

# NGD8201B

## Ignition IGBT, 20 A, 400 V N-Channel DPAK

This Logic Level Insulated Gate Bipolar Transistor (IGBT) features monolithic circuitry integrating ESD and Over-Voltage clamped protection for use in inductive coil drivers applications. Primary uses include Ignition, Direct Fuel Injection, or wherever high voltage and high current switching is required.

### Features

- Ideal for Coil-on-Plug Applications
- DPAK Package Offers Smaller Footprint for Increased Board Space
- Gate-Emitter ESD Protection
- Temperature Compensated Gate-Collector Voltage Clamp Limits Stress Applied to Load
- Integrated ESD Diode Protection
- New Design Increases Unclamped Inductive Switching (UIS) Energy Per Area
- Low Threshold Voltage Interfaces Power Loads to Logic or Microprocessor Devices
- Low Saturation Voltage
- High Pulsed Current Capability
- Emitter Ballasting for Short-Circuit Capability
- These are Pb-Free Devices

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

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CES}$	430	$V_{DC}$
Collector-Gate Voltage	$V_{CER}$	430	$V_{DC}$
Gate-Emitter Voltage	$V_{GE}$	18	$V_{DC}$
Collector Current-Continuous @ $T_C = 25^\circ\text{C}$ - Pulsed	$I_C$	15 50	$A_{DC}$ $A_{AC}$
ESD (Human Body Model) $R = 1500\ \Omega$ , $C = 100\ \text{pF}$	ESD	8.0	kV
ESD (Machine Model) $R = 0\ \Omega$ , $C = 200\ \text{pF}$	ESD	800	V
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	115 0.77	Watts $\text{W}/^\circ\text{C}$
Operating and Storage Temperature Range	$T_J$ , $T_{stg}$	-55 to +175	$^\circ\text{C}$

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.

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

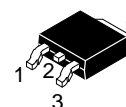
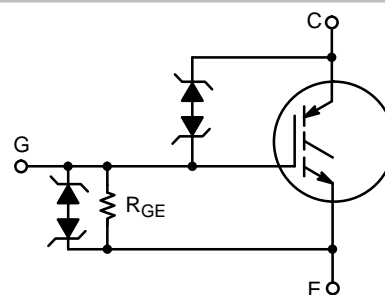


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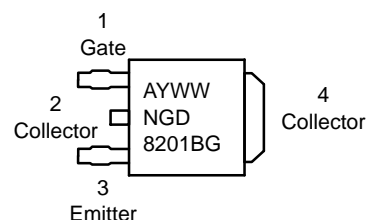
20 AMPS, 400 VOLTS

$V_{CE(on)} \leq 1.8\ \text{V}$  @  
 $I_C = 10\ \text{A}$ ,  $V_{GE} \geq 4.5\ \text{V}$



DPAK  
CASE 369C  
STYLE 7

### MARKING DIAGRAM



NGD8201B = Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
G = Pb-Free Device

### ORDERING INFORMATION

Device	Package	Shipping†
NGD8201BNT4G	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 Specification Brochure, BRD8011/D.

# NGD8201B

## UNCLAMPED COLLECTOR-TO-EMITTER AVALANCHE CHARACTERISTICS ( $-55^{\circ} \leq T_J \leq 175^{\circ}\text{C}$ )

Characteristic	Symbol	Value	Unit
Single Pulse Collector-to-Emitter Avalanche Energy $V_{CC} = 50\text{ V}$ , $V_{GE} = 5.0\text{ V}$ , Pk $I_L = 22\text{ A}$ , $R_G = 1000\ \Omega$ , $L = 1.8\text{ mH}$ , Starting $T_J = 25^{\circ}\text{C}$ $V_{CC} = 50\text{ V}$ , $V_{GE} = 5.0\text{ V}$ , Pk $I_L = 17\text{ A}$ , $R_G = 1000\ \Omega$ , $L = 3.0\text{ mH}$ , Starting $T_J = 25^{\circ}\text{C}$ $V_{CC} = 50\text{ V}$ , $V_{GE} = 5.0\text{ V}$ , Pk $I_L = 19\text{ A}$ , $R_G = 1000\ \Omega$ , $L = 1.8\text{ mH}$ , Starting $T_J = 125^{\circ}\text{C}$	$E_{AS}$	435 433 325	mJ
Reverse Avalanche Energy $V_{CC} = 100\text{ V}$ , $V_{GE} = 20\text{ V}$ , Pk $I_L = 25.8\text{ A}$ , $L = 6.0\text{ mH}$ , Starting $T_J = 25^{\circ}\text{C}$	$E_{AS(R)}$	2000	mJ

## THERMAL CHARACTERISTICS

Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.3	$^{\circ}\text{C/W}$
Thermal Resistance, Junction to Ambient DPAK (Note 1)	$R_{\theta JA}$	95	$^{\circ}\text{C/W}$
Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds	$T_L$	275	$^{\circ}\text{C}$

1. When surface mounted to an FR4 board using the minimum recommended pad size.

## ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
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## OFF CHARACTERISTICS

Collector-Emitter Clamp Voltage	$BV_{CES}$	$I_C = 2.0\text{ mA}$	$T_J = -40^{\circ}\text{C}$ to $150^{\circ}\text{C}$	380	395	420	$V_{DC}$
		$I_C = 10\text{ mA}$	$T_J = -40^{\circ}\text{C}$ to $150^{\circ}\text{C}$	390	405	430	
Zero Gate Voltage Collector Current	$I_{CES}$	$V_{CE} = 350\text{ V}$ , $V_{GE} = 0\text{ V}$	$T_J = 25^{\circ}\text{C}$	–	1.5	5	$\mu\text{A}_{DC}$
			$T_J = 150^{\circ}\text{C}$	–	10	30*	
			$T_J = -40^{\circ}\text{C}$	–	0.5	2.5	
		$V_{CE} = 15\text{ V}$ , $V_{GE} = 0\text{ V}$	$T_J = 25^{\circ}\text{C}$	–	–	2.0	
Reverse Collector-Emitter Leakage Current	$I_{ECS}$	$V_{CE} = -24\text{ V}$	$T_J = 25^{\circ}\text{C}$	–	0.7	1.0	mA
			$T_J = 150^{\circ}\text{C}$	–	12	25*	
			$T_J = -40^{\circ}\text{C}$	–	0.1	1.0	
Reverse Collector-Emitter Clamp Voltage	$BV_{CES(R)}$	$I_C = -75\text{ mA}$	$T_J = 25^{\circ}\text{C}$	27	33	37	$V_{DC}$
			$T_J = 150^{\circ}\text{C}$	30	36	40	
			$T_J = -40^{\circ}\text{C}$	25	32	35	
Gate-Emitter Clamp Voltage	$BV_{GES}$	$I_G = 5.0\text{ mA}$	$T_J = -40^{\circ}\text{C}$ to $150^{\circ}\text{C}$	11	13	15	$V_{DC}$
Gate-Emitter Leakage Current	$I_{GES}$	$V_{GE} = 10\text{ V}$	$T_J = -40^{\circ}\text{C}$ to $150^{\circ}\text{C}$	384	640	700	$\mu\text{A}_{DC}$
Gate Emitter Resistor (Note 3)	$R_{GE}$	–	$T_J = -40^{\circ}\text{C}$ to $150^{\circ}\text{C}$	10	16	26	k $\Omega$

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.

\*Maximum Value of Characteristic across Temperature Range.

# NGD8201B

## ELECTRICAL CHARACTERISTICS (continued)

Characteristic	Symbol	Test Conditions	Temperature	Min	Typ	Max	Unit
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### ON CHARACTERISTICS (Note 2)

Gate Threshold Voltage	$V_{GE(th)}$	$I_C = 1.0 \text{ mA}$ , $V_{GE} = V_{CE}$	$T_J = 25^\circ\text{C}$	1.2	1.5	1.8	$V_{DC}$
			$T_J = 150^\circ\text{C}$	0.8	1.0	1.3	
			$T_J = -40^\circ\text{C}$	1.4	1.7	2.0*	
Threshold Temperature Coefficient (Negative)	–	–	–	–	3.4	–	mV/°C
Collector-to-Emitter On-Voltage	$V_{CE(on)}$	$I_C = 6.0 \text{ A}$ , $V_{GE} = 4.0 \text{ V}$	$T_J = 25^\circ\text{C}$	1.0	1.2	1.5	$V_{DC}$
			$T_J = 150^\circ\text{C}$	1.0	1.2	1.5	
			$T_J = -40^\circ\text{C}$	1.0	1.2	1.5*	
		$I_C = 8.0 \text{ A}$ , $V_{GE} = 4.0 \text{ V}$	$T_J = 25^\circ\text{C}$	1.2	1.4	1.6*	
			$T_J = 150^\circ\text{C}$	1.2	1.4	1.6	
			$T_J = -40^\circ\text{C}$	1.2	1.4	1.6*	
		$I_C = 10 \text{ A}$ , $V_{GE} = 4.0 \text{ V}$	$T_J = 25^\circ\text{C}$	1.3	1.5	1.8	
			$T_J = 150^\circ\text{C}$	1.3	1.5	1.9	
			$T_J = -40^\circ\text{C}$	1.3	1.6	1.8*	
		$I_C = 15 \text{ A}$ , $V_{GE} = 4.0 \text{ V}$	$T_J = 25^\circ\text{C}$	1.7	1.9	2.3	
			$T_J = 150^\circ\text{C}$	1.9	2.2	2.5*	
			$T_J = -40^\circ\text{C}$	1.5	1.9	2.3	
		$I_C = 10 \text{ A}$ , $V_{GE} = 4.5 \text{ V}$	$T_J = 25^\circ\text{C}$	1.3	1.5	1.8*	
			$T_J = 150^\circ\text{C}$	1.3	1.5	1.8*	
			$T_J = -40^\circ\text{C}$	1.3	1.5	1.8*	
		$I_C = 6.5 \text{ A}$ , $V_{GE} = 3.7 \text{ V}$	$T_J = 25^\circ\text{C}$	–	–	1.65	
Forward Transconductance	gfs	$V_{CE} = 5.0 \text{ V}$ , $I_C = 6.0 \text{ A}$	$T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$	8.0	14	25	Mhos

### DYNAMIC CHARACTERISTICS (Note 3)

Input Capacitance	$C_{ISS}$	$V_{CC} = 25 \text{ V}$ , $V_{GE} = 0 \text{ V}$ $f = 1.0 \text{ MHz}$	$T_J = -40^\circ\text{C}$ to $150^\circ\text{C}$	400	800	1000	pF
Output Capacitance	$C_{OSS}$			50	75	100	
Transfer Capacitance	$C_{RSS}$			4.0	7.0	10	

### SWITCHING CHARACTERISTICS (Note 3)

Turn-Off Delay Time (Resistive)	$t_{d(off)}$	$V_{CC} = 300 \text{ V}$ , $I_C = 6.5 \text{ A}$ $R_G = 1.0 \text{ k}\Omega$ , $R_L = 46 \text{ }\Omega$	$T_J = 25^\circ\text{C}$	–	4.0	10	$\mu\text{Sec}$
Fall Time (Resistive)	$t_f$	$V_{CC} = 300 \text{ V}$ , $I_C = 6.5 \text{ A}$ $R_G = 1.0 \text{ k}\Omega$ , $R_L = 46 \text{ }\Omega$	$T_J = 25^\circ\text{C}$	–	9.0	15	
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 10 \text{ V}$ , $I_C = 6.5 \text{ A}$ $R_G = 1.0 \text{ k}\Omega$ , $R_L = 1.5 \text{ }\Omega$	$T_J = 25^\circ\text{C}$	–	0.7	4.0	$\mu\text{Sec}$
Rise Time	$t_r$	$V_{CC} = 10 \text{ V}$ , $I_C = 6.5 \text{ A}$ $R_G = 1.0 \text{ k}\Omega$ , $R_L = 1.5 \text{ }\Omega$	$T_J = 25^\circ\text{C}$	–	4.5	7.0	

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.

\*Maximum Value of Characteristic across Temperature Range.

2. Pulse Test: Pulse Width  $\leq 300 \text{ }\mu\text{S}$ , Duty Cycle  $\leq 2\%$ .

3. Not production tested.

TYPICAL ELECTRICAL CHARACTERISTICS

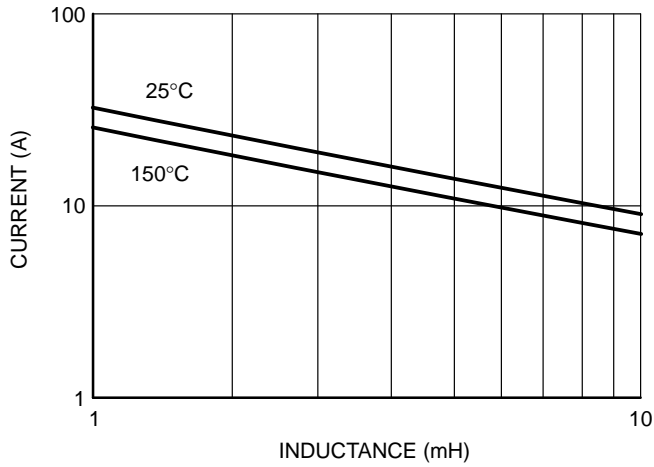


Figure 1. Maximum Single Pulse Switch Off Current vs. Inductance

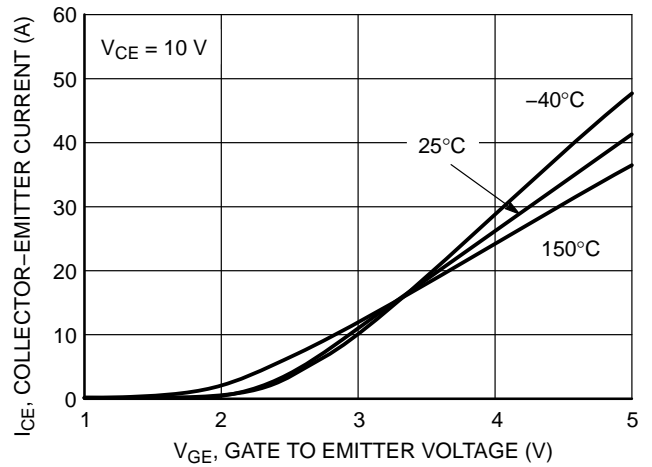


Figure 2. Transfer Characteristics

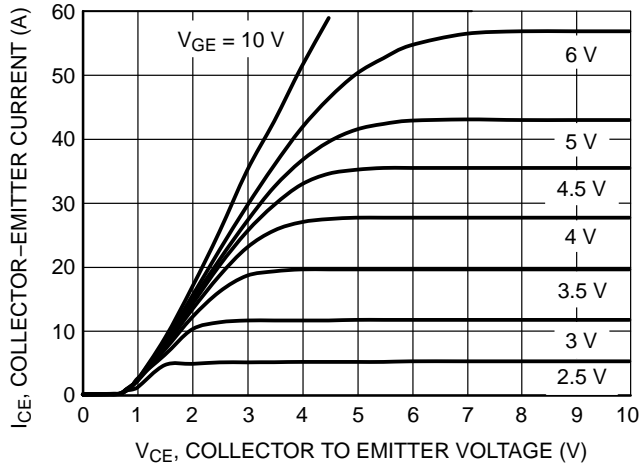


Figure 3. Output Characteristics,  $T_J = 25^\circ\text{C}$

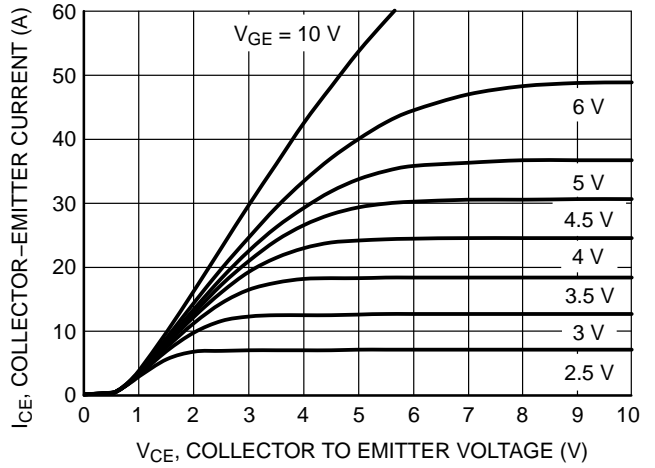


Figure 4. On-Region Characteristics,  $T_J = 150^\circ\text{C}$

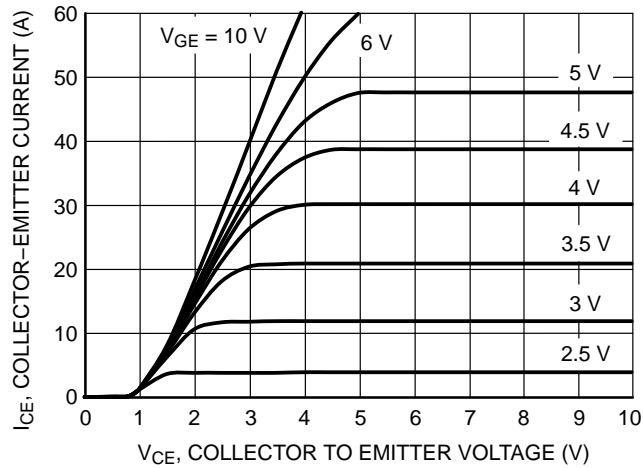


Figure 5. On-Region Characteristics,  $T_J = -40^\circ\text{C}$

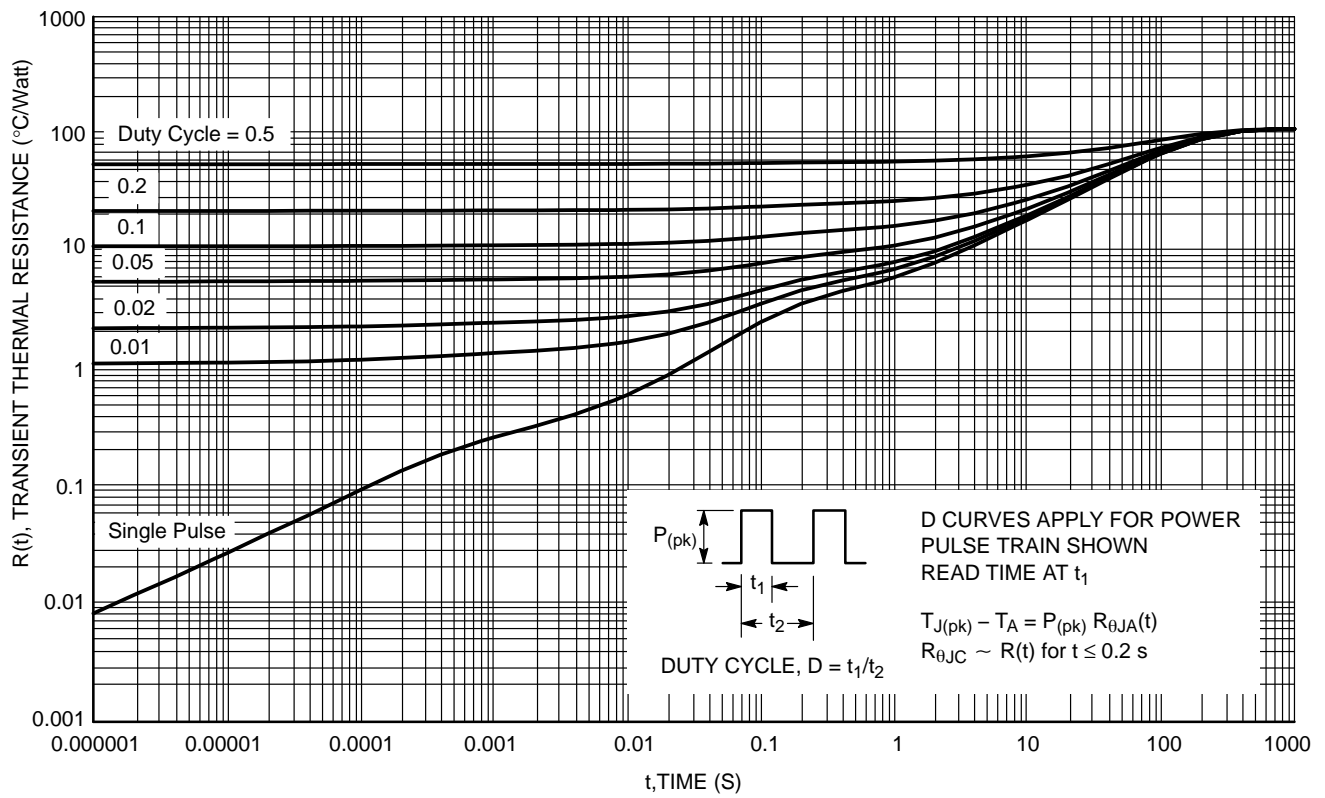
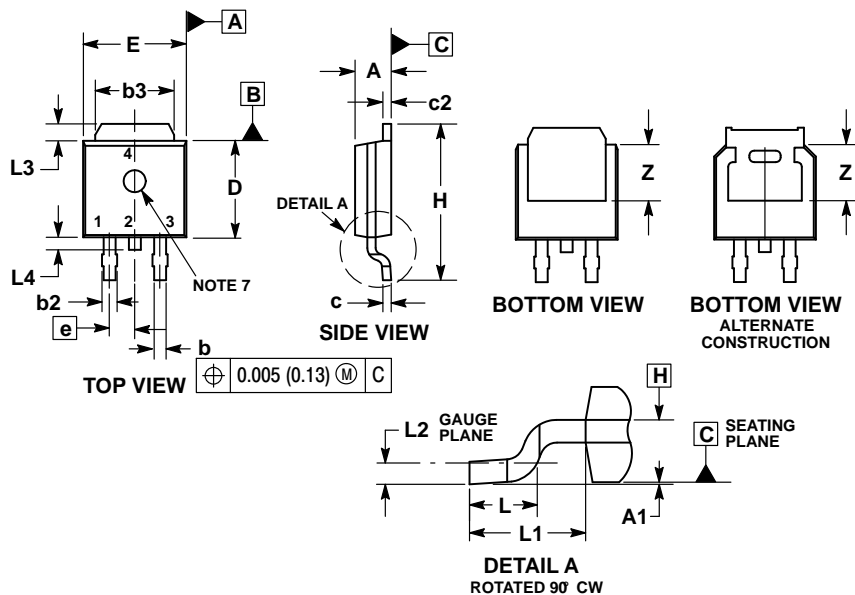


Figure 6. Transient Thermal Resistance (Non-normalized Junction-to-Ambient mounted on minimum pad area)

# NGD8201B

## PACKAGE DIMENSIONS

### DPAK CASE 369C ISSUE E

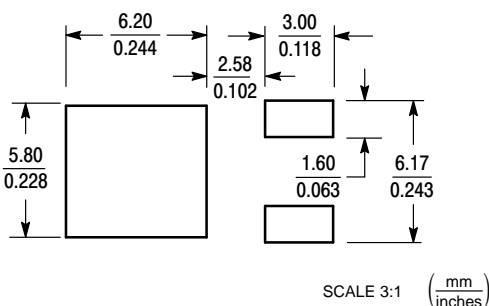


#### NOTES:

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.
7. 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	—

#### SOLDERING FOOTPRINT\*



#### STYLE 7:

- PIN 1: GATE
2. COLLECTOR
3. EMITTER
4. COLLECTOR

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

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