AP6604
20V Complementary MOSFET

- **General Description**

AP6604 combines advanced MOSFET technology with a low resistance package to provide excellent $R_{DS(ON)}$ and low gate charge. The complementary MOSFETs form a high-speed power inverter, which is suitable for a wide variety of applications.

- **Applications**

- Synchronous DC–DC conversion circuits
- Load/Power management of portable devices

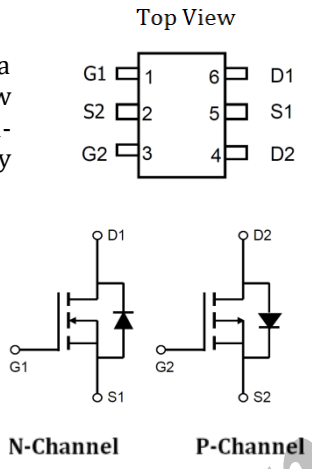
- **Product Summary**

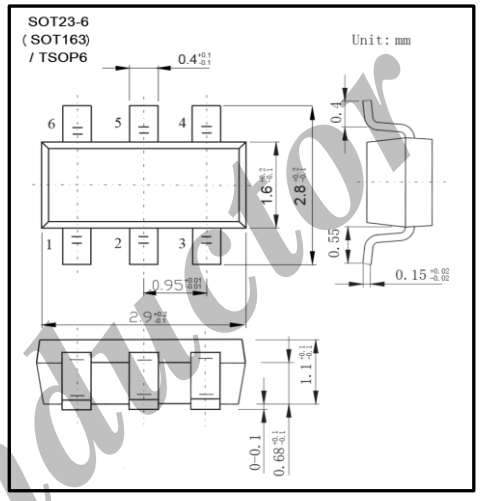
N-Channel

V_{DS}	20V
I_D (at V_{GS} = 4.5V)	3.4A
$R_{DS(ON)}$ (at V_{GS} = 4.5V)	< 65mΩ
$R_{DS(ON)}$ (at V_{GS} = 2.5V)	< 75mΩ
$R_{DS(ON)}$ (at V_{GS} = 1.8V)	< 100mΩ

P-Channel

V_{DS}	-20V
I_D (at V_{GS} = -4.5V)	-2.5A
$R_{DS(ON)}$ (at V_{GS} = -4.5V)	< 75mΩ
$R_{DS(ON)}$ (at V_{GS} = -2.5V)	< 95mΩ
$R_{DS(ON)}$ (at V_{GS} = -1.8V)	< 115mΩ





Pb-Free

RoHS COMPLIANT

- **Absolute Maximum Ratings Ta = 25°C**

Parameter		Symbol	N-Channel	P-Channel	Unit
Drain-Source Voltage		V_{DS}	20	-20	V
Gate-Source Voltage		V_{GS}	±8		V
Continuous Drain Current	Ta = 25°C	I_D	3.4	-2.5	A
	Ta = 70°C		2.5	-2.0	
Pulsed Drain Current		I_{DM}	13	-13	
Power Dissipation	Ta = 25°C	P_D	1.1		W
	Ta = 70°C		0.7		
Junction Temperature		T_J	150		°C
Storage Temperature Range		T_{STG}	-55 to 150		
Thermal Characteristics					
Thermal Resistance. Junction-to-Ambient	t ≤ 10s	$R_{\theta JA}$	110		°C/W
	Steady State		150		
Thermal Resistance. Junction-to-Lead		$R_{\theta JL}$	80		

- **Electrical Characteristics Ta = 25°C (N-Channel)**

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Static Parameters						
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=250μA, 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=250μA	0.4	0.7	1	V
On-State Drain Current	$I_{D(ON)}$	V_{GS}=4.5V, V_{DS}=5V	13			A
Static Drain-Source On-Resistance	$R_{DS(ON)}$	V_{GS}=4.5V, I_D=3.4A		51	65	mΩ
		V_{GS}=4.5V, I_D=3.4A, T_J=125°C		68	85	
		V_{GS}=2.5V, I_D=3A		58	75	
		V_{GS}=1.8V, I_D=2A		68	100	
Forward Transconductance	g_{FS}	V_{DS}=5V, I_D=3.4A		16		S
Diode Forward Voltage	V_{SD}	I_S=1A, V_{GS}=0V		0.7	1	V
Maximum Body-Diode Continuous Current	I_S				1.5	A
Dynamic Parameters						
Input Capacitance	C_{iss}	V_{GS}=0V, V_{DS}=10V, f=1MHz	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}=0V, V_{DS}=0V, f=1MHz	1.5	3	4.5	Ω
Switching Parameters						
Total Gate Charge (4.5V)	Q_g	V_{GS}=4.5V, V_{DS}=10V, I_D=3.4A		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}=5V, V_{DS}=10V, R_L=2.95Ω, R_{GEN}=3Ω		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=3.4A, d_i/d_t=100A/μs		14	19	
Body Diode Reverse Recovery Charge	Q_{rr}			3.8		nC

- **Electrical Characteristics Ta = 25°C (P-Channel)**

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Static Parameters						
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=-250μA, 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=-250μA	-0.4	-0.65	-1	V
On-State Drain Current	$I_{D(ON)}$	V_{GS}=-4.5V, V_{DS}=-5V	-13			A
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	
Forward Transconductance	g_{FS}	V_{DS}=-5V, I_D=-2.3A		13		S
Diode Forward Voltage	V_{SD}	I_S=-1A, V_{GS}=0V		-0.7	-1	V
Maximum Body-Diode Continuous Current	I_S				-1.5	A
Dynamic Parameters						
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
Switching Parameters						
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 Delay Time	$t_{D(on)}$	V_{GS}=-4.5V, V_{DS}=-10V, R_L=4Ω, R_{GEN}=6Ω		7.2		ns
Turn-On Rise Time	t_r			36		
Turn-Off Delay Time	$t_{D(off)}$			53		
Turn-Off Fall Time	t_f			56		
Body Diode Reverse Recovery Time	t_{rr}	I_F=-2.5A, d_i/d_t=100A/μs		37	49	
Body Diode Reverse Recovery Charge	Q_{rr}			27		nC

- **Ordering Information**

Ordering Part Number	Package	MOQ
AP6604	SOT23-6 (SOT163) / TSOP6	3,000 pcs / reel

- **Typical Electrical and Thermal Characteristics (N-Channel)**

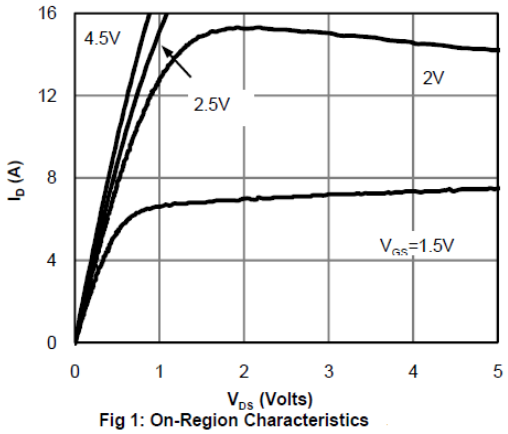


Fig 1: On-Region Characteristics

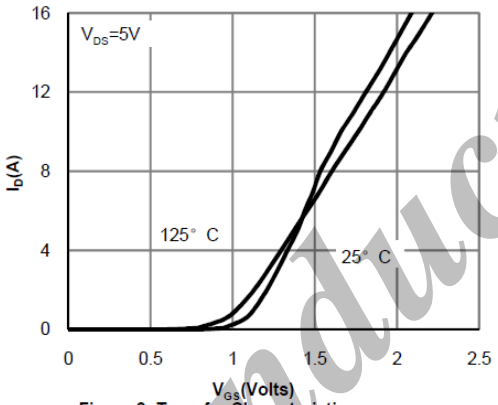


Figure 2: Transfer Characteristics

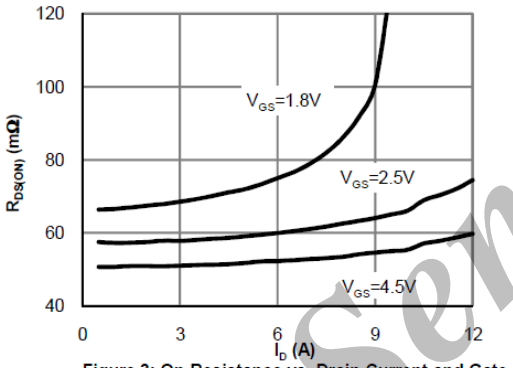


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

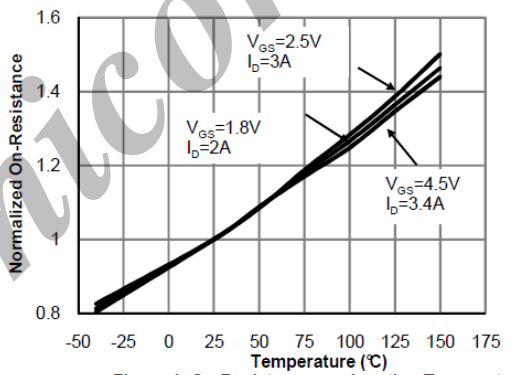


Figure 4: On-Resistance vs. Junction Temperature

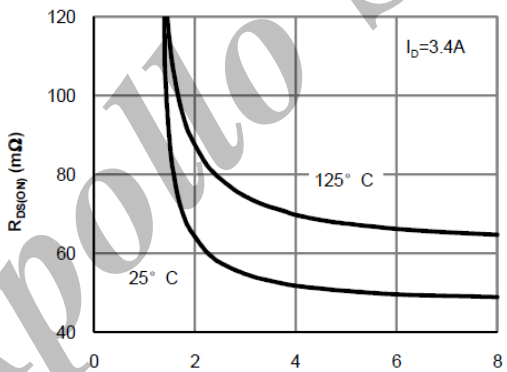


Figure 5: On-Resistance vs. Gate-Source Voltage

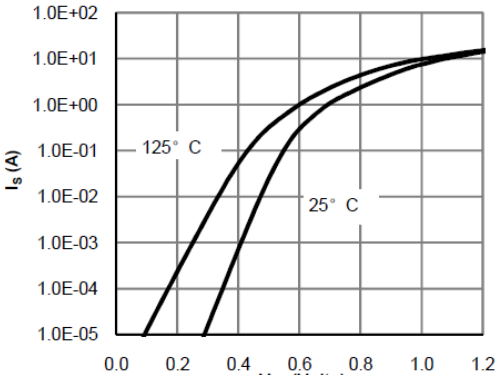


Figure 6: Body-Diode Characteristics

Note 1: The static characteristics in Figure 1 to 6 are obtained using <300μA pulses, duty cycle 0.5% max.

- **Typical Electrical and Thermal Characteristics (N-Channel)**

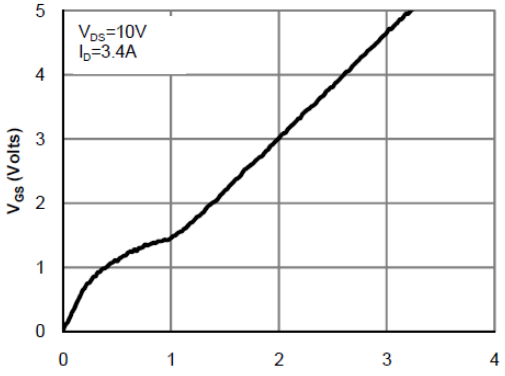


Figure 7: Gate-Charge Characteristics

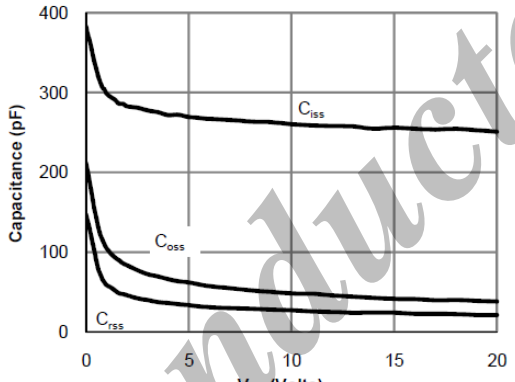


Figure 8: Capacitance Characteristics

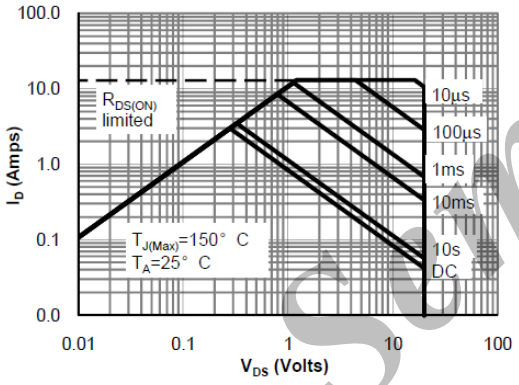


Figure 9: Maximum Forward Biased Safe Operating Area

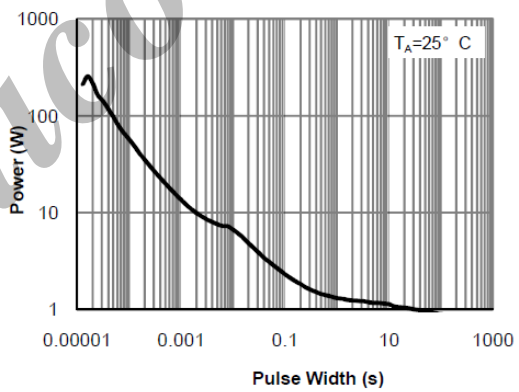


Figure 10: Single Pulse Power Rating Junction-to-Ambient

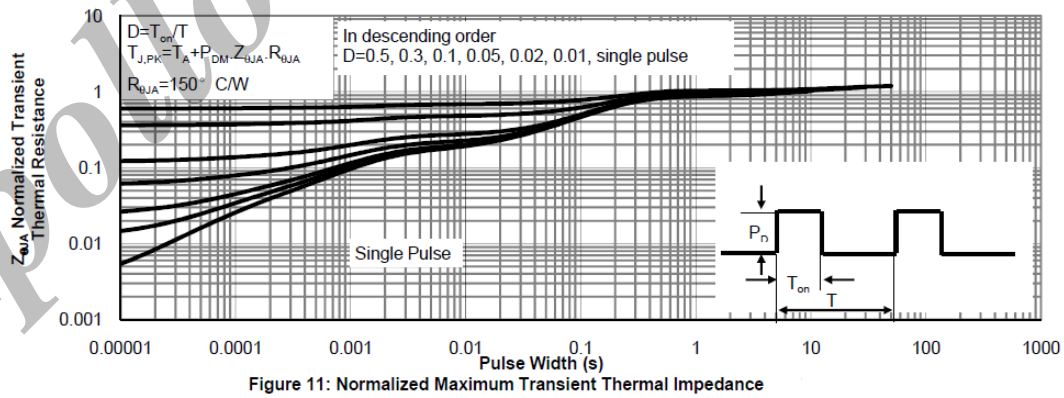


Figure 11: Normalized Maximum Transient Thermal Impedance

Note 2: The curves in Figure 9 to 11 are based on the junction-to-ambient thermal impedance which is measured with the device mounted on 1in² FR-4 board with 2oz. copper, assuming a maximum junction temperature of $T_{J(MAX)}$=150°C . The SOA curve provides a single pulse rating.

- **Typical Electrical and Thermal Characteristics (P-Channel)**

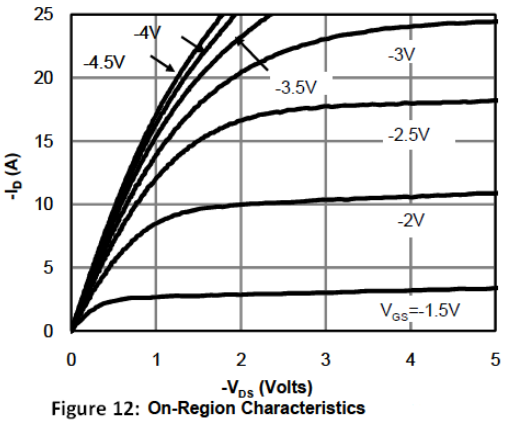


Figure 12: On-Region Characteristics

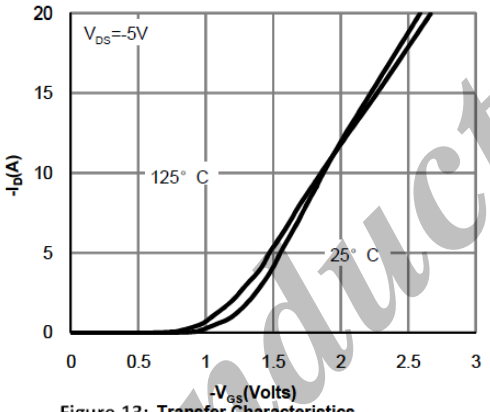


Figure 13: Transfer Characteristics

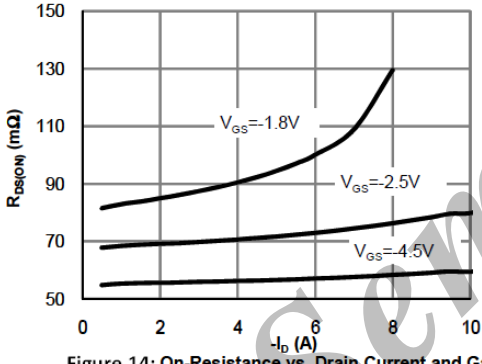


Figure 14: On-Resistance vs. Drain Current and Gate Voltage

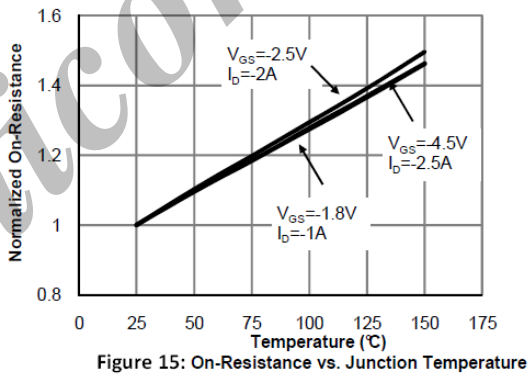


Figure 15: On-Resistance vs. Junction Temperature

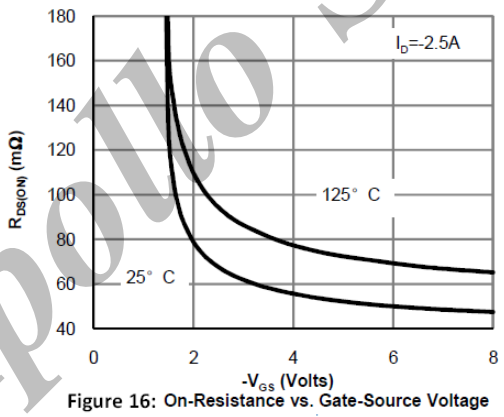


Figure 16: On-Resistance vs. Gate-Source Voltage

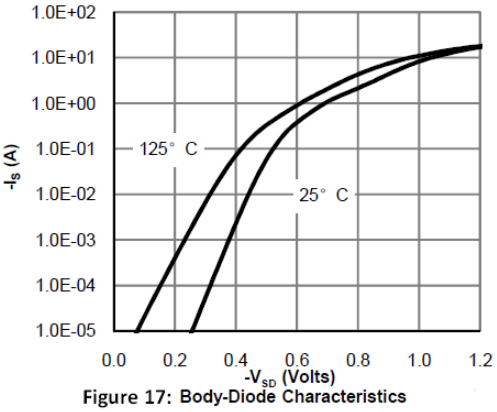


Figure 17: Body-Diode Characteristics

Note 3: The static characteristics in Figure 12 to 17 are obtained using <300μA pulses, duty cycle 0.5% max.

- **Typical Electrical and Thermal Characteristics (P-Channel)**

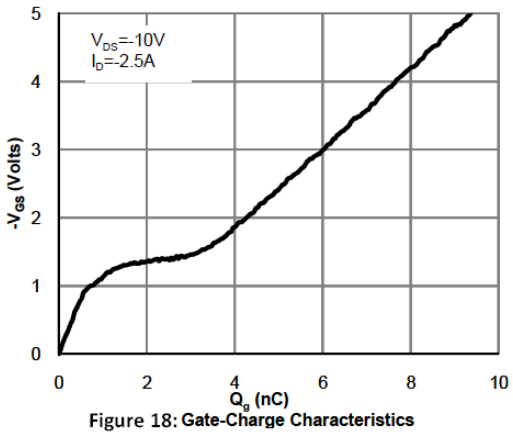


Figure 18: Gate-Charge Characteristics

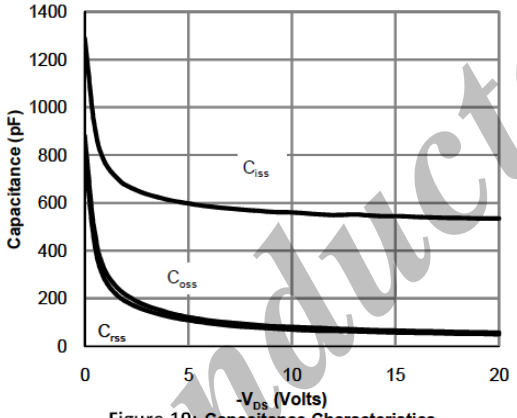


Figure 19: Capacitance Characteristics

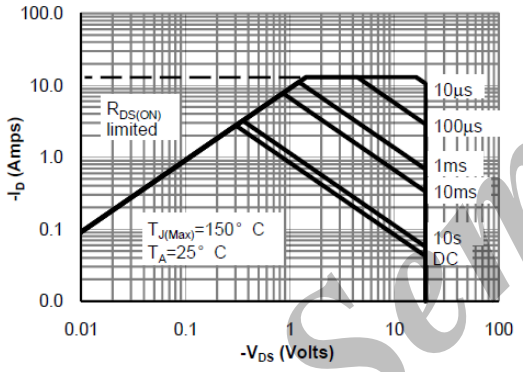


Figure 20: Maximum Forward Biased Safe Operating Area

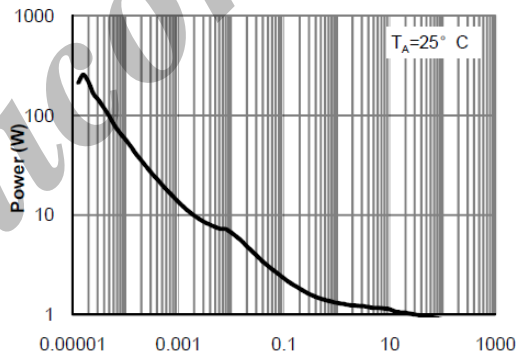


Figure 21: Single Pulse Power Rating Junction-to-Ambient

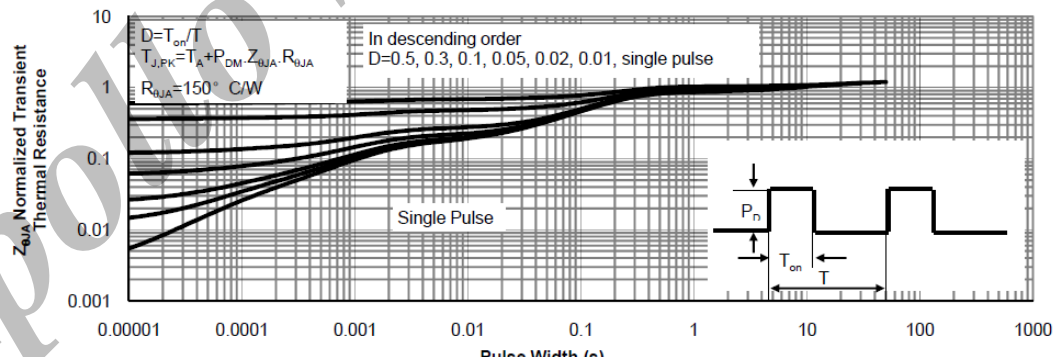


Figure 22: Normalized Maximum Transient Thermal Impedance

Note 4: The curves in Figure 20 to 22 are based on the junction-to-ambient thermal impedance which is measured with the device mounted on 1in² FR-4 board with 2oz. copper, assuming a maximum junction temperature of $T_{J(MAX)}$=150°C . The SOA curve provides a single pulse rating.

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