

## P-Channel 20-V (D-S) MOSFET

### PRODUCT SUMMARY

| $V_{DS}$ (V) | $R_{DS(on)}$ ( $\Omega$ )   | $I_D$ (A) |
|--------------|-----------------------------|-----------|
| - 20         | 0.057 at $V_{GS} = - 4.5$ V | - 3.3     |
|              | 0.076 at $V_{GS} = - 2.5$ V | - 2.8     |
|              | 0.110 at $V_{GS} = - 1.8$ V | - 2.3     |

### FEATURES

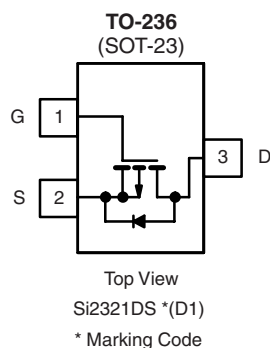
- Halogen-free Option Available
- TrenchFET® Power MOSFETS

### APPLICATIONS

- Load Switch
- PA Switch



**RoHS**  
COMPLIANT



Ordering Information: Si2321DS-T1-E3 (Lead (Pb)-free)  
Si2321DS-T1-GE3 (Lead (Pb)-free and Halogen-free)

### ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °C, unless otherwise noted

| ABSOLUTE MAXIMUM RATINGS T <sub>A</sub> = 25 °C, unless otherwise noted |                        |                                   |             |              |      |
|-------------------------------------------------------------------------|------------------------|-----------------------------------|-------------|--------------|------|
| Parameter                                                               |                        | Symbol                            | 5 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>                    | - 3.3       | - 2.9        | A    |
|                                                                         | T <sub>A</sub> = 70 °C |                                   | - 2.6       | - 2.3        |      |
| Pulsed Drain Current                                                    |                        | I <sub>DM</sub>                   | - 12        |              |      |
| Continuous Source Current (Diode Conduction) <sup>a</sup>               |                        | I <sub>S</sub>                    | - 0.74      | - 0.59       |      |
| Power Dissipation <sup>a</sup>                                          | T <sub>A</sub> = 25 °C | P <sub>D</sub>                    | 0.89        | 0.71         | W    |
|                                                                         | T <sub>A</sub> = 70 °C |                                   | 0.57        | 0.45         |      |
| Operating Junction and Storage Temperature Range                        |                        | T <sub>J</sub> , T <sub>stg</sub> | - 55 to 150 |              | °C   |

### THERMAL RESISTANCE RATINGS

| Parameter                                | Symbol       | Typical    | Maximum | Unit |
|------------------------------------------|--------------|------------|---------|------|
| Maximum Junction-to-Ambient <sup>a</sup> | $t \leq 5$ s | $R_{thJA}$ | 115     | °C/W |
|                                          | Steady State |            | 140     |      |
| Maximum Junction-to-Foot (Drain)         | Steady State | $R_{thJF}$ | 60      |      |

Notes:

a. Surface Mounted on FR4 board.

b.  $t \leq 5$  s.

For SPICE model information via the Worldwide Web: <http://www.vishay.com/www/product/spice.htm>

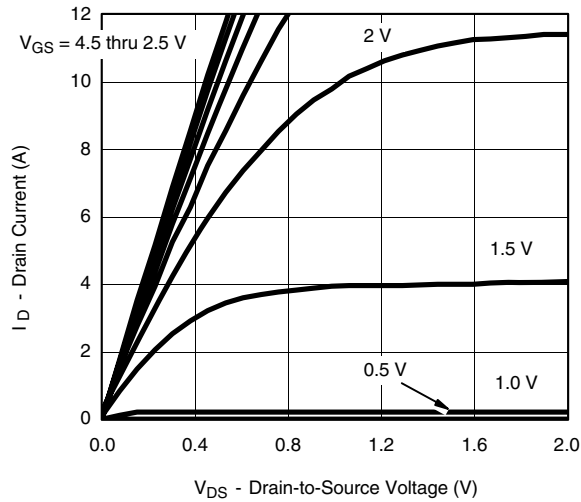
| SPECIFICATIONS $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted |                             |                                                                                                                                                                               |        |       |           |               |
|----------------------------------------------------------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|-----------|---------------|
| Parameter                                                                  | Symbol                      | Test Conditions                                                                                                                                                               | Limits |       |           | Unit          |
|                                                                            |                             |                                                                                                                                                                               | Min.   | Typ.  | Max.      |               |
| Static                                                                     |                             |                                                                                                                                                                               |        |       |           |               |
| Drain-Source Breakdown Voltage                                             | $V_{(\text{BR})\text{DSS}}$ | $V_{\text{GS}} = 0\text{ V}$ , $I_{\text{D}} = -10\text{ }\mu\text{A}$                                                                                                        | - 20   |       |           | V             |
| Gate-Threshold Voltage                                                     | $V_{\text{GS}(\text{th})}$  | $V_{\text{DS}} = V_{\text{GS}}$ , $I_{\text{D}} = -250\text{ }\mu\text{A}$                                                                                                    | - 0.40 |       | - 0.90    |               |
| Gate-Body Leakage                                                          | $I_{\text{GSS}}$            | $V_{\text{DS}} = 0\text{ V}$ , $V_{\text{GS}} = \pm 8\text{ V}$                                                                                                               |        |       | $\pm 100$ | nA            |
| Zero Gate Voltage Drain Current                                            | $I_{\text{DSS}}$            | $V_{\text{DS}} = 16\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$                                                                                                                  |        |       | - 1       | $\mu\text{A}$ |
|                                                                            |                             | $V_{\text{DS}} = 16\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$ , $T_J = 55\text{ }^{\circ}\text{C}$                                                                             |        |       | - 10      |               |
| On-State Drain Current <sup>a</sup>                                        | $I_{\text{D}(\text{on})}$   | $V_{\text{DS}} \leq -5\text{ V}$ , $V_{\text{GS}} = -4.5\text{ V}$                                                                                                            | - 6    |       |           | A             |
| Drain-Source On-Resistance <sup>a</sup>                                    | $R_{\text{DS}(\text{on})}$  | $V_{\text{GS}} = -4.5\text{ V}$ , $I_{\text{D}} = -3.3\text{ A}$                                                                                                              |        | 0.044 | 0.057     | $\Omega$      |
|                                                                            |                             | $V_{\text{GS}} = -2.5\text{ V}$ , $I_{\text{D}} = -2.8\text{ A}$                                                                                                              |        | 0.061 | 0.076     |               |
|                                                                            |                             | $V_{\text{GS}} = -1.8\text{ V}$ , $I_{\text{D}} = -2.3\text{ A}$                                                                                                              |        | 0.084 | 0.110     |               |
| Forward Transconductance <sup>a</sup>                                      | $g_{\text{fs}}$             | $V_{\text{DS}} = -5\text{ V}$ , $I_{\text{D}} = -3.3\text{ A}$                                                                                                                |        | 3     |           | S             |
| Diode Forward Voltage                                                      | $V_{\text{SD}}$             | $I_{\text{S}} = -1.6\text{ A}$ , $V_{\text{GS}} = 0\text{ V}$                                                                                                                 |        |       | - 1.2     | V             |
| Dynamic <sup>b</sup>                                                       |                             |                                                                                                                                                                               |        |       |           |               |
| Total Gate Charge                                                          | $Q_{\text{g}}$              | $V_{\text{DS}} = -6\text{ V}$ , $V_{\text{GS}} = -4.5\text{ V}$<br>$I_{\text{D}} \cong -3.3\text{ A}$                                                                         |        | 8     | 13        | nC            |
| Gate-Source Charge                                                         | $Q_{\text{gs}}$             |                                                                                                                                                                               |        | 1.2   |           |               |
| Gate-Drain Charge                                                          | $Q_{\text{gd}}$             |                                                                                                                                                                               |        | 2.2   |           |               |
| Input Capacitance                                                          | $C_{\text{iss}}$            | $V_{\text{DS}} = -6\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$ , $f = 1\text{ MHz}$                                                                                             |        | 715   |           | pF            |
| Output Capacitance                                                         | $C_{\text{oss}}$            |                                                                                                                                                                               |        | 170   |           |               |
| Reverse Transfer Capacitance                                               | $C_{\text{rss}}$            |                                                                                                                                                                               |        | 120   |           |               |
| Switching <sup>b</sup>                                                     |                             |                                                                                                                                                                               |        |       |           |               |
| Turn-On Time                                                               | $t_{\text{d}(\text{on})}$   | $V_{\text{DD}} = -6\text{ V}$ , $R_{\text{L}} = 6\text{ }\Omega$<br>$I_{\text{D}} \cong -1.0\text{ A}$ , $V_{\text{GEN}} = -4.5\text{ V}$<br>$R_{\text{G}} = 6\text{ }\Omega$ |        | 15    | 25        | ns            |
|                                                                            | $t_{\text{r}}$              |                                                                                                                                                                               |        | 35    | 55        |               |
| Turn-Off Time                                                              | $t_{\text{d}(\text{off})}$  |                                                                                                                                                                               |        | 60    | 90        |               |
|                                                                            | $t_{\text{f}}$              |                                                                                                                                                                               |        | 40    | 60        |               |

Notes:

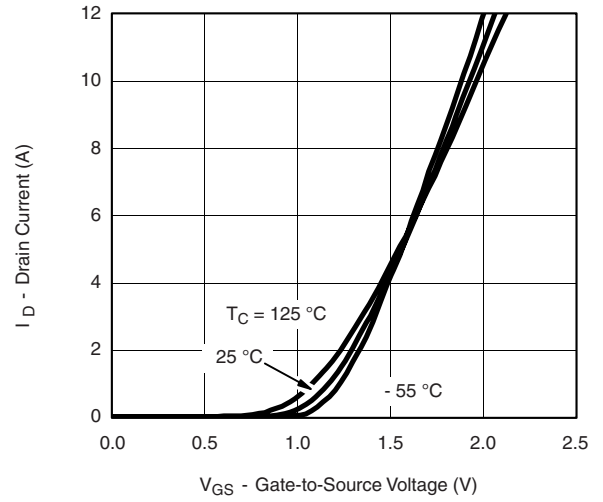
- a. For DESIGN AID ONLY, not subject to production testing.  
b. Pulse test:  $PW \leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
c. Switching time is essentially independent of operating temperature.

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.

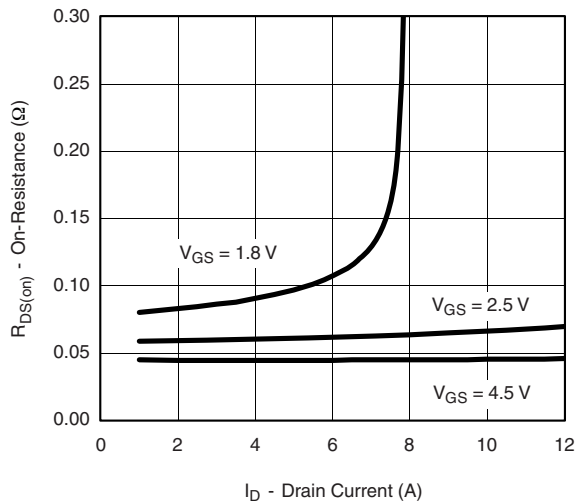
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



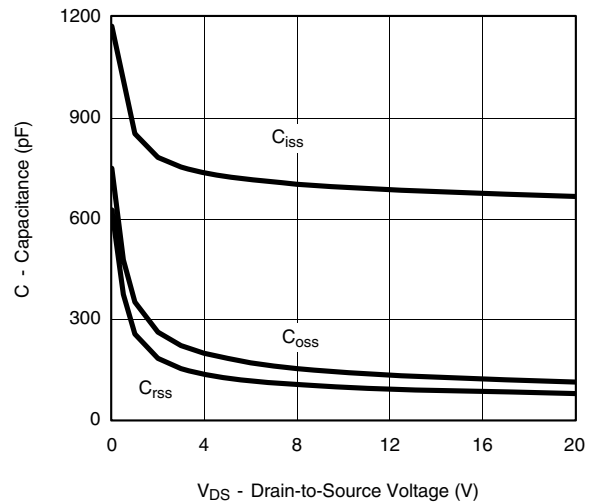
Output Characteristics



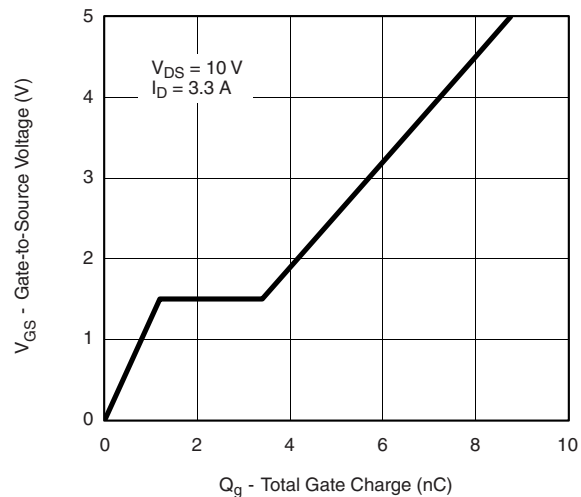
Transfer Characteristics



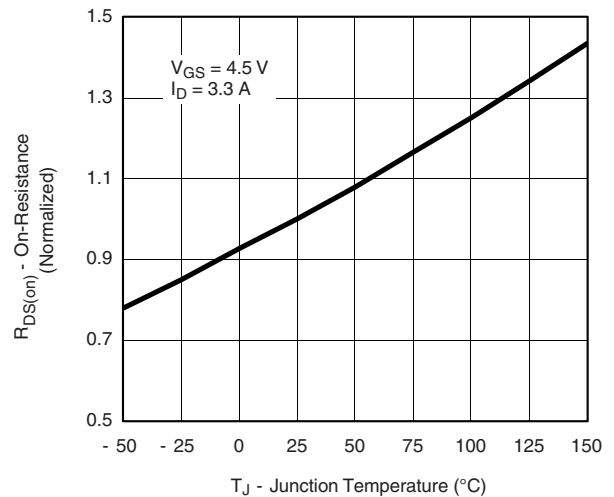
On-Resistance vs. Drain Current



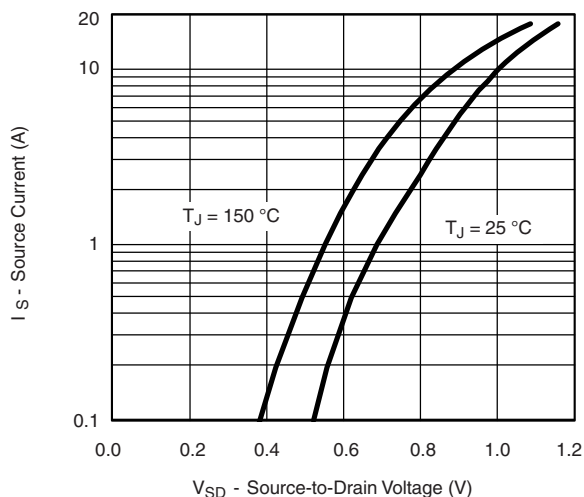
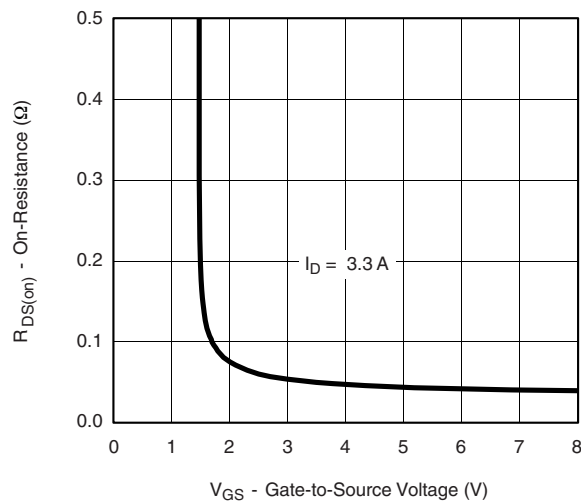
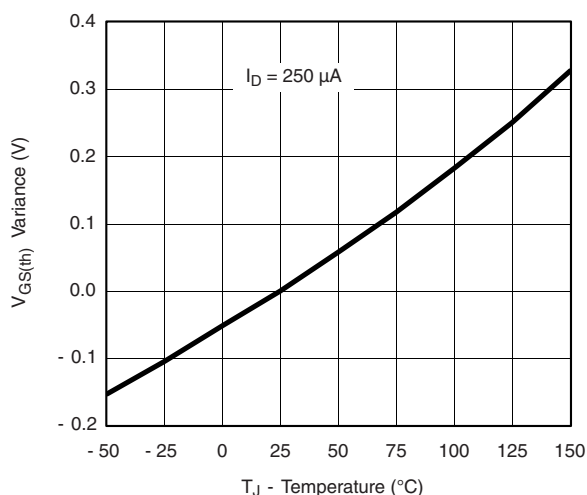
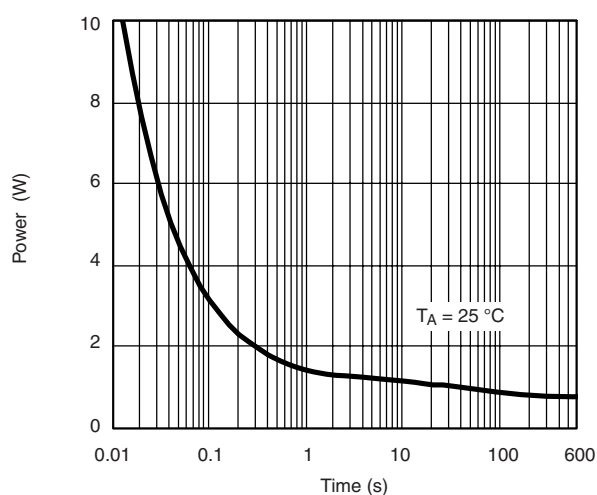
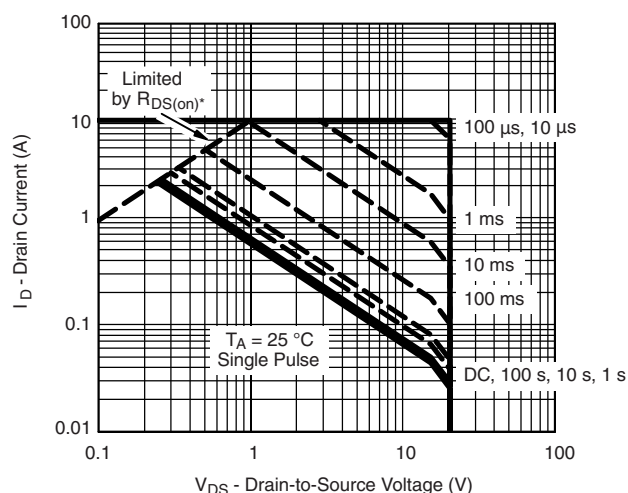
Capacitance



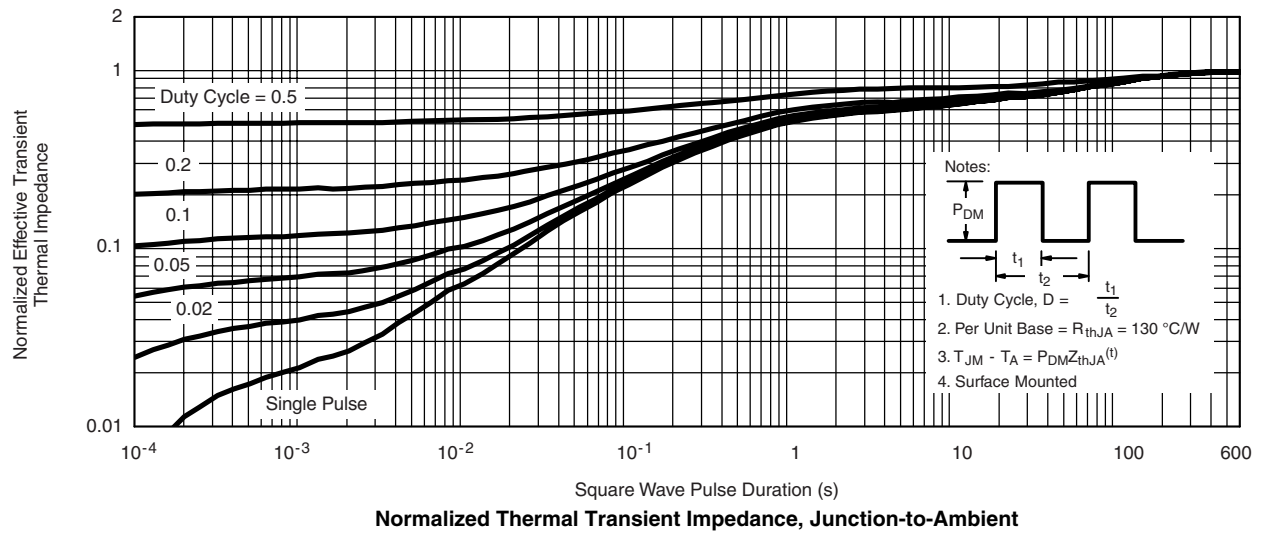
Gate Charge



Normalized On-Resistance vs. Junction Temperature

**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted**Source-Drain Diode Forward Voltage****On-Resistance vs. Gate-to-Source Voltage****Threshold Voltage****Single Pulse Power**\*  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified**Safe Operating Area**

## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



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