

# MMBT4401WT1G

## Switching Transistor

### NPN Silicon

#### Features

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

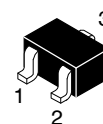
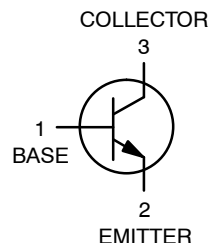
| Characteristic                                                  | Symbol          | Max         | Unit               |
|-----------------------------------------------------------------|-----------------|-------------|--------------------|
| Total Device Dissipation FR–5 Board<br>$T_A = 25^\circ\text{C}$ | $P_D$           | 150         | mW                 |
| Thermal Resistance,<br>Junction–to–Ambient                      | $R_{\theta JA}$ | 833         | $^\circ\text{C/W}$ |
| 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.



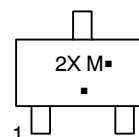
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SC-70 (SOT-323)  
CASE 419  
STYLE 3

#### MARKING DIAGRAM



(Note: Microdot may be in either location)

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

#### ORDERING INFORMATION

| Device       | Package            | Shipping†          |
|--------------|--------------------|--------------------|
| MMBT4401WT1G | SC-70<br>(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.

# MMBT4401WT1G

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

| Characteristic                                                                                            | Symbol               | Min | Max | Unit             |
|-----------------------------------------------------------------------------------------------------------|----------------------|-----|-----|------------------|
| <b>OFF CHARACTERISTICS</b>                                                                                |                      |     |     |                  |
| Collector–Emitter Breakdown Voltage (Note 1) (I <sub>C</sub> = 1.0 mA <sub>dc</sub> , I <sub>B</sub> = 0) | V <sub>(BR)CEO</sub> | 40  | –   | V <sub>dc</sub>  |
| Collector–Base Breakdown Voltage (I <sub>C</sub> = 0.1 mA <sub>dc</sub> , I <sub>E</sub> = 0)             | V <sub>(BR)CBO</sub> | 60  | –   | V <sub>dc</sub>  |
| Emitter–Base Breakdown Voltage (I <sub>E</sub> = 0.1 mA <sub>dc</sub> , I <sub>C</sub> = 0)               | V <sub>(BR)EBO</sub> | 6.0 | –   | V <sub>dc</sub>  |
| Base Cutoff Current (V <sub>CE</sub> = 35 V <sub>dc</sub> , V <sub>EB</sub> = 0.4 V <sub>dc</sub> )       | I <sub>BEV</sub>     | –   | 0.1 | μA <sub>dc</sub> |

## ON CHARACTERISTICS (Note 1)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                      |                             |                         |                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------------|-------------------------|------------------|
| DC Current Gain<br>(I <sub>C</sub> = 0.1 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )<br>(I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )<br>(I <sub>C</sub> = 10 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )<br>(I <sub>C</sub> = 150 mA <sub>dc</sub> , V <sub>CE</sub> = 1.0 V <sub>dc</sub> )<br>(I <sub>C</sub> = 500 mA <sub>dc</sub> , V <sub>CE</sub> = 2.0 V <sub>dc</sub> ) | h <sub>FE</sub>      | 20<br>40<br>80<br>100<br>40 | –<br>–<br>–<br>300<br>– | –                |
| Collector–Emitter Saturation Voltage<br>(I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B</sub> = 15 mA <sub>dc</sub> )<br>(I <sub>C</sub> = 500 mA <sub>dc</sub> , I <sub>B</sub> = 50 mA <sub>dc</sub> )                                                                                                                                                                                                                                         | V <sub>CE(sat)</sub> | –<br>–                      | 0.4<br>0.75             | V <sub>dc</sub>  |
| Base–Emitter Saturation Voltage<br>(I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B</sub> = 15 mA <sub>dc</sub> )<br>(I <sub>C</sub> = 500 mA <sub>dc</sub> , I <sub>B</sub> = 50 mA <sub>dc</sub> )                                                                                                                                                                                                                                              | V <sub>BE(sat)</sub> | 0.75<br>–                   | 0.95<br>1.2             | V <sub>dc</sub>  |
| Collector Cutoff Current (V <sub>CE</sub> = 35 V <sub>dc</sub> , V <sub>EB</sub> = 0.4 V <sub>dc</sub> )                                                                                                                                                                                                                                                                                                                                           | I <sub>CEX</sub>     | –                           | 0.1                     | μA <sub>dc</sub> |

## SMALL-SIGNAL CHARACTERISTICS

|                                                                                                                              |                 |     |     |                    |
|------------------------------------------------------------------------------------------------------------------------------|-----------------|-----|-----|--------------------|
| Current–Gain – Bandwidth Product (I <sub>C</sub> = 20 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 100 MHz) | f <sub>T</sub>  | 250 | –   | MHz                |
| Collector–Base Capacitance (V <sub>CB</sub> = 5.0 V <sub>dc</sub> , I <sub>E</sub> = 0, f = 1.0 MHz)                         | C <sub>cb</sub> | –   | 6.5 | pF                 |
| Emitter–Base Capacitance (V <sub>EB</sub> = 0.5 V <sub>dc</sub> , I <sub>C</sub> = 0, f = 1.0 MHz)                           | C <sub>eb</sub> | –   | 30  | pF                 |
| Input Impedance (I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 1.0 kHz)                 | h <sub>ie</sub> | 1.0 | 15  | kΩ                 |
| Voltage Feedback Ratio (I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 1.0 kHz)          | h <sub>re</sub> | 0.1 | 8.0 | X 10 <sup>–4</sup> |
| Small–Signal Current Gain (I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 1.0 kHz)       | h <sub>fe</sub> | 40  | 500 | –                  |
| Output Admittance (I <sub>C</sub> = 1.0 mA <sub>dc</sub> , V <sub>CE</sub> = 10 V <sub>dc</sub> , f = 1.0 kHz)               | h <sub>oe</sub> | 1.0 | 30  | μmhos              |

## SWITCHING CHARACTERISTICS

|              |                                                                                                                                                                    |                |   |     |    |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---|-----|----|
| Delay Time   | (V <sub>CC</sub> = 30 V <sub>dc</sub> , V <sub>EB</sub> = 2.0 V <sub>dc</sub> ,<br>I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B1</sub> = 15 mA <sub>dc</sub> ) | t <sub>d</sub> | – | 15  | ns |
| Rise Time    |                                                                                                                                                                    | t <sub>r</sub> | – | 20  |    |
| Storage Time | (V <sub>CC</sub> = 30 V <sub>dc</sub> , I <sub>C</sub> = 150 mA <sub>dc</sub> ,<br>I <sub>B1</sub> = I <sub>B2</sub> = 15 mA <sub>dc</sub> )                       | t <sub>s</sub> | – | 225 | ns |
| Fall Time    |                                                                                                                                                                    | t <sub>f</sub> | – | 30  |    |

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

## SWITCHING TIME EQUIVALENT TEST CIRCUITS

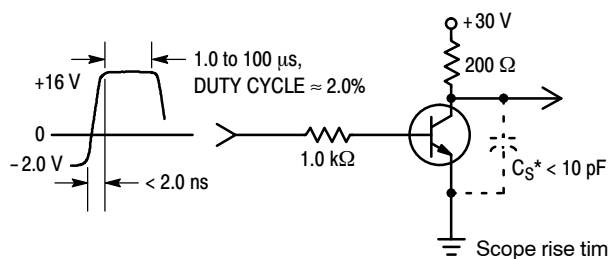


Figure 1. Turn–On Time

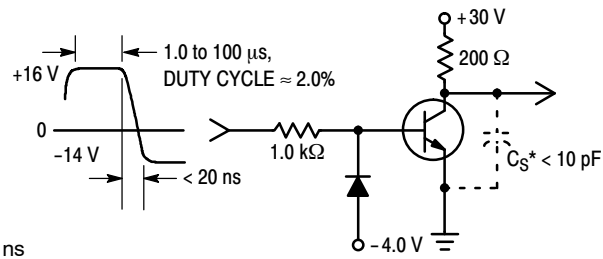


Figure 2. Turn–Off Time

# MMBT4401WT1G

## TRANSIENT CHARACTERISTICS

— 25°C — 100°C

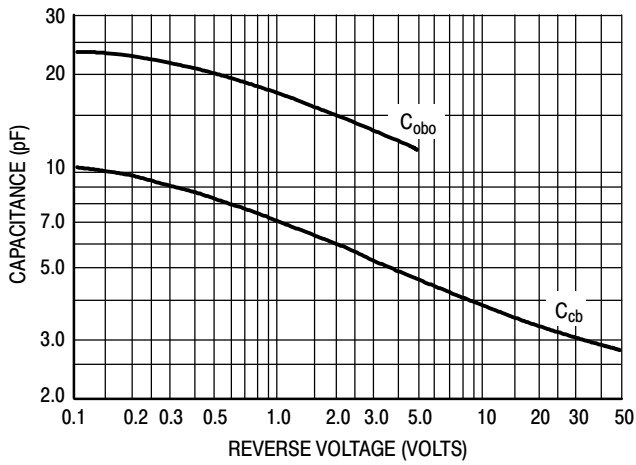


Figure 3. Capacitances

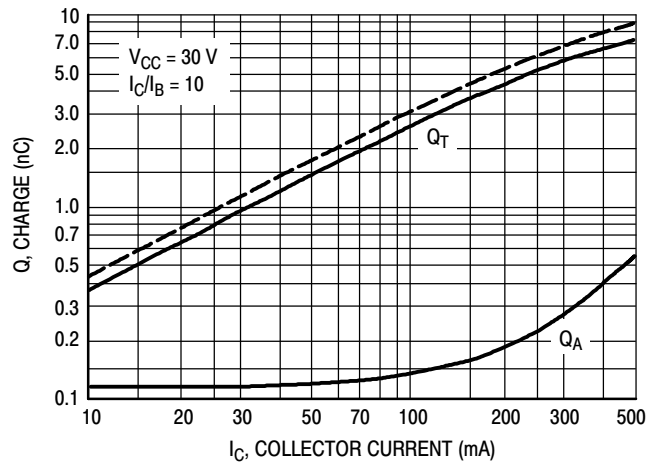


Figure 4. Charge Data

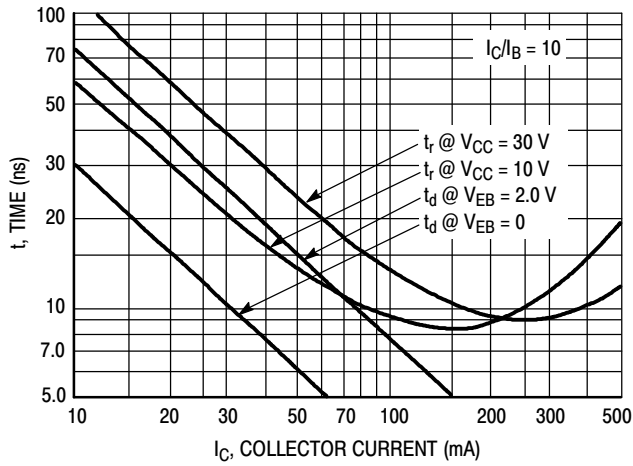


Figure 5. Turn-On Time

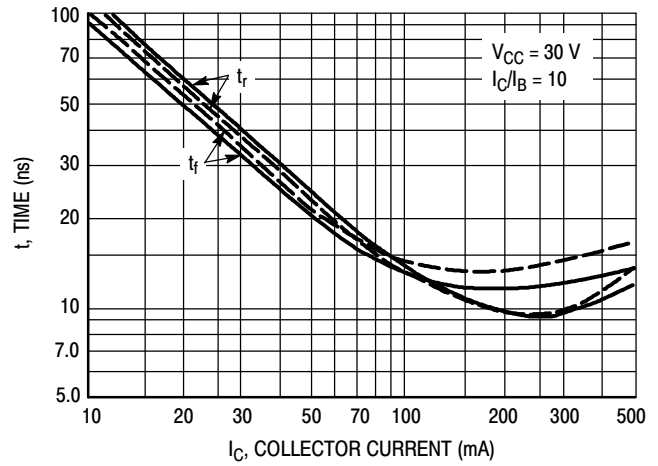


Figure 6. Rise and Fall Times

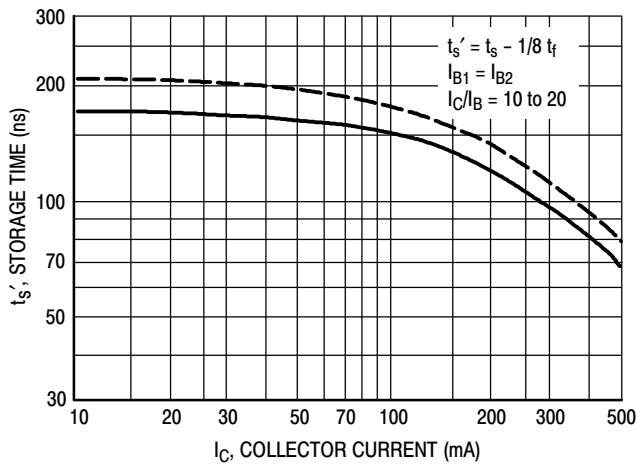


Figure 7. Storage Time

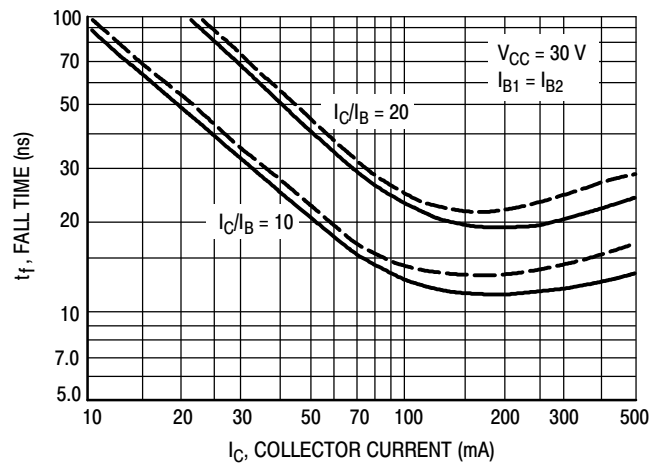


Figure 8. Fall Time

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## SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE

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

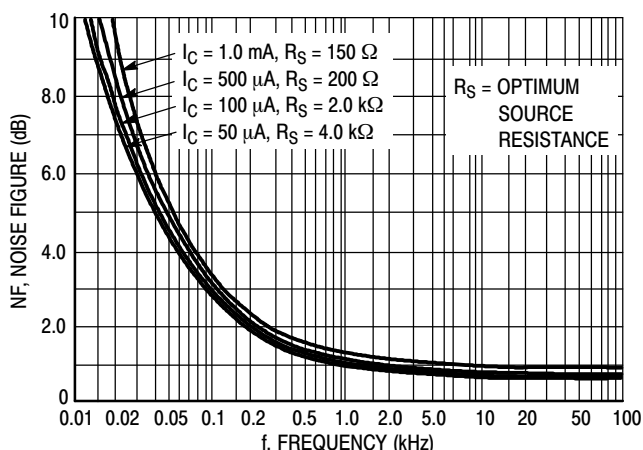


Figure 9. Frequency Effects

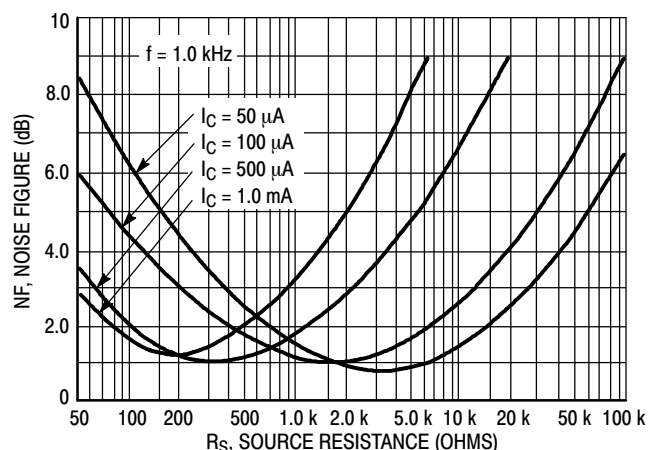


Figure 10. Source Resistance Effects

## h PARAMETERS

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

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.

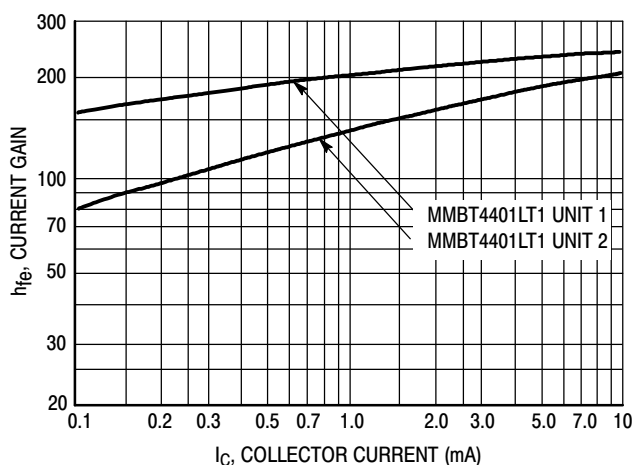


Figure 11. Current Gain

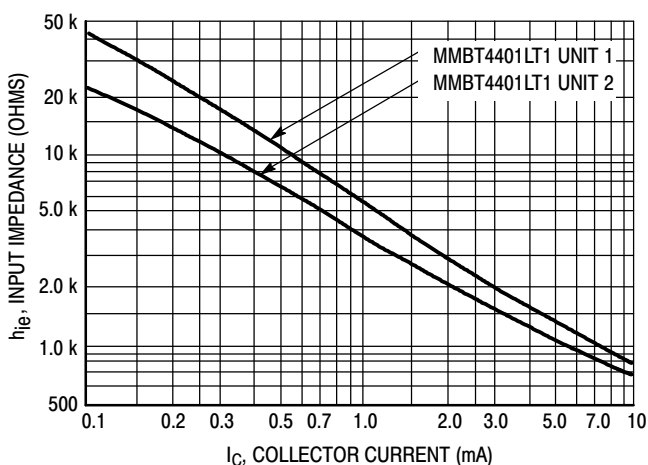


Figure 12. Input Impedance

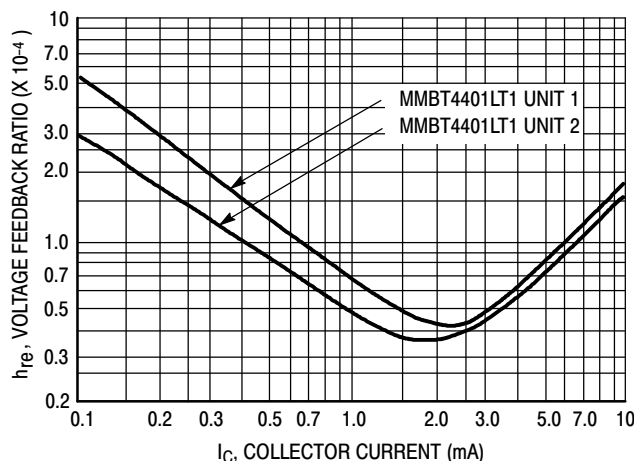


Figure 13. Voltage Feedback Ratio

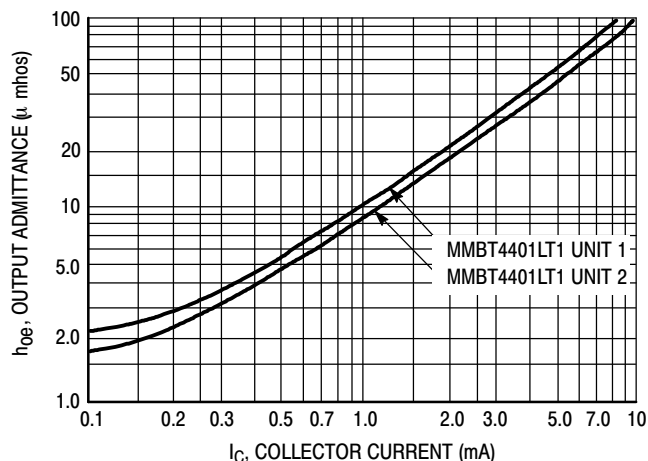


Figure 14. Output Admittance

# MMBT4401WT1G

## STATIC CHARACTERISTICS

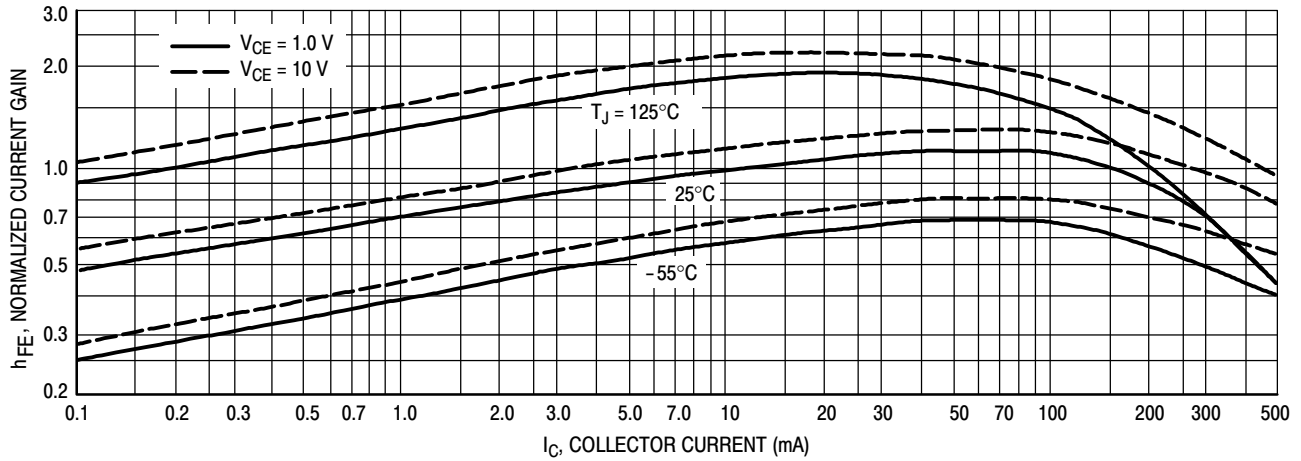


Figure 15. DC Current Gain

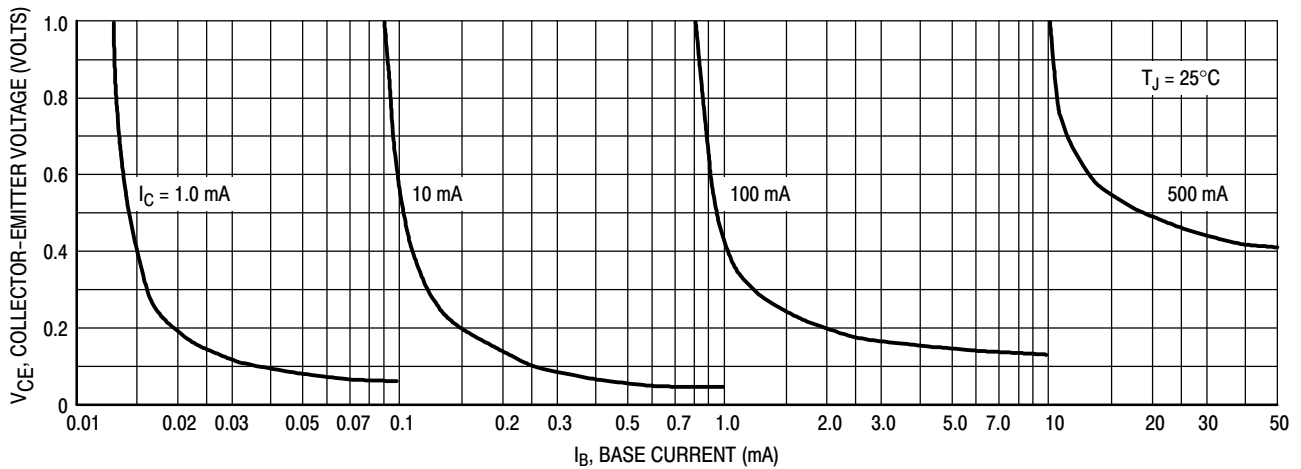


Figure 16. Collector Saturation Region

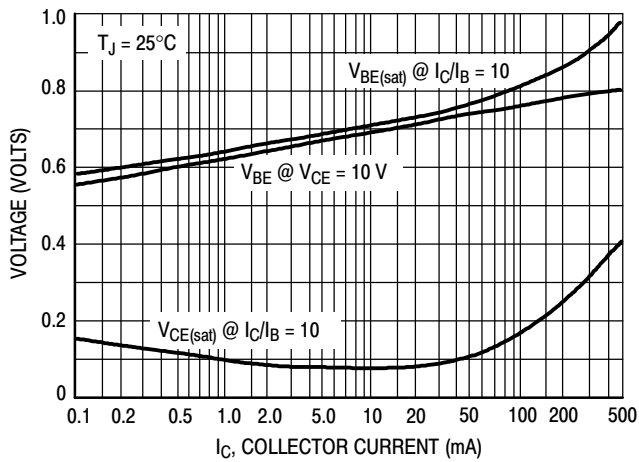


Figure 17. "On" Voltages

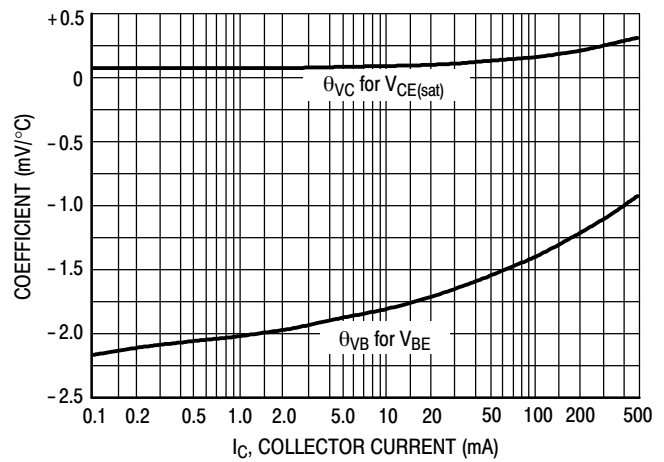
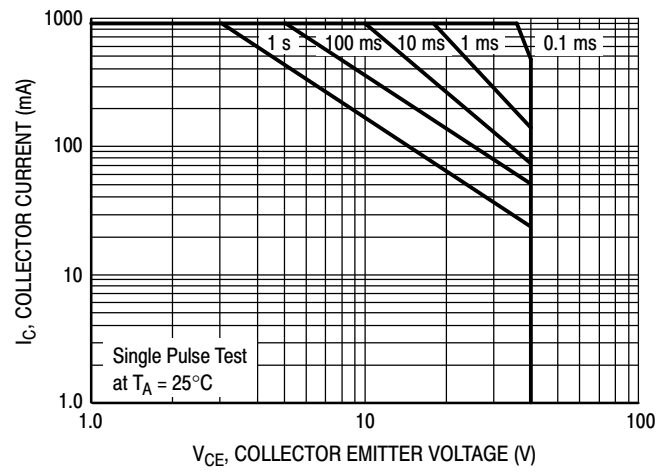


Figure 18. Temperature Coefficients

# MMBT4401WT1G

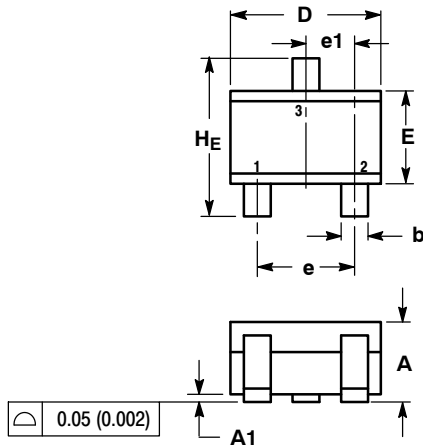


**Figure 19. Safe Operating Area**

# MMBT4401WT1G

## PACKAGE DIMENSIONS

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



#### NOTES:

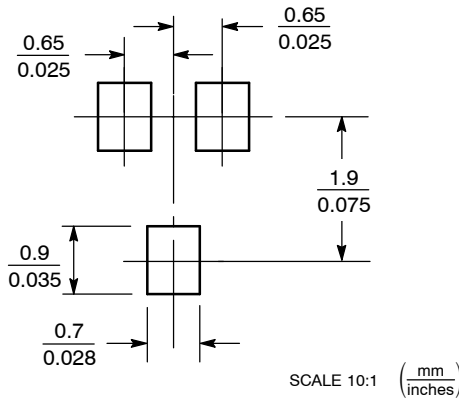
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

| 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 |
| He  | 2.00        | 2.10 | 2.40 | 0.079     | 0.083 | 0.095 |

#### STYLE 3:

- PIN 1. BASE
- EMITTER
- 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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MMBT4401WT1/D



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- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

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