Micro Linear

ML6518*

18 Line Hot-Insertable Active SCSI Terminator

GENERAL DESCRIPTION

The ML6518 BiCMOS 18 line SCSI terminator provides active termination in SCSI systems using single-ended drivers and receivers. Active SCSI termination helps to effectively control analog transmission line effects such as ringing, noise, crosstalk, and ground bounce. In addition, the ML6518 provides support for hot insertability on the SCSI bus.

The ML6518 provides a V-I characteristic optimized to minimize transmission line effects during both signal negation and assertion using a MOSFET-based architecture. The desired V-I characteristic is achieved by trimming one resistor in the control block. Internal clamping controls signal assertion transients and provides current sink capability to handle active negation driver overshoots above 2.85V. It provides a 2.85V reference through an internal low dropout (1V) linear regulator.

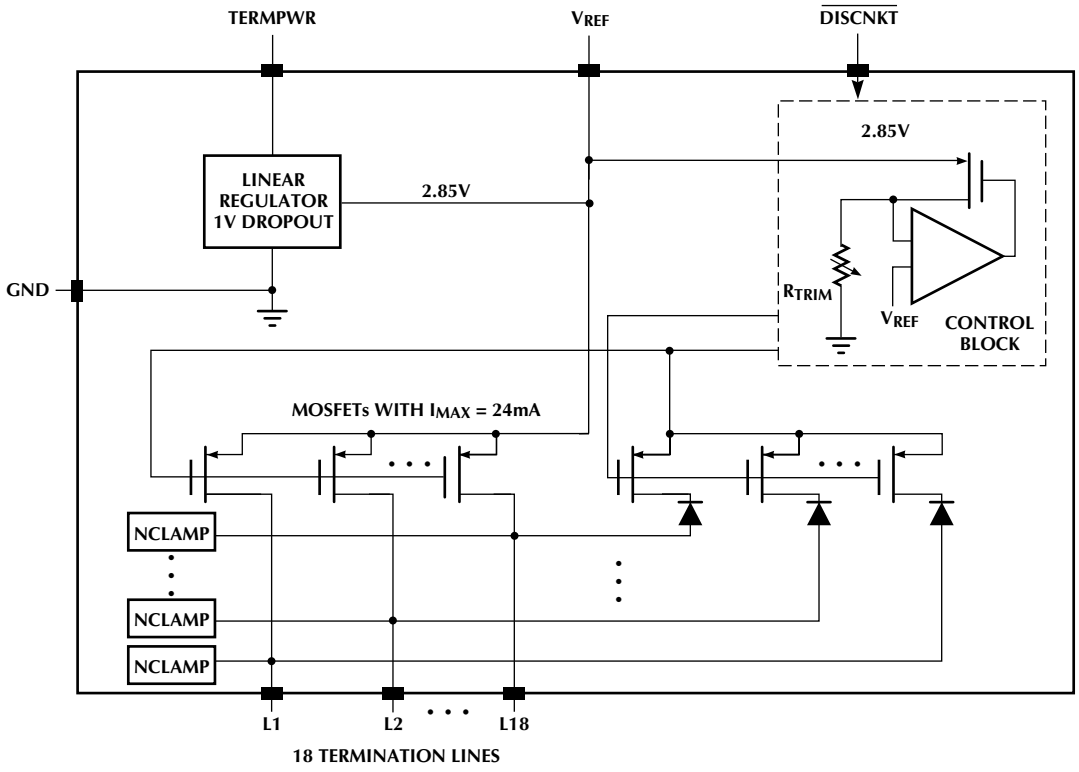
The ML6518 also provides a disconnect function which effectively removes the terminator from the SCSI bus. The disconnect mode capacitance is typically less than 5pF per line. Current limiting and thermal shutdown protection are also included.

FEATURES

- Fully monolithic IC solution providing active termination for 18 lines of the SCSI bus
- Provides onboard support for hot-insertability on the SCSI bus
- Low dropout voltage (1V) linear regulator, trimmed for accurate termination current
- Low disconnect capacitance (typically < 5pF)
- Logic pin with active pull-up to disconnect terminator from the SCSI bus
- Current sinking capability in excess of 8.3mA per line to handle active negation driver overshoots above 2.85V
- Negative clamping on all lines to handle signal assertion transients
- Regulator can source 400mA and sink 150mA while maintaining regulation
- Current limit and thermal shutdown protection

*This Part Is End Of Life As Of August 1, 2000

BLOCK DIAGRAM



NCLAMP = Negative Clamp

Circuit design patent pending.

PIN CONFIGURATIONS

ML6518
28-Pin SOIC (S28)

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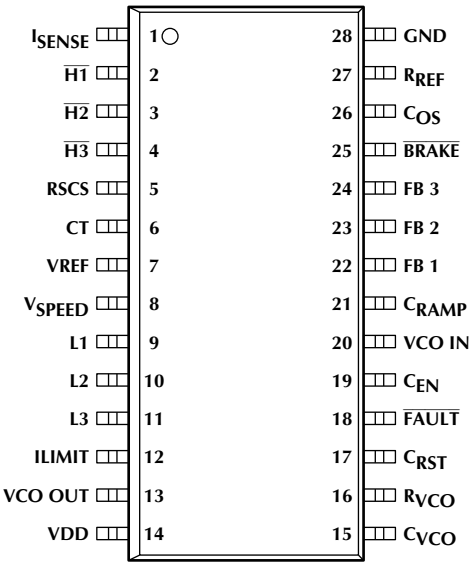

TOP VIEW

ML6518
32-Pin TQFP (H32-7)

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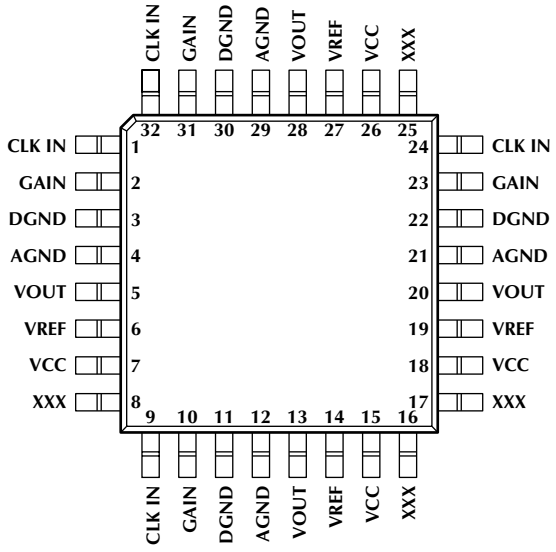


TOP VIEW

PIN DESCRIPTION

TQFP PIN#	SOIC PIN#	NAME	FUNCTION
1	25	L1	Signal termination for SCSI bus line 1
2	26	L2	Signal termination for SCSI bus line 2
3	27	L3	Signal termination for SCSI bus line 3
4	28	L4	Signal termination for SCSI bus line 4
5	1	L5	Signal termination for SCSI bus line 5
6	2	L6	Signal termination for SCSI bus line 6
7	3	L7	Signal termination for SCSI bus line 7
8	4	L8	Signal termination for SCSI bus line 8
9	6	L9	Signal termination for SCSI bus line 9
11–14, 27–30	7, 22, 23	GND	Ground
15	8	$\overline{\text{DISCNKT}}$	Terminator disconnect. Logic input to disconnect the terminator from the bus when the SCSI device no longer needs termination. $\overline{\text{DISCNKT}}$ has a 200ký internal pull-up resistor connected to TERMPWR for use with a mechanical switch
16	11	L10	Signal termination for SCSI bus line 10
17	12	L11	Signal termination for SCSI bus line 11
18	13	L12	Signal termination for SCSI bus line 12
19	14	L13	Signal termination for SCSI bus line 13
20	15	L14	Signal termination for SCSI bus line 14
21	16	L15	Signal termination for SCSI bus line 15
22	17	L16	Signal termination for SCSI bus line 16
23	18	L17	Signal termination for SCSI bus line 17
24	19	L18	Signal termination for SCSI bus line 18
25, 26	20, 21	TERMPWR	Power should be connected to the SCSI TERMPWR line. A 22µF tantalum bypass capacitor is recommended as shown in the application diagram
31, 32	24	V_{REF}	2.85V V_{REF} output. External decoupling with a 10µF tantalum in parallel with a 0.1µF ceramic capacitor is recommended as shown in the application diagram

ABSOLUTE MAXIMUM RATINGS

Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

Signal Line Voltage ..... GND – 0.3V to TERMPWR + 0.3V
Regulator Output Current ..... ±500mA
TERMPWR Voltage ..... –0.3 to 7V

Junction Temperature ..... 150°C
Storage Temperature Range ..... –65°C to 150°C
Lead Temperature (Soldering 10 sec) ..... +260°C
Thermal Resistance (θ_{JA})
SOIC Package ..... 75°C/W
TQFP Package ..... 65°C/W

OPERATING CONDITIONS

Temperature Range ..... 0°C to 70°C
TERMPWR Voltage Range ..... 4.0V to 5.25V

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, TERMPWR = 4V to 5.25V, T_A = Operating Temperature Range (Note 1)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Supply					
TERMPWR Supply Current	L1-L18 open, $\overline{\text{DISCNKT}}$ open		5	7	mA
	L1-L18 = 0.2V, $\overline{\text{DISCNKT}}$ open		450	500	mA
Disconnect Mode Current	$\overline{\text{DISCNKT}}$ = 0V		75	100	µA
$\overline{\text{DISCNKT}}$					
Input Low Voltage				1.0	V
Input High Voltage		TERMPWR –1.0			V
Output					
Output High Voltage	Each line measured with other 17 lines high	2.8	2.85	2.9	V
Output Current (Normal Mode)	V_{OUT} = 0.2V, each line measured with other 17 lines high	20		24	mA
Hot Insertion Peak Current	TERMPWR = 0V, V_{REF} = 0V, Any or all signal lines = 2.85V		1	2	µA
Output Clamp Voltage	I_{OUT} = –30mA	–150		150	mV
Sinking Current (per line)	V_{OUT} = 3.3V	10	12		mA
Output Capacitance (Micro Linear method)	$\overline{\text{DISCNKT}}$ = 0V, $2V_{P-P}$ 100kHz square wave biased at 1V applied to the output		4	5	pF
Output Capacitance (X3T9.2/855D method)	$\overline{\text{DISCNKT}}$ = 0V, $0.4V_{P-P}$ 1MHz square wave biased at 0.5V applied to the output		6	7	pF
Regulator					
Output Voltage	Sourcing 0-400mA	2.8	2.85	2.9	V
	Sinking 0-150mA	2.8	2.85	2.9	V
Sinking Current	V_{LINE} = 3.5	240	300		mA
Short Circuit Current	V_{REF} = 0V		300		mA
	V_{REF} = 5V		600		mA
Dropout Voltage	L1–L18 = 0.2V		1.0	1.2	V
Thermal Shutdown			170		°C

Note 1: Limits are guaranteed by 100% testing, sampling, or correlation with worst case test conditions.

FUNCTIONAL DESCRIPTION

SCSI terminators are used to decrease the transmission line effects of SCSI cable. Termination must be provided at the beginning and end of the SCSI bus to ensure that data errors due to reflections on the bus are eliminated. With the increasing use of higher data rates and cable lengths in SCSI subsystems, active termination has become necessary. Active termination also minimizes power dissipation and can be activated or deactivated under software control, thus eliminating the need for end user intervention. The V-I characteristics of popular SCSI termination schemes are shown in Figure 1. Theoretically, the desired V-I characteristics are the Boulay type for signal assertion (high to low) and the ideal type for signal negation (low to high). The ML6518 with its MOSFET-based nonlinear termination element provides the most optimum V-I characteristics for both signal assertion and negation.

The ML6518 provides active termination for 18 signal lines, thus accommodating basic SCSI which requires 18 lines to be terminated. When used with the ML6599, wide SCSI, which requires 27, 36 or 45 lines to be terminated, can also be accommodated. The ML6518 integrates an accurate voltage reference (1V dropout voltage) and 18 MOSFET-based termination lines. A single internal resistor is trimmed to tune the V-I characteristic of the MOSFETs. The voltage reference circuit produces a precise 2.85V level and is capable of sourcing 24mA into each of the nine terminating lines when low (active). When the signal line is negated (driver turns off), the terminator pulls the signal line back to 2.85V. The regulator will source 400mA and sink 150mA while maintaining regulation of 2.85V.

The ML6518 SCSI terminator provides an active low control signal ($\overline{\text{DISCNKT}}$) which has an internal 200ký pull-up resistor. The $\overline{\text{DISCNKT}}$ input isolates the ML6518 from the signal lines and effectively removes the terminator from the SCSI bus with a disconnect mode current of less than 100µA when pulled low. In addition, the ML6518 provides for negative clamping of signal transients and also supports current sink capability in excess of 8.3mA per signal line to handle active negation driver overshoot above 2.85V, a common occurrence with SCSI transceivers.

Disconnect mode capacitance is a very critical parameter in SCSI systems. The ML6518 provides a capacitance contribution of only 5pF.

HOT INSERTABILITY

"Hot" insertion of a SCSI device refers to the act of plugging a SCSI device which is initially unpowered into a powered SCSI bus. The SCSI device subsequently draws power from the TERMPWR line during its startup routine and thereafter. "Hot" removal refers to the act of removing a powered SCSI device from a powered SCSI bus. A device which performs both tasks with no physical damage to itself or other devices on the bus, nor which alters the existing state of the bus by drawing excessive currents, is termed "hot-swappable."

The ML6518 hot-insertable SCSI terminator typically draws 1µA from any given output line (L1–L18) during a hot insertion/removal procedure, thereby protecting itself and preserving the state of the bus. The low insertion current is achieved by effectively shorting the gate to drain of the output PMOS device until the 2.85V reference (V_{REF}) has powered up. A second PMOS in series with a Schottky diode is used as the shorting bypass device. After V_{REF} reaches a sufficient level, the bypass device is turned off and the part operates normally.

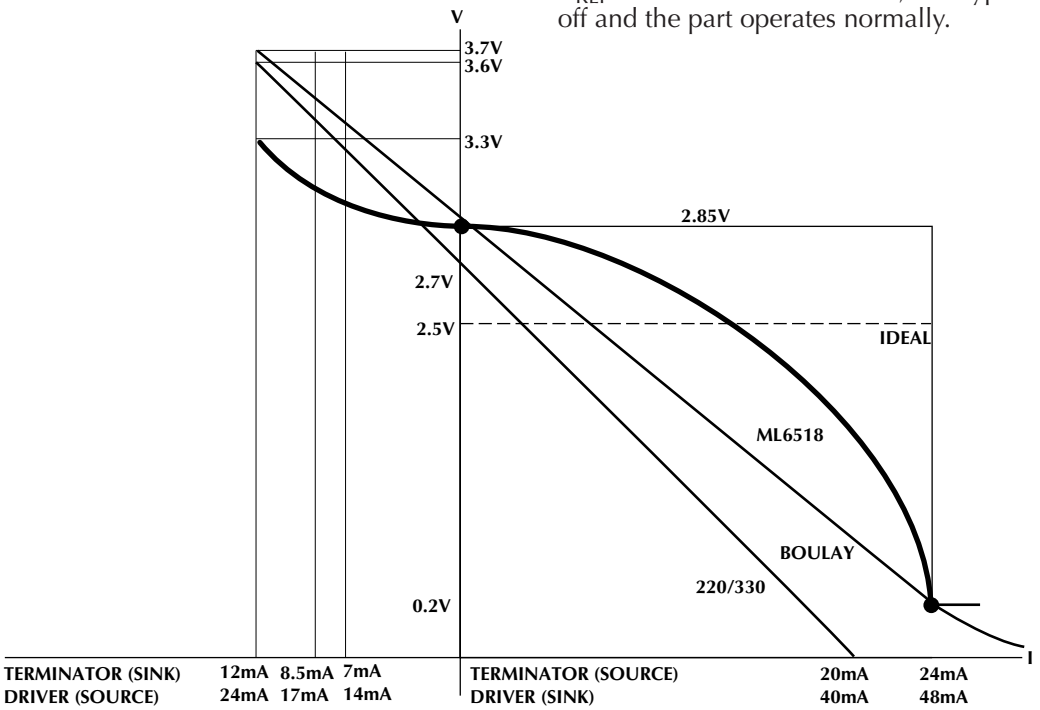


Figure 1. V-1 Characteristics of Various SCSI Termination Schemes

As outlined in Annex G of the ANSI SCSI-3 Parallel Interface Specification (X3T9.2/855D), "The SCSI bus termination shall be external to the device being inserted or removed." In other words, any terminator connected to a device being hot inserted/removed should be inactive (accomplished by grounding the $\overline{\text{DISCNKT}}$ pin in the case of the ML6518). If the terminator being inserted/removed were in the active state, at some point in time the bus would be terminated by either 1 or 3 terminators. In either case, data integrity on the bus will be compromised.

Figure 2 gives an application diagram showing a typical SCSI bus configuration. To ensure proper operation, the TERMPWR pin must be connected to the SCSI TERMPOWER line. Each ML6518 requires parallel 0.1µF and 10µF capacitors connected between the V_{REF} and GND pins and the TERMPOWER line needs a 10µF bypass capacitor at one node in the system.

In an 8-bit wide SCSI bus arrangement ("A" Cable), a single ML6518 would be needed at each end of the SCSI cable in order to terminate the 18 active signal lines. 16-bit wide SCSI would use one ML6518 and one ML6599, while 32-bit wide SCSI bus would require two ML6518s and one ML6599.

In a typical SCSI subsystem, the open collector driver in the SCSI transceiver pulls low when asserted. The termination resistance serves as the pull-up when negated. Figure 2 also shows a typical cable response to a pulse. The receiving end of the cable will exhibit a single time delay. When negated, the initial step will reach an intermediate level (V_{STEP}). With higher SCSI data rates, sampling could occur during this step portion. In order to get the most noise margin, the step needs to be as high as possible to prevent false triggering. For this reason the regulator voltage and the resistor defining the MOSFET characteristic are trimmed to ensure that the I_O is as close as possible to the SCSI maximum current specification. V_{STEP} is defined as:

$$V_{STEP} = V_{OL} + (I_O \infty Z_O)$$

where V_{OL} is the driver output low voltage, I_O is the current from the receiving terminator, and Z_O is the characteristic impedance of the cable.

This is a very important characteristic that the terminator helps to overcome by increasing the noise margin and boosting the step as high as possible.

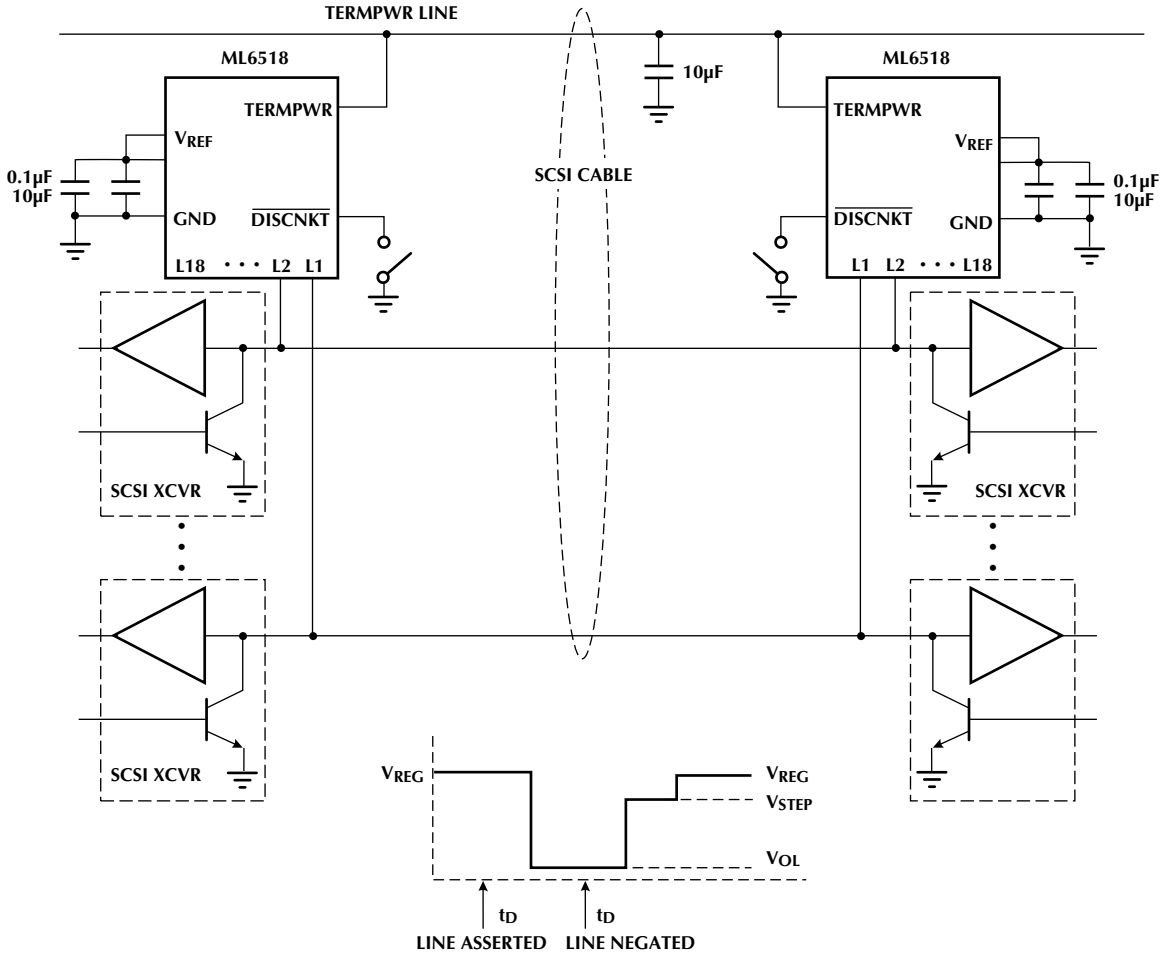
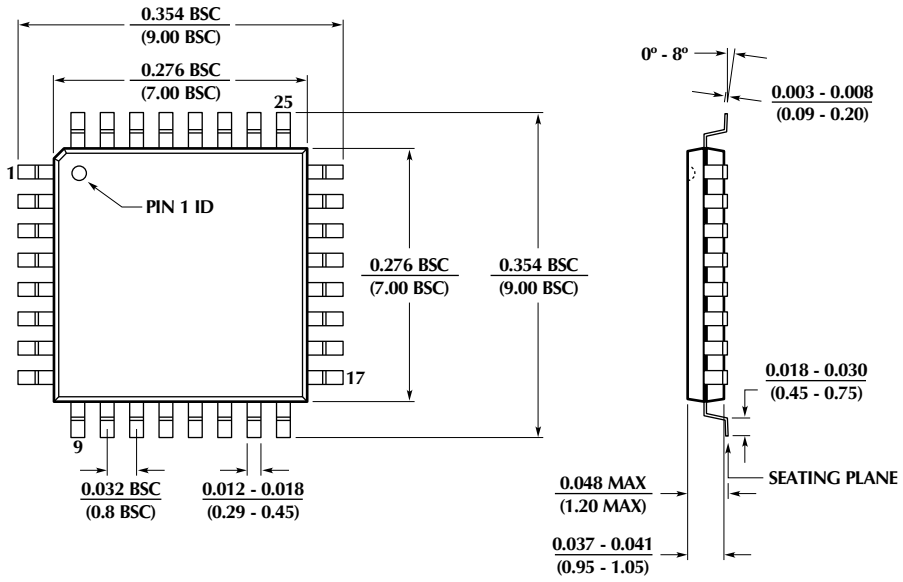


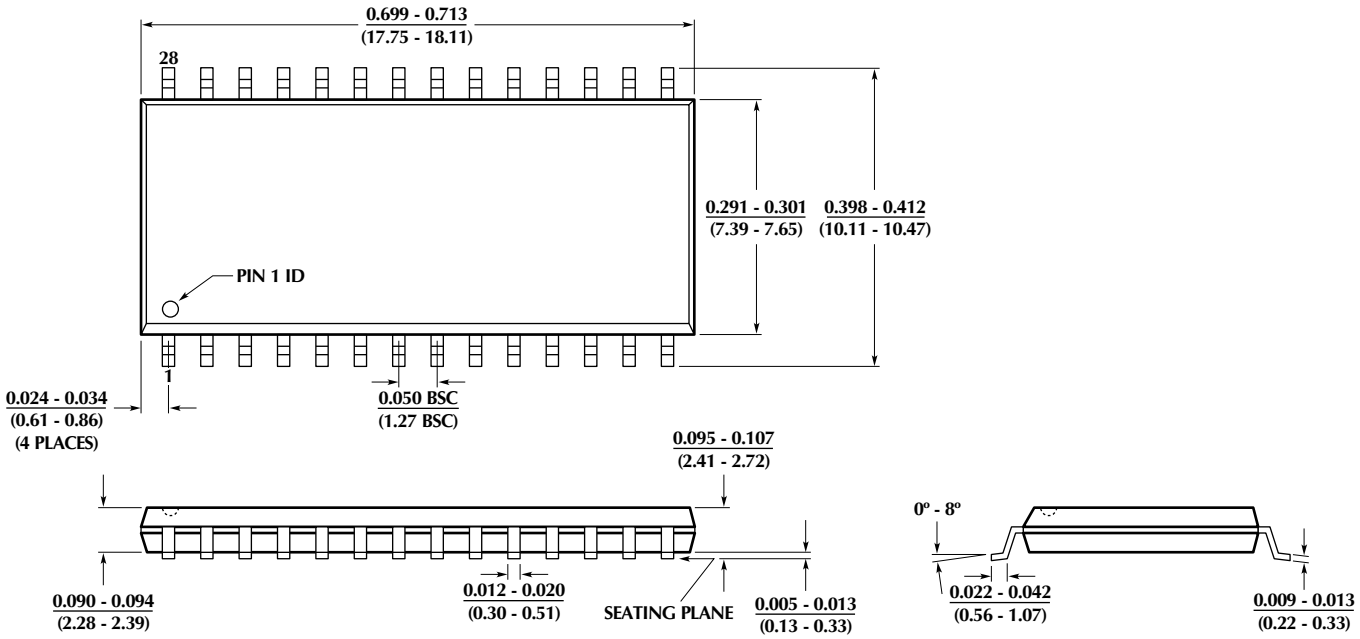
Figure 2. Application Diagram Showing Typical SCSI Bus Configuration with the ML6518

PHYSICAL DIMENSIONS inches (millimeters)

Package: H32-7
32-Pin (7 x 7 x 1mm) TQFP



Package: S28
28-Pin SOIC



ORDERING INFORMATION

PART NUMBER	TEMPERATURE RANGE	PACKAGE
ML6518CH	0°C to 70°C	32-pin TQFP (H32-7) (End Of Life)
ML6518CS	0°C to 70°C	28-pin SOIC (S28) (End Of Life)

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