


Features

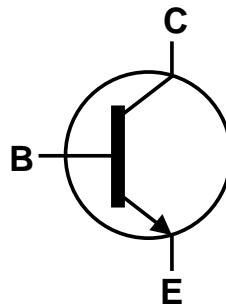
- Epitaxial Planar Die Construction
- Complementary PNP Type Available (MMBT3906)
- Ideal for Medium Power Amplification and Switching
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **Qualified to AEC-Q101 Standards for High Reliability**
- **PPAP Capable (Note 4)**

Mechanical Data

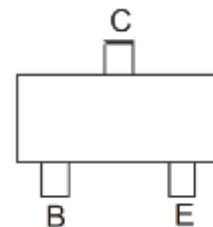
- Case: SOT23
- Case Material: Molded Plastic, "Green" Molding Compound.
UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads. Solderable per
MIL-STD-202, Method 208 
- Weight: 0.008 grams (Approximate)



Top View



Device Symbol

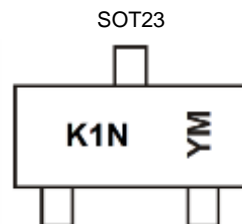

 Top View
Pin-Out

Ordering Information (Notes 4 & 5)

| Product | Status | Compliance | Marking | Reel Size (inches) | Tape Width (mm) | Quantity per Reel |
|----------------|--------|------------|---------|--------------------|-----------------|-------------------|
| MMBT3904-7-F | Active | AEC-Q101 | K1N | 7 | 8 | 3,000 |
| MMBT3904Q-7-F | Active | Automotive | K1N | 7 | 8 | 3,000 |
| MMBT3904Q-13-F | Active | Automotive | K1N | 13 | 8 | 10,000 |
| MMBT3904-13-F | Active | AEC-Q101 | K1N | 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



K1N = Product Type Marking Code
 YM = Date Code Marking
 Y or \bar{Y} = Year (ex: D = 2016)
 M or \bar{M} = Month (ex: 9 = September)

Date Code Key

| Year | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|------|------|------|------|------|------|------|------|------|
| Code | B | C | D | E | F | G | H | I |

| 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 | V |
| Collector Current | I _C | 200 | mA |

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

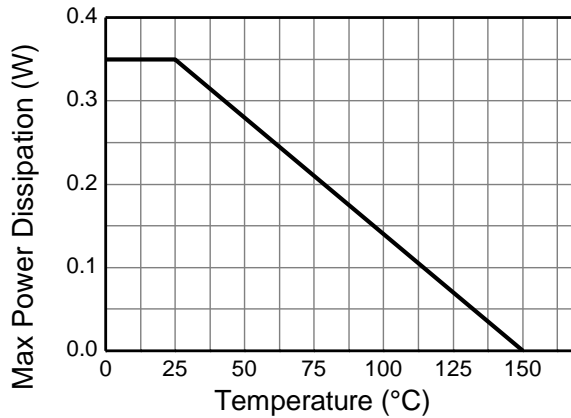
| Characteristic | Symbol | Value | Unit |
|---|-----------------------------------|-------------|------|
| Power Dissipation | P _D | 310 | mW |
| | | 350 | |
| Thermal Resistance, Junction to Ambient | R _{θJA} | 403 | °C/W |
| | | 357 | |
| Thermal Resistance, Junction to Leads | R _{θJL} | 350 |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

ESD Ratings (Note 9)

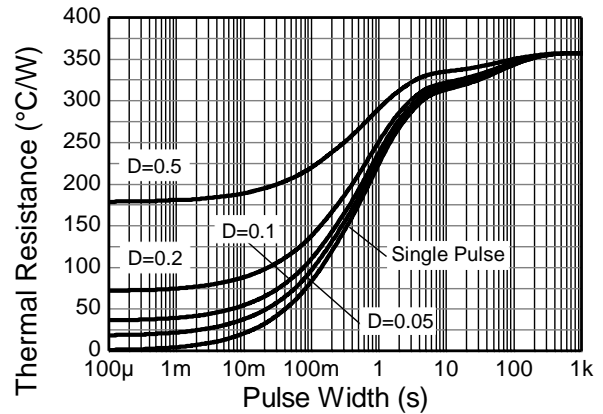
| Characteristic | Symbol | Value | Unit | JEDEC Class |
|--|---------|-------|------|-------------|
| Electrostatic Discharge - Human Body Model | ESD HBM | 4,000 | V | 3A |
| Electrostatic Discharge - Machine Model | ESD MM | 400 | V | C |

- 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.

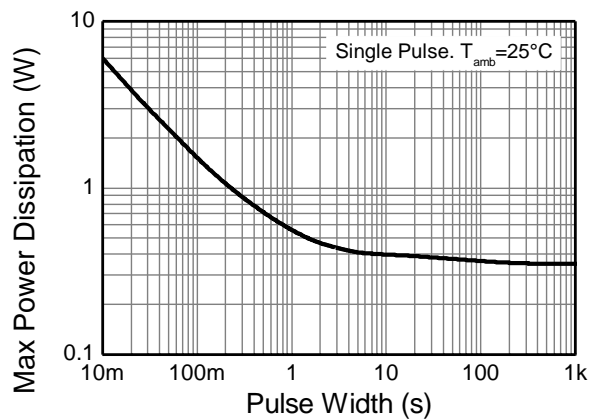
Thermal Characteristics and Derating Information



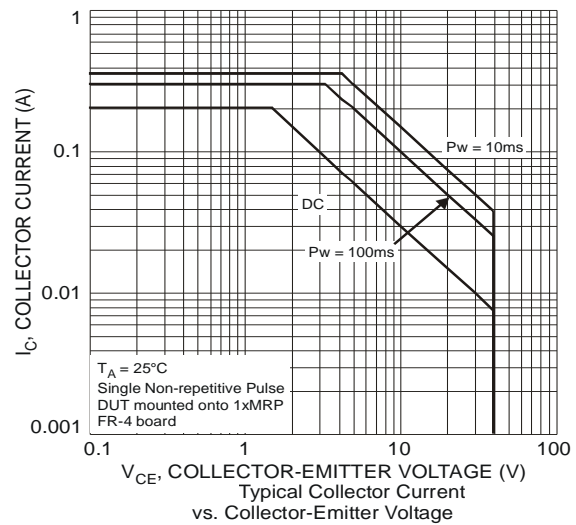
Derating Curve



Transient Thermal Impedance



Pulse Power Dissipation



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 = 10μA, I _E = 0 |
| Collector-Emitter Breakdown Voltage (Note 10) | BV _{CEO} | 40 | — | V | I _C = 10mA, I _B = 0 |
| Emitter-Base Breakdown Voltage | BV _{EBO} | 6.0 | — | V | I _E = 10μA, I _C = 0 |
| Collector Cut-Off Current | I _{CEX} | — | 50 | nA | V _{CE} = 30V, V _{EB(OFF)} = 3.0V |
| Base Cut-Off Current | I _{BL} | — | 50 | nA | V _{CE} = 30V, V _{EB(OFF)} = 3.0V |
| Emitter Base Cut-Off Current | I _{EBO} | — | 50 | nA | V _{EB} = 6V |
| Collector-Base Cut-Off Current | I _{CBO} | — | 50 | nA | V _{CB} = 48V |
| ON CHARACTERISTICS (Note 10) | | | | | |
| DC Current Gain | h _{FE} | 40 70 100 60 30 | — — 300 — — | — | I _C = 100μA, V _{CE} = 1.0V I _C = 1.0mA, V _{CE} = 1.0V I _C = 10mA, V _{CE} = 1.0V I _C = 50mA, V _{CE} = 1.0V I _C = 100mA, V _{CE} = 1.0V |
| Collector-Emitter Saturation Voltage | V _{CE(SAT)} | — | 0.20 0.30 | V | I _C = 10mA, I _B = 1.0mA I _C = 50mA, I _B = 5.0mA |
| Base-Emitter Saturation Voltage | V _{BE(SAT)} | 0.65 — | 0.85 0.95 | V | I _C = 10mA, I _B = 1.0mA I _C = 50mA, I _B = 5.0mA |
| SMALL SIGNAL CHARACTERISTICS | | | | | |
| Output Capacitance | C _{OBO} | — | 4.0 | pF | V _{CB} = 5.0V, f = 1.0MHz, I _E = 0 |
| Input Capacitance | C _{IBO} | — | 8.0 | pF | V _{EB} = 0.5V, f = 1.0MHz, I _C = 0 |
| Input Impedance | h _{IE} | 1.0 | 10 | kΩ | V _{CE} = 10V, I _C = 1.0mA, f = 1.0kHz |
| Voltage Feedback Ratio | h _{RE} | 0.5 | 8.0 | x 10 ⁻⁴ | |
| Small Signal Current Gain | h _{FE} | 100 | 400 | — | |
| Output Admittance | h _{OE} | 1.0 | 40 | μS | |
| Current Gain-Bandwidth Product | f _T | 300 | — | MHz | V _{CE} = 20V, I _C = 10mA, f = 100MHz |
| Noise Figure | NF | — | 5.0 | dB | V _{CE} = 5.0V, I _C = 100μA, R _S = 1.0kΩ, f = 1.0kHz |
| SWITCHING CHARACTERISTICS | | | | | |
| Delay Time | t _D | — | 35 | ns | V _{CC} = 3.0V, I _C = 10mA, |
| Rise Time | t _R | — | 35 | ns | V _{BE(OFF)} = - 0.5V, I _{B1} = 1.0mA |
| Storage Time | t _S | — | 200 | ns | V _{CC} = 3.0V, I _C = 10mA, |
| Fall Time | t _F | — | 50 | ns | I _{B1} = I _{B2} = 1.0mA |

Note: 10. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.

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

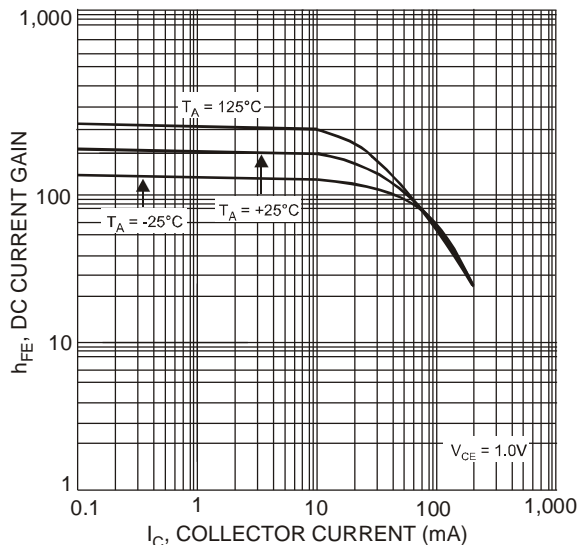


Fig. 1 Typical DC Current Gain vs. Collector Current

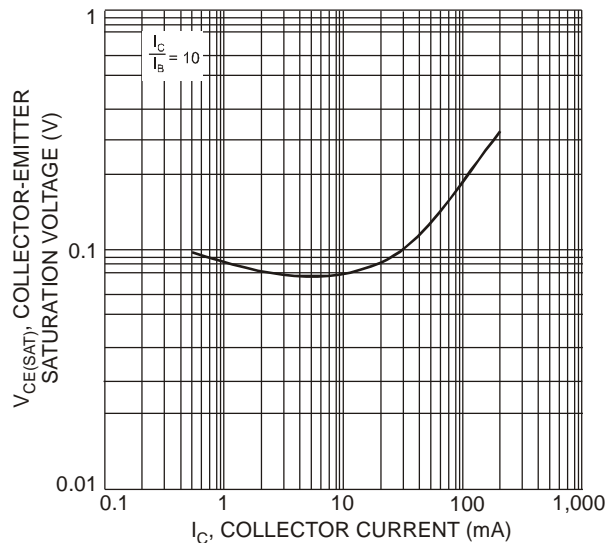


Fig. 2 Typical Collector-Emitter Saturation Voltage vs. Collector Current

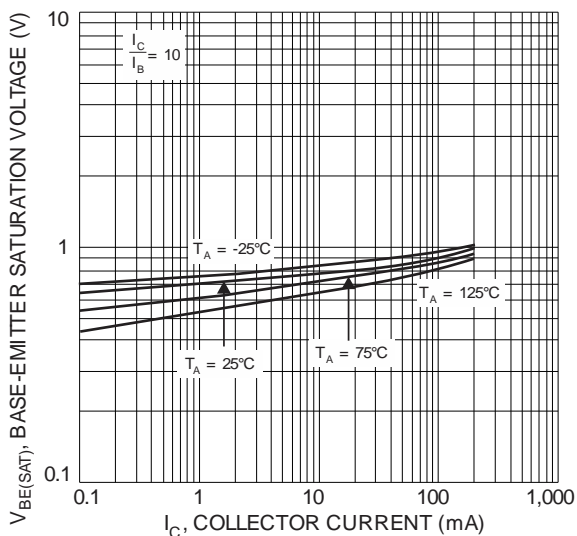


Fig. 3 Typical Base-Emitter Saturation Voltage vs. Collector Current

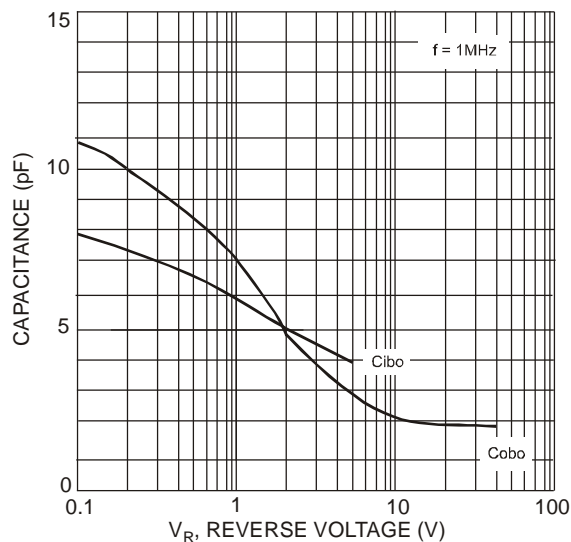
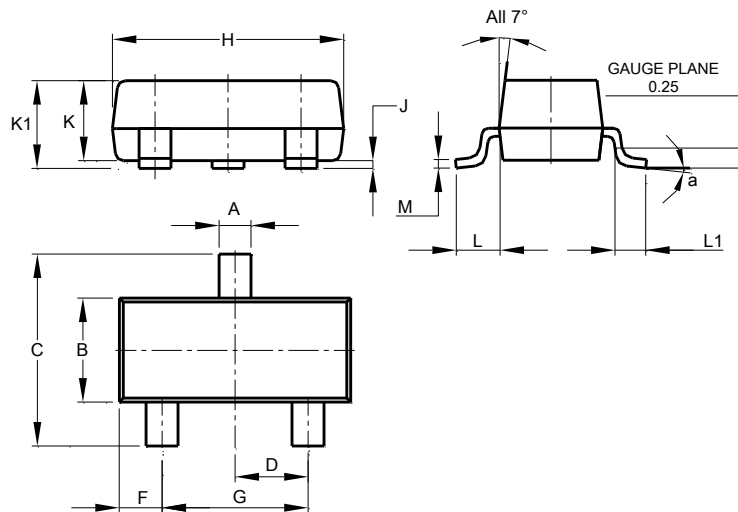


Fig. 4 Typical Capacitance Characteristics

Package Outline Dimensions

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

SOT23

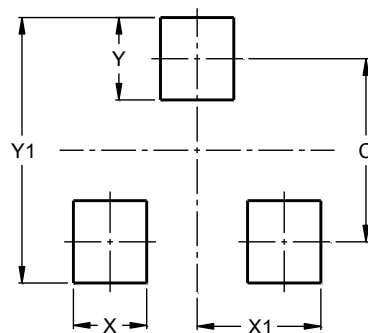


| SOT23 | | | |
|----------------------|-------|-------|-------|
| Dim | Min | Max | Typ |
| A | 0.37 | 0.51 | 0.40 |
| B | 1.20 | 1.40 | 1.30 |
| C | 2.30 | 2.50 | 2.40 |
| D | 0.89 | 1.03 | 0.915 |
| F | 0.45 | 0.60 | 0.535 |
| G | 1.78 | 2.05 | 1.83 |
| H | 2.80 | 3.00 | 2.90 |
| J | 0.013 | 0.10 | 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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