

March 2017

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40V NPN SMALL SIGNAL TRANSISTOR IN SOT23

Features

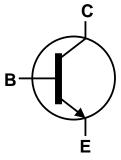
- Epitaxial Planar Die Construction
- Complementary PNP Type Available (MMBT3906)
- Ideal for Medium Power Amplification and Switching
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. "Green" Device (Note 3)
- Qualified to AEC-Q101 Standards for High Reliability
-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

Mechanical Data

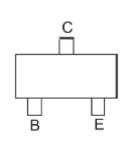
- Case: SOT23
- Case Material: Molded Plastic, "Green" Molding Compound.
 UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish Matte Tin Plated Leads. Solderable per MIL-STD-202, Method 208 (3)
- Weight: 0.008 grams (Approximate)







Device Symbol



Top View Pin-Out

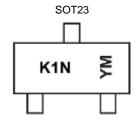
Ordering Information (Notes 4 & 5)

Product	Status	Compliance	Marking	Reel Size (inches)	Tape Width (mm)	Quantity per Reel
MMBT3904-7-F	Active	AEC-Q101	K1N	7	8	3,000
MMBT3904Q-7-F	Active	Automotive	K1N	7	8	3,000
MMBT3904Q-13-F	Active	Automotive	K1N	13	8	10,000
MMBT3904-13-F	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 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. For more information, please refer to http://www.diodes.com/quality/product_compliance_definitions/.
- 5. For packaging details, go to our website at http://www.diodes.com/products/packages.html.

Marking Information



$$\begin{split} &K1N = Product\ Type\ Marking\ Code \\ &YM = Date\ Code\ Marking \\ &Y\ or\ \overline{Y} = Year\ (ex:\ D=2016) \\ &M\ or\ \overline{M} = Month\ (ex:\ 9=September) \end{split}$$

Date Code Key

Year	2014		2015	2016		2017	2018		2019	2020		2021
Code	В		С	D		Е	F		G	Н		1
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Code	1	2	3	4	5	6	7	8	9	0	N	D



Absolute Maximum Ratings (@T_A = +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_{EBO}	6	V
Collector Current	Ic	200	mA

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

Characteristic		Symbol	Value	Unit	
Power Dissipation	(Note 6)	ь	310	mW	
Power Dissipation	(Note 7)	- P _D	350		
Thormal Posistanas, Junction to Ambient	(Note 6)	В	403	°C/W	
Thermal Resistance, Junction to Ambient	(Note 7)	R _{0JA}	357	C/VV	
Thermal Resistance, Junction to Leads (Note 8)		$R_{\theta JL}$	350	°C/W	
Operating and Storage Temperature Range		$T_{J,T_{STG}}$	-55 to +150	°C	

ESD Ratings (Note 9)

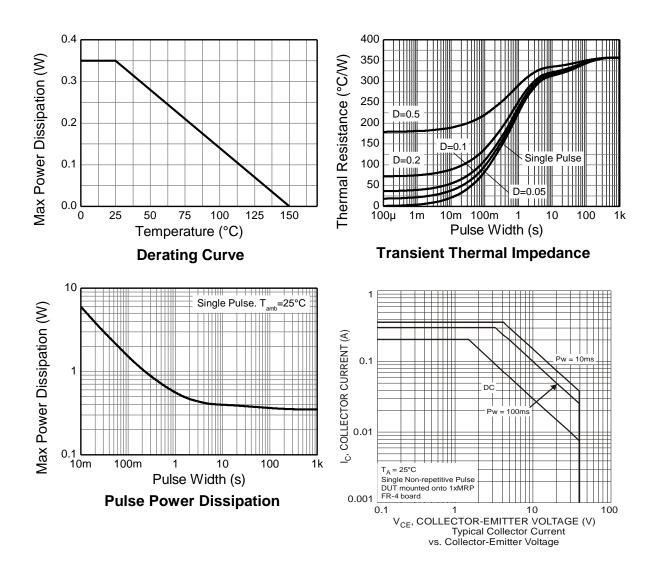
Characteristic	Symbol	Value	Unit	JEDEC Class
Electrostatic Discharge - Human Body Model	ESD HBM	4,000	V	3A
Electrostatic Discharge - Machine Model	ESD MM	400	V	С

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 For a device mounted of minimum recommended pad layout 102 copper that is conditions whilst operating in a steady-state.
 Same as Note 6, except the device is mounted on 15 mm x 15mm 1oz copper.
 Thermal resistance from junction to solder-point (at the end of the leads).
 Refer to JEDEC specification JESD22-A114 and JESD22-A115.



Thermal Characteristics and Derating Information





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	$I_C = 10\mu A, I_E = 0$
Collector-Emitter Breakdown Voltage (Note 10)	BV_{CEO}	40	_	V	$I_C = 10 \text{mA}, I_B = 0$
Emitter-Base Breakdown Voltage	BV _{EBO}	6.0	_	V	$I_E = 10\mu A, I_C = 0$
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 10)					
DC Current Gain	h _{FE}	40 70 100 60	— 300 —	_	$I_C = 100\mu A, V_{CE} = 1.0V$ $I_C = 1.0mA, V_{CE} = 1.0V$ $I_C = 10mA, V_{CE} = 1.0V$ $I_C = 50mA, V_{CE} = 1.0V$
		30			I _C = 100mA, V _{CE} = 1.0V
Collector-Emitter Saturation Voltage	V _{CE(SAT)}	_	0.20 0.30	V	I _C = 10mA, I _B = 1.0mA I _C = 50mA, I _B = 5.0mA
Base-Emitter Saturation Voltage	V _{BE(SAT)}	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	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	
Voltage Feedback Ratio	h _{RE}	0.5	8.0	x 10 ⁻⁴	$V_{CE} = 10V, I_{C} = 1.0mA,$
Small Signal Current Gain	h _{FE}	100	400	_	f = 1.0kHz
Output Admittance	h _{OE}	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 _D	_	35	ns	$V_{CC} = 3.0V, I_{C} = 10mA,$
Rise Time	t _R	_	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 _F	_	50	ns	$I_{B1} = I_{B2} = 1.0 \text{mA}$

Note: 10. Measured under pulsed conditions. Pulse width \leq 300 μ s. Duty cycle \leq 2%.



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

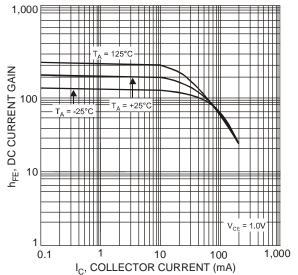
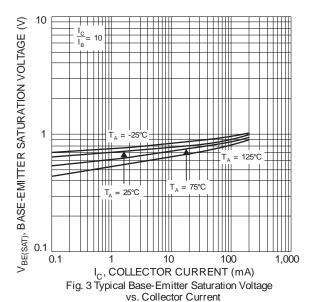


Fig. 1 Typical DC Current Gain vs. Collector Current



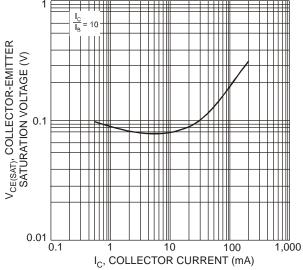


Fig. 2 Typical Collector-Emitter Saturation Voltage vs. Collector Current

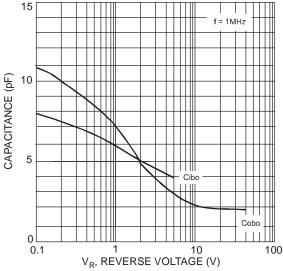


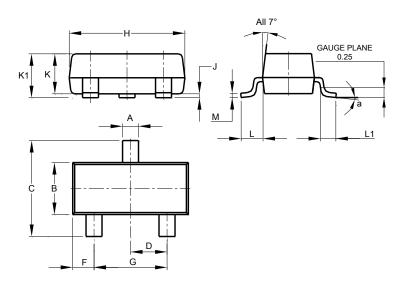
Fig. 4 Typical Capacitance Characteristics



Package Outline Dimensions

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

SOT23

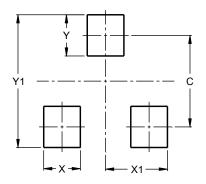


SOT23							
Dim	Min	Max	Тур				
Α	0.37	0.51	0.40				
В	1.20	1.40	1.30				
С	2.30	2.50	2.40				
D	0.89	1.03	0.915				
F	0.45	0.60	0.535				
G	1.78	2.05	1.83				
Н	2.80	3.00	2.90				
J	0.013	0.10	0.05				
K	0.890	1.00	0.975				
K 1	0.903	1.10	1.025				
٦	0.45	0.61	0.55				
L1	0.25	0.55	0.40				
M	0.085	0.150	0.110				
а	0°	8°					
All	Dimens	ions in	mm				

Suggested Pad Layout

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

SOT23



Dimensions	Value (in mm)
С	2.0
Х	0.8
X1	1.35
Y	0.9
V4	2.0



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