



DESCRIPTION

The MMBT3904L is available in SOT-23 package.

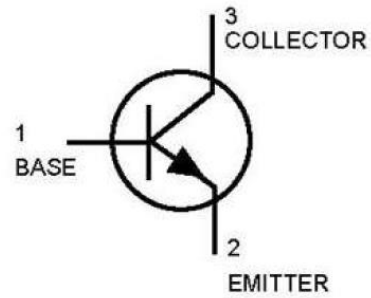
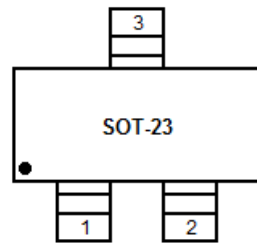
ORDERING INFORMATION

Package Type	Part Number
SOT-23	MMBT3904L
Note	SPQ: 3,000pcs/Reel
AiT provides all RoHS Compliant Products	

FEATURES

- Available in SOT-23 package

PIN DESCRIPTION





ABSOLUTE MAXIMUM RATINGS

V_{CEO} , Collector-Emitter Voltage	40Vdc
V_{CBO} , Collector-Base Voltage	60Vdc
V_{EBO} , Emitter-Base Voltage	6.0Vdc
I_C , Collector Current-Continuous	200mAdc

Stresses above may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated in the Electrical Characteristics are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

THERMAL CHARACTERISTICS

Parameter	Symbol	Max	Unit
Total Device Dissipation FR-5 Board ^{NOTE1} $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	225 1.8	mW mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{W}$
Total Device Dissipation Alumina Substrate ^{NOTE2} $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	300 2.4	mW mW/ $^\circ\text{C}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature	T_J, T_{STG}	-55 to +150	$^\circ\text{C}$



ELECTRICAL CHARACTERISTICS

T_A = 25°C unless otherwise noted

Parameter	Symbol	Conditions	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage ^{NOTE3}	V _{(BR)CEO}	I _C = 1.0mA _{dc} , I _B = 0	40	-	V _{dc}
Collector-Base Breakdown Voltage	V _{(BR)CBO}	I _C = 10μA _{dc} , I _E = 0	60	-	V _{dc}
Emitter-Base Breakdown Voltage	V _{(BR)EBO}	I _E = 10μA _{dc} , I _C = 0	6.0	-	V _{dc}
Base Cutoff Current	I _{BL}	V _{CE} = 30V _{dc} , V _{EB} = 3.0V _{dc}	-	50	nA _{dc}
Collector Cutoff Current	I _{CEx}	V _{CE} = 30V _{dc} , V _{EB} = 3.0V _{dc}	-	50	nA _{dc}
ON CHARACTERISTICS^{NOTE3}					
DC Current Gain ^{NOTE1}	h _{FE}	I _C = 0.1mA _{dc} , V _{CE} = 1.0V _{dc}	40	-	-
		I _C = 1.0mA _{dc} , V _{CE} = 1.0V _{dc}	70	-	
		I _C = 10mA _{dc} , V _{CE} = 1.0V _{dc}	100	300	
		I _C = 50mA _{dc} , V _{CE} = 1.0V _{dc}	60	-	
		I _C = 100mA _{dc} , V _{CE} = 1.0V _{dc}	30	-	
Collector-Emitter Saturation Voltage	V _{CE(sat)}	I _C = 10mA _{dc} , I _B = 1.0mA _{dc} NOTE3	-	0.2	V _{dc}
		I _C = 50mA _{dc} , I _B = 5.0mA _{dc}	-	0.3	
Base-Emitter Saturation Voltage ^{NOTE3}	V _{BE(sat)}	I _C = 10mA _{dc} , I _B = 1.0mA _{dc}	0.65	0.85	V _{dc}
		I _C = 50mA _{dc} , I _B = 5.0mA _{dc}	-	0.95	



Parameter	Symbol	Conditions	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain-Bandwidth Product	f_T	$I_C = 10\text{mA dc}$, $V_{CE} = 20\text{V dc}$, $f = 100\text{MHz}$	300	-	MHz
Output Capacitance	C_{obo}	$V_{CB} = 5.0\text{V dc}$, $I_E = 0$, $f = 1.0\text{MHz}$	-	4.0	pF
Input Capacitance	C_{ibo}	$V_{EB} = 0.5\text{V dc}$, $I_C = 0$, $f = 1.0\text{MHz}$	-	8.0	pF
Input Impedance	h_{ie}	$V_{CE} = 10\text{V dc}$, $I_C = 1.0\text{mA dc}$, $f = 1.0\text{kHz}$	1.0	10	pF
Voltage Feedback Ratio	h_{re}	$V_{CE} = 10\text{V dc}$, $I_C = 1.0\text{mA dc}$, $f = 1.0\text{kHz}$	0.5	8.0	$\times 10^{-4}$
Small-Signal Current Gain	h_{fe}	$V_{CE} = 10\text{V dc}$, $I_C = 1.0\text{mA dc}$, $f = 1.0\text{kHz}$	100	400	-
Output Admittance	h_{oe}	$V_{CE} = 10\text{V dc}$, $I_C = 1.0\text{mA dc}$, $f = 1.0\text{kHz}$	1.0	40	mhos
Noise Figure	NF	$V_{CE} = 5.0\text{V dc}$, $I_C = 100\mu\text{A dc}$, $R_S = 1.0\text{k}\Omega$, $f = 1.0\text{kHz}$	-	5.0	dB
SWITCHING CHARACTERISTICS					
Delay Time	t_d	$V_{CC} = 3.0\text{V dc}$, $V_{BE} = -0.5\text{V dc}$, $I_C = 10\text{mA dc}$, $I_{B1} = 1.0\text{mA dc}$	-	35	ns
Rise Time	t_r		-	35	
Storage Time	t_s	$V_{CC} = 3.0\text{V dc}$, $I_C = 10\text{mA dc}$, $I_{B1} = I_{B2} = 10\text{mA dc}$	-	200	ns
Fall Time	t_f		-	50	

NOTE1: FR-5 = 1.0 x 0.75 x 0.062 in.

NOTE2: Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

NOTE3: Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2.0\%$



TYPICAL CHARACTERISTICS

Figure 1. Delay and Rise Time Equivalent Test Circuit

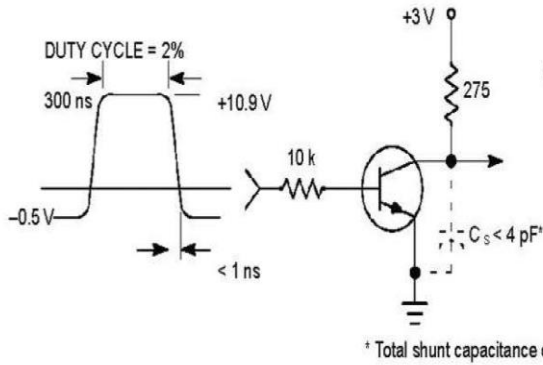


Figure 2. Storage and Fall Time Equivalent Test Circuit

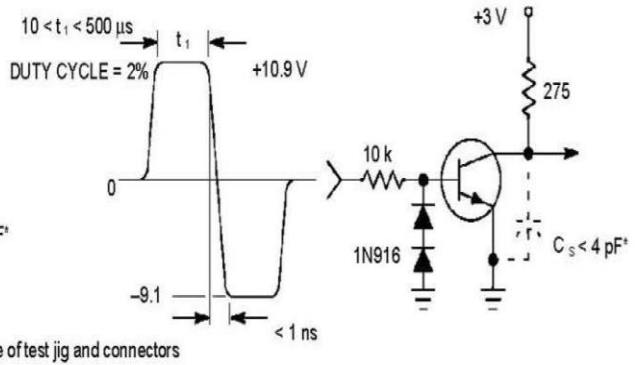


Figure 3. Capacitance

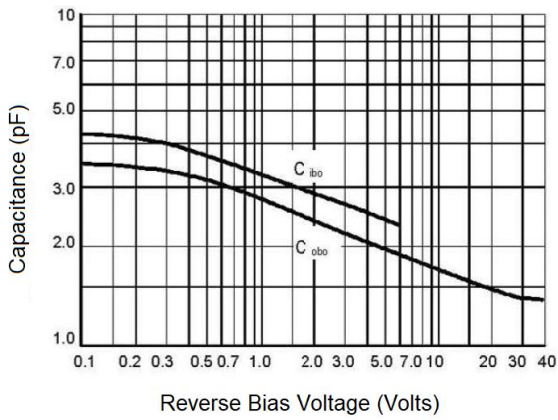


Figure 4. Charge Data

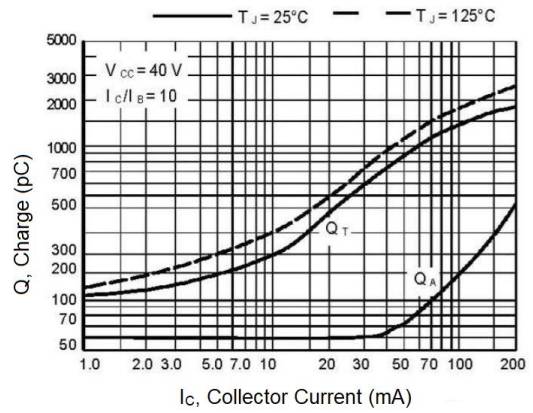


Figure 5. Turn-On Time

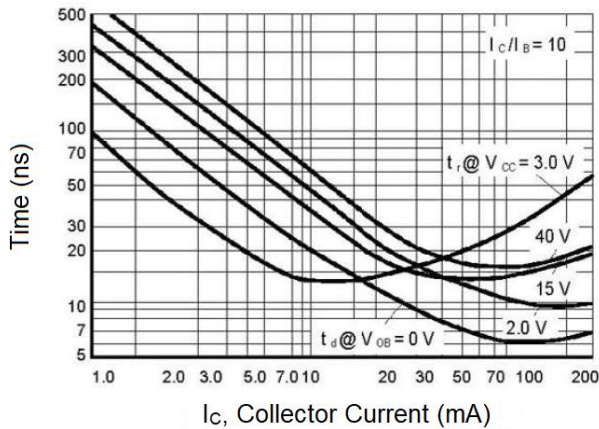


Figure 6. Rise Time

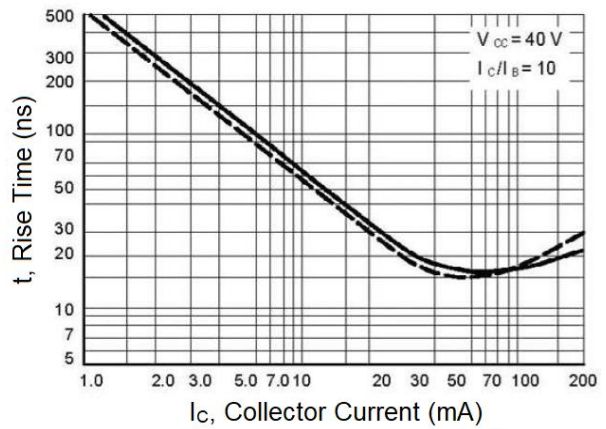




Figure 7. Storage Time

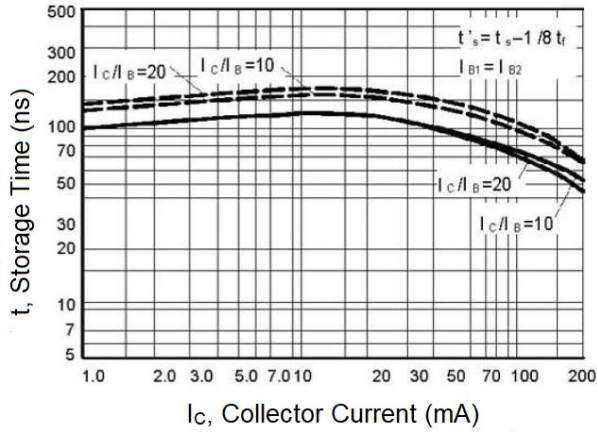
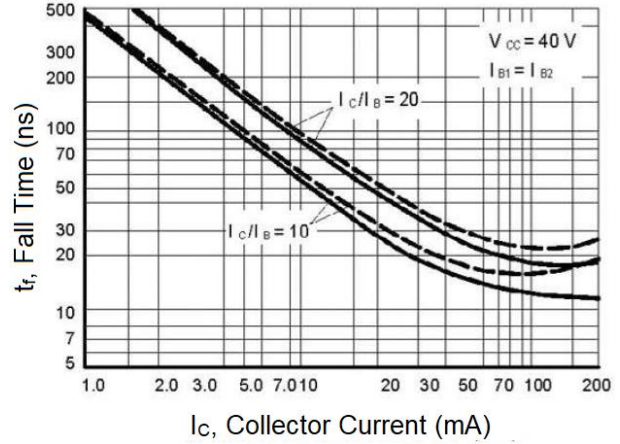


Figure 8. Fall Time



Typical Audio Small-Signal Characteristics Noise Figure Variations

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

Figure 9.

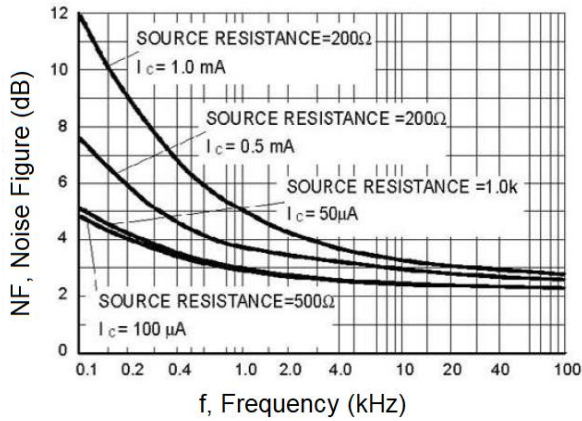
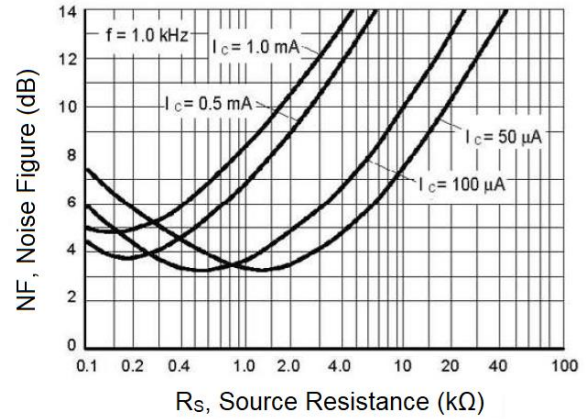


Figure 10.



h Parameters ($V_{CE} = 10V_{dc}$, $f = 1.0kHz$, $T_A = 25^\circ C$)

Figure 11. Current Gain

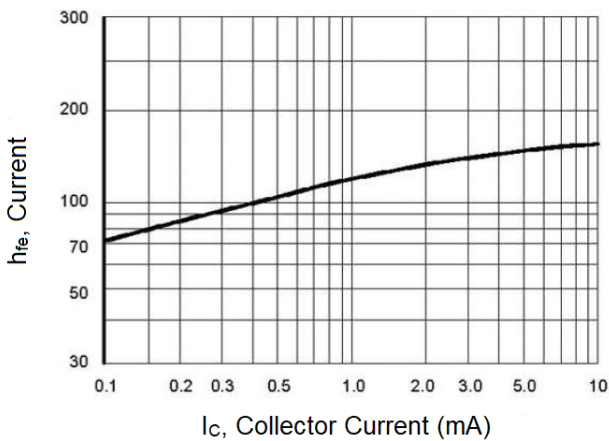


Figure 12. Output Admittance

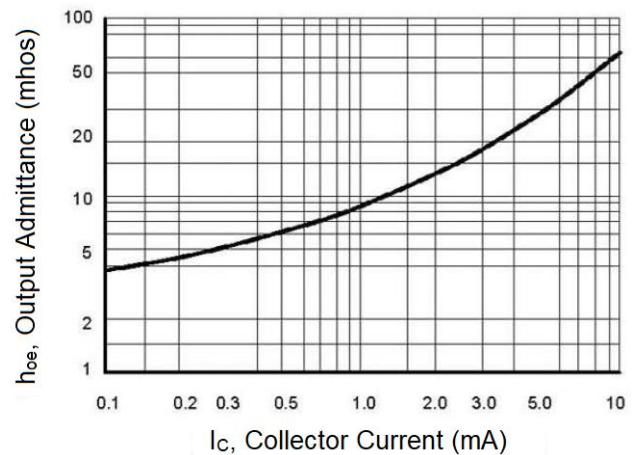




Figure 13. Input Impedance

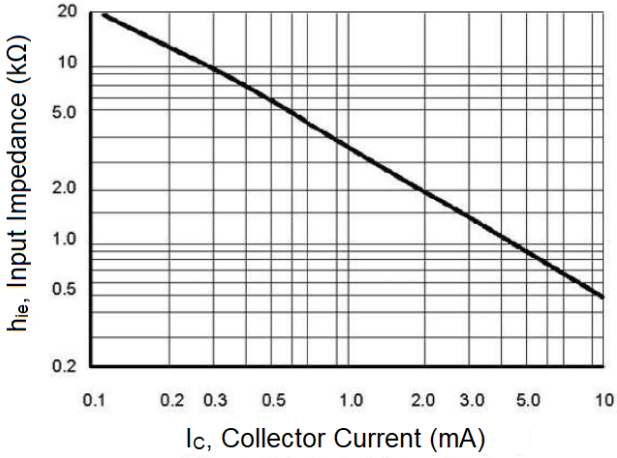
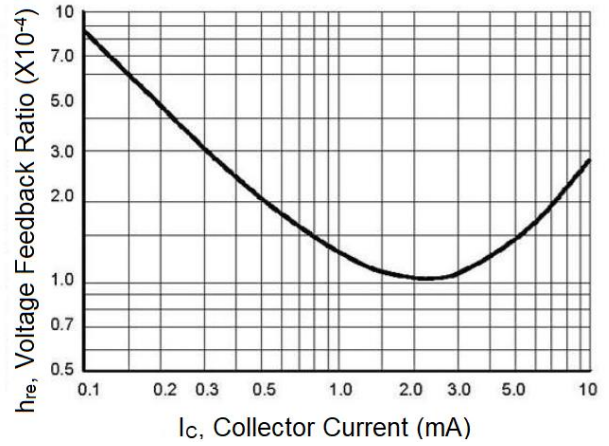
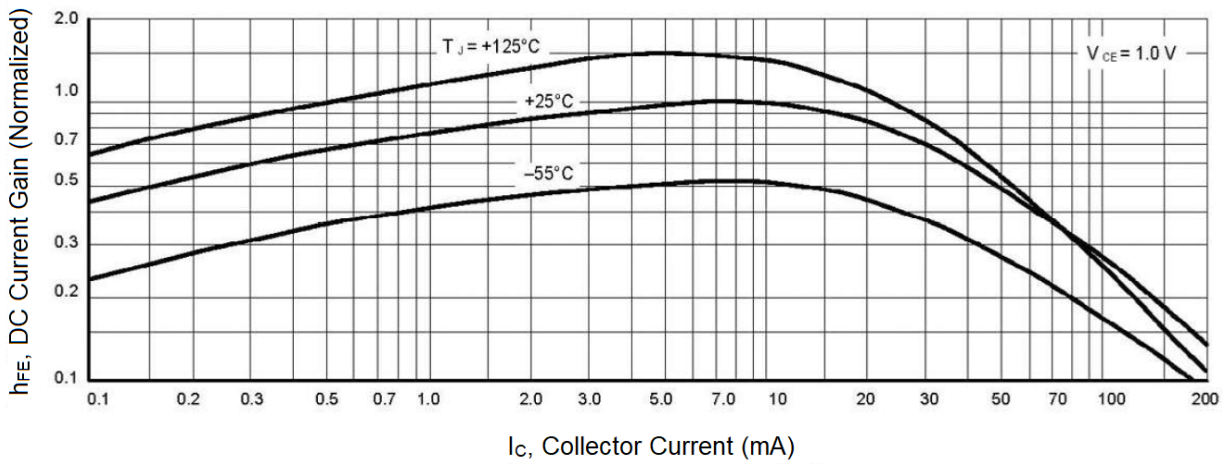


Figure 14. Voltage Feedback Ratio



Typical Static Characteristics

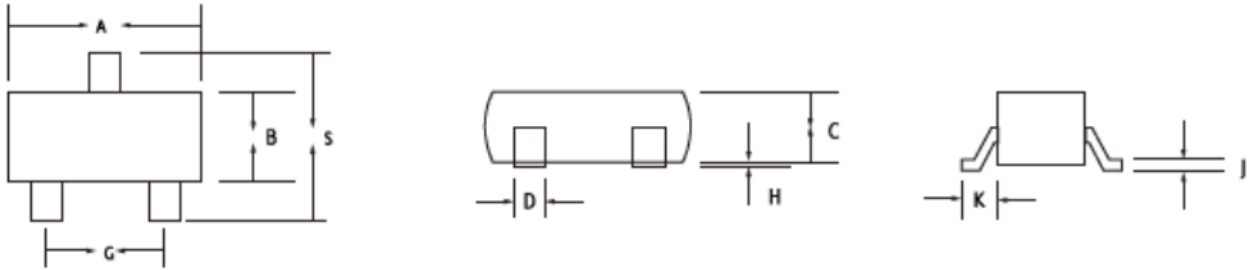
Figure 15. DC Current Gain





PACKAGE INFORMATION

Dimension in SOT-23 Package (Unit: mm)



Symbol	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	2.80	3.00	0.1102	0.1190
B	1.20	1.40	0.0472	0.0551
C	0.89	1.11	0.0350	0.0440
D	0.37	0.50	0.0150	0.0200
G	1.78	2.04	0.0701	0.0807
H	0.013	0.100	0.0005	0.0040
J	0.085	0.177	0.0034	0.0070
K	0.35	0.69	0.0140	0.0285
S	2.10	2.64	0.0830	0.1039



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