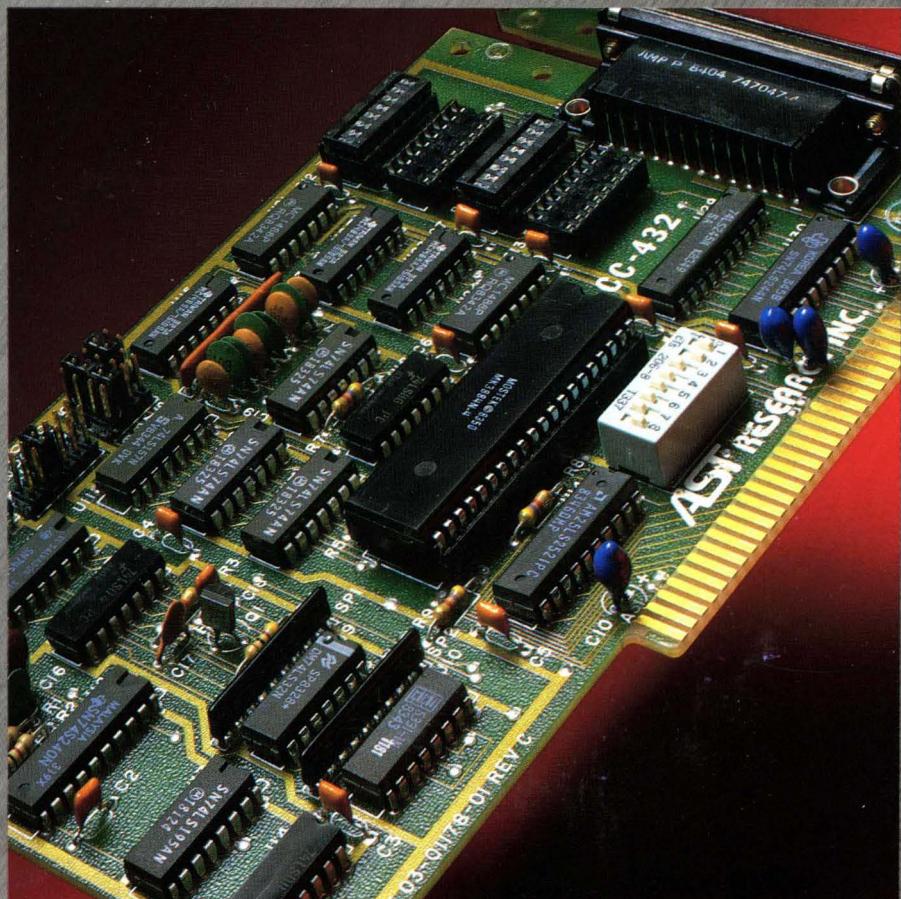


# AST CC-432

**AST**  
RESEARCH INC.

*Communications Hardware Product Providing a Synchronous Communications Channel, Normal and NRZI Data Encoding and Security for Customized Software*



*User's Manual*

**CC-432™**

**Advanced Communication Board**

**for the**

**IBM Personal Computer,  
and IBM PC-XT**

User's Manual  
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October 1985

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# **SECTION 1**

## **INTRODUCTION**

This manual tells you how to configure, install, and run the diagnostic for the AST Research, Inc., CC-432 Advanced Communication board. The CC-432 board allows you to configure its single-channel communications port as DTE (Data Terminal Equipment, the equipment associated with a user) or DCE (Data Communications Equipment, the equipment associated with the transmission facilities). The CC-432 board performs all serial-to-parallel and parallel-to-serial conversions in synchronous mode, and offers a choice of normal or Non Return to Zero Inverting (NRZI) data encoding.

The combination of the CC-432 board and AST Research communications packages provides convenience and cost saving by allowing you to support a variety of terminal emulation and communications protocols. To use a different type of emulation or communication capability, simply change diskettes and boot another AST Research communications program.

The communication element on the AST Research CC-432 board is its dual port Serial Input/Output (SIO) chip. The functions available on the SIO include modem control signals and CRC (Cyclic Redundancy Check) error checking.

### **1.1 PC Compatibility**

The AST Research CC-432 Advanced Communication board is completely compatible with the IBM PC and PC-XT.

## **1.2 Modem Compatibility**

The CC-432 board and its various associated AST Research software packages are designed for use with Bell-compatible synchronous modems. A Bell-compatible modem usually has a model number that corresponds to the Bell standard it complies with, and different model numbers operate at different baud rates (for example, 212 = 1200 baud, 201 = 2400 baud, and 208 = 4800 baud).

You can use other modems as long as the modems at both ends of the phone line are compatible with each other. The modem that you use must also be compatible with the modem at the host (the host is the machine that you are communicating to). For example, if you use an IBM modem at a host computer, you must use an IBM modem at an IBM PC at the other end of the phone line. An IBM modem will not communicate with a Bell-compatible modem.

All AST Research emulation package line protocols require synchronous modems. Asynchronous modems (such as the Hayes and Novation modems) will *not* work with AST Research emulation packages.

## **1.3 Related Documentation**

This manual assumes some familiarity with the PC-DOS operating system and the PC hardware. This information can be found in the following manuals:

*IBM Personal Computer Guide to Operations* manual

*IBM Personal Computer Technical Reference* manual

*IBM Personal Computer Disk Operating System* manual

The communication element of the AST Research CC-432 Advanced Communication board is the SIO (such as the Zilog Z-80 SIO-0 or the MOSTEK MK3884). Programming and vector interpretation of the SIO are detailed in an SIO reference manual such as:

*Zilog Z-80 SIO Technical Manual*

or

*MOSTEK MK3884/5/7 Serial I/O Controller Technical Manual*



## SECTION 2

### CONFIGURATION

If your CC-432 board is part of a complete AST Research hardware/software package, and you intend to communicate with a host computer via a modem/phone line link, it is probably ready to use in its factory default configuration.

#### NOTE

If you are using the AST-3780 package, the CC-432 board is ready to use as is (verify the factory configuration below). If you are using the AST-5251, AST-SNA, or AST-BSC communications packages, the only change you have to make to the factory configuration is to remove the shorting plug from position 8.

Otherwise, you must configure the AST Research CC-432 Advanced Communication board to select its IBM PC I/O addresses, interrupt line, baud rate, and to configure its communications port as DCE or DTE (default is DTE). You can also configure your CC-432 to take advantage of additional control signals, and to support the Non Return to Zero Inverting (NRZI) data encoding that is commonly used with some synchronous protocols (default is non-NRZI).

This section describes how to set the DIP switch, shunts, and shorting plugs for your application, and is intended primarily for those users who want to create their own custom software for the CC-432. If you are using the CC-432 as part of a complete AST Research communications package, this information is useful as a reference. Your AST Research communications package user's manual tells you how to configure your CC-432 board for your application.

## **NOTE**

When you install your AST Research communications package and CC-432 card in your PC, be sure that you know which IRQ lines and I/O addresses are used by each of the devices in your system (you can obtain this information from the device suppliers, user's manuals, and your dealer). Resolving device conflicts before installation will save time and frustration later on.

Refer to the CC-432 board layout (Figure 2-1) throughout this section.

### **2.1 Factory Default Configuration**

If your CC-432 board is part of a complete AST Research hardware/software package (such as AST-SNA, AST-BSC, AST-3780, or AST-5251), it is probably ready to use in its factory configuration, and you won't need to make any changes.

To verify proper factory default configuration, check your CC-432 board settings:

1. DIP switch SW1 set as follows:

1	2	3	4	5	6	7	8
ON	ON	OFF	OFF	OFF	OFF	OFF	ON

2. DIP shunts installed in positions U25 and U27 (DTE).
3. Shorting plugs installed in positions 1, 3, and 8.

### **2.2 Cable Information**

This Subsection gives cable configuration information that is important for standard use.

When you use the CC-432 in DTE mode, the cable should only be as long as necessary to reach a modem positioned next to your PC. When you use the CC-432 in DCE mode, limit the cable length to a maximum of 50 feet. Some installations require a shielded cable for reliable operation.

AST Research recommends that you use a shielded 25-pin cable for reliable operation. However, the 11-pin cable shown in Table 2-1 can be used for some installations; this typical configuration includes the CC-432 board (DTE mode) and a **synchronous** modem for use with an AST Research communications package (asynchronous modems will not work).

**Table 2-1. CC-432 (DTE mode) and Modem Configuration**

CC-432 J1 Pin	Signal Direction	Modem Pin	Signal Name
1		1	Chassis Ground
2	→	2	Transmit Data (TxD)
3	←	3	Receive Data (RxD)
4	→	4	Request To Send (RTS)
5	←	5	Clear To Send (CTS)
6	←	6	Data Set Ready (DSR)
7		7	Signal Ground
8	←	8	Data Carrier Detect (DCD)
15	←	15	Transmit Clock (TxDCE)
17	←	17	Receive Clock (RxDCE)
20	→	20	Data Terminal Ready (DTR)

**NOTE**

For DCE operation, the cable configuration is the same, but the signal directions are reversed.

## **2.3 Changing the Factory Default Configuration**

In its factory default configuration the CC-432 board is set up as follows:

1. Occupies PC I/O hexadecimal addresses 300-30F
2. DTE operation (external synchronous modem required)
3. Interrupts generated on IRQ2.

Your AST Research communications package user's manual tells you how to configure your CC-432 board for your application. This information is useful for technical personnel in the event that there is a hardware or software conflict between the CC-432 and another device installed in your PC:

To reconfigure the CC-432 for a different set of I/O addresses, refer to Subsection 2.4.

To reconfigure the CC-432 for DCE mode, refer to Subsection 2.5.

To reconfigure the CC-432 to use an interrupt other than IRQ2, refer to Subsection 2.6.

This section also includes information on the cable configuration, baud rate, shorting plug functions, additional modem control signals, and NRZI data encoding (see Subsections 2.7 through 2.10).

## **2.4 I/O Address and Function Selection**

The CC-432 occupies 16 consecutive locations of the IBM PC I/O address space. To avoid conflict with existing IBM PC peripheral boards, use an address range that is not used by any of the peripherals in your PC (Appendix A gives the standard I/O address map for the IBM PC). Positions 1 and 2 on DIP switch S1 select the I/O address range for the CC-432 (Table 2-2).

**Table 2-2. CC-432 I/O Address Select**

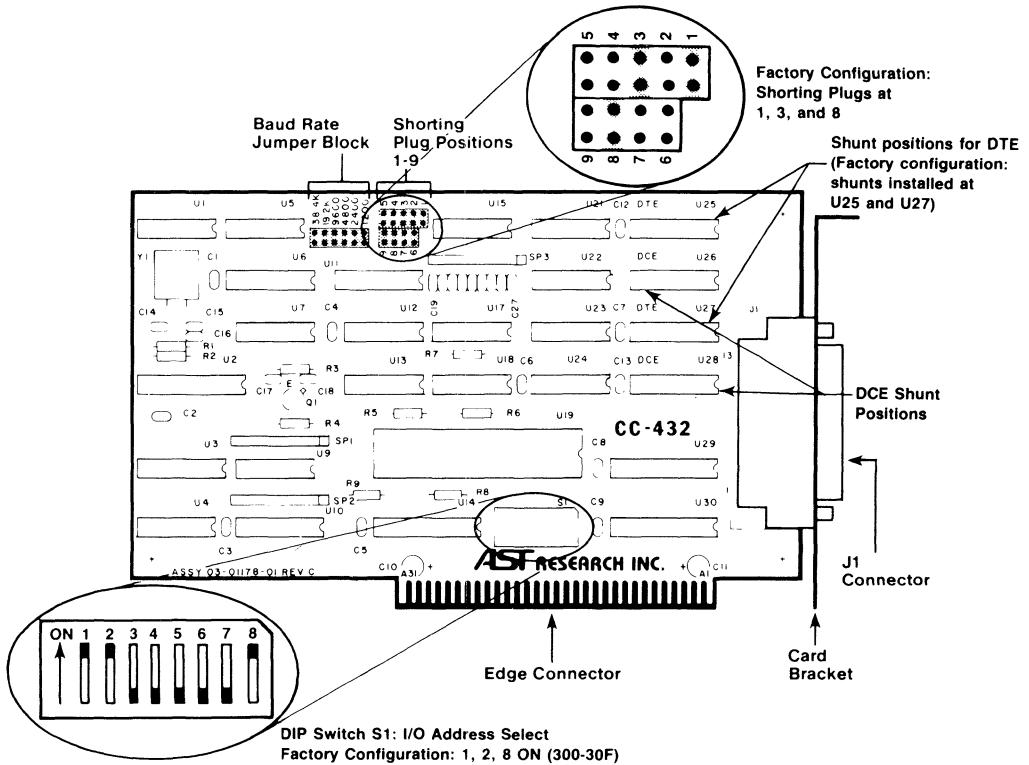
S1 Position 1	S1 Position 2	Hexadecimal I/O Addresses
ON	ON	300-30F*
OFF	ON	320-32F
ON	OFF	340-34F
OFF	OFF	360-36F

**NOTE**

\*The factory default setting for the CC-432 board is for I/O addresses 300-30F.

AST Research communications packages normally use I/O addresses 300-30F (S1 positions 1 and 2 ON). Consult your user's manual for information on other available address settings where applicable.

**Figure 2-1.** CC-432 Board Layout



Once the CC-432 board has been software-selected, address lines A0 through A3 select the functions summarized in Table 2-3.

**Table 2-3. CC-432 A0-A3 Function Select**

Address Lines				
A3	A2	A1	A0	Selected Function
0	0	0	0	Data port SIO channel A
0	0	0	1	Data port SIO channel B
0	0	1	0	Control port SIO channel A
0	0	1	1	Control port SIO channel B
0	1	X	X	Reserved
1	0	X	X	Reserved
1	1	X	X	Read interrupt vector

X = Don't Care

If the selected I/O address range is 300 through 30F, then 3n0 is 300, 3n1 is 301, and so on. Hexadecimal I/O addresses 3n0 through 3n3 select one of the SIO registers and perform a read or write (depending on the I/O instruction). The SIO contains eight registers (WR0 through WR7) that are programmed by the system program and determine the functional personality of the SIO channels (the SIO reference manual provides detailed programming information).

## 2.5 Port Configuration

The communications port on the AST Research CC-432 board can be configured as DTE or DCE. *In DTE mode:* the CC-432 expects to be connected to a synchronous modem that provides clocking signals as well as data. *In DCE mode:* the on-board modem eliminator is enabled. For some applications where the PC is in the same room as the host computer, the on-board CC-432 modem eliminator can replace a separate modem eliminator. The CC-432 modem eliminator does not replace the RS-232 interface that is required for communicating with the PC.

The eight-position shunts that configure the port also carry signals that can be used for modem controls. Install the shunts in the positions (shown in Figure 2-1) summarized in Table 2-4 for the desired configuration.

**Table 2-4. DTE and DCE Configurations**

Configuration	Shunt Positions
DCE	U26, U28
DTE*	U25, U27

\*The factory default configuration is for DTE operation.

Table 2-5 summarizes how the SIO data and modem control signals appear at the DB-25 connector in the DTE and DCE configurations.

**Table 2-5. SIO Data and Modem Control Signals**

SIO Signal	DTE Mode		DCE Mode	
	J1 Signal	J1 Pin	J1 Signal	J1 Pin
TxD Output	TxD	2	RxD	3
RxD Input	RxD	3	TxD	2
RTSA Output	RTS	4	DCD	8
CTSA Input	CTS	5	*	
DCDA Input	DCD	8	RTS/CTS	4/5**
CTSB Input	DSR	6	DTR	20
DTRA Output	DTR	20	DSR	6
TxC Input	TxC	15	TxC	15***
RxC Input	RxC	17	RxC	17***
Chassis Ground		1		1
Signal Ground		7		7

\*In DCE mode, the SIO RTSA output is routed to SIO CTSA input.

\*\*In DCE mode, J1 pin 4 RTS input is routed to J1 pin 5 CTS output and to SIO DCDA input.

\*\*\*In DCE mode, the J1 pins 15 and 17 clock outputs and SIO clock inputs are determined by the strapping of the baud rate jumpers as long as shorting plugs are installed in positions 2 and 4.

## 2.6 Interrupt Line Selection

Positions 3 through 8 on DIP switch S1 select an Interrupt Request (IRQ) line for the CC-432. Table 2-6 lists the IRQ line selected by each of these five positions. An ON condition selects the interrupt line, and only **one** IRQ position can be ON at any time.

**Table 2-6. Interrupt Line Selection**

S1 Position	Interrupt Line
8	IRQ2
7	IRQ3
6	IRQ4
5	IRQ5
4	IRQ6
3	IRQ7

### NOTE

AST Research communications packages normally use IRQ2. Consult your user's manual for information on other available interrupt options where applicable.

For all applications, make sure that the selected IRQ line is not used by another system device. Only **one** IRQ position on the CC-432 can be ON at any time.

Appendix B lists standard IBM assigned IRQ applications.

When you operate the CC-432 board with the SIO in the vectored interrupt mode and there is an interrupt from the SIO, you *must* read I/O address 3nF during the interrupt routine. The contents of that address tell you what condition caused the interrupt (that is, which of the eight interrupt service routines is pointed to). This vector *must* be read in the interrupt service routine regardless of whether the vector information is used. Failure to read this value can cause improper SIO interrupt operation. The SIO reference manual details programming and vector interpretation.

## **2.7 Baud Rate Selection (DCE mode only)**

### **NOTE**

If your CC-432 board is configured for DTE operation, the position of the baud rate shorting plug has no effect because the baud rate is determined by the modem.

If your CC-432 board is configured for DCE operation, the baud rate jumper block (shown in Figure 2-1) selects the baud rate for the CC-432 clock (as long as shorting plugs are installed in positions 2 and 4). To select the baud rate, install a shorting plug in the position that corresponds to the desired baud rate. For example, if you want to select a baud rate of 9600, install a shorting plug in the shorting block position labeled 9600.

## **2.8 CC-432 Shorting Plug Summary**

Table 2-7 summarizes the functions that correspond to the shorting plugs installed in positions 1 through 9 (illustrated in Figure 2-1) on the AST Research CC-432 board. The default configuration is for shorting plugs installed in positions 1, 3, and 8.

**Table 2-7. CC-432 Shorting Plug (Positions 1-9) Summary**

<b>Shorting Plug Position</b>	<b>Function</b>
1	DTE Mode: Routes J1 pin 17 Receive Clock input to the SIO RxCA Receive Clock input. DCE Mode: No function.

**Table 2-7. CC-432 Shorting Plug (Positions 1-9) Summary  
(Continued)**

<b>Shorting Plug Position</b>	<b>Function</b>
2	DTE Mode: Routes the internal baud rate generator clock to the SIO RxCA Receive Clock input. DCE Mode: Same as DTE. Also routes same clock to J1 pin 15 Transmit Clock output.
3	DTE Mode: Routes J1 pin 15 Transmit Clock input to the SIO TxClock input. DCE Mode: No function.
4	DTE Mode: Routes the internal baud rate generator clock to the SIO TxClock Transmit Clock output, and to the J1 pin 24 Transmit Clock input. DCE Mode: Routes the internal baud rate generator clock to the SIO TxClock Transmit Clock input and to the J1 pin 17 Receive Clock output.
5	DTE Mode: No function. DCE Mode: Routes the J1 pin 24 Transmit Clock input to the SIO RxCA Receive Clock input.
6	DTE Mode: Routes J1 pin 22 Ring Indicator input to the SIO DCDB input. DCE Mode: Forces J1 pin 22 Ring Indicator into a false state.

**Table 2-7. CC-432 Shorting Plug (Positions 1-9) Summary  
(Continued)**

<b>Shorting Plug Position</b>	<b>Function</b>
7	DTE Mode: Routes J1 pin 25 Test Indication input to the SIO DCDB input. DCE Mode: Routes J1 pin 18 Test input to the SIO DCDB input.
8	DTE Mode: Performs loopback of J1 pin 25 Test Indication input to J1 pin 18 Test output. DCE Mode: Performs loopback of J1 pin 18 Test input to J1 pin 25 Test Indication output.
9	DTE Mode: Routes SIO RTSB output to J1 pin 18 Test output. DCE Mode: Routes SIO RTSB output to J1 pin 25 Test Indication output.

The Test and Test Indication signals are not defined by the EIA RS-232 standard, but are supported by some IBM modems.

## **2.9 Additional Control Signals**

You can use the Request To Send (RTS) and Data Carrier Detect (DCD) signals from SIO channel B to control the additional interface signals summarized in Table 2-7 (see shorting plug positions 6 through 9).

## 2.10 NRZI Encode/Decode

The CC-432 board automatically defaults to NRZI disabled: you need to reconfigure the board only if you want to use Non Return to Zero Inverting (NRZI) transmission mode. However, the CC-432 board can support the NRZI data encoding method used with some synchronous protocols through a software enable.

The SIO channel B DTR (Data Terminal Ready) output controls the NRZI mode of data encoding and decoding. Enter NRZI mode by setting SIO channel B signal DTR true. The CC-432 remains in NRZI mode until the the DTR bit of channel B is reset, or until the next hardware reset or power-up condition.

If you use the CC-432 as part of an AST Research communications package that supports NRZI, you can enable or disable the NRZI function via program options. Your AST Research communications software user's manual tells you how to implement NRZI if applicable.

The following example (using BASIC statements) illustrates how to enable NRZI:

```
OUT  &H3n3,05      ;Select SIO Control Channel B, WR5  
OUT  &H3n3,&H80    ;Turn on DTRB
```

The following example (using BASIC statements) illustrates how to disable NRZI:

```
OUT  &H3n3,05      ;Select SIO Control Channel B, WR5  
OUT  &H3n3,0       ;Turn off DTRB
```

### NOTE

If the selected I/O address range is 300 through 30F, then 3n0 is 300, 3n1 is 301, and so on.



## **SECTION 3**

### **INSTALLATION**

This section describes how to install your AST Research CC-432 Advanced Communications board.

The CC-432 board can be inserted in any of the full-length expansion slot receptacles on the PC system board.

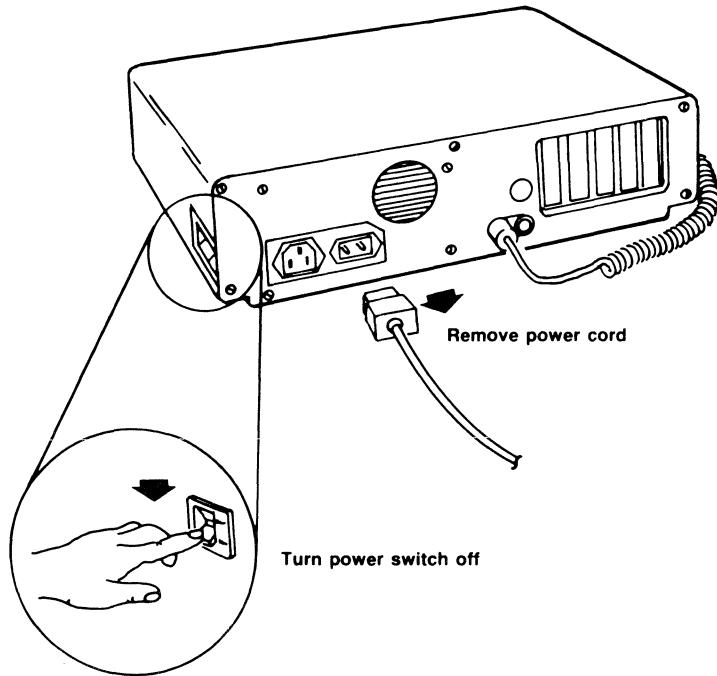
#### **CAUTION**

Be sure that the power is off and that the power cord is removed from the PC before installing or removing any equipment.

Also be sure that you have set the switch, shunts, and shorting plugs for your applications before you install the CC-432 board into the computer. Your AST Research communications user manual and Section 2 of this manual describe CC-432 configuration in detail.

## STEP 1

Power off your IBM PC, and all the equipment connected to it (Figure 3-1).

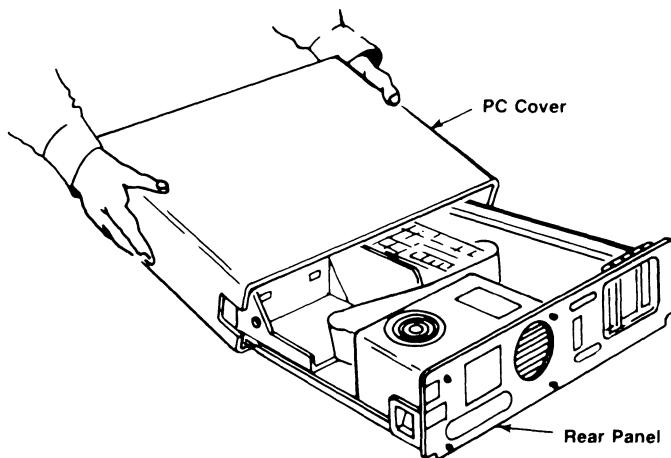


**Figure 3-1. Turn PC Power OFF (rear view)**

Remove the cover from the IBM PC by removing the cover-retaining screws from the computer's rear panel. Slide the cover off, toward the front of the computer (Figure 3-2).

**NOTE**

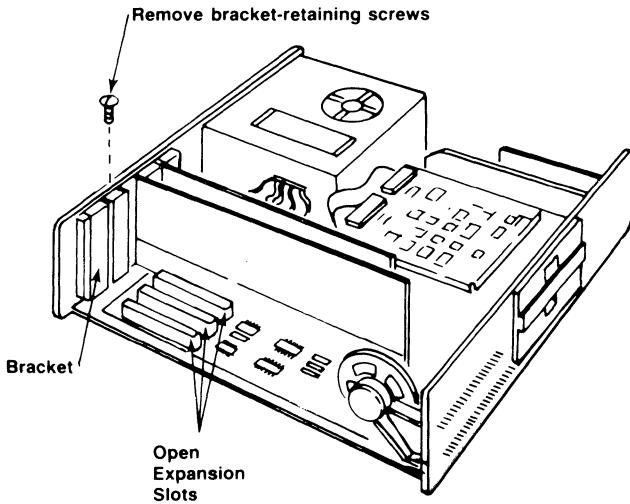
Never force the cover forward: if an obstacle inside the PC seems to be catching on the cover, carefully exert an upward pressure along the top-back of the cover until it clears the obstruction.



**Figure 3-2. Remove PC Cover**

**STEP 2**

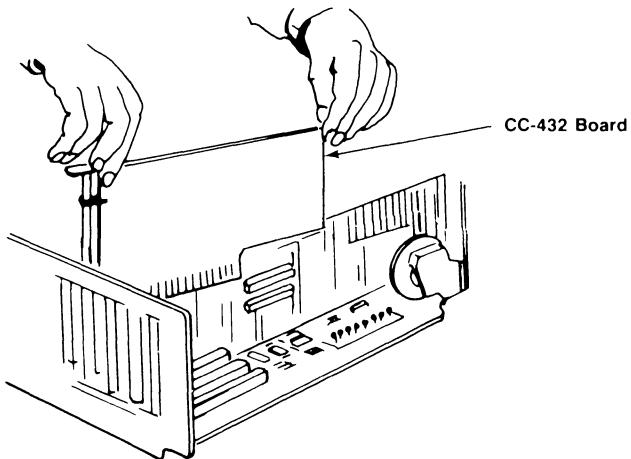
Select an unused expansion slot, and locate the metal bracket that covers the cutout in the back panel of the PC chassis for the slot that you have selected. Remove and save the bracket-retaining screw using a small flathead screwdriver or nut driver. Remove the bracket (Figure 3-3).



**Figure 3-3. IBM PC Expansion Slots**

### **STEP 3**

Arrange the CC-432 board inside the chassis so that its J1 connector faces the back of the computer. Align the board's gold edge connector with the expansion slot receptacle. Use an evenly distributed pressure to press the board straight down until it seats in the expansion slot (Figure 3-4).



**Figure 3-4. Install Your CC-432 Board**

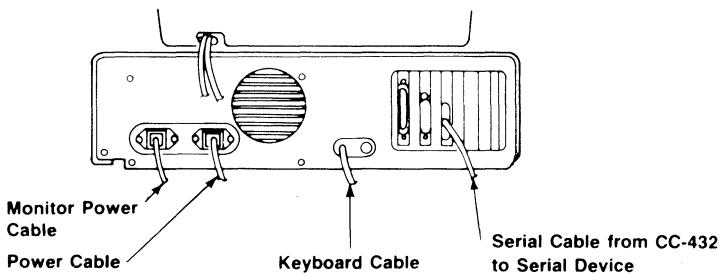
Install the bracket-retaining screw that was removed in STEP 1 to secure the board bracket to the rear of the PC chassis.

#### **STEP 4**

To replace the cover, carefully slide the cover from the front until it stops securely against the rear panel. Reinstall the cover mounting screws you removed earlier.

## STEP 5

Replace the power cord to the system unit and be sure that the keyboard and CRT connectors are plugged in. Connect the serial communications device to the computer by plugging the DB-25 connector on the cable into the CC-432 board's D-shell connector at the back of the computer (Figure 3-5).



**Figure 3-5. Install Cables**

## SECTION 4

# PROBLEM DETERMINATION PROCEDURES

This section tells you how to find and solve the most common problems that can prevent your CC-432 board from functioning properly, and what to do if your CC-432 board should ever require repair.

### 4.1 Finding the Problem

The following major problem areas can cause your AST Research communication package not to function correctly:

1. The modem, including: the modem cable, the modem at the PC, and the modem at the host system.
2. Software parameters on the AST Research communications package or the host system communications software.
3. The phone lines (or other communication lines).
4. PC system hardware conflicts, including CC-432 board configuration.

Modem (especially the cable and the modem at the PC) and software parameter problems are the most common.

#### 4.1.1 Modems

Be sure to use **synchronous** modems with AST Research terminal emulation software packages: asynchronous modems (such as the Hayes or Novation) will **not** work. AST Research packages require a minimum of 11 signals (for DTE and DCE operation) to pass through the modem cable to the CC-432 on pins 1 through 8, 15, 17, and 20.

Most modems also have internal switches and jumpers that you may have to set: consult the manufacturer's instructions for correct configuration, and the suitability of specific modems and transmission rates for your local telephone system. If you suspect that your modem is limiting your communications capability, your modem supplier is the best source of information and technical assistance.

#### **4.1.2 Software Parameters**

Your PC software parameters must match the host system parameters. Your AST Research terminal emulation package documentation or configuration software gives the applicable parameters in detail.

#### **4.1.3 Phone Lines**

You must tell the phone company (or companies) what modem you attach to your phone system. If you want to communicate through a PBX-type phone system (used in many offices), you will need an "exclusion key" or a separate, direct outside line. Your local phone company and PBX supplier can help you to determine your needs. Be sure that the modem is compatible with your phone system: some modems require a special phone jack to insure proper function (signal strength and data integrity).

#### **4.1.4 PC System Hardware**

Improper PC system configuration (including the CC-432 board) can prevent your AST Research software package from functioning correctly. The IBM Personal Computer *Technical Reference Manual and Guide to Operations* tell you how to configure your PC correctly. Your AST Research communications product user's manual and Section 2 of this manual tell you how to configure your CC-432 board for your application.

## **4.2 Repair Procedure**

If your AST Research product ever requires repair, contact your dealer first. The dealer from whom you originally purchased the product can usually service the product. If you must return a hardware product to the factory for service, follow these guidelines to ensure rapid, accurate turnaround:

1. *Call AST Research Technical Support for a Return Authorization Number (RAN):* A technician will discuss the problem with you; if factory service is required, the technician will give you a Return Authorization Number (RAN). Always refer to the RAN when you return anything for service. AST Research will return anything without a RAN to the sender.
2. *If the product is covered under an AST Research Warranty:* There is no charge for parts or labor involved in the repair. Please include a copy of your original purchase receipt as the proof of date of purchase for all warranty repairs.
3. *If the product is not covered under a warranty:* Contact your dealer or AST Research Technical Support for instructions on obtaining service for your product.
4. *Parts not covered under the warranty:* Dealer- or user-installed parts (such as RAM chips) are not covered under the terms of the warranty. Dealer-installed parts are warranted by the dealer; parts that you install are covered only by the parts suppliers' warranties. If we find that your dealer- or user-installed parts are defective, we can identify which parts are defective, but we will not replace parts unless you specifically authorize us to do so in writing when you send the board to us. The parts charges and any applicable labor charges will be billed COD.

5. *Describe the problem and return any related accessories:* Please include a brief but explicit written description of the problem when you return your AST product to the factory for repair. Also return any accessories that might relate to the problem. For example, if the parallel port does not function correctly, be sure to return the parallel port adapter cable with the board.
6. *Be sure to provide a return shipping address that UPS can deliver to and include your RAN:* UPS cannot normally deliver to post office boxes. Reference the RAN issued to you by AST Technical Support on all correspondence. Securely package all materials to prevent shipping damage. Shipping charges must be prepaid; CODs will not be accepted. Ship the materials to the following address:

AST Research, Inc.  
Customer Service—RAN xxxx  
2722 Michelson Avenue  
Irvine, CA 92715

where xxxx is your assigned Return Authorization Number.

7. Once your product is repaired, we will return it to you by UPS or UPS Blue Label service, whichever is appropriate for your geographical location. We will return items covered by warranty at our expense. Shipping costs and repair expenses for items not covered by warranty will be billed COD. If you prefer overnight service (UPS Red Label), the shipping charges will be billed COD. If you want us to ship Federal Express, please give us your Federal Express account number for billing purposes.

## **SECTION 5**

### **THE C432TEST DIAGNOSTIC**

C432TEST is a standalone diagnostic for the AST Research CC-432 communication board. C432TEST tests the board by looping transmitted data back to the board's receiver through an external synchronous modem or a loopback plug.

C432TEST checks the DCD (Data Carrier Detect) signal, but does not check CTS (Clear To Send) or DSR (Data Set Ready). This section tells you how to use the C432TEST.COM diagnostic with the AST Research CC-432 advanced communication board (up to and including board revision level ).

#### **5.1 Hardware Requirements**

The C432TEST diagnostic requires the following hardware:

1. An IBM PC with one disk drive and a minimum of 64 KB of system memory.
2. An AST Research CC-432 advanced communication board.
3. A synchronous modem with the analog loopback feature (the Universal Data Systems 208A/B, for example)

or

A loopback plug (included with all AST Research communications packages that use the CC-432 board); you can also order the loopback plug individually (AST Research P/N 202034-002); Topic 5.3.2 tells you how to build your own loopback plug.

## **5.2 Software Requirements**

The C432TEST diagnostic requires the following software:

1. An IBM DOS (version 1.1 or 2.0) diskette.
2. An AST Research C432TEST.COM diskette; if your CC-432 board is part of an AST Research communications package, the C432TEST.COM program is included on its software diskette.

## **5.3 Setup**

This subsection tells you how to set up your CC-432 board to run the C432TEST diagnostic, and how to build your own loopback plug if you do not have a synchronous modem with an analog loopback feature.

### **5.3.1 CC-432 Board Setup**

To run the C432TEST diagnostic properly, the CC-432 board must be configured as follows:

1. DTE mode: install DIP shunts at positions U25 and U27.
2. DIP switch S1 set to use hexadecimal I/O addresses 300 through 30F (S1 positions 1 and 2 ON), and interrupt line IRQ2 (S1 position 8 ON). S1 should look like this:

1	2	3	4	5	6	7	8
ON	ON	OFF	OFF	OFF	OFF	OFF	ON

3. *If you are using a Universal Data Systems 208A/B synchronous modem, configure your CC-432 board as follows:*
  - a. Install a shorting plug at positions 1, 4, and 8.

**NOTE**

The Universal Data Systems 208A/B synchronous modem outputs Receive Clock only.

- b. Install a shorting plug at position 4800 on the baud rate jumper block (NOTE: Install *only one* shorting plug on the baud rate jumper block).
4. *If you are using another synchronous modem with loopback, configure your CC-432 board as follows:*
  - a. If the modem outputs Receive Clock and Transmit Clock, install shorting plugs at positions 1, 3, and 8.
  - b. If the modem outputs Receive Clock only, install shorting plugs at positions 1, 4, and 8.
  - c. Install a shorting plug on the baud rate jumper block to select the same baud rate as the modem (NOTE: Install *only one* shorting plug on the baud rate jumper block).
5. *If you are using a loopback plug, configure your CC-432 board as follows:*
  - a. Install shorting plugs at positions 2, 4, and 8.
  - b. Install a shorting plug in any of the baud rate jumper block positions from 1200 through 19.2 (NOTE: install *only one* shorting plug on the baud rate jumper block).

### **5.3.2 Loopback Plug Configuration**

All AST Research communications packages that use the CC-432 board include a loopback plug. You can order the loopback plug separately (AST Research P/N 202034-002), or you can build your own according to the instructions in this topic. The loopback plug can substitute for a synchronous modem with the analog loopback feature. To build your own loopback plug, use a standard DB-25 female connector. Jumper its pins as follows:

1. Connect pin 2 to pin 3
2. Connect pin 4 to pin 5 to pin 22
3. Connect pin 6 to pin 8 to pin 20.

### **5.3.3 Install the Modem or Loopback Plug**

Install your CC-432 board into your PC, then install the modem or loopback plug onto the board's J1 connector. Section 3 of this manual tells you how to install the board. Now you are ready to run the C432TEST diagnostic.

## **5.4 Diagnostic Operation**

Once you have configured and installed the CC-432 board and the modem or loopback plug, you are ready to run the C432TEST diagnostic.

#### **NOTE**

It is very important to back up your AST C432TEST master diskette right away! That way you still have the master diskette to work with if your backup diskette is damaged.

Load the C432TEST diagnostic as follows:

1. Boot up your PC with a DOS 1.1 or 2.0 diskette.
2. Insert the AST Research, Inc., diskette that contains the C432TEST.COM program into a diskette drive. Enter this command to load the diagnostic:

**A>x:C432TEST<Enter>**

where A> is the default drive, x: is the drive that contains the C432TEST diskette, and <Enter> is the Carriage Return (CR) key.

Once the diagnostic is loaded, the PC screen looks like this:

AST Research, Inc.  
CC432 Board Modem Loop-back Test  
Version U1.00  
To run this test:  
—Set board address to 300  
—Set interrupt request to line 2  
—Set local or remote modem to loop-back mode  
Press CR to start or ESC to end:

To start the diagnostic, press the carriage return. The diagnostic will run three tests (described in Subsection 5.5). As each test begins, the diagnostic displays each test's title:

Running SIO register WRITE/READ test

Running INTERRUPT test

Running LOOP-BACK test in SDLC mode

Once each test has completed a pass, the screen displays the number of passes and errors:

Pass = x    Error = x    Total Error = x

where *Pass* is the current number of test passes, *Error* is the number of errors in the most recent pass, and *Total Error* is the sum of all the errors encountered in all the passes.

The diagnostic loops through all three tests indefinitely.

*If there is an error:* Testing stops when an error is detected, and the screen displays an error message (Subsection 5.6 explains the error messages).

*To continue testing:* Press the carriage return key to continue testing after an error is detected.

*To stop testing:* Press the <**Esc**> key; this aborts the current test and returns control to the C432TEST instruction menu.

Press the <**Esc**> key again to go from the diagnostic instruction menu to the DOS prompt.

## 5.5 Test Descriptions

This section describes the three C432TEST diagnostic tests in more detail:

1. SIO Register Write/Read Test
2. SIO Interrupt Test
3. SDLC Loopback Test

### 5.5.1 SIO Register Write/Read Test

This test verifies the CC-432 board's address decode and enable, I/O read/write, and SIO chip select. The test writes SIO channel B, register 2, with several data patterns (55, AA, FF, and 00), then reads and verifies the data.

### **5.5.2 SIO Interrupt Test**

This test checks for correct interrupt operation, and ignores any data transmissions to the line. The test initializes SIO channel A to transmit with its interrupt turned on. The test then loads a character into SIO channel A to generate an interrupt. If the PC system board receives the interrupt, the test sends an abort to the SIO to stop further interrupts. Otherwise, the SIO times out and an error message is displayed.

To prevent a system “crash”, this test traps any interrupt requests other than those tested. Once the test is complete or aborted, the interrupt vectors are restored to normal.

### **5.5.3 SDLC Loopback Test**

This test checks the SIO chip's operation and verifies the integrity of the communication line. To run this test successfully, you must install a modem with loopback or a loopback plug on the CC-432 board's J1 connector. This test does not test the baud rate clock circuit on the board if you use a modem that outputs an external Transmit Clock. The test initializes the SIO to transmit and receive in Synchronous Data Link Control (SDLC) mode, and enables the SIO's transmitter and receiver interrupts. The test then sends and receives a message of about 200 characters; data received is compared to data sent. The test checks the Data Carrier Detect (DCD) signal, and checks for Cyclic Redundancy Check and overrun errors.

## **5.6 Error Messages**

This subsection explains the error messages that your PC displays if the C432TEST diagnostic detects an error.

*Register Write/Read, Expected = 00xx Actual = 00xx*

Data read from the SIO register (the "actual" value) was not the same as data written (the "expected" value). Possible cause: incorrect switch setting for board address (check DIP switch S1).

#### **NOTE**

Occasionally DIP switches become dirty and do not make the proper connections. If your DIP switch does not seem to set the address correctly, flip the DIP switch back and forth a few times.

#### *No interrupt, Time-out*

Interrupt not received at all. Possible cause: IRQ line not selected (check DIP switch S1).

#### *Wrong Interrupt Vector*

Interrupt received at incorrect interrupt location. Possible cause: incorrect switch setting for IRQ line (check DIP switch S1).

#### *Unexpected interrupt*

Interrupt received when SIO was not enabled for interrupt. Possible cause: defective SIO chip, or another board in the PC using the same interrupt line (IRQ2).

#### *Lost DCD*

Data Carrier Detect (DCD) signal was not active. Possible cause: defective RS-232C drivers, defective loopback plug, or defective modem loopback.

#### *Parity/Overrun*

SIO status register indicates a parity or overrun error.

Possible cause: defective SIO chip or baud rate faster than 19.2K.

*Data Mismatched*

Data received by the SIO was not compared with the data transmitted after the correct number of characters were received. Possible cause: defective SIO chip or RS-232C drivers.

*CRC*

A Cyclic Redundancy Check (CRC) error was set in the SIO register. Possible cause: defective SIO chip or RS-232C drivers.

*Receiving Incomplete, Timeout*

SIO received too few or no data characters after the transmitter was disabled. Possible cause: defective SIO chip.

*No. of bytes received greater than transmitted*

SIO still received data characters after the transmitter was disabled. Possible cause: defective SIO chip.



## APPENDIX A

### I/O ADDRESS MAP

Appendix A lists the I/O address map for the IBM PC. To avoid conflict with existing devices in your PC, do not use their corresponding I/O address ranges.

#### NOTE

AST Research communications packages normally use I/O addresses 300-30F (S1 positions 1 and 2 ON). Consult your user's manual for information on other available address settings where applicable.

Hexadecimal Address Range	Application
000-00F	DMA Chip 8237A-5
020-021	Interrupt 8259A
040-043	Timer 8253-5
060-063	PPI 8255A-5
080-083	DMA Page Register
0An*	Non Mask Interrupt (NMI) Mask Register
0Cn	Reserved
0En	Reserved
200-20F	Game Control
210-217	Expansion Unit
220-24F	Reserved
278-27F	Printer
2C0-2DF	AST CLOCK
2F0-2F7	Reserved
2F8-2FF	Asynchronous Communications (COM2)
300-31F	Standard AST Research communications package address range
320-32F	IBM XT Fixed Disk
378-37F	Printer

<b>Hexadecimal Address Range</b>	<b>Application</b>
380-38C**	IBM SDLC Communications
380-389**	IBM Binary Synchronous Communications (secondary)
3A0-3A9	IBM Binary Synchronous Communications (primary)
3B0-3BF	IBM Monochrome Display/Printer
3C0-3CF	Reserved
3D0-3DF	Color/Graphics
3E0-3E7	Reserved
3F0-3F7	Diskette
3F8-3FF	Asynchronous Communications (COM1)

\*The NMI to the microprocessor is masked off at power-on. You can set and reset the mask bit via system software as follows:

To set the mask bit (enable NMI): Write hex 80 to I/O address A0.

To reset the mask bit (disable NMI): Write 00 to I/O address A0.

\*\*Do not use IBM SDLC Communications and IBM Secondary Binary Synchronous Communications together: their I/O addresses overlap.

## APPENDIX B

### HARDWARE INTERRUPT LINES

Appendix B gives the standard IBM-assigned hardware interrupt listing for the IBM PC. To avoid conflicts with installed devices, do not use their corresponding interrupt lines.

#### NOTE

AST Research communications packages normally use IRQ2. Consult your user's manual for information on other available interrupt options where applicable.

Only **one** IRQ switch position (positions 3 through 8 on DIP switch S1) on the CC-432 can be ON at any time.

IRQ Line	Application
NMI*	Parity
0	Timer
1	Keyboard
2	Reserved
3	Asynchronous Communications (COM1) IBM SDLC communications products IBM BSC (secondary) products Non-IBM hard disks (standard)
4	Asynchronous Communications (COM2) IBM SDLC communications products IBM BSC (primary) products
5	IBM fixed disk
6	Diskette adaptor board
7	Printer

\* Non Maskable Interrupt



## FCC WARNING

This equipment has been certified to comply with the limits for a Class B computing device, pursuant to Subpart J of Part 15 of FCC Rules. Only peripherals (computer input/output devices, terminals, printers, etc.) certified to comply with the Class B limits may be attached to a computer that complies with Class B limits. Operation with non-certified peripherals is likely to result in interference to radio and TV reception. When connecting to a peripheral device, a shielded I/O cable is required to ensure compliance with FCC Rules.

### Instructions to User

This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna.
- Relocate the computer with respect to the receiver.
- Move the computer away from the receiver.
- Plug the computer into a different outlet so that computer and receiver are on different branch circuits.
- Ensure that board slot covers are in place when no board is installed.
- Ensure that all brackets are fastened securely to the PC chassis.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission (FCC) helpful: "How to Identify and Resolve Radio-TV Interference Problems". This booklet is available from the U.S. Government Printing Office, Washington, DC 20402. Stock No. 004-000-00345-4.

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000140-001 D**

We appreciate your comments regarding any problems or suggestions related to AST Research products. Please use this form to communicate any observations that you have concerning the improvement of either the product itself or the product documentation provided in this manual.

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