

**60V COMPLEMENTARY NPN/PNP LOW VCE(sat) TRANSISTOR**
**Features**

- Complementary NPN/PNP
- NPN Transistor
  - $BV_{CEO} > 60V$
  - $I_C = 1A$  high Continuous Collector Current
  - Low Saturation Voltage  $V_{CE(sat)} < 220mV @ 1A$
- PNP Transistor
  - $BV_{CEO} > -60V$
  - $I_C = -1A$  high Continuous Collector Current
  - Low Saturation Voltage  $V_{CE(sat)} < -340mV @ -1A$
- $P_D$  up to 2.47W for power demanding applications
- $R_{\theta JA}$  efficient, 40% lower than SOT26
- Low profile 0.6mm high package for thin applications
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

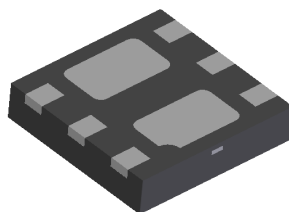
**Mechanical Data**

- Case: U-DFN2020-6
- UL Flammability Rating 94V-0
- Case Material: Molded Plastic. "Green" Molding Compound.
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish — NiPdAu, Solderable per MIL-STD-202, Method 208 <sup>(e4)</sup>
- Weight: 0.0065 grams (Approximate)

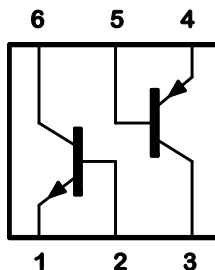
**Application**

- Gate Driving
- Load Switches
- Power Management
- Charging Circuits
- Power Switches (e.g. Motors, Fans)

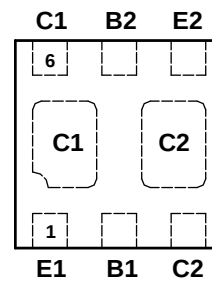
U-DFN2020-6



Bottom View



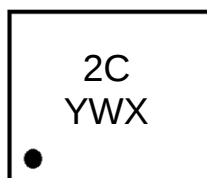
Device Symbol


 Top View  
Pin-Out

**Ordering Information** (Note 4)

| Product       | Marking | Reel size (inches) | Tape width (mm) | Quantity per reel |
|---------------|---------|--------------------|-----------------|-------------------|
| DSS45160FDB-7 | 2C      | 7                  | 8               | 3,000             |

- 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**


2C = Product type Marking Code  
 Y = Year: 0~9  
 W = Week: A~Z : 1~26 week;  
   a~z; 27~52 week; z represents  
   52 and 53 week  
 X = A~Z: Internal code

**Absolute Maximum Ratings – Q1 and Q2** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic               | Symbol           | NPN | PNP  | Unit |
|------------------------------|------------------|-----|------|------|
| Collector-Base Voltage       | V <sub>CB0</sub> | 60  | -60  | V    |
| Collector-Emitter Voltage    | V <sub>CEO</sub> | 60  | -60  | V    |
| Emitter-Base Voltage         | V <sub>EBO</sub> | 7   | -7   | V    |
| Continuous Collector Current | I <sub>C</sub>   | 1   | -1   | A    |
| Peak Pulse Collector Current | I <sub>CM</sub>  | 1.5 | -1.5 | A    |
| Base Current                 | I <sub>B</sub>   | 300 | -300 | mA   |
| Peak Base Current            | I <sub>BM</sub>  | 1   | -1   | A    |

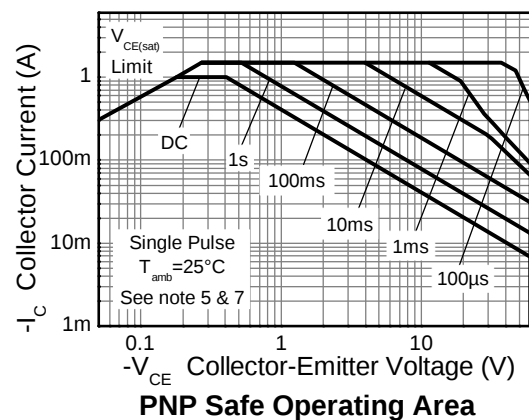
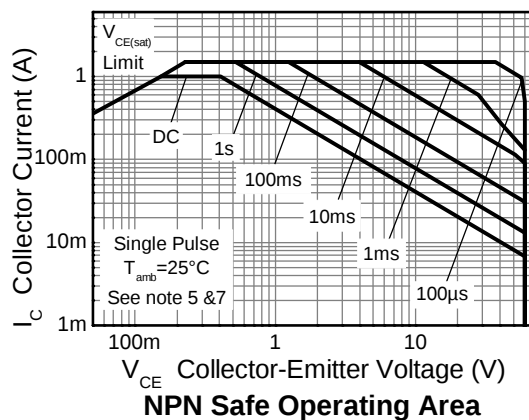
**Thermal Characteristics** (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Characteristic                          | Symbol                            | Value       | Unit |
|-----------------------------------------|-----------------------------------|-------------|------|
| Power Dissipation                       | P <sub>D</sub>                    | 405         | mW   |
|                                         |                                   | 510         |      |
|                                         |                                   | 1650        |      |
|                                         |                                   | 2470        |      |
| Thermal Resistance, Junction to Ambient | R <sub>θJA</sub>                  | 308         | °C/W |
|                                         |                                   | 245         |      |
|                                         |                                   | 76          |      |
|                                         |                                   | 51          |      |
| Thermal Resistance, Junction to Lead    | R <sub>θJL</sub>                  | 18          | °C/W |
| Operating and Storage Temperature Range | T <sub>J</sub> , T <sub>STG</sub> | -55 to +150 | °C   |

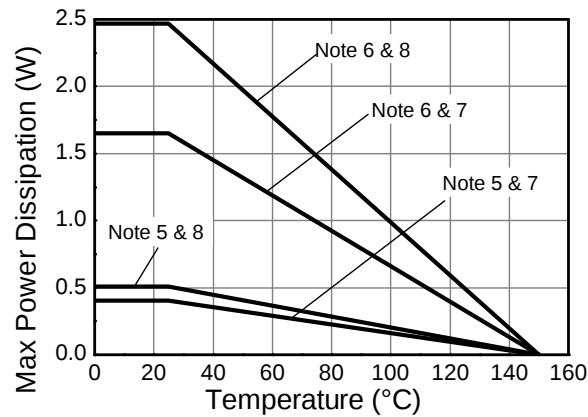
**ESD Ratings** (Note 10)

| Characteristic                             | Symbol  | Value | Unit | JEDEC Class |
|--------------------------------------------|---------|-------|------|-------------|
| Electrostatic Discharge – Human Body Model | ESD HBM | 4,000 | V    | 3A          |
| Electrostatic Discharge – Machine Model    | ESD MM  | 400   | V    | C           |

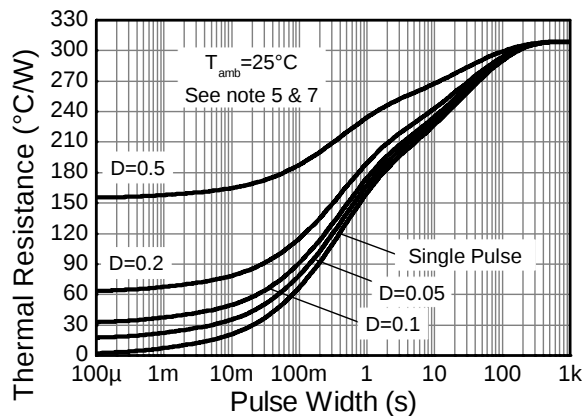
- Notes:
- For a device mounted with the exposed collector pads on minimum recommended pad layout that is on a single-sided 1.6mm FR4 PCB; device is measured under still air conditions whilst operating in a steady-state.
  - Same as note (5), except the device is mounted with the collector pad on 28mm x 28mm (8cm<sup>2</sup>) 2oz copper.
  - For a dual device with one active die.
  - For dual device with 2 active die running at equal power.
  - Thermal resistance from junction to solder-point (on the exposed collector pads).
  - Refer to JEDEC specification JESD22-A114 and JESD22-A115.

**Thermal Characteristics and Derating Information**


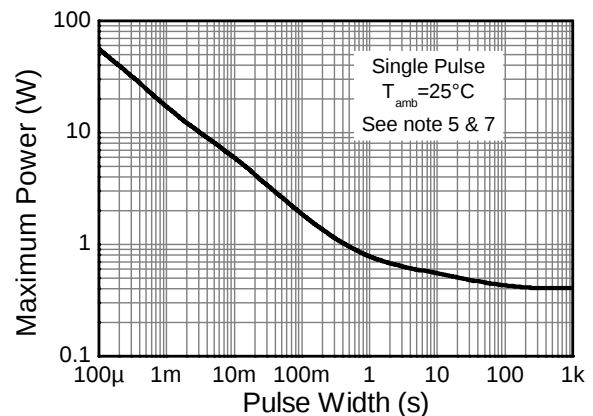
## Thermal Characteristics and Derating Information



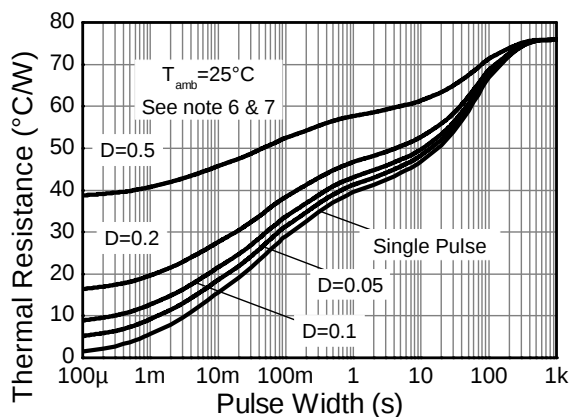
**Derating Curve**



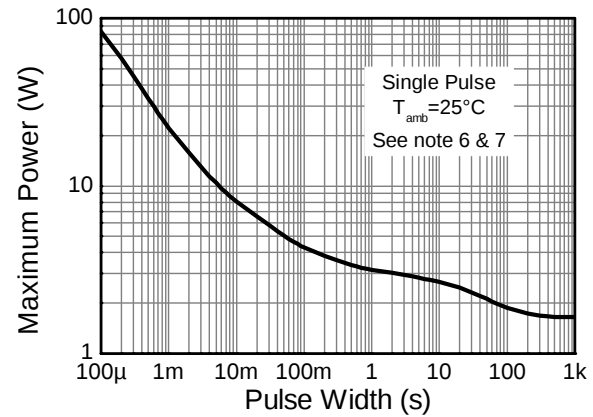
**Transient Thermal Impedance**



**Pulse Power Dissipation**



**Transient Thermal Impedance**



**Pulse Power Dissipation**

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

| Characteristic                                 | Symbol               | Min | Typ | Max | Unit | Test Conditions                                                                           |
|------------------------------------------------|----------------------|-----|-----|-----|------|-------------------------------------------------------------------------------------------|
| Collector-Base Breakdown Voltage               | BV <sub>CBO</sub>    | 60  | —   | —   | V    | I <sub>C</sub> = 100μA                                                                    |
| Collector-Emitter Breakdown Voltage (Note 11)  | BV <sub>CEO</sub>    | 60  | —   | —   | V    | I <sub>C</sub> = 10mA                                                                     |
| Emitter-Base Breakdown Voltage                 | BV <sub>EBO</sub>    | 7   | —   | —   | V    | I <sub>E</sub> = 100μA                                                                    |
| Collector-Base Cutoff Current                  | I <sub>CBO</sub>     | —   | —   | 100 | nA   | V <sub>CB</sub> = 48V, I <sub>E</sub> = 0                                                 |
|                                                |                      | —   | —   | 50  | μA   | V <sub>CB</sub> = 48V, I <sub>E</sub> = 0, T <sub>A</sub> = +150°C                        |
| Emitter-Base Cutoff Current                    | I <sub>EBO</sub>     | —   | —   | 100 | nA   | V <sub>EB</sub> = 5.6V, I <sub>C</sub> = 0                                                |
| DC Current Gain (Note 11)                      | h <sub>FE</sub>      | 290 | 430 | —   | —    | V <sub>CE</sub> = 2V, I <sub>C</sub> = 100mA                                              |
|                                                |                      | 150 | 220 | —   |      | V <sub>CE</sub> = 2V, I <sub>C</sub> = 500mA                                              |
|                                                |                      | 70  | 110 | —   |      | V <sub>CE</sub> = 2V, I <sub>C</sub> = 1A                                                 |
| Collector-Emitter Saturation Voltage (Note 11) | V <sub>CE(sat)</sub> | —   | 90  | 120 | mV   | I <sub>C</sub> = 500mA, I <sub>B</sub> = 50mA                                             |
|                                                |                      | —   | 170 | 220 |      | I <sub>C</sub> = 1A, I <sub>B</sub> = 100mA                                               |
|                                                |                      | —   | 185 | 240 |      | I <sub>C</sub> = 1A, I <sub>B</sub> = 50mA                                                |
| Equivalent On-Resistance (Note 11)             | R <sub>CE(sat)</sub> | —   | 180 | 240 | mΩ   | I <sub>C</sub> = 500mA, I <sub>B</sub> = 50mA                                             |
| Base-Emitter Saturation Voltage (Note 11)      | V <sub>BE(sat)</sub> | —   | —   | 1   | V    | I <sub>C</sub> = 0.5A, I <sub>B</sub> = 50mA                                              |
|                                                |                      | —   | —   | 1.1 |      | I <sub>C</sub> = 1A, I <sub>B</sub> = 50mA                                                |
|                                                |                      | —   | —   | 1.1 |      | I <sub>C</sub> = 1A, I <sub>B</sub> = 100mA                                               |
| Base-Emitter Turn-on Voltage (Note 11)         | V <sub>BE(on)</sub>  | —   | —   | 0.9 | V    | V <sub>CE</sub> = 2V, I <sub>C</sub> = 0.5A                                               |
| Transition Frequency                           | f <sub>T</sub>       | 90  | 175 | —   | MHz  | V <sub>CE</sub> = 10V, I <sub>C</sub> = 50mA, f = 100MHz                                  |
| Output (Collector) Capacitance                 | C <sub>ob(c)</sub>   | —   | 4   | 6   | pF   | V <sub>CB</sub> = -10V, f = 1MHz                                                          |
| Turn-On Time                                   | t <sub>on</sub>      | —   | 105 | —   | ns   | V <sub>CC</sub> = -10V, I <sub>C</sub> = -0.5A, I <sub>B1</sub> = -I <sub>B2</sub> = 25mA |
| Delay Time                                     | t <sub>d</sub>       | —   | 15  | —   | ns   |                                                                                           |
| Rise Time                                      | t <sub>r</sub>       | —   | 90  | —   | ns   |                                                                                           |
| Turn-Off Time                                  | t <sub>off</sub>     | —   | 540 | —   | ns   |                                                                                           |
| Storage Time                                   | t <sub>s</sub>       | —   | 410 | —   | ns   |                                                                                           |
| Fall Time                                      | t <sub>f</sub>       | —   | 130 | —   | ns   |                                                                                           |

Note: 11. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.

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

| Characteristic                                 | Symbol               | Min | Typ | Max  | Unit | Test Conditions                                                                           |
|------------------------------------------------|----------------------|-----|-----|------|------|-------------------------------------------------------------------------------------------|
| Collector-Base Breakdown Voltage               | BV <sub>CBO</sub>    | -60 | —   | —    | V    | I <sub>C</sub> = -100μA                                                                   |
| Collector-Emitter Breakdown Voltage (Note 11)  | BV <sub>CEO</sub>    | -60 | —   | —    | V    | I <sub>C</sub> = -10mA                                                                    |
| Emitter-Base Breakdown Voltage                 | BV <sub>EBO</sub>    | -7  | —   | —    | V    | I <sub>E</sub> = -100μA                                                                   |
| Collector-Base Cutoff Current                  | I <sub>CBO</sub>     | —   | —   | -100 | nA   | V <sub>CB</sub> = -48V, I <sub>E</sub> = 0                                                |
|                                                |                      | —   | —   | -50  | μA   | V <sub>CB</sub> = -48V, I <sub>E</sub> = 0, T <sub>A</sub> = +150°C                       |
| Emitter-Base Cutoff Current                    | I <sub>EBO</sub>     | —   | —   | -100 | nA   | V <sub>EB</sub> = -5.6V, I <sub>C</sub> = 0                                               |
| DC Current Gain (Note 11)                      | h <sub>FE</sub>      | 170 | —   | —    | —    | V <sub>CE</sub> = -2V, I <sub>C</sub> = -100mA                                            |
|                                                |                      | 120 | —   | —    |      | V <sub>CE</sub> = -2V, I <sub>C</sub> = -500mA                                            |
|                                                |                      | 70  | —   | —    |      | V <sub>CE</sub> = -2V, I <sub>C</sub> = -1A                                               |
| Collector-Emitter Saturation Voltage (Note 11) | V <sub>CE(sat)</sub> | —   | —   | -180 | mV   | I <sub>C</sub> = -500mA, I <sub>B</sub> = -50mA                                           |
|                                                |                      | —   | —   | -340 |      | I <sub>C</sub> = -1A, I <sub>B</sub> = -100mA                                             |
|                                                |                      | —   | —   | -550 |      | I <sub>C</sub> = -1A, I <sub>B</sub> = -50mA                                              |
| Equivalent On-Resistance (Note 11)             | R <sub>CE(sat)</sub> | —   | —   | 360  | mΩ   | I <sub>C</sub> = -500mA, I <sub>B</sub> = -50mA                                           |
| Base-Emitter Saturation Voltage (Note 11)      | V <sub>BE(sat)</sub> | —   | —   | -1   | V    | I <sub>C</sub> = -0.5A, I <sub>B</sub> = -50mA                                            |
|                                                |                      | —   | —   | -1.0 |      | I <sub>C</sub> = -1A, I <sub>B</sub> = -50mA                                              |
|                                                |                      | —   | —   | -1.1 |      | I <sub>C</sub> = -1A, I <sub>B</sub> = -100mA                                             |
| Base-Emitter Turn-on Voltage (Note 11)         | V <sub>BE(on)</sub>  | —   | —   | -0.9 | V    | V <sub>CE</sub> = -2V, I <sub>C</sub> = -0.5A                                             |
| Transition Frequency                           | f <sub>T</sub>       | 65  | —   | —    | MHz  | V <sub>CE</sub> = -10V, I <sub>C</sub> = -50mA, f = 100MHz                                |
| Output Capacitance                             | C <sub>ob</sub>      | —   | —   | 15   | pF   | V <sub>CB</sub> = -10V, f = 1MHz                                                          |
| Turn-On Time                                   | t <sub>on</sub>      | —   | 75  | —    | ns   | V <sub>CC</sub> = -10V, I <sub>C</sub> = -0.5A, I <sub>B1</sub> = -I <sub>B2</sub> = 25mA |
| Delay Time                                     | t <sub>d</sub>       | —   | 35  | —    | ns   |                                                                                           |
| Rise Time                                      | t <sub>r</sub>       | —   | 40  | —    | ns   |                                                                                           |
| Turn-Off Time                                  | t <sub>off</sub>     | —   | 265 | —    | ns   |                                                                                           |
| Storage Time                                   | t <sub>s</sub>       | —   | 230 | —    | ns   |                                                                                           |
| Fall Time                                      | t <sub>f</sub>       | —   | 35  | —    | ns   |                                                                                           |

Note: 11. Measured under pulsed conditions. Pulse width ≤ 300μs. Duty cycle ≤ 2%.

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

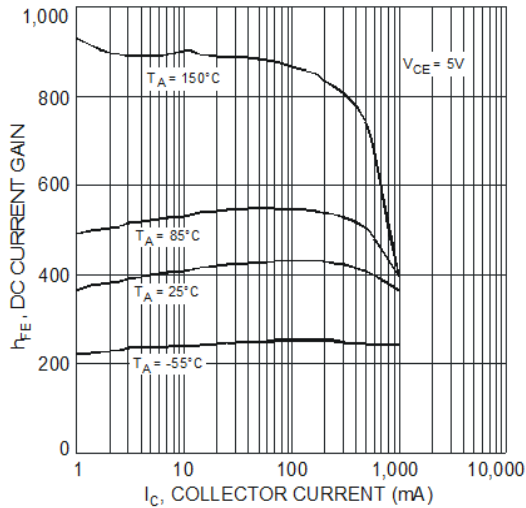


Fig. 1 Typical DC Current Gain vs. Collector Current

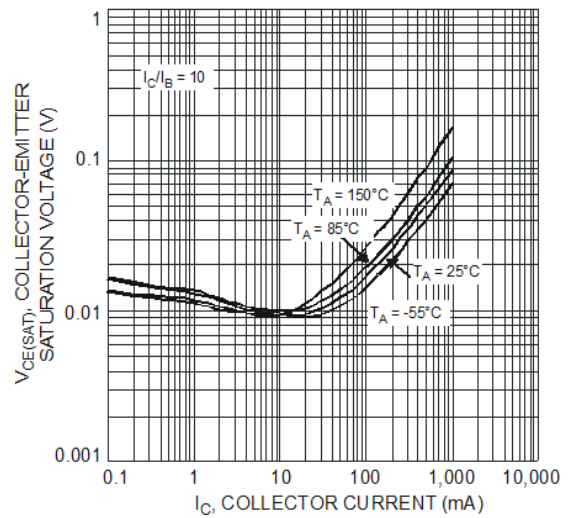


Fig. 2 Typical Collector-Emitter Saturation Voltage vs. Collector Current

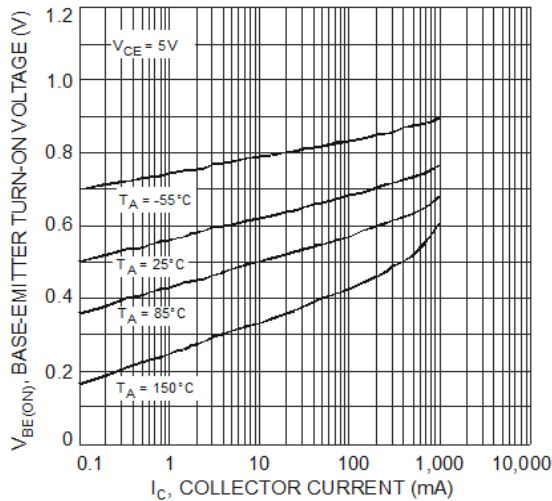


Fig. 3 Typical Base-Emitter Turn-On Voltage vs. Collector Current

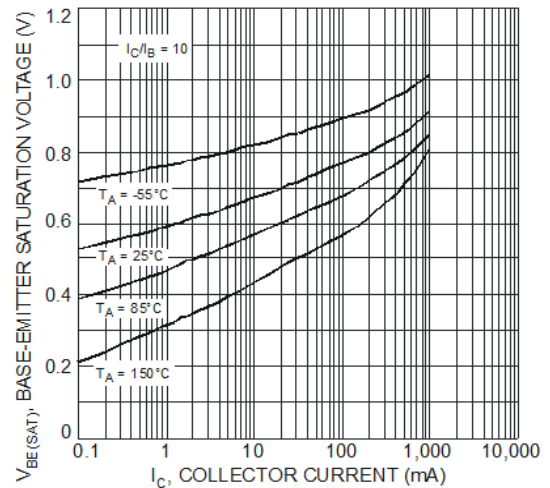


Fig. 4 Typical Base-Emitter Saturation Voltage vs. Collector Current

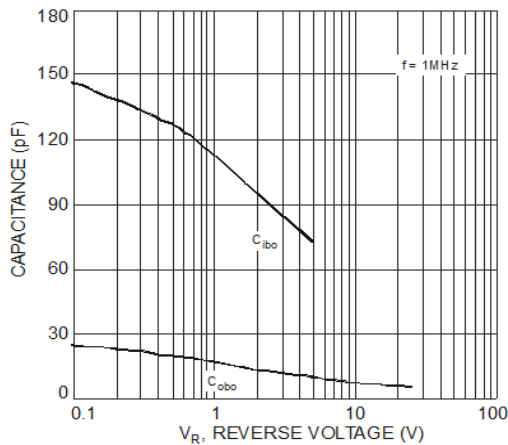
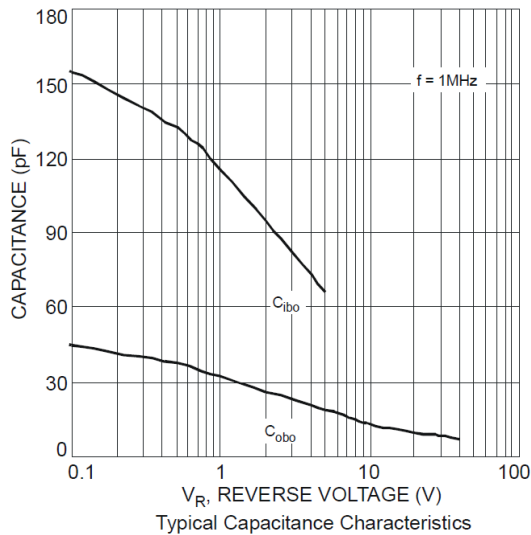
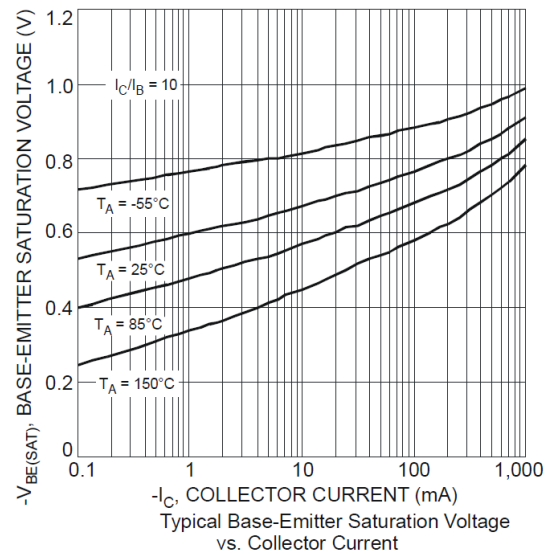
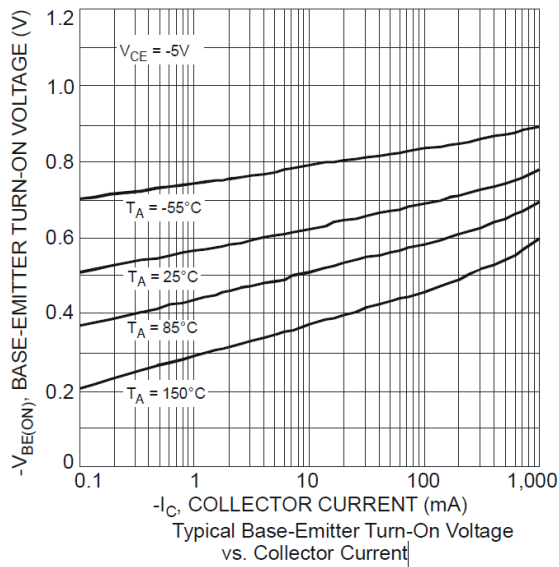
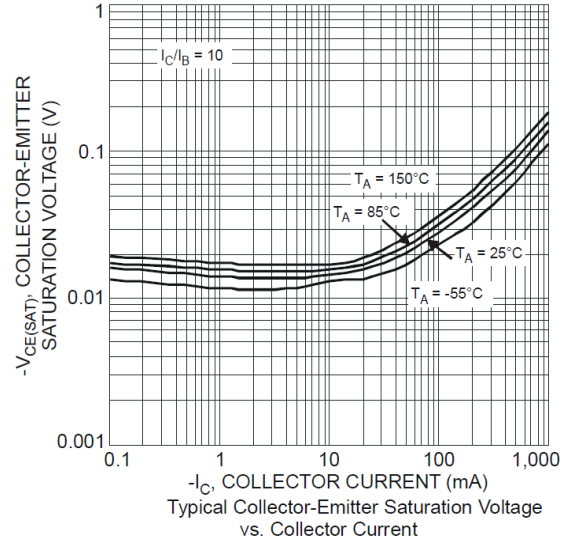
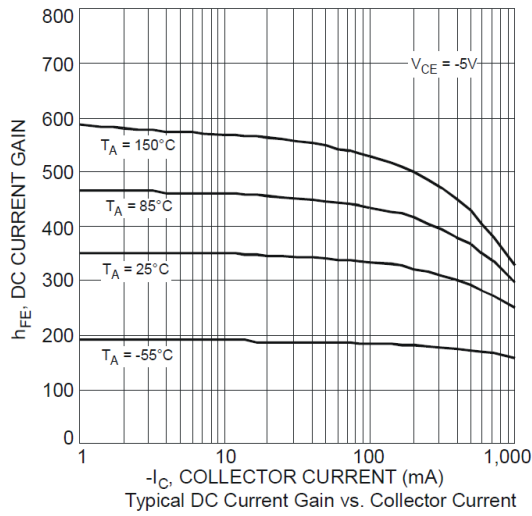


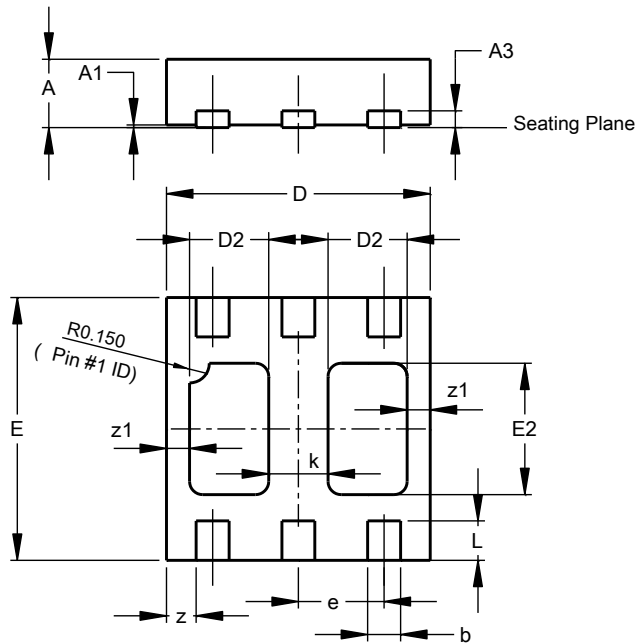
Fig. 5 Typical Capacitance Characteristics

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



## Package Outline Dimensions

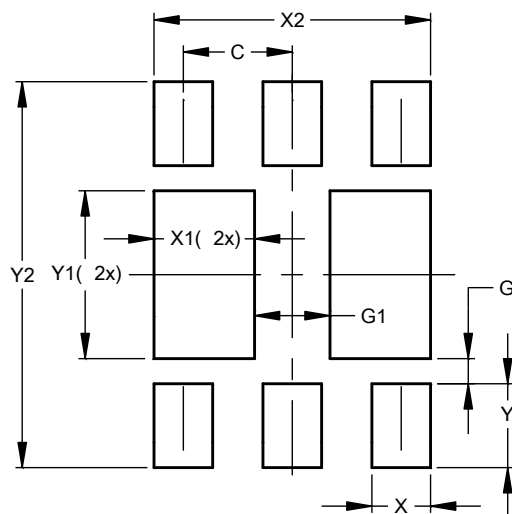
Please see AP02001 at [http://www.diodes.com/\\_files/datasheets/ap02001.pdf](http://www.diodes.com/_files/datasheets/ap02001.pdf) for the latest version.



| U-DFN2020-6          |       |       |       |
|----------------------|-------|-------|-------|
| Type B               |       |       |       |
| Dim                  | Min   | Max   | Typ   |
| A                    | 0.545 | 0.605 | 0.575 |
| A1                   | 0.00  | 0.05  | 0.02  |
| A3                   | -     | -     | 0.13  |
| b                    | 0.20  | 0.30  | 0.25  |
| D                    | 1.95  | 2.075 | 2.00  |
| D2                   | 0.50  | 0.70  | 0.60  |
| e                    | -     | -     | 0.65  |
| E                    | 1.95  | 2.075 | 2.00  |
| E2                   | 0.90  | 1.10  | 1.00  |
| k                    | -     | -     | 0.45  |
| L                    | 0.25  | 0.35  | 0.30  |
| z                    | -     | -     | 0.225 |
| z1                   | -     | -     | 0.175 |
| All Dimensions in mm |       |       |       |

## Suggested Pad Layout

Please see AP02001 at [http://www.diodes.com/\\_files/datasheets/ap02001.pdf](http://www.diodes.com/_files/datasheets/ap02001.pdf) for the latest version.



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 0.650         |
| G          | 0.150         |
| G1         | 0.450         |
| X          | 0.350         |
| X1         | 0.600         |
| X2         | 1.650         |
| Y          | 0.500         |
| Y1         | 1.000         |
| Y2         | 2.300         |

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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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