40V NPN SMALL-SIGNAL TRANSISTOR IN SOT23

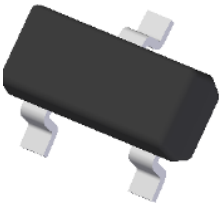
Features

- Epitaxial Planar Die Construction
- Ideal for Medium Power Amplification and Switching
- Complementary PNP Type: MMBT4403
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **An automotive-compliant part is available under separate datasheet (MMBT4401Q)**

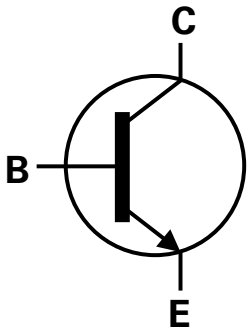
Mechanical Data

- Package: SOT23
- Package Material: Molded Plastic "Green" 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: 0.008 grams (Approximate)

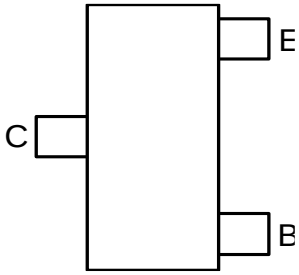
SOT23



Top View



Device Symbol



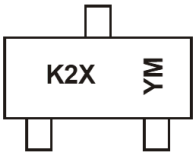
Top View
Pinout

Ordering Information (Note 4)

Orderable Part Number	Package	Marking	Reel Size (inches)	Tape Width (mm)	Packing	
					Qty.	Carrier
MMBT4401-7-F	SOT23	K2X	7	8	3,000	Reel
MMBT4401-13-F	SOT23	K2X	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



K2X = Product Type Marking Code
YM = Date Code Marking
Y or $\overline{Y}$ or $\underline{Y}$ = Year (ex: M = 2025)
M or $\overline{M}$ = Month (ex: 9 = September)

Date Code Key

Year	2010	-	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Code	X	-	M	N	P	R	S	T	U	V	W	X

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°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}	6.0	V
Collector Current	I_C	600	mA
Peak Collector Current	I_{CM}	1	A
Peak Base Current	I_{BM}	200	mA

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

Characteristic		Symbol	Value	Unit
Power Dissipation	(Note 5)	P_D	310	mW
	(Note 6)		350	
Thermal Resistance, Junction to Ambient	(Note 5)	$R_{\theta JA}$	403	°C/W
	(Note 6)		357	
Thermal Resistance, Junction to Leads	(Note 7)	$R_{\theta JL}$	350	°C/W
Thermal Resistance, Junction to Case	(Note 5)	$R_{\theta JC}$	120	°C/W
Operating and Storage Temperature Range		T_J,T_{STG}	-55 to +150	°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
Electrostatic Discharge – Charged Device Model	ESD CDM	1,000	V	C3

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 15mm 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, JESD22-A115 and JES-022-C101.

Thermal Characteristics and Derating Information

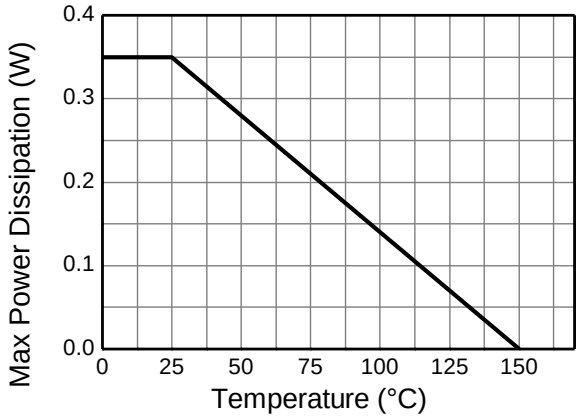


Figure 1. Derating Curve

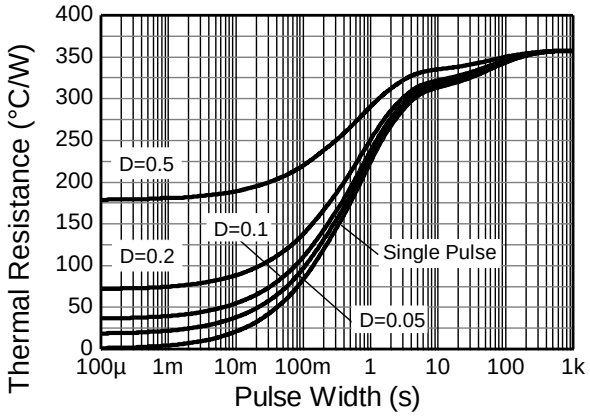


Figure 2. Transient Thermal Impedance

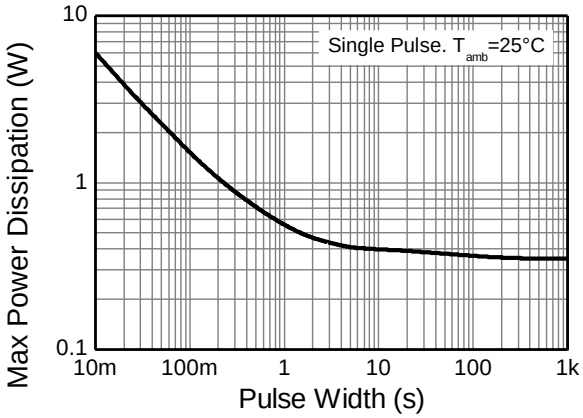


Figure 3. Pulse Power Dissipation

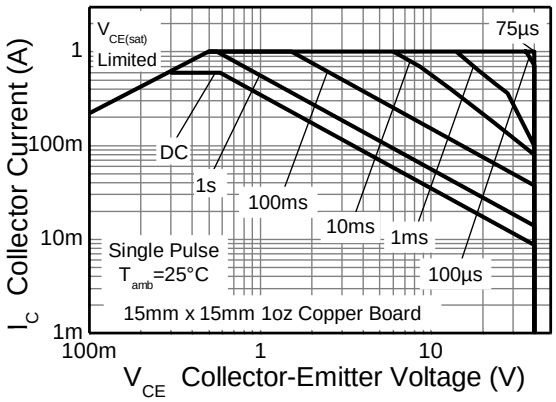


Figure 4. Safe Operating Area

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 = 100µA
Collector-Emitter Breakdown Voltage (Note 9)	BV_{CEO}	40	—	V	I_C = 10mA
Emitter-Base Breakdown Voltage	BV_{EBO}	6	—	V	I_E = 100µA
Collector Cutoff Current	I_{CEX}	—	100	nA	V_{CE} = 35V, $V_{EB(off)}$ = 0.4V
Base Cutoff Current	I_{BL}	—	100	nA	V_{CE} = 35V, $V_{EB(off)}$ = 0.4V
ON CHARACTERISTICS (Note 9)					
DC Current Gain	h_{FE}	20 40 80 100 40	— — — 300 —	—	I_C = 100µA, V_{CE} = 1V I_C = 1mA, V_{CE} = 1V I_C = 10mA, V_{CE} = 1V I_C = 150mA, V_{CE} = 1V I_C = 500mA, V_{CE} = 2V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	—	0.4 0.75	V	I_C = 150mA, I_B = 15mA I_C = 500mA, I_B = 50mA
Base-Emitter Saturation Voltage	$V_{BE(sat)}$	0.75 —	0.95 1.2	V	I_C = 150mA, I_B = 15mA I_C = 500mA, I_B = 50mA
SMALL-SIGNAL CHARACTERISTICS					
Output Capacitance	C_{cb}	—	6.5	pF	V_{CB} = 5V, f = 1MHz
Input Capacitance	C_{eb}	—	30	pF	V_{EB} = 0.5V, f = 1MHz
Input Impedance	h_{ie}	1	15	kΩ	V_{CE} = 10V, I_C = 1mA, f = 1kHz
Voltage Feedback Ratio	h_{re}	0.1	8	x 10^{-4}	
Small-Signal Current Gain	h_{fe}	40	500	—	
Output Admittance	h_{oe}	1	30	µS	
Current Gain-Bandwidth Product	f_T	250	—	MHz	V_{CE} = 10V, I_C = 20mA, f = 100MHz
SWITCHING CHARACTERISTICS					
Delay Time	t_d	—	15	ns	V_{CC} = 30V, I_C = 150mA, $V_{BE(off)}$ = 2V, I_{B1} = 15mA
Rise Time	t_r	—	20	ns	
Storage Time	t_s	—	225	ns	V_{CC} = 30V, I_C = 150mA, I_{B1} = -I_{B2} = 15mA
Fall Time	t_f	—	30	ns	

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

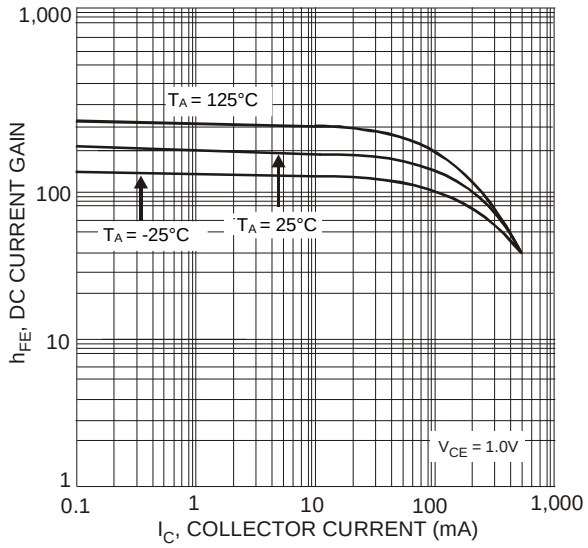


Figure 5 Typical DC Current Gain vs. Collector Current

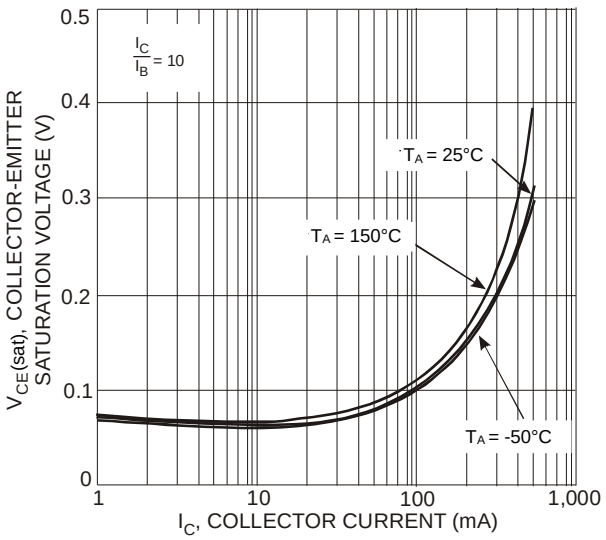


Figure 6 Collector-Emitter Saturation Voltage vs. Collector Current

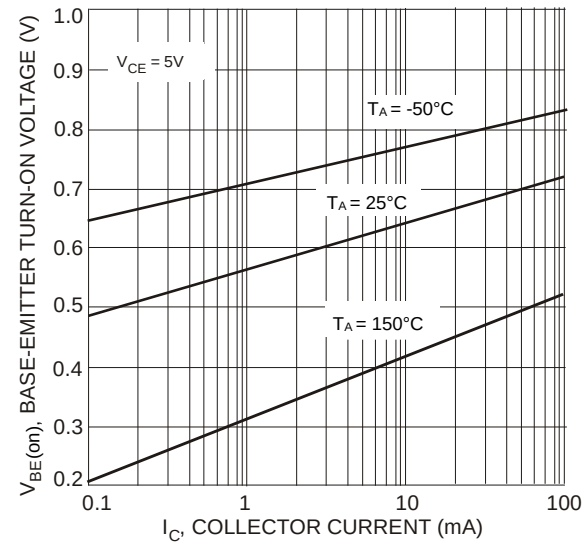


Figure 7 Typical Base-Emitter Turn-On Voltage vs. Collector Current

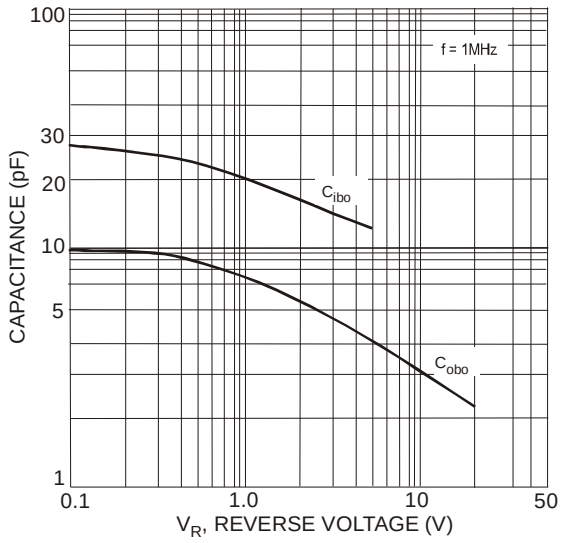


Figure 8 Typical Capacitance Characteristics

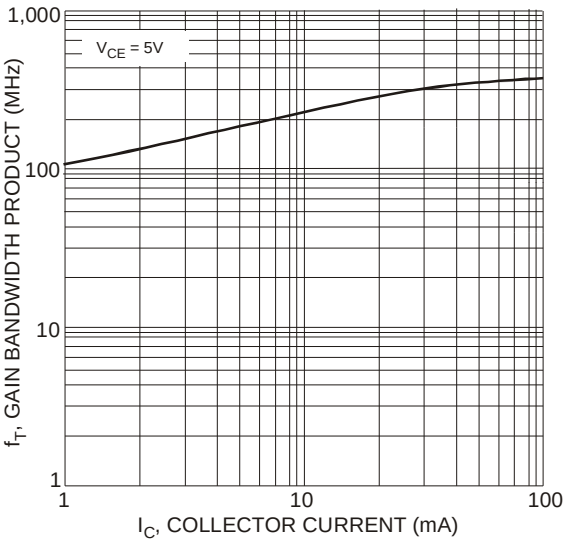


Figure 9 Typical Gain Bandwidth Product vs. Collector Current

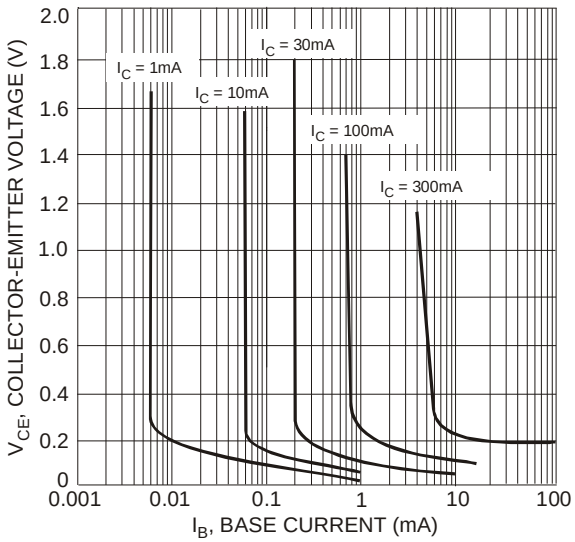
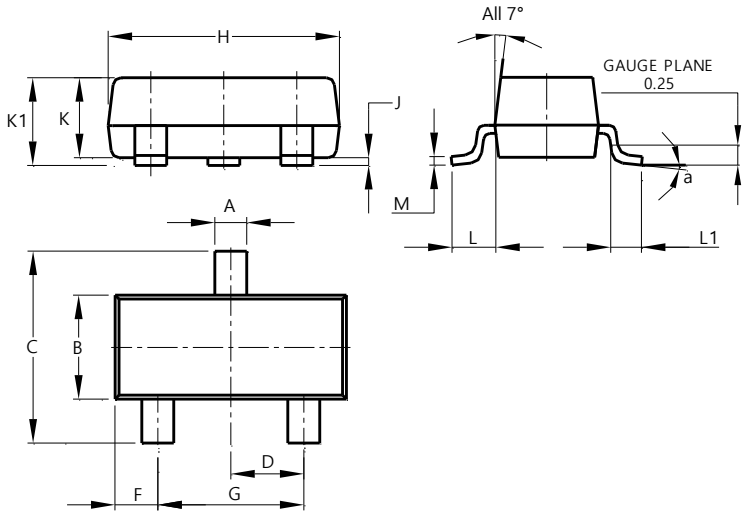


Figure 10 Typical Collector Saturation Region

Package Outline Dimensions

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

SOT23

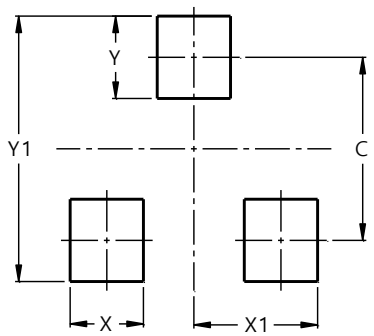


SOT23			
Dim	**Min**	**Max**	**Typ**
A	0.37	0.51	0.40
B	1.20	1.40	1.30
C	2.30	2.50	2.40
D	0.89	1.03	0.915
F	0.45	0.60	0.535
G	1.78	2.05	1.83
H	2.80	3.00	2.90
J	0.013	0.10	0.05
K	0.890	1.00	0.975
K1	0.903	1.10	1.025
L	0.45	0.61	0.55
L1	0.25	0.55	0.40
M	0.085	0.150	0.110
a	0°	8°	--
All Dimensions in mm			

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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