07FH	007H	03FH	0FFH	03FH	DEL & RUBOUT IN TICKER TAPE
010H	010H	01FH	0FFH	0FFH	DLE
0FFH	020H	0FFH	0FFH	0FFH	DS
019H	019H	03EH	0FFH	0FFH	EM
005H	02DH	02DH	0FFH	0FFH	ENQ
0FFH	026H	0FFH	0FFH	0FFH	EOB
004H	037H	01EH	0FFH	0FFH	EOT
01BH	027H	02AH	0FFH	0FFH	ESC
017H	026H	00FH	0FFH	0FFH	ETB
003H	003H	02EH	0FFH	0FFH	ETX
00CH	00CH	0FFH	0FFH	0FFH	FF
01CH	022H	0FFH	0FFH	0FFH	FS
01DH	0FFH	0FFH	0FFH	0FFH	GS
009H	005H	02FH	0FFH	0FFH	HT
0FFH	01CH	0FFH	0FFH	0FFH	IFS
0FFH	01DH	0FFH	0FFH	0FFH	IGS
0FFH	017H	0FFH	0FFH	0FFH	IL
0FFH	01EH	0FFH	0FFH	0FFH	IRS
0FFH	01FH	0FFH	0FFH	0FFH	IUS
0FFH	006H	0FFH	0FFH	0FFH	LC
00AH	025H	0FFH	002H	0FFH	LF
015H	03DH	03DH	0FFH	0FFH	NAK
0FFH	015H	0FFH	0FFH	0FFH	NL
000H	000H	0FFH	0FFH	000H	NUL & SPARE IN TICKER TAPE
0FFH	004H	0FFH	0FFH	0FFH	PF
0FFH	034H	0FFH	0FFH	0FFH	PN
0FFH	027H	0FFH	0FFH	0FFH	PRE
0FFH	014H	0FFH	0FFH	0FFH	RES
0FFH	009H	0FFH	0FFH	0FFH	RLF
01EH	035H	0FFH	0FFH	0FFH	RS
00FH	00FH	0FFH	0FFH	0FFH	SI
0FFH	02AH	0FFH	0FFH	0FFH	SM
0FFH	00AH	0FFH	0FFH	0FFH	SMM
00EH	00EH	0FFH	0FFH	0FFH	SO
001H	001H	000H	0FFH	0FFH	SOH

ASCI EBCD TRAN BAUD TICK	CHARACTER OR CONTROL:
ØFFH,Ø21H,ØFFH,ØFFH,ØFFH	SOS
Ø02H,Ø02H,ØØAH,ØFFH,ØFFH	STX
Ø1AH,Ø3FH,ØØEH,ØFFH,ØFFH	SUB
Ø16H,Ø32H,Ø3AH,ØFFH,ØFFH	SYN
ØFFH,Ø36H,ØFFH,ØFFH,ØFFH	UC
Ø1FH,ØFFH,Ø1DH,ØFFH,ØFFH	US
ØØBH,ØØBH,ØFFH,ØFFH,ØFFH	VT

6.7 TICKER TAPE

The following special codes in Ticker Tape cannot be converted to any of the other code sets. These codes are changed to other printable codes that Ticker Tape does not support. This allows the user to interpret Ticker Tape data by checking for these codes.

> ASCII & EBCDIC are the only code sets that all of the changed codes are valid in. Transcode & Baudot do not have many codes that ticker tape does not support. To interpret the special Ticker Tape codes available the Baudot and Transcode code sets would need more of these available codes (they do not). For example, if a Ticker Tape "WI" is sent to a Transcode device, it will be interpreted as a "W". If a Transcode device sends a "W" to a Ticker Tape device it will be interpreted as a "W" not as a "WI".

HEX:	TICKER CHAR	CHANGED CHAR ASCII EBCDIC	BAUDOT TRANSCODE	DESCRIPTION
ØØ		NUL	*	SPARE CODE
Ø2	.	/	/	LETTERS DOT
Ø3	P R	p	P	"P" WITH "R" BELOW
Ø8	W I	w	W	"W" WITH "I" BELOW
1F	R T	r	R	"R" WITH "T" BELOW
2Ø	.	a	A	SPECIAL FIGURE 5
22	c	c	C	LOWER CASE "C"
24	.	.	.	FIGURES DOT
25	s	s	S	LOWER CASE "S"
27	1 4	d	D	"1" WITH "4" BELOW (1/4 OPTION 2)

HEX:	TICKER CHAR	CHANGED CHAR ASCII EBCDIC	BAUDOT TRANSCODE	DESCRIPTION
2A	.	z	Z	END ANNOUNCEMENT
2B	.	y	Y	BEGIN ANNOUNCEMENT
2F	.	e	E	SPECIAL FIGURE 3
3Ø	1 8	|	-	"1" WITH "8" BELOW (1/8)
31	7 8	}	-	"7" WITH "8" BELOW (7/8)
32	S S	t	T	"S" WITH "S" BELOW
33	1 2	{	-	"1" WITH "2" BELOW (1/2)
35	3 4	]	-	"3" WITH "4" BELOW (3/4)
36	S T	s	S	"S" WITH "T" BELOW
37	1 4	[	-	"1" WITH "4" BELOW (1/4 OPTION 1
3B	B	b	B	ANOTHER CODE FOR "B"
3D	5 8	~	-	"5" WITH "8" BELOW (5/8)
3E	3 8	>	-	"3" WITH "8" BELOW (3/8)
3F	.	DEL	**	RUBOUT

* No conversion

** Del in Transcode, no conversion in BAUDOT