



**MMBT3904** 

#### NPN SMALL SIGNAL SURFACE MOUNT TRANSISTOR

#### **Features**

- Epitaxial Planar Die Construction
- Complementary PNP Type Available (MMBT3906)
- Ideal for Medium Power Amplification and Switching
- Lead, Halogen and Antimony Free, RoHS Compliant (Note 2)
- "Green" Device (Note 3)
- Qualified to AEC-Q101 Standards for High Reliability

### **Mechanical Data**

- Case: SOT-23
- Case Material: Molded Plastic, "Green" Molding Compound, (Note 3). UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020D
- Terminal Connections: See Diagram
- Terminals: Lead Free Plating (Matte Tin Finish annealed over Alloy 42 leadframe). Solderable per MIL-STD-202, Method 208
- Marking Information: See Page 4
- Ordering Information: See Page 4
- Weight: 0.008 grams (approximate)



Device Schematic



Top View

## Maximum Ratings @T<sub>A</sub> = 25°C unless otherwise specified

Characteristic	Symbol	Value	Unit
Collector-Base Voltage	$V_{CBO}$	60	V
Collector-Emitter Voltage	$V_{CEO}$	40	V
Emitter-Base Voltage	V <sub>EBO</sub>	6.0	V
Collector Current - Continuous (Note 1)	Ic	200	mA

#### Thermal Characteristics

Characteristic	Symbol	Value	Unit
Power Dissipation (Note 1)	$P_{D}$	300	mW
Thermal Resistance, Junction to Ambient (Note 1)	$R_{ hetaJA}$	417	°C/W
Operating and Storage and Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-55 to +150	°C

Notes:

- 1. Device mounted on FR-5 PCB 1.0 x 0.75 x 0.062 inch pad layout as shown on Diodes, Inc. suggested pad layout AP02001, which can be found on our website at http://www.diodes.com/datasheets/ap02001.pdf.
- 2. No purposefully added lead.
- Product manufactured with Data Code V9 (week 33, 2008) and newer are built with Green Molding Compound. Product manufactured prior to Date Code V9 are built with Non-Green Molding Compound and may contain Halogens or Sb<sub>2</sub>O<sub>3</sub> Fire Retardants.



# Electrical Characteristics @T<sub>A</sub> = 25°C unless otherwise specified

Characteristic	Symbol	Min	Max	Unit	Test Condition			
OFF CHARACTERISTICS								
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	60	_	V	$I_C = 10\mu A, I_E = 0$			
Collector-Emitter Breakdown Voltage (Note 4)	$V_{(BR)CEO}$	40	_	V	$I_C = 1.0 \text{mA}, I_B = 0$			
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	6.0	_	V	$I_E = 10 \mu A, I_C = 0$			
Collector Cutoff Current	I <sub>CEX</sub>	_	50	nA	$V_{CE} = 30V, V_{EB(OFF)} = 3.0V$			
Base Cutoff Current	$I_{BL}$	_	50	nA	$V_{CE} = 30V, V_{EB(OFF)} = 3.0V$			
ON CHARACTERISTICS (Note 4)								
DC Current Gain	h <sub>FE</sub>	40 70 100 60 30	- 300 - -	_	$\begin{split} & \text{IC} = 100 \mu\text{A}, \ \text{V}_{\text{CE}} = 1.0 \text{V} \\ & \text{IC} = 1.0 \text{mA}, \ \text{V}_{\text{CE}} = 1.0 \text{V} \\ & \text{IC} = 10 \text{mA}, \ \text{V}_{\text{CE}} = 1.0 \text{V} \\ & \text{IC} = 50 \text{mA}, \ \text{V}_{\text{CE}} = 1.0 \text{V} \\ & \text{IC} = 100 \text{mA}, \ \text{V}_{\text{CE}} = 1.0 \text{V} \end{split}$			
Collector-Emitter Saturation Voltage	V <sub>CE(SAT)</sub>	_	0.20 0.30	V	$I_C = 10$ mA, $I_B = 1.0$ mA $I_C = 50$ mA, $I_B = 5.0$ mA			
Base-Emitter Saturation Voltage	V <sub>BE(SAT)</sub>	0.65	0.85 0.95	V	$I_C = 10mA$ , $I_B = 1.0mA$ $I_C = 50mA$ , $I_B = 5.0mA$			
SMALL SIGNAL CHARACTERISTICS								
Output Capacitance	Cobo		4.0	pF	$V_{CB} = 5.0V$ , $f = 1.0MHz$ , $I_E = 0$			
Input Capacitance	C <sub>ibo</sub>		8.0	pF	$V_{EB} = 0.5V$ , $f = 1.0MHz$ , $I_{C} = 0$			
Input Impedance	h <sub>ie</sub>	1.0	10	kΩ				
Voltage Feedback Ratio	h <sub>re</sub>	0.5	8.0	x 10 <sup>-4</sup>	$V_{CE} = 10V, I_{C} = 1.0mA,$			
Small Signal Current Gain	h <sub>fe</sub>	100	400	_	f = 1.0kHz			
Output Admittance	hoe	1.0	40	μS				
Current Gain-Bandwidth Product	f⊤	300	_	MHz	$V_{CE} = 20V, I_{C} = 10mA,$ f = 100MHz			
Noise Figure	NF	_	5.0	dB	$V_{CE} = 5.0V$ , $I_{C} = 100\mu A$ , $R_{S} = 1.0k\Omega$ , $f = 1.0kHz$			
SWITCHING CHARACTERISTICS								
Delay Time	t <sub>d</sub>	_	35	ns	$V_{CC} = 3.0V, I_{C} = 10mA,$			
Rise Time	t <sub>r</sub>	_	35	ns	$V_{BE(off)} = -0.5V, I_{B1} = 1.0mA$			
Storage Time	ts	_	200	ns	$V_{CC} = 3.0V, I_{C} = 10mA,$			
Fall Time	t <sub>f</sub>		50	ns	$I_{B1} = I_{B2} = 1.0 \text{mA}$			

Notes: 4. Short duration pulse test used to minimize self-heating effect.

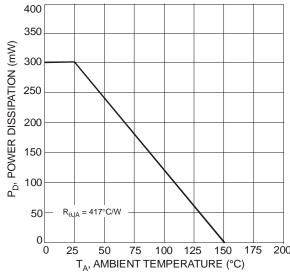
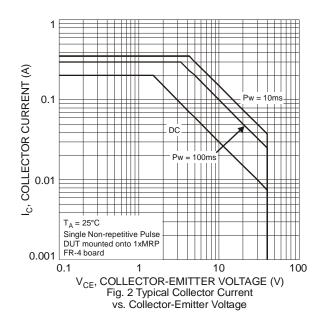


Fig. 1 Power Dissipation vs. Ambient Temperature (Note 1)





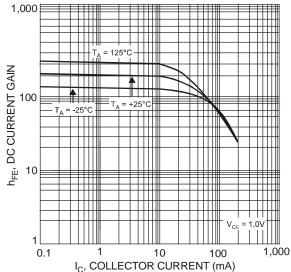
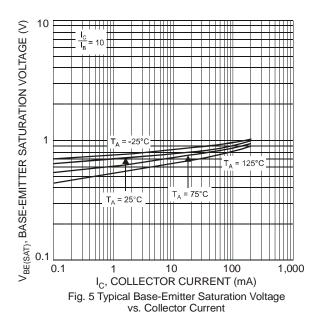


Fig. 3 Typical DC Current Gain vs. Collector Current



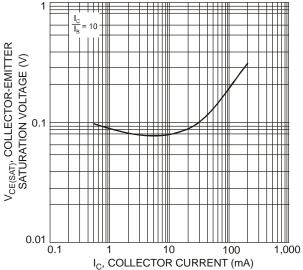
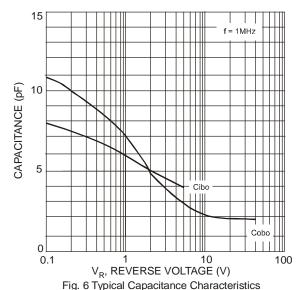


Fig. 4 Typical Collector-Emitter Saturation Voltage vs. Collector Current

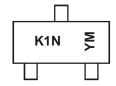


## Ordering Information (Note 5)

Part Number	Case	Packaging
MMBT3904-7-F	SOT-23	3000/Tape & Reel

Notes: 5. For packaging details, go to our website at http://www.diodes.com/datasheets/ap02007.pdf.

## **Marking Information**



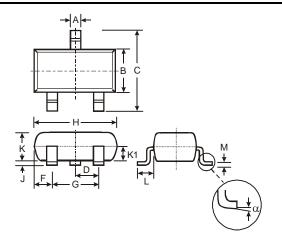
K1N = Product Type Marking Code YM = Date Code Marking Y = Year (ex: N = 2002) M = Month (ex: 9 = September)

Date Code Key

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Code	J	K	L	М	N	Р	R	S	Т	U	V	W	Χ	Υ	Z	Α	В	С
Month	Jan	1	Feb	Mai	r	Apr	May	,	Jun	Jul		Aug	Sep		Oct	Nov	,	Dec
Code	1		2	3		4	5		6	7		8	9		0	N		D

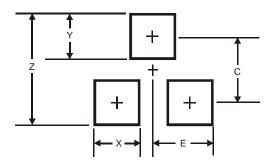


## **Package Outline Dimensions**



	SOT-23								
Dim	Min	Max	Тур						
Α	0.37	0.51	0.40						
В	1.20	1.40	1.30						
С	2.30	2.50	2.40						
D	0.89	1.03	0.915						
F	0.45	0.60	0.535						
G	1.78	2.05	1.83						
Н	2.80	3.00	2.90						
J	0.013	0.10	0.05						
K	0.903	1.10	1.00						
K1	-	1	0.400						
L	0.45	0.61	0.55						
M	0.085	0.18	0.11						
α	0°	8°	-						
All	All Dimensions in mm								

## **Suggested Pad Layout**



Dimensions	Value (in mm)
Z	2.9
Х	0.8
Υ	0.9
С	2.0
E	1.35

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