

## P-Channel 12-V (D-S) MOSFET

| PRODUCT SUMMARY     |                                    |                    |
|---------------------|------------------------------------|--------------------|
| V <sub>DS</sub> (V) | R <sub>DS(on)</sub> (Ω)            | I <sub>D</sub> (A) |
| - 12                | 0.032 at V <sub>GS</sub> = - 4.5 V | - 5.3              |
|                     | 0.042 at V <sub>GS</sub> = - 2.5 V | - 4.6              |
|                     | 0.059 at V <sub>GS</sub> = - 1.8 V | - 3.9              |

### FEATURES

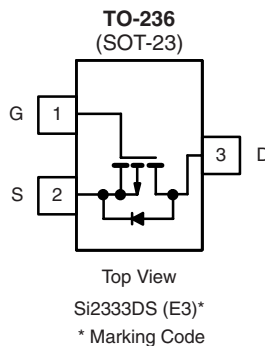
- Halogen-free According to IEC 61249-2-21 Available
- TrenchFET® Power MOSFET

### APPLICATIONS

- Load Switch
- PA Switch



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
Available



**Ordering Information:** Si2333DS-T1-E3 (Lead (Pb)-free)  
Si2333DS-T1-GE3 (Lead (Pb)-free and Halogen-free)

| 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>                   | - 12        |              | V    |
| Gate-Source Voltage   | V <sub>GS</sub>                   | ± 8         |              |      |
| Continuous Drain Current (T <sub>J</sub> = 150 °C) <sup>a, b</sup>      | T <sub>A</sub> = 25 °C            | - 5.3       | - 4.1        | A    |
|   | T <sub>A</sub> = 70 °C            | - 4.2       | - 3.3        |      |
| Pulsed Drain Current  | I <sub>DM</sub>                   | - 20        |              |      |
| Continuous Source Current (Diode Conduction) <sup>a, b</sup>            | I <sub>S</sub>                    | - 1.0       | - 0.6        |      |
| Maximum Power Dissipation <sup>a, b</sup>                               | T <sub>A</sub> = 25 °C            | 1.25        | 0.75         | W    |
|   | T <sub>A</sub> = 70 °C            | 0.8         | 0.48         |      |
| 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 ≤ 5 s      | 75      | 100     | °C/W |  |
|  | Steady State | 120     | 166     |      |  |
| Maximum Junction-to-Foot (Drain)         | Steady State | 40      | 50      |      |  |

Notes:

- a. Surface Mounted on 1" x 1" FR4 board.  
b. Pulse width limited by maximum junction temperature.

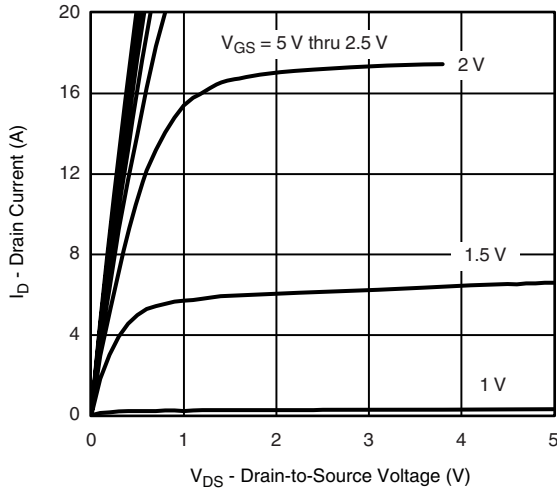
| SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted |               |  |        |       |           |               |
|--|---------------|--|--------|-------|-----------|---------------|
| Parameter  | Symbol        | Test Conditions  | Limits |       |           | Unit          |
|  |               |  | Min.   | Typ.  | Max.      |               |
| <b>Static</b>  |               |  |        |       |           |               |
| Drain-Source Breakdown Voltage   | $V_{(BR)DSS}$ | $V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$   | -12    |       |           | V             |
| Gate-Threshold Voltage   | $V_{GS(th)}$  | $V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$   | -0.40  |       | -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  | $I_{DSS}$     | $V_{DS} = -9.6\text{ V}, V_{GS} = 0\text{ V}$  |        |       | -1        | $\mu\text{A}$ |
|  |               | $V_{DS} = -9.6\text{ V}, V_{GS} = 0\text{ V}, T_J = 55\text{ }^\circ\text{C}$  |        |       | -10       |               |
| On-State Drain Current <sup>a</sup>                                      | $I_{D(on)}$   | $V_{DS} \leq -5\text{ V}, V_{GS} = -4.5\text{ V}$  | -20    |       |           | A             |
| Drain-Source On-Resistance <sup>a</sup>                                  | $R_{DS(on)}$  | $V_{GS} = -4.5\text{ V}, I_D = -5.3\text{ A}$  |        | 0.025 | 0.032     | $\Omega$      |
|  |               | $V_{GS} = -2.5\text{ V}, I_D = -4.6\text{ A}$  |        | 0.033 | 0.042     |               |
|  |               | $V_{GS} = -1.8\text{ V}, I_D = -2.0\text{ A}$  |        | 0.046 | 0.059     |               |
| Forward Transconductance <sup>a</sup>                                    | $g_{fs}$      | $V_{DS} = -5\text{ V}, I_D = -5.3\text{ A}$  |        | 17    |           | S             |
| Diode Forward Voltage  | $V_{SD}$      | $I_S = -1.0\text{ A}, V_{GS} = 0\text{ V}$   |        | -0.7  | -1.2      | V             |
| <b>Dynamic<sup>b</sup></b>   |               |  |        |       |           |               |
| Total Gate Charge  | $Q_g$         | $V_{DS} = -6\text{ V}, V_{GS} = -4.5\text{ V}$<br>$I_D \cong -5.3\text{ A}$  |        | 11.5  | 18        | nC            |
| Gate-Source Charge   | $Q_{gs}$      |  |        | 1.5   |           |               |
| Gate-Drain Charge  | $Q_{gd}$      |  |        | 3.2   |           |               |
| Input Capacitance  | $C_{iss}$     | $V_{DS} = -6\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$  |        | 1100  |           | pF            |
| Output Capacitance   | $C_{oss}$     |  |        | 390   |           |               |
| Reverse Transfer Capacitance   | $C_{rss}$     |  |        | 300   |           |               |
| <b>Switching<sup>c</sup></b>   |               |  |        |       |           |               |
| Turn-On Time   | $t_{d(on)}$   | $V_{DD} = -6\text{ V}, R_L = 6\text{ }\Omega$<br>$I_D \cong -1.0\text{ A}, V_{GEN} = -4.5\text{ V}$<br>$R_G = 6\text{ }\Omega$ |        | 25    | 40        | ns            |
|  | $t_r$         |  |        | 45    | 70        |               |
| Turn-Off Time  | $t_{d(off)}$  |  |        | 72    | 110       |               |
|  | $t_f$         |  |        | 60    | 90        |               |

## Notes:

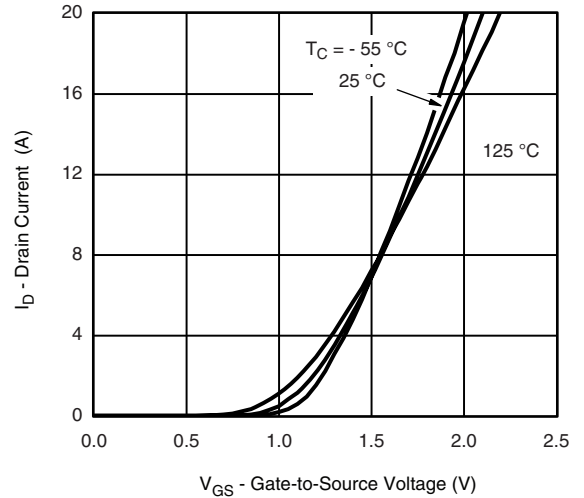
- a. Pulse test:  $PW \leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
b. For design aid only, not subject to production testing.  
c. Switching time is essentially independent of operating temperature.

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.

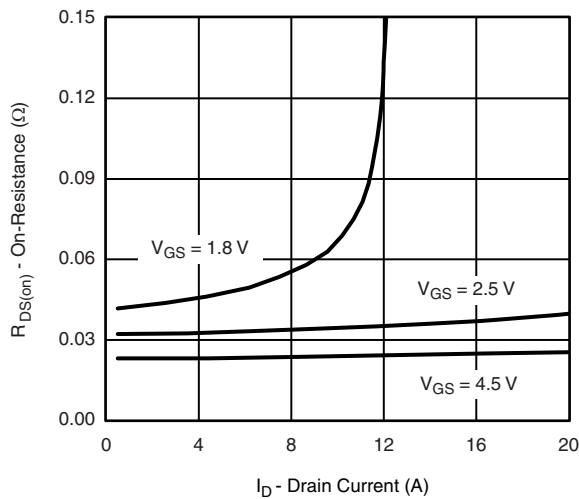
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



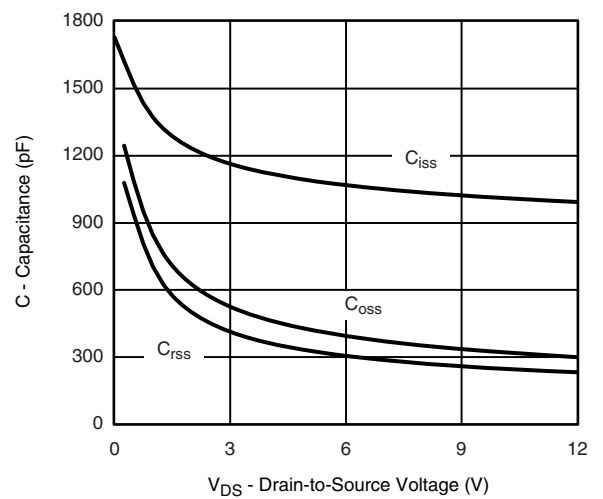
**Output Characteristics**



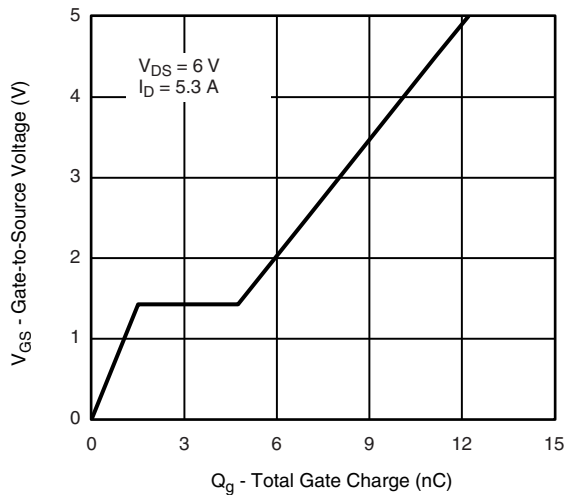
**Transfer Characteristics**



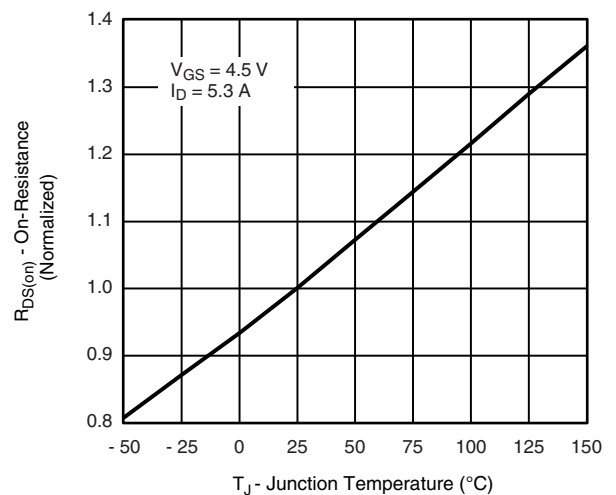
**On-Resistance vs. Drain Current**



**Capacitance**

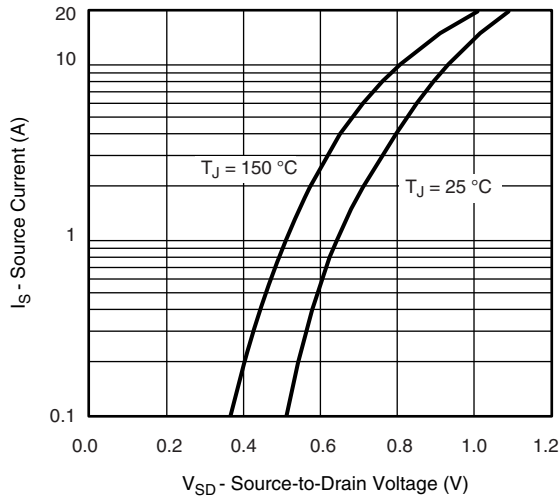


**Gate Charge**

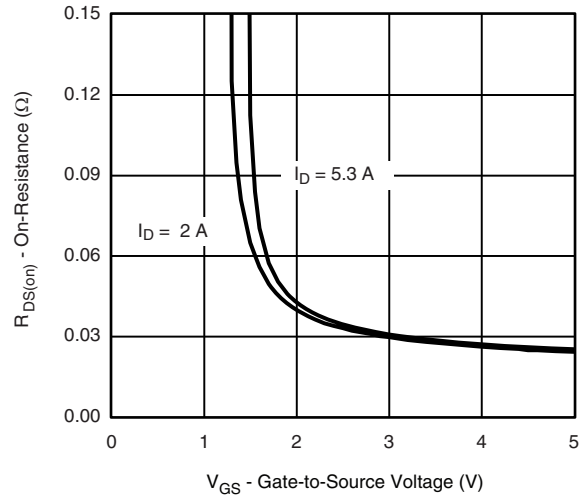


**On-Resistance vs. Junction Temperature**

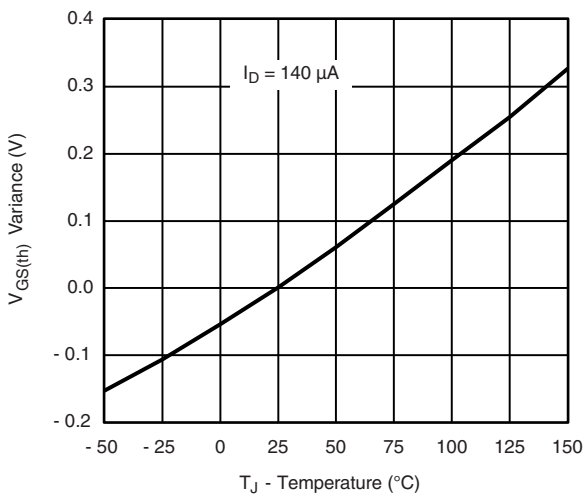
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



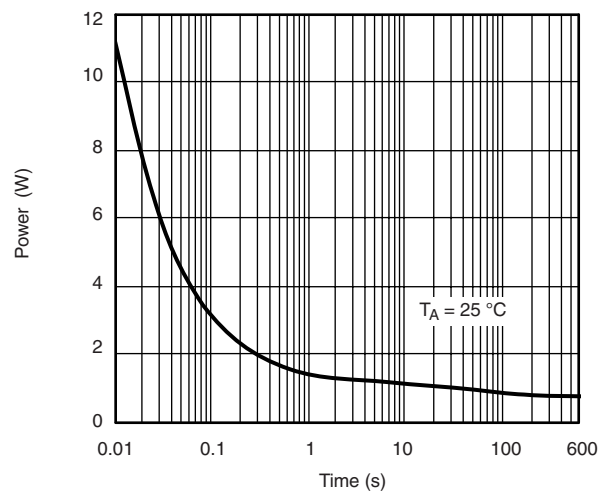
**Source-Drain Diode Forward Voltage**



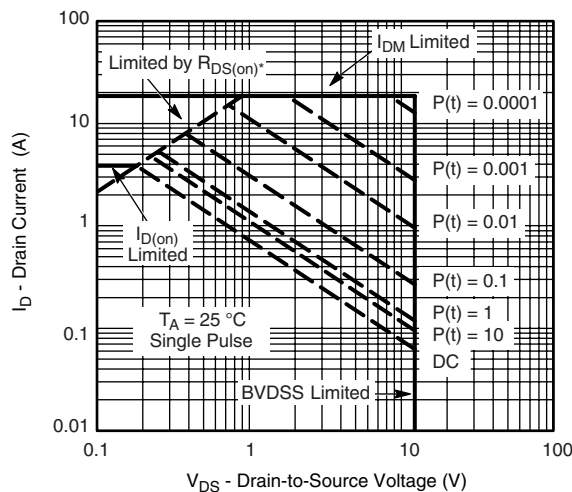
**On-Resistance vs. Gate-to-Source Voltage**



**Threshold Voltage**



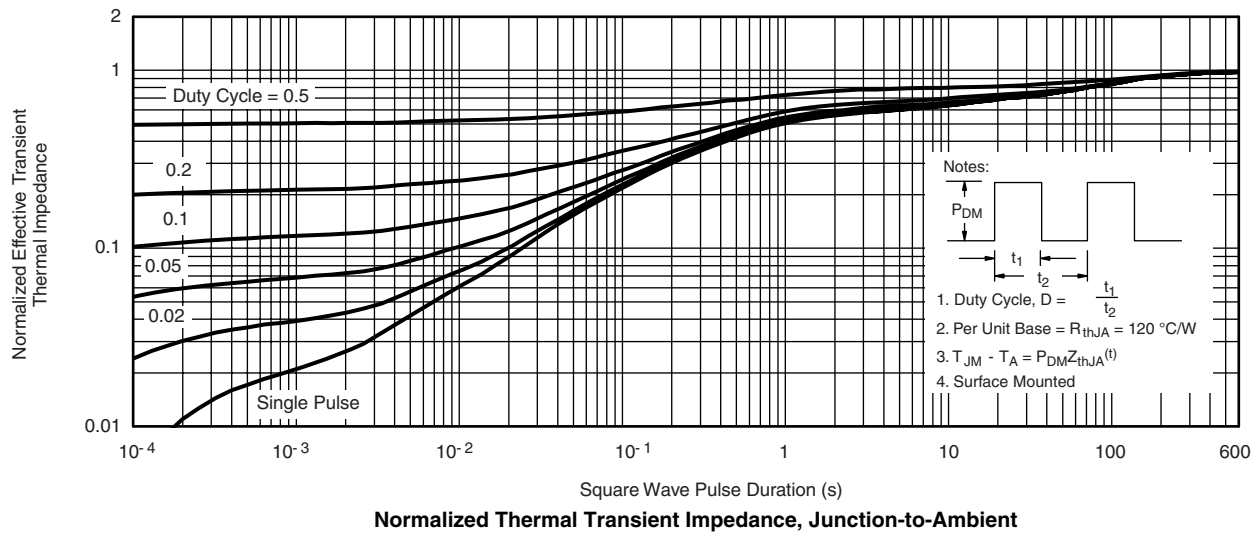
**Single Pulse Power**



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

**Safe Operating Area**

**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



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## SOT-23 (TO-236): 3-LEAD



| Dim            | MILLIMETERS |      | INCHES     |       |
|----------------|-------------|------|------------|-------|
|                | Min         | Max  | Min        | Max   |
| A              | 0.89        | 1.12 | 0.035      | 0.044 |
| A <sub>1</sub> | 0.01        | 0.10 | 0.0004     | 0.004 |
| A <sub>2</sub> | 0.88        | 1.02 | 0.0346     | 0.040 |
| b              | 0.35        | 0.50 | 0.014      | 0.020 |
| c              | 0.085       | 0.18 | 0.003      | 0.007 |
| D              | 2.80        | 3.04 | 0.110      | 0.120 |
| E              | 2.10        | 2.64 | 0.083      | 0.104 |
| E <sub>1</sub> | 1.20        | 1.40 | 0.047      | 0.055 |
| e              | 0.95 BSC    |      | 0.0374 Ref |       |
| e <sub>1</sub> | 1.90 BSC    |      | 0.0748 Ref |       |
| L              | 0.40        | 0.60 | 0.016      | 0.024 |
| L <sub>1</sub> | 0.64 Ref    |      | 0.025 Ref  |       |
| S              | 0.50 Ref    |      | 0.020 Ref  |       |
| q              | 3°          | 8°   | 3°         | 8°    |

ECN: S-03946-Rev. K, 09-Jul-01  
 DWG: 5479

## RECOMMENDED MINIMUM PADS FOR SOT-23



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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