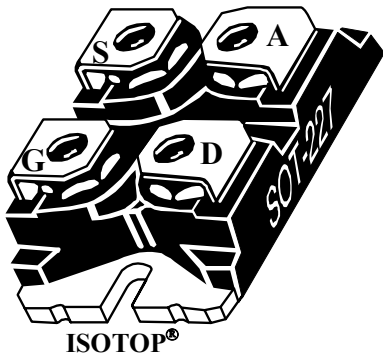
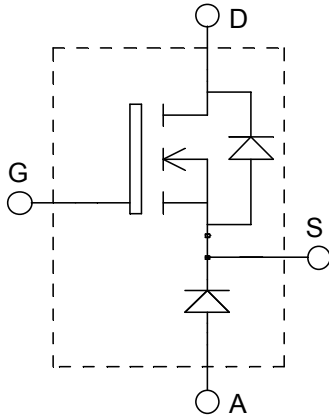


**ISOTOP® Buck chopper  
MOSFET Power Module**

**$V_{DSS} = 500V$   
 $R_{DSon} = 75m\Omega \text{ max @ } T_j = 25^\circ C$   
 $I_D = 51A \text{ @ } T_c = 25^\circ C$**



**Application**

- AC and DC motor control
- Switched Mode Power Supplies

**Features**

- Power MOS 7® MOSFETs
  - Low  $R_{DSon}$
  - Low input and Miller capacitance
  - Low gate charge
  - Fast intrinsic reverse diode
  - Avalanche energy rated
  - Very rugged
- ISOTOP® 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

**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	
		$T_c = 80^\circ C$	39	
$I_{DM}$	Pulsed Drain current	204	A	
$V_{GS}$	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	
$I_{AR}$	Avalanche current (repetitive and non repetitive)	51	A	
$E_{AR}$	Repetitive Avalanche Energy	50	mJ	
$E_{AS}$	Single Pulse Avalanche Energy	2500		
$I_{FAV}$	Maximum Average Forward Current	Duty cycle=0.5	$T_c = 80^\circ C$	30
$I_{FRMS}$	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
$BV_{DSS}$	Drain - Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A$	500			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{GS} = 0V, V_{DS} = 500V$   $T_j = 25^\circ\text{C}$			100	$\mu A$
		$V_{GS} = 0V, V_{DS} = 400V$   $T_j = 125^\circ\text{C}$			500	
$R_{DS(on)}$	Drain – Source on Resistance	$V_{GS} = 10V, I_D = 25.5A$			75	$m\Omega$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 1mA$	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	$V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1MHz$		5590		pF
$C_{oss}$	Output Capacitance			1180		
$C_{rss}$	Reverse Transfer Capacitance			85		
$Q_g$	Total gate Charge	$V_{GS} = 10V$ $V_{Bus} = 250V$ $I_D = 51A$		123		nC
$Q_{gs}$	Gate – Source Charge			33		
$Q_{gd}$	Gate – Drain Charge			65		
$T_{d(on)}$	Turn-on Delay Time	<b>Resistive Switching</b> $V_{GS} = 15V$ $V_{Bus} = 250V$ $I_D = 51A$ $R_G = 0.6\Omega$		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 ❶	<b>Inductive switching @ 25°C</b> $V_{GS} = 15V, V_{Bus} = 330V$ $I_D = 51A, R_G = 5\Omega$		755		$\mu J$
Eoff	Turn-off Switching Energy ❷			726		
Eon	Turn-on Switching Energy ❶	<b>Inductive switching @ 125°C</b> $V_{GS} = 15V, V_{Bus} = 330V$ $I_D = 51A, R_G = 5\Omega$		1241		$\mu J$
Eoff	Turn-off Switching Energy ❷			846		

❶ Eon includes diode reverse recovery

❷ In accordance with JEDEC standard JESD24-1.

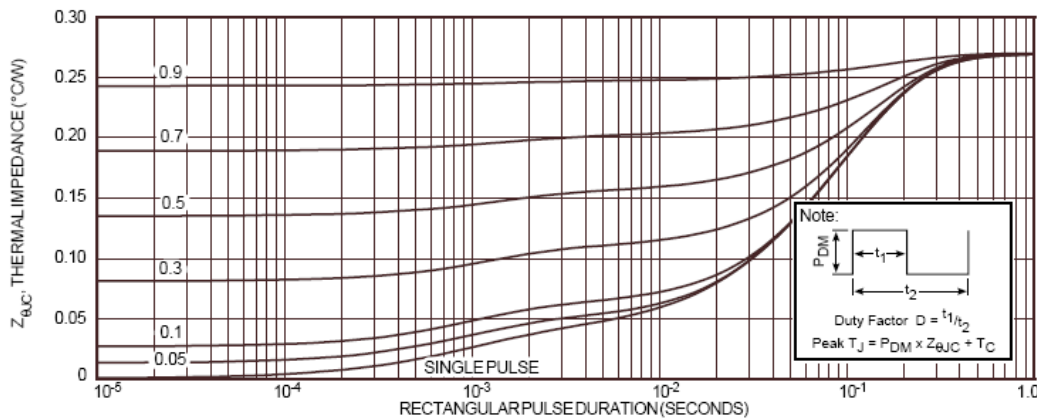
## Diode ratings and characteristics

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			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 di/dt =100A/μs	T <sub>j</sub> = 25°C	23		ns
	Reverse Recovery Time		T <sub>j</sub> = 25°C	85		
			T <sub>j</sub> = 125°C	160		
I <sub>RRM</sub>	Maximum Reverse Recovery Current	I <sub>F</sub> = 30A V <sub>R</sub> = 400V di/dt =200A/μs	T <sub>j</sub> = 25°C	4		A
			T <sub>j</sub> = 125°C	8		
			T <sub>j</sub> = 25°C	130		
Q <sub>rr</sub>	Reverse Recovery Charge		T <sub>j</sub> = 25°C	700		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	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 <sub>thJC</sub>	Junction to Case	MOSFET		0.27	°C/W
		Diode		1.21	
R <sub>thJA</sub>	Junction to Ambient (IGBT & Diode)			20	
V <sub>ISOL</sub>	RMS Isolation Voltage, any terminal to case t =1 min, I isol <1mA, 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 MOSFET Performance Curve



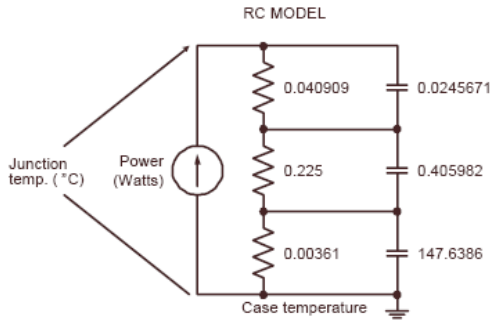


FIGURE 2, TRANSIENT THERMAL IMPEDANCE MODEL

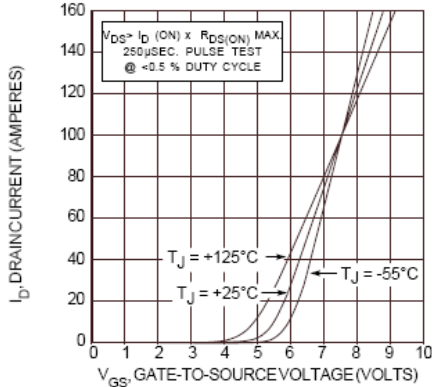


FIGURE 4, TRANSFER CHARACTERISTICS

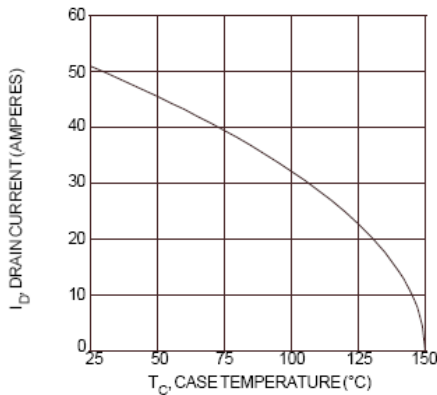


FIGURE 6, MAXIMUM DRAIN CURRENT vs CASE TEMPERATURE

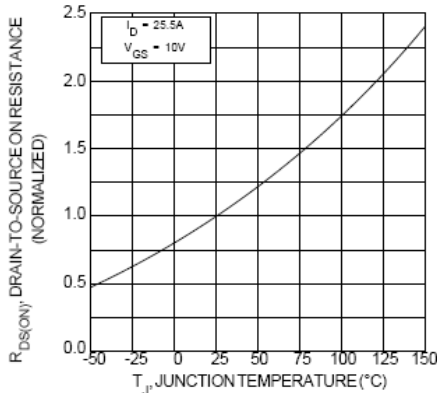


FIGURE 8,  $R_{DS(ON)}$  vs. TEMPERATURE

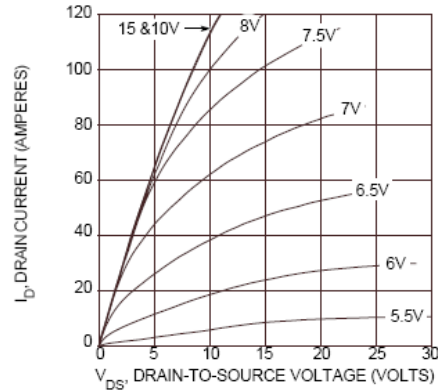


FIGURE 3, LOW VOLTAGE OUTPUT CHARACTERISTICS

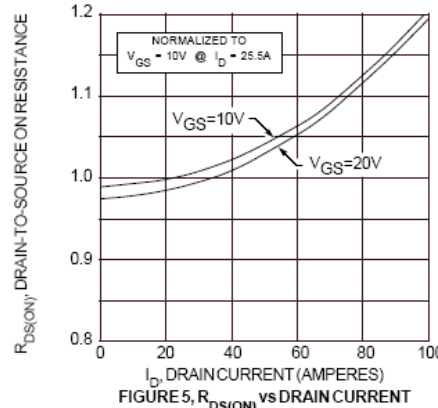


FIGURE 5,  $R_{DS(ON)}$  vs DRAIN CURRENT

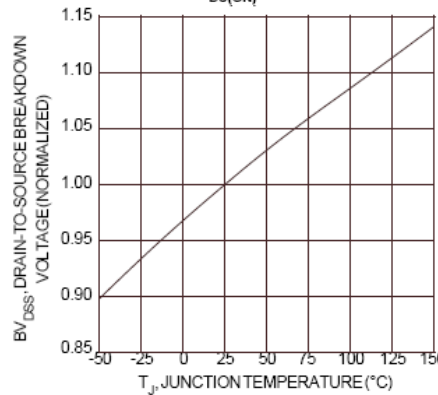


FIGURE 7, BREAKDOWN VOLTAGE vs TEMPERATURE

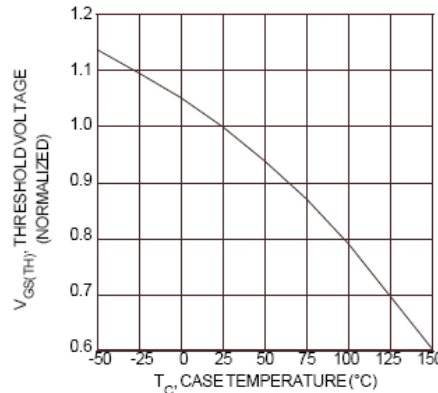


FIGURE 9, THRESHOLD VOLTAGE vs TEMPERATURE

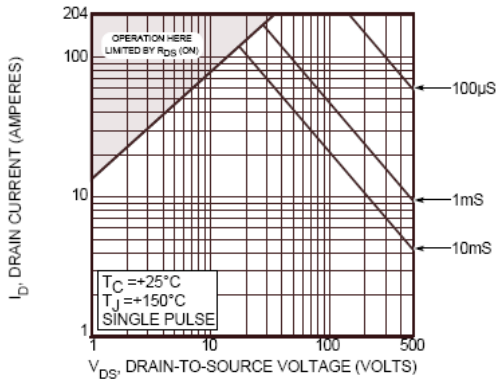


FIGURE 10, MAXIMUM SAFE OPERATING AREA

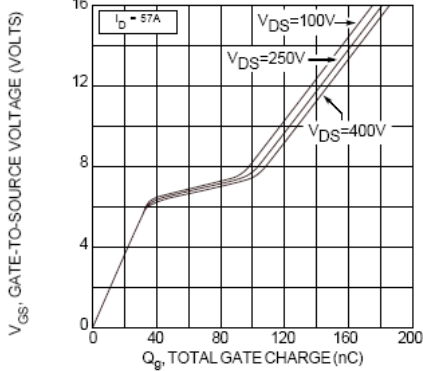


FIGURE 12, GATE CHARGE vs GATE-TO-SOURCE VOLTAGE

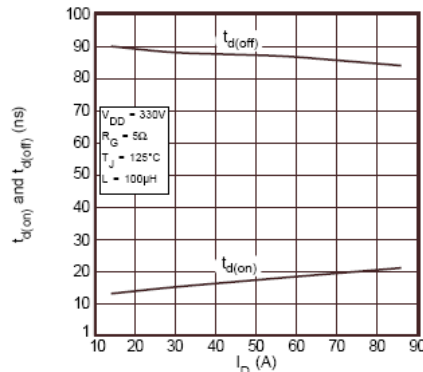


FIGURE 14, DELAY TIMES vs CURRENT

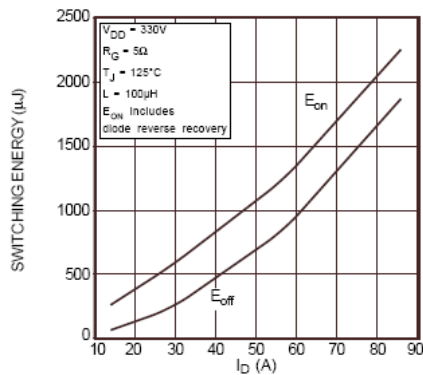


FIGURE 16, SWITCHING ENERGY vs CURRENT

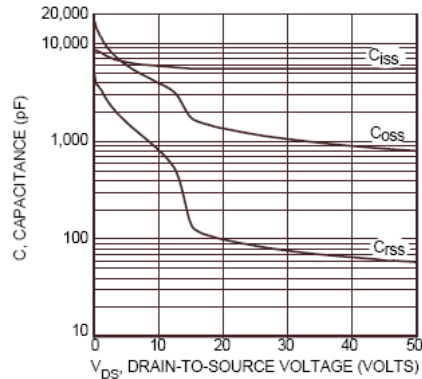


FIGURE 11, CAPACITANCE vs DRAIN-TO-SOURCE VOLTAGE

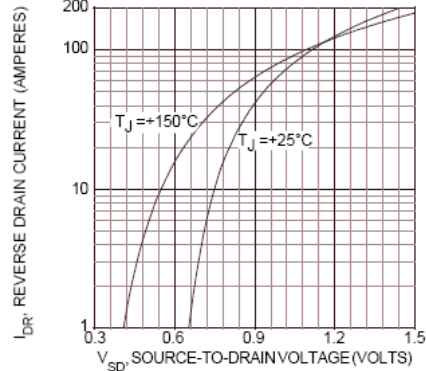


FIGURE 13, SOURCE-DRAIN DIODE FORWARD VOLTAGE

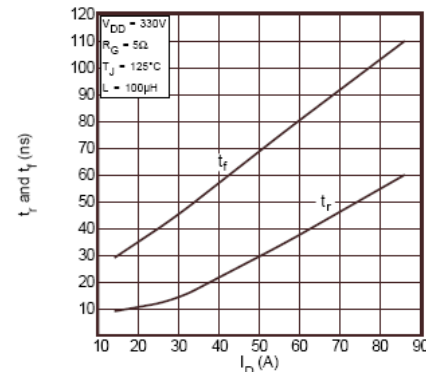


FIGURE 15, RISE AND FALL TIMES vs CURRENT

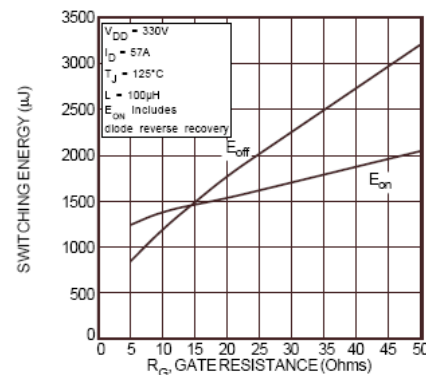


FIGURE 17, SWITCHING ENERGY vs. GATE RESISTANCE

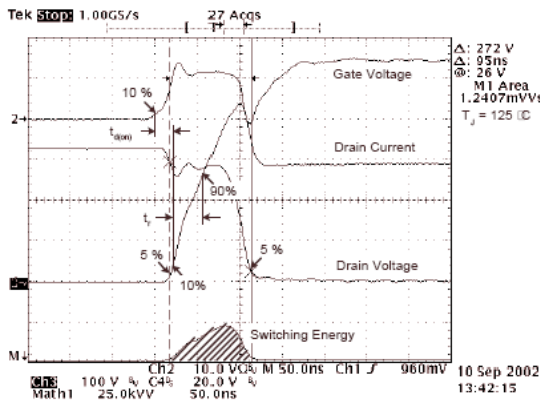


Figure 18, Turn-on Switching Waveforms and Definitions

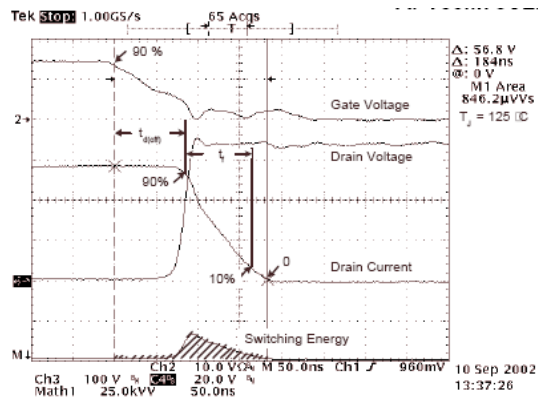


Figure 19, Turn-off Switching Waveforms and Definitions

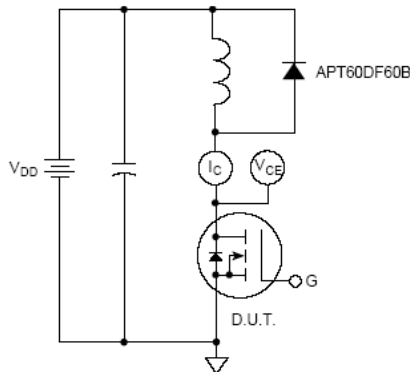


Figure 20, Inductive Switching Test Circuit

**Typical Diode Performance Curve**

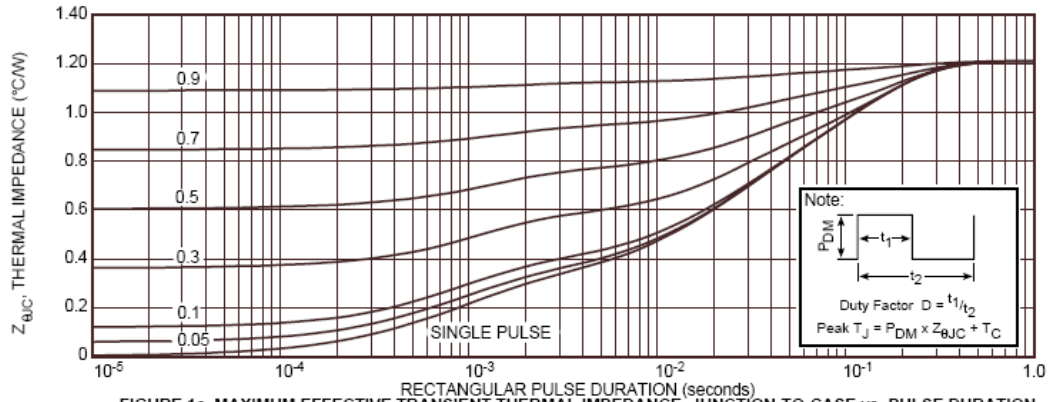


FIGURE 1a. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

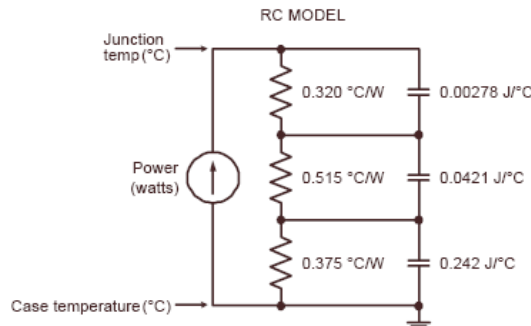


FIGURE 1b, TRANSIENT THERMAL IMPEDANCE MODEL

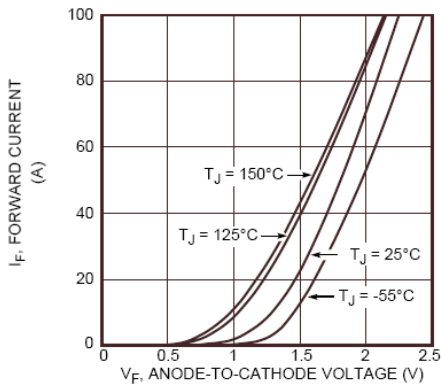


Figure 2. Forward Current vs. Forward Voltage

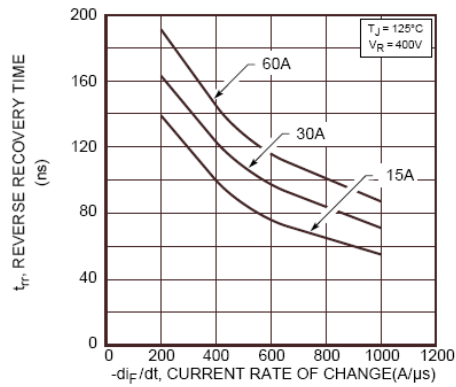


Figure 3. Reverse Recovery Time vs. Current Rate of Change

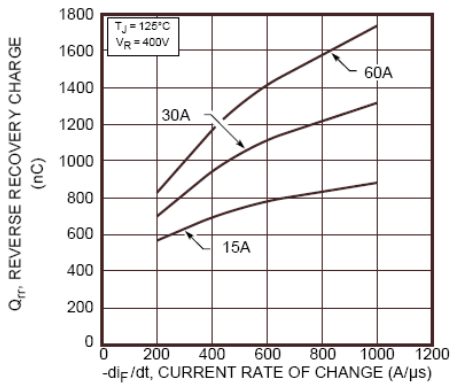


Figure 4. Reverse Recovery Charge vs. Current Rate of Change

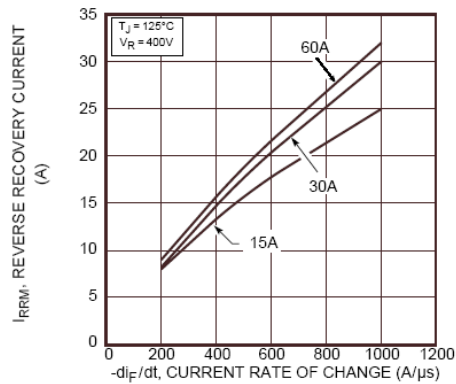


Figure 5. Reverse Recovery Current vs. Current Rate of Change

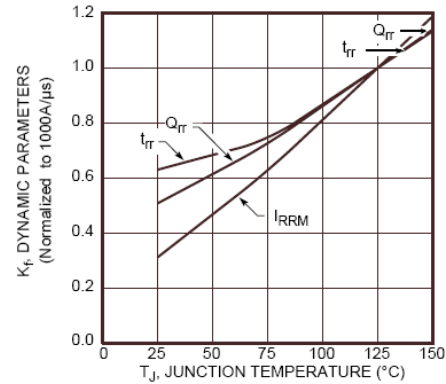


Figure 6. Dynamic Parameters vs. Junction Temperature

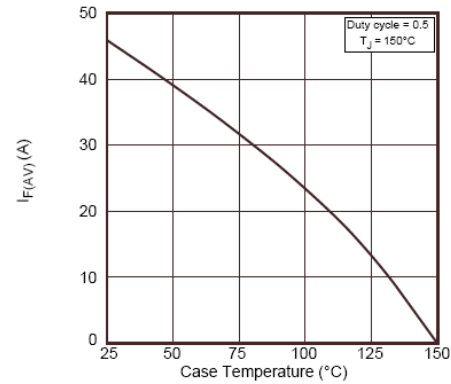


Figure 7. Maximum Average Forward Current vs. Case Temperature

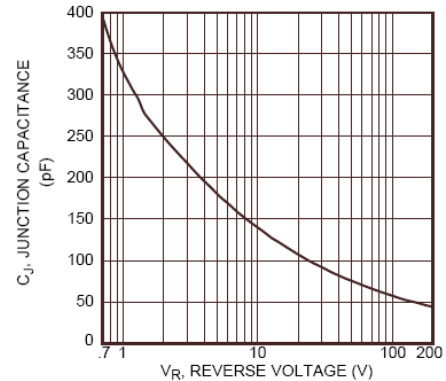


Figure 8. Junction Capacitance vs. Reverse Voltage

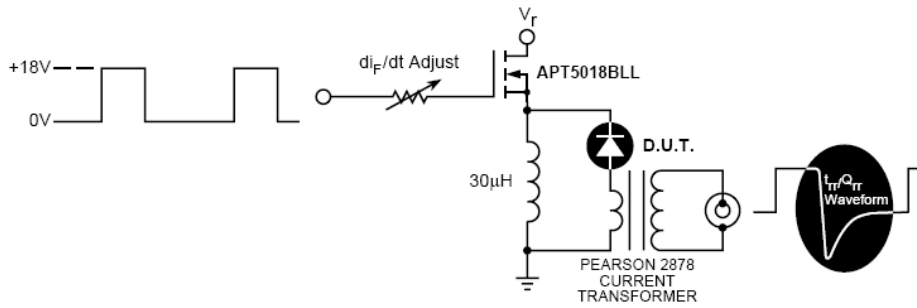


Figure 9. Diode Test Circuit

- ❶  $I_F$  - Forward Conduction Current
- ❷  $di_F/dt$  - Rate of Diode Current Change Through Zero Crossing.
- ❸  $I_{RRM}$  - Maximum Reverse Recovery Current.
- ❹  $t_{rr}$  - 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.
- ❺  $Q_{rr}$  - Area Under the Curve Defined by  $I_{RRM}$  and  $t_{rr}$ .

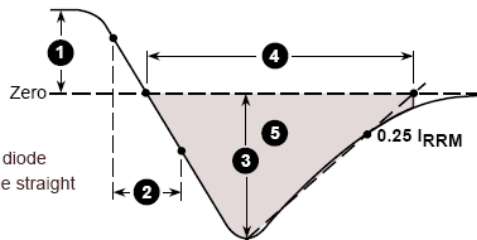
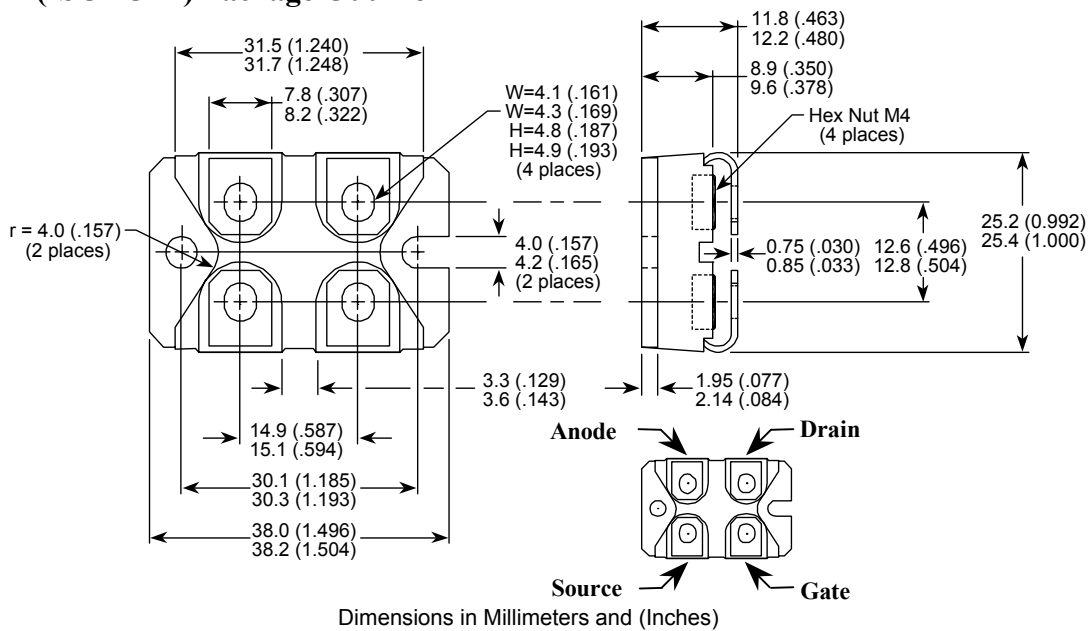


Figure 10. Diode Reverse Recovery Waveform and Definitions

**SOT-227 (ISOTOP®) Package Outline**



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APT'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.