# Product Termination Notification

**Product Group:** Vishay Siliconix/May 20, 2014/**PCN- SIL-0472014 Rev1**

## End of Life Notification

**DESCRIPTION OF CHANGE:** The affected part numbers listed in this notification are not our focus products and are being discontinued. As replacements, we are recommending products from our SQ series of automotive qualified Mosfets that are manufactured using our preferred 300M cell automotive qualified process technology at Vishay's wafer Fab located at Fraunhoferstraße 1, 25524 Itzehoe, Germany (Vishay Siliconix Itzehoe GmbH or VSIG). VSIG has been an automotive Fab with ISO14001 and TS16949 certifications for more than 10 years.

The recommended replacement products will have slightly different electrical characteristics but have been identified as a suitable replacements for the existing products.

***Production of the affected parts from both Santa Clara Fab and Global Foundries will be terminated per the time schedule in this notification and last time buy orders must be received within the specified timeframe.***

**CLASSIFICATION OF CHANGE:** End of life

**REASON FOR CHANGE:** Closure of Fab at Santa Clara and Global Foundries

**EXPECTED INFLUENCE ON QUALITY/RELIABILTY/PERFORMANCE:** Improvement

**PRODUCT CATAGORY:** Automotive MOSFETs

**VISHAY PART NUMBERS AFFECTED:** Affected and replacement part numbers are listed on the following page

**VISHAY BRAND(s):** Vishay-Siliconix

**TIME SCHEDULE:** Last time buy orders are required by 01-Oct-2014 for Global Foundries and 31-Dec-2014 for Santa Clara Fab. Last shipments should be scheduled before 30-June-2015.

**QUALIFICATION DATA:** Replacement products are manufactured using 300M cell process technology which has been AEC Q101 qualified. Please refer to the subsequent pages to see summary of qualification report for the lead 300M product. Qualification report for individual part type will be provided in PPAP and upon request.

**SAMPLE AVAILABILITY:** Schedule of availability of qualified samples is listed on the following page. For samples, please email automos.pcn@vishay.com with subject PCN-SIL-0472014 and include date by which samples are needed, required quantity, ship-to address and contact information.

**ISSUED BY:** Shishir Rai, Product Marketing Manager (E-mail: Shishir.Rai@Vishay.com)

**For further information, please contact your regional Vishay office.**


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# Product Termination Notification

**Product Group:** Vishay Siliconix/May 20, 2014/**PCN- SIL-0472014 Rev1**

**VISHAY PART NUMBERS AFFECTED:**

| Affected Vishay Part Number | Replacement Part Number | Qualified Sample Availability from VSIG Fab |
|---|---|---|
| SQ4936EY-T1-GE3 | SQ4940AEY-T1-GE3 | Available |
| SQ4940EY-T1-GE3 | SQ4940AEY-T1-GE3 | Available |
| SY4940DY-T1-E3 | SQ4940AEY-T1-GE3 | Available |
| SQD50N04-3M5L-GE3 | SQD100N04-3M6L-GE3 | Jun-14 |
| SQJ848EP-T1-GE3 | SQJ858AEP-T1-GE3 | Jun-14 |
| SQJ848AEP-T1-GE3 | SQJ858AEP-T1-GE3 | Jun-14 |
| SQ4942EY-T1-GE3 | SQ4284EY-T1-GE3 | Jun-14 |
| SY4942DY-T1-E3 | SQ4284EY-T1-GE3 | Jun-14 |
| SY3442BDV-T1-E3 | SQ3460EV-T1-GE3 | Jun-14 |
| SQ3442EV-T1-GE3 | SQ3456BEV-T1-GE3 | Jun-14 |
| SQ3456EV-T1-GE3 | SQ3456BEV-T1-GE3 | Jun-14 |
| SY3454ADV-T1-E3 | SQ3456BEV-T1-GE3 | Jun-14 |
| SY3456DV-T1-E3 | SQ3456BEV-T1-GE3 | Jun-14 |
| V50004 | SQ3456BEV-T1-GE3 | Jun-14 |
| SQ2318ES-T1-GE3 | SQ2318AES-T1-GE3 | Jun-14 |
| SY2316DS-T1-E3 | SQ2318AES-T1-GE3 | Jun-14 |
| SY2318DS-T1-E3 | SQ2318AES-T1-GE3 | Jun-14 |
| SQ2308BES-T1-GE3 | SQ2308CES-T1-GE3 | Jun-14 |
| SQ2308ES-T1-GE3 | SQ2308CES-T1-GE3 | Jun-14 |
| SY2308BDS-T1-E3 | SQ2308CES-T1-GE3 | Jun-14 |
| SQ1902EL-T1-GE3 | SQ1902AEL-T1-GE3 | Jun-14 |
| SY1902DL-T1-E3 | SQ1902AEL-T1-GE3 | Jun-14 |
| SY1958DH-T1-E3 | SQ1902AEL-T1-GE3 | Jun-14 |

**QUALIFICATION REPORT:**

Qualification report for lead product SQM120N04-1M7L-GE3 manufactured using 300M cell process technology at VSIG Fab is provided in subsequent pages. Qualification report for the replacement parts listed above will be provided in PPAP and upon request.

# Production Part Approval - Environmental Test Summary

| | | | |
|---|---|---|---|
| **Supplier:** | **Vishay Siliconix** | **General Specification:** | **AEC-Q101** |
| **Supplier Part Number:** | **SQM120N04-1M7L-GE3** | **Assembly Site:** | **Kaohsiung, Taiwan ROC** |
| **Process Technology:** | **300M Cell N-Channel G4** | **Fab Site:** | **VSIG, Itzehoe Germany** |

| Item | Test | Test Conditions | # of Lots | S.S. | # Failed | Additional Requirements | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | Pre- and Post Stress Electrical Test | | * | All | 0 | | |
| 2 | Pre-conditioning: Performed on surface mount devices (SMDs) prior to Temp Cycle, Autoclave, HAST, Power Cycle stresses only | J-STD-020C | * | All | 0 | @260 C | |
| 3 | External Visual: Inspect device construction, marking and workmanship. Electrical test not required. | Electricals per drawing | * | All | 0 | | |
| 4 | Parametric Verification | | 3 | 30 | 0 | | Evaluation<br>1.<br>2.<br>3. |
| 5 | High Temperature Reverse Bias (**HTRB**):<br>1000 hours max rated junction temperature specified in the user/supplier specification with device reverse biased to 100% of maximum breakdown voltage specified or max junction temperature to avoid thermal runaway. TEST before, at 500 hours, and 1000 hours. JESD22 A108 | 175C 1000 HRS | 1 | 77 | 0 | DEVICE SPECIFIC: | Evaluation<br>1. 1380274<br>2.<br>3. |
| 6 | High Temperature Gate Bias (**HTGB**):<br>1000 hours at Ta = device maximum rated junction temperature with gate biased at 100% of maximum gate voltage rating indicated in the detail specification with device OFF. TEST before, at 500 hours, and 1000 hours. JESD22 A108 | 175C 1000 HRS | 1 | 77 | 0 | DEVICE SPECIFIC: | Evaluation<br>1. 1380274<br>2.<br>3. |
| 7 | Temperature Cycling: JESD22 A-104, Air to air. (See Reliability Product Data Summary): | 1000CYC -65C ~ 150C | 1 | 77 | 0 | DEVICE SPECIFIC: | Evaluation<br>1. 1380274<br>2.<br>3. |
| 8 | Autoclave (Pressure Pot) | Ta = 121C, RH = 100%, 15psig, 96 hrs: Test before and after AC. | 1 | 77 | 0 | DEVICE SPECIFIC: | Evaluation<br>1. 1380274<br>2.<br>3. |
| 9 alt | HAST | 130C, 85% RH, 100 HRS | 1 | 77 | 0 | DEVICE SPECIFIC: | Evaluation<br>1. 1380274<br>2.<br>3. |
| 10 | Intermittent Operational Life (Power Cycle)<br>Delta Tj = 100C | 8572 CYC | 1 | 77 | 0 | DEVICE SPECIFIC: | Evaluation<br>1. 1380274<br>2.<br>3. |

# Production Part Approval - Environmental Test Summary

| | | | |
|---|---|---|---|
| **Supplier:** | **Vishay Siliconix** | **General Specification:** | **AEC-Q101** |
| **Supplier Part Number:** | **SQM120N04-1M7L-GE3** | **Assembly Site:** | **Kaohsiung, Taiwan ROC** |
| **Process Technology:** | **300M Cell N-Channel G4** | **Fab Site:** | **VSIG, Itzehoe Germany** |

| Item | Test | Test Conditions | # of Lots | S.S. | # Failed | Additional Requirements | Remarks |
|---|---|---|---|---|---|---|---|
| 11 | ESD Characterization - NOTE: Unless protected by internal ESD-specific protection circuitry, MOSFETs only have intrinsic protection that is dependent on the size of die and other environmental and physical factors, making them very sensitive to potential ESD damage and industry standard precautions should be taken not to expose them to any ESD. Due to the small size of MOSFET packages, these devices are generally not affected by the Charged Device Model, and we therefore substitute Machine Model testing. | Human Model | 1 | 10 | 0 | Passed 7.00KV MIL-STD-883D | Evaluation<br>1. 1340321 |
| | | Machine Model | 1 | 10 | 0 | Passed 1.30KV MIL-STD-883D | |
| 12 | Destructive Physical Analysis | AEC-Q101-004 Section 4 | 1 | 2X2 | 0 | | Evaluation<br>1. 1340321 |
| 13 | Physical Dimensions: Verify physical dimensions to the applicable user device packaging specification for dimensions and tolerances. | Siliconix Print Dimensions | N/A | N/A | N/A | | See PPAP |
| 14 | Termianl Strength | | N/A | N/A | N/A | | SMD Device |
| 15 | Resistance to Solvent | | N/A | N/A | N/A | | Laser Marked |
| 16 | Constant Acceleration | | N/A | N/A | N/A | | SMD Device |
| 17 | Vibration Variable Frequency | | N/A | N/A | N/A | | SMD Device |
| 18 | Mechanical Shock | | N/A | N/A | N/A | | SMD Device |
| 19 | Hermiticity | | N/A | N/A | N/A | | SMD Device |
| 20 | Resistance to Solder Heat (Solder Dunk) | JESD22 B-106-A, 260C, 10sec. Test before and after RSH. SMD devices shall be fully submerged during test | 1 | 50 | 0 | DEVICE SPECIFIC: | Evaluation<br>1. 1380274<br>2.<br>3. |
| 21 | Solderability | Pb-Free - JESD201 | 1 | 15 | 0 | DEVICE SPECIFIC: | Evaluation<br>1. 1380274<br>2.<br>3. |
| 22 | Thermal Resistance | JESD24-3 | 1 | 10 | 0 | DEVICE SPECIFIC: | Evaluation<br>1. 1440135<br>2.<br>3. |
| 23 | Wire Bond Strength | MIL-STD-750 Method 2037 | 1 | 40 | 0 | DEVICE SPECIFIC: | Evaluation<br>1. 1380274<br>2.<br>3. |
| 24 | Bond Shear | AEC-Q101-003 | N/A | N/A | N/A | Periodic sampling on production units | See Cpk data in PPAP |

# Production Part Approval - Environmental Test Summary

| | | | |
|---|---|---|---|
| **Supplier:** | **Vishay Siliconix** | **General Specification:** | **AEC-Q101** |
| **Supplier Part Number:** | **SQM120N04-1M7L-GE3** | **Assembly Site:** | **Kaohsiung, Taiwan ROC** |
| **Process Technology:** | **300M Cell N-Channel G4** | **Fab Site:** | **VSIG, Itzehoe Germany** |

| Item | Test | Test Conditions | # of Lots | S.S. | # Failed | Additional Requirements | Remarks |
|---|---|---|---|---|---|---|---|
| 25 | Die Shear | MIL-STD-750 Method 2017 | 1 | 10 | 0 | DEVICE SPECIFIC: | Evaluation<br>1. 1380274<br>2.<br>3. |
| 26 | UIS Testing | Non-destructive mode | 100% | 100% | 0 | | 100% tested at Final Test |
| 27 | Dielectric Integrity | Non-destructive mode | 100% | 100% | 0 | | 100% tested at Final Test |

Note: * = Samples taken from many lots

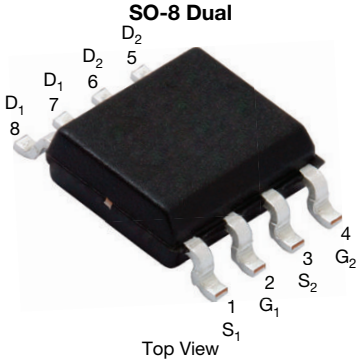
Prepared by: Julan Chen
Reliability Engineer 5/16/2014

Approved by: Arthur
Director of Reliability 5/16/2014

# Automotive Dual N-Channel 40 V (D-S) 175 °C MOSFET

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 40 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 10 V | 0.024 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 4.5 V | 0.029 |
| $I_D$ (A) | 8 |
| Configuration | Dual |

**SO-8 Dual**




Top View

## FEATURES

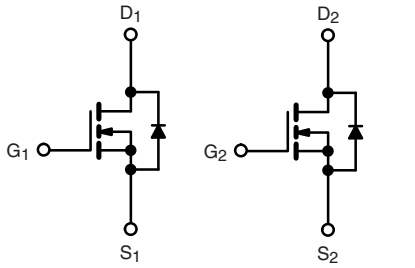
- TrenchFET® power MOSFET
- 100 % $R_g$ and UIS tested
- AEC-Q101 qualified [d]
- Material categorization:
  For definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

Pb-free

RoHS COMPLIANT

HALOGEN FREE




N-Channel MOSFET N-Channel MOSFET

| ORDERING INFORMATION | |
|---|---|
| Package | SO-8 |
| Lead (Pb)-free and Halogen-free | SQ4940AEY-T1-GE3 |

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 40 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current | $T_C$ = 25 °C [a] | $I_D$ | 8 | A |
| | $T_C$ = 125 °C | | 5.3 | |
| Continuous Source Current (Diode Conduction) | | $I_S$ | 3.6 | |
| Pulsed Drain Current [b] | | $I_{DM}$ | 32 | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 17 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 15 | mJ |
| Maximum Power Dissipation [b] | $T_C$ = 25 °C | $P_D$ | 4 | W |
| | $T_C$ = 125 °C | | 1.3 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | -55 to +175 | °C |

**THERMAL RESISTANCE RATINGS**

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Junction-to-Ambient | PCB Mount [c] | $R_{thJA}$ | 112 | °C/W |
| Junction-to-Foot (Drain) | | $R_{thJF}$ | 38 | |

**Notes**

a. Package limited.
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
c. When mounted on 1" square PCB (FR-4 material).
d. Parametric verification ongoing.

| **SPECIFICATIONS** ($T_C$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | | 40 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 1.5 | 2 | 2.5 | |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V | - | - | 1 | µA |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V, $T_J$ = 55 °C | - | - | 50 | |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V, $T_J$ = 175 °C | - | - | 150 | |
| On-State Drain Current [a] | $I_{D(on)}$ | $V_{GS}$ = 10 V | $V_{DS}$ ≥ 5 V | 30 | - | - | A |
| Drain-Source On-State Resistance [a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 5.3 A | - | 0.020 | 0.024 | Ω |
| | | $V_{GS}$ = 10 V | $I_D$ = 5.3 A, $T_J$ = 125 °C | - | - | 0.036 | |
| | | $V_{GS}$ = 10 V | $I_D$ = 5.3 A, $T_J$ = 175 °C | - | - | 0.043 | |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 4.9 A | - | 0.024 | 0.029 | |
| Forward Transconductance [b] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 5.3 A | | - | 33 | - | S |
| **Dynamic [b]** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 20 V, f = 1 MHz | - | 593 | 741 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 103 | 129 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 44 | 55 | |
| Total Gate Charge [c] | $Q_g$ | $V_{GS}$ = 10 V | $V_{DS}$ = 20 V, $I_D$ = 5.7 A | - | 28.4 | 43 | nC |
| Gate-Source Charge [c] | $Q_{gs}$ | | | - | 4 | - | |
| Gate-Drain Charge [c] | $Q_{gd}$ | | | - | 6 | - | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 0.5 | - | 2 | Ω |
| Turn-On Delay Time [c] | $t_{d(on)}$ | $V_{DD}$ = 20 V, $R_L$ = 3.5 Ω<br>$I_D$ ≅ 5.7 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | - | 8 | 12 | ns |
| Rise Time[c] | $t_r$ | | | - | 13 | 20 | |
| Turn-Off Delay Time [c] | $t_{d(off)}$ | | | - | 20 | 30 | |
| Fall Time [c] | $t_f$ | | | - | 9 | 14 | |
| **Source-Drain Diode Ratings and Characteristics [b]** | | | | | | | |
| Pulsed Current [a] | $I_{SM}$ | | | - | - | 32 | A |
| Forward Voltage | $V_{SD}$ | $I_F$ = 3.6 A, $V_{GS}$ = 0 V | | - | 0.75 | 1.1 | V |

**Notes**

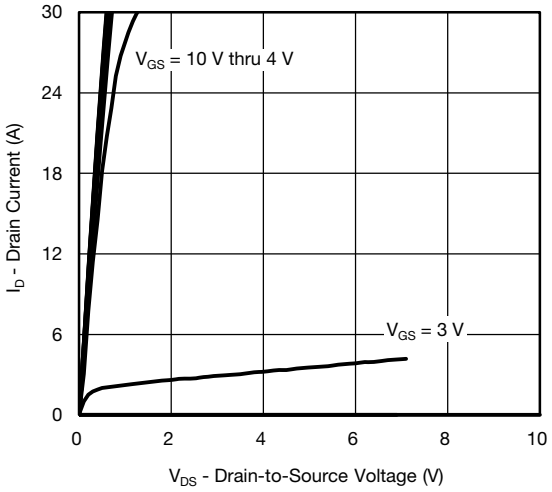
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.

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

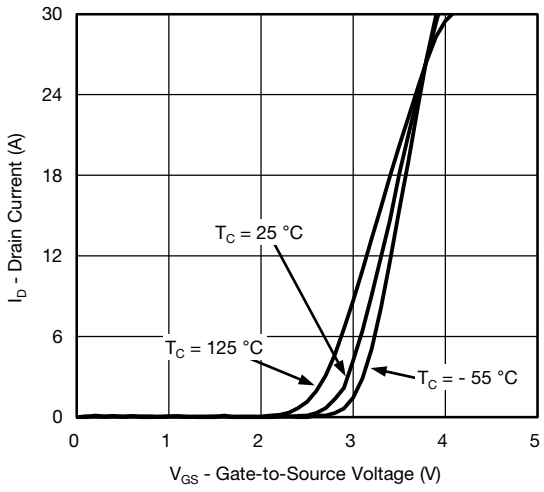
c. Independent of operating temperature.

*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.*

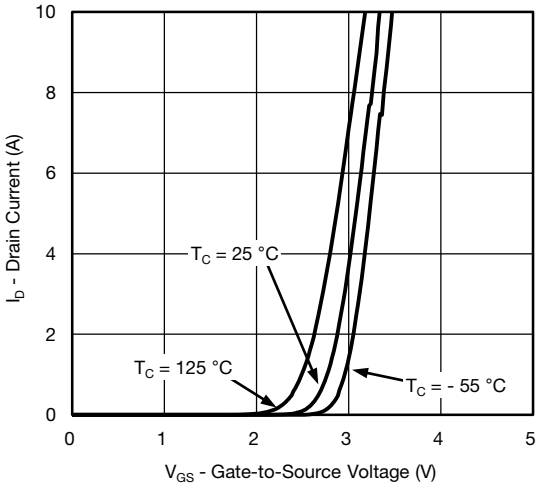
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



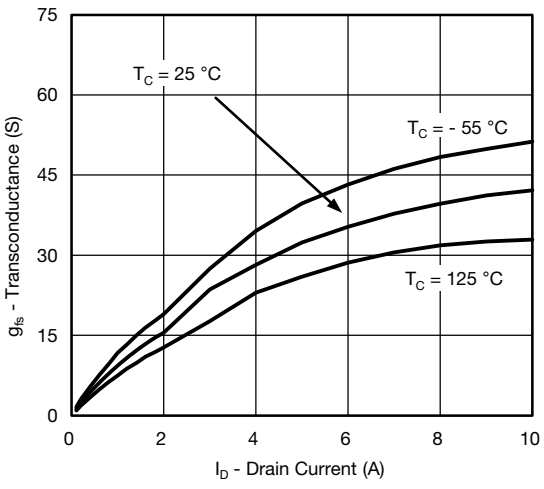

**Output Characteristics**



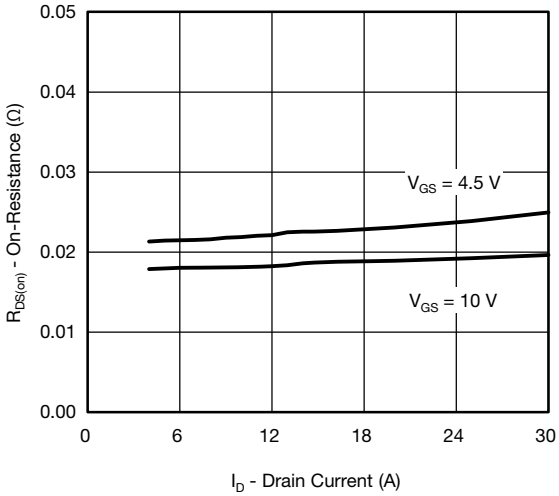

**Transfer Characteristics**



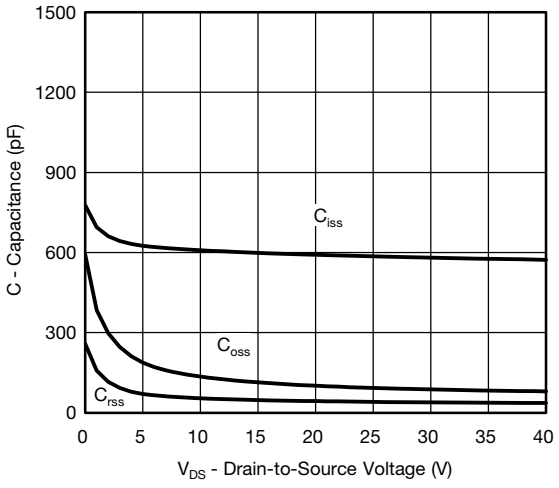

**Transfer Characteristics**




**Transconductance**

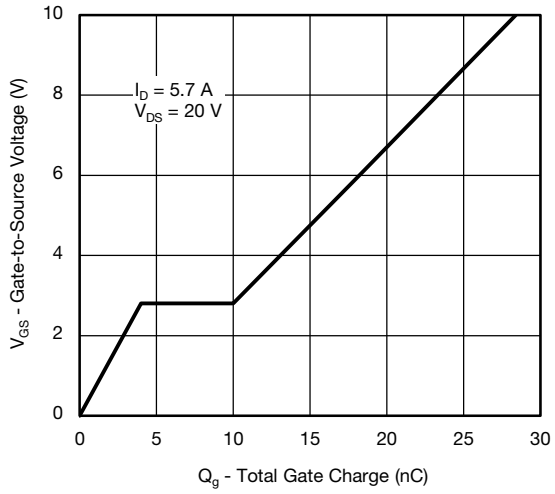



**On-Resistance vs. Drain Current**

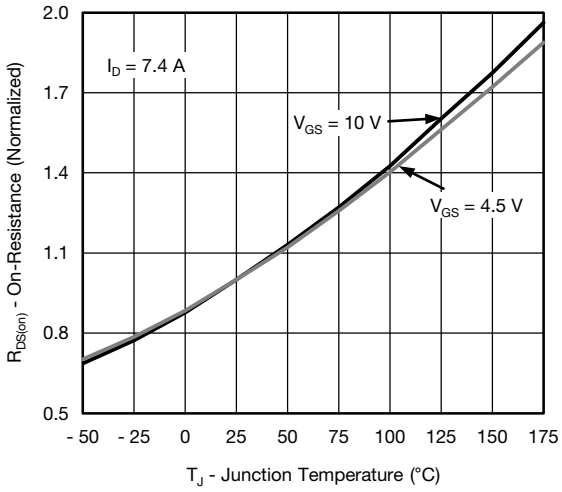



**Capacitance**

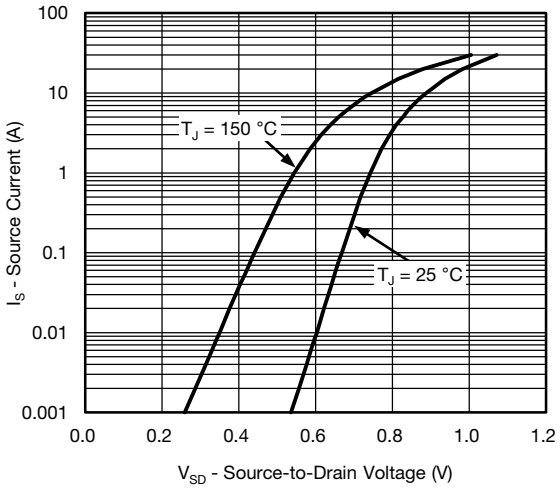
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



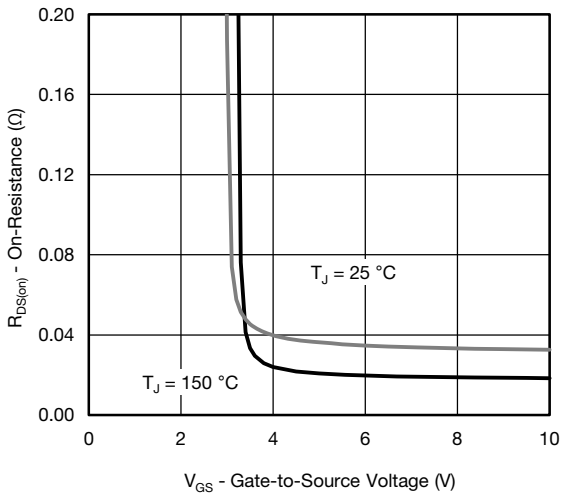

**Gate Charge**



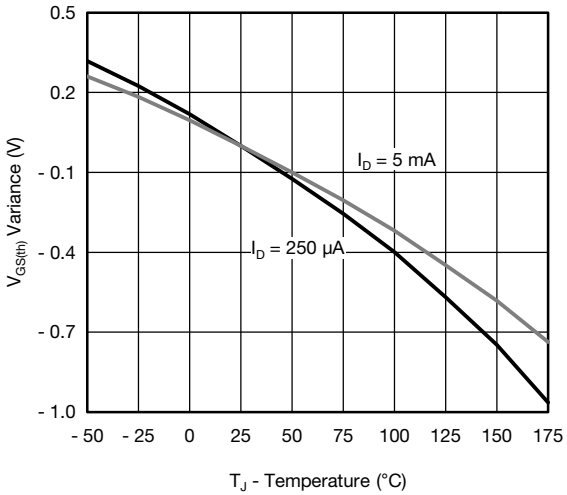

**On-Resistance vs. Junction Temperature**



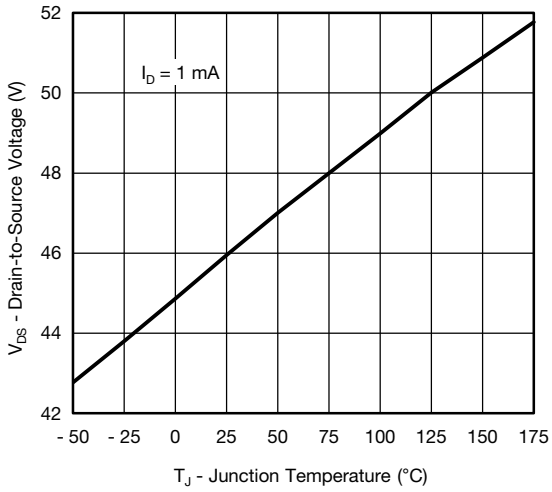

**Source Drain Diode Forward Voltage**




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

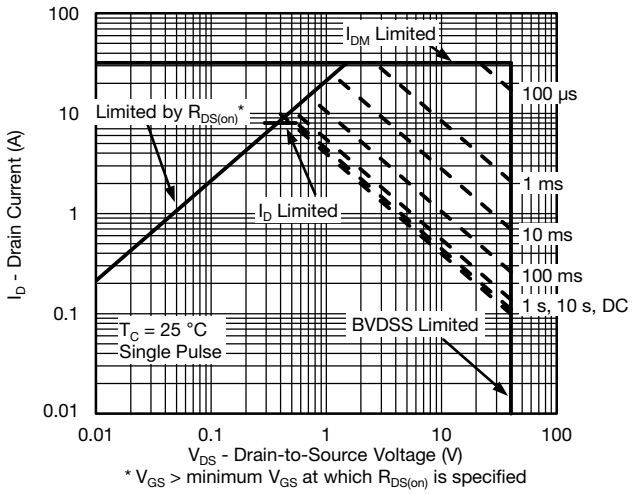



**Threshold Voltage**

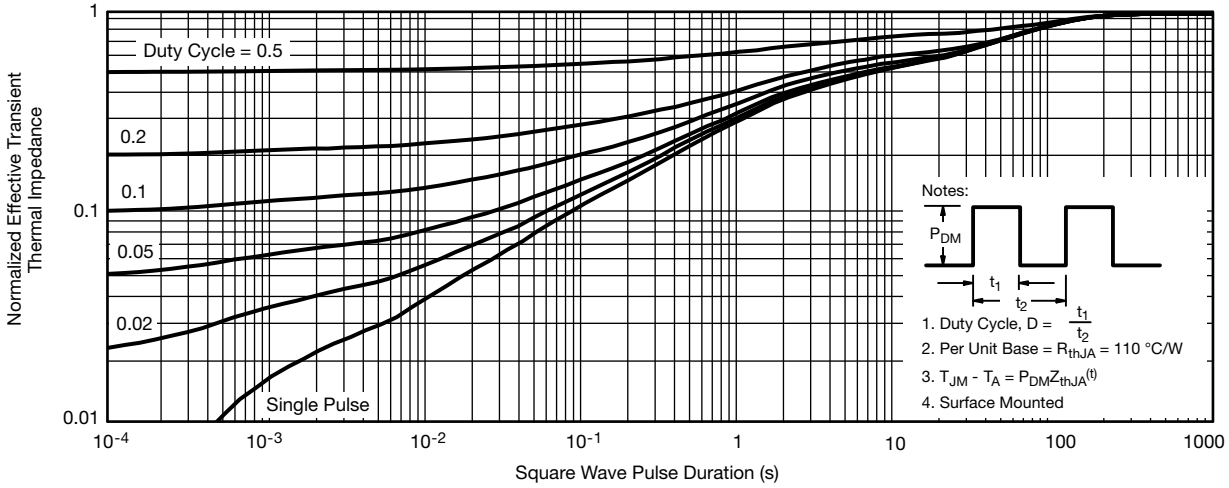



**Drain Source Breakdown vs. Junction Temperature**

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)

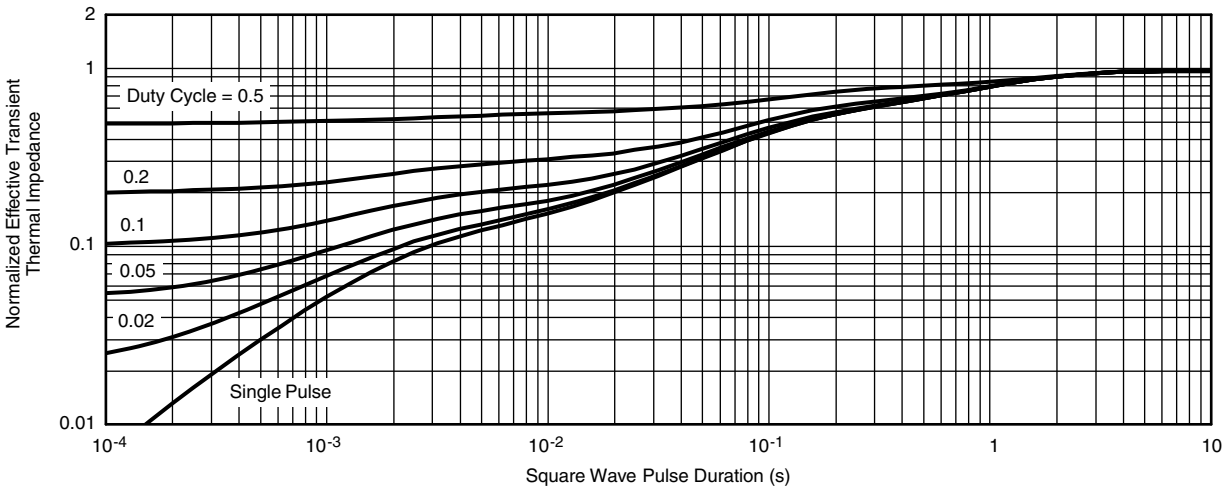



**Safe Operating Area**




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

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)




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

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Foot (25 °C)

  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

*Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?62916.*

# Automotive N-Channel 40 V (D-S) 175 °C MOSFET

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 40 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 10 V | 0.031 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 4.5 V | 0.036 |
| $I_D$ (A) | 8 |
| Configuration | Single |

## FEATURES

- TrenchFET® Power MOSFET
- AEC-Q101 Qualified[c]
- 100 % $R_g$ and UIS Tested
- Material categorization:
  For definitions of compliance please see www.vishay.com/doc?99912

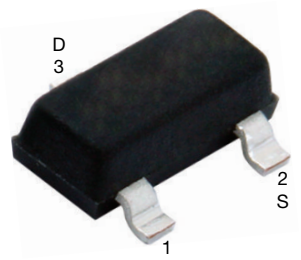
AUTOMOTIVE GRADE

Pb-free

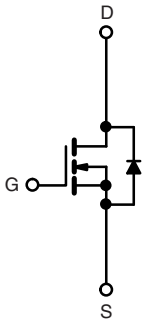
RoHS COMPLIANT

HALOGEN FREE

**SOT-23 (TO-236)**




Top View




N-Channel MOSFET

**Marking Code:** 8Y

| ORDERING INFORMATION | |
|---|---|
| Package | SOT-23 |
| Lead (Pb)-free and Halogen-free | SQ2318AES-T1-GE3 |

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 40 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current | $T_C$ = 25 °C | $I_D$ | 8 | A |
| | $T_C$ = 125 °C | | 4.6 | |
| Continuous Source Current (Diode Conduction) | | $I_S$ | 3.8 | |
| Pulsed Drain Current[a] | | $I_{DM}$ | 32 | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 13 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 8 | mJ |
| Maximum Power Dissipation[a] | $T_C$ = 25 °C | $P_D$ | 3 | W |
| | $T_C$ = 125 °C | | 1 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | -55 to +175 | °C |

**THERMAL RESISTANCE RATINGS**

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Junction-to-Ambient | PCB Mount[b] | $R_{thJA}$ | 166 | °C/W |
| Junction-to-Foot (Drain) | | $R_{thJF}$ | 50 | |

**Notes**

a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. When mounted on 1" square PCB (FR-4 material).
c. Parametric verification ongoing.

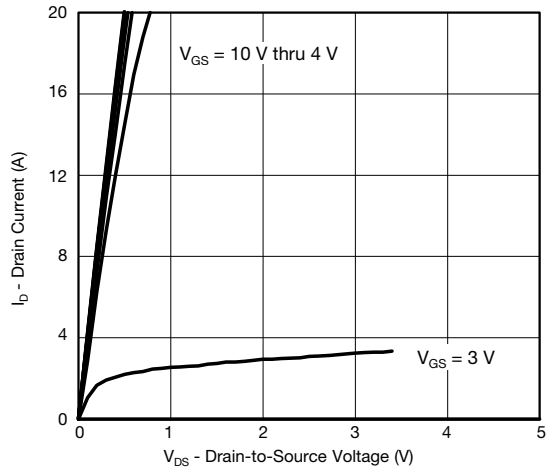
| **SPECIFICATIONS** ($T_C$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | | 40 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 1.5 | 2.0 | 2.5 | |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V | - | - | 1 | µA |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V, $T_J$ = 125 °C | - | - | 50 | |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V, $T_J$ = 175 °C | - | - | 150 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{GS}$ = 10 V | $V_{DS}$ ≥ 5 V | 10 | - | - | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 7.9 A | - | 0.026 | 0.031 | Ω |
| | | $V_{GS}$ = 10 V | $I_D$ = 7.9 A, $T_J$ = 125 °C | - | - | 0.045 | |
| | | $V_{GS}$ = 10 V | $I_D$ = 7.9 A, $T_J$ = 175 °C | - | - | 0.065 | |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 7.3 A | - | 0.030 | 0.036 | |
| Forward Transconductance[b] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 7.9 A | | - | 30 | - | S |
| **Dynamic[b]** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 20 V, f = 1 MHz | - | 442 | 553 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 79 | 99 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 37 | 46 | |
| Total Gate Charge[c] | $Q_g$ | $V_{GS}$ = 10 V | $V_{DS}$ = 20 V, $I_D$ = 3.9 A | - | 8.7 | 13 | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | - | 1.4 | - | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | - | 1.6 | - | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 1.5 | 3.0 | 4.5 | Ω |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = 20 V, $R_L$ = 20 Ω<br>$I_D$ ≅ 1 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | - | 7.5 | 11 | ns |
| Rise Time[c] | $t_r$ | | | - | 8.4 | 13 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | - | 12 | 18 | |
| Fall Time[c] | $t_f$ | | | - | 5.7 | 8.5 | |
| **Source-Drain Diode Ratings and Characteristics[b]** | | | | | | | |
| Pulsed Current[a] | $I_{SM}$ | | | - | - | 32 | A |
| Forward Voltage | $V_{SD}$ | $I_F$ = 5.4 A, $V_{GS}$ = 0 V | | - | 0.8 | 1.2 | V |

**Notes**

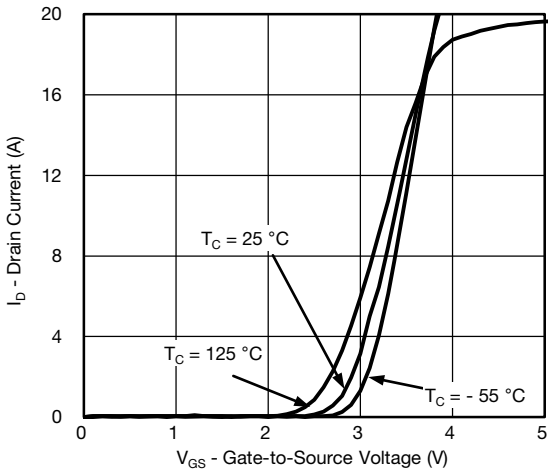
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*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.*

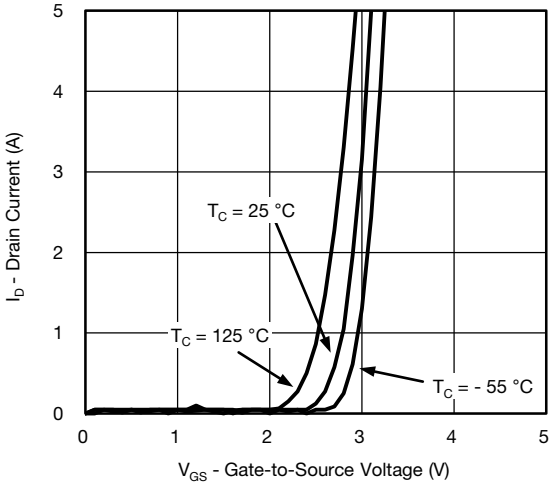
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)



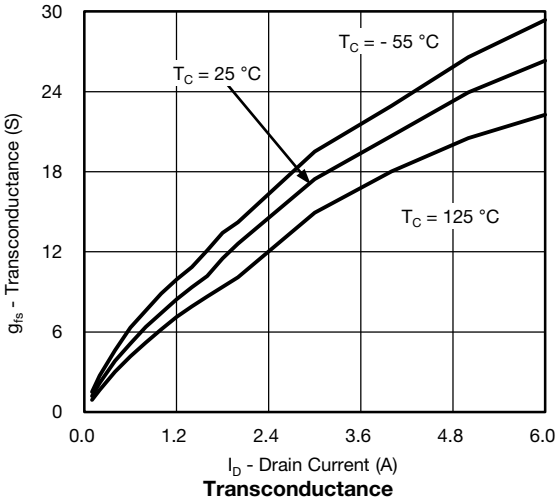

**Output Characteristics**



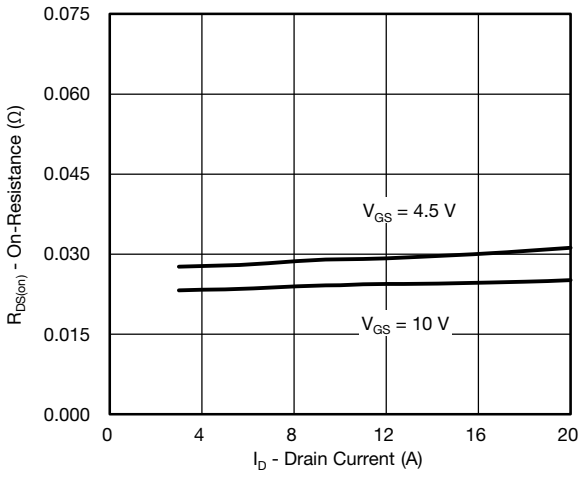

**Transfer Characteristics**



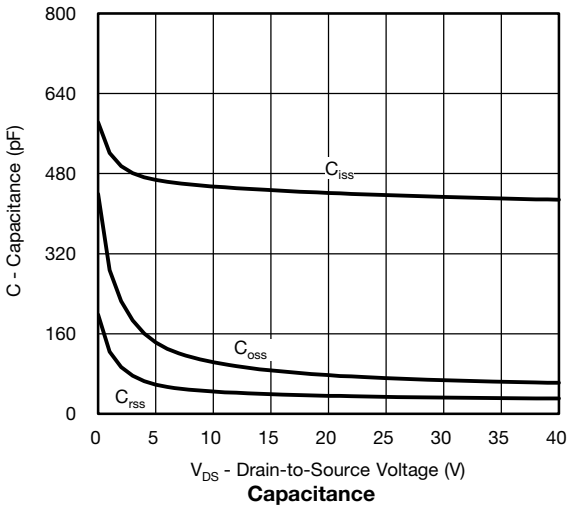

**Transfer Characteristics**




**Transconductance**

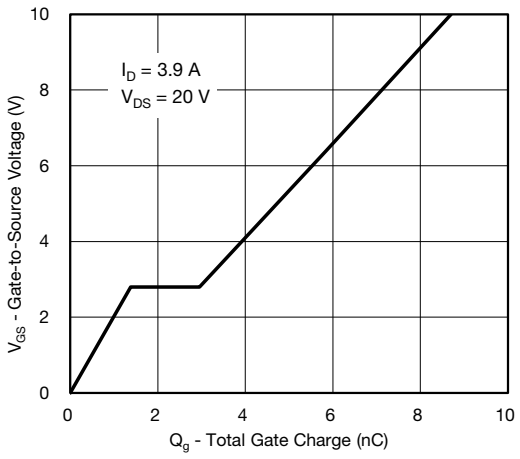



**On-Resistance vs. Drain Current**

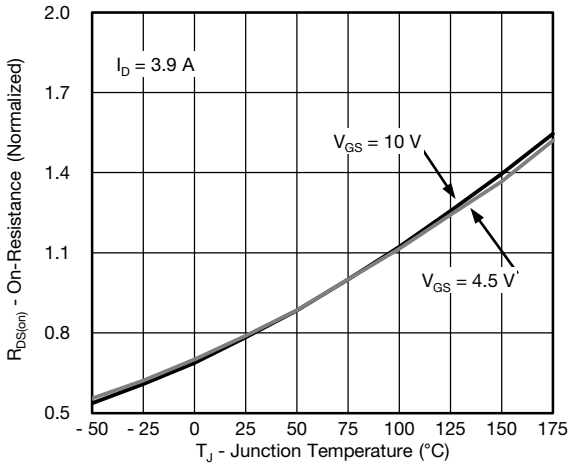



**Capacitance**

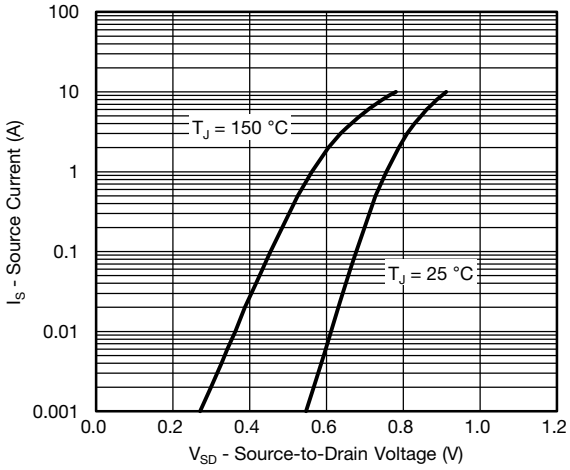
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



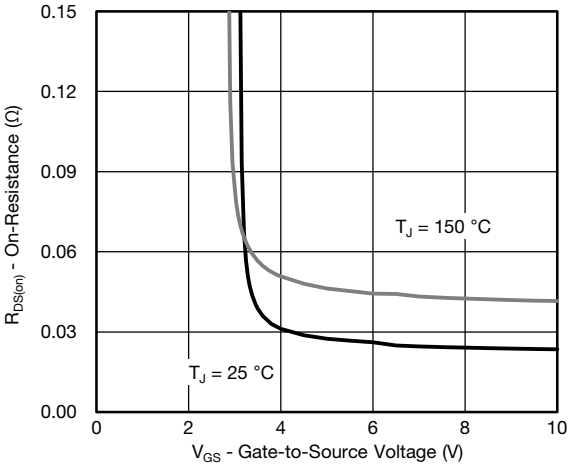

**Gate Charge**



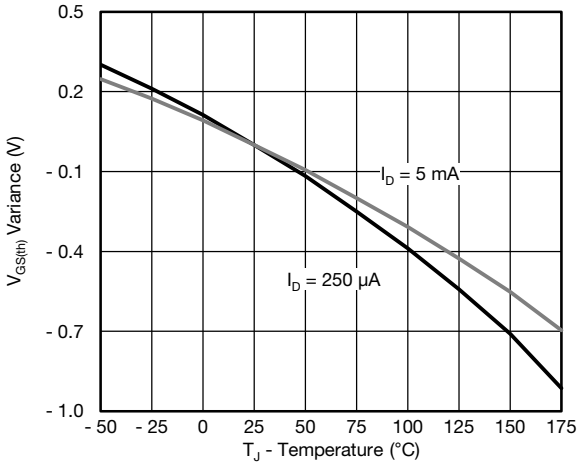

**On-Resistance vs. Junction Temperature**



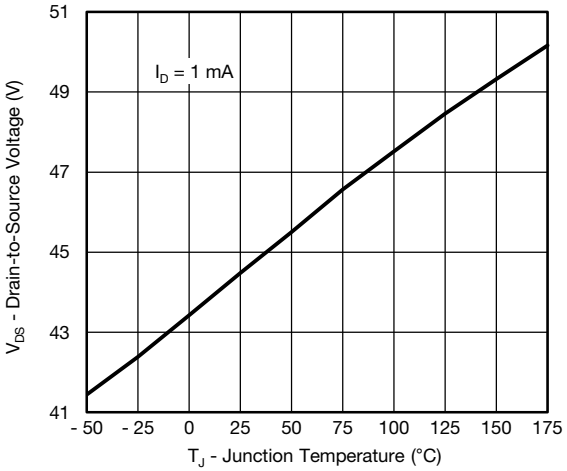

**Source Drain Diode Forward Voltage**




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

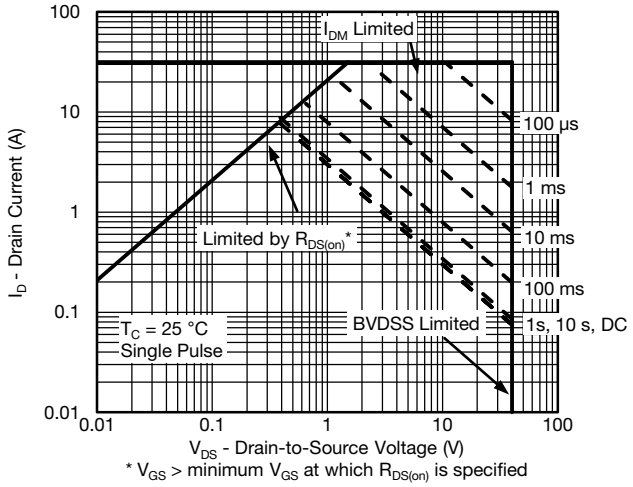



**Threshold Voltage**

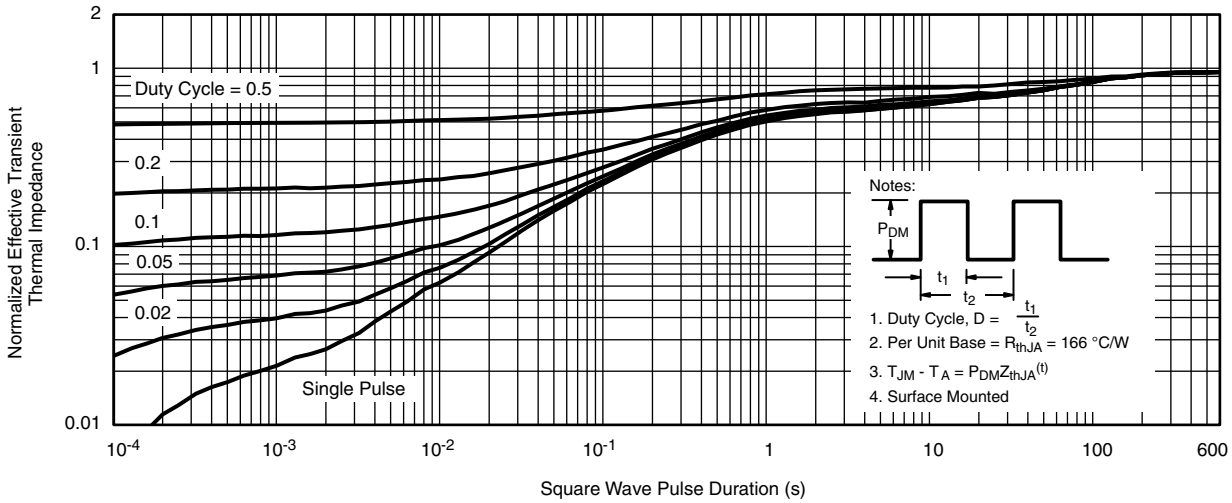



**Drain Source Breakdown vs. Junction Temperature**

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)

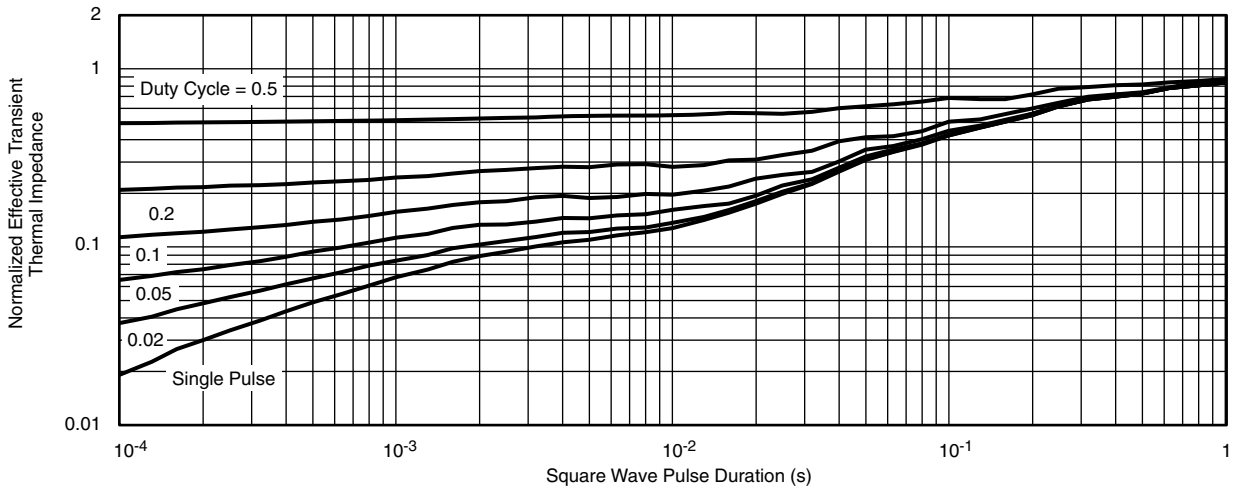



**Safe Operating Area**




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

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)




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

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Foot (25 °C)

  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

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# Automotive Dual N-Channel 40 V (D-S) 175 °C MOSFET

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 40 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 10 V | 0.0135 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 4.5 V | 0.0148 |
| $I_D$ (A) | 8 |
| Configuration | Dual |

## FEATURES

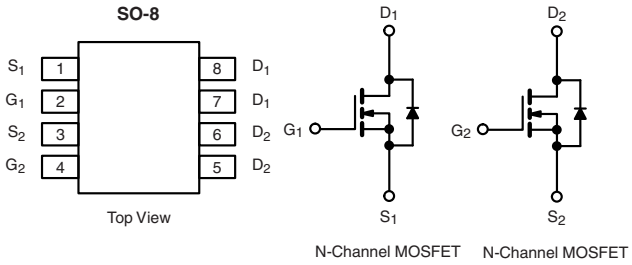
- TrenchFET® Power MOSFET
- AEC-Q101 Qualified
- 100 % $R_g$ and UIS Tested
- Material categorization:
  For definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

Pb-free

RoHS COMPLIANT

HALOGEN FREE




| ORDERING INFORMATION | |
|---|---|
| Package | SO-8 |
| Lead (Pb)-free and Halogen-free | SQ4284EY-T1-GE3 |

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 40 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current | $T_C$ = 25 °C[a] | $I_D$ | 8 | A |
| | $T_C$ = 125 °C | | 7.4 | |
| Continuous Source Current (Diode Conduction) | | $I_S$ | 3.5 | |
| Pulsed Drain Current[a] | | $I_{DM}$ | 32 | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 48 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 115 | mJ |
| Maximum Power Dissipation[a] | $T_C$ = 25 °C | $P_D$ | 3.9 | W |
| | $T_C$ = 125 °C | | 1.3 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to + 175 | °C |

**THERMAL RESISTANCE RATINGS**

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Junction-to-Ambient | PCB Mount[b] | $R_{thJA}$ | 120 | °C/W |
| Junction-to-Foot (Drain) | | $R_{thJF}$ | 38 | |

**Notes**

a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.

b. When mounted on 1" square PCB (FR-4 material).

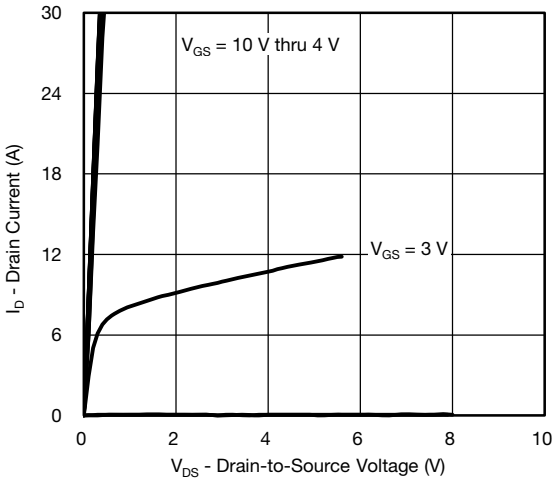
| **SPECIFICATIONS** ($T_C$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | | 40 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 1.5 | 2.0 | 2.5 | |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V | - | - | 1 | µA |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V, $T_J$ = 125 °C | - | - | 50 | |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V, $T_J$ = 175 °C | - | - | 150 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{GS}$ = 10 V | $V_{DS}$ ≥ 5 V | 25 | - | - | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 7 A | - | 0.0112 | 0.0135 | Ω |
| | | $V_{GS}$ = 10 V | $I_D$ = 7 A, $T_J$ = 125 °C | - | - | 0.0198 | |
| | | $V_{GS}$ = 10 V | $I_D$ = 7 A, $T_J$ = 175 °C | - | - | 0.0235 | |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 5 A | - | 0.0123 | 0.0148 | |
| Forward Transconductance[b] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 7 A | | - | 30 | - | S |
| **Dynamic[b]** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 25 V, f = 1 MHz | - | 1760 | 2200 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 252 | 315 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 93 | 116 | |
| Total Gate Charge[c] | $Q_g$ | $V_{GS}$ = 10 V | $V_{DS}$ = 20 V, $I_D$ = 5 A | - | 30 | 45 | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | - | 5.5 | - | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | - | 5 | - | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 2.2 | 4.53 | 6.8 | Ω |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = 20 V, $R_L$ = 4 Ω<br>$I_D$ ≅ 5 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | - | 10 | 15 | ns |
| Rise Time[c] | $t_r$ | | | - | 40 | 60 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | - | 32 | 48 | |
| Fall Time[c] | $t_f$ | | | - | 11 | 17 | |
| **Source-Drain Diode Ratings and Characteristics[b]** | | | | | | | |
| Pulsed Current[a] | $I_{SM}$ | | | - | - | 32 | A |
| Forward Voltage | $V_{SD}$ | $I_F$ = 7 A, $V_{GS}$ = 0 V | | - | 0.76 | 1.2 | V |

**Notes**

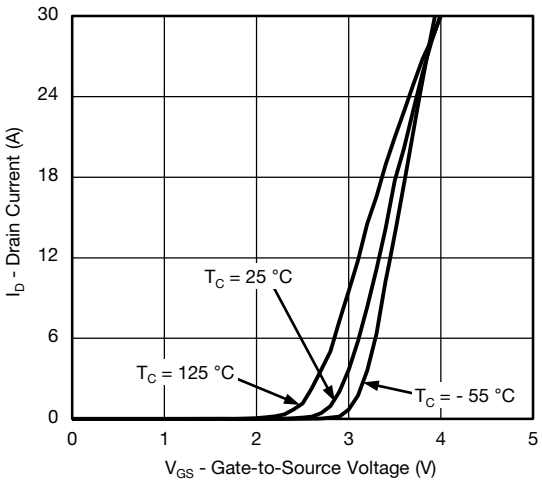
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*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.*

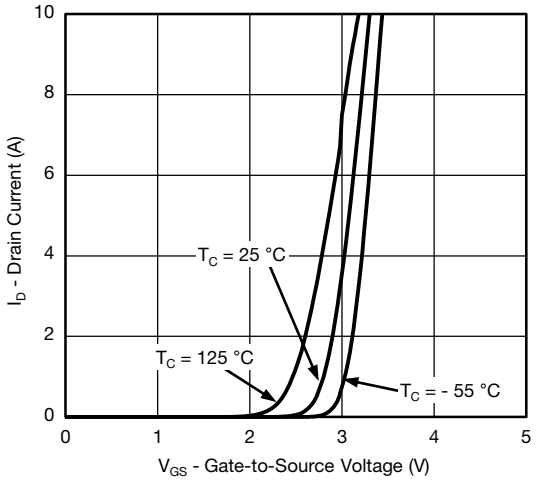
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)



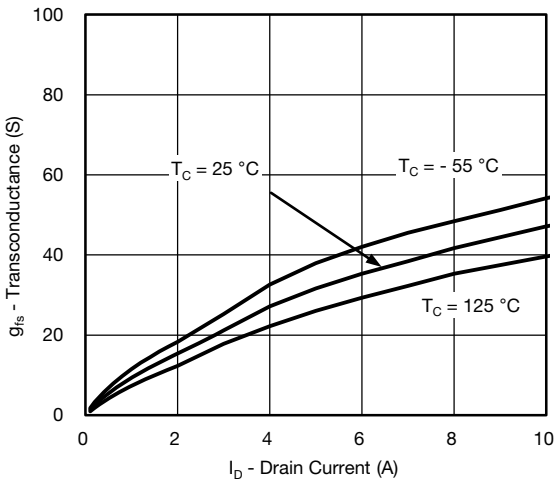

**Output Characteristics**



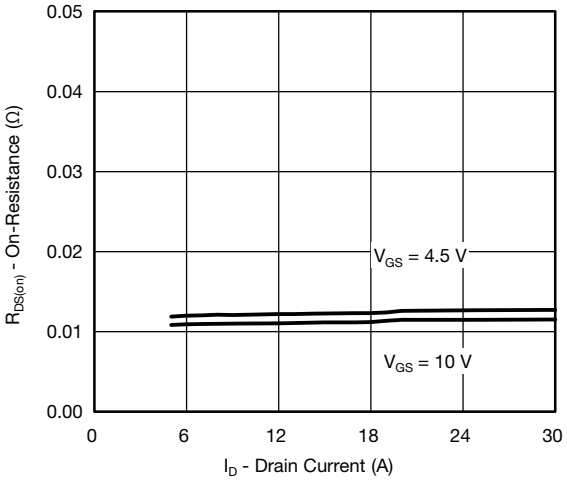

**Transfer Characteristics**



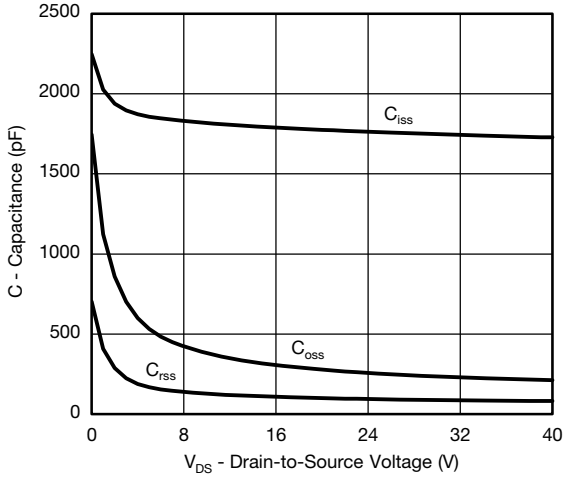

**Transfer Characteristics**




**Transconductance**

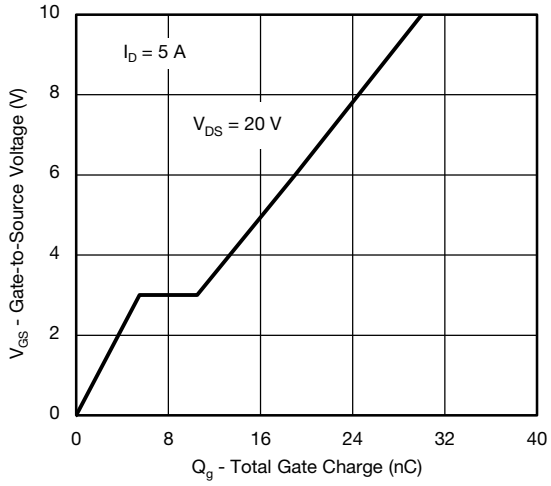



**On-Resistance vs. Drain Current**

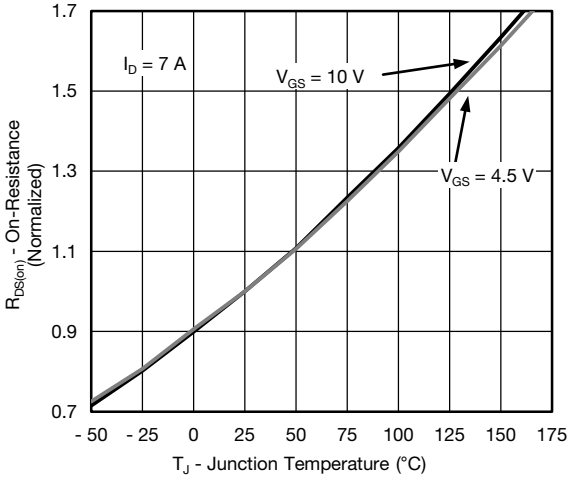



**Capacitance**

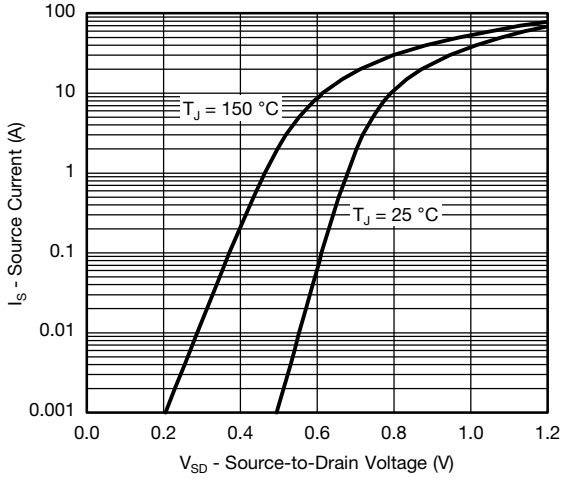
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)



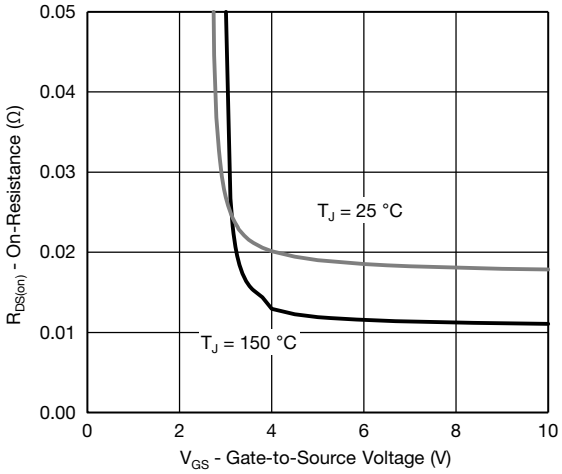

**Gate Charge**



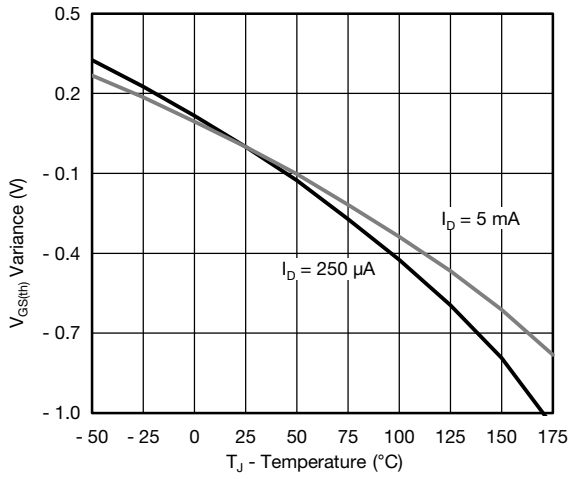

**On-Resistance vs. Junction Temperature**



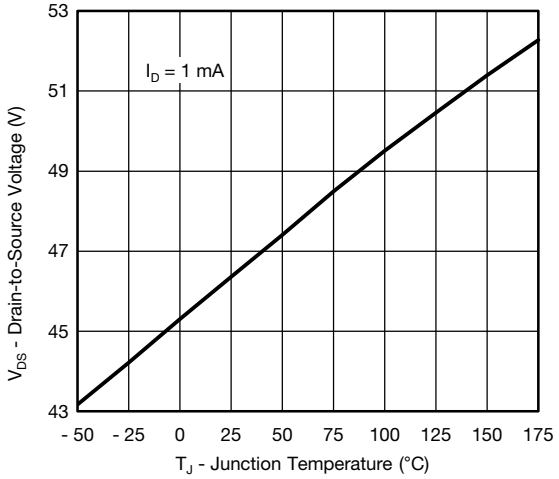

**Source Drain Diode Forward Voltage**




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

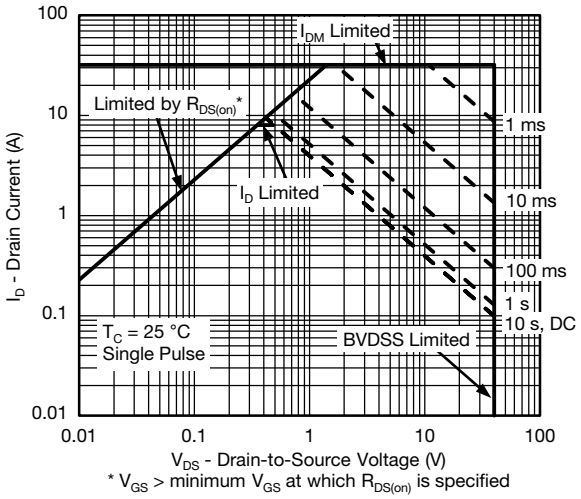



**Threshold Voltage**

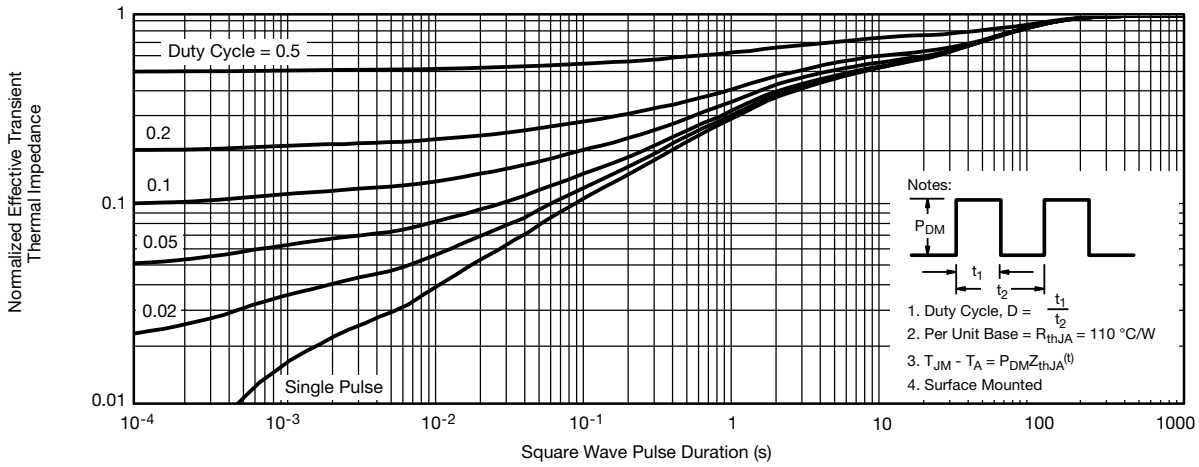



**Drain Source Breakdown vs. Junction Temperature**

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)

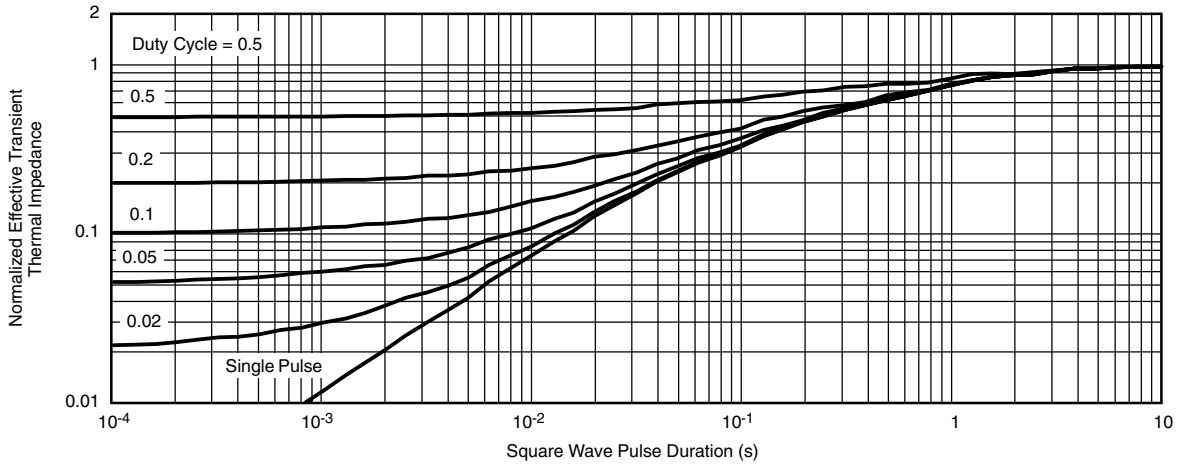



**Safe Operating Area**




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

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)




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

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Foot (25 °C)

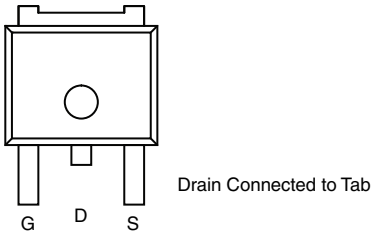
  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

*Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?67334.*

# Automotive N-Channel 40 V (D-S) 175 °C MOSFET

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 40 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 10 V | 0.0036 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 4.5 V | 0.0042 |
| $I_D$ (A) | 100 |
| Configuration | Single |

**TO-252**



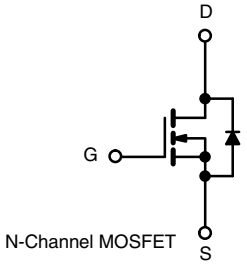

## FEATURES

- TrenchFET® Power MOSFET
- Package with Low Thermal Resistance
- 100 % $R_g$ and UIS Tested
- AEC-Q101 Qualified[d]
- Material categorization:
  For definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

RoHS COMPLIANT

HALOGEN FREE




| ORDERING INFORMATION | |
|---|---|
| Package | TO-252 |
| Lead (Pb)-free and Halogen-free | SQD100N04-3m6L-GE3 |

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 40 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current | $T_C$ = 25 °C[a] | $I_D$ | 100 | A |
| | $T_C$ = 125 °C | | 80 | |
| Continuous Source Current (Diode Conduction)[a] | | $I_S$ | 100 | |
| Pulsed Drain Current[b] | | $I_{DM}$ | 400 | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 55 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 151 | mJ |
| Maximum Power Dissipation[b] | $T_C$ = 25 °C | $P_D$ | 136 | W |
| | $T_C$ = 125 °C | | 45 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to + 175 | °C |

**THERMAL RESISTANCE RATINGS**

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Junction-to-Ambient | PCB Mount[c] | $R_{thJA}$ | 50 | °C/W |
| Junction-to-Case (Drain) | | $R_{thJC}$ | 1.1 | |

**Notes**

a. Package limited.
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
c. When mounted on 1" square PCB (FR-4 material).
d. Parametric verification ongoing.

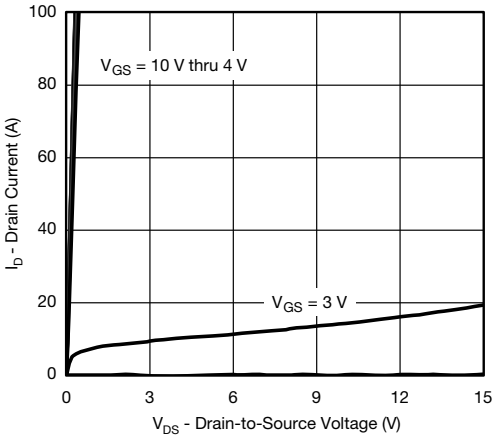
| **SPECIFICATIONS** ($T_C$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | | 40 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 1.5 | - | 2.5 | |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V | - | - | 1 | µA |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V, $T_J$ = 125 °C | - | - | 50 | |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V, $T_J$ = 175 °C | - | - | 150 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{GS}$ = 10 V | $V_{DS}$ ≥ 5 V | 50 | - | - | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 20 A | - | 0.0030 | 0.0036 | Ω |
| | | $V_{GS}$ = 10 V | $I_D$ = 20 A, $T_J$ = 125 °C | - | - | 0.0058 | |
| | | $V_{GS}$ = 10 V | $I_D$ = 20 A, $T_J$ = 175 °C | - | - | 0.0070 | |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 20 A | - | 0.0035 | 0.0042 | |
| Forward Transconductance[b] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 15 A | | - | 105 | - | S |
| **Dynamic[b]** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 25 V, f = 1 MHz | - | 4880 | 5860 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 560 | 670 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 250 | 300 | |
| Total Gate Charge[c] | $Q_g$ | $V_{GS}$ = 10 V | $V_{DS}$ = 20 V, $I_D$ = 50 A | - | 85 | 130 | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | - | 14 | - | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | - | 14 | - | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 1 | 2 | 3 | Ω |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = 20 V, $R_L$ = 0.4 Ω<br>$I_D$ ≅ 50 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | - | 9 | 11 | ns |
| Rise Time[c] | $t_r$ | | | - | 11 | 14 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | - | 39 | 47 | |
| Fall Time[c] | $t_f$ | | | - | 11 | 14 | |
| **Source-Drain Diode Ratings and Characteristics[b]** | | | | | | | |
| Pulsed Current[a] | $I_{SM}$ | | | - | - | 400 | A |
| Forward Voltage | $V_{SD}$ | $I_F$ = 30 A, $V_{GS}$ = 0 V | | - | 0.9 | 1.5 | V |

**Notes**

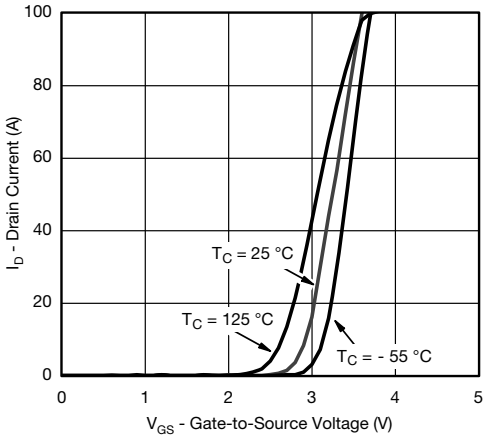
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*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.*

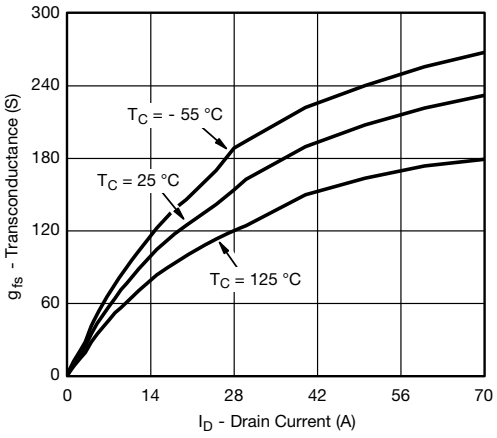
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



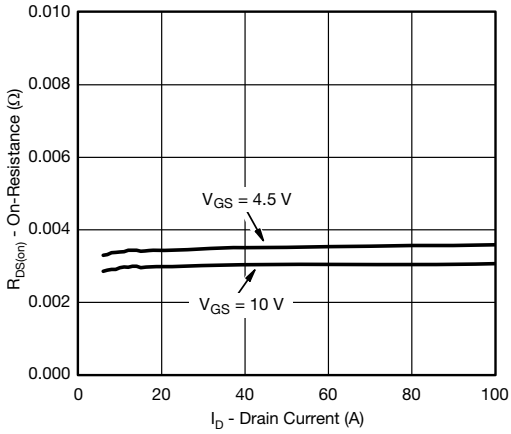

**Output Characteristics**



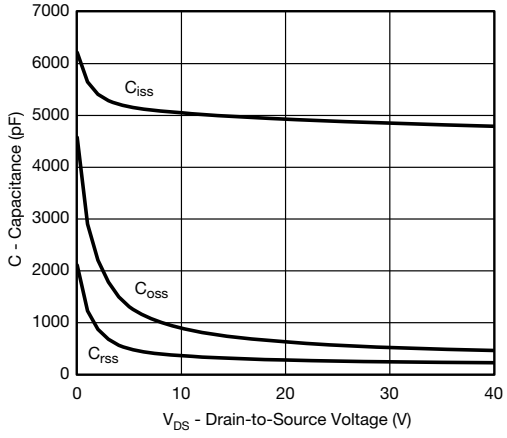

**Transfer Characteristics**



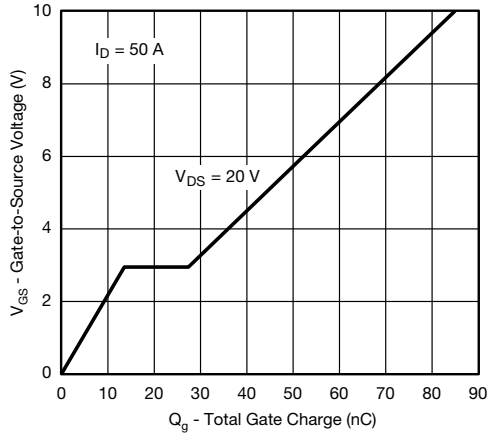

**Transconductance**




**On-Resistance vs. Drain Current**

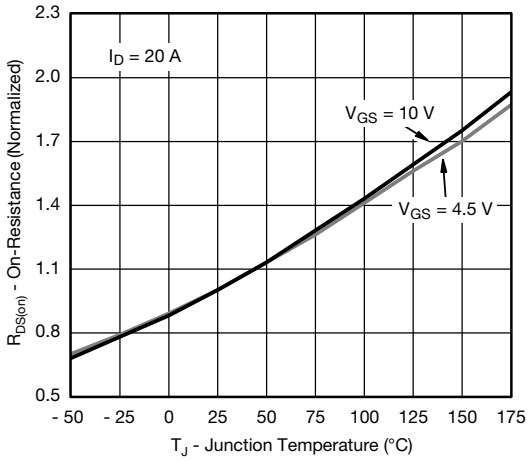



**Capacitance**

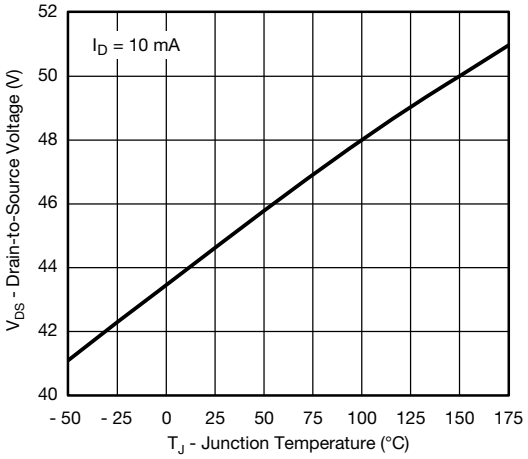



**Gate Charge**

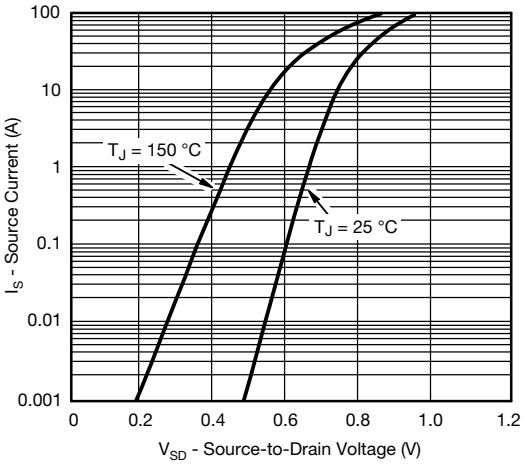
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



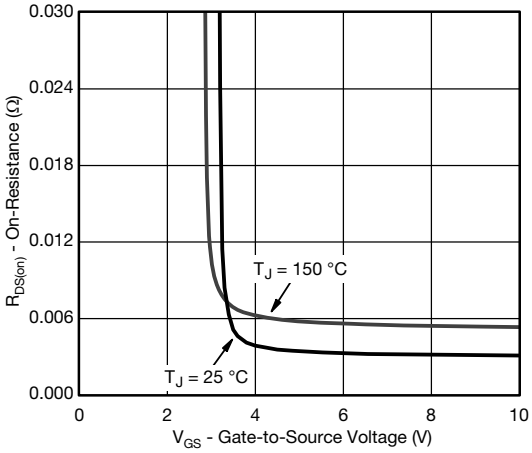

**On-Resistance vs. Junction Temperature**



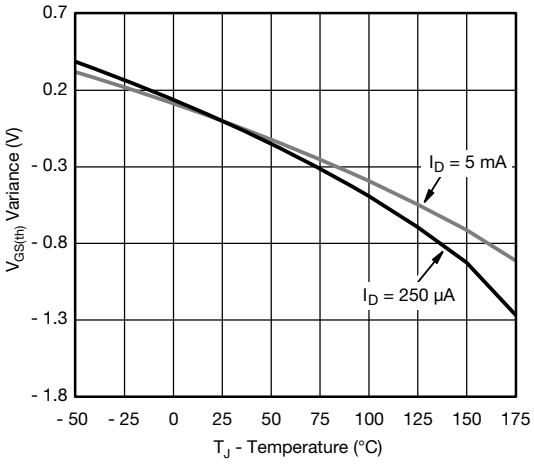

**Drain Source Breakdown vs. Junction Temperature**




**Source Drain Diode Forward Voltage**

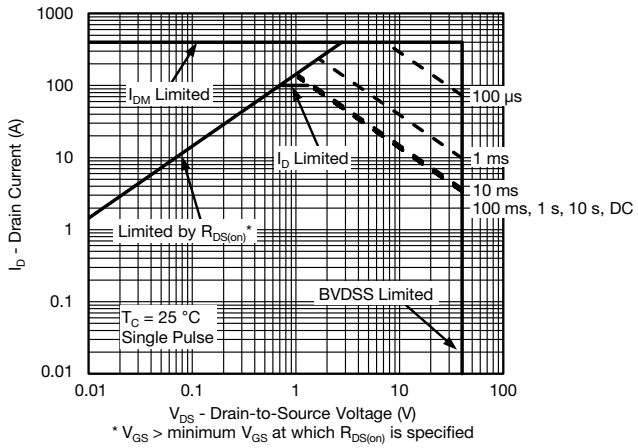



**On-Resistance vs. Gate-to-Source Voltage**

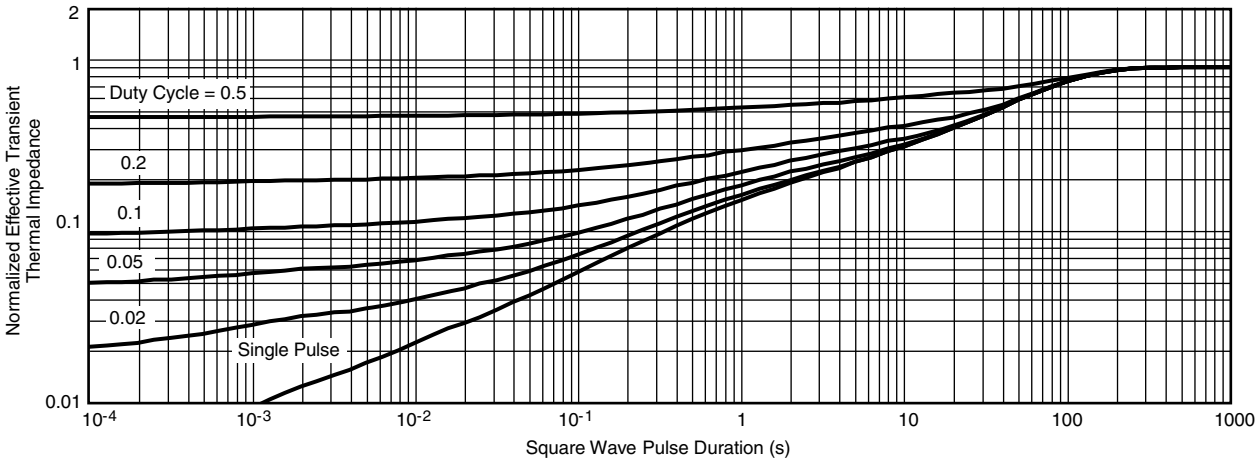



**Threshold Voltage**

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)

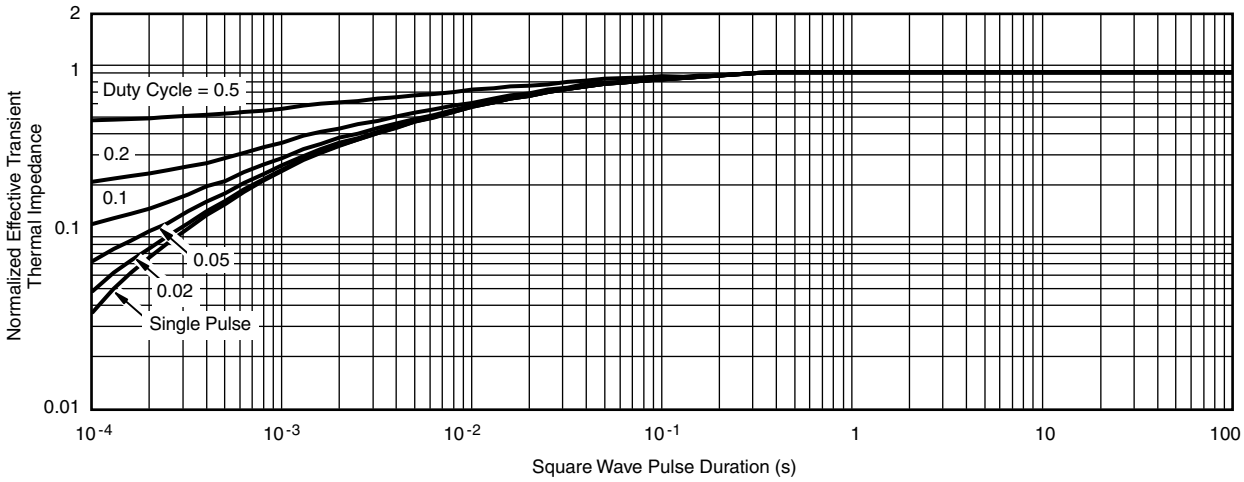



**Safe Operating Area**




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

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)




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

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Case (25 °C)

  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

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# Automotive Dual N-Channel 30 V (D-S) 175 °C MOSFET

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 30 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 10 V | 0.0145 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 4.5 V | 0.0175 |
| $I_D$ (A) per leg | 8 |
| Configuration | Dual |

## FEATURES

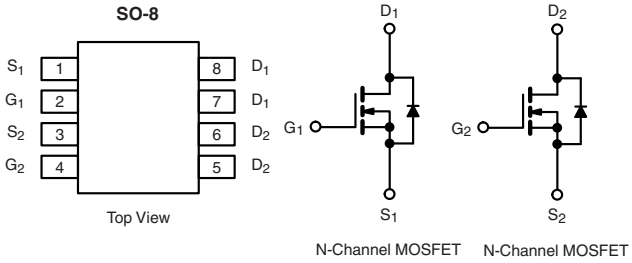
- TrenchFET® Power MOSFET
- AEC-Q101 Qualified[d]
- 100 % $R_g$ and UIS Tested
- Material categorization:
  For definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

Pb-free

RoHS COMPLIANT

HALOGEN FREE




| ORDERING INFORMATION | |
|---|---|
| Package | SO-8 |
| Lead (Pb)-free and Halogen-free | SQ4920EY-T1-GE3 |

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 30 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current[a] | $T_C$ = 25 °C | $I_D$ | 8 | A |
| | $T_C$ = 125 °C | | 7.2 | |
| Continuous Source Current (Diode Conduction)[a] | | $I_S$ | 4 | |
| Pulsed Drain Current[b] | | $I_{DM}$ | 32 | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 25 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 31 | mJ |
| Maximum Power Dissipation[b] | $T_C$ = 25 °C | $P_D$ | 4.4 | W |
| | $T_C$ = 125 °C | | 1.4 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to + 175 | °C |

**THERMAL RESISTANCE RATINGS**

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Junction-to-Ambient | PCB Mount[c] | $R_{thJA}$ | 110 | °C/W |
| Junction-to-Foot (Drain) | | $R_{thJF}$ | 34 | |

**Notes**

a. Package limited.
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
c. When mounted on 1" square PCB (FR-4 material).
d. Parametric verification ongoing.

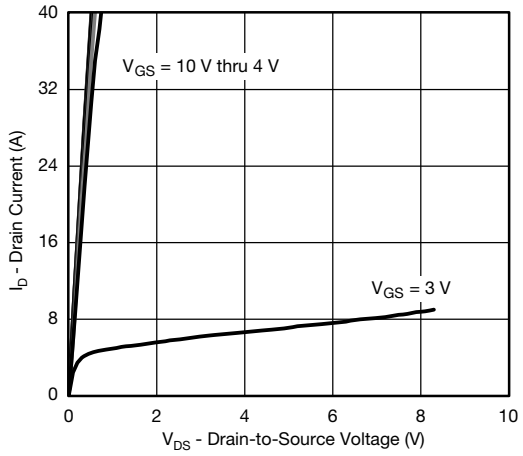
| **SPECIFICATIONS** ($T_C$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0, $I_D$ = 250 µA | | 30 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 1.5 | 2.0 | 2.5 | |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 30 V | - | - | 1.0 | µA |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 30 V, $T_J$ = 125 °C | - | - | 50 | |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 30 V, $T_J$ = 175 °C | - | - | 150 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{GS}$ = 10 V | $V_{DS}$ ≥ 5 V | 30 | - | - | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = 4.5 V | $I_D$ = 5 A | - | 0.016 | 0.0175 | Ω |
| | | $V_{GS}$ = 10 V | $I_D$ = 6 A | - | 0.013 | 0.0145 | |
| | | $V_{GS}$ = 10 V | $I_D$ = 6 A, $T_J$ = 125 °C | - | - | 0.024 | |
| | | $V_{GS}$ = 10 V | $I_D$ = 6 A, $T_J$ = 175 °C | - | - | 0.028 | |
| Forward Transconductance[f] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 6 A | | - | 43 | - | S |
| **Dynamic[b]** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 15 V, f = 1 MHz | - | 1175 | 1465 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 225 | 280 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 85 | 105 | |
| Total Gate Charge[c] | $Q_g$ | $V_{GS}$ = 10 V | $V_{DS}$ = 15 V, $I_D$ = 6.1 A | - | 19.7 | 30 | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | - | 3.8 | - | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | - | 2.9 | - | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 2.5 | - | 7.5 | Ω |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = 15 V, $R_L$ = 15 Ω<br>$I_D$ ≅ 1 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | - | 7 | 10 | ns |
| Rise Time[c] | $t_r$ | | | - | 10 | 15 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | - | 25 | 37 | |
| Fall Time[c] | $t_f$ | | | - | 8 | 12 | |
| **Source-Drain Diode Ratings and Characteristics[b]** | | | | | | | |
| Pulsed Current[a] | $I_{SM}$ | | | - | - | 32 | A |
| Forward Voltage | $V_{SD}$ | $I_F$ = 1.8 A, $V_{GS}$ = 0 | | - | 0.75 | 1.1 | V |

**Notes**

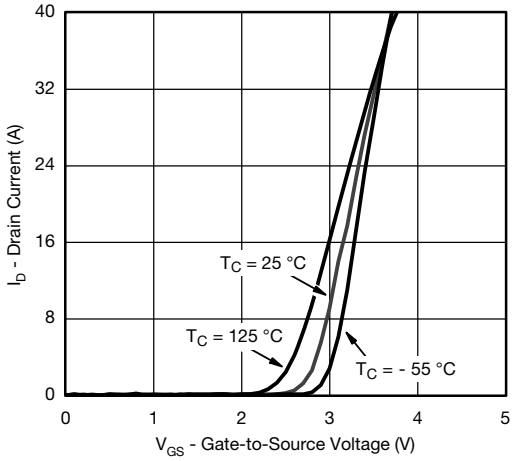
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*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.*

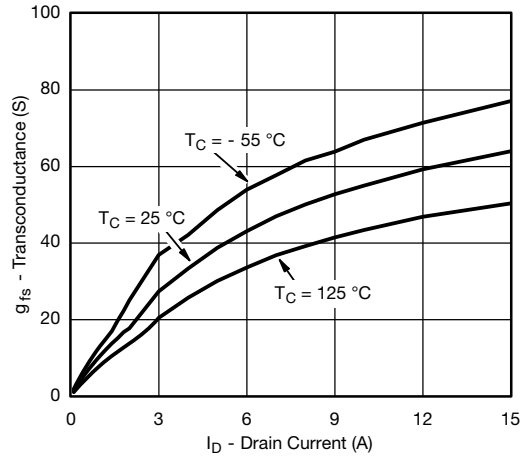
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)



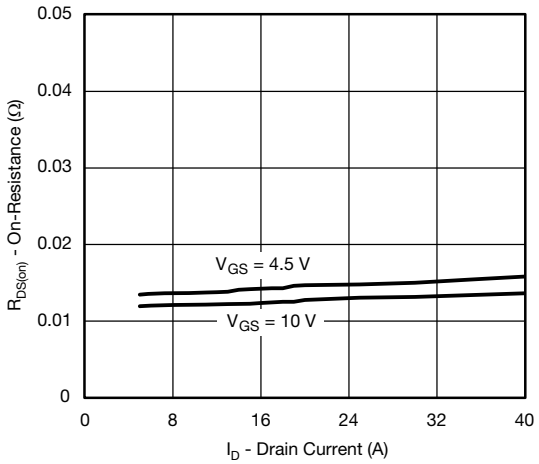

**Output Characteristics**



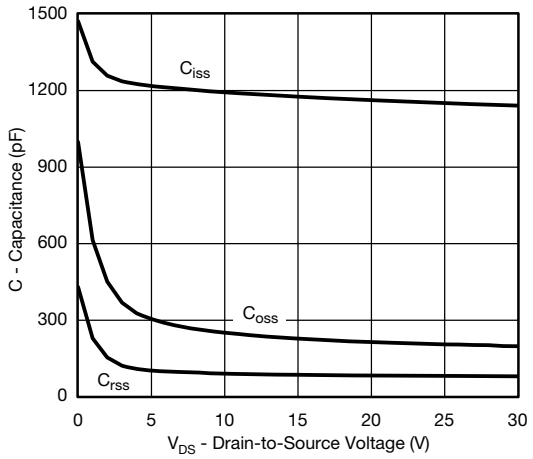

**Transfer Characteristics**



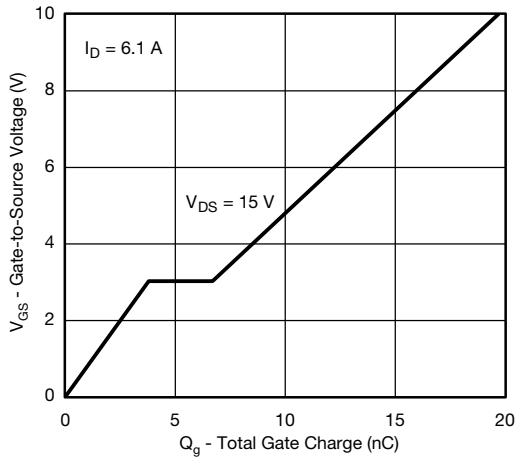

**Transconductance**




**On-Resistance vs. Drain Current**

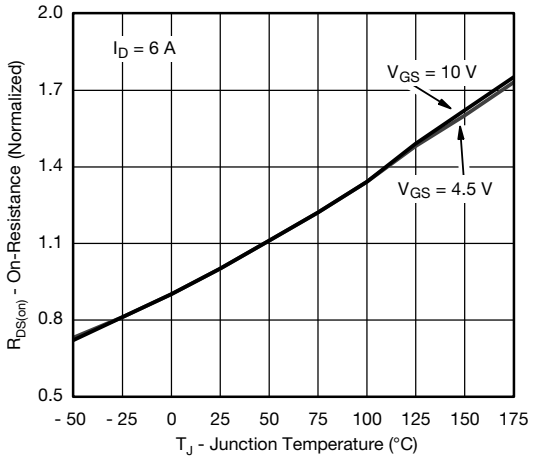



**Capacitance**

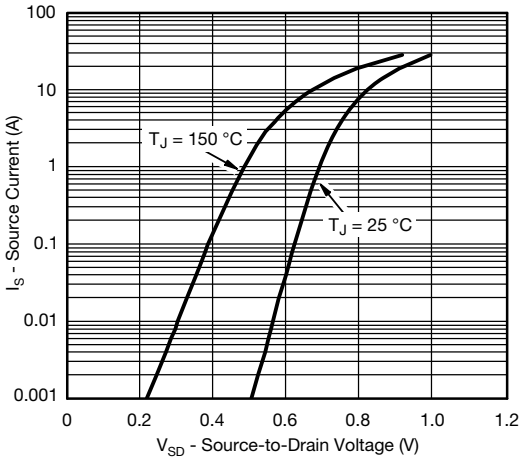



**Gate Charge**

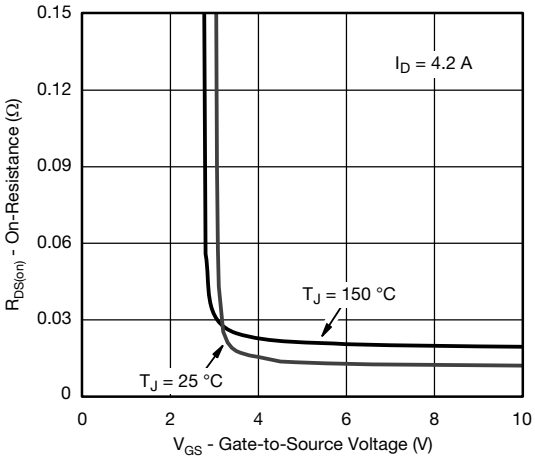
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)



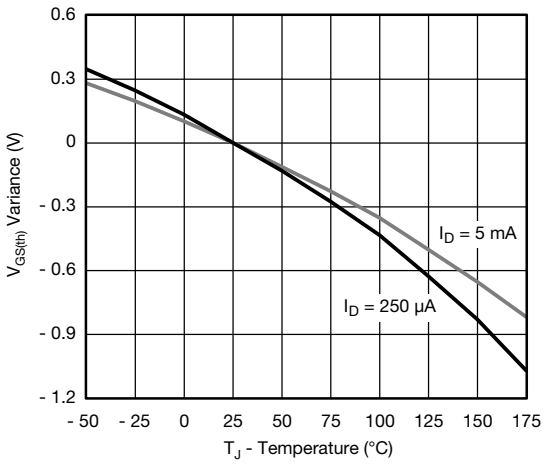

**On-Resistance vs. Junction Temperature**



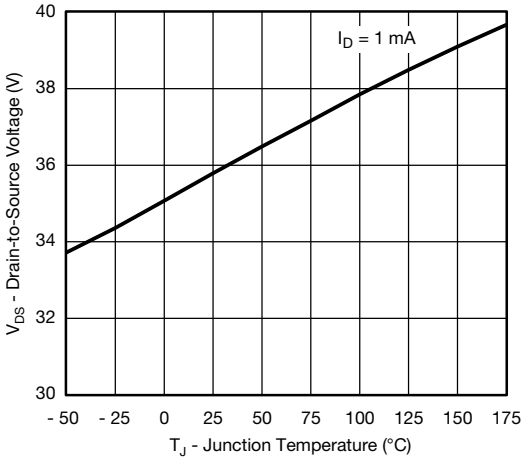

**Drain Source Breakdown vs. Junction Temperature**




**Source Drain Diode Forward Voltage**

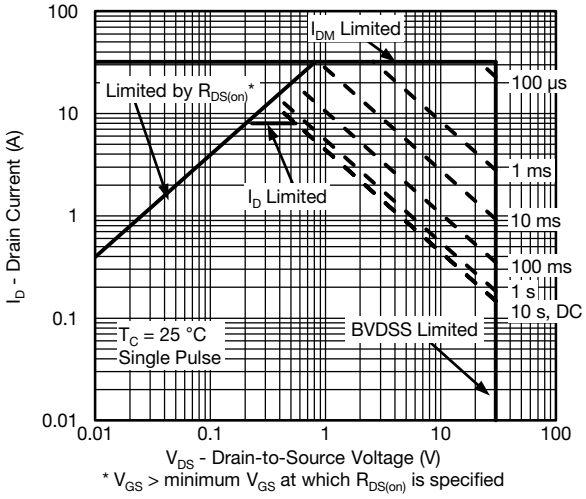



**On-Resistance vs. Gate-to-Source Voltage**

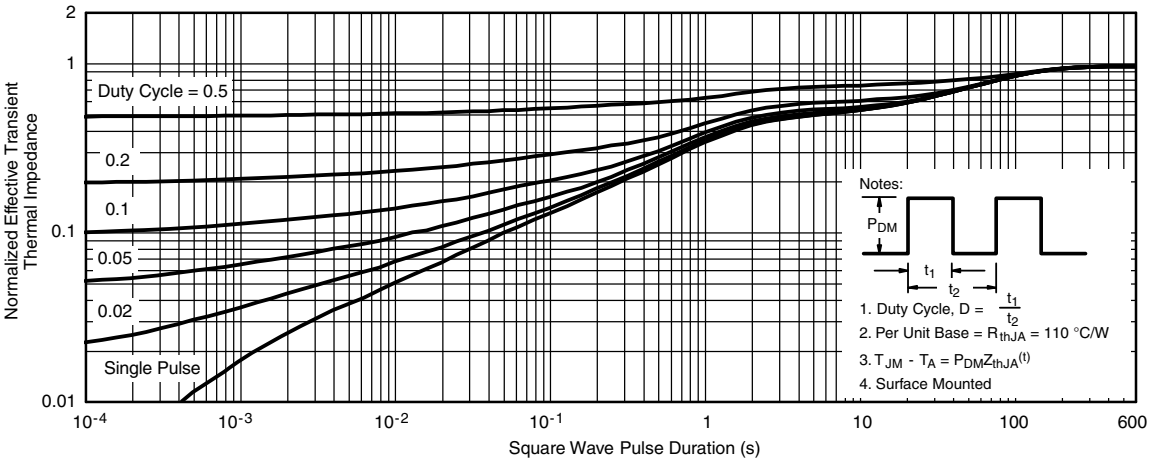



**Threshold Voltage**

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)

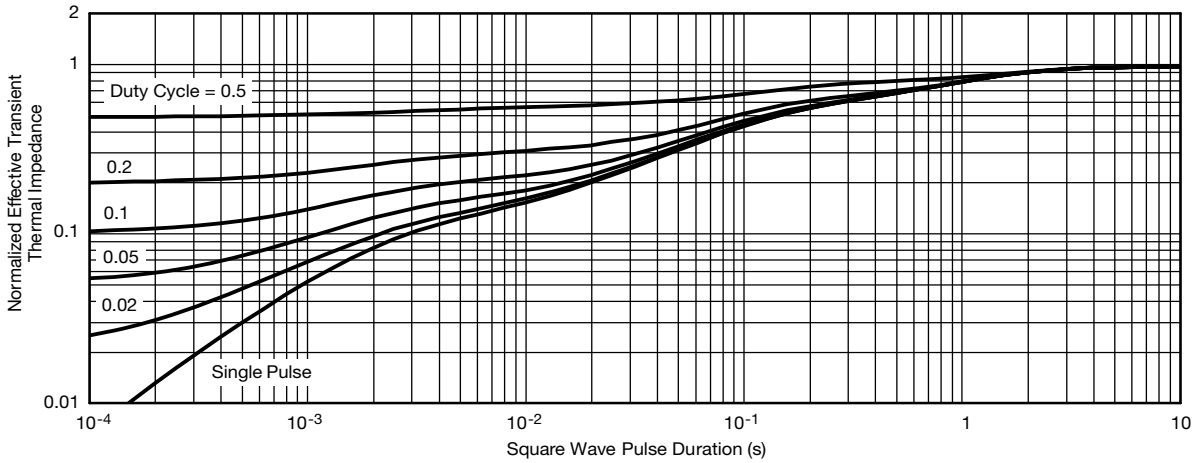



**Safe Operating Area**




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

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)




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

**Note**

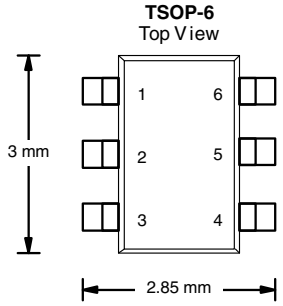
- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Case (25 °C)

  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

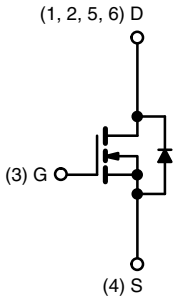
*Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?66724.*

# Automotive N-Channel 30 V (D-S) 175 °C MOSFET

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 30 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 10 V | 0.035 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 4.5 V | 0.052 |
| $I_D$ (A) | 7.8 |
| Configuration | Single |




**Marking Code:** 8Lxxx




N-Channel MOSFET

## FEATURES

- TrenchFET® Power MOSFET
- AEC-Q101 Qualified[c]
- 100 % $R_g$ and UIS Tested
- Material categorization:
  For definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

Pb-free

RoHS COMPLIANT

HALOGEN FREE

| ORDERING INFORMATION | |
|---|---|
| Package | TSOP-6 |
| Lead (Pb)-free and Halogen-free | SQ3456BEV-T1-GE3 |

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 30 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current | $T_C$ = 25 °C | $I_D$ | 7.8 | A |
| | $T_C$ = 125 °C | | 4.5 | |
| Continuous Source Current (Diode Conduction) | | $I_S$ | 5 | |
| Pulsed Drain Current[a] | | $I_{DM}$ | 31 | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 10 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 5 | mJ |
| Maximum Power Dissipation[a] | $T_C$ = 25 °C | $P_D$ | 4 | W |
| | $T_C$ = 125 °C | | 1.3 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to + 175 | °C |

**THERMAL RESISTANCE RATINGS**

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Junction-to-Ambient | PCB Mount[b] | $R_{thJA}$ | 110 | °C/W |
| Junction-to-Foot (Drain) | | $R_{thJF}$ | 38 | |

**Notes**

a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. When mounted on 1" square PCB (FR-4 material).
c. Parametric verification ongoing.

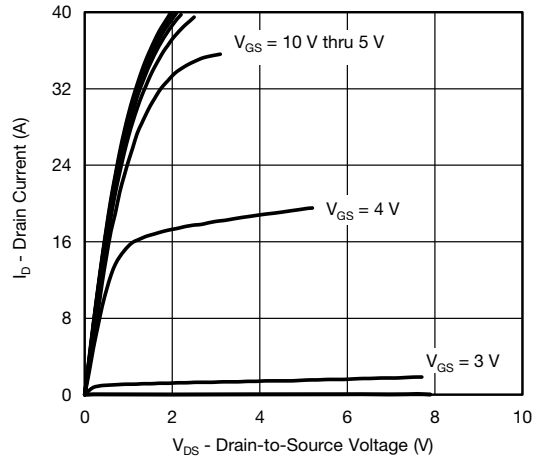
| **SPECIFICATIONS** ($T_C$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | | 30 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 1.5 | 2.0 | 2.5 | |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 30 V | - | - | 1 | µA |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 30 V, $T_J$ = 125 °C | - | - | 50 | |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 30 V, $T_J$ = 175 °C | - | - | 150 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{GS}$ = 10 V | $V_{DS}$ ≥ 5 V | 10 | - | - | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 6 A | - | 0.028 | 0.035 | Ω |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 4.9 A | - | 0.036 | 0.052 | |
| | | $V_{GS}$ = 10 V | $I_D$ = 6 A, $T_J$ = 125 °C | - | - | 0.054 | |
| | | $V_{GS}$ = 10 V | $I_D$ = 6 A, $T_J$ = 175 °C | - | - | 0.064 | |
| Forward Transconductance[b] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 5 A | | - | 21 | - | S |
| **Dynamic[b]** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 15 V, f = 1 MHz | - | 295 | 370 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 67 | 85 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 25 | 35 | |
| Total Gate Charge[c] | $Q_g$ | $V_{GS}$ = 10 V | $V_{DS}$ = 15 V, $I_D$ = 6 A | - | 6 | 10 | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | - | 1.2 | - | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | - | 1 | - | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 3.0 | 6.65 | 11 | Ω |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = 15 V, $R_L$ = 2.5 Ω<br>$I_D$ ≅ 6 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | - | 6 | 9 | ns |
| Rise Time[c] | $t_r$ | | | - | 12 | 18 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | - | 13 | 20 | |
| Fall Time[c] | $t_f$ | | | - | 8 | 12 | |
| **Source-Drain Diode Ratings and Characteristics[b]** | | | | | | | |
| Pulsed Current[a] | $I_{SM}$ | | | - | - | 31 | A |
| Forward Voltage | $V_{SD}$ | $I_F$ = 3 A, $V_{GS}$ = 0 V | | - | 0.8 | 1.1 | V |

**Notes**

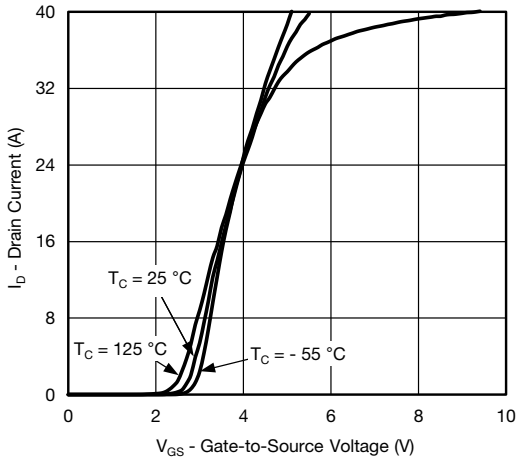
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*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.*

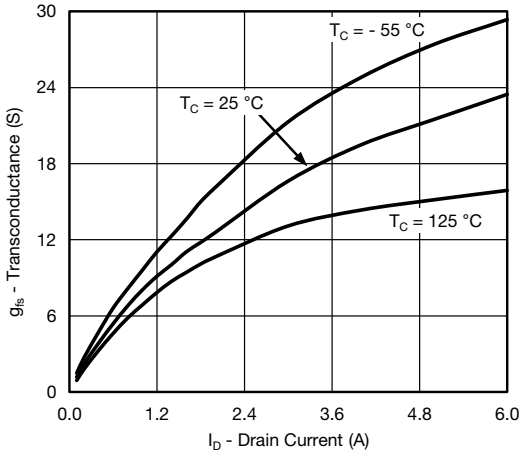
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



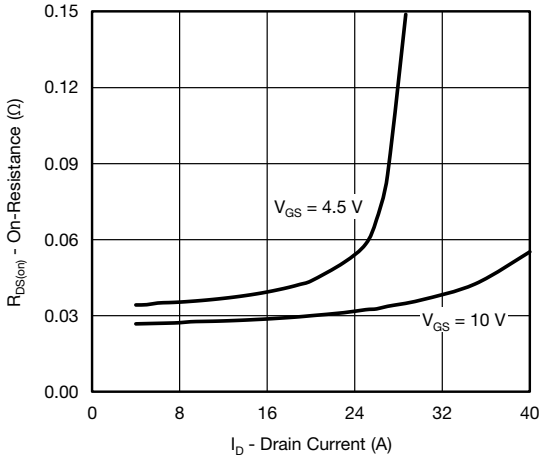

**Output Characteristics**



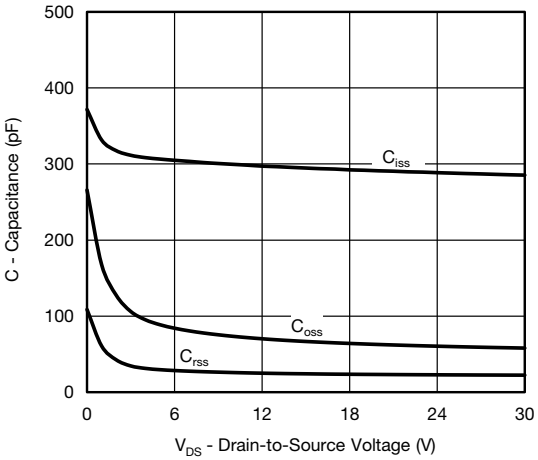

**Transfer Characteristics**



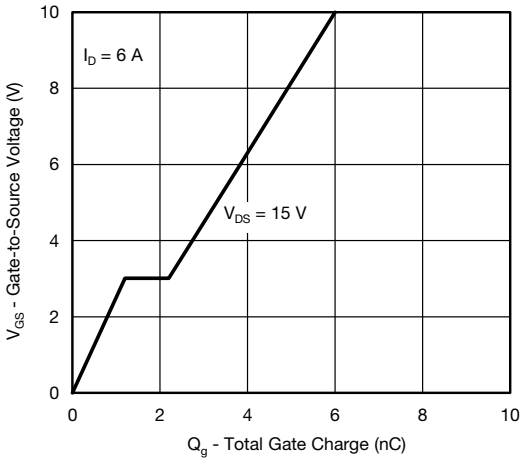

**Transconductance**




**On-Resistance vs. Drain Current**

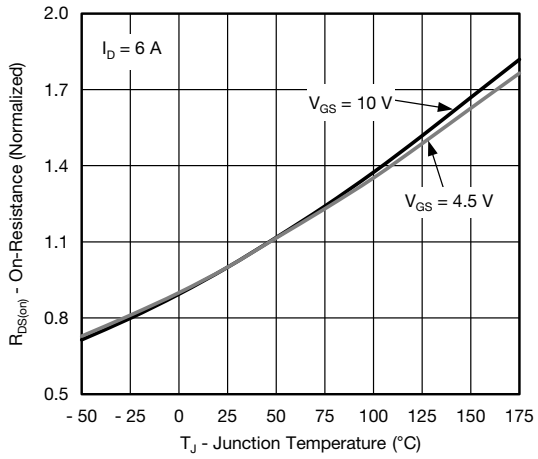



**Capacitance**

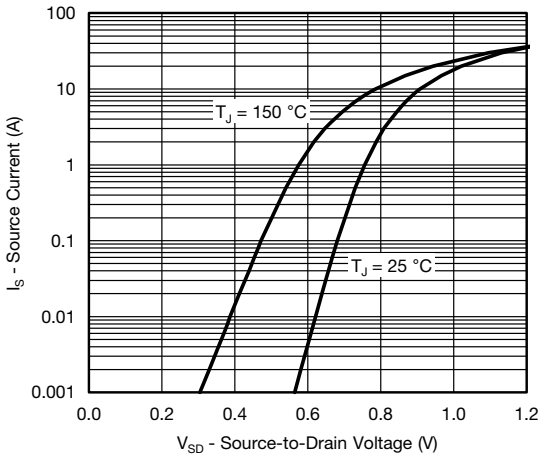



**Gate Charge**

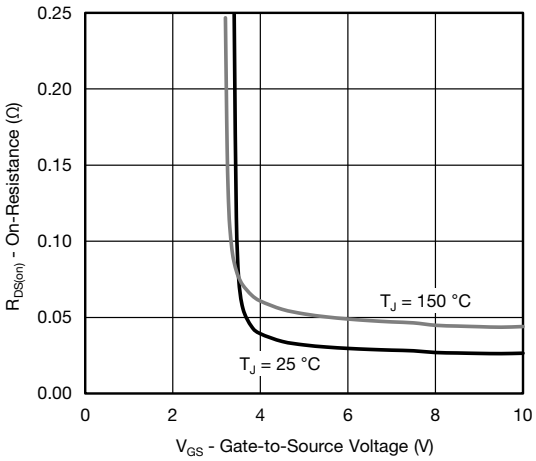
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



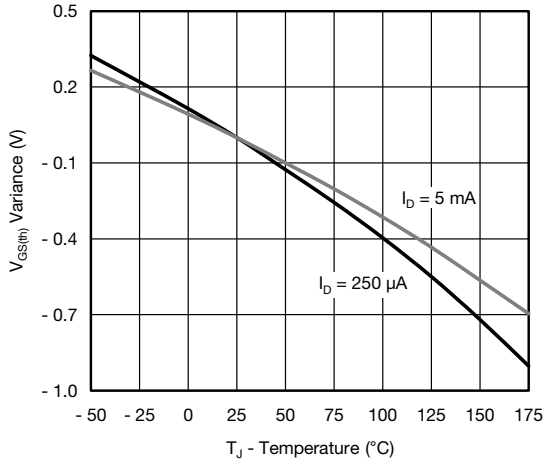

**On-Resistance vs. Junction Temperature**



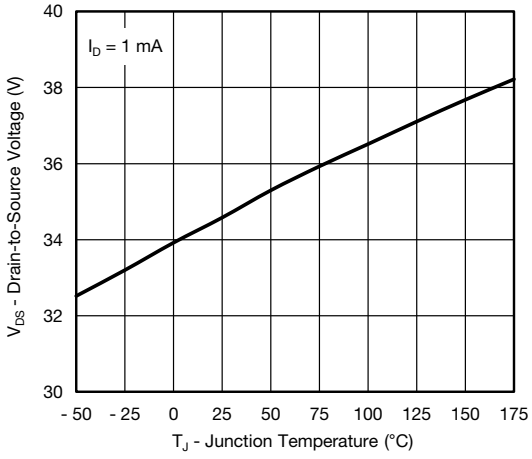

**Source-Drain Diode Forward Voltage**




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

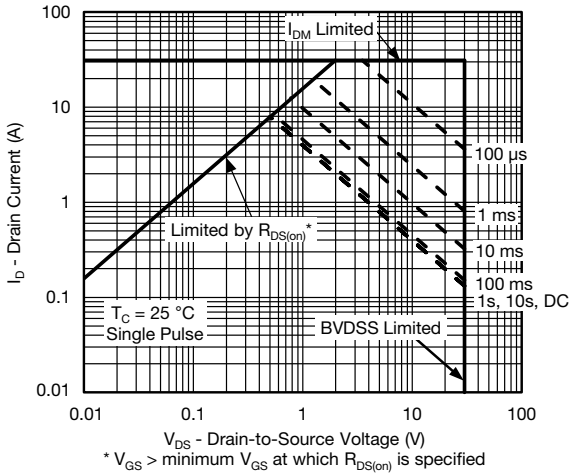



**Threshold Voltage**

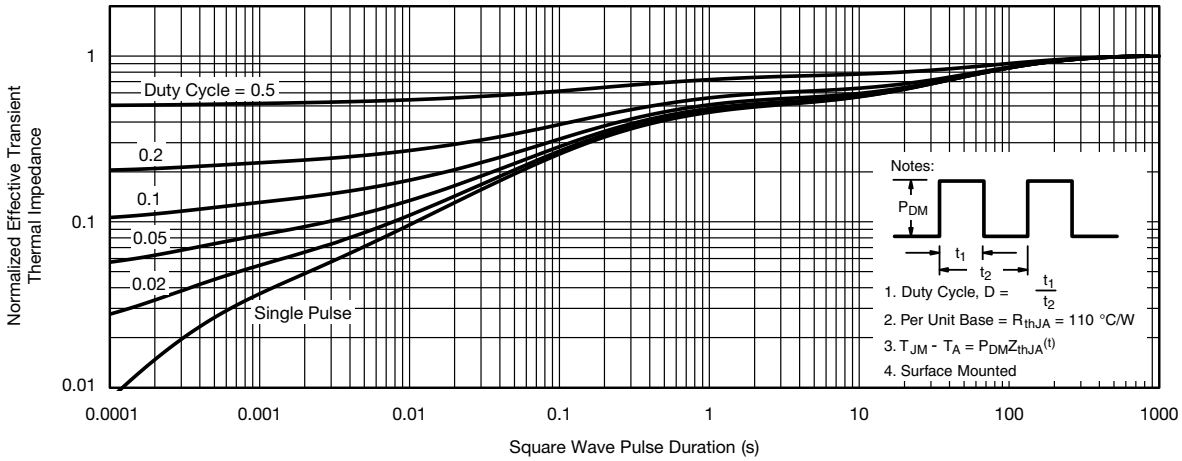



**Drain Source Breakdown vs. Junction Temperature**

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)

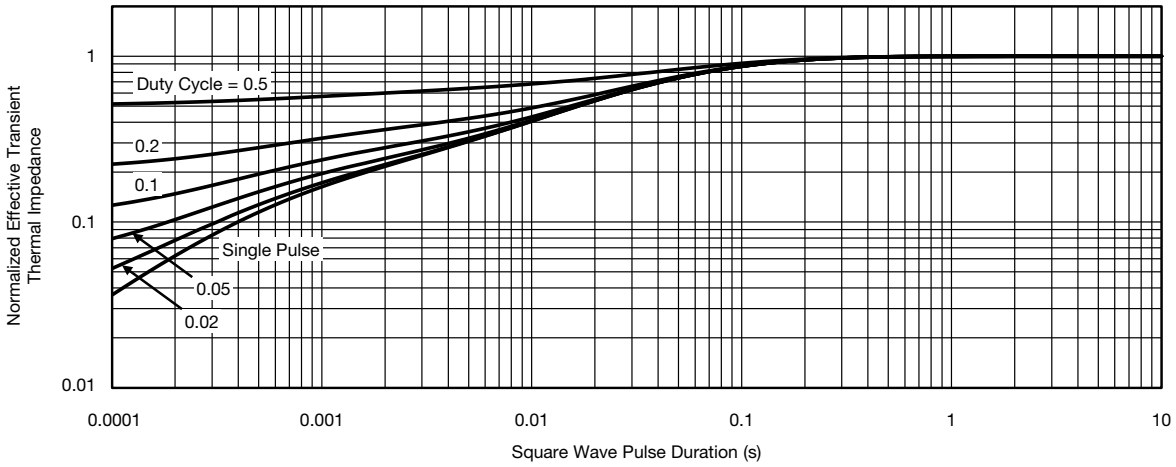



**Safe Operating Area**




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

## THERMAL RATINGS ($T_A$ = 25 °C, unless otherwise noted)




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

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Foot (25 °C)

  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

*Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?67934.*

# Automotive N-Channel 40 V (D-S) 175 °C MOSFET

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 40 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 10 V | 0.0040 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 4.5 V | 0.0055 |
| $I_D$ (A) | 50 |
| Configuration | Single |

## FEATURES

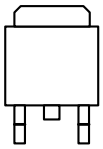
- TrenchFET® Power MOSFET
- Package with Low Thermal Resistance
- 100 % $R_g$ and UIS Tested
- AEC-Q101 Qualified[d]
- Material categorization:
  For definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

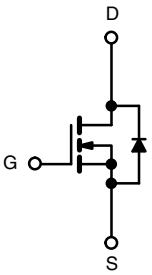
RoHS COMPLIANT

HALOGEN FREE

TO-263




Top View




N-Channel MOSFET

| ORDERING INFORMATION | |
|---|---|
| Package | TO-263 |
| Lead (Pb)-free and Halogen-free | SQM50N04-4m0L-GE3 |

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 40 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current[a] | $T_C$ = 25 °C | $I_D$ | 50 | A |
| | $T_C$ = 125 °C | | 50 | |
| Continuous Source Current (Diode Conduction)[a] | | $I_S$ | 50 | |
| Pulsed Drain Current[b] | | $I_{DM}$ | 200 | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 62 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 192 | mJ |
| Maximum Power Dissipation[b] | $T_C$ = 25 °C | $P_D$ | 150 | W |
| | $T_C$ = 125 °C | | 50 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to + 175 | °C |

**THERMAL RESISTANCE RATINGS**

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Junction-to-Ambient | PCB Mount[c] | $R_{thJA}$ | 40 | °C/W |
| Junction-to-Case (Drain) | | $R_{thJC}$ | 1 | |

**Notes**

a. Package limited.
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
c. When mounted on 1" square PCB (FR-4 material).
d. Parametric verification ongoing.

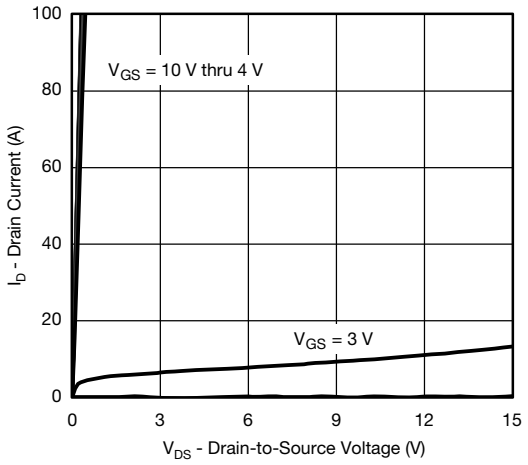
| **SPECIFICATIONS** ($T_C$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | | 40 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 1.5 | 2.0 | 2.5 | |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V | - | - | 1 | µA |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V, $T_J$ = 125 °C | - | - | 50 | |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V, $T_J$ = 175 °C | - | - | 150 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{GS}$ = 10 V | $V_{DS}$ ≥ 5 V | 50 | - | - | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 20 A | - | 0.0025 | 0.0040 | Ω |
| | | $V_{GS}$ = 10 V | $I_D$ = 20 A, $T_J$ = 125 °C | - | - | 0.0067 | |
| | | $V_{GS}$ = 10 V | $I_D$ = 20 A, $T_J$ = 175 °C | - | - | 0.0082 | |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 20 A | - | 0.0030 | 0.0055 | |
| Forward Transconductance[b] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 15 A | | - | 110 | - | S |
| **Dynamic[b]** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 25 V, f = 1 MHz | - | 4880 | 6100 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 560 | 700 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 250 | 315 | |
| Total Gate Charge[c] | $Q_g$ | $V_{GS}$ = 10 V | $V_{DS}$ = 20 V, $I_D$ = 50 A | - | 85 | 130 | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | - | 14 | - | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | - | 14 | - | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 1 | 2.15 | 3.3 | Ω |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = 20 V, $R_L$ = 0.4 Ω<br>$I_D$ ≅ 50 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | - | 9 | 14 | ns |
| Rise Time[c] | $t_r$ | | | - | 11 | 17 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | - | 39 | 59 | |
| Fall Time[c] | $t_f$ | | | - | 11 | 17 | |
| **Source-Drain Diode Ratings and Characteristics[b]** | | | | | | | |
| Pulsed Current[a] | $I_{SM}$ | | | - | - | 200 | A |
| Forward Voltage | $V_{SD}$ | $I_F$ = 50 A, $V_{GS}$ = 0 V | | - | 0.9 | 1.5 | V |

**Notes**

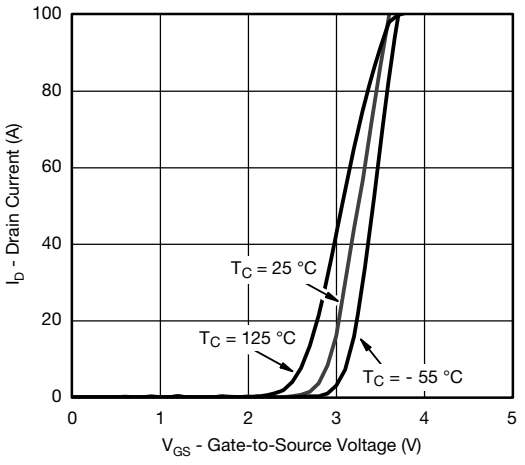
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*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.*

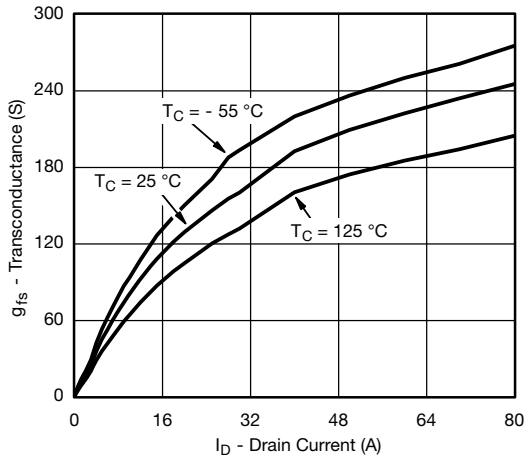
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)



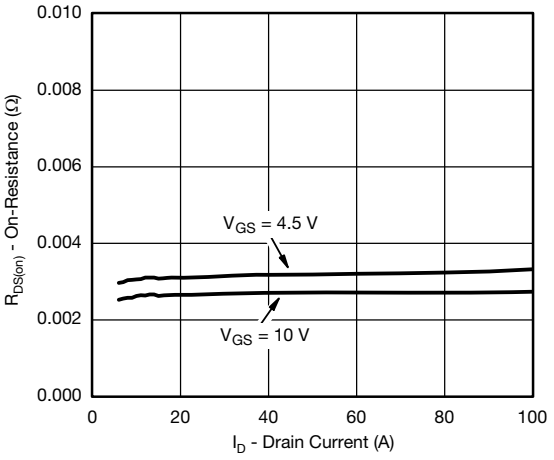

**Output Characteristics**



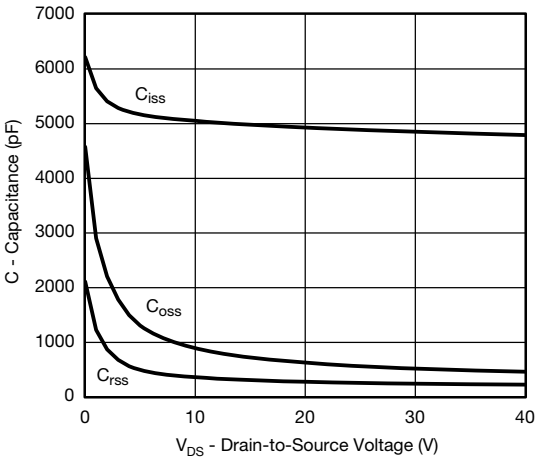

**Transfer Characteristics**



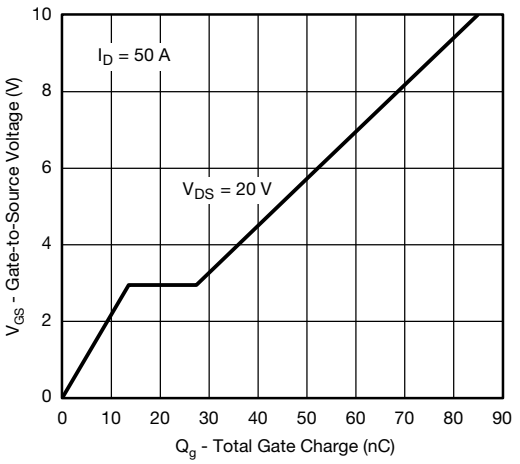

**Transconductance**




**On-Resistance vs. Drain Current**

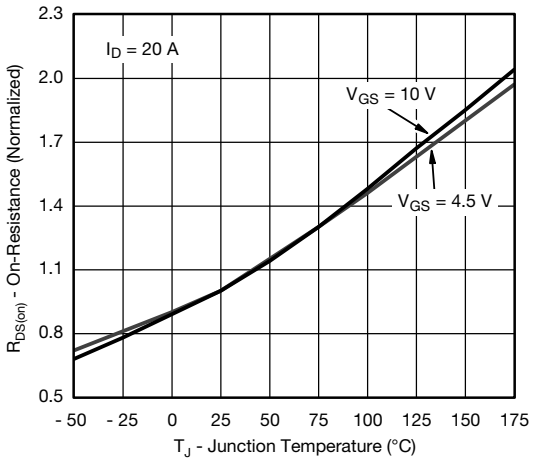



**Capacitance**

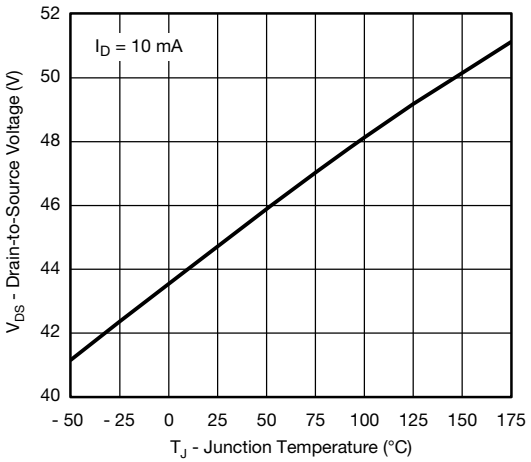



**Gate Charge**

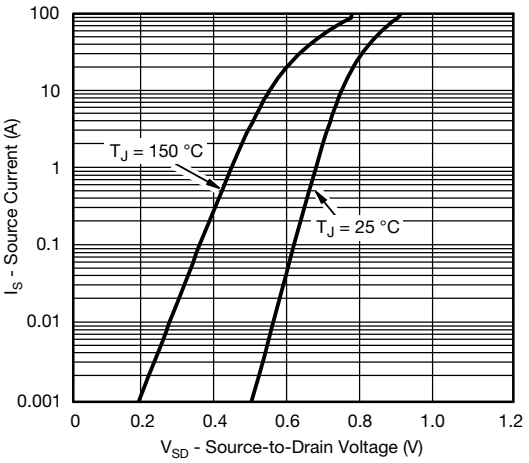
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



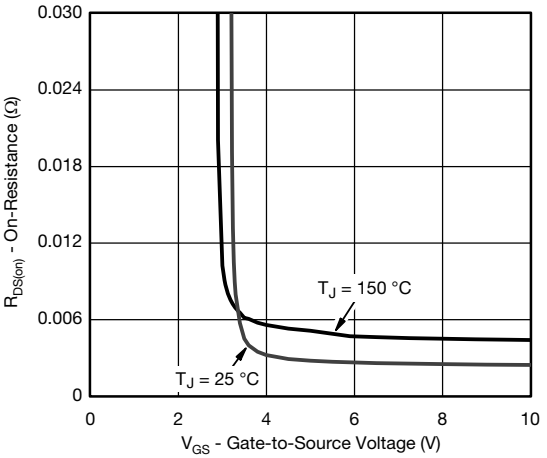

**On-Resistance vs. Junction Temperature**



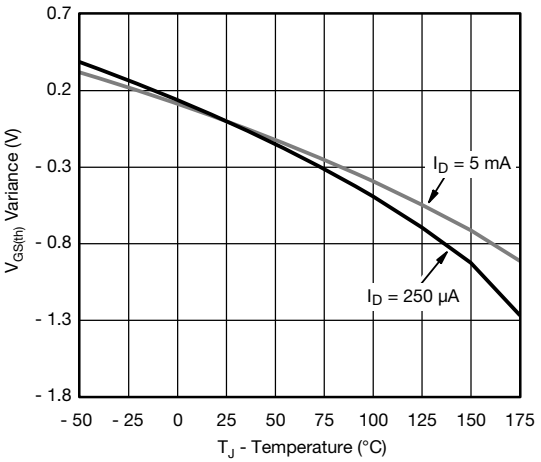

**Drain Source Breakdown vs. Junction Temperature**




**Source Drain Diode Forward Voltage**

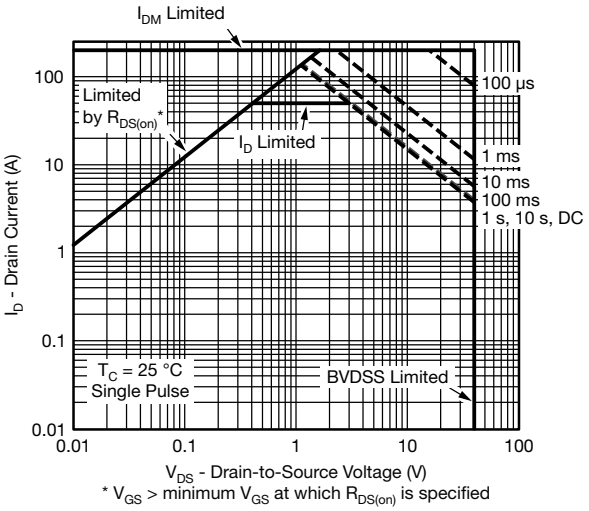



**On-Resistance vs. Gate-to-Source Voltage**

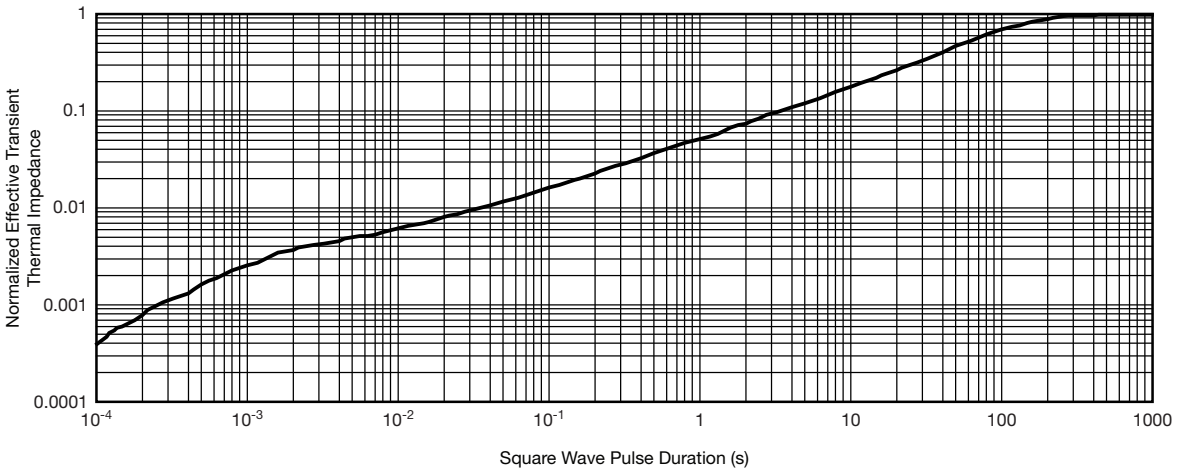



**Threshold Voltage**

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)

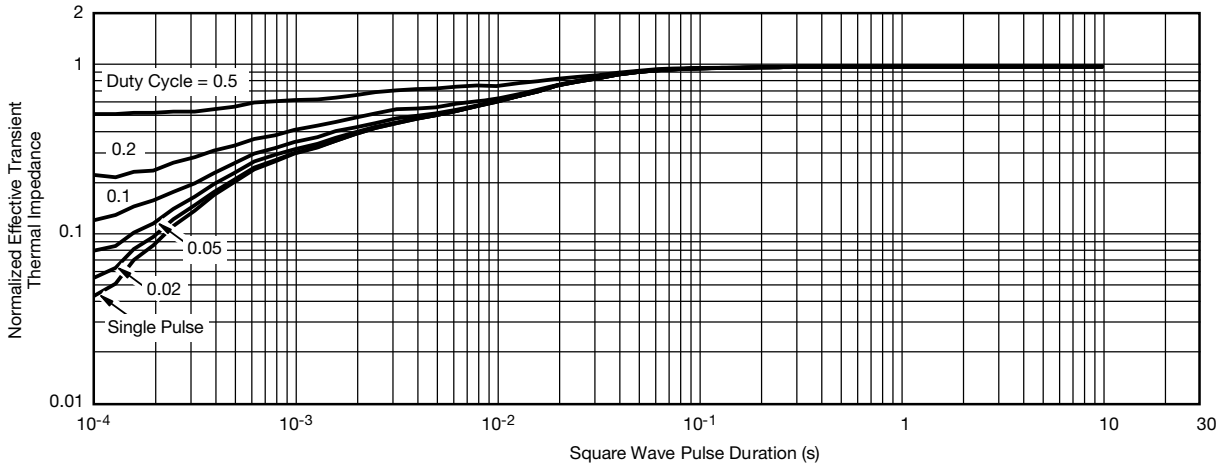



**Safe Operating Area**




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

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)




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

**Note**

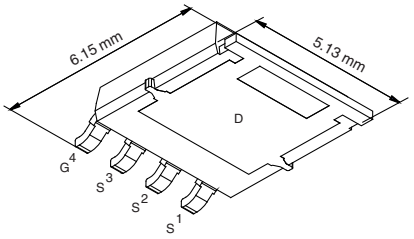
- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Case (25 °C)

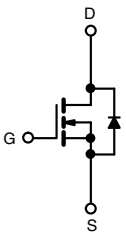
  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

# Automotive N-Channel 40 V (D-S) 175 °C MOSFET

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 40 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 10 V | 0.0063 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 4.5 V | 0.0075 |
| $I_D$ (A) | 58 |
| Configuration | Single |

PowerPAK® SO-8L Single




N-Channel MOSFET

## FEATURES

- TrenchFET® Power MOSFET
- AEC-Q101 Qualifiedd
- 100 % $R_g$ and UIS Tested
- Material categorization:
  For definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

Pb-free

RoHS COMPLIANT

HALOGEN FREE

| ORDERING INFORMATION | |
|---|---|
| Package | PowerPAK SO-8L |
| Lead (Pb)-free and Halogen-free | SQJ858AEP-T1-GE3 |

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 40 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current | $T_C$ = 25 °C | $I_D$ | 58 | A |
| | $T_C$ = 125 °C | | 33 | |
| Continuous Source Current (Diode Conduction) | | $I_S$ | 43 | |
| Pulsed Drain Current[a] | | $I_{DM}$ | 230 | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 35 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 61 | mJ |
| Maximum Power Dissipation[a] | $T_C$ = 25 °C | $P_D$ | 48 | W |
| | $T_C$ = 125 °C | | 16 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to + 175 | °C |
| Soldering Recommendations (Peak Temperature)[d, e] | | | 260 | |

**THERMAL RESISTANCE RATINGS**

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Junction-to-Ambient | PCB Mount[b] | $R_{thJA}$ | 85 | °C/W |
| Junction-to-Case (Drain) | | $R_{thJC}$ | 3.1 | |

**Notes**

a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. When mounted on 1" square PCB (FR-4 material).
c. Parametric verification ongoing.
d. See Solder Profile (www.vishay.com/doc?73257). The PowerPAK SO-8L 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.
e. Rework conditions: manual soldering with a soldering iron is not recommended for leadless components.

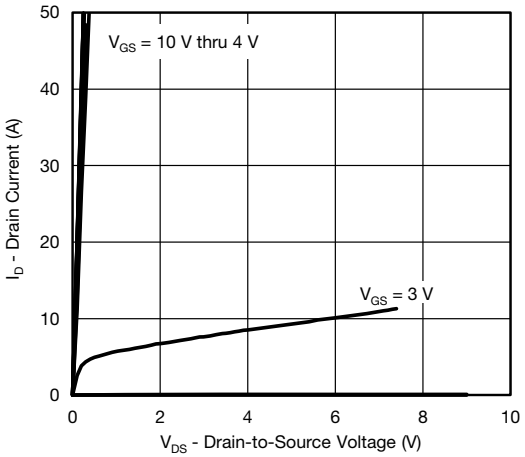
| **SPECIFICATIONS** ($T_C$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0, $I_D$ = 250 µA | | 40 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 1.5 | 2.0 | 2.5 | |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V | - | - | 1 | µA |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V, $T_J$ = 125 °C | - | - | 50 | |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 40 V, $T_J$ = 175 °C | - | - | 250 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{GS}$ = 10 V | $V_{DS}$ ≥ 5 V | 30 | - | - | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 14 A | - | 0.005 | 0.0063 | Ω |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 10 A | - | 0.006 | 0.0075 | |
| | | $V_{GS}$ = 10 V | $I_D$ = 14 A, $T_J$ = 125 °C | - | - | 0.012 | |
| | | $V_{GS}$ = 10 V | $I_D$ = 14 A, $T_J$ = 175 °C | - | - | 0.015 | |
| Forward Transconductance[b] | $g_{fs}$ | $V_{DS}$ = 14 V, $I_D$ = 16 A | | - | 99 | - | S |
| **Dynamic[b]** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 20 V, f = 1 MHz | - | 1951 | 2450 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 295 | 370 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 110 | 140 | |
| Total Gate Charge[c] | $Q_g$ | $V_{GS}$ = 10 V | $V_{DS}$ = 20 V, $I_D$ = 20 A | - | 36 | 55 | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | - | 8 | - | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | - | 6 | - | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 1.5 | 2.97 | 4.5 | Ω |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = 20 V, $R_L$ = 2 Ω<br>$I_D$ ≅ 10 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | - | 10 | 15 | ns |
| Rise Time[c] | $t_r$ | | | - | 9 | 14 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | - | 26 | 40 | |
| Fall Time[c] | $t_f$ | | | - | 8 | 12 | |
| **Source-Drain Diode Ratings and Characteristics[b]** | | | | | | | |
| Pulsed Current[a] | $I_{SM}$ | | | - | - | 230 | A |
| Forward Voltage | $V_{SD}$ | $I_F$ = 15 A, $V_{GS}$ = 0 | | - | 0.8 | 1.1 | V |

**Notes**

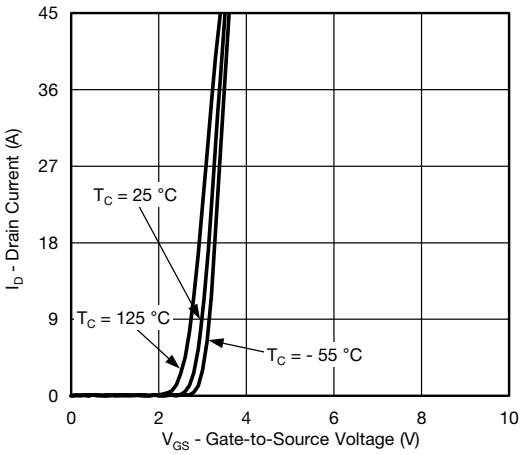
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*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.*

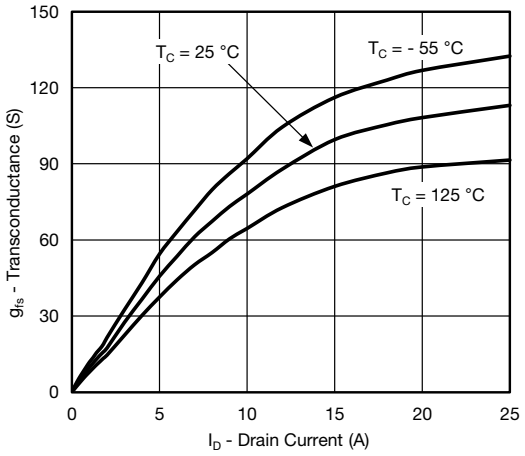
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



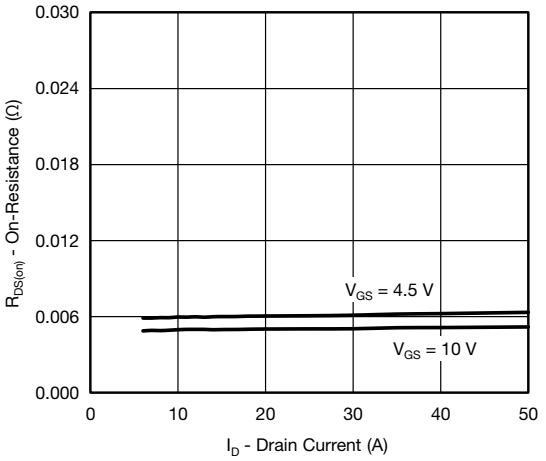

**Output Characteristics**



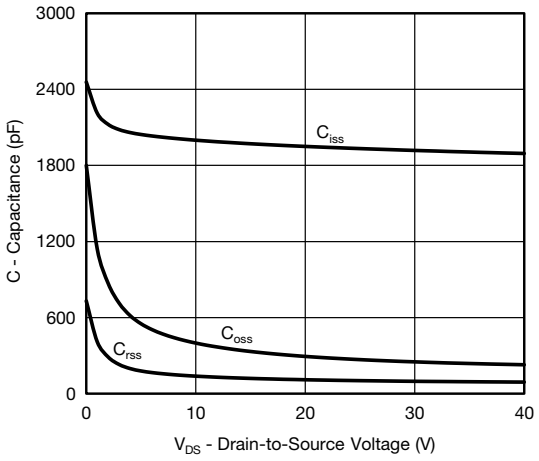

**Transfer Characteristics**



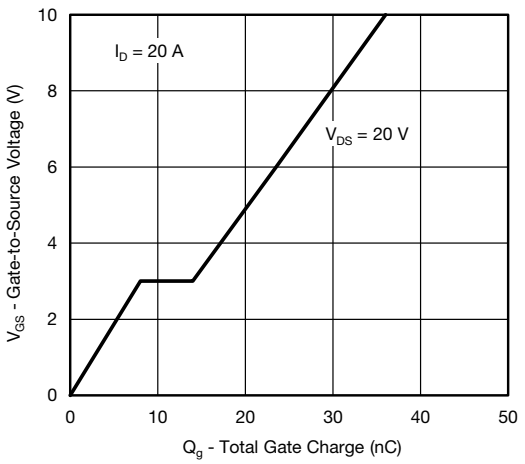

**Transconductance**




**On-Resistance vs. Drain Current**

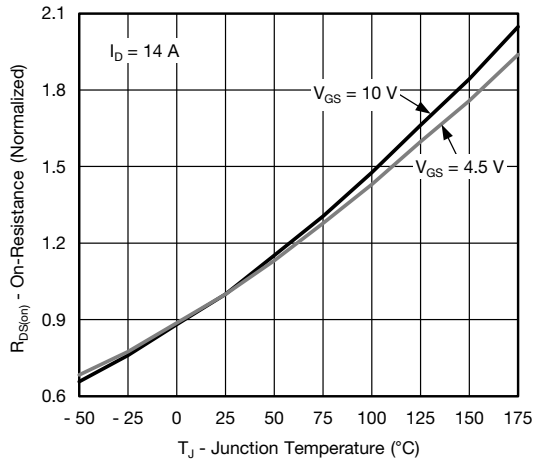



**Capacitance**

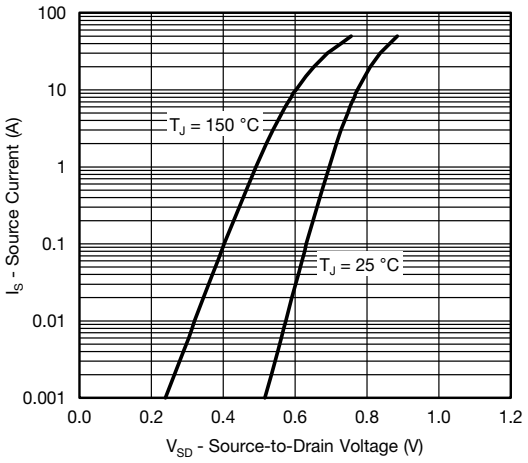



**Gate Charge**

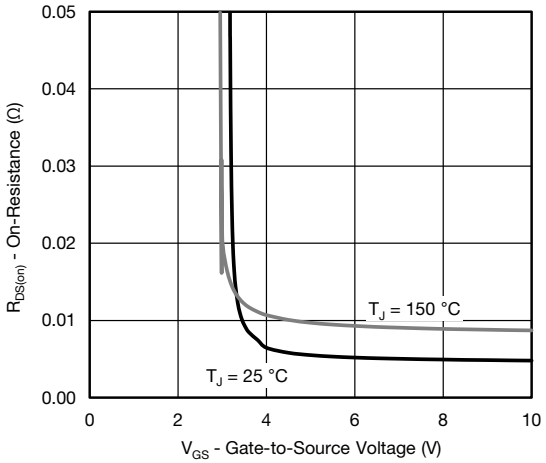
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



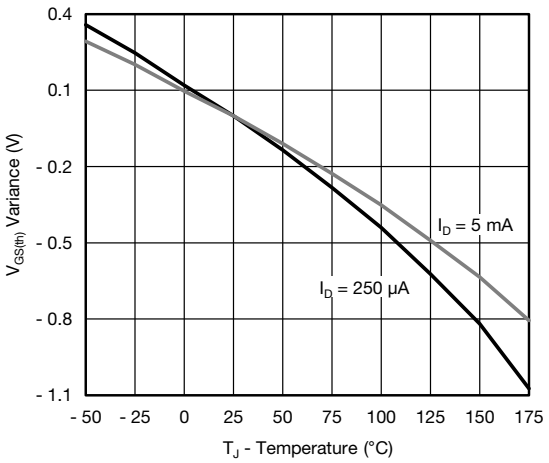

**On-Resistance vs. Junction Temperature**



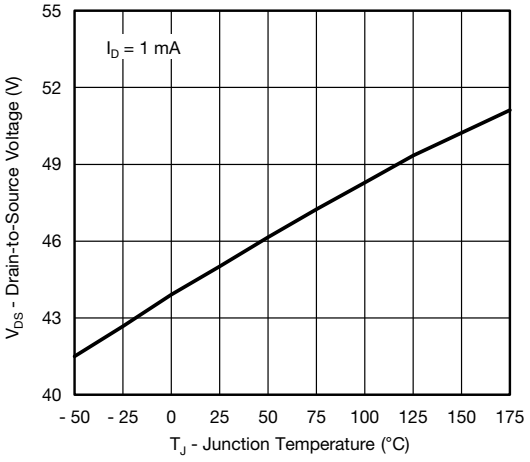

**Source Drain Diode Forward Voltage**




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

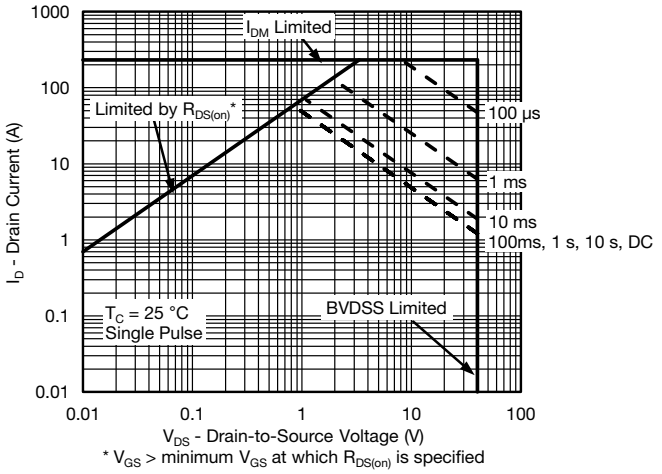



**Threshold Voltage**

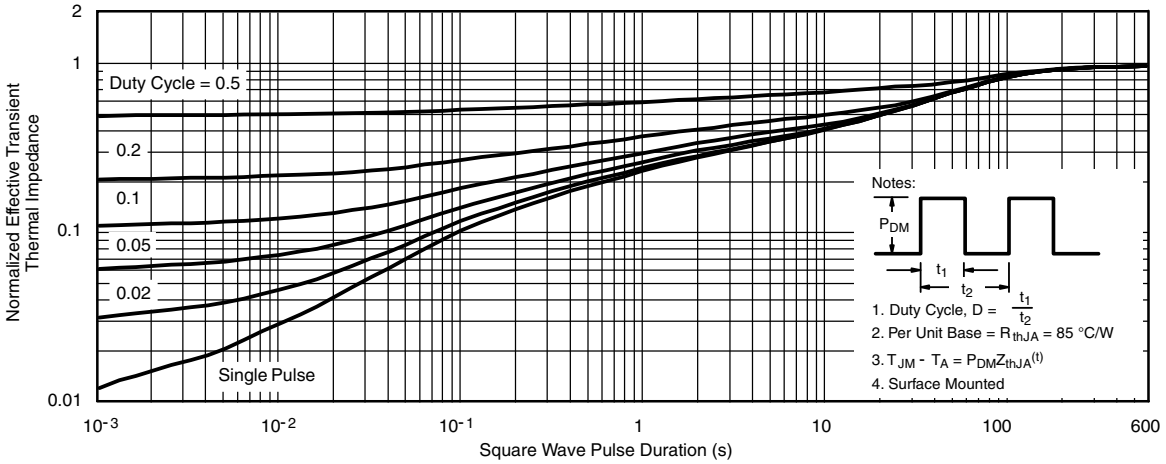



**Drain Source Breakdown vs. Junction Temperature**

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)

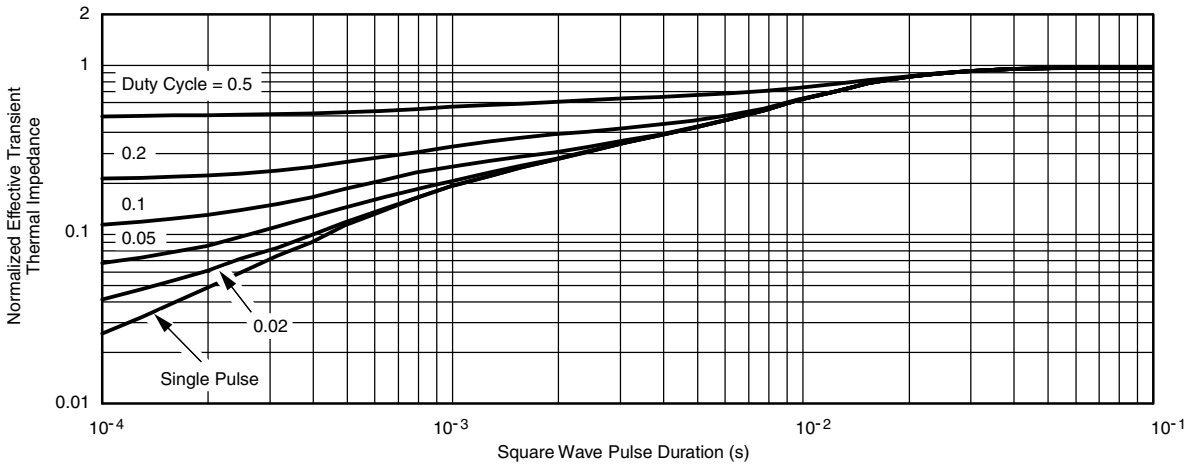



**Safe Operating Area**




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

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)




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

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Case (25 °C)

  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

*Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?63470.*

# Automotive N-Channel 20 V (D-S) 175 °C MOSFET

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 20 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 4.5 V | 0.030 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 2.5 V | 0.034 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 1.8 V | 0.038 |
| $I_D$ (A) | 8 |
| Configuration | Single |

## FEATURES

- **Halogen-free According to IEC 61249-2-21 Definition**
- TrenchFET® Power MOSFET
- AEC-Q101 Qualified[d]
- 100 % $R_g$ and UIS Tested
- Compliant to RoHS Directive 2002/95/EC

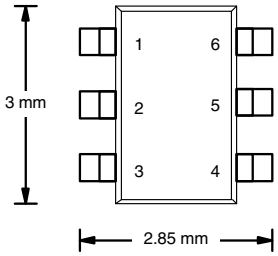
AUTOMOTIVE GRADE

Pb-free

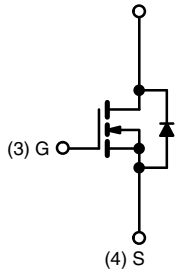
RoHS COMPLIANT

HALOGEN FREE

**TSOP-6**
Top View




**Marking Code:** 8Jxxx




N-Channel MOSFET

| ORDERING INFORMATION | |
|---|---|
| Package | TSOP-6 |
| Lead (Pb)-free and Halogen-free | SQ3460EV-T1-GE3 |

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 20 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 8 | |
| Continuous Drain Current | $T_C$ = 25 °C[a] | $I_D$ | 8 | A |
| | $T_C$ = 125 °C | | 4.8 | |
| Continuous Source Current (Diode Conduction) | | $I_S$ | 4.6 | |
| Pulsed Drain Current[b] | | $I_{DM}$ | 32 | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 10 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 5 | mJ |
| Maximum Power Dissipation[b] | $T_C$ = 25 °C | $P_D$ | 3.6 | W |
| | $T_C$ = 125 °C | | 1.2 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to + 175 | °C |

**THERMAL RESISTANCE RATINGS**

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Junction-to-Ambient | PCB Mount[c] | $R_{thJA}$ | 110 | °C/W |
| Junction-to-Foot (Drain) | | $R_{thJF}$ | 41 | |

**Notes**

a. Package limited.
b. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
c. When mounted on 1" square PCB (FR-4 material).
d. Parametric verification ongoing.

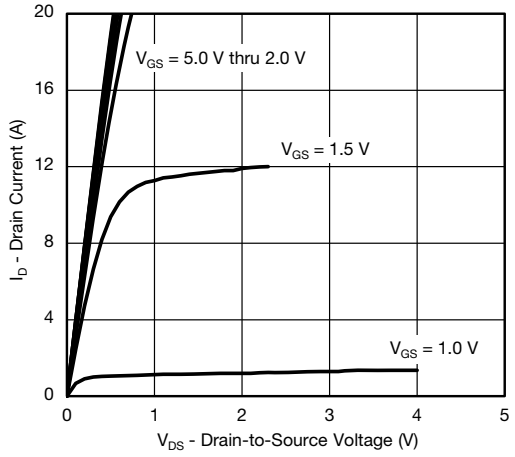
| **SPECIFICATIONS** ($T_C$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0, $I_D$ = 250 µA | | 20 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 0.4 | 0.6 | 1.0 | |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 8 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 20 V | - | - | 1 | µA |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 20 V, $T_J$ = 125 °C | - | - | 50 | |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 20 V, $T_J$ = 175 °C | - | - | 150 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{GS}$ = 4.5 V | $V_{DS}$ ≥ 5 V | 10 | - | - | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = 4.5 V | $I_D$ = 5.1 A | - | 0.025 | 0.030 | Ω |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 5.1 A, $T_J$ = 125 °C | - | - | 0.045 | |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 5.1 A, $T_J$ = 175 °C | - | - | 0.053 | |
| | | $V_{GS}$ = 2.5 V | $I_D$ = 4.7 A | - | 0.027 | 0.034 | |
| | | $V_{GS}$ = 1.8 V | $I_D$ = 2.5 A | - | 0.031 | 0.038 | |
| Forward Transconductance[b] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 5.1 A | | - | 28 | - | S |
| **Dynamic[b]** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 10 V, f = 1 MHz | - | 848 | 1060 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 117 | 146 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 68 | 85 | |
| Total Gate Charge[c] | $Q_g$ | $V_{GS}$ = 4.5 V | $V_{DS}$ = 10 V, $I_D$ = 5.1 A | - | 9.3 | 14 | nC |
| Gate-Source Charge[c] | $Q_{gs}$ | | | - | 1.1 | - | |
| Gate-Drain Charge[c] | $Q_{gd}$ | | | - | 1.4 | - | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 6.2 | 12.4 | 18.6 | Ω |
| Turn-On Delay Time[c] | $t_{d(on)}$ | $V_{DD}$ = 10 V, $R_L$ = 10 Ω<br>$I_D$ ≅ 1 A, $V_{GEN}$ = 4.5 V, $R_g$ = 1 Ω | | - | 8 | 12 | ns |
| Rise Time[c] | $t_r$ | | | - | 8 | 12 | |
| Turn-Off Delay Time[c] | $t_{d(off)}$ | | | - | 21 | 32 | |
| Fall Time[c] | $t_f$ | | | - | 8 | 12 | |
| **Source-Drain Diode Ratings and Characteristics[b]** | | | | | | | |
| Pulsed Current[a] | $I_{SM}$ | | | - | - | 32 | A |
| Forward Voltage | $V_{SD}$ | $I_F$ = 5 A, $V_{GS}$ = 0 | | - | 0.77 | 1.2 | V |

**Notes**

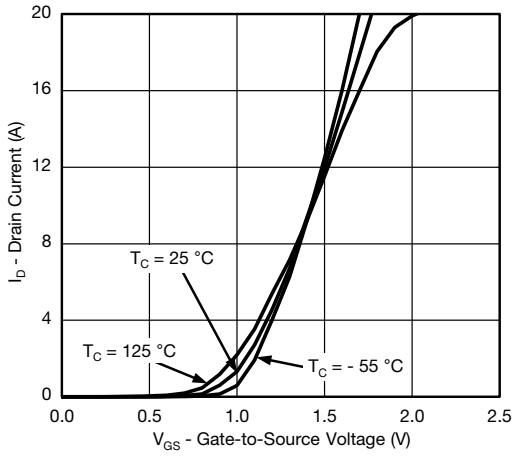
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*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.*

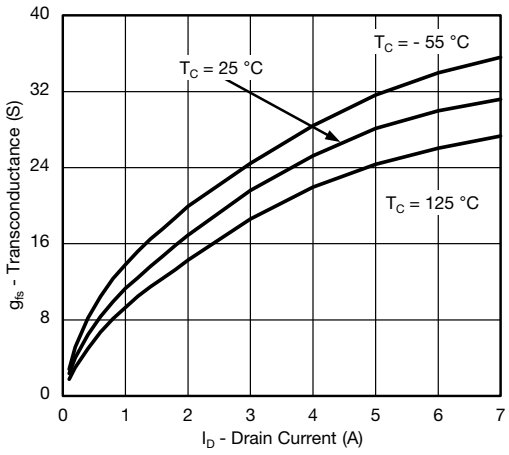
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)



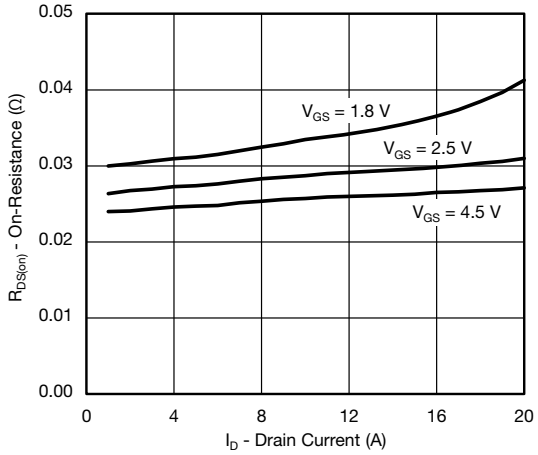

**Output Characteristics**



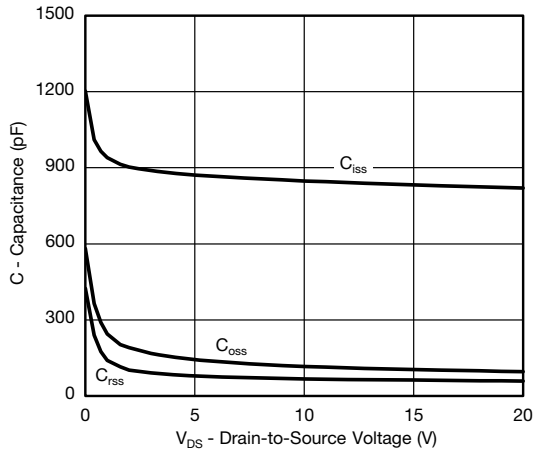

**Transfer Characteristics**



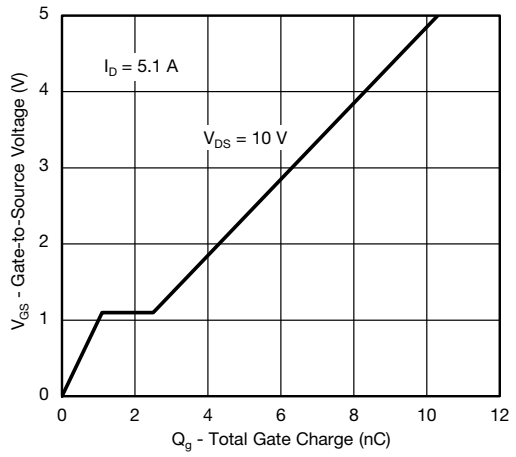

**Transconductance**




**On-Resistance vs. Drain Current**

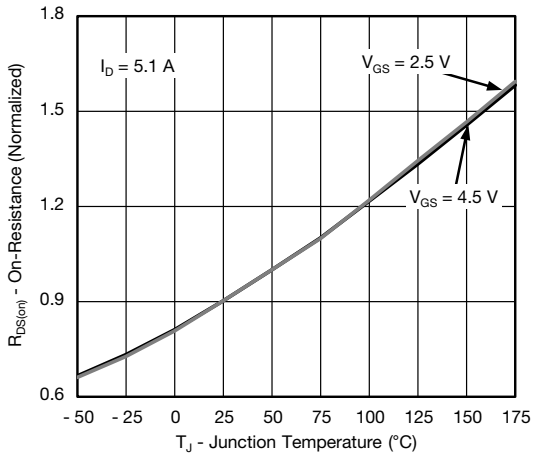



**Capacitance**

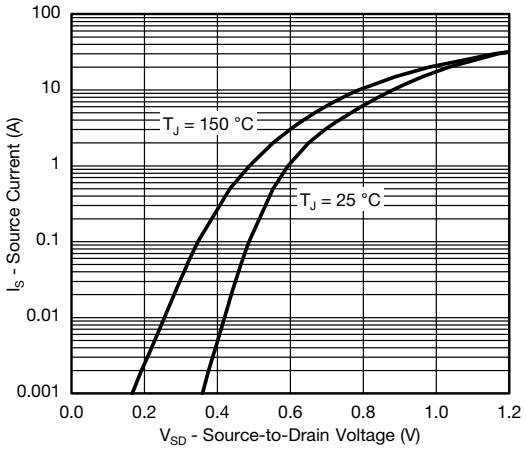



**Gate Charge**

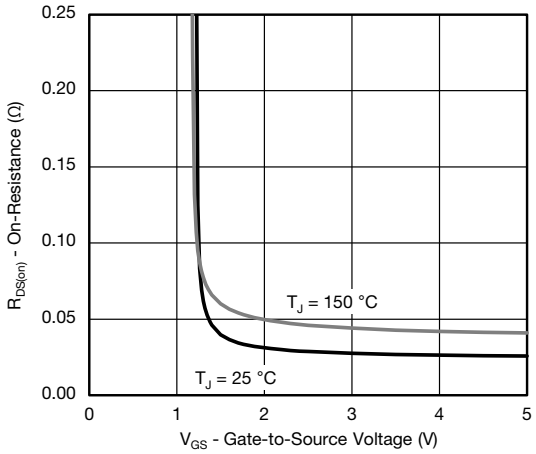
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)



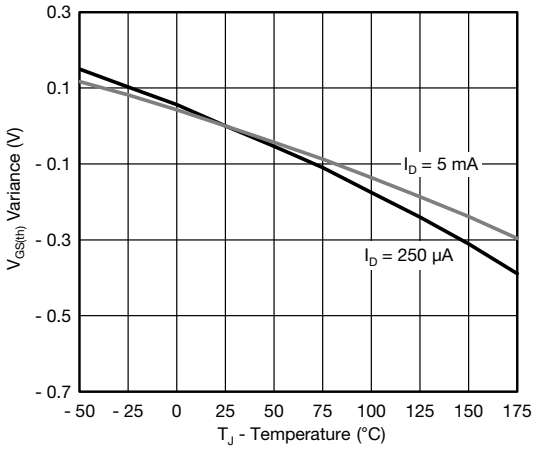

**On-Resistance vs. Junction Temperature**



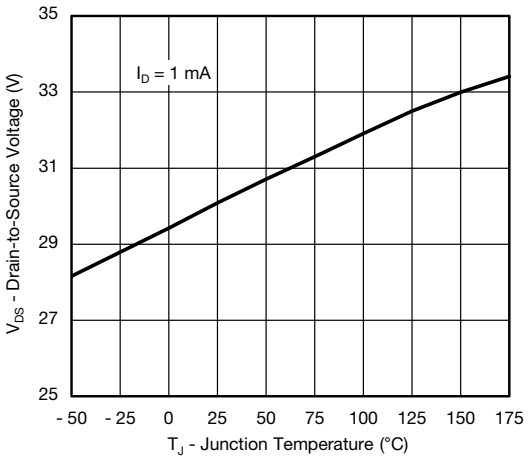

**Source Drain Diode Forward Voltage**




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

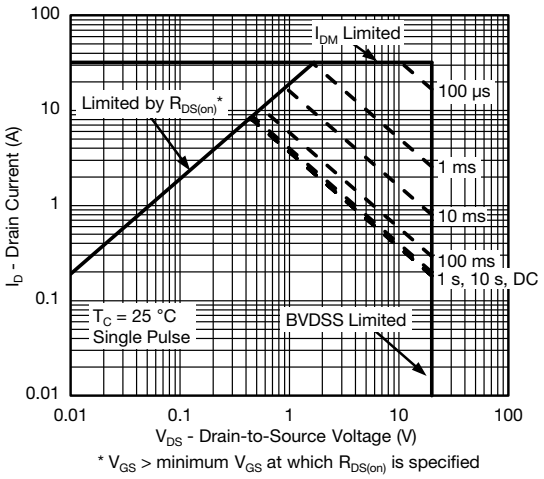



**Threshold Voltage**

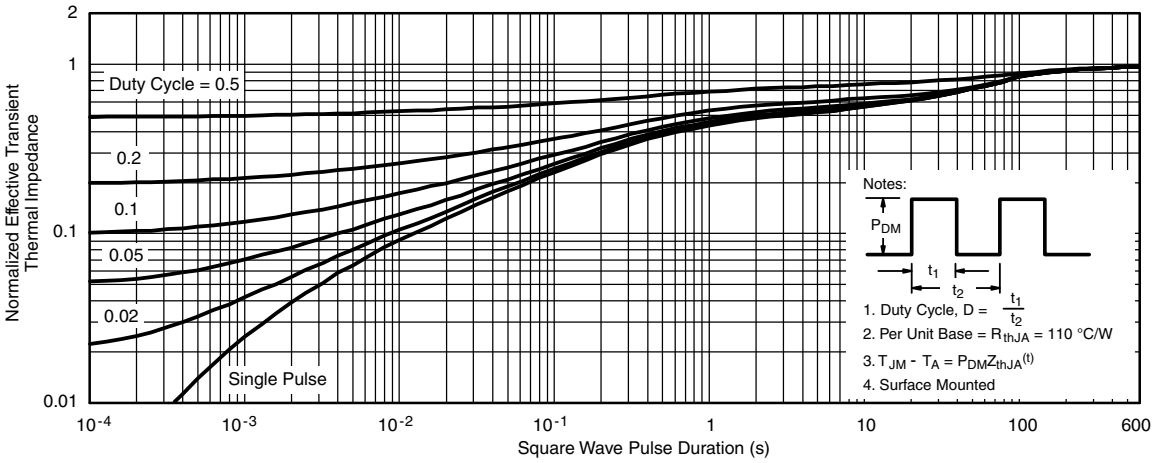



**Drain Source Breakdown vs. Junction Temperature**

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)

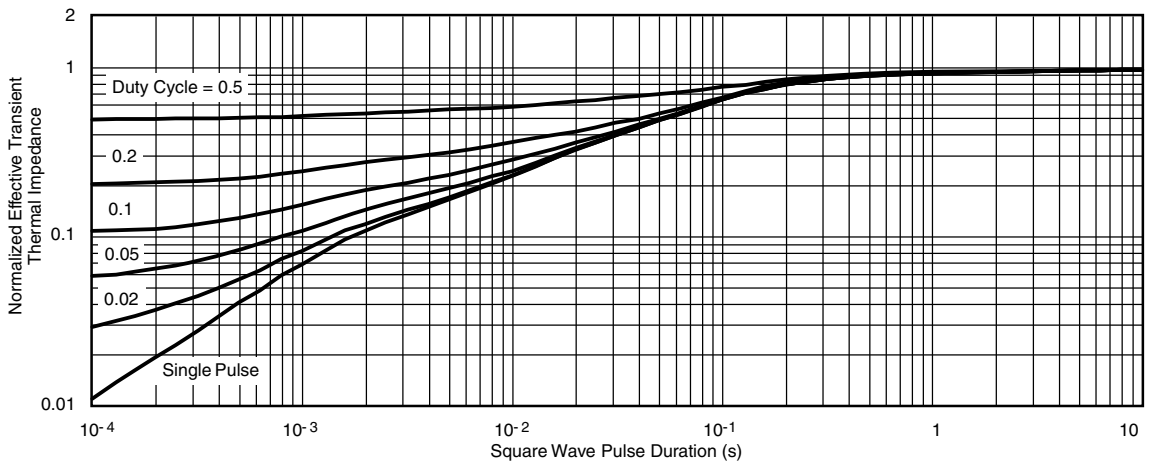



**Safe Operating Area**




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

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)




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

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Foot (25 °C)

  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

*Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?67037.*

# Automotive N-Channel 60 V (D-S) 175 °C MOSFET

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 60 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 10 V | 0.150 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 4.5 V | 0.164 |
| $I_D$ (A) | 2.3 |
| Configuration | Single |

## FEATURES

- TrenchFET® Power MOSFET
- AEC-Q101 Qualified [c]
- 100 % $R_g$ and UIS Tested
- Material categorization:
  For definitions of compliance please see www.vishay.com/doc?99912

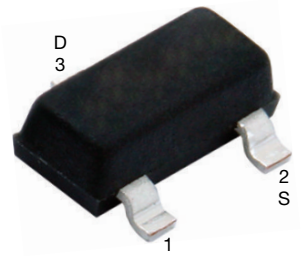
AUTOMOTIVE GRADE

Pb-free

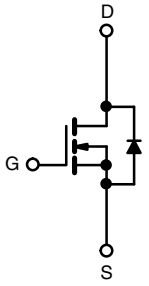
RoHS COMPLIANT

HALOGEN FREE

**SOT-23 (TO-236)**




Top View




N-Channel MOSFET

**Marking Code:** 8X

| ORDERING INFORMATION | |
|---|---|
| Package | SOT-23 |
| Lead (Pb)-free and Halogen-free | SQ2308CES-T1-GE3 |

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 60 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | |
| Continuous Drain Current | $T_C$ = 25 °C | $I_D$ | 2.3 | A |
| | $T_C$ = 125 °C | | 1.3 | |
| Continuous Source Current (Diode Conduction) | | $I_S$ | 2.4 | |
| Pulsed Drain Current [a] | | $I_{DM}$ | 9 | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 7 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 2.5 | mJ |
| Maximum Power Dissipation [a] | $T_C$ = 25 °C | $P_D$ | 2 | W |
| | $T_C$ = 125 °C | | 0.6 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | -55 to +175 | °C |

**THERMAL RESISTANCE RATINGS**

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Junction-to-Ambient | PCB Mount [b] | $R_{thJA}$ | 120 | °C/W |
| Junction-to-Foot (Drain) | | $R_{thJF}$ | 80 | |

**Notes**

a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. When mounted on 1" square PCB (FR-4 material).
c. Parametric verification ongoing.

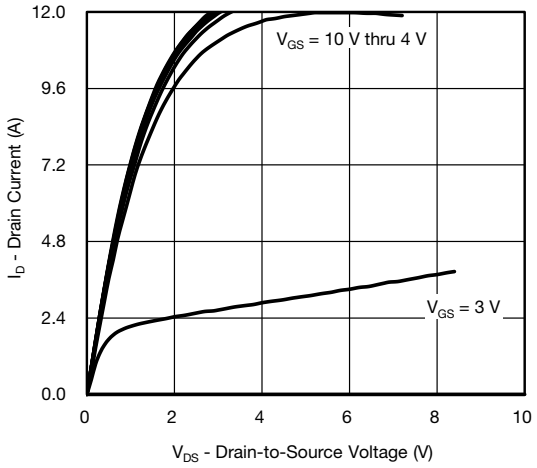
| **SPECIFICATIONS** ($T_C$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0, $I_D$ = 250 µA | | 60 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 1.5 | 2.0 | 2.5 | |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 60 V | - | - | 1 | µA |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 60 V, $T_J$ = 125 °C | - | - | 50 | |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 60 V, $T_J$ = 175 °C | - | - | 150 | |
| On-State Drain Current [a] | $I_{D(on)}$ | $V_{GS}$ = 10 V | $V_{DS}$ ≥ 5 V | 10 | - | - | A |
| Drain-Source On-State Resistance [a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 2.3 A | - | 0.125 | 0.150 | Ω |
| | | $V_{GS}$ = 10 V | $I_D$ = 2.3 A, $T_J$ = 125 °C | - | - | 0.250 | |
| | | $V_{GS}$ = 10 V | $I_D$ = 2.3 A, $T_J$ = 175 °C | - | - | 0.325 | |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 2.1 A | - | 0.136 | 0.164 | |
| Forward Transconductance [b] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 2.3 A | | - | 5.5 | - | S |
| **Dynamic [b]** | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 30 V, f = 1 MHz | - | 164 | 205 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 22 | 28 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 14 | 18 | |
| Total Gate Charge [c] | $Q_g$ | $V_{GS}$ = 10 V | $V_{DS}$ = 30 V, $I_D$ = 2 A | - | 3.5 | 5.3 | nC |
| Gate-Source Charge [c] | $Q_{gs}$ | | | - | 0.6 | - | |
| Gate-Drain Charge [c] | $Q_{gd}$ | | | - | 0.7 | - | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 2.9 | 5.84 | 9 | Ω |
| Turn-On Delay Time [c] | $t_{d(on)}$ | $V_{DD}$ = 30 V, $R_L$ = 15 Ω<br>$I_D$ ≅ 2 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | - | 4 | 6 | ns |
| Rise Time [c] | $t_r$ | | | - | 9 | 13 | |
| Turn-Off Delay Time [c] | $t_{d(off)}$ | | | - | 12 | 17 | |
| Fall Time [c] | $t_f$ | | | - | 12 | 18 | |
| **Source-Drain Diode Ratings and Characteristics [b]** | | | | | | | |
| Pulsed Current [a] | $I_{SM}$ | | | - | - | 9 | A |
| Forward Voltage | $V_{SD}$ | $I_F$ = 1.6 A, $V_{GS}$ = 0 | | - | 0.85 | 1.2 | V |

**Notes**

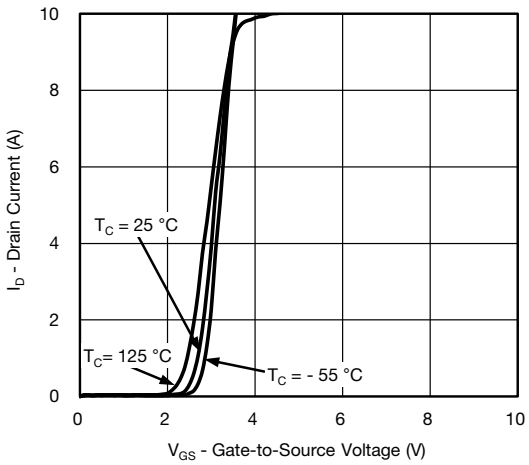
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*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.*

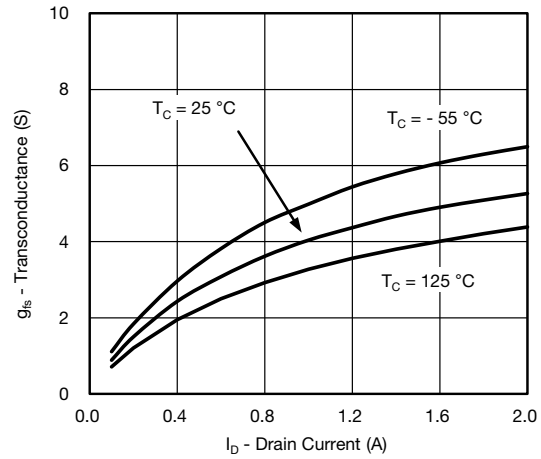
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



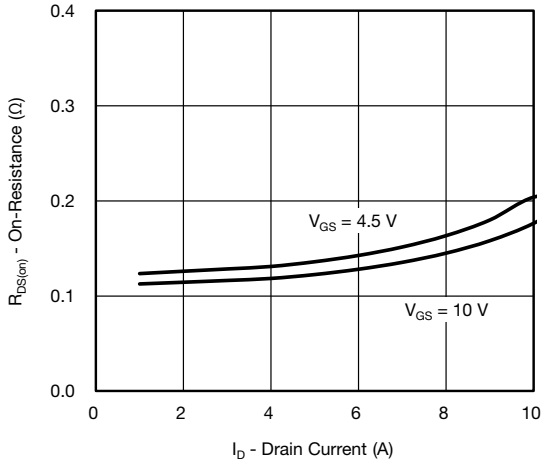

**Output Characteristics**



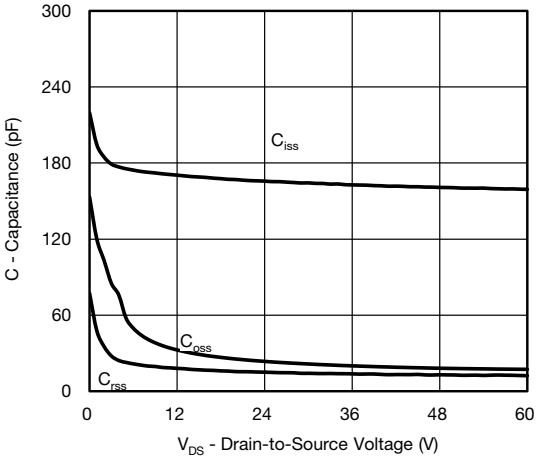

**Transfer Characteristics**



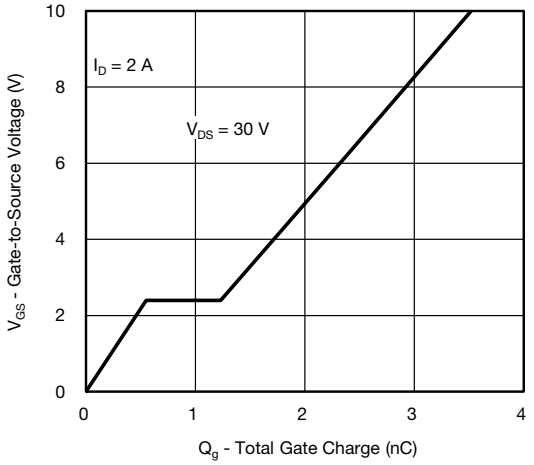

**Transconductance**




**On-Resistance vs. Drain Current**

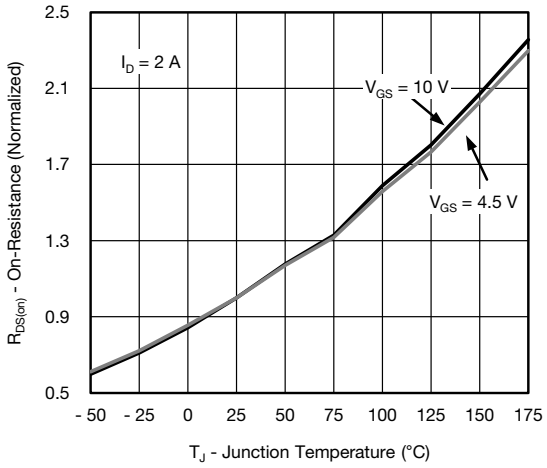



**Capacitance**

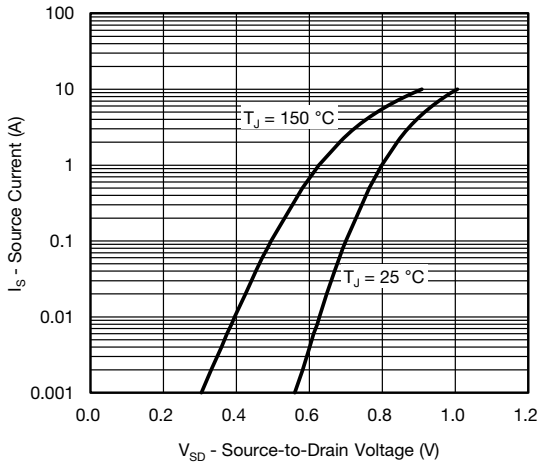



**Gate Charge**

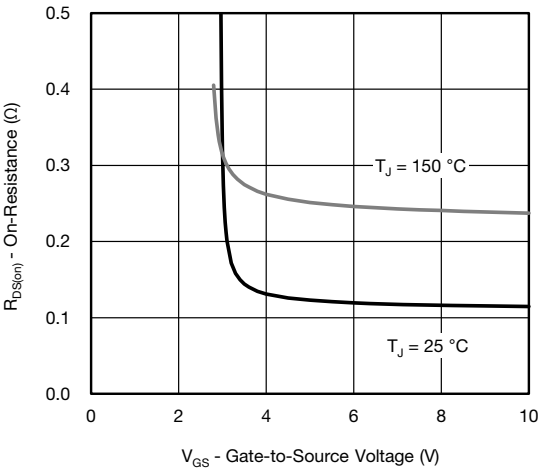
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



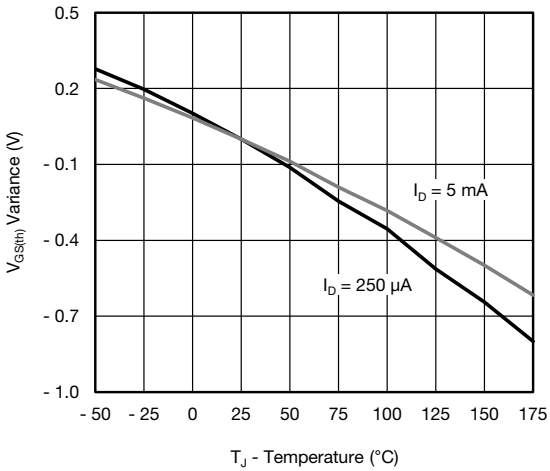

**On-Resistance vs. Junction Temperature**



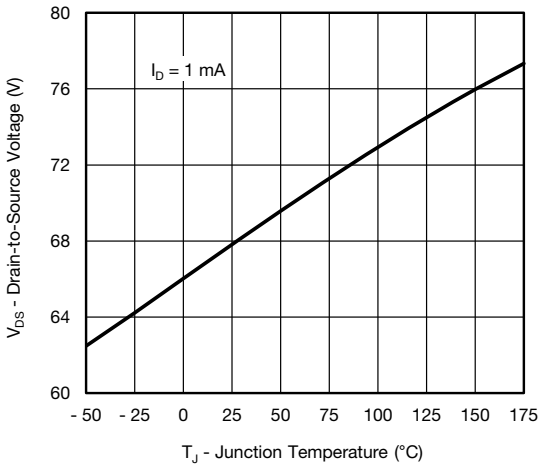

**Source Drain Diode Forward Voltage**




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

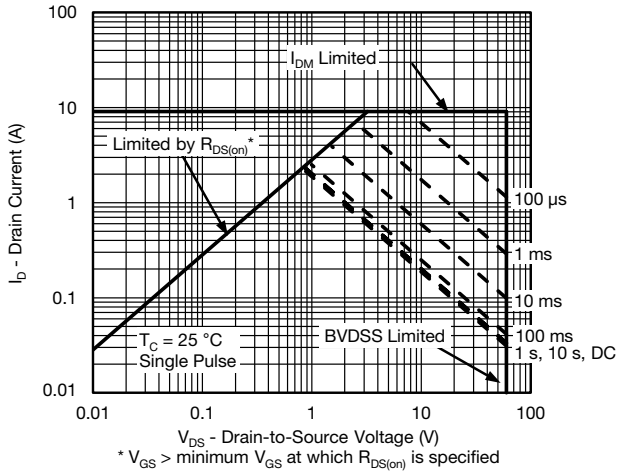



**Threshold Voltage**

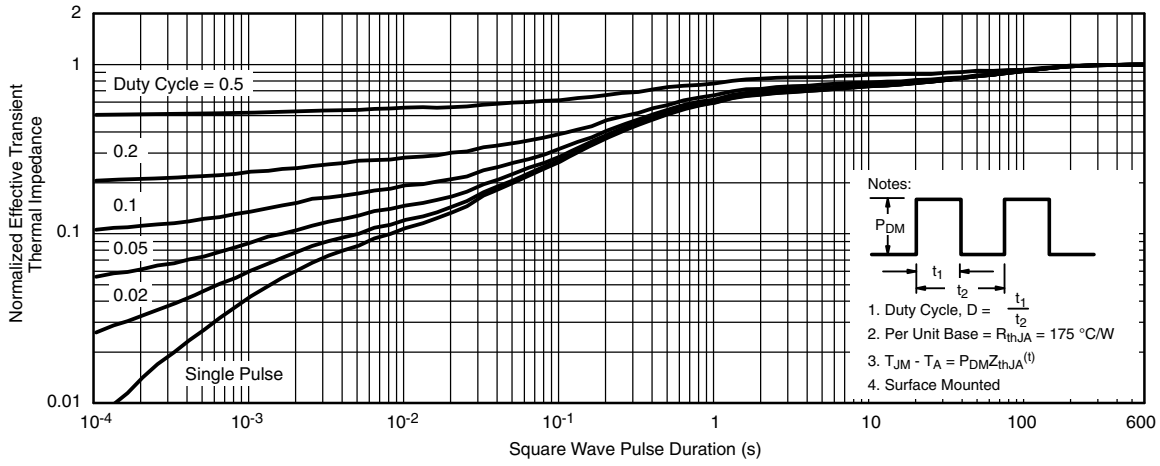



**Drain Source Breakdown vs. Junction Temperature**

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)

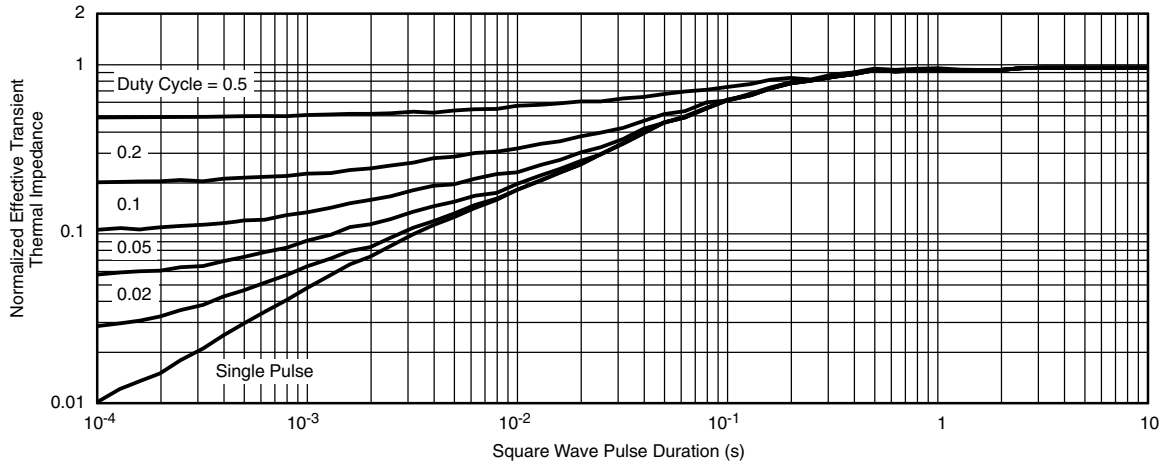



**Safe Operating Area**




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

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)




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

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Foot (25 °C)

  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

*Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?63877.*