MMBT2222LT1, MMBT2222ALT1

MMBT2222ALT1 is a Preferred Device

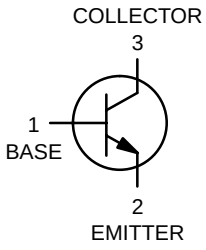
General Purpose Transistors

NPN Silicon

http://onsemi.com

Features

- Pb−Free Package May be Available. The G−Suffix Denotes a Pb−Free Lead Finish



MAXIMUM RATINGS

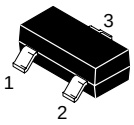
Rating	Symbol	Value	Unit
Collector−Emitter Voltage MMBT2222LT1 MMBT2222ALT1	V_{CEO}	 30 40	Vdc
Collector−Base Voltage MMBT2222LT1 MMBT2222ALT1	V_{CBO}	 60 75	Vdc
Emitter−Base Voltage MMBT2222LT1 MMBT2222ALT1	V_{EBO}	 5.0 6.0	Vdc
Collector Current − Continuous	I_C	600	mAdc

THERMAL CHARACTERISTICS

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

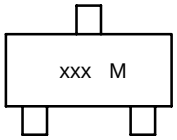
Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. FR−5 = 1.0 × 0.75 × 0.062 in.
2. Alumina = 0.4 × 0.3 × 0.024 in. 99.5% alumina.



SOT−23
CASE 318
Style 6

MARKING DIAGRAM



xxx = Specific Device Code
(M1B = MMBT2222LT1,
1P = MMBT2222ALT1)
M = Date Code

ORDERING INFORMATION

Device	Package	Shipping†
MMBT2222LT1	SOT−23	3000/Tape & Reel
MMBT2222LT1G	SOT−23 (Pb−Free)	3000/Tape & Reel
MMBT2222ALT1	SOT−23	3000/Tape & Reel
MMBT2222ALT1G	SOT−23 (Pb−Free)	3000/Tape & Reel
MMBT2222LT3	SOT−23	10,000/Tape & Reel
MMBT2222ALT3	SOT−23	10,000/Tape & Reel
MMBT2222ALT3G	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.

Preferred devices are recommended choices for future use and best overall value.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector−Emitter Breakdown Voltage (I_C = 10 mAdc, I_B = 0)	MMBT2222 MMBT2222A	$V_{(BR)CEO}$	30 40	− −	Vdc
Collector−Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)	MMBT2222 MMBT2222A	$V_{(BR)CBO}$	60 75	− −	Vdc
Emitter−Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)	MMBT2222 MMBT2222A	$V_{(BR)EBO}$	5.0 6.0	− −	Vdc
Collector Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc)	MMBT2222A	I_{CEX}	−	10	nAdc
Collector Cutoff Current (V_{CB} = 50 Vdc, I_E = 0) (V_{CB} = 60 Vdc, I_E = 0) (V_{CB} = 50 Vdc, I_E = 0, T_A = 125°C) (V_{CB} = 60 Vdc, I_E = 0, T_A = 125°C)	MMBT2222 MMBT2222A MMBT2222 MMBT2222A	I_{CBO}	− − − −	0.01 0.01 10 10	μAdc
Emitter Cutoff Current (V_{EB} = 3.0 Vdc, I_C = 0)	MMBT2222A	I_{EBO}	−	100	nAdc
Base Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc)	MMBT2222A	I_{BL}	−	20	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 0.1 mAdc, V_{CE} = 10 Vdc) (I_C = 1.0 mAdc, V_{CE} = 10 Vdc) (I_C = 10 mAdc, V_{CE} = 10 Vdc) (I_C = 10 mAdc, V_{CE} = 10 Vdc, T_A = −55°C) (I_C = 150 mAdc, V_{CE} = 10 Vdc) (Note 3) (I_C = 150 mAdc, V_{CE} = 1.0 Vdc) (Note 3) (I_C = 500 mAdc, V_{CE} = 10 Vdc) (Note 3)	 MMBT2222A only MMBT2222 MMBT2222A	h_{FE}	 35 50 75 35 100 50 30 40	 − − − − 300 − − −	−
Collector−Emitter Saturation Voltage (Note 3) (I_C = 150 mAdc, I_B = 15 mAdc) (I_C = 500 mAdc, I_B = 50 mAdc)	 MMBT2222 MMBT2222A MMBT2222 MMBT2222A	$V_{CE(sat)}$	 − − − −	 0.4 0.3 1.6 1.0	Vdc
Base−Emitter Saturation Voltage (Note 3) (I_C = 150 mAdc, I_B = 15 mAdc) (I_C = 500 mAdc, I_B = 50 mAdc)	 MMBT2222 MMBT2222A MMBT2222 MMBT2222A	$V_{BE(sat)}$	 − 0.6 − −	 1.3 1.2 2.6 2.0	Vdc
SMALL−SIGNAL CHARACTERISTICS					
Current−Gain − Bandwidth Product (Note 4) (I_C = 20 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)	 MMBT2222 MMBT2222A	f_T	 250 300	 − −	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)		C_{obo}	 −	 8.0	pF
Input Capacitance (V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	 MMBT2222 MMBT2222A	C_{ibo}	 − −	 30 25	pF
Input Impedance (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	 MMBT2222A MMBT2222A	h_{ie}	 2.0 0.25	 8.0 1.25	kΩ
Voltage Feedback Ratio (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	 MMBT2222A MMBT2222A	h_{re}	 − −	 8.0 4.0	X 10^{-4}
Small−Signal Current Gain (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	 MMBT2222A MMBT2222A	h_{fe}	 50 75	 300 375	−

3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
4. f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
SMALL−SIGNAL CHARACTERISTICS					
Output Admittance (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	 MMBT2222A MMBT2222A	h_{oe}	 5.0 25	 35 200	μmhos
Collector Base Time Constant (I_E = 20 mAdc, V_{CB} = 20 Vdc, f = 31.8 MHz)	 MMBT2222A	rb, C_c	 −	 150	ps
Noise Figure (I_C = 100 μAdc, V_{CE} = 10 Vdc, R_S = 1.0 kΩ, f = 1.0 kHz)	 MMBT2222A	NF	 −	 4.0	dB
SWITCHING CHARACTERISTICS (MMBT2222A only)					
Delay Time	(V_{CC} = 30 Vdc, $V_{BE(off)}$ = −0.5 Vdc, I_C = 150 mAdc, I_{B1} = 15 mAdc)	t_d	−	10	ns
Rise Time		t_r	−	25	
Storage Time	(V_{CC} = 30 Vdc, I_C = 150 mAdc, I_{B1} = I_{B2} = 15 mAdc)	t_s	−	225	ns
Fall Time		t_f	−	60	

3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
4. f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

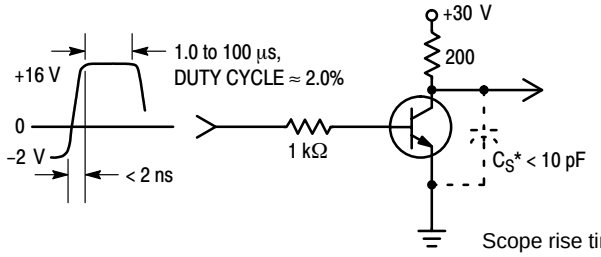


Figure 1. Turn−On Time

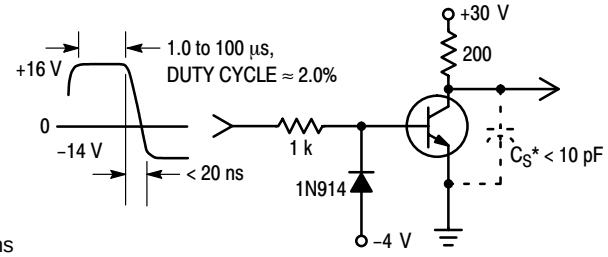


Figure 2. Turn−Off Time

Scope rise time < 4 ns
*Total shunt capacitance of test jig, connectors, and oscilloscope.

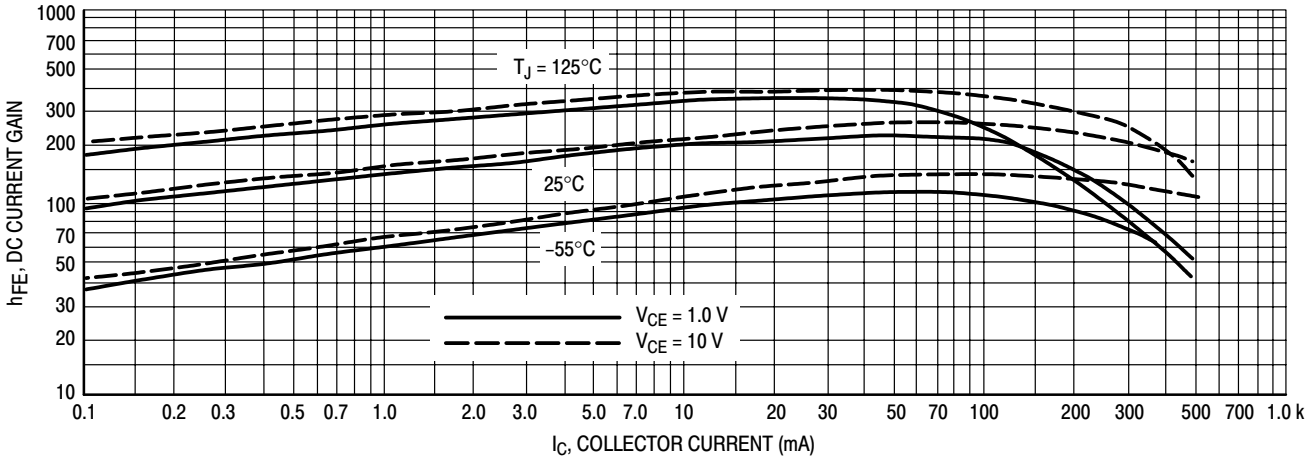


Figure 3. DC Current Gain

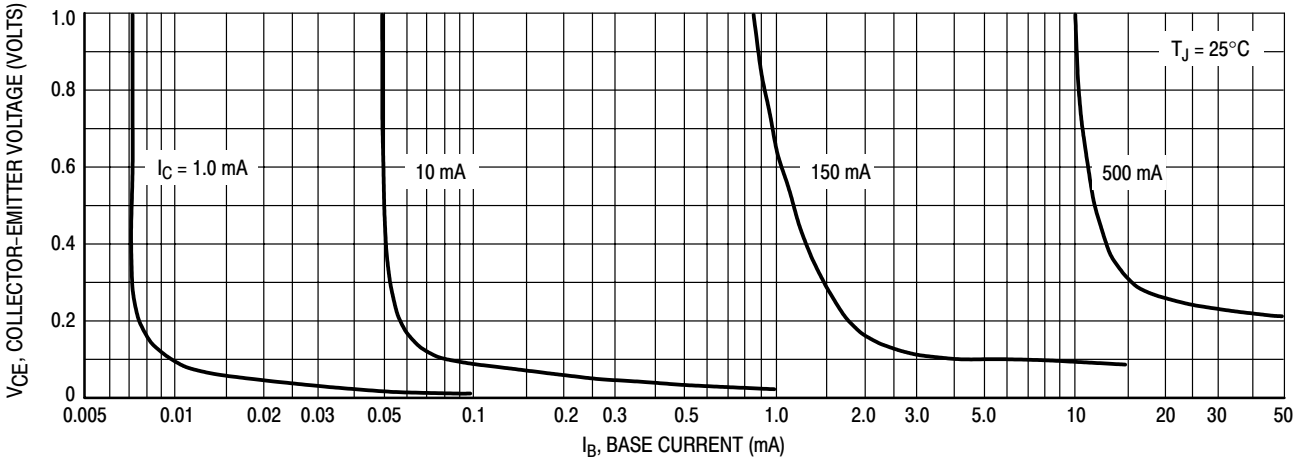


Figure 4. Collector Saturation Region

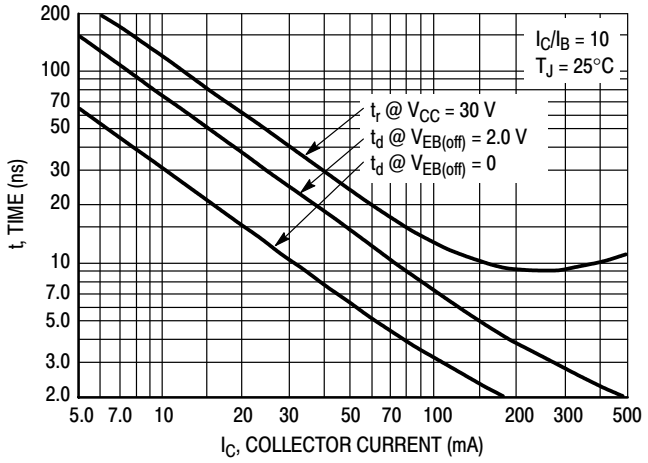


Figure 5. Turn−On Time

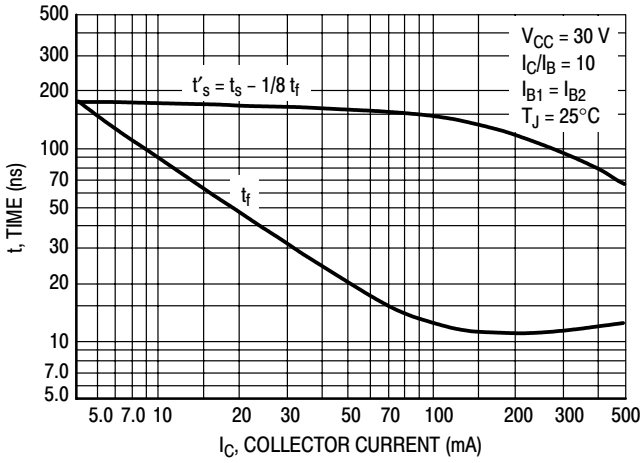


Figure 6. Turn−Off Time

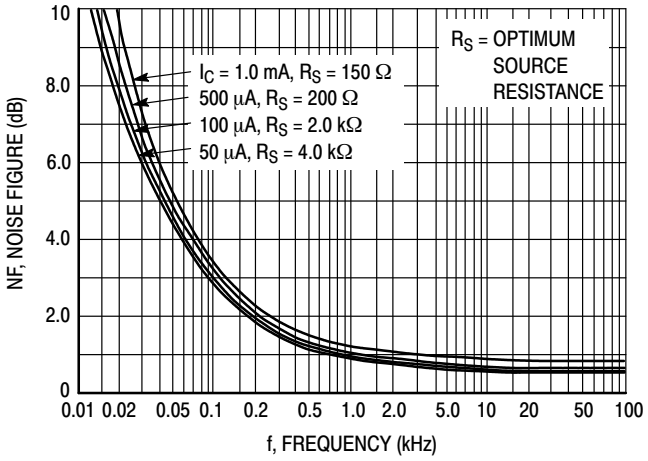


Figure 7. Frequency Effects

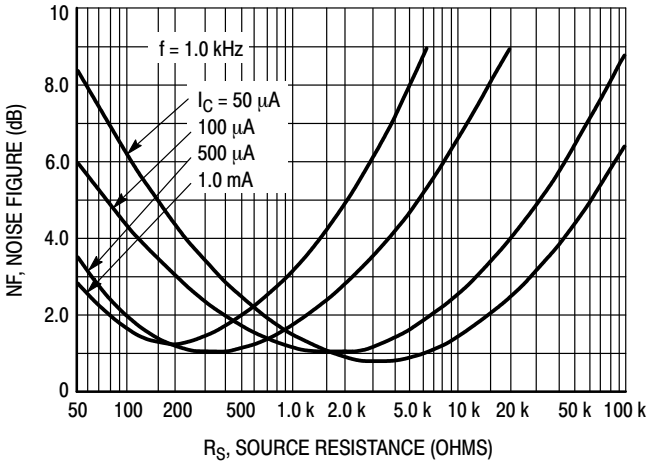


Figure 8. Source Resistance Effects

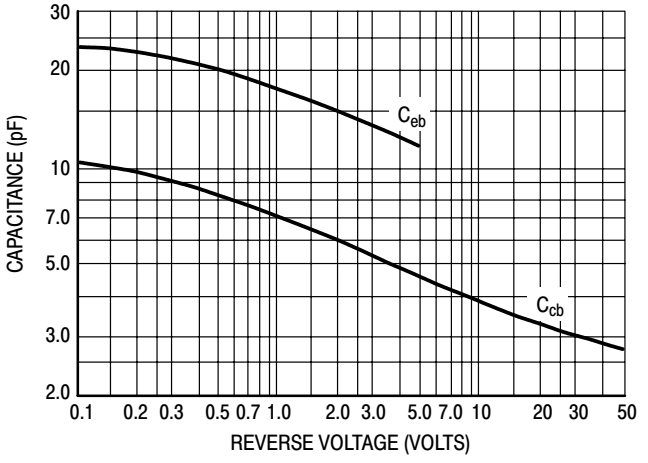


Figure 9. Capacitances

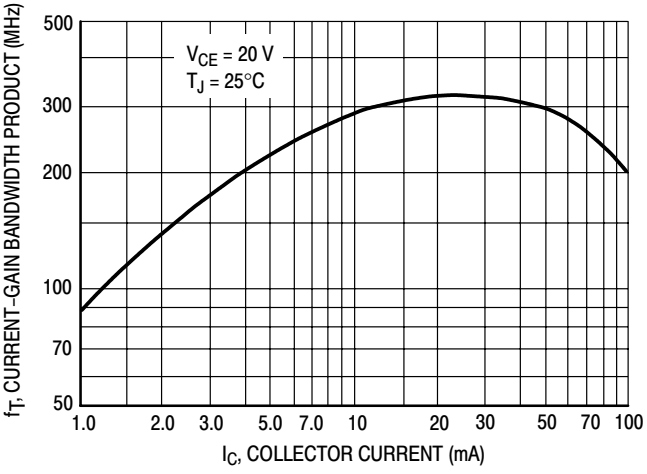


Figure 10. Current−Gain Bandwidth Product

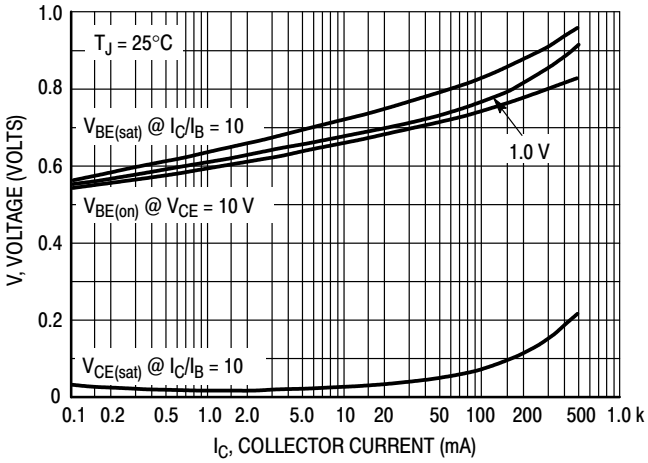


Figure 11. “On” Voltages

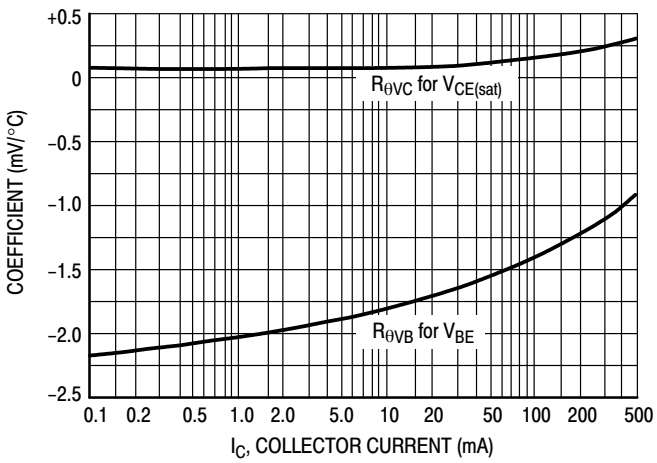
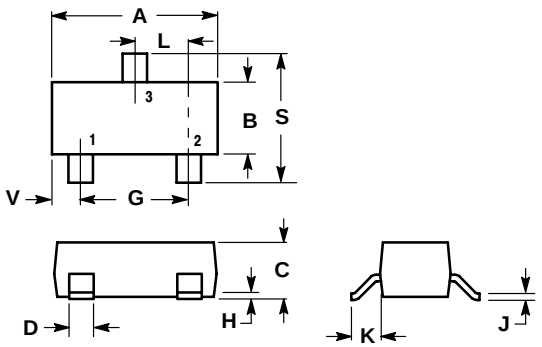


Figure 12. Temperature Coefficients

PACKAGE DIMENSIONS

SOT−23 (TO−236AB)
CASE 318−08
ISSUE AH

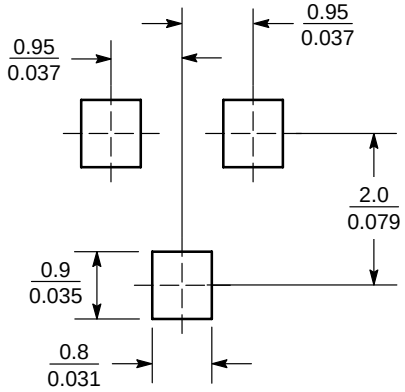


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318−03 AND −07 OBSOLETE, NEW STANDARD 318−08.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.1102	0.1197	2.80	3.04
B	0.0472	0.0551	1.20	1.40
C	0.0350	0.0440	0.89	1.11
D	0.0150	0.0200	0.37	0.50
G	0.0701	0.0807	1.78	2.04
H	0.0005	0.0040	0.013	0.100
J	0.0034	0.0070	0.085	0.177
K	0.0140	0.0285	0.35	0.69
L	0.0350	0.0401	0.89	1.02
S	0.0830	0.1039	2.10	2.64
V	0.0177	0.0236	0.45	0.60

STYLE 6:
PIN 1. BASE
2. EMITTER
3. 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.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
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Fax: 480−829−7709 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

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Japan: ON Semiconductor, Japan Customer Focus Center
2−9−1 Kamimeguro, Meguro−ku, Tokyo, Japan 153−0051
Phone: 81−3−5773−3850

ON Semiconductor Website: http://onsemi.com

Order Literature: http://www.onsemi.com/litorder

For additional information, please contact your local Sales Representative.

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