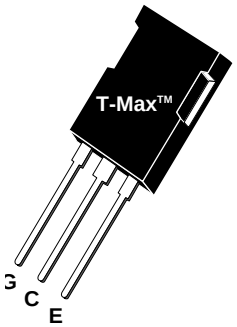
APT35GP120B2D2

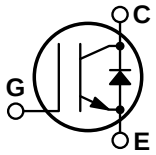
1200V

POWER MOS 7® IGBT



The POWER MOS 7® IGBT is a new generation of high voltage power IGBTs. Using Punch Through Technology this IGBT is ideal for many high frequency, high voltage switching applications and has been optimized for high frequency switchmode power supplies.

- **Low Conduction Loss**
- **Low Gate Charge**
- **Ultrafast Tail Current shutoff**
- **100 kHz operation @ 800V, 12A**
- **50 kHz operation @ 800V, 20A**
- **RBSOA rated**



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

Symbol	Parameter	APT35GP120B2D2	UNIT
V_{CES}	Collector-Emitter Voltage	1200	Volts
V_{GE}	Gate-Emitter Voltage	±20	
V_{GEM}	Gate-Emitter Voltage Transient	±30	
I_{C1}	Continuous Collector Current @ T_C = 25°C	96	Amps
I_{C2}	Continuous Collector Current @ T_C = 110°C	46	
I_{CM}	Pulsed Collector Current ① @ T_C = 25°C	140	
RBSOA	Reverse Bias Safe Operating Area @ T_J = 150°C	140A @ 960V	
P_D	Total Power Dissipation	540	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

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
BV_{CES}	Collector-Emitter Breakdown Voltage (V_{GE} = 0V, I_C = 500µA)	1200			Volts
$V_{GE(TH)}$	Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 1mA, T_j = 25°C)	3	4.5	6	
$V_{CE(ON)}$	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 35A, T_j = 25°C)		2.9	3.9	
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 35A, T_j = 125°C)		2.8		
I_{CES}	Collector Cut-off Current (V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 25°C) ②			500	µA
	Collector Cut-off Current (V_{CE} = V_{CES}, V_{GE} = 0V, T_j = 125°C) ②			3000	
I_{GES}	Gate-Emitter Leakage Current (V_{GE} = ±20V)			±100	nA

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

APT Website - http://www.advancedpower.com

050-7407 Rev B 7-2002

DYNAMIC CHARACTERISTICS

APT35GP120B2D2

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	**Capacitance**		3423		pF
C_{oes}	Output Capacitance	V_{GE} = 0V, V_{CE} = 25V		252		
C_{res}	Reverse Transfer Capacitance	f = 1 MHz		30		
V_{GEP}	Gate-to-Emitter Plateau Voltage	**Gate Charge**		7		V
Q_g	Total Gate Charge ③	V_{GE} = 15V		150		nC
Q_{ge}	Gate-Emitter Charge	V_{CE} = 600V		21		
Q_{gc}	Gate-Collector ("Miller") Charge	I_C = 35A		62		
RBSOA	Reverse Bias Safe Operating Area	T_J = 150°C, R_G = 5Ω, V_{GE} = 15V, L = 100µH, V_{CE} = 960V	140			A
$t_{d(on)}$	Turn-on Delay Time	**Inductive Switching (25°C)**		14		ns
t_r	Current Rise Time	V_{CC} = 800V		25		
$t_{d(off)}$	Turn-off Delay Time	V_{GE} = 15V		99		
t_f	Current Fall Time	I_C = 35A		77		
E_{on1}	Turn-on Switching Energy ④	R_G = 5Ω		1000		µJ
E_{on2}	Turn-on Switching Energy (Diode) ⑤	T_J = +25°C		2262		
E_{off}	Turn-off Switching Energy ⑥			1185		
$t_{d(on)}$	Turn-on Delay Time	**Inductive Switching (125°C)**		14		ns
t_r	Current Rise Time	V_{CC} = 800V		25		
$t_{d(off)}$	Turn-off Delay Time	V_{GE} = 15V		155		
t_f	Current Fall Time	I_C = 35A		128		
E_{on1}	Turn-on Switching Energy ④	R_G = 5Ω		1000		µJ
E_{on2}	Turn-on Switching Energy (Diode) ⑤	T_J = +125°C		4027		
E_{off}	Turn-off Switching Energy ⑥			3016		

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\Theta JC}$	Junction to Case (IGBT)			.23	°C/W
$R_{\Theta JC}$	Junction to Case (DIODE)			.90	
W_T	Package Weight			5.90	gm

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

② For Combi devices, I_{ces} includes both IGBT and FRED leakages

③ See MIL-STD-750 Method 3471.

④ E_{on1} is the clamped inductive turn-on-energy of the IGBT only, without the effect of a commutating diode reverse recovery current adding to the IGBT turn-on loss. (See Figure 24.)

⑤ E_{on2} is the clamped inductive turn-on energy that includes a commutating diode reverse recovery current in the IGBT turn-on switching loss. A Combi device is used for the clamping diode as shown in the E_{on2} test circuit. (See Figures 21, 22.)

⑥ E_{off} is the clamped inductive turn-off energy. (See Figures 21, 23.)

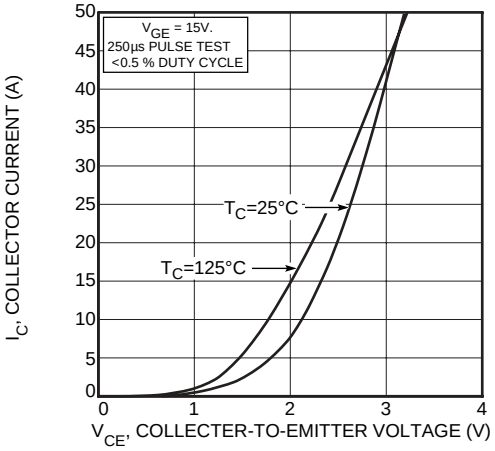


FIGURE 1, Output Characteristics(V_{GE} = 15V)

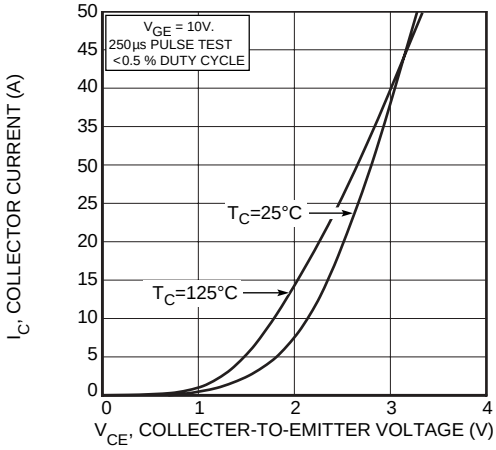


FIGURE 2, Output Characteristics (V_{GE} = 10V)

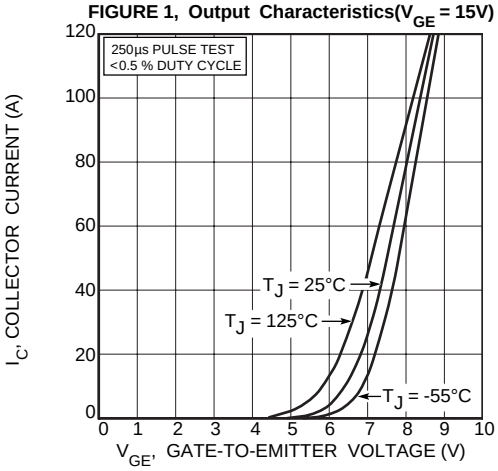


FIGURE 3, Transfer Characteristics

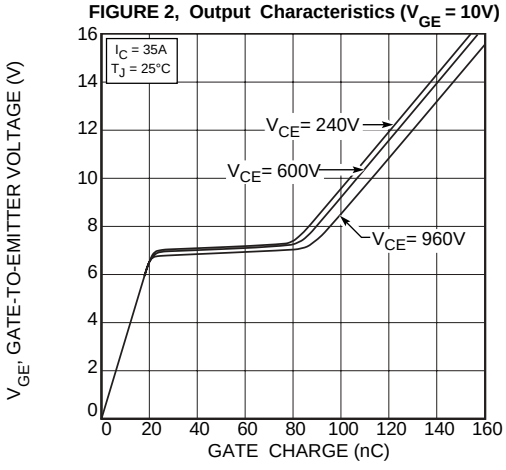


FIGURE 4, Gate Charge

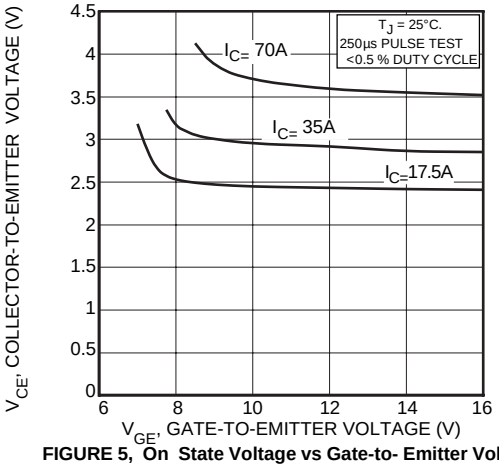


FIGURE 5, On State Voltage vs Gate-to- Emitter Voltage

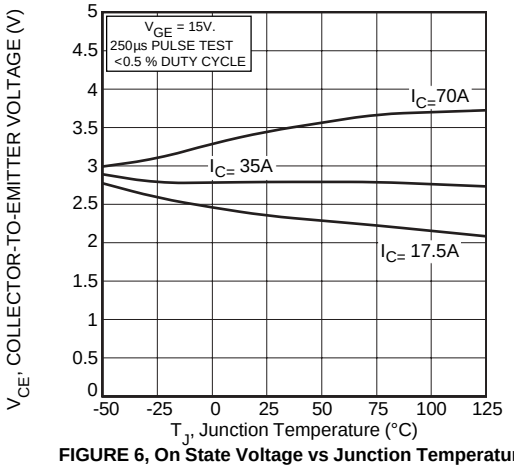


FIGURE 6, On State Voltage vs Junction Temperature

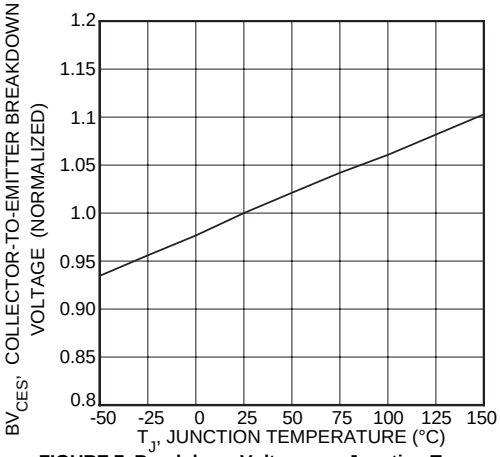


FIGURE 7, Breakdown Voltage vs. Junction Temperature

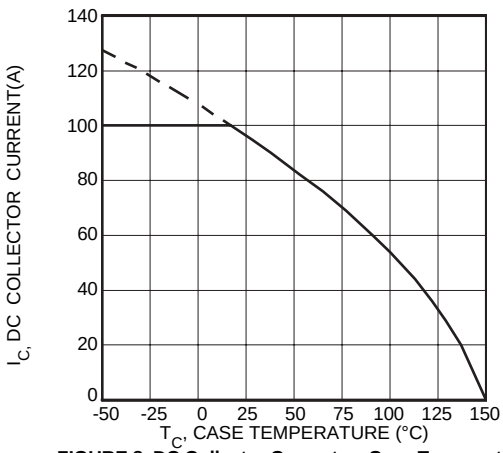


FIGURE 8, DC Collector Current vs Case Temperature

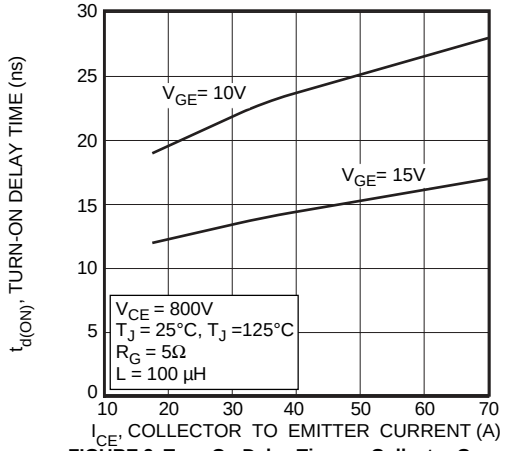


FIGURE 9, Turn-On Delay Time vs Collector Current

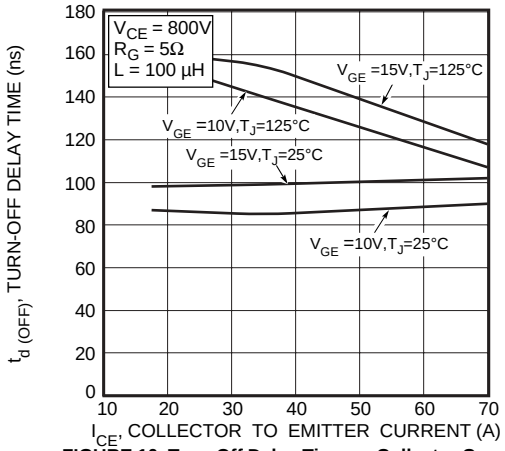


FIGURE 10, Turn-Off Delay Time vs Collector Current

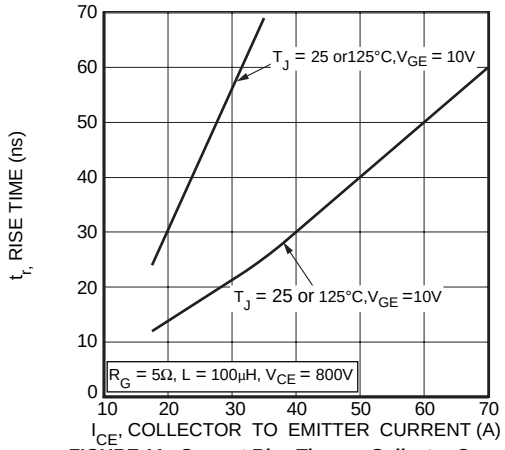


FIGURE 11, Current Rise Time vs Collector Current

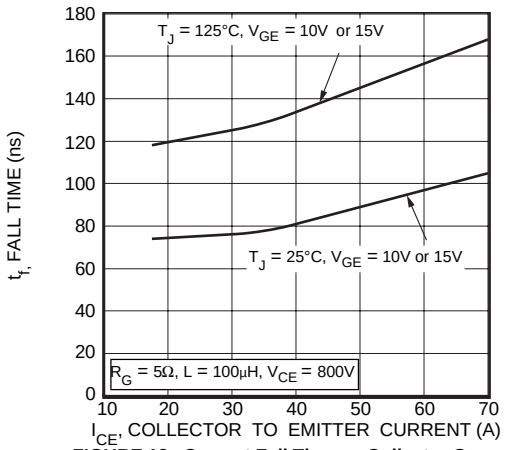


FIGURE 12, Current Fall Time vs Collector Current

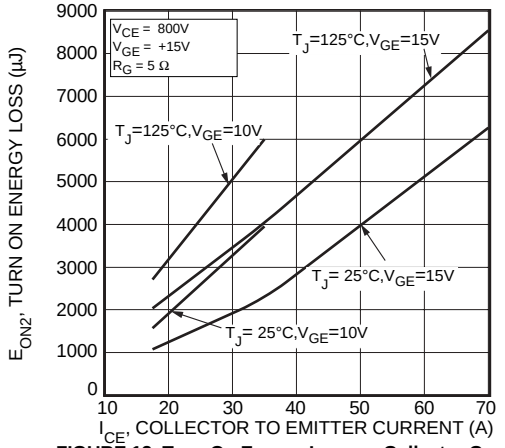


FIGURE 13, Turn-On Energy Loss vs Collector Current

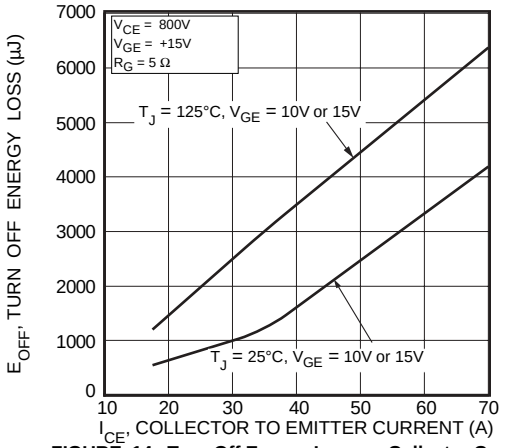


FIGURE 14, Turn Off Energy Loss vs Collector Current

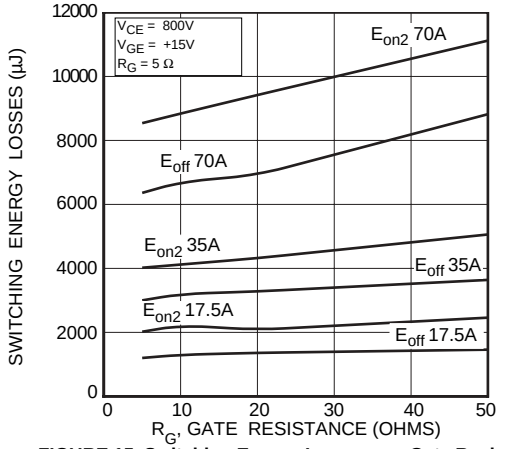


FIGURE 15, Switching Energy Losses vs. Gate Resistance

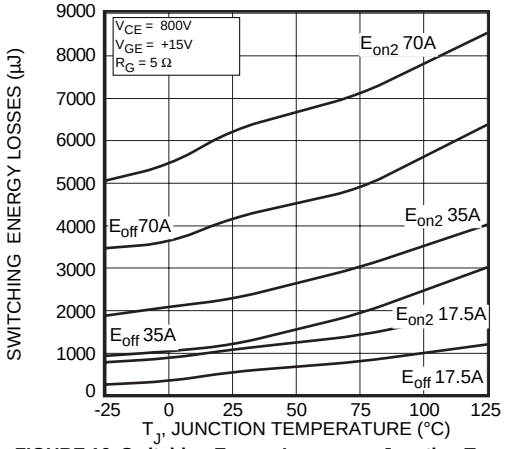


FIGURE 16, Switching Energy Losses vs Junction Temperature

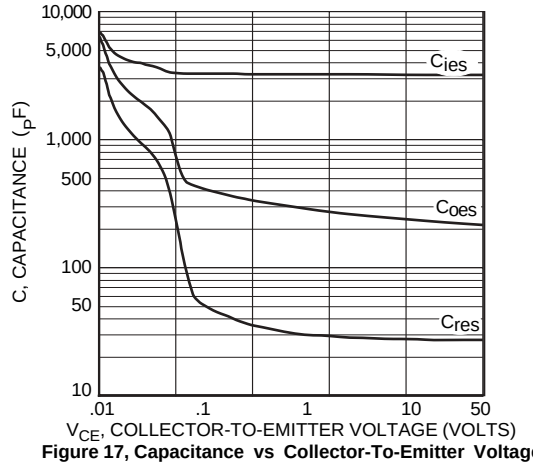


Figure 17, Capacitance vs Collector-To-Emitter Voltage

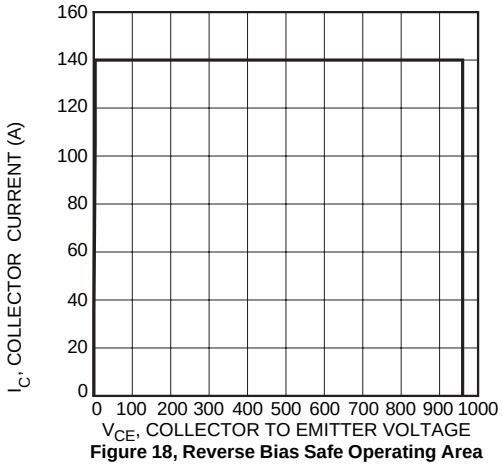


Figure 18, Reverse Bias Safe Operating Area

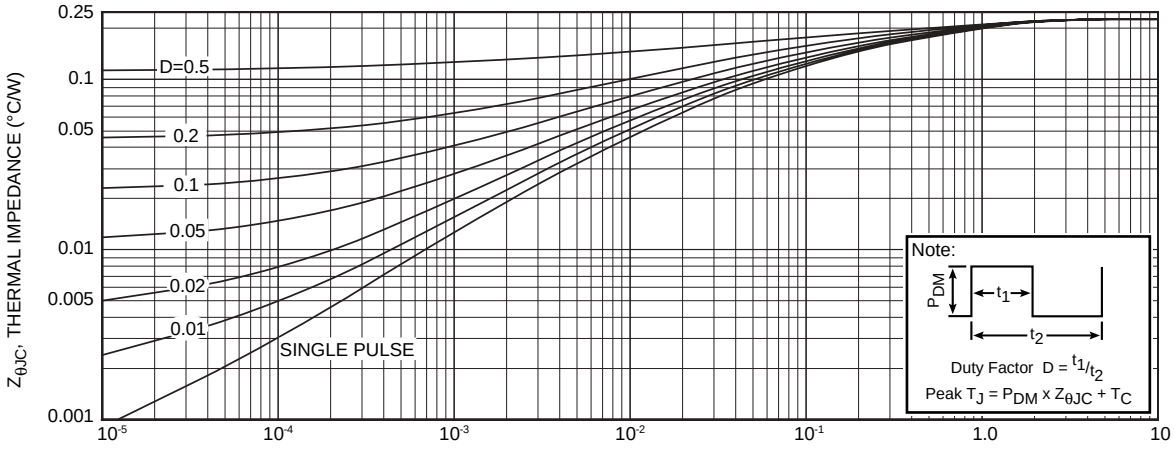


Figure 19, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

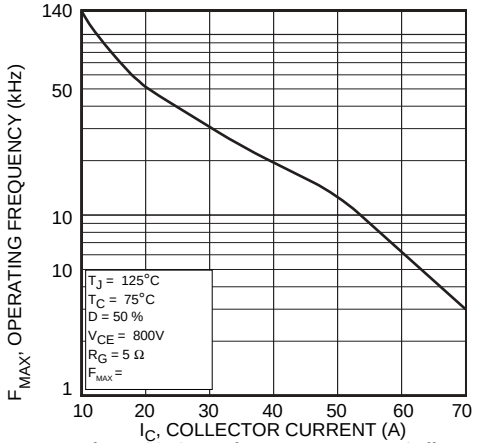


Figure 20, Operating Frequency vs Collector Current

$$F_{max} = \min(f_{max1}, f_{max2})$$

$$f_{max1} = \frac{0.05}{t_{d(on)} + t_r + t_{d(off)} + t_f}$$

$$f_{max2} = \frac{P_{diss} - P_{cond}}{E_{on2} + E_{off}}$$

$$P_{diss} = \frac{T_J - T_C}{R_{\theta JC}}$$

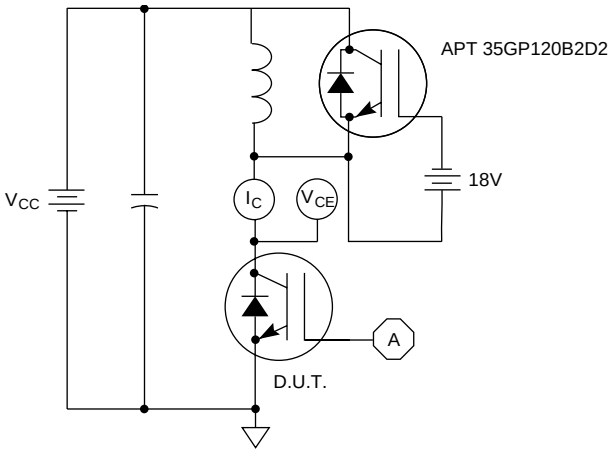


Figure 21, Inductive Switching Test Circuit

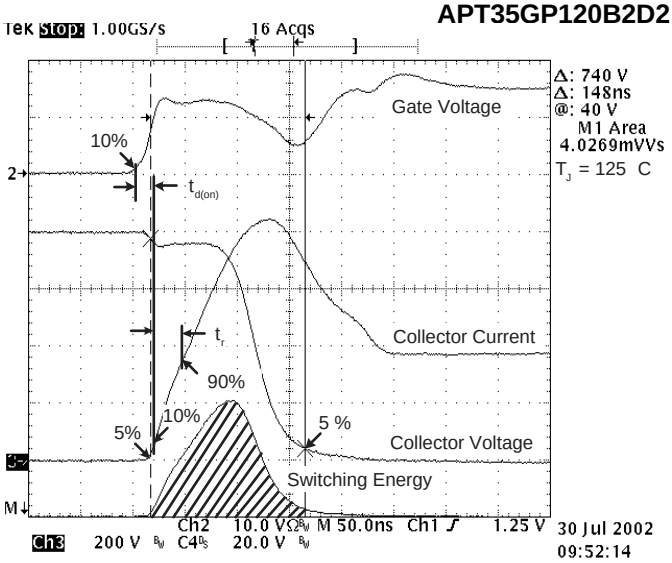


Figure 22, Turn-on Switching Waveforms and Definitions

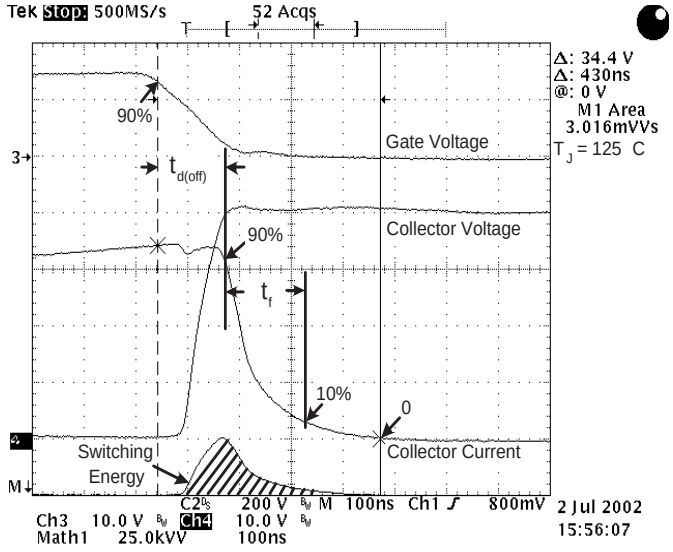


Figure 23, Turn-off Switching Waveforms and Definitions

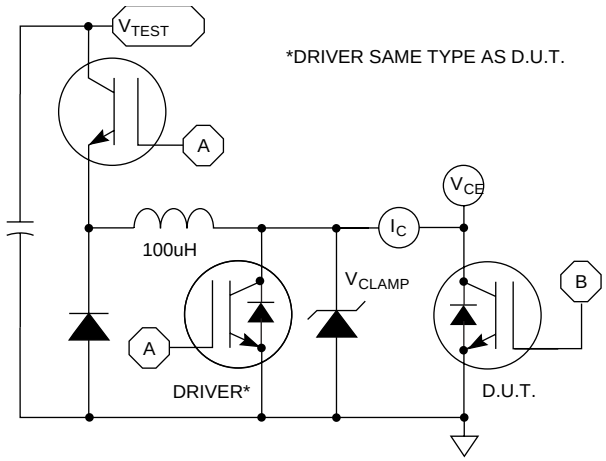


Figure 24, E_{ON1} Test Circuit

ULTRAFAST SOFT RECOVERY ANTI-PARALLEL DIODE

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

Symbol	Characteristic / Test Conditions	APT35GP120B2D2			UNIT
$I_F(AV)$	Maximum Average Forward Current (T_C = 80°C, Duty Cycle = 0.5)		35		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

Symbol	Characteristic / Test Conditions		MIN	TYP	MAX	UNIT
V_F	Maximum Forward Voltage	I_F = 35A			2.5	Volts
		I_F = 60A		2.0		
		I_F = 35A, T_J = 150°C			2.0	

DYNAMIC CHARACTERISTICS

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 = 35A, 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 = 35A, 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 = 35A, 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 = 35A, 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 = 35A, 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 = 35A, di_F/dt = -240A/µs, V_R = 650V (See Figure 33)	T_J = 100°C		160		

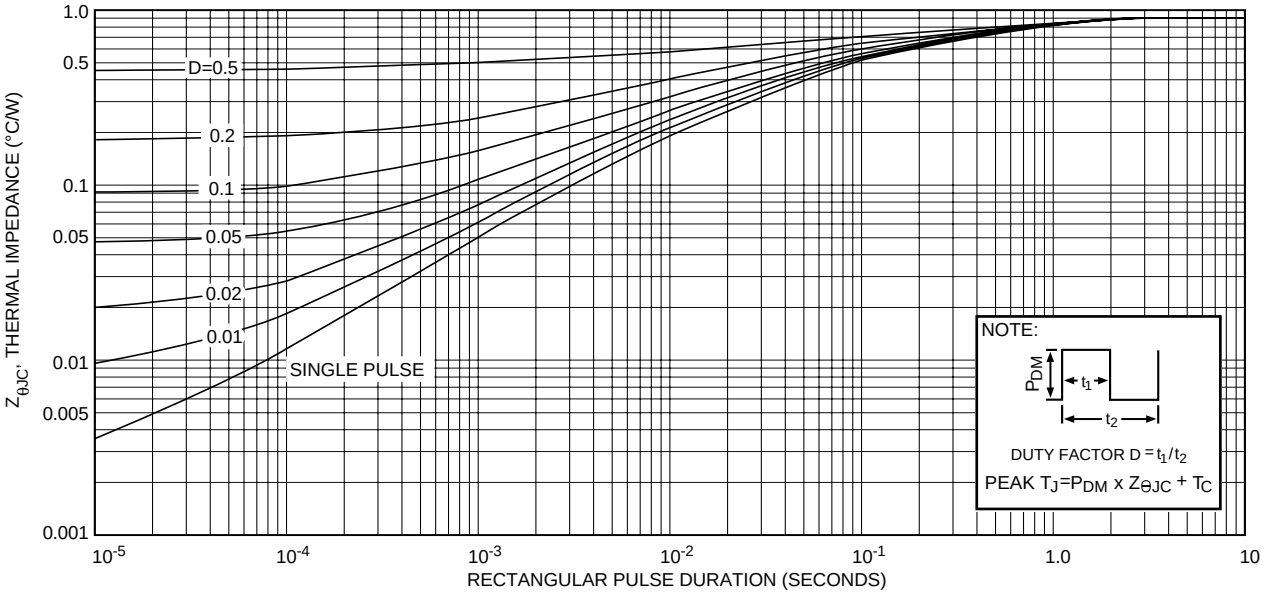


FIGURE 25, MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION

050-7407 Rev B 7-2002

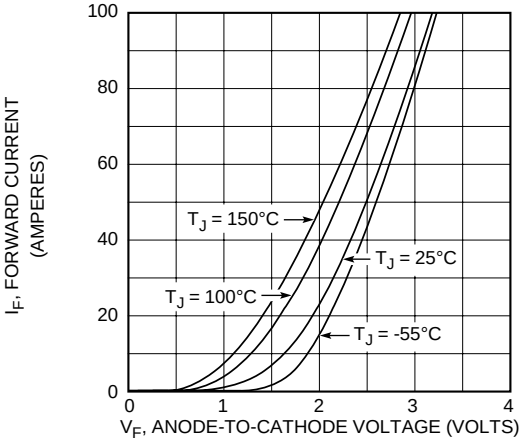


Figure 26, Forward Voltage Drop vs Forward Current

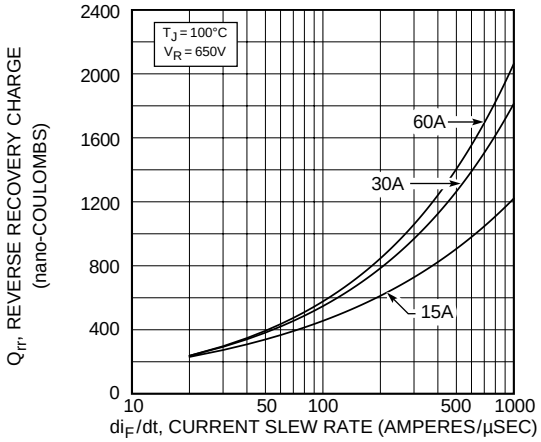


Figure 27, Reverse Recovery Charge vs Current Slew Rate

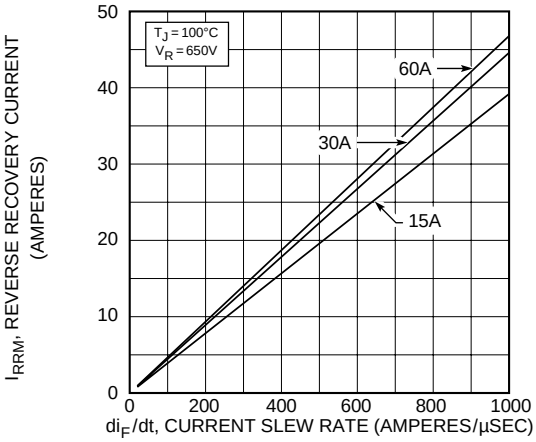


Figure 28, Reverse Recovery Current vs Current Slew Rate

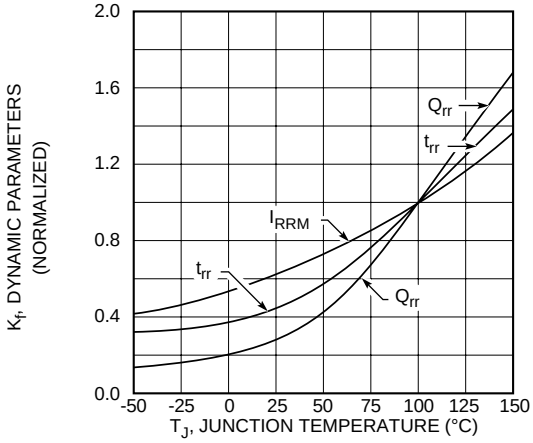


Figure 29, Dynamic Parameters vs Junction Temperature

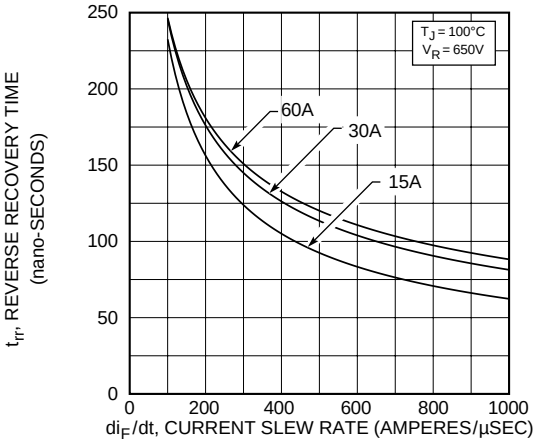


Figure 30, Reverse Recovery Time vs Current Slew Rate

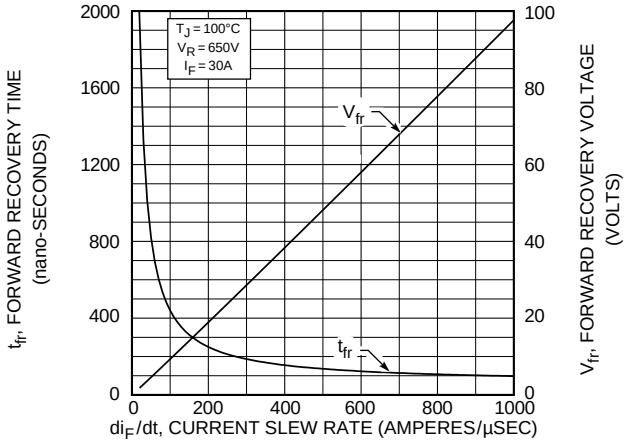


Figure31, Forward Recovery Voltage/Time vs Current Slew Rate

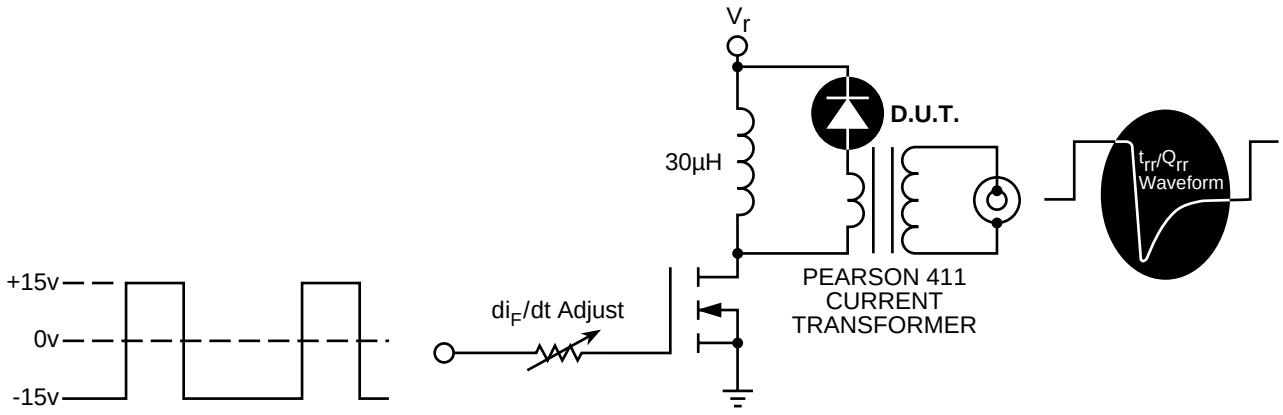


Figure 32, Diode Reverse Recovery Test Circuit and Wave Forms

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}.

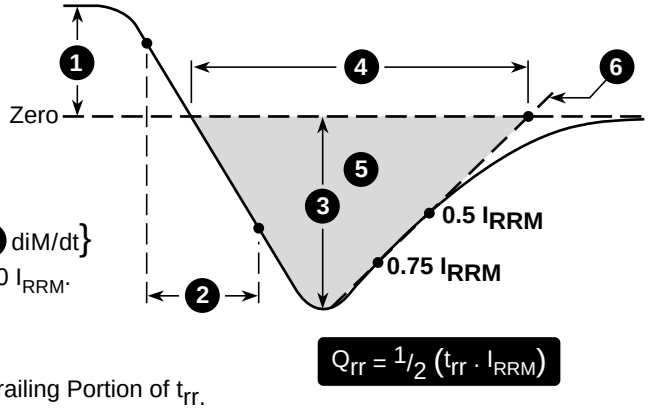
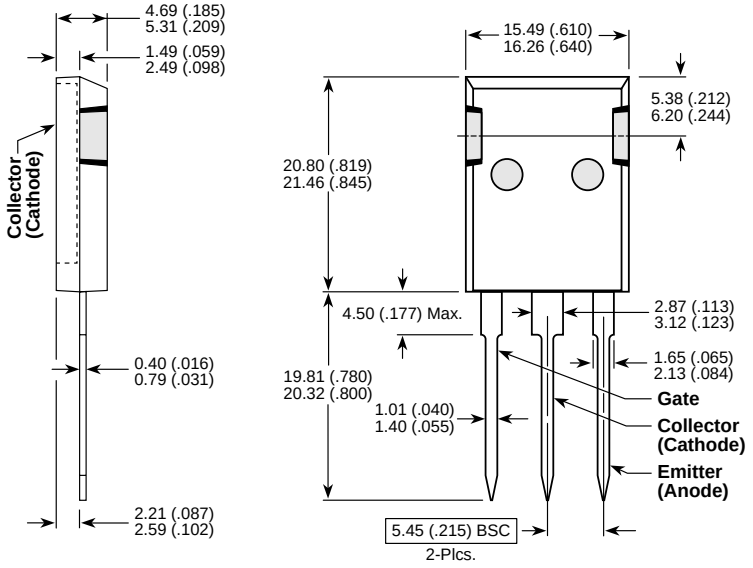


Figure 33, Diode Reverse Recovery Wave Forms and Definitions

T-Max™ (B2) Package Outline



Dimensions in Millimeters and (Inches)

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Microchip:
APT35GP120B2D2G