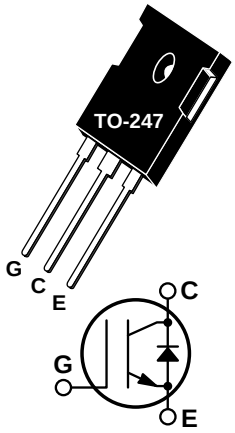
APT15GT60BRD

600V 30A

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.



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

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

Symbol	Parameter	APT15GT60BRD	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	30	Amps
I_{C2}	Continuous Collector Current @ T_C = 110°C	15	
I_{CM1}	Pulsed Collector Current ① @ T_C = 25°C	60	
I_{CM2}	Pulsed Collector Current ① @ T_C = 110°C	30	
E_{AS}	Single Pulse Avalanche Energy ②	24	mJ
P_D	Total Power Dissipation	125	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, T_j = -55°C)	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)			40	µA
	Collector Cut-off Current (V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 150°C)			200	
I_{GES}	Gate-Emitter Leakage Current (V_{GE} = ±25V, 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

USA
405 S.W. Columbia Street **Bend, Oregon 97702-1035** **Phone: (541) 382-8028** **FAX: (541) 388-0364**
EUROPE
Avenue J.F. Kennedy Bât B4 Parc Cadéra Nord **F-33700 Merignac - France** **Phone: (33) 5 57 92 15 15** **FAX: (33) 5 56 47 97 61**

052-6250 Rev -

DYNAMIC CHARACTERISTICS (IGBT) APT15GT60BRD

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	**Capacitance** V_{GE} = 0V, V_{CE} = 25V, f = 1 MHz		825		pF
C_{oes}	Output Capacitance			90		
C_{res}	Reverse Transfer Capacitance			52		
Q_g	Total Gate Charge ③	**Gate Charge** V_{GE} = 15V, V_{CC} = 0.66V_{CES}, I_C = 0.8I_{C2}		53		nC
Q_{ge}	Gate-Emitter Charge			37		
Q_{gc}	Gate-Collector ("Miller") Charge			7		
$t_d(on)$	Turn-on Delay Time	**Resistive Switching (25°C)** V_{GE} = 15V, V_{CC} = 0.66V_{CES}, I_C = 0.8I_{C2}, R_G = 5Ω		6		ns
t_r	Rise Time			18		
$t_d(off)$	Turn-off Delay Time			48		
t_f	Fall Time			78		
$t_d(on)$	Turn-on Delay Time	**Inductive Switching (150°C)** V_{CLAMP}(Peak) = 0.66V_{CES}, V_{GE} = 15V, I_C = 0.8I_{C2}, R_G = 5Ω, T_J = +150°C		13		ns
t_r	Rise Time			34		
$t_d(off)$	Turn-off Delay Time			84		
t_f	Fall Time			55		
E_{on}	Turn-on Switching Energy ④			0.29		mJ
E_{off}	Turn-off Switching Energy			0.29		
E_{ts}	Total Switching Losses ④			0.58		
$t_d(on)$	Turn-on Delay Time	**Inductive Switching (25°C)** V_{CLAMP}(Peak) = 0.66V_{CES}, V_{GE} = 15V, I_C = 0.8I_{C2}, R_G = 5Ω, T_J = +25°C		13		ns
t_r	Rise Time			35		
$t_d(off)$	Turn-off Delay Time			73		
t_f	Fall Time			34		
E_{ts}	Total Switching Losses ④			0.45		mJ
gfe	Forward Transconductance	V_{CE} = 20V, I_C = I_{C2}	3			S

THERMAL AND MECHANICAL CHARACTERISTICS (IGBT and FRED)

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\Theta JC}$	Junction to Case (IGBT)			1.0	°C/W
	Junction to Case (FRED)			2.0	
$R_{\Theta JA}$	Junction to Ambient			40	
W_T	Package Weight		0.22		oz
			6.1		gm
Torque	Mounting Torque using a 6-32 or 3mm Binding Head Machine Screw			10	lb•in
				1.1	N•m

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

② $I_C = I_{C2}$, V_{CC} = 50V, R_{GE} = 25Ω, L = 200µH, T_j = 25°C

③ See MIL-STD-750 Method 3471

④ Switching losses include the FRED and IGBT.

ULTRAFAST SOFT RECOVERY PARALLEL DIODE

MAXIMUM RATINGS (FRED)

All Ratings: T_C = 25°C unless otherwise specified.

Symbol	Characteristic / Test Conditions	APT15GT60BRD	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 = 90°C, Duty Cycle = 0.5)	15	Amps
I_F(RMS)	RMS Forward Current	25	
I_{FSM}	Non-Repetitive Forward Surge Current (T_J = 45°C, 8.3ms)	110	

STATIC ELECTRICAL CHARACTERISTICS (FRED)

Symbol	Characteristic / Test Conditions		MIN	TYP	MAX	UNIT
V_F	Maximum Forward Voltage	I_F = 15A			1.8	Volts
		I_F = 30A		1.6		
		I_F = 15A, T_J = 150°C			1.6	
I_{RM}	Maximum Reverse Leakage Current	V_R = V_R Rated			150	µA
		V_R = V_R Rated, T_J = 125°C			500	
L_S	Series Inductance (Lead to Lead 5mm from Base)			10		nH

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			40	50	ns
t_{rr2}	Reverse Recovery Time	T_J = 25°C		40		
t_{rr3}	I_F = 15A, di_F/dt = -100A/µs, V_R = 350V	T_J = 100°C		80		
t_{fr1}	Forward Recovery Time	T_J = 25°C		170		
t_{fr2}	I_F = 15A, di_F/dt = 100A/µs, V_R = 350V	T_J = 100°C		170		
I_{RRM1}	Reverse Recovery Current	T_J = 25°C		2.5	5	Amps
I_{RRM2}	I_F = 15A, di_F/dt = -100A/µs, V_R = 350V	T_J = 100°C		3	6	
Q_{rr1}	Recovery Charge	T_J = 25°C		50		nC
Q_{rr2}	I_F = 15A, di_F/dt = -100A/µs, V_R = 350V	T_J = 100°C		120		
V_{fr1}	Forward Recovery Voltage	T_J = 25°C		2.2		Volts
V_{fr2}	I_F = 15A, di_F/dt = 100A/µs, V_R = 350V	T_J = 100°C		2.2		
diM/dt	Rate of Fall of Recovery Current	T_J = 25°C		200		A/µs
	I_F = 15A, di_F/dt = -100A/µs, V_R = 350V (See Figure 10)	T_J = 100°C		100		

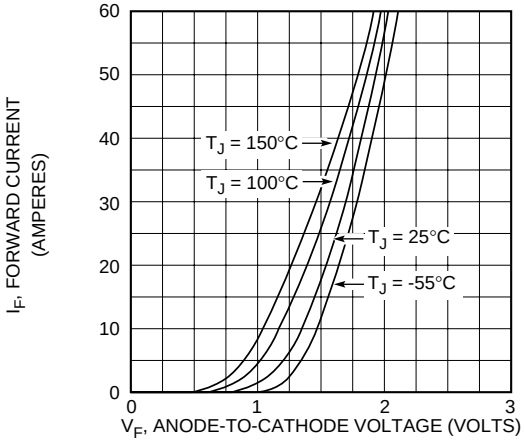


Figure 1, Forward Voltage Drop vs Forward Current

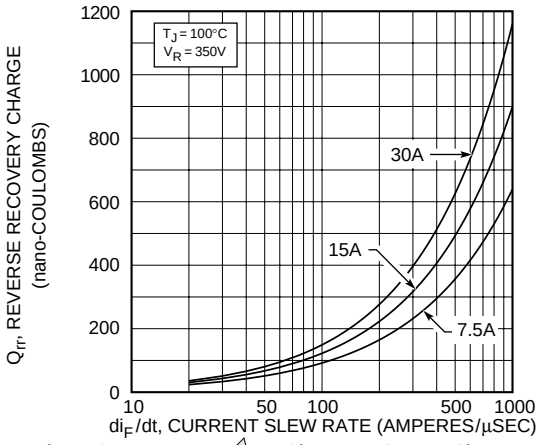


Figure 2, Reverse Recovery Charge vs Current Slew Rate

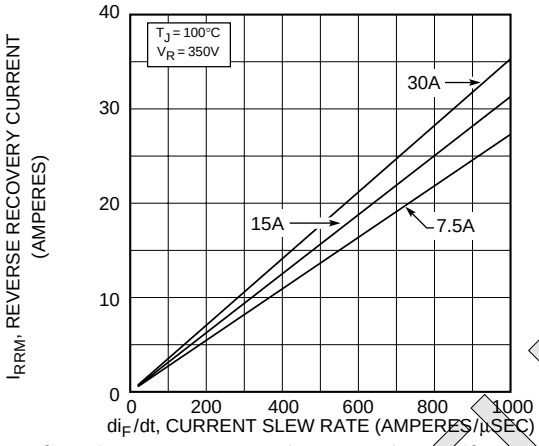


Figure 3, Reverse Recovery Current vs Current Slew Rate

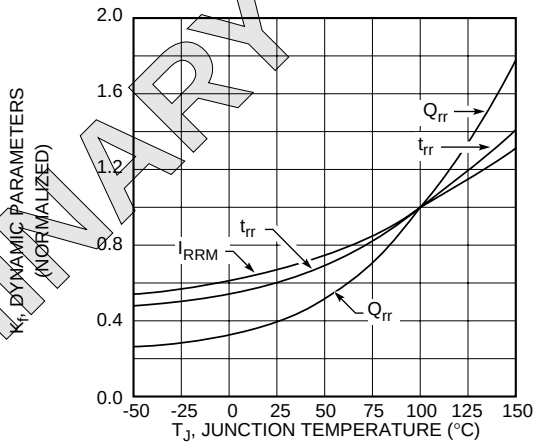


Figure 4, Dynamic Parameters vs Junction Temperature

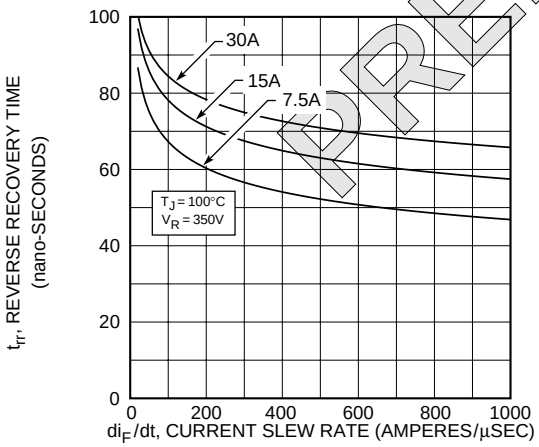


Figure 5, Reverse Recovery Time vs Current Slew Rate

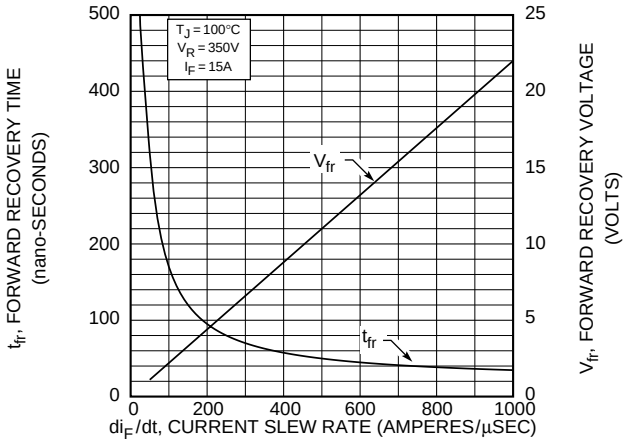


Figure 6, Forward Recovery Voltage/Time vs Current Slew Rate

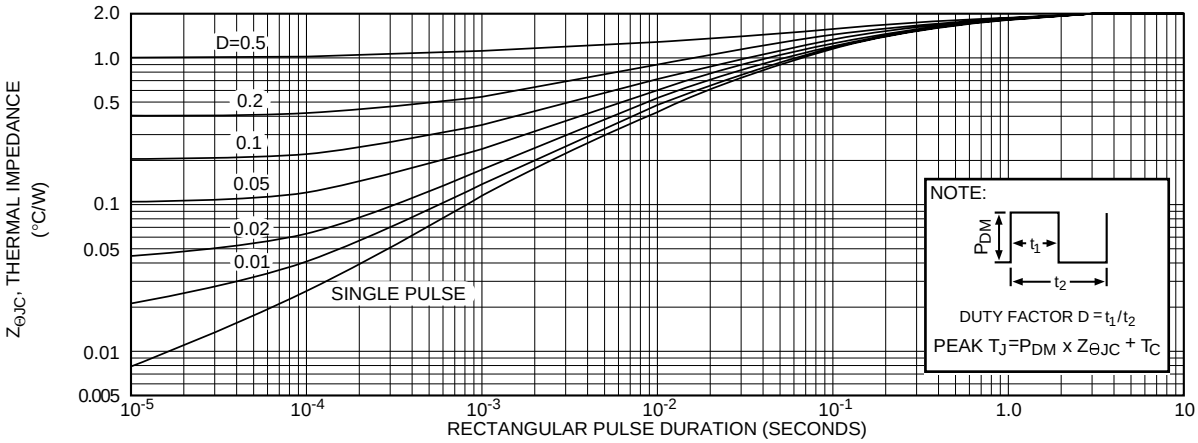


Figure 7, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

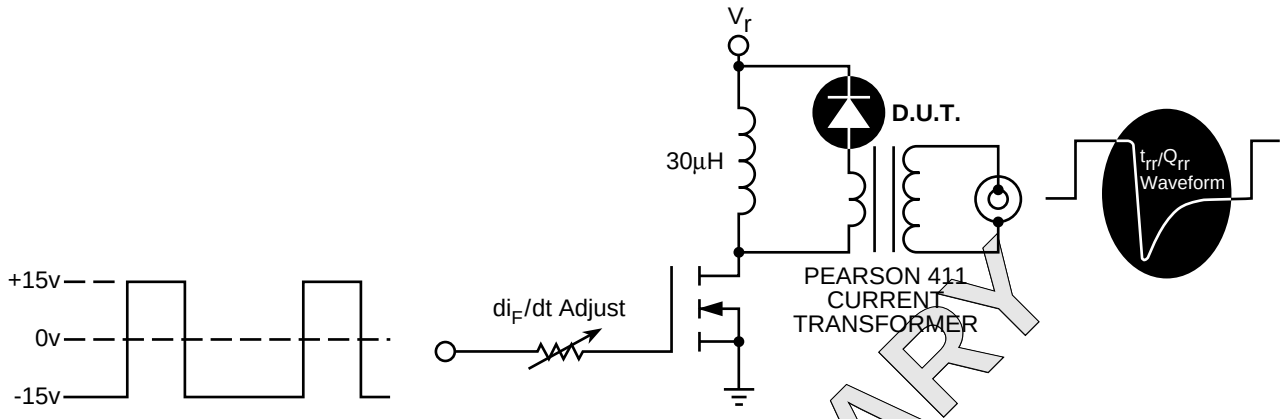


Figure 25, Diode Reverse Recovery Test Circuit and Waveforms

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}.

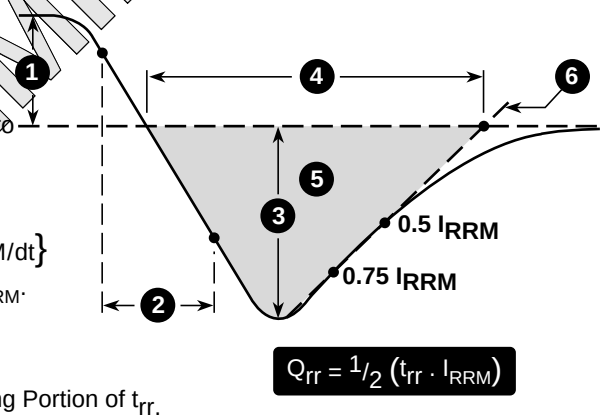
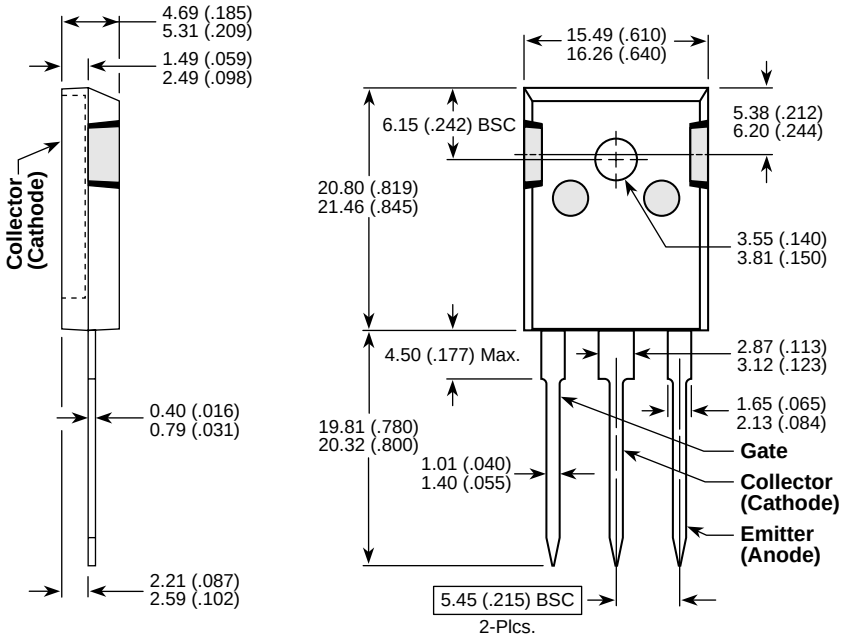


Figure 8, Diode Reverse Recovery Waveform and Definitions

TO-247 Package Outline



Dimensions in Millimeters and (Inches)