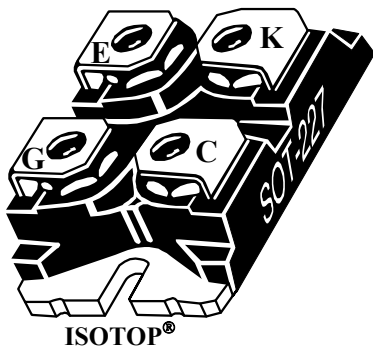
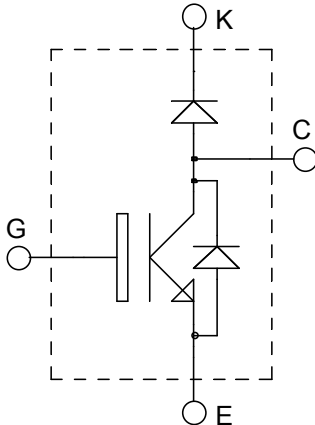


**ISOTOP<sup>®</sup> Boost chopper  
NPT IGBT**
 **$V_{CES} = 600V$   
 $I_C = 60A @ T_c = 95^{\circ}C$** 

**Application**

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

**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
  - Avalanche energy rated
  - 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	$T_c = 25^{\circ}C$	93
$I_{C2}$		$T_c = 95^{\circ}C$	60
$I_{CM}$	Pulsed Collector Current	$T_c = 25^{\circ}C$	360
$V_{GE}$	Gate - Emitter Voltage	$\pm 20$	V
$P_D$	Maximum Power Dissipation	$T_c = 25^{\circ}C$	378
$I_{LM}$	RBSOA clamped Inductive load Current $R_G=11\Omega$	$T_c = 25^{\circ}C$	360
$I_{FAV}$	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
$I_{CES}$	Zero Gate Voltage Collector Current	$V_{GE} = 0\text{V}$ $V_{CE} = 600\text{V}$	$T_j = 25^\circ\text{C}$		80	$\mu\text{A}$
			$T_j = 125^\circ\text{C}$		2000	
$V_{CE(sat)}$	Collector Emitter saturation Voltage	$V_{GE} = 15\text{V}$ $I_C = 60\text{A}$	$T_j = 25^\circ\text{C}$	2.0	2.5	V
			$T_j = 125^\circ\text{C}$		2.8	
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE} = V_{CE}, I_C = 500\mu\text{A}$	3	4	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	$V_{GE} = 0\text{V}$ $V_{CE} = 25\text{V}$ $f = 1\text{MHz}$		3125	3590	pF
$C_{oes}$	Output Capacitance			310	450	
$C_{res}$	Reverse Transfer Capacitance			180	310	
$Q_g$	Total gate Charge	$V_{GS} = 15\text{V}$ $V_{Bus} = 300\text{V}$ $I_C = 60\text{A}$		257	410	nC
$Q_{ge}$	Gate – Emitter Charge			19	30	
$Q_{gc}$	Gate – Collector Charge			120	180	
$T_{d(on)}$	Turn-on Delay Time	Resistive Switching ( $25^\circ\text{C}$ ) $V_{GE} = 15\text{V}$ $V_{Bus} = 300\text{V}$ $I_C = 60\text{A}$ $R_G = 5\Omega$		20	40	ns
$T_r$	Rise Time			95	190	
$T_{d(off)}$	Turn-off Delay Time			315	470	
$T_f$	Fall Time			245	490	
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching ( $25^\circ\text{C}$ ) $V_{GE} = 15\text{V}$ $V_{Bus} = 400\text{V}$ $I_C = 60\text{A}$ $R_G = 5\Omega$		26	50	ns
$T_r$	Rise Time			63	125	
$T_{d(off)}$	Turn-off Delay Time			395	590	
$T_f$	Fall Time			68	140	
$E_{ts}$	Total switching Losses			3.4	7	mJ
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching ( $150^\circ\text{C}$ ) $V_{GE} = 15\text{V}$ $V_{Bus} = 400\text{V}$ $I_C = 60\text{A}$ $R_G = 5\Omega$		25	50	ns
$T_r$	Rise Time			59	120	
$T_{d(off)}$	Turn-off Delay Time			430	650	
$T_f$	Fall Time			65	130	
$E_{on}$	Turn-on Switching Energy			1.6	3.2	mJ
$E_{off}$	Turn-off Switching Energy			2.4	4.8	
$E_{ts}$	Total switching Losses			4.0	8.0	

**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		
			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**

<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		0.33	°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

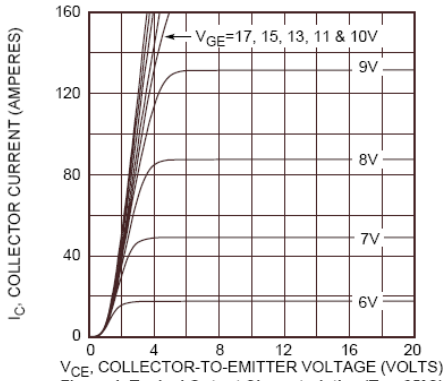


Figure 1, Typical Output Characteristics ( $T_J = 25^\circ\text{C}$ )

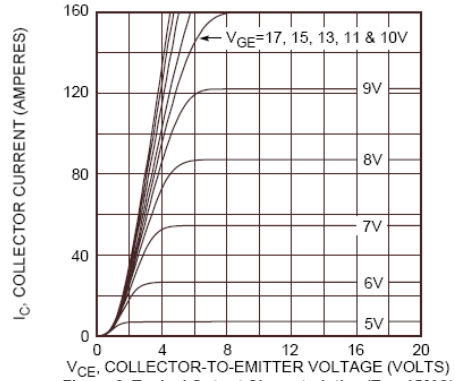


Figure 2, Typical Output Characteristics ( $T_J = 150^\circ\text{C}$ )

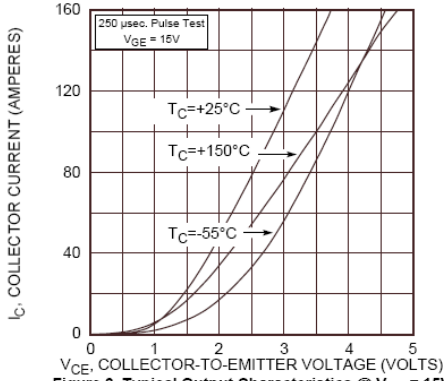


Figure 3, Typical Output Characteristics @  $V_{GE} = 15\text{V}$

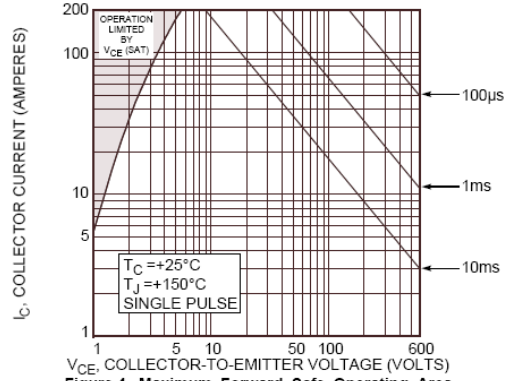


Figure 4, Maximum Forward Safe Operating Area

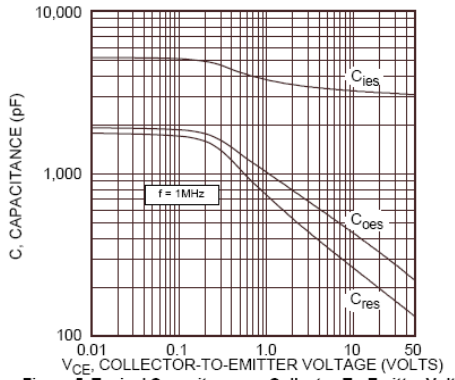


Figure 5, Typical Capacitance vs Collector-To-Emitter Voltage

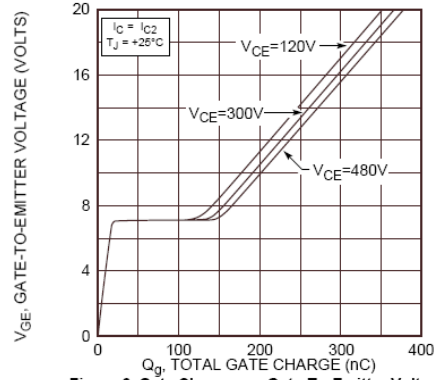


Figure 6, Gate Charges vs Gate-To-Emitter Voltage

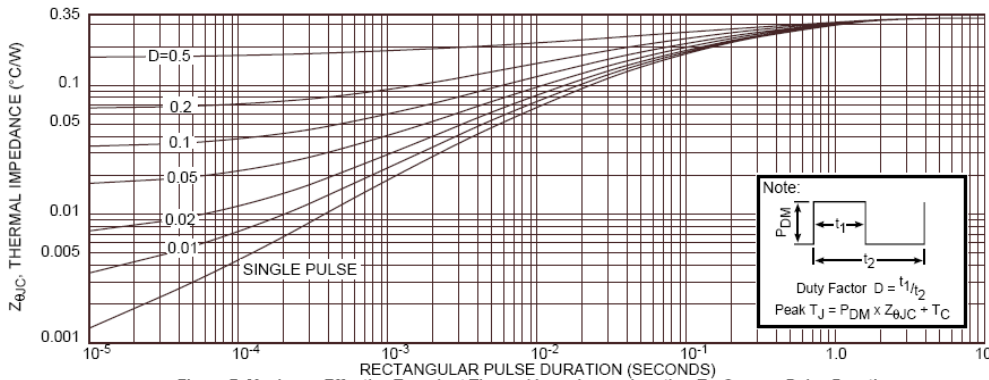


Figure 7, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

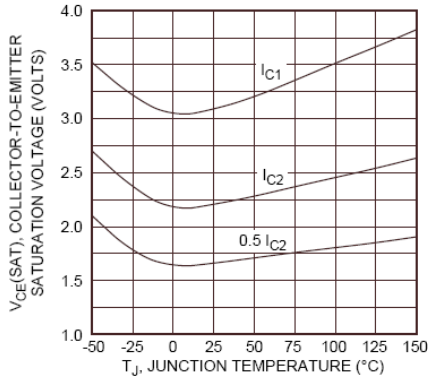


Figure 8, Typical  $V_{CE(SAT)}$  Voltage vs Junction Temperature

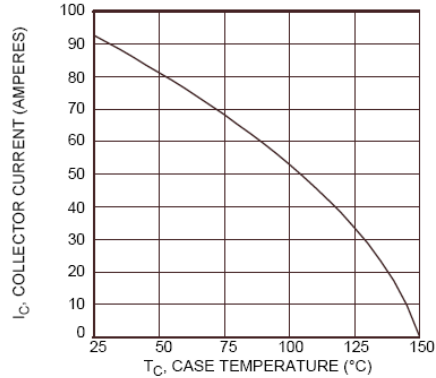


Figure 9, Maximum Collector Current vs Case Temperature

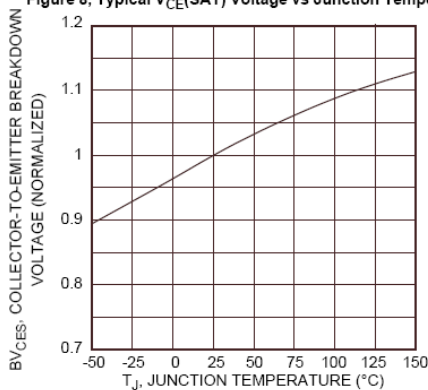


Figure 10, Breakdown Voltage vs Junction Temperature

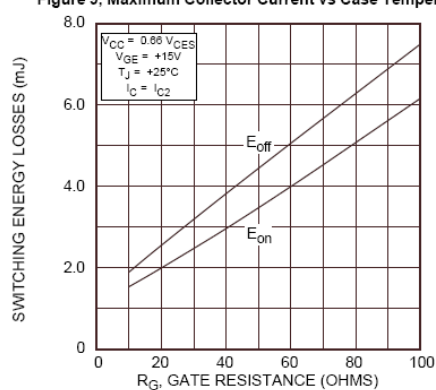


Figure 11, Typical Switching Energy Losses vs Gate Resistance

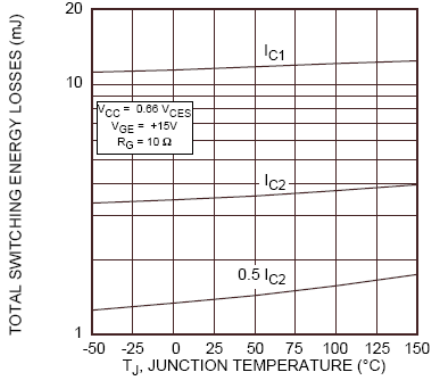


Figure 12, Typical Switching Energy Losses vs. Junction Temperature

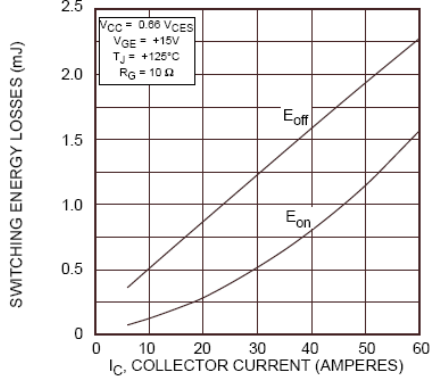


Figure 13, Typical Switching Energy Losses vs Collector Current

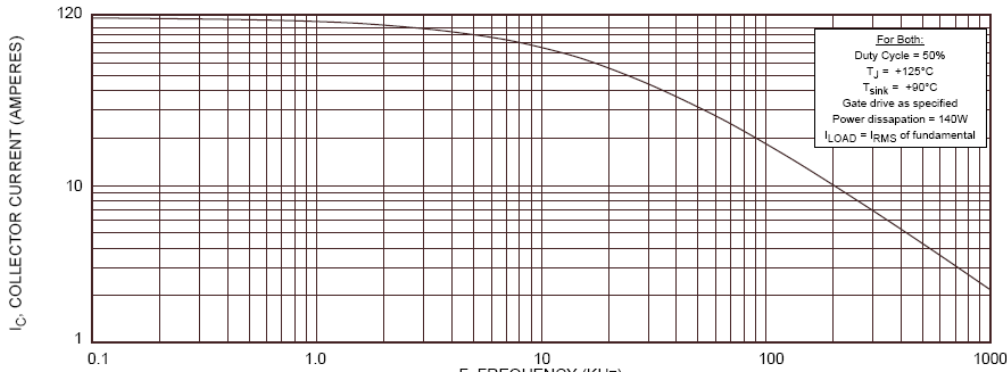


Figure 14, Typical Load Current vs Frequency

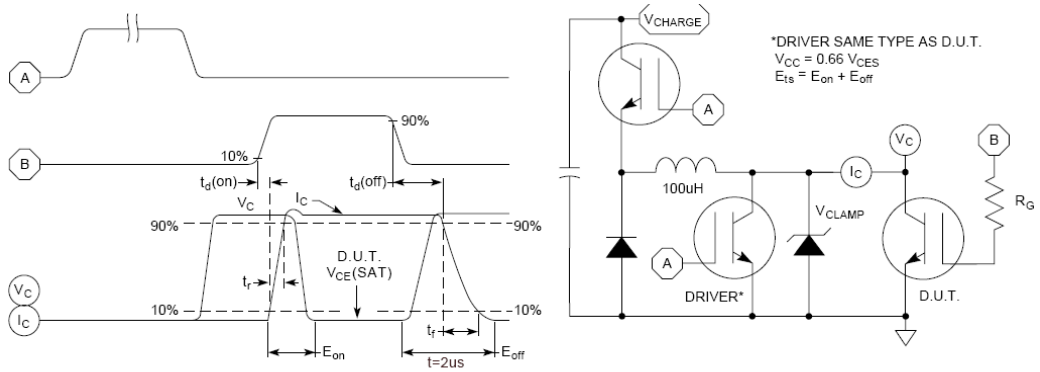


Figure 15, Switching Loss Test Circuit and Waveforms

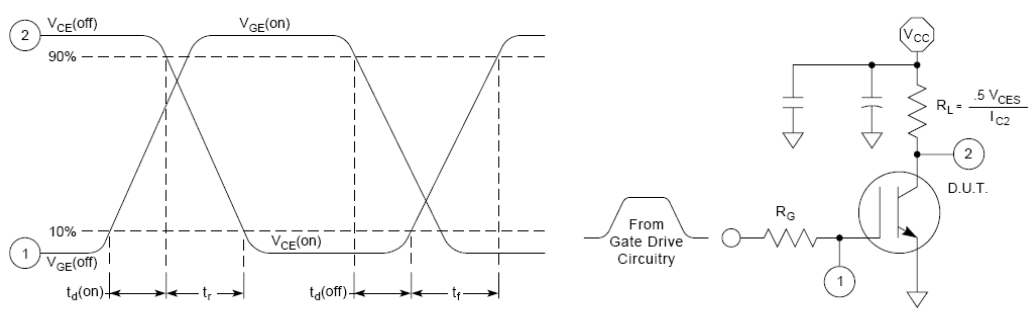


Figure 16, Resistive Switching Time Test Circuit and Waveforms

## Typical Diode Performance Curve

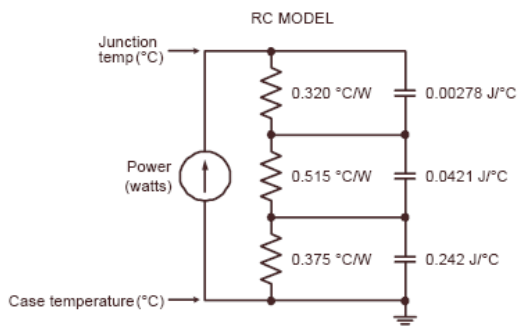
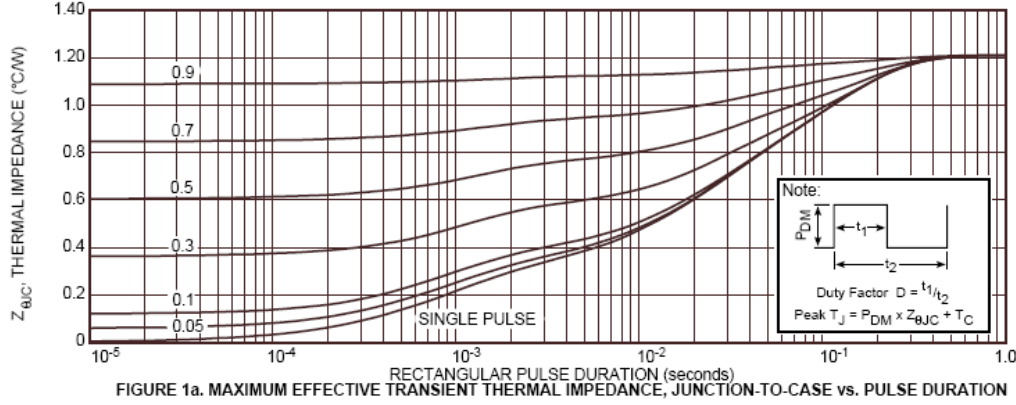


FIGURE 1b, TRANSIENT THERMAL IMPEDANCE MODEL

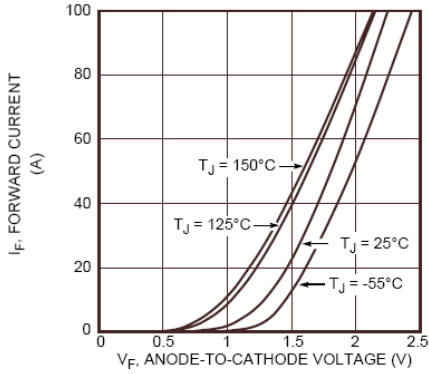


Figure 2. Forward Current vs. Forward Voltage

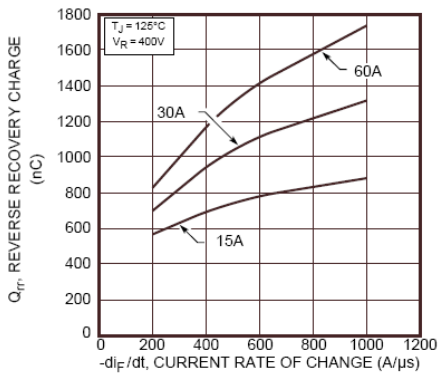


Figure 4. Reverse Recovery Charge vs. Current Rate of Change

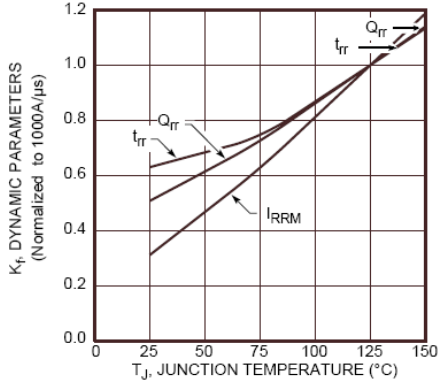


Figure 6. Dynamic Parameters vs. Junction Temperature

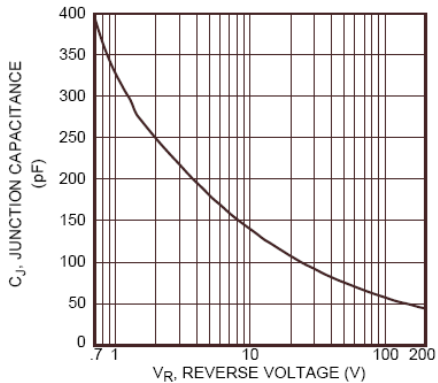


Figure 8. Junction Capacitance vs. Reverse Voltage

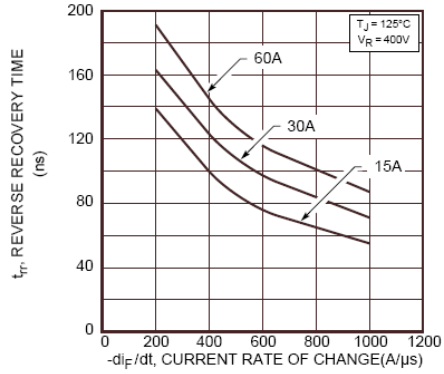


Figure 3. Reverse Recovery Time vs. Current Rate of Change

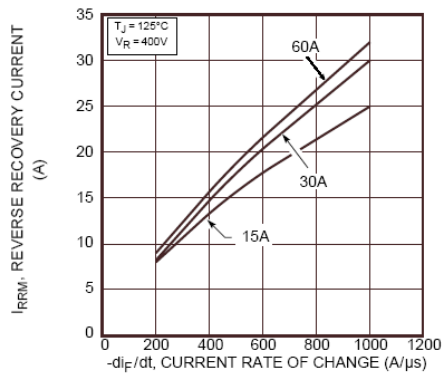


Figure 5. Reverse Recovery Current vs. Current Rate of Change

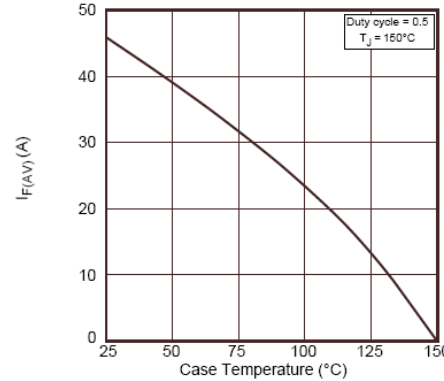


Figure 7. Maximum Average Forward Current vs. Case Temperature

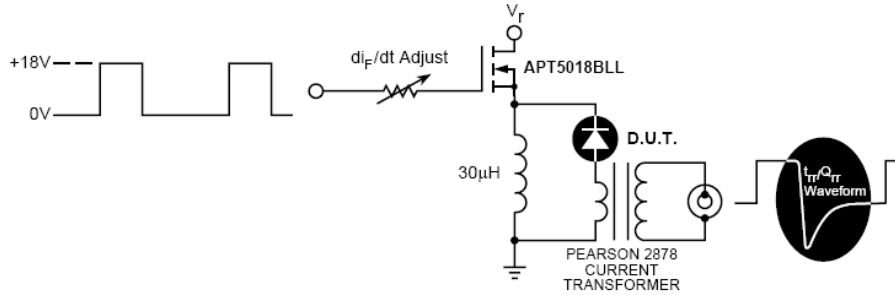


Figure 9. Diode Test Circuit

- 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  $t_{rr}$ .

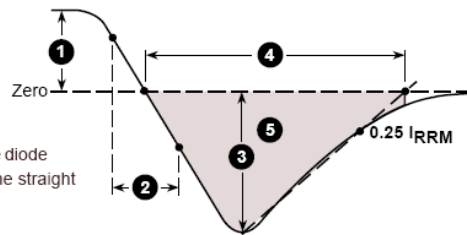
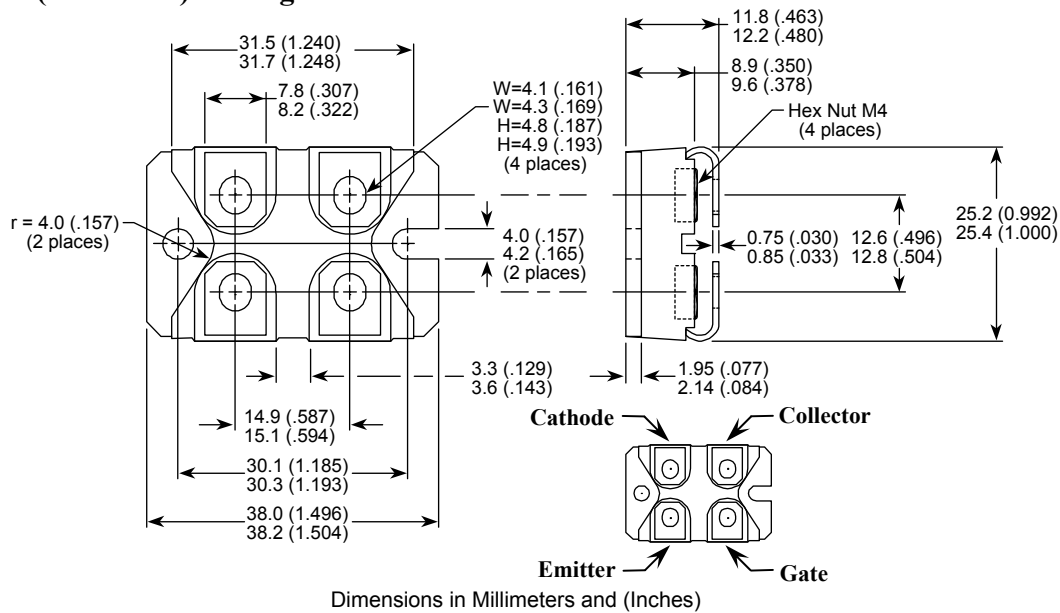


Figure 10. Diode Reverse Recovery Waveform and Definitions

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



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



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