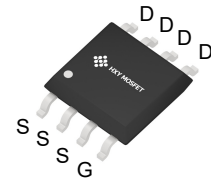




## Description

The SM4405PRL uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 2.5V. This device is suitable for use as a Battery protection or in other Switching application.



SOP-8

## General Features

$V_{DS} = -30V$   $I_D = -5.8A$

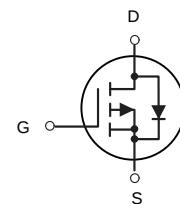
$R_{DS(ON)} < 55m\Omega$  @  $V_{GS}=10V$

## Application

Battery protection

Load switch

Uninterruptible power supply



P-Channel MOSFET

## Package Marking and Ordering Information

| Product ID | Pack  | Brand      | Qty(PCS) |
|------------|-------|------------|----------|
| SM4405PRL  | SOP-8 | HXY MOSFET | 3000     |

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

| Symbol               | Parameter                                                 | Rating     | Units |
|----------------------|-----------------------------------------------------------|------------|-------|
| $V_{DS}$             | Drain-Source Voltage                                      | - 30       | V     |
| $V_{GS}$             | Gate-Source Voltage                                       | $\pm 20$   | V     |
| $I_D@T_A=25^\circ C$ | Drain Current <sup>3</sup> , $V_{GS}$ @ 10V               | -5.8       | A     |
| IDM                  | Pulsed Drain Current <sup>1</sup>                         | -20        | A     |
| $P_D@T_A=25^\circ C$ | Total Power Dissipation                                   | 2.5        | W     |
|                      | Linear Derating Factor                                    | 0.02       | W/°C  |
| TSTG                 | Storage Temperature Range                                 | -55 to 150 | °C    |
| $T_J$                | Operating Junction Temperature Range                      | -55 to 150 | °C    |
| Rthj-a               | Maximum Thermal Resistance, Junction-ambient <sup>3</sup> | 50         | °C/W  |



**Electrical Characteristics ( $T_A=25^{\circ}\text{C}$  unless otherwise noted)**

| Parameter                                         | Symbol              | Condition                                                                              | Min | Typ  | Max  | Unit |
|---------------------------------------------------|---------------------|----------------------------------------------------------------------------------------|-----|------|------|------|
| Off Characteristics                               |                     |                                                                                        |     |      |      |      |
| Drain-Source Breakdown Voltage                    | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =-250μA                                             | -30 | -33  | -    | V    |
| Zero Gate Voltage Drain Current                   | I <sub>DSS</sub>    | V <sub>DS</sub> =-24V,V <sub>GS</sub> =0V                                              | -   | -    | -1   | μA   |
| Gate-Body Leakage Current                         | I <sub>GSS</sub>    | V <sub>GS</sub> =±20V,V <sub>DS</sub> =0V                                              | -   | -    | ±100 | nA   |
| On Characteristics <small>(Note 3)</small>        |                     |                                                                                        |     |      |      |      |
| Gate Threshold Voltage                            | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> ,I <sub>D</sub> =-250μA                               | -1  | -1.6 | -3   | V    |
| Drain-Source On-State Resistance                  | R <sub>DS(ON)</sub> | V <sub>GS</sub> =-10V, I <sub>D</sub> =-5.1A                                           | -   | 43   | 55   | mΩ   |
|                                                   |                     | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-4.2A                                          | -   | 62   | 90   | mΩ   |
| Forward Transconductance                          | g <sub>FS</sub>     | V <sub>DS</sub> =-15V,I <sub>D</sub> =-4.5A                                            | 4   | 7    | -    | S    |
| Dynamic Characteristics <small>(Note4)</small>    |                     |                                                                                        |     |      |      |      |
| Input Capacitance                                 | C <sub>iss</sub>    | V <sub>DS</sub> =-15V,V <sub>GS</sub> =0V,<br>F=1.0MHz                                 | -   | 520  | -    | PF   |
| Output Capacitance                                | C <sub>oss</sub>    |                                                                                        | -   | 130  | -    | PF   |
| Reverse Transfer Capacitance                      | C <sub>rss</sub>    |                                                                                        | -   | 70   | -    | PF   |
| Switching Characteristics <small>(Note 4)</small> |                     |                                                                                        |     |      |      |      |
| Turn-on Delay Time                                | t <sub>d(on)</sub>  | V <sub>DD</sub> =-15V, I <sub>D</sub> =-1A, V <sub>GS</sub> =-10V,R <sub>GEN</sub> =6Ω | -   | 7    | -    | nS   |
| Turn-on Rise Time                                 | t <sub>r</sub>      |                                                                                        | -   | 13   | -    | nS   |
| Turn-Off Delay Time                               | t <sub>d(off)</sub> |                                                                                        | -   | 14   | -    | nS   |
| Turn-Off Fall Time                                | t <sub>f</sub>      |                                                                                        | -   | 9    | -    | nS   |
| Total Gate Charge                                 | Q <sub>g</sub>      | V <sub>DS</sub> =-15V,I <sub>D</sub> =-5.1A,V <sub>GS</sub> =-10V                      | -   | 11   | -    | nC   |
| Gate-Source Charge                                | Q <sub>gs</sub>     |                                                                                        | -   | 2.2  | -    | nC   |
| Gate-Drain Charge                                 | Q <sub>gd</sub>     |                                                                                        | -   | 3    | -    | nC   |
| Drain-Source Diode Characteristics                |                     |                                                                                        |     |      |      |      |
| Diode Forward Voltage <small>(Note 3)</small>     | V <sub>SD</sub>     | V <sub>GS</sub> =0V,I <sub>S</sub> =-5.1A                                              | -   | -    | -1.2 | V    |

**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production



## Typical Electrical and Thermal Characteristics

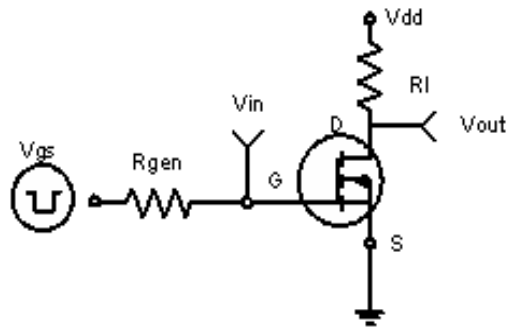


Figure 1: Switching Test Circuit

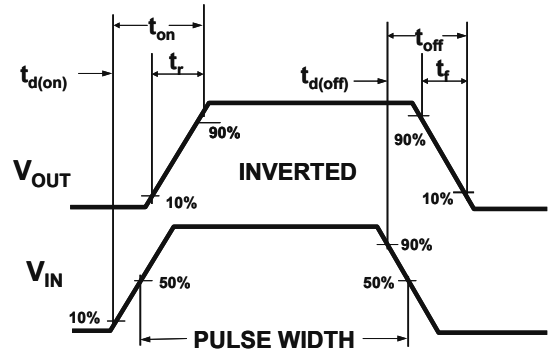


Figure 2: Switching Waveforms

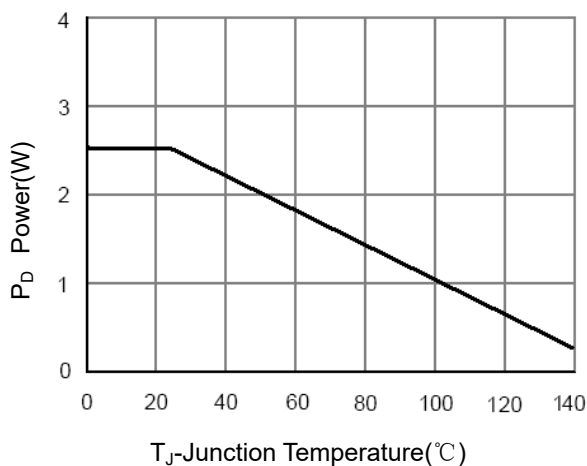


Figure 3 Power Dissipation

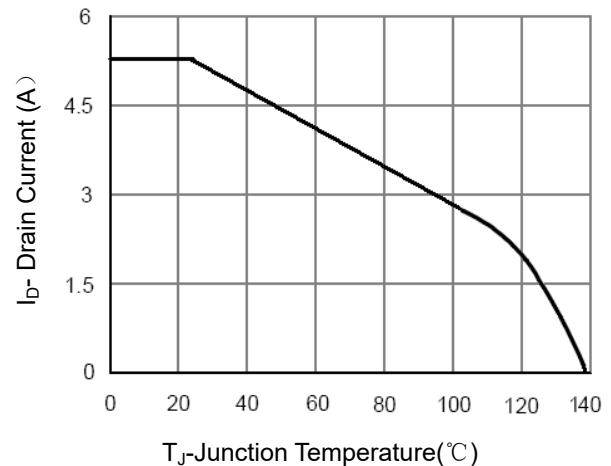


Figure 4 Drain Current

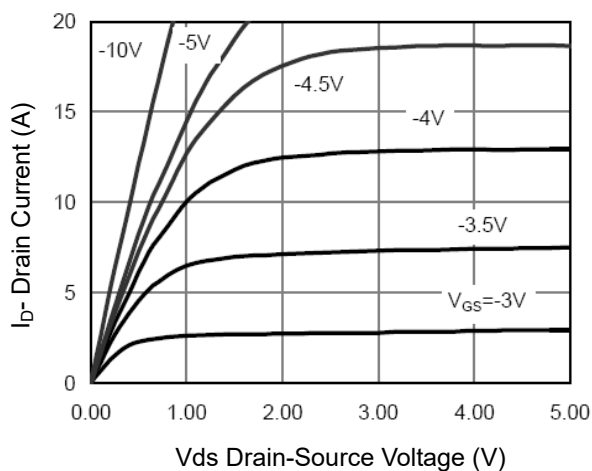


Figure 5 Output Characteristics

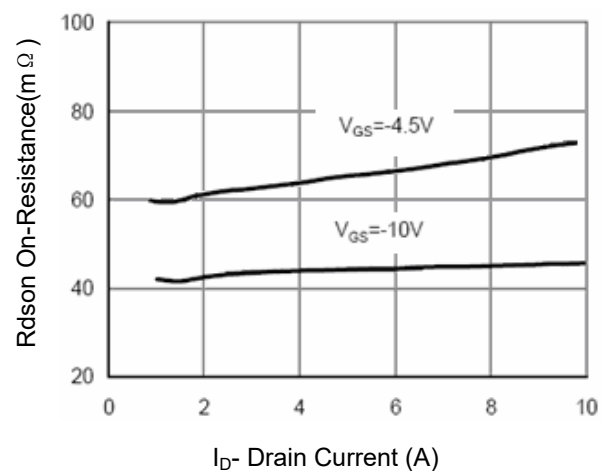
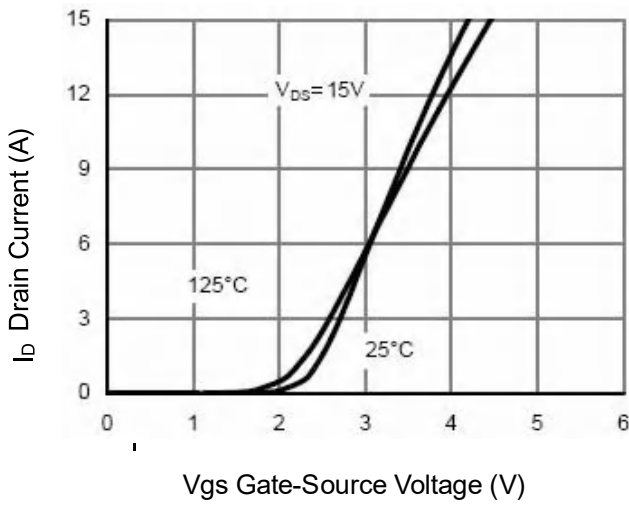


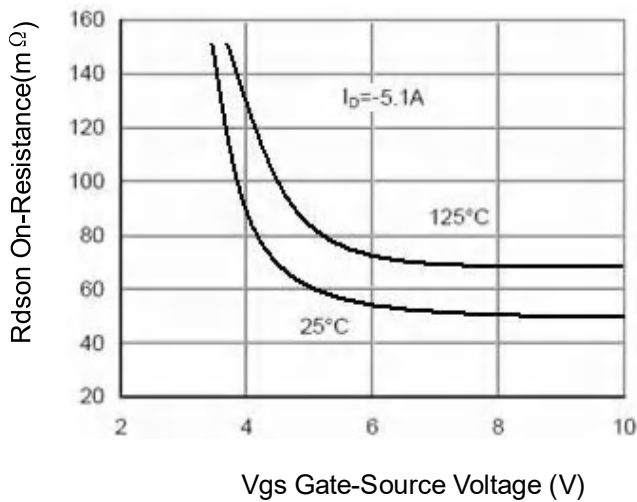
Figure 6 Drain-Source On-Resistance



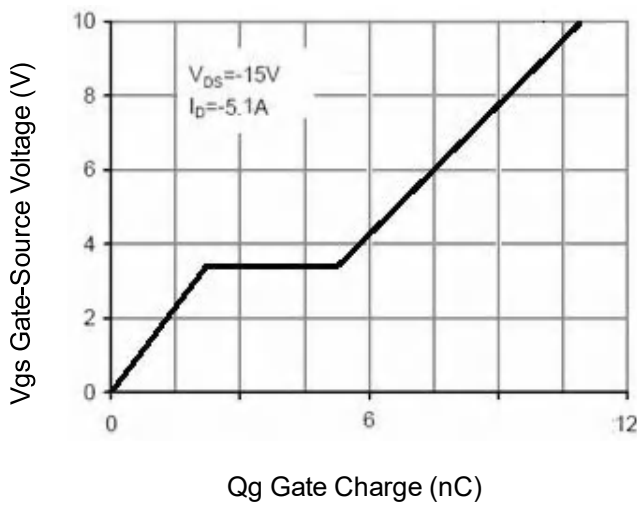
**Figure 5 Output Characteristics**



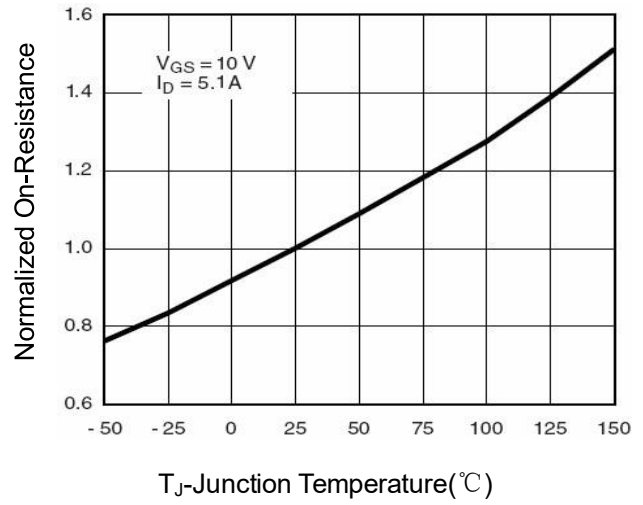
**Figure 7 Transfer Characteristics**



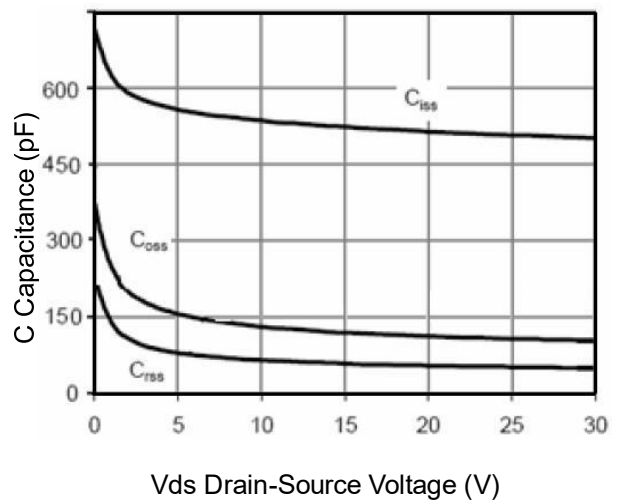
**Figure 9 Rdson vs Vgs**



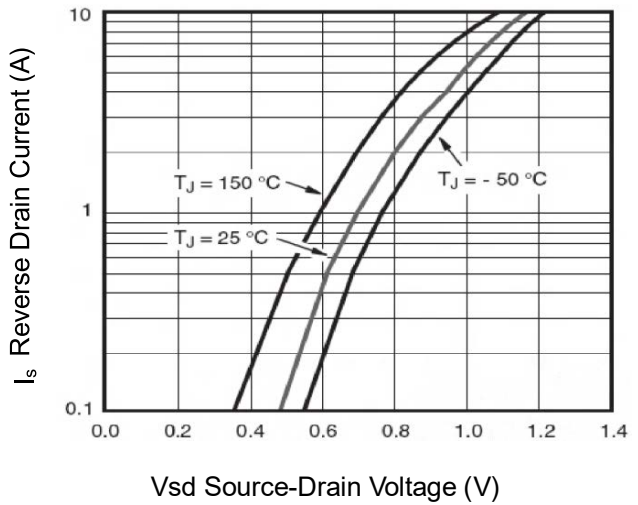
**Figure 11 Gate Charge**

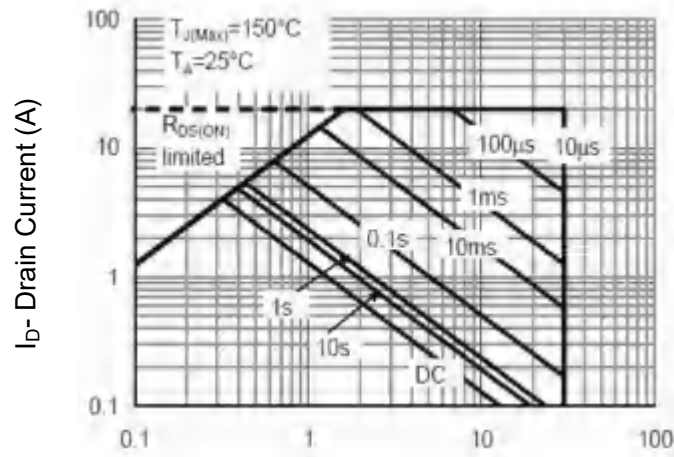


**Figure 10 Capacitance vs Vds**

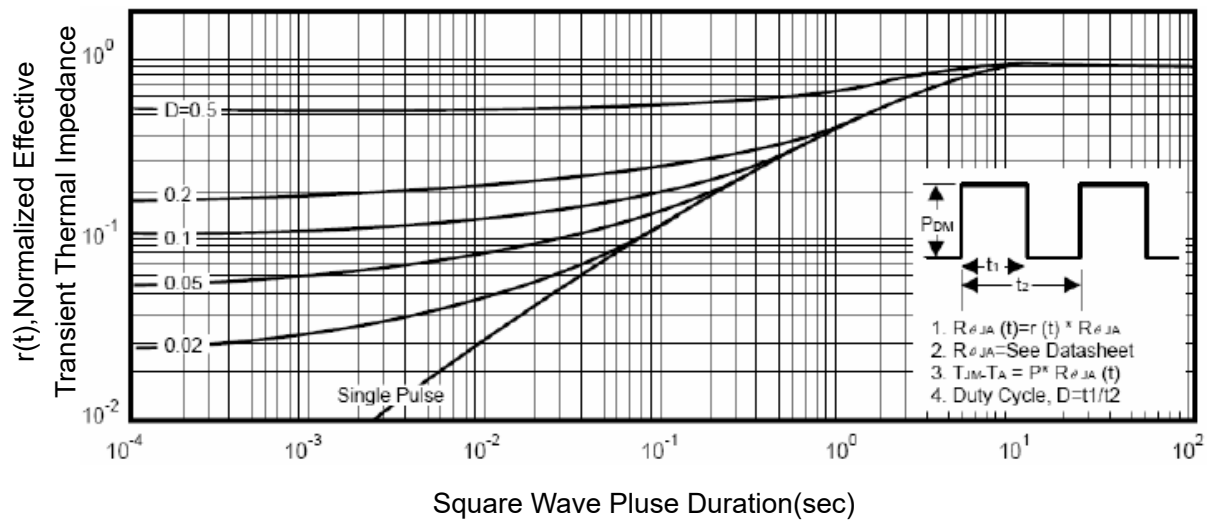


**Figure 12 Source- Drain Diode Forward**





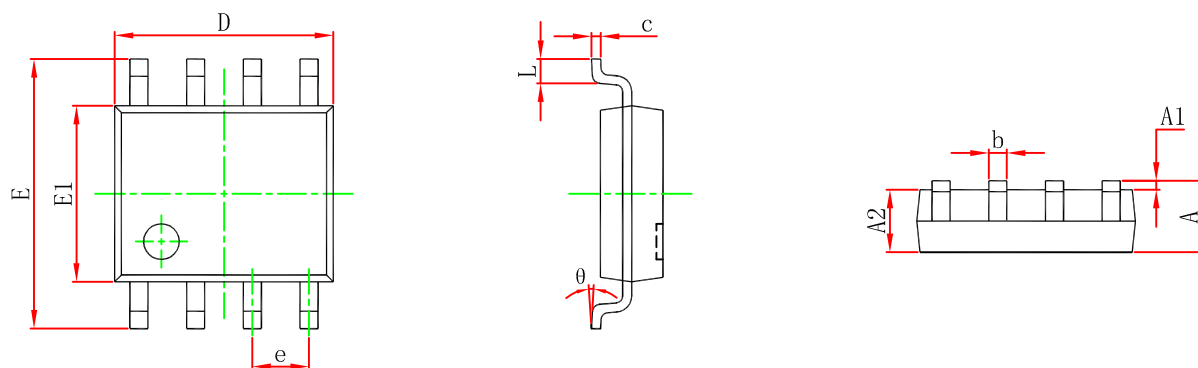
Vds Drain-Source Voltage (V)  
**Figure 13 Safe Operation Area**



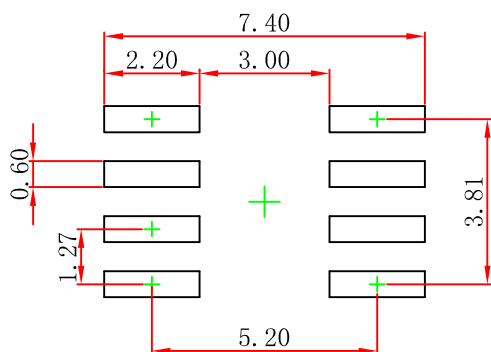
Square Wave Pluse Duration(sec)  
**Figure 14 Normalized Maximum Transient Thermal Impedance**



## SOP-8 Package Outline Dimensions



| 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 | 0.007                | 0.010 |
| D      | 4.800                     | 5.000 | 0.189                | 0.197 |
| e      | 1.270 (BSC)               |       | 0.050 (BSC)          |       |
| E      | 5.800                     | 6.200 | 0.228                | 0.244 |
| E1     | 3.800                     | 4.000 | 0.150                | 0.157 |
| L      | 0.400                     | 1.270 | 0.016                | 0.050 |
| θ      | 0°                        | 8°    | 0°                   | 8°    |



Note:  
1. Controlling dimension; in millimeters.  
2. General tolerance:  $\pm 0.05\text{mm}$ .  
3. The pad layout is for reference purposes only.



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