

# NVD5890N

## Power MOSFET 40 V, 123 A, Single N-Channel DPAK

### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- MSL 1/260°C
- AEC Q101 Qualified and PPAP Capable
- 100% Avalanche Tested
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- Motor Drivers
- Pump Drivers for Automotive Braking, Steering and Other High Current Systems

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

Parameter	Symbol	Value	Unit	
Drain-to-Source Voltage	$V_{DSS}$	40	V	
Gate-to-Source Voltage	$V_{GS}$	$\pm 20$	V	
Continuous Drain Current ( $R_{\theta JC}$ )	$I_D$	$T_C = 25^\circ\text{C}$	123	A
		$T_C = 85^\circ\text{C}$	95	
Power Dissipation ( $R_{\theta JC}$ )	$P_D$	$T_C = 25^\circ\text{C}$	107	W
Continuous Drain Current ( $R_{\theta JA}$ ) (Note 1)		$T_A = 25^\circ\text{C}$	24	A
Power Dissipation ( $R_{\theta JA}$ ) (Note 1)	$P_D$	$T_A = 85^\circ\text{C}$	18.5	
		$T_A = 25^\circ\text{C}$	4.0	W
Pulsed Drain Current	$I_{DM}$	400	A	
Current Limited by Package	$I_{DmaxPkg}$	100	A	
Operating Junction and Storage Temperature	$T_J, T_{stg}$	-55 to 175	$^\circ\text{C}$	
Source Current (Body Diode)	$I_S$	100	A	
Drain to Source dV/dt	dV/dt	6.0	V/ns	
Single Pulse Drain-to-Source Avalanche Energy ( $V_{DD} = 32\text{ V}, V_{GS} = 10\text{ V}, L = 0.3\text{ mH}, I_{L(pk)} = 40\text{ A}, R_G = 25\ \Omega$ )	$E_{AS}$	240	mJ	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)	$T_L$	260	$^\circ\text{C}$	

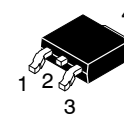
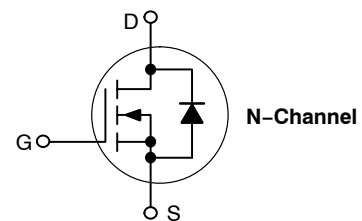
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.



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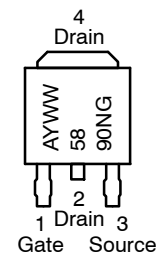
[www.onsemi.com](http://www.onsemi.com)

$V_{(BR)DSS}$	$R_{DS(on)}$	$I_D$
40 V	3.7 m $\Omega$ @ 10 V	123 A



CASE 369C  
DPAK  
(Bent Lead)  
STYLE 2

### MARKING DIAGRAMS & PIN ASSIGNMENT



A = Assembly Location\*  
Y = Year  
WW = Work Week  
5890N = Device Code  
G = Pb-Free Package

\* The Assembly Location Code (A) is front side optional. In cases where the Assembly Location is stamped in the package bottom (molding ejector pin), the front side assembly code may be blank.

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

# NVD5890N

## THERMAL RESISTANCE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	1.4	°C/W
Junction-to-Ambient - Steady State (Note 1)	$R_{\theta JA}$	37	
Junction-to-Ambient - Steady State (Note 2)	$R_{\theta JA}$	76	

- Surface-mounted on FR4 board using 650 mm<sup>2</sup> pad size, 2 oz Cu.
- Surface-mounted on FR4 board using 36 mm<sup>2</sup> pad size.

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	40			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$			40		mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 40\text{ V}$	$T_J = 25^\circ\text{C}$		1.0	$\mu\text{A}$
			$T_J = 150^\circ\text{C}$		100	
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA

### ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$	1.5		3.5	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			7.4		mV/°C
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 50\text{ A}$		2.9	3.7	m $\Omega$
Forward Transconductance	gFS	$V_{DS} = 15\text{ V}, I_D = 15\text{ A}$		16.8		S

### CHARGES AND CAPACITANCES

Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 12\text{ V}$		4975		pF
Output Capacitance	$C_{oss}$			785		
Reverse Transfer Capacitance	$C_{rss}$			490		
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 25\text{ V}$		4760		pF
Output Capacitance	$C_{oss}$			580		
Reverse Transfer Capacitance	$C_{rss}$			385		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = 10\text{ V}, V_{DS} = 15\text{ V}, I_D = 50\text{ A}$		74	100	nC
Threshold Gate Charge	$Q_{G(TH)}$			5.0		
Gate-to-Source Charge	$Q_{GS}$			17		
Gate-to-Drain Charge	$Q_{GD}$			16		

### SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = 10\text{ V}, V_{DS} = 20\text{ V}, I_D = 50\text{ A}, R_G = 2.0\ \Omega$		14		ns
Rise Time	$t_r$			55		
Turn-Off Delay Time	$t_{d(off)}$			35		
Fall Time	$t_f$			7.0		

- Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
- Switching characteristics are independent of operating junction temperatures.

# NVD5890N

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit	
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>							
Forward Diode Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 50 A	T <sub>J</sub> = 25°C		0.9	1.2	V
		V <sub>GS</sub> = 0 V, I <sub>S</sub> = 20 A	T <sub>J</sub> = 25°C		0.8	1.0	
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = 0 V, dI <sub>S</sub> /dt = 100 A/μs, I <sub>S</sub> = 50 A			35		ns
Charge Time	t <sub>a</sub>				20		
Discharge Time	t <sub>b</sub>				15		
Reverse Recovery Charge	Q <sub>RR</sub>				40		

TYPICAL PERFORMANCE CURVES

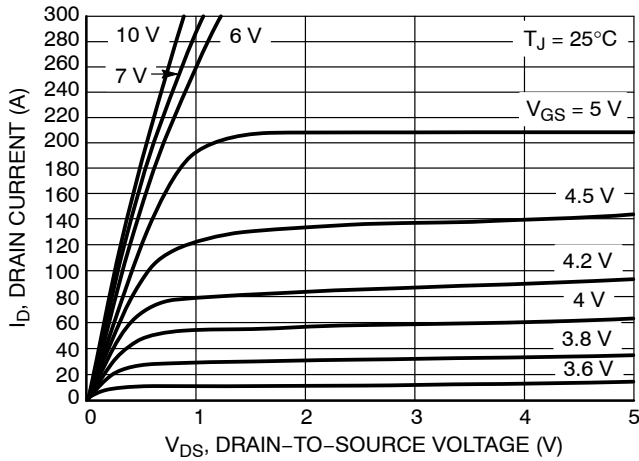


Figure 1. On-Region Characteristics

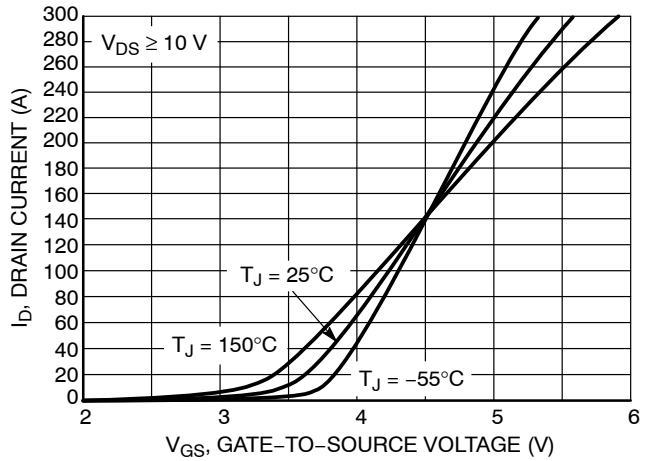


Figure 2. Transfer Characteristics

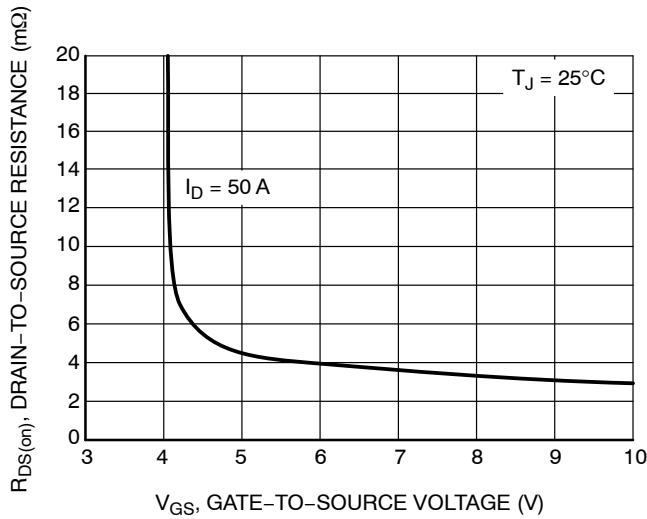


Figure 3. On-Resistance vs. Drain Current

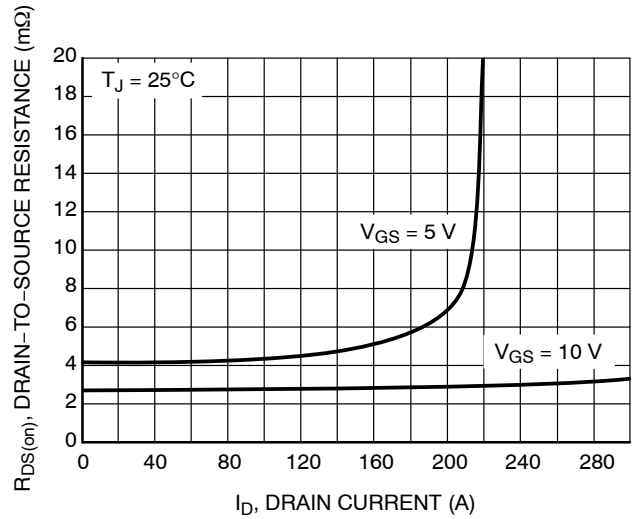


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

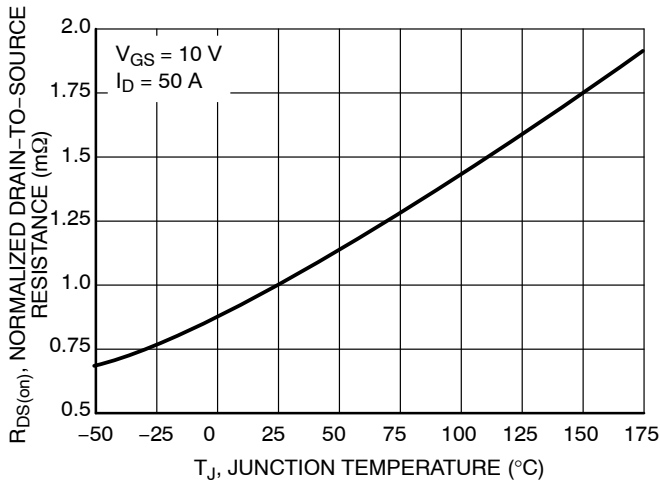


Figure 5. On-Resistance Variation with Temperature

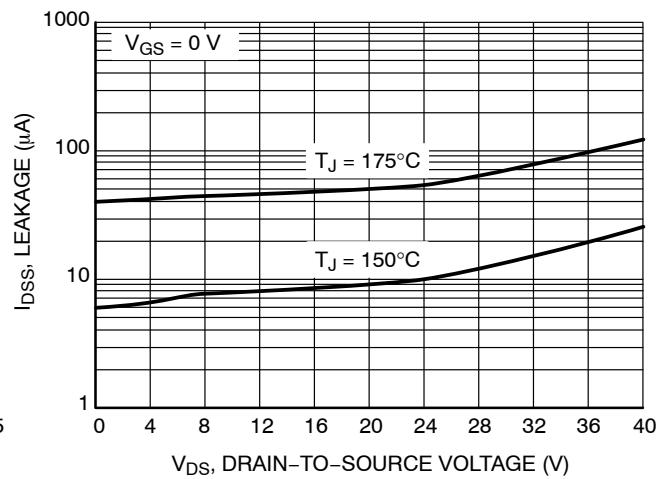


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL PERFORMANCE CURVES

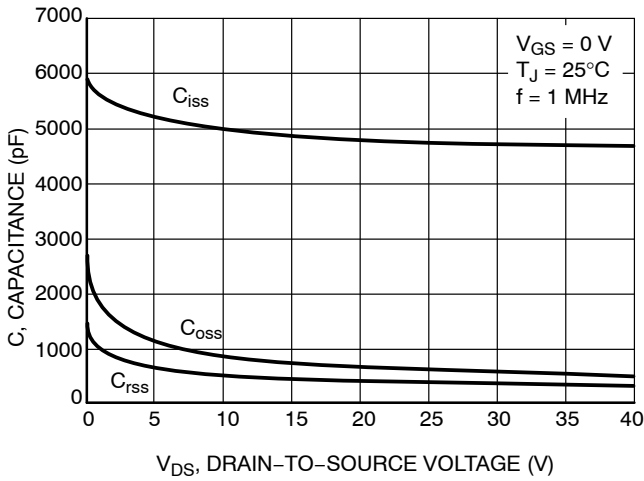


Figure 7. Capacitance Variation

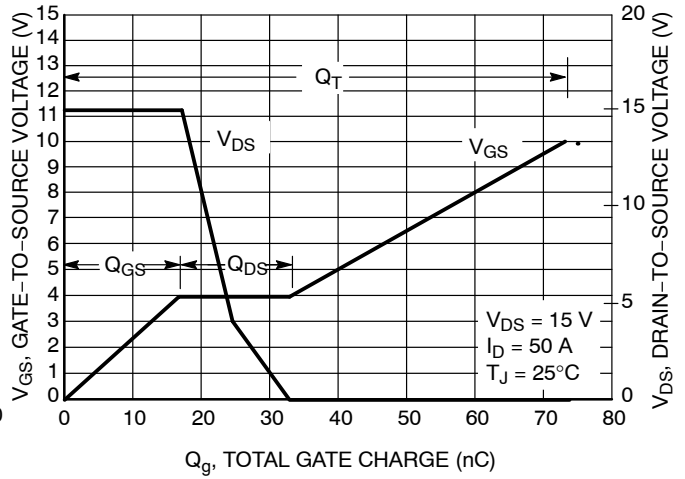


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

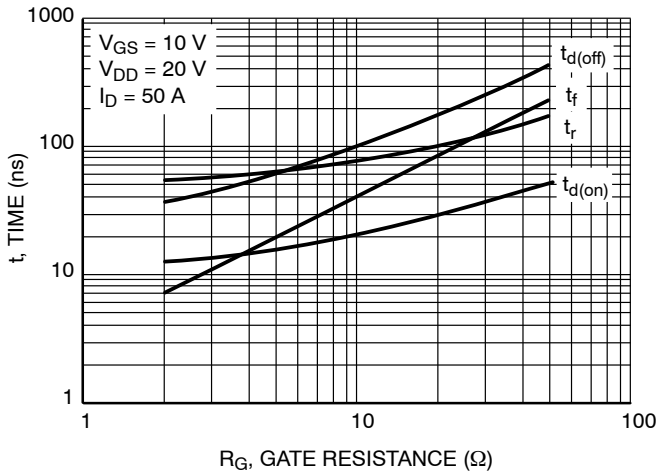


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

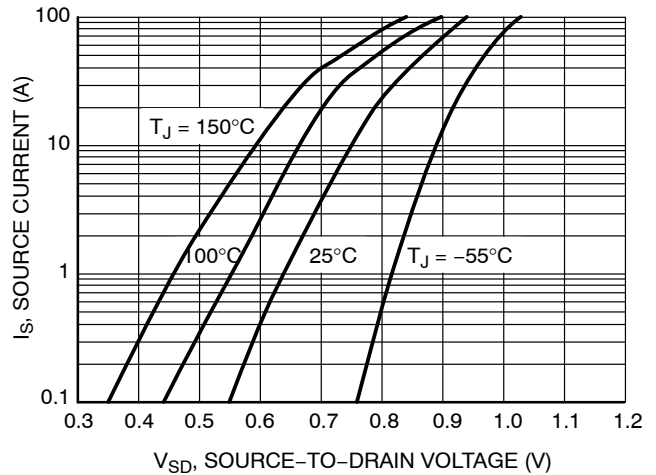


Figure 10. Diode Forward Voltage vs. Current

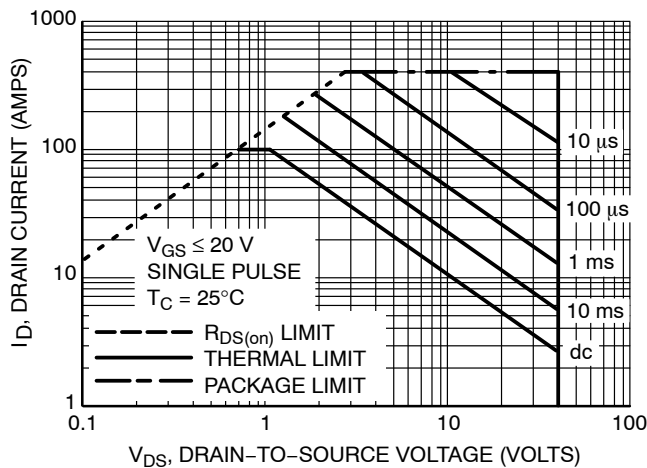


Figure 11. Maximum Rated Forward Biased Safe Operating Area

# NVD5890N

## TYPICAL PERFORMANCE CURVES

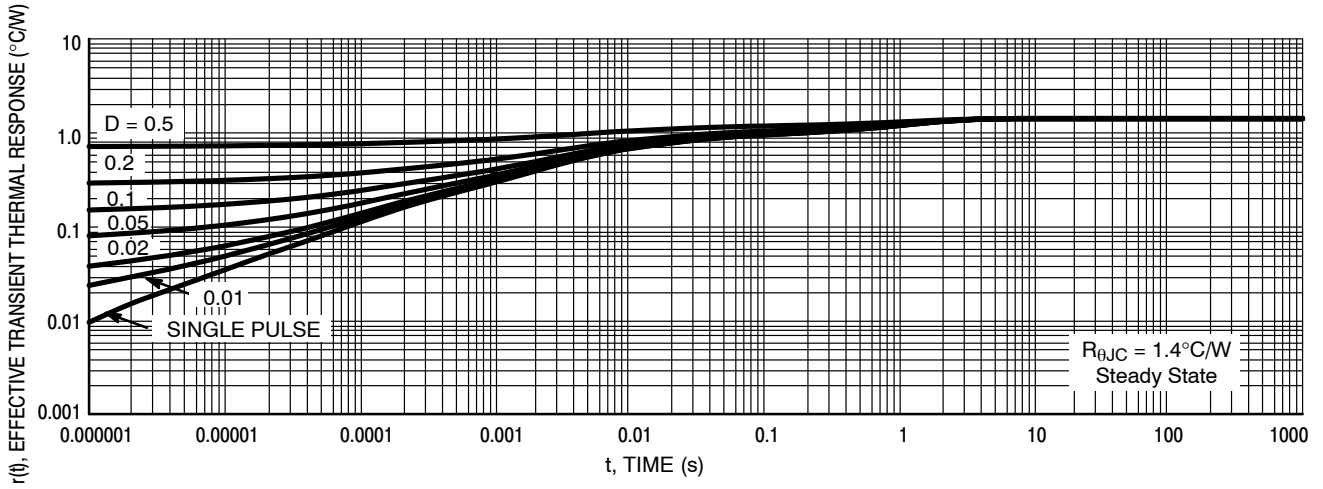


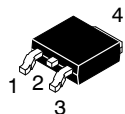
Figure 12. Thermal Response

### ORDERING INFORMATION

Order Number	Package	Shipping <sup>†</sup>
NVD5890NT4G	DPAK (Pb-Free)	2500/Tape & Reel
NVD5890NT4G-VF01	DPAK (Pb-Free)	2500/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.

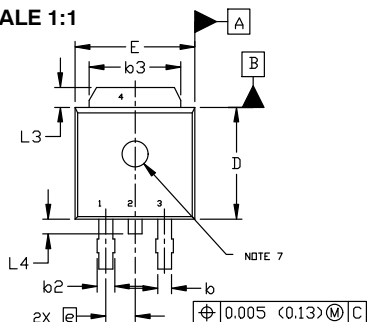
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



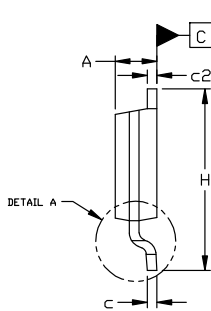
## DPAK (SINGLE GAUGE) CASE 369C ISSUE G

DATE 31 MAY 2023

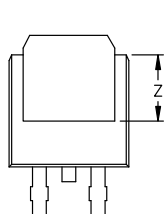
SCALE 1:1



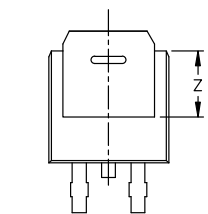
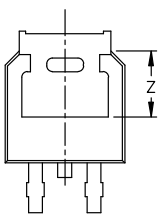
TOP VIEW



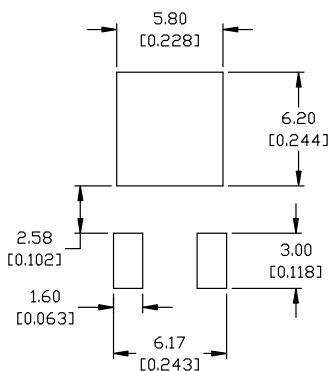
SIDE VIEW



BOTTOM VIEW



BOTTOM VIEW



### RECOMMENDED MOUNTING FOOTPRINT\*

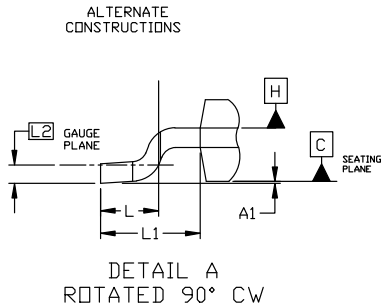
\*FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

- |  |  |   |   |  |
|--|--|---|---|--|
| <b>STYLE 1:</b><br>PIN 1. BASE<br>2. COLLECTOR<br>3. EMITTER<br>4. COLLECTOR | <b>STYLE 2:</b><br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE<br>4. DRAIN          | <b>STYLE 3:</b><br>PIN 1. ANODE<br>2. CATHODE<br>3. ANODE<br>4. CATHODE | <b>STYLE 4:</b><br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE<br>4. ANODE              | <b>STYLE 5:</b><br>PIN 1. GATE<br>2. ANODE<br>3. CATHODE<br>4. ANODE     |
| <b>STYLE 6:</b><br>PIN 1. MT1<br>2. MT2<br>3. GATE<br>4. MT2                 | <b>STYLE 7:</b><br>PIN 1. GATE<br>2. COLLECTOR<br>3. EMITTER<br>4. COLLECTOR | <b>STYLE 8:</b><br>PIN 1. N/C<br>2. CATHODE<br>3. ANODE<br>4. CATHODE   | <b>STYLE 9:</b><br>PIN 1. ANODE<br>2. CATHODE<br>3. RESISTOR ADJUST<br>4. CATHODE | <b>STYLE 10:</b><br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE<br>4. ANODE |

### NOTES:

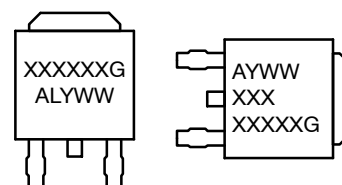
- DIMENSIONING AND TOLERANCING ASME Y14.5M, 1994.
- CONTROLLING DIMENSION: INCHES
- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3, AND Z.
- DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
- DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.
- OPTIONAL MOLD FEATURE.

DIM	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.086	0.094	2.18	2.38
A1	0.000	0.005	0.00	0.13
b	0.025	0.035	0.63	0.89
b2	0.028	0.045	0.72	1.14
b3	0.180	0.215	4.57	5.46
c	0.018	0.024	0.46	0.61
c2	0.018	0.024	0.46	0.61
D	0.235	0.245	5.97	6.22
E	0.250	0.265	6.35	6.73
e	0.090	BSC	2.29	BSC
H	0.370	0.410	9.40	10.41
L	0.055	0.070	1.40	1.78
L1	0.114	REF	2.90	REF
L2	0.020	BSC	0.51	BSC
L3	0.035	0.050	0.89	1.27
L4	----	0.040	---	1.01
Z	0.155	----	3.93	---



DETAIL A  
ROTATED 90° CW

### GENERIC MARKING DIAGRAM\*



- IC**
- Discrete**
- XXXXXX = Device Code  
 A = Assembly Location  
 L = Wafer Lot  
 Y = Year  
 WW = Work Week  
 G = Pb-Free Package

\*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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<b>DESCRIPTION:</b>	<b>DPAK (SINGLE GAUGE)</b>	<b>PAGE 1 OF 1</b>

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