

APT30GF60BNU1 600V 30A

POWER MOS IV[®] IGBT

N - CHANNEL ENHANCEMENT MODE HIGH VOLTAGE POWER INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST PARALLEL DIODE

MAXIMUM RATINGS

All Ratings: $T_C = 25^\circ\text{C}$ unless otherwise specified.

Symbol	Parameter	APT30GF60BNU1	UNIT
V_{CES}	Collector-Emitter Voltage	600	Volts
V_{GE}	Gate-Emitter Voltage	± 20	
I_{C1}^*	Continuous Collector Current	30	Amps
I_{C2}	Continuous Collector Current @ $T_C = 90^\circ\text{C}$	20	
I_{CM}	Pulsed Collector Current ^①	60	
I_{LM}	Clamped Inductive Load Current @ $T_J = +125^\circ\text{C}$ ^②	40	
P_D	Total Power Dissipation	147	Watts
T_J, T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	$^\circ\text{C}$
T_L	Max. Lead Temp. for Soldering: 0.063" from Case for 10 Sec.	300	

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
BV_{CES}	Collector-Emitter Breakdown Voltage ($V_{GE} = 0V, I_C = 1.0mA$)	600			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ($V_{CE} = V_{GE}, I_C = 1.0mA$)	3		6	
$V_{CE(ON)}$	Collector-Emitter On Voltage ($V_{GE} = 15V, I_C = I_{C2}$)		2.5	3	
I_{CES}	Collector Cut-off Current ($V_{CE} = 0.8 V_{CES}, V_{GE} = 0V$)			500	μA
	Collector Cut-off Current ($V_{CE} = 0.8 V_{CES}, V_{GE} = 0V, T_C = 125^\circ\text{C}$)			1.0	mA
I_{GES}	Gate-Emitter Leakage Current ($V_{GE} = \pm 20V, V_{CE} = 0V$)			± 100	nA
$V_{GE}/\Delta T_J$	Gate-Emitter Threshold Voltage Temperature Coefficient		-7.2		mV/ $^\circ\text{C}$
gfe	Forward Transconductance ($V_{CE} = 10V, I_C = I_{C2}$)		10.5		S



CAUTION: These Devices are Sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.

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APT3010

052-6105 Rev A

DYNAMIC CHARACTERISTICS

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Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C _{ies}	Input Capacitance	Capacitance V _{GE} = 0V V _{CE} = 10V f = 1 MHz		1200	1400	pF
C _{oes}	Output Capacitance			400	600	
C _{res}	Reverse Transfer Capacitance			80	130	
Q _g	Total Gate Charge ③	Gate Charge V _{GE} = 10V V _{CC} = 0.5 V _{CES} I _C = I _{C1}		45	65	nC
Q _{ge}	Gate-Emitter Charge			9	14	
Q _{gc}	Gate-Collector ("Miller") Charge			30	45	
t _{d(on)}	Turn-on Delay Time	Resistive Switching (25°C) V _{GE} = 15V V _{CC} = 0.5 V _{CES} I _C = I _{C2} R _G = 33Ω**		25	50	ns
t _r	Rise Time			90	180	
t _{d(off)}	Turn-off Delay Time			200	300	
t _f	Fall Time			320	600	
t _{d(on)}	Turn-on Delay Time	Inductive Switching (125°C) V _{CLAMP(Peak)} = 0.8V _{CES} V _{GE} = 15V I _C = I _{C2} R _G = 33Ω** T _J = +125°C		40	80	ns
t _r	Rise Time			60	150	
t _{d(off)}	Turn-off Delay Time			400	600	
t _f	Fall Time			500	1000	
E _{on}	Turn-on Switching Energy			1.6	3.2	mJ
E _{off}	Turn-off Switching Energy			2.7	5.4	
E _{ts}	Total Switching Losses			4.3	8.6	
t _{d(on)}	Turn-on Delay Time	Inductive Switching (25°C) V _{CLAMP(Peak)} = 0.8V _{CES} V _{GE} = 15V I _C = I _{C2} R _G = 33Ω** T _J = +25°C		40	80	ns
t _r	Rise Time			40	80	
t _{d(off)}	Turn-off Delay Time			300	600	
t _f	Fall Time			200	400	
E _{ts}	Total Switching Losses			1.8	3.6	mJ
L _E	Internal Emitter Inductance Measured 5mm/0.197in. From Package			5		nH

THERMAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case			0.85	°C/W
$R_{\theta JA}$	Junction to Ambient			40	
Torque	Mounting Torque using a 6-32 or 3mm Binding Head Machine Screw.			10	lb•in

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

② $V_{CLAMP} = 0.8V_{CES}$ Volts, $R_G = 2\Omega$.

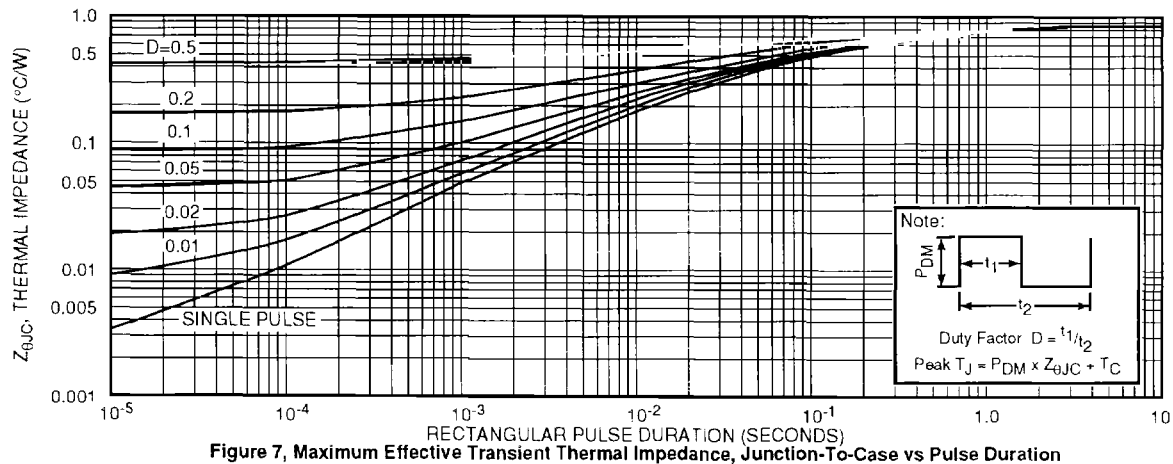
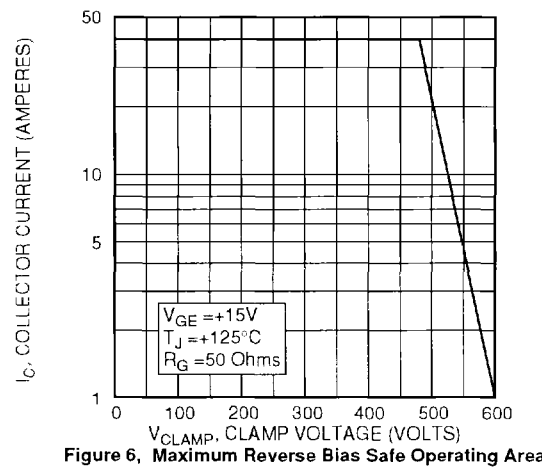
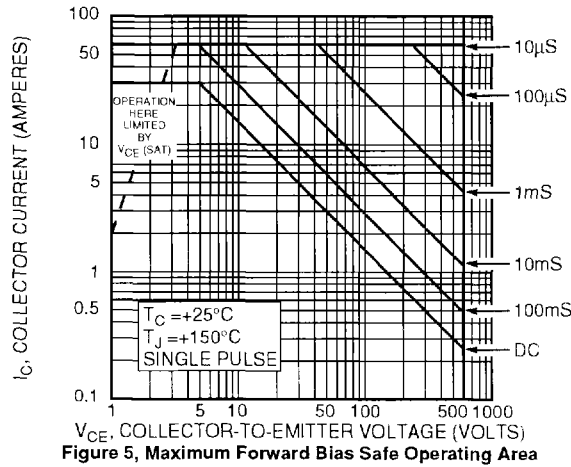
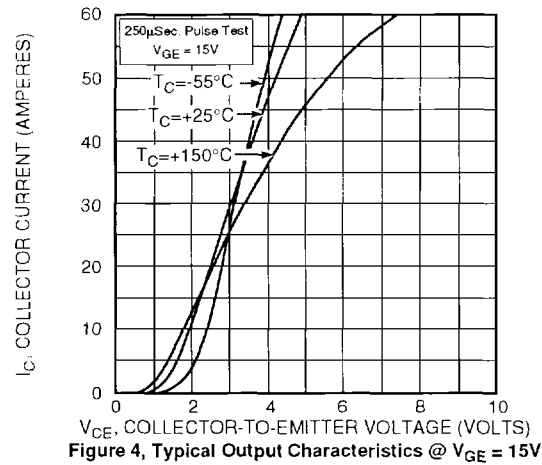
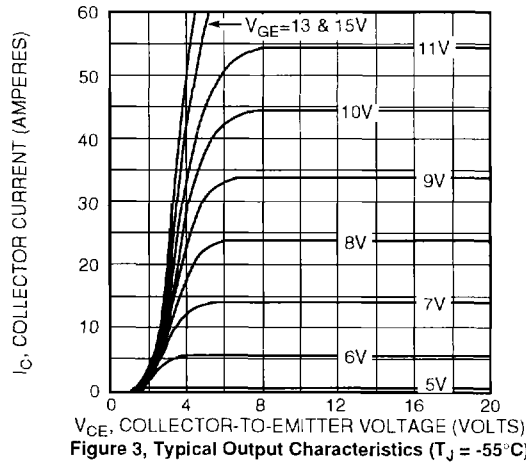
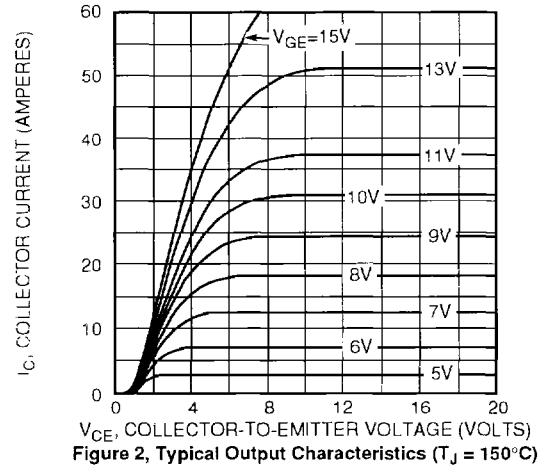
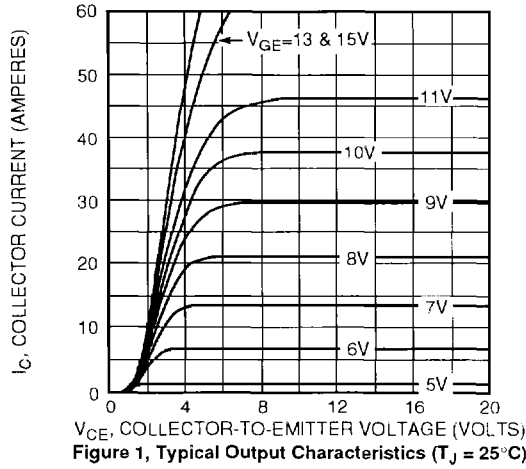
③ See MIL-STD-750 Method 3471

* This product when used in very fast switching circuits (turn-off $dV/dt > 15$ volts per ns) and under operating conditions of $T_c = +150^\circ C$ and $I_c > I_{C1}$ will latch in a thyristor mode of operation. When device latches, it must be commutated with minimum energy to prevent damage.

** R_G selected to give $240A/\mu S$ dI/dt at $+125^\circ C$ inductive switching (turn on).

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

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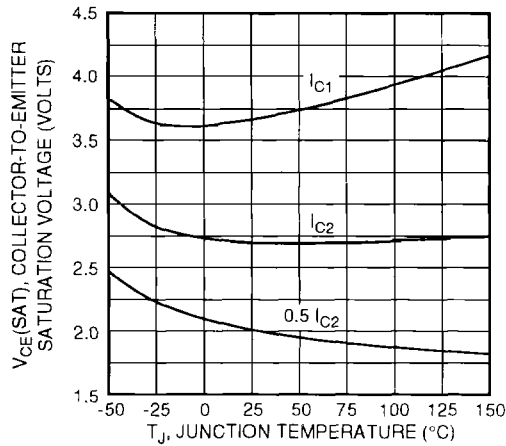


Figure 8, Typical $V_{CE(SAT)}$ Voltage vs Junction Temperature

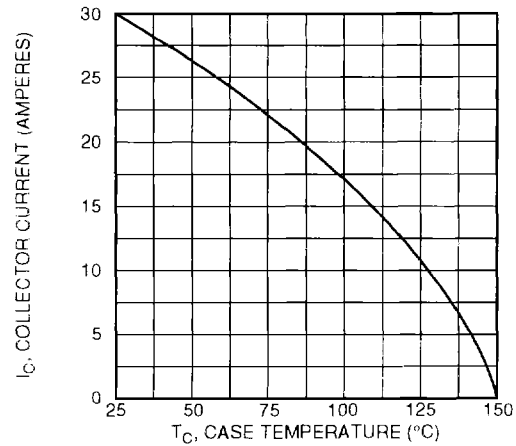


Figure 9, Maximum Collector Current vs Case Temperature

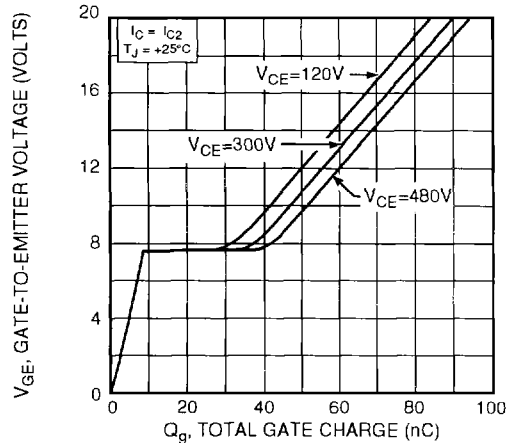


Figure 10, Gate Charges vs Gate-To-Emitter Voltage

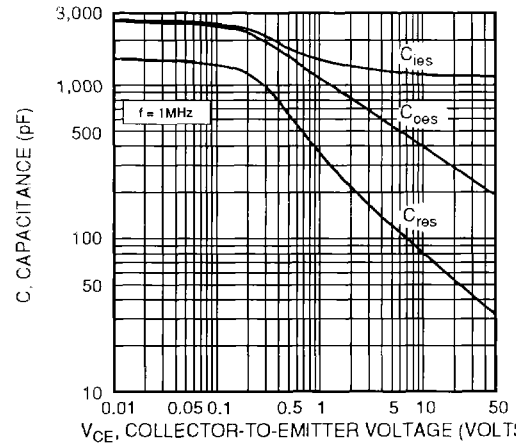


Figure 11, Typical Capacitance vs Collector-To-Emitter Voltage

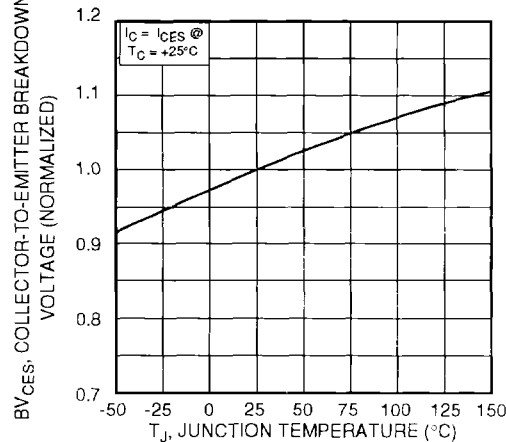


Figure 12, Breakdown Voltage vs Junction Temperature

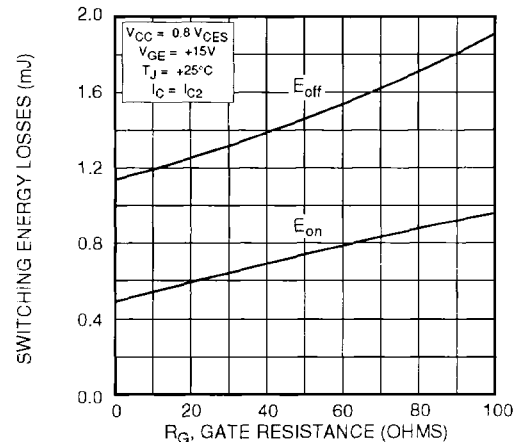


Figure 13, Typical Switching Energy Losses vs Gate Resistance

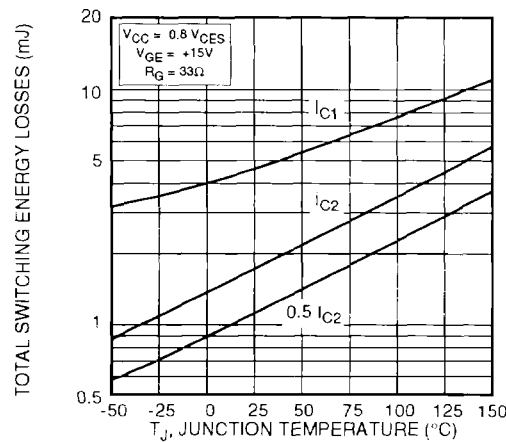


Figure 14, Typical Switching Energy Losses vs. Junction Temperature

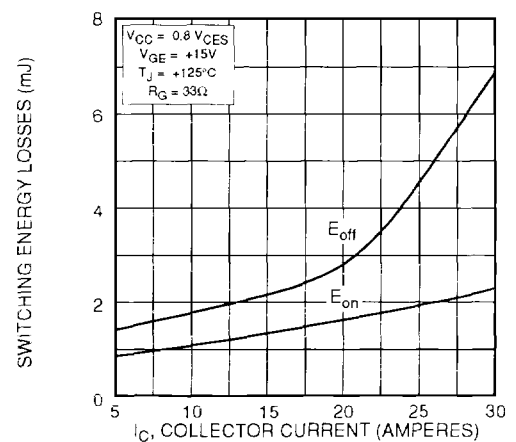


Figure 15, Typical Switching Energy Losses vs Collector Current

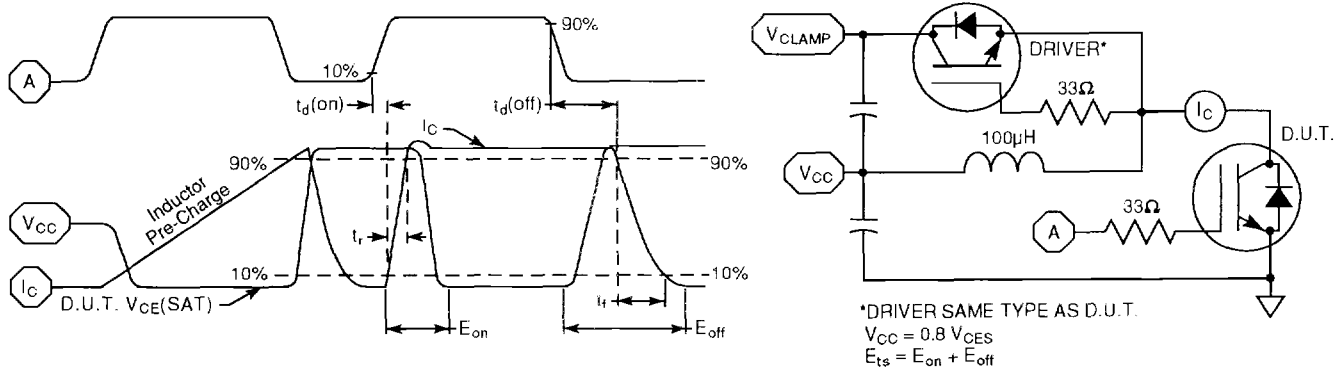


Figure 16, Switching Loss Test Circuit and Waveforms

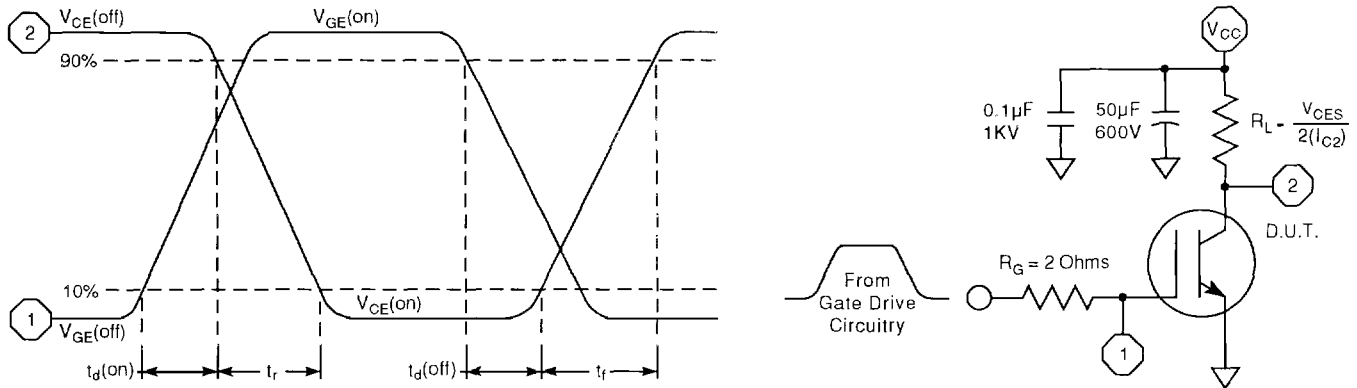


Figure 17, Resistive Switching Time Test Circuit and Waveforms

MAXIMUM RATINGS (UltraFast Recovery Diode)

All Ratings: $T_C = 25^\circ\text{C}$ unless otherwise specified.

Symbol	Characteristic / Test Conditions	APT30GF60BNU1	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 ($T_C = 85^\circ\text{C}$, Duty Cycle = 0.5)	30	Amps
$I_F(RMS)$	RMS Forward Current	70	
I_{FSM}	Non-Repetitive Forward Surge Current ($T_J = 45^\circ\text{C}$, 8.3ms)	320	
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to 150	$^\circ\text{C}$
T_L	Lead Temperature: 0.063" from Case for 10 Sec.	300	

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
V_F	Maximum Forward Voltage	$I_F = 30A$		1.6	Volts
		$I_F = 60A$		1.5	
		$I_F = 30A, T_J = 150^\circ C$		1.4	

DYNAMIC CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
t_{rr1}	Reverse Recovery Time, $I_F = 1.0A, di_F/dt = -15A/\mu S, V_R = 30V, T_J = 25^\circ C$		50	65	nS
t_{rr2}	Reverse Recovery Time	$T_J = 25^\circ C$		50	
t_{rr3}	$I_F = 30A, di_F/dt = -240A/\mu S, V_R = 350V$	$T_J = 100^\circ C$		80	
t_{fr1}	Forward Recovery Time	$T_J = 25^\circ C$		155	
t_{fr2}	$I_F = 30A, di_F/dt = 240A/\mu S, V_R = 350V$	$T_J = 100^\circ C$		155	
I_{RRM1}	Reverse Recovery Current	$T_J = 25^\circ C$		4	Amps
I_{RRM2}	$I_F = 30A, di_F/dt = -240A/\mu S, V_R = 350V$	$T_J = 100^\circ C$		7.5	
Q_{rr1}	Recovery Charge	$T_J = 25^\circ C$		100	nC
Q_{rr2}	$I_F = 30A, di_F/dt = -240A/\mu S, V_R = 350V$	$T_J = 100^\circ C$		300	
V_{fr1}	Forward Recovery Voltage	$T_J = 25^\circ C$		3	Volts
V_{fr2}	$I_F = 30A, di_F/dt = 240A/\mu S, V_R = 350V$	$T_J = 100^\circ C$		3	
diM/dt	Rate of Fall of Recovery Current	$T_J = 25^\circ C$		400	A/ μS
	$I_F = 30A, di_F/dt = -240A/\mu S, V_R = 350V$ (See Figure 10)	$T_J = 100^\circ C$		200	

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction-to-Case Thermal Resistance			0.90	$^\circ C/W$
$R_{\theta JA}$	Junction-to-Ambient Thermal Resistance			40	
W_T	Package Weight		0.22		oz
			6.1		gm
Torque	Maximum Mounting Torque (Screw Type = 6-32 or 3mm Machine)			10	lb•in
				1.1	Nm

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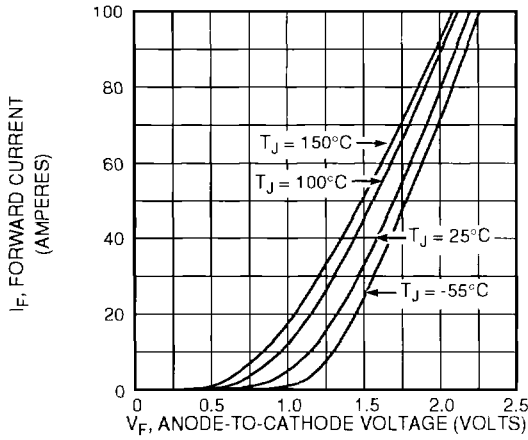


Figure 18, Forward Voltage Drop vs Forward Current

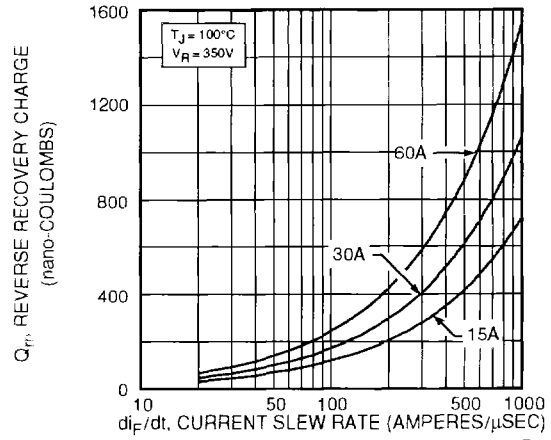


Figure 19, Reverse Recovery Charge vs Current Slew Rate

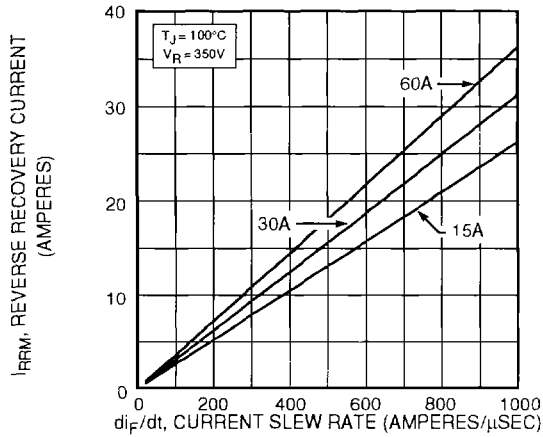


Figure 20, Reverse Recovery Current vs Current Slew Rate

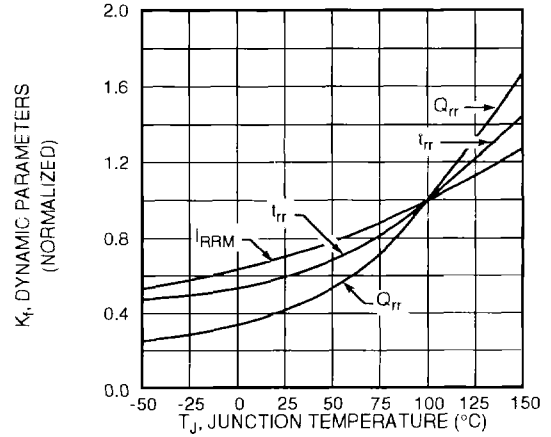


Figure 21, Dynamic Parameters vs Junction Temperature

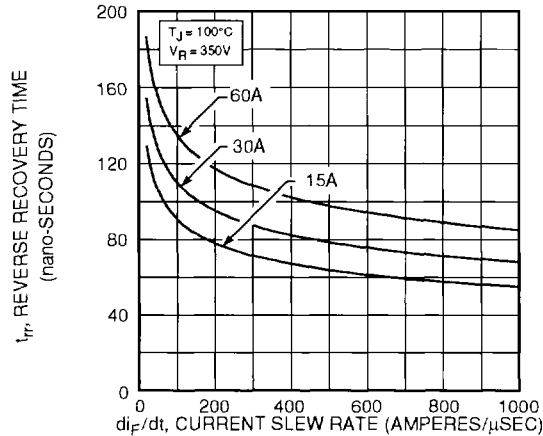


Figure 22, Reverse Recovery Time vs Current Slew Rate

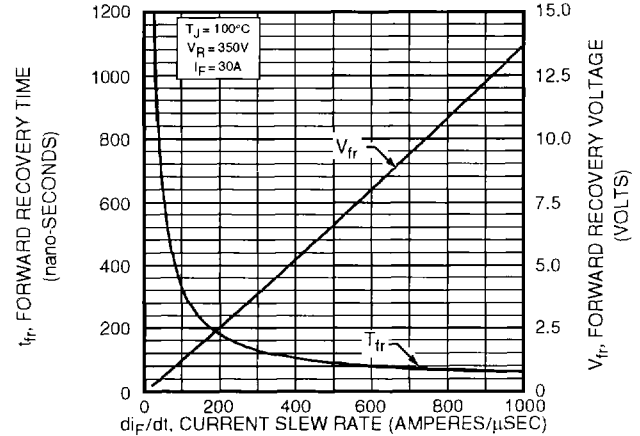


Figure 23, Forward Recovery Voltage/Time vs Current Slew Rate

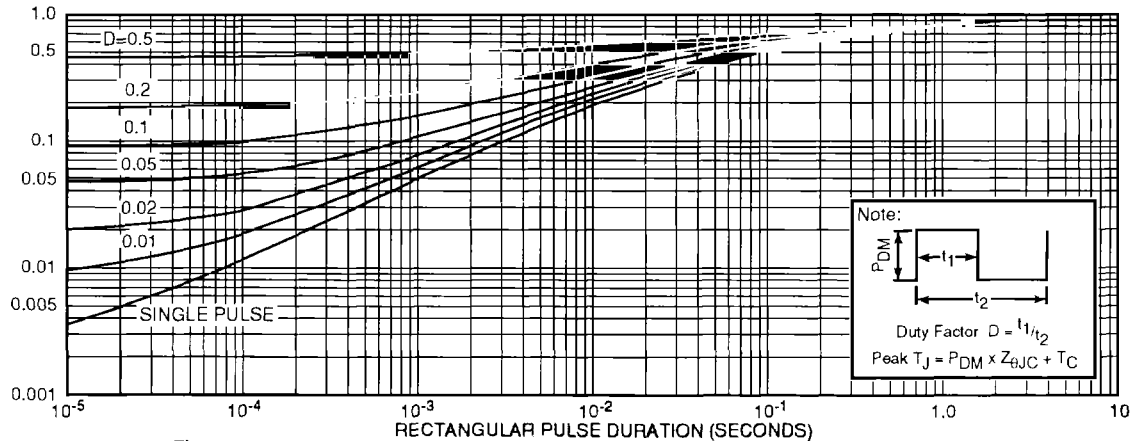


Figure 24, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

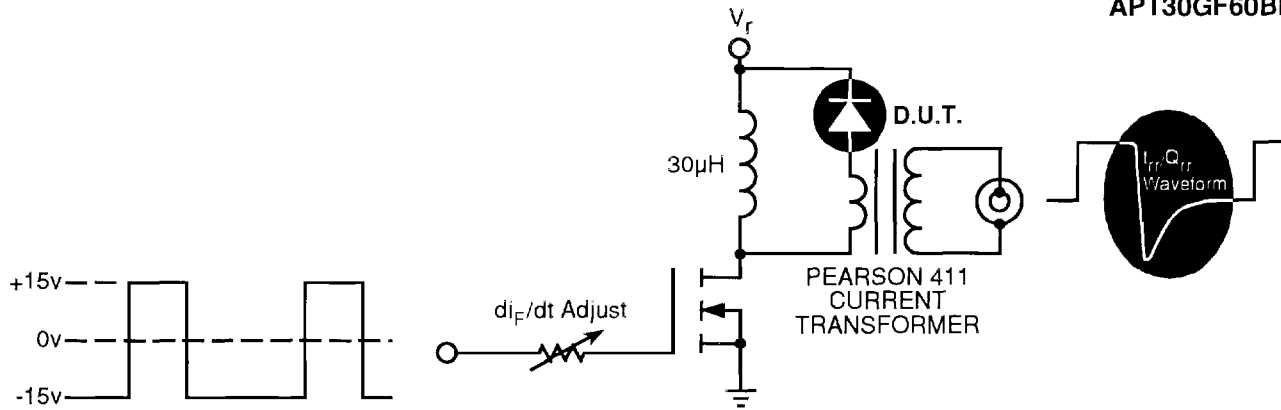


Figure 25, Diode Reverse Recovery Test Circuit and Waveforms

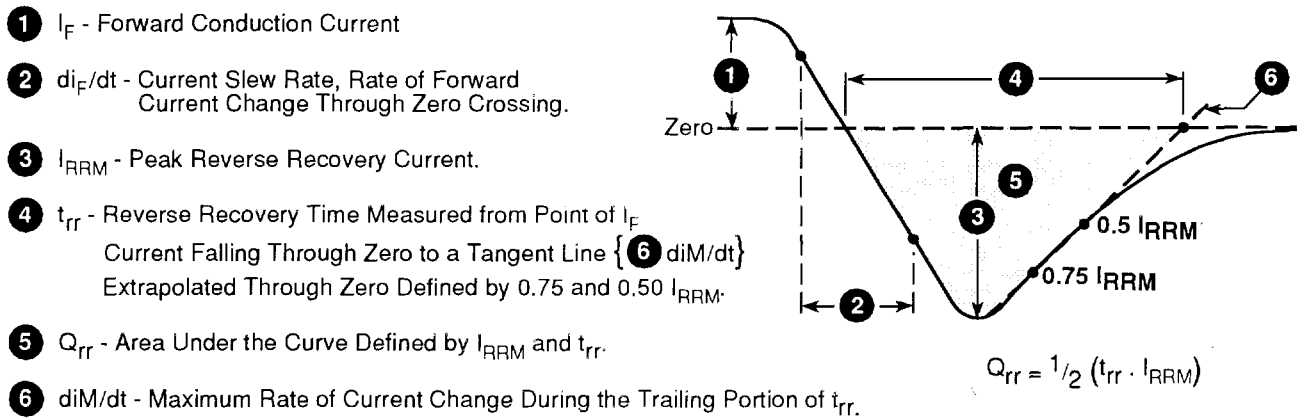
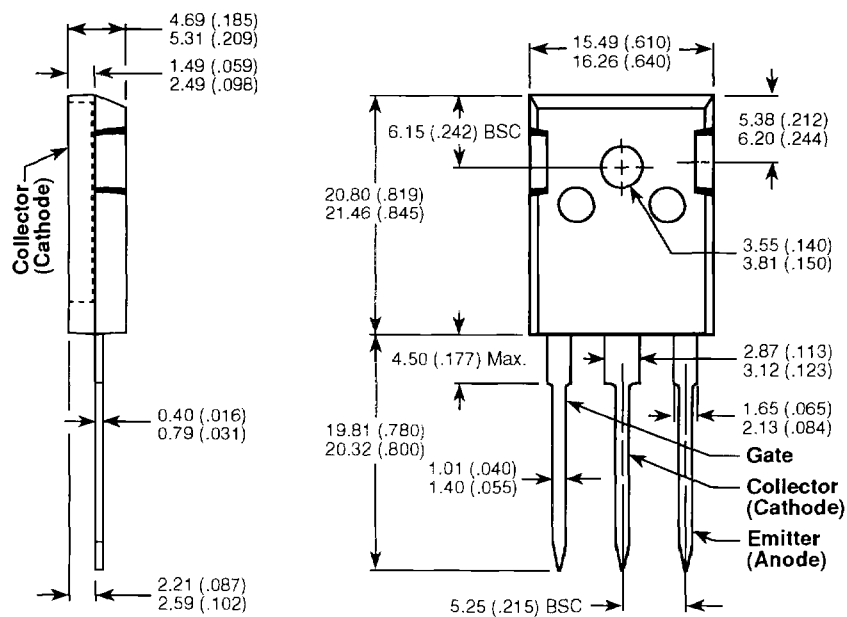


Figure 26, Diode Reverse Recovery Waveform and Definitions

TO-247AD Package Outline



Dimensions in Millimeters and (Inches)