MMST3904

60V NPN SMALL SIGNAL TRANSISTOR IN SOT323

Features

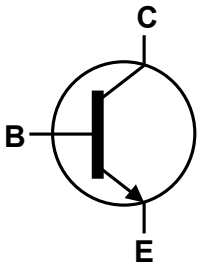
- BV_{CEO} > 40V
- I_C = 200mA Collector Current
- Epitaxial Planar Die Construction
- Ultra-Small Surface Mount Package
- Complementary PNP Type: MMST3906
- **Totally Lead-Free & Fully RoHS compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP Capable (Note 4)**

Mechanical Data

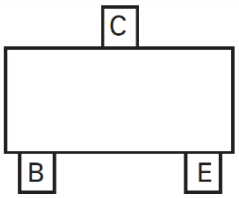
- Case: SOT323
- Case Material: Molded Plastic. "Green" Molding Compound. UL Flammability Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish - Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.006 grams (Approximate)

SOT323

Top View



Device symbol



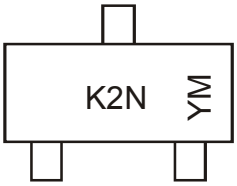
Pin-out Top view

Ordering Information (Notes 4 & 5)

Product	Compliance	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
MMST3904-7-F	AEC-Q101	K2N	7	8	3,000
MMST3904Q-7-F	Automotive	K2N	7	8	3,000

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



K4M = Product Type Marking Code
YM = Date Code Marking
Y or $\overline{Y}$ = Year (ex: A = 2013)
M or $\overline{M}$ = Month (ex: 9 = September)

Date Code Key

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Code	X	Y	Z	A	B	C	D	E	F	G	H

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

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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	I_C	200	mA

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

Characteristic	Symbol	Value	Unit
Power Dissipation (Note 6)	P_d	200	mW
Thermal Resistance, Junction to Ambient (Note 6)	$R_{\theta JA}$	625	°C/W
Operating and Storage Temperature Range	T_j, T_{STG}	-55 to +150	°C

ESD Ratings (Note 7)

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

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

Characteristic	Symbol	Min	Max	Unit	Test Condition
OFF CHARACTERISTICS (Note 8)					
Collector-Base Breakdown Voltage	BV_{CBO}	60	—	V	I_C = 10μA, I_E = 0
Collector-Emitter Breakdown Voltage	BV_{CEO}	40	—	V	I_C = 1mA, I_B = 0
Emitter-Base Breakdown Voltage	BV_{EBO}	5	—	V	I_E = 10μA, I_C = 0
Collector Cutoff Current	I_{CEX}	—	50	nA	V_{CE} = 30V, $V_{EB(OFF)}$ = 3V
Base Cutoff Current	I_{BL}	—	50	nA	V_{CE} = 30V, $V_{EB(OFF)}$ = 3V
ON CHARACTERISTICS (Note 8)					
DC Current Gain	h_{FE}	40 70 100 60 30	— — 300 — —	—	I_C = 100uA, V_{CE} = 1V I_C = 1mA, V_{CE} = 1V I_C = 10mA, V_{CE} = 1V I_C = 50mA, V_{CE} = 1V I_C = 100mA, V_{CE} = 1V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	—	0.25 0.30	V	I_C = 10mA, I_B = 1mA I_C = 50mA, I_B = 5mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	0.65 —	0.85 0.95	V	I_C = 10mA, I_B = 1mA I_C = 50mA, I_B = 5mA
SMALL SIGNAL CHARACTERISTICS					
Output Capacitance	C_{obo}	—	4	pF	V_{CB} = 5V, f = 1.0MHz, I_E = 0
Input Capacitance	C_{ibo}	—	8	pF	V_{EB} = 0.5V, f = 1.0MHz, I_C = 0
Input Impedance	h_{ie}	1	10	kΩ	V_{CE} = 10V, I_C = 1mA, f = 1.0MHz
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	40	μS	
Current Gain-Bandwidth Product	f_T	300	—	MHz	V_{CE} = 20V, I_C = 10mA, f = 100MHz
Noise Figure	NF	—	5	dB	V_{CC} = 5V, I_C = 100μA, R_S = 1kΩ, f = 1MHz
SWITCHING CHARACTERISTICS					
Delay Time	t_d	—	35	ns	V_{CC} = 3V, I_C = 10mA, $V_{BE(OFF)}$ = -0.5V, I_{B1} = 1mA
Rise Time	t_r	—	35	ns	

Notes:
6. For a device mounted with the collector lead on minimum recommended pad layout 1oz copper that is on a single-sided 1.6mm FR4 PCB; device is measured under still air conditions whilst operating in a steady-state.
7. Refer to JEDEC specification JESD22-A114 and JESD22-A115.
8. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.

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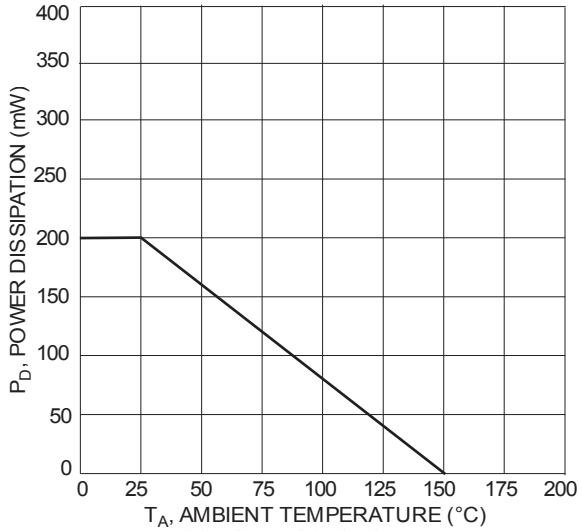
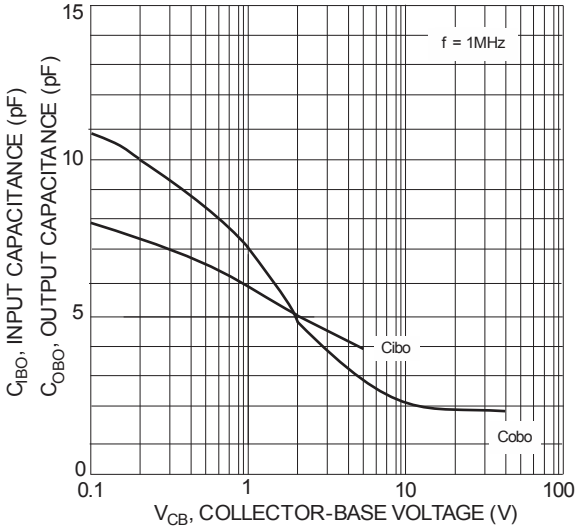
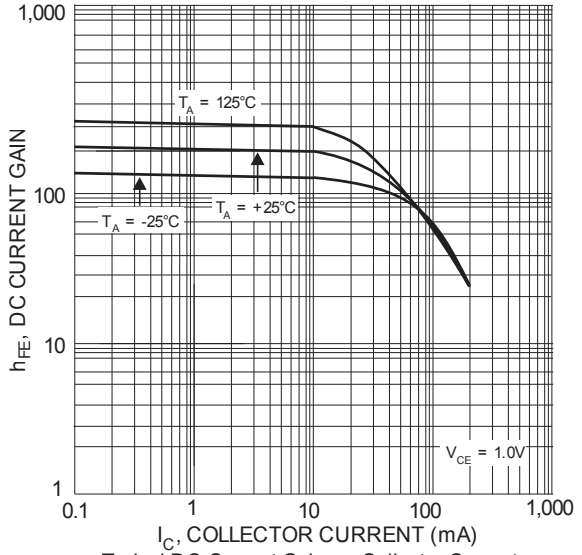
Typical Electrical Characteristics (@T_A = +25°C, unless otherwise specified.)



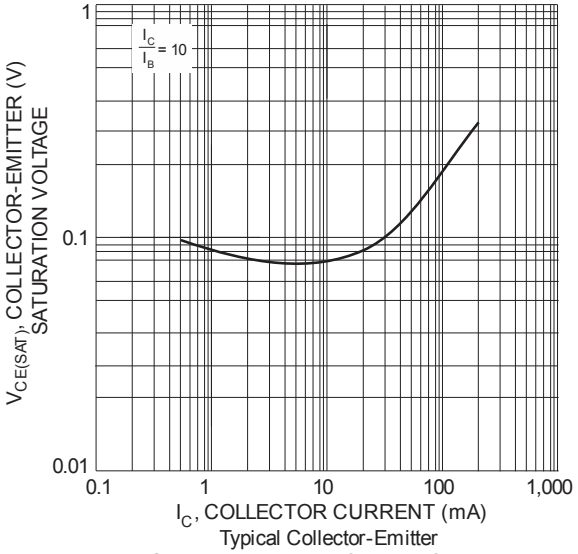
Max Power Dissipation vs.
Ambient Temperature



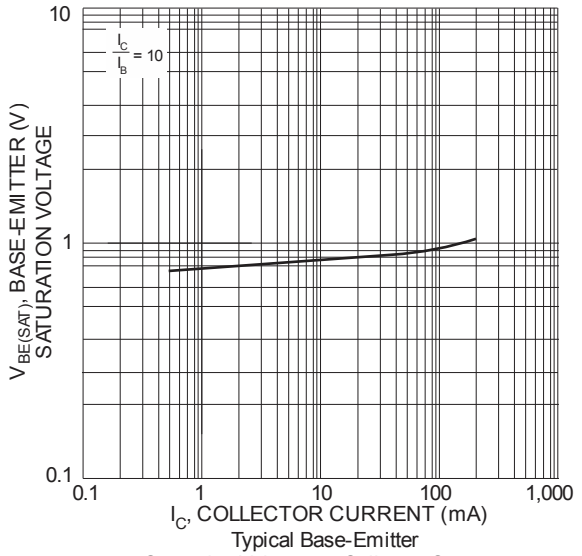
Input and Output Capacitance vs.
Collector-Base Voltage



Typical DC Current Gain vs. Collector Current



Typical Collector-Emitter
Saturation Voltage vs. Collector Current



Typical Base-Emitter
Saturation Voltage vs. Collector Current

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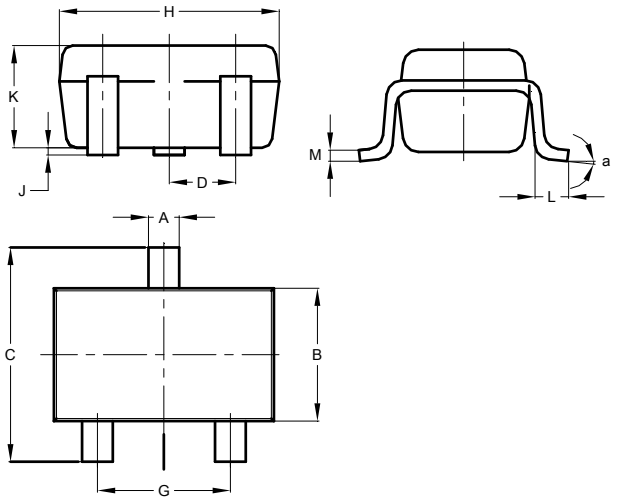
Package Outline Dimensions

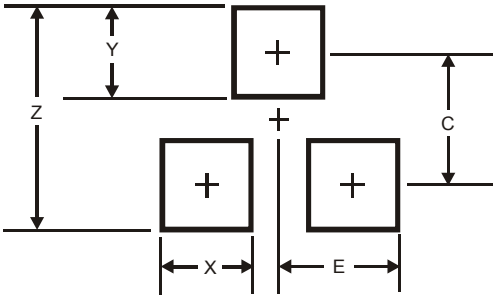
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for the latest version.



SOT323			
Dim	**Min**	**Max**	**Typ**
A	0.25	0.40	0.30
B	1.15	1.35	1.30
C	2.00	2.20	2.10
D	0.650 BSC		
F	0.375	0.475	0.425
G	1.20	1.40	1.30
H	1.80	2.20	2.15
J	0.00	0.10	0.05
K	0.90	1.00	0.95
L	0.25	0.40	0.30
M	0.10	0.18	0.11
a	8°C		
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)
Z	2.8
X	0.7
Y	0.9
C	1.9
E	1.0

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