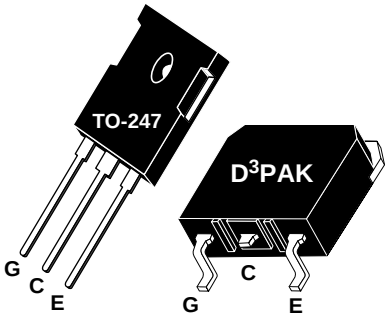
APT20GF120BRD
APT20GF120SRD

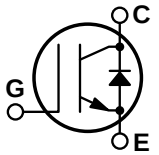
1200V 32A

Fast IGBT & FRED



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

- **Low Forward Voltage Drop**
- **High Freq. Switching to 20KHz**
- **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	APT20GF120BRD/SRD	UNIT
V_{CES}	Collector-Emitter Voltage	1200	Volts
V_{CGR}	Collector-Gate Voltage (R_{GE} = 20KΩ)	1200	
V_{GE}	Gate-Emitter Voltage	±20	
I_{C1}	Continuous Collector Current ③ @ T_C = 25°C	32	Amps
I_{C2}	Continuous Collector Current @ T_C = 105°C	20	
I_{CM}	Pulsed Collector Current ① @ T_C = 90°C	64	
I_{LM}	RBSOA Clamped Inductive Load Current @ R_g = 11Ω T_C = 125°C	40	
P_D	Total Power Dissipation	200	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
V_{GE}(TH)	Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 600µA, T_j = 25°C)	4.5	5.5	6.5	Volts
V_{CE}(ON)	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 15A, T_j = 25°C)		2.7	3.2	
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 15A, T_j = 125°C)		3.3	3.9	
I_{CES}	Collector Cut-off Current (V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 25°C)			1	mA
	Collector Cut-off Current (V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 125°C)			6	
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

052-6252 Rev C 4-2003

DYNAMIC CHARACTERISTICS (IGBT)

APT20GF120BRD/SRD

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	**Capacitance** V_{GE} = 0V, V_{CE} = 25V, f = 1 MHz		1050	1210	pF
C_{oes}	Output Capacitance			100	150	
C_{res}	Reverse Transfer Capacitance			63	110	
Q_g	Total Gate Charge ②	**Gate Charge** V_{GE} = 15V, V_{CC} = 0.5V_{CES}, I_C = I_{C2}		95	140	nC
Q_{ge}	Gate-Emitter Charge			13	20	
Q_{gc}	Gate-Collector ("Miller") Charge			62	90	
$t_d(on)$	Turn-on Delay Time	**Resistive Switching (25°C)** V_{GE} = 15V, V_{CC} = 0.8V_{CES}, I_C = I_{C2}, R_G = 10Ω		15	30	ns
t_r	Rise Time			67	130	
$t_d(off)$	Turn-off Delay Time			92	140	
t_f	Fall Time			93	190	
$t_d(on)$	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		17	34	ns
t_r	Rise Time			30	60	
$t_d(off)$	Turn-off Delay Time			105	160	
t_f	Fall Time			71	140	
E_{on}	Turn-on Switching Energy			1.3	3	mJ
E_{off}	Turn-off Switching Energy			1.5	3	
E_{ts}	Total Switching Losses			2.7	5	
$t_d(on)$	Turn-on Delay Time	**Inductive Switching (25°C)** V_{CLAMP}(Peak) = 0.66V_{CES}, V_{GE} = 15V, I_C = I_{C2}, R_G = 10Ω, T_J = +25°C		17	30	ns
t_r	Rise Time			35	70	
$t_d(off)$	Turn-off Delay Time			93	140	
t_f	Fall Time			70	140	
E_{ts}	Total Switching Losses			2.4	5	mJ
gfe	Forward Transconductance	V_{CE} = 20V, I_C = 15A		12		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 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 See MIL-STD-750 Method 3471

③ Switching losses include the FRED and IGBT.

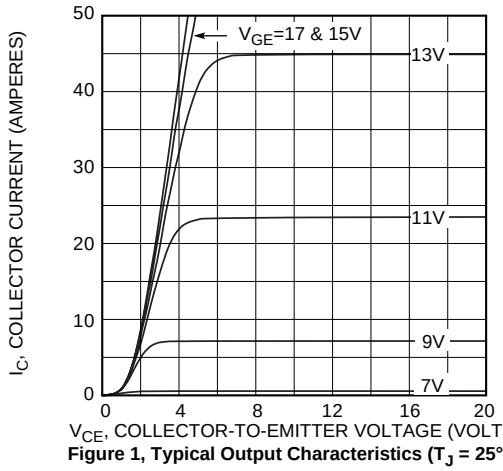


Figure 1, Typical Output Characteristics (T_J = 25°C)

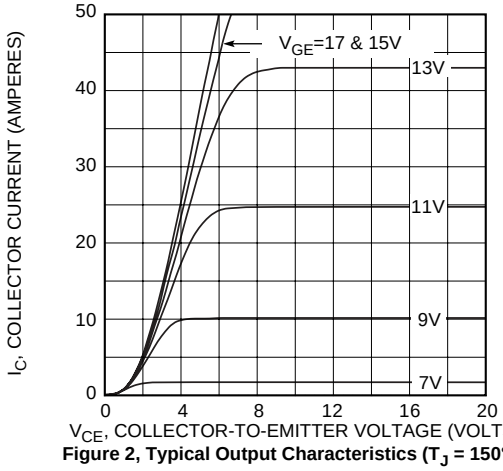


Figure 2, Typical Output Characteristics (T_J = 150°C)

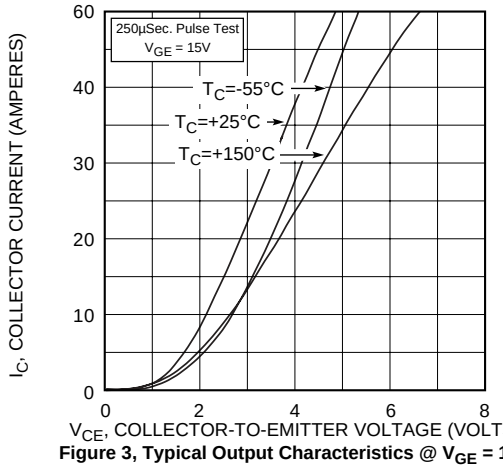


Figure 3, Typical Output Characteristics @ V_{GE} = 15V

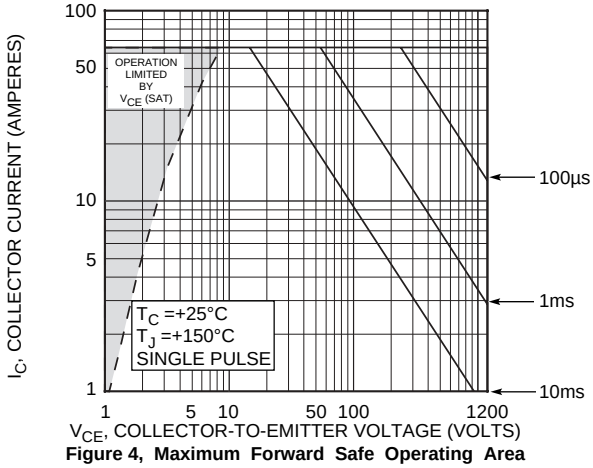


Figure 4, Maximum Forward Safe Operating Area

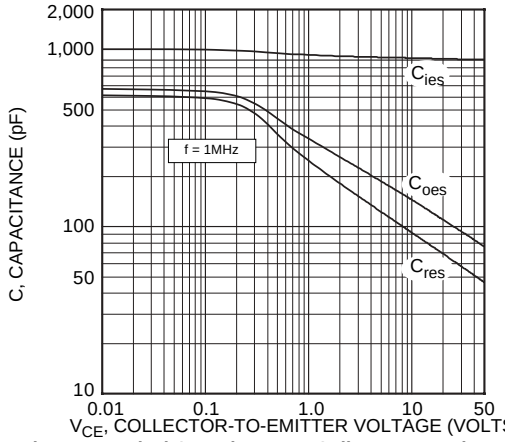


Figure 5, Typical Capacitance vs Collector-To-Emitter Voltage

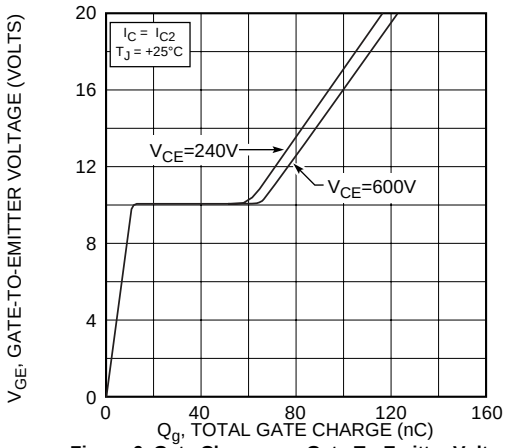


Figure 6, Gate Charges vs Gate-To-Emitter Voltage

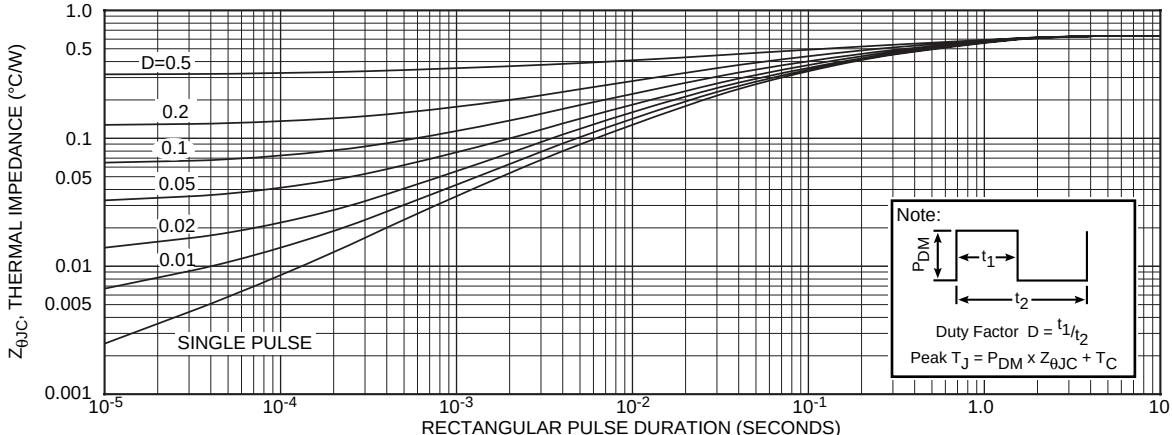


Figure 7, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

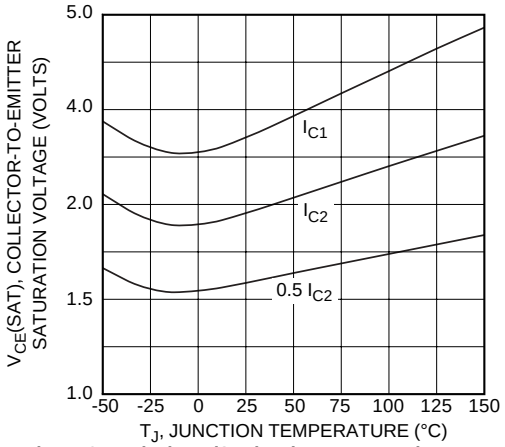


Figure 8, Typical V_{CE}(SAT) Voltage vs Junction Temperature

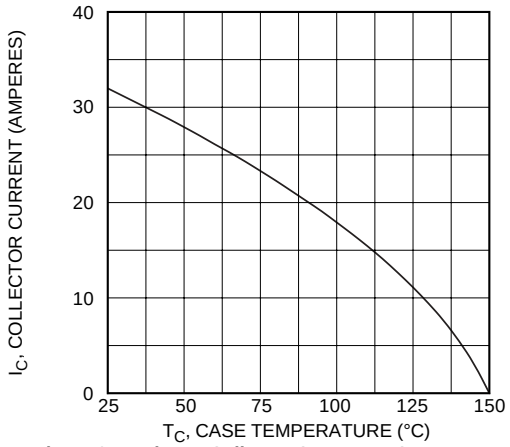


Figure 9, Maximum Collector Current vs Case Temperature

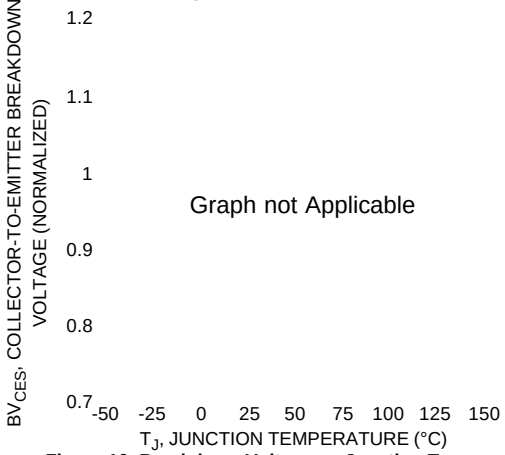


Figure 10, Breakdown Voltage vs Junction Temperature

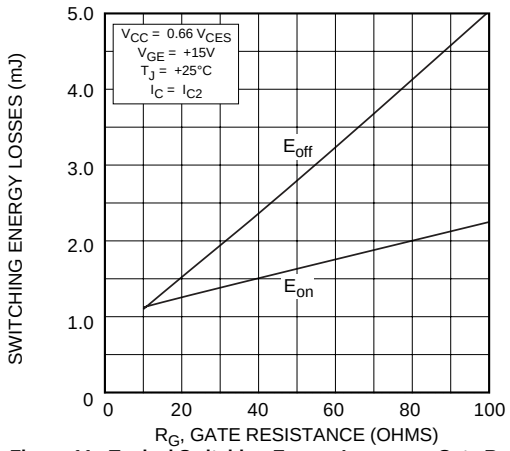


Figure 11, Typical Switching Energy Losses vs Gate Resistance

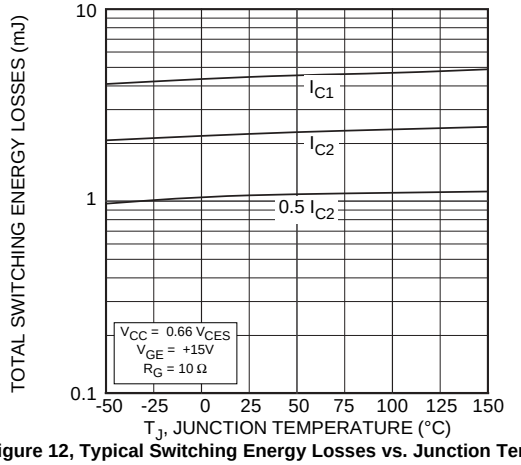


Figure 12, Typical Switching Energy Losses vs. Junction Temperature

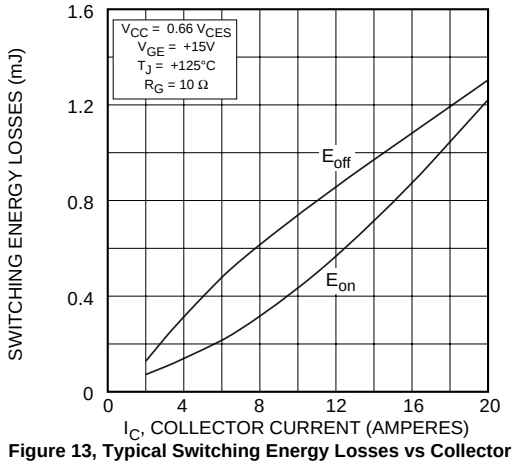


Figure 13, Typical Switching Energy Losses vs Collector Current

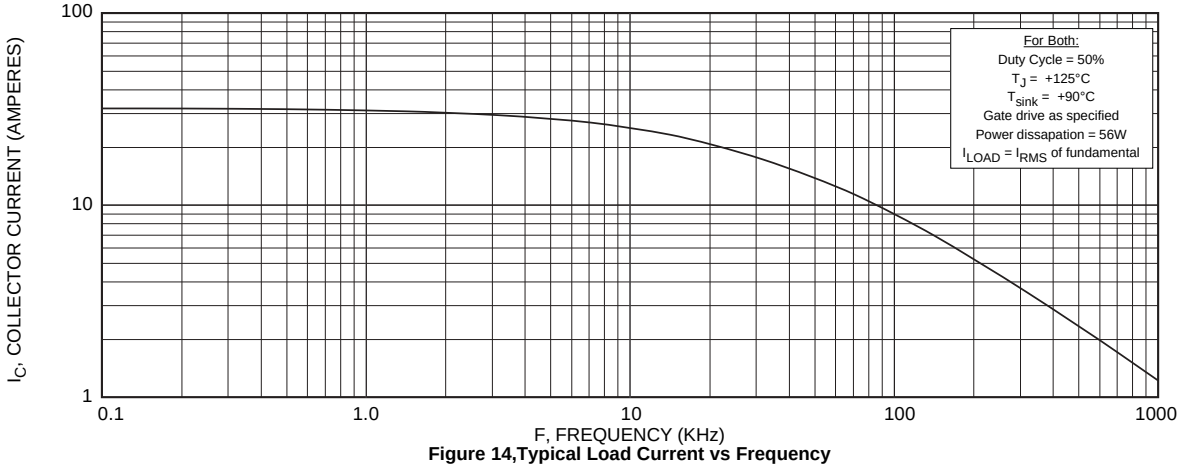


Figure 14,Typical Load Current vs Frequency

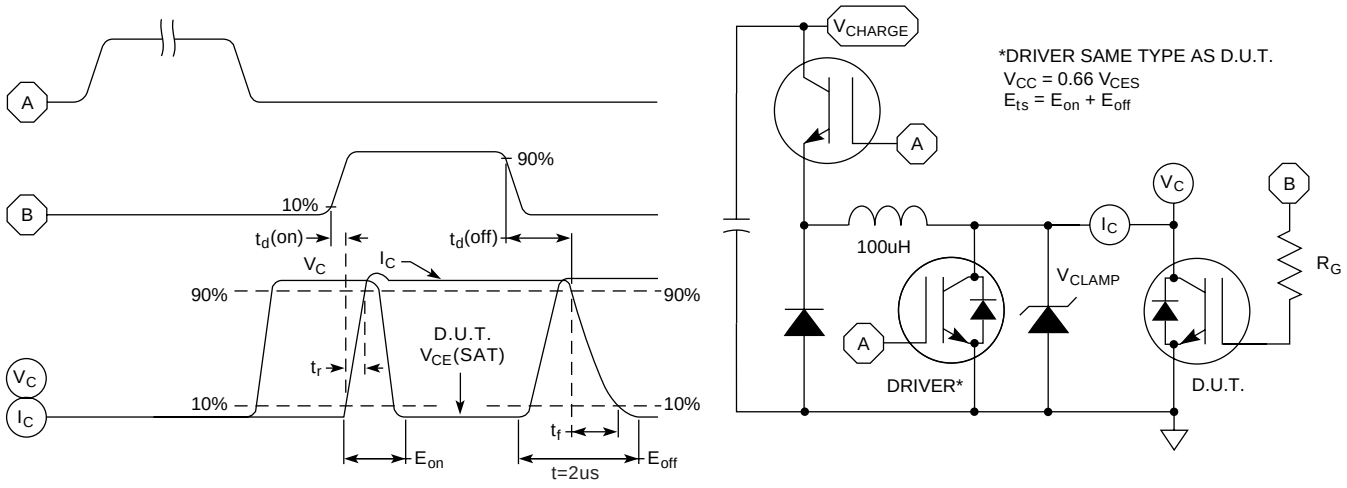


Figure 15, Switching Loss Test Circuit and Waveforms

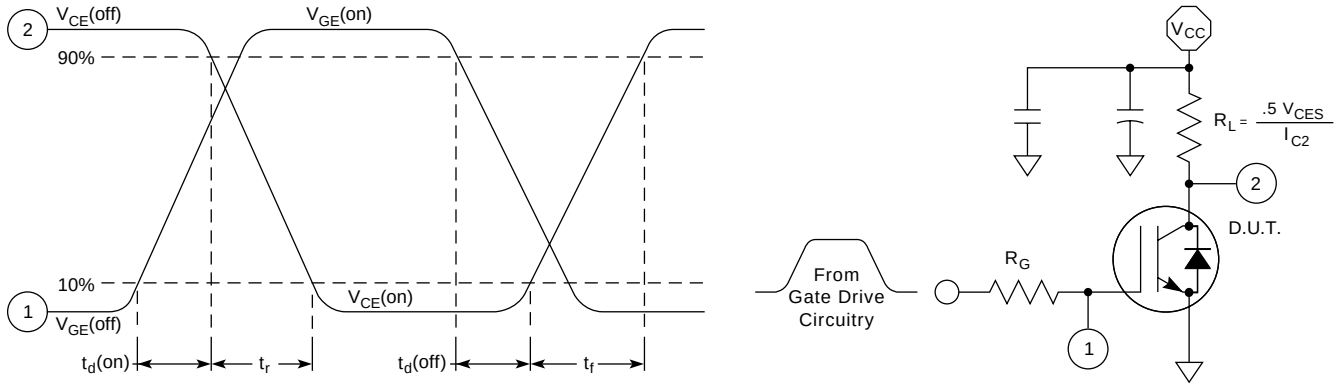


Figure 16, Resistive Switching Time Test Circuit and Waveforms

ULTRAFAST SOFT RECOVERY PARALLEL DIODE

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

Symbol	Characteristic	20GF120BRD/SRD	UNIT
IF_{AV}	Maximum Average Forward Current (T_C = 100°C, Duty Cycle = 0.5)	30	Amps
IF_{RMS}	RMS Forward Current	70	
I_{FSM}	Non-Repetive Forward Surge Current (T_J = 45°C, 8.3 ms)	210	

Symbol	Characteristic / Test Conditions		MIN	TYP	MAX	UNIT
V_F	Maximum Forward Voltage	I_F = 20A			2.3	Volts
		I_F = 60A		2.0		
		I_F = 20A, T_J = 150°C			1.7	
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			70	85	nS
t_{rr2}	Reverse Recovery Time	T_J = 25°C		70		
t_{rr3}	I_F = 20A, di_F/dt = -240A/µS, V_R = 650V	T_J = 100°C		160		
t_{fr1}	Forward Recovery Time	T_J = 25°C		255		
t_{fr2}	I_F = 20A, di_F/dt = 240A/µS, V_R = 650V	T_J = 100°C		255		
I_{RRM1}	Reverse Recovery Current	T_J = 25°C		7	12	Amps
I_{RRM2}	I_F = 20A, di_F/dt = -240A/µS, V_R = 650V	T_J = 100°C		12	20	
Q_{rr1}	Recovery Charge	T_J = 25°C		660		nC
Q_{rr2}	I_F = 20A, di_F/dt = -240A/µS, V_R = 650V	T_J = 100°C		1640		
V_{fr1}	Forward Recovery Voltage	T_J = 25°C		15		Volts
V_{fr2}	I_F = 20A, di_F/dt = 240A/µS, V_R = 650V	T_J = 100°C		20		
diM/dt	Rate of Fall of Recovery Current	T_J = 25°C		245		A/µS
	I_F = 20A, di_F/dt = -240A/µS, V_R = 650V (See Figure 18)	T_J = 100°C		160		

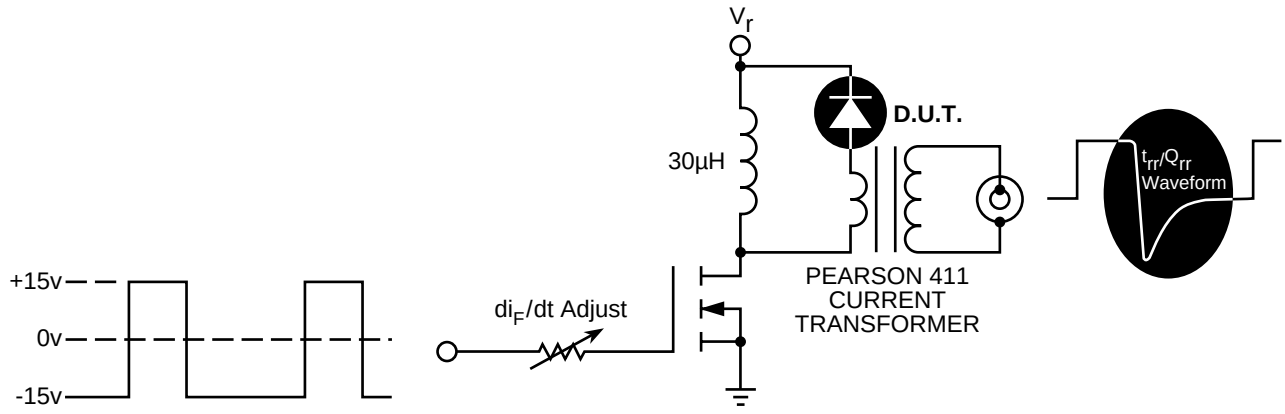


Figure 17, Diode Reverse Recovery Test Circuit and Waveforms

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}.

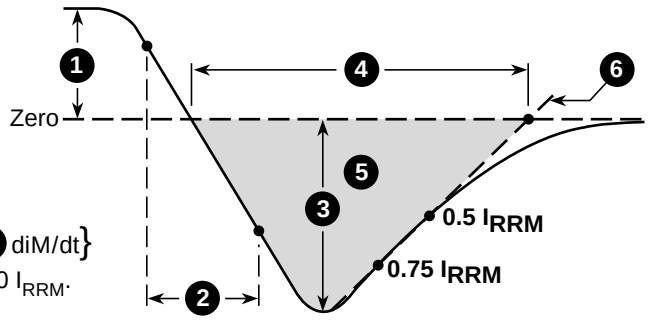


Figure 18, Diode Reverse Recovery Waveform and Definitions

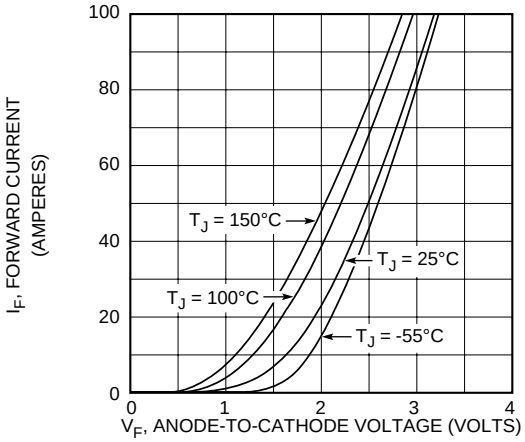


Figure 19, Forward Voltage Drop vs Forward Current

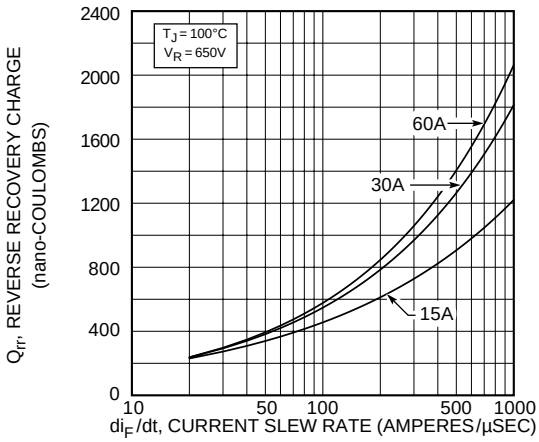


Figure 20, Reverse Recovery Charge vs Current Slew Rate

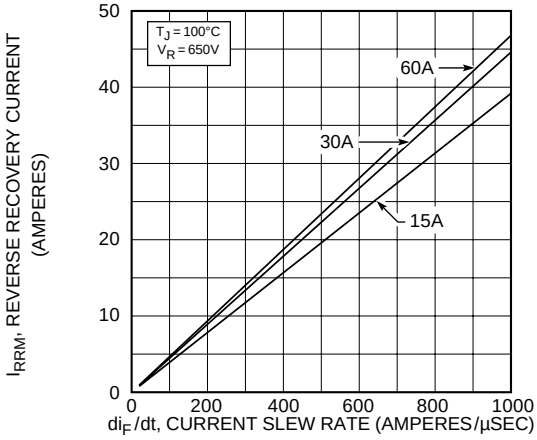


Figure 21, Reverse Recovery Current vs Current Slew Rate

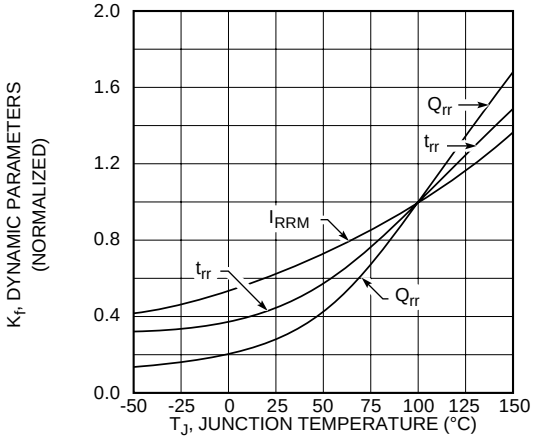


Figure 22, Dynamic Parameters vs Junction Temperature

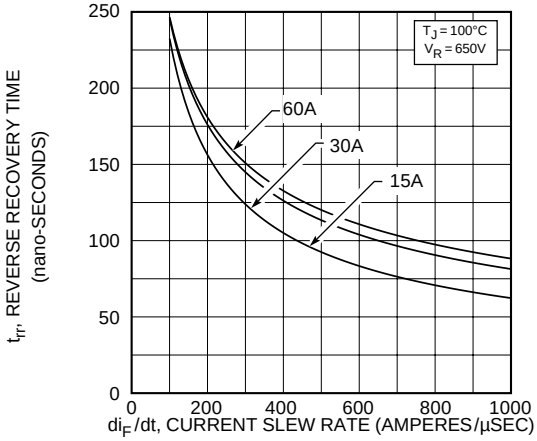


Figure 23, Reverse Recovery Time vs Current Slew Rate

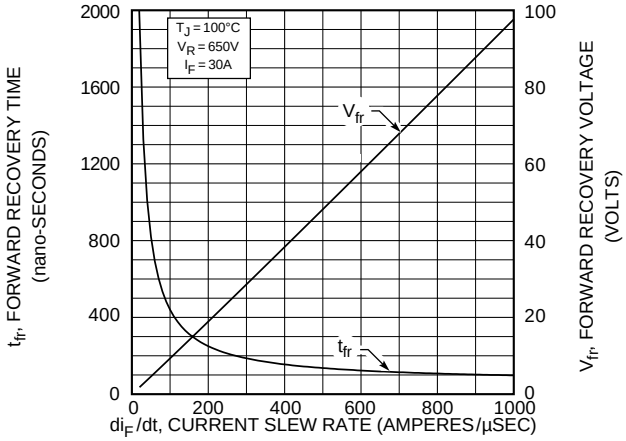


Figure 24, Forward Recovery Voltage/Time vs Current Slew Rate

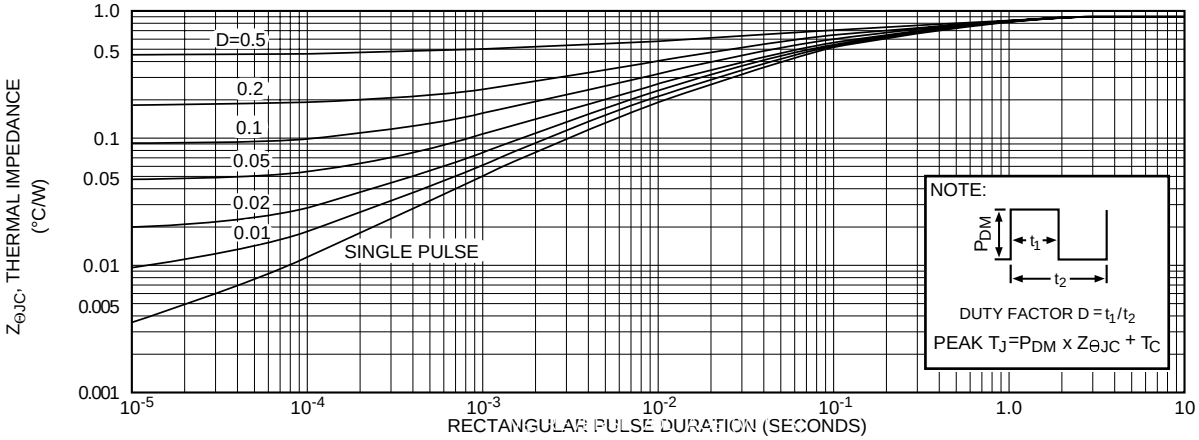
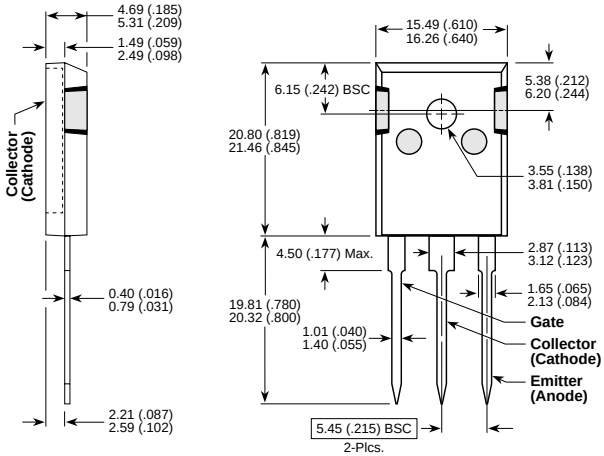


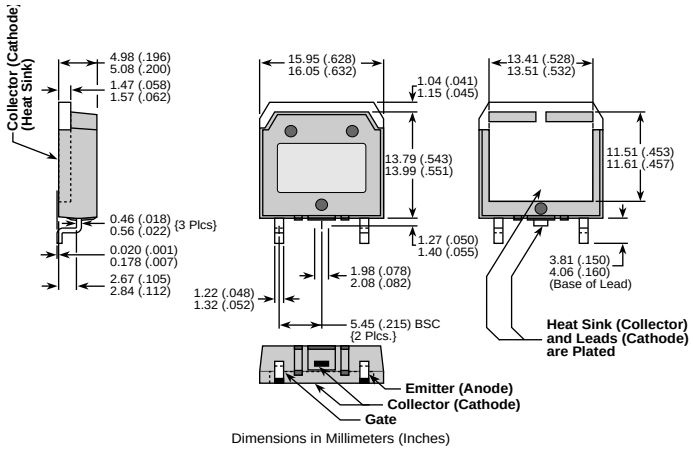
Figure 25, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

TO-247 Package Outline



Dimensions in Millimeters and (Inches)

D^{3}PAK Package Outline



Dimensions in Millimeters (Inches)

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