

MBT3904DW1, MBT3904DW2, SMBT3904DW1, NSVMBT3904DW1

Dual General Purpose Transistors

The MBT3904DW1 and MBT3904DW2 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 $V_{CE(sat)}$, ≤ 0.4 V
- Simplifies Circuit Design
- Reduces Board Space
- Reduces Component Count
- Available in 8 mm, 7-inch/3,000 Unit Tape and Reel
- S and NSV 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	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 Class 2 MM Class B	

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.

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	°C/W
Junction and Storage Temperature Range	T_J, T_{stg}	–55 to +150	°C

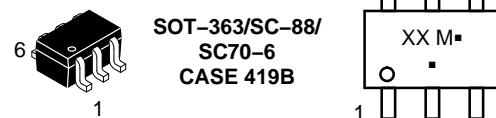
1. Device mounted on FR4 glass epoxy printed circuit board using the minimum recommended footprint.



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MARKING DIAGRAM

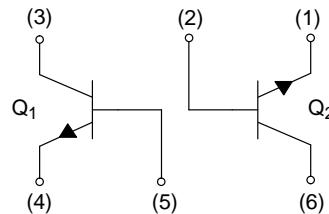


XX = MA for MBT3904DW1T1G
MJ for MBT3904DW2T1G

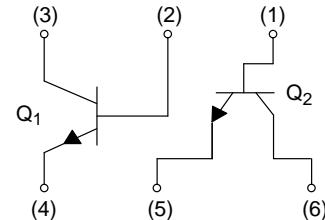
M = Date Code

▪ = Pb-Free Package

(Note: Microdot may be in either location)



MBT3904DW1T1
STYLE 1



MBT3904DW2T1
STYLE 27

ORDERING INFORMATION

Device	Package	Shipping [†]
MBT3904DW1T1G, MBT3904DW2T1G	SOT-363 (Pb-Free)	3000 / Tape & Reel
SMBT3904DW1T1G	SOT-363 (Pb-Free)	3000 / Tape & Reel
NSVMBT3904DW1T3G	SOT-363 (Pb-Free)	10000 / 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.

MBT3904DW1, MBT3904DW2, SMBT3904DW1, NSVMBT3904DW1

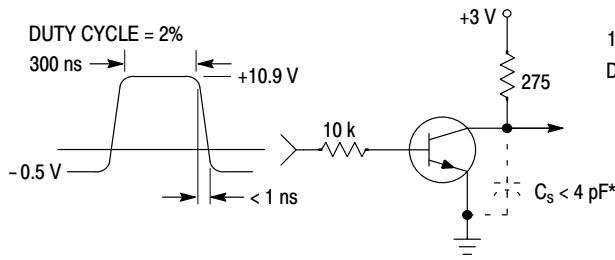
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Breakdown Voltage (Note 2) (I _C = 1.0 mA, 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	nA
Collector Cutoff Current (V _{CE} = 30 Vdc, V _{EB} = 3.0 Vdc)	I _{CEX}	–	50	nA
ON CHARACTERISTICS (Note 2)				
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 2.0	10 12	k Ω
Voltage Feedback Ratio (V _{CE} = 10 Vdc, I _C = 1.0 mA, f = 1.0 kHz)	h _{re}	0.5 0.1	8.0 10	X 10 ⁻⁴
Small–Signal Current Gain (V _{CE} = 10 Vdc, I _C = 1.0 mA, f = 1.0 kHz)	h _{fe}	100 100	400 400	–
Output Admittance (V _{CE} = 10 Vdc, I _C = 1.0 mA, f = 1.0 kHz)	h _{oe}	1.0 3.0	40 60	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

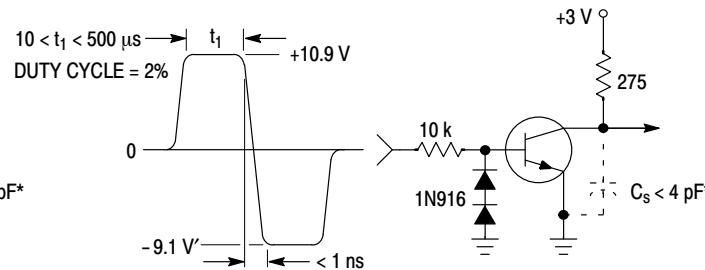
2. Pulse Test: Pulse Width ≤ 300 μs; Duty Cycle ≤ 2.0%.

SWITCHING CHARACTERISTICS

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



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

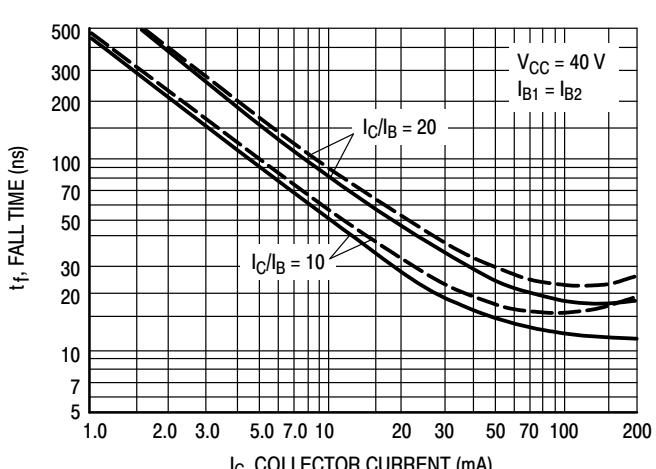
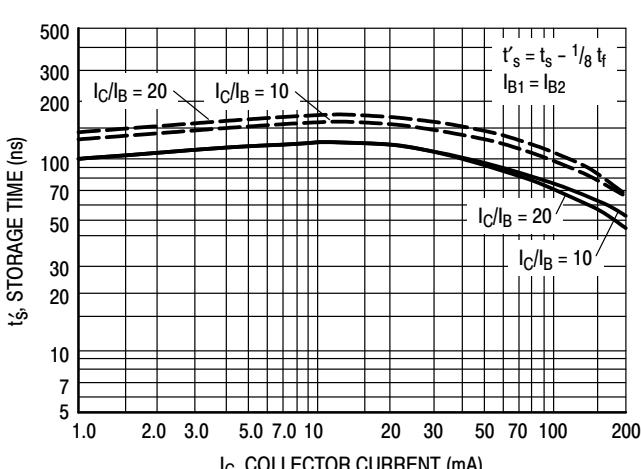
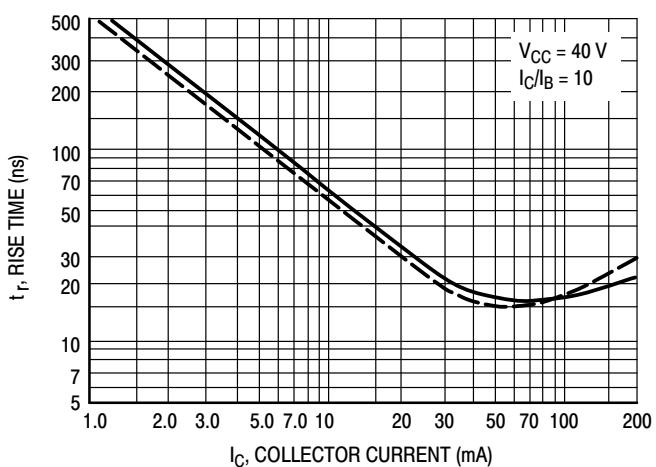
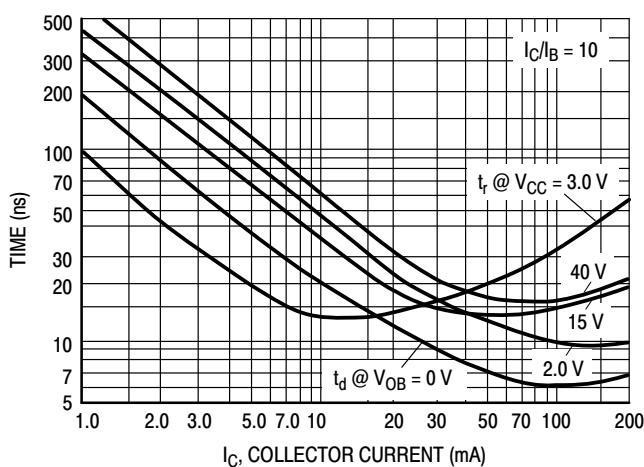
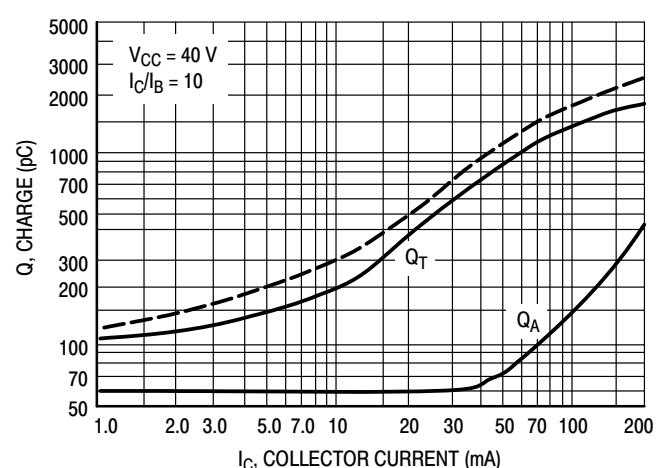
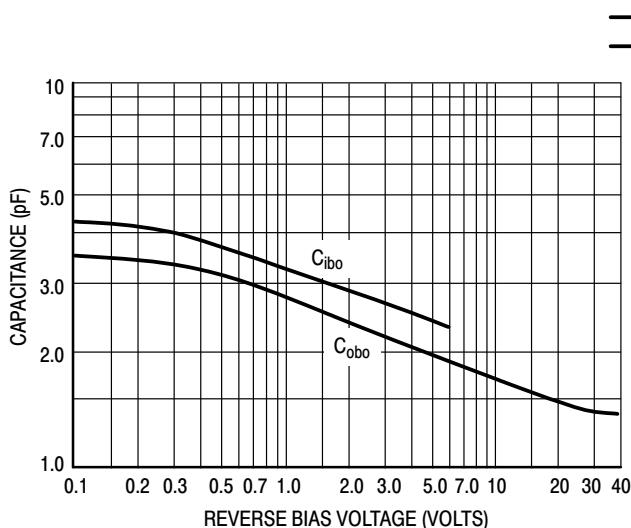


* Total shunt capacitance of test jig and connectors

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

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TYPICAL TRANSIENT CHARACTERISTICS



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TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

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

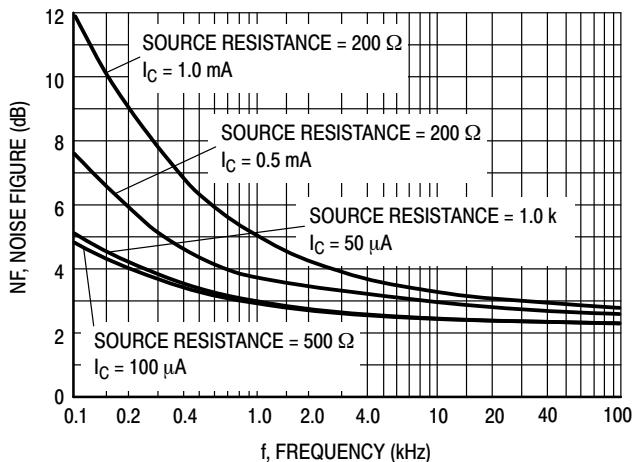


Figure 9. Noise Figure

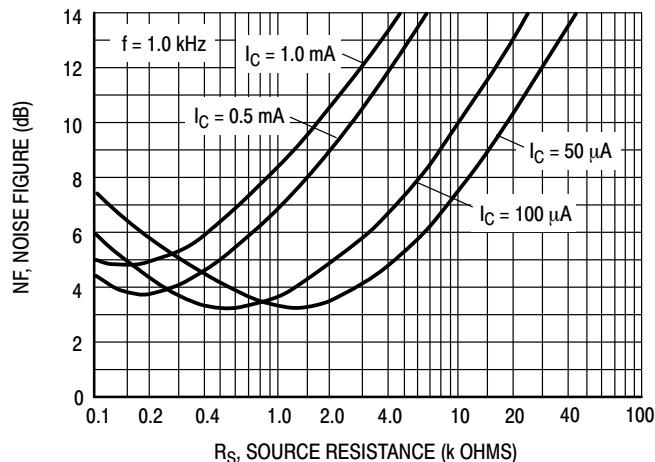


Figure 10. Noise Figure

h PARAMETERS

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

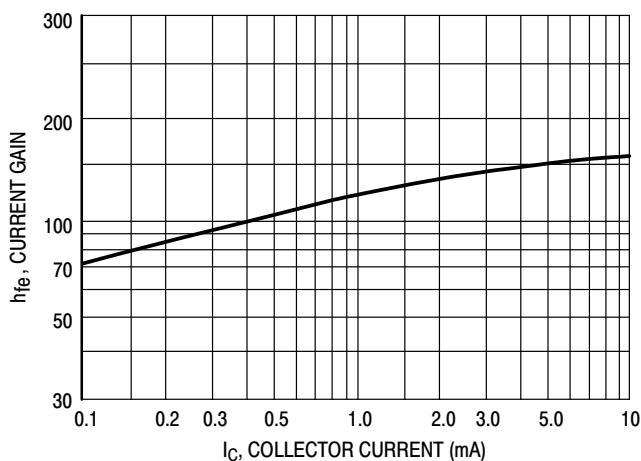


Figure 11. Current Gain

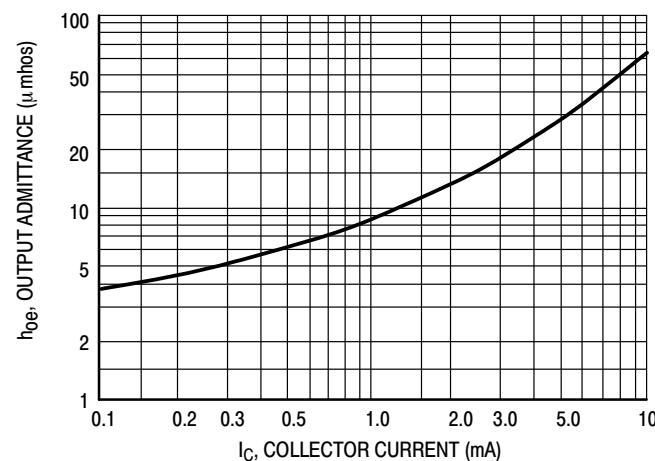


Figure 12. Output Admittance

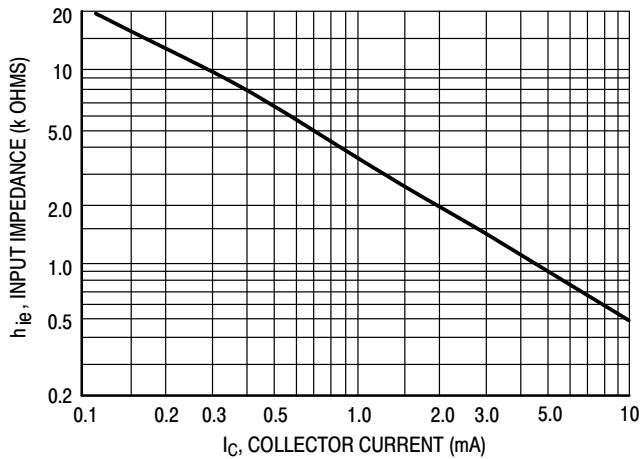


Figure 13. Input Impedance

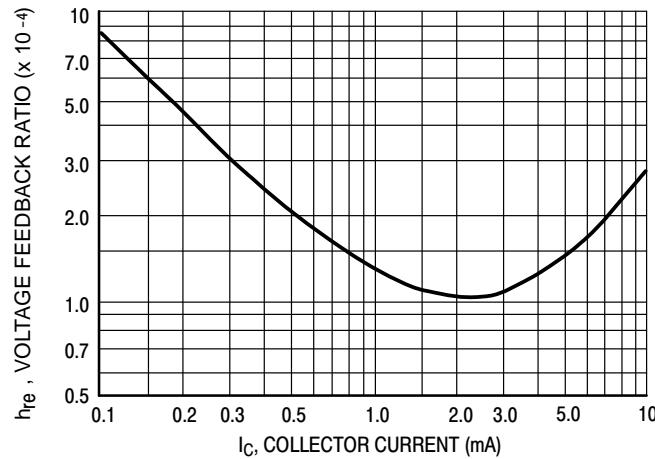


Figure 14. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

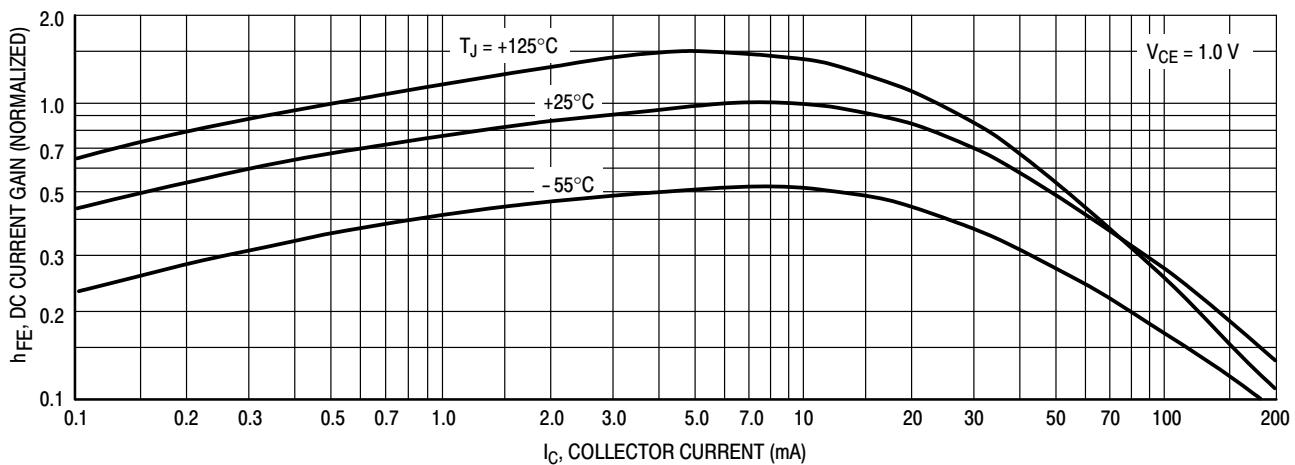


Figure 15. DC Current Gain

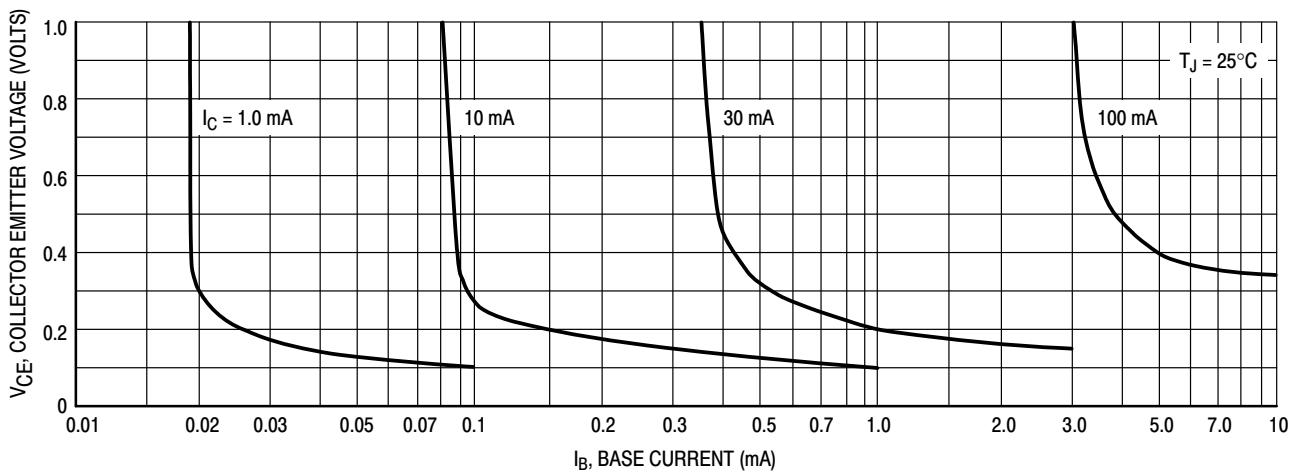


Figure 16. Collector Saturation Region

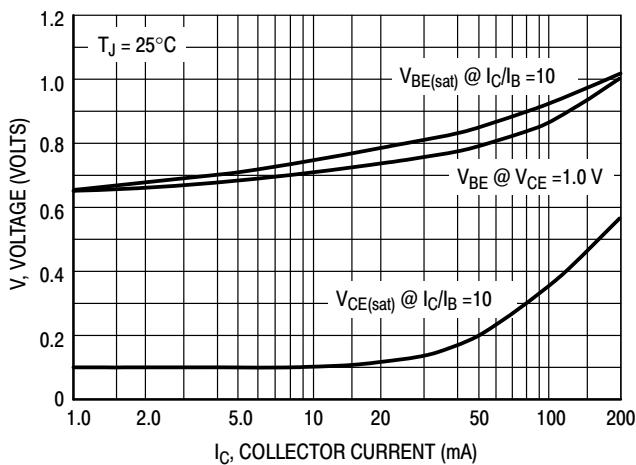


Figure 17. "ON" Voltages

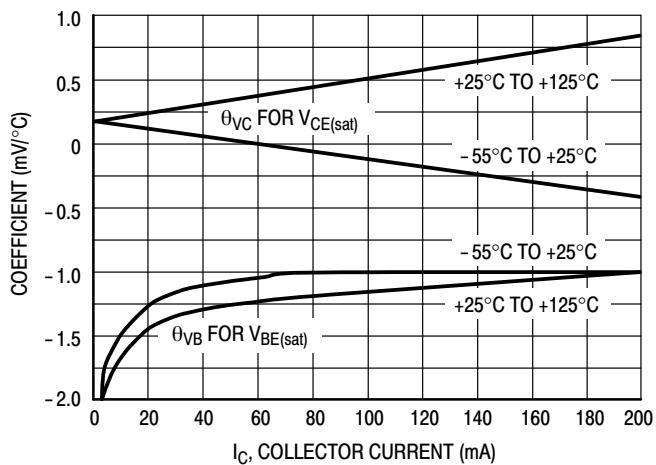


Figure 18. Temperature Coefficients

TYPICAL STATIC CHARACTERISTICS

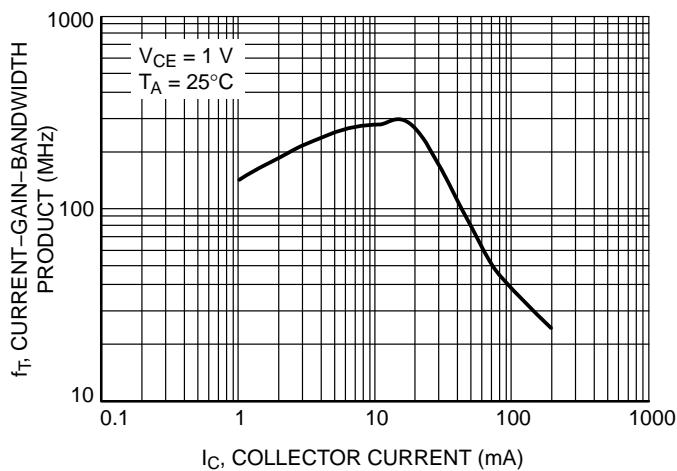


Figure 19. Current Gain Bandwidth Product

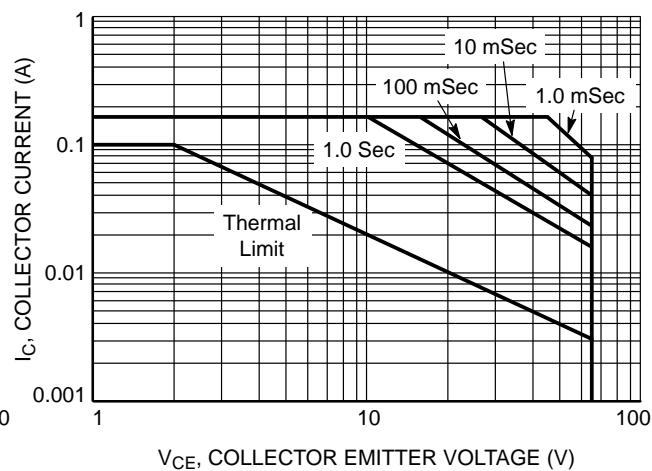
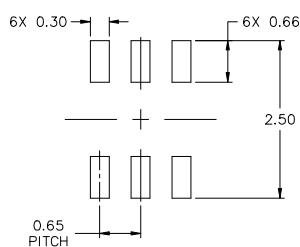
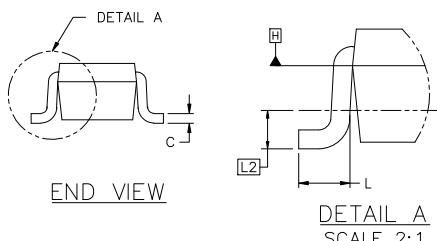
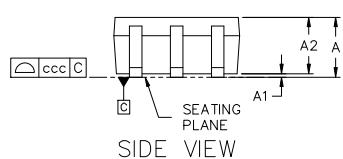
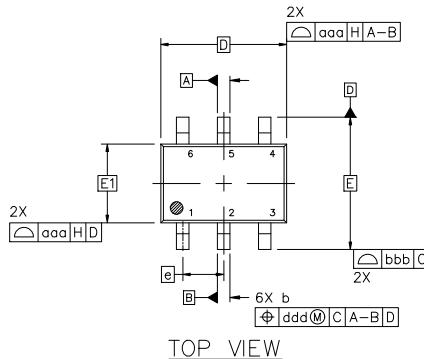


Figure 20. Safe Operating Area



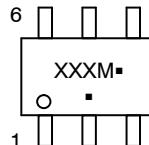
SC-88 2.00x1.25x0.90, 0.65P
CASE 419B-02
ISSUE Z

DATE 18 APR 2024



* 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***



XXX = Specific Device Code

M = Date Code*

■ = Pb-Free Package

(Note: Microdot may be in either location)

*Date Code orientation and/or position may vary depending upon manufacturing location.

*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.

STYLES ON PAGE 2

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CASE 419B-02

ISSUE Z

DATE 18 APR 2024

STYLE 1: PIN 1. Emitter 2 2. Base 2 3. Collector 1 4. Emitter 1 5. Base 1 6. Collector 2	STYLE 2: Cancelled	STYLE 3: Cancelled	STYLE 4: PIN 1. Cathode 2. Cathode 3. Collector 4. Emitter 5. Base 6. Anode	STYLE 5: PIN 1. Anode 2. Anode 3. Collector 4. Emitter 5. Base 6. Cathode	STYLE 6: PIN 1. Anode 2 2. N/C 3. Cathode 1 4. Anode 1 5. N/C 6. Cathode 2
STYLE 7: PIN 1. Source 2 2. Drain 2 3. Gate 1 4. Source 1 5. Drain 1 6. Gate 2	STYLE 8: Cancelled	STYLE 9: PIN 1. Emitter 2 2. Emitter 1 3. Collector 1 4. Base 1 5. Base 2 6. Collector 2	STYLE 10: PIN 1. Source 2 2. Source 1 3. Collector 1 4. Drain 1 5. Drain 2 6. Gate 2	STYLE 11: PIN 1. Cathode 2 2. Cathode 2 3. Anode 1 4. Cathode 1 5. Cathode 1 6. Anode 2	STYLE 12: PIN 1. Anode 2 2. Anode 2 3. Cathode 1 4. Anode 1 5. Anode 1 6. Cathode 2
STYLE 13: PIN 1. Anode 2. N/C 3. Collector 4. Emitter 5. Base 6. Cathode	STYLE 14: PIN 1. Vref 2. GND 3. GND 4. Iout 5. Ven 6. Vcc	STYLE 15: PIN 1. Anode 1 2. Anode 2 3. Anode 3 4. Cathode 3 5. Cathode 2 6. Cathode 1	STYLE 16: PIN 1. Base 1 2. Emitter 2 3. Collector 2 4. Base 2 5. Emitter 1 6. Collector 1	STYLE 17: PIN 1. Base 1 2. Emitter 1 3. Collector 2 4. Base 2 5. Emitter 2 6. Collector 1	STYLE 18: PIN 1. Vin1 2. Vcc 3. Vout2 4. Vin2 5. Gnd 6. Vout1
STYLE 19: PIN 1. Iout 2. Gnd 3. Gnd 4. Vcc 5. Ven 6. Vref	STYLE 20: PIN 1. Collector 2. Collector 3. Base 4. Emitter 5. Collector 6. Collector	STYLE 21: PIN 1. Anode 1 2. N/C 3. Anode 2 4. Cathode 2 5. N/C 6. Cathode 1	STYLE 22: PIN 1. D1 (i) 2. Gnd 3. D2 (i) 4. D2 (c) 5. Vbus 6. D1 (c)	STYLE 23: PIN 1. Vn 2. Ch1 3. Vp 4. N/C 5. Ch2 6. N/C	STYLE 24: PIN 1. Cathode 2. Anode 3. Cathode 4. Cathode 5. Cathode 6. Cathode
STYLE 25: PIN 1. Base 1 2. Cathode 3. Collector 2 4. Base 2 5. Emitter 6. Collector 1	STYLE 26: PIN 1. Source 1 2. Gate 1 3. Drain 2 4. Source 2 5. Gate 2 6. Drain 1	STYLE 27: PIN 1. Base 2 2. Base 1 3. Collector 1 4. Emitter 1 5. Emitter 2 6. Collector 2	STYLE 28: PIN 1. Drain 2. Drain 3. Gate 4. Source 5. Drain 6. Drain	STYLE 29: PIN 1. Anode 2. Anode 3. Collector 4. Emitter 5. Base/Anode 6. Cathode	STYLE 30: PIN 1. Source 1 2. Drain 2 3. Drain 2 4. Source 2 5. Gate 1 6. Drain 1

Note: Please refer to datasheet for style callout. If style type is not called out in the datasheet refer to the device datasheet pinout or pin assignment.

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