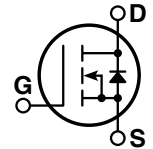
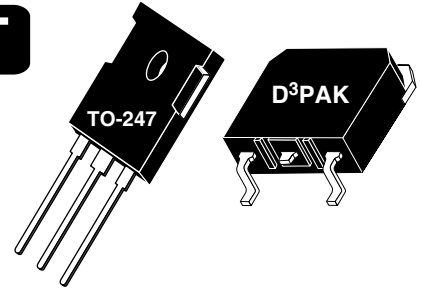


## Super Junction MOSFET



- Ultra low  $R_{DS(ON)}$
- Low Miller Capacitance
- Ultra Low Gate Charge,  $Q_g$
- Avalanche Energy Rated
- TO-247 or Surface Mount D<sup>3</sup>PAK Package

### MAXIMUM RATINGS

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

Symbol	Parameter	APT20N60BC3_SC3	UNIT
$V_{DSS}$	Drain-Source Voltage	600	Volts
$I_D$	Continuous Drain Current @ $T_C = 25^\circ\text{C}$	20.7	Amps
$I_{DM}$	Pulsed Drain Current <sup>①</sup>	62	
$V_{GS}$	Gate-Source Voltage Continuous	$\pm 20$	Volts
$V_{GSM}$	Gate-Source Voltage Transient	$\pm 30$	
$P_D$	Total Power Dissipation @ $T_C = 25^\circ\text{C}$	208	Watts
	Linear Derating Factor	1.67	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.	260	
$dv/dt$	Drain-Source Voltage slope ( $V_{DS} = 480\text{V}$ , $I_D = 20.7\text{A}$ , $T_J = 125^\circ\text{C}$ )	50	V/ns
$I_{AR}$	Repetitive Avalanche Current <sup>⑦</sup>	20	Amps
$E_{AR}$	Repetitive Avalanche Energy <sup>⑦</sup>	1	
$E_{AS}$	Single Pulse Avalanche Energy <sup>④</sup>	690	

### STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$BV_{DSS}$	Drain-Source Breakdown Voltage ( $V_{GS} = 0\text{V}$ , $I_D = 250\mu\text{A}$ )	600			Volts
$R_{DS(on)}$	Drain-Source On-State Resistance <sup>②</sup> ( $V_{GS} = 10\text{V}$ , $I_D = 13.1\text{A}$ )		0.16	0.19	Ohms
$I_{DSS}$	Zero Gate Voltage Drain Current ( $V_{DS} = 600\text{V}$ , $V_{GS} = 0\text{V}$ )		0.05	25	$\mu\text{A}$
	Zero Gate Voltage Drain Current ( $V_{DS} = 600\text{V}$ , $V_{GS} = 0\text{V}$ , $T_C = 150^\circ\text{C}$ )			250	
$I_{GSS}$	Gate-Source Leakage Current ( $V_{GS} = \pm 20\text{V}$ , $V_{DS} = 0\text{V}$ )			$\pm 100$	nA
$V_{GS(th)}$	Gate Threshold Voltage ( $V_{DS} = V_{GS}$ , $I_D = 1\text{mA}$ )	2.1	3	3.9	Volts

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

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

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
$C_{iss}$	Input Capacitance	$V_{GS} = 0V$ $V_{DS} = 25V$ $f = 1\text{ MHz}$		2440		pF
$C_{oss}$	Output Capacitance			860		
$C_{rss}$	Reverse Transfer Capacitance			50		
$Q_g$	Total Gate Charge ③	$V_{GS} = 10V$ $V_{DD} = 300V$ $I_D = 20.7A @ 25^\circ C$		90	114	nC
$Q_{gs}$	Gate-Source Charge			13		
$Q_{gd}$	Gate-Drain ("Miller") Charge			45		
$t_{d(on)}$	Turn-on Delay Time	<b>RESISTIVE SWITCHING</b> $V_{GS} = 15V$ $V_{DD} = 380V$ $I_D = 20.7A @ 25^\circ C$ $R_G = 3.6\Omega$		10		ns
$t_r$	Rise Time			5		
$t_{d(off)}$	Turn-off Delay Time			65		
$t_f$	Fall Time			5		
$E_{on}$	Turn-on Switching Energy ⑥	<b>INDUCTIVE SWITCHING @ 25°C</b> $V_{DD} = 400V, V_{GS} = 15V$ $I_D = 20.7A, R_G = 5\Omega$		180		$\mu J$
$E_{off}$	Turn-off Switching Energy			120		
$E_{on}$	Turn-on Switching Energy ⑥	<b>INDUCTIVE SWITCHING @ 125°C</b> $V_{DD} = 400V, V_{GS} = 15V$ $I_D = 20.7A, R_G = 5\Omega$		320		
$E_{off}$	Turn-off Switching Energy			135		

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$I_S$	Continuous Source Current (Body Diode)			20.7	Amps
$I_{SM}$	Pulsed Source Current ① (Body Diode)			62	
$V_{SD}$	Diode Forward Voltage ② ( $V_{GS} = 0V, I_S = -20.7A$ )		1	1.2	Volts
$t_{rr}$	Reverse Recovery Time ( $I_S = -20.7A, di_S/dt = 100A/\mu s, V_R = 480V$ )		500	800	ns
$Q_{rr}$	Reverse Recovery Charge ( $I_S = -20.7A, di_S/dt = 100A/\mu s, V_R = 480V$ )		11		$\mu C$
$dv/dt$	Peak Diode Recovery $dv/dt$ ⑤			6	V/ns

THERMAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case			0.60	$^\circ C/W$
$R_{\theta JA}$	Junction to Ambient			62	

- 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  $T_j = +25^\circ C, L = 13.80mH, R_G = 25\Omega, \text{Peak } I_L = 10A$
- ⑤  $dv/dt$  numbers reflect the limitations of the test circuit rather than the device itself.  $I_S \leq -I_D 20.7A, di/dt \leq 700A/\mu s, V_R \leq V_{DSS}, T_J \leq 150^\circ C$
- ⑥  $E_{on}$  includes diode reverse recovery. See figures 18, 20.
- ⑦ Repetitive avalanche causes additional power losses that can be calculated as  $P_{AV} = E_{AR} * f$

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

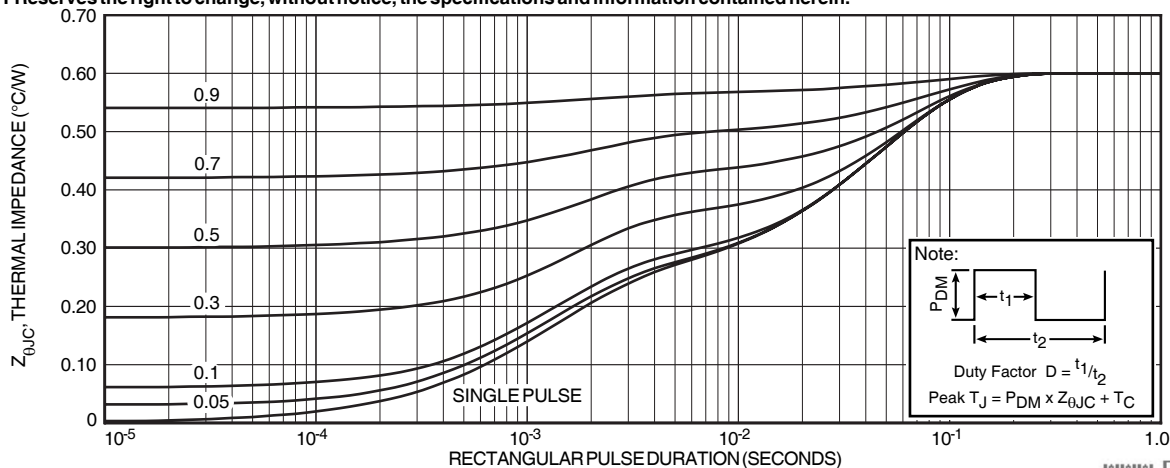


FIGURE 1, MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION

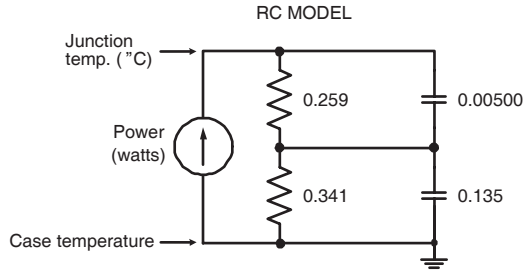


FIGURE 2, TRANSIENT THERMAL IMPEDANCE MODEL

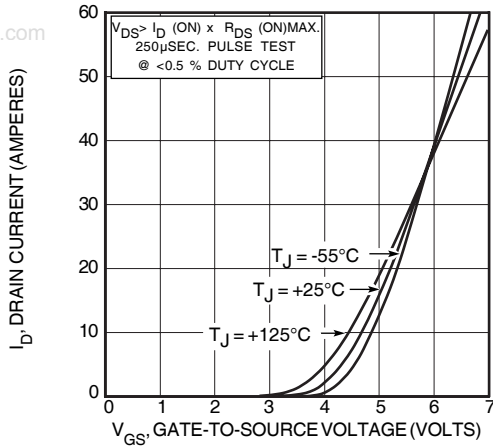


FIGURE 4, TRANSFER CHARACTERISTICS

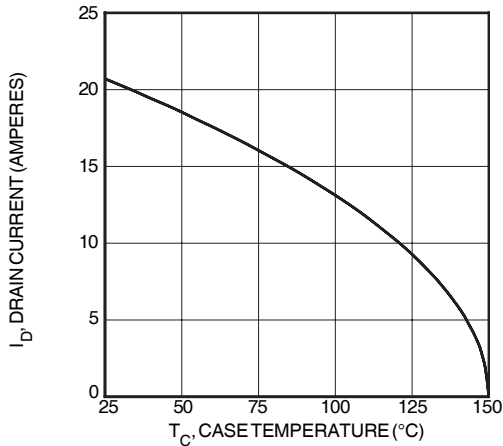


FIGURE 6, MAXIMUM DRAIN CURRENT vs CASE TEMPERATURE

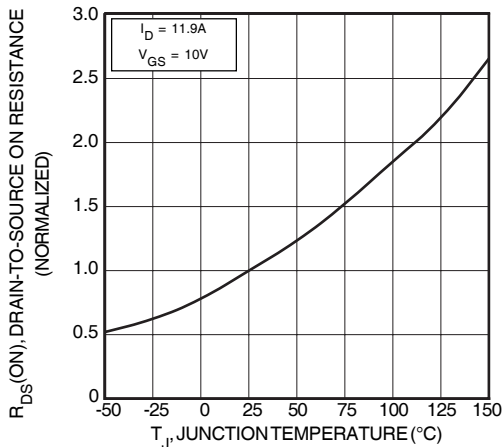


FIGURE 8, ON-RESISTANCE vs. TEMPERATURE

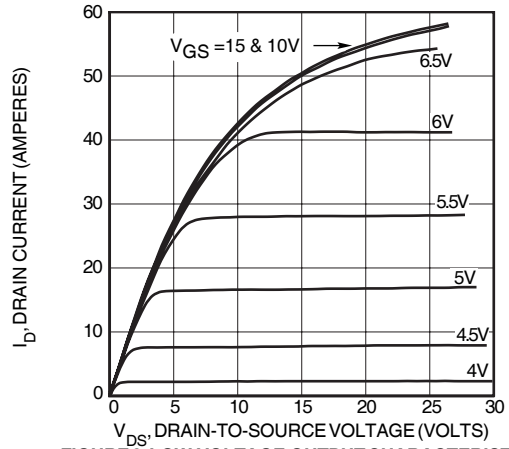


FIGURE 3, LOW VOLTAGE OUTPUT CHARACTERISTICS

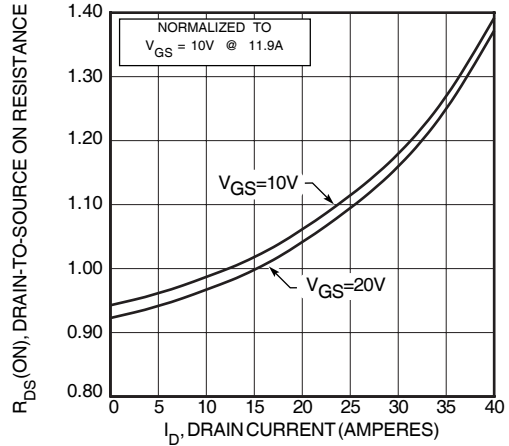


FIGURE 5,  $R_{DS(\text{ON})}$  vs DRAIN CURRENT

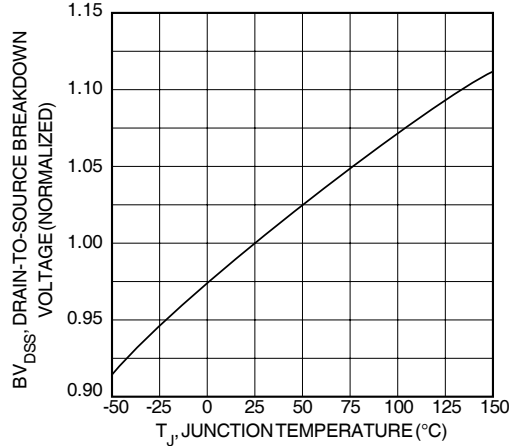


FIGURE 7, BREAKDOWN VOLTAGE vs TEMPERATURE

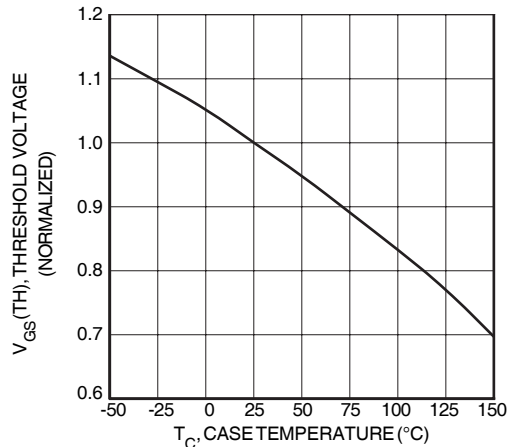


FIGURE 9, THRESHOLD VOLTAGE vs TEMPERATURE

# Typical Performance Curves

APT20N60B\_SC3

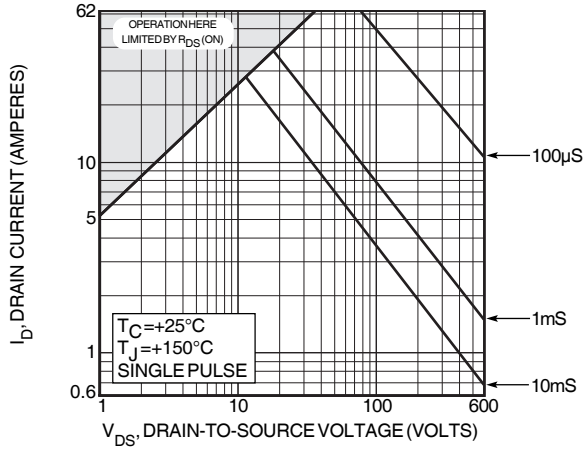


FIGURE 10, MAXIMUM SAFE OPERATING AREA

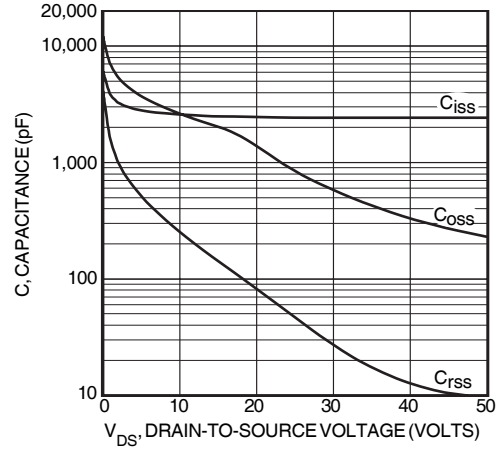


FIGURE 11, CAPACITANCE vs DRAIN-TO-SOURCE VOLTAGE

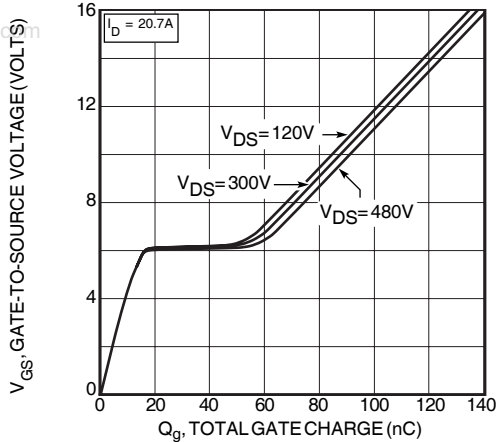


FIGURE 12, GATE CHARGES vs GATE-TO-SOURCE VOLTAGE

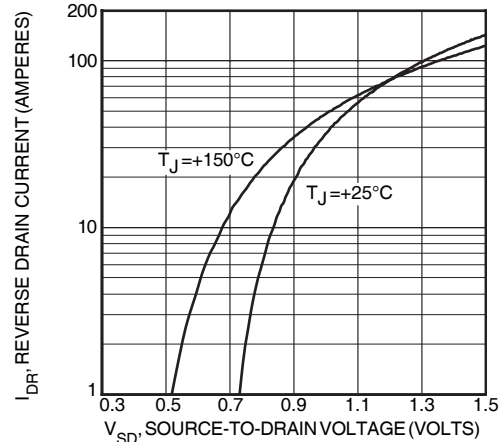


FIGURE 13, SOURCE-DRAIN DIODE FORWARD VOLTAGE

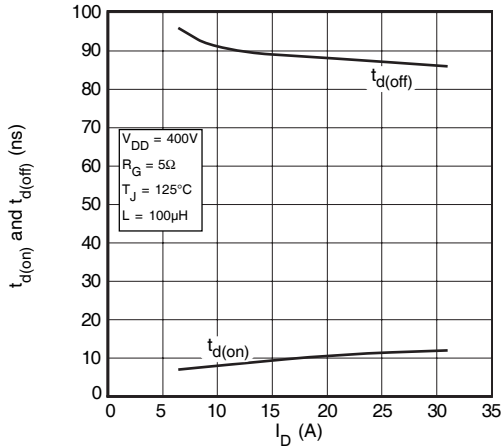


FIGURE 14, DELAY TIMES vs CURRENT

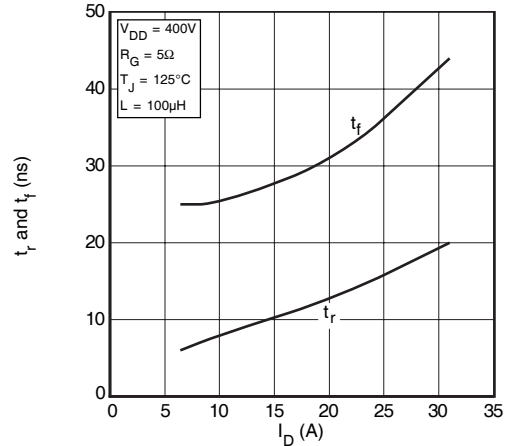


FIGURE 15, RISE AND FALL TIMES vs CURRENT

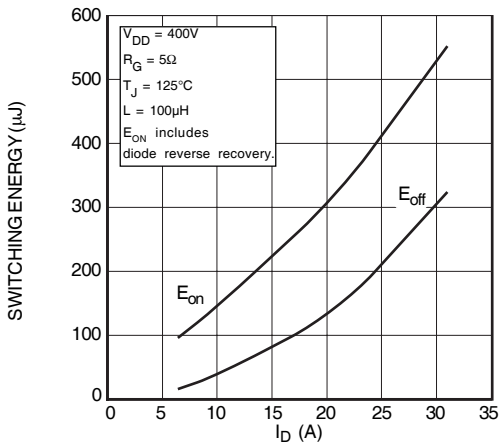


FIGURE 16, SWITCHING ENERGY vs CURRENT

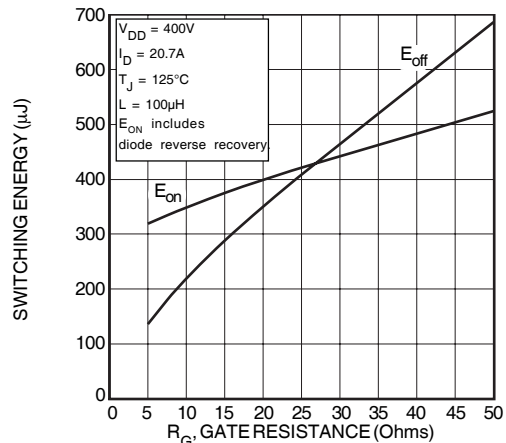


FIGURE 17, SWITCHING ENERGY vs. GATE RESISTANCE

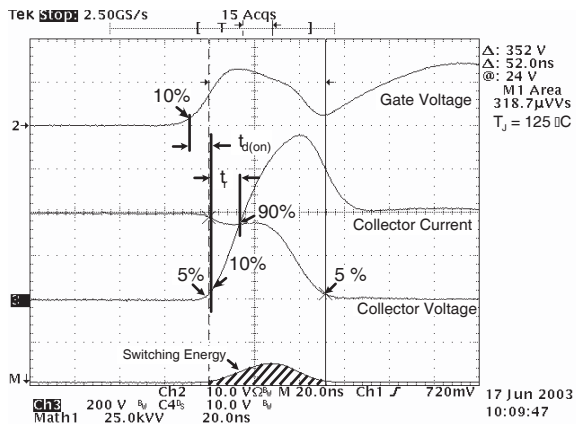


Figure 18, Turn-on Switching Waveforms and Definitions

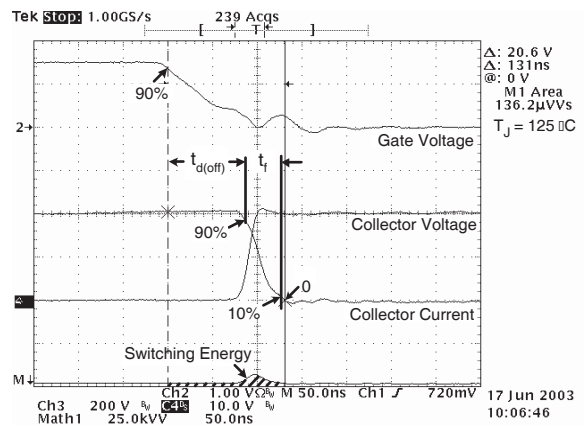


Figure 19, Turn-off Switching Waveforms and Definitions

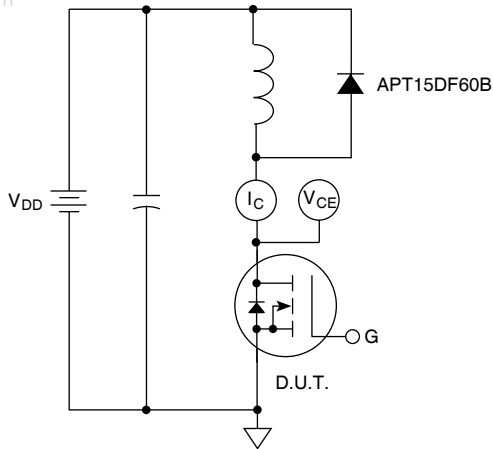
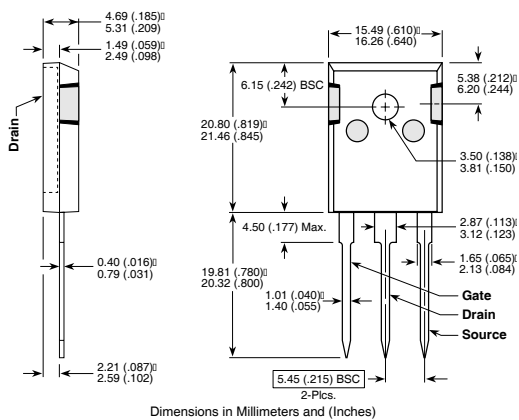
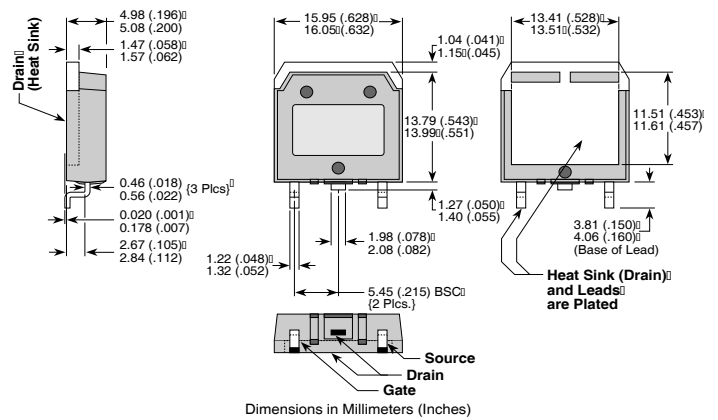


Figure 20, Inductive Switching Test Circuit

TO-247 Package Outline



D<sup>3</sup>PAK Package Outline



APT's products are covered by one or more of U.S. patents 4,895,810 5,045,903 5,089,434 5,182,234 5,019,522

5,262,336 6,503,786 5,256,583 4,748,103 5,283,202 5,231,474 5,434,095 5,528,058 and foreign patents. US and Foreign patents pending. All Rights Reserved.