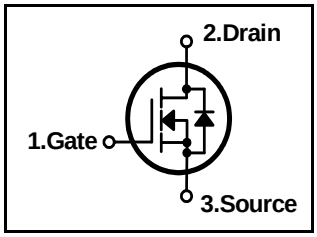
Discrete & Integration SEMICONDUCTOR

# DFP70N06

## *N-Channel MOSFET*

### Features

- Low $R_{DS}$(on) (0.014Ω )@$V_{GS}$=10V
- Low Gate Charge (Typical 70nC)
- Low Crss (Typical 160pF)
- Improved dv/dt Capability
- 100% Avalanche Tested
- Maximum Junction Temperature Range




**$BV_{DSS}$ = 60V**

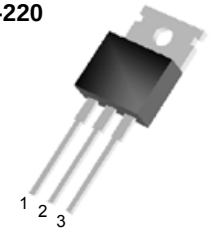
**$R_{DS(ON)}$ = 0.014 ohm**

**$I_D$ = 70A**

### General Description

This N-channel enhancement mode field-effect power transistor using DI semiconductor's advanced planar stripe, DMOS technology intended for battery operated systems like a DC-DC converter motor control , ups ,audio amplifier.
Also, especially designed to minimize rds(on) , low gate charge and high rugged avalanche characteristics.

**TO-220**




### Absolute Maximum Ratings

| Symbol | Parameter | | Value | Units |
|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | | 60 | V |
| $I_D$ | Continuous Drain Current(@$T_C$ = 25°C) | | 70 | A |
| | Continuous Drain Current(@$T_C$ = 100°C) | | 51 | A |
| $I_{DM}$ | Drain Current Pulsed | (Note 1) | 280 | A |
| $V_{GS}$ | Gate to Source Voltage | | ±25 | V |
| $E_{AS}$ | Single Pulsed Avalanche Energy | (Note 2) | 800 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | (Note 3) | 7.0 | V/ns |
| $P_D$ | Total Power Dissipation(@$T_C$ = 25 °C) | | 158 | W |
| | Derating Factor above 25 °C | | 1.05 | W/°C |
| $T_{STG}$, $T_J$ | Operating Junction Temperature & Storage Temperature | | - 55 ~ 175 | °C |
| $T_L$ | Maximum Lead Temperature for soldering purpose, 1/8 from Case for 5 seconds. | | 300 | °C |

### Thermal Characteristics

| Symbol | Parameter | Value | | | Units |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | - | - | 0.95 | °C/W |
| $R_{\theta CS}$ | Thermal Resistance, Case to Sink | - | 0.5 | - | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | - | - | 62.5 | °C/W |

## Electrical Characteristics ( $T_C$ = 25 °C unless otherwise noted )

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = 250uA | 60 | - | - | V |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temperature coefficient | $I_D$ = 250uA, referenced to 25 °C | - | 0.066 | - | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 60V, $V_{GS}$ = 0V | - | - | 1 | uA |
| | | $V_{DS}$ = 48V, $T_C$ = 150 °C | - | - | 10 | uA |
| $I_{GSS}$ | Gate-Source Leakage, Forward | $V_{GS}$ = 25V, $V_{DS}$ = 0V | | | 100 | nA |
| | Gate-Source Leakage, Reverse | $V_{GS}$ = -25V, $V_{DS}$ = 0V | - | - | -100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250uA | 2.0 | - | 4.0 | V |
| $R_{DS(ON)}$ | Static Drain-Source On-state Resistance | $V_{GS}$ =10 V, $I_D$ = 35A | - | - | 0.014 | Ω |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$ =0 V, $V_{DS}$ =25V, f = 1MHz | - | 2350 | 3050 | pF |
| $C_{oss}$ | Output Capacitance | | - | 690 | 890 | |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 160 | 200 | |
| **Dynamic Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD}$ =30V, $I_D$ =35A, $R_G$ =50Ω ※ **see fig. 13.** (Note 4, 5) | - | 30 | 70 | ns |
| $t_r$ | Rise Time | | - | 60 | 130 | |
| $t_{d(off)}$ | Turn-off Delay Time | | - | 125 | 260 | |
| $t_f$ | Fall Time | | - | 95 | 200 | |
| $Q_g$ | Total Gate Charge | $V_{DS}$ =48V, $V_{GS}$ =10V, $I_D$ =70A ※ **see fig. 12.** (Note 4, 5) | - | 70 | 90 | nC |
| $Q_{gs}$ | Gate-Source Charge | | - | 18 | - | |
| $Q_{gd}$ | Gate-Drain Charge(Miller Charge) | | - | 24 | - | |

## Source-Drain Diode Ratings and Characteristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit. |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current | Integral Reverse p-n Junction Diode in the MOSFET | - | - | 70 | A |
| $I_{SM}$ | Pulsed Source Current | | - | - | 280 | |
| $V_{SD}$ | Diode Forward Voltage | $I_S$ =70A, $V_{GS}$ =0V | - | - | 1.5 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_S$=70A,$V_{GS}$=0V,$dI_F/dt$=100A/us | - | 62 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 110 | - | nC |

※ NOTES
1. Repeativity rating : pulse width limited by junction temperature
2. L = 250 uH, $I_{AS}$ = 70A, $V_{DD}$ = 25V, $R_G$ = 0Ω , Starting $T_J$ = 25°C
3. ISD ≤ 70A, di/dt ≤ 300A/us, $V_{DD}$ ≤ $BV_{DSS}$, Starting $T_J$ = 25°C
4. Pulse Test : Pulse Width ≤ 300us, Duty Cycle ≤ 2%
5. Essentially independent of operating temperature.

**Fig 1. On-State Characteristics**

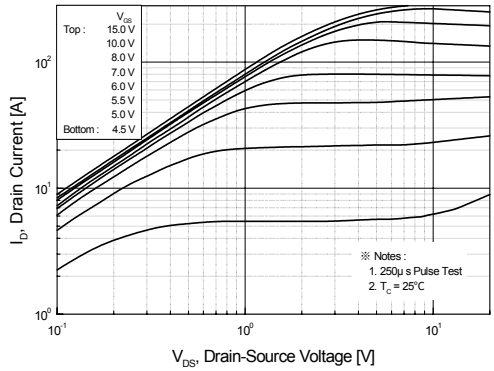



**Fig 2. Transfer Characteristics**

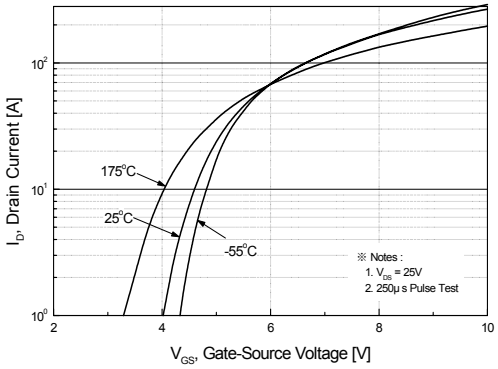



**Fig 3. On Resistance Variation vs. Drain Current and Gate Voltage**

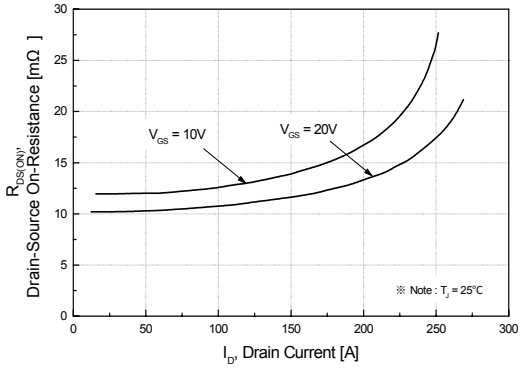



**Fig 4. On State Current vs. Allowable Case Temperature**

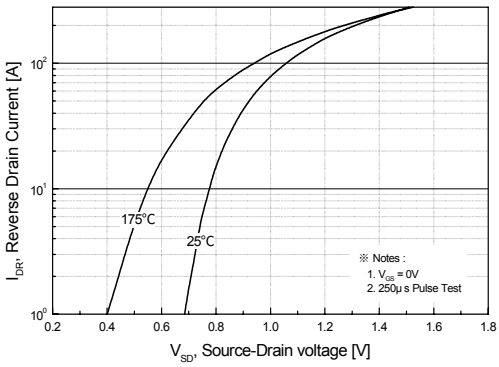



**Fig 5. Capacitance Characteristics**

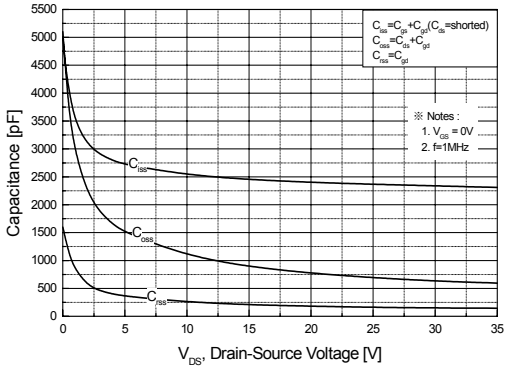



**Fig 6. Gate Charge Characteristics**

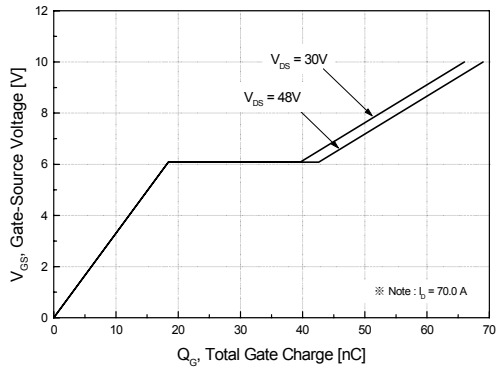


**Fig 7. Breakdown Voltage Variation vs. Junction Temperature**

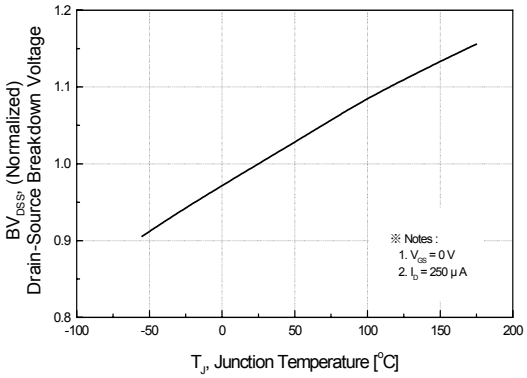



**Fig 8. On-Resistance Variation vs. Junction Temperature**

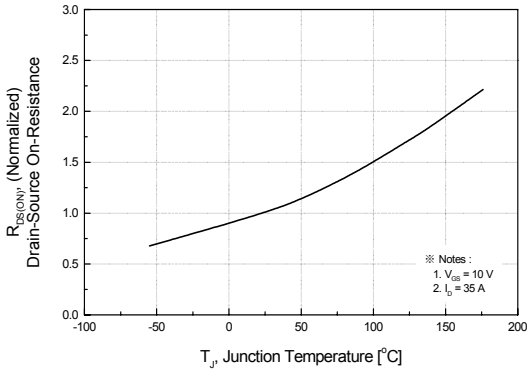



**Fig 9. Maximum Safe Operating Area**

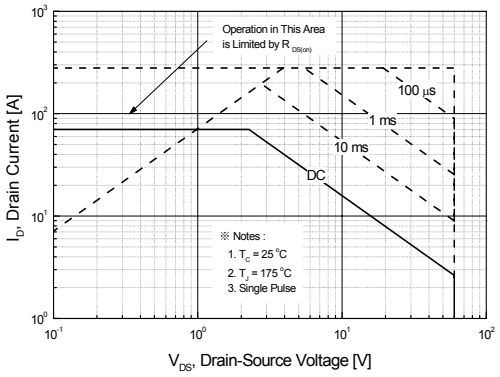



**Fig 10. Maximum Drain Current vs. Case Temperature**

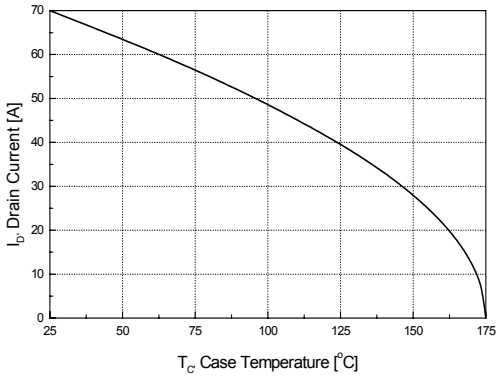



**Fig 11. Transient Thermal Response Curve**

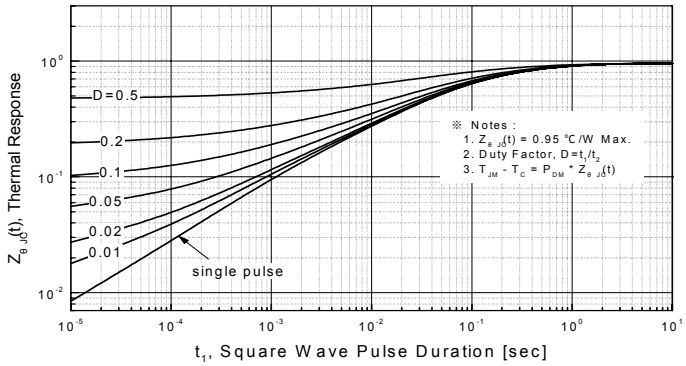


**Fig. 12. Gate Charge Test Circuit & Waveforms**

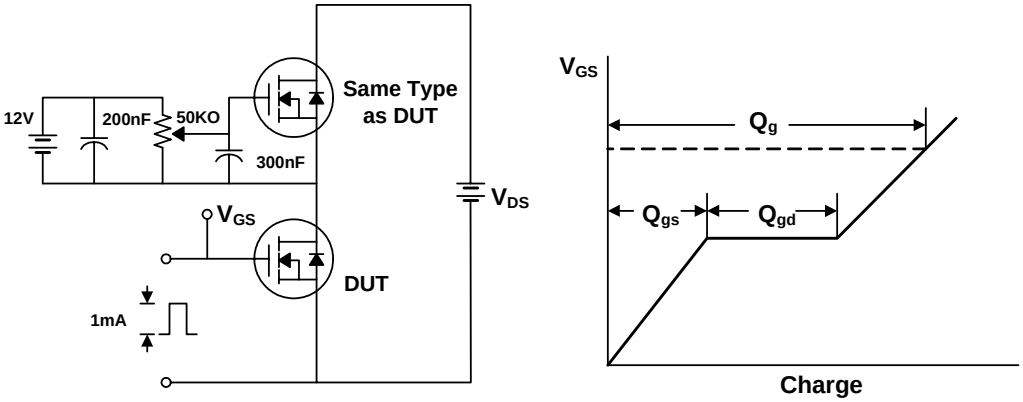



**Fig 13. Switching Time Test Circuit & Waveforms**

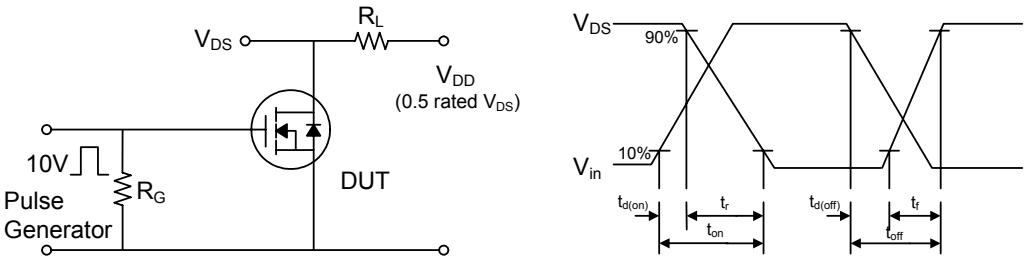



**Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms**

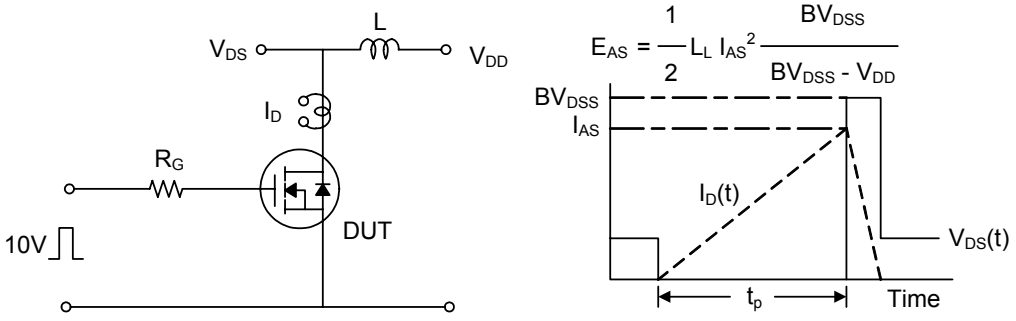
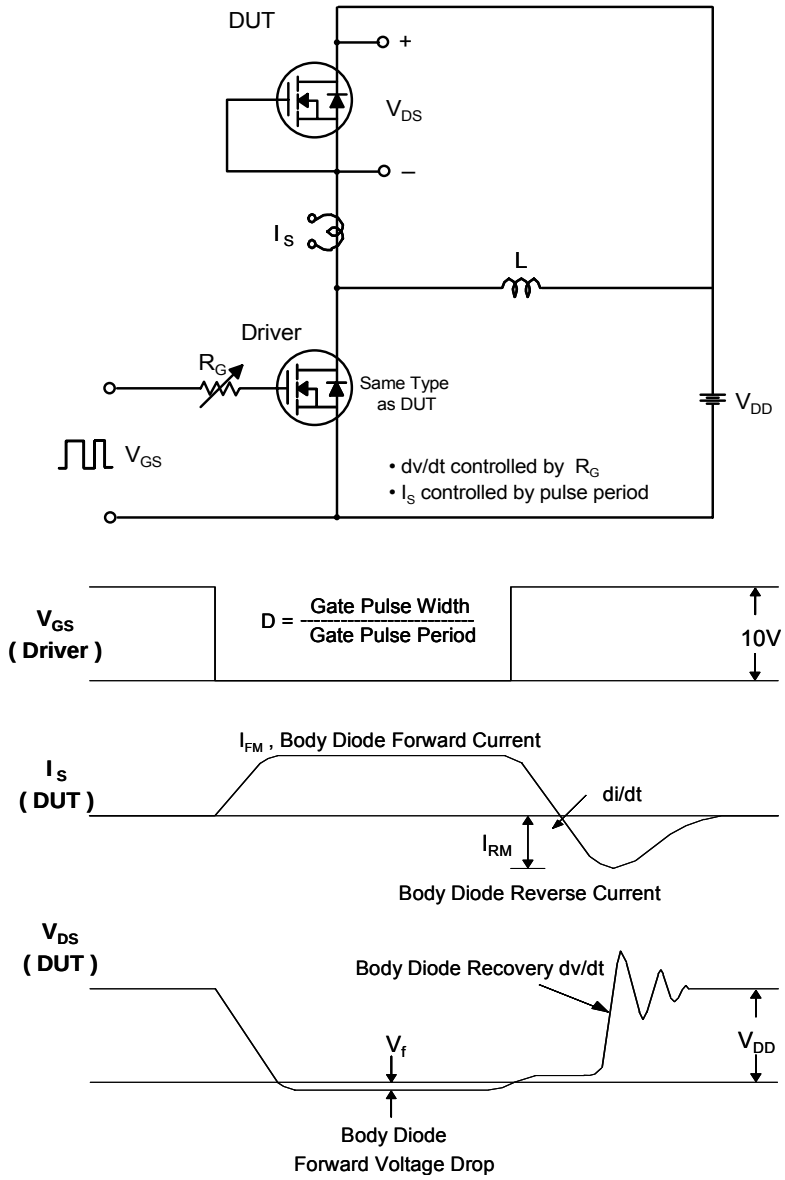


**Fig. 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms**



**TO-220 Package Dimension**

| Dim. | mm | | | Inch | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 6.12 | 6.32 | 6.52 | 0.241 | 0.249 | 0.257 |
| B | 9.00 | 9.20 | 9.40 | 0.354 | 0.362 | 0.370 |
| C | 12.88 | 13.08 | 13.28 | 0.507 | 0.515 | 0.523 |
| D | 2.70 | 2.80 | 2.90 | 0.106 | 0.110 | 0.114 |
| E | 1.20 | 1.30 | 1.40 | 0.047 | 0.051 | 0.055 |
| F | 15.12 | 15.52 | 15.92 | 0.595 | 0.611 | 0.627 |
| G | 2.70 | 3.00 | 3.30 | 0.106 | 0.118 | 0.130 |
| H | 4.30 | 4.50 | 4.70 | 0.169 | 0.177 | 0.185 |
| I | 1.25 | 1.30 | 1.40 | 0.049 | 0.051 | 0.055 |
| J | 0.45 | 0.50 | 0.60 | 0.018 | 0.020 | 0.024 |
| K | 2.30 | 2.40 | 2.50 | 0.091 | 0.094 | 0.098 |
| L | | 9.90 | | | 0.390 | |
| *M* | 1.42 | 1.52 | 1.62 | 0.056 | 0.060 | 0.064 |
| *N* | 0.75 | 0.85 | 0.95 | 0.030 | 0.03 | 0.037 |
| *O* | 2.44 | 2.54 | 2.64 | 0.096 | 0.100 | 0.104 |
| *P* | 4.88 | 5.08 | 5.28 | 0.192 | 0.200 | 0.208 |
| $\phi$ | | 3.60 | | | 0.142 | |