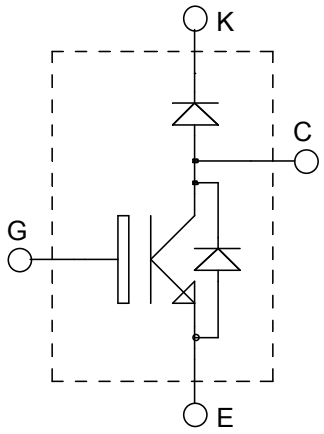
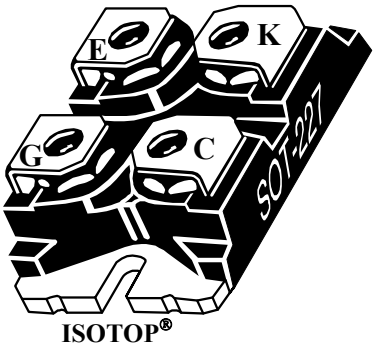
APT100GF60JU2

ISOTOP® Boost chopper NPT IGBT

V_{CES} = 600V
I_C = 100A @ Tc = 80°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
  - RBSOA and SCSOA rated
- 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
- 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°C	120	A
I_{C2}			T_C = 80°C	100	
I_{CM}	Pulsed Collector Current		T_C = 25°C	320	
V_{GE}	Gate – Emitter Voltage			±20	V
P_D	Maximum Power Dissipation		T_C = 25°C	416	W
IF_{AV}	Maximum Average Forward Current	Duty cycle=0.5	T_C = 80°C	30	A
IF_{RMS}	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°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 = 100µA		600			V
I_{CES}	Zero Gate Voltage Collector Current	V_{GE} = 0V V_{CE} = 600V	T_j = 25°C			100	µA
			T_j = 125°C			1000	
$V_{CE(sat)}$	Collector Emitter saturation Voltage	V_{GE} =15V I_C = 100A	T_j = 25°C		2.0	2.5	V
			T_j = 125°C		2.2		
$V_{GE(th)}$	Gate Threshold Voltage	V_{GE} = V_{CE}, I_C = 1mA		3		5	V
I_{GES}	Gate – Emitter Leakage Current	V_{GE} = ±20V, V_{CE} = 0V				±150	nA

Dynamic Characteristics

Symbol	*Characteristic*	*Test Conditions*	*Min*	*Typ*	*Max*	*Unit*
C_{ies}	Input Capacitance	V_{GE} = 0V V_{CE} = 25V f = 1MHz		4300		pF
C_{oes}	Output Capacitance			470		
C_{res}	Reverse Transfer Capacitance			400		
Q_g	Total gate Charge	V_{GS} = 15V V_{Bus} = 300V I_C = 100A		330		nC
Q_{ge}	Gate – Emitter Charge			290		
Q_{gc}	Gate – Collector Charge			200		
$T_{d(on)}$	Turn-on Delay Time	Resistive Switching (25°C) V_{GE} = 15V V_{Bus} = 400V I_C = 100A R_G = 5Ω		26		ns
T_r	Rise Time			25		
$T_{d(off)}$	Turn-off Delay Time			150		
T_f	Fall Time			30		
E_{on}	Turn-on Switching Energy			3.35		mJ
E_{off}	Turn off Switching Energy			2.85		
$T_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) V_{GE} = 15V V_{Bus} = 400V I_C = 100A R_G = 5Ω		26		ns
T_r	Rise Time			25		
$T_{d(off)}$	Turn-off Delay Time			170		
T_f	Fall Time			40		
E_{on}	Turn-on Switching Energy			4.3		mJ
E_{off}	Turn-off Switching Energy			3.5		

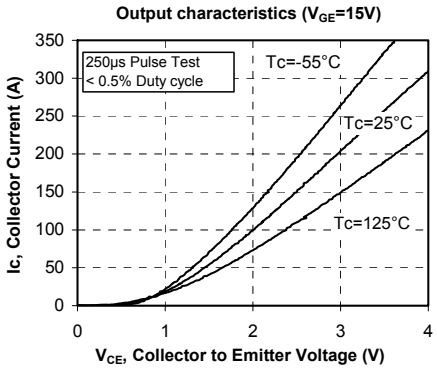
Chopper diode ratings and characteristics

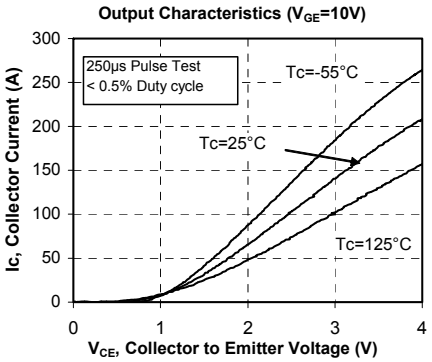
Symbol	Characteristic	Test Conditions		Min	Typ	Max	Unit
V_F	Diode Forward Voltage	I_F = 30A			1.6	1.8	V
		I_F = 60A			1.9		
		I_F = 30A	T_j = 125°C		1.4		
I_{RM}	Maximum Reverse Leakage Current	V_R = 600V	T_j = 25°C			250	µA
		V_R = 600V	T_j = 125°C			500	
C_T	Junction Capacitance	V_R = 200V			44		pF
t_{rr}	Reverse Recovery Time	I_F=1A,V_R=30V di/dt =100A/µs	T_j = 25°C		23		ns
	Reverse Recovery Time	I_F = 30A V_R = 400V di/dt =200A/µs	T_j = 25°C		85		
			T_j = 125°C		160		
I_{RRM}	Maximum Reverse Recovery Current		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 V_R = 400V di/dt =1000A/µs	T_j = 125°C		70		ns
Q_{rr}	Reverse Recovery Charge				1300		nC
I_{RRM}	Maximum Reverse Recovery Current				30		A

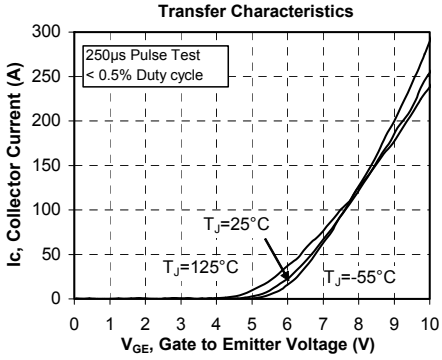
Thermal and package characteristics

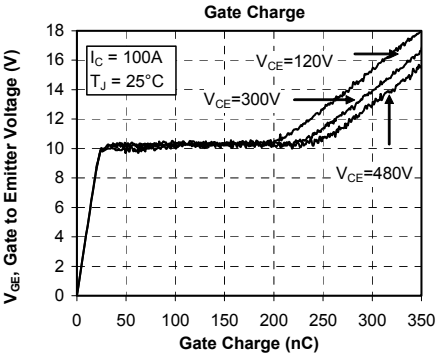
Symbol	Characteristic		Min	Typ	Max	Unit
R_{thJC}	Junction to Case Thermal Resistance	IGBT			0.3	°C/W
		Diode			1.21	
R_{thJA}	Junction to Ambient (IGBT & Diode)				20	
V_{ISOL}	RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz		2500			V
T_J,T_{STG}	Storage Temperature Range		-55		150	°C
T_L	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

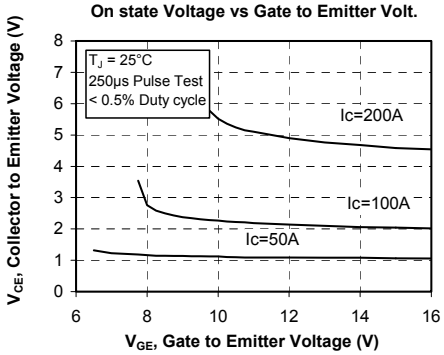
Typical IGBT Performance Curve

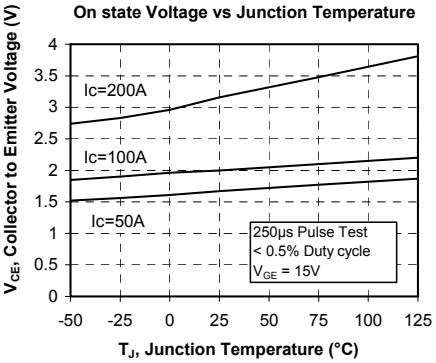


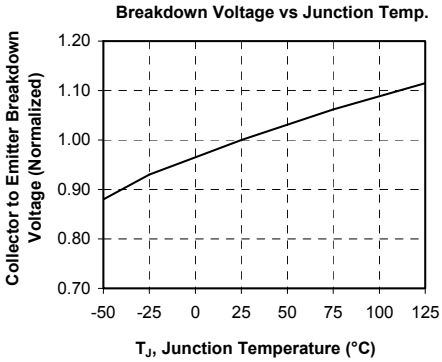


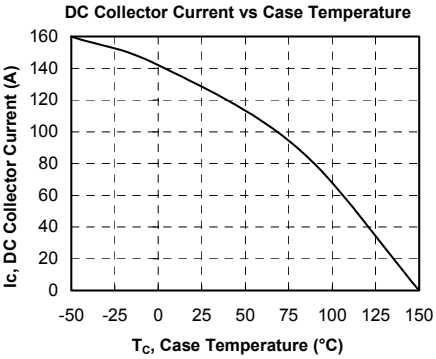


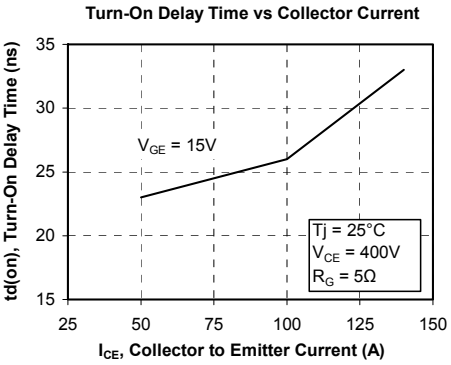


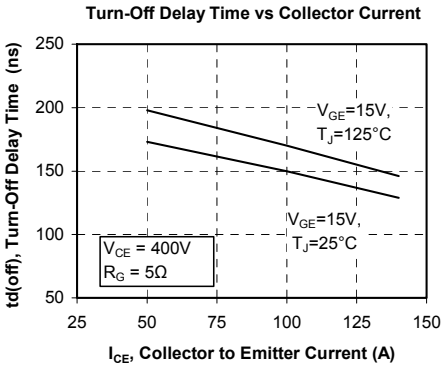


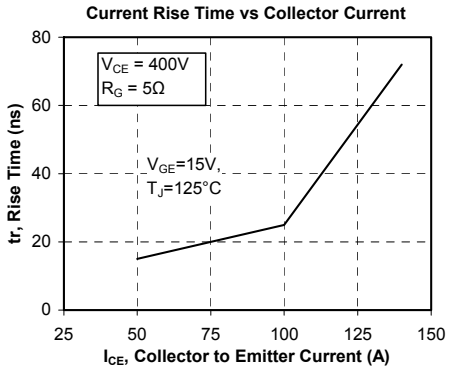


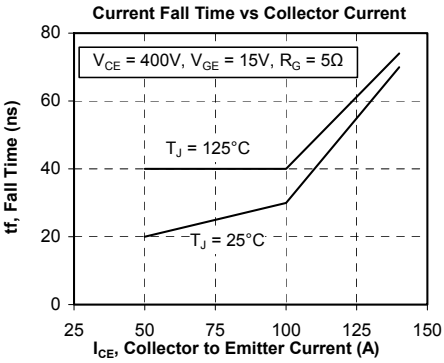


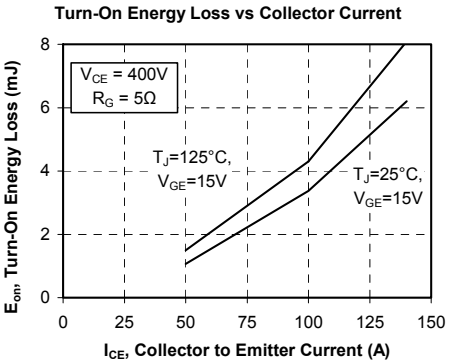


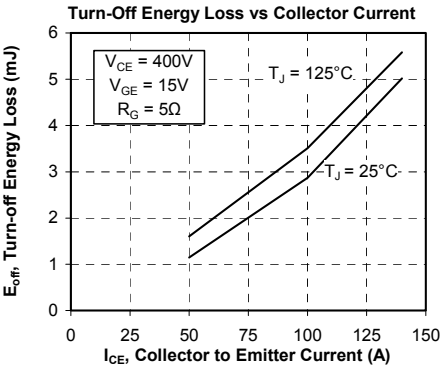

Turn-On Delay Time vs Collector Current
td(on), Turn-On Delay Time (ns)
35
30
25
20
15
25
50
75
100
125
150
VGE = 15V
Tj = 25°C
VCE = 400V
RG = 5Ω
ICE, Collector to Emitter Current (A)

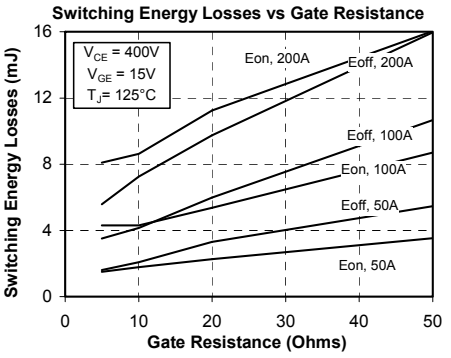

Turn-Off Delay Time vs Collector Current
td(off), Turn-Off Delay Time (ns)
250
200
150
100
50
25
50
75
100
125
150
VGE=15V,
TJ=125°C
VGE=15V,
TJ=25°C
VCE = 400V
RG = 5Ω
ICE, Collector to Emitter Current (A)

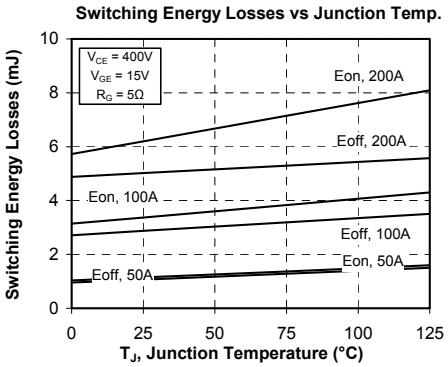

Current Rise Time vs Collector Current
tr, Rise Time (ns)
80
60
40
20
0
25
50
75
100
125
150
VCE = 400V
RG = 5Ω
VGE=15V,
TJ=125°C
ICE, Collector to Emitter Current (A)

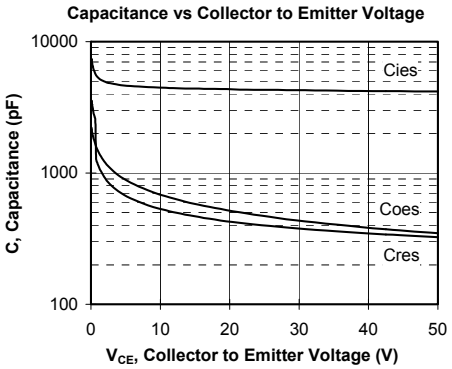

Current Fall Time vs Collector Current
tf, Fall Time (ns)
80
60
40
20
0
25
50
75
100
125
150
VCE = 400V, VGE = 15V, RG = 5Ω
TJ = 125°C
TJ = 25°C
ICE, Collector to Emitter Current (A)

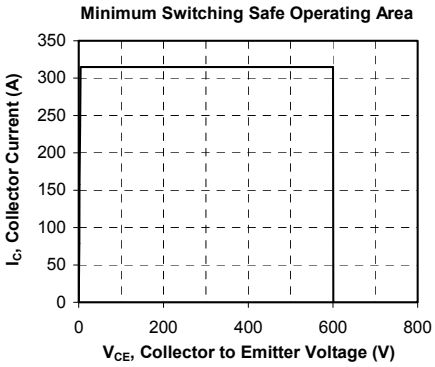

Turn-On Energy Loss vs Collector Current
Eon, Turn-On Energy Loss (mJ)
8
6
4
2
0
0
25
50
75
100
125
150
VCE = 400V
RG = 5Ω
TJ=125°C,
VGE=15V
TJ=25°C,
VGE=15V
ICE, Collector to Emitter Current (A)

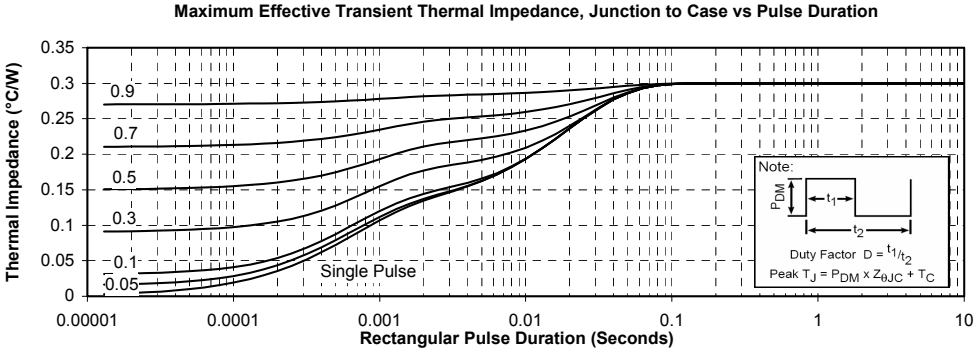

Turn-Off Energy Loss vs Collector Current
Eoff, Turn-off Energy Loss (mJ)
6
5
4
3
2
1
0
0
25
50
75
100
125
150
VCE = 400V
VGE = 15V
RG = 5Ω
TJ = 125°C
TJ = 25°C
ICE, Collector to Emitter Current (A)

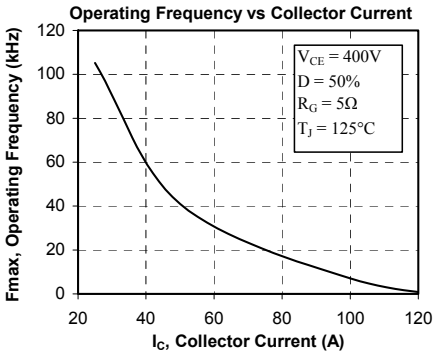

Switching Energy Losses vs Gate Resistance
Switching Energy Losses (mJ)
16
12
8
4
0
0
10
20
30
40
50
VCE = 400V
VGE = 15V
TJ= 125°C
Eon, 200A
Eoff, 200A
Eoff, 100A
Eon, 100A
Eoff, 50A
Eon, 50A
Gate Resistance (Ohms)


Switching Energy Losses vs Junction Temp.
Switching Energy Losses (mJ)
10
8
6
4
2
0
0
25
50
75
100
125
VCE = 400V
VGE = 15V
RG = 5Ω
Eon, 200A
Eoff, 200A
Eon, 100A
Eoff, 100A
Eon, 50A
Eoff, 50A
TJ, Junction Temperature (°C)


Capacitance vs Collector to Emitter Voltage
C, Capacitance (pF)
10000
1000
100
Cies
Coes
Cres
0
10
20
30
40
50
VCE, Collector to Emitter Voltage (V)


Minimum Switching Safe Operating Area
IC, Collector Current (A)
350
300
250
200
150
100
50
0
0
200
400
600
800
VCE, Collector to Emitter Voltage (V)


Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration
Thermal Impedance (°C/W)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.9
0.7
0.5
0.3
0.1
0.05
Single Pulse
Note:
PDM
t1
t2
Duty Factor D = t1/t2
Peak TJ = PDM x ZθJC + TC
0.00001
0.0001
0.001
0.01
0.1
1
10
Rectangular Pulse Duration (Seconds)


Operating Frequency vs Collector Current
Fmax, Operating Frequency (kHz)
120
100
80
60
40
20
0
VCE = 400V
D = 50%
RG = 5Ω
TJ = 125°C
20
40
60
80
100
120
IC, Collector Current (A)

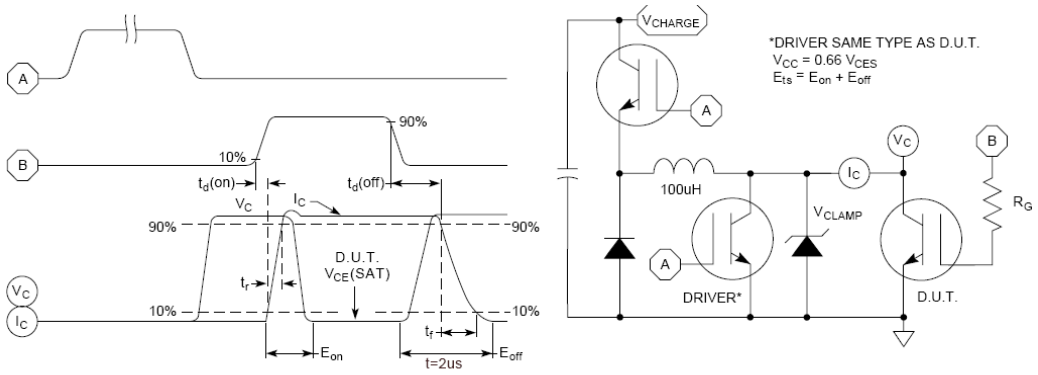


Figure 15, Switching Loss Test Circuit and Waveforms

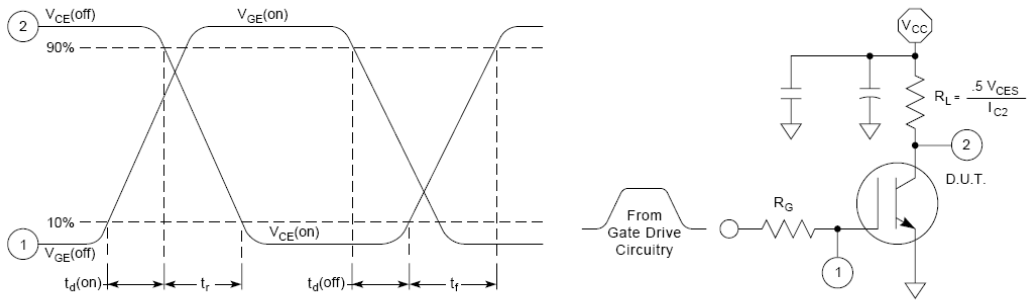


Figure 16, Resistive Switching Time Test Circuit and Waveforms

Typical Diode Performance Curve

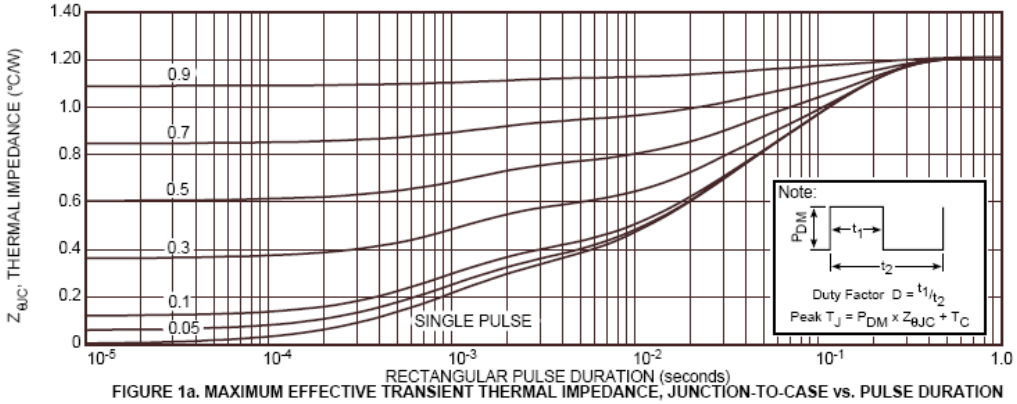


FIGURE 1a. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

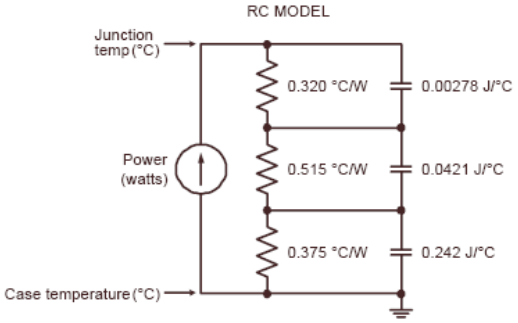


FIGURE 1b, TRANSIENT THERMAL IMPEDANCE MODEL

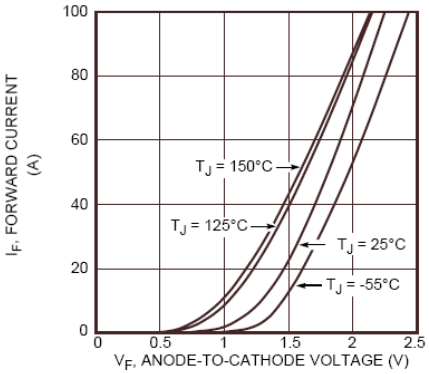


Figure 2. Forward Current *vs.* Forward Voltage

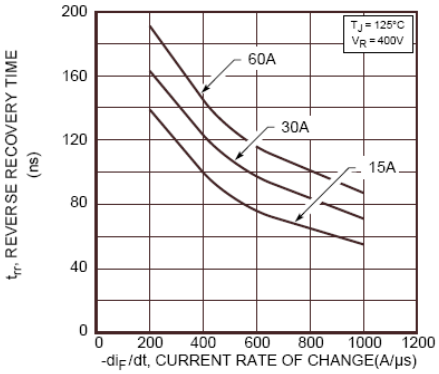


Figure 3. Reverse Recovery Time *vs.* Current Rate of Change

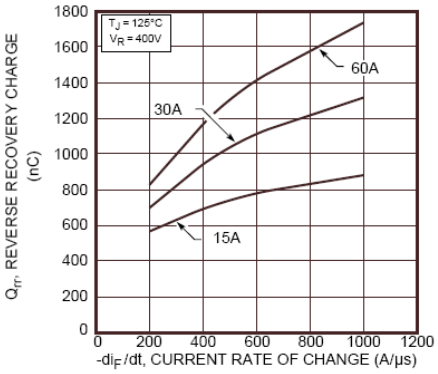


Figure 4. Reverse Recovery Charge *vs.* Current Rate of Change

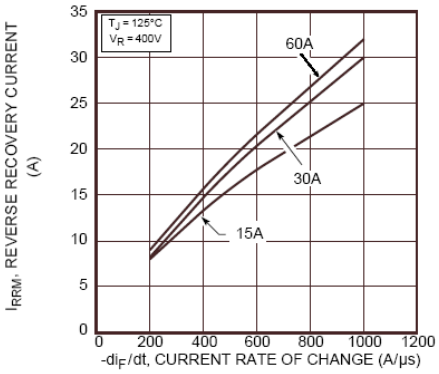


Figure 5. Reverse Recovery Current *vs.* Current Rate of Change

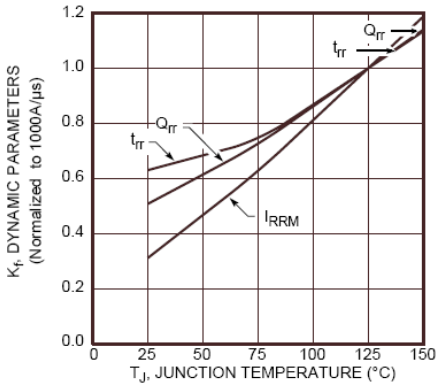


Figure 6. Dynamic Parameters *vs.* Junction Temperature

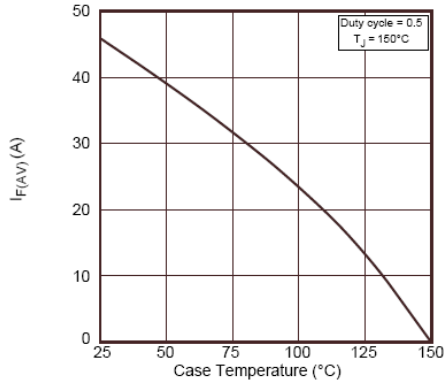


Figure 7. Maximum Average Forward Current *vs.* CaseTemperature

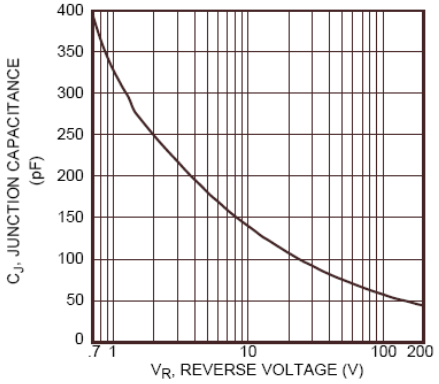


Figure 8. Junction Capacitance *vs.* Reverse Voltage

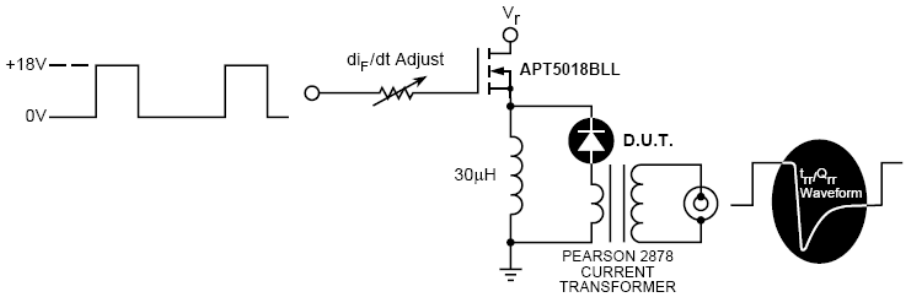


Figure 9. Diode Test Circuit

1. I_F - Forward Conduction Current
2. di_F/dt - Rate of Diode Current Change Through Zero Crossing.
3. I_{RRM} - Maximum Reverse Recovery Current.
4. 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 $0.25 \bullet I_{RRM}$ passes through zero.
5. Q_{rr} - Area Under the Curve Defined by I_{RRM} and t_{rr}.

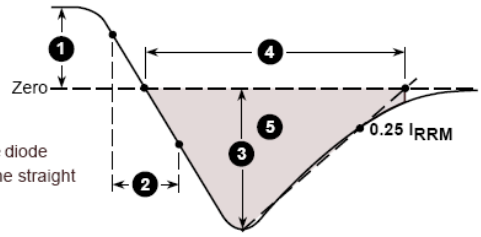
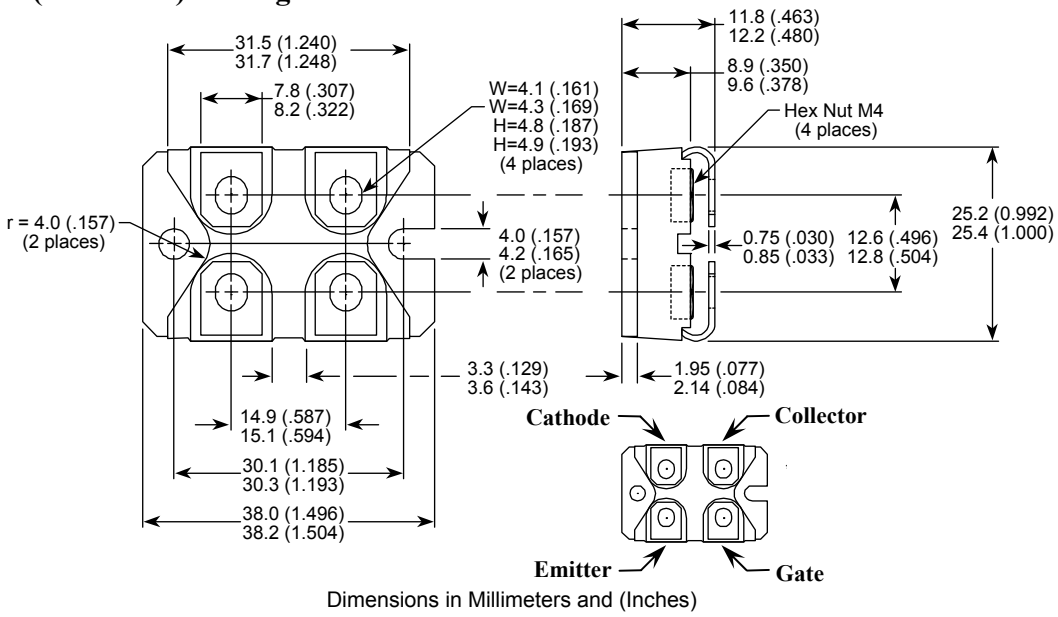


Figure 10, Diode Reverse Recovery Waveform and Definitions

SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (Inches)

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