

# STEALTH™ Diode

15 A, 600 V

## ISL9R1560G2, ISL9R1560P2, ISL9R1560S3S

### Description

The ISL9R1560G2, ISL9R1560P2, 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  $t_a$  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.

### 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
- These Devices are Pb-Free and are RoHS Compliant

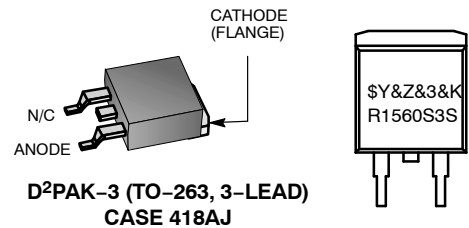
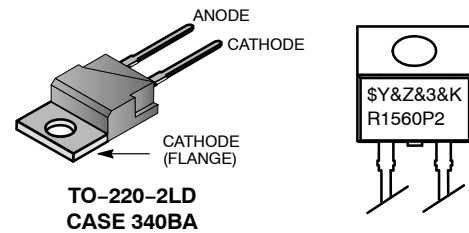
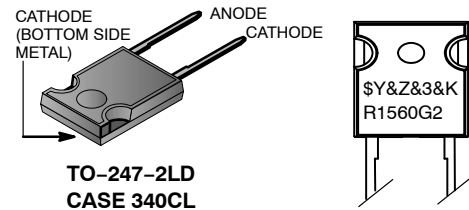
### Applications

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



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### MARKING DIAGRAM

\$Y = ON Semiconductor Logo  
&Z = Assembly Plant Code  
&3 = Numeric Date Code  
&K = Lot Code  
R1560G2, R1560P2,  
R1560S3S = Specific Device Code

### SYMBOL



### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# ISL9R1560G2, ISL9R1560P2, ISL9R1560S3S

## DEVICE MAXIMUM RATINGS (T<sub>C</sub> = 25°C unless otherwise noted)

Parameter	Symbol	Ratings	Unit
Repetitive Peak Reverse Voltage	V <sub>RRM</sub>	600	V
Working Peak Reverse Voltage	V <sub>RWM</sub>	600	V
DC Blocking Voltage	V <sub>R</sub>	600	V
Average Rectified Forward Current (T <sub>C</sub> = 145°C)	I <sub>F(AV)</sub>	15	A
Repetitive Peak Surge Current (20 kHz Square Wave)	I <sub>FRM</sub>	30	A
Non-repetitive Peak Surge Current (Halfwave 1 Phase 60 Hz)	I <sub>FSM</sub>	200	A
Power Dissipation	P <sub>D</sub>	150	W
Avalanche Energy (1 A, 40 mH)	E <sub>AVL</sub>	20	mJ
Operating and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-55 to +175	°C
Maximum Temperature for Soldering Leads at 0.063 in (1.6 mm) from Case for 10 s Package Body for 10 s, See Techbrief TB334	T <sub>L</sub> T <sub>PKG</sub>	300 260	°C °C

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.

## PACKAGE MARKING AND ORDERING INFORMATION

Device	Device Marking	Package	Packing Method	Reel Size	Tape Width	Quantity
ISL9R1560G2	R1560G2	TO-247-2LD	Tube	N/A	N/A	30
ISL9R1560P2	R1560P2	TO-220-2LD	Tube	N/A	N/A	50
ISL9R1560S3ST	R1560S3S	TO-263(D <sup>2</sup> -PAK)	Reel	13" dia	24 mm	800

## THERMAL CHARACTERISTICS

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Thermal Resistance Junction to Case	R <sub>θJC</sub>		-	-	1.0	°C/W
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	TO-247	-	-	30	°C/W
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	TO-220	-	-	62	°C/W
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	TO-263	-	-	62	°C/W

# ISL9R1560G2, ISL9R1560P2, ISL9R1560S3S

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
<b>Off State Characteristics</b>							
Instantaneous Reverse Current	I <sub>R</sub>	V <sub>R</sub> = 600 V	T <sub>C</sub> = 25°C	–	–	100	μA
			T <sub>C</sub> = 125°C	–	–	1.0	mA
<b>On State Characteristics</b>							
Instantaneous Forward Voltage	V <sub>F</sub>	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
<b>Dynamic Characteristics</b>							
Junction Capacitance	C <sub>J</sub>	V <sub>R</sub> = 10 V, I <sub>F</sub> = 0 A	–	62	–	pF	
<b>Switching Characteristics</b>							
Reverse Recovery Time	t <sub>rr</sub>	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	
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 15 A, di <sub>F</sub> /dt = 200 A/μs, V <sub>R</sub> = 390 V, T <sub>C</sub> = 25°C	–	29.4	–	ns	
Reverse Recovery Current	I <sub>rr</sub>		–	3.5	–	A	
Reverse Recovered Charge	Q <sub>rr</sub>		–	57	–	nC	
Reverse Recovery Time	t <sub>rr</sub>		–	90	–	ns	
Softness Factor (t <sub>b</sub> /t <sub>a</sub> )	S	I <sub>F</sub> = 15 A, di <sub>F</sub> /dt = 200 A/μs, V <sub>R</sub> = 390 V, T <sub>C</sub> = 125°C	–	2.0	–		
Reverse Recovery Current	I <sub>rr</sub>		–	5.0	–	A	
Reverse Recovered Charge	Q <sub>rr</sub>		–	275	–	nC	
Reverse Recovery Time	t <sub>rr</sub>		–	52	–	ns	
Softness Factor (t <sub>b</sub> /t <sub>a</sub> )	S	I <sub>F</sub> = 15 A, di <sub>F</sub> /dt = 800 A/μs, V <sub>R</sub> = 390 V, T <sub>C</sub> = 125°C	–	1.36	–		
Reverse Recovery Current	I <sub>rr</sub>		–	13.5	–	A	
Reverse Recovered Charge	Q <sub>rr</sub>		–	390	–	nC	
Maximum di/dt During t <sub>b</sub>	di <sub>M</sub> /dt		–	800	–	A/μs	

TYPICAL PERFORMANCE CURVES

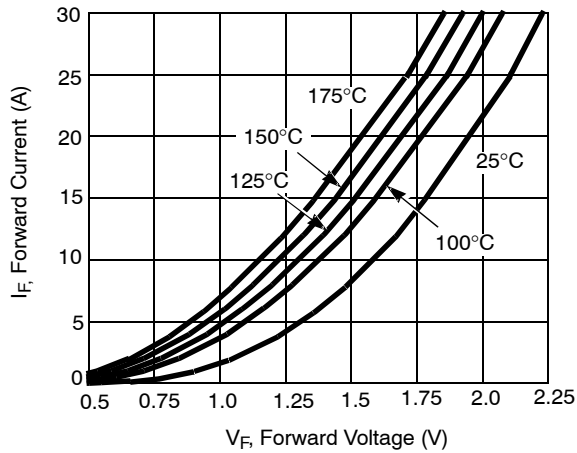


Figure 1. Forward Current vs. Forward Voltage

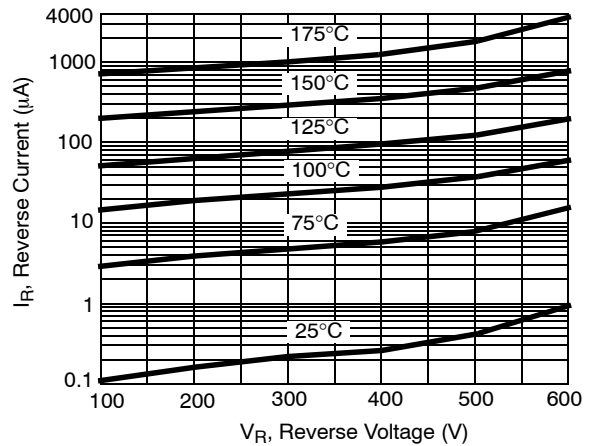


Figure 2. Reverse Current vs. Reverse Voltage

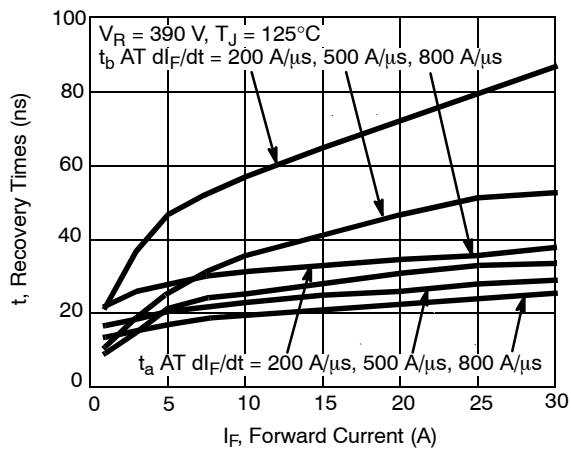


Figure 3.  $t_a$  and  $t_b$  Curves vs. Forward Current

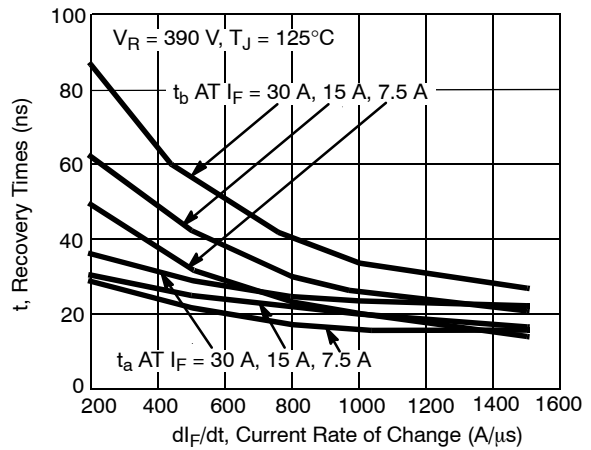


Figure 4.  $t_a$  and  $t_b$  Curves vs.  $di_F/dt$

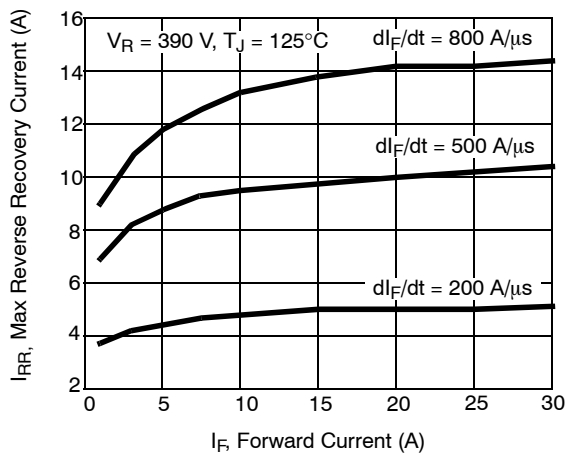


Figure 5. Maximum Reverse Recovery Current vs. Forward Current

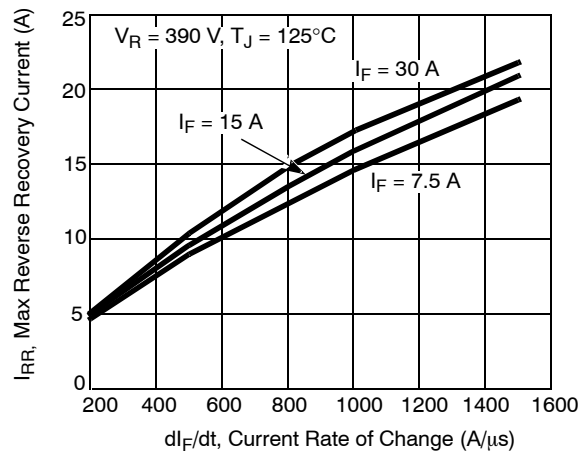
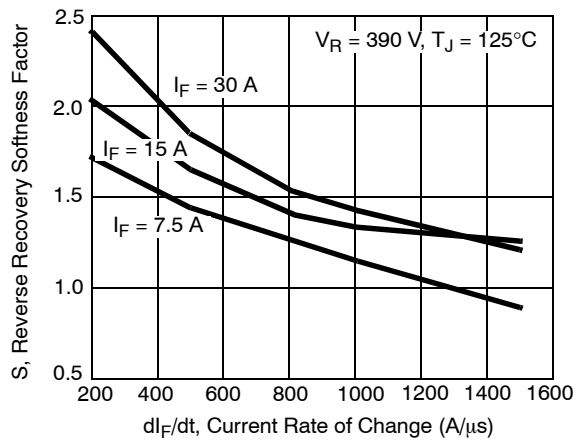


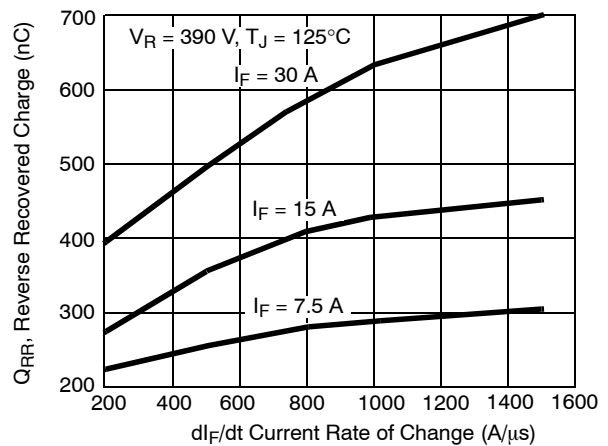
Figure 6. Maximum Reverse Recovery Current vs.  $di_F/dt$

# ISL9R1560G2, ISL9R1560P2, ISL9R1560S3S

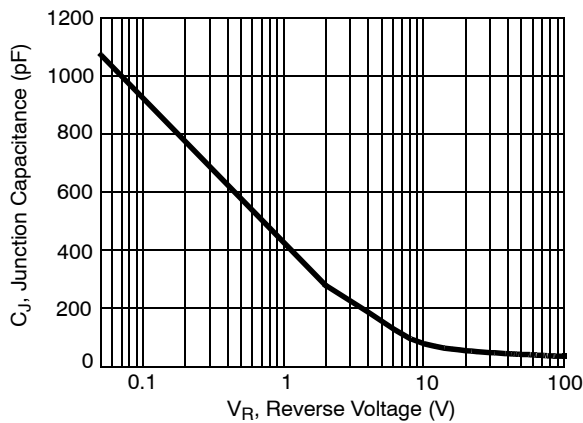
## TYPICAL PERFORMANCE CURVES (continued)



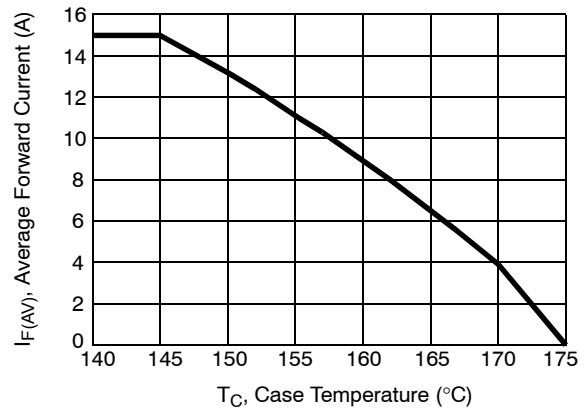
**Figure 7. Reverse Recovery Softness Factor vs.  $di_F/dt$**



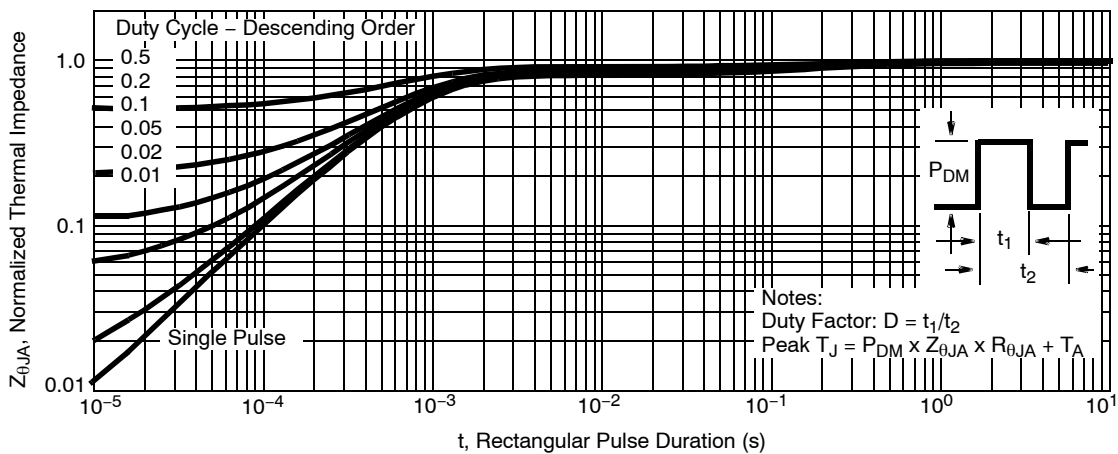
**Figure 8. Reverse Recovered Charge vs.  $di_F/dt$**



**Figure 9. Junction Capacitance vs. Reverse Voltage**



**Figure 10. DC Current Derating Curve**



**Figure 11. Normalized Maximum Transient Thermal Impedance**

TEST CIRCUIT AND WAVEFORMS

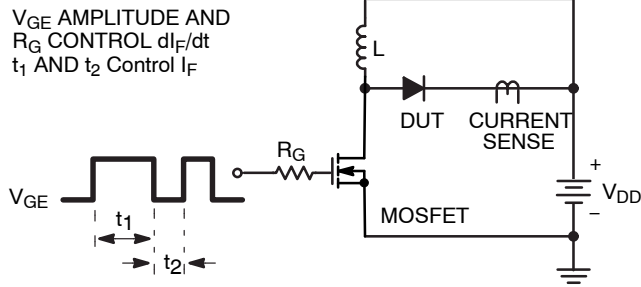


Figure 12.  $t_{rr}$  Test Circuit

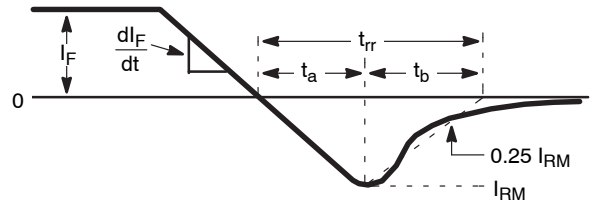


Figure 13.  $t_{rr}$  Waveforms and Definitions

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

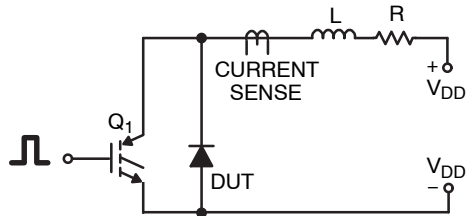


Figure 14. Avalanche Energy Test Circuit

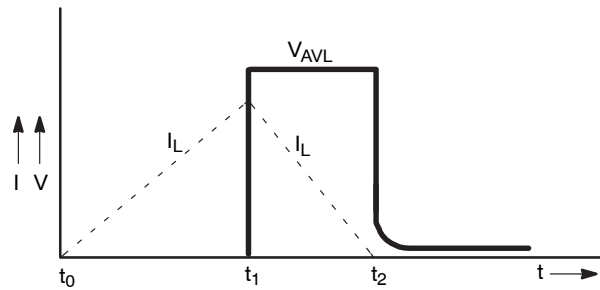


Figure 15. Avalanche Current and Voltage Waveforms

# MECHANICAL CASE OUTLINE

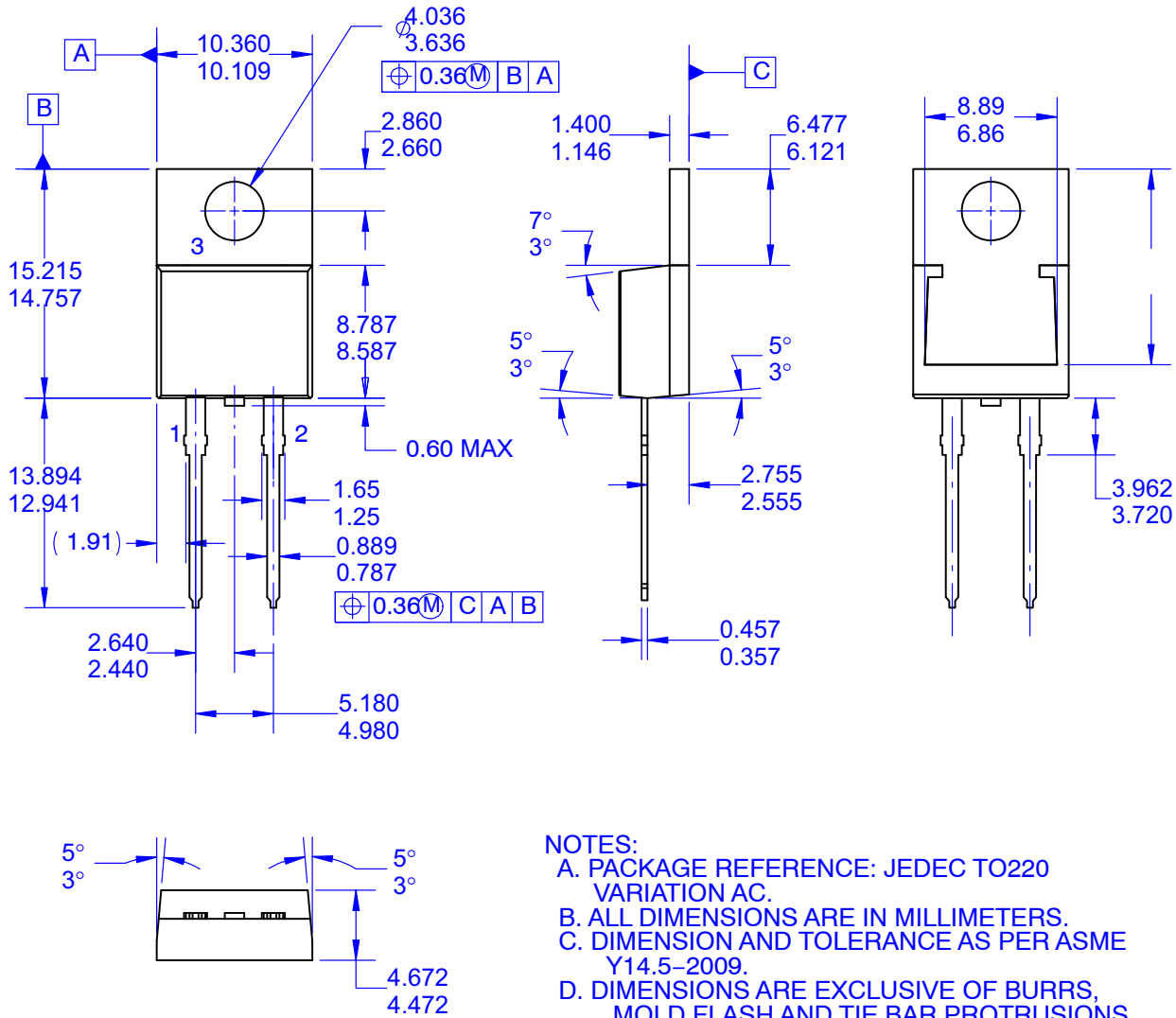
## PACKAGE DIMENSIONS

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TO-220-2LD  
CASE 340BA  
ISSUE O

DATE 31 AUG 2016



- NOTES:
- A. PACKAGE REFERENCE: JEDEC TO220 VARIATION AC.
  - B. ALL DIMENSIONS ARE IN MILLIMETERS.
  - C. DIMENSION AND TOLERANCE AS PER ASME Y14.5-2009.
  - D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.

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# MECHANICAL CASE OUTLINE

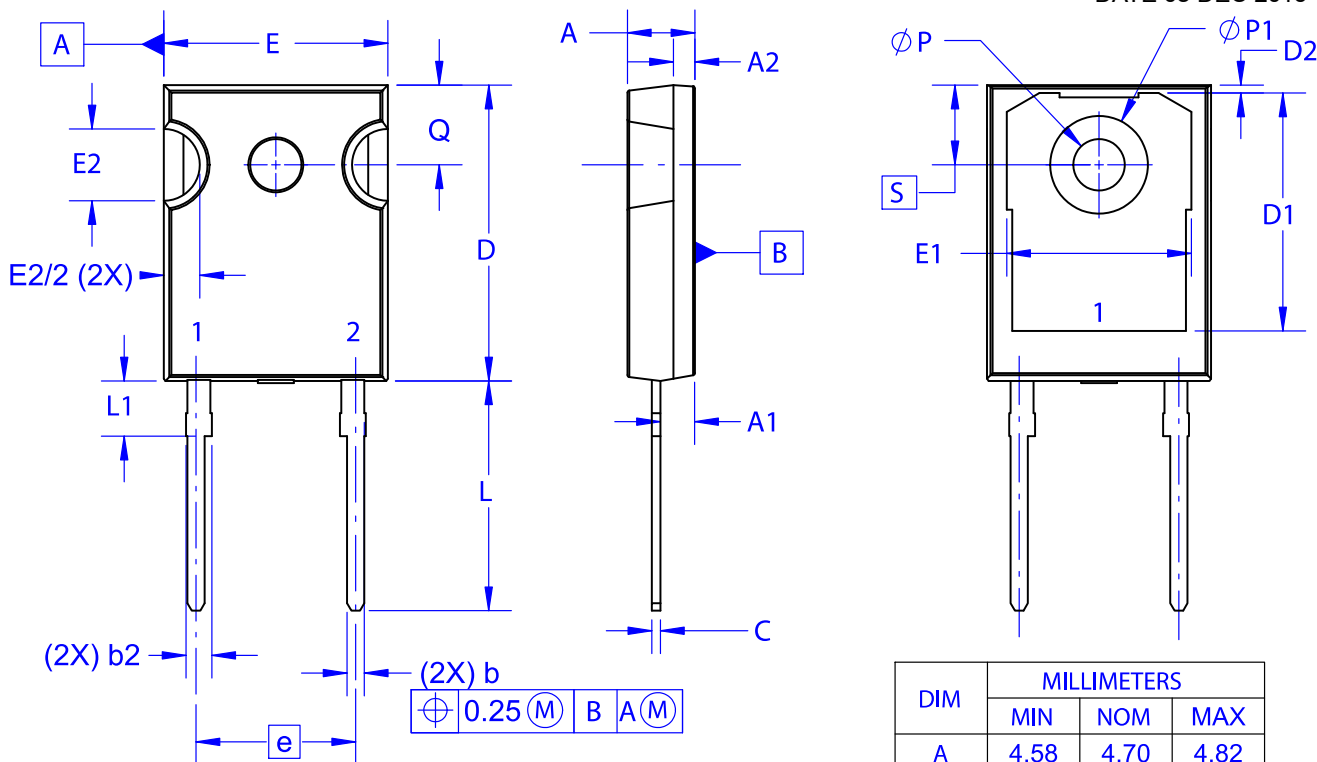
## PACKAGE DIMENSIONS

ON Semiconductor®



TO-247-2LD  
CASE 340CL  
ISSUE A

DATE 03 DEC 2019

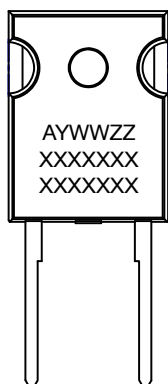


$\oplus 0.25 (M) B A (M)$

NOTES: UNLESS OTHERWISE SPECIFIED.

- A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- B. ALL DIMENSIONS ARE IN MILLIMETERS.
- C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
- D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
- E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

### GENERIC MARKING DIAGRAM\*



XXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
ZZ = Assembly Lot Code

\*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.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.29	2.40	2.66
A2	1.30	1.50	1.70
b	1.17	1.26	1.35
b2	1.53	1.65	1.77
c	0.51	0.61	0.71
D	20.32	20.57	20.82
D1	16.37	16.57	16.77
D2	0.51	0.93	1.35
E	15.37	15.62	15.87
E1	12.81	~	~
E2	4.96	5.08	5.20
e	~	11.12	~
L	15.75	16.00	16.25
L1	3.69	3.81	3.93
∅P	3.51	3.58	3.65
∅P1	6.61	6.73	6.85
Q	5.34	5.46	5.58
S	5.34	5.46	5.58

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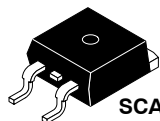
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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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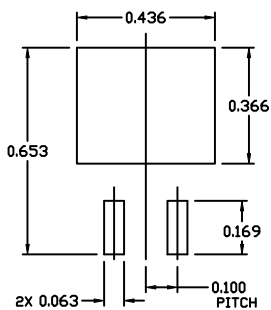
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### D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)

#### CASE 418AJ

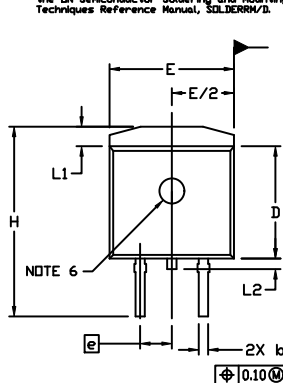
#### ISSUE F

DATE 11 MAR 2021



#### RECOMMENDED MOUNTING FOOTPRINT

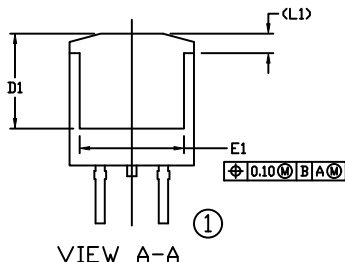
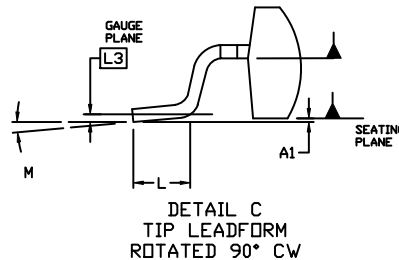
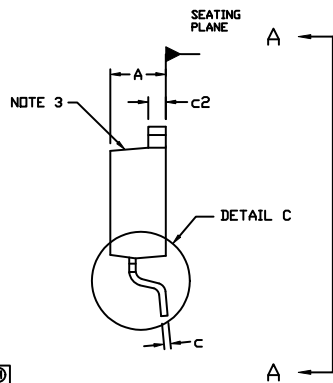
For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



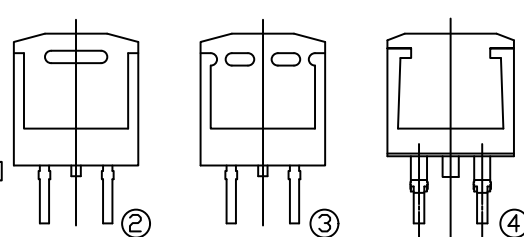
#### NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
- CONTROLLING DIMENSION: INCHES
- CHAMFER OPTIONAL.
- DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
- THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1, AND E1.
- OPTIONAL MOLD FEATURE.
- ①, ② ... OPTIONAL CONSTRUCTION FEATURE CALL OUTS.

DIM	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.160	0.190	4.06	4.83
A1	0.000	0.010	0.00	0.25
b	0.020	0.039	0.51	0.99
c	0.012	0.029	0.30	0.74
c2	0.045	0.065	1.14	1.65
D	0.330	0.380	8.38	9.65
D1	0.260	---	6.60	---
E	0.380	0.420	9.65	10.67
E1	0.245	---	6.22	---
e	0.100	BSC	2.54	BSC
H	0.575	0.625	14.60	15.88
L	0.070	0.110	1.78	2.79
L1	---	0.066	---	1.68
L2	---	0.070	---	1.78
L3	0.010	BSC	0.25	BSC
M	0*	8*	0*	8*

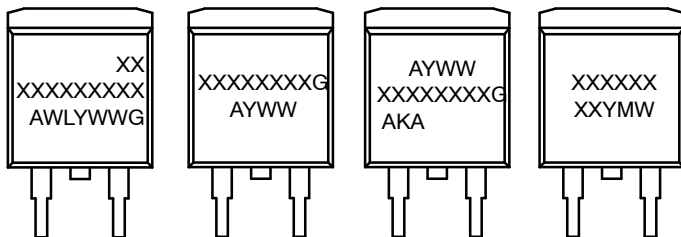


VIEW A-A



VIEW A-A  
OPTIONAL CONSTRUCTIONS

#### GENERIC MARKING DIAGRAMS\*



IC

Standard

Rectifier

SSG

- XXXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- Y = Year
- WW = Work Week
- W = Week Code (SSG)
- M = Month Code (SSG)
- G = Pb-Free Package
- AKA = Polarity Indicator

\*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.

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