OCTOBER 2001

IC496A-R2	**IC496AE-R2**
IC497A	**IC497AE**
IC498A	**IC498AE**
IC499A	**IC499AE**

SCSI Repeaters
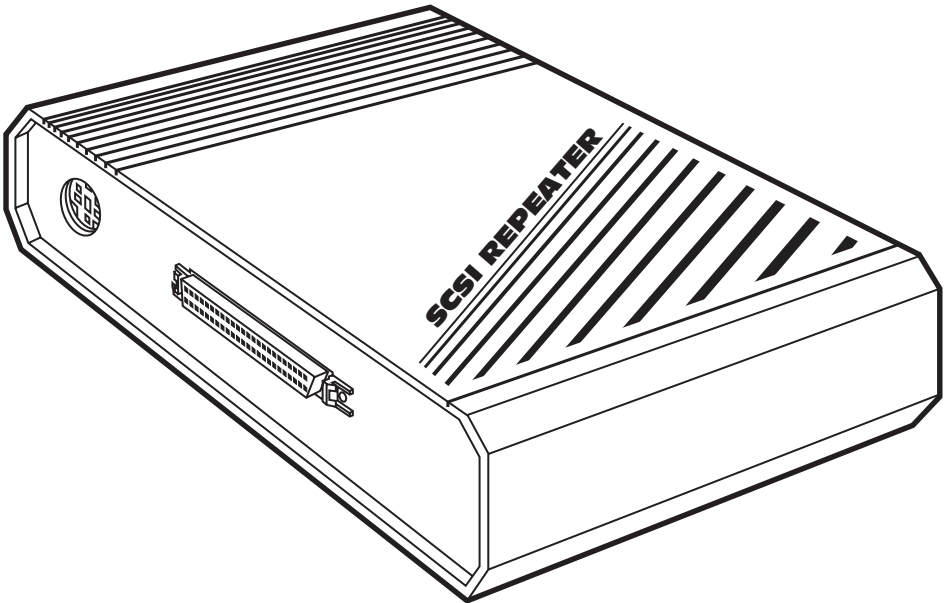
FEDERAL COMMUNICATIONS COMMISSION AND INDUSTRY CANADA
RADIO-FREQUENCY INTERFERENCE STATEMENTS

Class B Digital Device. This equipment has been tested and found to comply with the limits for a Class B computing device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. This equipment generates, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. If this equipment does cause harmful interference to radio or telephone reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult an experienced radio/TV technician for help.

Caution:

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

To meet FCC requirements, you should use shielded cables and power cords to connect this device to a personal computer or other Class B certified device.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

NORMAS OFICIALES MEXICANAS (NOM)
ELECTRICAL SAFETY STATEMENT

INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.

2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.

3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.

4. Todas las instrucciones de operación y uso deben ser seguidas.

5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc.

6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.

7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.

8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.

9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.

10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.

11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra fisica y la polarización del equipo no sea eliminada.

13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.

14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.

15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.

16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.

17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.

18. Servicio por personal calificado deberá ser provisto cuando:

    A: El cable de poder o el contacto ha sido dañado; u

    B: Objectos han caído o líquido ha sido derramado dentro del aparato; o

    C: El aparato ha sido expuesto a la lluvia; o

    D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o

    E: El aparato ha sido tirado o su cubierta ha sido dañada.

EUROPEAN UNION DECLARATION OF CONFORMITY

This equipment complies with the requirements of the European EMC Directive 89/336/EEC.

$$C\epsilon$$

Contents

1. Specifications

Compliance —   CE; FCC Part 15 Subpart J Class B, IC Class/classe B

Standards —   ANSI X3.131 and X3T9.2

Interfaces —   IC496 and IC497 models: Narrow SCSI-1 and SCSI-2
                        single-ended;
                        IC498 models: Wide SCSI-2 and Ultra SCSI (SCSI-3)
                        single-ended;
                        IC499 models: Wide Ultra2 SCSI LVD

Protocol —   Synchronous or asynchronous

**Maximum
Data Rate —**   IC496 and IC497 models: 20 MBps;
                        IC498 models: 40 MBps;
                        IC499 models: 80 MBps

**Maximum
Signal Delay —**   IC499 models: 10 ns;
                        All other models: 15 ns

**Maximum
Signal Slew —**   3 ns

**Maximum
Distance —**   IC496 and IC497 models:
                        From each port to the most distant directly attached
                          device:
                          6 m (19.7 ft.) at 5 MBps,
                          3 m (9.8 ft.) at 10 MBps, or
                          1.5 m (4.9 ft.) at 20 MBps;
                        Up to 3 units can be installed on one bus to extend
                          total bus length up to 24 m (78.7 ft.), 12 m (39.4 ft.),
                          or 6 m (19.7 ft.) respectively;

Maximum
Distance (cont'd) — IC498 models:
      From each port to the most distant directly attached
        device:
        6 m (19.7 ft.) at 10 MBps,
        3 m (9.8 ft.) at 20 MBps or (with four or fewer
          devices) at 40 MBps, or
        1.5 m (4.9 ft.) with more than four devices at
          40 MBps;
      Up to 3 units can be installed on one bus to extend
        total bus length up to 24 m (78.7 ft.), 12 m (39.4 ft.),
        or 6 m (19.7 ft.) respectively;
     IC499 models:
      Point-to-point (only two other devices on the bus):
        82 ft. (25 m) from each port to each directly
          attached device;
      Multipoint (more than two other devices on the bus):
        39.4 ft. (12 m) from each port to the most distant
          directly attached device;
      Up to 2 units can be installed on one bus to extend
        total bus length up to 246 ft. (75 m) or 118 ft. (36 m)
        respectively

SCSI ID — None required

Termination — Active internal or external (user-selectable)

Internal Terminator
Power — 1 amp; internal resettable fuse will provide 5 VDC at
       1 amp

User Controls — (2) Side-mounted slide switches: Internal vs. external
       termination

Indicator — (1) Unlabeled Power/Activity LED

Connectors — All models: (1) 5-pin mini-DIN female power jack;
       IC496 models: (2) 50-pin Centronics® female;
       IC497 models: (2) Micro D50 (50-pin high-density)
        female;
       IC498 models and IC499A: (2) Micro D68 (68-pin high-
        density) female

Power —	IC496A-R2, IC497A, and IC498A:
	From wallmount power supply:
	Optimal Input: 115 VAC, 60 Hz;
	Input Range: 103.5 to 126.5 VAC, 48 to 65 Hz;
	Input Current Rating: 0.25 amps;
	Output: 12 VDC at up to 1 amp;
	IC496AE-R2, IC497AE, and IC498AE:
	From desktop power supply:
	Optimal Input: 220 VAC, 50 Hz;
	Input Range: 198 to 242 VAC, 48 to 65 Hz;
	Input Current Rating: 0.25 amps;
	Output: 12 VDC at up to 1 amp;
	IC499A:
	From wallmount power supply:
	Optimal Input: 115 VAC, 60 Hz;
	Input Range: 103.5 to 126.5 VAC, 48 to 65 Hz;
	Input Current Rating: 0.25 amps;
	Output: 6 to 12 VDC at up to 1.3 amps
	IC499AE:
	From desktop power supply:
	Optimal Input: 230 VAC, 50 Hz;
	Input Current Rating: 110 mA
	Output: 12 VDC at up to 1 amp
MTBF —	50,000 hours
Temperature Tolerance —	32 to 131˚F (0 to 55˚C)
Humidity Tolerance —	Up to 90% noncondensing
Size —	1.1"H x 3.4"W x 4.7"D (2.8 x 8.6 x 11.9 cm)
Weight —	1 lb. (0.5 kg)

2. Introduction

NOTE

If you're not very familiar with how SCSI works or with the characteristics of its different varieties, please read the technical information in Appendix B**. It might help you (a) confirm that you have the proper Repeater and (b) prevent installation and operation problems.**

2.1 Overview

Your new SCSI Repeater gives you the freedom to extend the distance of any LVD SCSI bus (IC499 models) or single-ended SCSI bus (all other models) beyond the standard distance limits. It's a low-cost data repeater that plugs in-line on a SCSI chain, regenerating and reconditioning the data signal, doubling the distance your data can travel, and giving you the flexibility to install your SCSI peripherals wherever you need them most (see Figure 2-1).
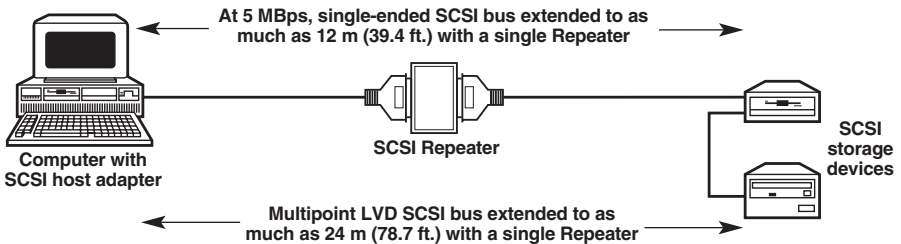

Figure 2-1. One SCSI Repeater doubles the distance of a SCSI bus.

In fact, you can link as many as three IC496, IC497, or IC498 model SCSI Repeaters to a single SCSI-1, SCSI-2, or Ultra SCSI (SCSI-3) bus in order to place disk drives, tape peripherals, CD-ROM drives, or laser printers up to 24 m (78.7 ft.) away from the host computer (see Figure 2-2 on the next page). Or you can link as many as two SCSI LVD Repeaters (IC499 models) to an Ultra2 SCSI bus to place one such devices as much as 246 ft. (75 m) from the host computer, or two or more such devices as much as 118 ft. (36 m) from the host computer.

NOTE

The maximum distance attainable in an IC496, IC497, or IC498 model SCSI Repeater system depends on whether the bus is narrow or wide, how many devices are on it, and how high the data rate is. See Section 3.3.2 **and** Section B.4**.**
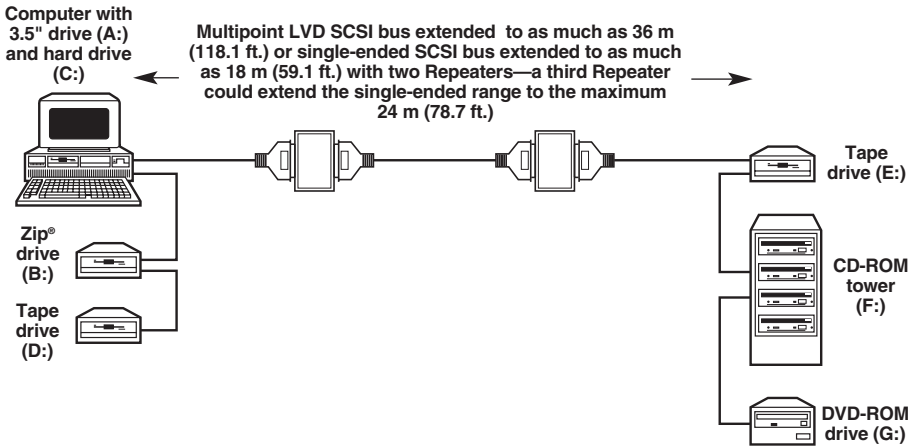
**Figure 2-2. Daisychain SCSI Repeaters for more distance (DOS/Windows®
drive-letter assignments shown).**

Three basic types of the SCSI Repeater are available. One supports "narrow" (8-bit)
single-ended SCSI devices, the second supports "wide" (16-bit) single-ended SCSI
devices, and the third supports low-voltage differential (LVD) SCSI devices. All
three Repeater types can double the distance of your SCSI bus.

2.2 Features

- Doubles SCSI-bus distance.

- Maximum data rate of 20 (narrow single-ended), 40 (wide single-ended), or
  80 (LVD) Mbps.

- Compatible with synchronous and asynchronous applications.

- User-installable.

- Transparent to SCSI controllers and peripherals.

- Internal active bus termination.

- No software required.

- IC496 and IC497 models are compatible with SCSI-1 and SCSI-2; IC498 models
  are compatible with SCSI-2 and Ultra SCSI (SCSI-3); and IC499 models are
  compatible with Ultra2 SCSI.

- Conforms to ANSI X3.131 and X3T9.2 SCSI specifications.

3. Installation

3.1 The Complete Package

The complete SCSI Repeater package you should have received includes the SCSI Repeater itself, its AC power supply, and this manual. If you didn't receive everything, or if anything arrived damaged, call Black Box immediately.

3.2 Placement

Your SCSI Repeater, shown in Figure 3-1, requires no additional software to operate. The only thing necessary to operate it is a nearby working AC outlet.

   You can install the SCSI Repeater in any position and any location that is convenient for you. The only exception is that you should not install the unit near any devices that generate (a) excessive heat, such as desk lamps or radiators, or (b) excessive electrical noise, such as motors, fluorescent lights, or compressors.

DC power plug (with flat side facing forward)

SCSI cable to computer (or peripheral or other Repeater)

SCSI cable to peripheral (or computer or other Repeater)

Single-ended SCSI cables can be up to 6 m (19.7 ft.) long depending on the data rate; LVD SCSI cables can be up to 25 m (82 ft.) long regardless of the data rate
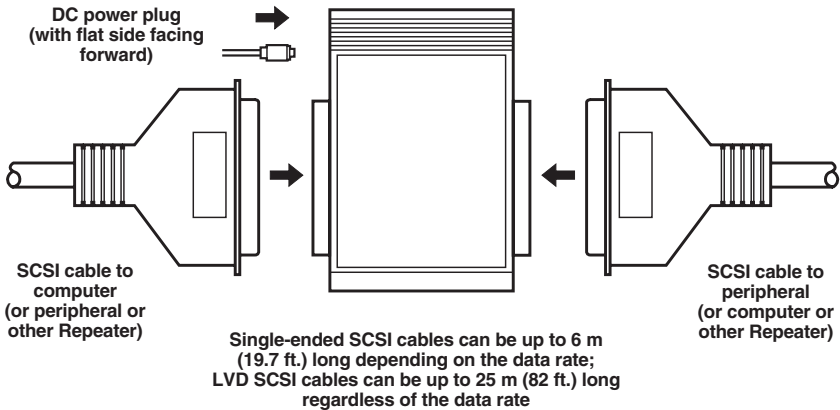
Figure 3-1. Top view of the SCSI Repeater, showing connections.

3.3 The Installation Procedure

3.3.1 ATTACHING THE AC POWER SUPPLY

The first step in installing your SCSI Repeater is to connect its power supply. Depending on which model of the Repeater you ordered, it will be shipped with either a 115- or 230-VAC supply. Both supplies have an attached 6-ft. (1.8-m) output cord terminated with a 5-pin mini-DIN DC plug.

The shape of this DC plug is "keyed" so that it will only fit the DC socket on the SCSI Repeater if it's positioned properly. If the plug doesn't seat easily, check to make sure it's positioned properly. Do not use excessive force to seat the plug. Refer to **Appendix A** for the pinout of this plug.

Next, plug the Repeater's power supply (115-VAC models) or its input cord (230-VAC models) into a working AC outlet. The red Power/Activity LED on the right side of the SCSI Repeater will light to indicate when the unit is powered ON.

3.3.2 CONNECTING THE SCSI REPEATER TO THE SCSI BUS

CAUTION!

Turn OFF any computers and peripherals attached to the SCSI bus before connecting the SCSI Repeater to the bus.
Don't *ever* attach the Repeater to a SCSI bus containing high-voltage differential (HVD) devices. This will damage or destroy the Repeater.

You may install the SCSI Repeater at any point on the SCSI bus. The Repeater has two SCSI connectors with locking tabs or screw locks for secure connections. These ports are not computer- or peripheral-specific, so you can connect cable from a computer or SCSI peripheral to either one.

Use good cable for your SCSI bus. High-quality shielded SCSI cables will provide a link with the greatest noise immunity, and across the greatest distance, between the SCSI Repeater and your other SCSI devices. No matter how good the cable is, however, no cable connected to the SCSI Repeater may be longer than the maximum for your bus type and data rate:

- 6 m (19.7 ft.) for single-ended SCSI at 5 MBps (narrow) or 10 MBps (wide);
- 3 m (9.8 ft.) for single-ended SCSI at 10 MBps (narrow), 20 MBps (wide), or 40 MBps (wide with four or fewer devices);
- 1.5 m (4.9 ft.) for single-ended SCSI at 20 MBps (narrow) or 40 MBps (wide with five or more devices);
- 25 m (82 ft.) for point-to-point LVD SCSI; or
- 12 m (39.4 ft.) for multipoint LVD SCSI.

3.3.3 ENSURING PROPER TERMINATION

All SCSI buses must be properly terminated at each end. But because the SCSI Repeater essentially ties together two SCSI chains that can each be as long as an entire bus, there has to be extra termination on each side of the Repeater in addition to the standard terminators at each end of the bus.

That's a total of four terminators—two on each side of the SCSI Repeater. Figure 3-2 shows the locations of the required terminators. Be careful, though—your system will fail if more than two terminators are installed on either side of the SCSI Repeater.
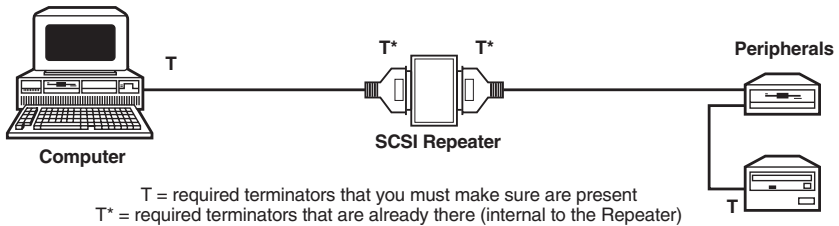

T = required terminators that you must make sure are present
T* = required terminators that are already there (internal to the Repeater)

Figure 3-2. Termination in a SCSI Repeater system.

Your SCSI Repeater comes standard with active-type internal terminators that provide the necessary termination on each side of the Repeater. However, your application or peripherals might require that you use external device terminators with the Repeater, in which case you must disable the internal terminators before attaching external ones. (The SCSI Repeater contains an internal resettable fuse that can provide power—1 amp at 5 volts—to an external terminator. Note that the SCSI Repeater contains internal protection and will not be affected if other SCSI devices provide terminator power.)

Select which type of termination you're going to use with the two slide switches on the right side of the SCSI Repeater. Switch "A" controls the internal terminators on the Repeater's Port A; switch "B" controls those on Port B. When the switches are in the "down" position, the Repeater's internal terminators are ON. For normal operation, leave the switches in the "down" (ON) position and install an additional terminator at each end of the SCSI bus.

3.3.4 POWERING UP THE SYSTEM

Once you've connected the SCSI Repeater to your properly terminated SCSI bus, power up the SCSI peripherals on the bus, then the host computer.

This completes your SCSI Repeater installation. The Repeater system should be ready for continuous operation.

4. Operation and Troubleshooting

4.1 Monitoring the LED

While the SCSI Repeater is working normally, boosting and regenerating SCSI data signals as they pass through it, the red Power/Activity LED on the right side of the Repeater will blink. If data communication is not getting from one side of the Repeater to the other, check your cable connections, your termination, and this LED. If the LED is dark even though the Repeater is plugged in and turned ON, there is a problem with either the unit or the site's electricity. If the LED is constantly lit (does not flicker) when you are trying to communicate with a device on the other side of the Repeater, even though your cable connections are secure and termination is properly set up, the Repeater is not working properly (see the next section).

4.2 Contacting Black Box

If you determine that your SCSI Repeater is malfunctioning, *do not attempt to alter or repair the unit.* It contains no user-serviceable parts. Call Black Box Technical Support at (412) 746-5500.

Before you do, make a record of the history of the problem. We will be able to provide more efficient and accurate assistance if you have a complete description, including:

- the nature and duration of the problem;

- when the problem occurs;

- the components (host computer, host adapter, SCSI devices and cables, etc.) involved in the problem;

- any particular application that, when used, appears to create the problem or make it worse; and

- the results of any testing you've already done.

4.3 Shipping and Packaging

If you need to transport or ship your SCSI Repeater:

- Package it carefully. We recommend that you use the original container.

- If you are shipping the Repeater for repair, make sure you include its power supply. If you are returning the Repeater, make sure you include its manual as well. Before you ship, contact Black Box to get a Return Authorization (RA) number.

Appendix A: Pinouts

A.1 50-Pin Narrow Single-Ended SCSI Ports (IC496 and IC497 Models)

The "narrow" single-ended SCSI ports on the IC496 and IC497 versions of the SCSI Repeater are pinned as shown in Table A-1.

Table A-1. Pinout chart for narrow single-ended SCSI connectors.

SIGNAL NAME	PIN NUMBER	SIGNAL NAME	PIN NUMBER
GROUND	1	–DB(0)	26
GROUND	2	–DB(1)	27
GROUND	3	–DB(2)	28
GROUND	4	–DB(3)	29
GROUND	5	–DB(4)	30
GROUND	6	–DB(5)	31
GROUND	7	–DB(6)	32
GROUND	8	–DB(7)	33
GROUND	9	–DB(P)	34
GROUND	10	GROUND	35
GROUND	11	GROUND	36
GROUND	12	GROUND	37
OPEN	13	TERMPWR	38
GROUND	14	GROUND	39
GROUND	15	GROUND	40
GROUND	16	–ATN	41
GROUND	17	GROUND	42
GROUND	18	–BSY	43
GROUND	19	–ACK	44
GROUND	20	–RST	45
GROUND	21	–MSG	46
GROUND	22	–SEL	47
GROUND	23	–C/D	48
GROUND	24	–REQ	49
GROUND	25	–I/O	50

A.2 68-Pin Wide Single-Ended SCSI Ports (IC498 Models)

The "wide" single-ended SCSI ports on the IC498 versions of the Repeater are pinned as shown in Table A-2.

Table A-2. Pinout chart for wide single-ended SCSI connectors.

SIGNAL NAME	PIN NUMBER	SIGNAL NAME	PIN NUMBER
GROUND	1	–DB(12)	35
GROUND	2	–DB(13)	36
GROUND	3	–DB(14)	37
GROUND	4	–DB(15)	38
GROUND	5	–DB(P1)	39
GROUND	6	–DB(0)	40
GROUND	7	–DB(1)	41
GROUND	8	–DB(2)	42
GROUND	9	–DB(3)	43
GROUND	10	–DB(4)	44
GROUND	11	–DB(5)	45
GROUND	12	–DB(6)	46
GROUND	13	–DB(7)	47
GROUND	14	–DB(P)	48
GROUND	15	GROUND	49
GROUND	16	GROUND	50
TERMPWR	17	TERMPWR	51
TERMPWR	18	TERMPWR	52
RESERVED	19	RESERVED	53
GROUND	20	GROUND	54
GROUND	21	–ATN	55
GROUND	22	GROUND	56
GROUND	23	–BSY	57
GROUND	24	–ACK	58
GROUND	25	–RST	59
GROUND	26	–MSG	60
GROUND	27	–SEL	61
GROUND	28	–C/D	62
GROUND	29	–REQ	63
GROUND	30	–I/O	64
GROUND	31	–DB(8)	65
GROUND	32	–DB(9)	66
GROUND	33	–DB(10)	67
GROUND	34	–DB(11)	68

A.3 68-Pin LVD SCSI Ports (IC499 Models)

The low-voltage differential (LVD) SCSI ports on the IC499 versions of the Repeater are pinned as shown in Table A-3.

Table A-3. Pinout chart for LVD SCSI connectors.

SIGNAL NAME	PIN NUMBER	SIGNAL NAME	PIN NUMBER
+DB(12)	1	-DB(12)	35
+DB(13)	2	-DB(13)	36
+DB(14)	3	-DB(14)	37
+DB(15)	4	-DB(15)	38
+DB(P1)	5	-DB(P1)	39
+DB(0)	6	-DB(0)	40
+DB(1)	7	-DB(1)	41
+DB(2)	8	-DB(2)	42
+DB(3)	9	-DB(3)	43
+DB(4)	10	-DB(4)	44
+DB(5)	11	-DB(5)	45
+DB(6)	12	-DB(6)	46
+DB(7)	13	-DB(7)	47
+DB(P)	14	-DB(P)	48
GROUND	15	GROUND	49
DIFFSENS	16	GROUND	50
TERMPWR	17	TERMPWR	51
TERMPWR	18	TERMPWR	52
RESERVED	19	RESERVED	53
GROUND	20	GROUND	54
+ATN	21	-ATN	55
GROUND	22	GROUND	56
+BSY	23	-BSY	57
+ACK	24	-ACK	58
+RST	25	-RST	59
+MSG	26	-MSG	60
+SEL	27	-SEL	61
+C/D	28	-C/D	62
+REQ	29	-REQ	63
+I/O	30	-I/O	64
+DB(8)	31	-DB(8)	65
+DB(9)	32	-DB(9)	66
+DB(10)	33	-DB(10)	67
+DB(11)	34	-DB(11)	68

A.4 Power Connector

The DC power-input port common to all versions of the SCSI Repeater, illustrated in Figure A-1, is pinned as shown in either Table A-4 or Table A-5.
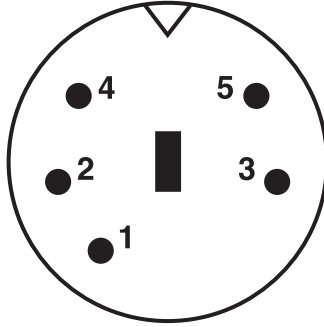

Figure A-1. The 5-pin mini-DIN power connector.

Table A-4. The pinout of the power connector on the IC499 models.

PIN NUMBER	DESCRIPTION
1	No connection
2	+6 to +12 VDC
3	Ground
4	+6 to +12 VDC
5	Ground
Shell	No connection

Table A-5. The pinout of the power connector on all other models.

PIN NUMBER	DESCRIPTION
1	+5 VDC
2	+12 VDC
3	Ground
4	+12 VDC
5	Ground
Shell	No connection

Appendix B:
SCSI Technical Information

B.1 SCSI Basics

This section briefly discusses some of the major topics involved with the SCSI (Small Computer Systems Interface).

SCSI-l
The original specification supported data transfers up to 5 MBps on an 8-bit-wide parallel data bus. However, the SCSI-1 standards did not solve certain incompatibility problems between host adapters and peripheral devices. The need to improve compatibility, increase transfer rates, and add other features for better performance prompted a review of this specification.

SCSI-2
Improved compatibility and higher transfer rates were provided in this enhancement. The addition of "Wide SCSI" permitted 16 or 32 bits to be transferred in parallel, the latter requiring two cables. "Fast SCSI," which doubled previous maximum data rates, was also added. The new specifications made it possible to achieve synchronous data transfers at up to 10 MBps for 8-bit buses, 20 MBps for 16-bit buses, and 40 MBps for 32-bit buses.

Ultra SCSI (SCSI-3)
The most significant additions in this enhancement were the ability to address up to 32 devices, a 16-bit single-cable data bus, and a serial SCSI protocol. In the Ultra SCSI standard, various aspects of the interface have their own subsidiary standards, including the SCSI Parallel Interface (SPI), which is a hardware specification, and the SCSI Interlocked Protocol (SIP), which is a software-link protocol.

Ultra2 SCSI
In this version of the SCSI specification, the Low-Voltage Differential (LVD) bus was added, which supports the distance and noise resistance of differential SCSI but uses the low power levels typical of single-ended SCSI (see the **Signal Wiring** section on the next page). The maximum data rate was also doubled again, to 80 MBps.

Signal Wiring: Single-Ended vs. Differential
The signal wiring used in a SCSI bus has an impact on bus performance. The two wiring techniques generally used for SCSI are called "single-ended" and "differential."

With single-ended wiring, a single wire carries the signal from initiator to target. Single-ended circuitry is not noise-resistant and is generally limited to about 6 meters at data-transfer speeds of 5 MBps (narrow) or 10 MBps (wide); distance is halved each time speed is doubled.

Differential wiring uses two wires for each signal and offers exceptional noise resistance because it does not rely on a common ground. This allows cables up to 25 meters and reliable operation at 10 or more MBps. Differential wiring and circuitry is more complex than single-ended and generally tends to be more expensive to implement.

Termination: Passive vs. Active
The majority of problems encountered with SCSI-bus installations are due to unbalanced or improper impedances on the SCSI-bus transmission cables, caused by interactions with and between varying manufacturers' peripheral devices. SCSI uses "terminators" (electrical regulators, if you will) to compensate for the inherent impedance mismatches on SCSI buses, to which several peripheral devices (such as hard drives, CD-ROM drives, scanners, and printers) are typically attached.

"Passive" terminators are the most basic type. They are resistor networks that allow signal voltages to vary with the load and terminator power supplied. This is fine on differential buses, and all differential terminators are by nature passive. It's another story on single-ended buses, however: Passive single-ended terminators are usually supplied with peripherals and frequently do a poor job of balancing bus impedance. The varying voltages they permit result in unstable signals from end to end on the bus and cause data errors. Passive terminators are no longer recommended by ANSI for single-ended SCSI-bus designs.

"Active" terminators, by contrast, add a voltage regulator to the circuit to regulate signal voltages with varying loads and terminator power, allowing a consistent signal to be transmitted everywhere on the bus and thereby compensating for varying bus lengths and signal loads. Active termination is now the minimum ANSI-recommended termination for single-ended SCSI buses.

B.2 SCSI Installation Tips

Keep any single-ended SCSI chain short. Official SCSI specifications limit a single-ended SCSI chain to no more than 6 meters (19.7 feet) long. Practical experience says the shorter the better. The maximum length you should allow between devices is 3 feet (about 1 meter).

Never assign the same SCSI ID number to two devices on the same bus. SCSI uses these numbers as addresses to ensure that information goes to the correct location. Giving two devices the same address can result in lost information.

Know that some default SCSI-ID numbers might have to be reassigned. Internal boot-source hard drives are usually set to ID "0," while secondary hard drives are set to "1." Motherboards and host adapters are generally set to ID "7."

Always terminate the first and last devices on the chain. Drives purchased specifically for internal use nearly always arrive with terminators installed. When in doubt, contact the vendor you purchased a device from.

If the last device on the chain has two SCSI connectors, attach the cable to one and a terminator to the other. Otherwise, you'll have an open connector that may cause noise on the SCSI chain.

Always turn off the power to your computer and SCSI devices before swapping cables or moving devices around. SCSI cables contain sensitive data-transmission lines and one or more live power wires.

Turn on your SCSI devices before you turn on the computer. Some SCSI devices will not mount if they are not running when you power up your computer. Shutting down your computer first and then the attached SCSI devices allows your system to completely "flush" itself.

B.3 SCSI Signal Descriptions

SCSI requires a total of 18 signals, described below.

BSY (BUSY): An "OR-tied" signal that indicates that the bus is being used.

SEL (SELECT): An "OR-tied" signal used by an initiator to select a target or by a target to reselect an initiator.

C/D (CONTROL/DATA): A signal driven by a target that indicates whether CONTROL or DATA information is on the DATA BUS. A "true" logic level indicates CONTROL.

I/O (INPUT/OUTPUT): A signal driven by a target that controls the direction of data movement on the DATA BUS with respect to an initiator. A "true" logic level indicates input to the initiator. This signal is also used to distinguish between SELECTION and RESELECTION phases.

MSG (MESSAGE): A signal driven by a target during the MESSAGE phase.

REQ (REQUEST): A signal driven by a target to indicate a request for a REQ/ACK data-transfer handshake.

ACK (ACKNOWLEDGE): A signal driven by an initiator to indicate an acknowledgement for a REQ/ACK data-transfer handshake.

ATN (ATTENTION): A signal driven by an initiator to indicate the ATTENTION condition.

RST (RESET): An "OR-tied" signal that indicates the RESET condition.

DB(15 or 7 through 0, plus P) (DATA BUS): Sixteen (for LVD and wide single-ended SCSI) or eight (for narrow single-ended SCSI) data-bit signals, plus a parity-bit signal, that form a DATA BUS. DB(15) or DB(7), respectively, is the most significant bit and has the highest priority during the ARBITRATION phase. Bit number, significance, and priority decrease downward to DB(0). A data bit is defined as "one" when the signal value is "true" and is defined as "zero" when the signal value is "false." The DB(P) bit is used to maintain odd parity.

B.4 Device and Distance Support By Bus Type

Bus Type	Max. No. of Devices	Maximum Distance
Single-ended SCSI-1	8	6 m (19.7 ft.)
Narrow single-ended SCSI-2	8	6 m (19.7 ft.)
Wide single-ended SCSI-2	16	6 m (19.7 ft.)
Wide single-ended Ultra SCSI (≤4 devices)	4	3 m (9.8 ft.)
Wide single-ended Ultra SCSI (>4 devices)	8	1.5 m (4.9 ft.)
LVD Ultra2 SCSI (point-to-point)	2	25 m (82 ft.)
LVD Ultra2 SCSI (multipoint)	16	12 m (39.4 ft.)

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