# FH4606K

**N and P-Channel Enhancement Mode Power MOSFET**

## ■ Description

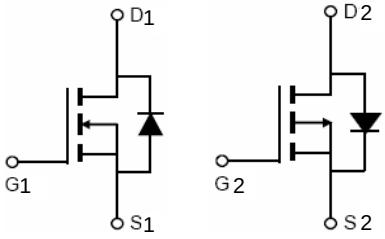
The FH4606K uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge . Thecomplementary MOSFETs may be used to form a level shifted high sideswitch, and for a host of other applications.

## ■ Applications

- Hhigh-frequency switching and synchronous rectification
- DC/DC Converter
- Surface mount package

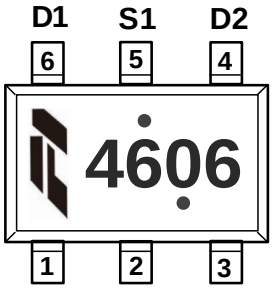
## ■ General Features

- **N-Channel** : $V_{DS}$ = 30V,$I_D$ = 7.2A
  - $R_{DS(ON)}$(Typ.)= 20mΩ @$V_{GS}$ = 10V
  - $R_{DS(ON)}$(Typ.)= 23mΩ @$V_{GS}$ = 4.5V
  - $R_{DS(ON)}$(Typ.)= 31mΩ @$V_{GS}$ = 2.5V
- **P-Channel** : $V_{DS}$ = -30V,$I_D$ = -7.1A
  - $R_{DS(ON)}$(Typ.)= 33mΩ @$V_{GS}$ = -10V
  - $R_{DS(ON)}$(Typ.)= 38mΩ @$V_{GS}$ = -4.5V
  - $R_{DS(ON)}$(Typ.)= 51mΩ @$V_{GS}$ = -2.5V

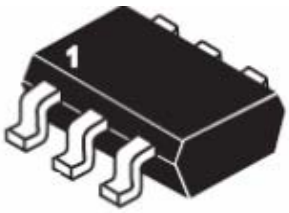



N-channel P-channel

Schematic diagram




Marking and pin assignment




SOT23-6 top view

## Absolute Maximum Ratings ($T_A$=25℃unless otherwise noted)

| Parameter | | Symbol | N-Channel | P-Channel | Unit |
|---|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 30 | -30 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±12 | ±12 | V |
| Continuous Drain Current | $T_A$=25℃ | $I_D$ | 7.2 | -7.1 | A |
| | $T_A$=80℃ | | 5.4 | -5.1 | |
| Pulsed Drain Current (Note 1) | | $I_{DM}$ | 28.8 | -28.4 | A |
| Maximum Power Dissipation | $T_A$=25℃ | $P_D$ | 2.0 | | W |
| Operating Junction and Storage Temperature Range | | $T_J$,$T_{STG}$ | -55 To 150 | | ℃ |

## Thermal Characteristic

| | | | |
|---|---|---|---|
| Thermal Resistance,Junction-to-Ambient (Note2) | $R_{\theta JA}$ | 98 | ℃/W |

## N-CH Electrical Characteristics ($T_A$=25℃unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS}$=0V $I_D$=250μA | 30 | - | - | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=30V,$V_{GS}$=0V | - | - | 1 | μA |
| Gate-Body Leakage Current | $I_{GSS}$ | $V_{GS}$=±12V,$V_{DS}$=0V | - | - | ±100 | nA |
| **On Characteristics** (Note 3) | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$,$I_D$=250μA | 0.5 | 0.8 | 1.1 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=4A | - | 20 | 27 | mΩ |
| | | $V_{GS}$=4.5V, $I_D$=4A | - | 23 | 29 | mΩ |
| | | $V_{GS}$=2.5V, $I_D$=2A | - | 31 | 42 | mΩ |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$=5V,$I_D$=4A | - | 18 | - | S |
| **Dynamic Characteristics** (Note4) | | | | | | |
| Input Capacitance | $C_{lss}$ | $V_{DS}$=15V,$V_{GS}$=0V, F=1.0MHz | - | 670 | - | PF |
| Output Capacitance | $C_{oss}$ | | - | 76 | - | PF |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 55 | - | PF |
| **Switching Characteristics** (Note 4) | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$=15V, $R_L$=2.5Ω $V_{GS}$=10V,$R_{GEN}$=3Ω | - | 5.2 | - | nS |
| Turn-on Rise Time | $t_r$ | | - | 2.5 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 17 | - | nS |
| Turn-Off Fall Time | $t_f$ | | - | 4 | - | nS |
| Total Gate Charge | $Q_g$ | $V_{DS}$=15V,$I_D$=4A, $V_{GS}$=10V | - | 7 | - | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 1.3 | - | nC |
| Gate-Drain Charge | $Q_{gd}$ | | - | 1.8 | - | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| Diode Forward Voltage (Note 3) | $V_{SD}$ | $V_{GS}$=0V,$I_S$=1A | - | 0.8 | 1.2 | V |

## P-CH Electrical Characteristics ($T_A$=25℃unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS}$=0V $I_D$=-250μA | -30 | - | - | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=-30V,$V_{GS}$=0V | - | - | -1 | μA |
| Gate-Body Leakage Current | $I_{GSS}$ | $V_{GS}$=±12V,$V_{DS}$=0V | - | - | ±100 | nA |
| **On Characteristics (Note 3)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$,$I_D$=-250μA | -0.5 | -0.8 | -1.4 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=-10V, $I_D$=-4A | - | 33 | 48 | mΩ |
| | | $V_{GS}$=-4.5V, $I_D$=-4A | - | 38 | 55 | mΩ |
| | | $V_{GS}$=-2.5V, $I_D$=-2A | - | 51 | 73 | mΩ |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$=-5V,$I_D$=-4A | - | 15 | - | S |
| **Dynamic Characteristics (Note4)** | | | | | | |
| Input Capacitance | $C_{lss}$ | $V_{DS}$=-15V,$V_{GS}$=0V, F=1.0MHz | - | 950 | - | PF |
| Output Capacitance | $C_{oss}$ | | - | 115 | - | PF |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 75 | - | PF |
| **Switching Characteristics (Note 4)** | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$=-15V,$R_L$=3.6Ω $V_{GS}$=-10V,$R_{GEN}$=3Ω | - | 9 | - | nS |
| Turn-on Rise Time | $t_r$ | | - | 5 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 19 | - | nS |
| Turn-Off Fall Time | $t_f$ | | - | 8 | - | nS |
| Total Gate Charge | $Q_g$ | $V_{DS}$=-15V,$I_D$=-4A,$V_{GS}$=-10V | - | 13 | - | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 2 | - | nC |
| Gate-Drain Charge | $Q_{gd}$ | | - | 3 | - | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| Diode Forward Voltage (Note 3) | $V_{SD}$ | $V_{GS}$=0V,$I_S$=-1A | - | -0.8 | -1.2 | V |

**Notes:**

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

## N- Channel Typical Electrical and Thermal Characteristics (Curves)

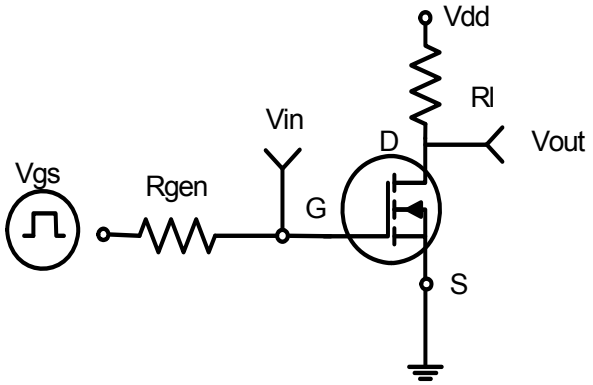



**Figure 1:Switching Test Circuit**

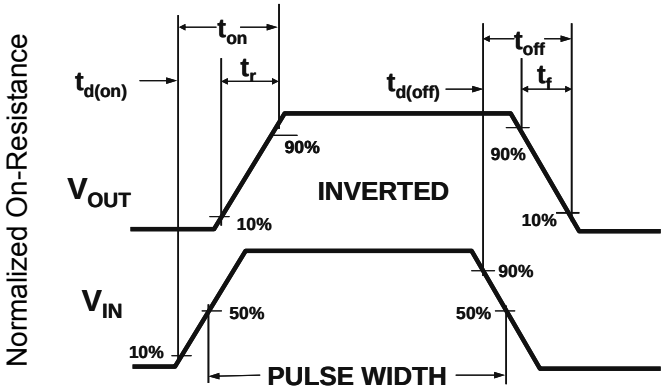



**Figure 2:Switching Waveforms**

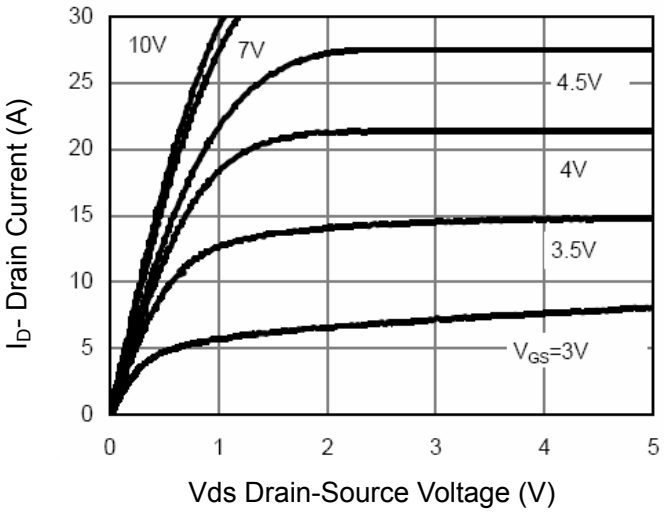



**Figure 3 Output Characteristics**

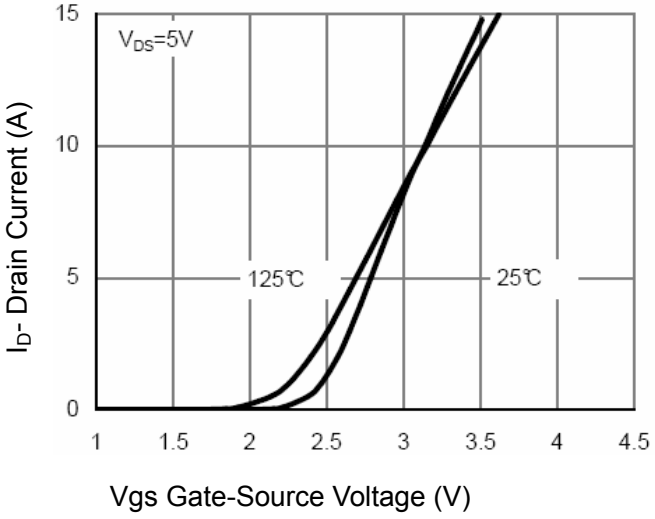



**Figure 4 Transfer Characteristics**

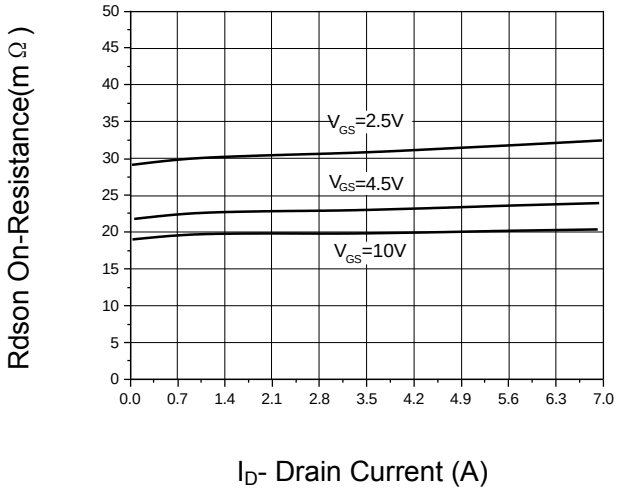



**Figure 5 Drain-Source On-Resistance**

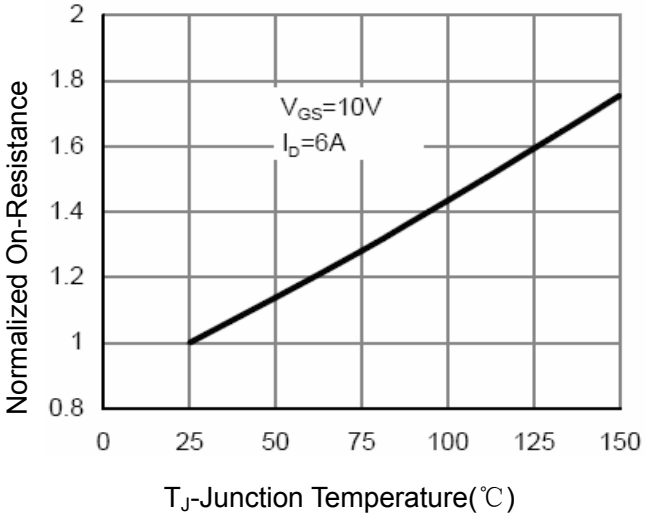
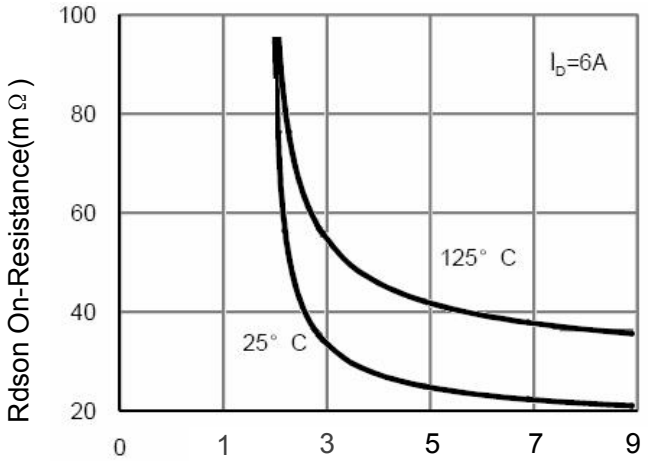
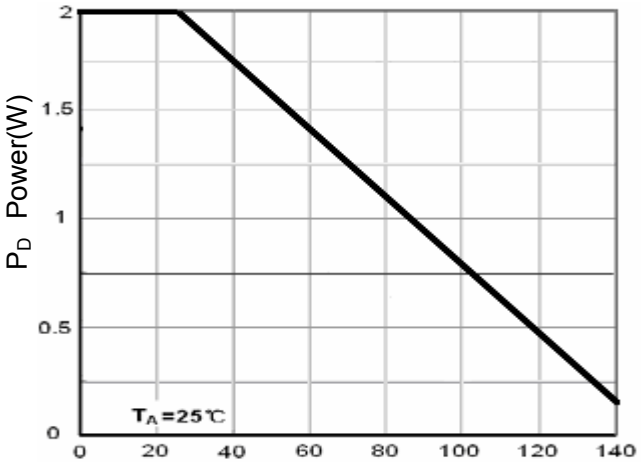



**Figure 6 Drain-Source On-Resistance**



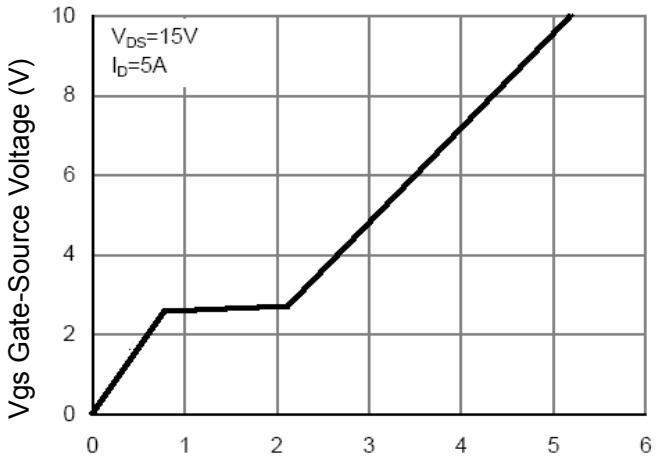

Vgs Gate-Source Voltage (V)

**Figure7 Rdson vs Vgs**



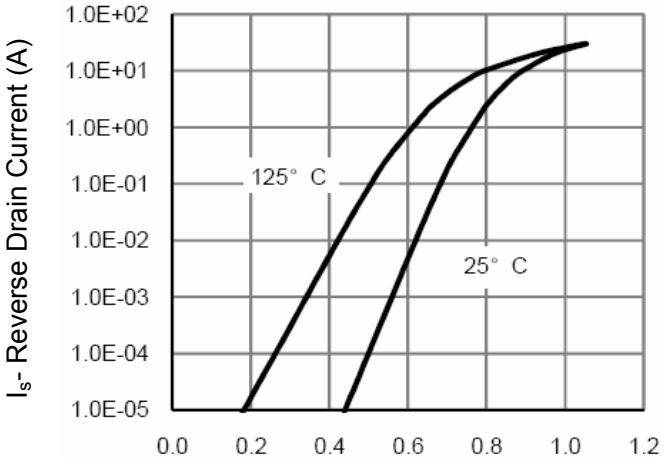

$T_J$-Junction Temperature(℃)

**Figure 8 Power Dissipation**



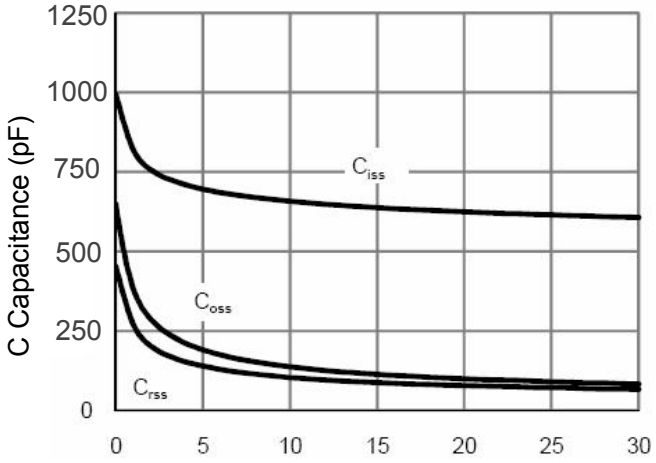

Qg Gate Charge (nC)

**Figure 9 Gate Charge**



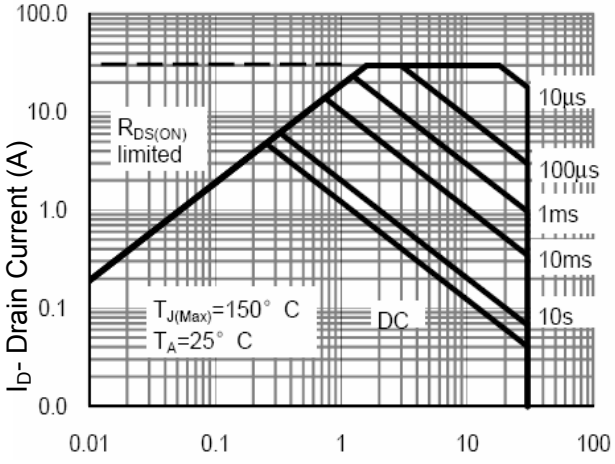

Vds Drain-Source Voltage (V)

**Figure 10 Source- Drain Diode Forward**




Vds Drain-Source Voltage (V)

**Figure 11 Capacitance vs Vds**




Vds Drain-Source Voltage (V)

**Figure 12 Safe Operation Area**

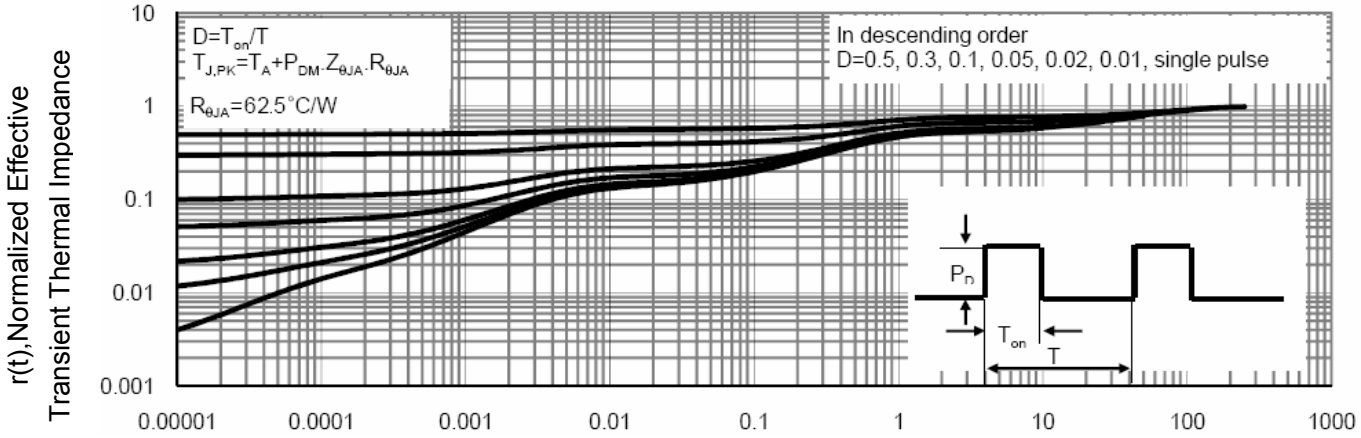



**Figure 13 Normalized Maximum Transient Thermal Impedance**

## P- Channel Typical Electrical and Thermal Characteristics (Curves)

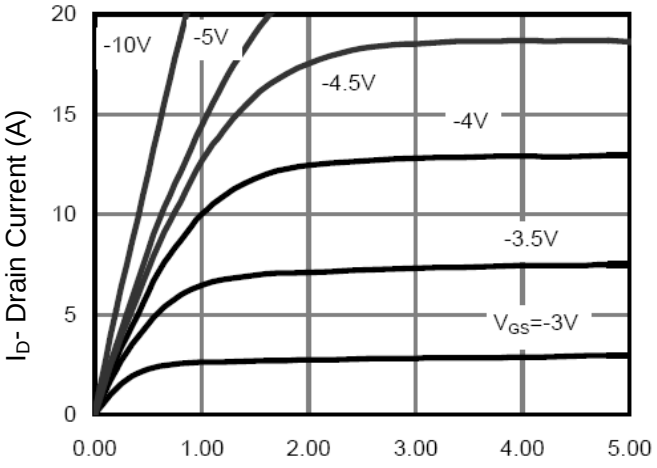



**Figure 1 Output CHARACTERISTICS**

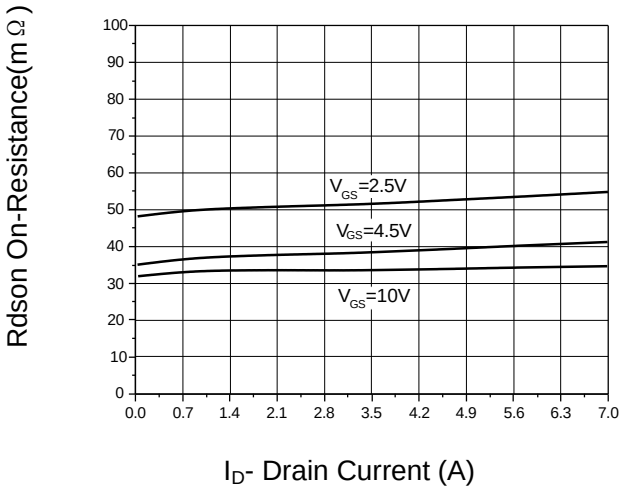



**Figure 2 Drain-Source On-Resistance**

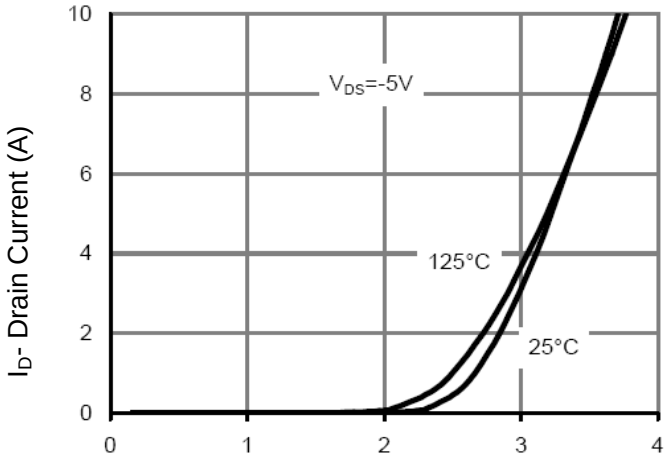



**Figure 3 Transfer Characteristics**

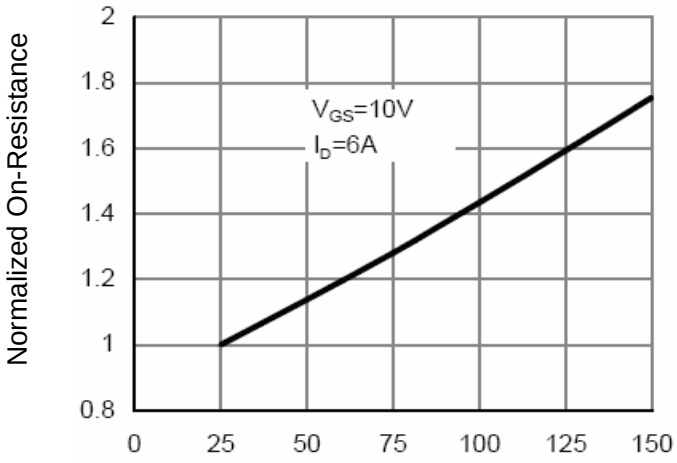



**Figure 4 Drain-Source On-Resistance**

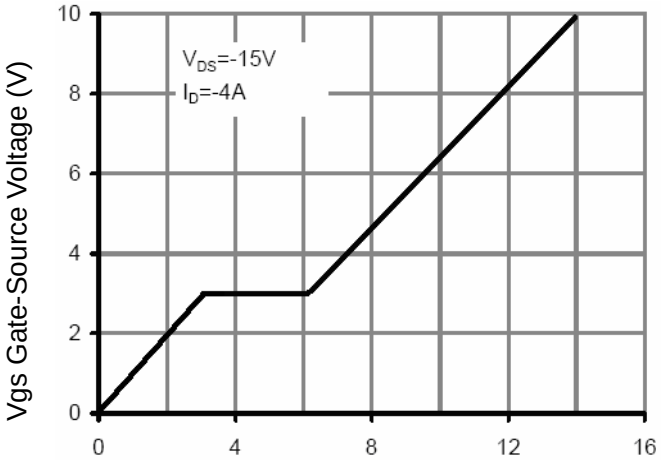



**Figure 5 Gate Charge**

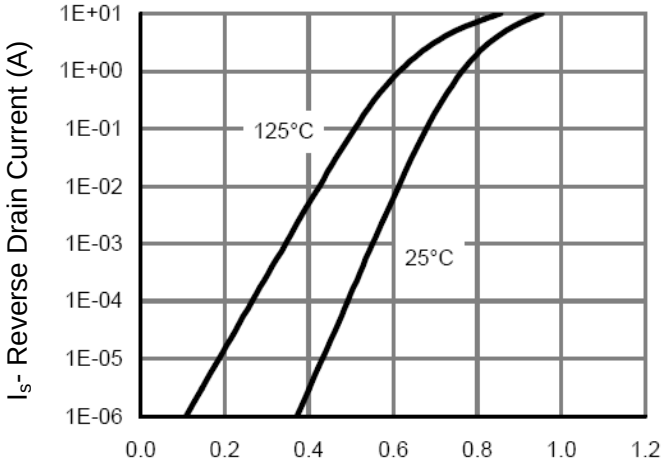



**Figure 6 Source- Drain Diode Forward**

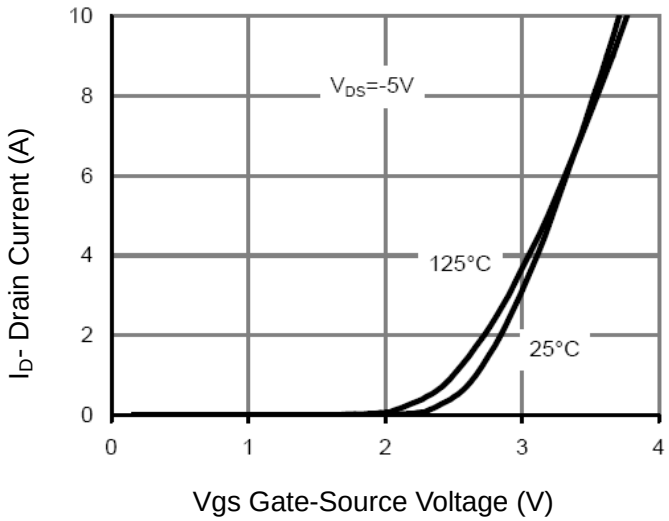



**Figure 7 Transfer Characteristics**

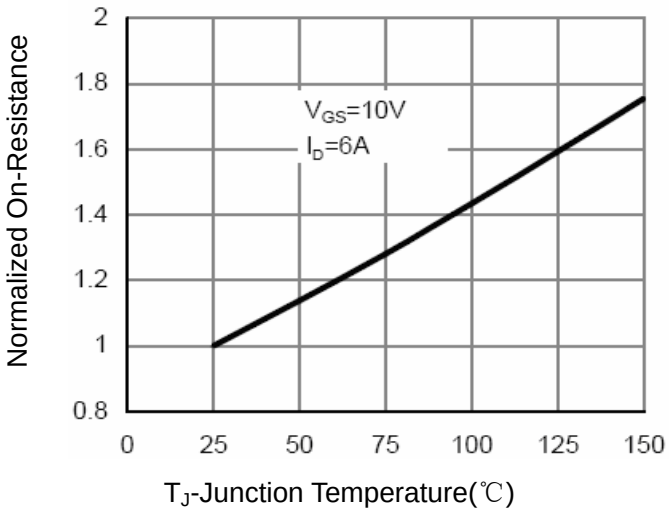



**Figure 8 Drain-Source On-Resistance**

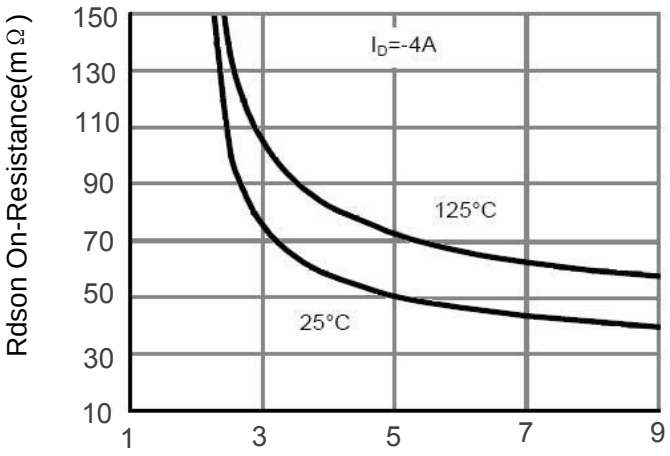



**Figure 9 Rdson vs Vgs**

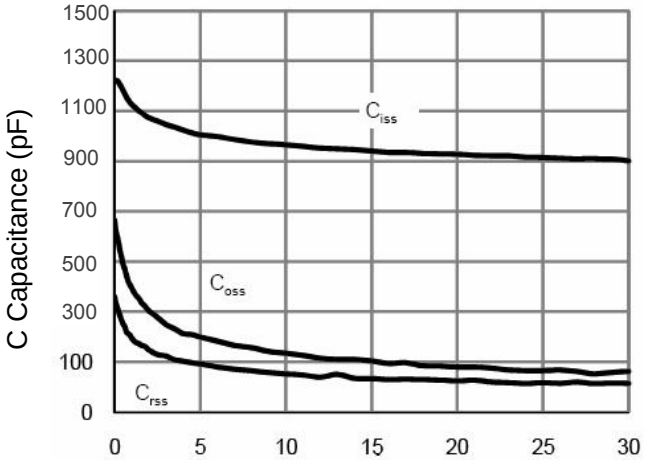



**Figure 10 Capacitance vs Vds**

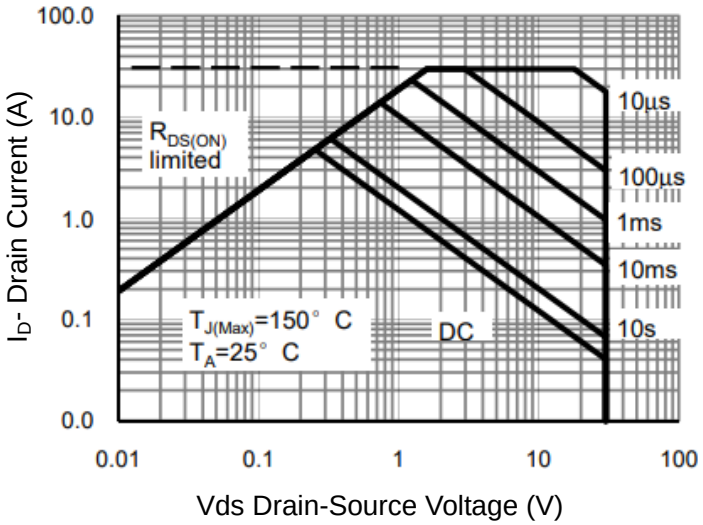



**Figure 11 Safe Operation Area**

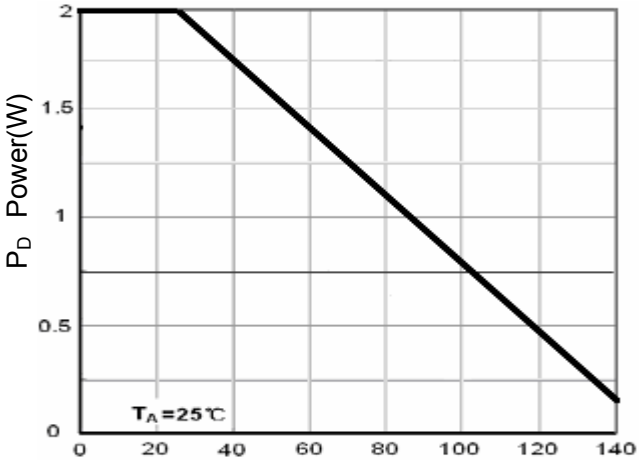
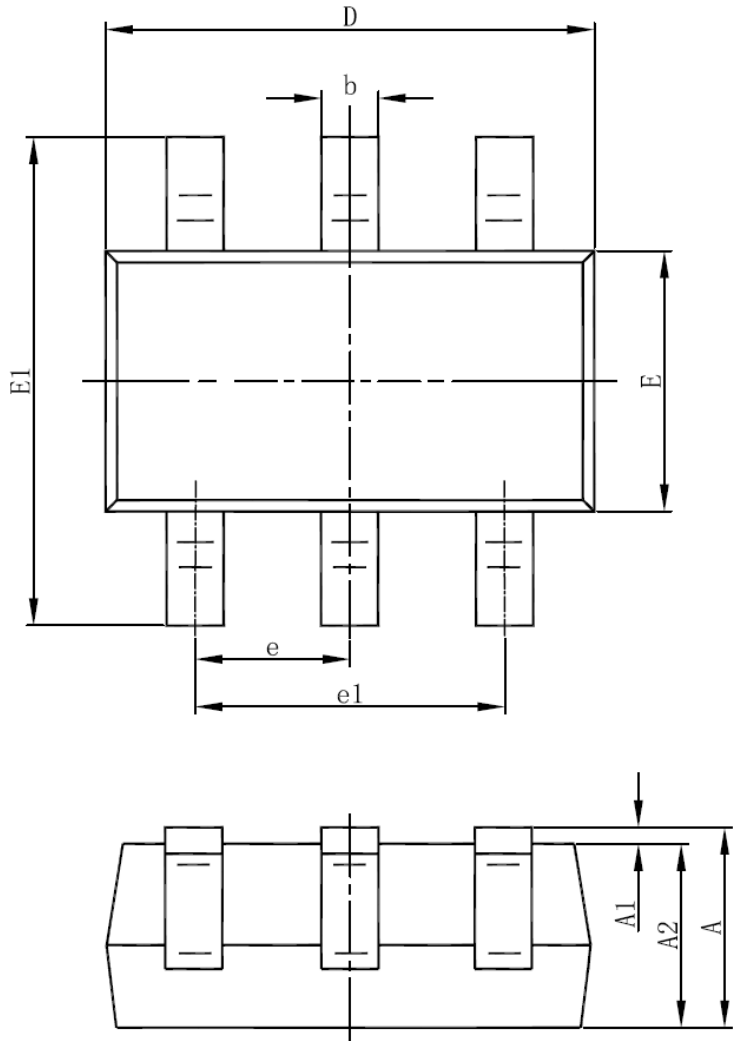



**Figure 12 Power Dissipation**

## Package Information : SOT23-6




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 1.050 | 1.250 | 0.041 | 0.049 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.100 | 0.200 | 0.004 | 0.008 |
| D | 2.820 | 3.020 | 0.111 | 0.119 |
| E | 1.500 | 1.700 | 0.059 | 0.067 |
| E1 | 2.650 | 2.950 | 0.104 | 0.116 |
| e | 0.950(BSC) | | 0.037(BSC) | |
| e1 | 1.800 | 2.000 | 0.071 | 0.079 |
| L | 0.300 | 0.600 | 0.012 | 0.024 |
| θ | 0° | 8° | 0° | 8° |