

## N and P-Channel Enhancement Mode Power MOSFET

### Description

The HM4630D uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. The complementary MOSFETs may be used to form a level shifted high side switch, and for a host of other applications.

### General Features

#### ● N-Channel

$$V_{DS} = 30V, I_D = 5A$$

$$R_{DS(ON)} < 36m\Omega @ V_{GS}=4.5V$$

$$R_{DS(ON)} < 52m\Omega @ V_{GS}=2.5V$$

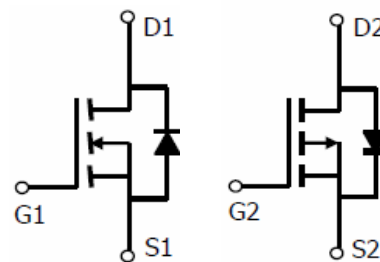
#### ● P-Channel

$$V_{DS} = -30V, I_D = -5A$$

$$R_{DS(ON)} < 6.5m\Omega @ V_{GS}=-4.5V$$

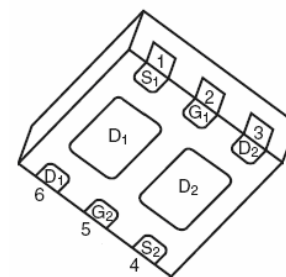
$$R_{DS(ON)} < 120m\Omega @ V_{GS}=-2.5V$$

- High power and current handing capability
- Lead free product is acquired
- Surface mount package



N-channel

P-channel



Pin assignment

### Package Marking and Ordering Information

| Device Marking | Device  | Device Package | Reel Size | Tape width | Quantity   |
|----------------|---------|----------------|-----------|------------|------------|
| 4630           | HM4630D | DFN2X2-6L      | Ø180mm    | 8mm        | 3000 units |

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

| Parameter                                        | Symbol         | N-Channel  | P-Channel  | Unit             |
|--------------------------------------------------|----------------|------------|------------|------------------|
| Drain-Source Voltage                             | $V_{DS}$       | 30         | -30        | V                |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 12$   | $\pm 12$   | V                |
| Continuous Drain Current                         | $I_D$          | 5          | -5         | A                |
|                                                  |                | 3.5        | -3.5       |                  |
| Pulsed Drain Current <sup>(Note 1)</sup>         | $I_{DM}$       | 15         | -15        | A                |
| Maximum Power Dissipation                        | $P_D$          | 0.8        | 0.8        | W                |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$ | -55 To 150 | -55 To 150 | $^\circ\text{C}$ |

### Thermal Characteristic

|                                                            |                 |      |     |                    |
|------------------------------------------------------------|-----------------|------|-----|--------------------|
| Thermal Resistance, Junction-to-Ambient <sup>(Note2)</sup> | $R_{\theta JA}$ | N-Ch | 156 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Ambient <sup>(Note2)</sup> | $R_{\theta JA}$ | P-Ch | 156 | $^\circ\text{C/W}$ |

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

| Parameter                          | Symbol       | Condition                                                     | Min | Typ | Max       | Unit       |
|------------------------------------|--------------|---------------------------------------------------------------|-----|-----|-----------|------------|
| Off Characteristics                |              |                                                               |     |     |           |            |
| Drain-Source Breakdown Voltage     | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$                                     | 20  | 22  | -         | V          |
| Zero Gate Voltage Drain Current    | $I_{DSS}$    | $V_{DS}=30V, V_{GS}=0V$                                       | -   | -   | 1         | $\mu A$    |
| Gate-Body Leakage Current          | $I_{GSS}$    | $V_{GS}=\pm 12V, V_{DS}=0V$                                   | -   | -   | $\pm 100$ | nA         |
| On Characteristics (Note 3)        |              |                                                               |     |     |           |            |
| Gate Threshold Voltage             | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$                                 | 0.6 | 0.9 | 1.4       | V          |
| Drain-Source On-State Resistance   | $R_{DS(ON)}$ | $V_{GS}=2.5V, I_D=2.8A$                                       | -   | 46  | 52        | m $\Omega$ |
|                                    |              | $V_{GS}=4.5V, I_D=5A$                                         | -   | 30  | 36        | m $\Omega$ |
| Forward Transconductance           | $g_{FS}$     | $V_{DS}=5V, I_D=5A$                                           | -   | 8   | -         | S          |
| Dynamic Characteristics (Note4)    |              |                                                               |     |     |           |            |
| Input Capacitance                  | $C_{ISS}$    | $V_{DS}=10V, V_{GS}=0V,$<br>$F=1.0MHz$                        | -   | 260 | -         | PF         |
| Output Capacitance                 | $C_{OSS}$    |                                                               | -   | 48  | -         | PF         |
| Reverse Transfer Capacitance       | $C_{RSS}$    |                                                               | -   | 27  | -         | PF         |
| Switching Characteristics (Note 4) |              |                                                               |     |     |           |            |
| Turn-on Delay Time                 | $t_{d(on)}$  | $V_{DD}=10V, R_L=3.3\Omega$<br>$V_{GS}=4.5V, R_{GEN}=6\Omega$ | -   | 2.5 | -         | nS         |
| Turn-on Rise Time                  | $t_r$        |                                                               | -   | 3.2 | -         | nS         |
| Turn-Off Delay Time                | $t_{d(off)}$ |                                                               | -   | 21  | -         | nS         |
| Turn-Off Fall Time                 | $t_f$        |                                                               | -   | 3   | -         | nS         |
| Total Gate Charge                  | $Q_g$        | $V_{DS}=10V, I_D=5A,$<br>$V_{GS}=4.5V$                        | -   | 2.9 | 5         | nC         |
| Gate-Source Charge                 | $Q_{gs}$     |                                                               | -   | 0.4 | -         | nC         |
| Gate-Drain Charge                  | $Q_{gd}$     |                                                               | -   | 0.6 | -         | nC         |
| Drain-Source Diode Characteristics |              |                                                               |     |     |           |            |
| Diode Forward Voltage (Note 3)     | $V_{SD}$     | $V_{GS}=0V, I_S=5A$                                           | -   | -   | 1.2       | V          |
| Diode Forward Current (Note 2)     | $I_S$        |                                                               | -   | -   | 5         | A          |

**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

**P-CH Electrical Characteristics (TA=25°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                                               | -20  |      | -    | V    |
| Zero Gate Voltage Drain Current    | I <sub>DSS</sub>    | V <sub>DS</sub> =-30V,V <sub>GS</sub> =0V                                                | -    | -    | -1   | μA   |
| Gate-Body Leakage Current          | I <sub>GSS</sub>    | V <sub>GS</sub> =±12V,V <sub>DS</sub> =0V                                                | -    | -    | ±100 | nA   |
| On Characteristics (Note 3)        |                     |                                                                                          |      |      |      |      |
| Gate Threshold Voltage             | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> ,I <sub>D</sub> =-250μA                                 | -0.6 | -0.9 | -2.0 | V    |
| Drain-Source On-State Resistance   | R <sub>DS(ON)</sub> | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-2.5 A                                           | -    | 60   | 165  | mΩ   |
|                                    |                     | V <sub>GS</sub> =-2.5V, I <sub>D</sub> =-2A                                              | -    | 95   | 120  | mΩ   |
| Forward Transconductance           | g <sub>FS</sub>     | V <sub>DS</sub> =-5V,I <sub>D</sub> =-2.5A                                               | -    | 9.5  | -    | S    |
| Dynamic Characteristics (Note4)    |                     |                                                                                          |      |      |      |      |
| Input Capacitance                  | C <sub>iss</sub>    | V <sub>DS</sub> =-10V,V <sub>GS</sub> =0V,<br>F=1.0MHz                                   | -    | 325  | -    | PF   |
| Output Capacitance                 | C <sub>oss</sub>    |                                                                                          | -    | 63   | -    | PF   |
| Reverse Transfer Capacitance       | C <sub>rss</sub>    |                                                                                          | -    | 37   | -    | PF   |
| Switching Characteristics (Note 4) |                     |                                                                                          |      |      |      |      |
| Turn-on Delay Time                 | t <sub>d(on)</sub>  | V <sub>DD</sub> =-10V, R <sub>L</sub> =5Ω<br>V <sub>GS</sub> =-4.5V,R <sub>GEN</sub> =3Ω | -    | 11   | -    | nS   |
| Turn-on Rise Time                  | t <sub>r</sub>      |                                                                                          | -    | 5.5  | -    | nS   |
| Turn-Off Delay Time                | t <sub>d(off)</sub> |                                                                                          | -    | 22   | -    | nS   |
| Turn-Off Fall Time                 | t <sub>f</sub>      |                                                                                          | -    | 8    | -    | nS   |
| Total Gate Charge                  | Q <sub>g</sub>      | V <sub>DS</sub> =-10V,I <sub>D</sub> =-2A,<br>V <sub>GS</sub> =-4.5V                     | -    | 3.2  | -    | nC   |
| Gate-Source Charge                 | Q <sub>gs</sub>     |                                                                                          | -    | 0.6  | -    | nC   |
| Gate-Drain Charge                  | Q <sub>gd</sub>     |                                                                                          | -    | 0.9  | -    | nC   |
| Drain-Source Diode Characteristics |                     |                                                                                          |      |      |      |      |
| Diode Forward Voltage (Note 3)     | V <sub>SD</sub>     | V <sub>GS</sub> =0V,I <sub>S</sub> =-5A                                                  | -    | -    | -1.2 | V    |
| Diode Forward Current (Note 2)     | I <sub>S</sub>      |                                                                                          | -    | -    | -5   | A    |

**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

N- Channel Typical Electrical and Thermal Characteristics (Curves)

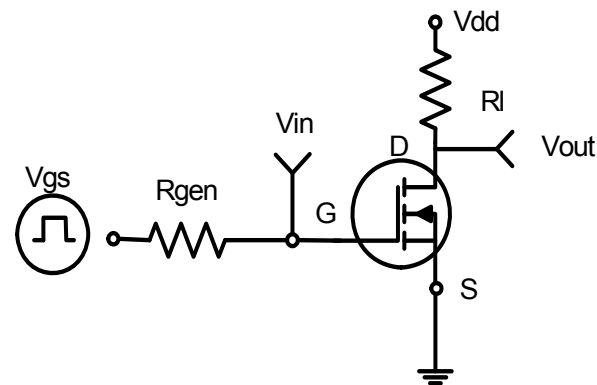


Figure 1:Switching Test Circuit

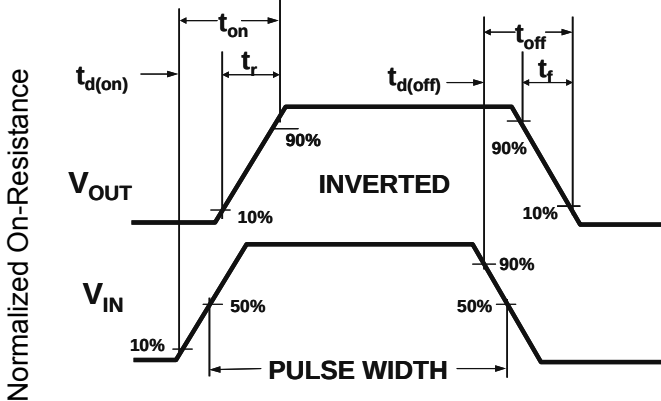


Figure 2:Switching Waveforms

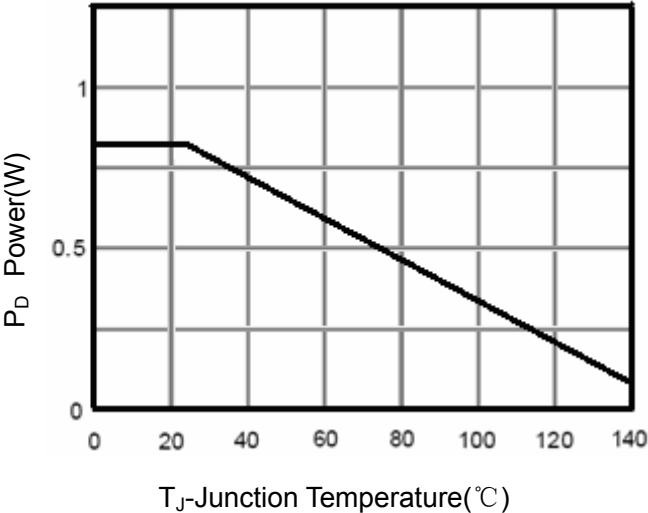


Figure 3 Power Dissipation

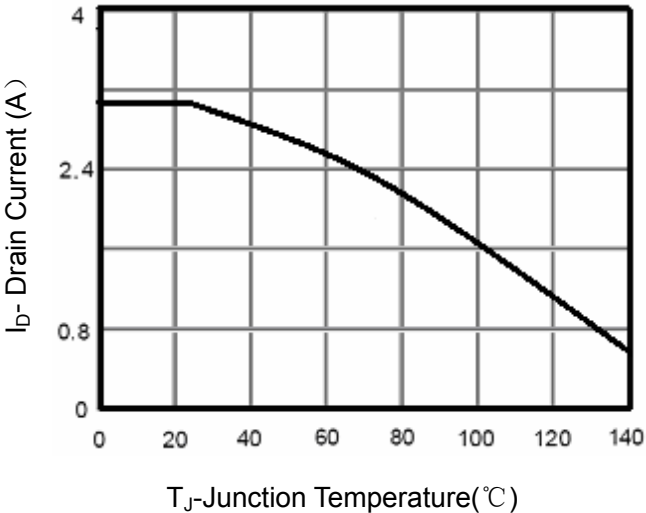


Figure 4 Drain Current

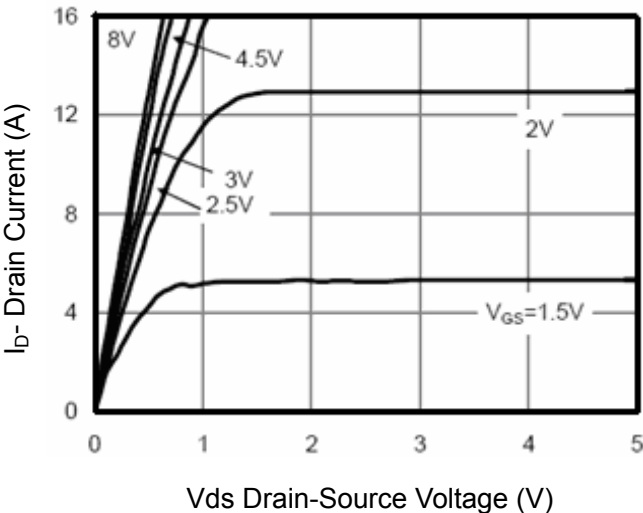


Figure 5 Output Characteristics

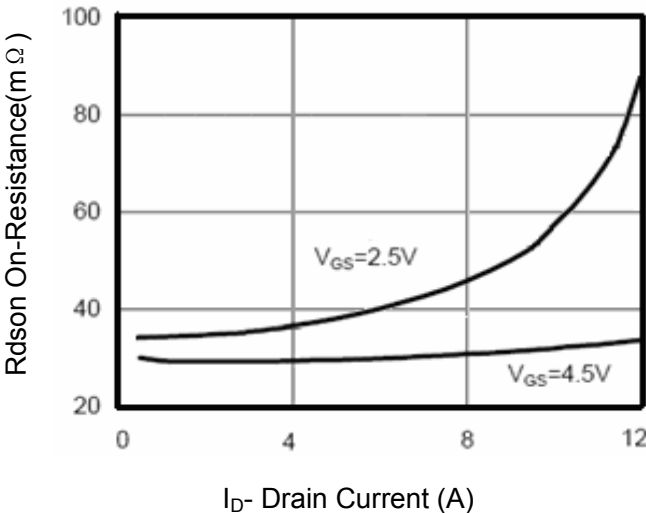


Figure 6 Drain-Source On-Resistance

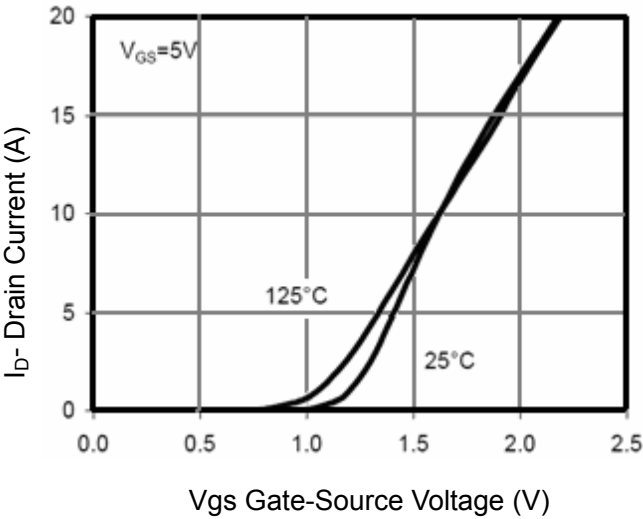


Figure 7 Transfer Characteristics

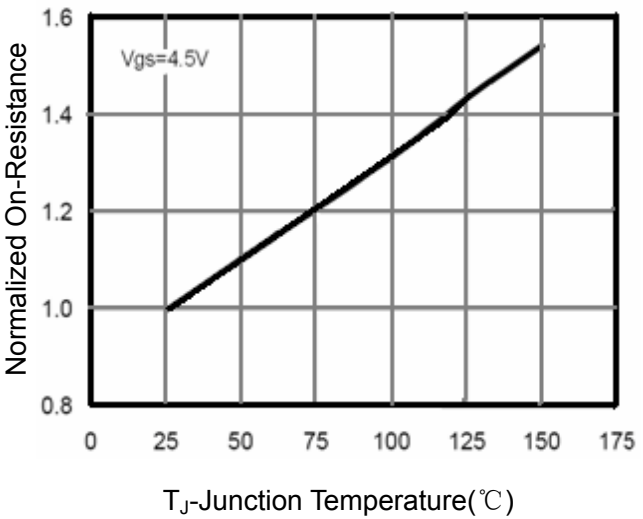


Figure 8 Drain-Source On-Resistance

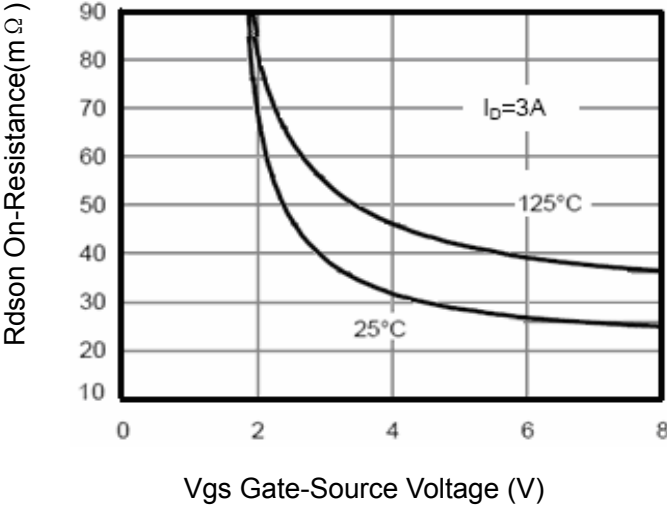


Figure 9 Rdson vs Vgs

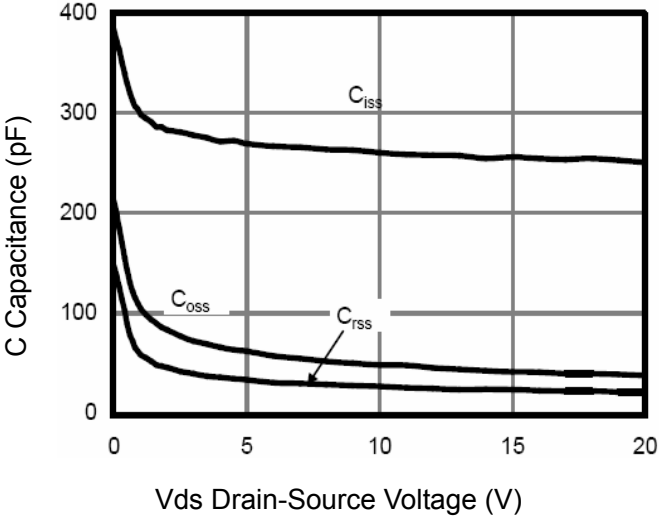


Figure 10 Capacitance vs Vds

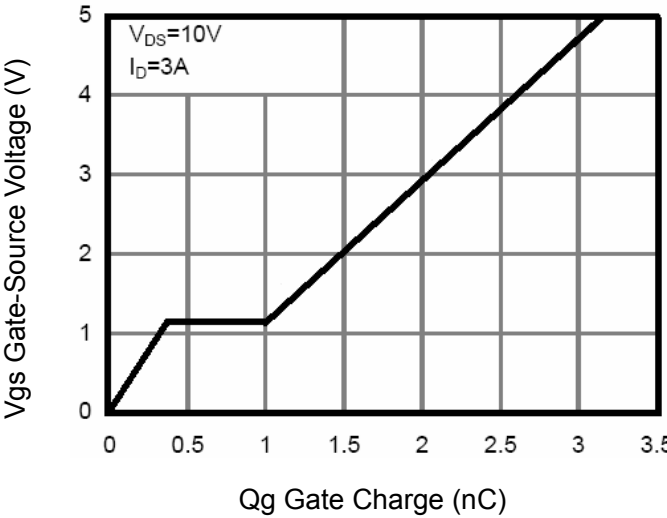


Figure 11 Gate Charge

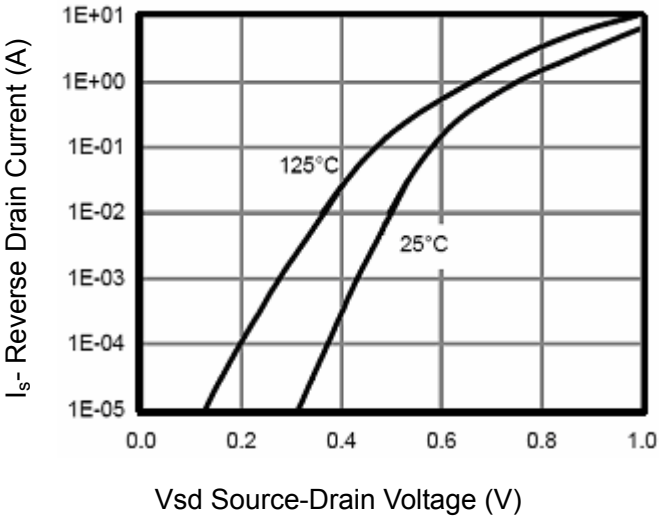


Figure 12 Source- Drain Diode Forward

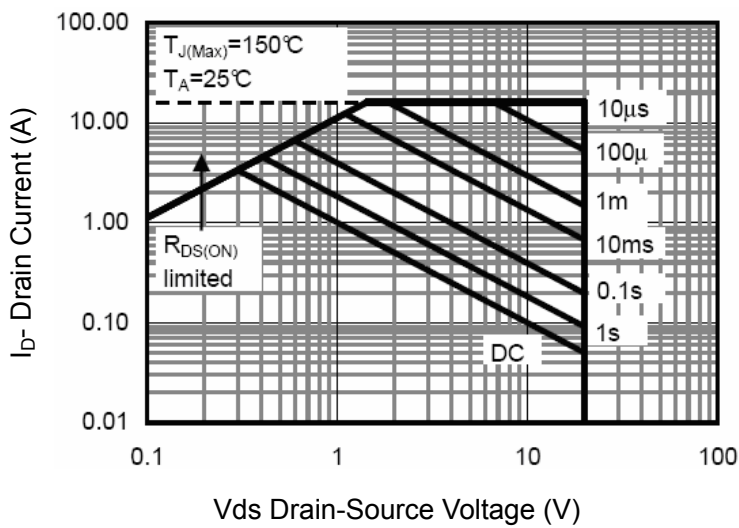


Figure 13 Safe Operation Area

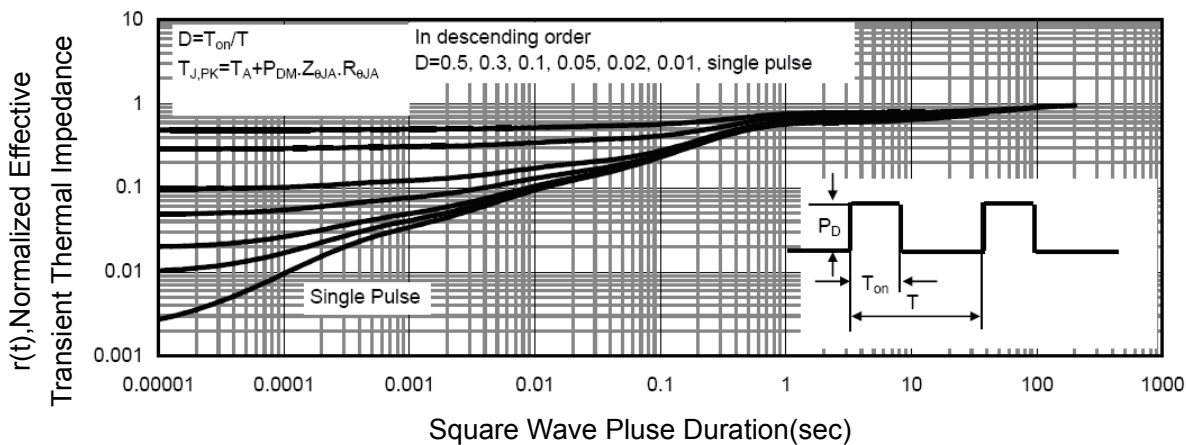


Figure 14 Normalized Maximum Transient Thermal Impedance

P- Channel Typical Electrical and Thermal Characteristics (Curves)

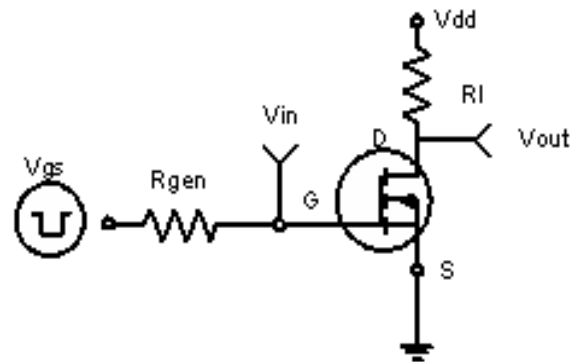


Figure 1:Switching Test Circuit

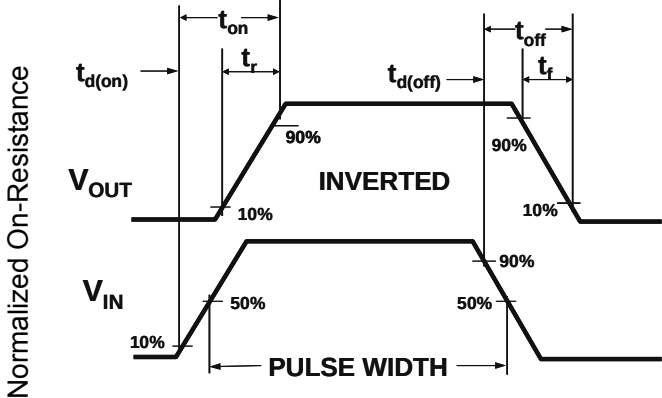


Figure 2:Switching Waveforms

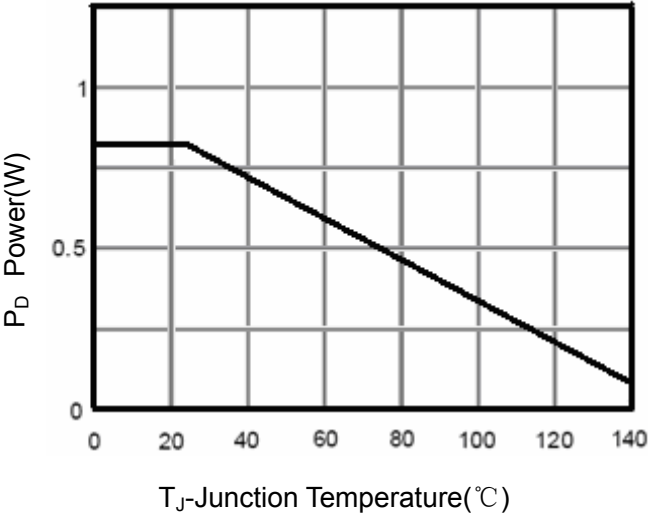


Figure 3 Power Dissipation

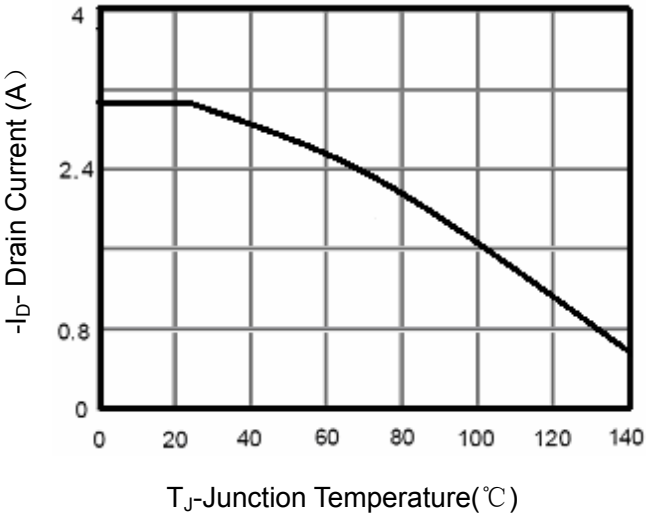


Figure 4 Drain Current

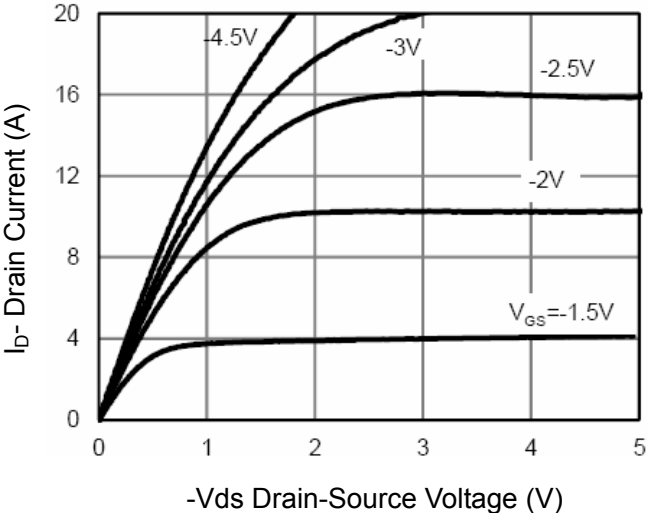


Figure 5 Output Characteristics

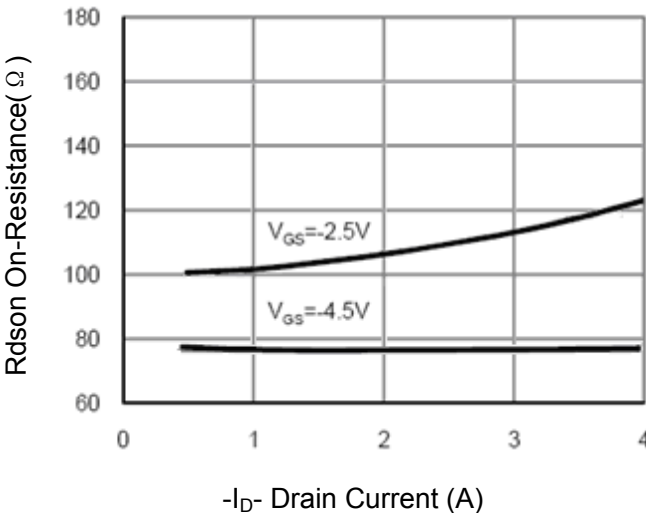


Figure 6 Drain-Source On-Resistance

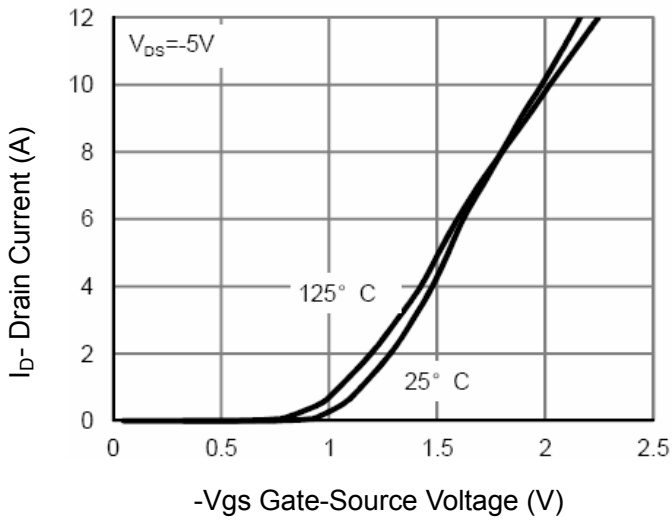


Figure 7 Transfer Characteristics

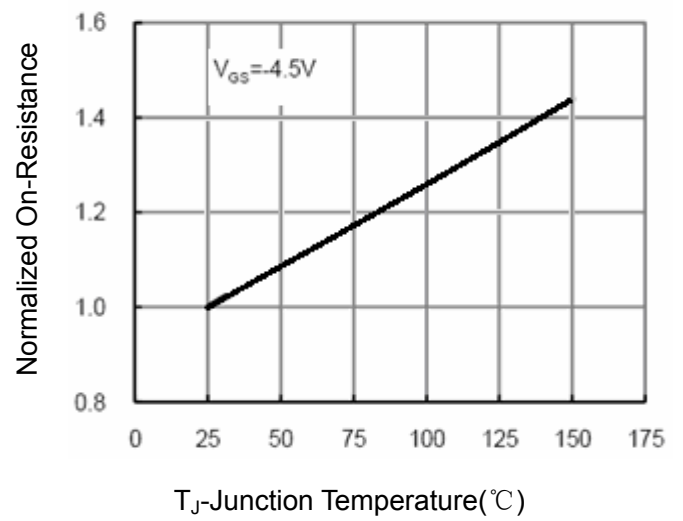


Figure 8 Drain-Source On-Resistance

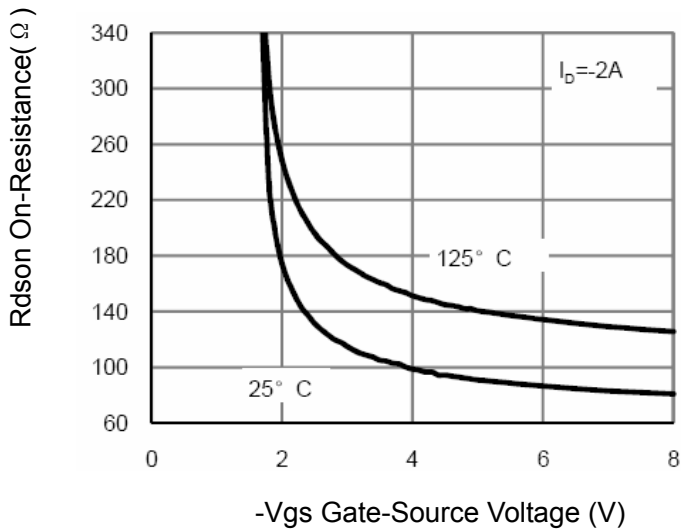


Figure 9 Rdson vs Vgs

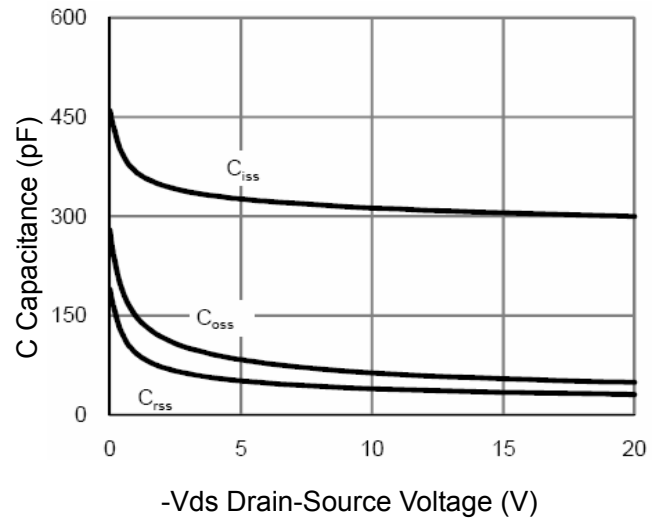


Figure 10 Capacitance vs Vds

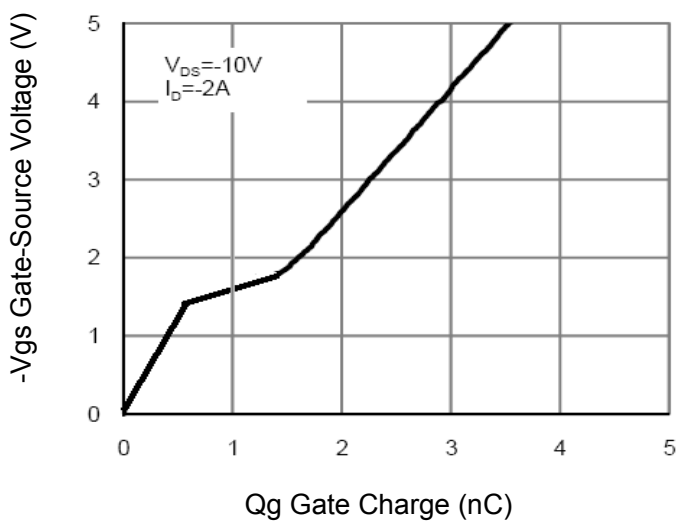


Figure 11 Gate Charge

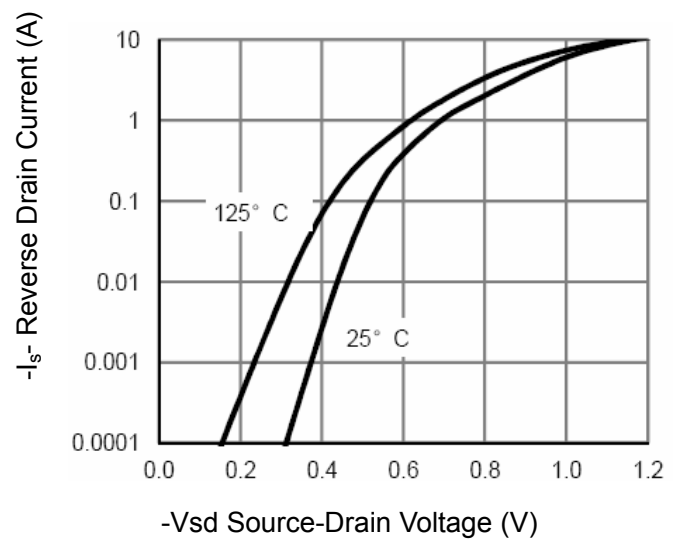


Figure 12 Source- Drain Diode Forward

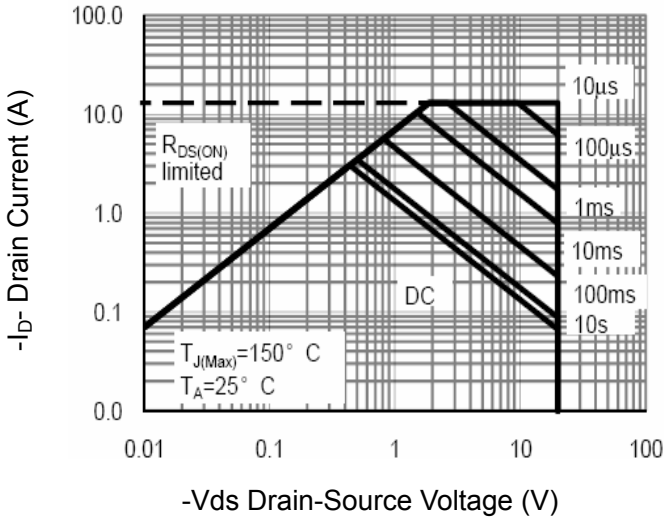


Figure 13 Safe Operation Area

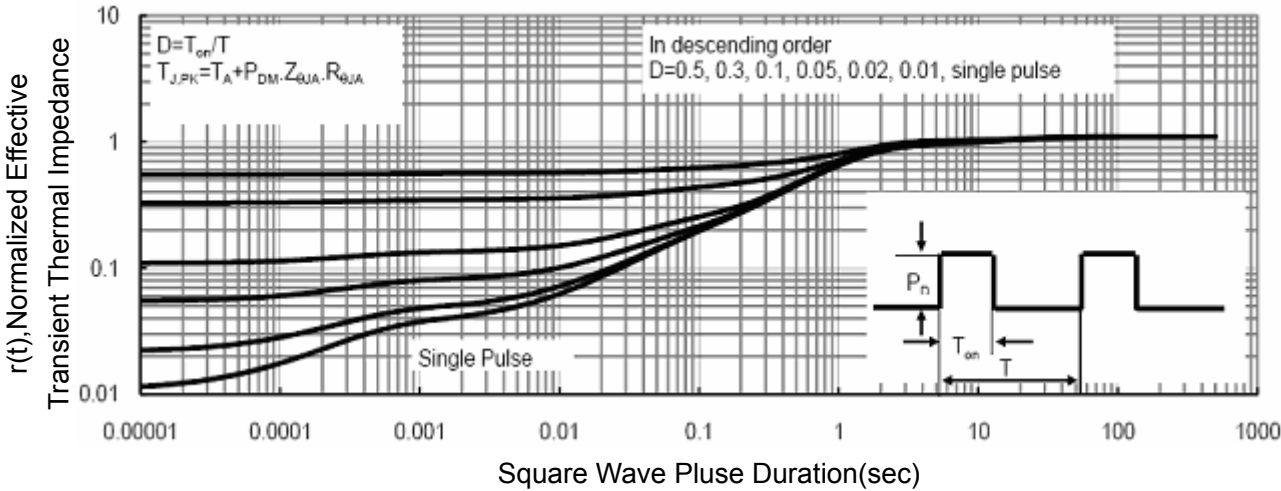
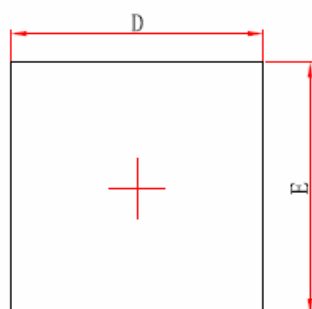
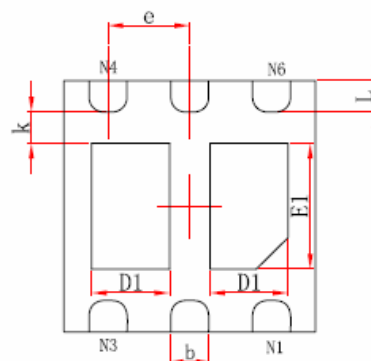


Figure 14 Normalized Maximum Transient Thermal Impedance

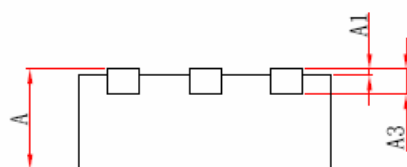
DFN2X2-6L Package Information



Top View



Bottom View



Side View

| Symbol | Dimensions In Millimeters |             | Dimensions In Inches |             |
|--------|---------------------------|-------------|----------------------|-------------|
|        | Min.                      | Max.        | Min.                 | Max.        |
| A      | 0.700/0.800               | 0.800/0.900 | 0.028/0.031          | 0.031/0.035 |
| A1     | 0.000                     | 0.050       | 0.000                | 0.002       |
| A3     | 0.203REF.                 |             | 0.008REF.            |             |
| D      | 1.924                     | 2.076       | 0.076                | 0.082       |
| E      | 1.924                     | 2.076       | 0.076                | 0.082       |
| D1     | 0.520                     | 0.720       | 0.020                | 0.028       |
| E1     | 0.900                     | 1.100       | 0.035                | 0.043       |
| k      | 0.200MIN.                 |             | 0.008MIN.            |             |
| b      | 0.250                     | 0.350       | 0.010                | 0.014       |
| e      | 0.650TYP.                 |             | 0.026TYP.            |             |
| L      | 0.174                     | 0.326       | 0.007                | 0.013       |