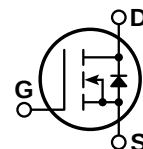


## POWER MOS 7® FREDFET

Power MOS 7® is a new generation of low loss, high voltage, N-Channel enhancement mode power MOSFETS. Both conduction and switching losses are addressed with Power MOS 7® by significantly lowering  $R_{DS(ON)}$  and  $Q_g$ . Power MOS 7® combines lower conduction and switching losses along with exceptionally fast switching speeds inherent with APT's patented metal gate structure.



- Lower Input Capacitance
- Lower Miller Capacitance
- Lower Gate Charge,  $Q_g$
- Increased Power Dissipation
- Easier To Drive
- Popular SOT-227 Package
- **FAST RECOVERY BODY DIODE**



### MAXIMUM RATINGS

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

| Symbol         | Parameter                                                      | APT10045JFLL | UNIT                |
|----------------|----------------------------------------------------------------|--------------|---------------------|
| $V_{DSS}$      | Drain-Source Voltage                                           | 1000         | Volts               |
| $I_D$          | Continuous Drain Current @ $T_C = 25^\circ\text{C}$            | 21           | Amps                |
| $I_{DM}$       | Pulsed Drain Current <sup>①</sup>                              | 84           |                     |
| $V_{GS}$       | Gate-Source Voltage Continuous                                 | $\pm 30$     | Volts               |
| $V_{GSM}$      | Gate-Source Voltage Transient                                  | $\pm 40$     |                     |
| $P_D$          | Total Power Dissipation @ $T_C = 25^\circ\text{C}$             | 460          | Watts               |
|                | Linear Derating Factor                                         | 3.68         | 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) | 21           | 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 ( $V_{GS} = 0V, I_D = 250\mu A$ )                                   | 1000 |     |           | Volts   |
| $I_{D(on)}$  | On State Drain Current <sup>②</sup> ( $V_{DS} > I_{D(on)} \times R_{DS(on)}$ Max, $V_{GS} = 10V$ ) | 21   |     |           | Amps    |
| $R_{DS(on)}$ | Drain-Source On-State Resistance <sup>②</sup> ( $V_{GS} = 10V, I_D = 11.5A$ )                      |      |     | 0.450     | Ohms    |
| $I_{DSS}$    | Zero Gate Voltage Drain Current ( $V_{DS} = 1000V, V_{GS} = 0V$ )                                  |      |     | 250       | $\mu A$ |
|              | Zero Gate Voltage Drain Current ( $V_{DS} = 800V, V_{GS} = 0V, T_C = 125^\circ\text{C}$ )          |      |     | 1000      |         |
| $I_{GSS}$    | Gate-Source Leakage Current ( $V_{GS} = \pm 30V, V_{DS} = 0V$ )                                    |      |     | $\pm 100$ | nA      |
| $V_{GS(th)}$ | Gate Threshold Voltage ( $V_{DS} = V_{GS}, I_D = 2.5mA$ )                                          | 3    |     | 5         | Volts   |

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

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

# DYNAMIC CHARACTERISTICS

APT10045JFLL

| Symbol       | Characteristic               | Test Conditions                                                                                                  | MIN | TYP  | MAX | UNIT    |
|--------------|------------------------------|------------------------------------------------------------------------------------------------------------------|-----|------|-----|---------|
| $C_{iss}$    | Input Capacitance            | $V_{GS} = 0V$<br>$V_{DS} = 25V$<br>$f = 1\text{ MHz}$                                                            |     | 4350 |     | pF      |
| $C_{oss}$    | Output Capacitance           |                                                                                                                  |     | 715  |     |         |
| $C_{rss}$    | Reverse Transfer Capacitance |                                                                                                                  |     | 120  |     |         |
| $Q_g$        | Total Gate Charge ③          | $V_{GS} = 10V$<br>$V_{DD} = 500V$<br>$I_D = 23A @ 25^\circ C$                                                    |     | 154  |     | nC      |
| $Q_{gs}$     | Gate-Source Charge           |                                                                                                                  |     | 26   |     |         |
| $Q_{gd}$     | Gate-Drain ("Miller") Charge |                                                                                                                  |     | 97   |     |         |
| $t_{d(on)}$  | Turn-on Delay Time           | <b>RESISTIVE SWITCHING</b><br>$V_{GS} = 15V$<br>$V_{DD} = 500V$<br>$I_D = 23A @ 25^\circ C$<br>$R_G = 0.6\Omega$ |     | 10   |     | ns      |
| $t_r$        | Rise Time                    |                                                                                                                  |     | 5    |     |         |
| $t_{d(off)}$ | Turn-off Delay Time          |                                                                                                                  |     | 30   |     |         |
| $t_f$        | Fall Time                    |                                                                                                                  |     | 8    |     |         |
| $E_{on}$     | Turn-on Switching Energy ⑥   | <b>INDUCTIVE SWITCHING @ 25°C</b><br>$V_{DD} = 670V, V_{GS} = 15V$<br>$I_D = 23A, R_G = 5\Omega$                 |     | 639  |     | $\mu J$ |
| $E_{off}$    | Turn-off Switching Energy    |                                                                                                                  |     | 380  |     |         |
| $E_{on}$     | Turn-on Switching Energy ⑥   | <b>INDUCTIVE SWITCHING @ 125°C</b><br>$V_{DD} = 670V, V_{GS} = 15V$<br>$I_D = 23A, R_G = 5\Omega$                |     | 1046 |     |         |
| $E_{off}$    | Turn-off Switching Energy    |                                                                                                                  |     | 451  |     |         |

# SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

| Symbol    | Characteristic / Test Conditions                                | MIN                 | TYP  | MAX | UNIT    |
|-----------|-----------------------------------------------------------------|---------------------|------|-----|---------|
| $I_S$     | Continuous Source Current (Body Diode)                          |                     |      | 23  | Amps    |
| $I_{SM}$  | Pulsed Source Current ① (Body Diode)                            |                     |      | 92  |         |
| $V_{SD}$  | Diode Forward Voltage ② ( $V_{GS} = 0V, I_S = -21A$ )           |                     |      | 1.3 | Volts   |
| $dv/dt$   | Peak Diode Recovery $dv/dt$ ⑤                                   |                     |      | 18  | V/ns    |
| $t_{rr}$  | Reverse Recovery Time<br>( $I_S = -21A, di/dt = 100A/\mu s$ )   | $T_J = 25^\circ C$  |      | 340 | ns      |
|           |                                                                 | $T_J = 125^\circ C$ |      | 640 |         |
| $Q_{rr}$  | Reverse Recovery Charge<br>( $I_S = -21A, di/dt = 100A/\mu s$ ) | $T_J = 25^\circ C$  | 1.78 |     | $\mu C$ |
|           |                                                                 | $T_J = 125^\circ C$ | 4.47 |     |         |
| $I_{RRM}$ | Peak Recovery Current<br>( $I_S = -21A, di/dt = 100A/\mu s$ )   | $T_J = 25^\circ C$  | 11.4 |     | Amps    |
|           |                                                                 | $T_J = 125^\circ C$ | 16.4 |     |         |

# THERMAL CHARACTERISTICS

| Symbol          | Characteristic      | MIN | TYP | MAX  | UNIT         |
|-----------------|---------------------|-----|-----|------|--------------|
| $R_{\theta JC}$ | Junction to Case    |     |     | 0.27 | $^\circ C/W$ |
| $R_{\theta JA}$ | Junction to Ambient |     |     | 40   |              |

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  $T_J = +25^\circ C$ ,  $L = 11.34mH$ ,  $R_G = 25\Omega$ , Peak  $I_L = 21A$

⑤  $dv/dt$  numbers reflect the limitations of the test circuit rather than the device itself.  $I_S \leq -I_D 21A$   $di/dt \leq 700A/\mu s$   $V_R \leq V_{DSS}$   $T_J \leq 150^\circ C$

⑥  $E_{on}$  includes diode reverse recovery. See figures 18, 20.

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

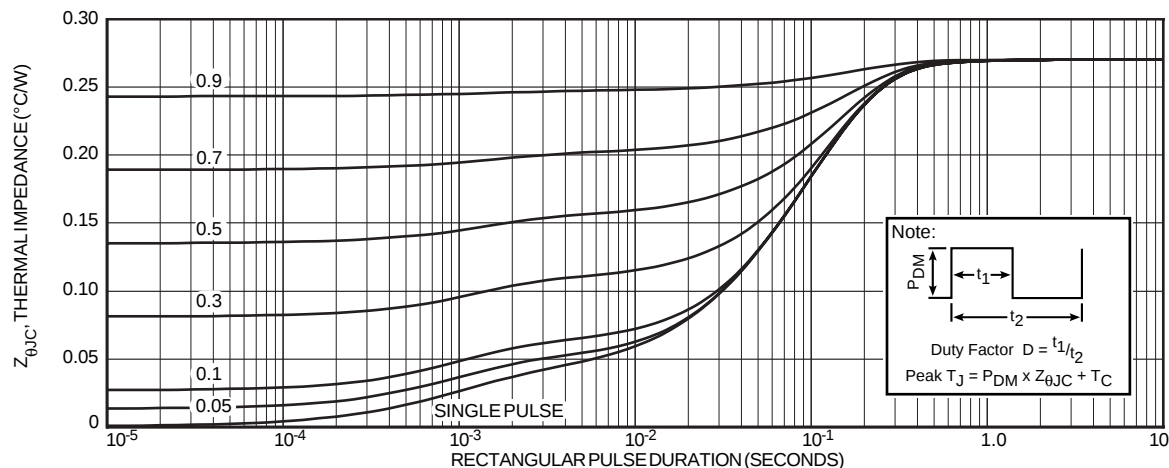


FIGURE 1, MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION

# Typical Performance Curves

APT10045JFLL

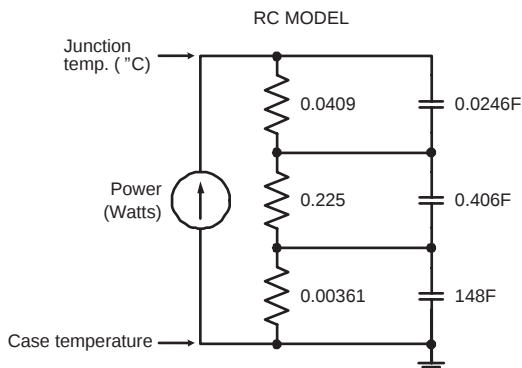


FIGURE 2, TRANSIENT THERMAL IMPEDANCE MODEL

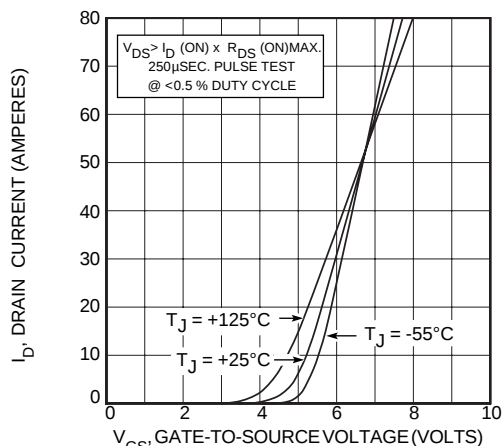


FIGURE 4, TRANSFER CHARACTERISTICS

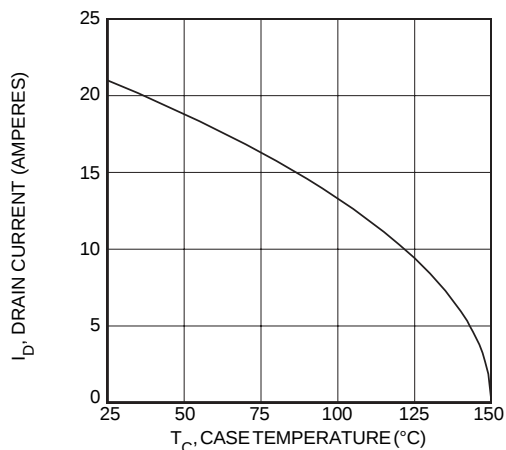


FIGURE 6, MAXIMUM DRAIN CURRENT vs CASE TEMPERATURE

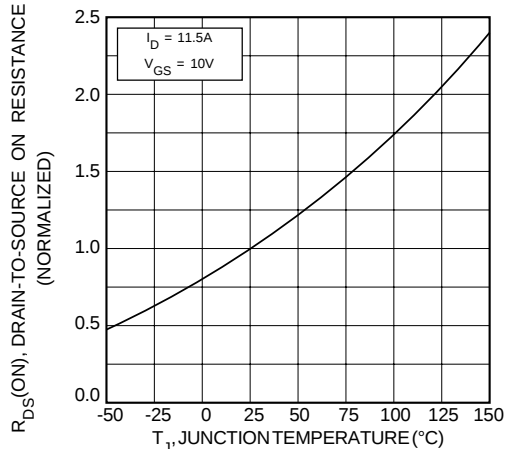


FIGURE 8, ON-RESISTANCE vs. TEMPERATURE

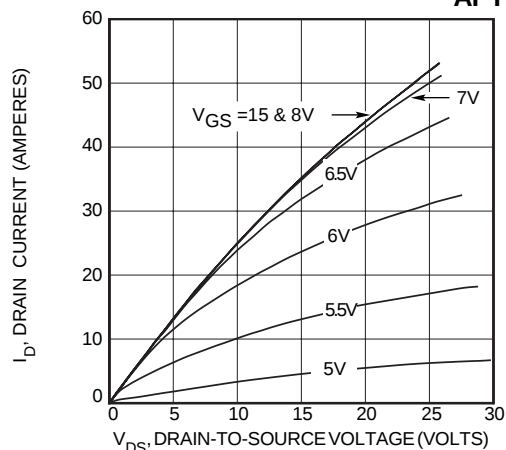


FIGURE 3, LOW VOLTAGE OUTPUT CHARACTERISTICS

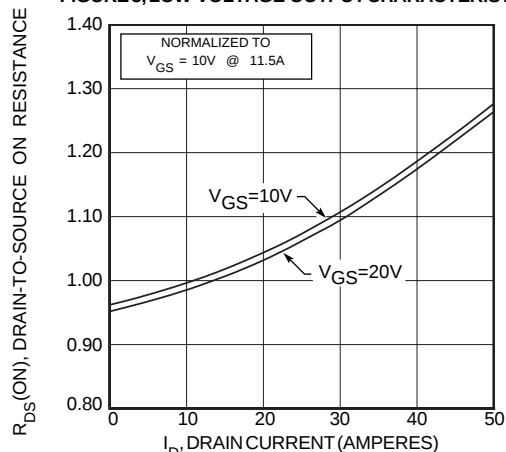


FIGURE 5,  $R_{DS}(\text{ON})$  vs DRAIN CURRENT

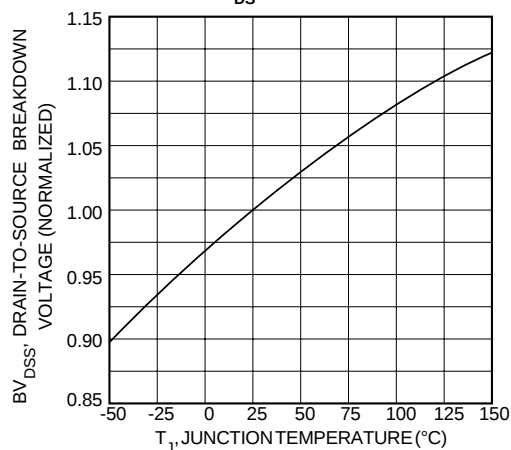


FIGURE 7, BREAKDOWN VOLTAGE vs TEMPERATURE

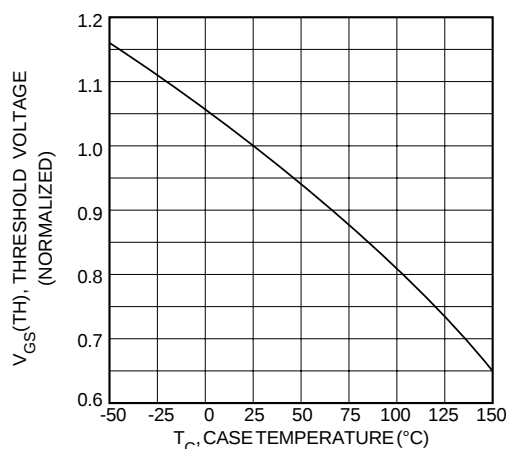


FIGURE 9, THRESHOLD VOLTAGE vs TEMPERATURE

# Typical Performance Curves

APT10045JFLL

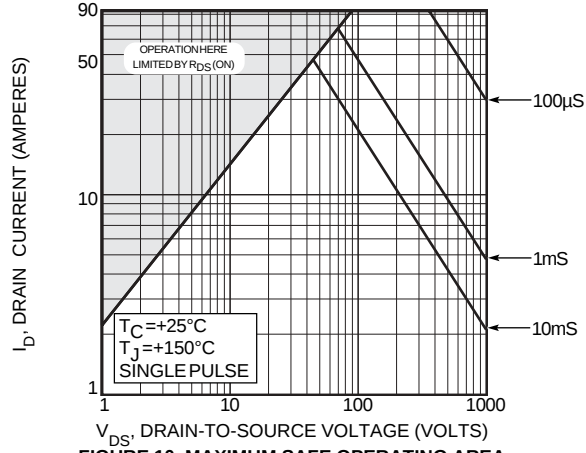


FIGURE 10, MAXIMUM SAFE OPERATING AREA

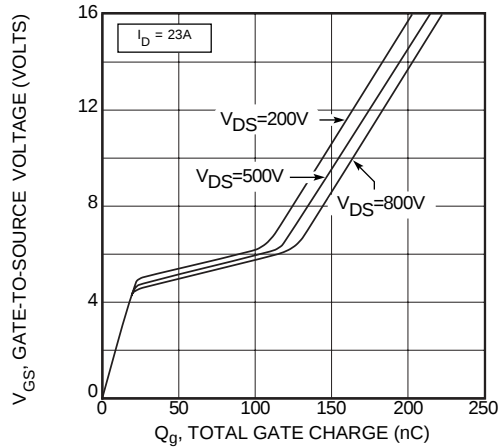


FIGURE 12, GATE CHARGES vs GATE-TO-SOURCE VOLTAGE

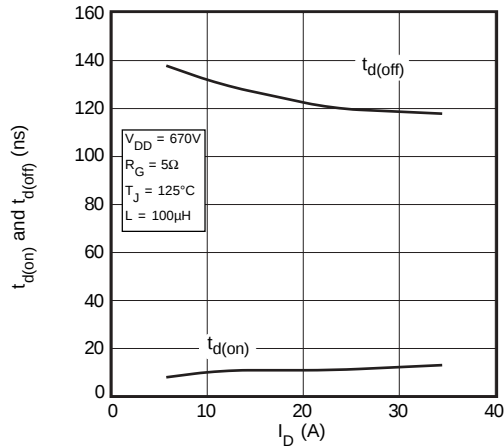


FIGURE 14, DELAY TIMES vs CURRENT

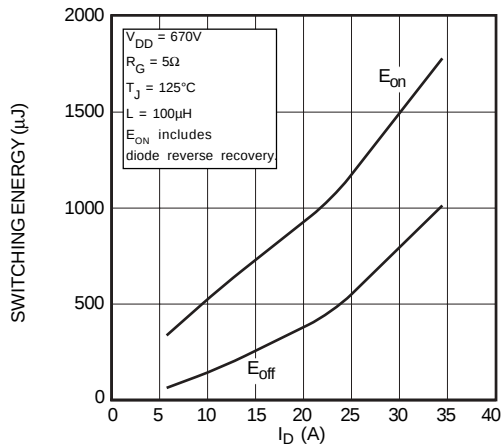


FIGURE 16, SWITCHING ENERGY vs CURRENT

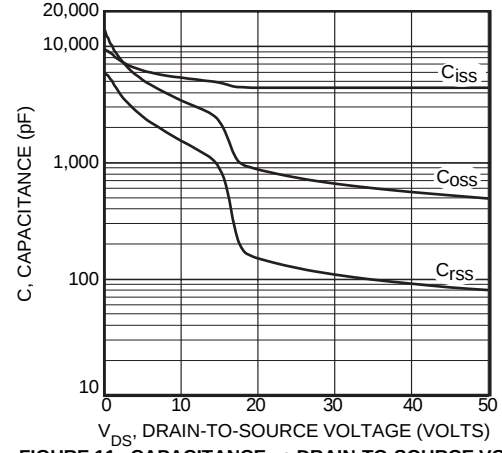


FIGURE 11, CAPACITANCE vs DRAIN-TO-SOURCE VOLTAGE

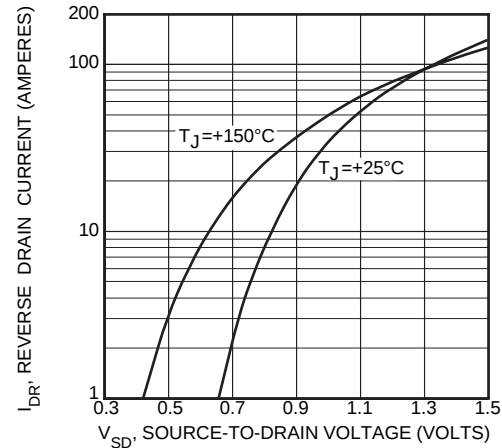


FIGURE 13, SOURCE-DRAIN DIODE FORWARD VOLTAGE

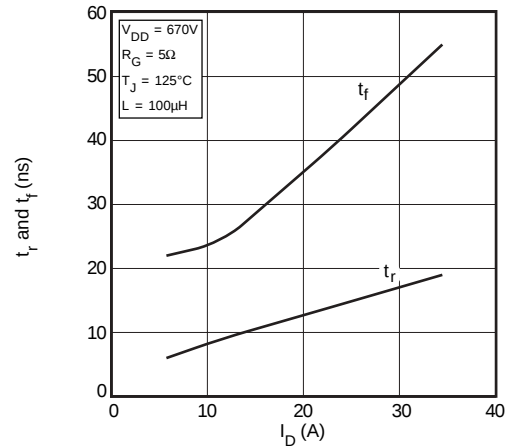


FIGURE 15, RISE AND FALL TIMES vs CURRENT

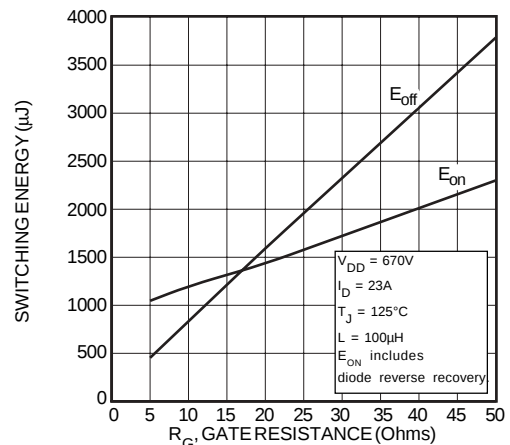


FIGURE 17, SWITCHING ENERGY VS. GATE RESISTANCE

$V_{DS} = 22.4\text{ V}$   
 $I_{DS} = 16.5\text{ mA}$   
 $V_{GS} = 8\text{ V}$   
 $M1\text{ Area} = 451\mu\text{m}^2$   
 $T_J = 125\text{ }^{\circ}\text{C}$

Gate Voltage  
 Drain Voltage  
 Drain Current

$t_{d(off)}$   
 $t_f$   
 $t_r$

Switching Energy

Ch1 Math1 500V 100kV 20.9V 50.0ms 15 Feb 2013 12:28:23

The drawing illustrates the mechanical specifications of the 4000 Series MOSFET package. It includes three views: a top view, a side view, and a detail view of the terminal connections.

**Top View Dimensions:**

- Overall width: 31.5 (1.240) mm, 31.7 (1.248) mm
- Distance between mounting holes: 7.8 (.307) mm, 8.2 (.322) mm
- Mounting hole diameter:  $r = 4.0$  (.157) mm (2 places)
- Terminal pitch: 4.0 (.157) mm, 4.2 (.165) mm (2 places)
- Terminal width: 3.3 (.129) mm, 3.6 (.143) mm
- Distance between source and gate terminals: 14.9 (.587) mm, 15.1 (.594) mm
- Distance between source and drain terminals: 30.1 (1.185) mm, 30.3 (1.193) mm
- Overall length: 38.0 (1.496) mm, 38.2 (1.504) mm

**Side View Dimensions:**

- Lead height: 11.8 (.463) mm, 12.2 (.480) mm
- Lead thickness: 8.9 (.350) mm, 9.6 (.378) mm
- Hex Nut M4 (4 places)
- Lead width: 0.75 (.030) mm, 12.6 (.496) mm
- Lead thickness: 0.85 (.033) mm, 12.8 (.504) mm
- Lead height: 25.2 (0.992) mm, 25.4 (1.000) mm

**Detail View Dimensions:**

- Distance between source and gate terminals: 1.95 (.077) mm, 2.14 (.084) mm

**Terminal Identification:**

- \* Source**: Points to the source terminal.
- Drain**: Points to the drain terminal.
- \* Source**: Points to the source terminal.
- Gate**: Points to the gate terminal.

**Note:** \* Source terminals are shorted internally. Current handling capability is equal for either Source terminal.

**Dimensions in Millimeters and (Inches)**