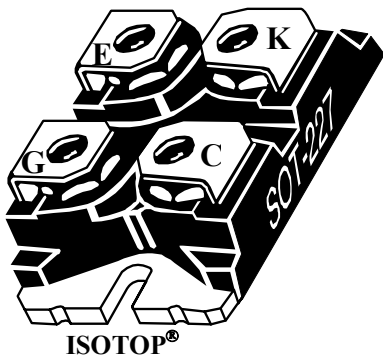
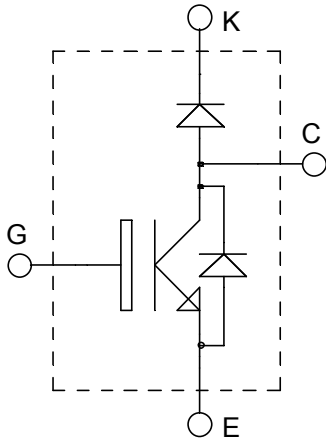


**ISOTOP® Boost chopper  
PT IGBT**

**$V_{CES} = 600V$   
 $I_C = 40A @ T_c = 110^\circ C$**



**Application**

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

**Features**

- Power MOS 7<sup>®</sup> Punch Through (PT) IGBT
  - Low conduction loss
  - Ultra fast tail current shutoff
  - Low gate charge
  - Switching frequency capability in the 200kHz range
  - Soft recovery parallel diodes
  - Low diode VF
- 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

**Absolute maximum ratings**

Symbol	Parameter	Max ratings	Unit
$V_{CES}$	Collector - Emitter Breakdown Voltage	600	V
$I_{C1}$	Continuous Collector Current	$T_C = 25^\circ C$	86
$I_{C2}$		$T_C = 110^\circ C$	40
$I_{CM}$	Pulsed Collector Current	$T_C = 25^\circ C$	160
$V_{GE}$	Gate - Emitter Voltage	$\pm 20$	V
$P_D$	Maximum Power Dissipation	$T_C = 25^\circ C$	284
SSOA	Switching Safe Operating Area	$T_J = 150^\circ C$	160A @ 600V
$I_{FAV}$	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
$BV_{CES}$	Collector - Emitter Breakdown Voltage	$V_{GE} = 0V, I_C = 250\mu A$	600			V
$I_{CES}$	Zero Gate Voltage Collector Current	$V_{GE} = 0V$			250	$\mu A$
		$V_{CE} = 600V$			2500	
$V_{CE(on)}$	Collector Emitter on Voltage	$V_{GE} = 15V$		2.2	2.7	V
		$I_C = 40A$		2.1		
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE} = V_{CE}, I_C = 1mA$	3	4.5	6	V
$I_{GES}$	Gate - Emitter Leakage Current	$V_{GE} = \pm 20V, V_{CE} = 0V$			$\pm 100$	nA

## Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit	
$C_{ies}$	Input Capacitance	$V_{GE} = 0V$		4610		pF	
$C_{oes}$	Output Capacitance	$V_{CE} = 25V$		395			
$C_{res}$	Reverse Transfer Capacitance	$f = 1MHz$		25			
$Q_g$	Total gate Charge	$V_{GS} = 15V$		135		nC	
$Q_{ge}$	Gate - Emitter Charge	$V_{Bus} = 300V$		30			
$Q_{gc}$	Gate - Collector Charge	$I_C = 40A$		40			
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching ( $25^\circ\text{C}$ ) $V_{GE} = 15V$ $V_{Bus} = 400V$ $I_C = 40A$ $R_G = 5\Omega$		20		ns	
$T_r$	Rise Time			30			
$T_{d(off)}$	Turn-off Delay Time			64			
$T_f$	Fall Time			45			
$E_{on1}$	Turn-on Switching Energy				385		$\mu J$
$E_{on2}$	Turn-on Switching Energy ①				644		
$E_{off}$	Turn-off Switching Energy ②				352		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching ( $125^\circ\text{C}$ ) $V_{GE} = 15V$ $V_{Bus} = 400V$ $I_C = 40A$ $R_G = 5\Omega$		20		ns	
$T_r$	Rise Time			30			
$T_{d(off)}$	Turn-off Delay Time			89			
$T_f$	Fall Time			69			
$E_{on1}$	Turn-on Switching Energy				385		$\mu J$
$E_{on2}$	Turn-on Switching Energy ①				972		
$E_{off}$	Turn-off Switching Energy ②				615		

①  $E_{on2}$  includes diode reverse recovery

② In accordance with JEDEC standard JESD24-1

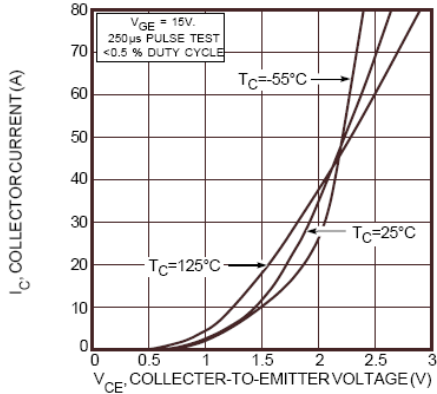
**Diode ratings and characteristics**

<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		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

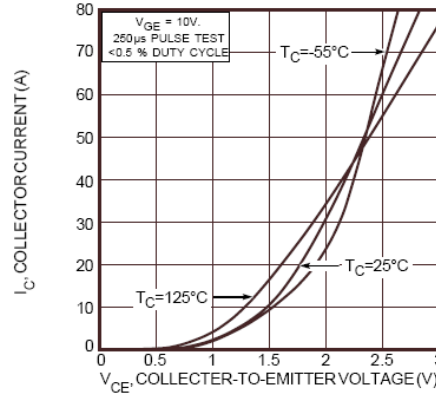
**Thermal and package characteristics**

<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	IGBT			0.44	°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 <sub>isol</sub> < 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

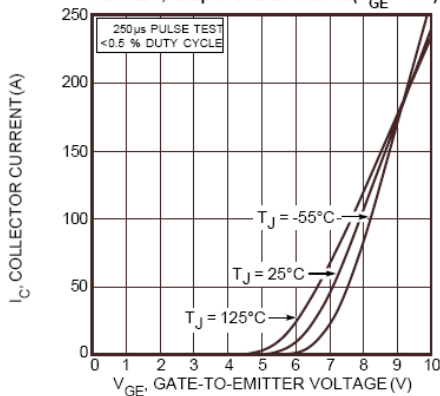
**Typical IGBT Performance Curve**



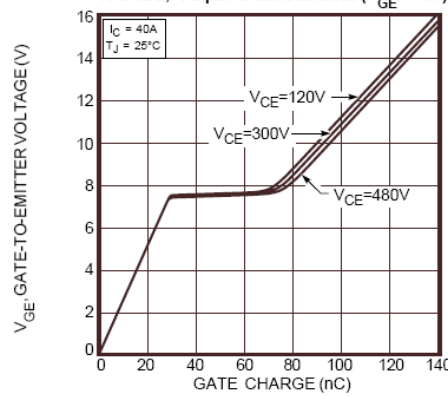
**FIGURE 1, Output Characteristics ( $V_{GE} = 15V$ )**



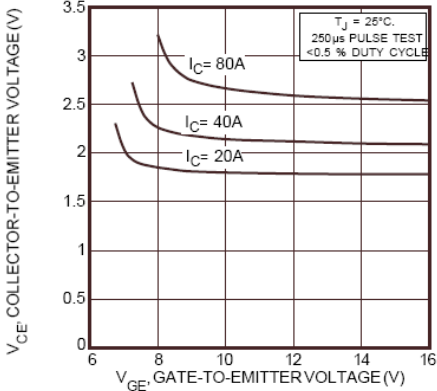
**FIGURE 2, Output Characteristics ( $V_{GE} = 10V$ )**



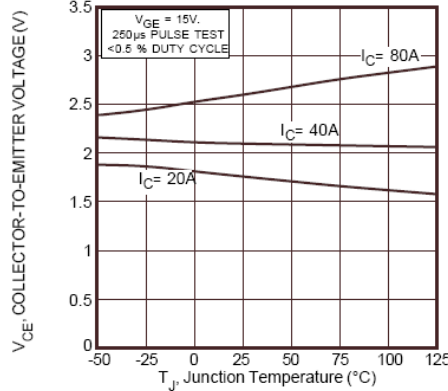
**FIGURE 3, Transfer Characteristics**



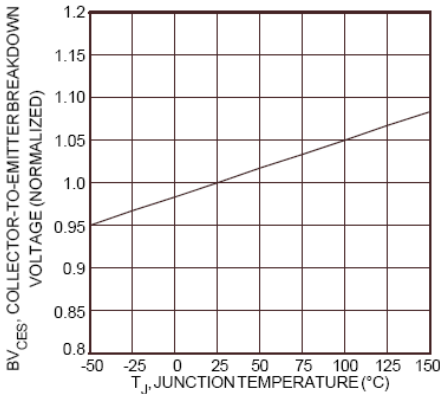
**FIGURE 4, Gate Charge**



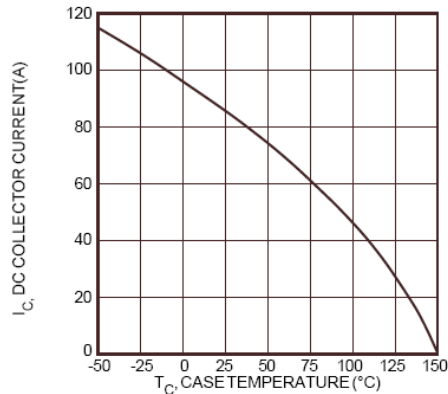
**FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage**



**FIGURE 6, On State Voltage vs Junction Temperature**



**FIGURE 7, Breakdown Voltage vs. Junction Temperature**



**FIGURE 8, DC Collector Current vs Case Temperature**

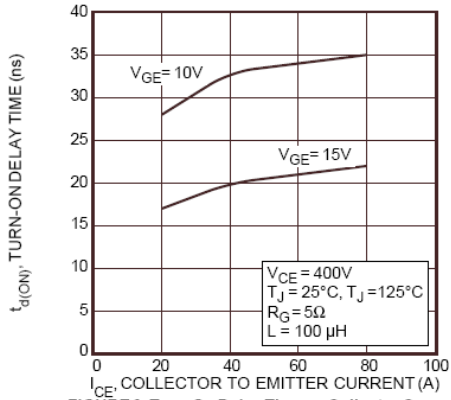


FIGURE 9, Turn-On Delay Time vs Collector Current

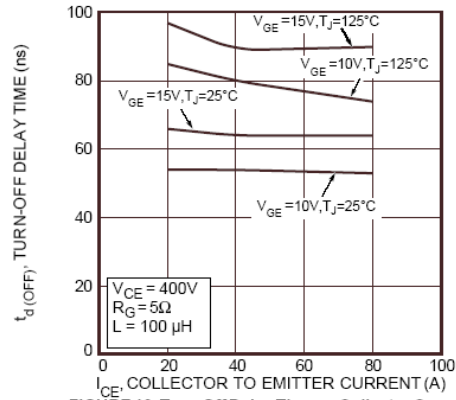


FIGURE 10, Turn-Off Delay Time vs Collector Current

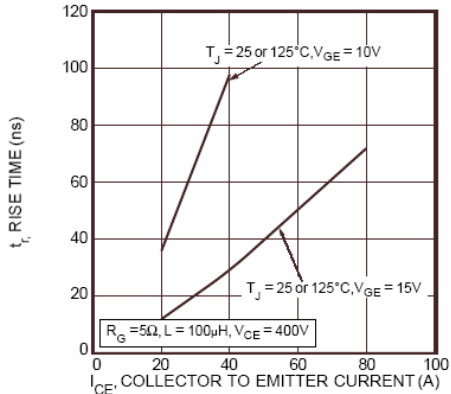


FIGURE 11, Current Rise Time vs Collector Current

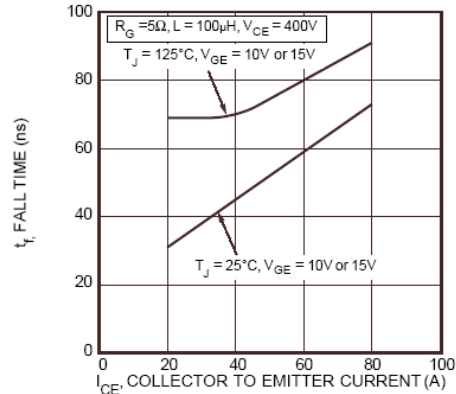


FIGURE 12, Current Fall Time vs Collector Current

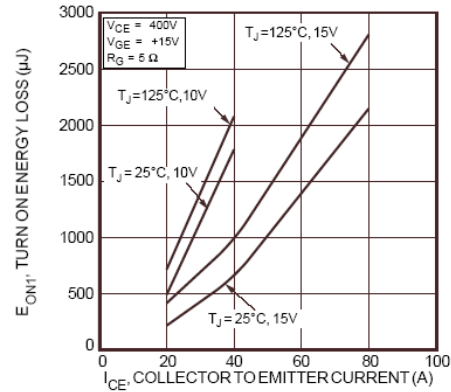


FIGURE 13, Turn-On Energy Loss vs Collector Current

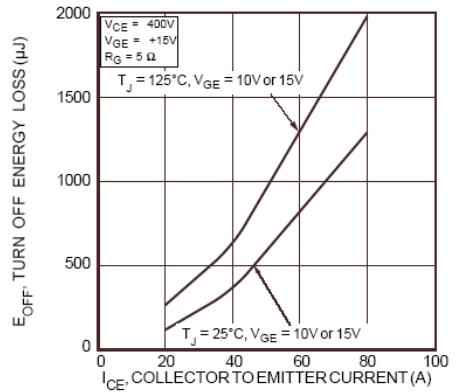


FIGURE 14, Turn Off Energy Loss vs Collector Current

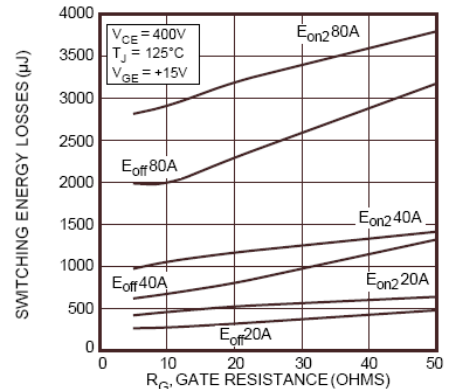


FIGURE 15, Switching Energy Losses vs. Gate Resistance

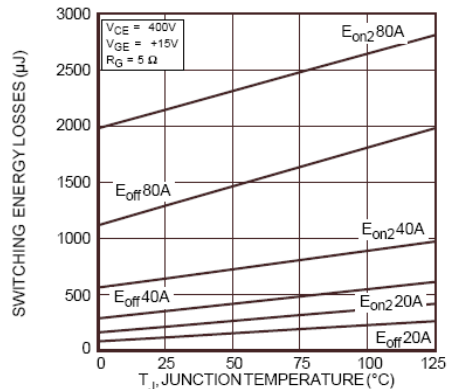


FIGURE 16, Switching Energy Losses vs Junction Temperature

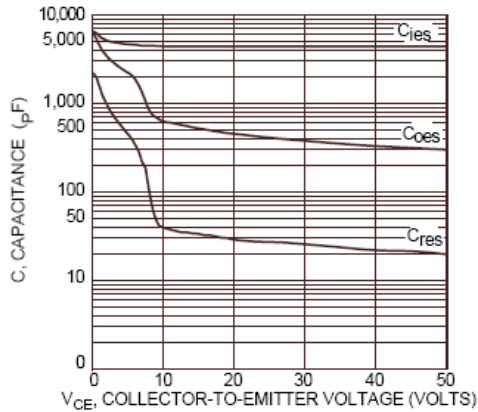


Figure 17, Capacitance vs Collector-To-Emitter Voltage

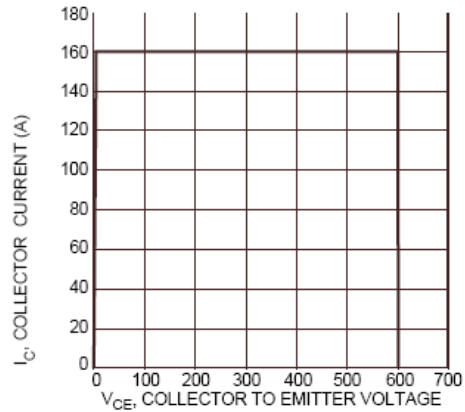


Figure 18, Minimum Switching Safe Operating Area

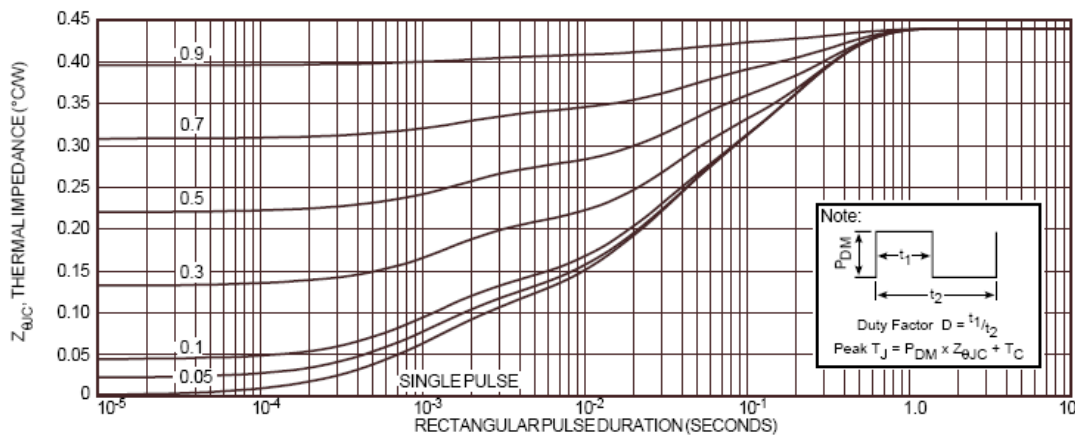


FIGURE 1, MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION

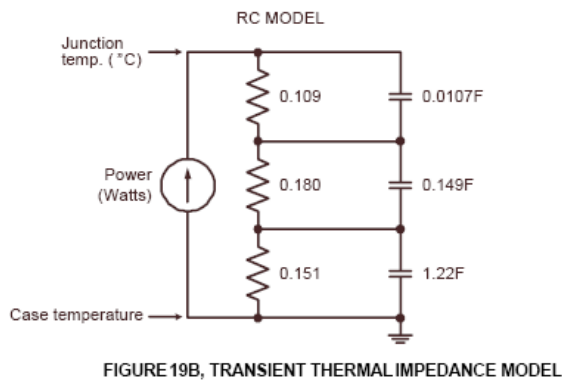


FIGURE 19B, TRANSIENT THERMAL IMPEDANCE MODEL

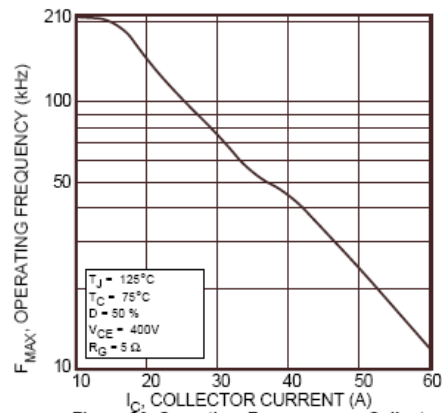


Figure 20, Operating Frequency vs Collector Current

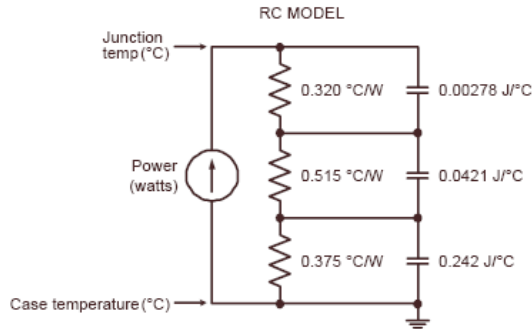
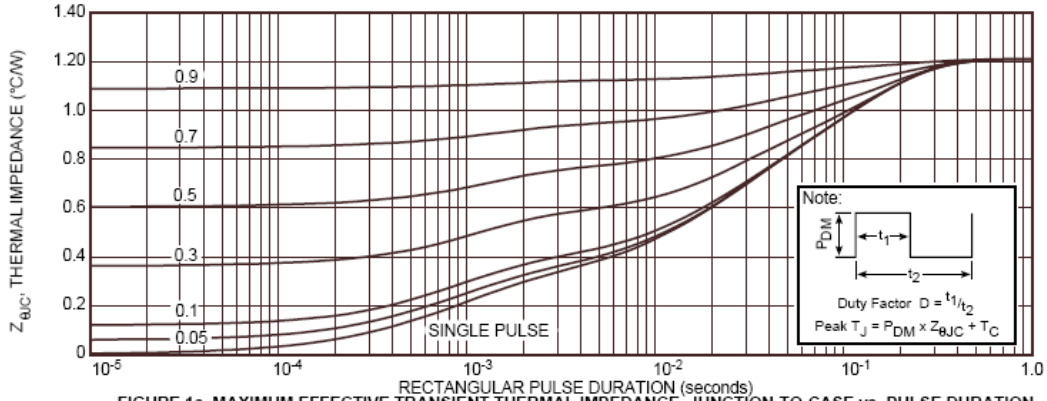
$$f_{max} = \min(f_{max1}, f_{max2})$$

$$f_{max1} = \frac{0.05}{t_{d(on)} + t_r + t_{d(off)} + t_f}$$

$$f_{max2} = \frac{P_{diss} - P_{cond}}{E_{on2} + E_{off}}$$

$$P_{diss} = \frac{T_j - T_c}{R_{\theta JC}}$$

**Typical Diode Performance Curve**



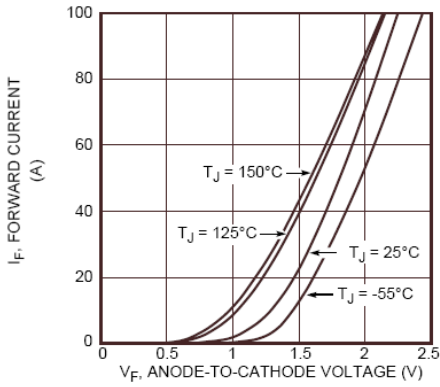


Figure 2. Forward Current vs. Forward Voltage

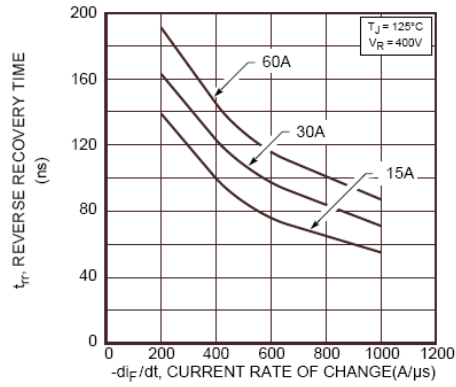


Figure 3. Reverse Recovery Time vs. Current Rate of Change

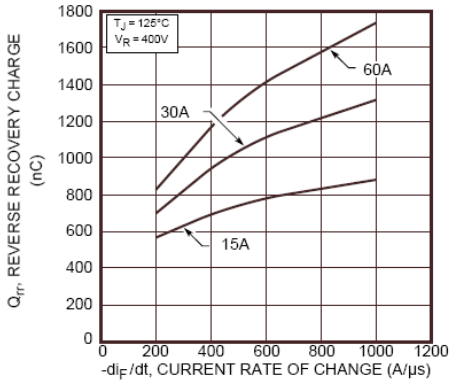


Figure 4. Reverse Recovery Charge vs. Current Rate of Change

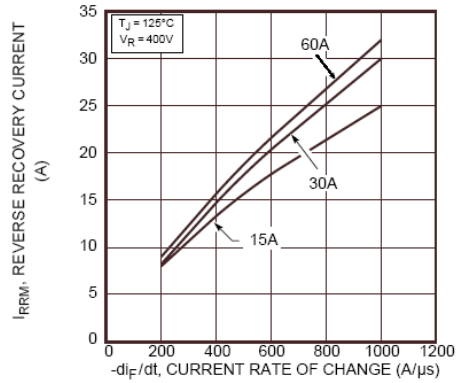


Figure 5. Reverse Recovery Current vs. Current Rate of Change

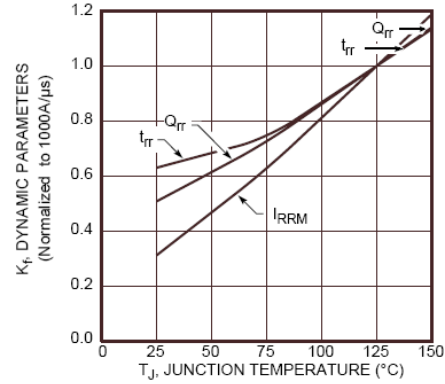


Figure 6. Dynamic Parameters vs. Junction Temperature

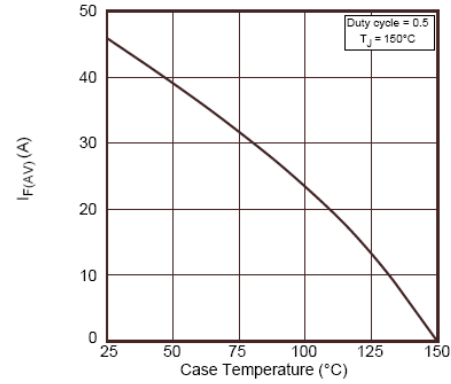


Figure 7. Maximum Average Forward Current vs. Case Temperature

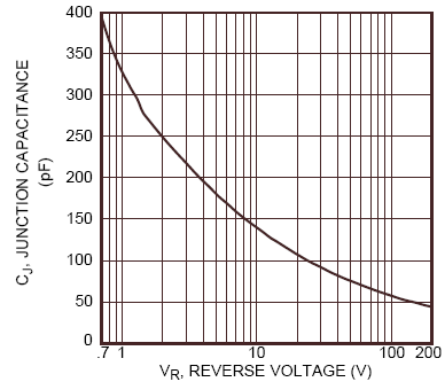


Figure 8. Junction Capacitance vs. Reverse Voltage



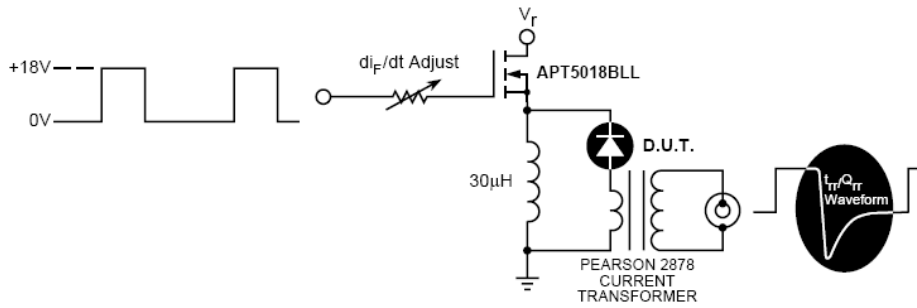


Figure 9. Diode Test Circuit

- 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  $t_{rr}$ .

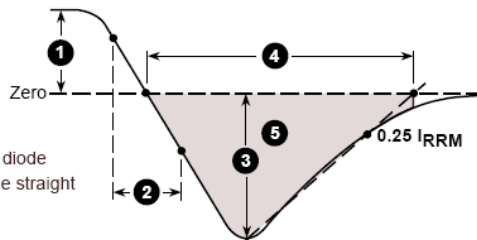
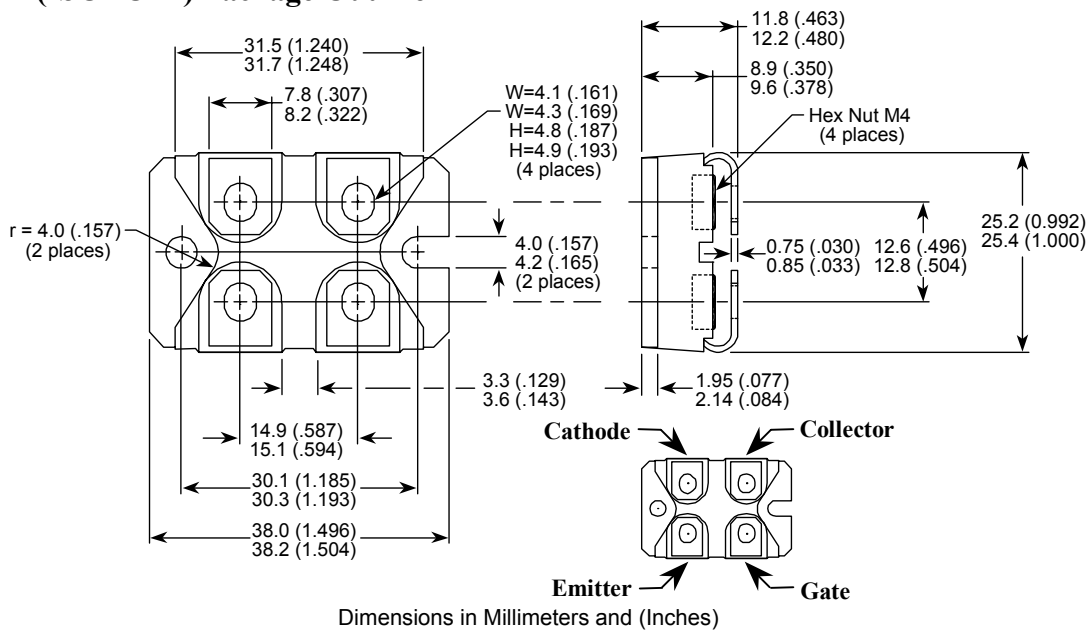


Figure 10. Diode Reverse Recovery Waveform and Definitions

**SOT-227 (ISOTOP®) Package Outline**



Dimensions in Millimeters and (Inches)

ISOTOP® is a Registered Trademark of SGS Thomson

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

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.