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

- 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 ($T_A = 25°C$)

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) @$T_A = 25°C$ Derated above 25°C	P_D	200 1.6	mW mW/°C
Thermal Resistance, Junction–to–Ambient (Note 1)	$R_{\theta JA}$	600	°C/W
Total Device Dissipation, FR–4 Board (Note 2) @$T_A = 25°C$ Derated above 25°C	P_D	300 2.4	mW mW/°C
Thermal Resistance, Junction–to–Ambient (Note 2)	$R_{\theta JA}$	400	°C/W
Junction and Storage Temperature Range	T_J, T_{stg}	–65 to +150	°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. 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.
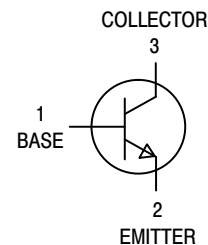
GENERAL PURPOSE AMPLIFIER TRANSISTORS SURFACE MOUNT

SOT–416/SC–75 CASE 463 STYLE 1

COLLECTOR
3

1
BASE

2
EMITTER

MARKING DIAGRAM

AM M ▪

1
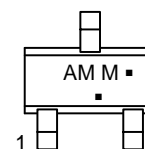
AM = Device Code
M = Date Code*
▪ = Pb–Free Package

(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.

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 mAdc, I_B = 0)	$V_{(BR)CEO}$	40	–	Vdc
Collector–Base Breakdown Voltage (I_C = 10 µAdc, I_E = 0)	$V_{(BR)CBO}$	60	–	Vdc
Emitter–Base Breakdown Voltage (I_E = 10 µAdc, 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 mAdc, V_{CE} = 1.0 Vdc) (I_C = 1.0 mAdc, V_{CE} = 1.0 Vdc) (I_C = 10 mAdc, V_{CE} = 1.0 Vdc) (I_C = 50 mAdc, V_{CE} = 1.0 Vdc) (I_C = 100 mAdc, V_{CE} = 1.0 Vdc)	h_{FE}	40 70 100 60 30	– – 300 – –	–
Collector–Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc) (I_C = 50 mAdc, I_B = 5.0 mAdc)	$V_{CE(sat)}$	– –	0.2 0.3	Vdc
Base–Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc) (I_C = 50 mAdc, I_B = 5.0 mAdc)	$V_{BE(sat)}$	0.65 –	0.85 0.95	Vdc
SMALL–SIGNAL CHARACTERISTICS				
Current–Gain – Bandwidth Product (I_C = 10 mAdc, 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 mAdc, f = 1.0 kHz)	h_{ie}	1.0	10	kΩ
Voltage Feedback Ratio (V_{CE} = 10 Vdc, I_C = 1.0 mAdc, 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 mAdc, f = 1.0 kHz)	h_{fe}	100	400	–
Output Admittance (V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	h_{oe}	1.0	40	µmhos
Noise Figure (V_{CE} = 5.0 Vdc, I_C = 100 µAdc, R_S = 1.0 kΩ, f = 1.0 kHz)	NF	–	5.0	dB
SWITCHING CHARACTERISTICS				
Delay Time (V_{CC} = 3.0 Vdc, V_{BE} = –0.5 Vdc) MMBT3904TT1G, SMMBT3904TT1G	t_d	–	35	ns
Rise Time (I_C = 10 mAdc, I_{B1} = 1.0 mAdc) MMBT3904TT1G, SMMBT3904TT1G	t_r	–	35	
Storage Time (V_{CC} = 3.0 Vdc, I_C = 10 mAdc) MMBT3904TT1G, SMMBT3904TT1G	t_s	–	200	
Fall Time (I_{B1} = I_{B2} = 1.0 mAdc) MMBT3904TT1G, SMMBT3904TT1G	t_f	–	50	

3. Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.
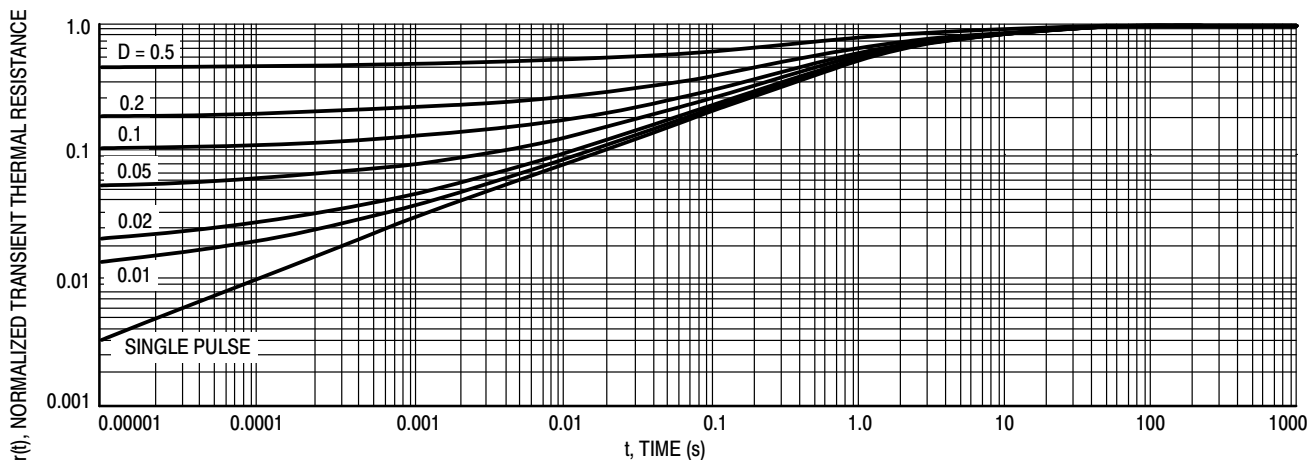
Figure 1. Normalized Thermal Response

* Total shunt capacitance of test jig and connectors
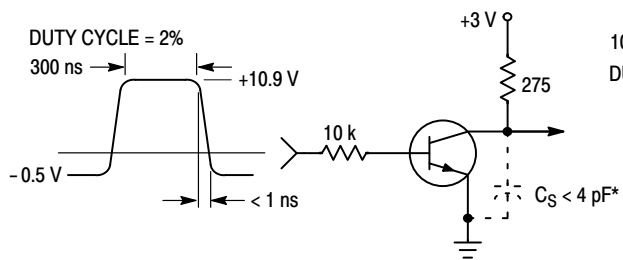
**Figure 2. Delay and Rise Time
Equivalent Test Circuit**
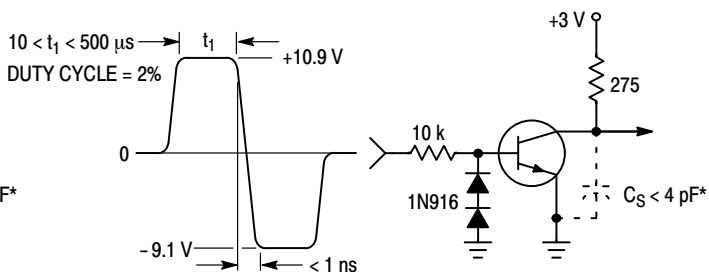
**Figure 3. Storage and Fall Time
Equivalent Test Circuit**

TYPICAL TRANSIENT CHARACTERISTICS

$T_J = 25°C$

$T_J = 125°C$
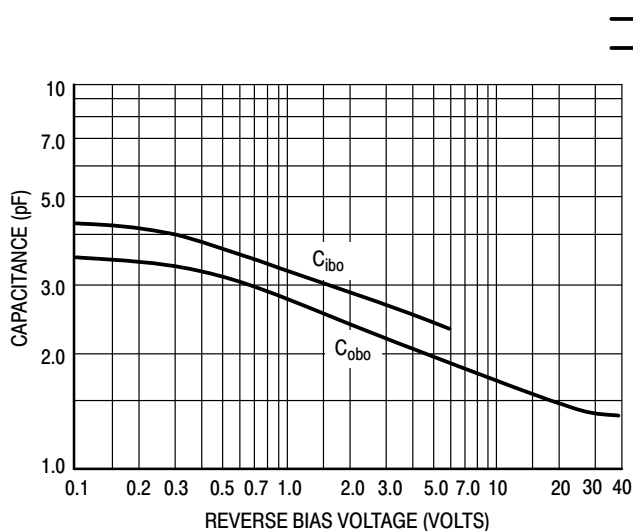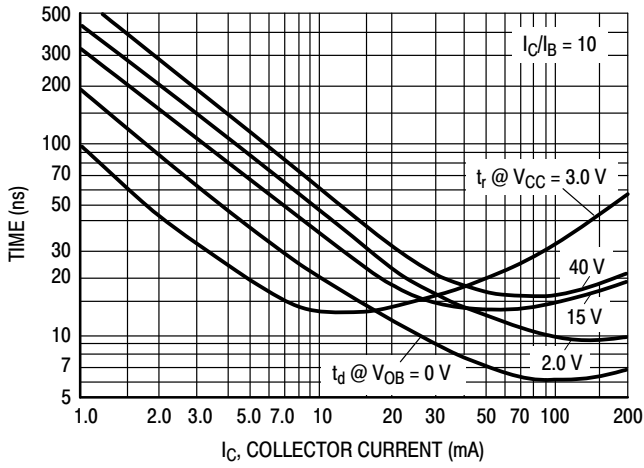

Figure 4. Capacitance
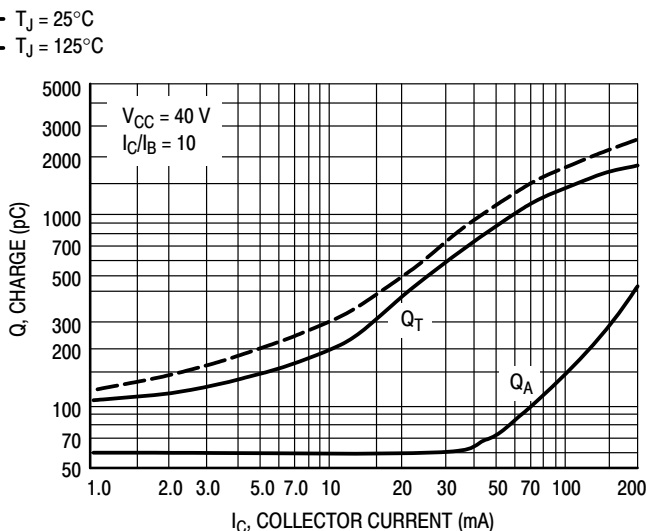
Figure 5. Charge Data

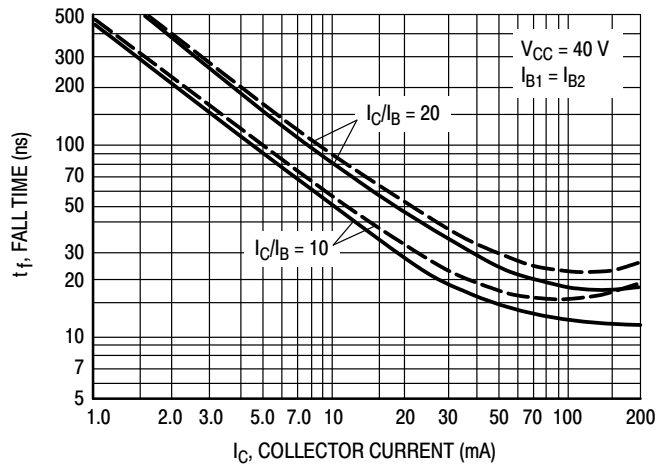Figure 6. Turn−On Time
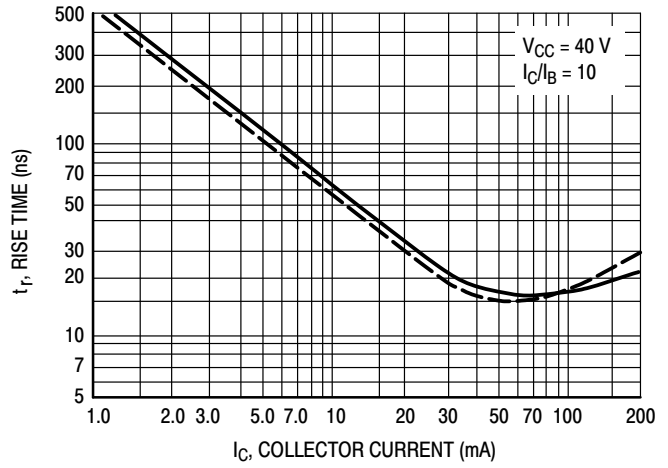
Figure 7. Rise Time
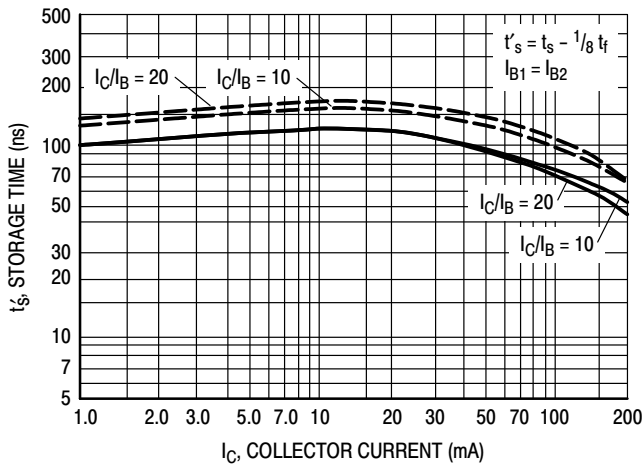
Figure 8. Storage Time

Figure 9. Fall Time

TYPICAL AUDIO SMALL−SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS
(V_{CE} = 5.0 Vdc, T_A = 25°C, Bandwidth = 1.0 Hz)
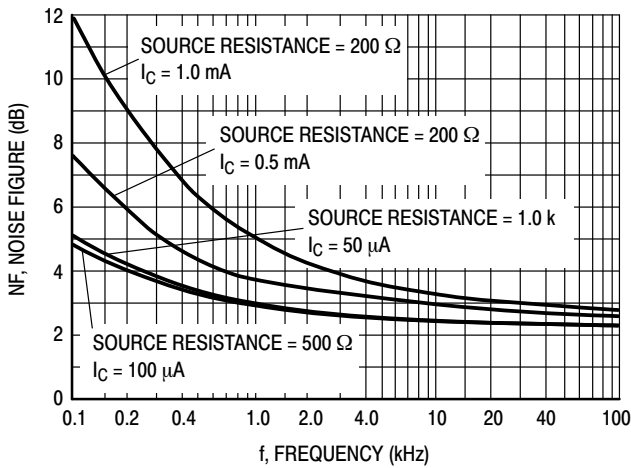
Figure 10. Noise Figure
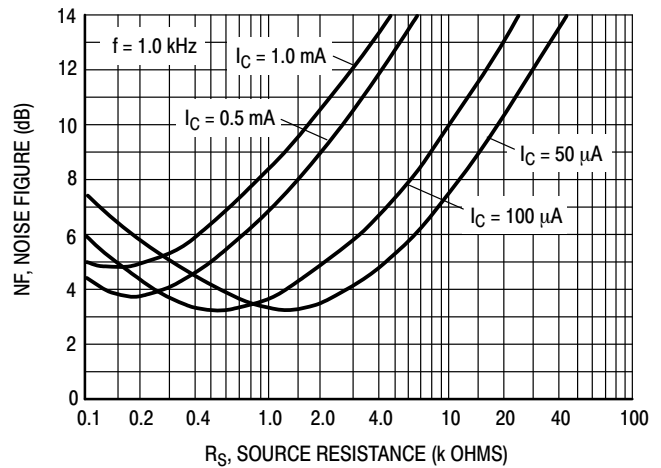
Figure 11. Noise Figure

h PARAMETERS

(V_{CE} = 10 Vdc, f = 1.0 kHz, T_A = 25°C)
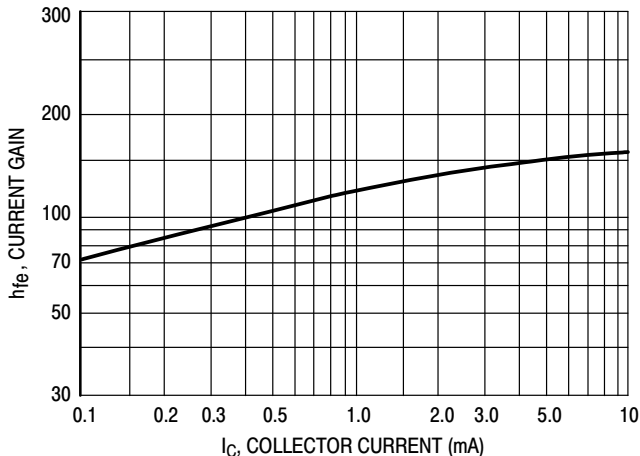
Figure 12. Current Gain
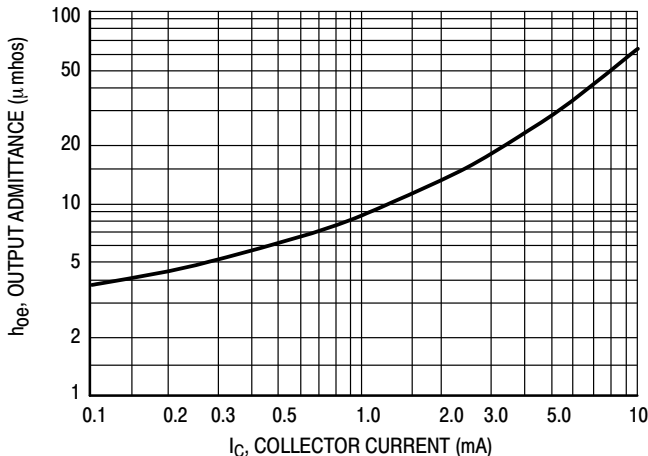
Figure 13. Output Admittance
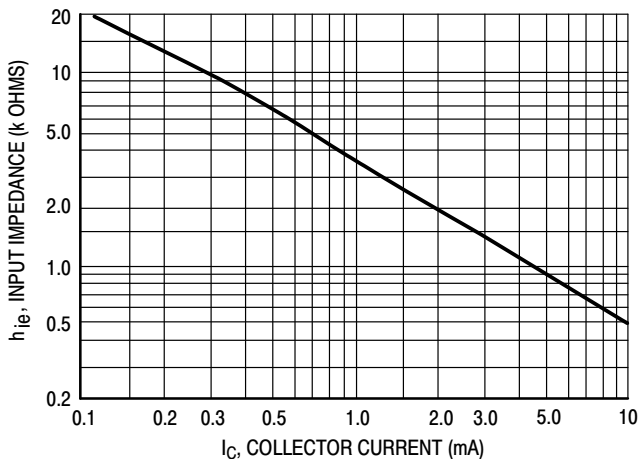
Figure 14. Input Impedance
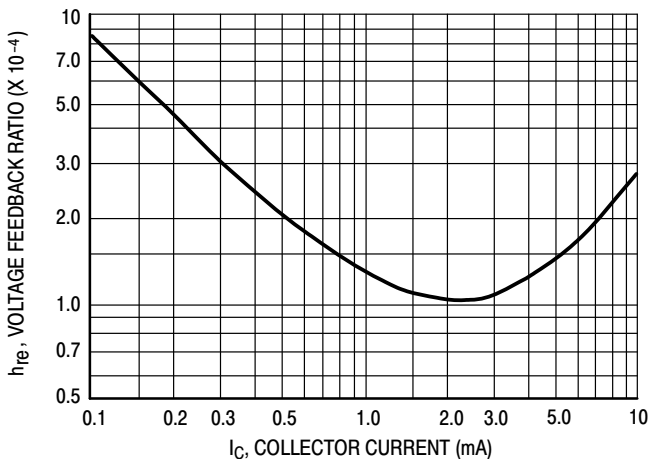
Figure 15. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS
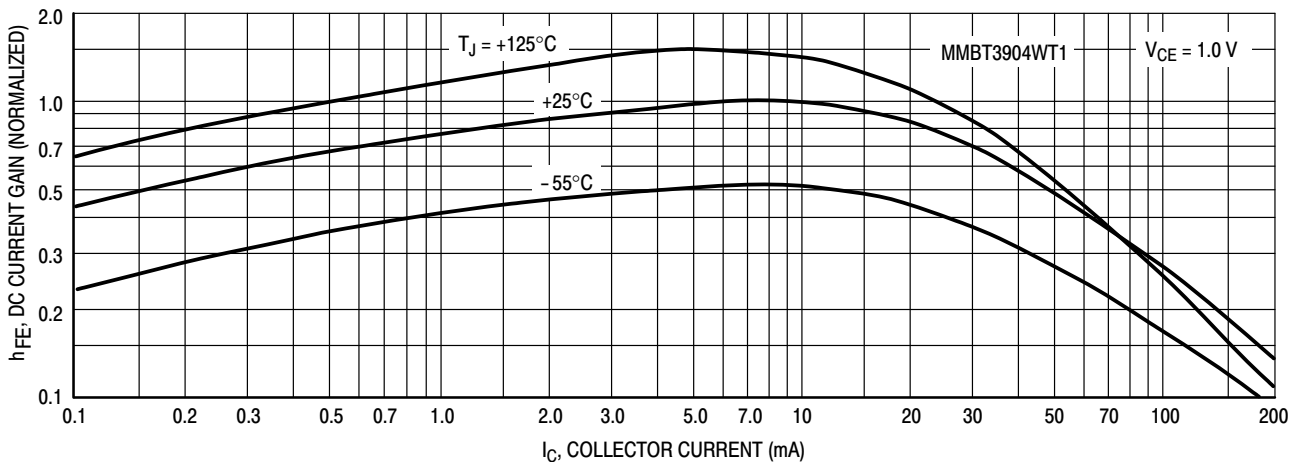
Figure 16. DC Current Gain
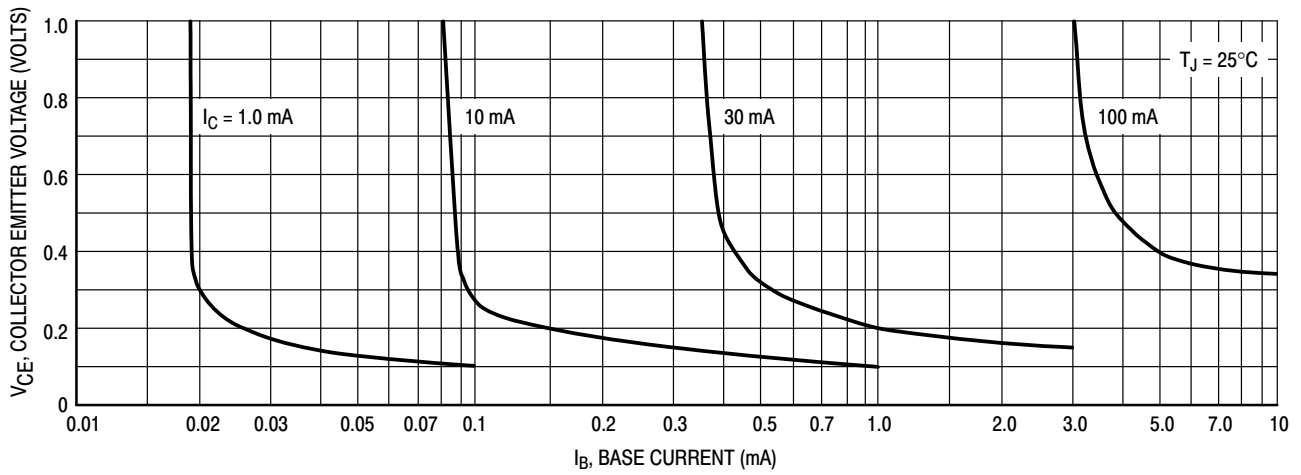
Figure 17. Collector Saturation Region
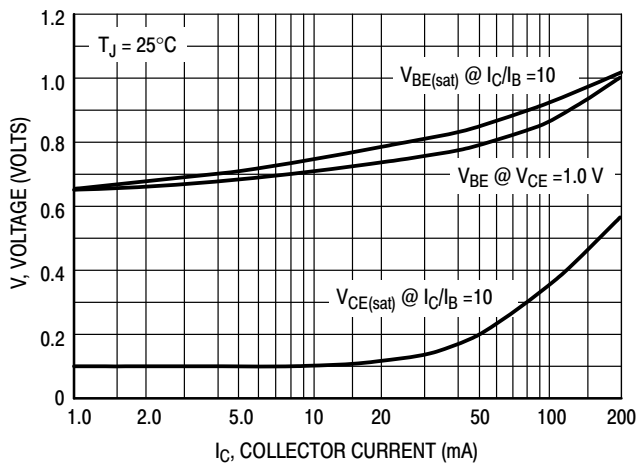
Figure 18. "ON" Voltages
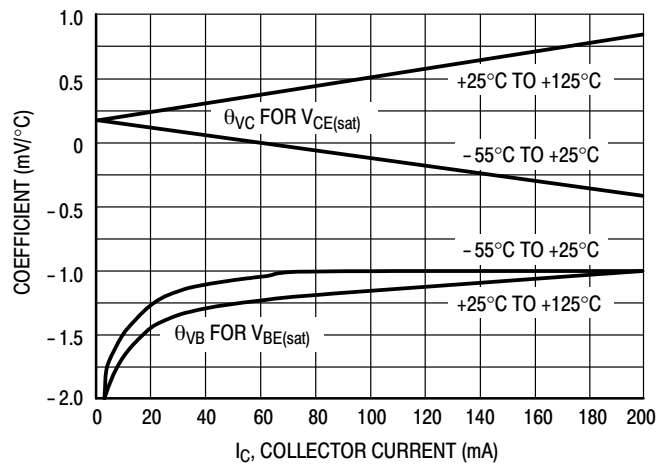
Figure 19. Temperature Coefficients
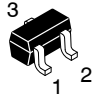
SC−75/SOT−416
CASE 463
ISSUE G

DATE 07 AUG 2015

3
1   2

SCALE 4:1

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	0.061	0.063	0.065
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	0.060	0.063	0.067

−E−

$\oplus$ | 0.20 (0.008) Ⓜ | D

b 3 PL

H_E $=$ | 0.20 (0.008) | E

C   A   A1   L

STYLE 1:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

STYLE 2:
PIN 1. ANODE
2. N/C
3. CATHODE

STYLE 3:
PIN 1. ANODE
2. ANODE
3. CATHODE

STYLE 4:
PIN 1. CATHODE
2. CATHODE
3. ANODE

STYLE 5:
PIN 1. GATE
2. SOURCE
3. DRAIN

RECOMMENDED SOLDERING FOOTPRINT*

$\dfrac{0.356}{0.014}$

$\dfrac{1.803}{0.071}$ $\dfrac{0.787}{0.031}$

$\dfrac{0.508}{0.020}$ $\dfrac{1.000}{0.039}$
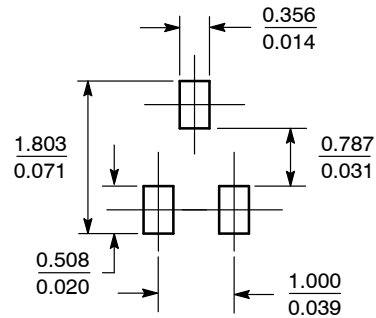
SCALE 10:1 $\left(\dfrac{mm}{inches}\right)$

*For additional information on our Pb−Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

GENERIC MARKING DIAGRAM*

XX M

1

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.

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DESCRIPTION:	SC−75/SOT−416		PAGE 1 OF 1

ADDITIONAL INFORMATION

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