# SiC JFET Division

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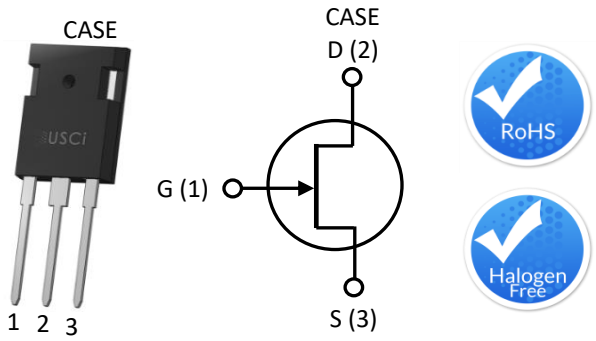
## Description

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 |
|---|---|---|
| UJ3N120070K3S | TO-247-3L | UJ3N120070K3S |

## Features

- Typical on-resistance $R_{DS(on),typ}$ of 70mΩ
- 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 | 33.5 | A |
| | | $T_C$ = 100°C | 24.5 | A |
| Pulsed drain current (3) | $I_{DM}$ | $T_C$ = 25°C | 85 | A |
| Power dissipation | $P_{tot}$ | $T_C$=25°C | 254 | 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 | | 5 | 30 | µA |
| | | $V_{DS}$ = 1200V, $V_{GS}$ = -20V, $T_J$ = 175°C | | 18 | | |
| Total gate leakage current | $I_G$ | $V_{GS}$=-20V, $T_j$=25°C | | 5 | 50 | µA |
| | | $V_{GS}$=-20V, $T_j$=175°C | | 20 | | |
| Drain-source on-resistance | $R_{DS(on)}$ | $V_{GS}$=2V, $I_D$=10A, $T_J$ = 25°C | | 63 | | mΩ |
| | | $V_{GS}$=0V, $I_D$=10A, $T_J$ = 25°C | | 70 | 90 | |
| | | $V_{GS}$=2V, $I_D$=10A, $T_J$ = 175°C | | 139 | | |
| | | $V_{GS}$=0V, $I_D$=10A, $T_J$ = 175°C | | 154 | | |
| Gate threshold voltage | $V_{G(th)}$ | $V_{DS}$= 5V, $I_D$ = 35mA | -14 | -11.5 | -6 | V |
| Gate resistance | $R_G$ | f = 1MHz, open drain | | 3.3 | | 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 | | 985 | | pF |
| Output capacitance | $C_{oss}$ | | | 100 | | |
| Reverse transfer capacitance | $C_{rss}$ | | | 95 | | |
| Effective output capacitance, energy related | $C_{oss(er)}$ | $V_{DS}$ = 0V to 800V, $V_{GS}$ = -20V | | 52 | | pF |
| Total gate charge | $Q_G$ | $V_{DS}$=800V, $I_D$ = 25A, $V_{GS}$=-18V to 0V | | 116 | | nC |
| Gate-drain charge | $Q_{GD}$ | | | 63 | | |
| Gate-source charge | $Q_{GS}$ | | | 11 | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DS}$=800V, $I_D$=25A, Gate Driver =-18V to 0V, $R_{G,EXT}$ = 1Ω, Inductive Load, FWD: UJ2D1215T $T_J$ = 25°C | | 17 | | ns |
| Rise time | $t_r$ | | | 25 | | |
| Turn-off delay time | $t_{d(off)}$ | | | 29 | | |
| Fall time | $t_f$ | | | 39 | | |
| Turn-on energy | $E_{ON}$ | | | 434 | | µJ |
| Turn-off energy | $E_{OFF}$ | | | 393 | | |
| Total switching energy | $E_{TOTAL}$ | | | 827 | | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DS}$=800V, $I_D$=25A, Gate Driver =-18V to 0V, $R_{G,EXT}$ = 1Ω, Inductive Load, FWD: UJ2D1215T $T_J$ = 150°C | | 17 | | ns |
| Rise time | $t_r$ | | | 23 | | |
| Turn-off delay time | $t_{d(off)}$ | | | 25 | | |
| Fall time | $t_f$ | | | 24 | | |
| Turn-on energy | $E_{ON}$ | | | 418 | | µJ |
| Turn-off energy | $E_{OFF}$ | | | 278 | | |
| Total switching energy | $E_{TOTAL}$ | | | 696 | | |

## Thermal Characteristics

| Parameter | symbol | Test Conditions | Value | | | Units |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Thermal resistance, junction-to-case | $R_{\theta JC}$ | | | 0.45 | 0.59 | °C/W |

## Typical Performance Diagrams

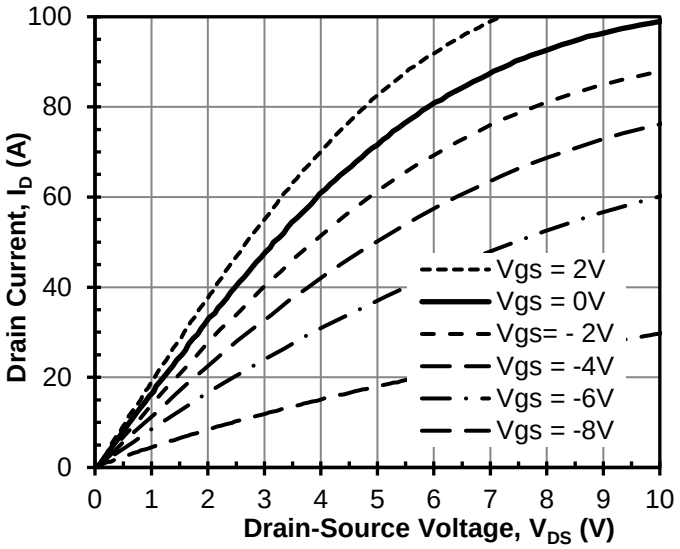



***Figure 1 Typical output characteristics at $T_J$ = -55°C***

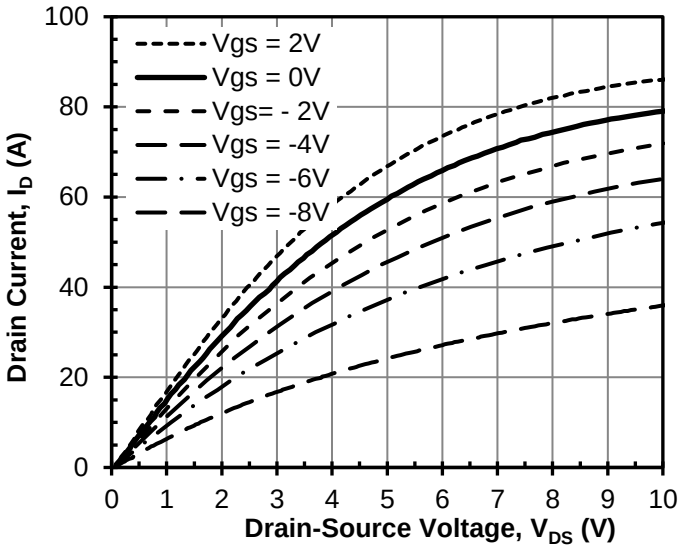



***Figure 2 Typical output characteristics at $T_J$ = 25°C***

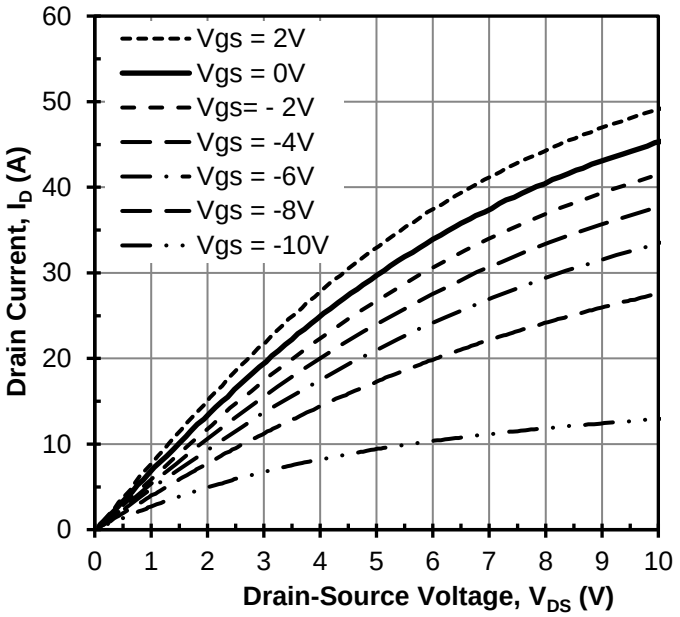



***Figure 3 Typical output characteristics at $T_J$ = 175°C***

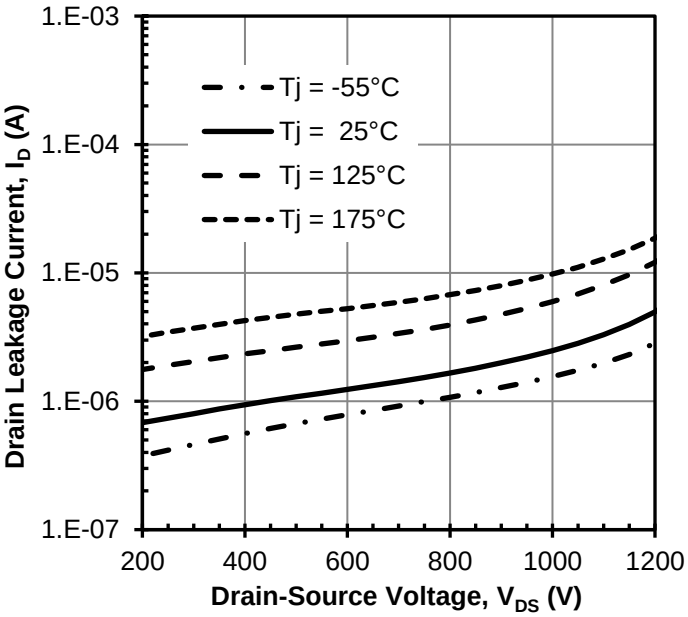



***Figure 4 Typical drain-source leakage at $V_{GS}$ = -20V***

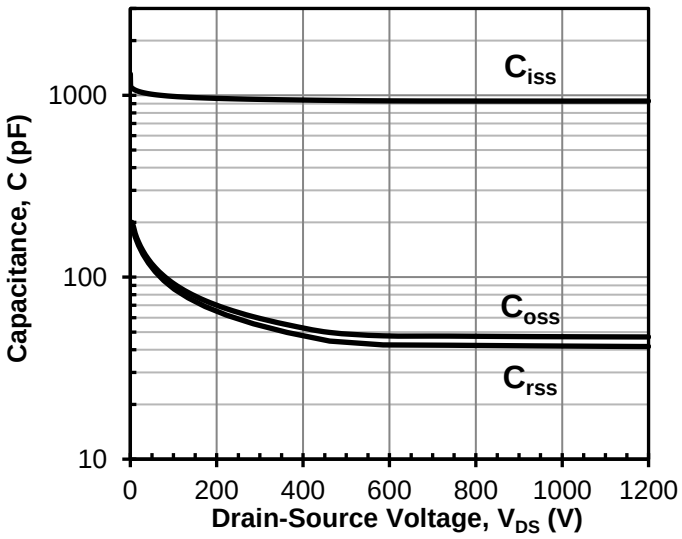



*Figure 5 Typical capacitances at 100kHz and $V_{GS}$ = -20V*

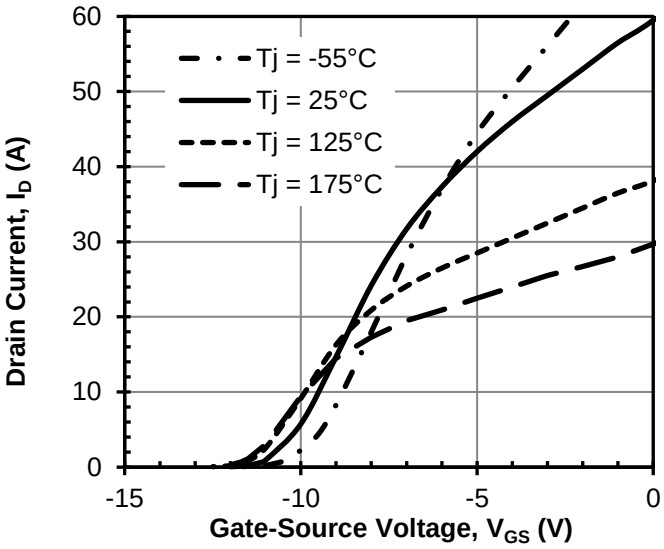



*Figure 6 Typical transfer characteristics at $V_{DS}$ = 5V*

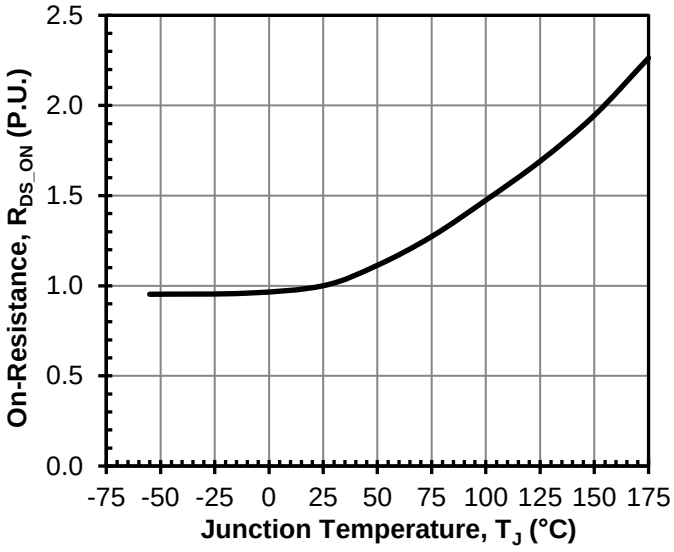



*Figure 7 Normalized on-resistance vs. temperature at $V_{GS}$ = 0V and $I_D$ = 10A*

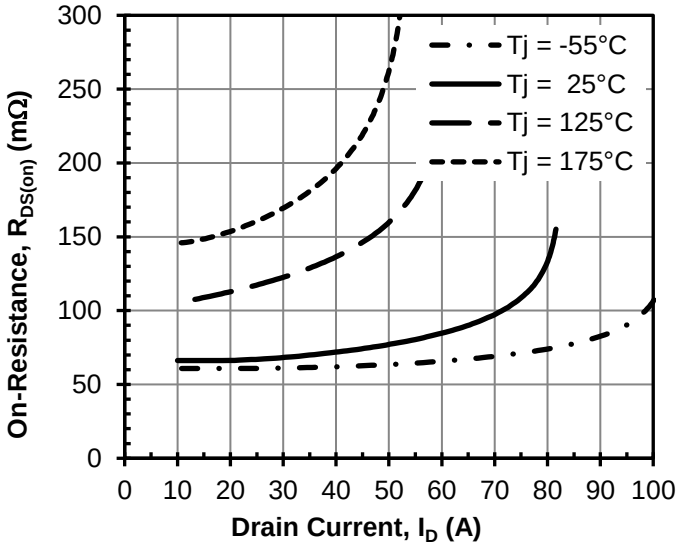



*Figure 8 Typical drain-source on-resistance at $V_{GS}$ = 0V*

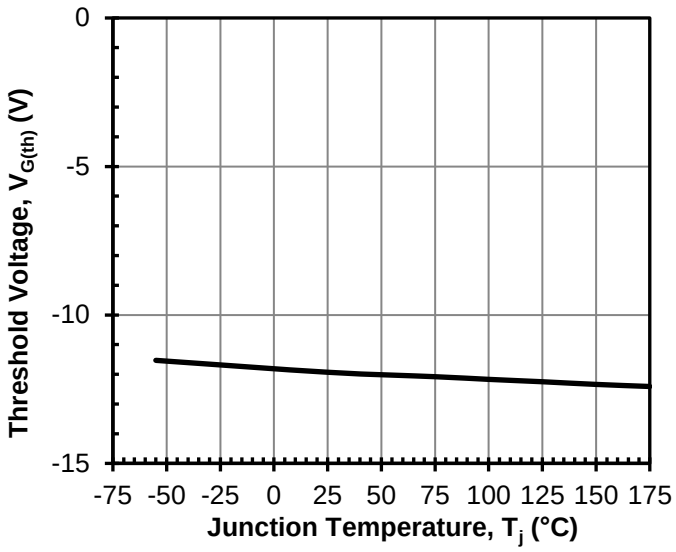



***Figure 9 Threshold voltage vs. Tj at $V_{DS}$ = 5V and $I_D$ = 35mA***

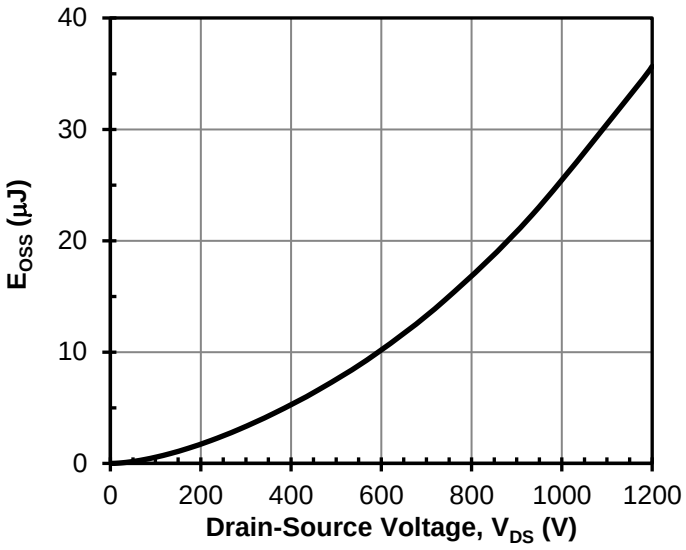



***Figure 10 Typical stored energy in $C_{OSS}$ at $V_{GS}$ = -20V***

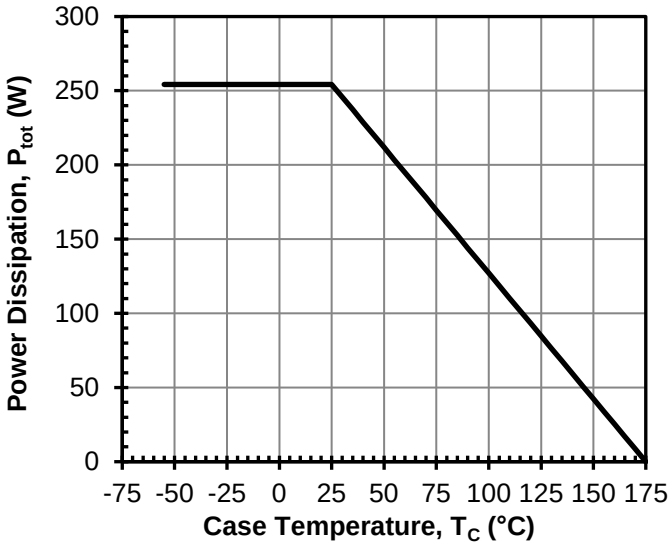



***Figure 11 Total power Dissipation***

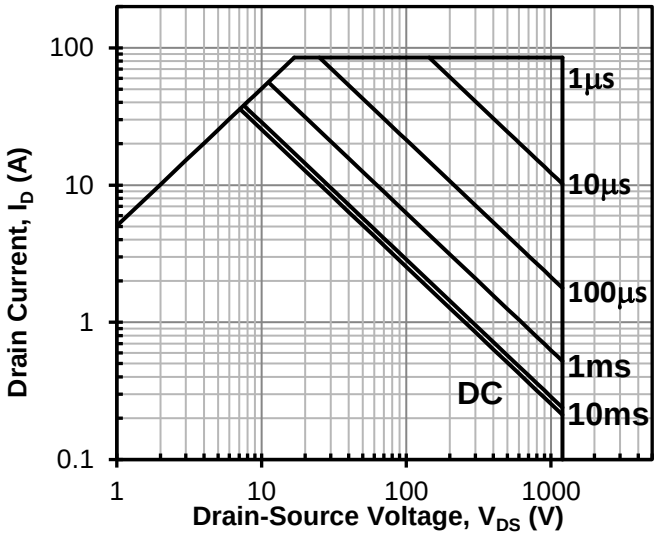



***Figure 12 Safe operation area $T_c$ = 25°C, Parameter $t_p$***

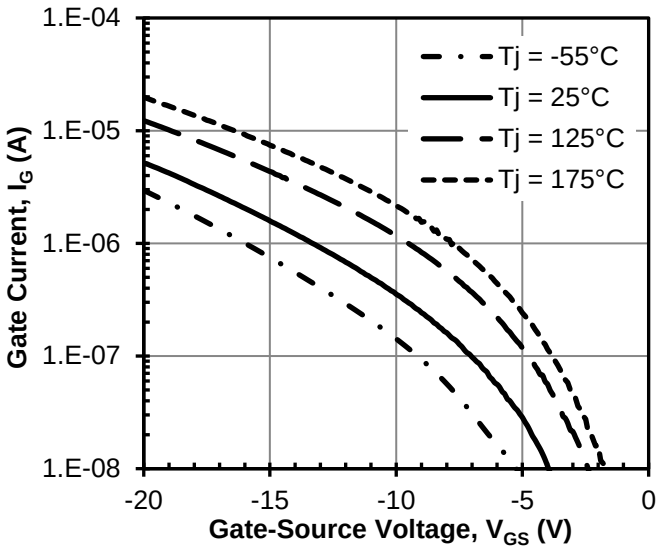



***Figure 13 Typical gate leakage current at $V_{DS}$ = 0V***

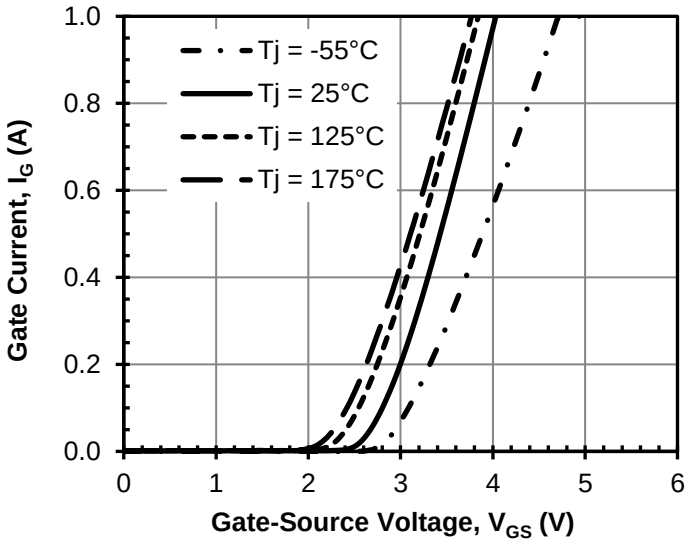



***Figure 14 Typical gate forward current at $V_{DS}$ = 0V***

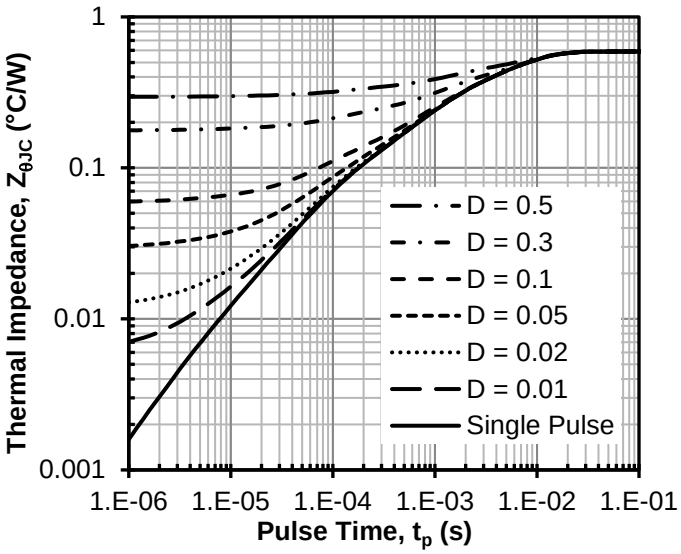



***Figure 15 Maximum transient thermal impedance***

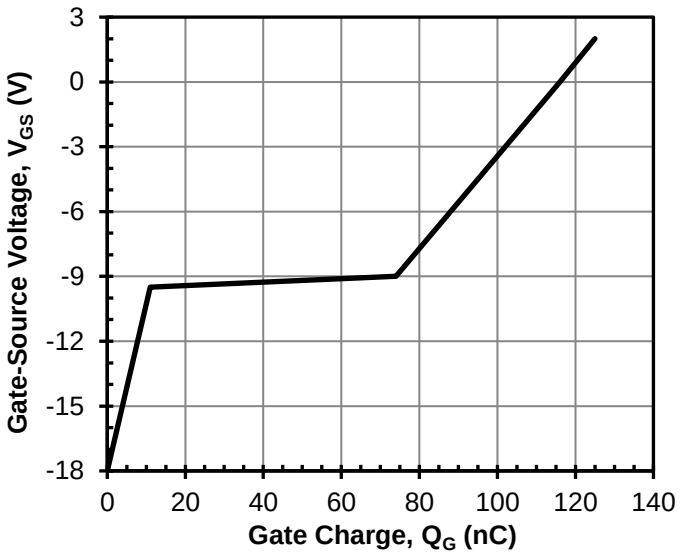



***Figure 16 Typical gate charge at $V_{DS}$ = 800V and $I_D$ = 25A***

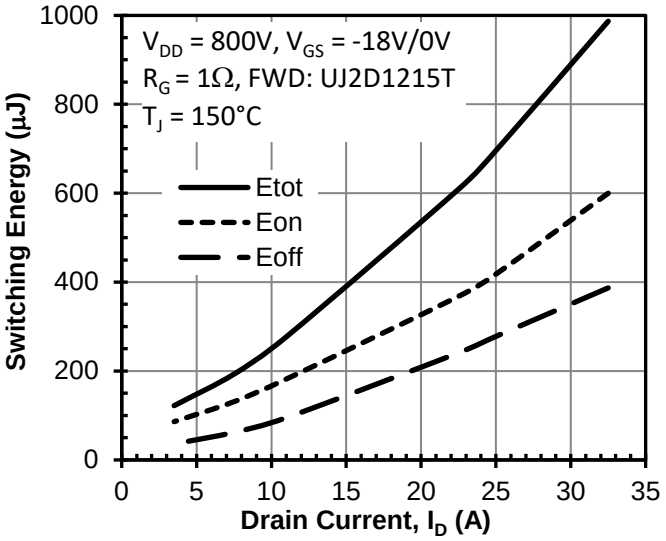



***Figure 17 Clamped inductive switching energy vs. drain current at $T_J$ = 150°C***

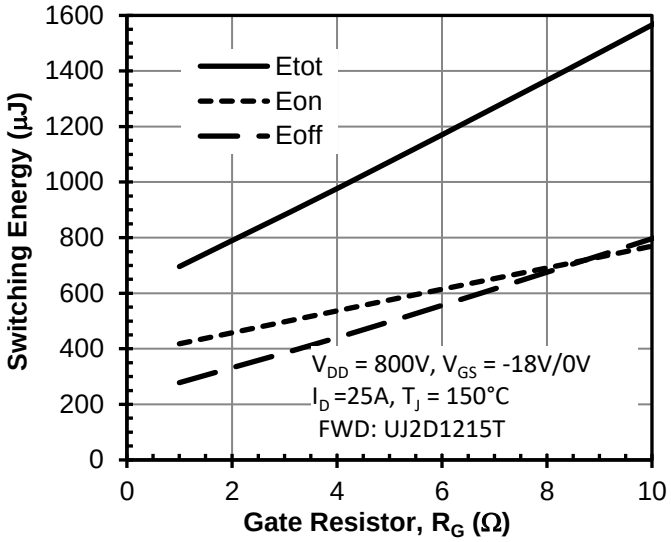



***Figure 18 Clamped inductive switching energy vs. gate resistor $R_G$***

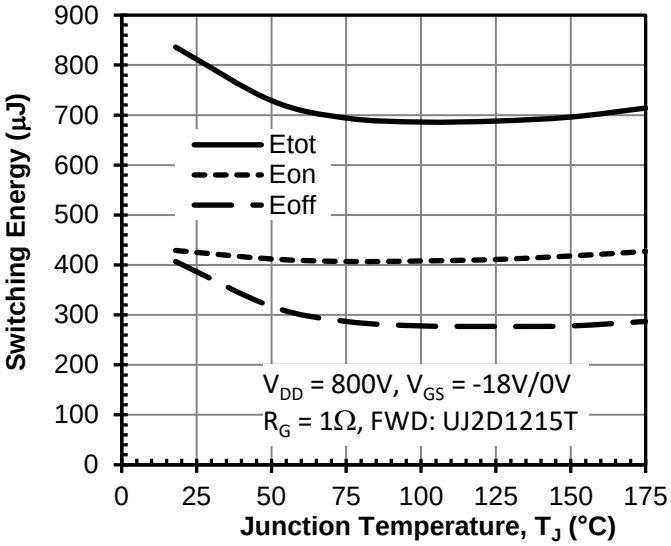



***Figure 19 Clamped inductive switching energy vs. junction temperature at $I_D$ = 25A***

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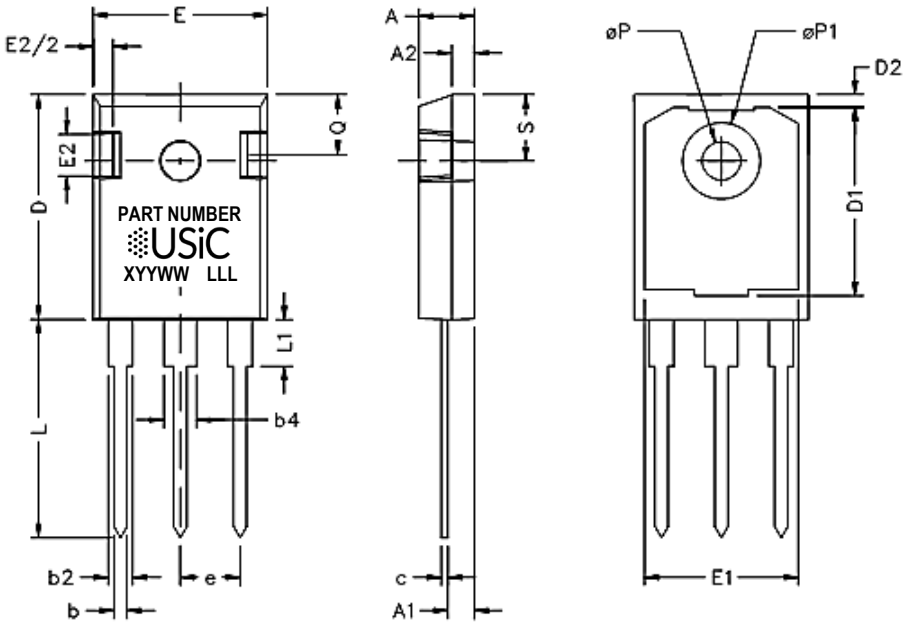
# TO-247-3L PACKAGE OUTLINE, PART MARKING AND TUBE SPECIFICATIONS

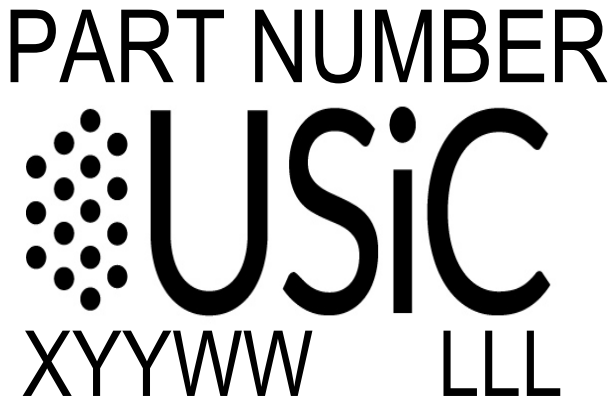
## PACKAGE OUTLINE




| SYM | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.185 | 0.209 | 4.699 | 5.309 |
| A1 | 0.087 | 0.102 | 2.21 | 2.61 |
| A2 | 0.059 | 0.098 | 1.499 | 2.489 |
| b | 0.039 | 0.055 | 0.991 | 1.397 |
| b2 | 0.065 | 0.094 | 1.651 | 2.388 |
| b4 | 0.102 | 0.135 | 2.591 | 3.429 |
| c | 0.015 | 0.035 | 0.381 | 0.889 |
| D | 0.819 | 0.845 | 20.803 | 21.463 |
| D1 | 0.515 | - | 13.081 | - |
| D2 | 0.02 | 0.053 | 0.508 | 1.346 |
| E | 0.61 | 0.64 | 15.494 | 16.256 |
| e | 0.214 BSC | | 5.44 BSC | |
| E1 | 0.53 | - | 13.462 | - |
| E2 | 0.135 | 0.157 | 3.429 | 3.988 |
| L | 0.78 | 0.8 | 19.812 | 20.32 |
| L1 | - | 0.177 | - | 4.496 |
| ØP | 0.14 | 0.144 | 3.556 | 3.658 |
| ØP1 | 0.278 | 0.291 | 7.061 | 7.391 |
| Q | 0.212 | 0.244 | 5.385 | 6.198 |
| S | 0.243 BSC | | 6.17 BSC | |

# TO-247-3L PACKAGE OUTLINE, PART MARKING AND TUBE SPECIFICATIONS

## PART MARKING




PART NUMBER = REFER TO DS_PN DECODER FOR DETAILS

X = ASSEMBLY SITE
YY = YEAR
WW = WORK WEEK
LLL = LOT ID

## PACKING TYPE

**ANTI-STATIC TUBE**

**QUANTITY /TUBE : 30 UNITS**

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