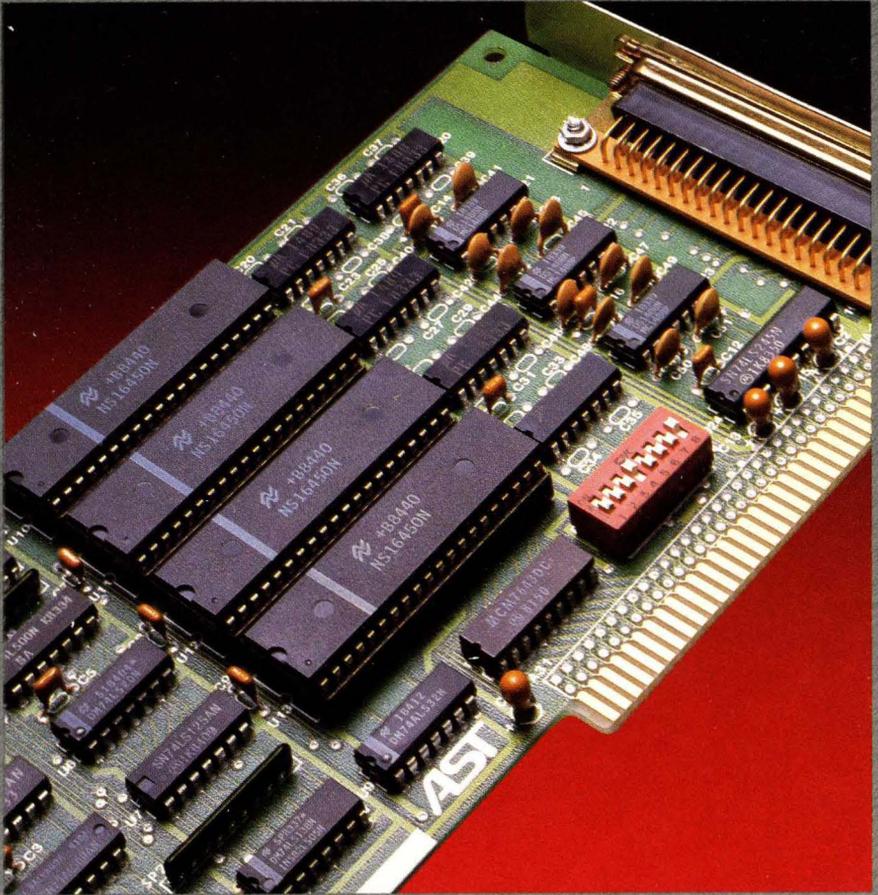


ASYNC CLUSTER ADAPTER

*Multichannel Board Pro-
viding Four Individually
Addressable RS-232 Serial
Ports on IBM PC/XT/AT
and Compatibles*



User's Manual

Async Cluster Adapter™

Communications Board

for the

IBM PC, IBM PC-XT, IBM PC-AT,

and

Other IBM-Compatible Systems

User's Manual
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AST Research, Inc.
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SECTION 1

INTRODUCTION

The Async Cluster Adapter™ is a printed circuit board containing four asynchronous ports using an RS-232C interface. Its purpose is to handle asynchronous serial data transmission between your IBM® Personal Computer (PC) and modems, serial printers, or other serial devices.

The Async Cluster Adapter board is designed for users who need more than the two serial ports that are specified by IBM for the PC. This product is also suitable for those who prefer to write their own software device drivers for their application(s).

The features of the Async Cluster Adapter board are summarized below:

- IBM PC hardware compatibility.
- Four RS-232C channels for asynchronous communications.
- NS16450 Asynchronous Communications Elements (ACEs).
- Variable PC input/output (I/O) address configuration.
- Interrupt selectable.
- COM1 and COM2 software compatibility (for two channels) when used with the IBM PC-AT.
- Shared interrupts for systems that include two Async Cluster Adapter boards.

You must either purchase a cable for connecting the Async Cluster Adapter board to your serial device(s) separately from AST Research (AST part number 202023-003), or build it yourself using the information provided in Section 4. (The appropriate cable configuration depends on the type of serial device — modem, or terminals and printers.)

NOTE

- If your application requires COM1 and COM2 software compatibility (for two channels) when using an IBM PC or IBM PC-XT, you must use AST Research's original Four-Port Async board (AST part number 500169-001), which uses 8250-B ACEs (instead of the NS16450 ACEs used by the Async Cluster Adapter board).

1.1 Checklist

Before getting started, check that your Async Cluster Adapter package includes the following items:

- Async Cluster Adapter board.
- *Async Cluster Adapter User's Manual.*

1.2 Product Overview

The Async Cluster Adapter communications board uses four NS16450 ACEs, and is appropriate for use with IBM's original 64-kilobyte (KB) system board PC, the newer (256-KB system board) PC, PC-XT, and PC-AT. The Async Cluster Adapter can also be used with the COMPAQ™ and other IBM PC compatibles.

The Async Cluster Adapter operates in compatible or enhanced mode:

- When used with the PC-AT, PC-DOS can control channels 1 and 2, with your own software device drivers controlling channels 3 and 4. This is called *compatible mode* of operation. You cannot operate in compatible mode if you use the Async Cluster Adapter in a PC or PC-XT.

If your application requires compatible mode when using an IBM PC or IBM PC-XT, you must use AST Research's original Four-Port Async board (AST part number 500169-001).

- You can also use your own software for all four channels. This is known as *enhanced mode* of operation. When the Async Cluster Adapter is used with the PC or PC-XT, it must operate in enhanced mode, with all four channels controlled by your own software.

Section 2.1 contains more information on compatible and enhanced modes of operation.

AST Research does not guarantee present or future compatibility between the Async Cluster Adapter board and any other manufacturers' hardware or software. References to other manufacturers' products are based on product specifications available at this manual's release date.

1.3 How To Use This Manual

This manual describes the performance and functional requirements of the Async Cluster Adapter board. It also defines the configuration, installation, and operation of the board.

This section provides an outline of the format notation used throughout the manual, a list of related documentation, and an outline of this manual.

1.3.1 Format Notation

The following format notation is used in this manual:

- *Uppercase characters* indicate items (such as commands) that you enter exactly as shown. However, you can enter those items in any combination of upper- or lowercase letters.
- *Boldface* indicates information that you enter, as contrasted to system prompts or messages (which are shown in regular typeface). A boldface entry can be a parameter such as a file name or a key to press.
- *Lowercase letters* represent parameters that are defined by the user. While the user defines the parameters, they must satisfy the conditions of the command description.
- *Angle brackets* tell you to press a key. For example, **<Esc>** instructs you to press the “Esc” key. You do not have to press the “Enter” key unless you are specifically told to do so.
- System prompts and messages are shown in color.
- *Hexadecimal numbers* are indicated with a leading zero (0) and a trailing “h” (for example, 02BFh).

1.3.2 Related Documentation

This manual assumes that the user has some familiarity with the PC Disk Operating System (PC-DOS) and the PC hardware. Consult the following publications for further reference:

EIA Standard RS-232C, August 1969

National Semiconductor NS16450 Asynchronous Communications Element Specification

IBM Personal Computer Technical Reference Manual

1.3.3 Manual Outline

The following outline describes this manual.

SECTION 1: INTRODUCTION

Outlines and briefly describes the features of the Async Cluster Adapter. Lists related reference material.

SECTION 2: CONFIGURATION

Explains compatible and enhanced modes of operation, and provides information on factory default configuration.

SECTION 3: INSTALLATION

Provides step-by-step instructions for installing the Async Cluster Adapter communications board.

SECTION 4: INTERFACE DESCRIPTION

Describes the I/O address selections, interrupt vectors, and communications interfaces.

APPENDIX A: I/O ADDRESS MAP

Lists the hexadecimal address ranges and corresponding applications for the IBM PC, PC-XT and PC-AT.

APPENDIX B: HARDWARE INTERRUPT LINES

Lists the hardware interrupt lines and corresponding applications for the IBM PC, PC-XT and PC-AT.

APPENDIX C: DIAGNOSTIC OVERVIEW

Provides information for running diagnostics on the Async Cluster Adapter.

APPENDIX D: PRODUCT REPAIR PROCEDURE

Provides instructions for obtaining repair service on your Async Cluster Adapter.

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SECTION 2

STANDARD HARDWARE CONFIGURATION

In addition to describing the factory default configuration of the Async Cluster Adapter communications board, this section explains the difference between the compatible and enhanced modes of operation, a concern for those using the Async Cluster Adapter with a PC-AT. PC and PC-XT users *do not* have a choice of mode of operation.

NOTE

This section describes only the standard configuration for the Async Cluster Adapter. If you need to change the standard configuration, see Section 4 for complete configuration information.

2.1 Compatible Mode Versus Enhanced Mode

If you are using the Async Cluster Adapter with a PC-AT, only two of the four ports, channels 1 and 2, may be controlled by PC-DOS. Channels 3 and 4 must have their own software. If you want channels 1 and 2 to respond as COM1 and COM2, respectively, you may operate in compatible mode by using DOS to control channels 1 and 2 and your own software device drivers to control channels 3 and 4. Otherwise, you must operate in enhanced mode, using your own software to control all four channels.

If you are using the Async Cluster Adapter with a PC or PC-XT, you do not have this option. You *must* use your own software device drivers to control *all four* channels, operating in enhanced mode.

If your application requires channels 1 and 2 to respond as COM1 and COM2 when using an IBM PC or PC-XT, use AST Research's original Four-Port Async board (not the Async Cluster Adapter).

2.2 Factory Default Switch Settings

If the factory configuration (summarized in Table 2-1) is appropriate for your system (that is, if no other device in your PC conflicts with these settings), proceed directly to Section 3 for installation instructions. Section 4 tells you how to change the Async Cluster Adapter configuration.

Verify proper factory default configuration of the switches on the Async Cluster Adapter board (shown in Figure 2-1).

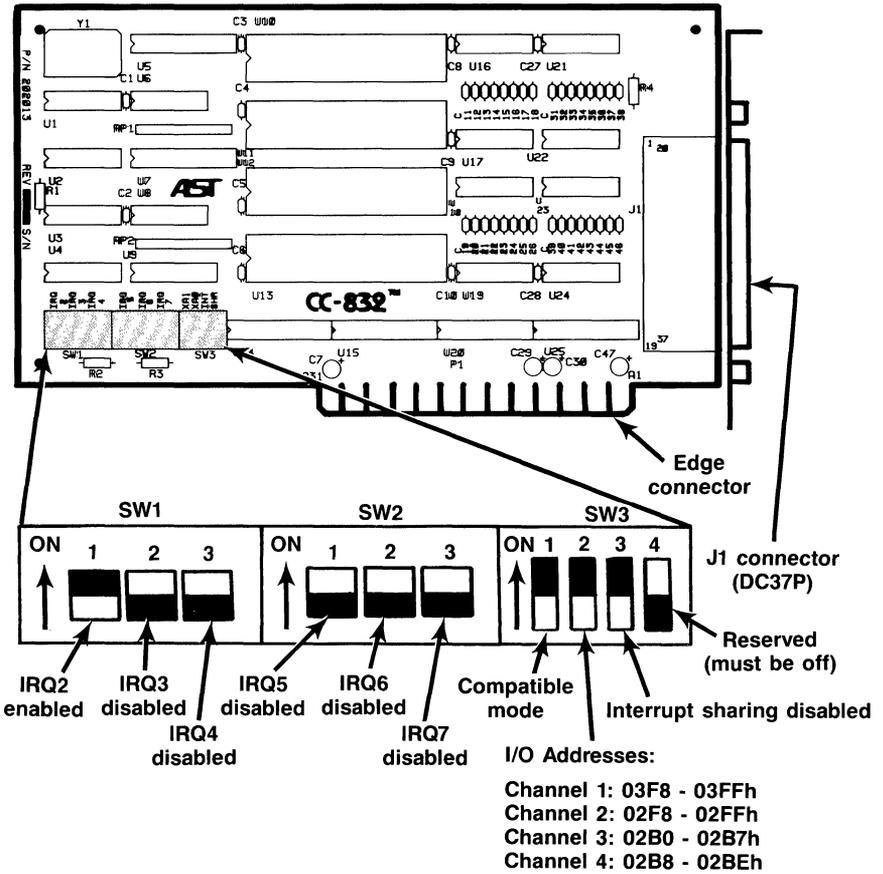


Figure 2-1. Async Cluster Adapter Board Layout (Default Configuration).

Table 2-1 summarizes the Async Cluster Adapter default switch settings.

Table 2-1. Async Cluster Adapter Default Configuration.

Parameter	Default Setting	Comments
Interrupt Enable	IRQ2 enabled (SW1-1 ON) IRQs 3-7 disabled (SW1-2 OFF SW1-3 OFF SW2-1 OFF SW2-2 OFF SW2-3 OFF)	<i>Enable only one interrupt request (IRQ) line.</i> In compatible mode, IRQ4 is automatically enabled for channel 1 and IRQ3 is enabled for channel 2 (do not enable those IRQs). The selected IRQ handles interrupts from channels 3 and 4 in compatible mode.
Mode	Compatible mode (SW3-1 ON)	Causes channel 1 to operate as COM1 (using IRQ4) and channel 2 as COM2 (using IRQ3) in the PC-AT. Can also select enhanced mode (see Section 2.1 for more information on modes).
I/O Address	Channel 3 uses 02B0-02B7h, channel 4 uses 02B8-02BEh (SW3-2 ON).	In compatible mode, the I/O addresses for channels 1 (03F8-03FFh) and channel 2 are (02F8-02FFh) are automatically selected. See Section 4 for further information on this parameter.
Interrupt Sharing	Disabled (SW3-3 ON)	This setting does not allow multiple Async Cluster Adapter boards in the same PC to share a common IRQ line.
NOTE		
Switch position SW3-4 is reserved and must be OFF.		

SECTION 3

INSTALLATION

This section tells you how to install the Async Cluster Adapter board into your PC. Section 4 provides special instructions for assembling your own connecting cable. Figure 3-1 summarizes the Async Cluster Adapter hardware installation procedure.

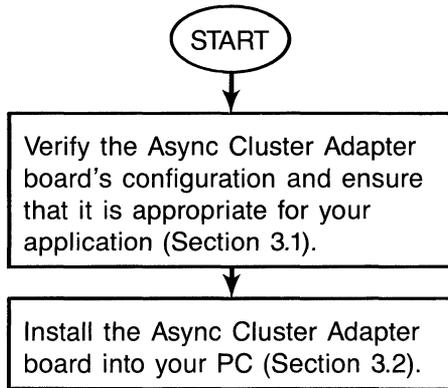


Figure 3-1. Hardware Installation Overview.

3.1 Configuration

The Async Cluster Adapter board is factory-configured for compatible mode (SW3-1 ON), where channels 1 and 2 respond as COM1 and COM2 for the PC-AT.

If you want to use your own software device drivers for all four channels in your PC-AT, or if you are installing the Async Cluster Adapter in a PC or PC-XT, use the enhanced mode switch setting (SW3-1 OFF) described in Section 4.

Once you have verified your board configuration, proceed to Section 3.2.

3.2 Installing the Async Cluster Adapter in Your PC

Before installing the Async Cluster Adapter, turn off your PC, disconnect any devices attached to it, and remove the PC cover. This section includes information for the PC, PC-XT, and the PC-AT.

CAUTION

Be sure that the power switch is off and the power cord is removed from the wall outlet. Turn off any other equipment connected to the computer. Installing any component while the power is on can permanently damage your computer and its components.

You will need a flathead screwdriver or nut driver to perform the following procedure.

STEP 1

Remove the PC cover: Use a flathead screwdriver or hex wrench to remove the cover mounting screws from your PC (see your PC's manual for the location of the cover mounting screws).

IBM PC and PC-XT: Once you have removed the cover mounting screws, pull the PC cover off as shown in Figure 3-2.

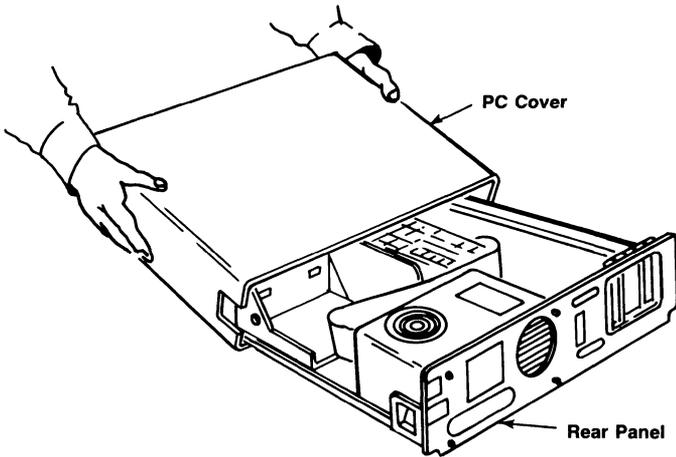


Figure 3-2. Removing the PC Cover.

PC-AT: Unlock the key lock at the front of the PC-AT by turning the key counterclockwise. Remove the back panel (which is attached to the PC-AT with plastic fastener strips) from the rear of the PC-AT. Use a flathead screwdriver or hex wrench to remove the cover mounting screws. Slide the cover toward the front until it comes off, as shown in Figure 3-3.

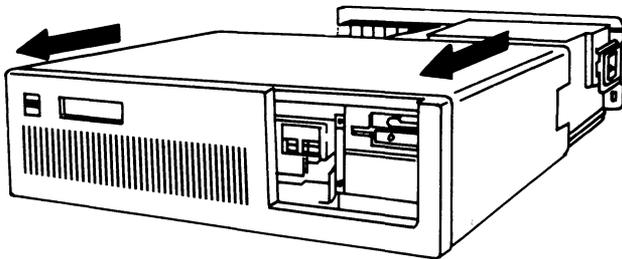


Figure 3-3. Removing the PC-AT Cover.

STEP 2

Select an open expansion slot: You can install the Async Cluster Adapter board in any unused expansion slot on the system board. The Async Cluster Adapter does not require a full-length slot.

For the PC-AT: You can install the board into a one- or two-connector slot.

STEP 3

Remove expansion slot cover: Locate the metal cover for 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. Remove the expansion slot cover.

STEP 4

Install the Async Cluster Adapter board: Position your Async Cluster Adapter board so that the J1 connector faces the back of the computer. Align the board's edge connector with the expansion slot receptacle. Arrange any wires or ribbon cables so they will pass either beneath or above the installed board and will not be damaged during installation. Lower the board until its edge connector is resting on the expansion slot receptacle. Using an evenly distributed pressure, press the Async Cluster Adapter straight down until it seats in the expansion slot (Figure 3-4).

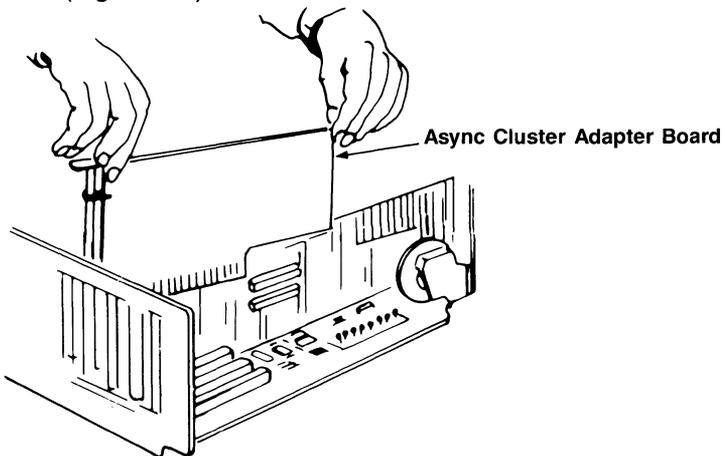


Figure 3-4. Installing the Async Cluster Adapter Board.

STEP 5

Secure the board to the rear of the PC chassis: Use the screw you removed from the expansion slot cover in STEP 3.

STEP 6

Replace PC cover:

PC and PC-XT: Carefully slide the cover from the front until it stops securely against the rear panel. Reinstall the cover mounting screws you removed earlier.

PC-AT: Carefully slide the cover from the front until it stops securely against the rear panel. Reinstall the cover mounting screws you removed earlier. Press the back panel so that the plastic fastener strips secure it in place.

STEP 7

Install cables: Connect the serial device to the computer by plugging the DC37S (socket, or female) connector on the cable into the Async Cluster Adapter board's DC37P (pin, or male) connector at the back of the computer.

Replace the power cord to the system unit and be sure that the keyboard and the monitor connectors are plugged in. Reattach any other cables and connectors you removed previously.

STEP 8

Now you can power up: You are ready to use any or all of the four asynchronous ports for serial communications. Refer to Appendix C for diagnostics.

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SECTION 4

INTERFACE DESCRIPTION

The following paragraphs describe the interface between the Async Cluster Adapter board and the IBM PC, PC-XT, and PC-AT.

The Async Cluster Adapter board uses four NS16450 Asynchronous Communications Elements (ACEs) to implement its four independent asynchronous communications channels. An address decode programmable read-only memory (PROM) detects a valid PC I/O operation and generates the chip select to the appropriate ACE. This address decode PROM also generates the control signals for reading the interrupt vector, and the signal to control the data transceiver.

The Baud rate clock circuit consists of a crystal oscillator with a frequency of 3.6864 Megahertz (MHz). This frequency is divided down to 1.8432 MHz and is provided to each of the four ACEs for their internal Baud rate selection.

4.1 I/O Address Response

This section describes how the Async Cluster Adapter board responds to I/O instructions within the PC I/O address space.

Switch position SW3-1 ON sets the Async Cluster Adapter board into a compatible mode for the PC-AT in which channels 1 and 2 respond as COM1 and COM2.

Switch 3-2 selects the address responses for channels 3 and 4 (in compatible mode, which is applicable to the PC-AT only), or for all four channels (in enhanced mode).

The address selections depend on the type of PC, and (for the PC-AT only) the mode of operation (compatible or enhanced). Tables 4-1 through 4-3 summarize the address select options for the various types of PCs. Note that there is only one set of selections which can be used with the 64- and 256-KB PC.

Table 4-1. I/O Address Select for 64-/256-KB PC, PC-XT, or PC-AT (Enhanced Mode).

S3-1	S3-2	Channel 1	Channel 2	Channel 3	Channel 4	Vector
OFF	ON	02A0-02A7h	02A8-02AFh	02B0-02B7h	02B8-02BEh	02BFh

Table 4-2. I/O Address Selection for PC-XT or PC-AT Only (Enhanced Mode).

S3-1	S3-2	Channel 1	Channel 2	Channel 3	Channel 4	Vector
OFF	OFF	01A0-01A7h	01A8-01AFh	01B0-01B7h	01B8-01BEh	01BFh

NOTE

If you are using a 64- or 256-KB PC, you cannot use the address selections listed in Table 4-2 because the PC reserves those address spaces.

Table 4-3. I/O Address Select for PC-AT Only (Compatible Mode).

S3-1	S3-2	Channel 1	Channel 2	Channel 3	Channel 4	Vector
ON	ON	03F8-03FFh	02F8-02FFh	02B0-02B7h	02B8-02BEh	02BFh
ON	OFF	03F8-03FFh	02F8-02FFh	01B0-01B7h	01B8-01BEh	01BFh

These addresses allow access to the internal registers of each of the four ACEs. The functions of the internal registers are fully described in the National Semiconductor specification for the NS16450 ACE (see Section 1.3.2 of this manual).

NOTE

The internal register address (A7) of channel 4's ACE is used to implement the interrupt vector, making the scratch register of the ACE for channel 4 inaccessible.

4.2 Interrupt Response

Interrupt operation of the Async Cluster Adapter board can be configured for COM1/COM2 compatibility (in compatible mode) or for the funneling of all interrupts through a single interrupt line (in enhanced mode). Table 4-4 illustrates the IRQ select switch settings.

Table 4-4. Switch Setting for IRQ Selection.

Switch Position ON	IRQ Enabled
SW2-3	IRQ7
SW2-2	IRQ6
SW2-1	IRQ5
SW1-3	IRQ4
SW1-2	IRQ3
SW1-1	IRQ2

NOTE

In compatible mode, this setting selects the IRQ for channels 3 and 4. In enhanced mode this setting selects the IRQ for all four channels. Only *one* IRQ line can be enabled at a time.

When operating the Async Cluster Adapter with interrupt sharing enabled (SW3-3 OFF), two Async Cluster Adapter boards share the selected IRQ (as summarized in Table 4-4).

Once an interrupt is received, any subsequent interrupts are locked out until the ACE that generated the interrupt is serviced by software. During the ACE servicing routine, all other ACEs are polled to see if any other IRQs have been generated.

Once software has serviced an interrupt, an I/O write to the appropriate address (summarized in Table 4-5) serves to clear the shared IRQ channel so that further interrupts can be handled.

Table 4-5. Shared Interrupt Clear I/O Addresses.

Shared IRQ	I/O address
IRQ2	02F2h
IRQ3	02F3h
IRQ4	02F4h
IRQ5	02F5h
IRQ6	02F6h
IRQ7	02F7h

4.2.1 Compatible Mode

In *compatible mode* (PC-AT only), channels 1 and 2 automatically respond with interrupts on IRQ4 and IRQ3, respectively (no switch setting is required). Channels 3 and 4 are funneled through another single interrupt line which you can select by setting one of the switch positions (shown in Table 4-4).

The interrupt service routine determines which of the two channels (channel 3 or 4) is creating the interrupt by reading the interrupt vector at address 02BFh (or 01BFh for the PC-XT

or PC-AT if SW3-2 is OFF). When a data bit is set to 0 (Figure 4-1 shows the interrupt vector numbering scheme), the corresponding channel is creating an interrupt. When the bit is set to 1, there is no interrupt.

For example, if the default I/O addresses are selected in compatible mode, and IRQ2 signals an interrupt, the interrupt vector is read from I/O address 02BFh. If the vector has the value 0F7h (bit 3 equals 0), then the interrupt came from channel 4.

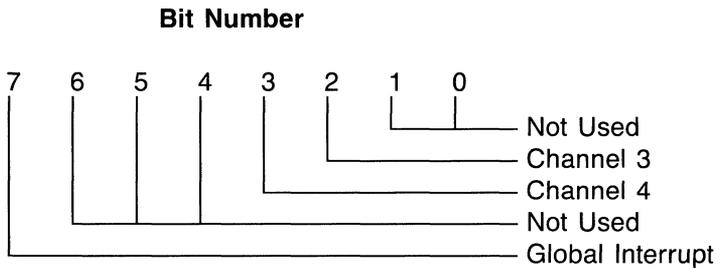


Figure 4-1. Interrupt Vector for Compatible Mode.

4.2.2 Enhanced Mode

In *enhanced mode*, all four interrupts from the Async Cluster Adapter board are funneled through a single interrupt line to the PC (as set by the switch settings in Table 4-4).

The interrupt service routine determines which of the four channels is creating the interrupt by reading the interrupt vector at address 02BFh (or 01BFh for the PC-XT or PC-AT if S3-2 is OFF). Figure 4-2 shows the interrupt vector bit numbering scheme. When a data bit is set to 0, the corresponding channel is creating an interrupt. When the bit is set to 1, there is no interrupt.

For example, if the default I/O addresses are selected in enhanced mode, and IRQ2 signals an interrupt, the interrupt vector is read from I/O address 01BFh. If the vector has the value 0F7h (bit 3 equals 0), then the interrupt came from channel 4.

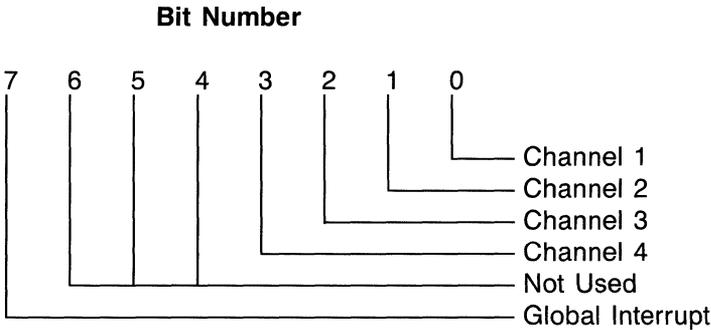


Figure 4-2. Interrupt Vector for Enhanced Mode.

In enhanced mode, a global interrupt is used to enable or disable all four channels by writing a logic 1 (to enable) or 0 (to disable) into the scratch register address 7. You can also enable or disable each channel separately by programming the OUT1 signal in the ACE. *In enhanced mode*, when the OUT1 signal is enabled, the OUT2 signal must be disabled, and vice versa.

NOTE

An I/O write command to address 02BFh or 01BFh must be performed after each reset or powerup to enable interrupts from the channels not configured as COM1 or COM2.

4.3 Communications Interface

The communications interface conforms to the Electronic Industries Association (EIA) RS-232C standard. However, due to the mechanical constraints of the IBM PC, all four Async Cluster Adapter channels are provided through a single DC37P connector (labeled "J1" on the Async Cluster Adapter board).

To separate the signals from the *DC37P* connector on the board into four *DB25P* connectors (which are connected to the serial devices), you must obtain or build a cable constructed for that purpose. The cable is a round, shielded cable with metal connectors. This section defines that cable (AST part number 202023-003), and provides the information you need to build it.

The following information is provided for your use if you are constructing a special cable for your devices:

- *Figure 4-3* shows the pin locations for the DC37 and DB25 connectors.
- *Table 4-6* lists the signal assignments for a DB25 connector.
- *Figure 4-4* shows the recommended method of interfacing the Async Cluster Adapter to other Data Terminal Equipment (DTE) devices such as printers or terminals (DTE to DTE connection).
- *Table 4-7* lists the signal assignments for a DC37 connector.
- *Table 4-8* provides the pin assignments for creating a cable connection between the DC37 connector on the board and four DB25 connectors on your Data Communications Equipment (DCE) devices.
- *Table 4-9* provides the pin assignments for creating a cable connection between the DC37 connector on the board and four DB25 connectors on your DTE devices.

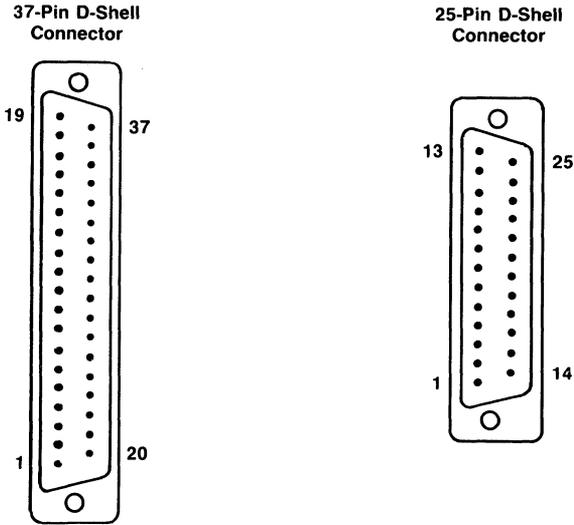


Figure 4-3. Pin Locations for DC37P and DB25P Connectors.

Table 4-6. DB25P Connector Signal Assignment for Serial Port Interface (DTE).

DB25P Pin #	Signal Name	RS-232C Name	Signal Direction
1	Chassis Ground (GND)	AA	Common
2	Transmit Data (TxD)	BA	Output
3	Receive Data (RxD)	BB	Input
4	Request to Send (RTS)	CA	Output
5	Clear to Send (CTS)	CB	Input
6	Data Set Ready (DSR)	CC	Input
7	Signal Ground (SG)	AB	Common
8	Data Carrier Detect (DCD)*	CF	Input
20	Data Terminal Ready (DTR)	CD	Output
22	Ring Indicator (RI)	CE	Input

* Data Carrier Detect (DCD) is also known as Received Line Signal Detector (RLSD).

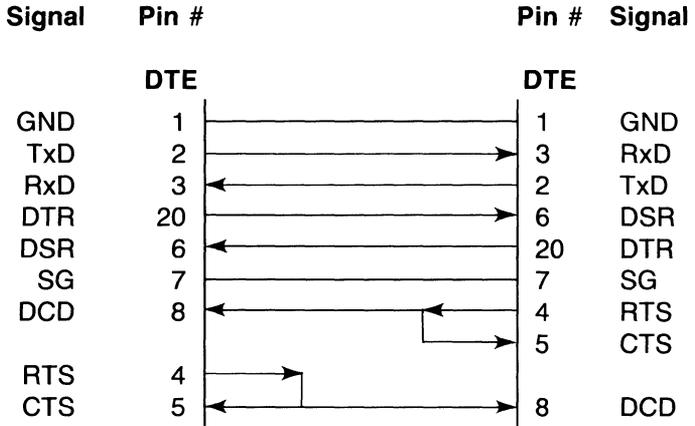


Figure 4-4. Recommended DTE to DTE Connection.

Table 4-7. DC37P Connector Channel Assignment for Serial Port Interface.

DC37 Pin #	Channel	Signal Name	RS-232C Name
1	—	No connect	—
2	3	Data Carrier Detect (DCD)*	CF
3	3	Signal Ground	BB
4	3	Clear to Send (CTS)	CB
5	3	Receive Data (RxD)	BB
6	4	Ring Indicator (RI)	CE
7	4	Data Terminal Ready (DTR)	CD
8	4	Data Set Ready (DSR)	CC
9	4	Request to Send (RTS)	CA
10	4	Transmit Data (TxD)	BA
11	2	Data Carrier Detect (DCD)*	CF
12	2	Signal Ground	AB
13	2	Clear to Send (CTS)	CB
14	2	Receive Data (RxD)	BB
15	1	Ring Indicator (RI)	CE
16	1	Data Terminal Ready (DTR)	CD
17	1	Data Set Ready (DSR)	CC
18	1	Request to Send (RTS)	CA
19	1	Transmit Data (TxD)	BA
20	3	Ring Indicator (RI)	CE
21	3	Data Terminal Ready (DTR)	CD
22	3	Data Set Ready (DSR)	CC
23	3	Request to Send (RTS)	CA
24	3	Transmit Data (TxD)	BA
25	4	Data Carrier Detect (DCD)*	CF
26	4	Signal Ground	AB
27	4	Clear to Send (CTS)	CB
28	4	Receive Data (RxD)	BB
29	2	Ring Indicator (RI)	CE
30	2	Data Terminal Ready (DTR)	CD
31	2	Data Set Ready (DSR)	CC
32	2	Request to Send (RTS)	CA
33	2	Transmit Data (TxD)	BA
34	1	Data Carrier Detect (DCD)*	CF
35	1	Signal Ground	AB
36	1	Clear to Send (CTS)	CB
37	1	Receive Data (RxD)	BB

* Data Carrier Detect (DCD) is also known as Received Line Signal Detector (RLSD).

Table 4-8. Cable Connection Pin Assignment for Connecting to Four DCE Devices (Four DTE Interfaces).

DC37 Pin	DB25 Connectors Pin Numbers			
	Chan. 1	Chan. 2	Chan. 3	Chan. 4
1				
2			8	
3			7	
4			5	
5			3	
6				22
7				20
8				6
9				4
10				2
11		8		
12		7		
13		5		
14		3		
15	22			
16	20			
17	6			
18	4			
19	2			
20			22	
21			20	
22			6	
23			4	
24			2	
25				8
26				7
27				5
28				3
29		22		
30		20		
31		6		
32		4		
33		2		
34	8			
35	7			
36	5			
37	3			

NOTE

Shield of all four cables should be tied to J5-1 and their respective housings.

Table 4-9. Cable Connection Pin Assignment for Connecting to Four DTE Devices (Four DCE Interfaces).

DC37 J5 Pin	DB25 Connectors Pin Numbers							
	J1 Chan. 1		J2 Chan. 2		J3 Chan. 3		J4 Chan. 4	
1								
2					4,5			
3					7			
4					8			
5					2			
6							6	
7							20	
8							8	
9							3	
10								
11			4,5					
12			7					
13			8					
14			2					
15								
16		6						
17		20						
18		8						
19		3						
20								
21					6			
22					20			
23					8			
24					3			
25							4,5	
26							7	
27							8	
28							2	
29								
30			6					
31			20					
32			8					
33			3					
34		4,5						
35		7						
36		8						
37		2						

NOTE

Shields of all four cables should be tied to J5-1 and their respective housings.

APPENDIX A

I/O ADDRESS MAP

Table A-1 lists the I/O address map for the IBM PC, PC-XT, and PC-AT. The map is the same for all three types of PC. To avoid conflict with existing devices in your PC, do not use their corresponding I/O address ranges.

Table A-1. IBM PC I/O Address Map.

Hexadecimal Address Range	Application
0000-000Fh	DMA Chip 8237A-5
0020-0021h	Interrupt 8259A
0040-0043h	Timer 8253-5
0060-0063h	PPI 8255A-5
0080-0083h	DMA Page Register
00Anh*	Non Mask Interrupt (NMI) Mask Register
00Cnh	Reserved
00Enh	Reserved
0200-020Fh	Game Control
0210-0217h	Expansion Unit
0220-024Fh	Reserved
0278-027Fh	Printer
02C0-02DFh	ASTCLOCK
02F0-02F7h	Reserved (shared IRQ acknowledge for Async Cluster Adapter)
02F8-02FFh	Asynchronous Communications (secondary)
0300-031Fh	Prototype Card
0320-032Fh	Fixed Disk
0378-037Fh	Printer
0380-038Ch	IBM SDLC Communications
0380-0389h	IBM Binary Synchronous Communications (secondary)
03A0-03A9h	IBM Binary Synchronous Communications (primary)
03B0-03BFh	IBM Monochrome Display/Printer
03C0-03CFh	Reserved
03D0-03DFh	Color/Graphics
03E0-03E7h	Reserved
03F0-03F7h	Diskette
03F8-03FFh	Asynchronous Communications (primary)
<p>* The NMI to the microprocessor is masked off at power on. To set the mask bit (enable NMI): write 080h to I/O address 00A0h. To reset the mask bit (disable NMI): write 000h to I/O address 00A0h.</p>	

APPENDIX B

HARDWARE INTERRUPT LINES

Table B-1 provides the standard IBM-assigned hardware interrupt request (IRQ) lines for the IBM PC, PC-XT, and PC-AT. The listing is the same for all three types of PC. To avoid conflicts with installed devices, do not use their corresponding interrupt lines.

NOTE

Enable only one IRQ line at a time.

In compatible mode (SW3-1 ON), IRQ4 is automatically enabled for channel 1, and IRQ3 is automatically enabled for channel 2. The enabled IRQ handles interrupts from channels 3 and 4 (channels 3 and 4 must use an interrupt line other than IRQ3 or IRQ4).

In enhanced mode (SW3-1 OFF), the enabled IRQ handles interrupts from all four channels.

Table B-1. IBM PC Hardware Interrupt Listing.

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

APPENDIX C

DIAGNOSTIC OVERVIEW

The QASYDIAG program is a standalone diagnostic written in assembly language to test and isolate problems of the Async Cluster Adapter board. QASYDIAG can be used as a go/no-go test, or as a diagnostic for board repairs.

The QASYDIAG diagnostic program and loopback plug are available as a maintenance kit (AST part number 500191-001). This kit does not come standard with the Async Cluster Adapter.

C.1 System Requirements

The following two sections describe the minimum hardware and software requirements for execution of the QASYDIAG diagnostic. The QASYDIAG diagnostic requires the following hardware:

- An IBM PC, PC-XT, or PC-AT with at least one disk drive and a minimum of 64 kilobytes (KB) of memory.
- An AST Research Async Cluster Adapter board.
- A loopback plug, which comes with the maintenance kit (Section C.2 describes the loopback plug configuration).

The QASYDIAG diagnostic requires the following software:

- A DOS diskette (version 1.10 or later).
- An AST Research QASYDIAG.COM diskette.

C.2 Loopback Plug Configuration

The loopback plug that you will use should consist of a DC37 male connector with the following pins connected:

For channel 1, connect:

- Pin 19 to pin 37
- Pin 15 to pin 16 to pin 17
- Pin 18 to pin 34 to pin 36

For channel 2, connect:

- Pin 14 to pin 33
- Pin 29 to pin 30 to pin 31
- Pin 11 to pin 13 to pin 32

For channel 3, connect:

- Pin 5 to pin 24
- Pin 20 to pin 21 to pin 22
- Pin 2 to pin 4 to pin 23

For channel 4, connect:

- Pin 10 to pin 28
- Pin 6 to pin 7 to pin 8
- Pin 9 to pin 25 to pin 27

C.3 Diagnostic Operation

After installing the Async Cluster Adapter board into your PC (Section 3 tells you how), install the loopback plug on the board's J1 connector. Now you can run the QASYDIAG diagnostic.

NOTE

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

CAUTION

No other background interrupt processing programs such as keyboard enhancement programs may be executed concurrently with the QASYDIAG diagnostic. Timing loop failures and subsequent error messages may result if the interrupt processing time of these programs is too great.

To load QASYDIAG: Enter this command:

QASYDIAG<Enter>

Once QASYDIAG is loaded, the main menu (Figure C-1) is displayed.

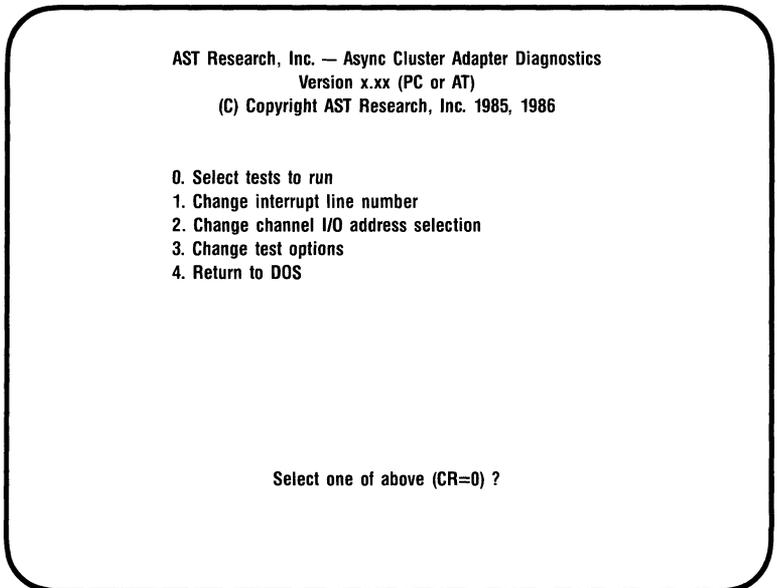


Figure C-1. QASYDIAG Main Menu.

CR=0 means that pressing the carriage return key (also called <Enter> in this manual) results in selecting the default value of 0.

In the main menu, the text *PC* or *AT* will be displayed depending on the type of IBM host system in use. *PC* refers to the IBM 64-or 256-KB PC, or PC-XT. *AT* refers to the IBM PC-AT. The internal timing loop durations are adjusted by the diagnostic for the faster PC-AT processor.

Option 0 (Select tests to run)

If you choose option 0 from the main menu, the test selection menu shown in Figure C-2 will be displayed. Section C.4 describes each test.

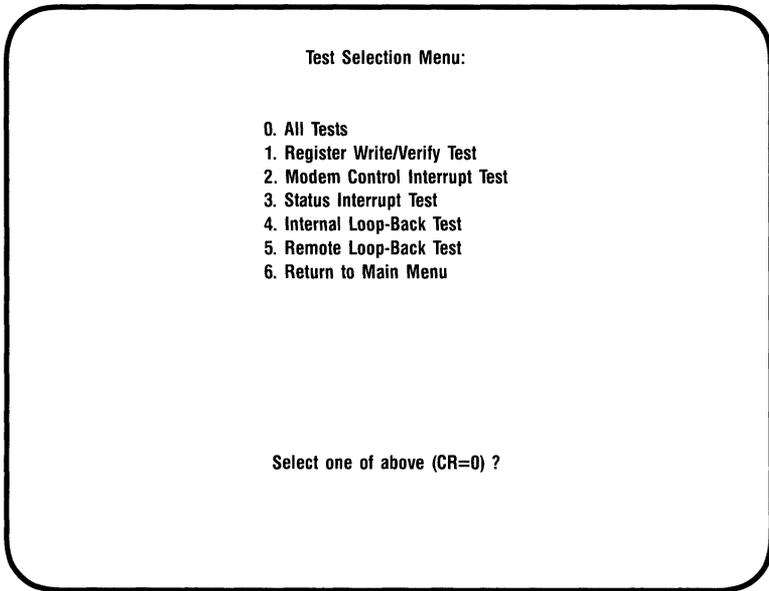


Figure C-2. Test Selection Menu.

STEP 1

Select a test: Once you have selected a test a prompt will appear asking for the channel number(s) to be tested. To test all four channels press:

<Enter>

To test specific channels, enter the channel numbers separated by commas (for example, **1,2,3<Enter>**).

STEP 2

Select the number of test passes: Once you have entered the channel numbers to be tested, a prompt will ask for the number of test passes.

To run the test indefinitely, press:

<Enter>

You can enter a maximum of 32767 test passes. The selected test will start running once you've selected the number of passes.

Option 1 (Change interrupt line number)

If you select option 1 from the main menu, a prompt will appear asking for the interrupt request (IRQ) line to be used by QASYDIAG. To select the default value (IRQ2 unless you have changed the IRQ since you loaded QASYDIAG) press:

<Enter>

If you have already changed the IRQ, pressing **<Enter>** selects the new IRQ. You can select an IRQ from 2 through 7. The selected IRQ *must* match the Async Cluster board's switch setting (otherwise the test will fail). Section 4 provides interrupt response information.

The IRQ number is irrelevant only when channel 1 or 2 is running in IBM-compatible mode.

Once you have selected an IRQ number, the main menu will reappear on the PC screen.

Option 2 (Change channel I/O address selection)

If you select option 2 from the main menu, the menu shown in Figure C-3 will appear on your screen.

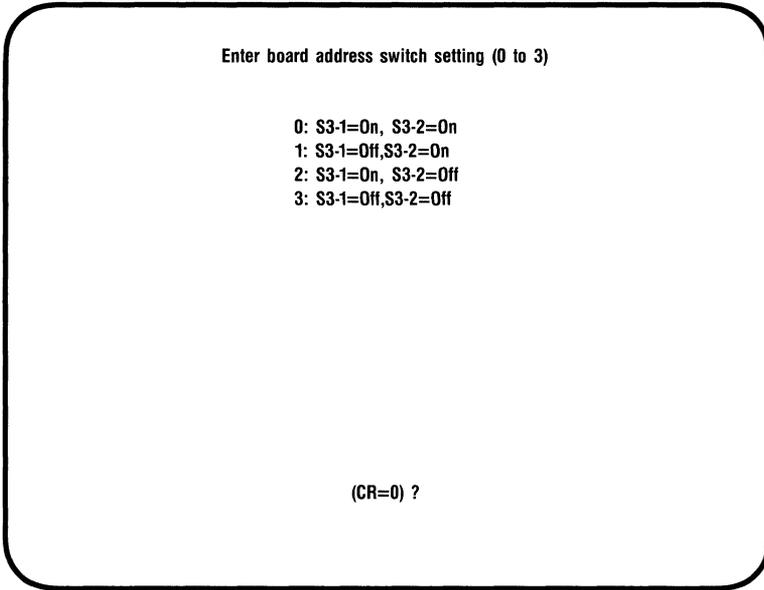


Figure C-3. Board Address Switch Setting Menu.

Select the number (0, 1, 2, or 3) that corresponds to the switch settings for SW3-1 and SW3-2 on the Async Cluster Adapter board. An incorrect board address can cause the test to fail.

To select the default number (0, unless you have changed the board address setting since you loaded QASYDIAG), press:

<Enter>

The default value for the board address remains 0 until a new address number is selected.

Once you have selected a board address, the main menu will reappear on your screen.

Option 3 (Change test options)

If you select option 3 from the main menu, the test option menu shown in Figure C-4 appears.

Test Options:

0. Return to Main Menu	
1. Display test title & pass number:	Yes
2. Display error messages :	Yes
3. Stop on error :	Yes
4. Loop on error :	No

Select one of above (CR=0) ?

Figure C-4. Test Option Menu.

Options 1 through 4 are yes/no toggles which can be changed by pressing the appropriate option number. Once you've made all the changes you want to make, press **<Enter>** to return to the main menu.

1. Display test title & pass number

When enabled, the test title is displayed on the screen at the beginning of each test, and the number of passes and errors are displayed at the end of the test.

2. Display error messages

When enabled, error messages are displayed when errors are encountered during a test. Section C.5 lists and explains the error messages.

3. *Stop on error*

When enabled, the test stops when an error is encountered. To resume testing after an error stop, press **<Enter>**.

4. *Loop on error*

When enabled, the diagnostic restarts the test rather than continue into the next test or the same test with different parameters. The test loop created is useful for troubleshooting problems with an oscilloscope.

To abort a test during processing, press:

<Esc>

QASYDIAG will display a message informing you that the test has been aborted. Press **<Enter>** to return to the main menu.

C.4 Test Descriptions

This section describes the five tests listed in the QASYDIAG Test Selection menu (Figure C-2).

Test 1: Register Write/Verify Test

Checks the I/O address decode, I/O read/write, and NS16450 asynchronous communications element (ACE) chip select logic. The test is done by writing, reading, and verifying four different patterns (55,AA,FF,00) into the divisor registers of the 16450 ACE.

Test 2: Modem Control Interrupt Test

Verifies the interrupt logic of the board. An interrupt is generated by writing into the modem status register of the NS16450. A *modem status changed* interrupt is expected to receive at the correct address and with the correct status bit set in the modem status register. The test times out when no interrupt is received.

Test 3: Status Interrupt Test

Verifies the interrupt logic of the board by writing into the line status register of the NS16450, thus generating an interrupt. The test is similar to test 2 (modem control interrupt test).

Test 4: Internal Loopback Test

Checks the Baud rate clock and data transmitting and receiving. The test is done by programming the NS16450 ACE in a special loopback mode, such that the transmitter is internally connected to the receiver, and the modem controls are connected to the modem input. 256 characters with incrementing data patterns are sent and received with different Baud rates, number of bits per character, and number of stop bits. The following configurations are tested:

19.2 kilobits per second (Kbps), 5 bits/character,
1 stop bit

2400 bits per second (bps), 6 bits/character,
2 stop bits

9600 bps, 7 bits/character, 2 stop bits

19.2 Kbps, 8 bits/character, 2 stop bits

4800 bps, 8 bits/character, 2 stop bits

300 bps, 8 bits/character, 2 stop bits

Test 5: Remote Loopback Test

Checks the Baud rate clock, data transmitting and receiving, interrupts and vector register. It is similar to the internal loopback test except that transmit and receive, and modem outputs and inputs are connected externally through a loopback plug. Signals have to pass through the RS-232C drivers; therefore, they are tested indirectly here.

C.5 Error Messages

This section lists and explains QASYDIAG error messages that may appear on your screen along with an explanation of each.

DIVISOR LATCH REGISTER UPPER EXPECTED = XX
ACTUAL = YY

Explanation: The NS16450 ACE upper byte divisor register failed the write and verify test. The data written was XX, and the data read was YY.

Action: Check board address select (I/O address decode is wrong), NS16450 ACE, or I/O bus.

DIVISOR LATCH REGISTER LOWER EXPECTED = XX
ACTUAL = YY

Explanation: The NS16450 ACE lower byte divisor register failed the write and verify test. The data written was XX, and the data read was YY.

Action: Check board address select (I/O address decode is wrong), NS16450 ACE, or I/O bus.

WRONG INTERRUPT LINE

Explanation: The interrupt was not received at the expected interrupt location.

Action: Check that IRQ switch setting is correct, and that the switch is not shorted.

UNKNOWN INTERRUPT

Explanation: An interrupt was received, but no interrupt pending was registered by the NS16450 ACE.

Action: Check that interrupt logic is not faulty, NS16450 ACE chip is functioning properly, and that no other board in the system is using the same IRQ line.

WRONG INTERRUPT I.D. EXPECTED = XX ACTUAL = YY

Explanation: The interrupt identification latch on the board did not register the expected interrupt channel. The actual ID value displayed here was complemented.

Action: Check that interrupt ID latch is not defective.

NO MODEM STATUS INTERRUPT

Explanation: The *modem status changed* interrupt was not received as expected.

Action: Check for defective interrupt logic or NS16450 ACE chip.

NO LINE STATUS INTERRUPT

Explanation: The *line status* interrupt was not received as expected.

Action: Check for defective interrupt logic or NS16450 ACE chip.

UNEXPECTED MODEM STATUS INTERRUPT

Explanation: A *modem status changed* interrupt was received while it was actually disabled in the NS16450 ACE chip.

Action: Check for defective NS16450 ACE.

UNEXPECTED STATUS ERROR INTERRUPT

Explanation: A *line status* interrupt was received while it was actually disabled in the NS16450 ACE chip.

Action: Check for defective NS16450 ACE.

UNEXPECTED THREE OR DATA READY INTERRUPT

Explanation: A *transmit holding register empty* interrupt or a *data character ready* interrupt was received while it was actually disabled in the NS16450 ACE.

Action: Check for defective NS16540 ACE chip.

BREAK INTERRUPT BIT NOT SET

Explanation: The break interrupt bit in the line status register of the NS16450 ACE was not set as expected.

Action: Check for defective NS16540 ACE chip.

RECEIVING INCOMPLETE, TIMEOUT

Explanation: No data character or too few characters were received after all characters were transmitted.

Action: Check for broken lines in the loopback plug, bad RS-232C drivers, defective NS16450 ACE, too-slow Baud rate, or faulty interrupt enable logic.

TRANSMITTING INCOMPLETE, TIMEOUT

Explanation: No data character or too few characters were transmitted.

Action: Check for defective NS16450 ACE or bad interrupt enable logic.

NO. OF BYTES RECEIVED GREATER THAN TRANSMITTED

Explanation: The NS16450 ACE chip still received data characters after the transmitter was disabled.

Action: Check for defective NS16450 ACE.

DATA MISMATCHED

Explanation: All expected characters were received without line status error, but they were not compared with the data that was transmitted.

Action: Check for defective NS16450 ACE

WRONG BAUD RATE

Explanation: The characters were not transmitted and received at the programmed Baud rate.

Action: Check for defective NS16450 ACE or faulty clock circuit.

PARITY

Explanation: A parity error was detected during receiving.

Action: Check for defective NS16450 ACE or RS232C drivers.

OVERRUN

Explanation: A character overrun error was detected on receiving.

Action: Check for defective Baud rate clock circuit.

FRAMING

Explanation: A character framing error was detected on receiving.

Action: Check for defective RS-232C drivers, Baud rate clock, or NS16450 ACE.

BREAK

Explanation: A line break error was detected while receiving characters.

Action: Check for defective RS232C drivers, broken line in loopback plug, or defective NS16450 ACE chip.

NO CTS

Explanation: The clear to send (CTS) modem signal was gone.

Action: Check for defective RS-232C drivers or broken loopback plug.

NO DSR

Explanation: The dataset ready (DSR) modem signal was gone.

Action: Check for defective RS-232C drivers or broken loopback plug.

NO DCD

Explanation: The data carrier detect (DCD) modem signal was gone.

Action: Check for defective RS-232C drivers or broken loopback plug.

NO RI

Explanation: The ring indicator (RI) modem signal was gone.

Action: Check for defective RS-232C drivers or broken loopback plug.

DCTS

Explanation: A changed state in the CTS modem signal was detected.

Action: Check for defective RS-232C drivers or broken loopback plug.

DDSR

Explanation: A changed state in the DSR modem signal was detected.

Action: Check for defective RS-232C drivers or broken loopback plug.

DDCD

Explanation: A changed state in the DCD modem signal was detected.

Action: Check for defective RS-232C drivers or broken loopback plug.

DRI

Explanation: A changed state in the RI modem signal was detected.

Action: Check for defective RS-232C drivers or broken loopback plug.

PRODUCT 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.

If the product is not covered under an AST Research warranty: Contact your dealer or AST Research Technical Support for further information.

3. *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.

4. *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 the parallel port does not function correctly, be sure to return the parallel port adapter cable with the board.

5. *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
RAN.

6. 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.

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.

FCC Warning

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.

AST RESEARCH, INC.

Product Comment Form

**Async Cluster Adapter™
User's Manual
000364-001 A**

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.

Submitter Information

Submitter's name:

Address:

Product/Manual Comments and Suggestions

Please mail this form to:

AST Research, Inc.
Attn: Product Marketing
2121 Alton Ave.
Irvine, CA 92714

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