

**FAIRCHILD**

SEMICONDUCTOR®

October 2009



ISL9R860P2, ISL9R860S3ST

**ISL9R860P2, ISL9R860S3ST****8A, 600V Stealth™ Diode****General Description**

The ISL9R860P2, ISL9R860S2 and ISL9R860S3S are Stealth™ diodes optimized for low loss performance in high frequency hard switched applications. The Stealth™ family exhibits low reverse recovery current ( $I_{RRM}$ ) 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  $I_{RRM}$  and short  $t_a$  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.

Formerly developmental type TA49409.

**Features**

- Soft Recovery . . . . .  $t_b / t_a > 2.5$
- Fast Recovery . . . . .  $t_{rr} < 25\text{ns}$
- Operating Temperature . . . . . 175°C
- Reverse Voltage . . . . . 600V
- Avalanche Energy Rated

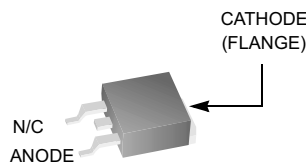
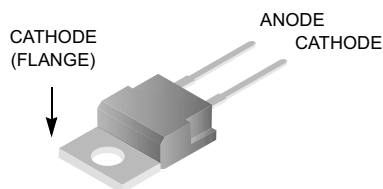
**Applications**

- Switch Mode Power Supplies
- Hard Switched PFC Boost Diode
- UPS Free Wheeling Diode
- Motor Drive FWD
- SMPS FWD
- Snubber Diode

**Package****Symbol**

JEDEC TO-220AC

JEDEC TO-263AB

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

Symbol	Parameter	Ratings	Units
$V_{RRM}$	Peak Repetitive 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 ( $T_C = 147^\circ\text{C}$ )	8	A
$I_{FRM}$	Repetitive Peak Surge Current (20kHz Square Wave)	16	A
$I_{FSM}$	Nonrepetitive Peak Surge Current (Halfwave 1 Phase 60Hz)	100	A
$P_D$	Power Dissipation	85	W
$E_{AVL}$	Avalanche Energy (1A, 40mH)	20	mJ
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to 175	°C
$T_L$	Maximum Temperature for Soldering		
$T_{PKG}$	Leads at 0.063in (1.6mm) from Case for 10s Package Body for 10s, See Techbrief TB334	300 260	°C °C

CAUTION: Stresses above those listed in "Absolute 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**

Device Marking	Device	Package	Tape Width	Quantity
R860P2	ISL9R860P2	TO-220AC	-	-
R860S3S	ISL9R860S3ST	TO-263AB	24mm	800

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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**Off State Characteristics**

$I_R$	Instantaneous Reverse Current	$V_R = 600\text{V}$	$T_C = 25^\circ\text{C}$	-	-	100	$\mu\text{A}$
			$T_C = 125^\circ\text{C}$	-	-	1.0	$\text{mA}$

**On State Characteristics**

$V_F$	Instantaneous Forward Voltage	$I_F = 8\text{A}$	$T_C = 25^\circ\text{C}$	-	2.0	2.4	$\text{V}$
			$T_C = 125^\circ\text{C}$	-	1.6	2.0	$\text{V}$

**Dynamic Characteristics**

$C_J$	Junction Capacitance	$V_R = 10\text{V}, I_F = 0\text{A}$	-	30	-	$\text{pF}$
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**Switching Characteristics**

$t_{rr}$	Reverse Recovery Time	$I_F = 1\text{A}, di_F/dt = 100\text{A}/\mu\text{s}, V_R = 30\text{V}$	-	18	25	$\text{ns}$
			$I_F = 8\text{A}, di_F/dt = 100\text{A}/\mu\text{s}, V_R = 30\text{V}$	-	21	30
$t_{rr}$	Reverse Recovery Time	$I_F = 8\text{A}, di_F/dt = 200\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 25^\circ\text{C}$	-	28	-	$\text{ns}$
$I_{RRM}$	Maximum Reverse Recovery Current		-	3.2	-	$\text{A}$
$Q_{RR}$	Reverse Recovery Charge		-	50	-	$\text{nC}$
$t_{rr}$	Reverse Recovery Time	$I_F = 8\text{A}, di_F/dt = 200\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 125^\circ\text{C}$	-	77	-	$\text{ns}$
S	Softness Factor ( $t_b/t_a$ )		-	3.7	-	
$I_{RRM}$	Maximum Reverse Recovery Current		-	3.4	-	$\text{A}$
$Q_{RR}$	Reverse Recovery Charge		-	150	-	$\text{nC}$
$t_{rr}$	Reverse Recovery Time	$I_F = 8\text{A}, di_F/dt = 600\text{A}/\mu\text{s}, V_R = 390\text{V}, T_C = 125^\circ\text{C}$	-	53	-	$\text{ns}$
S	Softness Factor ( $t_b/t_a$ )		-	2.5	-	
$I_{RRM}$	Maximum Reverse Recovery Current		-	6.5	-	$\text{A}$
$Q_{RR}$	Reverse Recovery Charge		-	195	-	$\text{nC}$
$di_M/dt$	Maximum $di/dt$ during $t_b$		-	500	-	$\text{A}/\mu\text{s}$

**Thermal Characteristics**

$R_{\theta JC}$	Thermal Resistance Junction to Case		-	-	1.75	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance Junction to Ambient	TO-220	-	-	62	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance Junction to Ambient	TO-263			62	$^\circ\text{C}/\text{W}$

Typical Performance Curves

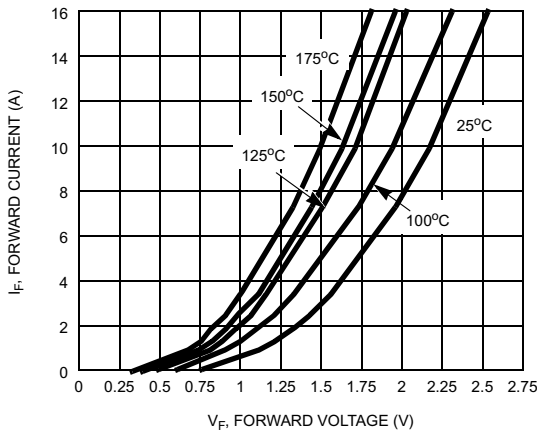


Figure 1. Forward Current vs Forward Voltage

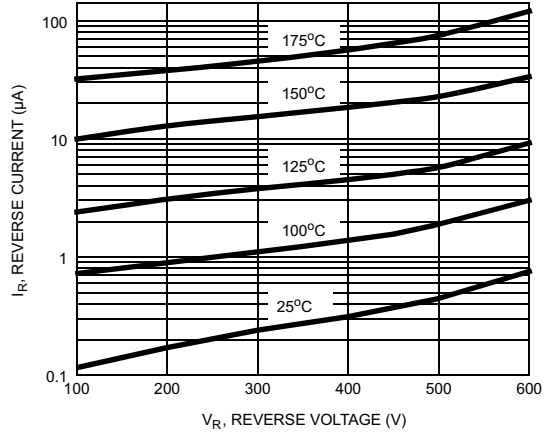


Figure 2. Reverse Current vs Reverse Voltage

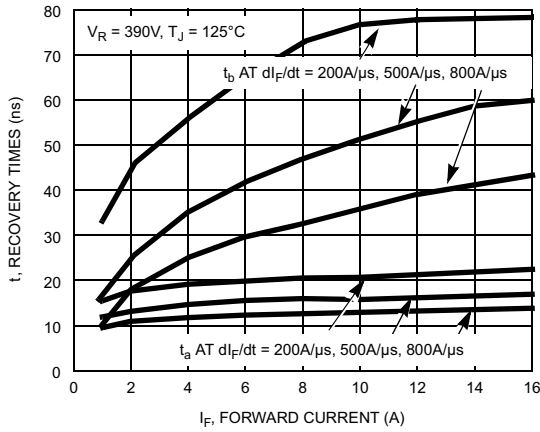


Figure 3.  $t_a$  and  $t_b$  Curves vs Forward Current

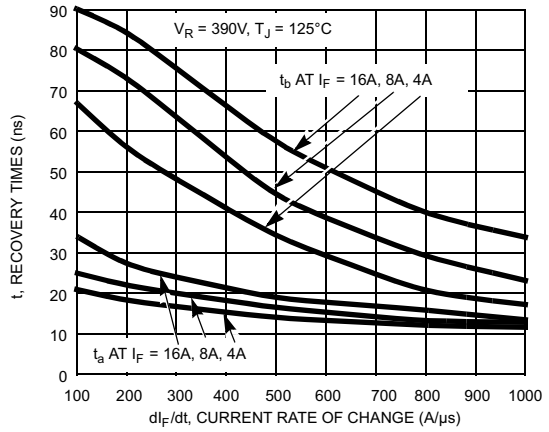


Figure 4.  $t_a$  and  $t_b$  Curves vs  $di_F/dt$

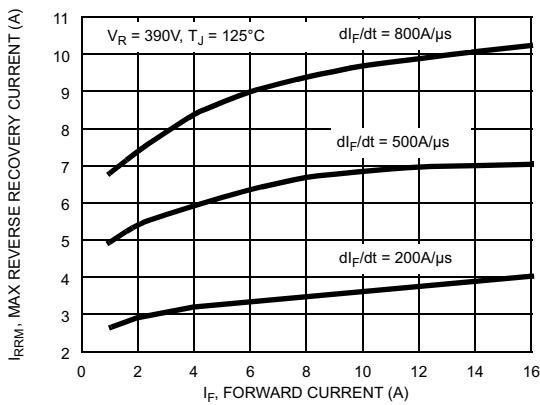


Figure 5. Maximum Reverse Recovery Current vs Forward Current

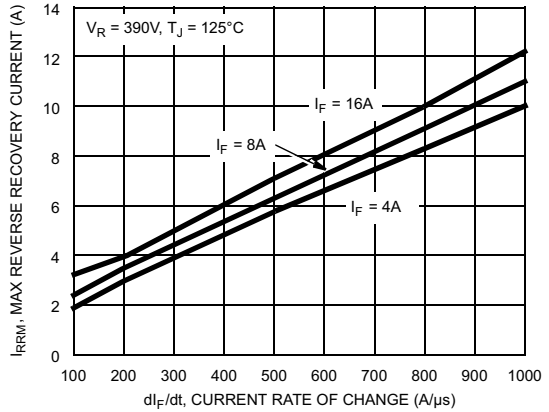


Figure 6. Maximum Reverse Recovery Current vs  $di_F/dt$

Typical Performance Curves (Continued)

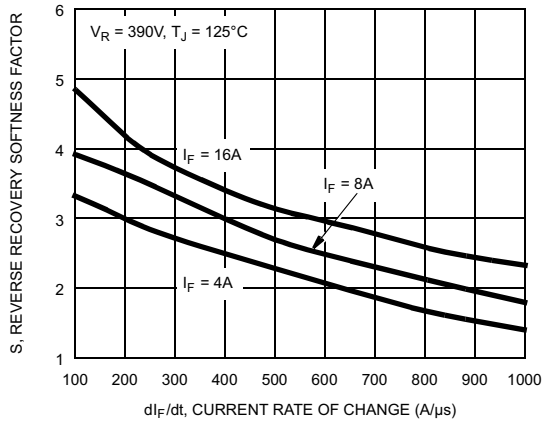


Figure 7. Reverse Recovery Softness Factor vs  $dI_F/dt$

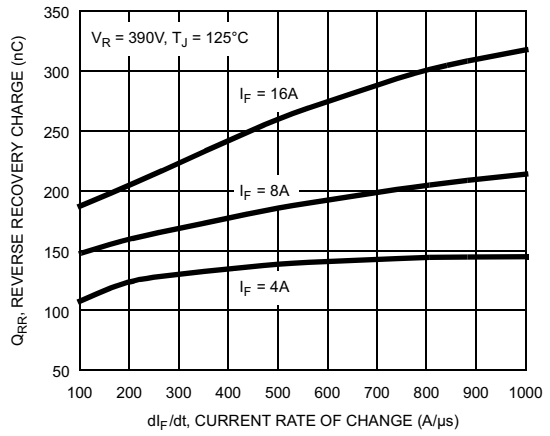


Figure 8. Reverse Recovery Charge vs  $dI_F/dt$

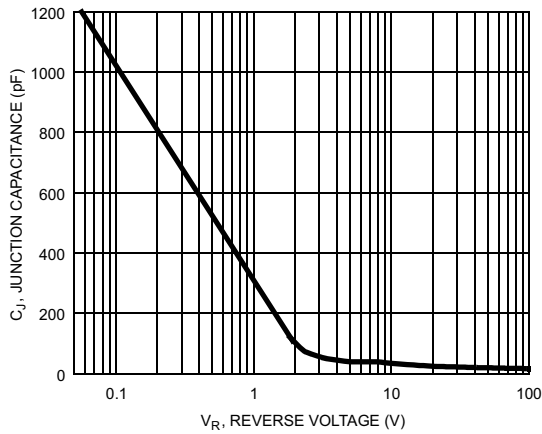


Figure 9. Junction Capacitance vs Reverse Voltage

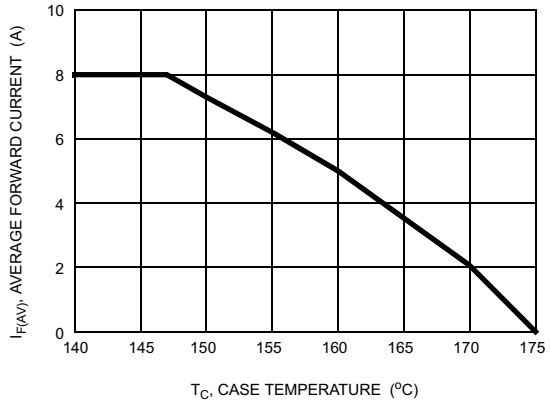


Figure 10. DC Current Derating Curve

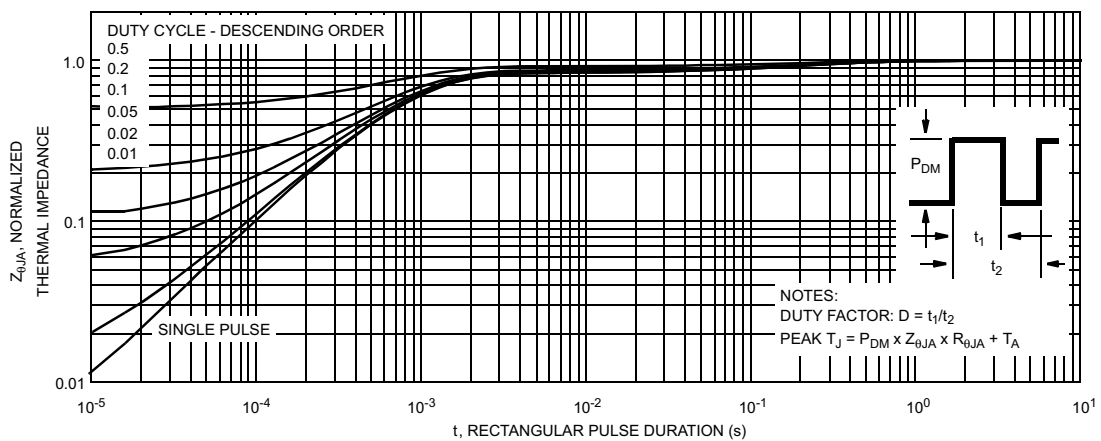


Figure 11. Normalized Maximum Transient Thermal Impedance

Test Circuits and Waveforms

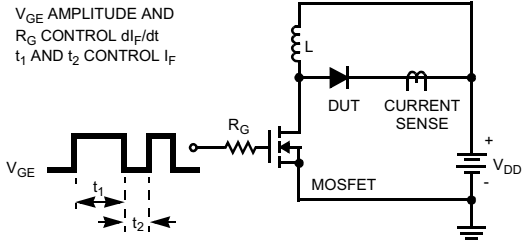


Figure 12.  $t_{rr}$  Test Circuit

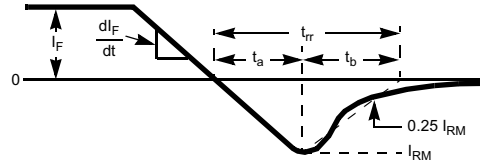


Figure 13.  $t_{rr}$  Waveforms and Definitions

$I = 1A$   
 $L = 40mH$   
 $R < 0.1\Omega$   
 $V_{DD} = 50V$   
 $E_{AVL} = 1/2LI^2 [V_{R(AVL)}/(V_{R(AVL)} - V_{DD})]$   
 $Q_1 = IGBT (BV_{CES} > DUT V_{R(AVL)})$

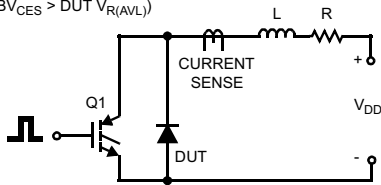


Figure 14. Avalanche Energy Test Circuit

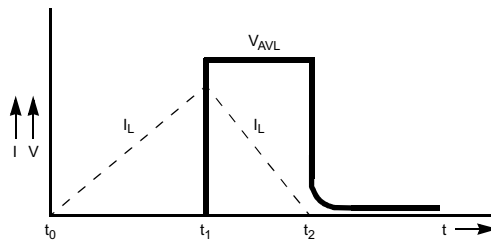
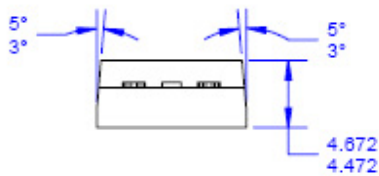
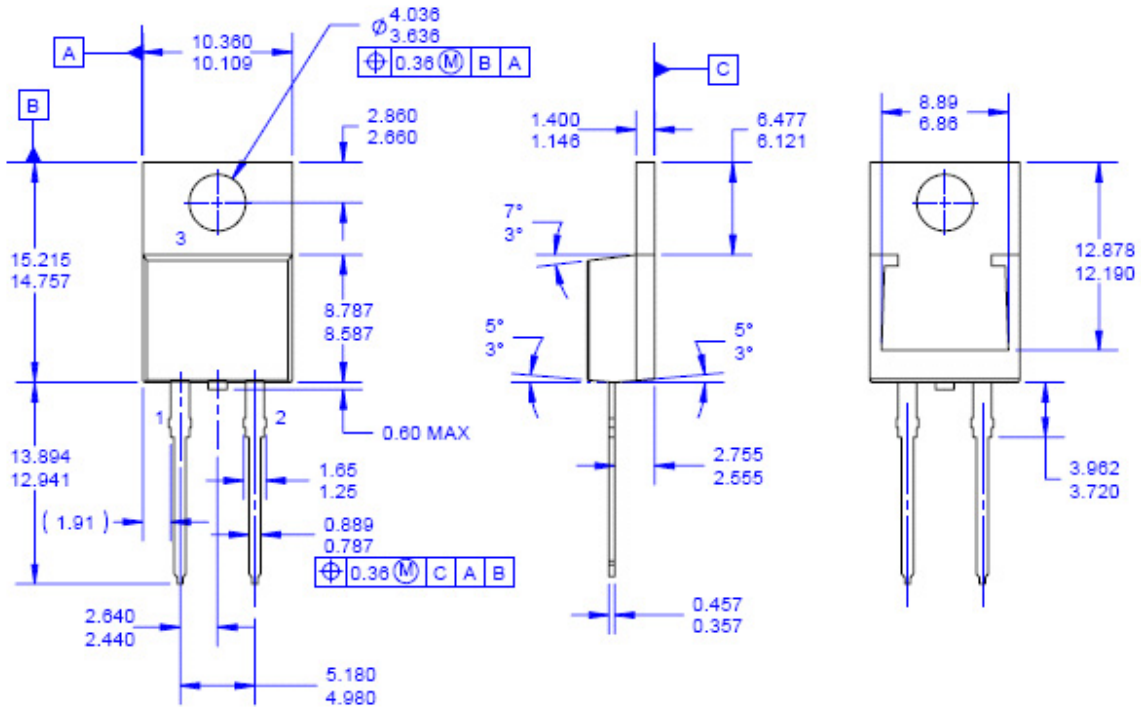


Figure 15. Avalanche Current and Voltage Waveforms

Mechanical Dimensions

TO-220AC

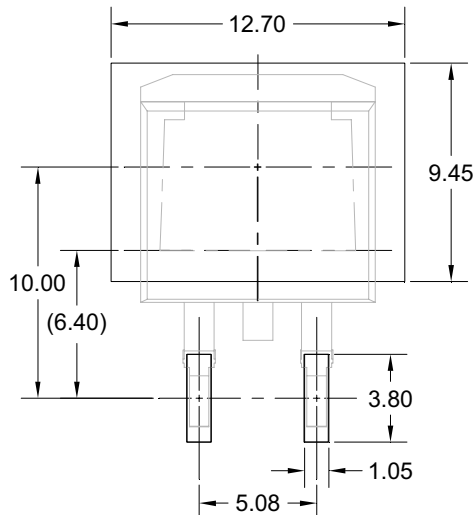
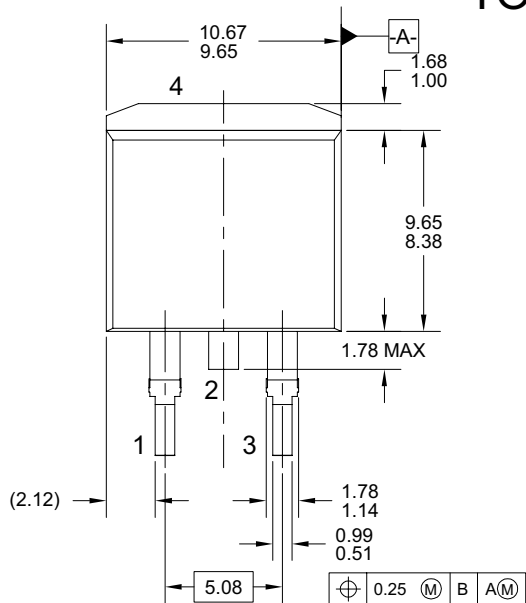


NOTES:

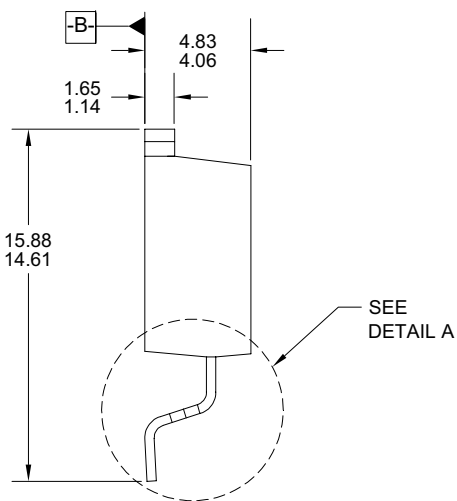
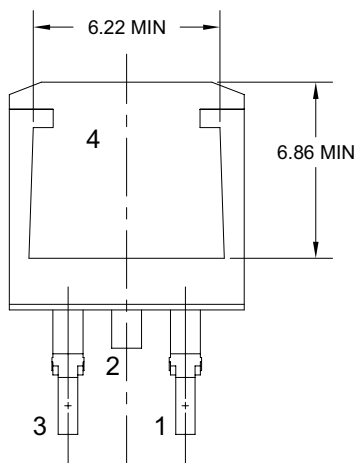
- A. PACKAGE REFERENCE: JEDEC TO220 VARIATION AC.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSION AND TOLERANCE AS PER ASME Y14.5-1994.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. THIS PACKAGE IS FSSZ INTERNAL PRODUCTION AND INTENDED FOR DELTA CUSTOMER ONLY.
- F. DRAWING FILE NAME: TO220B02REV4

Mechanical Dimensions

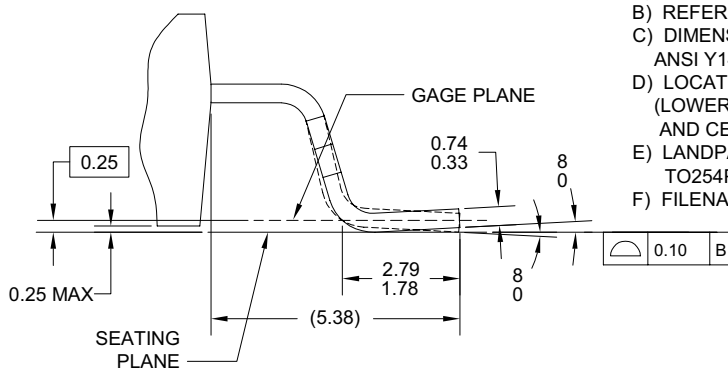
TO-263AB



LAND PATTERN RECOMMENDATION  
UNLESS NOTED, ALL DIMS TYPICAL



- NOTES: UNLESS OTHERWISE SPECIFIED  
 A) ALL DIMENSIONS ARE IN MILLIMETERS.  
 B) REFERENCE JEDEC, TO-263, VARIATION AB.  
 C) DIMENSIONING AND TOLERANCING PER ANSI Y14.5M - 1994.  
 D) LOCATION OF THE PIN HOLE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE).  
 E) LANDPATTERN RECOMMENDATION PER IPC TO254P1524X482-3N  
 F) FILENAME: TO263A02REV6







DETAIL A, ROTATED 90  
SCALE: 2X

Dimensions in Millimeters



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| Auto-SPM™   | F-PFS™  | PowerXS™  | the power®  |
| Build it Now™   | FRFET®  | Programmable Active Droop™  | franchise   |
| CorePLUS™   | Global Power Resource <sup>SM</sup>   | QFET®   | TinyBoost™  |
| CorePOWER™  | Green FPS™  | QS™   | TinyBuck™   |
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**PRODUCT STATUS DEFINITIONS**

**Definition of Terms**

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
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.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

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