

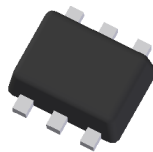
## Features

- $BV_{CEO} > 40V$
- $I_C = 200mA$  Collector Current
- SOT963 Ultra Small Package of  $1mm^2$  Footprint
- Epitaxial Planar Die Construction
- Ideally Suited for Automated Assembly Processes
- **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**

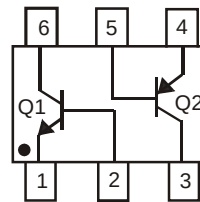
## Mechanical Data

- Case: SOT963
- 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(3)
- Weight: 0.0027 grams (Approximate)

SOT963



Top View



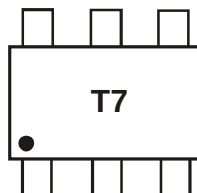
Top View  
Device Schematic  
and Pin-Out

## Ordering Information (Note 4)

| Product       | Marking | Reel Size (inches) | Tape Width (mm) | Quantity per Reel |
|---------------|---------|--------------------|-----------------|-------------------|
| DST3946DPJ-7  | T7      | 7                  | 8               | 10,000            |
| DST3946DPJ-7B | T7      | 7                  | 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](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. For packaging details, go to our website at <http://www.diodes.com/products/packages.html>.

## Marking Information



T7 = Product Type Marking Code

**Absolute Maximum Ratings - NPN (Q1)** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic            | Symbol           | Value | Unit |
|---------------------------|------------------|-------|------|
| Collector-Base Voltage    | V <sub>CBO</sub> | 60    | V    |
| Collector-Emitter Voltage | V <sub>CEO</sub> | 40    | V    |
| Emitter-Base Voltage      | V <sub>EBO</sub> | 6.0   | V    |
| Collector Current         | I <sub>C</sub>   | 200   | mA   |

**Absolute Maximum Ratings - PNP (Q2)** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic            | Symbol           | Value | Unit |
|---------------------------|------------------|-------|------|
| Collector-Base Voltage    | V <sub>CBO</sub> | -40   | V    |
| Collector-Emitter Voltage | V <sub>CEO</sub> | -40   | V    |
| Emitter-Base Voltage      | V <sub>EBO</sub> | -5.0  | V    |
| Collector Current         | I <sub>C</sub>   | -200  | mA   |

**Thermal Characteristics**

| Characteristic                                   | Symbol                            | Value       | Unit |
|--------------------------------------------------|-----------------------------------|-------------|------|
| Power Dissipation (Note 5)                       | P <sub>D</sub>                    | 300         | mW   |
| Thermal Resistance, Junction to Ambient (Note 5) | R <sub>θJA</sub>                  | 417         | °C/W |
| Operating and Storage Temperature Range          | T <sub>J</sub> , T <sub>STG</sub> | -55 to +150 | °C   |

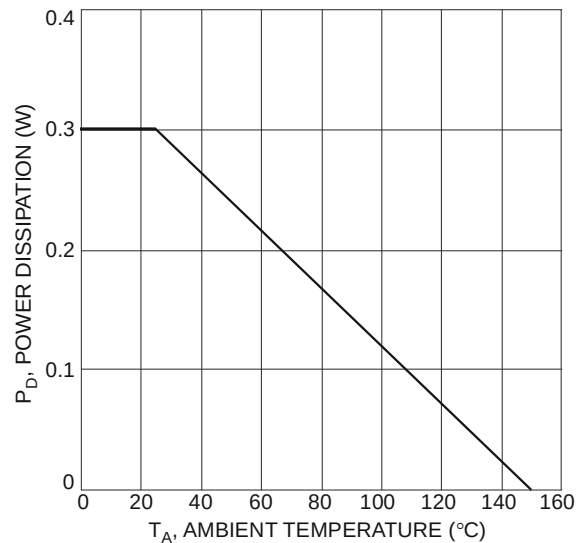
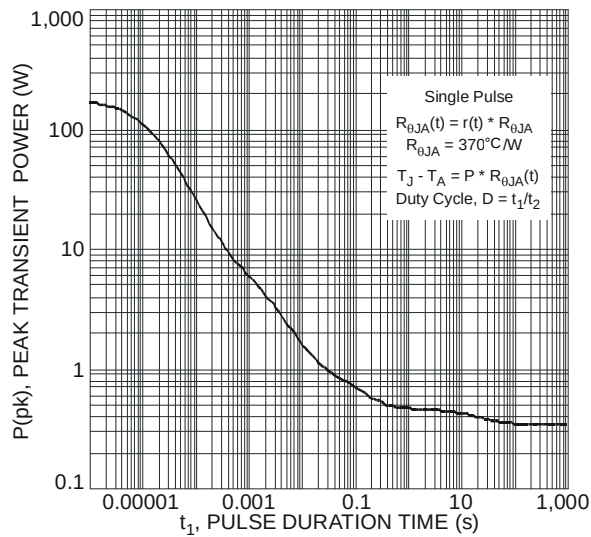
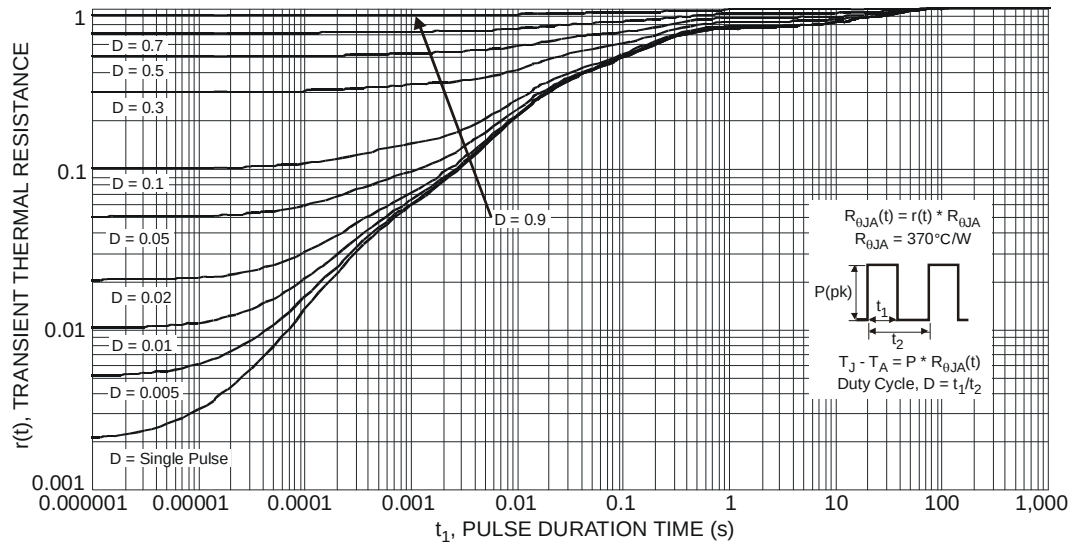
Note: 5. Device mounted on FR-4 PCB with minimum recommended pad layout.

**ESD Rating** (Note 6)

| Characteristic                             | Symbol  | Value | Unit | JEDEC Class |
|--------------------------------------------|---------|-------|------|-------------|
| Electrostatic Discharge - Human Body Model | ESD HBM | 4,000 | V    | 3A          |
| Electrostatic Discharge - Machine Model    | ESD MM  | 200   | V    | B           |

Note: 6. Refer to JEDEC specification JESD22-A114 and JESD22-A115.

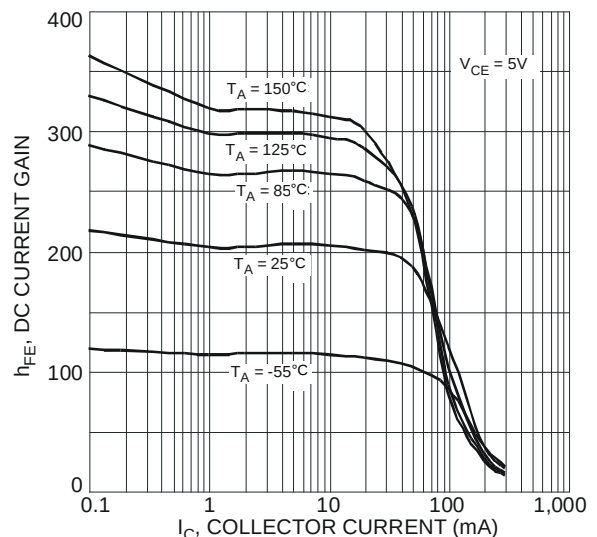
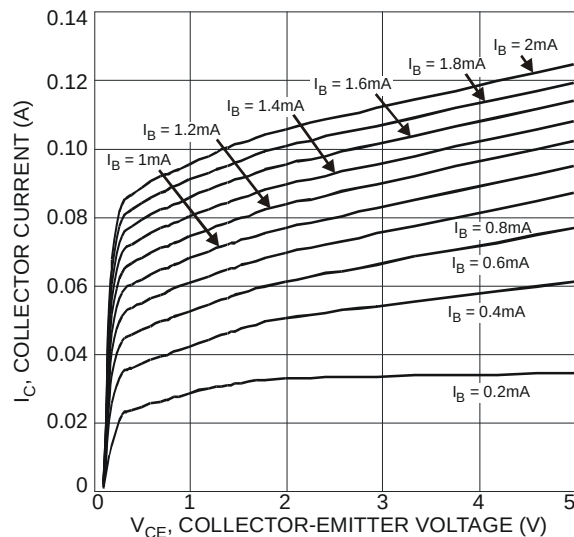
## Thermal Characteristics and Derating Information

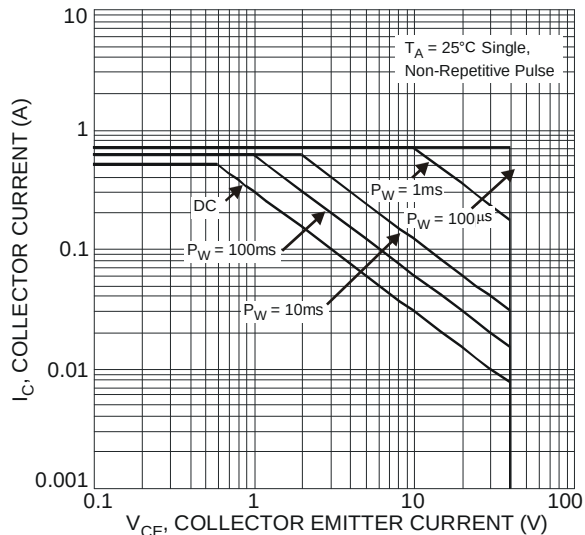
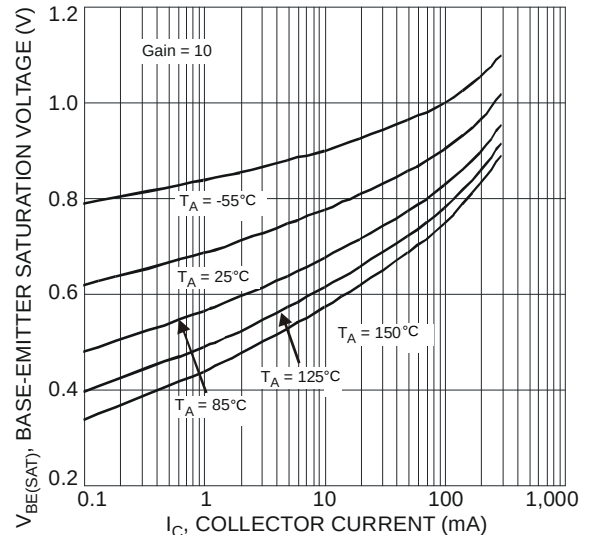
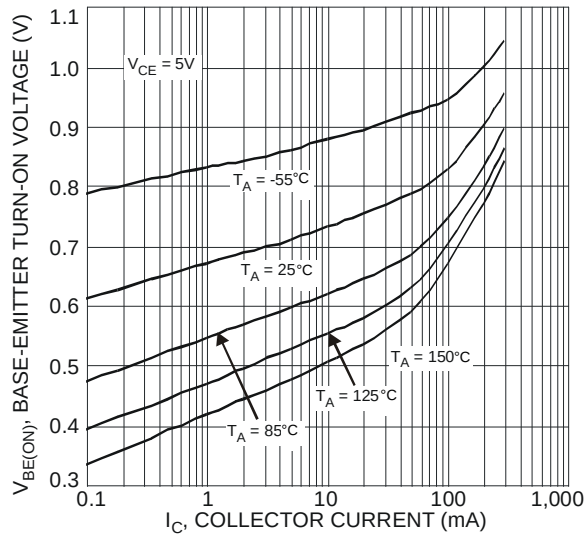
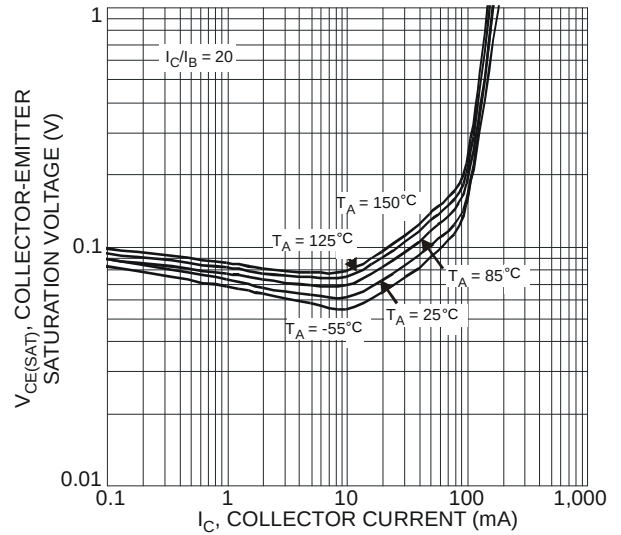
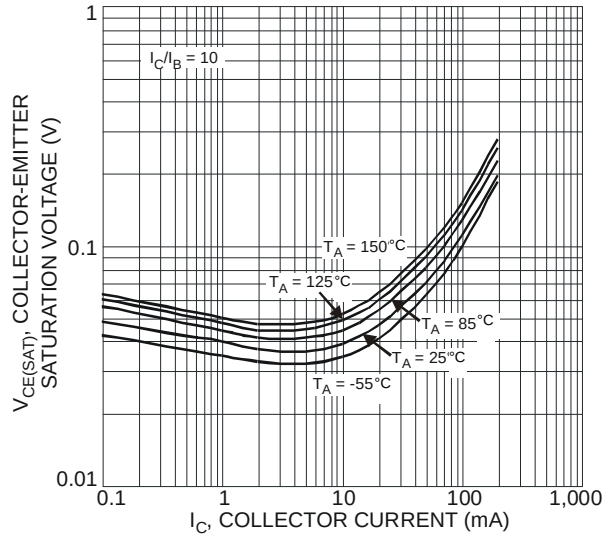


**Electrical Characteristics - NPN (Q1)** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic                               | Symbol               | Min                         | Max                     | Unit               | Test Condition                                                                                                                                                                                                                                       |
|----------------------------------------------|----------------------|-----------------------------|-------------------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>OFF CHARACTERISTICS (Note 7)</b>          |                      |                             |                         |                    |                                                                                                                                                                                                                                                      |
| Collector-Base Breakdown Voltage             | BV <sub>CBO</sub>    | 60                          | —                       | V                  | I <sub>C</sub> = 10μA, I <sub>E</sub> = 0                                                                                                                                                                                                            |
| Collector-Emitter Breakdown Voltage (Note 7) | 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> = 10μA, I <sub>C</sub> = 0                                                                                                                                                                                                            |
| Collector Cutoff Current                     | I <sub>CEX</sub>     | —                           | 50                      | nA                 | V <sub>CE</sub> = 30V, V <sub>EB(OFF)</sub> = 3.0V                                                                                                                                                                                                   |
| Base Cutoff Current                          | I <sub>BL</sub>      | —                           | 50                      | nA                 | V <sub>CE</sub> = 30V, V <sub>EB(OFF)</sub> = 3.0V                                                                                                                                                                                                   |
| <b>ON CHARACTERISTICS (Note 7)</b>           |                      |                             |                         |                    |                                                                                                                                                                                                                                                      |
| DC Current Gain                              | h <sub>FE</sub>      | 40<br>70<br>100<br>60<br>30 | —<br>—<br>300<br>—<br>— | —                  | I <sub>C</sub> = 100μA, V <sub>CE</sub> = 1.0V<br>I <sub>C</sub> = 1.0mA, V <sub>CE</sub> = 1.0V<br>I <sub>C</sub> = 10mA, V <sub>CE</sub> = 1.0V<br>I <sub>C</sub> = 50mA, V <sub>CE</sub> = 1.0V<br>I <sub>C</sub> = 100mA, V <sub>CE</sub> = 1.0V |
| Collector-Emitter Saturation Voltage         | V <sub>CE(SAT)</sub> | —                           | 0.20<br>0.30            | V                  | I <sub>C</sub> = 10mA, I <sub>B</sub> = 1.0mA<br>I <sub>C</sub> = 50mA, I <sub>B</sub> = 5.0mA                                                                                                                                                       |
| Base-Emitter Saturation Voltage              | V <sub>BE(SAT)</sub> | 0.65<br>—                   | 0.85<br>0.95            | V                  | I <sub>C</sub> = 10mA, I <sub>B</sub> = 1.0mA<br>I <sub>C</sub> = 50mA, I <sub>B</sub> = 5.0mA                                                                                                                                                       |
| <b>SMALL SIGNAL CHARACTERISTICS</b>          |                      |                             |                         |                    |                                                                                                                                                                                                                                                      |
| Output Capacitance                           | C <sub>OBO</sub>     | —                           | 4.0                     | pF                 | V <sub>CB</sub> = 5.0V, f = 1.0MHz, I <sub>E</sub> = 0                                                                                                                                                                                               |
| Input Capacitance                            | C <sub>IBO</sub>     | —                           | 8.5                     | pF                 | V <sub>EB</sub> = 0.5V, f = 1.0MHz, I <sub>C</sub> = 0                                                                                                                                                                                               |
| Input Impedance                              | h <sub>IE</sub>      | 1.0                         | 10                      | kΩ                 | V <sub>CE</sub> = 10V, I <sub>C</sub> = 1.0mA,<br>f = 1.0kHz                                                                                                                                                                                         |
| Voltage Feedback Ratio                       | h <sub>RE</sub>      | 0.5                         | 8.0                     | x 10 <sup>-4</sup> |                                                                                                                                                                                                                                                      |
| Small Signal Current Gain                    | h <sub>FE</sub>      | 100                         | 400                     | —                  |                                                                                                                                                                                                                                                      |
| Output Admittance                            | h <sub>OE</sub>      | 1.0                         | 40                      | μS                 |                                                                                                                                                                                                                                                      |
| Current Gain-Bandwidth Product               | f <sub>T</sub>       | 300                         | —                       | MHz                | V <sub>CE</sub> = 20V, I <sub>C</sub> = 10mA,<br>f = 100MHz                                                                                                                                                                                          |
| <b>SWITCHING CHARACTERISTICS</b>             |                      |                             |                         |                    |                                                                                                                                                                                                                                                      |
| Delay Time                                   | t <sub>D</sub>       | —                           | 35                      | ns                 | V <sub>CC</sub> = 3.0V, I <sub>C</sub> = 10mA,                                                                                                                                                                                                       |
| Rise Time                                    | t <sub>R</sub>       | —                           | 35                      | ns                 | V <sub>BE(OFF)</sub> = -0.5V, I <sub>B1</sub> = 1.0mA                                                                                                                                                                                                |
| Storage Time                                 | t <sub>S</sub>       | —                           | 200                     | ns                 | V <sub>CC</sub> = 3.0V, I <sub>C</sub> = 10mA,                                                                                                                                                                                                       |
| Fall Time                                    | t <sub>F</sub>       | —                           | 50                      | ns                 | I <sub>B1</sub> = -I <sub>B2</sub> = 1.0mA                                                                                                                                                                                                           |

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





**Electrical Characteristics - PNP (Q2)** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic                               | Symbol               | Min        | Max            | Unit               | Test Condition                                                                                            |
|----------------------------------------------|----------------------|------------|----------------|--------------------|-----------------------------------------------------------------------------------------------------------|
| OFF CHARACTERISTICS                          |                      |            |                |                    |                                                                                                           |
| Collector-Base Breakdown Voltage             | BV <sub>CBO</sub>    | -40        | —              | V                  | I <sub>C</sub> = -10μA, I <sub>E</sub> = 0                                                                |
| Collector-Emitter Breakdown Voltage (Note 8) | 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>    | -5.0       | —              | V                  | I <sub>E</sub> = -10μA, I <sub>C</sub> = 0                                                                |
| Collector Cutoff Current                     | I <sub>CEX</sub>     | —          | -50            | nA                 | V <sub>CE</sub> = -30V, V <sub>EB(OFF)</sub> = -3.0V                                                      |
|                                              | I <sub>CBO</sub>     | —          | -50            | nA                 | V <sub>CE</sub> = -30V, I <sub>E</sub> = 0                                                                |
| Base Cutoff Current                          | I <sub>BL</sub>      | —          | -50            | nA                 | V <sub>CE</sub> = -30V, V <sub>EB(OFF)</sub> = -3.0V                                                      |
| ON CHARACTERISTICS (Note 8)                  |                      |            |                |                    |                                                                                                           |
| DC Current Gain                              | h <sub>FE</sub>      | 60         | —              | —                  | I <sub>C</sub> = -100μA, V <sub>CE</sub> = -1.0V                                                          |
|                                              |                      | 80         | —              |                    | I <sub>C</sub> = -1.0mA, V <sub>CE</sub> = -1.0V                                                          |
|                                              |                      | 100        | 300            |                    | I <sub>C</sub> = -10mA, V <sub>CE</sub> = -1.0V                                                           |
|                                              |                      | 60         | —              |                    | I <sub>C</sub> = -50mA, V <sub>CE</sub> = -1.0V                                                           |
|                                              |                      | 30         | —              |                    | I <sub>C</sub> = -100mA, V <sub>CE</sub> = -1.0V                                                          |
| Collector-Emitter Saturation Voltage         | V <sub>CE(SAT)</sub> | —          | -0.25<br>-0.40 | V                  | I <sub>C</sub> = -10mA, I <sub>B</sub> = -1.0mA<br>I <sub>C</sub> = -50mA, I <sub>B</sub> = -5.0mA        |
| Base-Emitter Saturation Voltage              | V <sub>BE(SAT)</sub> | -0.65<br>— | -0.85<br>-0.95 | V                  | I <sub>C</sub> = -10mA, I <sub>B</sub> = -1.0mA<br>I <sub>C</sub> = -50mA, I <sub>B</sub> = -5.0mA        |
| SMALL SIGNAL CHARACTERISTICS                 |                      |            |                |                    |                                                                                                           |
| Output Capacitance                           | C <sub>OBO</sub>     | —          | 4.5            | pF                 | V <sub>CB</sub> = -5.0V, f = 1.0MHz, I <sub>E</sub> = 0                                                   |
| Input Capacitance                            | C <sub>IBO</sub>     | —          | 10             | pF                 | V <sub>EB</sub> = -0.5V, f = 1.0MHz, I <sub>C</sub> = 0                                                   |
| Input Impedance                              | h <sub>IE</sub>      | 2.0        | 12             | kΩ                 | V <sub>CE</sub> = -10V, I <sub>C</sub> = -1.0mA,<br>f = 1.0kHz                                            |
| Voltage Feedback Ratio                       | h <sub>RE</sub>      | 0.1        | 10             | × 10 <sup>-4</sup> |                                                                                                           |
| Small Signal Current Gain                    | h <sub>FE</sub>      | 100        | 400            | —                  |                                                                                                           |
| Output Admittance                            | h <sub>OE</sub>      | 3.0        | 60             | μs                 |                                                                                                           |
| Current Gain-Bandwidth Product               | f <sub>T</sub>       | 300        | —              | MHz                | V <sub>CE</sub> = -20V, I <sub>C</sub> = -10mA,<br>f = 100MHz                                             |
| SWITCHING CHARACTERISTICS                    |                      |            |                |                    |                                                                                                           |
| Delay Time                                   | t <sub>D</sub>       | —          | 35             | ns                 | V <sub>CC</sub> = -3.0V, I <sub>C</sub> = -10mA,<br>V <sub>BE(OFF)</sub> = 0.5V, I <sub>B1</sub> = -1.0mA |
| Rise Time                                    | t <sub>R</sub>       | —          | 35             | ns                 |                                                                                                           |
| Storage Time                                 | t <sub>S</sub>       | —          | 225            | ns                 | V <sub>CC</sub> = -3.0V, I <sub>C</sub> = -10mA,<br>I <sub>B1</sub> = -I <sub>B2</sub> = -1.0mA           |
| Fall Time                                    | t <sub>F</sub>       | —          | 75             | ns                 |                                                                                                           |

Note: 8. Short duration pulse test used to minimize self-heating effect.

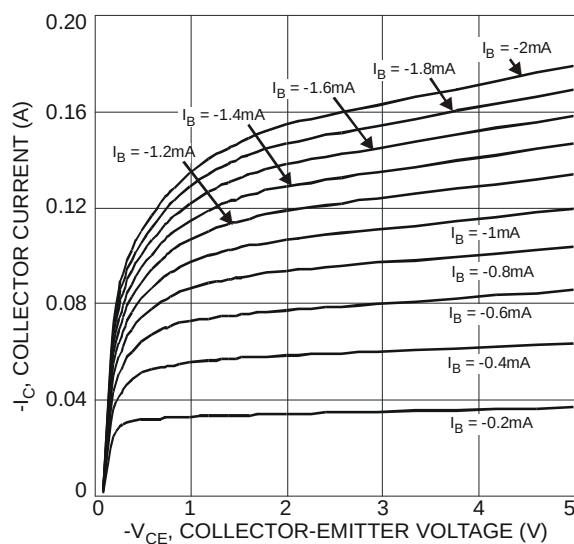


Fig. 11 Typical Collector Current vs. Collector-Emitter Voltage

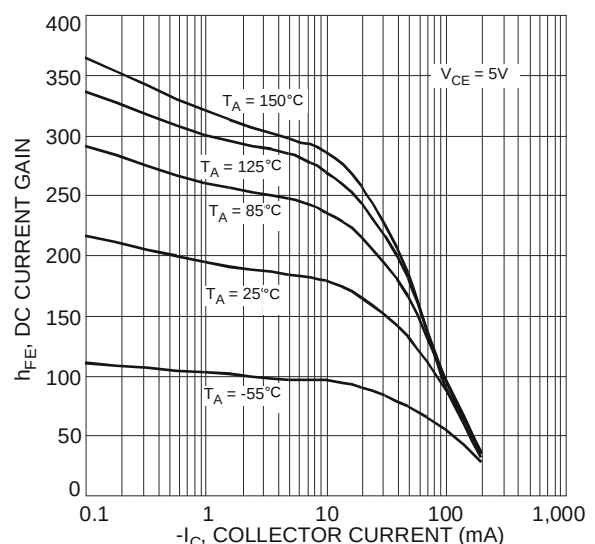


Fig. 12 Typical DC Current Gain vs. Collector Current

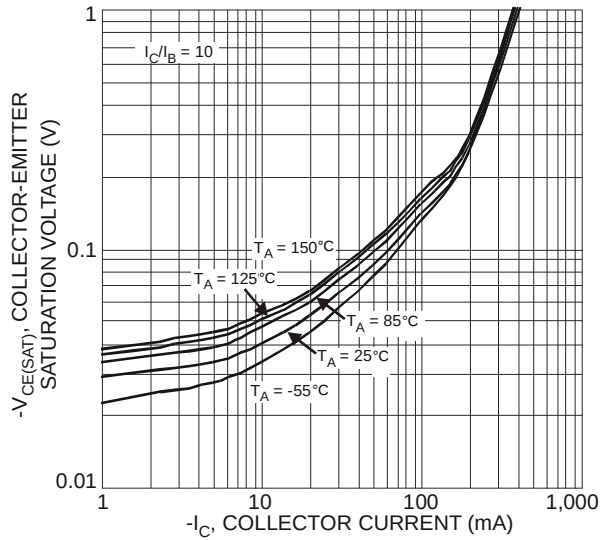


Fig. 13 Typical Collector-Emitter Saturation Voltage vs. Collector Current

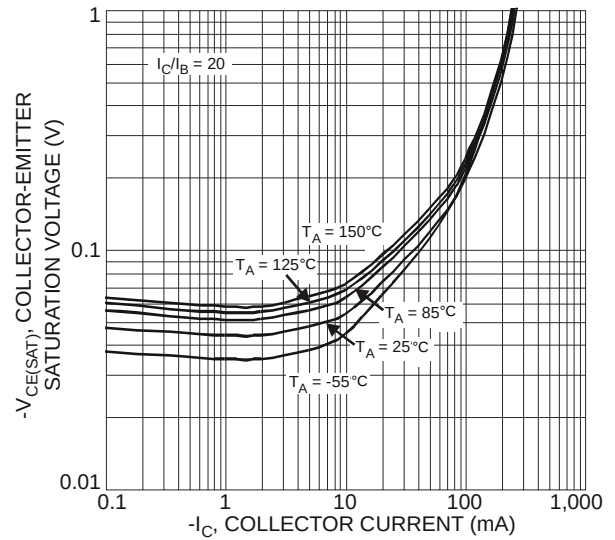


Fig. 14 Typical Collector-Emitter Saturation Voltage vs. Collector Current

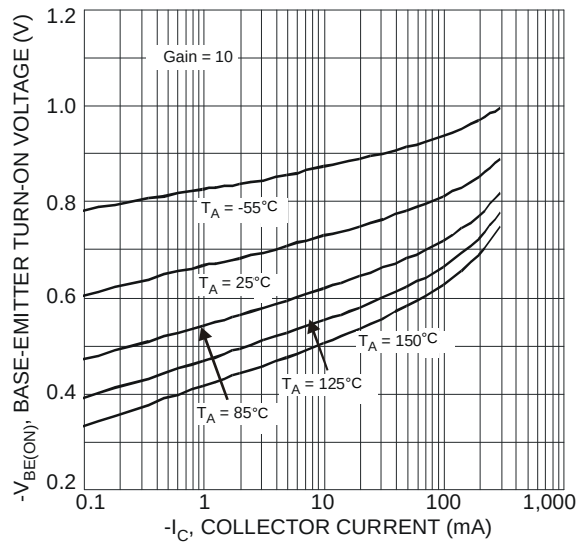


Fig. 15 Typical Base-Emitter Saturation Voltage vs. Collector Current

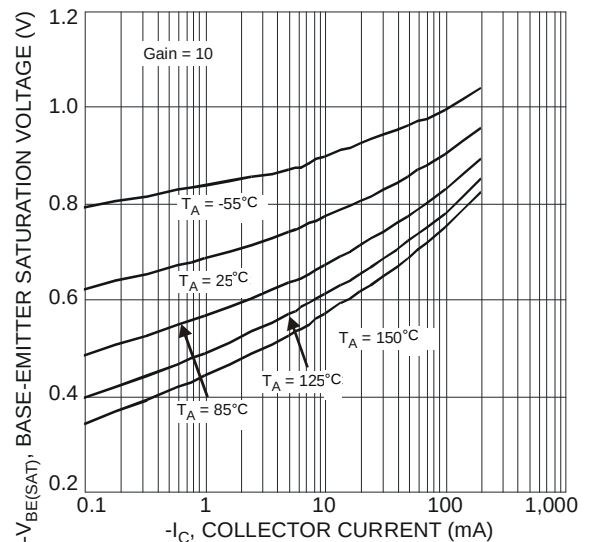


Fig. 16 Typical Base-Emitter Saturation Voltage vs. Collector Current

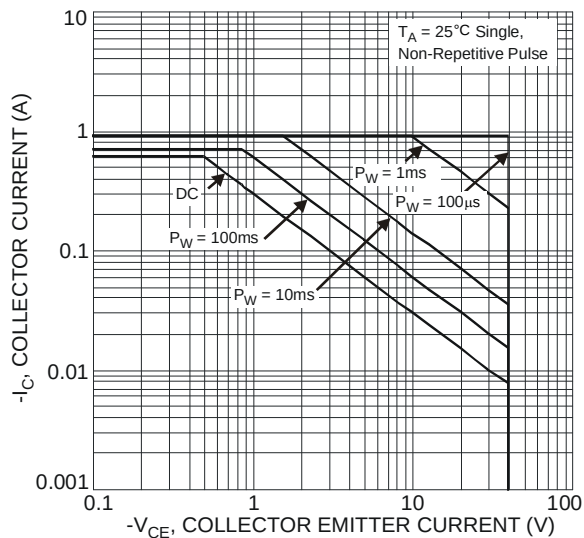
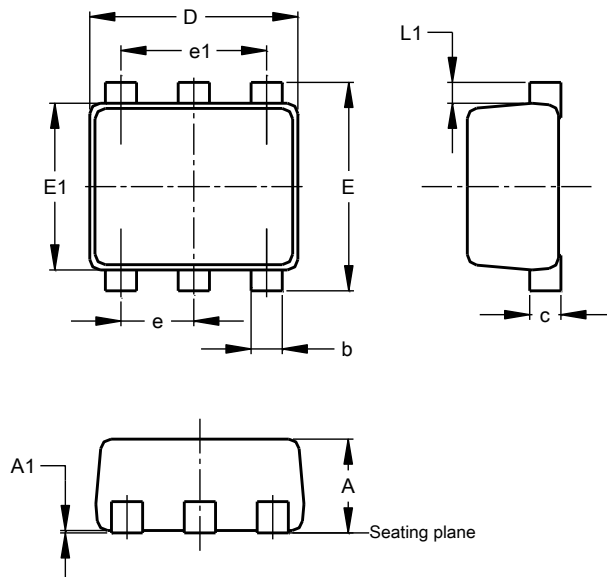


Fig. 17 Safe Operation Area (PNP)

## Package Outline Dimensions

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

**SOT963**

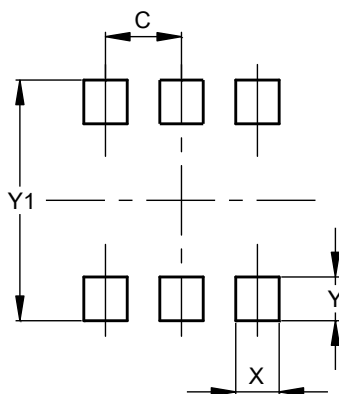


| SOT963               |       |       |       |
|----------------------|-------|-------|-------|
| Dim                  | Min   | Max   | Typ   |
| A                    | 0.40  | 0.50  | 0.45  |
| A1                   | 0.00  | 0.05  | --    |
| b                    | 0.10  | 0.20  | 0.15  |
| c                    | 0.120 | 0.180 | 0.150 |
| D                    | 0.95  | 1.05  | 1.00  |
| E                    | 0.95  | 1.05  | 1.00  |
| E1                   | 0.75  | 0.85  | 0.80  |
| e                    | --    | --    | 0.35  |
| e1                   | --    | --    | 0.70  |
| L1                   | 0.05  | 0.15  | 0.10  |
| All Dimensions in mm |       |       |       |

## Suggested Pad Layout

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

**SOT963**



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 0.350         |
| X          | 0.200         |
| Y          | 0.200         |
| Y1         | 1.100         |



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2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

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