

# Complementary MOSFET with schottky diode

ELM14607AA-N

## General description

ELM14607AA-N uses advanced trench technology to provide excellent  $R_{ds(on)}$  and low gate charge.

## Features

- N-channel
- $V_{ds}=30V$
- $I_d=6.9A$  ( $V_{gs}=10V$ )
- $R_{ds(on)} < 28m\Omega$  ( $V_{gs}=10V$ )
- $R_{ds(on)} < 42m\Omega$  ( $V_{gs}=4.5V$ )
- P-channel
- $V_{ds}=-30V$
- $I_d=-6A$  ( $V_{gs}=-10V$ )
- $R_{ds(on)} < 35m\Omega$  ( $V_{gs}=-10V$ )
- $R_{ds(on)} < 58m\Omega$  ( $V_{gs}=-4.5V$ )
- Schottky diode
- $V_{ds}(V)=30V$
- $I_f=3A$
- $V_f < 0.5V@1A$

## Maximum absolute ratings

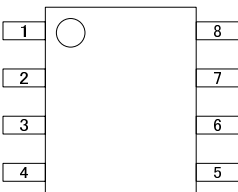
Parameter	Symbol	N-ch (Max.)	P-ch (Max.)	Schottky(Max.)	Unit	Note
Drain-source voltage	$V_{ds}$	30	-30		V	
Gate-source voltage	$V_{gs}$	$\pm 20$	$\pm 20$		V	
Continuous drain current	$T_a=25^\circ C$	6.9	-6.0		A	1
	$T_a=70^\circ C$	5.8	-5.0			
Pulsed drain current	$I_{dm}$	30	-30		A	2
Reverse voltage	$V_{ds}$			30	V	
Continuous forward current	$T_a=25^\circ C$			3	A	1
	$T_a=70^\circ C$			2		
Pulsed diode forward current	$I_{fm}$			20	A	2
Power dissipation	$T_a=25^\circ C$	2.00	2.00	2.00	W	1
	$T_a=70^\circ C$	1.28	1.28	1.28		
Junction and storage temperature range	$T_j, T_{stg}$	-55 to 150	-55 to 150	-55 to 150	$^\circ C$	

## Thermal characteristics

Parameter	Symbol	Device	Typ.	Max.	Unit	Note	
Maximum junction-to-ambient	$t \leq 10s$	R $\theta_{ja}$	N-ch	48.0	62.5	$^\circ C/W$	1
Maximum junction-to-ambient	Steady-state			74.0	110.0		
Maximum junction-to-lead	Steady-state			35.0	60.0		
Maximum junction-to-ambient	$t \leq 10s$	R $\theta_{ja}$	P-ch	48.0	62.5	$^\circ C/W$	1
Maximum junction-to-ambient	Steady-state			74.0	110.0		
Maximum junction-to-lead	Steady-state			35.0	40.0		
Maximum junction-to-ambient	$t \leq 10s$	R $\theta_{ja}$	Schottky	47.5	62.5	$^\circ C/W$	1
Maximum junction-to-ambient	Steady-state			71.0	110.0		
Maximum junction-to-lead	Steady-state			32.0	40.0		

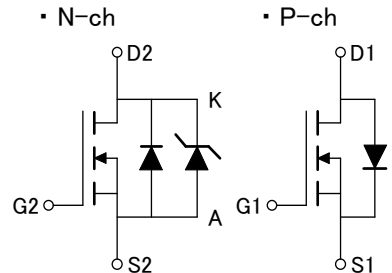
## Pin configuration

SOP-8 (TOP VIEW)



Pin No.	Pin name
1	SOURCE2/ANODE
2	GATE2
3	SOURCE1
4	GATE1
5	DRAIN1
6	DRAIN1
7	DRAIN2/CATHODE
8	DRAIN2/CATHODE

## Circuit



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## ■ Electrical characteristics (N-ch + Schottky)

T<sub>a</sub>=25°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
<b>STATIC PARAMETERS</b>						
Drain-source breakdown voltage	BV <sub>dss</sub>	I <sub>d</sub> =250 μA, V <sub>gs</sub> =0V	30			V
Zero gate voltage drain current (Set by Schottky leakage)	I <sub>dss</sub>	V <sub>r</sub> =30V		0.007	0.050	mA
		V <sub>r</sub> =30V, T <sub>j</sub> =125°C		3.2	10.0	
		V <sub>r</sub> =30V, T <sub>j</sub> =150°C		12.0	20.0	
Gate-body leakage current	I <sub>gss</sub>	V <sub>ds</sub> =0V, V <sub>gs</sub> =±20V			100	nA
Gate threshold voltage	V <sub>gs(th)</sub>	V <sub>ds</sub> =V <sub>gs</sub> , I <sub>d</sub> =250 μA	1.0	1.9	3.0	V
On state drain current	I <sub>d(on)</sub>	V <sub>gs</sub> =4.5V, V <sub>ds</sub> =5V	20			A
Static drain-source on-resistance	R <sub>ds(on)</sub>	V <sub>gs</sub> =10V		22.5	28.0	mΩ
		I <sub>d</sub> =6.9A	T <sub>j</sub> =125°C	31.3	38.0	
		V <sub>gs</sub> =4.5V, I <sub>d</sub> =5A		34.5	42.0	
Forward transconductance	G <sub>fs</sub>	V <sub>ds</sub> =5V, I <sub>d</sub> =6.9A	10.0	15.4		S
Body diode+Schottky forward voltage	V <sub>sd</sub>	I <sub>s</sub> =1A		0.45	0.50	V
Max. body-diode+Schottky continuous current	I <sub>s</sub>				5.5	A
<b>DYNAMIC PARAMETERS</b>						
Input capacitance	C <sub>iss</sub>			680	820	pF
Output capacitance (FET+Schottky)	C <sub>oss</sub>	V <sub>gs</sub> =0V, V <sub>ds</sub> =15V, f=1MHz		131		pF
Reverse transfer capacitance	C <sub>rss</sub>			77		pF
Gate resistance	R <sub>g</sub>	V <sub>gs</sub> =0V, V <sub>ds</sub> =0V, f=1MHz		3.0	3.6	Ω
<b>SWITCHING PARAMETERS</b>						
Total gate charge (10V)	Q <sub>g</sub>	V <sub>gs</sub> =10V, V <sub>ds</sub> =15V, I <sub>d</sub> =6.9A		13.84	16.60	nC
Total gate charge (4.5V)	Q <sub>g</sub>			6.74		nC
Gate-source charge	Q <sub>gs</sub>			1.82		nC
Gate-drain charge	Q <sub>gd</sub>			3.20		nC
Turn-on delay time	t <sub>d(on)</sub>			4.6		ns
Turn-on rise time	t <sub>r</sub>	V <sub>gs</sub> =10V, V <sub>ds</sub> =15V		4.1		ns
Turn-off delay time	t <sub>d(off)</sub>	R <sub>l</sub> =2.2 Ω, R <sub>gen</sub> =3 Ω		20.6		ns
Turn-off fall time	t <sub>f</sub>			5.2		ns
Body diode+Schottky reverse recovery time	t <sub>rr</sub>	I <sub>f</sub> =6.9A, dI/dt=100A/μs		13.7	16.5	ns
Body diode+Schottky reverse recovery charge	Q <sub>rr</sub>	I <sub>f</sub> =6.9A, dI/dt=100A/μs		4.1		nC

### NOTE :

- The value of R<sub>θja</sub> is measured with the device mounted on 1in<sup>2</sup> FR-4 board of 2oz. Copper, in still air environment with T<sub>a</sub>=25°C. The value in any given applications depends on the user's specific board design. The current rating is based on the t ≤ 10s thermal resistance rating.
- Repetitive rating, pulse width limited by junction temperature.
- The R<sub>θja</sub> is the sum of the thermal impedance from junction to lead R<sub>θjl</sub> and lead to ambient.
- The static characteristics in Figures 1 to 6 are obtained using 80μs pulses, duty cycle 0.5%max.
- These tests are performed with the device mounted on 1in<sup>2</sup> 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.
- The Schottky appears in parallel with the MOSFET body diode, even though it is a separate chip. Therefore, we provide the net forward drop, capacitance and recovery characteristics of the MOSFET and Schottky. However, the thermal resistance is specified for each chip separately.

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## Typical electrical and thermal characteristics (N-ch)

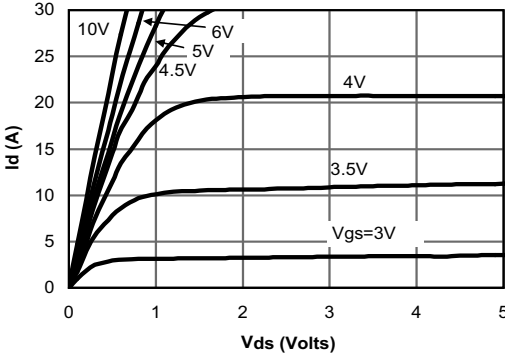


Figure 1: On-Region Characteristics

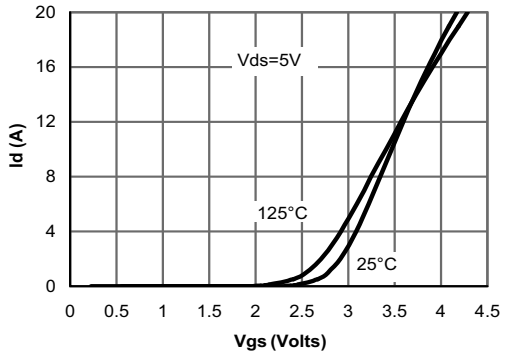


Figure 2: Transfer Characteristics

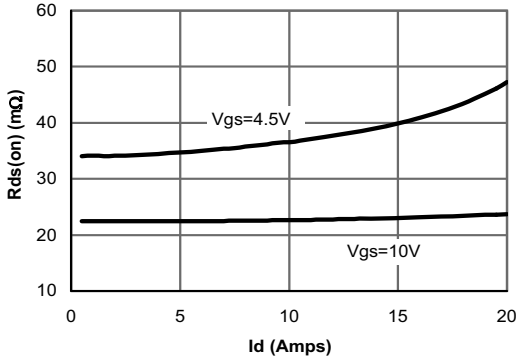


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

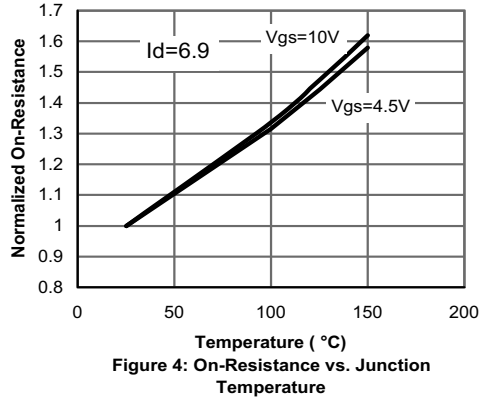


Figure 4: On-Resistance vs. Junction Temperature

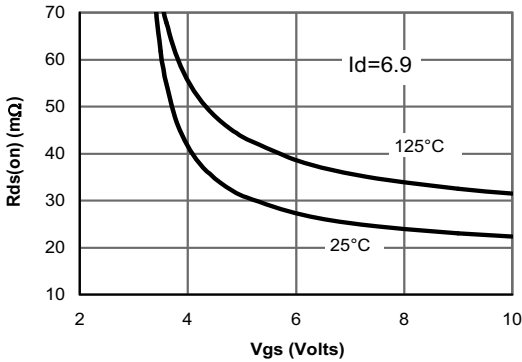


Figure 5: On-Resistance vs. Gate-Source Voltage

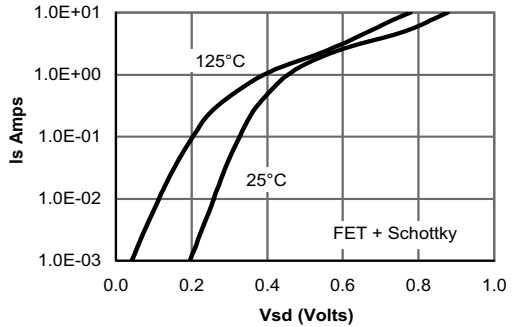


Figure 6: Body diode with parallel Schottky characteristics (Note F)

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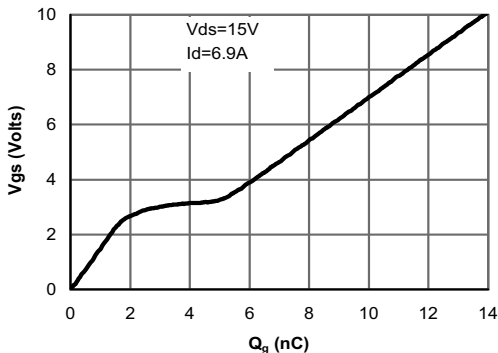


Figure 7: Gate-Charge characteristics

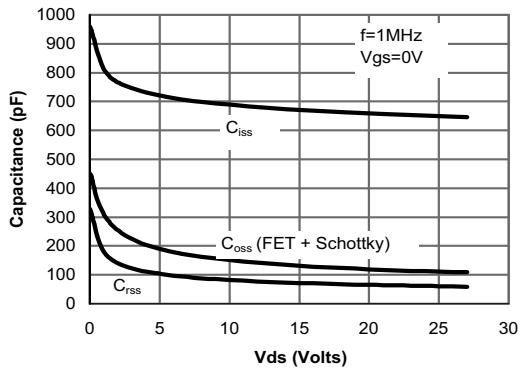


Figure 8: Capacitance Characteristics: MOSFET + Parallel Schottky

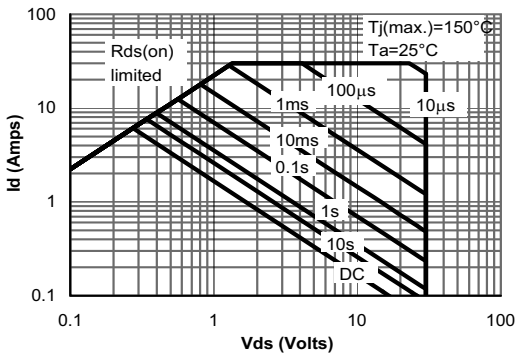


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

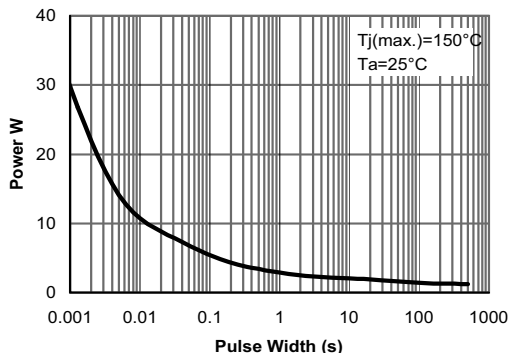


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

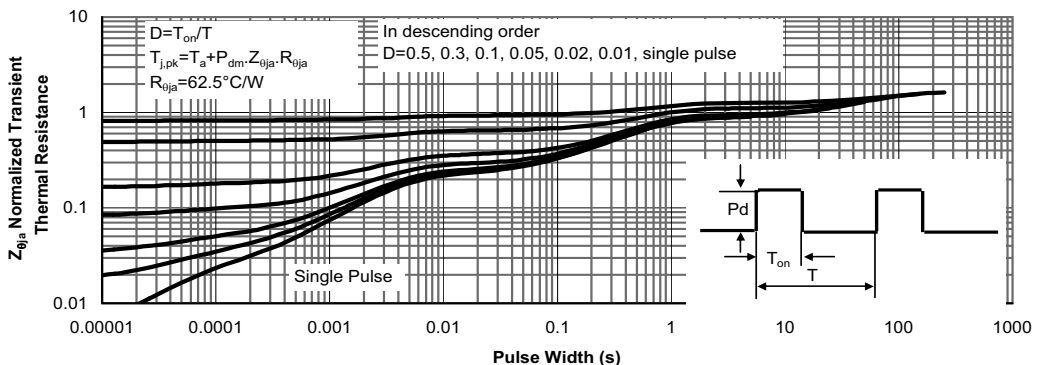


Figure 11: Normalized Maximum Transient Thermal Impedance

# Complementary MOSFET with schottky diode

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### ■ Electrical characteristics (P-ch)

T<sub>a</sub>=25°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	
<b>STATIC PARAMETERS</b>							
Drain-source breakdown voltage	BV <sub>dss</sub>	I <sub>d</sub> =-250 μA, V <sub>gs</sub> =0V	-30			V	
Zero gate voltage drain current	I <sub>dss</sub>	V <sub>ds</sub> =-24V V <sub>gs</sub> =0V T <sub>j</sub> =55°C			-1 -5	μA	
Gate-body leakage current	I <sub>gss</sub>	V <sub>ds</sub> =0V, V <sub>gs</sub> =±20V			±100	nA	
Gate threshold voltage	V <sub>gs(th)</sub>	V <sub>ds</sub> =V <sub>gs</sub> , I <sub>d</sub> =-250 μA	-1.2	-2.0	-2.4	V	
On state drain current	I <sub>d(on)</sub>	V <sub>gs</sub> =-10V, V <sub>ds</sub> =-5V	-30			A	
Static drain-source on-resistance	R <sub>ds(on)</sub>	V <sub>gs</sub> =-10V		28	35	mΩ	
		I <sub>d</sub> =-6A T <sub>j</sub> =125°C		37	45		
		V <sub>gs</sub> =-4.5V, I <sub>d</sub> =-5A		44	58	mΩ	
Forward transconductance	G <sub>fs</sub>	V <sub>ds</sub> =-5V, I <sub>d</sub> =-6A		13		S	
Diode forward voltage	V <sub>sd</sub>	I <sub>s</sub> =-1A, V <sub>gs</sub> =0V		-0.76	-1.00	V	
Max. body-diode continuous current	I <sub>s</sub>				-4.2	A	
<b>DYNAMIC PARAMETERS</b>							
Input capacitance	C <sub>iss</sub>	V <sub>gs</sub> =0V, V <sub>ds</sub> =-15V, f=1MHz		920	1100	pF	
Output capacitance	C <sub>oss</sub>			190		pF	
Reverse transfer capacitance	C <sub>rss</sub>			122		pF	
Gate resistance	R <sub>g</sub>	V <sub>gs</sub> =0V, V <sub>ds</sub> =0V, f=1MHz		3.6	4.4	Ω	
<b>SWITCHING PARAMETERS</b>							
Total gate charge (10V)	Q <sub>g</sub>	V <sub>gs</sub> =-10V, V <sub>ds</sub> =-15V, I <sub>d</sub> =-6A		18.5	22.2	nC	
Total gate charge (4.5V)	Q <sub>g</sub>			9.6		nC	
Gate-source charge	Q <sub>gs</sub>			2.7		nC	
Gate-drain charge	Q <sub>gd</sub>			4.5		nC	
Turn-on delay time	t <sub>d(on)</sub>				7.7		ns
Turn-on rise time	t <sub>r</sub>		V <sub>gs</sub> =-10V, V <sub>ds</sub> =-15V		5.7		ns
Turn-off delay time	t <sub>d(off)</sub>	R <sub>l</sub> =2.7 Ω, R <sub>gen</sub> =3 Ω		20.2		ns	
Turn-off fall time	t <sub>f</sub>			9.5		ns	
Body diode reverse recovery time	t <sub>rr</sub>	I <sub>f</sub> =-6A, dI/dt=100A/μs		20.0	24.0	ns	
Body diode reverse recovery charge	Q <sub>rr</sub>	I <sub>f</sub> =-6A, dI/dt=100A/μs		8.8		nC	

#### NOTE :

1. The value of R<sub>θja</sub> is measured with the device mounted on 1in<sup>2</sup> FR-4 board of 2oz. Copper, in still air environment with T<sub>a</sub>=25°C. The value in any given applications depends on the user's specific board design. The current rating is based on the t ≤ 10s thermal resistance rating.
2. Repetitive rating, pulse width limited by junction temperature.
3. The R<sub>θja</sub> is the sum of the thermal impedance from junction to lead R<sub>θjl</sub> and lead to ambient.
4. The static characteristics in Figures 1 to 6 are obtained using 80μs pulses, duty cycle 0.5%max.
5. These tests are performed with the device mounted on 1in<sup>2</sup> 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.

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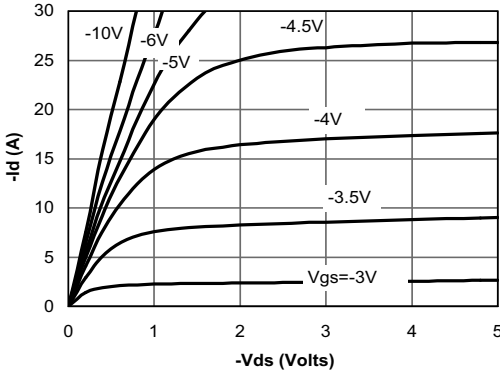


Fig 1: On-Region Characteristics

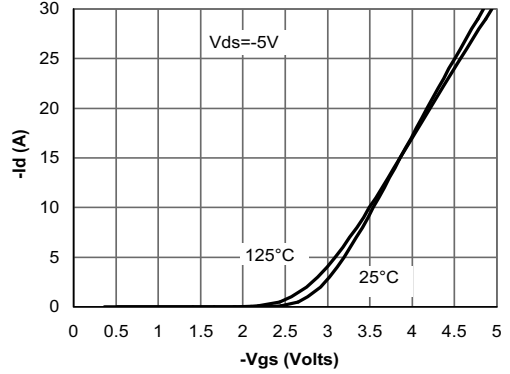


Figure 2: Transfer Characteristics

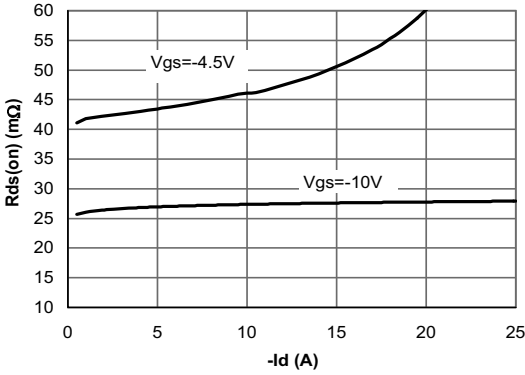


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

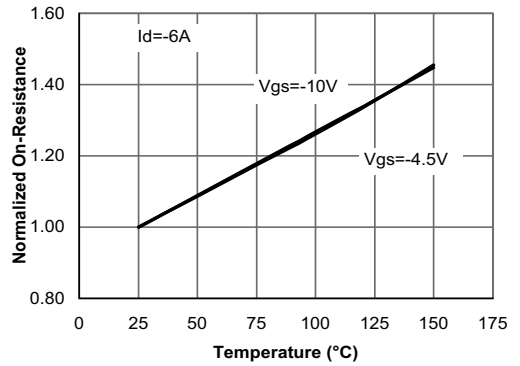


Figure 4: On-Resistance vs. Junction Temperature

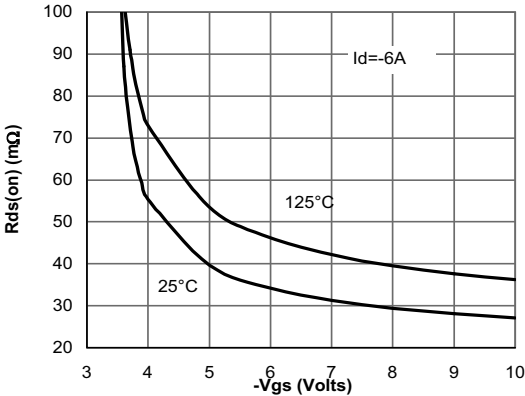


Figure 5: On-Resistance vs. Gate-Source Voltage

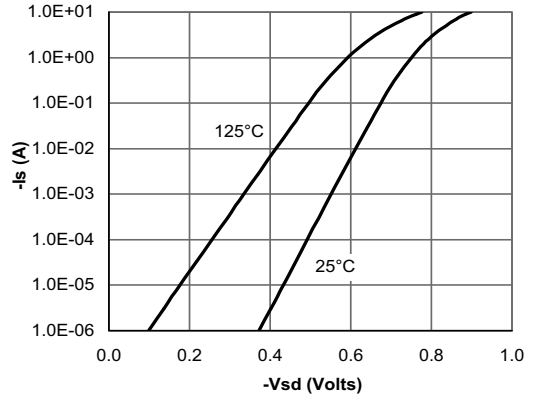


Figure 6: Body-Diode Characteristics

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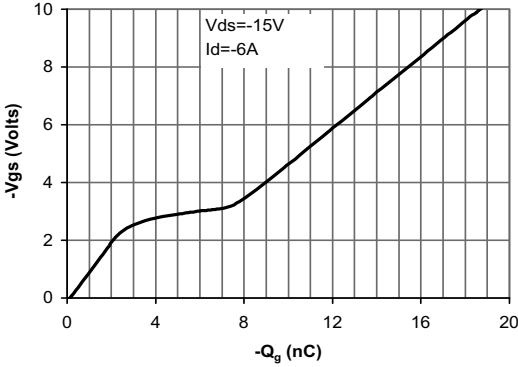


Figure 7: Gate-Charge Characteristics

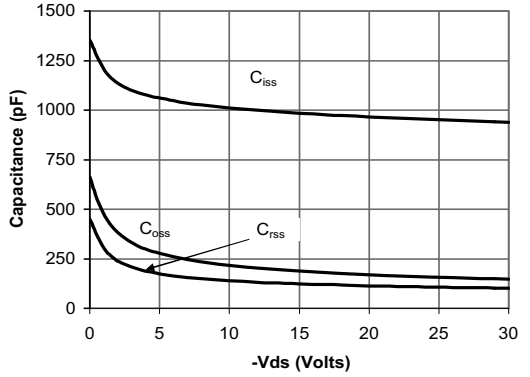


Figure 8: Capacitance Characteristics

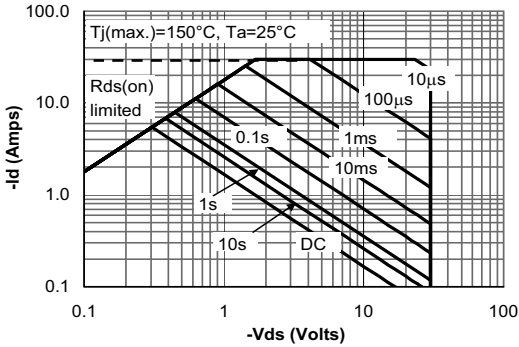


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

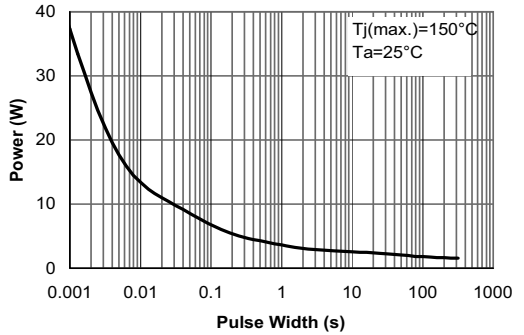


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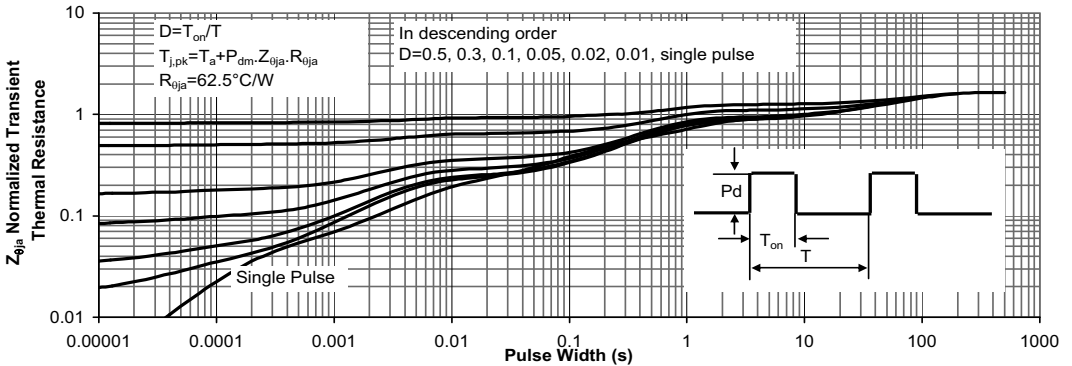


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