

MMBT3904TT1G, SMMBT3904TT1G

General Purpose Transistors

NPN Silicon

This transistor is designed for general purpose amplifier applications. It is housed in the SOT-416/SC-75 package which is designed for low power surface mount applications.

Features

- S 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 (T_A = 25°C)

| 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 | 200 | mAdc |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|-----------------------------------|-------------|-------------|
| Total Device Dissipation, FR-4 Board (Note 1) @T _A = 25°C Derated above 25°C | P _D | 200 1.6 | mW mW/°C |
| Thermal Resistance, Junction-to-Ambient (Note 1) | R _{θJA} | 600 | °C/W |
| Total Device Dissipation, FR-4 Board (Note 2) @T _A = 25°C Derated above 25°C | P _D | 300 2.4 | mW mW/°C |
| Thermal Resistance, Junction-to-Ambient (Note 2) | R _{θJA} | 400 | °C/W |
| Junction and Storage Temperature Range | T _J , T _{stg} | -65 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.

1. FR-4 @ Minimum Pad
2. FR-4 @ 1.0 × 1.0 Inch Pad

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



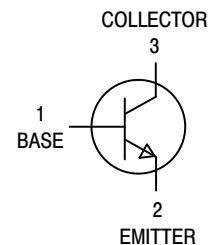
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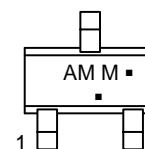
GENERAL PURPOSE AMPLIFIER TRANSISTORS SURFACE MOUNT



SOT-416/SC-75
CASE 463
STYLE 1



MARKING DIAGRAM



AM = Device Code
M = Date Code*
▪ = Pb-Free Package

(Note: Microdot may be in either location)

*Date Code orientation may vary depending upon manufacturing location.

ORDERING INFORMATION

| Device | Package | Shipping† |
|---------------|----------------------|-------------------|
| MMBT3904TT1G | SOT-416 (Pb-Free) | 3,000 Tape & Reel |
| SMMBT3904TT1G | SOT-416 (Pb-Free) | 3,000 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.

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

| Characteristic | Symbol | Min | Max | Unit |
|----------------|--------|-----|-----|------|
|----------------|--------|-----|-----|------|

OFF CHARACTERISTICS

| | | | | |
|---|----------------------|-----|----|------|
| Collector – Emitter Breakdown Voltage (Note 3) (I _C = 1.0 mA, I _B = 0) | V _{(BR)CEO} | 40 | – | Vdc |
| Collector – Base Breakdown Voltage (I _C = 10 μA, I _E = 0) | V _{(BR)CBO} | 60 | – | Vdc |
| Emitter – Base Breakdown Voltage (I _E = 10 μA, I _C = 0) | V _{(BR)EBO} | 6.0 | – | Vdc |
| Base Cutoff Current (V _{CE} = 30 Vdc, V _{EB} = 3.0 Vdc) | I _{BL} | – | 50 | nAdc |
| Collector Cutoff Current (V _{CE} = 30 Vdc, V _{EB} = 3.0 Vdc) | I _{CEX} | – | 50 | nAdc |

ON CHARACTERISTICS (Note 3)

| | | | | |
|---|----------------------|-----------------------------|-------------------------|-----|
| DC Current Gain (I _C = 0.1 mA, V _{CE} = 1.0 Vdc) (I _C = 1.0 mA, V _{CE} = 1.0 Vdc) (I _C = 10 mA, V _{CE} = 1.0 Vdc) (I _C = 50 mA, V _{CE} = 1.0 Vdc) (I _C = 100 mA, V _{CE} = 1.0 Vdc) | h _{FE} | 40 70 100 60 30 | – – 300 – – | – |
| Collector – Emitter Saturation Voltage (I _C = 10 mA, I _B = 1.0 mA) (I _C = 50 mA, I _B = 5.0 mA) | V _{CE(sat)} | – – | 0.2 0.3 | Vdc |
| Base – Emitter Saturation Voltage (I _C = 10 mA, I _B = 1.0 mA) (I _C = 50 mA, I _B = 5.0 mA) | V _{BE(sat)} | 0.65 – | 0.85 0.95 | Vdc |

SMALL – SIGNAL CHARACTERISTICS

| | | | | |
|---|------------------|-----|-----|--------------------|
| Current – Gain – Bandwidth Product (I _C = 10 mA, V _{CE} = 20 Vdc, f = 100 MHz) | f _T | 300 | – | MHz |
| Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz) | C _{obo} | – | 4.0 | pF |
| Input Capacitance (V _{EB} = 0.5 Vdc, I _C = 0, f = 1.0 MHz) | C _{ibo} | – | 8.0 | pF |
| Input Impedance (V _{CE} = 10 Vdc, I _C = 1.0 mA, f = 1.0 kHz) | h _{ie} | 1.0 | 10 | k Ω |
| Voltage Feedback Ratio (V _{CE} = 10 Vdc, I _C = 1.0 mA, f = 1.0 kHz) | h _{re} | 0.5 | 8.0 | X 10 ⁻⁴ |
| Small – Signal Current Gain (V _{CE} = 10 Vdc, I _C = 1.0 mA, f = 1.0 kHz) | h _{fe} | 100 | 400 | – |
| Output Admittance (V _{CE} = 10 Vdc, I _C = 1.0 mA, f = 1.0 kHz) | h _{oe} | 1.0 | 40 | μmhos |
| Noise Figure (V _{CE} = 5.0 Vdc, I _C = 100 μA, R _S = 1.0 k Ω, f = 1.0 kHz) | NF | – | 5.0 | dB |

SWITCHING CHARACTERISTICS

| | | | | |
|--|----------------|---|-----|----|
| Delay Time (V _{CC} = 3.0 Vdc, V _{BE} = –0.5 Vdc) MMBT3904TT1G, SMMBT3904TT1G | t _d | – | 35 | ns |
| Rise Time (I _C = 10 mA, I _{B1} = 1.0 mA) MMBT3904TT1G, SMMBT3904TT1G | t _r | – | 35 | |
| Storage Time (V _{CC} = 3.0 Vdc, I _C = 10 mA) MMBT3904TT1G, SMMBT3904TT1G | t _s | – | 200 | |
| Fall Time (I _{B1} = I _{B2} = 1.0 mA) MMBT3904TT1G, SMMBT3904TT1G | t _f | – | 50 | |

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

MMBT3904TT1G, SMMBT3904TT1G

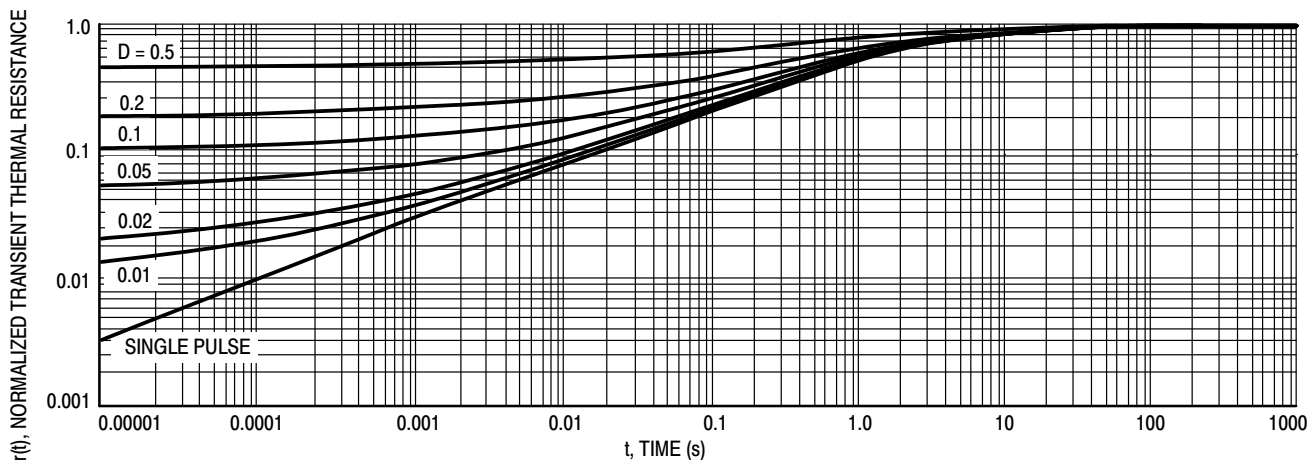


Figure 1. Normalized Thermal Response

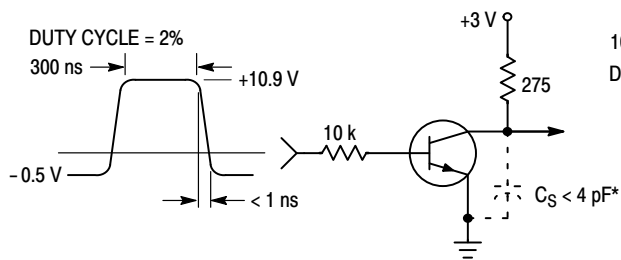


Figure 2. Delay and Rise Time Equivalent Test Circuit

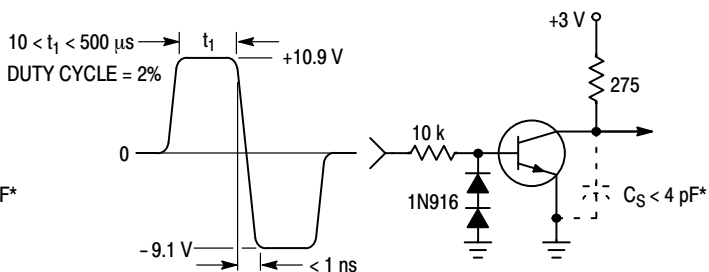


Figure 3. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

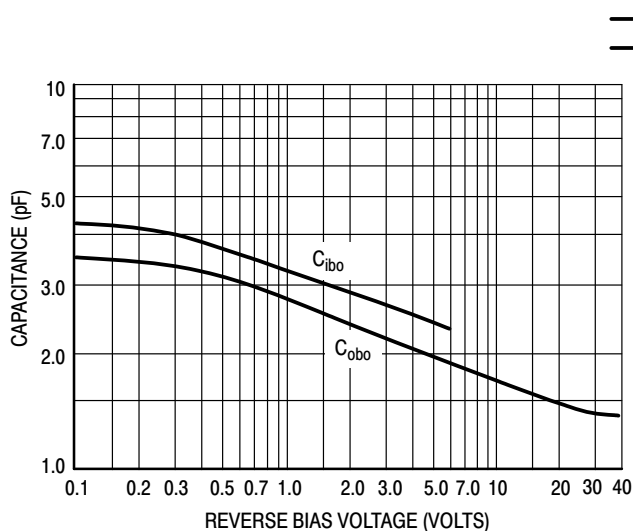


Figure 4. Capacitance

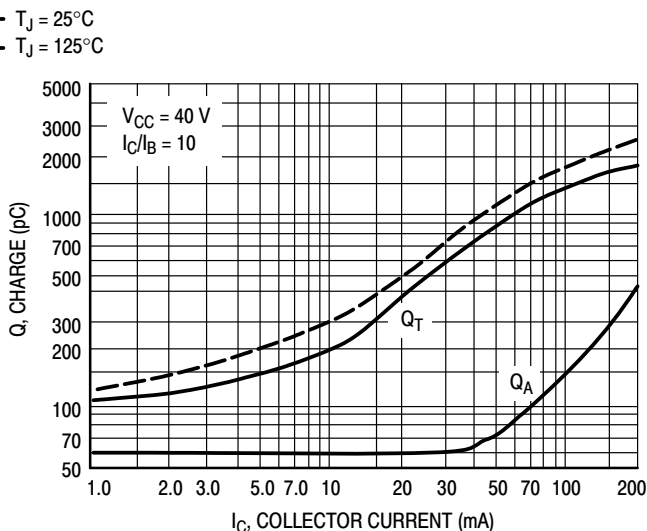


Figure 5. Charge Data

MMBT3904TT1G, SMMBT3904TT1G

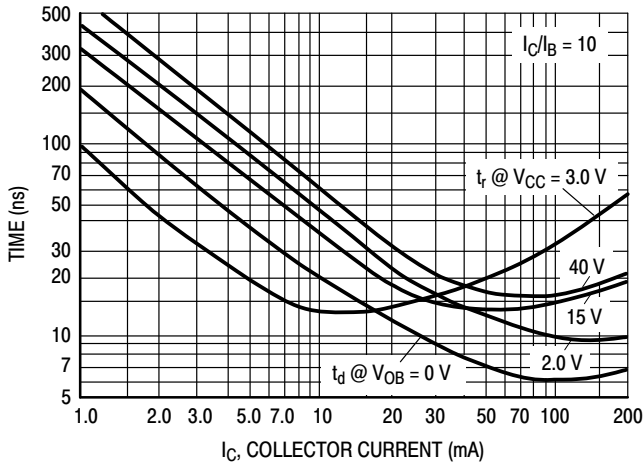


Figure 6. Turn-On Time

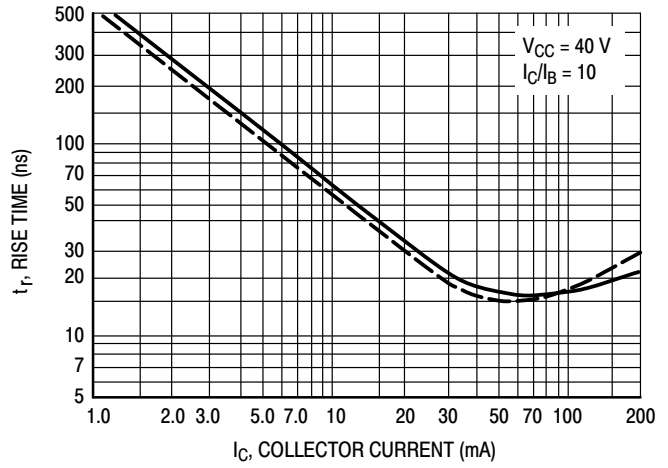


Figure 7. Rise Time

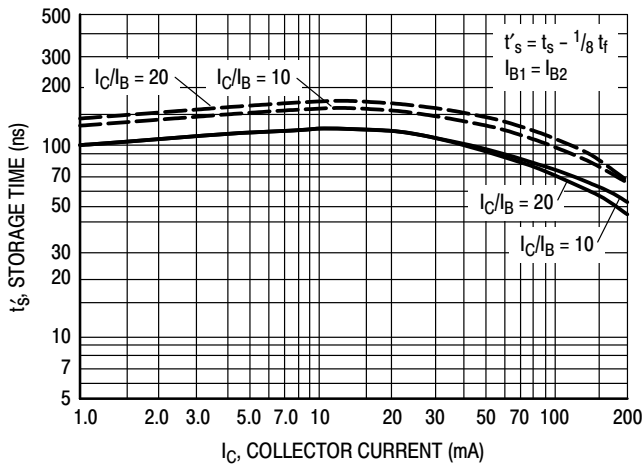


Figure 8. Storage Time

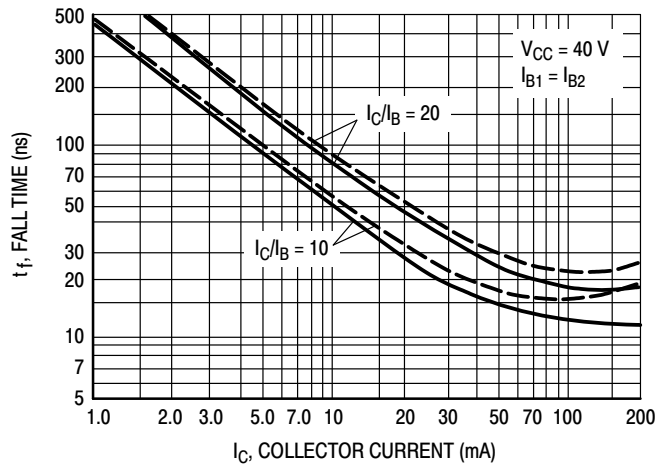


Figure 9. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

($V_{CE} = 5.0$ Vdc, $T_A = 25^\circ\text{C}$, Bandwidth = 1.0 Hz)

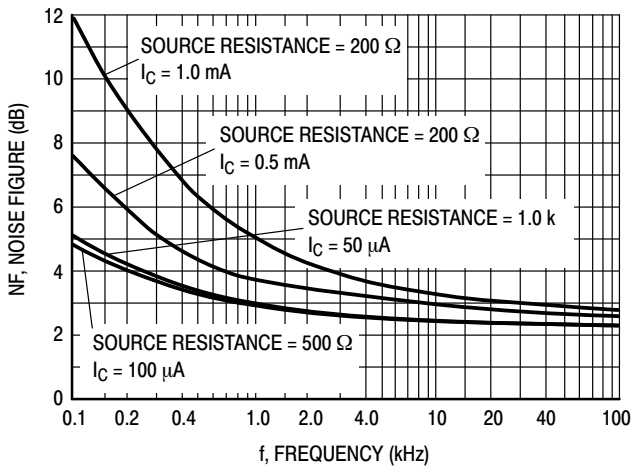


Figure 10. Noise Figure

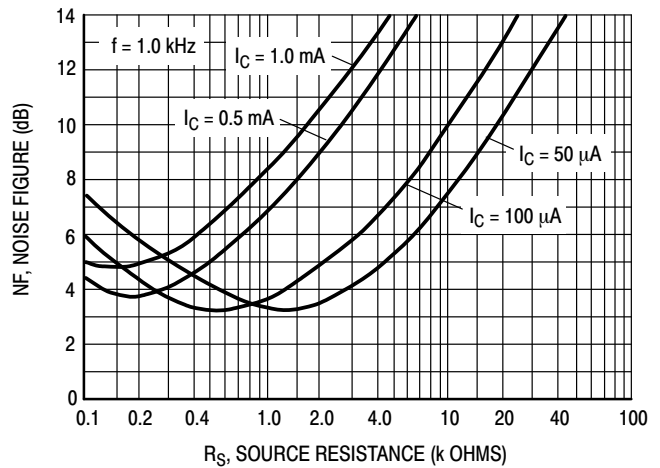


Figure 11. Noise Figure

MMBT3904TT1G, SMMBT3904TT1G

h PARAMETERS

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

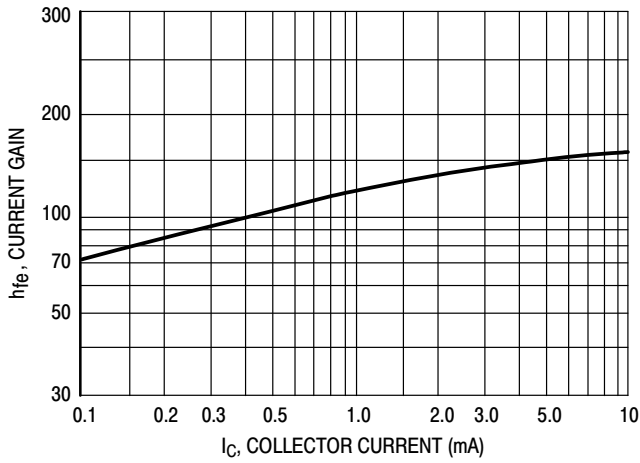


Figure 12. Current Gain

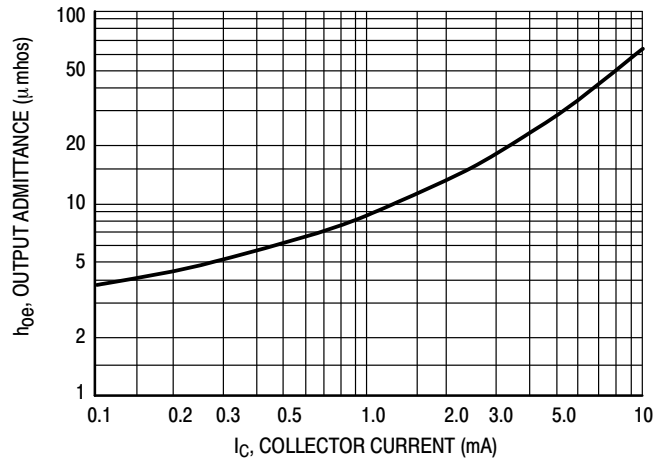


Figure 13. Output Admittance

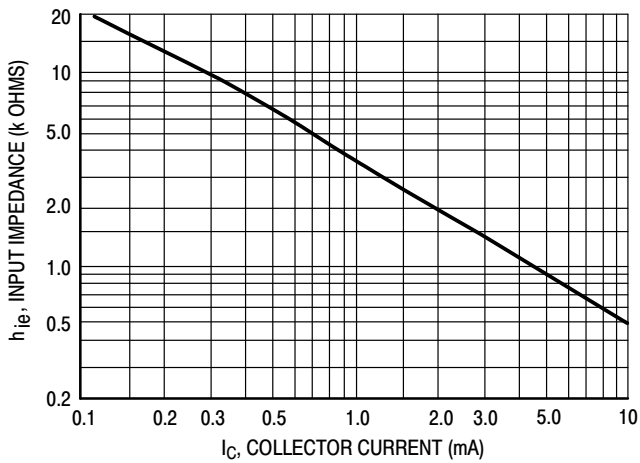


Figure 14. Input Impedance

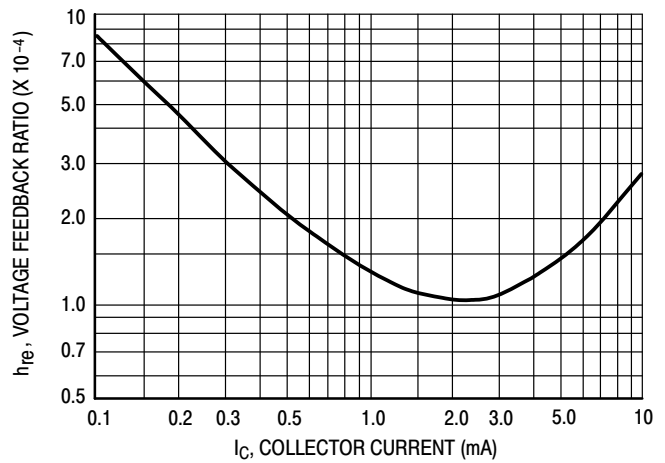


Figure 15. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

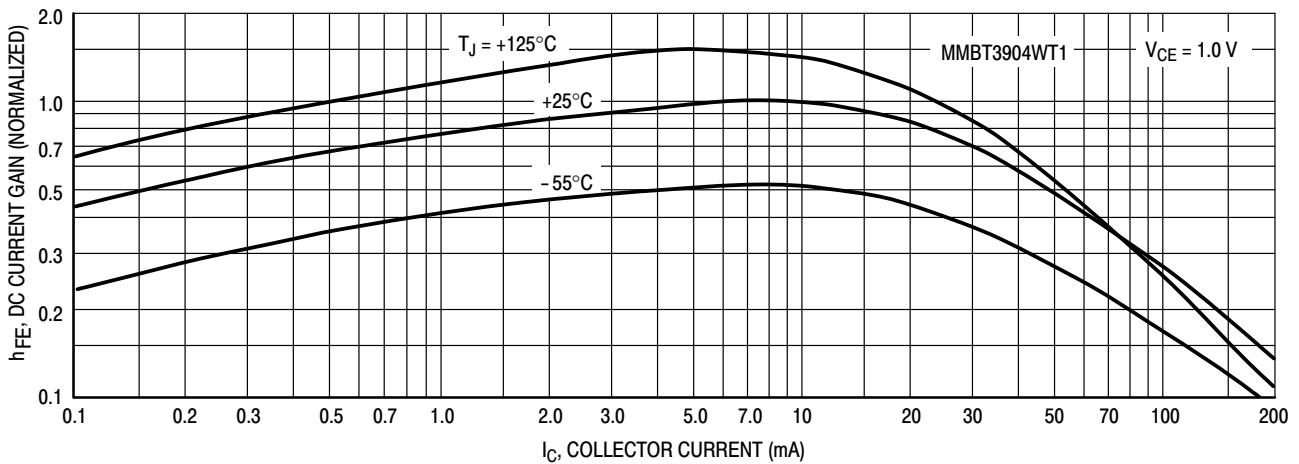


Figure 16. DC Current Gain

MMBT3904TT1G, SMMBT3904TT1G

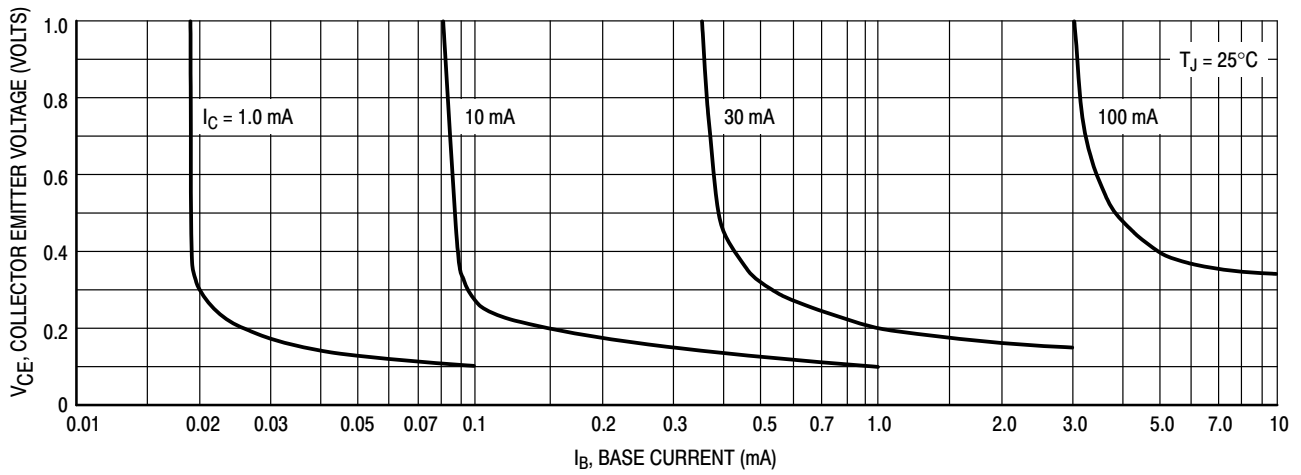


Figure 17. Collector Saturation Region

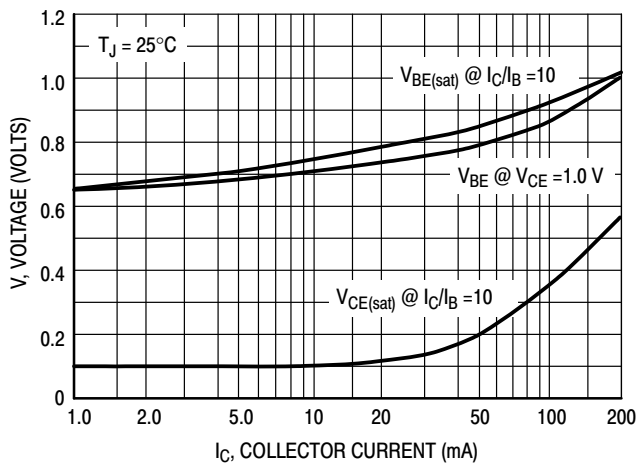


Figure 18. "ON" Voltages

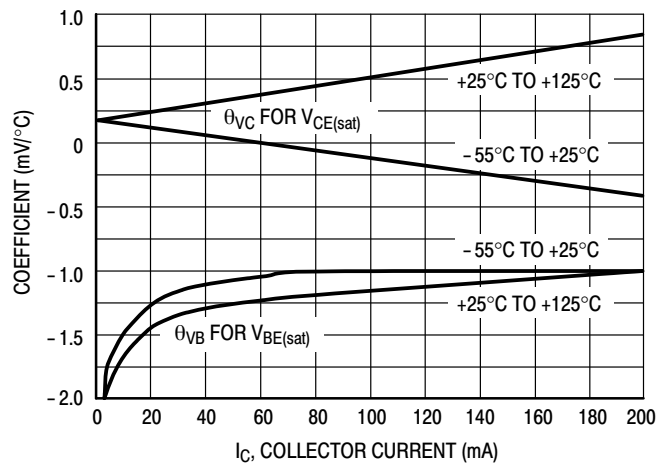
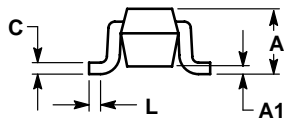
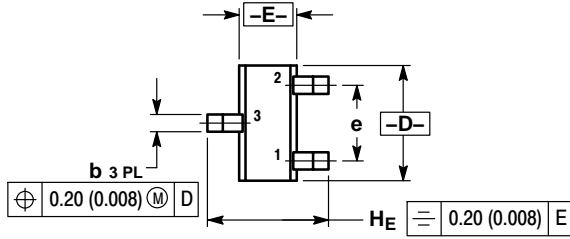


Figure 19. Temperature Coefficients

MMBT3904TT1G, SMMBT3904TT1G

PACKAGE DIMENSIONS

SC-75/SOT-416
CASE 463
ISSUE G



NOTES:

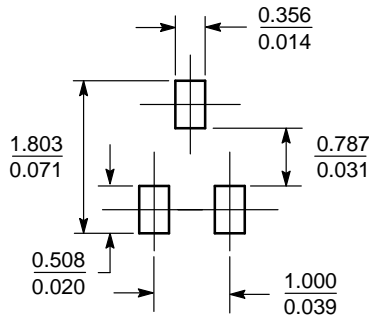
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

| DIM | MILLIMETERS | | | INCHES | | |
|----------------|-------------|------|------|----------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.70 | 0.80 | 0.90 | 0.027 | 0.031 | 0.035 |
| A1 | 0.00 | 0.05 | 0.10 | 0.000 | 0.002 | 0.004 |
| b | 0.15 | 0.20 | 0.30 | 0.006 | 0.008 | 0.012 |
| C | 0.10 | 0.15 | 0.25 | 0.004 | 0.006 | 0.010 |
| D | 1.55 | 1.60 | 1.65 | 0.061 | 0.063 | 0.065 |
| E | 0.70 | 0.80 | 0.90 | 0.027 | 0.031 | 0.035 |
| e | 1.00 BSC | | | 0.04 BSC | | |
| L | 0.10 | 0.15 | 0.20 | 0.004 | 0.006 | 0.008 |
| H _E | 1.50 | 1.60 | 1.70 | 0.060 | 0.063 | 0.067 |

STYLE 1:

- PIN 1. BASE
- EMITTER
- COLLECTOR

SOLDERING FOOTPRINT*



SCALE 10:1 ($\frac{\text{mm}}{\text{inches}}$)

*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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