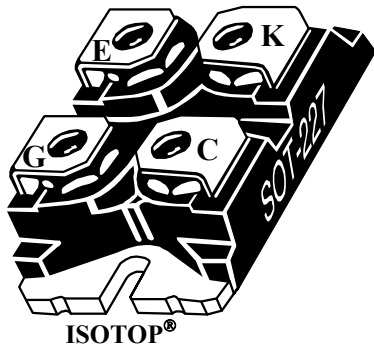
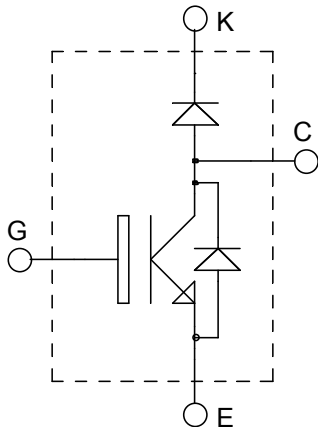


ISOTOP<sup>®</sup> Boost chopper  
Trench + Field Stop IGBT3

V<sub>CES</sub> = 1200V  
I<sub>C</sub> = 50A @ T<sub>c</sub> = 80°C



### Application

- AC and DC motor control
- Switched Mode Power Supplies
- Power Factor Correction
- Brake switch

### Features

- Trench + Field Stop IGBT3 Technology
  - Low voltage drop
  - Low tail current
  - Switching frequency up to 20 kHz
  - Soft recovery parallel diodes
  - Low diode VF
  - Low leakage current
  - RBSOA and SCSOA rated
- ISOTOP<sup>®</sup> Package (SOT-227)
- Very low stray inductance
- High level of integration

### Benefits

- Low conduction losses
- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Easy paralleling due to positive T<sub>C</sub> of V<sub>CEsat</sub>
- RoHS Compliant

### Absolute maximum ratings

| Symbol            | Parameter                                   | Max ratings           | Unit |
|-------------------|---|-----------------------|------|
| V <sub>CES</sub>  | Collector - Emitter Breakdown Voltage       | 1200                  | V    |
| I <sub>C1</sub>   | Continuous Collector Current                | T <sub>C</sub> = 25°C | 75   |
| I <sub>C2</sub>   |   | T <sub>C</sub> = 80°C | 50   |
| I <sub>CM</sub>   |   | T <sub>C</sub> = 25°C | 100  |
| V <sub>GE</sub>   | Gate - Emitter Voltage                      | ±20                   | V    |
| P <sub>D</sub>    | Maximum Power Dissipation                   | T <sub>C</sub> = 25°C | 347  |
| IF <sub>AV</sub>  | Maximum Average Forward Current             | Duty cycle=0.5        | A    |
| IF <sub>RMS</sub> | RMS Forward Current (Square wave, 50% duty) | T <sub>C</sub> = 80°C |      |
|                   |   |                       | 34   |

**CAUTION:** These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.

All ratings @  $T_j = 25^\circ\text{C}$  unless otherwise specified

**Electrical Characteristics**

| <i>Symbol</i> | <i>Characteristic</i>                | <i>Test Conditions</i>                        | <i>Min</i>  | <i>Typ</i> | <i>Max</i> | <i>Unit</i> |
|---------------|--------------------------------------|---|---|------------|------------|-------------|
| $I_{CES}$     | Zero Gate Voltage Collector Current  | $V_{GE} = 0\text{V}, V_{CE} = 1200\text{V}$   |   |            | 5          | mA          |
| $V_{CE(sat)}$ | Collector Emitter saturation Voltage | $V_{GE} = 15\text{V}$<br>$I_C = 50\text{A}$   | $T_j = 25^\circ\text{C}$<br>$T_j = 125^\circ\text{C}$ | 1.4<br>2.0 | 2.1        | V           |
| $V_{GE(th)}$  | Gate Threshold Voltage               | $V_{GE} = V_{CE}, I_C = 2\text{mA}$           |   | 5.0        | 6.5        | V           |
| $I_{GES}$     | Gate – Emitter Leakage Current       | $V_{GE} = \pm 20\text{V}, V_{CE} = 0\text{V}$ |   |            | 500        | nA          |

**Dynamic Characteristics**

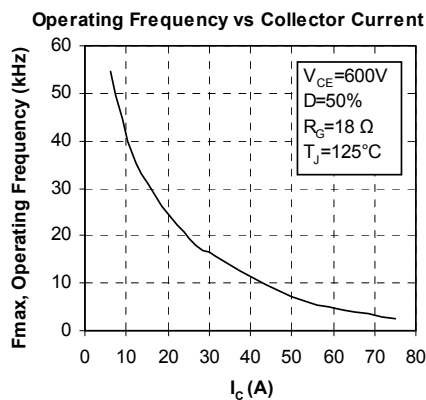
| <i>Symbol</i> | <i>Characteristic</i>        | <i>Test Conditions</i>                           | <i>Min</i> | <i>Typ</i> | <i>Max</i> | <i>Unit</i> |
|---------------|------------------------------|--|------------|------------|------------|-------------|
| $C_{ies}$     | Input Capacitance            | $V_{GE} = 0\text{V}$                             |            | 3600       |            | pF          |
| $C_{oes}$     | Output Capacitance           | $V_{CE} = 25\text{V}$                            |            | 188        |            |             |
| $C_{res}$     | Reverse Transfer Capacitance | $f = 1\text{MHz}$                                |            | 163        |            |             |
| $T_{d(on)}$   | Turn-on Delay Time           | Resistive Switching ( $25^\circ\text{C}$ )       |            | 85         |            | ns          |
| $T_r$         | Rise Time                    | $V_{GE} = 15\text{V}$<br>$V_{Bus} = 600\text{V}$ |            | 30         |            |             |
| $T_{d(off)}$  | Turn-off Delay Time          | $I_C = 50\text{A}$                               |            | 420        |            |             |
| $T_f$         | Fall Time                    | $R_G = 18\Omega$                                 |            | 65         |            |             |
| $T_{d(on)}$   | Turn-on Delay Time           | Inductive Switching ( $125^\circ\text{C}$ )      |            | 90         |            | ns          |
| $T_r$         | Rise Time                    | $V_{GE} = 15\text{V}$<br>$V_{Bus} = 600\text{V}$ |            | 45         |            |             |
| $T_{d(off)}$  | Turn-off Delay Time          | $I_C = 50\text{A}$                               |            | 520        |            |             |
| $T_f$         | Fall Time                    | $R_G = 18\Omega$                                 |            | 90         |            |             |
| $E_{on}$      | Turn-on Switching Energy     |  |            | 6.6        |            | mJ          |
| $E_{off}$     | Turn-off Switching Energy    |  |            | 5.8        |            |             |

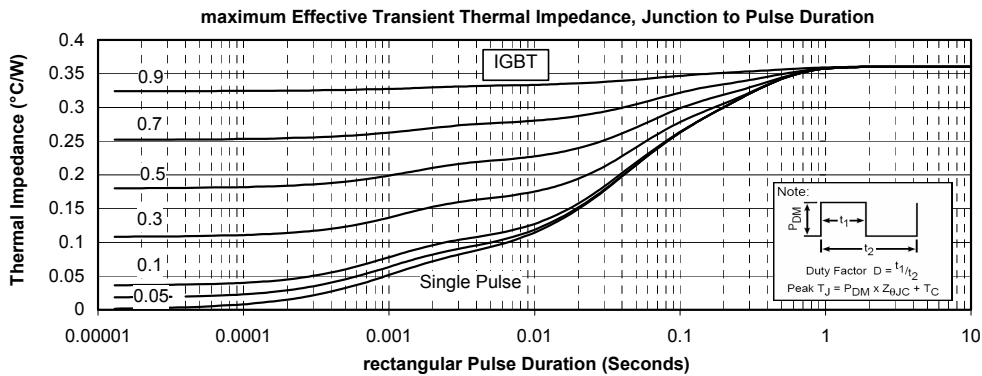
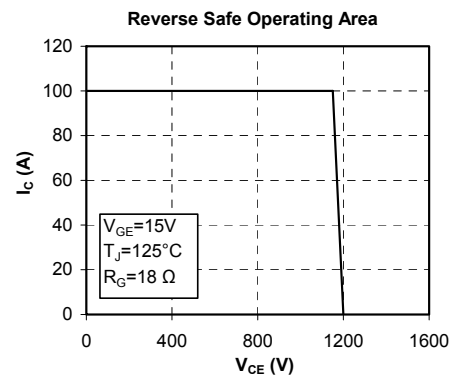
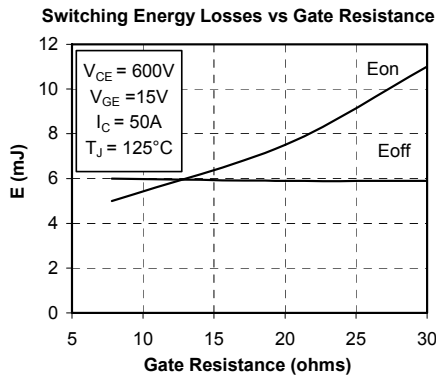
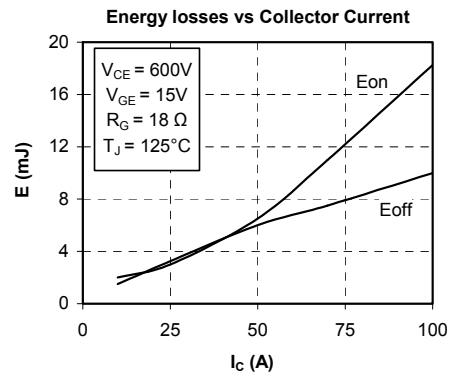
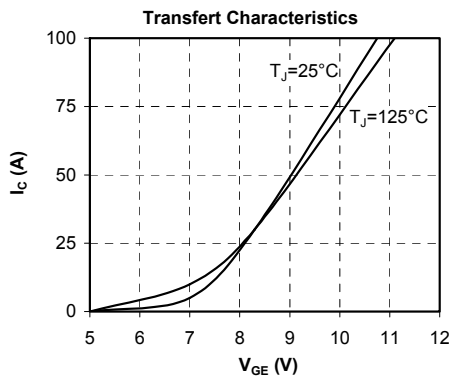
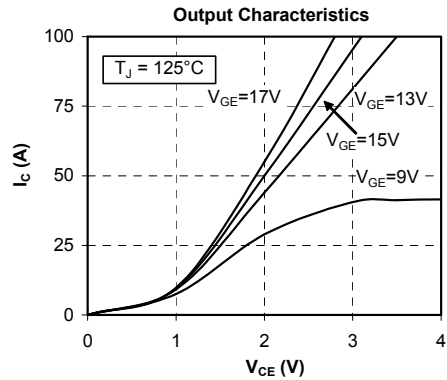
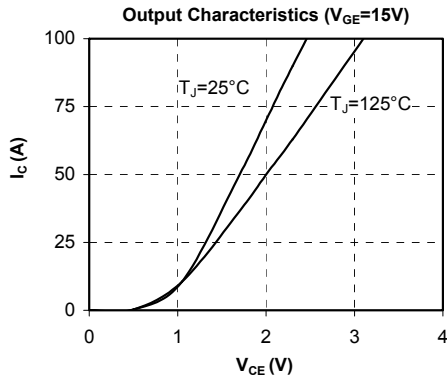
**Chopper diode ratings and characteristics**

| Symbol           | Characteristic                   | Test Conditions  | Min                    | Typ  | Max | Unit |
|------------------|----------------------------------|--|------------------------|------|-----|------|
| V <sub>F</sub>   | Diode Forward Voltage            | I <sub>F</sub> = 30A   |                        | 2.0  | 2.5 | V    |
|                  |                                  | I <sub>F</sub> = 60A   |                        | 2.3  |     |      |
|                  |                                  | I <sub>F</sub> = 30A   | T <sub>j</sub> = 125°C | 1.8  |     |      |
| I <sub>RM</sub>  | Maximum Reverse Leakage Current  | V <sub>R</sub> = 1200V   | T <sub>j</sub> = 25°C  |      | 250 | μA   |
|                  |                                  | V <sub>R</sub> = 1200V   | T <sub>j</sub> = 125°C |      | 500 |      |
| C <sub>T</sub>   | Junction Capacitance             | V <sub>R</sub> = 200V  |                        | 32   |     | pF   |
| t <sub>rr</sub>  | Reverse Recovery Time            | I <sub>F</sub> = 1A, V <sub>R</sub> = 30V<br>di/dt = 100A/μs     | T <sub>j</sub> = 25°C  | 31   |     | ns   |
|                  | Reverse Recovery Time            |  | T <sub>j</sub> = 25°C  | 370  |     |      |
|                  |                                  |  | T <sub>j</sub> = 125°C | 500  |     |      |
| I <sub>RRM</sub> | Maximum Reverse Recovery Current | I <sub>F</sub> = 30A<br>V <sub>R</sub> = 800V<br>di/dt = 200A/μs | T <sub>j</sub> = 25°C  | 5    |     | A    |
|                  |                                  |  | T <sub>j</sub> = 125°C | 12   |     |      |
|                  |                                  |  | T <sub>j</sub> = 25°C  | 660  |     |      |
| Q <sub>rr</sub>  | Reverse Recovery Charge          |  | T <sub>j</sub> = 25°C  | 3450 |     | nC   |
|                  |                                  |  | T <sub>j</sub> = 125°C |      |     |      |
| t <sub>rr</sub>  | Reverse Recovery Time            | I <sub>F</sub> = 30A   | T <sub>j</sub> = 125°C | 220  |     | ns   |
| Q <sub>rr</sub>  | Reverse Recovery Charge          | V <sub>R</sub> = 800V  |                        | 4650 |     | nC   |
| I <sub>RRM</sub> | Maximum Reverse Recovery Current | di/dt = 1000A/μs   |                        | 37   |     | A    |

**Thermal and package characteristics**

| Symbol                            | Characteristic   | Min   | Typ  | Max  | Unit |
|-----------------------------------|--|-------|------|------|------|
| R <sub>thJC</sub>                 | Junction to Case Thermal Resistance  | IGBT  |      | 0.36 | °C/W |
|                                   |  | Diode |      | 1.1  |      |
| R <sub>thJA</sub>                 | Junction to Ambient (IGBT & Diode)   |       |      | 20   |      |
| V <sub>ISOL</sub>                 | RMS Isolation Voltage, any terminal to case t = 1 min, 50/60Hz               | 2500  |      |      | V    |
| T <sub>J</sub> , T <sub>STG</sub> | Storage Temperature Range  | -55   |      | 150  | °C   |
| T <sub>L</sub>                    | Max Lead Temp for Soldering: 0.063" from case for 10 sec                     |       |      | 300  |      |
| Torque                            | Mounting torque (Mounting = 8-32 or 4mm Machine and terminals = 4mm Machine) |       |      | 1.5  | N.m  |
| Wt                                | Package Weight   |       | 29.2 |      | g    |

**Typical IGBT Performance Curve**




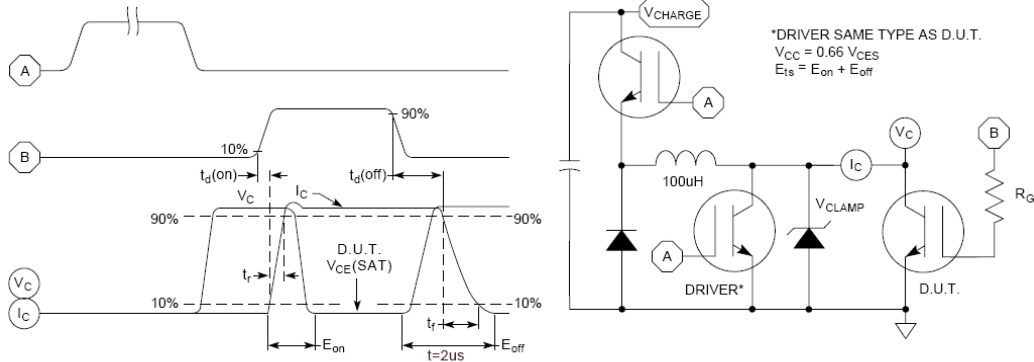


Figure 15, Switching Loss Test Circuit and Waveforms

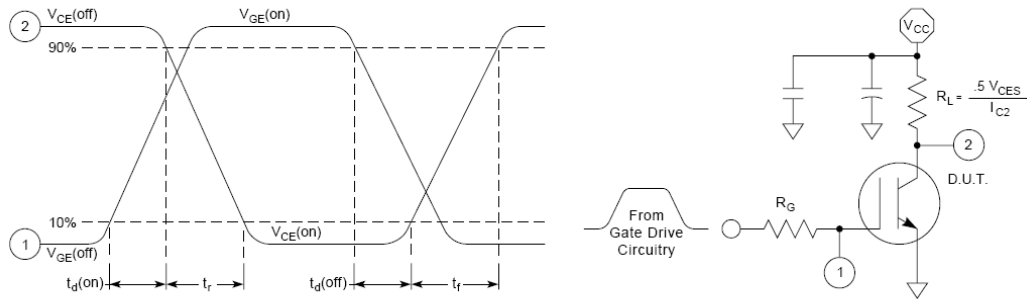


Figure 16, Resistive Switching Time Test Circuit and Waveforms

## Typical Diode Performance Curve

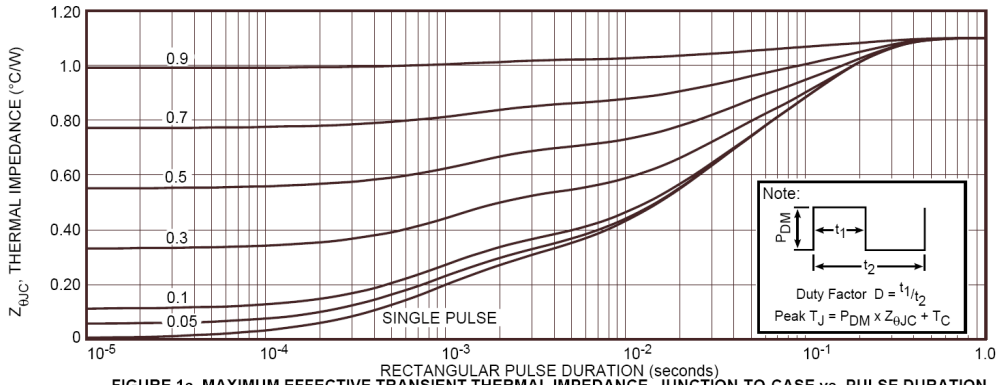


FIGURE 1a. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

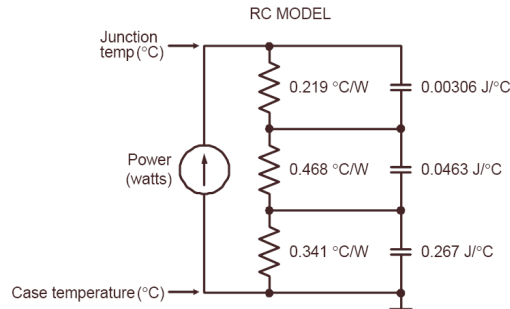


FIGURE 1b, TRANSIENT THERMAL IMPEDANCE MODEL

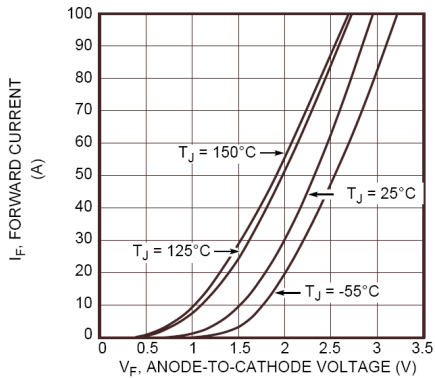


Figure 2. Forward Current vs. Forward Voltage

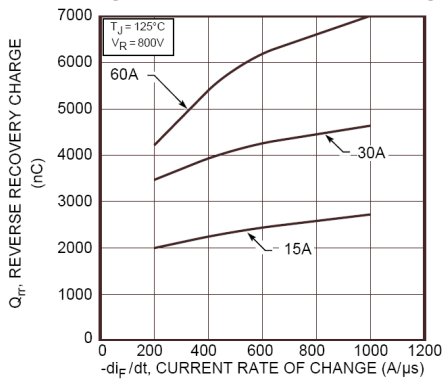


Figure 4. Reverse Recovery Charge vs. Current Rate of Change

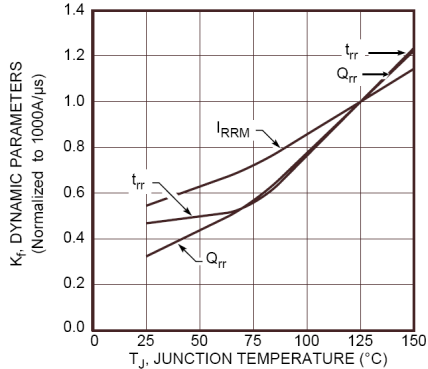


Figure 6. Dynamic Parameters vs. Junction Temperature

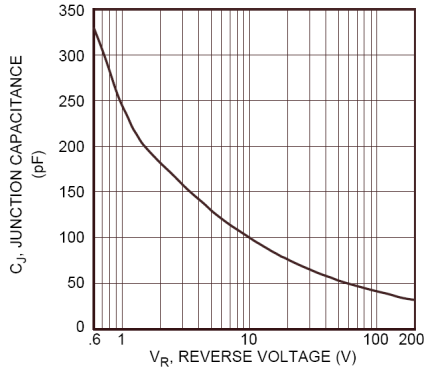


Figure 8. Junction Capacitance vs. Reverse Voltage

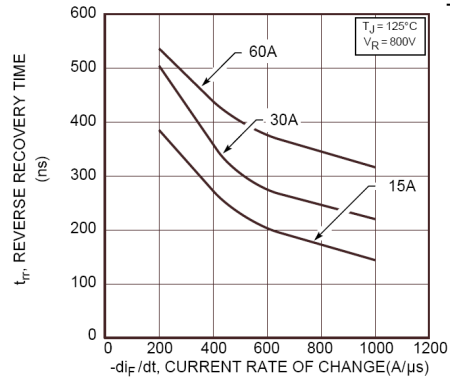


Figure 3. Reverse Recovery Time vs. Current Rate of Change

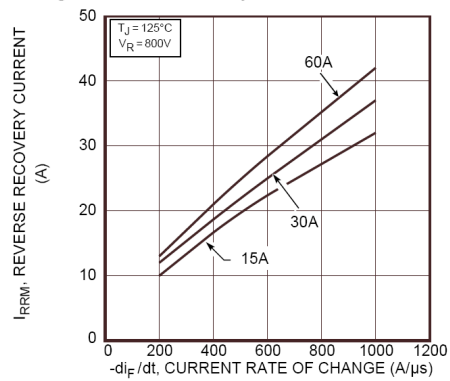


Figure 5. Reverse Recovery Current vs. Current Rate of Change

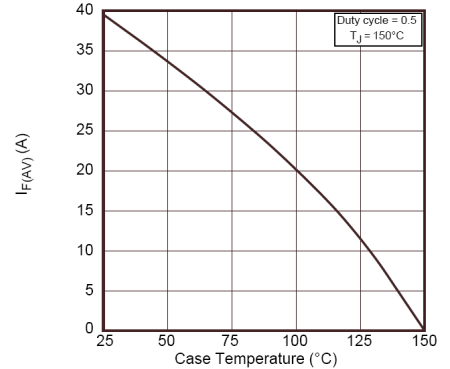


Figure 7. Maximum Average Forward Current vs. Case Temperature

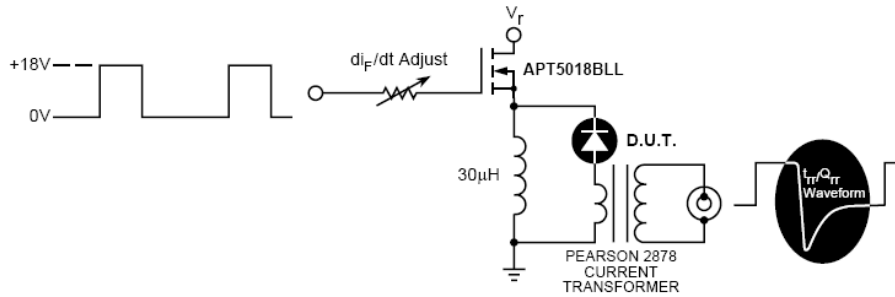


Figure 9. Diode Test Circuit

- 1  $I_F$  - Forward Conduction Current
- 2  $di_F/dt$  - Rate of Diode Current Change Through Zero Crossing.
- 3  $I_{RRM}$  - Maximum Reverse Recovery Current.
- 4  $t_{rr}$  - Reverse Recovery Time, measured from zero crossing where diode current goes from positive to negative, to the point at which the straight line through  $I_{RRM}$  and  $0.25 \cdot I_{RRM}$  passes through zero.
- 5  $Q_{rr}$  - Area Under the Curve Defined by  $I_{RRM}$  and  $t_{rr}$ .

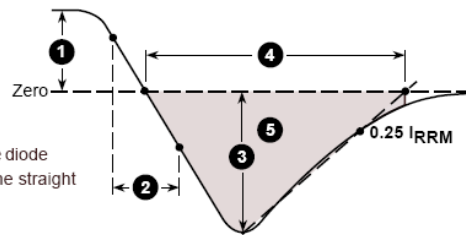
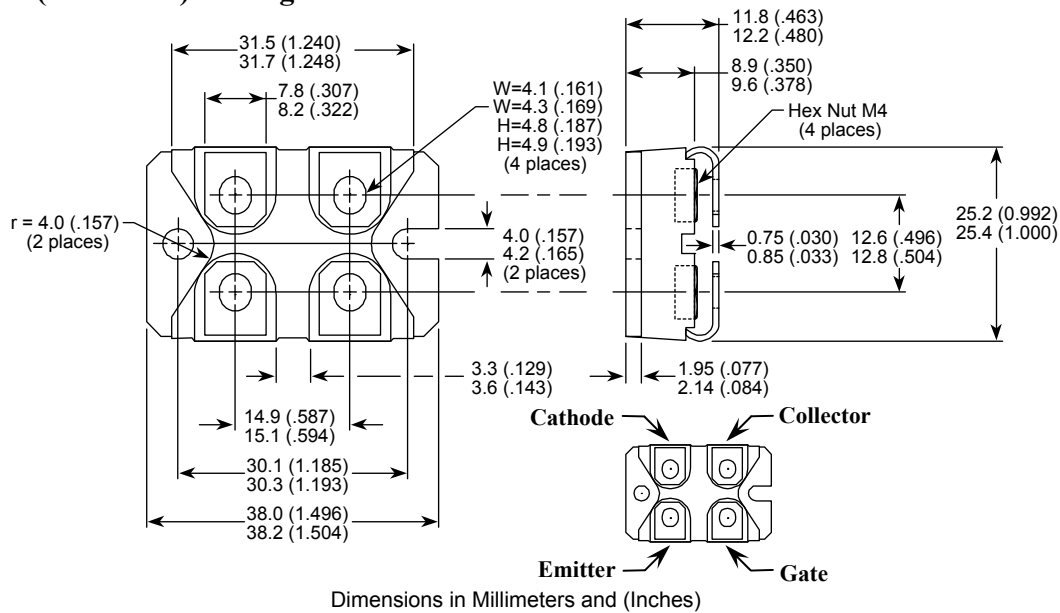


Figure 10. Diode Reverse Recovery Waveform and Definitions

## SOT-227 (ISOTOP<sup>®</sup>) Package Outline



ISOTOP<sup>®</sup> is a registered trademark of ST Microelectronics NV

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