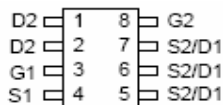
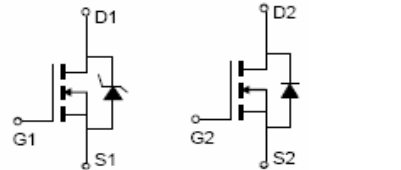


AO4938
Asymmetric Dual N-Channel Enhancement Mode Field Effect Transistor
SRFET™
General Description

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}	± 20		± 20		V
Continuous Drain Current ^{AF}	$T_A=25^\circ C$	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 ^B	I_{DM}	60		40		A
Avalanche Current ^B	I_{AR}	21		16		A
Repetitive avalanche energy $L=0.3mH$ ^B	E_{AR}	66		38		mJ
Power Dissipation ^A	$T_A=25^\circ C$	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 ^A $t \leq 10s$	$R_{\theta JA}$	48	62.5	$^\circ C/W$
Maximum Junction-to-Ambient ^A Steady-State		74	110	$^\circ C/W$
Maximum Junction-to-Lead ^C Steady-State	$R_{\theta JL}$	32	40	$^\circ C/W$

Thermal Characteristics FET2

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

FET1(Intergrated Schottky Diode) 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} =30V, V _{GS} =0V T _J =125°C			0.1 20	mA
I _{GSS}	Gate-Body leakage current	V _{DS} =0V, V _{GS} = ±20V			0.1	μA
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} I _D =250μA	1.3	1.65	2	V
I _{D(ON)}	On state drain current	V _{GS} =10V, V _{DS} =5V	60			A
R _{DS(ON)}	Static Drain-Source On-Resistance	V _{GS} =10V, I _D =9.6A T _J =125°C		11 16.5	13.5 21	mΩ
		V _{GS} =4.5V, I _D =7A		15.6	19.5	mΩ
g _{FS}	Forward Transconductance	V _{DS} =5V, I _D =9.6A		37		S
V _{SD}	Diode Forward Voltage	I _S =1A, V _{GS} =0V		0.40	0.5	V
I _S	Maximum Body-Diode + Schottky Continuous Current				3.5	A
DYNAMIC PARAMETERS						
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =15V, f=1MHz		1267	1600	pF
C _{oss}	Output Capacitance			308		pF
C _{rss}	Reverse Transfer Capacitance			118		pF
R _g	Gate resistance	V _{GS} =0V, V _{DS} =0V, f=1MHz		1.3	2.0	Ω
SWITCHING PARAMETERS						
Q _g (10V)	Total Gate Charge	V _{GS} =10V, V _{DS} =15V, I _D =9.6A		21	30	
Q _g (4.5V)	Total Gate Charge			10.4		nC
Q _{gs}	Gate Source Charge			3.0		nC
Q _{gd}	Gate Drain Charge			3.6		nC
t _{D(on)}	Turn-On Delay Time	V _{GS} =10V, V _{DS} =15V, R _L =1.6Ω, R _{GEN} =3Ω		5.2		ns
t _r	Turn-On Rise Time			3.8		ns
t _{D(off)}	Turn-Off Delay Time			21.2		ns
t _f	Turn-Off Fall Time			4.4		ns
t _{rr}	Body Diode Reverse Recovery Time	I _F =9.6A, di/dt=300A/μs		11.2	15	ns
Q _{rr}	Body Diode Reverse Recovery Charge	I _F =9.6A, di/dt=300A/μs		10.5		nC

A: The value of R_{θJA} 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.

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

C: The R_{θJA} is the sum of the thermal impedance from junction to lead R_{θJL} 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.

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

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FET1 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

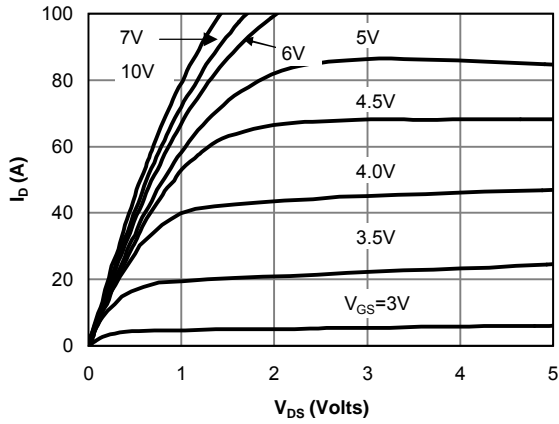


Figure 1: On-Region Characteristics

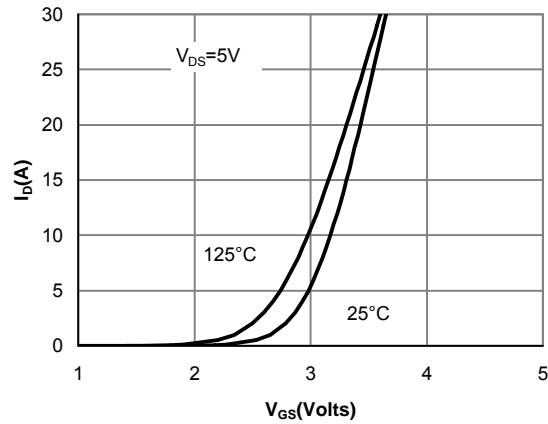


Figure 2: Transfer Characteristics

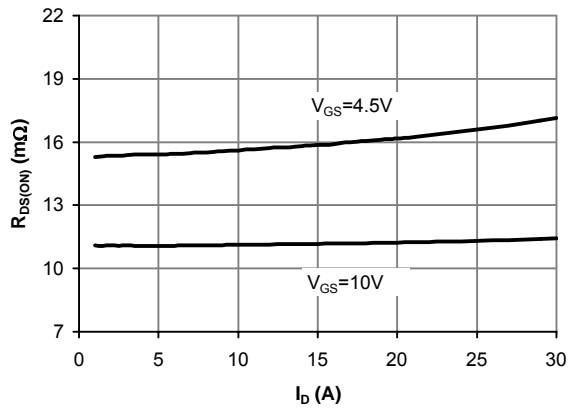


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

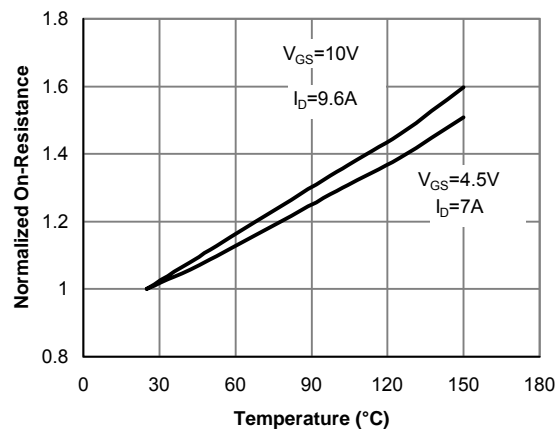


Figure 4: On-Resistance vs. Junction Temperature

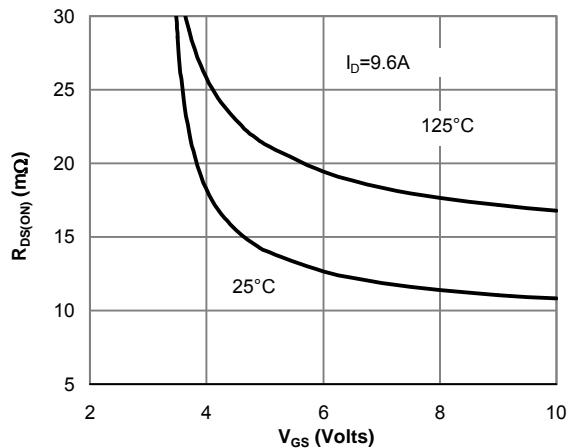


Figure 5: On-Resistance vs. Gate-Source Voltage

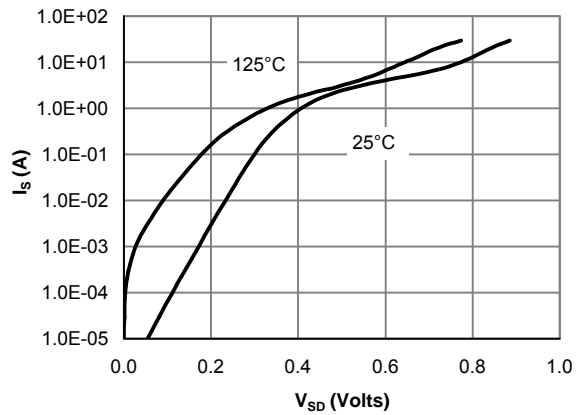


Figure 6: Body-Diode Characteristics

FET1 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

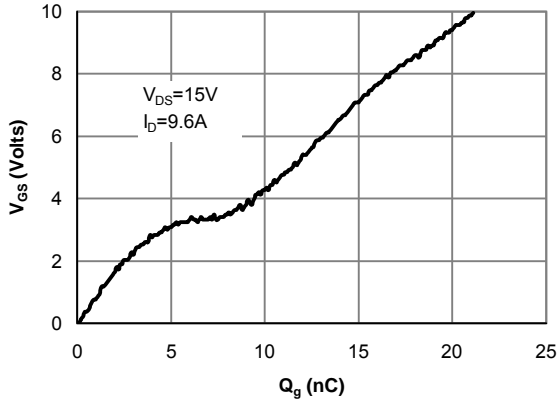


Figure 7: Gate-Charge Characteristics

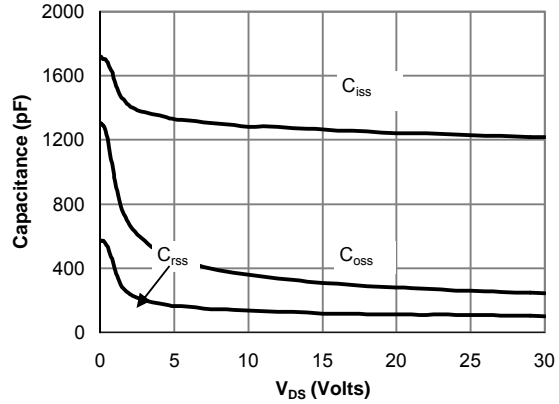


Figure 8: Capacitance Characteristics

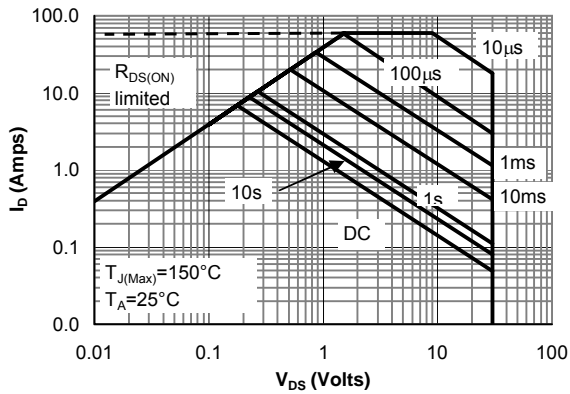


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

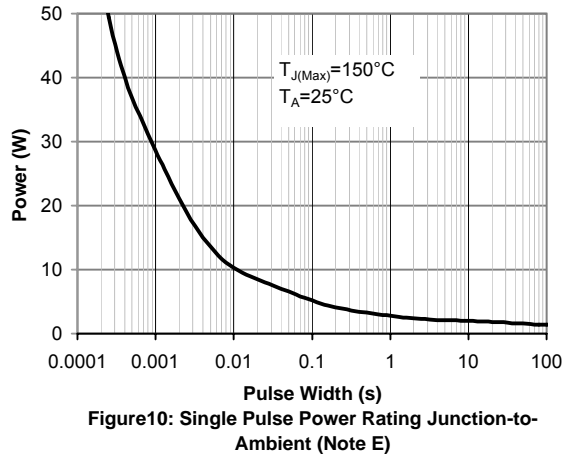


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

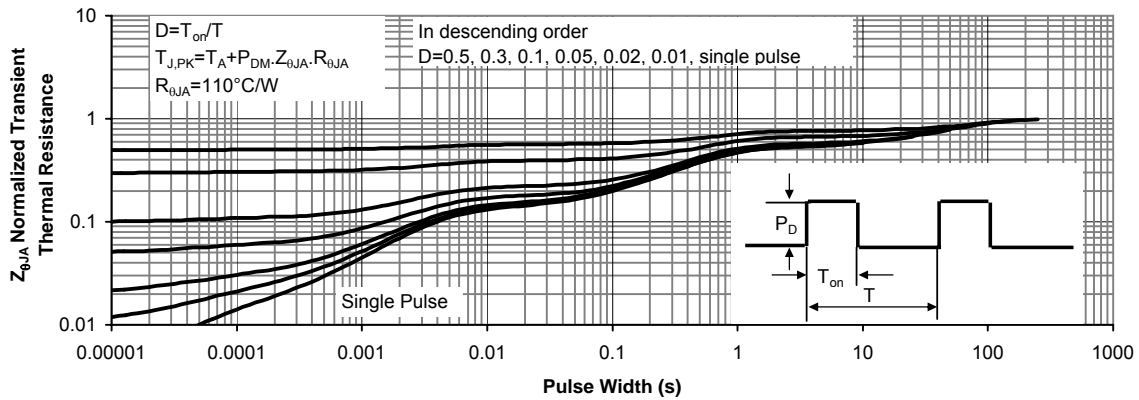


Figure 11: Normalized Maximum Transient Thermal Impedance

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
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	$V_{DS}=V_{GS}, I_D=250\mu\text{A}$	1.4	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
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_{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	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	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 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 $\leq 10\text{s}$ thermal resistance rating.

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FET2 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

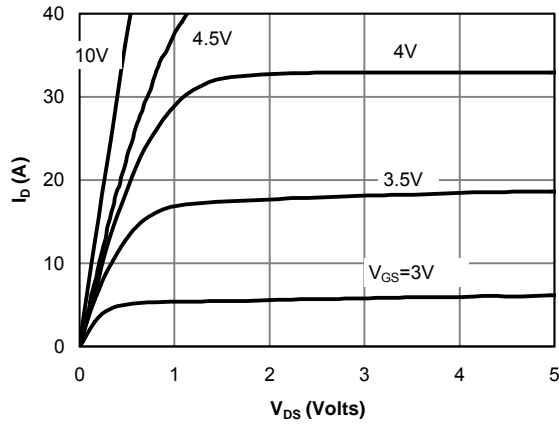


Figure 1: On-Region Characteristics

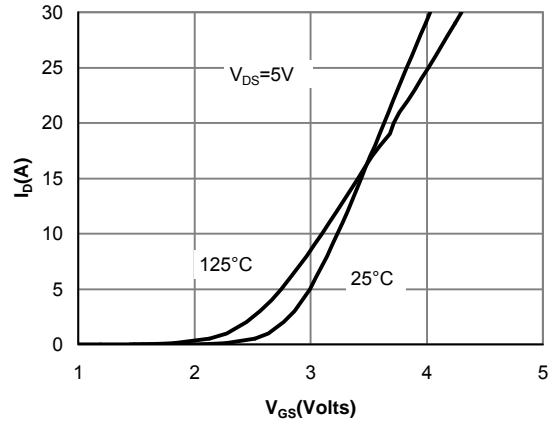


Figure 2: Transfer Characteristics

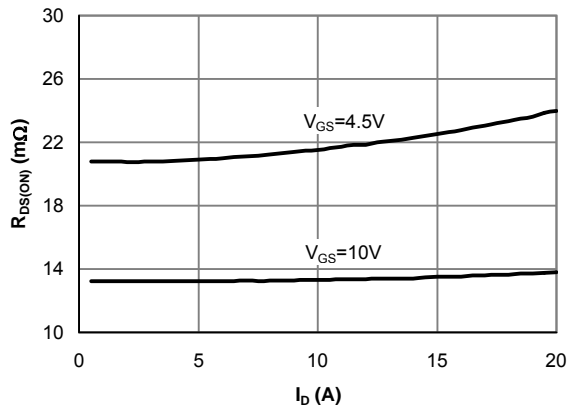


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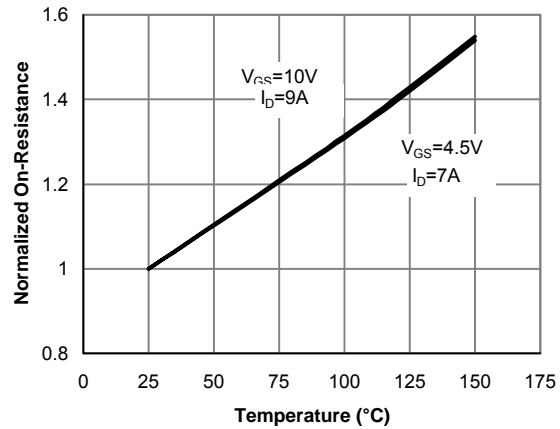


Figure 4: On-Resistance vs. Junction Temperature

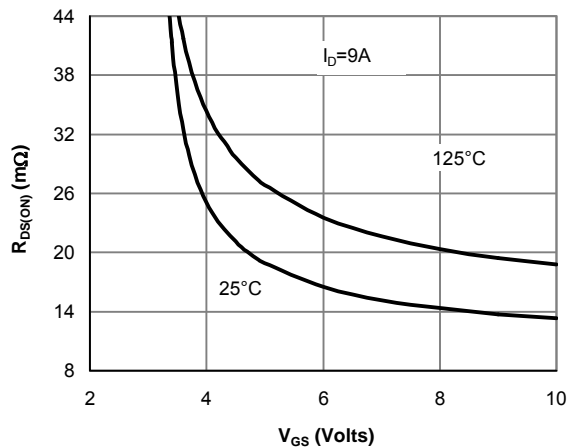


Figure 5: On-Resistance vs. Gate-Source Voltage

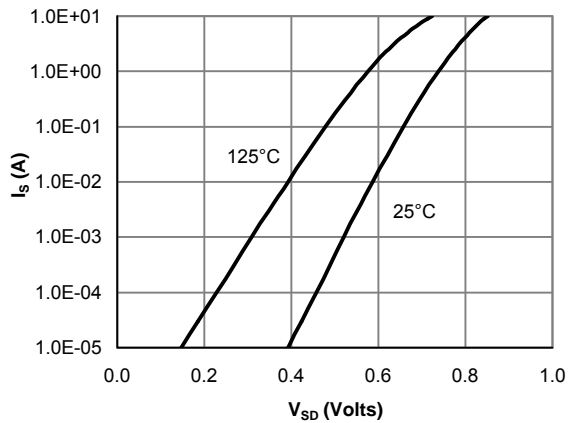


Figure 6: Body-Diode Characteristics

FET2 TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

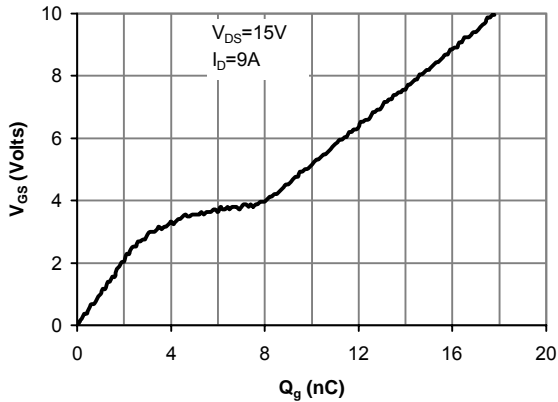


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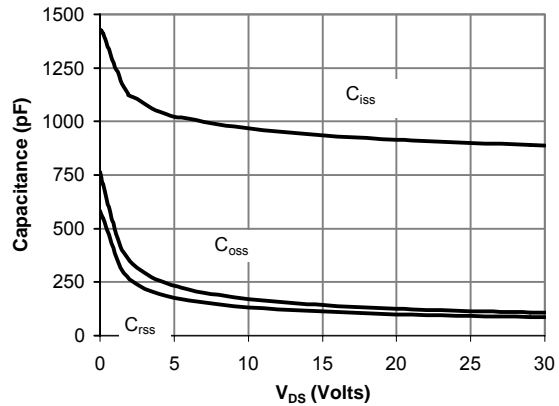


Figure 8: Capacitance Characteristics

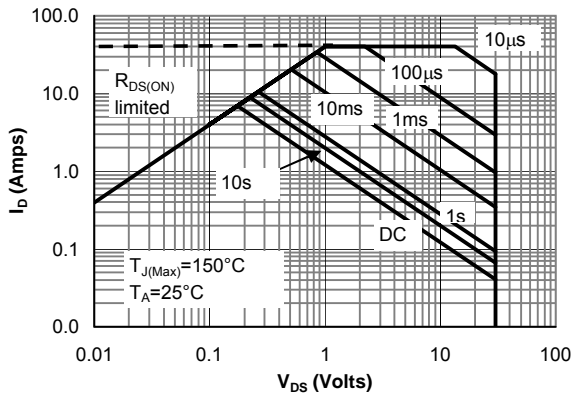


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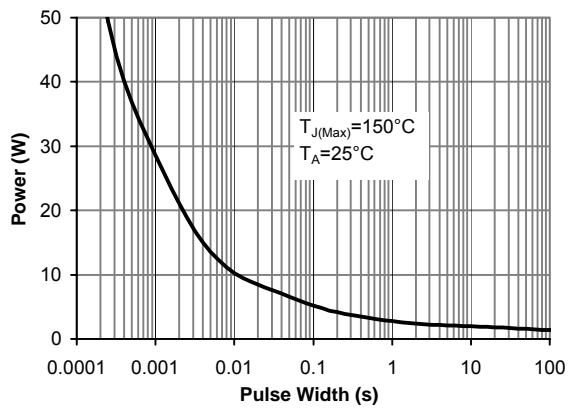


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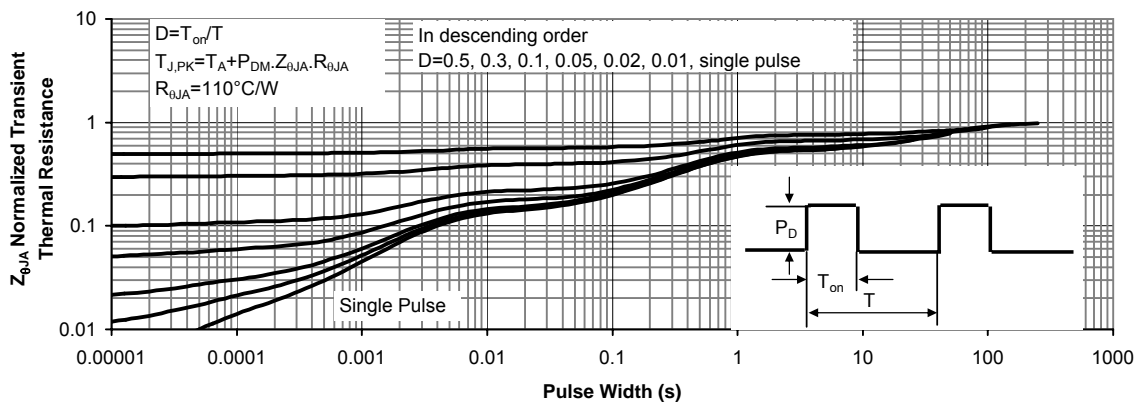


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