

### General Description

These N-channel MOSFET are produced using advanced MagnaChip's MOSFET Technology, which provides low on-state resistance, high switching performance and excellent quality.

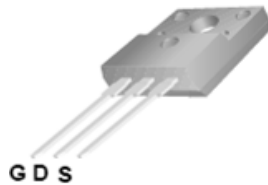
These devices are suitable device for SMPS, high Speed switching and general purpose applications.

### Features

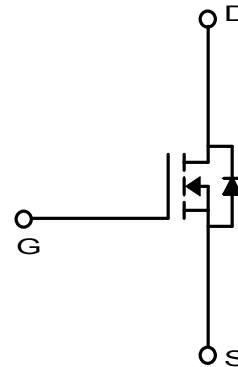
- $V_{DS} = 650V$
- $I_D = 4.0A$  @  $V_{GS} = 10V$
- $R_{DS(ON)} \leq 2.2 \Omega$  @  $V_{GS} = 10V$

### Applications

- Power Supply
- PFC
- High Current, High Speed Switching



TO-220F  
MDF Series



### Absolute Maximum Ratings (Ta = 25°C)

| Characteristics                              |                    | Symbol         | Rating  | Unit |
|--|--------------------|----------------|---------|------|
| Drain-Source Voltage                         |                    | $V_{DSS}$      | 650     | V    |
| Gate-Source Voltage                          |                    | $V_{GSS}$      | ±30     | V    |
| Continuous Drain Current                     | $T_C=25^\circ C$   | $I_D$          | 4.0*    | A    |
|  | $T_C=100^\circ C$  |                | 2.6*    | A    |
| Pulsed Drain Current <sup>(1)</sup>          |                    | $I_{DM}$       | 16*     | A    |
| Power Dissipation                            | $T_C=25^\circ C$   | $P_D$          | 35      | W    |
|  | Derate above 25 °C |                | 0.28    | W/°C |
| Repetitive Avalanche Energy <sup>(1)</sup>   |                    | $E_{AR}$       | 3.5     | mJ   |
| Peak Diode Recovery $dv/dt$ <sup>(3)</sup>   |                    | $dv/dt$        | 4.5     | V/ns |
| Single Pulse Avalanche Energy <sup>(4)</sup> |                    | $E_{AS}$       | 170     | mJ   |
| Junction and Storage Temperature Range       |                    | $T_J, T_{stg}$ | -55~150 | °C   |

\* Id limited by maximum junction temperature

### Thermal Characteristics

| Characteristics  | Symbol          | Rating | Unit |
|--|-----------------|--------|------|
| Thermal Resistance, Junction-to-Ambient <sup>(1)</sup> | $R_{\theta JA}$ | 62.5   | °C/W |
| Thermal Resistance, Junction-to-Case <sup>(1)</sup>    | $R_{\theta JC}$ | 3.55   |      |

## Ordering Information

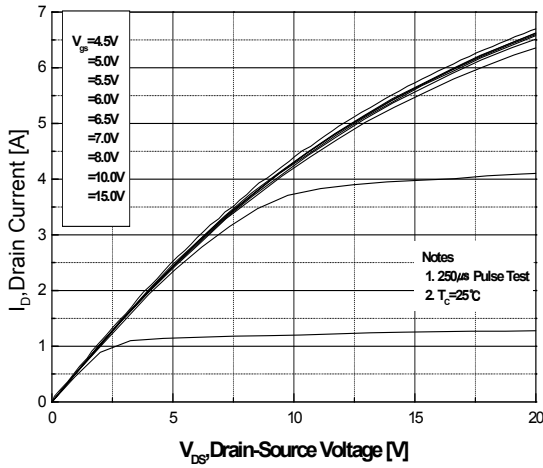
| Part Number | Temp. Range | Package | Packing | RoHS Status  |
|-------------|-------------|---------|---------|--------------|
| MDF4N65BTH  | -55~150°C   | TO-220F | Tube    | Halogen Free |

## Electrical Characteristics (Ta =25°C)

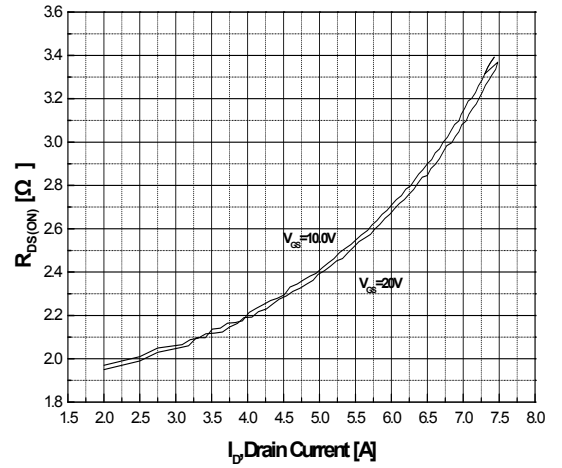
| Characteristics  | Symbol       | Test Condition  | Min | Typ  | Max | Unit     |
|--|--------------|---|-----|------|-----|----------|
| <b>Static Characteristics</b>                            |              |   |     |      |     |          |
| Drain-Source Breakdown Voltage                           | $BV_{DSS}$   | $I_D = 250\mu A, V_{GS} = 0V$                                   | 650 | -    | -   | V        |
| Gate Threshold Voltage                                   | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 250\mu A$                               | 2.0 | -    | 4.0 |          |
| Drain Cut-Off Current                                    | $I_{DSS}$    | $V_{DS} = 650V, V_{GS} = 0V$                                    | -   | -    | 1   | $\mu A$  |
| Gate Leakage Current                                     | $I_{GSS}$    | $V_{GS} = \pm 30V, V_{DS} = 0V$                                 | -   | -    | 100 | nA       |
| Drain-Source ON Resistance                               | $R_{DS(on)}$ | $V_{GS} = 10V, I_D = 2.0A$                                      |     | 1.8  | 2.2 | $\Omega$ |
| Forward Transconductance                                 | $g_{fs}$     | $V_{DS} = 30V, I_D = 2.0A$                                      | -   | 3.11 | -   | S        |
| <b>Dynamic Characteristics</b>                           |              |   |     |      |     |          |
| Total Gate Charge  | $Q_g$        | $V_{DS} = 520V, I_D = 4.0A, V_{GS} = 10V^{(3)}$                 | -   | 11.6 | -   | nC       |
| Gate-Source Charge                                       | $Q_{gs}$     |   | -   | 2.3  | -   |          |
| Gate-Drain Charge  | $Q_{gd}$     |   | -   | 4.6  | -   |          |
| Input Capacitance  | $C_{iss}$    | $V_{DS} = 25V, V_{GS} = 0V, f = 1.0MHz$                         | -   | 518  | -   | pF       |
| Reverse Transfer Capacitance                             | $C_{riss}$   |   | -   | 3    | -   |          |
| Output Capacitance                                       | $C_{oss}$    |   | -   | 61   | -   |          |
| Turn-On Delay Time                                       | $t_{d(on)}$  | $V_{GS} = 10V, V_{DS} = 325V, I_D = 4.0A, R_G = 25\Omega^{(3)}$ | -   | 13   | -   | ns       |
| Rise Time  | $t_r$        |   | -   | 22   | -   |          |
| Turn-Off Delay Time                                      | $t_{d(off)}$ |   | -   | 41   | -   |          |
| Fall Time  | $t_f$        |   | -   | 25   | -   |          |
| <b>Drain-Source Body Diode Characteristics</b>           |              |   |     |      |     |          |
| Maximum Continuous Drain to Source Diode Forward Current | $I_S$        |   | -   | 4    | -   | A        |
| Source-Drain Diode Forward Voltage                       | $V_{SD}$     | $I_S = 4.0A, V_{GS} = 0V$                                       | -   | -    | 1.4 | V        |
| Body Diode Reverse Recovery Time                         | $t_{rr}$     | $I_F = 4.0A, di/dt = 100A/\mu s^{(3)}$                          | -   | 245  | -   | ns       |
| Body Diode Reverse Recovery Charge                       | $Q_{rr}$     |   | -   | 1.5  | -   | $\mu C$  |

Note :

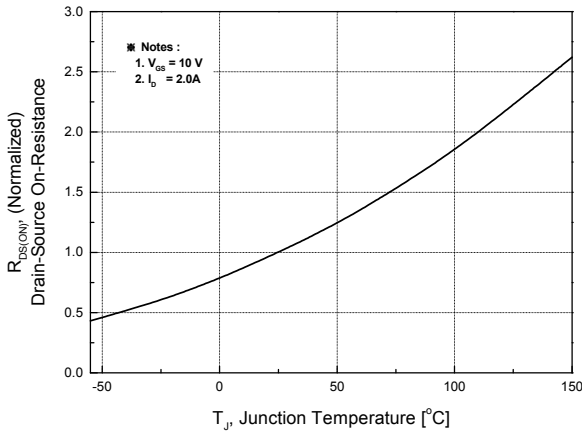
1. Pulse width is based on  $R_{\theta JC}$  &  $R_{\theta JA}$  and the maximum allowed junction temperature of 150°C.
2. Pulse test: pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$ , pulse width limited by junction temperature  $T_{J(MAX)} = 150^\circ C$ .
3.  $I_{SD} \leq 4.0A$ ,  $di/dt \leq 200A/\mu s$ ,  $V_{DD} \leq BV_{DSS}$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ C$
4.  $L = 19.6mH$ ,  $I_{AS} = 4.0A$ ,  $V_{DD} = 50V$ ,  $R_G = 25\Omega$ , Starting  $T_J = 25^\circ C$ ,



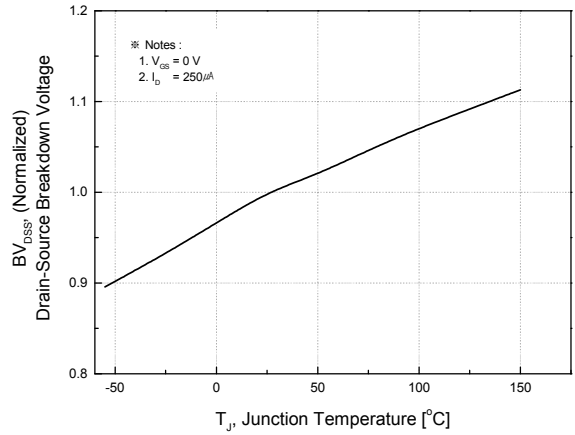
**Fig.1 On-Region Characteristics**



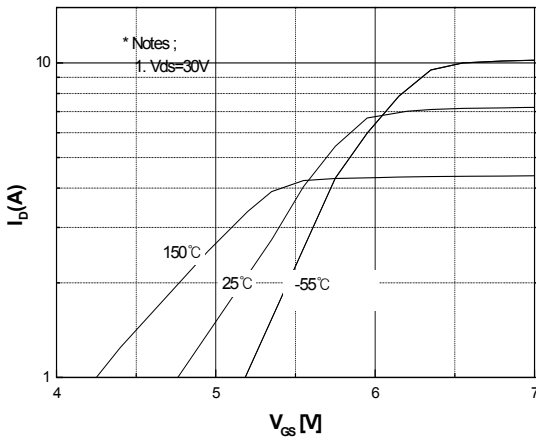
**Fig.2 On-Resistance Variation with Drain Current and Gate Voltage**



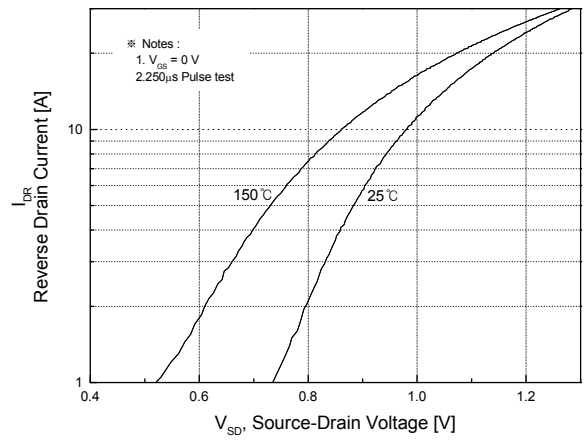
**Fig.3 On-Resistance Variation with Temperature**



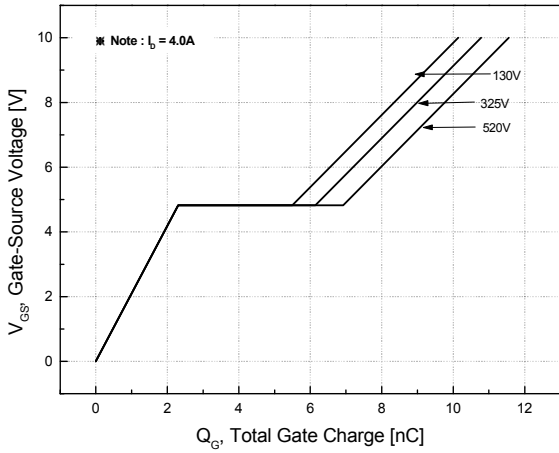
**Fig.4 Breakdown Voltage Variation vs. Temperature**



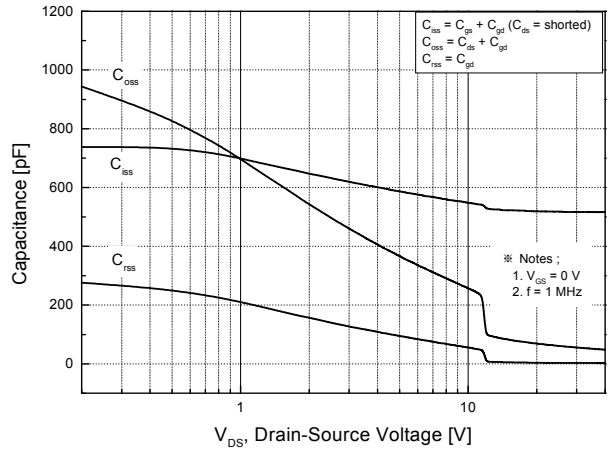
**Fig.5 Transfer Characteristics**



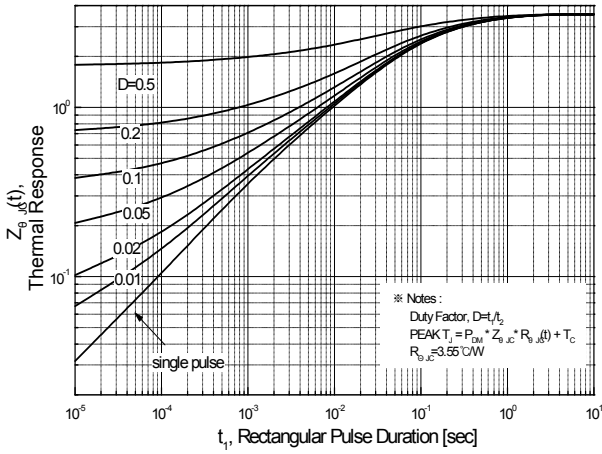
**Fig.6 Body Diode Forward Voltage Variation with Source Current and Temperature**



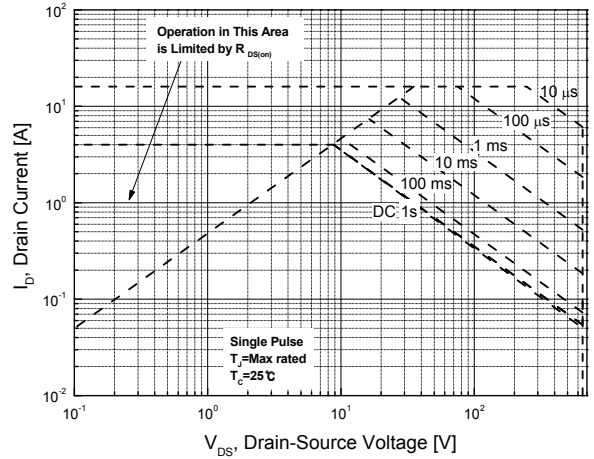
**Fig.7 Gate Charge Characteristics**



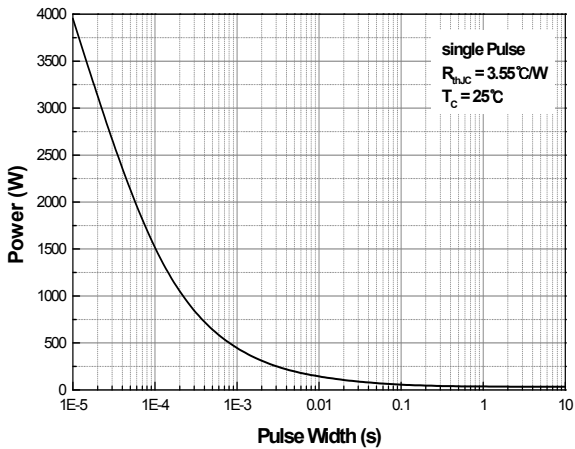
**Fig.8 Capacitance Characteristics**



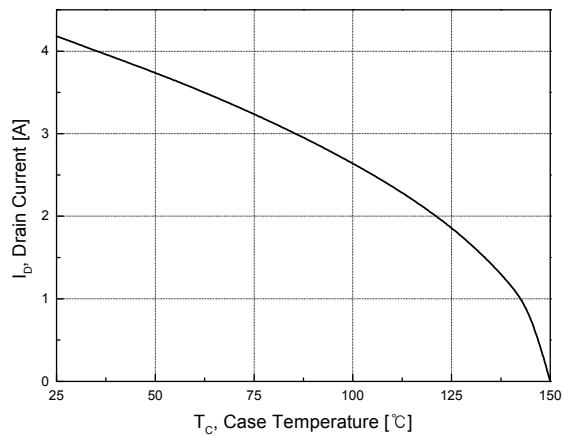
**Fig.9 Transient Thermal Response Curve**



**Fig.10 Maximum Safe Operating Area**



**Fig.11 Single Pulse Maximum Power Dissipation**

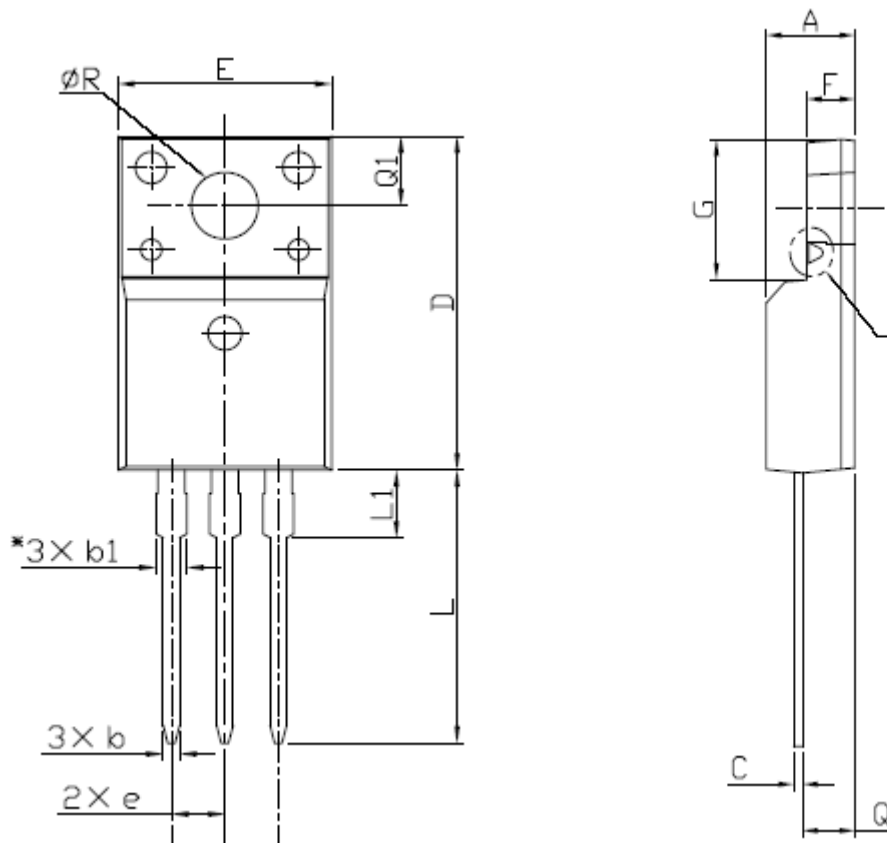


**Fig.12 Maximum Drain Current vs. Case Temperature**

## Physical Dimensions

### 3 Leads, TO-220F

Dimensions are in millimeters unless otherwise specified



| Symbol | Min   | Nom  | Max   |
|--------|-------|------|-------|
| A      | 4.50  |      | 4.93  |
| b      | 0.63  |      | 0.91  |
| b1     | 1.15  |      | 1.47  |
| C      | 0.33  |      | 0.63  |
| D      | 15.47 |      | 16.13 |
| E      | 9.60  |      | 10.71 |
| e      |       | 2.54 |       |
| F      | 2.34  |      | 2.84  |
| G      | 6.48  |      | 6.90  |
| L      | 12.24 |      | 13.72 |
| L1     | 2.79  |      | 3.67  |
| Q      | 2.52  |      | 2.96  |
| Q1     | 3.10  |      | 3.50  |
| ØR     | 3.00  |      | 3.55  |

**DISCLAIMER:**

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