

# NP23N06YDG

## MOS FIELD EFFECT TRANSISTOR

R07DS0014EJ0100

Rev.1.00

Jul 01, 2010

### Description

The NP23N06YDG is N-channel MOS Field Effect Transistor designed for high current switching applications.

### Features

- Low on-state resistance  
—  $R_{DS(on)} = 27 \text{ m}\Omega \text{ MAX.}$  ( $V_{GS} = 10 \text{ V}$ ,  $I_D = 11.5 \text{ A}$ )
- Low Ciss:  $C_{iss} = 1200 \text{ pF TYP.}$  ( $V_{DS} = 25 \text{ V}$ ,  $V_{GS} = 0 \text{ V}$ )
- Logic level drive type
- Designed for automotive application and AEC-Q101 qualified
- Small size package 8-pin HSON

### Ordering Information

| Part No.                        | LEAD PLATING  | PACKING          | Package                      |
|---------------------------------|---------------|------------------|------------------------------|
| NP23N06YDG -E1-AY <sup>*1</sup> | Pure Sn (Tin) | Tape 2500 p/reel | 8-pin HSON, Taping (E1 type) |
| NP23N06YDG -E2-AY <sup>*1</sup> |               |                  | 8-pin HSON, Taping (E2 type) |

Note: <sup>\*1</sup>. Pb-free (This product does not contain Pb in the external electrode.)

### Absolute Maximum Ratings ( $T_A = 25^\circ\text{C}$ )

| Item                                                               | Symbol         | Ratings                | Unit             |
|--------------------------------------------------------------------|----------------|------------------------|------------------|
| Drain to Source Voltage ( $V_{GS} = 0 \text{ V}$ )                 | $V_{DSS}$      | 60                     | V                |
| Gate to Source Voltage ( $V_{DS} = 0 \text{ V}$ )                  | $V_{GSS}$      | $\pm 20$               | V                |
| Drain Current (DC) ( $T_C = 25^\circ\text{C}$ )                    | $I_{D(DC)}$    | $\pm 23$               | A                |
| Drain Current (pulse) <sup>*1</sup>                                | $I_{D(pulse)}$ | $\pm 46$               | A                |
| Total Power Dissipation ( $T_C = 25^\circ\text{C}$ )               | $P_{T1}$       | 60                     | W                |
| Total Power Dissipation ( $T_A = 25^\circ\text{C}$ ) <sup>*2</sup> | $P_{T2}$       | 1.0                    | W                |
| Channel Temperature                                                | $T_{ch}$       | 175                    | $^\circ\text{C}$ |
| Storage Temperature                                                | $T_{stg}$      | $-55 \text{ to } +175$ | $^\circ\text{C}$ |
| Repetitive Avalanche Current <sup>*3</sup>                         | $I_{AR}$       | 11                     | A                |
| Repetitive Avalanche Energy <sup>*3</sup>                          | $E_{AR}$       | 12                     | mJ               |

### Thermal Resistance

|                                                     |                |     |                    |
|-----------------------------------------------------|----------------|-----|--------------------|
| Channel to Case Thermal Resistance                  | $R_{th(ch-C)}$ | 2.5 | $^\circ\text{C/W}$ |
| Channel to Ambient Thermal Resistance <sup>*2</sup> | $R_{th(ch-A)}$ | 150 | $^\circ\text{C/W}$ |

Notes: <sup>\*1</sup>.  $T_C = 25^\circ\text{C}$ ,  $PW \leq 10 \mu\text{s}$ , Duty Cycle  $\leq 1\%$

<sup>\*2</sup>. Mounted on glass epoxy substrate of 40 mm x 40 mm x 0.8 mm

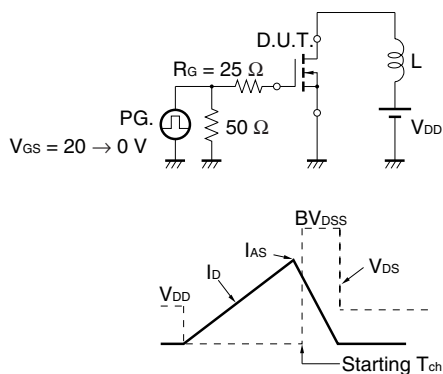
<sup>\*3</sup>.  $T_{ch(peak)} \leq 150^\circ\text{C}$ ,  $R_G = 25 \Omega$

Electrical Characteristics ( $T_A = 25^\circ\text{C}$ )

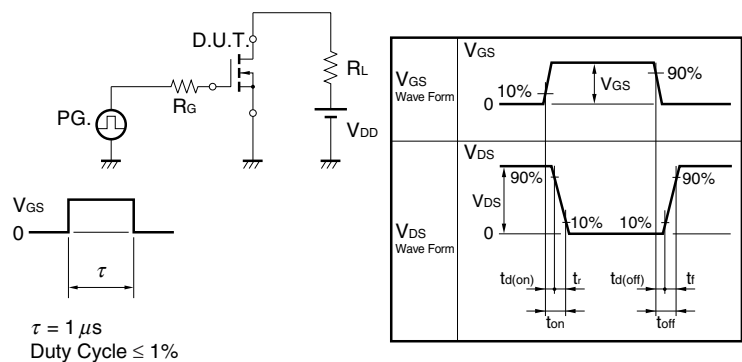
| Item                                              | Symbol        | Min | Typ  | Max       | Unit          | Test Conditions                                                                                    |
|---------------------------------------------------|---------------|-----|------|-----------|---------------|----------------------------------------------------------------------------------------------------|
| Zero Gate Voltage Drain Current                   | $I_{DSS}$     |     |      | 1         | $\mu\text{A}$ | $V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$                                                        |
| Gate Leakage Current                              | $I_{GSS}$     |     |      | $\pm 100$ | nA            | $V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$                                                    |
| Gate to Source Threshold Voltage                  | $V_{GS(th)}$  | 1.4 | 1.8  | 2.5       | V             | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$                                                    |
| Forward Transfer Admittance <sup>*1</sup>         | $ y_{fs} $    | 9.0 | 18   |           | S             | $V_{DS} = 5\text{ V}, I_D = 11.5\text{ A}$                                                         |
| Drain to Source On-state Resistance <sup>*1</sup> | $R_{DS(on)1}$ |     | 22   | 27        | m $\Omega$    | $V_{GS} = 10\text{ V}, I_D = 11.5\text{ A}$                                                        |
|                                                   | $R_{DS(on)2}$ |     | 24   | 37        | m $\Omega$    | $V_{GS} = 5\text{ V}, I_D = 11.5\text{ A}$                                                         |
| Input Capacitance                                 | $C_{iss}$     |     | 1200 | 1800      | pF            | $V_{DS} = 25\text{ V},$<br>$V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$                            |
| Output Capacitance                                | $C_{oss}$     |     | 100  | 150       | pF            |                                                                                                    |
| Reverse Transfer Capacitance                      | $C_{rss}$     |     | 70   | 130       | pF            |                                                                                                    |
| Turn-on Delay Time                                | $t_{d(on)}$   |     | 12   | 24        | ns            | $V_{DD} = 30\text{ V}, I_D = 11.5\text{ A},$<br>$V_{GS} = 10\text{ V},$<br>$R_G = 0\text{ }\Omega$ |
| Rise Time                                         | $t_r$         |     | 6    | 15        | ns            |                                                                                                    |
| Turn-off Delay Time                               | $t_{d(off)}$  |     | 36   | 72        | ns            |                                                                                                    |
| Fall Time                                         | $t_f$         |     | 4    | 10        | ns            | $V_{DD} = 48\text{ V},$<br>$V_{GS} = 10\text{ V},$<br>$I_D = 23\text{ A}$                          |
| Total Gate Charge                                 | $Q_G$         |     | 27   | 41        | nC            |                                                                                                    |
| Gate to Source Charge                             | $Q_{GS}$      |     | 5    |           | nC            |                                                                                                    |
| Gate to Drain Charge                              | $Q_{GD}$      |     | 8    |           | nC            | $I_F = 23\text{ A}, V_{GS} = 0\text{ V}$                                                           |
| Body Diode Forward Voltage <sup>*1</sup>          | $V_{F(S-D)}$  |     | 0.9  | 1.5       | V             |                                                                                                    |
| Reverse Recovery Time                             | $t_{rr}$      |     | 32   |           | ns            |                                                                                                    |
| Reverse Recovery Charge                           | $Q_{rr}$      |     | 37   |           | nC            | $di/dt = 100\text{ A}/\mu\text{s}$                                                                 |

Note: \*1. Pulsed

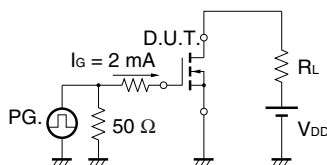
## TEST CIRCUIT 1 AVALANCHE CAPABILITY



## TEST CIRCUIT 2 SWITCHING TIME

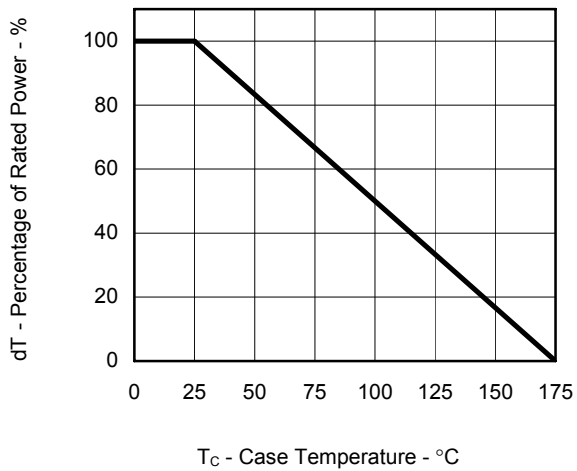


## TEST CIRCUIT 3 GATE CHARGE

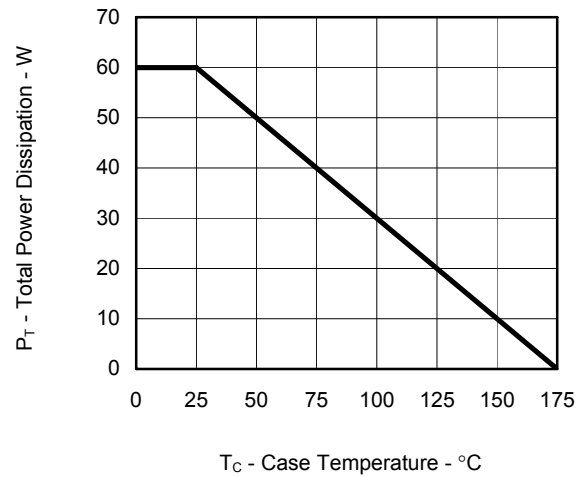


## Typical Characteristics ( $T_A = 25^\circ\text{C}$ )

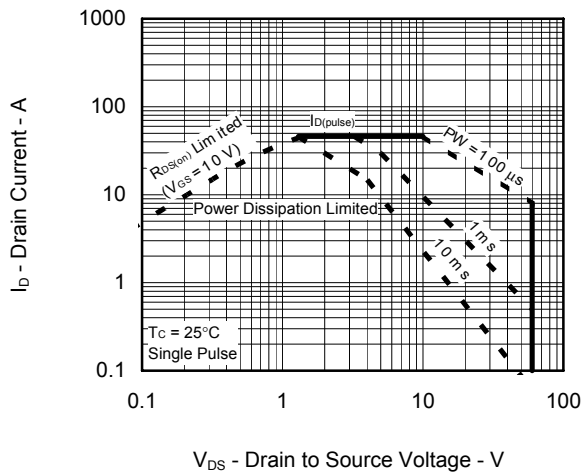
DERATING FACTOR OF FORWARD BIAS SAFE  
OPERATING AREA



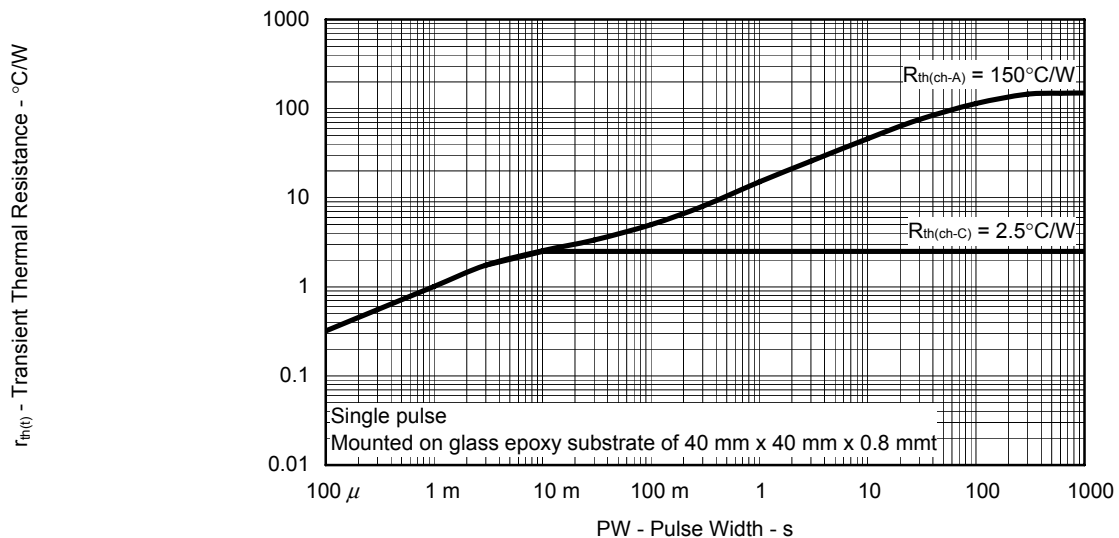
TOTAL POWER DISSIPATION vs.  
CASE TEMPERATURE

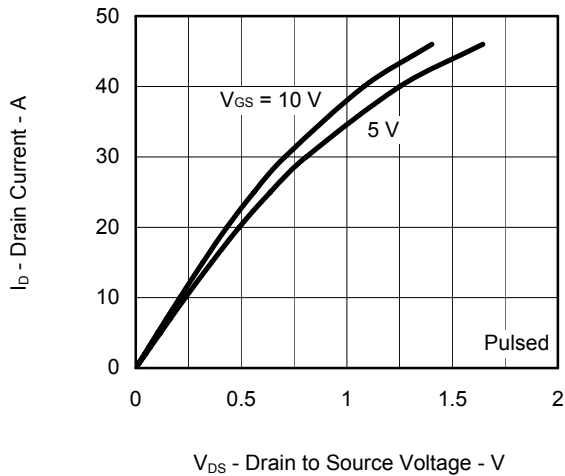


FORWARD BIAS SAFE OPERATING AREA

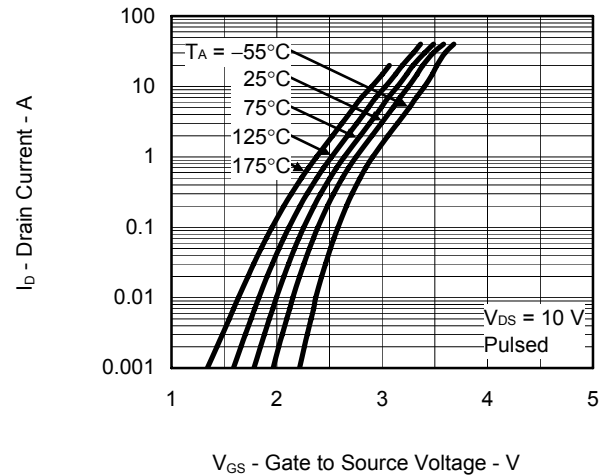
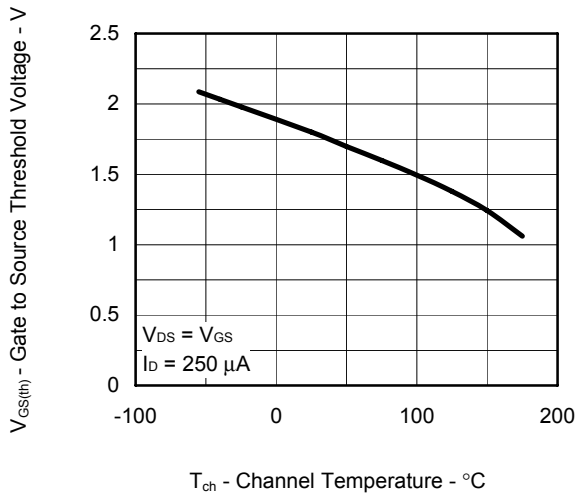
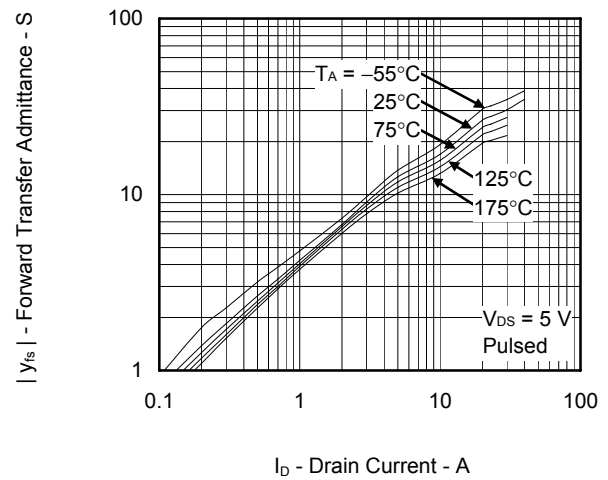
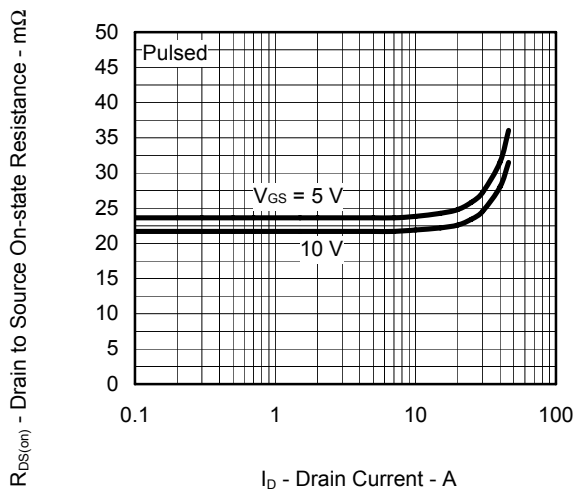
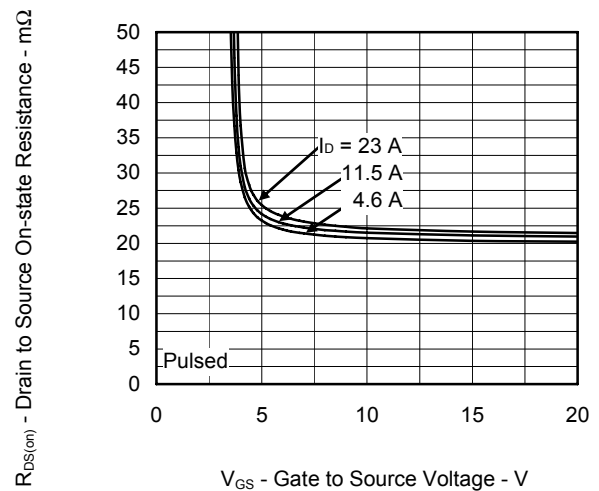


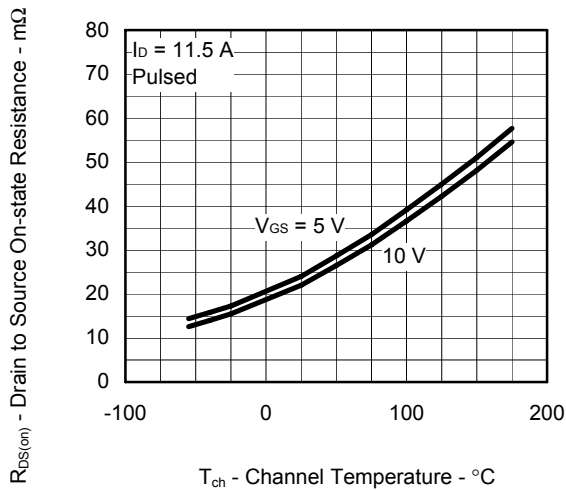
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



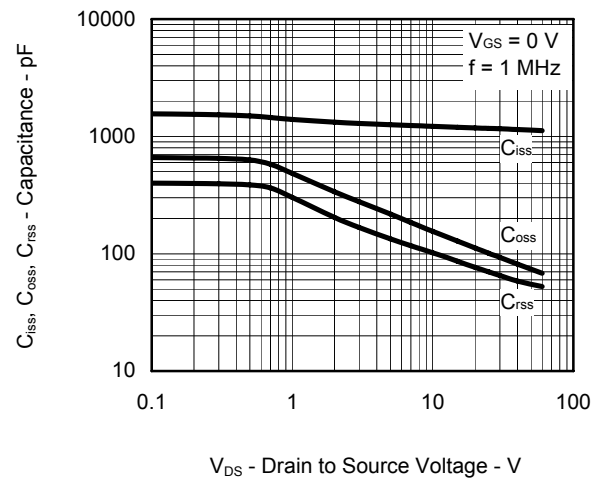
DRAIN CURRENT vs.  
DRAIN TO SOURCE VOLTAGE

FORWARD TRANSFER CHARACTERISTICS

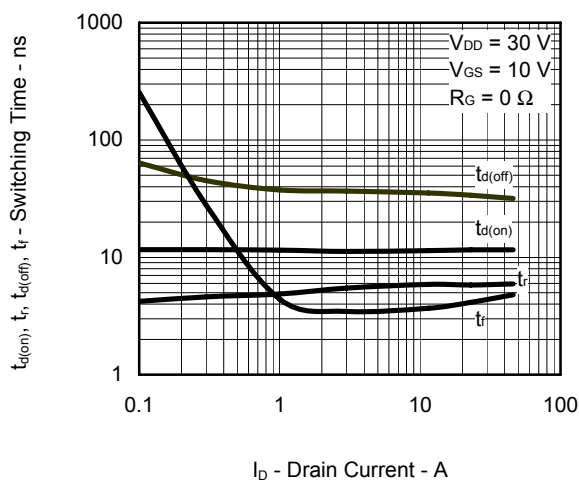
GATE TO SOURCE THRESHOLD VOLTAGE  
vs. CHANNEL TEMPERATUREFORWARD TRANSFER ADMITTANCE vs. DRAIN  
CURRENTDRAIN TO SOURCE ON-STATE RESISTANCE vs.  
DRAIN CURRENTDRAIN TO SOURCE ON-STATE RESISTANCE vs.  
GATE TO SOURCE VOLTAGE

DRAIN TO SOURCE ON-STATE RESISTANCE vs.  
CHANNEL TEMPERATURE

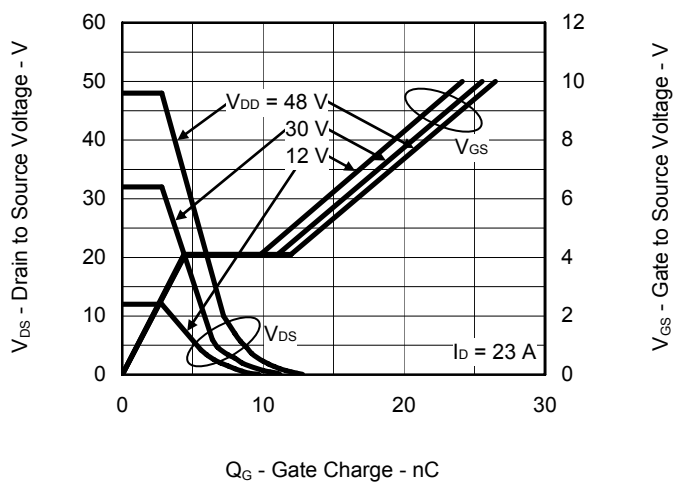
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



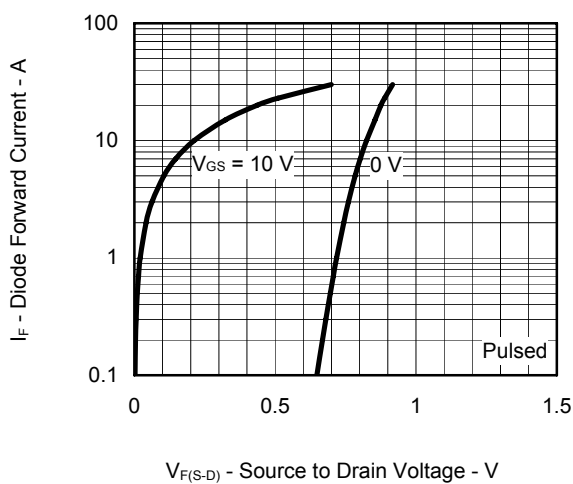
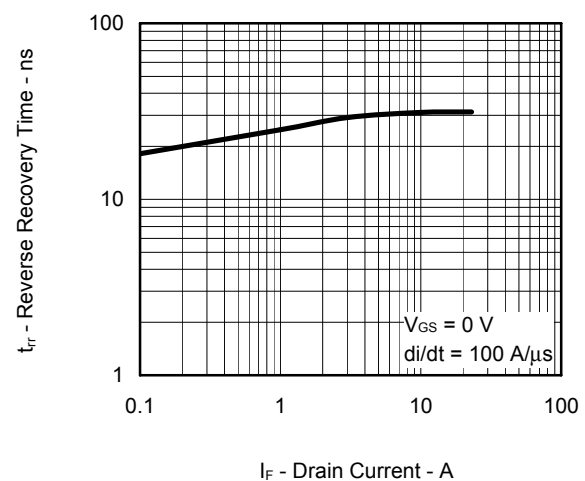
SWITCHING CHARACTERISTICS



DYNAMIC INPUT/OUTPUT CHARACTERISTICS

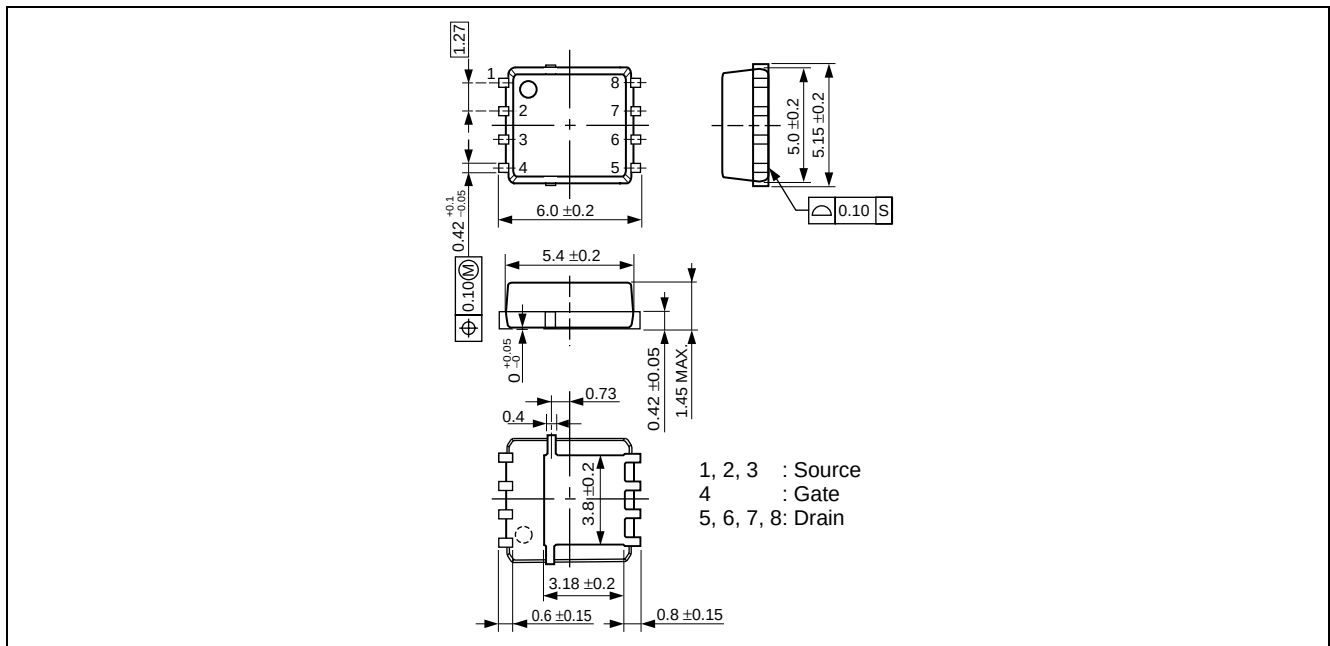


SOURCE TO DRAIN DIODE FORWARD VOLTAGE

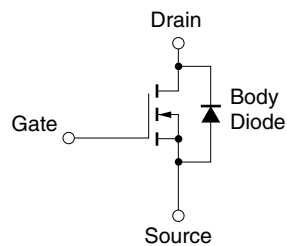
REVERSE RECOVERY TIME vs.  
DRAIN CURRENT

## Package Drawings (Unit: mm)

8-pin HSON (Mass: 0.13 g TYP.)



## Equivalent Circuit



**Remark** Strong electric field, when exposed to this device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred.

|                         |                   |
|-------------------------|-------------------|
| <b>Revision History</b> | <b>NP23N06YDG</b> |
|-------------------------|-------------------|

| <b>Rev.</b> | <b>Date</b>  | <b>Description</b> |                       |
|-------------|--------------|--------------------|-----------------------|
|             |              | <b>Page</b>        | <b>Summary</b>        |
| 1.00        | Jul 01, 2010 | –                  | First Eddition Issued |
|             |              |                    |                       |

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