

# MOSFET - Power, Single N-Channel, SUPERFET<sup>®</sup>, with Zener Diode, DPAK

## 600 V, 280 mΩ, 13 A

### NTD280N60S5Z

#### Description

SUPERFET V MOSFET Easy Drive series combines excellent switching performance without sacrificing ease of use and EMI issues for both hard and soft switching topologies.

#### Features

- 650 V @  $T_J = 150^\circ\text{C}$ , Typ.
- $R_{DS(on)} = 224\text{ m}\Omega$
- 100% Avalanche Tested
- Pb-Free, Halogen Free / BFR Free and are RoHS Compliant

#### Applications

- Computing / Display Power Supplies
- Telecom / Server Power Supplies
- Lighting / Charger / Adapter / Industrial Power Supplies

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

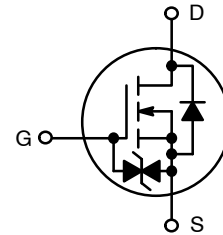
Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	600	V
Gate-to-Source Voltage	$V_{GS}$	DC	$\pm 20$
		AC ( $f > 1\text{ Hz}$ )	$\pm 20$
Continuous Drain Current	$I_D$	$T_C = 25^\circ\text{C}$	13
		$T_C = 100^\circ\text{C}$	8
Power Dissipation	$T_C = 25^\circ\text{C}$	$P_D$	89
Pulsed Drain Current (Note 1)	$T_C = 25^\circ\text{C}$	$I_{DM}$	39
Pulsed Source Current (Body Diode) (Note 1)		$I_{SM}$	39
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to +150	$^\circ\text{C}$
Source Current (Body Diode)	$I_S$	13	A
Single Pulse Avalanche Energy	$I_L = 2.9\text{ A}$ $R_G = 25\ \Omega$	$E_{AS}$	82
Avalanche Current	$I_{AS}$	2.9	A
Repetitive Avalanche Energy (Note 1)	$E_{AR}$	0.89	mJ
MOSFET dv/dt	dv/dt	120	V/ns
Peak Diode Recovery dv/dt (Note 2)		50	
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.

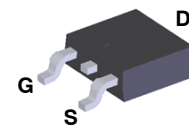
\*Drain current limited by maximum junction temperature.

1. Repetitive rating: pulse-width limited by maximum junction temperature.
2.  $I_{SD} \leq 5.5\text{ A}$ ,  $di/dt \leq 200\text{ A/s}$ ,  $V_{DD} \leq 400\text{ V}$ , starting  $T_J = 25^\circ\text{C}$ .

$V_{(BR)DSS}$	$R_{DS(ON)}\text{ MAX}$	$I_D\text{ MAX}$
600 V	280 mΩ @ $V_{GS} = 10\text{ V}$	13 A



N-CHANNEL MOSFET



DPAK  
CASE 369AS

#### MARKING DIAGRAM



T280N60S5Z = Specific Device Code  
 A = Assembly Location  
 Y = Year  
 WW = Work Week  
 ZZ = Lot Code

#### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NTD280N60S5Z	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 Specification Brochure, BRD8011/D.

# NTD280N60S5Z

## THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	1.4	°C/W
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	52	

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

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

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$	600	-	-	V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$\Delta V_{(BR)DSS} / \Delta T_J$	$I_D = 10\text{ mA}$ , Referenced to $25^\circ\text{C}$	-	630	-	mV/°C
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}, T_J = 25^\circ\text{C}$	-	-	1	$\mu\text{A}$
Gate-to-Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$	-	-	$\pm 5$	$\mu\text{A}$

### ON CHARACTERISTICS

Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 5.5\text{ A}, T_J = 25^\circ\text{C}$	-	224	280	m $\Omega$
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}, I_D = 1\text{ mA}, T_J = 25^\circ\text{C}$	2.4	-	4	V
Forward Trans-conductance	$g_{FS}$	$V_{DS} = 20\text{ V}, I_D = 5.5\text{ A}$	-	10.6	-	S

### CHARGES, CAPACITANCES & GATE RESISTANCE

Input Capacitance	$C_{ISS}$	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, f = 250\text{ kHz}$	-	978	-	pF
Output Capacitance	$C_{OSS}$		-	16.8	-	
Time Related Output Capacitance	$C_{OSS(tr)}$	$I_D = \text{Constant}, V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	-	276	-	
Energy Related Output Capacitance	$C_{OSS(er)}$		$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	-	30.5	
Total Gate Charge	$Q_{G(TOT)}$	$V_{DD} = 400\text{ V}, I_D = 5.5\text{ A}, V_{GS} = 10\text{ V}$	-	17.9	-	nC
Gate-to-Source Charge	$Q_{GS}$		-	4.53	-	
Gate-to-Drain Charge	$Q_{GD}$		-	4.8	-	
Gate Resistance	$R_G$		$f = 1\text{ MHz}$	-	5.11	

### SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = 0/10\text{ V}, V_{DD} = 400\text{ V}, I_D = 5.5\text{ A}, R_G = 12\ \Omega$	-	15.5	-	ns
Rise Time	$t_r$		-	4.27	-	
Turn-Off Delay Time	$t_{d(OFF)}$		-	52	-	
Fall Time	$t_f$		-	4.53	-	

### SOURCE-TO-DRAIN DIODE CHARACTERISTICS

Forward Diode Voltage	$V_{SD}$	$I_{SD} = 5.5\text{ A}, V_{GS} = 0\text{ V}, T_J = 25^\circ\text{C}$	-	-	1.2	V
Reverse Recovery Time	$t_{RR}$	$V_{GS} = 0\text{ V}, I_{SD} = 5.5\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_{DD} = 400\text{ V}$	-	229	-	ns
Reverse Recovery Charge	$Q_{RR}$		-	2114	-	nC

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.

# NTD280N60S5Z

## TYPICAL CHARACTERISTICS

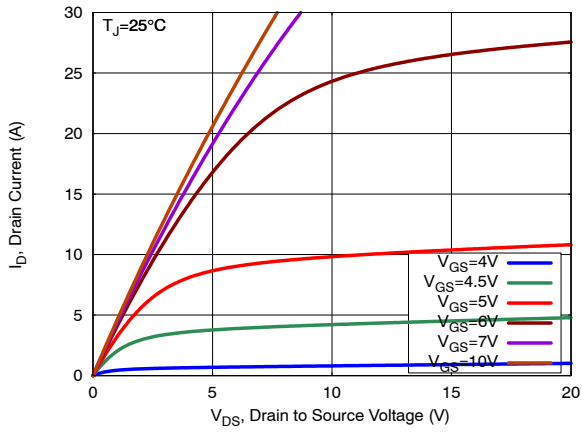


Figure 1. On-Region Characteristics

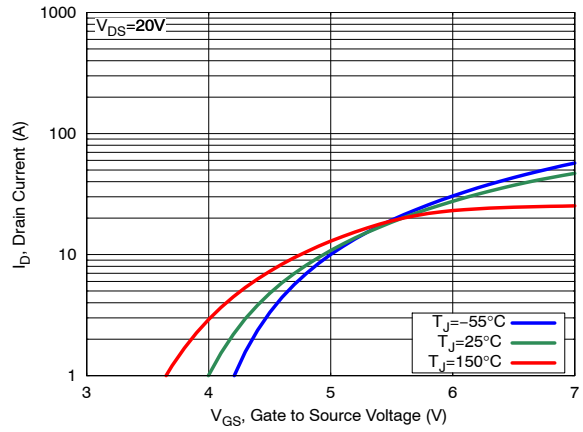


Figure 2. Transfer Characteristics

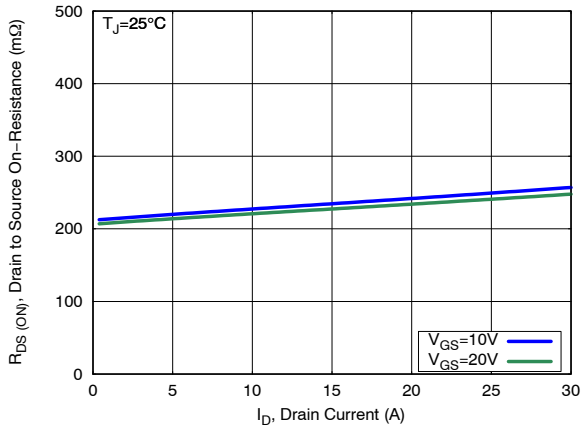


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

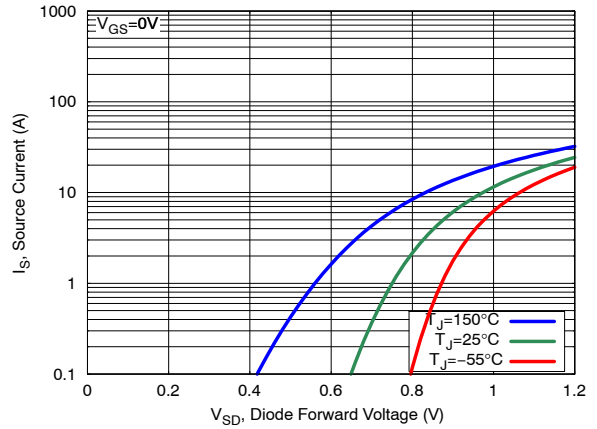


Figure 4. Diode Forward Voltage vs. Source Current

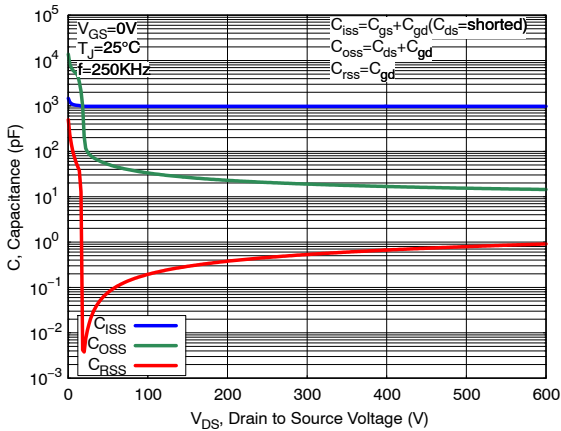


Figure 5. Capacitance Characteristics

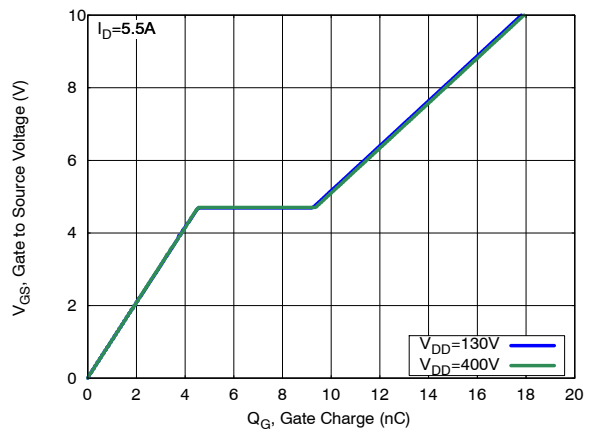


Figure 6. Gate Charge Characteristics

# NTD280N60S5Z

## TYPICAL CHARACTERISTICS

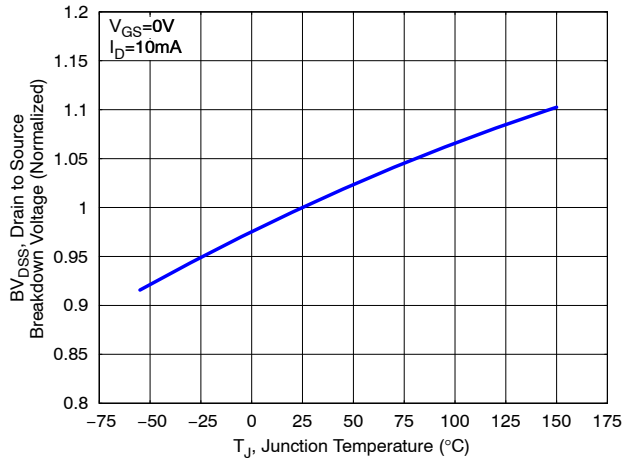


Figure 7. Breakdown Voltage Variation vs. Temperature

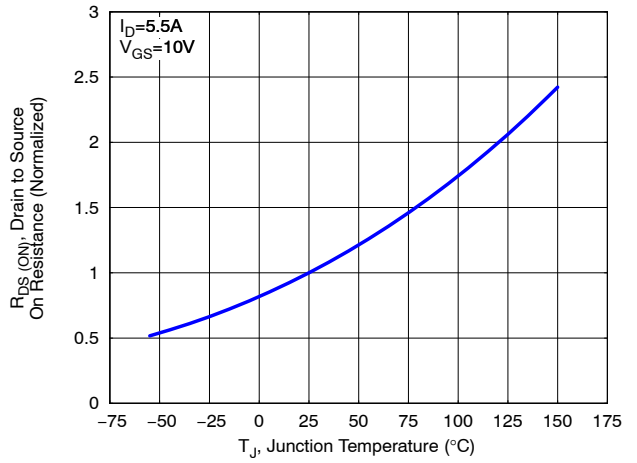


Figure 8. On-Resistance Variation vs. Temperature

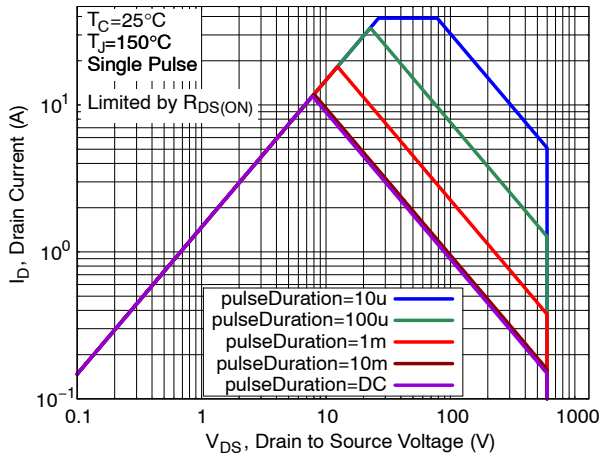


Figure 9. Maximum Safe Operating Area

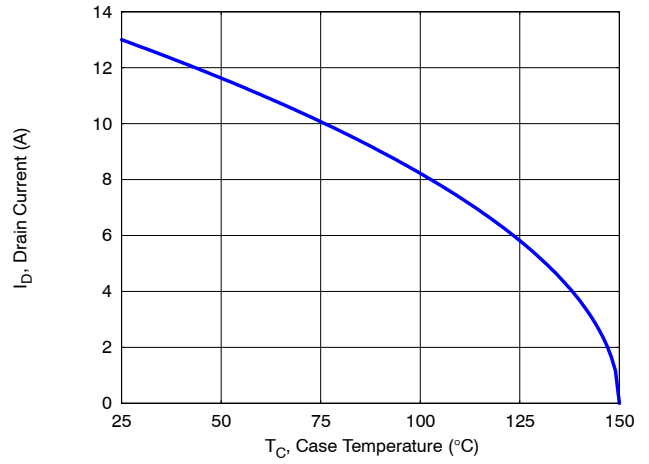


Figure 10. Maximum Drain Current vs. Case Temperature

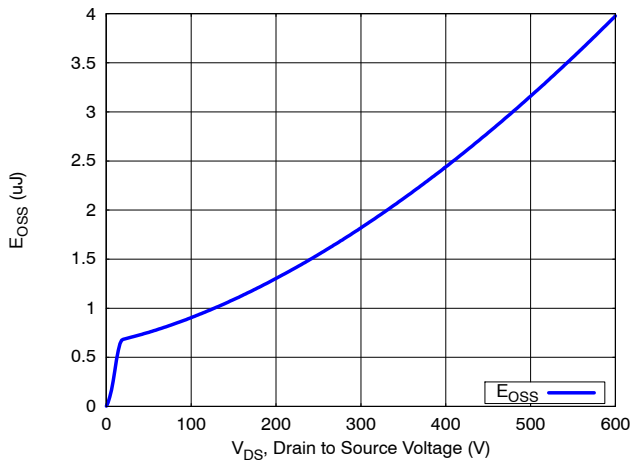


Figure 11.  $E_{OSS}$  vs. Drain-to-Source Voltage

# NTD280N60S5Z

## TYPICAL CHARACTERISTICS

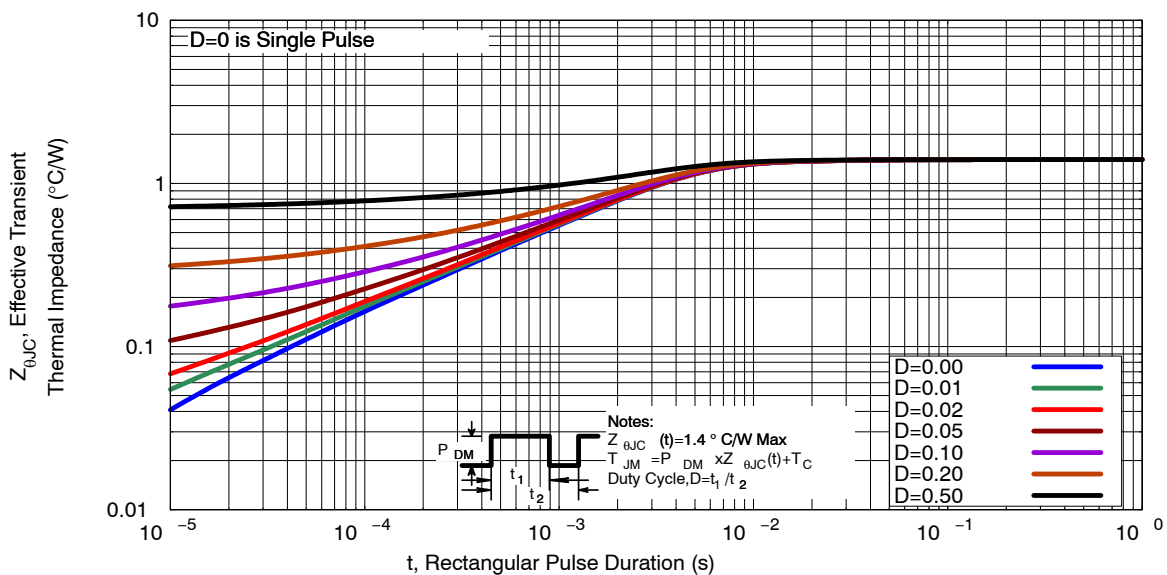
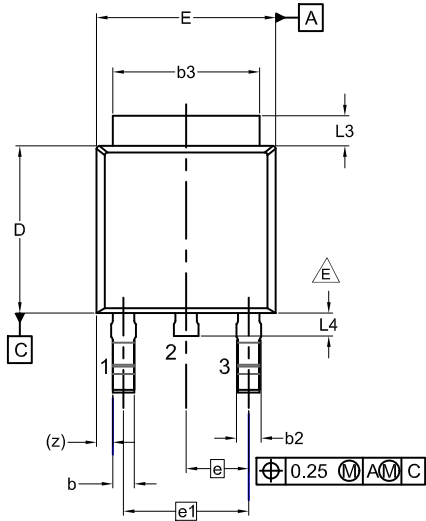


Figure 12. Transient Thermal Impedance

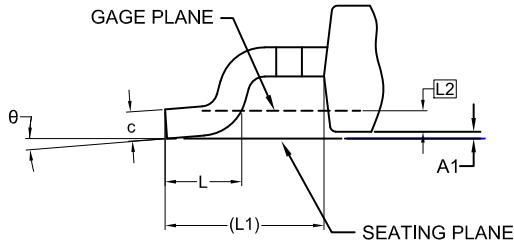
# NTD280N60S5Z

## PACKAGE DIMENSIONS

### DPAK3 (TO-252 3 LD) CASE 369AS ISSUE A



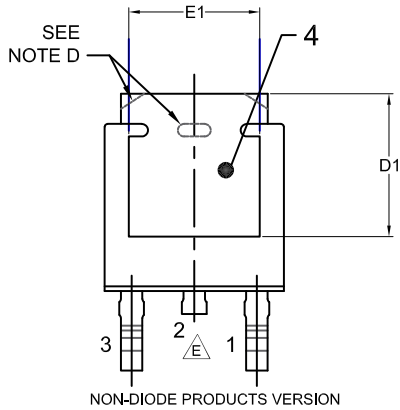
- NOTES: UNLESS OTHERWISE SPECIFIED
- A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE C, VARIATION AA.
  - B) ALL DIMENSIONS ARE IN MILLIMETERS.
  - C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
  - D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.
  - E) FOR DIODE PRODUCTS, L4 IS 0.25 MM MAX.
  - F) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
  - G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TO228P991X239-3N.



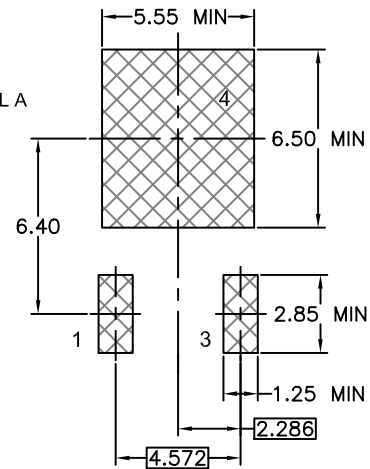
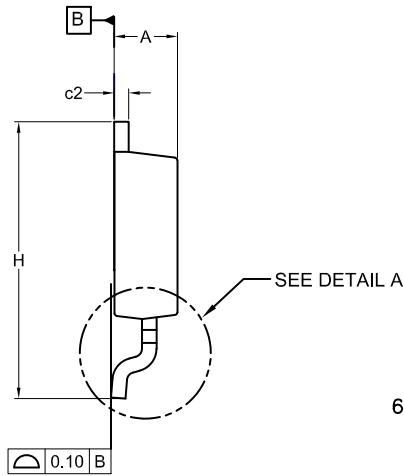
**DETAIL A**  
(ROTATED -90°)  
SCALE: 12X

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	2.18	2.29	2.39
A1	0.00	-	0.127
b	0.64	0.77	0.89
b2	0.76	0.95	1.14
b3	5.21	5.34	5.46
c	0.45	0.53	0.61
c2	0.45	0.52	0.58
D	5.97	6.10	6.22
D1	5.21	—	—
E	6.35	6.54	6.73
E1	4.32	—	—
e	2.286 BSC		
e1	4.572 BSC		
H	9.40	9.91	10.41
L	1.40	1.59	1.78
L1	2.90 REF		
L2	0.51 BSC		
L3	0.89	1.08	1.27
L4	—	—	1.02
theta	0°	--	10°

NON-DIODE PRODUCTS VERSION



NON-DIODE PRODUCTS VERSION



### LAND PATTERN RECOMMENDATION

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

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