

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

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

Rating	Symbol	Value	Unit
Collector – Emitter Voltage	V_{CE0}	40	Vdc
Collector – Base Voltage	V_{CB0}	60	Vdc
Emitter – Base Voltage	V_{EB0}	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	$^\circ\text{C}/\text{W}$
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	$^\circ\text{C}/\text{W}$
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.

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.



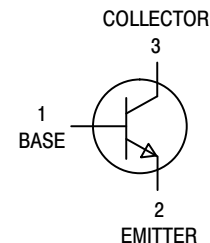
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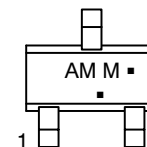
GENERAL PURPOSE AMPLIFIER TRANSISTORS SURFACE MOUNT



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

Characteristic	Symbol	Min	Max	Unit
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OFF CHARACTERISTICS

Collector – Emitter Breakdown Voltage (Note 3) ($I_C = 1.0\text{ mA}$, $I_B = 0$)	$V_{(BR)CEO}$	40	–	Vdc
Collector – Base Breakdown Voltage ($I_C = 10\text{ }\mu\text{A}$, $I_E = 0$)	$V_{(BR)CBO}$	60	–	Vdc
Emitter – Base Breakdown Voltage ($I_E = 10\text{ }\mu\text{A}$, $I_C = 0$)	$V_{(BR)EBO}$	6.0	–	Vdc
Base Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $V_{EB} = 3.0\text{ Vdc}$)	I_{BL}	–	50	nAdc
Collector Cutoff Current ($V_{CE} = 30\text{ Vdc}$, $V_{EB} = 3.0\text{ Vdc}$)	I_{CEX}	–	50	nAdc

ON CHARACTERISTICS (Note 3)

DC Current Gain ($I_C = 0.1\text{ mA}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 1.0\text{ mA}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 10\text{ mA}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 50\text{ mA}$, $V_{CE} = 1.0\text{ Vdc}$) ($I_C = 100\text{ mA}$, $V_{CE} = 1.0\text{ Vdc}$)	h_{FE}	40 70 100 60 30	– – 300 – –	–
Collector – Emitter Saturation Voltage ($I_C = 10\text{ mA}$, $I_B = 1.0\text{ mA}$) ($I_C = 50\text{ mA}$, $I_B = 5.0\text{ mA}$)	$V_{CE(sat)}$	– –	0.2 0.3	Vdc
Base – Emitter Saturation Voltage ($I_C = 10\text{ mA}$, $I_B = 1.0\text{ mA}$) ($I_C = 50\text{ mA}$, $I_B = 5.0\text{ mA}$)	$V_{BE(sat)}$	0.65 –	0.85 0.95	Vdc

SMALL-SIGNAL CHARACTERISTICS

Current – Gain – Bandwidth Product ($I_C = 10\text{ mA}$, $V_{CE} = 20\text{ Vdc}$, $f = 100\text{ MHz}$)	f_T	300	–	MHz
Output Capacitance ($V_{CB} = 5.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$)	C_{obo}	–	4.0	pF
Input Capacitance ($V_{EB} = 0.5\text{ Vdc}$, $I_C = 0$, $f = 1.0\text{ MHz}$)	C_{ibo}	–	8.0	pF
Input Impedance ($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mA}$, $f = 1.0\text{ kHz}$)	h_{ie}	1.0	10	k Ω
Voltage Feedback Ratio ($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mA}$, $f = 1.0\text{ kHz}$)	h_{re}	0.5	8.0	$\times 10^{-4}$
Small – Signal Current Gain ($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mA}$, $f = 1.0\text{ kHz}$)	h_{fe}	100	400	–
Output Admittance ($V_{CE} = 10\text{ Vdc}$, $I_C = 1.0\text{ mA}$, $f = 1.0\text{ kHz}$)	h_{oe}	1.0	40	μmhos
Noise Figure ($V_{CE} = 5.0\text{ Vdc}$, $I_C = 100\text{ }\mu\text{A}$, $R_S = 1.0\text{ k}\Omega$, $f = 1.0\text{ kHz}$)	NF	–	5.0	dB

SWITCHING CHARACTERISTICS

Delay Time ($V_{CC} = 3.0\text{ Vdc}$, $V_{BE} = -0.5\text{ Vdc}$) MMBT3904TT1G, SMMBT3904TT1G	t_d	–	35	ns
Rise Time ($I_C = 10\text{ mA}$, $I_{B1} = 1.0\text{ mA}$) MMBT3904TT1G, SMMBT3904TT1G	t_r	–	35	
Storage Time ($V_{CC} = 3.0\text{ Vdc}$, $I_C = 10\text{ mA}$) MMBT3904TT1G, SMMBT3904TT1G	t_s	–	200	
Fall Time ($I_{B1} = I_{B2} = 1.0\text{ mA}$) MMBT3904TT1G, SMMBT3904TT1G	t_f	–	50	

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

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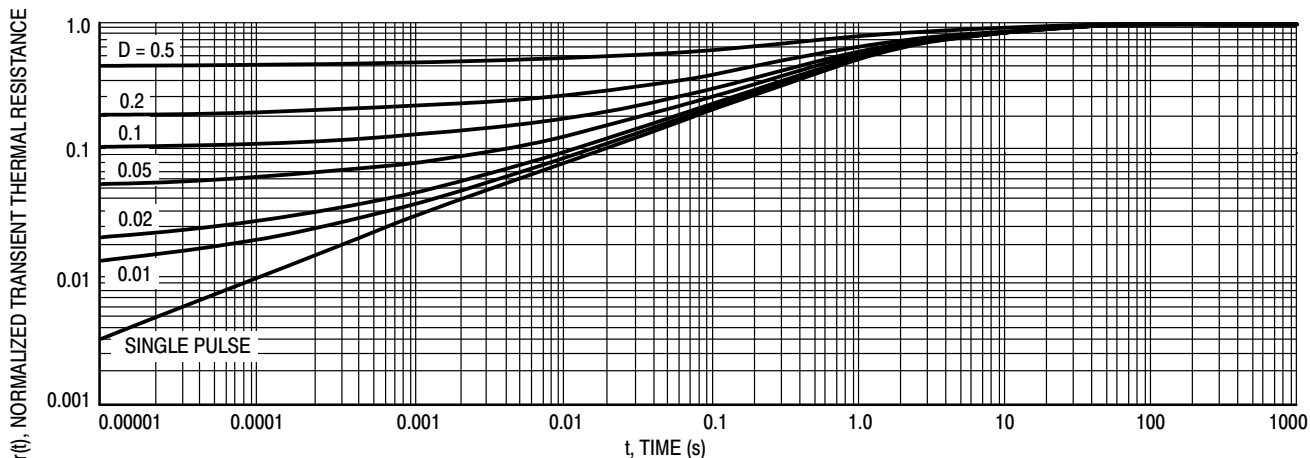


Figure 1. Normalized Thermal Response

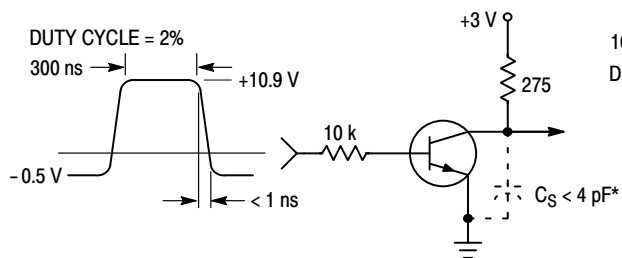


Figure 2. Delay and Rise Time Equivalent Test Circuit

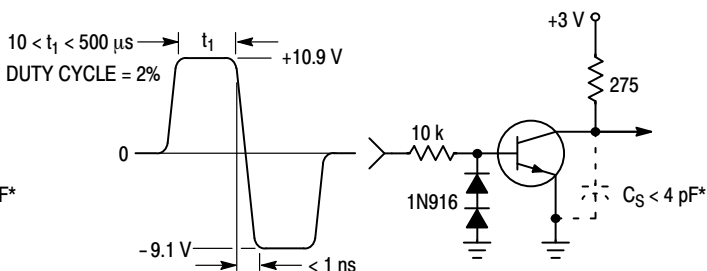


Figure 3. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

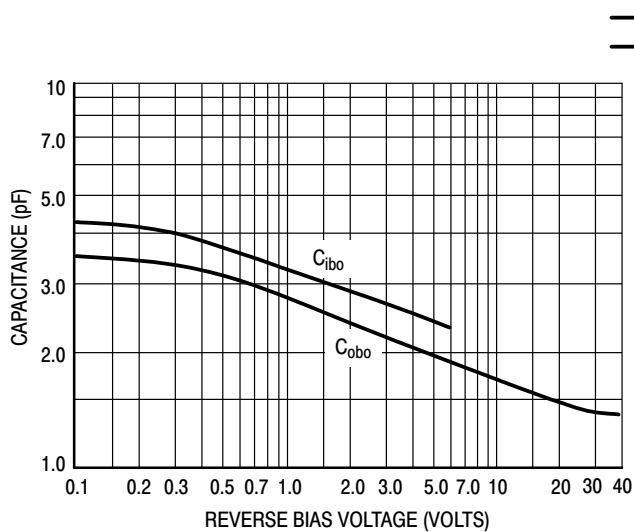


Figure 4. Capacitance

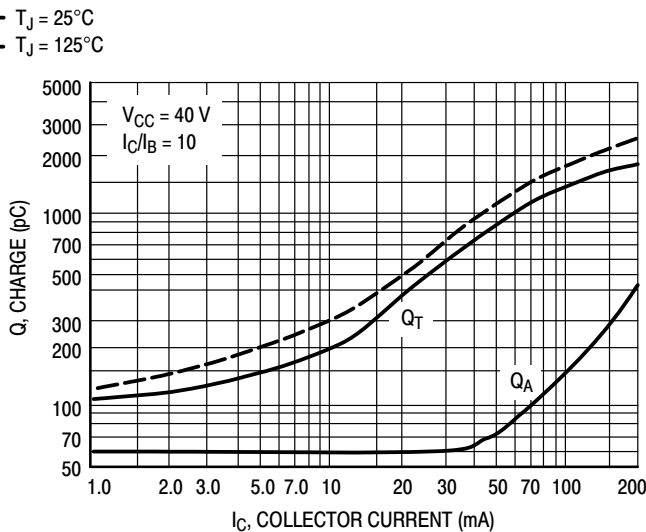


Figure 5. Charge Data

MMBT3904TT1G, SMMBT3904TT1G

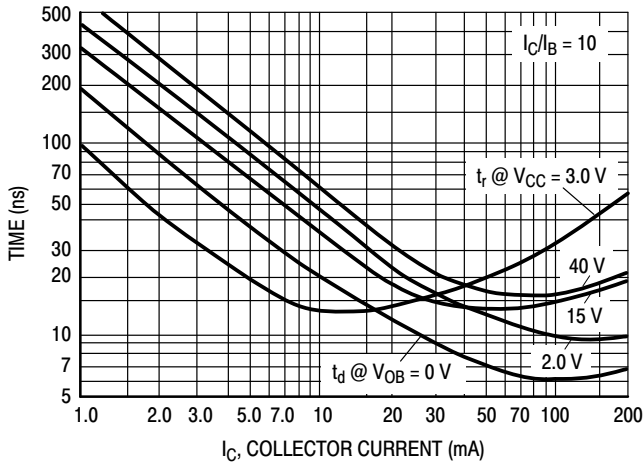


Figure 6. Turn-On Time

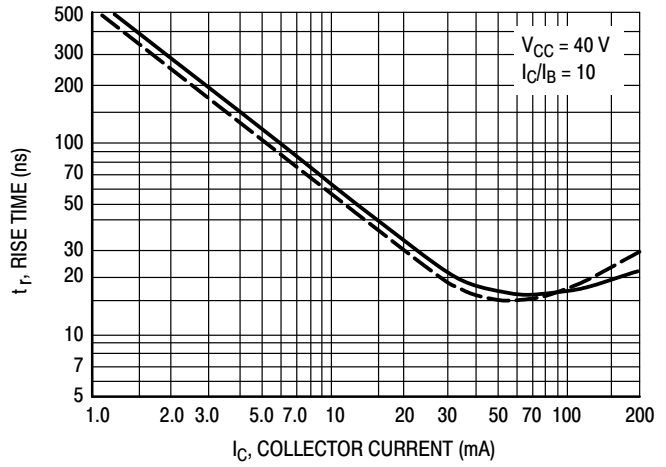


Figure 7. Rise Time

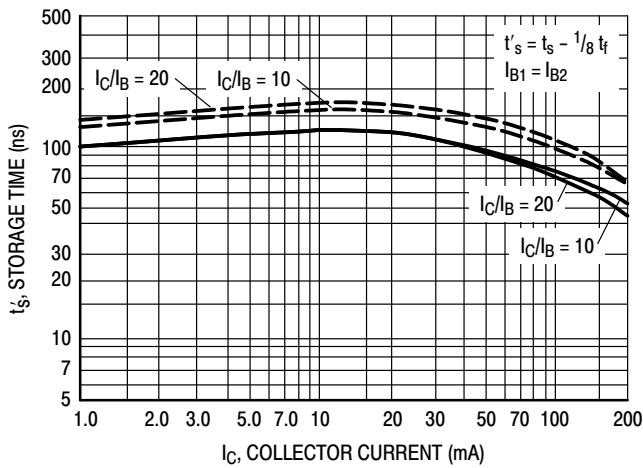


Figure 8. Storage Time

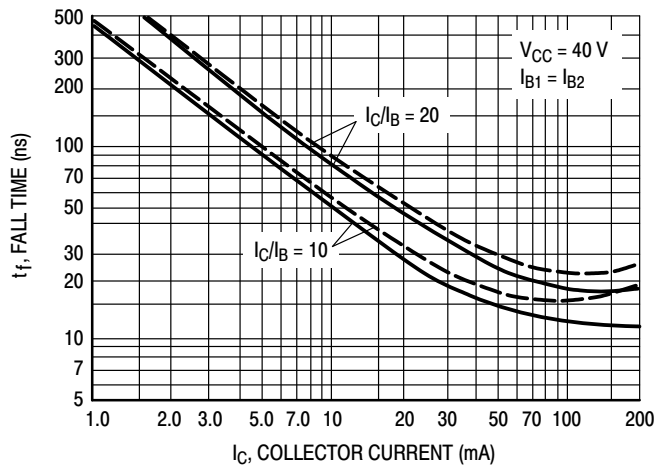


Figure 9. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

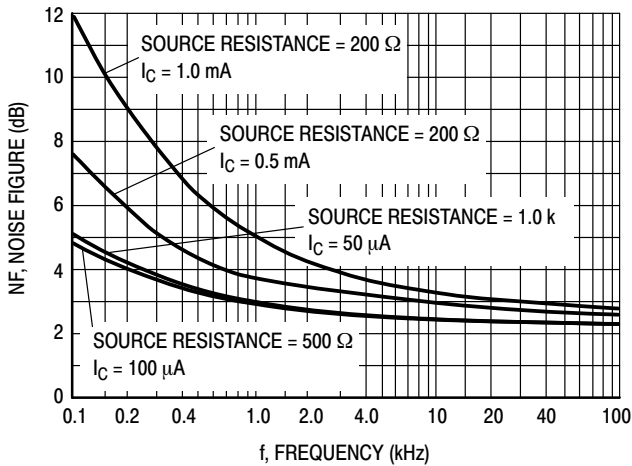


Figure 10. Noise Figure

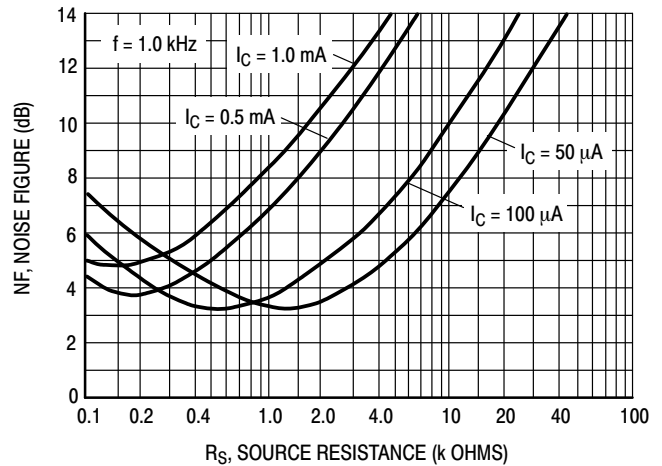


Figure 11. Noise Figure

MMBT3904TT1G, SMMBT3904TT1G

h PARAMETERS

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

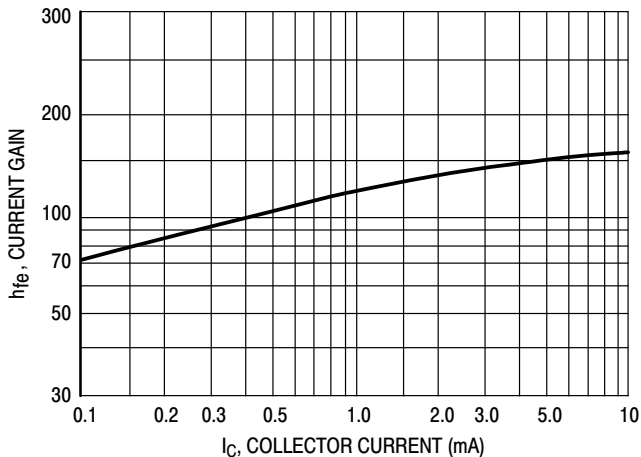


Figure 12. Current Gain

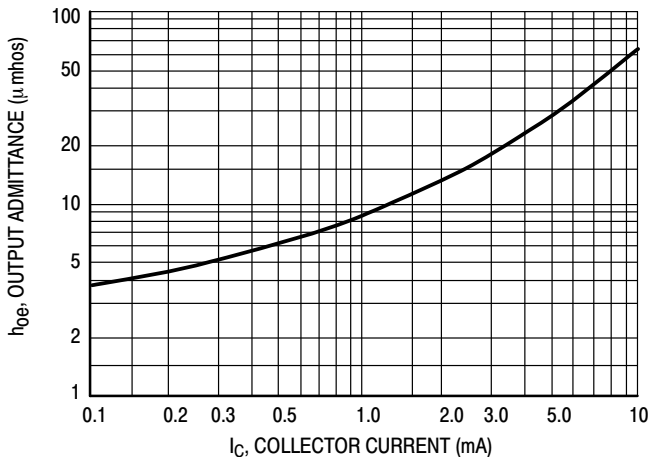


Figure 13. Output Admittance

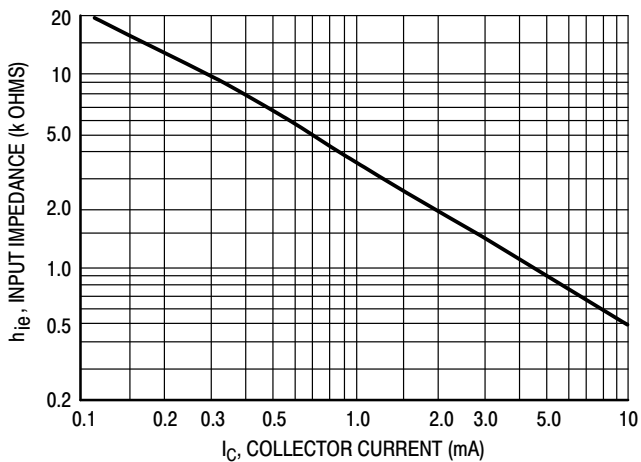


Figure 14. Input Impedance

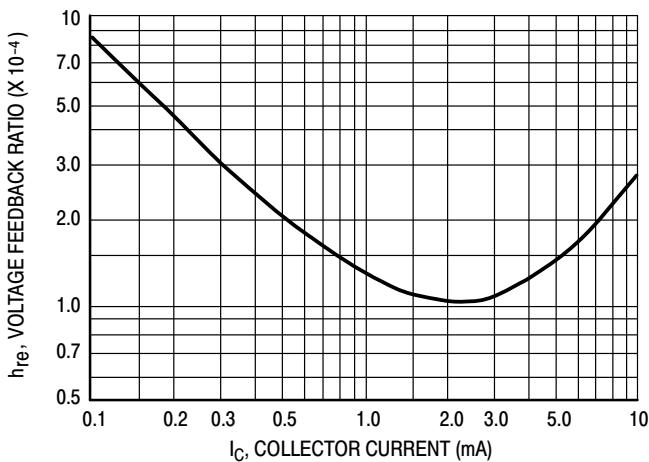


Figure 15. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

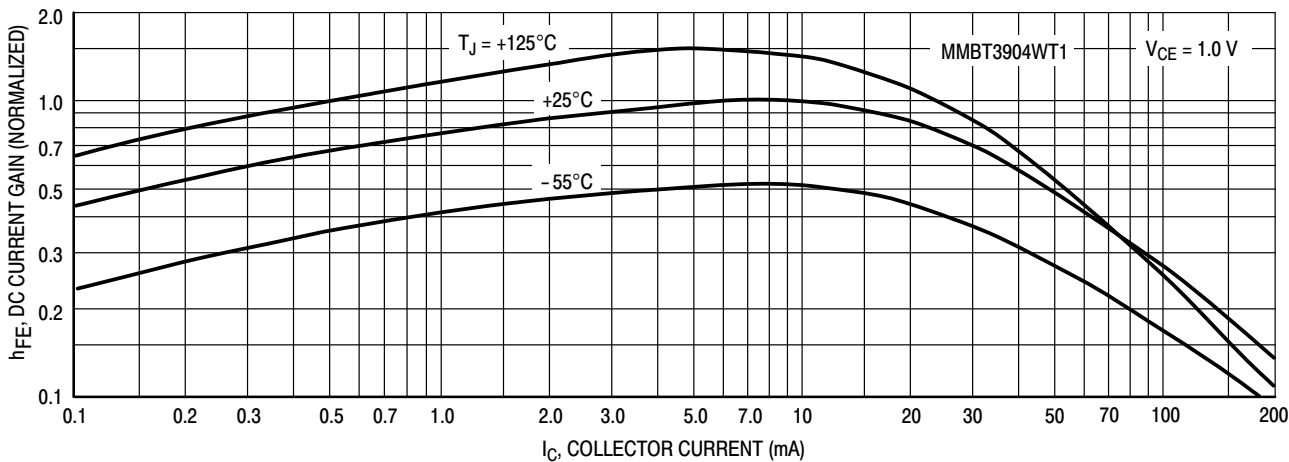


Figure 16. DC Current Gain

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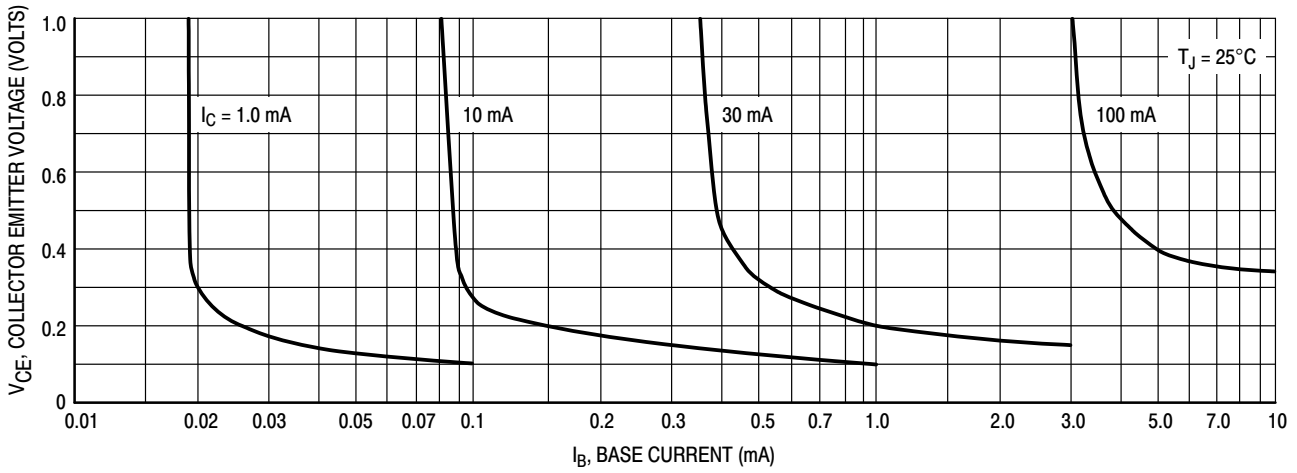


Figure 17. Collector Saturation Region

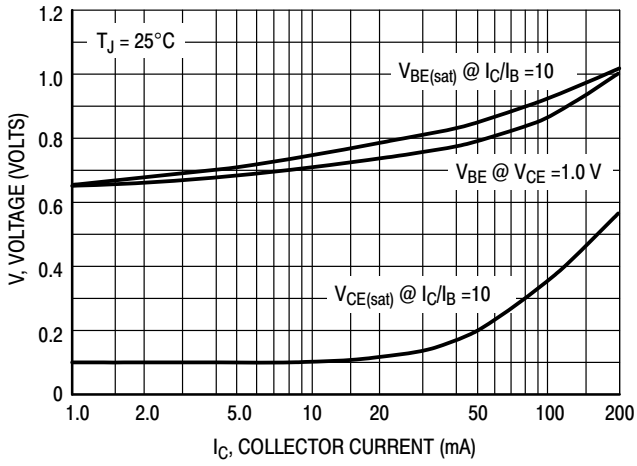


Figure 18. "ON" Voltages

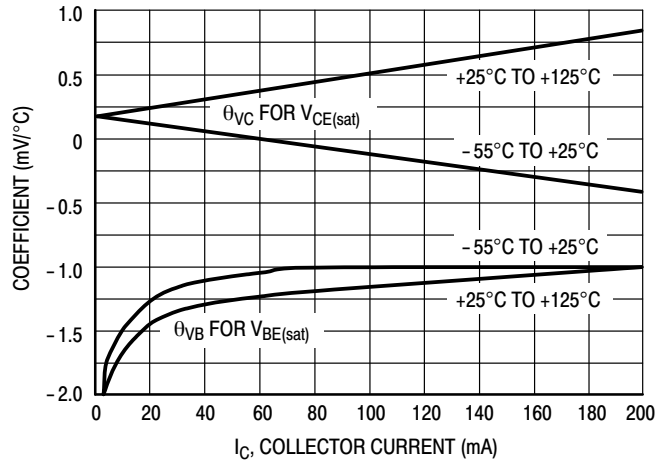
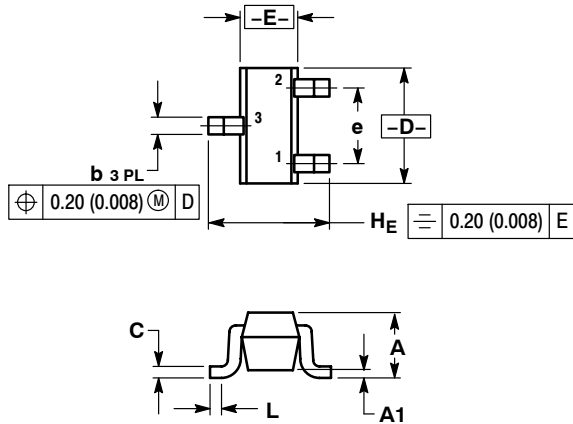


Figure 19. Temperature Coefficients

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PACKAGE DIMENSIONS

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



NOTES:

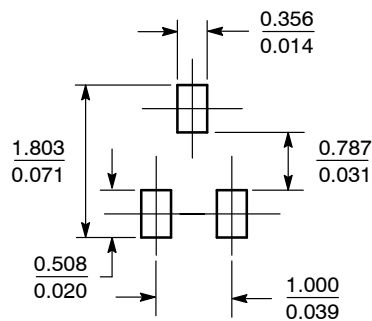
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

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
HE	1.50	1.60	1.70	0.061	0.063	0.065

STYLE 1:

1. BASE
2. EMITTER
3. 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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Телефон: +7 812 627 14 35

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