

**MOTOROLA**  
**SEMICONDUCTOR**  
**TECHNICAL DATA**

**MCCS142233**

**9-Bit Switchable SCSI Passive Bus Terminator (220 Ω and 330 Ω)**

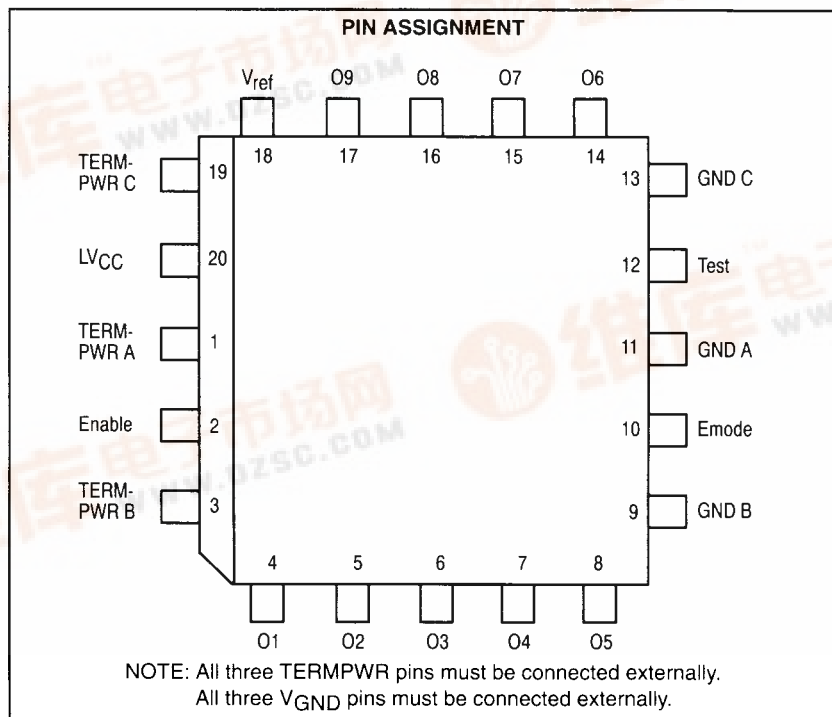
The MCCS142233 is a precision 9-bit switchable SCSI bus terminator with a Local-V<sub>CC</sub> (LV<sub>CC</sub>) low voltage sense circuit to latch the Enable state. When the switch is enabled according to the truth table the device provides a 220 Ω resistance to Terminator Power (TERMPWR) and 330 Ω resistance to Ground for SCSI termination of 9 bits. When the switch is disabled according to the truth table, the device is in a High Impedance State on all 9 bits.

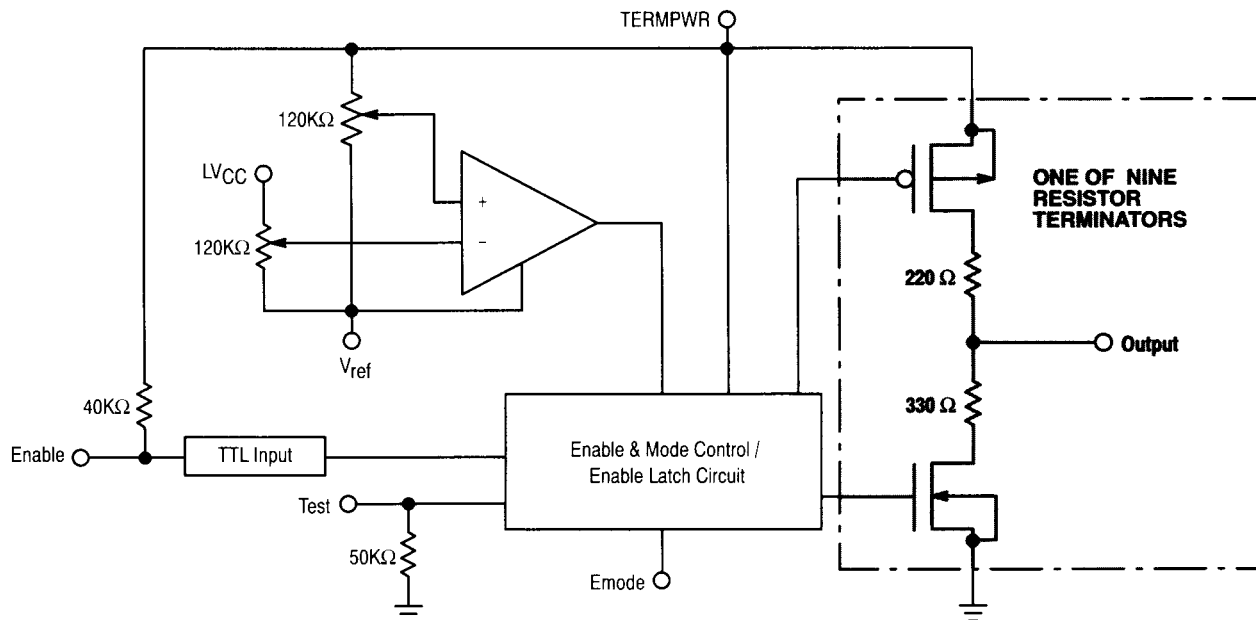
The low voltage sense circuit gives the device the ability to latch the current output state when power is removed from the LV<sub>CC</sub> pin. When powering down a SCSI peripheral containing this device as long as Terminator Power remains there is no interruption to the SCSI bus.

- 9 Switchable 220 Ω/330 Ω Terminating Resistor Pairs
- Resistor Ratio: R220/R330 = 220 Ω/330 Ω ± 2%
- Operating Temperature Range: 0°C to 70°C
- Local-V<sub>CC</sub> (LV<sub>CC</sub>) Low Voltage Sense Circuit
- Operating Voltage Range: 4.25 to 5.25 V
- Active High or Active Low Enable Input
- Resistor Tolerance ± 7.5% (Over Temperature And Supply Voltage Ranges)

**Truth Table**

|             | Test | Emode | Enable | Output     |           | Test | Emode | Enable | Output           |
|-------------|------|-------|--------|------------|-----------|------|-------|--------|------------------|
| Active Mode | 0    | 0     | 0      | Terminated | Test Mode | 1    | 0     | 0      | 330 Ω to GND     |
|             | 0    | 0     | 1      | Z          |           | 1    | 0     | 1      | 220 Ω to TERMPWR |
|             | 0    | 1     | 0      | Z          |           | 1    | 1     | 0      | 220 Ω to TERMPWR |
|             | 0    | 1     | 1      | Terminated |           | 1    | 1     | 1      | 330 Ω to GND     |





#### MAXIMUM RATINGS\*

| Symbol    | Parameter   | Value                  | Units |
|-----------|---|------------------------|-------|
| TERMPWR   | DC Terminator Power Voltage (Referenced to GND)           | - 0.5 to + 6.0         | V     |
| $V_{in}$  | DC Input Voltage (Referenced to GND) for Emode/Test pins  | - 0.5 to TERMPWR + 0.5 | V     |
| $V_{in}$  | DC Input Voltage (Referenced to GND) for LVCC/Enable pins | - 0.5 to + 6.0         | V     |
| $V_{out}$ | DC Output Voltage (Referenced to GND)                     | - 0.5 to TERMPWR + 0.5 | V     |
| $I_{in}$  | DC Input Current, per pin                                 | ± 20                   | mA    |
| $I_{out}$ | DC Output Current, per pin                                | ± 35                   | mA    |
| $I_{CC}$  | DC Supply Current, TERMPWR and GND pins                   | ± 250                  | mA    |
| $T_{stg}$ | Storage Temperature                                       | - 65 to + 150          | °C    |
| $T_L$     | Lead Temperature, 1mm from case for 10 seconds            | 260                    | °C    |

\* Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

#### RECOMMENDED OPERATING CONDITIONS

| Symbol            | Parameter                                       | Min  | Max      | Units |
|-------------------|---|------|----------|-------|
| TERMPWR           | DC Terminator Power Voltage (Referenced to GND) | 4.25 | 5.25     | V     |
| $V_{in}, V_{out}$ | DC Input Voltage                                | 0    | TERMPWR  | V     |
| $T_A$             | Operating Temperature                           | 0    | 70       | °C    |
| $t_r, t_f$        | Input Rise and Fall Time (All inputs but LVCC)  | 0    | 500      | ns    |
| $t_r, t_f$        | Input Rise and Fall Time (LVCC)                 | 0    | no limit | ns    |

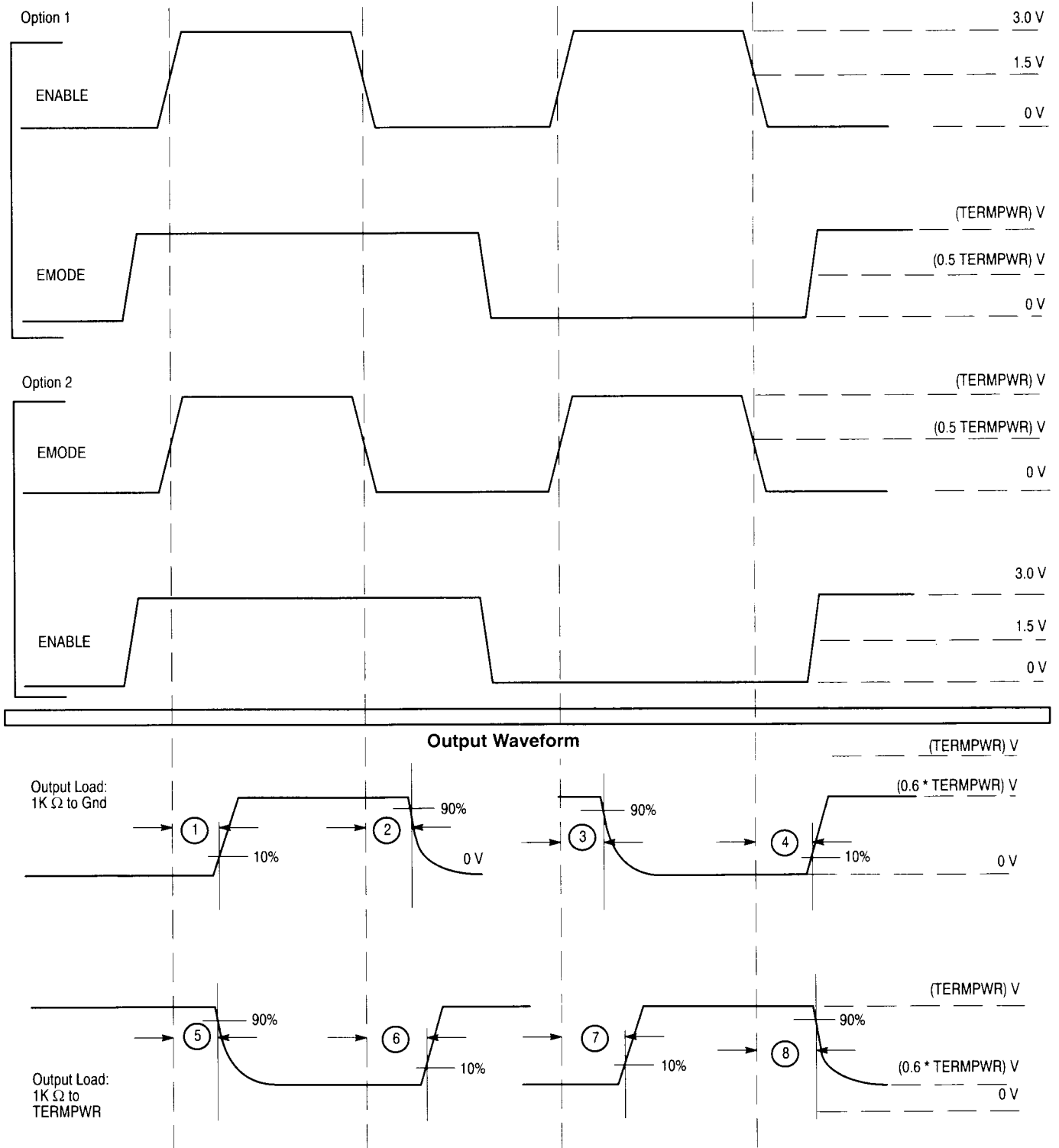
## DC CHARACTERISTICS

| Symbol           | Parameters   | TERMPWR<br>(V)  | 25°C              |              | 0°C to + 70°C |              | Unit | Condition  |
|------------------|--|-----------------|-------------------|--------------|---------------|--------------|------|--|
|                  |  |                 | Min               | Max          | Min           | Max          |      |  |
| V <sub>IH</sub>  | Min High-Level Input Voltage<br>(Emode & Test — HC Inputs)     | 4.25<br>5.25    | 2.98<br>3.68      |              | 2.98<br>3.68  |              | V    | Per Truth Table  |
|                  | Min High-Level Input Voltage<br>(Enable — HCT Input)           | 4.25<br>5.25    | 2.0<br>2.0        |              | 2.0<br>2.0    |              | V    | Per Truth Table  |
| V <sub>IL</sub>  | Max Low-Level Input Voltage<br>(Emode & Test — HC Inputs)      | 4.25<br>5.25    |                   | 1.27<br>1.57 |               | 1.27<br>1.57 | V    | Per Truth Table  |
|                  | Max Low-Level Input Voltage<br>(Enable — HCT Inputs)           | 4.25<br>5.25    |                   | 0.8<br>0.8   |               | 0.8<br>0.8   | V    | Per Truth Table  |
| V <sub>out</sub> | Output Voltage<br>When Terminated                              | 4.25<br>5.25    | 0.6 • TERMPWR ±2% |              |               |              | V    | V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub><br> I <sub>OUT</sub>   = 0 μA |
| I <sub>in</sub>  | Max Input Leakage Current<br>(Emode & LV <sub>CC</sub> Inputs) | 5.25            |                   | ±0.10        |               | ±1.0         | μA   | V <sub>in</sub> = TERMPWR or GND<br>V <sub>ref</sub> = TERMPWR                     |
|                  | Max Input Leakage Current<br>(Enable Input)                    | 5.25            |                   | ±0.10        |               | ±1.0         | μA   | V <sub>in</sub> = TERMPWR  |
|                  | Max Input Leakage Current<br>(Test Input)                      | 5.25            |                   | ±0.10        |               | ±1.0         | μA   | V <sub>in</sub> = GND  |
| I <sub>OZ</sub>  | Max Output Leakage Current                                     | 5.25            |                   | ±0.50        |               | ±5.0         | μA   | Per Truth Table  |
| I <sub>CC</sub>  | Max Quiescent Supply Current<br>(Enable Active Low)            | 5.25            |                   | 300          |               | 300          | μA   | Emode/V <sub>ref</sub> /LV <sub>CC</sub> = TERMPWR<br>Enable/Test = GND            |
|                  | Max Quiescent Supply Current<br>(Comparator Active)            | 5.25            |                   | 500          |               | 800          | μA   | Enable/LV <sub>CC</sub> = TERMPWR<br>Emode/V <sub>ref</sub> /Test = GND            |
| R220             | Output Pull-Up Resistor Value <sup>1</sup>                     | 4.25 to<br>5.25 | 218               | 222          | 203           | 237          | Ω    | Enable/Test/LV <sub>CC</sub> = TERMPWR<br>Emode/V <sub>ref</sub> = GND             |
| R330             | Output Pull-Down Resistor Value <sup>1</sup>                   | 4.25 to<br>5.25 | 327               | 333          | 305           | 355          | Ω    | Test/LV <sub>CC</sub> = TERMPWR<br>Enable/Emode/V <sub>ref</sub> = GND             |

<sup>1</sup> Resistor Values are compensated for a 30°C ambient to junction temperature delta. See "Thermal Considerations" section for a detailed explanation and formula. See Figures 3 & 4 for "Temperature Characteristics of Resistor Values".

| Symbol          | Parameter                                    | TERMPWR<br>(V)       | Typical @ +25°C      | Unit | Condition       |
|-----------------|--|----------------------|----------------------|------|-----------------|
| V <sub>T-</sub> | Max Latch Voltage (LV <sub>CC</sub> Input)   | 4.25<br>4.75<br>5.25 | 3.50<br>3.90<br>4.25 | V    | Per Truth Table |
| V <sub>T+</sub> | Min Unlatch Voltage (LV <sub>CC</sub> Input) | 4.25<br>4.75<br>5.25 | 4.00<br>4.40<br>4.75 | V    | Per Truth Table |

Figure 1. AC Characteristics Input Waveform Options



Note:

|                              |                  |                  |
|------------------------------|------------------|------------------|
| T ==> Terminated Level       | ① ==> $t_pZ(0)T$ | ⑤ ==> $t_pZ(1)T$ |
| Z(0) ==> Tristate Low Level  | ② ==> $t_pTZ(0)$ | ⑥ ==> $t_pTZ(1)$ |
| Z(1) ==> Tristate High Level | ③ ==> $t_pTZ(0)$ | ⑦ ==> $t_pTZ(1)$ |
|                              | ④ ==> $t_pZ(0)T$ | ⑧ ==> $t_pZ(1)T$ |

**AC CHARACTERISTICS** (TERMPWR = 4.75 ±0.5 V, C<sub>L</sub> = 50 pF, t<sub>r</sub> = t<sub>f</sub> = 6 ns)

| Symbol              | Parameters  | 25°C |     | 0°C to +70°C |     | Unit | Condition                    |
|---------------------|---|------|-----|--------------|-----|------|------------------------------|
|                     |   | Min  | Max | Min          | Max |      |                              |
| t <sub>pTZ(0)</sub> | Max Propagation Delay, Enable or Emode to Outputs | -    | 150 | -            | 200 | ns   | 1 KΩ to GND (See Fig. 1)     |
| t <sub>pTZ(1)</sub> | Max Propagation Delay, Enable or Emode to Outputs | -    | 100 | -            | 150 | ns   | 1 KΩ to TERMPWR (See Fig. 1) |
| t <sub>pZ(0)T</sub> | Max Propagation Delay, Enable or Emode to Outputs | -    | 150 | -            | 200 | ns   | 1 KΩ to GND (See Fig. 1)     |
| t <sub>pZ(1)T</sub> | Max Propagation Delay, Enable or Emode to Outputs | -    | 100 | -            | 150 | ns   | 1 KΩ to TERMPWR (See Fig. 1) |

**TIMING REQUIREMENTS** (TERMPWR = 4.75 ±0.5 V, C<sub>L</sub> = 50 pF, t<sub>r</sub> = t<sub>f</sub> = 6 ns)

| Symbol    | Parameters                                 | 25°C |     | 0°C to +70°C |     | Unit | Condition  |
|-----------|--|------|-----|--------------|-----|------|------------|
|           |  | Min  | Max | Min          | Max |      |            |
| t(Enable) | Min Setup Time, LV <sub>CC</sub> to Enable | 200  | -   | 500          | -   | ns   | See Fig. 2 |
| t(Latch)  | Min Hold Time, LV <sub>CC</sub> to Enable  | 50   | -   | 100          | -   | ns   | See Fig. 2 |

Figure 2. Timing Requirements

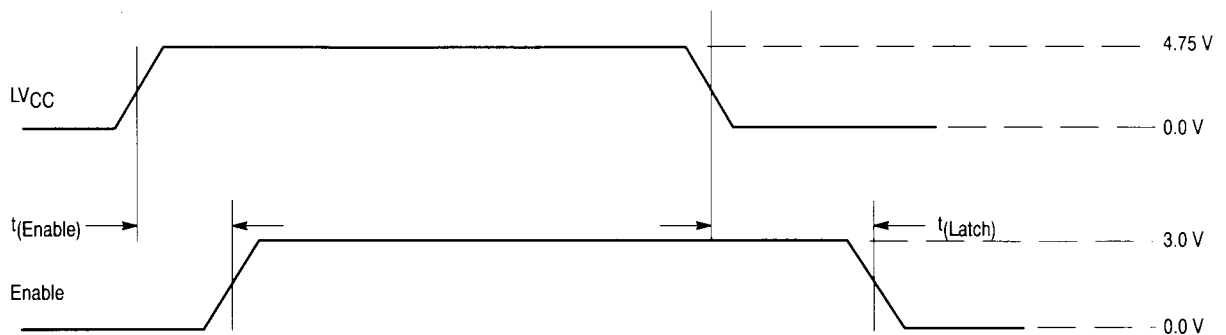
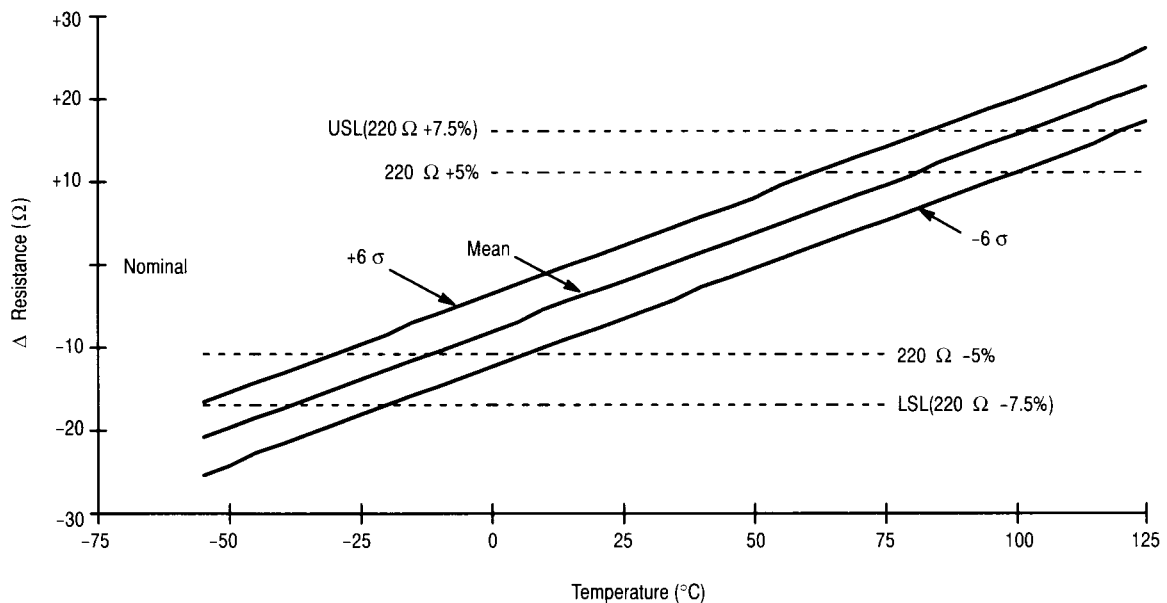


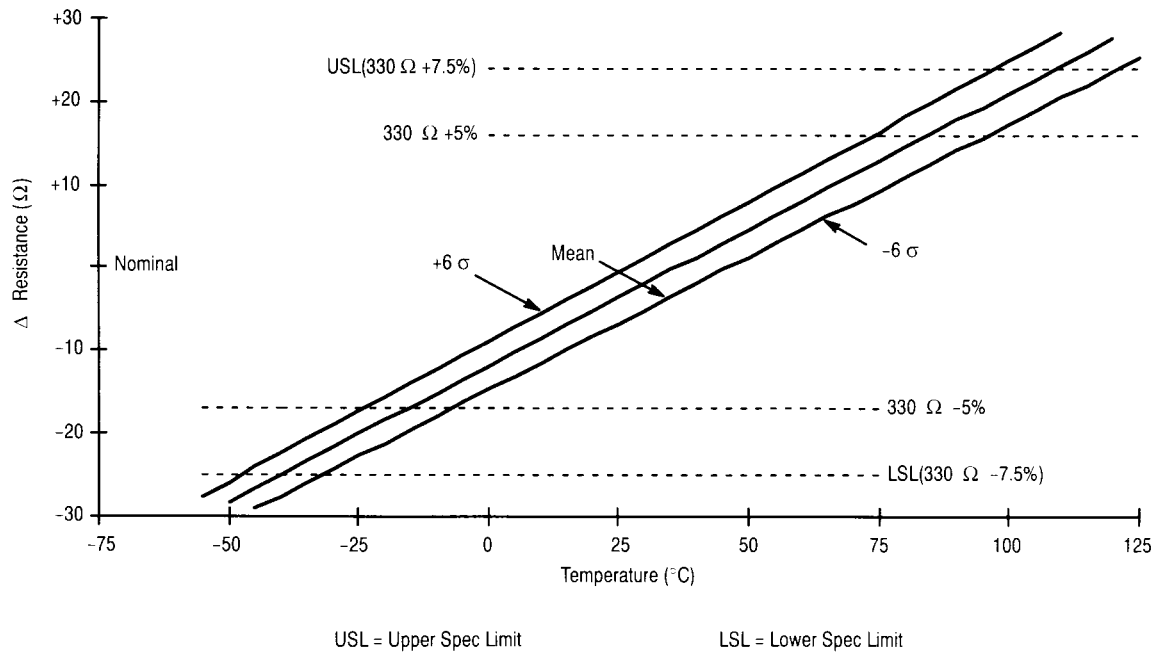
Figure 3. Temperature Characteristic of 220 Ω Resistor



USL = Upper Spec Limit

LSL = Lower Spec Limit

**Figure 4. Temperature Characteristic of 330 Ω Resistor**



## THERMAL CONSIDERATIONS

The following formula can be used to determine the operating junction temperature of the MCCS142233FN, 20 lead PLCC device:

$$T_J = ((28)(P_{diss})) + ((0.34)(T_C)) + ((0.66)(T_L))$$

$T_J$  = junction temperature

$T_C$  = case temperature(measured top center)

$T_L$  = lead temperature

$$P_{diss} = (TERMPWR)^2((\# \text{ bus lines low}/R220) + (\# \text{ bus lines high}/(R220 + R330)))$$

Minimum power dissipation, (0.45 watts) is achieved when all 9 bus lines are high. If all 9 bus lines are low, maximum power, (1.3 watts) is dissipated. The following section details the device reliability as a function of junction temperature.

### Optimizing the Long Term Reliability of Plastic Packages

Today's plastic integrated circuit packages are as reliable as ceramic packages under most environmental conditions. However when the ultimate in system reliability is required, thermal management must be considered as a prime system design goal.

Modern plastic package assembly technology utilizes gold wire bonded to aluminum bonding pads throughout the electronics industry. When exposed to high temperatures for protracted periods of time, an intermetallic compound can form in the bond area resulting in high impedance contacts and degradation of device performance. Since the formation of intermetallic compounds is directly related to device junction temperature, it is incumbent on the designer to determine that the device junction temperatures are consistent with system reliability goals.

### Predicting Bond Failure Time:

Based on the results of almost ten (10) years of +125°C operating life testing, a special arrhenius equation has been developed to show the relationship between junction temperature and reliability. Table I shows the relationship between junction temperature, and continuous operating time to 0.1% wire bond failure, (1 failure per 1000 bonds).

**Table I. Device Junction Temperature Vs. Time to 0.1% Bond Failures.**

| Junction Temperature<br>°C | Time<br>(Hours) | Time<br>(Years) |
|----------------------------|-----------------|-----------------|
| 80                         | 1,032,200       | 117.8           |
| 90                         | 419,300         | 47.9            |
| 100                        | 178,700         | 20.4            |
| 110                        | 79,600          | 9.4             |
| 120                        | 37,000          | 4.2             |
| 130                        | 17,800          | 2.0             |
| 140                        | 8,900           | 1.0             |

### MCCS142233 Applications Information

#### Enable & Emode:

The Enable and Emode input pins work together to determine the state of the termination resistors; either terminated(Enabled) or high impedance(Disabled). Enable and Emode allow the user to select the polarity of the enable signal to match the system logic signal used to drive the Enable input. If Emode is tied "high" (to TERMPWR), the enable input becomes active "high". Conversely, with Emode tied "low" (to GND), the Enable input becomes active low. This eliminates the need to add external inversion to the Enable signal regardless of the polarity of the system signal provided to the MCCS142233.

Emode can be used instead of Enable to select the state of the termination resistors. Emode has CMOS input levels, while Enable has TTL-compatible input levels.

#### LVCC & Vref:

LVcc (Local-VCC) and Vref pins provide a means for latching the proper termination state when the Enable input is driven by local logic. With Enable under local system logic control, the possibility exists for the peripheral containing the MCCS142233 to be powered down. The termination circuitry will still be powered from TERMPWR, but the Enable signal supplied to the chip by local logic will be lost. With the LVCC input tied to the peripheral's internal power supply, the MCCS142233 will sense the loss of local power prior to loss of a valid Enable input signal, and will latch the Enable state which is present prior to local power loss.

The Vref pin is the analog ground for the Local-VCC comparator and reference circuitry. For proper use of this feature, Vref must be tied to GND. Series resistance supplied by the user between Vref and GND will alter the data sheet latch threshold of LVCC. Thus the LVCC threshold may be tailored to the user's specific requirements.

Note: The input ESD structures on the Enable and LVCC inputs do not incorporate a diode to TERMPWR. Loss of TERMPWR will not result in the local power supply attempting to source TERMPWR to the system. Likewise, if the local supply (5.5 V maximum) exceeds TERMPWR (4.25 V minimum) current will not be drawn from the local power supply to TERMPWR through the MCCS142233.

Use of the Local-VCC sensing feature is only appropriate when the Enable input is driven by system logic. If the MCCS142233 is to be enabled using a wire jumper or throw switch, the user can disable the Local-VCC sensing circuitry by hardwiring the LVCC and Vref pins to TERMPWR. This will eliminate the power consumed by the comparator and reference circuitry to attain the lowest standby power condition possible.

#### Test:

The Test pin is used to open circuit one resistor branch of each terminator pair ("Test Mode") to facilitate measurement of the resistor value in production. It is held low internally through a pull-down resistor to operate the device in the "Active Mode" per the truth table. The Test mode may be of use in system debug once the MCCS142233 is on the PC board. It is recommended to leave the Test pin either unconnected (pulled low internally) or grounded depending on whether the "Test Mode" offers any utility to the user in the system configuration.

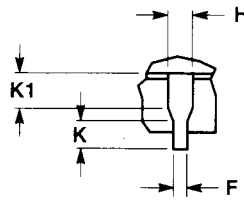
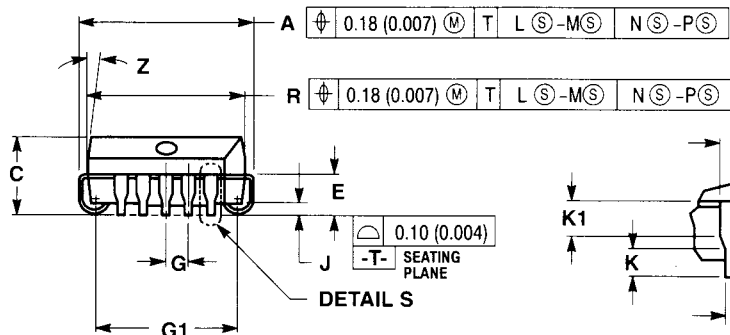
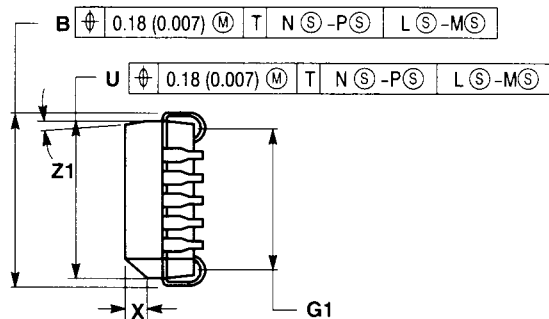
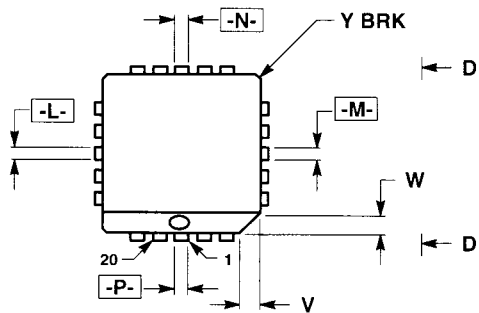
## MCCS142233 Applications Information

| Enable Input Application                             | Result   |
|--|--|
| <b>A. No Connection to Enable</b>                    | Enable input will be pulled “high” internally. Termination state will depend upon the polarity of the Emode input. Emode should be hardwired “high” or the termination will be permanently disabled.   |
| <b>B. Single Pole Switch to GND</b>                  | Enable input will be pulled “high” internally when the switch is open. Enable input will be held “low” when the switch is closed. Termination state will depend upon the polarity of the Emode input.  |
| <b>C. Double Pole Switch to Both TERMPWR and GND</b> | This is a more expensive way to accomplish application B. above. It is more economical to allow the internal pullup to provide the “high” input level.   |
| <b>D. Hardwired “High”</b>                           | With Emode also hardwired “high”, the MCCS142233 will be permanently enabled and provide termination on all outputs. With Emode hardwired “low”, the chip will be permanently disabled.  |
| <b>E. Hardwired “Low”</b>                            | With Emode also hardwired “low”, the MCCS142233 will be permanently enabled and provide termination on all outputs. With Emode hardwired “high” the chip will be permanently disabled. Application D. above is preferred over E. since D. does not draw current through the Enable input pull-up resistor. |
| <b>F. External Logic Driven</b>                      | With LV <sub>CC</sub> input connected to the local power supply and V <sub>ref</sub> connected to GND, the Local-V <sub>CC</sub> sensing and Enable latching feature will be active. If this feature is not desired, hardwire LV <sub>CC</sub> and V <sub>ref</sub> to TERMPWR.                            |



# OUTLINE DIMENSIONS

FN SUFFIX  
PLASTIC PACKAGE  
CASE 775-02



|               |              |     |   |            |            |
|---------------|--------------|-----|---|------------|------------|
| $\varnothing$ | 0.25 (0.010) | (M) | T | L (S)-M(S) | N (S)-P(S) |
|---------------|--------------|-----|---|------------|------------|

|               |              |     |   |            |            |
|---------------|--------------|-----|---|------------|------------|
| $\varnothing$ | 0.25 (0.010) | (M) | T | N (S)-P(S) | L (S)-M(S) |
|---------------|--------------|-----|---|------------|------------|

|               |              |     |   |            |            |
|---------------|--------------|-----|---|------------|------------|
| $\varnothing$ | 0.18 (0.007) | (M) | T | L (S)-M(S) | N (S)-P(S) |
|---------------|--------------|-----|---|------------|------------|

|               |              |     |   |            |            |
|---------------|--------------|-----|---|------------|------------|
| $\varnothing$ | 0.18 (0.007) | (M) | T | L (S)-M(S) | N (S)-P(S) |
|---------------|--------------|-----|---|------------|------------|

|               |              |     |   |            |            |
|---------------|--------------|-----|---|------------|------------|
| $\varnothing$ | 0.18 (0.007) | (M) | T | L (S)-M(S) | N (S)-P(S) |
|---------------|--------------|-----|---|------------|------------|

|               |              |     |   |            |            |
|---------------|--------------|-----|---|------------|------------|
| $\varnothing$ | 0.18 (0.007) | (M) | T | N (S)-P(S) | L (S)-M(S) |
|---------------|--------------|-----|---|------------|------------|

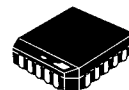
|               |              |     |   |            |            |
|---------------|--------------|-----|---|------------|------------|
| $\varnothing$ | 0.10 (0.004) | (M) | T | L (S)-M(S) | N (S)-P(S) |
|---------------|--------------|-----|---|------------|------------|


|               |              |     |   |            |            |
|---------------|--------------|-----|---|------------|------------|
| $\varnothing$ | 0.18 (0.007) | (M) | T | L (S)-M(S) | N (S)-P(S) |
|---------------|--------------|-----|---|------------|------------|

|               |              |     |   |            |            |
|---------------|--------------|-----|---|------------|------------|
| $\varnothing$ | 0.18 (0.007) | (M) | T | N (S)-P(S) | L (S)-M(S) |
|---------------|--------------|-----|---|------------|------------|

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 9.78        | 10.03 | 0.385     | 0.395 |
| B   | 9.78        | 10.03 | 0.385     | 0.395 |
| C   | 4.20        | 4.57  | 0.165     | 0.180 |
| E   | 2.29        | 2.79  | 0.090     | 0.110 |
| F   | 0.33        | 0.48  | 0.013     | 0.019 |
| G   | 1.27 BSC    |       | 0.050 BSC |       |
| H   | 0.66        | 0.81  | 0.026     | 0.032 |
| J   | 0.51        | —     | 0.020     | —     |
| K   | 0.64        | —     | 0.025     | —     |
| R   | 8.89        | 9.04  | 0.350     | 0.356 |
| U   | 8.89        | 9.04  | 0.350     | 0.356 |
| V   | 1.07        | 1.21  | 0.042     | 0.048 |
| W   | 1.07        | 1.21  | 0.042     | 0.048 |
| X   | 1.07        | 1.42  | 0.042     | 0.056 |
| Y   | —           | 0.50  | —         | 0.020 |
| Z   | 2°          | 10°   | 2°        | 10°   |
| G1  | 7.88        | 8.38  | 0.310     | 0.330 |
| K1  | 1.02        | —     | 0.040     | —     |
| Z1  | 2°          | 10°   | 2°        | 10°   |

- NOTES:
- DATUMS -L-, -M-, -N-, AND -P- DETERMINED WHERE TOP OF LEAD SHOULDER EXIT PLASTIC BODY AT MOLD PARTING LINE.
  - DIM G1, TRUE POSITION TO BE MEASURED AT DATUM -T-, SEATING PLANE.
  - DIM R AND U DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE MOLD PROTRUSION IS 0.25 (0.010) PER SIDE.
  - DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  - CONTROLLING DIMENSION: INCH.
  - 775-01 IS OBSOLETE. NEW STANDARD 775-02.



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