

General Purpose Transistors

NPN and PNP Silicon

MMBT3904WT1G, NPN, SMMBT3904WT1G, NPN, MMBT3906WT1G, PNP, SMMBT3906WT1G, PNP

These transistors are designed for general purpose amplifier applications. They are housed in the SOT-323/SC-70 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

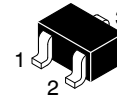
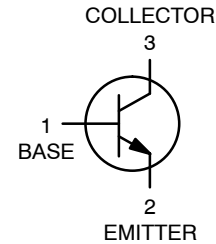
| Rating | Symbol | Value | Unit |
|--|-----------|-------------|------|
| Collector - Emitter Voltage MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1 | V_{CEO} | 40 -40 | Vdc |
| Collector - Base Voltage MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1 | V_{CBO} | 60 -40 | Vdc |
| Emitter - Base Voltage MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1 | V_{EBO} | 6.0 -5.0 | Vdc |
| Collector Current - Continuous MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1 | I_C | 200 -200 | mAdc |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|-----------------|-------------|---------------------------|
| Total Device Dissipation (Note 1) @ $T_A = 25^\circ\text{C}$ | P_D | 150 | mW |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 833 | $^\circ\text{C}/\text{W}$ |
| Junction and Storage Temperature | T_J, T_{stg} | -55 to +150 | $^\circ\text{C}$ |

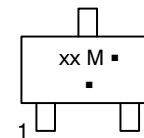
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Device mounted on FR4 glass epoxy printed circuit board using the minimum recommended footprint.



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

MARKING DIAGRAM



- xx = AM for MMBT3904WT1,
SMMBT3904WT
= 2A for MMBT3906WT1,
SMMBT3906WT1
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† |
|--------------------------------|--------------------------------|-----------------------|
| MMBT3904WT1G, SMMBT3904WT1G | SC-70/ SOT-323 (Pb-Free) | 3000 / Tape & Reel |
| MMBT3906WT1G, SMMBT3906WT1G | SC-70/ SOT-323 (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.

**MMBT3904WT1G, NPN, SMMBT3904WT1G, NPN, MMBT3906WT1G, PNP,
SMMBT3906WT1G, PNP**

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

| Characteristic | Symbol | Min | Max | Unit | |
|---|--|---------------|--|--|------|
| OFF CHARACTERISTICS | | | | | |
| Collector – Emitter Breakdown Voltage (Note 2) ($I_C = 1.0\text{ mAdc}$, $I_B = 0$) ($I_C = -1.0\text{ mAdc}$, $I_B = 0$) | MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1 | $V_{(BR)CEO}$ | 40 -40 | - - | Vdc |
| Collector – Base Breakdown Voltage ($I_C = 10\ \mu\text{Adc}$, $I_E = 0$) ($I_C = -10\ \mu\text{Adc}$, $I_E = 0$) | MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1 | $V_{(BR)CBO}$ | 60 -40 | - - | Vdc |
| Emitter – Base Breakdown Voltage ($I_E = 10\ \mu\text{Adc}$, $I_C = 0$) ($I_E = -10\ \mu\text{Adc}$, $I_C = 0$) | MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1 | $V_{(BR)EBO}$ | 6.0 -5.0 | - - | Vdc |
| Base Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $V_{EB} = 3.0\text{ Vdc}$) ($V_{CE} = -30\text{ Vdc}$, $V_{EB} = -3.0\text{ Vdc}$) | MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1 | I_{BL} | - - | 50 -50 | nAdc |
| Collector Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $V_{EB} = 3.0\text{ Vdc}$) ($V_{CE} = -30\text{ Vdc}$, $V_{EB} = -3.0\text{ Vdc}$) | MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1 | I_{CEX} | - - | 50 -50 | nAdc |
| ON CHARACTERISTICS (Note 2) | | | | | |
| DC Current Gain ($I_C = 0.1\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 1.0\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 10\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 50\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 100\text{ mAdc}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = -0.1\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$) ($I_C = -1.0\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$) ($I_C = -10\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$) ($I_C = -50\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$) ($I_C = -100\text{ mAdc}$, $V_{CE} = -1.0\text{ Vdc}$) | MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1 | h_{FE} | 40 70 100 60 30 60 80 100 60 30 | - - 300 - - - - 300 - - | - |
| Collector – Emitter Saturation Voltage ($I_C = 10\text{ mAdc}$, $I_B = 1.0\text{ mAdc}$) ($I_C = 50\text{ mAdc}$, $I_B = 5.0\text{ mAdc}$) ($I_C = -10\text{ mAdc}$, $I_B = -1.0\text{ mAdc}$) ($I_C = -50\text{ mAdc}$, $I_B = -5.0\text{ mAdc}$) | MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1 | $V_{CE(sat)}$ | - - - - | 0.2 0.3 -0.25 -0.4 | Vdc |
| Base – Emitter Saturation Voltage ($I_C = 10\text{ mAdc}$, $I_B = 1.0\text{ mAdc}$) ($I_C = 50\text{ mAdc}$, $I_B = 5.0\text{ mAdc}$) ($I_C = -10\text{ mAdc}$, $I_B = -1.0\text{ mAdc}$) ($I_C = -50\text{ mAdc}$, $I_B = -5.0\text{ mAdc}$) | MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1 | $V_{BE(sat)}$ | 0.65 - -0.65 - | 0.85 0.95 -0.85 -0.95 | Vdc |

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

**MMBT3904WT1G, NPN, SMMBT3904WT1G, NPN, MMBT3906WT1G, PNP,
SMMBT3906WT1G, PNP**

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

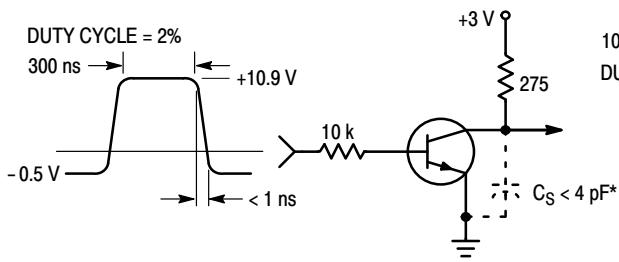
| Characteristic | Symbol | Min | Max | Unit |
|--|-----------|------------|-------------|------------------|
| SMALL-SIGNAL CHARACTERISTICS | | | | |
| Current-Gain – Bandwidth Product ($I_C = 10\text{ mAdc}$, $V_{CE} = 20\text{ Vdc}$, $f = 100\text{ MHz}$) ($I_C = -10\text{ mAdc}$, $V_{CE} = -20\text{ Vdc}$, $f = 100\text{ MHz}$) | f_T | 300 250 | – – | MHz |
| Output Capacitance ($V_{CB} = 5.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$) ($V_{CB} = -5.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$) | C_{obo} | – – | 4.0 4.5 | pF |
| Input Capacitance ($V_{EB} = 0.5\text{ Vdc}$, $I_C = 0$, $f = 1.0\text{ MHz}$) ($V_{EB} = -0.5\text{ Vdc}$, $I_C = 0$, $f = 1.0\text{ MHz}$) | C_{ibo} | – – | 8.0 10.0 | pF |
| Input Impedance ($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) ($V_{CE} = -10\text{ Vdc}$, $I_C = -1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) | h_{ie} | 1.0 2.0 | 10 12 | k Ω |
| Voltage Feedback Ratio ($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) ($V_{CE} = -10\text{ Vdc}$, $I_C = -1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) | h_{re} | 0.5 0.1 | 8.0 10 | $\times 10^{-4}$ |
| Small-Signal Current Gain ($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) ($V_{CE} = -10\text{ Vdc}$, $I_C = -1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) | h_{fe} | 100 100 | 400 400 | – |
| Output Admittance ($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) ($V_{CE} = -10\text{ Vdc}$, $I_C = -1.0\text{ mAdc}$, $f = 1.0\text{ kHz}$) | h_{oe} | 1.0 3.0 | 40 60 | μmhos |
| Noise Figure ($V_{CE} = 5.0\text{ Vdc}$, $I_C = 100\text{ }\mu\text{Adc}$, $R_S = 1.0\text{ k}\Omega$, $f = 1.0\text{ kHz}$) ($V_{CE} = -5.0\text{ Vdc}$, $I_C = -100\text{ }\mu\text{Adc}$, $R_S = 1.0\text{ k}\Omega$, $f = 1.0\text{ kHz}$) | NF | – – | 5.0 4.0 | dB |

SWITCHING CHARACTERISTICS

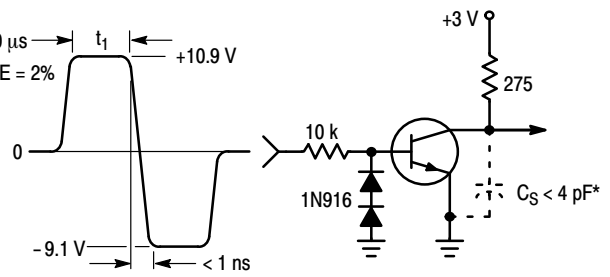
| Characteristic | Condition | Symbol | Min | Max | Unit |
|----------------|--|--------|--------|------------|------|
| Delay Time | ($V_{CC} = 3.0\text{ Vdc}$, $V_{BE} = -0.5\text{ Vdc}$) MMBT3904WT1, SMMBT3904WT1 ($V_{CC} = -3.0\text{ Vdc}$, $V_{BE} = 0.5\text{ Vdc}$) MMBT3906WT1, SMMBT3906WT1 | t_d | – – | 35 35 | ns |
| Rise Time | ($I_C = 10\text{ mAdc}$, $I_{B1} = 1.0\text{ mAdc}$) MMBT3904WT1, SMMBT3904WT1 ($I_C = -10\text{ mAdc}$, $I_{B1} = -1.0\text{ mAdc}$) MMBT3906WT1, SMMBT3906WT1 | t_r | – – | 35 35 | ns |
| Storage Time | ($V_{CC} = 3.0\text{ Vdc}$, $I_C = 10\text{ mAdc}$) MMBT3904WT1, SMMBT3904WT1 ($V_{CC} = -3.0\text{ Vdc}$, $I_C = -10\text{ mAdc}$) MMBT3906WT1, SMMBT3906WT1 | t_s | – – | 200 225 | ns |
| Fall Time | ($I_{B1} = I_{B2} = 1.0\text{ mAdc}$) MMBT3904WT1, SMMBT3904WT1 ($I_{B1} = I_{B2} = -1.0\text{ mAdc}$) MMBT3906WT1, SMMBT3906WT1 | t_f | – – | 50 75 | ns |

**MMBT3904WT1G, NPN, SMMBT3904WT1G, NPN, MMBT3906WT1G, PNP,
SMMBT3906WT1G, PNP**

MMBT3904WT1, SMMBT3904WT1



$10 < t_1 < 500 \mu\text{s}$
DUTY CYCLE = 2%



* Total shunt capacitance of test jig and connectors

**Figure 1. Delay and Rise Time
Equivalent Test Circuit**

**Figure 2. Storage and Fall Time
Equivalent Test Circuit**

MMBT3904WT1G, NPN, SMMBT3904WT1G, NPN, MMBT3906WT1G, PNP, SMMBT3906WT1G, PNP

MMBT3904WT1, SMMBT3904WT1

TYPICAL TRANSIENT CHARACTERISTICS

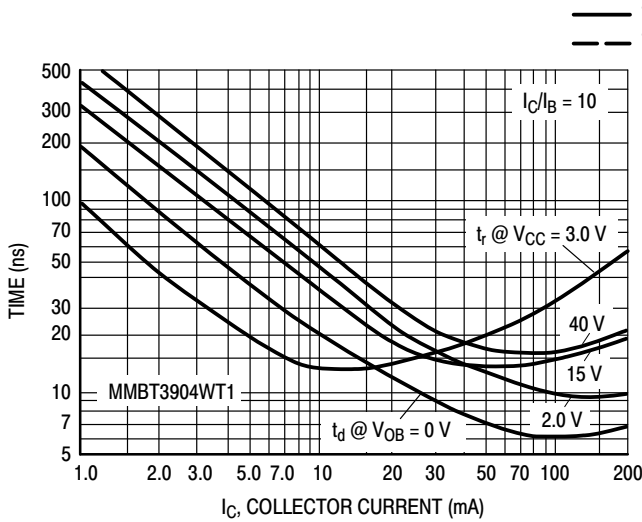


Figure 3. Turn-On Time

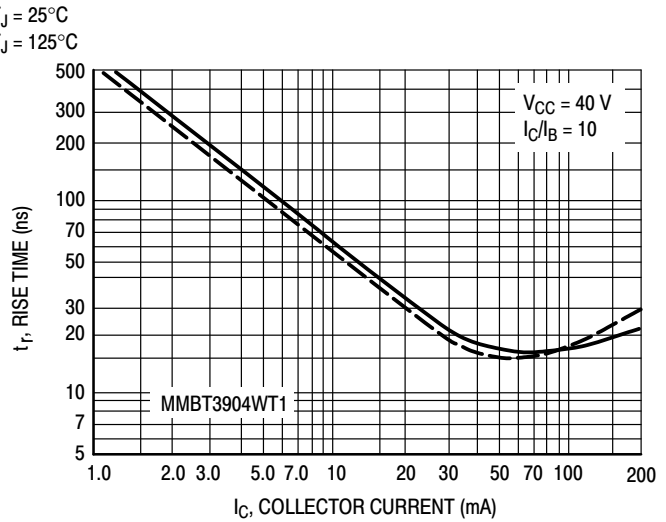


Figure 4. Rise Time

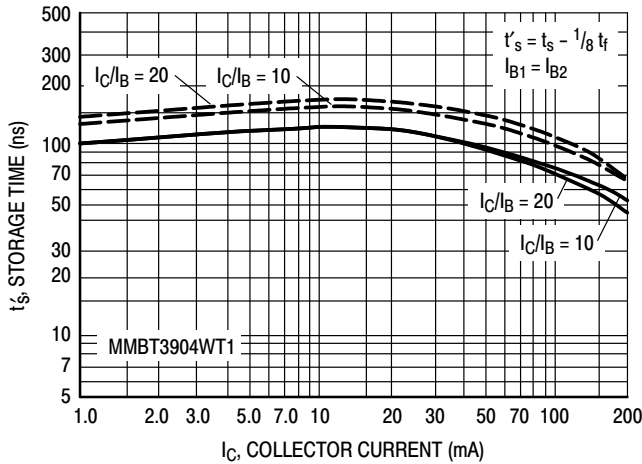


Figure 5. Storage Time

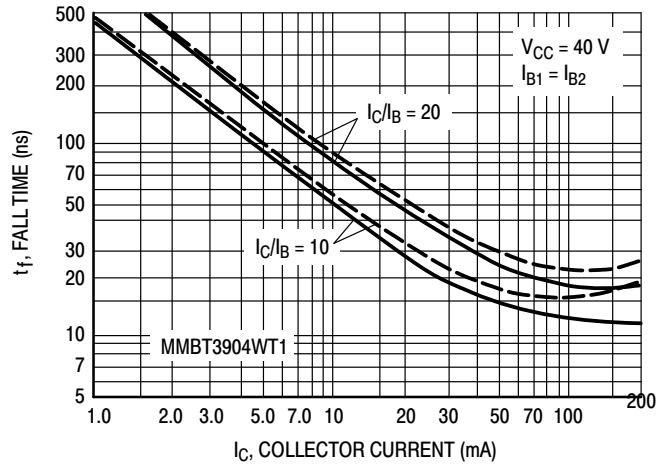


Figure 6. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

($V_{CE} = 5.0$ VDC, $T_A = 25^\circ\text{C}$, BANDWIDTH = 1.0 HZ)

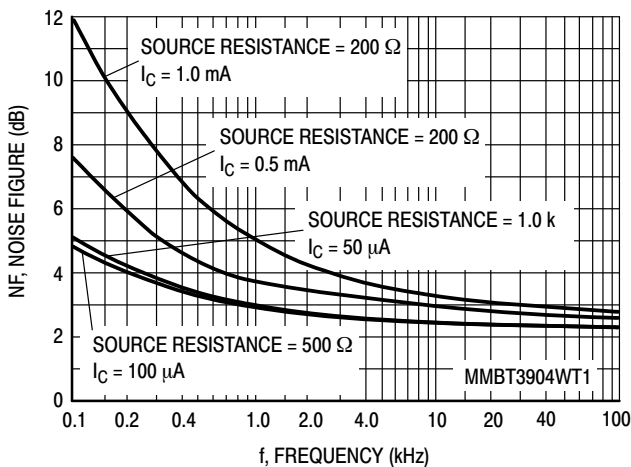


Figure 7. Noise Figure

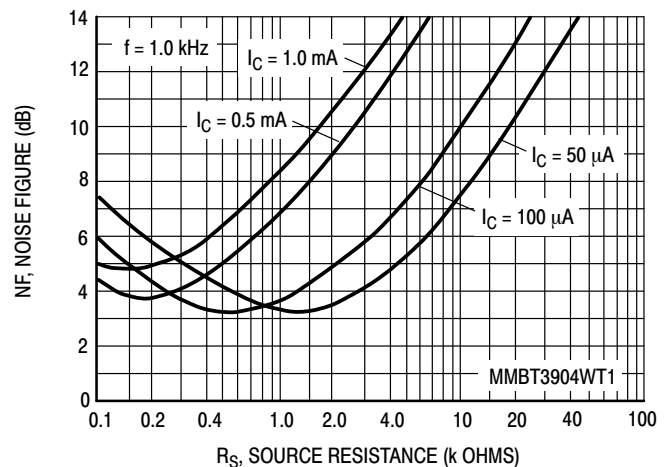


Figure 8. Noise Figure

MMBT3904WT1G, NPN, SMMBT3904WT1G, NPN, MMBT3906WT1G, PNP, SMMBT3906WT1G, PNP

MMBT3904WT1, SMMBT3904WT1

H PARAMETERS

($V_{CE} = 10 \text{ VDC}$, $F = 1.0 \text{ KHZ}$, $T_A = 25^\circ\text{C}$)

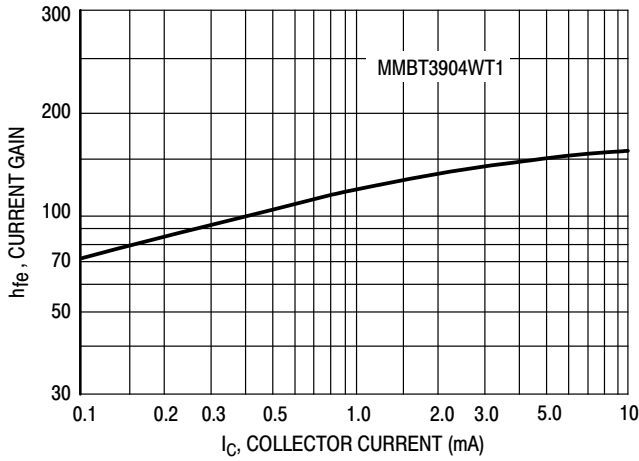


Figure 9. Current Gain

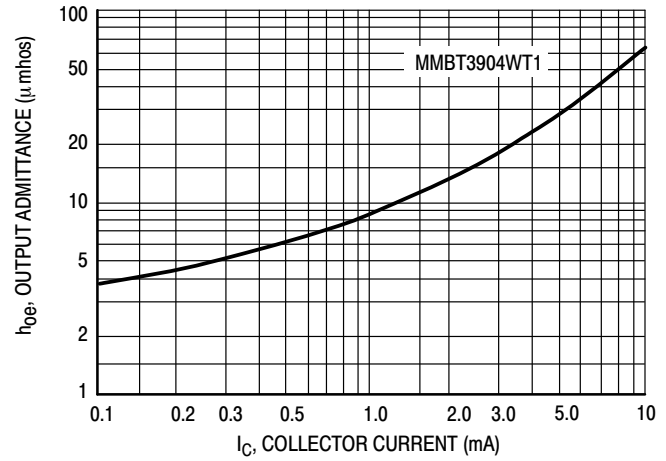


Figure 10. Output Admittance

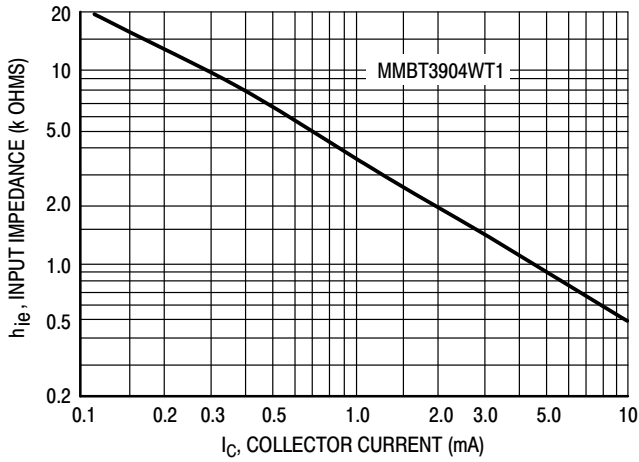


Figure 11. Input Impedance

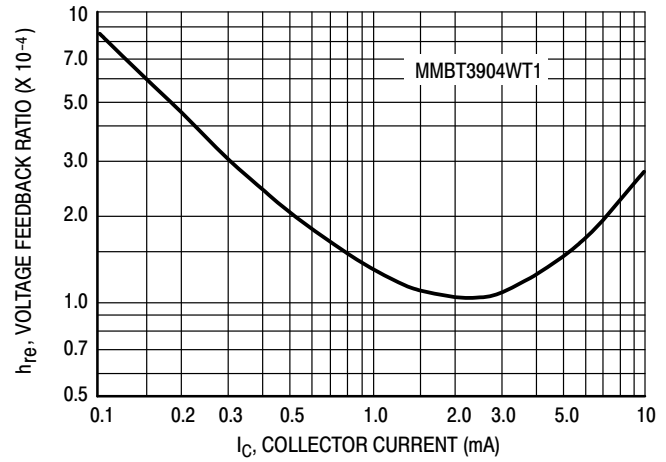


Figure 12. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

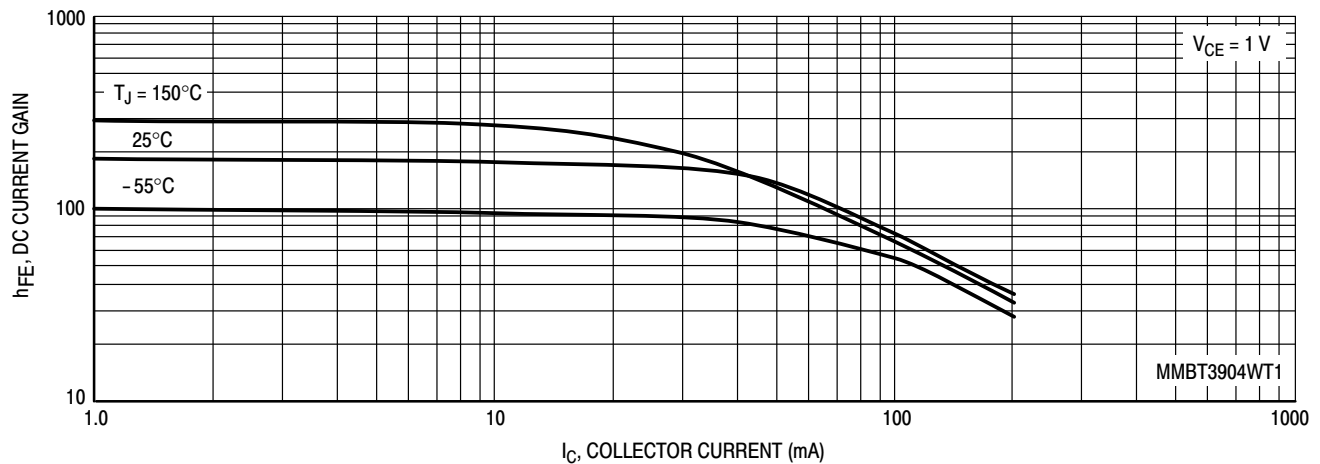


Figure 13. DC Current Gain

MMBT3904WT1G, NPN, SMMBT3904WT1G, NPN, MMBT3906WT1G, PNP,
SMMBT3906WT1G, PNP

MMBT3904WT1, SMMBT3904WT1

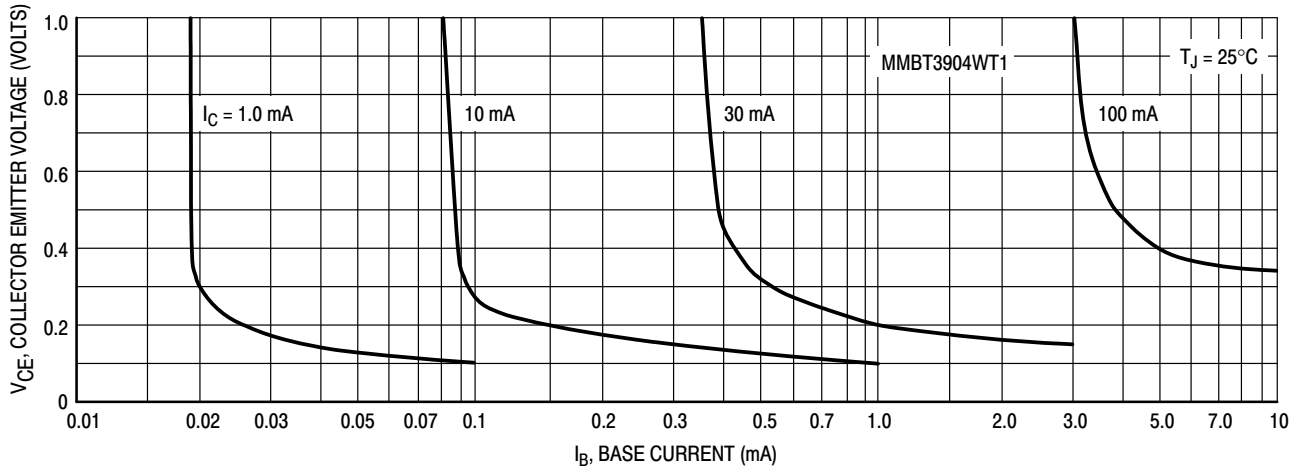


Figure 14. Collector Saturation Region

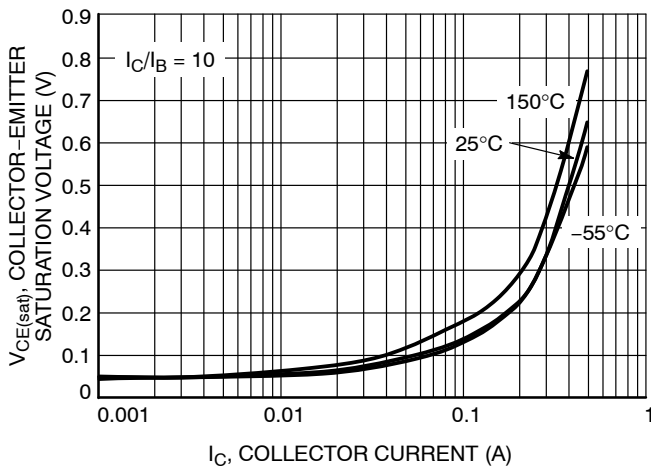


Figure 15. Collector-Emitter Saturation Voltage vs. Collector Current

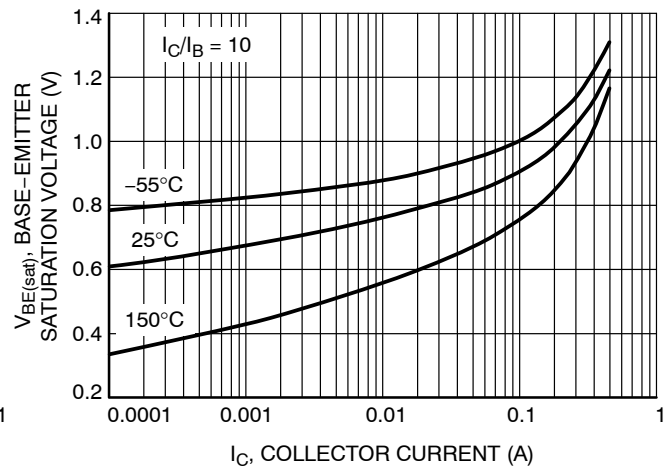


Figure 16. Base-Emitter Saturation Voltage vs. Collector Current

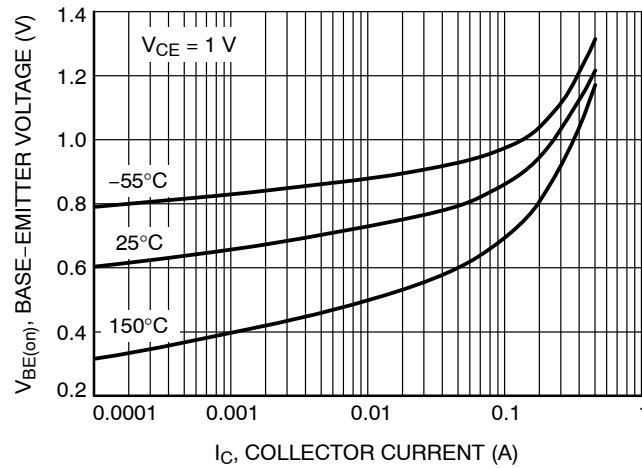


Figure 17. Base-Emitter Voltage vs. Collector Current

MMBT3904WT1G, NPN, SMMBT3904WT1G, NPN, MMBT3906WT1G, PNP, SMMBT3906WT1G, PNP

MMBT3904WT1, SMMBT3904WT1

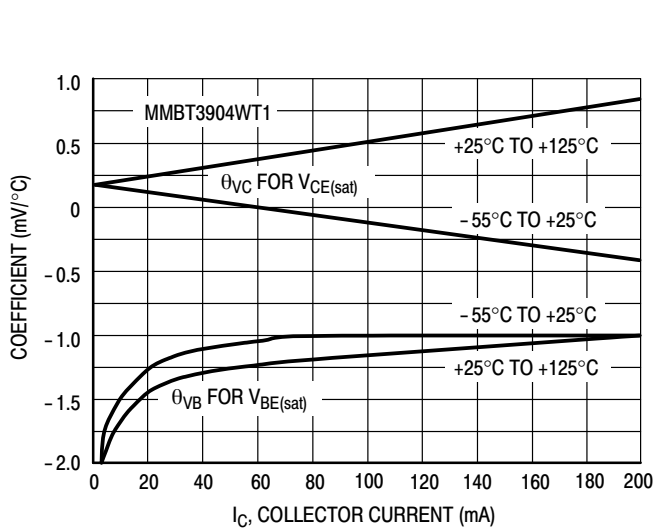


Figure 18. Temperature Coefficients

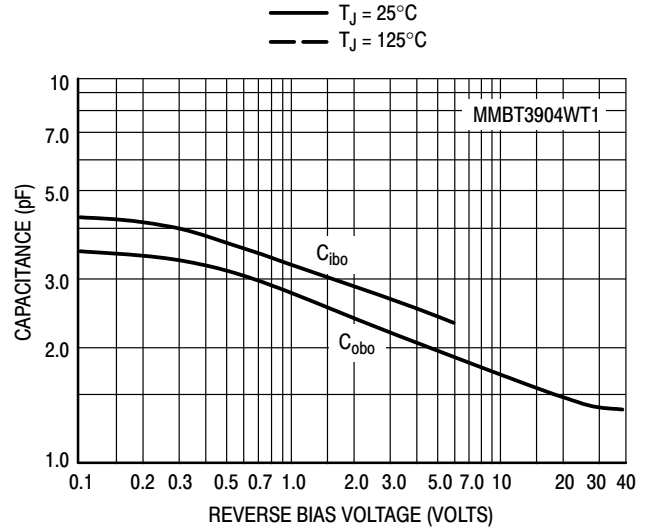


Figure 19. Capacitance

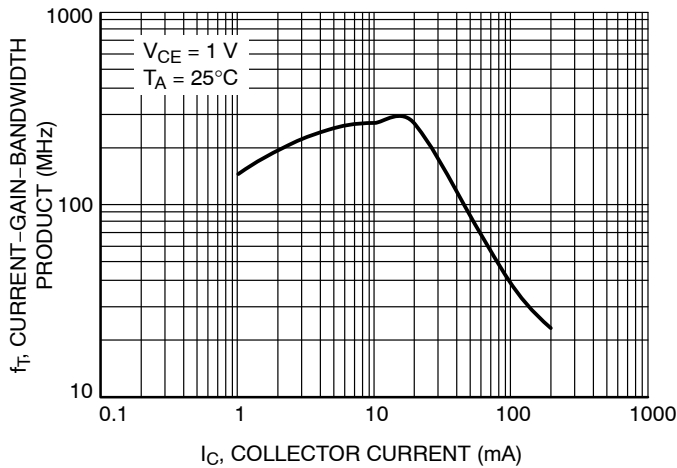


Figure 20. Current Gain Bandwidth Product vs. Collector Current

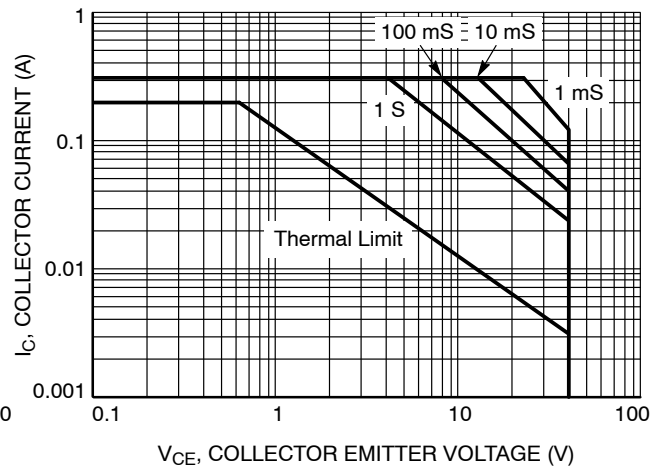


Figure 21. Safe Operating Area

MMBT3904WT1G, NPN, SMMBT3904WT1G, NPN, MMBT3906WT1G, PNP, SMMBT3906WT1G, PNP

MMBT3906WT1, SMMBT3906WT1

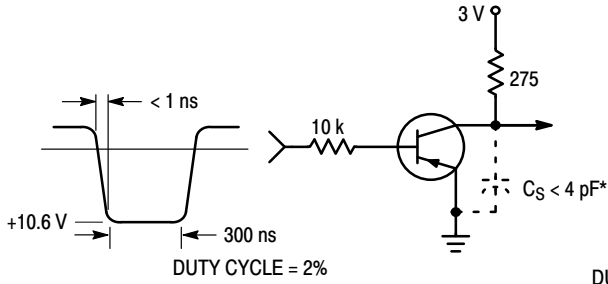


Figure 22. Delay and Rise Time Equivalent Test Circuit

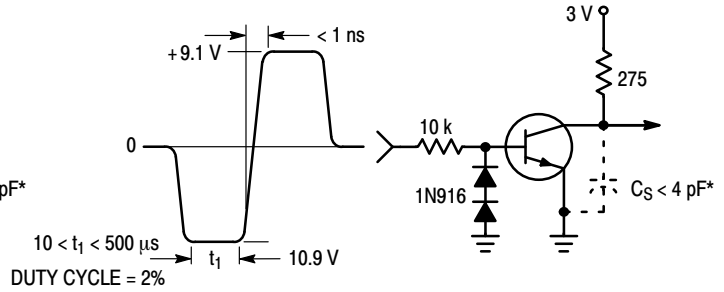


Figure 23. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

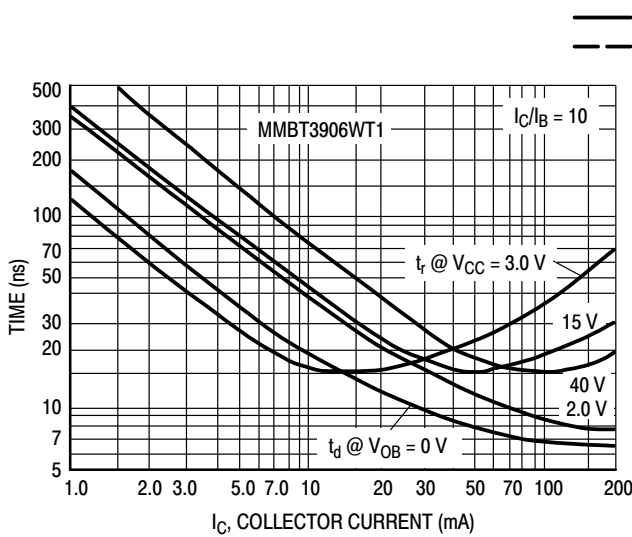


Figure 24. Turn-On Time

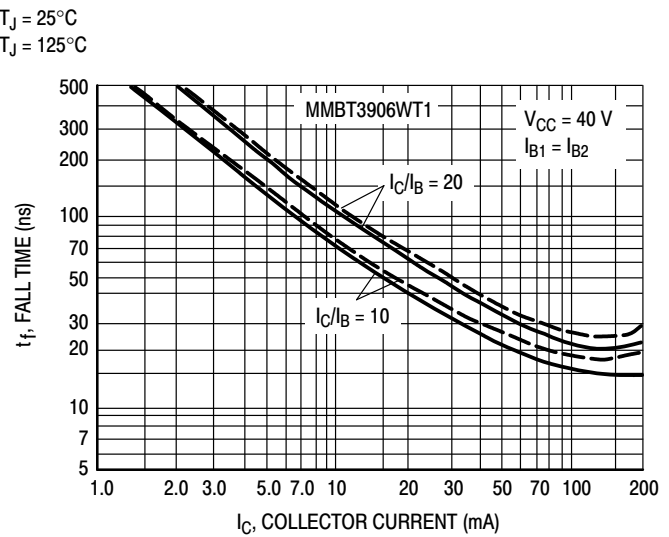


Figure 25. Fall Time

**TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS**

($V_{CE} = -5.0\text{ VDC}$, $T_A = 25^\circ\text{C}$, BANDWIDTH = 1.0 HZ)

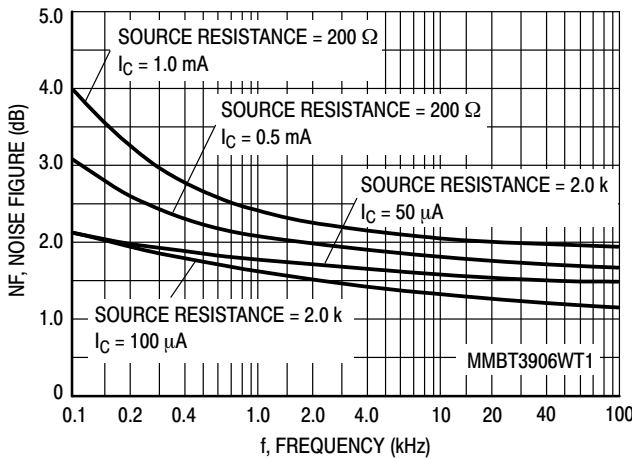


Figure 26.

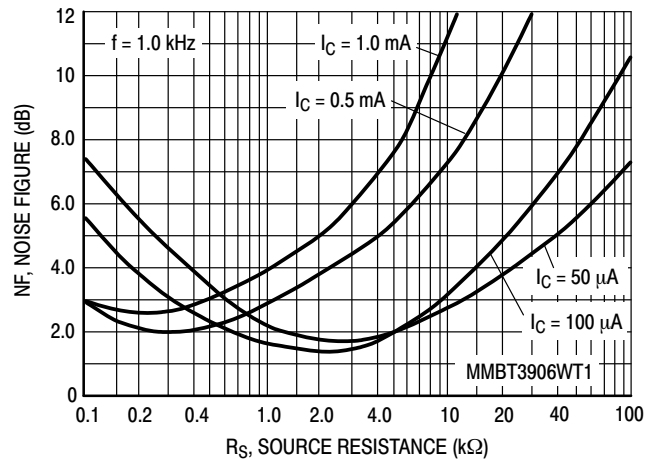


Figure 27.

MMBT3904WT1G, NPN, SMMBT3904WT1G, NPN, MMBT3906WT1G, PNP, SMMBT3906WT1G, PNP

MMBT3906WT1, SMMBT3906WT1

H PARAMETERS

($V_{CE} = -10$ VDC, $F = 1.0$ KHZ, $T_A = 25^\circ\text{C}$)

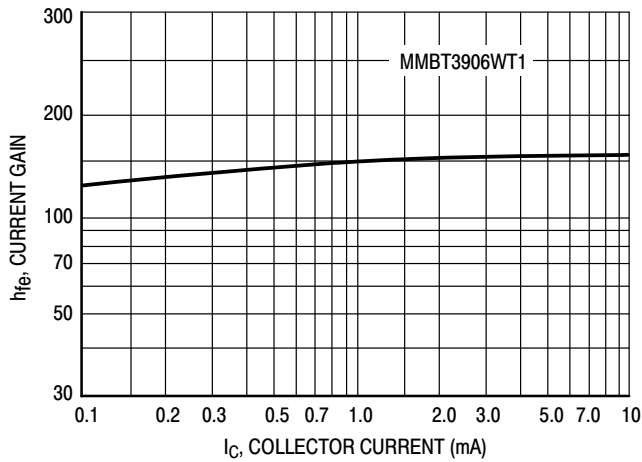


Figure 28. Current Gain

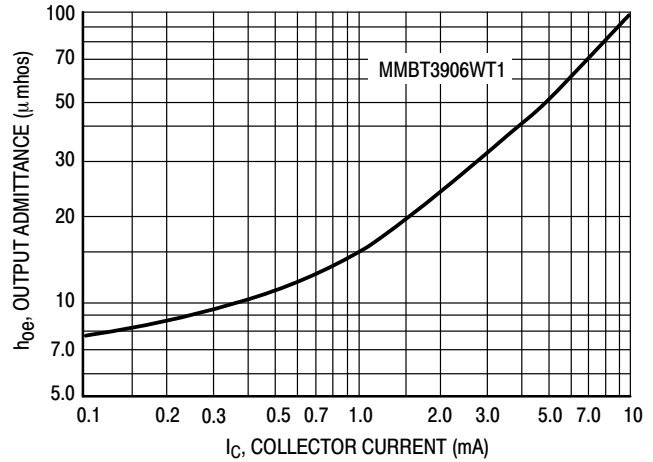


Figure 29. Output Admittance

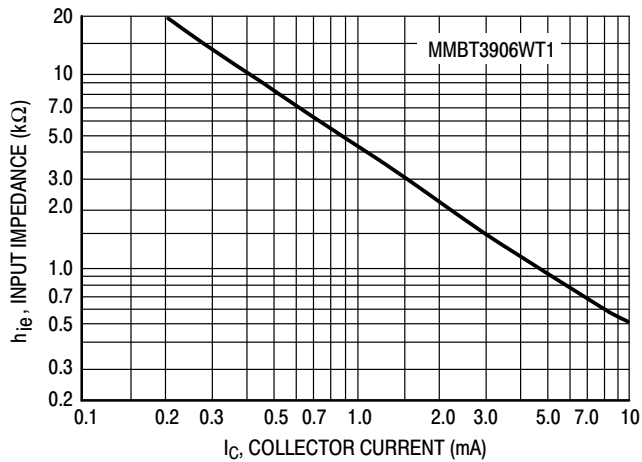


Figure 30. Input Impedance

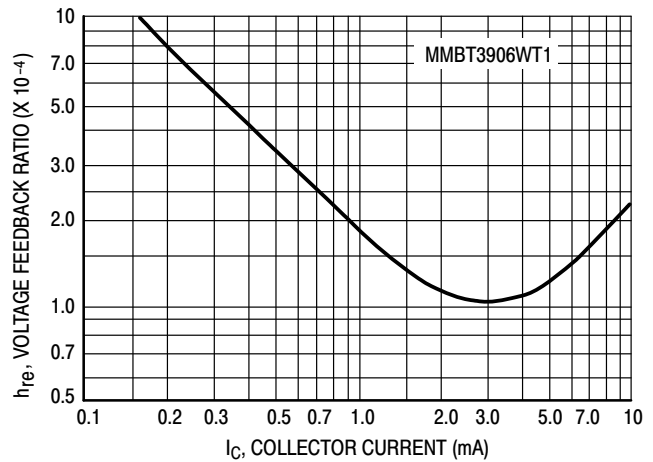


Figure 31. Voltage Feedback Ratio

STATIC CHARACTERISTICS

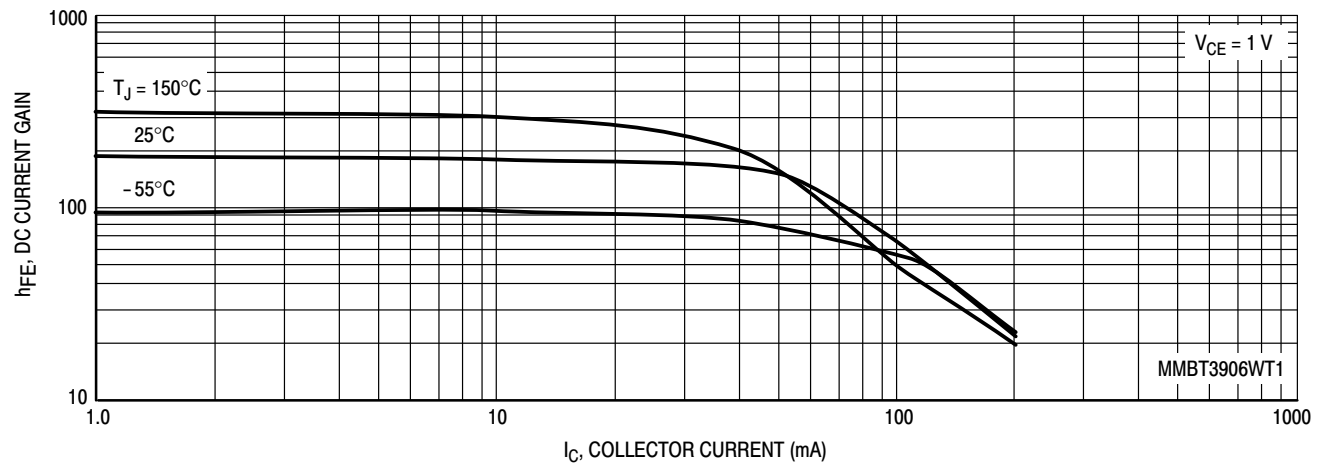


Figure 32. DC Current Gain

MMBT3904WT1G, NPN, SMMBT3904WT1G, NPN, MMBT3906WT1G, PNP,
SMMBT3906WT1G, PNP

MMBT3906WT1, SMMBT3906WT1

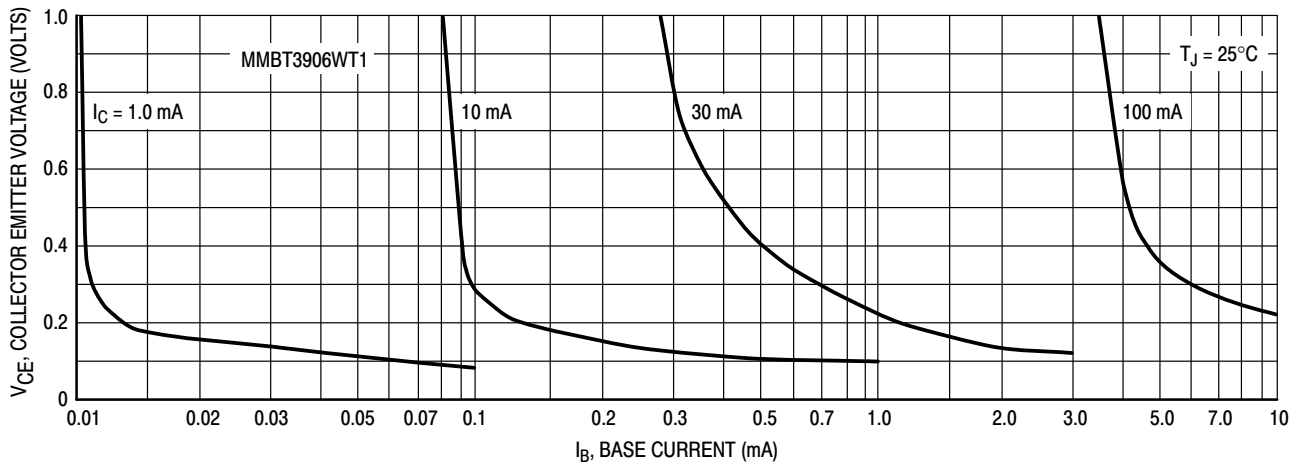


Figure 33. Collector Saturation Region

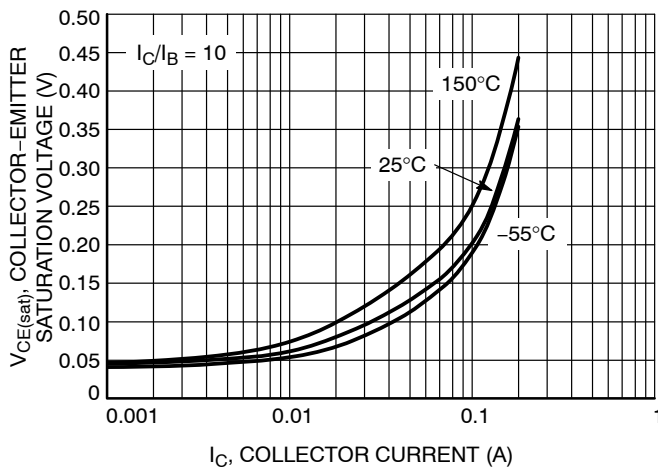


Figure 34. Collector Emitter Saturation Voltage vs. Collector Current

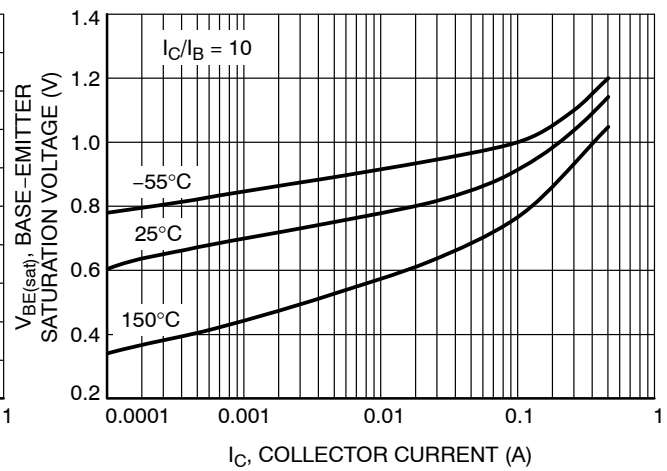


Figure 35. Base Emitter Saturation Voltage vs. Collector Current

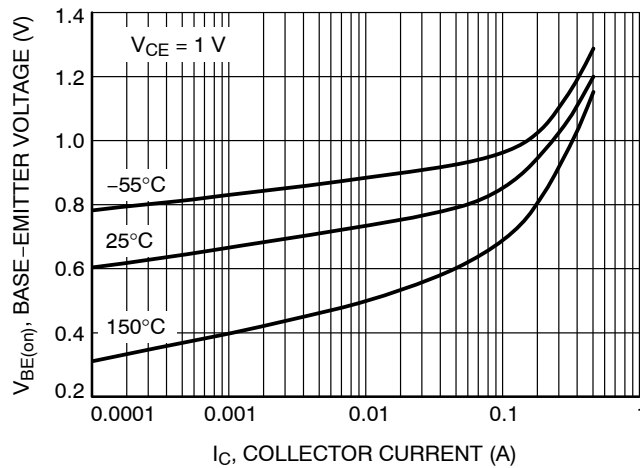


Figure 36. Base Emitter Voltage vs. Collector Current

MMBT3904WT1G, NPN, SMMBT3904WT1G, NPN, MMBT3906WT1G, PNP,
SMMBT3906WT1G, PNP

MMBT3906WT1, SMMBT3906WT1

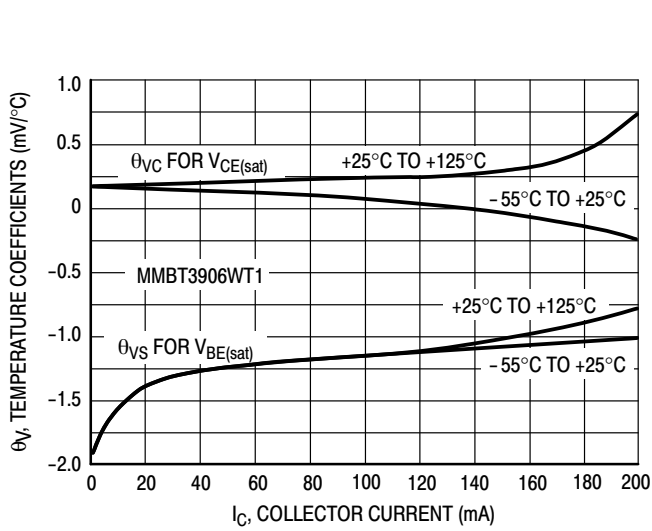


Figure 37. Temperature Coefficients

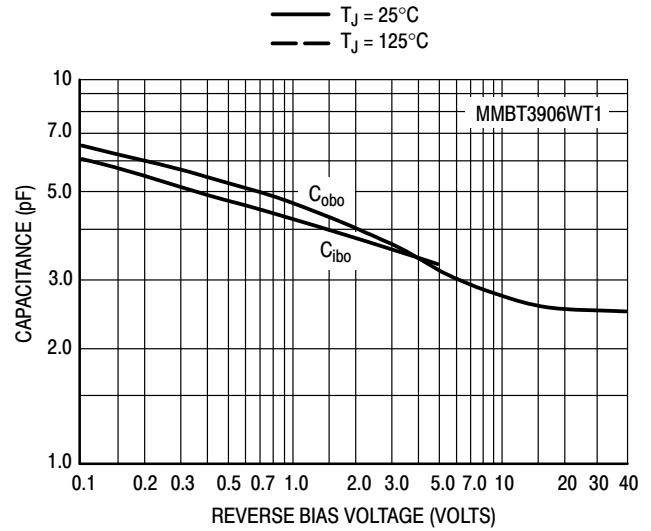


Figure 38. Capacitance

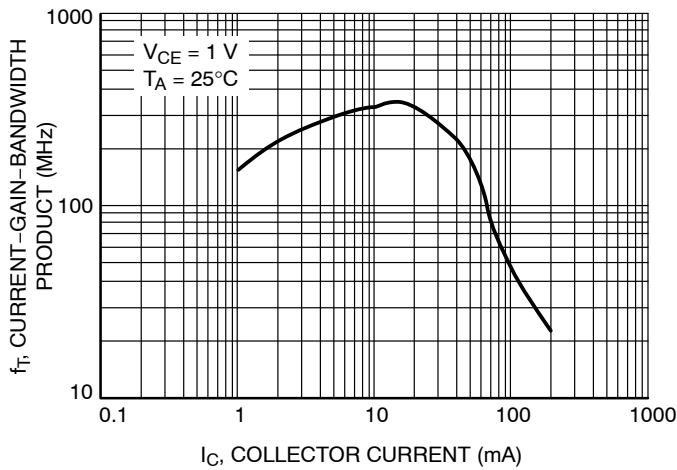


Figure 39. Current Gain Bandwidth Product vs. Collector Current

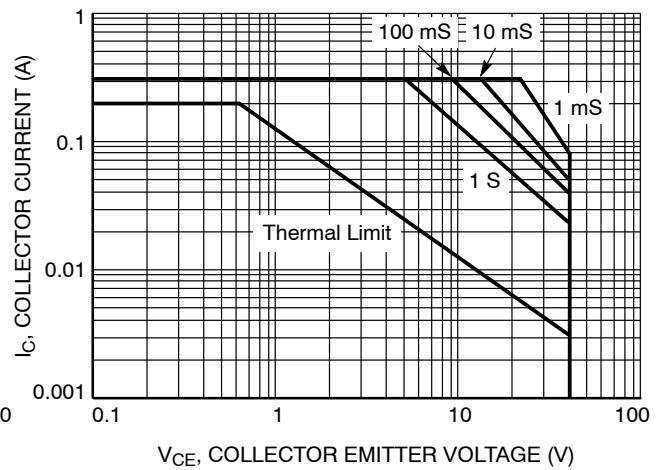
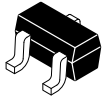


Figure 40. Safe Operating Area

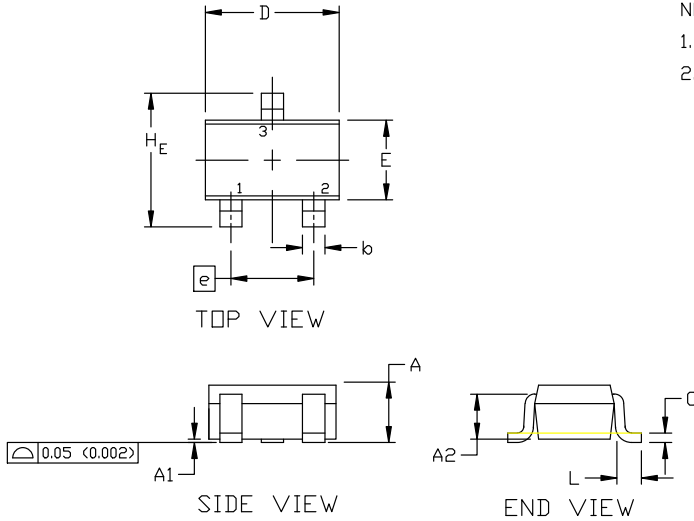
MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 4:1

SC-70 (SOT-323) CASE 419 ISSUE R

DATE 11 OCT 2022



NOTES:

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

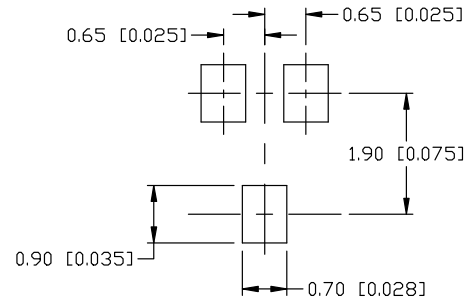
| DIM | MILLIMETERS | | | INCHES | | |
|----------------|-------------|------|------|-----------|-------|-------|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 0.80 | 0.90 | 1.00 | 0.032 | 0.035 | 0.040 |
| A1 | 0.00 | 0.05 | 0.10 | 0.000 | 0.002 | 0.004 |
| A2 | 0.70 REF | | | 0.028 BSC | | |
| 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 | 2.00 | 2.20 | 0.071 | 0.080 | 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 |

GENERIC MARKING DIAGRAM



- XX = Specific Device Code
- M = Date Code
- = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present. Some products may not follow the Generic Marking.



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

SOLDERING FOOTPRINT

| | | | | | |
|---|---|---|--|---|---|
| STYLE 1: CANCELLED | STYLE 2: PIN 1. ANODE 2. N.C. 3. CATHODE | STYLE 3: PIN 1. BASE 2. EMITTER 3. COLLECTOR | STYLE 4: PIN 1. CATHODE 2. CATHODE 3. ANODE | STYLE 5: PIN 1. ANODE 2. ANODE 3. CATHODE | |
| STYLE 6: PIN 1. EMITTER 2. BASE 3. COLLECTOR | STYLE 7: PIN 1. BASE 2. EMITTER 3. COLLECTOR | STYLE 8: PIN 1. GATE 2. SOURCE 3. DRAIN | STYLE 9: PIN 1. ANODE 2. CATHODE 3. CATHODE-ANODE | STYLE 10: PIN 1. CATHODE 2. ANODE 3. ANODE-CATHODE | STYLE 11: PIN 1. CATHODE 2. CATHODE 3. CATHODE |

| | | |
|-------------------------|------------------------|--|
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| DESCRIPTION: | SC-70 (SOT-323) | PAGE 1 OF 1 |

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