



# Ultra320 Multi-mode LVD/SE SCSI Terminator

## Features

- Auto-selectable multi-mode Single-Ended or LVD Termination
- Meets SCSI-1, SCSI-2, SCSI-3 SPI Ultra (Fast-20), Ultra 2(SPI-2 LVD), Ultra160 (SPI-3 LVD), and Ultra320 (SPI-4 LVD) standards
- Supports active negation
- 3pF channel capacitance
- 2.9V to 5.5V operation
- Thermal protection
- Hot-Swap compatible
- 5% tolerance on SE and LVD termination resistance
- 28 pin TSSOP package
- 28 Pin TSSOP: Pin Compatible with DS2119

## Applications

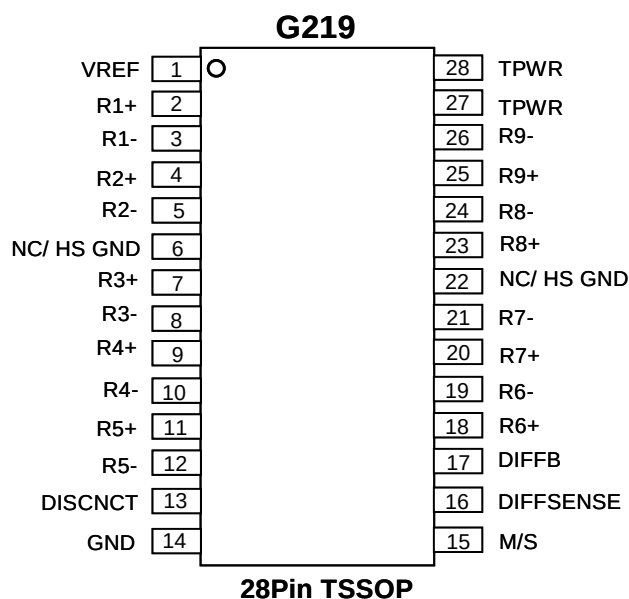
- Server and workstation
- High-end PC
- Industrial PC
- Disk Array (RAID)
- SCSI cable

## General Description

The G219 Multi-mode LVD/SE SCSI terminator provides a smooth transition into the next generation of the SCSI Parallel Interface (SPI-4). It automatically senses the bus, via DIFFSENS, and switches the termination to either single-ended (SE) or low voltage differential (LVD) SCSI, dependent on which type of devices are connected to the bus. If the G219 detects a HVD SCSI device, it switches to a high impedance state. For a 16-bit Wide SCSI bus to be operational, three G219 terminators are needed.

The Multi-mode terminator contains all functions required to terminate and auto detect and switch modes for SCSI Parallel Interface (SPI) bus architectures. For the SE termination, one regulator and nine precision 110ohm resistors are used. For the LVD termination, the G219 integrates 18 regulated supplies with nine precision resistor strings.

## Pin Configuration



## Ordering Information

| PART NUMBER | TEMP. RANGE | PIN-PACKAGE                |
|-------------|-------------|----------------------------|
| G219T-D3    | 0°C-70°C    | TSSOP-28 pin / Tube        |
| G219R-D3    | 0°C-70°C    | TSSOP-28 pin / Tape & Reel |

### Note:

DIFFSENS—Refers to the SCSI bus signal.

DIFFSENSE—Refers to the G219 pin name and internal circuitry relating to differential sensing.

DIFFB—Refers to the G219 pin name and internal circuitry relating to monitoring the DIFFSENS line.

## Functional Description

The G219 is used in multi-mode active termination applications, where single ended (SE) and low voltage differential (LVD) devices might coexist. The LVD termination section consists of 18 source/sink amplifiers (VTOP, VBOT), biasing circuitry and nine precision resistor strings (RTOP, RMID, RBOT). The SE termination section consists of a 2.85V source/sink regulator with 9 precision 110ohm resistor. The DIFFSENSE section consists of a 1.3V, 5mA driver and a sensing circuit (Figure 1)

DIFFSENS is used to identify which types of SCSI devices are present on the bus. If the voltage on DIFFSENS is between 0-0.5V the bus is single-ended; if it is between 0.7-1.9V the bus is LVD; and if it is greater than 2.4V, the bus is HVD.

The G219 DIFFB pin monitors the DIFFSENS line to determine the proper operating mode of the device.

**HVD Isolation Mode** The G219 identifies that there is an HVD (high voltage differential) device on the SCSI bus and isolates the termination pins from the bus.

When DISCNCT is pulled high, the termination pins are isolated from the SCSI bus, and VREF is grounded. During thermal shutdown, the termination pins are isolated from the SCSI bus and VREF is grounded. The DIFFSENSE driver is shut down during either of these two events.

To ensure proper operation, the TPWR pin should be connected to the SCSI bus TERMPWR line. As with all analog circuitry, the TERMPWR lines should be bypassed locally. A 2.2μF capacitor and a 0.01μF high frequency capacitor is recommended between TPWR and ground and placed as close as possible to the G219. The G219 should be placed as close as possible to the SCSI connector to minimize signal and power trace length, thereby resulting in less input ca-

pacitance and reflections which can degrade the bus signals.

The DIFFSENSE pin can drive the SCSI DIFFSENS line (when M/S is pulled high) to determine the SCSI bus operating mode. The G219 switches to the termination mode that is appropriate for the bus based on the value of the DIFFSENS voltage. These modes are:

**LVD mode** LVD termination is provided by a precision resistor string with two amplifiers. This configuration yields a 105Ω differential and 150Ω common mode impedance. A fail safe bias of 112mV is maintained when no drivers are connected to the SCSI bus.

**SE mode** When the external driver for a given signal line turns off, the active terminator will pull that signal line to 2.85 volts (quiescent state). When used with an active negation driver, the power amp can sink 22mA per line while keeping the voltage reference in regulation. The terminating resistors maintain their 110Ω value.

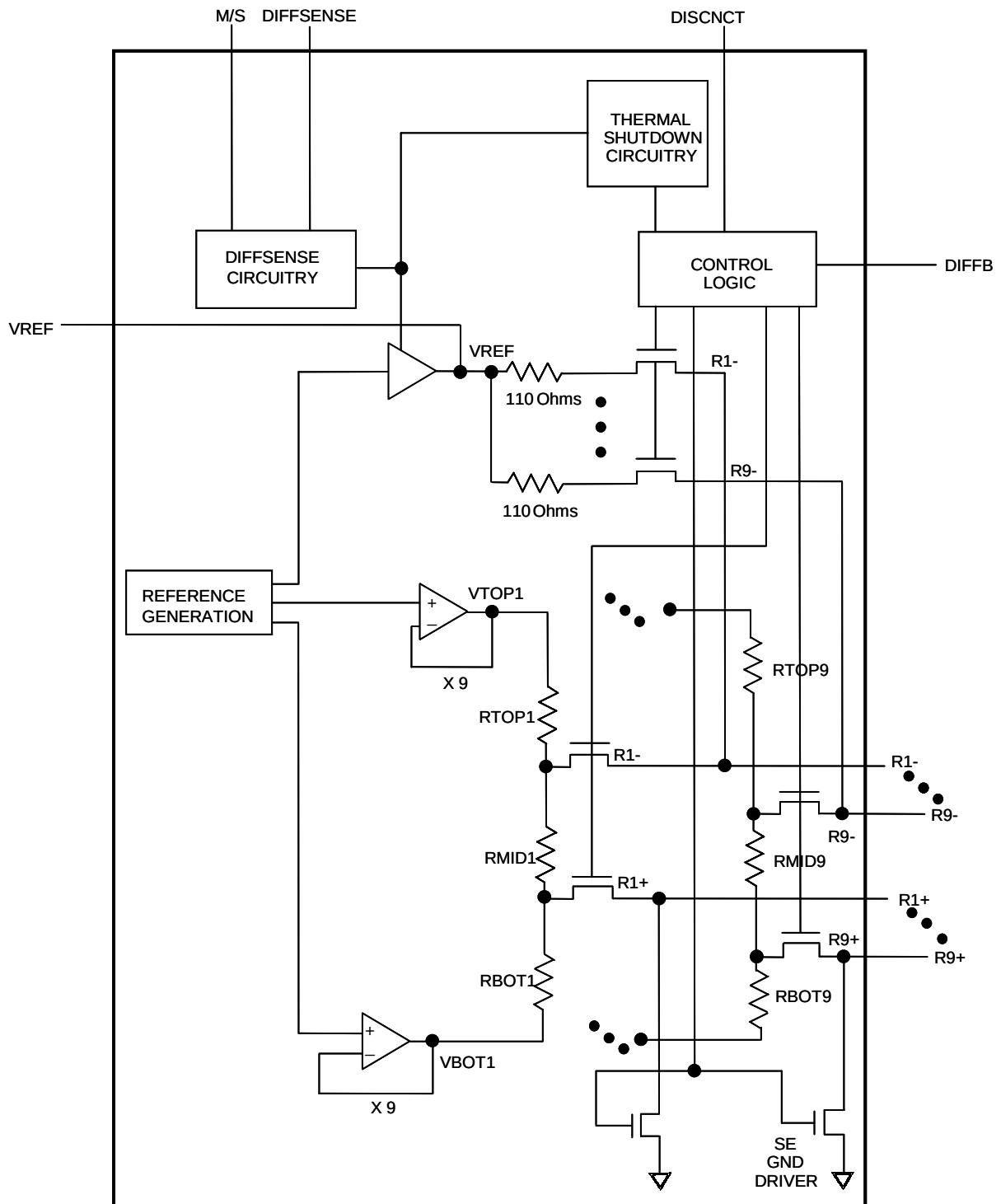
To maintain the specified regulation, a 4.7μF capacitor is required between the VREF pin and ground of each G219. A high frequency cap (0.1μF ceramic recommended) can also be placed on the VREF pin in applications that use fast rise/fall time drivers. A typical SCSI bus configuration is shown in Figure2.

An internal pull down resistor assures that the G219 will be terminating the bus if the DISCNCT pin is left floating.

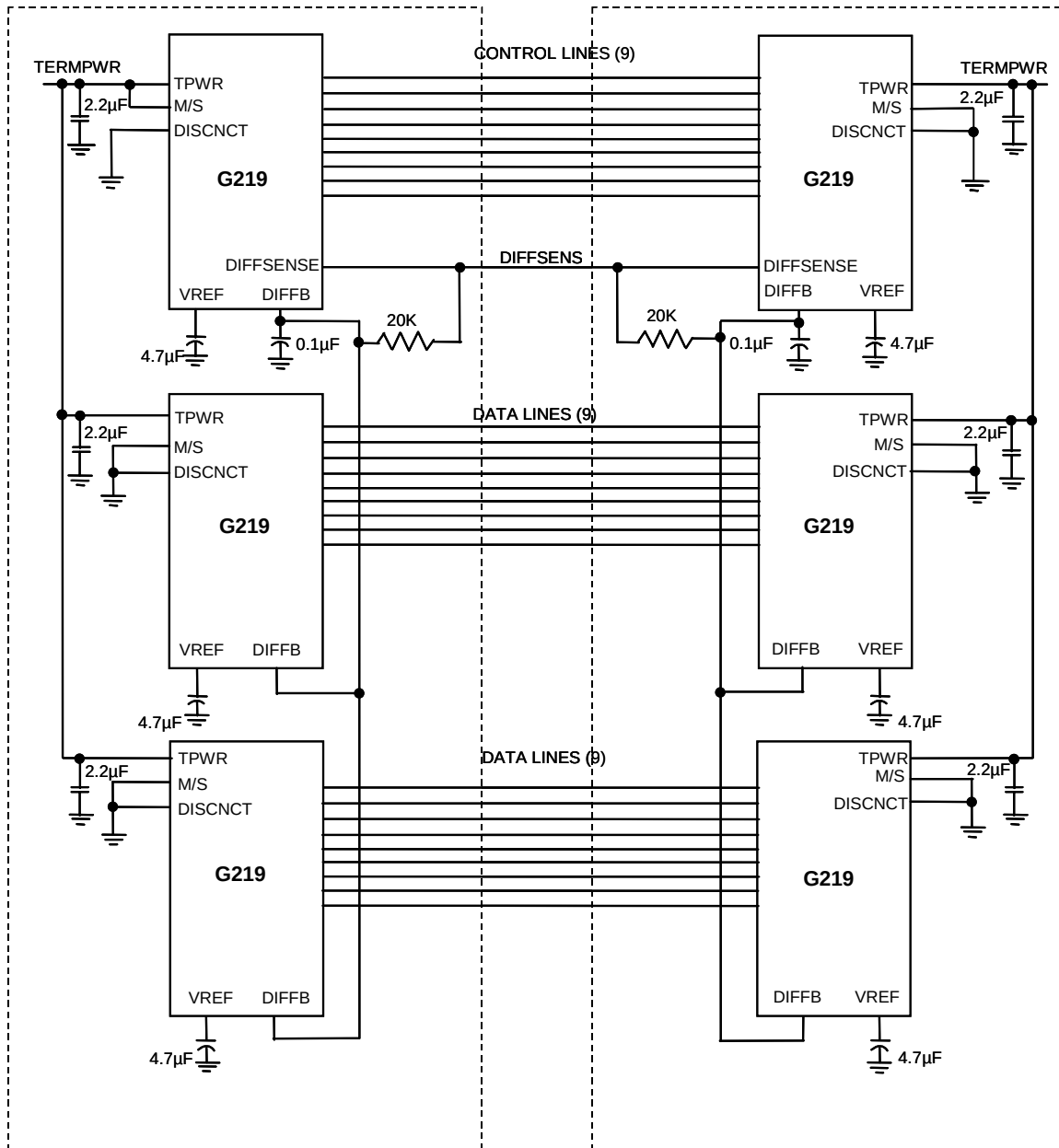
### DIFFSENS noise filtering

The G219 incorporates a internal digital filter to remove the noise signal on the DIFFSENS control line, thereby eliminating erroneous switching between modes. The external filter may be used in addition to the internal digital filter.

Block Diagram (Figure 1)



SCSI Bus Configuration (Figure 2)





## Recommended Operating Conditions

| PARAMETER             | SYMBOL          | MIN  | TYP | MAX            | UNITS |
|-----------------------|-----------------|------|-----|----------------|-------|
| Termpower Voltage     | $V_{tpwr}(SE)$  | 4.0  | 5   | 5.5            | V     |
|                       | $V_{tpwr}(LVD)$ | 2.9  | 5   | 5.5            |       |
| Logic 0               | $V_{il}$        | -0.3 |     | +0.8           | V     |
| Logic 1               | $V_{ih}$        | 2.0  |     | $V_{tpwr}+0.3$ | V     |
| Operating Temperature | $T_{amb}$       | 0    |     | 70             | °C    |

## Electrical Characteristics

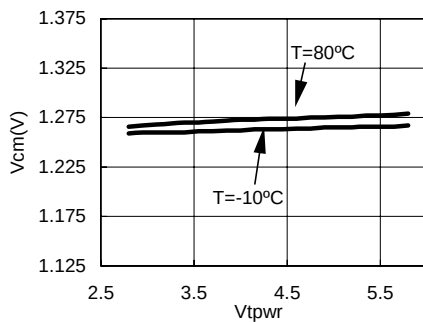
Unless otherwise specified, these specifications apply over the operating ambient temperature range of  $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$ .

| PARAMETER                                | SYMBOL      | CONDITION                      | MIN   | TYP  | MAX            | UNITS         |
|------------------------------------------|-------------|--------------------------------|-------|------|----------------|---------------|
| <b>LVD Terminator Section</b>            |             |                                |       |      |                |               |
| Differential Mode Termination Resistance | $R_{dm}$    |                                | 100   | 105  | 110            | Ohms          |
| Common Mode Termination Resistance       | $R_{cm}$    |                                | 110   | 150  | 190            | Ohms          |
| Differential Mode Bias                   | $V_{dm}$    | All lines Open                 | 100   | 112  | 125            | mV            |
| Common Mode Bias                         | $V_{cm}$    |                                | 1.125 | 1.25 | 1.375          | V             |
| <b>Single Ended Terminator Section</b>   |             |                                |       |      |                |               |
| Output Capacitance                       | $C_{out}$   | Note                           |       |      | 3              | pF            |
| SE Termination Resistance                | $R_{se}$    | $V_{line} = 0-3.0$ volts       | 104.5 | 110  | 115.5          | Ohms          |
| SE Voltage Reference                     | $V_{ref}$   |                                | 2.79  | 2.85 | 2.93           | Volts         |
| SE output Current                        | $I_{ose}$   | $V_{line} = 0.2$ volts         |       |      | 25.4           | mA            |
| <b>Regulator Section</b>                 |             |                                |       |      |                |               |
| Line Regulation                          | $LI_{REG}$  |                                |       | 1.0  | 2.5            | %             |
| Load Regulation                          | $LO_{REG}$  |                                |       | 1.3  | 3.5            | %             |
| Current Limit                            | $I_{LIM}$   |                                |       | 350  |                | mA            |
| Sink Current                             | $I_{SINK}$  |                                | 200   |      |                | mA            |
| <b>DC Section</b>                        |             |                                |       |      |                |               |
| Termpower Current                        | $I_{tpmr}$  | SE mode (No Load)              |       | 4    |                | mA            |
|                                          |             | LVD mode (No Load)             |       | 20   |                |               |
| Input Leakage High                       | $I_{ih}$    |                                | -1.0  |      |                | $\mu\text{A}$ |
| Input Leakage Low                        | $I_{il}$    |                                |       |      | 1.0            | $\mu\text{A}$ |
| <b>DIFFSENS Section</b>                  |             |                                |       |      |                |               |
| DIFFSENS SE Operating Range              | $V_{seor}$  |                                | -0.3  |      | 0.5            | V             |
| DIFFSENS LVD Operating Range             | $V_{lvdor}$ |                                | 0.7   |      | 1.9            | V             |
| DIFFSENS HVD Operating Range             | $V_{hvdor}$ |                                | 2.4   |      | $V_{tpwr}+0.3$ | V             |
| DIFFSENSE Driver Output Voltage          | $V_{dso}$   | M/S=1; $I_{ds} = 0-5\text{mA}$ | 1.2   |      | 1.4            | V             |
| DIFFSENSE Driver Source Current          | $I_{dsh}$   | M/S = 1; $V_{dso}=0\text{V}$   |       | 5    | 15             | mA            |
| DIFFSENSE Driver Sink Current            | $I_{dsl}$   | M/S=1; $V_{dso}=2.75\text{V}$  | 20    |      | 200            | $\mu\text{A}$ |

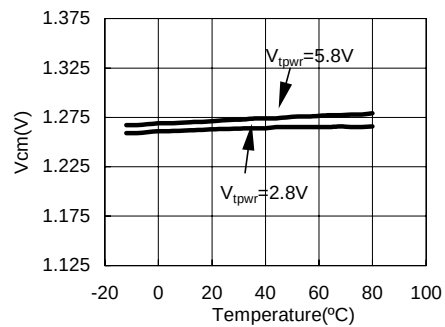
Note: Guaranteed by Design.

# Typical Operating Characteristics

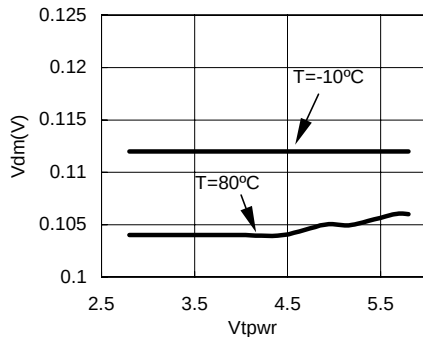
Common Mode Bias Vcm - Vtpwr



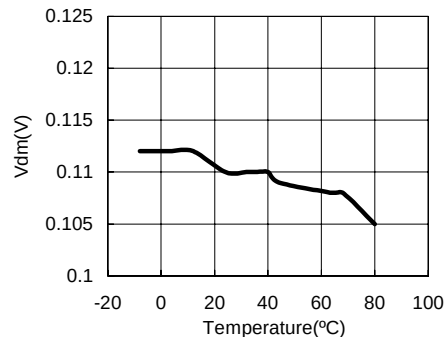
Common Mode Bias Vcm - Temperature



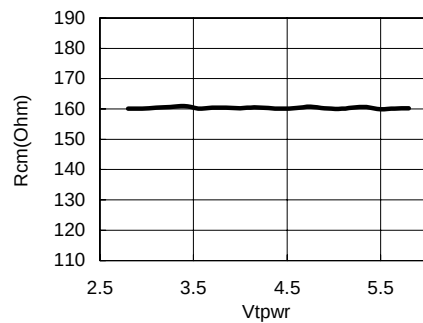
Differential Mode Bias Vdm - Vtpwr



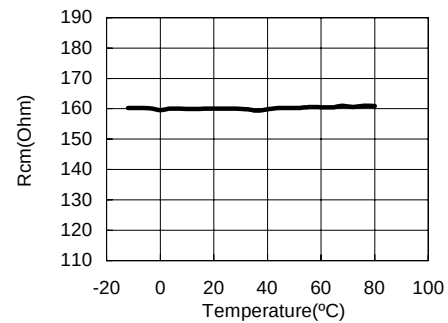
Differential Mode Bias Vdm - Temperature@Vtpwr=5V



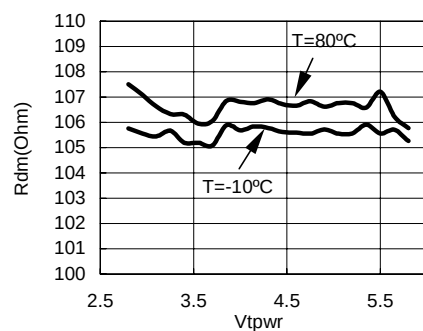
Common Mode Termination Resistance Rcm - Vtpwr @Temperature=24°C



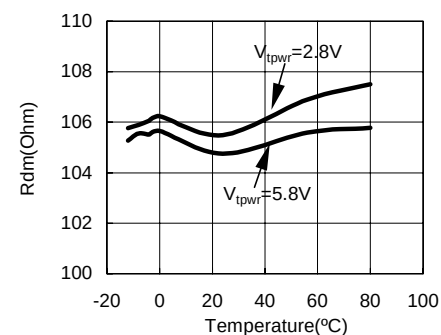
Common Mode Termination Resistance Rcm - Temperature@Vtpwr=5V



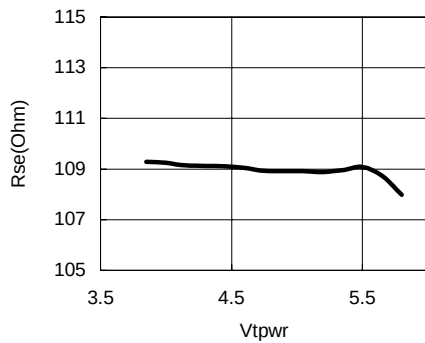
Differential Mode Termination Resistance Rdm - Vtpwr



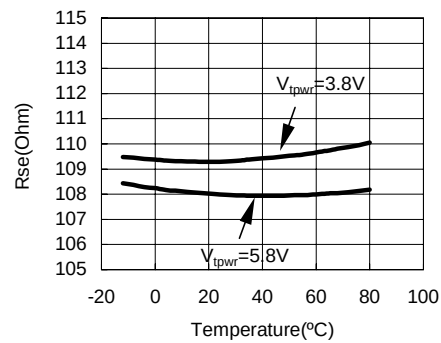
Differential Mode Termination Resistance Rdm - Temperature



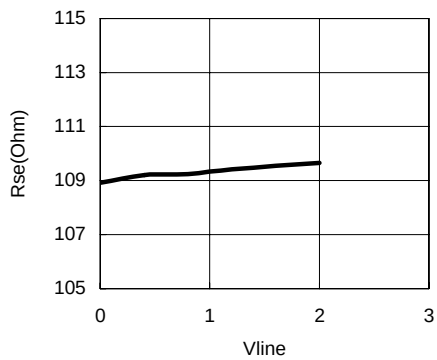
SE Termination Resistance Rse -  
Vtpwr @T=24°C;Vline=0V



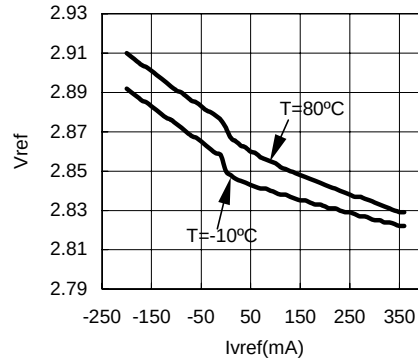
SE Termination Resistance Rse -  
Vtpwr @Vline=0V



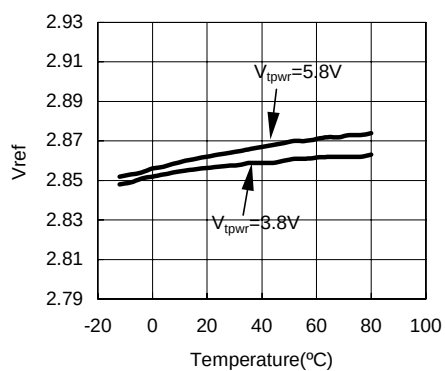
SE Termination Resistance Rse -  
Vtpwr @Vtpwr=5V;T=24°C



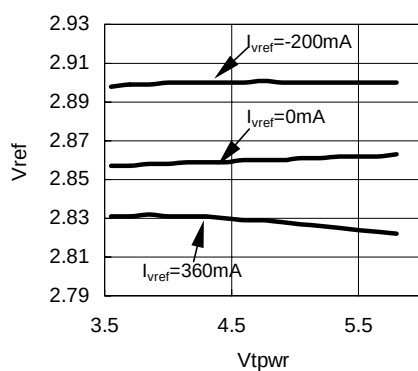
Vref - Ivref@Vtpwr=5V



Vref - Temperature@Ivref=0mA



Vref - Vtpwr@T=24°C

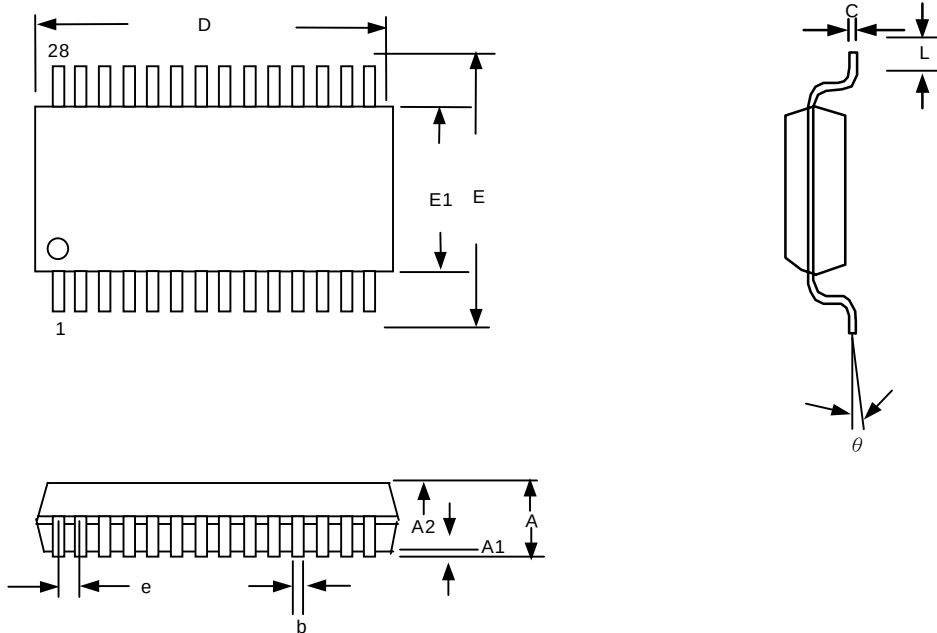


**Pin Description**

| PIN                       | SYMBOL     | DESCRIPTION                                                                                                                                                                                                                                                        |
|---------------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                         | VREF       | <b>Reference Voltage.</b> 2.85-volt reference in SE mode and 1.25V in LVD mode; must be connected to a 4.7 $\mu$ F capacitor.                                                                                                                                      |
| 2-5,7-12,<br>18-21, 23-26 | Rx+, Rx-   | <b>Signal Termination.</b> (X=1,2,3,.....9)<br>Rx+: Ground line for single-ended or positive line for differential applications for the SCSI bus.<br>Rx-: Signal line/active line for single-ended or negative line in differential applications for the SCSI bus. |
| 6,22                      | NC/ HS GND | <b>No Connect/Heat Sink Ground.</b> Should be grounded for heat sinking purpose                                                                                                                                                                                    |
| 13                        | DISCNCT    | <b>Disconnect.</b> When pulled high, the G219 isolates its bus pins (Rx+, Rx-) from the SCSI bus.                                                                                                                                                                  |
| 14                        | GND        | <b>Ground.</b> Terminator ground pin. Connected to ground.                                                                                                                                                                                                         |
| 15                        | M/S        | <b>Master/slave.</b> Used to select which terminator is the controlling device. M/S pin high enables the DIFFSENSE driver.                                                                                                                                         |
| 16                        | DIFFSENSE  | Output to drive the SCSI bus DIFFSENS line.                                                                                                                                                                                                                        |
| 17                        | DIFFB      | DIFFB pin should be connected to a 0.1 $\mu$ F capacitor to GND and 20k resistor to SCSI/Bus DIFFSENS line. An input pin to detect the type of device (differential or single-ended) on the SCSI bus.                                                              |
| 27,28                     | TPWR       | <b>Terminator Power.</b> Connect to the SCSI TERMPWR line and de-couple with a 2.2 $\mu$ F capacitor.                                                                                                                                                              |



## Package Information



Note:

1. Package body sizes exclude mold flash protrusions or gate burrs
2. Tolerance  $\pm 0.1\text{mm}$  unless otherwise specified
3. Coplanarity : 0.1mm
4. Controlling dimension is in millimeter. Converted inch dimensions are not necessarily accurate.
5. Follow JEDEC MO-153

| SYMBOL   | DIMENSION IN MM |       |       | DIMENSION IN INCH |       |       |
|----------|-----------------|-------|-------|-------------------|-------|-------|
|          | MIN.            | NOM.  | MAX.  | MIN.              | NOM.  | MAX.  |
| A        | -----           | ----- | 1.20  | -----             | ----- | 0.048 |
| A1       | 0.05            | ----- | 0.15  | 0.002             | ----- | 0.006 |
| A2       | 0.80            | 1.00  | 1.05  | 0.031             | 0.039 | 0.041 |
| b        | 0.19            | ----- | 0.30  | 0.007             | ----- | 0.012 |
| C        | 0.09            | ----- | 0.20  | 0.004             | ----- | 0.008 |
| D        | 9.60            | 9.70  | 9.80  | 0.378             | 0.382 | 0.386 |
| E        | -----           | 6.40  | ----- | -----             | 0.252 | ----- |
| E1       | 4.30            | 4.40  | 4.50  | 0.169             | 0.173 | 0.177 |
| e        | -----           | 0.65  | ----- | -----             | 0.026 | ----- |
| L        | 0.45            | 0.60  | 0.75  | 0.018             | 0.024 | 0.030 |
| y        | -----           | ----- | 0.10  | -----             | ----- | 0.004 |
| $\theta$ | 0°              | ----- | 8°    | 0°                | ----- | 8°    |

## Taping Specification

