RoHS Compliant
HALOGEN-FREE

Magnachip

# MDD9N40

## N-Channel MOSFET 400V, 6A, 0.85Ω



## 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.

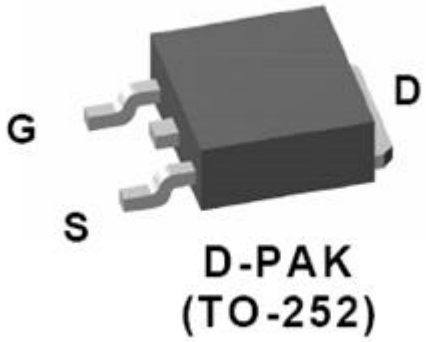
These devices are suitable device for SMPS, high Speed switching and general purpose applications.

## Features

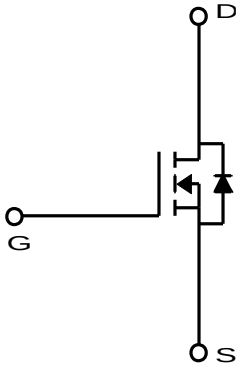
- $V_{DS}$ = 400V
- $I_D$ = 6A @ $V_{GS}$ = 10V
- $R_{DS(ON)}$ ≤ 0.85Ω @ $V_{GS}$ = 10V

## Applications

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




D-PAK
(TO-252)




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

| Characteristics | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DSS}$ | 400 | V |
| Gate-Source Voltage | | $V_{GSS}$ | ±30 | V |
| Continuous Drain Current | $T_C$=25°C | $I_D$ | 6.0* | A |
| | $T_C$=100°C | | 3.79* | A |
| Pulsed Drain Current(1) | | $I_{DM}$ | 24* | A |
| Power Dissipation | $T_C$=25°C | $P_D$ | 69.4 | W |
| | Derate above 25 °C | | 0.57 | W/°C |
| Repetitive Avalanche Energy(1) | | $E_{AR}$ | 6.94 | mJ |
| Peak Diode Recovery dv/dt(3) | | dv/dt | 4.5 | V/ns |
| Single Pulse Avalanche Energy(4) | | $E_{AS}$ | 300 | 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(1) | $R_{\theta JA}$ | 110 | °C/W |
| Thermal Resistance, Junction-to-Case(1) | $R_{\theta JC}$ | 1.75 | |

## Ordering Information

| Part Number | Temp. Range | Package | Packing | RoHS Status |
|---|---|---|---|---|
| MDD9N40RH | -55~150ºC | TO-252 (DPAK) | Tape & Reel | Halogen Free |

## Electrical Characteristics (Ta =25ºC)

| Characteristics | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $I_D$ = 250μA, $V_{GS}$ = 0V | 400 | - | - | V |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | 3.0 | - | 5.0 | |
| Drain Cut-Off Current | $I_{DSS}$ | $V_{DS}$ = 400V, $V_{GS}$ = 0V | - | - | 1 | μA |
| Gate Leakage Current | $I_{GSS}$ | $V_{GS}$ = ±30V, $V_{DS}$ = 0V | - | - | 100 | nA |
| Drain-Source ON Resistance | $R_{DS(ON)}$ | $V_{GS}$ = 10V, $I_D$ = 3.0A | | 0.67 | 0.85 | Ω |
| Forward Transconductance | $g_{fs}$ | $V_{DS}$ = 30V, $I_D$ = 3.0A | - | 8 | - | S |
| **Dynamic Characteristics** | | | | | | |
| Total Gate Charge | $Q_g$ | $V_{DS}$ = 320V, $I_D$ = 6A, $V_{GS}$ = 10V | - | 9.6 | - | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 3.4 | - | |
| Gate-Drain Charge | $Q_{gd}$ | | - | 3.6 | - | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 25V, $V_{GS}$ = 0V, f = 1.0MHz | - | 487.4 | - | pF |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 3.4 | - | |
| Output Capacitance | $C_{oss}$ | | - | 75.6 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{GS}$ = 10V, $V_{DS}$ = 200V, $I_D$ = 6A, $R_G$ = 25Ω | - | 12.6 | - | ns |
| Rise Time | $t_r$ | | - | 32 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 19.4 | - | |
| Fall Time | $t_f$ | | - | 13.2 | - | |
| **Drain-Source Body Diode Characteristics** | | | | | | |
| Maximum Continuous Drain to Source Diode Forward Current | $I_S$ | | - | - | 6.0 | A |
| Source-Drain Diode Forward Voltage | $V_{SD}$ | $I_S$ = 6A, $V_{GS}$ = 0V | - | - | 1.4 | V |
| Body Diode Reverse Recovery Time | $t_{rr}$ | $I_F$ = 6A, di/dt = 100A/μs[3] | - | 218 | - | ns |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | | - | 1.3 | - | μC |

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 ≤300us, duty cycle≤2%, pulse width limited by junction temperature $T_{J(MAX)}$=150°C.
3. $I_{SD}$ ≤6A, di/dt≤200A/us, $V_{DD}$≤BVDSS, Starting $T_J$=25°C
4. L=14.6mH, $I_{AS}$=6A, $V_{DD}$=50V, $R_g$ =25Ω, Starting $T_J$=25°C,

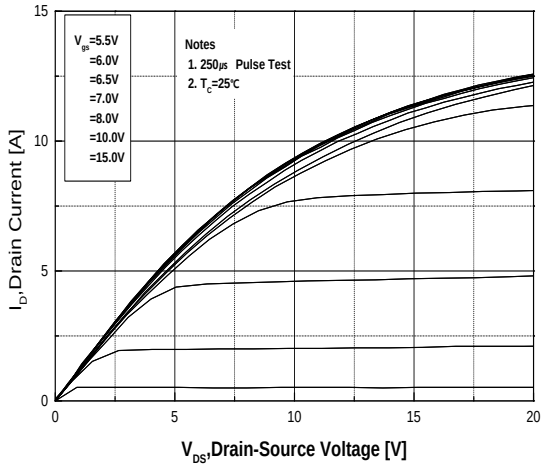



**Fig.1 On-Region Characteristics**

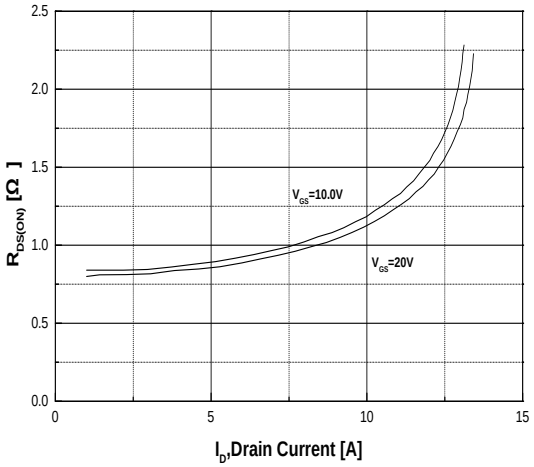



**Fig.2 On-Resistance Variation with Drain Current and Gate Voltage**

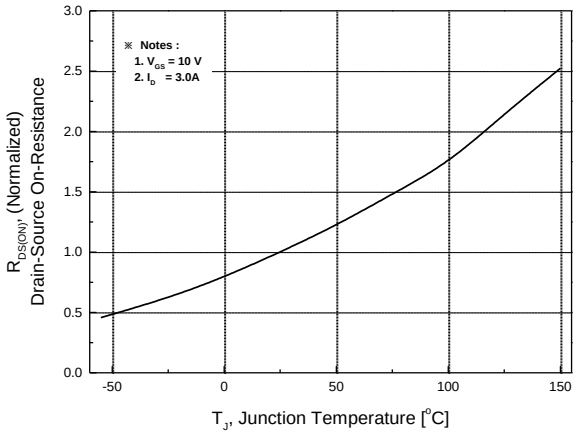



**Fig.3 On-Resistance Variation with Temperature**

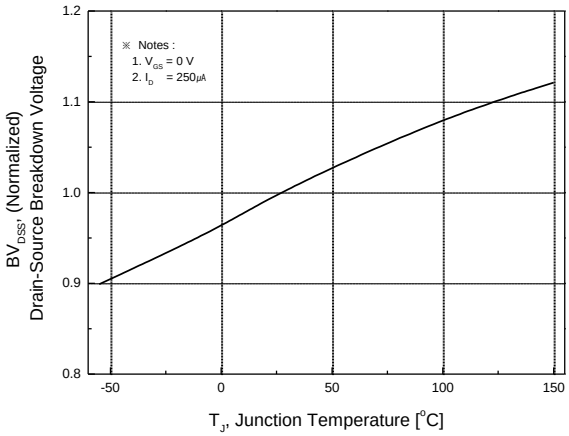



**Fig.4 Breakdown Voltage Variation vs. Temperature**

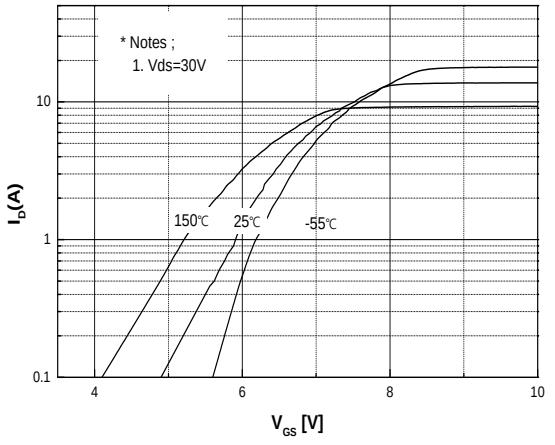



**Fig.5 Transfer Characteristics**

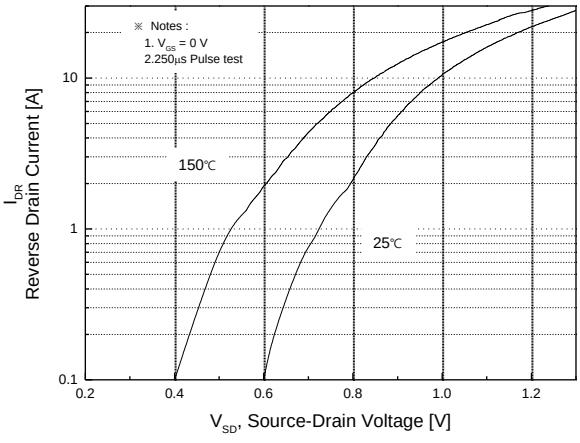



**Fig.6 Body Diode Forward Voltage Variation with Source Current and Temperature**

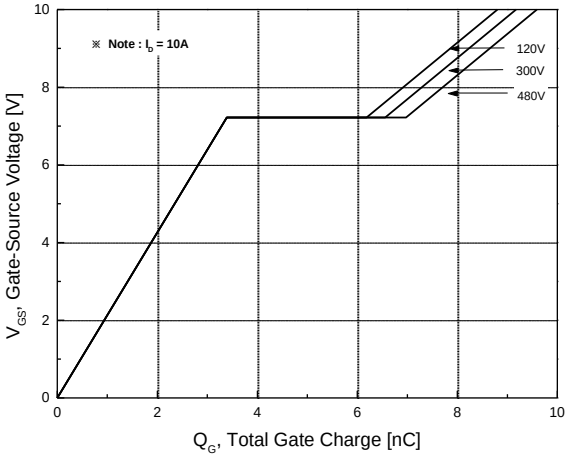



**Fig.7 Gate Charge Characteristics**

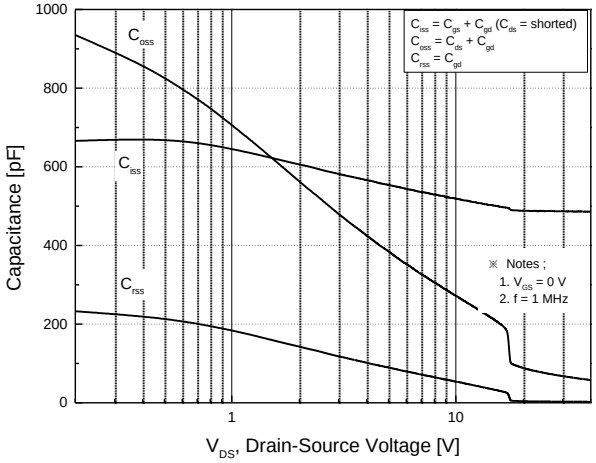



**Fig.8 Capacitance Characteristics**

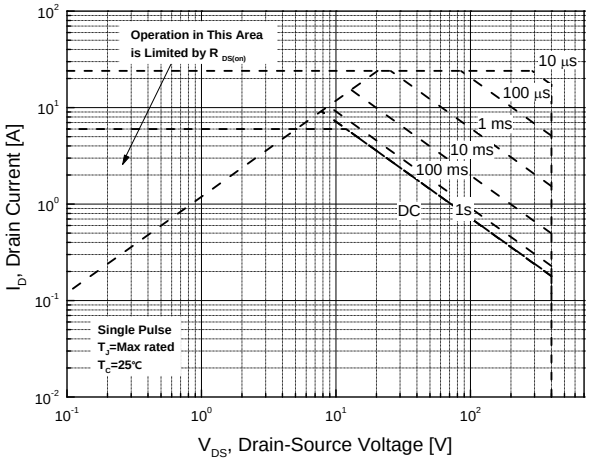



**Fig.9 Maximum Safe Operating Area**

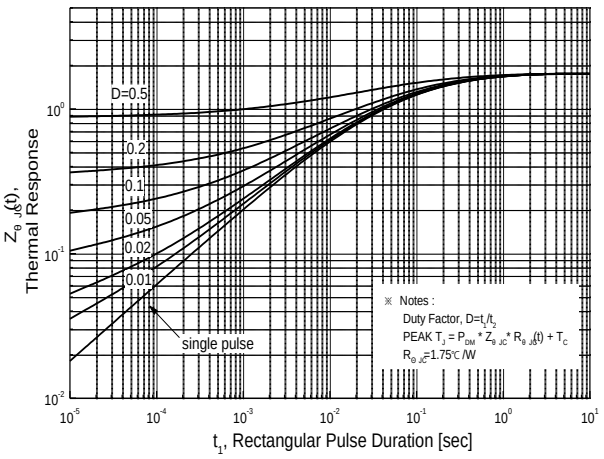



**Fig.10 Transient Thermal Response Curve**

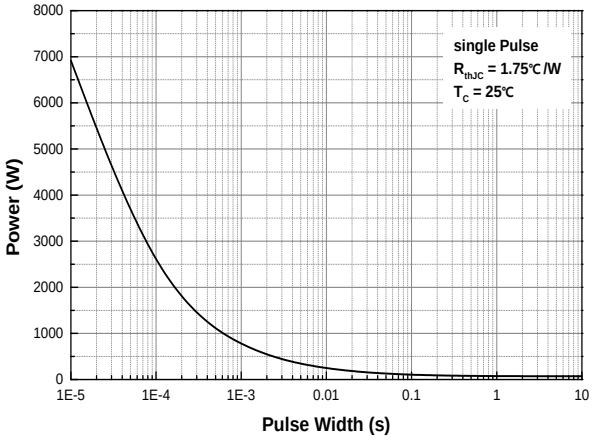



**Fig.11 Single Pulse Maximum Power Dissipation**

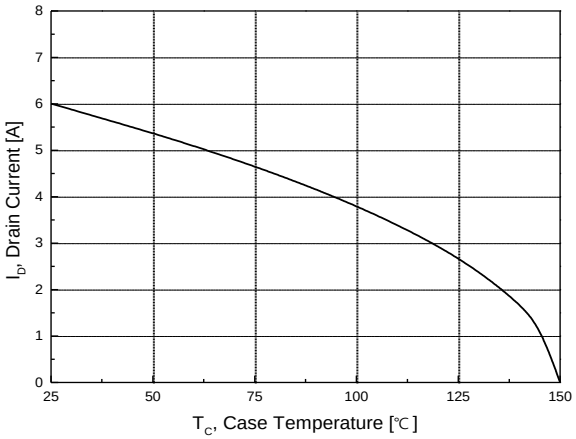
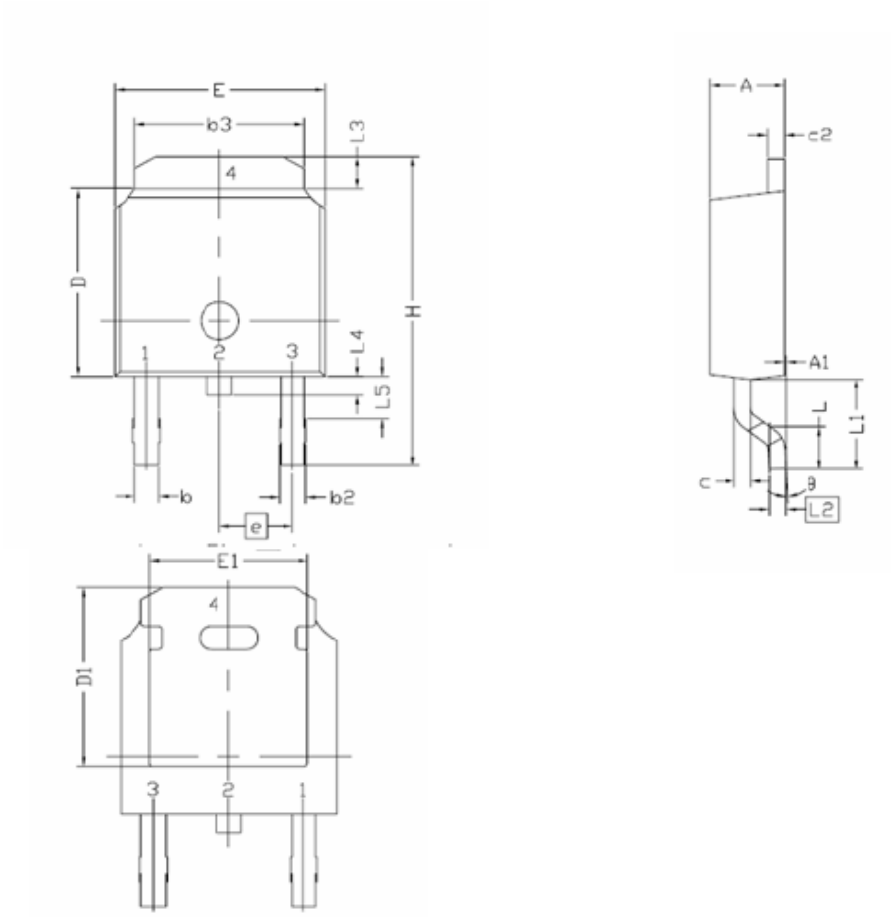



**Fig.15 Maximum Drain Current vs. Case Temperature**

## Physical Dimensions

### D-PAK (TO-252)

**Dimensions are in millimeters, unless otherwise specified**




| Symbol | Min | Nom | Max |
|---|---|---|---|
| E | 6.35 | - | 6.73 |
| L | 1.40 | 1.52 | 1.78 |
| L1 | | 2.74REF | |
| L2 | | 0.508BCS | |
| L3 | 0.89 | - | 1.27 |
| L4 | - | - | 1.02 |
| L5 | 1.14 | - | 1.52 |
| D | 5.97 | 6.10 | 6.22 |
| H | 9.40 | - | 10.41 |
| b | 0.64 | - | 0.89 |
| b2 | 0.76 | - | 1.14 |
| b3 | 4.95 | | 5.46 |
| e | | 2.286BSC | |
| A | 2.18 | - | 2.39 |
| A1 | - | - | 0.13 |
| c | 0.46 | - | 0.61 |
| c2 | 0.46 | - | 0.89 |
| D1 | 5.21 | - | - |
| E1 | 4.32 | - | - |
| Θ | 0.00 | - | 10.00 |

Note : Package body size, length and width do not include mold flash, protrusions and gate burrs.

**DISCLAIMER:**

The Products are not designed for use in hostile environments, including, without limitation, aircraft, nuclear power generation, medical appliances, and devices or systems in which malfunction of any Product can reasonably be expected to result in a personal injury. Seller's customers using or selling Seller's products for use in such applications do so at their own risk and agree to fully defend and indemnify Seller.