MMBT2222LT1, MMBT2222ALT1

MMBT2222ALT1 is a Preferred Device

General Purpose Transistors

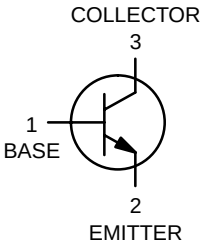
NPN Silicon

ON Semiconductor™

http://onsemi.com

Features

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



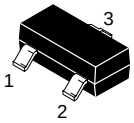
MAXIMUM RATINGS

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

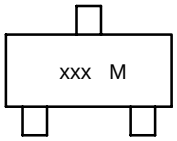
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR−5 Board (Note 1) T_A = 25°C Derate above 25°C	P_D	225 1.8	mW mW/°C
Thermal Resistance Junction−to−Ambient	$R_{\theta JA}$	556	°C/W
Total Device Dissipation Alumina Substrate (Note 2) T_A = 25°C Derate above 25°C	P_D	300 2.4	mW mW/°C
Thermal Resistance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

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
MMBT2222ALT1	SOT−23	3000/Tape & Reel
MMBT2222ALT1G	SOT−23	3000/Tape & Reel
MMBT2222LT3	SOT−23	10,000/Tape & Reel
MMBT2222ALT3	SOT−23	10,000/Tape & Reel
MMBT2222ALT3G	SOT−23	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

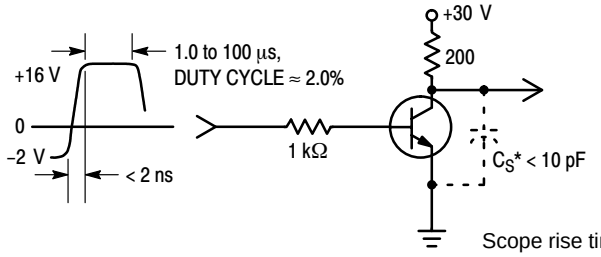


Figure 1. Turn−On Time

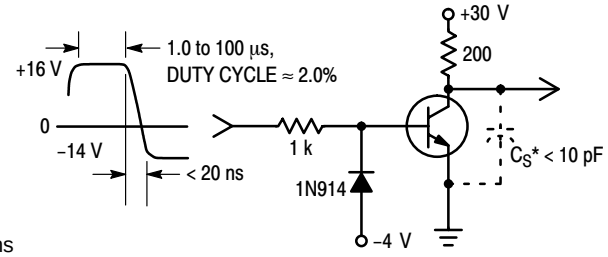


Figure 2. Turn−Off Time

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

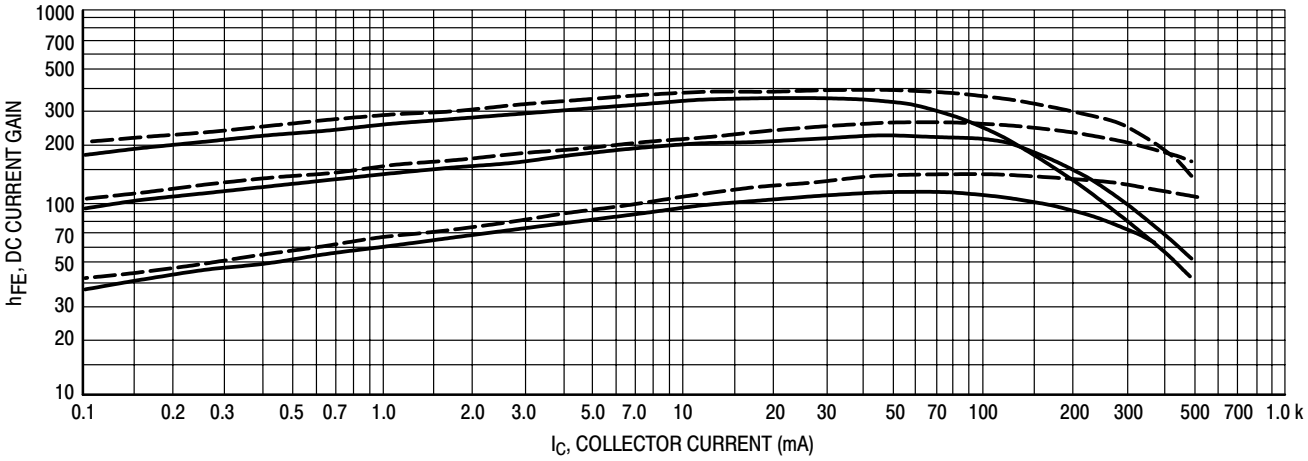


Figure 3. DC Current Gain

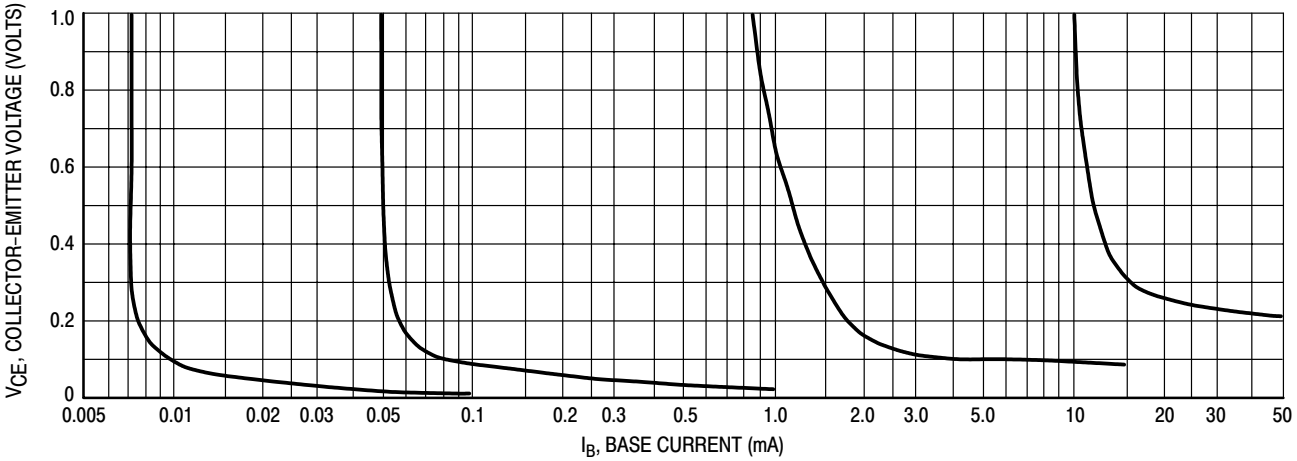


Figure 4. Collector Saturation Region

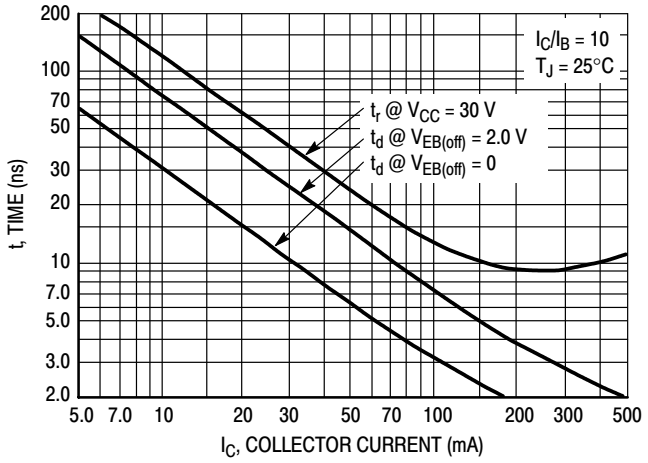


Figure 5. Turn−On Time

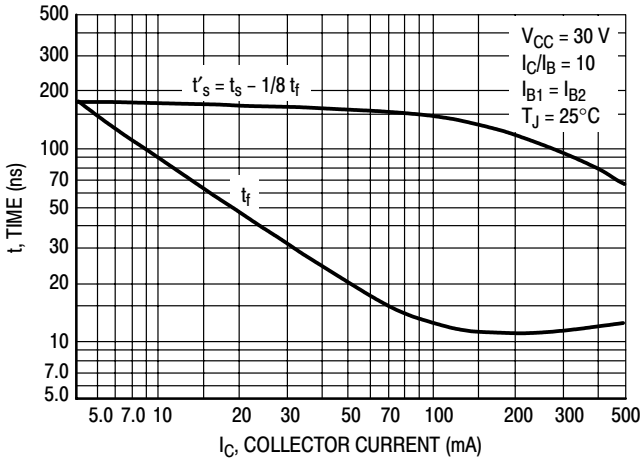


Figure 6. Turn−Off Time

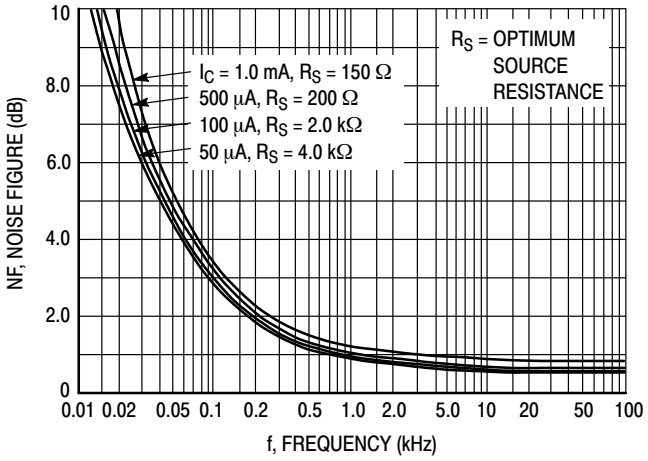


Figure 7. Frequency Effects

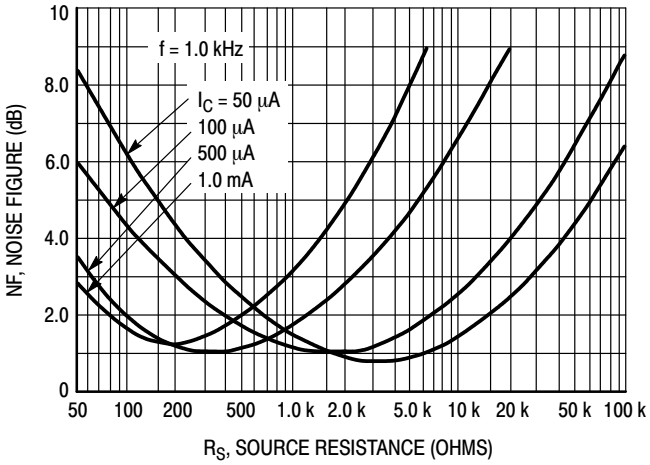


Figure 8. Source Resistance Effects

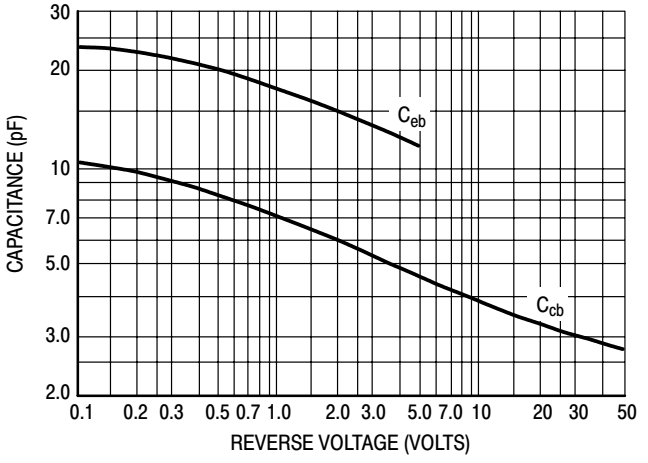


Figure 9. Capacitances

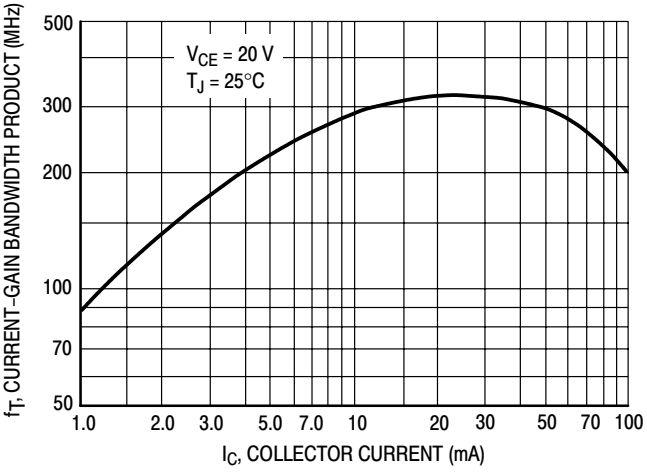


Figure 10. Current−Gain Bandwidth Product

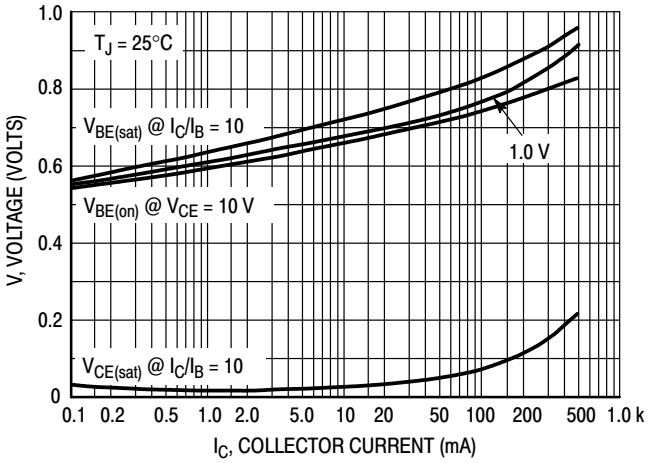


Figure 11. “On” Voltages

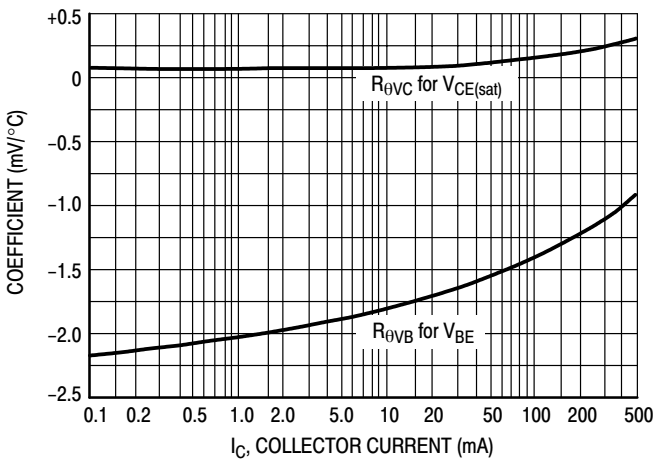
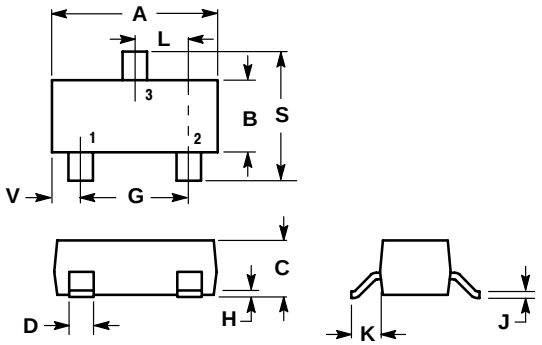


Figure 12. Temperature Coefficients

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*

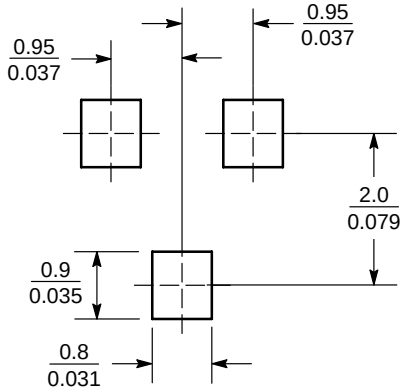


Figure 13. SOT−23

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