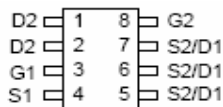
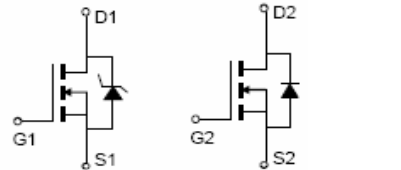


**AO4938**
**Asymmetric Dual N-Channel Enhancement Mode Field Effect Transistor**
**SRFET™**
**General Description**

The AO4938 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 AO4938 is Pb-free (meets ROHS & Sony 259 specifications).*

**Features**
**FET1**
 $V_{DS} (V) = 30V$ 
 $I_D = 9.6A$ 
 $R_{DS(ON)} < 13.5m\Omega$ 
 $R_{DS(ON)} < 19.5m\Omega$ 
**FET2**
 $V_{DS}(V) = 30V$ 
 $I_D=9A$ 
 $(V_{GS} = 10V)$ 
 $< 16m\Omega$   $(V_{GS} = 10V)$ 
 $< 26m\Omega$   $(V_{GS} = 4.5V)$ 
**UIS TESTED!**
**Rg,Ciss,Coss,Crss Tested**
**SOIC-8**

**SRFET™**
**Soft Recovery MOSFET:**  
**Integrated Schottky Diode**

**Absolute Maximum Ratings  $T_A=25^\circ C$  unless otherwise noted**

Parameter	Symbol	Max FET1		Max FET2		Units
		10 sec	Steady-State	10 sec	Steady-State	
Drain-Source Voltage	$V_{DS}$	30		30		V
Gate-Source Voltage	$V_{GS}$	$\pm 20$		$\pm 20$		V
Continuous Drain Current <sup>AF</sup>	$T_A=25^\circ C$	9.6	7.3	9.0	6.8	A
	$T_A=70^\circ C$	7.7	5.8	7.2	5.4	
Pulsed Drain Current <sup>B</sup>	$I_{DM}$	60		40		A
Avalanche Current <sup>B</sup>	$I_{AR}$	21		16		A
Repetitive avalanche energy $L=0.3mH$ <sup>B</sup>	$E_{AR}$	66		38		mJ
Power Dissipation <sup>A</sup>	$T_A=25^\circ C$	2	1.1	2	1.1	W
	$T_A=70^\circ C$	1.3	0.7	1.3	0.7	
Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 150		-55 to 150		$^\circ C$

**Thermal Characteristics FET1(Integrated Schottky Diode)**

Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup> $t \leq 10s$	$R_{\theta JA}$	48	62.5	$^\circ C/W$
Maximum Junction-to-Ambient <sup>A</sup> Steady-State		74	110	$^\circ C/W$
Maximum Junction-to-Lead <sup>C</sup> Steady-State	$R_{\theta JL}$	32	40	$^\circ C/W$

**Thermal Characteristics FET2**

Parameter	Symbol	Typ	Max	Units
Maximum Junction-to-Ambient <sup>A</sup> $t \leq 10s$	$R_{\theta JA}$	48	62.5	$^\circ C/W$
Maximum Junction-to-Ambient <sup>A</sup> Steady-State		74	110	$^\circ C/W$
Maximum Junction-to-Lead <sup>C</sup> Steady-State	$R_{\theta JL}$	32	40	$^\circ C/W$

FET1(Intergrated Schottky Diode) Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	I <sub>D</sub> =250μA, V <sub>GS</sub> =0V	30			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> =30V, V <sub>GS</sub> =0V T <sub>J</sub> =125°C			0.1 20	mA
I <sub>GSS</sub>	Gate-Body leakage current	V <sub>DS</sub> =0V, V <sub>GS</sub> = ±20V			0.1	μA
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> I <sub>D</sub> =250μA	1.3	1.65	2	V
I <sub>D(ON)</sub>	On state drain current	V <sub>GS</sub> =10V, V <sub>DS</sub> =5V	60			A
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> =10V, I <sub>D</sub> =9.6A T <sub>J</sub> =125°C		11 16.5	13.5 21	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =7A		15.6	19.5	mΩ
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =5V, I <sub>D</sub> =9.6A		37		S
V <sub>SD</sub>	Diode Forward Voltage	I <sub>S</sub> =1A, V <sub>GS</sub> =0V		0.40	0.5	V
I <sub>S</sub>	Maximum Body-Diode + Schottky Continuous Current				3.5	A
<b>DYNAMIC PARAMETERS</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =15V, f=1MHz		1267	1600	pF
C <sub>oss</sub>	Output Capacitance			308		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			118		pF
R <sub>g</sub>	Gate resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz		1.3	2.0	Ω
<b>SWITCHING PARAMETERS</b>						
Q <sub>g</sub> (10V)	Total Gate Charge	V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, I <sub>D</sub> =9.6A		21	30	
Q <sub>g</sub> (4.5V)	Total Gate Charge			10.4		nC
Q <sub>gs</sub>	Gate Source Charge			3.0		nC
Q <sub>gd</sub>	Gate Drain Charge			3.6		nC
t <sub>D(on)</sub>	Turn-On Delay Time	V <sub>GS</sub> =10V, V <sub>DS</sub> =15V, R <sub>L</sub> =1.6Ω, R <sub>GEN</sub> =3Ω		5.2		ns
t <sub>r</sub>	Turn-On Rise Time			3.8		ns
t <sub>D(off)</sub>	Turn-Off Delay Time			21.2		ns
t <sub>f</sub>	Turn-Off Fall Time			4.4		ns
t <sub>rr</sub>	Body Diode Reverse Recovery Time	I <sub>F</sub> =9.6A, di/dt=300A/μs		11.2	15	ns
Q <sub>rr</sub>	Body Diode Reverse Recovery Charge	I <sub>F</sub> =9.6A, di/dt=300A/μs		10.5		nC

A: The value of R<sub>θJA</sub> is measured with the device mounted on 1 in 2 FR-4 board with 2oz. Copper, in a still air environment with T<sub>A</sub>=25°C. The value in any given application depends on the user's specific board design.

B: Repetitive rating, pulse width limited by junction temperature T<sub>J(MAX)</sub>=150°C.

C: The R<sub>θJA</sub> is the sum of the thermal impedance from junction to lead R<sub>θJL</sub> 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<sub>A</sub>=25°C. The SOA curve provides a single pulse rating.

F: The current rating is based on the ≤ 10s thermal resistance rating.

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FET1 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

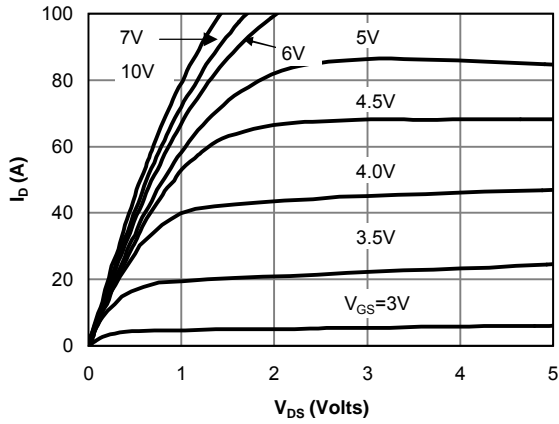


Figure 1: On-Region Characteristics

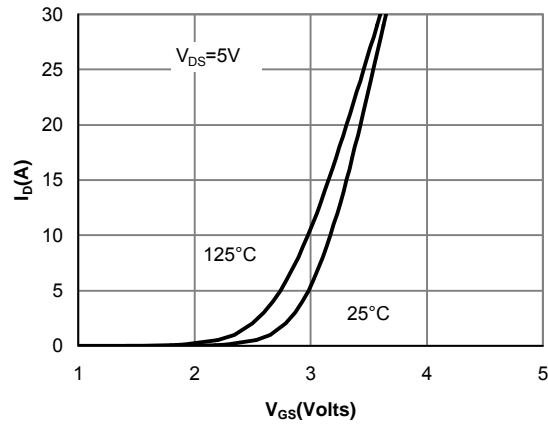


Figure 2: Transfer Characteristics

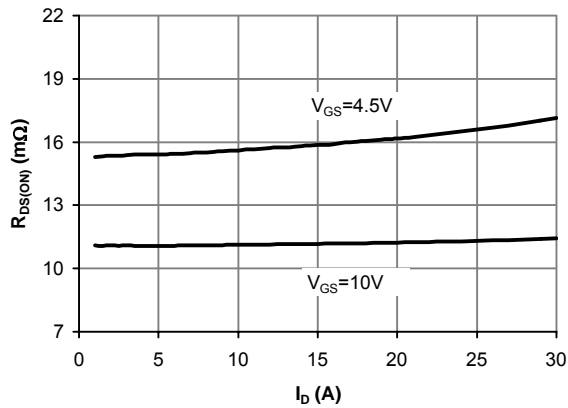


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

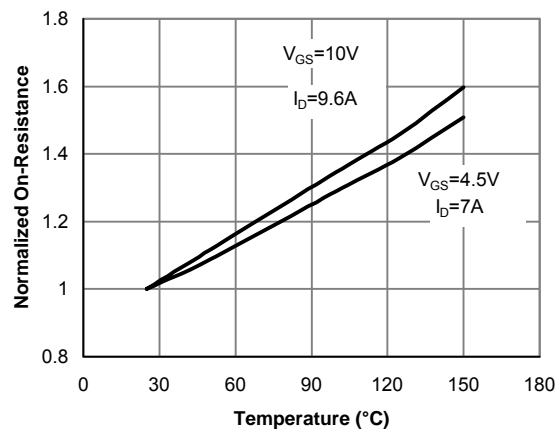


Figure 4: On-Resistance vs. Junction Temperature

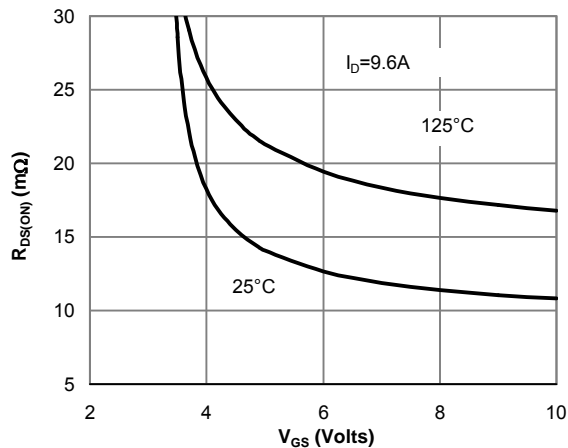


Figure 5: On-Resistance vs. Gate-Source Voltage

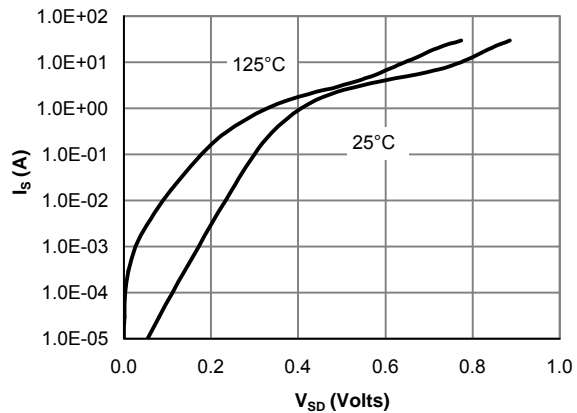


Figure 6: Body-Diode Characteristics

FET1 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

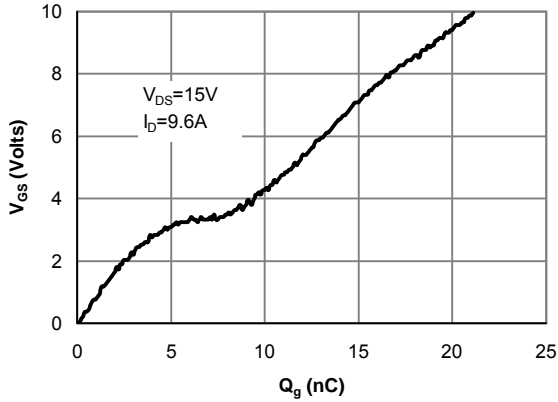


Figure 7: Gate-Charge Characteristics

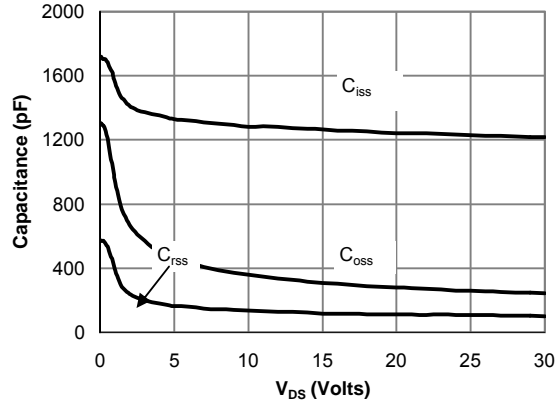


Figure 8: Capacitance Characteristics

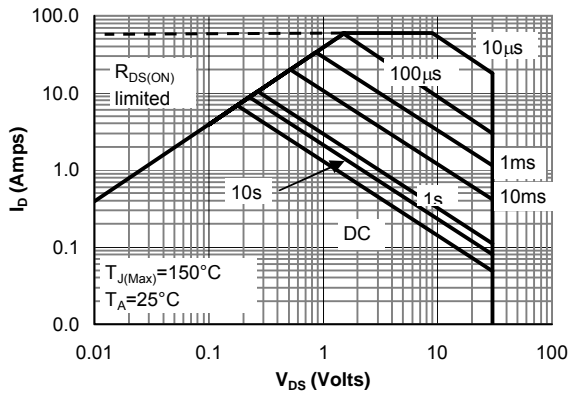


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

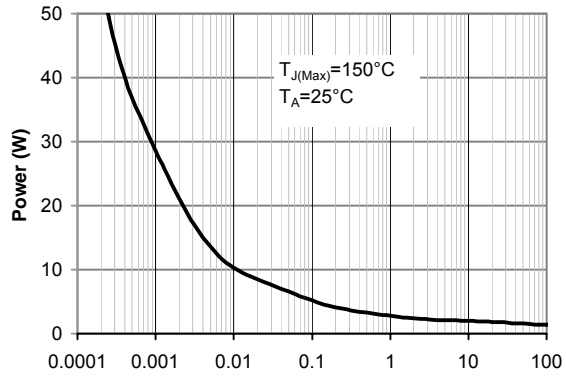


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

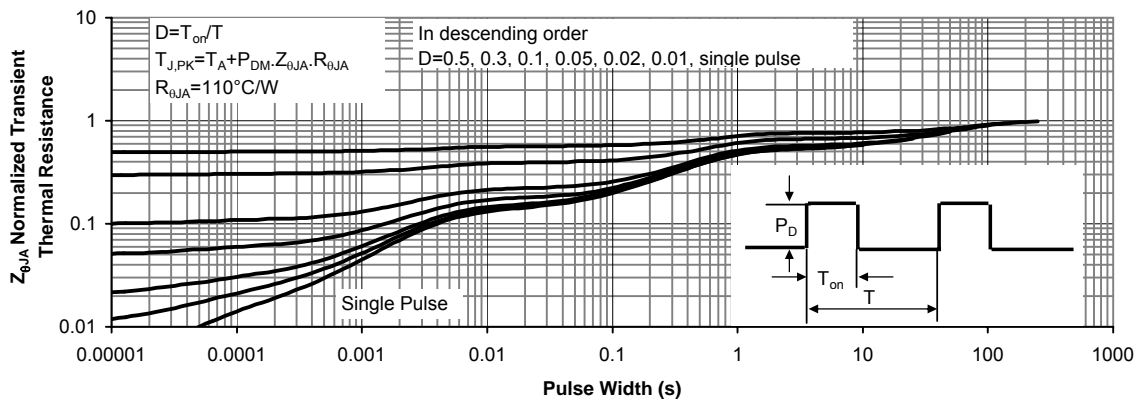


Figure 11: Normalized Maximum Transient Thermal Impedance

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>STATIC PARAMETERS</b>						
$BV_{DSS}$	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	$\mu\text{A}$
$I_{GSS}$	Gate-Body leakage current	$V_{DS}=0\text{V}$ , $V_{GS}=\pm 20\text{V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$ , $I_D=250\mu\text{A}$	1.4	1.65	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	$V_{GS}=10\text{V}$ , $I_D=9\text{A}$ $T_J=125^\circ\text{C}$		13.3	16	$\text{m}\Omega$
		$V_{GS}=4.5\text{V}$ , $I_D=7\text{A}$		21	26	$\text{m}\Omega$
$g_{FS}$	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
<b>DYNAMIC PARAMETERS</b>						
$C_{iss}$	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
$C_{riss}$	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	$\Omega$
<b>SWITCHING PARAMETERS</b>						
$Q_g(10\text{V})$	Total Gate Charge	$V_{GS}=10\text{V}$ , $V_{DS}=15\text{V}$ , $I_D=9\text{A}$		17	24	nC
$Q_g(4.5\text{V})$	Total Gate Charge			9	12	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	21	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 1in<sup>2</sup> 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 in<sup>2</sup> 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  $\leq 10\text{s}$  thermal resistance rating.

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FET2 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

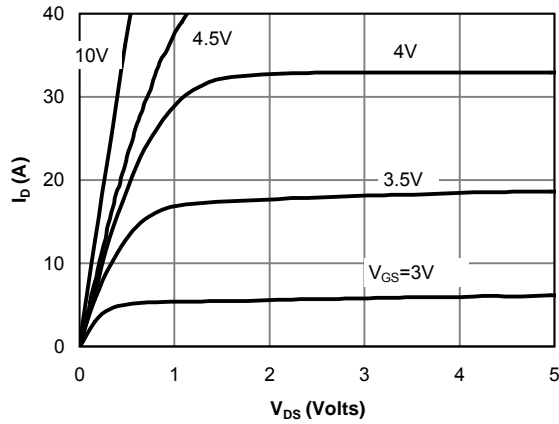


Figure 1: On-Region Characteristics

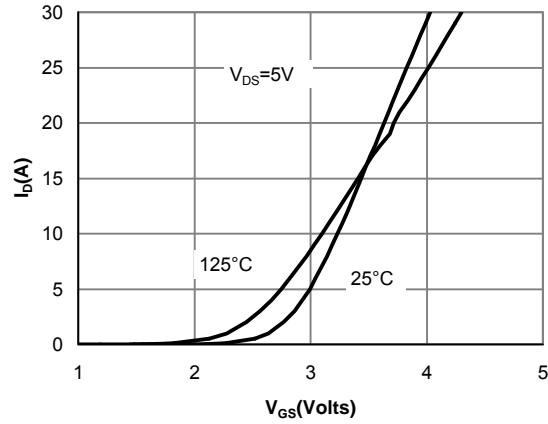


Figure 2: Transfer Characteristics

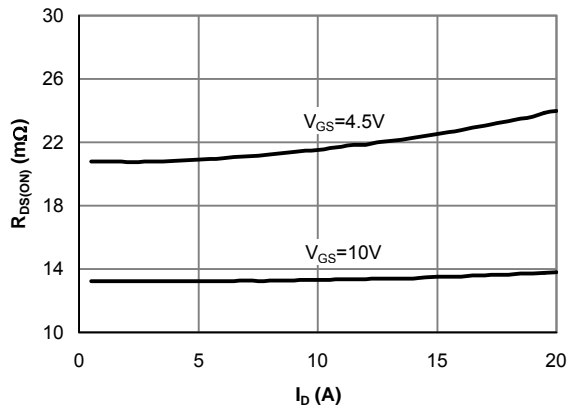


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

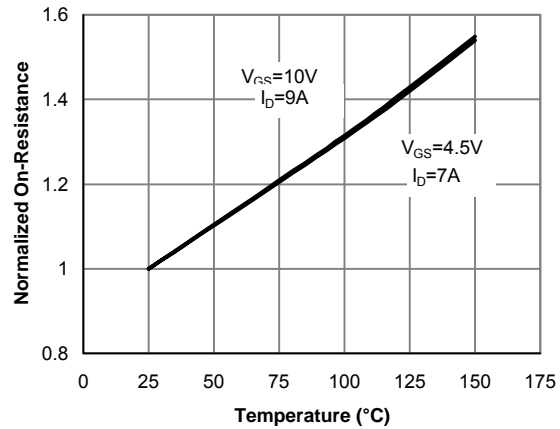


Figure 4: On-Resistance vs. Junction Temperature

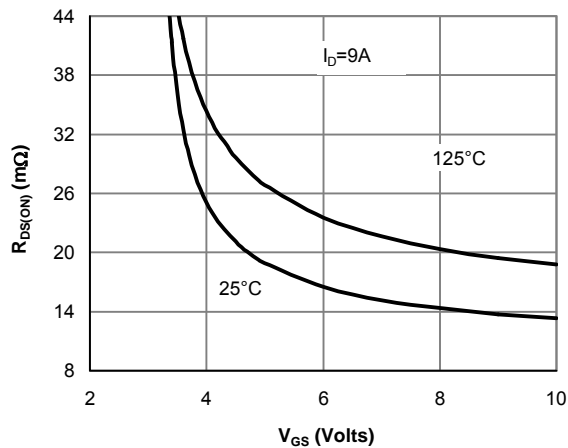


Figure 5: On-Resistance vs. Gate-Source Voltage

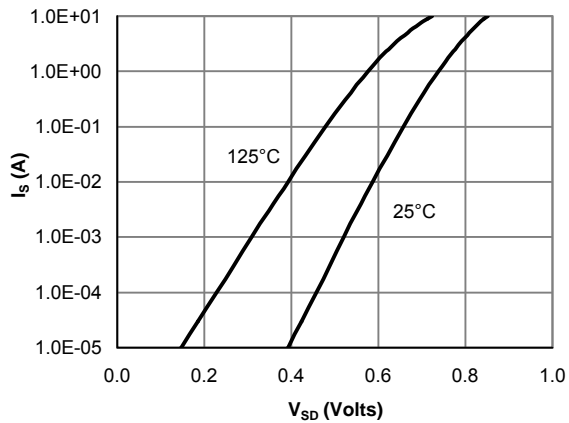


Figure 6: Body-Diode Characteristics

FET2 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

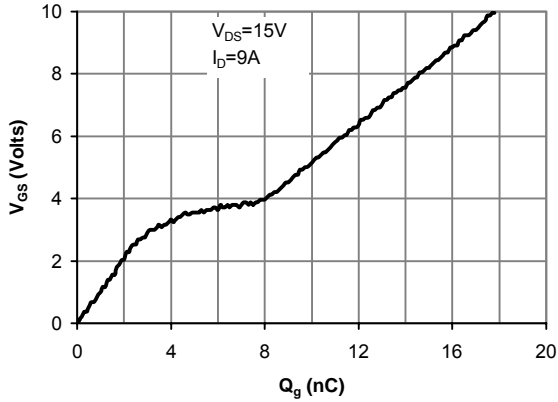


Figure 7: Gate-Charge Characteristics

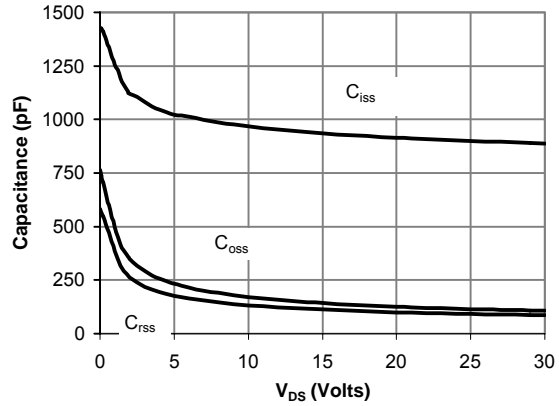


Figure 8: Capacitance Characteristics

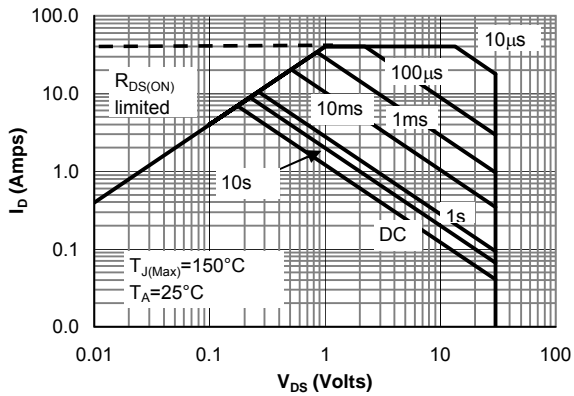


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

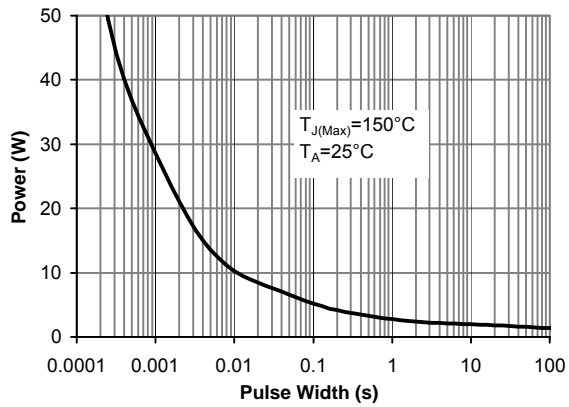


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

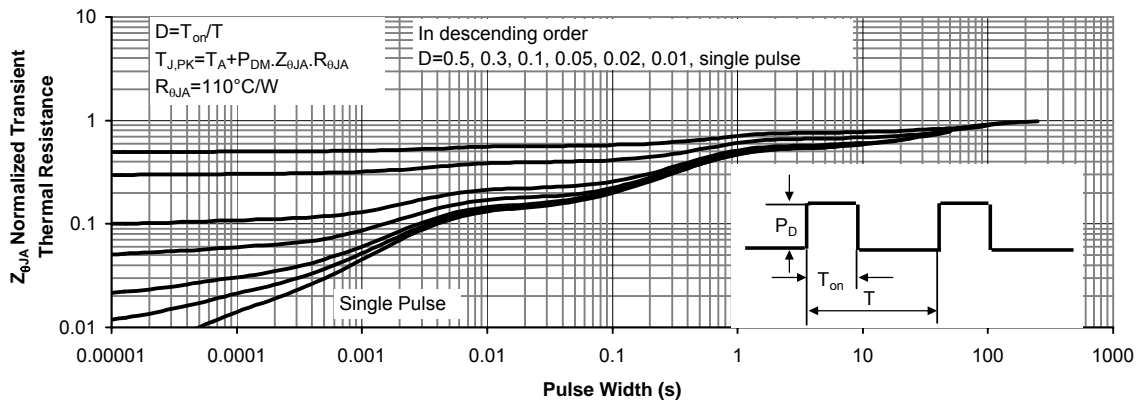


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