

# MMBT4401M3T5G

## NPN Switching Transistor

The MMBT4401M3T5G device is a spin-off of our popular SOT-23 three-leaded device. It is designed for general purpose switching applications and is housed in the SOT-723 surface mount package. This device is ideal for low-power surface mount applications where board space is at a premium.

### Features

- Reduces Board Space
- This is a Halide-Free Device
- This is a Pb-Free Device

### 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 (Note 1) $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	265 2.1	mW mW/ $^\circ\text{C}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	470	$^\circ\text{C}/\text{W}$
Total Device Dissipation Alumina Substrate, (Note 2) $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	640 5.1	mW mW/ $^\circ\text{C}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	195	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

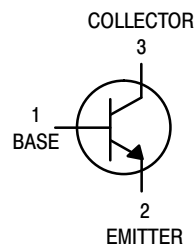
1. FR-5 =  $1.0 \times 0.75 \times 0.062$  in.

2. Alumina =  $0.4 \times 0.3 \times 0.024$  in. 99.5% alumina.

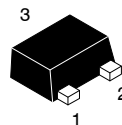


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### MARKING DIAGRAM



SOT-723  
CASE 631AA  
STYLE 1



AF = Specific Device Code  
M = Date Code

### ORDERING INFORMATION

Device	Package	Shipping†
MMBT4401M3T5G	SOT-723 (Pb-Free)	8000/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.

# MMBT4401M3T5G

## 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 3) ( $I_C = 1.0 \text{ mA dc}$ , $I_B = 0$ )	$V_{(BR)CEO}$	40	-	Vdc
Collector - Base Breakdown Voltage ( $I_C = 0.1 \text{ mA dc}$ , $I_E = 0$ )	$V_{(BR)CBO}$	60	-	Vdc
Emitter - Base Breakdown Voltage ( $I_E = 0.1 \text{ mA dc}$ , $I_C = 0$ )	$V_{(BR)EBO}$	6.0	-	Vdc
Base Cutoff Current ( $V_{CE} = 35 \text{ Vdc}$ , $V_{EB} = 0.4 \text{ Vdc}$ )	$I_{BEV}$	-	0.1	$\mu\text{A dc}$
Collector Cutoff Current ( $V_{CE} = 35 \text{ Vdc}$ , $V_{EB} = 0.4 \text{ Vdc}$ )	$I_{CEX}$	-	0.1	$\mu\text{A dc}$

## ON CHARACTERISTICS (Note 3)

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 ( $I_C = 150 \text{ mA dc}$ , $I_B = 15 \text{ mA dc}$ ) ( $I_C = 500 \text{ mA dc}$ , $I_B = 50 \text{ mA dc}$ )	$V_{CE(sat)}$	- -	0.4 0.75	Vdc
Base - Emitter Saturation Voltage ( $I_C = 150 \text{ mA dc}$ , $I_B = 15 \text{ mA dc}$ ) ( $I_C = 500 \text{ mA dc}$ , $I_B = 50 \text{ mA dc}$ )	$V_{BE(sat)}$	0.75 -	0.95 1.2	Vdc

## 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	

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

## SWITCHING TIME EQUIVALENT TEST CIRCUITS

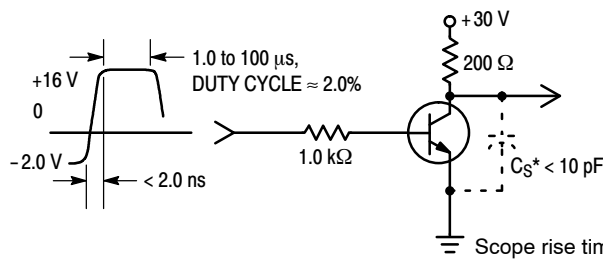


Figure 1. Turn-On Time

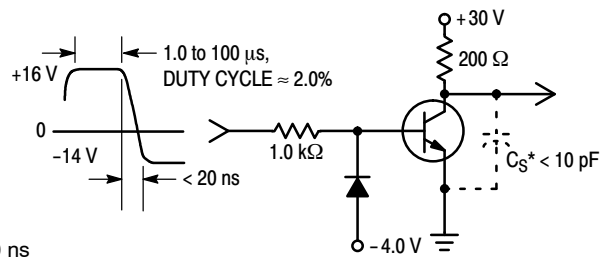


Figure 2. Turn-Off Time

# MMBT4401M3T5G

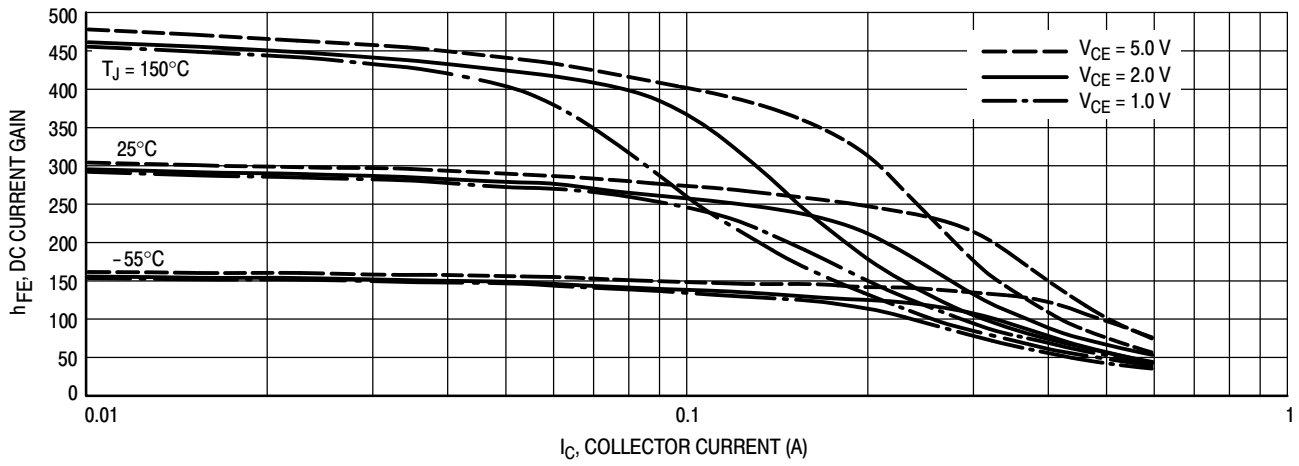


Figure 3. DC Current Gain

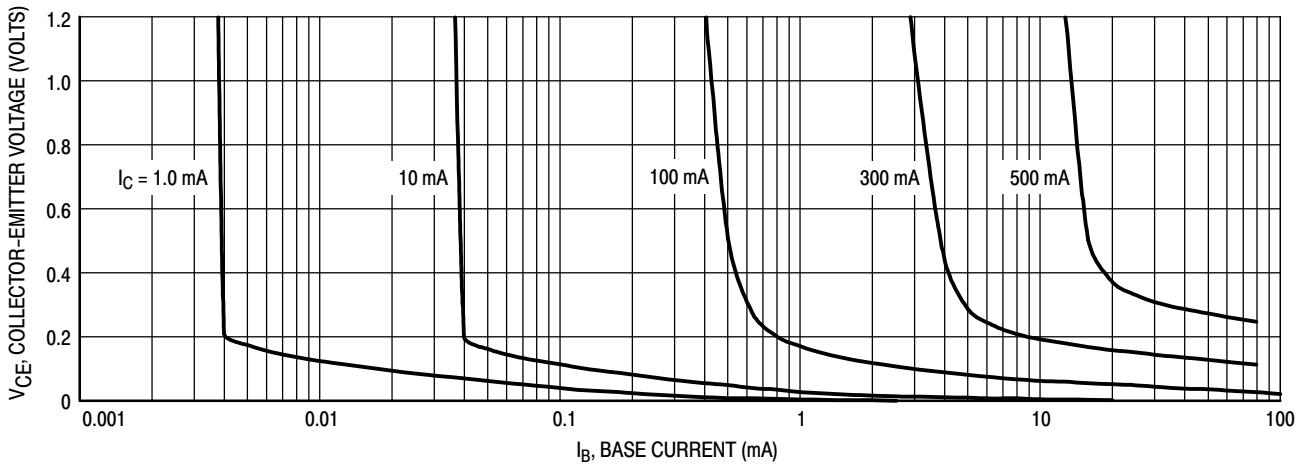


Figure 4. Collector Saturation Region

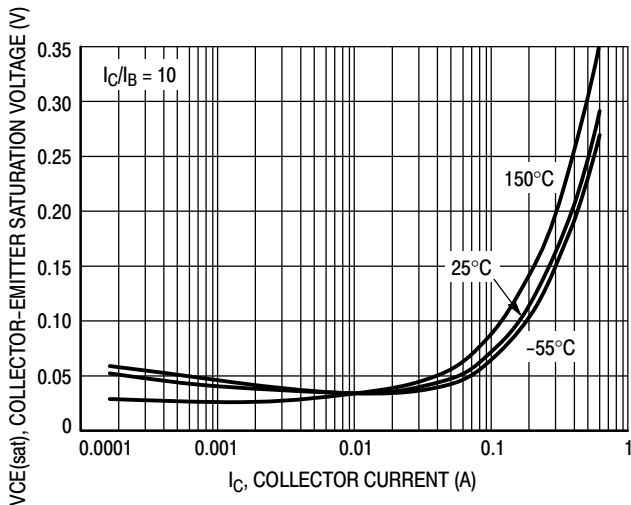


Figure 5. Collector-Emitter Saturation Voltage vs. Collector Current

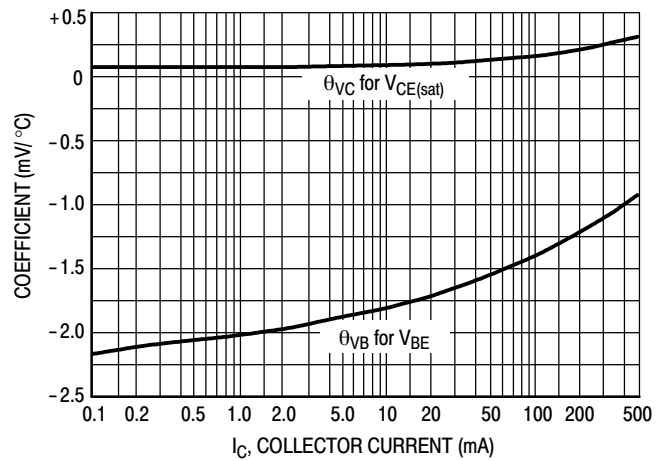
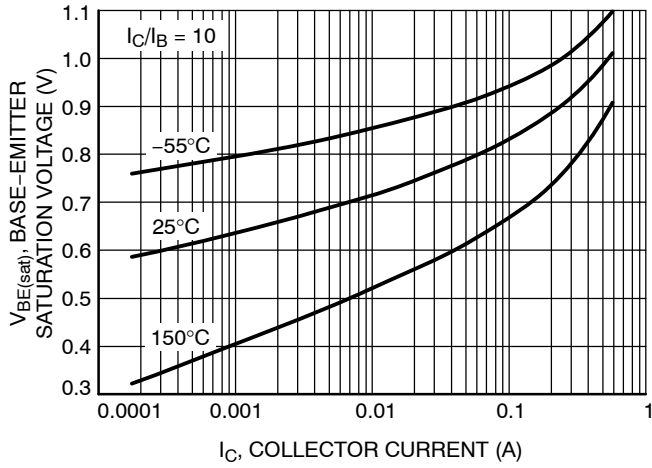
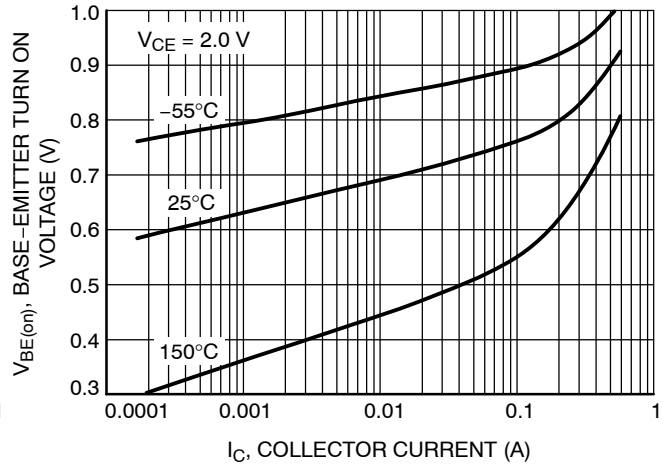


Figure 6. Temperature Coefficients

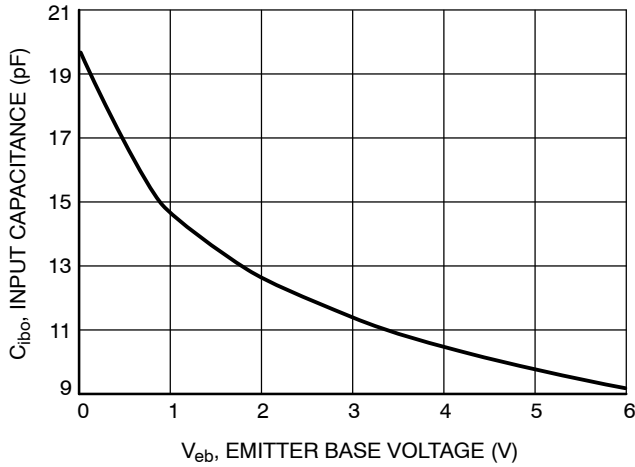
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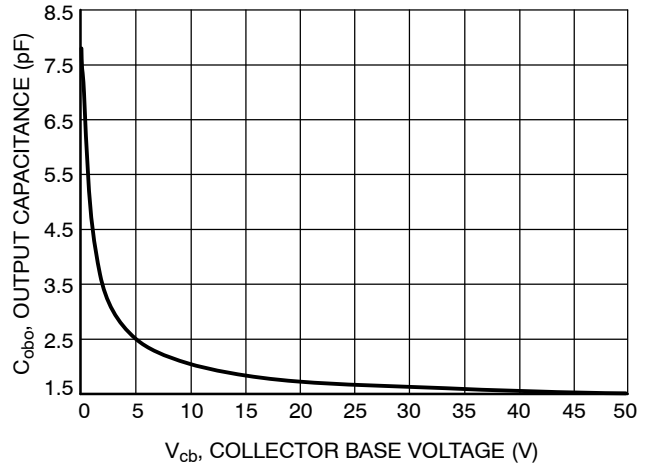
**Figure 7. Base-Emitter Saturation Voltage vs. Collector Current**



**Figure 8. Base-Emitter Turn On Voltage vs. Collector Current**



**Figure 9. Input Capacitance vs. Emitter Base Voltage**

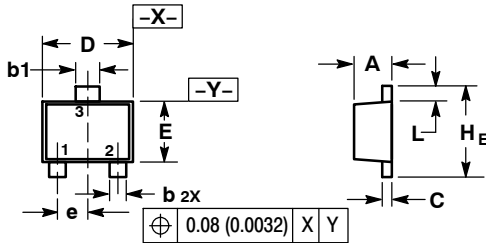


**Figure 10. Output Capacitance vs. Collector Base Voltage**

# MMBT4401M3T5G

## PACKAGE DIMENSIONS

SOT-723  
CASE 631AA-01  
ISSUE C



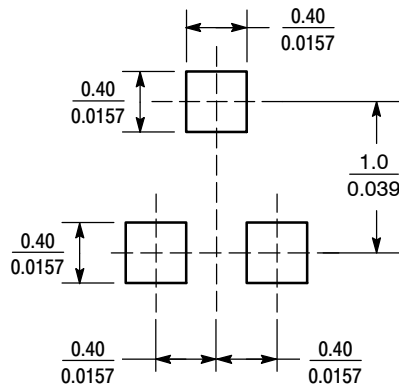
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.45	0.50	0.55	0.018	0.020	0.022
b	0.15	0.21	0.27	0.0059	0.0083	0.0106
b1	0.25	0.31	0.37	0.010	0.012	0.015
C	0.07	0.12	0.17	0.0028	0.0047	0.0067
D	1.15	1.20	1.25	0.045	0.047	0.049
E	0.75	0.80	0.85	0.03	0.032	0.034
e	0.40 BSC			0.016 BSC		
H E	1.15	1.20	1.25	0.045	0.047	0.049
L	0.15	0.20	0.25	0.0059	0.0079	0.0098

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

### SOLDERING FOOTPRINT\*



SCALE 20:1 (mm/inches)

\*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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