

# MBT3904DW1T1, MBT3904DW2T1

## Dual General Purpose Transistors

The MBT3904DW1T1 and MBT3904DW2T1 devices are a spin-off of our popular SOT-23/SOT-323 three-leaded device. It is designed for general purpose amplifier applications and is housed in the SOT-363 six-leaded surface mount package. By putting two discrete devices in one package, this device is ideal for low-power surface mount applications where board space is at a premium.

### Features

- $h_{FE}$ , 100–300
- Low  $V_{CE(sat)}$ ,  $\leq 0.4$  V
- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- Available in 8 mm, 7-inch/3,000 Unit Tape and Reel
- Pb-Free Packages are Available

### MAXIMUM RATINGS

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
Electrostatic Discharge	ESD	HBM>16000, MM>2000	V

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Package 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 Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

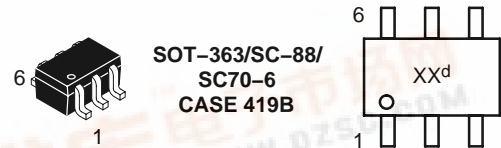
1. Device mounted on FR4 glass epoxy printed circuit board using the minimum recommended footprint.



ON Semiconductor®

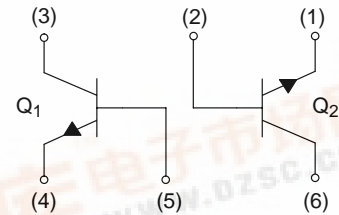
<http://onsemi.com>

### MARKING DIAGRAM

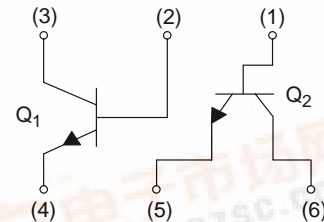


SOT-363/SC-88/  
SC70-6  
CASE 419B

XX = MA for MBT3904DW1T1  
MJ for MBT3904DW2T1  
d = Date Code



MBT3904DW1T1  
STYLE 1



MBT3904DW2T1  
STYLE 27

### ORDERING INFORMATION

Device	Package	Shipping†
MBT3904DW1T1	SOT-363	3000 Units/Reel
MBT3904DW1T1G	SOT-363 (Pb-Free)	3000 Units/Reel
MBT3904DW2T1	SOT-363	3000 Units/Reel
MBT3904DW2T1G	SOT-363 (Pb-Free)	3000 Units/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.



## MBT3904DW1T1, MBT3904DW2T1

### 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 2) ( $I_C = 1.0\text{ mAdc}$ , $I_B = 0$ )	$V_{(BR)CEO}$	40	–	Vdc
Collector–Base Breakdown Voltage ( $I_C = 10\text{ }\mu\text{Adc}$ , $I_E = 0$ )	$V_{(BR)CBO}$	60	–	Vdc
Emitter–Base Breakdown Voltage ( $I_E = 10\text{ }\mu\text{Adc}$ , $I_C = 0$ )	$V_{(BR)EBO}$	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 2)

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

#### SMALL–SIGNAL CHARACTERISTICS

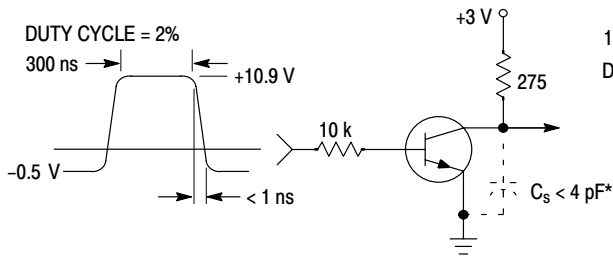
Current–Gain – Bandwidth Product ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 20\text{ Vdc}$ , $f = 100\text{ MHz}$ )	$f_T$	300	–	MHz
Output Capacitance ( $V_{CB} = 5.0\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	$C_{obo}$	–	4.0	pF
Input Capacitance ( $V_{EB} = 0.5\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )	$C_{ibo}$	–	8.0	pF
Input Impedance ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ )	$h_{ie}$	1.0 2.0	10 12	k $\Omega$
Voltage Feedback Ratio ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ )	$h_{re}$	0.5 0.1	8.0 10	$\times 10^{-4}$
Small–Signal Current Gain ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ )	$h_{fe}$	100 100	400 400	–
Output Admittance ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 1.0\text{ mAdc}$ , $f = 1.0\text{ kHz}$ )	$h_{oe}$	1.0 3.0	40 60	$\mu\text{mhos}$
Noise Figure ( $V_{CE} = 5.0\text{ Vdc}$ , $I_C = 100\text{ }\mu\text{Adc}$ , $R_S = 1.0\text{ k}\Omega$ , $f = 1.0\text{ kHz}$ )	NF	– –	5.0 4.0	dB

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

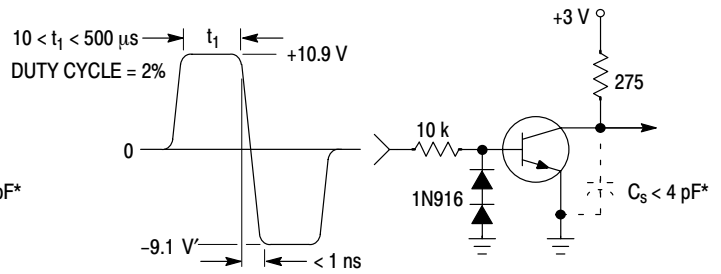
## MBT3904DW1T1, MBT3904DW2T1

### SWITCHING CHARACTERISTICS

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



**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

# MBT3904DW1T1, MBT3904DW2T1

## TYPICAL TRANSIENT CHARACTERISTICS

—  $T_J = 25^\circ\text{C}$   
 - - -  $T_J = 125^\circ\text{C}$

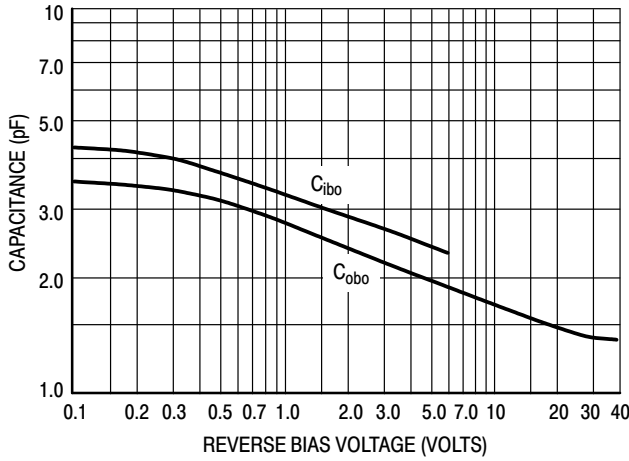


Figure 3. Capacitance

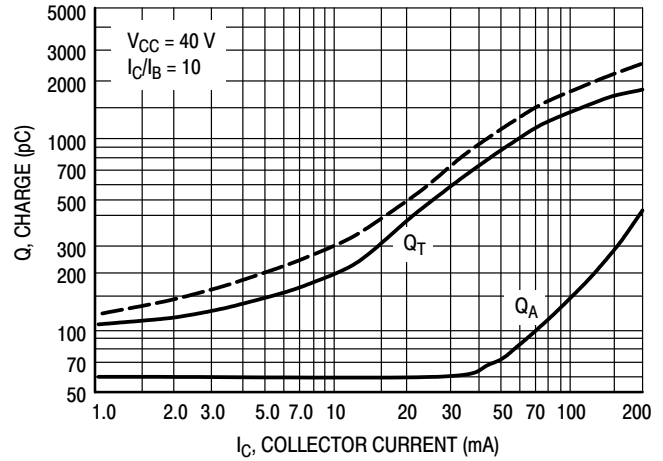


Figure 4. Charge Data

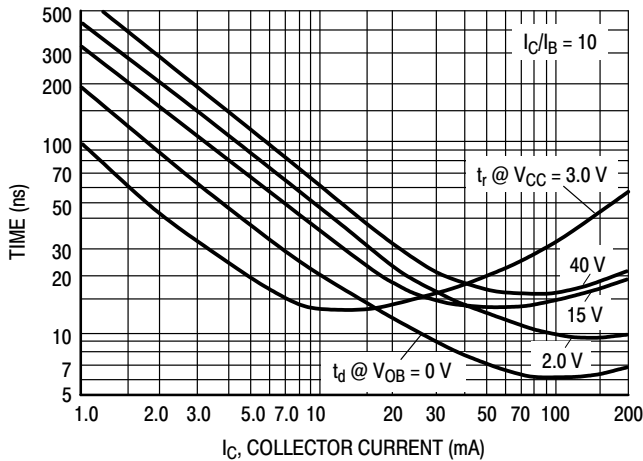


Figure 5. Turn-On Time

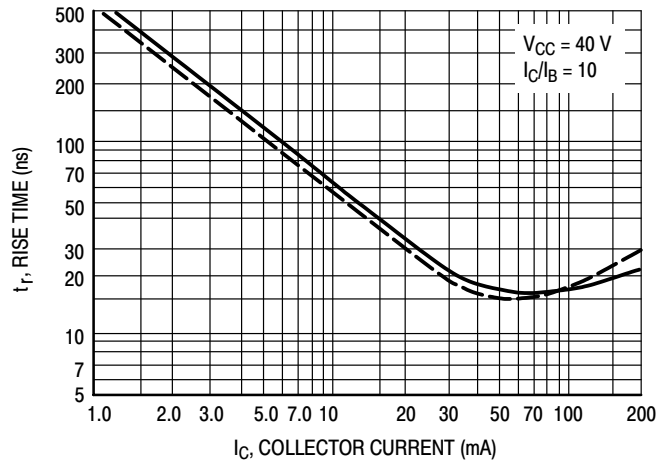


Figure 6. Rise Time

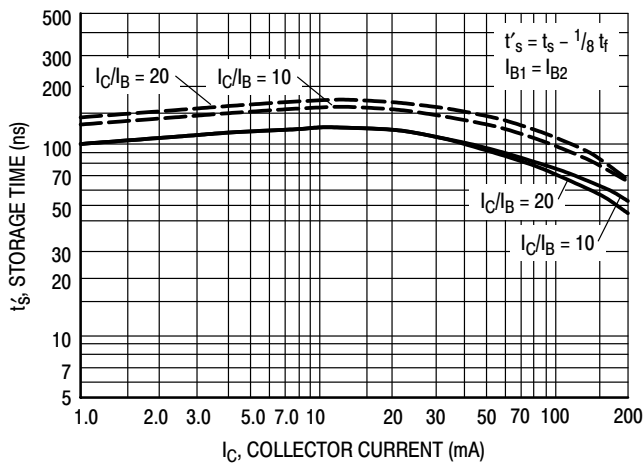


Figure 7. Storage Time

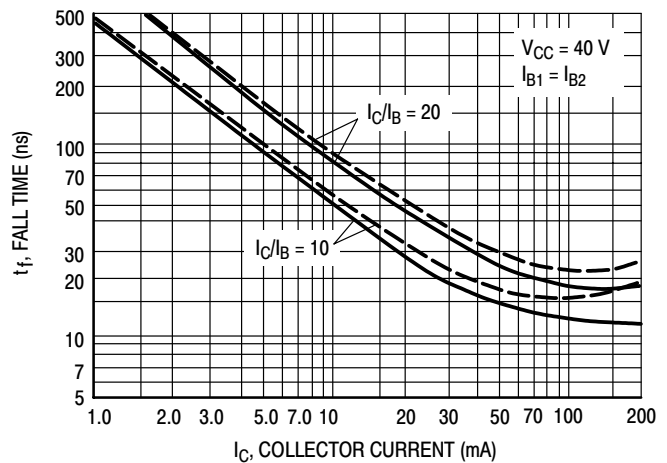


Figure 8. Fall Time

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## TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

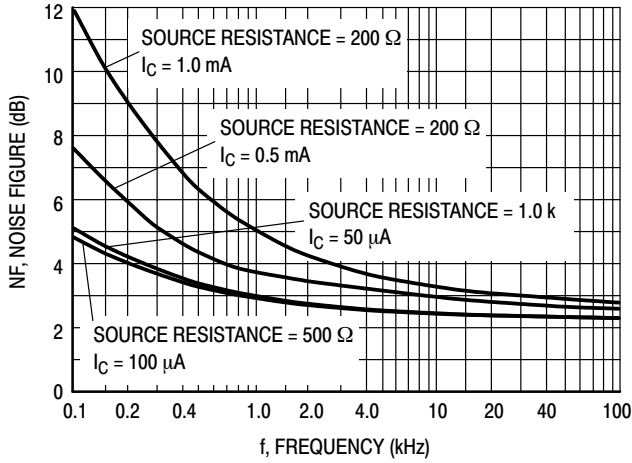


Figure 9. Noise Figure

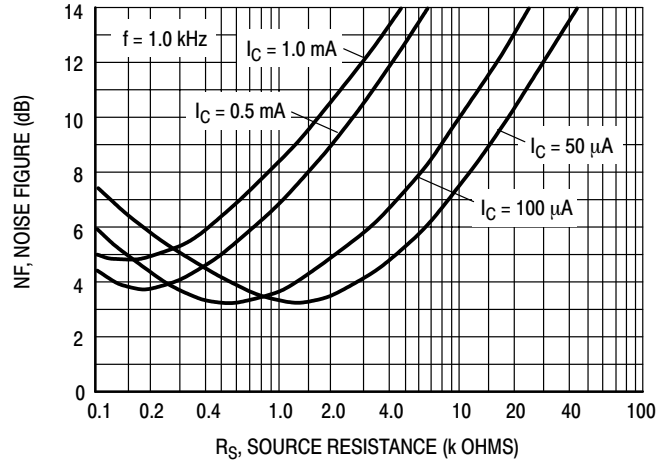


Figure 10. Noise Figure

## h PARAMETERS

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

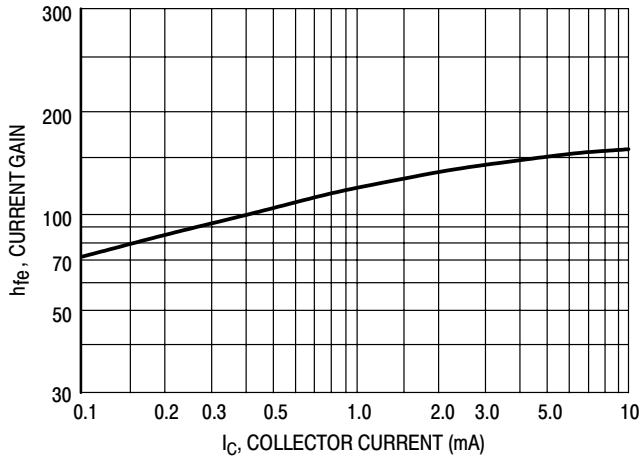


Figure 11. Current Gain

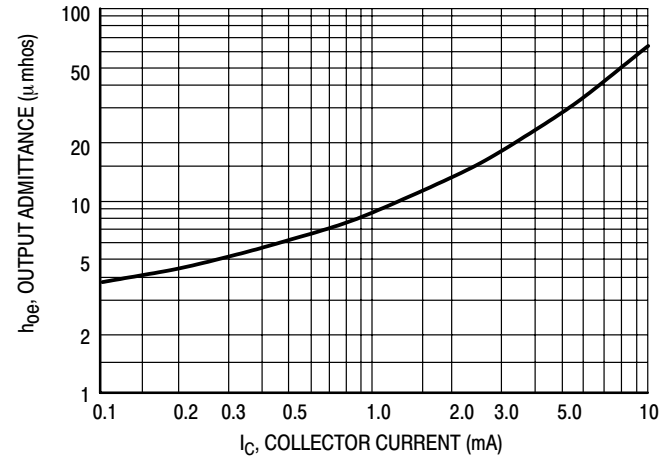


Figure 12. Output Admittance

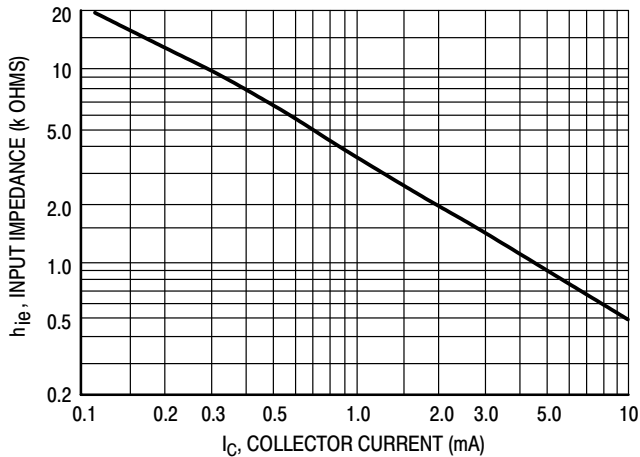


Figure 13. Input Impedance

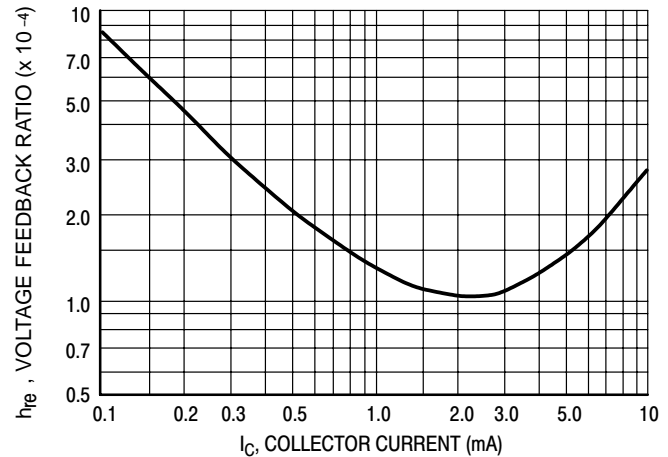
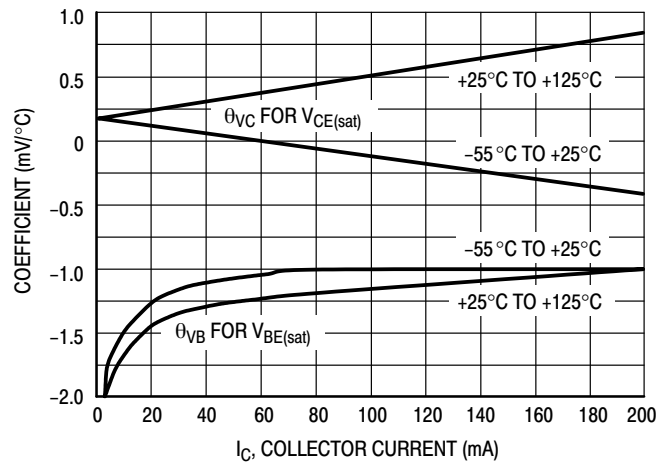
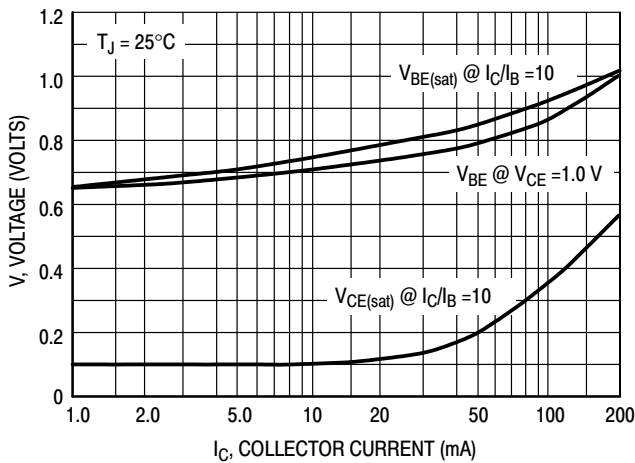
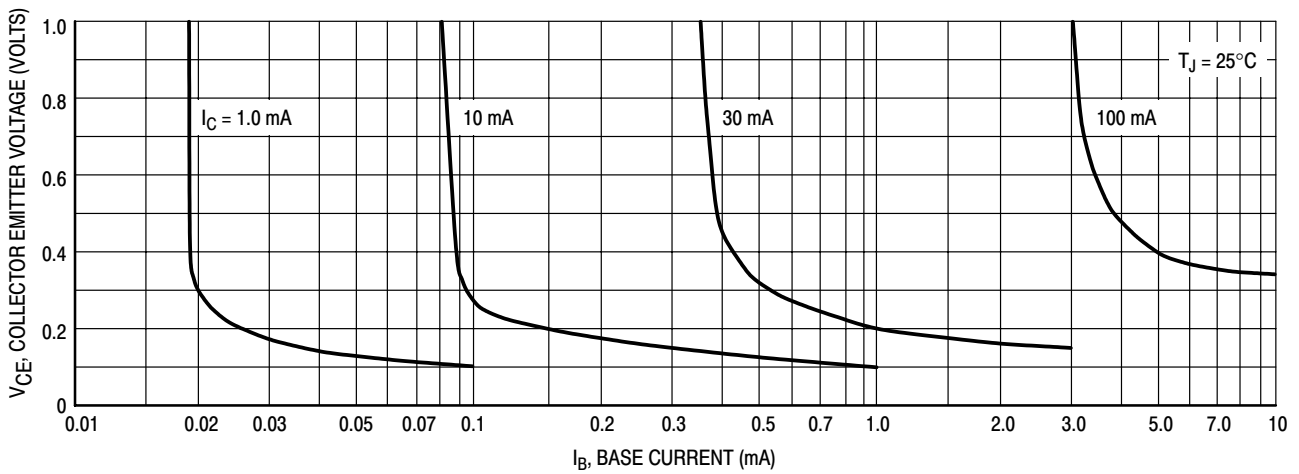
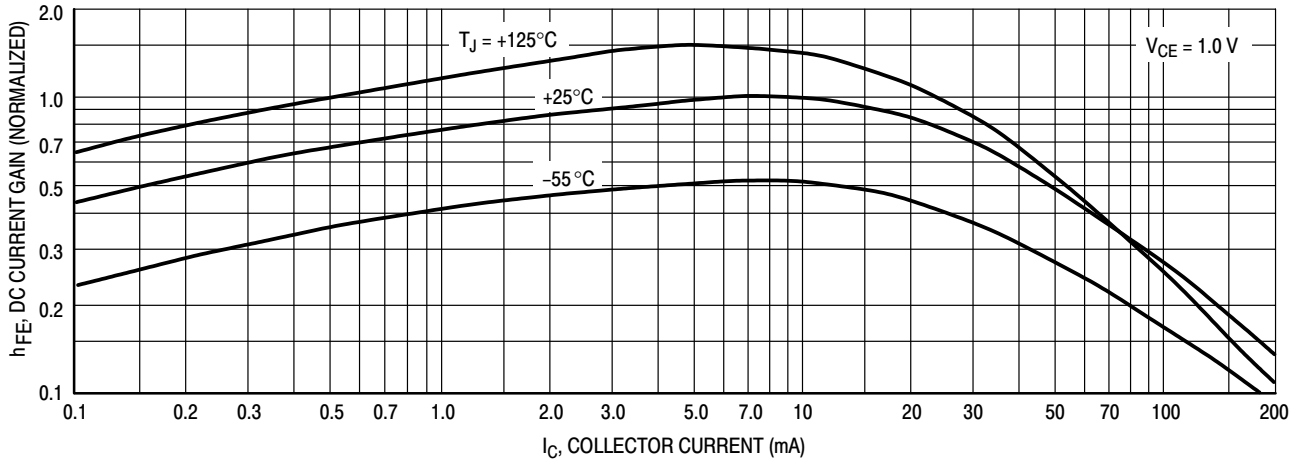


Figure 14. Voltage Feedback Ratio

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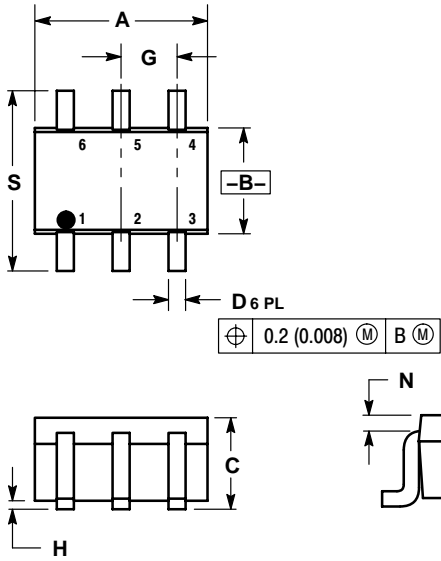
## TYPICAL STATIC CHARACTERISTICS



# MBT3904DW1T1, MBT3904DW2T1

## PACKAGE DIMENSIONS

SOT-363/SC-88/SC70-6  
CASE 419B-02  
ISSUE U



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 419B-01 OBSOLETE, NEW STANDARD 419B-02.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.071	0.087	1.80	2.20
B	0.045	0.053	1.15	1.35
C	0.031	0.043	0.80	1.10
D	0.004	0.012	0.10	0.30
G	0.026	BSC	0.65	BSC
H	---	0.004	---	0.10
J	0.004	0.010	0.10	0.25
K	0.004	0.012	0.10	0.30
N	0.008	REF	0.20	REF
S	0.079	0.087	2.00	2.20

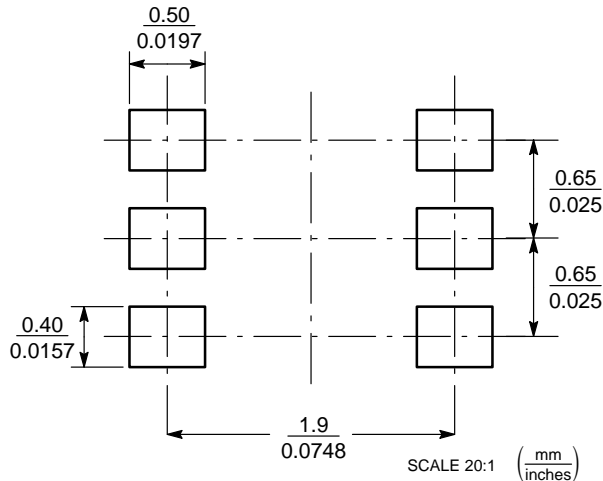
STYLE 1:

- PIN 1. EMITTER 2
2. BASE 2
3. COLLECTOR 1
4. EMITTER 1
5. BASE 1
6. COLLECTOR 2

STYLE 27:


- PIN 1. BASE 2
2. BASE 1
3. COLLECTOR 1
4. EMITTER 1
5. EMITTER 2
6. COLLECTOR 2

### 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.

# MBT3904DW1T1, MBT3904DW2T1

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