

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
- 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 (Note 1) $T_A = 25^\circ\text{C}$ Derate above 25°C | P_D | 265 | mW |
| | | 2.1 | 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°C | P_D | 640 | mW |
| | | 5.1 | 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 | $^\circ\text{C}$ |

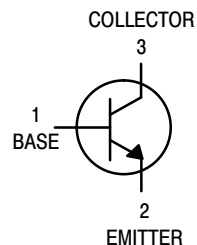
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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.

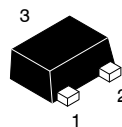


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MARKING DIAGRAM



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 |
|---------------------------------------------------------------------------------------------|---------------|-----|-----|------------------|
| OFF CHARACTERISTICS | | | | |
| 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 | μmhos |

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

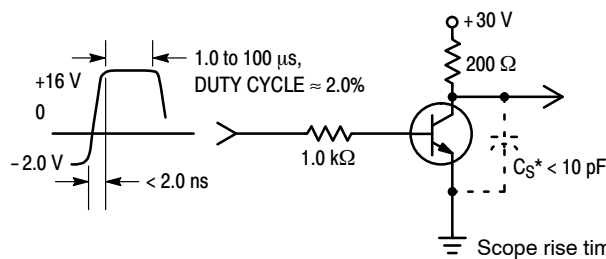


Figure 1. Turn-On Time

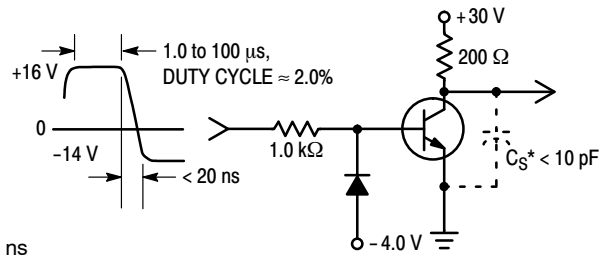


Figure 2. Turn-Off Time

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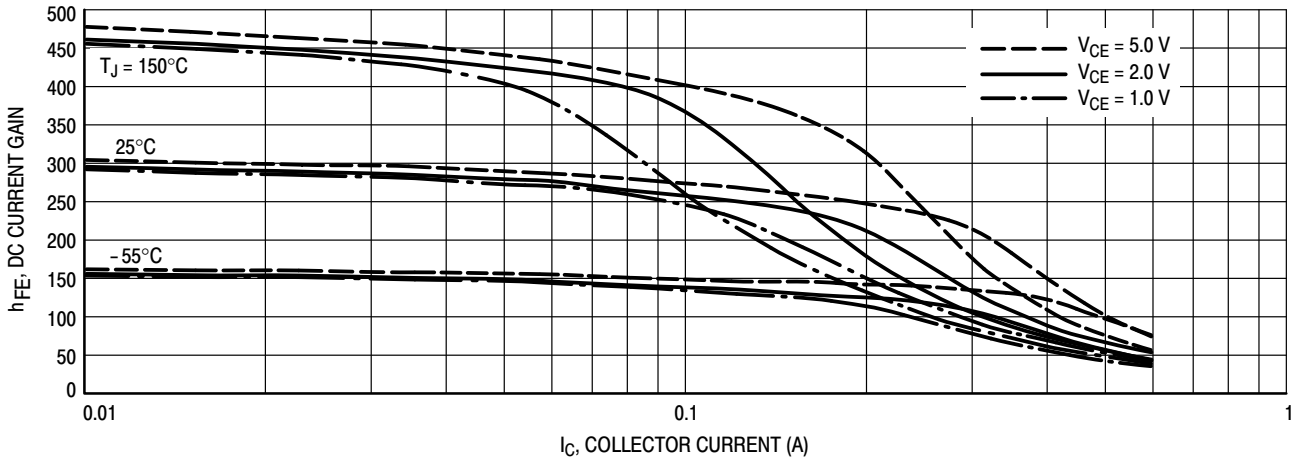


Figure 3. DC Current Gain

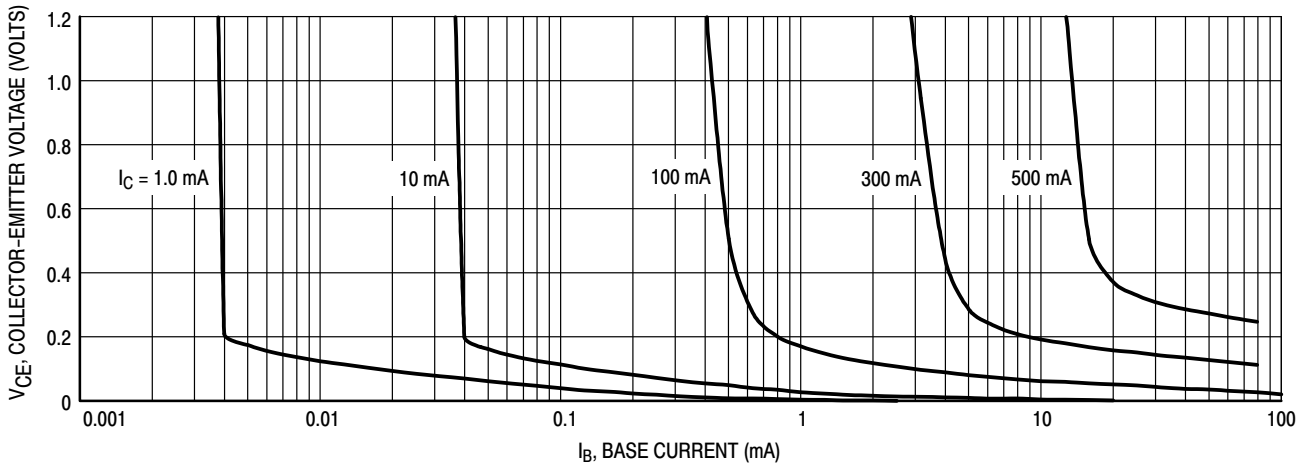


Figure 4. Collector Saturation Region

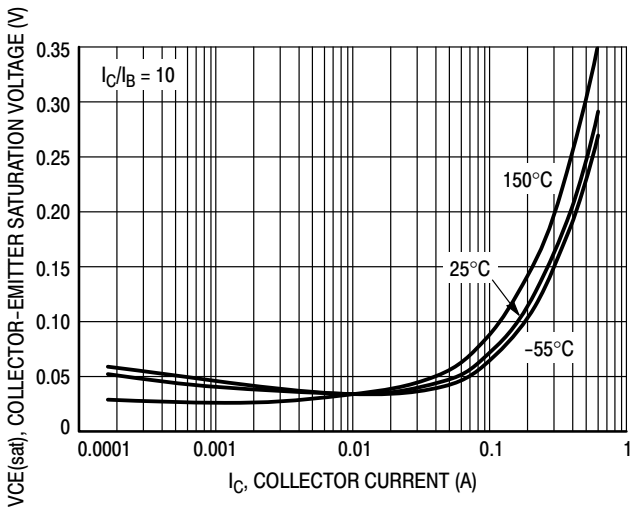


Figure 5. Collector-Emitter Saturation Voltage vs. Collector Current

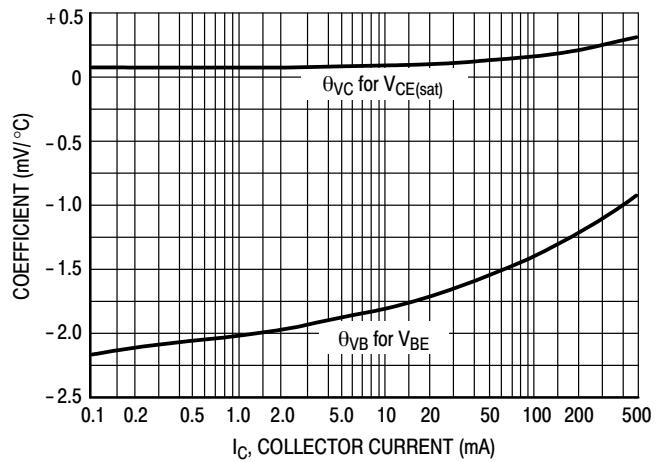


Figure 6. Temperature Coefficients

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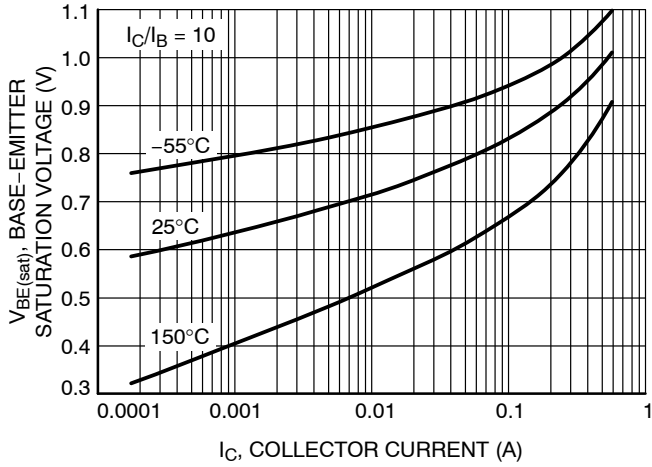


Figure 7. Base-Emitter Saturation Voltage vs. Collector Current

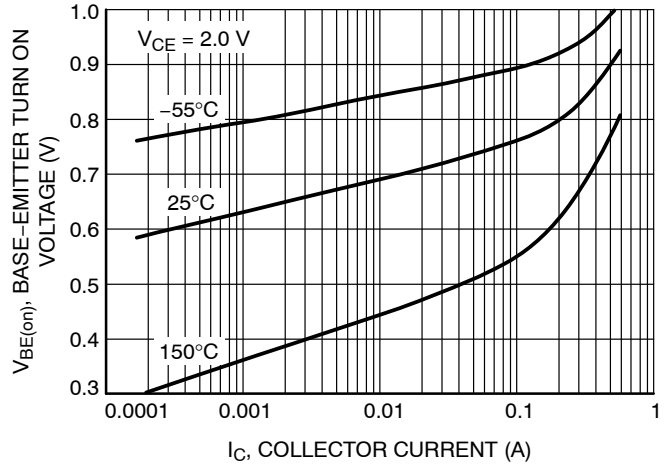


Figure 8. Base-Emitter Turn On Voltage vs. Collector Current

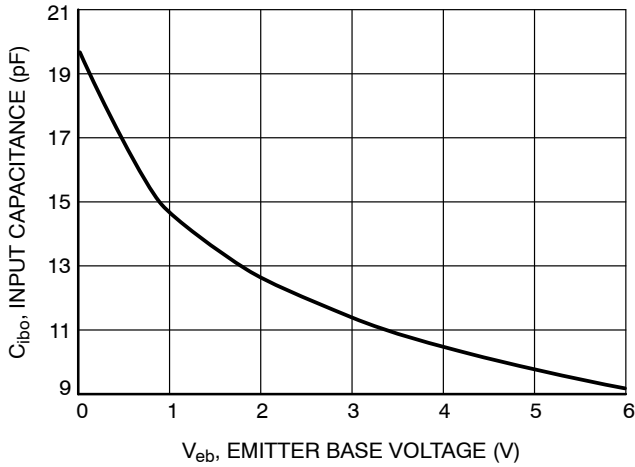


Figure 9. Input Capacitance vs. Emitter Base Voltage

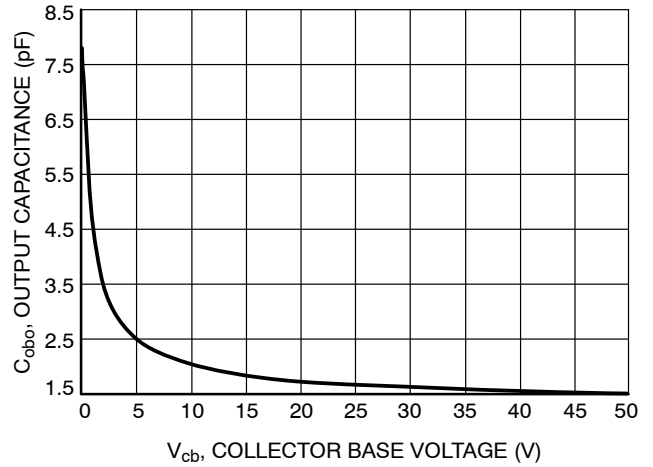


Figure 10. Output Capacitance vs. Collector Base Voltage

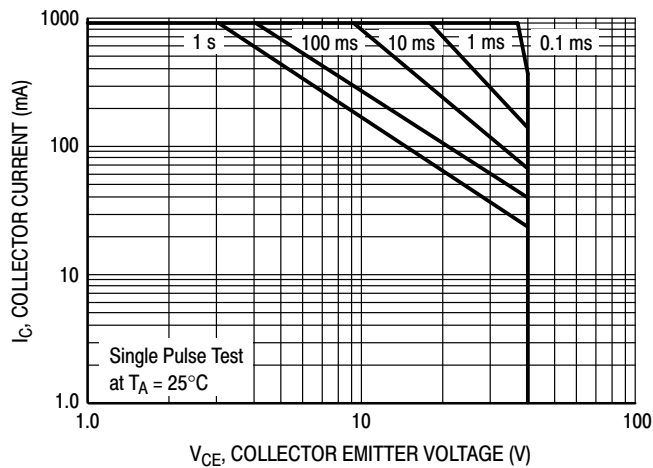
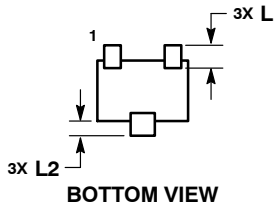
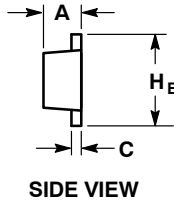
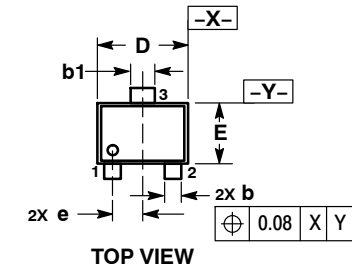


Figure 11. Safe Operating Area

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PACKAGE DIMENSIONS

SOT-723
CASE 631AA
ISSUE D



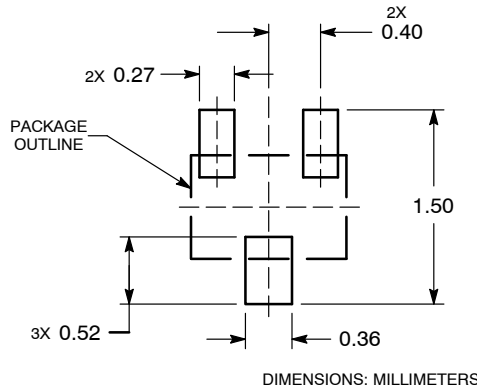
STYLE 1:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
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 | | |
|-----|-------------|------|------|
| | MIN | NOM | MAX |
| A | 0.45 | 0.50 | 0.55 |
| b | 0.15 | 0.21 | 0.27 |
| b1 | 0.25 | 0.31 | 0.37 |
| C | 0.07 | 0.12 | 0.17 |
| D | 1.15 | 1.20 | 1.25 |
| E | 0.75 | 0.80 | 0.85 |
| e | 0.40 BSC | | |
| HE | 1.15 | 1.20 | 1.25 |
| L | 0.29 REF | | |
| L2 | 0.15 | 0.20 | 0.25 |

RECOMMENDED SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*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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