

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

### PRODUCT SUMMARY

| $V_{DS}$ (V) | $R_{DS(on)}$ ( $\Omega$ ) | $I_D$ (A) |
|--------------|---------------------------|-----------|
| 20           | 0.030 at $V_{GS} = 4.5$ V | 7.7       |
|              | 0.036 at $V_{GS} = 2.5$ V | 7.0       |
|              | 0.045 at $V_{GS} = 1.8$ V | 6.3       |

### FEATURES

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

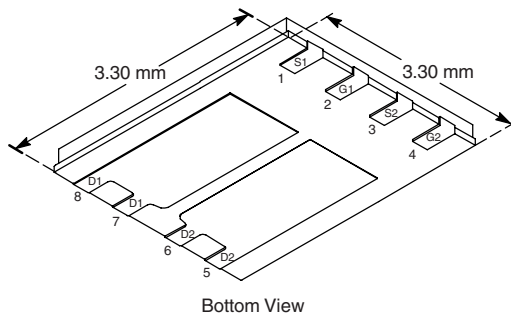


**RoHS**  
COMPLIANT

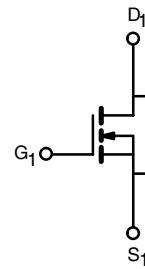
### APPLICATIONS

- HDD Spindle Drive

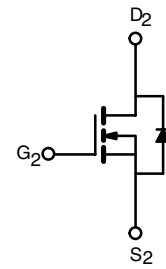
PowerPAK 1212-8



**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 $T_A = 25$ °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> | T <sub>A</sub> = 25 °C | I <sub>D</sub>                    | 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                                  | L = 0.1 mH             | I <sub>AS</sub>                   | 15          |              | mJ   |
| Avalanche Energy                                                |                        | E <sub>AS</sub>                   | 11          |              |      |
| Maximum Power Dissipation <sup>a</sup>                          | T <sub>A</sub> = 25 °C | P <sub>D</sub>                    | 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> | $R_{thJA}$ | 35      | 44      | °C/W |
|                                          |            | 75      | 94      |      |
| Maximum Junction-to-Case                 | $R_{thJC}$ | 4       | 5       |      |

Notes:

a. Surface Mounted on 1" x 1" FR4 board.

b. 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.

c. Rework Conditions: manual soldering with a soldering iron is not recommended for leadless components.

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

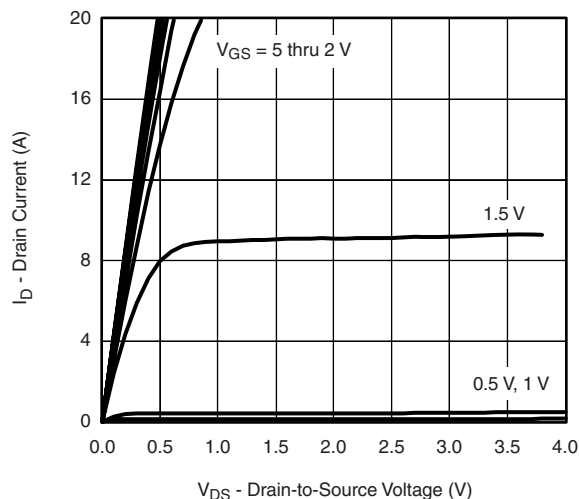
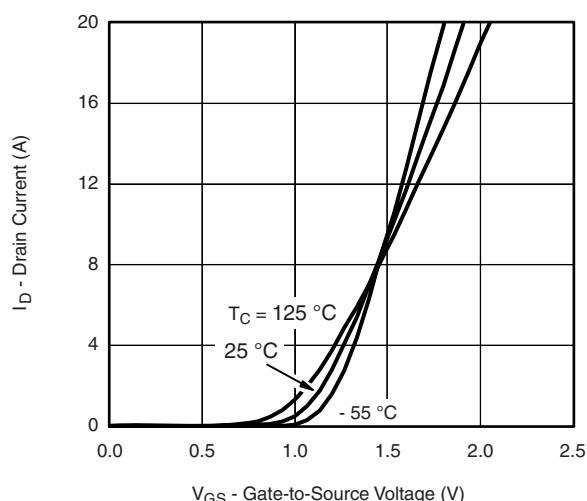
| Parameter                                     | Symbol       | Test Conditions                                                                                                           | Min. | Typ.  | Max.      | Unit          |
|-----------------------------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------|------|-------|-----------|---------------|
| <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                            | $t_{d(on)}$  | $V_{DD} = 10\ \text{V}$ , $R_L = 10\ \Omega$<br>$I_D \approx 1\ \text{A}$ , $V_{GEN} = 4.5\ \text{V}$ , $R_G = 6\ \Omega$ |      | 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:

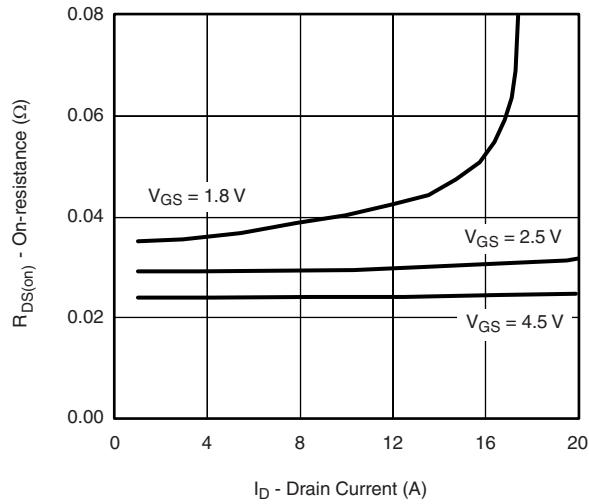
a. Pulse test; pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

b. Guaranteed by design, not subject to production testing.

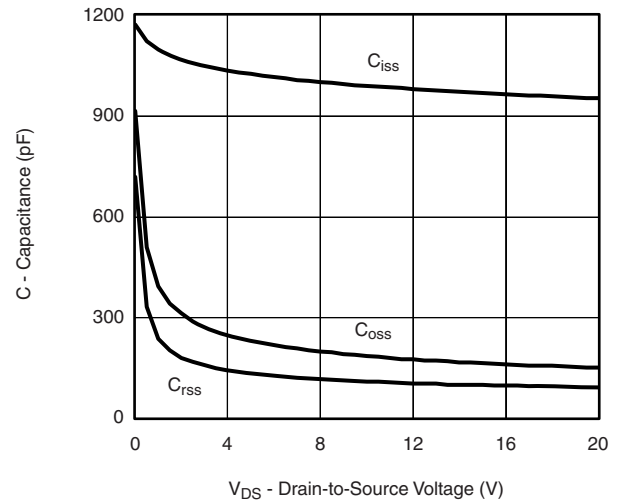
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

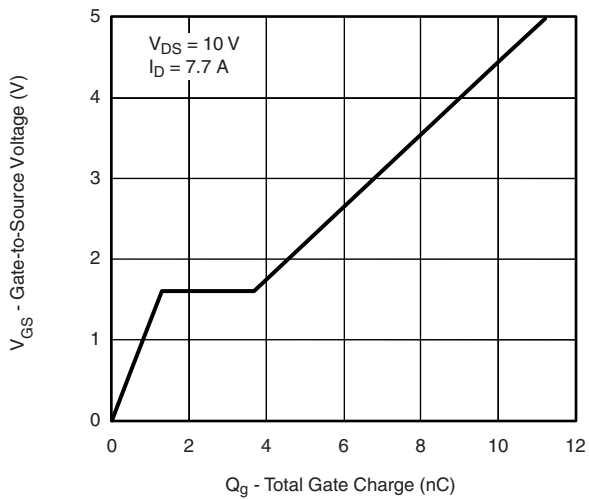
## TYPICAL CHARACTERISTICS $T_A = 25^\circ\text{C}$ , unless otherwise noted



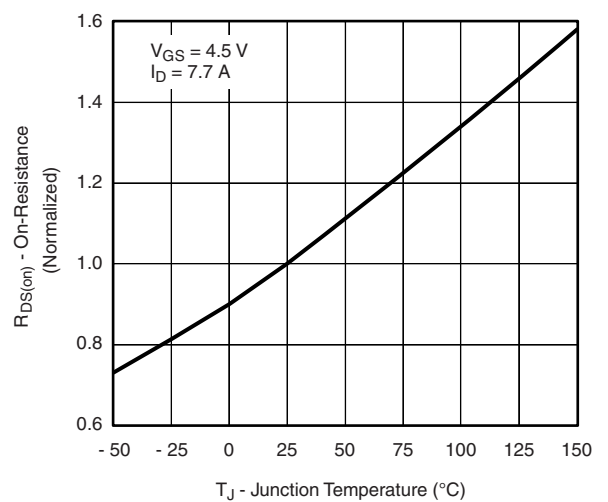
On-Resistance vs. Drain Current



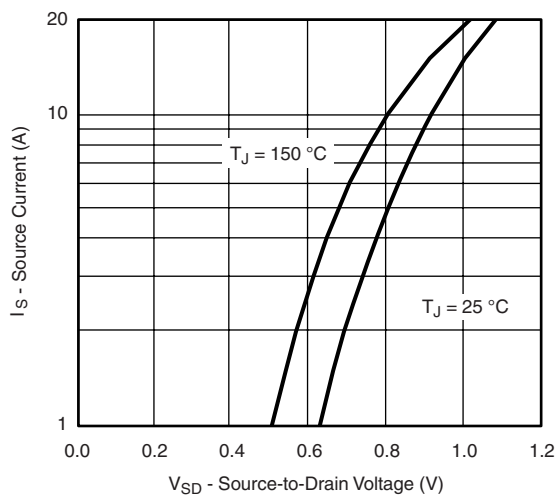
Capacitance



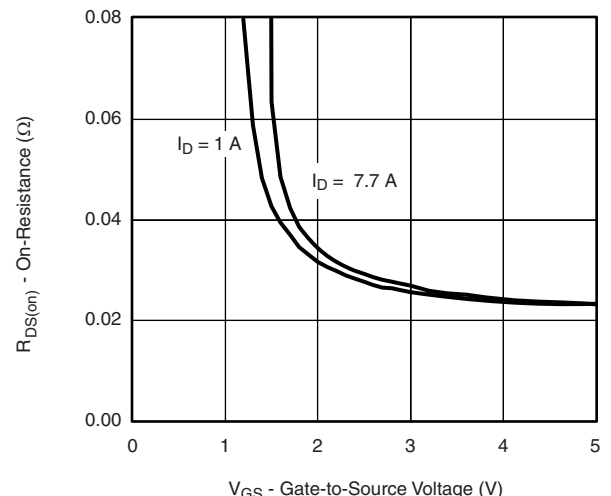
Gate Charge



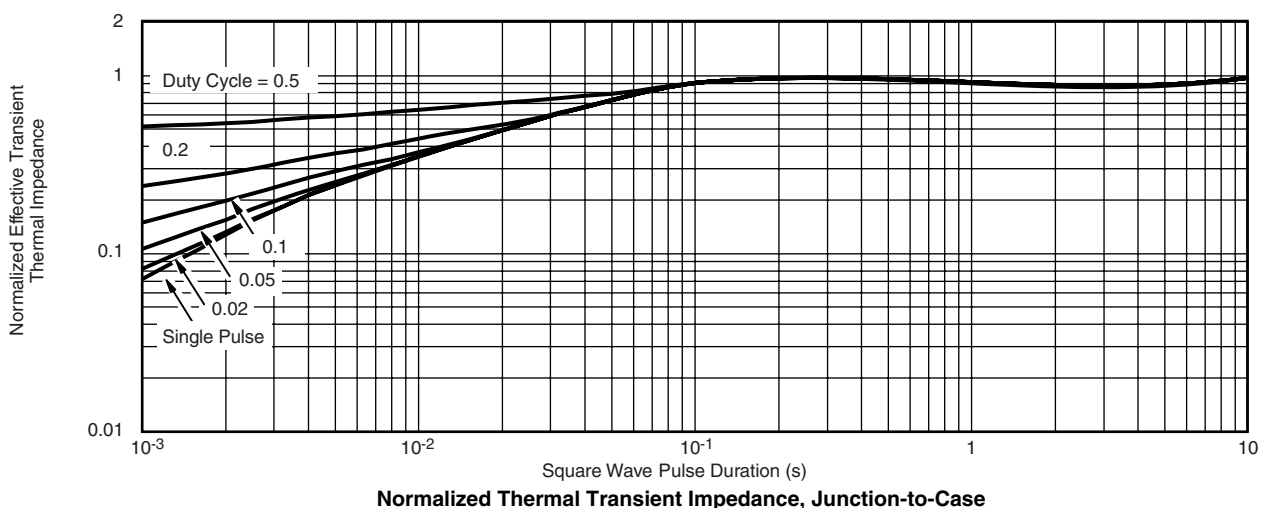
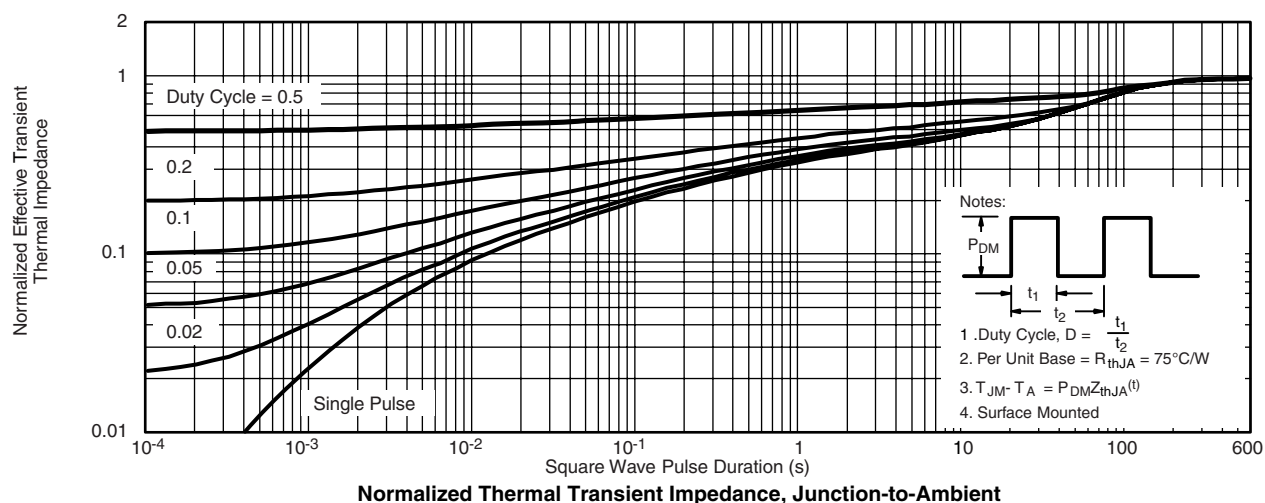
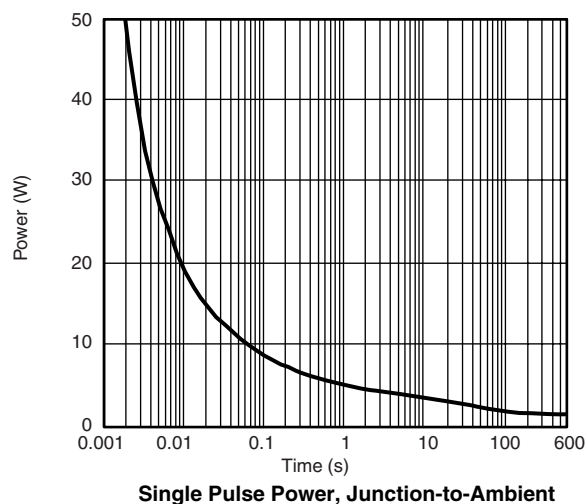
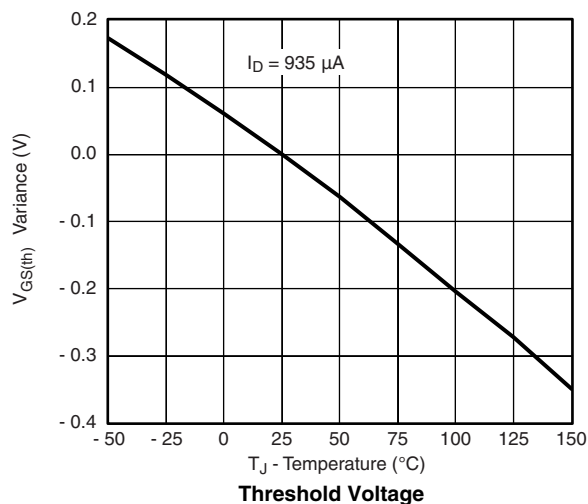
On-Resistance vs. Junction Temperature



Source-Drain Diode Forward Voltage



On-Resistance vs. Gate-to-Source Voltage

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