


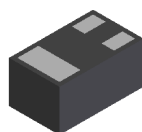
## Features

- 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**

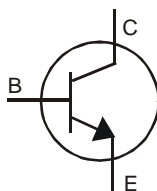
## Mechanical Data

- 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)

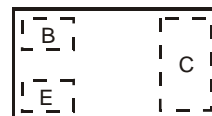
X2-DFN1006-3



Bottom View



Device Symbol



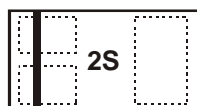
Top View  
Device Schematic

## 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.)

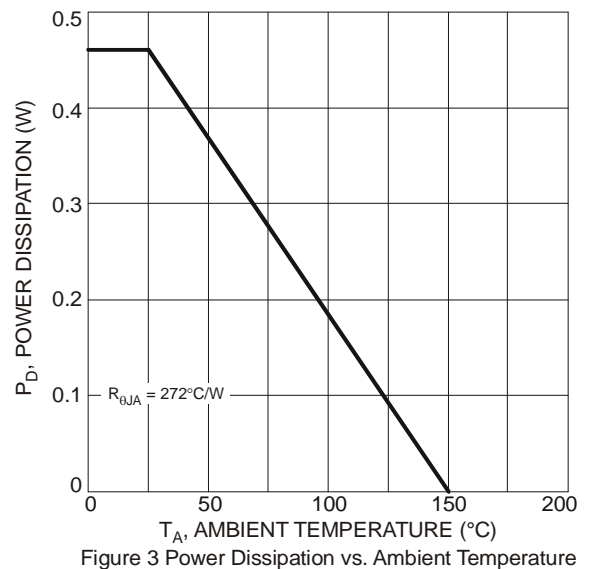
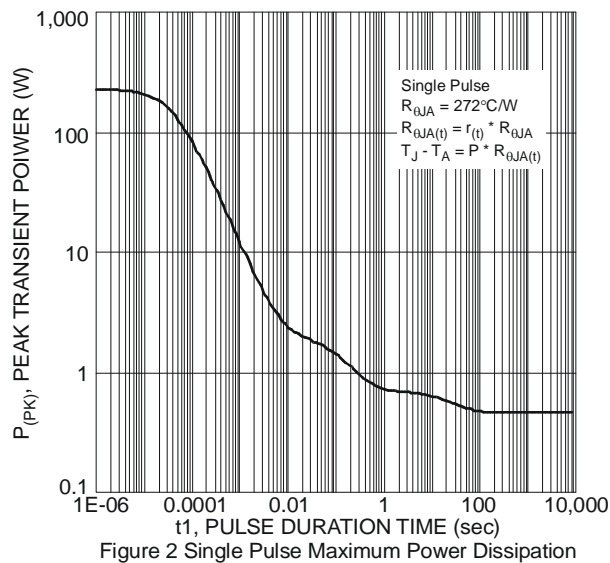
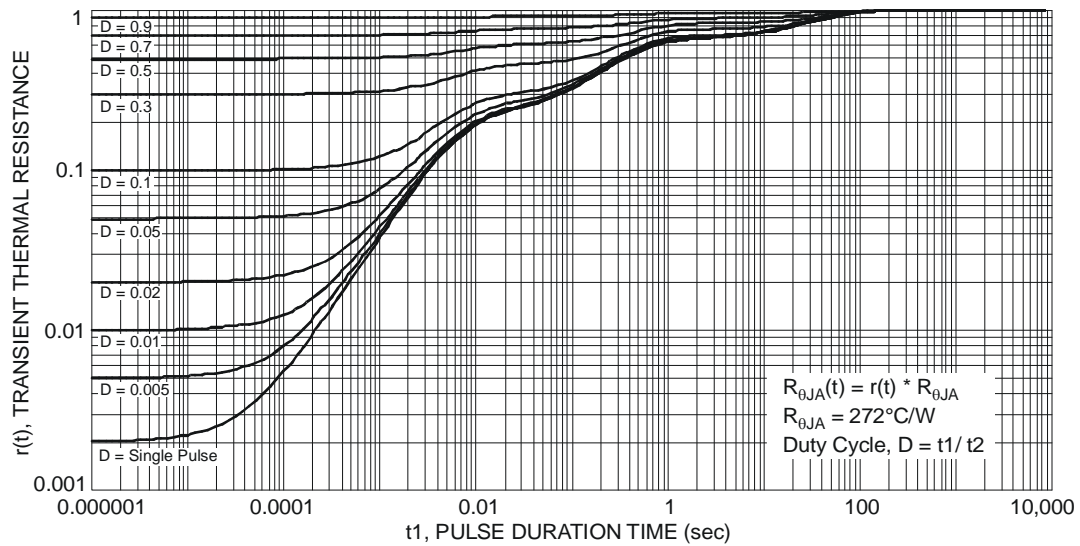
| Characteristic                                   | Symbol                            | Value       | Unit |
|--|-----------------------------------|-------------|------|
| Power Dissipation (Note 5)                       | P <sub>D</sub>                    | 460         | mW   |
| Power Dissipation (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  |
|--|---------------|----------|--------|------------|--------------------|---|
| OFF CHARACTERISTICS                          |               |          |        |            |                    |   |
| Collector-Base Breakdown Voltage             | $BV_{CBO}$    | 75       | —      | —          | V                  | $I_C = 100\mu A, I_E = 0$                                       |
| Collector-Emitter Breakdown Voltage (Note 6) | $BV_{CEO}$    | 40       | —      | —          | V                  | $I_C = 10mA, I_B = 0$   |
| Emitter-Base Breakdown Voltage               | $BV_{EBO}$    | 6        | —      | —          | V                  | $I_E = 100\mu A, I_C = 0$                                       |
| Collector Cutoff Current                     | $I_{CEX}$     | —        | —      | 10         | nA                 | $V_{CE} = 60V, V_{EB(off)} = 3V$                                |
| Collector Cutoff Current                     | $I_{CBO}$     | —        | —      | 10         | nA                 | $V_{CB} = 60V, I_E = 0$   |
|  |               | —        | —      | 10         | $\mu A$            | $V_{CB} = 60V, I_E = 0, T_A = +125^{\circ}C$                    |
| Emitter Cutoff Current                       | $I_{EBO}$     | —        | —      | 10         | nA                 | $V_{EB} = 5V, I_C = 0$  |
| Base Cutoff Current                          | $I_{BL}$      | —        | —      | 20         | nA                 | $V_{CE} = 60V, V_{EB(off)} = 3V$                                |
| ON CHARACTERISTICS (Note 6)                  |               |          |        |            |                    |   |
| DC Current Gain                              | $h_{FE}$      | 35       | —      | —          | —                  | $V_{CE} = 10V, I_C = 0.1mA$                                     |
|  |               | 50       | —      | —          | —                  | $V_{CE} = 10V, I_C = 1mA$                                       |
|  |               | 75       | —      | —          | —                  | $V_{CE} = 10V, I_C = 10mA$                                      |
|  |               | 35       | —      | —          | —                  | $V_{CE} = 10V, I_C = 10mA, T_A = -55^{\circ}C$                  |
|  |               | 100      | —      | 300        | —                  | $V_{CE} = 10V, I_C = 150mA$                                     |
|  |               | 50       | —      | —          | —                  | $V_{CE} = 1V, I_C = 150mA$                                      |
|  |               | 40       | —      | —          | —                  | $V_{CE} = 10V, I_C = 500mA$                                     |
| Collector-Emitter Saturation Voltage         | $V_{CE(sat)}$ | —<br>—   | —<br>— | 0.3<br>1.0 | V                  | $I_C = 150mA, I_B = 15mA$<br>$I_C = 500mA, I_B = 50mA$          |
| Base-Emitter Saturation Voltage              | $V_{BE(sat)}$ | 0.6<br>— | —<br>— | 1.2<br>2.0 | V                  | $I_C = 150mA, I_B = 15mA$<br>$I_C = 500mA, I_B = 50mA$          |
| SMALL SIGNAL CHARACTERISTICS (Note 6)        |               |          |        |            |                    |   |
| Output Capacitance                           | $C_{obo}$     | —        | —      | 8          | pF                 | $V_{CB} = 10V, f = 1.0MHz, I_E = 0$                             |
| Input Capacitance                            | $C_{ibo}$     | —        | —      | 25         | pF                 | $V_{EB} = 0.5V, f = 1.0MHz, I_C = 0$                            |
| Current Gain-Bandwidth Product               | $f_T$         | 300      | —      | —          | MHz                | $V_{CE} = 20V, I_C = 20mA, f = 100MHz$                          |
| Noise Figure                                 | NF            | —        | —      | 4.0        | dB                 | $V_{CE} = 10V, I_C = 100\mu A, R_S = 1.0k\Omega, f = 1.0kHz$    |
| Input Impedance                              | $h_{ie}$      | 0.25     | —      | 1.25       | k $\Omega$         | $I_C = 10mA, V_{CE} = 10V, f = 1.0kHz$                          |
| Voltage Feedback Ratio                       | $h_{re}$      | —        | —      | 4.0        | X 10 <sup>-4</sup> |   |
| Small-Signal Current Gain                    | $h_{fe}$      | 75       | —      | 375        | —                  |   |
| Output Admittance                            | $h_{oe}$      | 25       | —      | 200        | $\mu S$            |   |
| SWITCHING CHARACTERISTICS (Note 6)           |               |          |        |            |                    |   |
| Delay Time                                   | $t_d$         | —        | —      | 10         | nS                 | $V_{CC} = 30V, V_{BE(off)} = -0.5V, I_C = 150mA, I_{B1} = 15mA$ |
| Rise Time                                    | $t_r$         | —        | —      | 25         |                    | $V_{CC} = 30V, I_C = 150mA, I_{B1} = I_{B2} = 15mA$             |
| Storage Time                                 | $t_s$         | —        | —      | 225        |                    |   |
| Fall Time                                    | $t_f$         | —        | —      | 60         |                    |   |

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

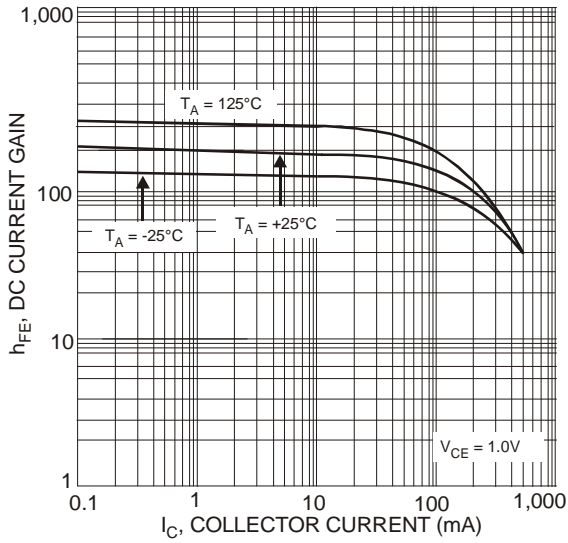


Figure 4 Typical DC Current Gain vs. Collector Current

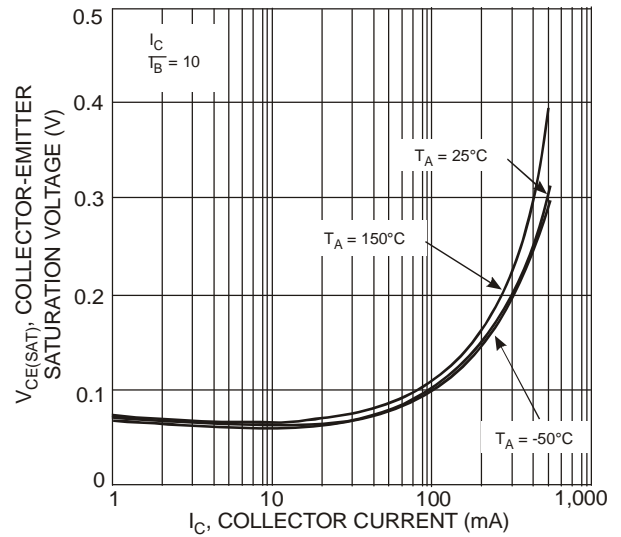


Figure 5 Typical Collector-Emitter Saturation Voltage vs. Collector Current

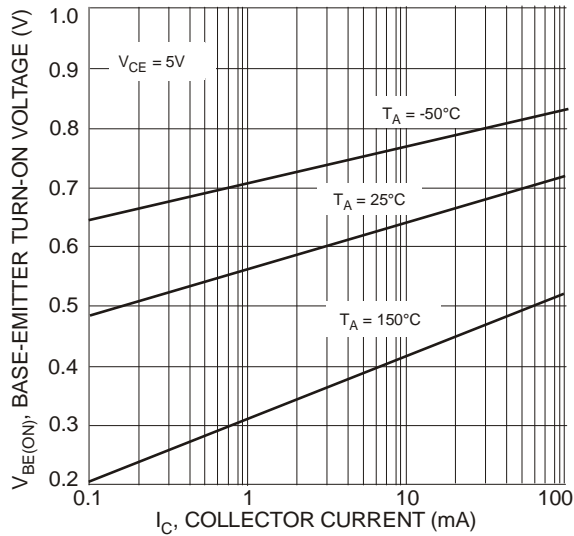


Figure 6 Typical Base-Emitter Turn-On Voltage vs. Collector Current

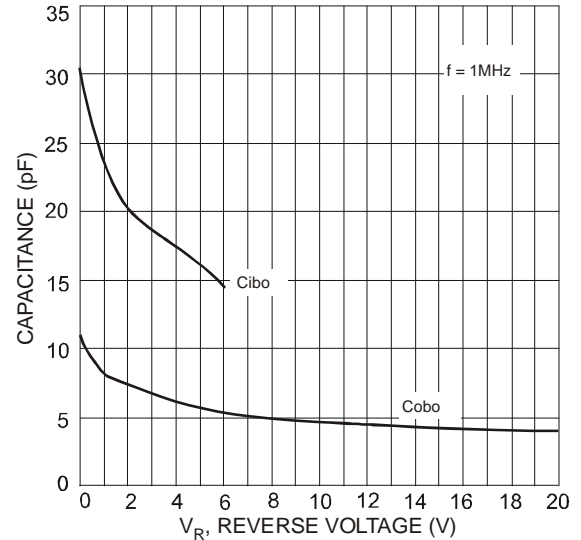


Figure 7 Typical Capacitance Characteristics

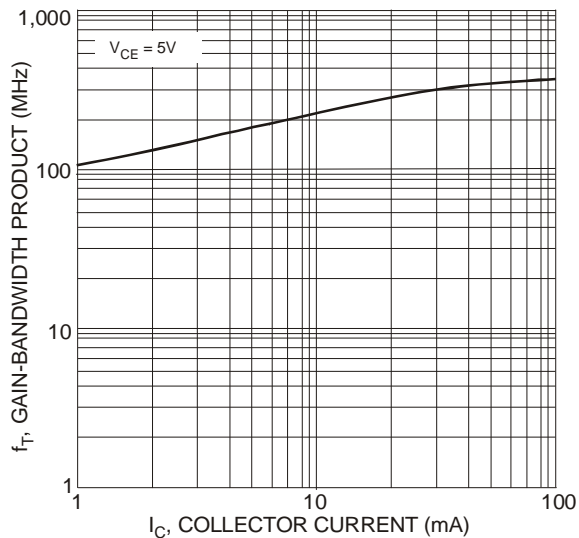


Figure 8 Typical Gain-Bandwidth Product vs. Collector Current

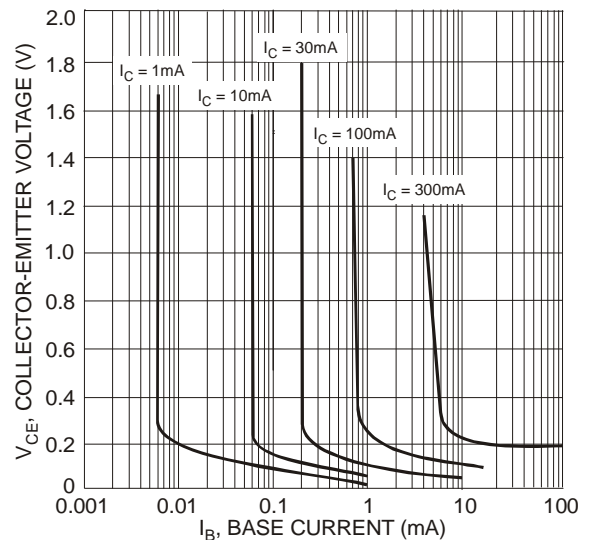
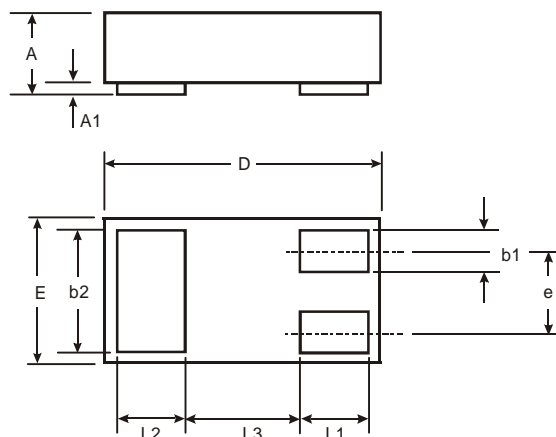


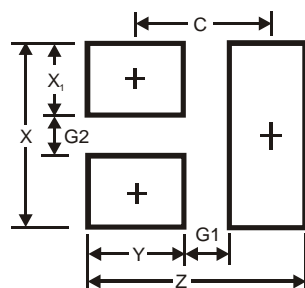
Figure 9 Typical Collector Saturation Region

## 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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