Complementary MOSFET

ELM24604HA-S

■General Description

ELM24604HA-S uses advanced trench technology to provide excellent Rds(on) and low gate charge.

■Features

N-channel	P-channel
• Vds=40V	Vds=-40V
• Id=8A(Vgs=10V)	Id=-8A(Vgs=-10V)
• Rds(on) < 33mΩ(Vgs=10V)	Rds(on) < 50mΩ(Vgs=-10V)
• Rds(on) < 47mΩ(Vgs=4.5V)	Rds(on) < 70mΩ(Vgs=-4.5V)

■Maximum Absolute Ratings

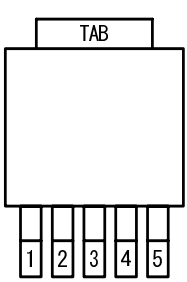
Parameter		Symbol	N-ch (Max.)	P-ch (Max.)	Unit	Note
Drain-source voltage		Vds	40	-40	V	
Gate-source voltage		Vgs	±20	±20	V	
Continuous drain current	Tc=25℃	Id	8	-8	A	7
	Tc=100℃		8	-8		
Pulsed drain current		Idm	30	-30	A	3
Avalanche current		Iar	8	-8	A	3
Repetitive avalanche energy L=0.1mH		Ear	20	30	mJ	3
Power dissipation	Tc=25℃	Pd	20	50	W	2
	Tc=100℃		10	25		
Power dissipation	Ta=25℃	Pdsm	2.0	2.5	W	1
	Ta=70℃		1.3	1.6		
Junction and storage temperature range		Tj,Tstg	-55 to 150	-55 to 150	℃	

■Thermal Characteristics

Parameter		Symbol	Device	Typ.	Max.	Unit	Note
Maximum junction-to-ambient	t≤10s	Rθja	N-ch	17.4	30.0	℃/W	1
Maximum junction-to-ambient	Steady-state			50.0	60.0	℃/W	
Maximum junction-to-case	Steady-state	Rθjc		4.0	7.5	℃/W	2
Maximum junction-to-ambient	t≤10s	Rθja	P-ch	16.7	25.0	℃/W	1
Maximum junction-to-ambient	Steady-state			40.0	50.0	℃/W	
Maximum junction-to-case	Steady-state	Rθjc		2.5	3.0	℃/W	2

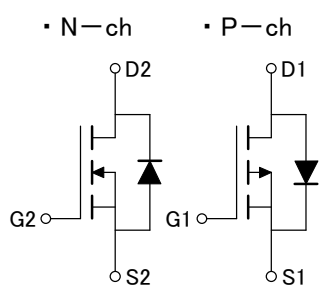
■Pin Configuration

TO-252-5 (TOP VIEW)



Pin No.	Pin name
1	SOURCE1
2	GATE1
3	DRAIN1/DRAIN2
4	GATE2
5	SOURCE2

■Circuit



■Electrical Characteristics (N-ch)

Ta=25℃

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
STATIC PARAMETERS							
Drain-source breakdown voltage	BVdss	Id=10mA, Vgs=0V		40			V
Zero gate voltage drain current	Idss	Vds=32V, Vgs=0V				1	μA
			Tj=55℃			5	
Gate-body leakage current	Igss	Vds=0V, Vgs=±20V				100	nA
Gate threshold voltage	Vgs(th)	Vds=Vgs, Id=250μA		1.0	2.3	3.0	V
On state drain current	Id(on)	Vgs=10V, Vds=5V		30			A
Static drain-source on-resistance	Rds(on)	Vgs=10V, Id=8A			25	33	mΩ
			Tj=125℃		39	52	
		Vgs=4.5V, Id=6A			34	47	
Forward transconductance	Gfs	Vds=5V, Id=8A			25		S
Diode forward voltage	Vsd	Is=1A, Vgs=0V			0.76	1.00	V
Max.body-diode continuous current	Is					8	A
DYNAMIC PARAMETERS							
Input capacitance	Ciss	Vgs=0V, Vds=20V, f=1MHz			404		pF
Output capacitance	Coss				95		pF
Reverse transfer capacitance	Crss				37		pF
Gate resistance	Rg	Vgs=0V, Vds=0V, f=1MHz			2.7		Ω
SWITCHING PARAMETERS							
Total gate charge (10V)	Qg	Vgs=10V, Vds=20V, Id=8A			9.2		nC
Total gate charge (4.5V)	Qg				4.5		nC
Gate-source charge	Qgs				1.6		nC
Gate-drain charge	Qgd				2.6		nC
Turn-on delay time	td(on)	Vgs=10V, Vds=20V, Rl=2.5Ω, Rgen=3Ω			3.5		ns
Turn-on rise time	tr				6.0		ns
Turn-off delay time	td(off)				13.2		ns
Turn-off fall time	tf				3.5		ns
Body-diode reverse recovery time	trr	If=8A, dI/dt=100A/μs			22.9		ns
Body-diode reverse recovery charge	Qrr	If=8A, dI/dt=100A/μs			18.3		nC

NOTE :

1. The value of $R_{\theta ja}$ is measured with the device mounted on $1in^2$ FR-4 board of 2oz. Copper, in still air environment with T_a=25℃. The power dissipation Pdsm is based on $R_{\theta ja}$ max. allowed junction temperature of 150℃. The value in any given applications depends on the user's specific board design, and the max. temperature of 175℃may be used if the PCB allows it.
2. The power dissipation Pd is based on Tj(max.)=175℃, using junction-to-case thermal resistance, and is more useful setting the upper dissipation limit for cases where additional heartsinking is used.
3. The repetitive rating and the pulse width are limited by junction temperature Tj(max.)=175℃.
4. The $R_{\theta ja}$ is the sum of the thermal impedance from junction to case $R_{\theta jc}$ and case to ambient.
5. The static characteristics in Figures 1 to 6 are obtained using <300μs pulses, duty cycle 0.5%max.
6. These curves are based on the junction-to-case thermal impedence which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of Tj(max.)=175℃.
7. The maximum current rating is limited by bond-wires.
8. These tests are performed with the device mounted on $1in^2$ FR-4 board with 2oz. Copper, in a still air environment with Ta=25℃. The SOA curve provides a single pulse rating.

■Typical Electrical and Thermal Characteristics (N-ch)

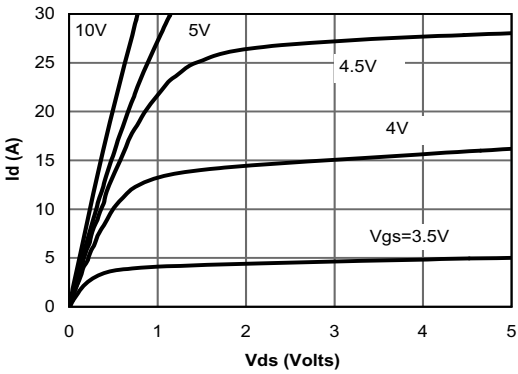


Fig 1: On-Region Characteristics

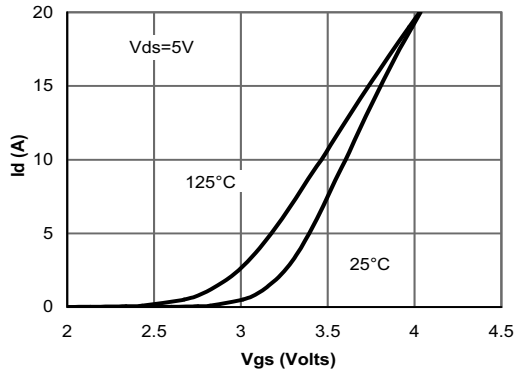


Figure 2: Transfer Characteristics

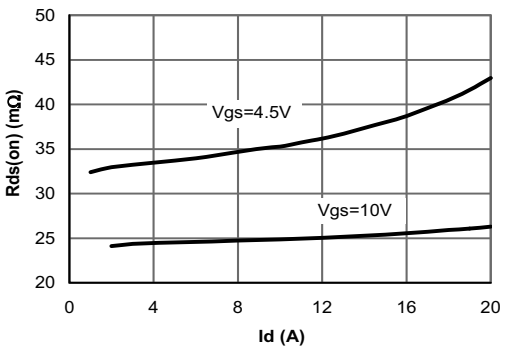


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

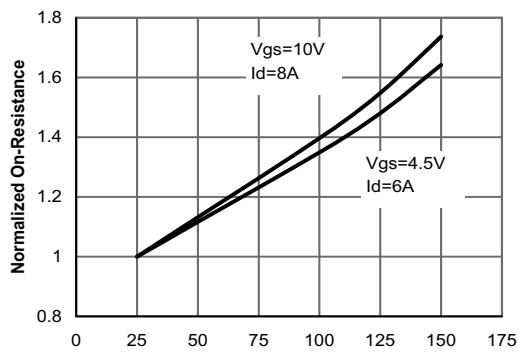


Figure 4: On-Resistance vs. Junction Temperature

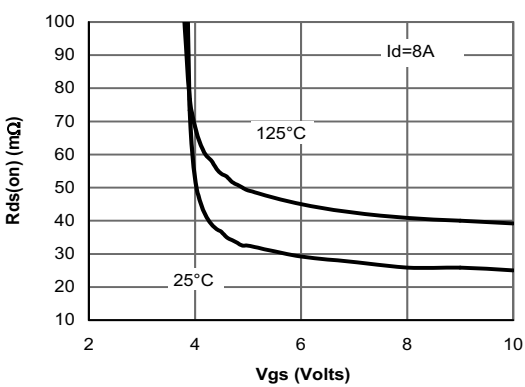


Figure 5: On-Resistance vs. Gate-Source Voltage

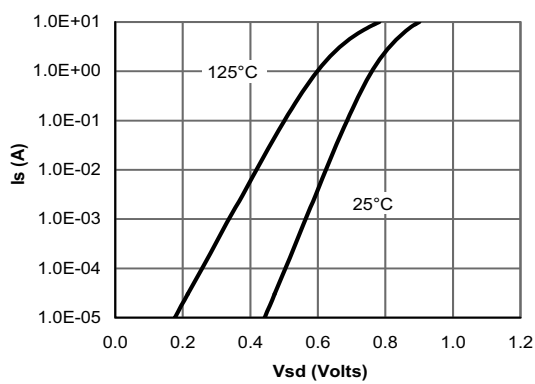


Figure 6: Body-Diode Characteristics

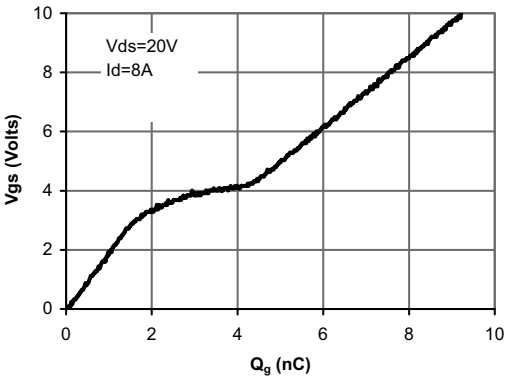


Figure 7: Gate-Charge Characteristics

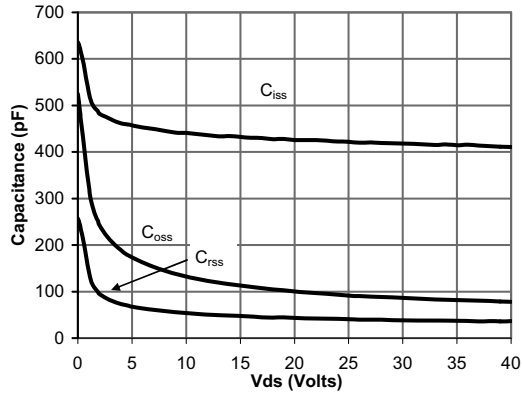


Figure 8: Capacitance Characteristics

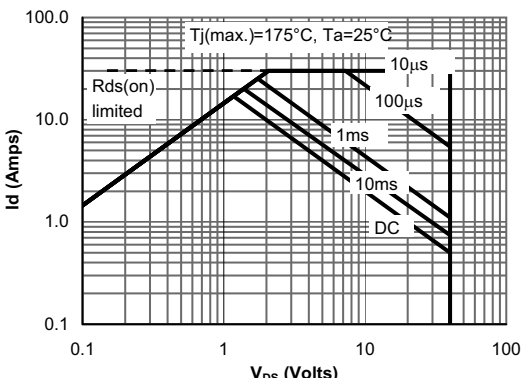


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

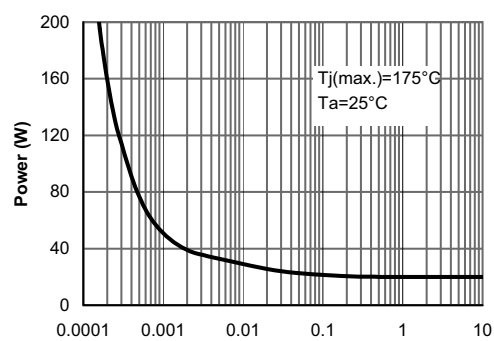


Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

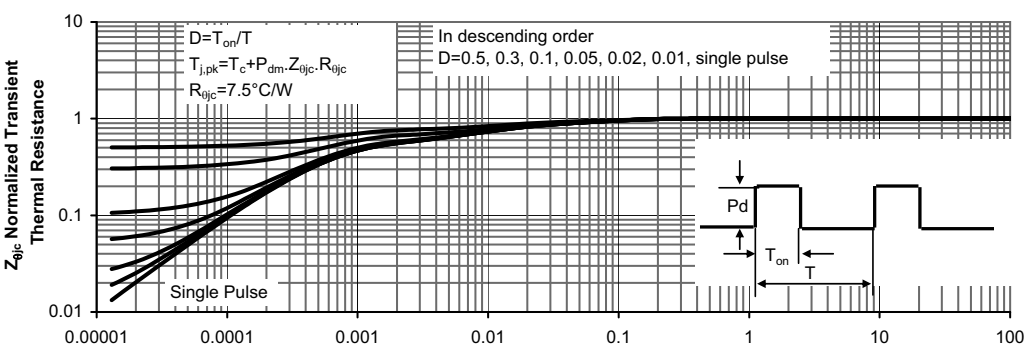


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

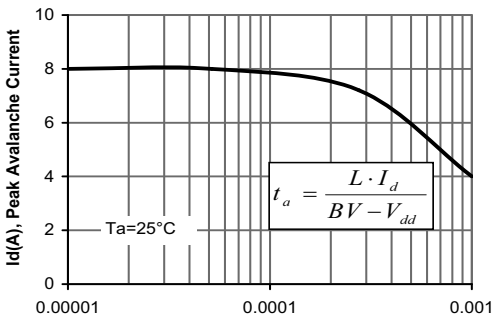


Figure 12: Single Pulse Avalanche capability

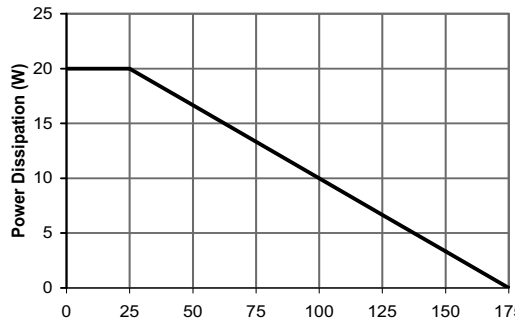


Figure 13: Power De-rating (Note B)

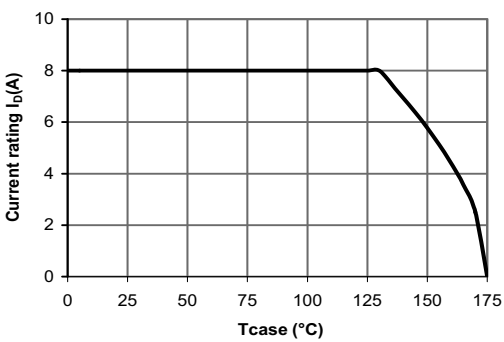


Figure 14: Current De-rating (Note B)

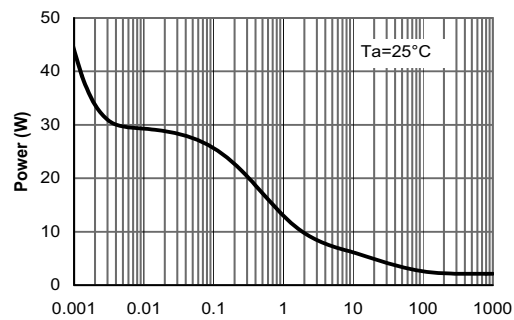


Figure 15: Single Pulse Power Rating Junction-to-Ambient (Note H)

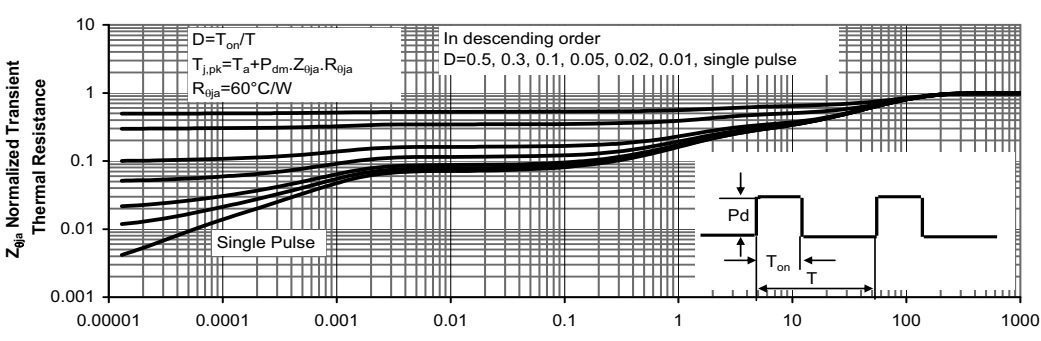


Figure 16: Normalized Maximum Transient Thermal Impedance (Note H)

■Electrical Characteristics (P-ch)

Ta=25℃

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
STATIC PARAMETERS							
Drain-source breakdown voltage	BVdss	Id=-10mA, Vgs=0V		-40			V
Zero gate voltage drain current	Idss	Vds=-32V, Vgs=0V				-1	μA
			Tj=55℃			-5	
Gate-body leakage current	Igss	Vds=0V, Vgs=±20V				±100	nA
Gate threshold voltage	Vgs(th)	Vds=Vgs, Id=-250μA		-1.0	-1.8	-3.0	V
On state drain current	Id(on)	Vgs=-10V, Vds=-5V		-30			A
Static drain-source on-resistance	Rds(on)	Vgs=-10V, Id=-8A			41	50	mΩ
			Tj=125℃		62		
		Vgs=-4.5V, Id=-4A			57	70	mΩ
Forward transconductance	Gfs	Vds=-5V, Id=-8A			16		S
Diode forward voltage	Vsd	Is=-1A, Vgs=0V			-0.75	-1.00	V
Max. body-diode continuous current	Is					-8	A
DYNAMIC PARAMETERS							
Input capacitance	Ciss	Vgs=0V, Vds=-20V, f=1MHz			657		pF
Output capacitance	Coss				143		pF
Reverse transfer capacitance	Crss				63		pF
Gate resistance	Rg	Vgs=0V, Vds=0V, f=1MHz			6.5		Ω
SWITCHING PARAMETERS							
Total gate charge (10V)	Qg	Vgs=-10V, Vds=-20V, Id=-8A			14.1		nC
Total gate charge (4.5V)	Qg				7.0		nC
Gate-source charge	Qgs				2.2		nC
Gate-drain charge	Qgd				4.1		nC
Turn-on delay time	td(on)	Vgs=-10V, Vds=-20V, Rl=2.5Ω, Rgen=3Ω			8.0		ns
Turn-on rise time	tr				12.2		ns
Turn-off delay time	td(off)				24.0		ns
Turn-off fall time	tf				12.5		ns
Body diode reverse recovery time	trr	If=-8A, dI/dt=100A/μs			23.2		ns
Body diode reverse recovery charge	Qrr	If=-8A, dI/dt=100A/μs			18.2		nC

NOTE :

1. The value of $R_{\theta ja}$ is measured with the device mounted on $1in^2$ FR-4 board of 2oz. Copper, in still air environment with T_a=25℃. The power dissipation Pdsm is based on $R_{\theta ja}$ max. allowed junction temperature of 150℃. The value in any given applications depends on the user's specific board design, and the max. temperature of 175℃may be used if the PCB allows it.
2. The power dissipation Pd is based on Tj(max.)=175℃, using junction-to-case thermal resistance, and is more useful setting the upper dissipation limit for cases where additional heartsinking is used.
3. The repetitive rating and the pulse width are limited by junction temperature Tj(max.)=175℃.
4. The $R_{\theta ja}$ is the sum of the thermal impedance from junction to case $R_{\theta jc}$ and case to ambient.
5. The static characteristics in Figures 1 to 6 are obtained using <300μs pulses, duty cycle 0.5%max.
6. These curves are based on the junction-to-case thermal impedence which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of Tj(max.)=175℃.
7. The maximum current rating is limited by bond-wires.
8. These tests are performed with the device mounted on $1in^2$ FR-4 board with 2oz. Copper, in a still air environment with Ta=25℃. The SOA curve provides a single pulse rating.

■Typical Electrical and Thermal Characteristics (P-ch)

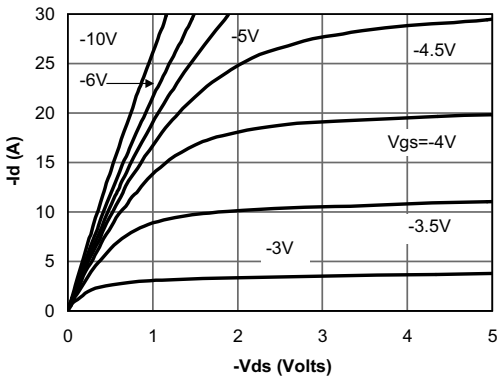


Fig 1: On-Region Characteristics

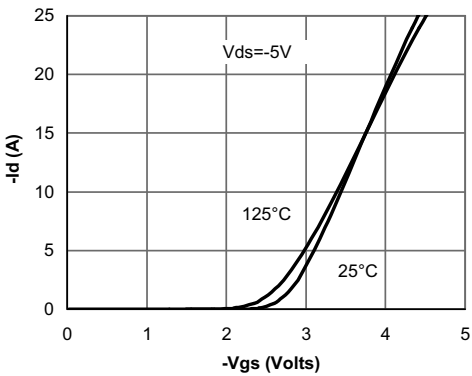


Figure 2: Transfer Characteristics

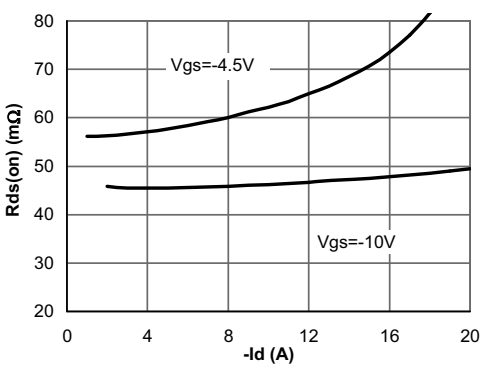


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

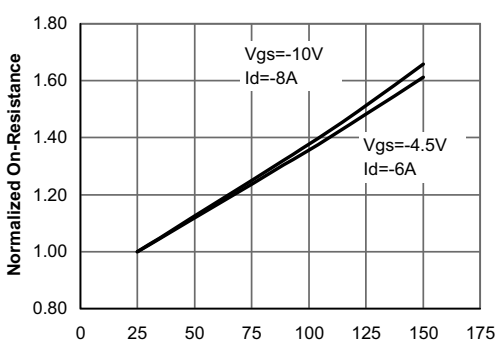


Figure 4: On-Resistance vs. Junction Temperature

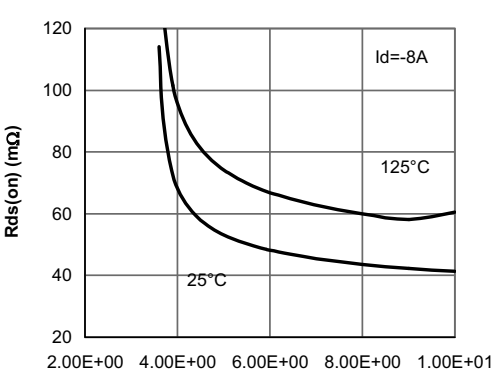


Figure 5: On-Resistance vs. Gate-Source Voltage

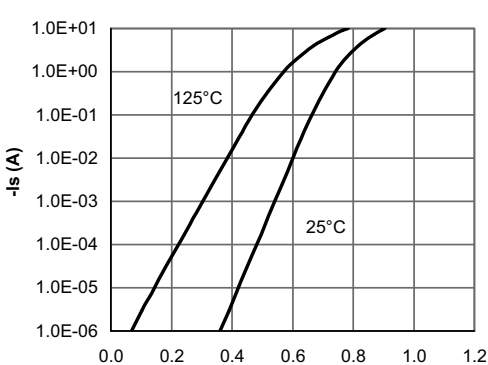


Figure 6: Body-Diode Characteristics

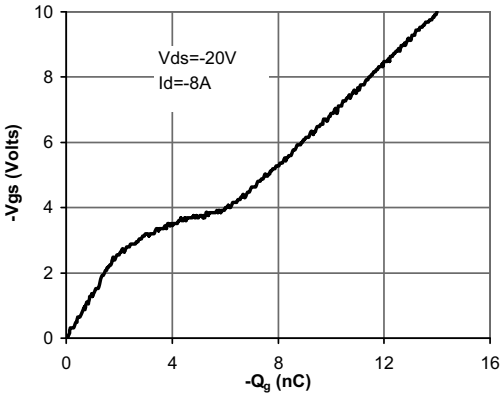


Figure 7: Gate-Charge Characteristics

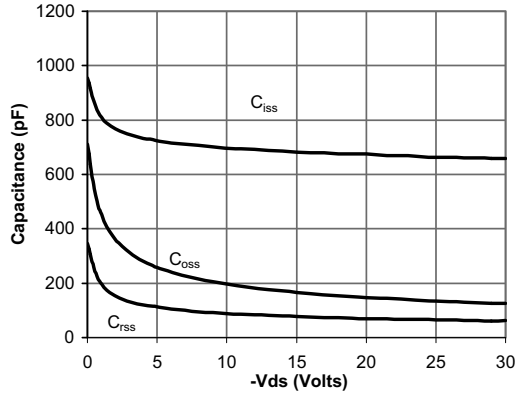


Figure 8: Capacitance Characteristics

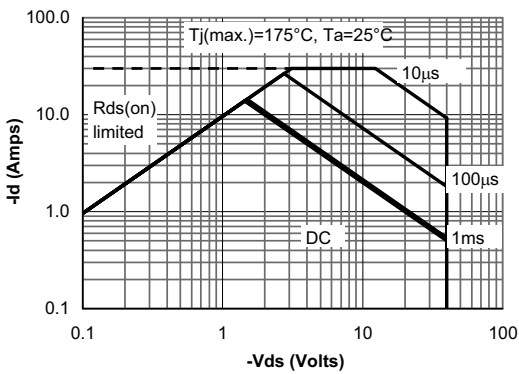


Figure 9: Maximum Forward Biased Safe Operating Area (Note F)

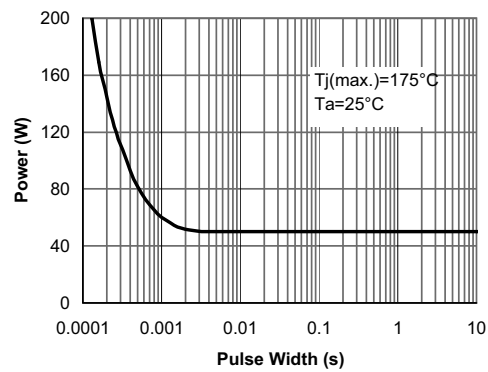


Figure 10: Single Pulse Power Rating Junction-to-Case (Note F)

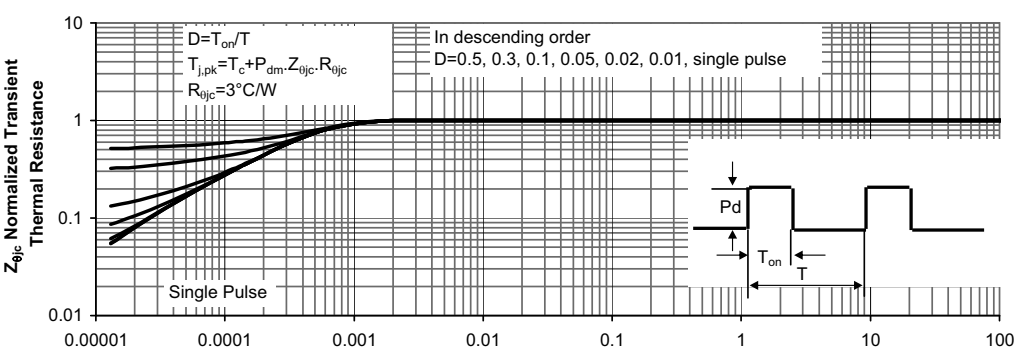


Figure 11: Normalized Maximum Transient Thermal Impedance (Note F)

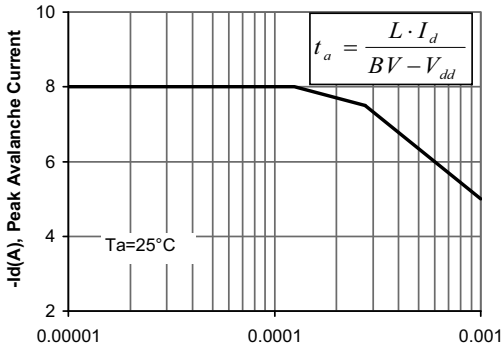


Figure 12: Single Pulse Avalanche capability

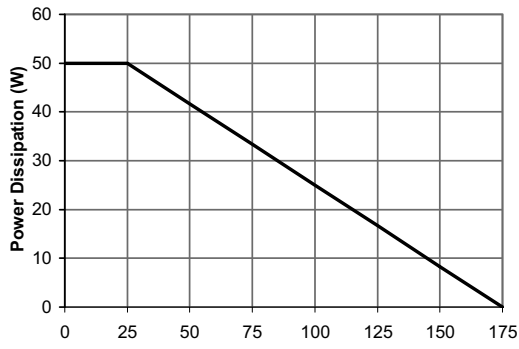


Figure 13: Power De-rating (Note B)

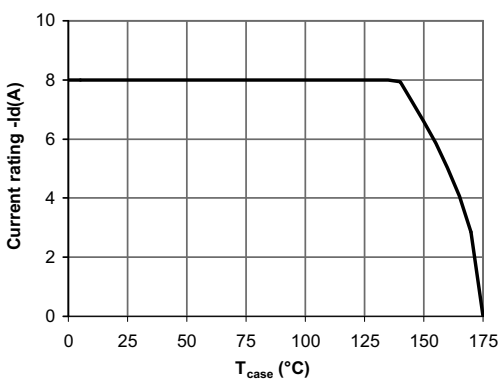


Figure 14: Current De-rating (Note B)

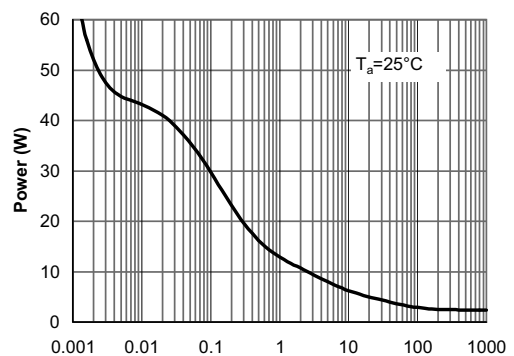


Figure 15: Single Pulse Power Rating Junction-to-Ambient (Note H)

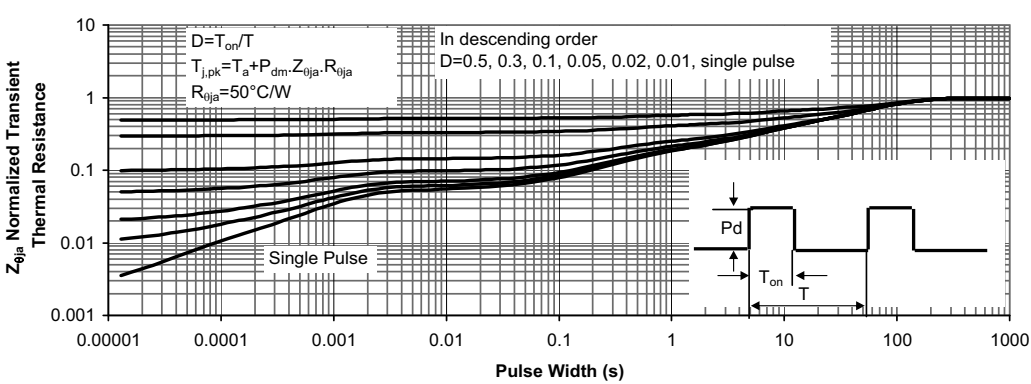


Figure 16: Normalized Maximum Transient Thermal Impedance (Note H)