

**ADVANCED  
POWER  
TECHNOLOGY®**

**APT5012JNU2 500V 43A 0.12Ω**

## POWER MOS IV®

**Single Die MOSFET and UltraFast  
Diode For "PFC Boost Circuits"**

### N-CHANNEL ENHANCEMENT MODE HIGH VOLTAGE POWER MOSFETS

#### MAXIMUM RATINGS

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

Symbol	Parameter	APT 5012JNU2	UNIT
$V_{DS}$	Drain-Source Voltage	500	Volts
$I_D$	Continuous Drain Current @ $T_C = 25^\circ\text{C}$	43	Amps
$I_{DM}, I_{LM}$	Pulsed Drain Current ① and Inductive Current Clamped	172	
$V_{GS}$	Gate-Source Voltage	$\pm 30$	Volts
$P_D$	Total Power Dissipation @ $T_C = 25^\circ\text{C}$	520	Watts
	Linear Derating Factor	4.16	W/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Junction 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 / Part Number	MIN	TYP	MAX	UNIT
$BV_{DS}$	Drain-Source Breakdown Voltage ( $V_{GS} = 0V, I_D = 250 \mu\text{A}$ )	APT5012JNU2	500		Volts
$I_{D(ON)}$	On State Drain Current ② ( $V_{DS} > I_{D(ON)} \times R_{DS(ON)}$ Max, $V_{GS} = 10V$ )	APT5012JNU2	43		Amps
$R_{DS(ON)}$	Drain-Source On-State Resistance ② ( $V_{GS} = 10V, 0.5 I_D$ [Cont.])	APT5012JNU2		0.12	Ohms
$I_{DSS}$	Zero Gate Voltage Drain Current ( $V_{DS} = V_{DSS}, V_{GS} = 0V$ )			250	$\mu\text{A}$
	Zero Gate Voltage Drain Current ( $V_{DS} = 0.8 V_{DSS}, V_{GS} = 0V, T_C = 125^\circ\text{C}$ )			1000	
$I_{GSS}$	Gate-Source Leakage Current ( $V_{GS} = \pm 30V, V_{DS} = 0V$ )			$\pm 100$	nA
$V_{GS(TH)}$	Gate Threshold Voltage ( $V_{DS} = V_{GS}, I_D = 2.5\text{mA}$ )	2		4	Volts

#### THERMAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case			0.24	$^\circ\text{C/W}$
$R_{\theta CS}$	Case to Sink (Use High Efficiency Thermal Joint Compound and Planer Heat Sink Surface.)		0.06		

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

**USA**

405 S.W. Columbia Street

**EUROPE**

Avenue J.F. Kennedy Bât B4 Parc Cadéra Nord F-33700 Merignac - France

Bend, Oregon 97702-1035

Phone: (541) 382-8028

FAX: (541) 388-0364

Phone: (33) 57 92 15 15

FAX: (33) 56 47 97 61

# DYNAMIC CHARACTERISTICS

APT5012JNU2

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
$C_{iss}$	Input Capacitance	$V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1 \text{ MHz}$		5570	6500	pF
$C_{oss}$	Output Capacitance			1170	1640	
$C_{rss}$	Reverse Transfer Capacitance			440	660	
$Q_g$	Total Gate Charge ③	$V_{GS} = 10V$ $V_{DD} = 0.5 V_{DSS}$ $I_D = I_D [\text{Cont.}] @ 25^\circ\text{C}$		240	370	nC
$Q_{gs}$	Gate-Source Charge			32	48	
$Q_{gd}$	Gate-Drain ("Miller") Charge			116	170	
$t_{d(on)}$	Turn-on Delay Time	$V_{GS} = 15V$ $V_{DD} = 0.5 V_{DSS}$ $I_D = I_D [\text{Cont.}] @ 25^\circ\text{C}$ $R_G = 0.6\Omega$		15	30	ns
$t_r$	Rise Time			25	50	
$t_{d(off)}$	Turn-off Delay Time			48	75	
$t_f$	Fall Time			12	25	

# SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$I_S$	Continuous Source Current (Body Diode)	APT5012JNU2		43	Amps
$I_{SM}$	Pulsed Source Current ① (Body Diode)	APT5012JNU2		172	Amps
$V_{SD}$	Diode Forward Voltage ② ( $V_{GS} = 0V$ , $I_S = -I_D [\text{Cont.}]$ )			1.8	Volts
$t_{rr}$	Reverse Recovery Time ( $I_S = -I_D [\text{Cont.}]$ , $dI_S/dt = 100A/\mu s$ )	210	415	830	ns
$Q_{rr}$	Reverse Recovery Charge ( $I_S = -I_D [\text{Cont.}]$ , $dI_S/dt = 100A/\mu s$ )	4	8.3	16	$\mu C$

# PACKAGE CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$L_D$	Internal Drain Inductance (Measured From Drain Terminal to Center of Die.)		3		nH
$L_S$	Internal Source Inductance (Measured From Source Terminals to Source Bond Pads)		5		
$V_{Isolation}$	RMS Voltage (50-60 Hz Sinusoidal Waveform From Terminals to Mounting Base for 1 Min.)	2500			Volts
$C_{Isolation}$	Drain-to-Mounting Base Capacitance ( $f = 1\text{MHz}$ )		35		pF
Torque	Maximum Torque for Device Mounting Screws and Electrical Terminations.			13	lb•in

① Repetitive Rating: Pulse width limited by maximum junction temperature. See Transient Thermal Impedance Curve. (Fig.1)

② Pulse Test: Pulse width < 380  $\mu s$ , Duty Cycle < 2%

③ See MIL-STD-750 Method 3471

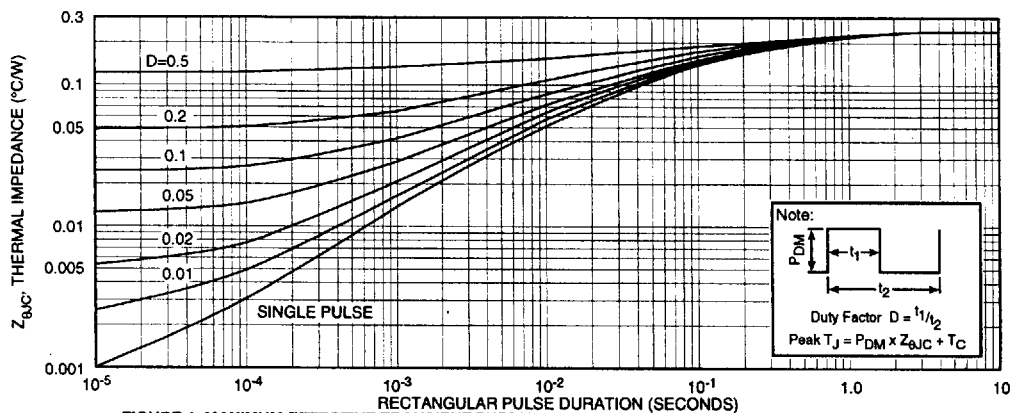


FIGURE 1, MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION

# APT5012JNU2

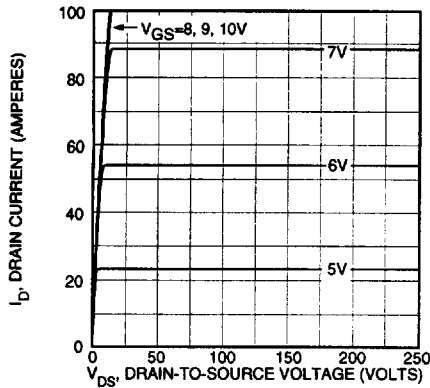


FIGURE 2, TYPICAL OUTPUT CHARACTERISTICS

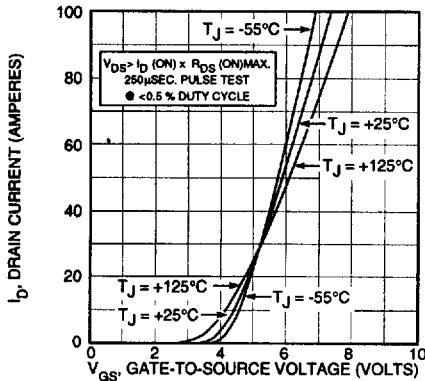


FIGURE 4, TYPICAL TRANSFER CHARACTERISTICS

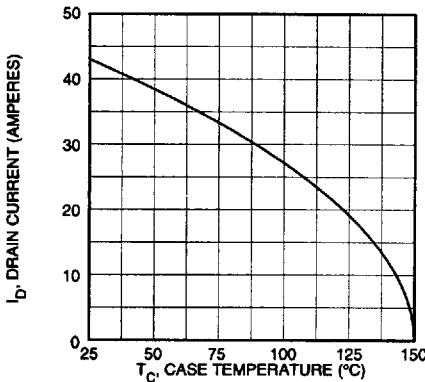


FIGURE 6, MAXIMUM DRAIN CURRENT vs CASE TEMPERATURE

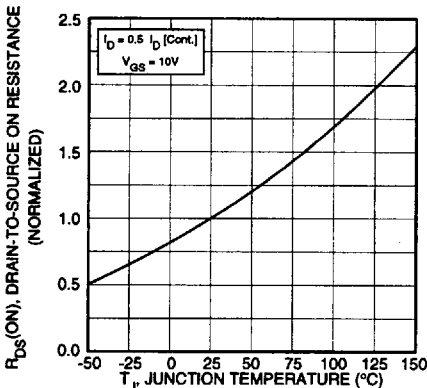


FIGURE 8, ON-RESISTANCE vs. TEMPERATURE

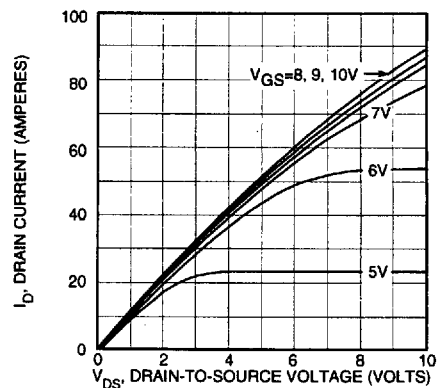


FIGURE 3, TYPICAL OUTPUT CHARACTERISTICS

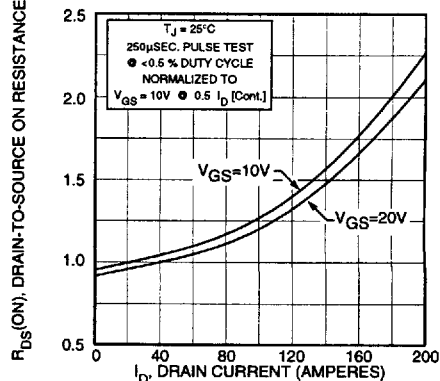


FIGURE 5,  $R_{DS(ON)}$  vs DRAIN CURRENT

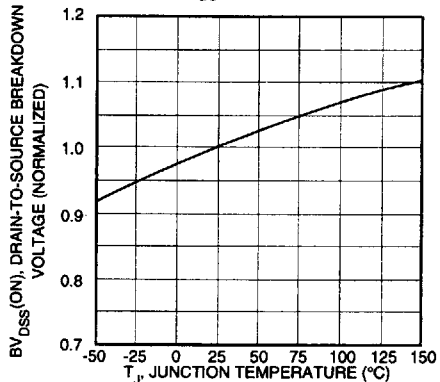


FIGURE 7, BREAKDOWN VOLTAGE vs TEMPERATURE

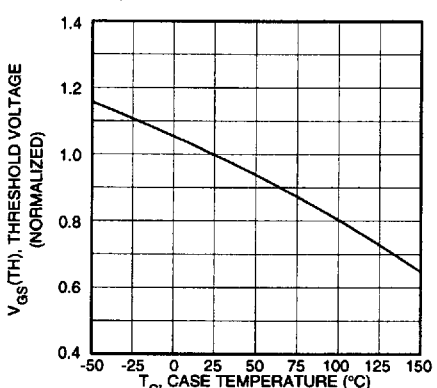


FIGURE 9, THRESHOLD VOLTAGE vs TEMPERATURE

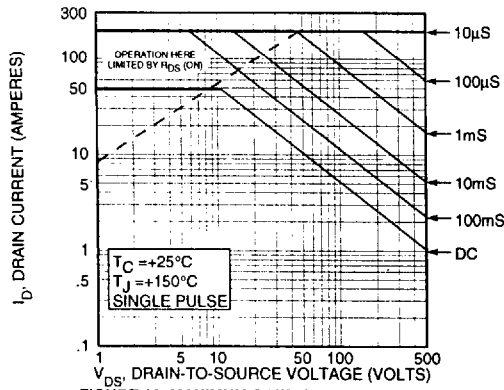


FIGURE 10, MAXIMUM SAFE OPERATING AREA

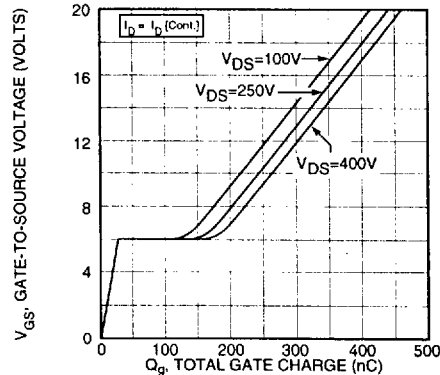


FIGURE 12, GATE CHARGES vs GATE-TO-SOURCE VOLTAGE

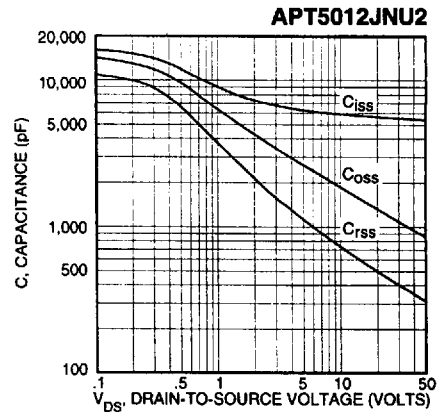


FIGURE 11, TYPICAL CAPACITANCE vs DRAIN-TO-SOURCE VOLTAGE

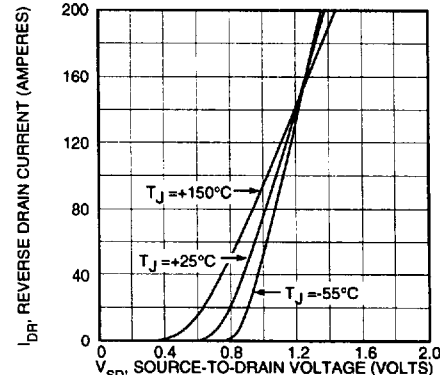


FIGURE 13, TYPICAL SOURCE-DRAIN DIODE FORWARD VOLTAGE

## MAXIMUM RATINGS (UltraFast Recovery Diode)

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

Symbol	Characteristic / Test Conditions	APT5012JNU2	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 ( $T_C = 80^\circ\text{C}$ , Duty Cycle = 0.5)	30	Amps
$I_F(RMS)$	RMS Forward Current	60	
$I_{FSM}$	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	$I_F = 30\text{A}$		1.8	Volts
		$I_F = 60\text{A}$		1.5	
		$I_F = 30\text{A}, T_J = 150^\circ\text{C}$		1.6	
$I_{RM}$	Maximum Reverse Leakage Current	$V_R = V_R \text{ Rated}$		250	$\mu\text{A}$
		$V_R = V_R \text{ Rated}, T_J = 125^\circ\text{C}$		500	
$C_T$	Junction Capacitance, $V_R = 200\text{V}$		40		pF

## 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		50		
$t_{rr3}$	$I_F = 30A$ , $di_F/dt = -240A/\mu S$ , $V_R = 350V$		80		
$t_{fr1}$	Forward Recovery Time		155		
$t_{fr2}$	$I_F = 30A$ , $di_F/dt = 240A/\mu S$ , $V_R = 350V$		155		
$I_{RRM1}$	Reverse Recovery Current		4	10	Amps
$I_{RRM2}$	$I_F = 30A$ , $di_F/dt = -240A/\mu S$ , $V_R = 350V$		7.5	15	
$Q_{rr1}$	Recovery Charge		100		nC
$Q_{rr2}$	$I_F = 30A$ , $di_F/dt = -240A/\mu S$ , $V_R = 350V$		300		
$V_{fr1}$	Forward Recovery Voltage		5		Volts
$V_{fr2}$	$I_F = 30A$ , $di_F/dt = 240A/\mu S$ , $V_R = 350V$		5		
$diM/dt$	Rate of Fall of Recovery Current		400		$A/\mu S$
	$I_F = 30A$ , $di_F/dt = -240A/\mu S$ , $V_R = 350V$ (See Figure 10)		200		

## THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction-to-Case Thermal Resistance			1.50	$^\circ C/W$
$R_{\theta JA}$	Junction-to-Ambient Thermal Resistance			20	
$W_T$	Package Weight		1.06		oz.
			30		gm.

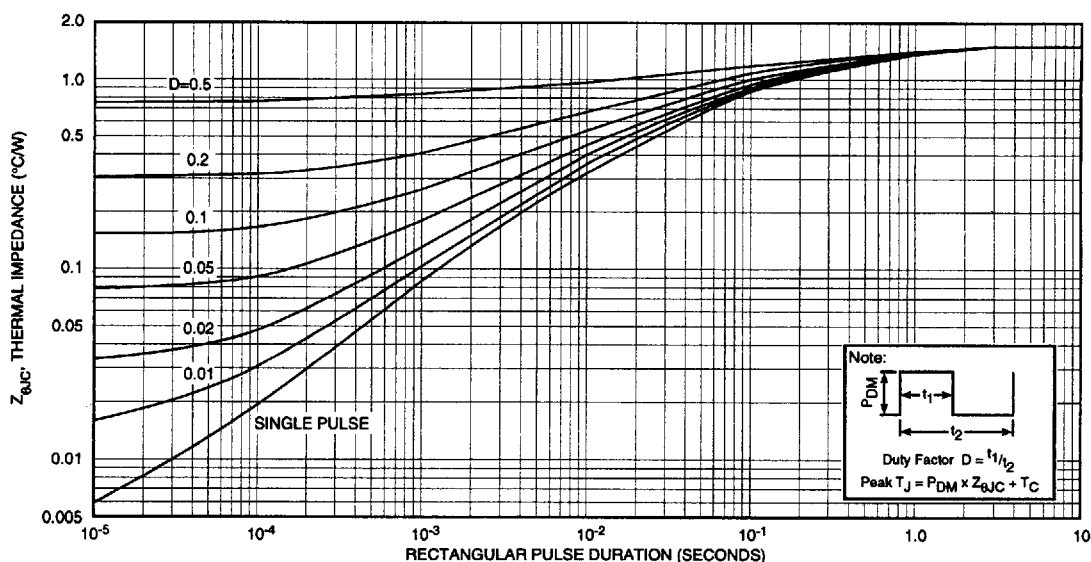


FIGURE 14. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION

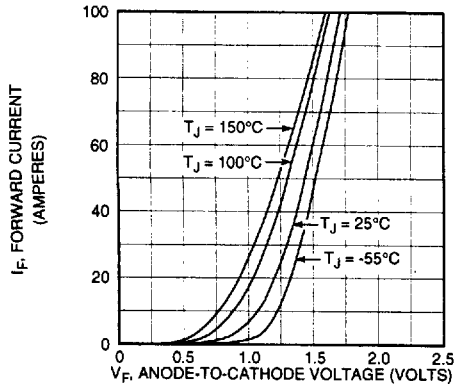


Figure 15, Forward Voltage Drop vs Forward Current

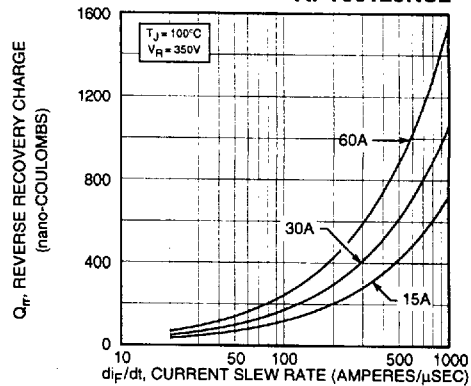


Figure 16, Reverse Recovery Charge vs Current Slew Rate

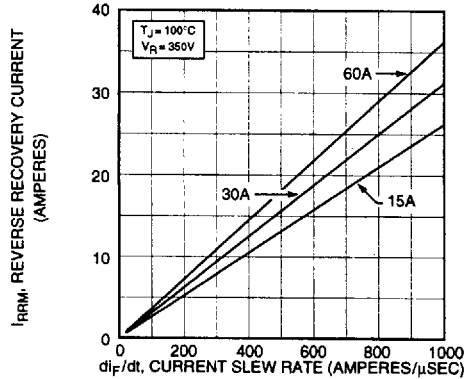


Figure 17, Reverse Recovery Current vs Current Slew Rate

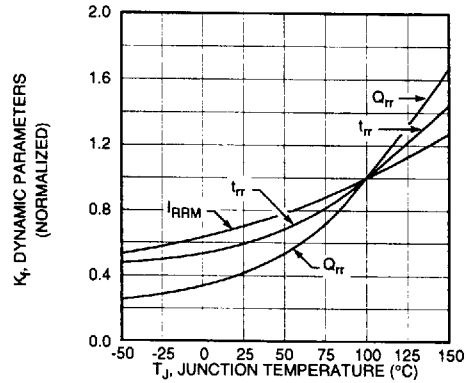


Figure 18, Dynamic Parameters vs Junction Temperature

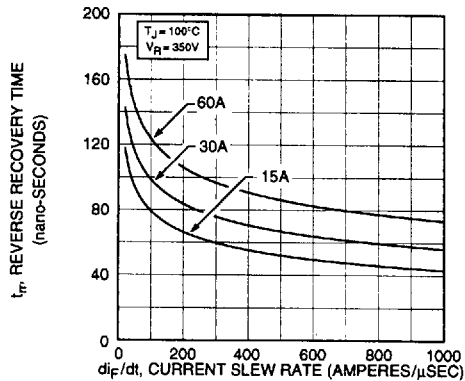


Figure 19, Reverse Recovery Time vs Current Slew Rate

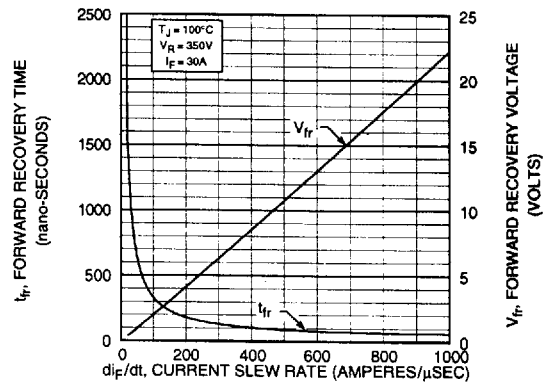


Figure 20, Forward Recovery Voltage/Time vs Current Slew Rate

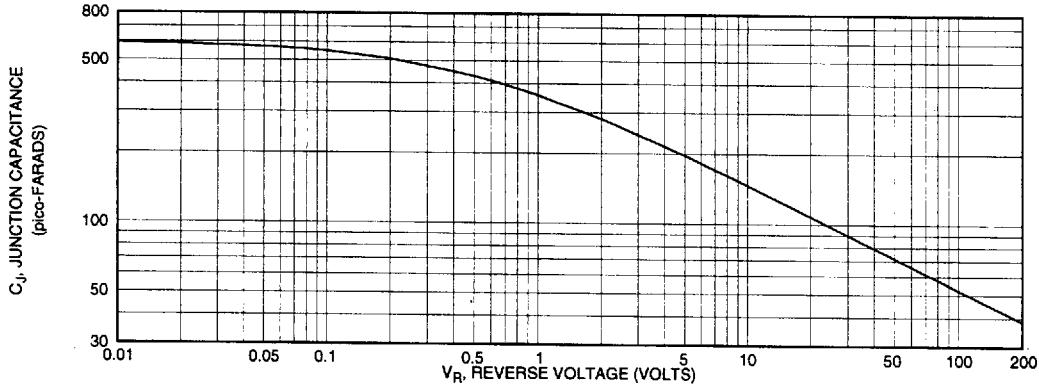


Figure 21, Junction Capacitance vs Reverse Voltage

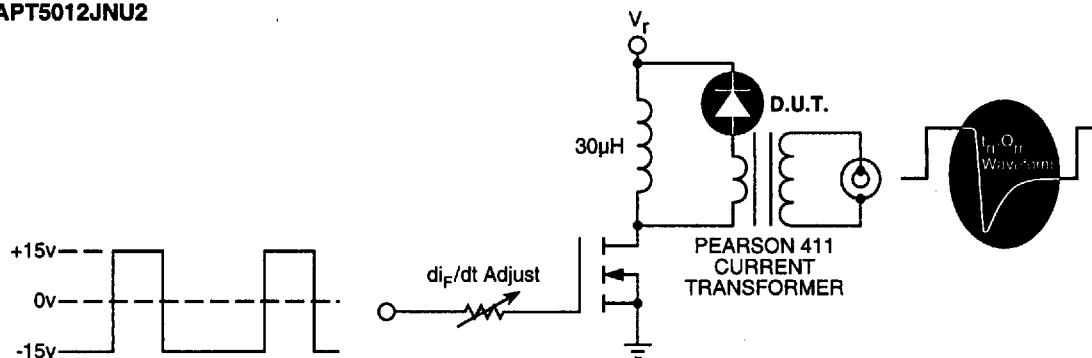


Figure 22, Diode Reverse Recovery Test Circuit and Waveforms

1  $I_F$  - Forward Conduction Current

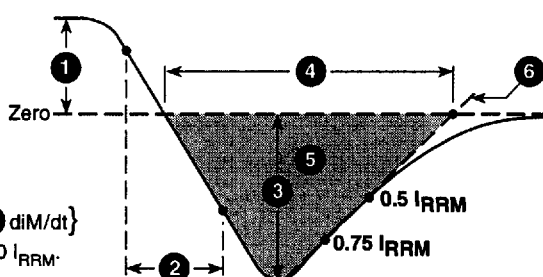
2  $di_F/dt$  - Current Slew Rate, Rate of Forward Current Change Through Zero Crossing.

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  $t_{rr}$ .

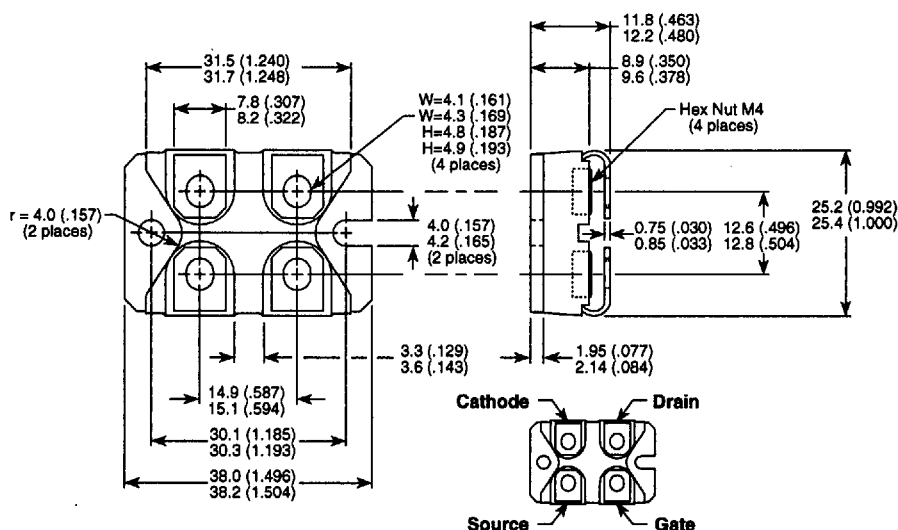


$$Q_{rr} = \frac{1}{2} (t_{rr} \cdot I_{RRM})$$

Figure 23, Diode Reverse Recovery Waveform and Definitions

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

### SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (Inches)