



INDUSTRIAL COMPUTER SOURCE®

**Model SCSI Solid State
Disk Drives
Product Manual**

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INDUSTRIAL COMPUTER SOURCE®

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FORWARD

This product manual provides information to install, operate and or program the referenced product(s) manufactured or distributed by Industrial Computer Source. The following pages contain information regarding the warranty and repair policies.

Technical assistance is available at: **1-800-480-0044**.

Manual Errors, Omissions and Bugs: A "Bug Sheet" is included as the last page of this manual. Please use the "Bug Sheet" if you experience any problems with the manual that requires correction.

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Guarantee

A thirty day money-back guarantee is provided on all **standard** products sold. **Special order products** are covered by our Limited Warranty, *however they may not be returned for refund or credit. EPROMs, RAM, Flash EPROMs or other forms of solid electronic media are not returnable for credit - but for replacement only. Extended Warranty available. Consult factory.*

Refunds

In order to receive refund on a product purchase price, the product must not have been damaged by the customer or by the common carrier chosen by the customer to return the goods, and the product must be returned complete (meaning all manuals, software, cables, etc.) within 30 days of receipt and in as-new and resalable condition. The **Return Procedure** must be followed to assure prompt refund.

Restocking Charges

Product returned *after* 30 days, and *before* 90 days, of the purchase will be subject to a **minimum** 20% restocking charge and any charges for damaged or missing parts.

Products not returned within 90 days of purchase, or products which are not in as-new and resaleable condition, are not eligible for credit return and will be returned to the customer.

Limited Warranty

One year limited warranty on all products sold with the exception of the "Performance Series" I/O products, which are warranted to the original purchaser, for as long as they own the product, subject to all other conditions below, including those regarding neglect, misuse and acts of God. Within one year of purchase, Industrial Computer Source will repair or replace, at our option, any defective product. At any time after one year, we will repair or replace, at our option, any defective "Performance Series" I/O product sold. This does not include products damaged in shipment, or damaged through customer neglect or misuse. Industrial Computer Source will service the warranty for all standard catalog products for the first year from the date of shipment. After the first year, for products not manufactured by Industrial Computer Source, the remainder of the manufacturer's warranty, if any, will be serviced by the manufacturer directly.

The **Return Procedure** must be followed to assure repair or replacement. Industrial Computer Source will normally return your replacement or repaired item via UPS Blue. *Overnight delivery or delivery via other carriers is available at additional charge.*

The limited warranty is void if the product has been subjected to alteration, neglect, misuse, or abuse; if any repairs have been attempted by anyone other than Industrial Computer Source or its authorized agent; or if the failure is caused by accident, acts of God, or other causes beyond the control of Industrial Computer Source or the manufacturer. Neglect, misuse, and abuse shall include any installation, operation, or maintenance of the product other than in accordance with the owners' manual.

No agent, dealer, distributor, service company, or other party is authorized to change, modify, or extend the terms of this Limited Warranty in any manner whatsoever. Industrial Computer Source reserves the right to make changes or improvements in any product without incurring any obligation to similarly alter products previously purchased.



Shipments not in compliance with this Guarantee and Limited Warranty Return Policy will not be accepted by Industrial Computer Source.

Return Procedure

For any Limited Warranty or Guarantee return, please contact Industrial Computer Source's Customer Service at **1-800-480-0044** and obtain a Return Material Authorization (RMA) Number. All product(s) returned to Industrial Computer Source for service or credit **must** be accompanied by a Return Material Authorization (RMA) Number. Freight on all returned items **must** be prepaid by the customer who is responsible for any loss or damage caused by common carrier in transit. Returns for Warranty **must** include a Failure Report for each unit, by serial number(s), as well as a copy of the original invoice showing date of purchase.

To reduce risk of damage, returns of product must be in an Industrial Computer Source shipping container. If the original container has been lost or damaged, new shipping containers may be obtained from Industrial Computer Source Customer Service at a nominal cost.

Limitation of Liability

In no event shall Industrial Computer Source be liable for any defect in hardware or software or loss or inadequacy of data of any kind, or for any direct, indirect, incidental, or consequential damages in connection with or arising out of the performance or use of any product furnished hereunder. Industrial Computer Source liability shall in no event exceed the purchase price of the product purchased hereunder. The foregoing limitation of liability shall be equally applicable to any service provided by Industrial Computer Source or its authorized agent.

Some *Sales Items* and *Customized Systems* are **not** subject to the guarantee and limited warranty. However in these instances, any deviations will be disclosed prior to sales and noted in the original invoice. ***Industrial Computer Source reserves the right to refuse returns or credits on software or special order items.***

Table of Contents

FORWARD	iii
Guarantee	v
Limited Warranty	v
Return Procedure	vi
Limitation of Liability	vi
Chapter 1: Introduction	1
Scope	1
Features	1
Model Numbers	1
Chapter 2: Specifications	2
Chapter 3: Installation	5
Inspection	5
Connector Requirements	5
Termination Requirements	5
(220/330 Ohms)	5
SCSI Bus ID	6
Parity Check	6
Terminator Power	7
Terminators	7
Drive Mounting	7
CMOS Configuration	8
Drive Preparation	8
Chapter 4: Operation	9
Data Reliability	9
Chapter 5: SCSI Commands and Status	10
Industrial Computer Source Implementation	10
SCSI Message Support	11
SCSI Command Support	12
SCSI Status & Error Codes	13
Appendix A: Command Options	15

List of Figures

Figure 1. SCSI-SSI Dimensions	3
Figure 2: Jumper Configuration	5
Figure 3: Jumper Settings.....	6

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Chapter 1: Introduction

Scope

This manual describes the specifications and installation of the Industrial Computer Source Solid State SCSI drives, both fixed and removable.

Features

Industrial Computer Source's Solid-State Drive has been specifically designed to replace hard disk drives in rugged and environmentally demanding applications. The unit is packaged in a sturdy 3.5" form factor suitable for use in hostile environments, such as portable industrial or military computers, factory floor computers, or mobile land, sea or air applications.

- Ruggedized for harsh environment use
- High reliability, solid state design, no moving parts
- SCSI I & SCSI II compatible
- Fast Access times
- Low power consumption
- Noiseless operation
- MTBF > 100,000 hours
- Unique FLASH memory with 512 byte erase/write sectors
- Built-in error detection and correction

Model Numbers

Model	Description	Capacity (Bytes / Blocks)	
SCSI04SSI	Fixed SCSI Drive, 4 MBytes		
SCSI10SSI	Fixed SCSI Drive, 10 MBytes	10,485,760	20,480
SCSI20SSI	Fixed SCSI Drive, 20 MBytes	20,971,520	40,960
SCSI40SSI	Fixed SCSI Drive, 40 MBytes	41,943,040	81,920
SCSI80SSI	Fixed SCSI Drive, 80 MBytes	83,886,080	163,840
SCSI160SSI	Fixed SCSI Drive, 160 MBytes	167,772,160	327,680

Chapter 2: Specifications

Data Transfer Rate

1.2 MBytes/sec (burst)
800 KBytes/sec (typical-reading)
140 KBytes/sec (typical-writing)

Interface

SCSI I & SCSI II
- Single Ended, Asynchronous
- Direct Access Target Device

Seek Time

< 2 msec (typical)

Data Transfer Latency

< 4 msec (typical)

Power Requirements

+5Vdc $\pm 5\%$ 0.6 A max
+12Vdc $\pm 5\%$ 0.3 A max @ -40°C

Overall Dimensions

4.00"W x 1.63"H x 5.75"D see Figure 1

Weight

800 grams (max)

Operating Temperature

-20°C to +71°C

Storage Temperature

-40°C to +85°C

Humidity

5 to 95 % Non-condensing

Shock

40 g Operating, 9 msec, ½ sine

Vibration

PSD 0.04g²/Hz, MIL-STD-810-E

Altitude

50,000 feet

Climate

Salt Atmosphere, Fungus, Sand and Dust Resistant

Reliability

MTBF	> 100,000 hours
Data Reliability	< 1 non-recoverable error in 10 ¹³ bits read
Endurance	> 100,000 cycles
Maintenance	none required

Connectors

SCSI	50 pin IDC
Power	4 pin mini
Pin Assignment	see Table 1a

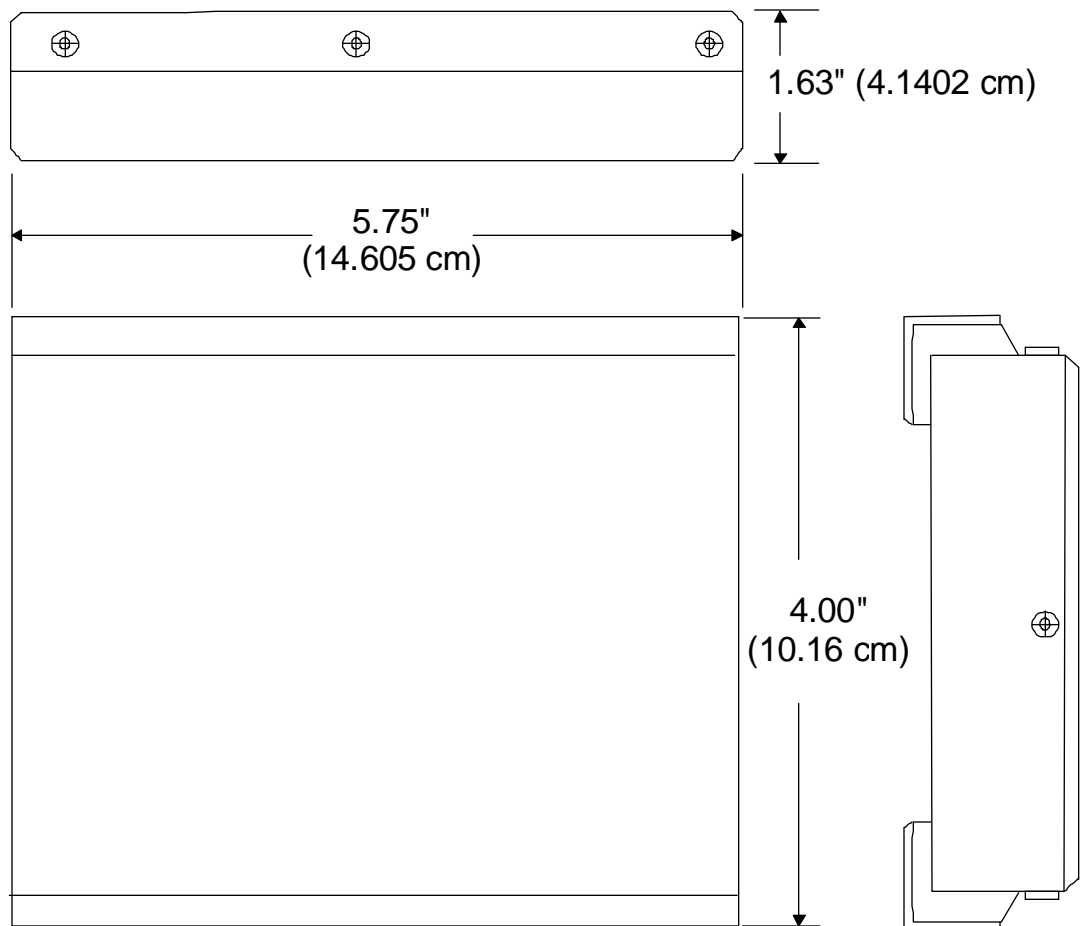


Figure 1. SCSI-SSI Dimensions

SCSI Pin Number	Pin Assignment	Power Pin Number	Pin Assignment
2	-DB0	1	+5 V
4	-DB1	2	+5 Return
6	-DB2	3	+12 Return
8	-DB3	4	+12 V
10	-DB4		
12	-DB5		
14	-DB6		
16	-DB7		
18	-DBP		
20	Ground		
22	Ground		
24	Ground		
26	TERMPWR		
28	Ground		
30	Ground		
32	-ATN		
34	Ground		
36	-BSY		
38	-ACK		
40	-RST		
42	-MSG		
44	-SEL		
46	-C/D		
48	-REQ		
50	-I/O		
25	n/c		
odd pins	Ground		

Chapter 3: Installation

Inspection

All Industrial Computer Source products are carefully inspected and tested before shipping. Inspect the packaging for any evidence of physical damage which may have occurred in transit. Examine the drive, accessories and documentation. If any item is missing or damaged, contact Industrial Computer Source.

Connector Requirements

Industrial Computer Source SCSI Drives are available in three connector models, and have the following connector requirements.

- C = 1 This model uses a Low Density, 50 pin Header and a mini 4 pin power connector. A power adapter cable is provided with the drive. Most applications use a flat ribbon cable with a 50 pin IDC connector.

Termination Requirements

The SCSI bus can be daisy chained to other SCSI devices using a common cable with a maximum of 8 SCSI devices (including the host). The SCSI devices at both ends of the daisy chain must be terminated, with the intermediate devices unterminated.

(220/330 Ohms)

Industrial Computer Source SCSI drives are shipped from the factory with “Passive” terminating resistors. For “Active” termination installation, contact Industrial Computer Source.

If application uses only one drive, leave the terminators installed. If your application uses multiple drives, the terminators should only be installed at the ends of the Bus.

To remove the terminators, remove the unit cover to access the interface board. For the Removable Drive, the interface board must also be removed. The three terminator strips can be removed from their sockets using small pliers.

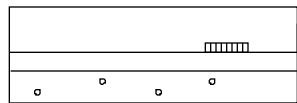


Figure 2: Jumper Configuration

The symptoms of an improperly terminated SCSI Bus may include data transfer errors or the drive held in reset by the RST (reset) signal. If you experience any difficulties, check your termination power. (See also the Terminator Power and Terminator sections later in the chapter).

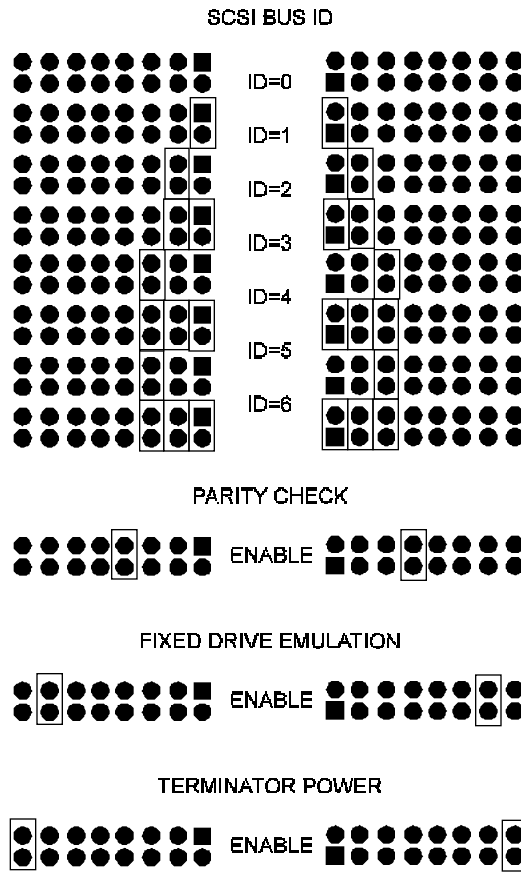


Figure 3: Jumper Settings

SCSI Bus ID

Each device on the SCSI Bus must have a unique SCSI ID. The SCSI Host Adapter typically uses SCSI ID 7. If you are installing only one drive, use SCSI ID 0. If you install a second drive, you can use any SCSI ID (SCSI ID 1 recommended).

Industrial Computer Source SCSI drives are shipped from Industrial Computer Source configured with SCSI ID 0. To change the SCSI ID remove the unit cover to access the configuration jumpers and set the SCSI ID as shown in Figure 3.

Parity Check

Industrial Computer Source SCSI drives are shipped with SCSI Bus Parity Check enabled. To change the Parity Check mode, remove the unit cover to access the configuration jumpers shown in Figure 3.

- Install the jumper shunt to enable Parity Checking
- Remove the jumper shunt to disable Parity Checking

Terminator Power

Industrial Computer Source SCSI drives are shipped with Terminator Power Disabled. This requires power for the Terminating Resistors must be provided from the SCSI Bus.

To change the source of Terminator Power, remove the unit cover to access the configuration jumpers shown in Figure 3.

Install the jumper shunt to

Remove the jumper shunt if Terminator Power on Bus

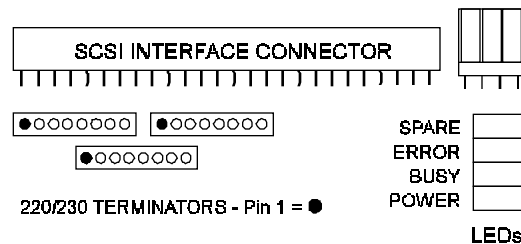
WARNING

The drive must be turned OFF when connecting or removing the SCSI Interface Cable. Failure to do so may blow an internal protective fuse if the drive is providing the SCSI Bus terminator power. To replace the fuse, the drive should be returned to Industrial Computer Source.

Terminators

SCSI drives are shipped with the "Passive" 220/330 Ohms terminating SIP resistor strips (RN1, RN2, RN3) installed and Termination Power provided from the Drive.

If your application uses only one drive, leave the terminators installed. If your application uses multiple drives, the terminators should only be installed at the ends of the SCSI Bus. To remove the terminators, remove the unit cover to access the interface board. For the removable Drive, the interface board must also be removed.



Drive Mounting

The SCSI Fixed Drive complies with the standard 3.5" half height disk drive form factor (Figure 1), and can be mounted in any orientation using the #6-32 mounting holes along the bottom and side of the unit.

CMOS Configuration

The following information applies to AT (286, 386 and 486) systems ONLY.

The AT BIOS uses nonvolatile CMOS RAM to store system date/time, system configuration, system diagnostic, and other information. When using IDE type drives, the Drive Type and Drive Geometry must be specified in the CMOS configuration.

When using SCSI type drives, the SCSI Host Adapter will use its own BIOS. The AT BIOS Drive type must be set to "No Drive Installed".

Refer to your system manual for details on accessing the CMOS Configuration.

Drive Preparation

CAUTION

Formatting a drive will erase existing data.

The Industrial Computer Source Solid-State Drives are low level formatted for 512 bytes per sector.

For AT applications it is necessary to prepare the drive before DOS can use it. If the drive is not prepared, the system may report "Invalid Drive Specification".

The drive must be partitioned, using the DOS fixed disk setup program call **FDISK**. The disk must then be initialized, using the DOS **FORMAT** program. Refer to your DOS documentation for additional instructions and options..

Chapter 4: Operation

Data Reliability

The Industrial Computer Source SCSI solid state drive provides enhanced data reliability via the following mechanisms;

- All FLASH erase/write operations are performed in a closed loop operation to verify data has been erased and programmed correctly with the proper voltage margins.
- Data is checked with a powerful ECC code that offers a high degree of data protection.
- Built in defect management with automatically sector reassignment based on detected memory errors.
- Durability enhanced by logging sector erasures and providing wear levelling feature to evenly distribute memory wear by reassigning high use sectors to low usage portions of memory. Wear level is executed upon receipt of the “Send Diagnostics” command.

Chapter 5: SCSI Commands and Status

The following information has been prepared based on the ANSI SCSI Standards X3.131-1986 and X3.131-1991 and the key legend indicators are:

- M Implementation is mandatory
- O Implementation is optional
- R Reserved
- V Implementation is vendor unique

The following sections provide an overview of the SCSI protocol implemented by Industrial Computer Source's SCSI drives. For detailed information, the SCSI standard can be obtained from:

Global Engineering Documents, Inc.
2805 McGraw Avenue
Irvine, CA 92714
(800) 854-7179 or (714) 261-1455

Industrial Computer Source Implementation

The Fixed SCSI drive conforms to the SCSI Direct-Access device model.

The Removable SCSI drive conforms to the SCSI Direct-Access, Removable device model. A jumper option is provided to override the Removable Media indicator in the INQUIRY and MODE SENSE commands.

The FLASH media has been implemented as a Direct-Access device, but includes additional features that are applicable to an Erasable Optical device - see Appendix A. These features are not required for normal drive operation, but are available for special applications.

SCSI Message Support

The SCSI message systems supports communication between the initiator and target for the purposes of physical path management. The messages supported by the Industrial Computer Source SCSI Drives are indicated () below; unsupported messages are answered with “Message Reject”.

MESSAGES	ICS	SCSI-I	SCSI-II	In/Out
00 CMD COMPLETE	+	M	M	In
01 EXENDED MSG	+	O	O	In/Out
02 SAVE DATA PTRS	-	O	O	In
03 RESTORE POINTERS	-	O	O	In
04 DISCONNECT	-	O	O	In/Out
05 INIT DETECT ERROR	+	O	M	Out
06 ABORT	+	O	M	Out
07 MESSAGE REJECT	+	O	M	In/Out
08 NO OPERATION	+	O	M	Out
09 MSG PARITY	+	O	M	Out
0A LINKED CMD DONE	-	O	O	In
0B LINKED CMD DONE	-	O	O	In
0C BUS DEVICE RESET	+	O	M	Out
0DABORT TAG	-	R	O	Out
0E CLEAR QUEUE	-	R	O	Out
0F INITIATE RECOVERY	-	R	O	Out
10 RELEASE RECOVERY	-	R	O	Out
11 TERMINATE I/O	-	R	O	Out
20 SIMPLE QUE TAG	-	R	O	In/Out
21 HEAD OF QUE TAG	-	R	O	Out
22 ORDERED QUE TAG	-	R	O	Out
23 IGNORE RESIDUE	-	R	O	In
8X IDENTIFY	+	O	M	In/Out

In Drive to Initiator

Out Initiator to Drive

SCSI Command Support

The SCSI command set supported by the Industrial Computer Source SCSI Drives is as indicated (+) below;

Command Group 0 (6 byte)	SCSI-SB	SCSI-I	SCSI-II
00 Test Unit Ready	+	O	M
01 Rezero Unit	+	O	O
03 Request Sense	+	M	M
04 Format Unit (Note 1)	+	M	M
07 Reassign Blocks	—	O	O
08 Read	+	M	O
0A Write	+	M	O
0B Seek	+	O	O
12 Inquiry	+	M	M
15 Mode Select	+	O	O
16 Reserve	+	O	M
17 Release	+	O	M
18 Copy	—	O	O
1A Mode Sense	+	O	O
1B Start/Stop Unit	+	O	O
1C Receive Diagnostic	—	O	O
1D Send Diagnostic	+	O	M
1E Prevent/Allow Removal	—	O	O

Note 1: Format command can take extended periods of time to execute, ie: 10-20 minutes.

Note 2: Send Diagnostics may take up to 120 seconds to execute, dependent on drive storage capacity as the Industrial Computer Source SCSI drive will execute a wear level utility after successfully completing self diagnostics.

Commands. Group 1 (10 bytes)	SCSI-SB	SCSI-I	SCSI-II
25 Read Capacity	+	O	M
28 Extended Read	+	O	M
29 Read Generation	—	V	V
2A Extended Write (Note 3)	+	O	M
2B Extended Seek	+	O	O
2C Erase (Note 3)	+	V	V
2D Read Update Block	—	V	V
2E Write & Verify (Note 3)	+	O	O
2F Verify (Note 3)	+	O	O
37 Read Defect Data	+	0	0
38 Medium Scan (Note 3)	+	O	O

Note 3: These commands include features that are defined for Erasable Optical Media that are well suited to supporting FLASH memory technology. Please refer to Appendix A for the list of command options.

SCSI Status & Error Codes

Upon the completion of a command, the Industrial Computer Source SCSI Drives will return a single Status Code byte, followed by a “Command Complete” Message.

Code	Status Code	Description
00	Good	Command was successful
02	Check Condition	Command encountered an error. Issue Request Sense Command to determine cause of error
04	Condition Met	Scan Operation successful
18	Reservation Conflict	Command not executed. Drive is reserved for use by another initiator

In response to the “Request Sense” command the Industrial Computer Source SCSI drive will return the following Sense Key and Sense Codes, where;

Sense Key: Indicates general error categories.
Sense Codes: Provides additional clarification of errors.

Code	Sense Key	Description
00	No Sense	Command was successful
01	Recovered Error	Command complete but recovery action performed
02	Not Ready	Drive cannot be accessed
03	Medium Error	Command terminated with a non-recoverable error
04	Hardware Error	Non-recoverable error detected during a command or self test
05	Illegal Request	Illegal parameter in Command Description Block
06	Unit Attention	Drive has been reset
07	Data Protected	Attempt to Read or Write to a protected region
0B	Aborted Command	Command aborted by the drive
0C	Equal	Command satisfied comparison
0E	Miscompare	Data Compare error detected

Error Code	Associated Sense Key	Description
00	No Sense	No additional info
03	Hardware Error	Write Fault
04	Not Ready	Drive not ready
10	Medium Error	ECC Error
11	Medium Error	Unrecovered Read Error
14	Medium Error	Record ID not found
17	Recovered	Read recovered with retries
18	Recovered	Read recovered with ECC
1F	Hardware Error	Transfer error to medium
20	Illegal Request	Invalid Cmd OP Code
21	Illegal Request	Illegal Logical Blk Address
22	Illegal Request	Illegal function
24	Illegal Request	Illegal data in CDB
25	Illegal Request	Invalid LUN
26	Illegal Request	Invalid field in Param. list
29	Unit Attention	Power On, Reset or Bus Reset
30	Medium Error	Incompatible medium
39	Illegal Request	Save Parameters not supported
3A	Medium Error	Medium not present
40	Hardware Error	RAM Failure
42	Hardware Error	Power On Diagnostic failure
43	Aborted Command	Message rejected
44	Hardware Error	Internal controlled error
47	Hardware Error	SCSI Bus Parity error
48	Aborted Command	Initiator detected error
49	Aborted Command	Inappropriate/Illegal Message

Appendix A: Command Options

For advanced applications, the Industrial Computer Source SCSI drive provides special command options that the programmer may include in his low level drivers.

Command	CDB - Byte 1	Description
2A Extended Write	0 0 0 0 0 E 0 0	E - Erase Bypass 0 - Normal write operation 1 - Bypass erase operation prior to writing data Sectors must be pre-erased before issuing this option
2C Erase	0 0 0 0 0 E 0 0	E - Erase All 0 - Erase specific area 1 - Erase to end of media (xfer length = 0)
2E Write & Verify	0 0 0 0 0 E B 0	E - Erase Bypass 0 - Normal write operation 1 - Bypass erase operation prior to writing data Sectors must be pre-erased before issuing this option B - Medium Verification 0 - No data comparison 1 - Byte by Byte compare
2F Verify	0 0 0 0 0 E B 0	E - Erase/Blank Verification B - Medium Verification EB 00 - No data comparison 01 - Byte by Byte compare 10 - Blank verification 11 - Invalid
38 Medium Scan	0 0 0 W 0 D 0 0	W - Written Block Search 0 - Scan for blank 1 - Scan for written D - Scan Direction 0 - Forward scan 1 - Reverse scan

Note: For a detailed description of the commands and options, please refer to the ANSI SCSI Specification.

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BUG REPORT

While we have tried to assure this manual is error free, it is a fact of life that works of man have errors. We request you to detail any errors you find on this BUG REPORT and return it to us. We will correct the errors/problems and send you a new manual as soon as available. Please return to:



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Product: **SCSI Solid State Disk Drives**

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