ADVANCED POWER TECHNOLOGY®

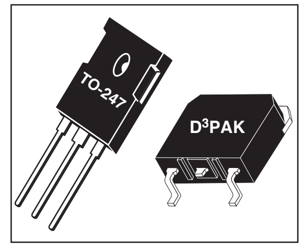
600V 20A 0.220Ω

APT20N60BCF APT20N60SCF
APT20N60BCFG* APT20N60SCFG*

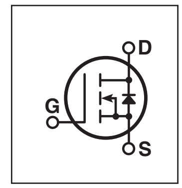
*G Denotes RoHS Compliant, Pb Free Terminal Finish.

COOLMOS Power Semiconductors

Super Junction FREDFET



- Ultra Low $R_{DS(ON)}$
- Low Miller Capacitance
- Ultra Low Gate Charge, Q_g
- Avalanche Energy Rated
- Extreme $dv/_{dt}$ Rated
- Intrinsic Fast-Recovery Body Diode
- Extreme Low Reverse Recovery Charge
- Ideal For ZVS Applications
- Popular TO-247 or Surface Mount D^3 Package



MAXIMUM RATINGS

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

Symbol	Parameter	APT20N60BCF(G)_SCF(G)	UNIT
V_{DSS}	Drain-Source Voltage	600	Volts
I_D	Continuous Drain Current @ T_C = 25°C	20	Amps
	Continuous Drain Current @ T_C = 100°C	13	
I_{DM}	Pulsed Drain Current ①	60	
V_{GS}	Gate-Source Voltage Continuous	±30	Volts
P_D	Total Power Dissipation @ T_C = 25°C	208	Watts
	Linear Derating Factor	1.67	W/°C
T_J,T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	°C
T_L	Lead Temperature: 0.063" from Case for 10 Sec.	260	
$dv/_{dt}$	Drain-Source Voltage slope (V_{DS} = 480V, I_D = 20A, T_J = 125°C)	80	V/ns
I_{AR}	Avalanche Current ⑦	20	Amps
E_{AR}	Repetitive Avalanche Energy ⑦	1	mJ
E_{AS}	Single Pulse Avalanche Energy ④	690	

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
BV_{DSS}	Drain-Source Breakdown Voltage (V_{GS} = 0V, I_D = 250μA)	600			Volts
$R_{DS(on)}$	Drain-Source On-State Resistance ② (V_{GS} = 10V, I_D = 13A)			0.220	Ohms
I_{DSS}	Zero Gate Voltage Drain Current (V_{DS} = 600V, V_{GS} = 0V)			2.1	μA
	Zero Gate Voltage Drain Current (V_{DS} = 600V, V_{GS} = 0V, T_C = 150°C)			1700	
I_{GSS}	Gate-Source Leakage Current (V_{GS} = ±20V, V_{DS} = 0V)			±100	nA
$V_{GS(th)}$	Gate Threshold Voltage (V_{DS} = V_{GS}, I_D = 1mA)	3	4	5	Volts

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

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

"COOLMOS™ comprise a new family of transistors developed by Infineon Technologies AG. "COOLMOS" is a trademark of Infineon Technologies AG."

DYNAMIC CHARACTERISTICS

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{iss}	Input Capacitance	V_{GS} = 0V V_{DS} = 25V f = 1 MHz		2520		pF
C_{oss}	Output Capacitance			670		
C_{rss}	Reverse Transfer Capacitance			40		
Q_g	Total Gate Charge ③	V_{GS} = 10V V_{DD} = 300V I_D = 20A @ 25°C		95		nC
Q_{gs}	Gate-Source Charge			18		
Q_{gd}	Gate-Drain ("Miller") Charge			55		
$t_{d(on)}$	Turn-on Delay Time	**RESISTIVE SWITCHING** V_{GS} = 15V V_{DD} = 380V I_D = 20A @ 25°C R_G = 3.6Ω		12		ns
t_r	Rise Time			15		
$t_{d(off)}$	Turn-off Delay Time			60		
t_f	Fall Time			6.4		
E_{on}	Turn-on Switching Energy ⑥	**INDUCTIVE SWITCHING @ 25°C** V_{DD} = 400V, V_{GS} = 15V I_D = 20A, R_G = 5Ω		180		µJ
E_{off}	Turn-off Switching Energy			60		
E_{on}	Turn-on Switching Energy ⑥	**INDUCTIVE SWITCHING @ 125°C** V_{DD} = 400V, V_{GS} = 15V I_D = 20A, R_G = 5Ω		315		
E_{off}	Turn-off Switching Energy			80		

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

Symbol	Characteristic / Test Conditions		MIN	TYP	MAX	UNIT
I_S	Continuous Source Current (Body Diode)				20	Amps
I_{SM}	Pulsed Source Current ① (Body Diode)				60	
V_{SD}	Diode Forward Voltage ② (V_{GS} = 0V, I_S = -20A)				1.2	Volts
$^{dv}/_{dt}$	Peak Diode Recovery $^{dv}/_{dt}$ ⑤				40	V/ns
t_{rr}	Reverse Recovery Time (I_S = -20A, $^{di}/_{dt}$ = 100A/µs)	T_j = 25°C		180		ns
		T_j = 125°C		260		
Q_{rr}	Reverse Recovery Charge (I_S = -20A, $^{di}/_{dt}$ = 100A/µs)	T_j = 25°C		1.4		µC
		T_j = 125°C		2.5		
I_{RRM}	Peak Recovery Current (I_S = -20A, $^{di}/_{dt}$ = 100A/µs)	T_j = 25°C		15		Amps
		T_j = 125°C		18		

THERMAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case			0.60	°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 µs, Duty Cycle < 2%

③ See MIL-STD-750 Method 3471

④ Starting T_j = +25°C, L = 13.80mH, R_G = 25Ω, 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$20A $^{di}/_{dt} \leq$ 700A/µs $V_R \leq$ 480V $T_J \leq$ 125°C

⑥ Eon 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.

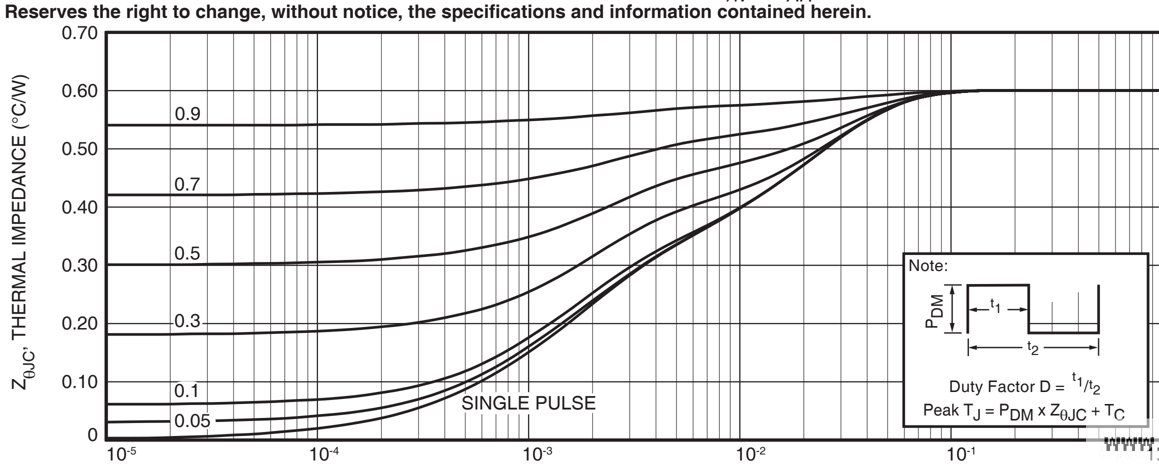


FIGURE 1, MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION

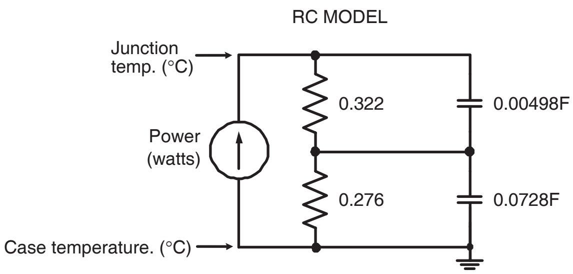


FIGURE 2, TRANSIENT THERMAL IMPEDANCE MODEL

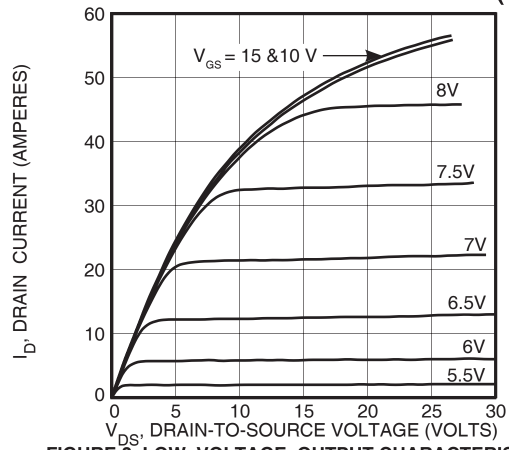


FIGURE 3, LOW VOLTAGE OUTPUT CHARACTERISTICS

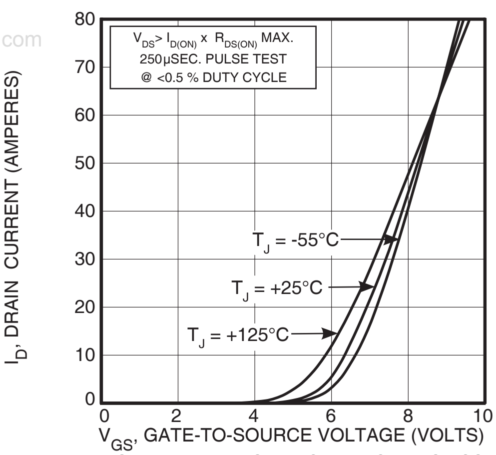


FIGURE 4, TRANSFER CHARACTERISTICS

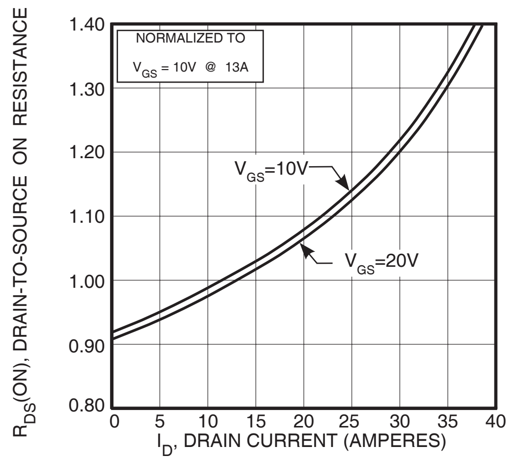


FIGURE 5, R_{DS}(ON) vs DRAIN CURRENT

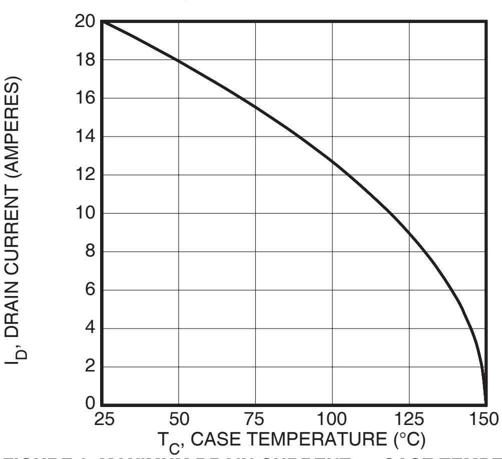


FIGURE 6, MAXIMUM DRAIN CURRENT vs CASE TEMPERATURE

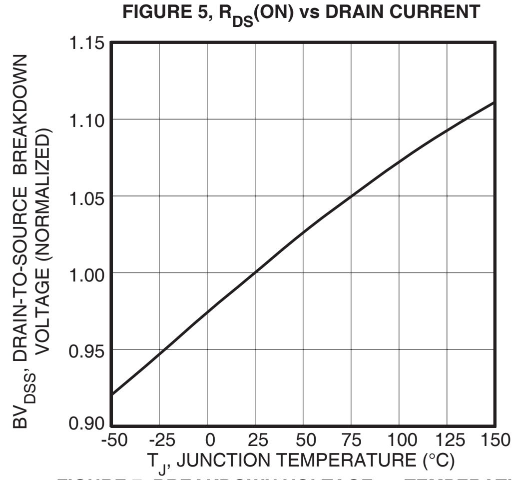


FIGURE 7, BREAKDOWN VOLTAGE vs TEMPERATURE

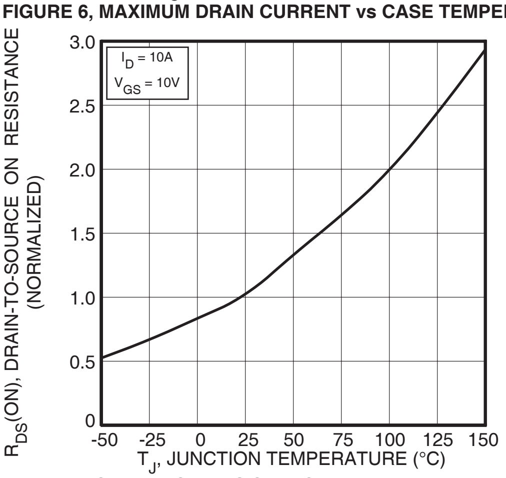


FIGURE 8, ON-RESISTANCE vs. TEMPERATURE

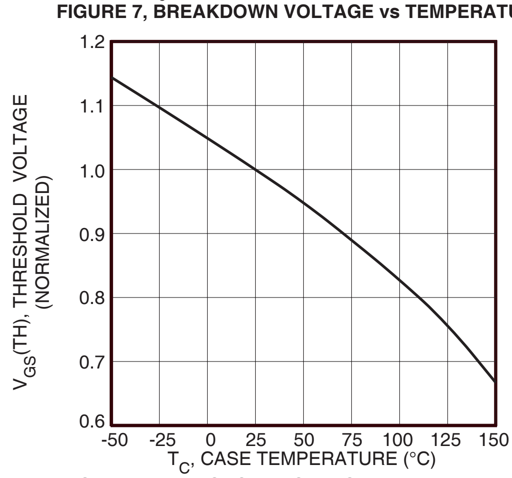


FIGURE 9, THRESHOLD VOLTAGE vs TEMPERATURE

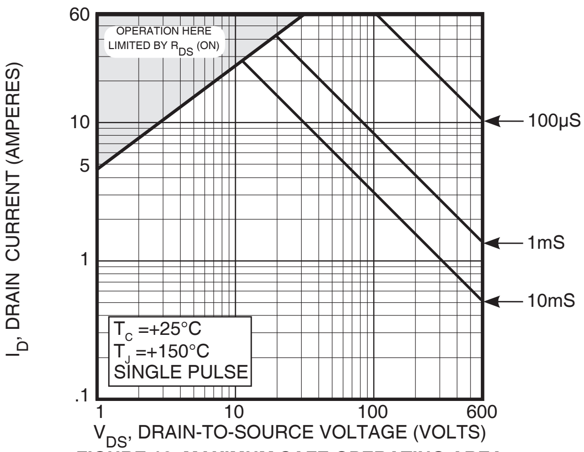


FIGURE 10, MAXIMUM SAFE OPERATING AREA

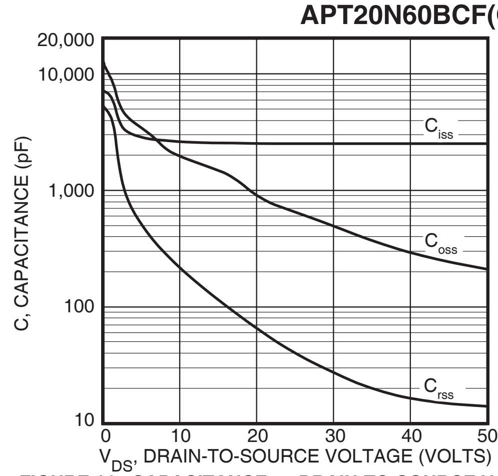


FIGURE 11, CAPACITANCE vs DRAIN-TO-SOURCE VOLTAGE

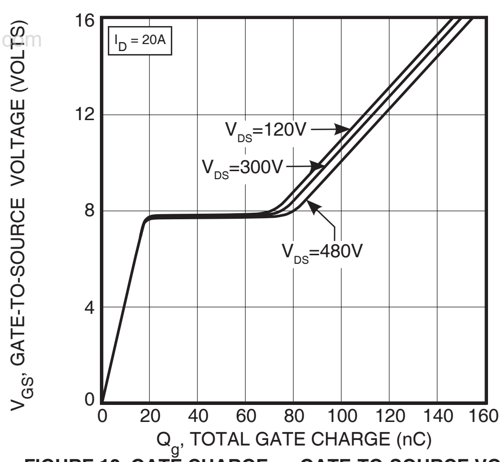


FIGURE 12, GATE CHARGE vs GATE-TO-SOURCE VOLTAGE

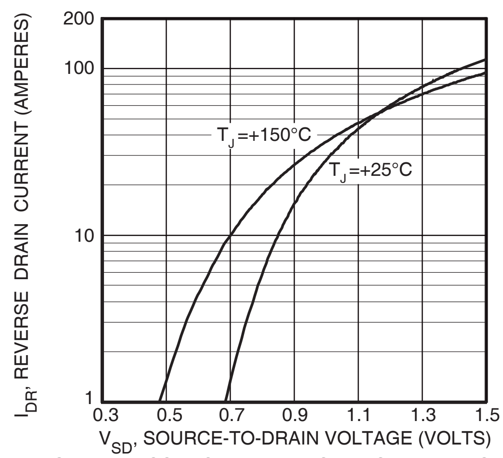


FIGURE 13, SOURCE-DRAIN DIODE FORWARD VOLTAGE

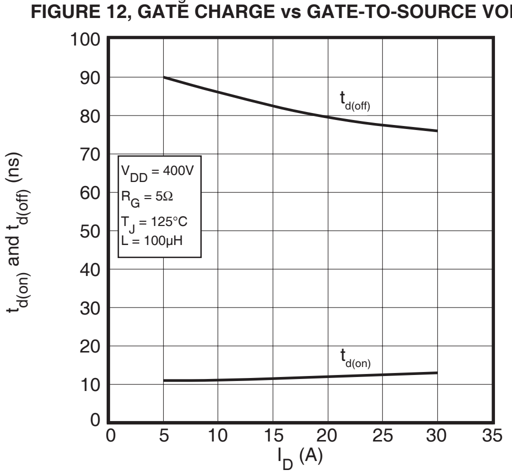


FIGURE 14, DELAY TIMES vs CURRENT

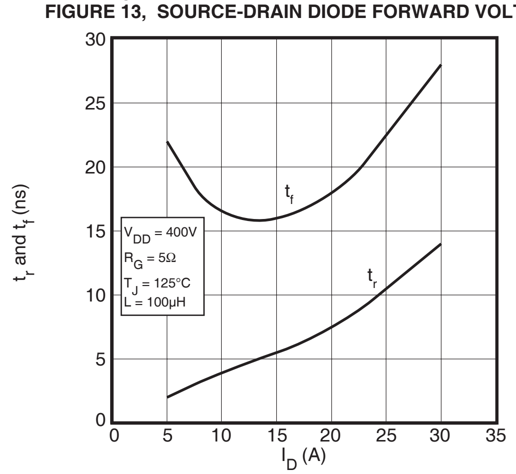


FIGURE 15, RISE AND FALL TIMES vs CURRENT

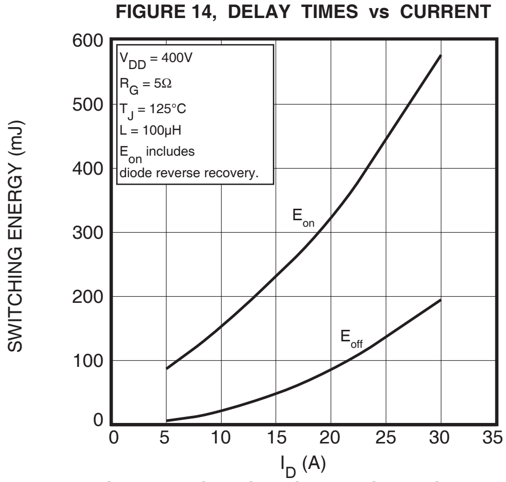


FIGURE 16, SWITCHING ENERGY vs CURRENT

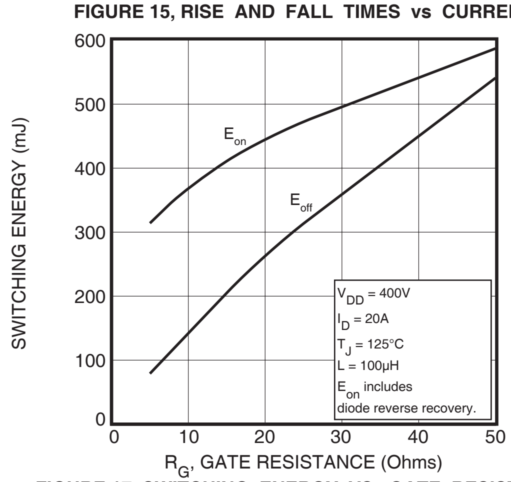


FIGURE 17, SWITCHING ENERGY VS. GATE RESISTANCE

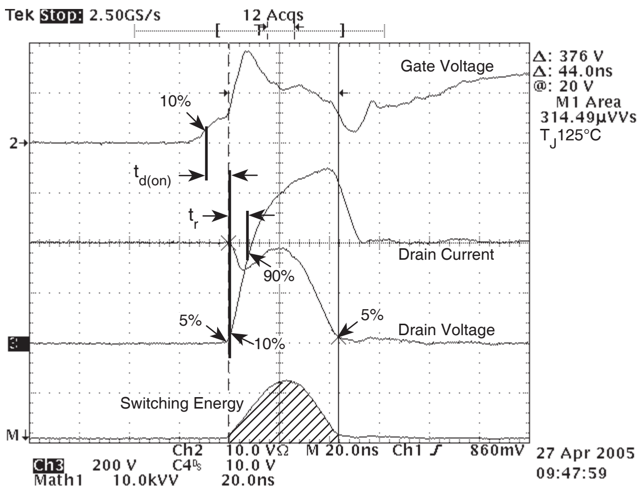


Figure 18, Turn-on Switching Waveforms and Definitions

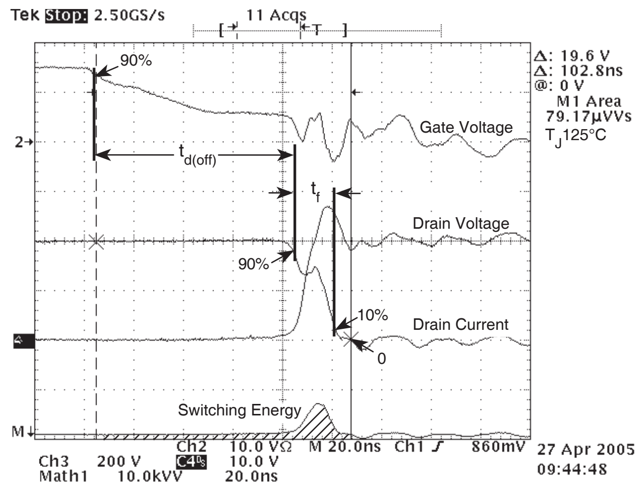


Figure 19, Turn-off Switching Waveforms and Definitions

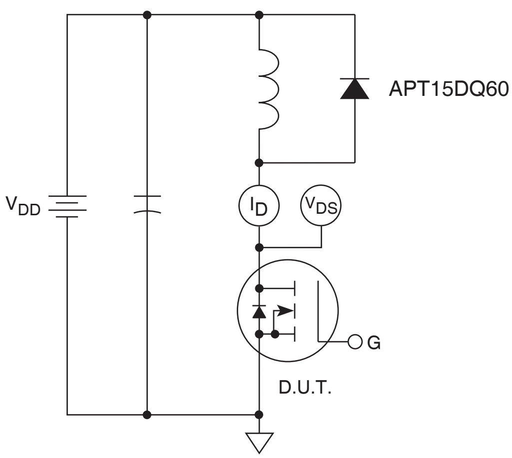
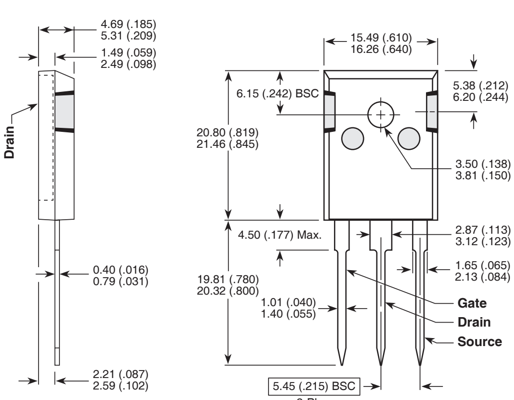


Figure 20, Inductive Switching Test Circuit

TO-247 Package Outline

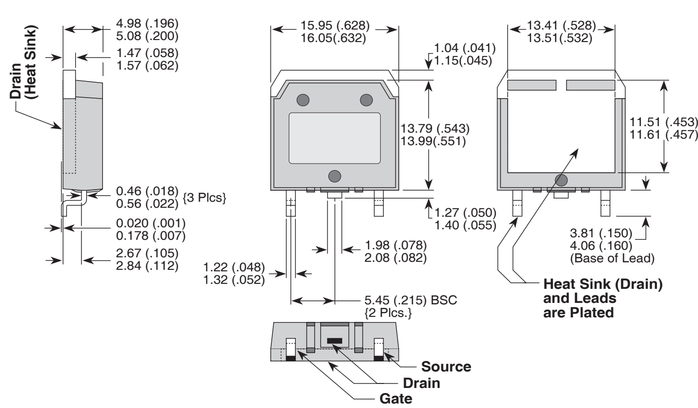
(e1) SAC: Tin, Silver, Copper



Dimensions in Millimeters and (Inches)

D^{3}PAK Package Outline

(e3) 100% Sn



Dimensions in Millimeters (Inches)

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.