

# ESD Protection Diode

## Low Capacitance ESD Protection for High Speed Data

### NUP2115L, SZNUP2115L

The SZ/NUP2115L has been designed to protect the FlexRay transceiver 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.

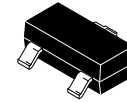
#### Features

- 200 W Peak Power Dissipation per Line (8/20  $\mu$ s Waveform)
- Diode Capacitance Matching
- Low Reverse Leakage Current (< 100 nA)
- Low Capacitance High-Speed FlexRay Data Rates
- IEC Compatibility:
  - IEC 61000-4-2 (ESD): Level 4
  - IEC 61000-4-4 (EFT): 50 A – 5/50 ns
  - IEC 61000-4-5 (Lighting) 3.0 A (8/20  $\mu$ s)
- ISO 7637-1, Nonrepetitive EMI Surge Pulse 2, 8.0 A (1/50  $\mu$ s)
- ISO 7637-3, Repetitive Electrical Fast Transient (EFT) EMI Surge Pulses, 50 A (5/50 ns)
- Flammability Rating UL 94 V-0
- SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These are Pb-Free Devices

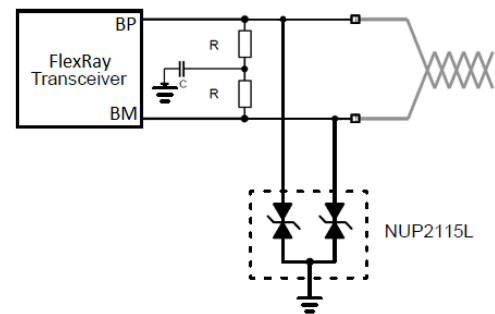
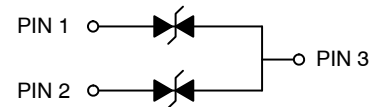
#### Applications

- Automotive Networks
  - ◆ FlexRay Bus

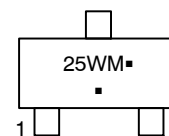
## SOT-23 DUAL BIDIRECTIONAL VOLTAGE SUPPRESSOR 200 W PEAK POWER



SOT-23  
CASE 318  
STYLE 27



#### MARKING DIAGRAM



25W = Device Code  
 M = Date Code  
 ■ = Pb-Free Package

(Note: Microdot may be in either location)

#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 2.

# NUP2115L, SZNUP2115L

## MAXIMUM RATINGS (T<sub>J</sub> = 25°C, unless otherwise specified)

| Symbol         | Rating   | Value      | Unit |
|----------------|--|------------|------|
| PPK            | Peak Power Dissipation, 8 x 20 μs Double Exponential Waveform (Note 1) | 200        | W    |
| T <sub>J</sub> | Operating Junction Temperature Range                                   | -55 to 150 | °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)   | 8.0        | kV   |
|                | Machine Model (MM)   | 400        | V    |
|                | IEC 61000-4-2 Specification (Contact)                                  | 30         | kV   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Non-repetitive current pulse per Figure 1.

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C, unless otherwise specified)

| 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> = 1 A (8/20 μs Waveform)<br>(Note 4) | -    | 33.4 | 36.6 | V    |
| V <sub>C</sub>   | Clamping Voltage           | I <sub>PP</sub> = 3 A (8/20 μs Waveform)<br>(Note 4) | -    | 44   | 50   | V    |
| I <sub>PP</sub>  | Maximum Peak Pulse Current | 8/20 μs Waveform (Note 4)                            | -    | -    | 3.0  | A    |
| C <sub>J</sub>   | Capacitance                | V <sub>R</sub> = 0 V, f = 1 MHz (Line to GND)        | -    | -    | 10   | pF   |
| ΔC               | Diode Capacitance Matching | V <sub>R</sub> = 0 V, 5 MHz (Note 5)                 | -    | 0.1  | 2    | %    |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Surge protection devices are normally selected according to the working peak reverse voltage (V<sub>RWM</sub>), which should be equal or greater than the DC or continuous peak operating voltage level.
3. V<sub>BR</sub> is measured at pulse test current I<sub>T</sub>.
4. Pulse waveform per Figure 1.
5. ΔC is the percentage difference between C<sub>J</sub> of lines 1 and 2 measured according to the test conditions given in the electrical characteristics table.

## ORDERING INFORMATION

| Device        | Package             | Shipping <sup>†</sup> |
|---------------|---------------------|-----------------------|
| NUP2115LT1G   | SOT-23<br>(Pb-Free) | 3,000 / Tape & Reel   |
| SZNUP2115LT1G | SOT-23<br>(Pb-Free) | 3,000 / Tape & Reel   |
| NUP2115LT3G   | SOT-23<br>(Pb-Free) | 10,000 / Tape & Reel  |

## DISCONTINUED (Note 6)

|               |                     |                      |
|---------------|---------------------|----------------------|
| SZNUP2115LT3G | SOT-23<br>(Pb-Free) | 10,000 / Tape & Reel |
|---------------|---------------------|----------------------|

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

6. **DISCONTINUED:** These devices are not recommended for new design. Please contact your **onsemi** representative for information. The most current information on these devices may be available on [www.onsemi.com](http://www.onsemi.com).

# NUP2115L, SZNUP2115L

## TYPICAL PERFORMANCE CURVES

( $T_J = 25^\circ\text{C}$  unless otherwise noted)

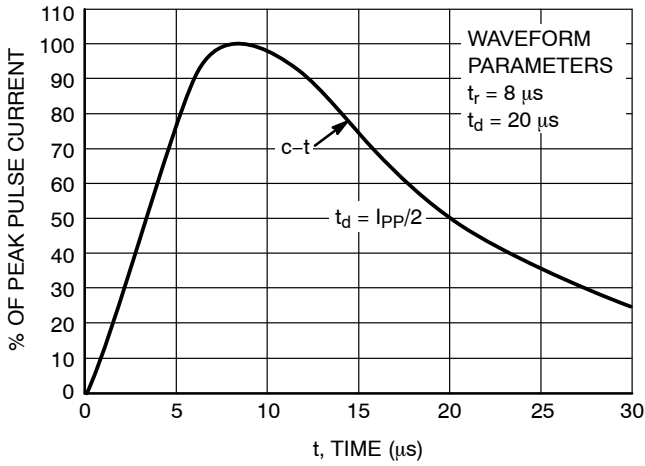


Figure 1. Pulse Waveform,  $8 \times 20 \mu\text{s}$

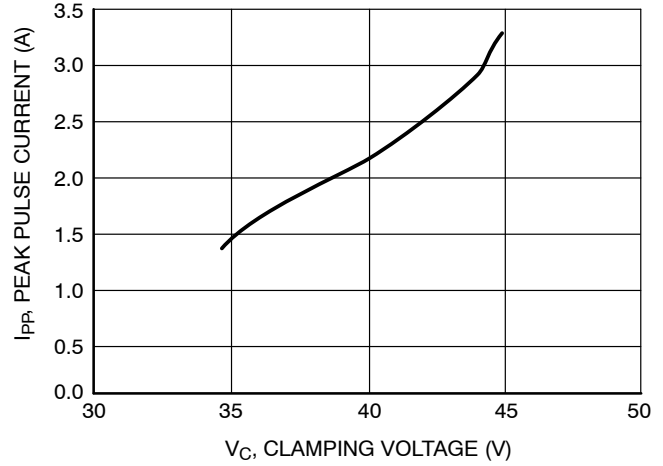


Figure 2. Clamping Voltage vs Peak Pulse Current

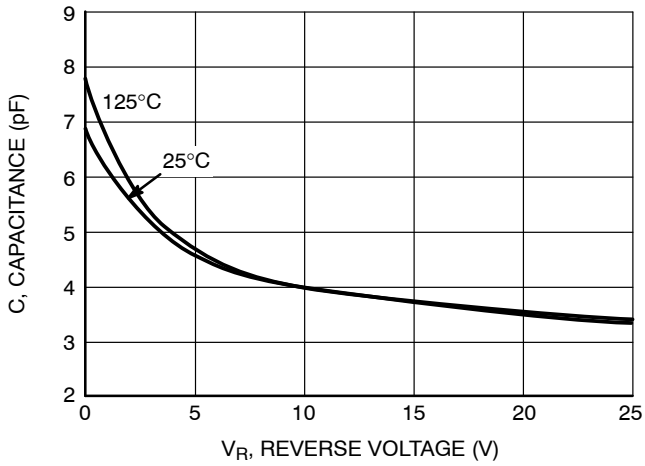


Figure 3. Typical Junction Capacitance vs Reverse Voltage

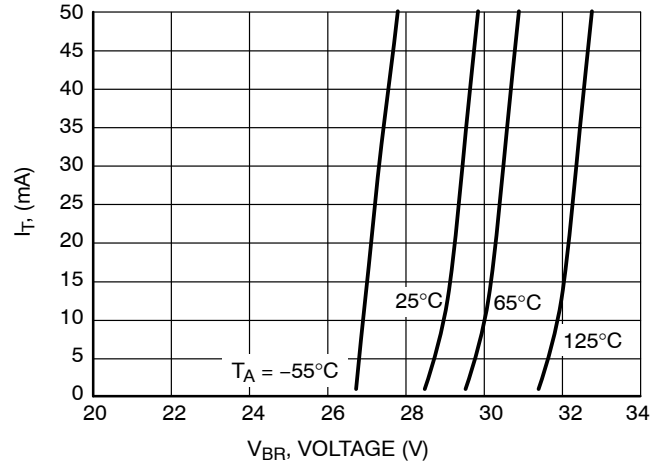


Figure 4.  $V_{BR}$  versus  $I_T$  Characteristics

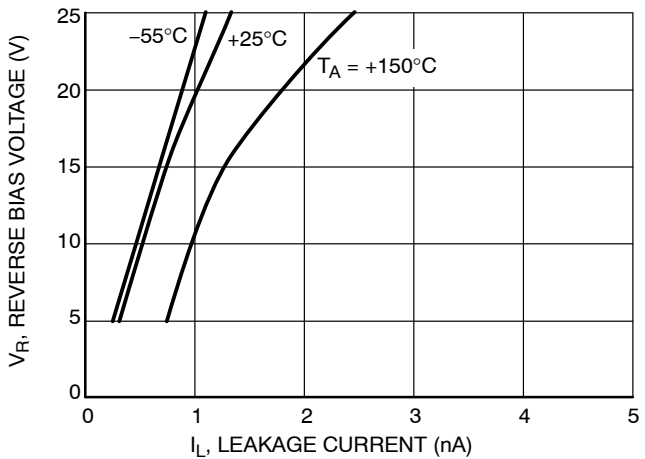


Figure 5.  $I_R$  versus Temperature Characteristics

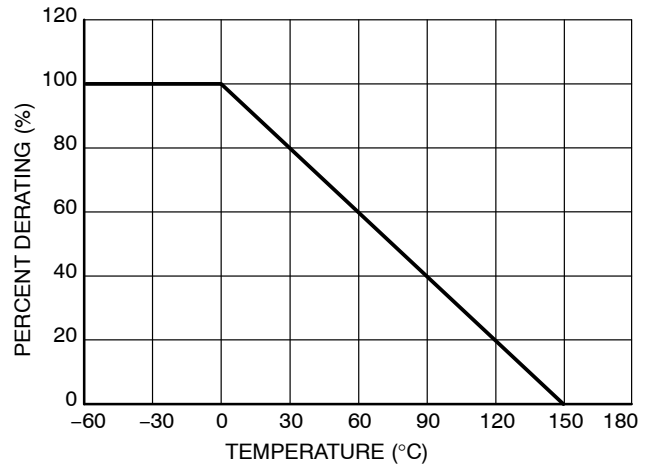


Figure 6. Temperature Power Dissipation Derating

## APPLICATIONS

Surge protection diodes provide a low cost solution to conducted and radiated Electromagnetic Interference (EMI) and Electrostatic Discharge (ESD) noise problems. The noise immunity level and reliability of FlexRay transceivers can be easily increased by adding external surge protection diodes to prevent transient voltage failures.

The NUP2115L provides a surge protection solution for FlexRay data communication lines. The NUP2115L is a dual bidirectional surge protection device in a compact SOT-23 package. This device is based on Zener technology that optimizes the active area of a PN junction to provide robust protection against transient EMI surge voltage and ESD.

### Surge Protection Diode Protection Circuit

Surge protection diodes provide protection to a transceiver by clamping a surge voltage to a safe level. surge protection diodes have high impedance below and low impedance above their breakdown voltage. A surge protection 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 surge protection diode array that can be used for protection with the FlexRay network. The bidirectional array is created from four identical Zener surge protection 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.

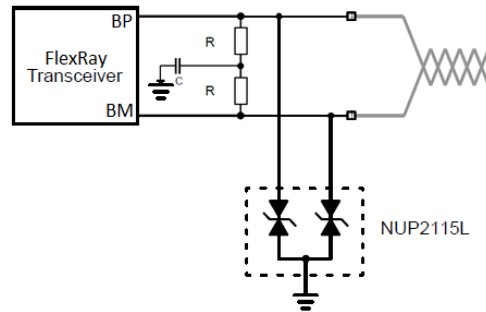


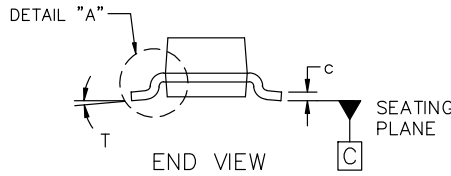
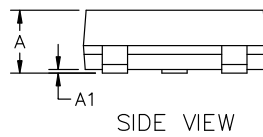
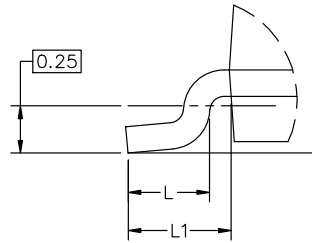
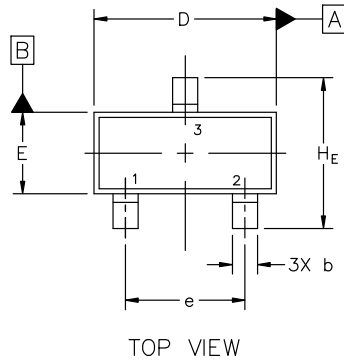
Figure 7. FlexRay Surge Protection Circuit



SCALE 4:1

**SOT-23 (TO-236) 2.90x1.30x1.00 1.90P**  
**CASE 318**  
**ISSUE AU**

DATE 14 AUG 2024

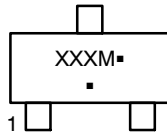


| MILLIMETERS |      |      |      |
|-------------|------|------|------|
| DIM         | MIN  | NOM  | MAX  |
| A           | 0.89 | 1.00 | 1.11 |
| A1          | 0.01 | 0.06 | 0.10 |
| b           | 0.37 | 0.44 | 0.50 |
| c           | 0.08 | 0.14 | 0.20 |
| D           | 2.80 | 2.90 | 3.04 |
| E           | 1.20 | 1.30 | 1.40 |
| e           | 1.78 | 1.90 | 2.04 |
| L           | 0.30 | 0.43 | 0.55 |
| L1          | 0.35 | 0.54 | 0.69 |
| HE          | 2.10 | 2.40 | 2.64 |
| T           | 0°   | ---  | 10°  |

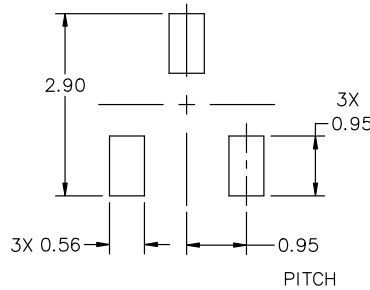
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSIONS: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

**GENERIC MARKING DIAGRAM\***



XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package



\* For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

**STYLES ON PAGE 2**

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**SOT-23 (TO-236) 2.90x1.30x1.00 1.90P**  
**CASE 318**  
**ISSUE AU**

DATE 14 AUG 2024

STYLE 1 THRU 5:  
CANCELLED

STYLE 6:  
PIN 1. BASE  
2. EMITTER  
3. COLLECTOR

STYLE 7:  
PIN 1. EMITTER  
2. BASE  
3. COLLECTOR

STYLE 8:  
PIN 1. ANODE  
2. NO CONNECTION  
3. CATHODE

STYLE 9:  
PIN 1. ANODE  
2. ANODE  
3. CATHODE

STYLE 10:  
PIN 1. DRAIN  
2. SOURCE  
3. GATE

STYLE 11:  
PIN 1. ANODE  
2. CATHODE  
3. CATHODE-ANODE

STYLE 12:  
PIN 1. CATHODE  
2. CATHODE  
3. ANODE

STYLE 13:  
PIN 1. SOURCE  
2. DRAIN  
3. GATE

STYLE 14:  
PIN 1. CATHODE  
2. GATE  
3. ANODE

STYLE 15:  
PIN 1. GATE  
2. CATHODE  
3. ANODE

STYLE 16:  
PIN 1. ANODE  
2. CATHODE  
3. CATHODE

STYLE 17:  
PIN 1. NO CONNECTION  
2. ANODE  
3. CATHODE

STYLE 18:  
PIN 1. NO CONNECTION  
2. CATHODE  
3. ANODE

STYLE 19:  
PIN 1. CATHODE  
2. ANODE  
3. CATHODE-ANODE

STYLE 20:  
PIN 1. CATHODE  
2. ANODE  
3. GATE

STYLE 21:  
PIN 1. GATE  
2. SOURCE  
3. DRAIN

STYLE 22:  
PIN 1. RETURN  
2. OUTPUT  
3. INPUT

STYLE 23:  
PIN 1. ANODE  
2. ANODE  
3. CATHODE

STYLE 24:  
PIN 1. GATE  
2. DRAIN  
3. SOURCE

STYLE 25:  
PIN 1. ANODE  
2. CATHODE  
3. GATE

STYLE 26:  
PIN 1. CATHODE  
2. ANODE  
3. NO CONNECTION

STYLE 27:  
PIN 1. CATHODE  
2. CATHODE  
3. CATHODE

STYLE 28:  
PIN 1. ANODE  
2. ANODE  
3. ANODE

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