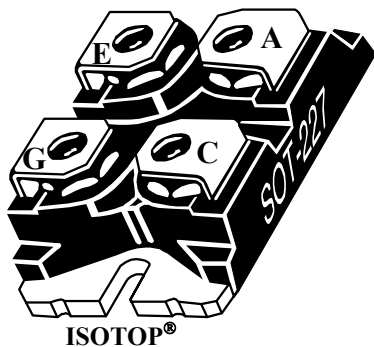
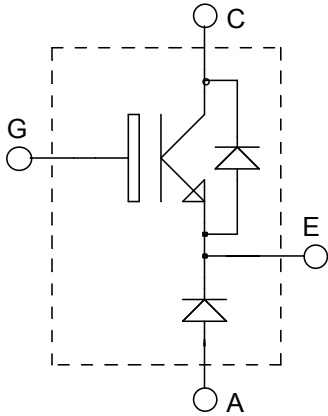


**ISOTOP<sup>®</sup> Buck chopper  
NPT IGBT**
 $V_{CES} = 600V$   
 $I_C = 50A @ T_c = 90^{\circ}C$ 

**Application**

- AC and DC motor control
- Switched Mode Power Supplies

**Features**

- Non Punch Through (NPT) THUNDERBOLT IGBT
  - Low voltage drop
  - Low tail current
  - Switching frequency up to 100 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**

- Outstanding performance at high frequency operation
- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Easy paralleling due to positive  $T_c$  of  $V_{CESat}$
- RoHS Compliant

**Absolute maximum ratings**

Symbol	Parameter	Max ratings	Unit
$V_{CES}$	Collector - Emitter Breakdown Voltage	600	V
$I_{C1}$	Continuous Collector Current	$T_c = 25^{\circ}C$	A
$I_{C2}$		$T_c = 90^{\circ}C$	
$I_{CM}$	Pulsed Collector Current	$T_c = 25^{\circ}C$	160
$V_{GE}$	Gate - Emitter Voltage	$\pm 20$	V
$P_D$	Maximum Power Dissipation	$T_c = 25^{\circ}C$	277
$I_{LM}$	RBSOA clamped Inductive load Current $R_G=11\Omega$	$T_c = 25^{\circ}C$	100
$I_{FAV}$	Maximum Average Forward Current	Duty cycle=0.5 $T_c = 80^{\circ}C$	A
$I_{FRMS}$	RMS Forward Current (Square wave, 50% duty)		

**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
$I_{CES}$	Zero Gate Voltage Collector Current	$V_{GE} = 0\text{V}$ $V_{CE} = 600\text{V}$	$T_j = 25^\circ\text{C}$		40	$\mu\text{A}$
			$T_j = 125^\circ\text{C}$		1000	
$V_{CE(sat)}$	Collector Emitter saturation Voltage	$V_{GE} = 15\text{V}$ $I_C = 50\text{A}$	$T_j = 25^\circ\text{C}$	2.1	2.7	V
			$T_j = 125^\circ\text{C}$	2.2	2.8	
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE} = V_{CE}, I_C = 700\mu\text{A}$	4.5	5.5	6.5	V
$I_{GES}$	Gate – Emitter Leakage Current	$V_{GE} = \pm 20\text{V}, V_{CE} = 0\text{V}$			$\pm 100$	nA

**Dynamic Characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$C_{ies}$	Input Capacitance	$V_{GE} = 0\text{V}$ $V_{CE} = 25\text{V}$ $f = 1\text{MHz}$		2250		pF
$C_{oes}$	Output Capacitance			255		
$C_{res}$	Reverse Transfer Capacitance			155		
$Q_g$	Total gate Charge	$V_{GS} = 15\text{V}$ $V_{Bus} = 300\text{V}$ $I_C = 50\text{A}$		175		nC
$Q_{ge}$	Gate – Emitter Charge			18		
$Q_{gc}$	Gate – Collector Charge			100		
$T_{d(on)}$	Turn-on Delay Time	Resistive Switching ( $25^\circ\text{C}$ ) $V_{GE} = 15\text{V}$ $V_{Bus} = 300\text{V}$ $I_C = 50\text{A}$ $R_G = 10\Omega$		29		ns
$T_r$	Rise Time			118		
$T_{d(off)}$	Turn-off Delay Time			150		
$T_f$	Fall Time			190		
$T_{d(on)}$	Turn-on Delay Time		Inductive Switching ( $25^\circ\text{C}$ ) $V_{GE} = 15\text{V}$ $V_{Bus} = 400\text{V}$ $I_C = 50\text{A}$ $R_G = 10\Omega$		30	
$T_r$	Rise Time			80		
$T_{d(off)}$	Turn-off Delay Time			240		
$T_f$	Fall Time			43		
$E_{ts}$	Total switching Losses			3.6		mJ
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching ( $150^\circ\text{C}$ ) $V_{GE} = 15\text{V}$ $V_{Bus} = 400\text{V}$ $I_C = 50\text{A}$ $R_G = 10\Omega$		28		ns
$T_r$	Rise Time			75		
$T_{d(off)}$	Turn-off Delay Time			265		
$T_f$	Fall Time			185		
$E_{on}$	Turn-on Switching Energy			1.8		
$E_{off}$	Turn-off Switching Energy		2.4			
$E_{ts}$	Total switching Losses		4.2			

**Chopper diode ratings and characteristics**

<i>Symbol</i>	<i>Characteristic</i>	<i>Test Conditions</i>		<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
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 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		
Q <sub>rr</sub>	Reverse Recovery Charge	I <sub>F</sub> = 30A V <sub>R</sub> = 400V di/dt = 200A/μs	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**

<i>Symbol</i>	<i>Characteristic</i>	<i>Min</i>	<i>Typ</i>	<i>Max</i>	<i>Unit</i>
R <sub>thJC</sub>	Junction to Case Thermal Resistance	IGBT		0.45	°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, 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

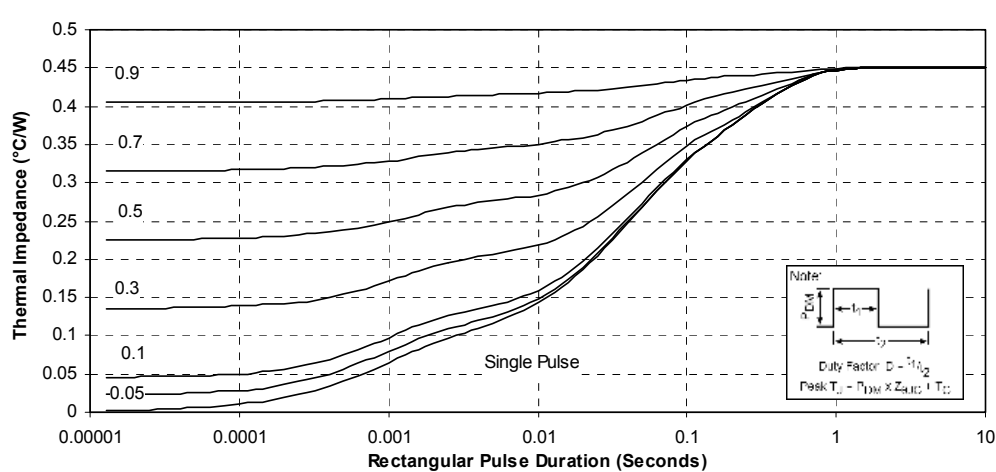
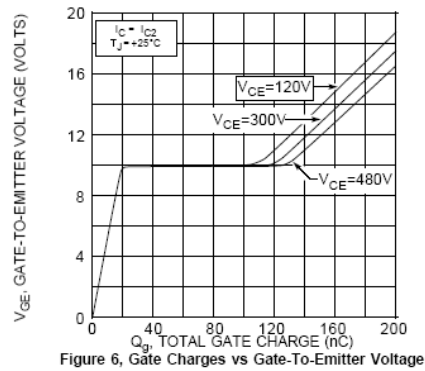
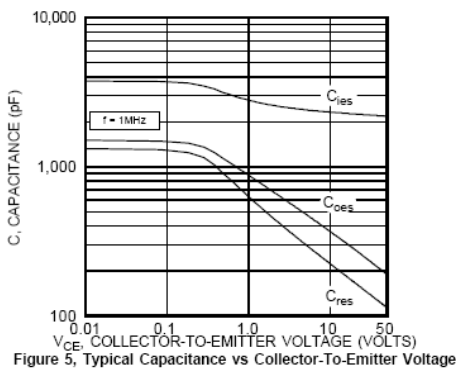
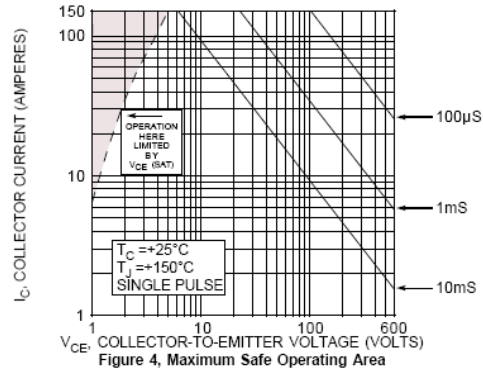
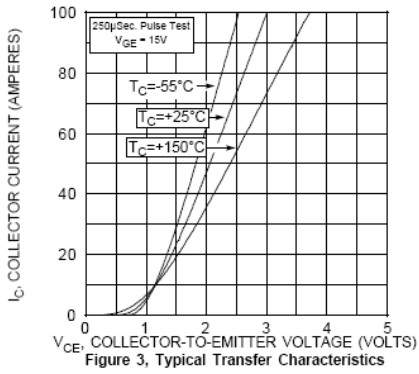
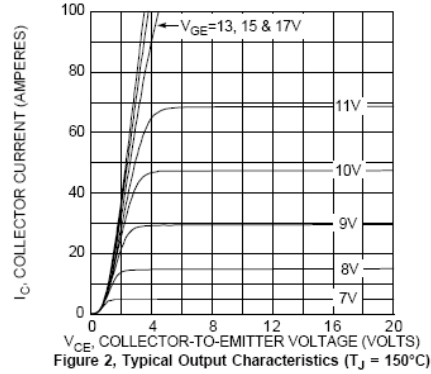
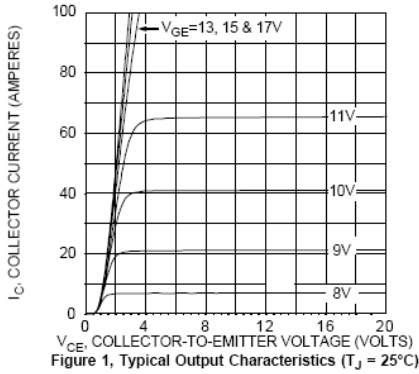


Figure 7, Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration

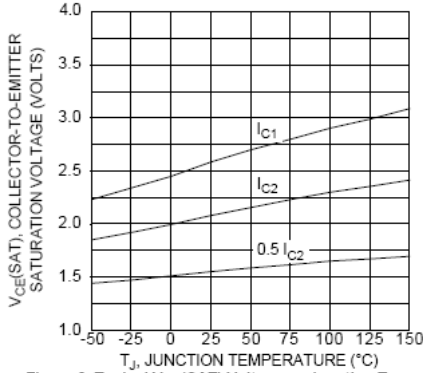


Figure 8, Typical  $V_{CE(SAT)}$  Voltage vs Junction Temperature

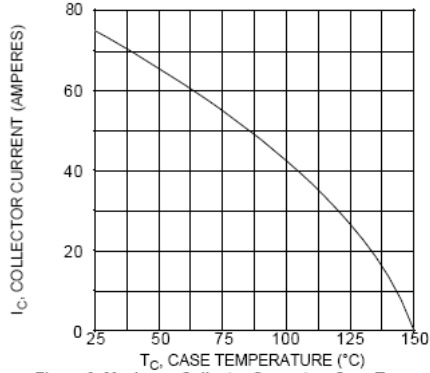


Figure 9, Maximum Collector Current vs Case Temperature

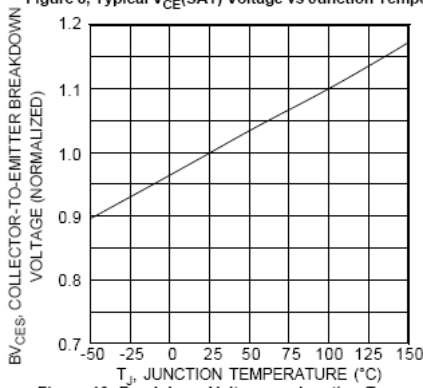


Figure 10, Breakdown Voltage vs Junction Temperature

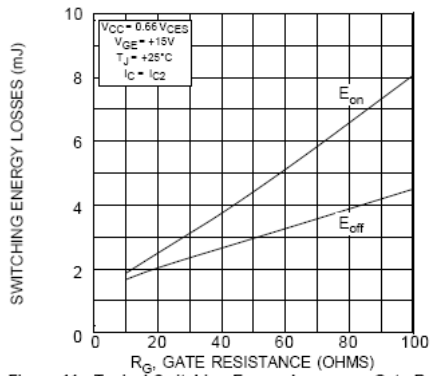


Figure 11, Typical Switching Energy Losses vs Gate Resistance

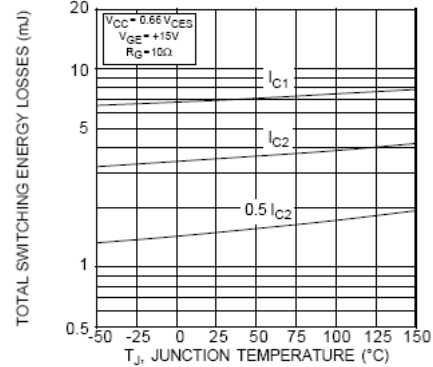


Figure 12, Typical Switching Energy Losses vs. Junction Temperature

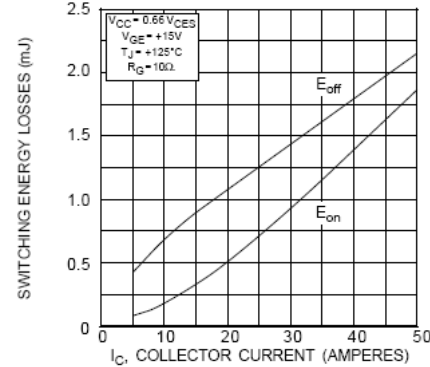


Figure 13, Typical Switching Energy Losses vs Collector Current

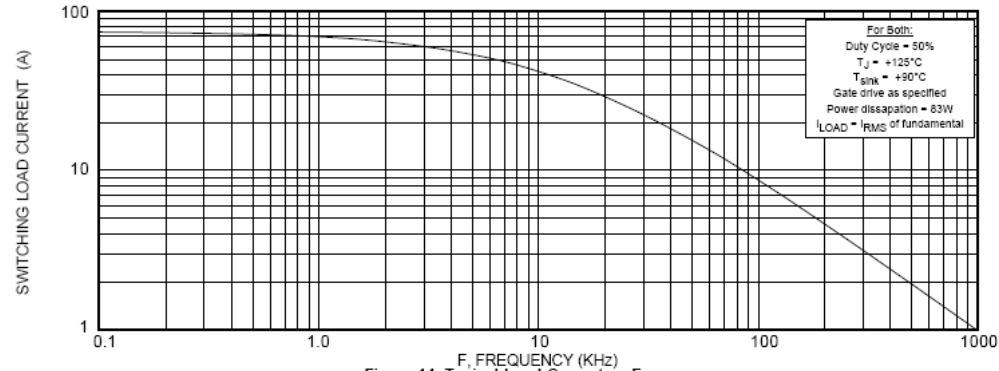


Figure 14, Typical Load Current vs Frequency

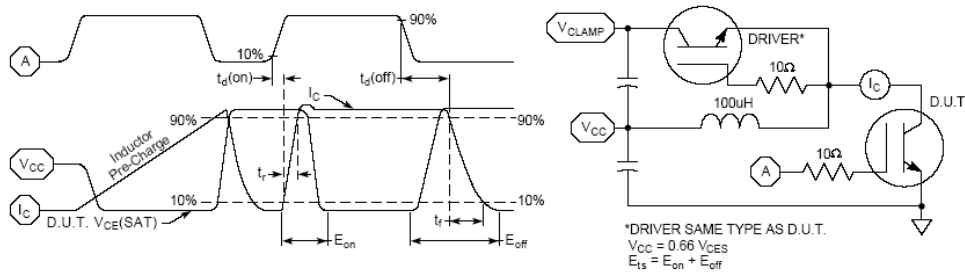


Figure 16, Switching Loss Test Circuit and Waveforms

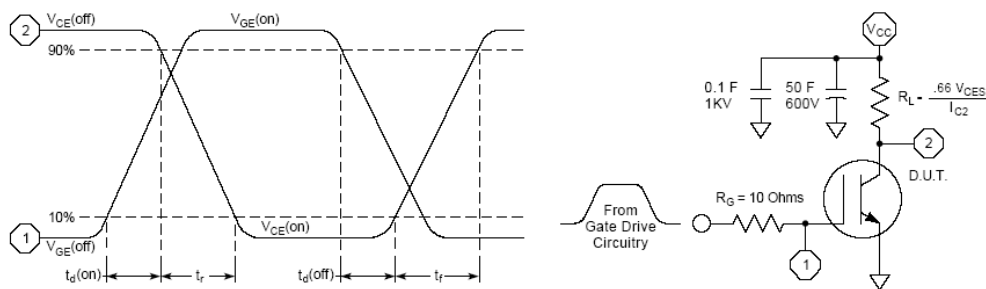


Figure 17, Resistive Switching Time Test Circuit and Waveforms

**Typical Diode Performance Curve**

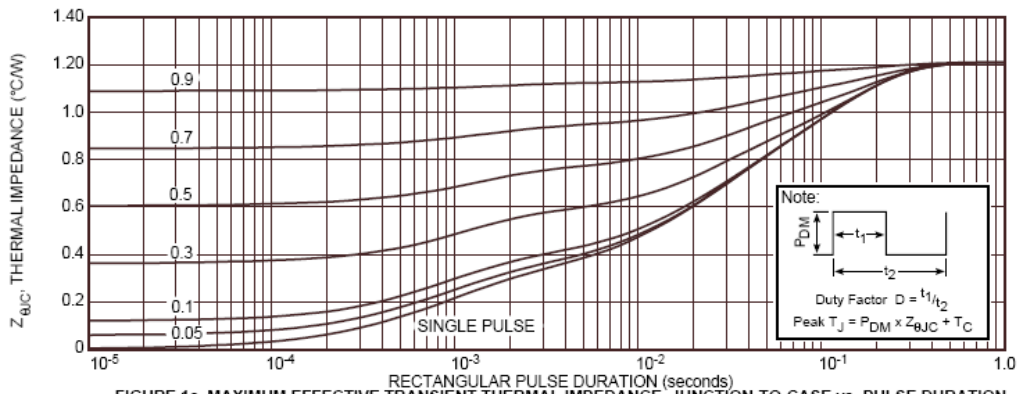


FIGURE 1a. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

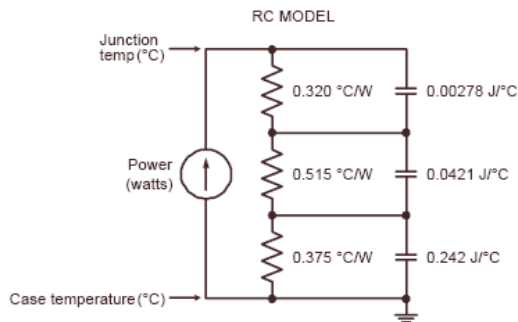


FIGURE 1b, TRANSIENT THERMAL IMPEDANCE MODEL

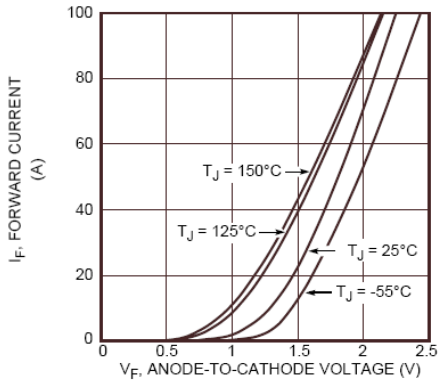


Figure 2. Forward Current vs. Forward Voltage

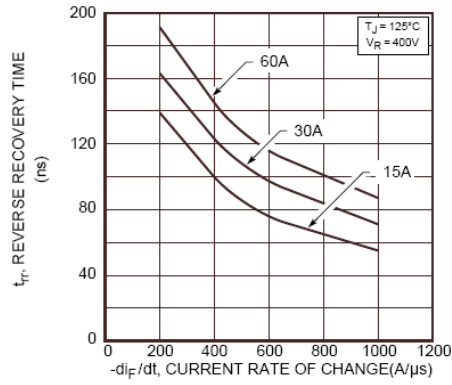


Figure 3. Reverse Recovery Time vs. Current Rate of Change

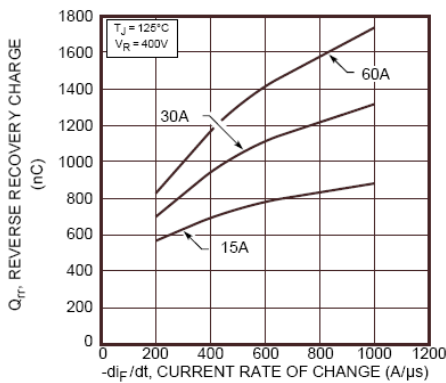


Figure 4. Reverse Recovery Charge vs. Current Rate of Change

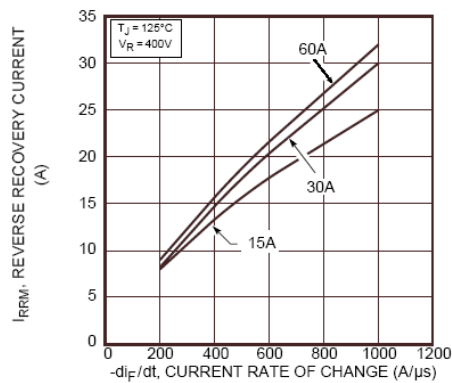


Figure 5. Reverse Recovery Current vs. Current Rate of Change

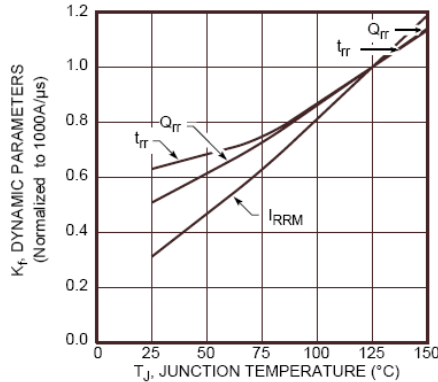


Figure 6. Dynamic Parameters vs. Junction Temperature

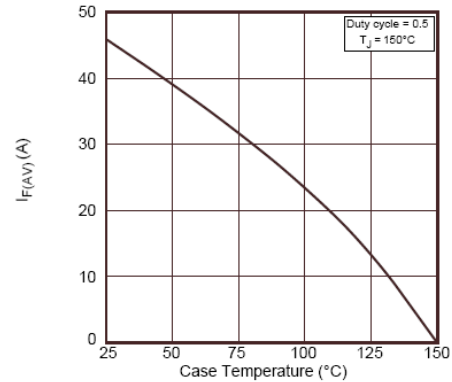


Figure 7. Maximum Average Forward Current vs. Case Temperature

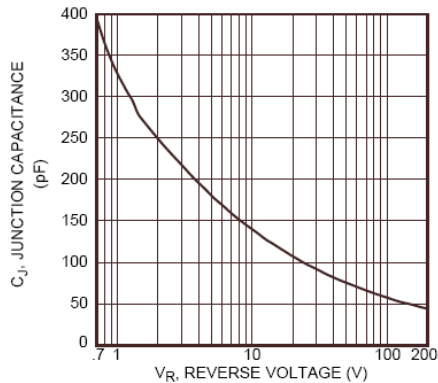


Figure 8. Junction Capacitance vs. Reverse Voltage

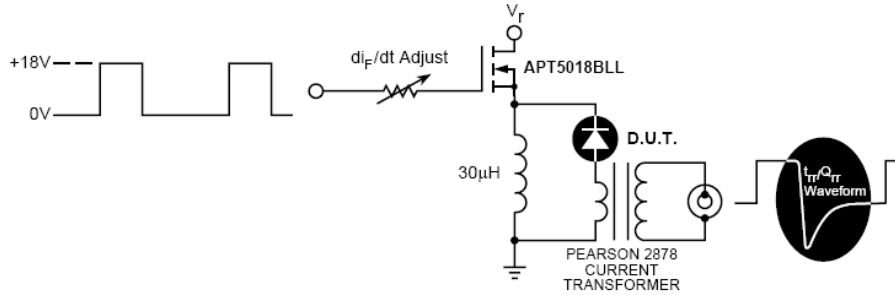


Figure 9. Diode Test Circuit

- 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  $t_{rr}$ .

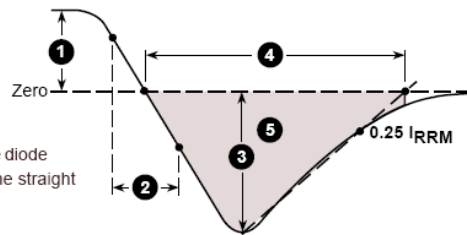
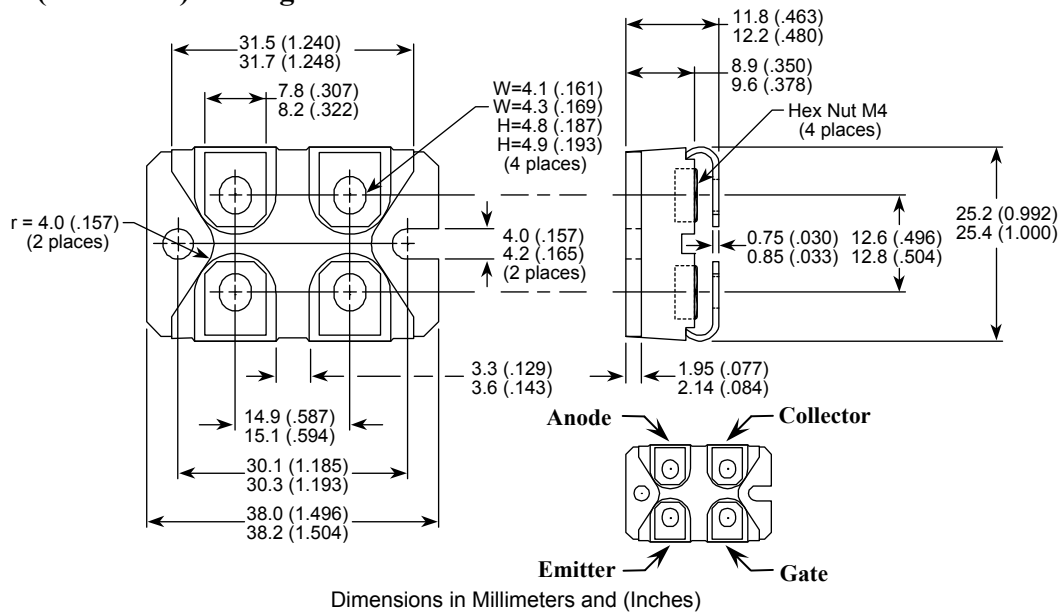


Figure 10. Diode Reverse Recovery Waveform and Definitions

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

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