Single Connector Attachment for Small SCSI Disk Drives

Revision 1.0

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Publication History

Revision Number	Description	Date
1.0	Initial Publication of Document	11/9/92

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Foreword

Sun Microsystems, Seagate Technology, and Conner Peripherals have created a design for a single connector SCSI drive suitable for direct attachment to backplanes and motherboards. All three companies feel that the technology, while not suitable for all SCSI applications, will be useful in a wide variety of SCSI system designs. The first design is intended for 1" high 3.5" disk drives, but the connector has been selected so that the same relative dimensions can be applied to 1.6" high 3.5" disk drives and to 2.5" disk drives. The single connector carries all the required SCSI signals as well as the necessary power and subsystem control signals.

Sun Microsystems, Seagate Technology, and Conner Peripherals expect that this design will prove useful to the disk drive and computer system industries and will make the design available to interested companies.

Single Connector Attachment for SCSI Disk Drives

1 Scope

This document defines a Single Connector Attachment (SCA) system designed for 8-bit and 16-bit SCSI devices. The single connector carries all standard SCSI signals as defined by the SCSI-3 Parallel Interface proposed standard. In addition, all required power and auxiliary signals are carried by the same single connector. The SCA mechanical definition allows the device to be plugged into a board socket. The dimensions are provided for 1" high 3.5" disk devices, but the same connector structure is appropriate for 1.6" high 3.5" devices as well as 2.5" devices.

2 Applicable Documents

SCSI-3 Parallel Interface (SPI), August 26, 1992, document X3T9.2/91-010 Revision 7

Small Computer System Interface 2 (SCSI-2), October 17, 1991, document X3T9/89-042 or X3T9.2/86-109, Revision 10H

3 Introduction

The Single Connector Attachment (SCA) system includes signals for a complete 8-bit or 16-bit single-ended SCSI. In addition, +5 V and +12 V power, spindle synch, I/D select, motor start control, and an LED drive signal are included in the connector definition. The SCA connector is designed and placed to allow plugging a drive directly into a backplane. The SCA connector provides the necessary electrical connection, but mechanical stability and device retention must be provided by other mechanisms, including mounting brackets, guide rails, clips, or screw attachments.

The connector selected for the SCA is the 80 position ribbon (ribbon, leaf, or single beam) connector made by AMP®, and sold as the Champ 0.050" Series 1. Various connector options are available to meet the different mounting requirements of the connector to the SCSI device and the different drive plugging requirements. Other connector manufacturers have compatible connector designs.

The SCA connector will allow drive-to-board mating.

Since power and address information are provided to the drives through the connector, special cables must be provided if daisy-chaining of drives is required.

The SCA is designed principally for the direct plugging of drives into a backplane. Even though a hot plugging capability is being investigated, it is still recommended that power be removed before removing or inserting a drive.

4 Connector Definition

The drive connector is a right angle or straddle mount plug, part number AMP Champ 557613-1 or AMP Champ 557114-5. The connector to which the drive plug mates is the AMP Champ 2-557103-1 vertical receptacle or the AMP Champ 2-557101-1 right angle receptacle.

The connector technology meets the following requirements:

- 80 signal contacts to provide power and all interface and control signals
- small connector to fit in the form factor of:
  a) 1" high 3.5" disk drives

b) 1.6" high 3.5" disk drives
c) 2.5" disk drives

- Right angle or straddle mount device connector to allow flexibility in drive design
- Vertical or right angle board mount receptacle to allow flexibility in mating drive to backplane
- Shrouded contacts for mechanical protection of mating surfaces
- Polarized housing to prevent incorrect insertion of drive into backplane sockets
- Tolerant alignment guide-in to allow blind mating
- Greater than 500 mating cycles
- Acceptable insertion and withdrawal forces (90 and 20 grams/contact)
- Electrical properties suitable for the application

5 Location Within Drive

The SCA connector is fixed in two dimensions with respect to the drive form factor. The connector is flush with the end of the drive in the Y dimension (see Figure 1) and centered side to side in the end of the drive in the X dimension. In the Z dimension, a small amount of variation among drive vendors or models is allowed. Among drives of the same model, a very tight tolerance in the third dimension is still required to allow the design of drive mounting guides and brackets that will properly guide the connector to the board socket. See Note 2 of Figure 2. The slight variation in connector location requires the space reserved for the drive on systems that accept multiple models of drive to be large enough to accommodate this variation. See Figure 3 for the allowable protrusion zone.

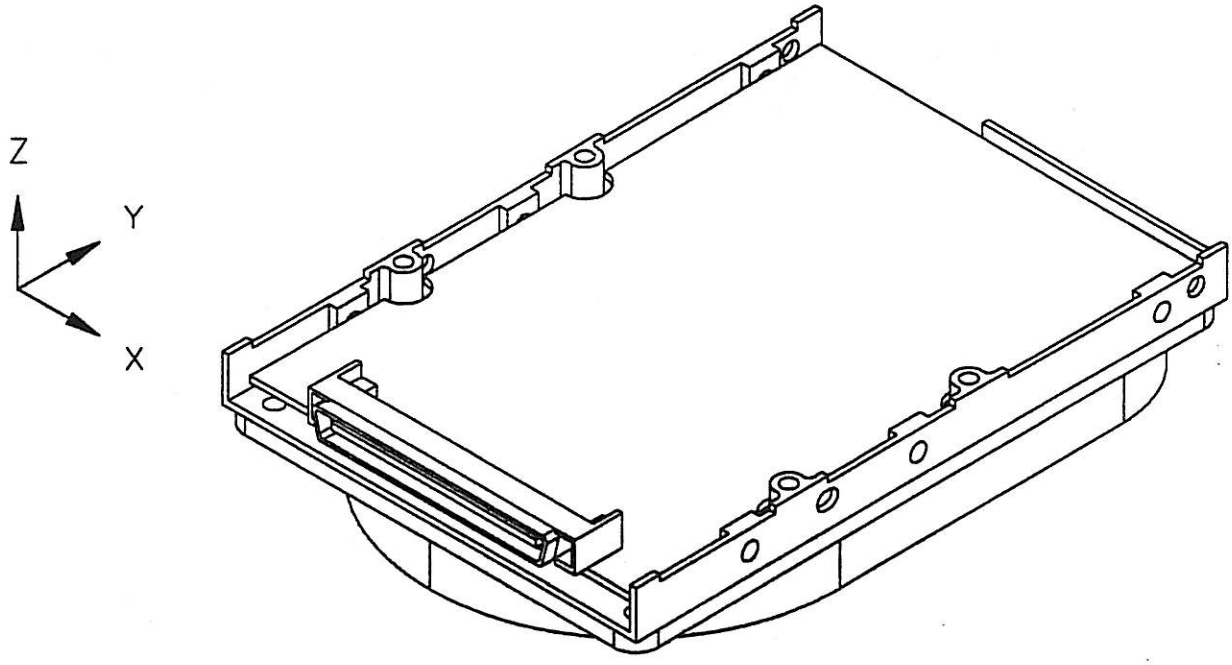
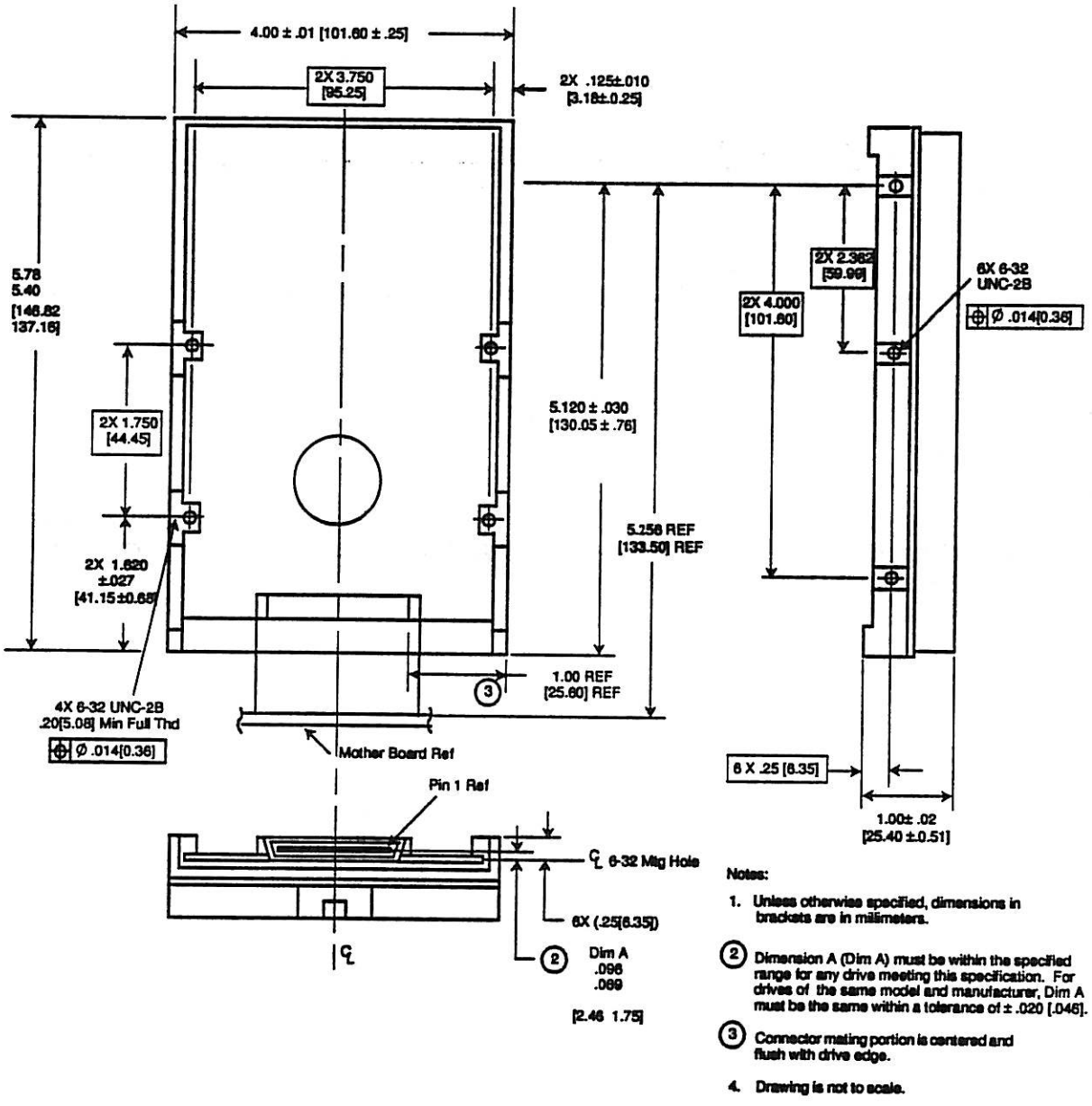


Figure 1: Definition of Dimensions

When the SCA disk drive is mated to a vertical board mount socket, there is 3.45 ± 0.7 mm clearance between the disk drive and the mated backplane. See Note 4, Figure 2.

Figure 2 provides the dimensions and tolerances associated with an SCA drive using a 1" high 3.5" disk drive.



Notes:

1. Unless otherwise specified, dimensions in brackets are in milimeters.
2. Dimension A (Dim A) must be within the specified range for any drive meeting this specification. For drives of the same model and manufacturer, Dim A must be the same within a tolerance of ± .020 [.046].
3. Connector mating portion is centered and flush with drive edge.
4. Drawing is not to scale.

Figure 2, Positioning of Connector

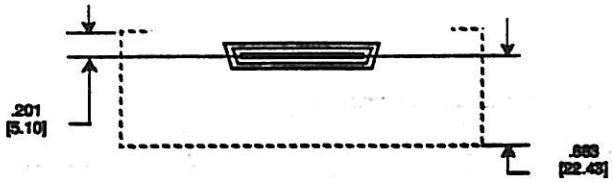


Figure 3, Maximum Possible Protrusion Zone of any Drive with respect to Connector

6 Pinout

The SCA connector pinout accommodates the signals for 8-bit and 16-bit single-ended SCSI, +5 V and +12 V power, spindle synch, SCSI Device I/D Selection, spin-up control, and an LED driver. The pin out is shown in Table 1. Pin 1 is required to be located as shown in Figure 2.

Table 1: Single Connector Pinout

Connector Contact	Signal Name	Signal Name	Connector Contact
1	12 VOLT	12 V GROUND	41
2	12 VOLT	12 V GROUND	42
3	12 VOLT	12 V GROUND	43
4	12 VOLT	12 V GROUND	44
5	RESERVED/NC	RESERVED/NC	45
6	RESERVED/NC	RESERVED/NC	46
7	DB(11)	GROUND	47
8	DB(10)	GROUND	48
9	DB(9)	GROUND	49
10	DB(8)	GROUND	50
11	I/O	GROUND	51
12	REQ	GROUND	52
13	C/D	GROUND	53
14	SEL	GROUND	54
15	MSG	GROUND	55
16	RST	GROUND	56
17	ACK	GROUND	57
18	BSY	GROUND	58
19	ATN	GROUND	59
20	DB(P0)	GROUND	60
21	DB(7)	GROUND	61
22	DB(6)	GROUND	62
23	DB(5)	GROUND	63
24	DB(4)	GROUND	64
25	DB(3)	GROUND	65
26	DB(2)	GROUND	66
27	DB(1)	GROUND	67
28	DB(0)	GROUND	68
29	DB(P1)	GROUND	69
30	DB(15)	GROUND	70
31	DB(14)	GROUND	71
32	DB(13)	GROUND	72
33	DB(12)	GROUND	73
34	5 VOLT	5 V GROUND	74
35	5 VOLT	5 V GROUND	75
36	5 VOLT	5 V GROUND	76
37	SYNC	ACTIVE LED OUT	77
38	RMT_START	DLYD_START	78
39	SCSI ID(0)	SCSI ID (1)	79
40	SCSI ID (2)	SCSI ID (3)	80

6.1 Single Connector Attachment design considerations

No termination power supply lines are included. The SCSI termination circuits are on the platform backplane.

Special cable structures are required if the drives are being connected using cables instead of direct backplane insertion. The cable structures must provide the SCSI Device ID and control information, the power, and the required characteristic impedance and loading for the SCSI signals. Cable structures must be designed with special care to prevent the coupling of power supply noise into the SCSI signals.

The backplane applications will use power planes for power distribution.

6.2 Single Connector Attachment signal definitions:

6.2.1 Power

Four 12 VOLT signals provide +12 volt power to the device. The current return for the +12 volt power supply is through the 12 V GROUND signals. The maximum total current that can be provided to a drive through the 12 VOLT signal pins is 3 amps. The supply current and return current must be distributed as evenly as possible among the pins. The maximum current typically occurs while the drive motor is starting.

Three 5 VOLT signals provide +5 volt power to the device. The current return for the +5 volt power supply is through the 5 V GROUND signals. It is expected that the 5 V GROUND will also establish the digital logic ground for the device. The supply current and return current must be distributed as evenly as possible among the pins. The maximum total current that can be provided to a drive through the 5 VOLT signals is 2 amps.

The maximum current specified is related to the connector's characteristics. Additional limitations may be associated with the power supply's current budgets and with the system's power dissipation budget. Those limitations are not controlled by this specification.

6.2.2 Spindle Sync

The spindle synch is assigned a single pin, SYNC. The synchronization protocol and the electronic requirements for the SYNC signal are defined in the drive specification. Industry standards presently require that the drives interconnected for synchronization be the same or equivalent models. Spindle synchronization is managed by the SCSI command set. The signal current requirements shall not exceed 100 milliamperes and the signal voltage shall not be higher than 5.25 or lower than -0.25 volts. The minimum driver capability required by the SYNC signal shall be sufficient to drive the receivers on 30 identical disk drives.

The SYNC signal when driving should be capable of driving a minimum of 30 identical disk drives.

The SYNC signal is a source for noise and may be affected by noise. The design of the SYNC signal interconnections should take this into account by properly laying out the SYNC signals on the backplane or motherboard. Proper layout must consider routing relative to other signals, the proper line impedance, and terminations if necessary. The selection of the electronic transceiver must also take into account the possibility of noise. The signal levels, signal risetime, receiver thresholds, and receiver hysteresis must be considered as part of that selection.

6.2.3 LED OUT

The ACTIVE LED OUT signal is driven by the drive when the drive is performing a SCSI operation. The ACTIVE LED OUT signal is required to be implemented and is used to indicate that the disk drive is operating. Other optional indications can be provided by properly flashing the LED. The host system is not required to generate any visual output when the ACTIVE LED OUT signal is raised, but if such a visual output is provided, it must be white or green to indicate that normal activity is being performed.

The ACTIVE LED OUT signal is designed to pull down the cathode of an LED. The anode is attached to the proper +5 voltage supply through an appropriate current limiting resistor. The LED and the current limiting resistor are external to the drive.

Table 2: Output Characteristics of LED Driver Signal

STATE	CURRENT DRIVE AVAILABLE	OUTPUT VOLTAGE
DRIVE LED OFF	$0 < I_{OH} < 100\ \mu A$	
DRIVE LED ON	$I_{OL} < -30\ mA$	$0 < V_{OL} < 0.8\ V$

6.2.4 Motor Start Controls

The method of starting the drive's motor is established by the signals RMT_START and DLYD_START, as described in Table 3. The state of these signals can either be wired into the backplane socket or driven by logic on the backplane. The OPEN and GND states are established as described in Table 4.

Table 3:
Definition of Motor Start Controls

Case	DLYD_START	RMT_START	Motor Spin Function
1	OPEN	OPEN	Motor spins up at DC power on.
2	OPEN	GND	Motor spins up only when SCSI "start" command is received.
3	GND	OPEN	Motor spins up after a delay of 12* seconds times the numeric SCSI target ID of the drive from DC power on.
4	GND	GND	Reserved. Drives not implementing this option shall execute power control according to the rules of Case 2.

* This value may be reduced by drive suppliers to reflect the worst case time duration of peak current drains at the 12 volt or 5 volt source (or both) during motor spin up. In no case should the delay exceed 12 seconds.

Table 4: Electronic Requirements for Motor Start Controls

STATE	VOLTAGE	CURRENT
OPEN	$2.4 < V_{IH} < V_{CC}+0.5$	$0 < I_{IH} < \pm 100\ \mu A$
GND	$-0.5\ V < V_{IL} < 0.4\ V$	$0 < I_{OH} < -3\ mA$

6.2.5 SCSI ID selection

The SCSI device address of the attached drive is determined by the state of the signals SCSI ID(0-3). Table 5 indicates the relationship between the level of the SCSI ID signals and the selected SCSI device address. The OPEN and GND states are established as specified in Table 6.

Table 5:
Definition of SCSI Device ID Selection Signals

Address	SCSI ID(0)	SCSI ID(1)	SCSI ID(2)	SCSI ID(3)
0	OPEN	OPEN	OPEN	OPEN
1	GND	OPEN	OPEN	OPEN
2	OPEN	GND	OPEN	OPEN
3	GND	GND	OPEN	OPEN
4	OPEN	OPEN	GND	OPEN
5	GND	OPEN	GND	OPEN
6	OPEN	GND	GND	OPEN
7	GND	GND	GND	OPEN
8*	OPEN	OPEN	OPEN	GND
9*	GND	OPEN	OPEN	GND
10*	OPEN	GND	OPEN	GND
11*	GND	GND	OPEN	GND
12*	OPEN	OPEN	GND	GND
13*	GND	OPEN	GND	GND
14*	OPEN	GND	GND	GND
15*	GND	GND	GND	GND

* Addresses in the range from 8 to 15 are only supported by drives implementing the 16-bit SCSI option.

Table 6: Electronic Requirements for SCSI ID Selection

STATE	VOLTAGE	CURRENT
OPEN	$2.4 < V_{IH} < V_{CC}+0.5$	$0 < I_{IH} < \pm 100\ \mu A$
GND	$-0.5\ V < V_{IL} < 0.4\ V$	$0 < I_{OH} < -3\ mA$

6.2.6 SCSI Signals

The SCSI signals implement a standard SCSI-2 interface. Standard SCSI voltage and current levels are supplied to the drives and expected from the drives. The 8-bit SCSI interface is defined by the SCSI-2 standard. The 16-bit SCSI interface is defined by the SCSI-3 Parallel Interface proposed standard. The SCSI signals defined are for standard single-ended drivers.

The ground leads opposing each SCSI signal are reserved signals. If differential SCSI implementations are ever required, the opposing signal will be used as the differential signal.

6.2.7 Reserved Signals

Reserved signals shall have no electronic connection to the disk drive circuitry or to motherboard circuitry until the use for those signals is defined by this specification.

6.3 SCSI Options

The device shall use the appropriate mandatory commands of the SCSI-2 command set. The support of optional SCSI-2 commands is negotiated between the drive vendor and customer.

The device shall have SCSI parity always enabled.

Support of a SCSI terminator is negotiated between the drive vendor and customer. If implemented on the drive, the terminator shall be a SCSI regulated terminator. The terminator on the drive must be removable or must have a mechanism allowing it to be disabled.

If the drive does not support 16-bit SCSI data transfers, then the signals DB(8) through DB(15) and DB(P1) shall not be electronically connected to the drive circuitry. The motherboard may optionally connect or not connect the high order SCSI signals to its internal SCSI host adapter. If the signals are supported by the motherboard, the signals must follow the standard SCSI rules for routing, characteristic impedance, and termination whether or not the attached drives connect to the signals.

7 Connector and Drive Environment

The drive connector will mate with the AMP Champ 2-557103-1 vertical receptacle or the AMP Champ 2-557101-1 right angle receptacle. The connector has been modified to allow for 0.040" of alignment tolerance along the X and Z axes. The connector will not be required to support the weight of the drive, although some vibration modes may place forces on the connector. Drives will be installed with appropriate brackets that will locate the drive and lock it in place.

8 Connector Properties

The "ribbon" or "leaf" contact connector, AMP Champ 0.050" Series 1, meets the following requirements:

Pin count	80
Contact resistance	35 mΩ maximum
Contact current rating	1 A per isolated contact
Durability	500 mating cycles minimum at maximum allowed misalignment
Insertion force	90 g/contact
Withdraw force	20 g/contact
Insulation resistance	1000 MΩ minimum at 250VDC; 500VDC desired
Dielectric withstanding voltage	500 V AC (rms), one minute
Hot plugging	Under Study
Contact plating	Appropriate to application requirements
Housing material	Appropriate to application requirements
Board retention features	Provided by backplane and associated hardware

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