

## 12V P-Channel Enhancement Mode MOSFET

### Description

The NP60P012D3 uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. It can be used in a wide variety of applications.

### General Features

- ◆  $V_{DS} = -12V$ ,  $I_D = -60A$   
 $R_{DS(ON)}(Typ.) = 4.8m\Omega$  @  $V_{GS} = -4.5V$   
 $R_{DS(ON)}(Typ.) = 6.3m\Omega$  @  $V_{GS} = -2.5V$
- ◆ High density cell design for ultra low  $R_{dson}$
- ◆ Fully characterized avalanche voltage and current
- ◆ Good stability and uniformity with high  $E_{AS}$
- ◆ Excellent package for good heat dissipation
- ◆ Special process technology for high ESD capability
- ◆ 100% UIS tested

### Application

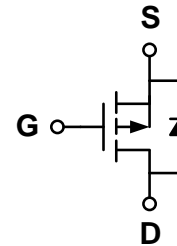
- ◆ Automotive applications
- ◆ Hard switched and high frequency circuits
- ◆ Uninterruptible power supply

### Package

- ◆ PDFN3.3\*3.3-8L



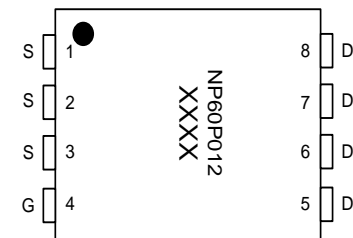
### Schematic diagram



### Marking and pin assignment

#### PDFN3.3\*3.3-8L

(Top View)



XXXX—Wafer Information

### Ordering Information

| Part Number  | Storage Temperature | Package        | Devices Per Reel |
|--------------|---------------------|----------------|------------------|
| NP60P012D3-G | -55°C to +150°C     | PDFN3.3*3.3-8L | 5000             |

### Absolute Maximum Ratings (TA=25°C unless otherwise noted)

| parameter                                     | symbol   | limit    | unit |   |
|---|----------|----------|------|---|
| Drain-source voltage                          | $V_{DS}$ | -12      | V    |   |
| Gate-source voltage                           | $V_{GS}$ | ±12      | V    |   |
| Continuous Drain Current                      | $I_D$    | TC=25°C  | -60  | A |
|   |          | TC=100°C | -40  |   |
| Pulsed Drain Current                          | $I_{DP}$ | -180     | A    |   |
| Avalanche energy( L=0.5mH) <sup>(note1)</sup> | $E_{AS}$ | 200      | mJ   |   |
| Maximum power dissipation                     | $P_D$    | 28       | W    |   |
| Operating junction Temperature range          | $T_j$    | -55—150  | °C   |   |

**Electrical Characteristics** (TA=25°C unless otherwise noted)

| Parameter                                     | Symbol       | Condition                                | Min              | Typ   | Max       | Unit       |         |
|---|--------------|--|------------------|-------|-----------|------------|---------|
| <b>Static Characteristics</b>                 |              |  |                  |       |           |            |         |
| Drain-source breakdown voltage                | $BV_{DSS}$   | $V_{GS}=0V, I_D=-250\mu A$               | -16              | -     | -         | V          |         |
| Zero gate voltage drain current               | $I_{DSS}$    | $V_{DS}=-12V, V_{GS}=0V$                 | $T_J=25^\circ C$ | -     | -         | -1         | $\mu A$ |
|   |              |  | $T_J=85^\circ C$ | -     | -         | -5         |         |
| Gate Leakage Current                          | $I_{GSS}$    | $V_{DS}=0V, V_{GS}=\pm 12V$              | -                | -     | $\pm 100$ | nA         |         |
| Gate threshold voltage                        | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=-250\mu A$           | -0.5             | -0.70 | -1.2      | V          |         |
| Drain-source on-state resistance <sup>1</sup> | $R_{DS(ON)}$ | $V_{GS}=-4.5V, I_D=-20A$                 | -                | 4.8   | 6         | m $\Omega$ |         |
|   |              | $V_{GS}=-2.5V, I_D=-20A$                 | -                | 6.3   | 8         |            |         |
| On Status Drain Current                       | $I_{D(ON)}$  | $V_{DS}=-20V, V_{GS}=-4.5V$              | 60               | -     | -         | A          |         |
| <b>Diode Characteristics</b>                  |              |  |                  |       |           |            |         |
| Diode Continuous Forward Current              | $I_S$        |  | -                | -     | 60        | A          |         |
| Reverse Recovery Time                         | $t_{rr}$     | $I_F=-20A,$                              | -                | 25    | -         | ns         |         |
| Reverse Recovery Charge                       | $Q_{rr}$     | $di/dt=20A/us$                           | -                | 24    | -         | nC         |         |
| <b>Dynamic Characteristics<sup>2</sup></b>    |              |  |                  |       |           |            |         |
| Input capacitance                             | $C_{ISS}$    | $V_{GS}=0V, V_{DS}=-6V$<br>$f=1.0MHz$    | -                | 4572  | -         | pF         |         |
| Output capacitance                            | $C_{OSS}$    |  | -                | 745   | -         |            |         |
| Reverse transfer capacitance                  | $C_{RSS}$    |  | -                | 670   | -         |            |         |
| Turn-on delay time                            | $t_{D(ON)}$  | $V_{GS}=-4.5V, V_{DD}=-6V, I_D=-2A$      | -                | 6.5   | -         | ns         |         |
| Turn-on Rise time                             | $t_r$        |  | -                | 17    | -         |            |         |
| Turn-off delay time                           | $t_{D(OFF)}$ |  | -                | 29.5  | -         |            |         |
| Turn-off Fall time                            | $t_f$        |  | -                | 17    | -         |            |         |
| Total gate charge                             | $Q_g$        | $V_{GS}=-4.5V, I_D=-20A$<br>$V_{DS}=-6V$ | -                | 88    | -         | nC         |         |
| Gate-source charge                            | $Q_{gs}$     |  | -                | 9.3   | -         |            |         |
| Gate-drain charge                             | $Q_{gd}$     |  | -                | 10.2  | -         |            |         |
| <b>Drain-Source Diode Characteristics</b>     |              |  |                  |       |           |            |         |
| Diode forward voltage                         | $V_{SD}$     | $I_{SD}=-10A, V_{GS}=0V$                 | -                | 0.8   | 1.2       | V          |         |

Note: 1: Eas test: VDD=8V, RG=25ohm, L=500uH

2: Pulse test; pulse width  $\leq 300ns$ , duty cycle  $\leq 2\%$ .

3: Guaranteed by design, not subject to production testing.

## Typical Performance Characteristics

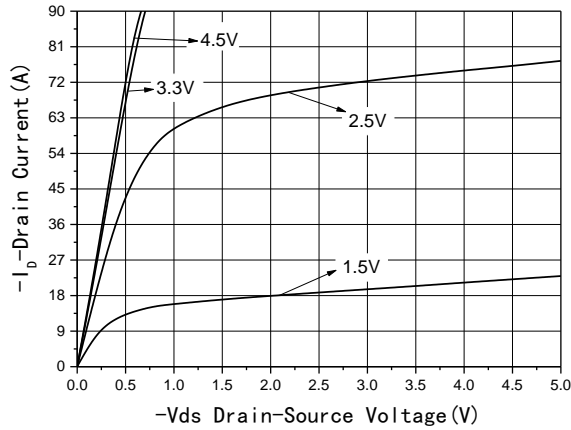


Fig1 Output Characteristics

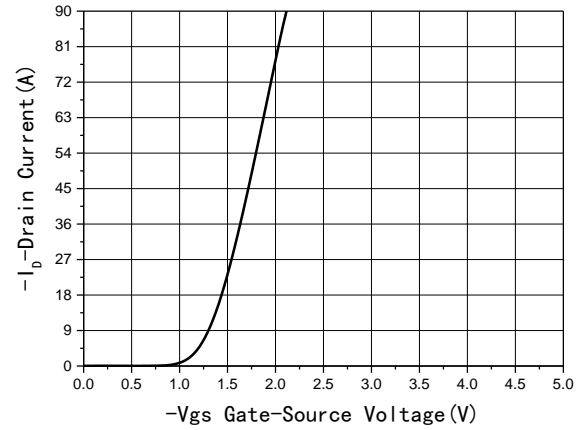


Fig2 Transfer Characteristics

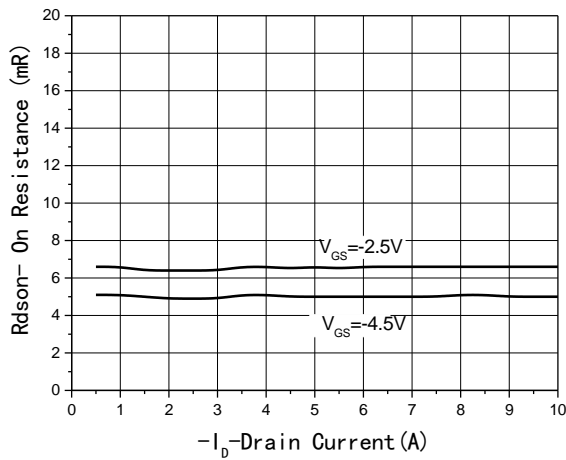


Fig3  $R_{DS(on)}$ -Drain current

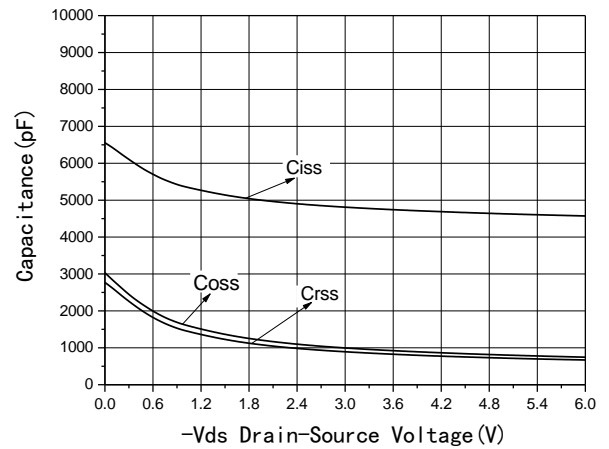


Fig4 Capacitance vs  $V_{DS}$

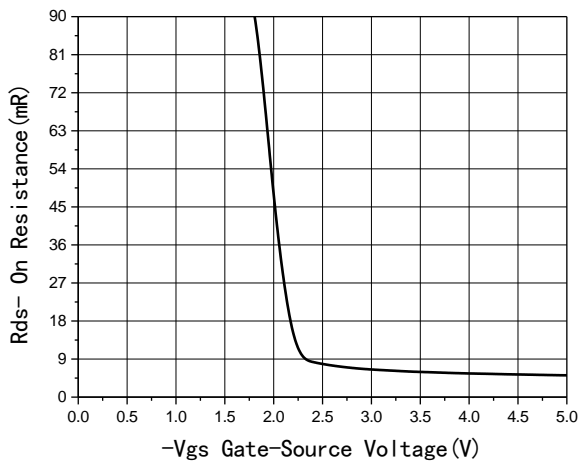


Fig5  $R_{DS(on)}$ -Gate Drain voltage

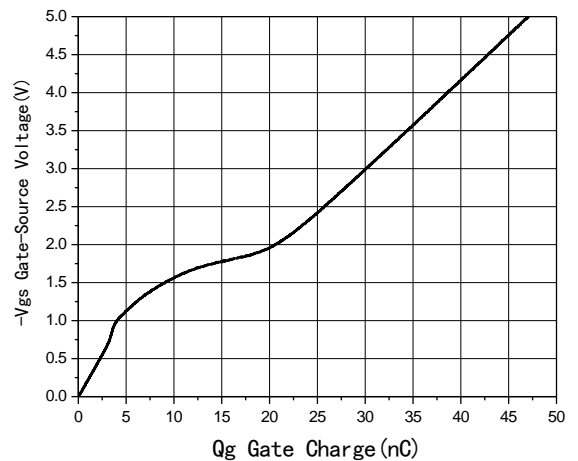
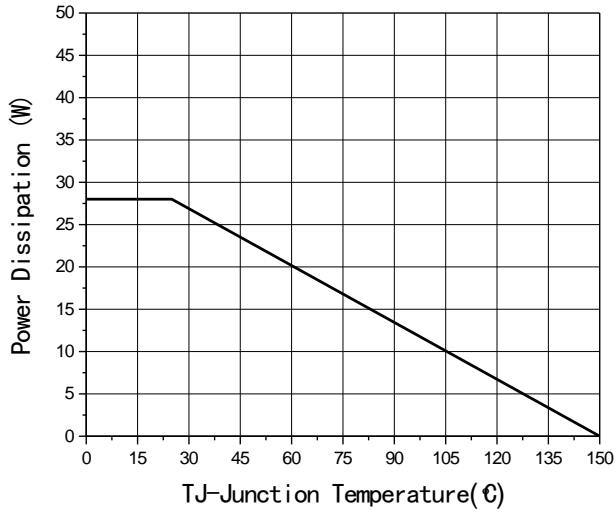
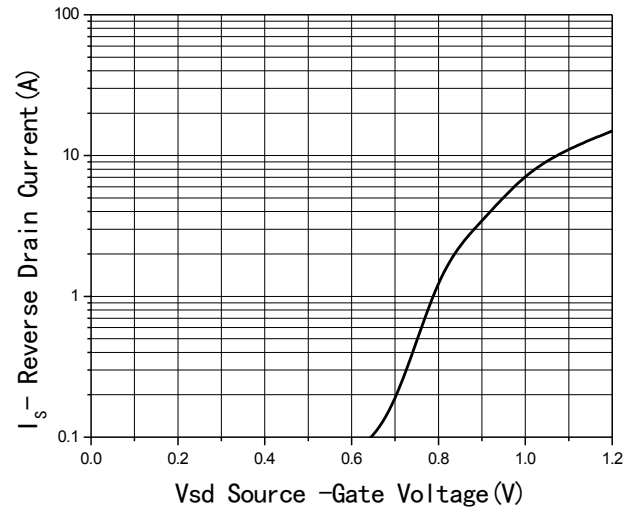


Fig6 Gate Charge



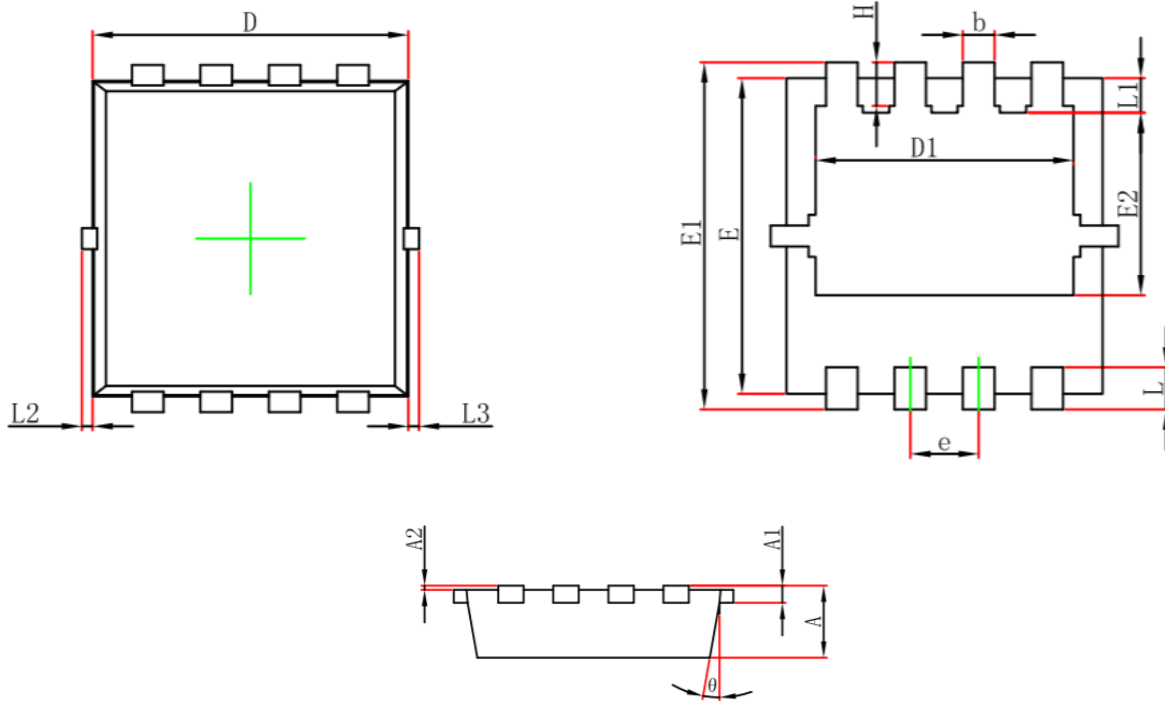
**Fig7 Power De-rating**



**Fig8 Source-Drain Diode Forward**

## Package Information

- PDFN3.3\*3.3-8L



| Symbol | Dimensions In Millimeters |       | Dimensions in inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min.                      | Max.  | Min.                 | Max.  |
| A      | 0.650                     | 0.850 | 0.026                | 0.033 |
| A1     | 0.152 REF.                |       | 0.006 REF.           |       |
| A2     | 0~0.05                    |       | 0~0.002              |       |
| D      | 2.900                     | 3.100 | 0.114                | 0.122 |
| D1     | 2.300                     | 2.600 | 0.091                | 0.102 |
| E      | 2.900                     | 3.100 | 0.114                | 0.122 |
| E1     | 3.150                     | 3.450 | 0.124                | 0.136 |
| E2     | 1.535                     | 1.935 | 0.060                | 0.076 |
| b      | 0.200                     | 0.400 | 0.008                | 0.016 |
| e      | 0.550                     | 0.750 | 0.022                | 0.030 |
| L      | 0.300                     | 0.500 | 0.012                | 0.020 |
| L1     | 0.180                     | 0.480 | 0.007                | 0.019 |
| L2     | 0~0.100                   |       | 0~0.004              |       |
| L3     | 0~0.100                   |       | 0~0.004              |       |
| H      | 0.315                     | 0.515 | 0.012                | 0.020 |
| θ      | 9°                        | 13°   | 9°                   | 13°   |