

MMBT3904WT1, NPN, SMMBT3904WT1, NPN, MMBT3906WT1, PNP

General Purpose Transistors

NPN and PNP Silicon

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

- AEC-Q101 Qualified and PPAP Capable
- S Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements
- 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 | V_{CEO} | 40 -40 | Vdc |
| Collector - Base Voltage MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1 | V_{CBO} | 60 -40 | Vdc |
| Emitter - Base Voltage MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1 | V_{EBO} | 6.0 -5.0 | Vdc |
| Collector Current - Continuous MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1 | 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 | $^\circ\text{C/W}$ |
| Junction and Storage Temperature | T_J, T_{stg} | -55 to +150 | $^\circ\text{C}$ |

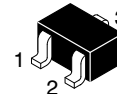
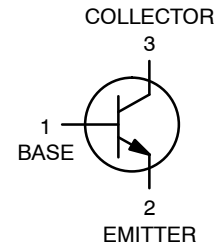
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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



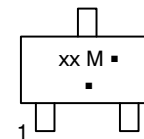
ON Semiconductor®

<http://onsemi.com>



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

MARKING DIAGRAM



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

MMBT3904WT1, NPN, SMMBT3904WT1, NPN, MMBT3906WT1, PNP

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

| Characteristic | Symbol | Min | Max | Unit |
|---|----------------------|-----------------------------|--------------------------------|------|
| OFF CHARACTERISTICS | | | | |
| Collector – Emitter Breakdown Voltage (Note 2) (I _C = 1.0 mA, I _B = 0) (I _C = -1.0 mA, I _B = 0) | V _{(BR)CEO} | 40 -40 | - - | Vdc |
| Collector – Base Breakdown Voltage (I _C = 10 μA, I _E = 0) (I _C = -10 μA, I _E = 0) | V _{(BR)CBO} | 60 -40 | - - | Vdc |
| Emitter – Base Breakdown Voltage (I _E = 10 μA, I _C = 0) (I _E = -10 μA, I _C = 0) | V _{(BR)EBO} | 6.0 -5.0 | - - | Vdc |
| Base Cutoff Current (V _{CE} = 30 Vdc, V _{EB} = 3.0 Vdc) (V _{CE} = -30 Vdc, V _{EB} = -3.0 Vdc) | I _{BL} | - - | 50 -50 | nA |
| Collector Cutoff Current (V _{CE} = 30 Vdc, V _{EB} = 3.0 Vdc) (V _{CE} = -30 Vdc, V _{EB} = -3.0 Vdc) | I _{CEX} | - - | 50 -50 | nA |
| ON CHARACTERISTICS (Note 2) | | | | |
| 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) (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) (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 -0.25 -0.4 | Vdc |
| Base – Emitter Saturation Voltage (I _C = 10 mA, I _B = 1.0 mA) (I _C = 50 mA, I _B = 5.0 mA) (I _C = -10 mA, I _B = -1.0 mA) (I _C = -50 mA, I _B = -5.0 mA) | V _{BE(sat)} | 0.65 - -0.65 - | 0.85 0.95 -0.85 -0.95 | Vdc |

2. Pulse Test: Pulse Width ≤ 300 μs; Duty Cycle ≤ 2.0%.

MMBT3904WT1, NPN, SMMBT3904WT1, NPN, MMBT3906WT1, PNP

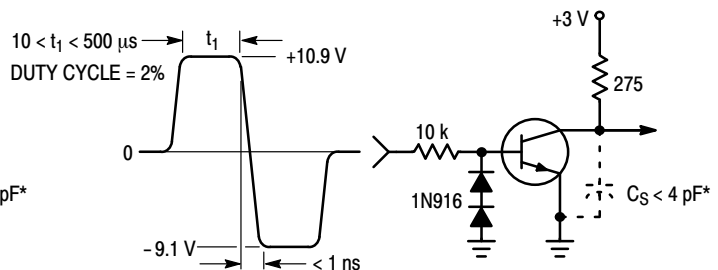
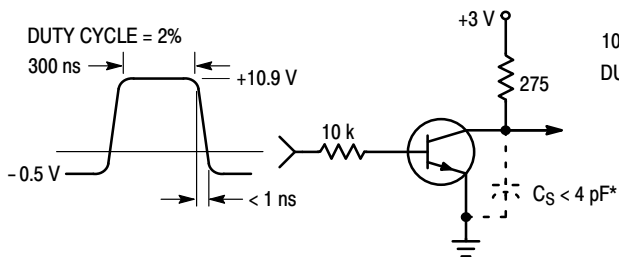
ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted) (Continued)

| 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 | 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 | 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 | 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 | t_f | - - | 50 75 | ns |

MMBT3904WT1, SMMBT3904WT1



* 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

MMBT3904WT1, NPN, SMMBT3904WT1, NPN, MMBT3906WT1, PNP

MMBT3904WT1, SMMBT3904WT1

TYPICAL TRANSIENT CHARACTERISTICS

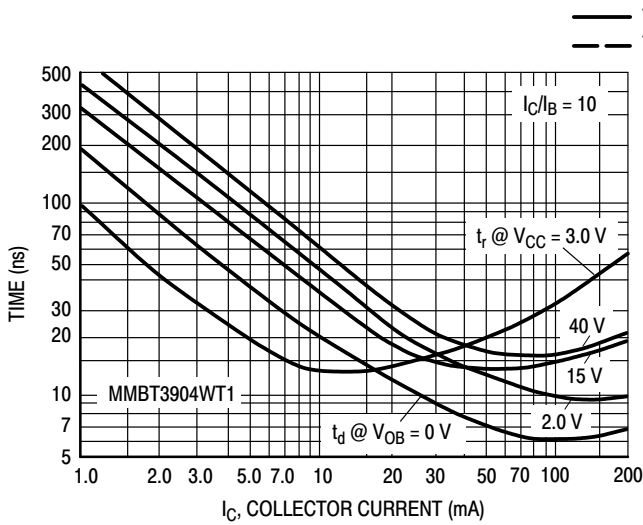


Figure 3. Turn-On Time

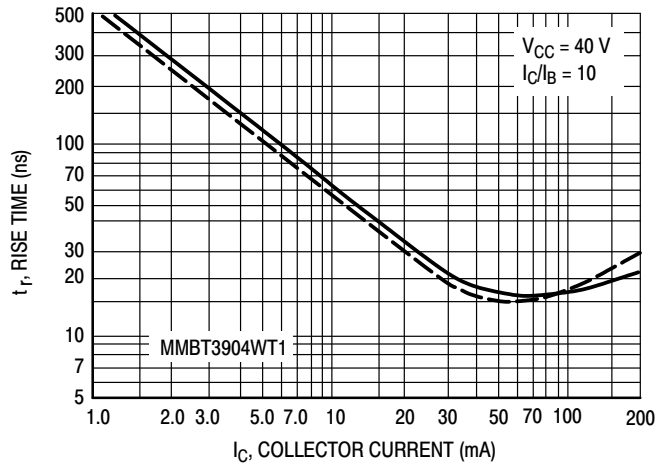


Figure 4. Rise Time

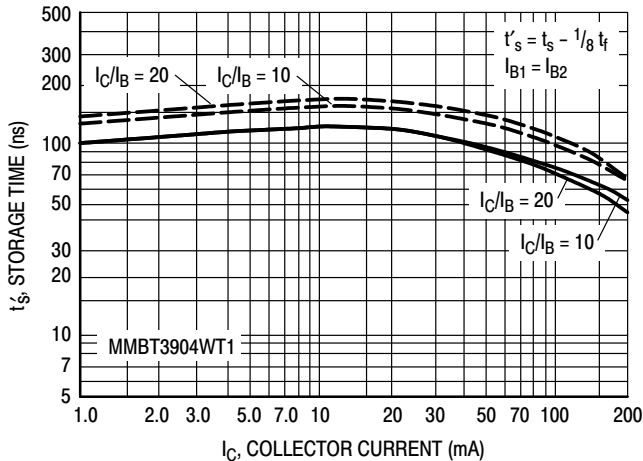


Figure 5. Storage Time

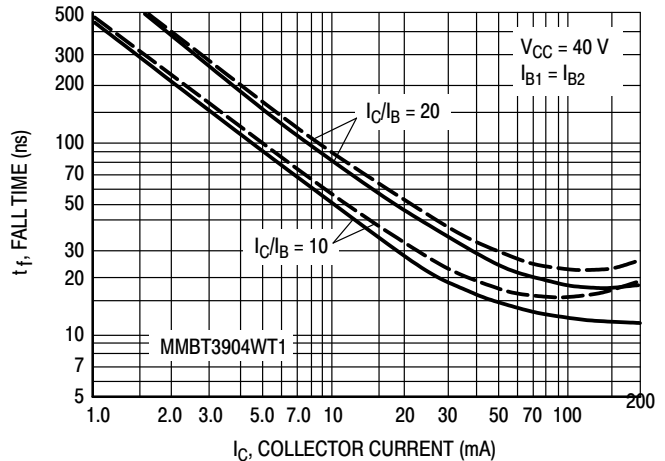


Figure 6. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

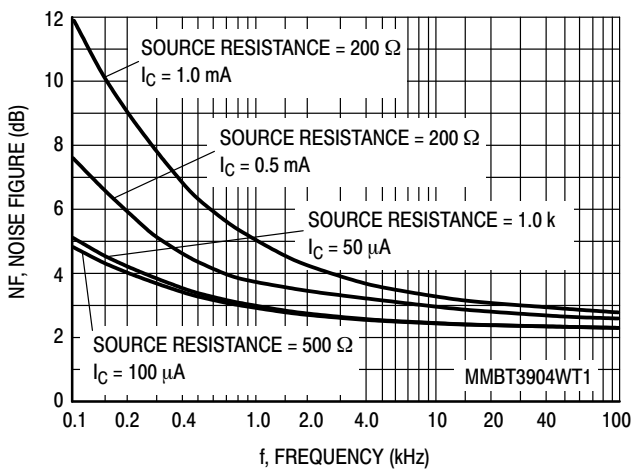


Figure 7. Noise Figure

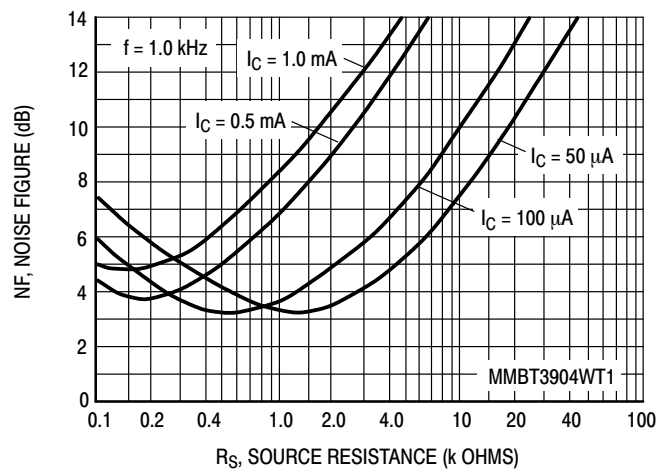


Figure 8. Noise Figure

MMBT3904WT1, NPN, SMMBT3904WT1, NPN, MMBT3906WT1, PNP

MMBT3904WT1, SMMBT3904WT1

h PARAMETERS

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

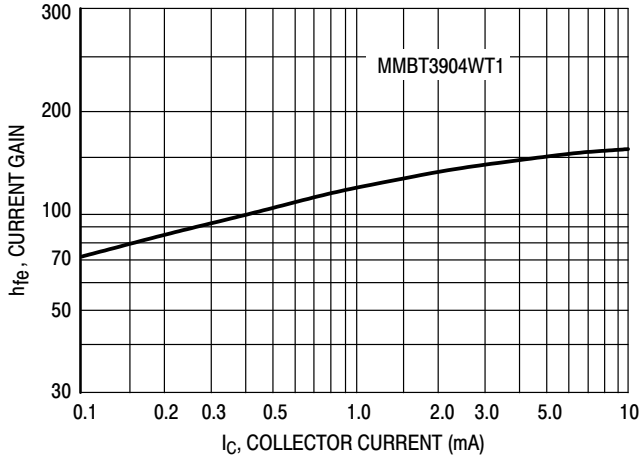


Figure 9. Current Gain

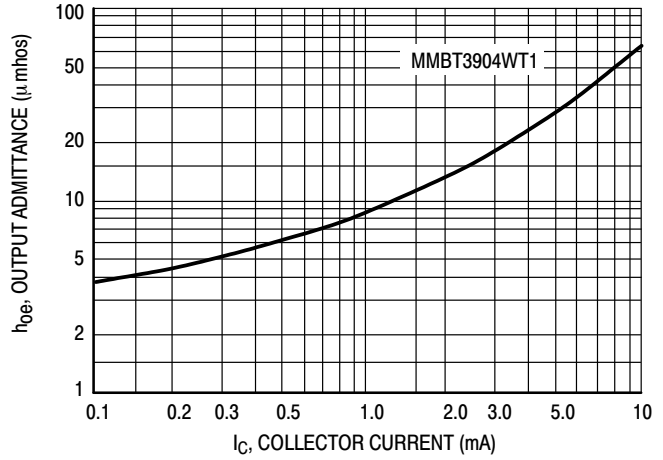


Figure 10. Output Admittance

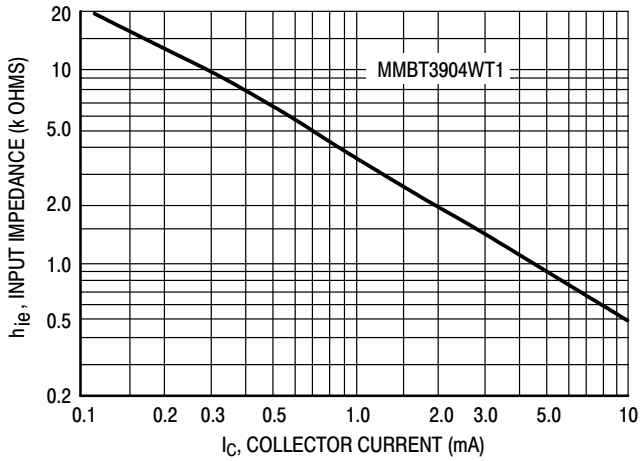


Figure 11. Input Impedance

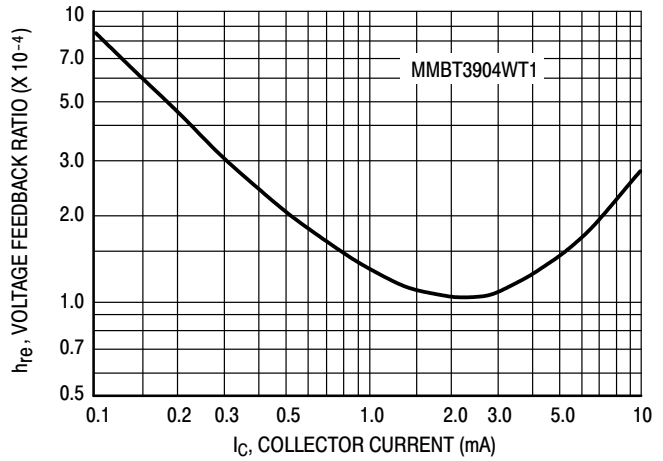


Figure 12. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

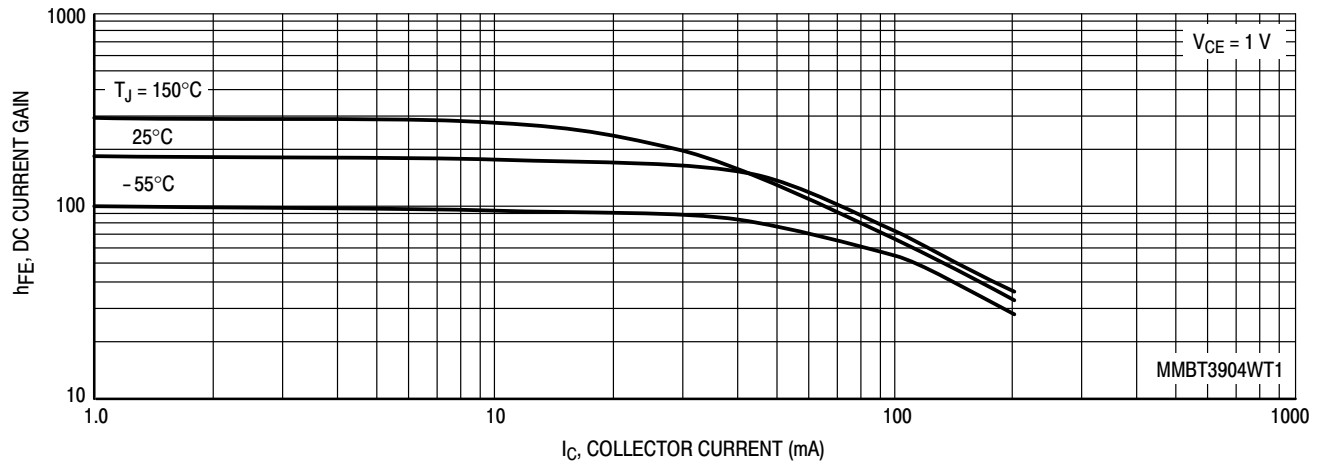


Figure 13. DC Current Gain

MMBT3904WT1, SMMBT3904WT1

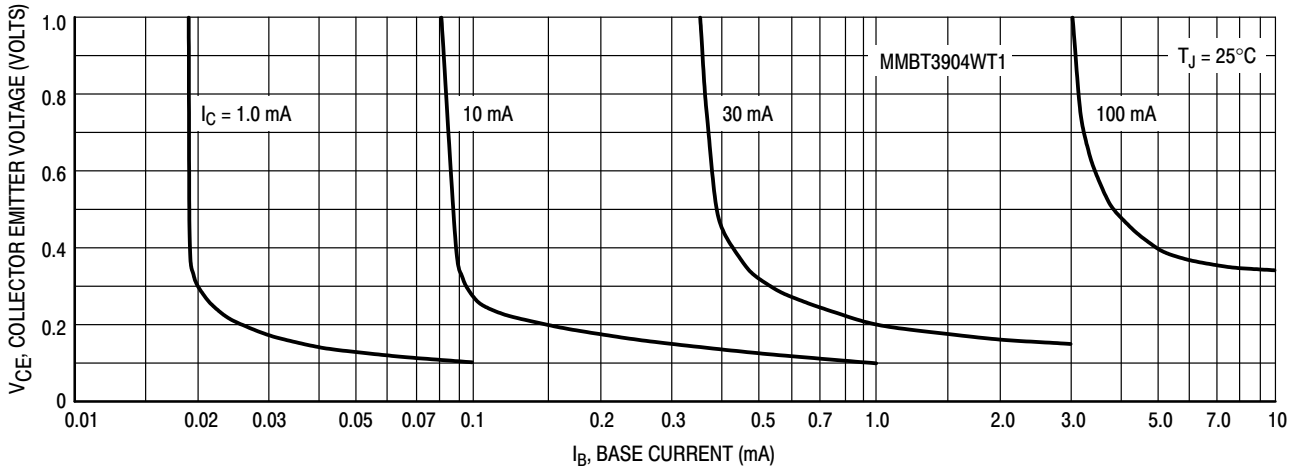


Figure 14. Collector Saturation Region

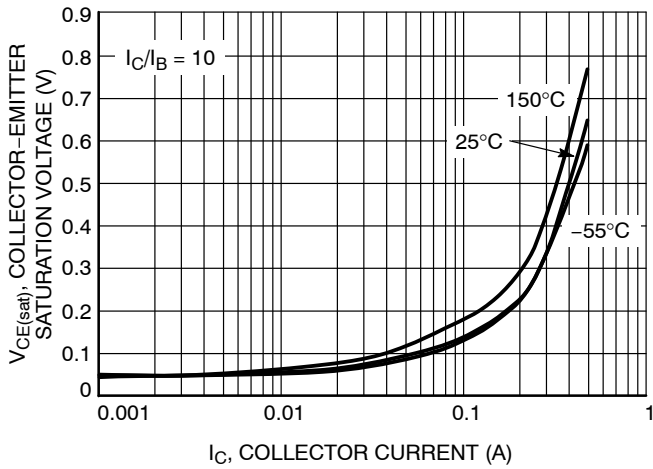


Figure 15. Collector Emitter Saturation Voltage vs. Collector Current

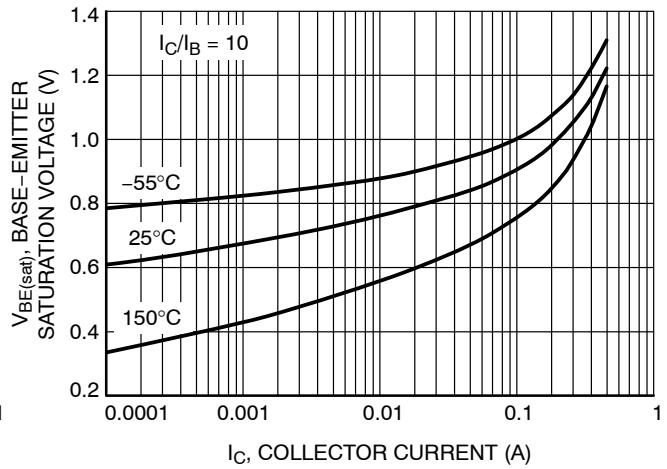


Figure 16. Base Emitter Saturation Voltage vs. Collector Current

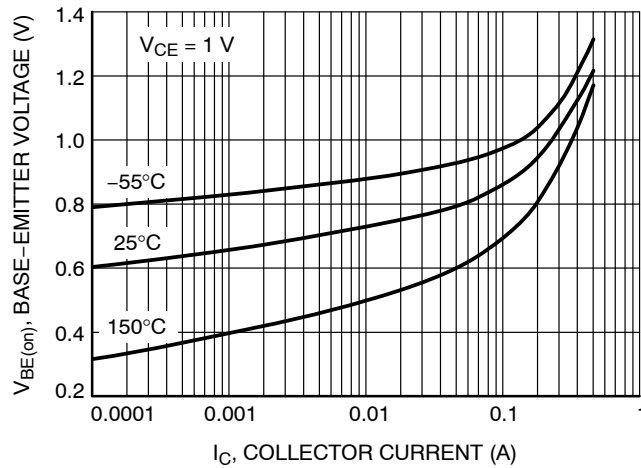


Figure 17. Base Emitter Voltage vs. Collector Current

MMBT3904WT1, NPN, SMMBT3904WT1, NPN, MMBT3906WT1, PNP

MMBT3904WT1, SMMBT3904WT1

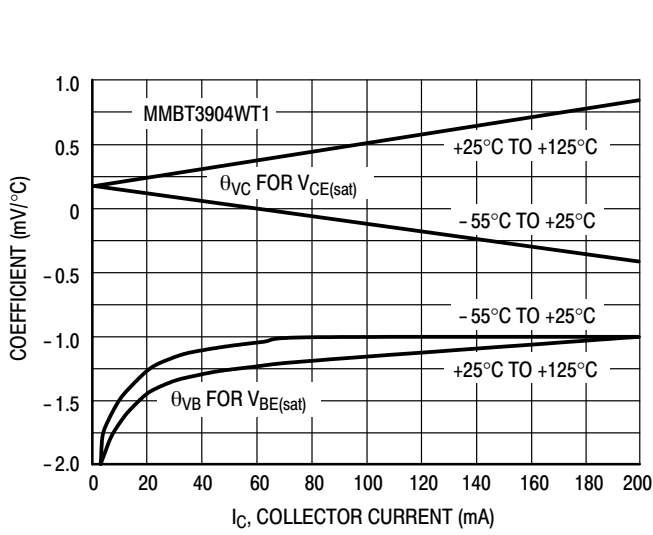


Figure 18. Temperature Coefficients

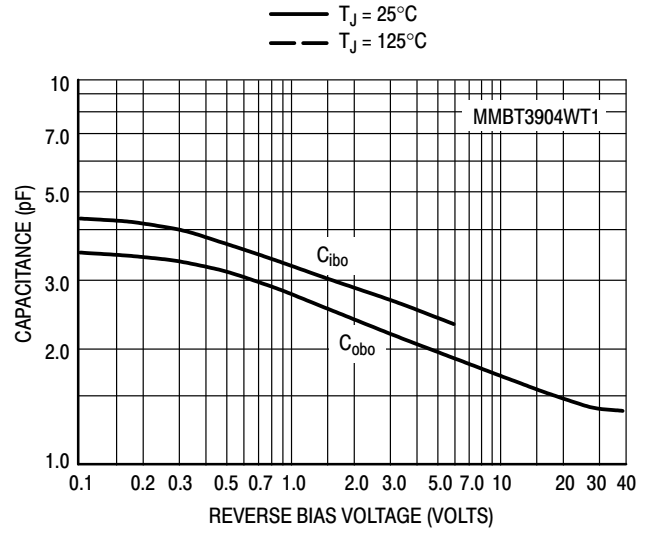


Figure 19. Capacitance

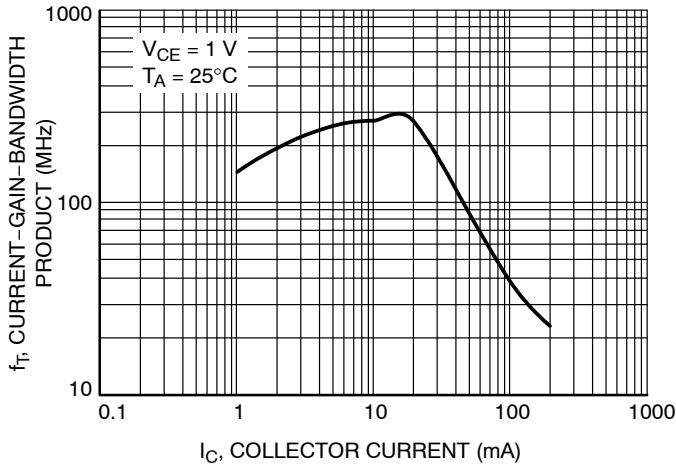


Figure 20. Current Gain Bandwidth Product vs. Collector Current

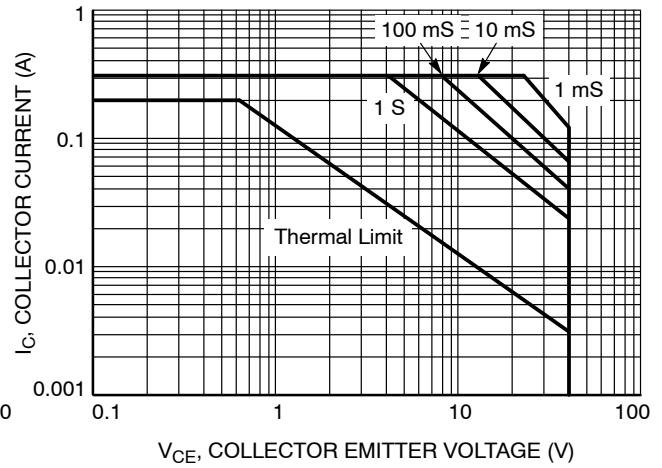


Figure 21. Safe Operating Area

MMBT3904WT1, NPN, SMMBT3904WT1, NPN, MMBT3906WT1, PNP

MMBT3906WT1

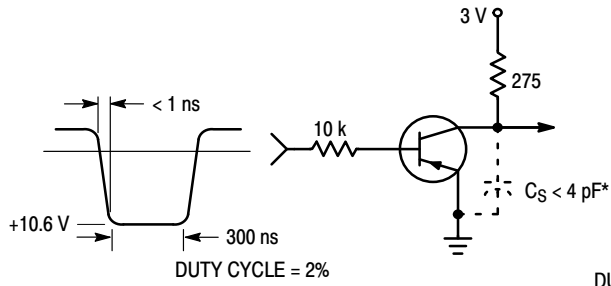


Figure 22. Delay and Rise Time Equivalent Test Circuit

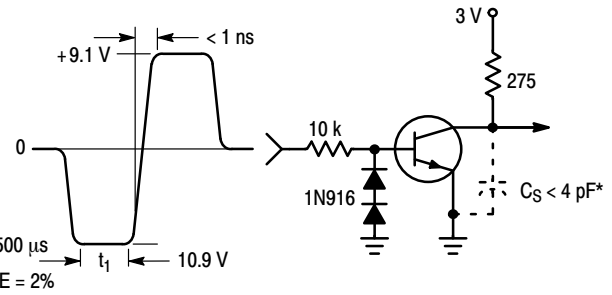


Figure 23. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

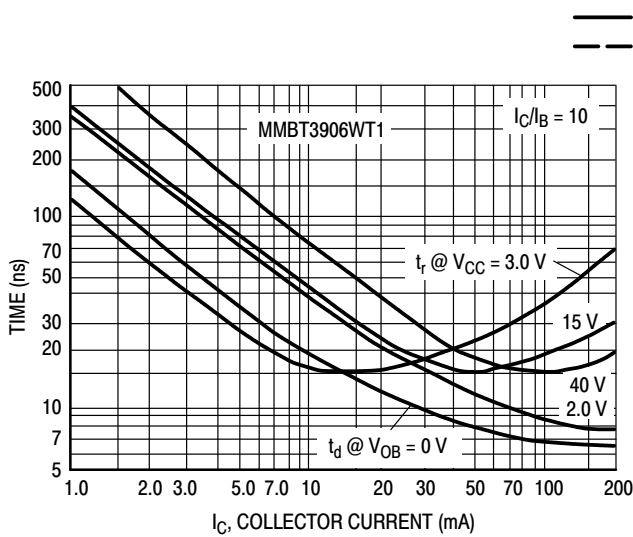


Figure 24. Turn-On Time

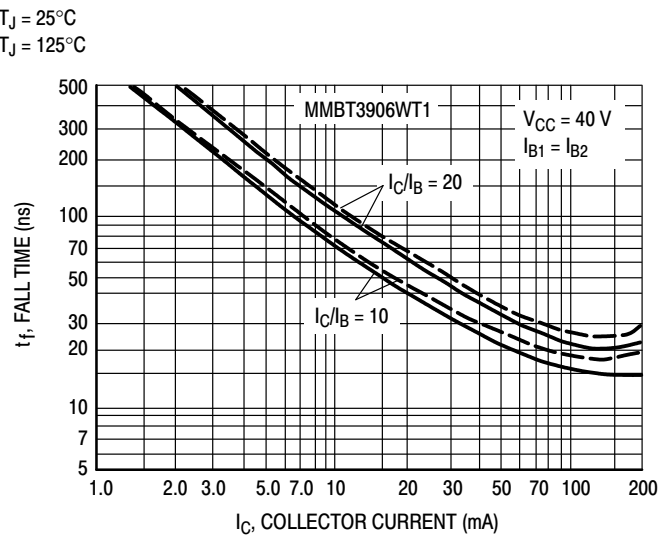


Figure 25. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS

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

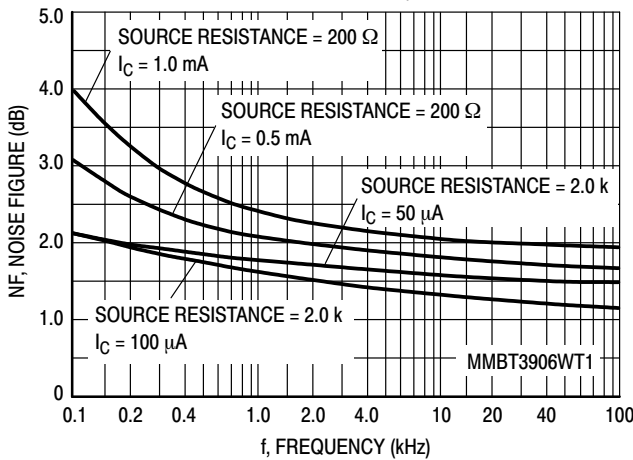


Figure 26.

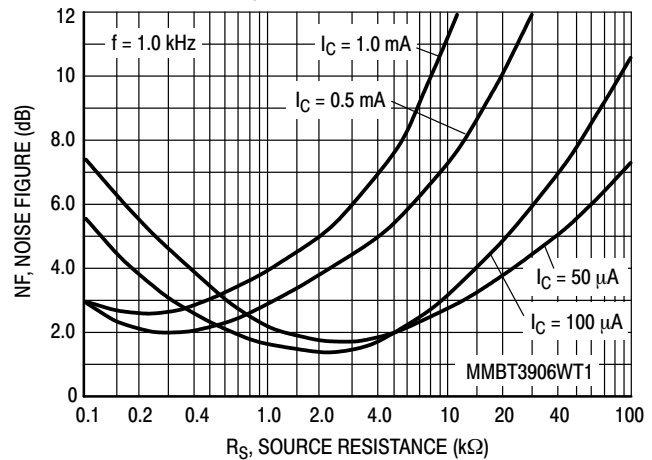


Figure 27.

MMBT3906WT1

h PARAMETERS

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

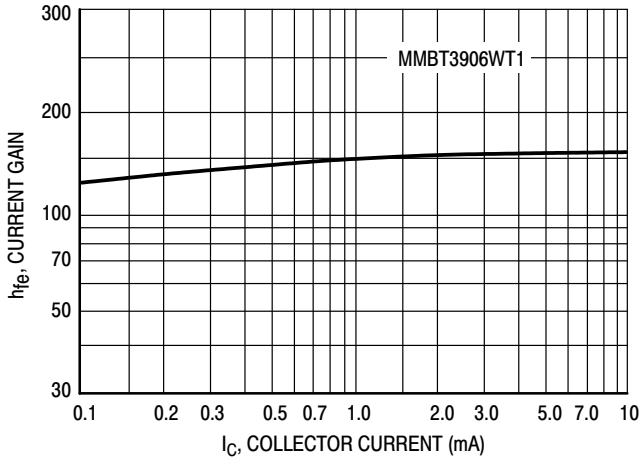


Figure 28. Current Gain

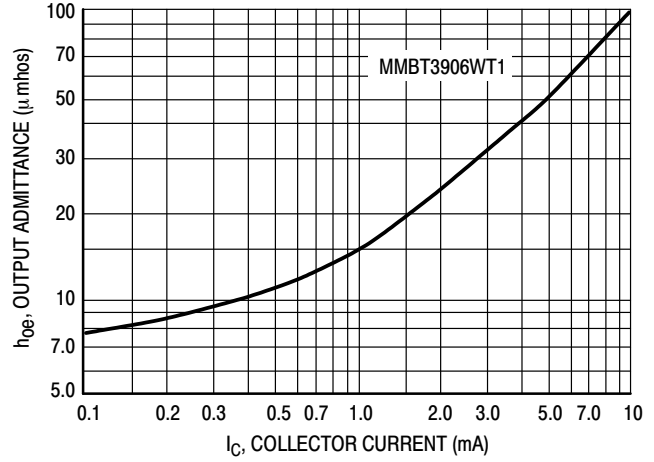


Figure 29. Output Admittance

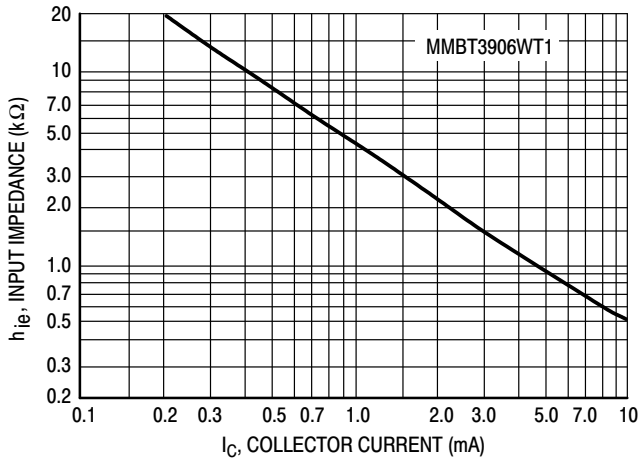


Figure 30. Input Impedance

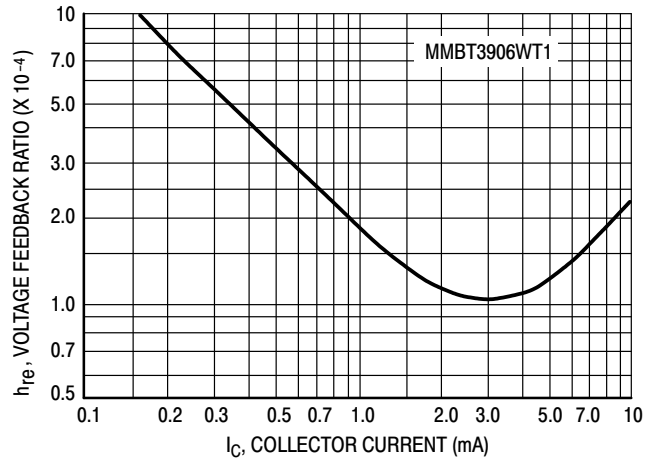


Figure 31. Voltage Feedback Ratio

STATIC CHARACTERISTICS

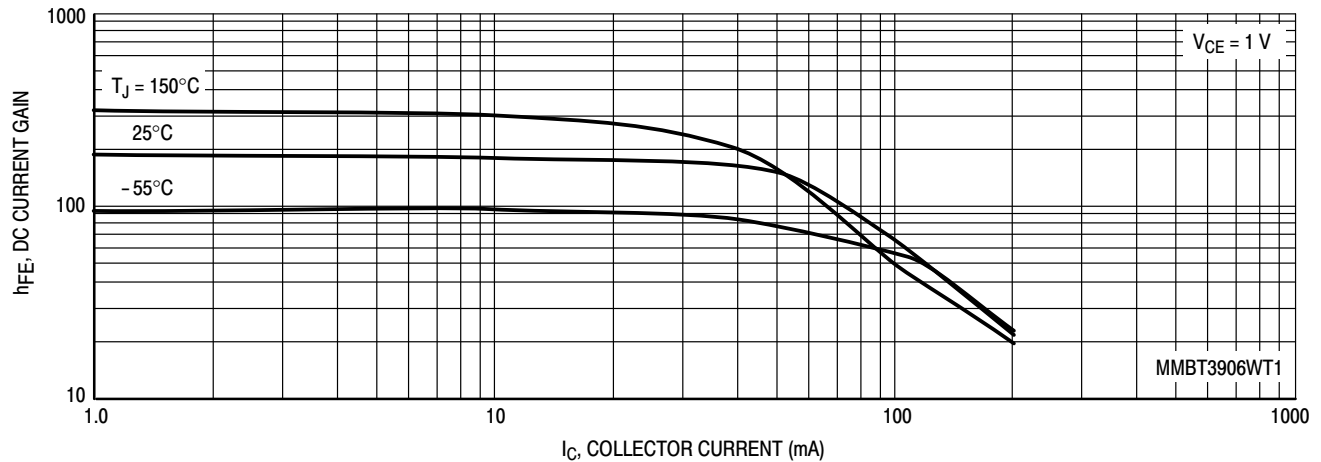


Figure 32. DC Current Gain

MMBT3906WT1

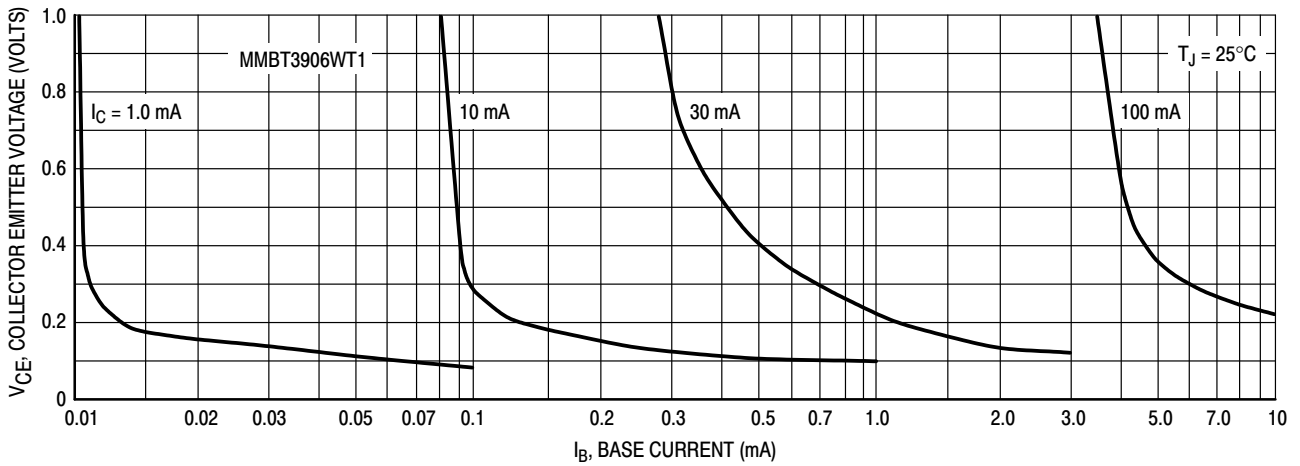


Figure 33. Collector Saturation Region

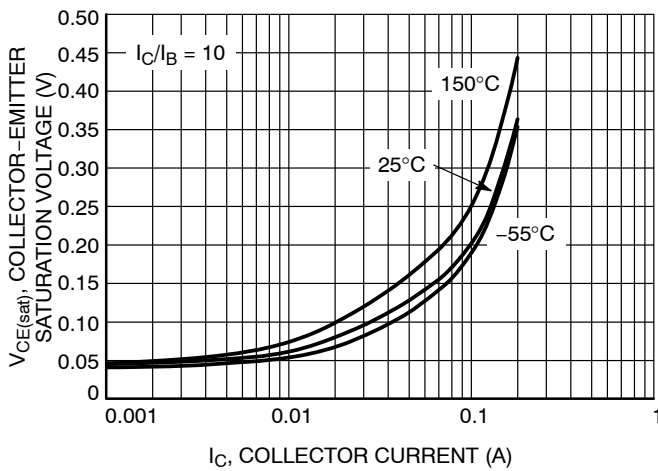


Figure 34. Collector Emitter Saturation Voltage vs. Collector Current

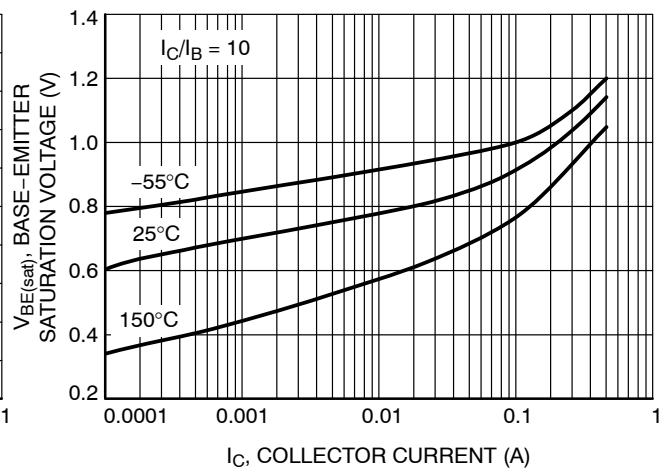


Figure 35. Base Emitter Saturation Voltage vs. Collector Current

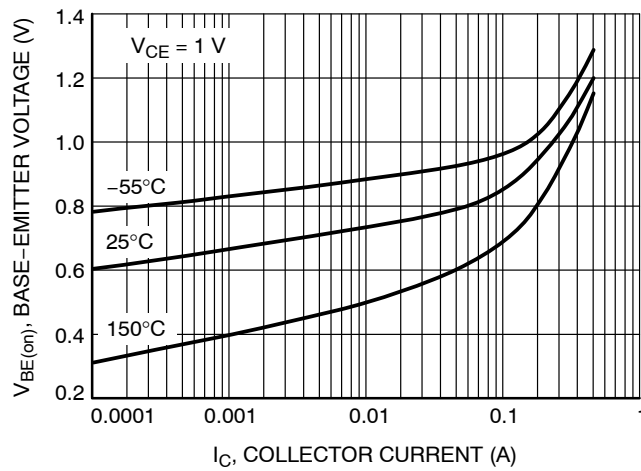


Figure 36. Base Emitter Voltage vs. Collector Current

MMBT3906WT1

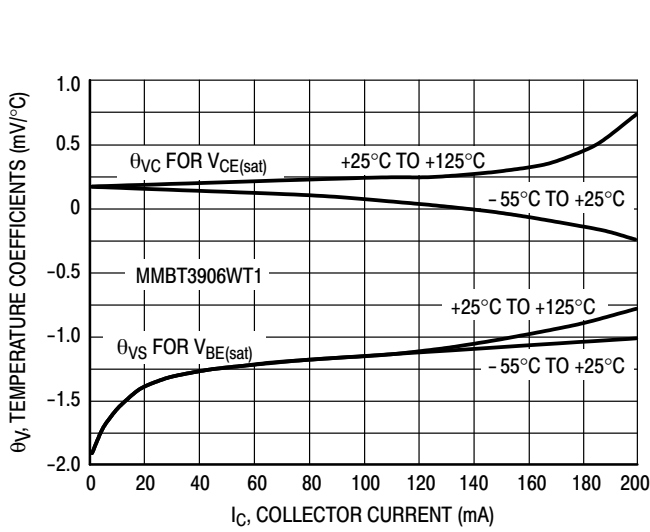


Figure 37. Temperature Coefficients

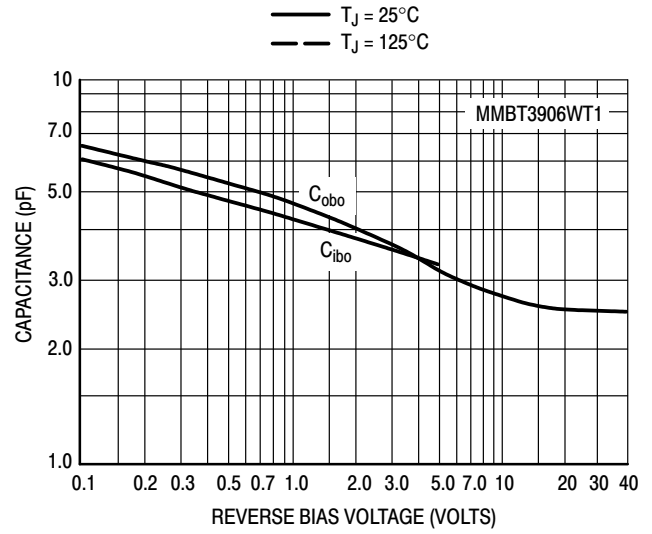


Figure 38. Capacitance

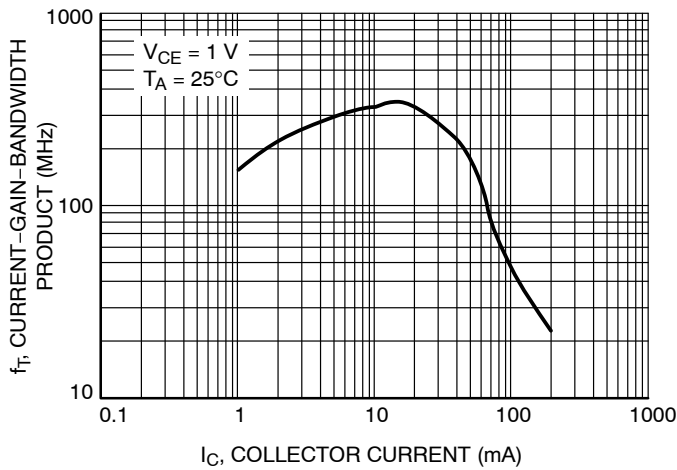


Figure 39. Current Gain Bandwidth Product vs. Collector Current

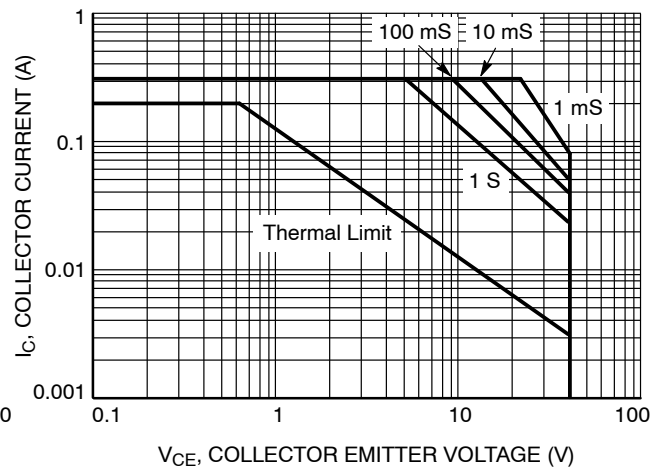
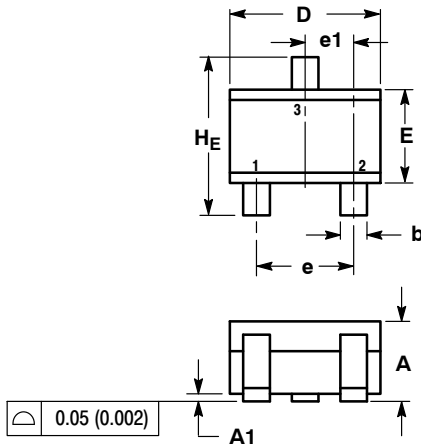


Figure 40. Safe Operating Area

MMBT3904WT1, NPN, SMMBT3904WT1, NPN, MMBT3906WT1, PNP

PACKAGE DIMENSIONS

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



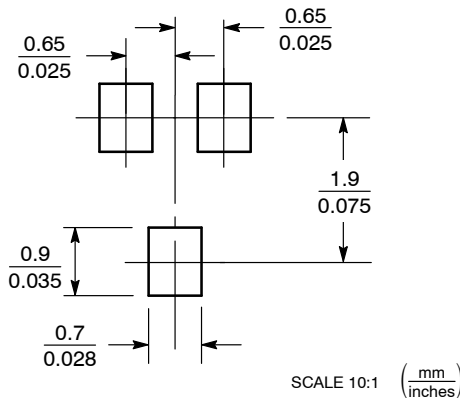
NOTES:

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
2. EMITTER
3. 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.

ON Semiconductor and are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative



**Стандарт
Электрон
Связь**

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

Минимальные сроки поставки, гибкие цены, неограниченный ассортимент и индивидуальный подход к клиентам являются основой для выстраивания долгосрочного и эффективного сотрудничества с предприятиями радиоэлектронной промышленности, предприятиями ВПК и научно-исследовательскими институтами России.

С нами вы становитесь еще успешнее!

Наши контакты:

Телефон: +7 812 627 14 35

Электронная почта: sales@st-electron.ru

Адрес: 198099, Санкт-Петербург,
Промышленная ул, дом № 19, литера Н,
помещение 100-Н Офис 331