

GENERAL DESCRIPTION

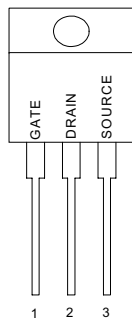
This high voltage MOSFET uses an advanced termination scheme to provide enhanced voltage-blocking capability without degrading performance over time. In addition, this advanced MOSFET is designed to withstand high energy in avalanche and commutation modes. The new energy efficient design also offers a drain-to-source diode with a fast recovery time. Designed for high voltage, high speed switching applications in power supplies, converters and PWM motor controls, these devices are particularly well suited for bridge circuits where diode speed and commutating safe operating areas are critical and offer additional and safety margin against unexpected voltage transients.

FEATURES

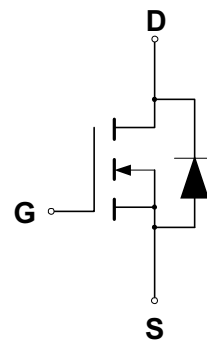
- ◆ Robust High Voltage Termination
- ◆ Avalanche Energy Specified
- ◆ Source-to-Drain Diode Recovery Time Comparable to a Discrete Fast Recovery Diode
- ◆ Diode is Characterized for Use in Bridge Circuits
- ◆ I_{BSS} Specified at Elevated Temperature

PIN CONFIGURATION

TO-220/TO-220FP
Front View



SYMBOL



N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS

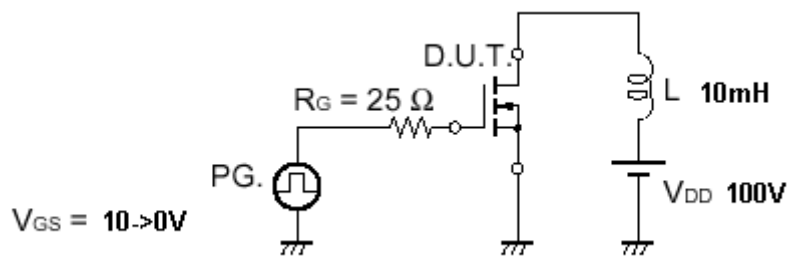
| Rating | Symbol | Value | Unit |
|--|----------------|------------|---------------|
| Drain to Current – Continuous | I_D | 6.0 | A |
| – Pulsed | I_{DM} | 18 | |
| Gate-to-Source Voltage – Continue | V_{GS} | ± 20 | V |
| – Non-repetitive | V_{GSM} | ± 40 | V |
| Total Power Dissipation | P_D | | W |
| TO-220 | | 125 | |
| TO-220FP | | 45 | |
| Operating and Storage Temperature Range | T_J, T_{STG} | -55 to 150 | $^{\circ}C$ |
| Single Pulse Drain-to-Source Avalanche Energy – $T_J = 25^{\circ}C$ ($V_{DD} = 100V, V_{GS} = 10V, I_L = 6A, L = 10mH, R_G = 25\Omega$) | E_{AS} | 180 | mJ |
| Thermal Resistance – Junction to Case | θ_{JC} | 1.0 | $^{\circ}C/W$ |
| – Junction to Ambient | θ_{JA} | 62.5 | |
| Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 seconds | T_L | 260 | $^{\circ}C$ |

- (1) $V_{DD} = 50V, I_D = 6A$
- (2) Pulse Width and frequency is limited by $T_{J(max)}$ and thermal response

ORDERING INFORMATION

| Part Number | Package |
|-------------|-----------------|
| IRF6N60 | TO-220 |
| IRF6N60FP | TO-220 Full Pak |

TEST CIRCUIT



Test Circuit – Avalanche Capability

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, $T_J = 25^\circ\text{C}$.

| Characteristic | | Symbol | IRF6N60 | | | Units |
|--|--|---------------|---------|------|-----------|---------------|
| | | | Min | Typ | Max | |
| Drain-Source Breakdown Voltage ($V_{GS} = 0\text{ V}$, $I_D = 250\ \mu\text{A}$) | | $V_{(BR)DSS}$ | 600 | | | V |
| Drain-Source Leakage Current ($V_{DS} = 600\text{ V}$, $V_{GS} = 0\text{ V}$) ($V_{DS} = 480\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125^\circ\text{C}$) | | I_{DSS} | | | 100 50 | μA |
| Gate-Source Leakage Current-Forward ($V_{gsf} = 20\text{ V}$, $V_{DS} = 0\text{ V}$) | | I_{GSSF} | | | 100 | nA |
| Gate-Source Leakage Current-Reverse ($V_{gsr} = 20\text{ V}$, $V_{DS} = 0\text{ V}$) | | I_{GSSR} | | | 100 | nA |
| Gate Threshold Voltage ($V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$) | | $V_{GS(th)}$ | 2.0 | | 4.0 | V |
| Static Drain-Source On-Resistance ($V_{GS} = 10\text{ V}$, $I_D = 3.5\text{A}$) * | | $R_{DS(on)}$ | | | 1.2 | Ω |
| Forward Transconductance ($V_{DS} = 15\text{ V}$, $I_D = 3.0\text{A}$) * | | g_{FS} | 3.4 | | | mhos |
| Input Capacitance | $(V_{DS} = 25\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 1.0\text{ MHz}$) | C_{iss} | | 1498 | 2100 | pF |
| Output Capacitance | | C_{oss} | | 158 | 220 | pF |
| Reverse Transfer Capacitance | | C_{rss} | | 29 | 60 | pF |
| Turn-On Delay Time | $(V_{DD} = 300\text{ V}$, $I_D = 6.0\text{ A}$, $V_{GS} = 10\text{ V}$, $R_G = 9.1\Omega$) * | $t_{d(on)}$ | | 14 | 30 | ns |
| Rise Time | | t_r | | 19 | 40 | ns |
| Turn-Off Delay Time | | $t_{d(off)}$ | | 40 | 80 | ns |
| Fall Time | | t_f | | 26 | 55 | ns |
| Total Gate Charge | $(V_{DS} = 300\text{ V}$, $I_D = 6.0\text{ A}$, $V_{GS} = 10\text{ V}$) * | Q_g | | 35.5 | 50 | nC |
| Gate-Source Charge | | Q_{gs} | | 8.1 | | nC |
| Gate-Drain Charge | | Q_{gd} | | 14.1 | | nC |
| Internal Drain Inductance (Measured from the drain lead 0.25" from package to center of die) | | L_D | | 4.5 | | nH |
| Internal Drain Inductance (Measured from the source lead 0.25" from package to source bond pad) | | L_S | | 7.5 | | nH |
| SOURCE-DRAIN DIODE CHARACTERISTICS | | | | | | |
| Forward On-Voltage(1) | $(I_S = 6.0\text{ A}$, $d_i/d_r = 100\mu\text{s}$) | V_{SD} | | 0.83 | 1.2 | V |
| Forward Turn-On Time | | t_{on} | | ** | | ns |
| Reverse Recovery Time | | t_{rr} | | 266 | | ns |

* Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$

** Negligible, Dominated by circuit inductance

TYPICAL ELECTRICAL CHARACTERISTICS

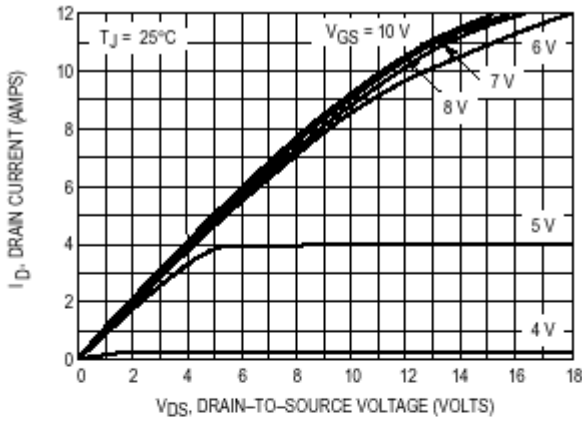


Figure 1. On-Region Characteristics

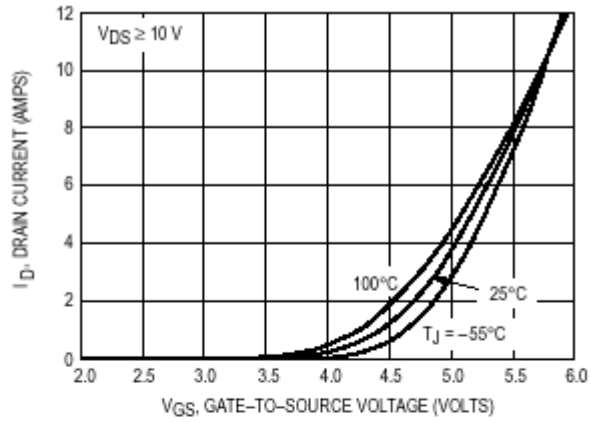


Figure 2. Transfer Characteristics

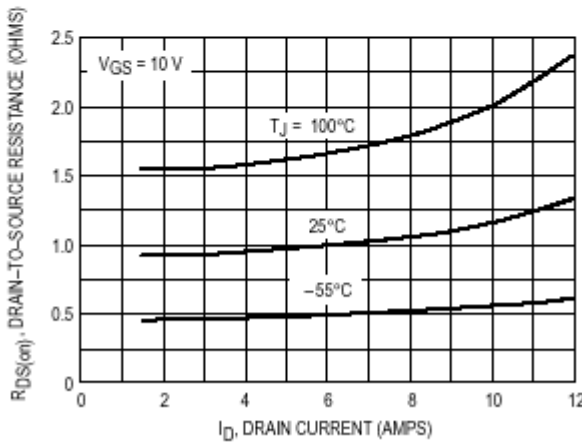


Figure 3. On-Resistance versus Drain Current and Temperature

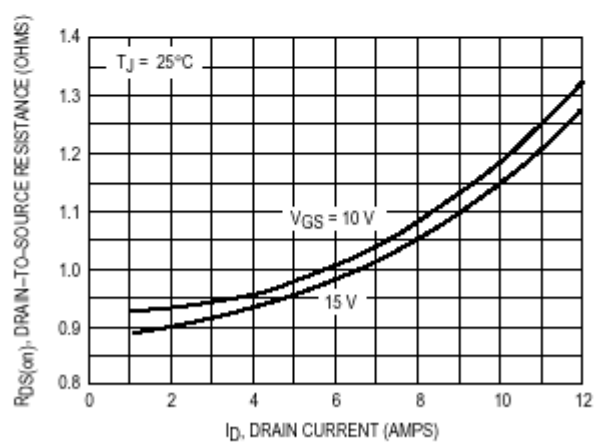


Figure 4. On-Resistance versus Drain Current and Gate Voltage

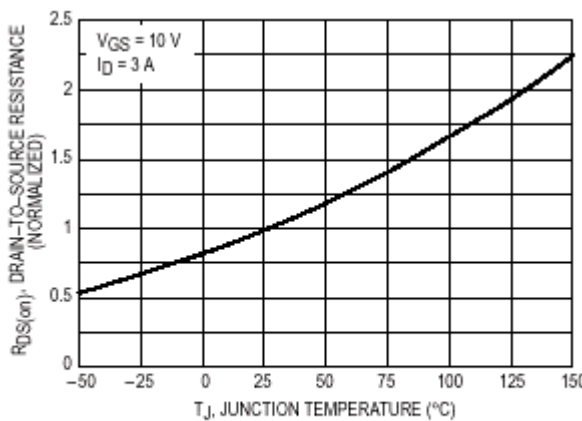


Figure 5. On-Resistance Variation with Temperature

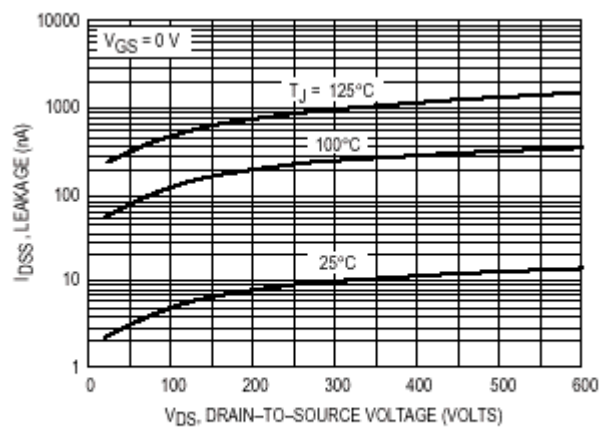
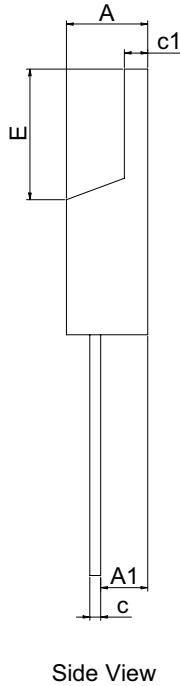
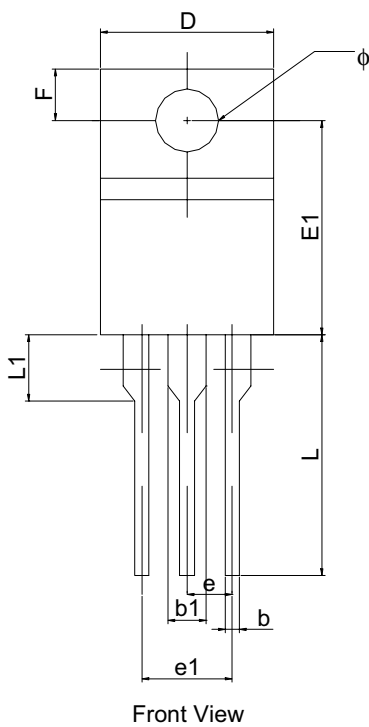


Figure 6. Drain-To-Source Leakage Current versus Voltage

PACKAGE DIMENSION

TO-220



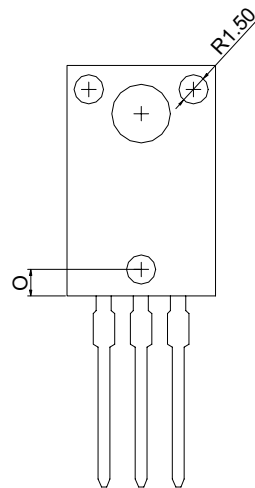
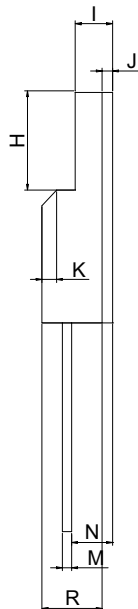
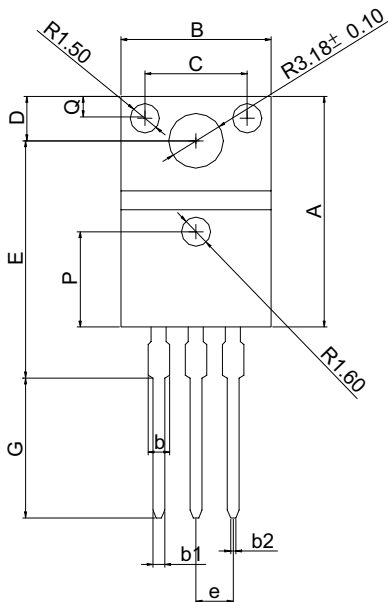
PIN 1: GATE
PIN 2: DRAIN
PIN 3: SOURCE

| SYMBOLS | DIMENSIONS IN MILLIMETERS | | | DIMENSIONS IN INCHES | | |
|---------|---------------------------|------|-------|----------------------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 4.47 | ---- | 4.67 | 0.176 | ---- | 0.184 |
| A1 | 2.52 | ---- | 2.82 | 0.099 | ---- | 0.111 |
| b | 0.71 | ---- | 0.91 | 0.028 | ---- | 0.036 |
| b1 | 1.17 | ---- | 1.37 | 0.046 | ---- | 0.054 |
| c | 0.31 | ---- | 0.53 | 0.012 | ---- | 0.021 |
| c1 | 1.17 | ---- | 1.37 | 0.046 | ---- | 0.054 |
| D | 10.01 | ---- | 10.31 | 0.394 | ---- | 0.406 |
| E | 8.50 | ---- | 8.90 | 0.335 | ---- | 0.350 |
| E1 | 12.06 | ---- | 12.46 | 0.475 | ---- | 0.491 |
| e | ---- | 2.54 | ---- | ---- | 0.100 | ---- |
| e1 | 4.98 | ---- | 5.18 | 0.196 | ---- | 0.204 |
| F | 2.59 | ---- | 2.89 | 0.102 | ---- | 0.114 |
| L | 13.40 | ---- | 13.80 | 0.528 | ---- | 0.543 |
| L1 | 3.56 | ---- | 3.96 | 0.140 | ---- | 0.156 |
| φ | 3.79 | ---- | 3.89 | 0.149 | ---- | 0.153 |

Front View

Side View

TO-220FP



| SYMBOLS | DIMENSIONS IN MILLIMETERS | | | DIMENSIONS IN INCHES | | |
|---------|---------------------------|------|-------|----------------------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 15.87 | ---- | 16.07 | 0.617 | ---- | 0.633 |
| B | 9.96 | ---- | 10.36 | 0.392 | ---- | 0.408 |
| C | ---- | 7.00 | ---- | ---- | 0.275 | ---- |
| D | 3.20 | ---- | 3.40 | 0.126 | ---- | 0.134 |
| E | 15.60 | ---- | 16.00 | 0.614 | ---- | 0.630 |
| G | 9.45 | ---- | 10.05 | 0.372 | ---- | 0.398 |
| H | 6.48 | ---- | 6.88 | 0.255 | ---- | 0.279 |
| I | 2.34 | ---- | 2.74 | 0.092 | ---- | 0.108 |
| J | ---- | 0.70 | ---- | ---- | 0.028 | ---- |
| K | ---- | 1.00 | ---- | ---- | 0.039 | ---- |
| M | 0.45 | ---- | 0.60 | 0.018 | ---- | 0.024 |
| N | 2.56 | ---- | 2.96 | 0.101 | ---- | 0.117 |
| O | ---- | 1.80 | ---- | ---- | 0.071 | ---- |
| P | ---- | 6.50 | ---- | ---- | 0.256 | ---- |
| Q | ---- | 1.50 | ---- | ---- | 0.059 | ---- |
| R | 4.50 | ---- | 4.90 | 0.177 | ---- | 0.193 |
| b | ---- | 1.47 | ---- | ---- | 0.058 | ---- |
| b1 | 0.70 | ---- | 0.90 | 0.028 | ---- | 0.035 |
| b2 | 0.25 | ---- | 0.45 | 0.010 | ---- | 0.018 |
| e | ---- | 2.54 | ---- | ---- | 0.100 | ---- |

Front View

Side View

Back View