

## P-Ch 60V Fast Switching MOSFETs

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

## Product Summary



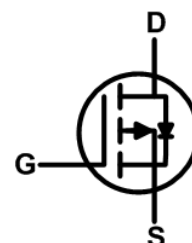
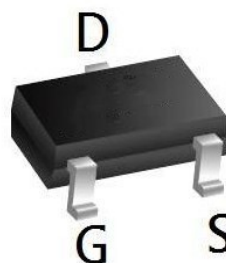
| BVDSS | RDSON  | ID   |
|-------|--------|------|
| -60V  | 160 mΩ | -2 A |

## Description

The XR2309 is the high cell density trenched P-ch MOSFETs, which provides excellent RDSON and efficiency for most of the small power switching and load switch applications.

The XR2309 meet the RoHS and Green Product requirement with full function reliability approved.

## SOT23 Pin Configuration



## Absolute Maximum Rating

| Parameter                                                | Symbol          | Value    | Unit |
|----------------------------------------------------------|-----------------|----------|------|
| Drain-Source voltage                                     | $V_{DS}$        | -60      | V    |
| Gate-Source voltage                                      | $V_{GS}$        | $\pm 20$ |      |
| Continuous Drain Current                                 | $I_D$           | -2.0     | A    |
| Pulsed Drain Current <sup>1</sup>                        | $I_{DM}$        | -5.2     | A    |
| Power Dissipation                                        | $P_D$           | 1        | W    |
| Junction Temperature                                     | $T_J$           | 150      | °C   |
| Storage Temperature                                      | $T_{STG}$       | -55~ 150 | °C   |
| Thermal Resistance from Junction to Ambient <sup>2</sup> | $R_{\theta JA}$ | 125      | °C/W |

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## Electrical Characteristics (T = 25°C unless otherwise noted)

| Symbol                                                                               | Parameter                                              | Condition                                                                                        | Min  | Typ   | Max  | Unit |
|--------------------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------------------------------------------------|------|-------|------|------|
| Static Electrical Characteristics @ T <sub>J</sub> = 25°C (unless otherwise stated)  |                                                        |                                                                                                  |      |       |      |      |
| V <sub>(BR)DSS</sub>                                                                 | Drain-Source Breakdown Voltage                         | V <sub>GS</sub> =0V I <sub>D</sub> =-250μA                                                       | -60  | --    | --   | V    |
| I <sub>DSS</sub>                                                                     | Zero Gate Voltage Drain Current(T <sub>A</sub> =25°C)  | V <sub>DS</sub> =-60V, V <sub>GS</sub> =0V                                                       | --   | --    | -1   | μA   |
|                                                                                      | Zero Gate Voltage Drain Current(T <sub>A</sub> =125°C) | V <sub>DS</sub> =-60V, V <sub>GS</sub> =0V                                                       | --   | --    | -100 | uA   |
| I <sub>GSS</sub>                                                                     | Gate-Body Leakage Current                              | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                                                       | --   | --    | ±100 | nA   |
| V <sub>GS(TH)</sub>                                                                  | Gate Threshold Voltage                                 | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA                                        | -1.0 | -1.5  | -2.5 | V    |
| R <sub>DS(ON)</sub>                                                                  | Drain-Source On-State Resistance②                      | V <sub>GS</sub> =-10V, I <sub>D</sub> =-2A                                                       | --   | 160   | 200  | mΩ   |
| R <sub>DS(ON)</sub>                                                                  | Drain-Source On-State Resistance②                      | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-1A                                                      | --   | 200   | 300  | mΩ   |
| Dynamic Electrical Characteristics @ T <sub>J</sub> = 25°C (unless otherwise stated) |                                                        |                                                                                                  |      |       |      |      |
| C <sub>iss</sub>                                                                     | Input Capacitance                                      | V <sub>DS</sub> =-30V, V <sub>GS</sub> =0V,<br>f=1MHz                                            | --   | 310   | --   | pF   |
| C <sub>oss</sub>                                                                     | Output Capacitance                                     |                                                                                                  | --   | 22    | --   | pF   |
| C <sub>rss</sub>                                                                     | Reverse Transfer Capacitance                           |                                                                                                  | --   | 15    | --   | pF   |
| Q <sub>g</sub>                                                                       | Total Gate Charge                                      | V <sub>DS</sub> =-30V<br>I <sub>D</sub> =-2A,<br>V <sub>GS</sub> =-10V                           | --   | 5.4   | --   | nC   |
| Q <sub>gs</sub>                                                                      | Gate Source Charge                                     |                                                                                                  | --   | 1.1   | --   | nC   |
| Q <sub>gd</sub>                                                                      | Gate Drain Charge                                      |                                                                                                  | --   | 1.6   | --   | nC   |
| Switching Characteristics                                                            |                                                        |                                                                                                  |      |       |      |      |
| t <sub>d(on)</sub>                                                                   | Turn on Delay Time                                     | V <sub>DD</sub> =-30V,<br>I <sub>D</sub> =-2A,<br>R <sub>G</sub> =3.3Ω,<br>V <sub>GS</sub> =-10V | --   | 41    | --   | ns   |
| t <sub>r</sub>                                                                       | Turn on Rise Time                                      |                                                                                                  | --   | 22    | --   | ns   |
| t <sub>d(off)</sub>                                                                  | Turn Off Delay Time                                    |                                                                                                  | -    | 25    | --   | ns   |
| t <sub>f</sub>                                                                       | Turn Off Fall Time                                     |                                                                                                  | --   | 32    | --   | ns   |
| Source Drain Diode Characteristics                                                   |                                                        |                                                                                                  |      |       |      |      |
| I <sub>SD</sub>                                                                      | Source drain current(Body Diode)                       | T <sub>A</sub> =25°C                                                                             | --   | --    | -2.0 | A    |
| V <sub>SD</sub>                                                                      | Forward on voltage②                                    | T <sub>J</sub> =25°C, I <sub>SD</sub> =-2A,<br>V <sub>GS</sub> =0V                               | --   | -0.84 | -1.2 | V    |

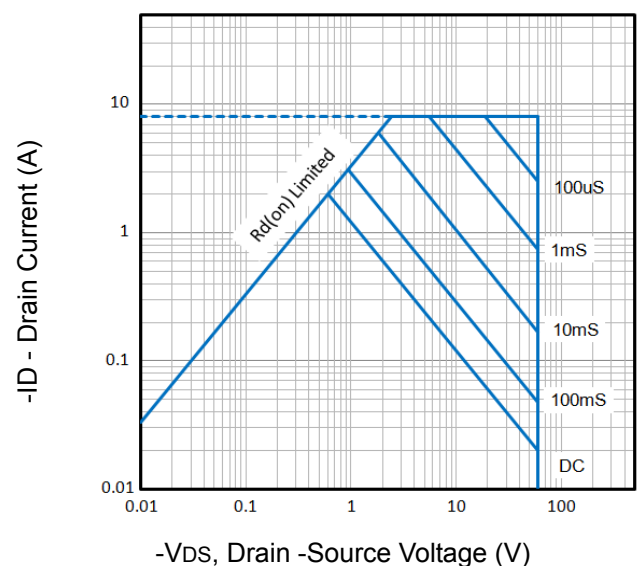
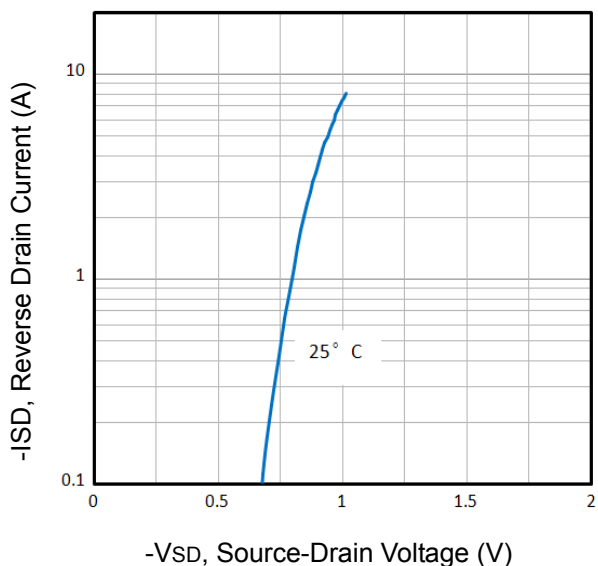
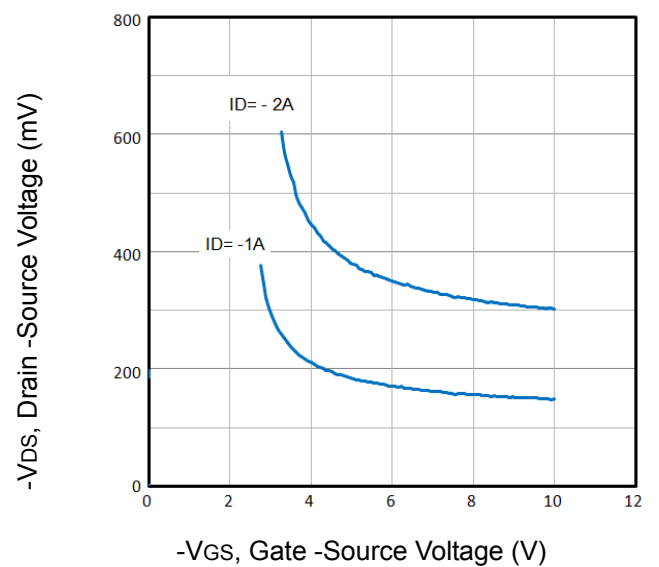
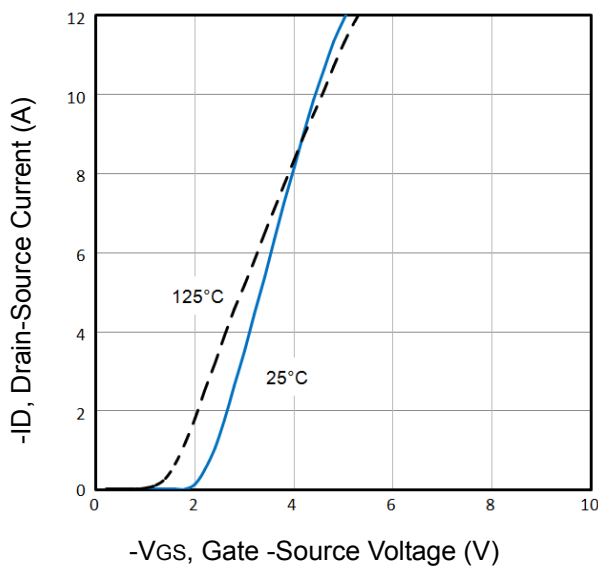
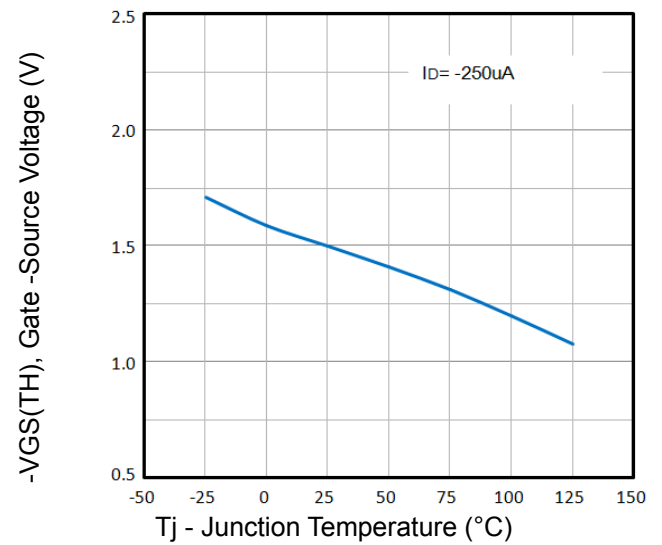
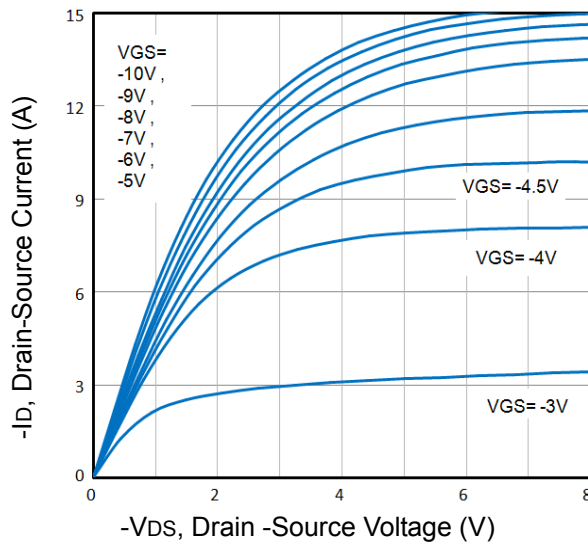
## Notes:

① Pulse width limited by maximum allowable junction temperature

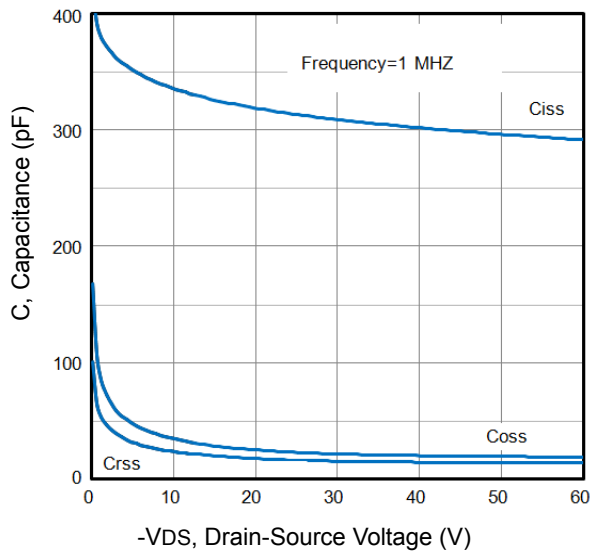
②Pulse test ; Pulse width≤300μs, duty cycle≤2%.

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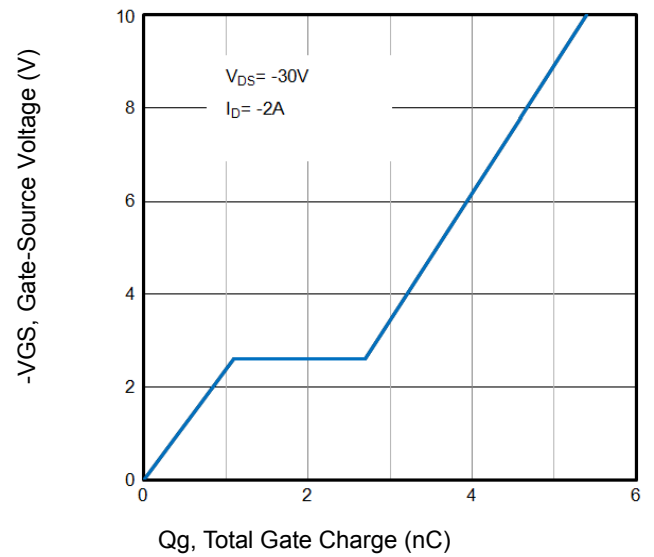
### Typical Characteristics



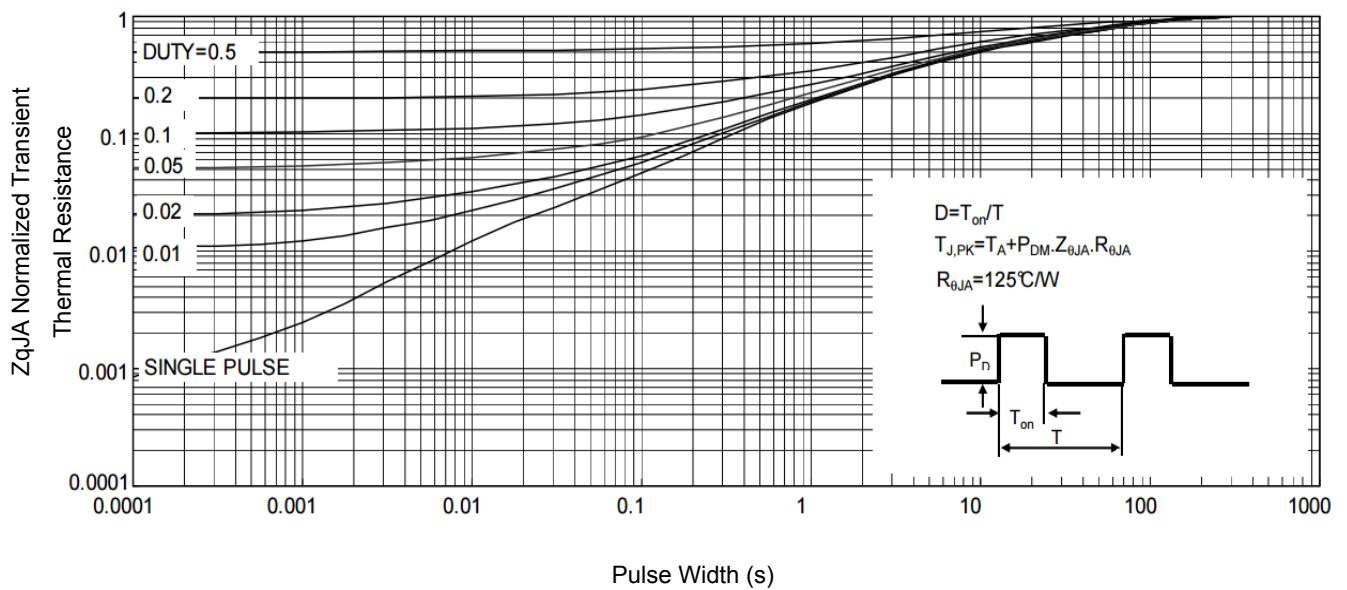
### Typical Characteristics



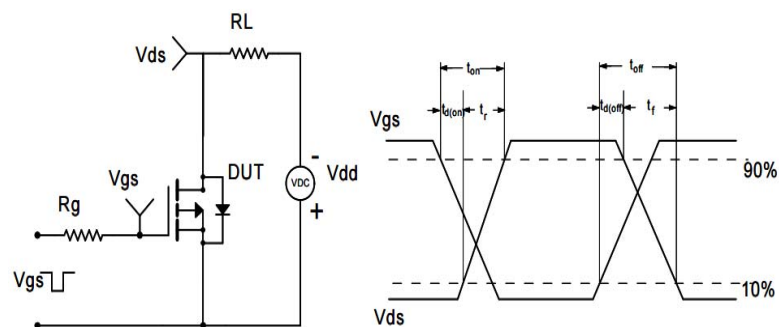
**Fig7.** Typical Capacitance Vs. Drain-Source Voltage



**Fig8.** Typical Gate Charge Vs. Gate-Source Voltage

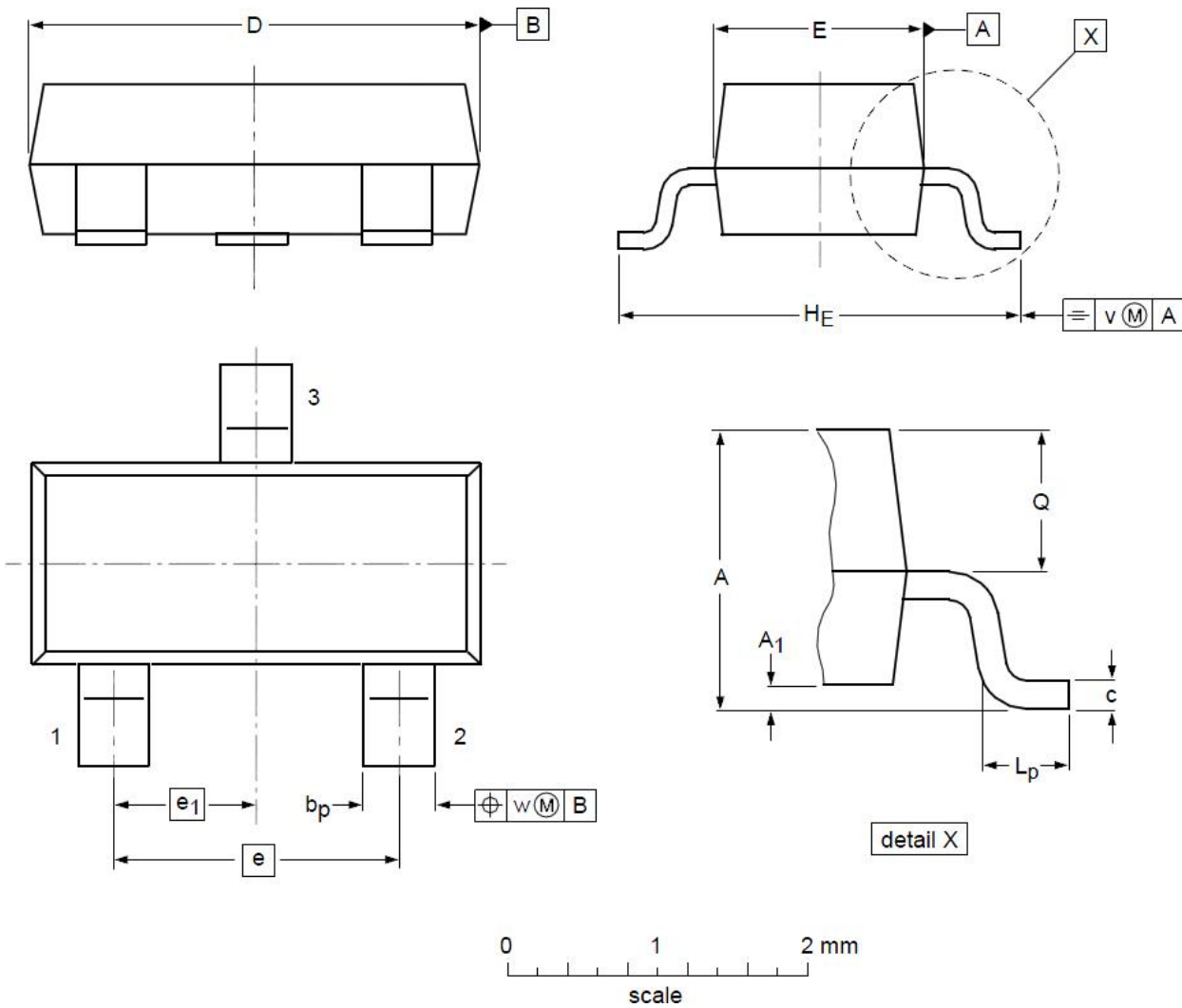


**Fig9.** Normalized Maximum Transient Thermal Impedance



**Fig10.** Switching Time Test Circuit and waveforms

Package Mechanical Data-SOT-23



DIMENSIONS ( unit : mm )

| Symbol         | Min  | Typ  | Max  | Symbol         | Min  | Typ  | Max  |
|----------------|------|------|------|----------------|------|------|------|
| A              | 0.90 | 1.01 | 1.15 | A <sub>1</sub> | 0.01 | 0.05 | 0.10 |
| b <sub>p</sub> | 0.30 | 0.42 | 0.50 | c              | 0.08 | 0.13 | 0.15 |
| D              | 2.80 | 2.92 | 3.00 | E              | 1.20 | 1.33 | 1.40 |
| e              | --   | 1.90 | --   | e <sub>1</sub> | --   | 0.95 | --   |
| H <sub>E</sub> | 2.25 | 2.40 | 2.55 | L <sub>p</sub> | 0.30 | 0.42 | 0.50 |
| Q              | 0.45 | 0.49 | 0.55 | v              | --   | 0.20 | --   |
| w              | --   | 0.10 | --   |                |      |      |      |