



# APT5010JVRU3

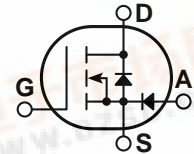
500V 44A 0.100Ω

## POWER MOS V<sup>®</sup>

Power MOS V<sup>®</sup> is a new generation of high voltage N-Channel enhancement mode power MOSFETs. This new technology minimizes the JFET effect, increases packing density and reduces the on-resistance. Power MOS V<sup>®</sup> also achieves faster switching speeds through optimized gate layout.



- Faster Switching
- Lower Leakage
- Single Die MOSFET & FRED
- 100% Avalanche Tested
- Popular SOT-227 Package
- PFC "Buck" Configuration



### MAXIMUM RATINGS

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

Symbol	Parameter	APT5010JVRU3	UNIT
$V_{DSS}$	Drain-Source Voltage	500	Volts
$I_D$	Continuous Drain Current @ $T_C = 25^\circ\text{C}$	44	Amps
$I_{DM}$	Pulsed Drain Current <sup>①</sup>	176	
$V_{GS}$	Gate-Source Voltage Continuous	$\pm 30$	Volts
$V_{GSM}$	Gate-Source Voltage Transient	$\pm 40$	
$P_D$	Total Power Dissipation @ $T_C = 25^\circ\text{C}$	450	Watts
	Linear Derating Factor	3.6	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	
$I_{AR}$	Avalanche Current <sup>①</sup> (Repetitive and Non-Repetitive)	44	Amps
$E_{AR}$	Repetitive Avalanche Energy <sup>①</sup>	50	mJ
$E_{AS}$	Single Pulse Avalanche Energy <sup>④</sup>	2500	

### STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$BV_{DSS}$	Drain-Source Breakdown Voltage ( $V_{GS} = 0V, I_D = 250\mu\text{A}$ )	500			Volts
$I_{D(on)}$	On State Drain Current <sup>②</sup> ( $V_{DS} > I_{D(on)} \times R_{DS(on)}$ Max, $V_{GS} = 10V$ )	44			Amps
$R_{DS(on)}$	Drain-Source On-State Resistance <sup>②</sup> ( $V_{GS} = 10V, 0.5 I_{D(Cont.)}$ )			0.100	Ohms
$I_{DSS}$	Zero Gate Voltage Drain Current ( $V_{DS} = V_{DSS}, V_{GS} = 0V$ )			25	$\mu\text{A}$
	Zero Gate Voltage Drain Current ( $V_{DS} = 0.8 V_{DSS}, V_{GS} = 0V, T_C = 125^\circ\text{C}$ )			250	
$I_{GSS}$	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

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

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

**DYNAMIC CHARACTERISTICS**

**APT5010JVRU3**

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
$C_{iss}$	Input Capacitance	$V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1\text{ MHz}$		7410		pF
$C_{oss}$	Output Capacitance			1050		
$C_{rss}$	Reverse Transfer Capacitance			390		
$Q_g$	Total Gate Charge ③	$V_{GS} = 10V$ $V_{DD} = 0.5 V_{DSS}$ $I_D = I_{D[Cont.]} @ 25^\circ C$		312		nC
$Q_{gs}$	Gate-Source Charge			37		
$Q_{gd}$	Gate-Drain ("Miller") Charge			127		
$t_{d(on)}$	Turn-on Delay Time	$V_{GS} = 15V$ $V_{DD} = 0.5 V_{DSS}$ $I_D = I_{D[Cont.]} @ 25^\circ C$ $R_G = 0.6\Omega$		18		ns
$t_r$	Rise Time			16		
$t_{d(off)}$	Turn-off Delay Time			54		
$t_f$	Fall Time			5		

**SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS**

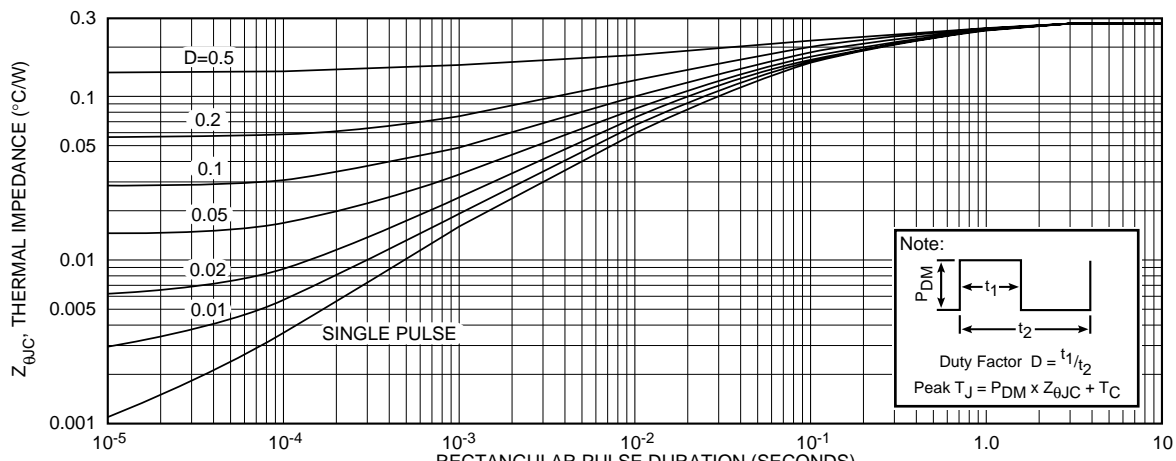
Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$I_S$	Continuous Source Current (Body Diode)			44	Amps
$I_{SM}$	Pulsed Source Current ① (Body Diode)			176	
$V_{SD}$	Diode Forward Voltage ② ( $V_{GS} = 0V, I_S = -I_{D[Cont.]}$ )			1.3	Volts
$t_{rr}$	Reverse Recovery Time ( $I_S = -I_{D[Cont.]}, di_S/dt = 100A/\mu s$ )		620		ns
$Q_{rr}$	Reverse Recovery Charge ( $I_S = -I_{D[Cont.]}, di_S/dt = 100A/\mu s$ )		14.7		$\mu C$

**THERMAL/PACKAGE CHARACTERISTICS**

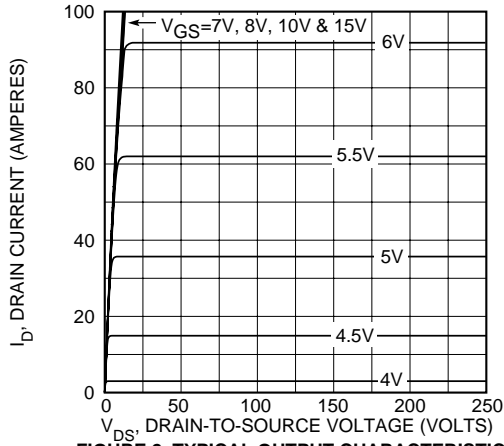
Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case			0.28	$^\circ C/W$
$R_{\theta JA}$	Junction to Ambient			40	
$V_{Isolation}$	RMS Voltage (50-60 Hz Sinusoidal Waveform From Terminals to Mounting Base for 1 Min.)	2500			Volts
Torque	Maximum Torque for Device Mounting Screws and Electrical Terminations.			13	lb•in

- ① Repetitive Rating: Pulse width limited by maximum junction temperature.
- ② Pulse Test: Pulse width < 380  $\mu s$ , Duty Cycle < 2%
- ③ See MIL-STD-750 Method 3471
- ④ Starting  $T_j = +25^\circ C$ ,  $L = 2.58mH$ ,  $R_G = 25\Omega$ , Peak  $I_L = 44A$

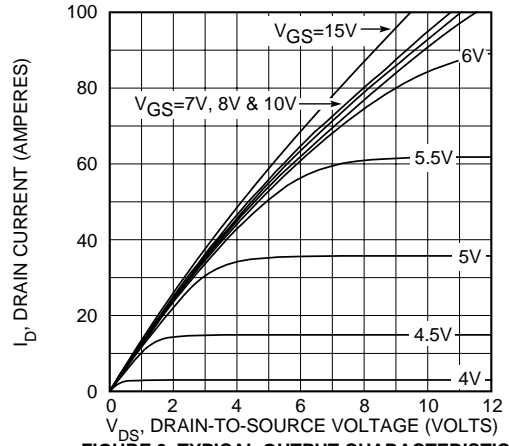
APT Reserves the right to change, without notice, the specifications and information contained herein.



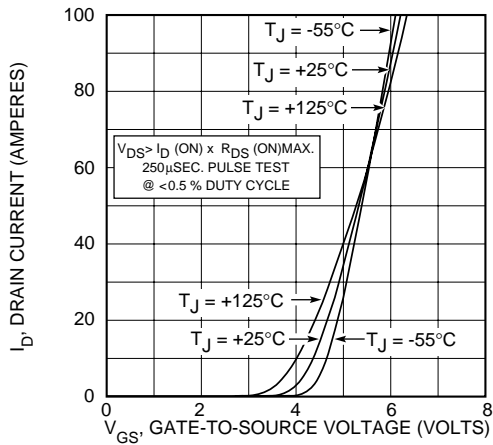
**APT5010JVRU3**



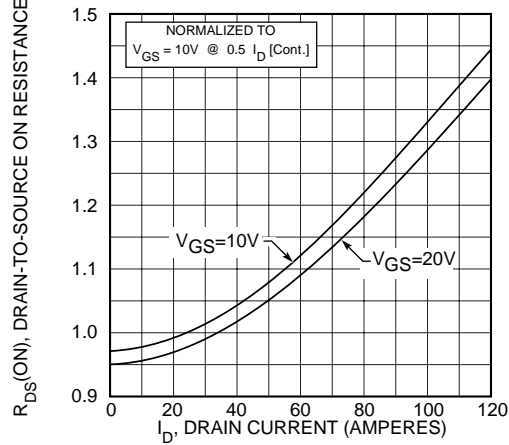
**FIGURE 2, TYPICAL OUTPUT CHARACTERISTICS**



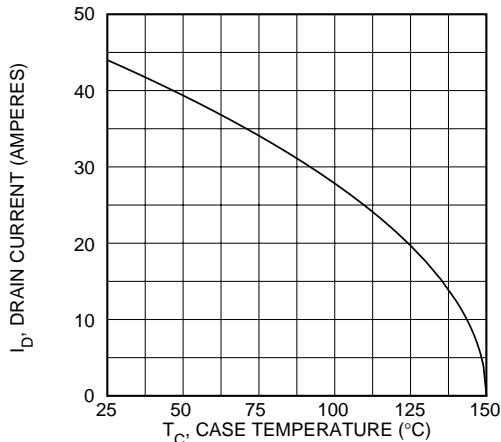
**FIGURE 3, TYPICAL OUTPUT CHARACTERISTICS**



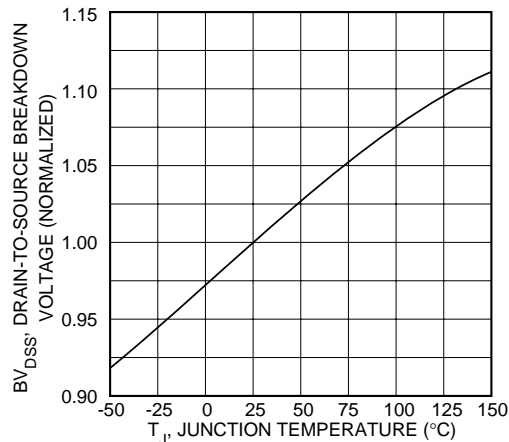
**FIGURE 4, TYPICAL TRANSFER CHARACTERISTICS**



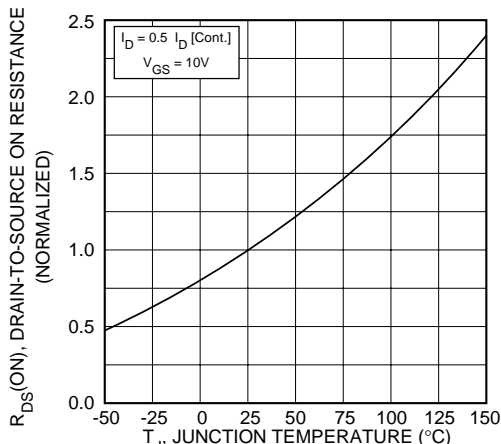
**FIGURE 5,  $R_{DS(ON)}$  vs DRAIN CURRENT**



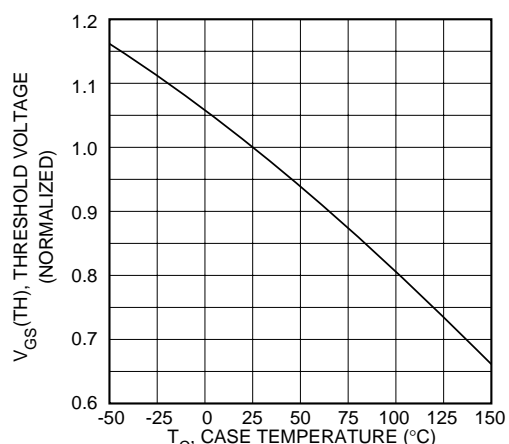
**FIGURE 6, MAXIMUM DRAIN CURRENT vs CASE TEMPERATURE**



**FIGURE 7, BREAKDOWN VOLTAGE vs TEMPERATURE**



**FIGURE 8, ON-RESISTANCE vs. TEMPERATURE**



**FIGURE 9, THRESHOLD VOLTAGE vs TEMPERATURE**

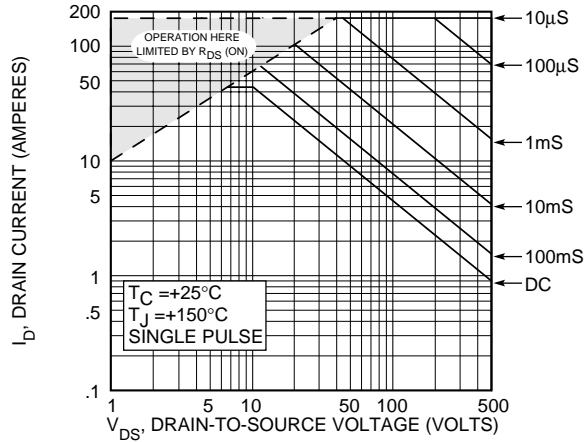


FIGURE 10, MAXIMUM SAFE OPERATING AREA

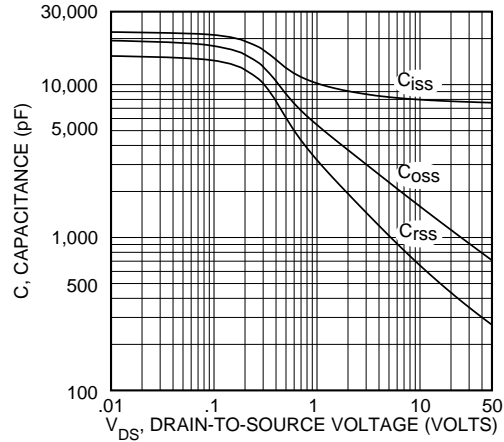


FIGURE 11, TYPICAL CAPACITANCE vs DRAIN-TO-SOURCE VOLTAGE

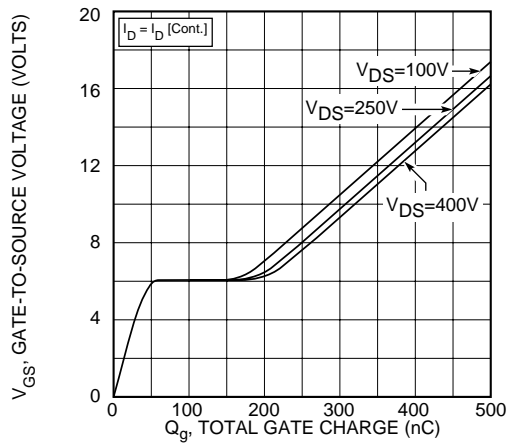


FIGURE 12, GATE CHARGES vs GATE-TO-SOURCE VOLTAGE

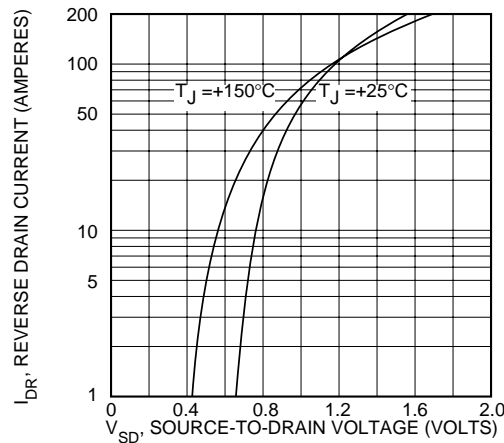


FIGURE 13, TYPICAL SOURCE-DRAIN DIODE FORWARD VOLTAGE

Diode Specifications Section

MAXIMUM RATINGS (UltraFast Recovery Diode)

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

Symbol	Characteristic / Test Conditions	APT5010JVRU3	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	
$C$	Junction Capacitance, $V_D = 200\text{V}$		40		pF

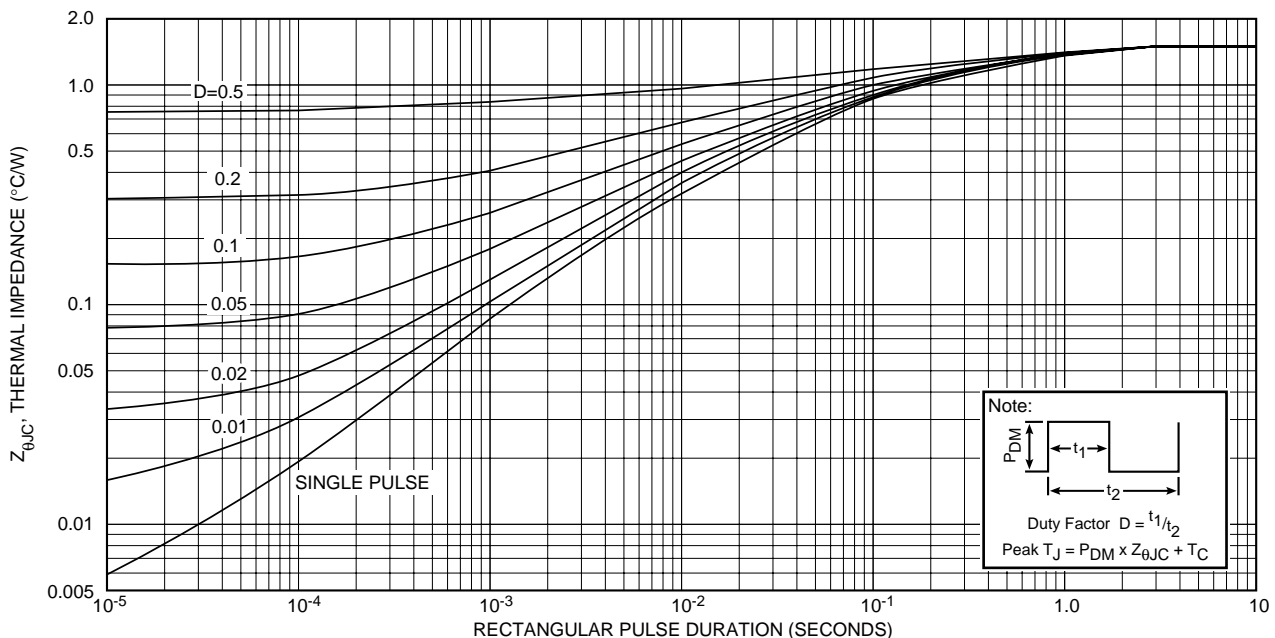
**APT5010JVRU3**

**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	10	Amps
$I_{RRM2}$	$I_F = 30A, di_F/dt = -240A/\mu S, V_R = 350V$	$T_J = 100^\circ C$	7.5	15	
$Q_{rr1}$	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	$T_J = 25^\circ C$	5		Volts
$V_{fr2}$	$I_F = 30A, di_F/dt = 240A/\mu S, V_R = 350V$	$T_J = 100^\circ C$	5		
$di_M/dt$	Rate of Fall of Recovery Current	$T_J = 25^\circ C$	400		A/ $\mu S$
	$I_F = 30A, di_F/dt = -240A/\mu S, V_R = 350V$ (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			20	
$W_T$	Package Weight		1.06		oz.
			30		gm.



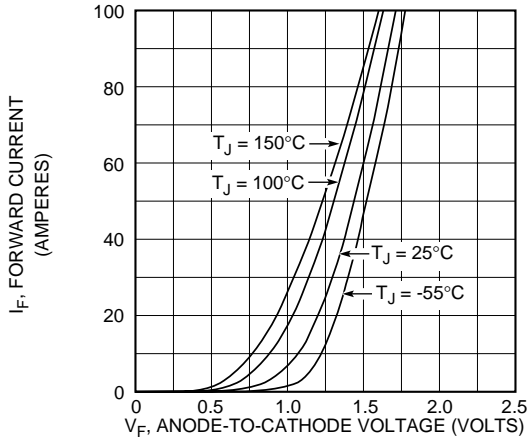


Figure 15, Forward Voltage Drop vs Forward Current

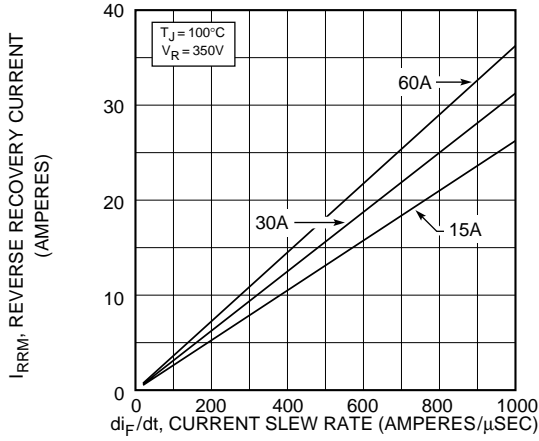


Figure 17, Reverse Recovery Current vs Current Slew Rate

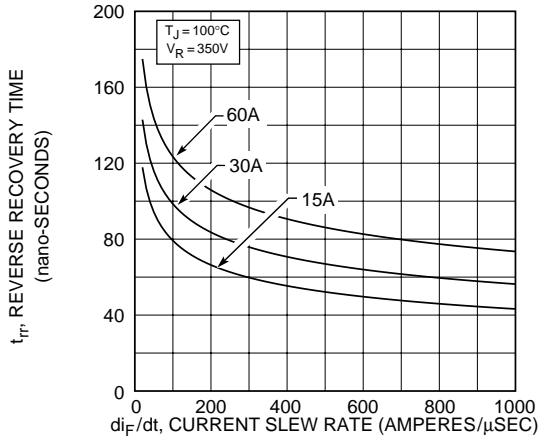


Figure 19, Reverse Recovery Time vs Current Slew Rate

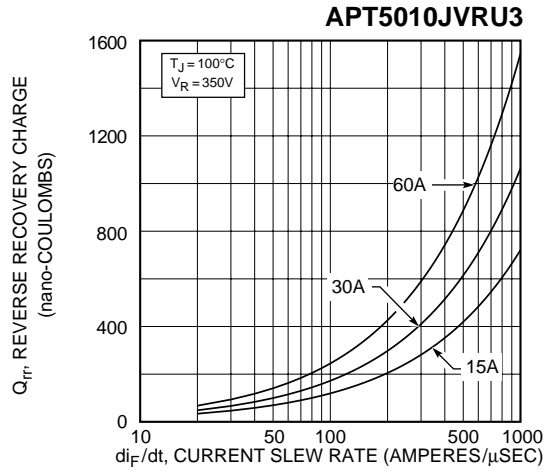


Figure 16, Reverse Recovery Charge vs Current Slew Rate

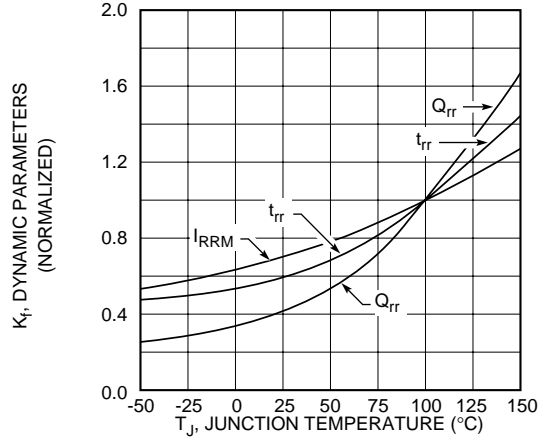


Figure 18, Dynamic Parameters vs Junction Temperature

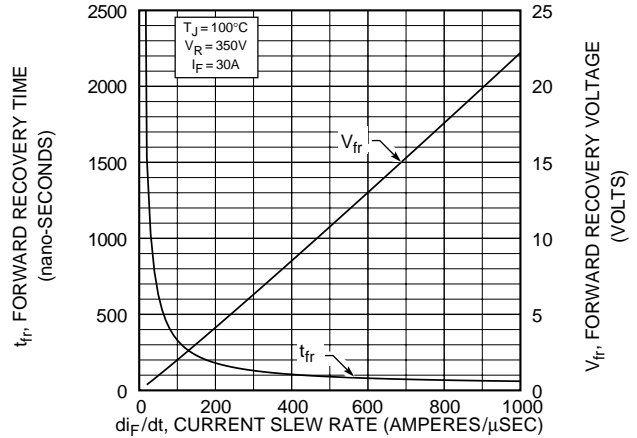


Figure 20, Forward Recovery Voltage/Time vs Current Slew Rate

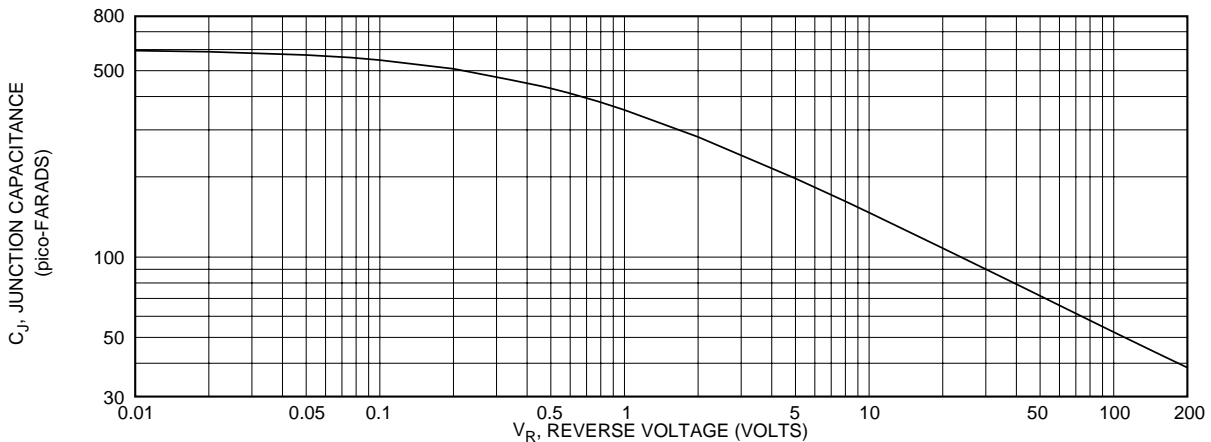


Figure 21, Junction Capacitance vs Reverse Voltage

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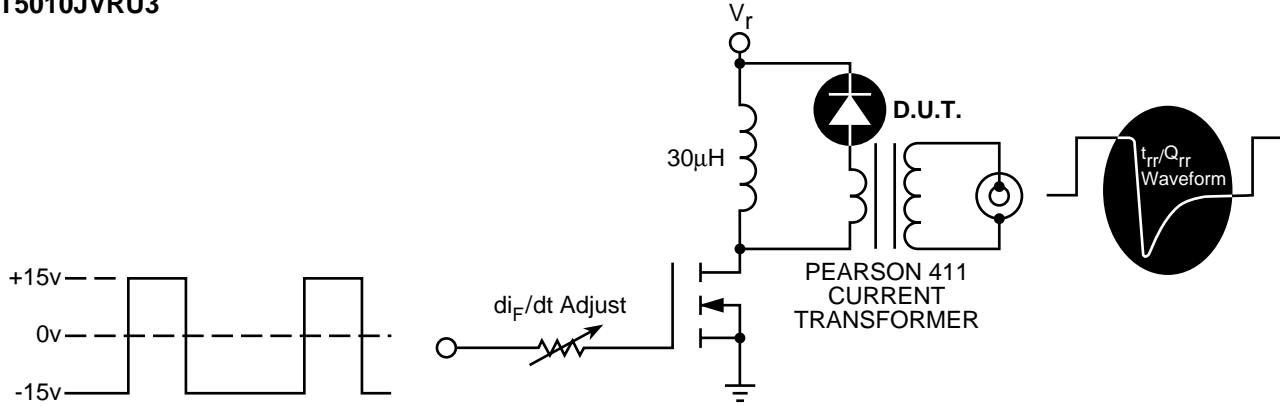
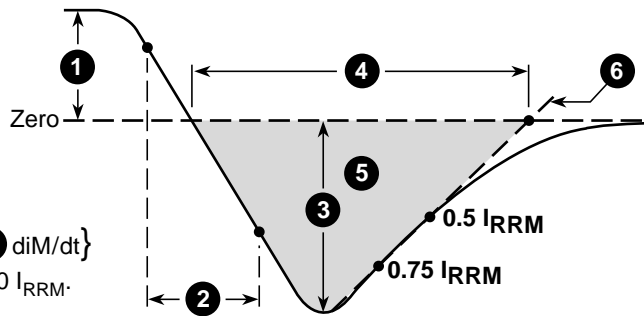


Figure 22, Diode Reverse Recovery Test Circuit and Waveforms

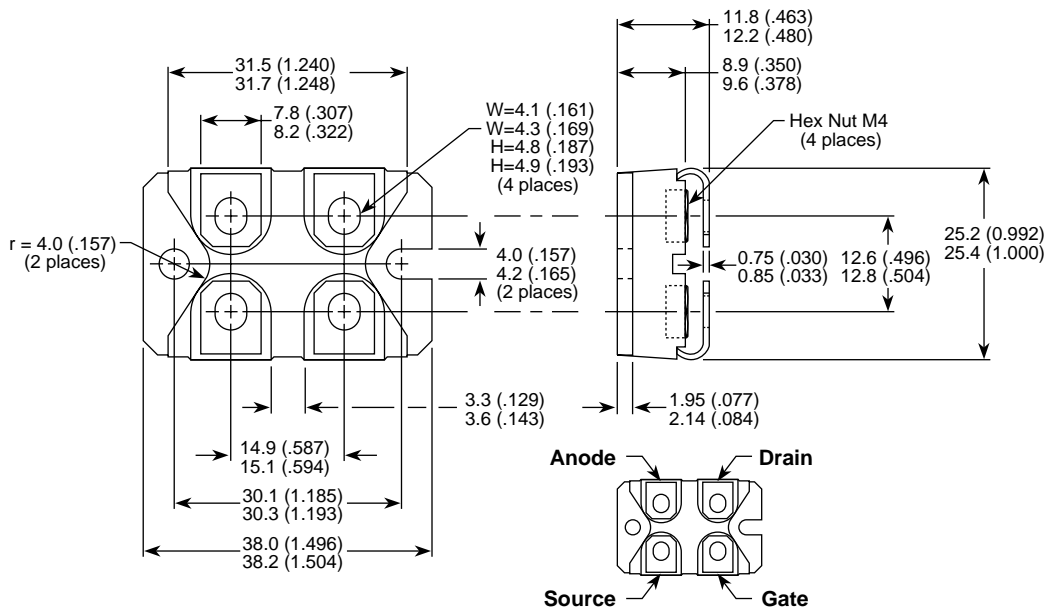
- 1  $I_F$  - Forward Conduction Current
- 2  $di_F/dt$  - Current Slew Rate, Rate of Forward Current Change Through Zero Crossing.
- 3  $I_{RRM}$  - Peak Reverse Recovery Current.
- 4  $t_{rr}$  - Reverse Recovery Time Measured from Point of  $I_F$  Current Falling Through Zero to a Tangent Line { 6  $di/dt$  } 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  $di/dt$  - 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

SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (Inches)