

N-Channel 60 V (D-S) MOSFET



PRODUCT SUMMARY	
V_{DS} (V)	60
$R_{DS(on)}$ max. (Ω) at $V_{GS} = 10$ V	0.0089
$R_{DS(on)}$ max. (Ω) at $V_{GS} = 4.5$ V	0.0124
Q_g typ. (nC)	8.5
I_D (A)	51 ^a
Configuration	Single

FEATURES

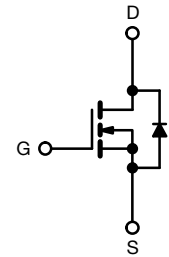
- TrenchFET® Gen IV power MOSFET
- Very low $R_{DS} \times Q_g$ figure-of-merit (FOM)
- Tuned for the lowest $R_{DS} \times Q_{oss}$ FOM
- 100 % R_g and UIS tested
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE

APPLICATIONS

- Synchronous rectification
- Primary side switch
- DC/DC converters
- OR-ing
- Power supplies
- Motor drive control
- Battery and load switch



N-Channel MOSFET

ORDERING INFORMATION	
Package	PowerPAK SO-8
Lead (Pb)-free and halogen-free	SIR4604LDP-T1-GE3

ABSOLUTE MAXIMUM RATINGS ($T_A = 25$ °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Drain-source voltage		V_{DS}	60	V
Gate-source voltage		V_{GS}	± 20	V
Continuous drain current ($T_J = 150$ °C)	$T_C = 25$ °C	I_D	51	A
	$T_C = 70$ °C		40.7	
	$T_A = 25$ °C		15.6 ^{b, c}	
	$T_A = 70$ °C		12.4 ^{b, c}	
Pulsed drain current ($t = 100$ μ s)		I_{DM}	100	
Continuous source-drain diode current	$T_C = 25$ °C	I_S	37.8 ^a	
	$T_A = 25$ °C		3.5 ^{b, c}	
Single pulse avalanche current	L = 0.1 mH	I_{AS}	20	mJ
Single pulse avalanche energy		E_{AS}	20	
Maximum power dissipation	$T_C = 25$ °C	P_D	41.6	W
	$T_C = 70$ °C		26.6	
	$T_A = 25$ °C		3.9 ^{b, c}	
	$T_A = 70$ °C		2.5 ^{b, c}	
Operating junction and storage temperature range		T_J, T_{stg}	-55 to +150	°C
Soldering recommendations (peak temperature) °C			260	

THERMAL RESISTANCE RATINGS					
PARAMETER		SYMBOL	TYPICAL	MAXIMUM	UNIT
Maximum junction-to-ambient ^b	$t \leq 10$ s	R_{thJA}	23	32	°C/W
Maximum junction-to-case (drain)	Steady state	R_{thJC}	2.4	3.0	

Notes

- $T_C = 25$ °C
- Surface mounted on 1" x 1" FR4 board
- $t = 10$ s
- See solder profile (www.vishay.com/doc?73257). The PowerPAK SO-8 is a leadless package. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper tip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection
- Rework conditions: manual soldering with a soldering iron is not recommended for leadless components
- Maximum under steady state conditions is 70 °C/W



SPECIFICATIONS (T _J = 25 °C, unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Static						
Drain-source breakdown voltage	V _{DS}	V _{GS} = 0 V, I _D = 250 μA	60	-	-	V
V _{DS} temperature coefficient	ΔV _{DS} /T _J	I _D = 10 mA	-	34	-	mV/°C
V _{GS(th)} temperature coefficient	ΔV _{GS(th)} /T _J	I _D = 250 μA	-	-5.1	-	
Gate-source threshold voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA	1	-	3	V
Gate-source leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 20 V	-	-	100	nA
Zero gate voltage drain current	I _{DSS}	V _{DS} = 60 V, V _{GS} = 0 V	-	-	1	μA
		V _{DS} = 60 V, V _{GS} = 0 V, T _J = 70 °C	-	-	15	
Drain-source on-state resistance ^a	R _{DS(on)}	V _{GS} = 10 V, I _D = 10 A	-	0.0074	0.0089	Ω
		V _{GS} = 4.5 V, I _D = 10 A	-	0.0103	0.0124	
Forward transconductance ^a	g _{fs}	V _{DS} = 15 V, I _D = 10 A	-	43	-	S
Dynamic ^b						
Input capacitance	C _{iss}	V _{DS} = 30 V, V _{GS} = 0 V, f = 1 MHz	-	1180	-	pF
Output capacitance	C _{oss}		-	250	-	
Reverse transfer capacitance	C _{rss}		-	15	-	
Total gate charge	Q _g	V _{DS} = 30 V, V _{GS} = 10 V, I _D = 10 A	-	18.3	28	nC
Gate-source charge	Q _{gs}	V _{DS} = 30 V, V _{GS} = 4.5 V, I _D = 10 A	-	8.5	13	
Gate-drain charge	Q _{gd}		-	4	-	
Output charge	Q _{oss}		-	2.3	-	
Gate resistance	R _g	V _{DS} = 30 V, V _{GS} = 0 V f = 1 MHz	-	15.3	-	
Turn-on delay time	t _{d(on)}	V _{DD} = 30 V, R _L = 3 Ω, I _D ≅ 10 A, V _{GEN} = 10 V, R _g = 1 Ω	0.3	0.80	1.5	ns
Rise time	t _r		-	10	20	
Turn-off delay time	t _{d(off)}		-	4	8	
Fall time	t _f		-	19	38	
Turn-on delay time	t _{d(on)}	V _{DD} = 30 V, R _L = 3 Ω, I _D ≅ 10 A, V _{GEN} = 4.5 V, R _g = 1 Ω	-	4	8	
Rise time	t _r		-	16	32	
Turn-off delay time	t _{d(off)}		-	44	88	
Fall time	t _f		-	19	38	
			-	7	14	
Drain-Source Body Diode Characteristics						
Continuous source-drain diode current	I _S	T _C = 25 °C	-	-	37.8	A
Pulse diode forward current	I _{SM}		-	-	100	
Body diode voltage	V _{SD}	I _S = 5 A, V _{GS} = 0 V	-	0.8	1.1	V
Body diode reverse recovery time	t _{rr}	I _F = 10 A, di/dt = 100 A/μs, T _J = 25 °C	-	22	44	ns
Body diode reverse recovery charge	Q _{rr}		-	13	26	nC
Reverse recovery fall time	t _a		-	11	-	ns
Reverse recovery rise time	t _b		-	11	-	

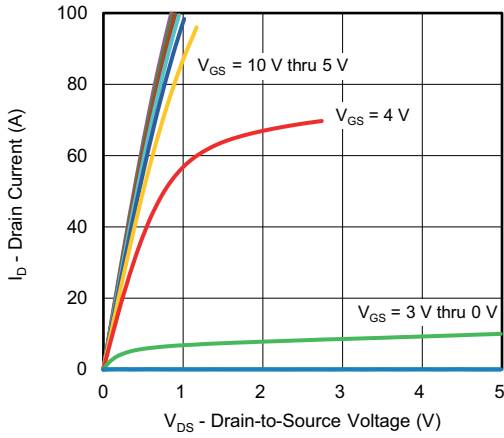
Notes

- a. Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %
- b. Guaranteed by design, not subject to production testing

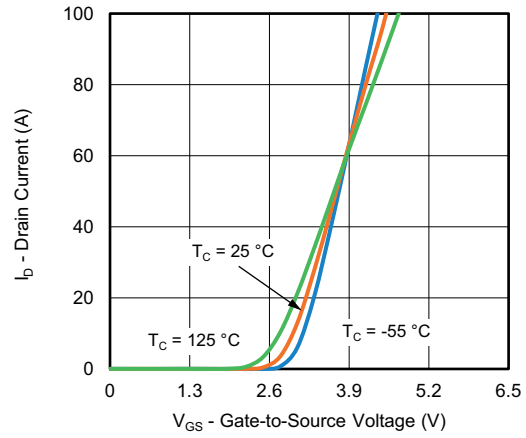
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.



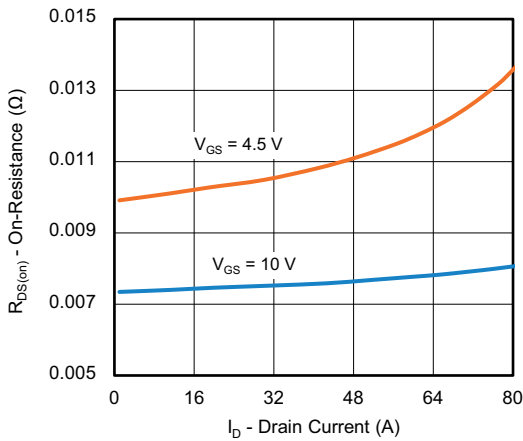
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



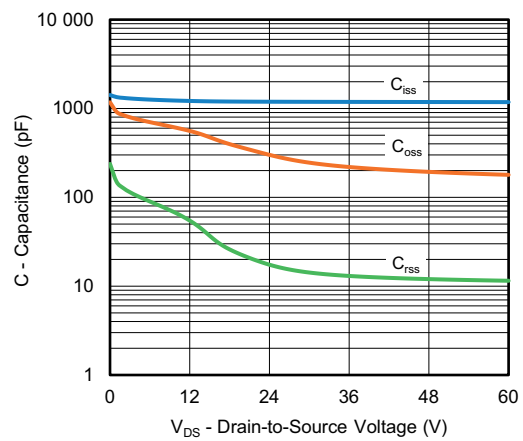
Output Characteristics



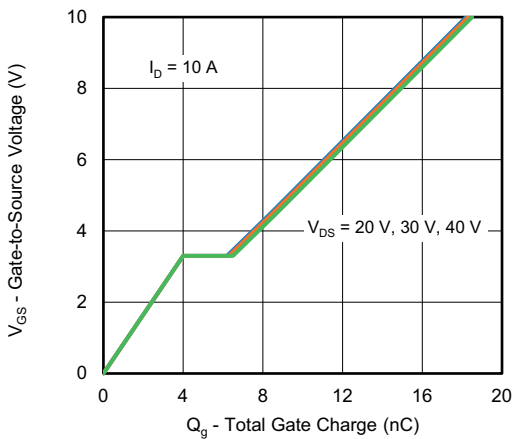
Transfer Characteristics



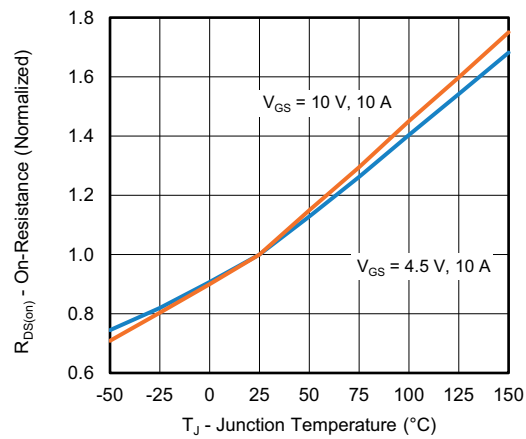
On-Resistance vs. Drain Current and Gate Voltage



Capacitance



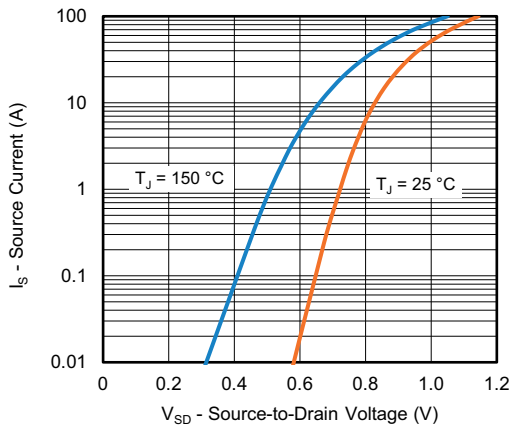
Gate Charge



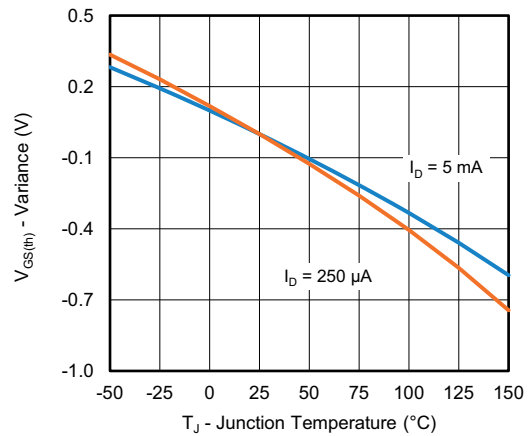
On-Resistance vs. Junction Temperature



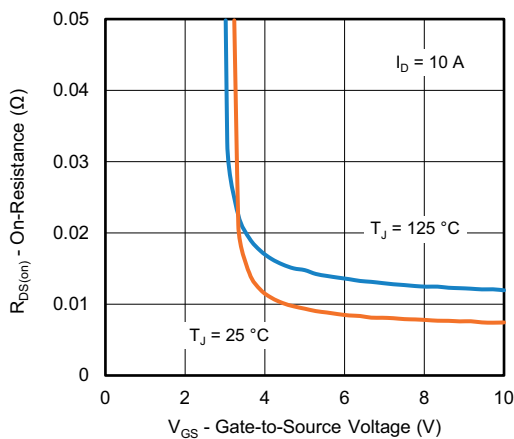
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



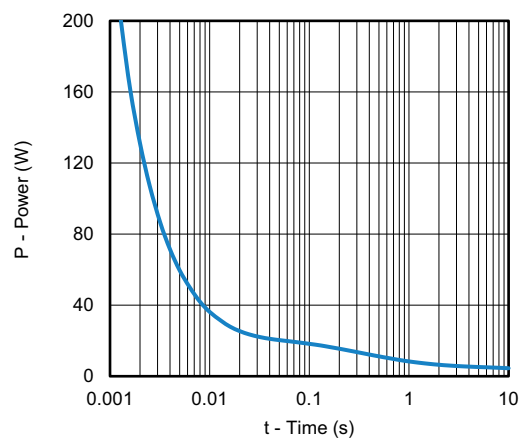
Source-Drain Diode Forward Voltage



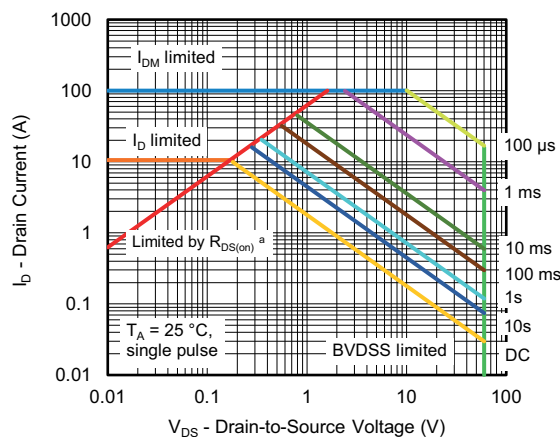
Threshold Voltage



On-Resistance vs. Gate-to-Source Voltage



Single Pulse Power, Junction-to-Ambient



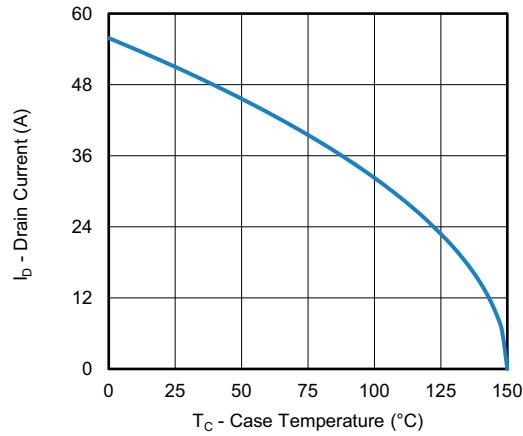
Safe Operating Area, Junction-to-Ambient

Note

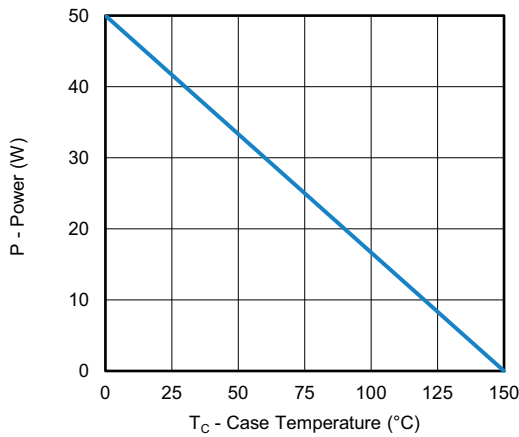
a. $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified



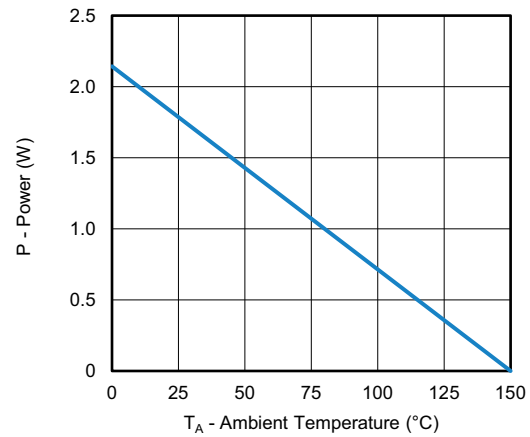
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Current Derating ^a



Power, Junction-to-Case



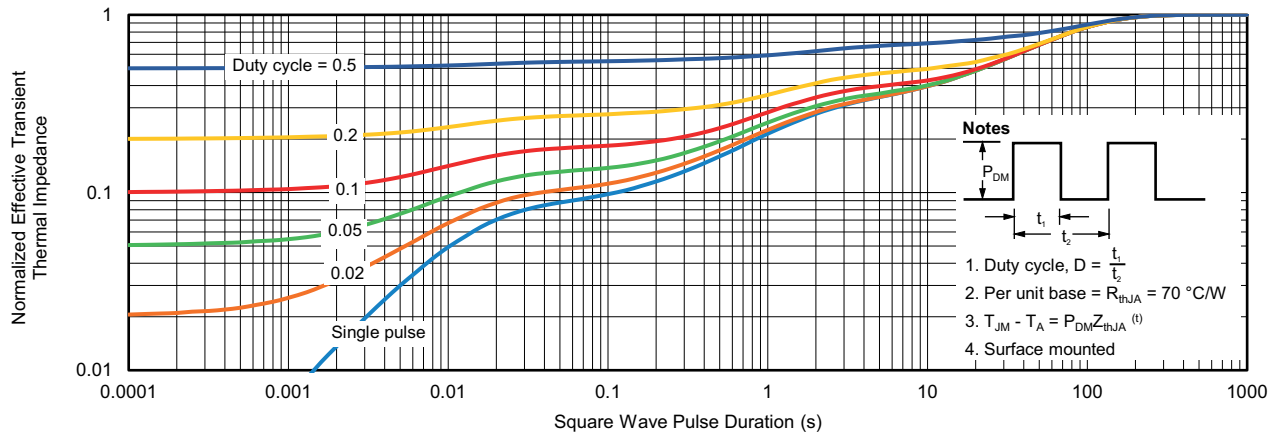
Power, Junction-to-Ambient

Note

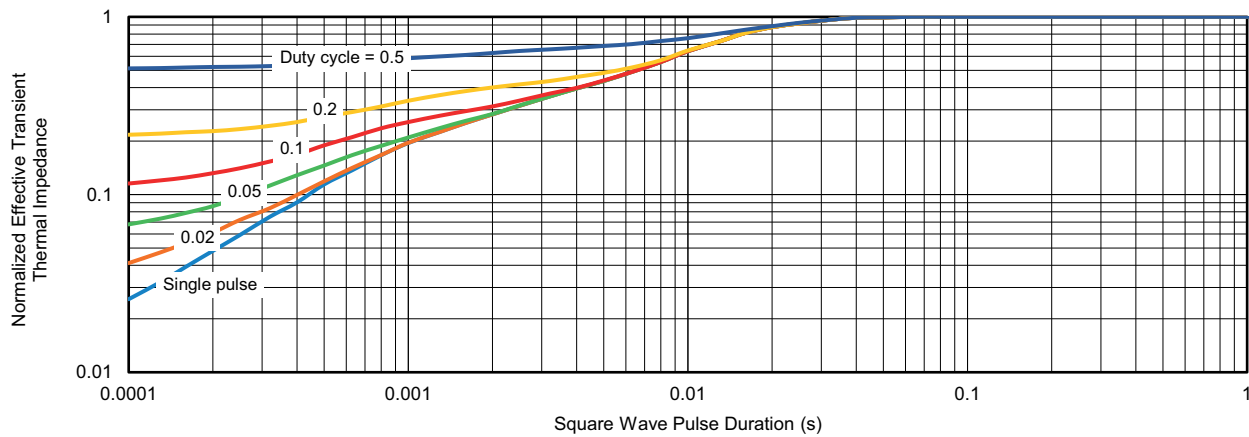
- a. The power dissipation P_D is based on T_J max. = 150 °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit



TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Normalized Thermal Transient Impedance, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Case

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