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Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



# NSS60601MZ4

## 60 V, 6.0 A, Low $V_{CE(sat)}$ NPN Transistor

ON Semiconductor's e<sup>2</sup>PowerEdge family of low  $V_{CE(sat)}$  transistors are surface mount devices featuring ultra low saturation voltage ( $V_{CE(sat)}$ ) and high current gain capability. These are designed for use in low voltage, high speed switching applications where affordable efficient energy control is important.

Typical applications are DC-DC converters and power management in portable and battery powered products such as cellular and cordless phones, PDAs, computers, printers, digital cameras and MP3 players. Other applications are low voltage motor controls in mass storage products such as disc drives and tape drives. In the automotive industry they can be used in air bag deployment and in the instrument cluster. The high current gain allows e<sup>2</sup>PowerEdge devices to be driven directly from PMU's control outputs, and the Linear Gain (Beta) makes them ideal components in analog amplifiers.

### Features

- NSV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant\*
- Complementary to NSS60600MZ4

### MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ )

Rating	Symbol	Max	Unit
Collector-Emitter Voltage	$V_{CEO}$	60	Vdc
Collector-Base Voltage	$V_{CBO}$	100	Vdc
Emitter-Base Voltage	$V_{EBO}$	6.0	Vdc
Collector Current - Continuous	$I_C$	6.0	A
Collector Current - Peak	$I_{CM}$	12.0	A

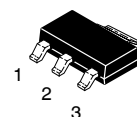
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



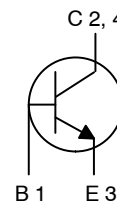
**ON Semiconductor**<sup>®</sup>

<http://onsemi.com>

**60 VOLTS, 6.0 AMPS  
2.0 WATTS  
NPN LOW  $V_{CE(sat)}$  TRANSISTOR  
EQUIVALENT  $R_{DS(on)} 50 \text{ m}\Omega$**

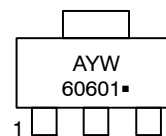


**SOT-223  
CASE 318E  
STYLE 1**



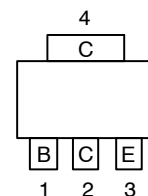
**Schematic**

### MARKING DIAGRAM



- A = Assembly Location
- Y = Year
- W = Work Week
- 60601 = Specific Device Code
- = Pb-Free Package

### PIN ASSIGNMENT



**Top View Pinout**

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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

# NSS60601MZ4

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$ (Note 1)	800 6.5	mW mW/ $^\circ\text{C}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$ (Note 1)	155	$^\circ\text{C}/\text{W}$
Total Device Dissipation $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$ (Note 2)	2 15.6	W mW/ $^\circ\text{C}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$ (Note 2)	64	$^\circ\text{C}/\text{W}$
Total Device Dissipation (Single Pulse < 10 sec.)	$P_{D\text{single}}$ (Note 3)	710	mW
Junction and Storage Temperature Range	$T_J, T_{\text{stg}}$	-55 to +150	$^\circ\text{C}$

1. FR-4 @ 7.6 mm<sup>2</sup>, 1 oz. copper traces.
2. FR-4 @ 645 mm<sup>2</sup>, 1 oz. copper traces.
3. Thermal response.

## ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NSS60601MZ4T1G	SOT-223 (Pb-Free)	1,000 / Tape & Reel
NSV60601MZ4T1G*	SOT-223 (Pb-Free)	1,000 / Tape & Reel
NSS60601MZ4T3G	SOT-223 (Pb-Free)	4,000 / Tape & Reel
NSV60601MZ4T3G*	SOT-223 (Pb-Free)	4,000 / 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.

\*NSV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.

# NSS60601MZ4

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector – Emitter Breakdown Voltage ( $I_C = 10 \text{ mAdc}$ , $I_B = 0$ )	$V_{(BR)CEO}$	60	–	–	Vdc
Collector – Base Breakdown Voltage ( $I_C = 0.1 \text{ mAdc}$ , $I_E = 0$ )	$V_{(BR)CBO}$	100	–	–	Vdc
Emitter – Base Breakdown Voltage ( $I_E = 0.1 \text{ mAdc}$ , $I_C = 0$ )	$V_{(BR)EBO}$	6.0	–	–	Vdc
Collector Cutoff Current ( $V_{CB} = 100 \text{ Vdc}$ , $I_E = 0$ )	$I_{CBO}$	–	–	0.1	$\mu\text{Adc}$
Emitter Cutoff Current ( $V_{EB} = 6.0 \text{ Vdc}$ )	$I_{EBO}$	–	–	0.1	$\mu\text{Adc}$

## ON CHARACTERISTICS

DC Current Gain (Note 4) ( $I_C = 500 \text{ mA}$ , $V_{CE} = 2.0 \text{ V}$ ) ( $I_C = 1.0 \text{ A}$ , $V_{CE} = 2.0 \text{ V}$ ) ( $I_C = 2.0 \text{ A}$ , $V_{CE} = 2.0 \text{ V}$ ) ( $I_C = 6.0 \text{ A}$ , $V_{CE} = 2.0 \text{ V}$ )	$h_{FE}$	150 120 100 50	– – – –	– 360 – –	–
Collector – Emitter Saturation Voltage (Note 4) ( $I_C = 0.1 \text{ A}$ , $I_B = 2.0 \text{ mA}$ ) ( $I_C = 1.0 \text{ A}$ , $I_B = 0.100 \text{ A}$ ) ( $I_C = 2.0 \text{ A}$ , $I_B = 0.200 \text{ A}$ ) ( $I_C = 3.0 \text{ A}$ , $I_B = 60 \text{ mA}$ ) ( $I_C = 6.0 \text{ A}$ , $I_B = 0.6 \text{ A}$ )	$V_{CE(sat)}$	– – – – –	– 0.045 0.085 – –	0.040 0.060 0.100 0.220 0.300	V
Base – Emitter Saturation Voltage (Note 4) ( $I_C = 1.0 \text{ A}$ , $I_B = 0.1 \text{ A}$ )	$V_{BE(sat)}$	–	–	0.900	V
Base – Emitter Turn-on Voltage (Note 4) ( $I_C = 1.0 \text{ A}$ , $V_{CE} = 2.0 \text{ V}$ )	$V_{BE(on)}$	–	–	0.900	V
Cutoff Frequency ( $I_C = 500 \text{ mA}$ , $V_{CE} = 10 \text{ V}$ , $f = 1.0 \text{ MHz}$ )	$f_T$	100	–	–	MHz
Input Capacitance ( $V_{EB} = 5.0 \text{ V}$ , $f = 1.0 \text{ MHz}$ )	$C_{ibo}$	–	400	–	pF
Output Capacitance ( $V_{CB} = 10 \text{ V}$ , $f = 1.0 \text{ MHz}$ )	$C_{obo}$	–	37	–	pF

## SWITCHING CHARACTERISTICS

Delay ( $V_{CC} = 30 \text{ V}$ , $I_C = 750 \text{ mA}$ , $I_{B1} = 15 \text{ mA}$ )	$t_d$	–	85	–	ns
Rise ( $V_{CC} = 30 \text{ V}$ , $I_C = 750 \text{ mA}$ , $I_{B1} = 15 \text{ mA}$ )	$t_r$	–	115	–	ns
Storage ( $V_{CC} = 30 \text{ V}$ , $I_C = 750 \text{ mA}$ , $I_{B1} = 15 \text{ mA}$ )	$t_s$	–	1350	–	ns
Fall ( $V_{CC} = 30 \text{ V}$ , $I_C = 750 \text{ mA}$ , $I_{B1} = 15 \text{ mA}$ )	$t_f$	–	125	–	ns

4. Pulsed Condition: Pulse Width = 300 msec, Duty Cycle  $\leq 2\%$ .

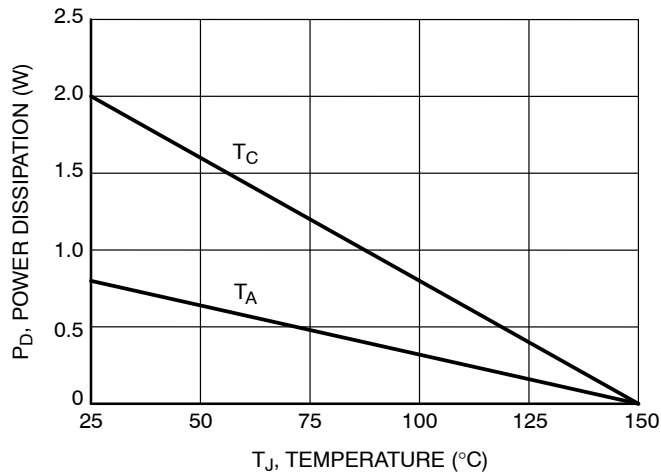


Figure 1. Power Derating

# NSS60601MZ4

## TYPICAL CHARACTERISTICS

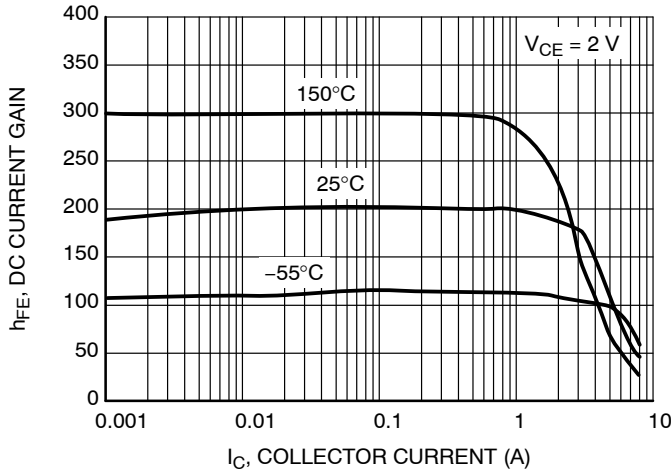


Figure 2. DC Current Gain

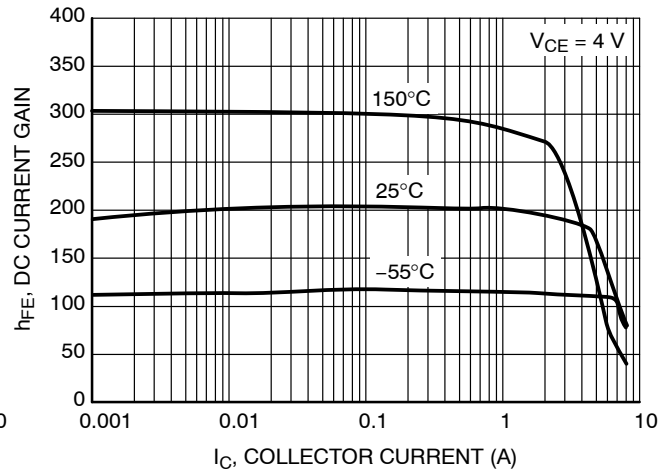


Figure 3. DC Current Gain

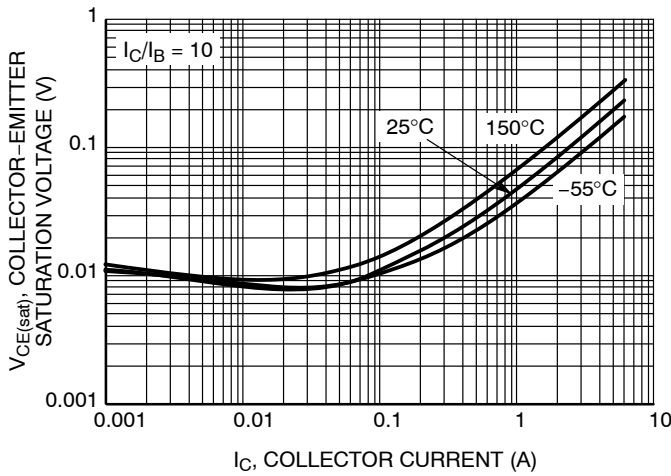


Figure 4. Collector-Emitter Saturation Voltage

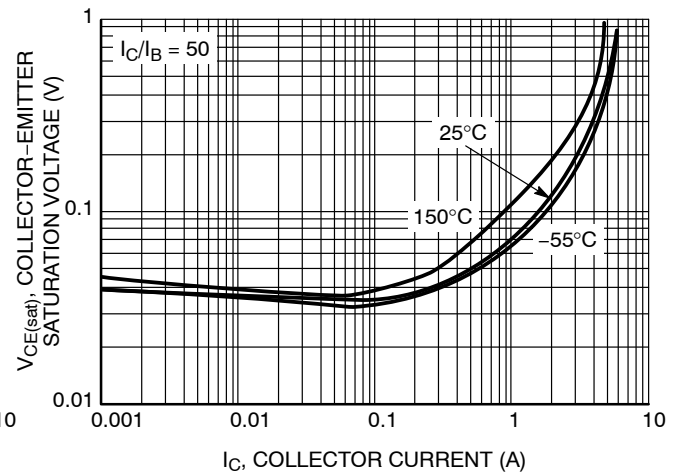


Figure 5. Collector-Emitter Saturation Voltage

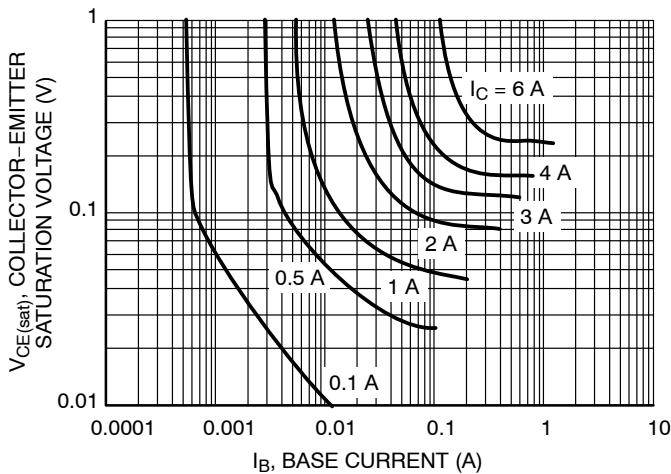


Figure 6. Collector Saturation Region

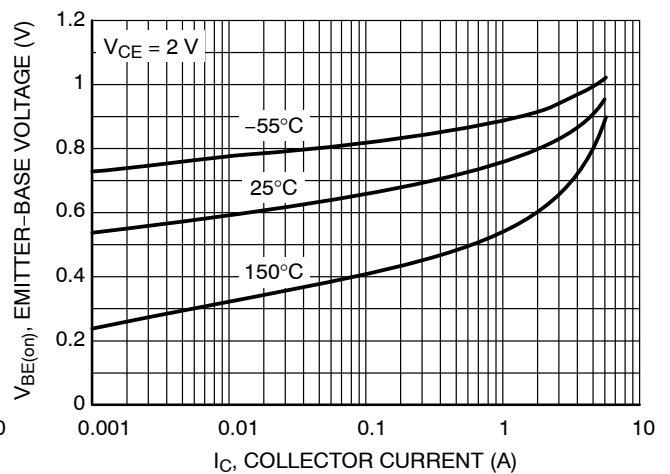


Figure 7.  $V_{BE(on)}$  Voltage

TYPICAL CHARACTERISTICS

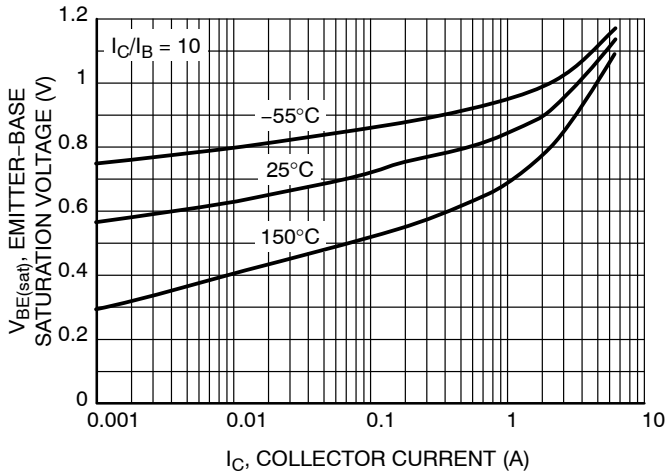


Figure 8. Base-Emitter Saturation Voltage

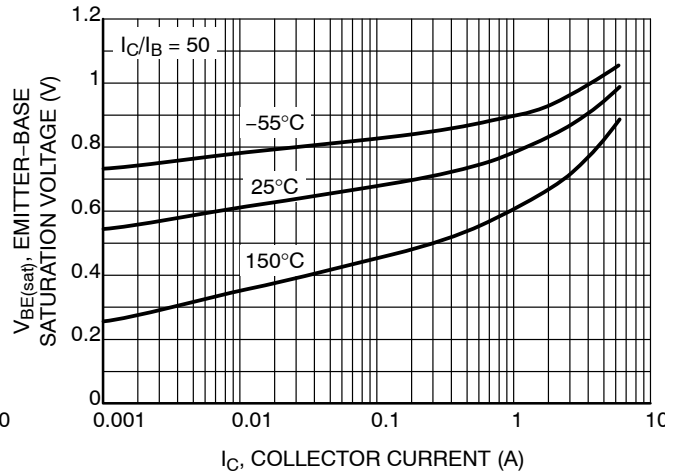


Figure 9. Base-Emitter Saturation Voltage

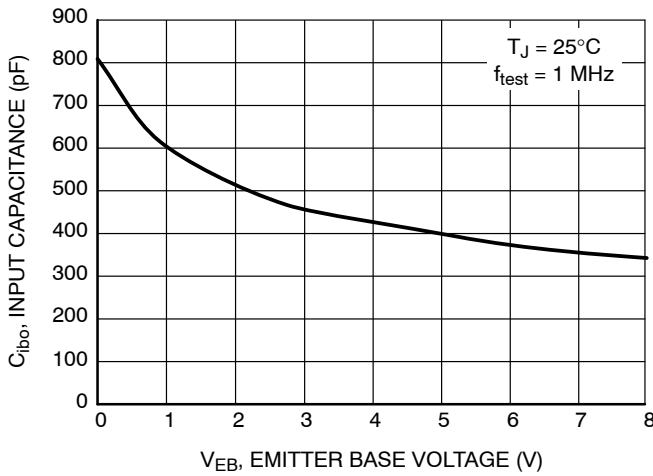


Figure 10. Input Capacitance

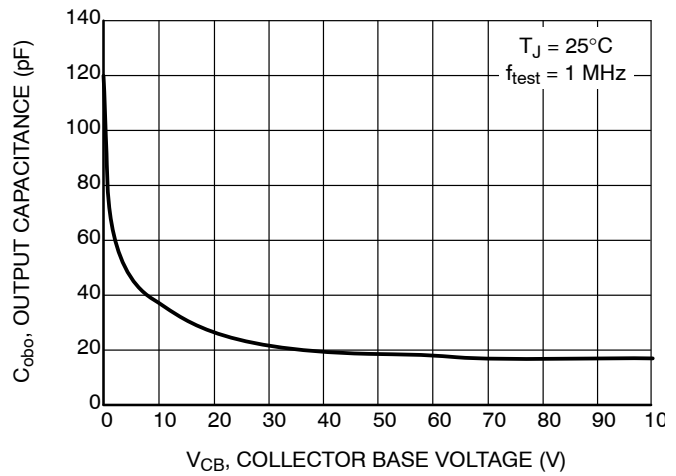


Figure 11. Output Capacitance

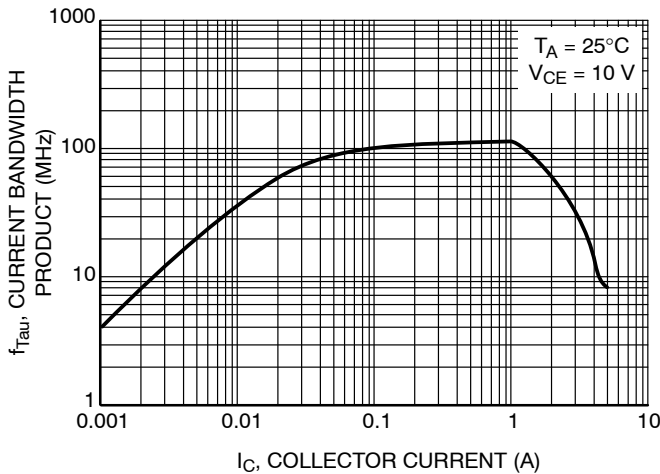


Figure 12. Current-Gain Bandwidth Product

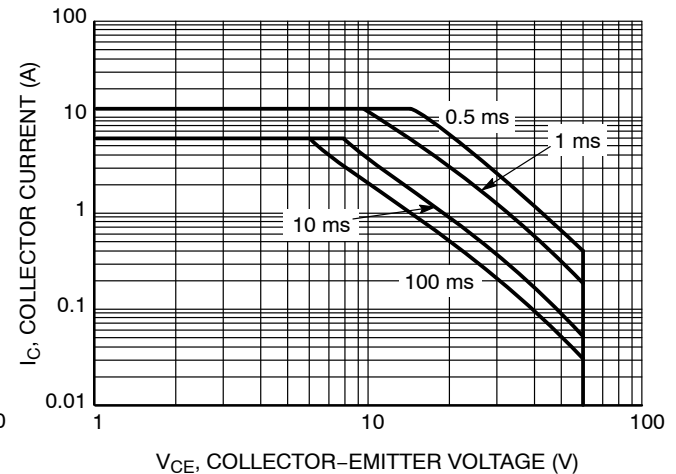
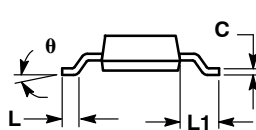
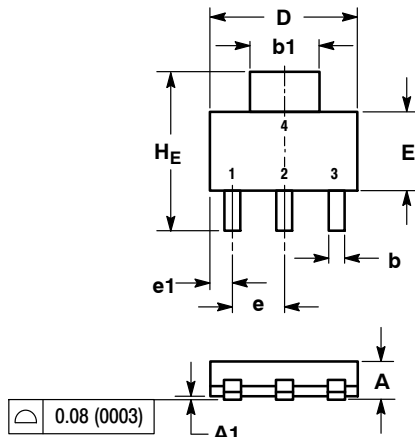


Figure 13. Safe Operating Area

# NSS60601MZ4

## PACKAGE DIMENSIONS

SOT-223 (TO-261)  
CASE 318E-04  
ISSUE N



NOTES:

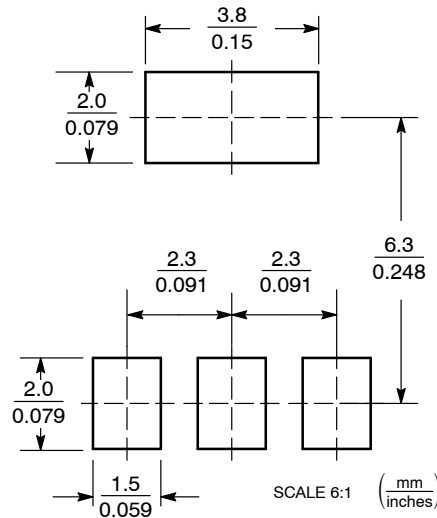
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCH.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.50	1.63	1.75	0.060	0.064	0.068
A1	0.02	0.06	0.10	0.001	0.002	0.004
b	0.60	0.75	0.89	0.024	0.030	0.035
b1	2.90	3.06	3.20	0.115	0.121	0.126
c	0.24	0.29	0.35	0.009	0.012	0.014
D	6.30	6.50	6.70	0.249	0.256	0.263
E	3.30	3.50	3.70	0.130	0.138	0.145
e	2.20	2.30	2.40	0.087	0.091	0.094
e1	0.85	0.94	1.05	0.033	0.037	0.041
L	0.20	---	---	0.008	---	---
L1	1.50	1.75	2.00	0.060	0.069	0.078
HE	6.70	7.00	7.30	0.264	0.276	0.287
θ	0°	-	10°	0°	-	10°

STYLE 1:

- PIN 1. BASE
- COLLECTOR
- EMITTER
- COLLECTOR

### 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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