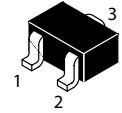
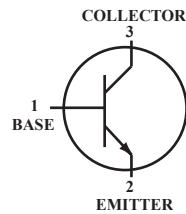


General Purpose Transistor NPN Silicon

 Lead(Pb)-Free



SOT-323(SC-70)

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

Thermal Characteristics

Characteristics	Symbol	Max	Unit
Total Device Dissipation TA=25°C	P _D	150	mW
Thermal Resistance, Junction to Ambient	R _{θJA}	833	°C/W
Junction and Storage, Temperature	T _J , T _{stg}	-55 to +150	°C

Device Marking

MMBT3904W=AM

Electrical Characteristics (TA=25°C Unless Otherwise noted)

Characteristics	Symbol	Min	Max	Unit
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Off Characteristics

Collector-Emitter Breakdown Voltage ⁽²⁾ (I _C =1.0mAdc, 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} =30Vdc, V _{EB} =3.0Vdc)	I _{CEX}	-	50	nAdc

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

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

Electrical Characteristics (T_A=25°C unless otherwise noted) (Continued)

Characteristics	Symbol	Min	Max	Unit
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On Characteristics (2)

DC Current Gain (I _C = 0.1 mA _{dc} , V _{CE} =1.0V _{dc}) (I _C = 1.0 mA _{dc} , V _{CE} = 1.0 V _{dc}) (I _C = 10 mA _{dc} , V _{CE} = 1.0V _{dc}) (I _C = 50 mA _{dc} , V _{CE} = 1.0V _{dc}) (I _C = 100 mA _{dc} , V _{CE} = 1.0V _{dc})	H _{FE}	40 70 100 60 30	. . 300 . .	-
Collector-Emitter Saturation Voltage (2) (I _C = 10 mA _{dc} , I _B = 1.0mA _{dc}) (I _C = 50 mA _{dc} , I _B = 5.0mA _{dc})	V _{CE(sat)}	. .	0.2 0.3	V _{dc}
Base-Emitter Saturation Voltage (2) (I _C = 10 mA _{dc} , I _B = 1.0 mA _{dc}) (I _C = 50 mA _{dc} , I _B = 5.0 mA _{dc})	V _{BE(sat)}	0.65 .	0.85 0.95	V _{dc}

Small-signal Characteristics

Current-Gain-Bandwidth Product (I _C = 10 mA _{dc} , V _{CE} = 20 V _{dc} , f=100MHz)	f _T	300	-	MHz
Output Capacitance (V _{CB} = 5.0 V _{dc} , I _E =0, f=1.0MHz)	C _{obo}	-	4.0	pF
Input Capacitance (V _{EB} = 0.5 V _{dc} , I _C =0, f=1.0MHz)	C _{ibo}	-	8.0	pF
Input Impedance (V _{CE} = 10 V _{dc} , I _C =1.0 mA _{dc} , f=1.0 kHz)	h _{ie}	1.0	10	k ohms
Voltage Feedback Ratio (V _{CE} = 10V _{dc} , I _C =1.0 mA _{dc} , f=1.0 kHz)	h _{re}	0.5	8.0	x 10 ⁻⁴
Small-Signal Current Gain (V _{CE} = 10V _{dc} , I _C =1.0 mA _{dc} , f=1.0 kHz)	h _{fe}	100	400	.
Output Admittance (V _{CE} = 10V _{dc} , I _C =1.0 mA _{dc} , f=1.0kHz)	h _{oe}	1.0	40	μmhos
Noise Figure (V _{CE} = 5.0V _{dc} , I _C = 100 μA _{dc} , R _S =1.0k ohms, f=1.0kHz)	NF	-	5.0	dB

Switching Characteristics

Delay Time	(V _{cc} = 3.0 V _{dc} , V _{BE} = -0.5 V _{dc} I _C = 10 mA _{dc} , I _{B1} = 1.0 mA _{dc})	t _d	-	35	ns
Rise Time		t _r	-	35	
Storage Time	(V _{cc} = 3.0 V _{dc} , I _C = 10 mA _{dc} , I _{B1} =I _{B2} = 1.0 mA _{dc})	t _s	-	200	ns
Fall Time		t _f	-	50	

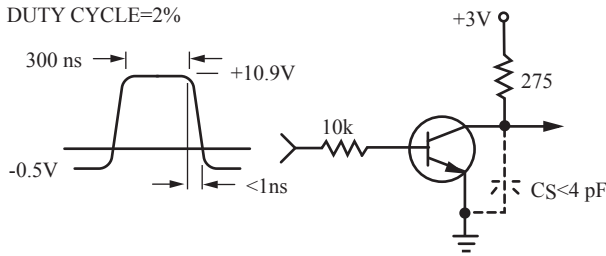


Figure 1. Delay and Rise Time Equivalent Test Circuit

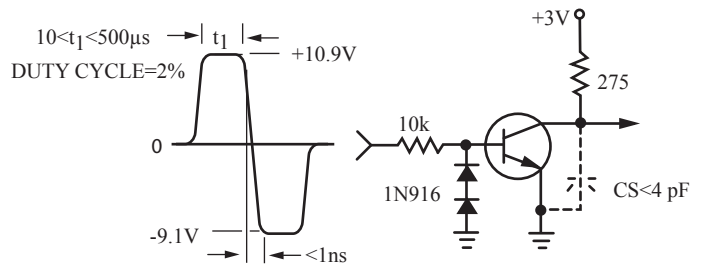


Figure 2. Storage and Fall Time Equivalent Test Circuit

*Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

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

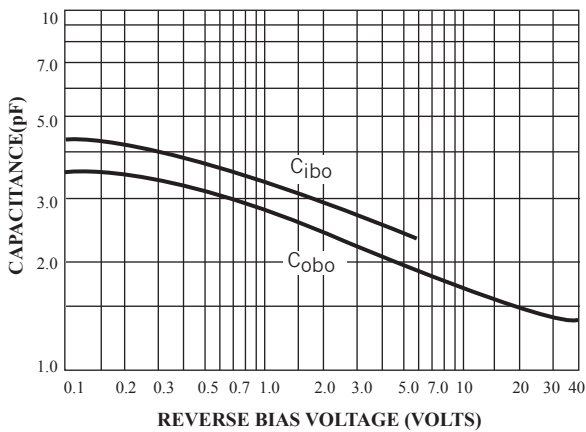


Figure 3. Capacitance

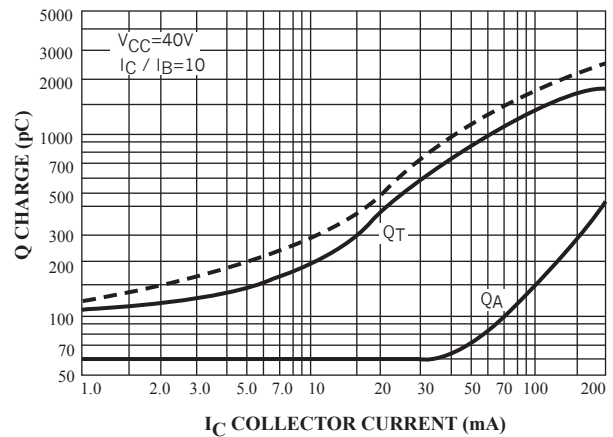


Figure 4. Charge Data

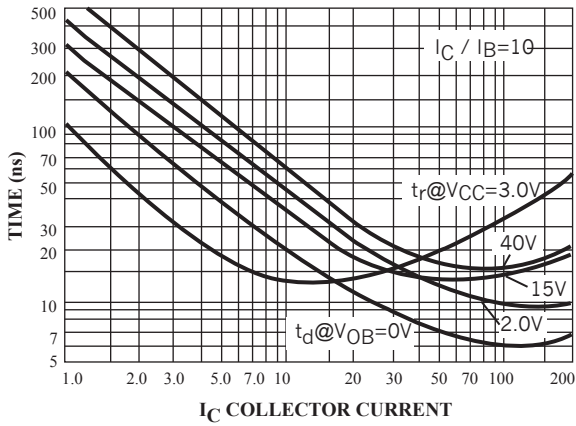


Figure 5. Turn-On Time

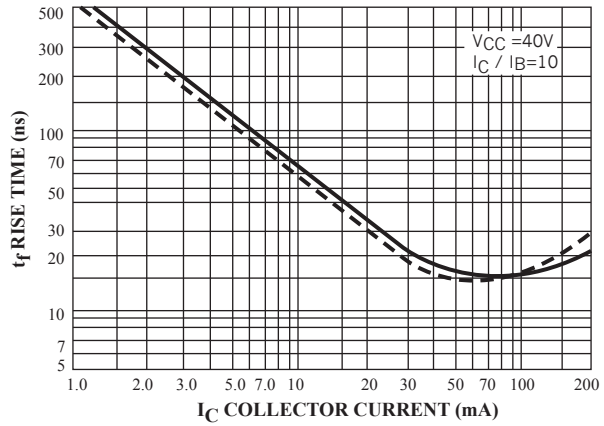


Figure 6. Rise Time

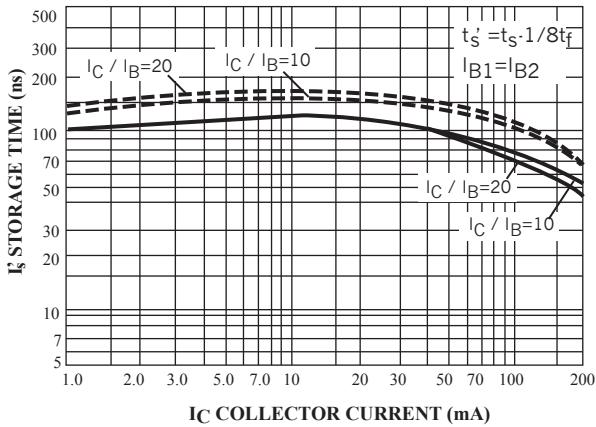


Figure 7. Storage Time

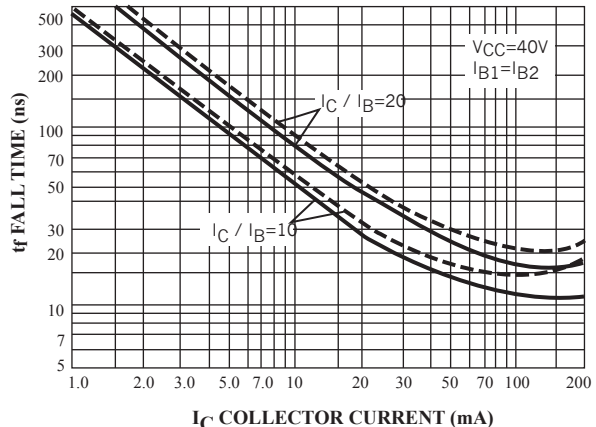


Figure 8. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS (VCE=5.0 Vdc, TA=25 °C, Bandwidth=1.0Hz)

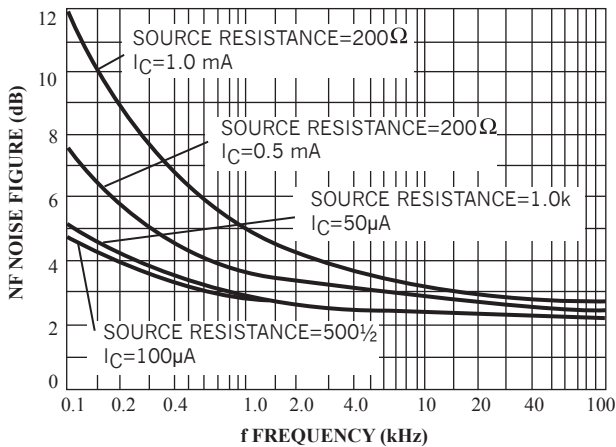


Figure 9.

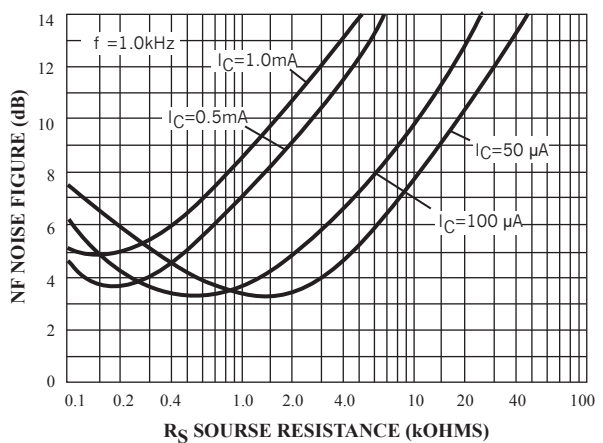


Figure 10.

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

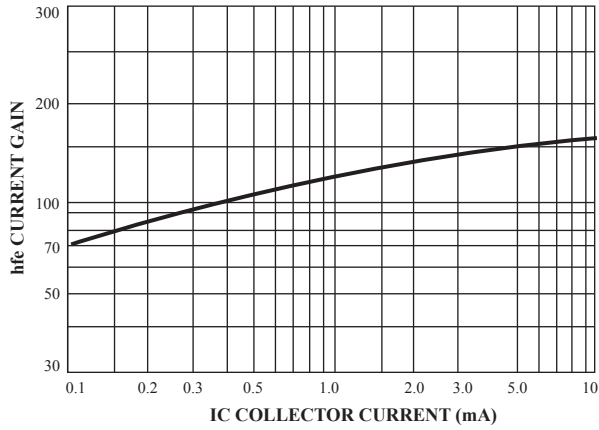


Figure 11. Current Gain

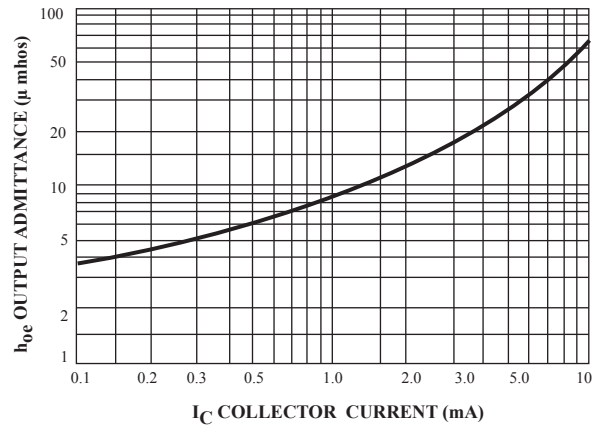


Figure 12. Output Admittance

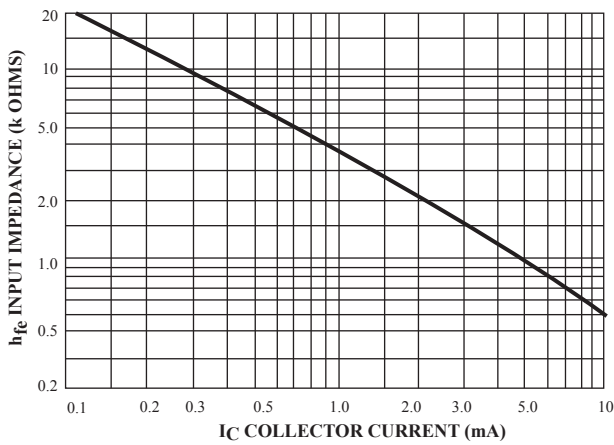


Figure 13. Input Impedance

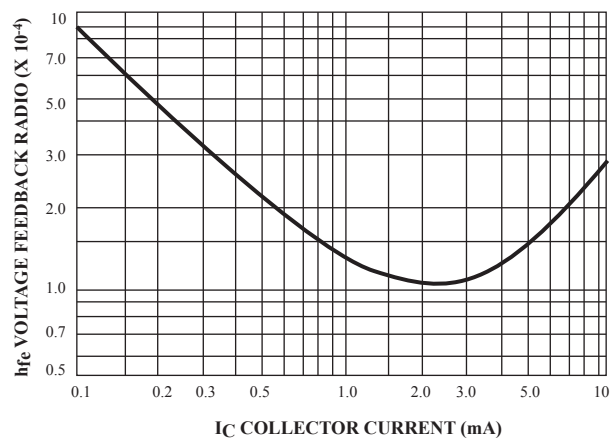


Figure 14. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

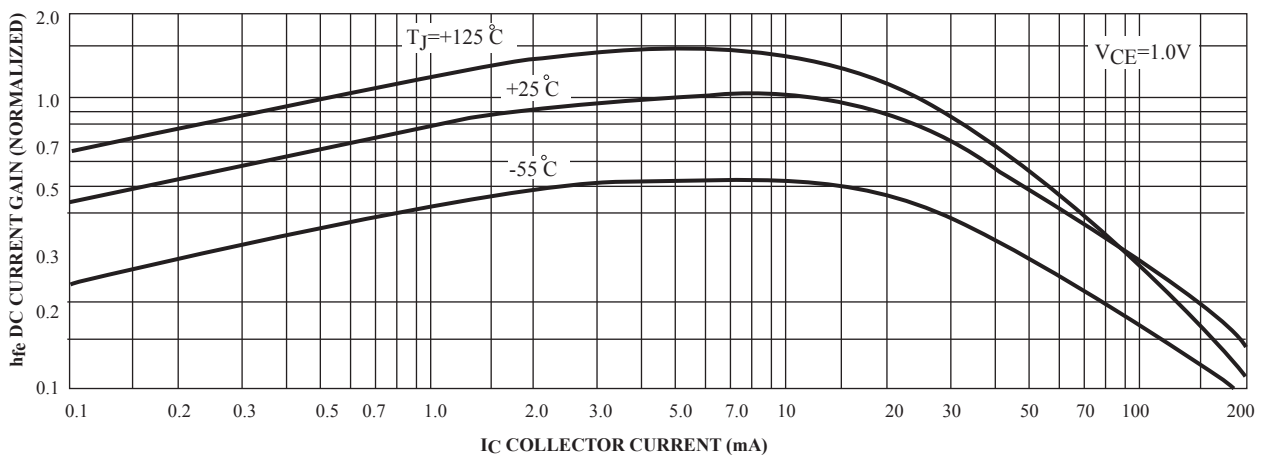


Figure 15. DC Current Gain

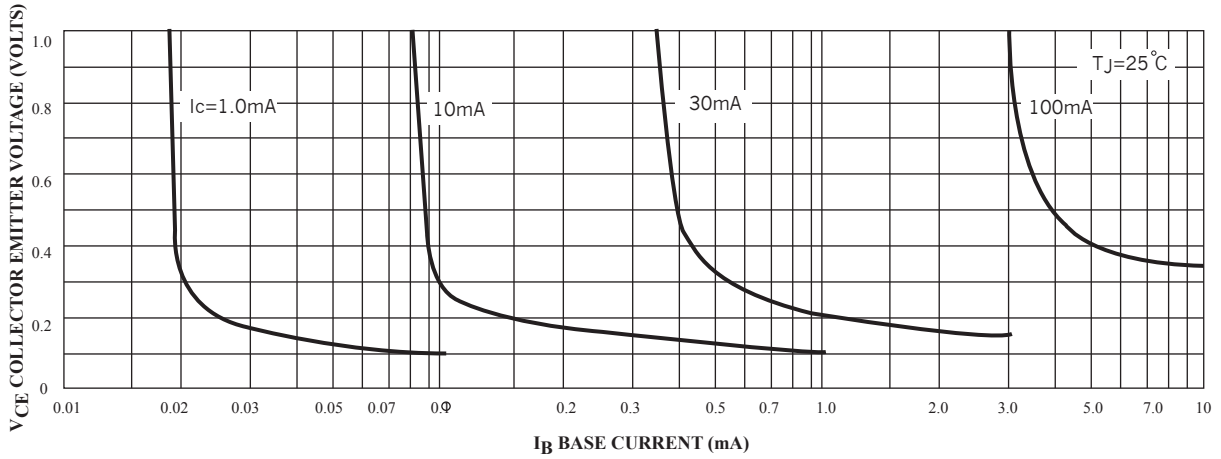


Figure 16. Collector Saturation Region

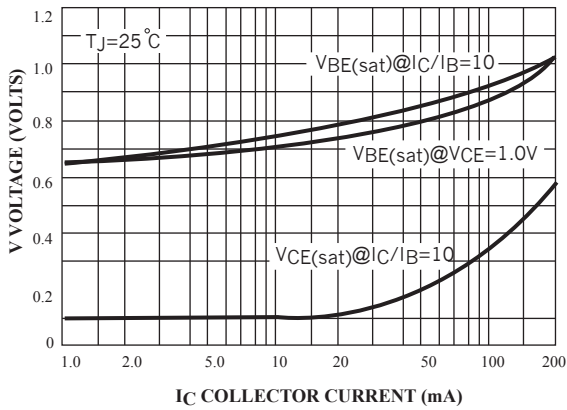


Figure 17. "ON" Voltage

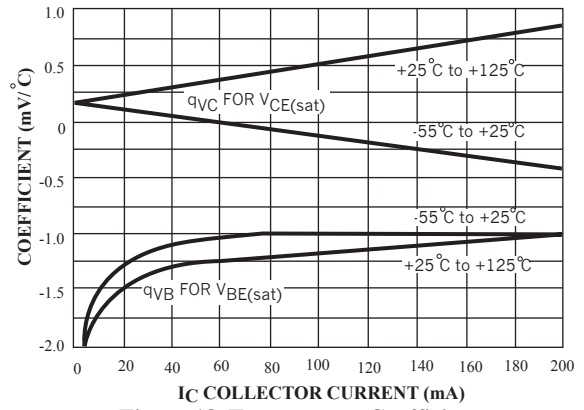
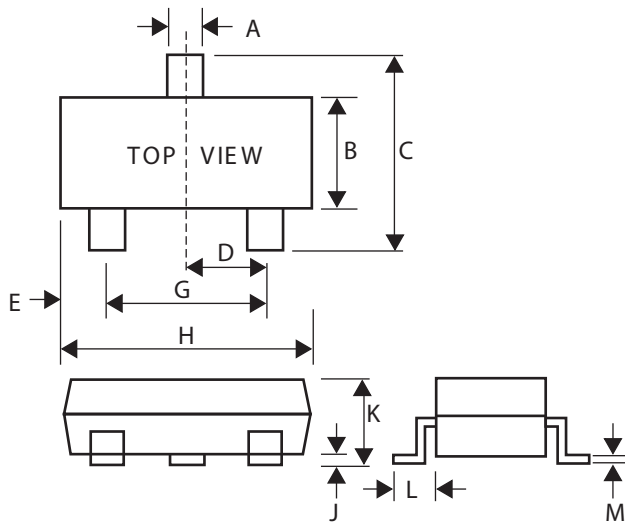


Figure 18. Temperature Coefficients

SOT-323 Outline Demensions

Unit:mm



SOT-323		
Dim	Min	Max
A	0.30	0.40
B	1.15	1.35
C	2.00	2.40
D	-	0.65
E	0.30	0.40
G	1.20	1.40
H	1.80	2.20
J	0.00	0.10
K	0.80	1.00
L	0.42	0.53
M	0.10	0.25