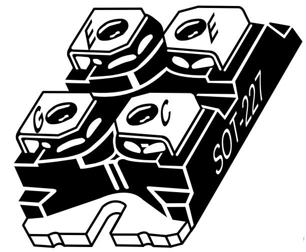
APT60GT60JRD

600V 90A

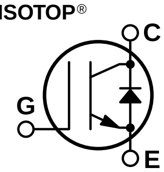
ADVANCED POWER TECHNOLOGY®

Thunderbolt IGBT™ & FRED

The Thunderbolt IGBT™ is a new generation of high voltage power IGBTs. Using Non-Punch Through Technology the Thunderbolt IGBT™ combined with an APT free-wheeling ultraFast Recovery Epitaxial Diode (FRED) offers superior ruggedness and ultrafast switching speed.



ISOTOP®



- **Low Forward Voltage Drop**
- **Low Tail Current**
- **Ultrafast Soft Recovery Antiparallel Diode**
- **High Freq. Switching to 150KHz**
- **Ultra Low Leakage Current**
- **RBSOA and SCSOA Rated**

MAXIMUM RATINGS (IGBT) All Ratings: T_C = 25°C unless otherwise specified.

Symbol	Parameter	APT60GF60JRD	UNIT
V_{CES}	Collector-Emitter Voltage	600	Volts
V_{CGR}	Collector-Gate Voltage (R_{GE} = 20KΩ)	600	
V_{GE}	Gate-Emitter Voltage	±20	
I_{C1}	Continuous Collector Current @ T_C = 25°C	90	Amps
I_{C2}	Continuous Collector Current @ T_C = 110°C	60	
I_{CM1}	Pulsed Collector Current ① @ T_C = 25°C	180	
I_{CM2}	Pulsed Collector Current ① @ T_C = 110°C	120	
P_D	Total Power Dissipation	375	Watts
T_J,T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	°C
T_L	Max. Lead Temp. for Soldering: 0.063" from Case for 10 Sec.	300	

STATIC ELECTRICAL CHARACTERISTICS (IGBT)

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
BV_{CES}	Collector-Emitter Breakdown Voltage (V_{GE} = 0V, I_C = 0.5mA)	600			Volts
V_{GE}(TH)	Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 700µA, T_j = 25°C)	3	4	5	
V_{CE}(ON)	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = I_{C2}, T_j = 25°C)	1.6	2.0	2.5	
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = I_{C2}, T_j = 150°C)			2.8	
I_{CES}	Collector Cut-off Current (V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 25°C)			0.3	mA
	Collector Cut-off Current (V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 125°C)			3.0	
I_{GES}	Gate-Emitter Leakage Current (V_{GE} = ±20V, V_{CE} = 0V)			±100	nA

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

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

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DYNAMIC CHARACTERISTICS (IGBT)

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	**Capacitance** V_{GE} = 0V, V_{CE} = 25V, f = 1 MHz		3200		pF
C_{oes}	Output Capacitance			400		
C_{res}	Reverse Transfer Capacitance			180		
Q_g	Total Gate Charge ②	**Gate Charge** V_{GE} = 15V, V_{CC} = 0.8V_{CES}, I_C = I_{C2}		280		nC
Q_{ge}	Gate-Emitter Charge			120		
Q_{gc}	Gate-Collector ("Miller") Charge			20		
t_d(on)	Turn-on Delay Time	**Resistive Switching (25°C)** V_{GE} = 15V, V_{CC} = 0.8V_{CES}, I_C = I_{C2}, R_G = 5Ω		14		ns
t_r	Rise Time			55		
t_d(off)	Turn-off Delay Time			200		
t_f	Fall Time			140		
t_d(on)	Turn-on Delay Time	**Inductive Switching (150°C)** V_{CLAMP}(Peak) = 0.66V_{CES}, V_{GE} = 15V, I_C = I_{C2}, R_G = 5Ω, T_J = +150°C		25		ns
t_r	Rise Time			75		
t_d(off)	Turn-off Delay Time			300		
t_f	Fall Time			95		
E_{on}	Turn-on Switching Energy ③			1.9		mJ
E_{off}	Turn-off Switching Energy ③			2.4		
E_{ts}	Total Switching Losses			4.3		
t_d(on)	Turn-on Delay Time	**Inductive Switching (25°C)** V_{CLAMP}(Peak) = 0.66V_{CES}, V_{GE} = 15V, I_C = I_{C2}, R_G = 5Ω, T_J = +25°C		25		ns
t_r	Rise Time			75		
t_d(off)	Turn-off Delay Time			260		
t_f	Fall Time			90		
E_{ts}	Total Switching Losses ③			3.8		mJ
gfe	Forward Transconductance	V_{CE} = 20V, I_C = I_{C2}	6			S

THERMAL AND MECHANICAL CHARACTERISTICS (IGBT and FRED)

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\Theta JC}$	Junction to Case (IGBT)			0.33	°C/W
	Junction to Case (FRED)			0.66	
$R_{\Theta JA}$	Junction to Ambient			20	
W_T	Package Weight		1.03		oz
			29.2		gm
Torque	Mounting Torque (Mounting = 8-32 or 4mm Machine and Terminals = 4mm Machine)			13.6	lb•in
				1.5	N•m

① Repetitive Rating: Pulse width limited by maximum junction temperature.

② See MIL-STD-750 Method 3471

③ These switching losses are a combination of both the FRED and the IGBT.

ULTRAFAST SOFT RECOVERY PARALLEL DIODE

MAXIMUM RATINGS (FRED) All Ratings: T_C = 25°C unless otherwise specified.

Symbol	Characteristic / Test Conditions	APT60GT60JRD	UNIT
V_R	Maximum D.C. Reverse Voltage	600	Volts
V_{RRM}	Maximum Peak Repetitive Reverse Voltage		
V_{RWM}	Maximum Working Peak Reverse Voltage		
$I_F(AV)$	Maximum Average Forward Current (T_C = 85°C, Duty Cycle = 0.5)	60	Amps
$I_F(RMS)$	RMS Forward Current	100	
I_{FSM}	Non-Repetitive Forward Surge Current (T_J = 45°C, 8.3ms)	600	

STATIC ELECTRICAL CHARACTERISTICS (FRED)

Symbol	Characteristic / Test Conditions		MIN	TYP	MAX	UNIT
V_F	Maximum Forward Voltage	I_F = 60A			1.8	Volts
		I_F = 120A		1.75		
		I_F = 60A, T_J = 150°C			1.5	

DYNAMIC CHARACTERISTICS (FRED)

Symbol	Characteristic		MIN	TYP	MAX	UNIT
t_{rr1}	Reverse Recovery Time, I_F = 1.0A, di_F/dt = -15A/µs, V_R = 30V, T_J = 25°C			55	70	ns
t_{rr2}	Reverse Recovery Time	T_J = 25°C		70		
t_{rr3}	I_F = 60A, di_F/dt = -480A/µs, V_R = 350V	T_J = 100°C		90		
t_{fr1}	Forward Recovery Time	T_J = 25°C		160		
t_{fr2}	I_F = 60A, di_F/dt = 480A/µs, V_R = 350V	T_J = 100°C		160		
I_{RRM1}	Reverse Recovery Current	T_J = 25°C		10	17	Amps
I_{RRM2}	I_F = 60A, di_F/dt = -480A/µs, V_R = 350V	T_J = 100°C		20	30	
Q_{rr1}	Recovery Charge	T_J = 25°C		350		nC
Q_{rr2}	I_F = 60A, di_F/dt = -480A/µs, V_R = 350V	T_J = 100°C		900		
V_{fr1}	Forward Recovery Voltage	T_J = 25°C		6		Volts
V_{fr2}	I_F = 60A, di_F/dt = 480A/µs, V_R = 350V	T_J = 100°C		6		
diM/dt	Rate of Fall of Recovery Current	T_J = 25°C		800		A/µs
	I_F = 60A, di_F/dt = -480A/µs, V_R = 350V	T_J = 100°C		500		

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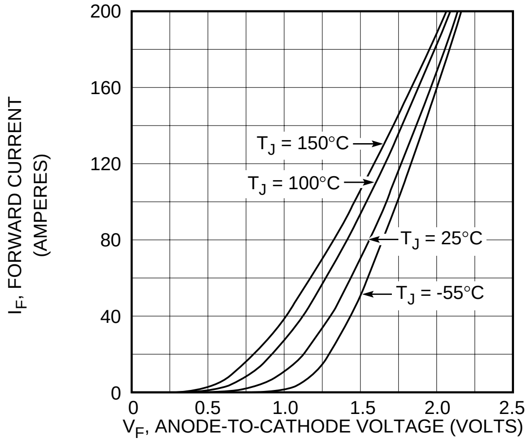


Figure 1, Forward Voltage Drop vs Forward Current

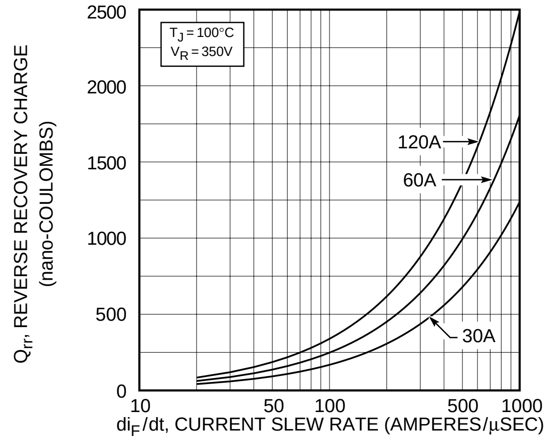


Figure 2, Reverse Recovery Charge vs Current Slew Rate

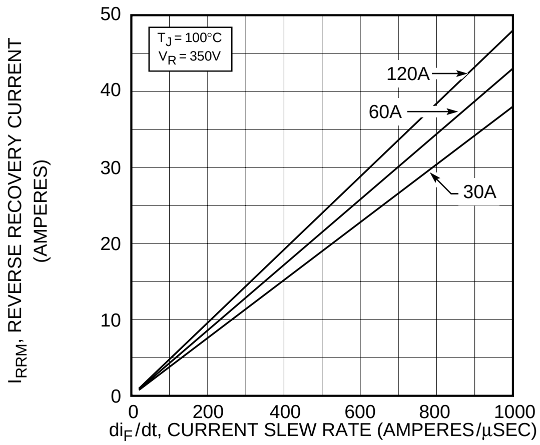


Figure 3, Reverse Recovery Current vs Current Slew Rate

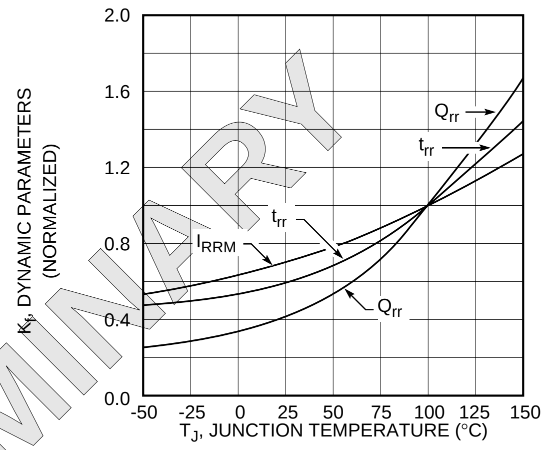


Figure 4, Dynamic Parameters vs Junction Temperature

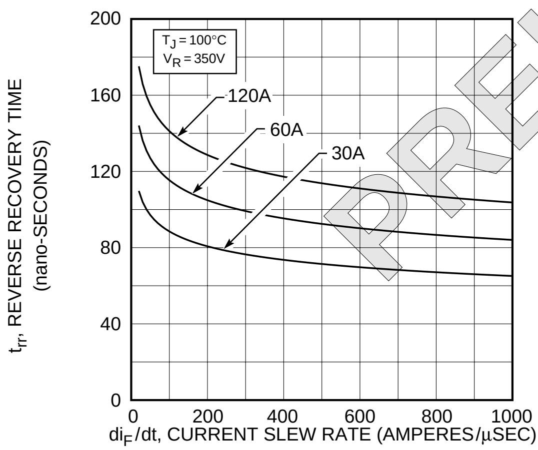


Figure 5, Reverse Recovery Time vs Current Slew Rate

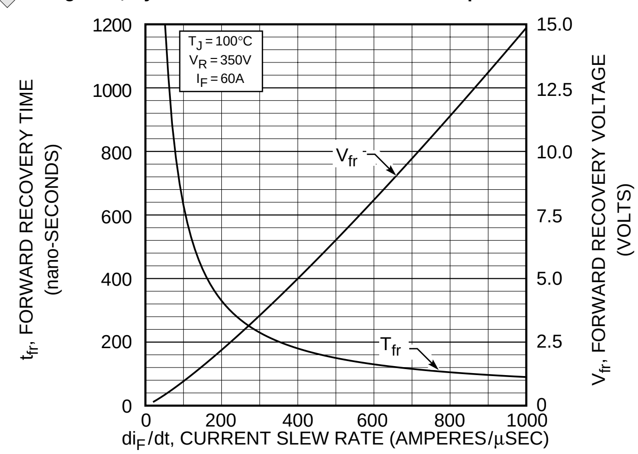


Figure 6, Forward Recovery Voltage/Time vs Current Slew Rate

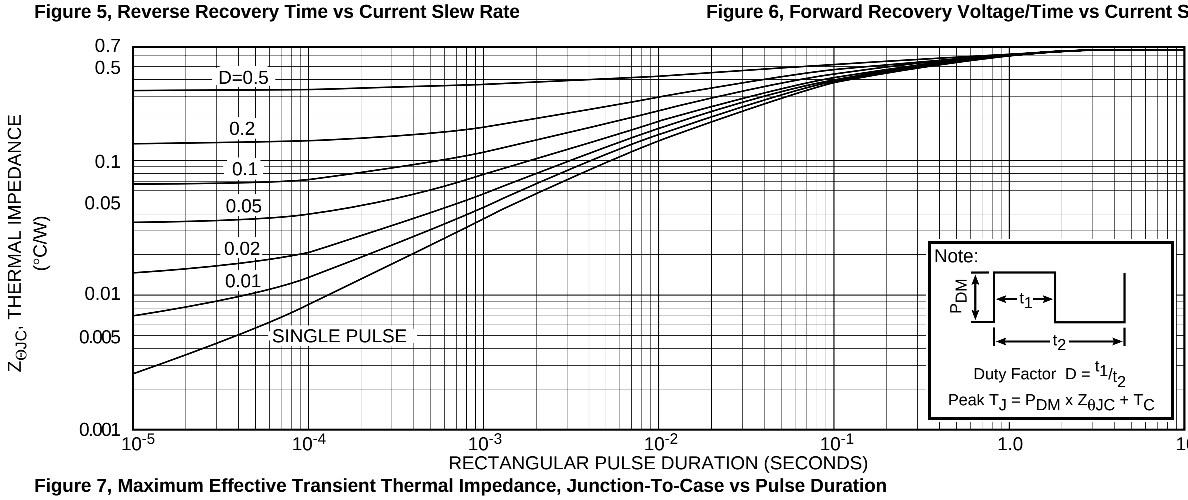


Figure 7, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

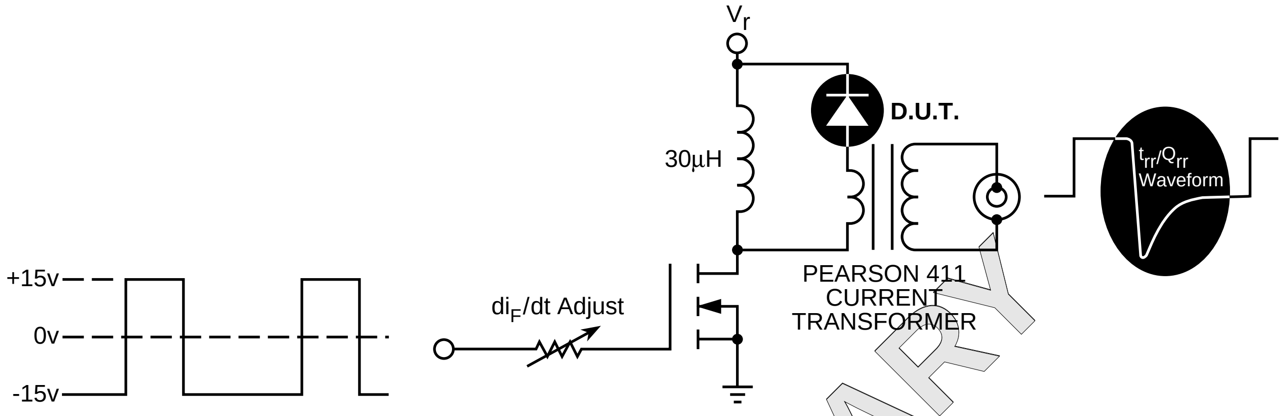
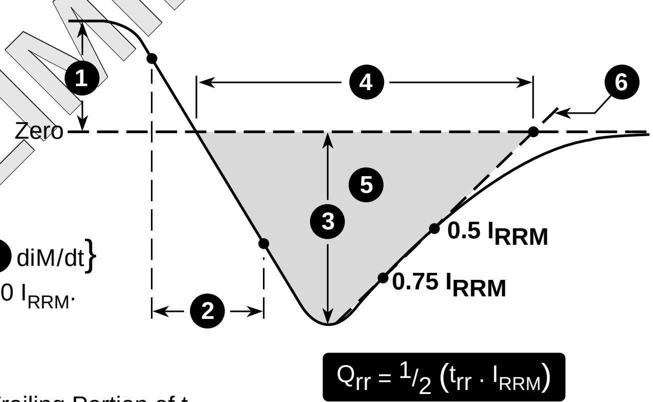
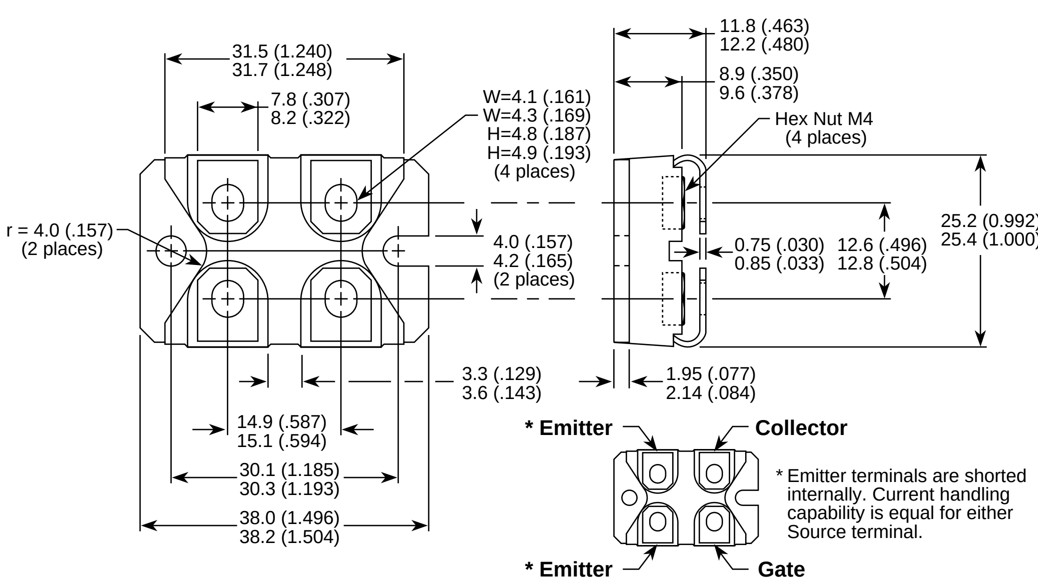


Figure 25, Diode Reverse Recovery Test Circuit and Waveforms

1. I_F - Forward Conduction Current
2. di_F/dt - Current Slew Rate, Rate of Forward Current Change Through Zero Crossing.
3. I_{RRM} - Peak Reverse Recovery Current.
4. t_{rr} - Reverse Recovery Time Measured from Point of I_F Current Falling Through Zero to a Tangent Line {6 diM/dt} Extrapolated Through Zero Defined by 0.75 and 0.50 I_{RRM}.
5. Q_{rr} - Area Under the Curve Defined by I_{RRM} and t_{rr}.
6. diM/dt - Maximum Rate of Current Change During the Trailing Portion of t_{rr}.



SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (Inches)