

## Dual N-Channel 20-V (D-S) MOSFET

PRODUCT SUMMARY		
V <sub>DS</sub> (V)	R <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A)
20	0.030 at V <sub>GS</sub> = 4.5 V	7.7
	0.036 at V <sub>GS</sub> = 2.5 V	7.0
	0.045 at V <sub>GS</sub> = 1.8 V	6.3

### FEATURES

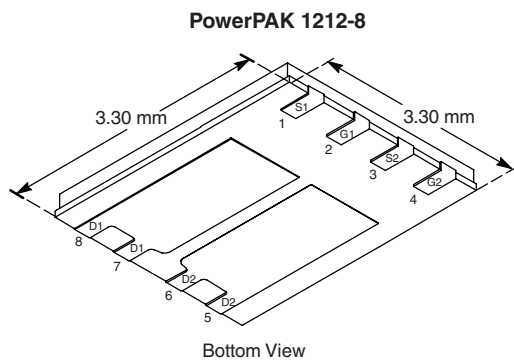
- Halogen-free Option Available
- TrenchFET<sup>®</sup> Power MOSFETS: 1.8 V Rated
- New Low Thermal Resistance PowerPAK<sup>®</sup> Package with Low 1.07 mm Profile



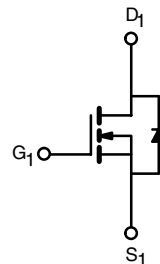
**RoHS**  
COMPLIANT

### APPLICATIONS

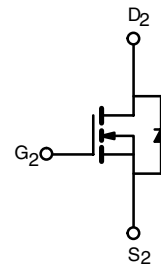
- HDD Spindle Drive



**Ordering Information:** Si7904DN-T1-E3 (Lead (Pb)-free)  
Si7904DN-T1-GE3 (Lead (Pb)-free and Halogen-free)



N-Channel MOSFET



N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted					
Parameter	Symbol	10 s	Steady State	Unit	
Drain-Source Voltage	V <sub>DS</sub>	20		V	
Gate-Source Voltage	V <sub>GS</sub>	± 8			
Continuous Drain Current (T <sub>J</sub> = 150 °C) <sup>a</sup>	I <sub>D</sub>	T <sub>A</sub> = 25 °C	7.7	5.3	A
		T <sub>A</sub> = 85 °C	5.5	3.8	
Pulsed Drain Current	I <sub>DM</sub>	20			
Continuous Source Current (Diode Conduction) <sup>a</sup>	I <sub>S</sub>	2.3	1.1		
Single Pulse Avalanche Current	I <sub>AS</sub>	15		mJ	
Avalanche Energy	E <sub>AS</sub>	11			
Maximum Power Dissipation <sup>a</sup>	P <sub>D</sub>	T <sub>A</sub> = 25 °C	2.8	1.3	W
		T <sub>A</sub> = 85 °C	1.5	0.85	
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>stg</sub>	- 55 to 150		°C	
Soldering Recommendations <sup>b,c</sup>		260			

THERMAL RESISTANCE RATINGS					
Parameter		Symbol	Typical	Maximum	Unit
Maximum Junction-to-Ambient <sup>a</sup>	t ≤ 10 s	R <sub>thJA</sub>	35	44	°C/W
	Steady State		75	94	
Maximum Junction-to-Case	Steady State	R <sub>thJC</sub>	4	5	

Notes:

- Surface Mounted on 1" x 1" FR4 board.
- See Solder Profile (<http://www.vishay.com/ppg?73257>). The PowerPAK 1212-8 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.



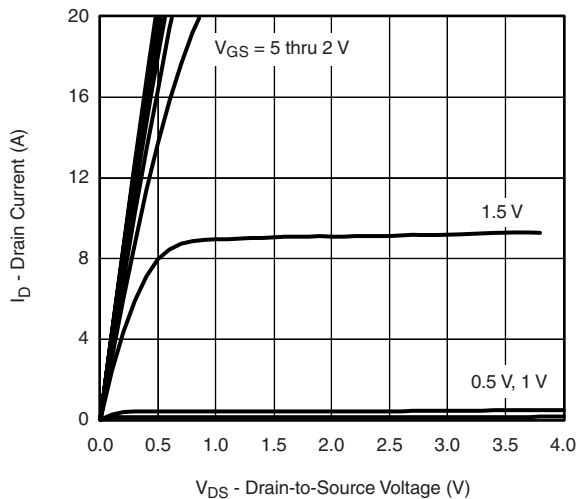
SPECIFICATIONS $T_J = 25^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static</b>						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 935\ \mu\text{A}$	0.45		1.0	V
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0\ \text{V}, V_{GS} = \pm 8\ \text{V}$			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 20\ \text{V}, V_{GS} = 0\ \text{V}$			1	$\mu\text{A}$
		$V_{DS} = 20\ \text{V}, V_{GS} = 0\ \text{V}, T_J = 85^\circ\text{C}$			5	
On-State Drain Current <sup>a</sup>	$I_{D(on)}$	$V_{DS} \geq 5\ \text{V}, V_{GS} = 4.5\ \text{V}$	20			A
Drain-Source On-State Resistance <sup>a</sup>	$R_{DS(on)}$	$V_{GS} = 4.5\ \text{V}, I_D = 7.7\ \text{A}$		0.025	0.030	$\Omega$
		$V_{GS} = 2.5\ \text{V}, I_D = 7.0\ \text{A}$		0.030	0.036	
		$V_{GS} = 1.8\ \text{V}, I_D = 1\ \text{A}$		0.037	0.045	
Forward Transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = 10\ \text{V}, I_D = 7.7\ \text{A}$		23		S
Diode Forward Voltage <sup>a</sup>	$V_{SD}$	$I_S = 2.3\ \text{A}, V_{GS} = 0\ \text{V}$		0.70	1.2	V
<b>Dynamic<sup>b</sup></b>						
Total Gate Charge	$Q_g$	$V_{DS} = 10\ \text{V}, V_{GS} = 4.5\ \text{V}, I_D = 7.7\ \text{A}$		10.2	15	nC
Gate-Source Charge	$Q_{gs}$			1.3		
Gate-Drain Charge	$Q_{gd}$			2.4		
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 10\ \text{V}, R_L = 10\ \Omega$ $I_D \cong 1\ \text{A}, V_{GEN} = 4.5\ \text{V}, R_G = 6\ \Omega$		15	23	ns
Rise Time	$t_r$			50	75	
Turn-Off Delay Time	$t_{d(off)}$			60	90	
Fall Time	$t_f$			45	68	
Source-Drain Reverse Recovery Time	$t_{rr}$	$I_F = 2.3\ \text{A}, di/dt = 100\ \text{A}/\mu\text{s}$		40	80	

Notes:

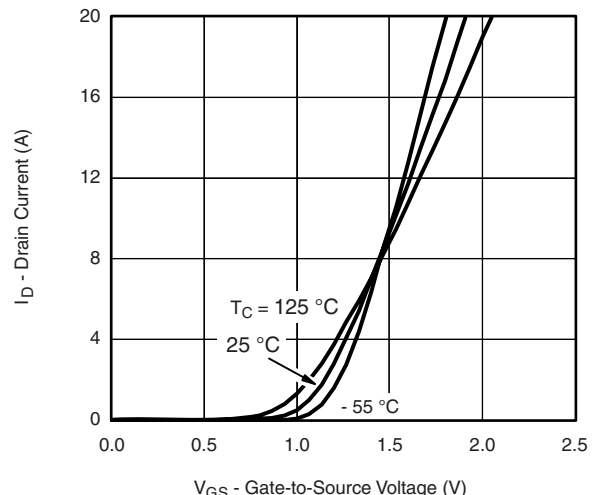
- a. Pulse test; pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .
- b. Guaranteed by design, not subject to production testing.

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**  $T_A = 25^\circ\text{C}$ , unless otherwise noted

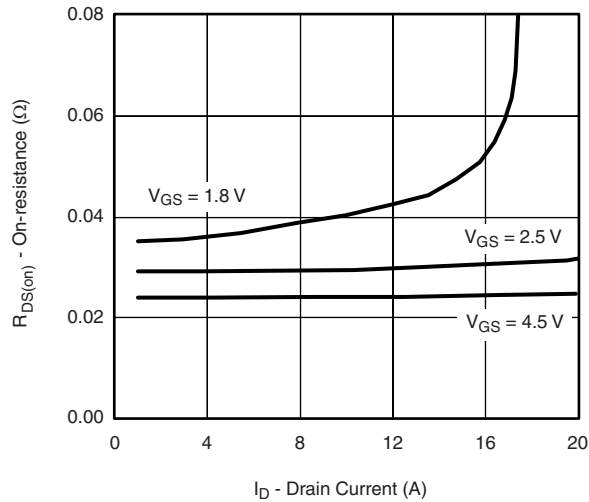


**Output Characteristics**

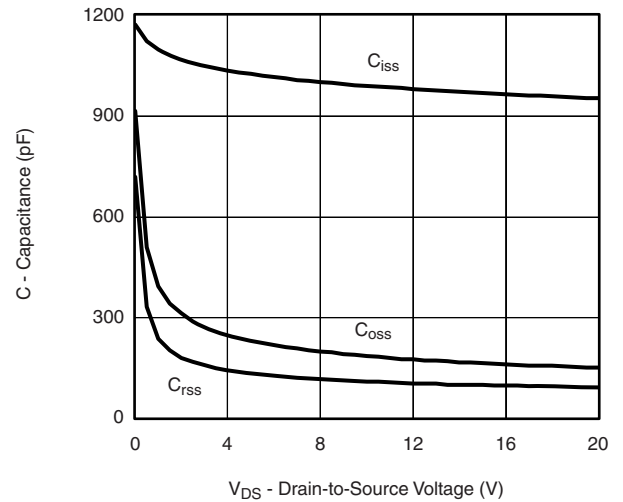


**Transfer Characteristics**

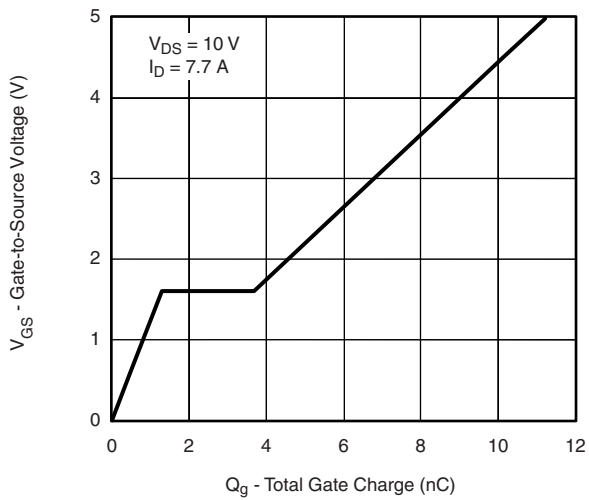
**TYPICAL CHARACTERISTICS**  $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted



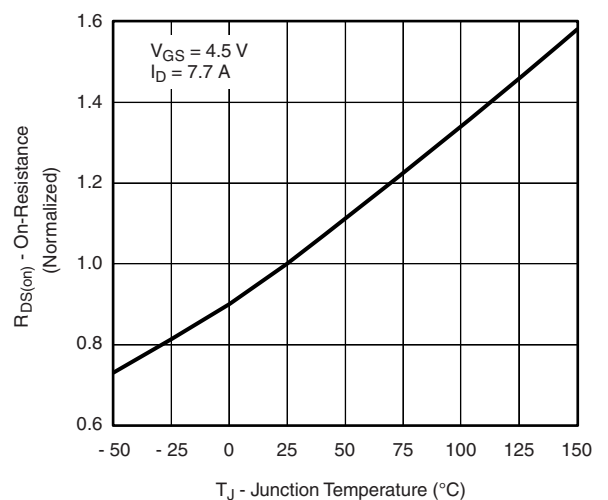
**On-Resistance vs. Drain Current**



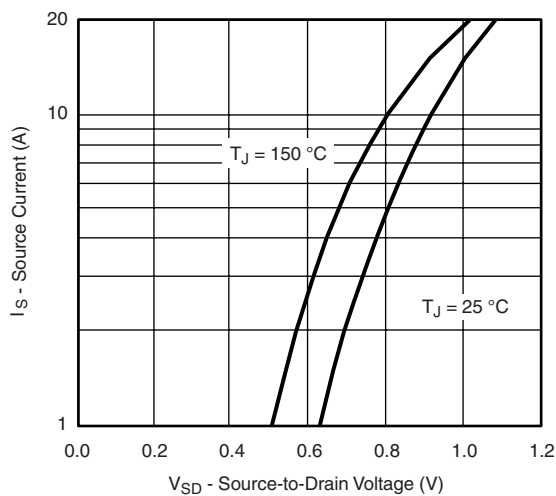
**Capacitance**



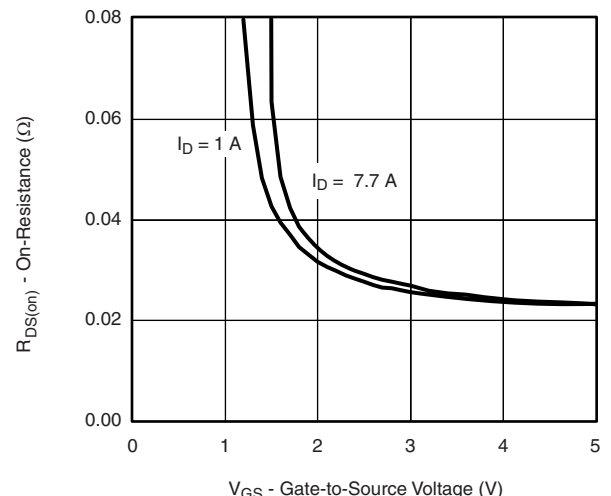
**Gate Charge**



**On-Resistance vs. Junction Temperature**

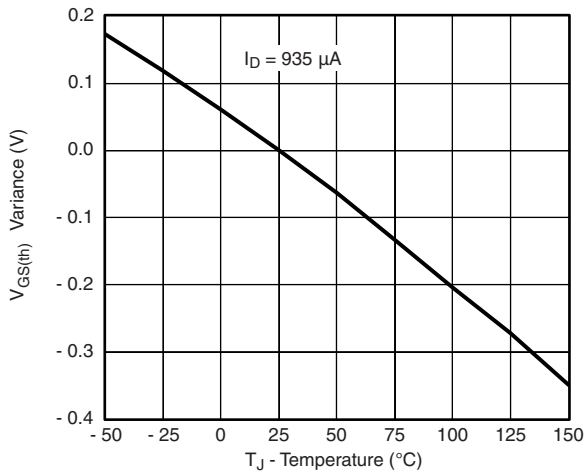


**Source-Drain Diode Forward Voltage**

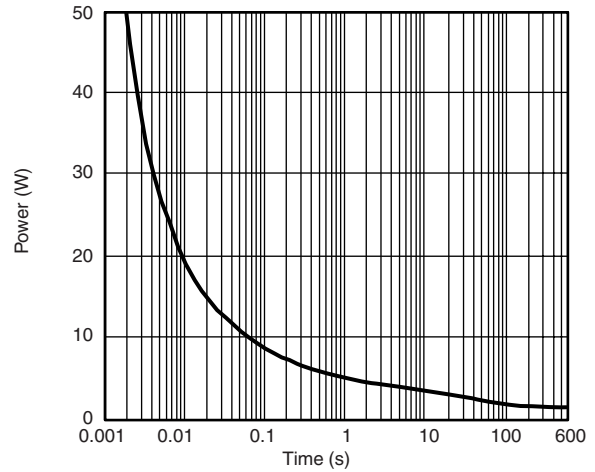


**On-Resistance vs. Gate-to-Source Voltage**

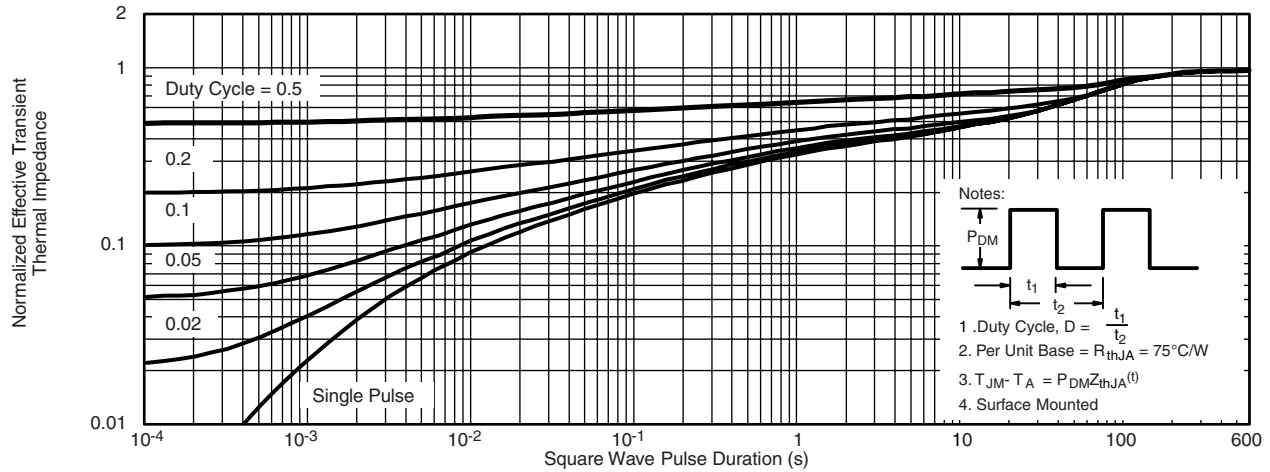
**TYPICAL CHARACTERISTICS**  $T_A = 25^\circ\text{C}$ , unless otherwise noted



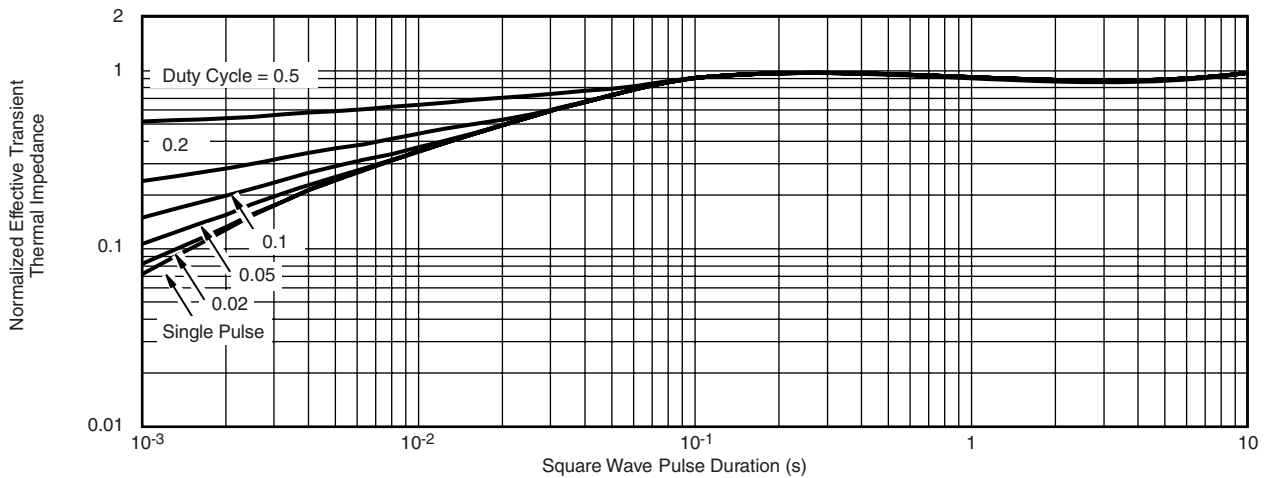
**Threshold Voltage**



**Single Pulse Power, Junction-to-Ambient**



**Normalized Thermal Transient Impedance, Junction-to-Ambient**



**Normalized Thermal Transient Impedance, Junction-to-Case**

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