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X3T10/9[redacted] SPI-LV
SCSI-3 SPI Low Voltage

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Abstract:
This standard defines the additional requirements for 3.3 Volt applications over the SCSI-3 Parallel Interface (SPI) standard. This is not a standalone document, but an additional requirements document for 3.3 Volt applications, only the differences with SPI are defined in this document.

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1.0 Foreword:

There is a requirement that has developed by the 3,3 Volt Logic, PCI, Laptop and PCMCIA for a low voltage version of SCSI-3 SPI. This effects the TERMPWR voltage, termination and maximum signal voltage, it does not effect the thresholds.

Low Voltage systems must interoperate with standard SCSI buses and devices, it may clamp bus signal maximum to 3,6 Volts. The clamp may be required to protect the 3,3 Volt controller logic.

1.1 Scope:

This document specifies items that are different than SCSI-3 SPI, it is not a complete parallel SCSI definition. Items not define in this document, SCSI-3 SPI rules apply.

2.0 TERMPWR Specification:

The JEDEC Standard for battery systems allows voltages from 3,0 Volts to 3,6 Volts. The very low voltage drop across fusing and unidirectional device shall be less than 0,2 Volts under the specified bus load conditions. The unidirectional device must withstand connection to 5 Volt SCSI devices, this allows SPI-LV products to connect to standard SCSI products. (Products are either targets or initiators.) An example of a Unidirectional device and fusing devices is an integrated electronic circuit breaker that does not have a body diode across the FET.

Not all controllers can provide adequate current for termination on both ends of the bus, for example the PCMCIA 32 bit standard only allows 1 Amp total for the PCMCIA card, this must be used for the logic on the card and power to the terminator on the card, it can not provide power to the terminator at the far end of the cable. Initiators that can not provide TERMPWR for the terminators shall use the SCSI symbols defined with a T covered by a circle with a slash. (See Annex A symbols.)

8 Bit data buses with 18 lines of termination shall supply a minimum current of 1 Amps.

16 Bit data buses with 27 lines of termination shall supply a minimum current of 1,5 Amps.

TERMPWR voltage at the source shall be 2,8 Volts to 5,25 Volts. TERMPWR voltage at the far end of the cable can be from 2,7 Volts to 5,25 Volts.

Single Ended TERMPWR	**Minimum Voltage**	**Maximum Voltage**	**Minimum Current**	**Current Limit ***
5,0 Volt TERMPWR	4,25 Volts	5,25 Volts	1,5 Amps	2,0 Amps
3,3 Volt 8 data bit TERMPWR	2,8 Volts	3,6 Volts	1,0 Amps	1,5 Amps
3,3 Volt 16 data bit TERMPWR	2,8 Volts	3,6 Volts	1,5 Amps	2,0 Amps
Differential TERMPWR				
5,0 Volt TERMPWR	4,0 Volts	5,25 Volts	1,0 Amps	2,0 Amps
3,3 Volt TERMPWR	2,8 Volts	3,6 Volts	1,0 Amps	2,0 Amps

* Nominal Current Limit

3.0 Termination

3.1 Single ended Termination

Regulated terminators shall be used to allow the terminators to perform the same over the full voltage range of 2,7 Volts to 5,25 Volts. The regulated terminators reduce the idle current reducing the power requirements.

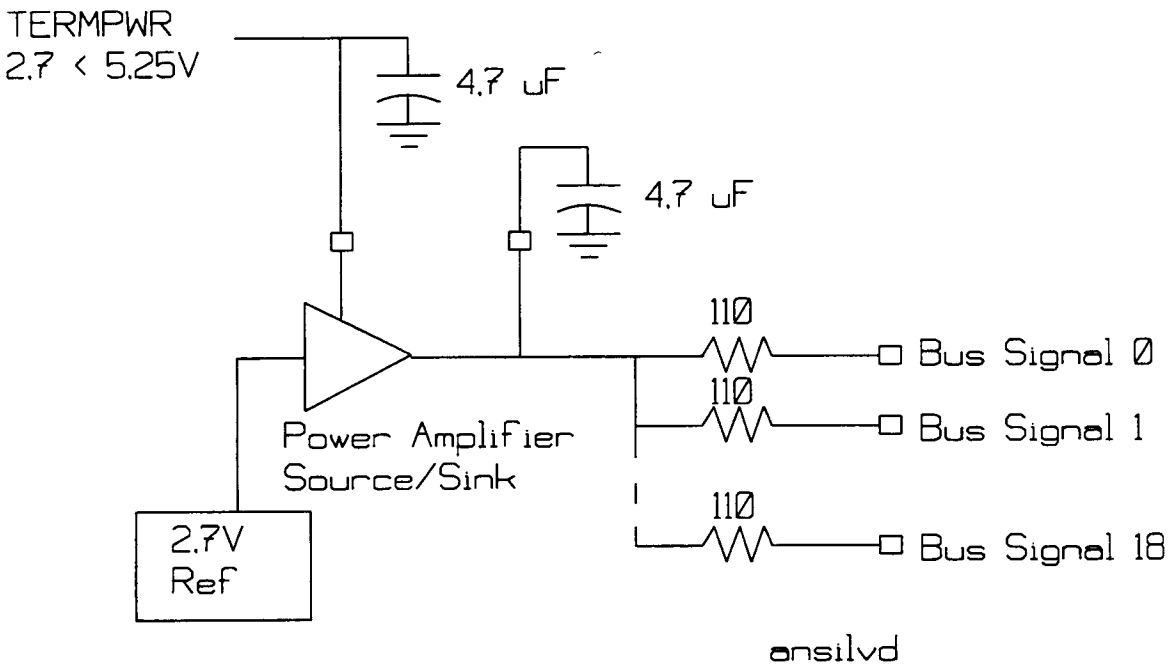
Termination must pull the signal lines to 2,5 Volts, the TERMPWR voltage at the far end of the cable can drop to 2,7 Volts. A 0,2 Volt regulator drop out is required to meet the minimum TERMPWR voltage and the minimum pull up Voltage.

The maximum pull up current is 24 mA measured at 0,2 V d.c., even when all the other signal lines are pulled to 4,0 Volts.

Terminators shall sink current when the Voltage exceeds 3,24 V d.c., but shall not exceed 12 mA when the signal lines are pulled to 3,5 V d.c.

Note: Terminators shall meet all other the requirements in SPI 7.1.1 over the 2,7 Volt to 5,25 Volt TERMPWR range.

Regulated terminators shall work with active negation drivers. The active negation drivers can drive the lines higher than the reference voltage, if a source only regulator is used the voltage can be pulled above. This can violate the maximum pull up current. Source/sink regulators, power amplifier designs shall be used.



The Circuit shown above is designed with power amplifier regulator circuit. The circuit maintains the output voltage even when the signal lines are pulled above the regulator voltage. The bypassing on the input of the power amplifier is required because inductance of the long cable that may be providing TERMPWR. The capacitor on the output of the power amplifier does two key functions. It allows the regulator to ride through glitches on the TERMPWR line, and it reduces the response time required for the power amplifier circuit.

This circuit will source current when the signal is below 2,5 Volts and sink current when the signal is greater than 2,9 Volts. Note: the reference 2,7 Volts is nominal.

3.2 Differential Termination

3.2.1 Resistor Network Termination

Differential terminators resistor networks will drop the 1 volt bus idle differential voltage, but it will be well above the 200 mV thresholds of the receiver.

TERMPWR = 5 Volts, Bias = 0,93 Volts
TERMPWR = 4 Volts, Bias = 0,735 Volts
TERMPWR = 3 Volts, Bias = 0,555 Volts

Differential termination power requirements can be very high considering the common mode voltage of -7 Volts to +12 Volts with a maximum 6 volt signal. This means the signal lines can be as low as -10 Volts or as high as +15 Volts. The current resistor network, the 330 ohm resistors must withstand 15 Volts or 680 mW.

3.2.2 Alternate Termination

Differential Alternate termination Specifications should be developed, this could reduce the power required over the resistor network.

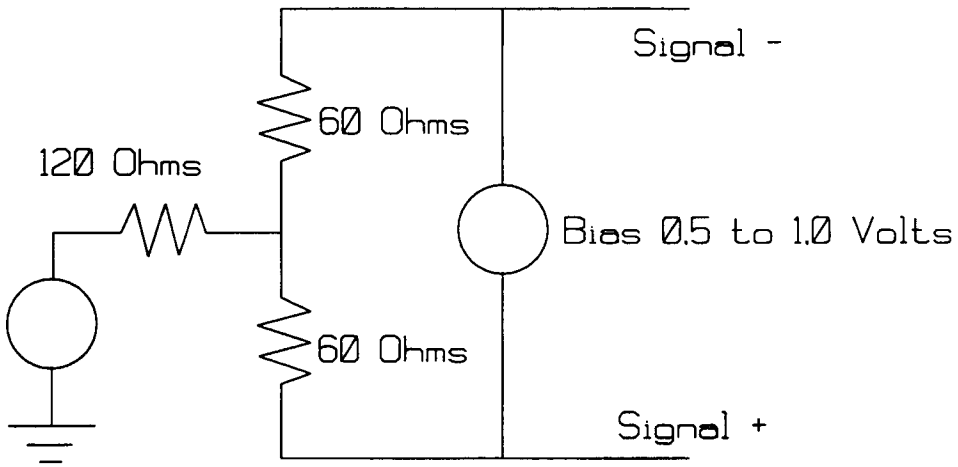
Alternate termination possibilities should be allowed that establish a bias voltage, with the minimum bias voltage of 0,5 Volts and maintain the differential and common mode termination. The termination is an equivalent 120 ohm differential, and 120/160 ohm common mode.

Note: the EIA485 specification is just the differential termination resistor of 120 ohms.

A 2 Volt reference point with a 120/160 ohm common mode impedance to ground, and 120 ohm differential impedance with a bias of 0,5 to 1,0 Volts. This would reduce the power required for the differential termination.

The 2 Volt reference point can reduce the high transient currents that could be passed to the TERMPWR line from the high common mode voltages.

Differential Alternate Termination

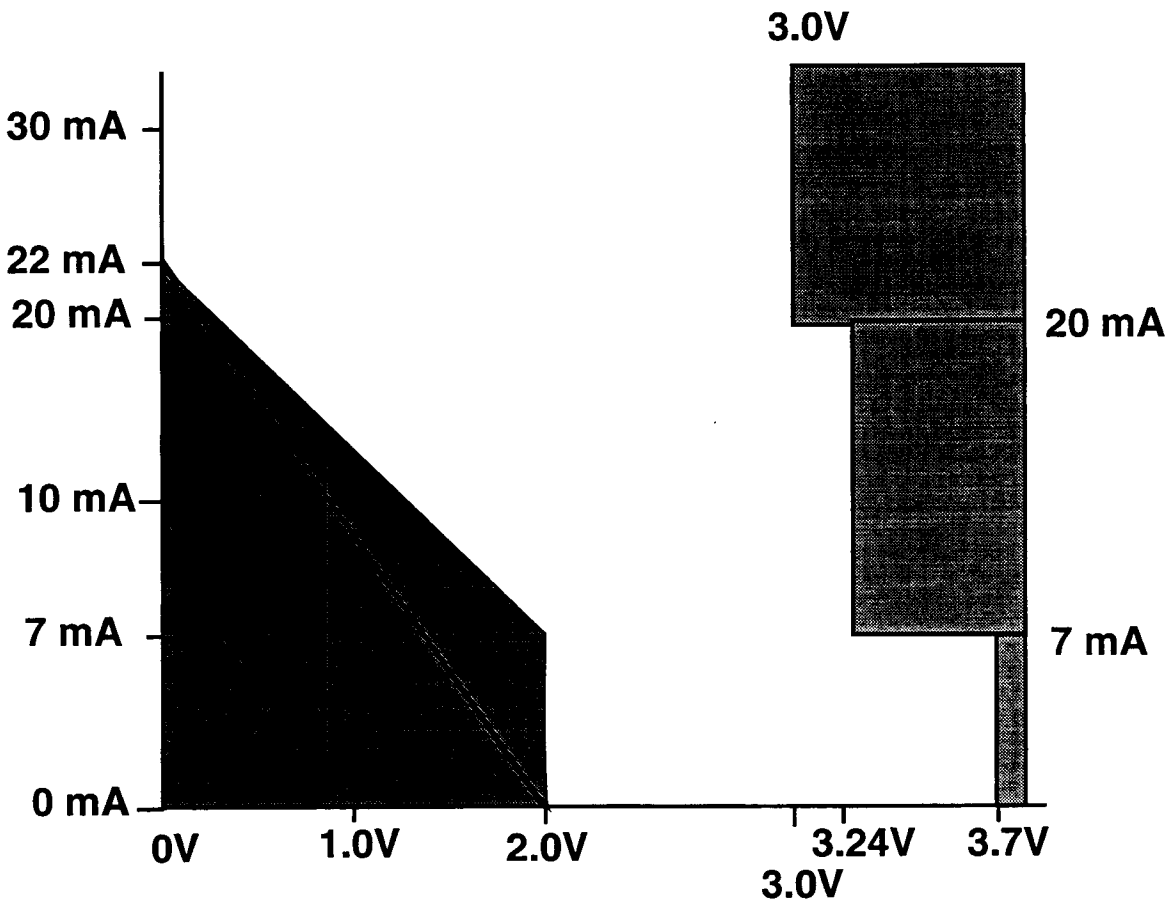


2.0 Volt Reference

4.0 Clamping

Controllers designed on 3,3 Volt processes may not be able to withstand 5,25 Volts. Active Negation drivers may drive the bus above 3,6 Volts. Bus signals may be clamped at 3,6 Volts to protect the controller. Clamping should only be used when the technology requires it, clamping is an impedance mismatch and may cause reflections.

Note: Drivers shall not driver more than 7 mA above 3,24 Volts SPI 7.1.2 (See figure below)



Active Negation Current Versus Voltage

The figure white area is the current range of an active negation driver as defined in FAST-20. This specifies both the minimum and maximum currents allowed over the active negation voltage range. Once the voltage is over 3,24 Volts, the driver must not source more than 7 mA.

Annex A Symbols

Symbol for Single-ended SCSI with 3,3 Volt source, and TERMPWR is not adequate, another device must provide TERMPWR.

This is the standard symbol with 3,3 V added in the center for the lower source voltage.

The T with the circle and slash means that TERMPWR is not available. The T with the circle and slash shall only be used when the device can not supply adequate TERMPWR for the terminators, another device must provide TERMPWR.