

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

SOT-23 (TO-236)



Top View

Marking code: N2

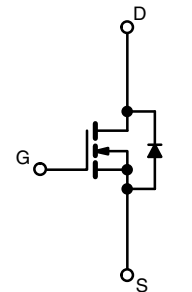
### FEATURES

- TrenchFET® power MOSFET
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


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

### APPLICATIONS

- Load switching for portable devices
- DC/DC converter



N-Channel MOSFET

| PRODUCT SUMMARY                                    |        |
|--|--------|
| $V_{DS}$ (V)                                       | 20     |
| $R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = 4.5$ V | 0.057  |
| $R_{DS(on)}$ max. ( $\Omega$ ) at $V_{GS} = 2.5$ V | 0.075  |
| $Q_g$ typ. (nC)                                    | 3.5    |
| $I_D$ (A)  | 2.9    |
| Configuration                                      | Single |

| ORDERING INFORMATION            |                  |
|---------------------------------|------------------|
| Package                         | SOT-23           |
| Lead (Pb)-free                  | Si2302CDS-T1-E3  |
| Lead (Pb)-free and halogen-free | Si2302CDS-T1-GE3 |

| ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °C, unless otherwise noted) |                |               |              |      |
|---|----------------|---------------|--------------|------|
| PARAMETER   | SYMBOL         | 5 S           | STEADY STATE | UNIT |
| Drain-source voltage  | $V_{DS}$       | 20            | 20           | V    |
| Gate-source voltage   | $V_{GS}$       | $\pm 8$       | $\pm 8$      |      |
| Continuous drain current ( $T_J = 150$ °C) <sup>a</sup>           | $I_D$          | $T_A = 25$ °C | 2.9          | A    |
|   |                | $T_A = 70$ °C | 2.3          |      |
| Pulsed drain current <sup>b</sup>                                 | $I_{DM}$       | 10            | 10           | A    |
| Continuous source current (diode conduction) <sup>a</sup>         | $I_S$          | 0.72          | 0.6          |      |
| Power dissipation <sup>a</sup>                                    | $P_D$          | $T_A = 25$ °C | 0.86         | W    |
|   |                | $T_A = 70$ °C | 0.55         |      |
| Operating junction and storage temperature range                  | $T_J, T_{stg}$ | -55 to +150   | -55 to +150  | °C   |

| THERMAL RESISTANCE RATINGS               |            |              |         |      |      |
|--|------------|--------------|---------|------|------|
| PARAMETER                                | SYMBOL     | TYPICAL      | MAXIMUM | UNIT |      |
| Maximum junction-to-ambient <sup>a</sup> | $R_{thJA}$ | $t \leq 5$ s | 120     | 145  | °C/W |
|  |            | Steady state | 140     | 175  |      |
| Maximum junction-to-foot                 | $R_{thJF}$ | 62           | 78      |      |      |

### Notes

- Surface mounted on 1" x 1" FR4 board
- Pulse width limited by maximum junction temperature



| SPECIFICATIONS ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |              |  |        |       |           |               |
|---|--------------|--|--------|-------|-----------|---------------|
| PARAMETER   | SYMBOL       | TEST CONDITIONS  | LIMITS |       |           | UNIT          |
|   |              |  | MIN.   | TYP.  | MAX.      |               |
| <b>Static</b>   |              |  |        |       |           |               |
| Drain-source breakdown voltage  | $V_{DS}$     | $V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$   | 20     | -     | -         | V             |
| Gate-threshold voltage  | $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$   | 0.40   | -     | 0.85      |               |
| Gate-body leakage   | $I_{GSS}$    | $V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 8\text{ V}$  | -      | -     | $\pm 100$ | nA            |
| Zero gate voltage drain current   | $I_{DSS}$    | $V_{DS} = 20\text{ V}$ , $V_{GS} = 0\text{ V}$   | -      | -     | 0.1       | $\mu\text{A}$ |
|   |              | $V_{DS} = 20\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 50\text{ }^\circ\text{C}$  | -      | -     | 4         |               |
|   |              | $V_{DS} = 20\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 70\text{ }^\circ\text{C}$  | -      | -     | 15        |               |
| On-state drain current <sup>a</sup>   | $I_{D(on)}$  | $V_{DS} \geq 10\text{ V}$ , $V_{GS} = 4.5\text{ V}$  | 6      | -     | -         | A             |
| Drain-source on-resistance <sup>a</sup>                                     | $R_{DS(on)}$ | $V_{GS} = 4.5\text{ V}$ , $I_D = 3.6\text{ A}$   | -      | 0.045 | 0.057     | $\Omega$      |
|   |              | $V_{GS} = 2.5\text{ V}$ , $I_D = 3.1\text{ A}$   | -      | 0.056 | 0.075     |               |
| Forward transconductance <sup>a</sup>                                       | $g_{fs}$     | $V_{DS} = 5\text{ V}$ , $I_D = 3.6\text{ A}$   | -      | 13    | -         | S             |
| Diode forward voltage   | $V_{SD}$     | $I_S = 0.95\text{ A}$ , $V_{GS} = 0\text{ V}$  | -      | 0.7   | 1.2       | V             |
| <b>Dynamic <sup>b</sup></b>   |              |  |        |       |           |               |
| Total gate charge   | $Q_g$        | $V_{DS} = 10\text{ V}$ , $V_{GS} = 4.5\text{ V}$ , $I_D = 3.6\text{ A}$  | -      | 3.5   | 5.5       | nC            |
| Gate-source charge  | $Q_{gs}$     |  | -      | 0.6   | -         |               |
| Gate-drain charge   | $Q_{gd}$     |  | -      | 0.45  | -         |               |
| Gate resistance   | $R_g$        | $f = 1\text{ MHz}$   | 2      | 4     | 8         | $\Omega$      |
| <b>Switching</b>  |              |  |        |       |           |               |
| Turn-on delay time  | $t_{d(on)}$  | $V_{DD} = 10\text{ V}$ , $R_L = 2.78\text{ }\Omega$<br>$I_D \cong 3.6\text{ A}$ , $V_{GEN} = 4.5\text{ V}$ , $R_g = 1\text{ }\Omega$ | -      | 8     | 15        | ns            |
| Rise time   | $t_r$        |  | -      | 7     | 15        |               |
| Turn-off delay time   | $t_{d(off)}$ |  | -      | 30    | 45        |               |
| Fall time   | $t_f$        |  | -      | 7     | 15        |               |
| Source-drain reverse recovery time  | $t_{rr}$     | $I_F = 3.6\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$  | -      | 8.5   | 15        | nC            |
| Body diode reverse recovery charge  | $Q_{rr}$     |  | -      | 2     | 4         |               |

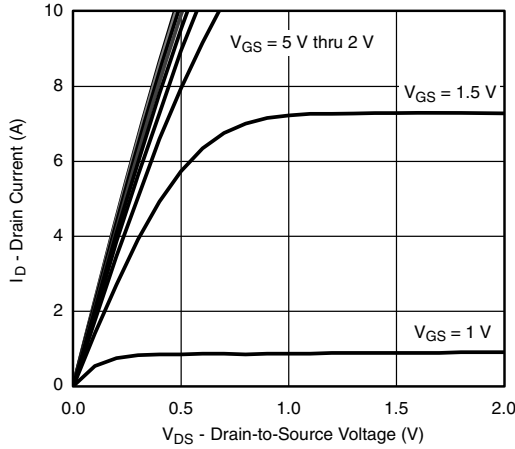
**Notes**

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

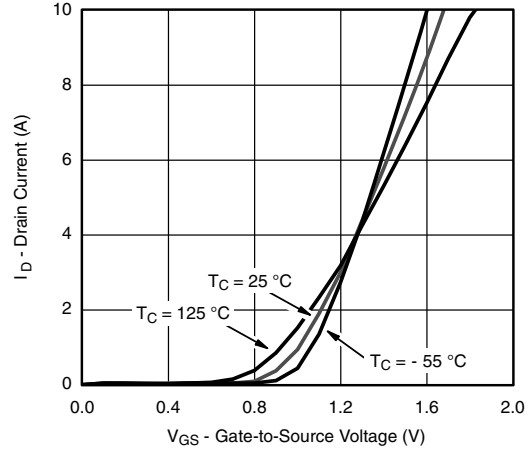
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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



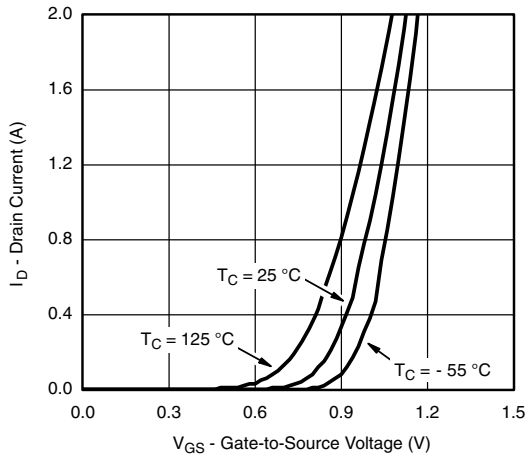
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



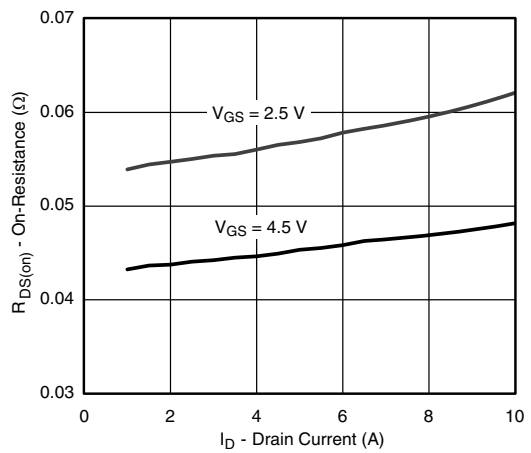
Output Characteristics



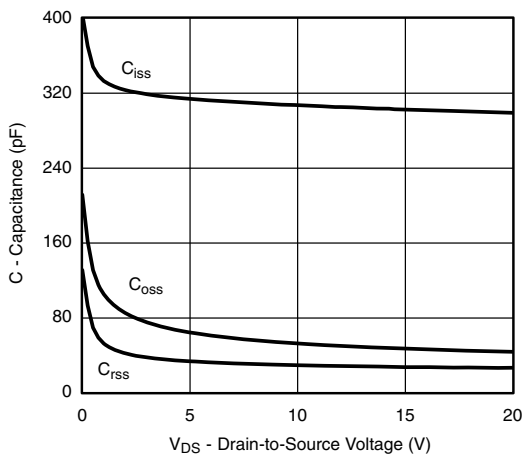
Transfer Characteristics



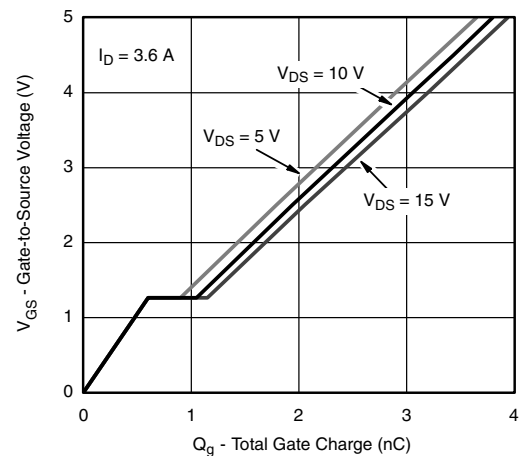
Transfer Characteristics



On-Resistance vs. Drain Current



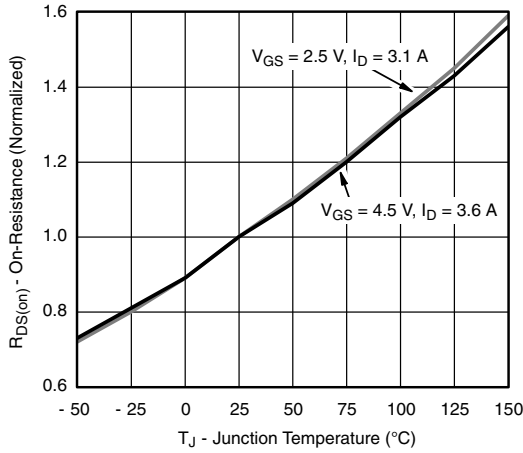
Capacitance



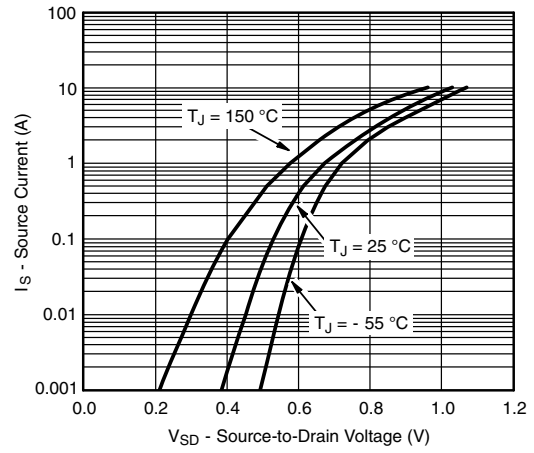
Gate Charge



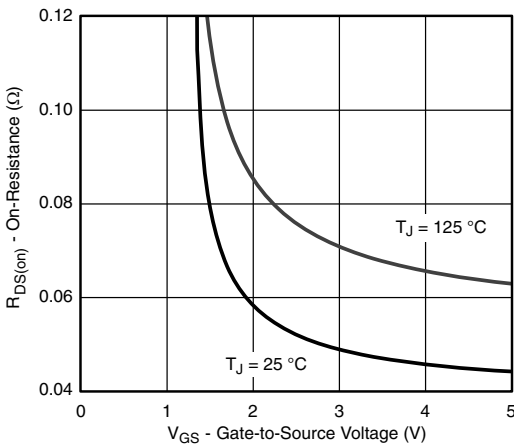
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



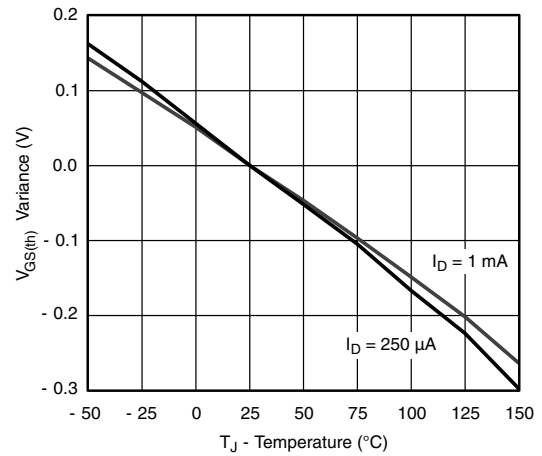
On-Resistance vs. Junction Temperature



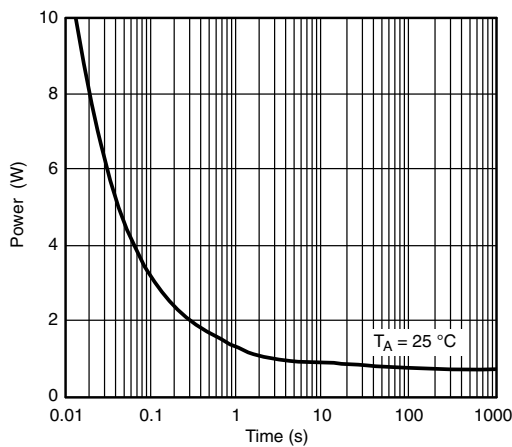
Source-Drain Diode Forward Voltage



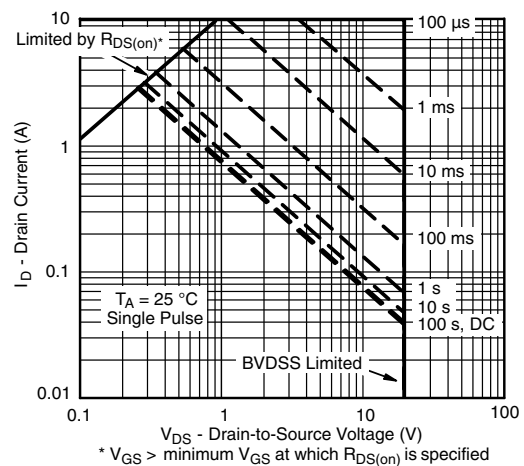
On-Resistance vs. Gate-to-Source Voltage



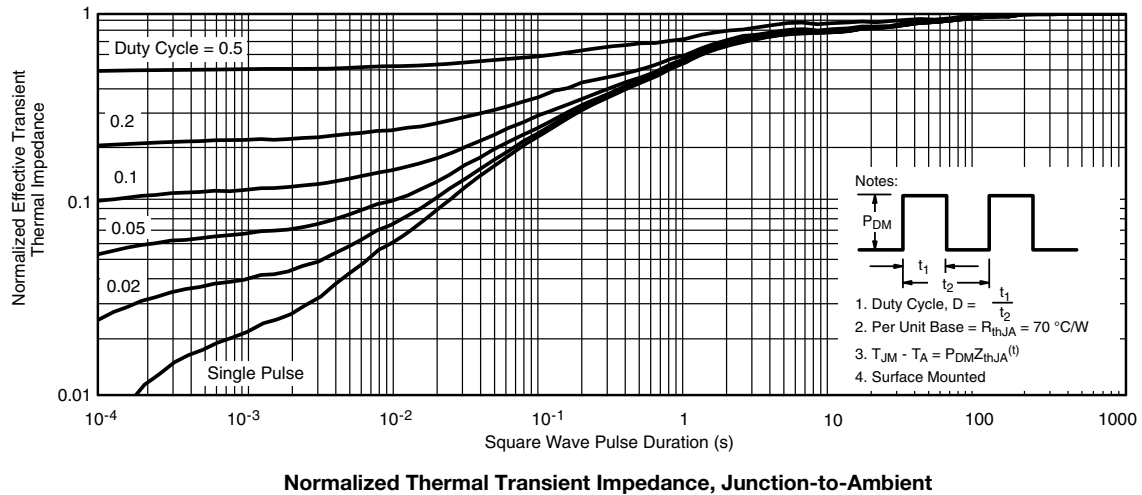
Threshold Voltage



Single Pulse Power



Safe Operating Area, Junction-to-Ambient

**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)

[Return to Index](#)



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