

### Description

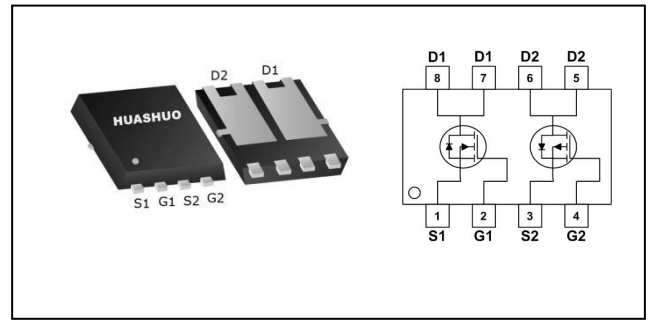
The HSBB4600 uses advanced trench technology to provide excellent RDS(ON), low gate charge and high density cell Design for ultra low on-resistance. This device is suitable for use as a load switch or in PWM applications.

- PWM applications
- Load switch

### Product Summary

| BVDSS | RDSON  | ID   |
|-------|--------|------|
| 20V   | 7.8mΩ  | 12A  |
| -20V  | 10.5mΩ | -10A |

### PDFN3.3\*3.3 Pin Configuration



### Absolute Maximum Ratings

| Symbol                | Parameter                                  | Rating     |            | Units       |
|-----------------------|--------------------------------------------|------------|------------|-------------|
|                       |                                            | N-Ch       | P-Ch       |             |
| $V_{DS}$              | Drain-Source Voltage                       | 20         | -20        | V           |
| $V_{GS}$              | Gate-Source Voltage                        | $\pm 12$   | $\pm 12$   | V           |
| $I_D@T_A=25^{\circ}C$ | Continuous Drain Current, $V_{GS} @ 10V^1$ | 12         | -10        | A           |
| $I_D@T_A=70^{\circ}C$ | Continuous Drain Current, $V_{GS} @ 10V^1$ | 9.5        | -8         | A           |
| $I_{DM}$              | Pulsed Drain Current <sup>2</sup>          | 48         | -40        | A           |
| $P_D@T_C=25^{\circ}C$ | Total Power Dissipation <sup>4</sup>       | 40         | 40         | W           |
| $T_{STG}$             | Storage Temperature Range                  | -55 to 150 | -55 to 150 | $^{\circ}C$ |
| $T_J$                 | Operating Junction Temperature Range       | -55 to 150 | -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>    | ---  | 3.2  | $^{\circ}C/W$ |



### N-Channel Electrical Characteristics ( $T_J=25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

| Symbol       | Parameter                                      | Conditions                                               | Min. | Typ. | Max.      | Unit      |
|--------------|------------------------------------------------|----------------------------------------------------------|------|------|-----------|-----------|
| $BV_{DSS}$   | Drain-Source Breakdown Voltage                 | $V_{GS}=0V$ , $I_D=250\mu A$                             | 20   | ---  | ---       | V         |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance <sup>2</sup> | $V_{GS}=4.5V$ , $I_D=6A$                                 | ---  | 7.8  | 10        | $m\Omega$ |
|              |                                                | $V_{GS}=2.5V$ , $I_D=6A$                                 | ---  | 10   | 12        |           |
| $V_{GS(th)}$ | Gate Threshold Voltage                         | $V_{GS}=V_{DS}$ , $I_D=250\mu A$                         | 0.4  | 0.7  | 1.0       | V         |
| $I_{DSS}$    | Drain-Source Leakage Current                   | $V_{DS}=16V$ , $V_{GS}=0V$ , $T_J=25^{\circ}\text{C}$    | ---  | ---  | 1         | $\mu A$   |
|              |                                                | $V_{DS}=16V$ , $V_{GS}=0V$ , $T_J=55^{\circ}\text{C}$    | ---  | ---  | 5         |           |
| $I_{GSS}$    | Gate-Source Leakage Current                    | $V_{GS}=\pm 12V$ , $V_{DS}=0V$                           | ---  | ---  | $\pm 100$ | nA        |
| $R_g$        | Gate Resistance                                | $V_{DS}=0V$ , $V_{GS}=0V$ , $f=1\text{MHz}$              | ---  | 1.7  | ---       | $\Omega$  |
| $Q_g$        | Total Gate Charge (4.5V)                       | $V_{DS}=10V$ , $V_{GS}=4.5V$ , $I_D=6A$                  | ---  | 20   | ---       | nC        |
| $Q_{gs}$     | Gate-Source Charge                             |                                                          | ---  | 4.5  | ---       |           |
| $Q_{gd}$     | Gate-Drain Charge                              |                                                          | ---  | 3.2  | ---       |           |
| $T_{d(on)}$  | Turn-On Delay Time                             | $V_{DD}=10V$ , $V_{GS}=4.5V$ , $R_G=3\Omega$<br>$I_D=6A$ | ---  | 4    | ---       | ns        |
| $T_r$        | Rise Time                                      |                                                          | ---  | 9    | ---       |           |
| $T_{d(off)}$ | Turn-Off Delay Time                            |                                                          | ---  | 48   | ---       |           |
| $T_f$        | Fall Time                                      |                                                          | ---  | 13   | ---       |           |
| $C_{iss}$    | Input Capacitance                              | $V_{DS}=10V$ , $V_{GS}=0V$ , $f=1\text{MHz}$             | ---  | 1650 | ---       | pF        |
| $C_{oss}$    | Output Capacitance                             |                                                          | ---  | 225  | ---       |           |
| $C_{rss}$    | Reverse Transfer Capacitance                   |                                                          | ---  | 203  | ---       |           |

### Diode Characteristics

| Symbol   | Parameter                          | Conditions                                        | Min. | Typ. | Max. | Unit |
|----------|------------------------------------|---------------------------------------------------|------|------|------|------|
| $V_{SD}$ | Diode Forward Voltage <sup>2</sup> | $V_{GS}=0V$ , $I_S=1A$ , $T_J=25^{\circ}\text{C}$ | ---  | ---  | 1.2  | V    |

Note :

- 1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 20Z copper.
- 2.The data tested by pulsed , pulse width  $\leq 300\mu s$  , duty cycle  $\leq 2\%$
- 3.The power dissipation is limited by  $150^{\circ}\text{C}$  junction temperature
- 4.The data is theoretically the same as  $I_D$  and  $I_{DM}$  , in real applications , should be limited by total power dissipation.



### P-Channel Electrical Characteristics ( $T_J=25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

| Symbol       | Parameter                                      | Conditions                                                     | Min.  | Typ. | Max.      | Unit      |
|--------------|------------------------------------------------|----------------------------------------------------------------|-------|------|-----------|-----------|
| $BV_{DSS}$   | Drain-Source Breakdown Voltage                 | $V_{GS}=0V$ , $I_D=-250\mu A$                                  | -20   | ---  | ---       | V         |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance <sup>2</sup> | $V_{GS}=-4.5V$ , $I_D=-8A$                                     | ---   | 17   | 26        | $m\Omega$ |
|              |                                                | $V_{GS}=-2.5V$ , $I_D=-5A$                                     | ---   | 22   | 37        |           |
| $V_{GS(th)}$ | Gate Threshold Voltage                         | $V_{GS}=V_{DS}$ , $I_D=-250\mu A$                              | -0.45 | -0.7 | -1.0      | V         |
| $I_{DSS}$    | Drain-Source Leakage Current                   | $V_{DS}=-16V$ , $V_{GS}=0V$ , $T_J=25^{\circ}\text{C}$         | ---   | ---  | -1        | $\mu A$   |
|              |                                                | $V_{DS}=-16V$ , $V_{GS}=0V$ , $T_J=55^{\circ}\text{C}$         | ---   | ---  | -5        |           |
| $I_{GSS}$    | Gate-Source Leakage Current                    | $V_{GS}=\pm 12V$ , $V_{DS}=0V$                                 | ---   | ---  | $\pm 100$ | nA        |
| $g_{fs}$     | Forward Transconductance                       | $V_{DS}=-5V$ , $I_D=-3A$                                       | ---   | 5    | ---       | S         |
| $Q_g$        | Total Gate Charge (-4.5V)                      | $V_{DS}=-10V$ , $V_{GS}=-4.5V$ , $I_D=-5A$                     | ---   | 33   | ---       | nC        |
| $Q_{gs}$     | Gate-Source Charge                             |                                                                | ---   | 3.8  | ---       |           |
| $Q_{gd}$     | Gate-Drain Charge                              |                                                                | ---   | 11   | ---       |           |
| $T_{d(on)}$  | Turn-On Delay Time                             | $V_{DD}=-10V$ , $V_{GS}=-4.5V$ , $R_G=10\Omega$ ,<br>$I_D=-5A$ | ---   | 11   | ---       | ns        |
| $T_r$        | Rise Time                                      |                                                                | ---   | 41   | ---       |           |
| $T_{d(off)}$ | Turn-Off Delay Time                            |                                                                | ---   | 33   | ---       |           |
| $T_f$        | Fall Time                                      |                                                                | ---   | 11   | ---       |           |
| $C_{iss}$    | Input Capacitance                              | $V_{DS}=-10V$ , $V_{GS}=0V$ , $f=1\text{MHz}$                  | ---   | 1250 | ---       | pF        |
| $C_{oss}$    | Output Capacitance                             |                                                                | ---   | 194  | ---       |           |
| $C_{rss}$    | Reverse Transfer Capacitance                   |                                                                | ---   | 158  | ---       |           |

### Diode Characteristics

| Symbol   | Parameter                          | Conditions                                         | Min. | Typ. | Max. | Unit |
|----------|------------------------------------|----------------------------------------------------|------|------|------|------|
| $V_{SD}$ | Diode Forward Voltage <sup>2</sup> | $V_{GS}=0V$ , $I_S=-1A$ , $T_J=25^{\circ}\text{C}$ | ---  | ---  | -1.2 | V    |

Note :

- 1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 20Z copper.
- 2.The data tested by pulsed , pulse width  $\leq 300\mu s$  , duty cycle  $\leq 2\%$
- 3.The power dissipation is limited by  $150^{\circ}\text{C}$  junction temperature
- 4.The data is theoretically the same as  $I_D$  and  $I_{DM}$  , in real applications , should be limited by total power dissipation.



N-Channel Typical Characteristics

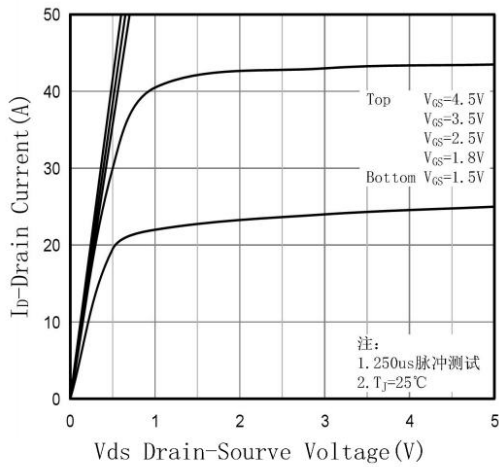


Fig.1 Output Characteristic

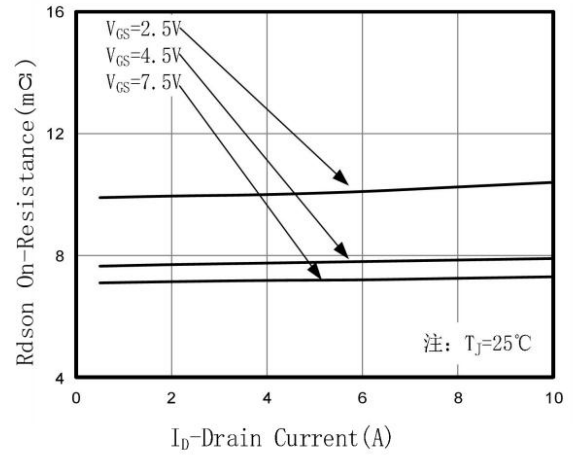


Fig.2 On-Resistance vs. Drain Current

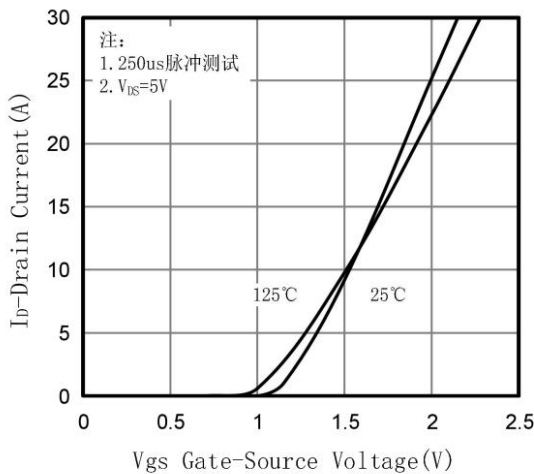


Fig.3 Transfer Characteristic

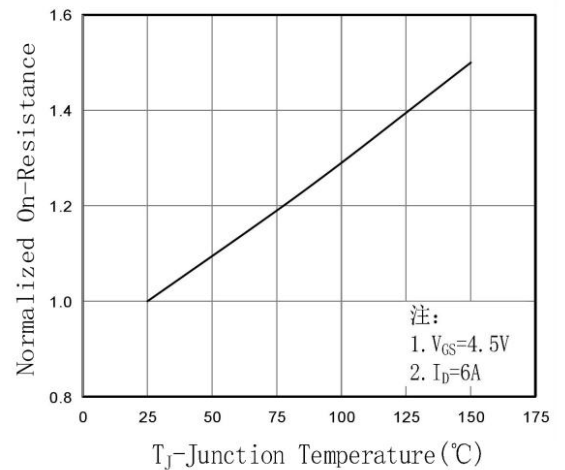


Fig.4 On-Resistance vs. Junction Temperature

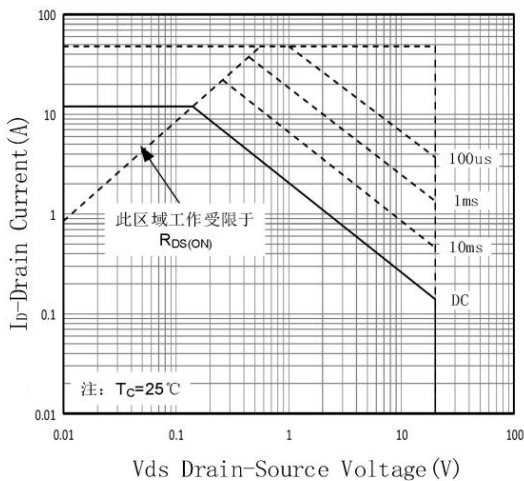


Fig.5 Safe Operation Area

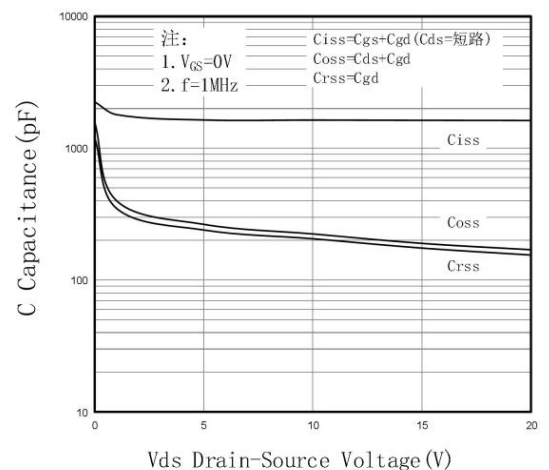


Fig.6 Capacitance Characteristic

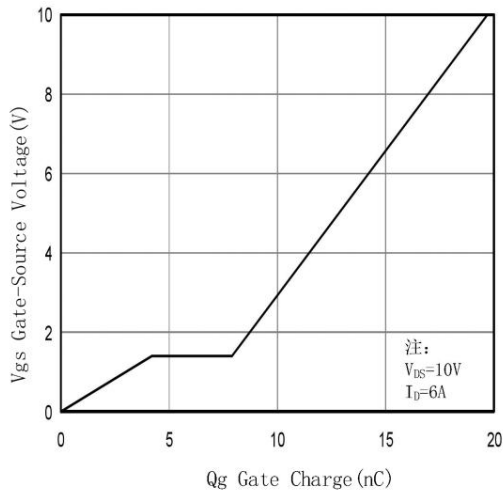


Fig.7 Gate-Charge Characteristic

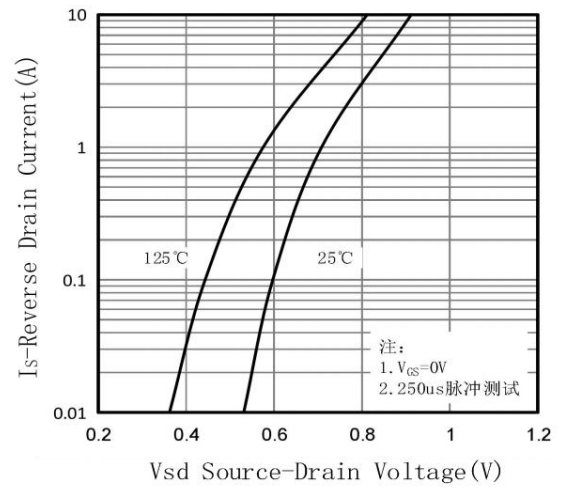


Fig.8 Body Diode Characteristic

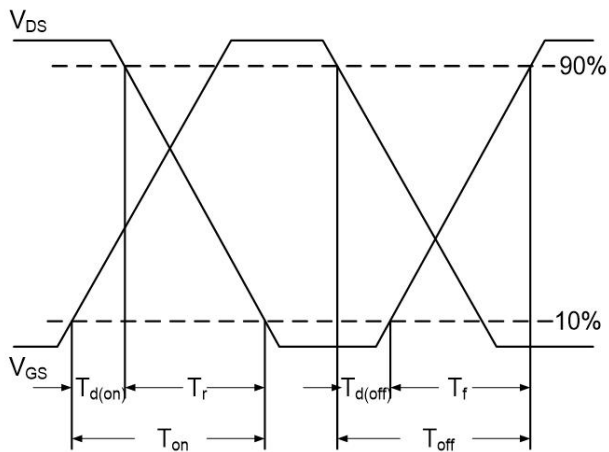


Fig.9 Switching Time Waveform

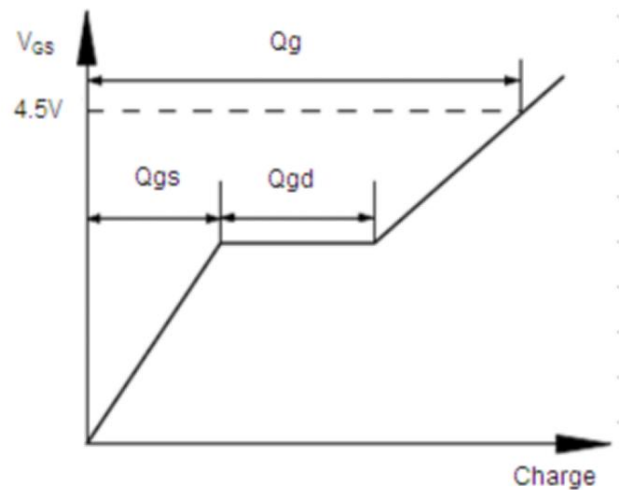


Fig.10 Gate Charge Waveform



P-Channel Typical Characteristics

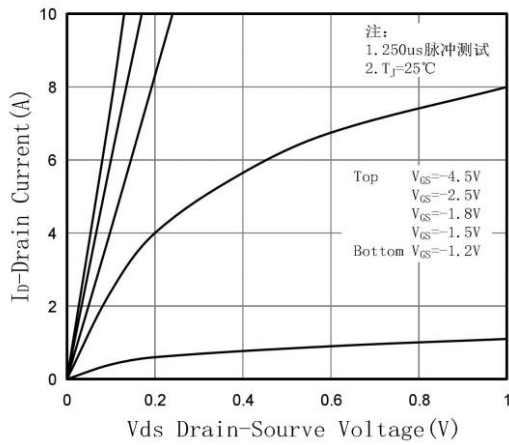


Fig.1 Output Characteristic

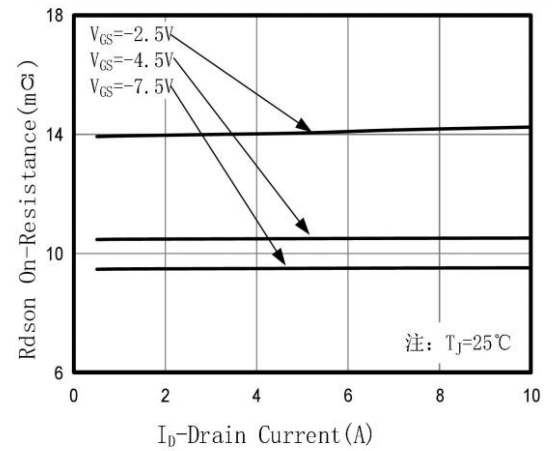


Fig.2 On-Resistance vs. Drain Current

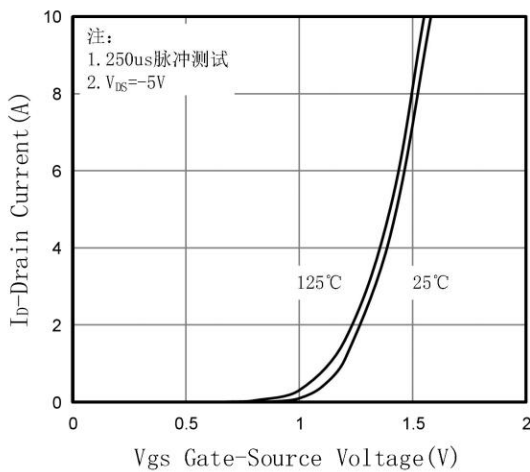


Fig.3 Transfer Characteristic

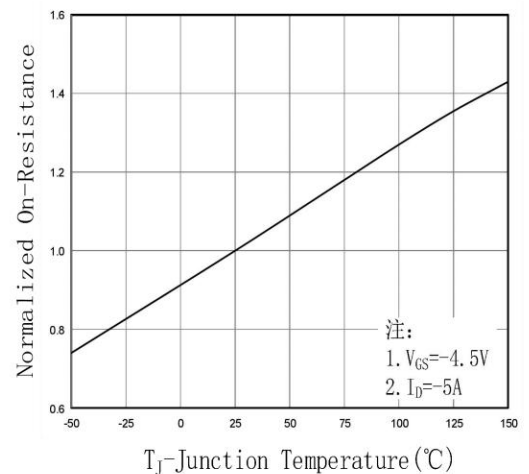


Fig.4 On-Resistance vs. Junction Temperature

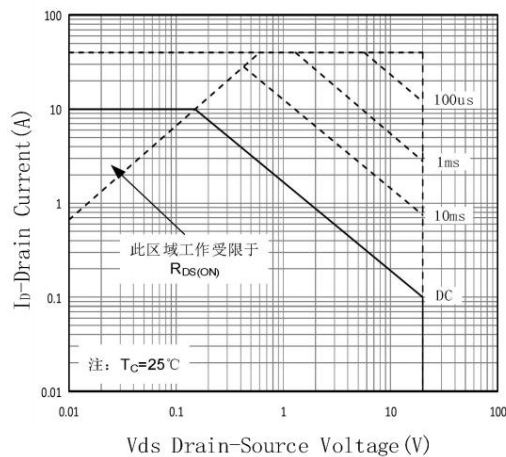


Fig.5 Safe Operation Area

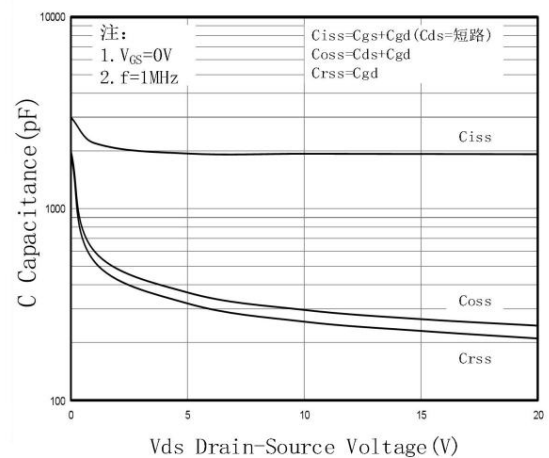


Fig.6 Capacitance Characteristic

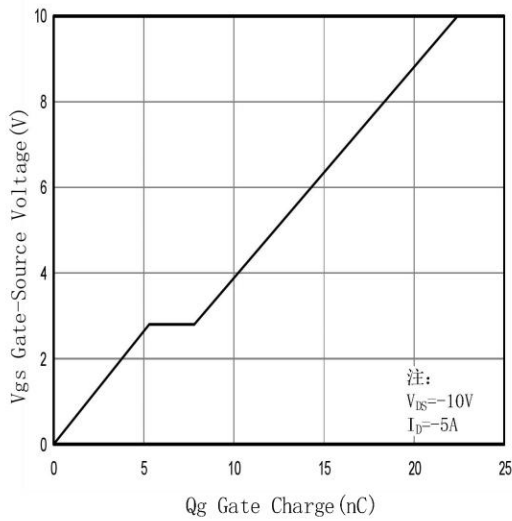


Fig.7 Gate-Charge Characteristic

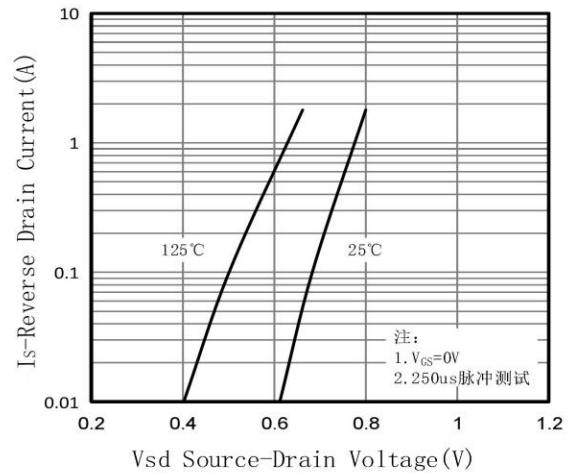


Fig.8 Body Diode Characteristic

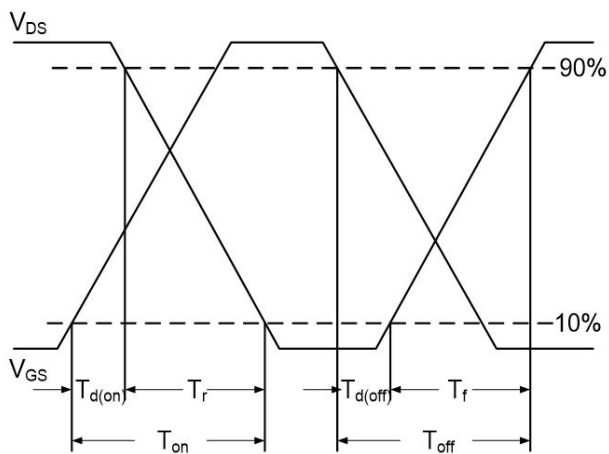


Fig.9 Switching Time Waveform

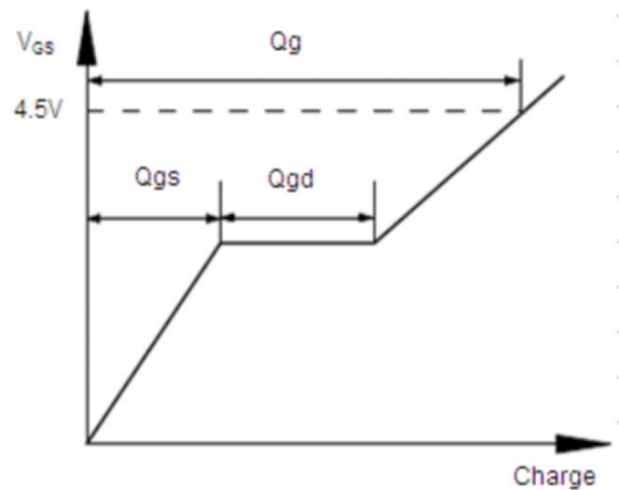
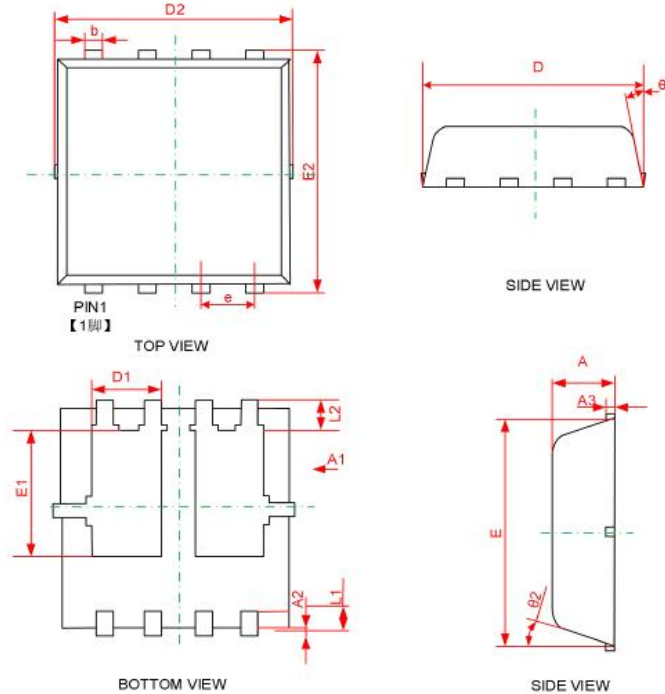


Fig.10 Gate Charge Waveform



## PACKAGE INFORMATION

● PDFN3.3×3.3-8L



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | Min                       | Max   | Min                  | Max   |
| A      | 0.750                     | 0.850 | 0.030                | 0.033 |
| A1     | 0.000                     | 0.050 | 0.000                | 0.002 |
| A2     | 0.100                     | 0.200 | 0.004                | 0.008 |
| A3     | 0.152 REF.                |       | 0.006 REF.           |       |
| b      | 0.200                     | 0.400 | 0.008                | 0.016 |
| D      | 3.050                     | 3.250 | 0.120                | 0.128 |
| D1     | 0.935                     | 1.135 | 0.037                | 0.045 |
| D2     | 3.200                     | 3.400 | 0.126                | 0.134 |
| E      | 2.900                     | 3.100 | 0.114                | 0.122 |
| E1     | 1.635                     | 1.835 | 0.064                | 0.072 |
| E2     | 3.150                     | 3.350 | 0.124                | 0.132 |
| e      | 0.625                     | 0.675 | 0.025                | 0.027 |
| L1     | 0.350                     | 0.450 | 0.014                | 0.018 |
| L2     | 0.365                     | 0.465 | 0.014                | 0.018 |
| θ1     | 10°                       | 12°   | 10°                  | 12°   |
| θ2     | 10°                       | 12°   | 10°                  | 12°   |