

AO4932
Asymmetric Dual N-Channel Enhancement Mode Field Effect Transistor
SRFET™
General Description

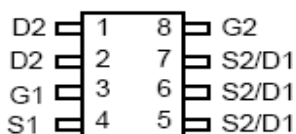
The AO4932 uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge. The two MOSFETs make a compact and efficient switch and synchronous rectifier combination for use in DC-DC converters. A monolithically integrated Schottky diode in parallel with the synchronous MOSFET to boost efficiency further. Standard Product AO4932 is Pb-free (meets ROHS & Sony 259 specifications).

Features
FET1

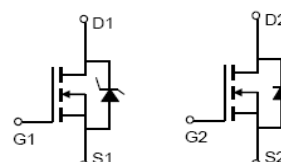
V_{DS} (V) = 30V
 I_D = 9A
 $R_{DS(ON)}$ < 15.8m Ω
 $R_{DS(ON)}$ < 19.6m Ω

FET2

V_{DS} (V) = 30V
 I_D =9A (V_{GS} = 10V)
 <15.8m Ω (V_{GS} = 10V)
 <23m Ω (V_{GS} = 4.5V)

UIS TESTED!
Rg,Ciss,Coss,Crss Tested

SRFET™

Soft Recovery MOSFET:
Integrated Schottky Diode


Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted

| Parameter | Symbol | Max FET1 | Max FET2 | Units |
|---|------------------------|------------|------------|------------------|
| Drain-Source Voltage | V_{DS} | 30 | 30 | V |
| Gate-Source Voltage | V_{GS} | ± 12 | ± 20 | V |
| Continuous Drain Current ^{AF} | $T_A=25^\circ\text{C}$ | 9.0 | 9.0 | A |
| | $T_A=70^\circ\text{C}$ | 7.2 | 7.2 | |
| Pulsed Drain Current ^B | I_{DM} | 40 | 40 | A |
| Avalanche Current ^C | I_{AR} | 16 | 16 | A |
| Repetitive avalanche energy $L=0.3\text{mH}$ ^C | E_{AR} | 38 | 38 | mJ |
| Power Dissipation | $T_A=25^\circ\text{C}$ | 2.0 | 2.0 | W |
| | $T_A=70^\circ\text{C}$ | 1.3 | 1.3 | |
| Junction and Storage Temperature Range | T_J, T_{STG} | -55 to 150 | -55 to 150 | $^\circ\text{C}$ |

Thermal Characteristics FET1

| Parameter | Symbol | Typ | Max | Units |
|--|-----------------|-----|------|--------------------|
| Maximum Junction-to-Ambient ^A | $R_{\theta JA}$ | 48 | 62.5 | $^\circ\text{C/W}$ |
| Maximum Junction-to-Ambient ^A | | 74 | 90 | $^\circ\text{C/W}$ |
| Maximum Junction-to-Lead ^C | $R_{\theta JL}$ | 32 | 40 | $^\circ\text{C/W}$ |

Thermal Characteristics FET2

| Parameter | Symbol | Typ | Max | Units |
|--|-----------------|-----|------|--------------------|
| Maximum Junction-to-Ambient ^A | $R_{\theta JA}$ | 48 | 62.5 | $^\circ\text{C/W}$ |
| Maximum Junction-to-Ambient ^A | | 74 | 90 | $^\circ\text{C/W}$ |
| Maximum Junction-to-Lead ^C | $R_{\theta JL}$ | 32 | 40 | $^\circ\text{C/W}$ |

FET1 Electrical Characteristics ($T_J=25^{\circ}\text{C}$ unless otherwise noted)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|-----------------------------|--|--|-----|------------|--------------|---------------|
| STATIC PARAMETERS | | | | | | |
| BV_{DSS} | Drain-Source Breakdown Voltage | $I_D=1\text{mA}$, $V_{GS}=0\text{V}$ | 30 | | | V |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS}=30\text{V}$, $V_{GS}=0\text{V}$ $T_J=125^{\circ}\text{C}$ | | 0.01 5 | 0.1 10 | mA |
| I_{GSS} | Gate-Body leakage current | $V_{DS}=0\text{V}$, $V_{GS}=\pm 12\text{V}$ | | | 0.1 | μA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}=V_{GS}$, $I_D=250\mu\text{A}$ | 1.5 | 1.8 | 2.4 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}=4.5\text{V}$, $V_{DS}=5\text{V}$ | 40 | | | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}=10\text{V}$, $I_D=9\text{A}$ $T_J=125^{\circ}\text{C}$ | | 13 20.2 | 15.8 25.2 | m Ω |
| | | $V_{GS}=4.5\text{V}$, $I_D=7\text{A}$ | | 16 | 19.6 | m Ω |
| g_{FS} | Forward Transconductance | $V_{DS}=5\text{V}$, $I_D=9\text{A}$ | | 64 | | S |
| V_{SD} | Diode Forward Voltage | $I_S=1\text{A}$, $V_{GS}=0\text{V}$ | | 0.4 | 0.6 | V |
| I_S | Maximum Body-Diode + Schottky Continuous Current | | | | 4.5 | A |
| DYNAMIC PARAMETERS | | | | | | |
| C_{iss} | Input Capacitance | $V_{GS}=0\text{V}$, $V_{DS}=15\text{V}$, $f=1\text{MHz}$ | | 1450 | 1885 | pF |
| C_{oss} | Output Capacitance | | | 224 | | pF |
| C_{rss} | Reverse Transfer Capacitance | | | 92 | | pF |
| R_g | Gate resistance | $V_{GS}=0\text{V}$, $V_{DS}=0\text{V}$, $f=1\text{MHz}$ | | 1.6 | 3.0 | Ω |
| SWITCHING PARAMETERS | | | | | | |
| $Q_g(10\text{V})$ | Total Gate Charge | $V_{GS}=10\text{V}$, $V_{DS}=15\text{V}$, $I_D=9\text{A}$ | | 24 | 31 | |
| $Q_g(4.5\text{V})$ | Total Gate Charge | | | 12.0 | 16 | nC |
| Q_{gs} | Gate Source Charge | | | 3.9 | | nC |
| Q_{gd} | Gate Drain Charge | | | 4.2 | | nC |
| $t_{D(on)}$ | Turn-On DelayTime | $V_{GS}=10\text{V}$, $V_{DS}=15\text{V}$, $R_L=1.7\Omega$, $R_{GEN}=3\Omega$ | | 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 | $I_F=9\text{A}$, $dI/dt=300\text{A}/\mu\text{s}$ | | 10 | 12 | ns |
| Q_{rr} | Body Diode Reverse Recovery Charge | $I_F=9\text{A}$, $dI/dt=300\text{A}/\mu\text{s}$ | | 6.8 | | nC |

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, in a still air environment with $T_A=25^{\circ}\text{C}$. The value in any given application depends on the user's specific board design.

B: Repetitive rating, pulse width limited by junction temperature.

C: The $R_{\theta JA}$ is the sum of the thermal impedance from junction to lead $R_{\theta JL}$ and lead to ambient.

D: The static characteristics in Figures 1 to 6 are obtained using $<300\mu\text{s}$ pulses, duty cycle 0.5% max.

E: These tests are performed with the device mounted on 1 in² FR-4 board with 2oz. Copper, in a still air environment with $T_A=25^{\circ}\text{C}$. The SOA curve provides a single pulse rating.

F: The current rating is based on the $t \leq 10\text{s}$ thermal resistance rating.

Rev 2: June 2007

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FET1 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

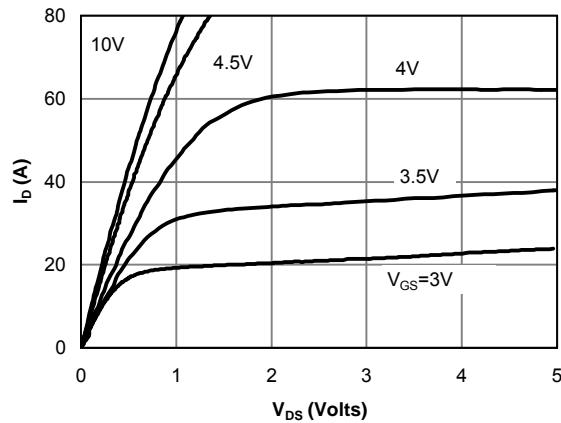


Figure 1: On-Region Characteristics

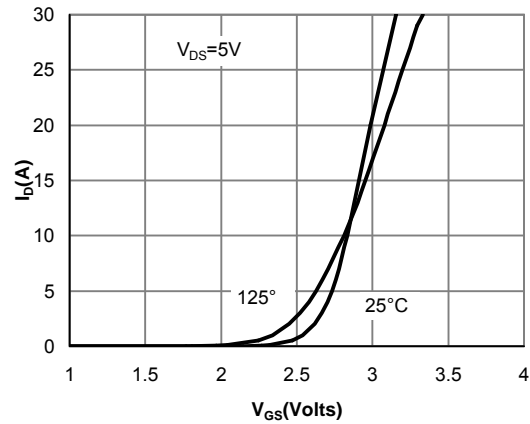


Figure 2: Transfer Characteristics

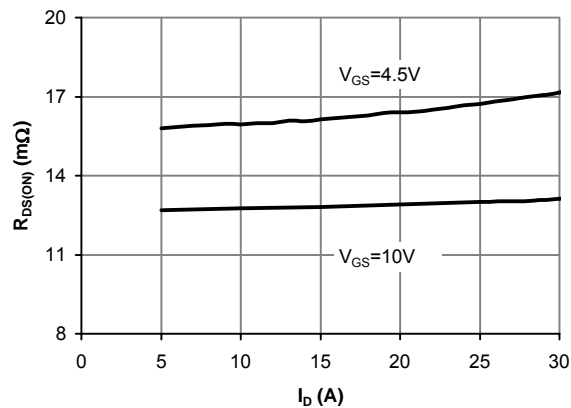


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

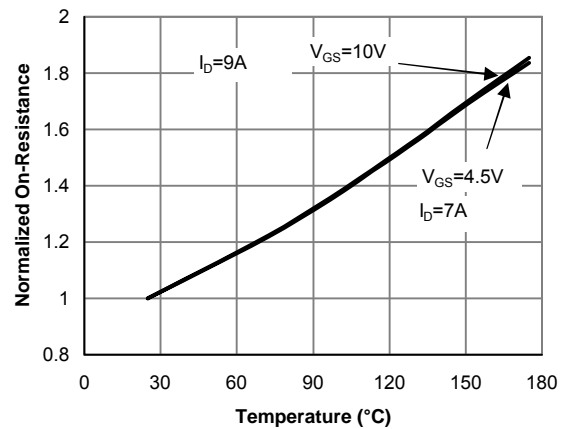


Figure 4: On-Resistance vs. Junction Temperature

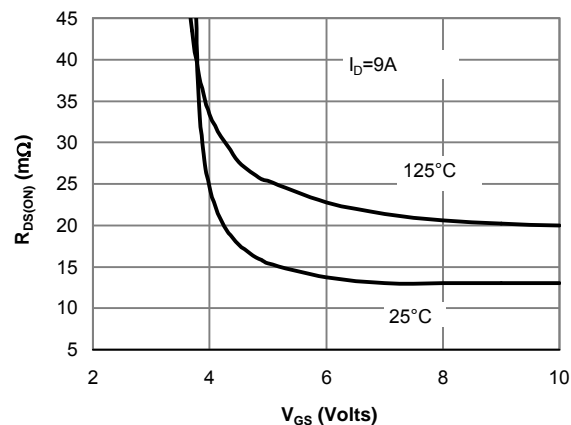


Figure 5: On-Resistance vs. Gate-Source Voltage

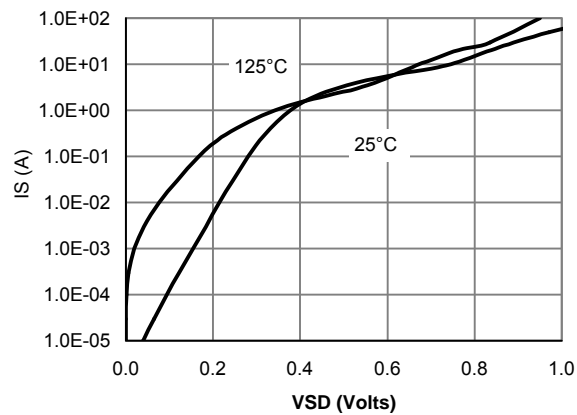


Figure 6: Body-Diode Characteristics

FET1 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

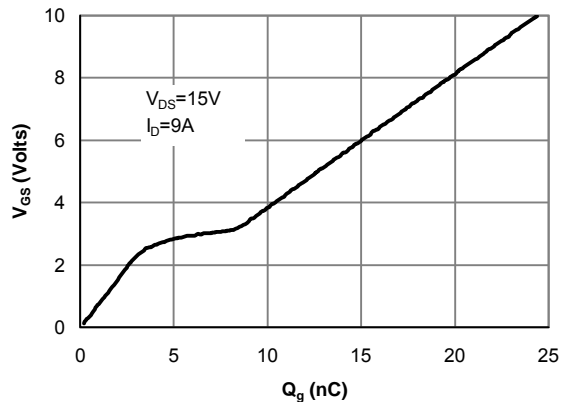


Figure 7: Gate-Charge Characteristics

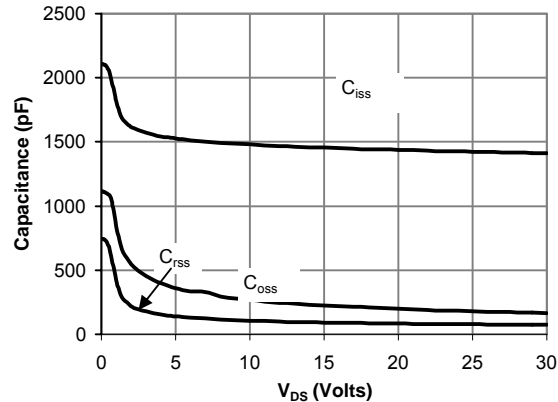


Figure 8: Capacitance Characteristics

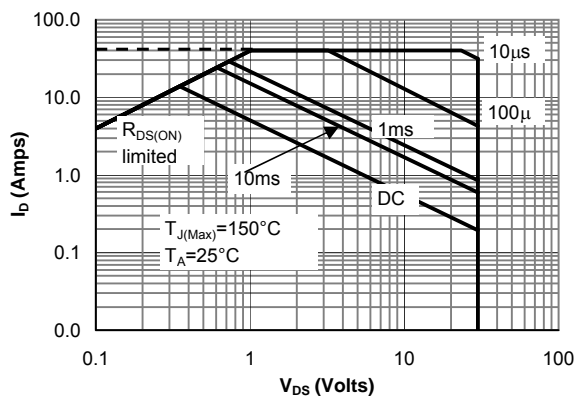


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

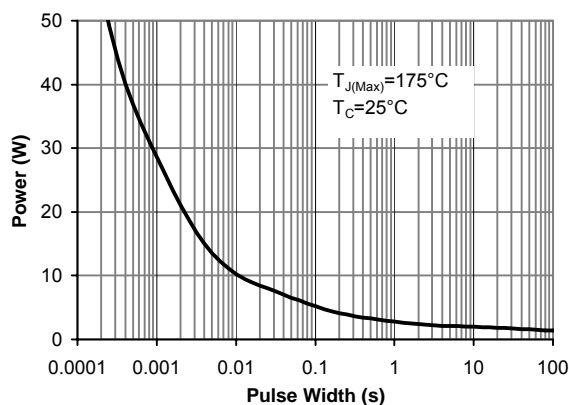


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

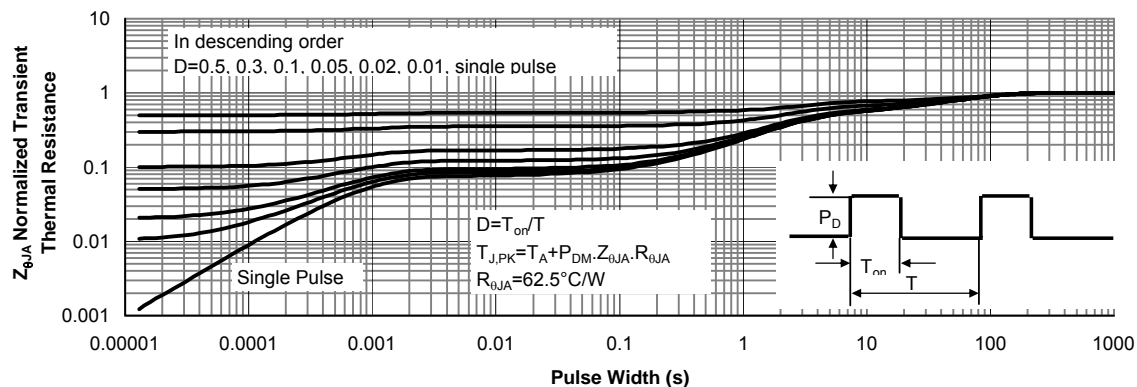


Figure 11: Normalized Maximum Transient Thermal Impedance (Note E)

FET1 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

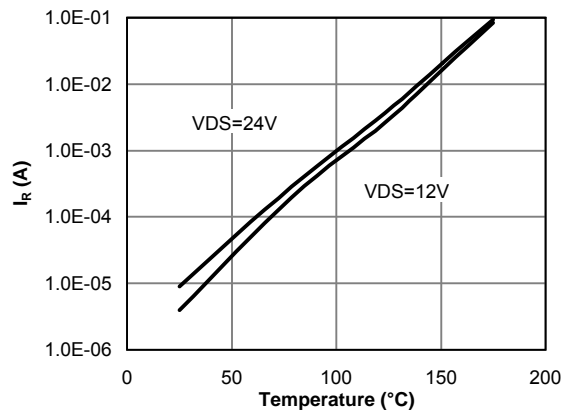


Figure 12: Diode Reverse Leakage Current vs. Junction Temperature

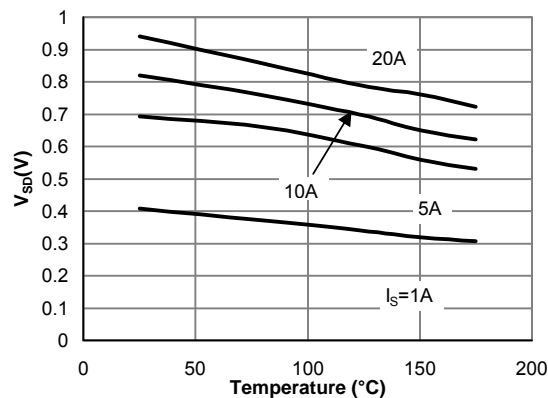


Figure 13: Diode Forward voltage vs. Junction Temperature

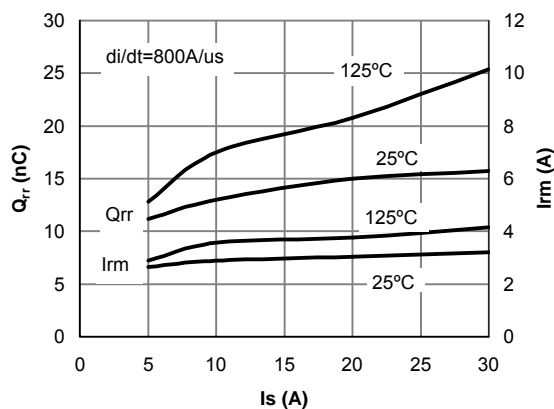


Figure 14: Diode Reverse Recovery Charge and Peak Current vs. Conduction Current

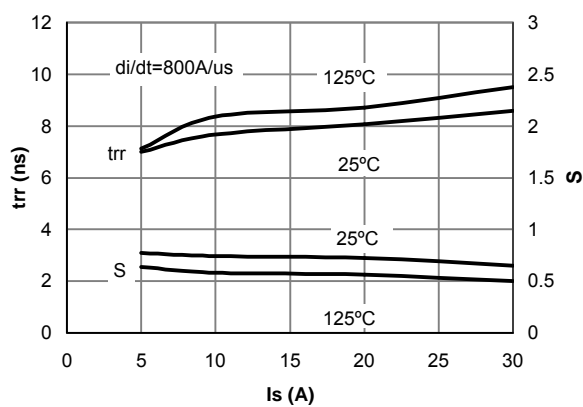


Figure 15: Diode Reverse Recovery Time and Soft Coefficient vs. Conduction Current

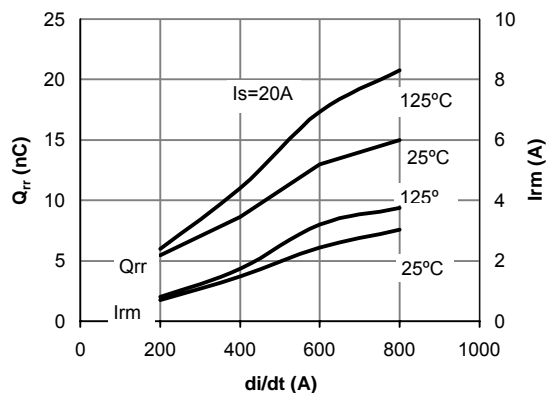


Figure 16: Diode Reverse Recovery Charge and Peak Current vs. di/dt

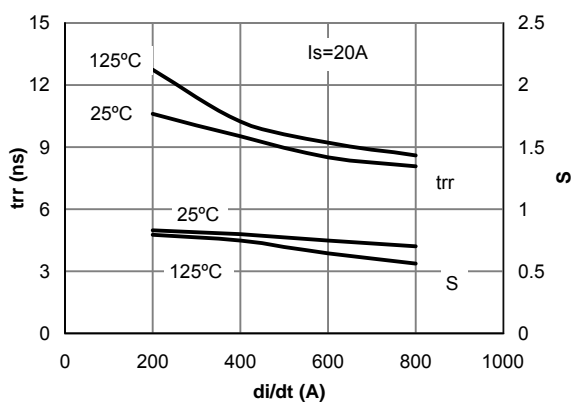


Figure 17: Diode Reverse Recovery Time and Soft Coefficient vs. di/dt

FET2 Electrical Characteristics ($T_J=25^{\circ}\text{C}$ unless otherwise noted)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|-----------------------------|---------------------------------------|--|-----|----------|------------|------------------|
| STATIC PARAMETERS | | | | | | |
| BV_{DSS} | Drain-Source Breakdown Voltage | $I_D=250\mu\text{A}$, $V_{GS}=0\text{V}$ | 30 | | | V |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS}=30\text{V}$, $V_{GS}=0\text{V}$ $T_J=55^{\circ}\text{C}$ | | | 1 5 | μA |
| I_{GSS} | Gate-Body leakage current | $V_{DS}=0\text{V}$, $V_{GS}=\pm 20\text{V}$ | | | 100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}=V_{GS}$, $I_D=250\mu\text{A}$ | 1.3 | 1.7 | 2.3 | V |
| $I_{D(ON)}$ | On state drain current | $V_{GS}=10\text{V}$, $V_{DS}=5\text{V}$ | 40 | | | A |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}=10\text{V}$, $I_D=9\text{A}$ $T_J=125^{\circ}\text{C}$ | | 13 19 | 15.8 23 | $\text{m}\Omega$ |
| | | $V_{GS}=4.5\text{V}$, $I_D=7\text{A}$ | | 18.6 | 23 | $\text{m}\Omega$ |
| g_{FS} | Forward Transconductance | $V_{DS}=5\text{V}$, $I_D=9\text{A}$ | | 23 | | S |
| V_{SD} | Diode Forward Voltage | $I_S=1\text{A}$, $V_{GS}=0\text{V}$ | | 0.75 | 1 | V |
| I_S | Maximum Body-Diode Continuous Current | | | | 3 | A |
| DYNAMIC PARAMETERS | | | | | | |
| C_{iss} | Input Capacitance | $V_{GS}=0\text{V}$, $V_{DS}=15\text{V}$, $f=1\text{MHz}$ | | 955 | 1250 | pF |
| C_{oss} | Output Capacitance | | | 145 | | pF |
| C_{rss} | Reverse Transfer Capacitance | | | 112 | | pF |
| R_g | Gate resistance | $V_{GS}=0\text{V}$, $V_{DS}=0\text{V}$, $f=1\text{MHz}$ | | 0.5 | 0.85 | Ω |
| SWITCHING PARAMETERS | | | | | | |
| $Q_g(10\text{V})$ | Total Gate Charge | $V_{GS}=10\text{V}$, $V_{DS}=15\text{V}$, $I_D=9\text{A}$ | | 17 | 22 | nC |
| $Q_g(4.5\text{V})$ | Total Gate Charge | | | 9 | 11.7 | nC |
| Q_{gs} | Gate Source Charge | | | 3.4 | | nC |
| Q_{gd} | Gate Drain Charge | | | 4.7 | | nC |
| $t_{D(on)}$ | Turn-On Delay Time | $V_{GS}=10\text{V}$, $V_{DS}=15\text{V}$, $R_L=1.7\Omega$, $R_{GEN}=3\Omega$ | | 5 | | ns |
| t_r | Turn-On Rise Time | | | 6 | | ns |
| $t_{D(off)}$ | Turn-Off Delay Time | | | 19 | | ns |
| t_f | Turn-Off Fall Time | | | 4.5 | | ns |
| t_{rr} | Body Diode Reverse Recovery Time | $I_F=9\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$ | | 16.7 | 20 | ns |
| Q_{rr} | Body Diode Reverse Recovery Charge | $I_F=9\text{A}$, $dI/dt=100\text{A}/\mu\text{s}$ | | 6.7 | | nC |

A: The value of $R_{\theta JA}$ is measured with the device mounted on 1in² FR-4 board with 2oz. Copper, in a still air environment with $T_A=25^{\circ}\text{C}$. The value in any given application depends on the user's specific board design.

B: Repetitive rating, pulse width limited by junction temperature.

C: The $R_{\theta JA}$ is the sum of the thermal impedance from junction to lead $R_{\theta JL}$ and lead to ambient.

D: The static characteristics in Figures 1 to 6 are obtained using $<300\mu\text{s}$ pulses, duty cycle 0.5% max.

E: These tests are performed with the device mounted on 1 in² FR-4 board with 2oz. Copper, in a still air environment with $T_A=25^{\circ}\text{C}$. The SOA curve provides a single pulse rating.

F: The current rating is based on the $t \leq 10\text{s}$ thermal resistance rating.

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FET2 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

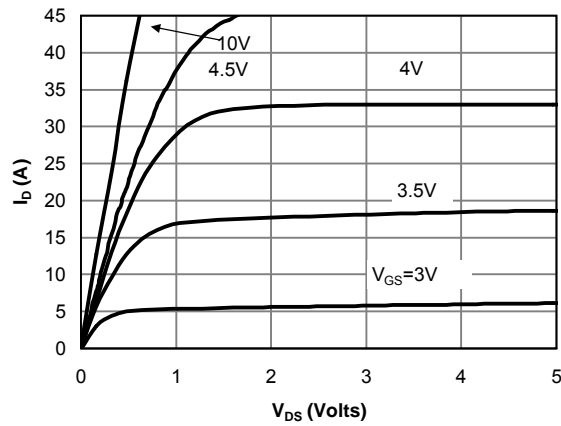


Figure 1: On-Region Characteristics

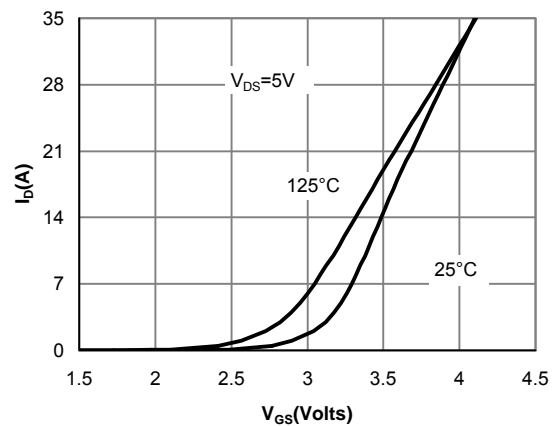


Figure 2: Transfer Characteristics

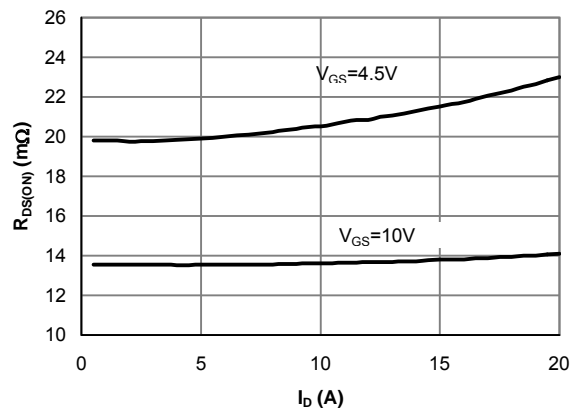


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

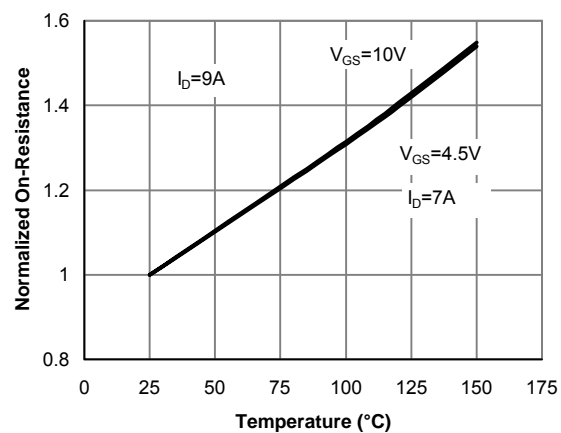


Figure 4: On-Resistance vs. Junction Temperature

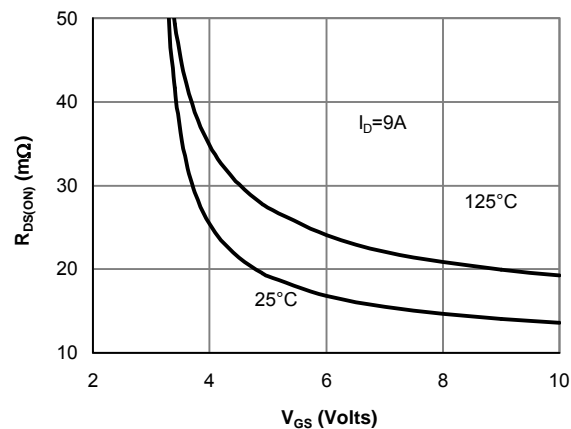


Figure 5: On-Resistance vs. Gate-Source Voltage

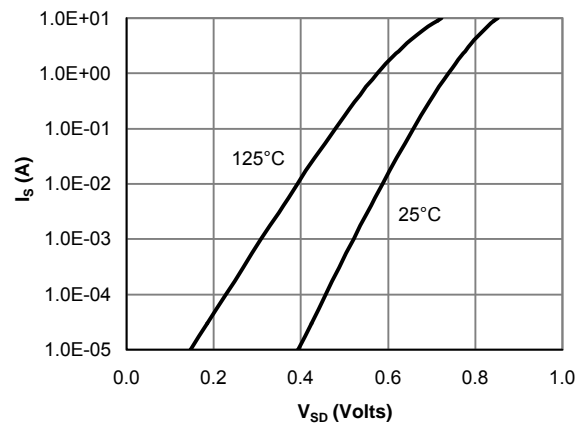


Figure 6: Body-Diode Characteristics

FET2 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

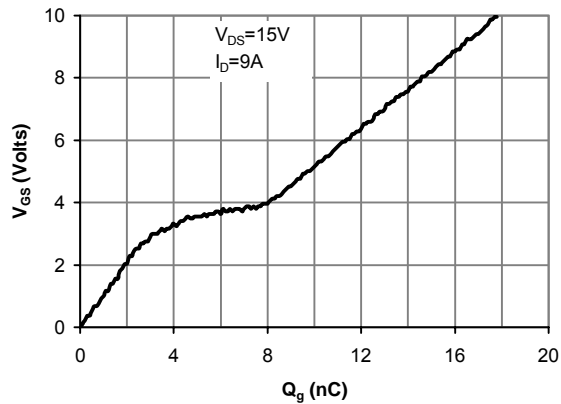


Figure 7: Gate-Charge Characteristics

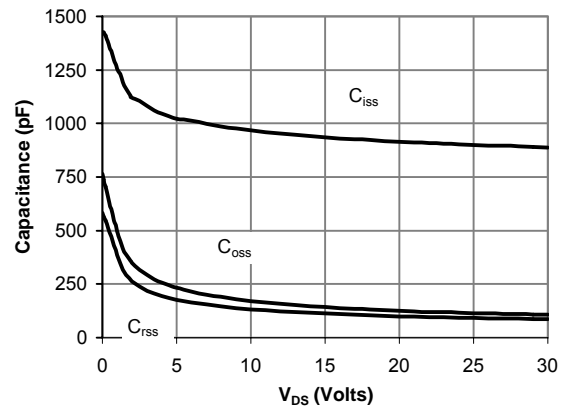


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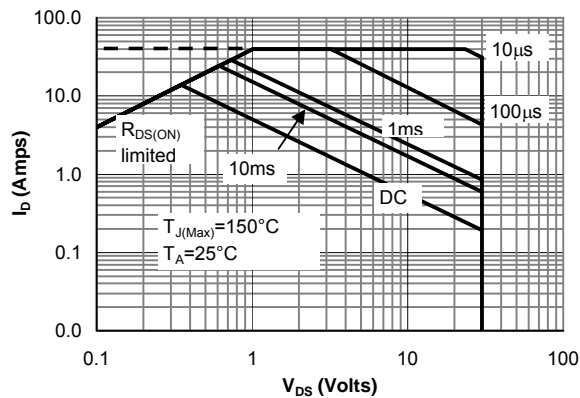


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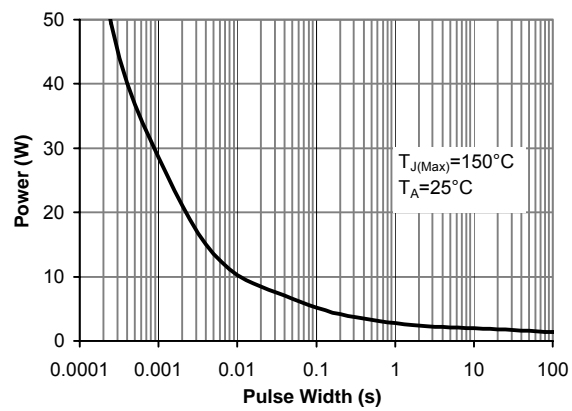


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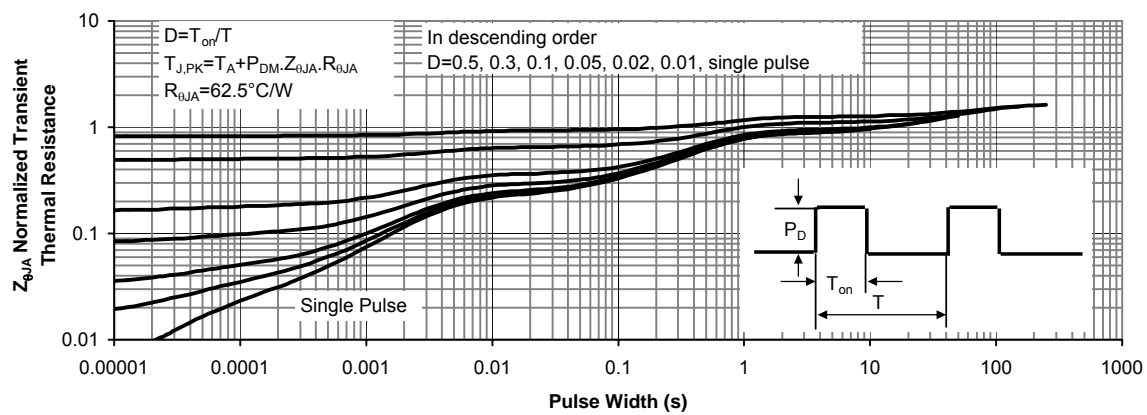


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