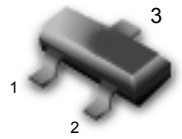
General Purpose Transistors

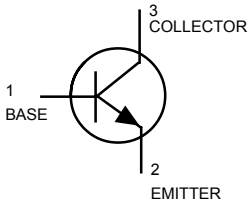
NPN Silicon

- We declare that the material of product compliance with RoHS requirements.
- S- Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.

MMBT2222LT1
MMBT2222ALT1
S-MMBT2222LT1
S-MMBT2222ALT1



SOT– 23



MAXIMUM RATINGS

Rating	Symbol	2222	2222A	Unit
Collector–Emitter Voltage	V_{CEO}	30	40	Vdc
Collector–Base Voltage	V_{CBO}	60	75	Vdc
Emitter–Base Voltage	V_{EBO}	5.0	6.0	Vdc
Collector Current — Continuous	I_C	600	600	mAdc

THERMAL CHARACTERISTICS

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

ORDERING INFORMATION

Device	Marking	Shipping
MMBT2222LT1 S-MMBT2222LT1	M1B M1B	3000/Tape & Reel
MMBT2222LT3 S-MMBT2222LT3	M1B M1B	10000/Tape & Reel
MMBT2222ALT1 S-MMBT2222ALT1	1P	3000/Tape & Reel
MMBT2222ALT3 S-MMBT2222ALT3	1P	10000/Tape & Reel

DEVICE MARKING

MMBT2222LT1 = M1B; MMBT2222ALT1 = 1P

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector–Emitter Breakdown Voltage	MMBT2222	$V_{(BR)CEO}$	30	—	Vdc
(I_C = 10 mAdc, I_B = 0)	MMBT2222A		40	—	
Collector–Base Breakdown Voltage	MMBT2222	$V_{(BR)CBO}$	60	—	Vdc
(I_C = 10 µAdc, I_E = 0)	MMBT2222A		75		
Emitter–Base Breakdown Voltage	MMBT2222	$V_{(BR)EBO}$	5.0	—	Vdc
(I_E = 10 µAdc, I_C = 0)	MMBT2222A		6.0	—	
Collector Cutoff Current	MMBT2222A	I_{CEX}	—	10	nAdc
(V_{CE} = 60 Vdc, $I_{EB(off)}$ = 3.0Vdc)					
Collector Cutoff Current		I_{CBO}			µAdc
(V_{CB} = 50 Vdc, I_E = 0)	MMBT2222		—	0.01	
(V_{CB} = 60 Vdc, I_E = 0)	MMBT2222A		—	0.01	
(V_{CB} = 50 Vdc, I_E = 0, T_A = 125°C)	MMBT2222		—	10	
(V_{CB} = 60 Vdc, I_E = 0, T_A = 125°C)	MMBT2222A		—	10	
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

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

ELECTRICAL CHARACTERISTICS (T A = 25°C unless otherwise noted) (Continued)

Characteristic		Symbol	Min	Max	Unit
ON CHARACTERISTICS					
DC Current Gain		h_{FE}			—
(I_C = 0.1 mAdc, V_{CE} = 10 Vdc)			35	—	
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc)			50	—	
(I_C = 10 mAdc, V_{CE} = 10 Vdc)			75	—	
(I_C = 10 mAdc, V_{CE} = 10 Vdc,T_A = –55°C)	MMBT2222A only		35	—	
(I_C = 150 mAdc, V_{CE} = 10 Vdc) (3)			100	300	
(I_C = 150 mAdc, V_{CE} = 1.0 Vdc) (3)			50	—	
(I_C = 500 mAdc, V_{CE} = 10 Vdc)(3)	MMBT2222		30	—	
	MMBT2222A		40	—	
Collector–Emitter Saturation Voltage(3)		$V_{CE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)	MMBT2222		—	0.4	
	MMBT2222A		—	0.3	
(I_C = 500mAdc, I_B = 50 mAdc)	MMBT2222		—	1.6	
	MMBT2222A		—	1.0	
Base–Emitter Saturation Voltage		$V_{BE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)	MMBT2222		—	1.3	
	MMBT2222A		0.6	1.2	
(I_C = 500 mAdc, I_B = 50 mAdc)	MMBT2222		—	2.6	
	MMBT2222A		—	2.0	
SMALL–SIGNAL CHARACTERISTICS					
Current–Gain — Bandwidth Product(4)	MMBT2222	f_T	250	—	MHz
(I_C = 20mAdc, V_{CE}= 20Vdc, f = 100MHz)	MMBT2222A		300	—	
Output Capacitance(V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)		C_{obo}	—	8.0	pF
Input Capacitance	MMBT2222	C_{ibo}	—	30	pF
(V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	MMBT2222A		—	25	
Input Impedance(V_{CE}= 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	MMBT2222A	h_{ie}	2.0	8.0	kΩ
(V_{CE}= 10 Vdc, I_C = 10 mAdc, f = 1.0 kHz)	MMBT2222A		0.25	1.25	
Voltage Feedback Ratio(V_{CE}=10 Vdc, I_C= 1.0mAdc, f =1.0kHz)	MMBT2222A	h_{re}	—	8.0	X 10^{-4}
(V_{CE}= 10 Vdc, I_C = 10 mAdc, f = 1.0 kHz)	MMBT2222A		—	4.0	
Small–Signal Current Gain(V_{CE}=10Vdc,I_C=1.0mAdc, f=1.0kHz)	MMBT2222A	h_{fe}	50	300	—
(V_{CE}= 10 Vdc, I_C = 10 mAdc, f = 1.0 kHz)	MMBT2222A		75	375	
Output Admittance(V_{CE}=10 Vdc, I_C = 1.0 mAdc,f =1.0 kHz)	MMBT2222A	h_{oe}	5.0	35	µmhos
(V_{CE}= 10 Vdc, I_C = 10 mAdc, f = 1.0 kHz)	MMBT2222A		25	200	
Curren Base Time Comstant					
(V_{CB}= 20 Vdc, I_E = 20 mAdc, f = 31.8 MHz)	MMBT2222A	rb, C_C	—	150	ps
Noise Figure(V_{CE}=10Vdc, I_C=100µAdc, R_S=1.0kΩ, f =1.0kHz)	MMBT2222A	NF	—	4.0	dB

SWITCHING CHARACTERISTICS

Delay Time	(V_{CC} = 30 Vdc, $V_{EB(off)}$ = – 0.5 Vdc	t_d	—	10	
Rise Time	I_C = 150 mAdc, I_{B1} = 15 mAdc)	t_r	—	25	ns
Storage Time	(V_{CC} = 30 Vdc, I_C = 150 mAdc	t_s	—	225	ns
Fall Time	I_{B1} = I_{B2} = 15 mAdc)	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

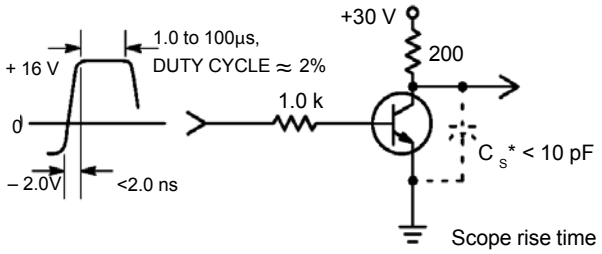


Figure 1. Turn–On Time

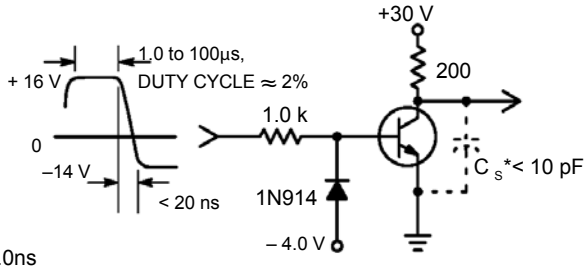


Figure 2. Turn–Off Time

Scope rise time < 4.0ns

*Total shunt capacitance of test jig, connectors, and oscilloscope.

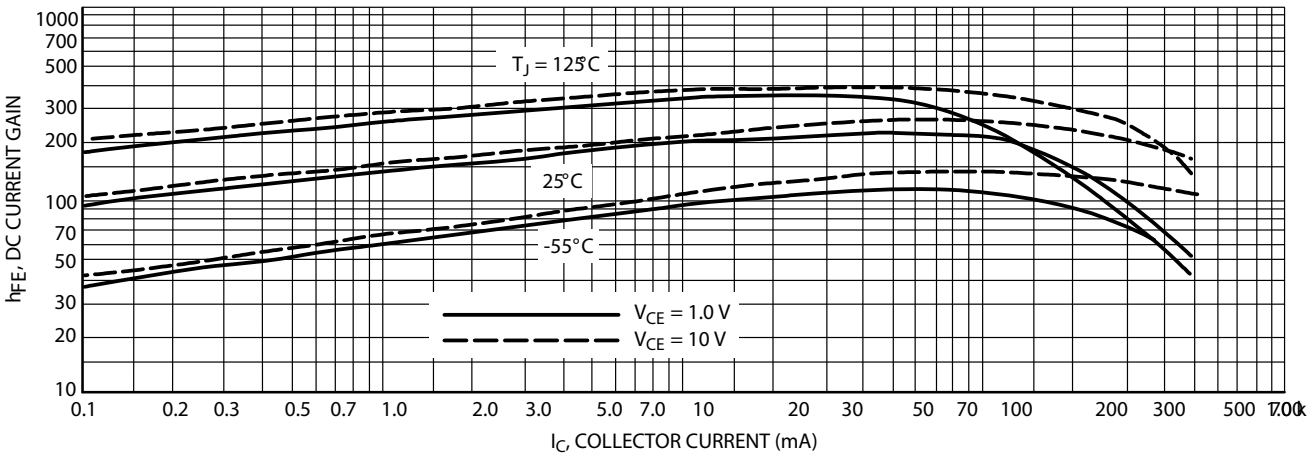


Figure 3. DC Current Gain

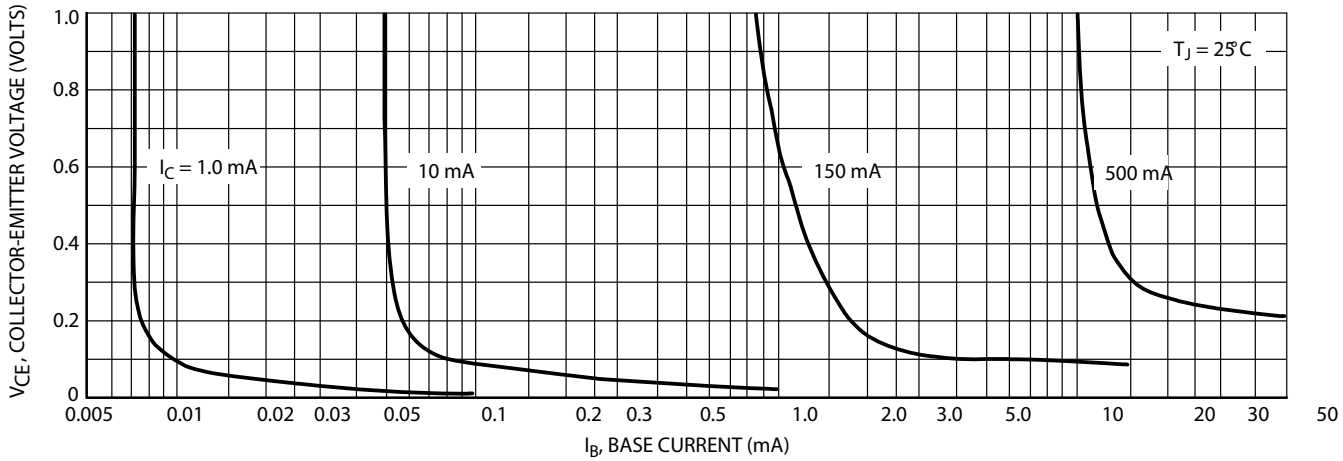


Figure 4. Collector Saturation Region

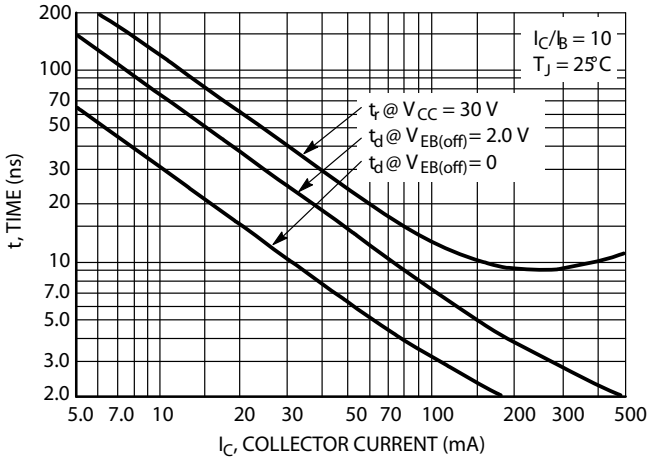


Figure 5. Turn–On Time

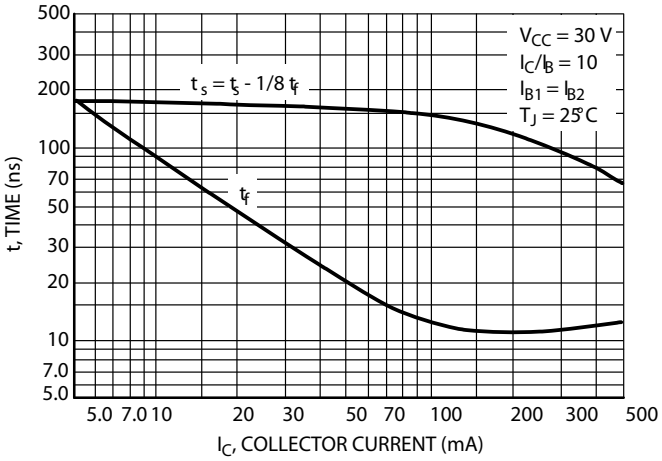


Figure 6. Turn - Off Time

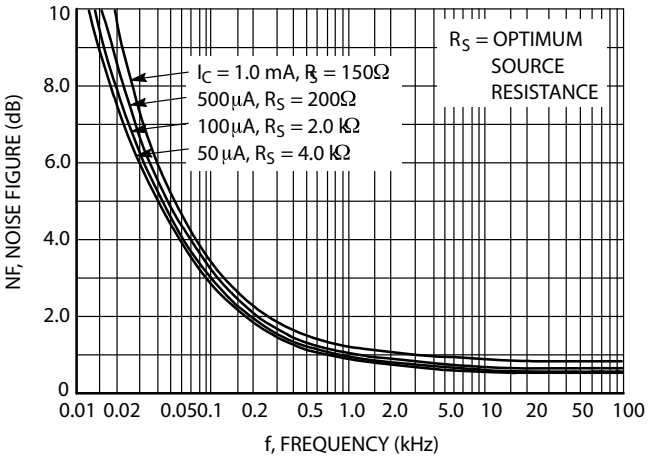


Figure 7. Frequency Effects

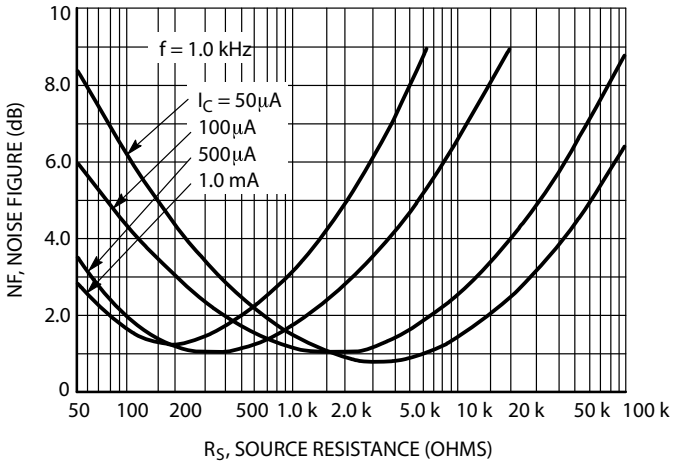


Figure 8. Source Resistance Effects

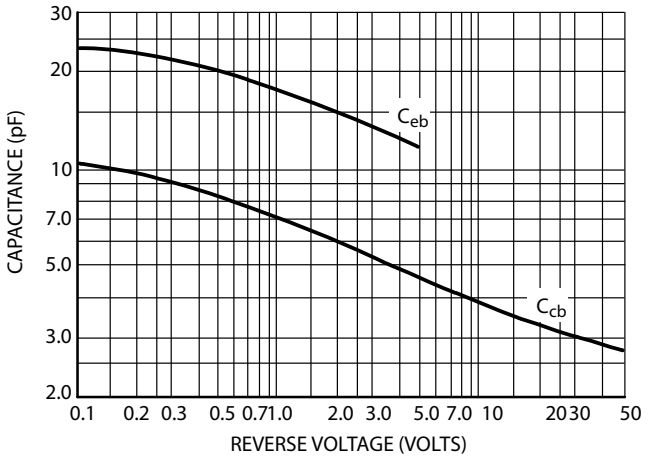


Figure 9. Capacitances

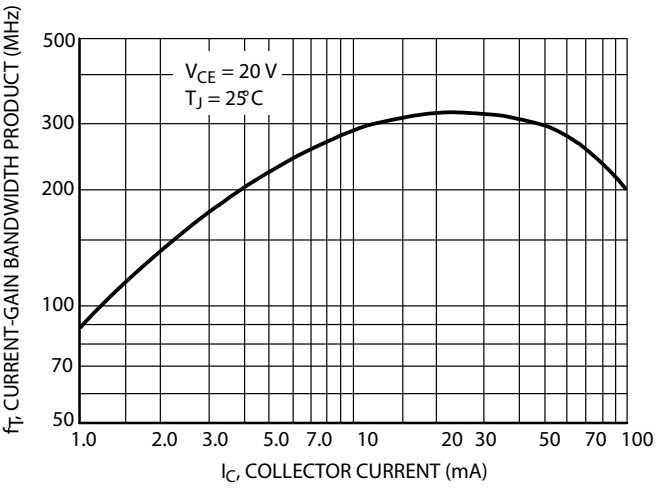


Figure 10. Current –Gain Bandwidth Product

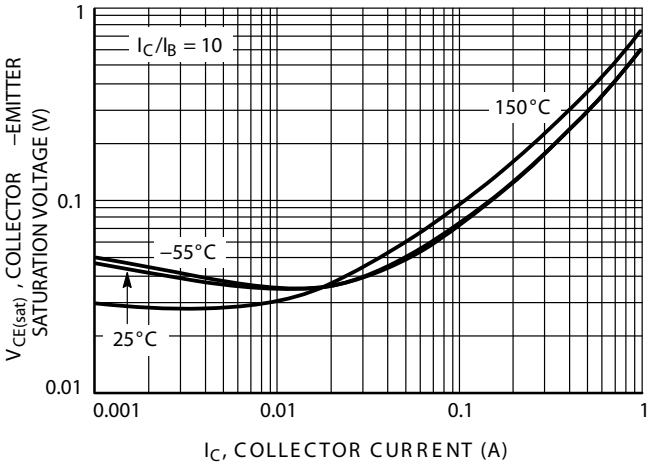


Figure 11. Collector Emitter Saturation Voltage vs. Collector Current

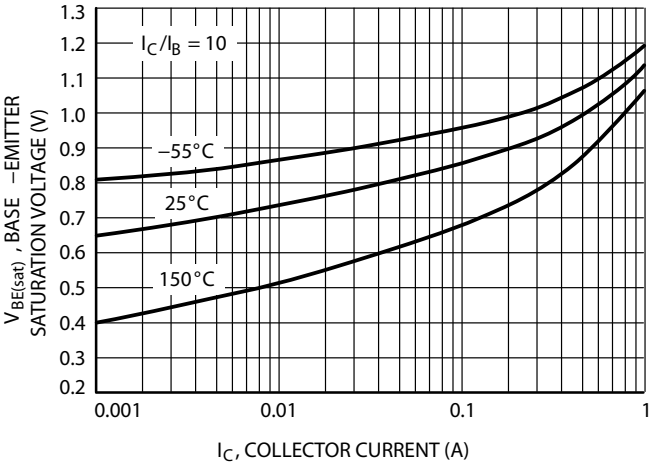


Figure 12. Base Emitter Saturation Voltage vs. Collector Current

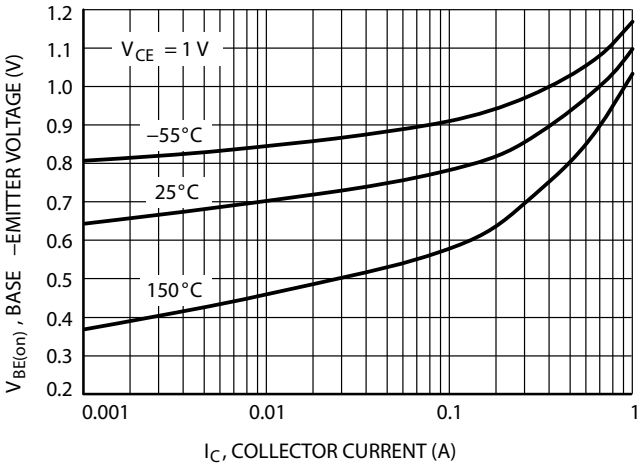


Figure 13. Base Emitter Voltage vs. Collector Current

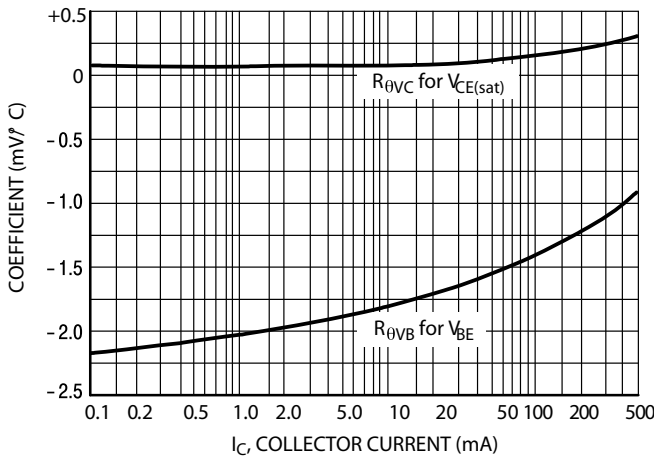


Figure 14. Temperature Coefficients

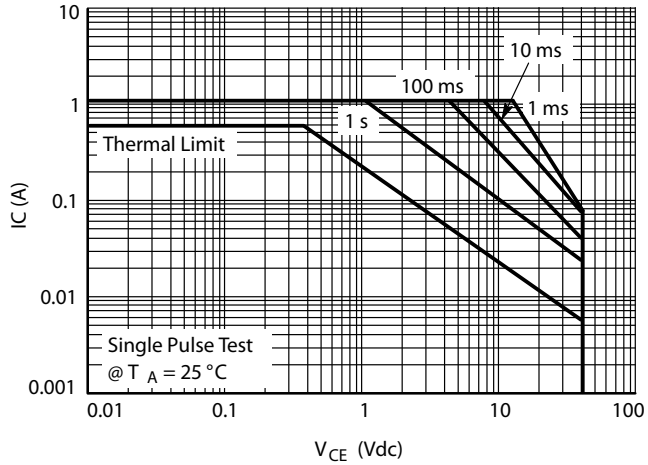


Figure 15. Safe Operating Area

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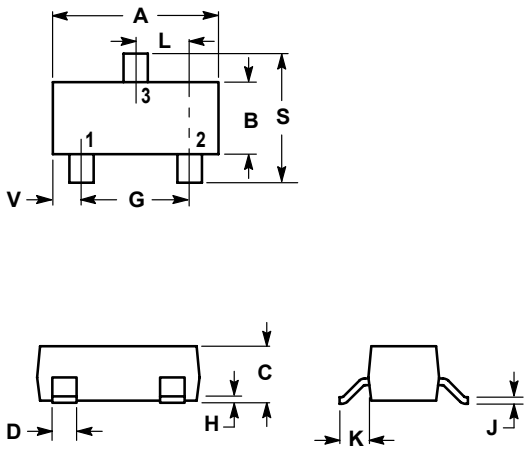

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M,1982
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	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