MMBT3904

NPN General Purpose Amplifier

Features

- Collector current capability IC = -200 mA
- Collector-emitter voltage VCEO = -40 V
- RoHS compliant package

Application

- General switching and amplification

Mechanical Data

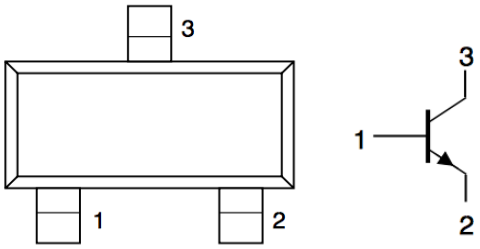
Case outline: SOT23

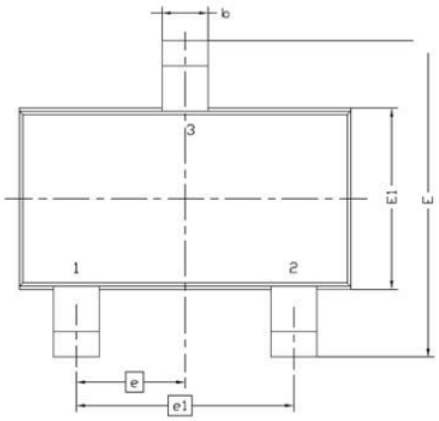
Packing & Order Information

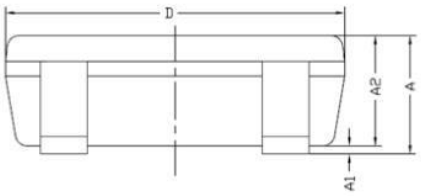
3,000/Reel

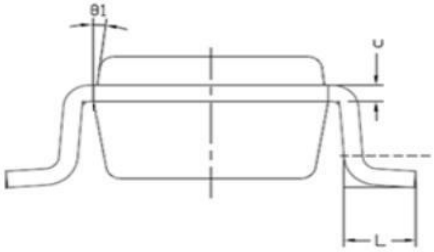
RoHS
COMPLIANT

Graphic symbol









Symbol	MILLIMETERS	
	MIN	MAX
A	0.8	1.2
A1	0	0.1
A2	0.7	1.1
b	0.3	0.5
c	0.1	0.2
D	2.7	3.1
E	2.6	3
E1	1.4	1.8
e	0.95 BSC	
e1	1.9 BSC	
L	0.3	0.6
θ1	7° NOM	

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MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

MAXIMUM RATINGS			
Symbol	**Characteristic**	**Rating**	**Unit**
V_{CBO}	Collector-Base Voltage	40	Vdc
V_{CEO}	Collector-Emitter Voltage	60	Vdc
V_{EBO}	Emitter-Base Voltage	6	Vdc
I_C	Collector Current -Continuous	200	mAdc

THERMAL CHARACTERISTICS			
Symbol	**Characteristic**	**Max**	**Unit**
P_D	Total Device Dissipation FR-5 Board(1) TA=25°C Derate above 25°C	 225 1.8	 mW mW/°C

THERMAL CHARACTERISTICS			
Symbol	**Characteristic**	**Rating**	**Unit**
P_D	Total Device Dissipation Alumina Substrate TA=25°C Derate above 25°C	 300 2.4	 mW mW/°C
$R_{\theta JA}$	Thermal Resistance Junction to Ambient	417	°C/W
T_J,Tstg	Junction and Storage Temperature	150°C, -55 to + 150°C	

ELECTRICAL CHARACTERISTICS @ Ta=25°C unless otherwise specified

OFF CHARACTERISTICS				
Symbol	**Characteristic**	**Min**	**Max**	**Unit**
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage(3) (I_C = 1.0mAdc , I_B = 0)	40	--	Vdc
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage (I_C = 10μAdc , I_E = 0)	40	--	Vdc
$V_{(BR)CEO}$	Emitter-Base Breakdown Voltage (I_E = 10μAdc , I_C = 0)	6.0	--	Vdc
I_{BEX}	Base Cutoff Current (V_{CE} = 30Vdc , V_{EB} = 3.0 Vdc)	--	50	nAdc
I_{CEX}	Collector Cutoff Current (V_{CE}= 30Vdc , V_{EB} = 3.0 Vdc)	--	50	nAdc

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ON CHARACTERISTICS				
Symbol	**Characteristic**	**Min**	**Max**	**Unit**
h_{PE}	DC Current Gain			--
	I_C = 0.1mAdc , V_{CE} = 1.0Vdc	40	--	
	I_C = 1.0mAdc , V_{CE} = 1.0Vdc	70	--	
	I_C = 10mAdc , V_{CE} = 1.0Vdc	100	300	
	I_C = 50mAdc , V_{CE} = 1.0Vdc	60	--	
	I_C = 100mAdc , V_{CE} = 1.0Vdc	30	--	

ON CHARACTERISTICS				
Symbol	**Characteristic**	**Min**	**Max**	**Unit**
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage (I_C = 10mAdc ,V_B = 1.0 mAdc) (I_C = 50mAdc ,V_B = 5.0 mAdc)	 -- --	 0.25 0.4	Vdc

ON CHARACTERISTICS				
Symbol	**Characteristic**	**Min**	**Max**	**Unit**
$V_{CE(sat)}$	Base-Emitter Saturation Voltage (I_C = 10mAdc , V_B = 1.0 mAdc) (I_C = 50mAdc , V_B = 5.0 mAdc)	0.65 --	0.85 0.95	Vdc

SMALL-SIGNAL CHARACTERISTICS				
Symbol	**Characteristic**	**Min**	**Max**	**Unit**
f_T	Current-Gain-Bandwidth Product (I_C = 10mAdc , V_{CE} = 20Vdc , f= 100MHz)	300	--	MHZ
C_{obo}	Output Capacitance (V_{CB} = 5.0Vdc , I_E = 0 , f = 1.0MHz)	--	4.0	pF
C_{ibo}	Input Capacitance (V_{EB} = 0.5Vdc , I_C=0 , f = 1.0MHz)	--	8.0	pF
Hie	Input Impedance (V_{CE} = 10Vdc , I_C= 1.0mAdc , f = 1.0KHz)	1.0	10	kΩ
Hre	Voltage Feedback Ration (V_{CE} = 10Vdc , I_C= 1.0mAdc , f = 1.0KHz)	0.5	8.0	$\times 10^{-4}$
Hfe	Small-Signal Current Gain (V_{CE} = 10Vdc , I_C= 1.0mAdc , f = 1.0KHz)	100	400	--
Hoe	Output Admittance (V_{CE} = 10Vdc , I_C= 1.0mAdc , f = 1.0KHz)	1.0	40	μmhos
NF	Noise Figure (V_{CE} = 5.0Vdc , I_C = 100μAdc , Rs = 1.0kΩf = 1.0KHz)	--	5.0	dB

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SMALL-SIGNAL CHARACTERISTICS					
Symbol	**Characteristic**		**Min**	**Max**	**Unit**
t_d	Delay Time	(V_{CC} = 3.0Vdc , V_{BE} = 0.5Vdc,	--	35	ns
t_r	Rise Time	I_C = 10mAdc , I_{B1} = 1.0mAdc)	--	35	ns
t_s	Storage Time	(V_{CC} = 3.0Vdc, I_C = 10 mAdc,	--	225	ns
t_f	Fall Time	I_{B1}=I_{B2}= 1.0mAdc)	--	75	ns

1. FR-5=1.0 × 0.75 × 0.062in.
2. Alumina=0.4 × 0.3 × 0.024in. 99.5% alumina.
3. Pulse Width ≦ 300us,Duty Cycle ≦2.0%
4. Pulse Test : Pulse Width ≦ 300us ; Duty Cycle 2.0%

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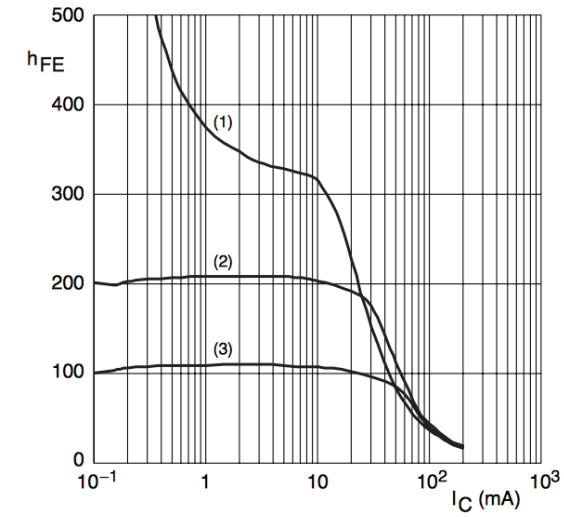
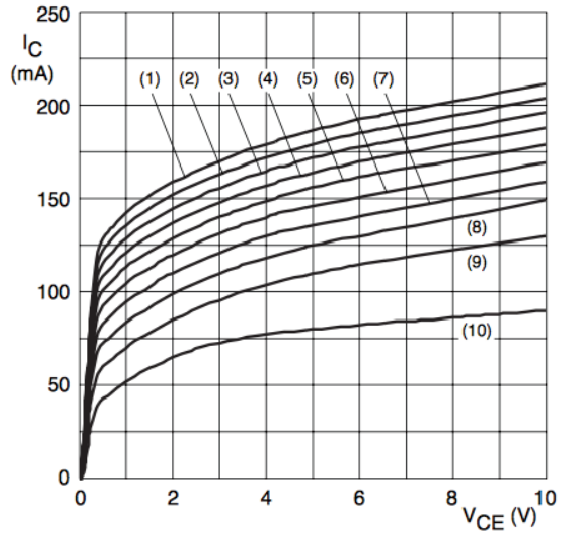
■Characteristics Curve



V_{CE} = 1 V.
(1) T_{amb} = 150 °C.
(2) T_{amb} = 25 °C.
(3) T_{amb} = –55 °C.

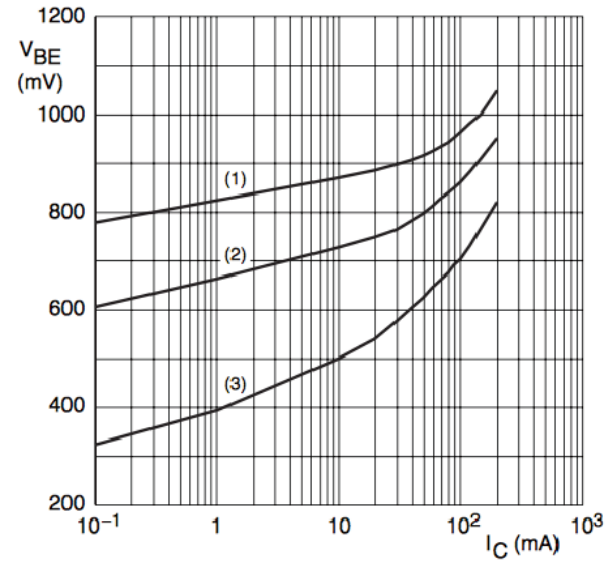
FIG.1-DC current gain; typical values



T_{amb} = 25 °C.

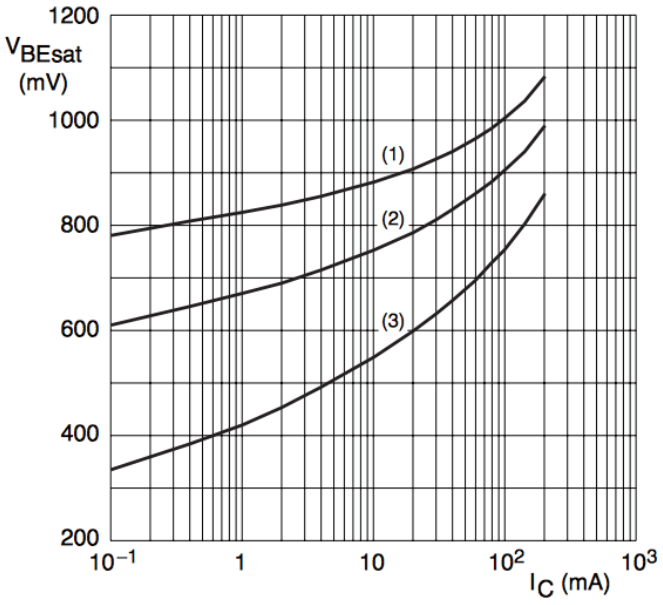
(1) I_B = 5 mA.
(2) I_B = 4.5 mA.
(3) I_B = 4 mA.
(4) I_B = 3.5 mA.
(5) I_B = 3 mA.
(6) I_B = 2.5 mA.
(7) I_B = 2 mA.
(8) I_B = 1.5 mA.
(9) I_B = 1 mA.
(10) I_B = 0.5 mA.

FIG.2-Collector current as a function of collector-emitter voltage.



V_{CE} = 1 V.
(1) T_{amb} = –55 °C.
(2) T_{amb} = 25 °C.
(3) T_{amb} = 150 °C.

FIG.3-Base-emitter voltage as a function of collector current.



I_C/I_B = 10.
(1) T_{amb} = –55 °C.
(2) T_{amb} = 25 °C.
(3) T_{amb} = 150 °C.

FIG.4-Base-emitter saturation voltage as a function of collector current.

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