# 40V COMPLEMENTARY NPN-PNP SMALL SIGNAL TRANSISTOR IN SOT363

## Features

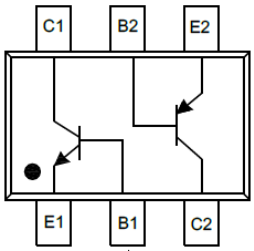
- $BV_{CEO}$ >40V
- $I_C$ = 200mA High Collector Current
- Ultra-Small Surface Mount Package
- Ideal for Low Power Amplification and Switching
- **Totally Lead-Free & Fully RoHS compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **The MMDT3946Q is suitable for automotive applications requiring specific change control; this part is AEC-Q101 qualified, PPAP capable, and manufactured in IATF16949 certified facilities.**
  **https://www.diodes.com/quality/product-definitions/**

## Mechanical Data

- Package: SOT363
- Package Material: Molded Plastic, "Green" Molding Compound;
- UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Finish; Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.006 grams (Approximate)

SOT363

Top View




E2, B2, C2 = PNP
E1, B1, C1 = NPN

Device Schematic and Pinout
Top View

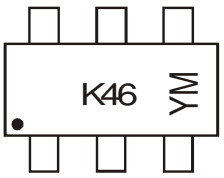
## Ordering Information (Note 4)

| Product | Compliance | Marking | Reel size (inches) | Tape width (mm) | Quantity per reel |
|---|---|---|---|---|---|
| MMDT3946Q-7R | Automotive | K46 | 7 | 8 | 3,000 |

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

SOT363




K46 = Product Type Marking Code
YM = Date Code Marking
Y or $\overline{Y}$ = Year (ex: I = 2021)
M or $\overline{M}$ = Month (ex: 9 = September)

Date Code Key

| Year | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | I | J | K | L | M | N | O | P | R | S | T | U |

| 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, NPN (@ $T_A$ = +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 |

## Absolute Maximum Ratings, PNP (@ $T_A$ = +25°C unless otherwise specified.)

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Base Voltage | $V_{CBO}$ | -40 | V |
| Collector-Emitter Voltage | $V_{CEO}$ | -40 | V |
| Emitter-Base Voltage | $V_{EBO}$ | -5 | V |
| Collector Current | $I_C$ | -200 | mA |

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

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Power Dissipation (Note 5) | $P_D$ | 200 | mW |
| Thermal Resistance, Junction to Ambient Air (Note 5) | $R_{\theta JA}$ | 625 | °C/W |
| Operating and Storage Temperature Range | $T_J$, $T_{STG}$ | -55 to +150 | °C |

Note: 5. For a device mounted on minimum recommended pad layout with 1oz copper that is on a single-sided 1.6mm FR4 PCB; the device is measured under still air conditions whilst operating in a steady-state.

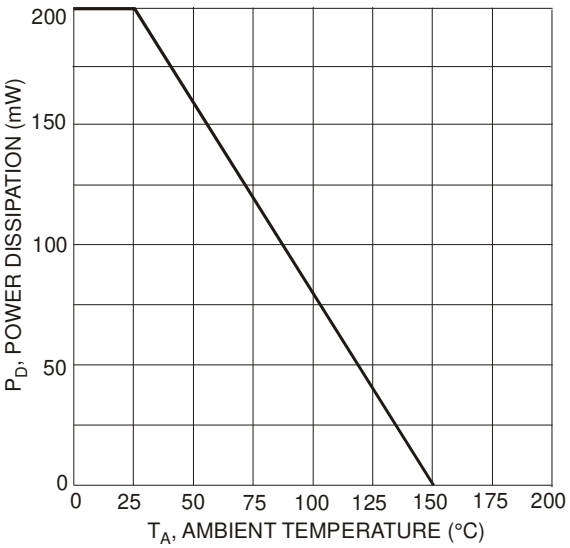


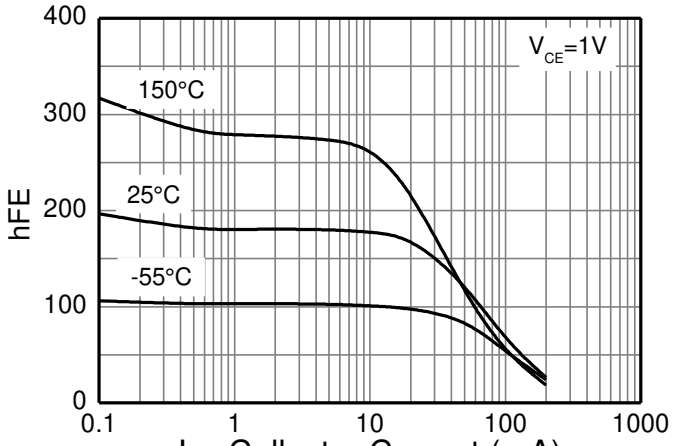

Fig. 1, Power Dissipation vs. Ambient Temperature (Total Device)

## Electrical Characteristics, NPN (@ $T_A$ = +25°C unless otherwise specified.)

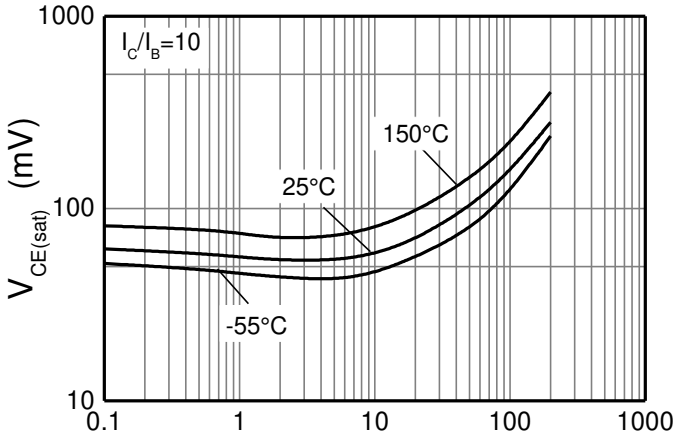
| Characteristic | Symbol | Min | Max | Unit | Test Condition |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 6)** | | | | | |
| Collector-Base Breakdown Voltage | $BV_{CBO}$ | 60 | — | V | $I_C$ = 10µA, $I_E$ = 0 |
| Collector-Emitter Breakdown Voltage | $BV_{CEO}$ | 40 | — | V | $I_C$ = 1mA, $I_B$ = 0 |
| Emitter-Base Breakdown Voltage | $BV_{EBO}$ | 6 | — | V | $I_E$ = 10µA, $I_C$ = 0 |
| Collector Cutoff Current | $I_{CEX}$ | — | 50 | nA | $V_{CE}$ = 30V, $V_{EB(OFF)}$ = 3V |
| Base Cutoff Current | $I_{BL}$ | — | 50 | nA | $V_{CE}$ = 30V, $V_{EB(OFF)}$ = 3V |
| **ON CHARACTERISTICS (Note 6)** | | | | | |
| Static Forward Current Transfer Ratio | $h_{FE}$ | 40<br>70<br>100<br>60<br>30 | —<br>—<br>300<br>—<br>— | — | $I_C$ = 100µA, $V_{CE}$ = 1V<br>$I_C$ = 1mA, $V_{CE}$ = 1V<br>$I_C$ = 10mA, $V_{CE}$ = 1V<br>$I_C$ = 50mA, $V_{CE}$ = 1V<br>$I_C$ = 100mA, $V_{CE}$ = 1V |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | — | 0.20<br>0.30 | V | $I_C$ = 10mA, $I_B$ = 1mA<br>$I_C$ = 50mA, $I_B$ = 5mA |
| Base-Emitter Saturation Voltage | $V_{BE(sat)}$ | 0.65<br>— | 0.85<br>0.95 | V | $I_C$ = 10mA, $I_B$ = 1mA<br>$I_C$ = 50mA, $I_B$ = 5mA |
| **SMALL SIGNAL CHARACTERISTICS** | | | | | |
| Output Capacitance | $C_{obo}$ | — | 4 | pF | $V_{CB}$ = 5V, f = 1MHz, $I_E$ = 0 |
| Input Capacitance | $C_{ibo}$ | — | 8 | pF | $V_{EB}$ = 0.5V, f = 1MHz, $I_C$ = 0 |
| Input Impedance | $h_{ie}$ | 1 | 10 | kΩ | $V_{CE}$ = 10V, $I_C$ = 1mA, f = 1kHz |
| Voltage Feedback Ratio | $h_{re}$ | 0.5 | 8 | x $10^{-4}$ | |
| Small Signal Current Gain | $h_{fe}$ | 100 | 400 | — | |
| Output Admittance | $h_{oe}$ | 1 | 40 | µS | |
| Current Gain-Bandwidth Product | $f_T$ | 300 | — | MHz | $V_{CE}$ = 20V, $I_C$ = 20mA, f = 100MHz |
| Noise Figure | NF | — | 5.0 | dB | $V_{CE}$ = 5V, $I_C$ = 100µA, $R_S$ = 1kΩ, f = 1kHz |
| **SWITCHING CHARACTERISTICS** | | | | | |
| Delay Time | $t_d$ | — | 35 | ns | $V_{CC}$ = 3V, $I_C$ = 10mA, $V_{BE(off)}$ = 0.5V, $I_{B1}$ = 1mA |
| Rise Time | $t_r$ | — | 35 | ns | |
| Storage Time | $t_s$ | — | 200 | ns | $V_{CC}$ = 3V, $I_C$ = 10mA, $I_{B1}$ = -$I_{B2}$ = 1mA |
| Fall Time | $t_f$ | — | 50 | ns | |

Note: 6. Measured under pulsed conditions. Pulse width ≤ 300µs. Duty cycle ≤ 2%

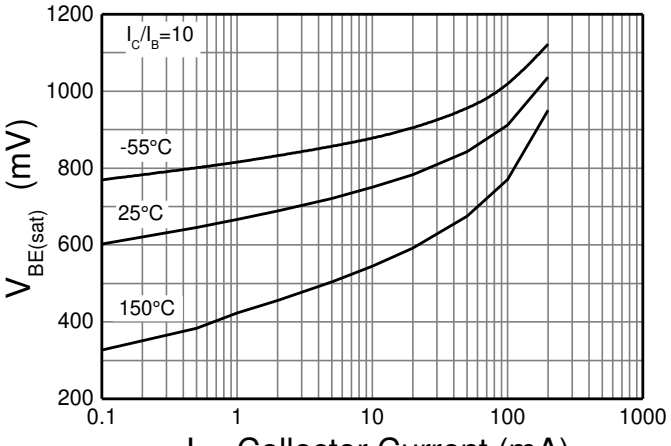
## Typical Electrical Characteristics, NPN (@ $T_A$ = +25°C unless otherwise specified.)



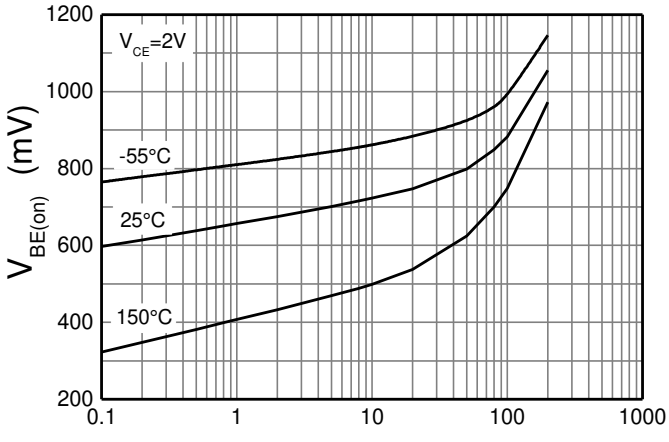

**$h_{FE}$ v $I_C$**



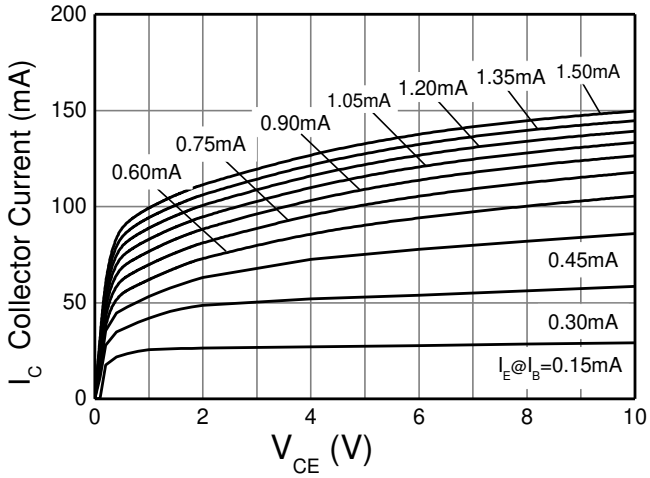

**$V_{CE(sat)}$ v $I_C$**



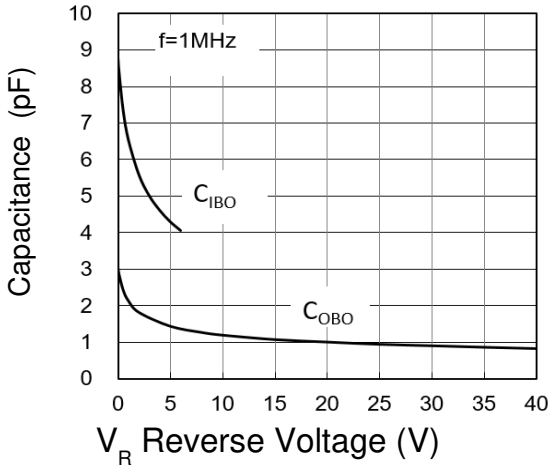

**$V_{BE(sat)}$ v $I_C$**




**$V_{BE(on)}$ v $I_C$**




**$I_C$ v $V_{CE}$**



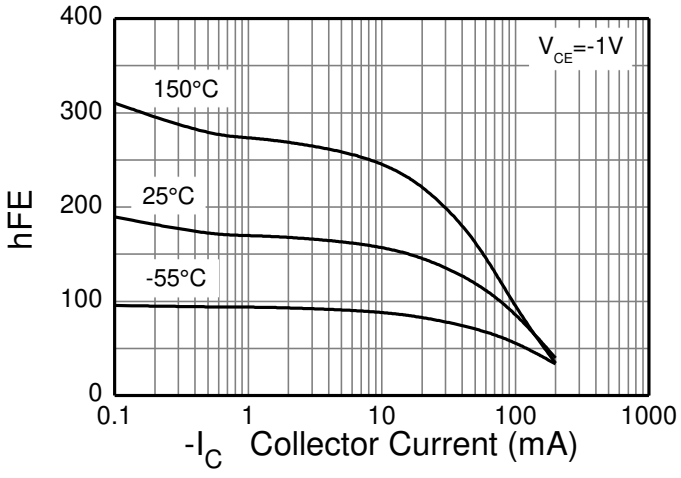

**Capacitance v $V_R$**

## Electrical Characteristics, PNP (@ $T_A$ = +25°C unless otherwise specified.)

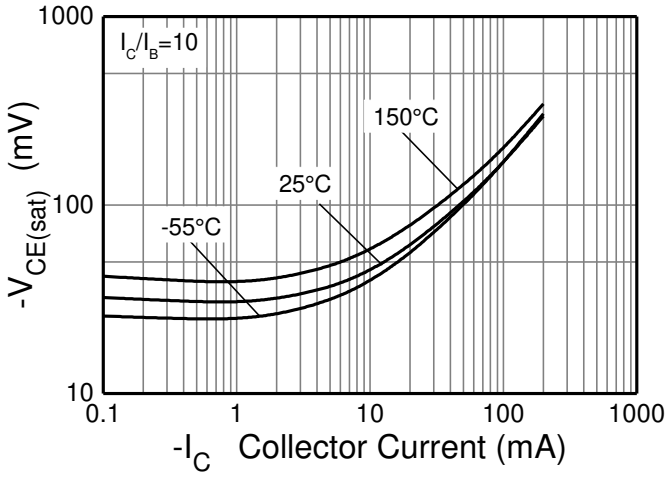
| Characteristic | Symbol | Min | Max | Unit | Test Condition |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 6)** | | | | | |
| Collector-Base Breakdown Voltage | $BV_{CBO}$ | -40 | — | V | $I_C$ = -10μA, $I_E$ = 0 |
| Collector-Emitter Breakdown Voltage | $BV_{CEO}$ | -40 | — | V | $I_C$ = -1mA, $I_B$ = 0 |
| Emitter-Base Breakdown Voltage | $BV_{EBO}$ | -5 | — | V | $I_E$ = -10μA, $I_C$ = 0 |
| Collector Cutoff Current | $I_{CEX}$ | — | -50 | nA | $V_{CE}$ = -30V, $V_{EB(OFF)}$ = -3V |
| Base Cutoff Current | $I_{BL}$ | — | -50 | nA | $V_{CE}$ = -30V, $V_{EB(OFF)}$ = -3V |
| **ON CHARACTERISTICS (Note 6)** | | | | | |
| Static Forward Current Transfer Ratio | $h_{FE}$ | 60<br>80<br>100<br>60<br>30 | —<br>—<br>300<br>—<br>— | — | $I_C$ = -100μA, $V_{CE}$ = -1V<br>$I_C$ = -1mA, $V_{CE}$ = -1V<br>$I_C$ = -10mA, $V_{CE}$ = -1V<br>$I_C$ = -50mA, $V_{CE}$ = -1V<br>$I_C$ = -100mA, $V_{CE}$ = -1V |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | — | -0.25<br>-0.40 | V | $I_C$ = -10mA, $I_B$ = -1mA<br>$I_C$ = -50mA, $I_B$ = -5mA |
| Base-Emitter Saturation Voltage | $V_{BE(sat)}$ | -0.65<br>— | -0.85<br>-0.95 | V | $I_C$ = -10mA, $I_B$ = -1mA<br>$I_C$ = -50mA, $I_B$ = -5mA |
| **SMALL SIGNAL CHARACTERISTICS** | | | | | |
| Output Capacitance | $C_{obo}$ | — | 4.5 | pF | $V_{CB}$ = -5V, f = 1MHz, $I_E$ = 0 |
| Input Capacitance | $C_{ibo}$ | — | 10 | pF | $V_{EB}$ = -0.5V, f = 1MHz, $I_C$ = 0 |
| Input Impedance | $h_{ie}$ | 2 | 12 | kΩ | $V_{CE}$ = -10V, $I_C$ = -1mA, f = 1kHz |
| Voltage Feedback Ratio | $h_{re}$ | 0.1 | 10 | x $10^{-4}$ | |
| Small Signal Current Gain | $h_{fe}$ | 100 | 400 | — | |
| Output Admittance | $h_{oe}$ | 3 | 60 | μS | |
| Current Gain-Bandwidth Product | $f_T$ | 250 | — | MHz | $V_{CE}$ = -20V, $I_C$ = -10mA, f = 100MHz |
| Noise Figure | NF | — | 4 | dB | $V_{CE}$ = -5V, $I_C$ = -100μA, $R_S$ = 1kΩ, f = 1kHz |
| **SWITCHING CHARACTERISTICS** | | | | | |
| Delay Time | $t_d$ | — | 35 | ns | $V_{CC}$ = -3V, $I_C$ = -10mA, $V_{BE(off)}$ = -0.5V, $I_{B1}$ = -1mA |
| Rise Time | $t_r$ | — | 35 | ns | |
| Storage Time | $t_s$ | — | 225 | ns | $V_{CC}$ = -3V, $I_C$ = -10mA, $I_{B1}$ = $-I_{B2}$ = -1mA |
| Fall Time | $t_f$ | — | 75 | ns | |

Note: 6. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%

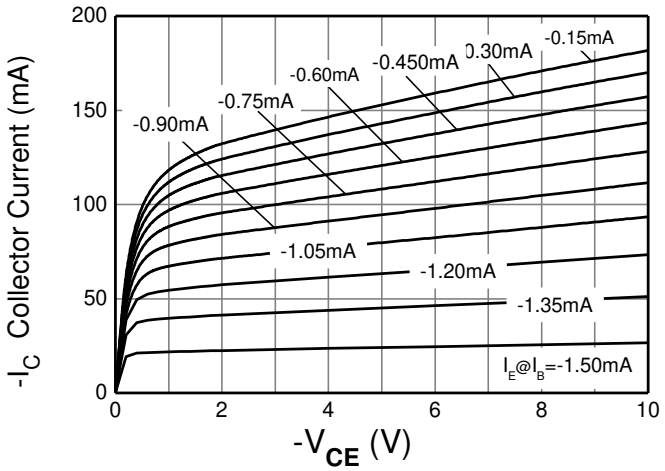
## Typical Electrical Characteristics, PNP (@ $T_A$ = +25°C unless otherwise specified.)



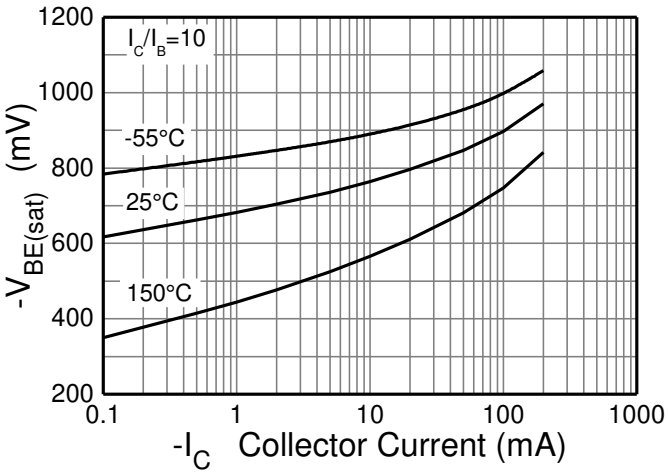

**$h_{FE}$ v $I_C$**



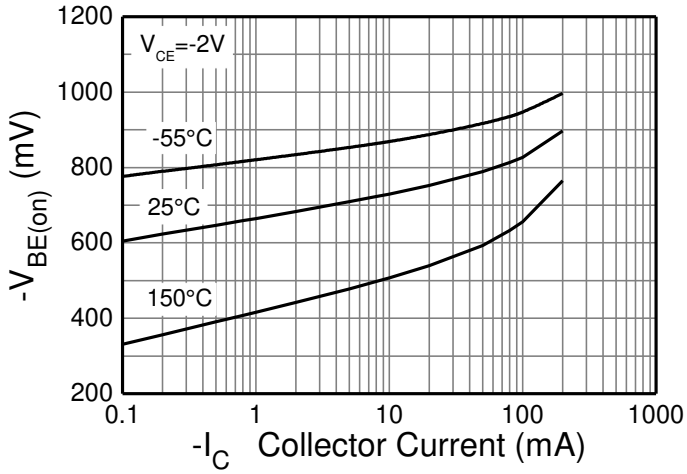

**$V_{CE(sat)}$ v $I_C$**



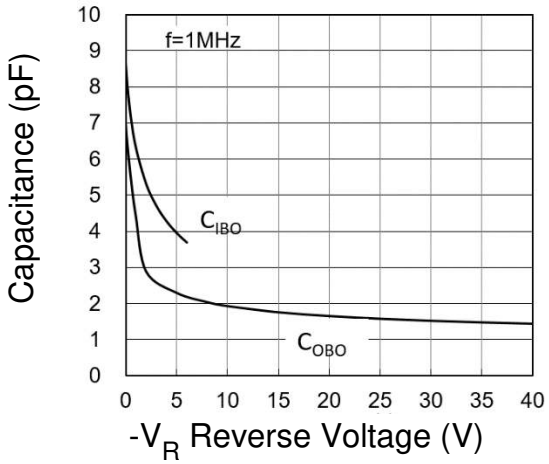

**$I_C$ v $V_{CE}$**




**$V_{BE(sat)}$ v $I_C$**



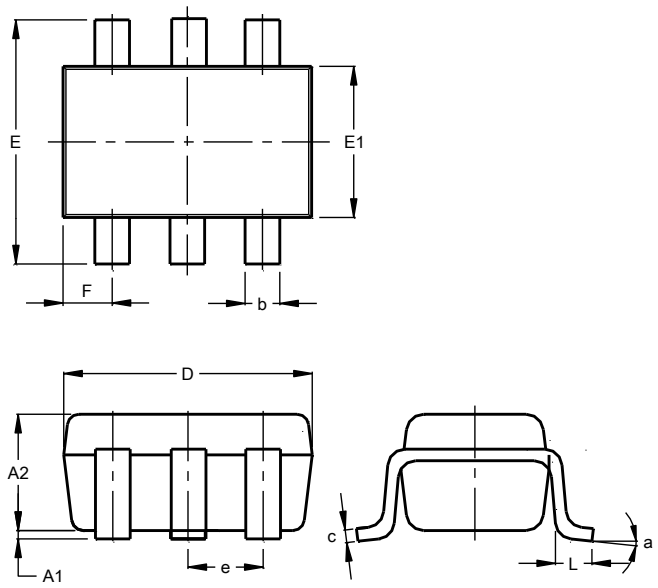

**$V_{BE(on)}$ v $I_C$**




**Capacitance v $V_R$**

## Package Outline Dimensions

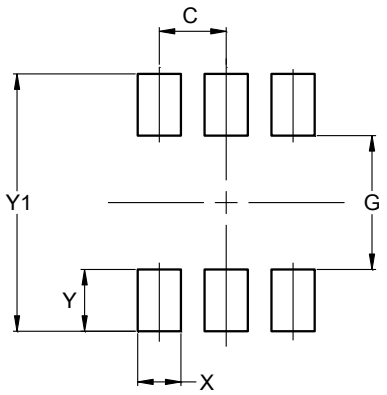
Please see http://www.diodes.com/package-outlines.html for the latest version.




| SOT363 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A1** | 0.00 | 0.10 | 0.05 |
| **A2** | 0.90 | 1.00 | 1.00 |
| **b** | 0.10 | 0.30 | 0.25 |
| **c** | 0.10 | 0.22 | 0.11 |
| **D** | 1.80 | 2.20 | 2.15 |
| **E** | 2.00 | 2.20 | 2.10 |
| **E1** | 1.15 | 1.35 | 1.30 |
| **e** | 0.650 BSC | | |
| **F** | 0.40 | 0.45 | 0.425 |
| **L** | 0.25 | 0.40 | 0.30 |
| **a** | 0° | 8° | -- |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

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




| Dimensions | Value (in mm) |
|---|---|
| **C** | 0.650 |
| **G** | 1.300 |
| **X** | 0.420 |
| **Y** | 0.600 |
| **Y1** | 2.500 |

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