

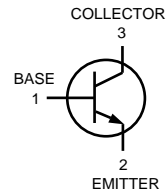
## General Purpose Transistor

**NPN Silicon**

**Lead free product**

**Halogen-free type**

**MMBT3904WGH**



### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V <sub>CEO</sub>	40	V <sub>d</sub> c
Collector-Base Voltage	V <sub>CBO</sub>	60	V <sub>d</sub> c
Emitter-Base Voltage	V <sub>EBO</sub>	6.0	V <sub>d</sub> c
Collector Current-Continuous	I <sub>C</sub>	200	mA <sub>d</sub> c

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max.	Unit
Total Device Dissipation FR-5 Board <sup>(1)</sup> T <sub>A</sub> =25°C Derate above 25°C	P <sub>D</sub>	225 1.8	mW mW / °C
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	556	°C / W
Total Device Dissipation Alumina Substrate, <sup>(2)</sup> T <sub>A</sub> =25°C Derate above 25°C	P <sub>D</sub>	300 2.4	mW mW / °C
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	417	°C / W
Junction and Storage Temperature	T <sub>J</sub> ,T <sub>STG</sub>	-55 to +150	°C

### ELECTRICAL CHARACTERISTICS (T<sub>A</sub>=25°C unless otherwise noted)

Characteristic	Symbol	Min.	Max.	Unit
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### OFF CHARACTERISTICS

Collector-Emitter Breakdowe Voltage <sup>(3)</sup> ( I <sub>C</sub> =1.0mA <sub>d</sub> c, I <sub>B</sub> =0 )	V <sub>(BR)CEO</sub>	40	-	V <sub>d</sub> c
Collector-Base Breakdowe Voltage ( I <sub>C</sub> =10 uA <sub>d</sub> c, I <sub>E</sub> =0 )	V <sub>(BR)CBO</sub>	60	-	V <sub>d</sub> c
Emitter-Base Breakdowe Voltage ( I <sub>E</sub> =10 uA <sub>d</sub> c, I <sub>C</sub> =0 )	V <sub>(BR)EBO</sub>	6.0	-	V <sub>d</sub> c
Base Cutoff Current ( V <sub>CE</sub> =30 V <sub>d</sub> c, V <sub>EB</sub> =3.0 V <sub>d</sub> c )	I <sub>BL</sub>	-	50	nA <sub>d</sub> c
Collector Cutoff Current ( V <sub>CE</sub> =30 V <sub>d</sub> c, V <sub>EB</sub> =3.0 V <sub>d</sub> c )	I <sub>C</sub> EX	-	50	nA <sub>d</sub> c

**ELECTRICAL CHARACTERISTICS** (TA=25°C unless otherwise noted) (Continued)

Characteristic	Symbol	Min.	Max.	Unit
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**ON CHARACTERISTICS<sup>(3)</sup>**

DC Current Gain ( IC=0.1 mAdc, VCE=1.0 Vdc ) ( IC=1.0 mAdc, VCE=1.0 Vdc ) ( IC=10 mAdc, VCE=1.0 Vdc ) ( IC=50 mAdc, VCE=1.0 Vdc ) ( IC=100 mAdc, VCE=1.0 Vdc )	HFE	40 70 100 60 30	- - 300 - -	-
Collector-Emitter Saturation Voltage <sup>(3)</sup> ( IC=10 mAdc, IB=1.0 mAdc ) ( IC=50 mAdc, IB=5.0 mAdc )	VCE(sat)	- -	0.2 0.3	Vdc
Base-Emitter Saturation Voltage <sup>(3)</sup> ( IC=10 mAdc, IB=1.0 mAdc ) ( IC=50 mAdc, IB=5.0 mAdc )	VBE(sat)	0.65 -	0.85 0.95	Vdc

**SMALL-SIGNAL CHARACTERISTIC**

Current-Gain-Bandwidth Product ( IC=10 mAdc, VCE=20 Vdc, f=100 MHz )	ft	300	-	MHZ
Output Capacitance ( VCB=5.0 Vdc, IE=0, f=1.0 MHz )	Cobo	-	4.0	pF
Input Capacitance ( VEB=0.5 Vdc, IC=0, f=1.0 MHz )	Cibo	-	8.0	pF
Input Impedance ( VCE=10 Vdc, IC=1.0 mAdc, f=1.0 kHz )	hie	1.0	10	k ohms
Voltage Feedback Ratio ( VCE=10 Vdc, IC=1.0 mAdc, f=1.0 kHz )	hre	0.5	8.0	X 10 <sup>-4</sup>
Small-Signal Current Gain ( VCE=10 Vdc, IC=1.0 mAdc, f=1.0 kHz )	hfe	100	400	-
Output Admittance ( VCE=10 Vdc, IC=1.0 mAdc, f=1.0 kHz )	hoe	1.0	40	u mhos
Noise Figure ( VCE=5.0 Vdc, IC=100 uAdc, RS=1.0 k ohm, f=1.0 kHz )	NF	-	5.0	dB

**SWITCHING CHARACTERISTICS**

Delay Time	( VCC=3.0 Vdc, VBE=-0.5 Vdc, IC=10 mAdc, IB1=1.0 mAdc )	td	-	35	nS
Rise Time		tr	-	35	
Storage Time	( VCC=3.0 Vdc, IC=10 mAdc, IB1=IB2=1.0 mAdc )	ts	-	200	nS
Fall Time		tf	-	50	

(1) FR-5=1.0 x 0.75 x 0.062in.

(2) Alumina=0.4 x 0.3 x 0.024in. 99.5% alumina.

(3) Pulse Test : Pulse Width ≤ 300uS, Duty Cycle ≤ 2.0%.

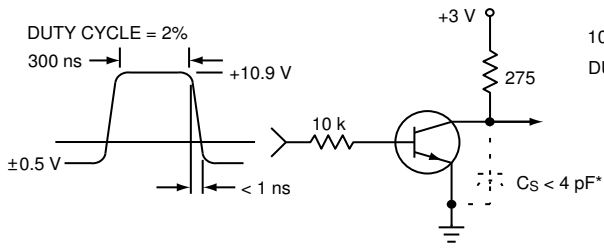


Figure 1. Delay and Rise Time Equivalent Test Circuit

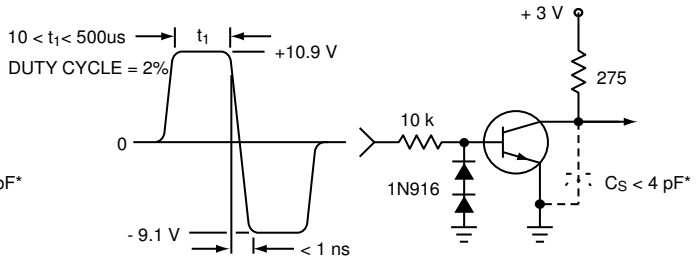


Figure 2. Storage and Fall Time Equivalent Test Circuit

\* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

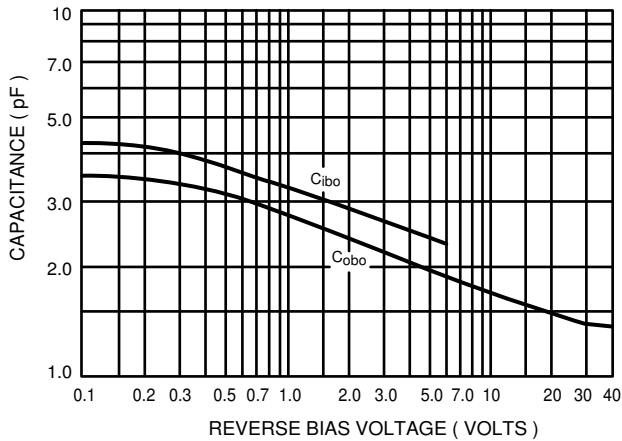


Figure 3. Capacitance

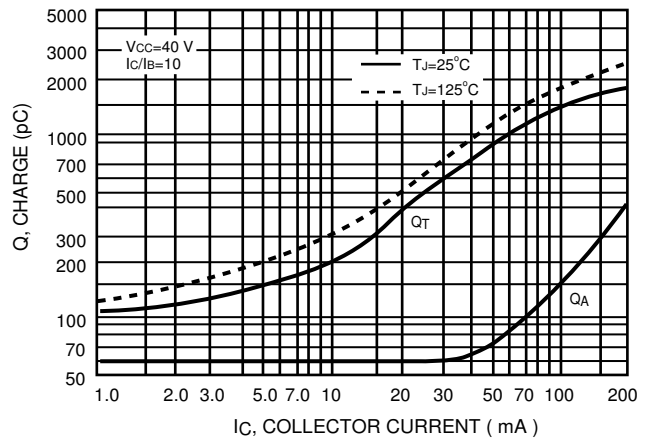


Figure 4. Charge Data

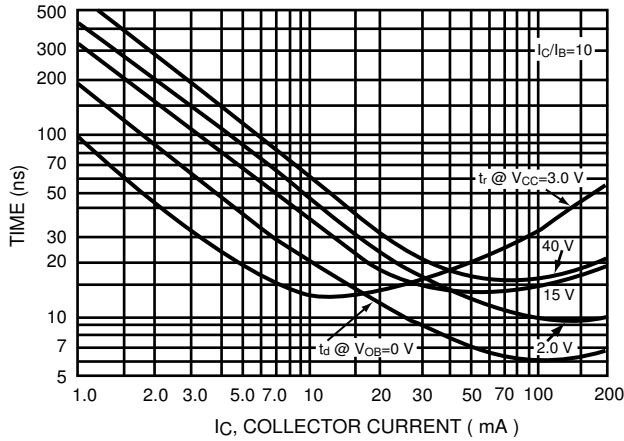


Figure 5. Turn-On Time

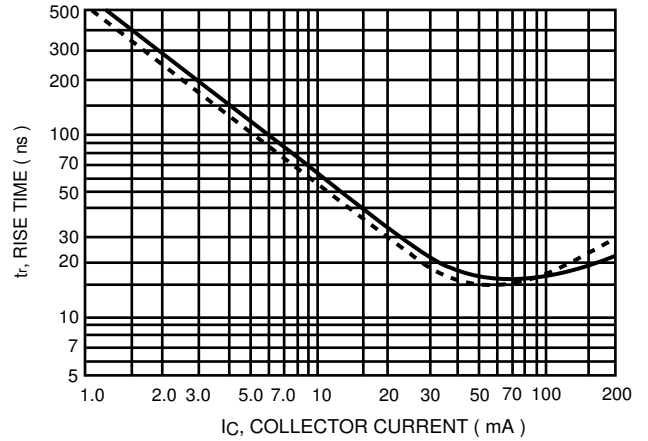


Figure 6. Rise Time

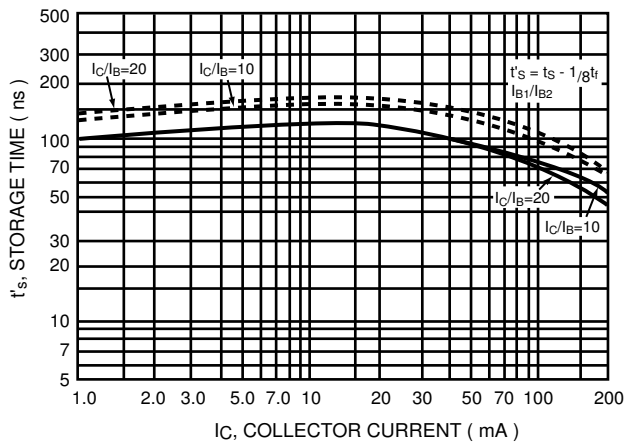


Figure 7. Storage Time

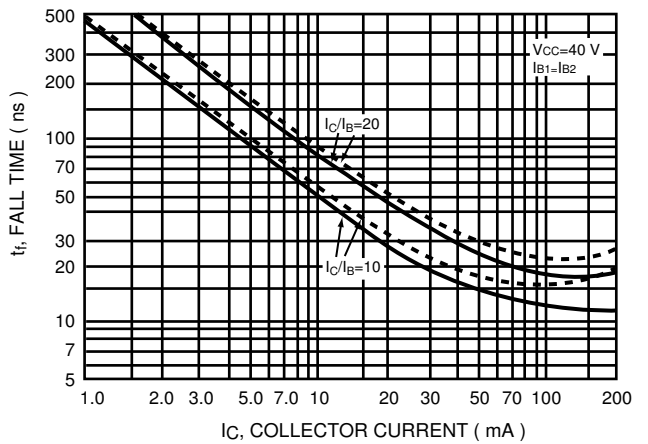


Figure 8. Fall Time

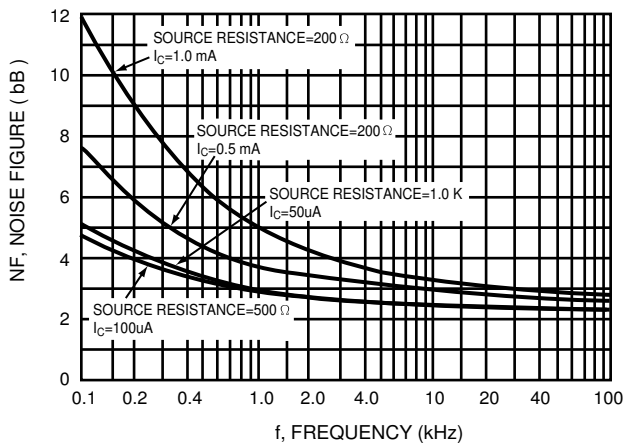


Figure 9.

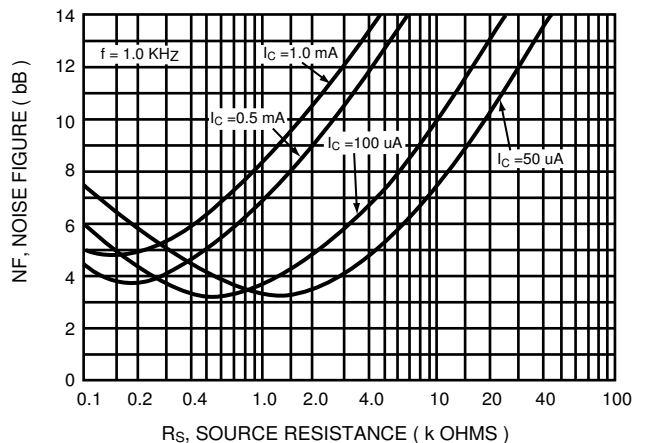
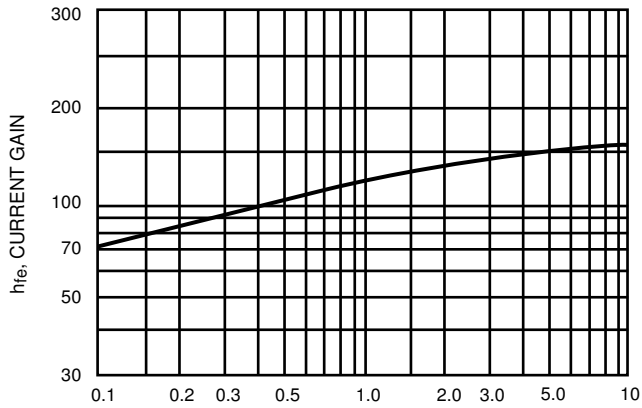
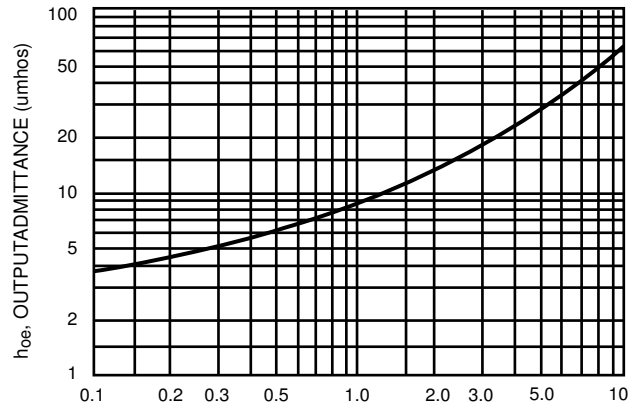


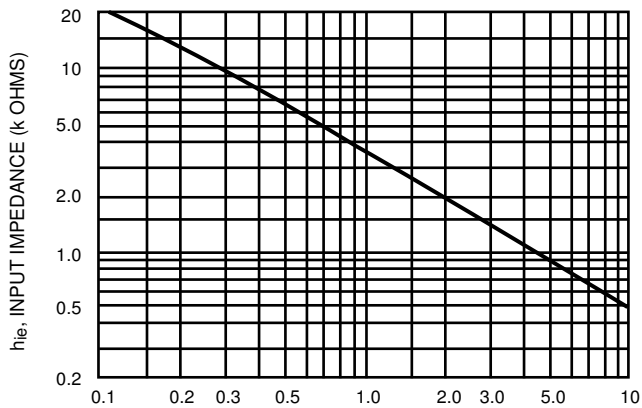
Figure 10.



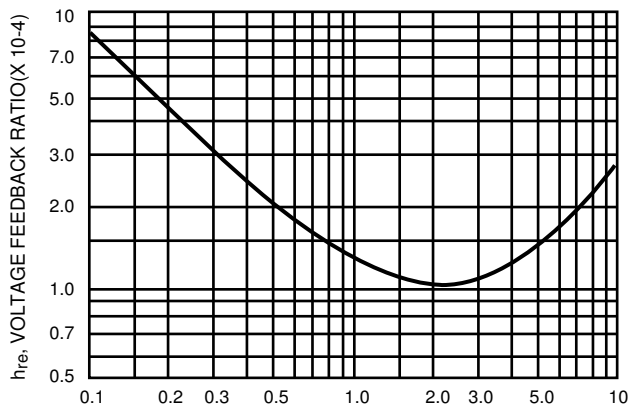
IC, COLLECTOR CURRENT ( mA )  
**Figure 11. Current Gain**



IC, COLLECTOR CURRENT ( mA )  
**Figure 12. Output Admittance**

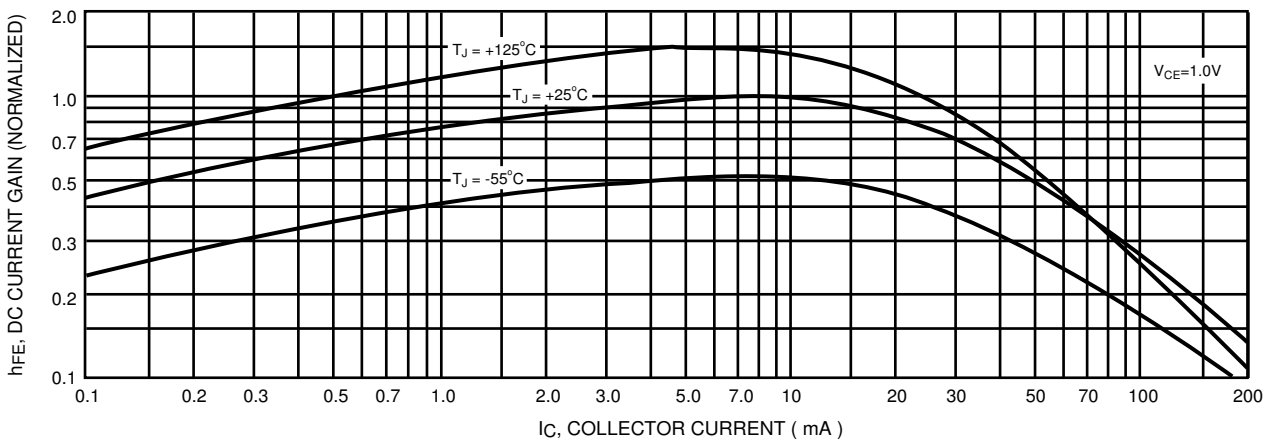


IC, COLLECTOR CURRENT ( mA )  
**Figure 13. Input Impedance**



IC, COLLECTOR CURRENT ( mA )  
**Figure 14. Voltage Feedback Ratio**

**TYPICAL STATIC CHARACTERISTICS**



**Figure 15. DC Current Gain**

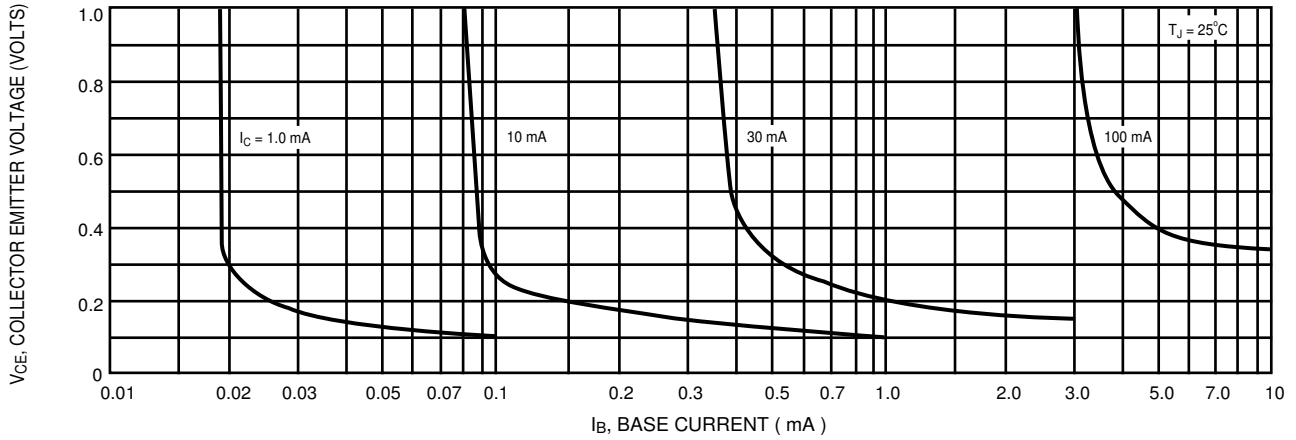


Figure 16. Collector Saturation Region

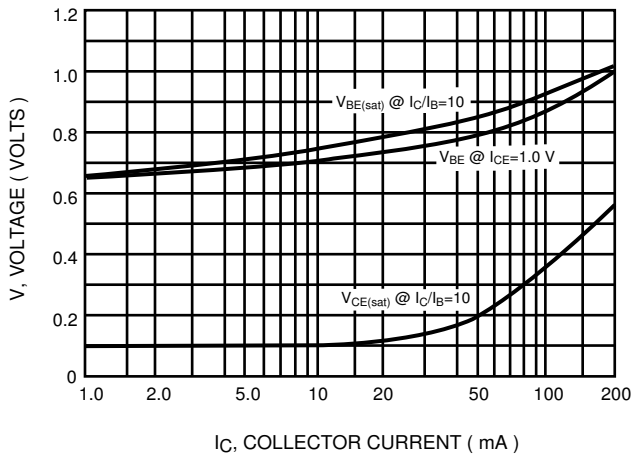


Figure 17. " ON " Voltage

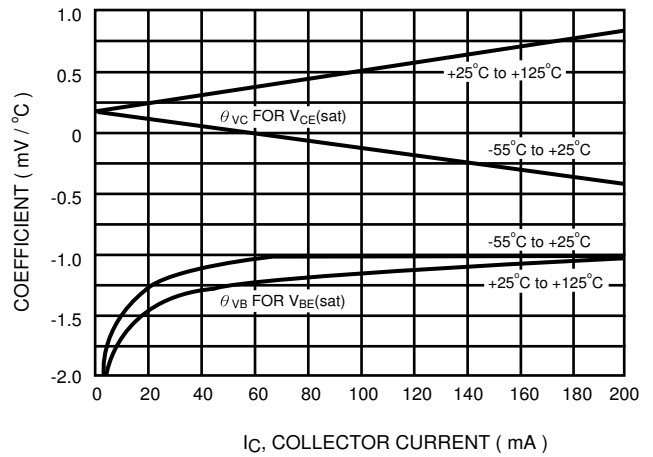


Figure 18. Temperature Coefficients