

TM049P06DF

P -Channel Enhancement Mosfet

**General Description**

- Low  $R_{DS(ON)}$
- RoHS and Halogen-Free Compliant

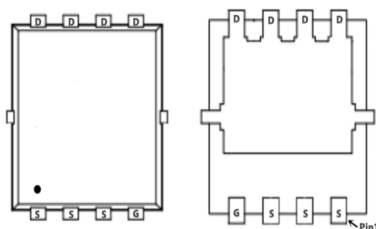
**Applications**

- Load switch
- PWM

**General Features**

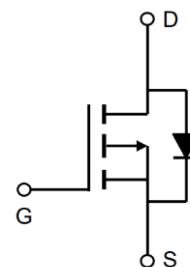
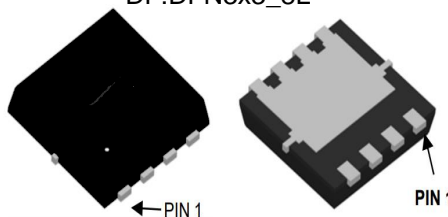
$V_{DS} = -60V$   $I_D = -20A$   
 $R_{DS(ON)} = 49m\Omega$  (typ.) @  $V_{GS} = -10V$

100% UIS Tested  
 100%  $R_g$  Tested



Marking:20P06

DF:DFN3x3\_8L



**Absolute Maximum Ratings:** ( $T_C=25^\circ C$  unless otherwise noted)

| Symbol                  | Parameter                                   | Rating     | Units      |
|-------------------------|---|------------|------------|
| $V_{DS}$                | Drain-Source Voltage                        | -60        | V          |
| $V_{GS}$                | Gate-Source Voltage                         | $\pm 20$   | V          |
| $I_D @ T_C=25^\circ C$  | Continuous Drain Current, $V_{GS} @ -10V^1$ | -20        | A          |
| $I_D @ T_C=100^\circ C$ | Continuous Drain Current, $V_{GS} @ -10V^1$ | -12        | A          |
| $I_D @ T_A=25^\circ C$  | Continuous Drain Current, $V_{GS} @ -10V^1$ | -4.5       | A          |
| $I_D @ T_A=70^\circ C$  | Continuous Drain Current, $V_{GS} @ -10V^1$ | -4.0       | A          |
| $I_{DM}$                | Pulsed Drain Current <sup>2</sup>           | -30        | A          |
| EAS                     | Single Pulse Avalanche Energy <sup>3</sup>  | 18.1       | mJ         |
| $I_{AS}$                | Avalanche Current                           | -13        | A          |
| $P_D @ T_C=25^\circ C$  | Total Power Dissipation <sup>4</sup>        | 25         | W          |
| $P_D @ T_A=25^\circ C$  | Total Power Dissipation <sup>4</sup>        | 2          | W          |
| $T_{STG}$               | Storage Temperature Range                   | -55 to 150 | $^\circ C$ |
| $T_J$                   | Operating Junction Temperature Range        | -55 to 150 | $^\circ C$ |

**Thermal Data**

| Symbol          | Parameter  | Typ. | Max. | Unit         |
|-----------------|--|------|------|--------------|
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient <sup>1</sup> | ---  | 62   | $^\circ C/W$ |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case <sup>1</sup>    | ---  | 5    | $^\circ C/W$ |

**Electrical Characteristics (T<sub>J</sub>=25 °C, unless otherwise noted)**

| Symbol                              | Parameter                                      | Conditions   | Min. | Typ.   | Max. | Unit  |
|-------------------------------------|--|--|------|--------|------|-------|
| BV <sub>DSS</sub>                   | Drain-Source Breakdown Voltage                 | V <sub>GS</sub> =0V, I <sub>D</sub> =-250uA  | -60  | ---    | ---  | V     |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | BV <sub>DSS</sub> Temperature Coefficient      | Reference to 25°C, I <sub>D</sub> =-1mA  | ---  | -0.023 | ---  | V/°C  |
| R <sub>DS(ON)</sub>                 | Static Drain-Source On-Resistance <sup>2</sup> | V <sub>GS</sub> =-10V, I <sub>D</sub> =-10A  | ---  | 49     | 60   | mΩ    |
|                                     |  | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-6A  | ---  | 61     | 75   |       |
| V <sub>GS(th)</sub>                 | Gate Threshold Voltage                         | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =-250uA                                | -1.2 | ---    | -2.5 | V     |
| ΔV <sub>GS(th)</sub>                | V <sub>GS(th)</sub> Temperature Coefficient    |  | ---  | 4      | ---  | mV/°C |
| I <sub>DSS</sub>                    | Drain-Source Leakage Current                   | V <sub>DS</sub> =-24V, V <sub>GS</sub> =0V, T <sub>J</sub> =25°C                         | ---  | ---    | -1   | uA    |
|                                     |  | V <sub>DS</sub> =-24V, V <sub>GS</sub> =0V, T <sub>J</sub> =55°C                         | ---  | ---    | -5   |       |
| I <sub>GSS</sub>                    | Gate-Source Leakage Current                    | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V   | ---  | ---    | ±100 | nA    |
| g <sub>fs</sub>                     | Forward Transconductance                       | V <sub>DS</sub> =-5V, I <sub>D</sub> =-15A   | ---  | 12     | ---  | S     |
| Q <sub>g</sub>                      | Total Gate Charge (-4.5V)                      | V <sub>DS</sub> =-15V, V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-15A                      | ---  | 6.1    | ---  | nC    |
| Q <sub>gs</sub>                     | Gate-Source Charge                             |  | ---  | 3.1    | ---  |       |
| Q <sub>gd</sub>                     | Gate-Drain Charge                              |  | ---  | 1.8    | ---  |       |
| T <sub>d(on)</sub>                  | Turn-On Delay Time                             | V <sub>DD</sub> =-15V, V <sub>GS</sub> =-10V, R <sub>G</sub> =3.3Ω, I <sub>D</sub> =-15A | ---  | 2.6    | ---  | ns    |
| T <sub>r</sub>                      | Rise Time                                      |  | ---  | 8.6    | ---  |       |
| T <sub>d(off)</sub>                 | Turn-Off Delay Time                            |  | ---  | 33.6   | ---  |       |
| T <sub>f</sub>                      | Fall Time                                      |  | ---  | 6      | ---  |       |
| C <sub>iss</sub>                    | Input Capacitance                              | V <sub>DS</sub> =-15V, V <sub>GS</sub> =0V, f=1MHz                                       | ---  | 585    | ---  | pF    |
| C <sub>oss</sub>                    | Output Capacitance                             |  | ---  | 100    | ---  |       |
| C <sub>rss</sub>                    | Reverse Transfer Capacitance                   |  | ---  | 85     | ---  |       |

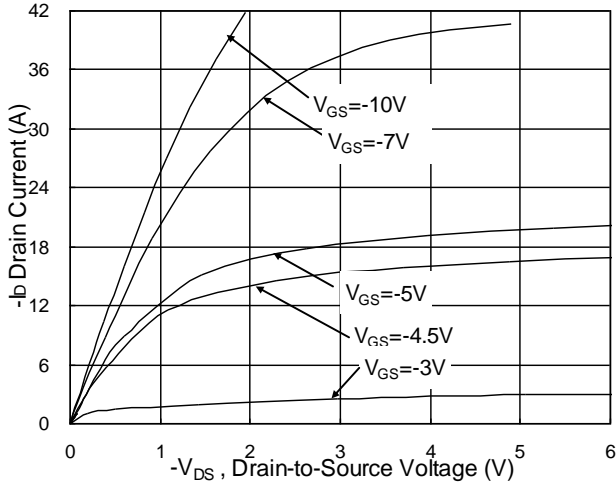
**Diode Characteristics**

| Symbol          | Parameter                                | Conditions   | Min. | Typ. | Max. | Unit |
|-----------------|--|--|------|------|------|------|
| I <sub>S</sub>  | Continuous Source Current <sup>1,5</sup> | V <sub>G</sub> =V <sub>D</sub> =0V, Force Current              | ---  | ---  | -20  | A    |
| I <sub>SM</sub> | Pulsed Source Current <sup>2,5</sup>     |  | ---  | ---  | -30  | A    |
| V <sub>SD</sub> | Diode Forward Voltage <sup>2</sup>       | V <sub>GS</sub> =0V, I <sub>S</sub> =-1A, T <sub>J</sub> =25°C | ---  | ---  | -1.2 | V    |
| t <sub>rr</sub> | Reverse Recovery Time                    | I <sub>F</sub> =-15A, dI/dt=100A/μs,                           | ---  | 6.1  | ---  | nS   |
| Q <sub>rr</sub> | Reverse Recovery Charge                  | T <sub>J</sub> =25°C   | ---  | 1.4  | ---  | nC   |

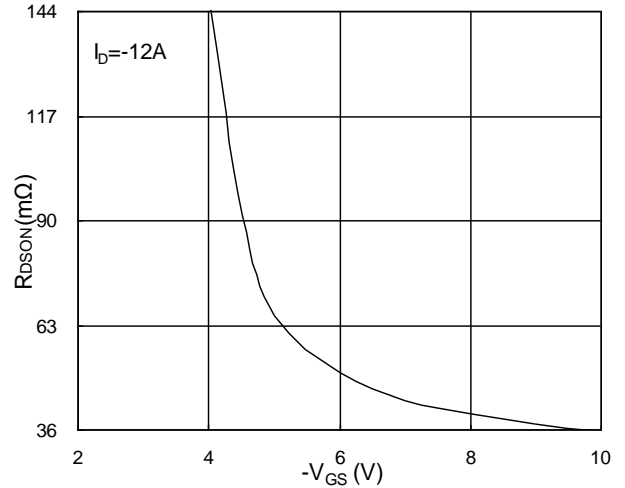
Note :

- The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper.
- The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%
- The EAS data shows Max. rating. The test condition is V<sub>DD</sub>=-25V, V<sub>GS</sub>=-10V, L=0.1mH, I<sub>AS</sub>=-19A
- The power dissipation is limited by 150°C junction temperature
- The data is theoretically the same as I<sub>D</sub> and I<sub>DM</sub>, in real applications, should be limited by total power dissipation.

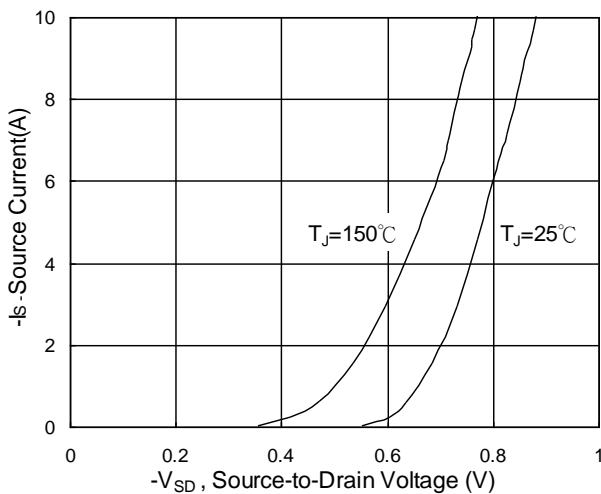
**Typical Characteristics**



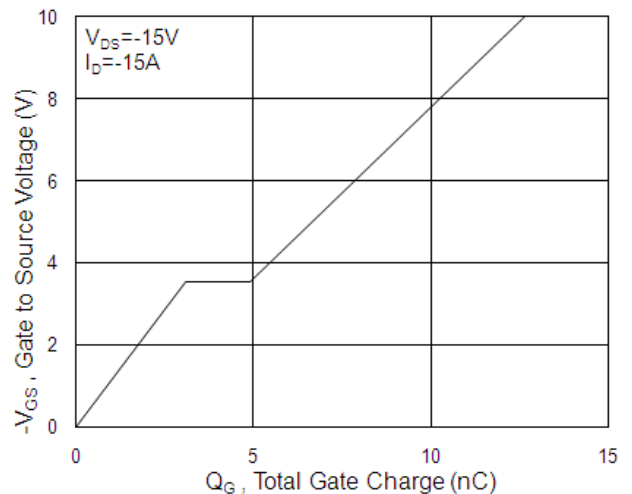
**Fig.1 Typical Output Characteristics**



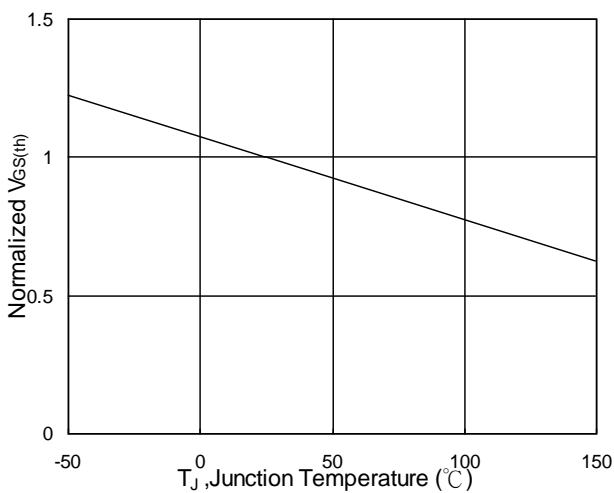
**Fig.2 On-Resistance v.s Gate-Source**



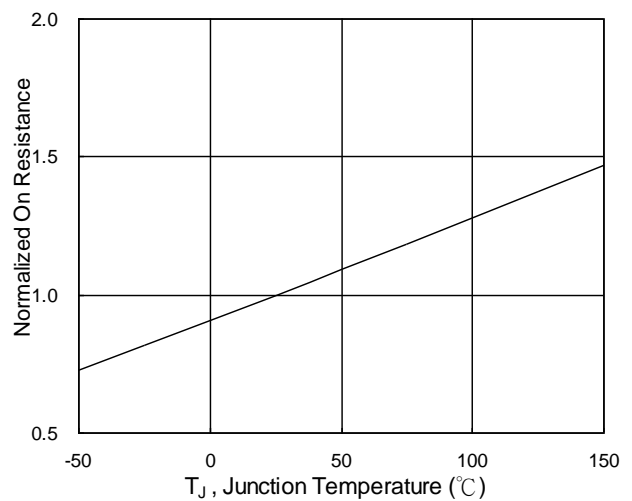
**Fig.3 Forward Characteristics Of Reverse**



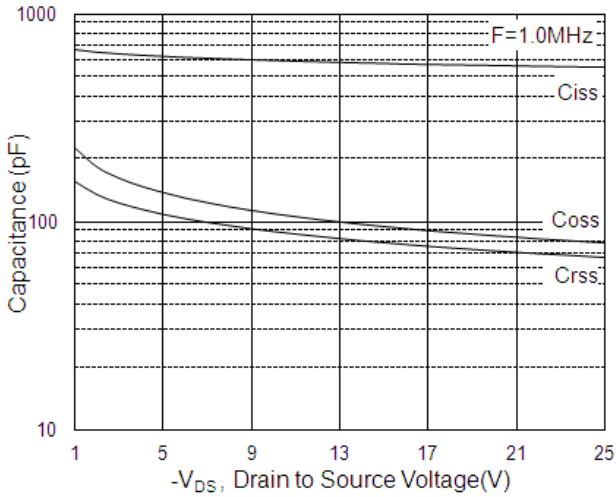
**Fig.4 Gate Charge Characteristics**



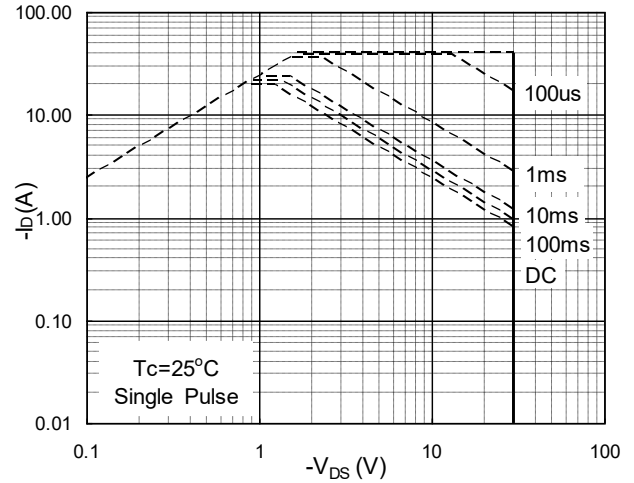
**Fig.5 Normalized  $V_{GS(th)}$  vs.  $T_J$**



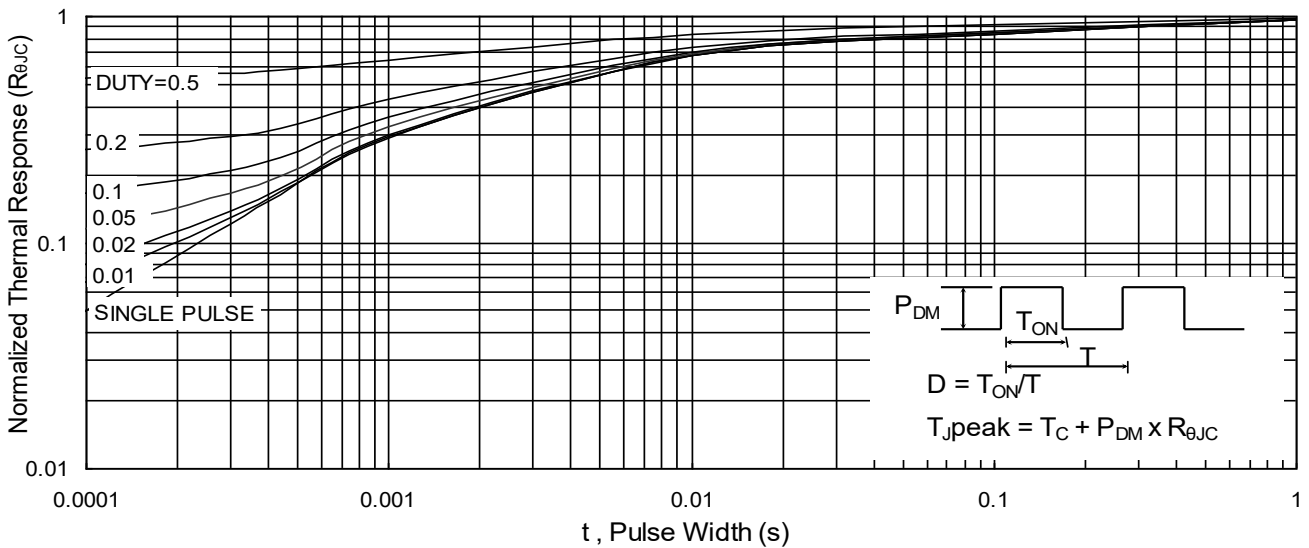
**Fig.6 Normalized  $R_{DS(on)}$  vs.  $T_J$**



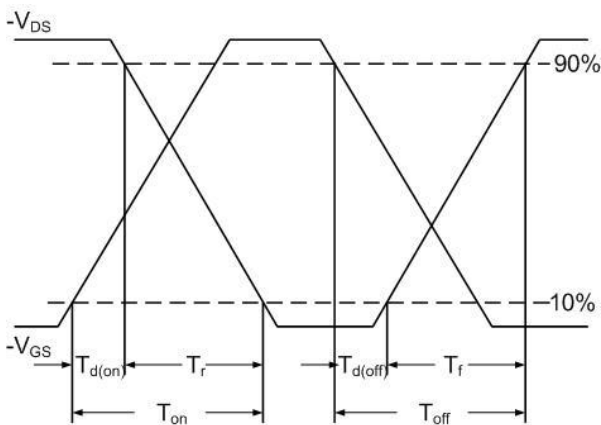
**Fig.7 Capacitance**



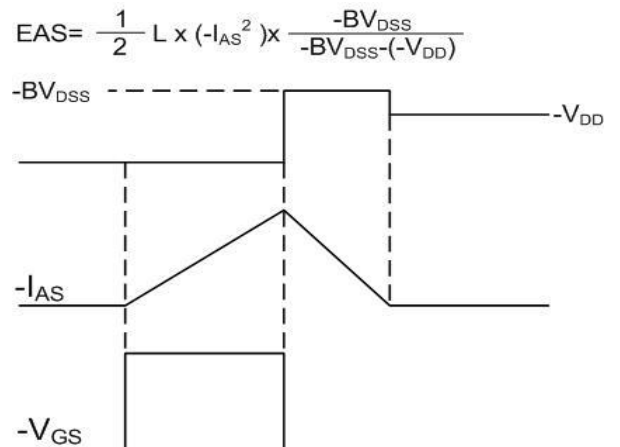
**Fig.8 Safe Operating Area**



**Fig.9 Normalized Maximum Transient Thermal Impedance**

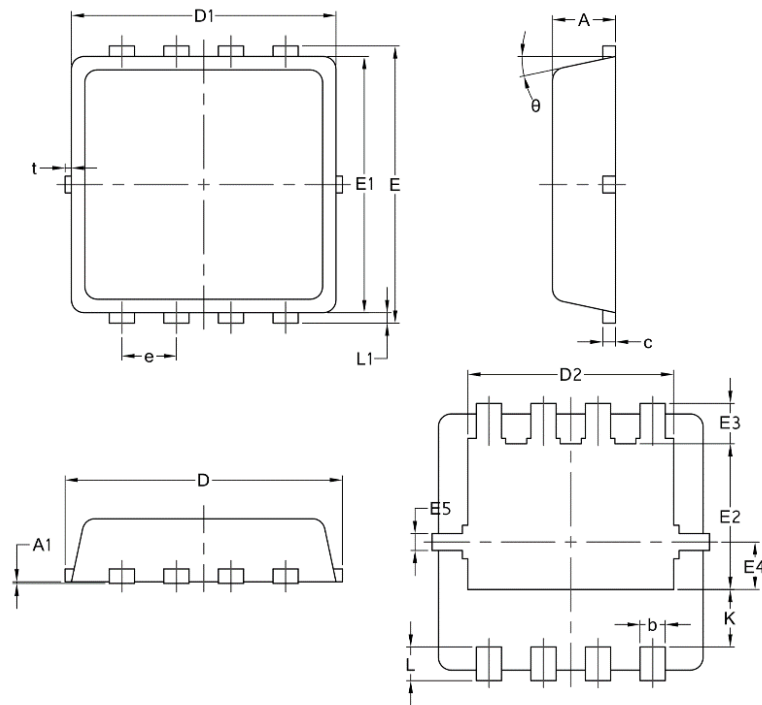


**Fig.10 Switching Time Waveform**



**Fig.11 Unclamped Inductive Switching Waveform**

## Package Mechanical Data:DFN3x3-8L



| Symbol | Common |       |      |
|--------|--------|-------|------|
|        | mm     |       |      |
|        | Mim    | Nom   | Max  |
| A      | 0.70   | 0.75  | 0.85 |
| A1     | /      | /     | 0.05 |
| b      | 0.20   | 0.30  | 0.40 |
| c      | 0.10   | 0.152 | 0.25 |
| D      | 3.15   | 3.30  | 3.45 |
| D1     | 3.00   | 3.15  | 3.25 |
| D2     | 2.29   | 2.45  | 2.65 |
| E      | 3.15   | 3.30  | 3.45 |
| E1     | 2.90   | 3.05  | 3.20 |
| E2     | 1.54   | 1.74  | 1.94 |
| E3     | 0.28   | 0.48  | 0.65 |
| E4     | 0.37   | 0.57  | 0.77 |
| E5     | 0.10   | 0.20  | 0.30 |
| e      | 0.60   | 0.65  | 0.70 |
| K      | 0.59   | 0.69  | 0.89 |
| L      | 0.30   | 0.40  | 0.50 |
| L1     | 0.06   | 0.125 | 0.20 |
| t      | 0      | 0.075 | 0.13 |
| $\Phi$ | 10     | 12    | 14   |

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