



Subject: **TLS-4000
 SCSI Connection Guide**

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Introduction

The intent of this document is to help the system architect and/or installer successfully connect a Qualstar tape library system with multiple tape drives to a host computer via the SCSI interface. The SCSI specifications were once simple and had few options or restrictions. There are now many choices and some of those choices incur serious restrictions. Our experience has shown that most problems are caused by excessively long cables in single-ended installations.

Degradation in SCSI bus performance can be total or partial. Total degradation results in a non-functioning system. Partial failure usually results in degraded throughput caused by bus errors that are automatically corrected by retries. Partial degradation can also result in occasional bus lockups which can cause the host application and perhaps even the host computer to crash.

This document will present some of the pertinent SCSI specifications and then list the maximum external cable lengths that can be used in virtually any possible configuration plus some additional tips to optimize the installation.

Present SCSI Technologies Summary

STA Terms	Bus Speed, MBytes/Sec. Max. ^⑦	Bus Width, bits	Max. Bus Lengths, Meters ^{①, ⑧}			Max Device Support
			Single- Ended	LVD	HVD	
SCSI-1 ^②	5	8	6	③	25	8
Fast SCSI ^②	10	8	3	③	25	8
Fast Wide SCSI	20	16	3	③	25	16
Ultra SCSI ^②	20	8	1.5	③	25	8
Ultra SCSI ^②	20	8	3	–	–	4
Wide Ultra SCSI	40	16	–	③	25	16
Wide Ultra SCSI	40	16	1.5	–	–	8
Wide Ultra SCSI	40	16	3	–	–	4
Ultra 2 SCSI ^{②, ④}	40	8	④	12	25	8
Wide Ultra2 SCSI ^④	80	16	④	12	25	16
Ultra3 SCSI or Ultra160 SCSI ^⑥	160	16	④	12	⑤	16
Ultra320 SCSI ^⑥	320	16	④	12	⑤	16

Notes:

- ① The listed maximum bus lengths may be exceeded by Point to-Point and engineered applications.
 - ② Use of the word “Narrow”, preceding SCSI, Ultra SCSI, or Ultra2 SCSI is optional.
 - ③ LVD was not defined in the original SCSI standards for this speed. If all devices on the bus support LVD, then 12-meters operation is possible at this speed. However, if any device on the bus is single-ended only, then the entire bus switched to single-ended mode and the distances in the single-ended column apply.
 - ④ Single-ended is not defined for speeds beyond Ultra.
 - ⑤ HVD (Differential) is not defined for speeds beyond Ultra2.
 - ⑥ After Ultra2 all new speeds are wide only.
 - ⑦ Synchronous Mode –Maximum Data Transfer rate in megabytes per second (2 bytes per wide transfer).
 - ⑧ Determined by ANSI X3.302
- All wide technology requires 68 pin connectors/cables. Narrow may occur on 50 or 68 pin connectors/cables.



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8mm Tape Drive Capabilities

Type	Model Number	SCSI Capabilities	Burst Rate ①	Sustained Rate ①	Remarks
AIT-1 SE	SDX-300C/L	Fast-5, Fast-10	20	3	
AIT-1 DIFF	SDX-310C/L	Fast-5, Fast-10	20	3	
AIT-2 LVD/SE	SDX-500C/L	Fast-5, Fast-10, Fast-20	40	6*	* 4 using AIT-1 tapes
AIT-2 HVD	SDX-510C/L	Fast-5, Fast-10, Fast-20	40	6*	* 4 using AIT-1 tapes
AIT-3 LVD	SDX-700C/L	Fast-5, Fast-10, Fast-20, Fast-40	160	12	

① Synchronous Mode – Maximum Data Transfer rate in megabytes per second in wide mode.

Note: A SCSI connection to a given peripheral may be “throttled down” to a lower burst rate (Fast-5 or Fast-10) on some SCSI Host Adapters.

External Cable Length Limits for LVD and SE

TLS Model	Cabling Configuration	Maximum Permitted External Cable Length			
		LVD Fast-20	SE Fast-5	SE Fast-10 (or Fast-20 with 1 to 4 devices)	SE Fast-20 with 5 to 8 devices
42xx	MC + both drives	10.8 m / 35.4 ft	4.8m / 15.7 ft	1.8 m / 5.9 ft	0.3 m / 1.0 ft
44xx 1 bus of 4 drives	MC + 4 drives + bridge	10.0 m / 33.0 ft	4.0 m / 13.3 ft	1.0 m / 3.5 ft	Unusable
	MC only	11.7 m / 38.4 ft	5.7 m / 18.7 ft	2.7 m / 8.9 ft	1.2 m / 4.0 ft
	All 4 drives	10.5 m / 34.4 ft	4.5 m / 14.7 ft	1.5 m / 4.9 ft	Unusable
44xx 2 buses of 2 drives	MC + 4 drives + bridge	9.7 m / 32.0 ft	3.8 m / 12.4 ft	0.8 m / 2.5 ft	Unusable
	MC + top 2 drives	10.8 m / 35.4 ft	4.8m / 15.7 ft	1.8 m / 5.9 ft	0.3 m / 1.0 ft
	Bottom 2 drives	11.1 m / 36.4 ft	5.1m / 16.7 ft	2.1 m / 6.9 ft	0.6 m / 2.0 ft
46xxx 2 buses of 3 drives	MC + 4 drives + bridge	9.16 m / 30.0 ft	3.2 m / 10.4 ft	Unusable	Unusable
	MC + top 3 drives	10.5 m / 34.4 ft	4.5 m / 14.7 ft	1.5 m / 4.9 ft	Unusable
	Bottom 3 drives	10.8 m / 35.4 ft	4.8m / 15.7 ft	1.8 m / 5.9 ft	0.3 m / 1.0 ft
46xxx 3 buses of 2 drives	MC + 6 drives + 2 bridges	8.7 m / 28.5 ft	2.7 m / 8.8 ft	Unusable	Unusable
	MC + top 2 drives	10.8 m / 35.4 ft	4.8m / 15.7 ft	1.8 m / 5.9 ft	0.3 m / 1.0 ft
	Middle or bottom 2 drives	11.1 m / 36.4 ft	5.1m / 16.7 ft	2.1 m / 6.9 ft	0.6 m / 2.0 ft
412xxx 4 buses of 3 drives	MC + 6 drives + 2 bridges	9.0 m / 29.7 ft	3.0 m / 10.0 ft	Unusable	Unusable
	MC + 3 drives + 1 bridges	10.3 m / 34.0 ft	4.3 m / 14.3 ft	1.3 m / 4.5 ft	Unusable
	MC Only	11.7 m / 38.4 ft	5.7 m / 18.7 ft	2.7 m / 8.9 ft	1.2 m / 4.0 ft
	Top or bottom 3 drives	10.8 m / 35.4 ft	4.8m / 15.7 ft	1.8 m / 5.9 ft	0.3 m / 1.0 ft
412xxx 6 buses of 2 drives	MC + 6 drives + 2 bridges	8.7 m / 28.7 ft	2.7 m / 9.0 ft	Unusable	Unusable
	MC + 2 drives + 1 bridge	10.6 m / 35.0 ft	4.6 m / 15.3 ft	1.6 m / 5.5 ft	Unusable
	MC Only	11.7 m / 38.4 ft	5.7 m / 18.7 ft	2.7 m / 8.9 ft	1.2 m / 4.0 ft
	Any 2 drive group	11.1 m / 36.4 ft	5.1m / 16.7 ft	2.1 m / 6.9 ft	0.6 m / 2.0 ft

Shading indicates a **Not-Recommended** combination.

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TLS Model	Cabling Configuration	HVD Fast-20/10
SCSI Max.		25 meters
42xx	MC & 2 drives	23.3 m / 76.5 ft
44xx	MC + 4 drives + 1 bridges	22.4 m / 73.7 ft
1 bus of	MC only	24.1 m / 79.0 ft
4 drives	All 4 drives	23.5 m / 77.0 ft
44xx	MC + 4 drives + 2 bridges	22.0 m / 72.3 ft
2 busses	MC + top 2 drives + bridge	23.0 m / 75.7 ft
of	MC only	24.1 m / 79.0 ft
2 drives	Top or Bottom 2 drives	24.1 m / 79.0 ft
46xxx	MC + 6 drives + 2 bridges	21.4 m / 70.3 ft
2 busses	MC + top 3 drives + bridge	22.7 m / 74.7 ft
of	MC only	24.1 m / 79.0 ft
3 drives	Top or Bottom 3 drives	23.8 m / 78.0 ft
46xxx	MC + 6 drives + 3 bridges	21.0 m / 69.0 ft
3 busses	MC + top 2 drives + bridge	23.0 m / 75.7 ft
of	MC only	24.1 m / 79.0 ft
2 drives	Any 2 drive group	24.1 m / 79.0 ft
412xxx	MC + 6 drives + 2 bridges	21.4 m / 70.3 ft
4 busses of	MC + 3 drives + 1 bridges	22.7 m / 74.7 ft
3 drives	MC Only	24.1 m / 79.0 ft
	Top or bottom 3 drives	23.8 m / 78.0 ft
412xxx	MC + 6 drives + 2 bridges	21.0 m / 69.0 ft
6 busses of	MC + 2 drives + 1 bridge	23.0 m / 75.7 ft
2 drives	MC Only	24.1 m / 79.0 ft
	Any 2 drive group	24.1 m / 79.0 ft

Installation Tips

1. The higher data rates of AIT-2 tape drives require higher performance cables than AIT-1. See the following section for a sample SCSI Fast-20/40 cable specification.
2. The SCSI Termination Power should be enabled on the tape drive next to a SCSI terminator. This will provide the highest possible termination voltage. Otherwise, it's possible for this voltage to sag significantly due to SCSI cable resistance. Refer to Qualstar's AIT Installation & Operation Manual (P/N 501050) to change the AIT tape drive settings.
3. Older passive single-ended SCSI terminators should not be used in high-performance systems. Qualstar recommends the following terminators:

SCSI Bus Type	QUALSTAR P/N
Low Voltage Differential or Single-Ended – LVD/SE	117-0011-9
High-Voltage Differential – HVD	117-0006-9



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SCSI Fast-20/40 Cable Specification

The SCSI specifications require higher performance cables to facilitate the faster data transfer rates. The following is a brief cable specification for purchasing purposes:

1. The cable is to meet the requirements of American National Standard for SCSI Parallel Interface-2, Document No. X3.302:199X Revision 20B. This document is also known as the Working Draft American National Standard T10 Project 1142D.
2. The cable is a 68-contact alternative 3 shielded mating P cable. The cable is intended for use with FAST 20 and FAST 40 devices.
3. The cable material used shall meet the requirements for differential cables as defined in X3.302. The cable shall be AMP/Madison P/N 1282046-1 or equivalent. This cable material consists of 34 pairs of 30 (7/38) AWG, a differential impedance of 124 ohms and a mutual capacitance of 11 pf/ft. The cable has foil and braid shields and an outer black PVC jacket.
4. The connectors used shall meet the requirements of the 68-contact alternative 3 mating connector (P cable). The cable connectors shall be a molded AMP AMPLIMITE .050 Series Cable Plug Connectors Series III, P/N 750913-7 or equivalent.
5. The cable and connectors shall be wired according to X3.302 Table 8. The following applies:
 - a. The cable conductor pairs #47-48 (+ACK, ACKQ) and #57-58 (+REQ,-REQ) shall be in the cable core.
 - b. If there are more than three conductor pairs in the cable core, conductor pairs #47-48 (+ACK,-ACK) and #57-58 (+REQ,-REQ) shall not be adjacent to each other
 - c. Cable conductor pairs used for the DATA BUS (DBxx) signals, including DB(P) and DB(P1), shall be in the outer layer of the cable.
 - d. The twisted pairs in the cable shall be wired to physically opposing contacts in the connector.
 - e. Twisted pairs shall be used for the + side and the - side of all signals.