

## Features

- Epitaxial Planar Die Construction
- Complementary PNP Type Available (MMBT3906)
- Ideal for Medium Power Amplification and Switching
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP Capable (Note 4)**

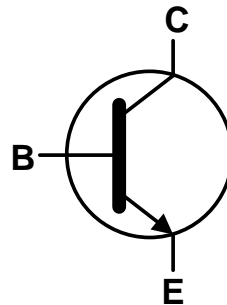
## Mechanical Data

- Case: SOT23
- Case Material: Molded Plastic, "Green" Molding Compound; UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads; Solderable per MIL-STD-202, Method 208<sup>(3)</sup>
- Weight: 0.008 grams (Approximate)

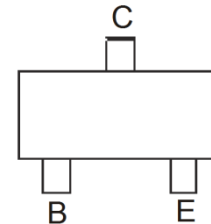


SOT23

Top View



Device Symbol

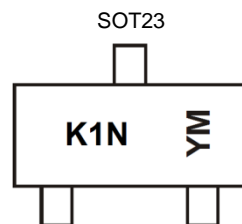

 Top View  
Pin-Out

## Ordering Information (Notes 4 & 5)

Product	Status	Compliance	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
MMBT3904-7-F	NRND	AEC-Q101	K1N	7	8	3,000
MMBT3904Q-7-F	Active	Automotive	K1N	7	8	3,000
MMBT3904-13-F	NRND	AEC-Q101	K1N	13	8	10,000
MMBT3904-7	Active	AEC-Q101	K1N	7	8	3,000
MMBT3904-13	Active	AEC-Q101	K1N	13	8	10,000

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
  3. Halogen and Antimony free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
  4. Automotive products are AEC-Q101 qualified and are PPAP capable. Automotive, AEC-Q101 and standard products are electrically and thermally the same, except where specified.
  5. NRND - Not Recommended for New design. For packaging details, go to our website at <http://www.diodes.com/products/packages.html>.

## Marking Information



K1N = Product Type Marking Code  
 YM = Date Code Marking  
 Y or  $\bar{Y}$  = Year (ex: A = 2013)  
 M or  $\bar{M}$  = Month (ex: 9 = September)

### Date Code Key

Year	2014	2015	2016	2017	2018	2019	2020	2021
Code	B	C	D	E	F	G	H	I

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Code	1	2	3	4	5	6	7	8	9	O	N	D

**Absolute Maximum Ratings** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Value	Unit
Collector-Base Voltage	V <sub>CBO</sub>	60	V
Collector-Emitter Voltage	V <sub>CEO</sub>	40	V
Emitter-Base Voltage	V <sub>EBO</sub>	6	V
Collector Current	I <sub>C</sub>	200	mA

**Thermal Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

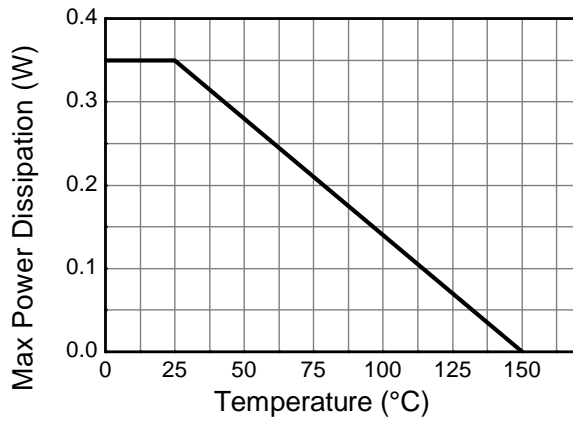
Characteristic	Symbol	Value	Unit
Power Dissipation	P <sub>D</sub>	(Note 6) 310	mW
		(Note 7) 350	
Thermal Resistance, Junction to Ambient	R <sub>θJA</sub>	(Note 6) 403	°C/W
		(Note 7) 357	
Thermal Resistance, Junction to Leads	R <sub>θJL</sub>	350	°C/W
Operating and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-55 to +150	°C

**ESD Ratings** (Note 9)

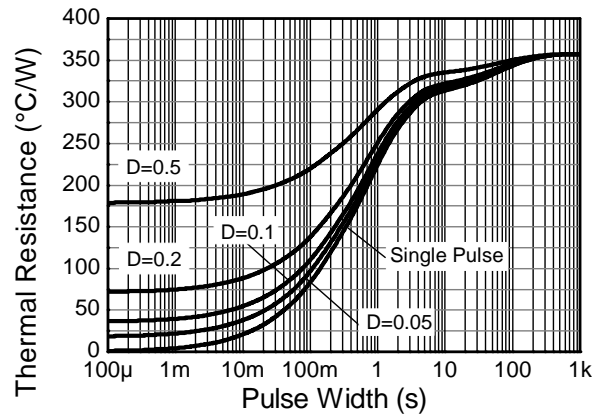
Characteristic	Symbol	Value	Unit	JEDEC Class
Electrostatic Discharge - Human Body Model	ESD HBM	4,000	V	3A
Electrostatic Discharge - Machine Model	ESD MM	400	V	C

- Notes:
6. For a device mounted on minimum recommended pad layout 1oz copper that is on a single-sided FR4 PCB; device is measured under still air conditions whilst operating in a steady-state.
  7. Same as Note 6, except the device is mounted on 15 mm x 15mm 1oz copper.
  8. Thermal resistance from junction to solder-point (at the end of the leads).
  9. Refer to JEDEC specification JESD22-A114 and JESD22-A115.

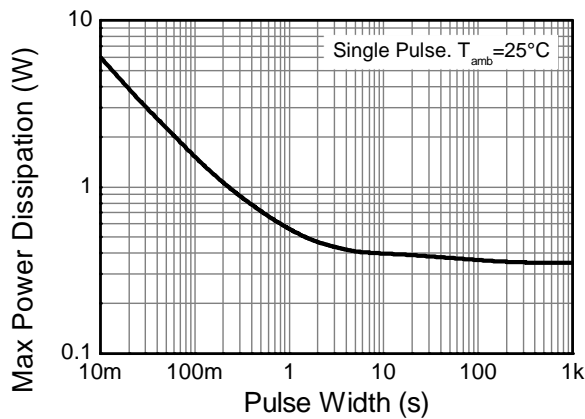
**Thermal Characteristics and Derating Information**



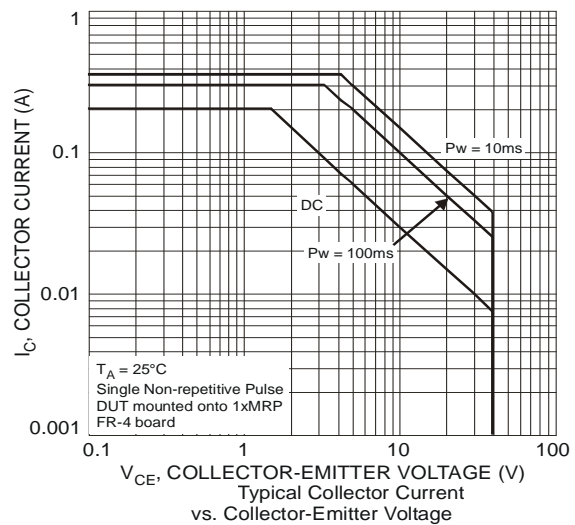
**Derating Curve**



**Transient Thermal Impedance**



**Pulse Power Dissipation**



**Electrical Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

Characteristic	Symbol	Min	Max	Unit	Test Condition	
<b>OFF CHARACTERISTICS</b>						
Collector-Base Breakdown Voltage	BV <sub>CBO</sub>	60	—	V	I <sub>C</sub> = 10μA, I <sub>E</sub> = 0	
Collector-Emitter Breakdown Voltage (Note 10)	BV <sub>CEO</sub>	40	—	V	I <sub>C</sub> = 10mA, I <sub>B</sub> = 0	
Emitter-Base Breakdown Voltage	BV <sub>EBO</sub>	6.0	—	V	I <sub>E</sub> = 10μA, I <sub>C</sub> = 0	
Collector Cut-Off Current	I <sub>CEX</sub>	—	50	nA	V <sub>CE</sub> = 30V, V <sub>EB(OFF)</sub> = 3.0V	
Base Cut-Off Current	I <sub>BL</sub>	—	50	nA	V <sub>CE</sub> = 30V, V <sub>EB(OFF)</sub> = 3.0V	
Emitter Base Cut-Off Current	I <sub>EBO</sub>	—	50	nA	V <sub>EB</sub> = 6V	
Collector-Base Cut-Off Current	I <sub>CBO</sub>	—	50	nA	V <sub>CB</sub> = 48V	
<b>ON CHARACTERISTICS (Note 10)</b>						
DC Current Gain	h <sub>FE</sub>	40	—	—	I <sub>C</sub> = 100μA, V <sub>CE</sub> = 1.0V	
		70	—			
		100	300			I <sub>C</sub> = 1.0mA, V <sub>CE</sub> = 1.0V
		60	—			I <sub>C</sub> = 10mA, V <sub>CE</sub> = 1.0V
		30	—			I <sub>C</sub> = 50mA, V <sub>CE</sub> = 1.0V
					I <sub>C</sub> = 100mA, V <sub>CE</sub> = 1.0V	
Collector-Emitter Saturation Voltage	V <sub>CE(sat)</sub>	—	0.20 0.30	V	I <sub>C</sub> = 10mA, I <sub>B</sub> = 1.0mA I <sub>C</sub> = 50mA, I <sub>B</sub> = 5.0mA	
Base-Emitter Saturation Voltage	V <sub>BE(sat)</sub>	0.65 —	0.85 0.95	V	I <sub>C</sub> = 10mA, I <sub>B</sub> = 1.0mA I <sub>C</sub> = 50mA, I <sub>B</sub> = 5.0mA	
<b>SMALL SIGNAL CHARACTERISTICS</b>						
Output Capacitance	C <sub>obo</sub>	—	4.0	pF	V <sub>CB</sub> = 5.0V, f = 1.0MHz, I <sub>E</sub> = 0	
Input Capacitance	C <sub>ibo</sub>	—	8.0	pF	V <sub>EB</sub> = 0.5V, f = 1.0MHz, I <sub>C</sub> = 0	
Input Impedance	h <sub>ie</sub>	1.0	10	kΩ	V <sub>CE</sub> = 10V, I <sub>C</sub> = 1.0mA, f = 1.0kHz	
Voltage Feedback Ratio	h <sub>re</sub>	0.5	8.0	x 10 <sup>-4</sup>		
Small Signal Current Gain	h <sub>fe</sub>	100	400	—		
Output Admittance	h <sub>oe</sub>	1.0	40	μS		
Current Gain-Bandwidth Product	f <sub>T</sub>	300	—	MHz		
Noise Figure	NF	—	5.0	dB	V <sub>CE</sub> = 5.0V, I <sub>C</sub> = 100μA, R <sub>S</sub> = 1.0kΩ, f = 1.0kHz	
<b>SWITCHING CHARACTERISTICS</b>						
Delay Time	t <sub>d</sub>	—	35	ns	V <sub>CC</sub> = 3.0V, I <sub>C</sub> = 10mA, V <sub>BE(off)</sub> = -0.5V, I <sub>B1</sub> = 1.0mA	
Rise Time	t <sub>r</sub>	—	35	ns		
Storage Time	t <sub>s</sub>	—	200	ns	V <sub>CC</sub> = 3.0V, I <sub>C</sub> = 10mA, I <sub>B1</sub> = I <sub>B2</sub> = 1.0mA	
Fall Time	t <sub>f</sub>	—	50	ns		

Note: 10. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.

**Typical Electrical Characteristics** (@ $T_A = +25^\circ\text{C}$ , unless otherwise specified.)

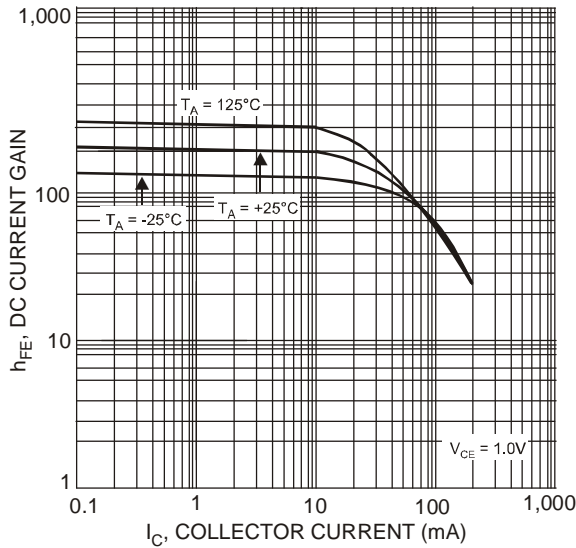


Fig. 1 Typical DC Current Gain vs. Collector Current

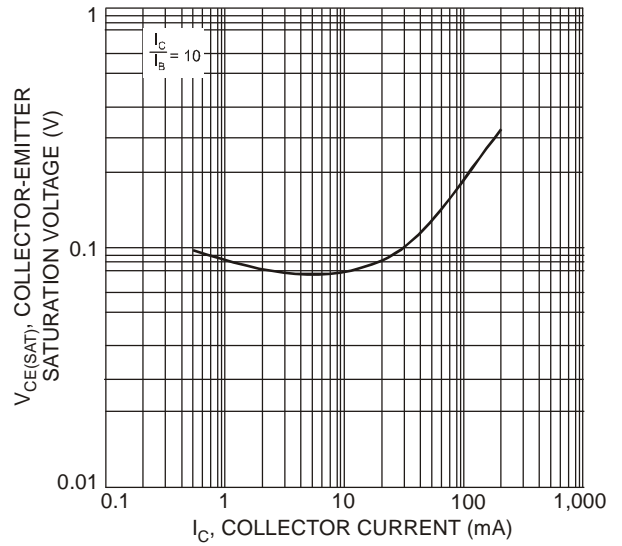


Fig. 2 Typical Collector-Emitter Saturation Voltage vs. Collector Current

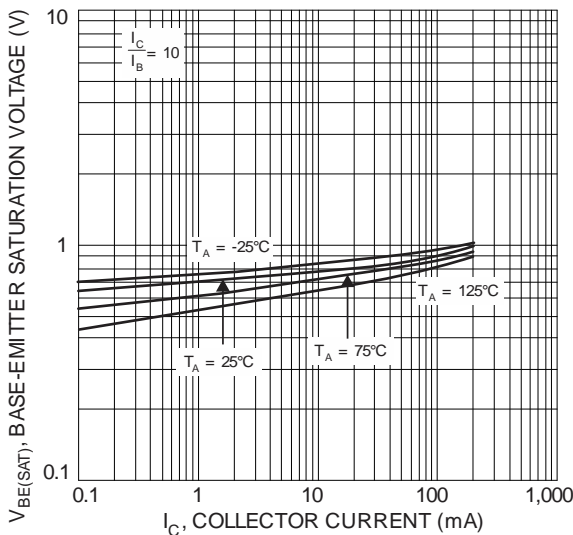


Fig. 3 Typical Base-Emitter Saturation Voltage vs. Collector Current

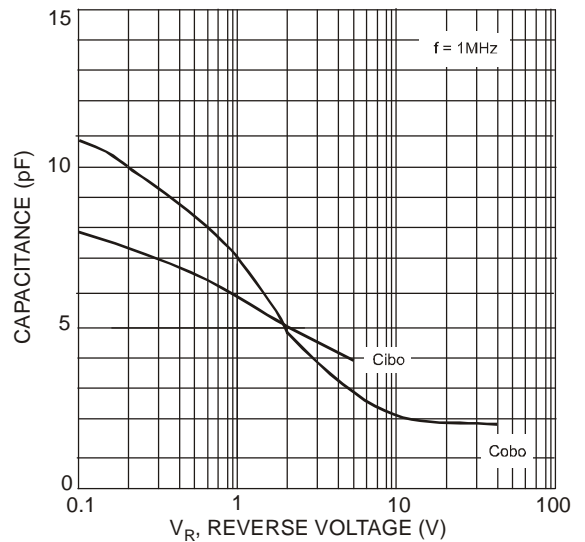
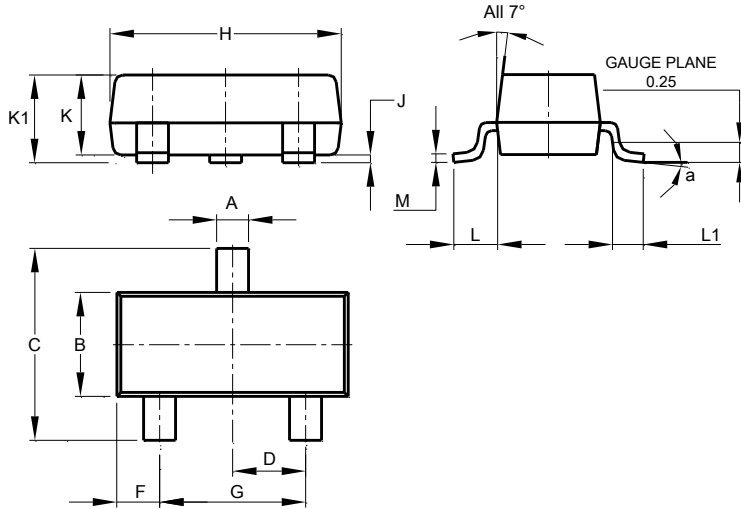


Fig. 4 Typical Capacitance Characteristics

**Package Outline Dimensions**

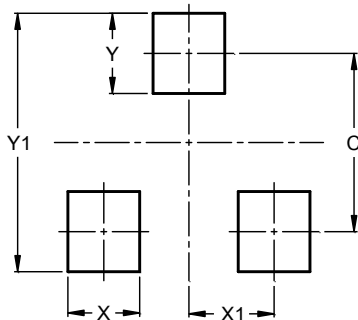
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.



SOT23			
Dim	Min	Max	Typ
A	0.37	0.51	0.40
B	1.20	1.40	1.30
C	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
H	2.80	3.00	2.90
J	0.013	0.10	0.05
K	0.890	1.00	0.975
K1	0.903	1.10	1.025
L	0.45	0.61	0.55
L1	0.25	0.55	0.40
M	0.085	0.150	0.110
a	0°	8°	--
All Dimensions in mm			

**Suggested Pad Layout**

Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.



Dimensions	Value (in mm)
C	2.0
X	0.8
X1	1.35
Y	0.9
Y1	2.9

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