

Description

This bipolar junction transistor (BJT) is designed to meet the stringent requirements of automotive applications.

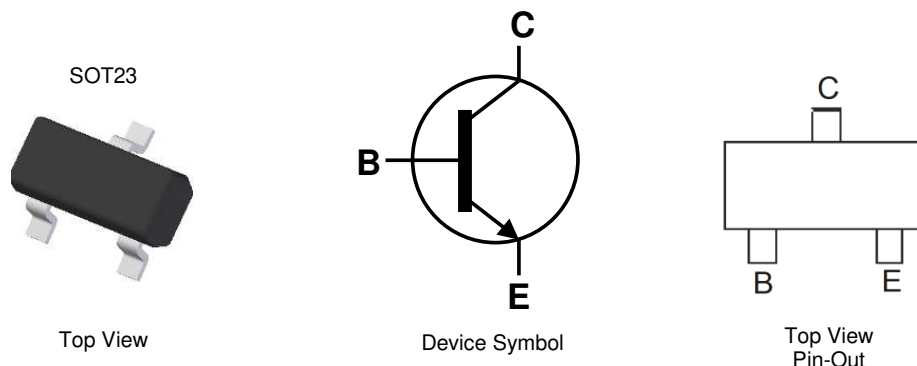
Features

- Complementary PNP Type Available (DIODES™ MMBT3906Q)
- Ideal for Medium Power Amplification and Switching
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **The DIODES™ MMBT3904Q is suitable for automotive applications requiring specific change control; this part is AEC-Q101 qualified, PPAP capable, and manufactured in IATF16949 certified facilities.**

<https://www.diodes.com/quality/product-definitions/>

Mechanical Data

- Package: SOT23
- Package 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 Ⓒ③
- Weight: 0.008 grams (Approximate)

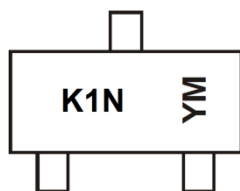


Ordering Information (Note 4)

Product	Package	Marking	Reel Size (inches)	Tape Width (mm)	Packing	
					Qty.	Carrier
MMBT3904Q-7-F	SOT23	K1N	7	8	3,000	Reel
MMBT3904Q-13-F	SOT23	K1N	13	8	10,000	Reel

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
 2. See <https://www.diodes.com/quality/lead-free/> 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. For packaging details, go to our website at <https://www.diodes.com/design/support/packaging/diodes-packaging/>.

Marking Information



K1N = Product Type Marking Code
 YM = Date Code Marking
 Y or Y = Year (ex: J = 2022)
 M or M = Month (ex: 9 = September)

Date Code Key

Year	2014	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Code	B	J	K	L	M	N	O	P	R	S	T
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 (@ $T_A = +25^\circ\text{C}$, 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_{EBO}	6	V
Collector Current	I_C	200	mA

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

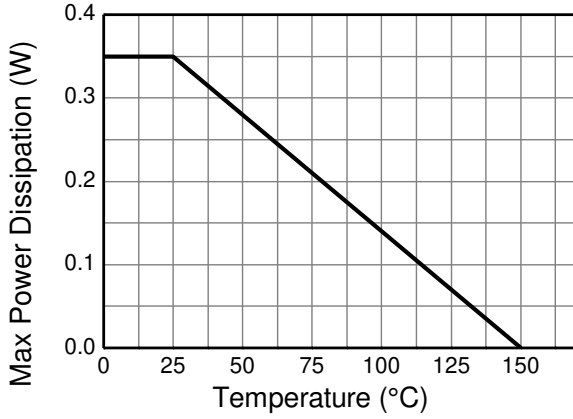
Characteristic	Symbol	Value	Unit
Power Dissipation	P_D	(Note 5)	310
		(Note 6)	350
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	(Note 5)	403
		(Note 6)	357
Thermal Resistance, Junction to Leads	$R_{\theta JL}$	350	$^\circ\text{C/W}$
Operating and Storage Temperature Range	T_J, T_{STG}	-55 to +150	$^\circ\text{C}$

ESD Ratings (Note 8)

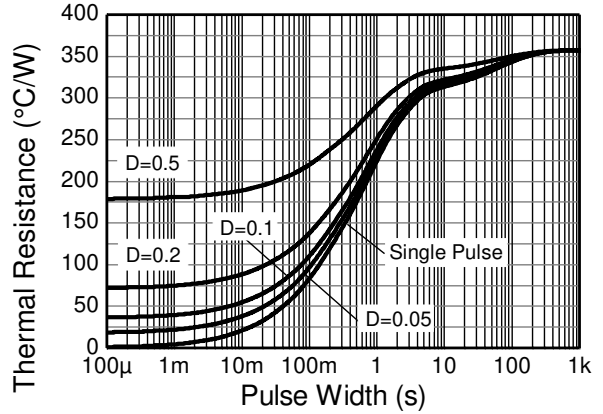
Characteristic	Symbol	Value	Unit	JEDEC Class
Electrostatic Discharge - Human Body Model	ESD HBM	4,000	V	3A
Electrostatic Discharge - Machine Model	ESD MM	400	V	C

- Notes:
5. 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.
 6. Same as Note 5, except the device is mounted on 15 mm x 15mm 1oz copper.
 7. Thermal resistance from junction to solder-point (at the end of the leads).
 8. Refer to JEDEC specification JESD22-A114 and JESD22-A115.

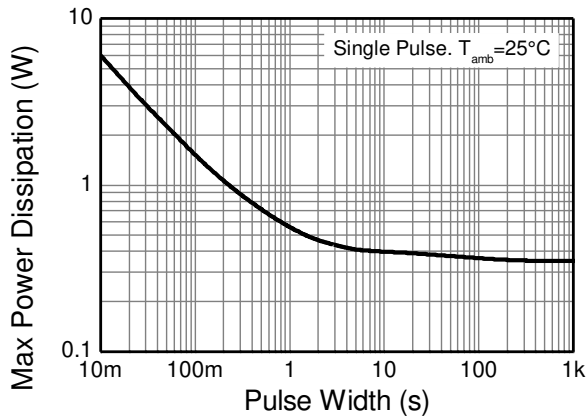
Thermal Characteristics and Derating Information



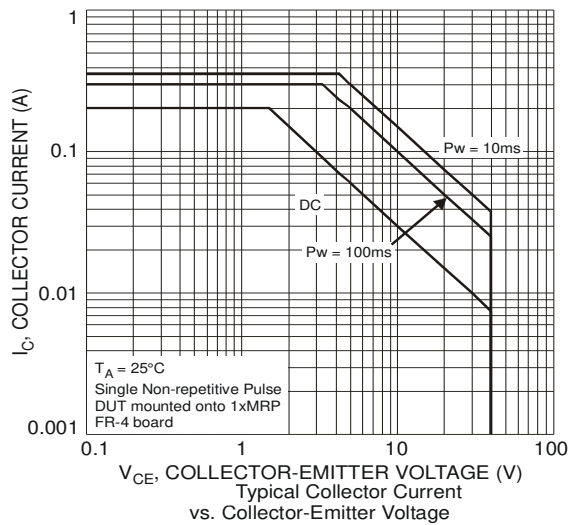
Derating Curve



Transient Thermal Impedance



Pulse Power Dissipation



Electrical Characteristics (@T_A = +25°C, unless otherwise specified.)

Characteristic	Symbol	Min	Max	Unit	Test Condition	
OFF CHARACTERISTICS						
Collector-Base Breakdown Voltage	BV _{CBO}	60	—	V	I _C = 10μA, I _E = 0	
Collector-Emitter Breakdown Voltage (Note 9)	BV _{CEO}	40	—	V	I _C = 10mA, I _B = 0	
Emitter-Base Breakdown Voltage	BV _{EBO}	6.0	—	V	I _E = 10μA, I _C = 0	
Collector Cut-Off Current	I _{CEX}	—	50	nA	V _{CE} = 30V, V _{EB(off)} = 3.0V	
Base Cut-Off Current	I _{BL}	—	50	nA	V _{CE} = 30V, V _{EB(off)} = 3.0V	
Emitter Base Cut-Off Current	I _{EBO}	—	50	nA	V _{EB} = 6V	
Collector-Base Cut-Off Current	I _{CBO}	—	50	nA	V _{CB} = 48V	
ON CHARACTERISTICS (Note 9)						
DC Current Gain	h _{FE}	40	—	—	I _C = 100μA, V _{CE} = 1.0V	
		70	—			
		100	300			I _C = 1.0mA, V _{CE} = 1.0V
		60	—			I _C = 10mA, V _{CE} = 1.0V
		30	—			I _C = 50mA, V _{CE} = 1.0V
Collector-Emitter Saturation Voltage	V _{CE(sat)}	—	0.20	V	I _C = 10mA, I _B = 1.0mA	
		—	0.30			
Base-Emitter Saturation Voltage	V _{BE(sat)}	0.65	0.85	V	I _C = 10mA, I _B = 1.0mA	
		—	0.95			
SMALL SIGNAL CHARACTERISTICS						
Output Capacitance	C _{OBO}	—	4.0	pF	V _{CB} = 5.0V, f = 1.0MHz, I _E = 0	
Input Capacitance	C _{IBO}	—	8.0	pF	V _{EB} = 0.5V, f = 1.0MHz, I _C = 0	
Input Impedance	h _{iE}	1.0	10	kΩ	V _{CE} = 10V, I _C = 1.0mA, f = 1.0kHz	
Voltage Feedback Ratio	h _{RE}	0.5	8.0	x 10 ⁻⁴		
Small Signal Current Gain	h _{FE}	100	400	—		
Output Admittance	h _{oE}	1.0	40	μS		
Current Gain-Bandwidth Product	f _T	300	—	MHz		
Noise Figure	NF	—	5.0	dB	V _{CE} = 5.0V, I _C = 100μA, R _S = 1.0kΩ, f = 1.0kHz	
SWITCHING CHARACTERISTICS						
Delay Time	t _d	—	35	ns	V _{CC} = 3.0V, I _C = 10mA, V _{BE(OFF)} = -0.5V, I _{B1} = 1.0mA	
Rise Time	t _r	—	35	ns		
Storage Time	t _s	—	200	ns	V _{CC} = 3.0V, I _C = 10mA, I _{B1} = I _{B2} = 1.0mA	
Fall Time	t _f	—	50	ns		

Note: 9. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.

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

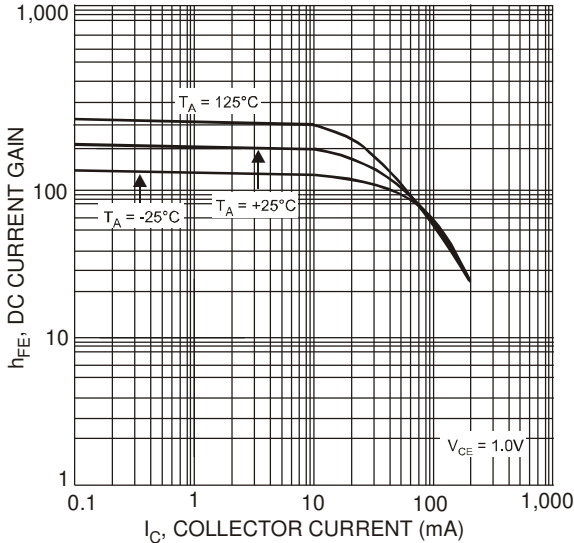


Fig. 1 Typical DC Current Gain vs. Collector Current

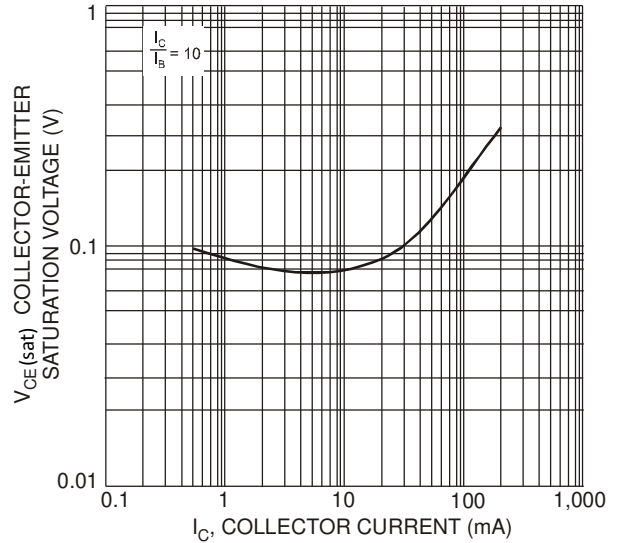


Fig. 2 Typical Collector-Emitter Saturation Voltage vs. Collector Current

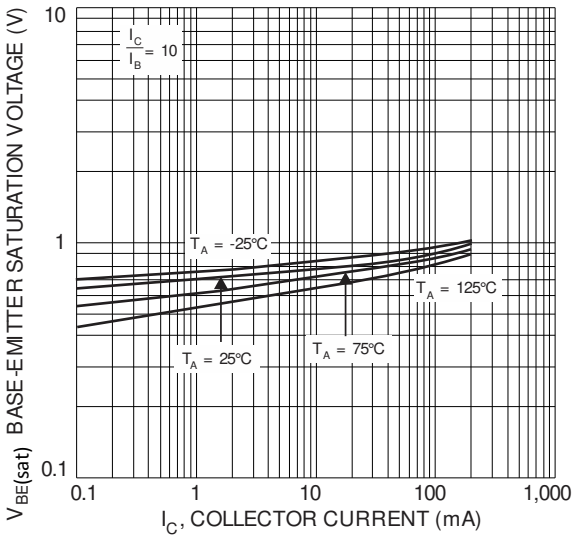


Fig. 3 Typical Base-Emitter Saturation Voltage vs. Collector Current

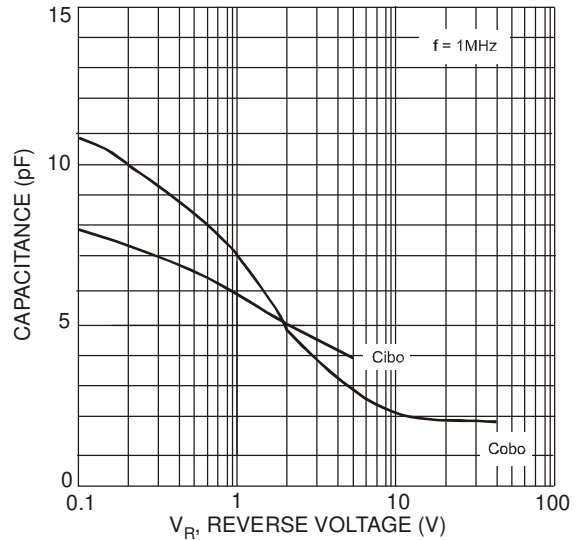
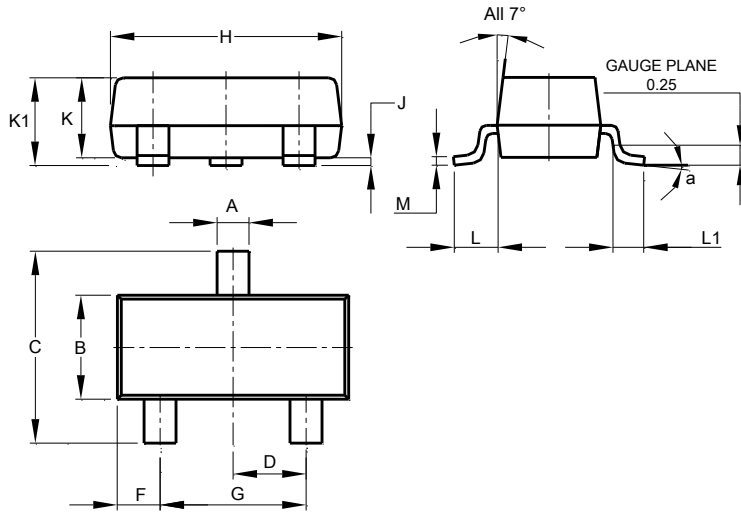


Fig. 4 Typical Capacitance Characteristics

Package Outline Dimensions

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

SOT23

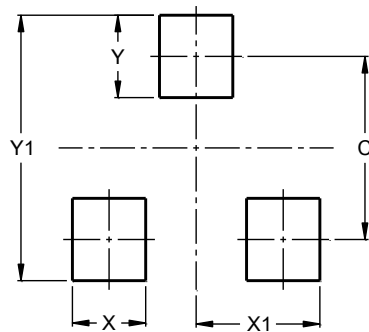


SOT23			
Dim	Min	Max	Typ
A	0.37	0.51	0.40
B	1.20	1.40	1.30
C	2.30	2.50	2.40
D	0.89	1.03	0.915
F	0.45	0.60	0.535
G	1.78	2.05	1.83
H	2.80	3.00	2.90
J	0.013	0.10	0.05
K	0.890	1.00	0.975
K1	0.903	1.10	1.025
L	0.45	0.61	0.55
L1	0.25	0.55	0.40
M	0.085	0.150	0.110
a	0°	8°	--
All Dimensions in mm			

Suggested Pad Layout

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

SOT23



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

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