# CoolSiC™

TOLL

## 440V CoolSiC™ G2 MOSFET with extended $V_{DS}$

## 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
- Fully tested in production to guarantee extended $V_{(BR)DSS}$

## Potential applications

- Application specific MOSFET designed to power AI
- High Power SMPS for server, datacenter and telecom rectifiers
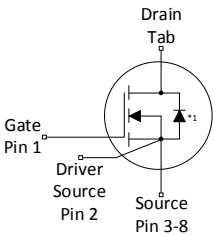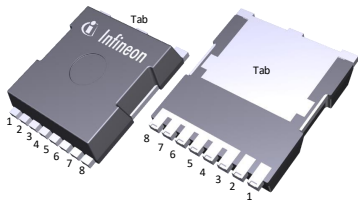
## Product validation

Qualified for industrial applications according to the relevant tests of JEDEC JESD47, JESD22 and J-STD-020.
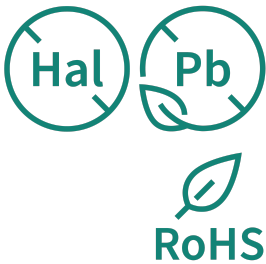
*1: Internal body diode*

**Table 1  Key performance parameters**

| Parameter | Value | Unit |
|---|---|---|
| $V_{DS}$ | 440 | V |
| $V_{DS,tr}$ | 455 | V |
| $R_{DS(on),typ}$ | 25.4 | mΩ |
| $I_D$ | 68 | A |
| $Q_{oss}$ | 59 | nC |
| $E_{oss}$ | 4.2 | µJ |
| $Q_G$ | 36 | nC |

| Part number | Package | Marking | Related links |
|---|---|---|---|
| IMT44R025M2H | PG-HSOF-8 | 44R025M2 | - |

# 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] | $I_D$ | - | - | 68 | A | $V_{GS}$=18 V, $T_C$=25 °C |
| | | | | 48 | | $V_{GS}$=18 V, $T_C$=100 °C |
| | | | | 9 | | $V_{GS}$=18 V, $T_A$=25 °C, $R_{THJA}$=40 °C/W [2] |
| Pulsed drain current [3] | $I_{D,pulse}$ | - | - | 204 | A | $T_C$=25 °C |
| Avalanche energy, single pulse [4] | $E_{AS}$ | - | - | 93 | mJ | $I_D$=15.7 A, $R_{GS}$=25 Ω |
| Avalanche energy, repetitive | $E_{AR}$ | | | 0.47 | | |
| 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 | $P_{tot}$ | - | - | 214 | W | $T_C$=25 °C |
| | | | | 3.8 | | $T_A$=25 °C, $R_{THJA}$=40 °C/W [2] |
| 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] Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm$^2$ (one layer, 70 μm thick) copper area for drain connection. PCB is vertical in still air.

[3] See Diagram 3 for more detailed information.

[4] 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 | $R_{thJC}$ | | | 0.7 | °C/W | - |
| Thermal resistance, junction - ambient, 6 cm² cooling area [5] | $R_{thJA}$ | - | - | 40 | | |

[5]    Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

## 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 | $V_{(BR)DSS}$ | 440 | - | - | V | $V_{GS}$=0 V, $I_D$=0.56 mA |
| Transient drain-source breakdown voltage [6] | $V_{(BR)DSS,tr}$ | 455 | - | - | V | $V_{GS}$=0 V, $I_D$=5.6 mA, $t_{pulse}$≤10 ms, duty cycle≤50% |
| Gate threshold voltage [7] | $V_{GS(th)}$ | 3.5 | 4.5 | 5.6 | V | $V_{DS}$=$V_{GS}$, $I_D$=5.6 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 | $R_{DS(on)}$ | - | 25.4 | 32.1 | mΩ | $V_{GS}$=18 V, $I_D$=15.7 A, $T_j$=25 °C |
| | | | 36.5 | - | | $V_{GS}$=18 V, $I_D$=15.7 A, $T_j$=175 °C |
| | | | 31.1 | - | | $V_{GS}$=15 V, $I_D$=15.7 A, $T_j$=25 °C |
| Gate resistance | $R_G$ | - | 3.3 | 5.0 | Ω | - |

[6] Guaranteed by design, rated for transient startup overvoltages to comply with IPC-9592B derating guidelines.

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

### Table 6 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | | 1200 | 1690 | pF | $V_{GS}$=0 V, $V_{DS}$=200 V, $f$=1 MHz |
| Output capacitance | $C_{oss}$ | - | 180 | - | | |
| Reverse transfer capacitance | $C_{rss}$ | | 14 | - | | |
| Effective output capacitance, energy related [8] | $C_{o(er)}$ | - | 211 | - | pF | $V_{GS}$=0 V, $V_{DS}$=0...200 V |
| Effective output capacitance, time related [9] | $C_{o(tr)}$ | - | 290 | - | pF | $I_D$=constant, $V_{GS}$=0 V, $V_{DS}$=0...200 V |
| Turn-on delay time | $t_{d(on)}$ | - | 12.5 | - | ns | $V_{DD}$=200 V, $V_{GS}$=0...18 V, $I_D$=15.7 A, $R_{G,ext}$=1.8 Ω |
| Rise time | $t_r$ | | 11.9 | | | |
| Turn-off delay time | $t_{d(off)}$ | - | 19.9 | - | ns | $V_{DD}$=200 V, $V_{GS}$=18...0 V, $I_D$=15.7 A, $R_{G,ext}$=1.8 Ω |
| Fall time | $t_f$ | | 7.9 | | | |

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

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

**Table 7    Gate Charge Characteristics** [10]

| Parameter | Symbol | Values | | | Unit | Note / Test condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | - | 9.8 | - | nC | $V_{DD}$=200 V, $I_D$=15.7 A, $V_{GS}$=0 to 18 V |
| Gate to drain charge | $Q_{gd}$ | | 7.5 | | | |
| Gate charge total | $Q_g$ | | 36 | | | |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | - | 34 | - | nC | $V_{DS}$=0.1 V, $V_{GS}$=0 to 18 V |
| Output charge | $Q_{oss}$ | - | 59 | - | nC | $V_{DS}$=200 V, $V_{GS}$=0 V |
| Output Energy | $E_{oss}$ | | 4.2 | | µJ | |

[10]    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 | $I_S$ | - | - | 32 | A | $T_C$=25 °C |
| Diode pulse current | $I_{S,pulse}$ | - | - | 204 | A | $T_C$=25 °C, $t_{pulse}$≤250 ns |
| Diode forward voltage | $V_{SD}$ | - | 3.5 | 4.3 | V | $V_{GS}$=0 V, $I_S$=15.7 A, $T_j$=25 °C |
| MOSFET forward recovery time | $t_{fr}$ | - | 13.6 | - | ns | $V_R$=200 V, $I_S$=15.7 A, d$i_S$/d$t$=1000 A/µs |
| | | | 8.9 | | | $V_R$=200 V, $I_S$=15.7 A, d$i_S$/d$t$=4000 A/µs |
| MOSFET forward recovery charge [11] | $Q_{fr}$ | - | 55 | - | nC | $V_R$=200 V, $I_S$=15.7 A, d$i_S$/d$t$=1000 A/µs |
| | | | 116 | | | $V_R$=200 V, $I_S$=15.7 A, d$i_S$/d$t$=4000 A/µs |

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

# 5 Electrical characteristics diagrams

| Diagram 1: Power dissipation | Diagram 2: Drain current |
|---|---|



$P_{tot}=f(T_C)$



$I_D=f(T_C)$; $V_{GS}{\geq}18$ V

| Diagram 3: Safe operating area | Diagram 4: Safe operating area |
|---|---|



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



$I_D=f(V_{DS})$; $T_C=125$ °C; $D=0$; parameter: $t_p$
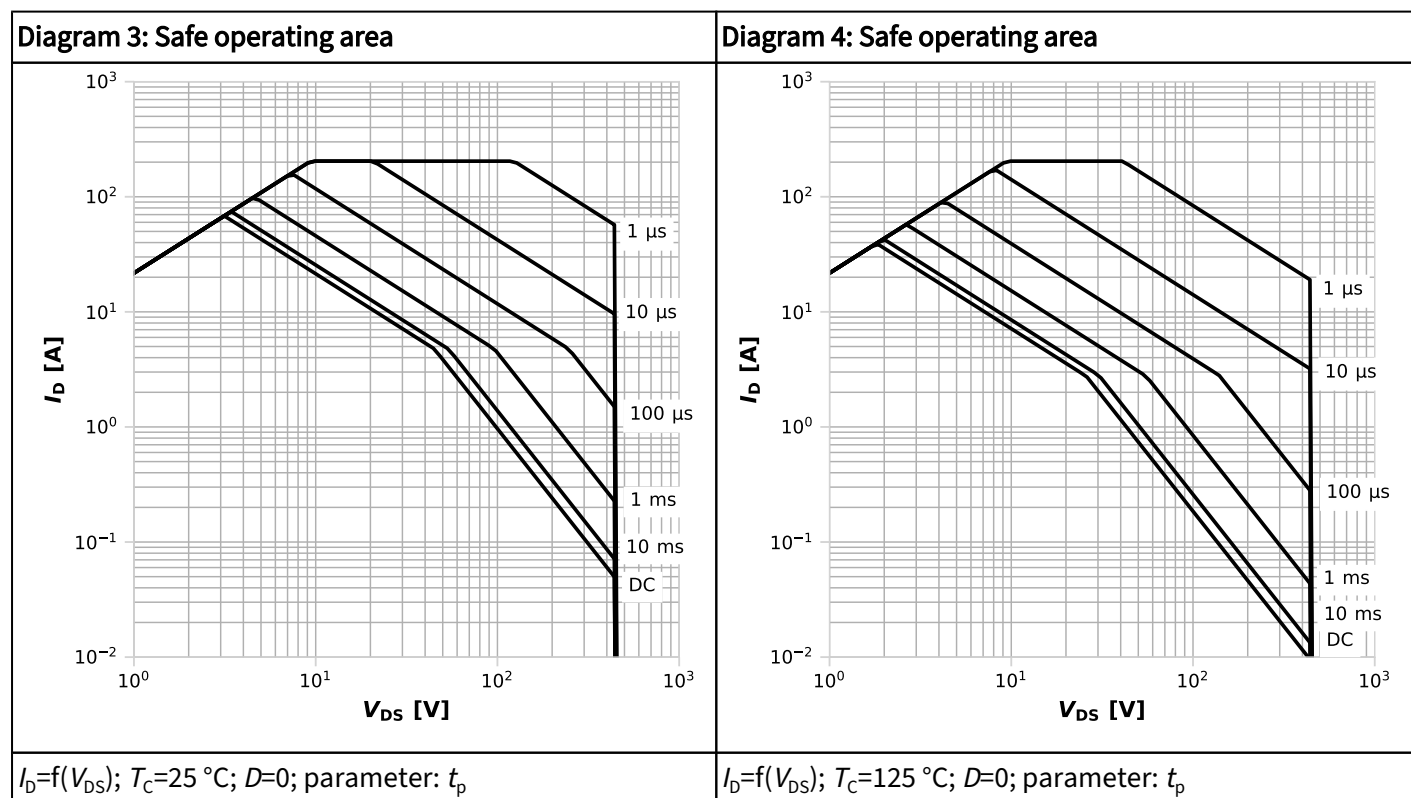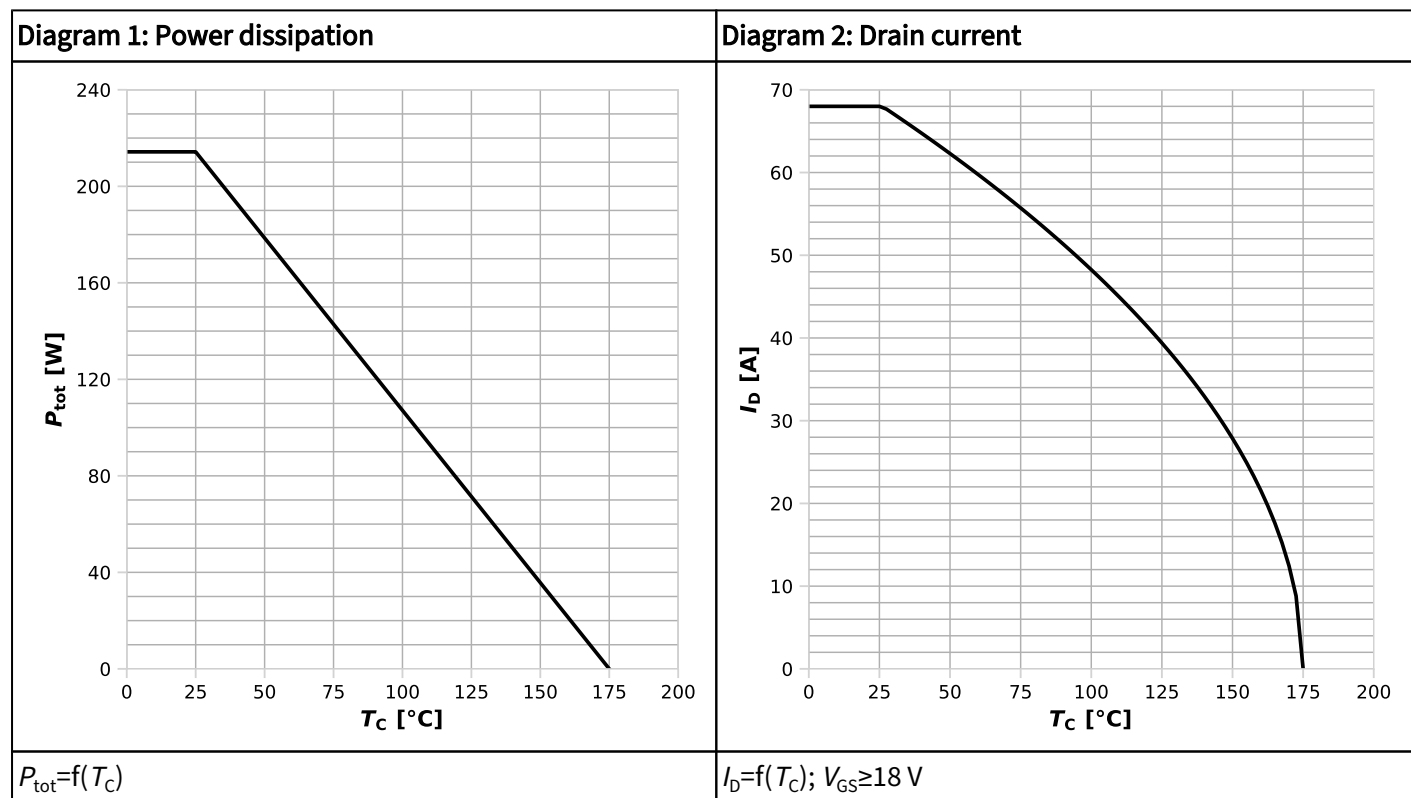
**Diagram 5: Typ. output characteristics**
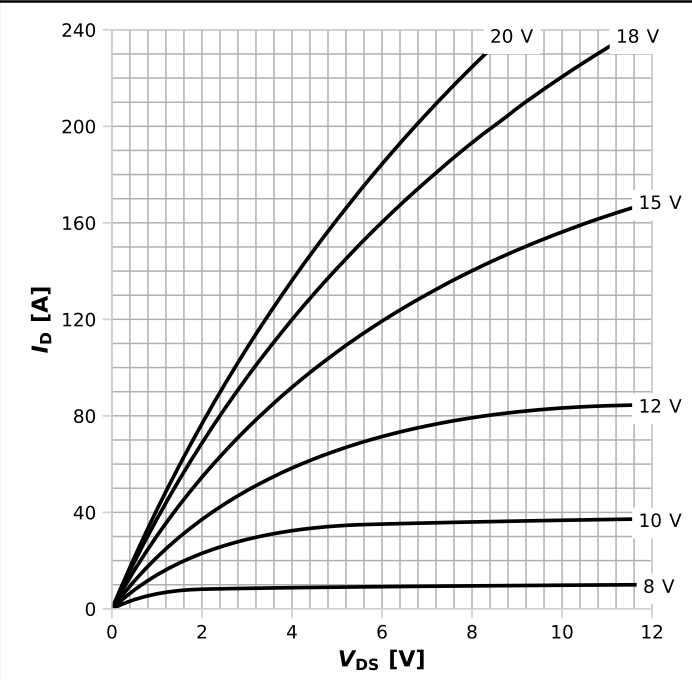


$I_D$=f($V_{DS}$), $T_j$=25 °C; parameter: $V_{GS}$

**Diagram 6: Typ. output characteristics**
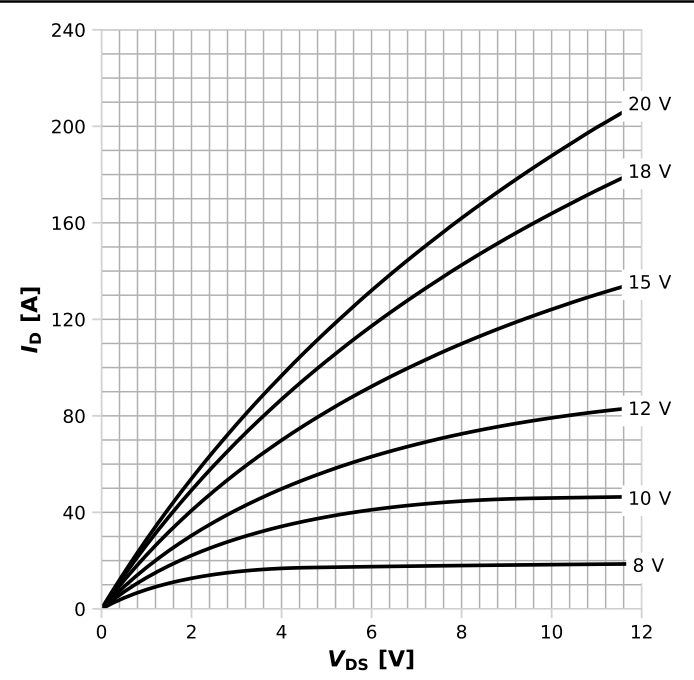


$I_D$=f($V_{DS}$), $T_j$=175 °C; parameter: $V_{GS}$

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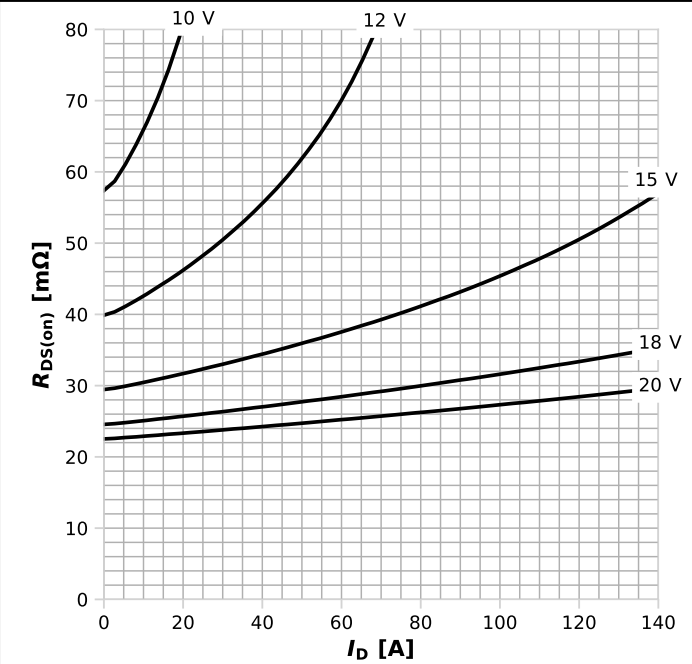


$R_{DS(on)}$=f($I_D$), $T_j$=25 °C; parameter: $V_{GS}$

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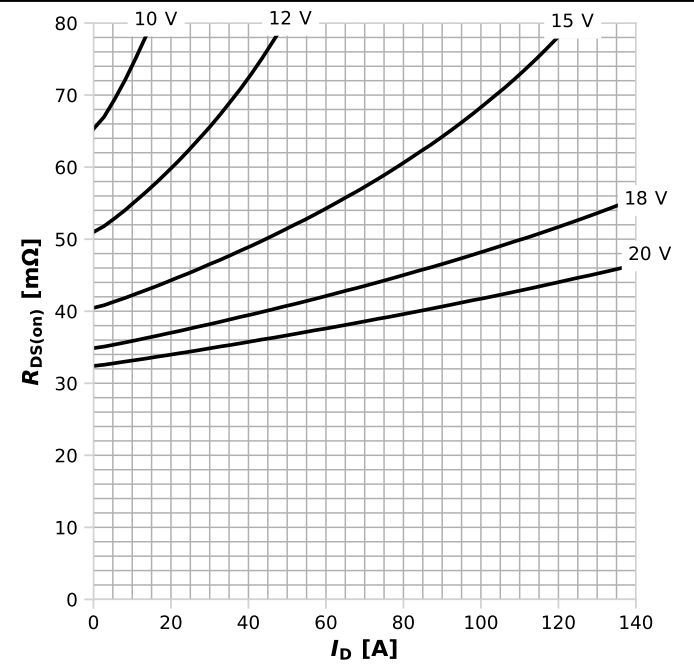


$R_{DS(on)}$=f($I_D$), $T_j$=175 °C; parameter: $V_{GS}$

## Diagram 9: Normalized drain-source on resistance
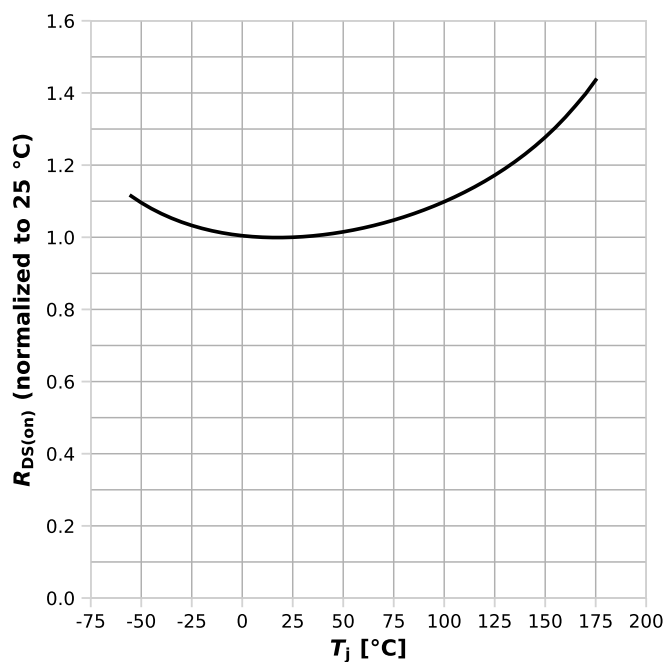
$R_{DS(on)}$=f($T_j$), $I_D$=15.7 A, $V_{GS}$=18 V

## Diagram 10: Typ. gate threshold voltage
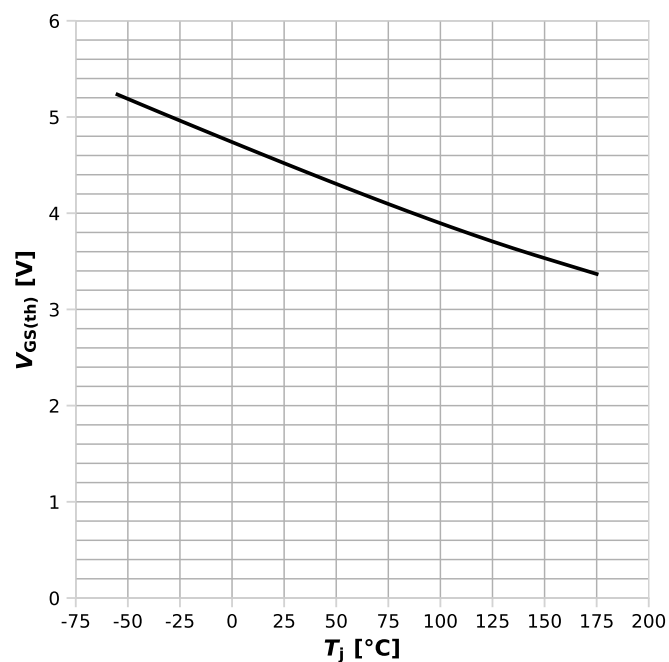
$V_{GS(th)}$=f($T_j$), $V_{GS}$=$V_{DS}$, $I_D$=5.6 mA

## Diagram 11: Typ. transfer characteristics
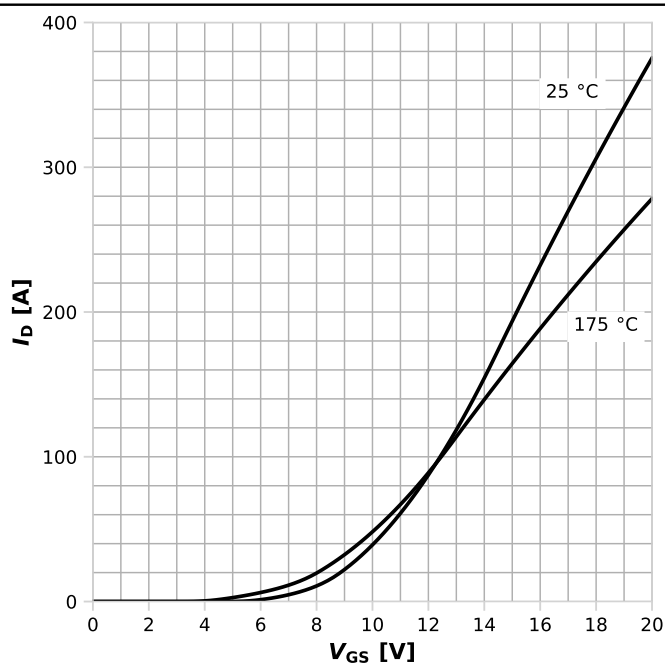
$I_D$=f($V_{GS}$), $|V_{DS}|$>2$|I_D|R_{DS(on)max}$; parameter: $T_j$

## Diagram 12: Max. transient thermal impedance
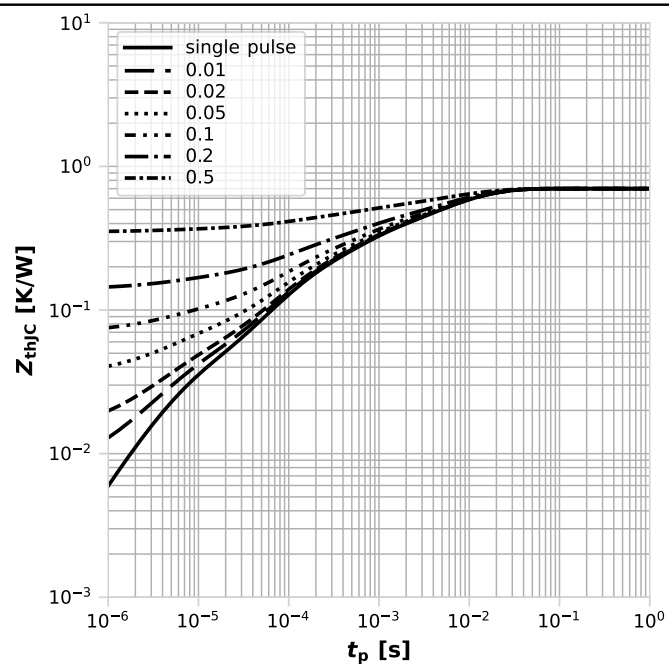
$Z_{thJC}$=f($t_p$); parameter: $D$=$t_p$/$T$

**Diagram 13: Reverse output characteristics**
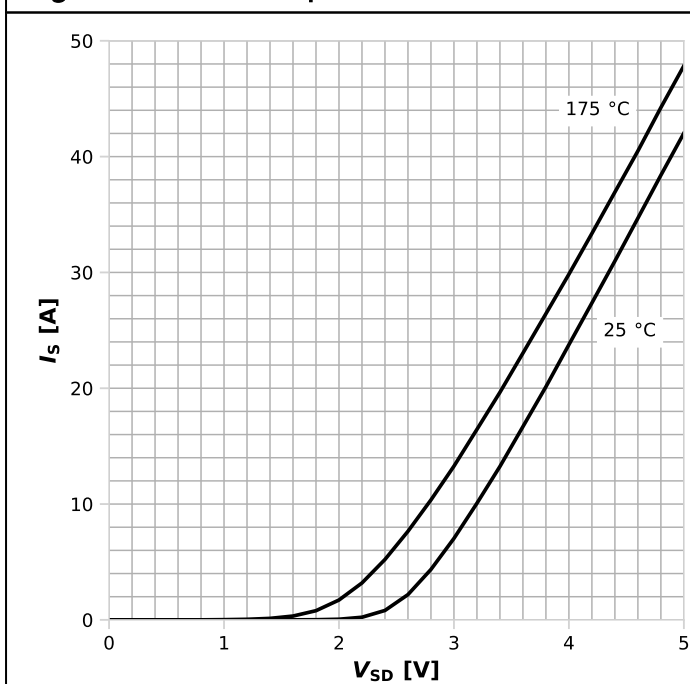


$I_F$=f($V_{SD}$), $V_{GS}$=0 V; parameter: $T_j$

**Diagram 14: Reverse output characteristics**
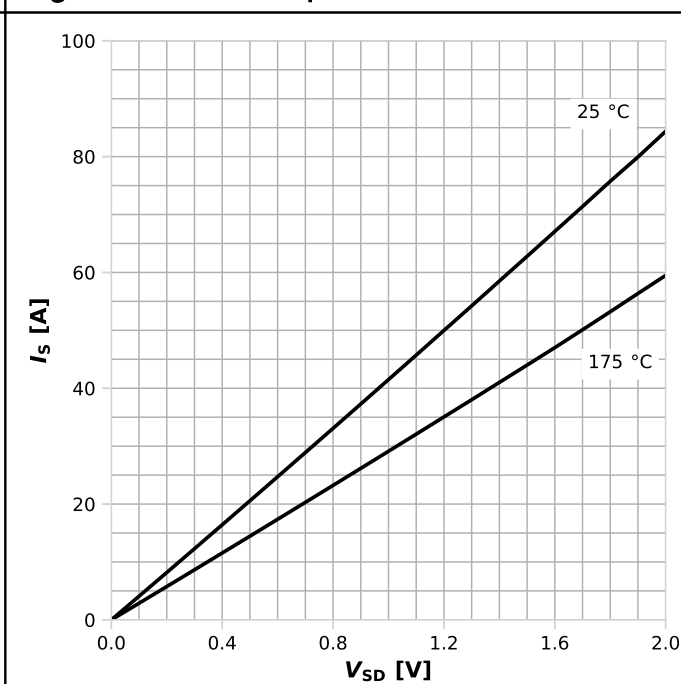


$I_F$=f($V_{SD}$), $V_{GS}$=18 V; parameter: $T_j$

**Diagram 15: Typ. capacitances**
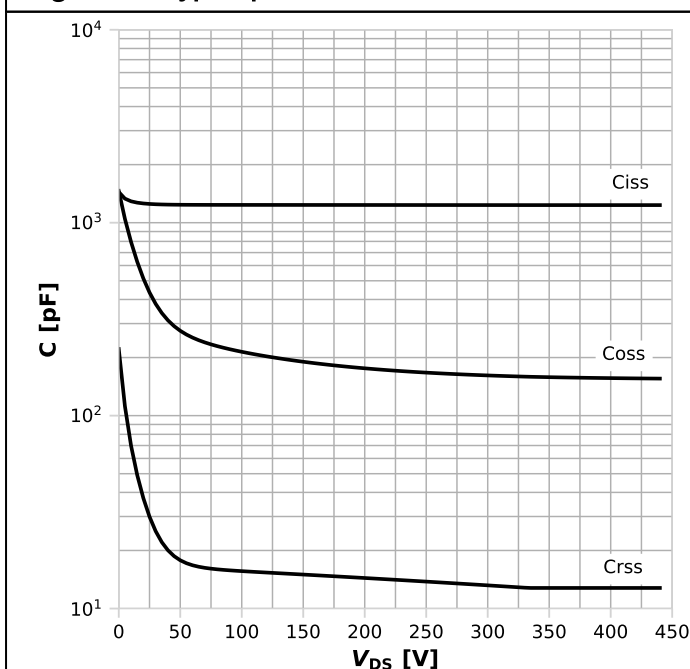


$C$=f($V_{DS}$); $V_{GS}$=0 V; $f$=1 MHz

**Diagram 16: Typ. gate charge**
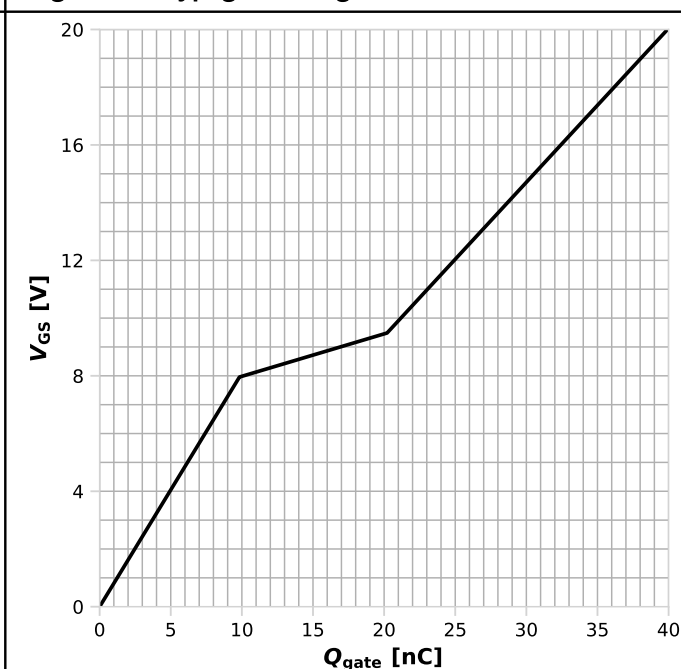


$V_{GS}$=f($Q_{gate}$), $V_{DD}$=200 V, $I_D$=15.7 A pulsed, $T_j$=25 °C

| 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($T_j$); $I_D$=0.56 mA |
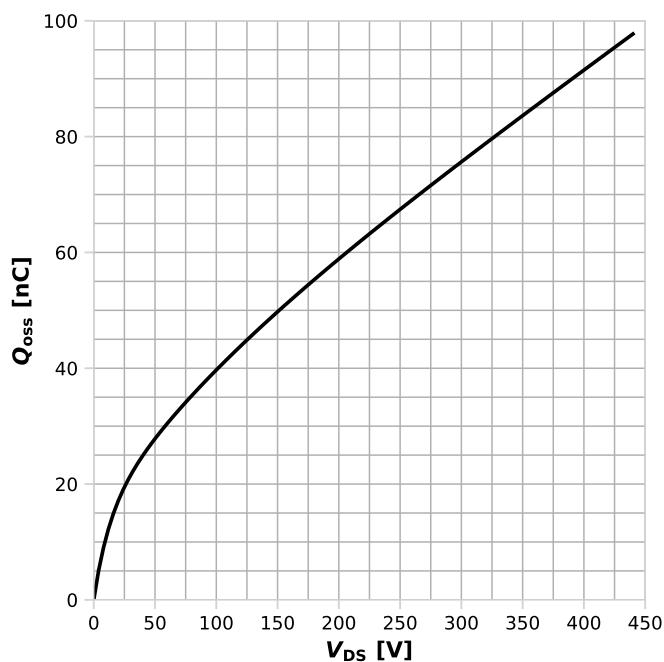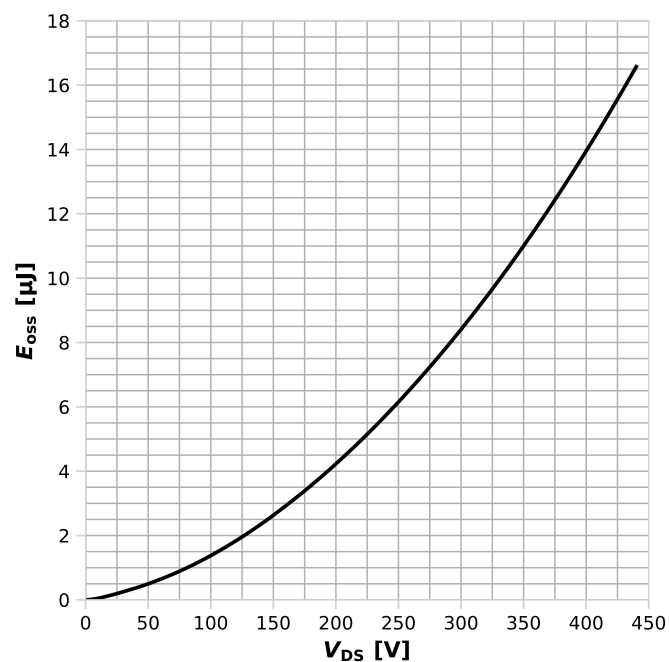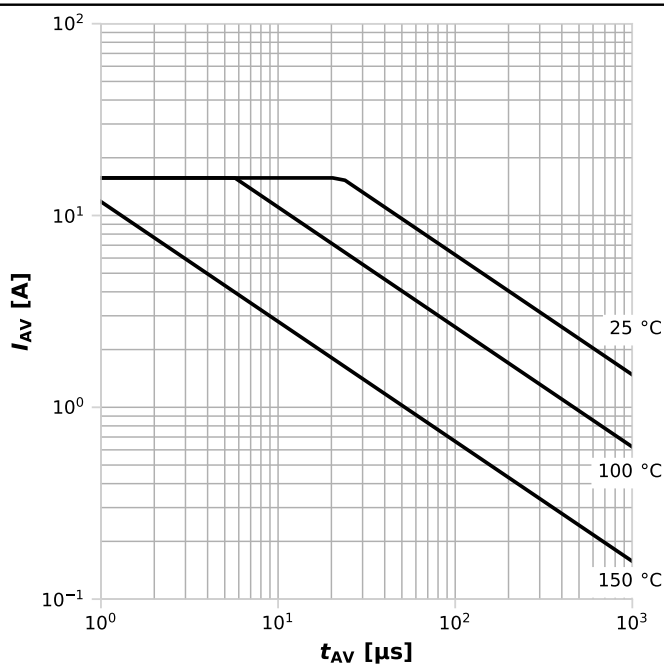
Infineon

**Diagram 21: Typ. turn-on switching losses**



$E_{on}$=f($R_{g,ext}$), $V_{DD}$=200 V, $V_G$=0...18 V; parameter: $I_D$

**Diagram 22: Typ. turn-off switching losses**



$E_{off}$=f($R_{g,ext}$), $V_{DD}$=200 V, $V_G$=18...0 V; parameter: $I_D$

**Diagram 23: Typ. turn-on switching losses**



$E_{on}$=f($R_{g,ext}$), $V_{DD}$=320 V, $V_G$=0...18 V; parameter: $I_D$

**Diagram 24: Typ. turn-off switching losses**



$E_{off}$=f($R_{g,ext}$), $V_{DD}$=320 V, $V_G$=18...0 V; parameter: $I_D$
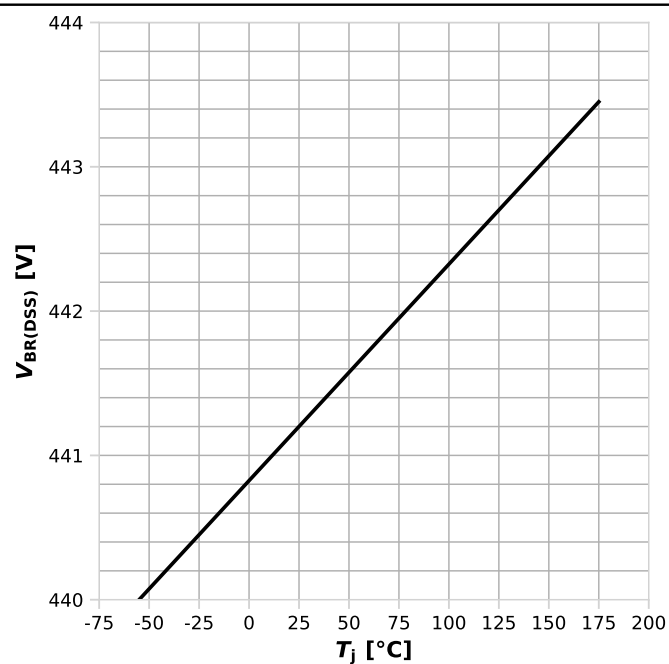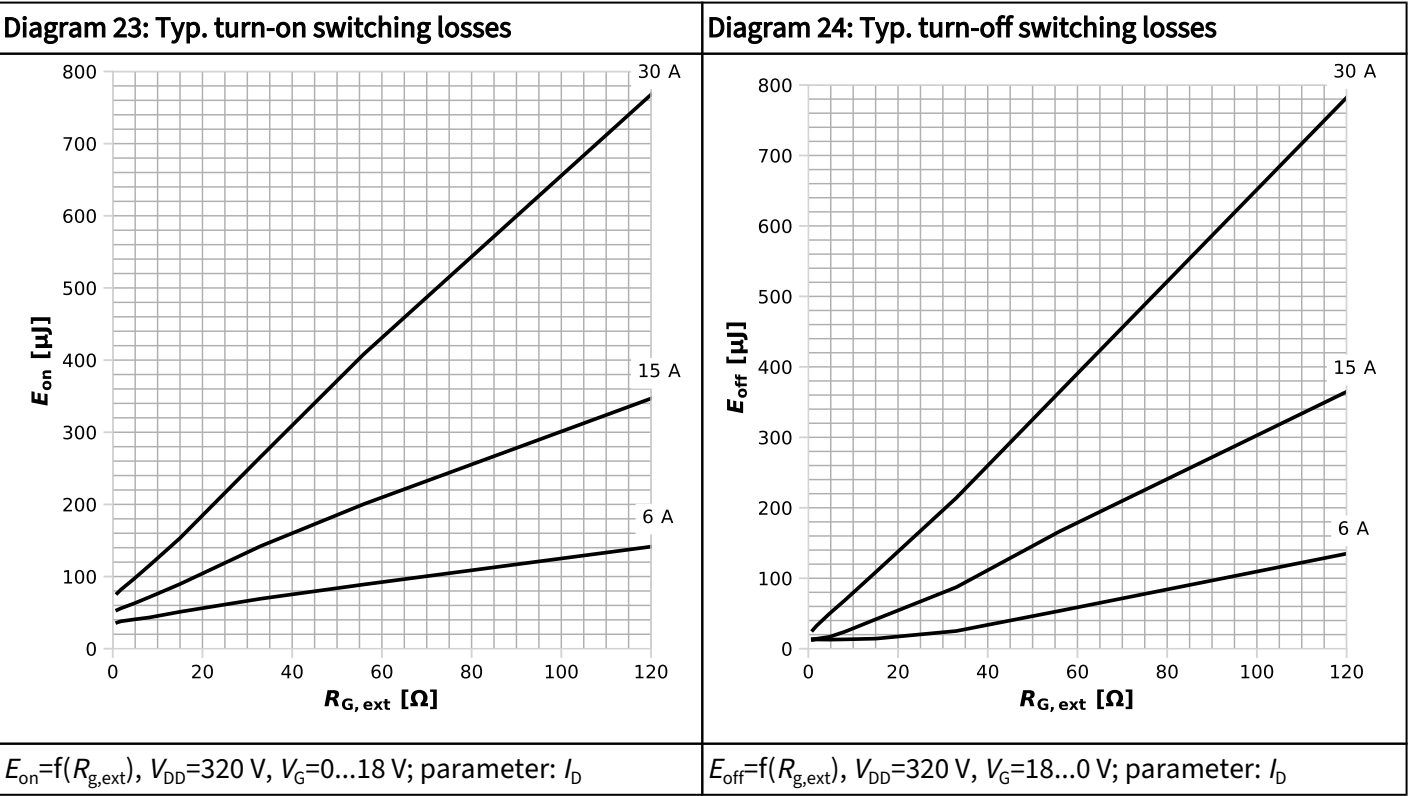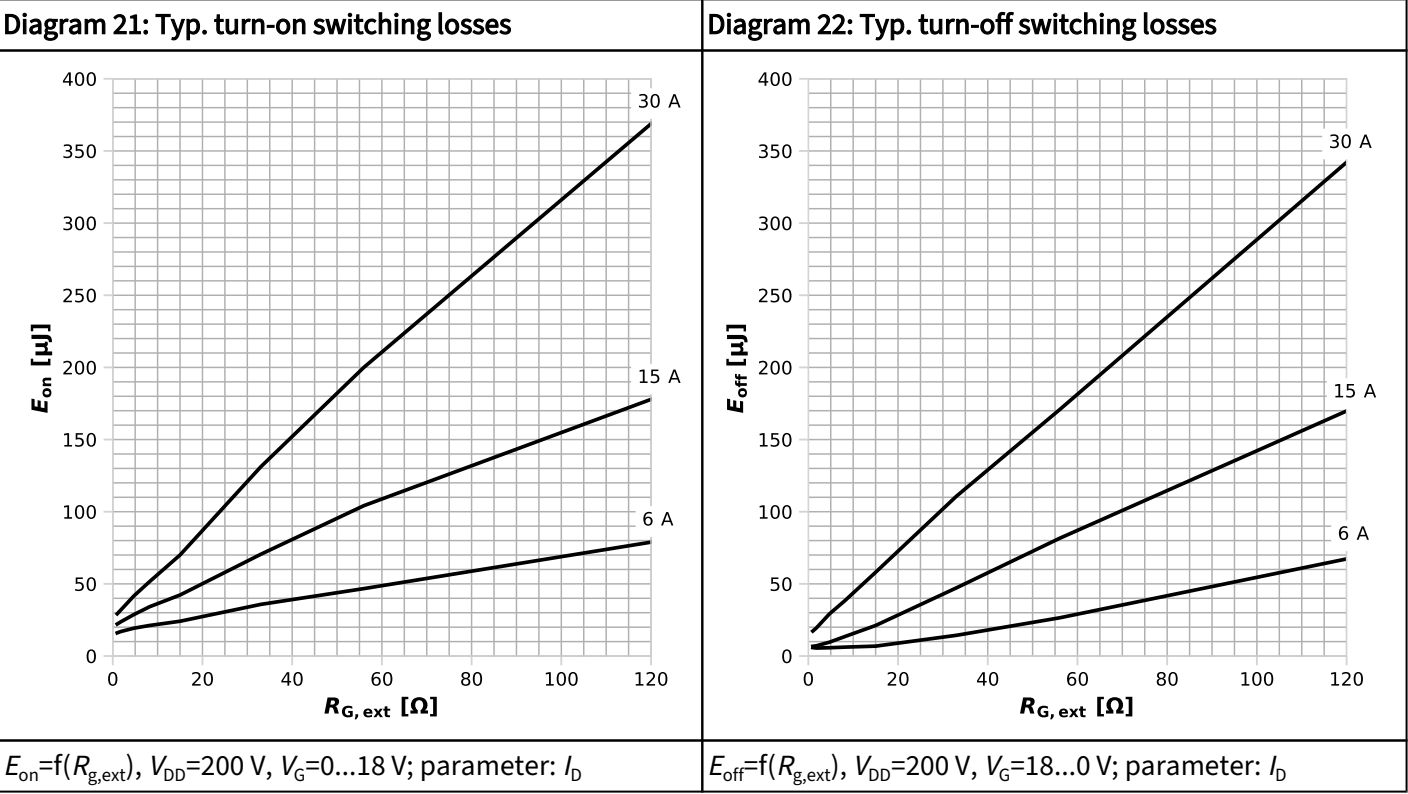
# 6  Test circuits

## Table 9    Switching times

| Switching times test circuit for inductive load | Switching times waveform |
|---|---|
|  |  |
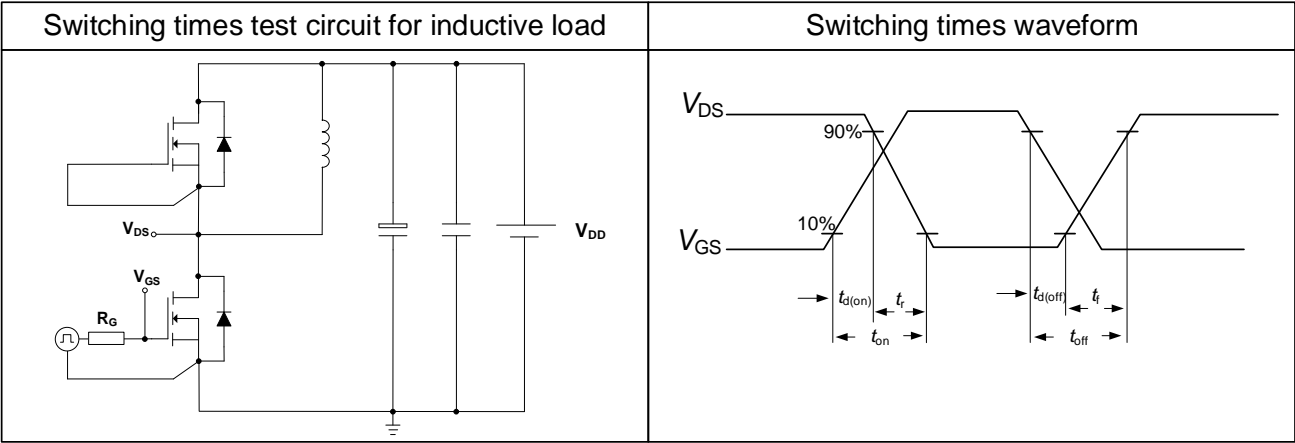
## Table 10    Body diode characteristics

| Test circuit for body diode characteristics | Body diode recovery waveform |
|---|---|
|  |  |
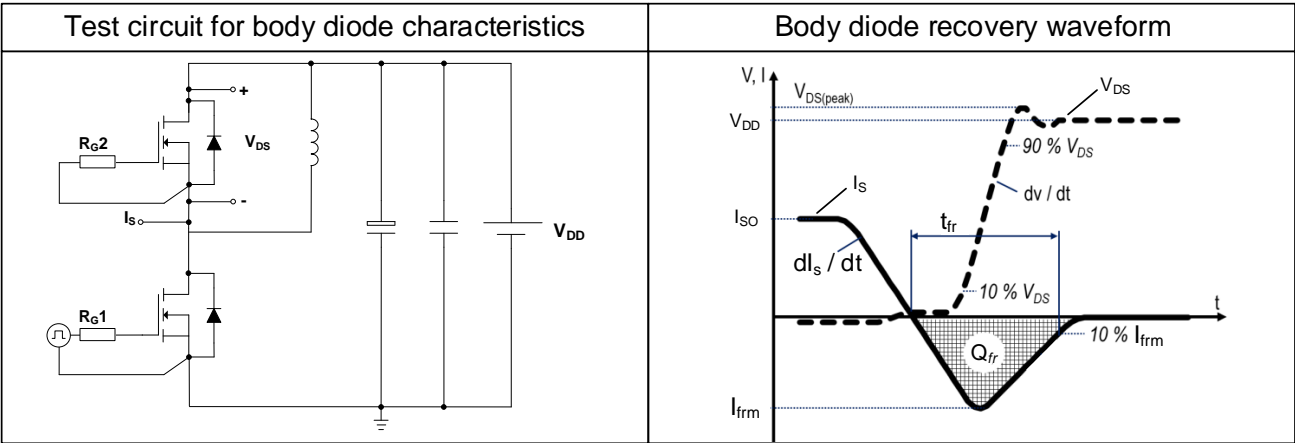
# 7 Package outlines
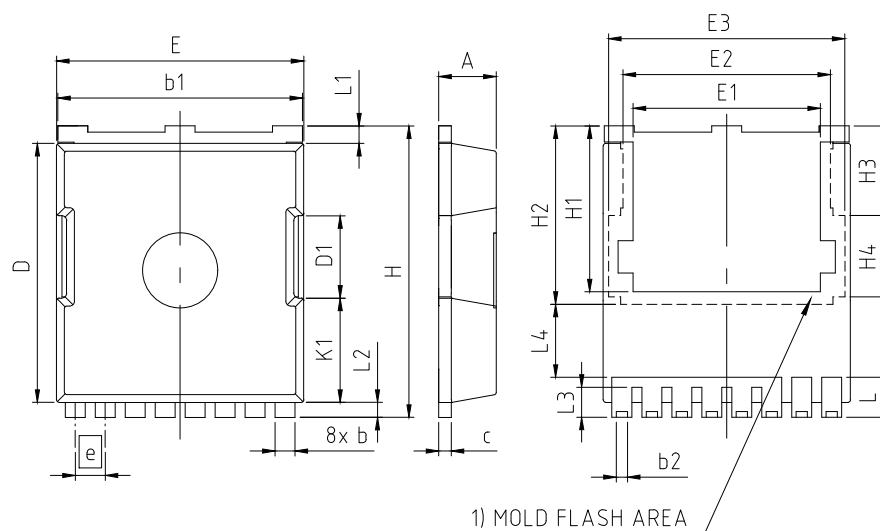


| PACKAGE - GROUP NUMBER: | PG-HSOF-8-U02 | |
|---|---|---|
| **DIMENSIONS** | **MILLIMETERS** | |
| | MIN. | MAX. |
| A | 2.20 | 2.40 |
| b | 0.70 | 0.90 |
| b1 | 9.70 | 9.90 |
| b2 | 0.42 | 0.50 |
| c | 0.40 | 0.60 |
| D | 10.28 | 10.58 |
| D1 | 3.30 | |
| E | 9.70 | 10.10 |
| E1 | 7.50 | |
| E2 | 8.50 | |
| E3 | 9.46 | |
| e | 1.20 (BSC) | |
| H | 11.48 | 11.88 |
| H1 | 6.55 | 6.95 |
| H2 | 7.15 | |
| H3 | 3.59 | |
| H4 | 3.26 | |
| N | 8 | |
| K1 | 4.18 | |
| L | 1.40 | 1.80 |
| L1 | 0.50 | 0.90 |
| L2 | 0.50 | 0.70 |
| L3 | 1.00 | 1.30 |
| L4 | 2.62 | 2.81 |

1) MOLD FLASH AREA

1) PARTIALLY COVERED WITH MOLD FLASH

**Figure 1   Outline PG-HSOF-8, dimensions in mm**
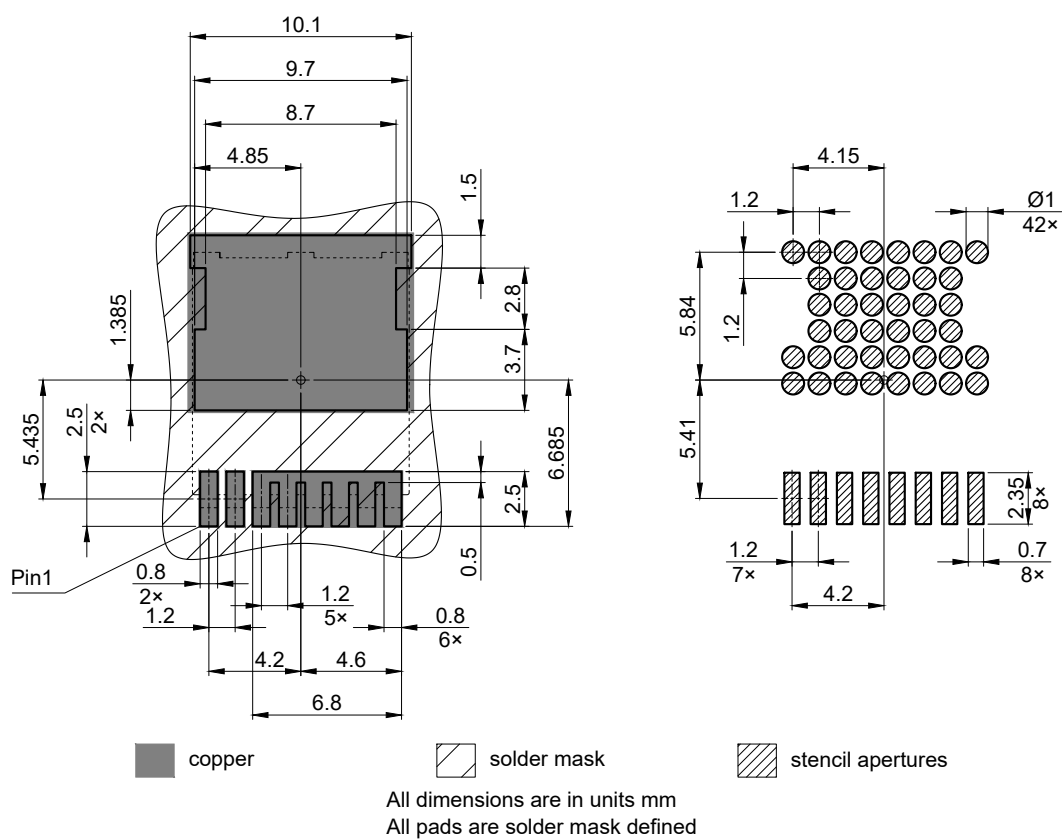
**Figure 2    Footprint drawing PG-HSOF-8, dimensions in mm**

All dimensions are in units mm
All pads are solder mask defined

copper    solder mask    stencil apertures
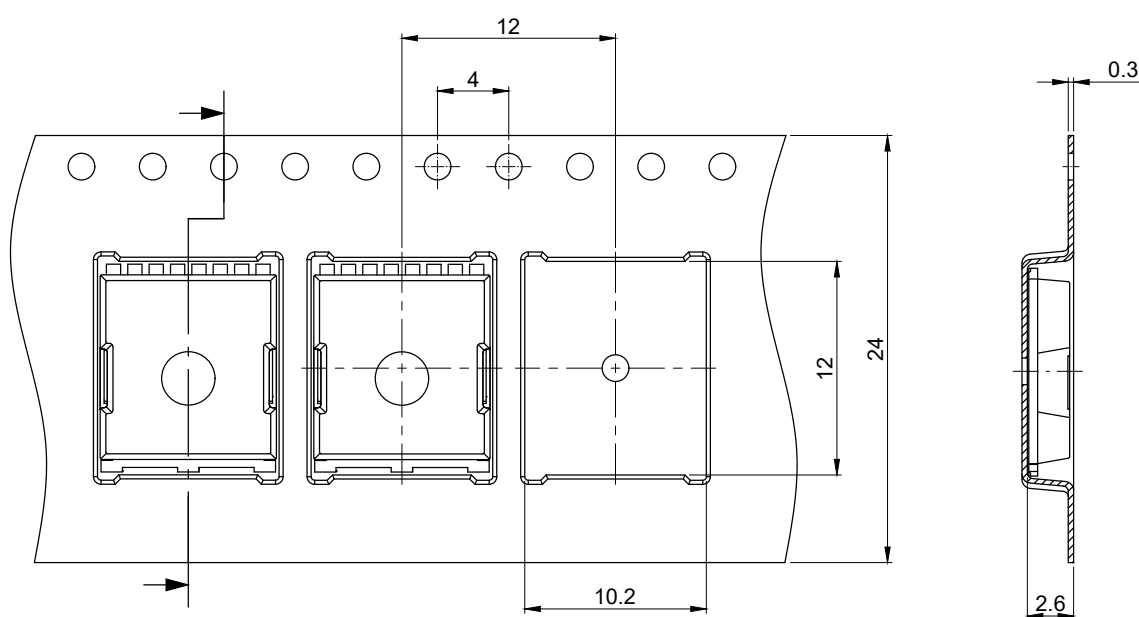
All dimensions are in units mm

The drawing is in compliance with ISO 128-30, Projection Method 1 [⊲⊕]

**Figure 3**   **Packaging variant PG-HSOF-8, dimensions in mm**

## Revision history

IMT44R025M2H

### Revision 2025-05-27, Rev. 1.0

Previous revisions

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 1.0 | 2025-05-27 | Release of final datasheet |

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