

## 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)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](mailto:contact@diodes.com) or your local Diodes representative. <https://www.diodes.com/quality/product-definitions/>**

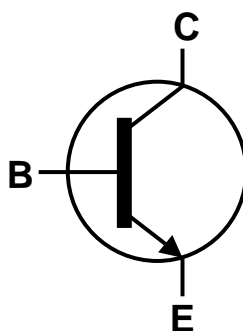
## Mechanical Data

- 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
- Weight: 0.008 grams (Approximate)

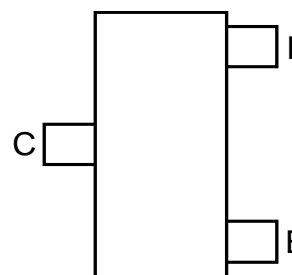


SOT23

Top View



Device Symbol

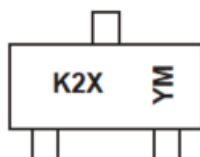

 Top View  
Pin-Out

## Ordering Information (Note 4)

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

- 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  $\bar{Y}$  = Year (ex: I = 2021)  
 M or  $\bar{M}$  = Month (ex: 9 = September)

### Date Code Key

| Year | 2010 | ..... | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|------|------|-------|------|------|------|------|------|------|------|------|------|------|
| Code | X    | ..... | I    | J    | K    | L    | M    | N    | O    | P    | R    | S    |

| 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** (@  $T_A = +25^\circ\text{C}$  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         | $I_C$     | 600   | mA   |
| Peak Collector Current    | $I_{CM}$  | 1     | A    |
| Peak Base Current         | $I_{BM}$  | 200   | mA   |

**Thermal Characteristics** (@  $T_A = +25^\circ\text{C}$  unless otherwise specified)

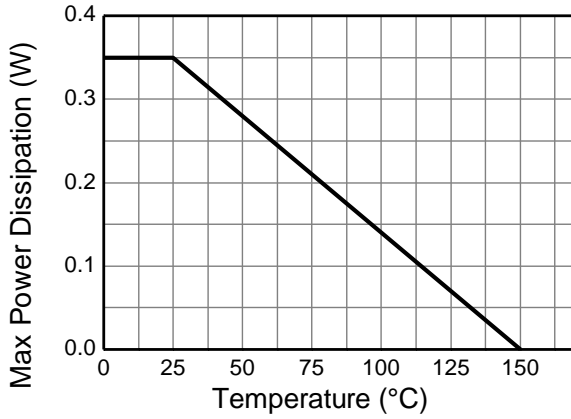
| Characteristic                          | Symbol          | Value       | Unit                      |
|---|-----------------|-------------|---------------------------|
| Power Dissipation                       | $P_D$           | (Note 5)    | 310                       |
|   |                 | (Note 6)    | 350                       |
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | (Note 5)    | 403                       |
|   |                 | (Note 6)    | 357                       |
| Thermal Resistance, Junction to Leads   | $R_{\theta JL}$ | 350         | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance, Junction to Case    | $R_{\theta JC}$ | 120         | $^\circ\text{C}/\text{W}$ |
| Operating and Storage Temperature Range | $T_J, T_{STG}$  | -55 to +150 | $^\circ\text{C}$          |

**ESD Ratings** (Note 8)

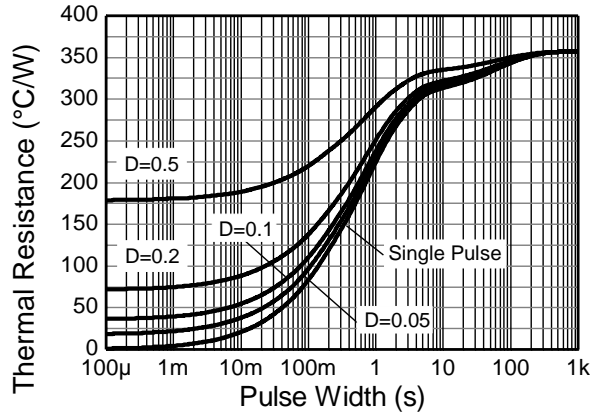
| Characteristic                             | Symbol  | Value | Unit | JEDEC Class |
|--|---------|-------|------|-------------|
| Electrostatic Discharge - Human Body Model | ESD HBM | 4,000 | V    | 3A          |
| Electrostatic Discharge - Machine Model    | ESD MM  | 400   | V    | C           |

- 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 15 mm 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 and JESD22-A115.

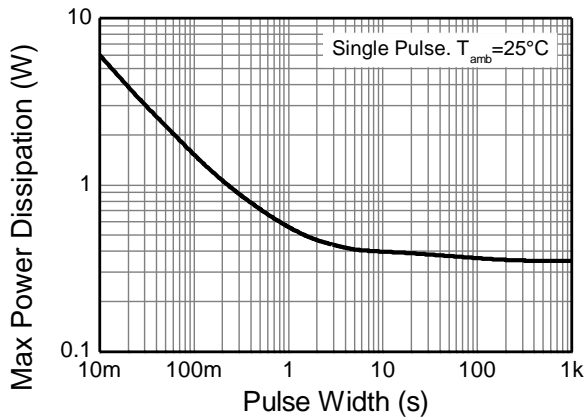
**Thermal Characteristics and Derating Information**



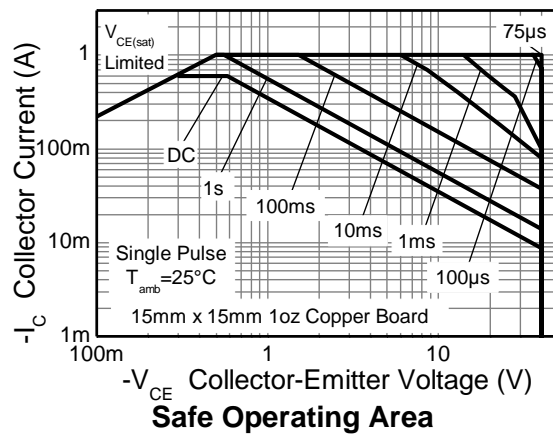
**Derating Curve**



**Transient Thermal Impedance**



**Pulse Power Dissipation**



**Safe Operating Area**

**Electrical Characteristics** (@  $T_A = +25^\circ\text{C}$  unless otherwise specified)

| Characteristic                              | Symbol        | Min       | Max          | Unit             | Test Condition  |
|---|---------------|-----------|--------------|------------------|---|
| <b>OFF CHARACTERISTICS</b>                  |               |           |              |                  |   |
| Collector-Base Breakdown Voltage            | $BV_{CBO}$    | 60        | —            | V                | $I_C = 100\mu\text{A}, I_E = 0$   |
| Collector-Emitter Breakdown Voltage(Note 9) | $BV_{CEO}$    | 40        | —            | V                | $I_C = 10.0\text{mA}, I_B = 0$  |
| Emitter-Base Breakdown Voltage              | $BV_{EBO}$    | 6.0       | —            | V                | $I_E = 100\mu\text{A}, I_C = 0$   |
| Collector Cutoff Current                    | $I_{CEX}$     | —         | 100          | nA               | $V_{CE} = 35\text{V}, V_{EB(OFF)} = 0.4\text{V}$  |
| Base Cutoff Current                         | $I_{BL}$      | —         | 100          | nA               | $V_{CE} = 35\text{V}, V_{EB(OFF)} = 0.4\text{V}$  |
| <b>ON CHARACTERISTICS (Note 9)</b>          |               |           |              |                  |   |
| DC Current Gain                             | $h_{FE}$      | 20        | —            | —                | $I_C = 100\mu\text{A}, V_{CE} = 1.0\text{V}$<br>$I_C = 1.0\text{mA}, V_{CE} = 1.0\text{V}$<br>$I_C = 10\text{mA}, V_{CE} = 1.0\text{V}$<br>$I_C = 150\text{mA}, V_{CE} = 1.0\text{V}$<br>$I_C = 500\text{mA}, V_{CE} = 2.0\text{V}$ |
|   |               | 40        | —            |                  |   |
|   |               | 80        | —            |                  |   |
|   |               | 100       | 300          |                  |   |
|   |               | 40        | —            |                  |   |
| Collector-Emitter Saturation Voltage        | $V_{CE(sat)}$ | —         | 0.40<br>0.75 | V                | $I_C = 150\text{mA}, I_B = 15\text{mA}$<br>$I_C = 500\text{mA}, I_B = 50\text{mA}$  |
| Base-Emitter Saturation Voltage             | $V_{BE(sat)}$ | 0.75<br>— | 0.95<br>1.2  | V                | $I_C = 150\text{mA}, I_B = 15\text{mA}$<br>$I_C = 500\text{mA}, I_B = 50\text{mA}$  |
| <b>SMALL SIGNAL CHARACTERISTICS</b>         |               |           |              |                  |   |
| Output Capacitance                          | $C_{cb}$      | —         | 6.5          | pF               | $V_{CB} = 5.0\text{V}, f = 1.0\text{MHz}, I_E = 0$  |
| Input Capacitance                           | $C_{eb}$      | —         | 30           | pF               | $V_{EB} = 0.5\text{V}, f = 1.0\text{MHz}, I_C = 0$  |
| Input Impedance                             | $h_{ie}$      | 1.0       | 15           | k $\Omega$       | $V_{CE} = 10\text{V}, I_C = 1.0\text{mA},$<br>$f = 1.0\text{kHz}$   |
| Voltage Feedback Ratio                      | $h_{re}$      | 0.1       | 8.0          | $\times 10^{-4}$ |   |
| Small Signal Current Gain                   | $h_{fe}$      | 40        | 500          | —                |   |
| Output Admittance                           | $h_{oe}$      | 1.0       | 30           | $\mu\text{S}$    |   |
| Current Gain-Bandwidth Product              | $f_T$         | 250       | —            | MHz              | $V_{CE} = 10\text{V}, I_C = 20\text{mA},$<br>$f = 100\text{MHz}$  |
| <b>SWITCHING CHARACTERISTICS</b>            |               |           |              |                  |   |
| Delay Time                                  | $t_d$         | —         | 15           | ns               | $V_{CC} = 30\text{V}, I_C = 150\text{mA},$<br>$V_{BE(off)} = 2.0\text{V}, I_{B1} = 15\text{mA}$   |
| Rise Time                                   | $t_r$         | —         | 20           | ns               |   |
| Storage Time                                | $t_s$         | —         | 225          | ns               | $V_{CC} = 30\text{V}, I_C = 150\text{mA},$<br>$I_{B1} = -I_{B2} = 15\text{mA}$  |
| Fall Time                                   | $t_f$         | —         | 30           | ns               |   |

 Note: 9. Measured under pulsed conditions. Pulse width  $\leq 300\mu\text{s}$ . Duty cycle  $\leq 2\%$ .

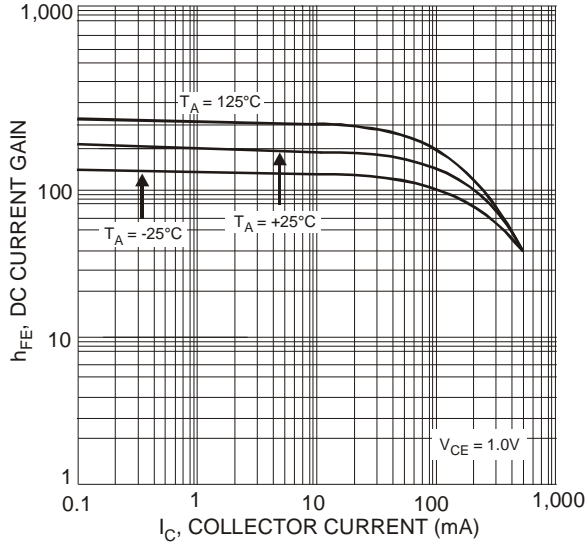


Figure 1 Typical DC Current Gain vs. Collector Current

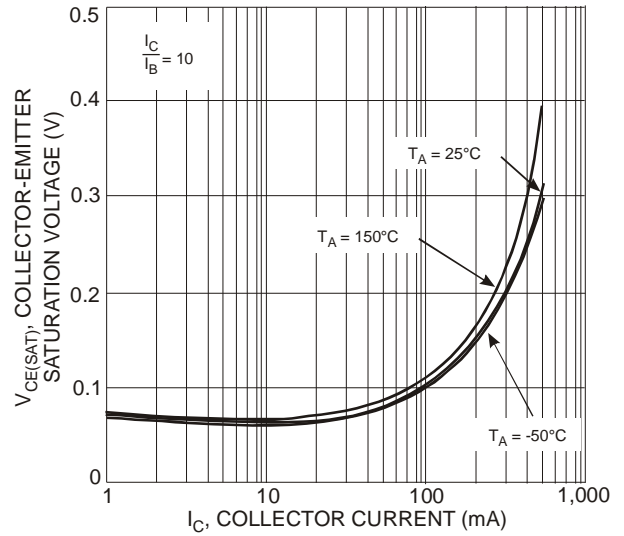


Figure 2 Collector-Emitter Saturation Voltage vs. Collector Current

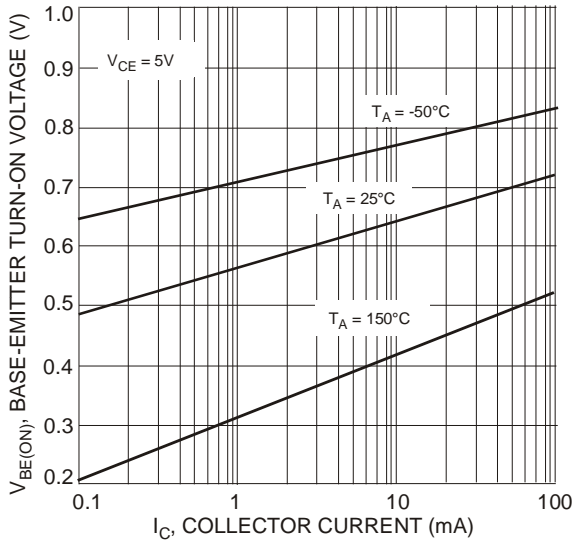


Figure 3 Typical Base-Emitter Turn-On Voltage vs. Collector Current

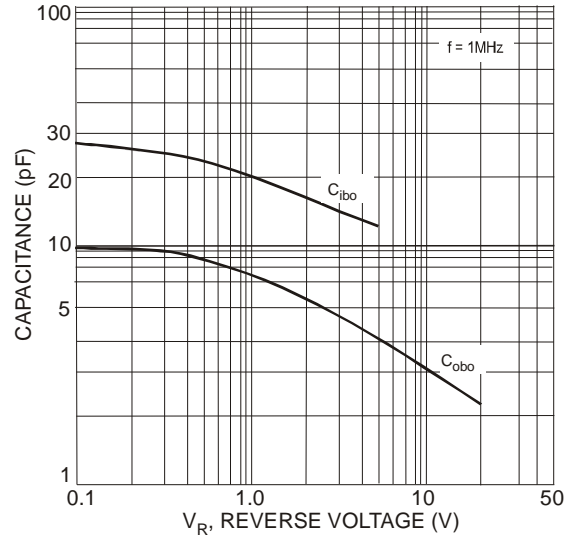


Figure 4 Typical Capacitance Characteristics

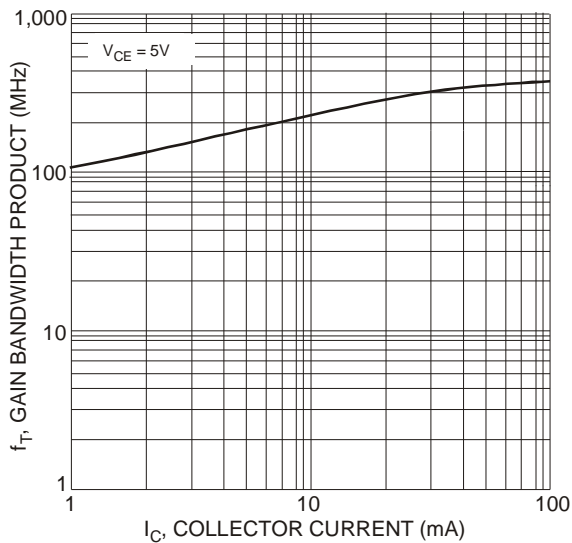


Figure 5 Typical Gain Bandwidth Product vs. Collector Current

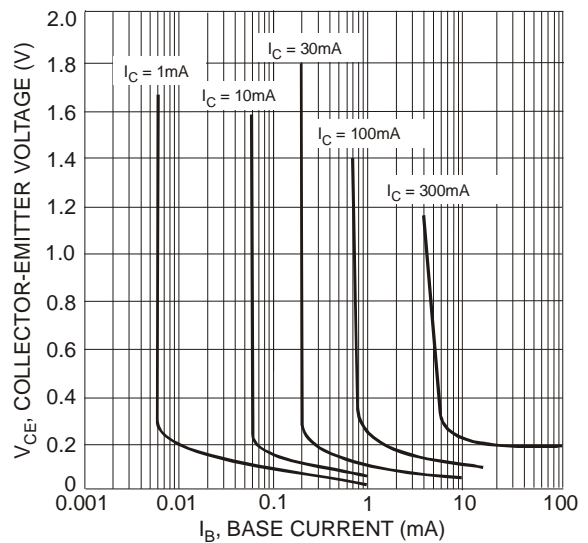
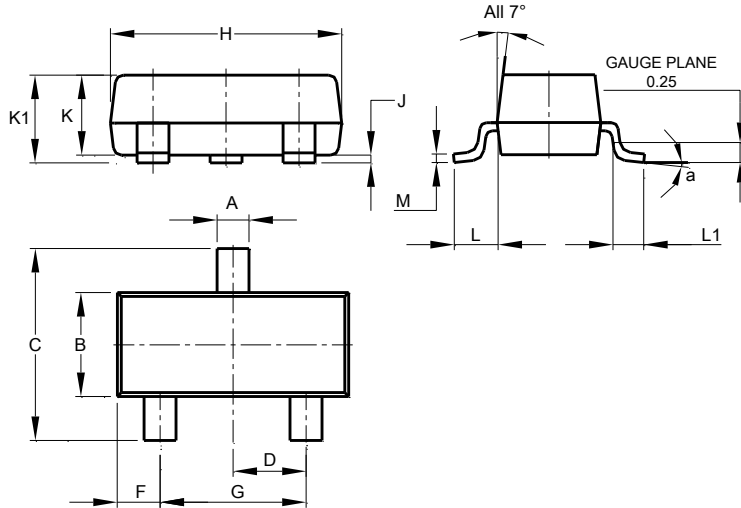


Figure 6 Typical Collector Saturation Region

## Package Outline Dimensions

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

**SOT23**

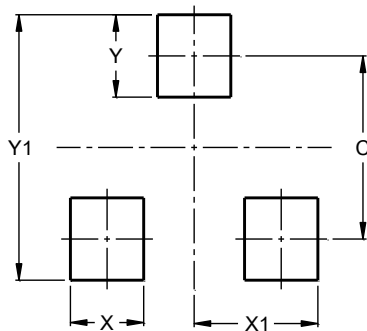


| SOT23                |       |       |       |
|----------------------|-------|-------|-------|
| Dim                  | Min   | Max   | Typ   |
| A                    | 0.37  | 0.51  | 0.40  |
| B                    | 1.20  | 1.40  | 1.30  |
| C                    | 2.30  | 2.50  | 2.40  |
| D                    | 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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