

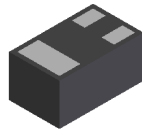
### Features

- Low Collector-Emitter Saturation Voltage,  $V_{CE(sat)}$
- Ultra-Small Leadless Surface Mount Package
- **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**

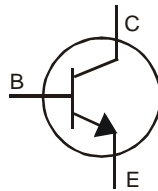
### Mechanical Data

- Case: X2-DFN1006-3
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish — NiPdAu over Copper leadframe. Solderable per MIL-STD-202, Method 208
- Weight: 0.0009 grams (Approximate)

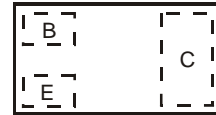
X2-DFN1006-3



Bottom View



Device Symbol

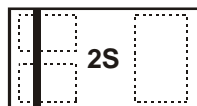

 Top View  
Device Schematic

### Ordering Information (Note 4)

| Product         | Marking | Reel size (inches) | Tape width (mm) | Quantity per reel |
|-----------------|---------|--------------------|-----------------|-------------------|
| MMBT2222ALP4-7B | 2S      | 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> 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>.

### Marking Information



Top View

2S = Product Type Marking Code  
Bar Denotes Base and Emitter Side

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

| Characteristic                 | Symbol           | Value | Unit |
|--------------------------------|------------------|-------|------|
| Collector-Base Voltage         | V <sub>CBO</sub> | 75    | V    |
| Collector-Emitter Voltage      | V <sub>CEO</sub> | 40    | V    |
| Emitter-Base Voltage           | V <sub>EBO</sub> | 6     | V    |
| Collector Current - Continuous | I <sub>C</sub>   | 600   | mA   |
| Peak Collector Current         | I <sub>CM</sub>  | 800   | mA   |

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

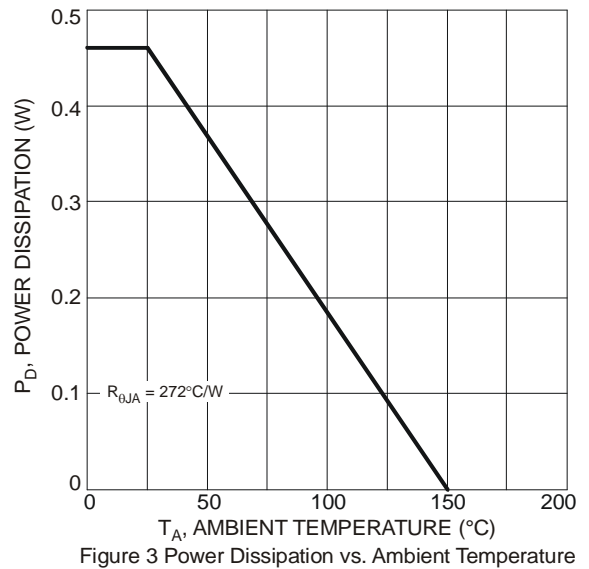
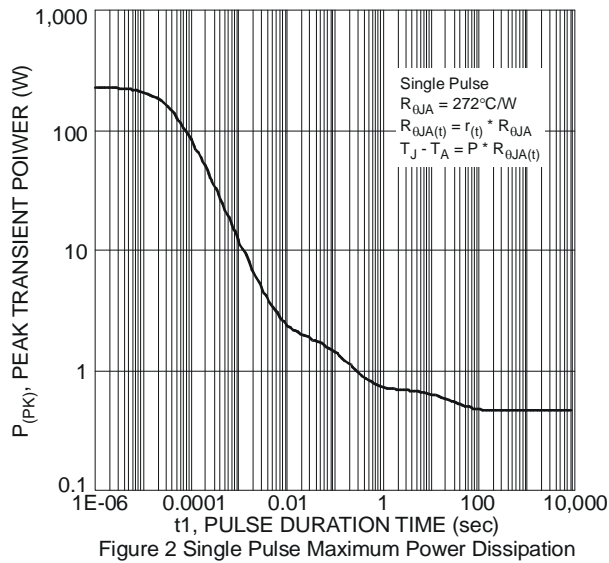
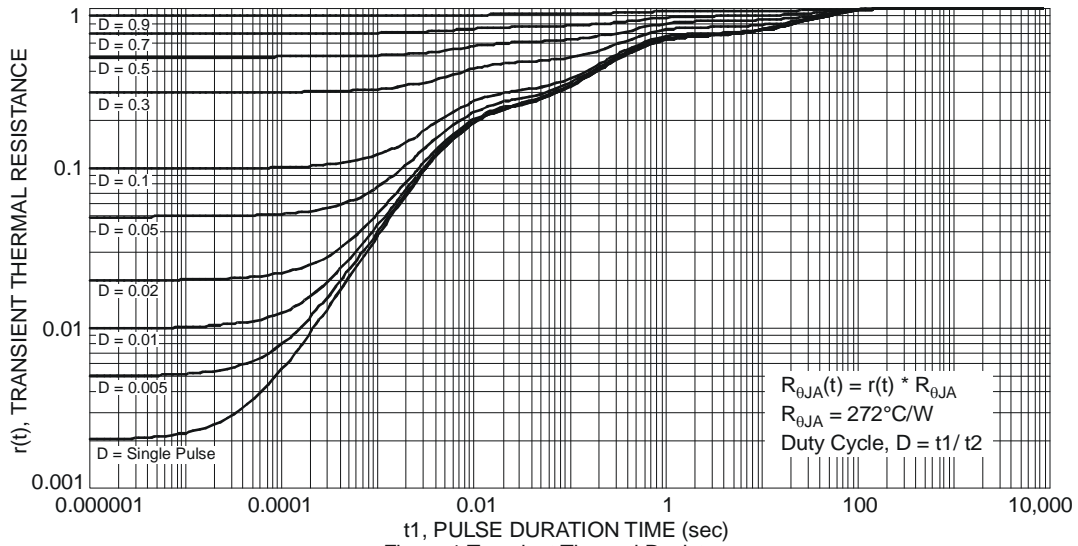
| Characteristic                                   | Symbol                            | Value       | Unit |
|--|-----------------------------------|-------------|------|
| Power Dissipation (Note 5)                       | P <sub>D</sub>                    | 460         | mW   |
| Power Dissipation (Note 6)                       | P <sub>D</sub>                    | 1           | W    |
| Thermal Resistance, Junction to Ambient (Note 5) | R <sub>θJA</sub>                  | 272         | °C/W |
| Thermal Resistance, Junction to Ambient (Note 6) | R <sub>θJA</sub>                  | 120         | °C/W |
| Thermal Resistance, Junction to Lead (Note 7)    | R <sub>θJL</sub>                  | 110         | °C/W |
| Operating and Storage Temperature Range          | T <sub>J</sub> , T <sub>STG</sub> | -55 to +150 | °C   |

**ESD Ratings** (Note 8)

| Characteristic                             | Symbol  | Value   | Unit | JEDEC Class |
|--|---------|---------|------|-------------|
| Electrostatic Discharge - Human Body Model | ESD HBM | ≥ 8,000 | V    | 3B          |
| Electrostatic Discharge - Machine Model    | ESD MM  | ≥ 400   | V    | C           |

- Notes:
5. For a device surface mounted on minimum recommended pad layout FR-4 PCB with single sided 1oz copper, in still air conditions; the device is measured when operating in a steady-state condition. The entire exposed collector pad is attached to the heatsink.
  6. Same as note 5, except device is surface mounted on 25mm X 25mm collector pad heatsink with 1oz copper.
  7. Thermal resistance from junction to solder-point (at the end of the collector lead).
  8. Refer to JEDEC specification JESD22-A114 and JESD22-A115.

**Thermal Characteristics**



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

| Characteristic                               | Symbol               | Min  | Typ | Max  | Unit               | Test Condition   |
|--|----------------------|------|-----|------|--------------------|--|
| <b>OFF CHARACTERISTICS</b>                   |                      |      |     |      |                    |  |
| Collector-Base Breakdown Voltage             | BV <sub>CB0</sub>    | 75   | —   | —    | V                  | I <sub>C</sub> = 100μA, I <sub>E</sub> = 0   |
| Collector-Emitter Breakdown Voltage (Note 6) | BV <sub>CEO</sub>    | 40   | —   | —    | V                  | I <sub>C</sub> = 10mA, I <sub>B</sub> = 0  |
| Emitter-Base Breakdown Voltage               | BV <sub>EBO</sub>    | 6    | —   | —    | V                  | I <sub>E</sub> = 100μA, I <sub>C</sub> = 0   |
| Collector Cutoff Current                     | I <sub>CEX</sub>     | —    | —   | 10   | nA                 | V <sub>CE</sub> = 60V, V <sub>EB(off)</sub> = 3V   |
| Collector Cutoff Current                     | I <sub>CB0</sub>     | —    | —   | 10   | nA                 | V <sub>CB</sub> = 60V, I <sub>E</sub> = 0  |
|  |                      | —    | —   | 10   | μA                 | V <sub>CB</sub> = 60V, I <sub>E</sub> = 0, T <sub>A</sub> = +125°C                                     |
| Emitter Cutoff Current                       | I <sub>EBO</sub>     | —    | —   | 10   | nA                 | V <sub>EB</sub> = 5V, I <sub>C</sub> = 0   |
| Base Cutoff Current                          | I <sub>BL</sub>      | —    | —   | 20   | nA                 | V <sub>CE</sub> = 60V, V <sub>EB(off)</sub> = 3V   |
| <b>ON CHARACTERISTICS (Note 6)</b>           |                      |      |     |      |                    |  |
| DC Current Gain                              | h <sub>FE</sub>      | 35   | —   | —    | —                  | V <sub>CE</sub> = 10V, I <sub>C</sub> = 0.1mA  |
|  |                      | 50   | —   | —    | —                  | V <sub>CE</sub> = 10V, I <sub>C</sub> = 1mA  |
|  |                      | 75   | —   | —    | —                  | V <sub>CE</sub> = 10V, I <sub>C</sub> = 10mA   |
|  |                      | 35   | —   | —    | —                  | V <sub>CE</sub> = 10V, I <sub>C</sub> = 10mA, T <sub>A</sub> = -55°C                                   |
|  |                      | 100  | —   | 300  | —                  | V <sub>CE</sub> = 10V, I <sub>C</sub> = 150mA  |
|  |                      | 50   | —   | —    | —                  | V <sub>CE</sub> = 1V, I <sub>C</sub> = 150mA   |
| Collector-Emitter Saturation Voltage         | V <sub>CE(sat)</sub> | —    | —   | 0.3  | V                  | I <sub>C</sub> = 150mA, I <sub>B</sub> = 15mA  |
|  |                      | —    | —   | 1.0  | V                  | I <sub>C</sub> = 500mA, I <sub>B</sub> = 50mA  |
| Base-Emitter Saturation Voltage              | V <sub>BE(sat)</sub> | 0.6  | —   | 1.2  | V                  | I <sub>C</sub> = 150mA, I <sub>B</sub> = 15mA  |
|  |                      | —    | —   | 2.0  | V                  | I <sub>C</sub> = 500mA, I <sub>B</sub> = 50mA  |
| <b>SMALL SIGNAL CHARACTERISTICS (Note 6)</b> |                      |      |     |      |                    |  |
| Output Capacitance                           | C <sub>obo</sub>     | —    | —   | 8    | pF                 | V <sub>CB</sub> = 10V, f = 1.0MHz, I <sub>E</sub> = 0  |
| Input Capacitance                            | C <sub>ibo</sub>     | —    | —   | 25   | pF                 | V <sub>EB</sub> = 0.5V, f = 1.0MHz, I <sub>C</sub> = 0   |
| Current Gain-Bandwidth Product               | f <sub>T</sub>       | 300  | —   | —    | MHz                | V <sub>CE</sub> = 20V, I <sub>C</sub> = 20mA, f = 100MHz   |
| Noise Figure                                 | NF                   | —    | —   | 4.0  | dB                 | V <sub>CE</sub> = 10V, I <sub>C</sub> = 100μA, R <sub>S</sub> = 1.0kΩ, f = 1.0kHz                      |
| Input Impedance                              | h <sub>ie</sub>      | 0.25 | —   | 1.25 | kΩ                 | I <sub>C</sub> = 10mA, V <sub>CE</sub> = 10V, f = 1.0kHz   |
| Voltage Feedback Ratio                       | h <sub>re</sub>      | —    | —   | 4.0  | X 10 <sup>-4</sup> |  |
| Small-Signal Current Gain                    | h <sub>fe</sub>      | 75   | —   | 375  | —                  |  |
| Output Admittance                            | h <sub>oe</sub>      | 25   | —   | 200  | μS                 |  |
| <b>SWITCHING CHARACTERISTICS (Note 6)</b>    |                      |      |     |      |                    |  |
| Delay Time                                   | t <sub>d</sub>       | —    | —   | 10   | nS                 | V <sub>CC</sub> = 30V, V <sub>BE(off)</sub> = -0.5V,<br>I <sub>C</sub> = 150mA, I <sub>B1</sub> = 15mA |
| Rise Time                                    | t <sub>r</sub>       | —    | —   | 25   |                    |  |
| Storage Time                                 | t <sub>s</sub>       | —    | —   | 225  |                    |  |
| Fall Time                                    | t <sub>f</sub>       | —    | —   | 60   |                    |  |

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

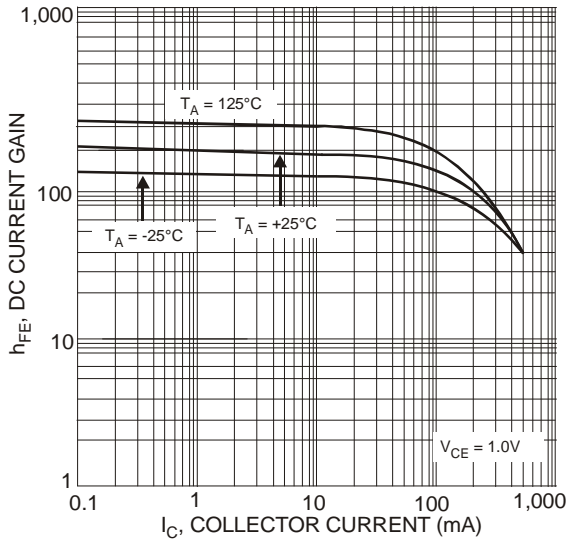


Figure 4 Typical DC Current Gain vs. Collector Current

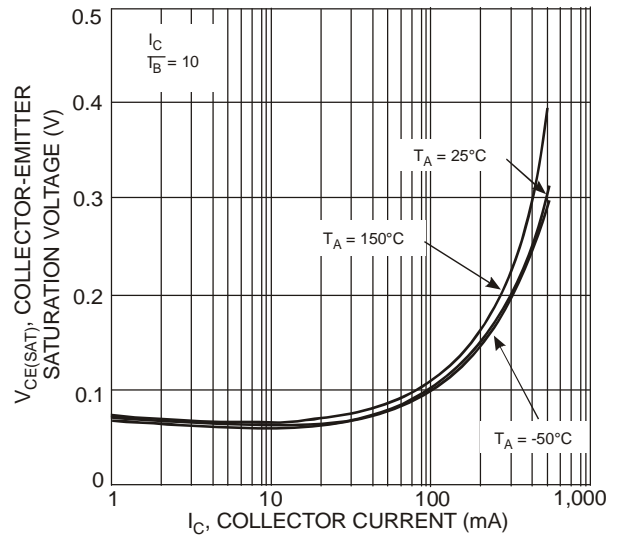


Figure 5 Typical Collector-Emitter Saturation Voltage vs. Collector Current

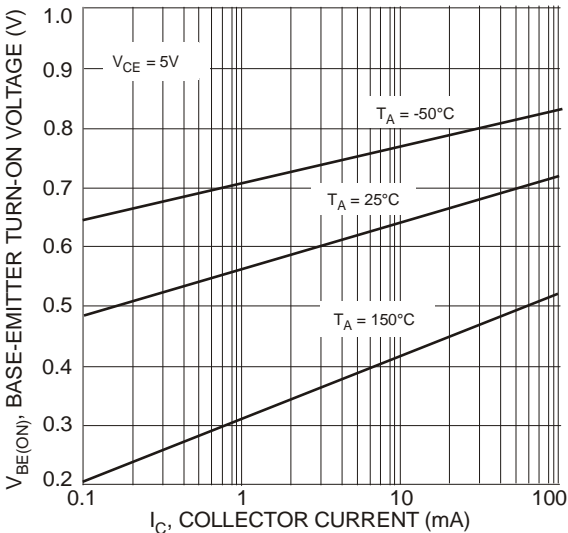


Figure 6 Typical Base-Emitter Turn-On Voltage vs. Collector Current

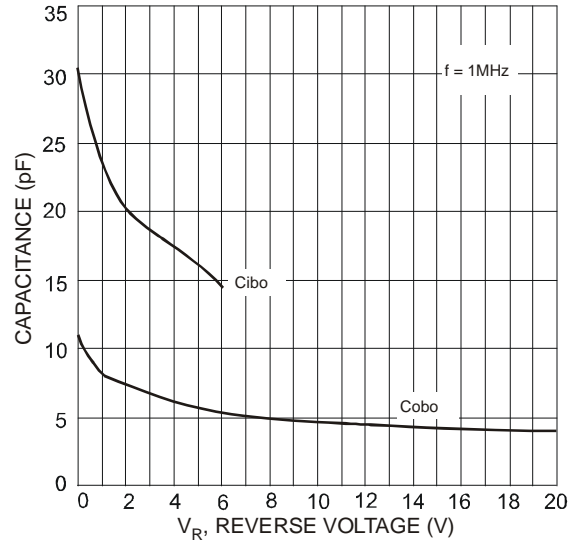


Figure 7 Typical Capacitance Characteristics

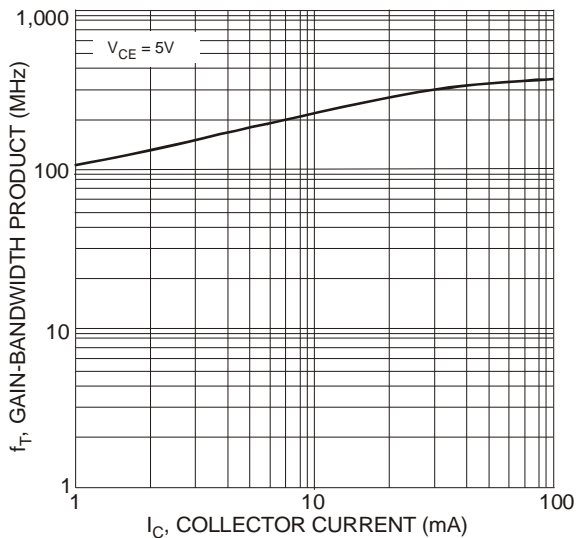


Figure 8 Typical Gain-Bandwidth Product vs. Collector Current

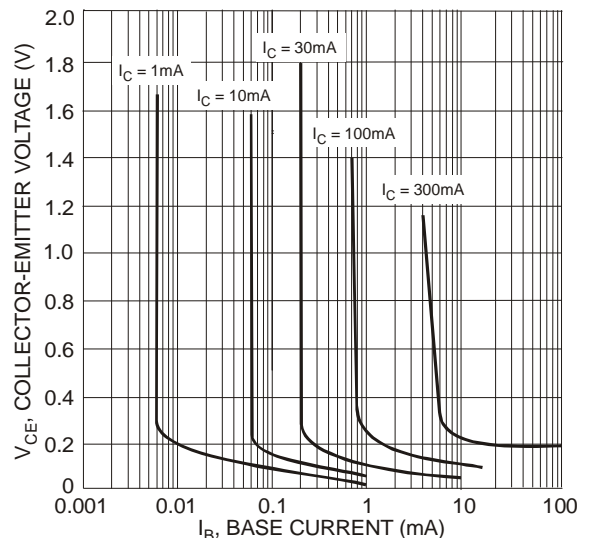
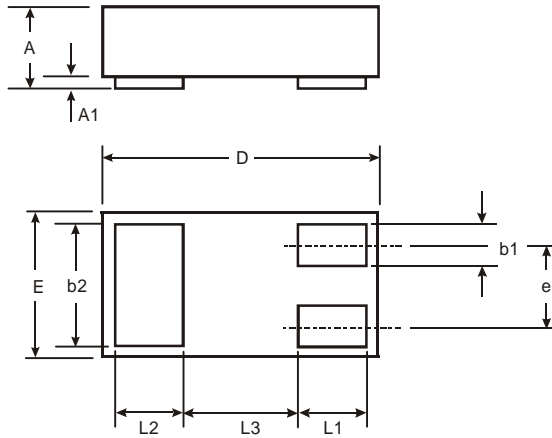


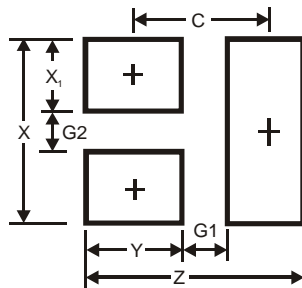
Figure 9 Typical Collector Saturation Region

**Package Outline Dimensions**



| X2-DFN1006-3         |      |      |      |
|----------------------|------|------|------|
| Dim                  | Min  | Max  | Typ  |
| A                    | —    | 0.40 | —    |
| A1                   | 0    | 0.05 | 0.03 |
| b1                   | 0.10 | 0.20 | 0.15 |
| b2                   | 0.45 | 0.55 | 0.50 |
| D                    | 0.95 | 1.05 | 1.00 |
| E                    | 0.55 | 0.65 | 0.60 |
| e                    | —    | —    | 0.35 |
| L1                   | 0.20 | 0.30 | 0.25 |
| L2                   | 0.20 | 0.30 | 0.25 |
| L3                   | —    | —    | 0.40 |
| All Dimensions in mm |      |      |      |

**Suggested Pad Layout**



| Dimensions | Value (in mm) |
|------------|---------------|
| Z          | 1.1           |
| G1         | 0.3           |
| G2         | 0.2           |
| X          | 0.7           |
| X1         | 0.25          |
| Y          | 0.4           |
| C          | 0.7           |

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