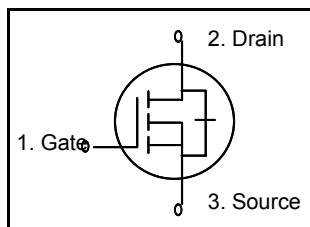


N-Channel MOSFET

Features

- High ruggedness
- $R_{DS(on)}$ (Max 2.5 Ω)@ $V_{GS}=10V$
- Gate Charge (Typical 25nC)
- Improved dv/dt Capability
- 100% Avalanche Tested

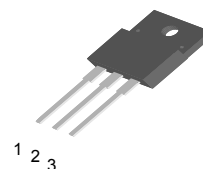


$BV_{DSS} = 600V$
 $R_{DS(ON)} = 2.5 \text{ ohm}$
 $I_D = 4A$

General Description

This N-channel enhancement mode field-effect power transistor using D&I semiconductor's advanced planar stripe, DMOS technology intended for off-line switch mode power supply. Also, especially designed to minimize $r_{ds(on)}$ and high rugged avalanche characteristics. The TO-220F (Isolated) pkg is well suited for adaptor power unit and power inverter application.

TO-220F



Absolute Maximum Ratings

| Symbol | Parameter | Value | Units |
|----------------|--|------------|---------------|
| V_{DSS} | Drain to Source Voltage | 600 | V |
| I_D | Continuous Drain Current(@ $T_C = 25^\circ C$)* | 4 | A |
| | Continuous Drain Current(@ $T_C = 100^\circ C$)* | 2.5 | A |
| I_{DM} | Drain Current Pulsed (Note 1) | 16 | A |
| V_{GS} | Gate to Source Voltage | ± 30 | V |
| E_{AS} | Single Pulsed Avalanche Energy (Note 2) | 262 | mJ |
| E_{AR} | Repetitive Avalanche Energy (Note 1) | 3.3 | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | 4.5 | V/ns |
| P_D | Total Power Dissipation(@ $T_C = 25^\circ C$) | 33 | W |
| | Derating Factor above $25^\circ C$ | 0.26 | W/ $^\circ C$ |
| T_{STG}, T_J | Operating Junction Temperature & Storage Temperature | - 55 ~ 150 | $^\circ C$ |
| T_L | Maximum Lead Temperature for soldering purpose, 1/8 from Case for 5 seconds. | 300 | $^\circ C$ |

* Ensure that the channel temperature does not exceed 150

Thermal Characteristics

| Symbol | Parameter | Value | | | Units |
|-----------------|---|-------|------|------|--------------|
| | | Min. | Typ. | Max. | |
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | - | - | 3.79 | $^\circ C/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | - | - | 62.5 | $^\circ C/W$ |

DFF4N60

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 | 600 | - | - | V |
| BV _{DSS} / T _J | Breakdown Voltage Temperature coefficient | I _D = 250uA, referenced to 25 °C | - | 0.68 | - | V/°C |
| I _{DSS} | Drain-Source Leakage Current | V _{DS} = 600V, V _{GS} = 0V | - | - | 10 | uA |
| | | V _{DS} = 480V, T _C = 125 °C | - | - | 100 | uA |
| I _{GSS} | Gate-Source Leakage, Forward | V _{GS} = 30V, V _{DS} = 0V | - | - | 100 | nA |
| | Gate-source Leakage, Reverse | V _{GS} = -30V, 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 = 2.0A | - | 2.0 | 2.5 | |
| Dynamic Characteristics | | | | | | |
| C _{iss} | Input Capacitance | V _{GS} = 0 V, V _{DS} = 25V, f = 1MHz | - | 520 | 650 | pF |
| C _{oss} | Output Capacitance | | - | 135 | 195 | |
| C _{rss} | Reverse Transfer Capacitance | | - | 280 | 400 | |
| Dynamic Characteristics | | | | | | |
| t _{d(on)} | Turn-on Delay Time | V _{DD} = 300V, I _D = 4.0A, R _G = 25 see fig. 13. (Note 4, 5) | - | 25 | 32 | ns |
| t _r | Rise Time | | - | 54 | 70 | |
| t _{d(off)} | Turn-off Delay Time | | - | 120 | 157 | |
| t _f | Fall Time | | - | 34 | 45 | |
| Q _g | Total Gate Charge | V _{DS} = 480V, V _{GS} = 10V, I _D = 4.0A see fig. 12. (Note 4, 5) | - | 22 | 28 | nC |
| Q _{gs} | Gate-Source Charge | | - | 3.2 | - | |
| Q _{gd} | Gate-Drain Charge(Miller Charge) | | - | 7.8 | - | |

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 | - | - | 4.0 | A |
| I _{SM} | Pulsed Source Current | | - | - | 16.0 | |
| V _{SD} | Diode Forward Voltage | I _S = 4.0A, V _{GS} = 0V | - | - | 1.4 | V |
| t _{rr} | Reverse Recovery Time | I _S = 4.0A, V _{GS} = 0V, di/dt = 100A/us | - | 560 | - | ns |
| Q _{rr} | Reverse Recovery Charge | | - | 1.78 | - | uC |

NOTES

1. Repeativity rating : pulse width limited by junction temperature
2. L = 30mH, I_{AS} = 4.0A, V_{DD} = 50V, R_G = 50 , Starting T_J = 25°C
3. I_{SD} 4.0, 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.

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Fig 1. On-State Characteristics

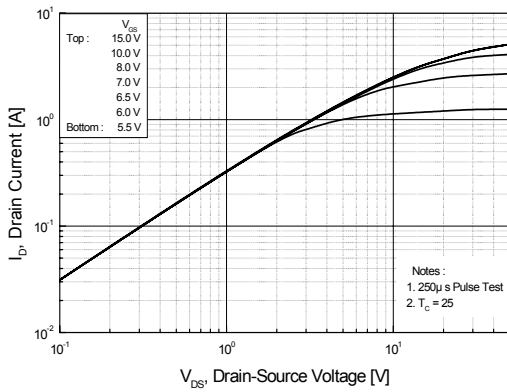


Fig 2. Transfer Characteristics

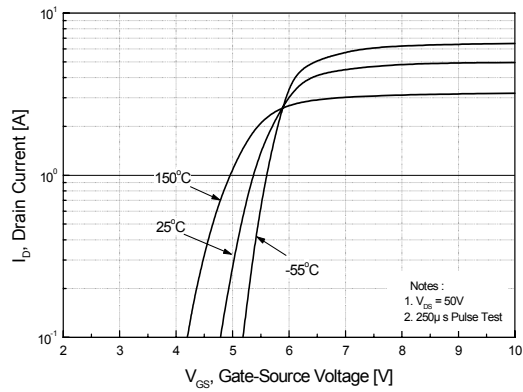


Fig 3. On Resistance Variation vs. Drain Current and Gate Voltage

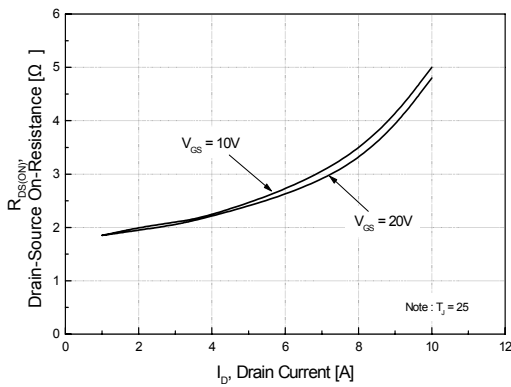


Fig 4. On State Current vs. Allowable Case Temperature

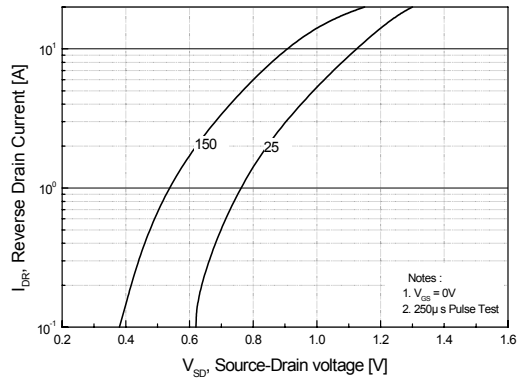


Fig 5. Capacitance Characteristics (Non-Repetitive)

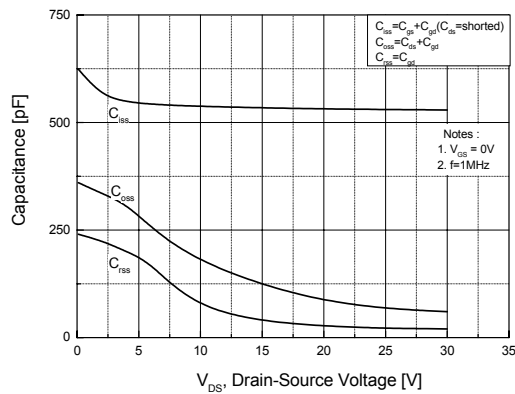
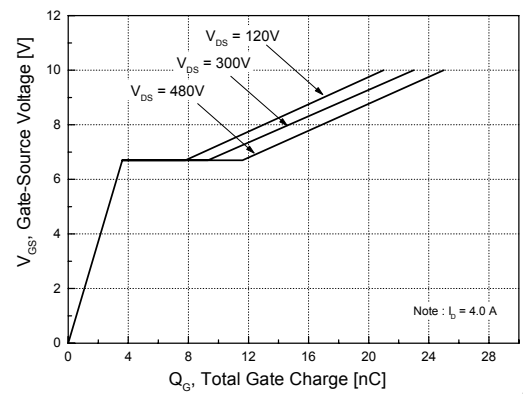


Fig 6. Gate Charge Characteristics



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Fig 7. Breakdown Voltage Variation vs. Junction Temperature

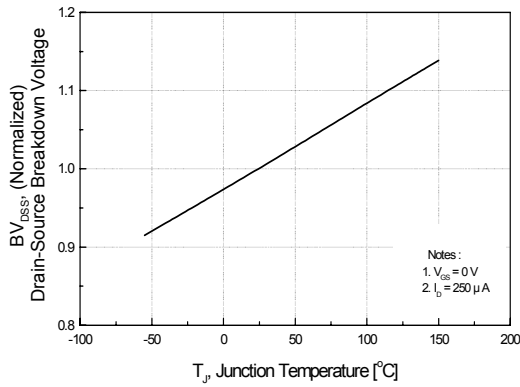


Fig 8. On-Resistance Variation vs. Junction Temperature

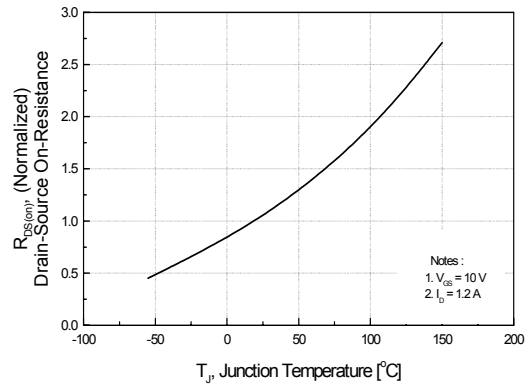


Fig 9. Maximum Safe Operating Area

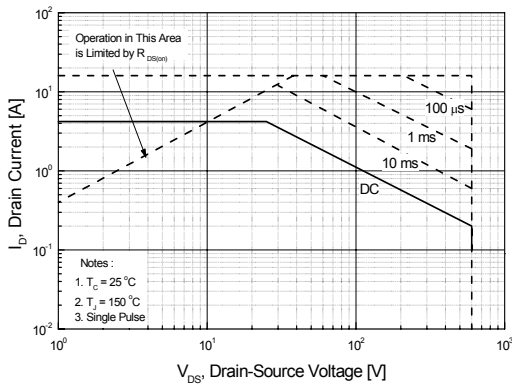


Fig 10. Maximum Drain Current vs. Case Temperature

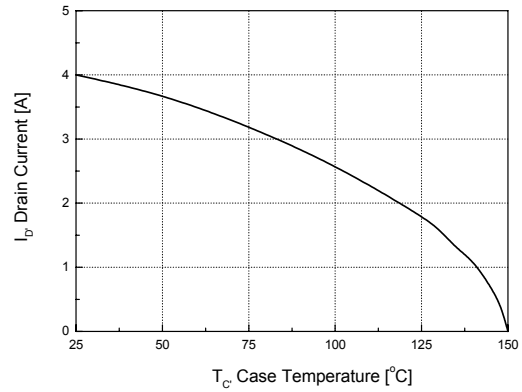
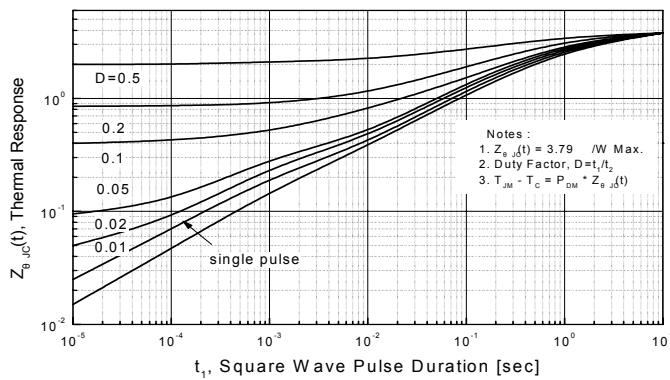


Fig 11. Transient Thermal Response Curve



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Fig. 12. Gate Charge Test Circuit & Waveforms

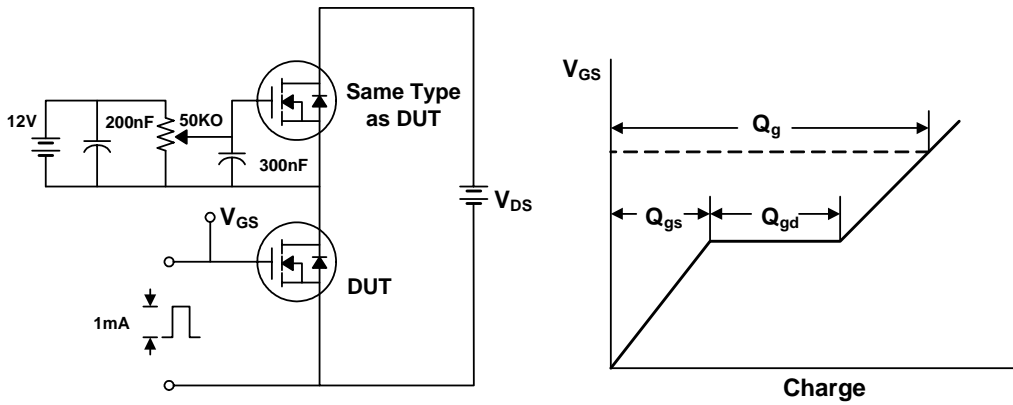


Fig 13. Switching Time Test Circuit & Waveforms

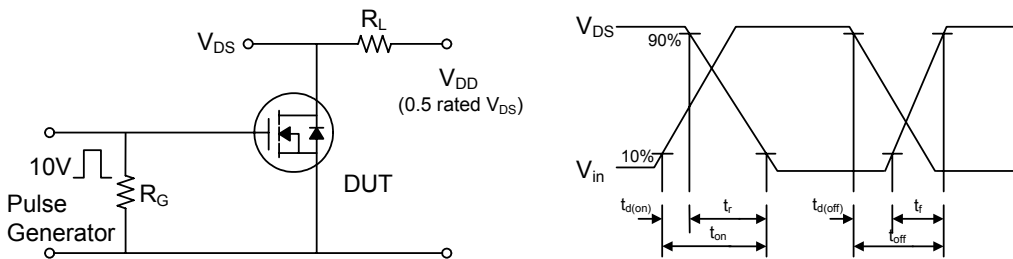
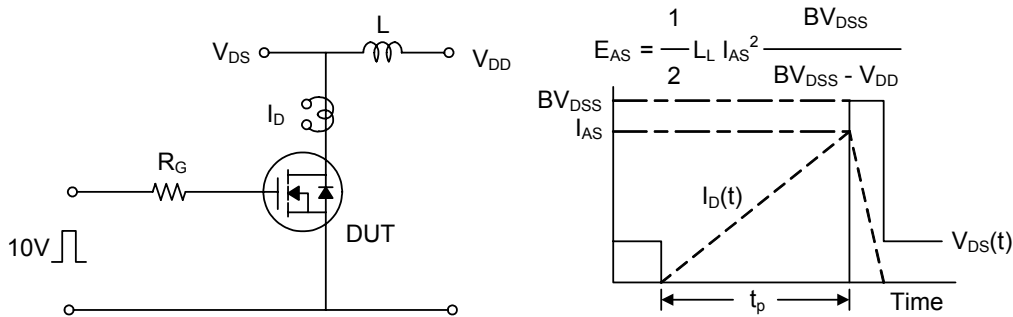
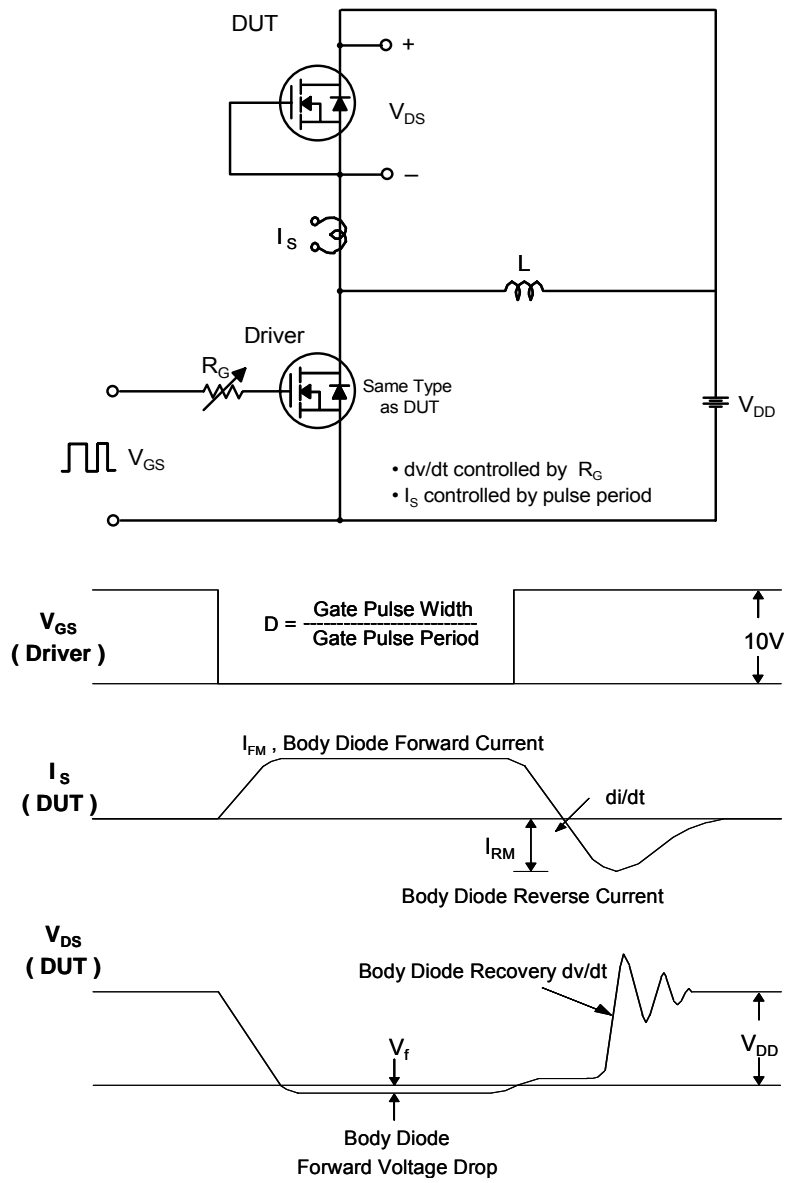


Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms

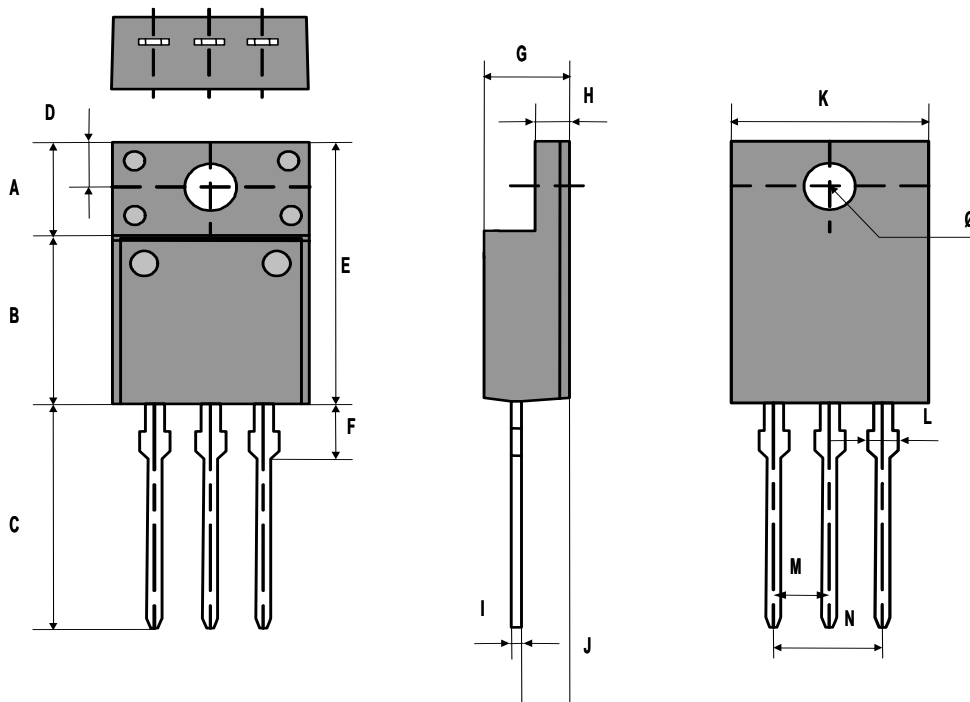


DFF4N60

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



DFF4N60



| | Dimension [mm] | | | | Dimension [mm] | | |
|---|----------------|-------|-------|---|----------------|------|------|
| | Min. | Typ. | Max. | | Min. | Typ. | Max. |
| A | 6.73 | 6.93 | 7.13 | I | 0.55 | 0.59 | 0.65 |
| B | 7.82 | 8.02 | 8.22 | J | 2.26 | 2.46 | 2.66 |
| C | 13.05 | 13.25 | 13.45 | K | 9.00 | 9.50 | 10.0 |
| D | 2.20 | 2.50 | 2.80 | L | 1.10 | 1.50 | 1.90 |
| E | 14.47 | 14.77 | 15.07 | M | 2.47 | 2.57 | 2.67 |
| F | 2.98 | 3.18 | 3.38 | N | 4.94 | 5.04 | 5.14 |
| G | 4.35 | 4.55 | 4.75 | Ø | 3.00 | 3.05 | 3.10 |
| H | 2.96 | 3.06 | 3.16 | | | | |