ALPHA & OMEGA SEMICONDUCTOR

# AO4928

## Asymmetric Dual N-Channel MOSFET

**SRFET™**

## General Description

The AO4928 uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge. The two MOSFETs make a compact and efficient switch and synchronous rectifier combination for use in DC-DC converters. A monolithically integrated Schottky diode in parallel with the synchronous MOSFET to boost efficiency further.

## Product Summary

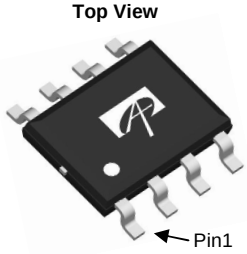
| FET1 | FET2 | |
|---|---|---|
| $V_{DS}$ (V) = 30V | $V_{DS}$(V) = 30V | |
| $I_D$ = 9A | $I_D$=7.3A | ($V_{GS}$ = 10V) |
| $R_{DS(ON)}$ < 16mΩ | <24mΩ | ($V_{GS}$ = 10V) |
| $R_{DS(ON)}$ < 19.5mΩ | <29mΩ | ($V_{GS}$ = 4.5V) |

100% UIS Tested
100% Rg Tested

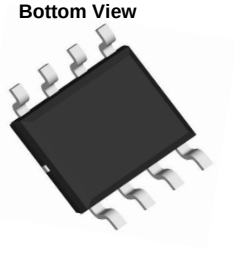
Green Product

SOIC-8

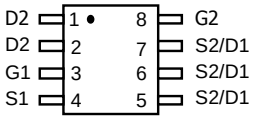
Top View



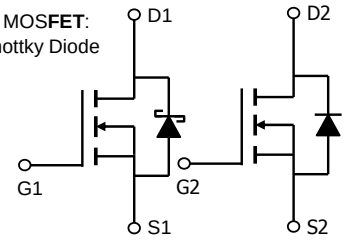

Bottom View



Top View




**SRFET™**
**S**oft **R**ecovery MOS**FET**:
Integrated Schottky Diode




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

| Parameter | | Symbol | Max FET1 | Max FET2 | Units |
|---|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 30 | 30 | V |
| Gate-Source Voltage | | $V_{GS}$ | ±12 | ±12 | V |
| Continuous Drain Current [A] | $T_A$=25°C | $I_{DSM}$ | 9.0 | 7.3 | A |
| | $T_A$=70°C | | 7.2 | 5.9 | |
| Pulsed Drain Current [B] | | $I_{DM}$ | 40 | 40 | |
| Avalanche Current [C] | | $I_{AR}$ | 16 | 12 | A |
| Repetitive avalanche energy L=0.3mH [C] | | $E_{AR}$ | 38 | 22 | mJ |
| Power Dissipation | $T_A$=25°C | $P_{DSM}$ | 2.0 | 2.0 | W |
| | $T_A$=70°C | | 1.3 | 1.3 | |
| Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 to 150 | -55 to 150 | °C |

**Thermal Characteristics FET1**

| Parameter | | Symbol | Typ | Max | Units |
|---|---|---|---|---|---|
| Maximum Junction-to-Ambient [A] | t ≤ 10s | $R_{\theta JA}$ | 48 | 62.5 | °C/W |
| Maximum Junction-to-Ambient [A] | Steady-State | | 74 | 90 | °C/W |
| Maximum Junction-to-Lead [C] | Steady-State | $R_{\theta JL}$ | 32 | 40 | °C/W |

**Thermal Characteristics FET2**

| Parameter | | Symbol | Typ | Max | Units |
|---|---|---|---|---|---|
| Maximum Junction-to-Ambient [A] | t ≤ 10s | $R_{\theta JA}$ | 48 | 62.5 | °C/W |
| Maximum Junction-to-Ambient [A] | Steady-State | | 74 | 90 | °C/W |
| Maximum Junction-to-Lead [C] | Steady-State | $R_{\theta JL}$ | 32 | 40 | °C/W |

**FET1 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 | 30 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=24V, $V_{GS}$=0V | | 0.01 | 0.1 | mA |
| | | $T_J$=125°C | | 5 | 10 | |
| $I_{GSS}$ | Gate-Body leakage current | $V_{DS}$=0V, $V_{GS}$= ±12V | | | 0.1 | µA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$ $I_D$=250µA | 1.5 | 1.85 | 2.4 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}$=4.5V, $V_{DS}$=5V | 40 | | | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=10V, $I_D$=9A | | 13.2 | 16 | mΩ |
| | | $T_J$=125°C | | 20.5 | 25.6 | |
| | | $V_{GS}$=4.5V, $I_D$=7A | | 15.7 | 19.5 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=5V, $I_D$=9A | | 64 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=1A,$V_{GS}$=0V | | 0.4 | 0.6 | V |
| $I_S$ | Maximum Body-Diode + Schottky Continuous Current | | | | 4.5 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=15V, f=1MHz | | 1450 | 1885 | pF |
| $C_{oss}$ | Output Capacitance | | | 224 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 92 | | pF |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | | 1.6 | 3.0 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$(10V) | Total Gate Charge | $V_{GS}$=10V, $V_{DS}$=15V, $I_D$=9A | | 24.0 | 31 | nC |
| $Q_g$(4.5V) | Total Gate Charge | | | 12.0 | | nC |
| $Q_{gs}$ | Gate Source Charge | | | 3.9 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 4.2 | | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}$=10V, $V_{DS}$=15V, $R_L$=1.7Ω, $R_{GEN}$=3Ω | | 5.5 | | ns |
| $t_r$ | Turn-On Rise Time | | | 4.7 | | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | | 24.0 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 4.0 | | ns |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=9A, dI/dt=300A/µs | | 10 | 13 | ns |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | $I_F$=9A, dI/dt=300A/µs | | 6.8 | | nC |

A: The value of $R_{\theta JA}$ is measured with the device in a still air environment with $T_A$ =25°C. The power dissipation $P_{DSM}$ and current rating $I_{DSM}$ are based on $T_{J(MAX)}$=150°C, using t ≤ 10s junction-to-ambient thermal resistance.

B: Repetitive rating, pulse width limited by junction temperature $T_{J(MAX)}$=150°C.

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 <300 µs 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.

Rev1: May 2011

## FET1 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

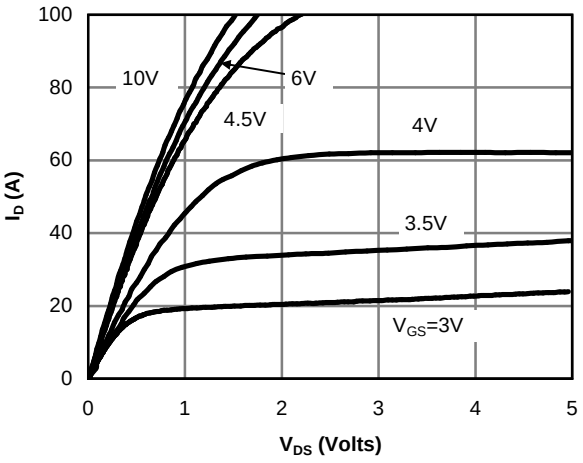



**Figure 1: On-Region Characteristics**

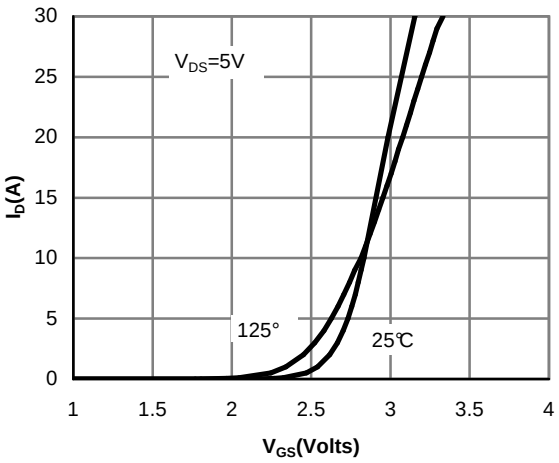



**Figure 2: Transfer Characteristics**

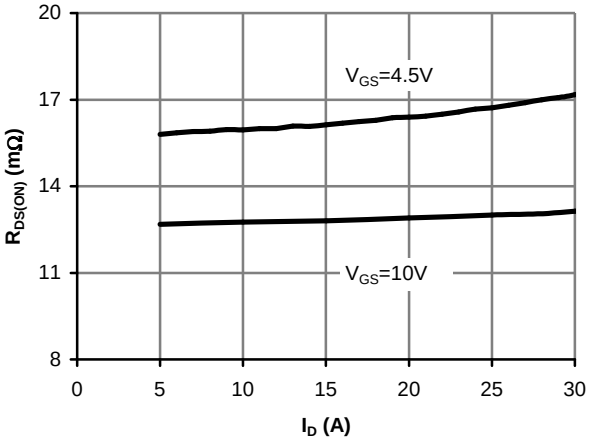



**Figure 3: On-Resistance vs. Drain Current and Gate Voltage**

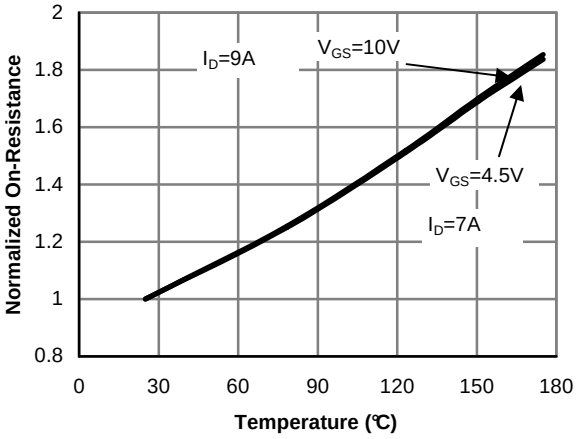



**Figure 4: On-Resistance vs. Junction Temperature**

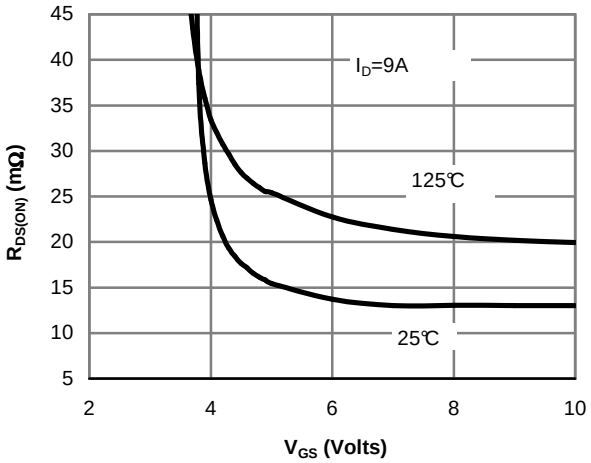



**Figure 5: On-Resistance vs. Gate-Source Voltage**

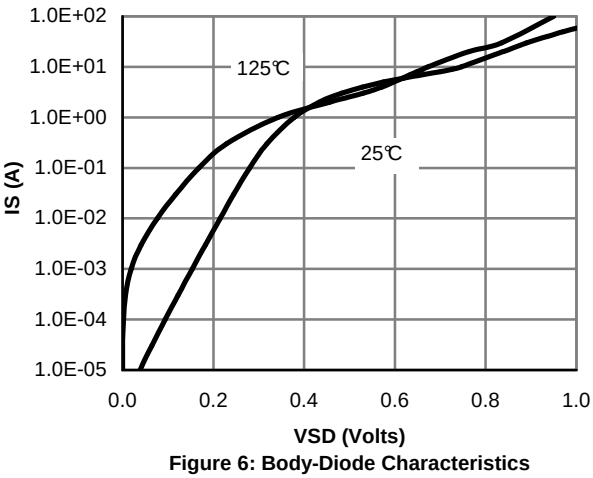



**Figure 6: Body-Diode Characteristics**

## FET1 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

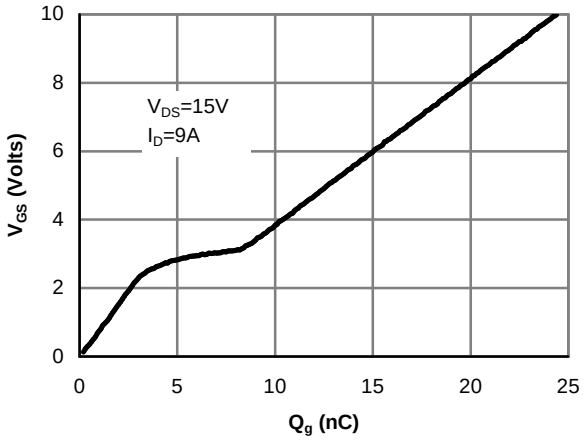



**Figure 7: Gate-Charge Characteristics**

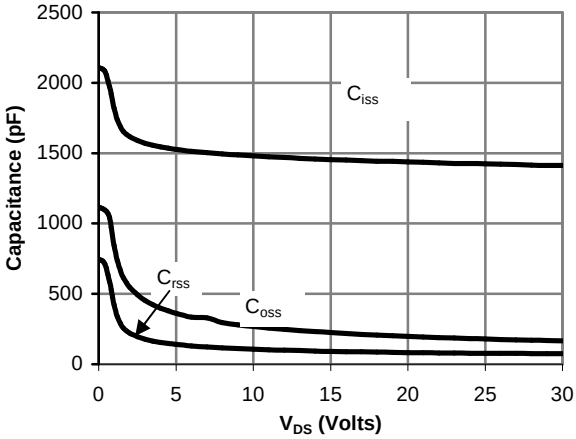



**Figure 8: Capacitance Characteristics**

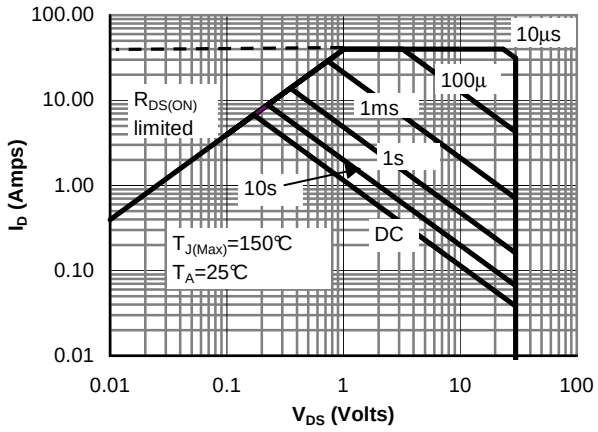



**Figure 9: Maximum Forward Biased Safe Operating Area (Note E)**

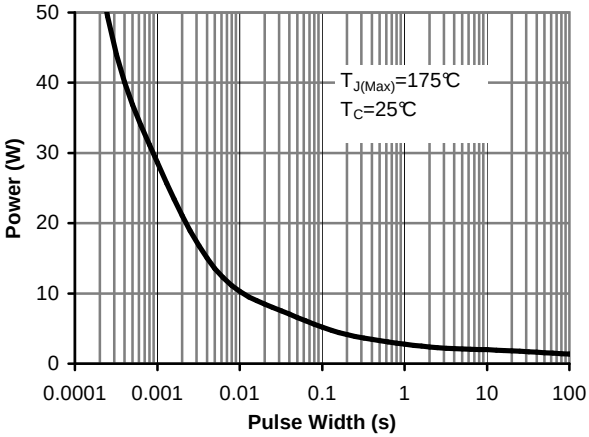



**Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)**

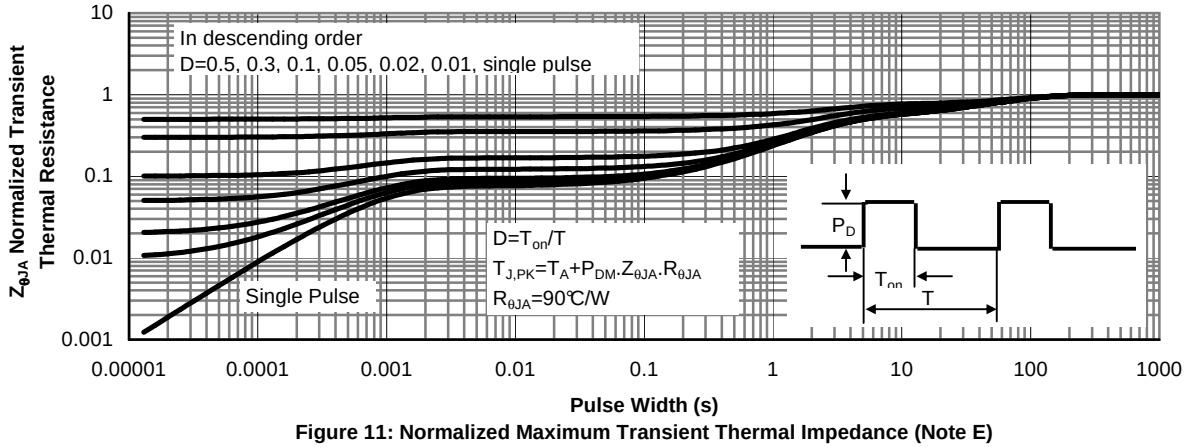



**Figure 11: Normalized Maximum Transient Thermal Impedance (Note E)**

## FET1 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

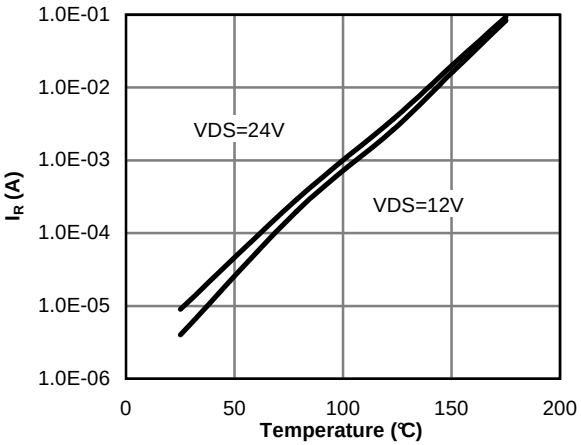



**Figure 12: Diode Reverse Leakage Current vs. Junction Temperature**

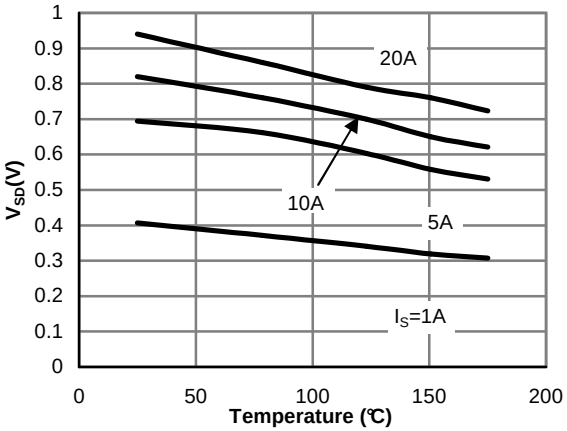



**Figure 13: Diode Forward voltage vs. Junction Temperature**

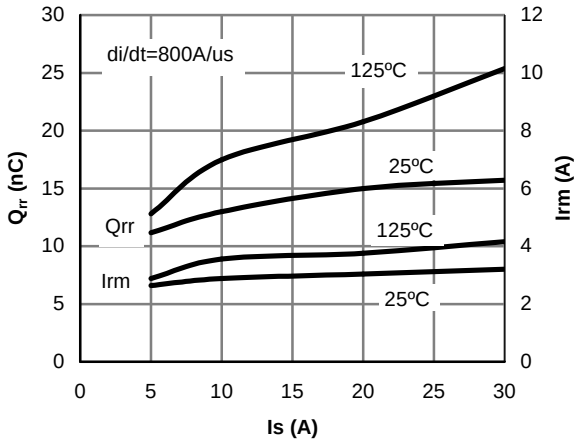



**Figure 14: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current**

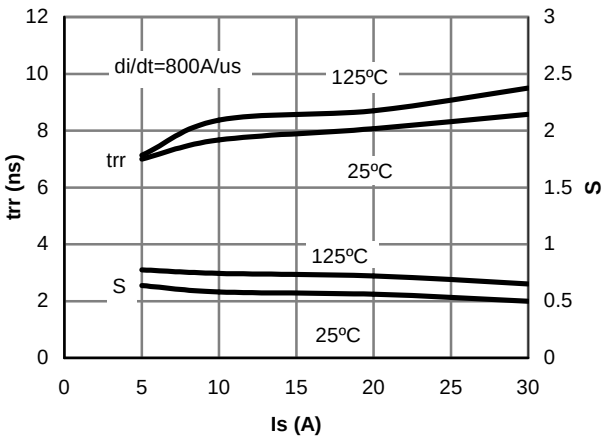



**Figure 15: Diode Reverse Recovery Time and Soft Coefficient vs. Conduction Current**

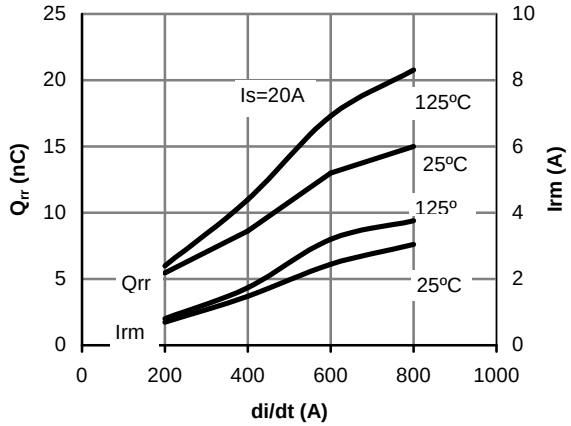



**Figure 16: Diode Reverse Recovery Charge and Peak Current vs. di/dt**

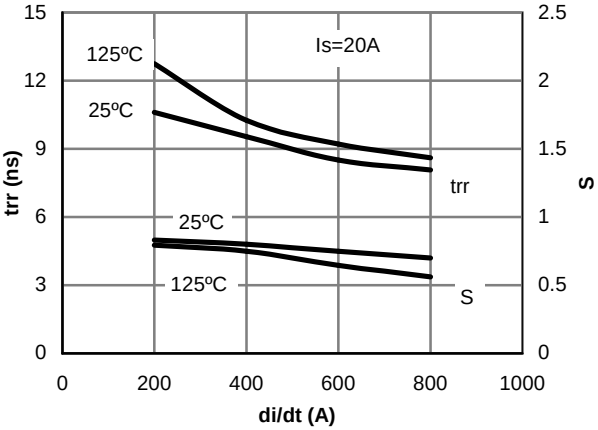



**Figure 17: Diode Reverse Recovery Time and Soft Coefficient vs. di/dt**

**FET2 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 | 30 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=24V, $V_{GS}$=0V | | | 1 | µA |
| | | $T_J$=55°C | | | 5 | |
| $I_{GSS}$ | Gate-Body leakage current | $V_{DS}$=0V, $V_{GS}$= ±12V | | | 100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$ $I_D$=250µA | 0.7 | 1 | 1.5 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}$=4.5V, $V_{DS}$=5V | 40 | | | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=10V, $I_D$=7.3A | | 20 | 24 | mΩ |
| | | $T_J$=125°C | | 30.0 | 36 | |
| | | $V_{GS}$=4.5V, $I_D$=6A | | 23.4 | 29 | mΩ |
| | | $V_{GS}$=2.5V, $I_D$=5.5A | | 35.4 | 48 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=5V, $I_D$=7.3A | | 26 | | S |
| $V_{SD}$ | Diode Forward Voltage | $I_S$=1A,$V_{GS}$=0V | | 0.71 | 1 | V |
| $I_S$ | Maximum Body-Diode Continuous Current | | | | 4.5 | A |
| **DYNAMIC PARAMETERS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=15V, f=1MHz | | 900 | 1100 | pF |
| $C_{oss}$ | Output Capacitance | | | 88 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 65 | | pF |
| $R_g$ | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1MHz | | 0.95 | 1.5 | Ω |
| **SWITCHING PARAMETERS** | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{GS}$=4.5V, $V_{DS}$=15V, $I_D$=7.3A | | 10 | | nC |
| $Q_{gs}$ | Gate Source Charge | | | 1.8 | | nC |
| $Q_{gd}$ | Gate Drain Charge | | | 3.75 | | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}$=10V, $V_{DS}$=15V, $R_L$=2.1Ω, $R_{GEN}$=6Ω | | 3.2 | | ns |
| $t_r$ | Turn-On Rise Time | | | 3.5 | | ns |
| $t_{D(off)}$ | Turn-Off DelayTime | | | 21.5 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 2.7 | | ns |
| $t_{rr}$ | Body Diode Reverse Recovery Time | $I_F$=7.3A, dI/dt=100A/µs | | 16.8 | | ns |
| $Q_{rr}$ | Body Diode Reverse Recovery Charge | $I_F$=7.3A, dI/dt=100A/µs | | 8 | | nC |

A: The value of $R_{\theta JA}$ is measured 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 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 <300 µs 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.

Rev1: May 2011

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

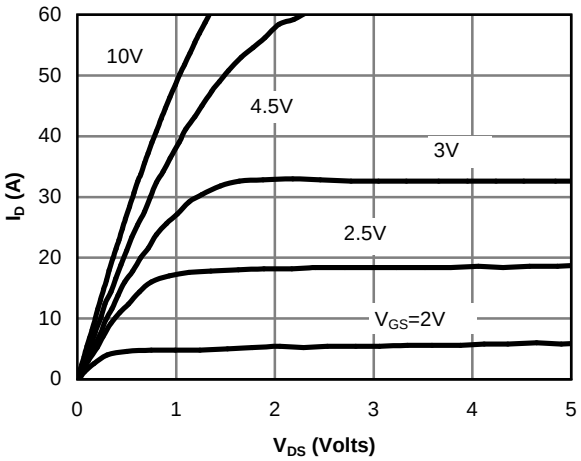



**Figure 1: On-Region Characteristics**

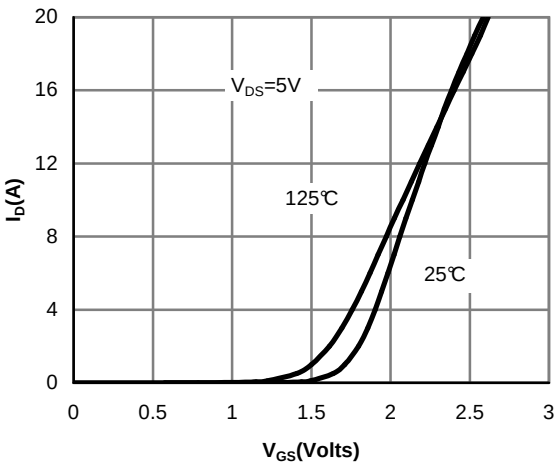



**Figure 2: Transfer Characteristics**

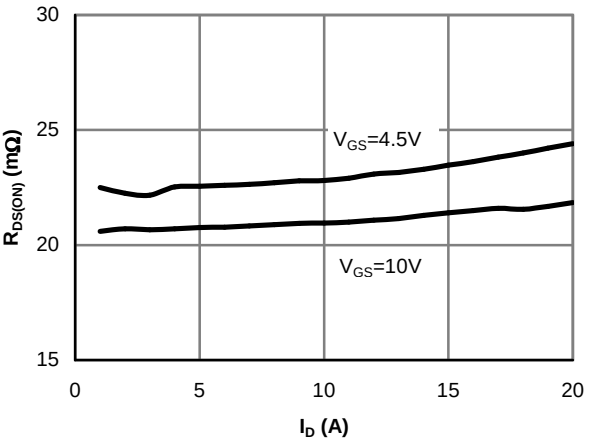



**Figure 3: On-Resistance vs. Drain Current and Gate Voltage**

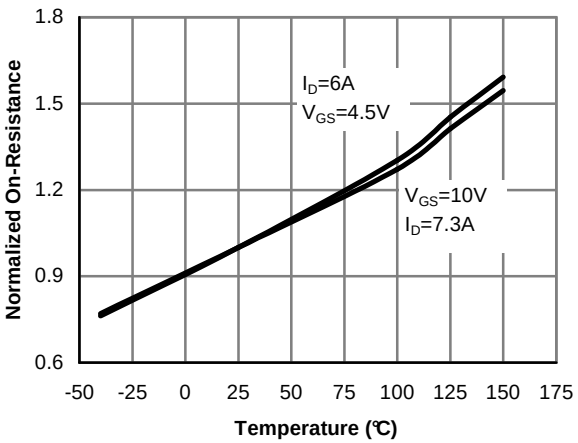



**Figure 4: On-Resistance vs. Junction Temperature**

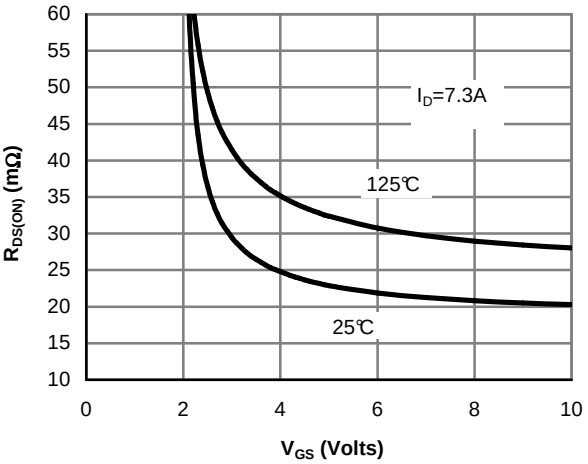



**Figure 5: On-Resistance vs. Gate-Source Voltage**

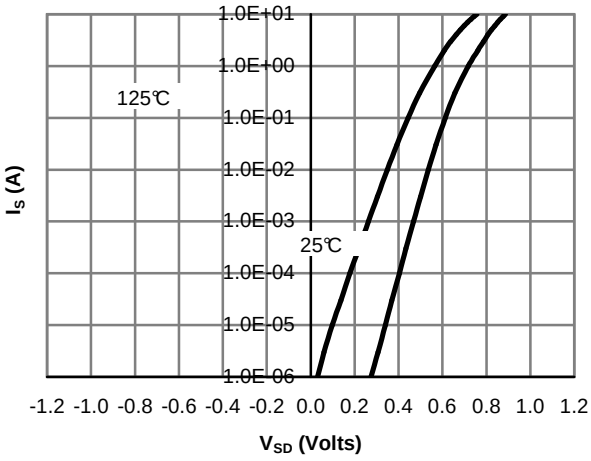



**Figure 6: Body-Diode Characteristics**

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

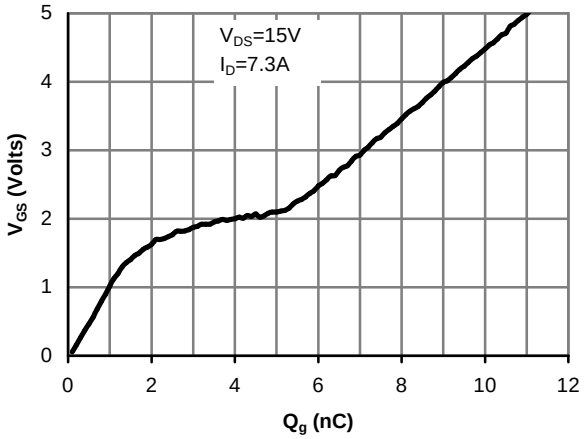



**Figure 7: Gate-Charge Characteristics**

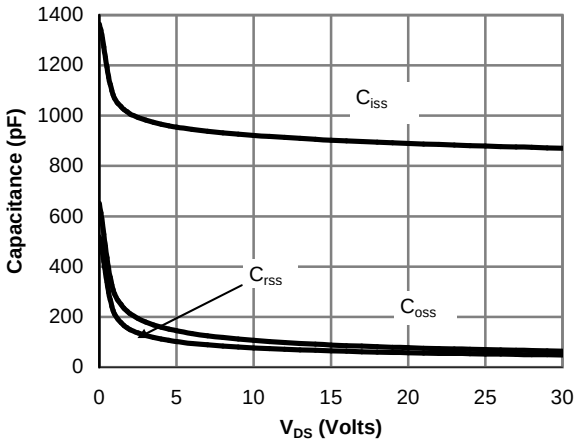



**Figure 8: Capacitance Characteristics**

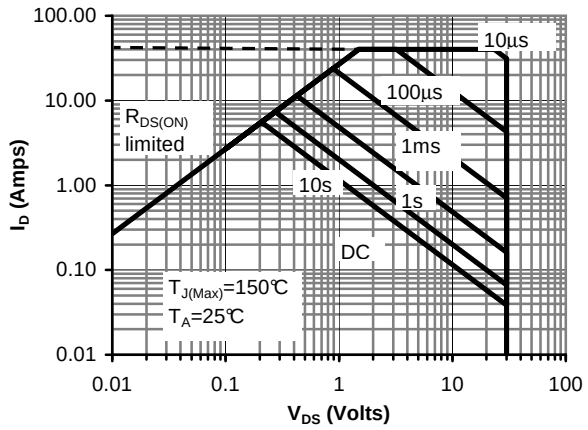



**Figure 9: Maximum Forward Biased Safe Operating Area (Note E)**

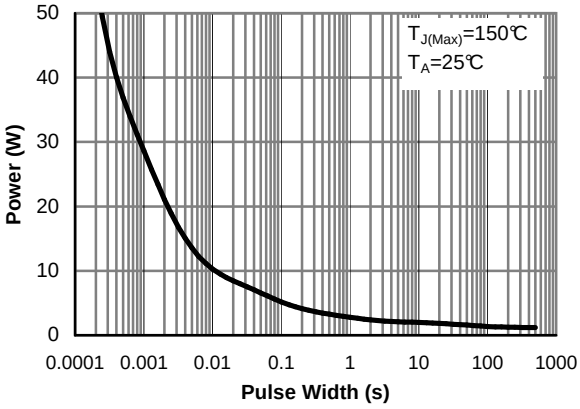



**Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)**

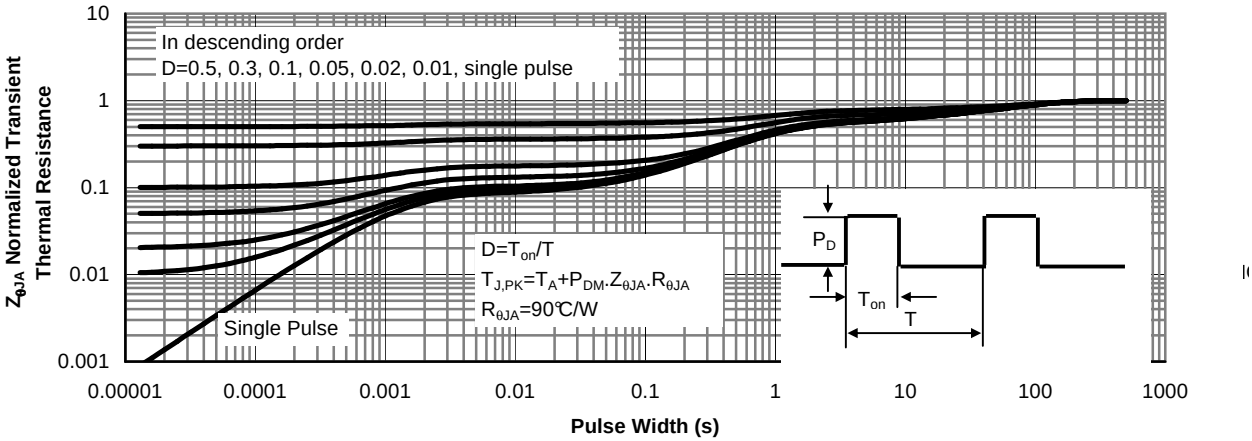



**Figure 11: Normalized Maximum Transient Thermal Impedance**