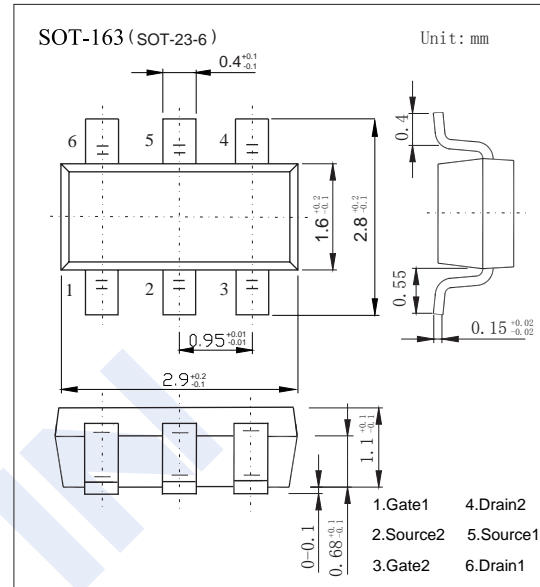
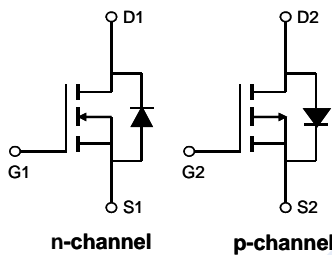


Complementary Trench MOSFET

2NP02

■ Features

- N-Channel: $V_{DS}=20V$ $I_D=3.4A$
 - $R_{DS(ON)} < 30m\Omega$ ($V_{GS} = 4.5V$)
 - $R_{DS(ON)} < 36m\Omega$ ($V_{GS} = 2.5V$)
 - $R_{DS(ON)} < 52m\Omega$ ($V_{GS} = 1.8V$)
- P-Channel: $V_{DS}=-20V$ $I_D=-2.5A$
 - $R_{DS(ON)} < 75m\Omega$ ($V_{GS} = -4.5V$)
 - $R_{DS(ON)} < 95m\Omega$ ($V_{GS} = -2.5V$)
 - $R_{DS(ON)} < 115m\Omega$ ($V_{GS} = -1.8V$)



■ Absolute Maximum Ratings $T_a = 25^\circ C$

Parameter	Symbol	N-Channel	P-Channel	Unit
Drain-Source Voltage	V_{DS}	20	-20	V
Gate-Source Voltage	V_{GS}	± 8		
Continuous Drain Current	I_D	$T_a = 25^\circ C$	3.4	A
		$T_a = 70^\circ C$	2.5	
Pulsed Drain Current	I_{DM}	13	-13	
Power Dissipation	P_D	$T_a = 25^\circ C$	1.1	
		$T_a = 70^\circ C$	0.7	
Thermal Resistance.Junction- to-Ambient $t \leq 10s$	R_{thJA}	110		$^\circ C/W$
		Steady-State		
Thermal Resistance.Junction- to-Lead	R_{thJL}	80		
Junction Temperature	T_J	150		$^\circ C$
Storage Temperature Range	T_{stg}	-55 to 150		

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■ N-Channel Electrical Characteristics $T_a = 25^\circ\text{C}$

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Drain-Source Breakdown Voltage	V_{DS}	$I_D=250\ \mu\text{A}$, $V_{GS}=0\text{V}$	20			V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS}=20\text{V}$, $V_{GS}=0\text{V}$			1	μA
		$V_{DS}=20\text{V}$, $V_{GS}=0\text{V}$, $T_J=55^\circ\text{C}$			5	
Gate-Body Leakage Current	I_{GSS}	$V_{DS}=0\text{V}$, $V_{GS}=\pm 8\text{V}$			± 100	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$, $I_D=250\ \mu\text{A}$	0.4	0.7	1	V
Static Drain-Source On-Resistance	$R_{DS(on)}$	$V_{GS}=4.5\text{V}$, $I_D=3.4\text{A}$			30	m Ω
		$V_{GS}=4.5\text{V}$, $I_D=3.4\text{A}$, $T_J=125^\circ\text{C}$			55	
		$V_{GS}=2.5\text{V}$, $I_D=3\text{A}$			36	
		$V_{GS}=1.8\text{V}$, $I_D=2\text{A}$			52	
On State Drain Current	$I_{D(on)}$	$V_{GS}=4.5\text{V}$, $V_{DS}=5\text{V}$	13			A
Forward Transconductance	g_{FS}	$V_{DS}=5\text{V}$, $I_D=3.4\text{A}$		16		S
Input Capacitance	C_{iss}	$V_{GS}=0\text{V}$, $V_{DS}=10\text{V}$, $f=1\text{MHz}$	205	260	320	pF
Output Capacitance	C_{oss}		33	48	63	
Reverse Transfer Capacitance	C_{rss}		16	27	38	
Gate Resistance	R_g	$V_{GS}=0\text{V}$, $V_{DS}=0\text{V}$, $f=1\text{MHz}$	1.5	3	4.5	Ω
Total Gate Charge (4.5V)	Q_g	$V_{GS}=4.5\text{V}$, $V_{DS}=10\text{V}$, $I_D=3.4\text{A}$		2.9	3.8	nC
Gate Source Charge	Q_{gs}		0.4			
Gate Drain Charge	Q_{gd}		0.6			
Turn-On Delay Time	$t_{d(on)}$	$V_{GS}=5\text{V}$, $V_{DS}=10\text{V}$, $R_L=2.95\ \Omega$, $R_G=3\ \Omega$		2.5		ns
Turn-On Rise Time	t_r			3.2		
Turn-Off Delay Time	$t_{d(off)}$			21		
Turn-Off Fall Time	t_f			3		
Body Diode Reverse Recovery Time	t_{rr}	$I_F=3.4\text{A}$, $di/dt=100\text{A}/\mu\text{s}$		14	19	nC
Body Diode Reverse Recovery Charge	Q_{rr}			3.8		
Maximum Body-Diode Continuous Current	I_S				1.5	A
Diode Forward Voltage	V_{SD}	$I_S=1\text{A}$, $V_{GS}=0\text{V}$		0.7	1	V

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■ P-Channel Electrical Characteristics Ta = 25°C

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Drain-Source Breakdown Voltage	V _{DSS}	I _D =-250 μA, V _{GS} =0V	-20			V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =-20V, V _{GS} =0V			-1	μA
		V _{DS} =-20V, V _{GS} =0V, T _J =55°C			-5	
Gate-Body leakage current	I _{GSS}	V _{DS} =0V, V _{GS} =±8V			±100	nA
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} I _D =-250 μA	-0.4	-0.65	-1	V
Static Drain-Source On-Resistance	R _{DS(on)}	V _{GS} =-4.5V, I _D =-2.5A		56	75	mΩ
		V _{GS} =-4.5V, I _D =-2.5A T _J =125°C		80	105	
		V _{GS} =-2.5V, I _D =-2A		70	95	
		V _{GS} =-1.8V, I _D =-1A		85	115	
On state drain current	I _{D(ON)}	V _{GS} =-4.5V, V _{DS} =-5V	-13			A
Forward Transconductance	g _{FS}	V _{DS} =-5V, I _D =-2.5A		13		S
Input Capacitance	C _{iss}	V _{GS} =0V, V _{DS} =-10V, f=1MHz		560	745	pF
Output Capacitance	C _{oss}			80		
Reverse Transfer Capacitance	C _{rss}			70		
Gate resistance	R _g	V _{GS} =0V, V _{DS} =0V, f=1MHz		15	23	Ω
Total Gate Charge (4.5V)	Q _g	V _{GS} =-4.5V, V _{DS} =-10V, I _D =-2.5A		8.5	11	nC
Gate Source Charge	Q _{gs}			1.2		
Gate Drain Charge	Q _{gd}			2.1		
Turn-On DelayTime	t _{d(on)}	V _{GS} =-4.5V, V _{DS} =-10V, R _L =4 Ω, R _{GEN} =6 Ω		7.2		ns
Turn-On Rise Time	t _r			36		
Turn-Off DelayTime	t _{d(off)}			53		
Turn-Off Fall Time	t _f			56		
Body Diode Reverse Recovery Time	t _{rr}	I _F =-2.5A, di/dt=100A/μs		37	49	nC
Body Diode Reverse Recovery Charge	Q _{rr}			27		
Maximum Body-Diode Continuous Current	I _S				-1.5	A
Diode Forward Voltage	V _{SD}	I _S =-1A, V _{GS} =0V		-0.7	-1	V

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■ N-Channel Typical Characteristics

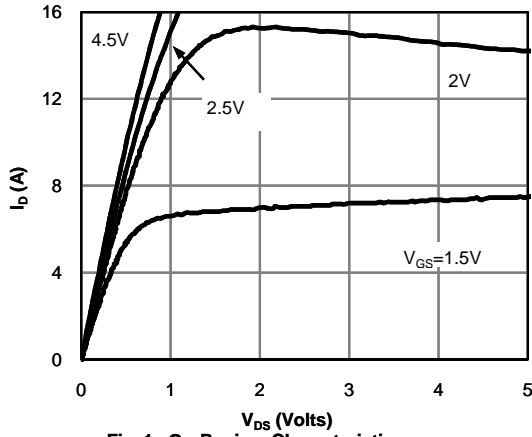


Fig 1: On-Region Characteristics

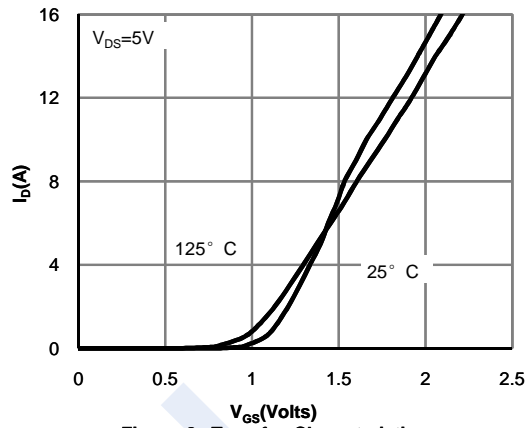


Figure 2: Transfer Characteristics

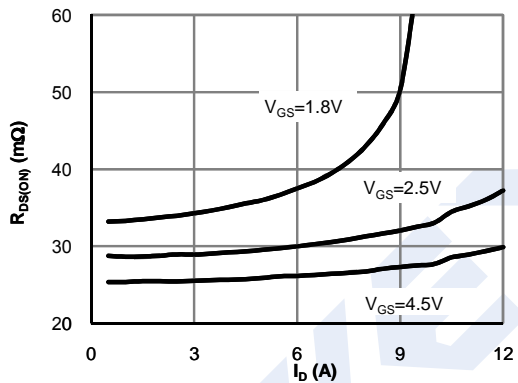


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

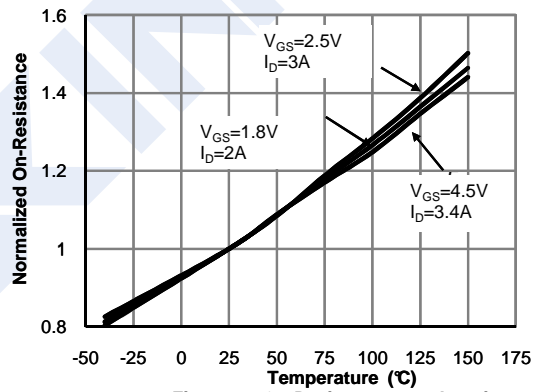


Figure 4: On-Resistance vs. Junction Temperature

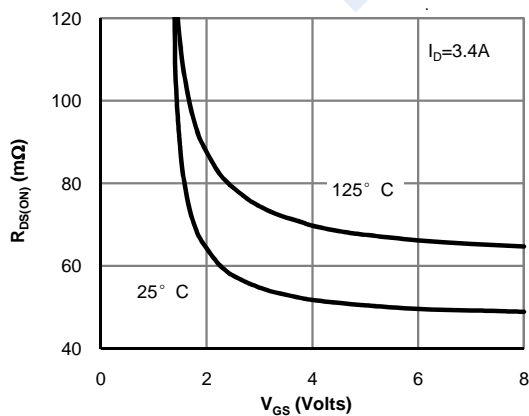


Figure 5: On-Resistance vs. Gate-Source Voltage

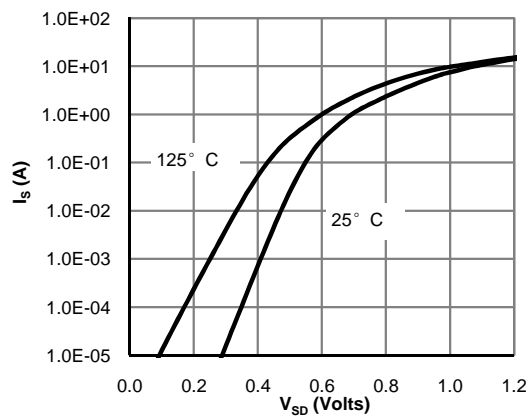


Figure 6: Body-Diode Characteristics

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■ N-Channel Typical Characteristics

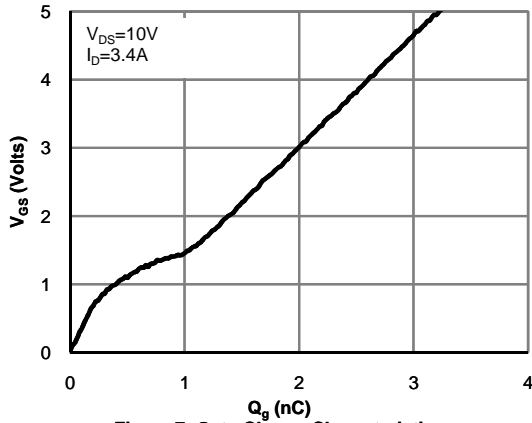


Figure 7: Gate-Charge Characteristics

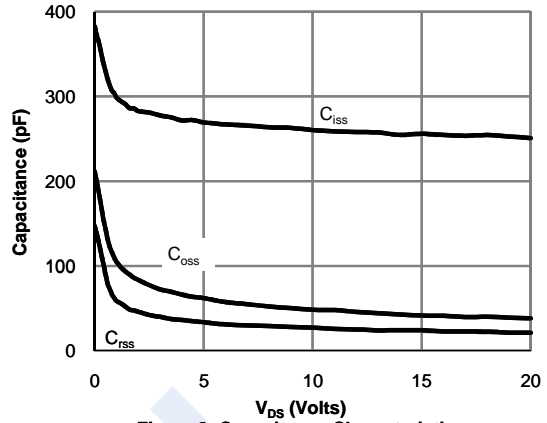


Figure 8: Capacitance Characteristics

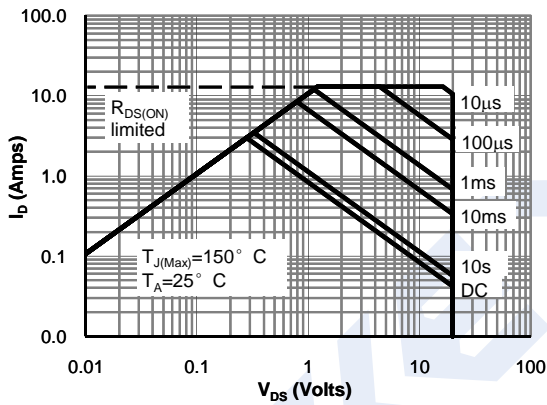


Figure 9: Maximum Forward Biased Safe Operating Area

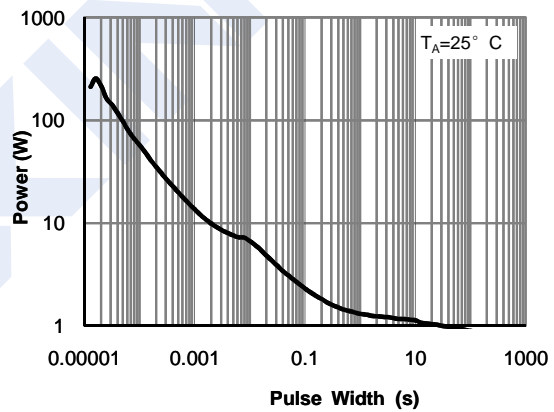


Figure 10: Pulse Power Rating

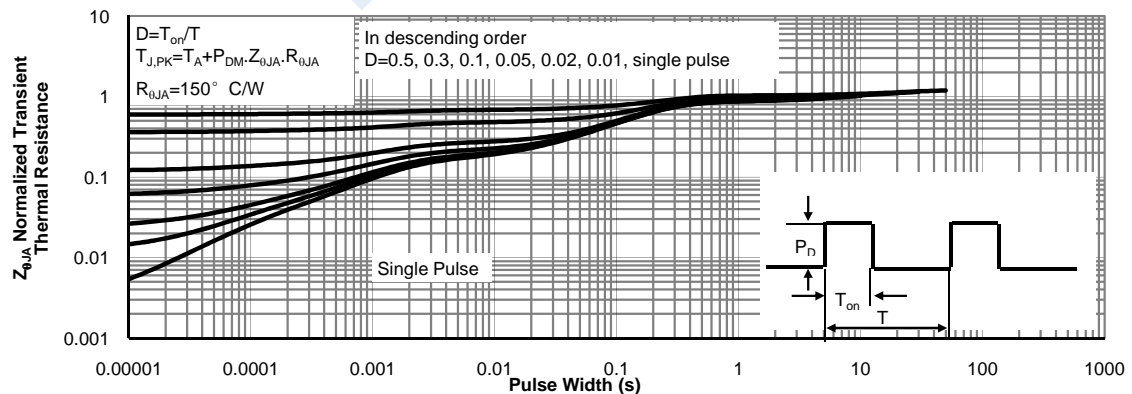


Figure 11: Normalized Maximum Transient Thermal Impedance

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■ P-Channel Typical Characteristics

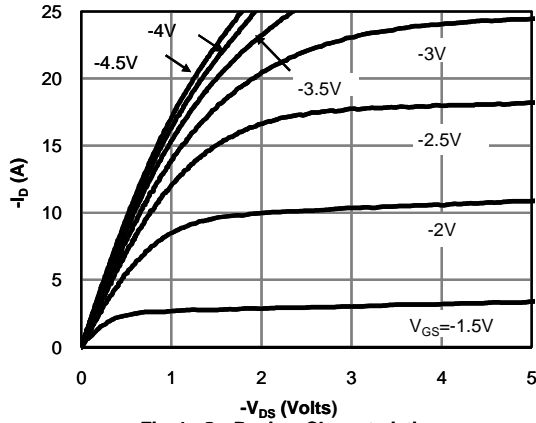


Fig 1: On-Region Characteristics

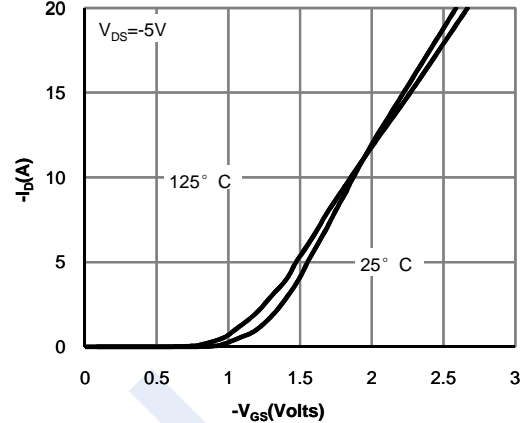


Figure 2: Transfer Characteristic

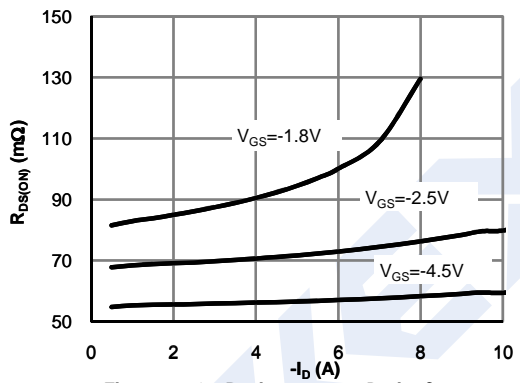


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

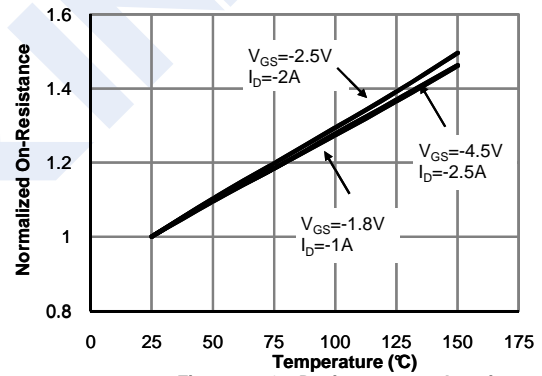


Figure 4: On-Resistance vs. Junction Temperature

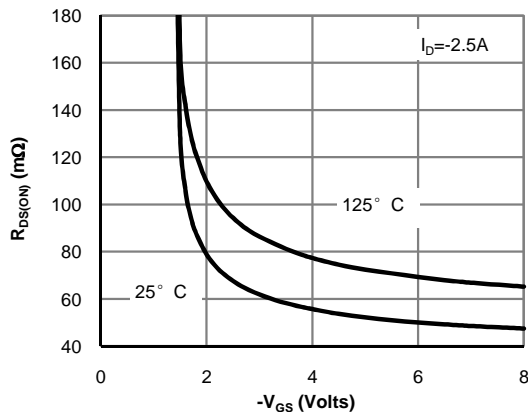


Figure 5: On-Resistance vs. Gate-Source Voltage

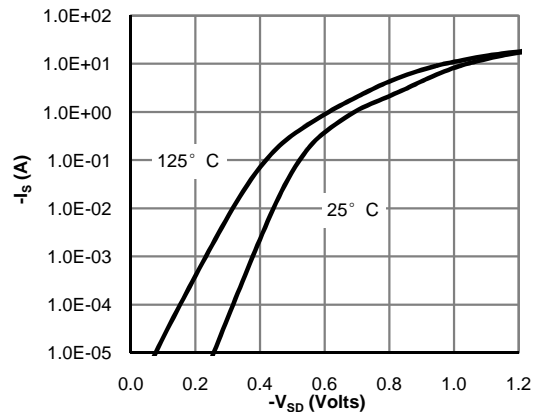


Figure 6: Body-Diode Characteristics

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■ P-Channel Typical Characteristics

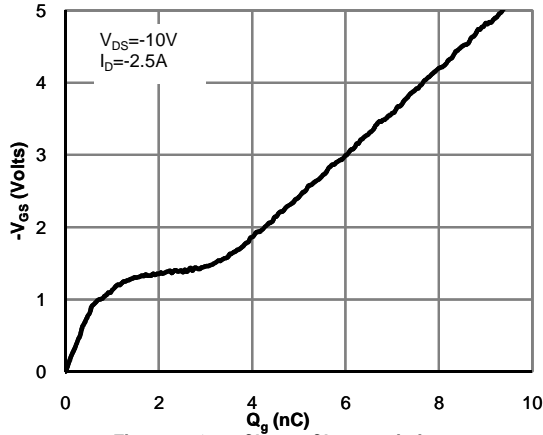


Figure 7: Gate-Charge Characteristics

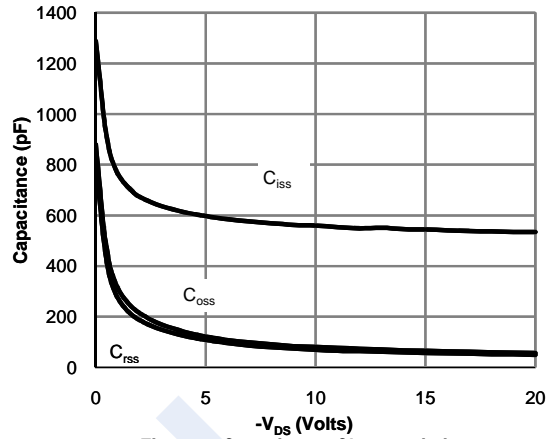


Figure 8: Capacitance Characteristics

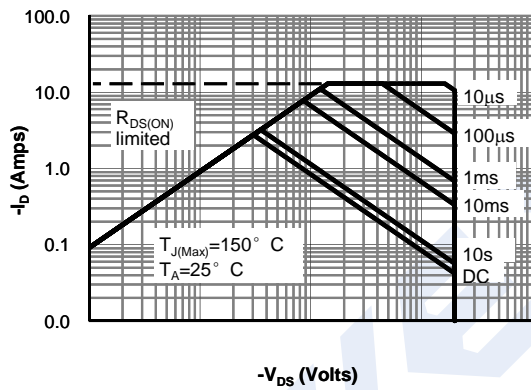


Figure 9: Maximum Forward Biased Safe Operating Area

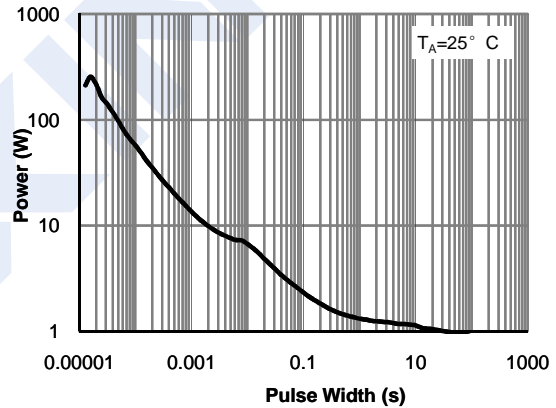


Figure 10: Single Pulse Power Rating

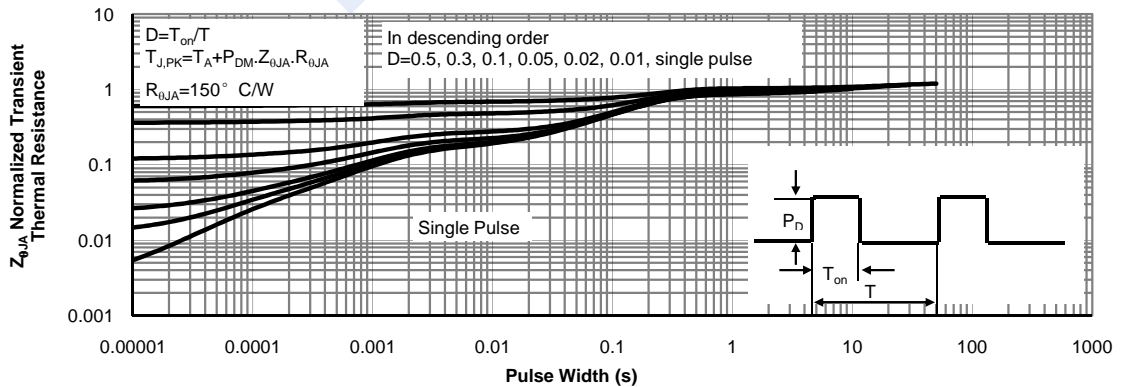


Figure 11: Normalized Maximum Transient Thermal Impedance