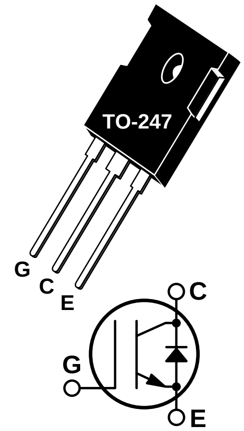
APT30GT60BRD

600V 55A

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**
- **RBSOA and SCSOA Rated**
- **Ultrafast Soft Recovery Antiparallel Diode**

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

Symbol	Parameter	APT30GT60BRD	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	55	Amps
I_{C2}	Continuous Collector Current @ T_C = 95°C	30	
I_{CM}	Pulsed Collector Current ① @ T_C = 25°C	110	
I_{LM}	RBSOA Clamped Inductive Load Current R_G = 11Ω T_C = 125°C	55	
P_D	Total Power Dissipation	198	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 = 250μA)	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)			250	μA
	Collector Cut-off Current (V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 150°C)			2000	
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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052-6251 Rev C 4-2002

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		1600	2000	pF
C_{oes}	Output Capacitance			250	350	
C_{res}	Reverse Transfer Capacitance			90	140	
Q_g	Total Gate Charge ③	**Gate Charge** V_{GE} = 15V V_{CC} = 0.5V_{CES} I_C = I_{C2}		142	213	nC
Q_{ge}	Gate-Emitter Charge			11	13	
Q_{gc}	Gate-Collector ("Miller") Charge			62	93	
t_d(on)	Turn-on Delay Time	**Resistive Switching (25°C)** V_{GE} = 15V V_{CC} = 0.66V_{CES} I_C = I_{C2} R_G = 10Ω		14	28	ns
t_r	Rise Time			64	128	
t_d(off)	Turn-off Delay Time			195	292	
t_f	Fall Time			140	280	
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 = 10Ω T_J = +150°C		15	20	ns
t_r	Rise Time			30	60	
t_d(off)	Turn-off Delay Time			300	600	
t_f	Fall Time			40	80	
E_{on}	Turn-on Switching Energy ④			.5	1	mJ
E_{off}	Turn-off Switching Energy			1.2	2.4	
E_{ts}	Total Switching Losses ④			1.7	3.4	
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		16	32	ns
t_r	Rise Time			32	64	
t_d(off)	Turn-off Delay Time			265	530	
t_f	Fall Time			25	50	
E_{ts}	Total Switching Losses ④			1.2	2.4	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)			0.63	°C/W
	Junction to Case (FRED)			0.90	
$R_{\Theta JA}$	Junction to Ambient			40	
W_T	Package Weight		0.22		oz
			6.1		gm
Torque	Mounting Torque (Mounting = 8-32 or 4mm Machine and Terminals = 4mm Machine)			10	lb•in
				1.1	N•m

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

② Leakages include the FRED and IGBT.

③ See MIL-STD-750 Method 3471

④ Switching losses include the FRED and IGBT.

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

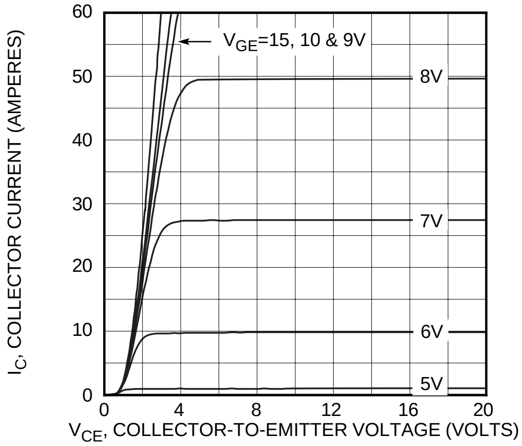


Figure 1, Typical Output Characteristics (T_J = 25°C)

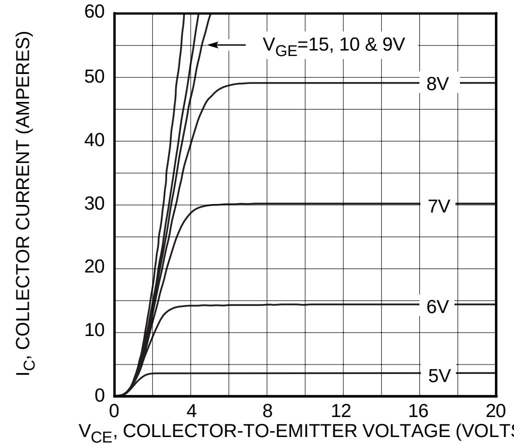


Figure 2, Typical Output Characteristics (T_J = 150°C)

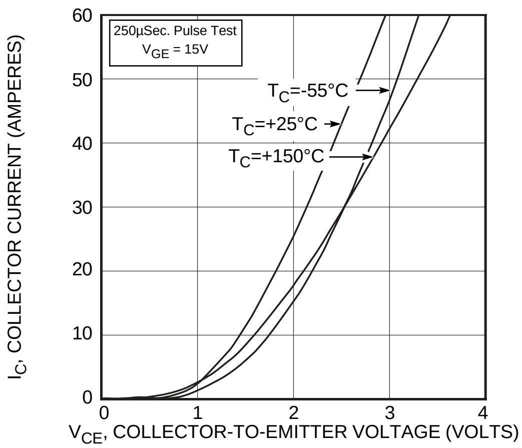


Figure 3, Typical Output Characteristics

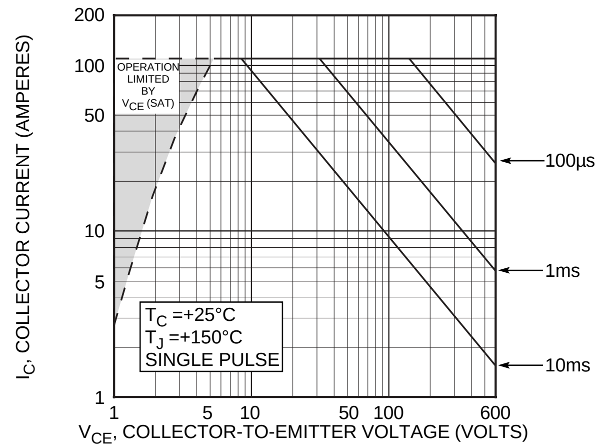


Figure 4, Typical Output Characteristics @ V_{GE} = 15V

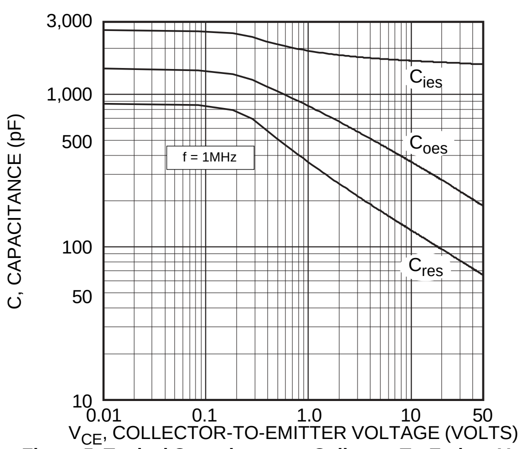


Figure 5, Typical Capacitance vs Collector-To-Emitter Voltage

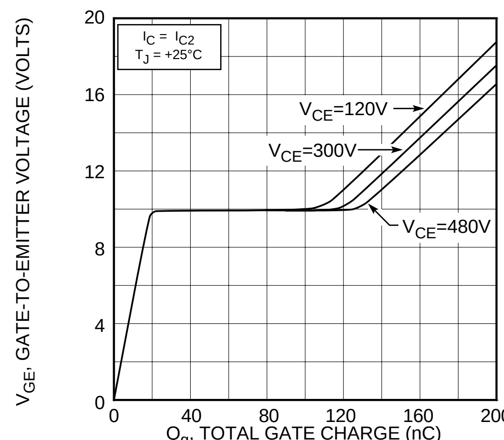


Figure 6, Gate Charges vs Gate-To-Emitter Voltage

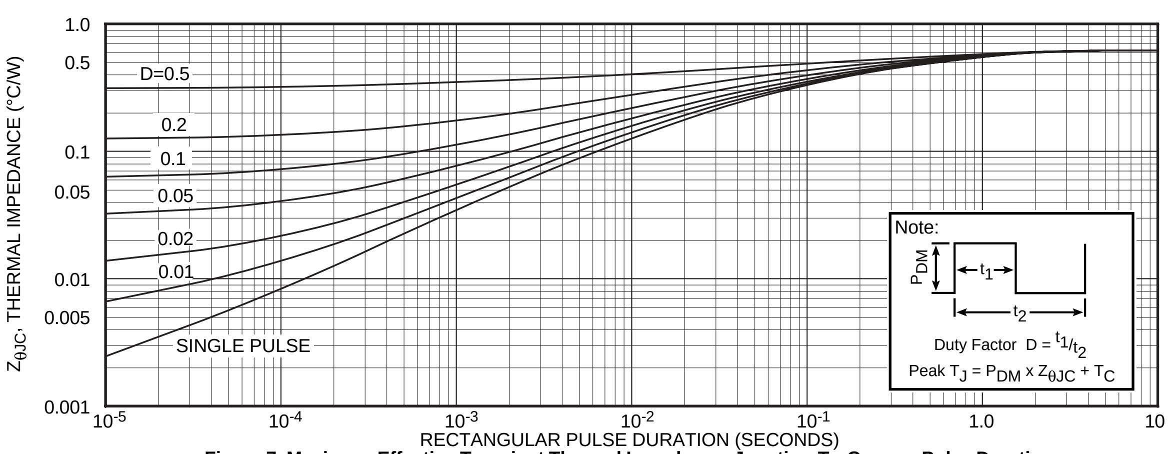


Figure 7, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

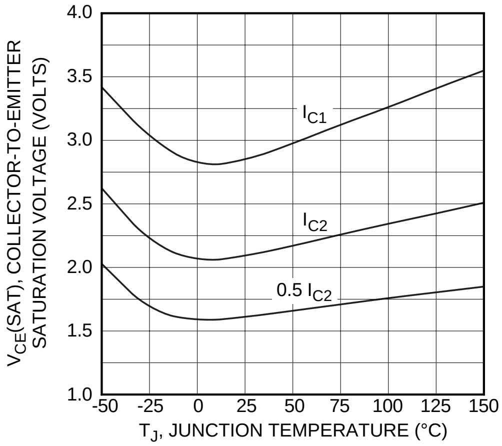


Figure 8, Typical V_{CE}(SAT) Voltage vs Junction Temperature

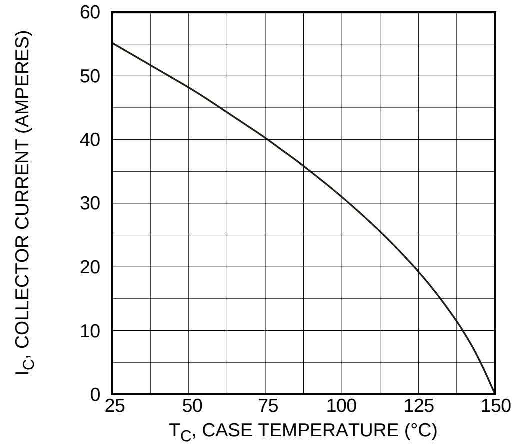


Figure 9, Maximum Collector Current vs Case Temperature

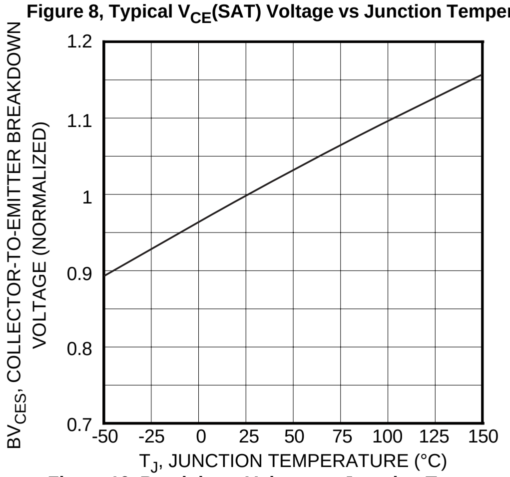


Figure 10, Breakdown Voltage vs Junction Temperature

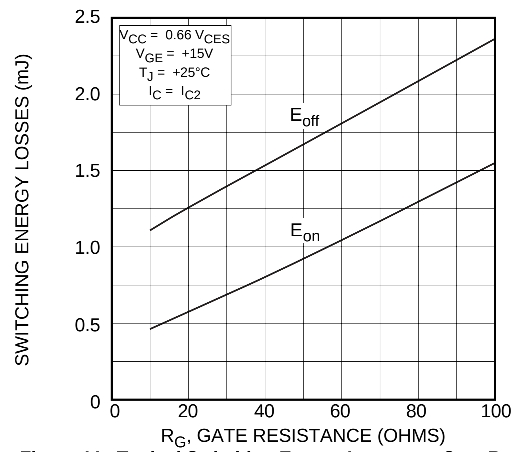


Figure 11, Typical Switching Energy Losses vs Gate Resistance

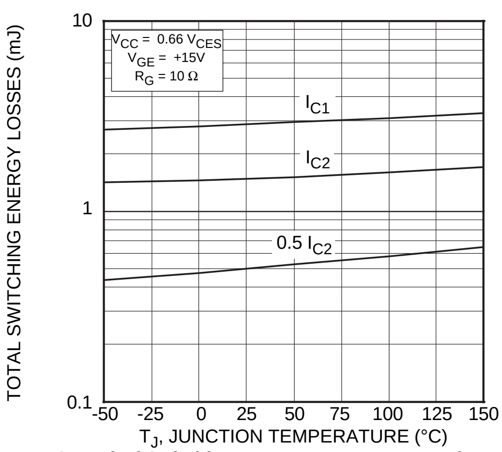


Figure 12, Typical Switching Energy Losses vs. Junction Temperature

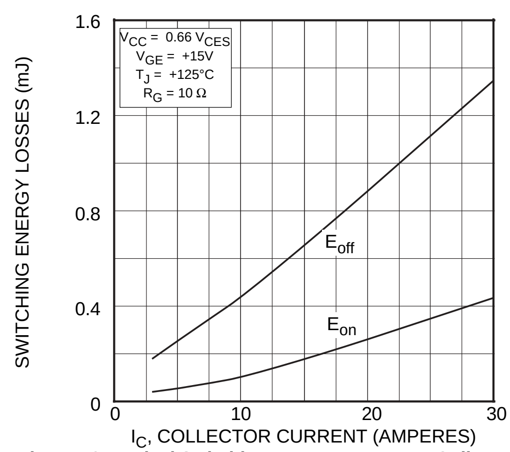


Figure 13, Typical Switching Energy Losses vs Collector Current

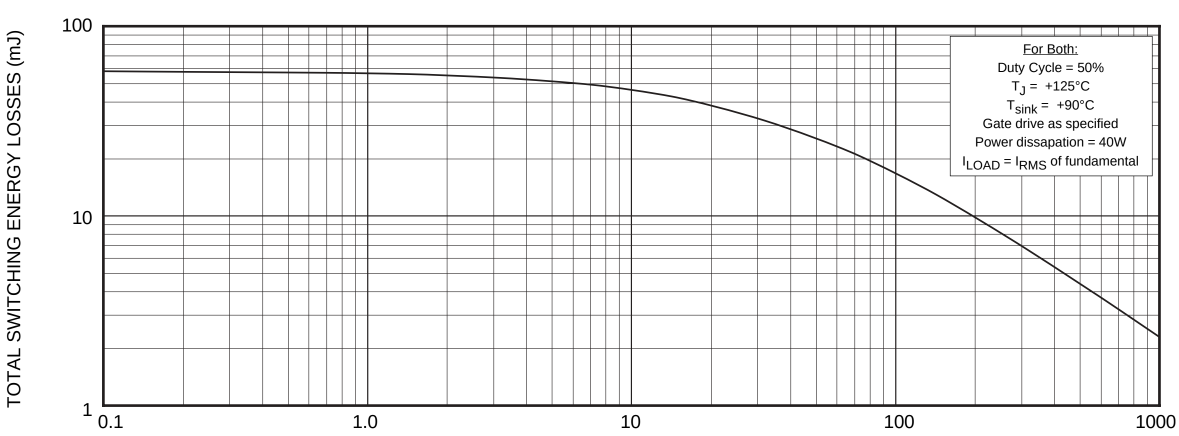


Figure 14,Typical Load Current vs Frequency

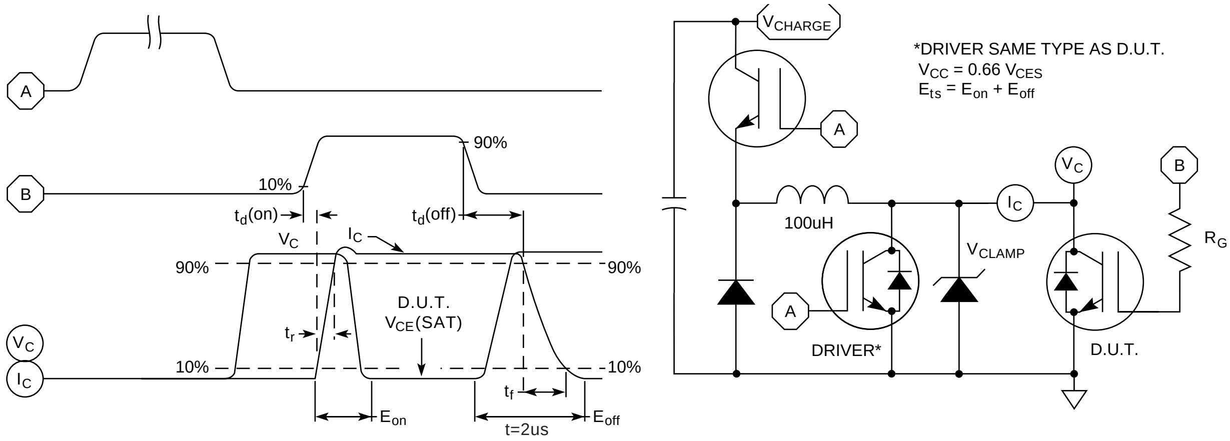


Figure 15, Switching Loss Test Circuit and Waveforms

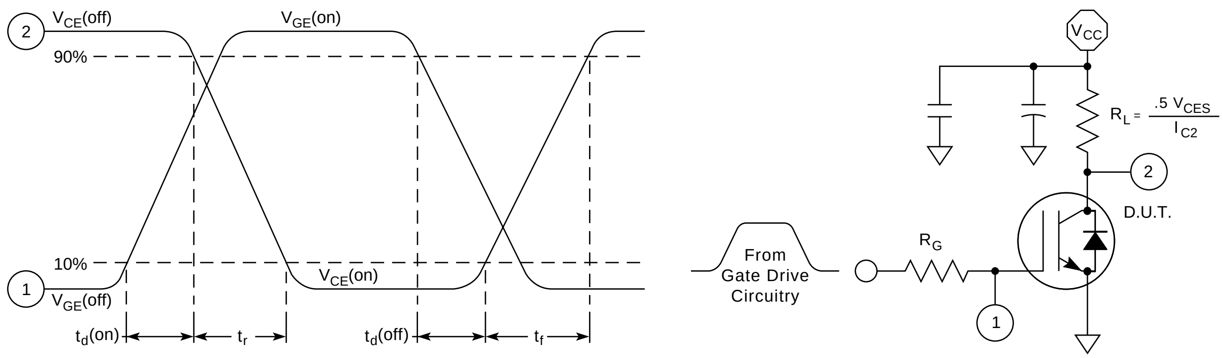


Figure 16, Resistive Switching Time Test Circuit and Waveforms

MAXIMUM RATINGS (FRED)

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

Symbol	Characteristic	30GT60BRD	UNIT
IF_{AV}	Maximum Average Forward Current (T_C = 100°C, Duty Cycle = 0.5)	30	Amps
IF_{RMS}	RMS Forward Current	75	
I_{FSM}	Non-Repetive Forward Surge Current (T_J = 45°C, 8.3 ms)	320	

STATIC ELECTRICAL CHARACTERISTICS (FRED)

Symbol	Characteristic / Test Conditions		MIN	TYP	MAX	UNIT
V_F	Maximum Forward Voltage	I_F = 30A			1.8	Volts
		I_F = 60A		1.5		
		I_F = 30A, T_J = 150°C			1.6	
L_S	Series Inductance (Lead to Lead 5mm from Base)			10		nH

DYNAMIC CHARACTERISTICS (FRED)

Symbol	Characteristic/ Test Conditions		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			50	65	ns
t_{rr2}	Reverse Recovery Time	T_J = 25°C		50		ns
t_{rr3}	I_F = 30A, di_F/dt = -240A/µs, V_R = 350V	T_J = 100°C		80		ns
t_{fr1}	Forward Recovery Time	T_J = 25°C		155		ns
t_{fr2}	I_F = 30A, di_F/dt = 240A/µs, V_R = 350V	T_J = 100°C		155		ns
I_{RRM1}	Reverse Recovery Current	T_J = 25°C		4	10	Amps
I_{RRM2}	I_F = 30A, di_F/dt = -240A/µs, V_R = 350V	T_J = 100°C		7.5	15	Amps
Q_{rr1}	Recovery Charge	T_J = 25°C		100		nC
Q_{rr2}	I_F = 30A, di_F/dt = -240A/µs, V_R = 350V	T_J = 100°C		300		nC
V_{fr1}	Forward Recovery Voltage	T_J = 25°C		5		Volts
V_{fr2}	I_F = 30A, di_F/dt = 240A/µs, V_R = 350V	T_J = 100°C		5		Volts
diM/dt	Rate of Fall of Recovery Current	T_J = 25°C		400		A/µs
diM/dt	I_F = 30A, di_F/dt = -240A/µs, V_R = 350V (See Figure 18)	T_J = 100°C		200		A/µs

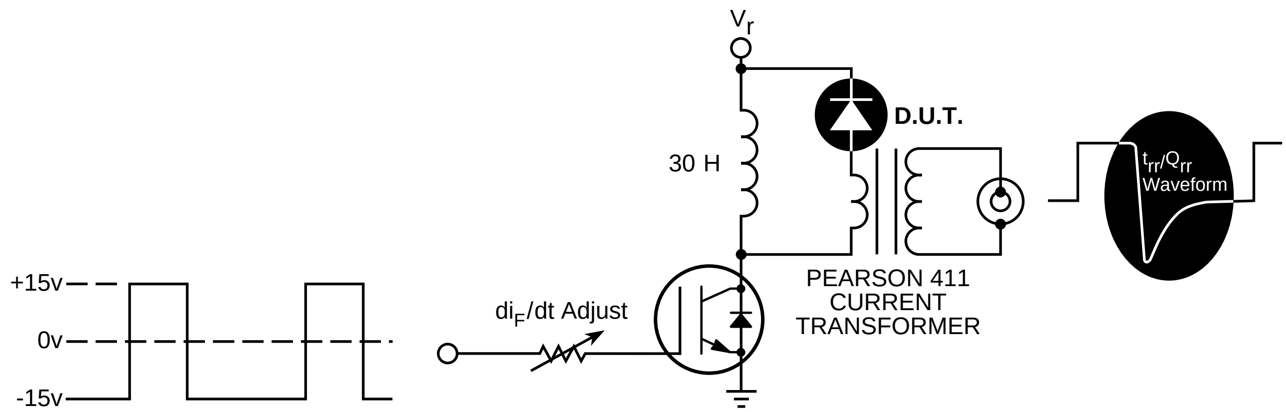


Figure 17, Diode Reverse Recovery Test Circuit and Waveforms

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}.

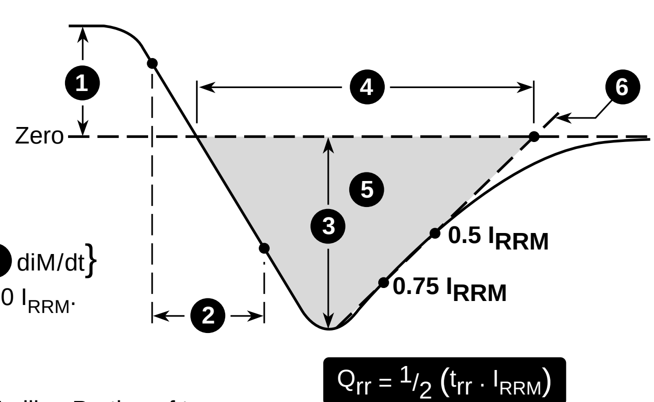


Figure 18, Diode Reverse Recovery Waveform and Definitions

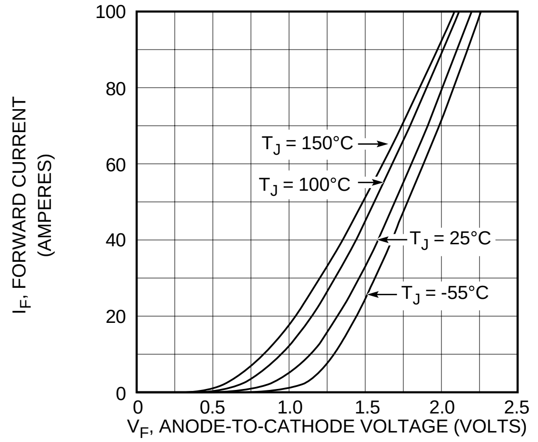


Figure 19, Forward Voltage Drop vs Forward Current

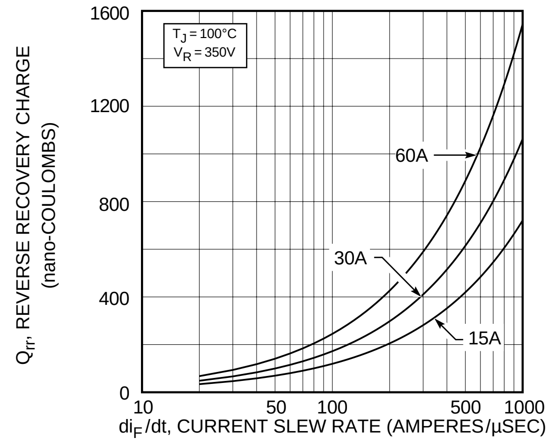


Figure 20, Reverse Recovery Charge vs Current Slew Rate

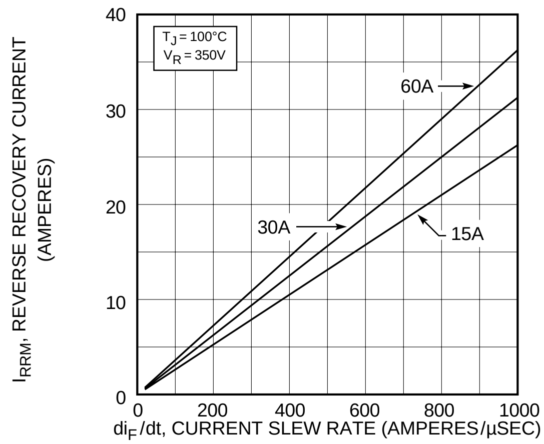


Figure 21, Reverse Recovery Current vs Current Slew Rate

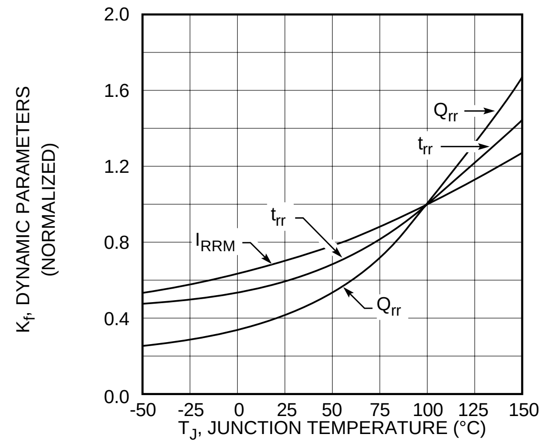


Figure 22, Dynamic Parameters vs Junction Temperature

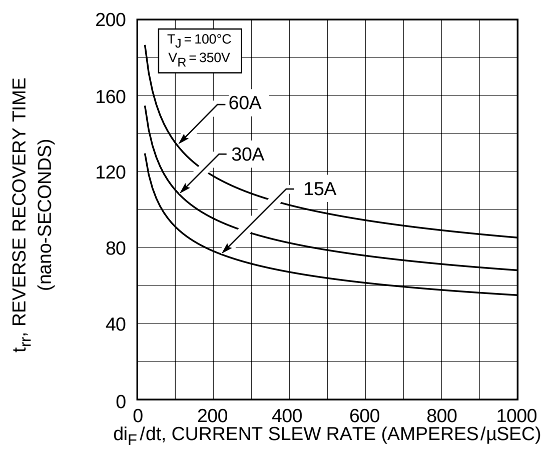


Figure 23, Reverse Recovery Time vs Current Slew Rate

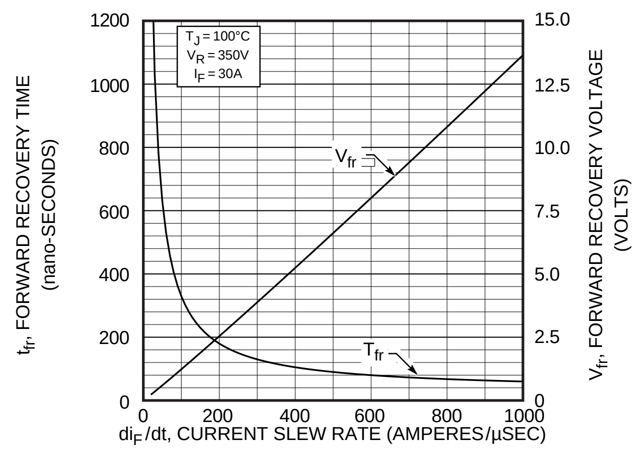


Figure 24, Forward Recovery Voltage/Time vs Current Slew Rate

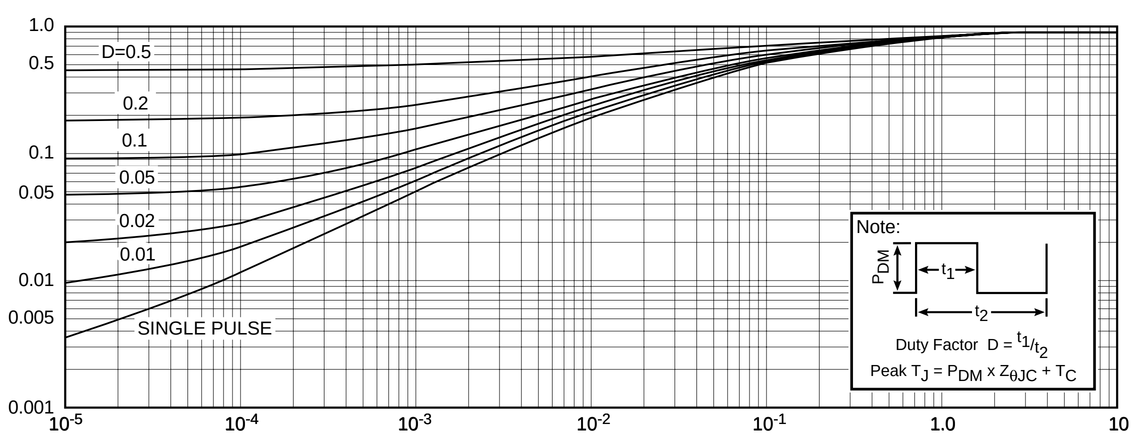
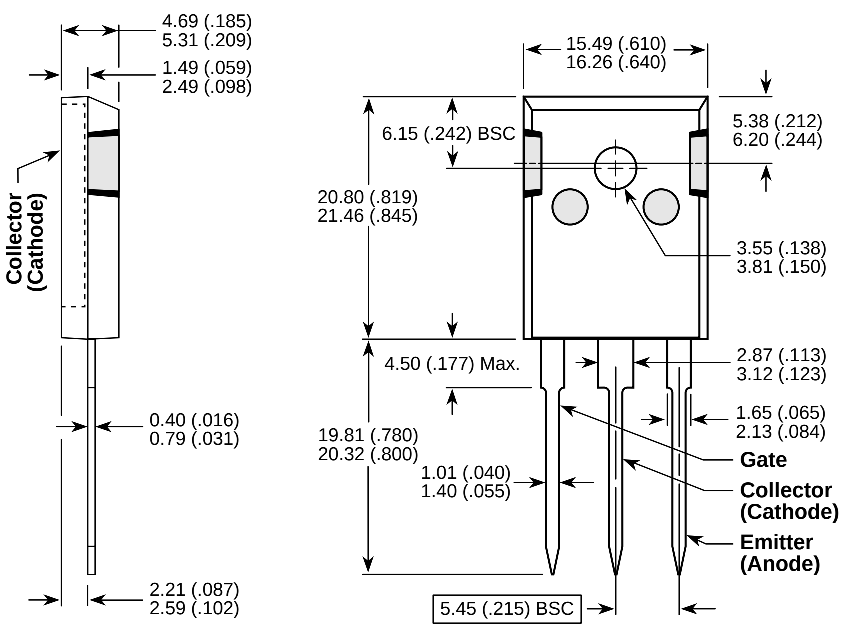


Figure 25, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

T0-247 Package Outline



Dimensions in Millimeters and (Inches)