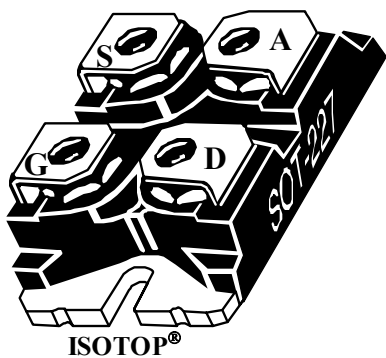
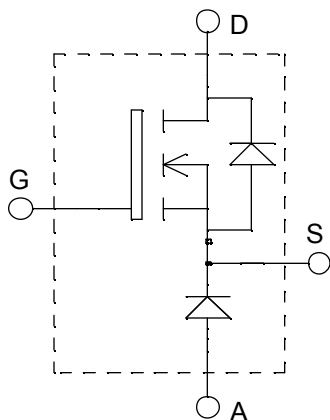


## ISOTOP<sup>®</sup> Buck chopper MOSFET Power Module

$$V_{DSS} = 500V$$

$$R_{DSon} = 75m\Omega \text{ max @ } T_j = 25^{\circ}C$$

$$I_D = 51A \text{ @ } T_c = 25^{\circ}C$$



### Application

- AC and DC motor control
- Switched Mode Power Supplies

### Features

- Power MOS 7<sup>®</sup> MOSFETs
  - Low  $R_{DSon}$
  - Low input and Miller capacitance
  - Low gate charge
  - Fast intrinsic reverse diode
  - Avalanche energy rated
  - Very rugged
- ISOTOP<sup>®</sup> Package (SOT-227)
- Very low stray inductance
- High level of integration

### Benefits

- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Very rugged
- Low profile
- RoHS Compliant

### Absolute maximum ratings

| Symbol        | Parameter                                         |                     |                     | Max ratings | Unit       |
|---------------|---------------------------------------------------|---------------------|---------------------|-------------|------------|
| $V_{DSS}$     | Drain - Source Breakdown Voltage                  |                     |                     | 500         | V          |
| $I_D$         | Continuous Drain Current                          | $T_c = 25^{\circ}C$ |                     | 51          | A          |
|               |                                                   | $T_c = 80^{\circ}C$ |                     | 39          |            |
| $I_{DM}$      | Pulsed Drain current                              |                     |                     | 204         |            |
| $V_{GS}$      | Gate - Source Voltage                             |                     |                     | $\pm 30$    | V          |
| $R_{DSon}$    | Drain - Source ON Resistance                      |                     |                     | 75          | m $\Omega$ |
| $P_D$         | Maximum Power Dissipation                         | $T_c = 25^{\circ}C$ |                     | 290         | W          |
| $I_{AR}$      | Avalanche current (repetitive and non repetitive) |                     |                     | 51          | A          |
| $E_{AR}$      | Repetitive Avalanche Energy                       |                     |                     | 50          | mJ         |
| $E_{AS}$      | Single Pulse Avalanche Energy                     |                     |                     | 2500        |            |
| $I_{F_{AV}}$  | Maximum Average Forward Current                   | Duty cycle=0.5      | $T_c = 80^{\circ}C$ | 30          | A          |
| $I_{F_{RMS}}$ | RMS Forward Current (Square wave, 50% duty)       |                     |                     | 39          |            |



**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**

| Symbol       | Characteristic                  | Test Conditions                                        | Min | Typ | Max       | Unit             |
|--------------|---------------------------------|--------------------------------------------------------|-----|-----|-----------|------------------|
| $I_{DSS}$    | Zero Gate Voltage Drain Current | $V_{GS} = 0V, V_{DS} = 500V$ $T_j = 25^\circ\text{C}$  |     |     | 100       | $\mu\text{A}$    |
|              |                                 | $V_{GS} = 0V, V_{DS} = 400V$ $T_j = 125^\circ\text{C}$ |     |     | 500       |                  |
| $R_{DS(on)}$ | Drain – Source on Resistance    | $V_{GS} = 10V, I_D = 25.5A$                            |     |     | 75        | $\text{m}\Omega$ |
| $V_{GS(th)}$ | Gate Threshold Voltage          | $V_{GS} = V_{DS}, I_D = 1\text{mA}$                    | 3   |     | 5         | V                |
| $I_{GSS}$    | Gate – Source Leakage Current   | $V_{GS} = \pm 20V, V_{DS} = 0V$                        |     |     | $\pm 100$ | nA               |

**Dynamic Characteristics**

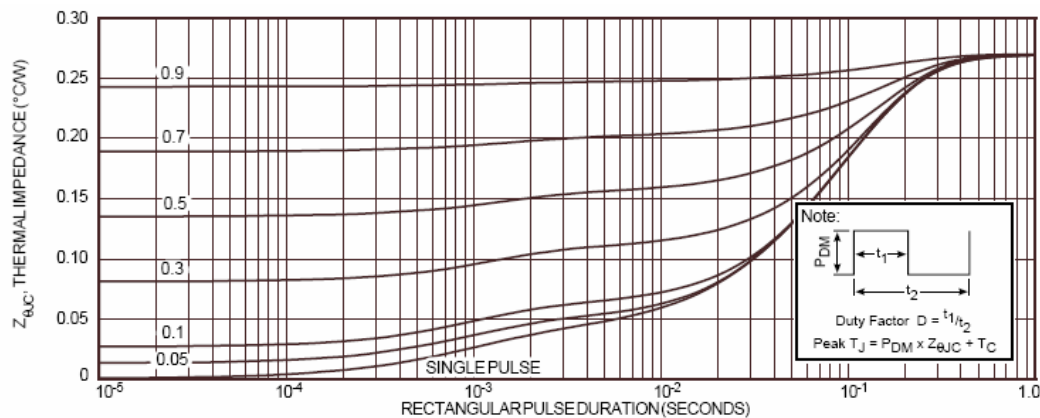
| Symbol       | Characteristic               | Test Conditions                                                                                                             | Min | Typ  | Max | Unit          |
|--------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----|------|-----|---------------|
| $C_{iss}$    | Input Capacitance            | $V_{GS} = 0V$                                                                                                               |     | 5590 |     | pF            |
| $C_{oss}$    | Output Capacitance           | $V_{DS} = 25V$                                                                                                              |     | 1180 |     |               |
| $C_{rss}$    | Reverse Transfer Capacitance | $f = 1\text{MHz}$                                                                                                           |     | 85   |     |               |
| $Q_g$        | Total gate Charge            | $V_{GS} = 10V$                                                                                                              |     | 123  |     | nC            |
| $Q_{gs}$     | Gate – Source Charge         | $V_{Bus} = 250V$                                                                                                            |     | 33   |     |               |
| $Q_{gd}$     | Gate – Drain Charge          | $I_D = 51A$                                                                                                                 |     | 65   |     |               |
| $T_{d(on)}$  | Turn-on Delay Time           | <b>Resistive Switching</b><br>$V_{GS} = 15V$<br>$V_{Bus} = 250V$<br>$I_D = 51A$<br>$R_G = 0.6\Omega$                        |     | 10   |     | ns            |
| $T_r$        | Rise Time                    |                                                                                                                             |     | 20   |     |               |
| $T_{d(off)}$ | Turn-off Delay Time          |                                                                                                                             |     | 21   |     |               |
| $T_f$        | Fall Time                    |                                                                                                                             |     | 5    |     |               |
| Eon          | Turn-on Switching Energy     | <b>Inductive switching @ <math>25^\circ\text{C}</math></b><br>$V_{GS} = 15V, V_{Bus} = 330V$<br>$I_D = 51A, R_G = 5\Omega$  |     | 755  |     | $\mu\text{J}$ |
| Eoff         | Turn-off Switching Energy    |                                                                                                                             |     | 726  |     |               |
| Eon          | Turn-on Switching Energy     | <b>Inductive switching @ <math>125^\circ\text{C}</math></b><br>$V_{GS} = 15V, V_{Bus} = 330V$<br>$I_D = 51A, R_G = 5\Omega$ |     | 1241 |     | $\mu\text{J}$ |
| Eoff         | Turn-off Switching Energy    |                                                                                                                             |     | 846  |     |               |

**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                                            |                        |                        | 1.6                    | 1.8 | V    |    |
|                  |                                  | I <sub>F</sub> = 60A                                            |                        |                        | 1.9                    |     |      |    |
|                  |                                  | I <sub>F</sub> = 30A                                            | T <sub>j</sub> = 125°C |                        | 1.4                    |     |      |    |
| I <sub>RM</sub>  | Maximum Reverse Leakage Current  | V <sub>R</sub> = 600V                                           | T <sub>j</sub> = 25°C  |                        |                        | 250 | μA   |    |
|                  |                                  | V <sub>R</sub> = 600V                                           | T <sub>j</sub> = 125°C |                        |                        | 500 |      |    |
| C <sub>T</sub>   | Junction Capacitance             | V <sub>R</sub> = 200V                                           |                        |                        | 44                     |     | 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  |                        | 23                     |     | ns   |    |
|                  | Reverse Recovery Time            | I <sub>F</sub> = 30A<br>V <sub>R</sub> = 400V<br>di/dt =200A/μs | T <sub>j</sub> = 25°C  |                        | 85                     |     |      |    |
|                  |                                  |                                                                 | T <sub>j</sub> = 125°C |                        | 160                    |     |      |    |
| I <sub>RRM</sub> | Maximum Reverse Recovery Current |                                                                 | T <sub>j</sub> = 25°C  |                        | 4                      | A   |      |    |
|                  |                                  |                                                                 | T <sub>j</sub> = 125°C |                        | 8                      |     |      |    |
| Q <sub>rr</sub>  | Reverse Recovery Charge          |                                                                 |                        |                        | T <sub>j</sub> = 25°C  |     | 130  | nC |
|                  |                                  |                                                                 |                        |                        | T <sub>j</sub> = 125°C |     | 700  |    |
| t <sub>rr</sub>  | Reverse Recovery Time            |                                                                 | I <sub>F</sub> = 30A   | T <sub>j</sub> = 125°C |                        | 70  |      | ns |
| Q <sub>rr</sub>  | Reverse Recovery Charge          | V <sub>R</sub> = 400V                                           |                        |                        | 1300                   |     | nC   |    |
| I <sub>RRM</sub> | Maximum Reverse Recovery Current | di/dt =1000A/μs                                                 |                        |                        | 30                     |     | A    |    |

**Thermal and package characteristics**

| Symbol         | Characteristic                                                                      |        | Min  | Typ  | Max  | Unit         |
|----------------|-------------------------------------------------------------------------------------|--------|------|------|------|--------------|
| $R_{thJC}$     | Junction to Case Thermal Resistance                                                 | MOSFET |      |      | 0.27 | $^\circ C/W$ |
|                |                                                                                     | Diode  |      |      | 1.21 |              |
| $R_{thJA}$     | Junction to Ambient (IGBT & Diode)                                                  |        |      |      | 20   | $^\circ C/W$ |
| $V_{ISOL}$     | RMS Isolation Voltage, any terminal to case $t = 1$ min, $I_{isol} < 1mA$ , 50/60Hz |        | 2500 |      |      | V            |
| $T_J, T_{STG}$ | Storage Temperature Range                                                           |        | -55  |      | 150  | $^\circ C$   |
| $T_L$          | 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 MOSFET Performance Curve**


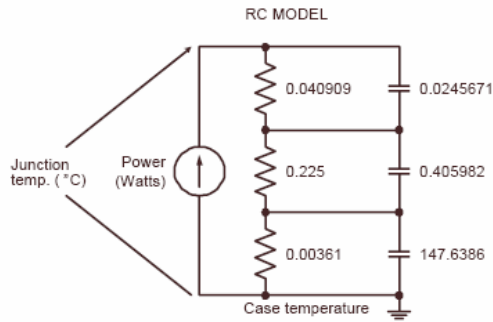


FIGURE 2, TRANSIENT THERMAL IMPEDANCE MODEL

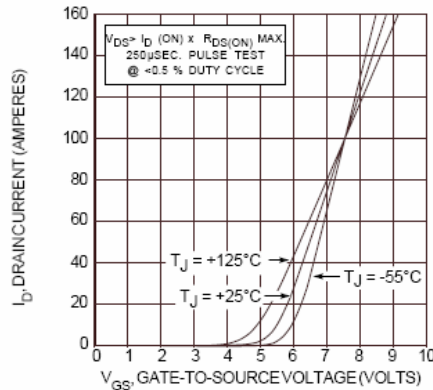


FIGURE 4, TRANSFER CHARACTERISTICS

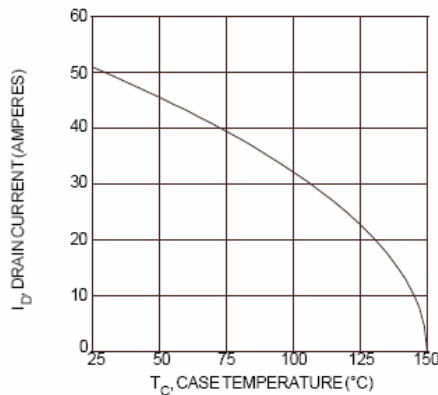


FIGURE 6, MAXIMUM DRAIN CURRENT vs CASE TEMPERATURE

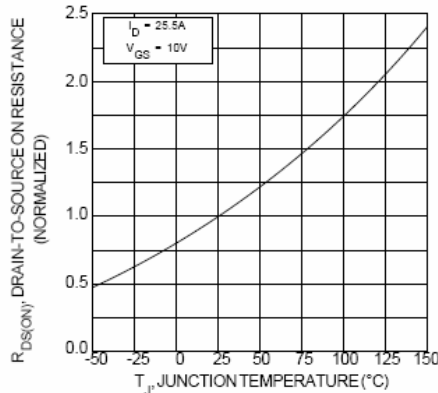


FIGURE 8,  $R_{DS(ON)}$  vs. TEMPERATURE

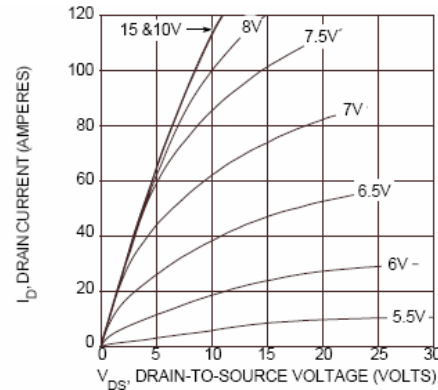


FIGURE 3, LOW VOLTAGE OUTPUT CHARACTERISTICS

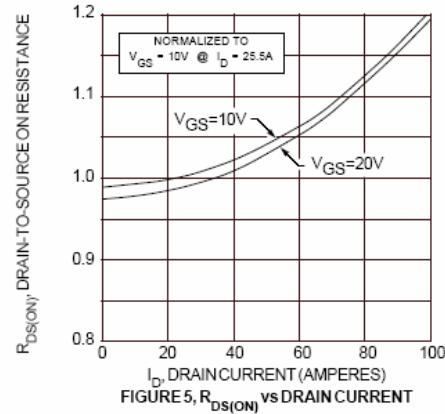


FIGURE 5,  $R_{DS(ON)}$  vs DRAIN CURRENT

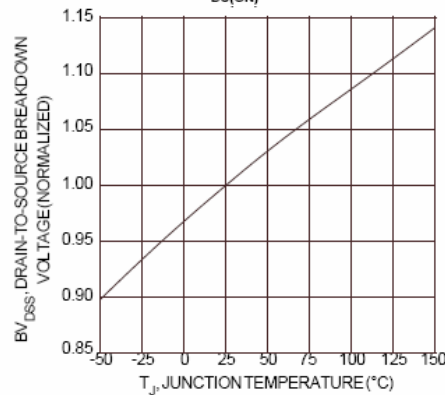


FIGURE 7, BREAKDOWN VOLTAGE vs TEMPERATURE

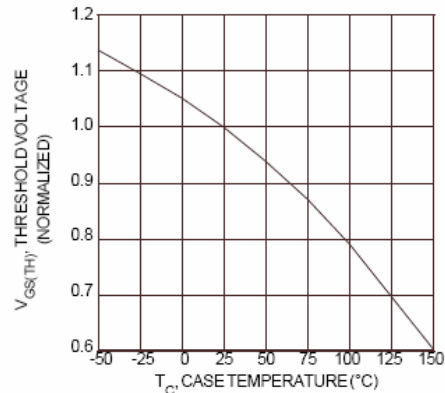


FIGURE 9, THRESHOLD VOLTAGE vs TEMPERATURE

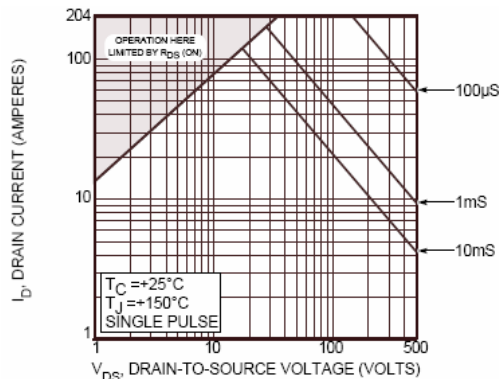


FIGURE 10, MAXIMUM SAFE OPERATING AREA

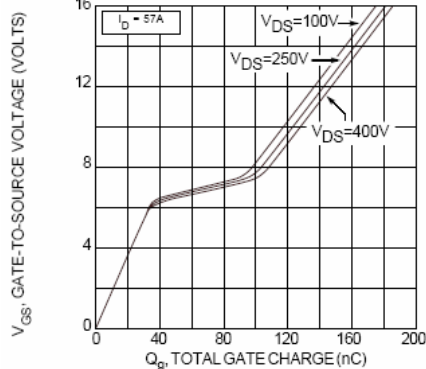


FIGURE 12, GATE CHARGE vs GATE-TO-SOURCE VOLTAGE

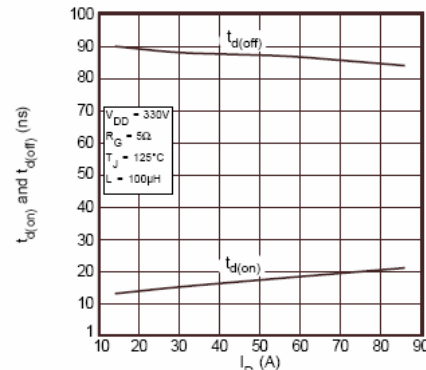


FIGURE 14, DELAY TIMES vs CURRENT

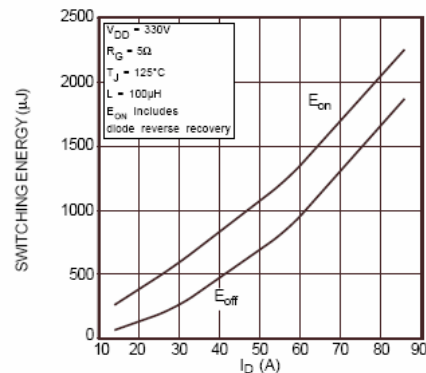


FIGURE 16, SWITCHING ENERGY vs CURRENT

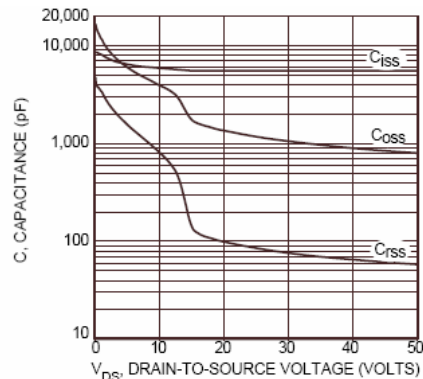


FIGURE 11, CAPACITANCE vs DRAIN-TO-SOURCE VOLTAGE

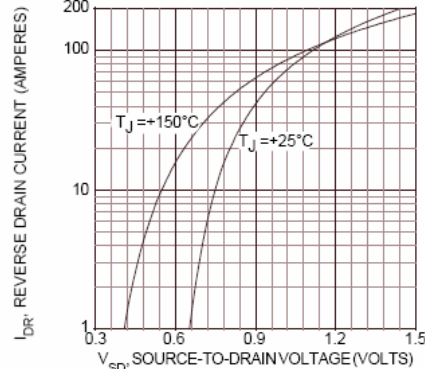


FIGURE 13, SOURCE-DRAIN DIODE FORWARD VOLTAGE

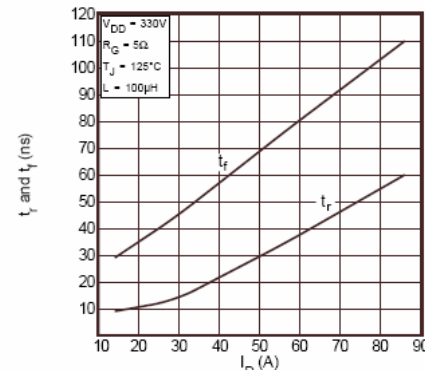


FIGURE 15, RISE AND FALL TIMES vs CURRENT

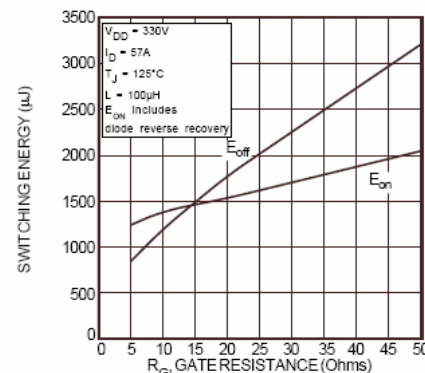


FIGURE 17, SWITCHING ENERGY vs. GATE RESISTANCE

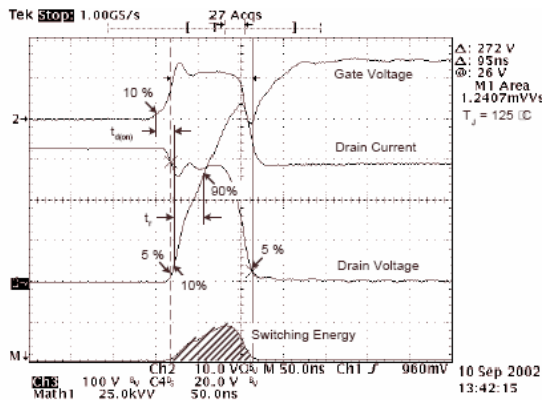


Figure 18, Turn-on Switching Waveforms and Definitions

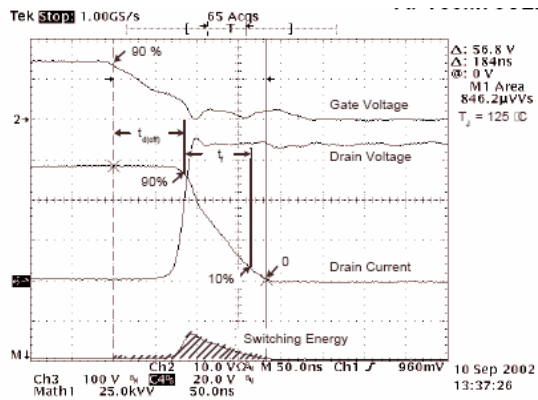


Figure 19, Turn-off Switching Waveforms and Definitions

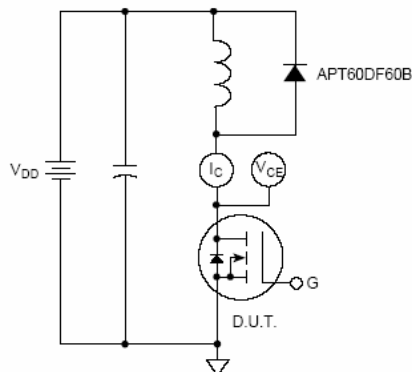


Figure 20, Inductive Switching Test Circuit

## Typical Diode Performance Curve

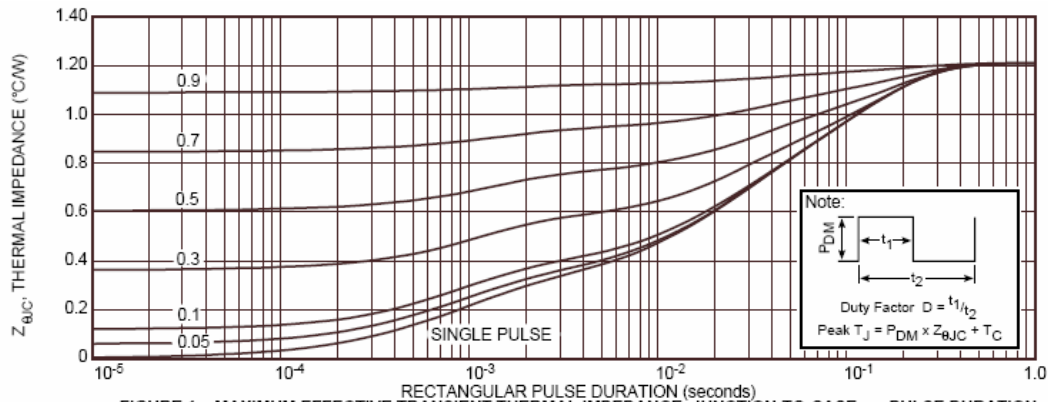


FIGURE 1a. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

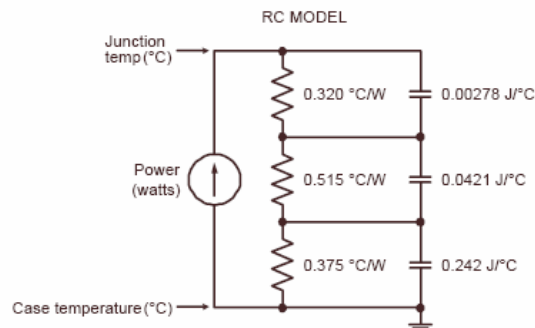


FIGURE 1b, TRANSIENT THERMAL IMPEDANCE MODEL

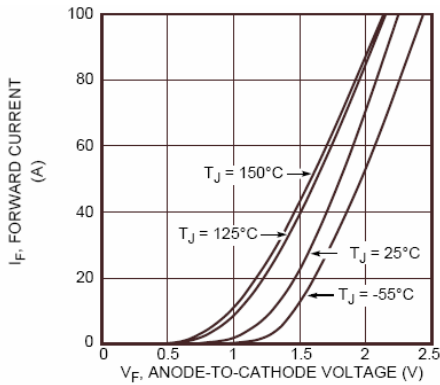


Figure 2. Forward Current vs. Forward Voltage

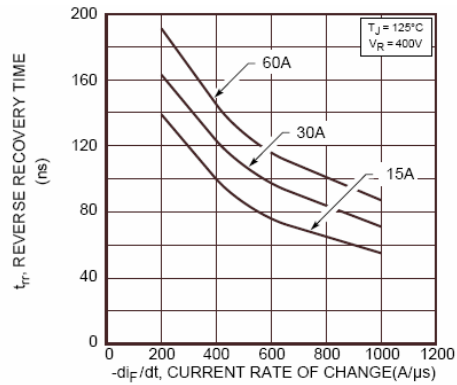


Figure 3. Reverse Recovery Time vs. Current Rate of Change

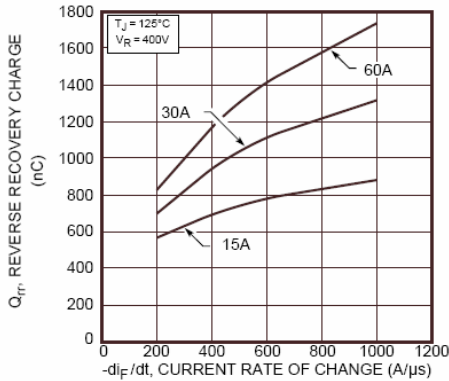


Figure 4. Reverse Recovery Charge vs. Current Rate of Change

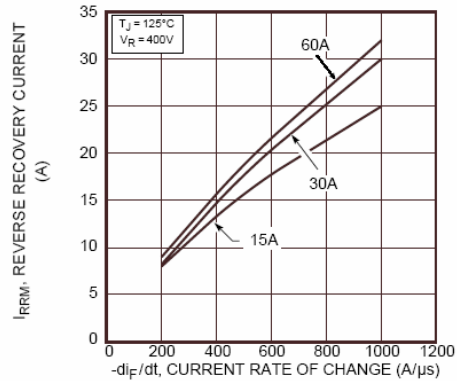


Figure 5. Reverse Recovery Current vs. Current Rate of Change

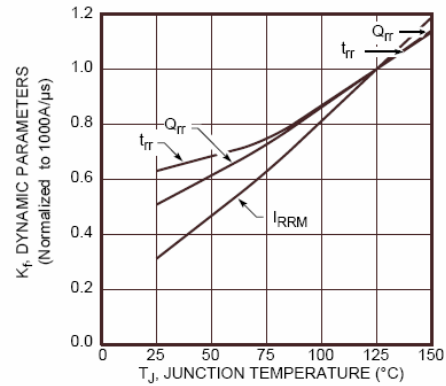


Figure 6. Dynamic Parameters vs. Junction Temperature

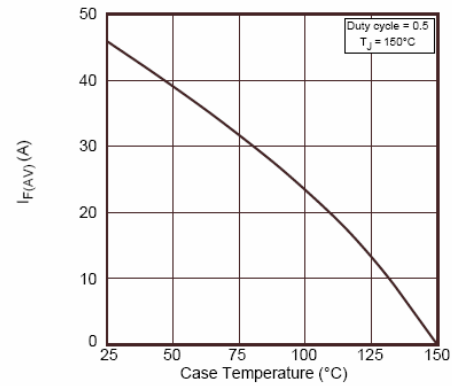


Figure 7. Maximum Average Forward Current vs. Case Temperature

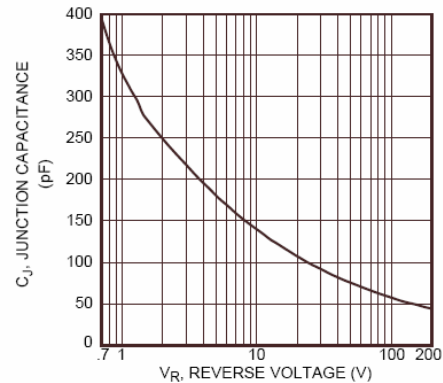


Figure 8. Junction Capacitance vs. Reverse Voltage



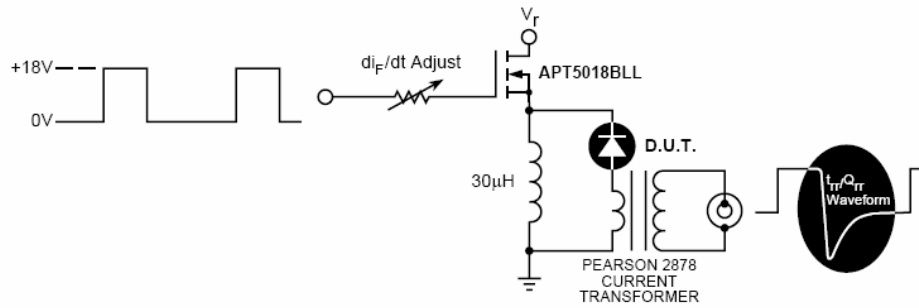


Figure 9. Diode Test Circuit

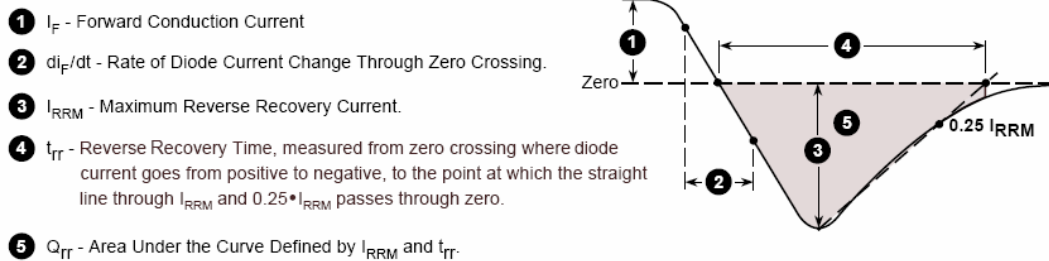
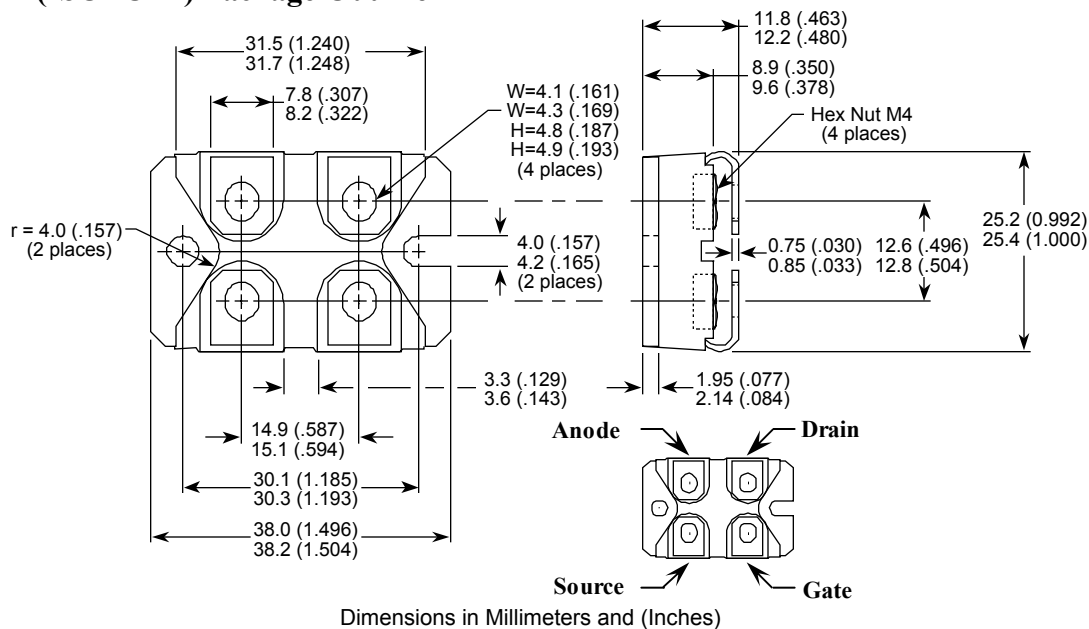


Figure 10. Diode Reverse Recovery Waveform and Definitions

## SOT-227 (ISOTOP®) Package Outline



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Microsemi reserves the right to change, without notice, the specifications and information contained herein

Microsemi's products are covered by one or more of U.S. patents 4,895,810 5,045,903 5,089,434 5,182,234 5,019,522 5,262,336 6,503,786 5,256,583 4,748,103 5,283,202 5,231,474 5,434,095 5,528,058 and foreign patents. U.S. and Foreign patents pending. All Rights Reserved.