

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

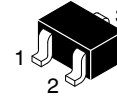
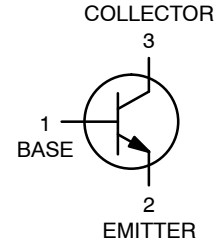
Rating	Symbol	Value	Unit
Collector - Emitter Voltage MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1	V_{CEO}	40 -40	Vdc
Collector - Base Voltage MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1	V_{CBO}	60 -40	Vdc
Emitter - Base Voltage MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1	V_{EBO}	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	$^\circ\text{C/W}$
Junction and Storage Temperature	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$

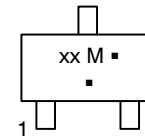
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit	
OFF CHARACTERISTICS					
Collector – Emitter Breakdown Voltage (Note 2) (I _C = 1.0 mA _{dc} , I _B = 0) (I _C = -1.0 mA _{dc} , I _B = 0)	MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1	V _{(BR)CEO}	40 -40	- -	V _{dc}
Collector – Base Breakdown Voltage (I _C = 10 μA _{dc} , I _E = 0) (I _C = -10 μA _{dc} , I _E = 0)	MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1	V _{(BR)CBO}	60 -40	- -	V _{dc}
Emitter – Base Breakdown Voltage (I _E = 10 μA _{dc} , I _C = 0) (I _E = -10 μA _{dc} , I _C = 0)	MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1	V _{(BR)EBO}	6.0 -5.0	- -	V _{dc}
Base Cutoff Current (V _{CE} = 30 V _{dc} , V _{EB} = 3.0 V _{dc}) (V _{CE} = -30 V _{dc} , V _{EB} = -3.0 V _{dc})	MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1	I _{BL}	- -	50 -50	nA _{dc}
Collector Cutoff Current (V _{CE} = 30 V _{dc} , V _{EB} = 3.0 V _{dc}) (V _{CE} = -30 V _{dc} , V _{EB} = -3.0 V _{dc})	MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1	I _{CEX}	- -	50 -50	nA _{dc}
ON CHARACTERISTICS (Note 2)					
DC Current Gain (I _C = 0.1 mA _{dc} , V _{CE} = 1.0 V _{dc}) (I _C = 1.0 mA _{dc} , V _{CE} = 1.0 V _{dc}) (I _C = 10 mA _{dc} , V _{CE} = 1.0 V _{dc}) (I _C = 50 mA _{dc} , V _{CE} = 1.0 V _{dc}) (I _C = 100 mA _{dc} , V _{CE} = 1.0 V _{dc}) (I _C = -0.1 mA _{dc} , V _{CE} = -1.0 V _{dc}) (I _C = -1.0 mA _{dc} , V _{CE} = -1.0 V _{dc}) (I _C = -10 mA _{dc} , V _{CE} = -1.0 V _{dc}) (I _C = -50 mA _{dc} , V _{CE} = -1.0 V _{dc}) (I _C = -100 mA _{dc} , V _{CE} = -1.0 V _{dc})	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 mA _{dc} , I _B = 1.0 mA _{dc}) (I _C = 50 mA _{dc} , I _B = 5.0 mA _{dc}) (I _C = -10 mA _{dc} , I _B = -1.0 mA _{dc}) (I _C = -50 mA _{dc} , I _B = -5.0 mA _{dc})	MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1	V _{CE(sat)}	- - - -	0.2 0.3 -0.25 -0.4	V _{dc}
Base – Emitter Saturation Voltage (I _C = 10 mA _{dc} , I _B = 1.0 mA _{dc}) (I _C = 50 mA _{dc} , I _B = 5.0 mA _{dc}) (I _C = -10 mA _{dc} , I _B = -1.0 mA _{dc}) (I _C = -50 mA _{dc} , I _B = -5.0 mA _{dc})	MMBT3904WT1, SMMBT3904WT1 MMBT3906WT1, SMMBT3906WT1	V _{BE(sat)}	0.65 - -0.65 -	0.85 0.95 -0.85 -0.95	V _{dc}

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

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

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

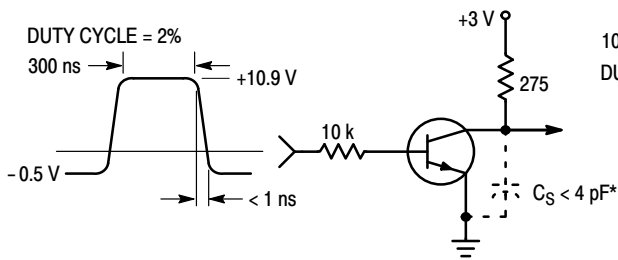
Characteristic	Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain-Bandwidth Product ($I_C = 10\text{ mAdc}$, $V_{CE} = 20\text{ Vdc}$, $f = 100\text{ MHz}$) ($I_C = -10\text{ mAdc}$, $V_{CE} = -20\text{ Vdc}$, $f = 100\text{ MHz}$)	f_T	300 250	- -	MHz
Output Capacitance ($V_{CB} = 5.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$) ($V_{CB} = -5.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$)	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

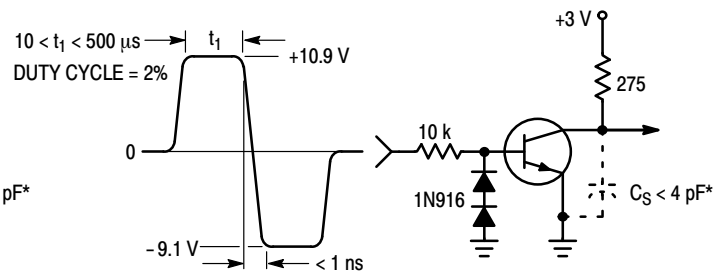
Characteristic	Condition	Symbol	Min	Max	Unit
Delay Time	($V_{CC} = 3.0\text{ Vdc}$, $V_{BE} = -0.5\text{ Vdc}$) MMBT3904WT1, SMMBT3904WT1 ($V_{CC} = -3.0\text{ Vdc}$, $V_{BE} = 0.5\text{ Vdc}$) MMBT3906WT1, SMMBT3906WT1	t_d	- -	35 35	ns
Rise Time	($I_C = 10\text{ mAdc}$, $I_{B1} = 1.0\text{ mAdc}$) MMBT3904WT1, 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



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



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

* Total shunt capacitance of test jig and connectors

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

MMBT3904WT1, SMMBT3904WT1

TYPICAL TRANSIENT CHARACTERISTICS

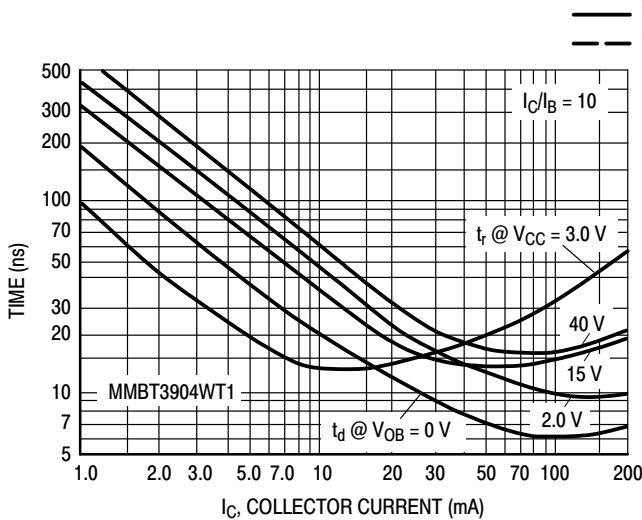


Figure 3. Turn-On Time

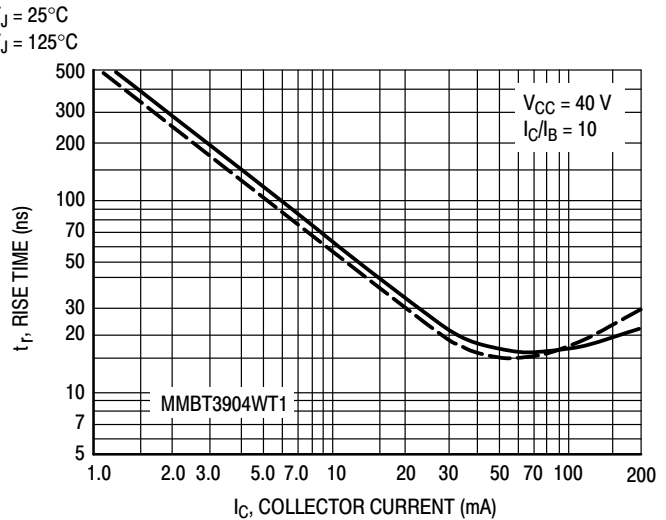


Figure 4. Rise Time

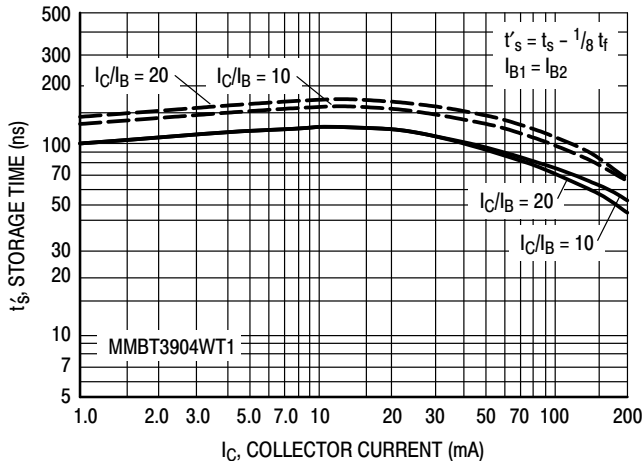


Figure 5. Storage Time

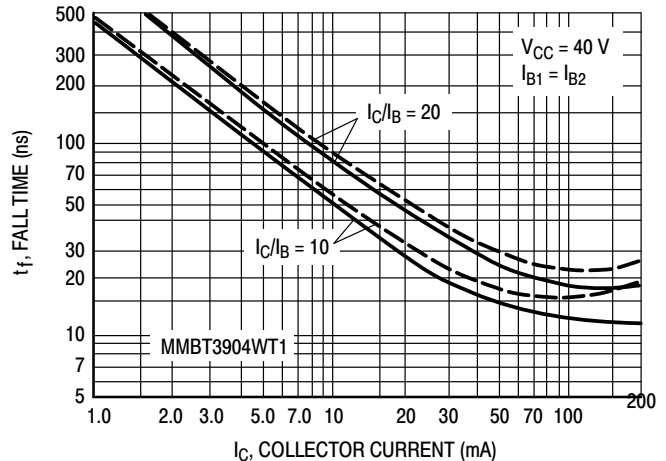


Figure 6. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

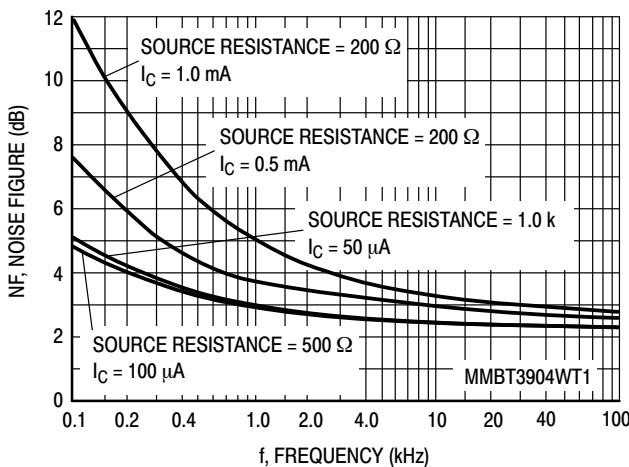


Figure 7. Noise Figure

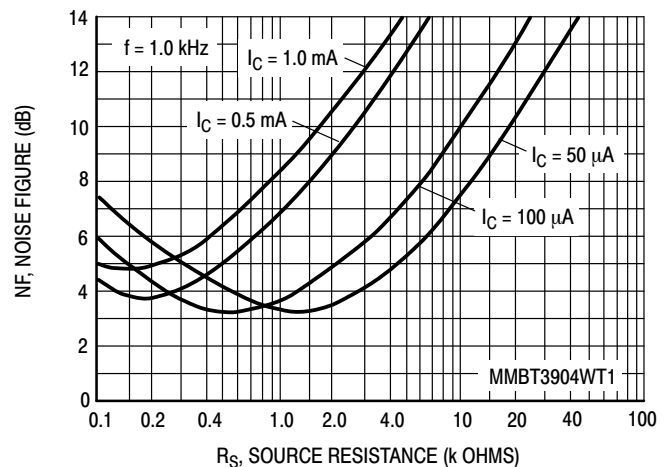


Figure 8. Noise Figure

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

MMBT3904WT1, SMMBT3904WT1

H PARAMETERS

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

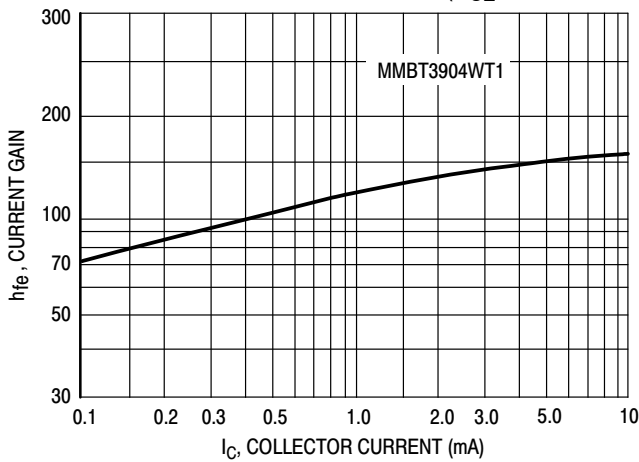


Figure 9. Current Gain

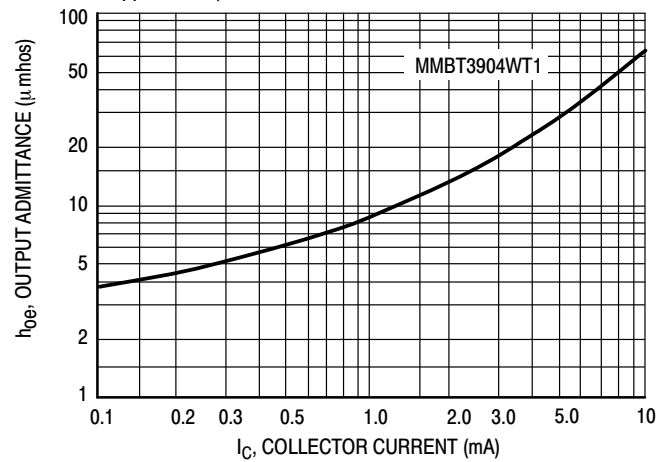


Figure 10. Output Admittance

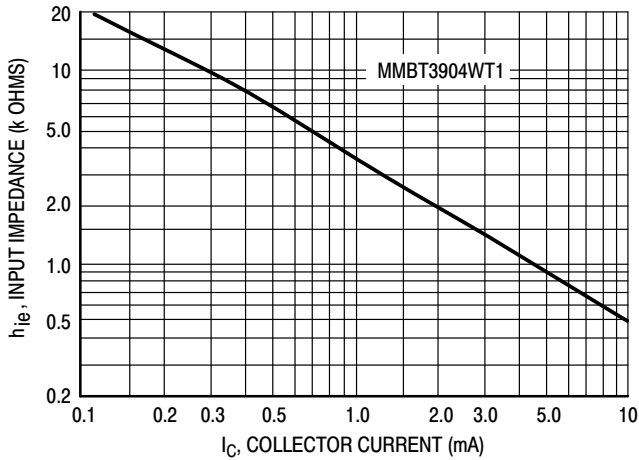


Figure 11. Input Impedance

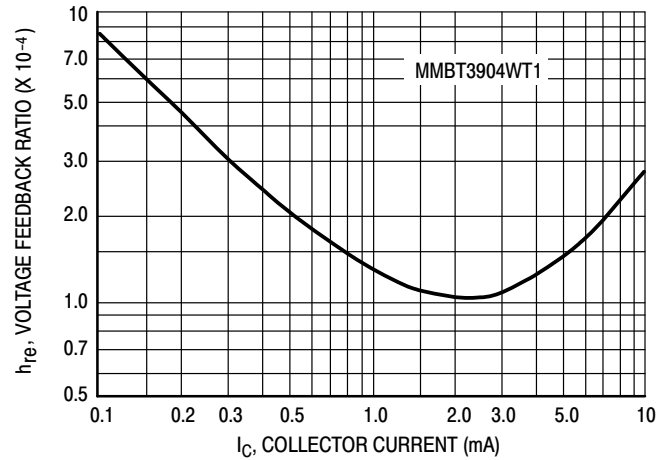


Figure 12. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

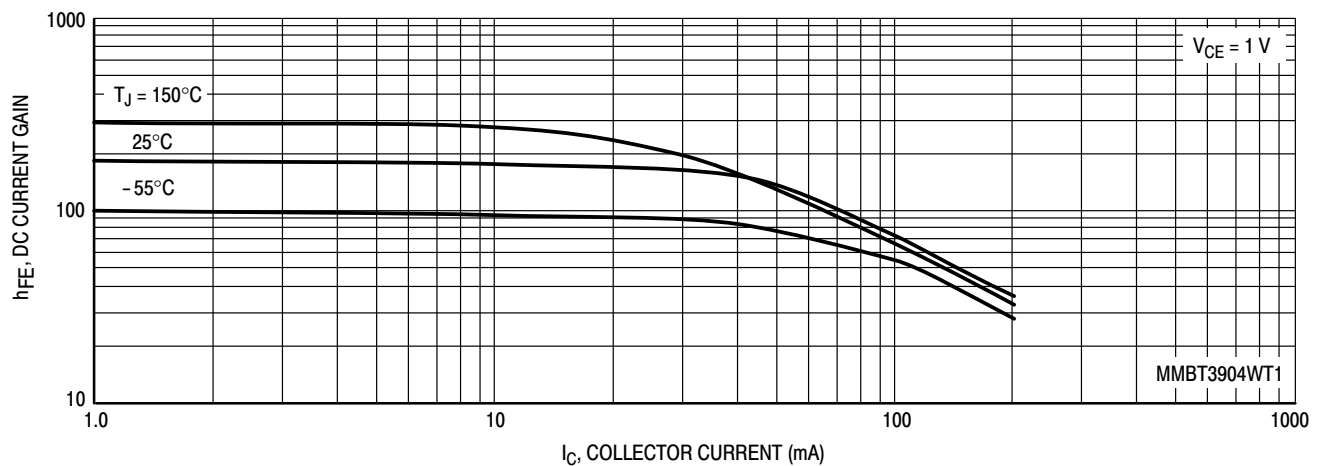


Figure 13. DC Current Gain

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

MMBT3904WT1, SMMBT3904WT1

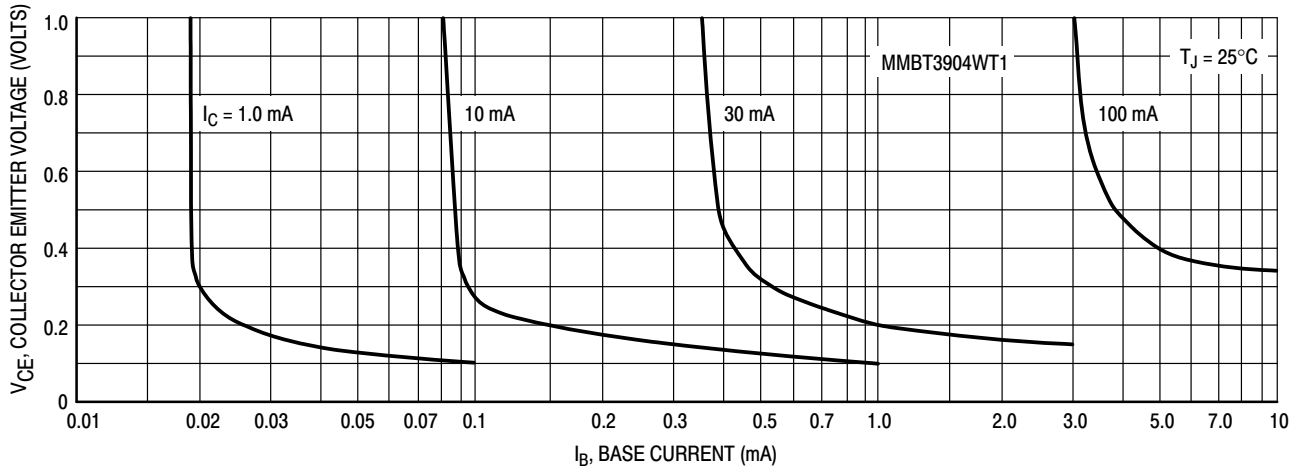


Figure 14. Collector Saturation Region

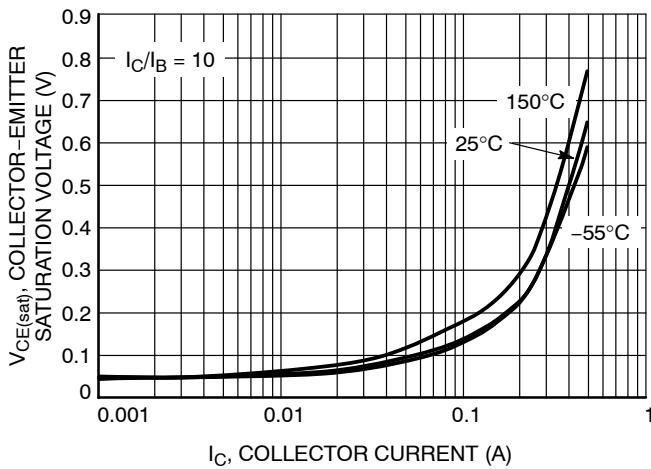


Figure 15. Collector-Emitter Saturation Voltage vs. Collector Current

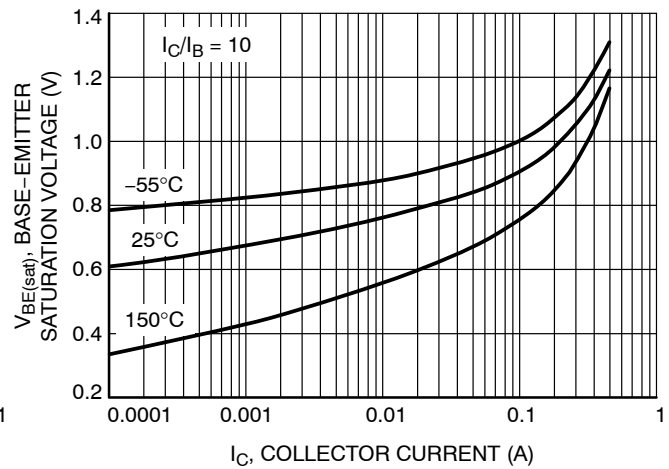


Figure 16. Base-Emitter Saturation Voltage vs. Collector Current

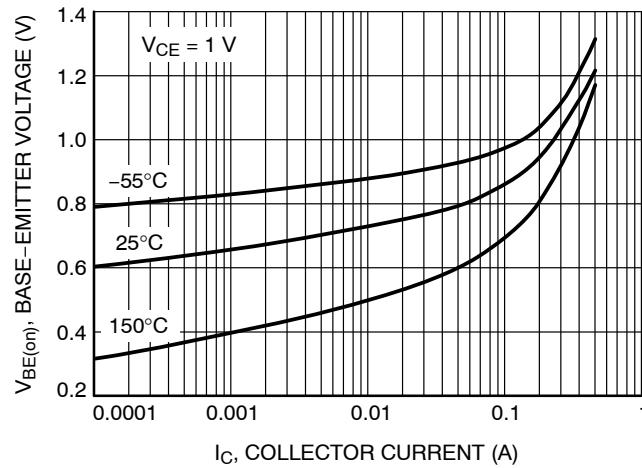


Figure 17. Base-Emitter Voltage vs. Collector Current

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

MMBT3904WT1, SMMBT3904WT1

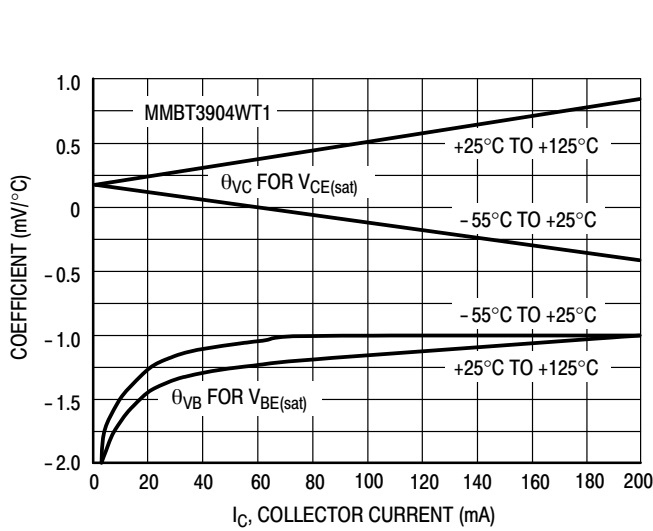


Figure 18. Temperature Coefficients

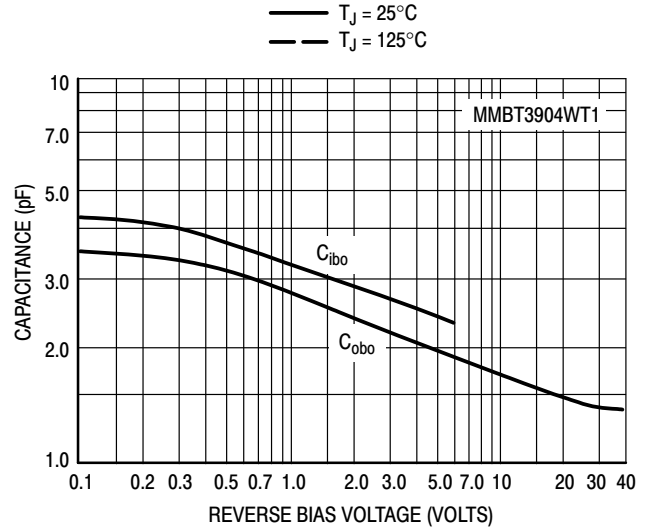


Figure 19. Capacitance

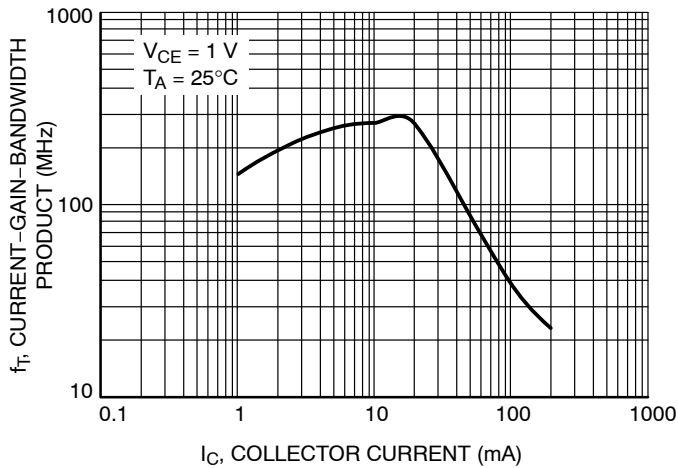


Figure 20. Current Gain Bandwidth Product vs. Collector Current

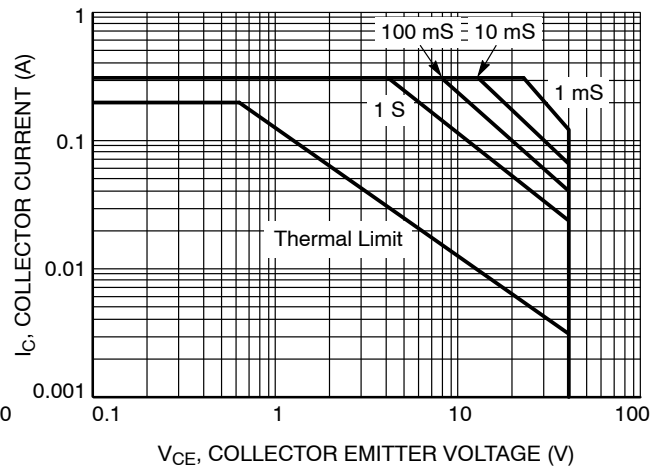


Figure 21. Safe Operating Area

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

MMBT3906WT1, SMMBT3906WT1

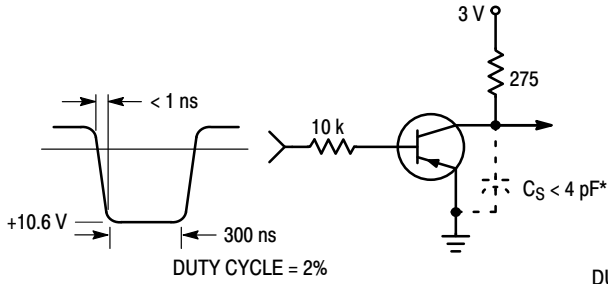


Figure 22. Delay and Rise Time Equivalent Test Circuit

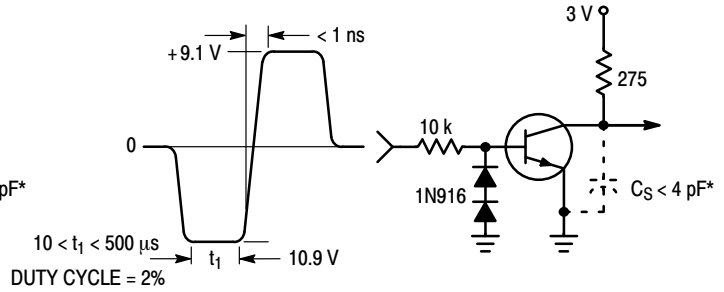


Figure 23. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

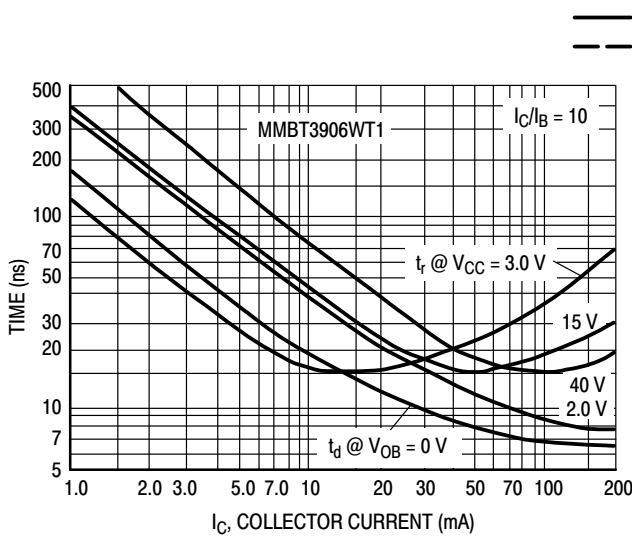


Figure 24. Turn-On Time

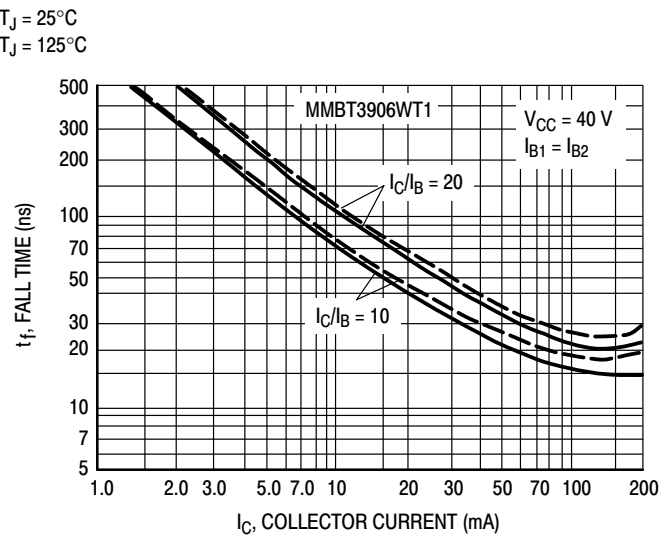


Figure 25. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

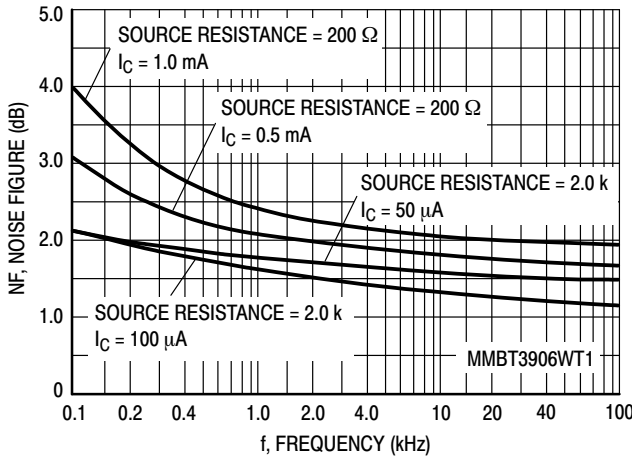


Figure 26.

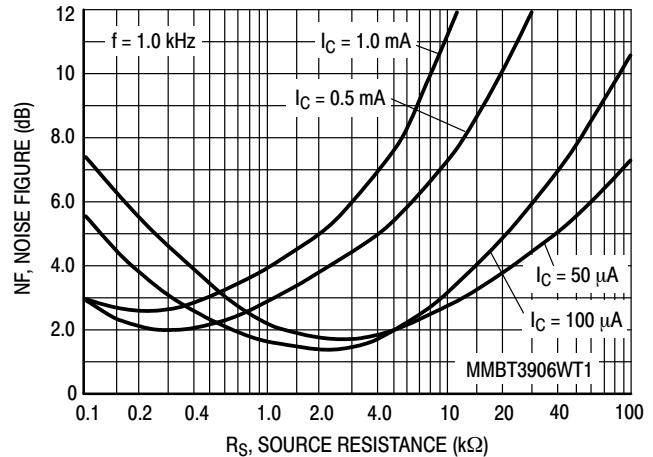


Figure 27.

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

MMBT3906WT1, SMMBT3906WT1

H PARAMETERS

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

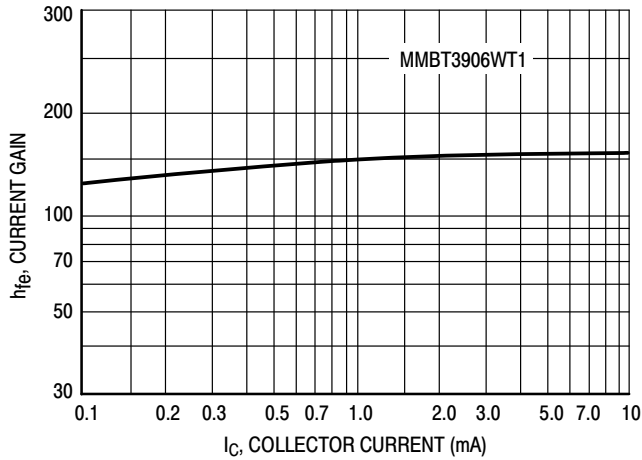


Figure 28. Current Gain

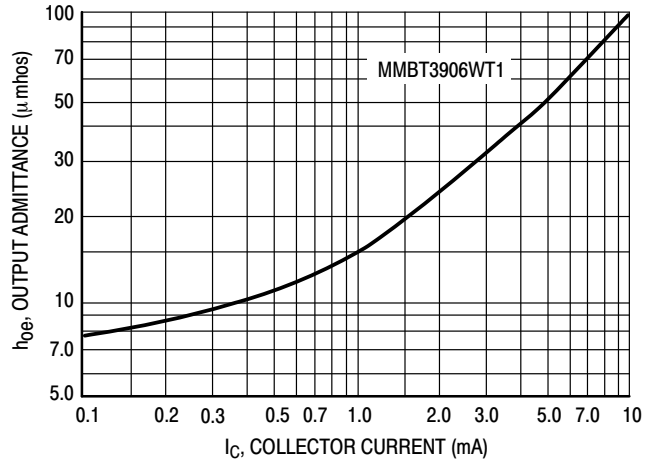


Figure 29. Output Admittance

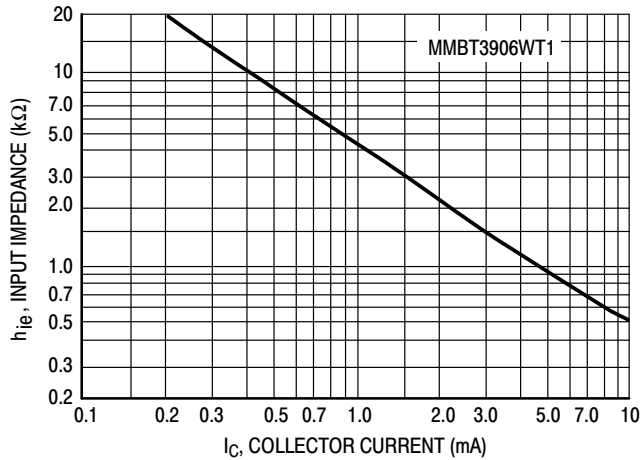


Figure 30. Input Impedance

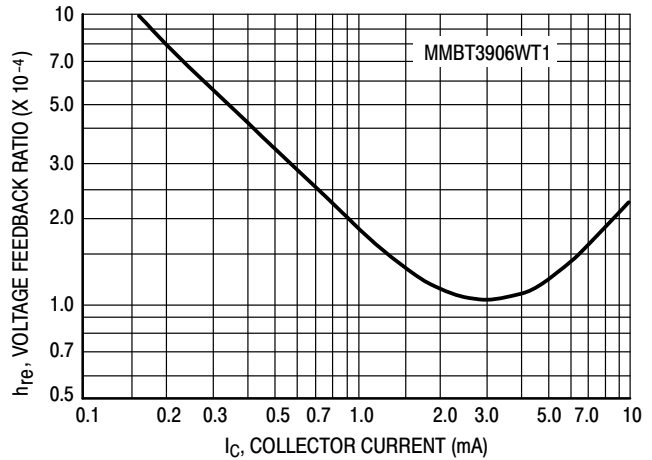


Figure 31. Voltage Feedback Ratio

STATIC CHARACTERISTICS

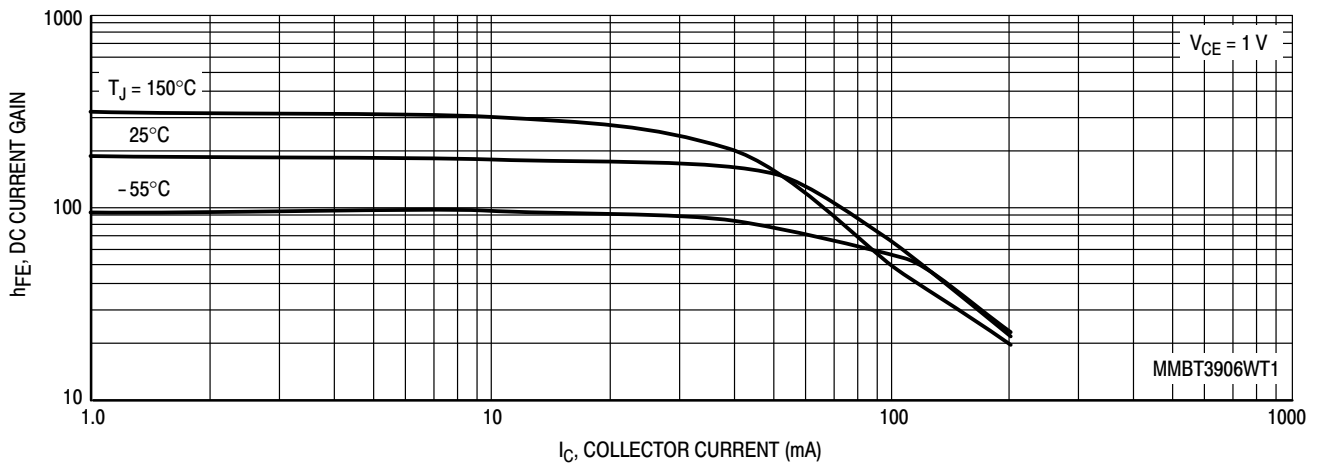


Figure 32. DC Current Gain

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

MMBT3906WT1, SMMBT3906WT1

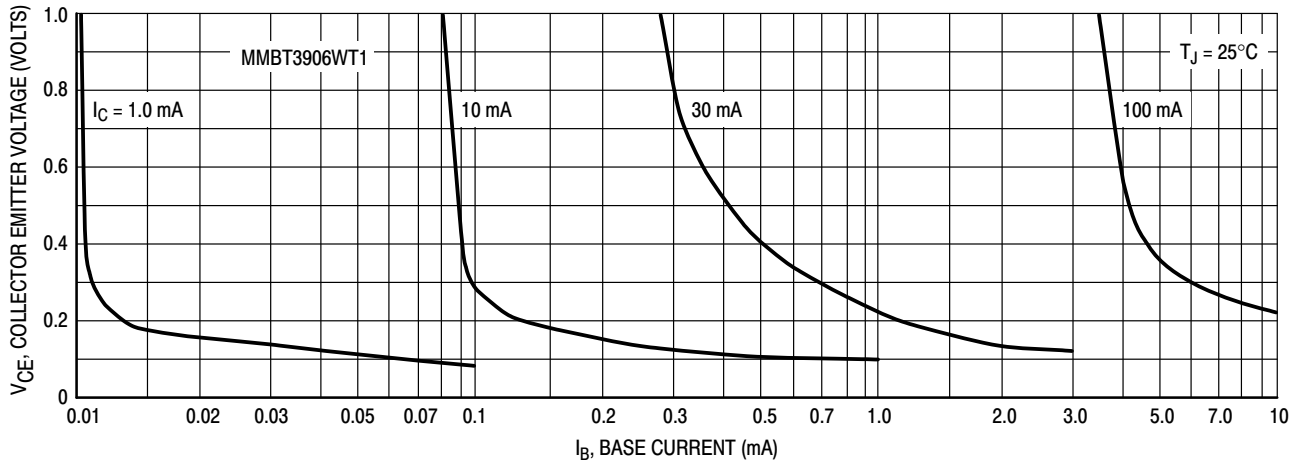


Figure 33. Collector Saturation Region

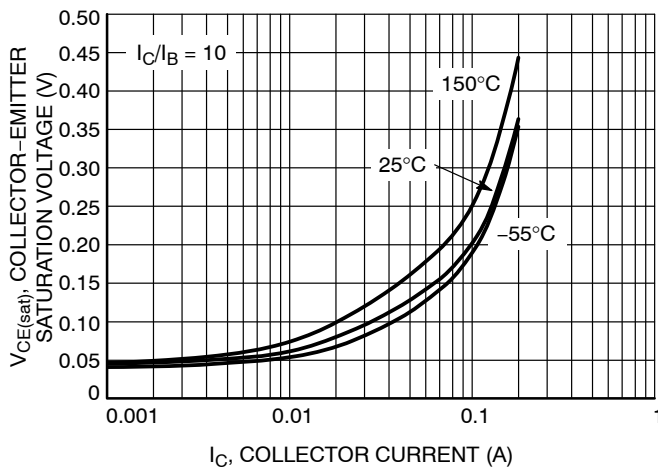


Figure 34. Collector Emitter Saturation Voltage vs. Collector Current

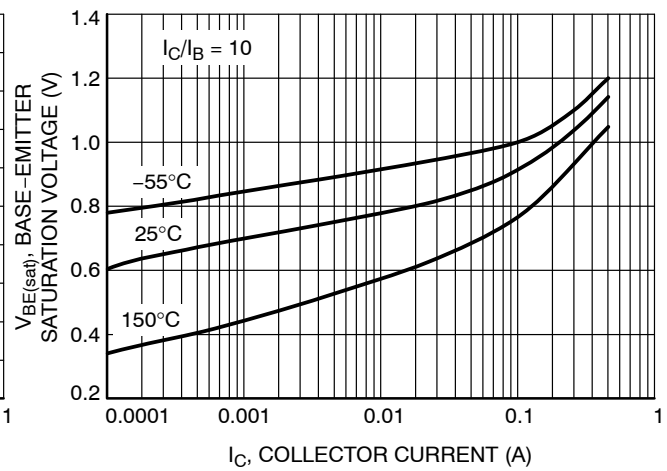


Figure 35. Base Emitter Saturation Voltage vs. Collector Current

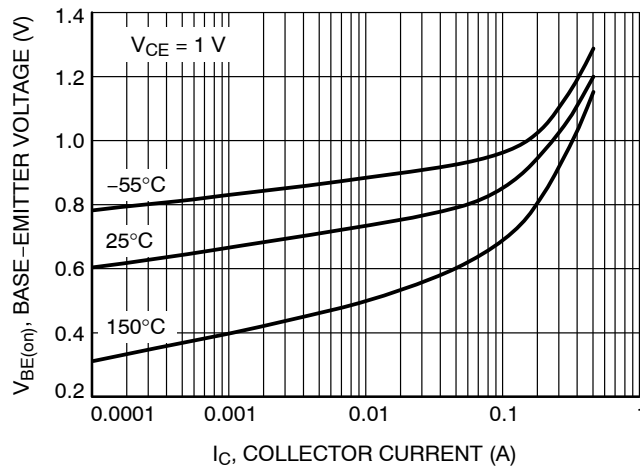


Figure 36. Base Emitter Voltage vs. Collector Current

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

MMBT3906WT1, SMMBT3906WT1

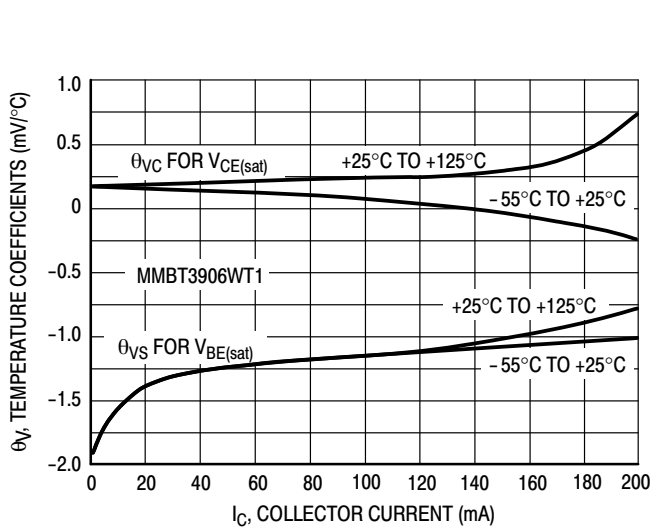


Figure 37. Temperature Coefficients

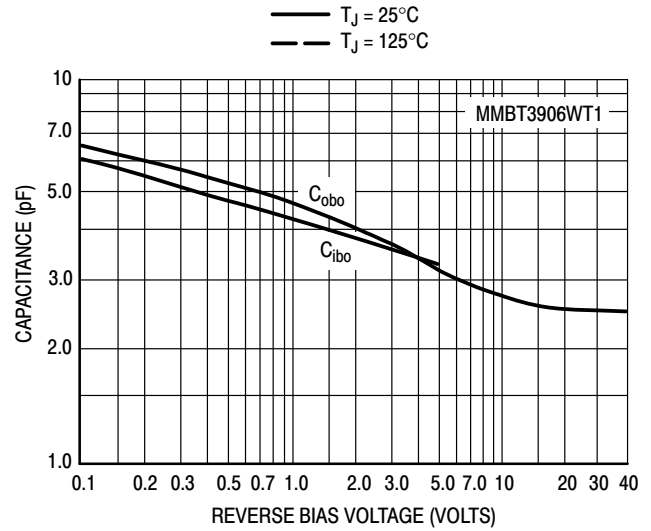


Figure 38. Capacitance

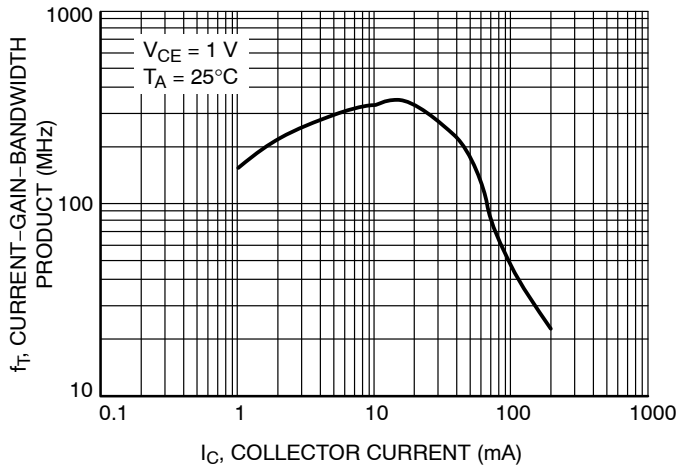


Figure 39. Current Gain Bandwidth Product vs. Collector Current

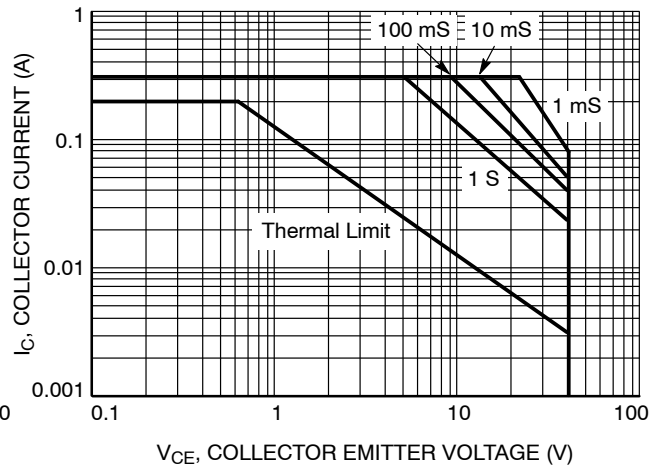


Figure 40. Safe Operating Area

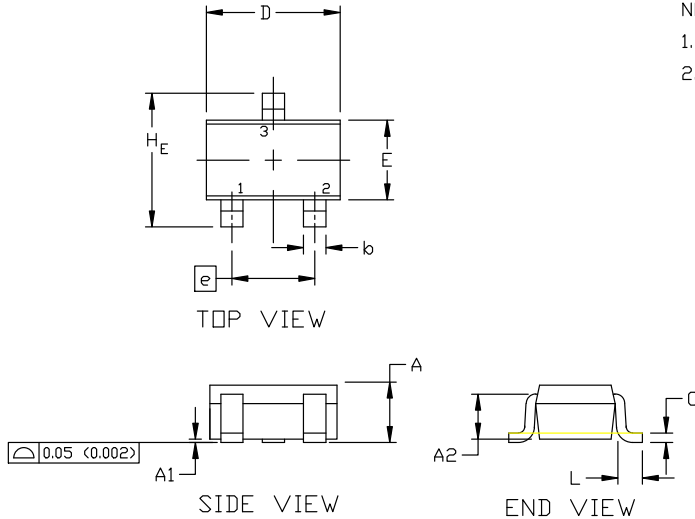
MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 4:1

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

DATE 11 OCT 2022



NOTES:

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

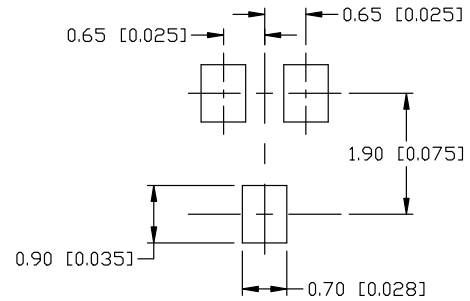
DIM	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.80	0.90	1.00	0.032	0.035	0.040
A1	0.00	0.05	0.10	0.000	0.002	0.004
A2	0.70 REF			0.028 BSC		
b	0.30	0.35	0.40	0.012	0.014	0.016
c	0.10	0.18	0.25	0.004	0.007	0.010
D	1.80	2.00	2.20	0.071	0.080	0.087
E	1.15	1.24	1.35	0.045	0.049	0.053
e	1.20	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 |

DOCUMENT NUMBER:	98ASB42819B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	SC-70 (SOT-323)	PAGE 1 OF 1

onsemi and ONSEMI are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi 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. onsemi does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** 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. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** 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. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** 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 **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales

