

**APT5040CNR 500V 13.0A 0.400Ω**

# POWER MOS IV™ Avalanche Rated

## N - CHANNEL ENHANCEMENT MODE HIGH VOLTAGE POWER MOSFETS

- **Faster Switching**                      • **100% Avalanche Tested**                      • **Popular TO-254 Package**
- **Low Gate Charge**                      • **Similar to the 2N7228, JX2N7228 and JV2N7228**

### MAXIMUM RATINGS

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

Symbol	Parameter	APT5040CNR	UNIT
$V_{DSS}$	Drain-Source Voltage	500	Volts
$I_D$	Continuous Drain Current @ $T_C = 25^\circ\text{C}$	13	Amps
$I_{DM}$	Pulsed Drain Current <sup>①</sup>	52	
$V_{GS}$	Gate-Source Voltage Continuous	$\pm 30$	Volts
$V_{GSM}$	Gate-Source Voltage Transient	$\pm 40$	
$P_D$	Total Power Dissipation @ $T_C = 25^\circ\text{C}$	150	Watts
	Linear Derating Factor	1.2	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)	13	Amps
$E_{AR}$	Repetitive Avalanche Energy <sup>①</sup>	20	mJ
$E_{AS}$	Single Pulse Avalanche Energy <sup>③</sup>	800	

### 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, $V_{GS} = 10V$ )	13			Amps
$R_{DS(on)}$	Drain-Source On-State Resistance <sup>②</sup> ( $V_{GS} = 10V, 0.5 I_{D[Cont.]}$ )			0.40	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 ( $V_{DS} = V_{GS}, I_D = 1.0\text{mA}$ )	2		4	Volts



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

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## DYNAMIC CHARACTERISTICS

APT5040CNR

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
$C_{DC}$	Drain-to-Case Capacitance	$f = 1 \text{ MHz}$		15	22	pF
$C_{ISS}$	Input Capacitance	$V_{GS} = 0V$		1430	1800	
$C_{OSS}$	Output Capacitance	$V_{DS} = 25V$		330	465	
$C_{RSS}$	Reverse Transfer Capacitance	$f = 1 \text{ MHz}$		130	200	
$Q_g$	Total Gate Charge	$V_{GS} = 10V$		71	105	nC
$Q_{gs}$	Gate-Source Charge	$V_{DD} = 0.5 V_{DSS}$		8.7	12	
$Q_{gd}$	Gate-Drain ("Miller") Charge	$I_D = I_D [\text{Cont.}] @ 25^\circ\text{C}$		37	55	
$t_{d(on)}$	Turn-on Delay Time	$V_{GS} = 10V$		14	28	ns
$t_r$	Rise Time	$V_{DD} = 0.5 V_{DSS}$		21	42	
$t_{d(off)}$	Turn-off Delay Time	$I_D = I_D [\text{Cont.}] @ 25^\circ\text{C}$		44	66	
$t_f$	Fall Time	$R_G = 1.80\Omega$		15	30	

## SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$I_S$	Continuous Source Current (Body Diode)			13	Amps
$I_{SM}$	Pulsed Source Current <sup>①</sup> (Body Diode)			52	
$V_{SD}$	Diode Forward Voltage <sup>②</sup> ( $V_{GS} = 0V, I_S = -I_D [\text{Cont.}]$ )			1.3	Volts
$t_{rr}$	Reverse Recovery Time ( $I_S = -I_D [\text{Cont.}], di_S/dt = 100A/\mu s$ )		296	592	ns
$Q_{rr}$	Reverse Recovery Charge ( $I_S = -I_D [\text{Cont.}], di_S/dt = 100A/\mu s$ )		4.4	8.8	$\mu C$

## THERMAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case			0.80	W/°C
$R_{\theta JA}$	Junction to Ambient			50	

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 Starting  $T_J = +25^\circ\text{C}$ ,  $L = 9.47\text{mH}$ ,  $R_G = 25\Omega$ , Peak  $I_L = 13A$

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

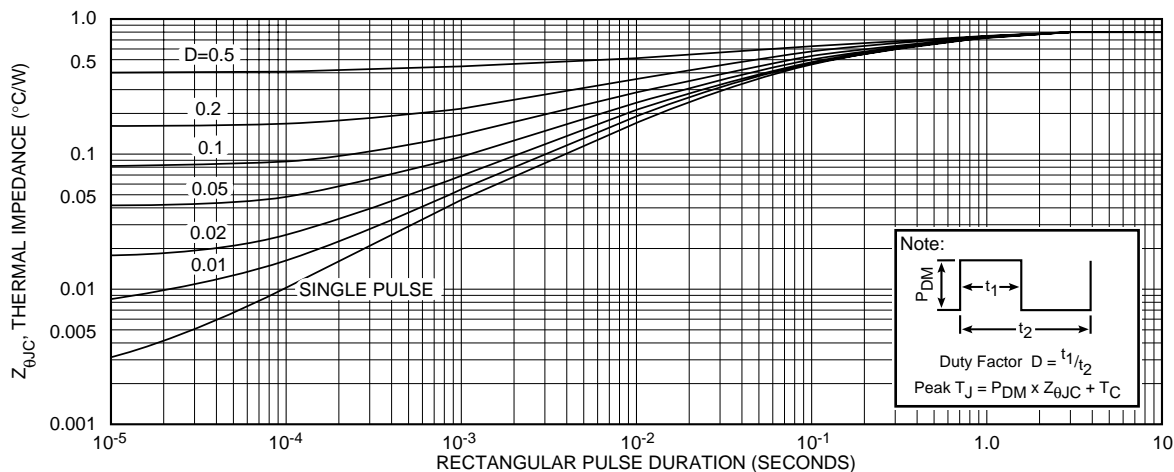
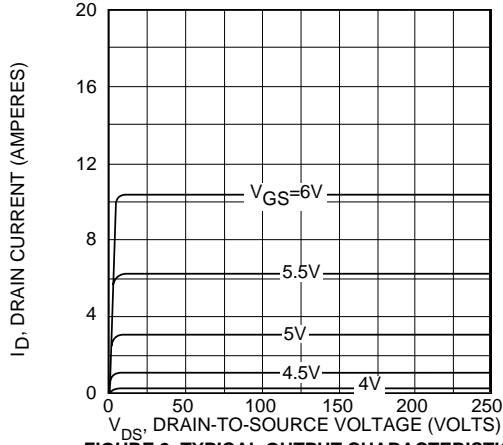
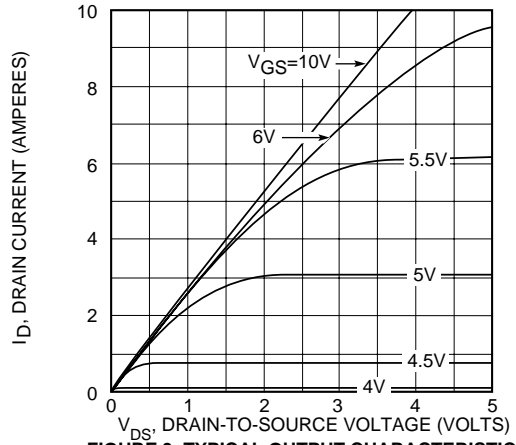


FIGURE 1, MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION

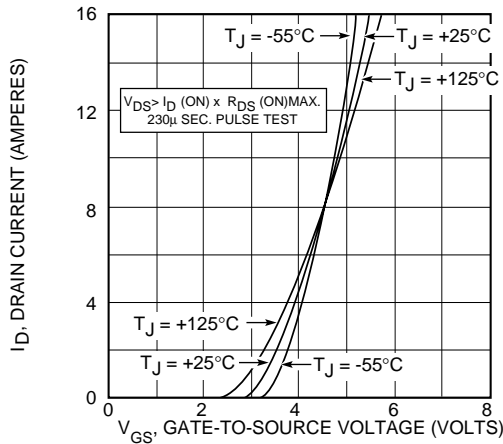
**APT5040CNR**



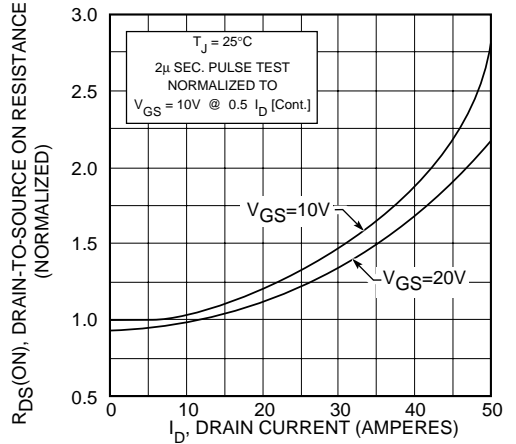
**FIGURE 2, TYPICAL OUTPUT CHARACTERISTICS**



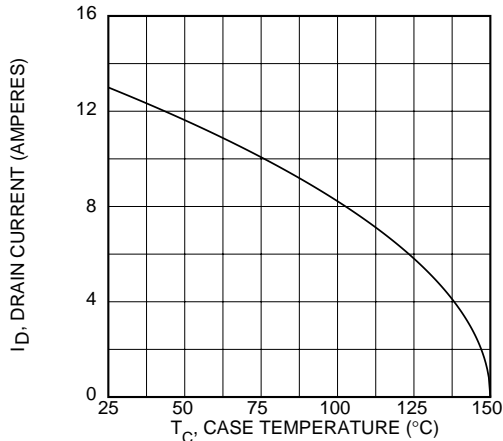
**FIGURE 3, TYPICAL OUTPUT CHARACTERISTICS**



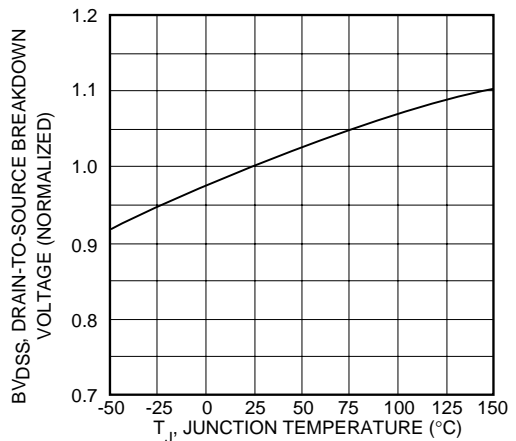
**FIGURE 4, TYPICAL TRANSFER CHARACTERISTICS**



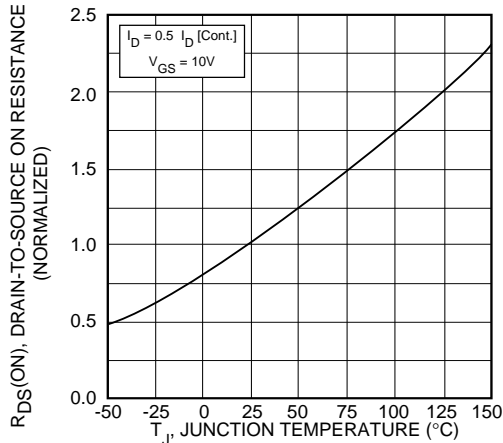
**FIGURE 5,  $R_{DS(ON)}$  vs DRAIN CURRENT**



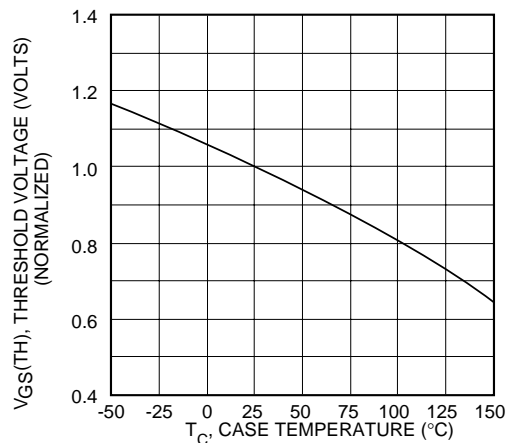
**FIGURE 6, MAXIMUM DRAIN CURRENT vs CASE TEMPERATURE**



**FIGURE 7, BREAKDOWN VOLTAGE vs TEMPERATURE**



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



**FIGURE 9, THRESHOLD VOLTAGE vs TEMPERATURE**

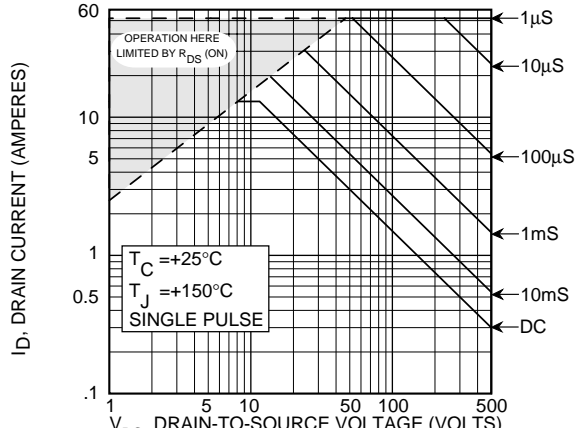


FIGURE 10, MAXIMUM SAFE OPERATING AREA

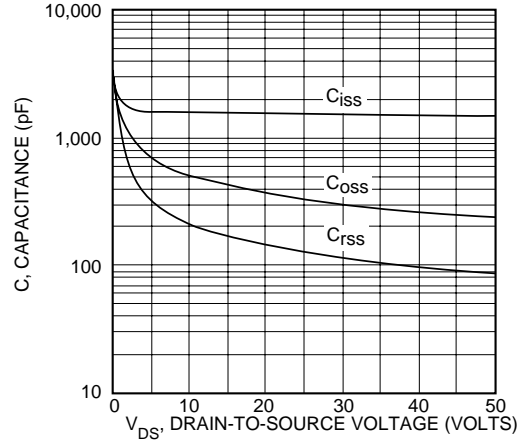


FIGURE 11, TYPICAL CAPACITANCE vs DRAIN-TO-SOURCE VOLTAGE

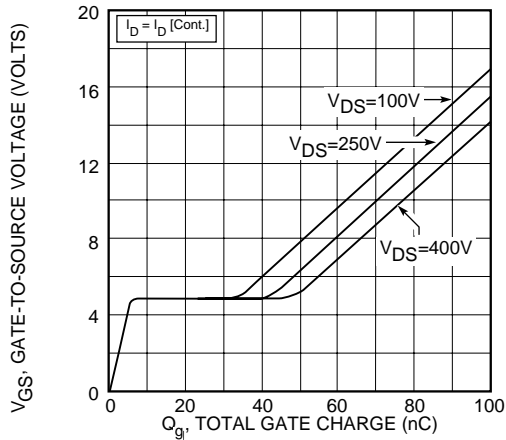


FIGURE 12, GATE CHARGES vs GATE-TO-SOURCE VOLTAGE

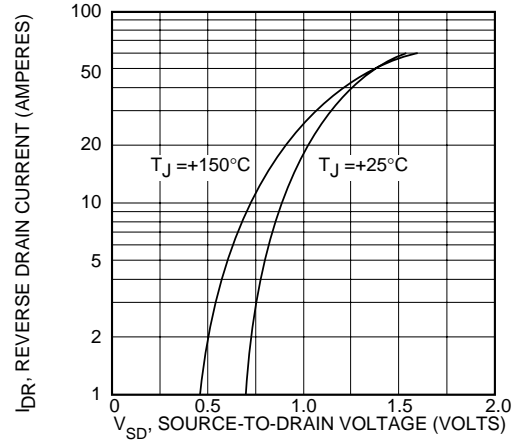
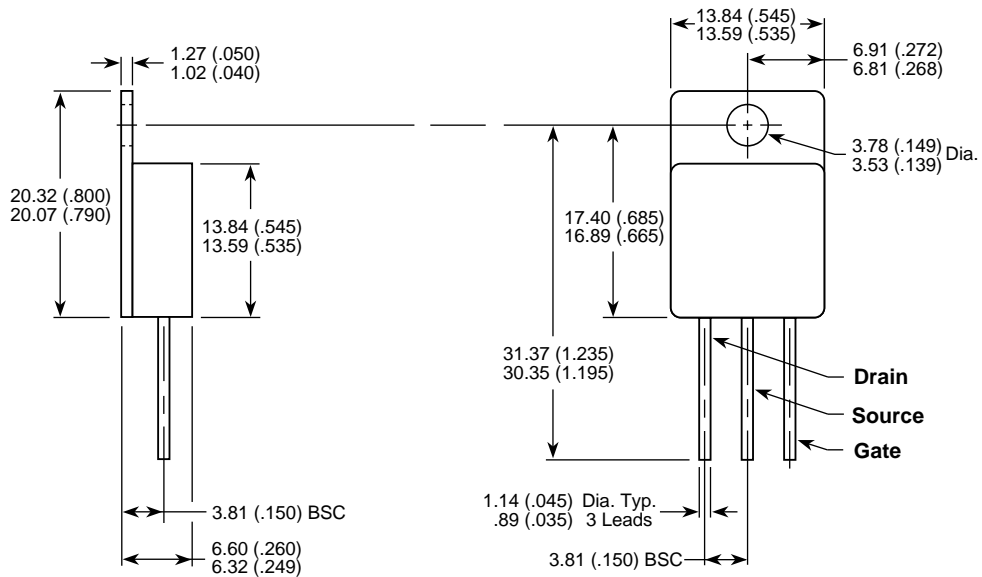


FIGURE 13, TYPICAL SOURCE-DRAIN DIODE FORWARD VOLTAGE

TO-254AA Package Outline



Dimensions in Millimeters and (Inches)