

RoHS Compliant Product
A suffix of "-C" specifies halogen and lead free

FEATURES

- Collector Current Capability $I_C=200\text{mA}$
- Collector-Emitter Voltage $V_{CEO}=40\text{V}$

APPLICATION

- General Switching and Amplification.

MARKING



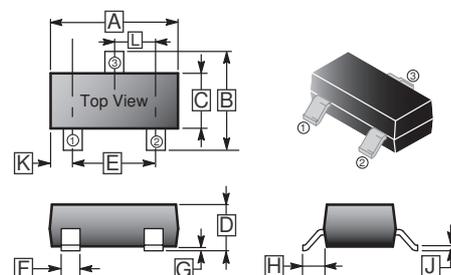
PACKAGE INFORMATION

Package	MPQ	Leader Size
SOT-23	3K	7 inch

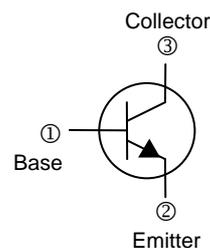
ORDER INFORMATION

Part Number	Type
MMBT3904-C	Lead (Pb)-free and Halogen-free

SOT-23



REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	2.70	3.10	G	0	0.18
B	2.10	2.95	H	0.55	REF.
C	1.20	1.7	J	0.08	0.20
D	0.89	1.3	K	0.6	REF.
E	1.70	2.3	L	0.95	BSC.
F	0.30	0.50			



ABSOLUTE MAXIMUM RATINGS ($T_A=25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Ratings	Unit
Collector-Emitter Voltage	V_{CEO}	40	V
Collector-Base Voltage	V_{CBO}	60	V
Emitter-Base Voltage	V_{EBO}	6	V
Collector Current-Continuous	I_C	200	mA
Total Device Dissipation FR-5 Board ¹ , $T_A=25^\circ\text{C}$	P_D	225	mW
Total Device Dissipation FR-5 Board, Derate above 25°C		1.8	mW/ $^\circ\text{C}$
Thermal Resistance, Junction-Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{W}$
Total Device Dissipation Alumina Substrate ² , $T_A=25^\circ\text{C}$	P_D	300	mW
Total Device Dissipation Alumina Substrate, Derate above 25°C		2.4	mW/ $^\circ\text{C}$
Thermal Resistance, Junction-Ambient	$R_{\theta JA}$	417	$^\circ\text{C}/\text{W}$
Junction, Storage Temperature	T_J, T_{STG}	-55~150	$^\circ\text{C}$

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

Parameter	Symbol	Min.	Max.	Unit	Test Conditions
Collector-Emitter Breakdown Voltage ³	$V_{(BR)CEO}$	40	-	V	$I_C=1\text{mA}, I_B=0$
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	60	-	V	$I_C=10\mu\text{A}, I_E=0$
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	6	-	V	$I_E=10\mu\text{A}, I_C=0$
Base Cut-off Current	I_{BL}	-	50	nA	$V_{CE}=30\text{V}, V_{EB}=3\text{V}$
Collector Cut-off Current	I_{CEX}	-	50	nA	$V_{CE}=30\text{V}, V_{EB}=3\text{V}$
DC Current Gain ³	$h_{FE(1)}$	40	-		$I_C=0.1\text{mA}, V_{CE}=1\text{V}$
	$h_{FE(2)}$	70	-		$I_C=1\text{mA}, V_{CE}=1\text{V}$
	$h_{FE(3)}$	100	300		$I_C=10\text{mA}, V_{CE}=1\text{V}$
	$h_{FE(4)}$	60	-		$I_C=50\text{mA}, V_{CE}=1\text{V}$
	$h_{FE(5)}$	30	-		$I_C=100\text{mA}, V_{CE}=1\text{V}$
Collector-Emitter Saturation Voltage ³	$V_{CE(sat)}$	-	0.2	V	$I_C=10\text{mA}, I_B=1\text{mA}$
		-	0.3		$I_C=50\text{mA}, I_B=5\text{mA}$
Base-Emitter Saturation Voltage ³	$V_{BE(sat)}$	0.65	0.85	V	$I_C=10\text{mA}, I_B=1\text{mA}$
		-	0.95		$I_C=50\text{mA}, I_B=5\text{mA}$
Current-Gain-Bandwidth Product	f_T	300	-	MHz	$I_C=10\text{mA}, V_{CE}=20\text{V}, f=100\text{MHz}$
Output Capacitance	C_{obo}	-	4	pF	$V_{CB}=5\text{V}, I_E=0, f=1\text{MHz}$
Input Capacitance	C_{ibo}	-	8	pF	$V_{EB}=0.5\text{V}, I_C=0, f=1\text{MHz}$
Input Impedance	h_{ie}	1	10	k Ω	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$
Voltage Feedback Ratio	h_{re}	0.5	8	$\times 10^{-4}$	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$
Small-Signal Current Gain	h_{fe}	100	400		$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$
Output Admittance	H_{oe}	1	40	μmhos	$V_{CE}=10\text{V}, I_C=1\text{mA}, f=1\text{kHz}$
Noise Figure	NF	-	5	dB	$V_{CE}=5\text{V}, I_C=100\mu\text{A}, R_S=1\text{K}\Omega, f=1\text{kHz}$
Delay Time	t_d	-	35	nS	$V_{CC}=3\text{V}, V_{BE}=-0.5\text{V}$ $I_C=10\text{mA}, I_{B1}=1\text{mA}$
Rise Time	t_r	-	35		
Storage Time	t_s	-	200		
Fall Time	t_f	-	50		

Notes:

- FR-5=1x0.75x0.062 in.
- Alumina=0.4x0.3x0.024 in. 99.5% alumina.
- Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$.

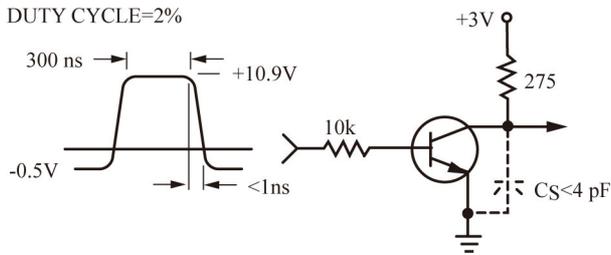


FIG.1 Delay and Rise Time
Equivalent Test Circuit

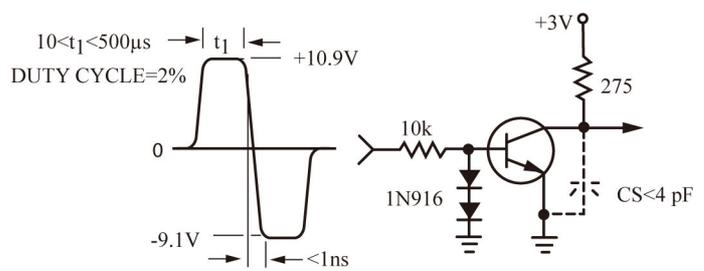


FIG.2 Storage and Fall Time
Equivalent Test Circuit

*Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

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

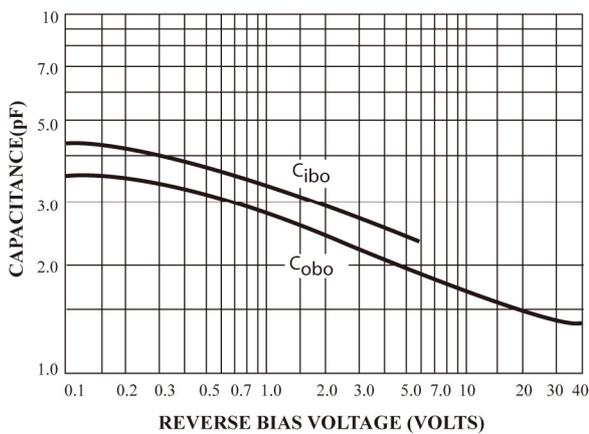


FIG.3 Capacitance

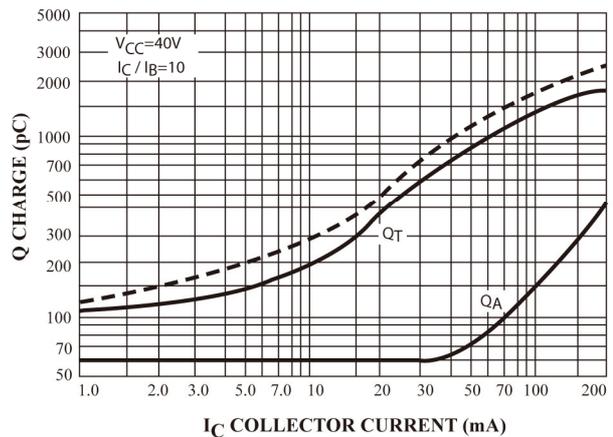


FIG.4 Charge Data

TYPICAL TRANSIENT CHARACTERISTIC CURVES

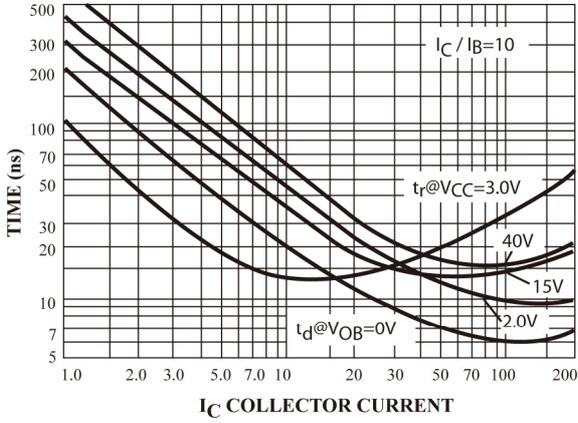


FIG.5 Turn-On Time

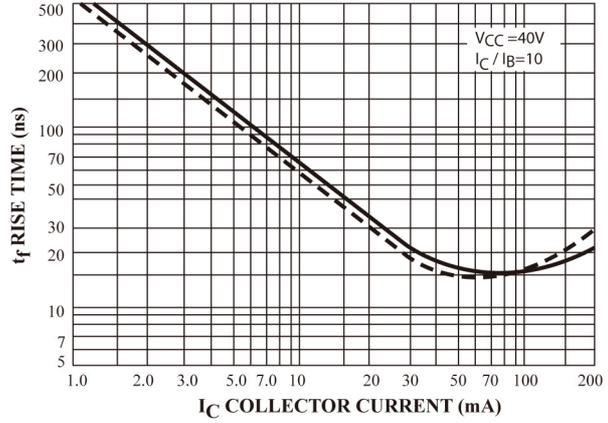


FIG.6 Rise Time

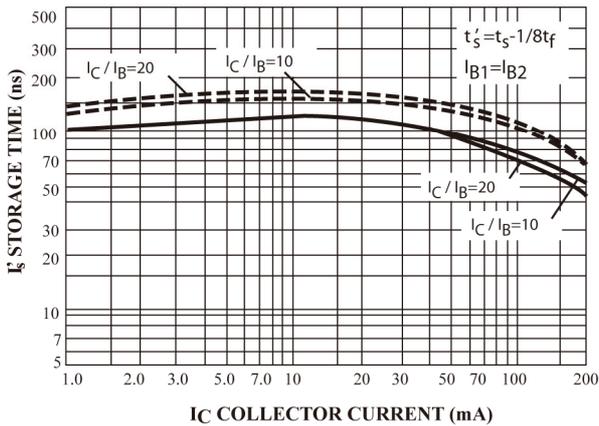


FIG.7 Storage Time

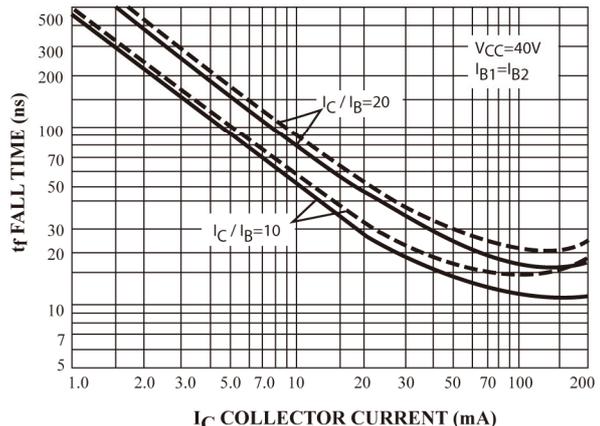


FIG.8 Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE VARIATIONS

(VCE=5.0 Vdc, TA=25 °C, Bandwidth=1.0Hz)

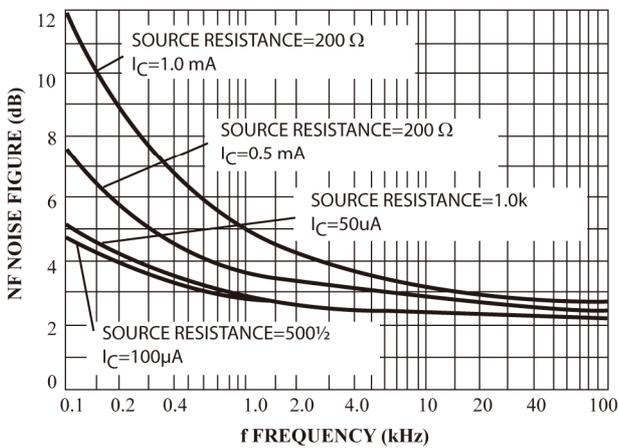


FIG.9

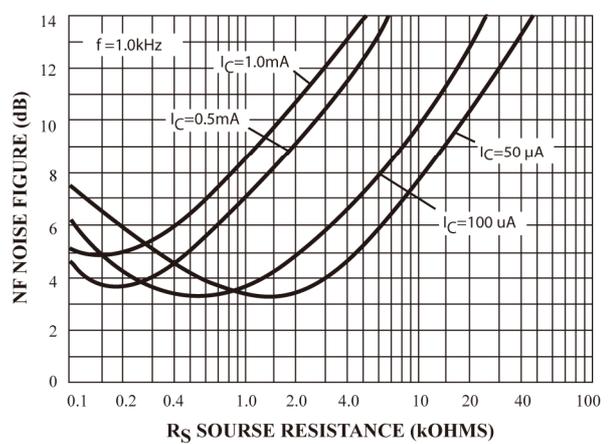


FIG.10

(NPN)

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

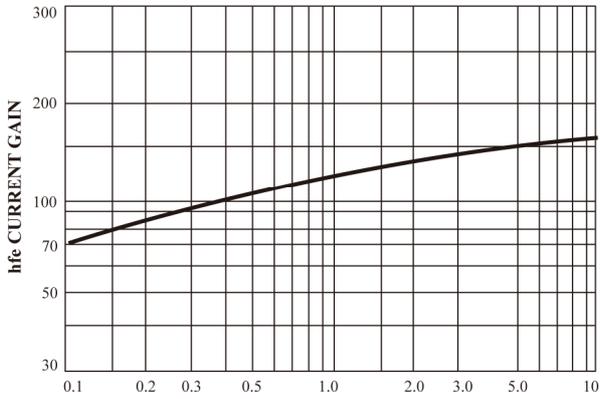


FIG.11 Current Gain

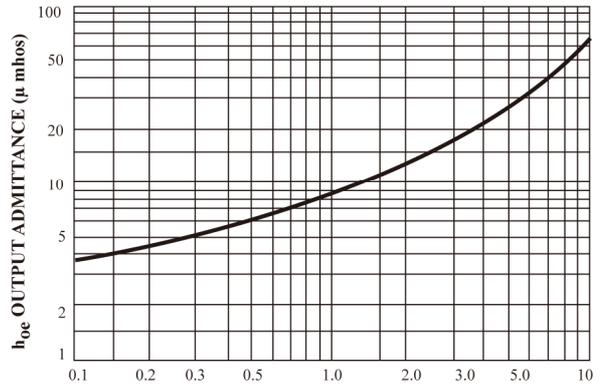


FIG.12 Output Admittance

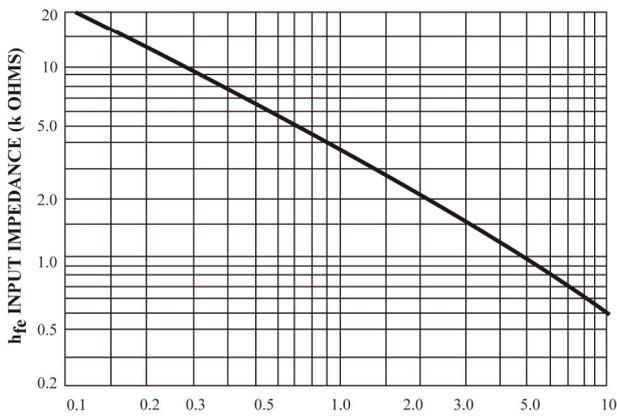


FIG.13 Input Impedance

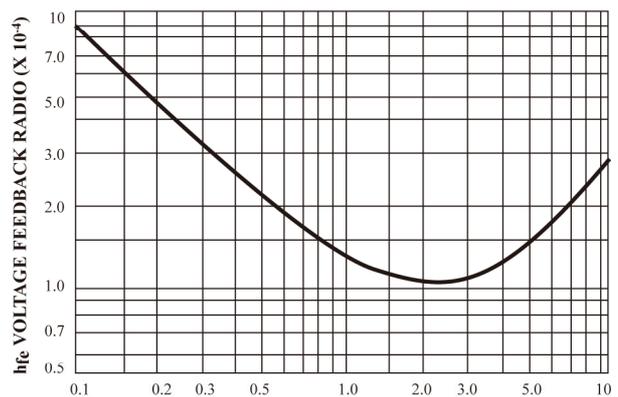


FIG.14 Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

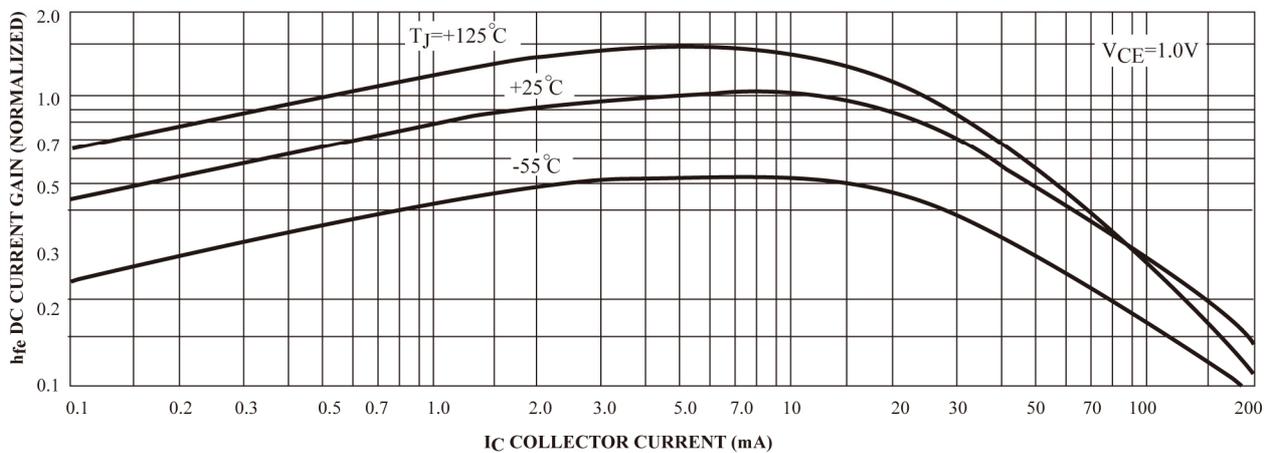


FIG.15 DC Current Gain

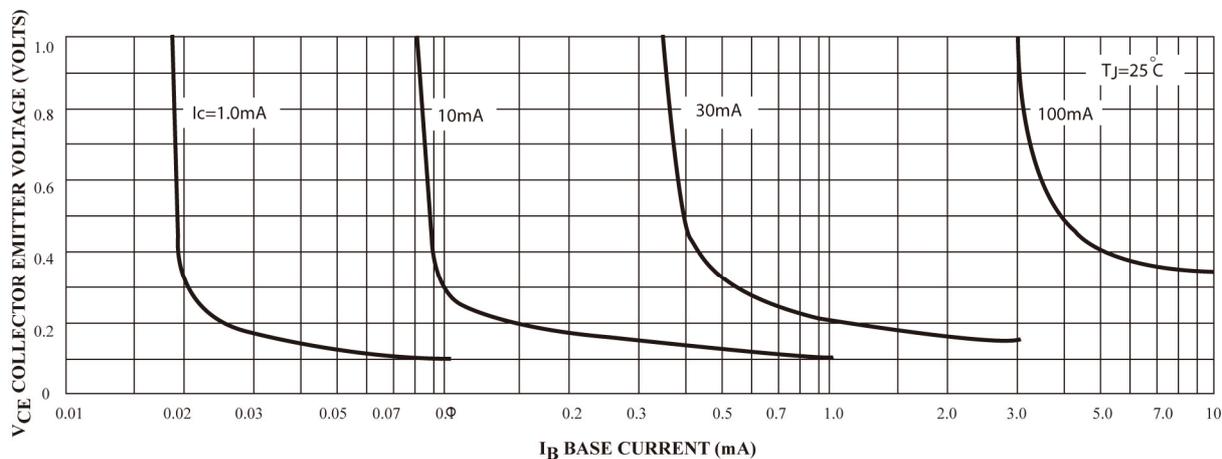


FIG.16 Collector Saturation Region

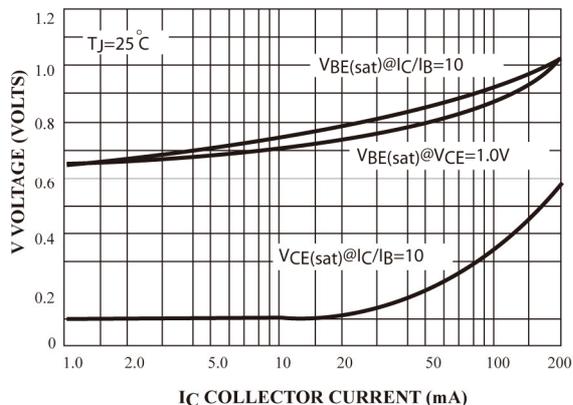


FIG.17 "ON" Voltage

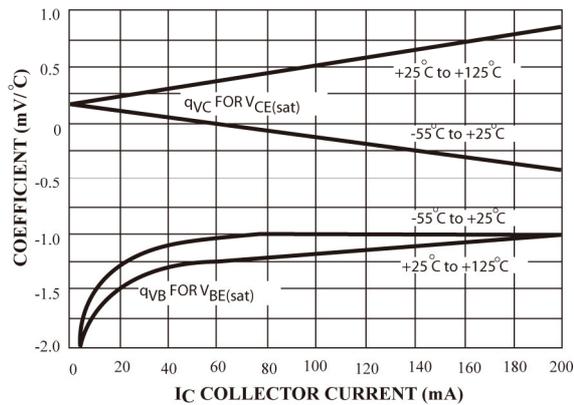


FIG.18 Temperature Coefficients