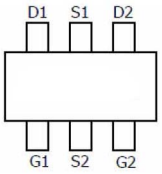
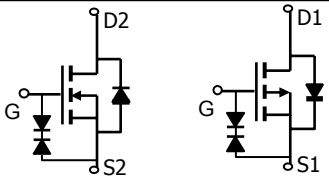
# HM6604DB
## Complementary Enhancement Mode Field Effect Transistor

### General Description
The HM6604DB uses advanced trench technology MOSFETs to provide excellent $R_{DS(ON)}$ and low gate charge. The complementary MOSFETs may be used to form a level shifted high side switch, an inverter, and for a host of other applications. Both devices are ESD protected. *HM6604DB are electrically identical.*
*-RoHS Compliant*
*-HM6604DB is Halogen Free*

### Features
| n-channel | p-channel |
|---|---|
| $V_{DS}$ (V) = 20V | -20V |
| $I_D$ = 0.9A ($V_{GS}$=4.5V) | -0.8A ($V_{GS}$=-4.5V) |
| $R_{DS(ON)}$ | $R_{DS(ON)}$ |
| < 270mΩ ($V_{GS}$=4.5V) | < 480mΩ ($V_{GS}$=-4.5V) |
| < 330mΩ ($V_{GS}$=2.5V) | < 950mΩ ($V_{GS}$=-2.5V) |
| < 450mΩ ($V_{GS}$=1.8V) | < 2200mΩ ($V_{GS}$=-1.8V) |

**SOT-23-6L top view**




**n-channel** **p-channel**

**Absolute Maximum Ratings $T_A$=25°C unless otherwise noted**

| Parameter | | Symbol | Max n-channel | Max p-channel | Units |
|---|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 20 | -20 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±8 | ±8 | V |
| Continuous Drain Current [A] | $T_A$=25°C | $I_D$ | 0.9 | -0.8 | A |
| | $T_A$=70°C | | 0.7 | -0.56 | |
| Pulsed Drain Current [B] | | $I_{DM}$ | 5 | -2.4 | |
| Power Dissipation | $T_A$=25°C | $P_D$ | 0.3 | 0.3 | W |
| | $T_A$=70°C | | 0.19 | 0.19 | |
| Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to 150 | -55 to 150 | °C |

**Thermal Characteristics: n-channel and p-channel**

| Parameter | | Symbol | Device | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Maximum Junction-to-Ambient [A] | t ≤ 10s | $R_{\theta JA}$ | n-ch | 360 | 415 | °C/W |
| Maximum Junction-to-Ambient [A] | Steady-State | | n-ch | 400 | 460 | °C/W |
| Maximum Junction-to-Lead [C] | Steady-State | $R_{\theta JL}$ | n-ch | 300 | 350 | °C/W |
| Maximum Junction-to-Ambient [A] | t ≤ 10s | $R_{\theta JA}$ | p-ch | 360 | 415 | °C/W |
| Maximum Junction-to-Ambient [A] | Steady-State | | p-ch | 400 | 460 | °C/W |
| Maximum Junction-to-Lead [C] | Steady-State | $R_{\theta JL}$ | p-ch | 300 | 350 | °C/W |

**N-Channel: Electrical Characteristics ($T_J$=25°C unless otherwise noted)**

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **STATIC PARAMETERS** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $I_D$=250μA, $V_{GS}$=0V | 20 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=16V, $V_{GS}$=0V | | | 1 | μA |
| | | $T_J$=55°C | | | 5 | |
| $I_{GSS}$ | Gate-Body leakage current | $V_{DS}$=0V, $V_{GS}$=±8V | | | 25 | μA |
| $V_{GS(th}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$ $I_D$=250μA | 0.45 | | 1.2 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}$=4.5V, $V_{DS}$=5V | 5 | | | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=4.5V, $I_D$=0.9A | | 220 | 270 | mΩ |
| | | $T_J$=125°C | | | | |
| | | $V_{GS}$=2.5V, $I_D$=0.75A | | 260 | 330 | mΩ |
| | | $V_{GS}$=1.8V, $I_D$=0.7A | | 330 | 450 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=5V, $I_D$=0.8A | | 2.6 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=0.5A,$V_{GS}$=0V | | 0.69 | 1 | V |
| $I_S$ | Maximum Body-Diode Continuous Current | | | | 0.4 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=10V, f=1MHz | | 101 | 120 | pF |
| $C_{oss}$ | Output Capacitance | | | 17 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 14 | | pF |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | | 3 | 4 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{GS}$=4.5V, $V_{DS}$=10V, $I_D$=0.8A | | 1.57 | 1.9 | nC |
| $Q_{gs}$ | Gate Source Charge | | | 0.13 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 0.36 | | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}$=5V, $V_{DS}$=10V, $R_L$=12.5Ω, $R_{GEN}$=6Ω | | 3.2 | | ns |
| $t_r$ | Turn-On Rise Time | | | 4 | | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | | 15.5 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 2.4 | | ns |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=0.8A, dI/dt=100A/μs | | 6.7 | 8.1 | ns |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | $I_F$=0.8A, dI/dt=100A/μs | | 1.6 | | nC |

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in$^2$ FR-4 board with 2oz. Copper, in a still air environment with $T_A$=25°C. The value in any given application depends on the user's specific board design. The current rating is based on the t≤ 10s thermal resistance rating.
B: Repetitive rating, pulse width limited by junction temperature.
C. The $R_{\theta JA}$ is the sum of the thermal impedence from junction to lead $R_{\theta JL}$ and lead to ambient.
D. The static characteristics in Figures 1 to 6 are obtained using 80μs pulses, duty cycle 0.5% max.
E. These tests are performed with the device mounted on 1 in$^2$ FR-4 board with 2oz. Copper, in a still air environment with $T_A$=25°C. The SOA curve provides a single pulse rating.
Rev 4 : Feb 2008

## N-Channel: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

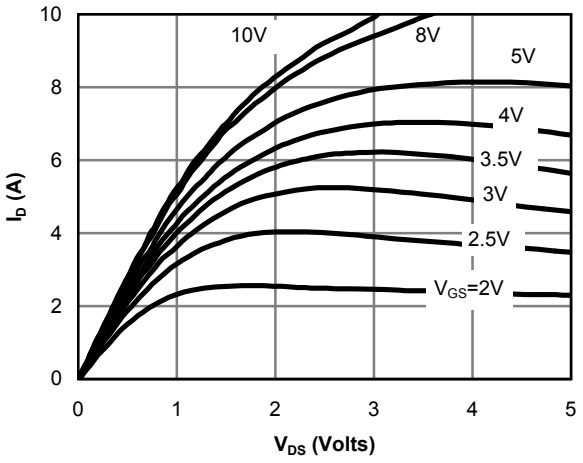



Fig 1: On-Region Characteristics

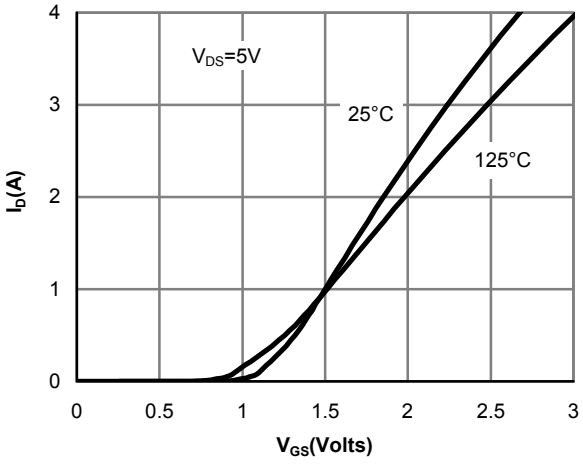



Figure 2: Transfer Characteristics

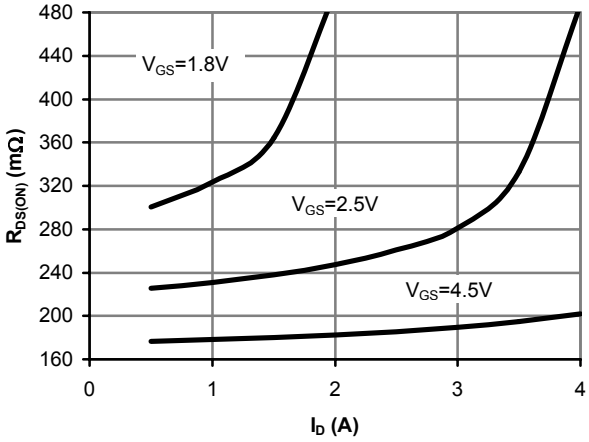



Figure 3: On-Resistance vs. Drain Current and Gate Voltage

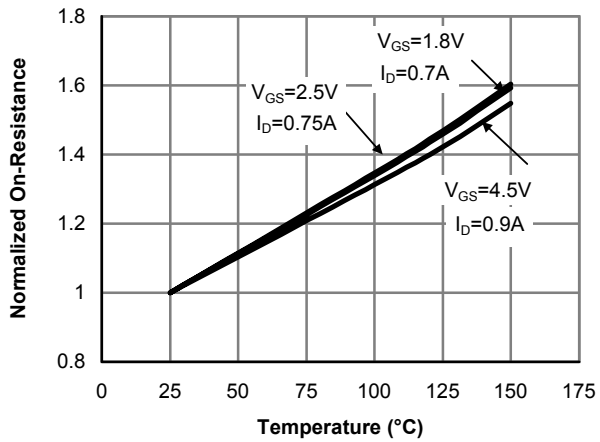



Figure 4: On-Resistance vs. Junction Temperature

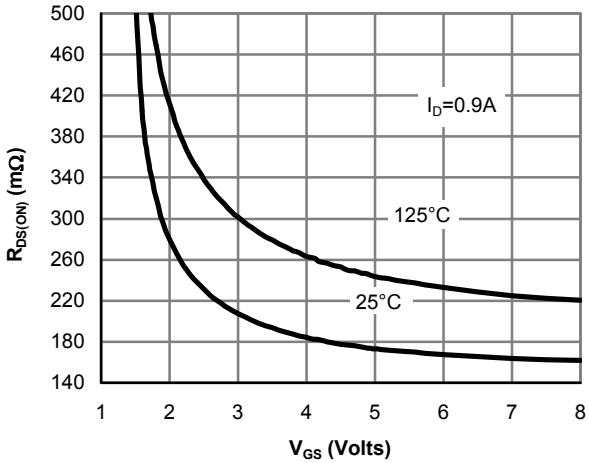



Figure 5: On-Resistance vs. Gate-Source Voltage

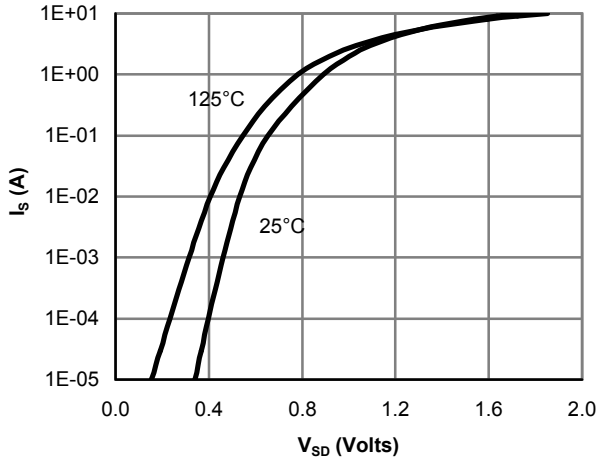



Figure 6: Body-Diode Characteristics

## N-Channel: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

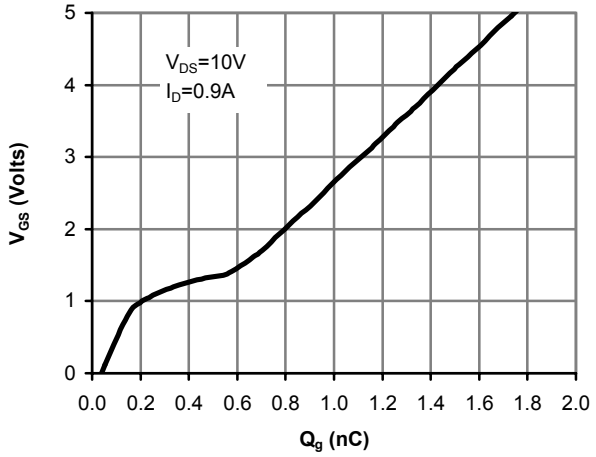



**Figure 7: Gate-Charge Characteristics**

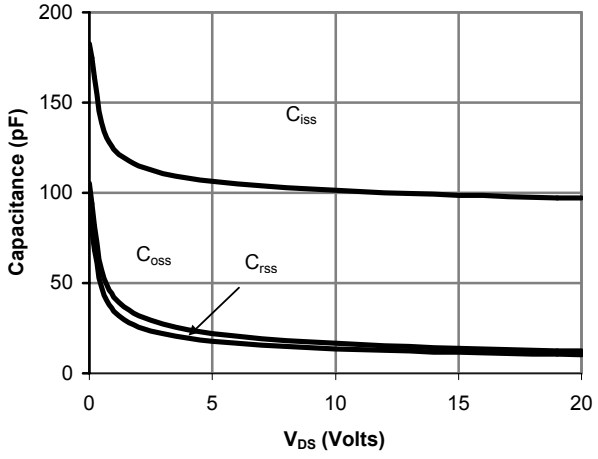



**Figure 8: Capacitance Characteristics**

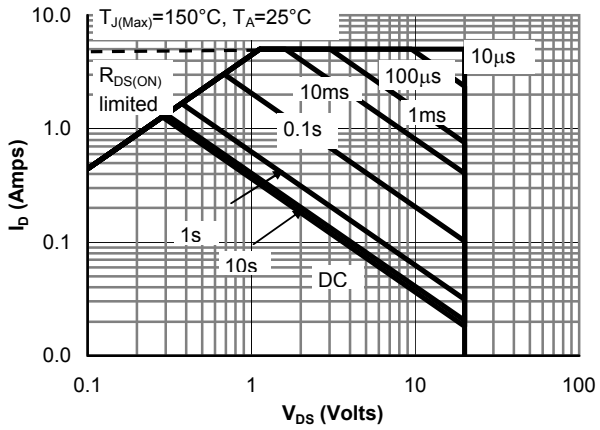



**Figure 9: Maximum Forward Biased Safe Operating Area (Note E)**

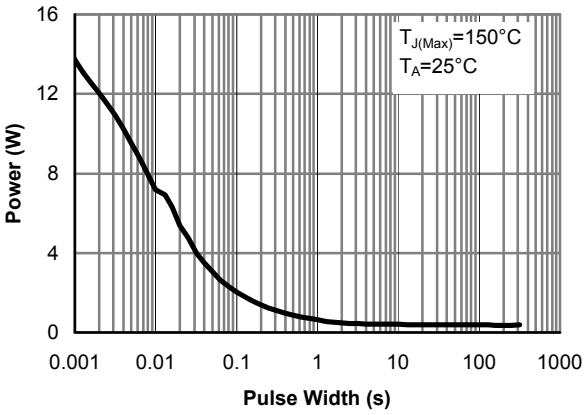



**Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)**

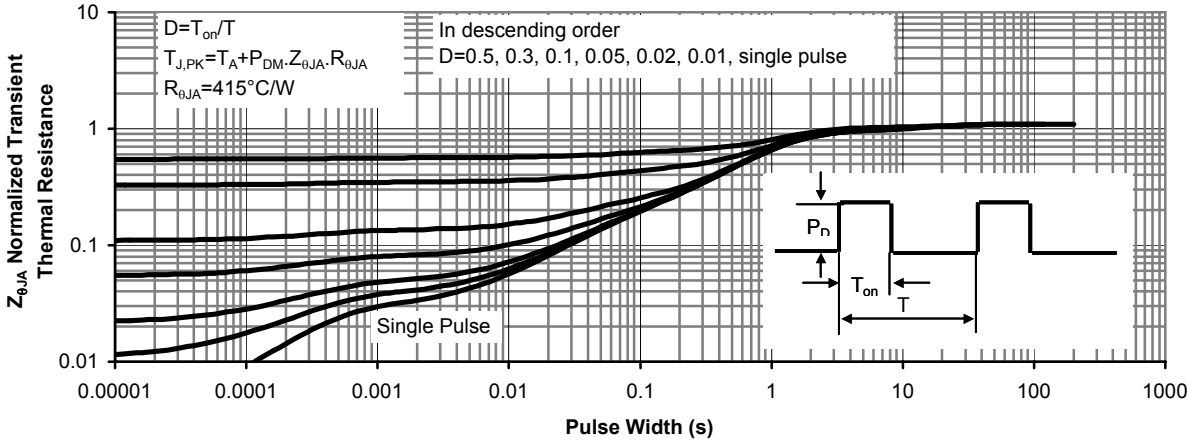



**Figure 11: Normalized Maximum Transient Thermal Impedance**

**P-Channel Electrical Characteristics ($T_J$=25°C unless otherwise noted)**

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **STATIC PARAMETERS** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $I_D$=-250μA, $V_{GS}$=0V | -20 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=-16V, $V_{GS}$=0V | | | -1 | μA |
| | | $T_J$=55°C | | | -5 | |
| $I_{GSS}$ | Gate-Body leakage current | $V_{DS}$=0V, $V_{GS}$=±8V | | | ±10 | μA |
| $V_{GS(t}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$ $I_D$=-250μA | -0.45 | | -1.2 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}$=-4.5V, $V_{DS}$=-5V | -3 | | | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=-4.5V, $I_D$=-0.8A | | 350 | 480 | mΩ |
| | | $T_J$=125°C | | 440 | 670 | |
| | | $V_{GS}$=-2.5V, $I_D$=-0.5A | | 550 | 950 | mΩ |
| | | $V_{GS}$=-1.8V, $I_D$=-0.4A | | 780 | 2200 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=-5V, $I_D$=-0.8A | | 1.7 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=-0.5A,$V_{GS}$=0V | | -0.86 | -1 | V |
| $I_S$ | Maximum Body-Diode Continuous Current | | | | -0.4 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=-10V, f=1MHz | | 114 | 140 | pF |
| $C_{oss}$ | Output Capacitance | | | 17 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 14 | | pF |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | | 12 | 17 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{GS}$=-4.5V, $V_{DS}$=-10V, $I_D$=-0.8A | | 1.44 | 1.8 | nC |
| $Q_{gs}$ | Gate Source Charge | | | 0.14 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 0.35 | | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}$=-4.5V, $V_{DS}$=-10V, $R_L$=16.7Ω, $R_{GEN}$=3Ω | | 6.5 | | ns |
| $t_r$ | Turn-On Rise Time | | | 6.5 | | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | | 18.2 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 5.5 | | ns |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=-0.8A, dI/dt=100A/μs | | 10 | 13 | ns |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | $I_F$=-0.8A, dI/dt=100A/μs | | 3 | | nC |

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in$^2$ FR-4 board with 2oz. Copper, in a still air environment with $T_A$ =25°C. The value in any given application depends on the user's specific board design. The current rating is based on the t≤ 10s thermal resistance rating.
B: Repetitive rating, pulse width limited by junction temperature.
C. The $R_{\theta JA}$ is the sum of the thermal impedence from junction to lead $R_{\theta JL}$ and lead to ambient.
D. The static characteristics in Figures 1 to 6,12,14 are obtained using 80μs pulses, duty cycle 0.5% max.
E. These tests are performed with the device mounted on 1 in$^2$ FR-4 board with 2oz. Copper, in a still air environment with $T_A$=25°C. The SOA curve provides a single pulse rating.
Rev 4 : Feb 2008

## P-Channel: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

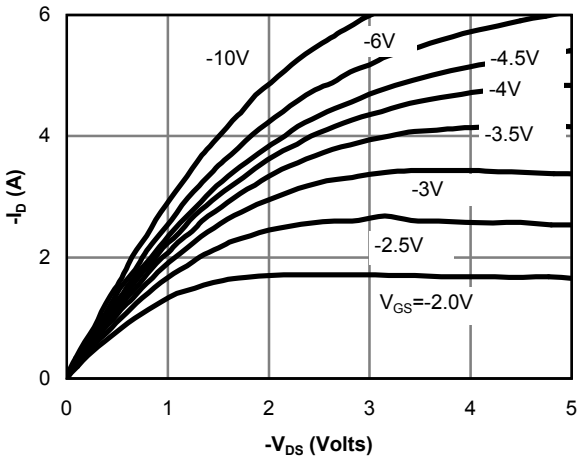



Fig 1: On-Region Characteristics

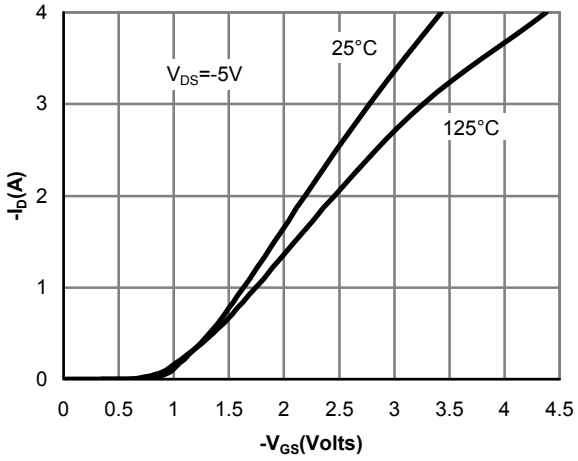



Figure 2: Transfer Characteristics

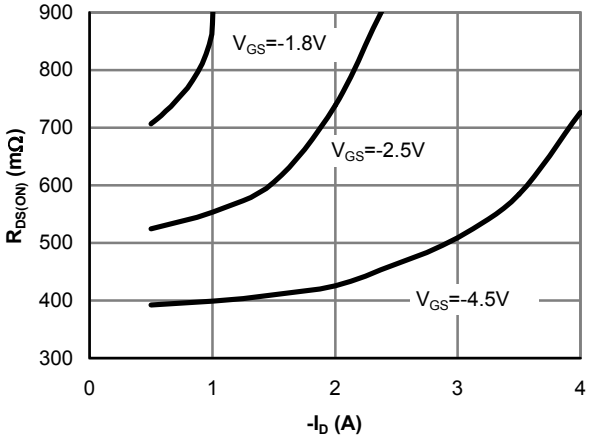



Figure 3: On-Resistance vs. Drain Current and Gate Voltage

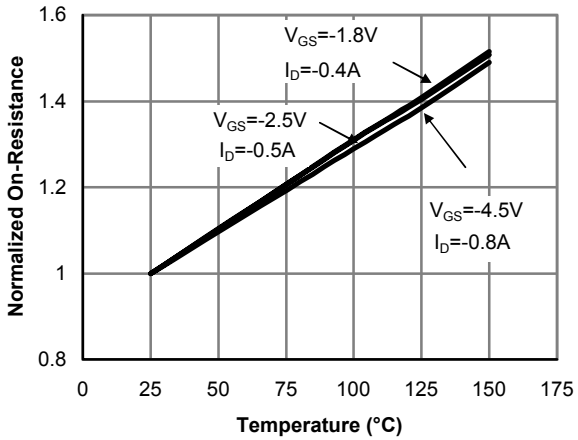



Figure 4: On-Resistance vs. Junction Temperature

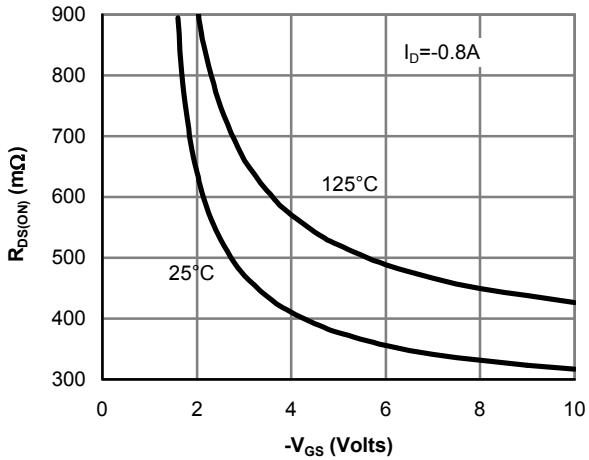



Figure 5: On-Resistance vs. Gate-Source Voltage

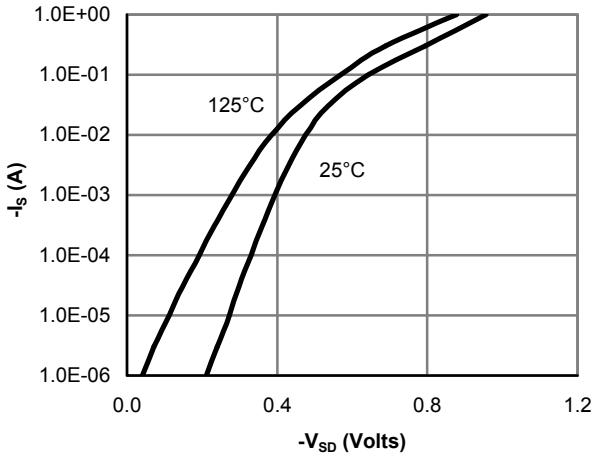



Figure 6: Body-Diode Characteristics

## P-Channel: TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

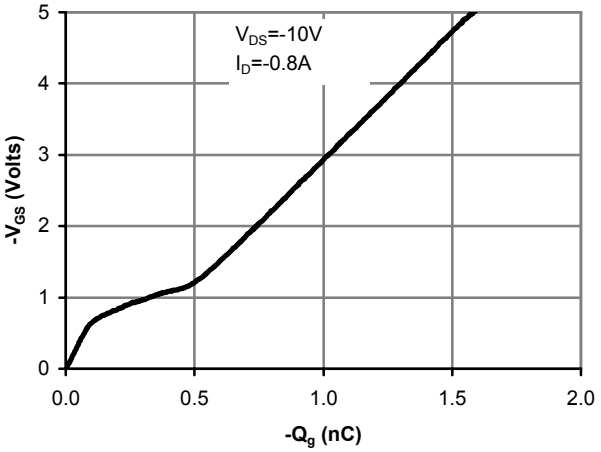



Figure 7: Gate-Charge Characteristics

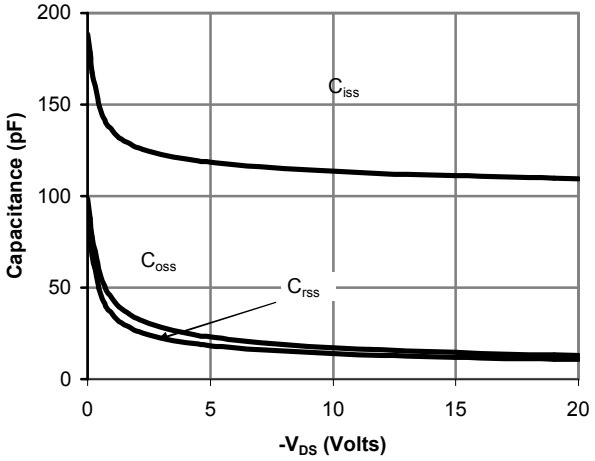



Figure 8: Capacitance Characteristics

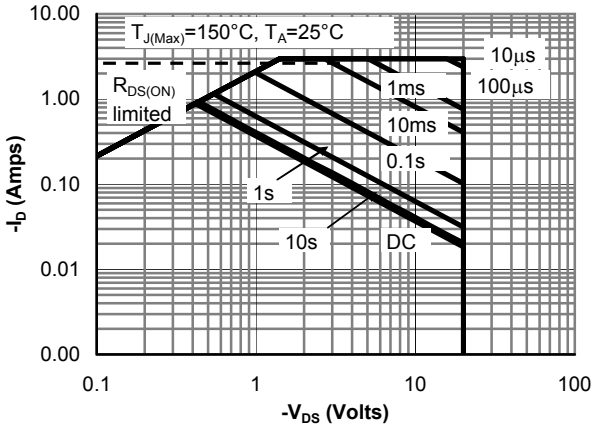



Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

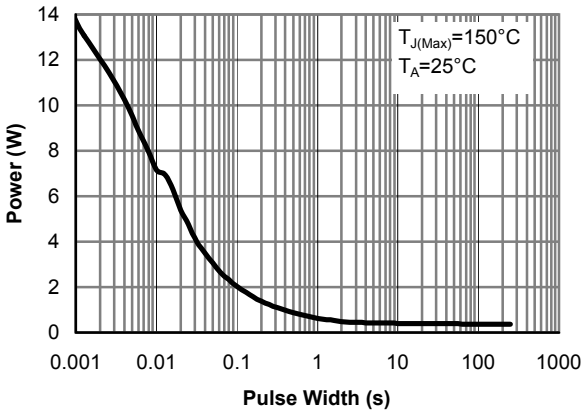



Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

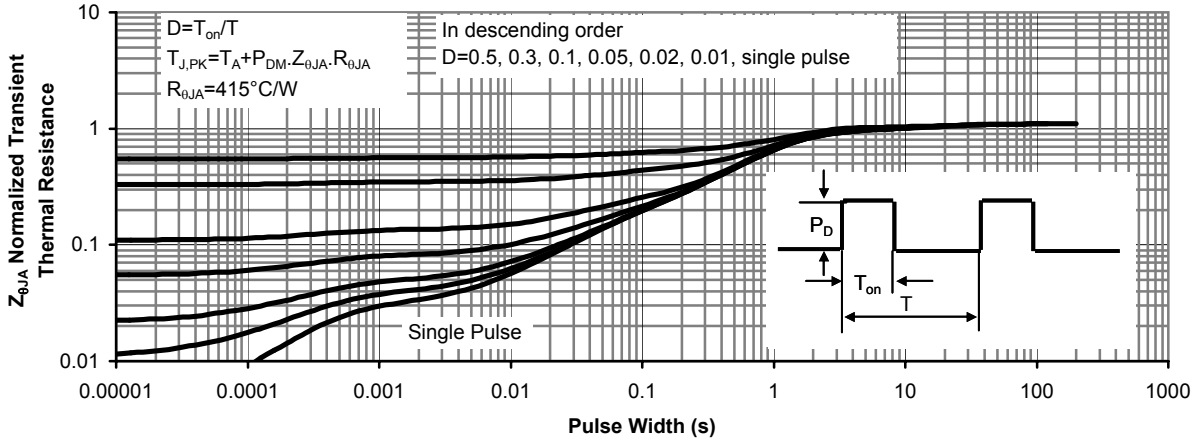
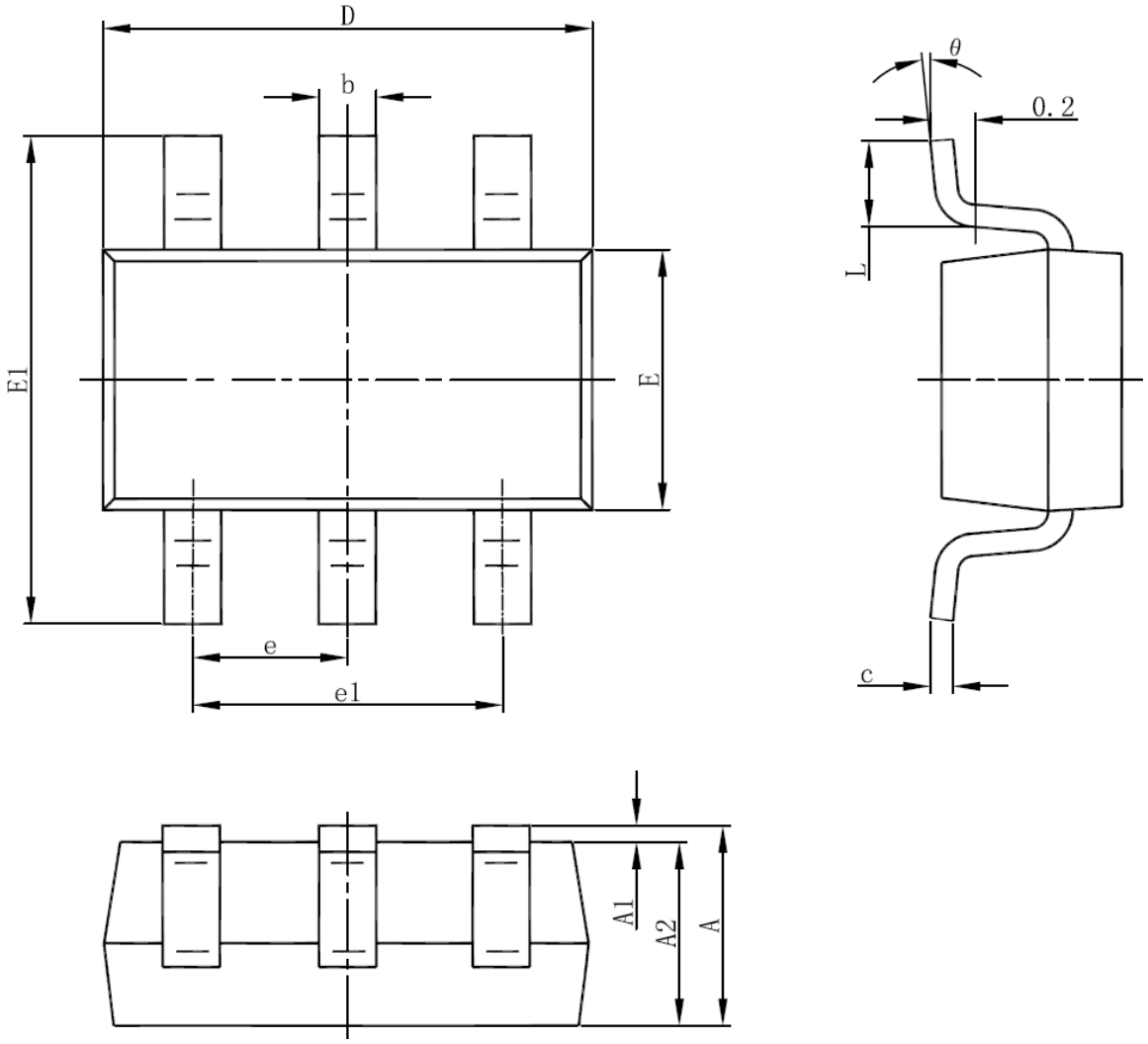



Figure 11: Normalized Maximum Transient Thermal Impedance

**SOT23-6L Package Information**




| 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° |