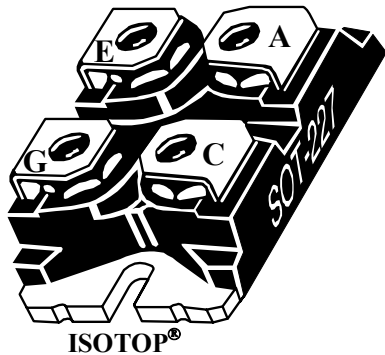
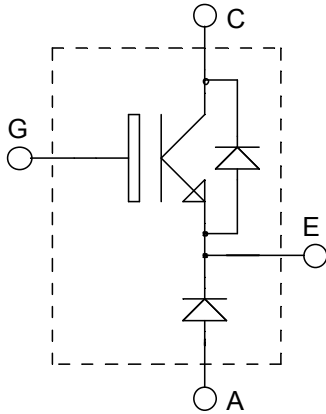


**ISOTOP® Buck chopper
PT IGBT**

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



Application

- AC and DC motor control
- Switched Mode Power Supplies

Features

- Power MOS 7® 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® 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	$T_c = 25^\circ C$	A
I_{C2}		$T_c = 110^\circ C$	
I_{CM}	Pulsed Collector Current	$T_c = 25^\circ C$	160
V_{GE}	Gate - Emitter Voltage	± 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	A
I_{FRMS}	RMS Forward Current (Square wave, 50% duty)	$T_c = 80^\circ C$	
			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	μA
		$V_{CE} = 600V$			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	$V_{GE} = \pm 20V, V_{CE} = 0V$			± 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°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		μJ
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°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		μJ
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

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
V _F	Diode Forward Voltage	I _F = 30A		1.6	1.8	V
		I _F = 60A		1.9		
		I _F = 30A	T _j = 125°C		1.4	
I _{RM}	Maximum Reverse Leakage Current	V _R = 600V	T _j = 25°C		250	μA
		V _R = 600V	T _j = 125°C		500	
C _T	Junction Capacitance	V _R = 200V		44		pF
t _{rr}	Reverse Recovery Time	I _F = 1A, V _R = 30V di/dt = 100A/μs	T _j = 25°C		23	ns
	Reverse Recovery Time		T _j = 25°C		85	
			T _j = 125°C		160	
I _{RRM}	Maximum Reverse Recovery Current	I _F = 30A V _R = 400V di/dt = 200A/μs	T _j = 25°C		4	A
			T _j = 125°C		8	
Q _{rr}	Reverse Recovery Charge		T _j = 25°C		130	nC
			T _j = 125°C		700	
t _{rr}	Reverse Recovery Time	I _F = 30A	T _j = 125°C		70	ns
Q _{rr}	Reverse Recovery Charge	V _R = 400V			1300	nC
I _{RRM}	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	IGBT		0.44	°C/W
		Diode		1.21	
R _{thJA}	Junction to Ambient (IGBT & Diode)			20	
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	°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 IGBT Performance Curve

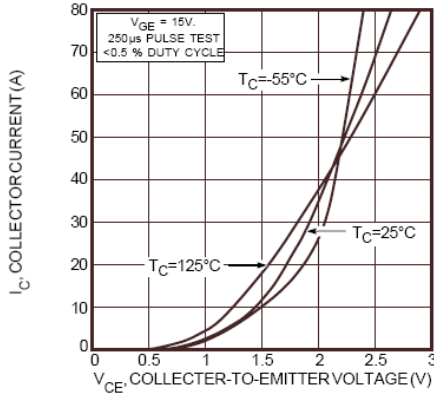


FIGURE 1, Output Characteristics ($V_{GE} = 15V$)

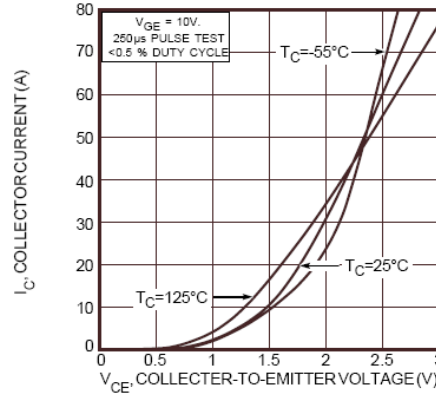


FIGURE 2, Output Characteristics ($V_{GE} = 10V$)

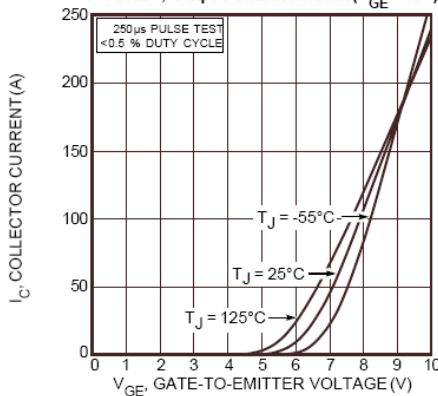


FIGURE 3, Transfer Characteristics

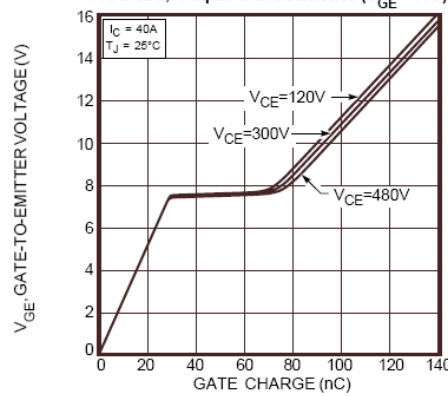


FIGURE 4, Gate Charge

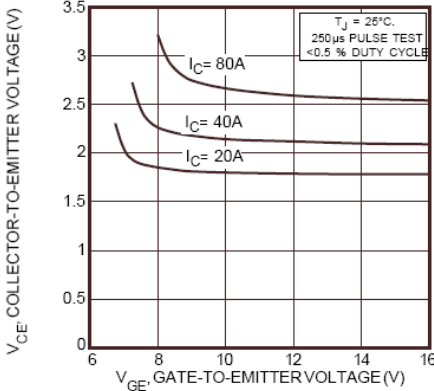


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

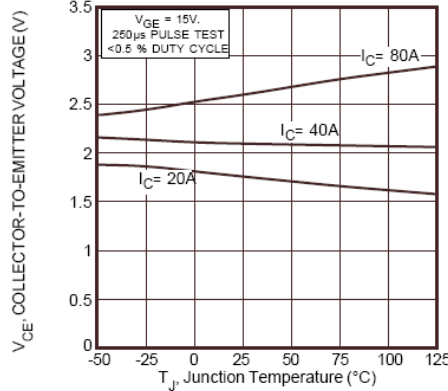


FIGURE 6, On State Voltage vs Junction Temperature

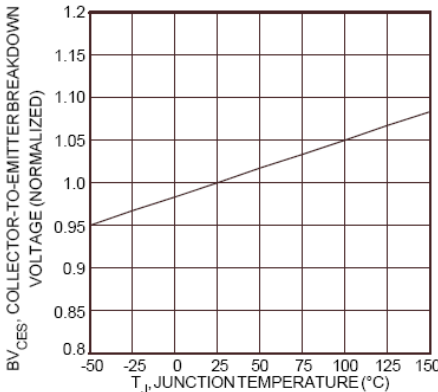


FIGURE 7, Breakdown Voltage vs. Junction Temperature

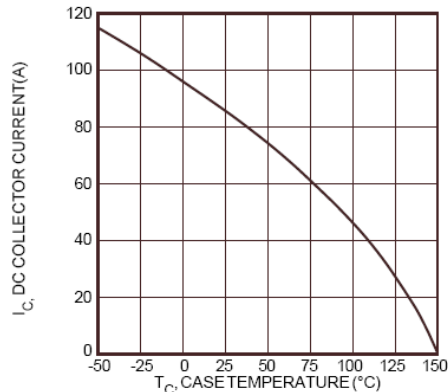


FIGURE 8, DC Collector Current vs Case Temperature

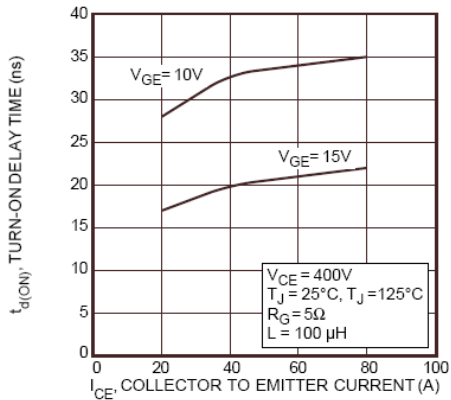


FIGURE 9, Turn-On Delay Time vs Collector Current

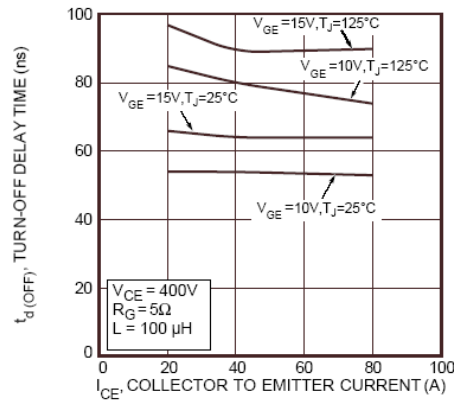


FIGURE 10, Turn-Off Delay Time vs Collector Current

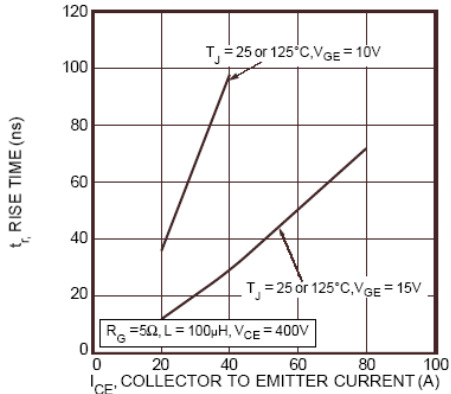


FIGURE 11, Current Rise Time vs Collector Current

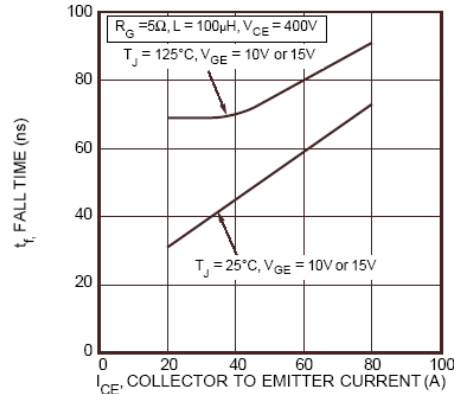


FIGURE 12, Current Fall Time vs Collector Current

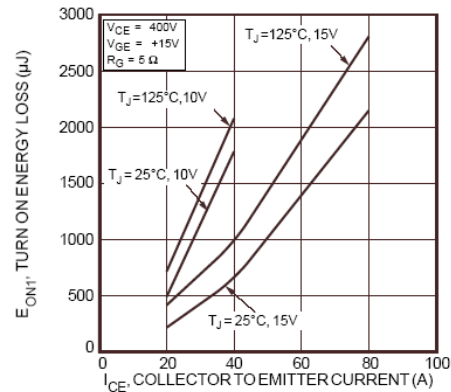


FIGURE 13, Turn-On Energy Loss vs Collector Current

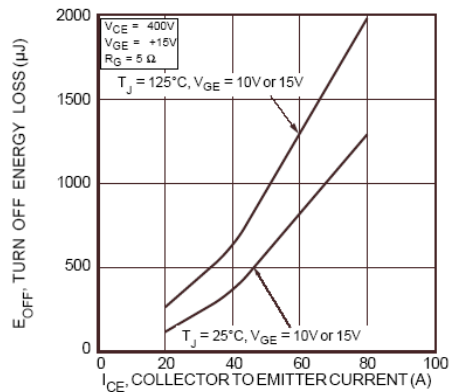


FIGURE 14, Turn Off Energy Loss vs Collector Current

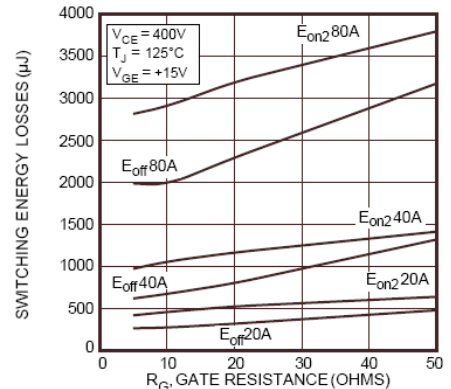


FIGURE 15, Switching Energy Losses vs. Gate Resistance

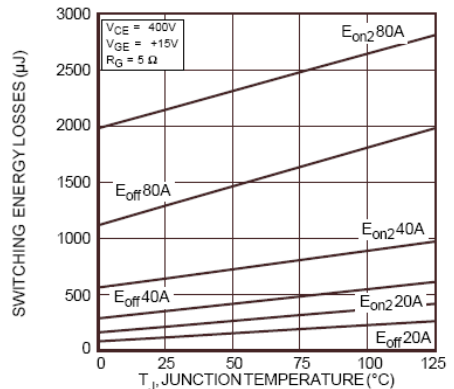


FIGURE 16, Switching Energy Losses vs Junction Temperature

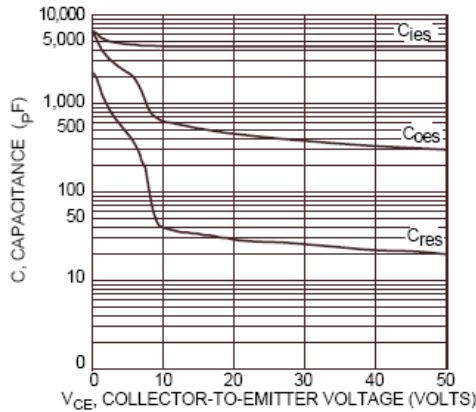


Figure 17, Capacitance vs Collector-To-Emitter Voltage

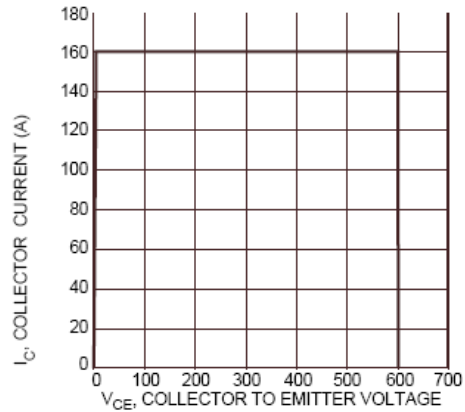


Figure 18, Minimum Switching Safe Operating Area

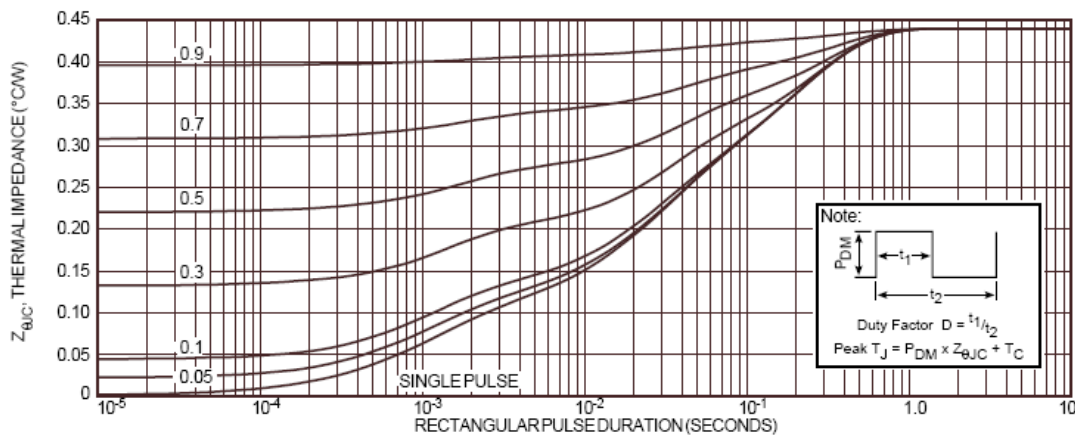


FIGURE 1, MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION

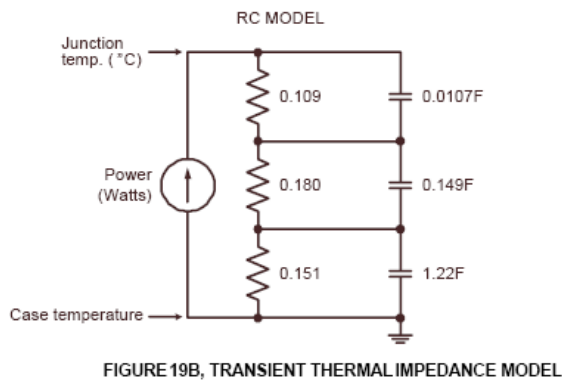


FIGURE 19B, TRANSIENT THERMAL IMPEDANCE MODEL

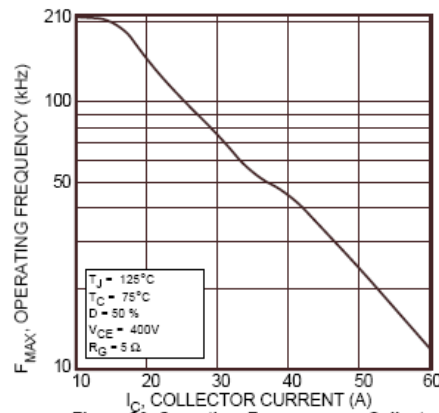


Figure 20, Operating Frequency vs Collector Current

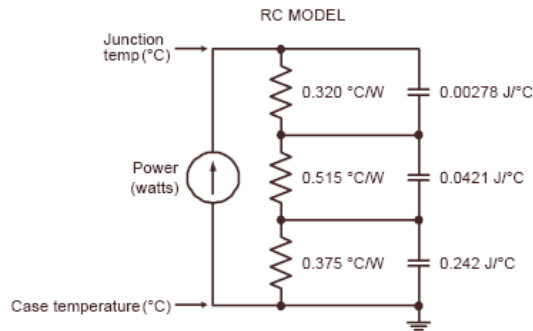
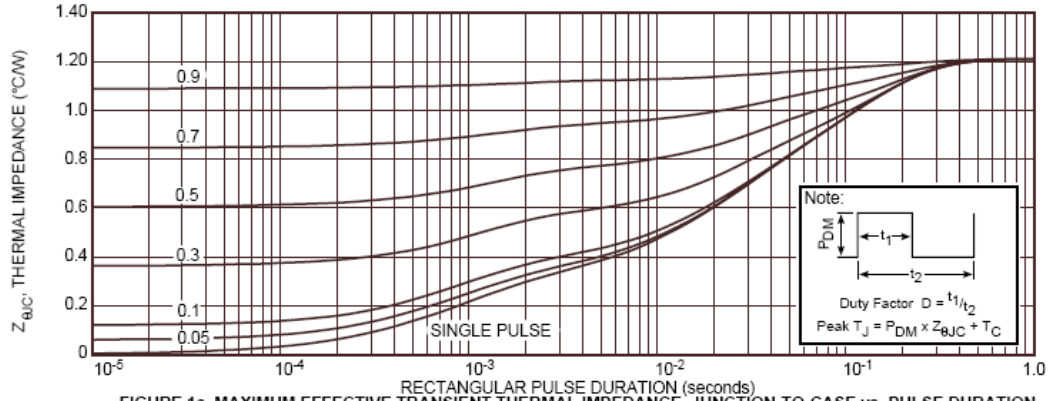
$$F_{max} = \min(f_{max1}, f_{max2})$$

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

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

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

Typical Diode Performance Curve



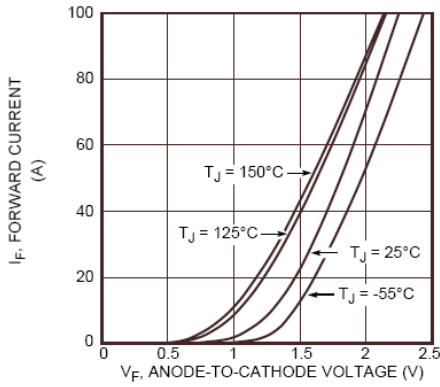


Figure 2. Forward Current vs. Forward Voltage

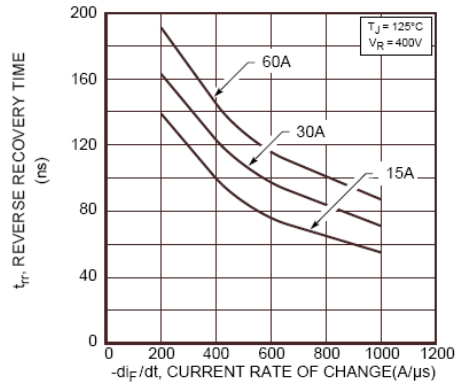


Figure 3. Reverse Recovery Time vs. Current Rate of Change

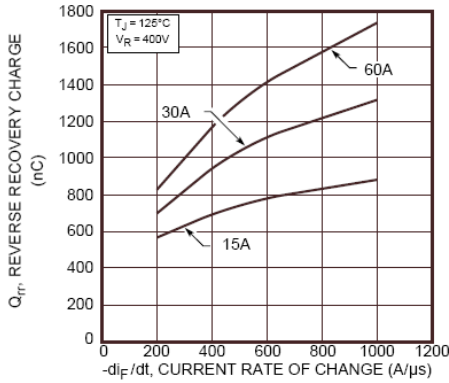


Figure 4. Reverse Recovery Charge vs. Current Rate of Change

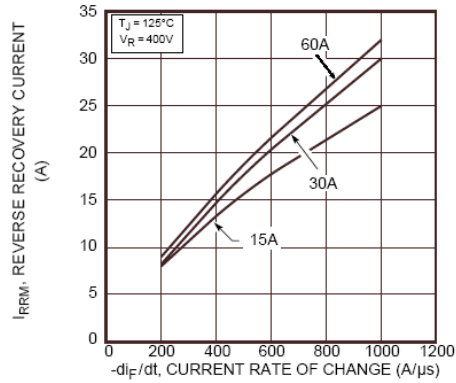


Figure 5. Reverse Recovery Current vs. Current Rate of Change

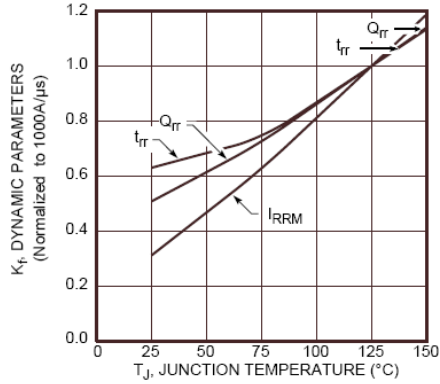


Figure 6. Dynamic Parameters vs. Junction Temperature

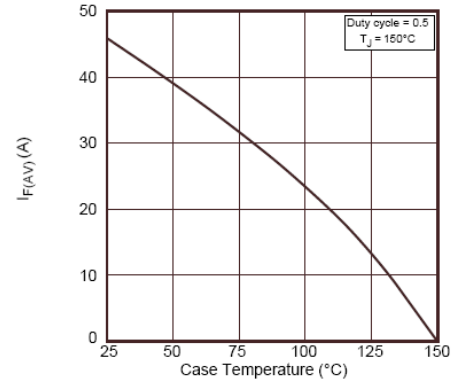


Figure 7. Maximum Average Forward Current vs. Case Temperature

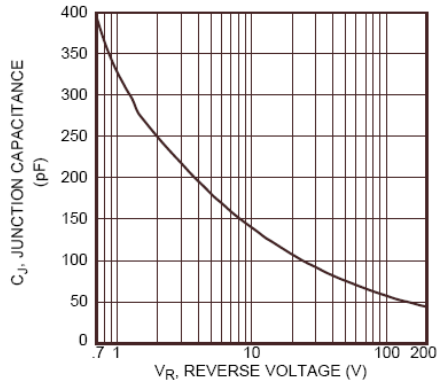


Figure 8. Junction Capacitance vs. Reverse Voltage

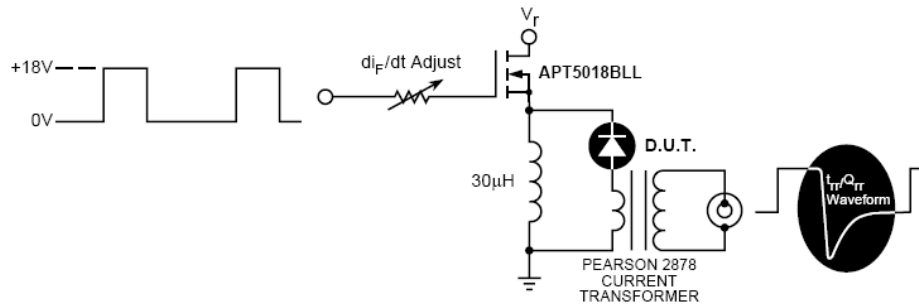


Figure 9. Diode Test Circuit

- 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} .

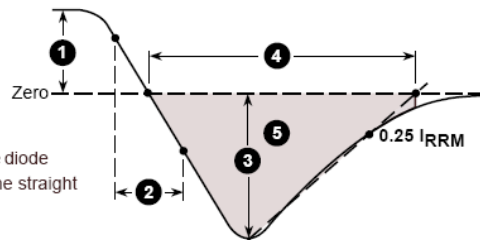
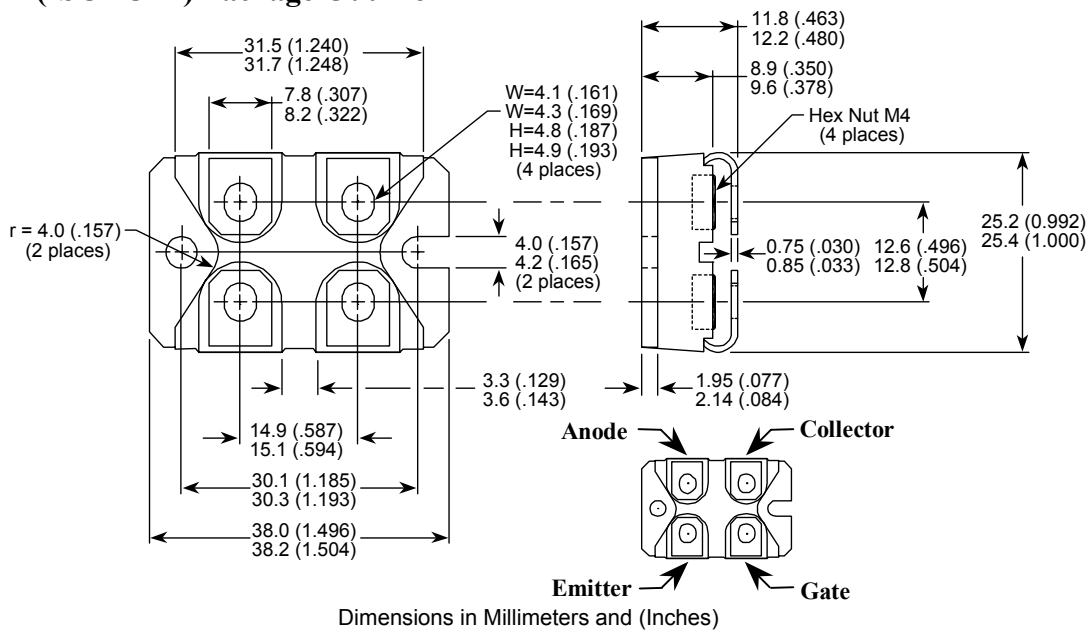


Figure 10. Diode Reverse Recovery Waveform and Definitions

SOT-227 (ISOTOP®) Package Outline



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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.