

MMBT3904TT1

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

- Pb-Free Package is Available

MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$)

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) @ $T_A = 25^\circ\text{C}$ Derated above 25°C	P_D	200 1.6	mW mW/ $^\circ\text{C}$
Thermal Resistance, Junction- to- Ambient (Note 1)	$R_{\theta JA}$	600	$^\circ\text{C/W}$
Total Device Dissipation, FR-4 Board (Note 2) @ $T_A = 25^\circ\text{C}$ Derated above 25°C	P_D	300 2.4	mW mW/ $^\circ\text{C}$
Thermal Resistance, Junction- to- Ambient (Note 2)	$R_{\theta JA}$	400	$^\circ\text{C/W}$
Junction and Storage Temperature Range	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.

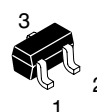
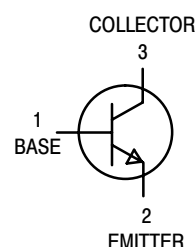
- FR-4 @ Minimum Pad
- FR-4 @ 1.0×1.0 Inch Pad



ON Semiconductor®

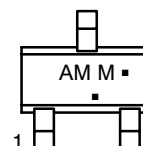
<http://onsemi.com>

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 [†]
MMBT3904TT1	SOT-416	3000 Tape & Reel
MMBT3904TT1G	SOT-416 (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.

MMBT3904TT1

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)	MMBT3904TT1	t _d	-	35	ns
Rise Time	(I _C = 10 mA, I _{B1} = 1.0 mA)	MMBT3904TT1	t _r	-	35	
Storage Time	(V _{CC} = 3.0 Vdc, I _C = 10 mA)	MMBT3904TT1	t _s	-	200	ns
Fall Time	(I _{B1} = I _{B2} = 1.0 mA)	MMBT3904TT1	t _f	-	50	

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

MMBT3904TT1

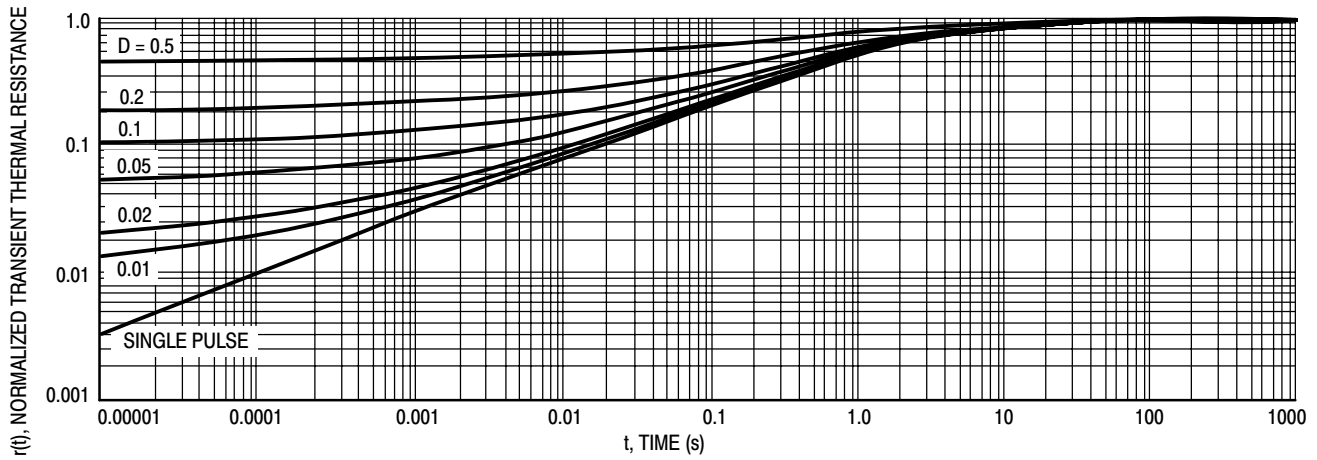


Figure 1. Normalized Thermal Response

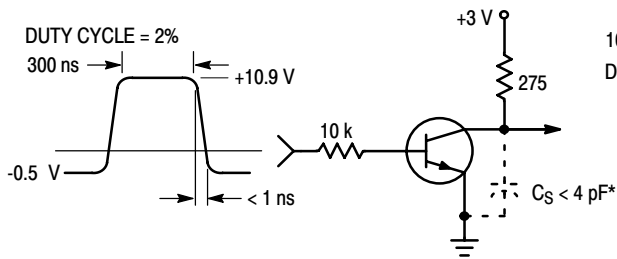


Figure 2. Delay and Rise Time Equivalent Test Circuit

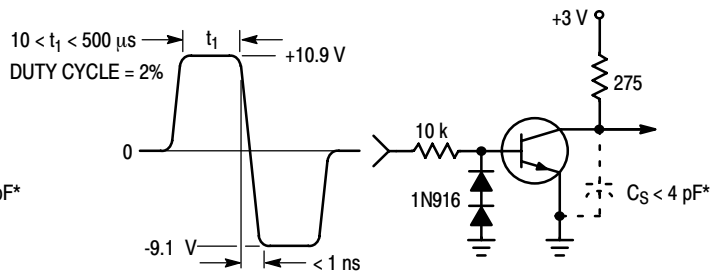


Figure 3. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

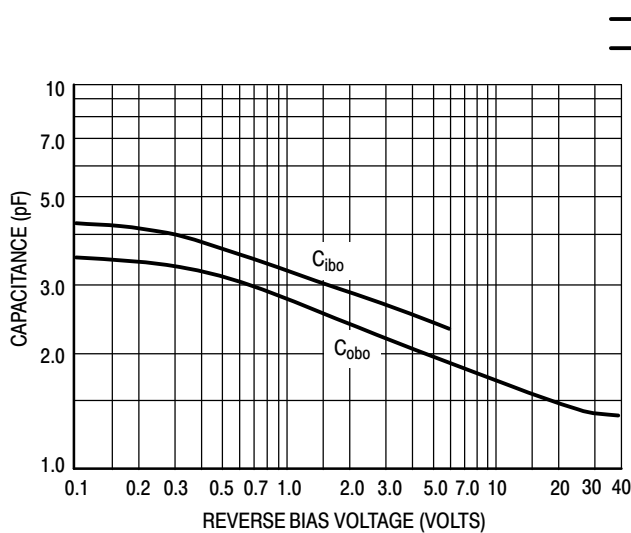


Figure 4. Capacitance

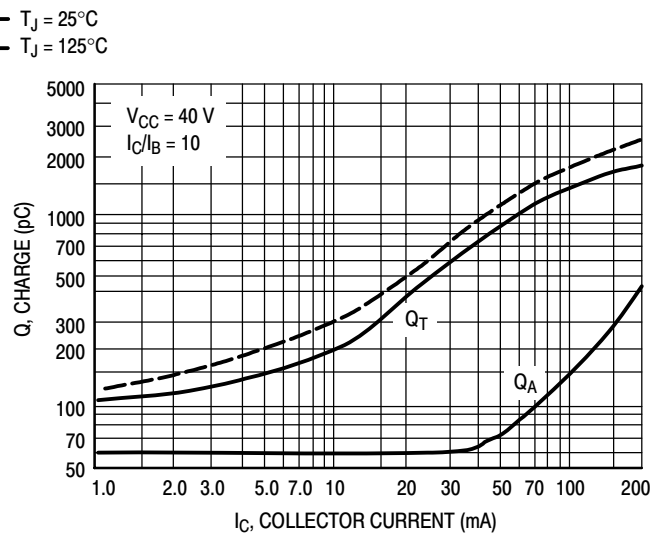


Figure 5. Charge Data

MMBT3904TT1

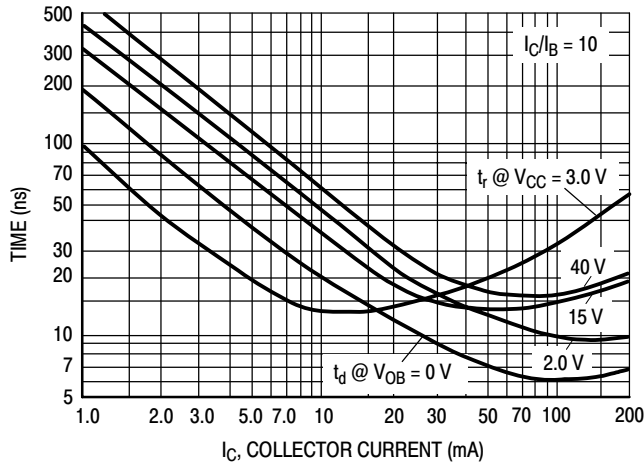


Figure 6. Turn-On Time

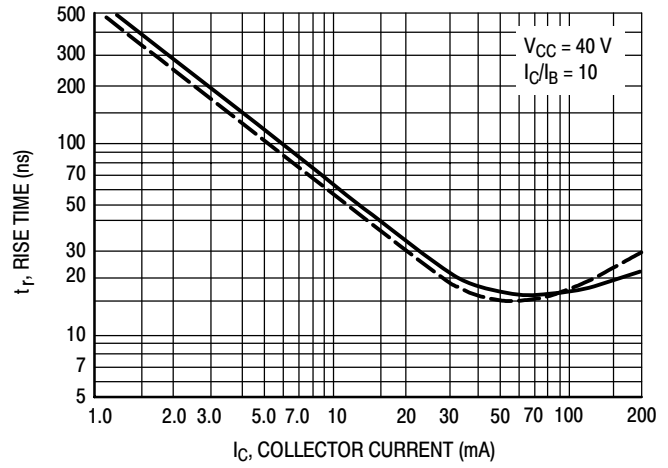


Figure 7. Rise Time

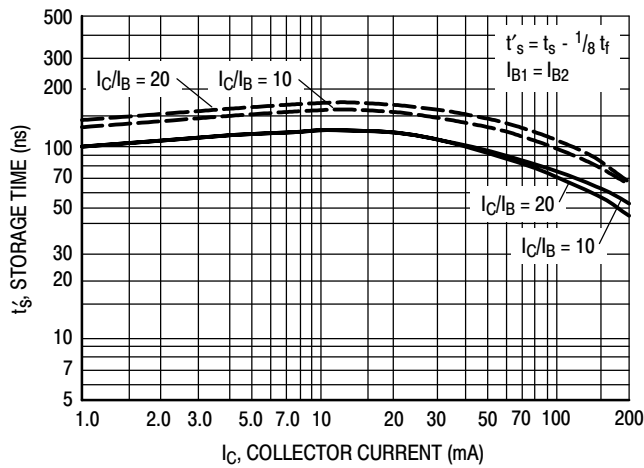


Figure 8. Storage Time

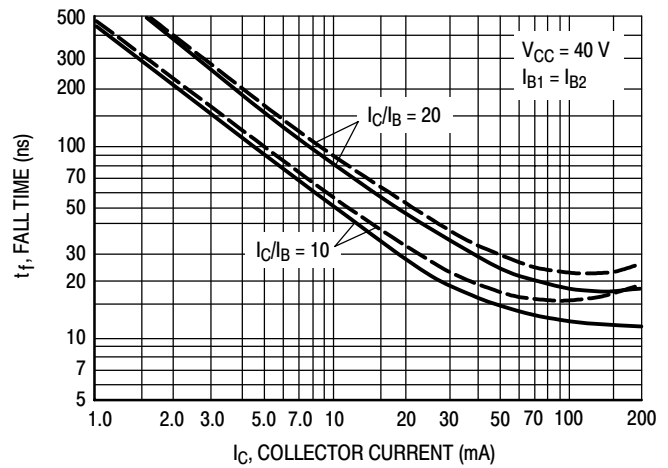


Figure 9. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

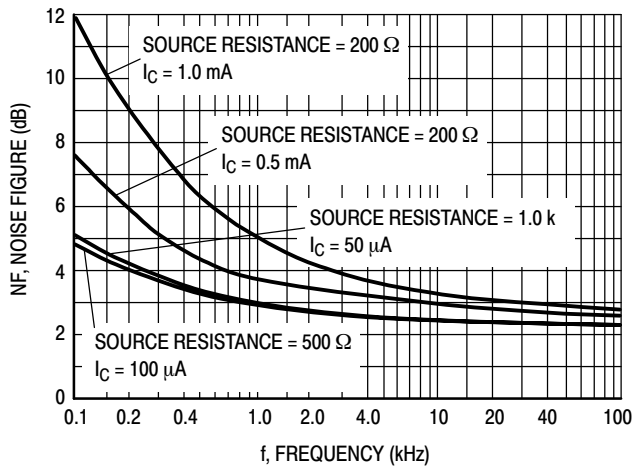


Figure 10. Noise Figure

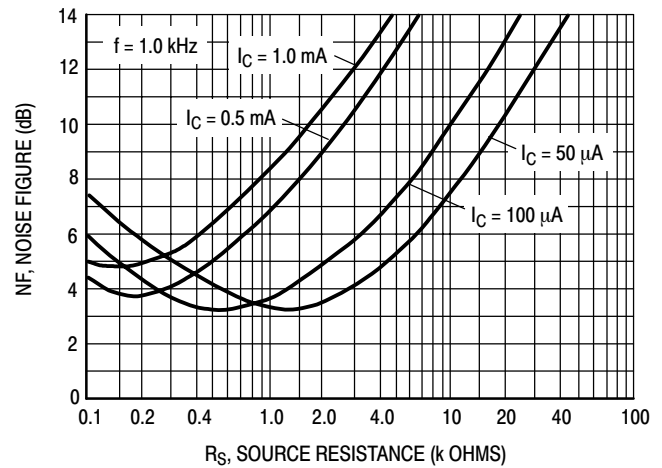


Figure 11. Noise Figure

MMBT3904TT1

h PARAMETERS

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

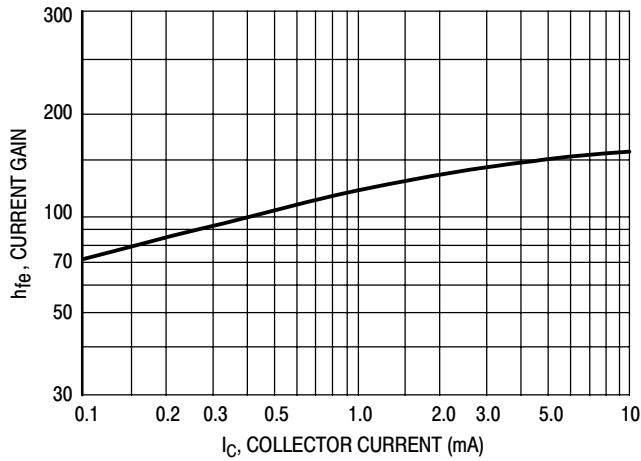


Figure 12. Current Gain

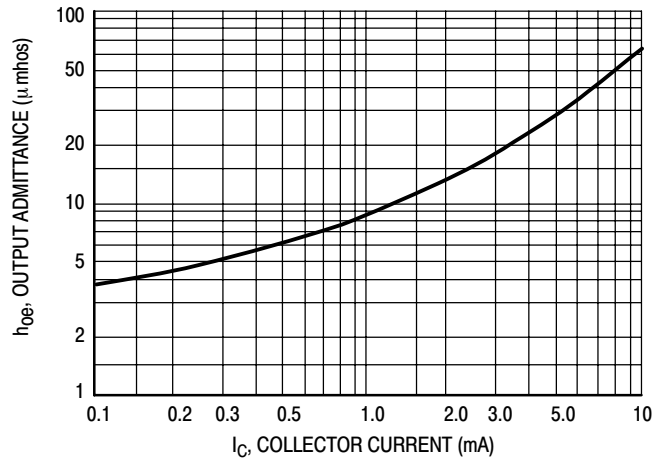


Figure 13. Output Admittance

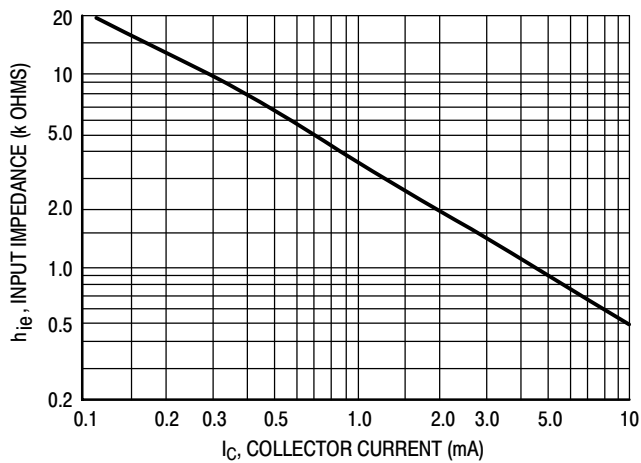


Figure 14. Input Impedance

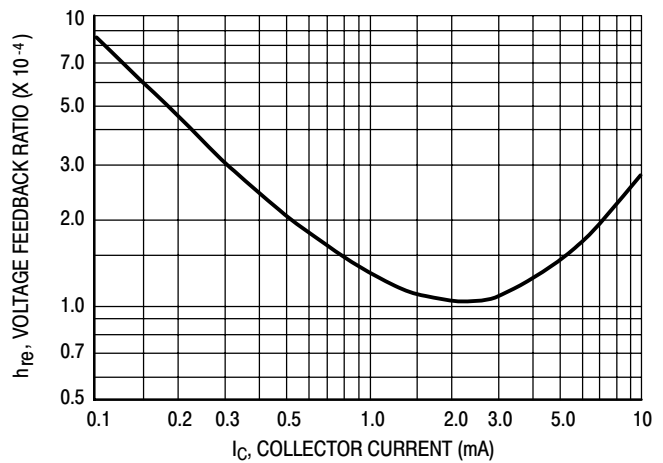


Figure 15. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

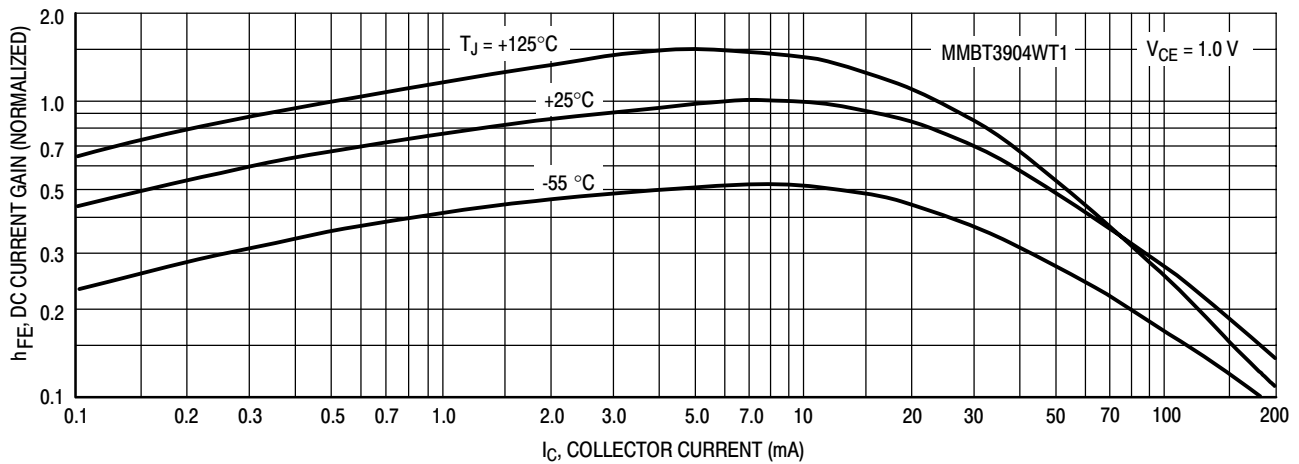


Figure 16. DC Current Gain

MMBT3904TT1

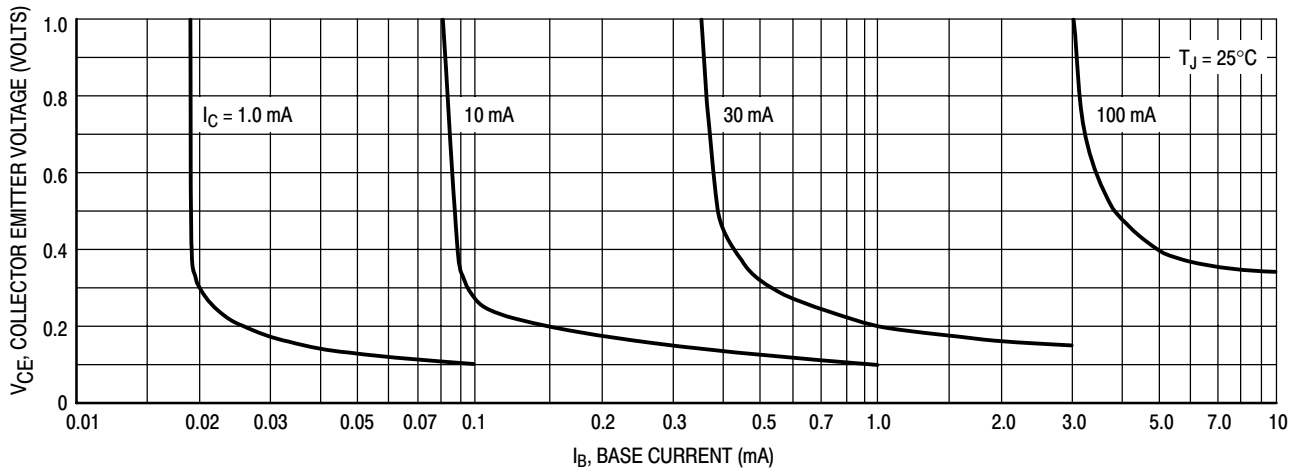


Figure 17. Collector Saturation Region

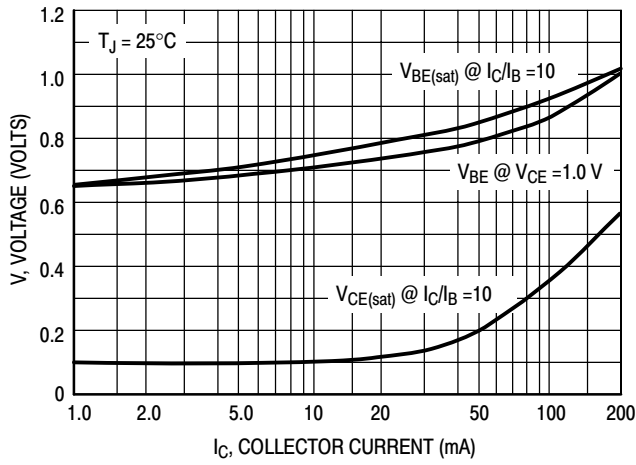


Figure 18. "ON" Voltages

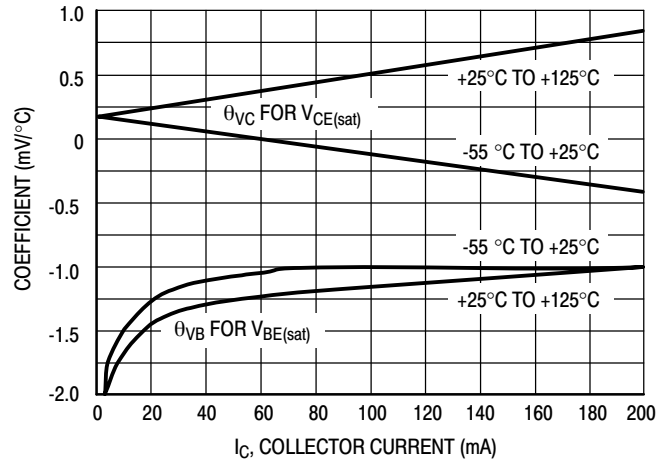
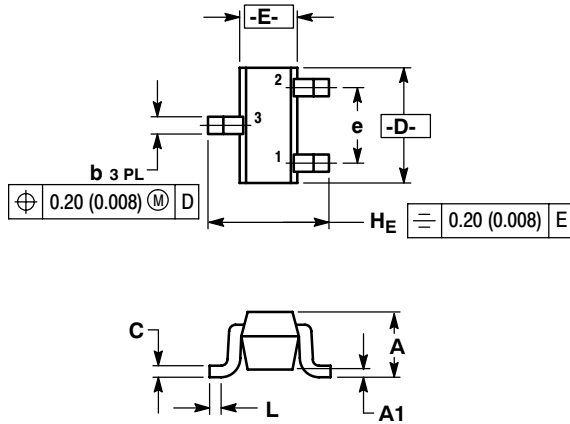


Figure 19. Temperature Coefficients

MMBT3904TT1

PACKAGE DIMENSIONS

SC-75/SOT-416
CASE 463-01
ISSUE F



NOTES:

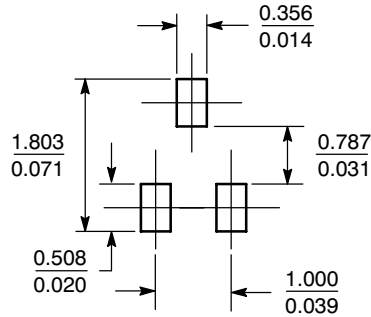
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

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	0.059	0.063	0.067
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	0.061	0.063	0.065

STYLE 1:

- PIN 1. BASE
- EMITTER
- COLLECTOR

SOLDERING FOOTPRINT*



SCALE 10:1 (mm/inches)

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/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: 81-3-5773-3850

ON Semiconductor Website: www.onsemi.com

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

For additional information, please contact your local
Sales Representative

MMBT3904TT1/D