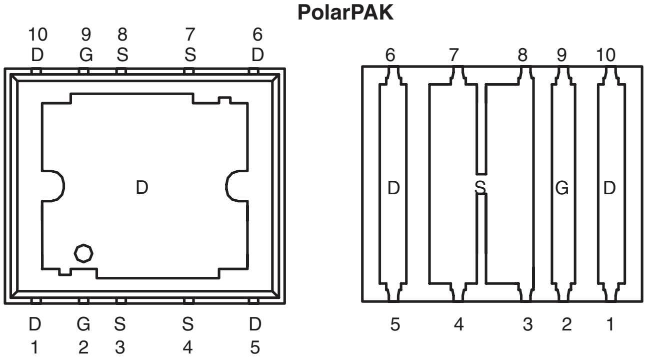
# N-Channel 20-V (D-S) MOSFET

## PRODUCT SUMMARY

| $V_{DS}$ (V) | $R_{DS(on)}$ (Ω) | $I_D$ (A)[a] Silicon Limit | $I_D$ (A)[a] Package Limit | $Q_g$ (Typ.) |
|---|---|---|---|---|
| 20 | 0.0035 at $V_{GS}$ = 4.5 V | 136 | 50 | 43 nC |
| | 0.0064 at $V_{GS}$ = 2.5 V | 100 | 50 | |

Package Drawing
www.vishay.com/doc?73398

**PolarPAK**




Top View    Bottom View

Top surface is connected to pins 1, 5, 6, and 10

**Ordering Information:** SiE820DF-T1-E3 (Lead (Pb)-free)
SiE820DF-T1-GE3 (Lead (Pb)-free and Halogen-free)

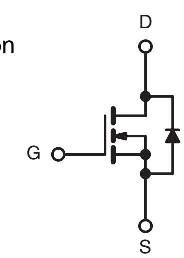
## FEATURES

- **Halogen-free According to IEC 61249-2-21 Definition**
- Extremely Low $Q_{gd}$ WFET Technology for Low Switching Losses
- TrenchFET® Power MOSFET
- Ultra Low Thermal Resistance Using Top-Exposed PolarPAK® Package for Double-Sided Cooling
- Leadframe-Based New Encapsulated Package
  - Die Not Exposed
  - Same Layout Regardless of Die Size
- Low $Q_{gd}/Q_{gs}$ Ratio Helps Prevent Shoot-Through
- 100 % $R_g$ and UIS Tested
- Compliant to RoHS directive 2002/95/EC

RoHS COMPLIANT
HALOGEN FREE Available

## APPLICATIONS

- VRM
- DC/DC Conversion
- Synchronous Rectification




N-Channel MOSFET

For Related Documents
www.vishay.com/ppg?74447

## ABSOLUTE MAXIMUM RATINGS $T_A$ = 25 °C, unless otherwise noted

| Parameter | | Symbol | Limit | Unit |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 20 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 12 | V |
| Continuous Drain Current ($T_J$ = 150 °C) | $T_C$ = 25 °C | $I_D$ | 136 (Silicon Limit) | A |
| | | | 50[a] (Package Limit) | |
| | $T_C$ = 70 °C | | 50[a] | |
| | $T_A$ = 25 °C | | 30[b, c] | |
| | $T_A$ = 70 °C | | 24[b, c] | |
| Pulsed Drain Current | | $I_{DM}$ | 80 | |
| Continuous Source-Drain Diode Current | $T_C$ = 25 °C | $I_S$ | 50[a] | |
| | $T_A$ = 25 °C | | 4.3[b, c] | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 30 | |
| Avalanche Energy | | $E_{AS}$ | 45 | mJ |
| Maximum Power Dissipation | $T_C$ = 25 °C | $P_D$ | 104 | W |
| | $T_C$ = 70 °C | | 66 | |
| | $T_A$ = 25 °C | | 5.2[b, c] | |
| | $T_A$ = 70 °C | | 3.3[b, c] | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | - 55 to 150 | °C |
| Soldering Recommendations (Peak Temperature)[d, e] | | | 260 | |

Notes:
a. Package limited is 50 A.
b. Surface Mounted on 1" x 1" FR4 board.
c. t = 10 s.
d. See Solder Profile (*www.vishay.com/doc?73257*). The PolarPAK 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.

## THERMAL RESISTANCE RATINGS

| Parameter | | Symbol | Typical | Maximum | Unit |
|---|---|---|---|---|---|
| Maximum Junction-to-Ambient[a, b] | t ≤ 10 s | $R_{thJA}$ | 20 | 24 | °C/W |
| Maximum Junction-to-Case (Drain Top)[a] | Steady State | $R_{thJC}$ (Drain) | 1 | 1.2 | |
| Maximum Junction-to-Case (Source)[a, c] | | $R_{thJC}$ (Source) | 2.8 | 3.4 | |

Notes:
a. Surface Mounted on 1" x 1" FR4 board.
b. Maximum under Steady State conditions is 68 °C/W.
c. Measured at source pin (on the side of the package).

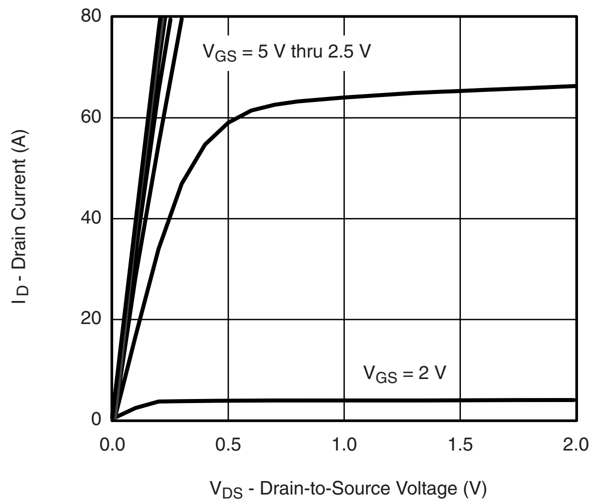
## SPECIFICATIONS $T_J$ = 25 °C, unless otherwise noted

| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Static** | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | 20 | | | V |
| $V_{DS}$ Temperature Coefficient | $\Delta V_{DS}/T_J$ | $I_D$ = 250 µA | | 20 | | mV/°C |
| $V_{GS(th)}$ Temperature Coefficient | $\Delta V_{GS(th)}/T_J$ | | | - 4.8 | | |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$ , $I_D$ = 250 µA | 0.6 | 1.4 | 2 | V |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 12 V | | | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 20 V, $V_{GS}$ = 0 V | | | 1 | µA |
| | | $V_{DS}$ = 20 V, $V_{GS}$ = 0 V, $T_J$ = 55 °C | | | 10 | |
| On-State Drain Current[a] | $I_{D(on)}$ | $V_{DS}$ ≥ 5 V, $V_{GS}$ = 4.5 V | 25 | | | A |
| Drain-Source On-State Resistance[a] | $R_{DS(on)}$ | $V_{GS}$ = 4.5 V, $I_D$ = 18 A | | 0.0029 | 0.0035 | Ω |
| | | $V_{GS}$ = 2.5 V, $I_D$ = 13.4 A | | 0.0053 | 0.0064 | |
| Forward Transconductance[a] | $g_{fs}$ | $V_{DS}$ = 10 V, $I_D$ = 18 A | | 106 | | S |
| **Dynamic[b]** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0 V, f = 1 MHz | | 4300 | | pF |
| Output Capacitance | $C_{oss}$ | | | 950 | | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 450 | | |
| Total Gate Charge | $Q_g$ | $V_{DS}$ = 10 V, $V_{GS}$ = 10 V, $I_D$ = 20 A | | 95 | 143 | nC |
| | | $V_{DS}$ = 10 V, $V_{GS}$ = 4.5 V, $I_D$ = 20 A | | 43 | 65 | |
| Gate-Source Charge | $Q_{gs}$ | | | 11.5 | | |
| Gate-Drain Charge | $Q_{gd}$ | | | 10 | | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 1.0 | 1.5 | Ω |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 10 V, $R_L$ = 1.0 Ω<br>$I_D$ ≅ 10 A, $V_{GEN}$ = 4.5 V, $R_g$ = 1 Ω | | 35 | 55 | ns |
| Rise Time | $t_r$ | | | 115 | 175 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 105 | 160 | |
| Fall Time | $t_f$ | | | 30 | 45 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 10 V, $R_L$ = 1.0 Ω<br>$I_D$ ≅ 10 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | 15 | 25 | |
| Rise Time | $t_r$ | | | 35 | 55 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 55 | 85 | |
| Fall Time | $t_f$ | | | 10 | 15 | |
| **Drain-Source Body Diode Characteristics** | | | | | | |
| Continuous Source-Drain Diode Current | $I_S$ | $T_C$ = 25 °C | | | 50 | A |
| Pulse Diode Forward Current[a] | $I_{SM}$ | | | | 80 | |
| Body Diode Voltage | $V_{SD}$ | $I_S$ = 10 A | | 0.8 | 1.2 | V |
| Body Diode Reverse Recovery Time | $t_{rr}$ | $I_F$ = 10 A, dI/dt = 100 A/µs, $T_J$ = 25 °C | | 101 | 150 | ns |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | | | 100 | 150 | nC |
| Reverse Recovery Fall Time | $t_a$ | | | 75 | | ns |
| Reverse Recovery Rise Time | $t_b$ | | | 25 | | |

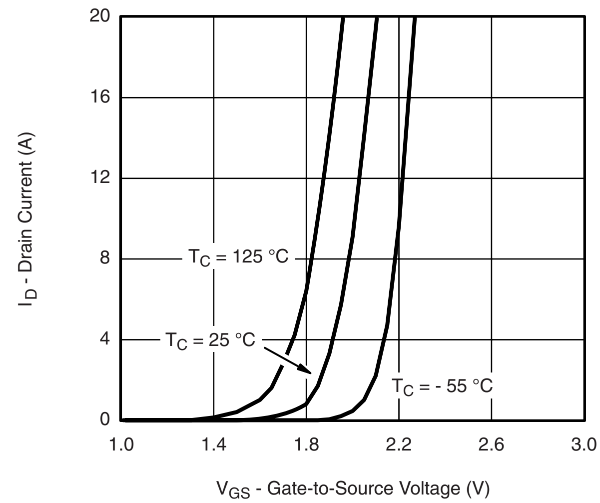
Notes:
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %
b. Guaranteed by design, not subject to production testing.

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

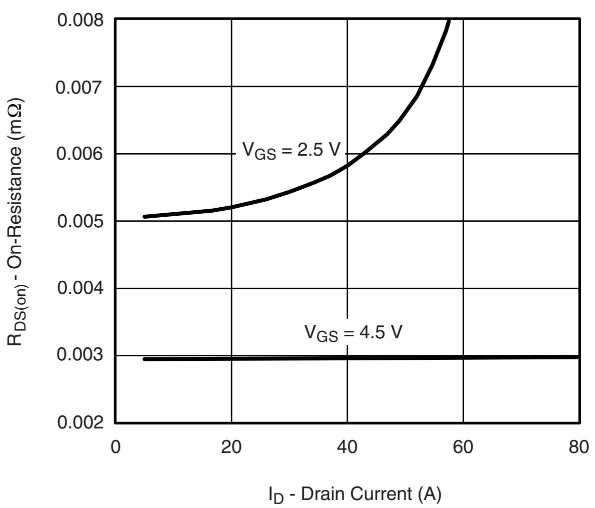
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



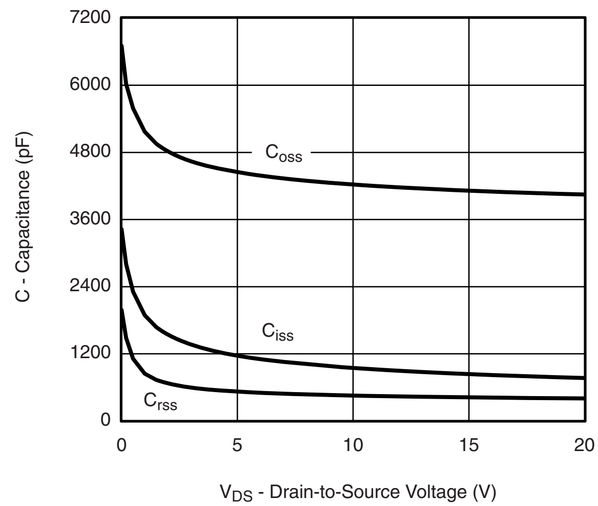

**Output Characteristics**



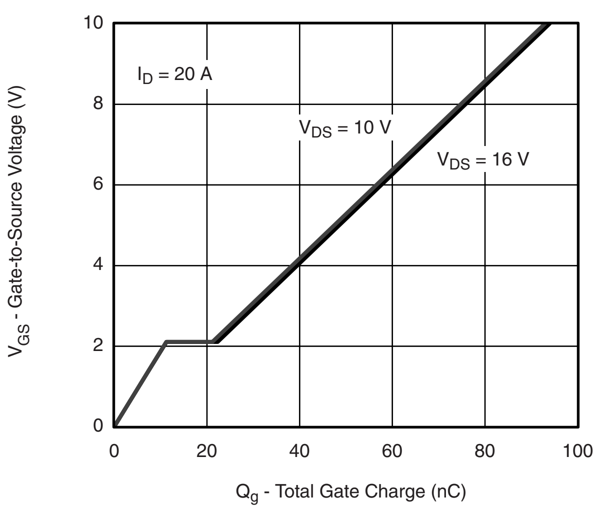

**Transfer Characteristics**



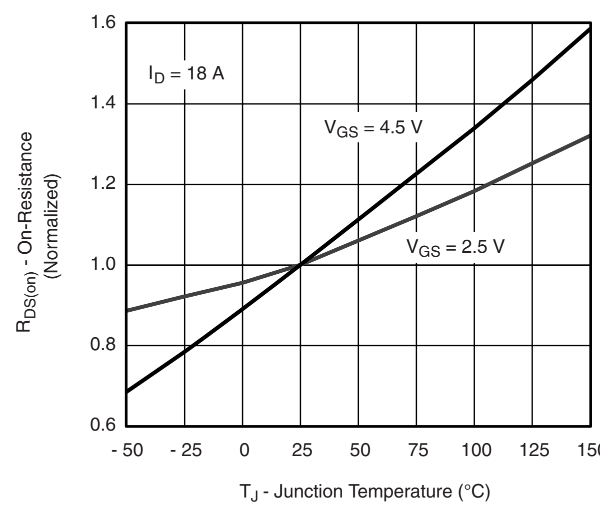

**On-Resistance vs. Drain Current**




**Capacitance**

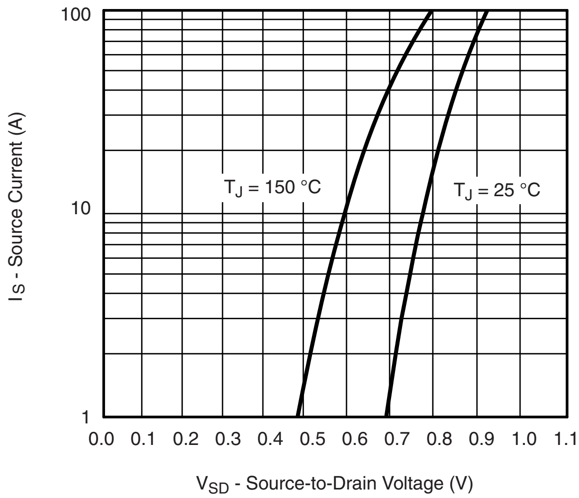



**Gate Charge**

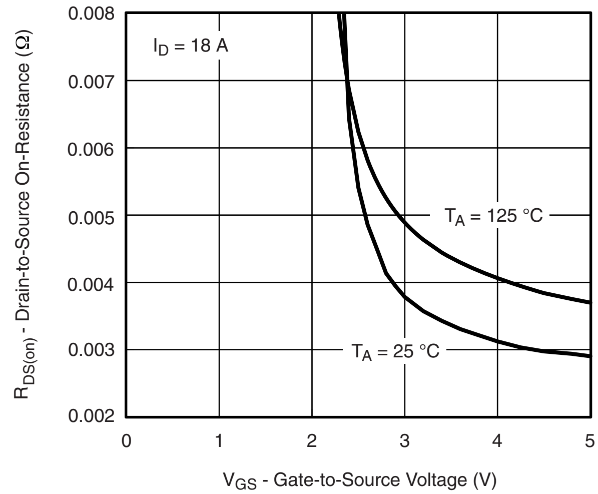



**On-Resistance vs. Junction Temperature**

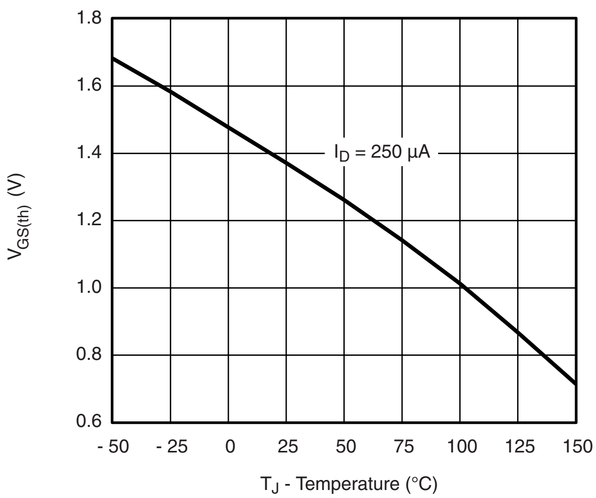
**TYPICAL CHARACTERISTICS** 25 °C, unless otherwise noted



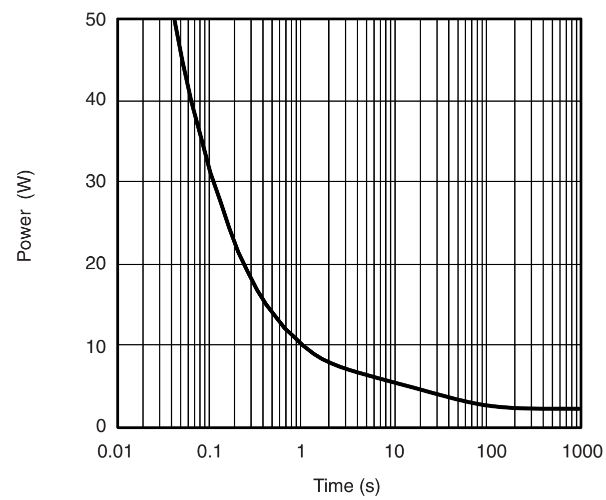

**Source-Drain Diode Forward Voltage**



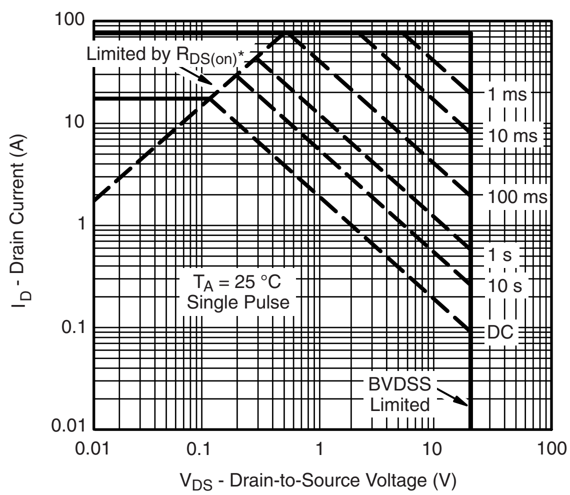

**On-Resistance vs. Gate-to-Source Voltage**




**Threshold Voltage**



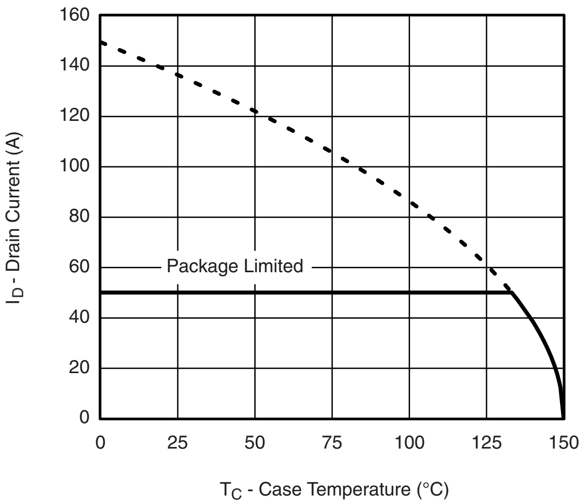

**Single Pulse Power, Junction-to-Ambient**



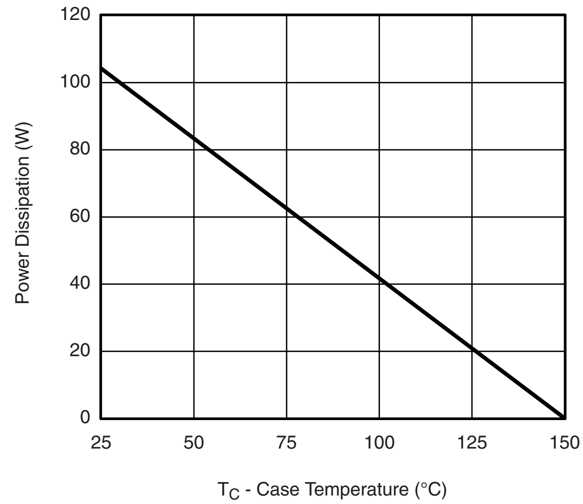

* $V_{GS}$ > minimum $V_{GS}$ at which $R_{DS(on)}$ is specified

**Safe Operating Area, Junction-to-Ambient**

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



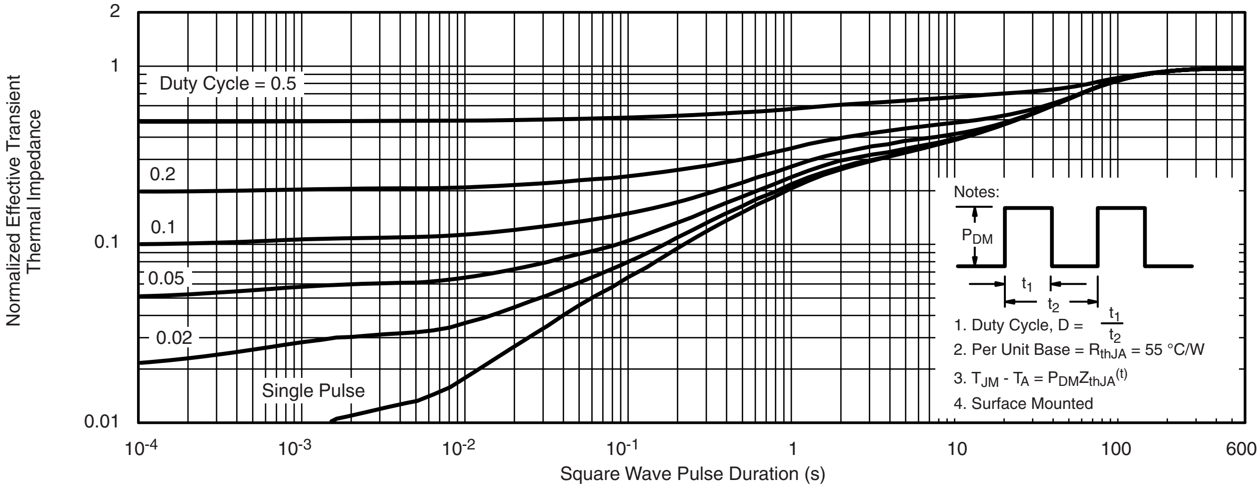

**Current Derating***



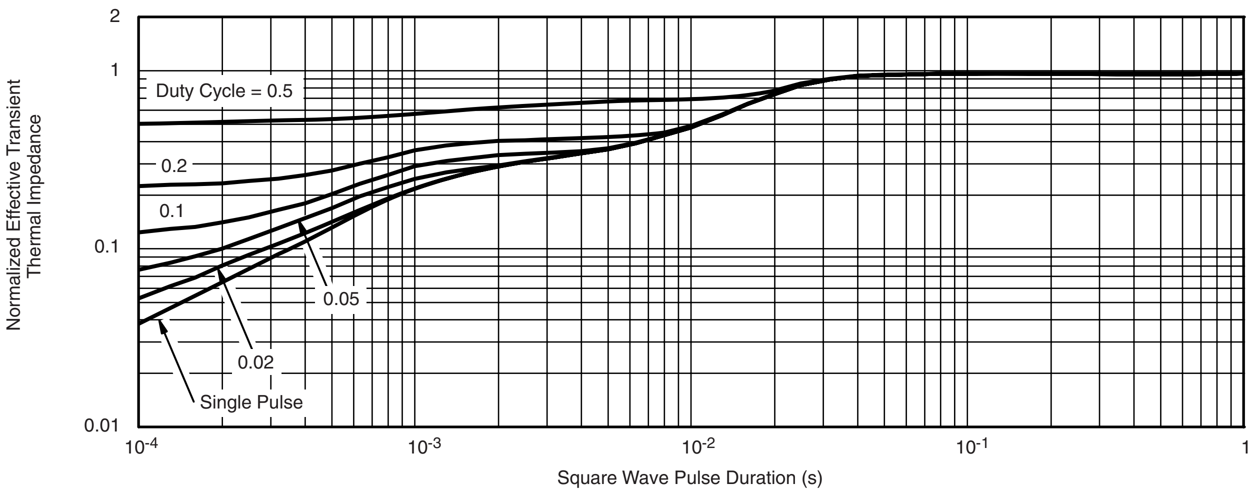

**Power Derating, Junction-to-Case**

* 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.

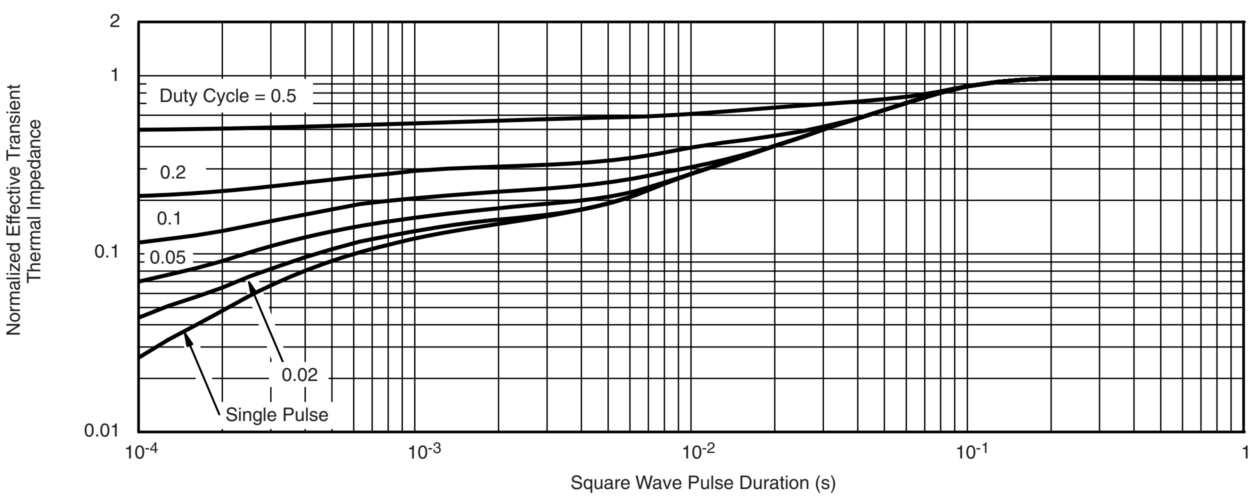
## TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted




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




**Normalized Thermal Transient Impedance, Junction-to-Case (Drain Top)**




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

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