freescale
飞思卡尔(深圳)功率半导体有限公司

# AOP609

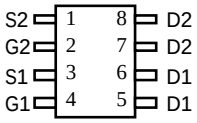
Complementary Enhancement Mode Field Effect Transistor

## General Description

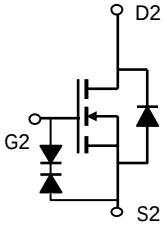
The AOP609 uses advanced trench technology MOSFETs to provide excellent $R_{DS(ON)}$ and low gate charge. The complementary MOSFETs may be used in H-bridge, Inverters and other applications. *Standard Product AOP609 is Pb- free (meets ROHS & Sony 259 specifications).*

## Features

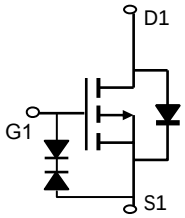
| n-channel | p-channel |
|---|---|
| $V_{DS}$ (V) = 60V | -60V |
| $I_D$ = 4.7A ($V_{GS}$=10V) | -3.5A ($V_{GS}$=-10V) |
| $R_{DS(ON)}$ | $R_{DS(ON)}$ |
| < 60mΩ ($V_{GS}$=10V) | < 115mΩ ($V_{GS}$ =-10V) |
| < 75mΩ ($V_{GS}$=4.5V) | < 140mΩ ($V_{GS}$ =-4.5V) |




**PDIP-8**




**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 | | $V_{DS}$ | 60 | -60 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±20 | ±20 | V |
| Continuous Drain Current [A] | $T_A$=25°C | $I_D$ | 4.7 | -3.5 | A |
| | $T_A$=70°C | | 3.8 | -2.9 | |
| Pulsed Drain Current [B] | | $I_{DM}$ | 20 | -20 | |
| Power Dissipation | $T_A$=25°C | $P_D$ | 2.5 | 2.5 | W |
| | $T_A$=70°C | | 1.6 | 1.6 | |
| 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 | 37 | 50 | °C/W |
| Maximum Junction-to-Ambient [A] | Steady-State | | n-ch | 74 | 90 | °C/W |
| Maximum Junction-to-Lead [C] | Steady-State | $R_{\theta JL}$ | n-ch | 28 | 40 | °C/W |
| Maximum Junction-to-Ambient [A] | t ≤ 10s | $R_{\theta JA}$ | p-ch | 35 | 50 | °C/W |
| Maximum Junction-to-Ambient [A] | Steady-State | | p-ch | 73 | 90 | °C/W |
| Maximum Junction-to-Lead [C] | Steady-State | $R_{\theta JL}$ | p-ch | 32 | 40 | °C/W |

# AOP609

Complementary Enhancement Mode Field Effect Transistor

**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 | 60 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=48V, $V_{GS}$=0V | | | 1 | μA |
| | | $T_J$=55°C | | | 5 | |
| $I_{GSS}$ | Gate-Body leakage current | $V_{DS}$=0V, $V_{GS}$= ±20V | | | 250 | μA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$ $I_D$=250μA | 1.5 | 2.4 | 3 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}$=10V, $V_{DS}$=5V | 20 | | | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=10V, $I_D$=4.7A | | 49 | 60 | mΩ |
| | | $T_J$=125°C | | 65 | | |
| | | $V_{GS}$=4.5V, $I_D$=3.0A | | 57 | 75 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=5V, $I_D$=4.7A | | 17 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=1A,$V_{GS}$=0V | | 0.78 | 1 | V |
| $I_S$ | Maximum Body-Diode Continuous Current | | | | 3.5 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=30V, f=1MHz | | 450 | 570 | pF |
| $C_{oss}$ | Output Capacitance | | | 74 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 30 | | pF |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | | 1.65 | 2 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$(10V) | Total Gate Charge | $V_{GS}$=10V, $V_{DS}$=30V, $I_D$=4.7A | | 5.1 | 7 | nC |
| $Q_g$(4.5V) | Total Gate Charge | | | 2.5 | 3 | nC |
| $Q_{gs}$ | Gate Source Charge | | | 1 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 1.4 | | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}$=10V, $V_{DS}$=30V, $R_L$=6Ω, $R_{GEN}$=3Ω | | 5.4 | | ns |
| $t_r$ | Turn-On Rise Time | | | 5.5 | | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | | 17.2 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 2.9 | | ns |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=4.7A, dI/dt=100A/μs | | 25.4 | 35 | ns |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | $I_F$=4.7A, dI/dt=100A/μs | | 29.4 | | 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 <300μs 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 2 : Sept 2007

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: N-CHANNEL

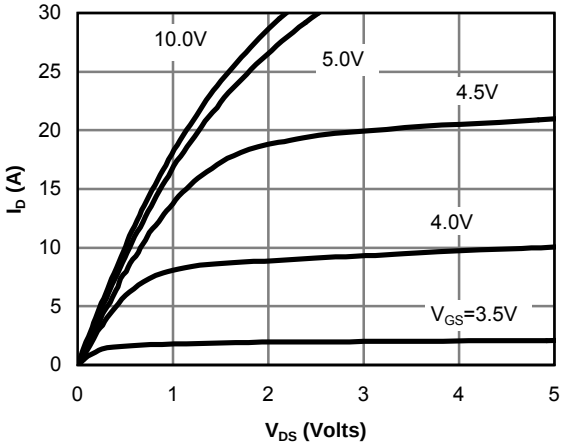



Fig 1: On-Region Characteristics

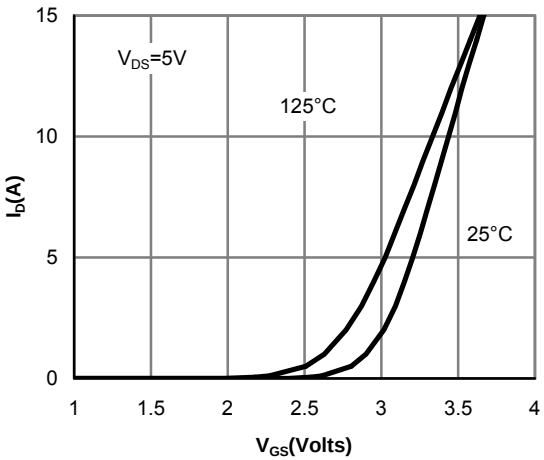



Figure 2: Transfer Characteristics

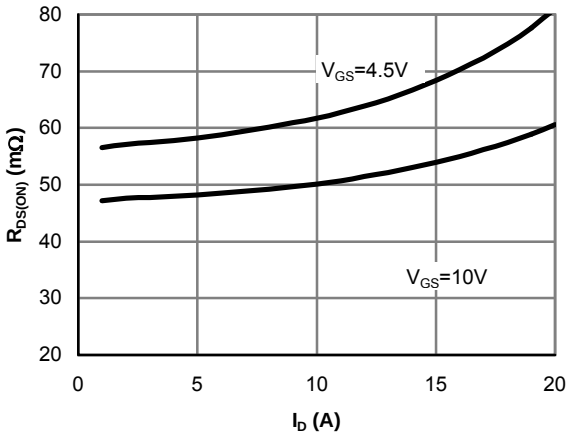



Figure 3: On-Resistance vs. Drain Current and Gate Voltage

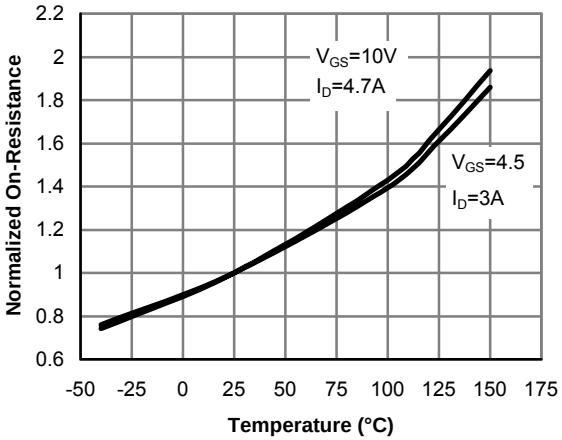



Figure 4: On-Resistance vs. Junction Temperature

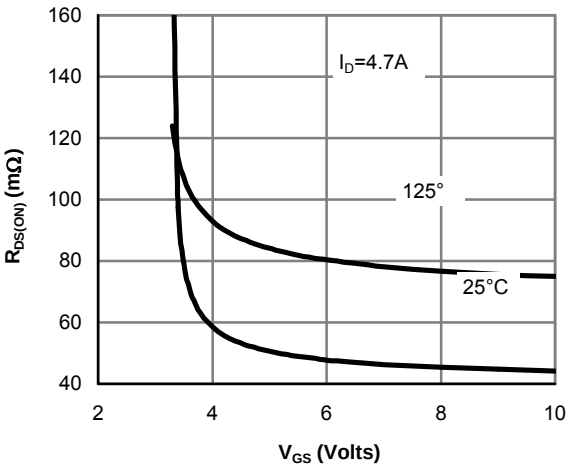



Figure 5: On-Resistance vs. Gate-Source Voltage

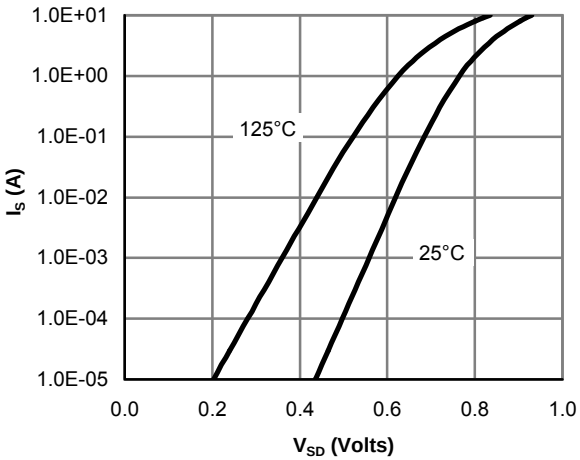



Figure 6: Body-Diode Characteristics

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: N-CHANNEL

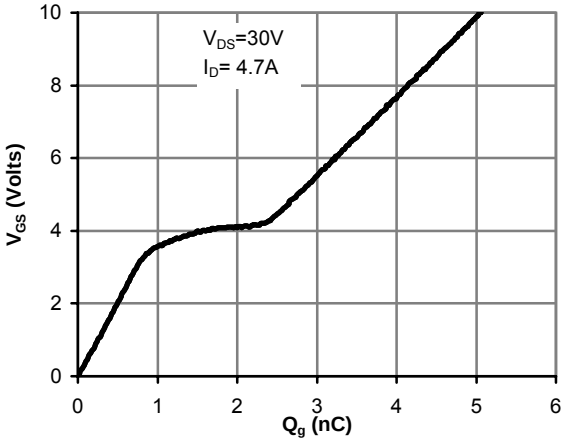



Figure 7: Gate-Charge Characteristics

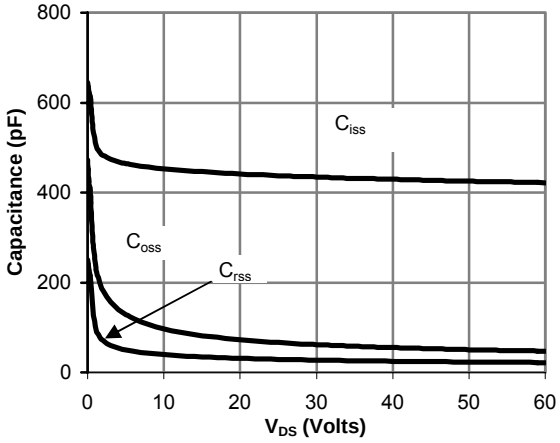



Figure 8: Capacitance Characteristics

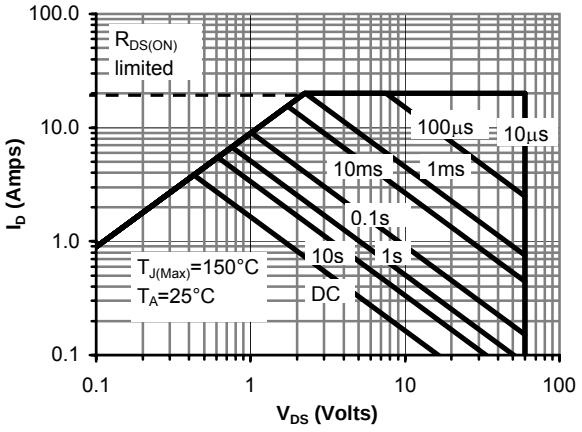



Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

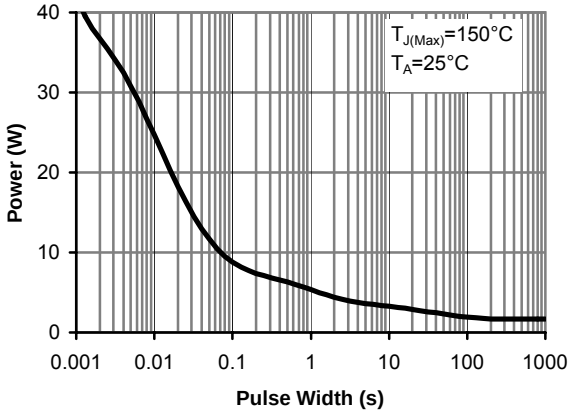



Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

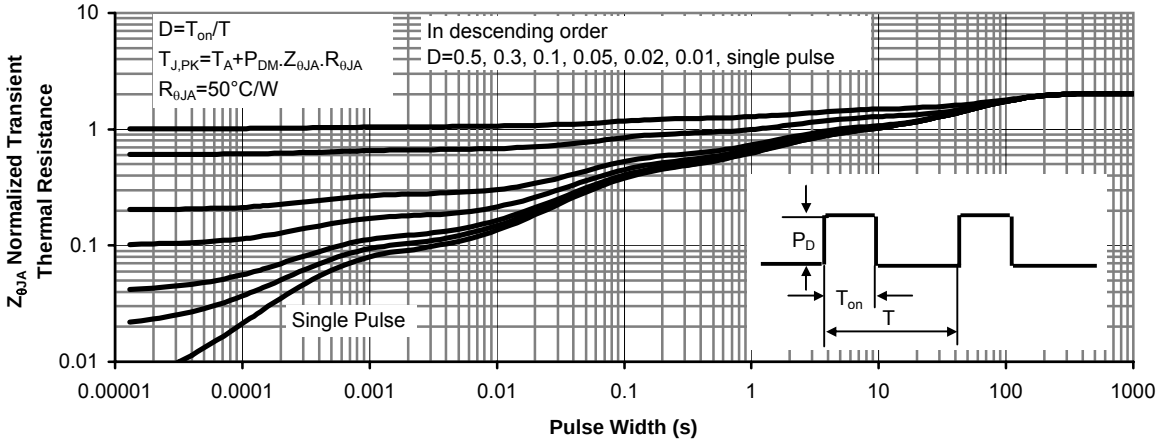



Figure 11: Normalized Maximum Transient Thermal Impedance

# AOP609

Complementary Enhancement Mode Field Effect Transistor

**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 | -60 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=-48V, $V_{GS}$=0V | | | -1 | µA |
| | | $T_J$=55°C | | | -5 | |
| $I_{GSS}$ | Gate-Body leakage current | $V_{DS}$=0V, $V_{GS}$=±20V | | | 100 | µA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$ $I_D$=-250µA | -1.5 | -1.8 | -3 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}$=-10V, $V_{DS}$=-5V | -20 | | | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=-10V, $I_D$=-3.5A | | 95 | 115 | mΩ |
| | | $T_J$=125°C | | 133 | | |
| | | $V_{GS}$=-4.5V, $I_D$=-2.8A | | 112 | 140 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=-5V, $I_D$=-3.5A | | 9 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=-1A,$V_{GS}$=0V | | -0.77 | -1 | V |
| $I_S$ | Maximum Body-Diode Continuous Current | | | | -3.5 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=-30V, f=1MHz | | 897 | 1080 | pF |
| $C_{oss}$ | Output Capacitance | | | 88 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 36 | | pF |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | | 7.2 | 9 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$(10V) | Total Gate Charge (10V) | $V_{GS}$=-10V, $V_{DS}$=-30V, $I_D$=-3.5A | | 8.1 | 10 | nC |
| $Q_g$(4.5V) | Total Gate Charge (4.5V) | | | 3.9 | 5 | nC |
| $Q_{gs}$ | Gate Source Charge | | | 1.4 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 1.7 | | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}$=-10V, $V_{DS}$=-30V, $R_L$=8.1Ω, $R_{GEN}$=3Ω | | 9 | | ns |
| $t_r$ | Turn-On Rise Time | | | 7.2 | | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | | 35 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 25.5 | | ns |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=-3.5A, dI/dt=100A/µs | | 25.8 | 35 | ns |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | $I_F$=-3.5A, dI/dt=100A/µs | | 28.8 | | 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 <300µs 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.

Rev2:Sept 2007

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: P-CHANNEL

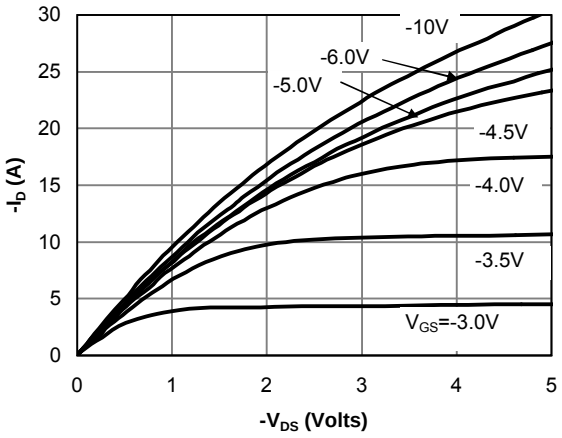



Fig 1: On-Region Characteristics

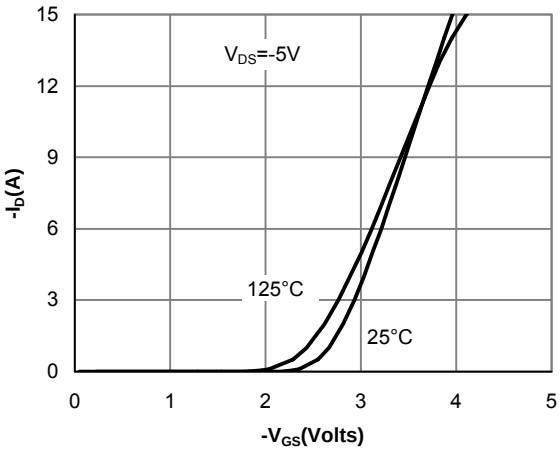



Figure 2: Transfer Characteristics

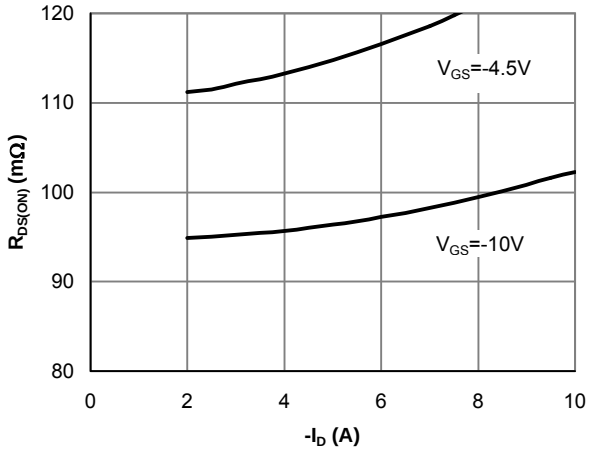



Figure 3: On-Resistance vs. Drain Current and Gate Voltage

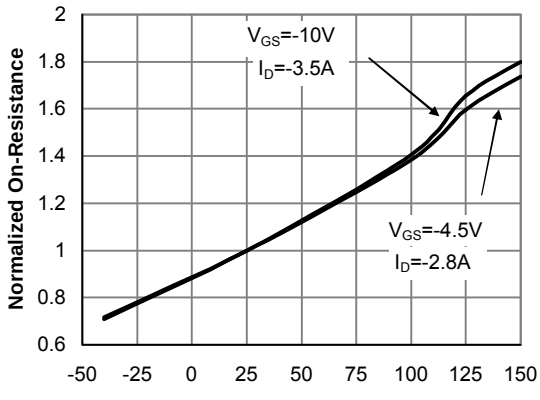



Figure 4: On-Resistance vs. Junction Temperature

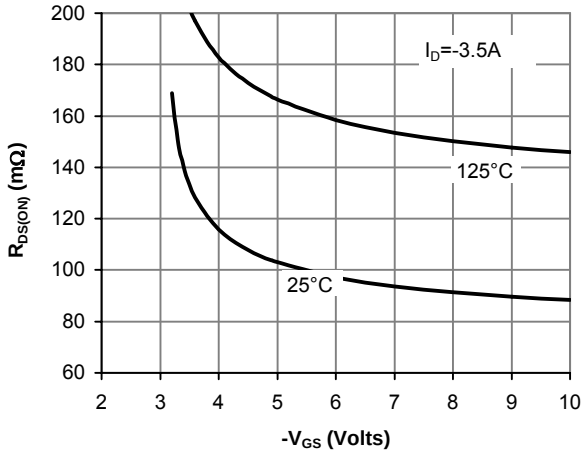



Figure 5: On-Resistance vs. Gate-Source Voltage

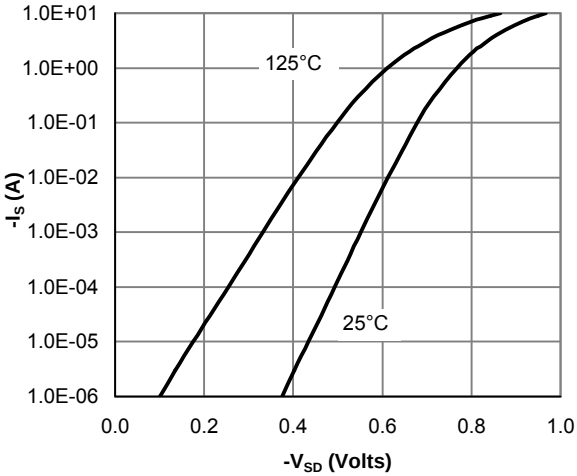



Figure 6: Body-Diode Characteristics

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS: P-CHANNEL

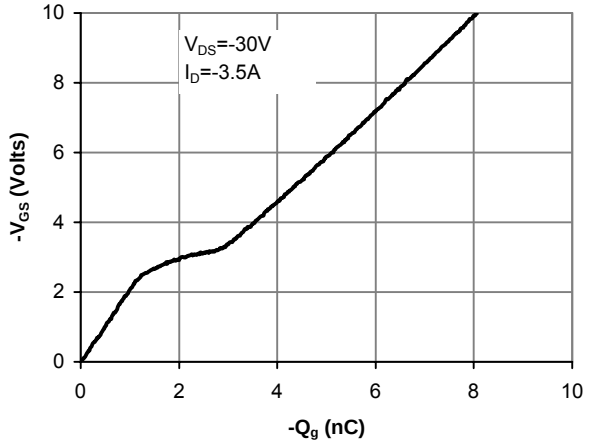
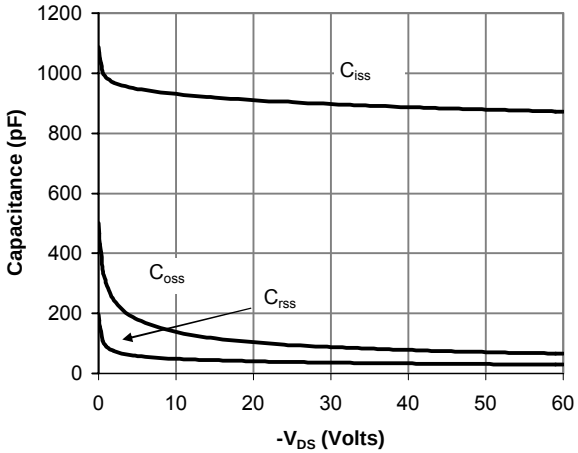



**Figure 7: Gate-Charge Characteristics**

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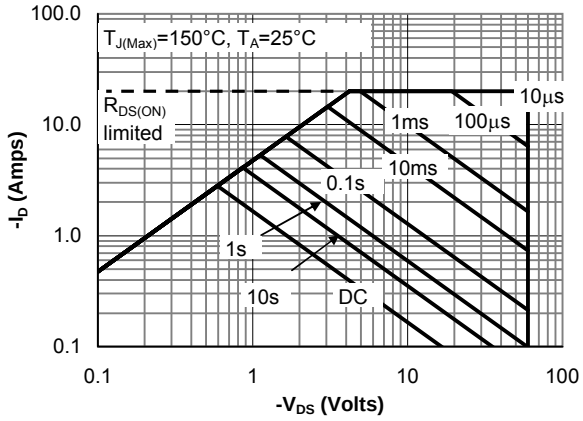


**Figure 9: Maximum Forward Biased Safe Operating Area (Note E)**

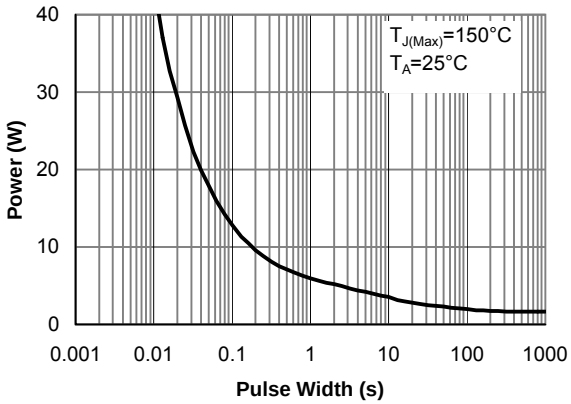


**Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)**

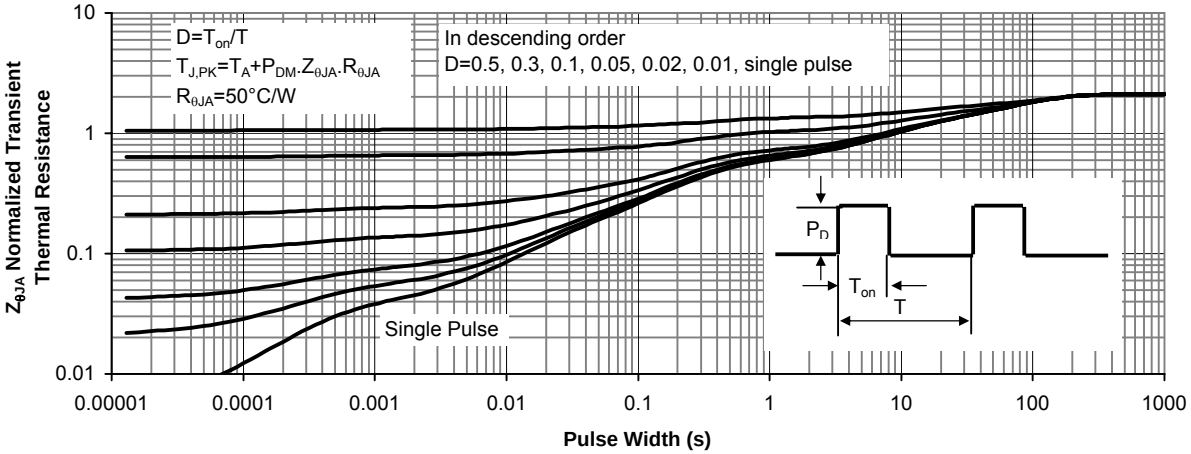


**Figure 11: Normalized Maximum Transient Thermal Impedance**