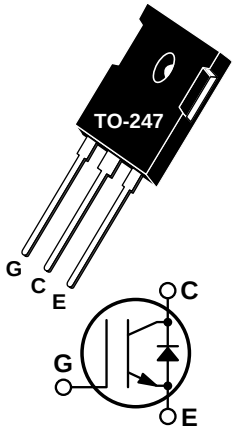
APT20GF120BRD

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	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 @ T_C = 25°C	32	Amps
I_{C2}	Continuous Collector Current @ T_C = 90°C	20	
I_{CM1}	Pulsed Collector Current ① @ T_C = 25°C	64	
I_{CM2}	Pulsed Collector Current ① @ T_C = 90°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
BV_{CES}	Collector-Emitter Breakdown Voltage (V_{GE} = 0V, I_C = 1.0mA)	1200			Volts
$V_{GE}(TH)$	Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 350µA, T_j = 25°C)	4.5	5.5	6.5	
$V_{CE}(ON)$	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)			1.0	mA
	Collector Cut-off Current (V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 125°C)			6.0	
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

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**

052-6252 Rev A

DYNAMIC CHARACTERISTICS (IGBT) APT20GF120BRD

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	**Capacitance** V_{GE} = 0V, V_{CE} = 25V, f = 1 MHz		1100	1500	pF
C_{oes}	Output Capacitance			165	250	
C_{res}	Reverse Transfer Capacitance			70	100	
Q_g	Total Gate Charge ②	**Gate Charge** V_{GE} = 15V, V_{CC} = 0.5V_{CES}, I_C = I_{C2}		95	150	nC
Q_{ge}	Gate-Emitter Charge			13	20	
Q_{gc}	Gate-Collector ("Miller") Charge			55	85	
$t_d(on)$	Turn-on Delay Time	**Resistive Switching (25°C)** V_{GE} = 15V, V_{CC} = 0.8V_{CES}, I_C = I_{C2}, R_G = 10Ω		17		ns
t_r	Rise Time			75		
$t_d(off)$	Turn-off Delay Time			99		
t_f	Fall Time			170		
$t_d(on)$	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		20	30	ns
t_r	Rise Time			35	70	
$t_d(off)$	Turn-off Delay Time			190	275	
t_f	Fall Time			90	135	
E_{on}	Turn-on Switching Energy ③			1.2		mJ
E_{off}	Turn-off Switching Energy			1.8		
E_{ts}	Total Switching Losses ③			3.0		
$t_d(on)$	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		20		ns
t_r	Rise Time			35		
$t_d(off)$	Turn-off Delay Time			160		
t_f	Fall Time			90		
E_{ts}	Total Switching Losses ③			2.7		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.

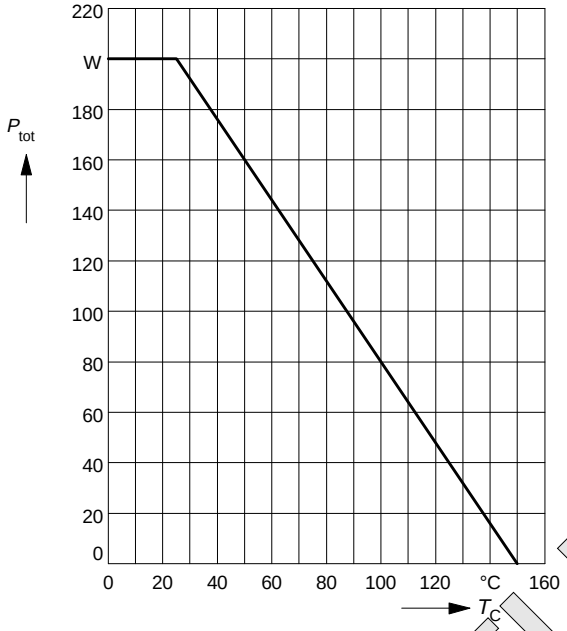
② See MIL-STD-750 Method 3471

③ Switching losses include the FRED and IGBT.

Power dissipation

$P_{tot} = f(T_C)$

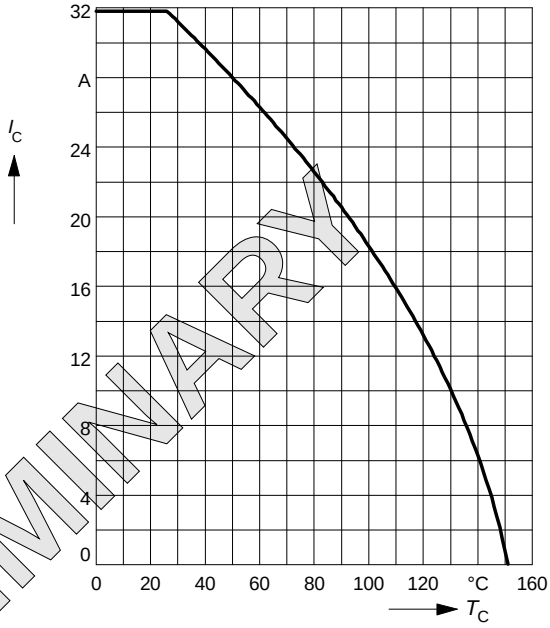
parameter: $T_j \leq 150$ °C



Collector current

$I_C = f(T_C)$

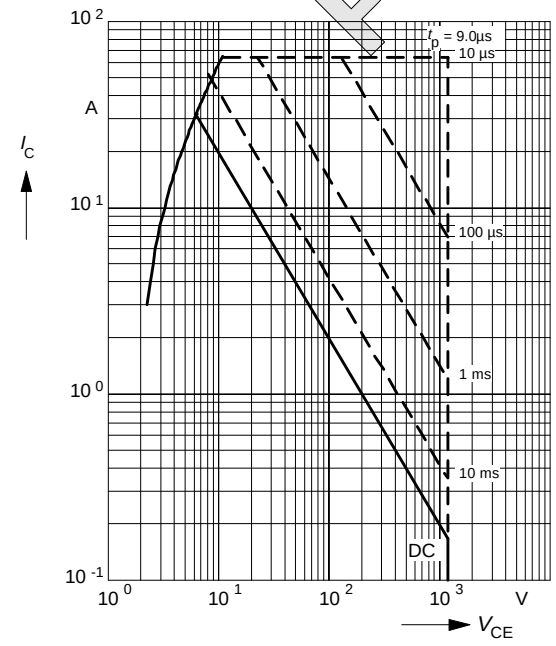
parameter: $V_{GE} \geq 15$ V , $T_j \leq 150$ °C



Safe operating area

$I_C = f(V_{CE})$

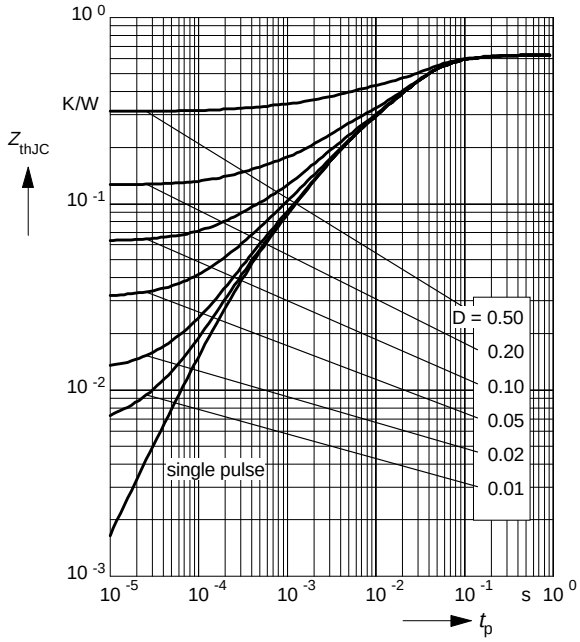
parameter: $D = 0$, $T_C = 25$°C , $T_j \leq 150$ °C



Transient thermal impedance IGBT

$Z_{th\,JC} = f(t_p)$

parameter: $D = t_p / T$



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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
USA
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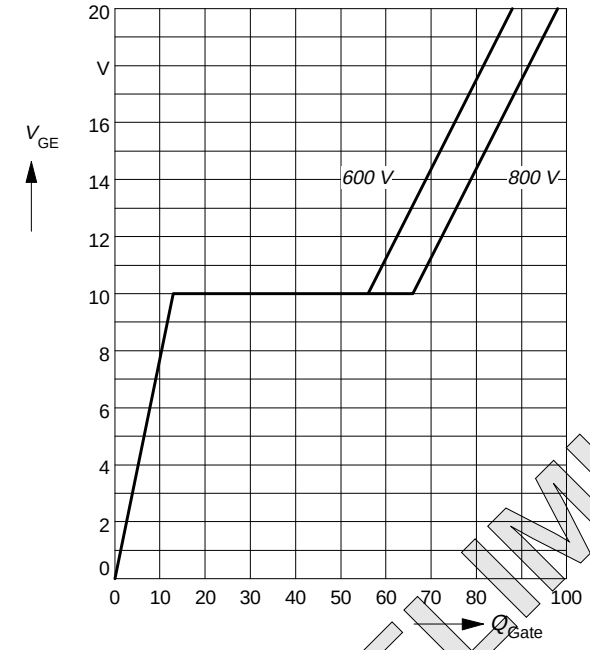
Typ. gate charge

$V_{GE} = f(Q_{Gate})$

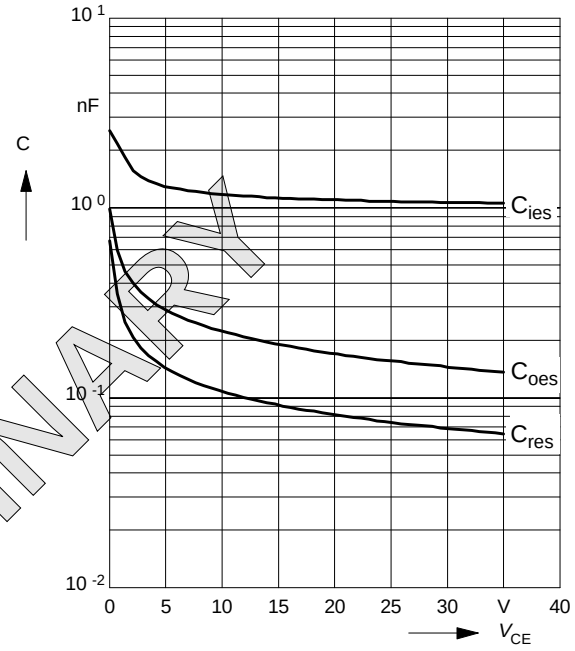
parameter: $I_{C\ puls}$ = 16A



Typ. capacitances

$C = f(V_{CE})$

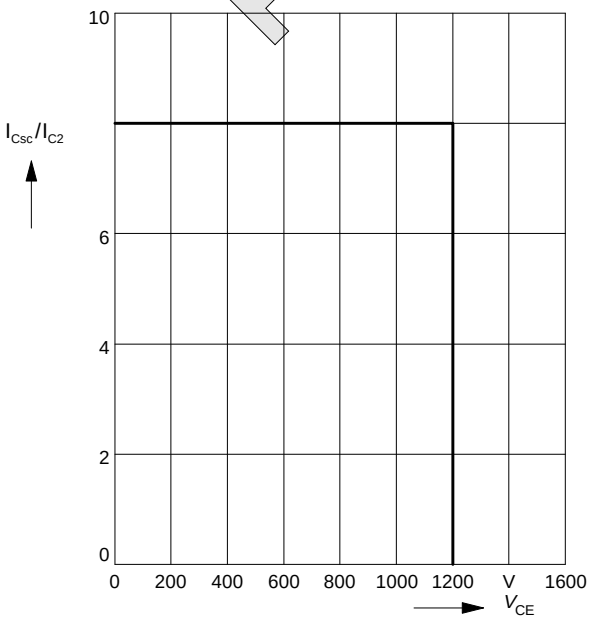
parameter: V_{GE} = 0 V, f = 1 MHz



Short circuit safe operating area

$I_{Csc} = f(V_{CE})$, T_j = 150°C

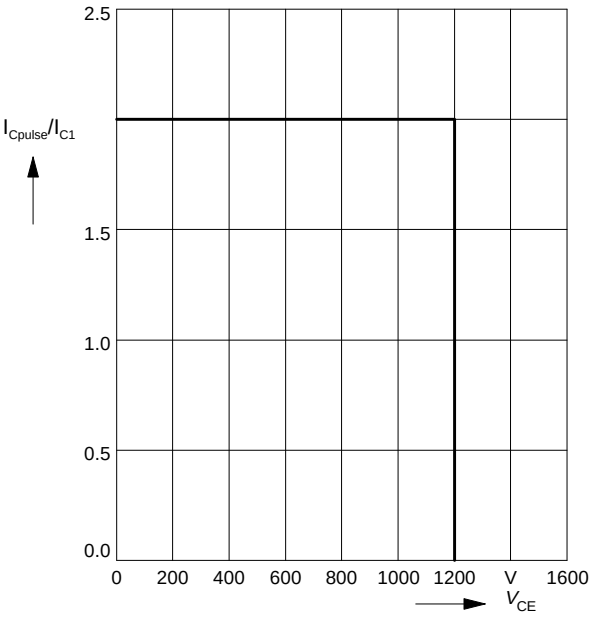
parameter: V_{GE} = ± 15 V, t_{sc} ≤ 10 µs, L < 25 nH



Reverse biased safe operating area

$I_{Cpuls} = f(V_{CE})$, T_j = 150°C

parameter: V_{GE} = 15 V



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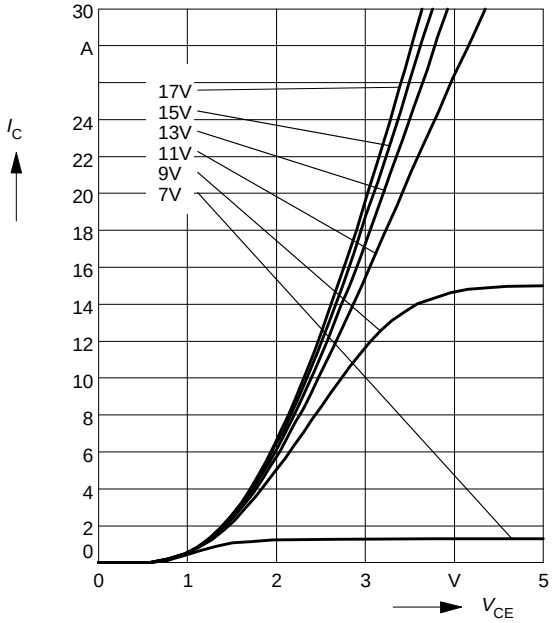
405 S.W. Columbia Street Bend, Oregon 97702-1035 Phone: (541) 382-8028 FAX: (541) 388-0364

Typ. output characteristics

$I_C = f(V_{CE})$

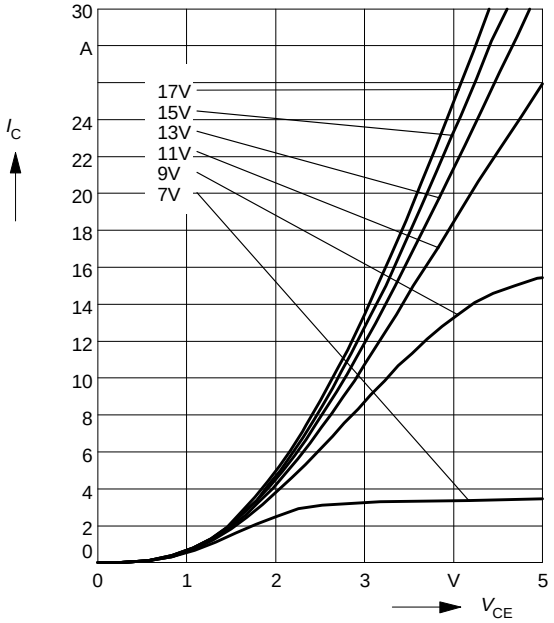
parameter: t_p = 80 µs, T_j = 25 °C



Typ. output characteristics

$I_C = f(V_{CE})$

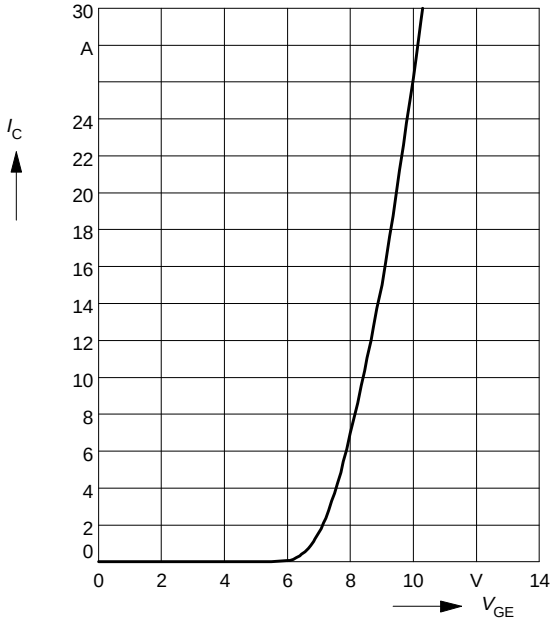
parameter: t_p = 80 µs, T_j = 125 °C



Typ. transfer characteristics

$I_C = f(V_{GE})$

parameter: t_p = 80 µs, V_{CE} = 20 V



ULTRAFAST SOFT RECOVERY PARALLEL DIODE

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

Symbol	Characteristic / Test Conditions	APT20GF120BRD	UNIT
V_R	Maximum D.C. Reverse Voltage	1200	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)	30	Amps
$I_F(RMS)$	RMS Forward Current	70	
I_{FSM}	Non-Repetitive Forward Surge Current (T_J = 45°C, 8.3ms)	210	

STATIC ELECTRICAL CHARACTERISTICS (FRED)

Symbol	Characteristic / Test Conditions		MIN	TYP	MAX	UNIT
V_F	Maximum Forward Voltage	I_F = 30A			2.5	Volts
		I_F = 60A		2.0		
		I_F = 30A, T_J = 150°C			2.0	
I_{RM}	Maximum Reverse Leakage Current	$V_R = V_R$ Rated			250	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			70	85	ns
t_{rr2}	Reverse Recovery Time	T_J = 25°C		70		
t_{rr3}	I_F = 30A, 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 = 30A, 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 = 30A, 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 = 30A, 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 = 30A, 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 = 30A, di_F/dt = -240A/µs, V_R = 650V	T_J = 100°C		160		

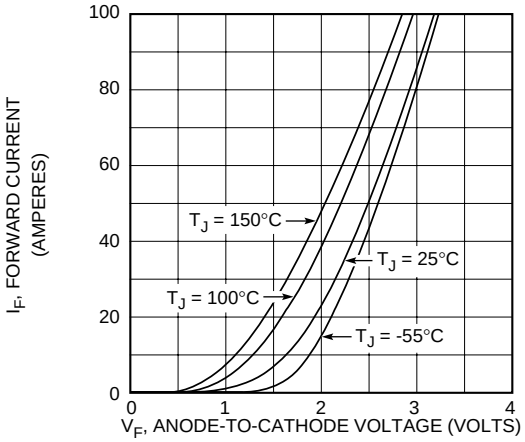


Figure 1, Forward Voltage Drop vs Forward Current

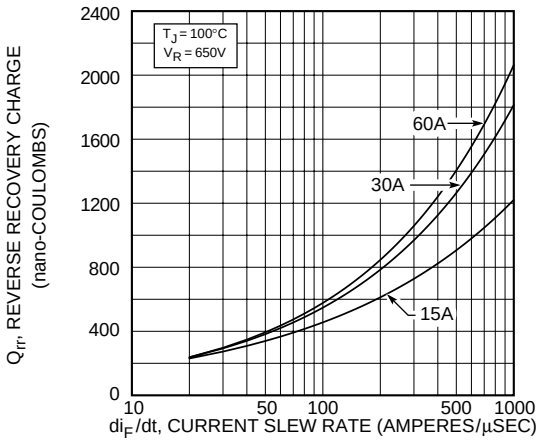


Figure 2, Reverse Recovery Charge vs Current Slew Rate

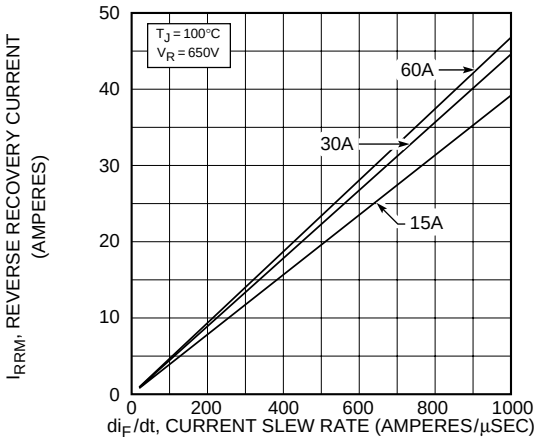


Figure 3, Reverse Recovery Current vs Current Slew Rate

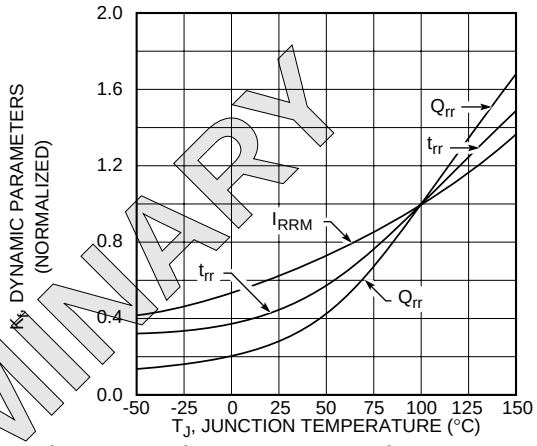


Figure 4, Dynamic Parameters vs Junction Temperature

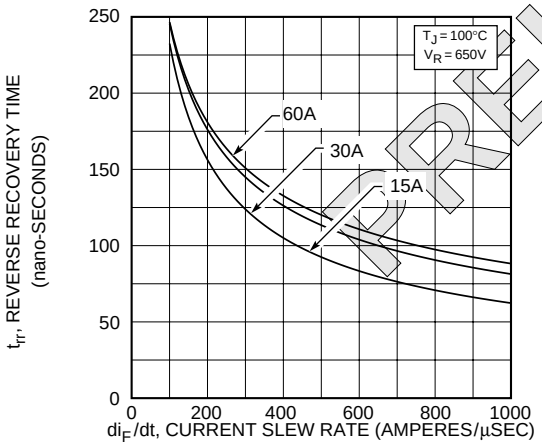


Figure 5, Reverse Recovery Time vs Current Slew Rate

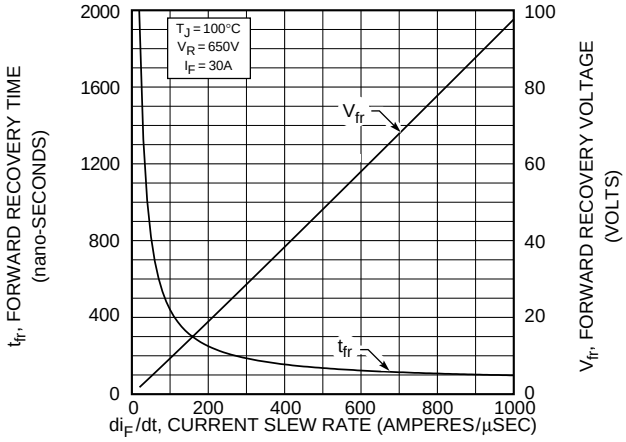


Figure 6, Forward Recovery Voltage/Time vs Current Slew Rate

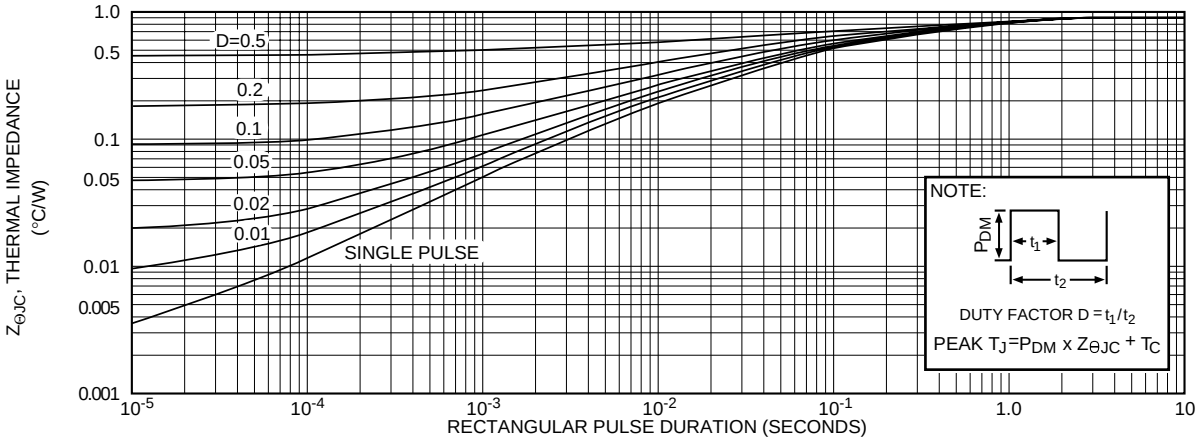


Figure 7, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

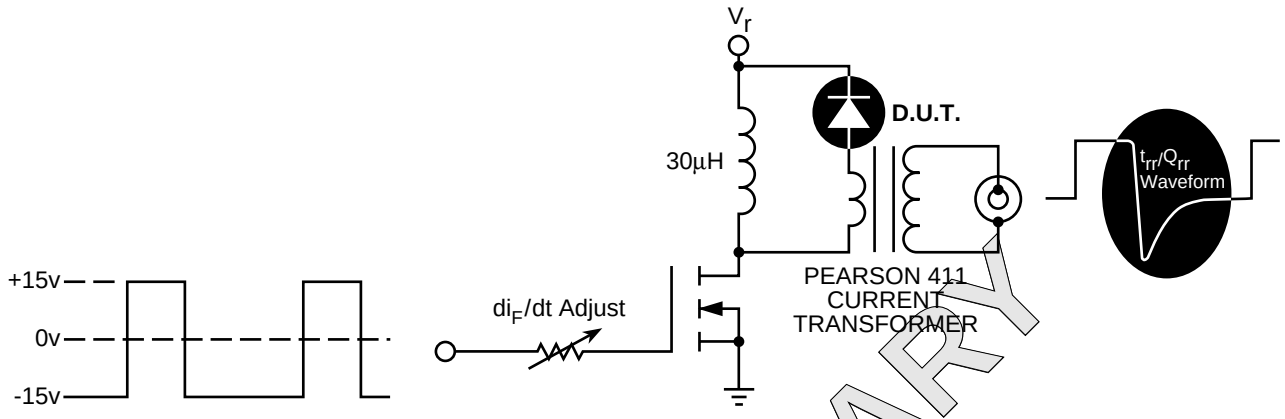


Figure 25, Diode Reverse Recovery Test Circuit and Waveforms

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}.

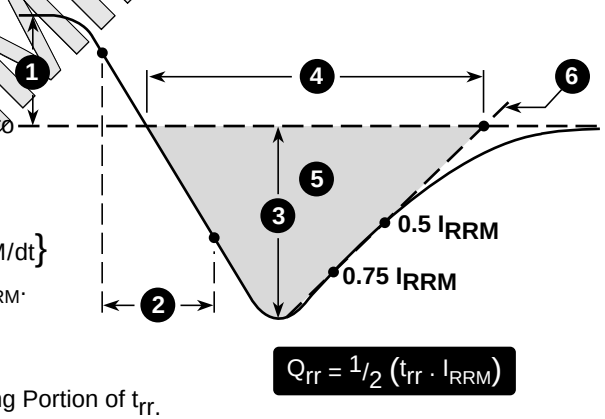
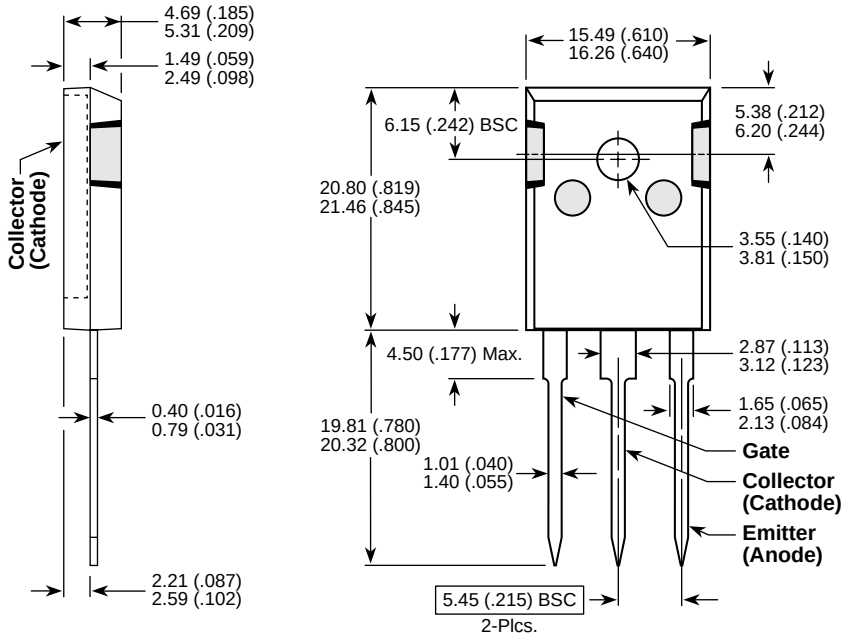


Figure 8, Diode Reverse Recovery Waveform and Definitions

TO-247 Package Outline



Dimensions in Millimeters and (Inches)