

# MMBT5401L, SMMBT5401L, NSVMMBT5401L

## High Voltage Transistor

### PNP Silicon

#### Features

- S and 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

#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	$V_{CEO}$	–150	Vdc
Collector–Base Voltage	$V_{CBO}$	–160	Vdc
Emitter–Base Voltage	$V_{EBO}$	–5.0	Vdc
Collector Current – Continuous	$I_C$	–500	mAdc

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.

#### THERMAL CHARACTERISTICS

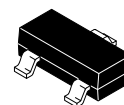
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR–5 Board (Note 1) $T_A = 25^\circ\text{C}$ Derate Above $25^\circ\text{C}$	$P_D$	225	mW
		1.8	mW/ $^\circ\text{C}$
Thermal Resistance, Junction–to–Ambient	$R_{\theta JA}$	556	$^\circ\text{C/W}$
Total Device Dissipation Alumina Substrate (Note 2) $T_A = 25^\circ\text{C}$ Derate Above $25^\circ\text{C}$	$P_D$	300	mW
		2.4	mW/ $^\circ\text{C}$
Thermal Resistance, Junction–to–Ambient	$R_{\theta JA}$	417	$^\circ\text{C/W}$
Junction and Storage Temperature	$T_J, T_{stg}$	–55 to +150	$^\circ\text{C}$

1. FR–5 =  $1.0 \times 0.75 \times 0.062$  in.
2. Alumina =  $0.4 \times 0.3 \times 0.024$  in 99.5% alumina.

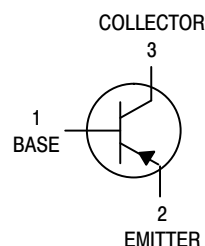


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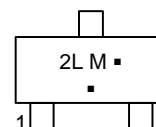
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SOT–23 (TO–236)  
CASE 318  
STYLE 6



#### MARKING DIAGRAM



2L = Specific Device Code  
M = Date Code\*  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*Date Code orientation and/or overbar may vary depending upon manufacturing location.

#### ORDERING INFORMATION

Device	Package	Shipping†
MMBT5401LT1G	SOT–23 (Pb–Free)	3,000 / Tape & Reel
SMMBT5401LT1G	SOT–23 (Pb–Free)	3,000 / Tape & Reel
MMBT5401LT3G	SOT–23 (Pb–Free)	10,000 / Tape & Reel
NSVMMBT5401LT3G	SOT–23 (Pb–Free)	10,000 / 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 ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
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### OFF CHARACTERISTICS

Collector–Emitter Breakdown Voltage ( $I_C = -1.0\text{ mA}$ , $I_B = 0$ )	$V_{(BR)CEO}$	-150	–	Vdc
Collector–Base Breakdown Voltage ( $I_C = -100\text{ }\mu\text{A}$ , $I_E = 0$ )	$V_{(BR)CBO}$	-160	–	Vdc
Emitter–Base Breakdown Voltage ( $I_E = -10\text{ }\mu\text{A}$ , $I_C = 0$ )	$V_{(BR)EBO}$	-5.0	–	Vdc
Collector–Base Cutoff Current ( $V_{CB} = -120\text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = -120\text{ Vdc}$ , $I_E = 0$ , $T_A = 100^\circ\text{C}$ )	$I_{CBO}$	– –	-50 -50	nAdc $\mu\text{Adc}$

### ON CHARACTERISTICS

DC Current Gain ( $I_C = -1.0\text{ mA}$ , $V_{CE} = -5.0\text{ Vdc}$ ) ( $I_C = -10\text{ mA}$ , $V_{CE} = -5.0\text{ Vdc}$ ) ( $I_C = -50\text{ mA}$ , $V_{CE} = -5.0\text{ Vdc}$ )	$h_{FE}$	50 60 50	– 240 –	–
Collector–Emitter Saturation Voltage ( $I_C = -10\text{ mA}$ , $I_B = -1.0\text{ mA}$ ) ( $I_C = -50\text{ mA}$ , $I_B = -5.0\text{ mA}$ )	$V_{CE(sat)}$	– –	-0.2 -0.5	Vdc
Base–Emitter Saturation Voltage ( $I_C = -10\text{ mA}$ , $I_B = -1.0\text{ mA}$ ) ( $I_C = -50\text{ mA}$ , $I_B = -5.0\text{ mA}$ )	$V_{BE(sat)}$	– –	-1.0 -1.0	Vdc

### SMALL–SIGNAL CHARACTERISTICS

Current–Gain — Bandwidth Product ( $I_C = -10\text{ mA}$ , $V_{CE} = -10\text{ Vdc}$ , $f = 100\text{ MHz}$ )	$f_T$	100	300	MHz
Output Capacitance ( $V_{CB} = -10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	$C_{obo}$	–	6.0	pF
Small Signal Current Gain ( $I_C = -1.0\text{ mA}$ , $V_{CE} = -10\text{ Vdc}$ , $f = 1.0\text{ kHz}$ )	$h_{fe}$	40	200	–
Noise Figure ( $I_C = -200\text{ }\mu\text{A}$ , $V_{CE} = -5.0\text{ Vdc}$ , $R_S = 10\text{ }\Omega$ , $f = 1.0\text{ kHz}$ )	NF	–	8.0	dB

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.

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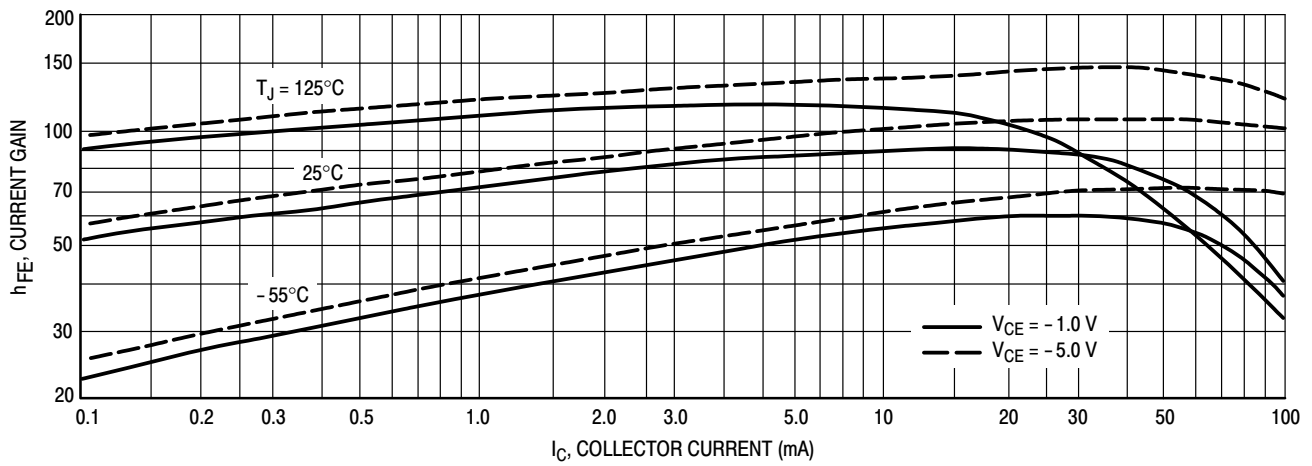


Figure 1. DC Current Gain

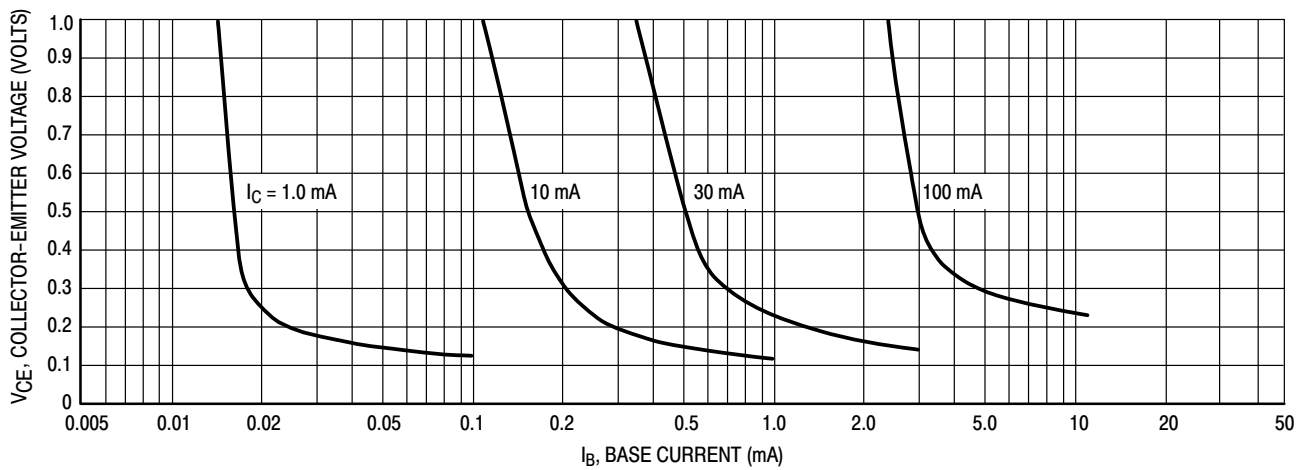


Figure 2. Collector Saturation Region

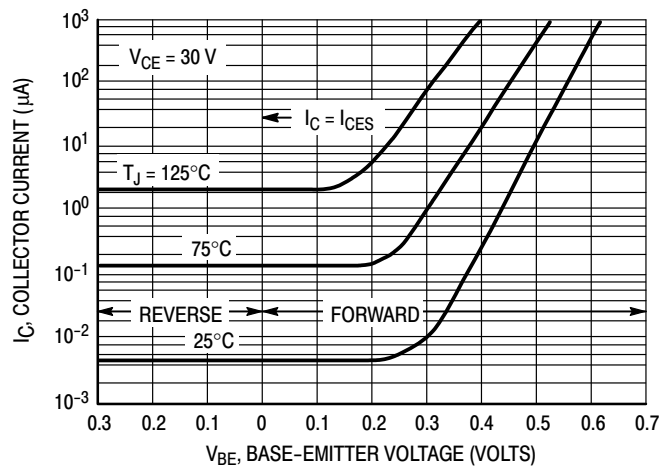
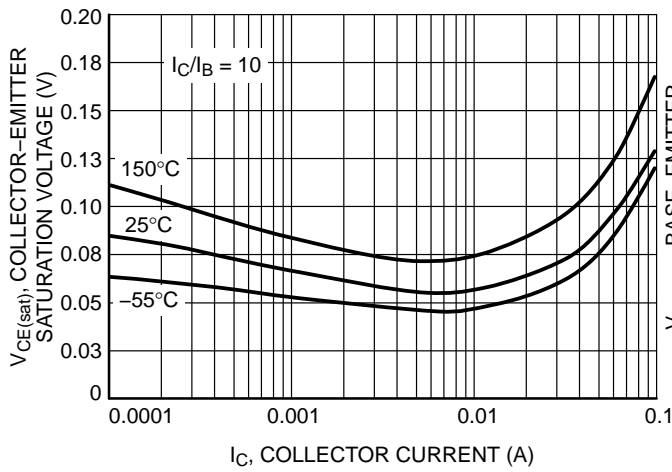
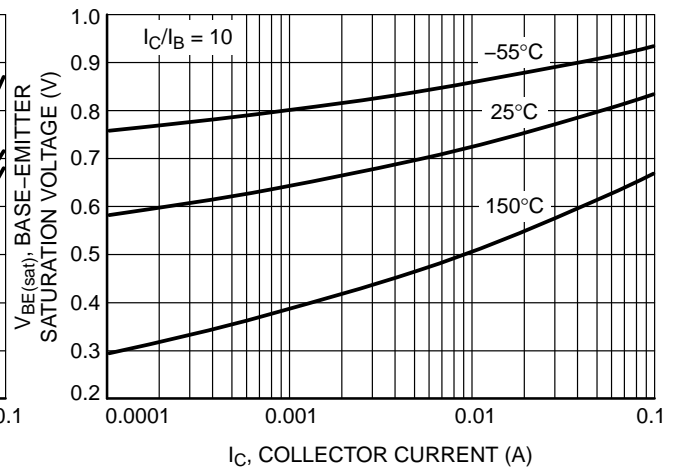


Figure 3. Collector Cut-Off Region

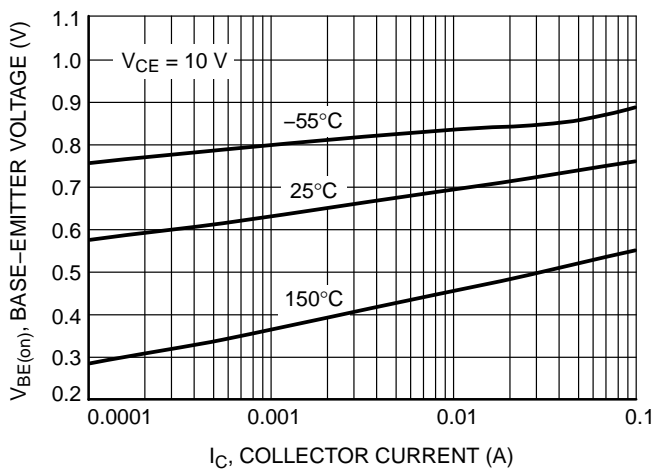
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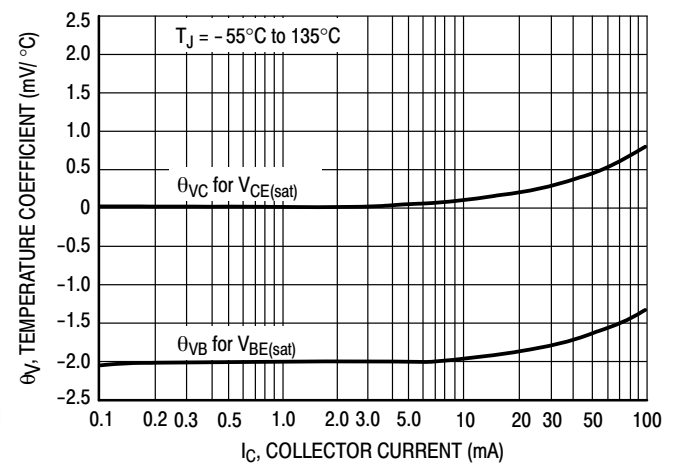
**Figure 4. Collector Emitter Saturation Voltage vs. Collector Current**



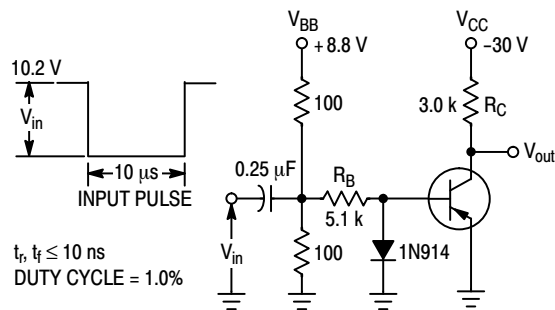
**Figure 5. Base Emitter Saturation Voltage vs. Collector Current**



**Figure 6. Base Emitter Voltage vs. Collector Current**

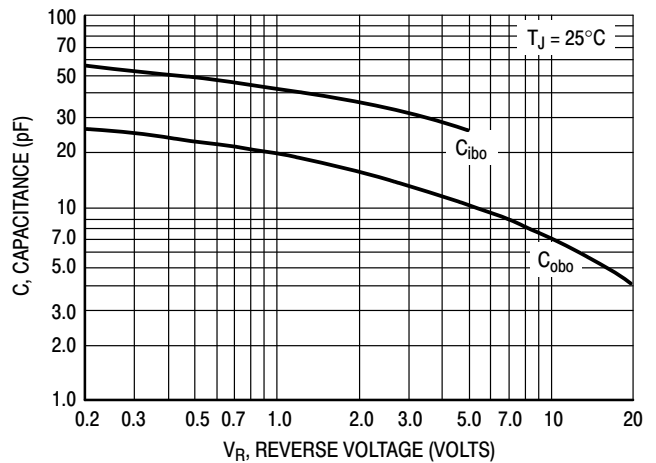


**Figure 7. Temperature Coefficients**



Values Shown are for  $I_C$  @ 10 mA

**Figure 8. Switching Time Test Circuit**



**Figure 9. Capacitances**

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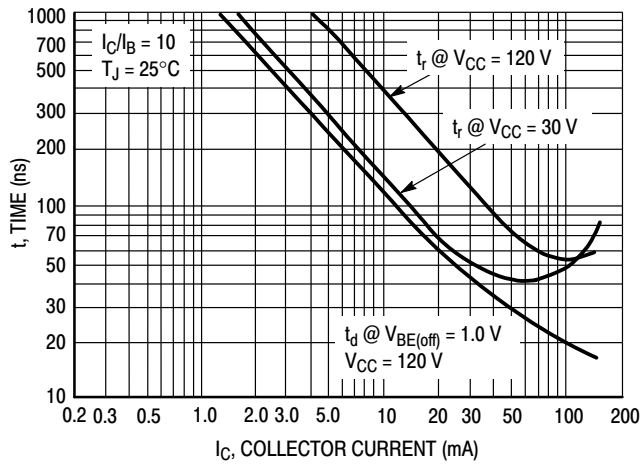


Figure 10. Turn-On Time

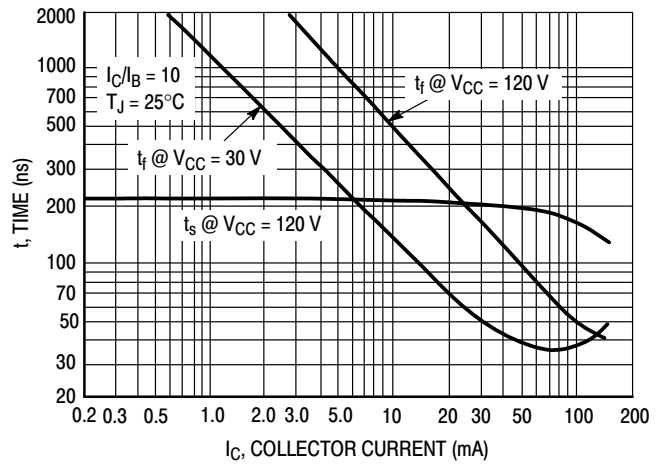


Figure 11. Turn-Off Time

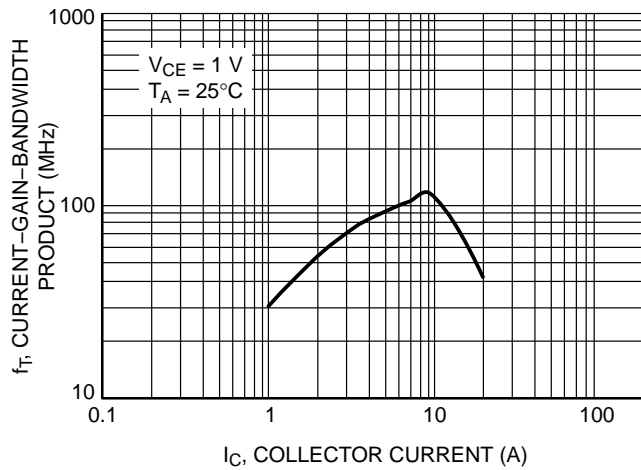


Figure 12. Current Gain Bandwidth Product

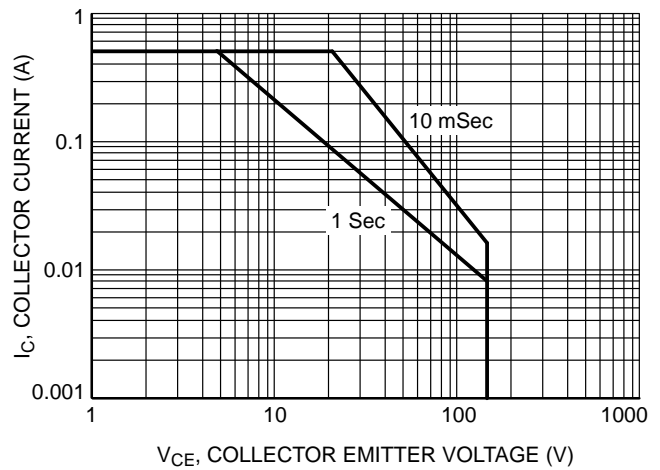


Figure 13. Safe Operating Area

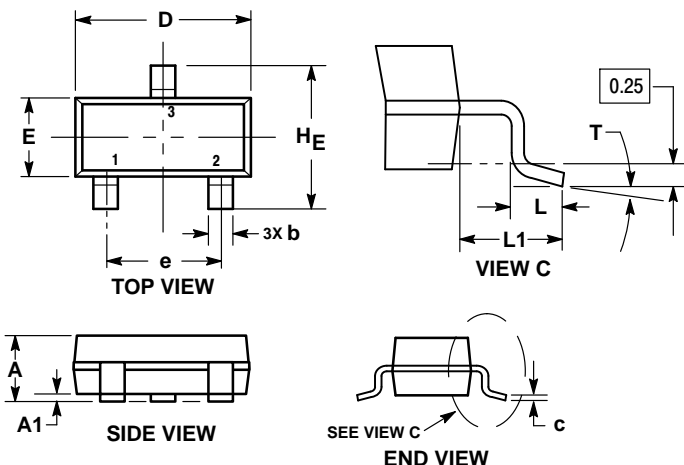
# MMBT5401L, SMMBT5401L, NSVMMBT5401L

## PACKAGE DIMENSIONS

### SOT-23 (TO-236)

CASE 318-08

ISSUE AR



#### NOTES:

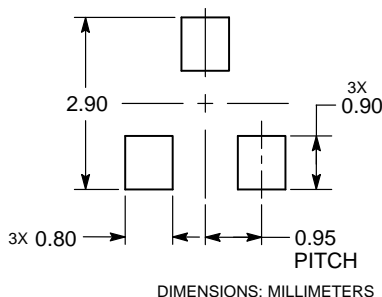
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.89	1.00	1.11	0.035	0.039	0.044
A1	0.01	0.06	0.10	0.000	0.002	0.004
b	0.37	0.44	0.50	0.015	0.017	0.020
c	0.08	0.14	0.20	0.003	0.006	0.008
D	2.80	2.90	3.04	0.110	0.114	0.120
E	1.20	1.30	1.40	0.047	0.051	0.055
e	1.78	1.90	2.04	0.070	0.075	0.080
L	0.30	0.43	0.55	0.012	0.017	0.022
L1	0.35	0.54	0.69	0.014	0.021	0.027
HE	2.10	2.40	2.64	0.083	0.094	0.104
T	0°	—	10°	0°	—	10°

#### STYLE 6:

1. BASE
2. EMITTER
3. COLLECTOR

### RECOMMENDED 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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