



**THE DATASHEET OF
MMBT4401-13-F**



Features

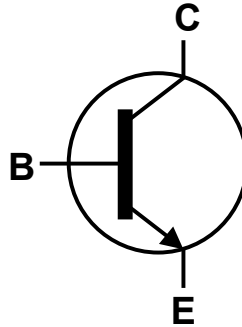
- Epitaxial Planar Die Construction
- Ideal for Medium Power Amplification and Switching
- Complementary PNP Type: MMBT4403
- **Totally Lead-Free & Fully RoHS compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP capable (Note 4)**

Mechanical Data

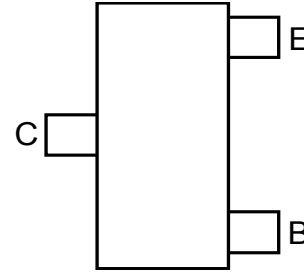
- Case: SOT23
- Case material: molded Plastic "Green" Compound
UL Flammability Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish - Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 Ⓔ3
- Weight: 0.008 grams (Approximate)



Top View



Device Symbol



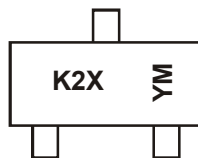
Top View
Pin-Out

Ordering Information (Notes 4 & 5)

Product	Compliance	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
MMBT4401-7-F	AEC-Q101	K2X	7	8	3,000
MMBT4401-13-F	AEC-Q101	K2X	13	8	10,000
MMBT4401Q-13-F	Automotive	K2X	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



K2X = Product Type Marking Code
 YM = Date Code Marking
 Y or \bar{Y} = Year (ex: A = 2013)
 M or \bar{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

Absolute Maximum Ratings (@T_A = +25°C unless otherwise specified)

Characteristic	Symbol	Value	Unit
Collector-Base Voltage	V _{CB0}	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)

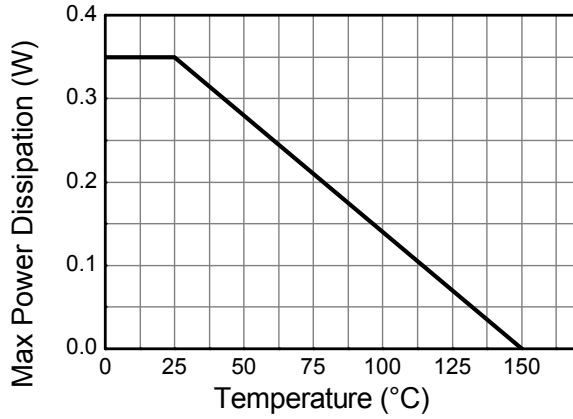
Characteristic	Symbol	Value	Unit
Power Dissipation	P _D	(Note 6)	310
		(Note 7)	350
Thermal Resistance, Junction to Ambient	R _{θJA}	(Note 6)	403
		(Note 7)	357
Thermal Resistance, Junction to Leads	R _{θJL}	350	°C/W
Operating and Storage Temperature Range	T _J , T _{STG}	-55 to +150	°C

ESD Ratings (Note 9)

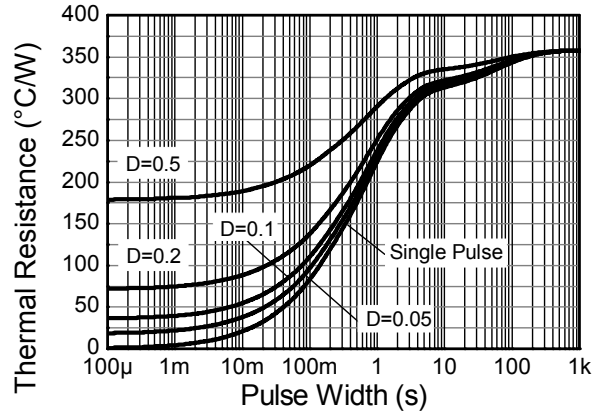
Characteristic	Symbol	Value	Unit	JEDEC Class
Electrostatic Discharge - Human Body Model	ESD HBM	4,000	V	3A
Electrostatic Discharge - Machine Model	ESD MM	400	V	C

- 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 conditions whilst operating in a steady-state.
 7. Same as note (6), except the device is mounted on 15 mm x 15mm 1oz copper.
 8. Thermal resistance from junction to solder-point (at the end of the leads).
 9. Refer to JEDEC specification JESD22-A114 and JESD22-A115.

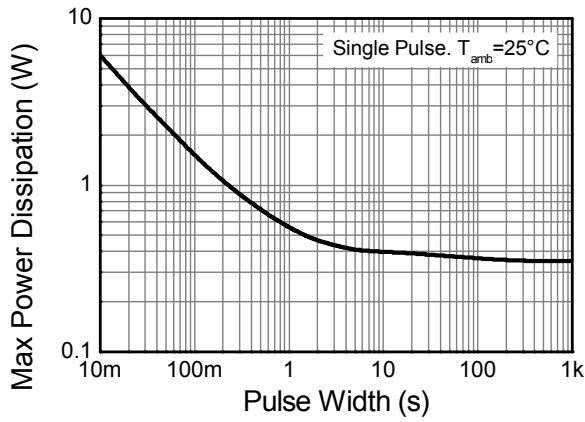
Thermal Characteristics and Derating Information



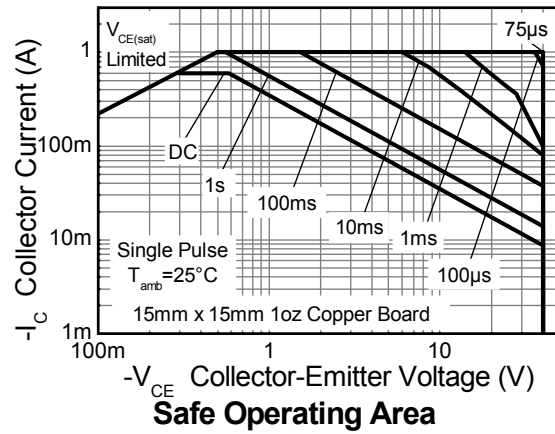
Derating Curve



Transient Thermal Impedance



Pulse Power Dissipation



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 _{CB0}	60	—	V	I _C = 100μA, I _E = 0
Collector-Emitter Breakdown Voltage(Note 10)	BV _{CEO}	40	—	V	I _C = 10.0mA, I _B = 0
Emitter-Base Breakdown Voltage	BV _{EBO}	6.0	—	V	I _E = 100μA, I _C = 0
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 10)					
DC Current Gain	h _{FE}	20	—	—	I _C = 100μA, V _{CE} = 1.0V
		40	—		I _C = 1.0mA, V _{CE} = 1.0V
		80	—		I _C = 10mA, V _{CE} = 1.0V
		100	300		I _C = 150mA, V _{CE} = 1.0V
		40	—		I _C = 500mA, V _{CE} = 2.0V
Collector-Emitter Saturation Voltage	V _{CE(sat)}	—	0.40 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} = 5.0V, f = 1.0MHz, I _E = 0
Input Capacitance	C _{eb}	—	30	pF	V _{EB} = 0.5V, f = 1.0MHz, I _C = 0
Input Impedance	h _{ie}	1.0	15	kΩ	V _{CE} = 10V, I _C = 1.0mA, f = 1.0kHz
Voltage Feedback Ratio	h _{re}	0.1	8.0	x 10 ⁻⁴	
Small Signal Current Gain	h _{fe}	40	500	—	
Output Admittance	h _{oe}	1.0	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)} = 2.0V, 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: 10. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.

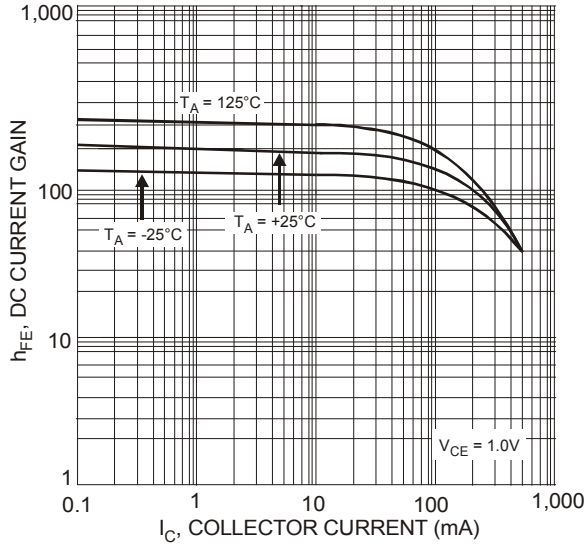


Figure 1 Typical DC Current Gain vs. Collector Current

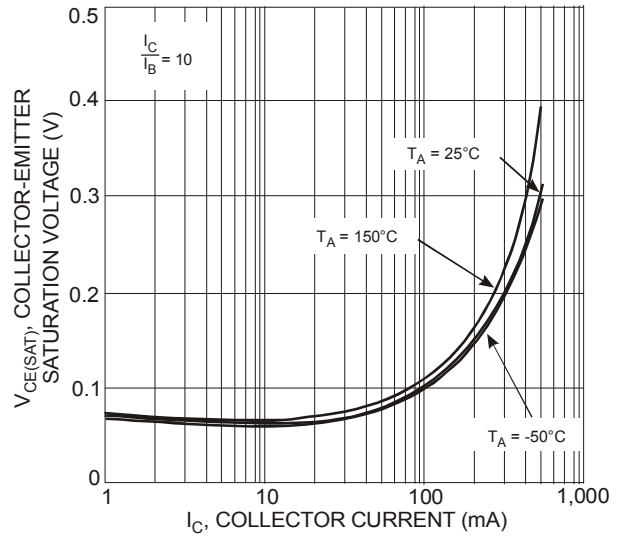


Figure 2 Collector-Emitter Saturation Voltage vs. Collector Current

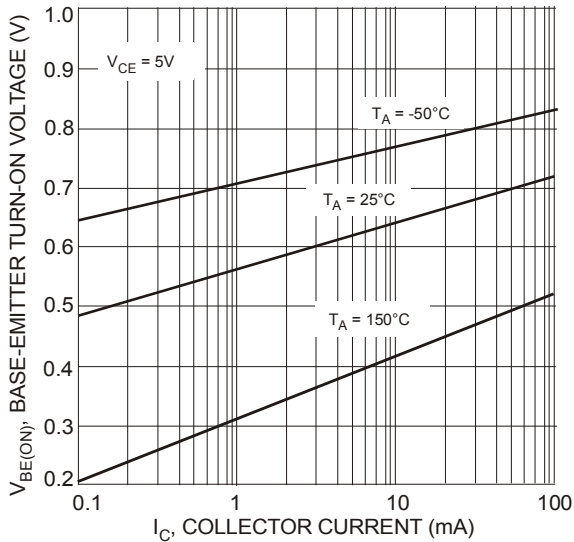


Figure 3 Typical Base-Emitter Turn-On Voltage vs. Collector Current

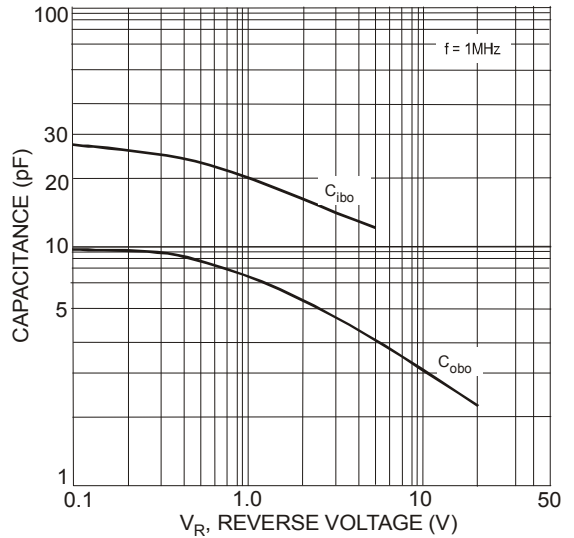


Figure 4 Typical Capacitance Characteristics

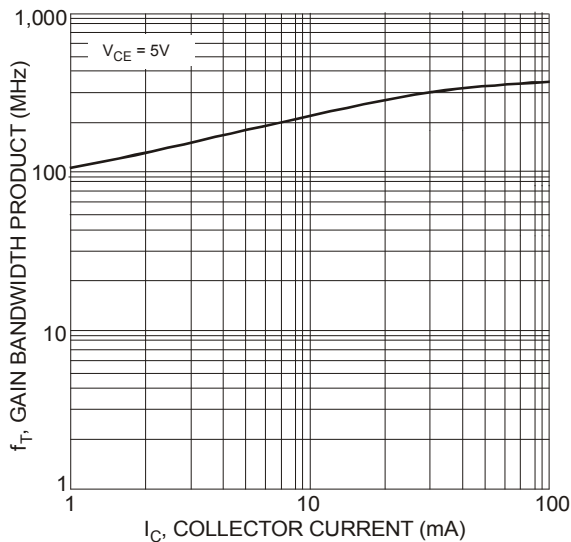


Figure 5 Typical Gain Bandwidth Product vs. Collector Current

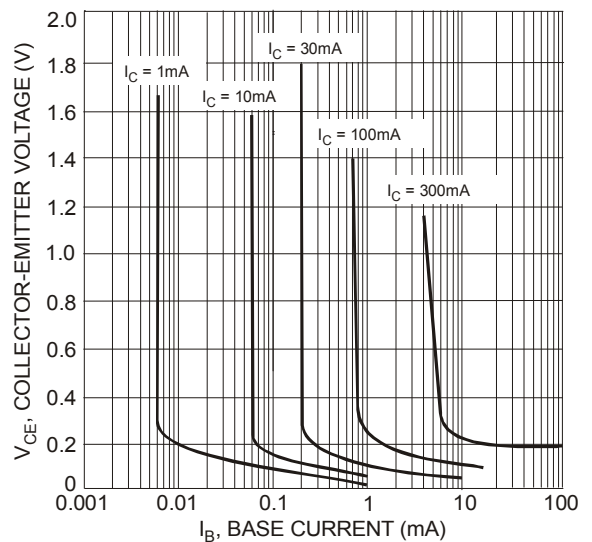
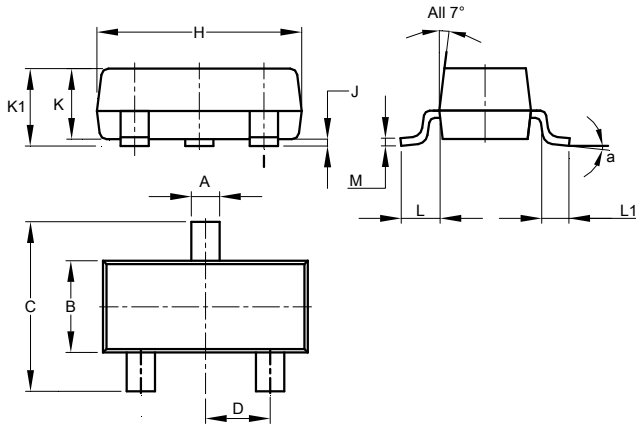


Figure 6 Typical Collector Saturation Region

Package Outline Dimensions

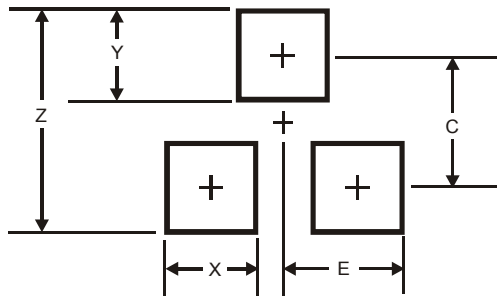
Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.



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	8°		
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	2.9
X	0.8
Y	0.9
C	2.0
E	1.35

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