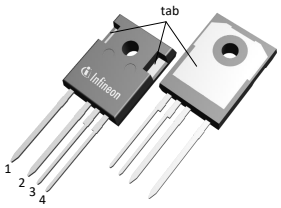
# CoolSiC™

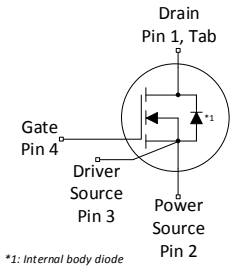
## 400V CoolSiC™ G2 MOSFET

PG-TO247-4




## Features

- Ideal for high frequency switching and synchronous rectification
- Commutation robust fast body diode with low $Q_{fr}$
- Low $R_{DS(on)}$ dependency on temperature
- Benchmark gate threshold voltage, $V_{GS(th)}$ = 4.5 V
- Recommended gate driving voltage 0 V to 18 V
- .XT interconnection technology for best-in-class thermal performance
- 100% avalanche tested




## Potential applications

- SMPS
- Solar PV inverters
- Energy storage, UPS and battery formation
- Class-D audio
- Motor drives

## Product validation

Qualified for industrial applications according to the relevant tests of JEDEC JESD47, JESD22 and J-STD-020.

Hal Pb RoHS

**Table 1 Key performance parameters**

| Parameter | Value | Unit |
|---|---|---|
| $V_{DS}$ | 400 | V |
| $R_{DS(on),typ}$ | 45.2 | mΩ |
| $I_D$ | 40 | A |
| $Q_{oss}$ | 34 | nC |
| $E_{oss}$ | 2.4 | µJ |
| $Q_G$ | 21 | nC |

| Part number | Package | Marking | Related links |
|---|---|---|---|
| IMZA40R045M2H | PG-TO247-4 | 40R045M2 | - |

# Table of contents

# 1 Maximum ratings

at $T_A$=25 °C, unless otherwise specified

**Table 2 Maximum ratings**

| Parameter | Symbol | Values | | | Unit | Note / Test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Continuous drain current [1] | $I_D$ | - | - | 40 | A | $V_{GS}$=18 V, $T_C$=25 °C |
| | | | | 28 | | $V_{GS}$=18 V, $T_C$=100 °C |
| Pulsed drain current [2] | $I_{D,pulse}$ | - | - | 120 | A | $T_C$=25 °C |
| Avalanche energy, single pulse [3] | $E_{AS}$ | - | - | 53 | mJ | $I_D$=8.9 A, $R_{GS}$=25 Ω |
| Avalanche energy, repetitive | $E_{AR}$ | | | 0.27 | | |
| Gate source voltage (static) | $V_{GS,DC}$ | -7 | - | 23 | V | - |
| Gate source voltage (transient) | $V_{GS,AC}$ | -10 | - | 25 | V | $t_{pulse}$≤500 ns, duty cycle≤1% |
| Power dissipation | $P_{tot}$ | - | - | 130 | W | $T_C$=25 °C |
| Storage temperature | $T_{stg}$ | -55 | - | 150 | °C | - |
| Operating junction temperature | $T_j$ | | | 175 | | |

[1] Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature at 25°C. For higher case temperature please refer to Diagram 2. De-rating will be required based on the actual environmental conditions.

[2] See Diagram 3 for more detailed information.

[3] See Diagram 19 for more detailed information.

# 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction - case | $R_{thJC}$ | - | - | 1.15 | °C/W | - |

# 3 Operating range

**Table 4 Operating range**

| Parameter | Symbol | Values | | | Unit | Note / Test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Recommended turn-on voltage | $V_{GS(on)}$ | - | 18 | - | V | - |
| Recommended turn-off voltage | $V_{GS(off)}$ | | 0 | | | |

# 4 Electrical characteristics

at $T_j$=25 °C, unless otherwise specified

**Table 5 Static characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | 400 | - | - | V | $V_{GS}$=0 V, $I_D$=0.32 mA |
| Gate threshold voltage [4] | $V_{GS(th)}$ | 3.5 | 4.5 | 5.6 | V | $V_{DS}$=$V_{GS}$, $I_D$=3.2 mA |
| Zero gate voltage drain current | $I_{DSS}$ | - | 1 | 75 | µA | $V_{DS}$=400 V, $V_{GS}$=0 V, $T_j$=25 °C |
| | | | 2 | - | | $V_{DS}$=400 V, $V_{GS}$=0 V, $T_j$=175 °C |
| Gate-source leakage current | $I_{GSS}$ | - | 1 | 100 | nA | $V_{GS}$=20 V, $V_{DS}$=0 V |
| Drain-source on-state resistance | $R_{DS(on)}$ | - | 45.2 | 56.2 | mΩ | $V_{GS}$=18 V, $I_D$=8.9 A, $T_j$=25 °C |
| | | | 65 | - | | $V_{GS}$=18 V, $I_D$=8.9 A, $T_j$=175 °C |
| | | | 55.3 | - | | $V_{GS}$=15 V, $I_D$=8.9 A, $T_j$=25 °C |
| Gate resistance | $R_G$ | - | 5.8 | - | Ω | - |

[4] Tested after 1ms pulse at $V_{GS}$ = +20V.

**Table 6 Dynamic characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | - | 710 | - | pF | $V_{GS}$=0 V, $V_{DS}$=200 V, $f$=1 MHz |
| Output capacitance | $C_{oss}$ | | 100 | | | |
| Reverse transfer capacitance | $C_{rss}$ | | 9 | | | |
| Effective output capacitance, energy related [5] | $C_{o(er)}$ | - | 121 | - | pF | $V_{GS}$=0 V, $V_{DS}$=0...200 V |
| Effective output capacitance, time related [6] | $C_{o(tr)}$ | - | 170 | - | pF | $I_D$=constant, $V_{GS}$=0 V, $V_{DS}$=0...200 V |
| Turn-on delay time [7] | $t_{d(on)}$ | - | 7.4 | - | ns | $V_{DD}$=200 V, $V_{GS}$=0...18 V, $I_D$=8.9 A, $R_{G,ext}$=1.8 Ω |
| Rise time [7] | $t_r$ | | 7.3 | | | |
| Turn-off delay time [7] | $t_{d(off)}$ | - | 17.0 | - | ns | $V_{DD}$=200 V, $V_{GS}$=18...0 V, $I_D$=8.9 A, $R_{G,ext}$=1.8 Ω |
| Fall time [7] | $t_f$ | | 6.2 | | | |

[5] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 200 V.

[6] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 200 V.

[7] Refer to Table 9 for test setup.

**Table 7 Gate Charge Characteristics** [8)]

| Parameter | Symbol | Values | | | Unit | Note / Test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | - | 5.6 | - | nC | $V_{DD}$=200 V, $I_D$=8.9 A, $V_{GS}$=0 to 18 V |
| Gate to drain charge | $Q_{gd}$ | | 4.4 | | | |
| Gate charge total | $Q_g$ | | 21 | | | |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | - | 19 | - | nC | $V_{DS}$=0.1 V, $V_{GS}$=0 to 18 V |
| Output charge | $Q_{oss}$ | - | 34 | - | nC | $V_{DS}$=200 V, $V_{GS}$=0 V |
| Output Energy | $E_{oss}$ | | 2.4 | | µJ | |

[8)] As per JEP192, Guidelines for Gate Charge ($Q_G$) Test Method for SiC MOSFET.

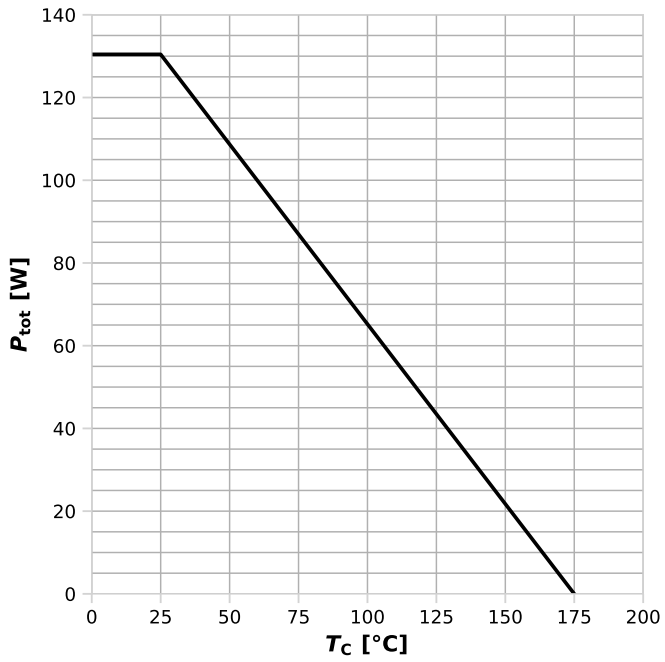
**Table 8 Reverse diode characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Diode continuous forward current | $I_S$ | - | - | 19 | A | $T_C$=25 °C |
| Diode pulse current | $I_{S,pulse}$ | - | - | 120 | A | $T_C$=25 °C, $t_{pulse}$≤250 ns |
| Diode forward voltage | $V_{SD}$ | - | 3.5 | 4.3 | V | $V_{GS}$=0 V, $I_S$=8.9 A, $T_j$=25 °C |
| MOSFET forward recovery time | $t_{fr}$ | - | 11.4 | - | ns | $V_R$=200 V, $I_S$=8.9 A, $di_S/dt$=1000 A/µs |
| | | | 9.3 | | | $V_R$=200 V, $I_S$=8.9 A, $di_S/dt$=3000 A/µs |
| MOSFET forward recovery charge [9)] | $Q_{fr}$ | - | 41.1 | - | nC | $V_R$=200 V, $I_S$=8.9 A, $di_S/dt$=1000 A/µs |
| | | | 102.3 | | | $V_R$=200 V, $I_S$=8.9 A, $di_S/dt$=3000 A/µs |

[9)] $Q_{fr}$ includes $Q_{oss}$. Refer to Table 10 for test setup.

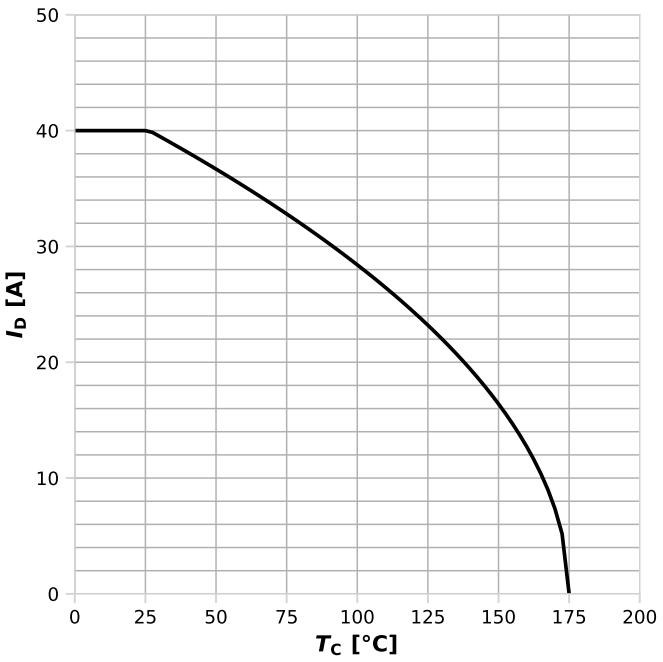
# 5 Electrical characteristics diagrams

**Diagram 1: Power dissipation**



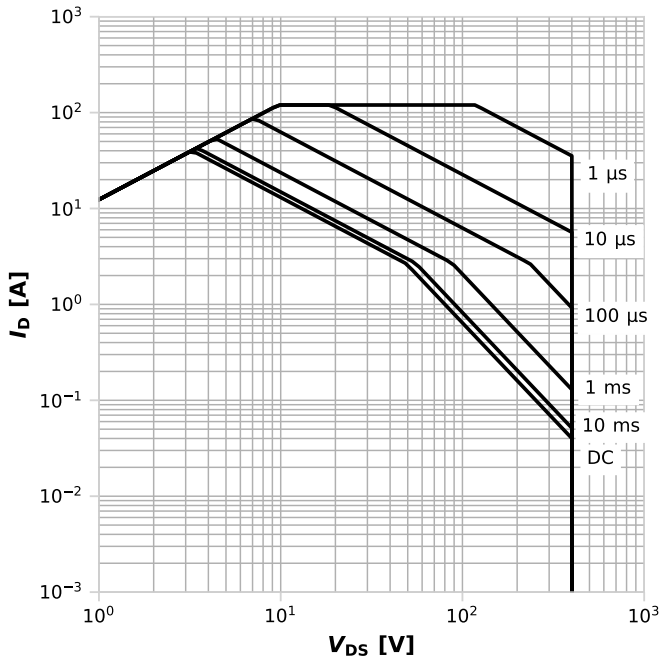

$P_{tot}$=f($T_C$)

**Diagram 2: Drain current**



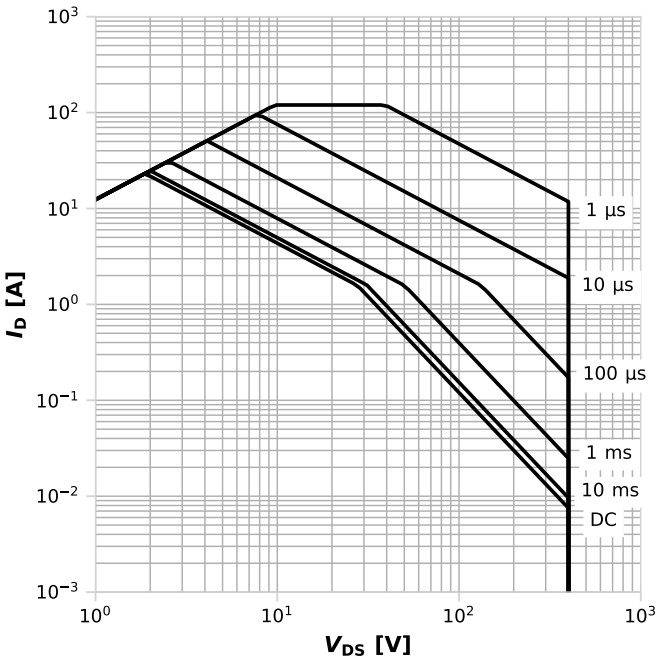

$I_D$=f($T_C$); $V_{GS}$≥18 V

**Diagram 3: Safe operating area**



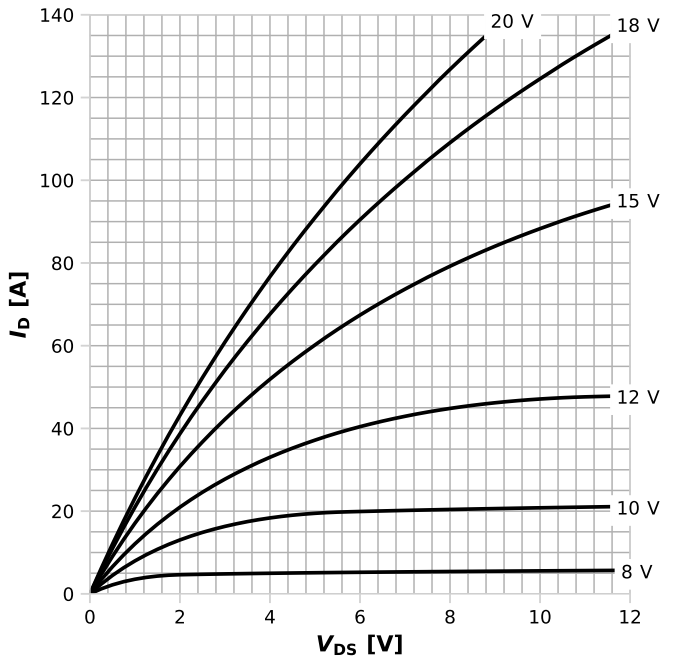

$I_D$=f($V_{DS}$); $T_C$=25 °C; $D$=0; parameter: $t_p$

**Diagram 4: Safe operating area**



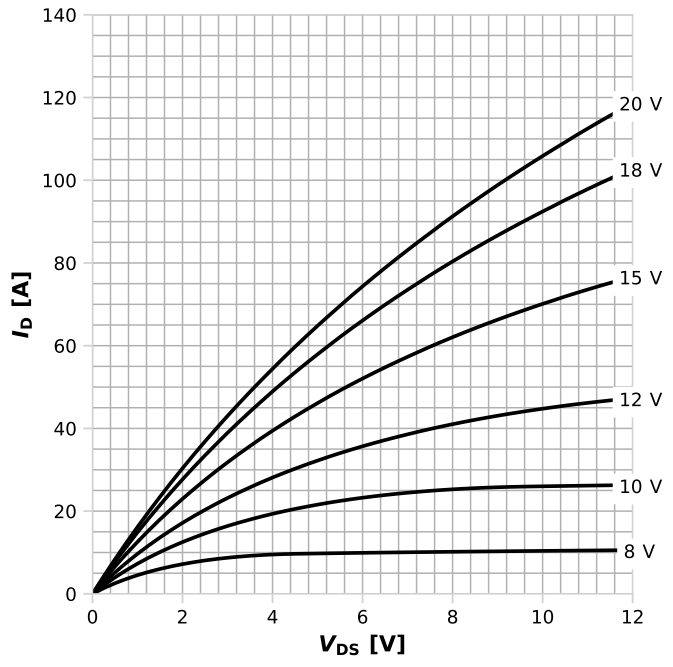

$I_D$=f($V_{DS}$); $T_C$=125 °C; $D$=0; parameter: $t_p$

**Diagram 5: Typ. output characteristics**



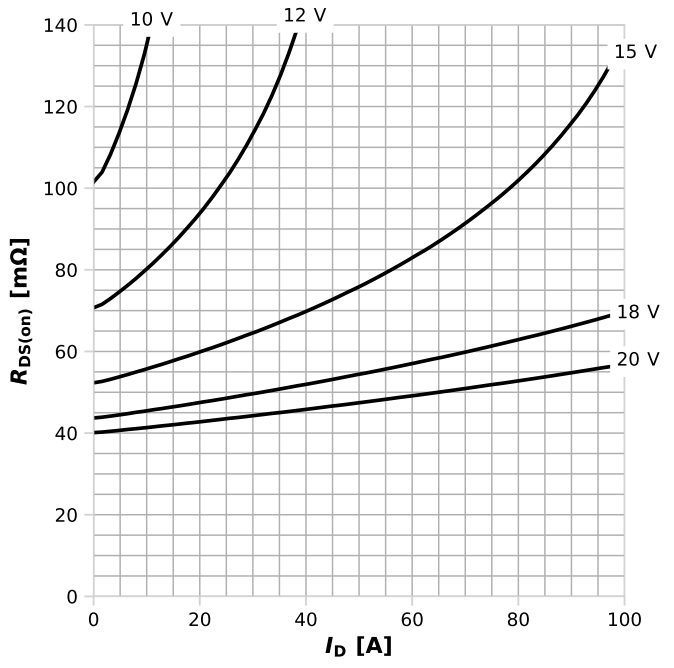

$I_D$=f($V_{DS}$), $T_j$=25 °C; parameter: $V_{GS}$

**Diagram 6: Typ. output characteristics**



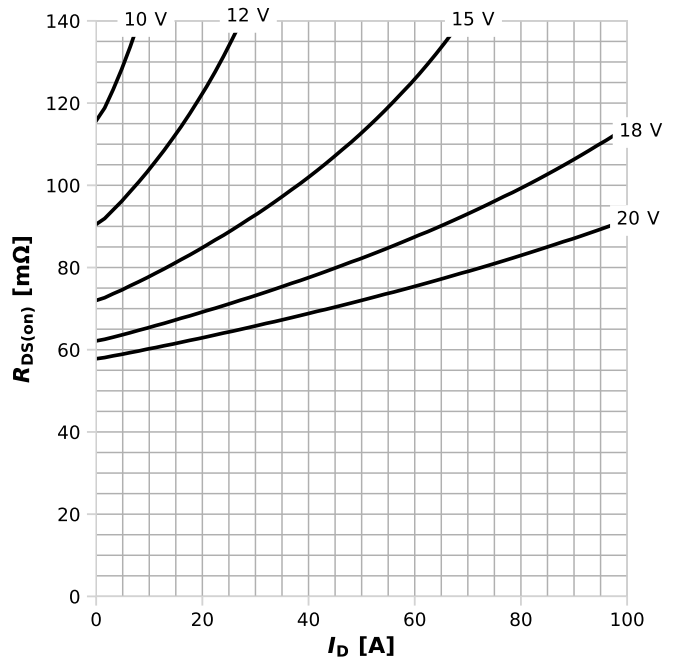

$I_D$=f($V_{DS}$), $T_j$=175 °C; parameter: $V_{GS}$

**Diagram 7: Typ. drain-source on resistance**

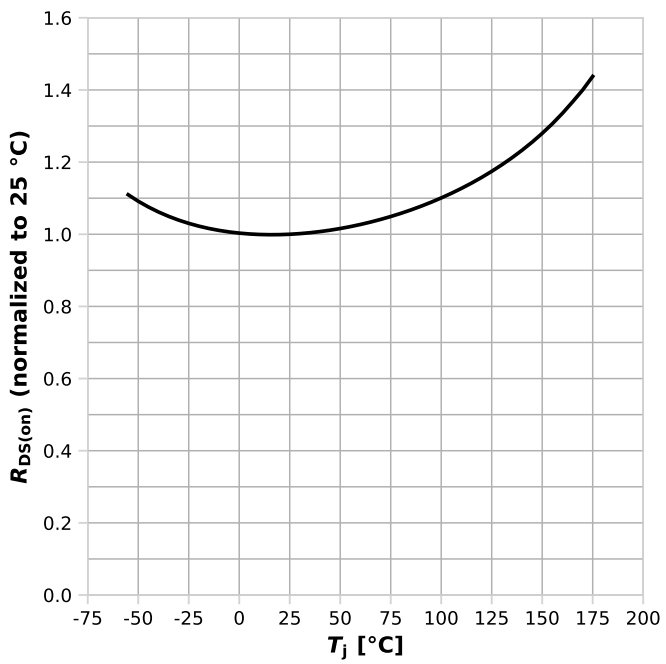
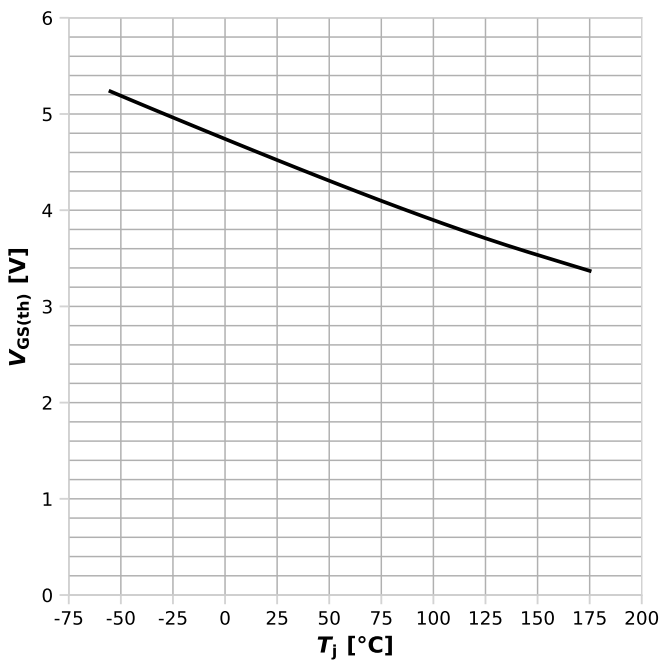


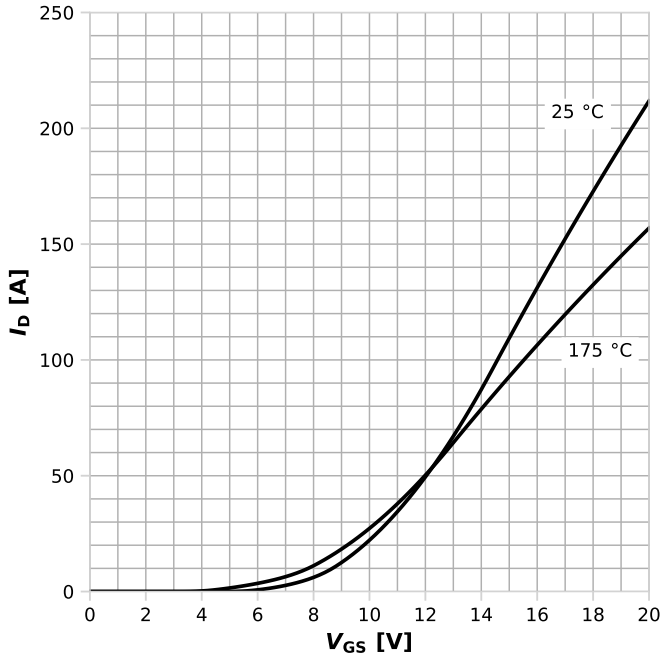
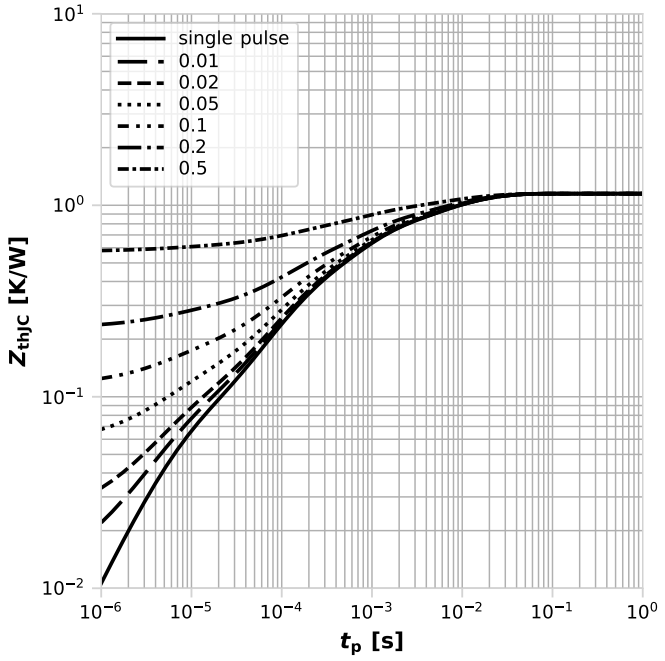

$R_{DS(on)}$=f($I_D$), $T_j$=25 °C; parameter: $V_{GS}$

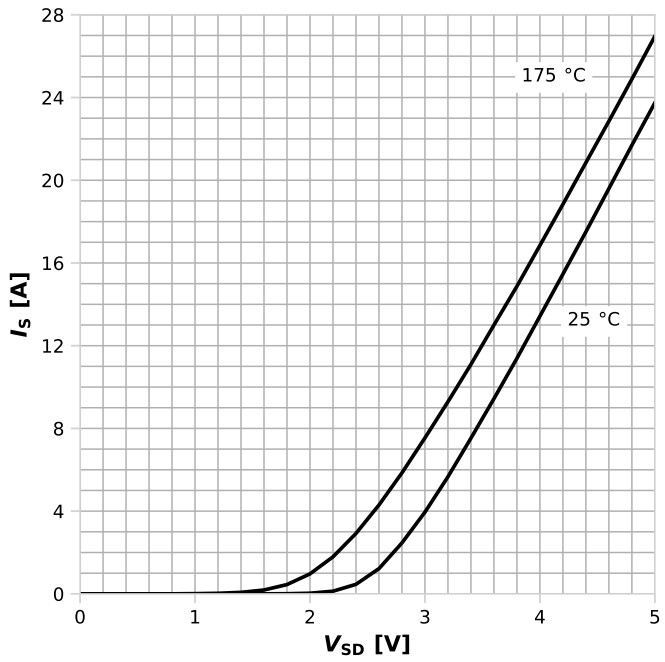
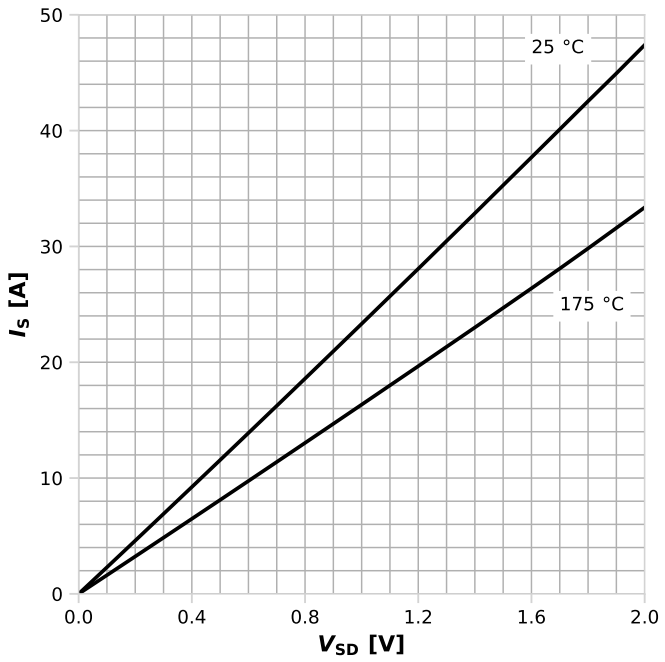
**Diagram 8: Typ. drain-source on resistance**

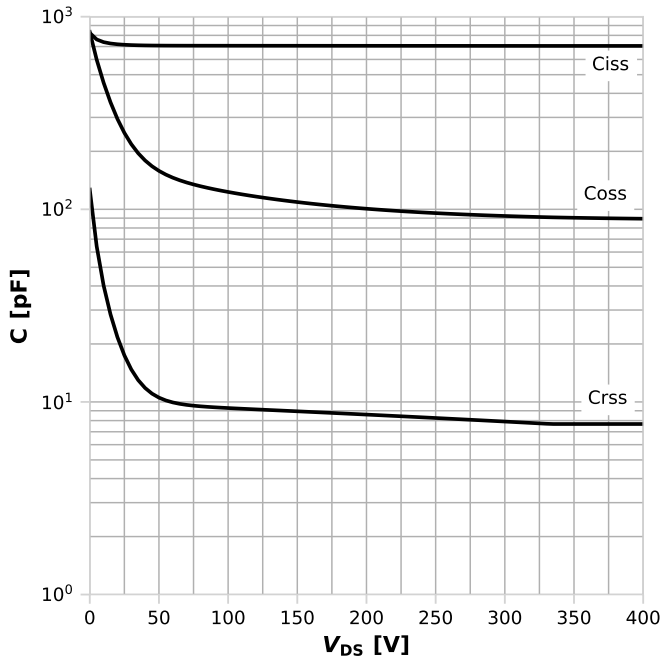
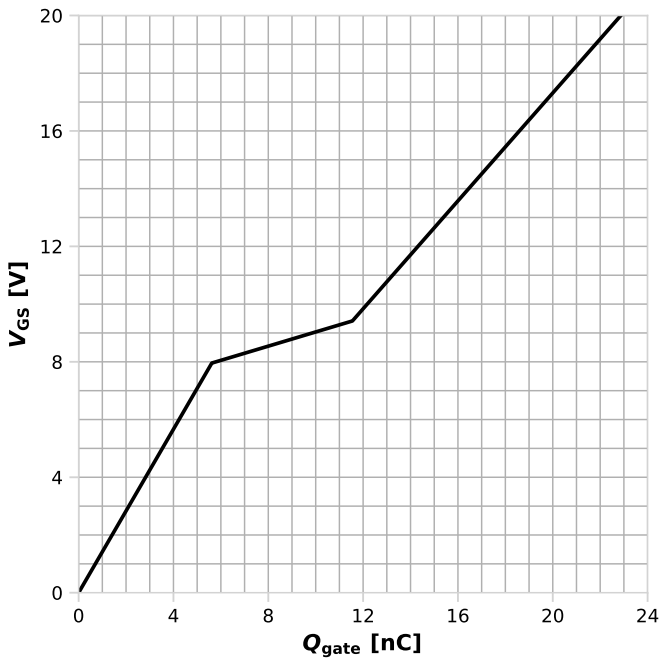


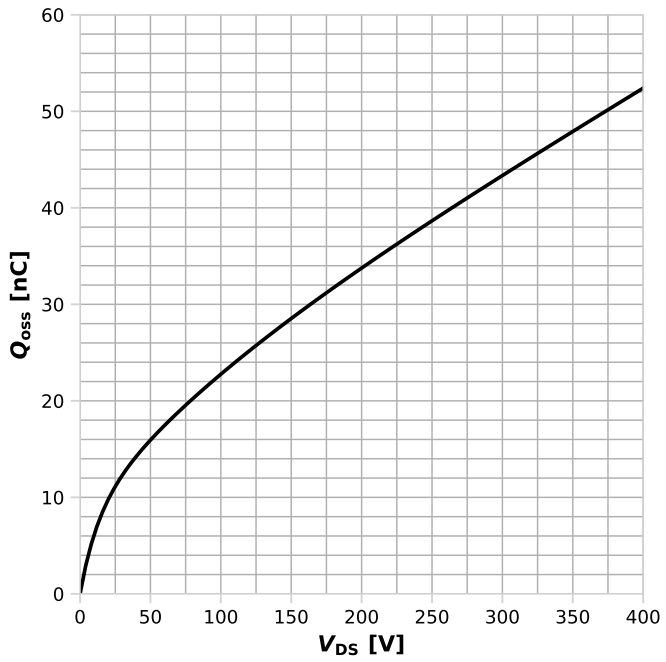
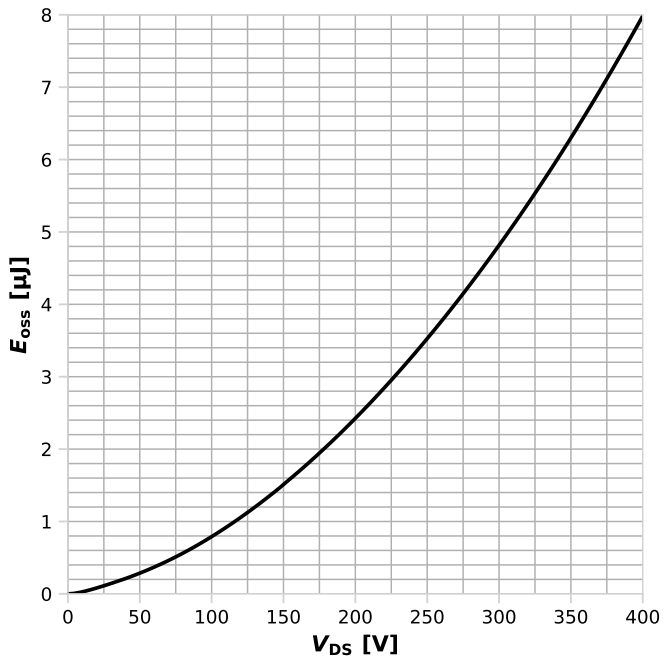

$R_{DS(on)}$=f($I_D$), $T_j$=175 °C; parameter: $V_{GS}$

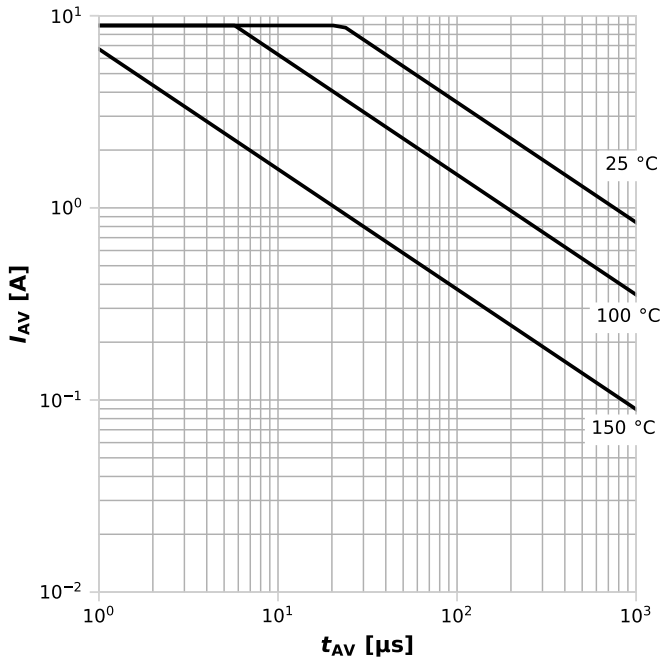
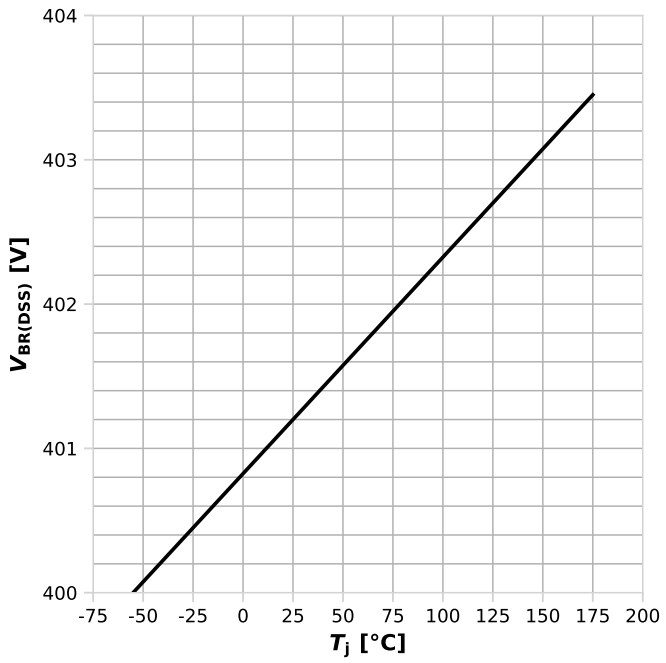
| Diagram 9: Normalized drain-source on resistance | Diagram 10: Typ. gate threshold voltage |
|---|---|
|  |  |
| $R_{DS(on)}$=f($T_j$), $I_D$=8.9 A, $V_{GS}$=18 V | $V_{GS(th}$=f($T_j$), $V_{GS}$=$V_{DS}$, $I_D$=3.2 mA |

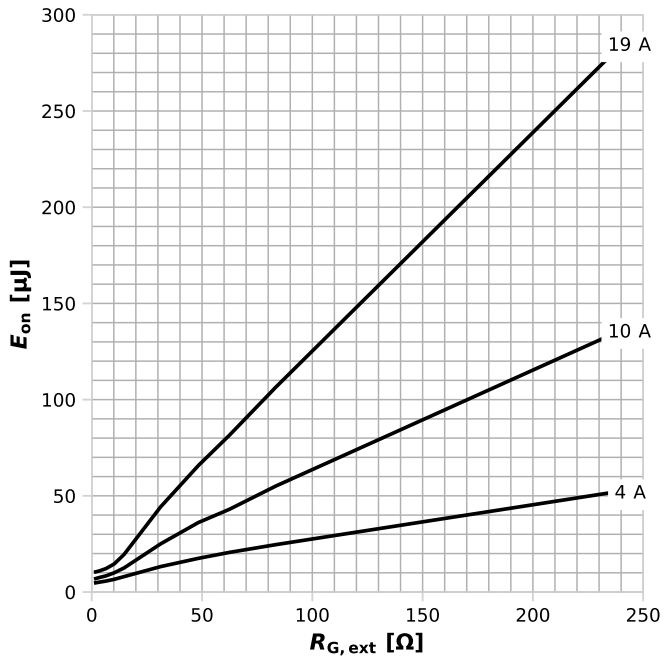
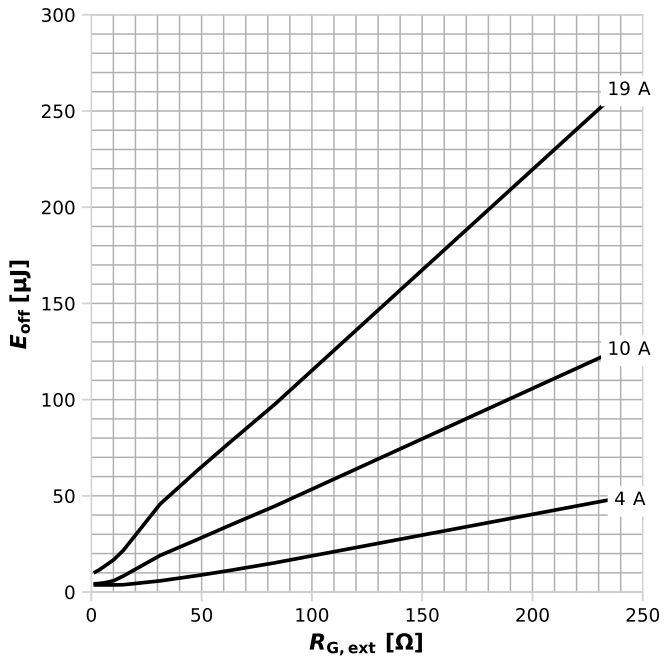
| Diagram 11: Typ. transfer characteristics | Diagram 12: Max. transient thermal impedance |
|---|---|
|  |  |
| $I_D$=f($V_{GS}$), $\|V_{DS}\|$>2$\|I_D\|R_{DS(on)max}$; parameter: $T_j$ | $Z_{thJC}$=f($t_p$); parameter: $D$=$t_p$/$T$ |

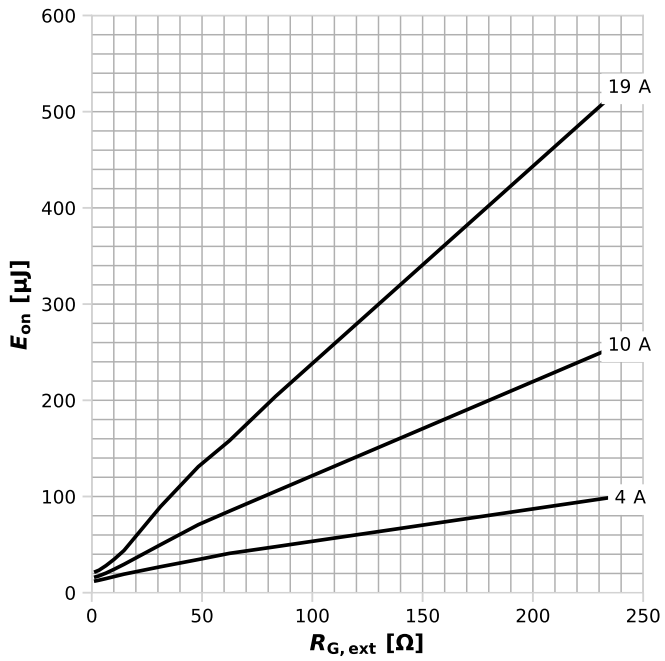
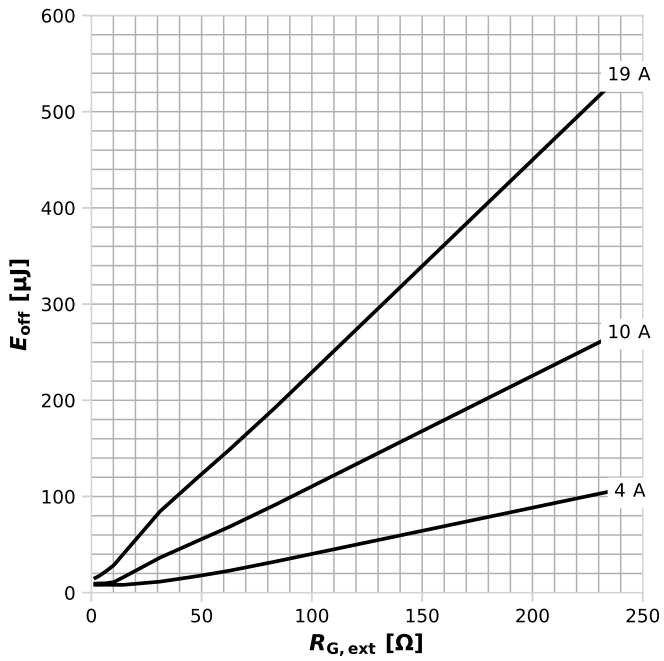
| Diagram 13: Reverse output characteristics | Diagram 14: Reverse output characteristics |
|---|---|
|  |  |
| $I_F$=f($V_{SD}$), $V_{GS}$=0 V; parameter: $T_j$ | $I_F$=f($V_{SD}$), $V_{GS}$=18 V; parameter: $T_j$ |

| Diagram 15: Typ. capacitances | Diagram 16: Typ. gate charge |
|---|---|
|  |  |
| $C$=f($V_{DS}$); $V_{GS}$=0 V; $f$=1 MHz | $V_{GS}$=f($Q_{gate}$), $V_{DD}$=200 V, $I_D$=8.9 A pulsed, $T_j$=25 °C |

| Diagram 17: Typ. output charge | Diagram 18: Typ. output energy |
|---|---|
|  |  |
| $Q_{oss}$=f($V_{DS}$), $V_{GS}$=0 V | $E_{oss}$=f($V_{DS}$), $V_{GS}$=0 V |

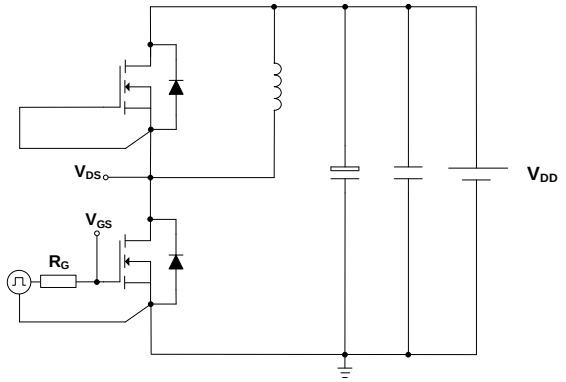
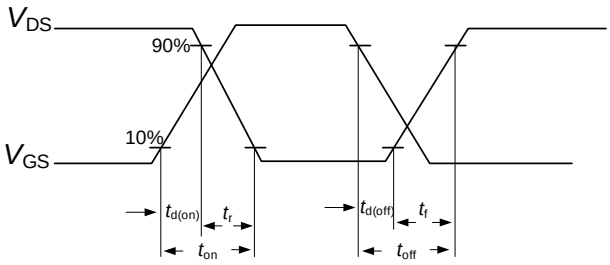
| Diagram 19: Avalanche characteristics | Diagram 20: Min. drain-source breakdown voltage |
|---|---|
|  |  |
| $I_{AS}$=f($t_{AV}$); $R_{GS}$=25 Ω; parameter: $T_{j,start}$ | $V_{BR(DSS)}$=f($T_j$); $I_D$=0.32 mA |

| Diagram 21: Typ. turn-on switching losses | Diagram 22: Typ. turn-off switching losses |
|---|---|
|  |  |
| $E_{on}$=f($R_{g,ext}$), $V_{DD}$=200 V, $V_G$=0...18 V; parameter: $I_D$ | $E_{off}$=f($R_{g,ext}$), $V_{DD}$=200 V, $V_G$=18...0 V; parameter: $I_D$ |

| Diagram 23: Typ. turn-on switching losses | Diagram 24: Typ. turn-off switching losses |
|---|---|
|  |  |
| $E_{on}$=f($R_{g,ext}$), $V_{DD}$=320 V, $V_G$=0...18 V; parameter: $I_D$ | $E_{off}$=f($R_{g,ext}$), $V_{DD}$=320 V, $V_G$=18...0 V; parameter: $I_D$ |

# 6 Test circuits

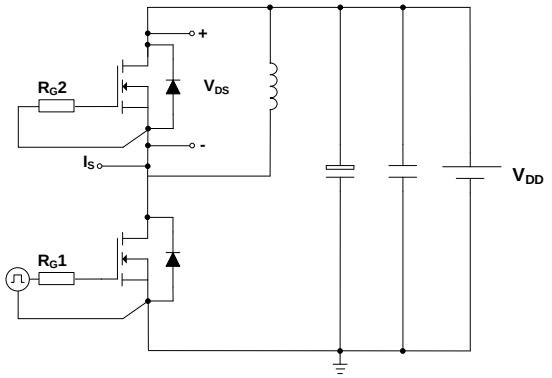
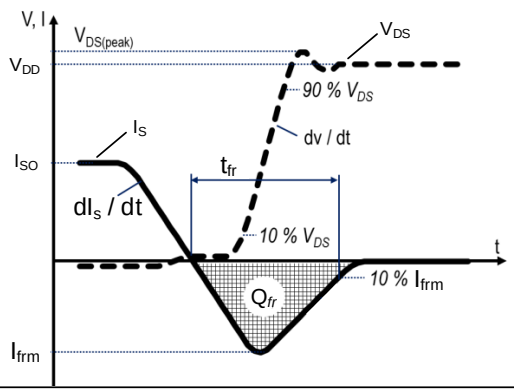
## Table 9 Switching times

| Switching times test circuit for inductive load | Switching times waveform |
|---|---|
|  |  |

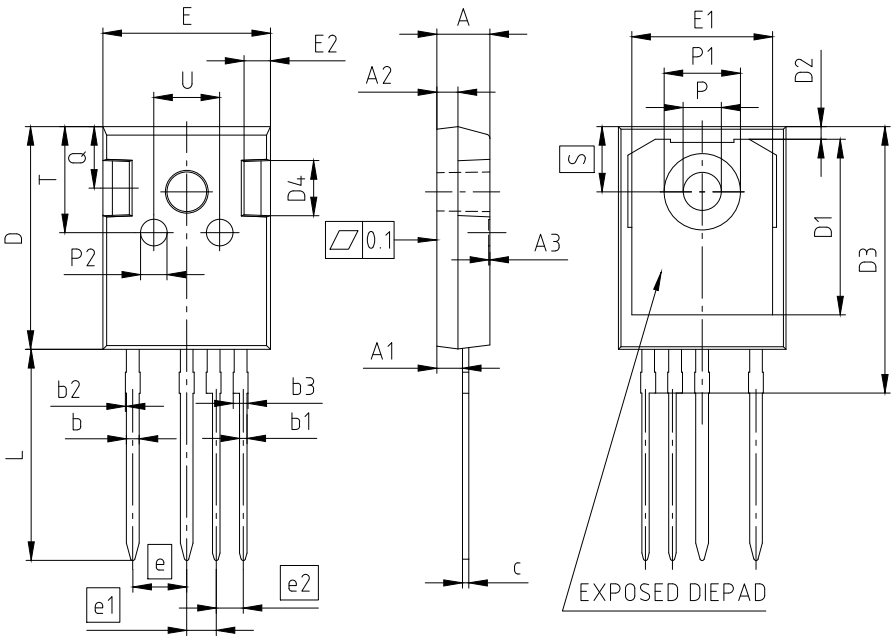




## Table 10 Body diode characteristics

| Test circuit for body diode characteristics | Body diode recovery waveform |
|---|---|
|  |  |

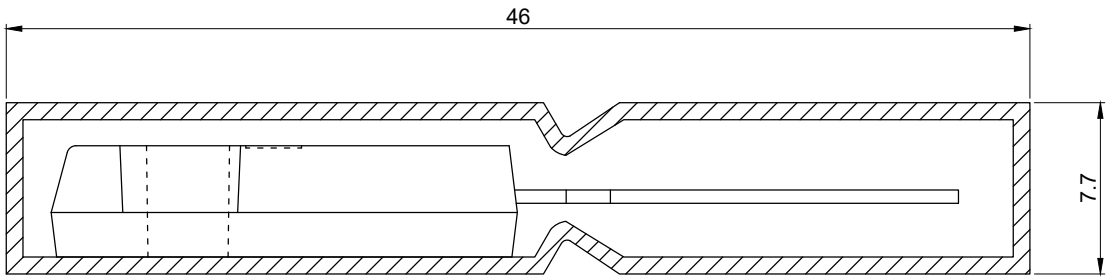
# 7 Package outlines




NOTES:
DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS

| PACKAGE - GROUP NUMBER: | PG-TO247-4-U02 | | | | |
|---|---|---|---|---|---|
| DIMENSIONS | MILLIMETERS | | DIMENSIONS | MILLIMETERS | |
| | MIN. | MAX. | | MIN. | MAX. |
| A | 4.90 | 5.10 | E | 15.70 | 15.90 |
| A1 | 2.31 | 2.51 | E1 | 13.10 | 13.50 |
| A2 | 1.90 | 2.10 | E2 | 2.40 | 2.60 |
| A3 | 0.05 | 0.25 | e | 5.08 | |
| b | 1.10 | 1.30 | e1 | 2.79 | |
| b1 | 0.65 | 0.79 | e2 | 2.54 | |
| b2 | --- | 0.20 | N | 4 | |
| b3 | 1.34 | 1.44 | L | 19.80 | 20.10 |
| c | 0.58 | 0.66 | øP | 3.50 | 3.70 |
| D | 20.90 | 21.10 | øP1 | 7.00 | 7.40 |
| D1 | 16.25 | 16.85 | øP2 | 2.40 | 2.60 |
| D2 | 1.05 | 1.35 | Q | 5.60 | 6.00 |
| D3 | 24.97 | 25.27 | S | 6.15 | |
| D4 | 4.90 | 5.10 | T | 9.80 | 10.20 |
| | | | U | 6.00 | 6.40 |

**Figure 1 Outline PG-TO247-4, dimensions in mm**




All dimensions are in units mm
The drawing is in compliance with ISO 128-30, Projection Method 1 [ ]

**Figure 2 Packaging variant PG-TO247-4, dimensions in mm**

## Revision history

IMZA40R045M2H

### Revision 2025-07-15, Rev. 1.0

Previous revisions

| Revision | Date | Subjects (major changes since last revision) |
|---|---|---|
| 1.0 | 2025-07-15 | Release of final datasheet |

**Trademarks**
All referenced product or service names and trademarks are the property of their respective owners.

**We Listen to Your Comments** Any information within this document that you feel is wrong, unclear or missing at all? Your feedback will help us to continuously improve the quality of this document. Please send your proposal (including a reference to this document) to: **erratum@infineon.com**

**Published by**
**Infineon Technologies AG**
**81726 München, Germany**


**Important notice**
The products which may also include samples and may be comprised of hardware or software or both ("Product") are sold or provided and delivered by Infineon Technologies AG and its affiliates ("Infineon") subject to the terms and conditions of the frame supply contract or other written agreement(s) executed by a customer and Infineon or, in the absence of the foregoing, the applicable Sales Conditions of Infineon. General terms and conditions of a customer or deviations from applicable Sales Conditions of Infineon shall only be binding for Infineon if and to the extent Infineon has given its express written consent.

For the avoidance of doubt, Infineon disclaims all warranties of non-infringement of third-party rights and implied warranties such as warranties of fitness for a specific use/purpose or merchantability.

Infineon shall not be responsible for any information with respect to samples, the application or customer's specific use of any Product or for any examples or typical values given in this document.

The data contained in this document is exclusively intended for technically qualified and skilled customer representatives. It is the responsibility of the customer to evaluate the suitability of the Product for the intended application and the customer's specific use and to verify all relevant technical data contained in this document in the intended application and the customer's specific use. The customer is responsible for properly designing, programming, and testing the functionality and safety of the intended application, as well as complying with any legal requirements related to its use.

Unless otherwise explicitly approved by Infineon, Products may not be used in any application where a failure of the Product or any consequences of the use thereof can reasonably be expected to result in personal injury. However, the foregoing shall not prevent the customer from using any Product in such fields of use that Infineon has explicitly designed and sold it for, provided that the overall responsibility for the application lies with the customer.

If the Product includes security features:
Because no computing device can be absolutely secure, and despite security measures implemented in the Product, Infineon does not guarantee that the Product will be free from intrusion, data theft or loss, or other breaches ("Security Breaches"), and Infineon shall have no liability arising out of any Security Breaches.

If this document includes or references software:
The software is owned by Infineon under the intellectual property laws and treaties of the United States, Germany, and other countries worldwide. All rights reserved. Therefore, you may use the software only as provided in the software license agreement accompanying the software. If no software license agreement applies, Infineon hereby grants you a personal, non-exclusive, non-transferable license (without the right to sublicense) under its intellectual property rights in the software (a) for software provided in source code form, to modify and reproduce the software solely for use with Infineon hardware products, only internally within your organization, and (b) to distribute the software in binary code form externally to end users, solely for use on Infineon hardware products. Any other use, reproduction, modification, translation, or compilation of the software is prohibited.

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office (www.infineon.com).