

# MMBT4401WT1G

## Switching Transistor

NPN Silicon

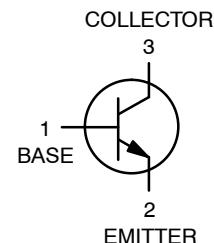
### Features

- 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



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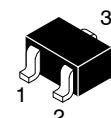
### MAXIMUM RATINGS

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

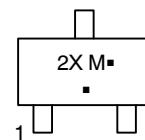
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board $T_A = 25^\circ\text{C}$	$P_D$	150	mW
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	833	°C/W
Junction and Storage Temperature	$T_J, T_{stg}$	-55 to +150	°C

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.



SC-70 (SOT-323)  
CASE 419  
STYLE 3

### MARKING DIAGRAM



(Note: Microdot may be in either location)

\*Date Code orientation may vary depending upon manufacturing location.

### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
MMBT4401WT1G	SC-70 (Pb-Free)	3000 / Tape & Reel
NSVMMBT4401WT1G	SC-70 (Pb-Free)	3000 / Tape & Reel

<sup>†</sup>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.

# MMBT4401WT1G

ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Breakdown Voltage (Note 1) ( $I_C = 1.0 \text{ mA DC}, I_B = 0$ )	$V_{(\text{BR})\text{CEO}}$	40	–	Vdc
Collector-Base Breakdown Voltage ( $I_C = 0.1 \text{ mA DC}, I_E = 0$ )	$V_{(\text{BR})\text{CBO}}$	60	–	Vdc
Emitter-Base Breakdown Voltage ( $I_E = 0.1 \text{ mA DC}, I_C = 0$ )	$V_{(\text{BR})\text{EBO}}$	6.0	–	Vdc
Base Cutoff Current ( $V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$ )	$I_{BEV}$	–	0.1	$\mu\text{A DC}$
<b>ON CHARACTERISTICS</b> (Note 1)				
DC Current Gain ( $I_C = 0.1 \text{ mA DC}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 1.0 \text{ mA DC}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 10 \text{ mA DC}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 150 \text{ mA DC}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 500 \text{ mA DC}, V_{CE} = 2.0 \text{ Vdc}$ )	$h_{FE}$	20 40 80 100 40	– – – 300 –	–
Collector-Emitter Saturation Voltage ( $I_C = 150 \text{ mA DC}, I_B = 15 \text{ mA DC}$ ) ( $I_C = 500 \text{ mA DC}, I_B = 50 \text{ mA DC}$ )	$V_{CE(\text{sat})}$	– –	0.4 0.75	Vdc
Base-Emitter Saturation Voltage ( $I_C = 150 \text{ mA DC}, I_B = 15 \text{ mA DC}$ ) ( $I_C = 500 \text{ mA DC}, I_B = 50 \text{ mA DC}$ )	$V_{BE(\text{sat})}$	0.75 –	0.95 1.2	Vdc
Collector Cutoff Current ( $V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$ )	$I_{CEX}$	–	0.1	$\mu\text{A DC}$

## SMALL-SIGNAL CHARACTERISTICS

Current-Gain – Bandwidth Product ( $I_C = 20 \text{ mA DC}, V_{CE} = 10 \text{ Vdc}, f = 100 \text{ MHz}$ )	$f_T$	250	–	MHz
Collector-Base Capacitance ( $V_{CB} = 5.0 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz}$ )	$C_{cb}$	–	6.5	pF
Emitter-Base Capacitance ( $V_{EB} = 0.5 \text{ Vdc}, I_C = 0, f = 1.0 \text{ MHz}$ )	$C_{eb}$	–	30	pF
Input Impedance ( $I_C = 1.0 \text{ mA DC}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$ )	$h_{ie}$	1.0	15	k $\Omega$
Voltage Feedback Ratio ( $I_C = 1.0 \text{ mA DC}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$ )	$h_{re}$	0.1	8.0	$\times 10^{-4}$
Small-Signal Current Gain ( $I_C = 1.0 \text{ mA DC}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$ )	$h_{fe}$	40	500	–
Output Admittance ( $I_C = 1.0 \text{ mA DC}, V_{CE} = 10 \text{ Vdc}, f = 1.0 \text{ kHz}$ )	$h_{oe}$	1.0	30	$\mu\text{mhos}$

## SWITCHING CHARACTERISTICS

Delay Time	$(V_{CC} = 30 \text{ Vdc}, V_{EB} = 2.0 \text{ Vdc}, I_C = 150 \text{ mA DC}, I_{B1} = 15 \text{ mA DC})$	$t_d$	–	15	ns
Rise Time		$t_r$	–	20	
Storage Time	$(V_{CC} = 30 \text{ Vdc}, I_C = 150 \text{ mA DC}, I_{B1} = I_{B2} = 15 \text{ mA DC})$	$t_s$	–	225	ns
Fall Time		$t_f$	–	30	

1. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

## SWITCHING TIME EQUIVALENT TEST CIRCUITS

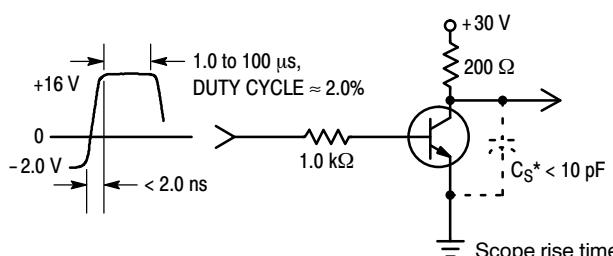


Figure 1. Turn-On Time

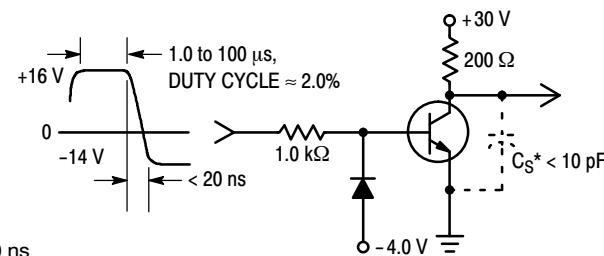


Figure 2. Turn-Off Time

## TRANSIENT CHARACTERISTICS

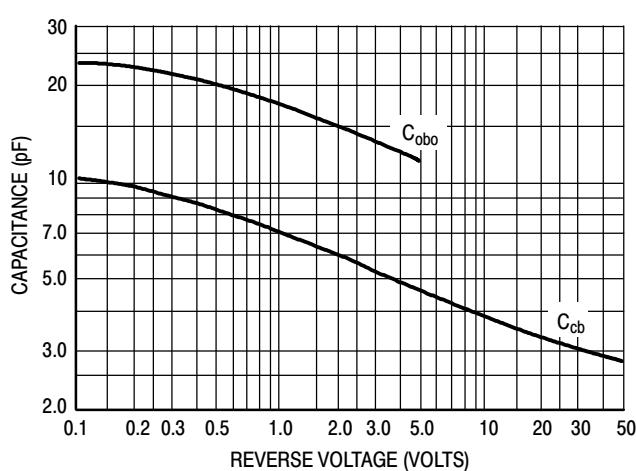


Figure 3. Capacitances

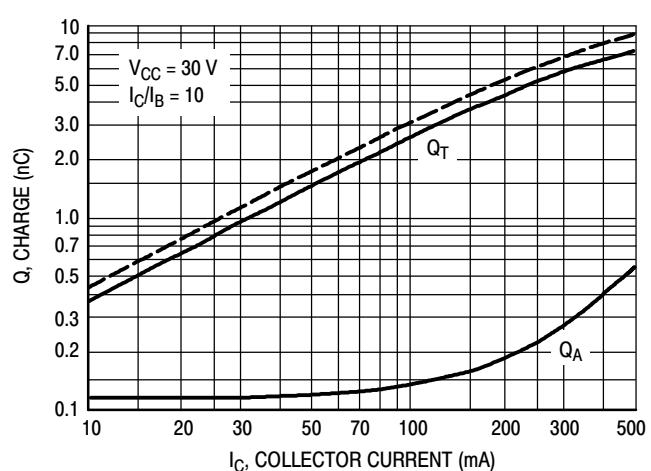


Figure 4. Charge Data

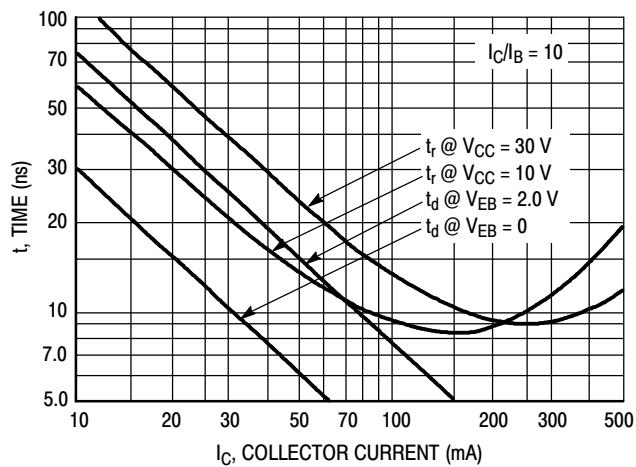


Figure 5. Turn-On Time

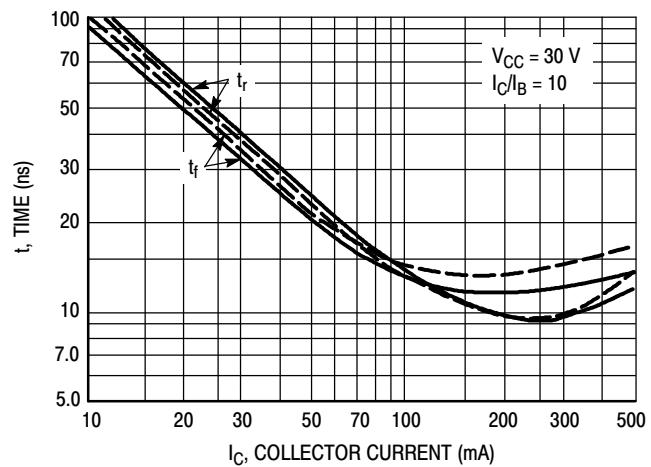


Figure 6. Rise and Fall Times

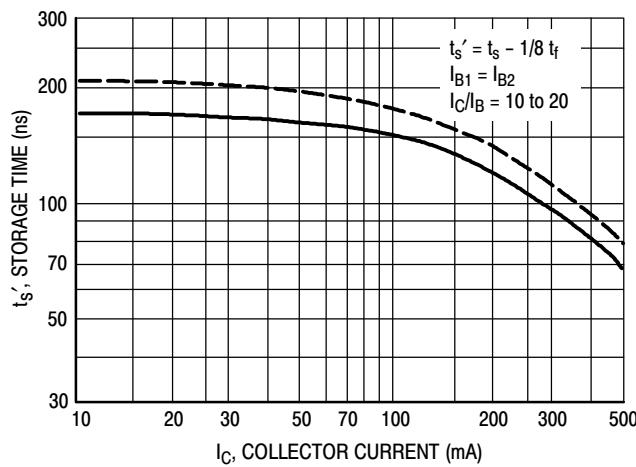


Figure 7. Storage Time

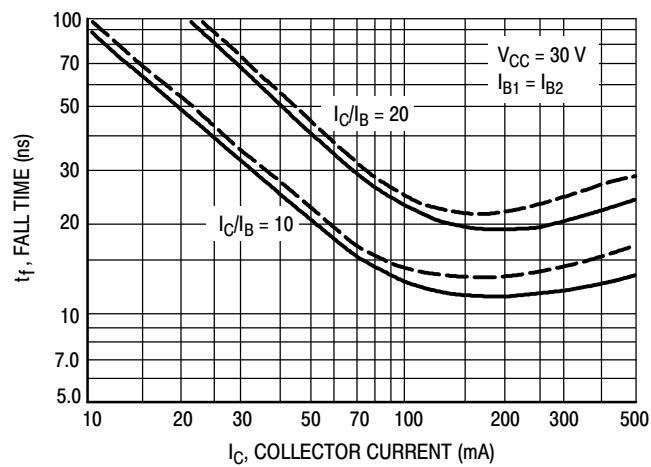


Figure 8. Fall Time

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## SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE

$V_{CE} = 10$  Vdc,  $T_A = 25^\circ\text{C}$ ; Bandwidth = 1.0 Hz

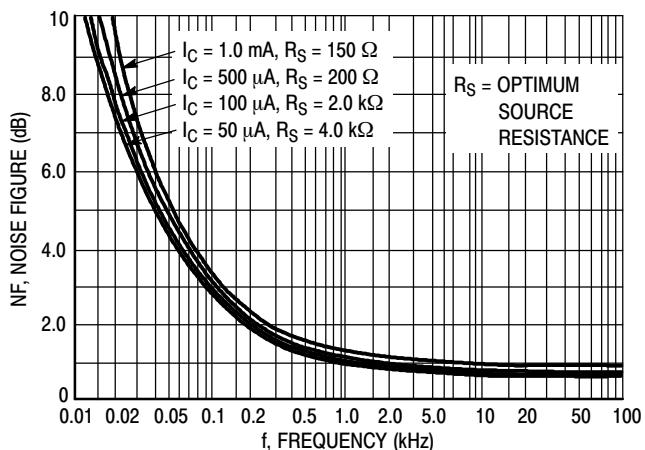


Figure 9. Frequency Effects

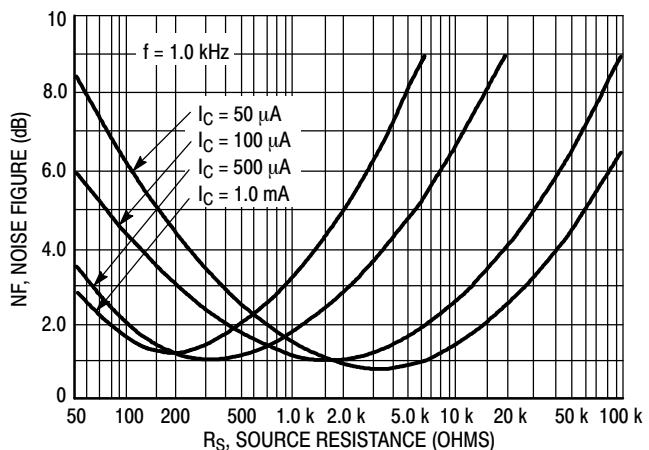


Figure 10. Source Resistance Effects

## **h** PARAMETERS

$V_{CE} = 10$  Vdc,  $f = 1.0$  kHz,  $T_A = 25^\circ\text{C}$

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.

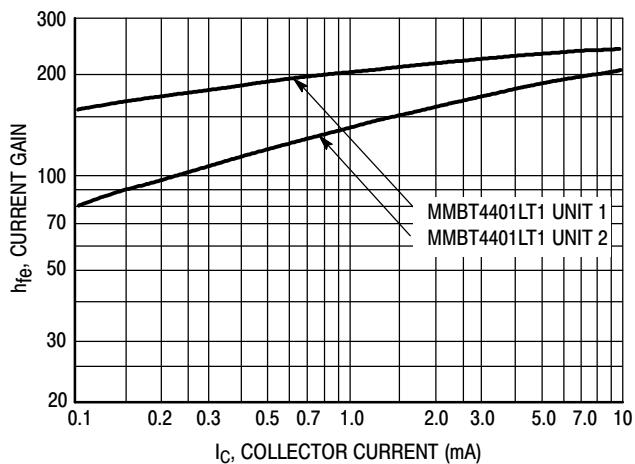


Figure 11. Current Gain

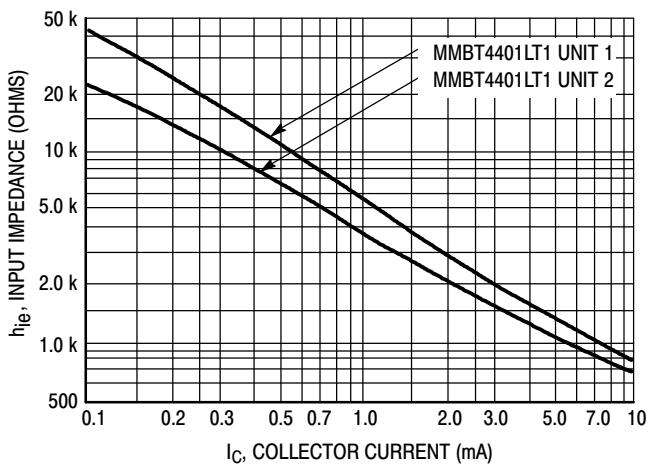


Figure 12. Input Impedance

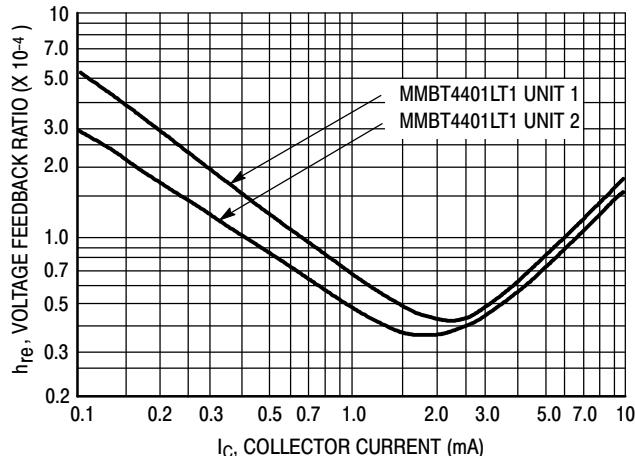


Figure 13. Voltage Feedback Ratio

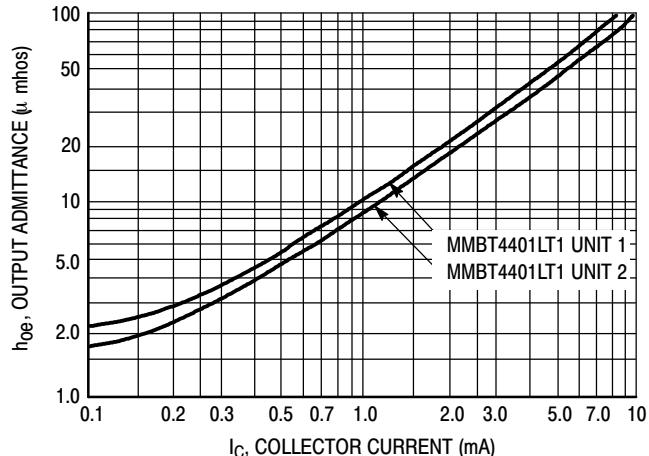
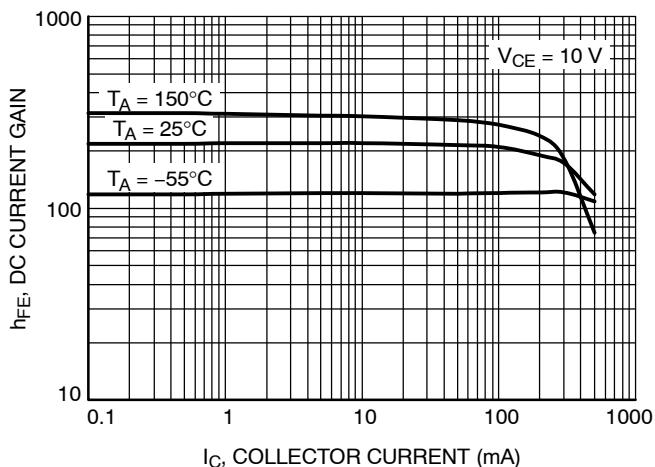
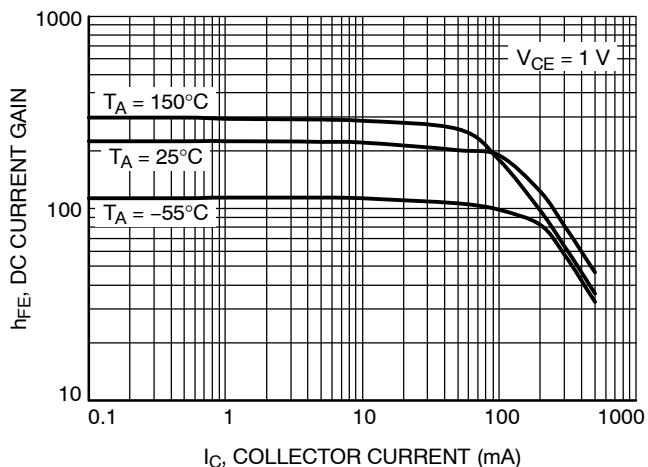


Figure 14. Output Admittance

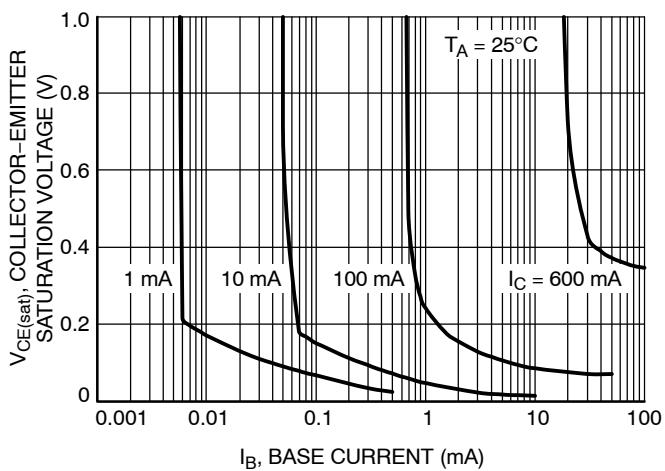
## STATIC CHARACTERISTICS



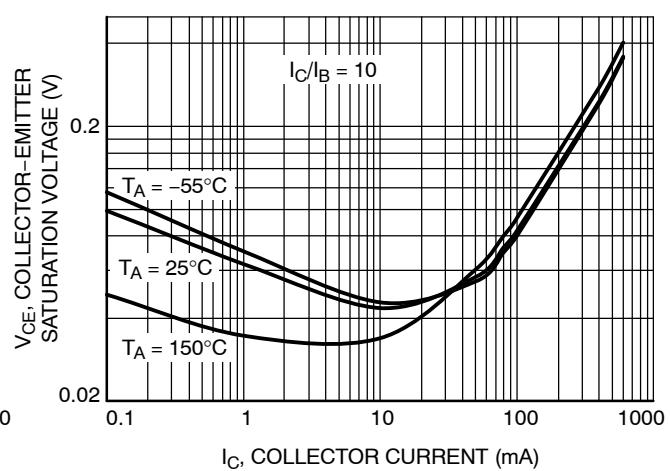
**Figure 15. DC Current Gain vs. Collector Current**



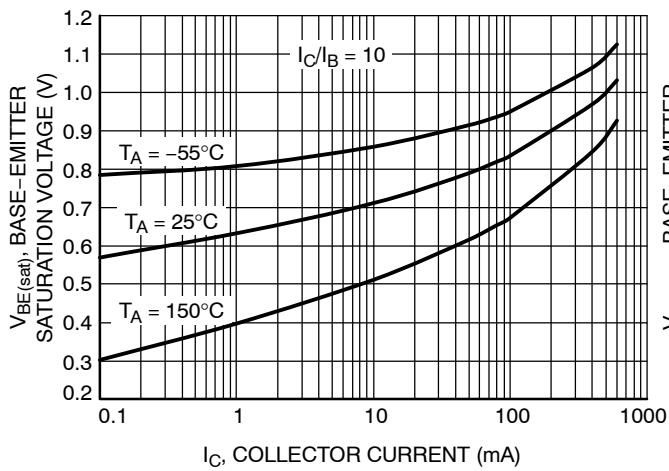
**Figure 16. DC Current Gain vs. Collector Current**



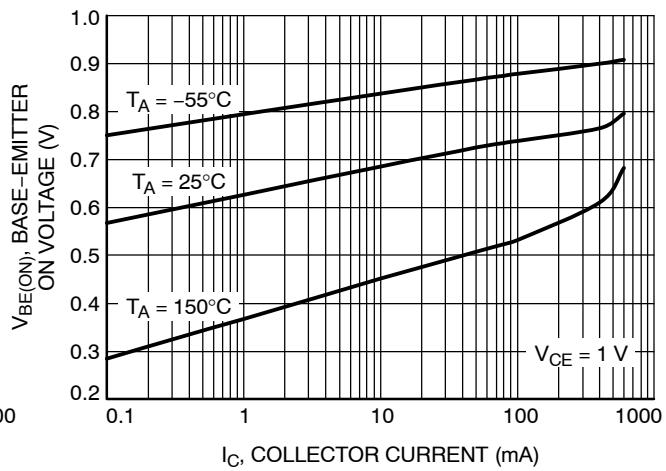
**Figure 17. Saturation Region**



**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**

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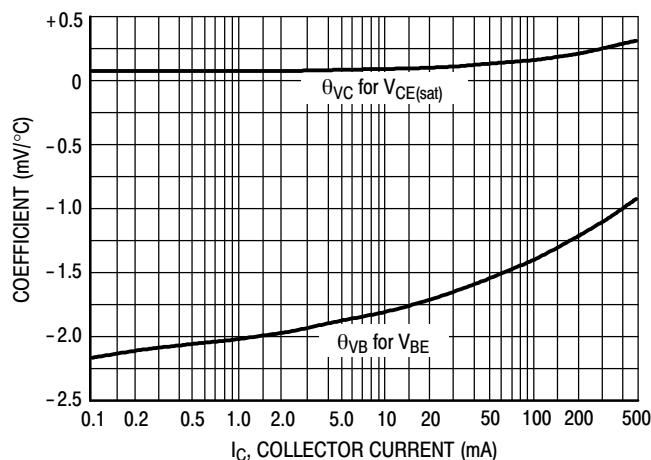


Figure 21. Temperature Coefficients

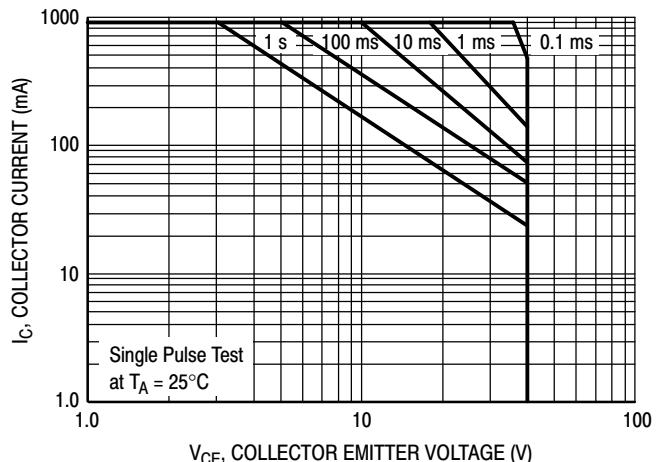
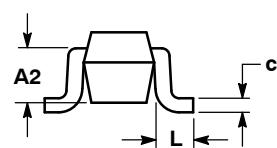
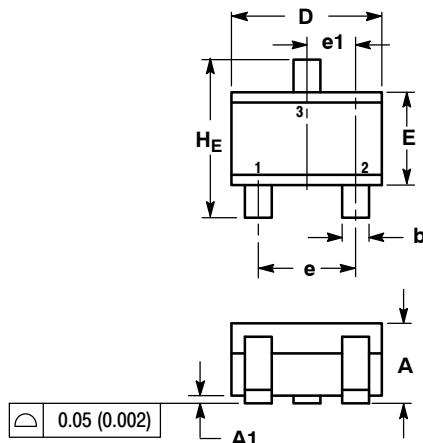


Figure 22. Safe Operating Area

# MMBT4401WT1G

## PACKAGE DIMENSIONS

### SC-70 (SOT-323) CASE 419-04 ISSUE N



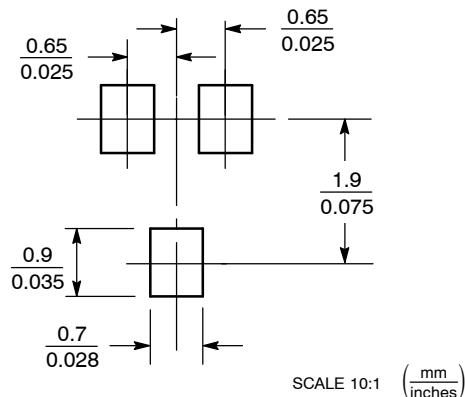
#### NOTES:

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

DIM	MILLIMETERS			INCHES		
	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 REF		
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	2.10	2.20	0.071	0.083	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

STYLE 3:  
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.

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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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Факс: 8 (812) 320-02-42

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