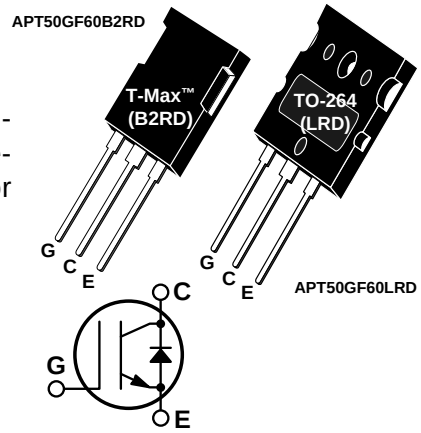
APT50GF60B2RD
APT50GF60LRD
600V 80A

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	APT50GF60B2RD/LRD	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	80	Amps
I_{C2}	Continuous Collector Current @ T_C = 90°C	50	
I_{CM1}	Pulsed Collector Current ① @ T_C = 25°C	160	
I_{CM2}	Pulsed Collector Current ① @ T_C = 90°C	100	
P_D	Total Power Dissipation	300	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	

PRELIMINARY

STATIC ELECTRICAL CHARACTERISTICS (IGBT)

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
BV_{CES}	Collector-Emitter Breakdown Voltage (V_{GE} = 0V, I_C = 0.50mA)	600			Volts
$V_{GE}(TH)$	Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 700µA, T_j = 25°C)	4.5	5.5	6.5	
$V_{CE}(ON)$	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = I_{C2}, T_j = 25°C)		2.1	2.7	
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = I_{C2}, T_j = 125°C)		2.2	2.8	
I_{CES}	Collector Cut-off Current (V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 25°C) ②			0.50	mA
	Collector Cut-off Current (V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 125°C) ②			TBD	
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.

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052-6253 Rev A

DYNAMIC CHARACTERISTICS (IGBT)

APT50GF60B2RD/LRD

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	**Capacitance**		2600	3600	
C_{oes}	Output Capacitance	V_{GE} = 0V V_{CE} = 25V		475	710	pF
C_{res}	Reverse Transfer Capacitance	f = 1 MHz		165	250	
Q_g	Total Gate Charge ③	**Gate Charge**		170	225	
Q_{ge}	Gate-Emitter Charge	V_{GE} = 15V V_{CC} = 0.5V_{CES}		25	45	nC
Q_{gc}	Gate-Collector ("Miller") Charge	I_C = I_{C2}		100	140	
t_d(on)	Turn-on Delay Time	**Resistive Switching (25°C)**		20		
t_r	Rise Time	V_{GE} = 15V V_{CC} = .8V_{CES}		100		ns
t_d(off)	Turn-off Delay Time	I_C = I_{C2}		160		
t_f	Fall Time	R_G = 10Ω		200		
t_d(on)	Turn-on Delay Time			30	50	
t_r	Rise Time	**Inductive Switching (150°C)**		90	135	ns
t_d(off)	Turn-off Delay Time	V_{CLAMP}(Peak) = 0.66V_{CES}		290	435	
t_f	Fall Time	V_{GE} = 15V		170	340	
E_{on}	Turn-on Switching Energy ④	I_C = I_{C2} R_G = 10Ω		2.2		
E_{off}	Turn-off Switching Energy	T_J = +150°C		2.4		mJ
E_{ts}	Total Switching Losses ④			4.6		
t_d(on)	Turn-on Delay Time	**Inductive Switching (25°C)**		30		
t_r	Rise Time	V_{CLAMP}(Peak) = 0.66V_{CES}		90		ns
t_d(off)	Turn-off Delay Time	V_{GE} = 15V		260		
t_f	Fall Time	I_C = I_{C2} R_G = 10Ω		100		
E_{ts}	Total Switching Losses ④	T_J = +25°C		4.3		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)			0.42	
	Junction to Case (FRED)			0.66	°C/W
$R_{\Theta JA}$	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 Leakages include the FRED and IGBT.

③ See MIL-STD-750 Method 3471

④ Switching losses include the FRED and IGBT.

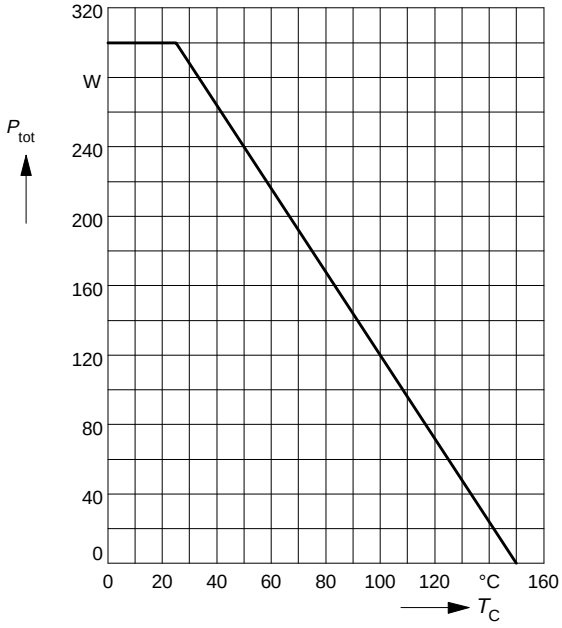
APT Reserves the right to change, without notice, the specifications and information contained herein.

PRELIMINARY

Power dissipation

$P_{tot} = f(T_C)$

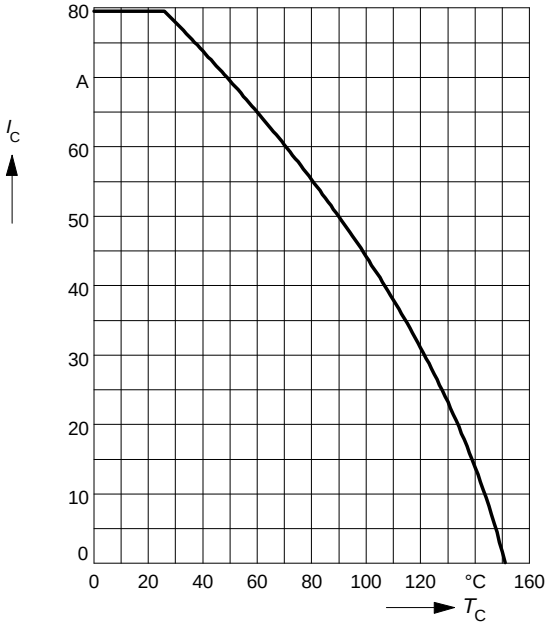
parameter: $T_j \leq 150$ °C



Collector current

$I_C = f(T_C)$

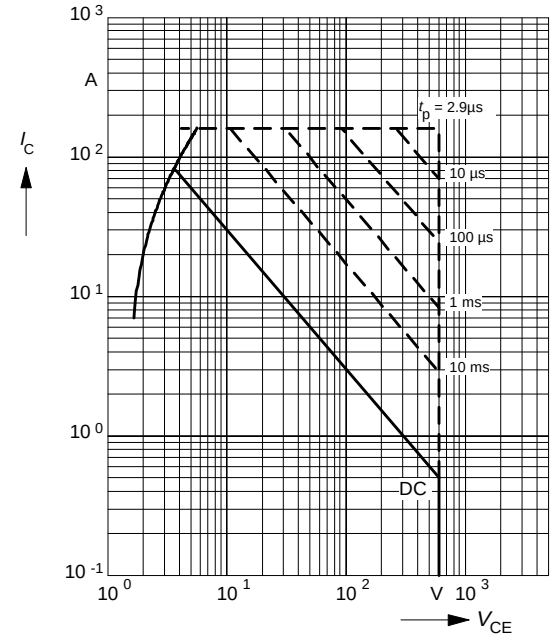
parameter: $V_{GE} \geq 15$ V , $T_j \leq 150$ °C



Safe operating area

$I_C = f(V_{CE})$

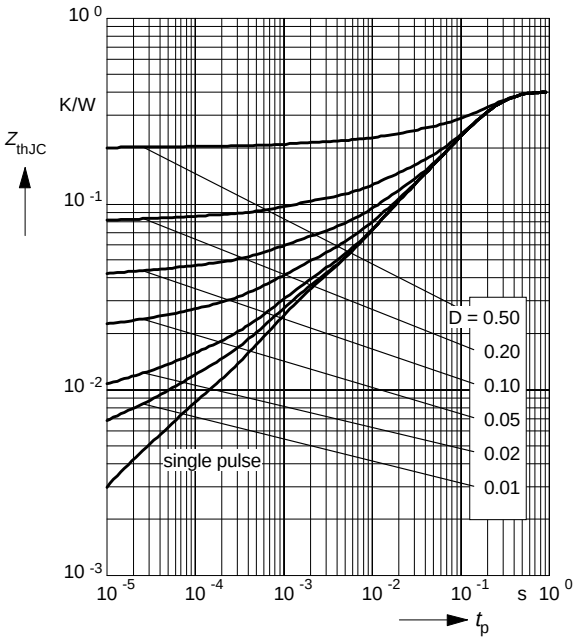
parameter: $D = 0$, $T_C = 25$°C , $T_j \leq 150$ °C



Transient thermal impedance IGBT

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

parameter: $D = t_p / T$



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USA
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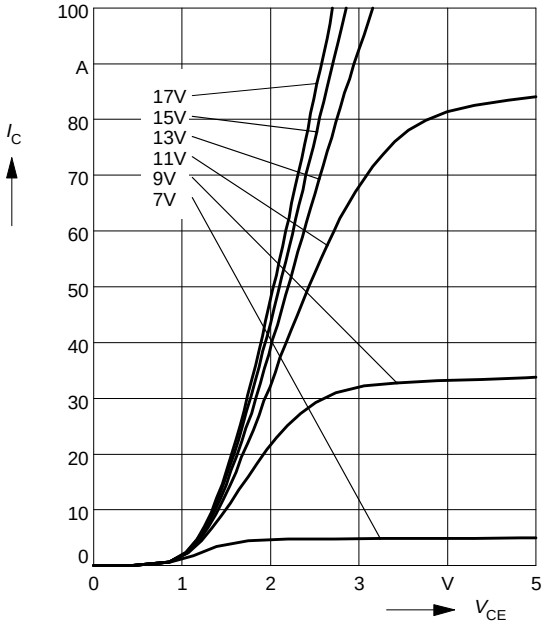
Typ. output characteristics

$I_C = f(V_{CE})$

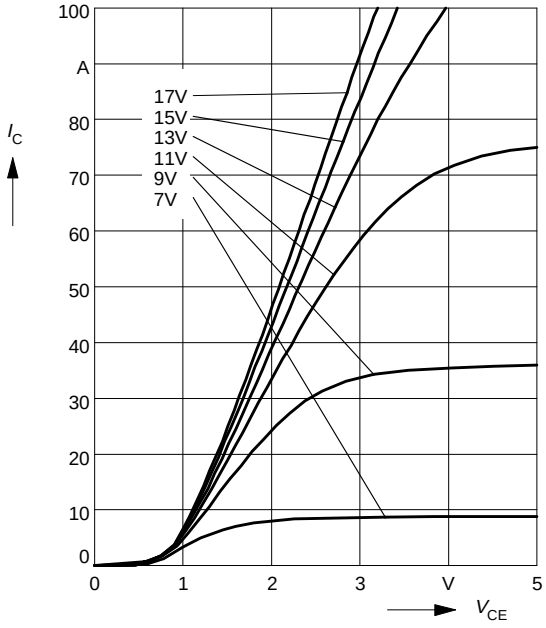
parameter: t_p = 80 µs, T_j = 25 °C



Typ. output characteristics

$I_C = f(V_{CE})$

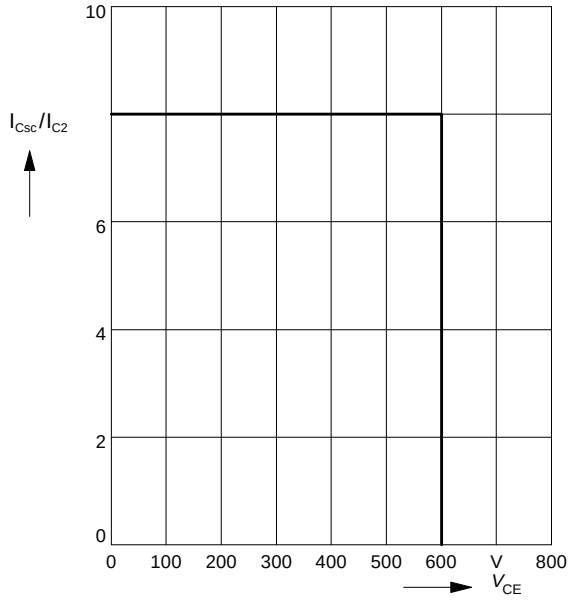
parameter: t_p = 80 µs, T_j = 125 °C



Short circuit safe operating area

$I_{Csc} = f(V_{CE})$, T_j = 150°C

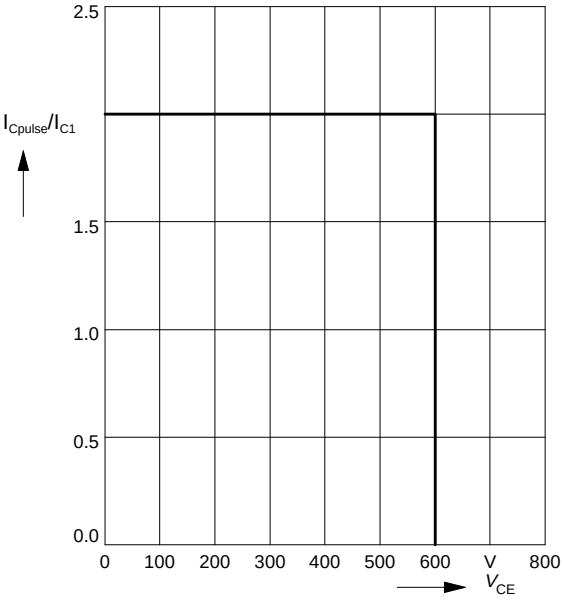
parameter: V_{GE} = ± 15 V, t_{sc} ≤ 10 µs, L < 50 nH



Reverse biased safe operating area

$I_{Cpuls} = f(V_{CE})$, T_j = 150°C

parameter: V_{GE} = 15 V



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ULTRAFAST SOFT RECOVERY PARALLEL DIODE

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

Symbol	Characteristic / Test Conditions	APT50GF60B2RD/LRD	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	

PRELIMINARY

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		

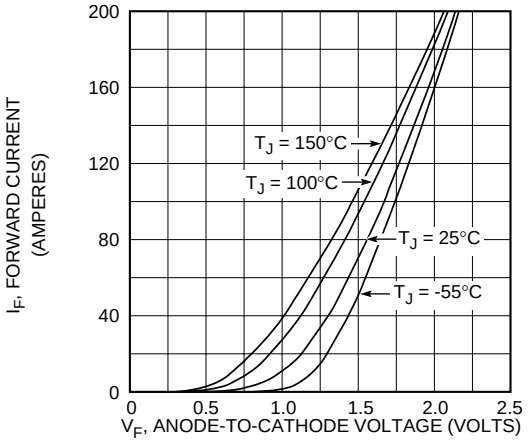


Figure 1, Forward Voltage Drop vs Forward Current

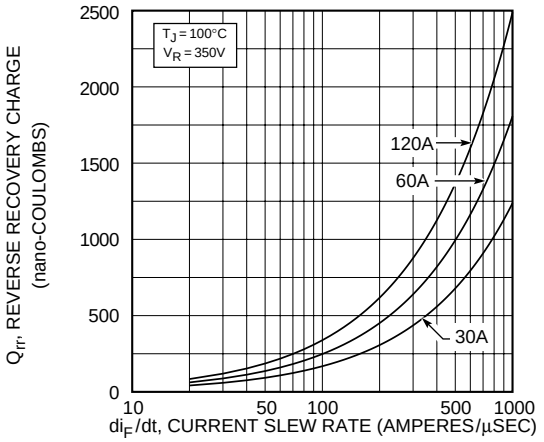


Figure 2, Reverse Recovery Charge vs Current Slew Rate

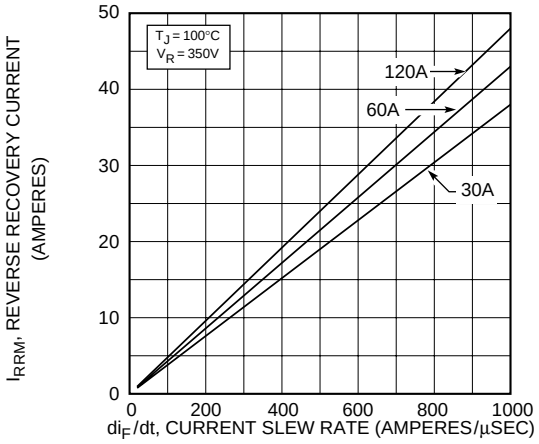


Figure 3, Reverse Recovery Current vs Current Slew Rate

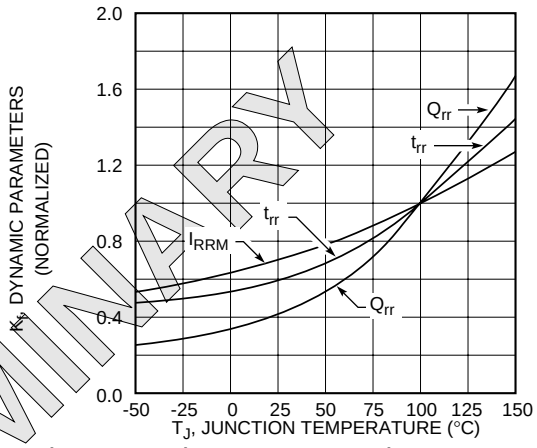


Figure 4, Dynamic Parameters vs Junction Temperature

PRELIMINARY

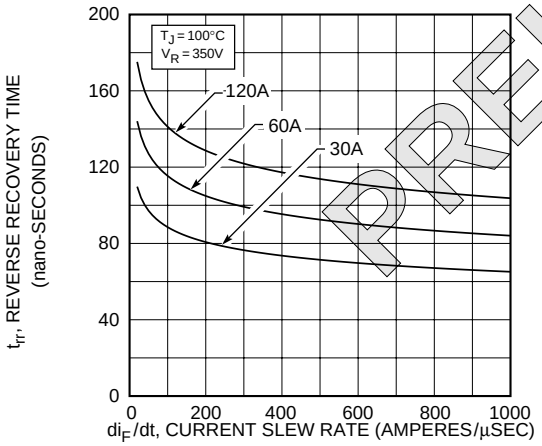


Figure 5, Reverse Recovery Time vs Current Slew Rate

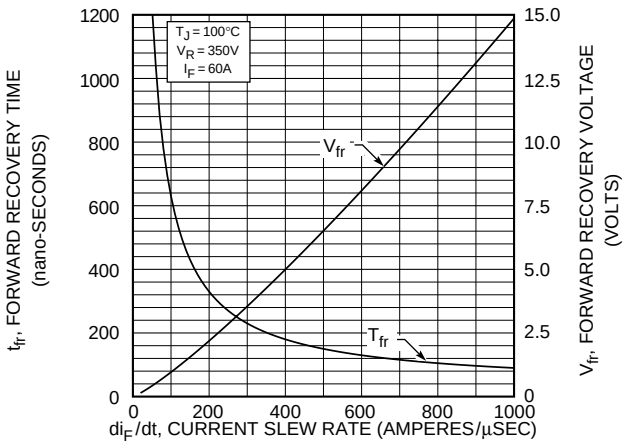


Figure 6, Forward Recovery Voltage/Time vs Current Slew Rate

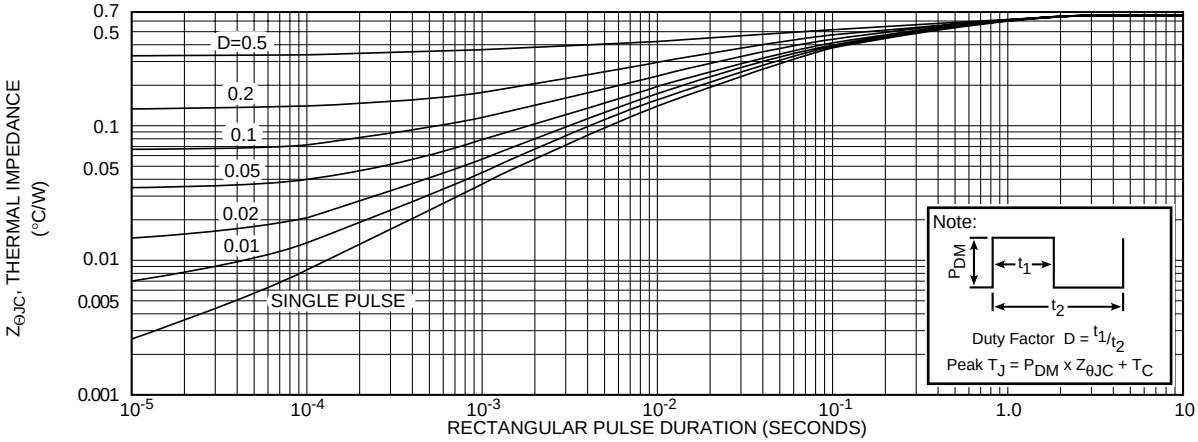


Figure 7, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

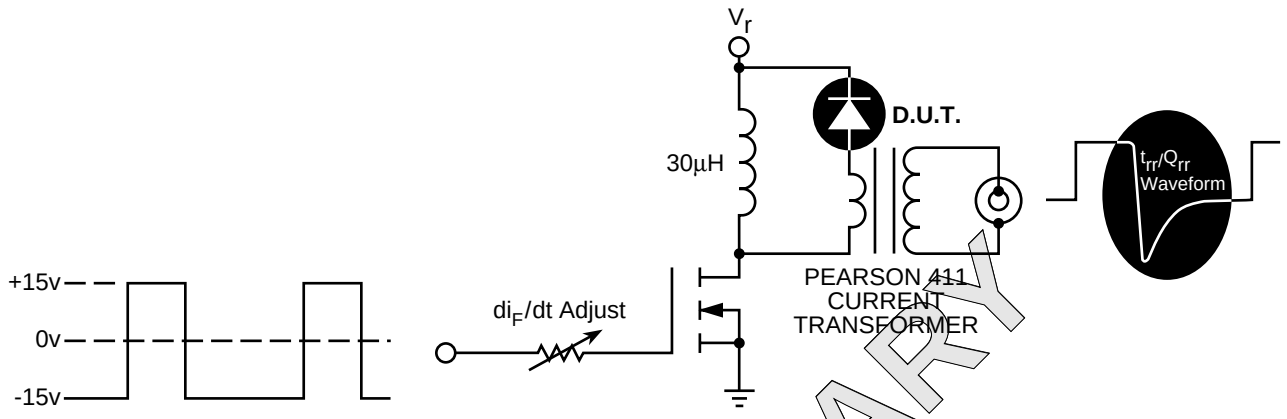


Figure 25, Diode Reverse Recovery Test Circuit and Waveforms

PRELIMINARY

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}.

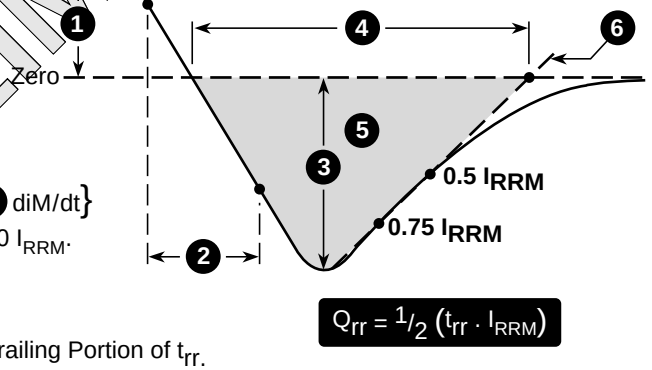
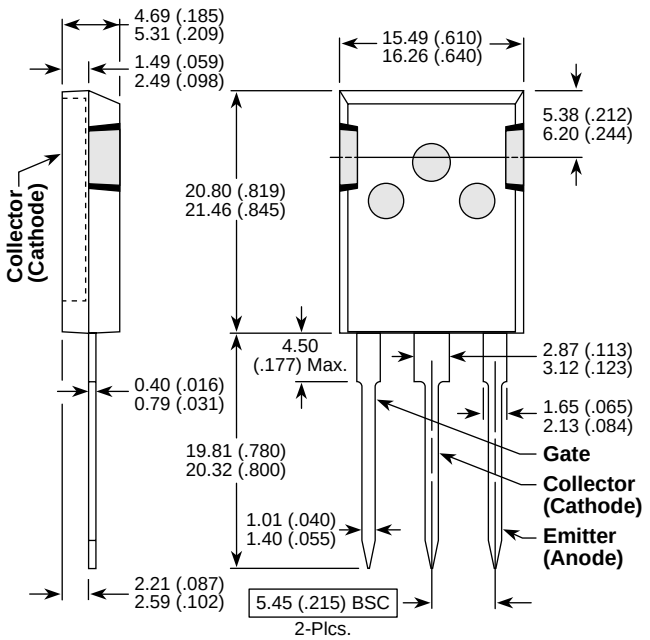


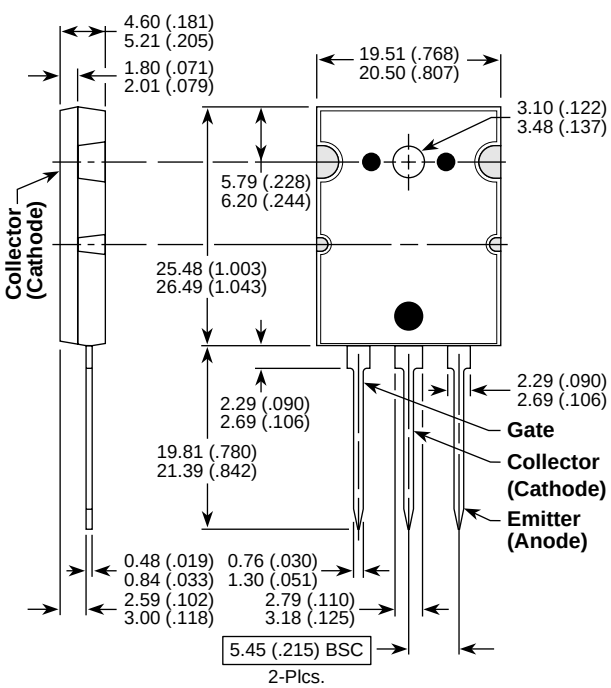
Figure 8, Diode Reverse Recovery Waveform and Definitions

T-MAX™ Package Outline



Dimensions in Millimeters and (Inches)

TO-264 Package Outline



Dimensions in Millimeters and (Inches)