# N and P-Channel Enhancement Mode Power MOSFET

## Description

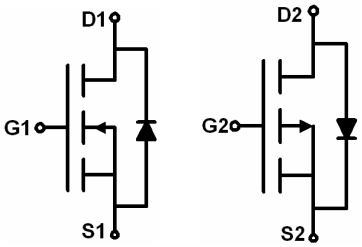
The HM4606D uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge . This device is suitable for use as a load switch or in PWM applications.

## General Features

- **N-Channel**
  $V_{DS}$ = 30V,$I_D$ =6.5A
  $R_{DS(ON)}$ < 32mΩ @ $V_{GS}$=10V
  $R_{DS(ON)}$ < 36mΩ @ $V_{GS}$=4.5V
- **P-Channel**
  $V_{DS}$ = -30V,$I_D$ = -5.1A
  $R_{DS(ON)}$ < 65mΩ @ $V_{GS}$=-4.5V
  $R_{DS(ON)}$ < 55mΩ @ $V_{GS}$=-10V
- High power and current handing capability
- Lead free product is acquired
- Surface mount pack age

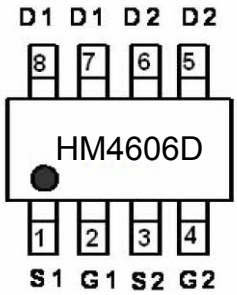
## Application

- PWM applications
- Load switch
- Power management

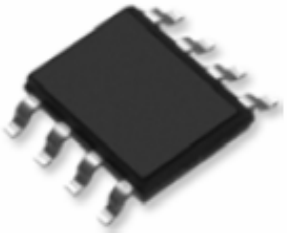



**N-channel** **P-channel**

**Schematic diagram**




**Marking and pin assignment**



**SOP-8 top view**

## Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity |
|---|---|---|---|---|---|
| HM4606D | HM4606D | SOP-8 | Ø330mm | 12mm | 2500 units |

## 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 | $V_{GS}$ | ±20 | ±20 | V |
| Continuous Drain Current | $I_D$ | 6.5 | -5.1 | A |
| Pulsed Drain Current (Note 1) | $I_{DM}$ | 20 | -20 | A |
| Maximum Power Dissipation | $P_D$ | 2.5 | 2.5 | W |
| Operating Junction and Storage Temperature Range | $T_J$,$T_{STG}$ | -55 To 150 | -55 To 150 | ℃ |

## Thermal Characteristic

| | | | | |
|---|---|---|---|---|
| Thermal Resistance,Junction-to-Ambient (Note2) | $R_{\theta JA}$ | N-Ch | 89 | ℃/W |
| | | P-Ch | 90 | |

## 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 | 33 | - | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=30V,$V_{GS}$=0V | - | - | 1 | μA |
| Gate-Body Leakage Current | $I_{GSS}$ | $V_{GS}$=±20V,$V_{DS}$=0V | - | - | ±100 | nA |
| **On Characteristics (Note 3)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$,$I_D$=250μA | 0.6 | 0.9 | 1.4 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=5A | - | 26 | 32 | mΩ |
| | | $V_{GS}$=4.5V, $I_D$=4A | - | 30 | 36 | mΩ |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$=5V,$I_D$=5A | - | 15 | - | S |
| **Dynamic Characteristics (Note4)** | | | | | | |
| Input Capacitance | $C_{lss}$ | $V_{DS}$=15V,$V_{GS}$=0V, F=1.0MHz | - | 255 | - | PF |
| Output Capacitance | $C_{oss}$ | | - | 45 | - | PF |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 35 | - | PF |
| **Switching Characteristics (Note 4)** | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$=15V, $R_L$=3Ω $V_{GS}$=10V,$R_{GEN}$=3Ω | - | 4.5 | - | nS |
| Turn-on Rise Time | $t_r$ | | - | 2.5 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 14.5 | - | nS |
| Turn-Off Fall Time | $t_f$ | | - | 3.5 | - | nS |
| Total Gate Charge | $Q_g$ | $V_{DS}$=15V,$I_D$=5A, $V_{GS}$=10V | - | 5.2 | - | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 0.85 | - | nC |
| Gate-Drain Charge | $Q_{gd}$ | | - | 1.3 | - | 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 |

## 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 | -33 | - | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=-24V,$V_{GS}$=0V | - | - | -1 | μA |
| Gate-Body Leakage Current | $I_{GSS}$ | $V_{GS}$=±20V,$V_{DS}$=0V | - | - | ±100 | nA |
| **On Characteristics (Note 3)** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$,$I_D$=-250μA | -0.6 | -0.9 | -2 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=-10V, $I_D$=-4.1A | - | 45 | 55 | mΩ |
| | | $V_{GS}$=-4.5V, $I_D$=-4A | - | 55 | 65 | mΩ |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$=-5V,$I_D$=-4.1A | 5.5 | - | - | S |
| **Dynamic Characteristics (Note4)** | | | | | | |
| Input Capacitance | $C_{lss}$ | $V_{DS}$=-15V,$V_{GS}$=0V, F=1.0MHz | - | 700 | - | PF |
| Output Capacitance | $C_{oss}$ | | - | 120 | - | 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 | $t_{d(off)}$ | | - | 28 | - | nS |
| Turn-Off Fall Time | $t_f$ | | - | 13.5 | - | nS |
| Total Gate Charge | $Q_g$ | $V_{DS}$=-15V,$I_D$=-4A,$V_{GS}$=-10V | - | 14 | - | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 3.1 | - | 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 | - | - | -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)

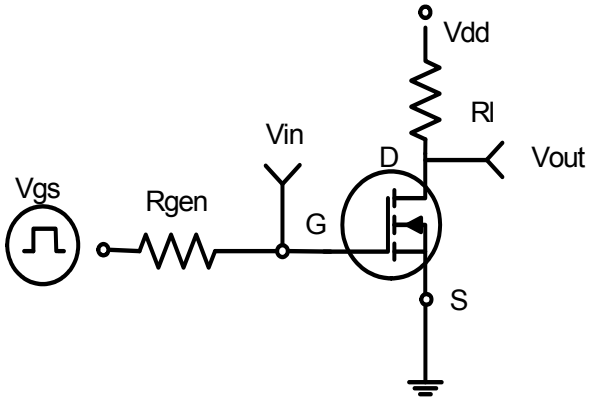



**Figure 1:Switching Test Circuit**

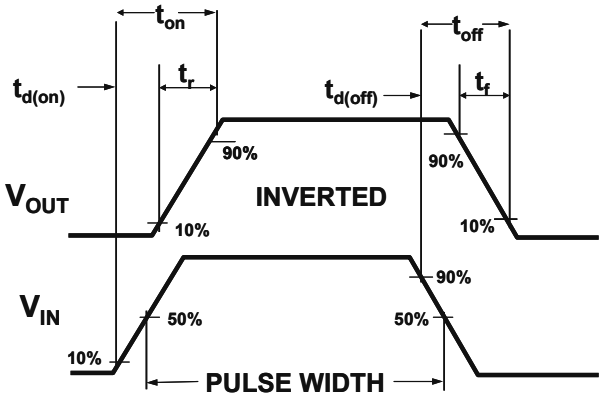



**Figure 2:Switching Waveforms**

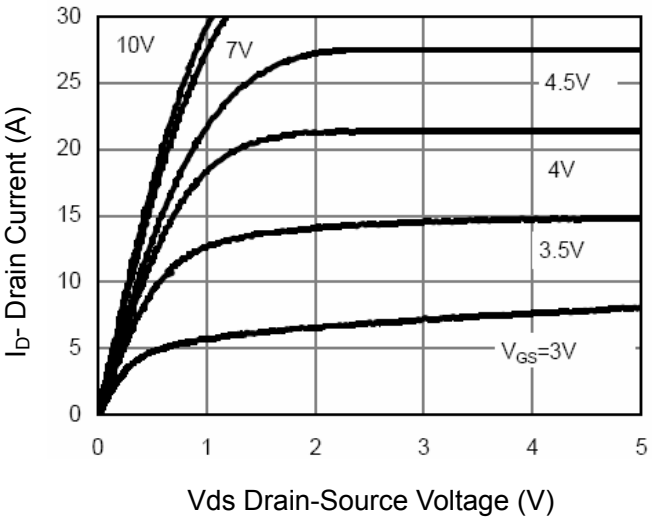



**Figure 3 Output Characteristics**

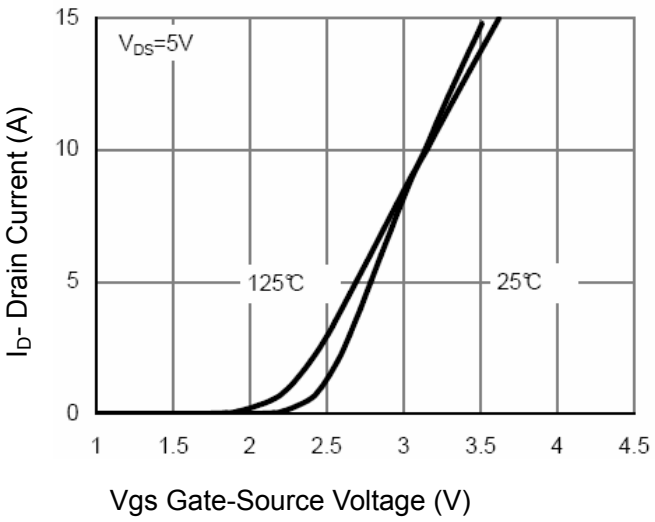



**Figure 4 Transfer Characteristics**

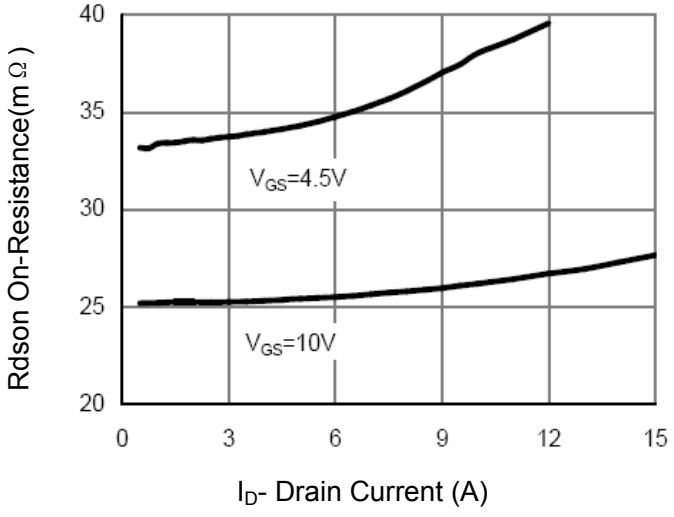



**Figure 5 Drain-Source On-Resistance**

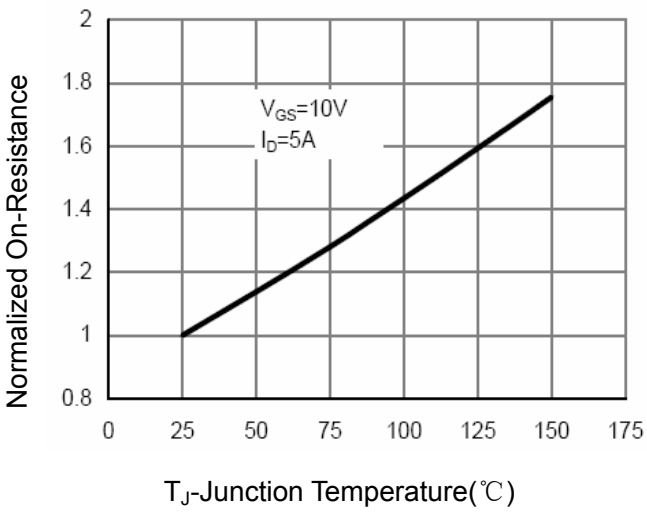



**Figure 6 Drain-Source On-Resistance**

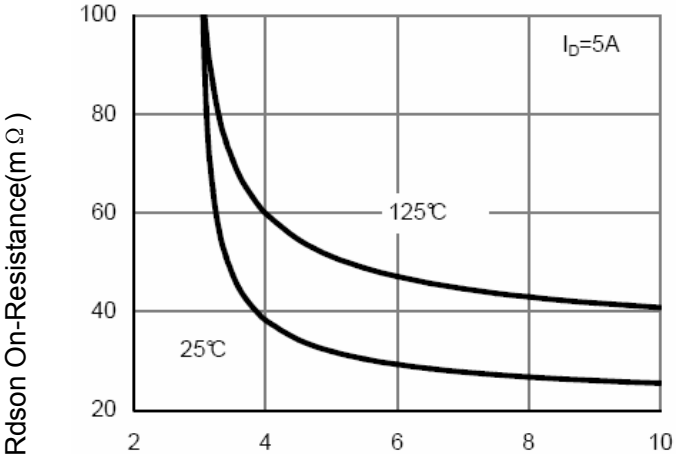



**Figure7 Rdson vs Vgs**

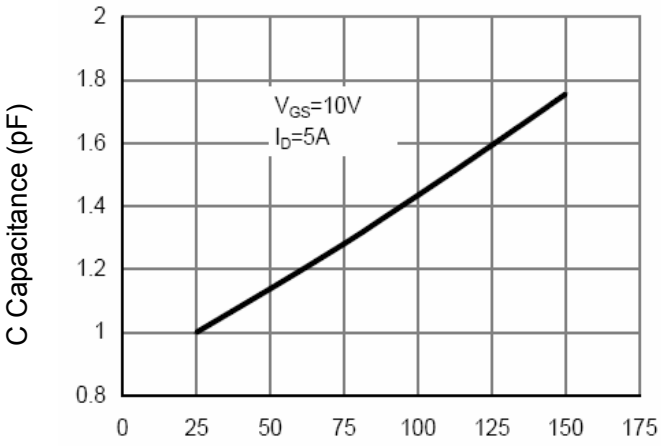



**Figure 8 Drain-Source On-Resistance**

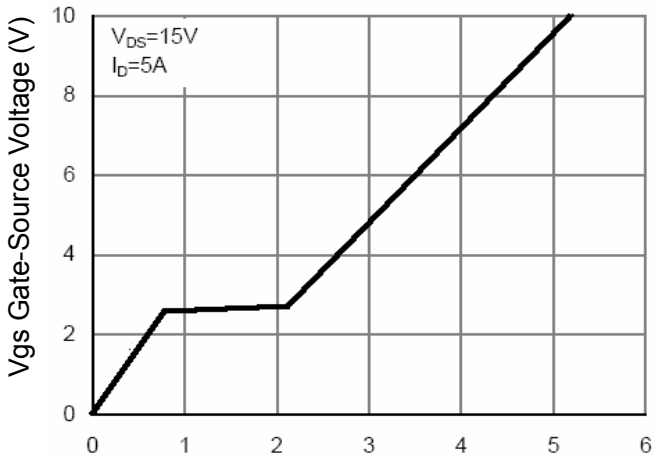



**Figure 9 Gate Charge**

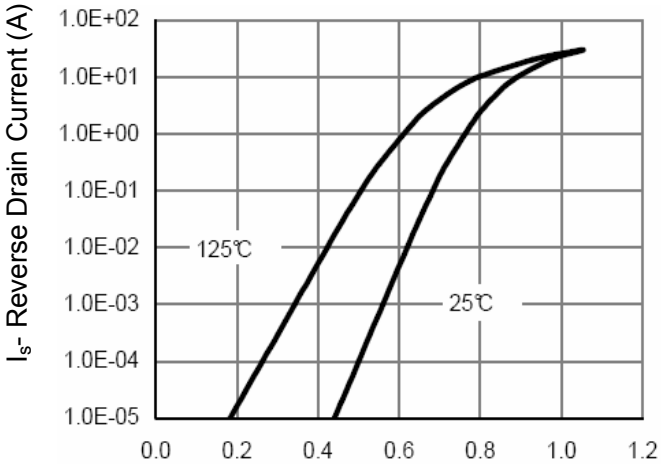



**Figure 10 Source- Drain Diode Forward**

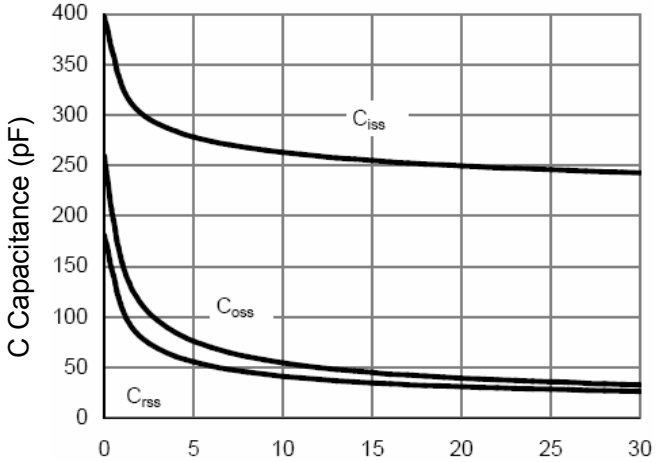



**Figure 11 Capacitance vs Vds**

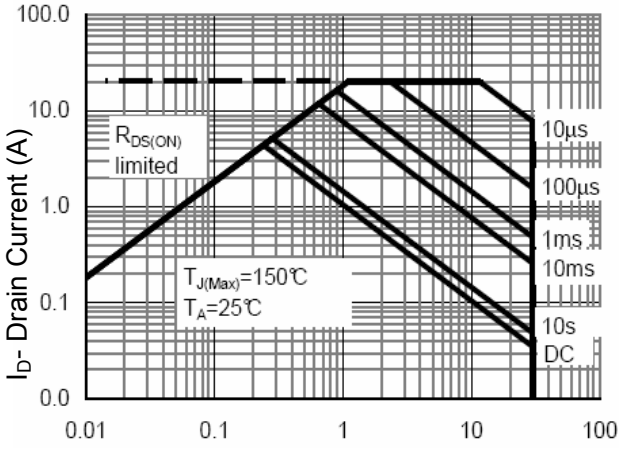



**Figure 12 Safe Operation Area**

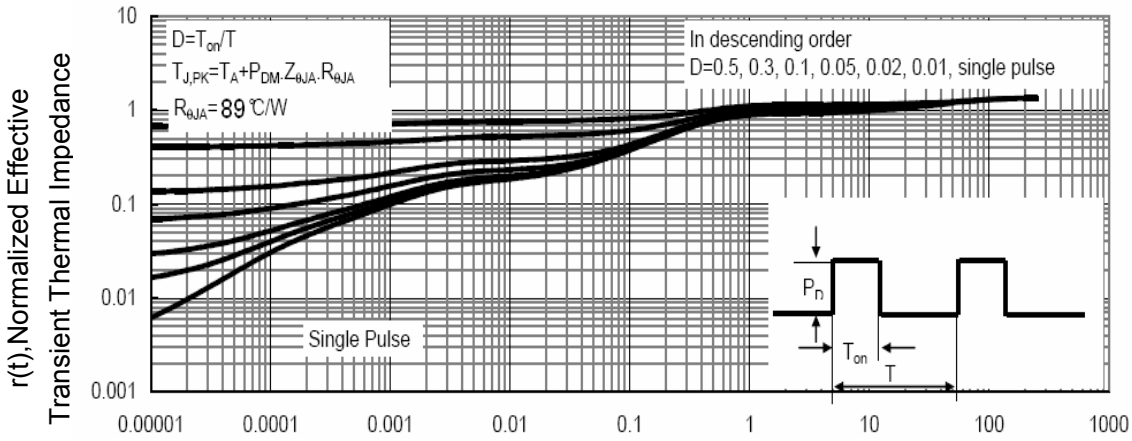



**Figure 13 Normalized Maximum Transient Thermal Impedance**

## P-Channel Typical Electrical and Thermal Characteristics

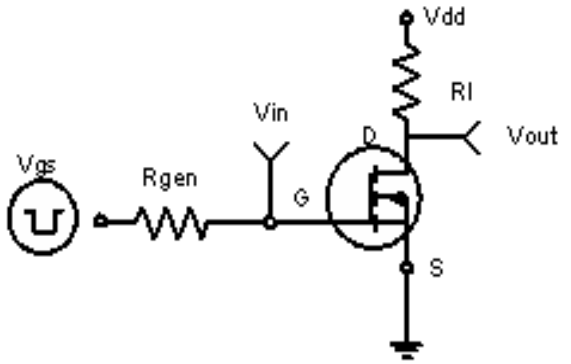



**Figure 1:Switching Test Circuit**

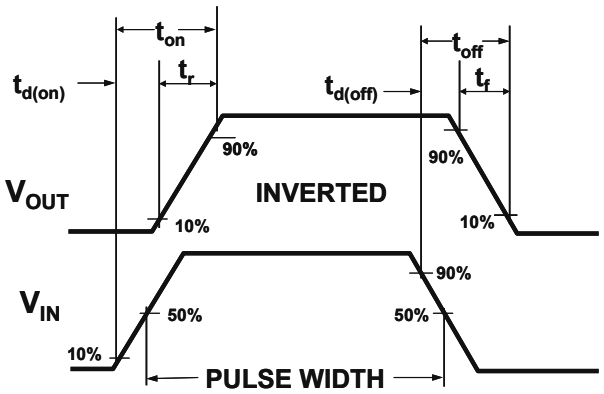



**Figure 2:Switching Waveforms**

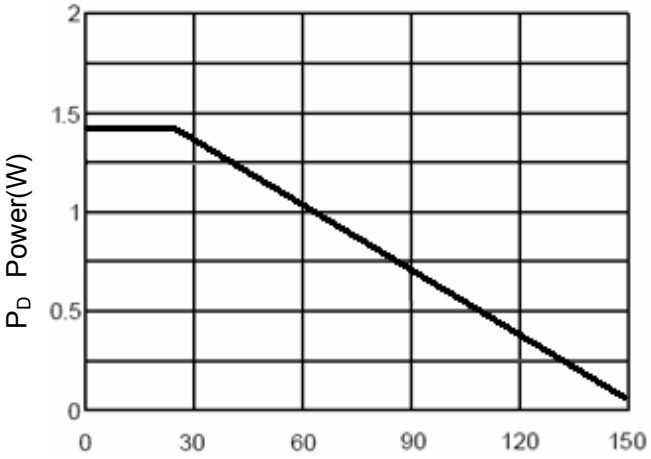



**Figure 3 Power Dissipation**

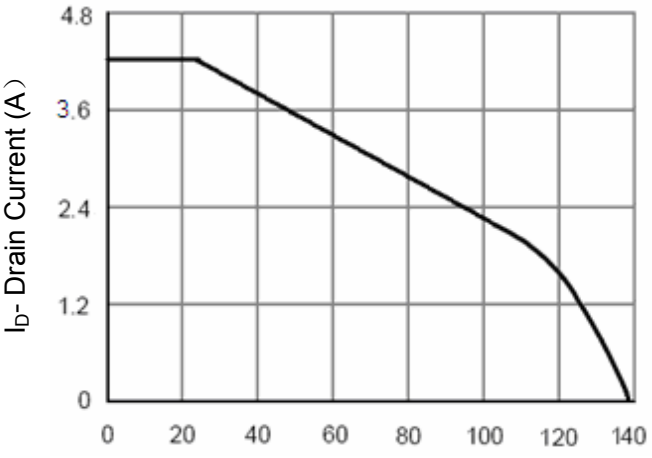



**Figure 4 Drain Current**

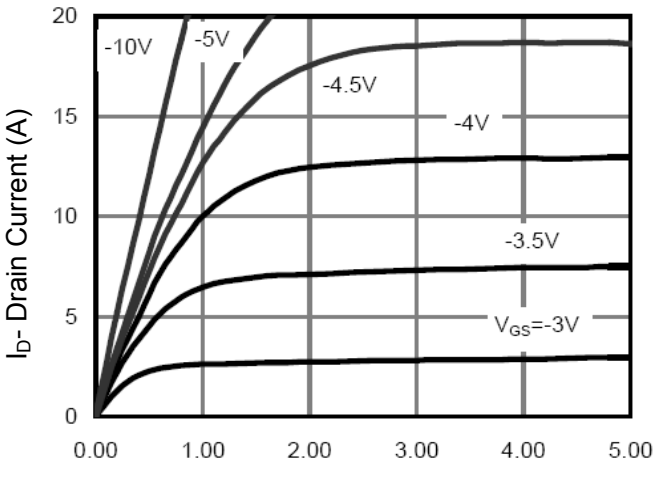



**Figure 5 Output CHARACTERISTICS**

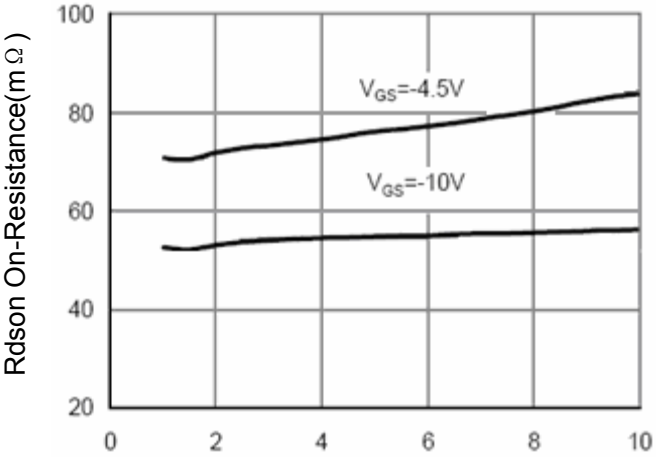



**Figure 6 Drain-Source On-Resistance**

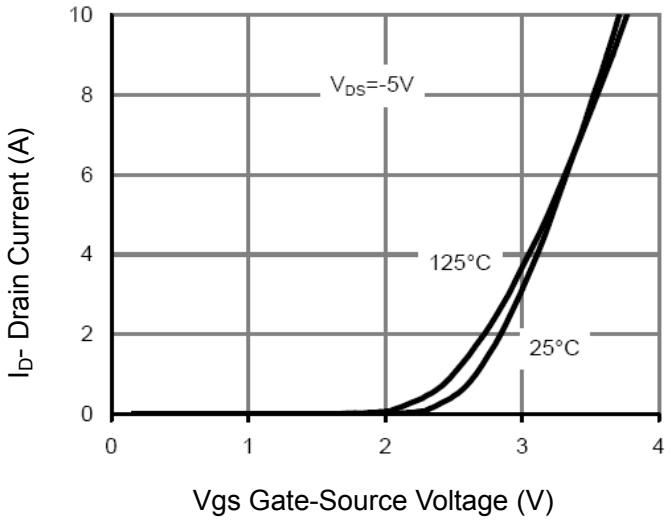



**Figure 7 Transfer Characteristics**

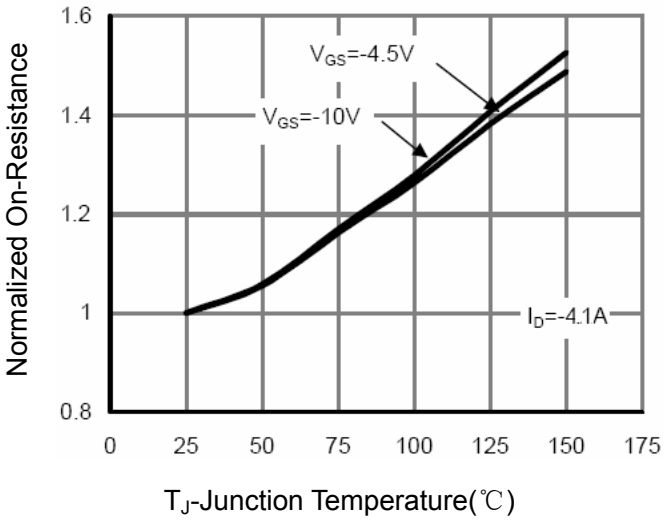



**Figure 8 Drain-Source On-Resistance**

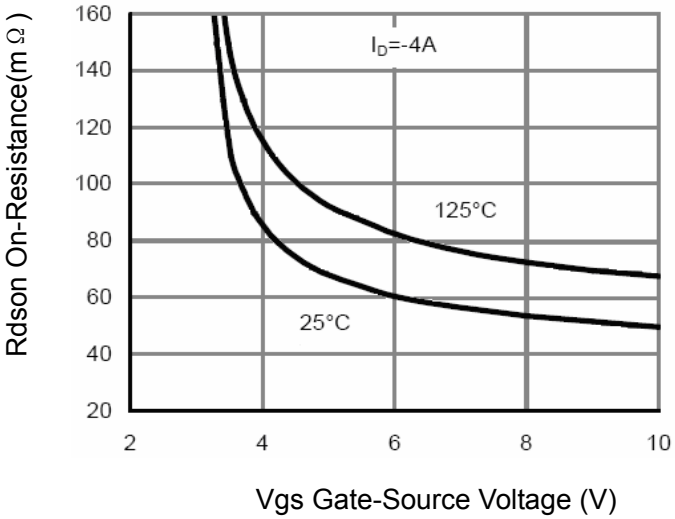



**Figure 9 Rdson vs Vgs**

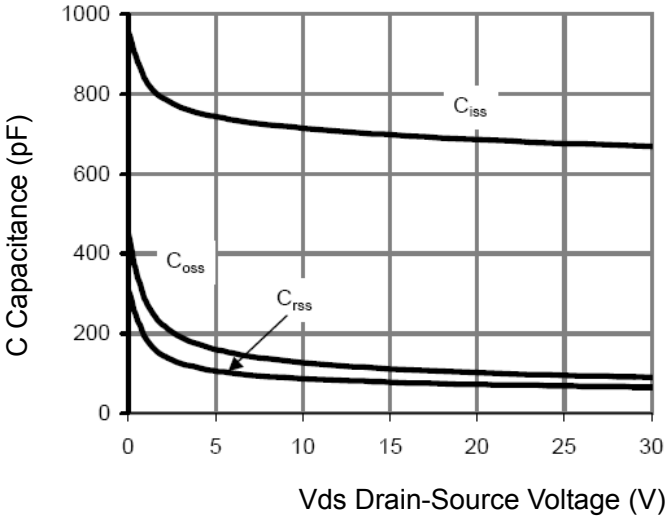



**Figure 10 Capacitance vs Vds**

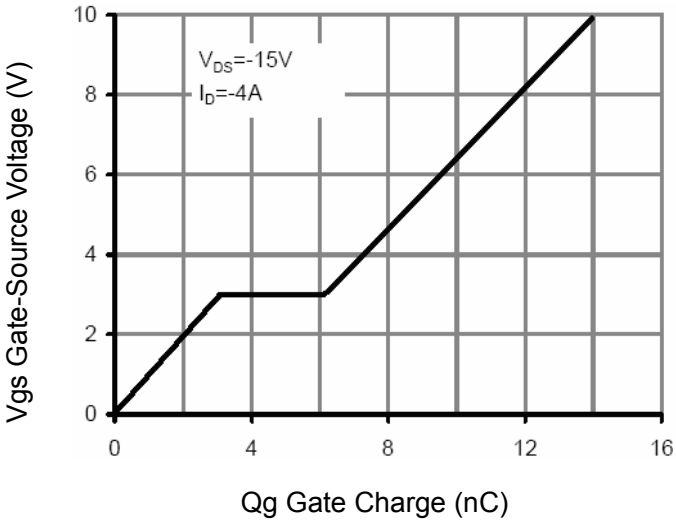



**Figure 11 Gate Charge**

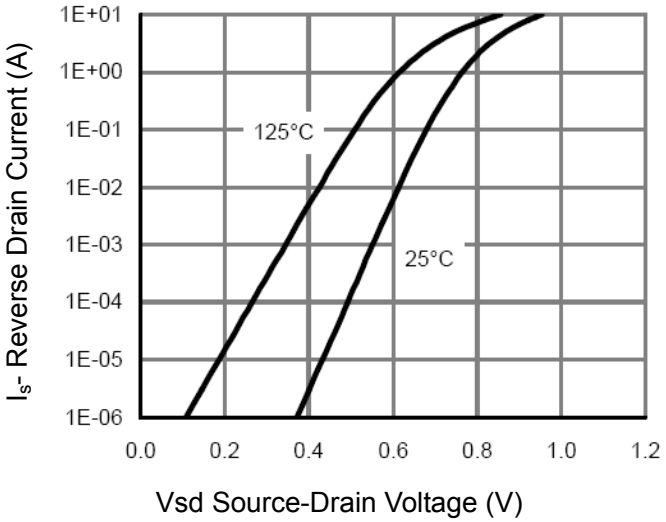



**Figure 12 Source- Drain Diode Forward**

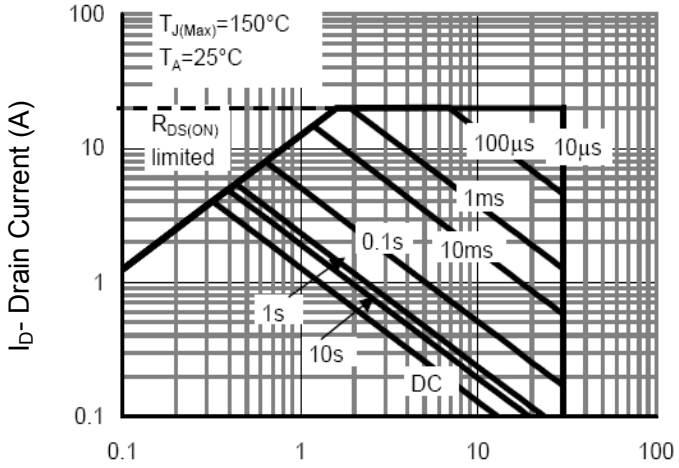



**Figure 13 Safe Operation Area**

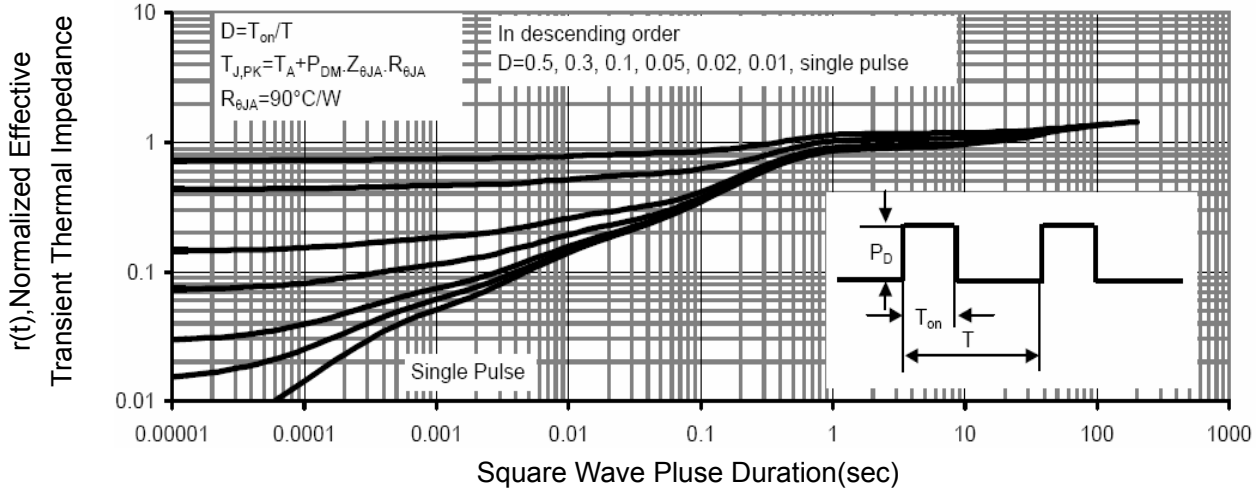
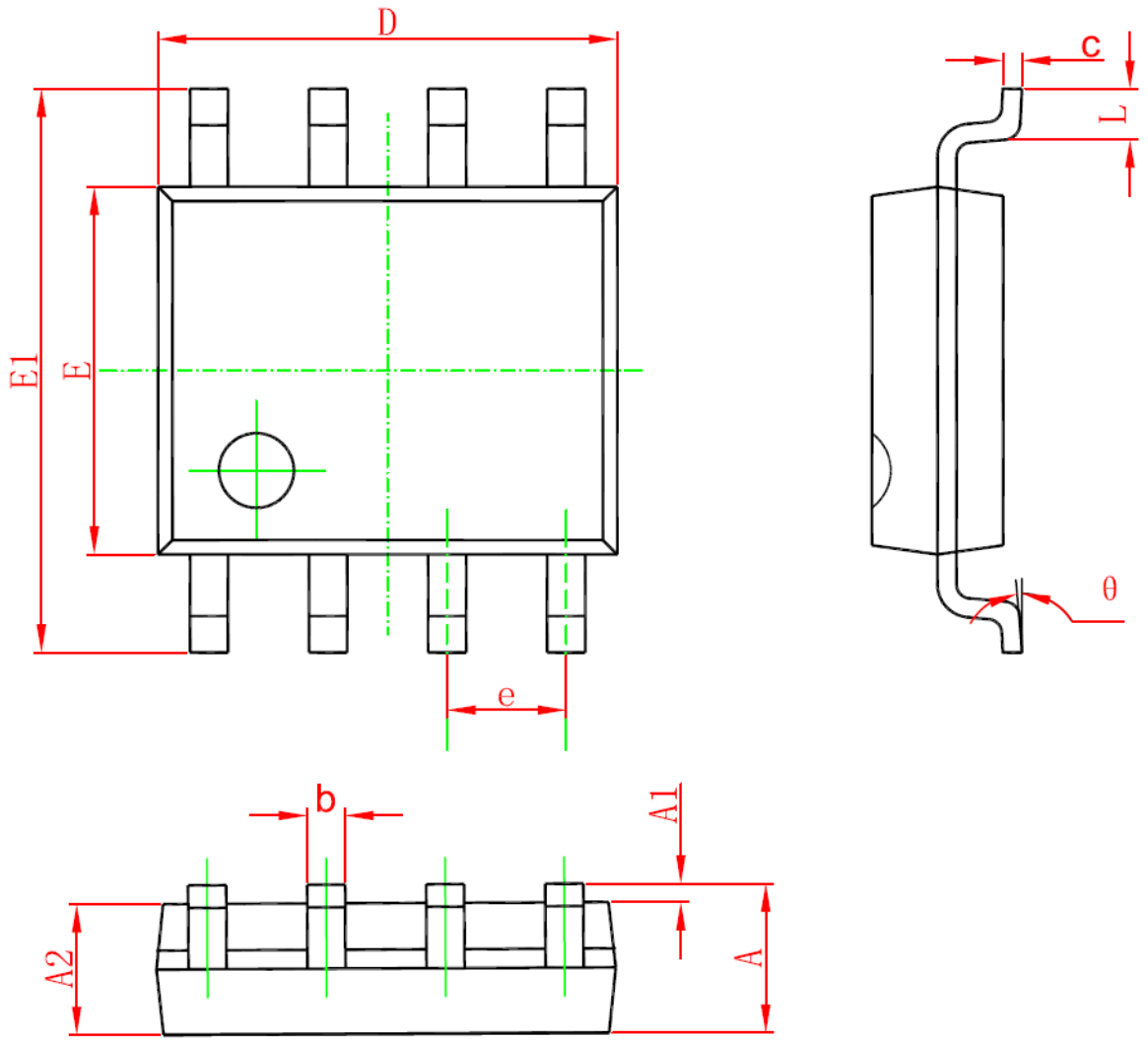



**Figure 14 Normalized Maximum Transient Thermal Impedance**

## 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 |
| θ | 0° | 8° | 0° | 8° |

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