

# NTD5406N

## Power MOSFET 40 V, 70 A, Single N-Channel, DPAK

### Features

- Low  $R_{DS(on)}$
- High Current Capability
- Low Gate Charge
- These are Pb-Free Devices

### Applications

- Electronic Brake Systems
- Electronic Power Steering
- Bridge Circuits

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

Parameter		Symbol	Value	Unit	
Drain-to-Source Voltage		$V_{DSS}$	40	V	
Gate-to-Source Voltage		$V_{GS}$	$\pm 20$	V	
Continuous Drain Current – $R_{\theta JC}$	Steady State	$T_C = 25^\circ\text{C}$	$I_D$	70	A
		$T_C = 125^\circ\text{C}$		40	
Power Dissipation – $R_{\theta JC}$	Steady State	$T_C = 25^\circ\text{C}$	$P_D$	100	W
Continuous Drain Current – $R_{\theta JA}$ (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	$I_D$	12.2	A
		$T_A = 125^\circ\text{C}$		7.0	
Power Dissipation – $R_{\theta JA}$ (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	$P_D$	3.0	W
Pulsed Drain Current	$t_p = 10 \mu\text{s}$	$I_{DM}$	150	A	
Operating Junction and Storage Temperature		$T_J, T_{STG}$	-55 to 175	$^\circ\text{C}$	
Source Current (Body Diode) Pulsed		$I_S$	63.5	A	
Single Pulse Drain-to-Source Avalanche Energy – ( $V_{DD} = 50 \text{ V}, V_{GS} = 10 \text{ V}, I_{PK} = 30 \text{ A}, L = 1 \text{ mH}, R_G = 25 \Omega$ )		EAS	450	mJ	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		$T_L$	260	$^\circ\text{C}$	

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

### THERMAL RESISTANCE RATINGS (Note 1)

Parameter	Symbol	Max	Unit
Junction-to-Case (Drain)	$R_{\theta JC}$	1.5	$^\circ\text{C}/\text{W}$
Junction-to-Case (Note 1)	$R_{\theta JA}$	49	

1. Surface mounted on FR4 board using 1 sq in pad size, (Cu Area 1.127 sq in [2 oz] including traces).

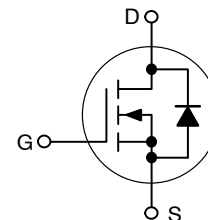


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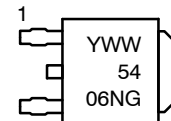
$V_{(BR)DSS}$	$R_{DS(ON)}$ TYP	$I_D$ MAX (Note 1)
40 V	8.7 m $\Omega$ @ 10 V	70 A

### N-Channel



DPAK  
CASE 369C  
STYLE 2

### MARKING DIAGRAM



Y = Year  
WW = Work Week  
5406N = Specific Device Code  
G = Pb-Free Device

### ORDERING INFORMATION

Device	Package	Shipping†
NTD5406NG	DPAK (Pb-Free)	75 Units / Rail
NTD5406NT4G	DPAK (Pb-Free)	2500 / Tape & Reel

†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.

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-to-Source Breakdown Voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	40			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	V <sub>(BR)DSS</sub> /T <sub>J</sub>			42		mV/°C
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 40 V	T <sub>J</sub> = 25°C		1.0	μA
			T <sub>J</sub> = 100°C		10	
Gate-to-Source Leakage Current	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±30 V			±100	nA

## ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 250 μA	1.5		3.5	V
Gate Threshold Temperature Coefficient	V <sub>GS(TH)</sub> /T <sub>J</sub>			-7.0		mV/°C
Drain-to-Source On Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 30 A		8.7	10	mΩ
		V <sub>GS</sub> = 5.0 V, I <sub>D</sub> = 10 A		13.2	17	
Forward Transconductance	g <sub>FS</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 10 A		19		S

## CHARGES AND CAPACITANCES

Input Capacitance	C <sub>ISS</sub>	V <sub>GS</sub> = 0 V, f = 1.0 MHz, V <sub>DS</sub> = 32 V		1375	2500	pF
Output Capacitance	C <sub>OSS</sub>			370	700	
Reverse Transfer Capacitance	C <sub>RSS</sub>			160	300	
Total Gate Charge	Q <sub>G(TOT)</sub>	V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 32 V, I <sub>D</sub> = 30 A		45		nC
Threshold Gate Charge	Q <sub>G(TH)</sub>			2.0		
Gate-to-Source Charge	Q <sub>GS</sub>			5.4		
Gate-to-Drain Charge	Q <sub>GD</sub>			20		

## SWITCHING CHARACTERISTICS, V<sub>GS</sub> = 10 V (Note 3)

Turn-On Delay Time	t <sub>d(ON)</sub>	V <sub>GS</sub> = 10 V, V <sub>DD</sub> = 32 V, I <sub>D</sub> = 30 A, R <sub>G</sub> = 2.5 Ω		7.2		ns
Rise Time	t <sub>r</sub>			57		
Turn-Off Delay Time	t <sub>d(OFF)</sub>			30		
Fall Time	t <sub>f</sub>			67		

## SWITCHING CHARACTERISTICS, V<sub>GS</sub> = 5 V (Note 3)

Turn-On Delay Time	t <sub>d(ON)</sub>	V <sub>GS</sub> = 5.0 V, V <sub>DD</sub> = 20 V, I <sub>D</sub> = 30 A, R <sub>G</sub> = 2.5 Ω		15		ns
Rise Time	t <sub>r</sub>			147		
Turn-Off Delay Time	t <sub>d(OFF)</sub>			20		
Fall Time	t <sub>f</sub>			29		

## DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 10 A	T <sub>J</sub> = 25°C	0.82	1.1	V
			T <sub>J</sub> = 125°C	0.67		
Reverse Recovery Time	t <sub>RR</sub>	V <sub>GS</sub> = 0 V, dI <sub>SD</sub> /dt = 100 A/μs, I <sub>S</sub> = 10 A		46		ns
Charge Time	t <sub>a</sub>			24		
Discharge Time	t <sub>b</sub>			22		
Reverse Recovery Charge	Q <sub>RR</sub>			65		

- Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%.
- Switching characteristics are independent of operating junction temperatures.

TYPICAL PERFORMANCE CURVES

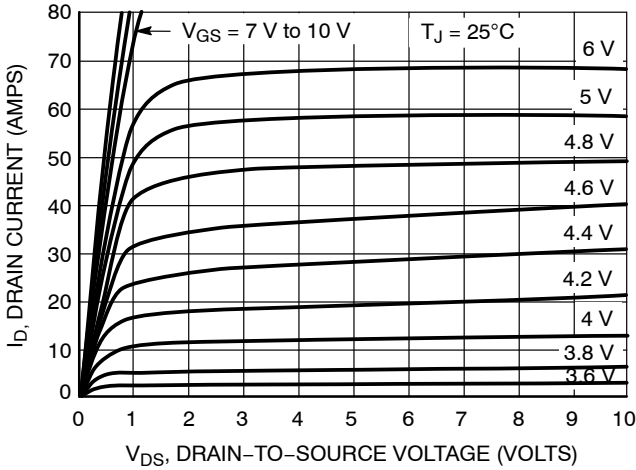


Figure 1. On-Region Characteristics

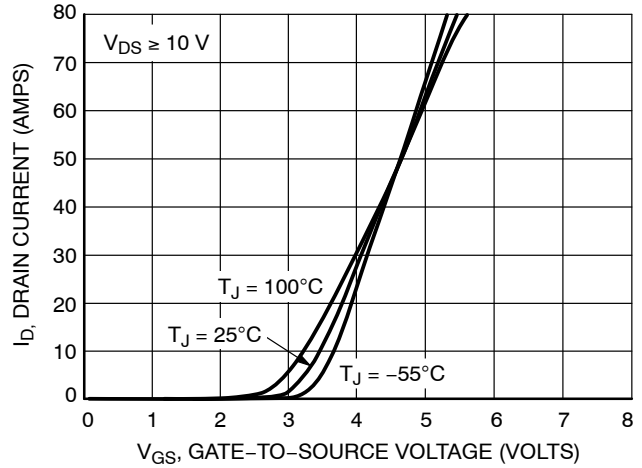


Figure 2. Transfer Characteristics

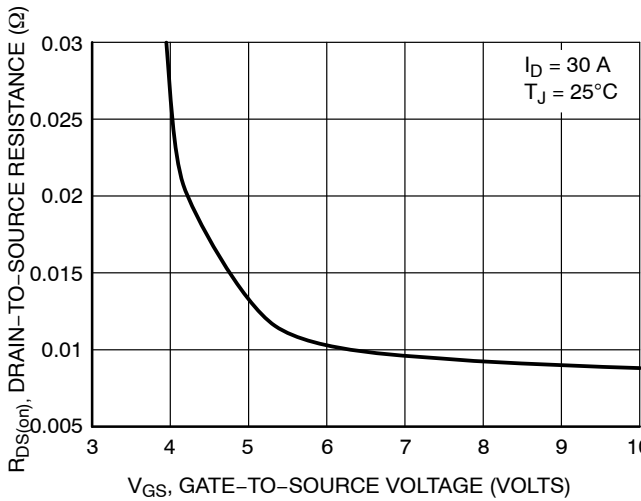


Figure 3. On-Resistance vs. Gate-to-Source Voltage

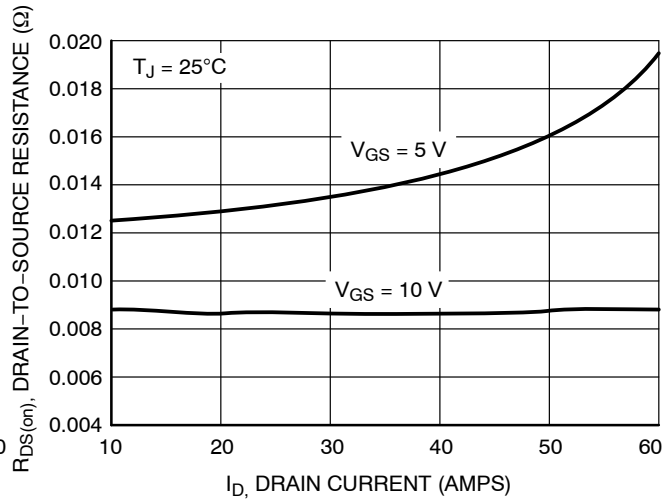


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

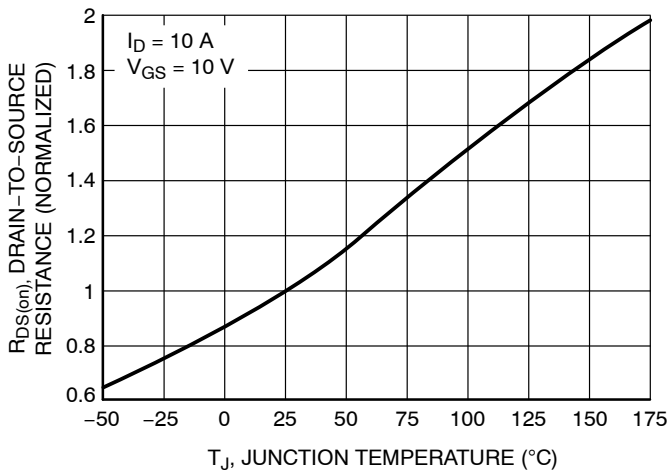


Figure 5. On-Resistance Variation with Temperature

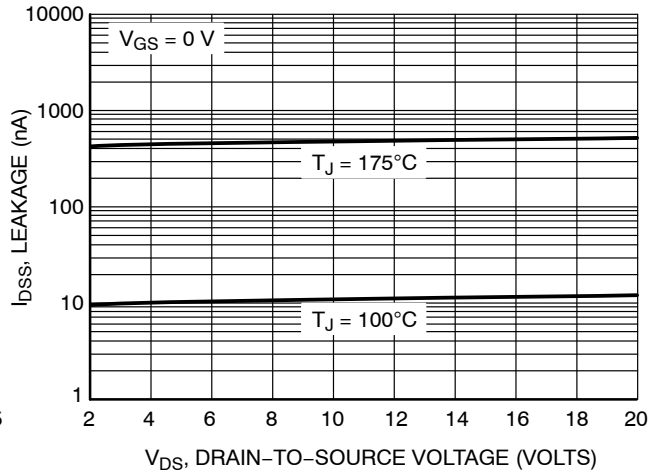


Figure 6. Drain-to-Source Leakage Current vs. Voltage

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## TYPICAL PERFORMANCE CURVES

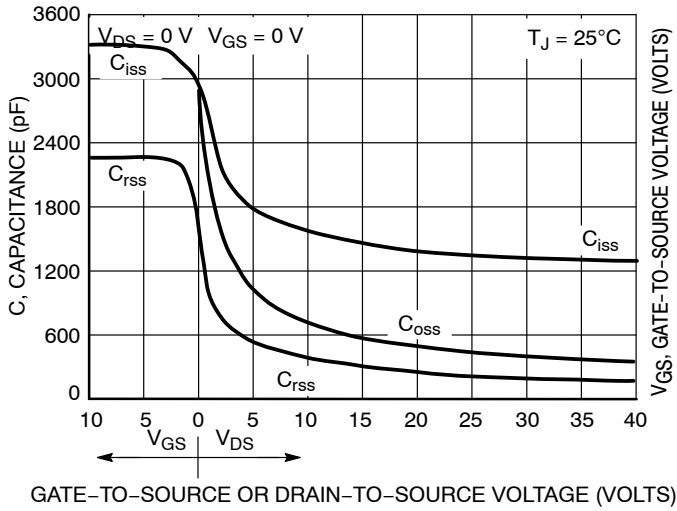


Figure 7. Capacitance Variation

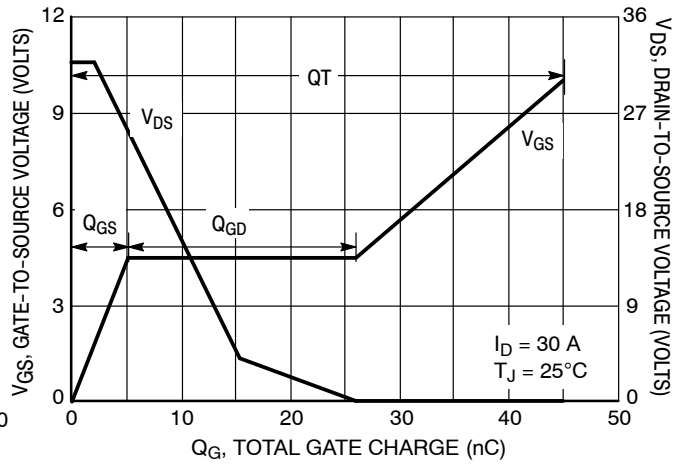


Figure 8. Gate-To-Source and Drain-To-Source Voltage vs. Total Charge

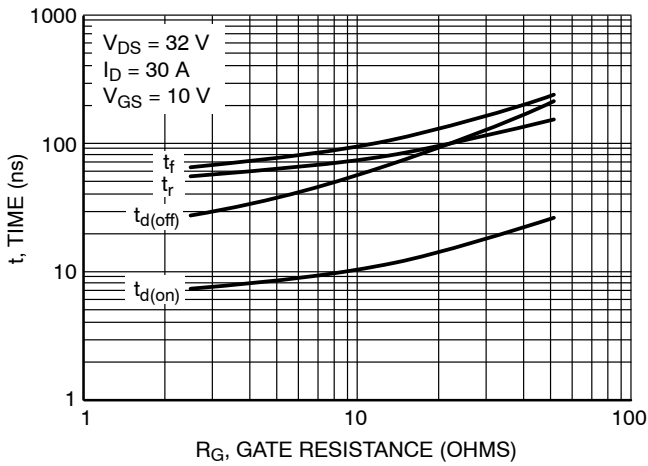


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

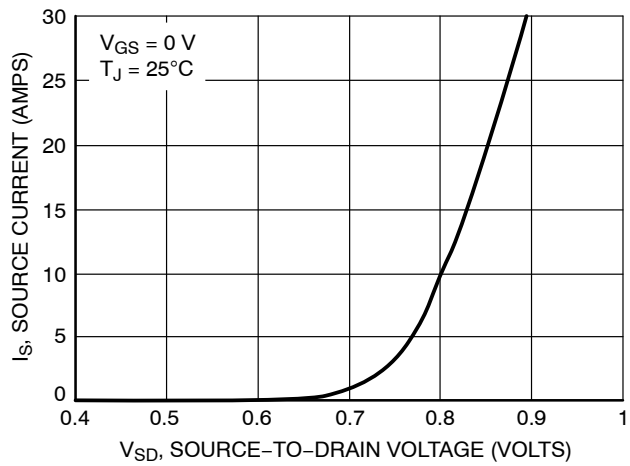


Figure 10. Diode Forward Voltage vs. Current

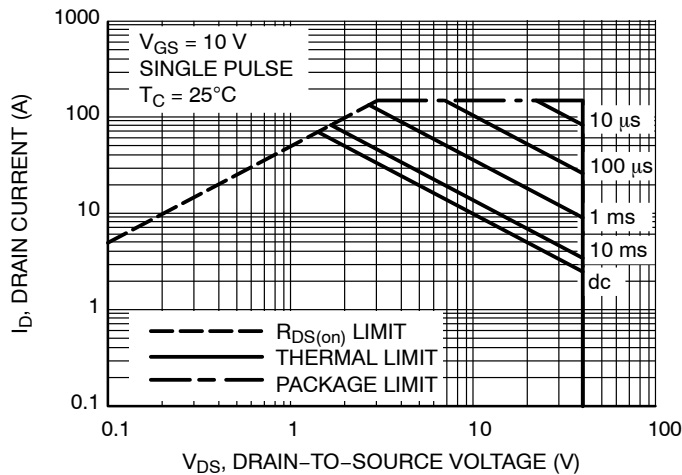


Figure 11. Maximum Rated Forward Biased Safe Operating Area

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## TYPICAL PERFORMANCE CURVES

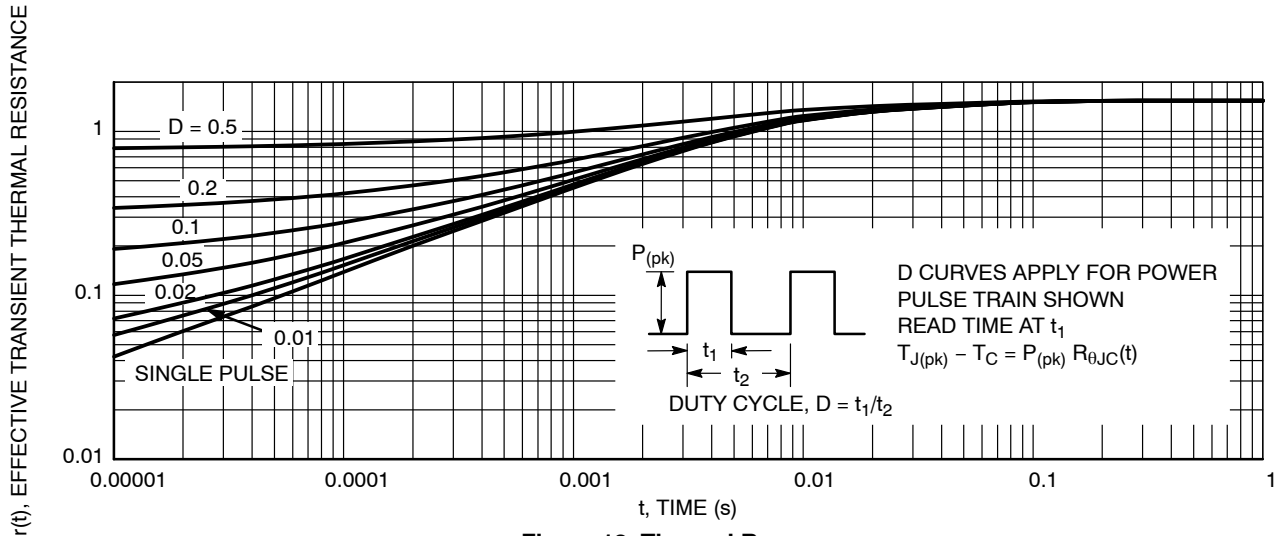
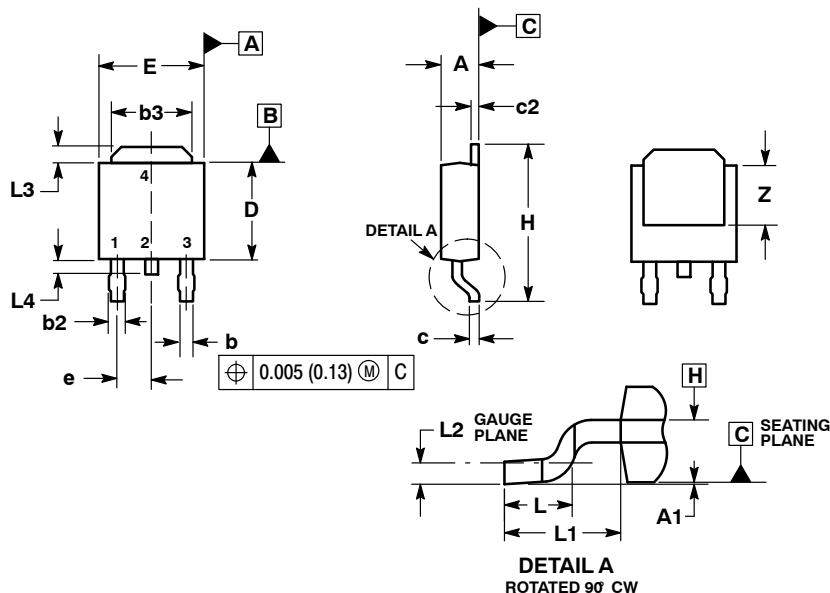


Figure 12. Thermal Response

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## PACKAGE DIMENSIONS

### DPAK (SINGLE GAUGE) CASE 369C-01 ISSUE D

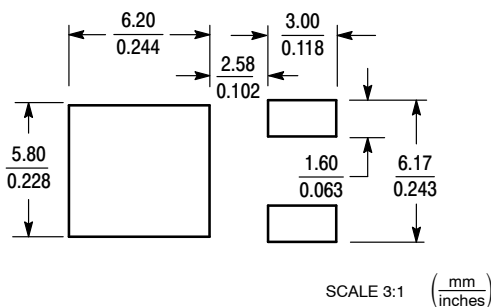


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
4. 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.
5. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
6. DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.

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	0.030	0.045	0.76	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	0.108	REF	2.74	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	---

### SOLDERING 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.

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