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FAIRCHILD

SEMICONDUCTOR®

November 2013

# ISL9R1560G2, ISL9R1560P2, ISL9R1560S2, ISL9R1560S3S

## 15 A, 600 V, STEALTH™ Diode

### Features

- Stealth Recovery  $t_{rr} = 29.4$  ns (@  $I_F = 15$  A)
- Max Forward Voltage,  $V_F = 2.2$  V (@  $T_C = 25^\circ\text{C}$ )
- 600 V Reverse Voltage and High Reliability
- Avalanche Energy Rated
- RoHS Compliant

### Applications

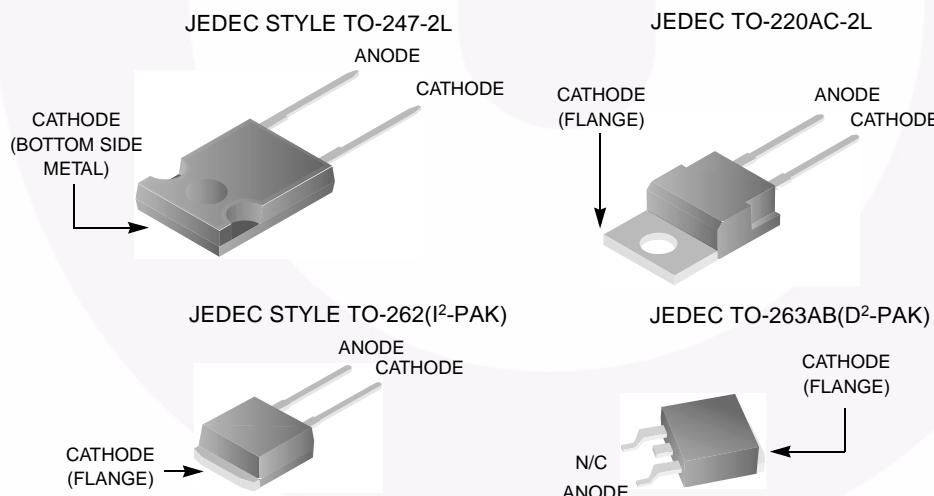
- SMPS
- Hard Switched PFC Boost Diode
- UPS Free Wheeling Diode
- Motor Drive FWD
- SMPS FWD
- Snubber Diode

### Description

The ISL9R1560G2, ISL9R1560P2, ISL9R1560S2, ISL9R1560S3S is a STEALTH™ diode optimized for low loss performance in high frequency hard switched applications. The STEALTH™ family exhibits low reverse recovery current ( $I_{rr}$ ) and exceptionally soft recovery under typical operating conditions. This device is intended for use as a free wheeling or boost diode in power supplies and other power switching applications. The low  $I_{rr}$  and short  $t_{rr}$  phase reduce loss in switching transistors. The soft recovery minimizes ringing, expanding the range of conditions under which the diode may be operated without the use of additional snubber circuitry. Consider using the STEALTH™ diode with an SMPS IGBT to provide the most efficient and highest power density design at lower cost.

### Package

### Symbol



### Device Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

| Symbol      | Parameter   | Ratings | Unit |
|-------------|---|---------|------|
| $V_{RRM}$   | Repetitive Peak Reverse Voltage                                 | 600     | V    |
| $V_{RWM}$   | Working Peak Reverse Voltage                                    | 600     | V    |
| $V_R$       | DC Blocking Voltage   | 600     | V    |
| $I_{F(AV)}$ | Average Rectified Forward Current ( $T_C = 145^\circ\text{C}$ ) | 15      | A    |
| $I_{FRM}$   | Repetitive Peak Surge Current (20kHz Square Wave)               | 30      | A    |
| $I_{FSM}$   | Nonrepetitive Peak Surge Current (Halfwave 1 Phase 60Hz)        | 200     | A    |

| Symbol                             | Parameter  | Ratings    | Unit     |
|------------------------------------|--|------------|----------|
| P <sub>D</sub>                     | Power Dissipation  | 150        | W        |
| E <sub>AVL</sub>                   | Avalanche Energy (1 A, 40 mH)  | 20         | mJ       |
| T <sub>J</sub> , T <sub>STG</sub>  | Operating and Storage Temperature Range  | -55 to 175 | °C       |
| T <sub>L</sub><br>T <sub>PKG</sub> | Maximum Temperature for Soldering<br>Leads at 0.063in (1.6mm) from Case for 10s<br>Package Body for 10s, See Techbrief TB334 | 300<br>260 | °C<br>°C |

CAUTION: Stresses above those listed in "Device Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

### Package Marking and Ordering Information

| Part Number   | Top Mark     | Package                     | Packing Method | Reel Size | Tape Width | Quantity |
|---------------|--------------|-----------------------------|----------------|-----------|------------|----------|
| ISL9R1560G2   | ISL9R1560G2  | TO-247-2L                   | Tube           | N/A       | N/A        | 30       |
| ISL9R1560P2   | ISL9R1560P2  | TO-220AC-2L                 | Tube           | N/A       | N/A        | 50       |
| ISL9R1560S2   | ISL9R1560S2  | TO-262(I <sup>2</sup> -PAK) | Tube           | N/A       | N/A        | 50       |
| ISL9R1560S3ST | ISL9R1560S3S | TO-263(D <sup>2</sup> -PAK) | Reel           | 13" dia   | 24mm       | 800      |

### Electrical Characteristics $T_C = 25^\circ\text{C}$ unless otherwise noted

| Symbol                           | Parameter | Test Conditions | Min | Typ | Max | Unit |
|----------------------------------|-----------|-----------------|-----|-----|-----|------|
| <b>Off State Characteristics</b> |           |                 |     |     |     |      |

|                |                               |                        |                        |   |   |     |    |
|----------------|-------------------------------|------------------------|------------------------|---|---|-----|----|
| I <sub>R</sub> | Instantaneous Reverse Current | V <sub>R</sub> = 600 V | T <sub>C</sub> = 25°C  | - | - | 100 | μA |
|                |                               |                        | T <sub>C</sub> = 125°C | - | - | 1.0 | mA |

### On State Characteristics

|                |                               |                       |                        |   |      |     |   |
|----------------|-------------------------------|-----------------------|------------------------|---|------|-----|---|
| V <sub>F</sub> | Instantaneous Forward Voltage | I <sub>F</sub> = 15 A | T <sub>C</sub> = 25°C  | - | 1.8  | 2.2 | V |
|                |                               |                       | T <sub>C</sub> = 125°C | - | 1.65 | 2.0 | V |

### Dynamic Characteristics

|                |                      |   |   |    |   |    |
|----------------|----------------------|---|---|----|---|----|
| C <sub>J</sub> | Junction Capacitance | V <sub>R</sub> = 10 V, I <sub>F</sub> = 0 A | - | 62 | - | pF |
|----------------|----------------------|---|---|----|---|----|

### Switching Characteristics

|                     |   |  |   |      |    |      |
|---------------------|---|--|---|------|----|------|
| t <sub>rr</sub>     | Reverse Recovery Time                             | I <sub>F</sub> = 1 A, di <sub>F</sub> /dt = 100 A/μs, V <sub>R</sub> = 30 V  | - | 25   | 30 | ns   |
|                     |   | I <sub>F</sub> = 15 A, di <sub>F</sub> /dt = 100 A/μs, V <sub>R</sub> = 30 V | - | 35   | 40 | ns   |
| t <sub>rr</sub>     | Reverse Recovery Time                             | I <sub>F</sub> = 15 A,   | - | 29.4 | -  | ns   |
| I <sub>rr</sub>     | Reverse Recovery Current                          | di <sub>F</sub> /dt = 200 A/μs,  | - | 3.5  | -  | A    |
| Q <sub>rr</sub>     | Reverse Recovered Charge                          | V <sub>R</sub> = 390 V, T <sub>C</sub> = 25°C                                | - | 57   | -  | nC   |
| t <sub>rr</sub>     | Reverse Recovery Time                             | I <sub>F</sub> = 15 A,   | - | 90   | -  | ns   |
| S                   | Softness Factor (t <sub>b</sub> /t <sub>a</sub> ) | di <sub>F</sub> /dt = 200 A/μs,  | - | 2.0  | -  |      |
| I <sub>rr</sub>     | Reverse Recovery Current                          | V <sub>R</sub> = 390 V,  | - | 5.0  | -  | A    |
| Q <sub>rr</sub>     | Reverse Recovered Charge                          | T <sub>C</sub> = 125°C   | - | 275  | -  | nC   |
| t <sub>rr</sub>     | Reverse Recovery Time                             | I <sub>F</sub> = 15 A,   | - | 52   | -  | ns   |
| S                   | Softness Factor (t <sub>b</sub> /t <sub>a</sub> ) | di <sub>F</sub> /dt = 800 A/μs,  | - | 1.36 | -  |      |
| I <sub>rr</sub>     | Reverse Recovery Current                          | V <sub>R</sub> = 390 V,  | - | 13.5 | -  | A    |
| Q <sub>rr</sub>     | Reverse Recovered Charge                          | T <sub>C</sub> = 125°C   | - | 390  | -  | nC   |
| di <sub>M</sub> /dt | Maximum di/dt during t <sub>b</sub>               |  | - | 800  | -  | A/μs |

### Thermal Characteristics

|                  |  |        |   |   |     |      |
|------------------|--|--------|---|---|-----|------|
| R <sub>θJC</sub> | Thermal Resistance Junction to Case    |        | - | - | 1.0 | °C/W |
| R <sub>θJA</sub> | Thermal Resistance Junction to Ambient | TO-247 | - | - | 30  | °C/W |
| R <sub>θJA</sub> | Thermal Resistance Junction to Ambient | TO-220 | - | - | 62  | °C/W |
| R <sub>θJA</sub> | Thermal Resistance Junction to Ambient | TO-262 | - | - | 62  | °C/W |
| R <sub>θJA</sub> | Thermal Resistance Junction to Ambient | TO-263 | - | - | 62  | °C/W |

## Typical Performance Curves

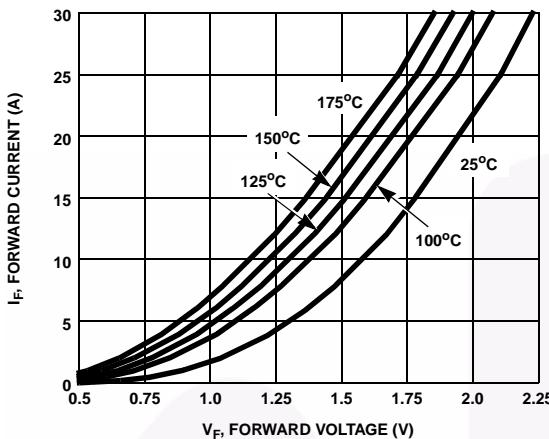


Figure 1. Forward Current vs Forward Voltage

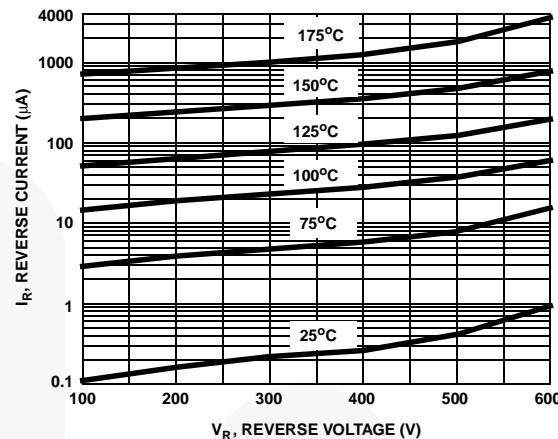


Figure 2. Reverse Current vs Reverse Voltage

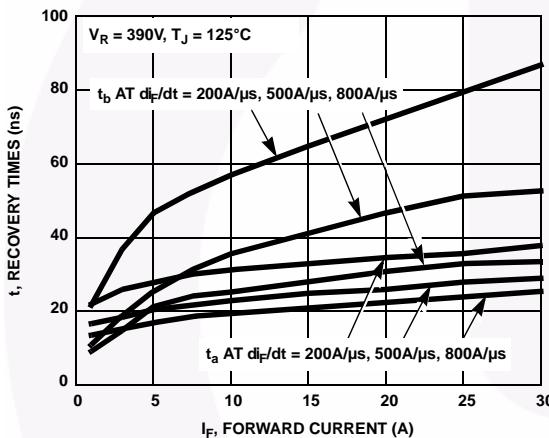


Figure 3.  $t_a$  and  $t_b$  Curves vs Forward Current

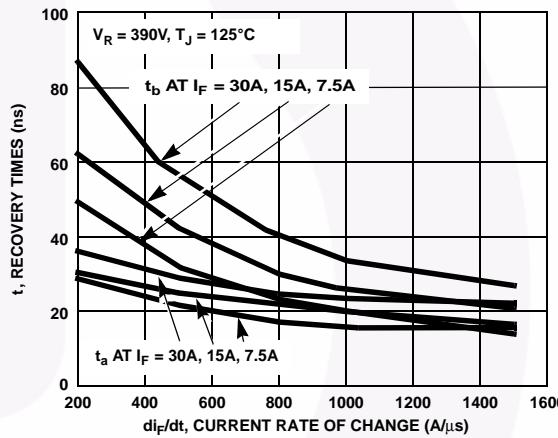


Figure 4.  $t_a$  and  $t_b$  Curves vs  $di_F/dt$

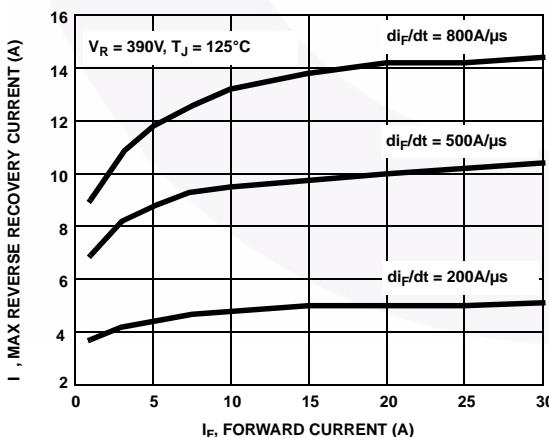


Figure 5. Maximum Reverse Recovery Current vs Forward Current

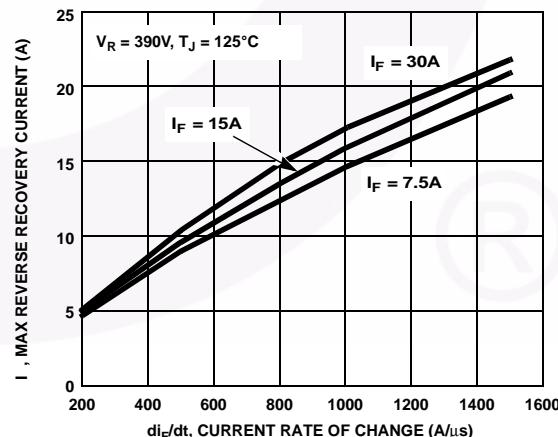


Figure 6. Maximum Reverse Recovery Current vs  $di_F/dt$

### Typical Performance Curves (Continued)

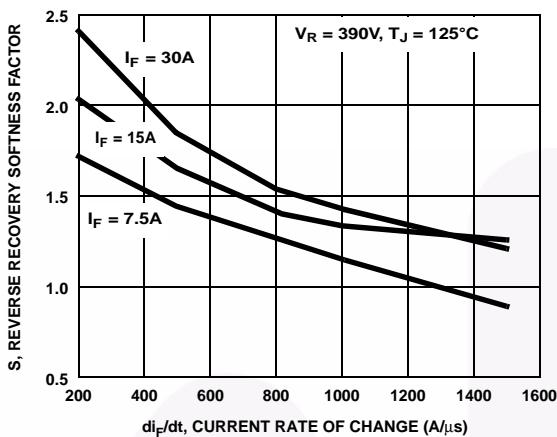


Figure 7. Reverse Recovery Softness Factor vs  $di_F/dt$

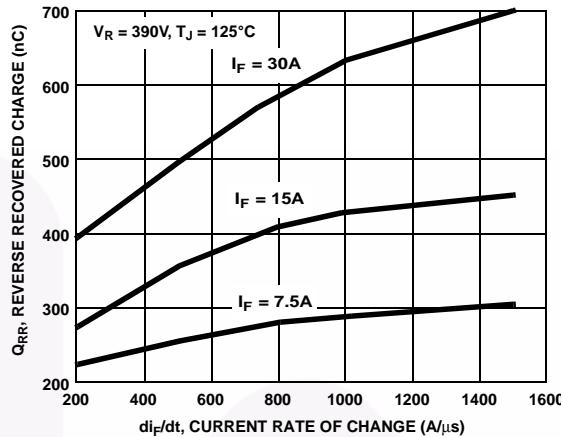


Figure 7. Reverse Recovered Charge vs  $di_F/dt$

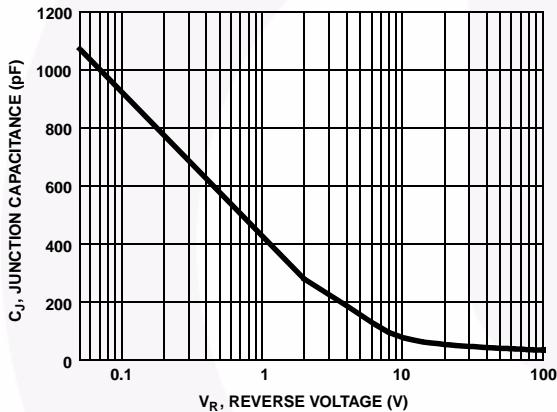


Figure 9. Junction Capacitance vs Reverse Voltage

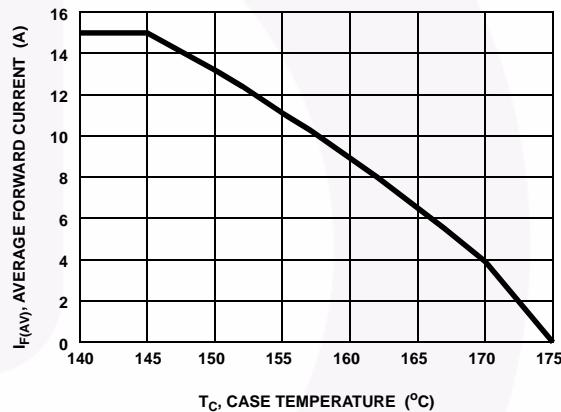


Figure 10. DC Current Derating Curve

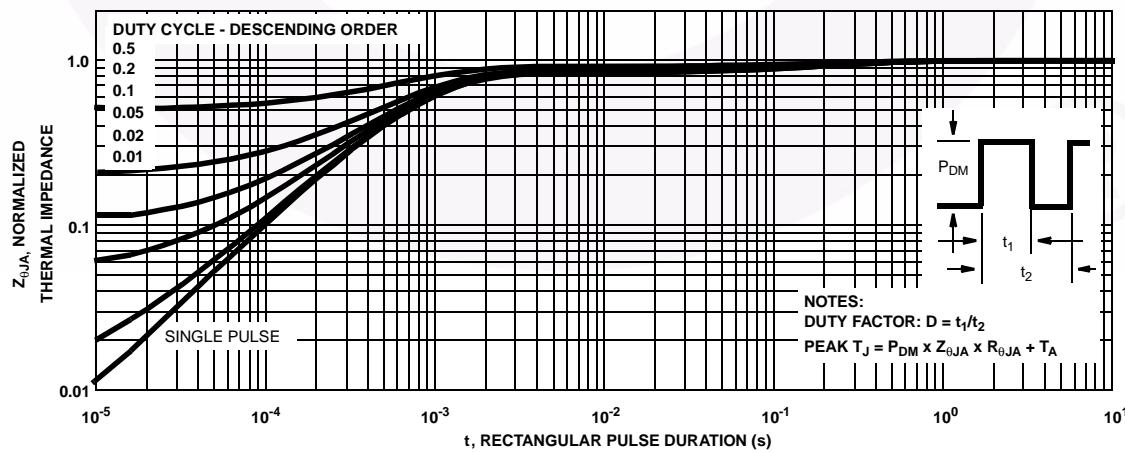


Figure 11. Normalized Maximum Transient Thermal Impedance

## Test Circuit and Waveforms

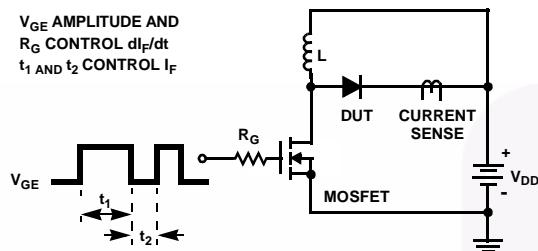


Figure 12. t<sub>rr</sub> Test Circuit

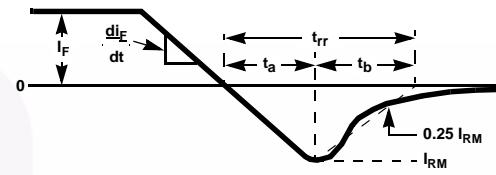


Figure 13. t<sub>rr</sub> Waveforms and Definitions

I = 1A  
L = 40mH  
R < 0.1Ω  
V<sub>DD</sub> = 50V  
 $E_{AVL} = 1/2L^2 [V_{R(AVL)}/(V_{R(AVL)} - V_{DD})]$   
Q<sub>1</sub> = IGBT (BV<sub>CES</sub> > DUT V<sub>R(AVL)</sub>)

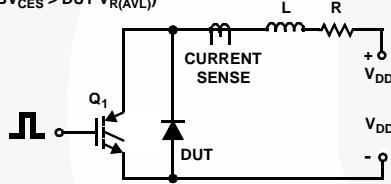


Figure 14. Avalanche Energy Test Circuit

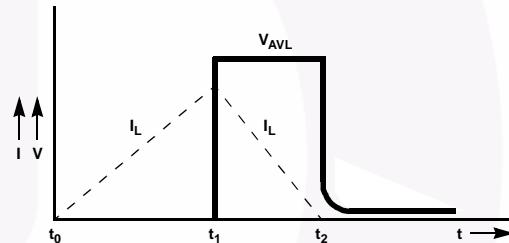
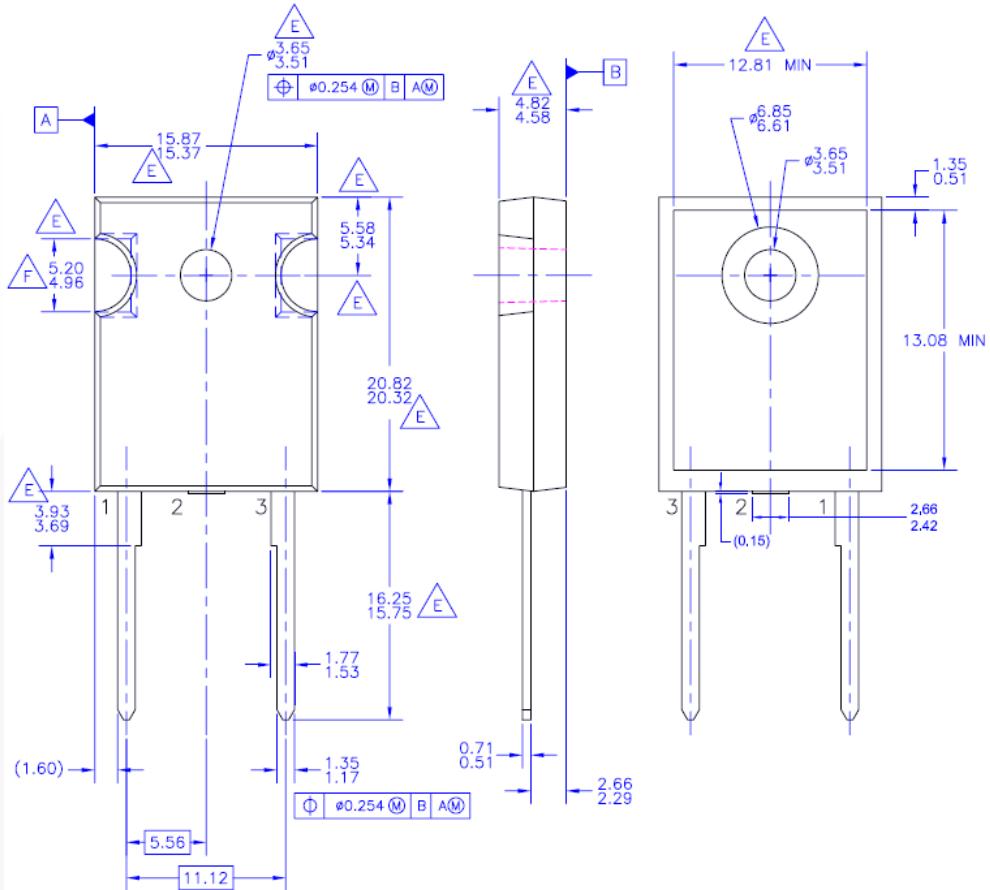


Figure 15. Avalanche Current and Voltage Waveforms

## Mechanical Dimensions



**NOTES: UNLESS OTHERWISE SPECIFIED**

A. PACKAGE REFERENCE: JEDEC TO-247.

ISSUE E, VARIATION AB, DATED JUNE, 2004.

**B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.**

C. ALL DIMENSIONS ARE IN MILLIMETERS.

D. DRAWING CONFORMS TO ASME Y14.5 - 1994

#### E. DOES NOT COMPLY JEDEC STANDARD VALUE

### △ NOTCH MAY BE SQUARE

G. DRAWING FILE NAME: MKT-T0247B02 REV02

**Figure 16. TO-247 2L - TO247-MOLDED-2LD, JEDEC OPTION AB**

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## Mechanical Dimensions

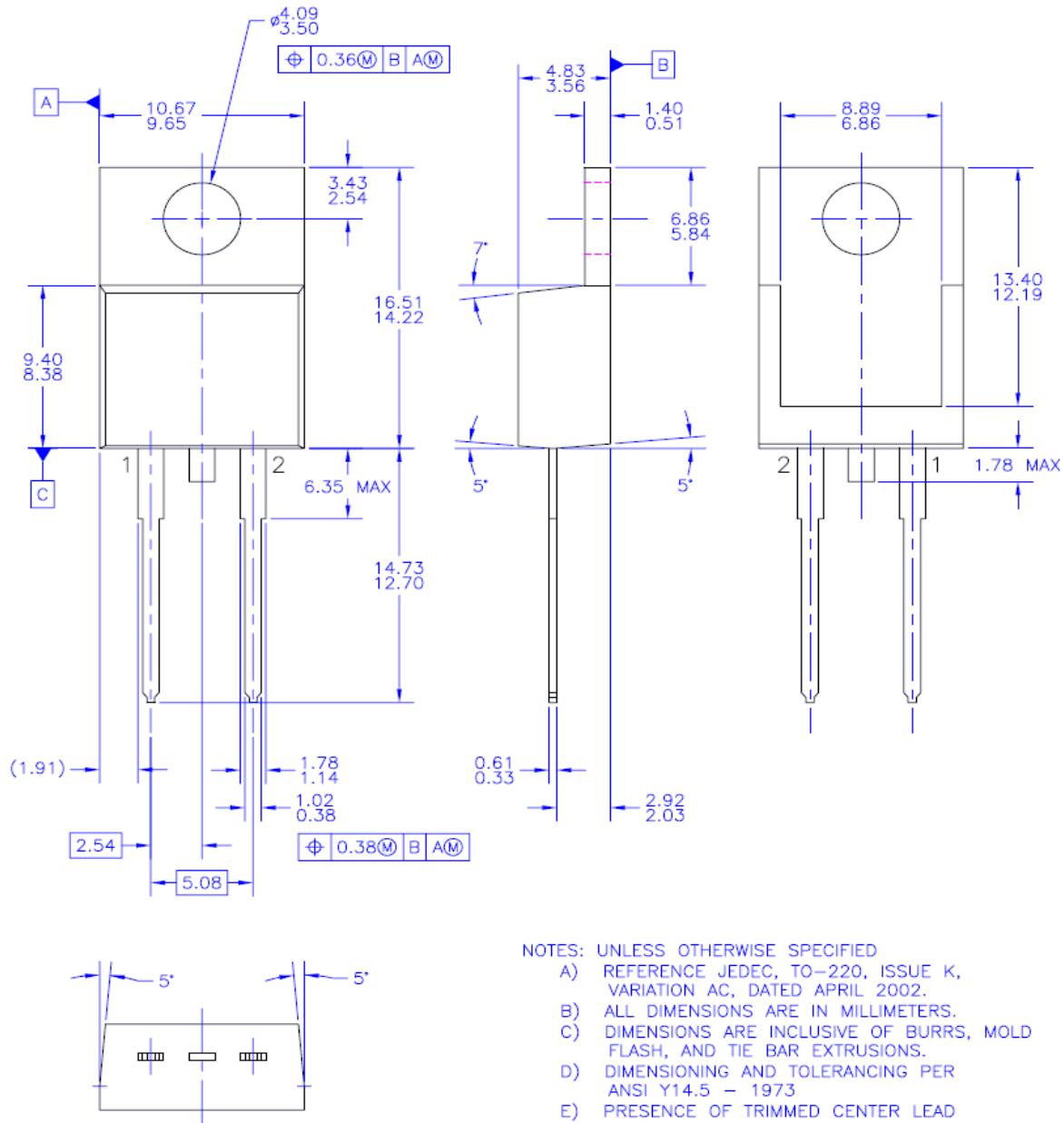


Figure 1 . TO-220 2L - 2LD.T0220.JEDEC TO-220 VARIATION AC

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## Mechanical Dimensions

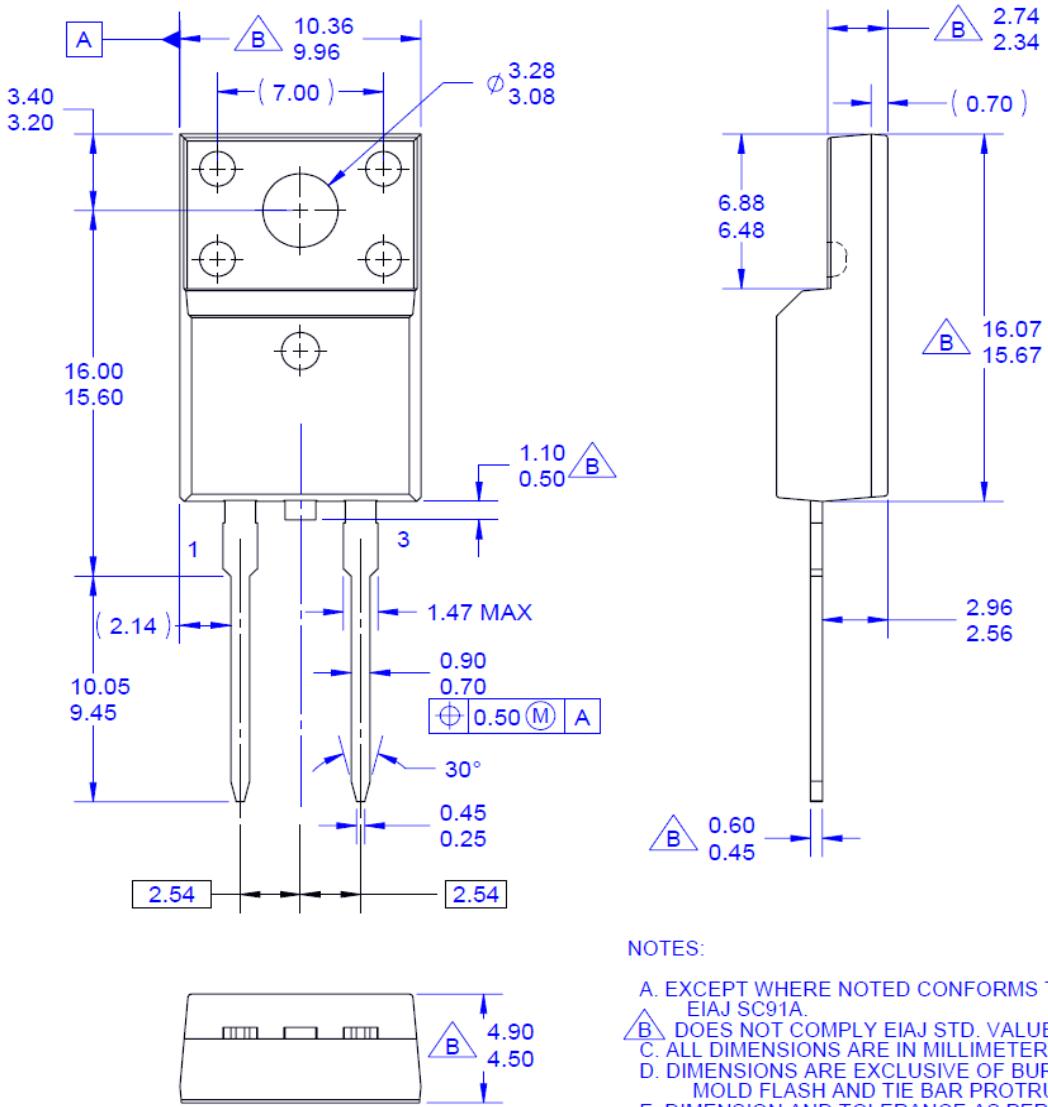


Figure 1 . TO-220F 2L - 2LD; TO220; MOLDED; FULL PACK

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## Me i Dimensions

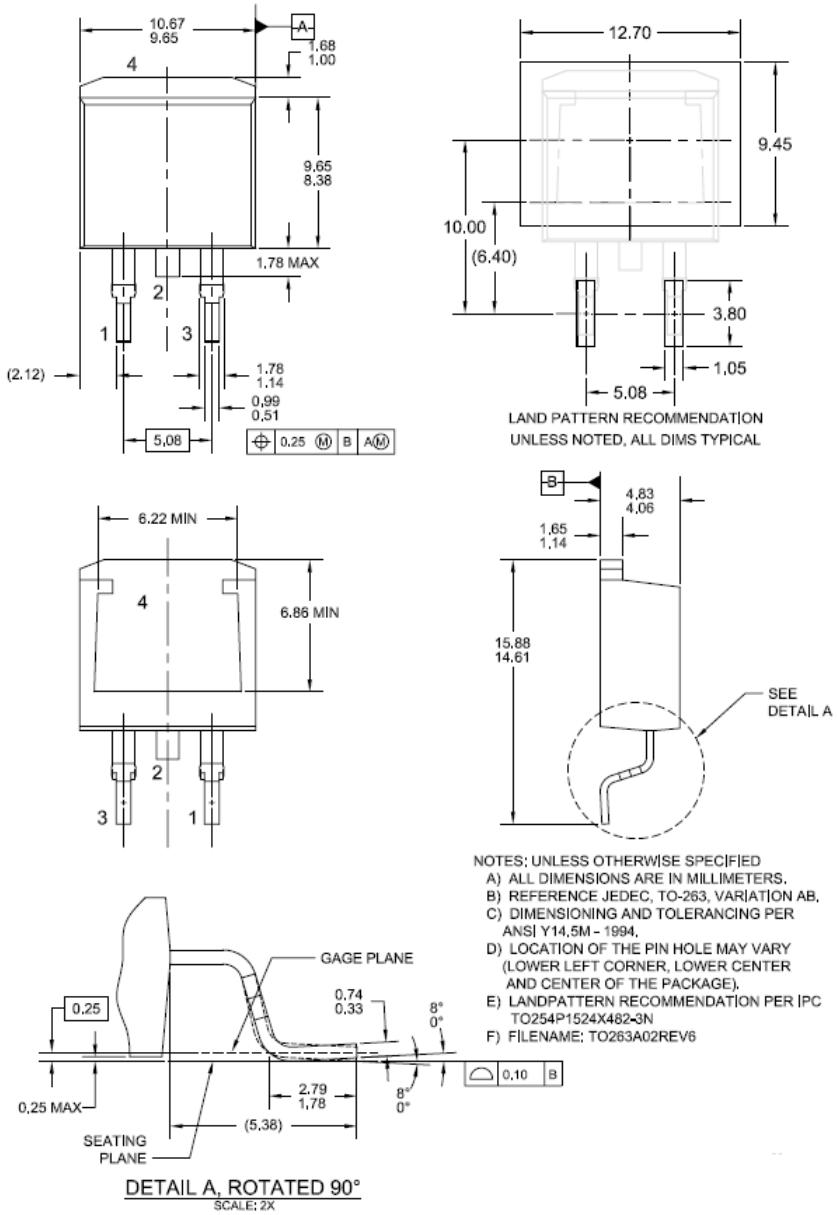


Figure 19. TO-263 2L (D2PAK) - 2LD, TO263, SURFACE MOUNT

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|--------------------------|-----------------------|---|
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| Preliminary              | First Production      | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production       | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.   |
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