

P-Channel 20-V (D-S) MOSFET with Schottky Diode

| MOSFET PRODUCT SUMMARY | | | |
|-------------------------------|----------------------------|------------------------|--------------|
| V_{DS} (V) | $R_{DS(on)}$ (Ω) | I_D (A) ^a | Q_g (Typ.) |
| - 20 | 0.058 at $V_{GS} = -4.5$ V | 6 | 5.5 nC |
| | 0.100 at $V_{GS} = -2.5$ V | 6 | |

| SCHOTTKY PRODUCT SUMMARY | | |
|---------------------------------|------------------------------------|------------------------|
| V_{KA} (V) | V_F (V) Diode Forward Voltage | I_F (A) ^a |
| 20 | 0.375 at 1 A | 2 |

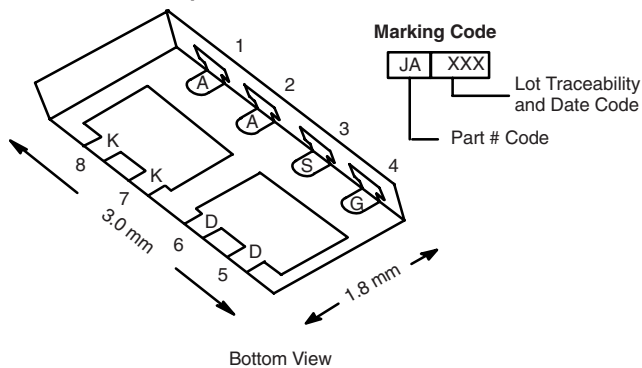
FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- LITTLE FOOT[®] Plus Power MOSFET
- New Thermally Enhanced PowerPAK[®] ChipFET[®] Package
 - Small Footprint Area
 - Low On-Resistance
 - Thin 0.8 mm Profile
- Compliant to RoHS Directive 2002/95/EC



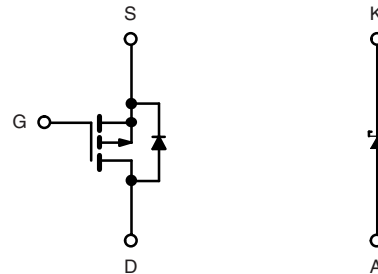
RoHS
COMPLIANT
HALOGEN
FREE

PowerPAK[®] ChipFET[®] Dual



APPLICATIONS

- Charging Switch for Portable Devices
 - With Integrated Low V_F Trench Schottky Diode



Ordering Information: Si5857DU-T1-GE3 (Lead (Pb)-free and Halogen-free)

P-Channel MOSFET

| ABSOLUTE MAXIMUM RATINGS $T_A = 25$ °C, unless otherwise noted | | | | | |
|---|----------------|---------------|------|--|---------------------|
| Parameter | Symbol | Limit | Unit | | |
| Drain-Source Voltage (MOSFET) | V_{DS} | - 20 | V | | |
| Reverse Voltage (Schottky) | V_{KA} | 20 | | | |
| Gate-Source Voltage (MOSFET) | V_{GS} | ± 12 | | | |
| Continuous Drain Current ($T_J = 150$ °C) (MOSFET) | I_D | $T_C = 25$ °C | A | | |
| | | $T_C = 70$ °C | | | |
| | | $T_A = 25$ °C | | | |
| | | $T_A = 70$ °C | | | |
| Pulsed Drain Current (MOSFET) | I_{DM} | - 20 | A | | |
| Continuous Source Current (MOSFET Diode Conduction) | I_S | $T_C = 25$ °C | | | - 6 ^a |
| | | $T_A = 25$ °C | | | 1.9 ^{b, c} |
| Average Forward Current (Schottky) | I_F | 2 | A | | |
| Pulsed Forward Current (Schottky) | I_{FM} | 7 | | | |
| Maximum Power Dissipation (MOSFET) | P_D | $T_C = 25$ °C | W | | |
| | | $T_C = 70$ °C | | | |
| | | $T_A = 25$ °C | | | |
| | | $T_A = 70$ °C | | | |
| Maximum Power Dissipation (Schottky) | P_D | $T_C = 25$ °C | W | | |
| | | $T_C = 70$ °C | | | |
| | | $T_A = 25$ °C | | | |
| | | $T_A = 70$ °C | | | |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | - 55 to 150 | °C | | |
| Soldering Recommendation (Peak Temperature) ^{d, e} | | 260 | | | |

THERMAL RESISTANCE RATINGS

| Parameter | | Symbol | Typical | Maximum | Unit |
|--|--------------|------------|---------|---------|------|
| Maximum Junction-to-Ambient (MOSFET) ^{b, f} | $t \leq 5$ s | R_{thJA} | 43 | 55 | °C/W |
| Maximum Junction-to-Case (Drain) (MOSFET) | | R_{thJC} | 9.5 | 12 | |
| Maximum Junction-to-Ambient (Schottky) ^{b, g} | $t \leq 5$ s | R_{thJA} | 49 | 61 | |
| Maximum Junction-to-Case (Drain) (Schottky) | | R_{thJC} | 13 | 16 | |

Notes:

- a. Package limited.
b. Surface Mounted on FR4 board.
c. $t \leq 5$ s.
d. See Solder Profile (www.vishay.com/doc?73257). The PowerPAK ChipFET 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. Rework Conditions: manual soldering with a soldering iron is not recommended for leadless components.
e. Rework Conditions: manual soldering with a soldering iron is not recommended for leadless components.
f. Maximum under Steady State conditions for MOSFETS is 105 °C/W.
g. Maximum under Steady State conditions for Schottky is 110 °C/W.

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, $I_D = -250$ μ A | - 20 | | | V |
| V_{DS} Temperature Coefficient | $\Delta V_{DS/TJ}$ | $I_D = -250$ μ A | | - 19 | | mV/°C |
| $V_{GS(th)}$ Temperature Coefficient | $\Delta V_{GS(th)/TJ}$ | | 2.6 | | | |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}$, $I_D = -250$ μ A | - 0.6 | | - 1.5 | V |
| Gate-Body Leakage | I_{GSS} | $V_{DS} = 0$ V, $V_{GS} = \pm 12$ V | | | ± 100 | ns |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = -20$ V, $V_{GS} = 0$ V | | | - 1 | μ A |
| | | $V_{DS} = -20$ V, $V_{GS} = 0$ V, $T_J = 55$ °C | | | - 10 | |
| On-State Drain Current ^a | $I_{D(on)}$ | $V_{DS} \leq -5$ V, $V_{GS} = -4.5$ V | - 20 | | | A |
| Drain-Source On-State Resistance ^a | $R_{DS(on)}$ | $V_{GS} = -4.5$ V, $I_D = -3.6$ A | | 0.048 | 0.058 | Ω |
| | | $V_{GS} = -2.5$ V, $I_D = -1$ A | | 0.081 | 0.100 | |
| Forward Transconductance ^a | g_{fs} | $V_{DS} = -10$ V, $I_D = -3.6$ A | | 10 | | S |
| Dynamic^b | | | | | | |
| Input Capacitance | C_{iss} | $V_{DS} = -10$ V, $V_{GS} = 0$ V, $f = 1$ MHz | | 480 | | pF |
| Output Capacitance | C_{oss} | | 125 | | | |
| Reverse Transfer Capacitance | C_{rss} | | 90 | | | |
| Total Gate Charge | Q_g | $V_{DS} = -10$ V, $V_{GS} = -10$ V, $I_D = -5$ A | | 11 | 17 | nC |
| | | $V_{DS} = -10$ V, $V_{GS} = -4.5$ V, $I_D = -5$ A | | 5.5 | 8.5 | |
| Gate-Source Charge | Q_{gs} | | 1.2 | | | |
| Gate-Drain Charge | Q_{gd} | | 1.8 | | | |
| Gate Resistance | R_g | $f = 1$ MHz | | 9 | | Ω |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = -10$ V, $R_L = 2.5$ Ω $I_D \cong -4$ A, $V_{GEN} = -4.5$ V, $R_g = 1$ Ω | | 11 | 20 | ns |
| Rise Time | t_r | | | 42 | 65 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 33 | 50 | |
| Fall Time | t_f | | | 50 | 75 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = -10$ V, $R_L = 2.5$ Ω $I_D \cong -4$ A, $V_{GEN} = -10$ V, $R_g = 1$ Ω | | 5 | 10 | |
| Rise Time | t_r | | | 15 | 25 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 25 | 40 | |
| Fall Time | t_f | | | 10 | 20 | |



| SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted | | | | | | |
|--|----------|--|------|-------|-------|------|
| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit |
| Drain-Source Body Diode Characteristics | | | | | | |
| Continuous Source-Drain Diode Current | I_S | $T_C = 25\text{ }^\circ\text{C}$ | | | - 6 | A |
| Pulse Diode Forward Current | I_{SM} | | | | - 20 | |
| Body Diode Voltage | V_{SD} | $I_S = - 4\text{ A}, V_{GS} = 0\text{ V}$ | | - 0.9 | - 1.2 | V |
| Body Diode Reverse Recovery Time | t_{rr} | $I_F = - 4\text{ A } dI/dt = 100\text{ A}/\mu\text{s } T_J = 25\text{ }^\circ\text{C}$ | | 25 | 50 | ns |
| Body Diode Reverse Recovery Charge | Q_{rr} | | | 10 | 20 | nC |
| Reverse Recovery Fall Time | t_a | | | 9 | | ns |
| Reverse Recovery Rise Time | t_b | | | 16 | | |

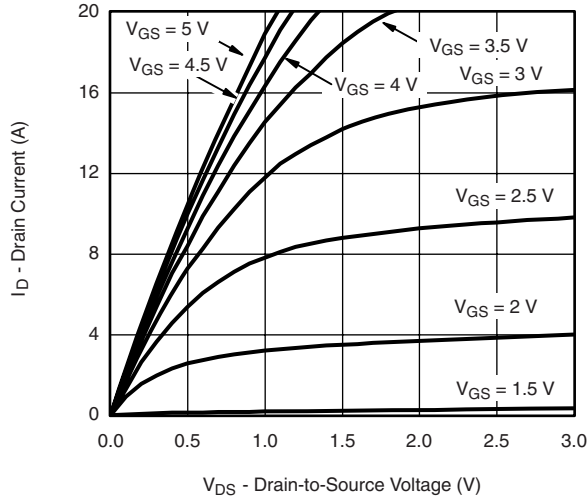
Notes:

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

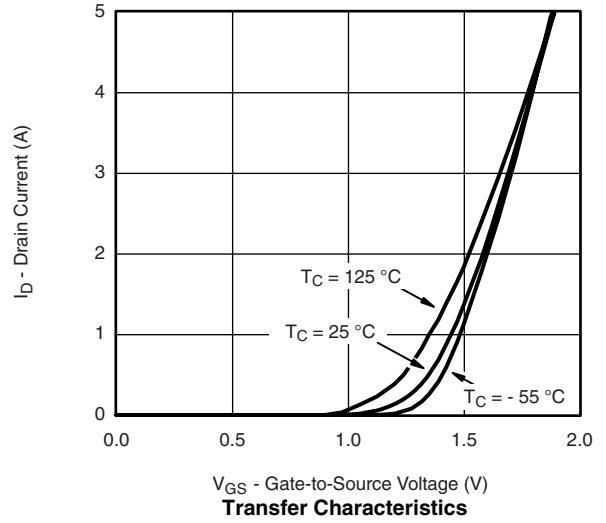
| SCHOTTKY SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted | | | | | | |
|---|----------|--|------|-------|-------|------|
| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit |
| Forward Voltage Drop | V_F | $I_F = 1\text{ A}$ | | 0.34 | 0.375 | V |
| | | $I_F = 1\text{ A}, T_J = 125\text{ }^\circ\text{C}$ | | 0.255 | 0.290 | |
| Maximum Reverse Leakage Current | I_{rm} | $V_R = 20\text{ V}$ | | 0.05 | 0.500 | mA |
| | | $V_R = 20\text{ V}, T_J = 85\text{ }^\circ\text{C}$ | | 2 | 20 | |
| | | $V_R = 20\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | | 10 | 100 | |
| Junction Capacitance | C_T | $V_R = 10\text{ V}$ | | 90 | | pF |

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.

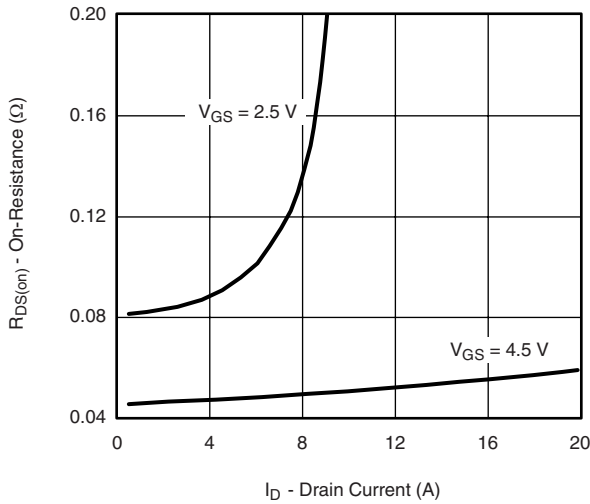
MOSFET TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



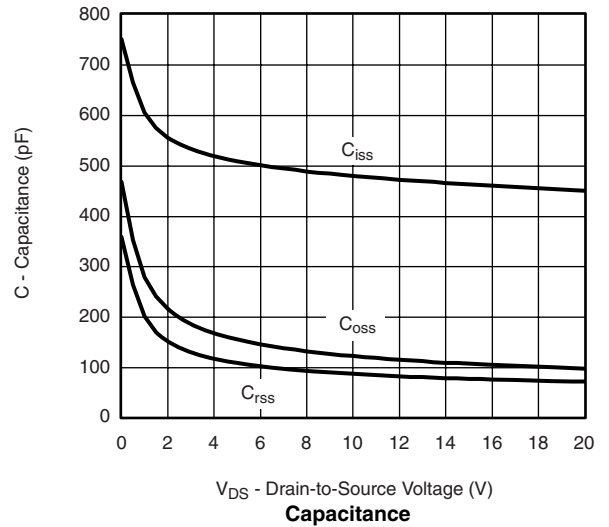
Output Characteristics



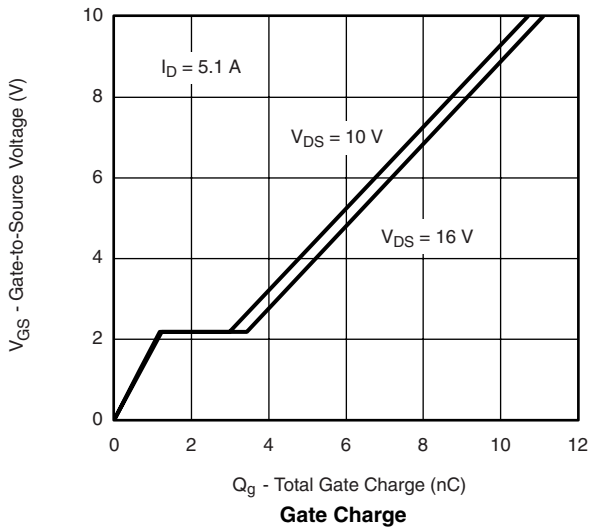
Transfer Characteristics



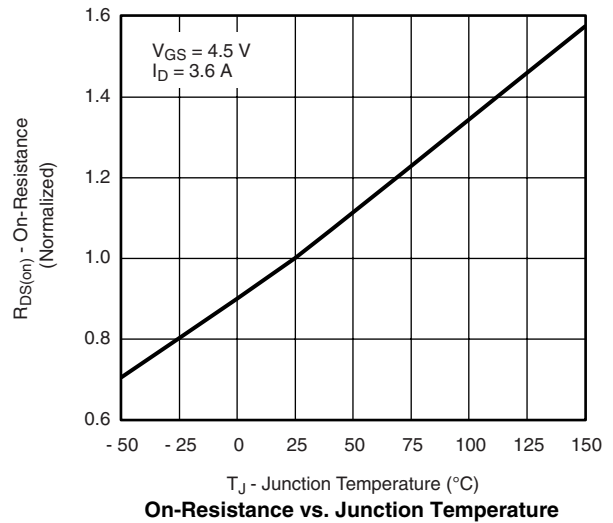
On-Resistance vs. Drain Current and Gate Voltage



Capacitance

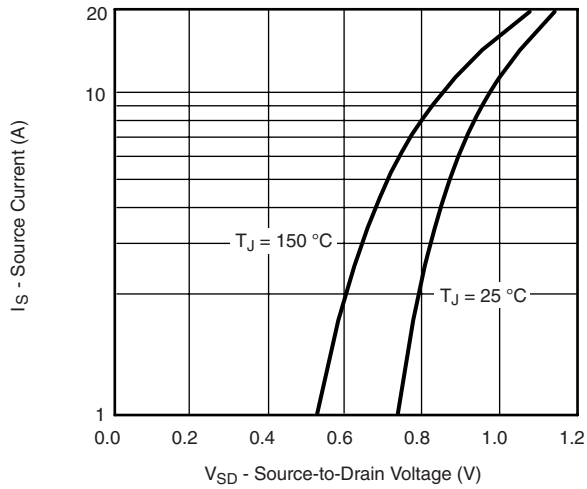


Gate Charge

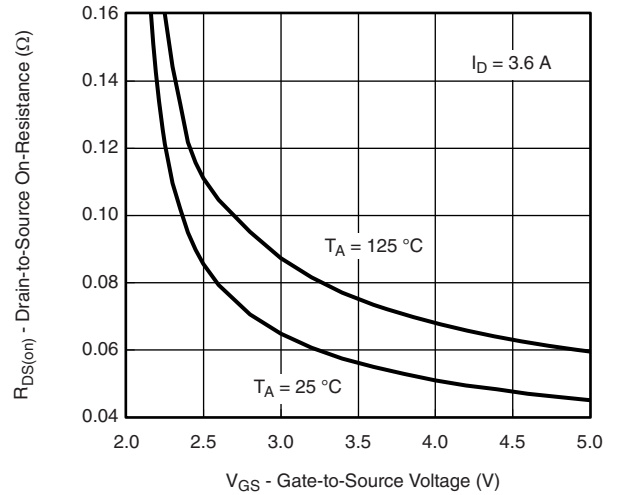


On-Resistance vs. Junction Temperature

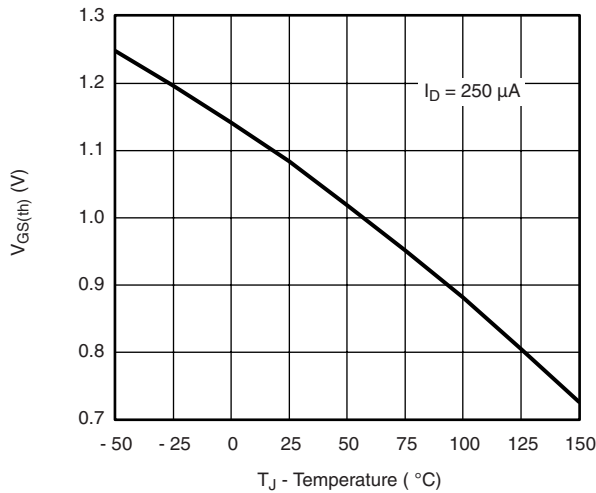
MOSFET TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



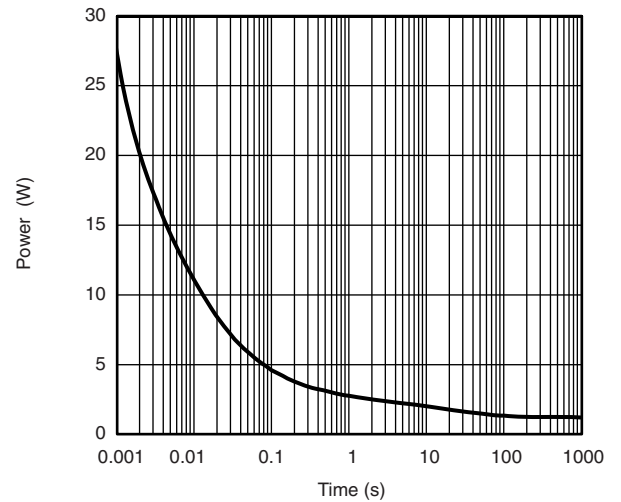
Source-Drain Diode Forward Voltage



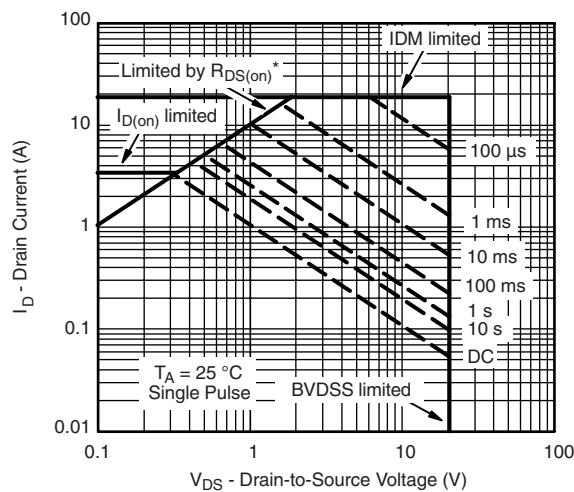
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage



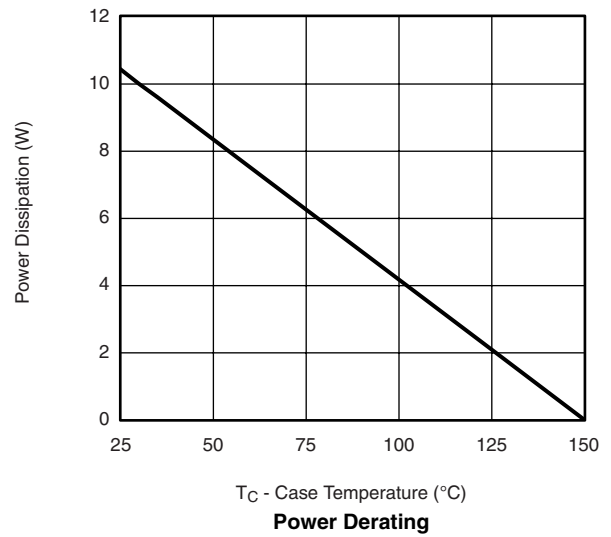
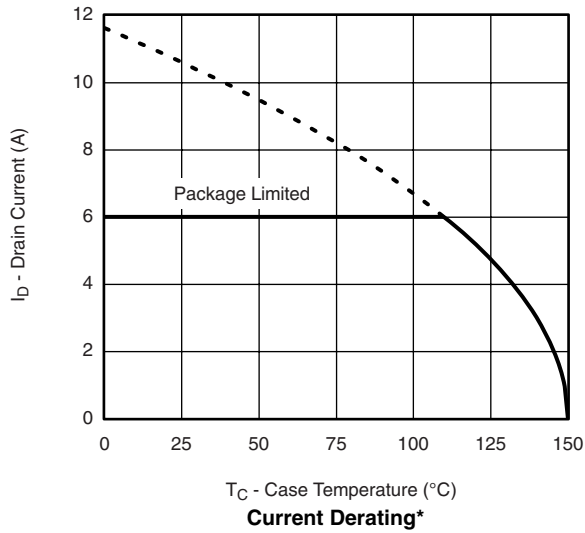
Single Pulse Power, Junction-to-Ambient



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

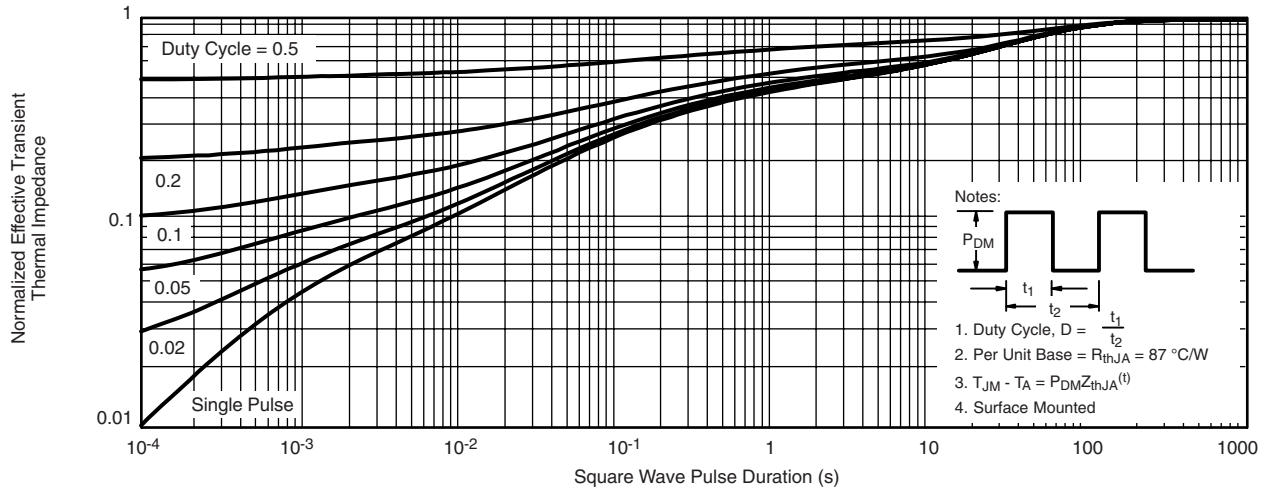
Safe Operating Area, Junction-to-Case

MOSFET TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

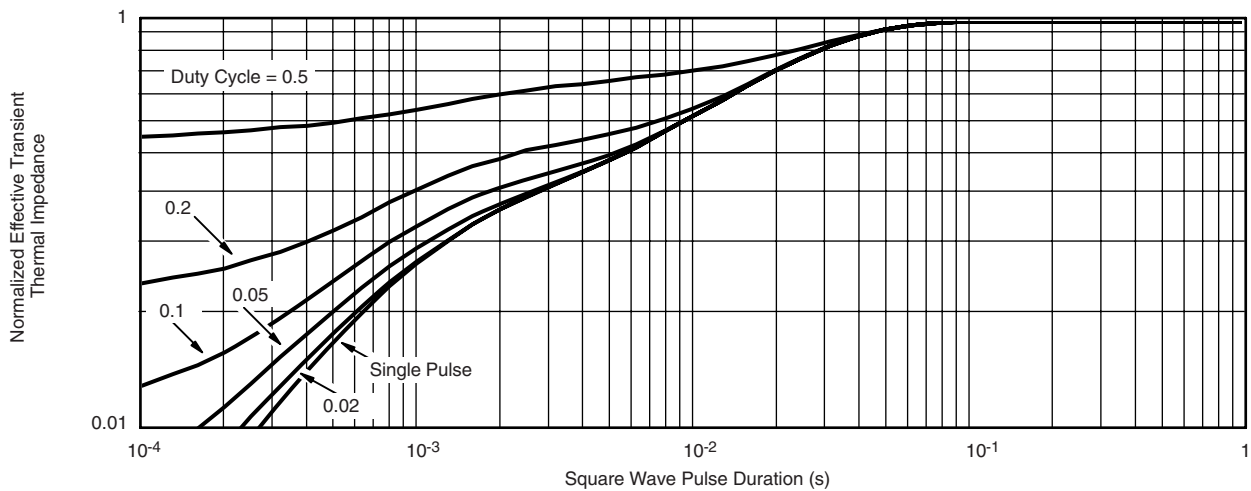


* The power dissipation P_D is based on $T_{J(max)} = 150$ °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

MOSFET TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

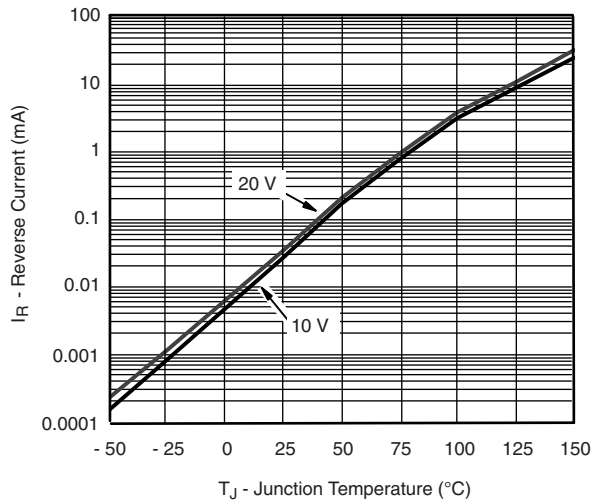


Normalized Thermal Transient Impedance, Junction-to-Ambient

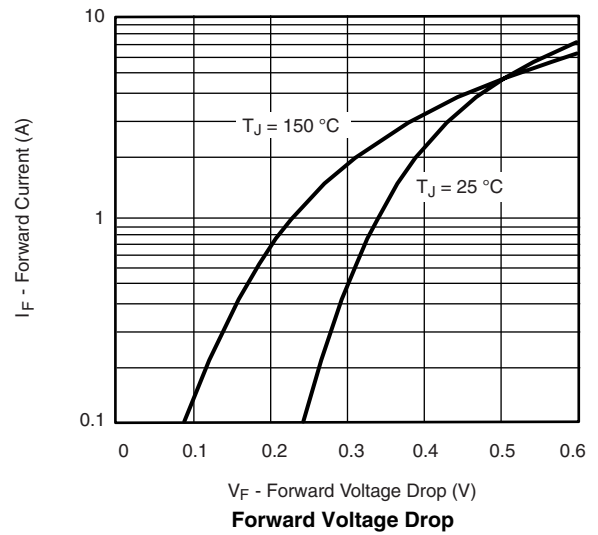


Normalized Thermal Transient Impedance, Junction-to-Case

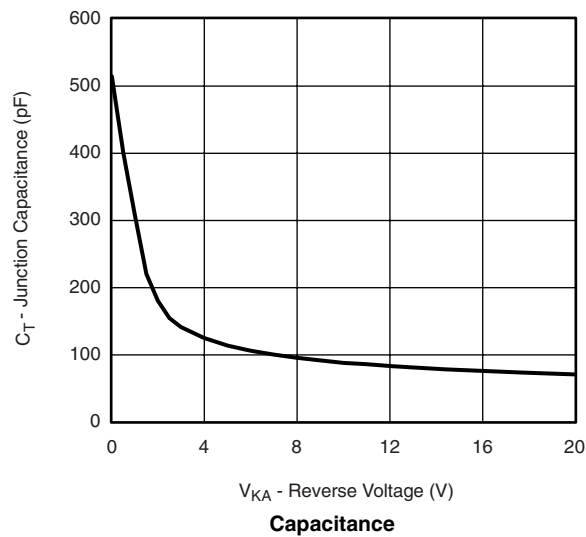
SCHOTTKY TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Reverse Current vs. Junction Temperature

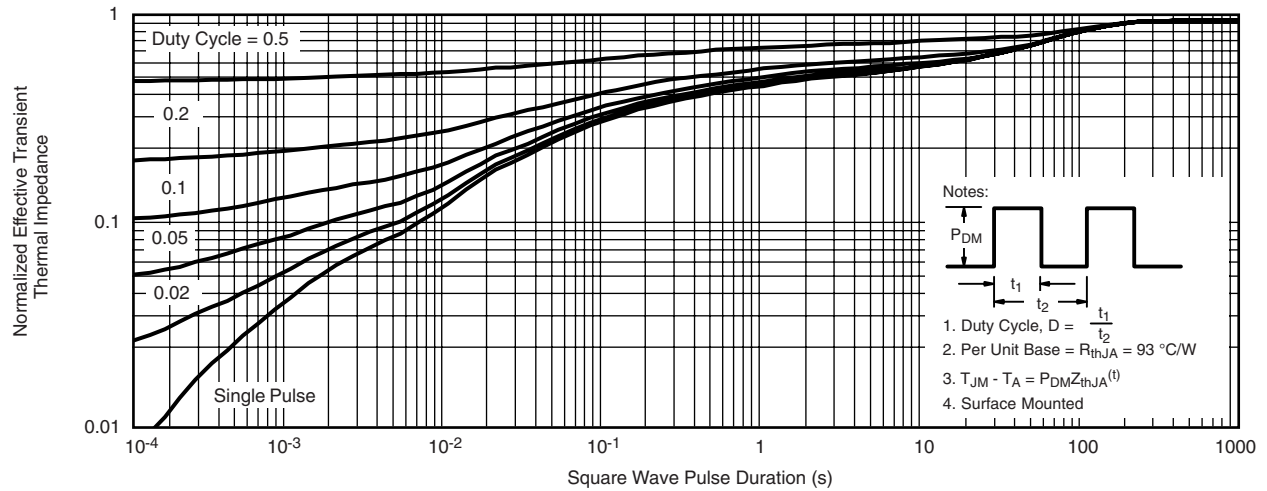


Forward Voltage Drop

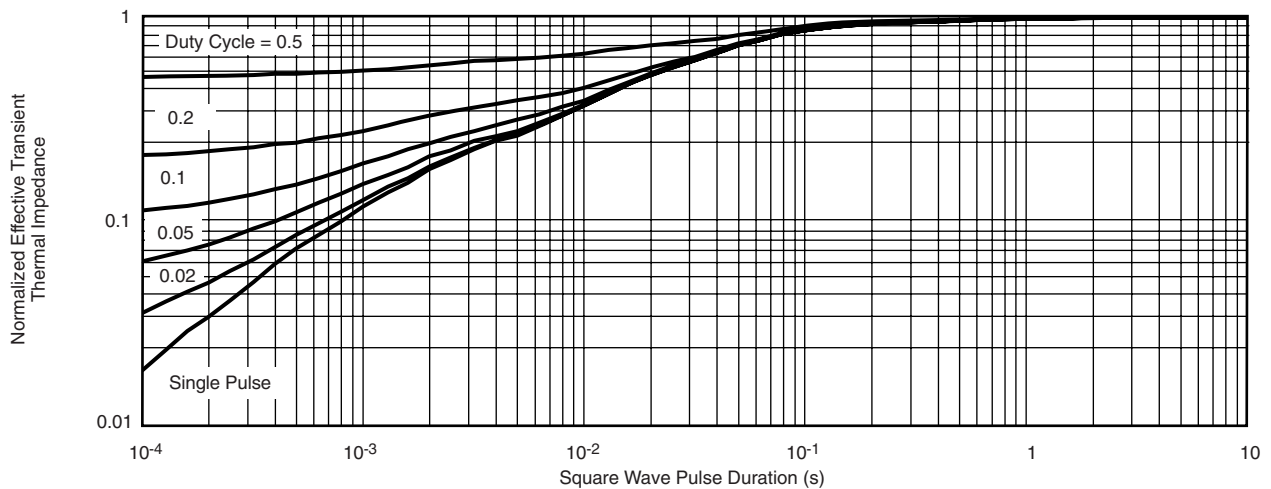


Capacitance

SCHOTTKY TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



Normalized Thermal Transient Impedance, Junction-to-Ambient



Normalized Thermal Transient Impedance, Junction-to-Case

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