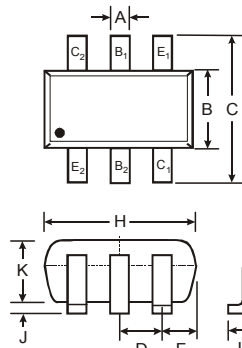


**COMPLEMENTARY NPN / PNP SMALL SIGNAL SURFACE MOUNT TRANSISTOR**

**Features**

- Complementary Pair
- One 4401-Type NPN,  
One 4403-Type PNP
- Epitaxial Planar Die Construction
- Ideal for Low Power Amplification and Switching
- Ultra-Small Surface Mount Package
- **Lead Free/RoHS Compliant (Note 3)**
- **"Green" Device (Note 4 and 5)**

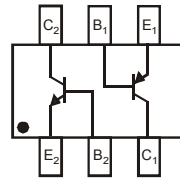


| SOT-363              |              |      |
|----------------------|--------------|------|
| Dim                  | Min          | Max  |
| A                    | 0.10         | 0.30 |
| B                    | 1.15         | 1.35 |
| C                    | 2.00         | 2.20 |
| D                    | 0.65 Nominal |      |
| F                    | 0.30         | 0.40 |
| H                    | 1.80         | 2.20 |
| J                    | —            | 0.10 |
| K                    | 0.90         | 1.00 |
| L                    | 0.25         | 0.40 |
| M                    | 0.10         | 0.25 |
| $\alpha$             | 0°           | 8°   |
| All Dimensions in mm |              |      |

**Mechanical Data**

- Case: SOT-363
- Case Material: Molded Plastic. UL Flammability Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020C
- Terminals: Solderable per MIL-STD-202, Method 208
- Lead Free Plating (Matte Tin Finish annealed over Alloy 42 leadframe).
- Terminal Connections: See Diagram
- Marking Information: See Page 6
- Ordering & Date Code Information: See Page 6
- Weight: 0.006 grams (approximate)

Note:  
E1, B1, and C1 = PNP 4403 Section,  
E2, B2, and C2 = NPN 4401 Section.  
Type marking indicates orientation



**Maximum Ratings, Total Device** @ $T_A = 25^\circ\text{C}$  unless otherwise specified

| Characteristic                                   | Symbol          | Value       | Unit                      |
|--|-----------------|-------------|---------------------------|
| Power Dissipation (Note 1, 2)                    | $P_d$           | 200         | mW                        |
| Thermal Resistance, Junction to Ambient (Note 1) | $R_{\theta JA}$ | 625         | $^\circ\text{C}/\text{W}$ |
| Operating and Storage Temperature Range          | $T_j, T_{STG}$  | -55 to +150 | $^\circ\text{C}$          |

**Maximum Ratings, NPN 4401 Section** @ $T_A = 25^\circ\text{C}$  unless otherwise specified

| Characteristic                          | Symbol    | NPN4401 | Unit |
|---|-----------|---------|------|
| Collector-Base Voltage                  | $V_{CB0}$ | 60      | V    |
| Collector-Emitter Voltage               | $V_{CE0}$ | 40      | V    |
| Emitter-Base Voltage                    | $V_{EB0}$ | 6.0     | V    |
| Collector Current - Continuous (Note 1) | $I_C$     | 600     | mA   |

**Maximum Ratings, PNP 4403 Section** @ $T_A = 25^\circ\text{C}$  unless otherwise specified

| Characteristic                          | Symbol    | PNP4403 | Unit |
|---|-----------|---------|------|
| Collector-Base Voltage                  | $V_{CB0}$ | -40     | V    |
| Collector-Emitter Voltage               | $V_{CE0}$ | -40     | V    |
| Emitter-Base Voltage                    | $V_{EB0}$ | -5.0    | V    |
| Collector Current - Continuous (Note 1) | $I_C$     | -600    | mA   |

- Notes:
1. Device mounted on FR-4 PCB, 1 inch x 0.85 inch x 0.062 inch; pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.
  2. Maximum combined dissipation.
  3. No purposefully added lead.
  4. Diodes Inc.'s "Green" policy can be found on our website at [http://www.diodes.com/products/lead\\_free/index.php](http://www.diodes.com/products/lead_free/index.php).
  5. Product manufactured with Date Code UO (week 40, 2007) and newer are built with Green Molding Compound. Product manufactured prior to Date Code UO are built with Non-Green Molding Compound and may contain Halogens or Sb2O3 Fire Retardants.

**Electrical Characteristics, NPN 4401 Section** @ $T_A = 25^\circ\text{C}$  unless otherwise specified

| Characteristic                       | Symbol        | Min       | Max          | Unit             | Test Condition  |
|--------------------------------------|---------------|-----------|--------------|------------------|---|
| <b>OFF CHARACTERISTICS (Note 6)</b>  |               |           |              |                  |   |
| Collector-Base Breakdown Voltage     | $V_{(BR)CBO}$ | 60        | —            | V                | $I_C = 100\mu\text{A}, I_E = 0$   |
| Collector-Emitter Breakdown Voltage  | $V_{(BR)CEO}$ | 40        | —            | V                | $I_C = 1.0\text{mA}, I_B = 0$   |
| Emitter-Base Breakdown Voltage       | $V_{(BR)EBO}$ | 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 6)</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           | $k\Omega$        | $V_{CE} = 10\text{V}, I_C = 1.0\text{mA}, f = 1.0\text{kHz}$  |
| 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              |   |
| <b>SWITCHING CHARACTERISTICS</b>     |               |           |              |                  |   |
| Delay Time                           | $t_d$         | —         | 15           | ns               | $V_{CC} = 30\text{V}, I_C = 150\text{mA}, V_{BE(off)} = 2.0\text{V}, I_{B1} = 15\text{mA}$  |
| Rise Time                            | $t_r$         | —         | 20           | ns               |   |
| Storage Time                         | $t_s$         | —         | 225          | ns               | $V_{CC} = 30\text{V}, I_C = 150\text{mA}, I_{B1} = I_{B2} = 15\text{mA}$  |
| Fall Time                            | $t_f$         | —         | 30           | ns               |   |

Notes: 6. Short duration pulse test used to minimize self-heating effect.

**Electrical Characteristics, PNP 4403 Section** @T<sub>A</sub> = 25°C unless otherwise specified

| Characteristic                       | Symbol               | Min                          | Max                     | Unit               | Test Condition  |
|--------------------------------------|----------------------|------------------------------|-------------------------|--------------------|---|
| <b>OFF CHARACTERISTICS (Note 6)</b>  |                      |                              |                         |                    |   |
| Collector-Base Breakdown Voltage     | V <sub>(BR)CBO</sub> | -40                          | —                       | V                  | I <sub>C</sub> = -100μA, I <sub>E</sub> = 0   |
| Collector-Emitter Breakdown Voltage  | V <sub>(BR)CEO</sub> | -40                          | —                       | V                  | I <sub>C</sub> = -1.0mA, I <sub>B</sub> = 0   |
| Emitter-Base Breakdown Voltage       | V <sub>(BR)EBO</sub> | -5.0                         | —                       | V                  | I <sub>E</sub> = -100μA, I <sub>C</sub> = 0   |
| Collector Cutoff Current             | I <sub>CEX</sub>     | —                            | -100                    | nA                 | V <sub>CE</sub> = -35V, V <sub>EB(OFF)</sub> = -0.4V  |
| Base Cutoff Current                  | I <sub>BL</sub>      | —                            | -100                    | nA                 | V <sub>CE</sub> = -35V, V <sub>EB(OFF)</sub> = -0.4V  |
| <b>ON CHARACTERISTICS (Note 6)</b>   |                      |                              |                         |                    |   |
| DC Current Gain                      | h <sub>FE</sub>      | 30<br>60<br>100<br>100<br>20 | —<br>—<br>—<br>300<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> = -150mA, V <sub>CE</sub> = -2.0V<br>I <sub>C</sub> = -500mA, V <sub>CE</sub> = -2.0V |
| Collector-Emitter Saturation Voltage | V <sub>CE(SAT)</sub> | —                            | -0.40<br>-0.75          | V                  | I <sub>C</sub> = -150mA, I <sub>B</sub> = -15mA<br>I <sub>C</sub> = -500mA, I <sub>B</sub> = -50mA  |
| Base-Emitter Saturation Voltage      | V <sub>BE(SAT)</sub> | -0.75<br>—                   | -0.95<br>-1.30          | V                  | I <sub>C</sub> = -150mA, I <sub>B</sub> = -15mA<br>I <sub>C</sub> = -500mA, I <sub>B</sub> = -50mA  |
| <b>SMALL SIGNAL CHARACTERISTICS</b>  |                      |                              |                         |                    |   |
| Output Capacitance                   | C <sub>cb</sub>      | —                            | 8.5                     | pF                 | V <sub>CB</sub> = -10V, f = 1.0MHz, I <sub>E</sub> = 0  |
| Input Capacitance                    | C <sub>eb</sub>      | —                            | 30                      | pF                 | V <sub>EB</sub> = -0.5V, f = 1.0MHz, I <sub>C</sub> = 0   |
| Input Impedance                      | h <sub>ie</sub>      | 1.5                          | 15                      | kΩ                 | V <sub>CE</sub> = -10V, I <sub>C</sub> = -1.0mA, f = 1.0kHz   |
| Voltage Feedback Ratio               | h <sub>re</sub>      | 0.1                          | 8.0                     | x 10 <sup>-4</sup> |   |
| Small Signal Current Gain            | h <sub>fe</sub>      | 60                           | 500                     | —                  |   |
| Output Admittance                    | h <sub>oe</sub>      | 1.0                          | 100                     | μS                 |   |
| Current Gain-Bandwidth Product       | f <sub>T</sub>       | 200                          | —                       | MHz                | V <sub>CE</sub> = -10V, I <sub>C</sub> = -20mA, f = 100MHz  |
| <b>SWITCHING CHARACTERISTICS</b>     |                      |                              |                         |                    |   |
| Delay Time                           | t <sub>d</sub>       | —                            | 15                      | ns                 | V <sub>CC</sub> = -30V, I <sub>C</sub> = -150mA,  |
| Rise Time                            | t <sub>r</sub>       | —                            | 20                      | ns                 | V <sub>BE(off)</sub> = -2.0V, I <sub>B1</sub> = -15mA   |
| Storage Time                         | t <sub>s</sub>       | —                            | 225                     | ns                 | V <sub>CC</sub> = -30V, I <sub>C</sub> = -150mA,  |
| Fall Time                            | t <sub>f</sub>       | —                            | 30                      | ns                 | I <sub>B1</sub> = I <sub>B2</sub> = -15mA   |

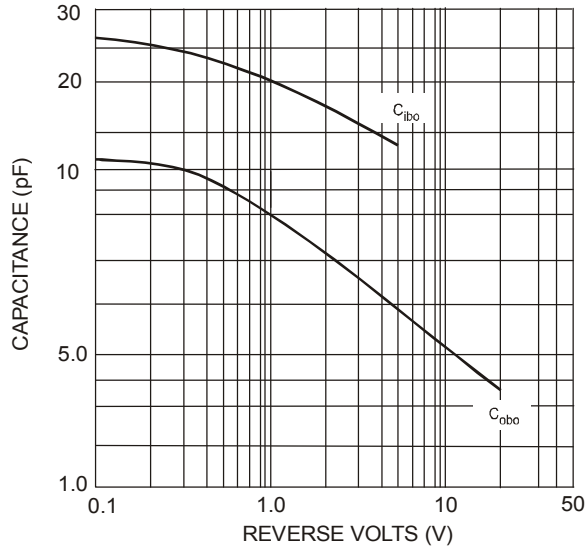


Fig. 1 Typical Capacitance (4401)

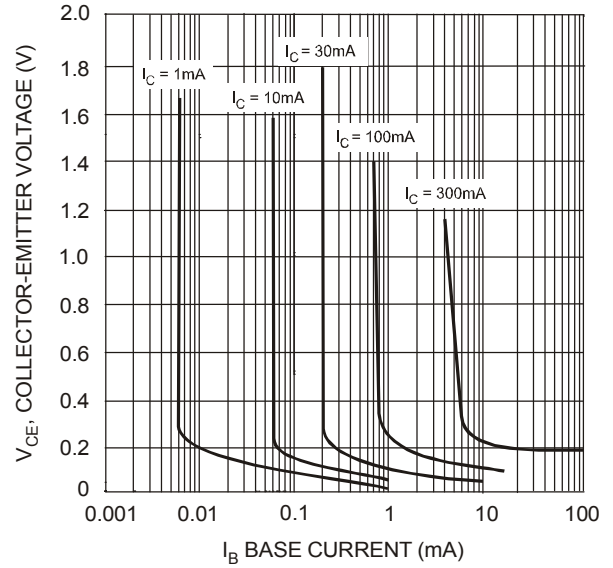


Fig. 2 Typical Collector Saturation Region (4401)

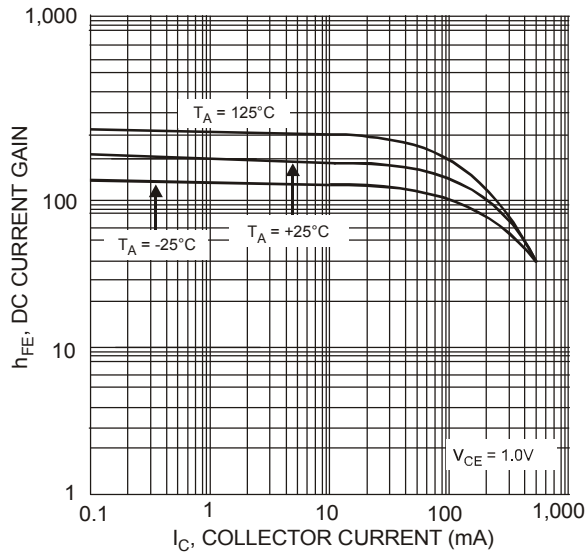


Fig. 3 Typical DC Current Gain vs. Collector Current (4401)

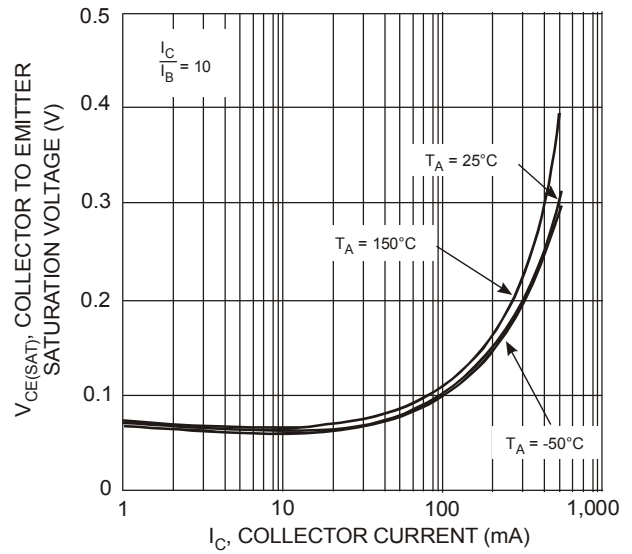


Fig. 4 Collector Emitter Saturation Voltage vs. Collector Current (4401)

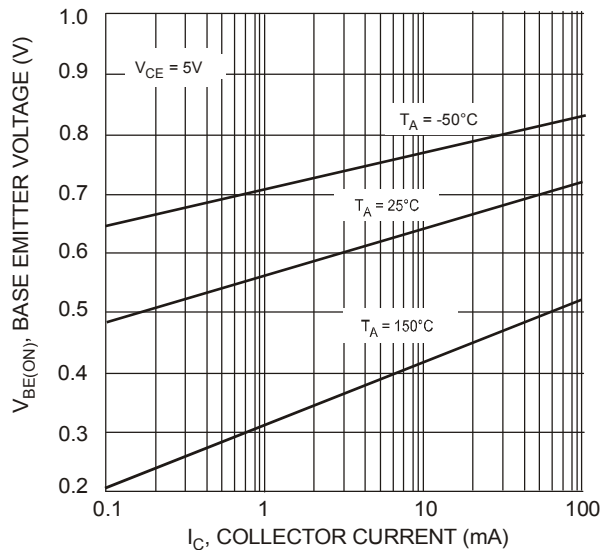


Fig. 5 Base Emitter Voltage vs. Collector Current (4401)

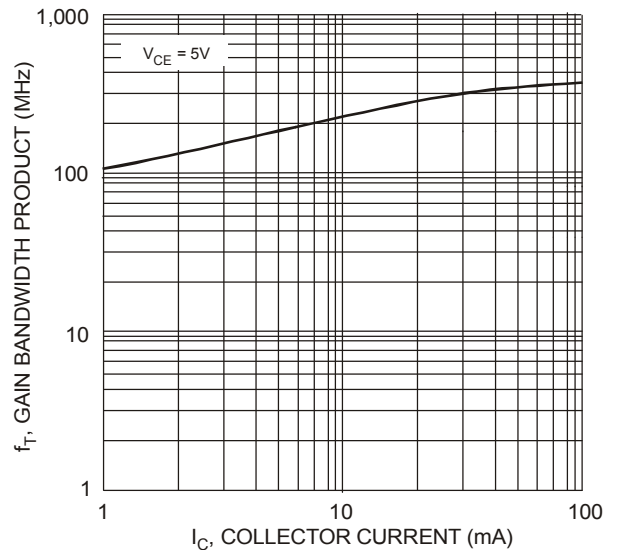


Fig. 6 Gain Bandwidth Product vs. Collector Current (4401)

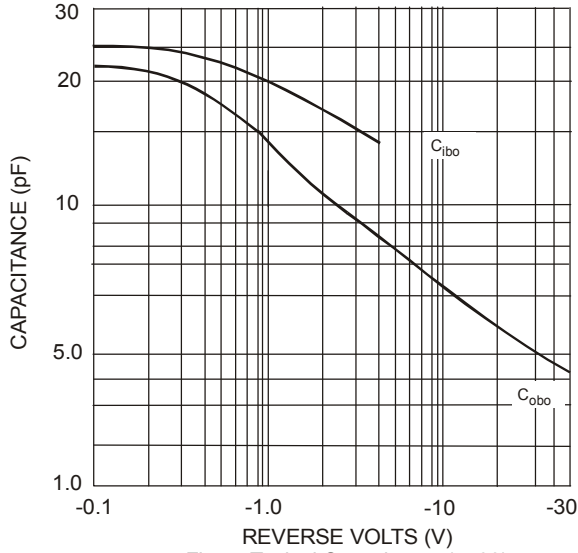


Fig. 7 Typical Capacitance (4403)

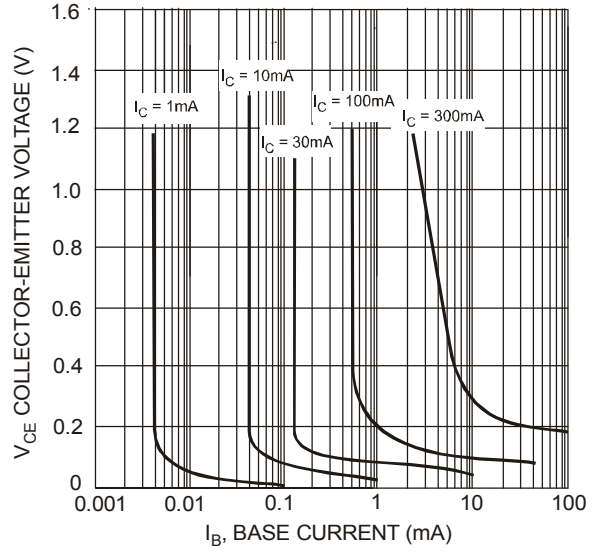


Fig. 8 Typical Collector Saturation Region (4403)

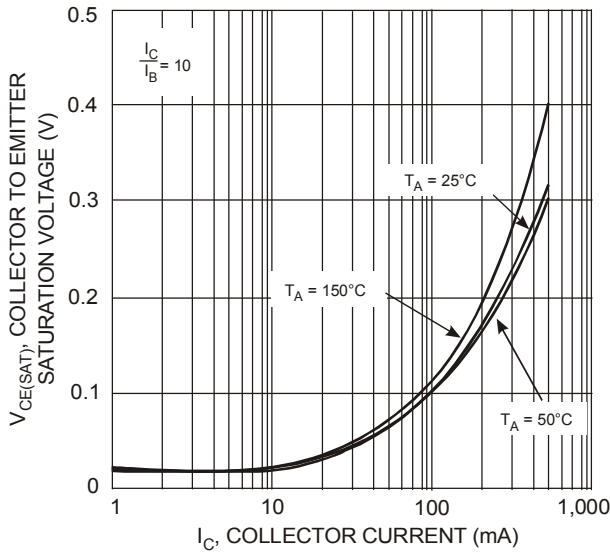


Fig. 9 Collector Emitter Saturation Voltage vs. Collector Current (4403)

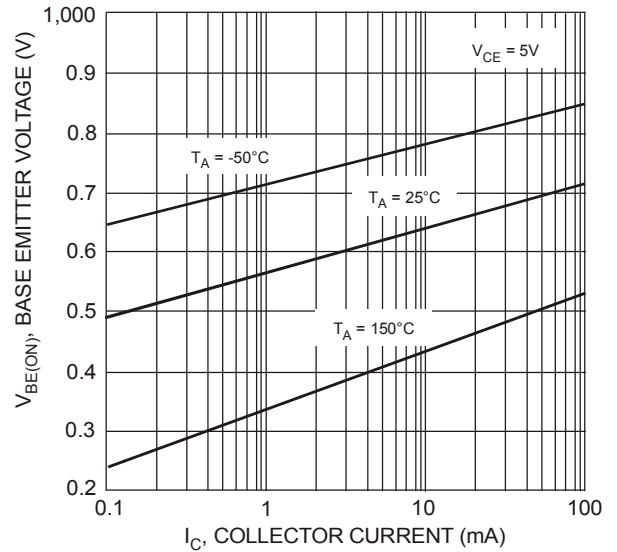


Fig. 10 Base-Emitter Voltage vs. Collector Current (4403)

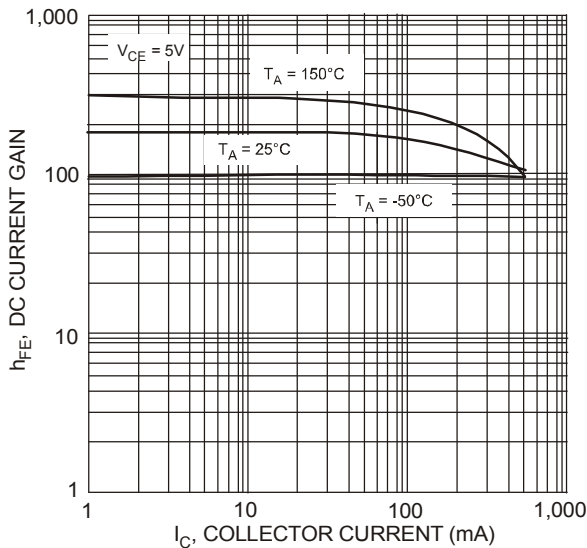


Fig. 11 DC Current Gain vs. Collector Current (4403)

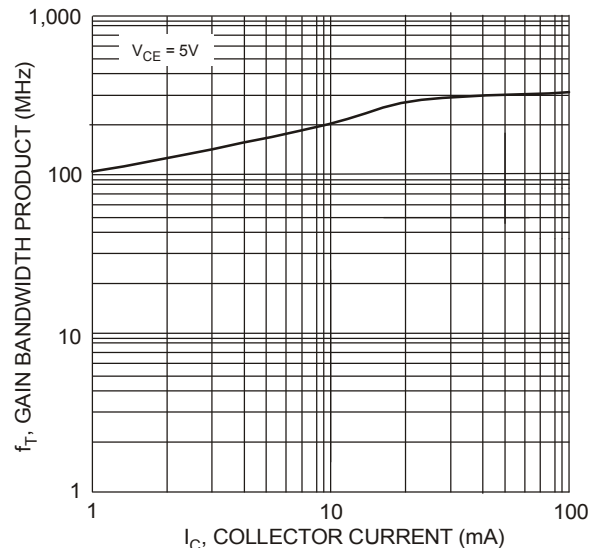


Fig. 12 Gain Bandwidth Product vs. Collector Current (4403)

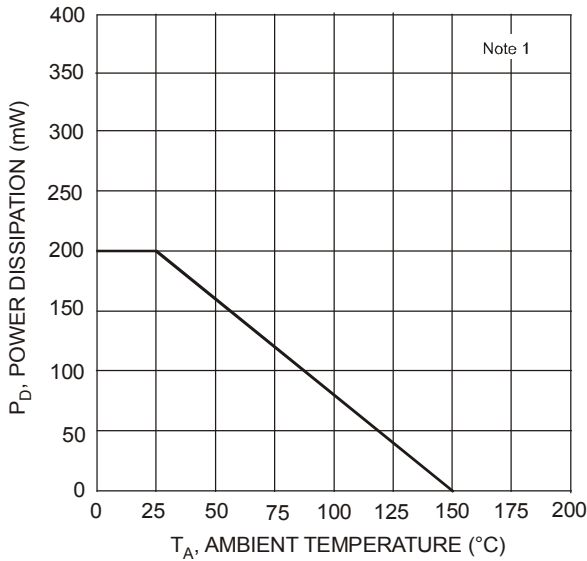


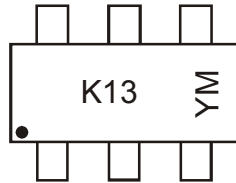
Fig. 13 Max Power Dissipation vs. Ambient Temperature (Total Device)

## Ordering Information (Note 7)

| Device       | Packaging | Shipping         |
|--------------|-----------|------------------|
| MMDT4413-7-F | SOT-363   | 3000/Tape & Reel |

Notes: 7. For packaging details, go to our website at <http://www.diodes.com/datasheets/ap02007.pdf>.

## Marking Information



K13 = Product Type Marking Code  
 YM = Date Code Marking  
 Y = Year ex: N = 2002  
 M = Month ex: 9 = September

### Data Code Key

| Year | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Code | J    | K    | L    | M    | N    | P    | R    | S    | T    | U    | V    | W    | X    | Y    | Z    |

| 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   |

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