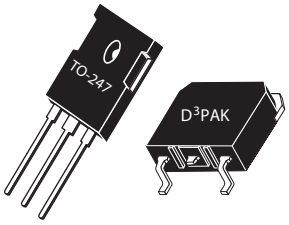
# APT47N65BC3
# APT47N65SC3

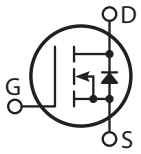
**650V 47A 0.070Ω**

COOLMOS Power Semiconductors

## Super Junction MOSFET




- **Ultra low $R_{DS(ON)}$**
- **Increased Power Dissipation**
- **Low Miller Capacitance**
- **Ultra Low Gate Charge, $Q_g$**
- **Avalanche Energy Rated**
- **TO-247 or Surface Mount D³PAK Package**




### MAXIMUM RATINGS

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

| Symbol | Parameter | APT47N65B_SC3 | UNIT |
|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | 650 | Volts |
| $I_D$ | Continuous Drain Current @ $T_C$ = 25°C | 47 | Amps |
| $I_{DM}$ | Pulsed Drain Current [1] | 141 | |
| $V_{GS}$ | Gate-Source Voltage Continuous | ±20 | Volts |
| $V_{GSM}$ | Gate-Source Voltage Transient | ±30 | |
| $P_D$ | Total Power Dissipation @ $T_C$ = 25°C | 417 | Watts |
| | Linear Derating Factor | 3.33 | 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, $I_D$ = 47A, $T_J$ = 125°C) | 50 | V/ns |
| $I_{AR}$ | Repetitive Avalanche Current [7] ++++Repetitive Avalanche Energy [7] | 20 | Amps |
| $E_{AR}$ | Single Pulse Avalanche Energy [4] | 1 | mJ |
| $E_{AS}$ | Single Pulse Avalanche Energy [4] | 1800 | |

### STATIC ELECTRICAL CHARACTERISTICS

| Symbol | Characteristic / Test Conditions | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-Source Breakdown Voltage ($V_{GS}$ = 0V, $I_D$ = 250µA) | 650 | | | Volts |
| $R_{DS(on)}$ | Drain-Source On-State Resistance [2] ($V_{GS}$ = 10V, $I_D$ = 30A) | | 0.06 | 0.07 | Ohms |
| $I_{DSS}$ | Zero Gate Voltage Drain Current ($V_{DS}$ = 650V, $V_{GS}$ = 0V) | | 0.5 | 25 | µA |
| | Zero Gate Voltage Drain Current ($V_{DS}$ = 650V, $V_{GS}$ = 0V, $T_J$ = 150°C) | | | 250 | |
| $I_{GSS}$ | Gate-Source Leakage Current ($V_{GS}$ = ±20V, $V_{DS}$ = 0V) | | | ±100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage ($V_{DS}$ = $V_{GS}$, $I_D$ = 2.7mA) | 2.10 | 3 | 3.9 | Volts |

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

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## DYNAMIC CHARACTERISTICS

**APT47N65BC3**

| Symbol | Characteristic | Test Conditions | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input Capacitance | $V_{GS}$ = 0V<br>$V_{DS}$ = 25V<br>f = 1 MHz | | 6965 | 8355 | pF |
| $C_{oss}$ | Output Capacitance | | | 2100 | 2940 | |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 85 | 127 | |
| $Q_g$ | Total Gate Charge [3] | $V_{GS}$ = 10V<br>$V_{DD}$ = 300V<br>$I_D$ = 47A @ 25°C | | 250 | 375 | nC |
| $Q_{gs}$ | Gate-Source Charge | | | 30 | 45 | |
| $Q_{gd}$ | Gate-Drain ("Miller") Charge | | | 105 | 157 | |
| $t_{d(on)}$ | Turn-on Delay Time | **INDUCTIVE SWITCHING**<br>$V_{GS}$ = 13V<br>$V_{DD}$ = 380V<br>$I_D$ = 47A @ 125°C<br>$R_G$ = 5Ω | | 18 | 36 | ns |
| $t_r$ | Rise Time | | | 28 | 56 | |
| $t_{d(off)}$ | Turn-off Delay Time | | | 295 | 442 | |
| $t_f$ | Fall Time | | | 84 | 168 | |
| $E_{on}$ | Turn-on Switching Energy [6] | **INDUCTIVE SWITCHING @ 25°C**<br>$V_{DD}$ = 400V, $V_{GS}$ = 15V<br>$I_D$ = 47A, $R_G$ = 5Ω | | 810 | 1620 | µJ |
| $E_{off}$ | Turn-off Switching Energy | | | 840 | 1680 | |
| $E_{on}$ | Turn-on Switching Energy [6] | **INDUCTIVE SWITCHING @ 125°C**<br>$V_{DD}$ = 400V $V_{GS}$ = 15V<br>$I_D$ = 47A, $R_G$ = 5Ω | | 1172 | 1758 | |
| $E_{off}$ | Turn-off Switching Energy | | | 985 | 1970 | |

## SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

| Symbol | Characteristic / Test Conditions | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current (Body Diode) | | | 47 | Amps |
| $I_{SM}$ | Pulsed Source Current [1] (Body Diode) | | | 141 | |
| $V_{SD}$ | Diode Forward Voltage [2] ($V_{GS}$ = 0V, $I_S$ = -47A) | | | 1.2 | Volts |
| $t_{rr}$ | Reverse Recovery Time ($I_S$ = -47A, $dI_S/dt$ = 100A/µs, $V_R$ = 350V) | | 580 | 650 | ns |
| $Q_{rr}$ | Reverse Recovery Charge ($I_S$ = -47A, $dI_S/dt$ = 100A/µs, $V_R$ = 350V) | | 23 | 16.5 | µC |
| $^{dv}/_{dt}$ | Peak Diode Recovery $^{dv}/_{dt}$ [5] | | | 6 | V/ns |

## THERMAL CHARACTERISTICS

| Symbol | Characteristic | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction to Case | | | 0.30 | °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 = 36.0mH, $R_G$ = 25Ω, Peak $I_L$ = 10A

⑤ $^{dv}/_{dt}$ numbers reflect the limitations of the test circuit rather than the device itself. $I_S$ = $-I_D$47A , $^{di}/_{dt}$ = 700A/µs $V_R = V_{DSS}$, $T_J$ = 150°C

⑥ Eon includes diode reverse recovery. See figures 18, 20.

⑦ Repetitve avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR}*f$



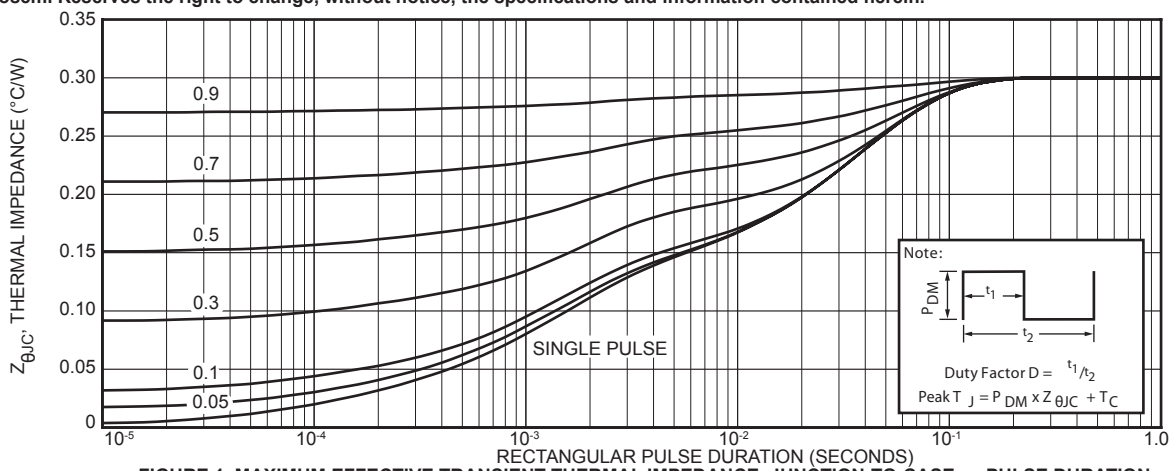



**FIGURE 1, MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION**

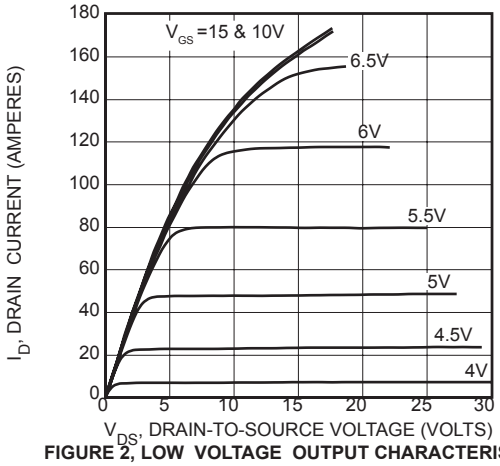



**FIGURE 2, LOW VOLTAGE OUTPUT CHARACTERISTICS**

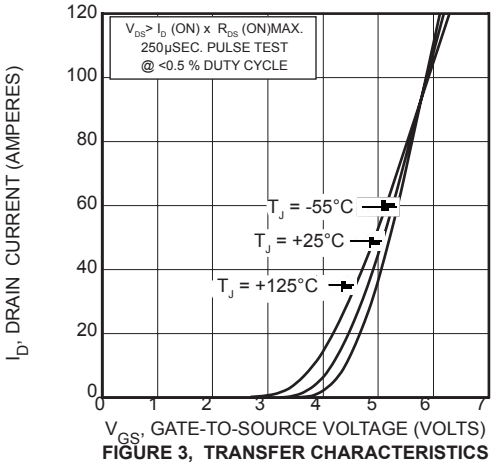



**FIGURE 3, TRANSFER CHARACTERISTICS**

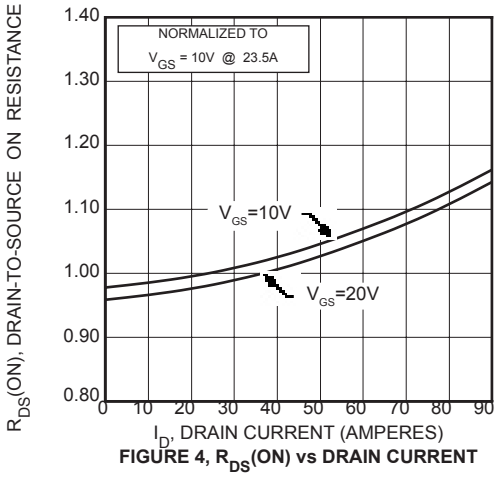



**FIGURE 4, $R_{DS}$(ON) vs DRAIN CURRENT**

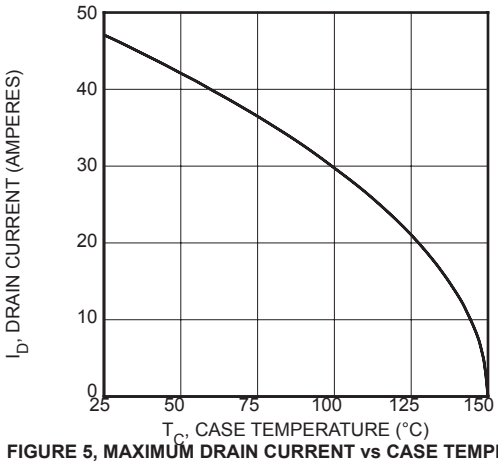



**FIGURE 5, MAXIMUM DRAIN CURRENT vs CASE TEMPERATURE**

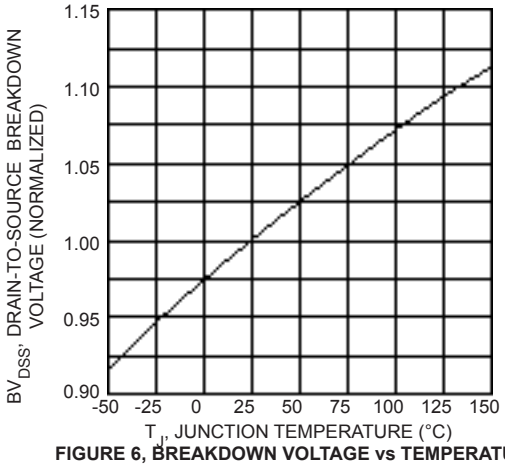



**FIGURE 6, BREAKDOWN VOLTAGE vs TEMPERATURE**

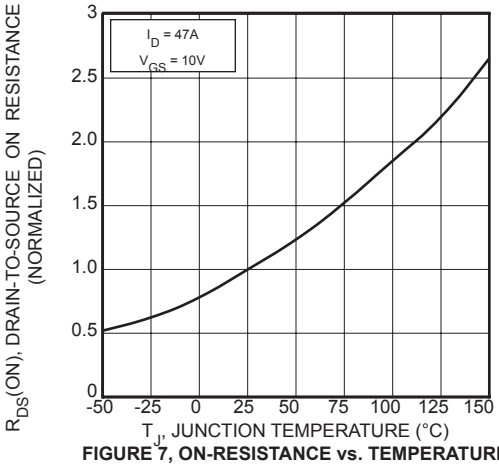



**FIGURE 7, ON-RESISTANCE vs. TEMPERATURE**

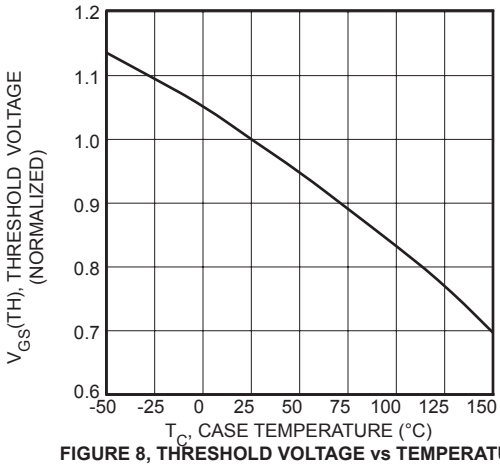



**FIGURE 8, THRESHOLD VOLTAGE vs TEMPERATURE**

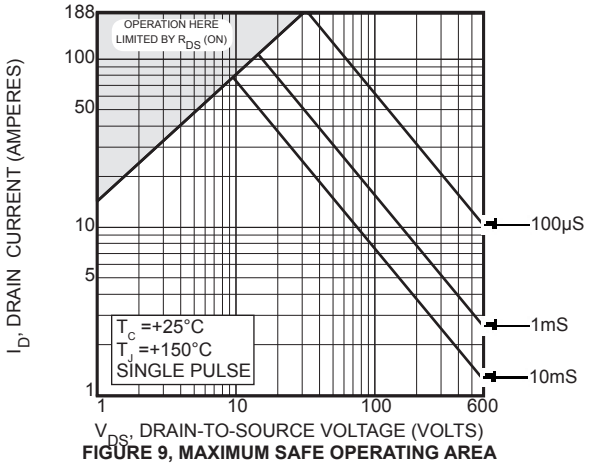



FIGURE 9, MAXIMUM SAFE OPERATING AREA

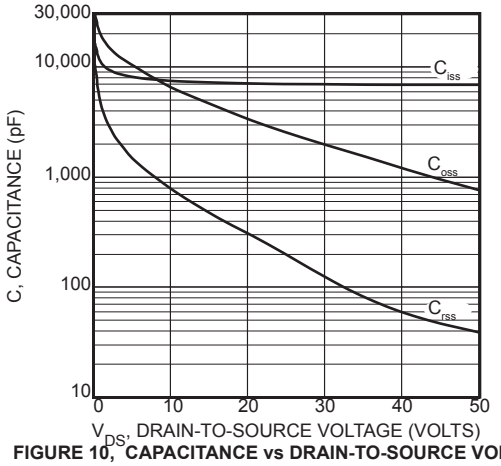



FIGURE 10, CAPACITANCE vs DRAIN-TO-SOURCE VOLTAGE

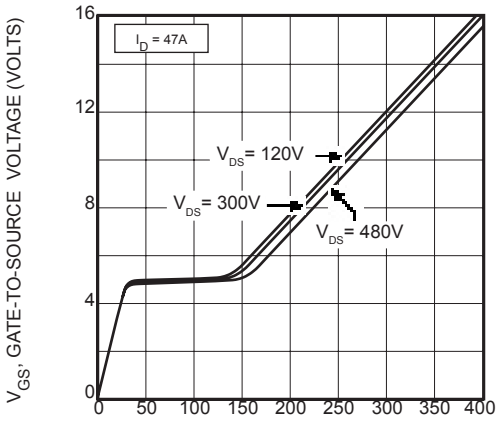



FIGURE 11, GATE CHARGES vs GATE-TO-SOURCE VOLTAGE

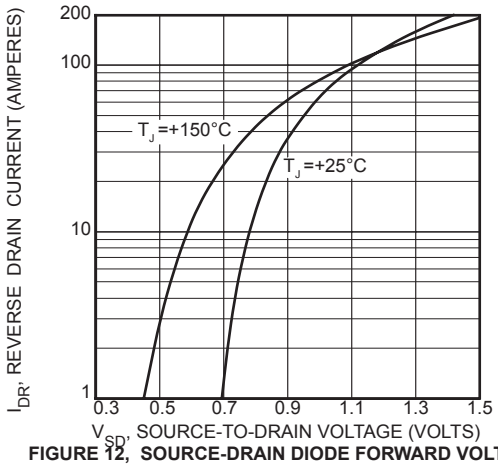



FIGURE 12, SOURCE-DRAIN DIODE FORWARD VOLTAGE

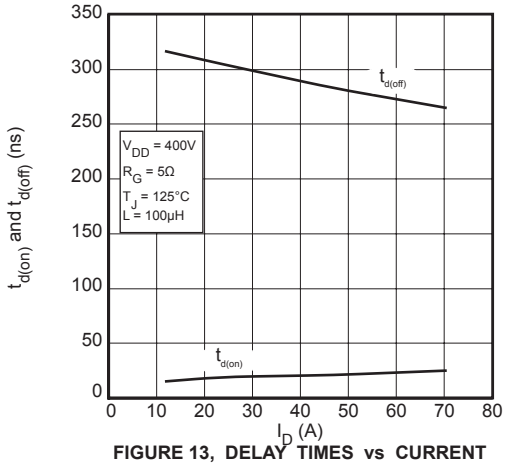



FIGURE 13, DELAY TIMES vs CURRENT

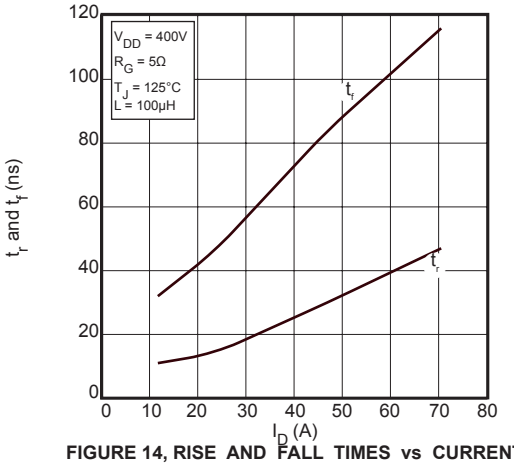



FIGURE 14, RISE AND FALL TIMES vs CURRENT

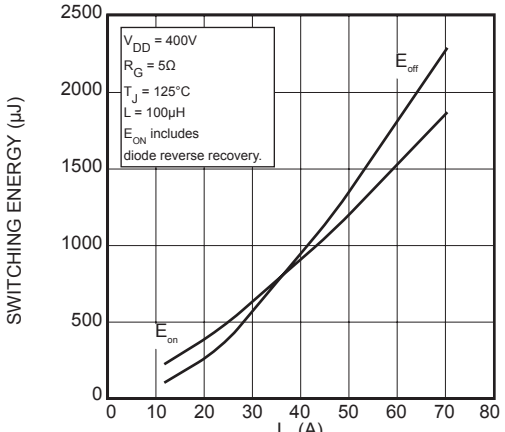



FIGURE 15, SWITCHING ENERGY vs CURRENT

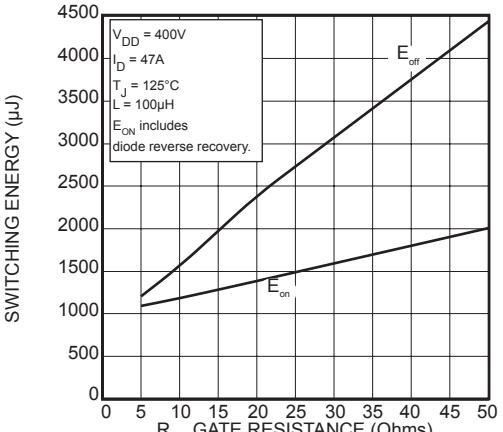



FIGURE 16, SWITCHING ENERGY VS. GATE RESISTANCE

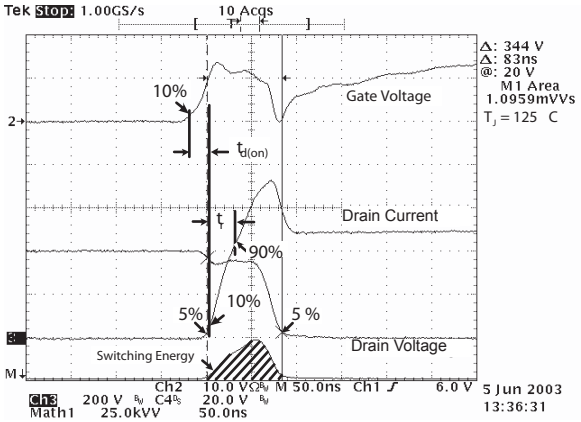



**Figure 18, Turn-on Switching Waveforms and Definitions**

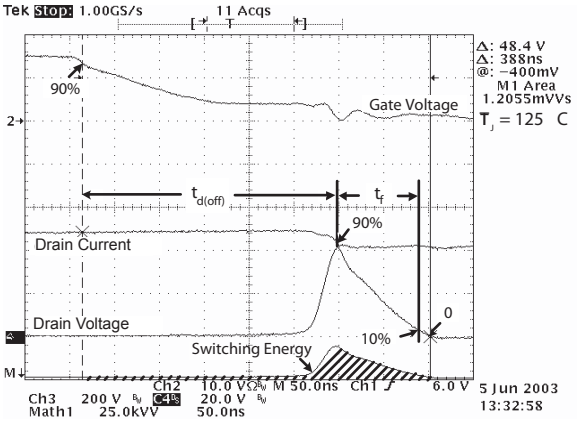



**Figure 19, Turn-off Switching Waveforms and Definitions**

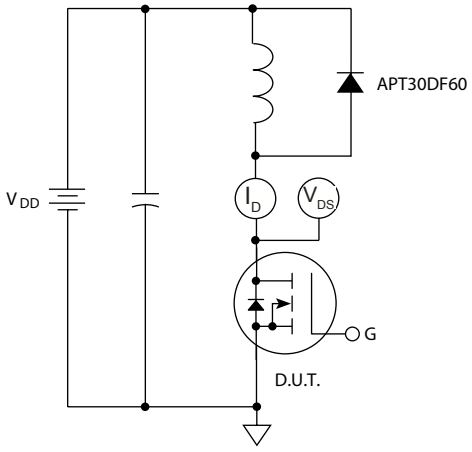
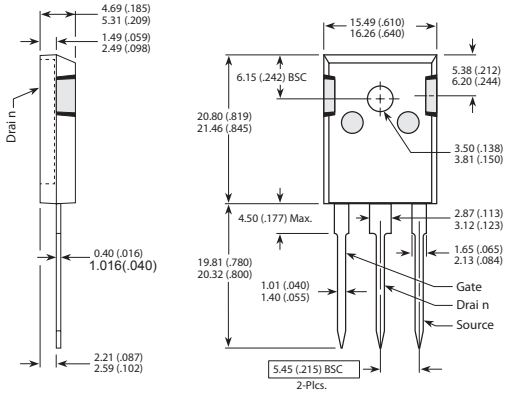


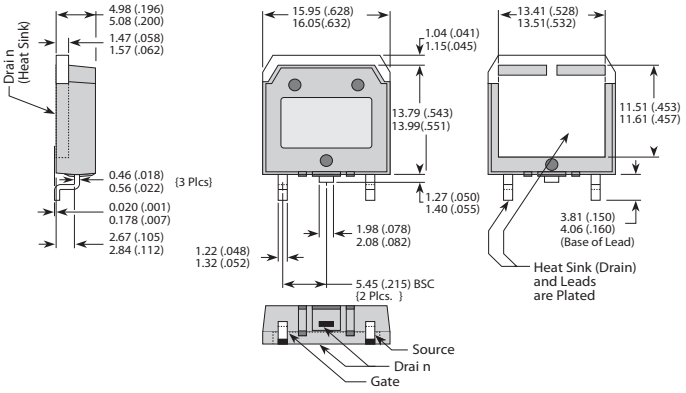

Figure 20, Inductive Switching Test Circuit

## TO-247 Package Outline




## D³PAK (S) Package Outline

e3 100% SN Plated



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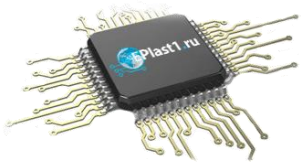


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