



- ★ Super Low Gate Charge
- ★ 100% EAS Guaranteed
- ★ Green Device Available
- ★ Excellent CdV/dt effect decline
- ★ Advanced high cell density Trench technology

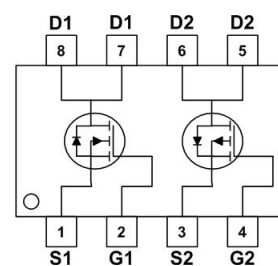
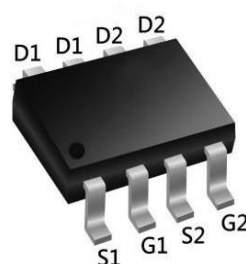
### Description

The XR4612 is the high performance complementary N-ch and P-ch MOSFETs with high cell density, which provide excellent RDSON and gate charge for most of the synchronous buck converter applications .  
The XR4612 meet the RoHS and Green Product requirement 100% EAS guaranteed with full function reliability approved.

### Product Summary

| BVDSS | RDSON | ID    |
|-------|-------|-------|
| 60V   | 60mΩ  | 5.0A  |
| -60V  | 100mΩ | -4.0A |

### SOP8 Pin Configuration



### Absolute Maximum Ratings

| Symbol                     | Parameter                                  | Rating     |            | Units            |
|----------------------------|--------------------------------------------|------------|------------|------------------|
|                            |                                            | N-Channel  | P-Channel  |                  |
| $V_{DS}$                   | Drain-Source Voltage                       | 60         | -60        | V                |
| $V_{GS}$                   | Gate-Source Voltage                        | $\pm 20$   | $\pm 20$   | V                |
| $I_D@T_A=25^\circ\text{C}$ | Continuous Drain Current, $V_{GS} @ 10V^1$ | 5.0        | -4.0       | A                |
| $I_D@T_A=70^\circ\text{C}$ | Continuous Drain Current, $V_{GS} @ 10V^1$ | 3.8        | -3         | A                |
| $I_{DM}$                   | Pulsed Drain Current <sup>2</sup>          | 9.6        | -7.5       | A                |
| EAS                        | Single Pulse Avalanche Energy <sup>3</sup> | 15.5       | 20.3       | mJ               |
| $I_{AS}$                   | Avalanche Current                          | 12.6       | -16.6      | A                |
| $P_D@T_A=25^\circ\text{C}$ | Total Power Dissipation <sup>4</sup>       | 1.5        | 1.5        | W                |
| $T_{STG}$                  | Storage Temperature Range                  | -55 to 150 | -55 to 150 | $^\circ\text{C}$ |
| $T_J$                      | Operating Junction Temperature Range       | -55 to 150 | -55 to 150 | $^\circ\text{C}$ |

### Thermal Data

| Symbol          | Parameter                                        | Typ. | Max. | Unit               |
|-----------------|--------------------------------------------------|------|------|--------------------|
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient <sup>1</sup> | ---  | 62   | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case <sup>1</sup>    | ---  | 3    | $^\circ\text{C/W}$ |

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

| Symbol                       | Parameter                                      | Conditions                                                  | Min. | Typ.  | Max.      | Unit                |
|------------------------------|------------------------------------------------|-------------------------------------------------------------|------|-------|-----------|---------------------|
| $BV_{DSS}$                   | Drain-Source Breakdown Voltage                 | $V_{GS}=0V$ , $I_D=250\mu A$                                | 60   | ---   | ---       | V                   |
| $\Delta BV_{DSS}/\Delta T_J$ | $BV_{DSS}$ Temperature Coefficient             | Reference to $25^\circ\text{C}$ , $I_D=1mA$                 | ---  | 0.063 | ---       | $V/^\circ\text{C}$  |
| $R_{DS(ON)}$                 | Static Drain-Source On-Resistance <sup>2</sup> | $V_{GS}=10V$ , $I_D=4A$                                     | ---  | 60    | 75        | $m\Omega$           |
|                              |                                                | $V_{GS}=4.5V$ , $I_D=2A$                                    | ---  | 70    | 95        |                     |
| $V_{GS(th)}$                 | Gate Threshold Voltage                         | $V_{GS}=V_{DS}$ , $I_D=250\mu A$                            | 1.2  | ---   | 2.5       | V                   |
| $\Delta V_{GS(th)}$          | $V_{GS(th)}$ Temperature Coefficient           |                                                             | ---  | -5.24 | ---       | $mV/^\circ\text{C}$ |
| $I_{DSS}$                    | Drain-Source Leakage Current                   | $V_{DS}=48V$ , $V_{GS}=0V$ , $T_J=25^\circ\text{C}$         | ---  | ---   | 1         | $\mu A$             |
|                              |                                                | $V_{DS}=48V$ , $V_{GS}=0V$ , $T_J=55^\circ\text{C}$         | ---  | ---   | 5         |                     |
| $I_{GSS}$                    | Gate-Source Leakage Current                    | $V_{GS}=\pm 20V$ , $V_{DS}=0V$                              | ---  | ---   | $\pm 100$ | nA                  |
| $g_{fs}$                     | Forward Transconductance                       | $V_{DS}=5V$ , $I_D=4A$                                      | ---  | 21    | ---       | S                   |
| $R_g$                        | Gate Resistance                                | $V_{DS}=0V$ , $V_{GS}=0V$ , $f=1MHz$                        | ---  | 3.2   | ---       | $\Omega$            |
| $Q_g$                        | Total Gate Charge (4.5V)                       | $V_{DS}=12V$ , $V_{GS}=10V$ , $I_D=4A$                      | ---  | 5.5   | ---       | nC                  |
| $Q_{gs}$                     | Gate-Source Charge                             |                                                             | ---  | 1.8   | ---       |                     |
| $Q_{gd}$                     | Gate-Drain Charge                              |                                                             | ---  | 2.4   | ---       |                     |
| $T_{d(on)}$                  | Turn-On Delay Time                             | $V_{DD}=12V$ , $V_{GS}=10V$ , $R_G=3.3\Omega$ ,<br>$I_D=4A$ | ---  | 6     | ---       | ns                  |
| $T_r$                        | Rise Time                                      |                                                             | ---  | 10    | ---       |                     |
| $T_{d(off)}$                 | Turn-Off Delay Time                            |                                                             | ---  | 15    | ---       |                     |
| $T_f$                        | Fall Time                                      |                                                             | ---  | 7     | ---       |                     |
| $C_{iss}$                    | Input Capacitance                              | $V_{DS}=15V$ , $V_{GS}=0V$ , $f=1MHz$                       | ---  | 695   | ---       | pF                  |
| $C_{oss}$                    | Output Capacitance                             |                                                             | ---  | 148   | ---       |                     |
| $C_{rss}$                    | Reverse Transfer Capacitance                   |                                                             | ---  | 7     | ---       |                     |

## Diode Characteristics

| Symbol   | Parameter                                | Conditions                                      | Min. | Typ. | Max. | Unit |
|----------|------------------------------------------|-------------------------------------------------|------|------|------|------|
| $I_S$    | Continuous Source Current <sup>1,5</sup> | $V_G=V_D=0V$ , Force Current                    | ---  | ---  | 5.0  | A    |
| $I_{SM}$ | Pulsed Source Current <sup>2,5</sup>     |                                                 | ---  | ---  | 9.6  | A    |
| $V_{SD}$ | 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 EAS data shows Max. rating. The test condition is  $V_{DD}=25V$ ,  $V_{GS}=10V$ ,  $L=0.1mH$ ,  $I_{AS}=5A$ 4. The power dissipation is limited by  $150^\circ\text{C}$  junction temperature5. 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<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                                                     | ---  | -0.049 | ---      | V/°C  |
| R <sub>DS(ON)</sub>                 | Static Drain-Source On-Resistance <sup>2</sup> | V <sub>GS</sub> =-10V , I <sub>D</sub> =-3A                                                  | ---  | 100    | 115      | mΩ    |
|                                     |                                                | V <sub>GS</sub> =-4.5V , I <sub>D</sub> =-2A                                                 | ---  | 115    | 130      |       |
| 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    |                                                                                              | ---  | 4.56   | ---      | mV/°C |
| I <sub>DSS</sub>                    | Drain-Source Leakage Current                   | V <sub>DS</sub> =-48V , V <sub>GS</sub> =0V , T <sub>J</sub> =25°C                           | ---  | ---    | 1        | uA    |
|                                     |                                                | V <sub>DS</sub> =-48V , 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                                                  | ---  | ---    | ±10<br>0 | nA    |
| g <sub>fs</sub>                     | Forward Transconductance                       | V <sub>DS</sub> =-5V , I <sub>D</sub> =-3A                                                   | ---  | 5.8    | ---      | S     |
| R <sub>g</sub>                      | Gate Resistance                                | V <sub>DS</sub> =0V , V <sub>GS</sub> =0V , f=1MHz                                           | ---  | 13.5   | ---      | Ω     |
| Q <sub>g</sub>                      | Total Gate Charge (-4.5V)                      | V <sub>DS</sub> =-20V , V <sub>GS</sub> =-4.5V , I <sub>D</sub> =-3A                         | ---  | 5.9    | ---      | nC    |
| Q <sub>gs</sub>                     | Gate-Source Charge                             |                                                                                              | ---  | 2.9    | ---      |       |
| Q <sub>gd</sub>                     | Gate-Drain Charge                              |                                                                                              | ---  | 1.8    | ---      |       |
| T <sub>d(on)</sub>                  | Turn-On Delay Time                             | V <sub>DD</sub> =-12V , V <sub>GS</sub> =-10V , R <sub>G</sub> =3.3Ω,<br>I <sub>D</sub> =-3A | ---  | 10     | ---      | ns    |
| T <sub>r</sub>                      | Rise Time                                      |                                                                                              | ---  | 17     | ---      |       |
| T <sub>d(off)</sub>                 | Turn-Off Delay Time                            |                                                                                              | ---  | 22     | ---      |       |
| T <sub>f</sub>                      | Fall Time                                      |                                                                                              | ---  | 21     | ---      |       |
| C <sub>iss</sub>                    | Input Capacitance                              | V <sub>DS</sub> =-15V , V <sub>GS</sub> =0V , f=1MHz                                         | ---  | 715    | ---      | pF    |
| C <sub>oss</sub>                    | Output Capacitance                             |                                                                                              | ---  | 51     | ---      |       |
| C <sub>rss</sub>                    | Reverse Transfer Capacitance                   |                                                                                              | ---  | 34     | ---      |       |

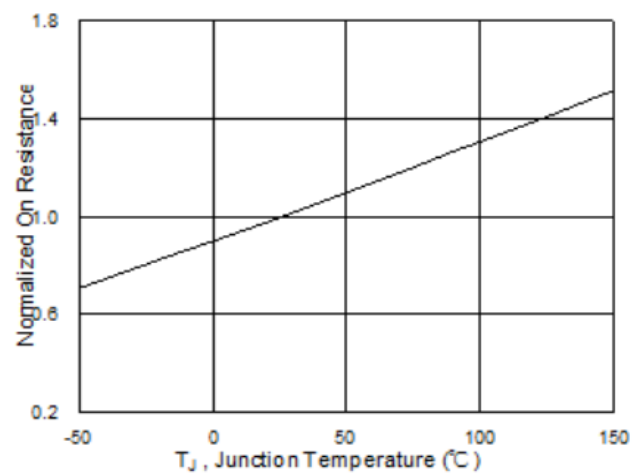
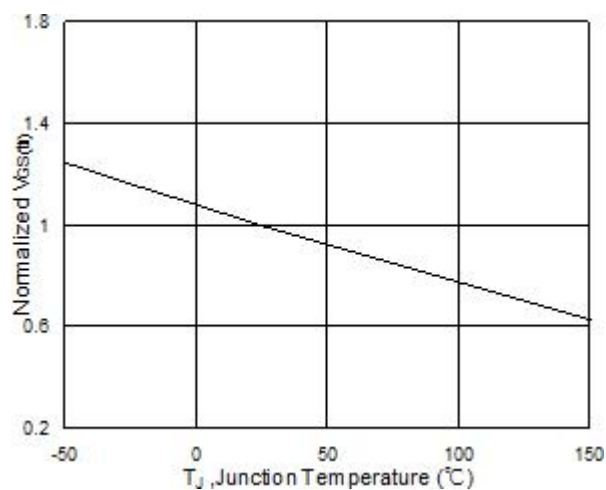
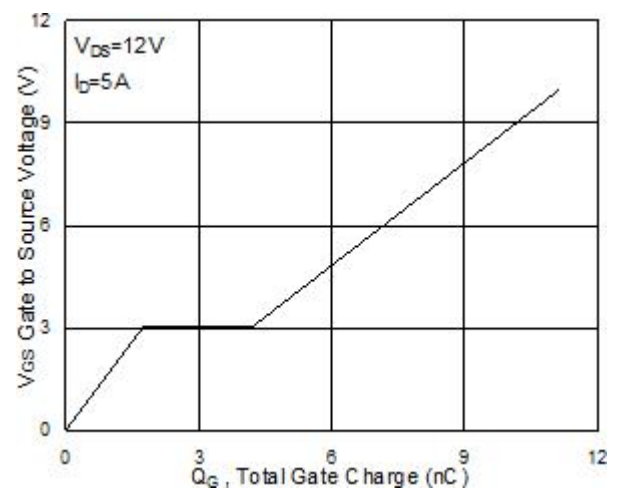
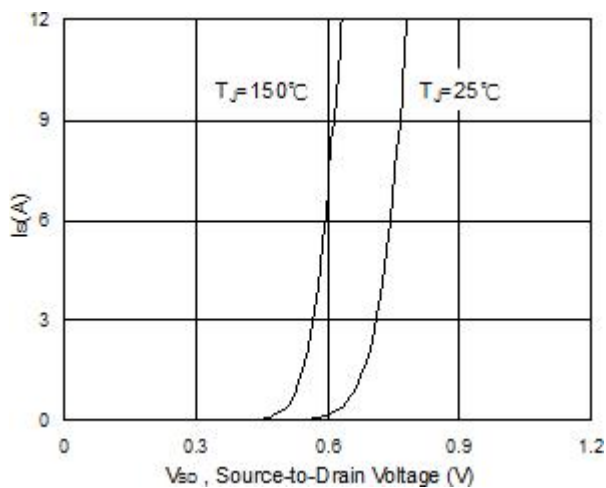
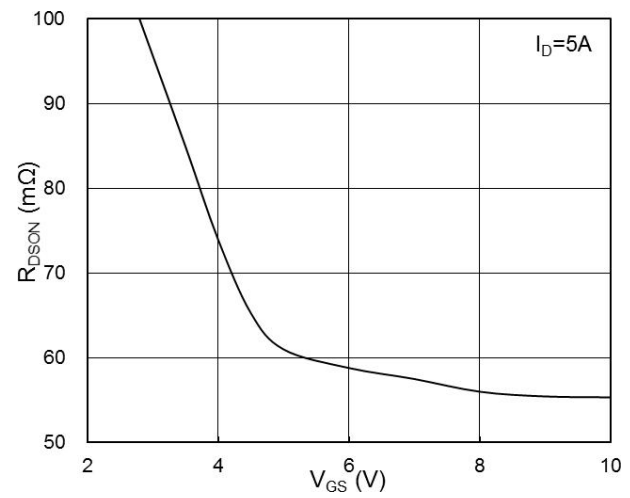
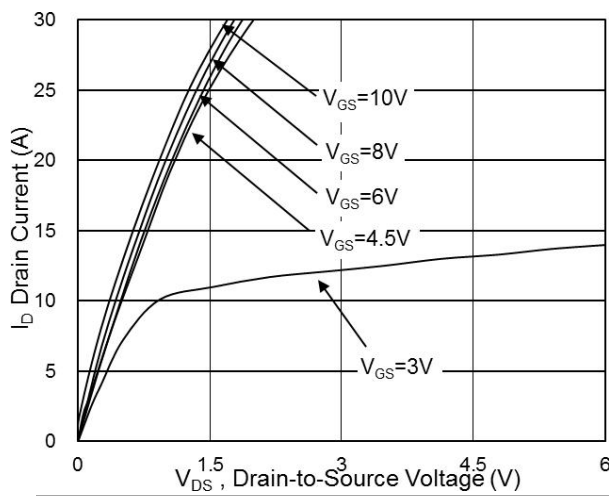
### Diode Characteristics

| 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               | ---  | ---  | -4.0 | A    |
| I <sub>SM</sub> | Pulsed Source Current <sup>2,5</sup>     |                                                                  | ---  | ---  | -7.5 | 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    |

Note :

- 1.The data tested by surface mounted on a 1 inch<sup>2</sup> FR-4 board with 2OZ copper.
- 2.The data tested by pulsed , pulse width ≤ 300us , duty cycle ≤ 2%
- 3.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>=-20.0A
- 4.The power dissipation is limited by 150°C junction temperature
- 5.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.

### N-Channel Typical Characteristics



### N-Channel Typical Characteristics

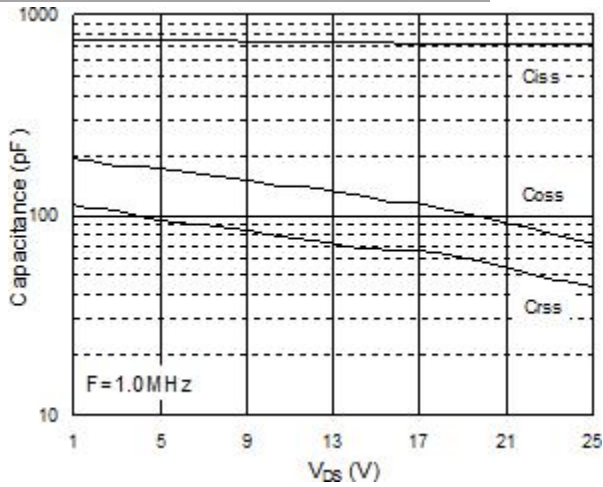


Fig.7 Capacitance

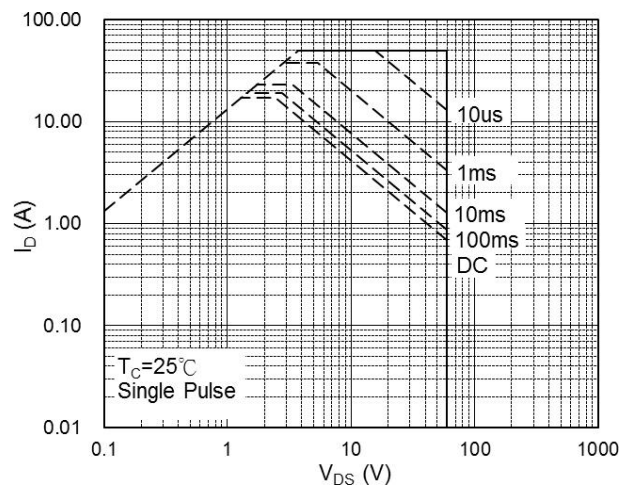


Fig.8 Safe Operating Area

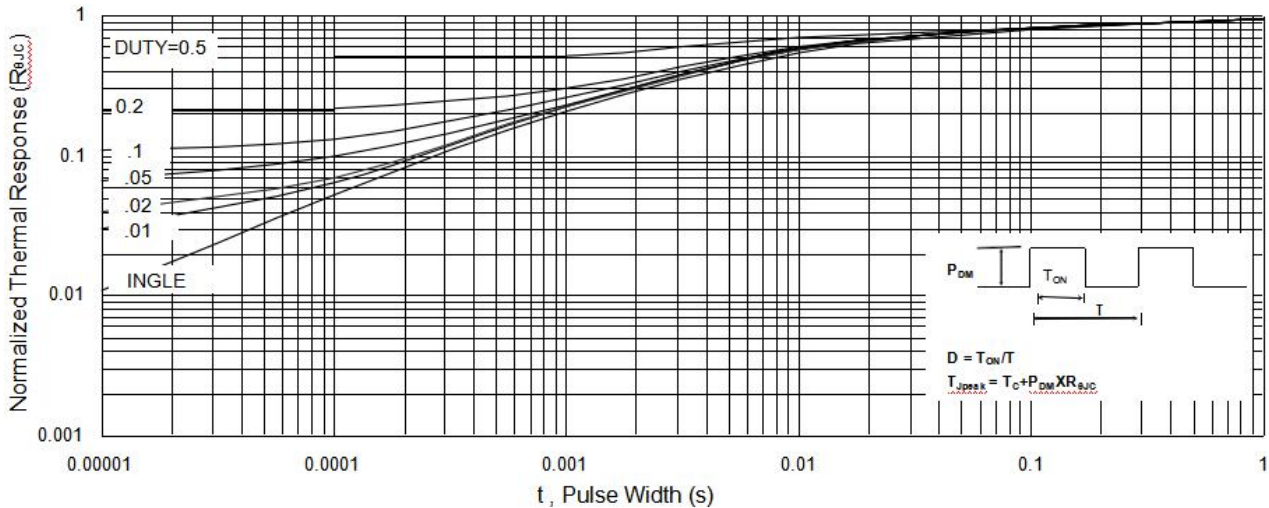


Fig.9 Normalized Maximum Transient Thermal Impedance

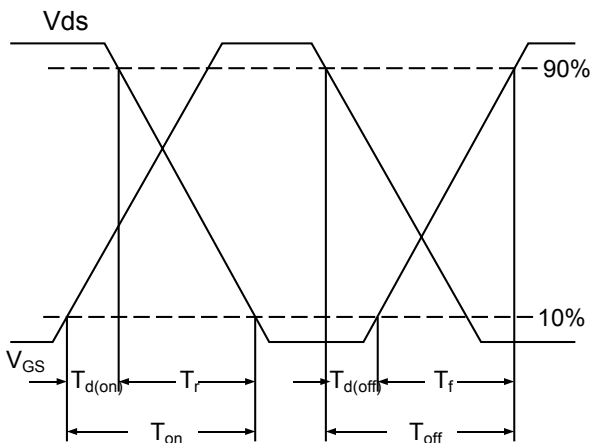


Fig.10 Switching Time Waveform

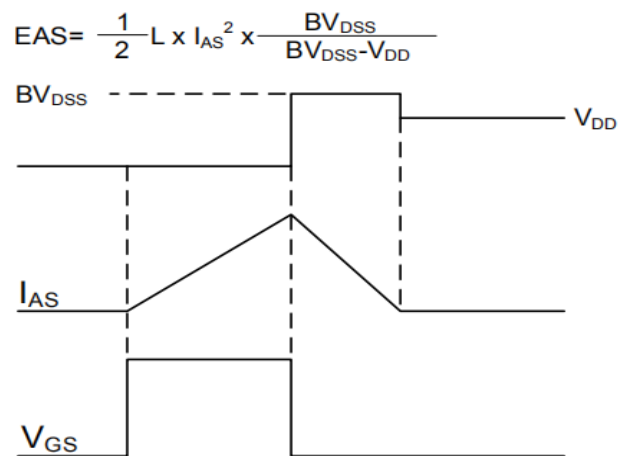
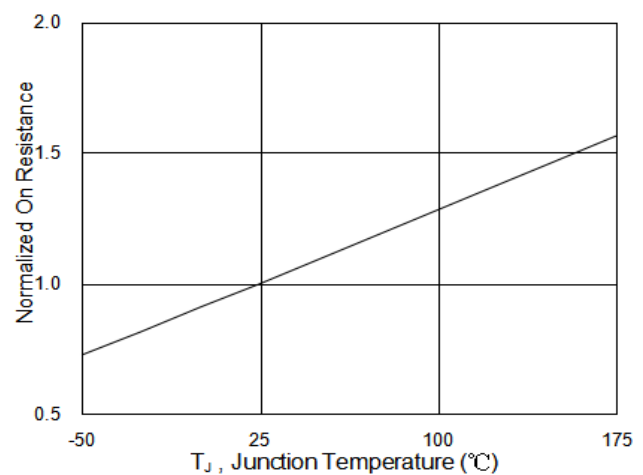
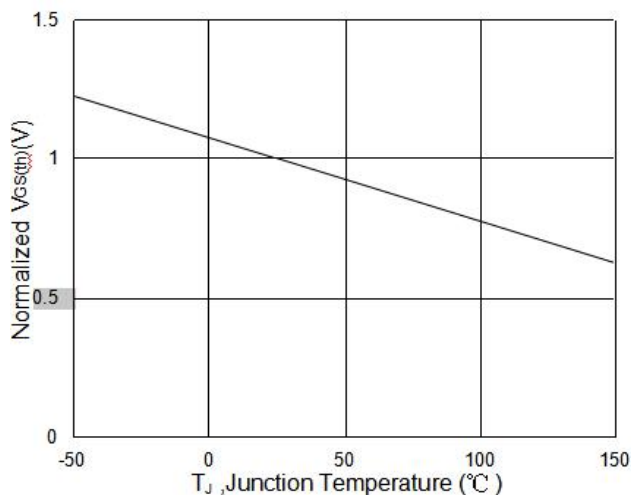
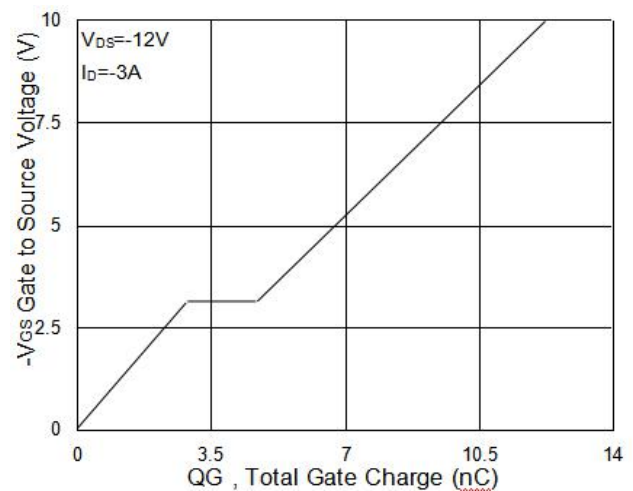
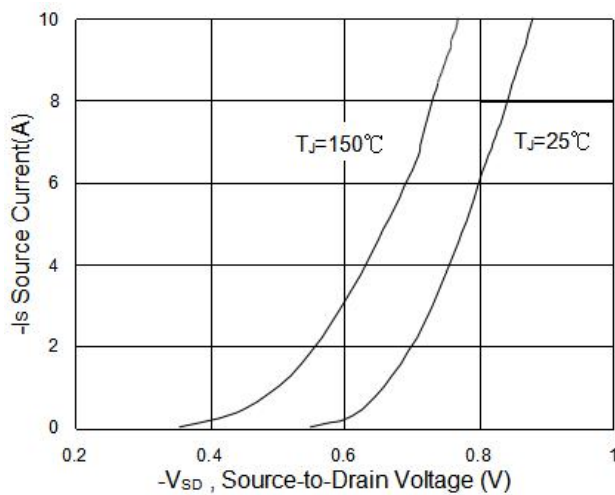
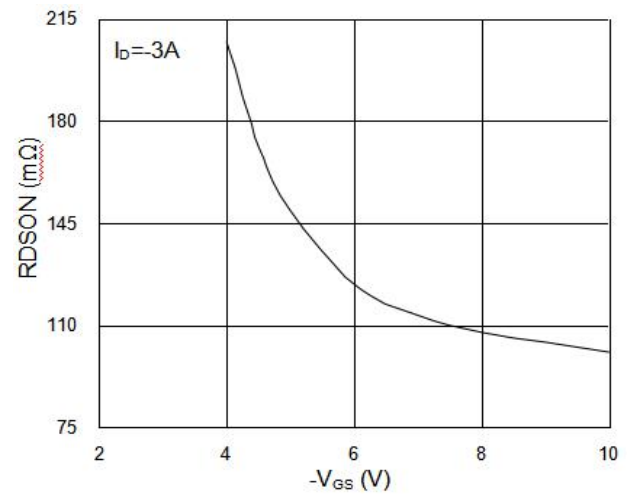
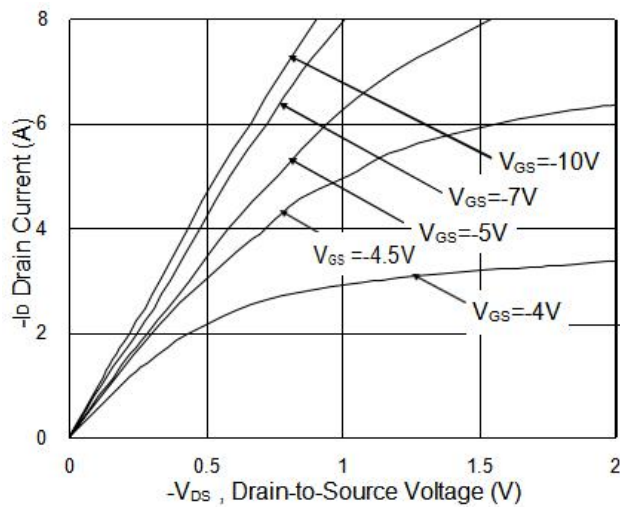


Fig.11 Unclamped Inductive Waveform

#### P-Channel Typical Characteristics



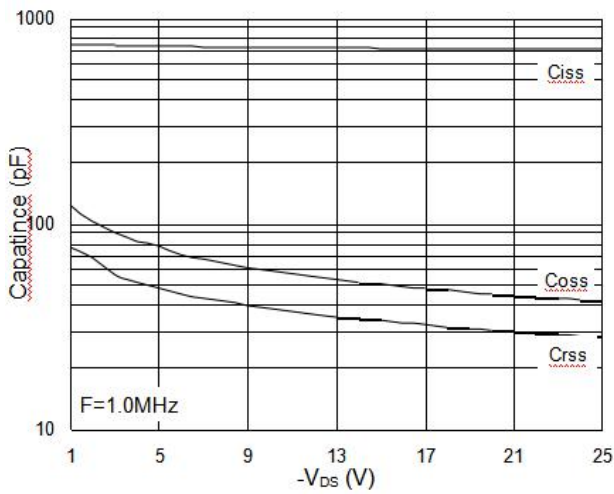


Fig.7 Capacitance

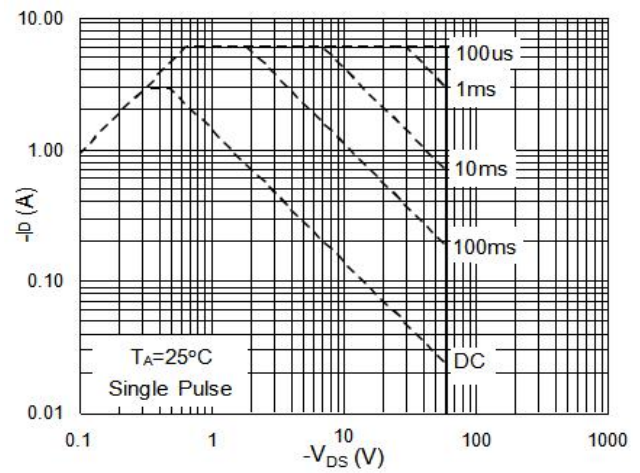


Fig.8 Safe Operating Area

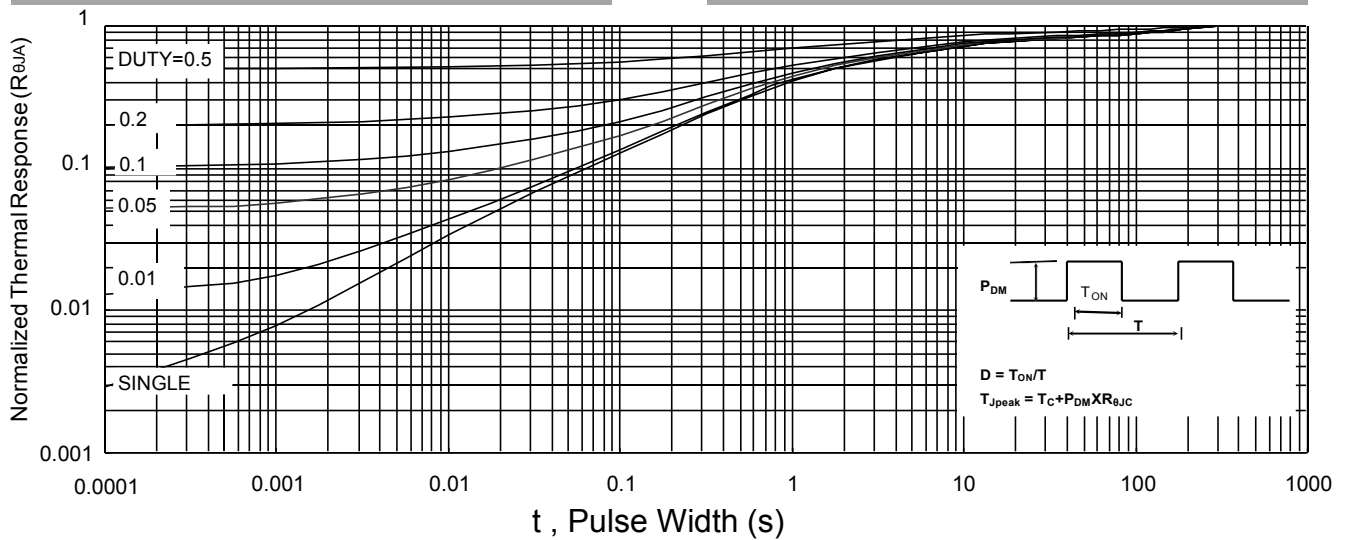


Fig.9 Normalized Maximum Transient Thermal Impedance

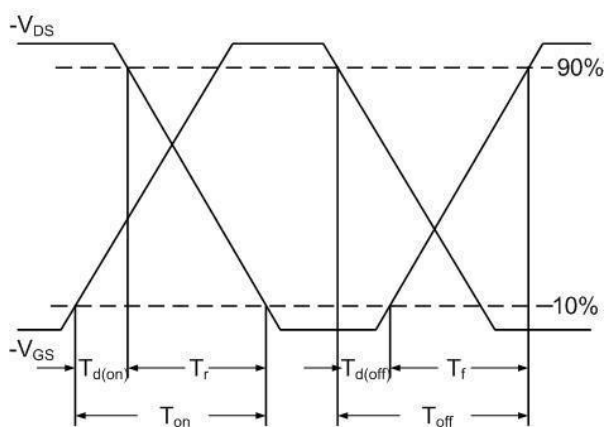


Fig.10 Switching Time Waveform

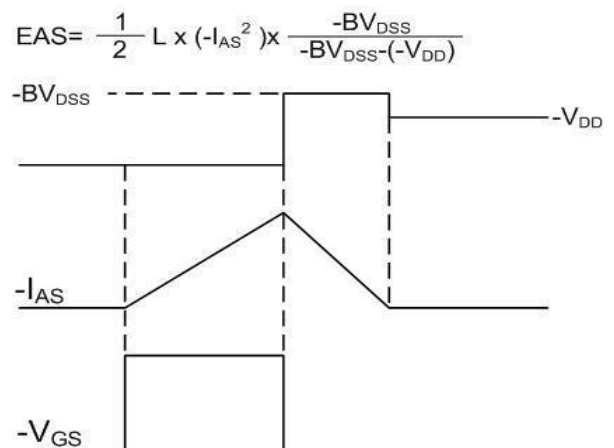
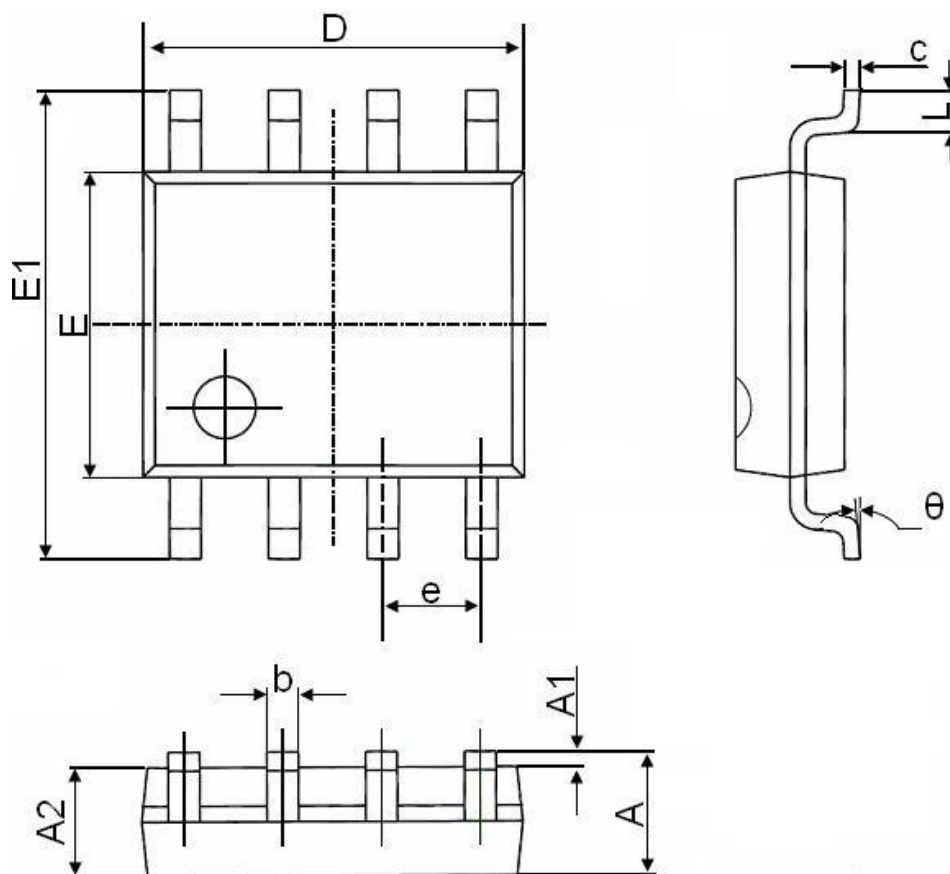


Fig.11 Unclamped Inductive Waveform

#### SOP-8 Package Information



| Symbol   | Dimensions In Millimeters |       | Dimensions In Inches |       |
|----------|---------------------------|-------|----------------------|-------|
|          | Min.                      | Max.  | Min.                 | Max.  |
| A        | 1.350                     | 1.750 | 0.053                | 0.069 |
| A1       | 0.100                     | 0.250 | 0.004                | 0.010 |
| A2       | 1.350                     | 1.550 | 0.053                | 0.061 |
| b        | 0.330                     | 0.510 | 0.013                | 0.020 |
| c        | 0.170                     | 0.250 | 0.006                | 0.010 |
| D        | 4.700                     | 5.100 | 0.185                | 0.200 |
| E        | 3.800                     | 4.000 | 0.150                | 0.157 |
| E1       | 5.800                     | 6.200 | 0.228                | 0.244 |
| e        | 1.270(BSC)                |       | 0.050(BSC)           |       |
| L        | 0.400                     | 1.270 | 0.016                | 0.050 |
| $\theta$ | 0°                        | 8°    | 0°                   | 8°    |