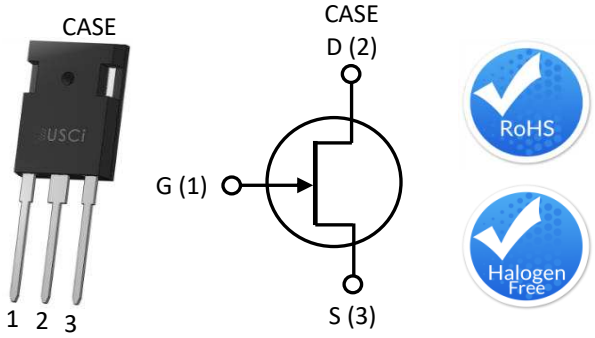
## Description

United Silicon Carbide, Inc offers the high-performance G3 SiC normally-on JFET transistors. This series exhibits ultra-low on resistance ($R_{DS(ON)}$) and gate charge ($Q_G$) allowing for low conduction and switching loss. The device normally-on characteristics with low $R_{DS(ON)}$ at $V_{GS}$ = 0 V is also ideal for current protection circuits without the need for active control, as well as for cascode operation.




| Part Number | Package | Marking |
|---|---|---|
| UJ3N120035K3S | TO-247-3L | UJ3N120035K3S |

## Features

- Typical on-resistance $R_{DS(on),typ}$ of 35mΩ
- Voltage controlled
- Maximum operating temperature of 175°C
- Extremely fast switching not dependent on temperature
- Low gate charge
- Low intrinsic capacitance
- RoHS compliant

## Typical Applications

- Over current protection circuits
- DC-AC inverters
- Switch mode power supplies
- Power factor correction modules
- Motor drives
- Induction heating

## Maximum Ratings

| Parameter | Symbol | Test Conditions | Value | Units |
|---|---|---|---|---|
| Drain-source voltage | $V_{DS}$ | | 1200 | V |
| Gate-source voltage | $V_{GS}$ | DC | -20 to +3 | V |
| | | AC (1) | -20 to +20 | |
| Continuous drain current (2) | $I_D$ | $T_C$ = 25°C | 63 | A |
| | | $T_C$ = 100°C | 46 | A |
| Pulsed drain current (3) | $I_{DM}$ | $T_C$ = 25°C | 185 | A |
| Power dissipation | $P_{tot}$ | $T_C$=25°C | 429 | W |
| Maximum junction temperature | $T_{J,max}$ | | 175 | °C |
| Operating and storage temperature | $T_J$, $T_{STG}$ | | -55 to 175 | °C |
| Max. lead temperature for soldering, 1/8" from case for 5 seconds | $T_L$ | | 250 | °C |

(1) +20V AC rating applies for turn-on pulses <200ns applied with external $R_G$ > 1Ω.

(2) Limited by $T_{J,max}$

(3) Pulse width $t_p$ limited by $T_{J,max}$

**Electrical Characteristics** ($T_J$ = +25°C unless otherwise specified)

**Typical Performance - Static**

| Parameter | Symbol | Test Conditions | Value | | | Units |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Drain-source breakdown voltage | $BV_{DS}$ | $V_{GS}$= - 20V, $I_D$=1mA | 1200 | | | V |
| Total drain leakage current | $I_D$ | $V_{DS}$ = 1200V, $V_{GS}$ = -20V, $T_J$ = 25°C | | 10 | 60 | µA |
| | | $V_{DS}$ = 1200V, $V_{GS}$ = -20V, $T_J$ = 175°C | | 35 | | |
| Total gate leakage current | $I_G$ | $V_{GS}$=-20V, $T_j$=25°C | | 12 | 100 | µA |
| | | $V_{GS}$=-20V, $T_j$=175°C | | 50 | | |
| Drain-source on-resistance | $R_{DS(on)}$ | $V_{GS}$=2V, $I_D$=20A, $T_J$ = 25°C | | 31 | | mΩ |
| | | $V_{GS}$=0V, $I_D$=20A, $T_J$ = 25°C | | 35 | 45 | |
| | | $V_{GS}$=2V, $I_D$=20A, $T_J$ = 175°C | | 68 | | |
| | | $V_{GS}$=0V, $I_D$=20A, $T_J$ = 175°C | | 76 | | |
| Gate threshold voltage | $V_{G(th)}$ | $V_{DS}$= 5V, $I_D$ = 70mA | -14 | -11.5 | -6 | V |
| Gate resistance | $R_G$ | f = 1MHz, open drain | | 2.4 | | Ω |

## Typical Performance - Dynamic

| Parameter | symbol | Test Conditions | Value | | | Units |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Input capacitance | $C_{iss}$ | $V_{DS}$ = 100V, $V_{GS}$ = -20V, f = 100kHz | | 2145 | | pF |
| Output capacitance | $C_{oss}$ | | | 180 | | |
| Reverse transfer capacitance | $C_{rss}$ | | | 172 | | |
| Effective output capacitance, energy related | $C_{oss(er)}$ | $V_{DS}$ = 0V to 800V, $V_{GS}$ = -20V | | 105 | | pF |
| Total gate charge | $Q_G$ | $V_{DS}$=800V, $I_D$ = 40A, $V_{GS}$=-18V to 0V | | 235 | | nC |
| Gate-drain charge | $Q_{GD}$ | | | 130 | | |
| Gate-source charge | $Q_{GS}$ | | | 25 | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DS}$=800V, $I_D$=40A, Gate Driver =-18V to 0V, $R_{G,EXT}$ = 1Ω, Inductive Load, FWD: UJ3D1220KSD $T_J$ = 25°C | | 25 | | ns |
| Rise time | $t_r$ | | | 37 | | |
| Turn-off delay time | $t_{d(off)}$ | | | 48 | | |
| Fall time | $t_f$ | | | 39 | | |
| Turn-on energy | $E_{ON}$ | | | 935 | | µJ |
| Turn-off energy | $E_{OFF}$ | | | 828 | | |
| Total switching energy | $E_{TOTAL}$ | | | 1763 | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DS}$=800V, $I_D$=40A, Gate Driver =-18V to 0V, $R_{G,EXT}$ = 1Ω, Inductive Load, FWD: UJ3D1220KSD $T_J$ = 150°C | | 24 | | ns |
| Rise time | $t_r$ | | | 35 | | |
| Turn-off delay time | $t_{d(off)}$ | | | 43 | | |
| Fall time | $t_f$ | | | 37 | | |
| Turn-on energy | $E_{ON}$ | | | 880 | | µJ |
| Turn-off energy | $E_{OFF}$ | | | 800 | | |
| Total switching energy | $E_{TOTAL}$ | | | 1680 | | |

## Thermal Characteristics

| Parameter | symbol | Test Conditions | Value | | | Units |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Thermal resistance, junction-to-case | $R_{\theta JC}$ | | | 0.27 | 0.35 | °C/W |

## Typical Performance Diagrams

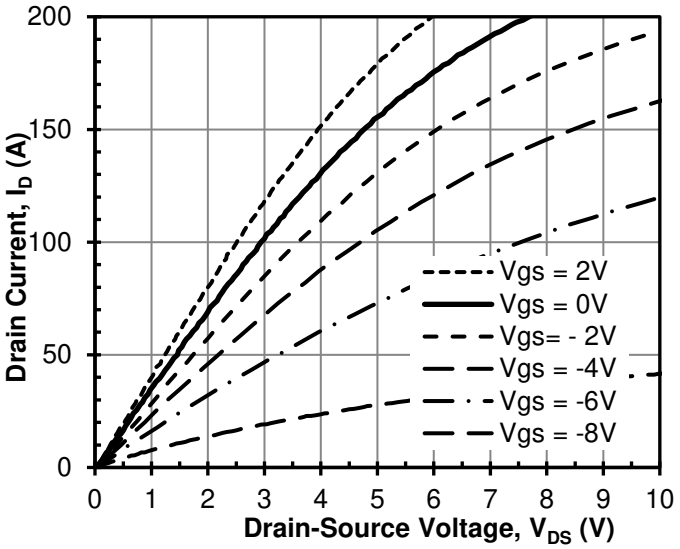



*Figure 1 Typical output characteristics at $T_J$ = -55°C*

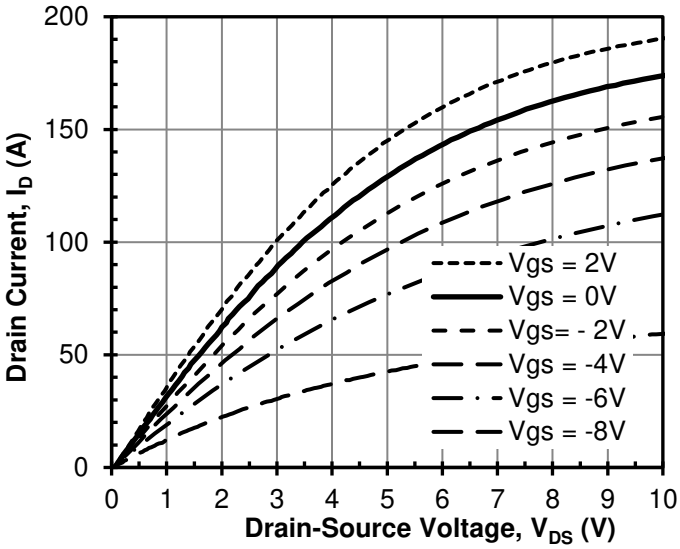



*Figure 2 Typical output characteristics at $T_J$ = 25°C*

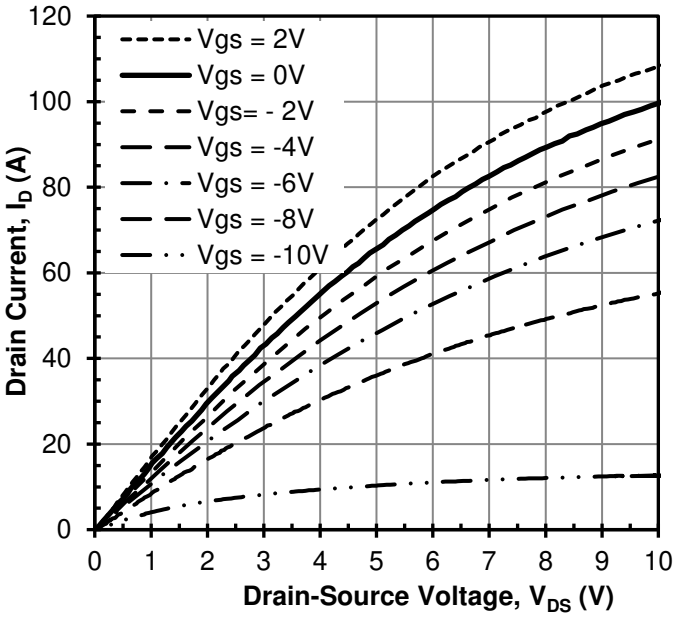



*Figure 3 Typical output characteristics at $T_J$ = 175°C*

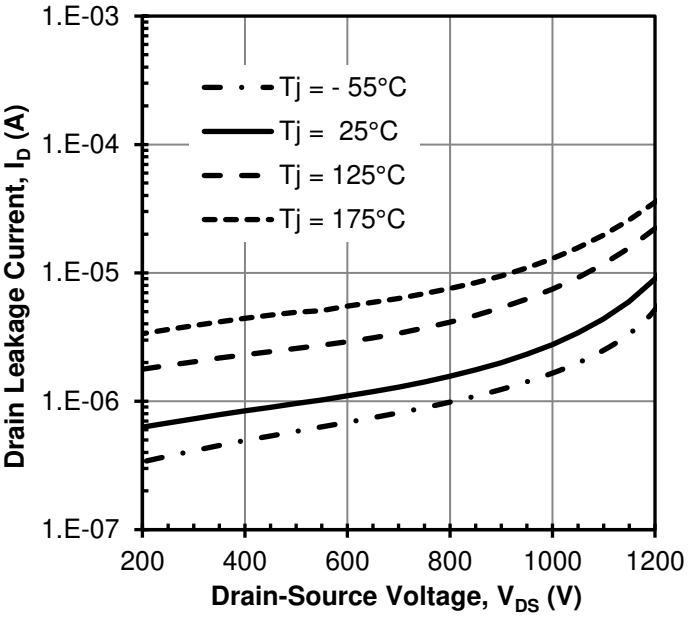



*Figure 4 Typical drain-source leakage at $V_{GS}$ = -20V*

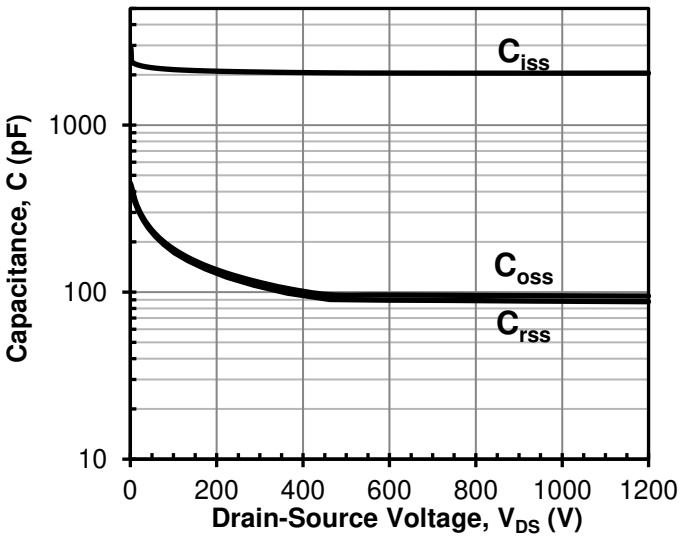



*Figure 5 Typical capacitances at 100kHz and $V_{GS}$ = -20V*

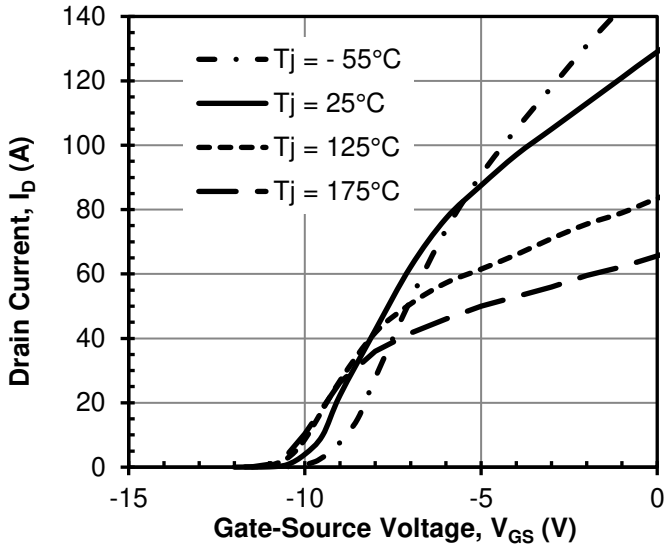



*Figure 6 Typical transfer characteristics at $V_{DS}$ = 5V*

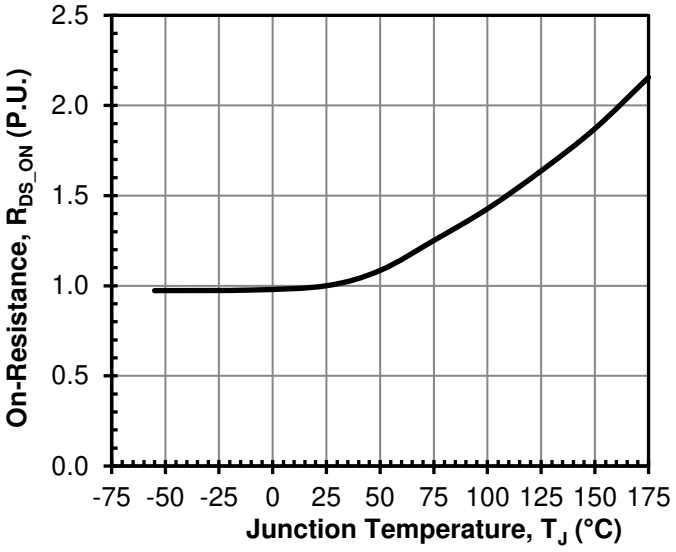



*Figure 7 Normalized on-resistance vs. temperature at $V_{GS}$ = 0V and $I_D$ = 20A*

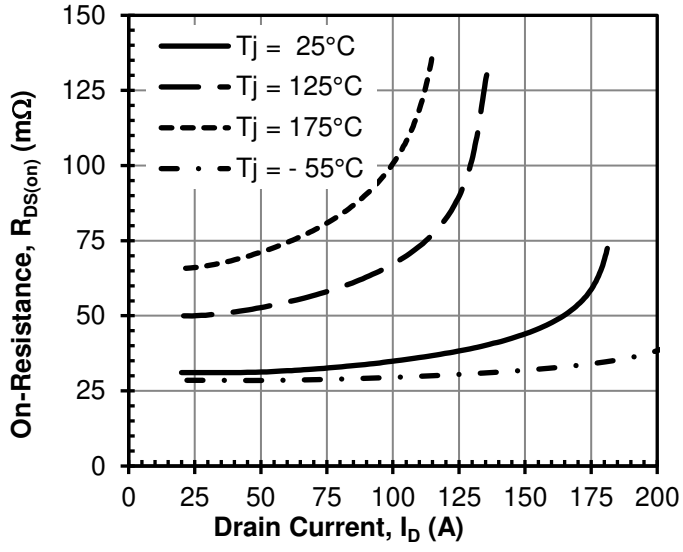



*Figure 8 Typical drain-source on-resistance at $V_{GS}$ = 0V*

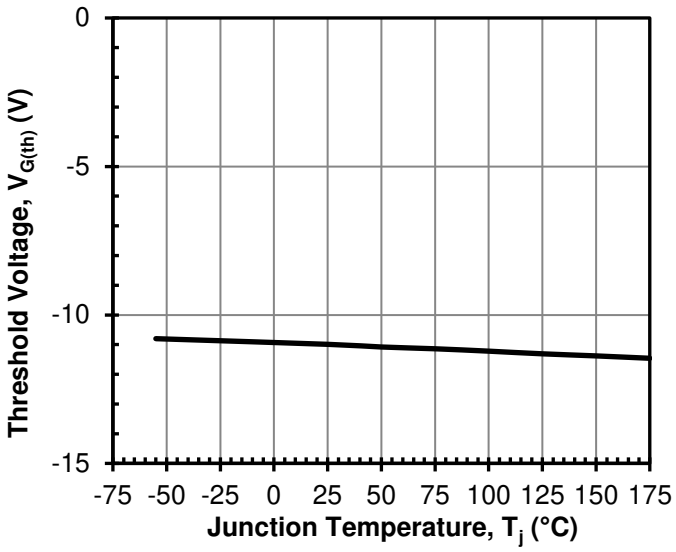



*Figure 9 Threshold voltage vs. Tj at $V_{DS}$ = 5V and $I_D$ = 70mA*

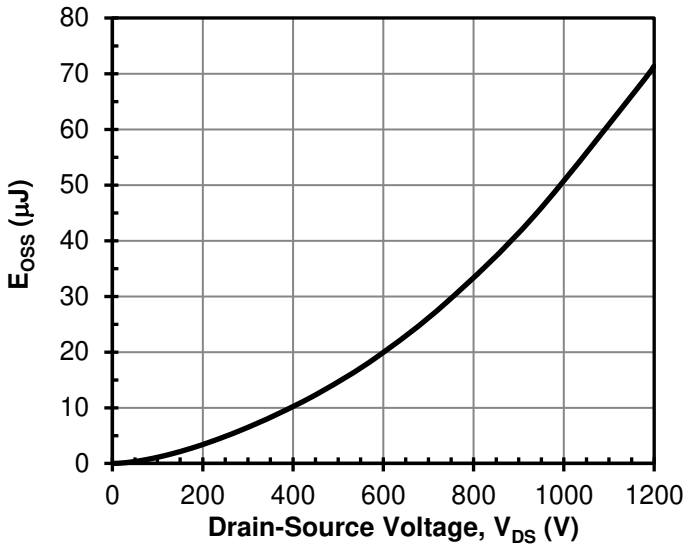



*Figure 10 Typical stored energy in $C_{OSS}$ at $V_{GS}$ = -20V*

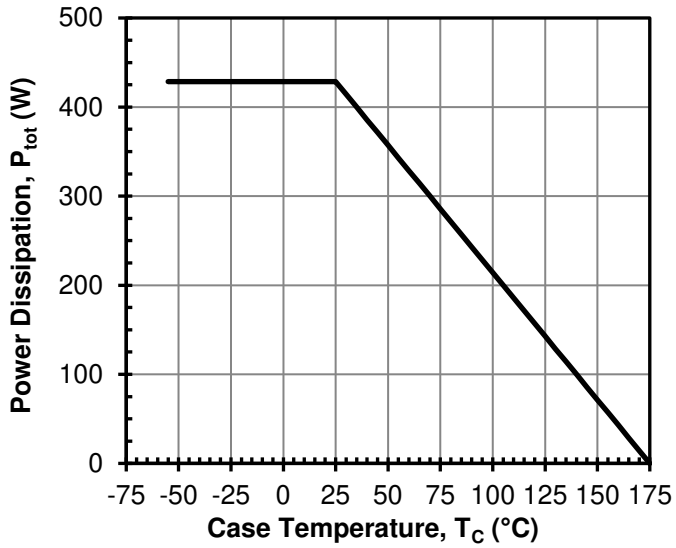



*Figure 11 Total power Dissipation*

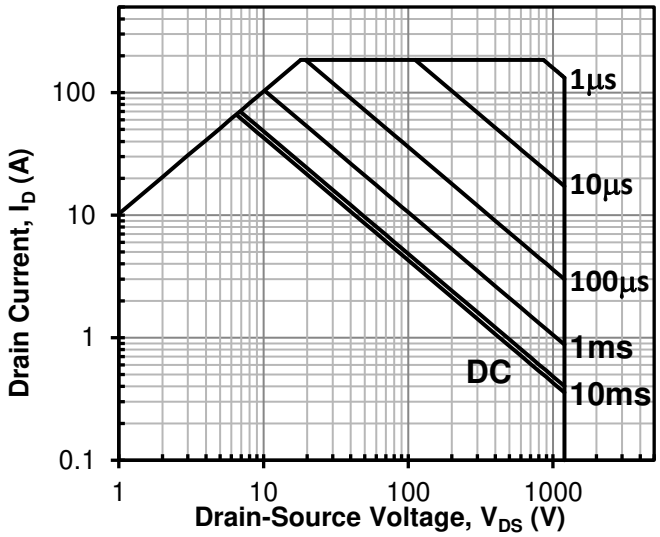



*Figure 12 Safe operation area $T_c$ = 25°C, Parameter $t_p$*

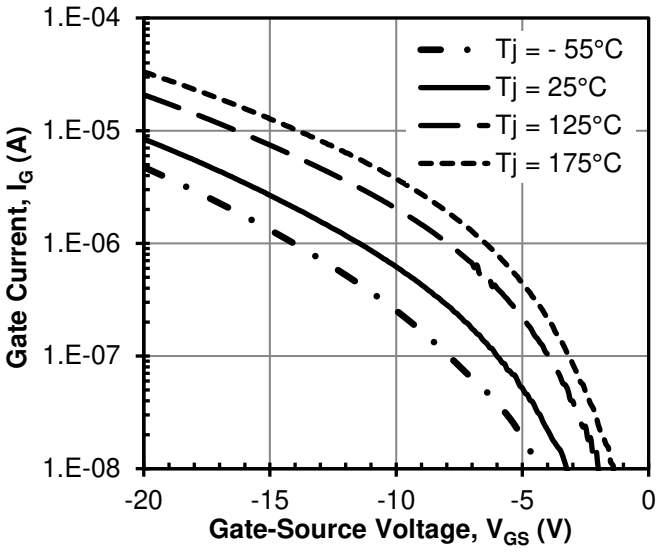



***Figure 13 Typical gate leakage current at $V_{DS}$ = 0V***

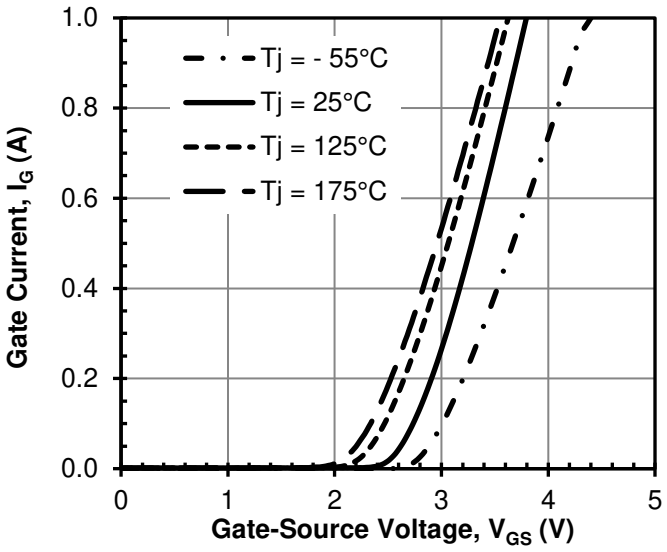



***Figure 14 Typical gate forward current at $V_{DS}$ = 0V***

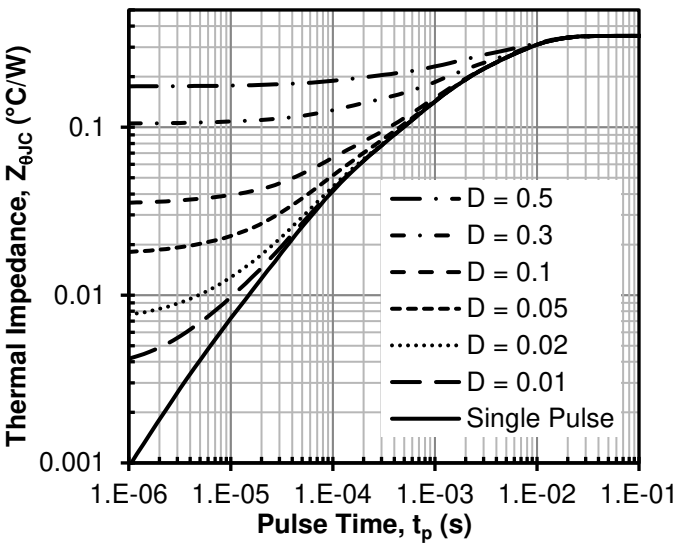



***Figure 15 Maximum transient thermal impedance***

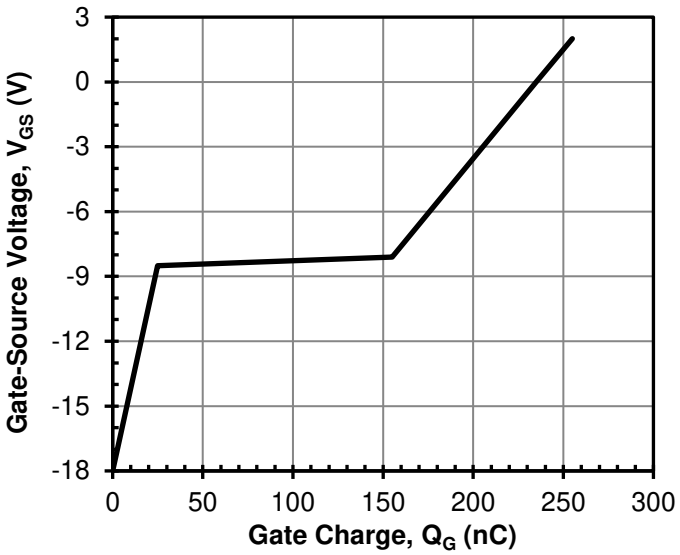



***Figure 16 Typical gate charge at $V_{DS}$ = 800V and $I_D$ = 40A***

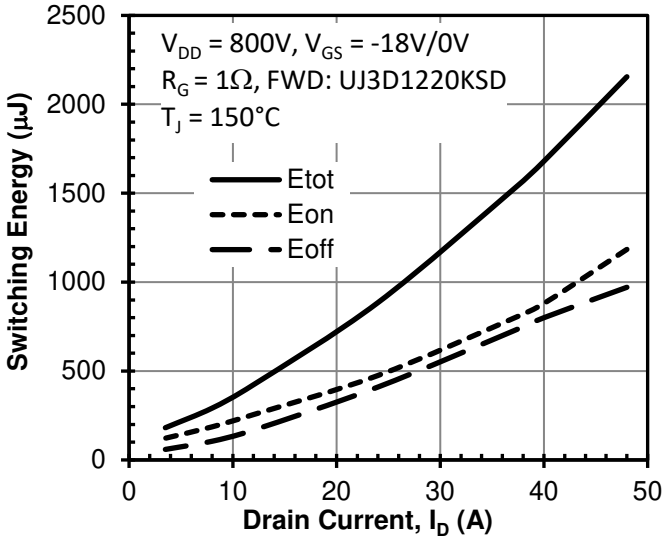



*Figure 17 Clamped inductive switching energy vs. drain current at $T_J$ = 150°C*

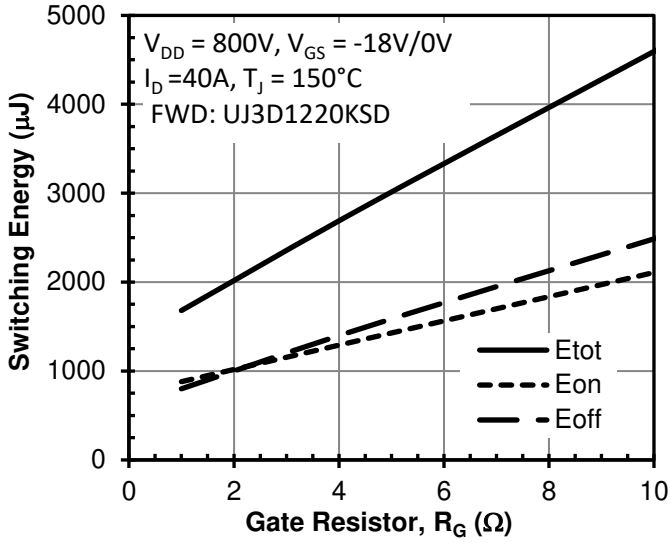



*Figure 18 Clamped inductive switching energy vs. gate resistor $R_G$*

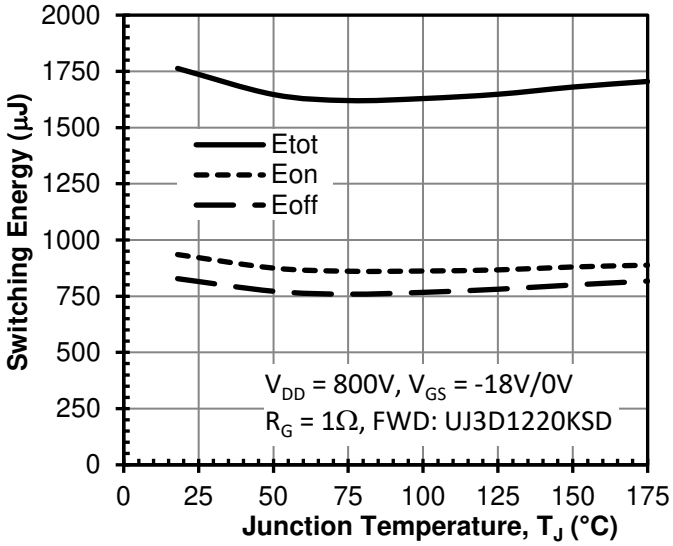



*Figure 19 Clamped inductive switching energy vs. junction temperature at $I_D$ = 40A*

## Disclaimer

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