

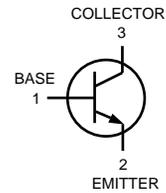
General Purpose Transistor

NPN Silicon

Lead free product

Halogen-free type

MMBT3904WGH



MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V _{CEO}	40	V _{dc}
Collector-Base Voltage	V _{CBO}	60	V _{dc}
Emitter-Base Voltage	V _{EBO}	6.0	V _{dc}
Collector Current-Continuous	I _C	200	mA _{dc}

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max.	Unit
Total Device Dissipation FR-5 Board ⁽¹⁾ T _A =25°C Derate above 25°C	P _D	225 1.8	mW mW / °C
Thermal Resistance Junction to Ambient	R _{θJA}	556	°C / W
Total Device Dissipation Alumina Substrate, ⁽²⁾ T _A =25°C Derate above 25°C	P _D	300 2.4	mW mW / °C
Thermal Resistance Junction to Ambient	R _{θJA}	417	°C / W
Junction and Storage Temperature	T _J ,T _{STG}	-55 to +150	°C

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

Characteristic	Symbol	Min.	Max.	Unit
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OFF CHARACTERISTICS

Collector-Emitter Breakdowe Voltage ⁽³⁾ (I _C =1.0mA _{dc} , I _B =0)	V _{(BR)CEO}	40	-	V _{dc}
Collector-Base Breakdowe Voltage (I _C =10 uA _{dc} , I _E =0)	V _{(BR)CBO}	60	-	V _{dc}
Emitter-Base Breakdowe Voltage (I _E =10 uA _{dc} , I _C =0)	V _{(BR)EBO}	6.0	-	V _{dc}
Base Cutoff Current (V _{CE} =30 V _{dc} , V _{EB} =3.0 V _{dc})	I _{BL}	-	50	nA _{dc}
Collector Cutoff Current (V _{CE} =30 V _{dc} , V _{EB} =3.0 V _{dc})	I _{CEX}	-	50	nA _{dc}

ELECTRICAL CHARACTERISTICS ($T_A=25^{\circ}\text{C}$ unless otherwise noted) (Continued)

Characteristic	Symbol	Min.	Max.	Unit
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ON CHARACTERISTICS⁽³⁾

DC Current Gain ($I_C=0.1\text{ mAdc}$, $V_{CE}=1.0\text{ Vdc}$) ($I_C=1.0\text{ mAdc}$, $V_{CE}=1.0\text{ Vdc}$) ($I_C=10\text{ mAdc}$, $V_{CE}=1.0\text{ Vdc}$) ($I_C=50\text{ mAdc}$, $V_{CE}=1.0\text{ Vdc}$) ($I_C=100\text{ mAdc}$, $V_{CE}=1.0\text{ Vdc}$)	HFE	40 70 100 60 30	- - 300 - -	-
Collector-Emitter Saturation Voltage ⁽³⁾ ($I_C=10\text{ mAdc}$, $I_B=1.0\text{ mAdc}$) ($I_C=50\text{ mAdc}$, $I_B=5.0\text{ mAdc}$)	$V_{CE(sat)}$	- -	0.2 0.3	Vdc
Base-Emitter Saturation Voltage ⁽³⁾ ($I_C=10\text{ mAdc}$, $I_B=1.0\text{ mAdc}$) ($I_C=50\text{ mAdc}$, $I_B=5.0\text{ mAdc}$)	$V_{BE(sat)}$	0.65 -	0.85 0.95	Vdc

SMALL-SIGNAL CHARACTERISTIC

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_{ob0}	-	4.0	pF
Input Capacitance ($V_{EB}=0.5\text{ Vdc}$, $I_C=0$, $f=1.0\text{ MHz}$)	C_{ib0}	-	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	10	k ohms
Voltage Feedback Ratio ($V_{CE}=10\text{ Vdc}$, $I_C=1.0\text{ mAdc}$, $f=1.0\text{ kHz}$)	h_{re}	0.5	8.0	$\times 10^{-4}$
Small-Signal Current Gain ($V_{CE}=10\text{ Vdc}$, $I_C=1.0\text{ mAdc}$, $f=1.0\text{ kHz}$)	h_{fe}	100	400	-
Output Admittance ($V_{CE}=10\text{ Vdc}$, $I_C=1.0\text{ mAdc}$, $f=1.0\text{ kHz}$)	h_{oe}	1.0	40	$\mu\text{ mhos}$
Noise Figure ($V_{CE}=5.0\text{ Vdc}$, $I_C=100\text{ uAdc}$, $R_S=1.0\text{ k ohm}$, $f=1.0\text{ kHz}$)	NF	-	5.0	dB

SWITCHING CHARACTERISTICS

Delay Time	($V_{CC}=3.0\text{ Vdc}$, $V_{BE}=-0.5\text{ Vdc}$, $I_C=10\text{ mAdc}$, $I_{B1}=1.0\text{ mAdc}$)	t_d	-	35	nS
Rise Time		t_r	-	35	
Storage Time	($V_{CC}=3.0\text{ Vdc}$, $I_C=10\text{ mAdc}$, $I_{B1}=I_{B2}=1.0\text{ mAdc}$)	t_s	-	200	nS
Fall Time		t_f	-	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 $\leq 300\mu\text{s}$, Duty Cycle $\leq 2.0\%$.

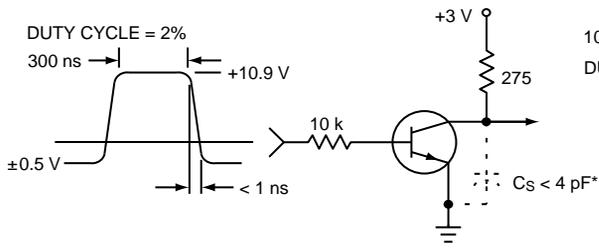


Figure 1. Delay and Rise Time Equivalent Test Circuit

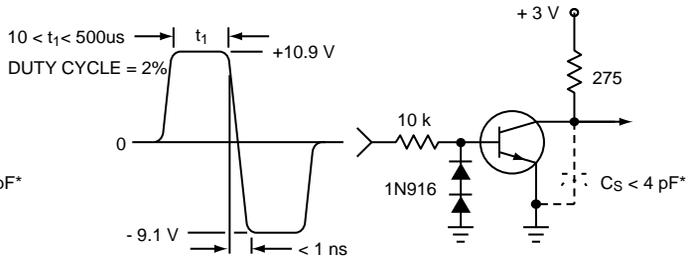


Figure 2. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

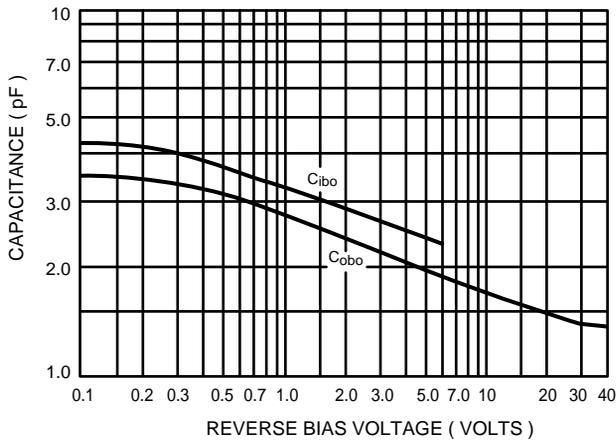


Figure 3. Capacitance

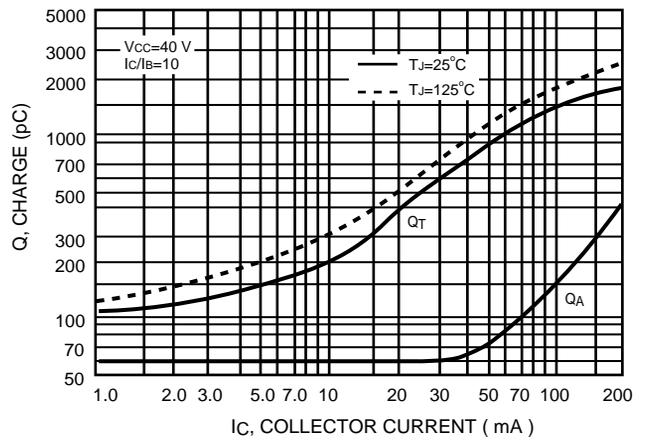


Figure 4. Charge Data

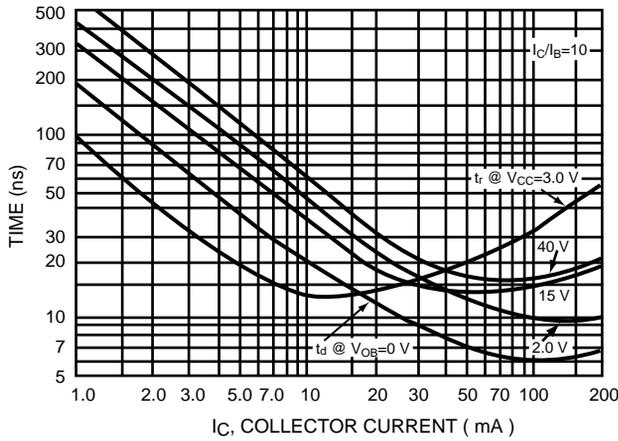


Figure 5. Turn-On Time

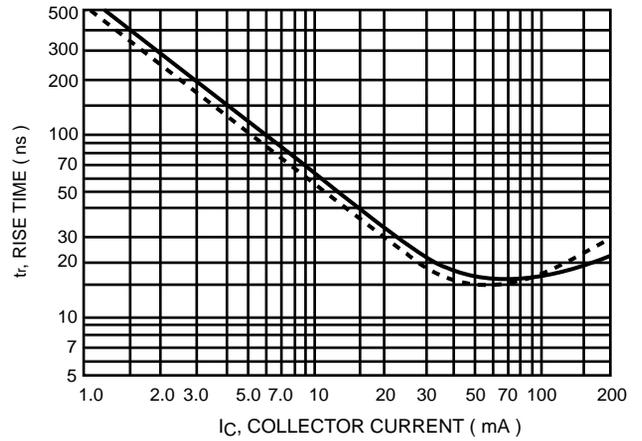


Figure 6. Rise Time

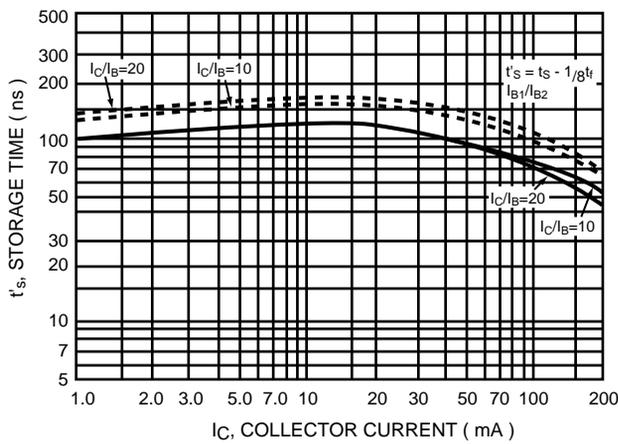


Figure 7. Storage Time

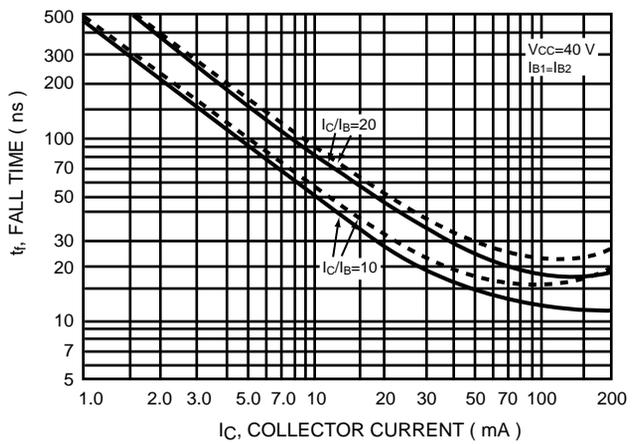


Figure 8. Fall Time

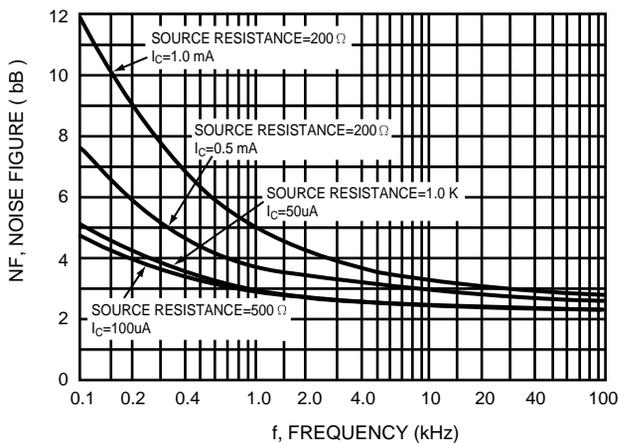


Figure 9.

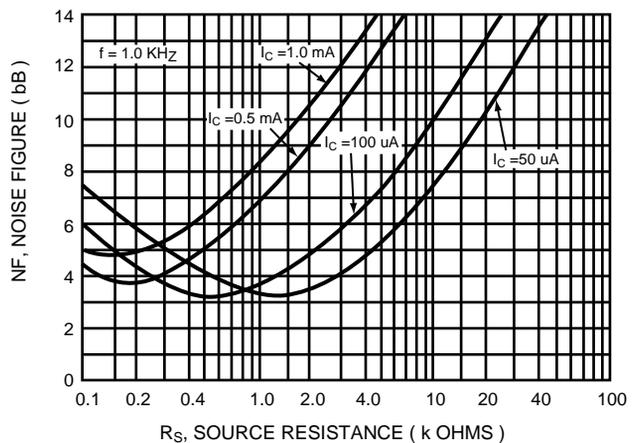
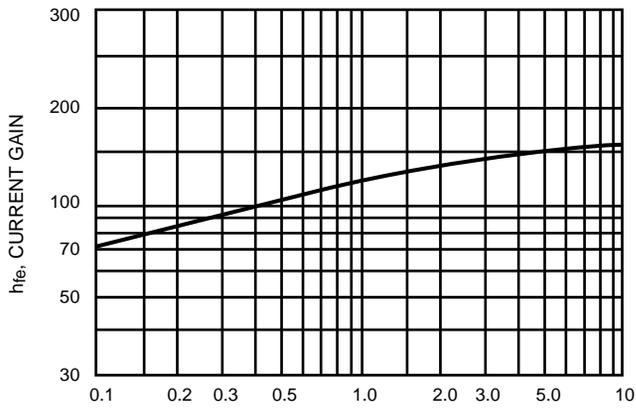
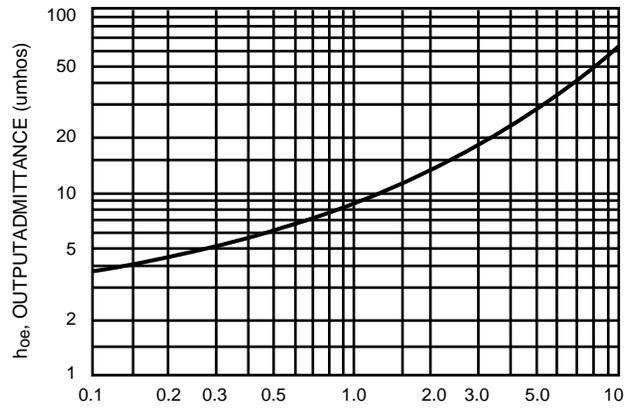


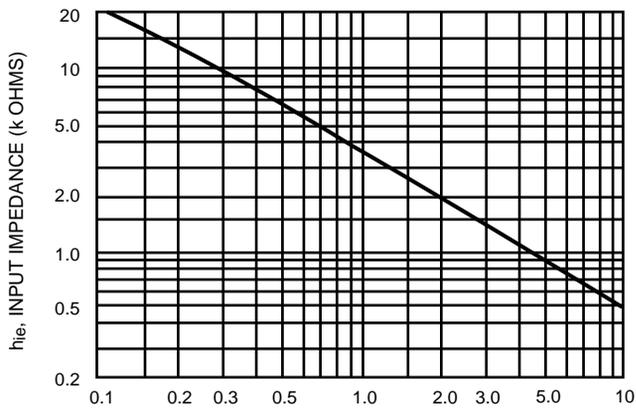
Figure 10.



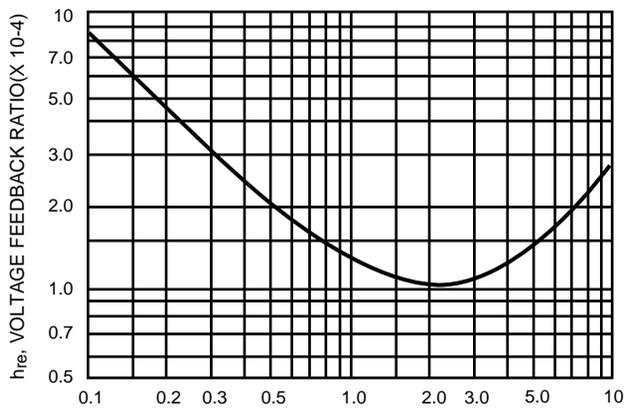
IC, COLLECTOR CURRENT (mA)
Figure 11. Current Gain



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

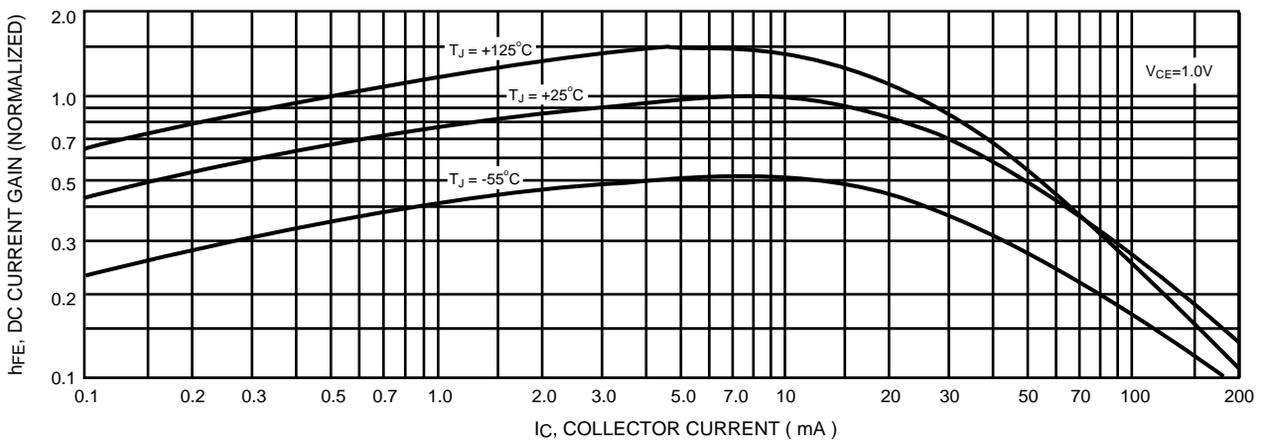


Figure 15. DC Current Gain

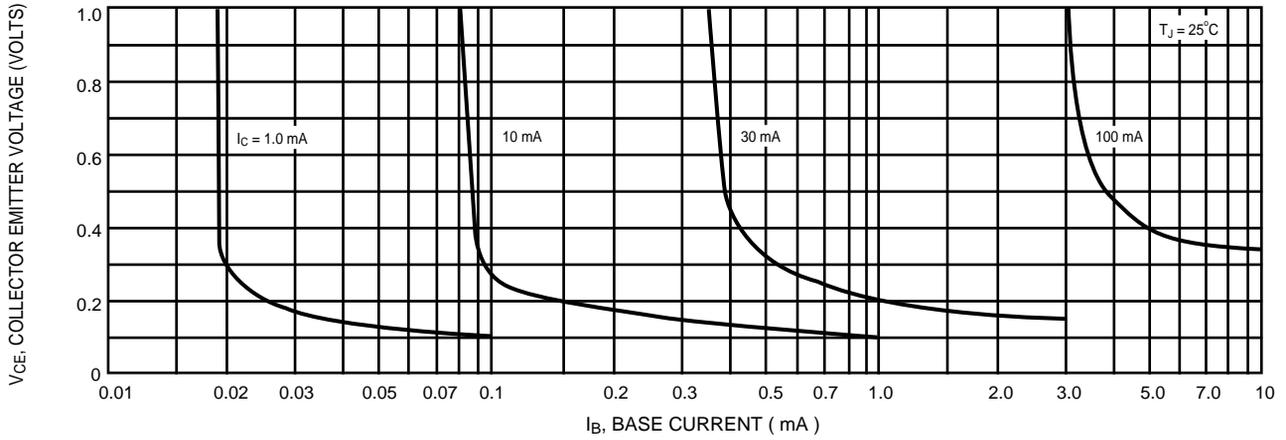


Figure 16. Collector Saturation Region

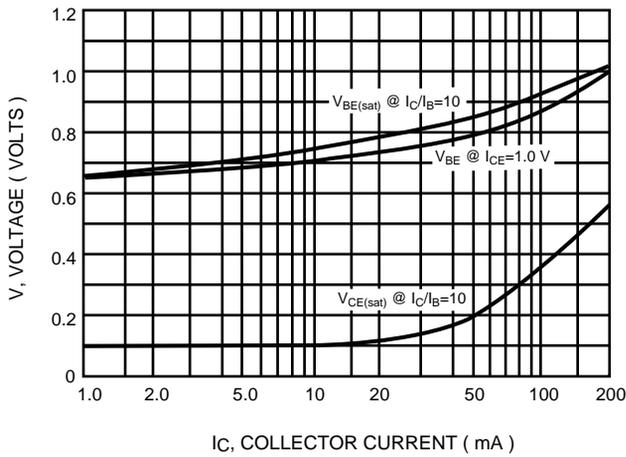


Figure 17. " ON " Voltage

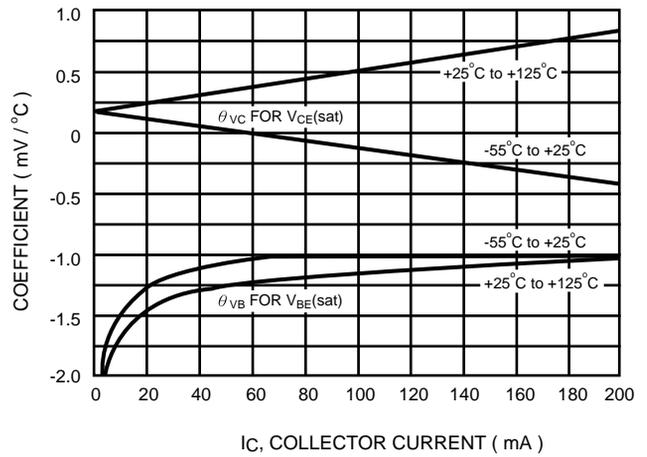


Figure 18. Temperature Coefficients