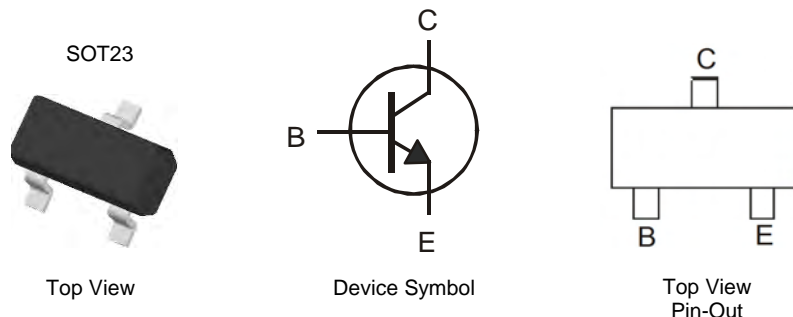


**40V NPN SURFACE MOUNT SMALL SIGNAL TRANSISTOR IN SOT23**
**Features**

- Epitaxial Planar Die Construction
- Complementary PNP Type Available (MMBT4403)
- Ideal for Medium Power Amplification and Switching
- **Lead Free, RoHS Compliant (Note 1)**
- **Halogen and Antimony Free "Green" Device (Note 2)**
- **Qualified to AEC-Q101 Standards for High Reliability**

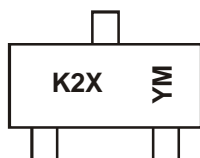
**Mechanical Data**

- Case: SOT23
- UL Flammability Rating 94V-0
- Case material: molded Plastic "Green" Compound
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Matte Tin Finish
- Weight: 0.008 grams (Approximate)


**Ordering Information** (Note 3 & 4)

Product	Grade	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
MMBT4401-7-F	Commercial	K2X	7	8	3,000
MMBT4401-13-F	Commercial	K2X	13	8	10,000
MMBT4401Q-13-F	Automotive	K2X	13	8	10,000

- Notes:
1. No purposefully added lead.
  2. Diodes Inc.'s "Green" Policy can be found on our website at <http://www.diodes.com>
  3. For more packaging details, go to our website at <http://www.diodes.com>.
  4. Products with Q-suffix are automotive grade. Automotive products are electrical and thermal the same as the commercial, except where specified.

**Marking Information**


K2X = Product Type Marking Code  
 YM = Date Code Marking  
 Y = Year (ex: Y = 2011)  
 M = Month (ex: 9 = September)

**Date Code Key**

Year	2010	2011	2012	2013	2014	2015	2016	2017
Code	X	Y	Z	A	B	C	D	E

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

## 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	$V_{EBO}$	6.0	V
Collector Current - Continuous (Note 5)	$I_C$	600	mA

## Thermal Characteristics @ $T_A = 25^\circ\text{C}$ unless otherwise specified

Characteristic	Symbol	Value	Unit
Power Dissipation (Note 5)	$P_D$	300	mW
Thermal Resistance, Junction to Ambient (Note 5)	$R_{\theta JA}$	417	$^\circ\text{C/W}$
Thermal Resistance, Junction to Lead (Note 6)	$R_{\theta JL}$	350	$^\circ\text{C/W}$
Operating and Storage Temperature Range	$T_J, T_{STG}$	-55 to +150	$^\circ\text{C}$

- Notes:
- For a device surface mounted on minimum recommended pad layout FR4 PCB with high coverage of single sided 1oz copper in still air conditions; the device is measured when operating in a steady-state condition.
  - Thermal resistance from junction to solder-point (at the end of the collector lead).

## Typical Thermal Characteristics

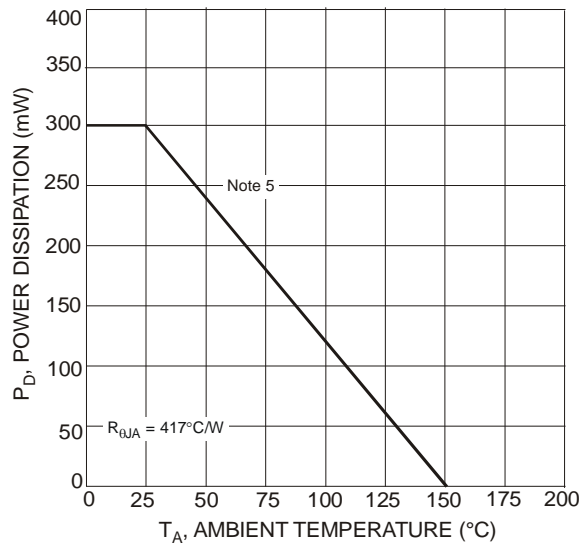


Fig. 1 Power Dissipation vs. Ambient Temperature

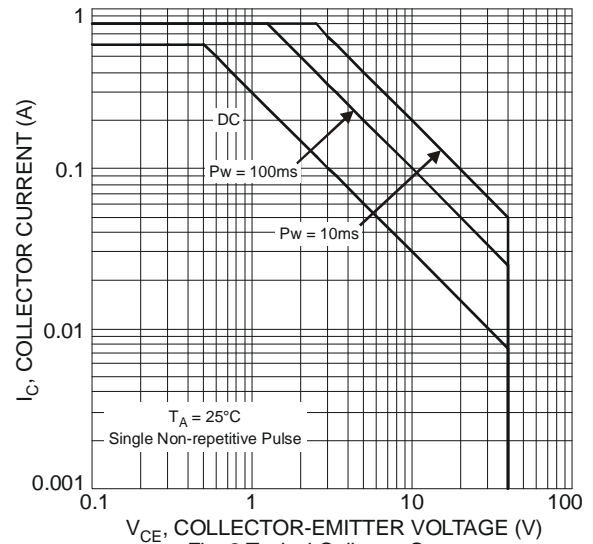
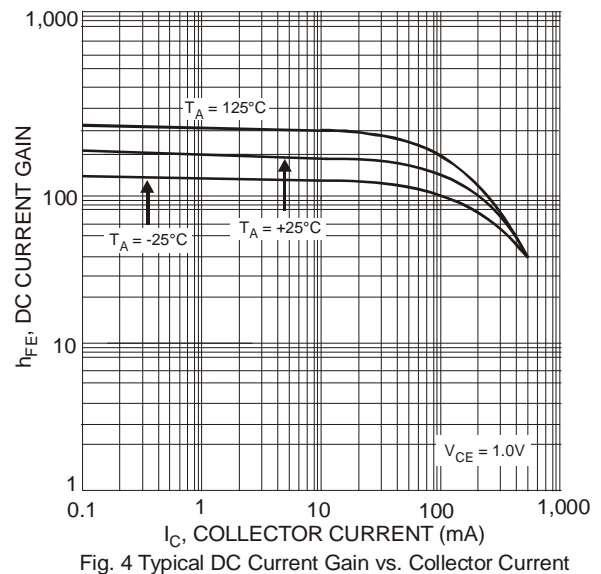
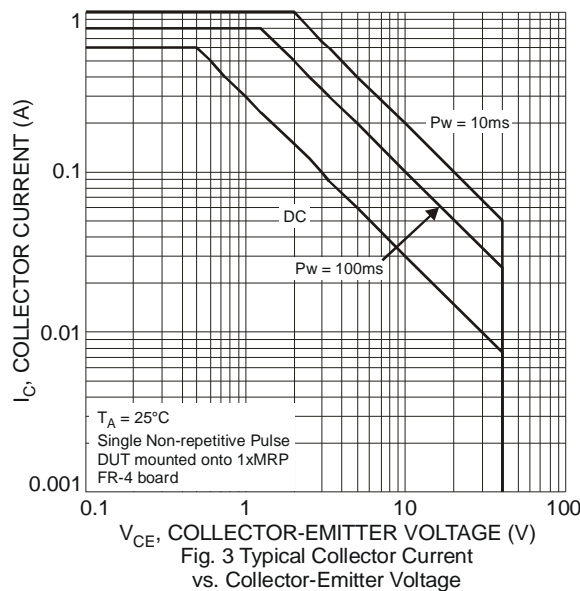


Fig. 2 Typical Collector Current vs. Collector-Emitter Voltage

**Electrical Characteristics** @T<sub>A</sub> = 25°C unless otherwise specified

Characteristic	Symbol	Min	Max	Unit	Test Condition
OFF CHARACTERISTICS (Note 7)					
Collector-Base Breakdown Voltage	BV <sub>CBO</sub>	60	—	V	I <sub>C</sub> = 100μA, I <sub>E</sub> = 0
Collector-Emitter Breakdown Voltage	BV <sub>CEO</sub>	40	—	V	I <sub>C</sub> = 1.0mA, I <sub>B</sub> = 0
Emitter-Base Breakdown Voltage	BV <sub>EBO</sub>	6.0	—	V	I <sub>E</sub> = 100μA, I <sub>C</sub> = 0
Collector Cutoff Current	I <sub>CEX</sub>	—	100	nA	V <sub>CE</sub> = 35V, V <sub>EB(OFF)</sub> = 0.4V
Base Cutoff Current	I <sub>BL</sub>	—	100	nA	V <sub>CE</sub> = 35V, V <sub>EB(OFF)</sub> = 0.4V
ON CHARACTERISTICS (Note 7)					
DC Current Gain	h <sub>FE</sub>	20	—	—	I <sub>C</sub> = 100μA, V <sub>CE</sub> = 1.0V
		40	—		I <sub>C</sub> = 1.0mA, V <sub>CE</sub> = 1.0V
		80	—		I <sub>C</sub> = 10mA, V <sub>CE</sub> = 1.0V
		100	300		I <sub>C</sub> = 150mA, V <sub>CE</sub> = 1.0V
		40	—		I <sub>C</sub> = 500mA, V <sub>CE</sub> = 2.0V
Collector-Emitter Saturation Voltage	V <sub>CE(sat)</sub>	—	0.40 0.75	V	I <sub>C</sub> = 150mA, I <sub>B</sub> = 15mA I <sub>C</sub> = 500mA, I <sub>B</sub> = 50mA
Base-Emitter Saturation Voltage	V <sub>BE(sat)</sub>	0.75 —	0.95 1.2	V	I <sub>C</sub> = 150mA, I <sub>B</sub> = 15mA I <sub>C</sub> = 500mA, I <sub>B</sub> = 50mA
SMALL SIGNAL CHARACTERISTICS					
Output Capacitance	C <sub>cb</sub>	—	6.5	pF	V <sub>CB</sub> = 5.0V, f = 1.0MHz, I <sub>E</sub> = 0
Input Capacitance	C <sub>eb</sub>	—	30	pF	V <sub>EB</sub> = 0.5V, f = 1.0MHz, I <sub>C</sub> = 0
Input Impedance	h <sub>ie</sub>	1.0	15	kΩ	V <sub>CE</sub> = 10V, I <sub>C</sub> = 1.0mA, f = 1.0kHz
Voltage Feedback Ratio	h <sub>re</sub>	0.1	8.0	x 10 <sup>-4</sup>	
Small Signal Current Gain	h <sub>fe</sub>	40	500	—	
Output Admittance	h <sub>oe</sub>	1.0	30	μS	
Current Gain-Bandwidth Product	f <sub>T</sub>	250	—	MHz	V <sub>CE</sub> = 10V, I <sub>C</sub> = 20mA, f = 100MHz
SWITCHING CHARACTERISTICS					
Delay Time	t <sub>d</sub>	—	15	ns	V <sub>CC</sub> = 30V, I <sub>C</sub> = 150mA, V <sub>BE(off)</sub> = 2.0V, I <sub>B1</sub> = 15mA
Rise Time	t <sub>r</sub>	—	20	ns	
Storage Time	t <sub>s</sub>	—	225	ns	V <sub>CC</sub> = 30V, I <sub>C</sub> = 150mA, I <sub>B1</sub> = I <sub>B2</sub> = 15mA
Fall Time	t <sub>f</sub>	—	30	ns	

Notes: 7. Short duration pulse test used to minimize self-heating effect.

**Typical Electrical Characteristics**


## Typical Electrical Characteristics – Continued

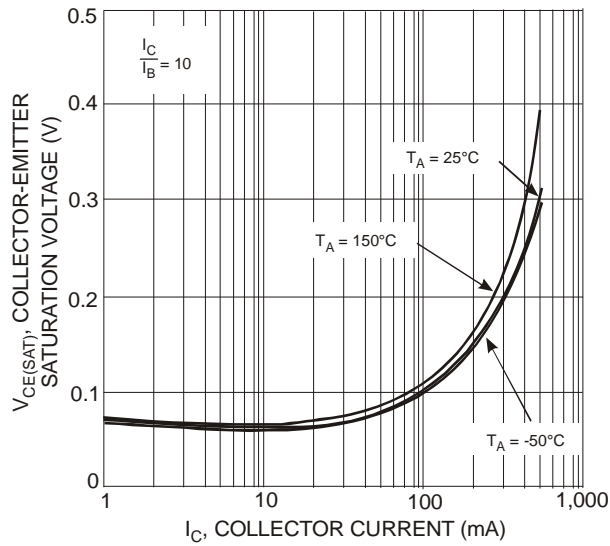


Fig. 5 Collector-Emitter Saturation Voltage vs. Collector Current

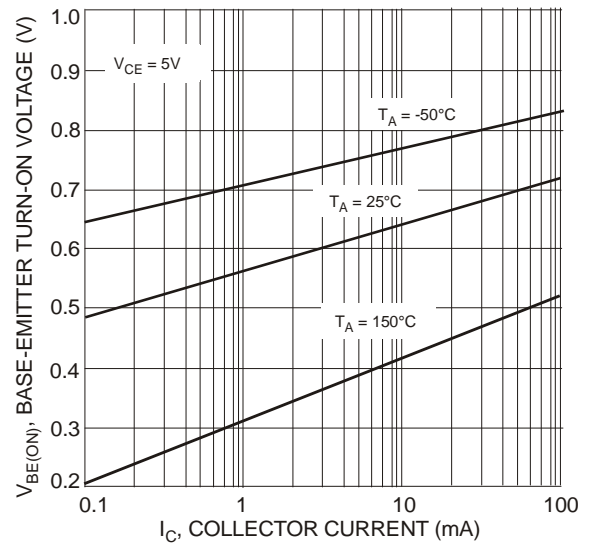


Fig. 6 Typical Base-Emitter Turn-On Voltage vs. Collector Current

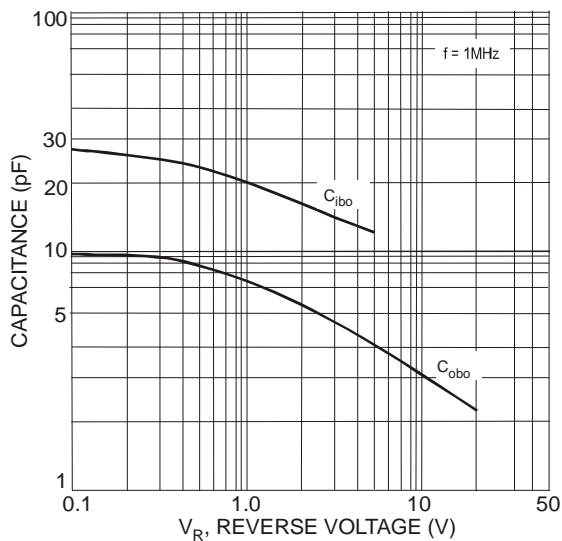


Fig. 7 Typical Capacitance Characteristics

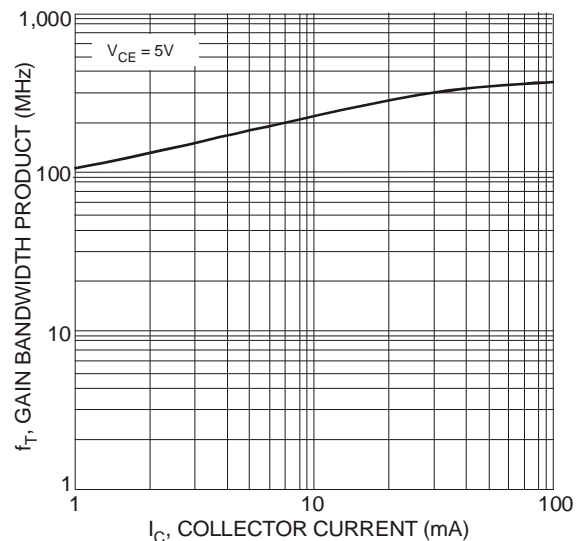


Fig. 8 Typical Gain Bandwidth Product vs. Collector Current

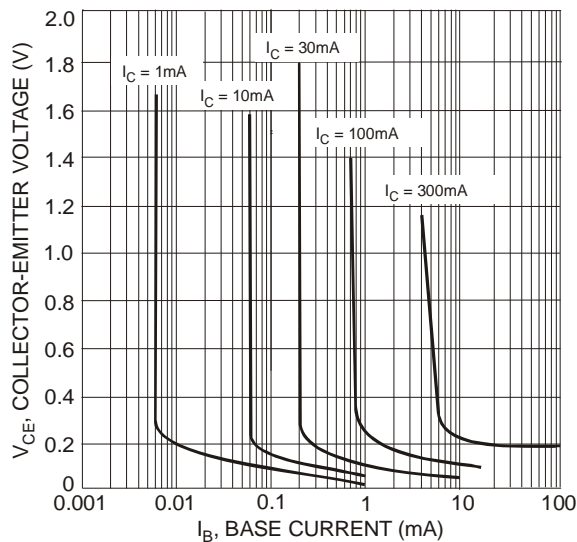
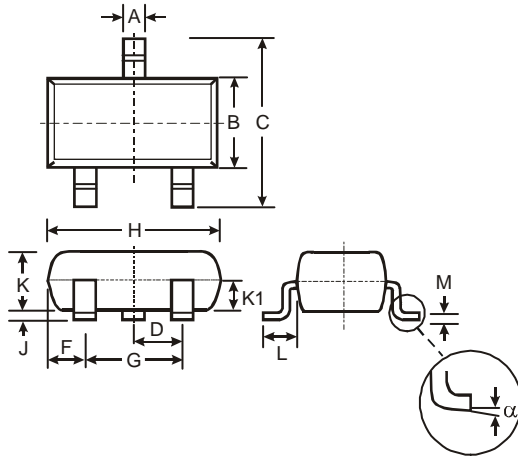


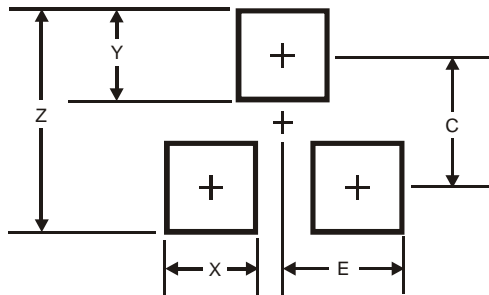
Fig. 9 Typical Collector Saturation Region

## Package Outline Dimensions



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	0.903	1.10	1.00
K1	-	-	0.400
L	0.45	0.61	0.55
M	0.085	0.18	0.11
$\alpha$	0°	8°	-
All Dimensions in mm			

## Suggested Pad Layout



Dimensions	Value (in mm)
Z	2.9
X	0.8
Y	0.9
C	2.0
E	1.35

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