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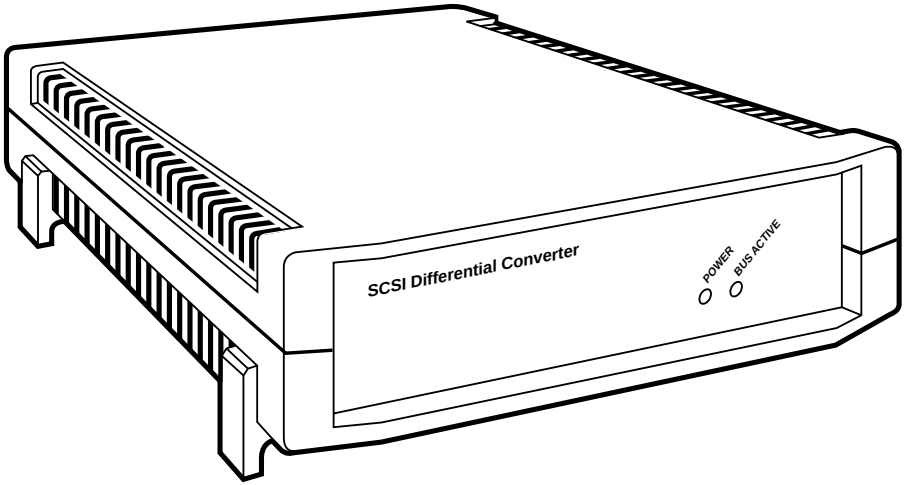
BLACK BOX®
NETWORK SERVICES

JULY 2000
IC124A
IC125A
IC152A

SCSI Differential Converters



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FEDERAL COMMUNICATIONS COMMISSION
AND
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This equipment generates, uses, and can radiate 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 communication. It has been tested and found to comply with the limits for a Class A 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 when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

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

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.

TRADEMARKS USED IN THIS MANUAL

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Contents

Chapter Page

1. Specifications

Compliance — FCC Class A, DOC Class/MDC classe A

Standards — SCSI: ANSI X3.131 and X3T9.2

Interfaces — IC124A: Narrow SCSI;
IC125A: SE to HVD Wide SCSI;
IC152A: SE/LVD to HVD Wide SCSI

Compatibility — IC124A: SCSI-1 and Fast SCSI (SCSI-2);
IC125A: Fast SCSI (SCSI-2);
IC152A: SCSI-1, SCSI-2, SCSI-3, and Ultra-SCSI-2

Protocol — Synchronous or asynchronous

Maximum Data Rate — IC124A: 10 megabytes per second;
IC125A: 20 megabytes per second;
IC152A: 80 megabytes per second

Maximum Signal Slew — 5 ns

Maximum S.-E./Diff. Conversion Delay — 30 ns

Maximum Total Delay — Across SCSI bus extended to maximum distance through Converter: ~210 ns

Maximum Distance — IC124A:
From single-ended port to most distant attached device: 6 m (19.7 ft.) at 5 MBps or 3 m (9.8 ft.) at 10 MBps;
From differential port to most distant attached device: 25 m (82 ft.);
IC125A:
From single-ended port to most distant attached device: 6 m (19.7 ft.) at 10 MBps or 3 m (9.8 ft.) at 20 MBps;

Maximum Distance (continued)—

From differential port to most distant attached device: 25 m (82 ft.);

IC152A:

From single-ended port to most distant attached device: 6 m (19.7 ft.) at 40 MBps or 3m (9.8 ft.) at 80 MBps

From differential port to most distant attached device: 25 m (82 ft.)

SCSI ID — None required

Termination — Single-ended port: Single-ended: Internal active or external (user-selectable);
Differential port: Internal differential (can be removed in favor of an external terminator)

Internal Terminator Power — 1 amp to the single-ended port and/or the differential port (user-selectable); internal resettable fuse will provide 5 VDC at 1 amp

User Controls — (1) Rear-mounted ON/OFF rocker switch;
(3) Internal jumpers for termination and terminator power

Indicator — (2) Front-mounted LEDs: Power, Bus Active

Connectors — All rear-mounted:
(1) IEC 320 male power inlet;
IC124A only:
(1) 50-pin Centronics female for single-ended SCSI data;
(1) 50-pin high-density female for differential SCSI data;
IC125A only:
(2) 68-pin high-density female for single-ended and differential SCSI data
IC152A only:
(2) 68-pin high-density female for single-ended/low-voltage differential and high-voltage differential SCSI data

Power —	Through detachable power cord and internal power supply: Optimal Input: 110 VAC, 60 Hz, or 220 VAC, 50 Hz (user-selectable); Input Range: 99 to 121 VAC or 198 to 242 VAC, 48 to 65 Hz; Input Current Rating: 1.5 amps; Consumption (all models): 15 watts
MTBF —	283,000 hours
Temperature Tolerance —	32 to 131˚F (0 to 55˚C)
Humidity Tolerance —	0 to 90% noncondensing
Size —	2.1"H x 6"W x 9.6"D (5.3 x 15.2 x 24.4 cm)
Weight —	2.5 lb. (1.1 kg)

2. Introduction

2.1 General Overview

The SCSI Differential Converter is a high-performance bus converter that translates single-ended SCSI-bus signals into differential bus signals and vice versa. Through these Converters, computers with single-ended host adapters can communicate with differential peripherals, and computers with differential host adapters can access single-ended peripherals.

The "narrow SCSI" Converter (product code IC124A) is fully compatible with 8-bit SCSI-1 and Fast SCSI (SCSI-2) applications; the "wide SCSI" Converters (product code IC125A and IC152A) are fully compatible with 16-bit Fast SCSI applications.

You can also use a pair of Converters to extend one single-ended SCSI bus: Attaching a 6-m (19.7-ft.) single-ended bus to each Converter and running a 25-m (82-ft.) differential cable between them would create a single single-ended SCSI bus 37 m (121.4 ft.) long.

2.2 Features

- Differential (HVD) to single-ended (SE), single-ended to differential converter
- Low-voltage Differential (LVD) to Differential (HVD), Differential to Low Voltage Differential converter
- Extend SCSI bus by up to 25 m (82 ft.).
- Compatible with SCSI-1, Fast SCSI (SCSI-2), and SCSI-3
- Supports Ultra/Ultra2 SCSI narrow and wide devices
- Asynchronous and synchronous compatible
- 10-, 20-, 40-, or 80-Megabyte-per-second (MBps) maximum data rate
- Compatible with synchronous and asynchronous applications
- Transparent to SCSI controllers and peripherals; require no SCSI IDs
- Units can be paired to extend a single-ended bus
- Internal bus termination ("active" single-ended termination)

- No additional software required
- User-installable

2.3 Hardware Description

The industry-standard SCSI (pronounced “scuzzy”) bus is a popular high-speed medium used to interconnect micro-, mini-, and mainframe computers and high-performance peripherals. However, it is subdivided into several mutually incompatible specifications, such as “single-ended” (one-signal) vs. “differential” (two-signal) SCSI and “narrow” (8-bit) vs. “wide” (16-bit) SCSI. The SCSI Differential Converters help to overcome these incompatibilities: The narrow model (product code IC124A) lets narrow single-ended equipment talk to narrow differential equipment, and through one of the wide models (product code IC125A), wide single-ended equipment can talk to wide differential equipment. The other wide model (product code IC152A) lets wide single-ended/low-voltage differential equipment communicate with wide high-voltage differential equipment. The IC152A is also a 25-meter extender.

The Converters support a maximum SCSI data rate of 10 MBps (IC124A), 20 MBps (IC125A), or 80 MBps (IC152A) in asynchronous or synchronous mode. All models support the “Fast SCSI” standard available in top-of-the-line computers and peripherals. Proprietary switching enables the Converters to maintain complete SCSI command functionality and remain transparent to the user.

The Converters conform to ANSI X3.131 and X3T9.2 specifications for device termination. Disconnect and Reselect are fully supported to ensure complete SCSI compatibility. And the Converters do not require SCSI device addresses (ID numbers).

You can install a Converter at any point on the SCSI bus to provide single-ended/differential conversion. This makes it possible to interconnect computers with different types of SCSI host adapters in a communication link that outperforms standard local area networks such as 10-Mbps Ethernet and 16-Mbps Token Ring. You can also install a pair of Converters and up to 25 m (82 ft.) of differential cabling to link two chains of one single-ended bus.

Three different SCSI Differential Converter applications are shown in Figure 2-1 on the next page.

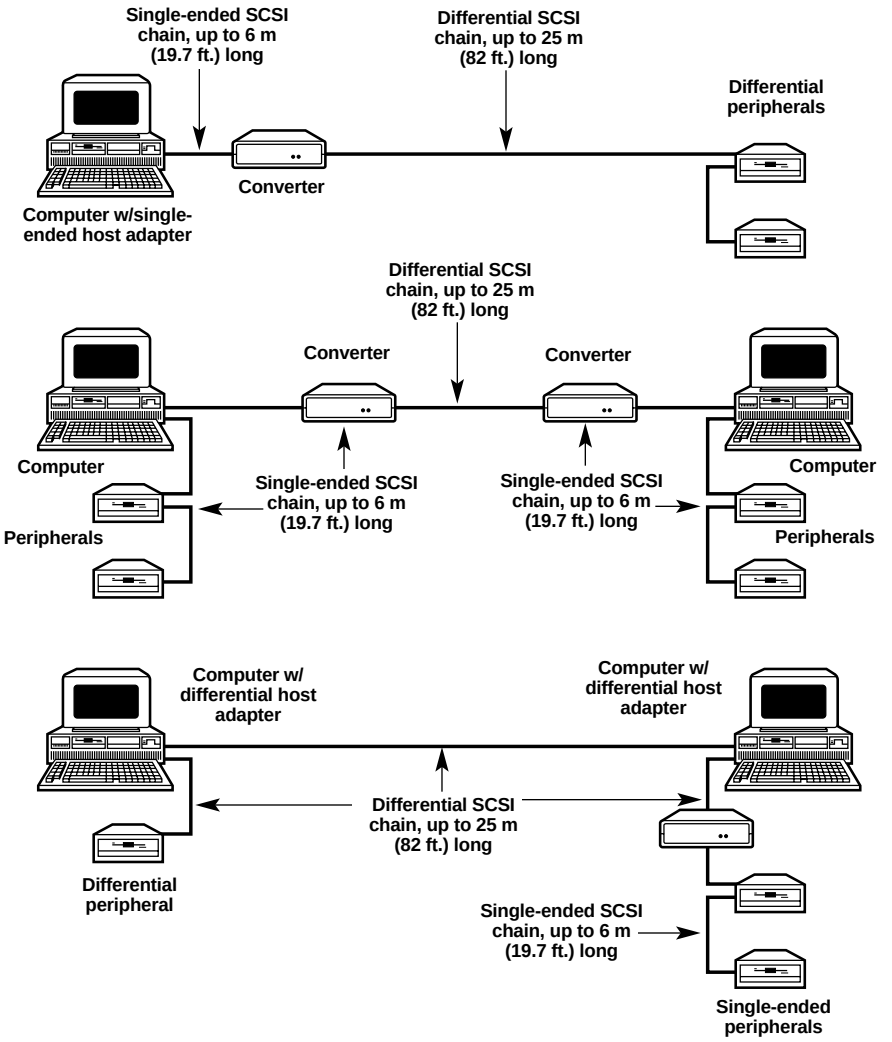

Figure 2-1. Typical Converter applications.

3. Installation

3.1 Unpacking Your Shipment

Check the contents of the shipping carton as you unpack your SCSI Differential Converter. The package should at least contain:

- (1) SCSI Differential Converter
- (1) Package of replacement parts consisting of:
  (1) 1.5-Amp input-power fuse and
  (1) 1-Amp terminator fuse
- This user's manual

Customers in North America and certain other world regions will also receive an AC power cord. If you didn't receive everything, or if anything arrived damaged, call Black Box immediately.

3.2 Configuration

You will have to open the SCSI Differential Converter and make adjustments to its internal components if you need to do any of these things:

- Set the unit for 220-VAC input power;
- Set its single-ended port for external termination (see Section 3.3.5 for a discussion of termination options);
- Set its differential port for external termination;
- Replace any of its internal terminators; or
- Remove or replace its input-power fuse or terminator-power fuse.

Refer to Appendix C; it gives you step-by-step directions for opening the Converter and making any of these adjustments.

3.3 Placement

Your SCSI Differential Converter requires no additional software to operate. The only thing necessary to operate it is a nearby working AC outlet.

You can install the Converter in any position and any location near your SCSI devices that is convenient for you. The only exceptions are:

- You must make sure that the ventilation slots on the sides of the unit get adequate air flow.
- Don't 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.

3.4 The Installation Procedure

3.4.1 Attaching the Power Cord

First, plug the IEC 320 female outlet on the power cord of your SCSI Differential Converter into the Converter's IEC 320 male inlet, shown in Figure 3-1 below. The other end of the cord should have a plug suitable for your type of outlet, but do not plug the cord into an outlet yet.

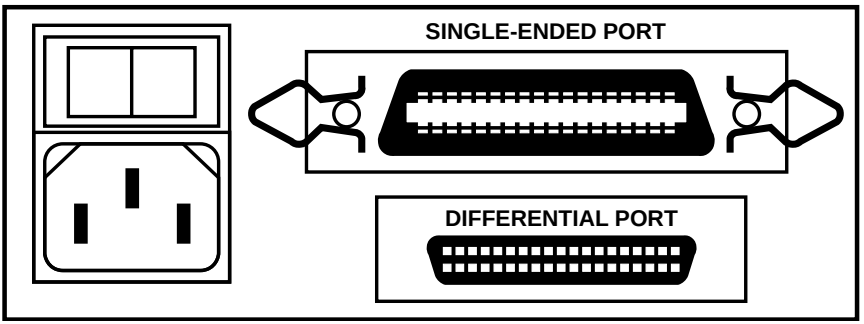

Figure 3-1. The rear panel of the SCSI Differential Converter (the narrow model, IC124A, shown).

3.4.2 Powering Down the System

Before you insert the SCSI Differential Converter into your SCSI system, power down all of the computers and peripherals that will be part of the same SCSI bus as the Converter. This minimizes the chances that problems or accidental damage will occur.

3.4.3 Connecting the Converter to the SCSI Bus

Install the SCSI Differential Converter at one end or the other of the single-ended SCSI chain and differential chain that you want to interconnect. (That is, run standard single-ended cable to the Converter from either the first or last device on the single-ended chain, and run standard differential cable to the Converter from either the first or last device on the differential chain.) The Converter has one single-ended (50-pin Centronics® or 68-pin high-density) female connector and one differential (50- or 68-pin high-density) female connector, with locking tabs/clips and screwlocks respectively for secure connections. These ports are not computer- or peripheral-specific, so you can connect cable from either a computer or a SCSI peripheral to either of them.

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 Converter and your other SCSI devices. No matter how good the cable is, however, no single-ended SCSI cable connected to the Converter may be longer than 6 m (19.7 ft.)—3 m (9.8 ft.) if you're running at a Fast SCSI data rate—and no attached differential cable may be longer than 25 m (82 ft.). We highly recommend that even differential cable runs be kept to a maximum of 5 or 10 m (16.4 or 32.8 ft.) for optimum system performance.

CAUTION!

Do not attach a differential SCSI bus to the Converter's single-ended port. This could damage the Converter even though it has internal protection.

Don't attach a single-ended bus to the differential port, either. The differential port is also internally protected and would not be damaged by a brief attachment to a single-ended bus, but its voltage levels could damage the other devices on the bus.

3.4.5 Ensuring Proper Termination

All SCSI buses must be properly terminated at each end. But because the SCSI Differential Converter 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 Converter 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 Converter. Figure 3-2 on the next page 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 Converter.

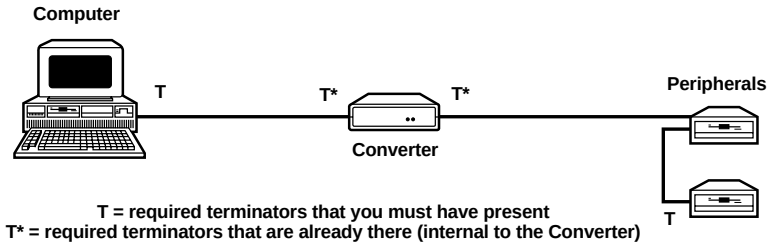

Figure 3-1. Termination in a SCSI Differential Converter system.

Your SCSI Differential Converter comes standard with internal terminators that provide the necessary termination on each side of the Converter. However, your application or peripherals might require that you use external terminators with the Converter, in which case you should already have removed or replaced the internal terminators; if you haven't yet, see Section 3.2 and Appendix C. (The Converter contains an internal resettable fuse that can provide power—1 amp at 5 volts—to an external terminator. Note that the Converter contains internal protection and will not be affected if other SCSI devices provide terminator power.)

3.4.6 Powering Up the System

You may now plug in the SCSI Differential Converter and turn it ON by moving the Power switch on its rear panel to the "I" position. Check the POWER LED on the Converter's front panel; if it's lit, the Converter should be powered up and ready to go.

Now power up any SCSI peripherals on the bus, and lastly power up any host computers on the bus. This completes the installation of your SCSI Differential Converter; your "hybrid" single-ended/differential SCSI system should be ready for continuous operation.

4. Operation

4.1 The Front Panel and Its LEDs

Each SCSI Differential Converter has two LEDs on its front panel, shown in Figure 4-1 below, that give you at-a-glance status information about the unit's operation:

Power—Lights when the unit is plugged in, turned ON, and receiving AC power.

Bus Active—Dark when there is no communication on the SCSI bus; flickers (in response to the SCSI interface's BUSY signal) when devices are communicating on the bus.

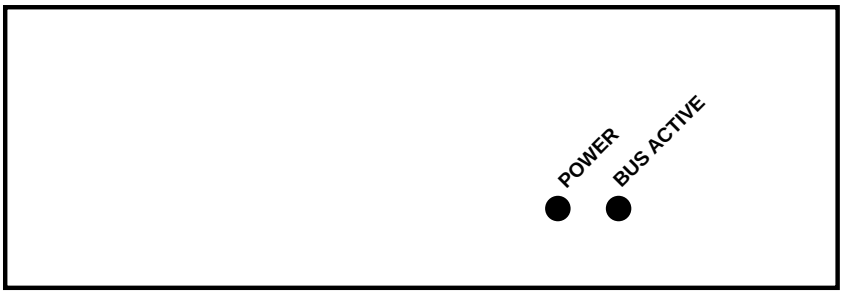

Figure 4-1. The SCSI Differential Converter's front panel.

4.2 System Function and Performance

The SCSI Differential Converter translates single-ended SCSI data and command information into standard differential formats and vice versa. SCSI-bus signals are routed through proprietary switching logic that enables the Converter to appear "transparent" to other devices on the bus.

The Converter will support any combination of asynchronous and synchronous SCSI devices on the bus. Overall system performance will depend on the individual data rate and protocol of each SCSI device, plus the overhead of the host computer.

The Converter does, however, introduce a 15-ns conversion delay between its single-ended and differential ports. And because the Converter—especially when used in pairs—extends the length of the SCSI bus well beyond its original design specifications, there is also some extra propagation delay. Across a bus 30 m (~100 ft.) long, the total additional delay is approximately 150 ns. This delay might

reduce the data-transfer rates between certain peripheral devices and host adapters, and it increases the time required for Arbitration, Selection, and Reselection.

5. Troubleshooting

5.1 Contacting Black Box

If you determine that your SCSI Differential Converter is malfunctioning, do not attempt to alter or repair the unit. It contains no user-serviceable parts. Call Black Box Technical Support at 724-746-5500.

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 involved in the problem.
- any particular application that, when used, appears to create the problem or make it worse.

5.2 Shipping and Packaging

If you need to transport or ship your SCSI Differential Converter:

- Package it carefully. We recommend that you use the original container.
- If you are shipping the Converter for repair, make sure you include its power cord and its bag of replacement parts. If you are returning the Converter, make sure you include everything you received with it. Before you ship, contact Black Box to get a Return Materials Authorization (RMA) number.

Appendix A: Connector Pinouts

A.1 Single-Ended Narrow SCSI (50-Pin Centronics) Port (IC124A)

The single-ended narrow SCSI port on the IC124A model of the SCSI Differential Converter are pinned as shown in Table A-1 below.

Table A-1. Pinout Chart for Single-Ended Narrow SCSI Connectors

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

A.2 Differential Narrow SCSI (50-Pin High-Density) Port (IC124A)

The differential narrow SCSI ports on the IC124A model of the SCSI Differential Converter are pinned as shown in Table A-2 below.

Table A-2. Pinout Chart for Differential Narrow SCSI Connectors

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

A.3 Low-Voltage Differential (LVD) 16-Bit SCSI Wide (IC152A Models)

The IC125A's single-ended wide SCSI ports are pinned as shown in Table A-3 below.

Table A-3. Pinout Chart for Low-Voltage Differential (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

Table A-3 (continued). Pinout Chart for Low-Voltage Differential (LVD) SCSI Connectors

Signal Name	Pin Number	Signal Name	Pin Number
+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 Differential Wide SCSI (68-Pin High-Density) Ports (IC125A)

The IC125A's differential wide SCSI ports are pinned as shown in Table A-4 below.

Table A-4. Pinout Chart for Differential Wide SCSI Connectors

Signal Name	Pin Number	Signal Name	Pin Number
–DB(12)	35	+DB(12)	1
–DB(13)	36	+DB(13)	2
–DB(14)	37	+DB(14)	3
–DB(15)	38	+DB(15)	4
–DB(P1)	39	+DB(P1)	5
GROUND	40	GROUND	6
–DB(0)	41	+DB(0)	7
–DB(1)	42	+DB(1)	8
–DB(2)	43	+DB(2)	9
–DB(3)	44	+DB(3)	10
–DB(4)	45	+DB(4)	11
–DB(5)	46	+DB(5)	12
–DB(6)	47	+DB(6)	13
–DB(7)	48	+DB(7)	14
–DB(P)	49	+DB(P)	15
GROUND	50	DIFFSENS	16
TERMPWR	51	TERMPWR	17
TERMPWR	52	TERMPWR	18
RESERVED	53	RESERVED	19
–ATN	54	+ATN	20

Table A-4 (continued). Pinout Chart for Differential Wide SCSI Connectors

Signal Name	Pin Number	Signal Name	Pin Number
GROUND	55	GROUND	21
–BSY	56	+BSY	22
–ACK	57	+ACK	23
–RST	58	+RST	24
–MSG	59	+MSG	25
–SEL	60	+SEL	26
–C/D	61	+C/D	27
–REQ	62	+REQ	28
–I/O	63	+I/O	29
GROUND	64	GROUND	30
–DB(8)	65	+DB(8)	31
–DB(9)	66	+DB(9)	32
–DB(10)	67	+DB(10)	33
–DB(11)	68	+DB(11)	34

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-1

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. The Ultra SCSI standard has been split into several subdocuments, including the SCSI Parallel Interface (SPI), which is a hardware specification, and the SCSI Interlocked Protocol (SIP), which is a software-link protocol.

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, or 3 meters at 10 MBps.

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 MBps or greater. 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 termpower, 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 your 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 SCSI-ID numbers may 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, call 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 and on the next page.

BSY (BUSY): A signal that indicates that the bus is being used.

SEL (SELECT): A 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): A signal that indicates the RESET condition.

DB(15 or 7 through 0, plus P) (DATA BUS): Sixteen (for Wide SCSI) or eight (for Narrow 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.

Appendix C. Internal Adjustments

Certain procedures for configuring or reconfiguring the SCSI Differential Converter—specifically, those listed in Section 3.2 of the manual text and described in Sections C.2 through C.6 of this appendix—require you to open the unit's chassis and set, remove, or replace some of its internal components. Begin by following the directions for opening the Converter in Section C.1.

C.1 Opening the Converter

To open the SCSI Differential Converter, take these steps:

1. *If the Converter you want to open is already installed and operating in your system:* Make sure that no one is transmitting data on the SCSI bus. We recommend that you also shut down all host computers on the SCSI bus to avoid confusing them.

2. Make sure that the SCSI Differential Converter is turned OFF, unplugged, and disconnected from its power supply and from the rest of the SCSI bus.

3. Examine the bottom of the Converter. Use a Phillips screwdriver to unscrew the four screws—one in the center of each of the unit's legs, as shown in Figure 3-1 on the next page—until they're loose, then remove and set aside the legs.

CAUTION!

Make sure that the SCSI Differential Converter is powered OFF and unplugged before you open it.

4. Gently separate the two halves of the unit and examine the Converter's circuit board; compare it to the illustration in Figure 3-2 to find any components you need to set, remove, or replace.

Refer to Sections C.2 through C.6 for how to make various adjustments to the Converter's components. When you're finished, see Section C.7 for how to put the Converter back together.

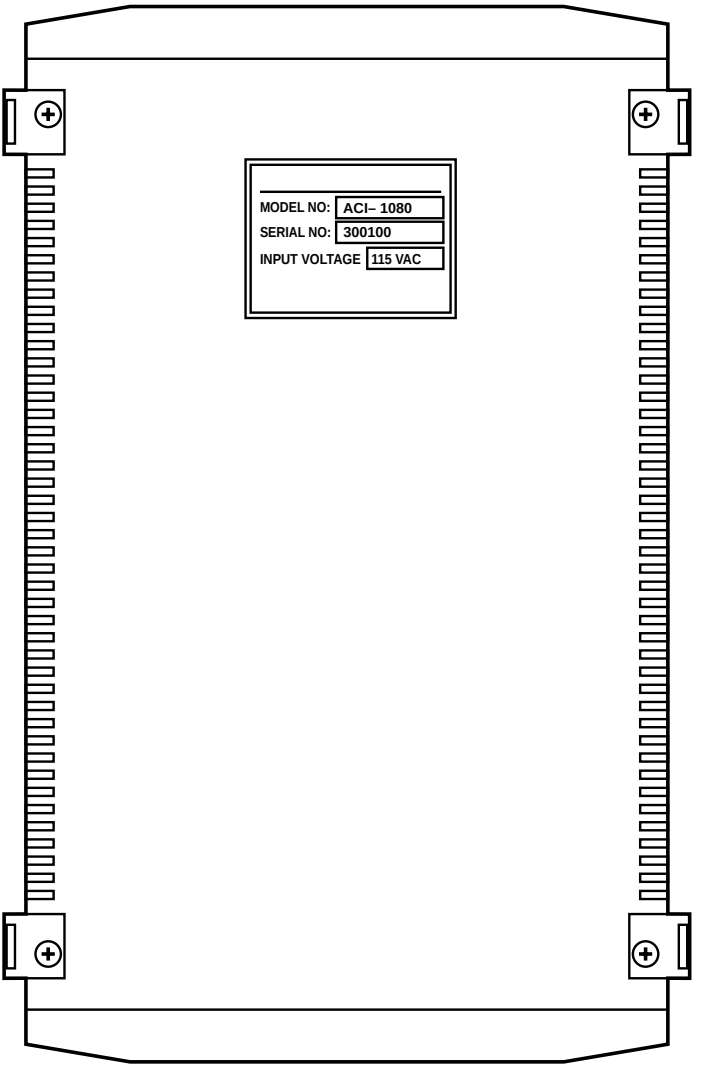

Figure C-1. Locations of the screws that must be removed.

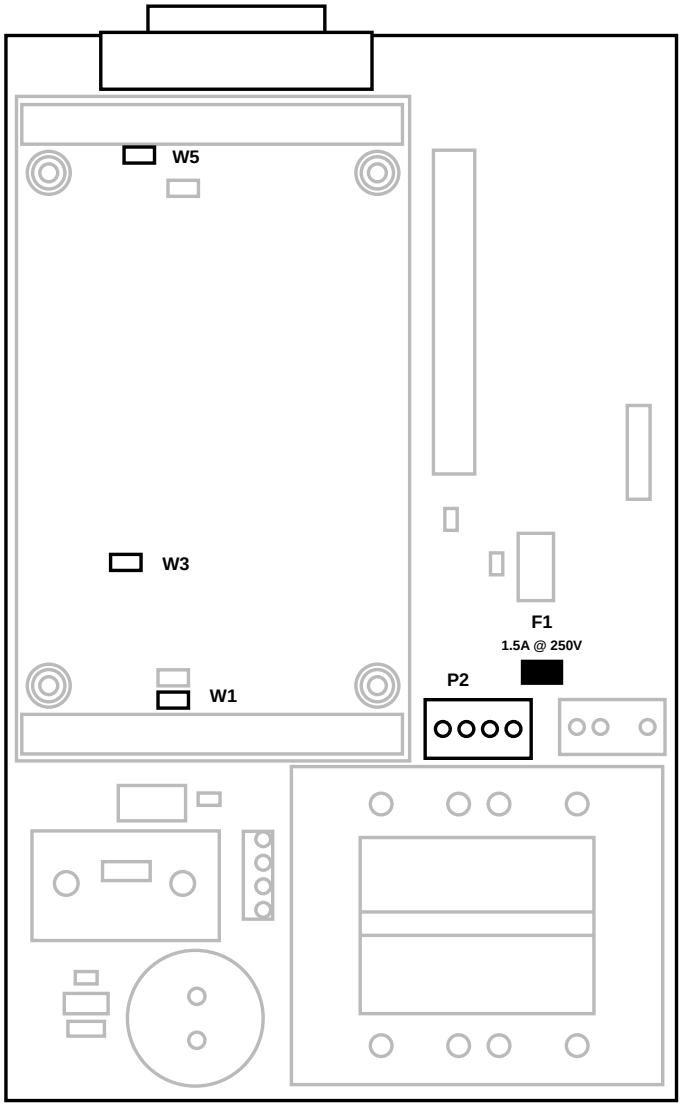

Figure C-2. The circuit board of a "narrow" Converter (IC124A).

C.2 Setting the Converter for 220-VAC Input Power

Find the four jumper posts at location P2. The SCSI Differential Converter is shipped from the factory with one jumper on the two left-hand-posts and another on the two right-hand posts. While the Converter is jumpered this way, it expects to receive 115-VAC input power.

To set the Converter for 220-VAC input power, remove both jumpers and reinstall one of them on the center two posts. (You can either discard the other jumper or leave it one end of it "hanging" on one of the two end posts.)

C.3 Setting the Single-Ended Port for External Termination

Find the two jumper posts at location W3 and the two posts at location W1. The SCSI Differential Converter is shipped from the factory with a jumper installed across the posts at W3 but no jumper on the posts at W1. While the Converter is jumpered this way, the internal terminator on its single-ended port will be active.

To disable the single-ended port's internal terminator so that you can install an external terminator on that port, remove jumper W3. Then, to set the Converter to provide TERMPWR on the single-ended port for use by the external terminator, install the jumper you just removed across the posts at W1.

C.4 Setting the Differential Port for External Termination

Find the two jumper posts at location W5. The SCSI Differential Converter is shipped from the factory with no jumper on these posts, and with a bank of eight terminator networks behind its differential port. While W5 is empty and the eight networks are in place, the internal terminator on the Converter's differential port will be active.

To disable the differential port's internal terminator so that you can install an external terminator on that port, remove all eight of the terminator networks, using a chip extractor, tweezers, or a pair of angled needle-nosed pliers to gently slide them out of their moorings. Then, to set the Converter to provide TERMPWR on the differential port for use by the external terminator, install a standard jumper across the posts at W5.

C.5 Replacing Internal Terminators

If a surge or other electrical problem damages any of the SCSI Differential Converter's internal terminators, you might need to replace them; call Black Box Technical Support for replacements.

Once you receive these, use a chip extractor, tweezers, or a pair of angled needle-nosed pliers to gently slide the damaged terminators out of their moorings and slide the new ones in.

C.6 Removing or Replacing Fuses

If a surge or other electrical problem damages either of the SCSI Differential Converter's internal fuses, you might need to replace them; the Converter is shipped with one replacement for each.

To remove or replace the Converter's input-power fuse, use a chip extractor, tweezers, or a pair of angled needle-nosed pliers to gently slide the old fuse out of its moorings and slide the new one in.

The Converter's original terminator fuse is large and resettable: It functions much like a thermostat, and if it opens (blows), turning the Converter OFF and back ON again will close (reset) it. Normally you would not ever need to replace this, but if for whatever reason you should have to, we have provided a replacement. (Note that the substitute fuse is smaller and cannot be reset; if it ever blows, it in turn must be replaced.) Removing and replacing the terminator fuse requires further disassembly of the Converter and some soldering, and should only be attempted by a trained professional; call Black Box for technical support.

If you need to replace either of these parts for a second or subsequent time, call Black Box for technical support.

C.7 Closing the Converter

Once you've finished making your adjustments, close up the Converter. Put the two halves of the Converter back together, put the unit's legs back on, and screw the four leg-center screws back in. If you took the Converter out of service to make the adjustments, reconnect the Converter to the SCSI bus and to its power supply, then plug the Converter back in and turn them ON. Lastly, if you turned OFF any host computers in Step 1 of Section C.1, turn them back ON.