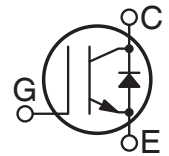


Utilizing the latest Field Stop and Trench Gate technologies, these IGBTs have ultra low $V_{CE(ON)}$ and are ideal for low frequency applications that require absolute minimum conduction loss. Easy paralleling is a result of very tight parameter distribution and a slightly positive $V_{CE(ON)}$ temperature coefficient. A built-in gate resistor ensures extremely reliable operation, even in the event of a short circuit fault. Low gate charge simplifies gate drive design and minimizes losses.



- **600V NPT Field Stop**
- **Trench Gate: Low $V_{CE(on)}$**
- **Easy Paralleling**
- **10 μ s Short Circuit Capability**
- **Intergrated Gate Resistor: Low EMI, High Reliability**

Applications: welding, inductive heating, solar inverters, motor drives, UPS, pass transistor

MAXIMUM RATINGS

All Ratings: $T_C = 25^\circ\text{C}$ unless otherwise specified.

Symbol	Parameter	APT200GN60JDQ4	UNIT
V_{CES}	Collector-Emitter Voltage	600	Volts
V_{GE}	Gate-Emitter Voltage	± 20	
I_{C1}	Continuous Collector Current @ $T_C = 25^\circ\text{C}$	250	Amps
I_{C2}	Continuous Collector Current @ $T_C = 110^\circ\text{C}$	110	
I_{CM}	Pulsed Collector Current ^① @ $T_C = 150^\circ\text{C}$	600	
SSOA	Switching Safe Operating Area @ $T_J = 150^\circ\text{C}$	600A @ 600V	
P_D	Total Power Dissipation	568	Watts
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	$^\circ\text{C}$

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage ($V_{GE} = 0\text{V}, I_C = 4\text{mA}$)	600			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ($V_{CE} = V_{GE}, I_C = 3.2\text{mA}, T_J = 25^\circ\text{C}$)	5	5.8	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage ($V_{GE} = 15\text{V}, I_C = 200\text{A}, T_J = 25^\circ\text{C}$)	1.05	1.45	1.85	
	Collector-Emitter On Voltage ($V_{GE} = 15\text{V}, I_C = 200\text{A}, T_J = 125^\circ\text{C}$)		1.65		
	Collector-Emitter On Voltage ($V_{GE} = 15\text{V}, I_C = 100\text{A}, T_J = 25^\circ\text{C}$)		1.15		
	Collector-Emitter On Voltage ($V_{GE} = 15\text{V}, I_C = 100\text{A}, T_J = 125^\circ\text{C}$)		1.19		
I_{CES}	Collector Cut-off Current ($V_{CE} = 600\text{V}, V_{GE} = 0\text{V}, T_J = 25^\circ\text{C}$) ^②			4	mA
	Collector Cut-off Current ($V_{CE} = 600\text{V}, V_{GE} = 0\text{V}, T_J = 125^\circ\text{C}$) ^②			TBD	
I_{GES}	Gate-Emitter Leakage Current ($V_{GE} = \pm 20\text{V}$)			600	nA
R_{GINT}	Intergrated Gate Resistor		2		Ω



CAUTION: These Devices are Sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.

APT Website - <http://www.advancedpower.com>

DYNAMIC CHARACTERISTICS

APT200GN60JDQ4

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C _{ies}	Input Capacitance	Capacitance V _{GE} = 0V, V _{CE} = 25V f = 1 MHz		14100		pF
C _{oes}	Output Capacitance			4610		
C _{res}	Reverse Transfer Capacitance			4000		
V _{GEP}	Gate-to-Emitter Plateau Voltage	Gate Charge		8.2		V
Q _g	Total Gate Charge ^③	V _{GE} = 15V		1180		nC
Q _{ge}	Gate-Emitter Charge	V _{CE} = 300V		85		
Q _{gc}	Gate-Collector ("Miller") Charge	I _C = 100A		660		
SSOA	Switching Safe Operating Area	T _J = 150°C, R _G = 5Ω ^⑦ , V _{GE} = 15V, L = 100μH, V _{CE} = 600V	600			A
SCSOA	Short Circuit Safe Operating Area	V _{CC} = 480V, V _{GE} = 15V, T _J = 125°C, R _G = 5Ω ^⑦	10			μs
t _{d(on)}	Turn-on Delay Time	Inductive Switching (25°C) V _{CC} = 400V V _{GE} = 15V I _C = 100A R _G = 5Ω ^⑦ T _J = +25°C		55		ns
t _r	Current Rise Time			20		
t _{d(off)}	Turn-off Delay Time			1050		
t _f	Current Fall Time			50		μJ
E _{on1}	Turn-on Switching Energy ^④			TBD		
E _{on2}	Turn-on Switching Energy (Diode) ^⑤			1720		
E _{off}	Turn-off Switching Energy ^⑥		2810			
t _{d(on)}	Turn-on Delay Time	Inductive Switching (125°C) V _{CC} = 400V V _{GE} = 15V I _C = 100A R _G = 5Ω ^⑦ T _J = +125°C		55		ns
t _r	Current Rise Time			20		
t _{d(off)}	Turn-off Delay Time			1150		
t _f	Current Fall Time			60		μJ
E _{on1}	Turn-on Switching Energy ^④			TBD		
E _{on2}	Turn-on Switching Energy (Diode) ^⑤			1955		
E _{off}	Turn-off Switching Energy ^⑥		2865			

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
R _{θJC}	Junction to Case (IGBT)			.22	°C/W
R _{θJC}	Junction to Case (DIODE)			.33	
V _{Isolation}	RMS Voltage (50-60Hz Sinusoidal Waveform from Terminals to Mounting Base for 1 Min.)	2500			Volts
W _T	Package Weight		1.03		oz
			29.2		gm
Torque	Maximum Terminal & Mounting Torque			10	lb•in
				1.1	N•m

- ① Repetitive Rating: Pulse width limited by maximum junction temperature.
- ② For Combi devices, I_{CES} includes both IGBT and FRED leakage.
- ③ See MIL-STD-750 Method 3471.
- ④ E_{on1} is the clamped inductive turn-on energy of the IGBT only, without the effect of a commutating diode reverse recovery current adding to the IGBT turn-on loss. (See Figure 24)
- ⑤ E_{on2} is the clamped inductive turn-on energy that includes a commutating diode reverse recovery current in the IGBT turn-on switching loss. (See Figures 21, 22)
- ⑥ E_{off} is the clamped inductive turn-off energy measured in accordance with JEDEC standard JESD24-1. (See Figures 21, 23)
- ⑦ R_G is external gate resistance, not including R_{Gint} nor gate driver impedance. (MIC4452)

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

TYPICAL PERFORMANCE CURVES

APT200GN60JDQ4

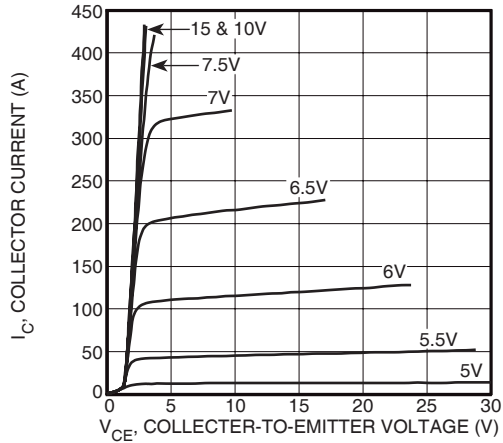


FIGURE 1, Output Characteristics ($T_J = 25^\circ\text{C}$)

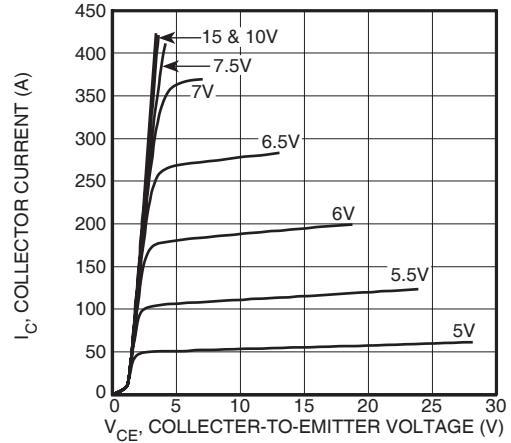


FIGURE 2, Output Characteristics ($T_J = 125^\circ\text{C}$)

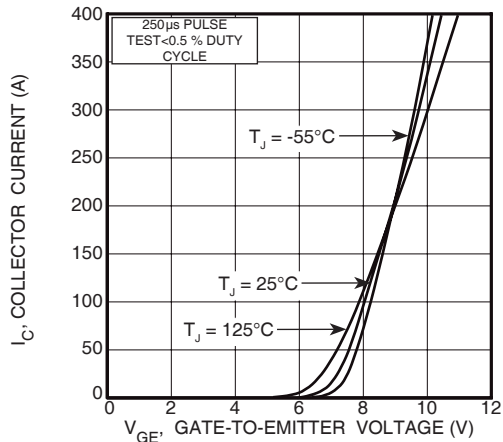


FIGURE 3, Transfer Characteristics

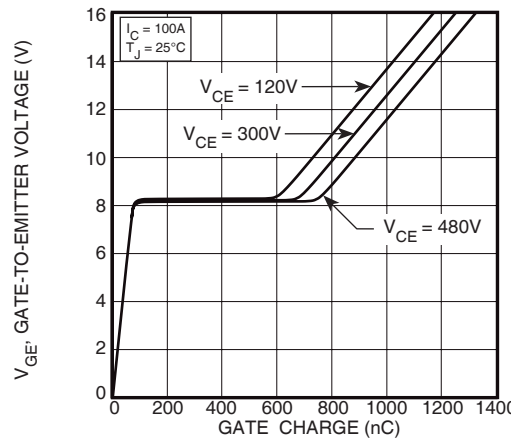


FIGURE 4, Gate Charge

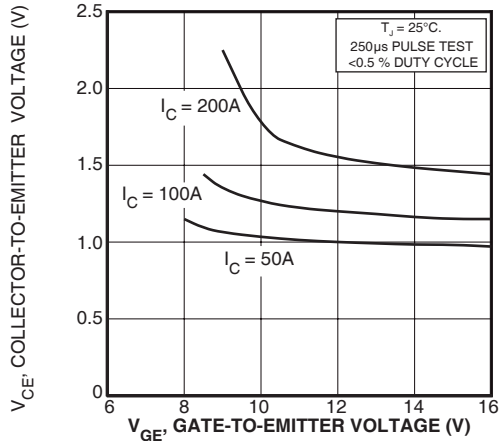


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

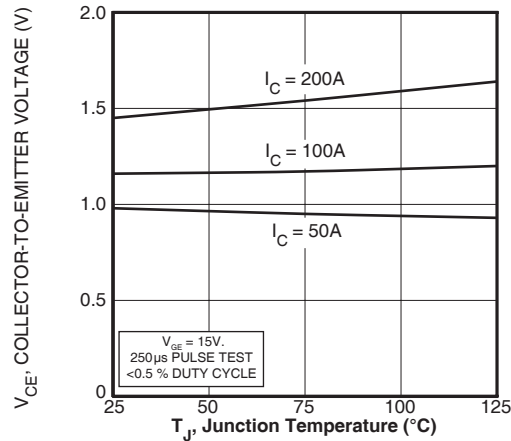


FIGURE 6, On State Voltage vs Junction Temperature

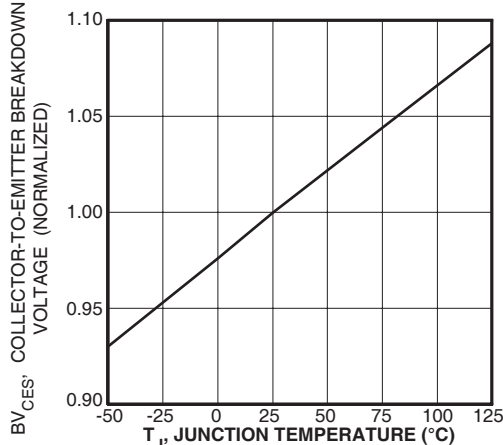


FIGURE 7, Breakdown Voltage vs. Junction Temperature

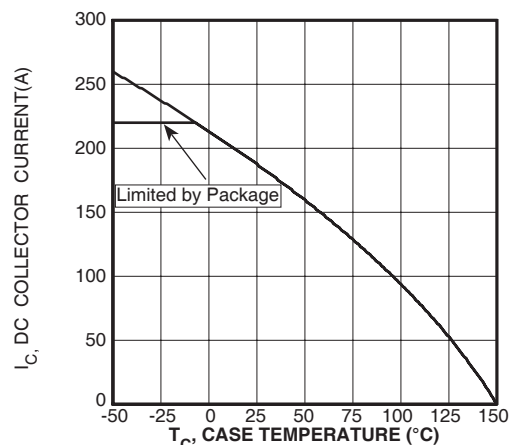


FIGURE 8, DC Collector Current vs Case Temperature

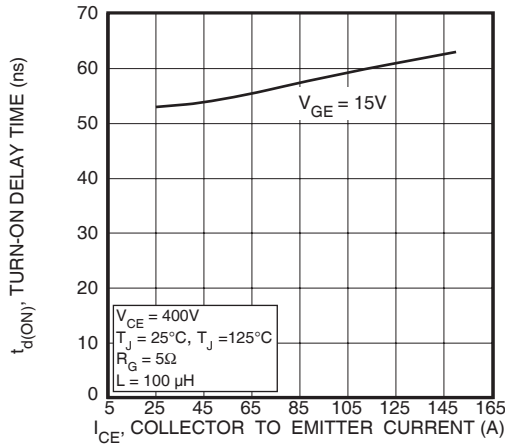


FIGURE 9, Turn-On Delay Time vs Collector Current

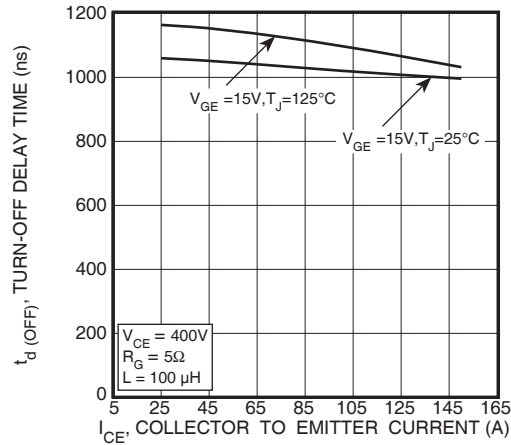


FIGURE 10, Turn-Off Delay Time vs Collector Current

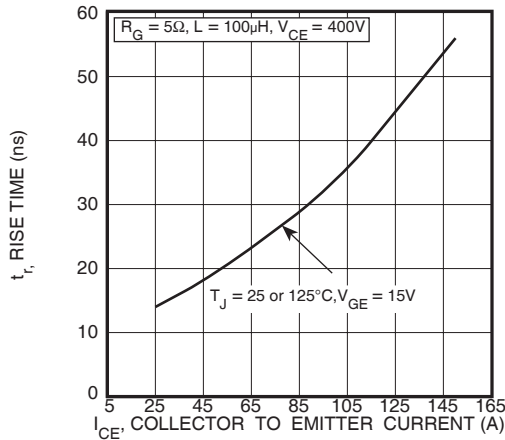


FIGURE 11, Current Rise Time vs Collector Current

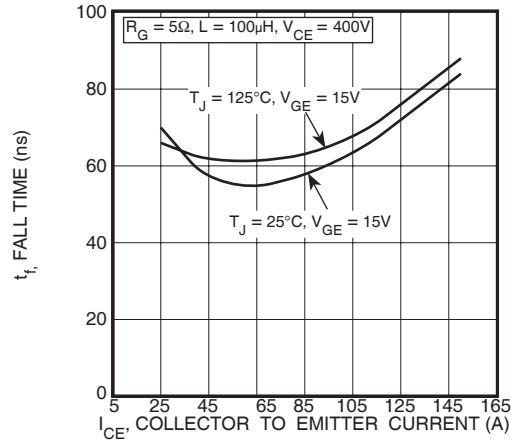


FIGURE 12, Current Fall Time vs Collector Current

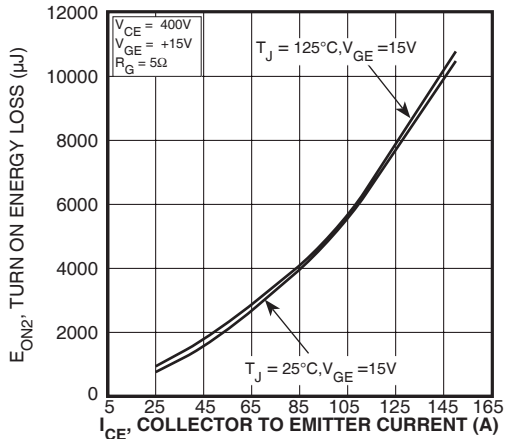


FIGURE 13, Turn-On Energy Loss vs Collector Current

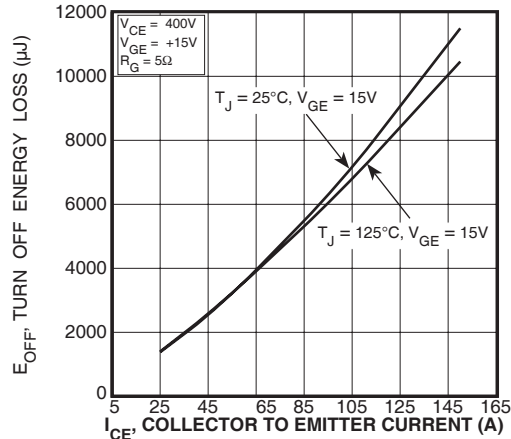


FIGURE 14, Turn Off Energy Loss vs Collector Current

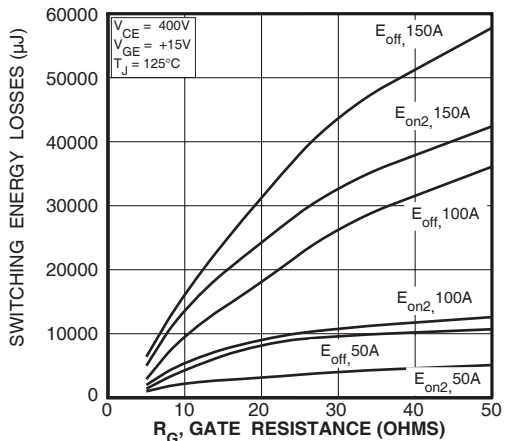


FIGURE 15, Switching Energy Losses vs. Gate Resistance

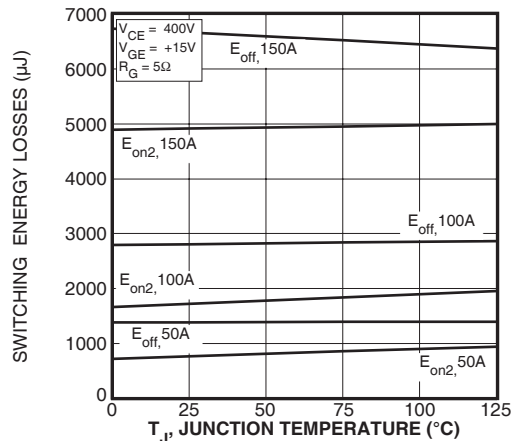


FIGURE 16, Switching Energy Losses vs Junction Temperature

TYPICAL PERFORMANCE CURVES

APT200GN60JDQ4

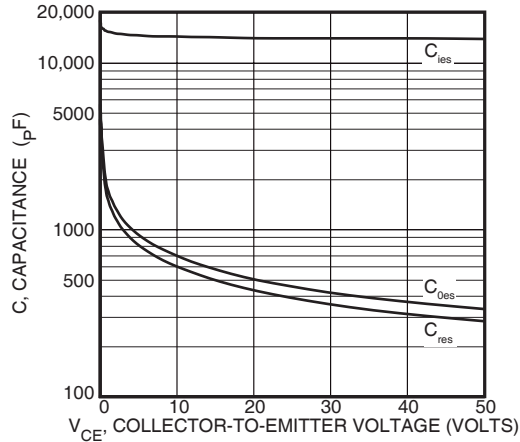


Figure 17, Capacitance vs Collector-To-Emitter Voltage

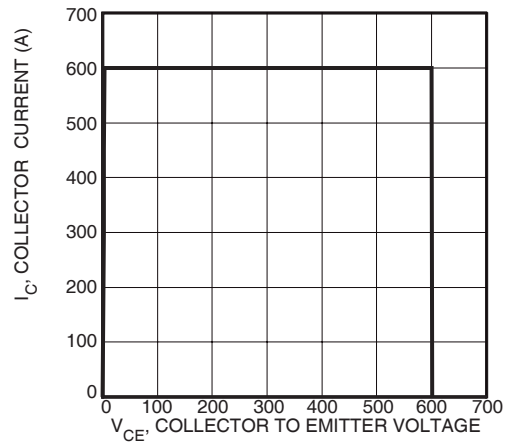


Figure 18, Minimum Switching Safe Operating Area

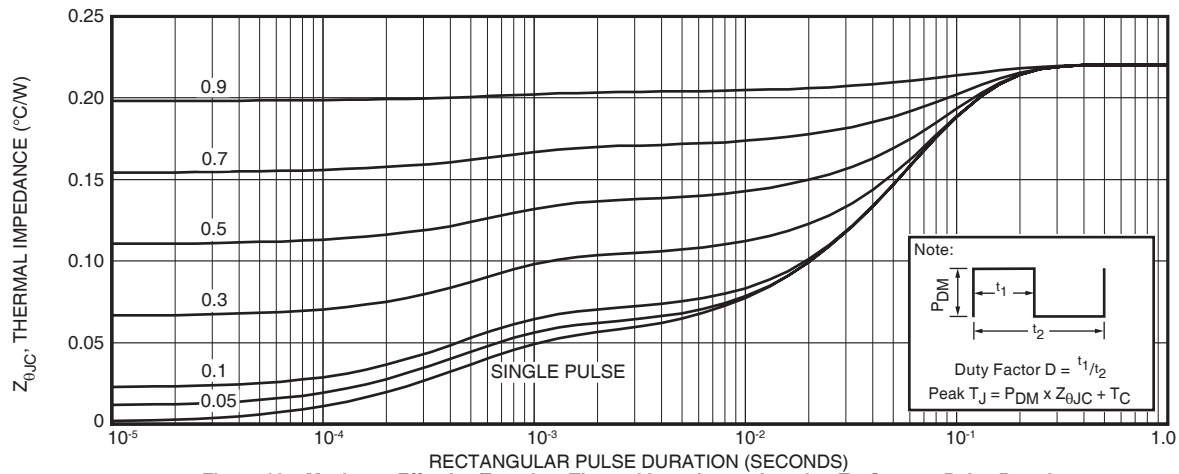


Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

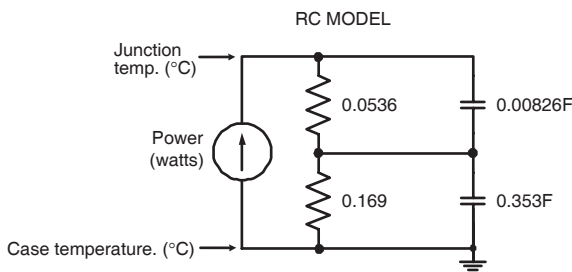


FIGURE 19b, TRANSIENT THERMAL IMPEDANCE MODEL

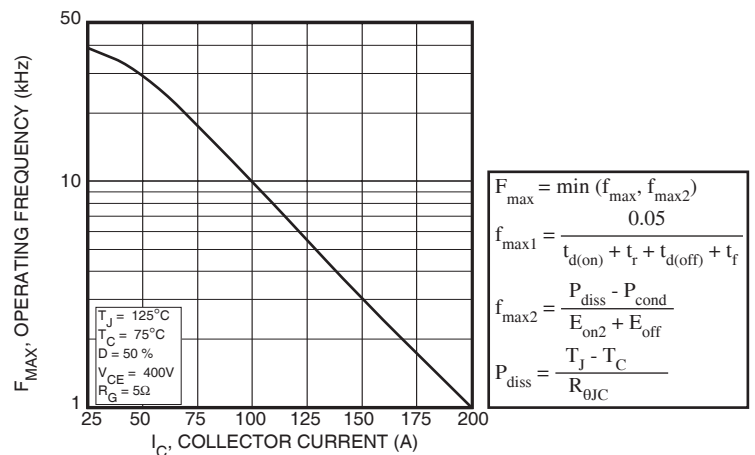


Figure 20, Operating Frequency vs Collector Current

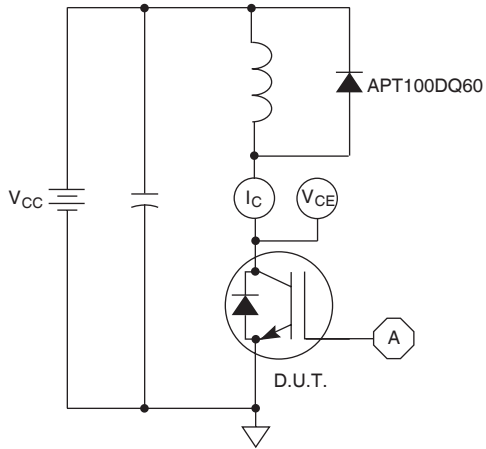


Figure 21, Inductive Switching Test Circuit

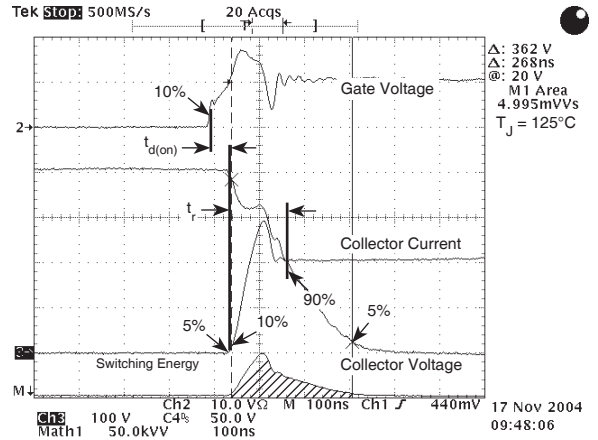


Figure 22, Turn-on Switching Waveforms and Definitions

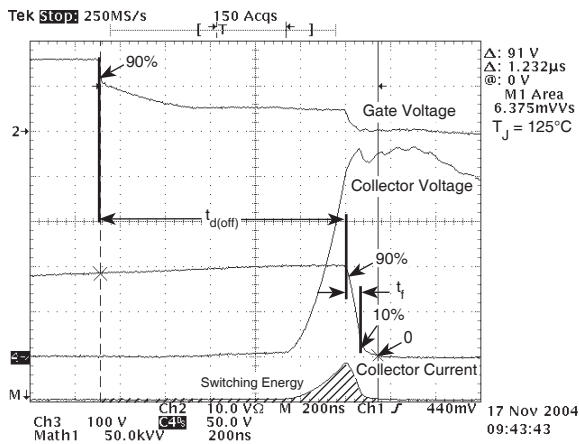


Figure 23, Turn-off Switching Waveforms and Definitions

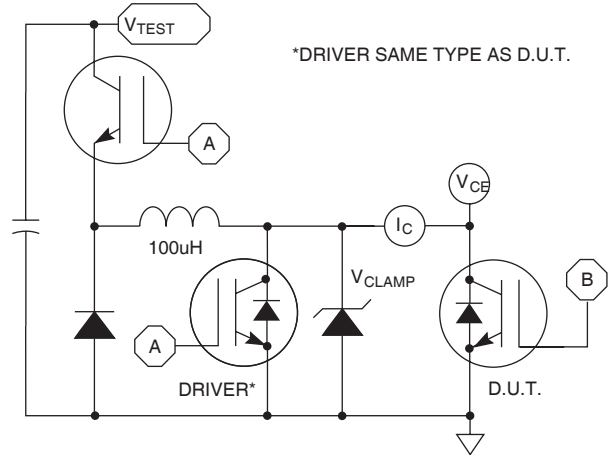


Figure 24, EON1 Test Circuit

ULTRAFAST SOFT RECOVERY ANTI-PARALLEL DIODE

MAXIMUM RATINGS

All Ratings: $T_C = 25^\circ\text{C}$ unless otherwise specified.

Symbol	Characteristic / Test Conditions	APT200GN60JDQ4			UNIT
$I_F(AV)$	Maximum Average Forward Current ($T_C = 108^\circ\text{C}$, Duty Cycle = 0.5)		100		Amps
$I_F(RMS)$	RMS Forward Current (Square wave, 50% duty)		156		
I_{FSM}	Non-Repetitive Forward Surge Current ($T_J = 45^\circ\text{C}$, 8.3ms)		1000		

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT	
V_F	Forward Voltage		$I_F = 100\text{A}$	1.6	2.2	Volts
			$I_F = 200\text{A}$	2.05		
			$I_F = 100\text{A}, T_J = 125^\circ\text{C}$	1.28		

DYNAMIC CHARACTERISTICS

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
t_{rr}	Reverse Recovery Time	$I_F = 1\text{A}, di_F/dt = -100\text{A}/\mu\text{s}, V_R = 30\text{V}, T_J = 25^\circ\text{C}$	-	34		ns
t_{rr}	Reverse Recovery Time	$I_F = 100\text{A}, di_F/dt = -200\text{A}/\mu\text{s}, V_R = 400\text{V}, T_C = 25^\circ\text{C}$	-	160		
Q_{rr}	Reverse Recovery Charge		-	290		nC
I_{RRM}	Maximum Reverse Recovery Current		-	5	-	Amps
t_{rr}	Reverse Recovery Time	$I_F = 100\text{A}, di_F/dt = -200\text{A}/\mu\text{s}, V_R = 400\text{V}, T_C = 125^\circ\text{C}$	-	220		ns
Q_{rr}	Reverse Recovery Charge		-	1530		nC
I_{RRM}	Maximum Reverse Recovery Current		-	13	-	Amps
t_{rr}	Reverse Recovery Time	$I_F = 100\text{A}, di_F/dt = -1000\text{A}/\mu\text{s}, V_R = 400\text{V}, T_C = 125^\circ\text{C}$	-	100		ns
Q_{rr}	Reverse Recovery Charge		-	2890		nC
I_{RRM}	Maximum Reverse Recovery Current		-	44		Amps

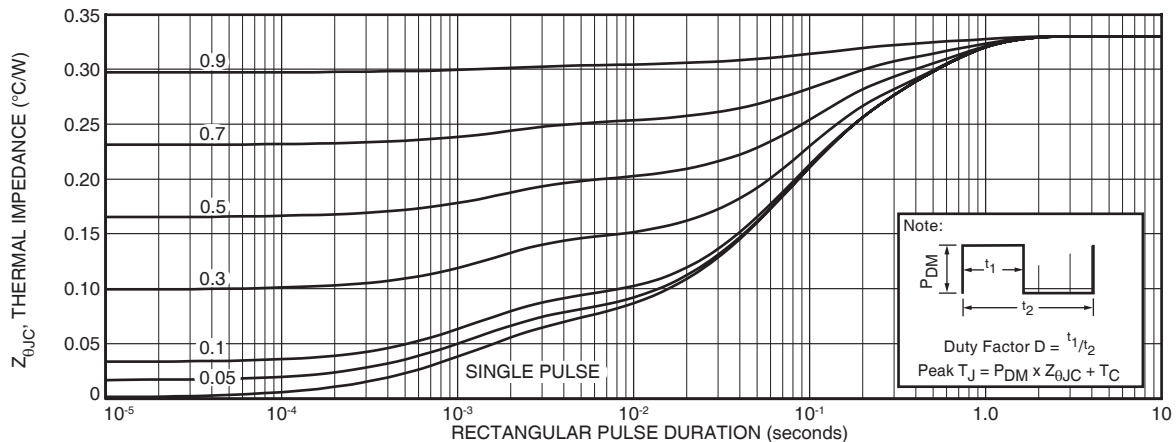


FIGURE 25a. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

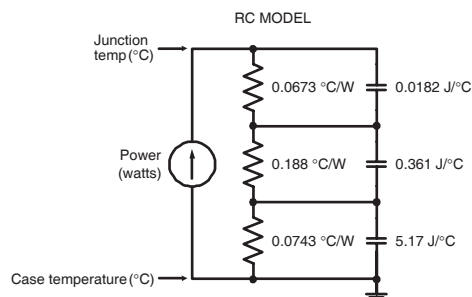


FIGURE 25b, TRANSIENT THERMAL IMPEDANCE MODEL

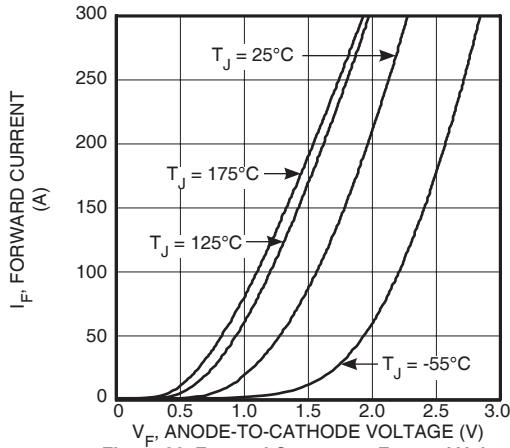


Figure 26. Forward Current vs. Forward Voltage

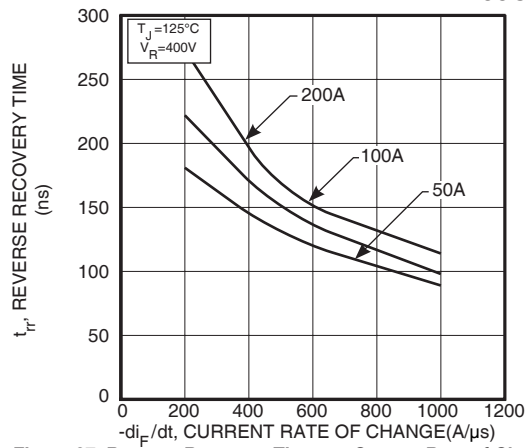


Figure 27. Reverse Recovery Time vs. Current Rate of Change

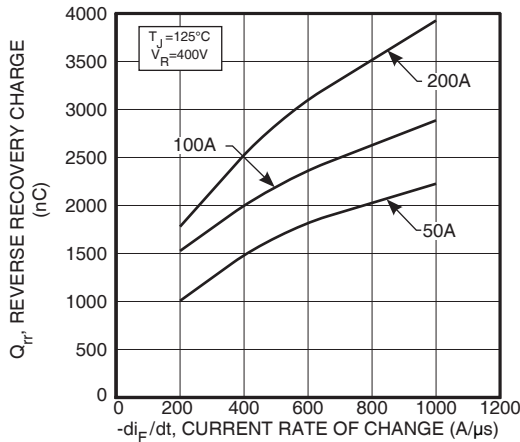


Figure 28. Reverse Recovery Charge vs. Current Rate of Change

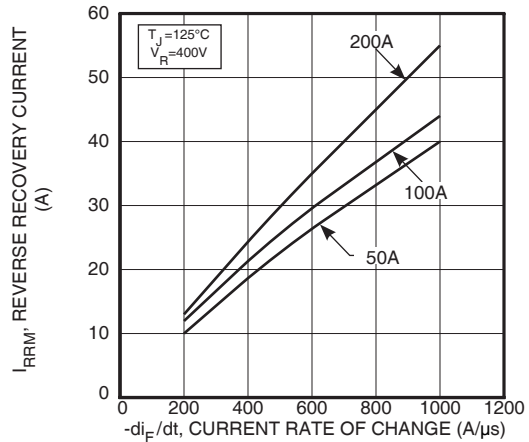


Figure 29. Reverse Recovery Current vs. Current Rate of Change

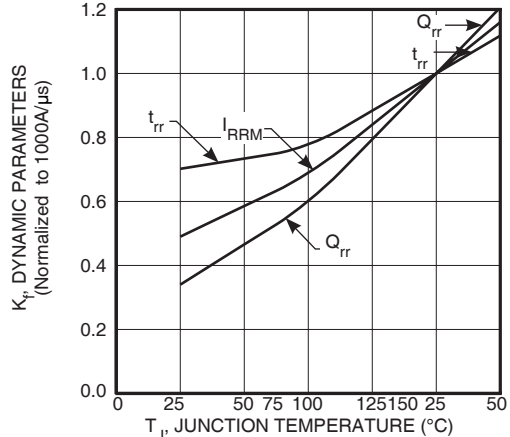


Figure 30. Dynamic Parameters vs. Junction Temperature

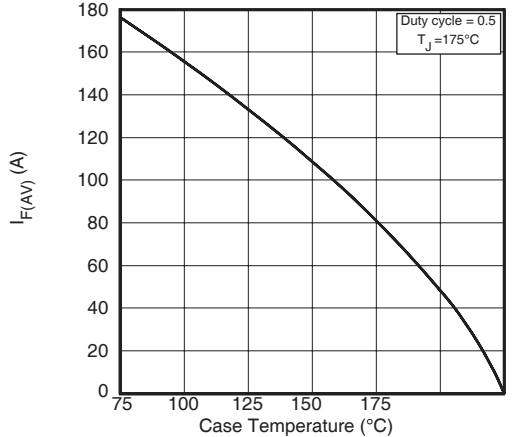


Figure 31. Maximum Average Forward Current vs. Case Temperature

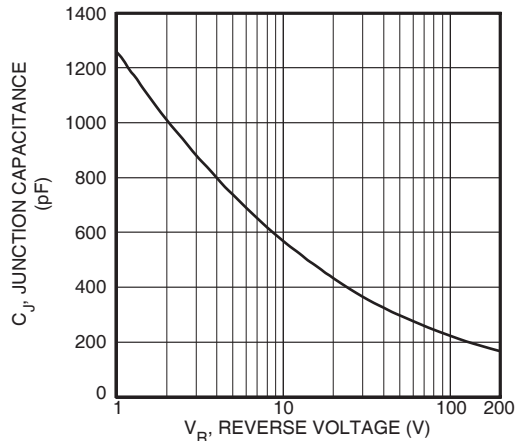


Figure 32. Junction Capacitance vs. Reverse Voltage

TYPICAL PERFORMANCE CURVES

APT200GN60JDQ4

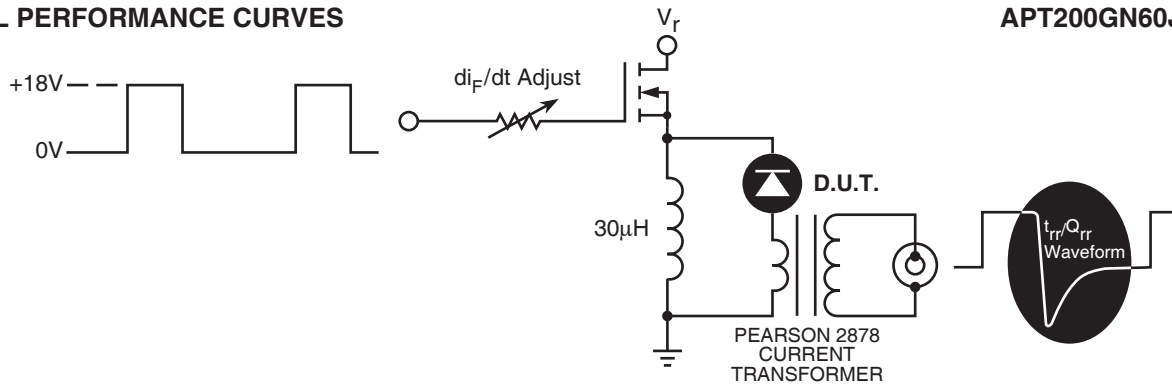


Figure 33. Diode Test Circuit

- 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 $0.25 \cdot I_{RRM}$ passes through zero.
- 5 Q_{rr} - Area Under the Curve Defined by I_{RRM} and t_{rr} .

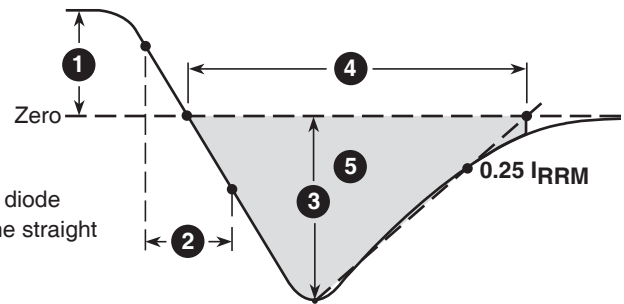
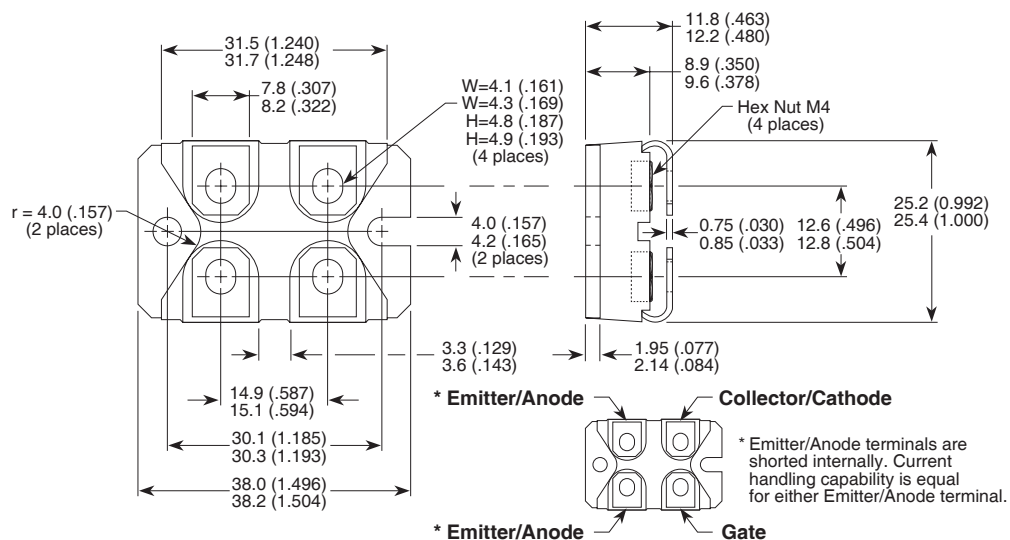


Figure 34, Diode Reverse Recovery Waveform and Definitions

SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (Inches)