# WNSC2M1K0170W

## N-Channel Silicon Carbide MOSFET

Rev.01 - 25 July 2022 Product data sheet

## 1. General description

Silicon Carbide MOSFET in a 3-lead TO247 plastic package, designed for high frequency, high efficiency systems.

RoHS Halogen-Free Lead-Free

## 2. Features and benefits

- Low on-resistance
- Optimized for fly-back topologies
- 15V/0V gate-source voltage compatible with fly-back controllers
- 100% UIS Tested
- Controllable dV/dt for optimized EMI
- Reduced cooling requirements
- RoHS compliant

## 3. Applications

- Switch Mode Power Supplies
- Auxiliary Power Supplies

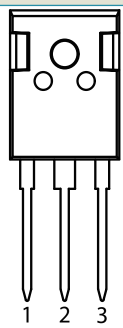
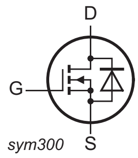
## 4. Quick reference data

**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | Notes | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Absolute maximum rating** | | | | | | | |
| $V_{DS}$ | drain-source voltage | 25 °C ≤ $T_j$ ≤ 175 °C | | - | - | 1700 | V |
| $I_D$ | drain current | $V_{GS}$ = 18 V; $T_{mb}$ = 25 °C | | - | - | 7 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C | | - | - | 79 | W |
| $T_j$ | junction temperature | | | -55 | - | 175 | °C |
| **Static characteristics** | | | | | | | |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS}$ = 15 V; $I_D$ = 1 A; $T_j$ = 25 °C | | - | 1000 | - | mΩ |
| | | $V_{GS}$ = 18 V; $I_D$ = 1 A; $T_j$ = 25 °C | | - | 750 | 1000 | mΩ |
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 2 A; $V_{DS}$ = 1200 V; $V_{GS}$ = 0V/18 V; $T_j$ = 25 °C | | - | 12 | - | nC |
| $Q_{GD}$ | gate-drain charge | | | - | 5 | - | nC |
| **Source-drain diode** | | | | | | | |
| $Q_r$ | recovered charge | $I_{SD}$ = 1 A; di/dt = 500 A/µs; $V_{DS}$ = 400 V; $T_j$ = 25 °C | | - | 38 | - | nC |

## 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | G | gate |   |   |
| 2 | D | drain | | |
| 3 | S | source | | |
| mb | D | mounting base; connected to drain | | |

## 6. Ordering information

**Table 3. Ordering information**

| Type number | Package Name | Orderable part number | Packing method | Small packing quantity | Package version | Package issue date |
|---|---|---|---|---|---|---|
| WNSC2M1K0170W | TO247 | WNSC2M1K0170WQ | Tube | 30 | TO247N | 20-July-2016 |

## 7. Marking

**Table 4. Marking codes**

| Type number | Marking codes |
|---|---|
| WNSC2M1K0170W | WNSC2M<br>1K0170W |

# 8. Limiting values

**Table 5. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | Notes | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | 25 °C ≤ $T_j$ ≤ 175 °C | | - | 1700 | V |
| $V_{GS,max}$ | gate-source voltage | | | -10 | 22 | V |
| $V_{GS,op}$ | gate-source voltage | | | -5 | 18 | V |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C | | - | 79 | W |
| $I_D$ | drain current | $V_{GS}$ = 18 V; $T_{mb}$ = 25 °C | | - | 7 | A |
| | | $V_{GS}$ = 18 V; $T_{mb}$ = 100 °C | | - | 5 | A |
| $I_{DM}$ | peak drain current | pulsed; $t_p$ ≤ 10 µs; $T_{mb}$ = 25 °C | | - | 20 | A |
| $E_{as}$ | single pulse drain−to-source avalanche | $I_{AS}$ = 7 A; L = 1 mH; $V_{DD}$ = 100 V, $T_{j(init)}$ = 25 °C | | 24.5 | - | mJ |
| $T_{stg}$ | storage temperature | | | -55 | 175 | °C |
| $T_j$ | junction temperature | | | -55 | 175 | °C |
| $T_{sld(M)}$ | peak soldering temperature | | | - | 260 | °C |

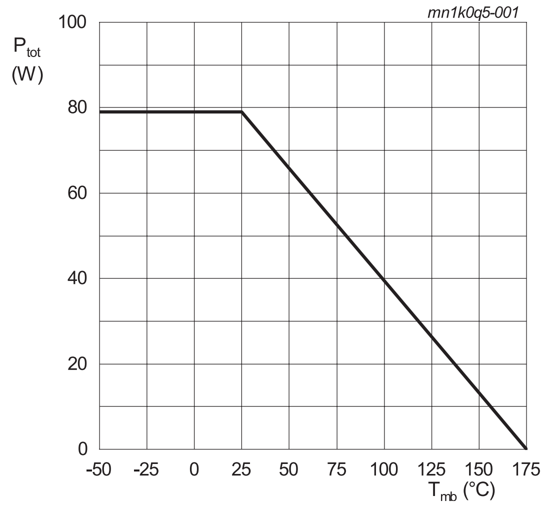



**Fig. 1. Normalized total power dissipation as a function of mounting base temperature; maximum values**

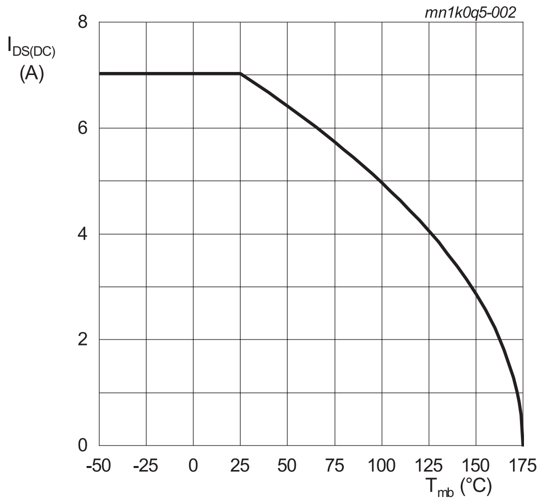



**Fig. 2. Continuous Drain Current as a function of mounting base temperature**

# 9. Thermal & Mechanical characteristics

**Table 6. Thermal & Mechanical characteristics**

| Symbol | Parameter | Conditions | Notes | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | | | - | - | 1.90 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | | - | 40 | - | K/W |
| $M_d$ | Mounting torque | M3 or 6 - 32 screw | | - | - | 0.6 | Nm |

Note: It is recommended that a metal washer is inserted between screw head and mounting tab.
Do not use self-tapping screws.
Device is ESD sensitive. Handling precautions are recommanded.

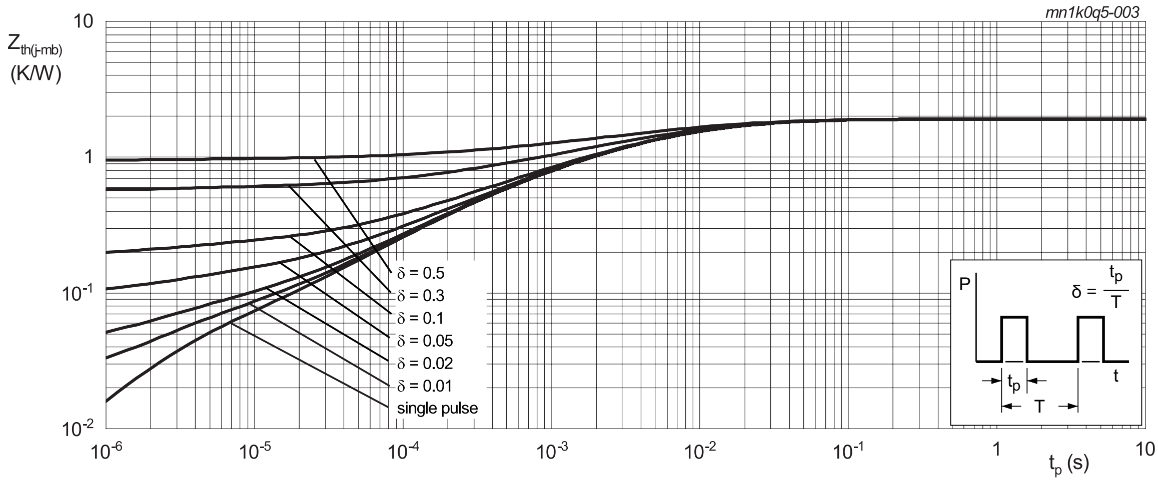
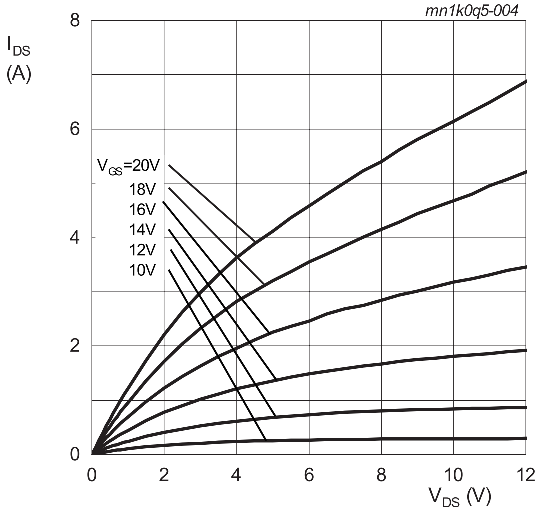



**Fig. 3. Transient thermal impedance from junction to mounting base as a function of pulse duration**

# 10. Characteristics

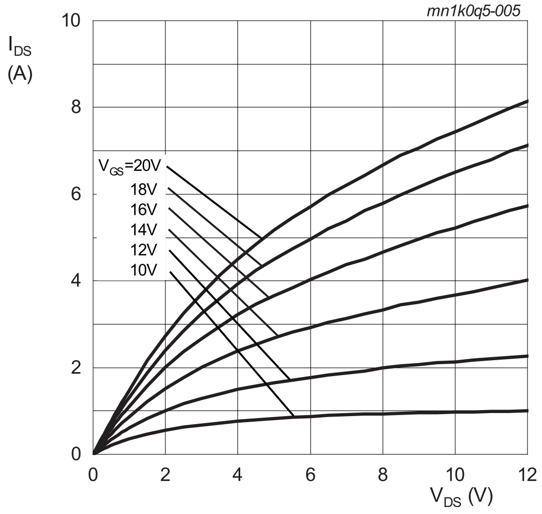
**Table 7. Characteristics**

| Symbol | Parameter | Conditions | Notes | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = 100 μA; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | 1700 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 0.8 mA; $V_{DS}$ = 10 V; $T_j$ = 25 °C | | 2.3 | 3.2 | 4.2 | V |
| | | $I_D$ = 0.8 mA; $V_{DS}$ = 10 V; $T_j$ = 150 °C | | - | 2.4 | - | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 1700 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | 0.1 | 10 | μA |
| | | $V_{DS}$ = 1700 V; $V_{GS}$ = 0 V; $T_j$ = 150 °C | | - | 1 | - | μA |
| $I_{GSS}$ | gate leakage current (absolute value) | $V_{GS}$ = 18 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | 10 | 100 | nA |
| | | $V_{GS}$ = -10 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | 10 | 100 | nA |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS}$ = 15 V; $I_D$ = 1 A; $T_j$ = 25 °C | | - | 1000 | - | mΩ |
| | | $V_{GS}$ = 18 V; $I_D$ = 1 A; $T_j$ = 25 °C | | - | 750 | 1000 | mΩ |
| | | $V_{GS}$ = 18 V; $I_D$ = 1 A; $T_j$ = 150 °C | | - | 1050 | - | mΩ |
| $R_G$ | gate resistance | f = 1 MHz; $T_j$ = 25 °C | | - | 16 | - | Ω |
| $g_{fs}$ | transconductance | $V_{DS}$ = 10 V; $I_D$ = 1 A; $T_j$ = 25 °C | | - | 0.5 | - | S |
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 2 A; $V_{DS}$ = 1200 V; $V_{GS}$ = 0 V/18 V; $T_j$ = 25 °C | | - | 12 | - | nC |
| $Q_{GS}$ | gate-source charge | | | - | 3.8 | - | nC |
| $Q_{GD}$ | gate-drain charge | | | - | 5 | - | nC |
| $C_{iss}$ | input capacitance | $V_{DS}$ = 1000 V; $V_{GS}$ = 0 V; f = 1 MHz; $T_j$ = 25 °C | | - | 225 | - | pF |
| $C_{oss}$ | output capacitance | | | - | 15 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | | | - | 2.8 | - | pF |
| $E_{oss}$ | Coss stored energy | | | - | 7.5 | - | μJ |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = 1000 V; $V_{GS}$ = -3/18 V; $R_{G(ext)}$ = 5.1 Ω; $I_D$ = 2 A; L = 4.8 mH; $T_j$ = 25 °C | | - | 5.6 | - | ns |
| $t_r$ | rise time | | | - | 18 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | | - | 7.8 | - | ns |
| $t_f$ | fall time | | | - | 60 | - | ns |
| $E_{on}$ | turn-on energy (Body Diode FWD) | | | - | 57 | - | μJ |
| $E_{off}$ | turn-off energy (Body Diode FWD) | | | - | 11 | - | μJ |
| **Source-drain diode** | | | | | | | |
| $V_{SD}$ | source-drain voltage | $V_{GS}$ = 0 V; $I_F$ = 1 A; $T_j$ = 25 °C | | - | 3.9 | - | V |
| | | $V_{GS}$ = 0 V; $I_F$ = 1 A; $T_j$ = 150 °C | | - | 3.4 | - | V |
| $t_{rr}$ | reverse recovery time | $I_{SD}$ = 1 A; di/dt = 500 A/μs; $V_{DS}$ = 400 V; $T_j$ = 25 °C | | - | 36 | - | ns |
| $Q_r$ | recovered charge | | | - | 38 | - | nC |
| $I_{rrm}$ | reverse recovery current | | | - | 1.8 | - | A |



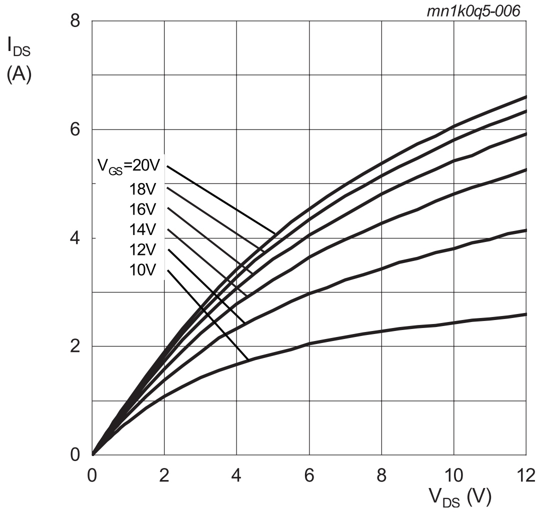

$T_j$ = -55 °C; $t_p$ < 200 µs

**Fig. 4. Output characteristics; drain current as a function of drain-source voltage; typical values**



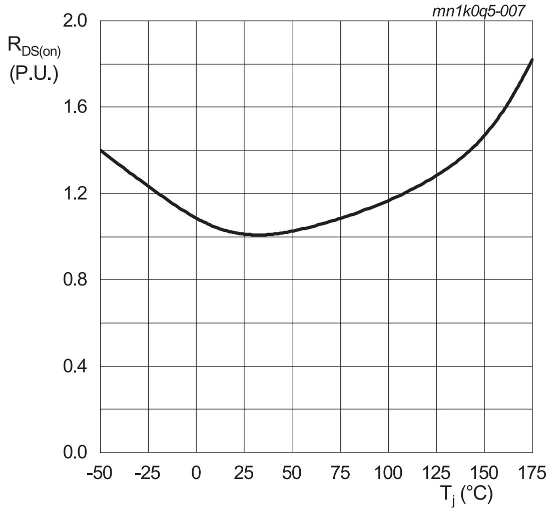

$T_j$ = 25 °C; $t_p$ < 200 µs

**Fig. 5. Output characteristics; drain current as a function of drain-source voltage; typical values**



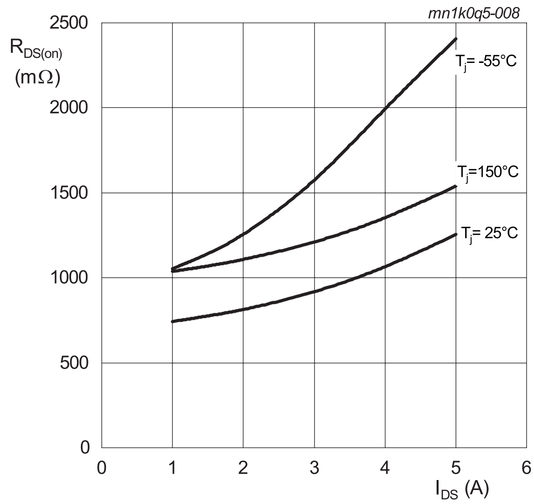

$T_j$ = 150 °C; $t_p$ < 200 µs

**Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values**



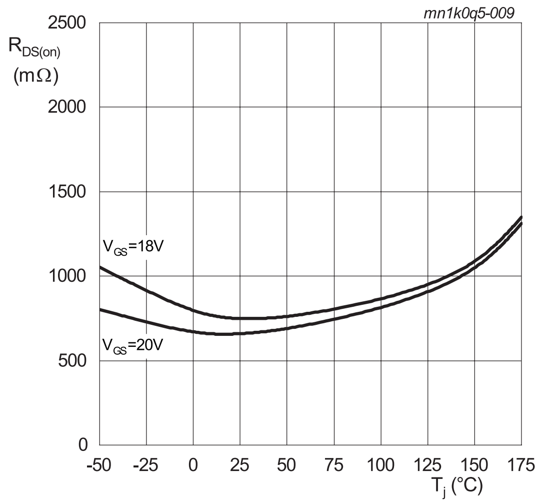

$I_{DS}$ = 1 A; $V_{GS}$ = 18 V; $t_p$ < 200 µs

**Fig. 7. Normalized drain-source on-state resistance as a function of junction temperature**



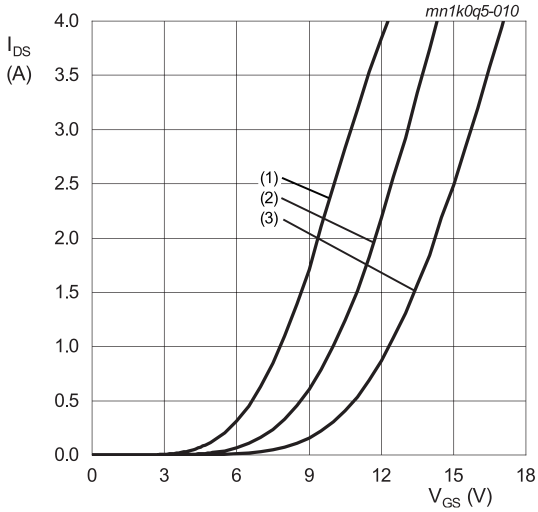

$V_{GS}$ = 18 V; $t_p$ < 200 µs

**Fig. 8. Drain-source on-state resistance as a function of drain current; typical values**




$I_{DS}$ = 1 A; $t_p$ < 200 µs

**Fig. 9. Drain-source on-state resistance as a function of junction temperature**



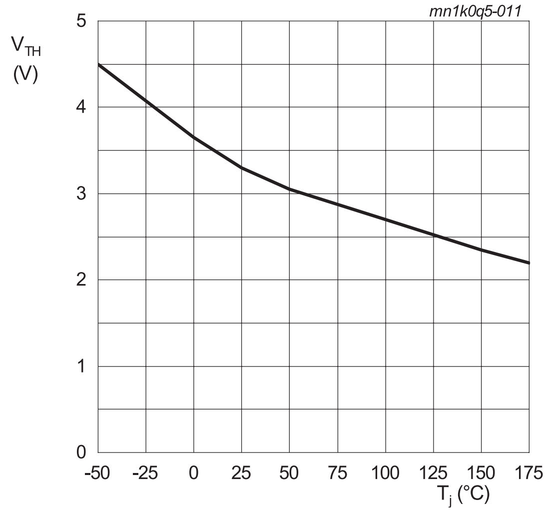

$V_{DS}$ = 10 V; $t_p$ < 200 µs

(1) $T_j$ = 150 °C

(2) $T_j$ = 25 °C

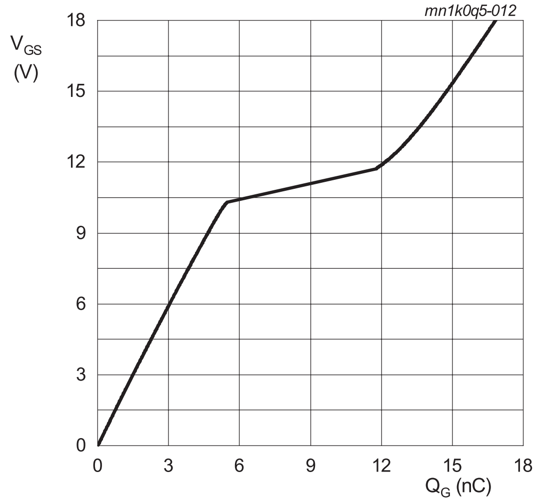
(3) $T_j$ = -55 °C

**Fig. 10. Transfer characteristics; drain current as a function of gate-source voltage; typical values**




$V_{DS}$ = 10 V; $I_{DS}$ = 0.8 mA

**Fig. 11. Threshold voltage as a function of junction temperature**




$I_{DS}$ = 2 A; $I_{GS}$ = 0.1 mA; $V_{DS}$ = 1200 V; $T_j$ = 25 °C

**Fig. 12. Gate-source voltage as a function of gate charge; typical values**

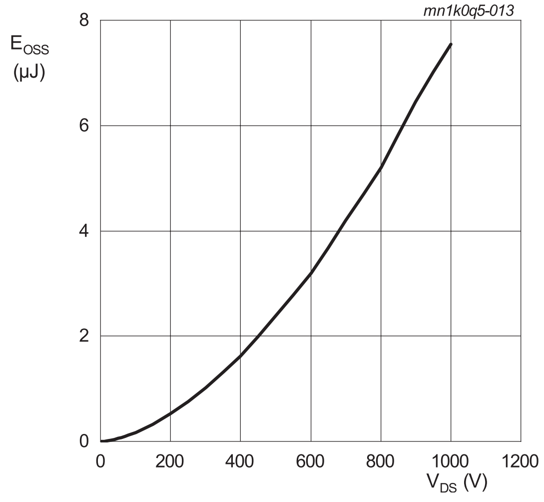
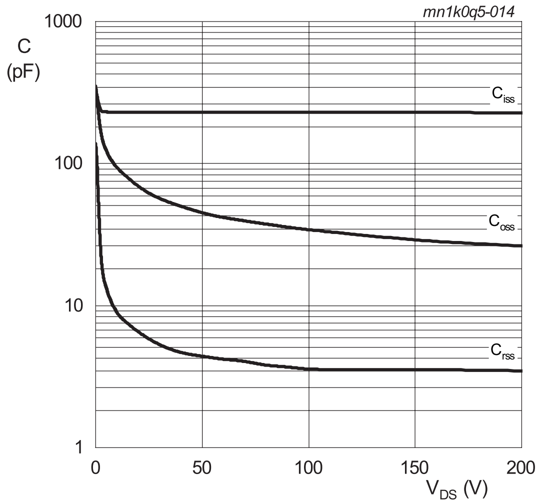
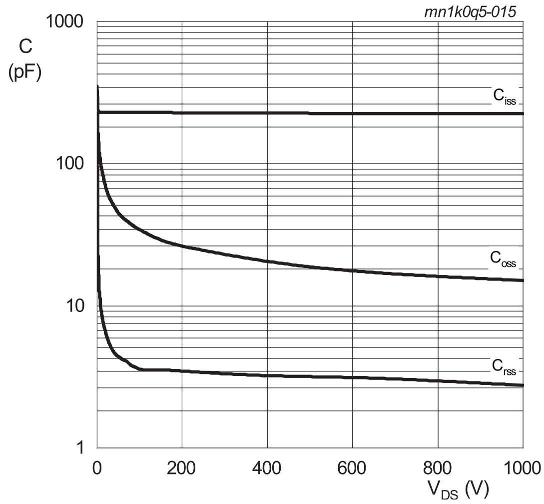



**Fig. 13. Output capacitor stored energy as a function of drain-source voltage**



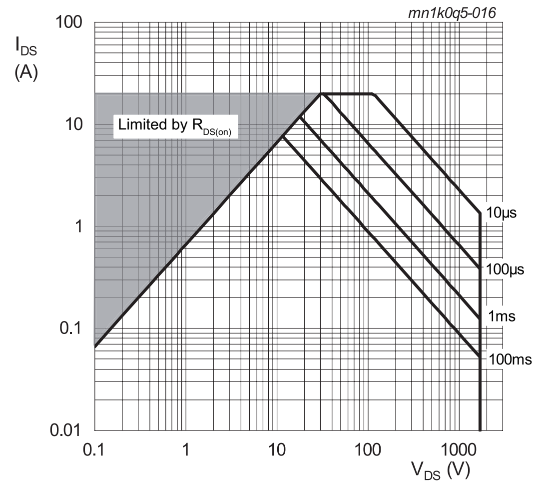

$V_{DS}$ = 0 - 200 V
$T_j$ = 25 °C; $V_{AC}$ = 25 mV; f = 1 MHz

**Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**




$V_{DS}$ = 0 - 1000 V
$T_j$ = 25 °C; $V_{AC}$ = 25 mV; f = 1 MHz

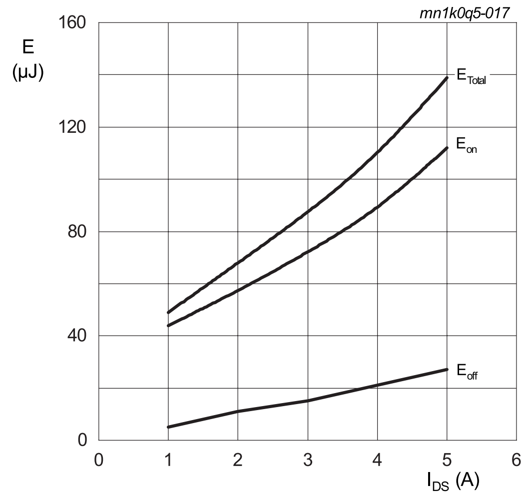
**Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**




$T_c$ = 25 °C; D = 0

Parameter: $t_p$

**Fig. 16. Forward bias safe operating area**

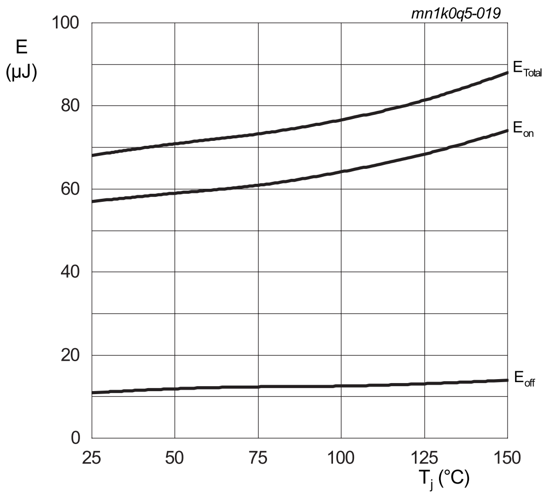



$T_j$ = 25 °C; $V_{DD}$ = 1000 V; $R_{G(ext)}$ = 5.1 Ω;

$V_{GS}$ = -3V/18 V; L = 4.8 mH;

FWD = WNSC2M1K0170W

**Fig. 17. Clamped Inductive Switching Energy as a function of drain current**

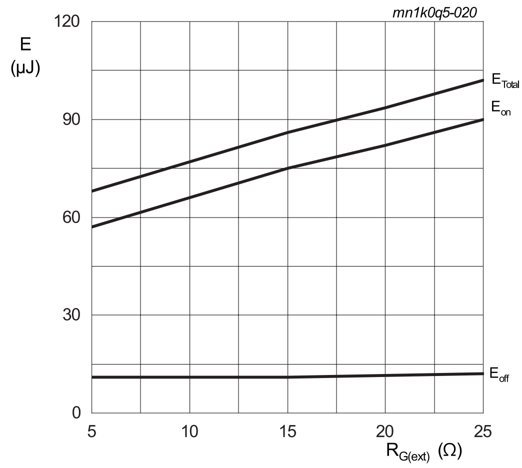



$I_{DS}$ = 2 A; $V_{DD}$ = 1000 V; $R_{G(ext)}$ = 5.1 Ω;

$V_{GS}$ = -3V/18 V; L = 4.8 mH;

FWD = WNSC2M1K0170W

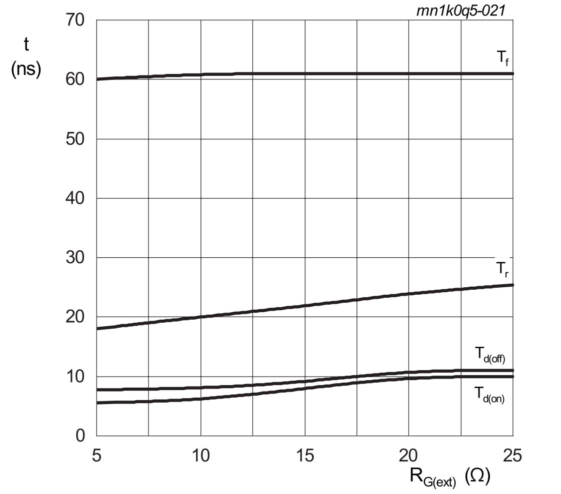
**Fig. 18. Clamped Inductive Switching Energy as a function of junction temperature**




$T_j$ = 25 °C; $V_{DD}$ = 1000 V; $I_{DS}$ = 2 A; $V_{GS}$ = -3V/18 V

FWD = WNSC2M1K0170W; L = 4.8 mH

**Fig. 19. Clamped Inductive Switching Energy as a function of external gate resistance**




$T_j$ = 25 °C; $V_{DD}$ = 1000 V; $I_{DS}$ = 2 A; $V_{GS}$ = -3V/18 V
FWD = WNSC2M1K0170W; L = 4.8 mH

**Fig. 20. Switching time as a function of external gate resistance**

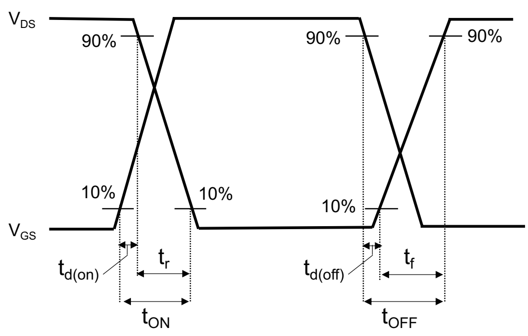
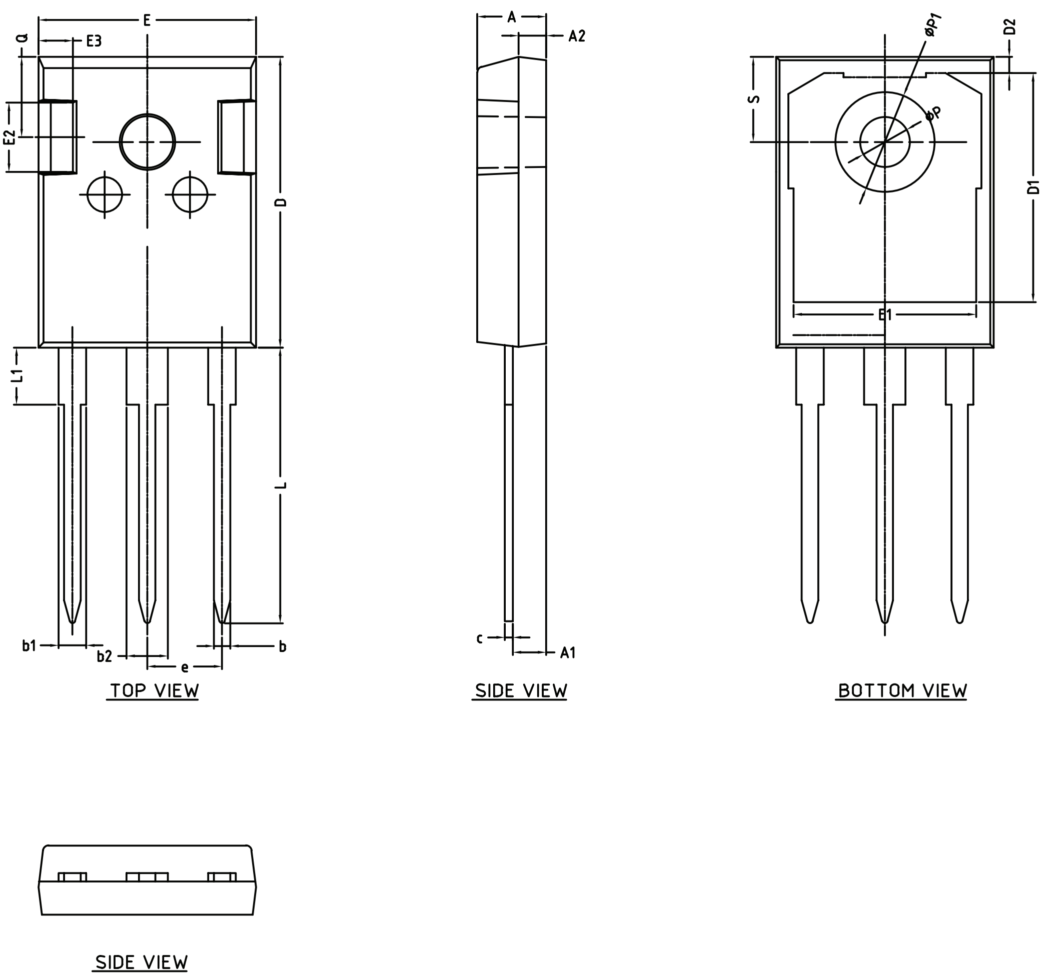



**Fig. 21. Switching time definition**

## 11. Package outline

Plastic single-ended through-hole package; heatsink mounted; 1 mounting hole; 3-lead TO-247 — SOT429N




| UNIT | | A | A1 | A2 | b | b1 | b2 | c | D | D1 | D2 | E | E1 | E2 | E3 | e | L | L1 | P | P1 | Q | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | MAX | 5.20 | 2.60 | 2.10 | 1.40 | 2.20 | 3.20 | 0.70 | 21.10 | 16.85 | 1.35 | 15.90 | 13.50 | 5.20 | 2.60 | | 20.10 | 4.75 | 3.70 | 7.40 | 6.00 | 6.25 |
| | NOM | | | | | | | | | | | | | | | 5.45 | | | | | | |
| | MIN | 4.70 | 2.20 | 1.90 | 1.00 | 1.80 | 2.80 | 0.50 | 20.90 | 16.25 | 1.05 | 15.70 | 13.10 | 4.80 | 2.40 | | 19.80 | – | 3.50 | – | 5.60 | 6.05 |

| OUTLINE VERSION | REFERENCES | | | | PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT429N | | TO-247 | | | | |

# 12. Legal information

## Data sheet status

| Document status [1][2] | Product status [3] | Definition |
|---|---|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
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