

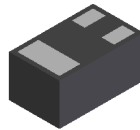
### Features

- 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**

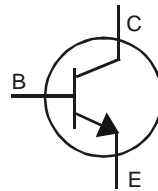
### Mechanical Data

- 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)

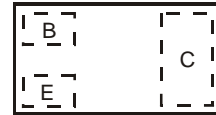
X2-DFN1006-3



Bottom View



Device Symbol

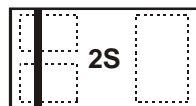

 Top View  
Device Schematic

### 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.)

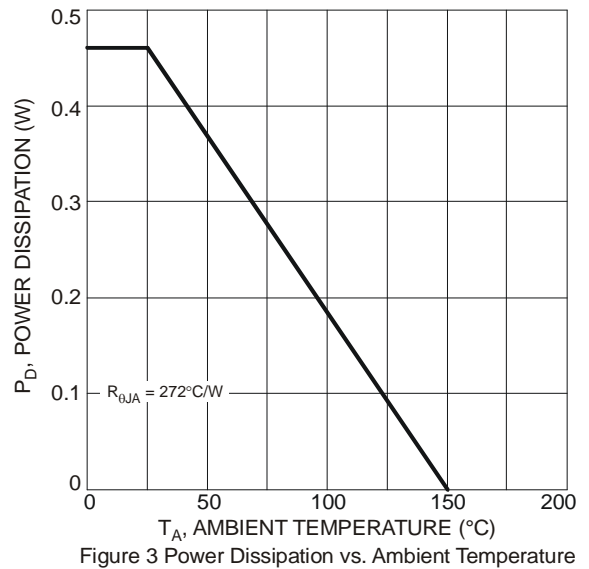
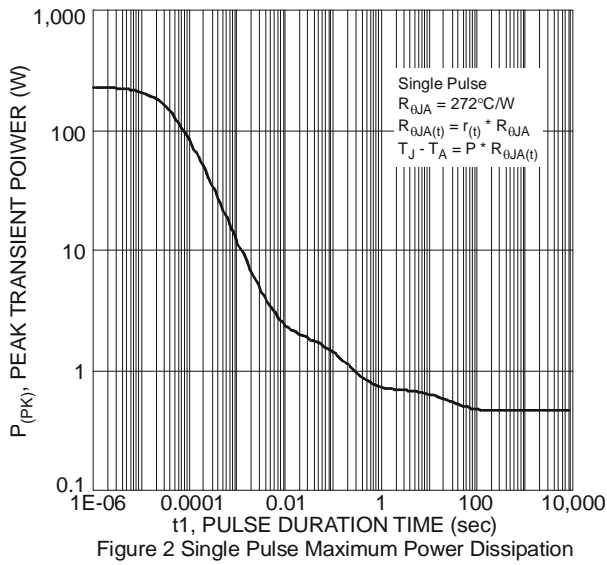
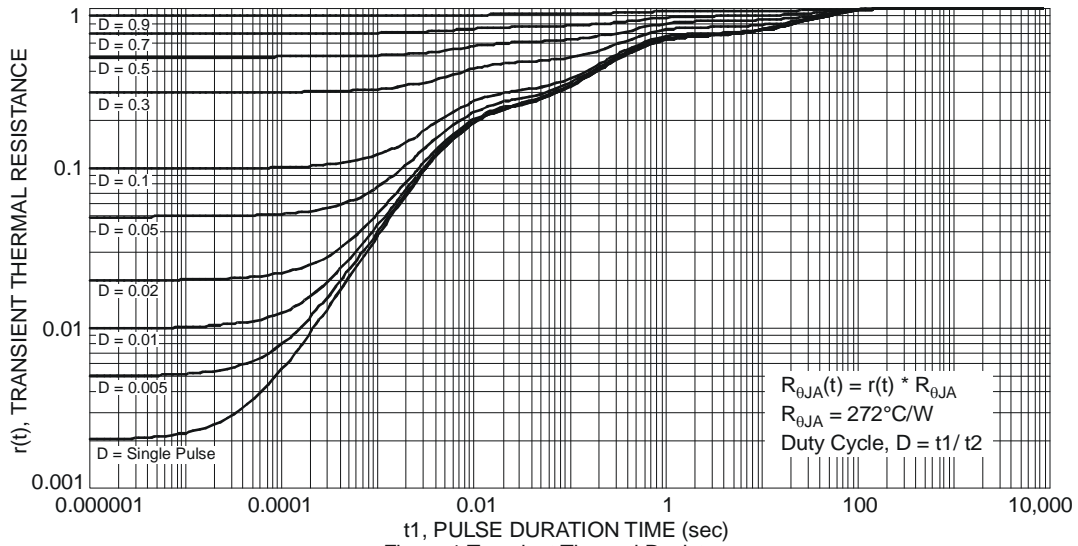
Characteristic	Symbol	Value	Unit
Power Dissipation (Note 5)	P <sub>D</sub>	460	mW
Power Dissipation (Note 6)	P <sub>D</sub>	1	W
Thermal Resistance, Junction to Ambient (Note 5)	R <sub>θJA</sub>	272	°C/W
Thermal Resistance, Junction to Ambient (Note 6)	R <sub>θJA</sub>	120	°C/W
Thermal Resistance, Junction 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>CBO</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>CBO</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, 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%.

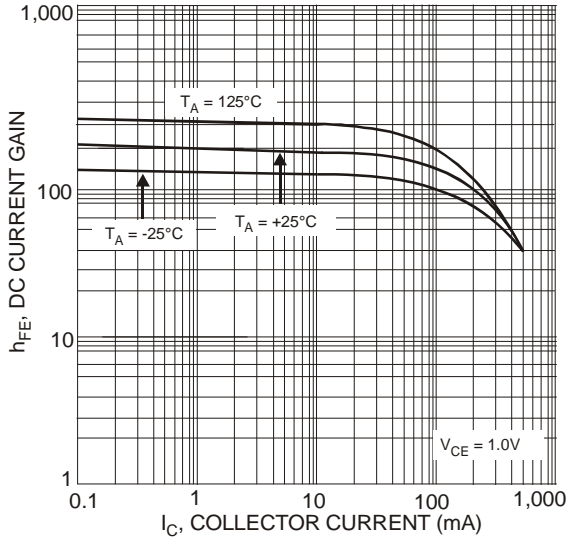


Figure 4 Typical DC Current Gain vs. Collector Current

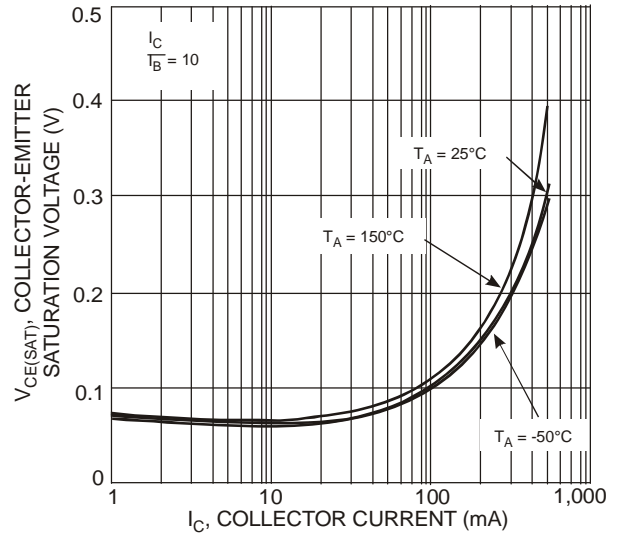


Figure 5 Typical Collector-Emitter Saturation Voltage vs. Collector Current

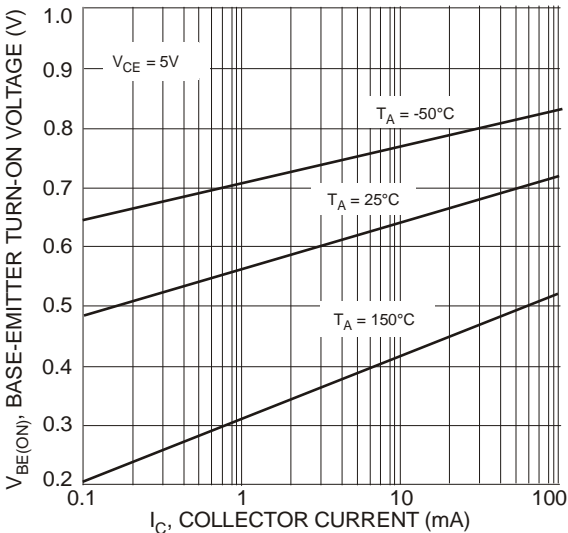


Figure 6 Typical Base-Emitter Turn-On Voltage vs. Collector Current

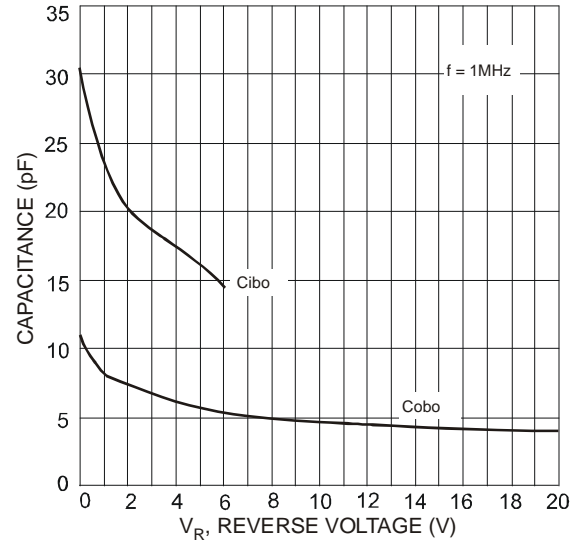


Figure 7 Typical Capacitance Characteristics

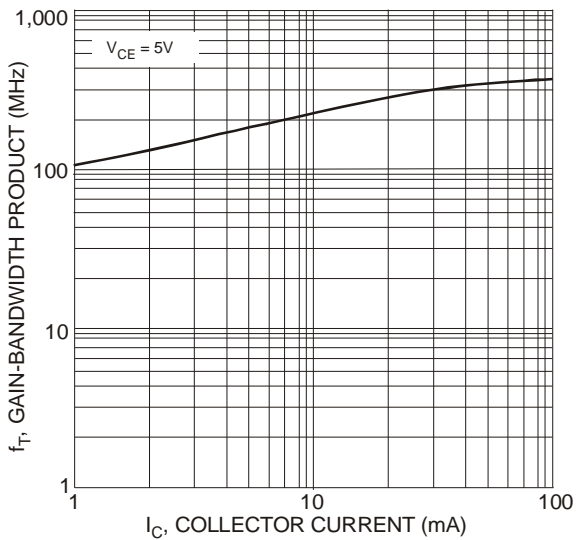


Figure 8 Typical Gain-Bandwidth Product vs. Collector Current

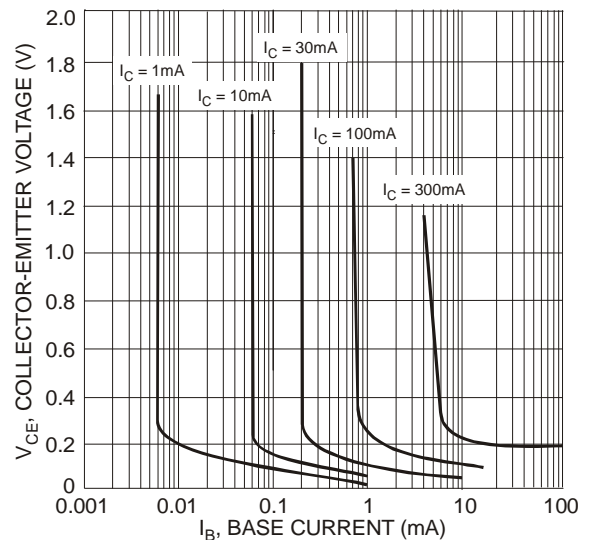
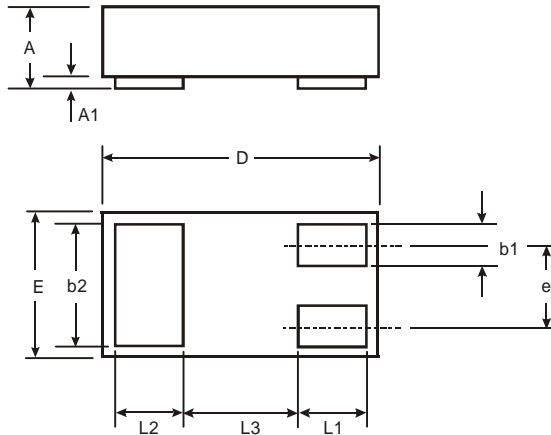


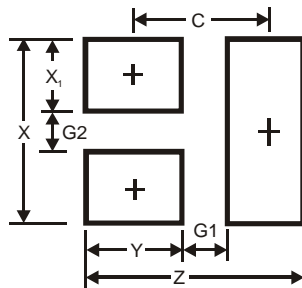
Figure 9 Typical Collector Saturation Region

**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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