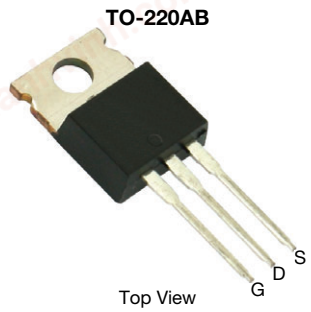
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# N-Channel 60 V (D-S) MOSFET



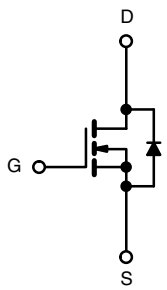

## FEATURES

- TrenchFET® Gen IV power MOSFET
- Maximum 175 °C junction temperature
- Very low $Q_{gd}$ reduces power loss from passing through $V_{plateau}$
- 100 % $R_g$ and UIS tested
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT
HALOGEN FREE

## APPLICATIONS

- Power supply
  - Secondary synchronous rectification
- DC/DC converter
- Power tools
- Motor drive switch
- DC/AC inverter
- Battery management
- OR-ing / e-fuse



N-Channel MOSFET

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 60 |
| $R_{DS(on)}$ max. (Ω) at $V_{GS}$ = 10 V | 0.00173 |
| $R_{DS(on)}$ max. (Ω) at $V_{GS}$ = 4.5 V | 0.0023 |
| $Q_g$ typ. (nC) | 192 |
| $I_D$ (A) | 150 [d] |
| Configuration | Single |

| ORDERING INFORMATION | |
|---|---|
| Package | TO-220 |
| Lead (Pb)-free and halogen-free | SUP50010EL-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 ($T_J$ = 150 °C) | $T_C$ = 25 °C | $I_D$ | 150 [d] | A |
| | $T_C$ = 70 °C | | 150 [d] | |
| Pulsed drain current (t = 100 µs) | | $I_{DM}$ | 500 | |
| Avalanche current | | $I_{AS}$ | 60 | |
| Single avalanche energy [a] | L = 0.1 mH | $E_{AS}$ | 180 | mJ |
| Maximum power dissipation [a] | $T_C$ = 25 °C | $P_D$ | 375 [b] | W |
| | $T_C$ = 125 °C | | 125 [b] | |
| 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) | $R_{thJC}$ | 0.4 | |

**Notes**

a. Duty cycle ≤ 1 %
b. See SOA curve for voltage derating
c. When mounted on 1" square PCB (FR4 material)
d. Package limited


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| **SPECIFICATIONS** ($T_J$ = 25 °C, unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | |
| Drain-source breakdown voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 1 mA | 60 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 1 | - | 2.5 | |
| Gate-body leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | - | - | ± 250 | nA |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V | - | - | 1 | µA |
| | | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | - | - | 150 | |
| | | $V_{DS}$ = 60 V, $V_{GS}$ = 0 V, $T_J$ = 175 °C | - | - | 5 | mA |
| Drain-source on-state resistance [a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 30 A | - | 0.00138 | 0.00173 | Ω |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 20 A | - | 0.00165 | 0.0023 | |
| Forward transconductance [a] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 30 A | - | 140 | - | S |
| **Dynamic [b]** | | | | | | |
| Input capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 30 V, f = 1 MHz | - | 13 646 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 2474 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 82 | - | |
| Total gate charge [c] | $Q_g$ | $V_{DS}$ = 30 V, $V_{GS}$ = 10 V, $I_D$ = 30 A | - | 192 | 288 | nC |
| Gate-source charge [c] | $Q_{gs}$ | | - | 32 | - | |
| Gate-drain charge [c] | $Q_{gd}$ | | - | 17.5 | - | |
| Output charge | $Q_{oss}$ | $V_{DS}$ = 30 V, $V_{GS}$ = 0 V | - | 156 | 235 | |
| Gate resistance | $R_g$ | f = 1 MHz | 0.4 | 0.9 | 1.6 | Ω |
| Turn-on delay time [c] | $t_{d(on)}$ | $V_{DD}$ = 30 V, $R_L$ = 3 Ω<br>$I_D \cong$ 10 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | - | 19 | 38 | ns |
| Rise time [c] | $t_r$ | | - | 11 | 22 | |
| Turn-off delay time [c] | $t_{d(off)}$ | | - | 68 | 130 | |
| Fall time [c] | $t_f$ | | - | 14 | 28 | |
| **Drain-Source Body Diode Ratings and Characteristics [b]** ($T_C$ = 25 °C) | | | | | | |
| Pulsed current (t = 100 µs) | $I_{SM}$ | | - | - | 250 | A |
| Forward voltage [a] | $V_{SD}$ | $I_F$ = 10 A, $V_{GS}$ = 0 V | - | 0.74 | 1.5 | V |
| Reverse recovery time | $t_{rr}$ | $I_F$ = 34 A, di/dt = 100 A/µs | - | 81 | 160 | ns |
| Peak reverse recovery charge | $I_{RM(REC)}$ | | - | 3.5 | 7.0 | A |
| Reverse recovery charge | $Q_{rr}$ | | - | 0.16 | 0.32 | µC |
| Reverse recovery fall time | $t_a$ | | - | 48 | - | ns |
| Reverse recovery rise time | $t_b$ | | - | 32 | - | |

**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

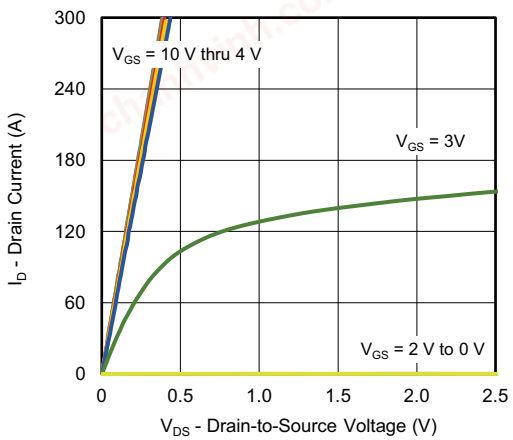
*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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


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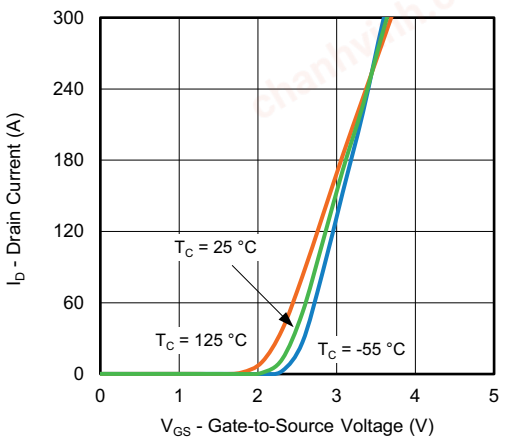
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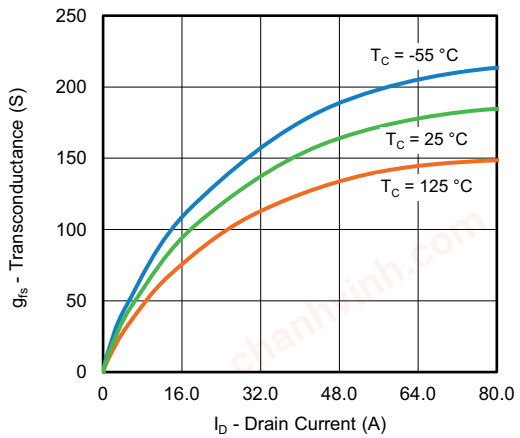
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)



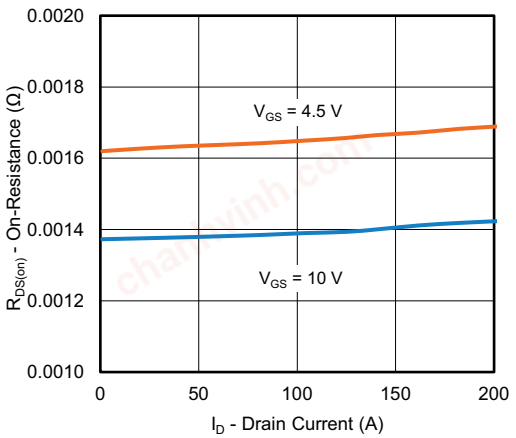

**Output Characteristics**



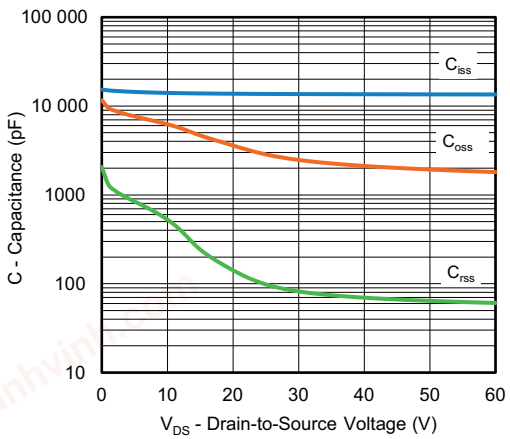

**Transfer Characteristics**



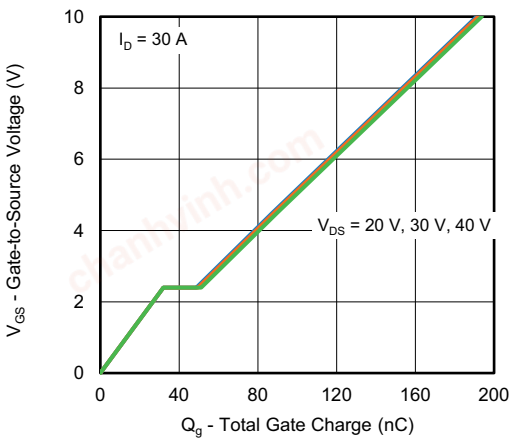

**Transconductance**




**On-Resistance vs. Drain Current**




**Capacitance**



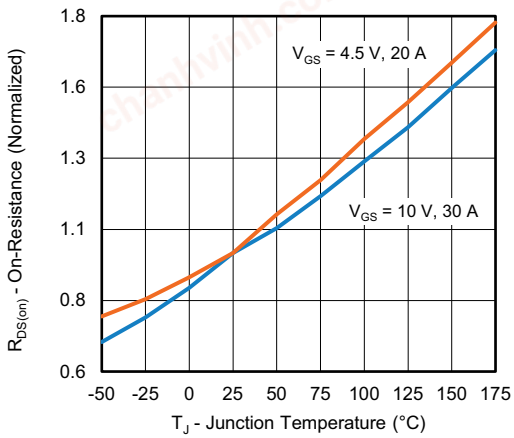

**Gate Charge**


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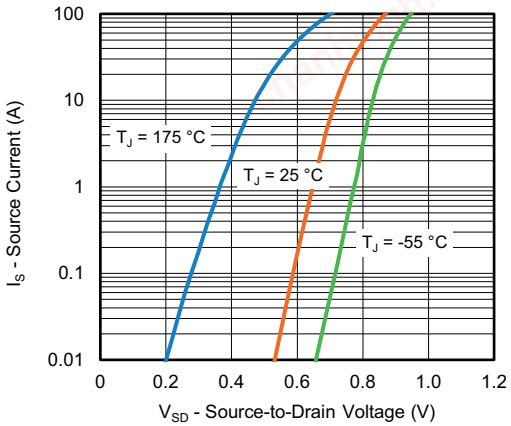
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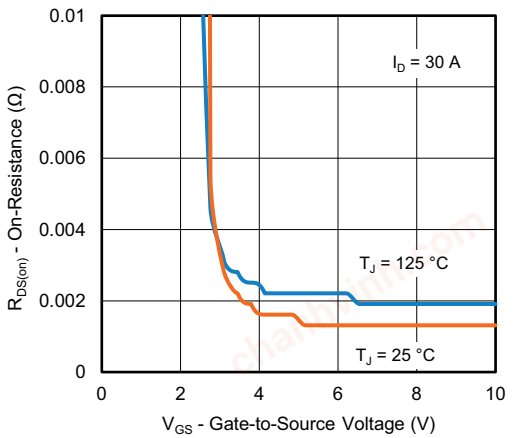
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



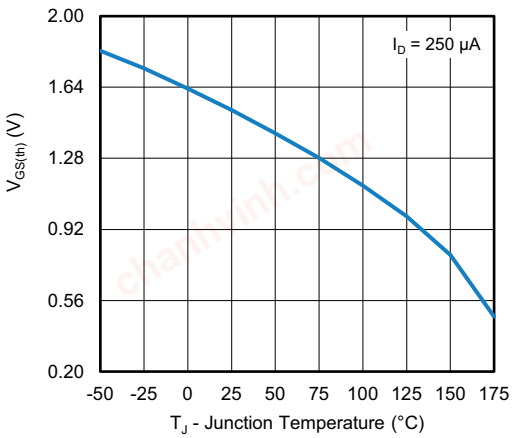

**On-Resistance vs. Junction Temperature**



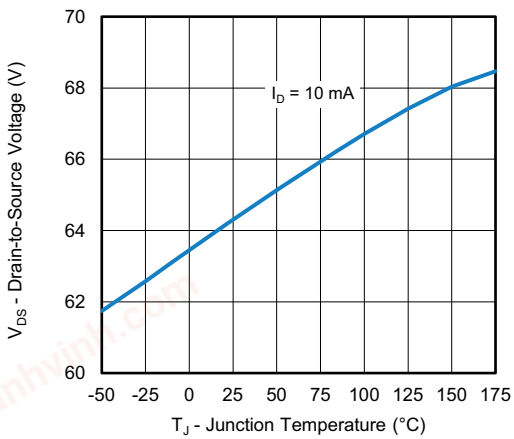

**Source Drain Diode Forward Voltage**



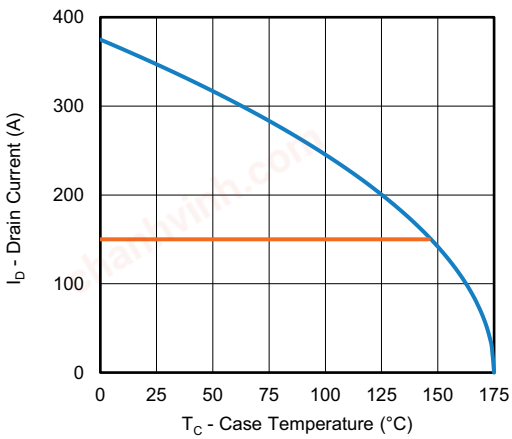

**On-Resistance vs. Gate-to-Source Voltage**




**Threshold Voltage**




**Drain Source Breakdown vs. Junction Temperature**



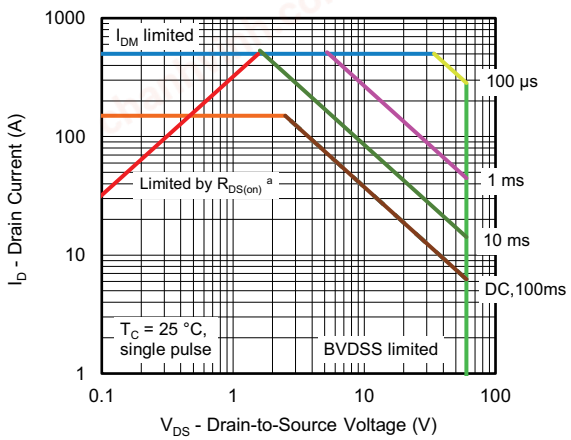

**Current De-rating**


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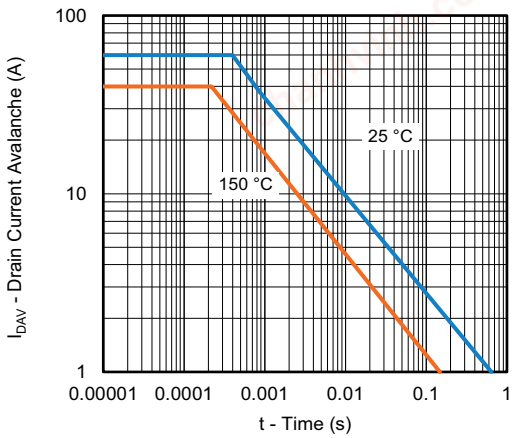
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**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)




**Safe Operating Area**




**Avalanche Current vs. Time**

**Note**

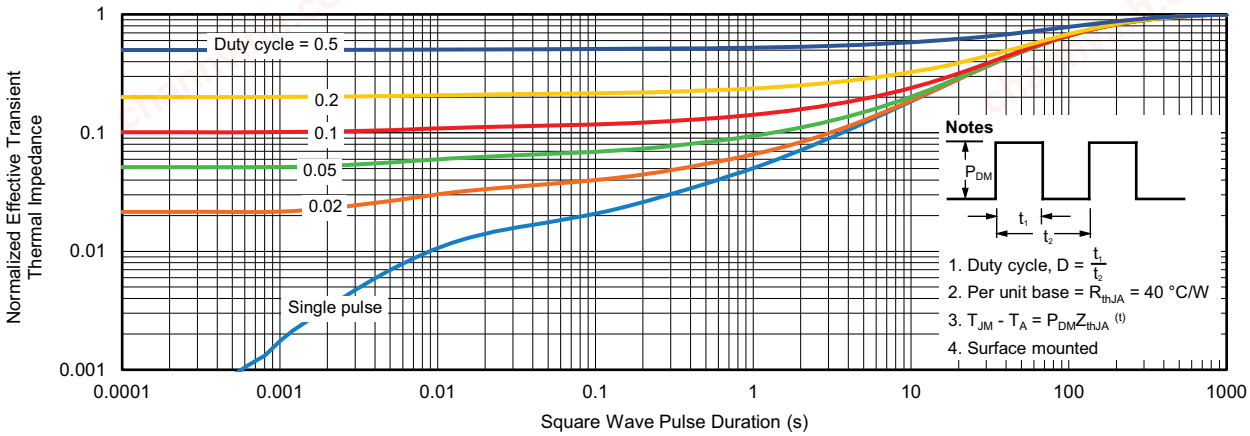
a. $V_{GS}$ > minimum $V_{GS}$ at which $R_{DS(on)}$ is specified


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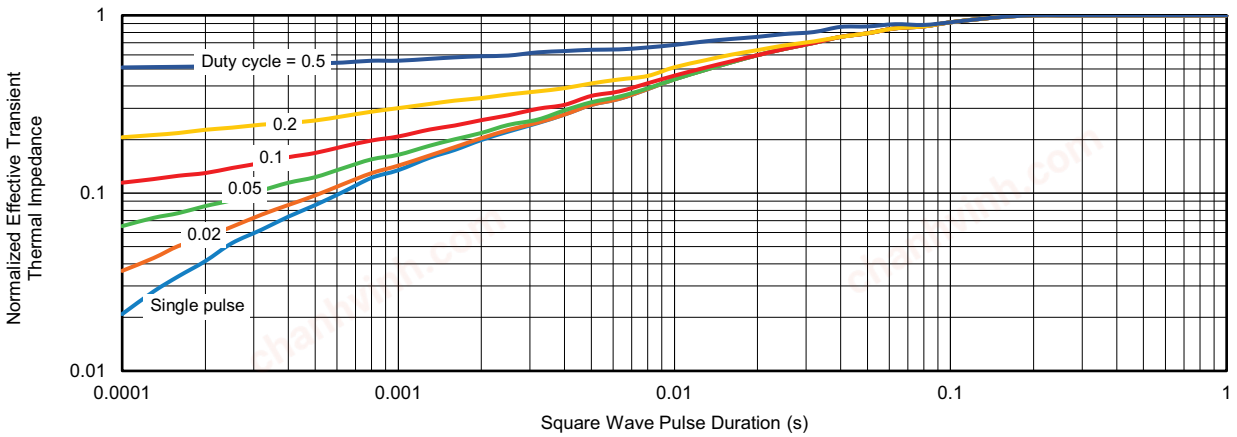
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**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)




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




**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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