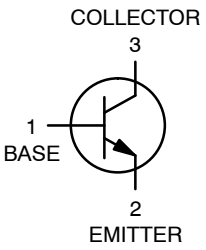
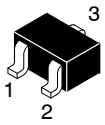
Switching Transistor

NPN Silicon

MMBT4401WT1G





SC−70 (SOT−323)
CASE 419
STYLE 3

Features

- Moisture Sensitivity Level: 1
- ESD Rating: Human Body Model; 4 kV,
  Machine Model; 400 V
- 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

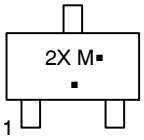
Rating	Symbol	Value	Unit
Collector − Emitter Voltage	V_{CEO}	40	Vdc
Collector − Base Voltage	V_{CBO}	60	Vdc
Emitter − Base Voltage	V_{EBO}	6.0	Vdc
Collector Current − Continuous	I_C	600	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR−5 Board T_A = 25°C	P_D	150	mW
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	833	°C/W
Junction and Storage Temperature	T_J, T_{stg}	−55 to +150	°C

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.

MARKING DIAGRAM



(Note: Microdot may be in either location)

*Date Code orientation may vary depending upon manufacturing location.

ORDERING INFORMATION

Device	Package	Shipping†
MMBT4401WT1G	SC−70 (Pb−Free)	3000 / Tape & Reel
NSVMMBT4401WT1G	SC−70 (Pb−Free)	3000 / 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.

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector – Emitter Breakdown Voltage (Note 1) (I_C = 1.0 mAdc, I_B = 0)	$V_{(BR)CEO}$	40	–	Vdc
Collector – Base Breakdown Voltage (I_C = 0.1 mAdc, I_E = 0)	$V_{(BR)CBO}$	60	–	Vdc
Emitter – Base Breakdown Voltage (I_E = 0.1 mAdc, I_C = 0)	$V_{(BR)EBO}$	6.0	–	Vdc
Base Cutoff Current (V_{CE} = 35 Vdc, V_{EB} = 0.4 Vdc)	I_{BEV}	–	0.1	μAdc
ON CHARACTERISTICS (Note 1)				
DC Current Gain	h_{FE}			–
(I_C = 0.1 mAdc, V_{CE} = 1.0 Vdc)		20	–	
(I_C = 1.0 mAdc, V_{CE} = 1.0 Vdc)		40	–	
(I_C = 10 mAdc, V_{CE} = 1.0 Vdc)		80	–	
(I_C = 150 mAdc, V_{CE} = 1.0 Vdc)		100	300	
(I_C = 500 mAdc, V_{CE} = 2.0 Vdc)		40	–	
Collector – Emitter Saturation Voltage	$V_{CE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)		–	0.4	
(I_C = 500 mAdc, I_B = 50 mAdc)		–	0.75	
Base – Emitter Saturation Voltage	$V_{BE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)		0.75	0.95	
(I_C = 500 mAdc, I_B = 50 mAdc)		–	1.2	
Collector Cutoff Current (V_{CE} = 35 Vdc, V_{EB} = 0.4 Vdc)	I_{CEX}	–	0.1	μAdc
SMALL– SIGNAL CHARACTERISTICS				
Current – Gain – Bandwidth Product (I_C = 20 mAdc, V_{CE} = 10 Vdc, f = 100 MHz)	f_T	250	–	MHz
Collector–Base Capacitance (V_{CB} = 5.0 Vdc, I_E = 0, f = 1.0 MHz)	C_{cb}	–	6.5	pF
Emitter–Base Capacitance (V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	C_{eb}	–	30	pF
Input Impedance (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{ie}	1.0	15	kΩ
Voltage Feedback Ratio (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{re}	0.1	8.0	X 10^{-4}
Small – Signal Current Gain (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{fe}	40	500	–
Output Admittance (I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{oe}	1.0	30	μmhos
SWITCHING CHARACTERISTICS				
Delay Time	(V_{CC} = 30 Vdc, V_{EB} = 2.0 Vdc, I_C = 150 mAdc, I_{B1} = 15 mAdc)	t_d	–	15	ns
Rise Time		t_r	–	20	
Storage Time	(V_{CC} = 30 Vdc, I_C = 150 mAdc, I_{B1} = I_{B2} = 15 mAdc)	t_s	–	225	ns
Fall Time		t_f	–	30	

1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

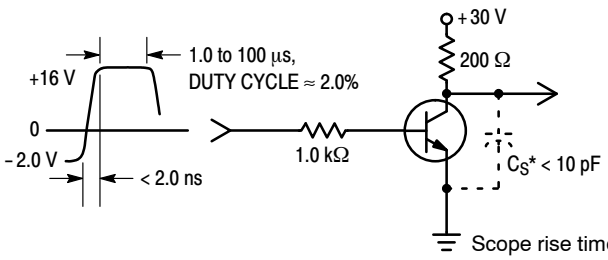


Figure 1. Turn–On Time

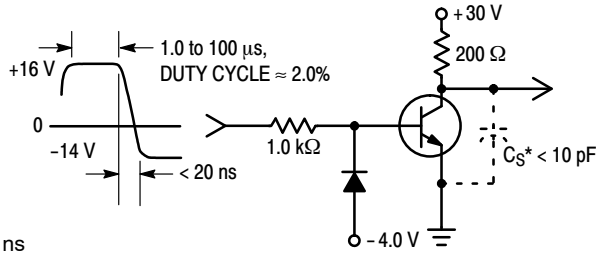


Figure 2. Turn–Off Time

Scope rise time < 4.0 ns
*Total shunt capacitance of test jig connectors, and oscilloscope

TRANSIENT CHARACTERISTICS

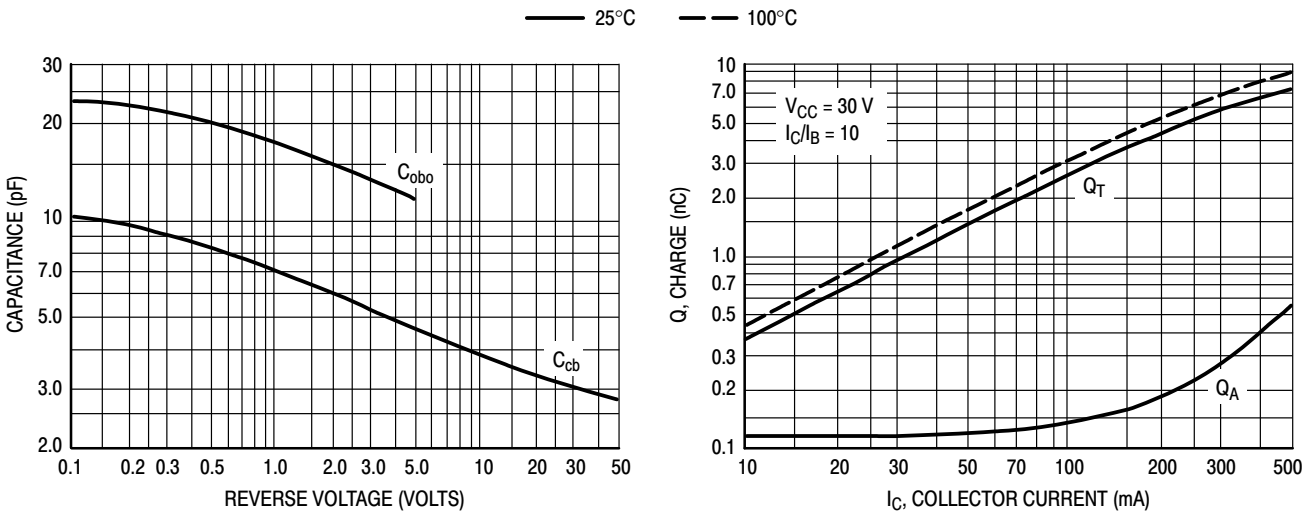


Figure 3. Capacitances

Figure 4. Charge Data

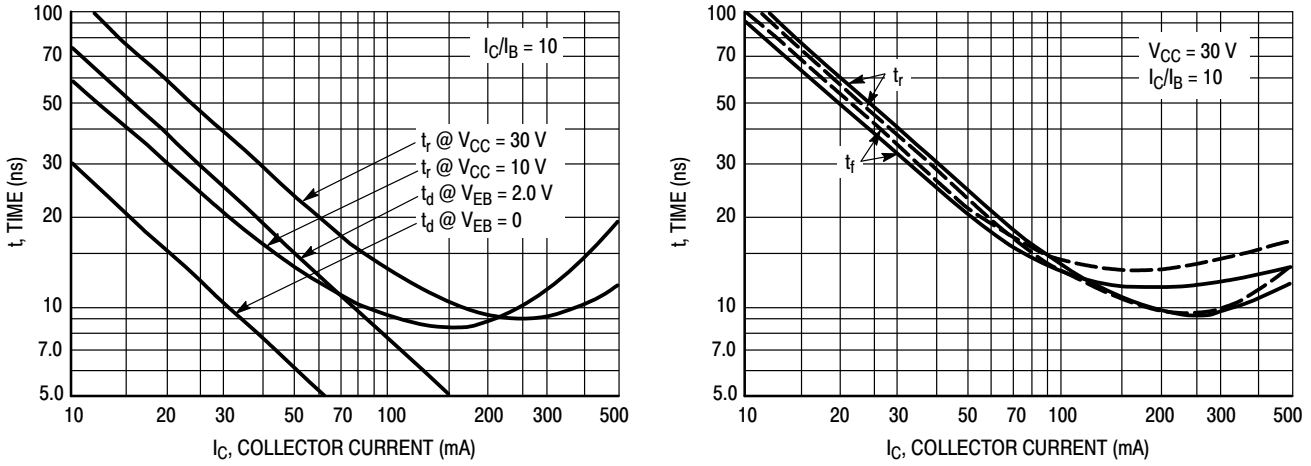


Figure 5. Turn−On Time

Figure 6. Rise and Fall Times

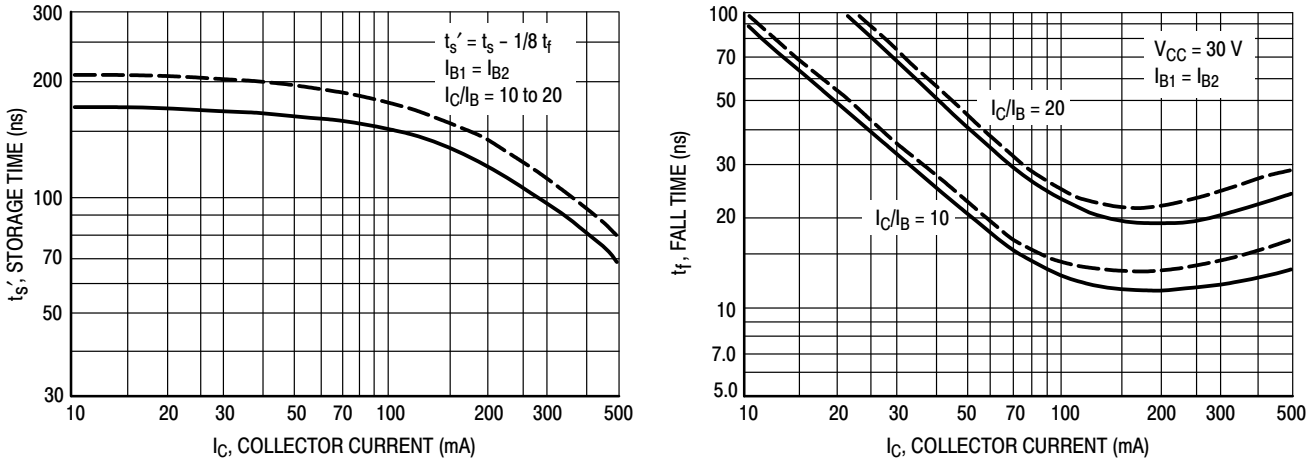


Figure 7. Storage Time

Figure 8. Fall Time

SMALL−SIGNAL CHARACTERISTICS NOISE FIGURE

V_{CE} = 10 Vdc, T_A = 25°C; Bandwidth = 1.0 Hz

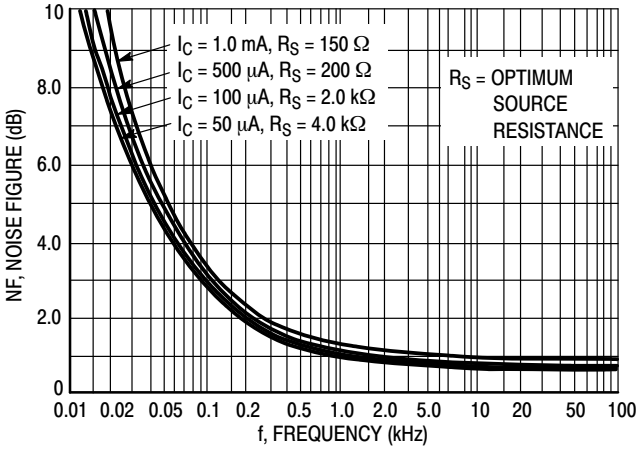


Figure 9. Frequency Effects

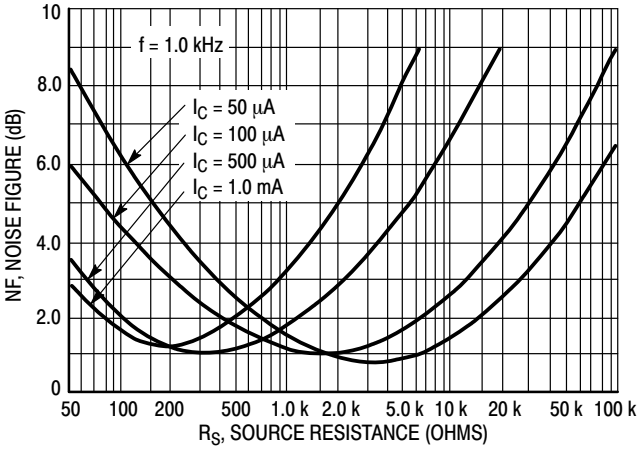


Figure 10. Source Resistance Effects

h PARAMETERS

V_{CE} = 10 Vdc, f = 1.0 kHz, T_A = 25°C

This group of graphs illustrates the relationship between h_{fe} and other "h" parameters for this series of transistors. To obtain these curves, a high−gain and a low−gain unit were selected from the MMBT4401WT1 lines, and the same units were used to develop the correspondingly numbered curves on each graph.

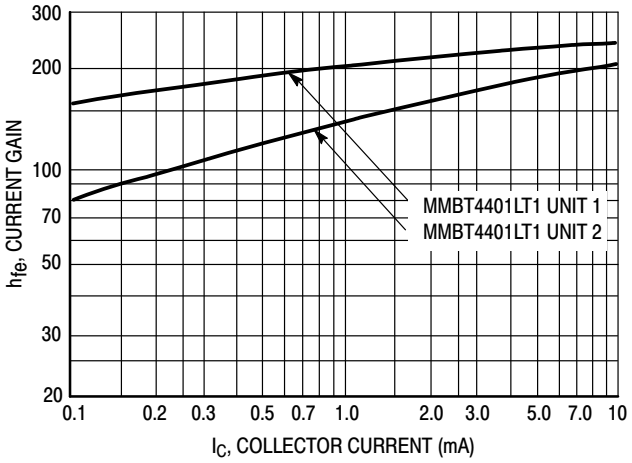


Figure 11. Current Gain

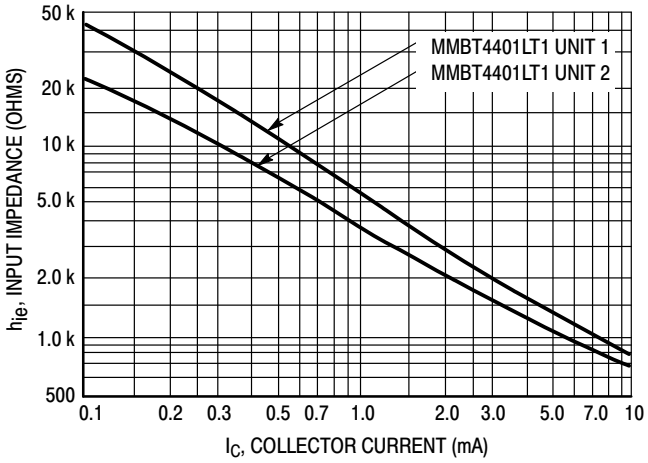


Figure 12. Input Impedance

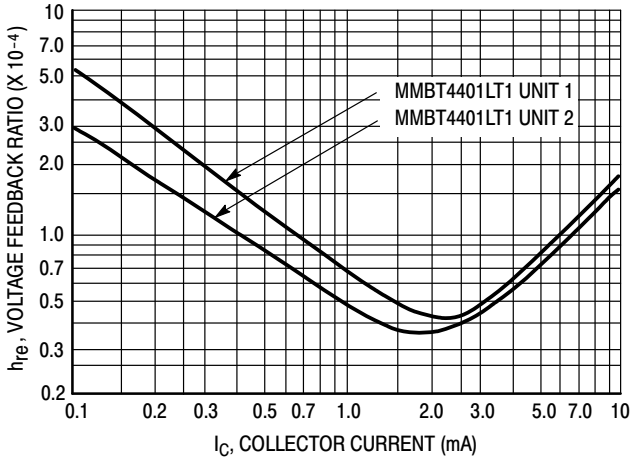


Figure 13. Voltage Feedback Ratio

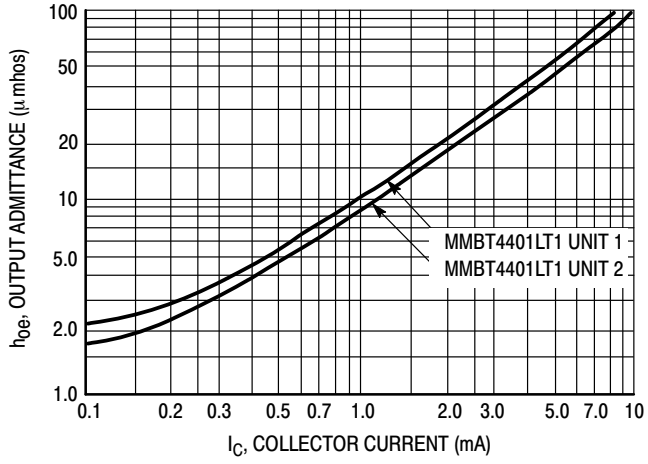


Figure 14. Output Admittance

STATIC CHARACTERISTICS

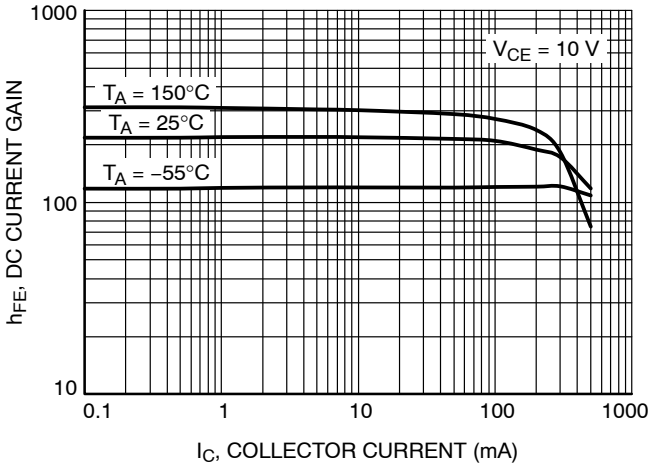


Figure 15. DC Current Gain vs. Collector Current

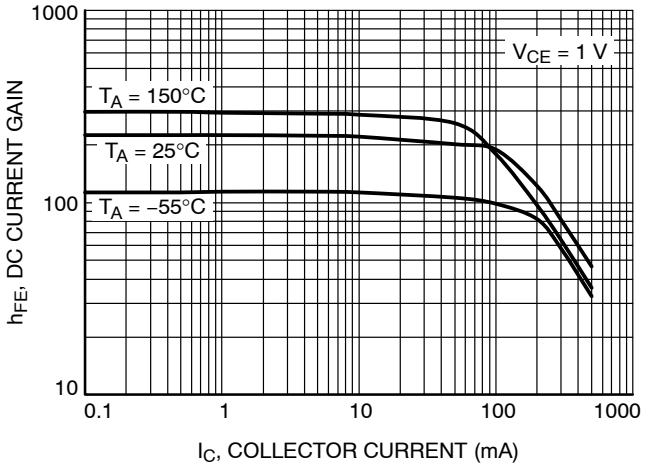


Figure 16. DC Current Gain vs. Collector Current

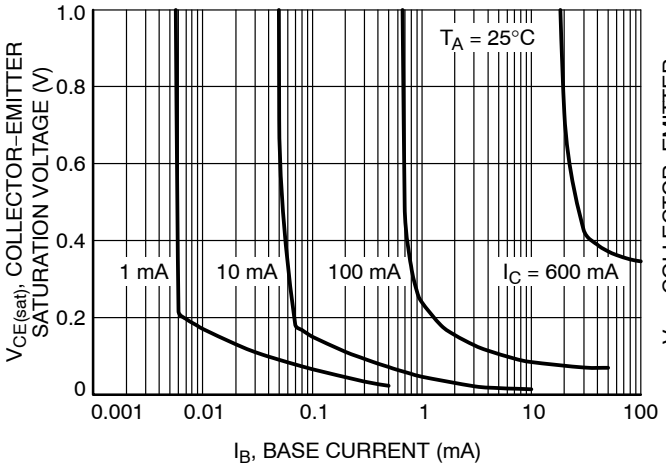


Figure 17. Saturation Region

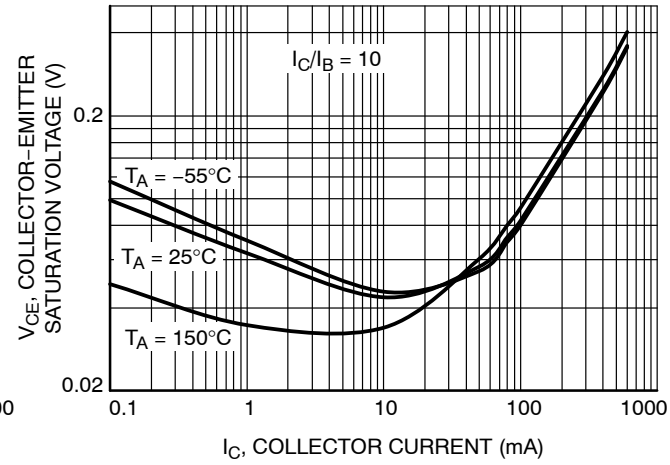


Figure 18. Collector Emitter Saturation Voltage vs. Collector Current

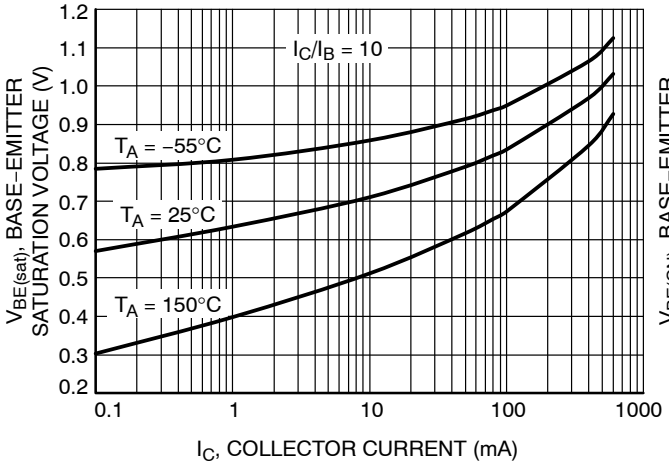


Figure 19. Base Emitter Saturation Voltage vs. Collector Current

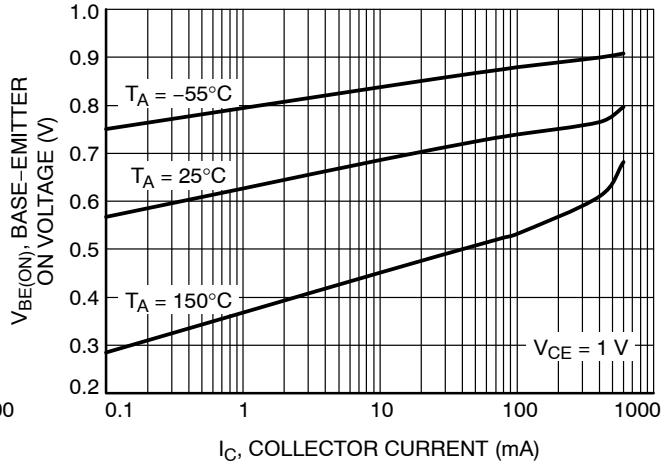


Figure 20. Base Emitter Turn−ON Voltage vs. Collector Current

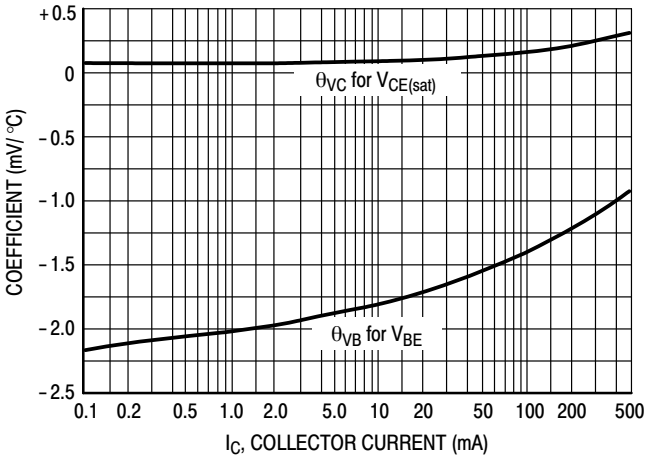


Figure 21. Temperature Coefficients

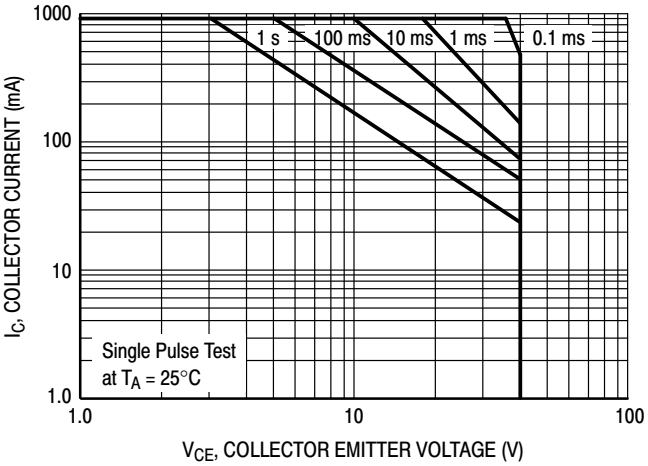
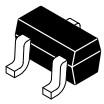


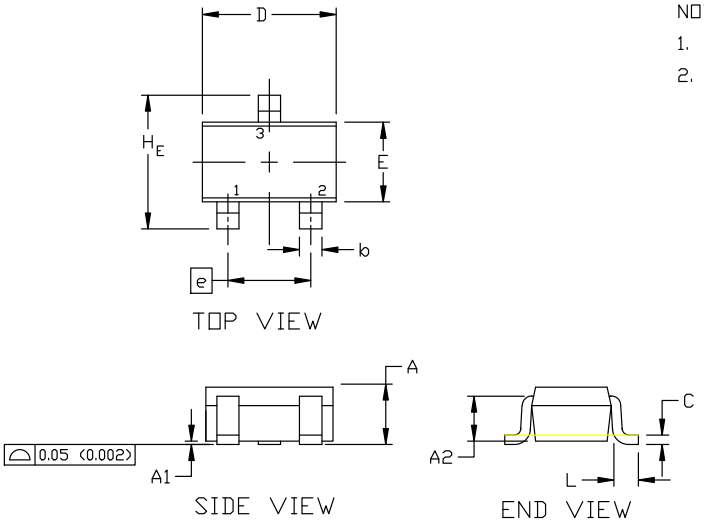
Figure 22. Safe Operating Area



SCALE 4:1

SC−70 (SOT−323)
CASE 419
ISSUE R

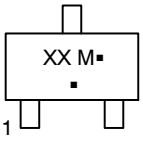
DATE 11 OCT 2022



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

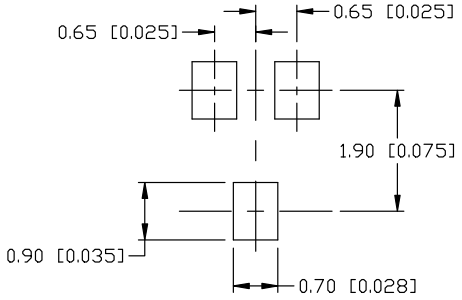
	MILLIMETERS			INCHES		
DIM	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.80	0.90	1.00	0.032	0.035	0.040
A1	0.00	0.05	0.10	0.000	0.002	0.004
A2	0.70 REF			0.028 BSC		
b	0.30	0.35	0.40	0.012	0.014	0.016
c	0.10	0.18	0.25	0.004	0.007	0.010
D	1.80	2.00	2.20	0.071	0.080	0.087
E	1.15	1.24	1.35	0.045	0.049	0.053
e	1.20	1.30	1.40	0.047	0.051	0.055
e1	0.65 BSC			0.026 BSC		
L	0.20	0.38	0.56	0.008	0.015	0.022
H_E	2.00	2.10	2.40	0.079	0.083	0.095

GENERIC MARKING DIAGRAM



XX = Specific Device Code
M = Date Code
▪ = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.



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

SOLDERING FOOTPRINT

STYLE 1:
CANCELLED

STYLE 2:
PIN 1. ANODE
2. N.C.
3. CATHODE

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

STYLE 4:
PIN 1. CATHODE
2. CATHODE
3. ANODE

STYLE 5:
PIN 1. ANODE
2. ANODE
3. CATHODE

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

STYLE 7:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

STYLE 8:
PIN 1. GATE
2. SOURCE
3. DRAIN

STYLE 9:
PIN 1. ANODE
2. CATHODE
3. CATHODE−ANODE

STYLE 10:
PIN 1. CATHODE
2. ANODE
3. ANODE−CATHODE

STYLE 11:
PIN 1. CATHODE
2. CATHODE
3. CATHODE

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DESCRIPTION:	**SC−70 (SOT−323)**	**PAGE 1 OF 1**

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