

## NUP2105

## Dual Line CAN Bus Protector

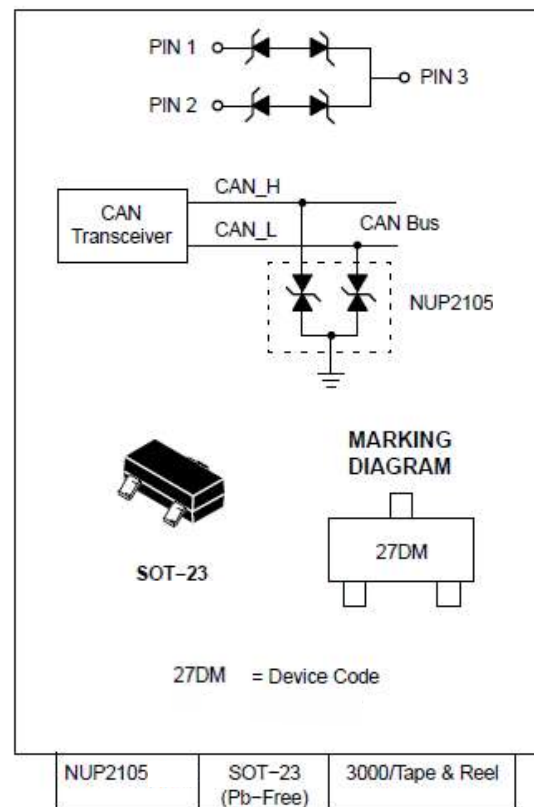
The NUP2105 has been designed to protect the CAN transceiver in high-speed and fault tolerant networks from ESD and other harmful transient voltage events. This device provides bidirectional protection for each data line with a single compact SOT-23 package, giving the system designer a low cost option for improving system reliability and meeting stringent EMI requirements.

### FEATURES

- 350 W Peak Power Dissipation per Line (8 x 20  $\mu$ sec Waveform)
- Low Reverse Leakage Current (< 100 nA)
- Low Capacitance High-Speed CAN Data Rates
- IEC Compatibility:
  - IEC 61000-4-2 (ESD): Level 4
  - IEC 61000-4-4 (EFT): 40 A – 5/50 ns
  - IEC 61000-4-5 (Lighting) 8.0 A (8/20  $\mu$ s)
- ISO 7637-1, Nonrepetitive EMI Surge Pulse 2, 9.5 A (1 x 50  $\mu$ s)
- ISO 7637-3, Repetitive Electrical Fast Transient (EFT) EMI Surge Pulses, 50 A (5 x 50 ns)
- Flammability Rating UL 94 V-0
- Pb-Free Packages are Available

### APPLICATIONS

- Industrial Control Networks
  - ♦ Smart Distribution Systems (SDS™)
  - ♦ DeviceNet™
- Automotive Networks
  - ♦ Low and High-Speed CAN
  - ♦ Fault Tolerant CAN



## Maximum Ratings (T<sub>J</sub>=25°C Unless Otherwise Specified)

| Symbol         | Rating                                                                                | Value           | Unit          |
|----------------|---------------------------------------------------------------------------------------|-----------------|---------------|
| PPK            | Peak Power Dissipation<br>8 x 20 $\mu$ s Double Exponential Waveform (Note 1)         | 350             | W             |
| T <sub>J</sub> | Operating Junction Temperature Range                                                  | -40 to 125      | °C            |
| T <sub>J</sub> | Storage Temperature Range                                                             | -55 to 150      | °C            |
| T <sub>L</sub> | Lead Solder Temperature (10 s)                                                        | 260             | °C            |
| ESD            | Human Body model (HBM)<br>Machine Model (MM)<br>IEC 61000-4-2 Specification (Contact) | 16<br>400<br>30 | kV<br>V<br>kV |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. Non-repetitive current pulse per Figure 1.

## ELECTRICAL CHARACTERISTICS

| Symbol           | Parameter                  | Test Conditions                                             | Min  | Typ | Max | Unit |
|------------------|----------------------------|-------------------------------------------------------------|------|-----|-----|------|
| V <sub>RWM</sub> | Reverse Working Voltage    | (Note 2)                                                    | 24   |     |     | V    |
| V <sub>BR</sub>  | Breakdown Voltage          | I <sub>T</sub> = 1 mA (Note 3)                              | 26.2 |     | 32  | V    |
| I <sub>R</sub>   | Reverse Leakage Current    | V <sub>RWM</sub> = 24 V                                     |      | 15  | 100 | nA   |
| V <sub>C</sub>   | Clamping Voltage           | I <sub>PP</sub> = 5 A (8 x 20 $\mu$ s Waveform)<br>(Note 4) |      |     | 40  | V    |
| V <sub>C</sub>   | Clamping Voltage           | I <sub>PP</sub> = 8 A (8 x 20 $\mu$ s Waveform)<br>(Note 4) |      |     | 44  | V    |
| I <sub>PP</sub>  | Maximum Peak Pulse Current | 8 x 20 $\mu$ s Waveform (Note 4)                            |      |     | 8.0 | A    |
| C <sub>J</sub>   | Capacitance                | V <sub>R</sub> = 0 V, f = 1 MHz (1 line to GND)             |      |     | 30  | pF   |

2. TVS devices are normally selected according to the working peak reverse voltage (VRWM), which should be equal or greater than the DC or continuous peak operating voltage level.

3. VBR is measured at pulse test current IT.

4. Pulse waveform per Figure 1.

## TYPICAL PERFORMANCE CURVES

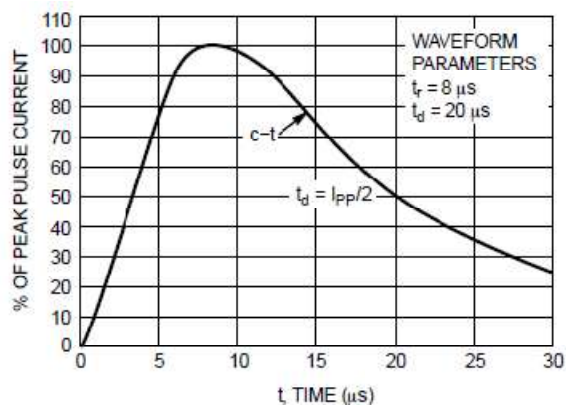


Figure 1. Pulse Waveform,  $8 \times 20 \mu s$

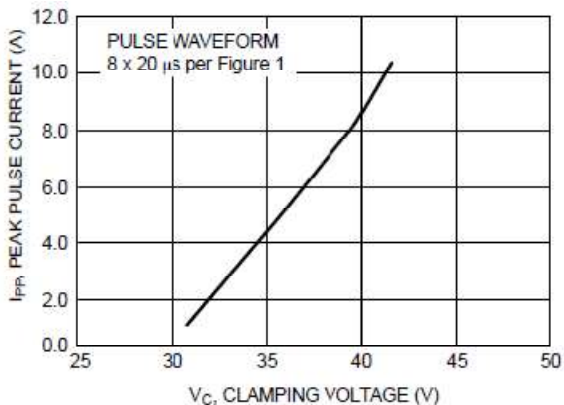


Figure 2. Clamping Voltage vs Peak Pulse Current

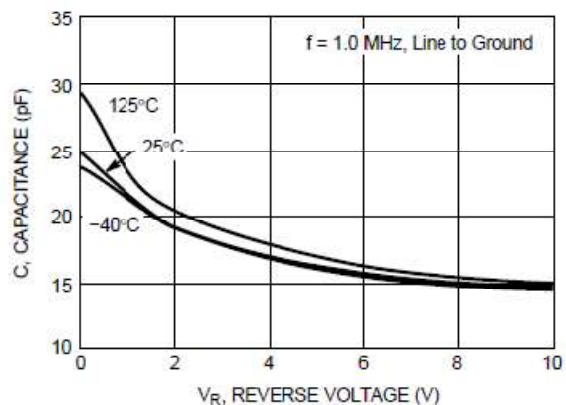


Figure 3. Typical Junction Capacitance vs Reverse Voltage

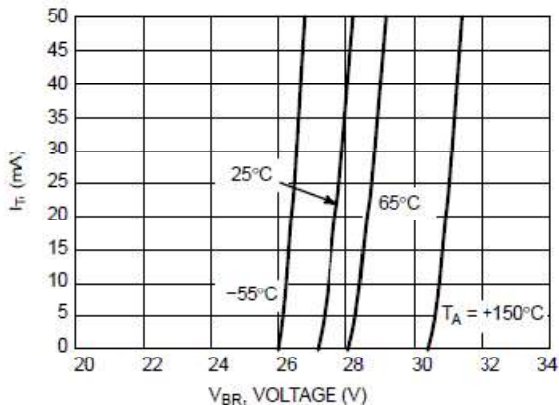


Figure 4.  $V_{BR}$  versus  $I_T$  Characteristics of the NUP2105

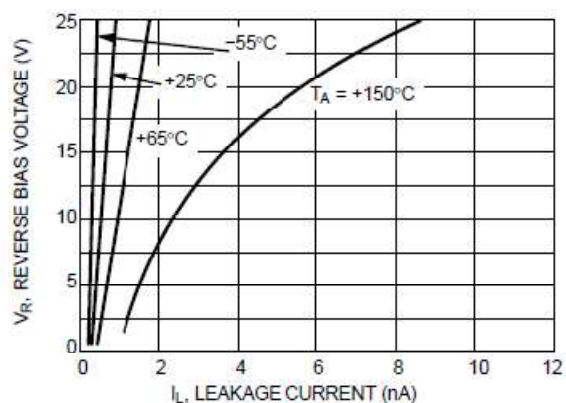


Figure 5.  $I_R$  versus Temperature Characteristics of the NUP2105

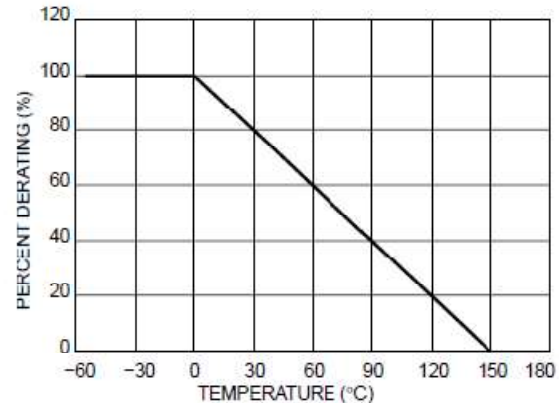


Figure 6. Temperature Power Dissipation Derating of the NUP2105

## TVS Diode Protection Circuit

TVS diodes provide protection to a transceiver by clamping a surge voltage to a safe level. TVS diodes have high impedance below and low impedance above their breakdown voltage. A TVS Zener diode has its junction optimized to absorb the high peak energy of a transient event, while a standard Zener diode is designed and specified to clamp a steady state voltage.

Figure 7 provides an example of a dual bidirectional TVS diode array that can be used for protection with the high-speed CAN network. The bidirectional array is created from four identical Zener TVS diodes. The clamping voltage of the composite device is equal to the breakdown

voltage of the diode that is reversed biased, plus the diode drop of the second diode that is forward biased.

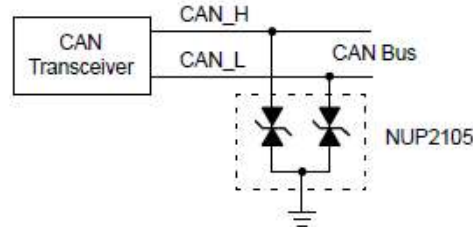
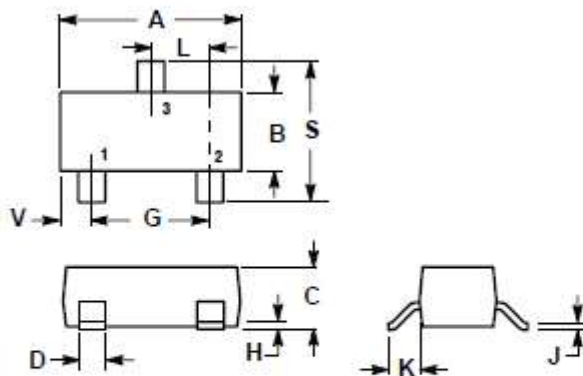


Figure 7. High-Speed and Fault Tolerant CAN TVS Protection Circuit

## PACKAGE DIMENSIONS

### SOT-23



#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318-01 THRU -07 AND -09 OBSOLETE, NEW STANDARD 318-08.

| DIM | INCHES |        | MILLIMETERS |       |
|-----|--------|--------|-------------|-------|
|     | MIN    | MAX    | MIN         | MAX   |
| A   | 0.1102 | 0.1197 | 2.80        | 3.04  |
| B   | 0.0472 | 0.0551 | 1.20        | 1.40  |
| C   | 0.0350 | 0.0440 | 0.89        | 1.11  |
| D   | 0.0150 | 0.0200 | 0.37        | 0.50  |
| G   | 0.0701 | 0.0807 | 1.78        | 2.04  |
| H   | 0.0005 | 0.0040 | 0.013       | 0.100 |
| J   | 0.0034 | 0.0070 | 0.085       | 0.177 |
| K   | 0.0140 | 0.0285 | 0.35        | 0.69  |
| L   | 0.0350 | 0.0401 | 0.89        | 1.02  |
| S   | 0.0830 | 0.1039 | 2.10        | 2.64  |
| V   | 0.0177 | 0.0238 | 0.45        | 0.60  |

#### STYLE 27:

- PIN 1. CATHODE  
2. CATHODE  
3. CATHODE