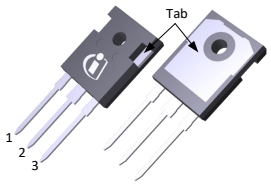
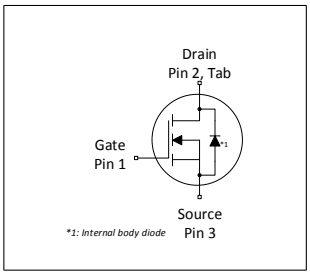
# MOSFET

## 600V CoolMOS™ CM8 Power Transistor

PG-TO247-3




The CoolMOS™ 8th generation platform is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. The 600V CoolMOS™ CM8 series is the successor to the CoolMOS™ 7.
It combines the benefits of a fast switching SJ MOSFET with excellent ease of use, e.g low ringing tendency, implemented fast body diode (CFD) for all products with outstanding robustness against hard commutation and excellent ESD capability. Furthermore, extremely low switching and conduction losses of CM8, make switching applications even more efficient.




## Features

- Suitable for hard and soft switching topologies thanks to an outstanding commutation ruggedness
- Significant reduction of switching and conduction losses
- Best in class $R_{DS(on)}$ per package products enabled by ultra low $R_{DS(on)}$*A

## Benefits

- Ease of use and fast design-in through low ringing tendency and usage across PFC and PWM stages
- Simplified thermal management thanks to our advanced die attach technique
- Increased power density solutions enabled by using products with smaller footprint and higher manufacturing quality due state of the art ESD protection
- Suitable for a wide variety of applications and power ranges

## Potential applications

- Power supplies and converters
- PFC stages & LLC resonant converters
- High efficiency switching applications
- e.g. Server, Telecom, EV Charging, UPS

## Product validation

Fully qualified according to JEDEC for Industrial Applications

*Please note: For MOSFET paralleling the use of ferrite beads on the gate or separate totem poles is generally recommended.*

### Table 1 Key Performance Parameters

| Parameter | Value | Unit |
|---|---|---|
| $V_{DS}$ @ $T_{j,max}$ | 650 | V |
| $R_{DS(on),max}$ | 37 | mΩ |
| $Q_{g,typ}$ | 79 | nC |
| $I_{D,pulse}$ | 230 | A |
| $E_{oss}$ @ 400V | 10.6 | µJ |
| Body diode $di_F/dt$ | 1300 | A/µs |
| ESD class (HBM) | 2 | - |

| Type / Ordering Code | Package | Marking | Related Links |
|---|---|---|---|
| IPW60R037CM8 | PG-TO247-3 | 60R037C8 | see Appendix A |

## Table of Contents

# 1 Maximum ratings

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

## Table 2 Maximum ratings

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Continuous drain current[1)] | $I_D$ | -<br>- | -<br>- | 64<br>40 | A | $T_C$=25°C<br>$T_C$=100°C |
| Pulsed drain current[2)] | $I_{D,pulse}$ | - | - | 230 | A | $T_C$=25°C |
| Avalanche energy, single pulse | $E_{AS}$ | - | - | 135 | mJ | $I_D$=7.8A; $V_{DD}$=50V; see table 10 |
| Avalanche energy, repetitive | $E_{AR}$ | - | - | 0.68 | mJ | $I_D$=7.8A; $V_{DD}$=50V; see table 10 |
| Avalanche current, single pulse | $I_{AS}$ | - | - | 7.8 | A | - |
| MOSFET dv/dt ruggedness | dv/dt | - | - | 120 | V/ns | $V_{DS}$=0...400V |
| Gate source voltage (static) | $V_{GS}$ | -20 | - | 20 | V | static; |
| Gate source voltage (dynamic) | $V_{GS}$ | -30 | - | 30 | V | AC (f>1 Hz) |
| Power dissipation | $P_{tot}$ | - | - | 329 | W | $T_C$=25°C |
| Storage temperature | $T_{stg}$ | -55 | - | 150 | °C | - |
| Operating junction temperature | $T_j$ | -55 | - | 150 | °C | - |
| Extended operating junction temperature | $T_j$ | 150 | - | 175 | °C | ≤50 h in the application lifetime |
| Mounting torque | - | - | - | 60 | Ncm | M3 and M3.5 screws |
| Continuous diode forward current | $I_S$ | - | - | 64 | A | $T_C$=25°C |
| Diode pulse current[2)] | $I_{S,pulse}$ | - | - | 230 | A | $T_C$=25°C |
| Reverse diode dv/dt[3)] | dv/dt | - | - | 70 | V/ns | $V_{DS}$=0...400V, $I_{SD}$≤64A, $T_j$=25°C see table 8 |
| Maximum diode commutation speed | $di_F/dt$ | - | - | 1300 | A/µs | $V_{DS}$=0...400V, $I_{SD}$≤64A, $T_j$=25°C see table 8 |
| Insulation withstand voltage | $V_{ISO}$ | - | - | n.a. | V | $V_{rms}$, $T_C$=25°C, $t$=1min |

[1)] Limited by $T_{j,max}$.
[2)] Pulse width $t_p$ limited by $T_{j,max}$
[3)] Identical low side and high side switch with identical $R_G$

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction - case | $R_{thJC}$ | - | - | 0.38 | K/W | - |
| Thermal resistance, junction - ambient | $R_{thJA}$ | - | - | 62 | K/W | leaded |
| Thermal resistance, junction - ambient for SMD version | $R_{thJA}$ | - | - | - | K/W | - |
| Soldering temperature, wavesoldering only allowed at leads | $T_{sold}$ | - | - | 260 | °C | 1.6mm (0.063 in.) from case for 10s |

# 3 Electrical characteristics

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

## Table 4 Static characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | 600 | - | - | V | $V_{GS}$=0V, $I_D$=1mA |
| Gate threshold voltage | $V_{(GS)th}$ | 3.7 | 4.2 | 4.7 | V | $V_{DS}$=$V_{GS}$, $I_D$=0.68mA |
| Zero gate voltage drain current | $I_{DSS}$ | -<br>- | -<br>88.9 | 1<br>- | µA | $V_{DS}$=600V, $V_{GS}$=0V, $T_j$=25°C<br>$V_{DS}$=600V, $V_{GS}$=0V, $T_j$=150°C |
| Gate-source leakage current | $I_{GSS}$ | - | - | 0.1 | µA | $V_{GS}$=20V, $V_{DS}$=0V |
| Drain-source on-state resistance | $R_{DS(on)}$ | -<br>- | 0.031<br>0.068 | 0.037<br>- | Ω | $V_{GS}$=10V, $I_D$=27.0A, $T_j$=25°C<br>$V_{GS}$=10V, $I_D$=27.0A, $T_j$=150°C |
| Gate resistance | $R_G$ | - | 1 | - | Ω | $f$=1MHz |

## Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | - | 3458 | - | pF | $V_{GS}$=0V, $V_{DS}$=400V, $f$=250kHz |
| Output capacitance | $C_{oss}$ | - | 43 | - | pF | $V_{GS}$=0V, $V_{DS}$=400V, $f$=250kHz |
| Effective output capacitance, energy related[1)] | $C_{o(er)}$ | - | 133 | - | pF | $V_{GS}$=0V, $V_{DS}$=0...400V |
| Effective output capacitance, time related[2)] | $C_{o(tr)}$ | - | 1372 | - | pF | $I_D$=constant, $V_{GS}$=0V, $V_{DS}$=0...400V |
| Turn-on delay time | $t_{d(on)}$ | - | 23 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=13.5A, $R_G$=5.3Ω; see table 9 |
| Rise time | $t_r$ | - | 11 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=13.5A, $R_G$=5.3Ω; see table 9 |
| Turn-off delay time | $t_{d(off)}$ | - | 101.6 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=13.5A, $R_G$=5.3Ω; see table 9 |
| Fall time | $t_f$ | - | 5.8 | - | ns | $V_{DD}$=400V, $V_{GS}$=13V, $I_D$=13.5A, $R_G$=5.3Ω; see table 9 |

## Table 6 Gate charge characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | - | 21 | - | nC | $V_{DD}$=400V, $I_D$=13.5A, $V_{GS}$=0 to 10V |
| Gate to drain charge | $Q_{gd}$ | - | 28 | - | nC | $V_{DD}$=400V, $I_D$=13.5A, $V_{GS}$=0 to 10V |
| Gate charge total | $Q_g$ | - | 79 | - | nC | $V_{DD}$=400V, $I_D$=13.5A, $V_{GS}$=0 to 10V |
| Gate plateau voltage | $V_{plateau}$ | - | 5.9 | - | V | $V_{DD}$=400V, $I_D$=13.5A, $V_{GS}$=0 to 10V |

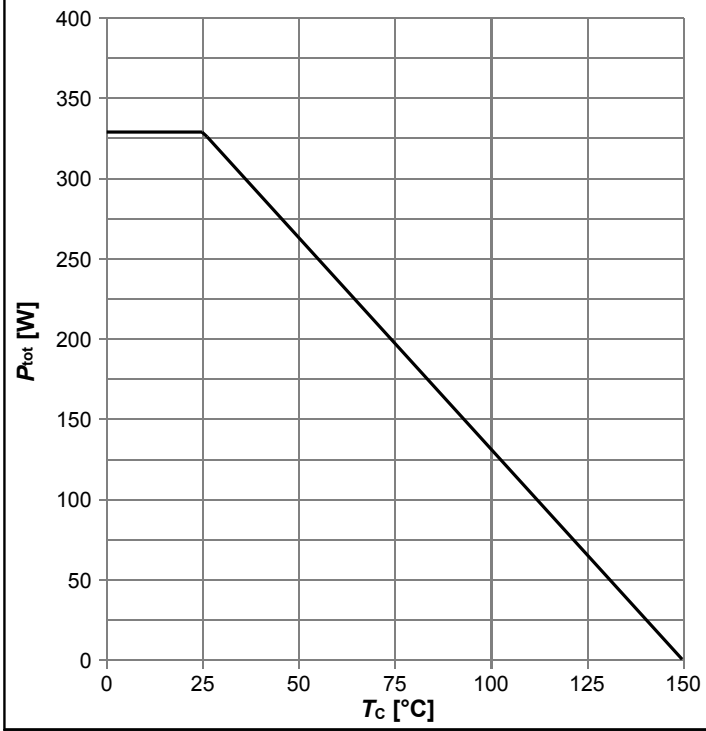
[1)] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 400V
[2)] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 400V

## Table 7 Reverse diode characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Diode forward voltage | $V_{SD}$ | - | 0.9 | - | V | $V_{GS}$=0V, $I_F$=13.5A, $T_j$=25°C |
| Reverse recovery time | $t_{rr}$ | - | 120 | 150 | ns | $V_R$=400V, $I_F$=13.5A, d$i_F$/d$t$=100A/µs; see table 8 |
| Reverse recovery charge | $Q_{rr}$ | - | 0.73 | 1.10 | µC | $V_R$=400V, $I_F$=13.5A, d$i_F$/d$t$=100A/µs; see table 8 |
| Peak reverse recovery current | $I_{rrm}$ | - | 11.8 | - | A | $V_R$=400V, $I_F$=13.5A, d$i_F$/d$t$=100A/µs; see table 8 |

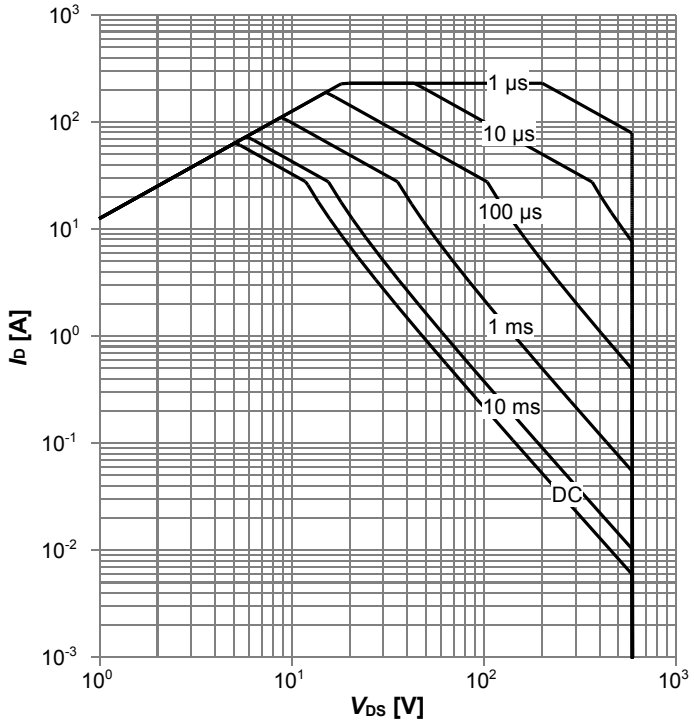
# 4 Electrical characteristics diagrams

**Diagram 1: Power dissipation**



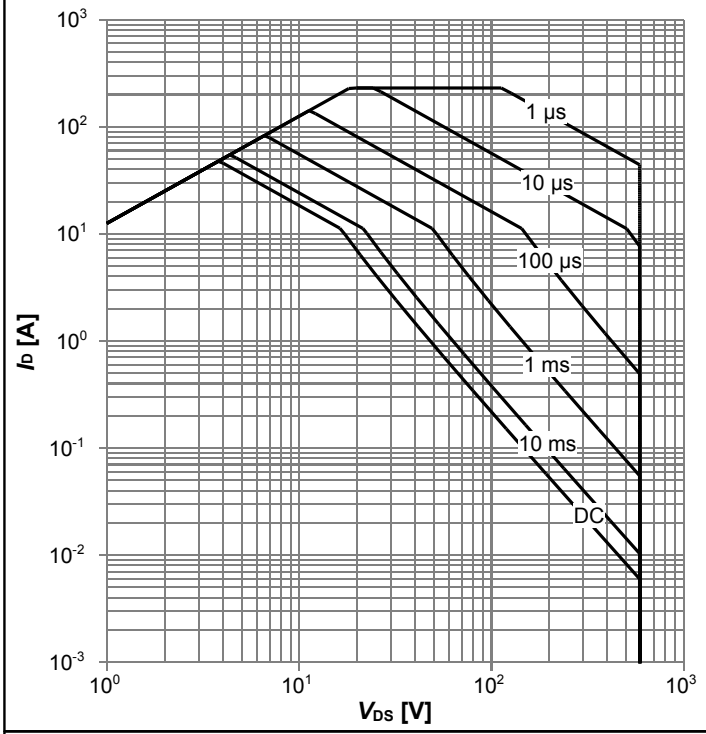

$P_{tot}=f(T_C)$

**Diagram 2: Safe operating area**



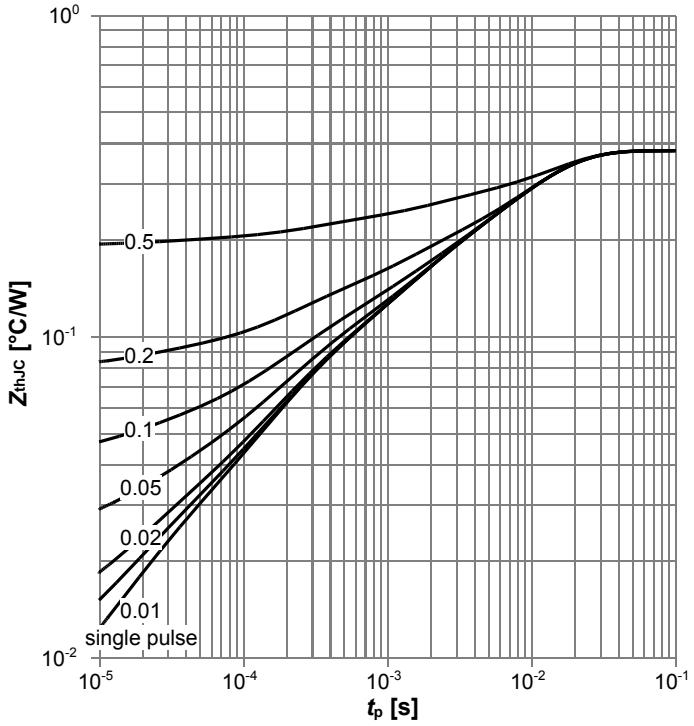

$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: $t_p$

**Diagram 3: Safe operating area**



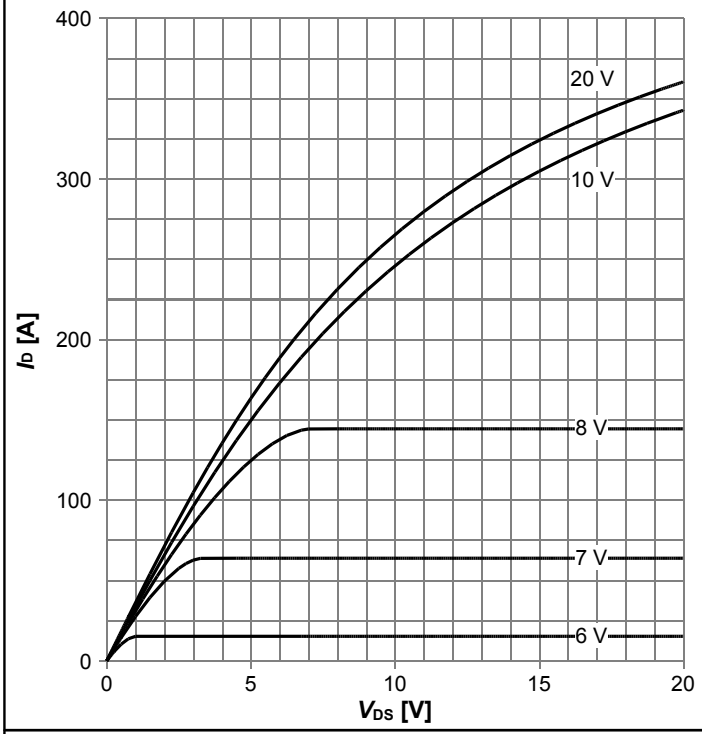

$I_D=f(V_{DS})$; $T_C=80$ °C; $D=0$; parameter: $t_p$

**Diagram 4: Max. transient thermal impedance**



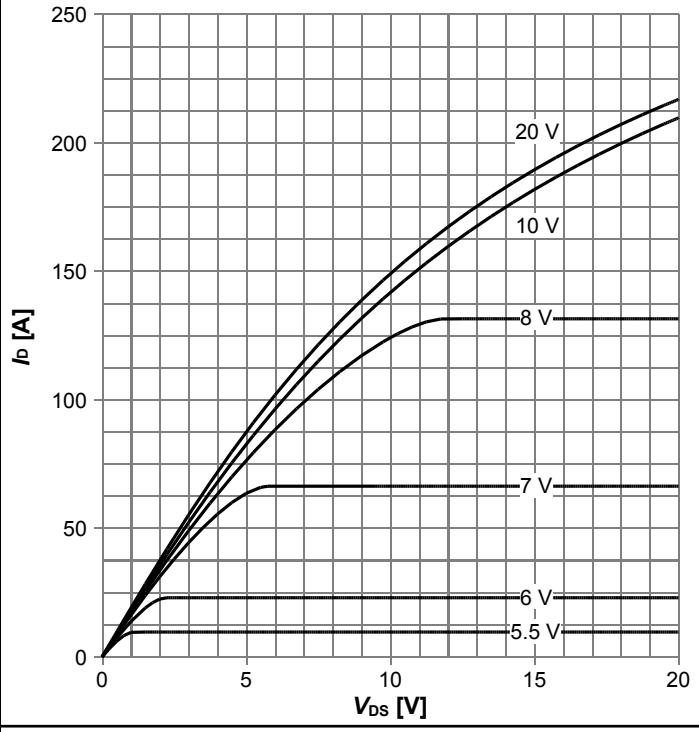

$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

**Diagram 5: Typ. output characteristics**



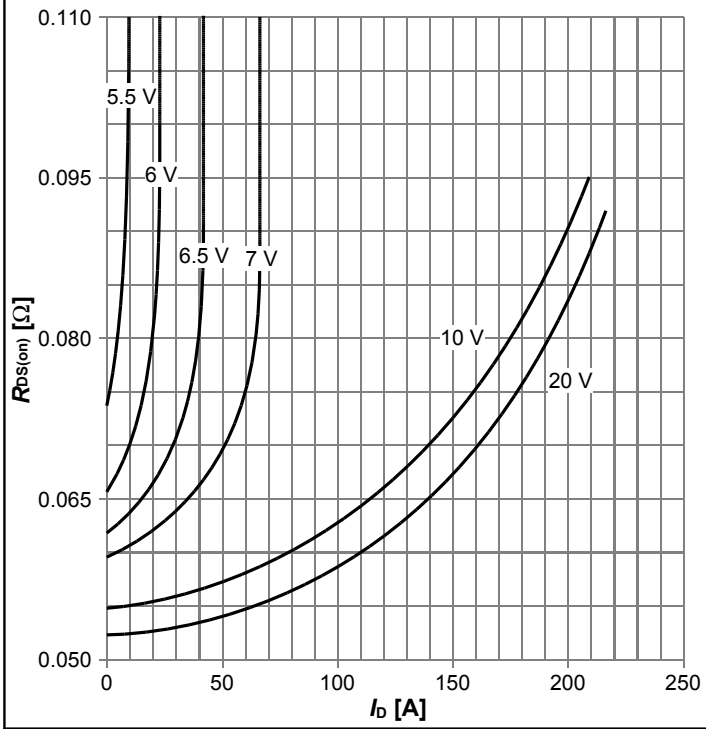

$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: $V_{GS}$

**Diagram 6: Typ. output characteristics**



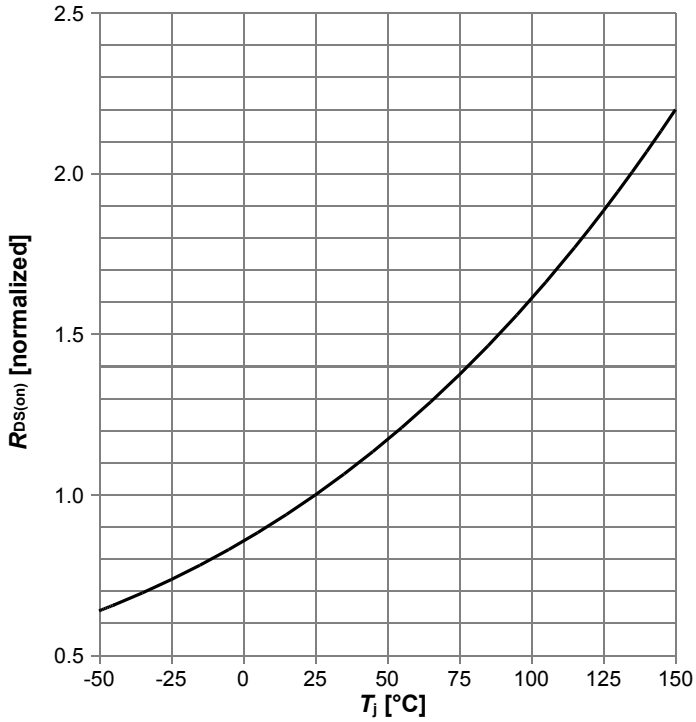

$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: $V_{GS}$

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



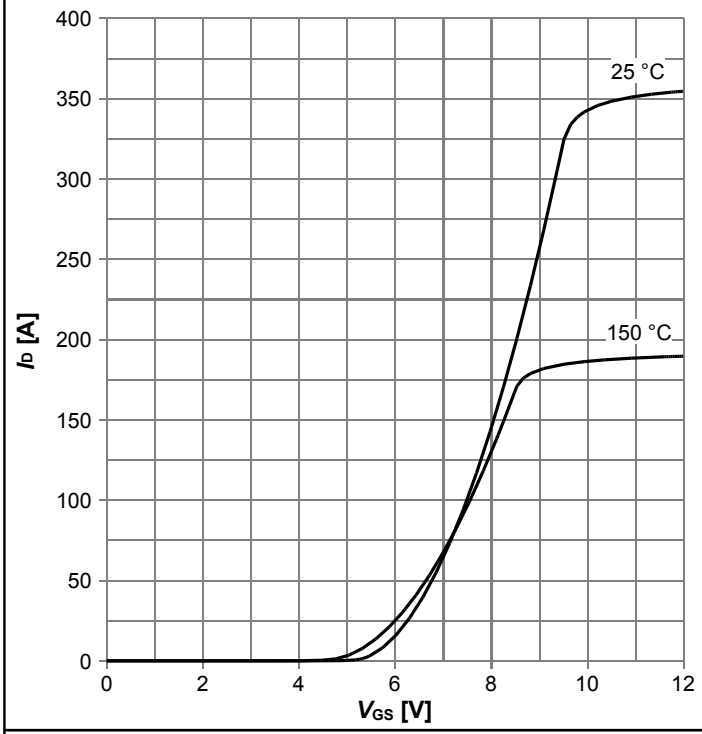

$R_{DS(on)}=f(I_D)$; $T_j=125$ °C; parameter: $V_{GS}$

**Diagram 8: Drain-source on-state resistance**



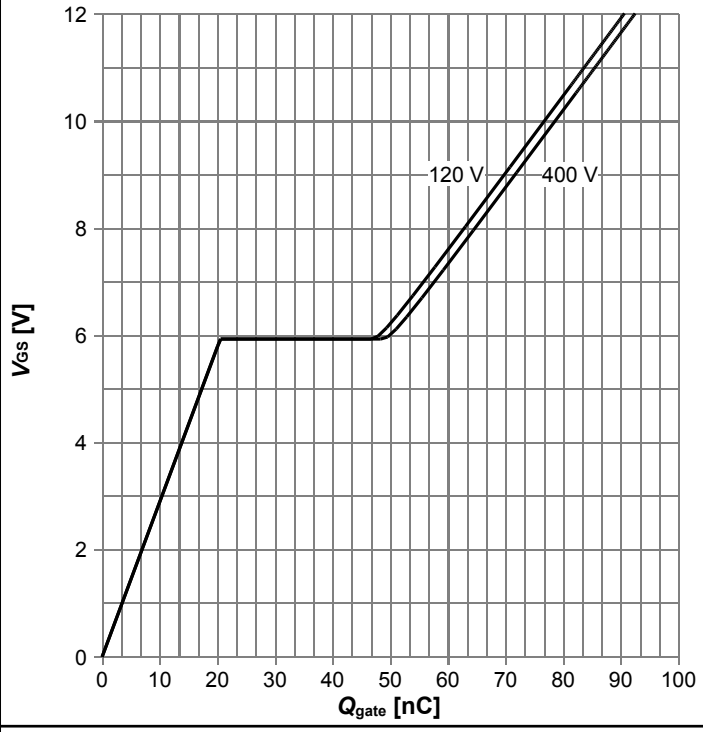

$R_{DS(on)}=f(T_j)$; $I_D=27.0$ A; $V_{GS}=10$ V

**Diagram 9: Typ. transfer characteristics**



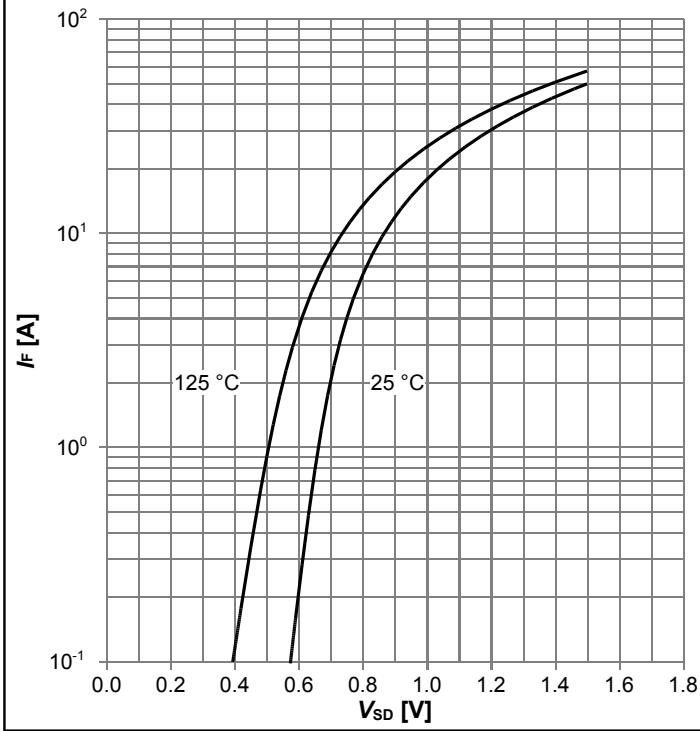

$I_D=f(V_{GS})$; $V_{DS}$=20V; parameter: $T_j$

**Diagram 10: Typ. gate charge**



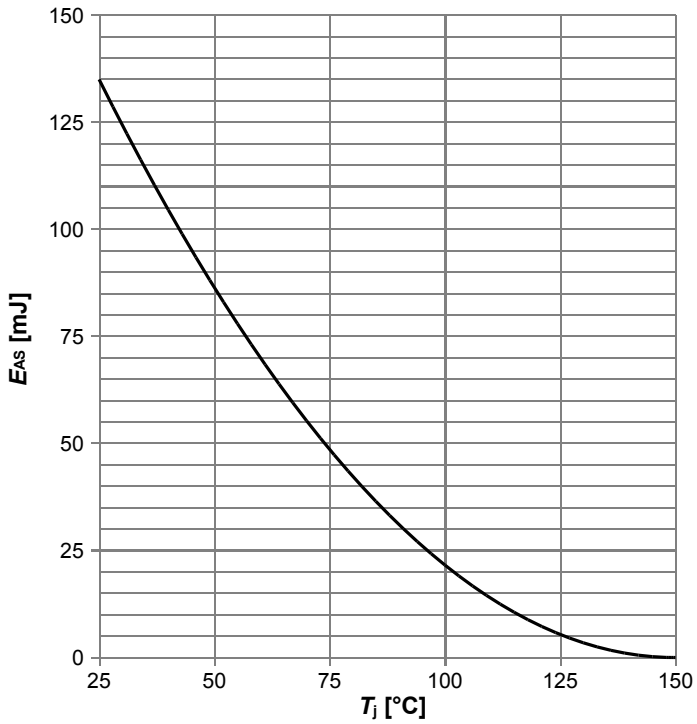

$V_{GS}=f(Q_{gate})$; $I_D$=13.5 A pulsed; parameter: $V_{DD}$

**Diagram 11: Forward characteristics of reverse diode**



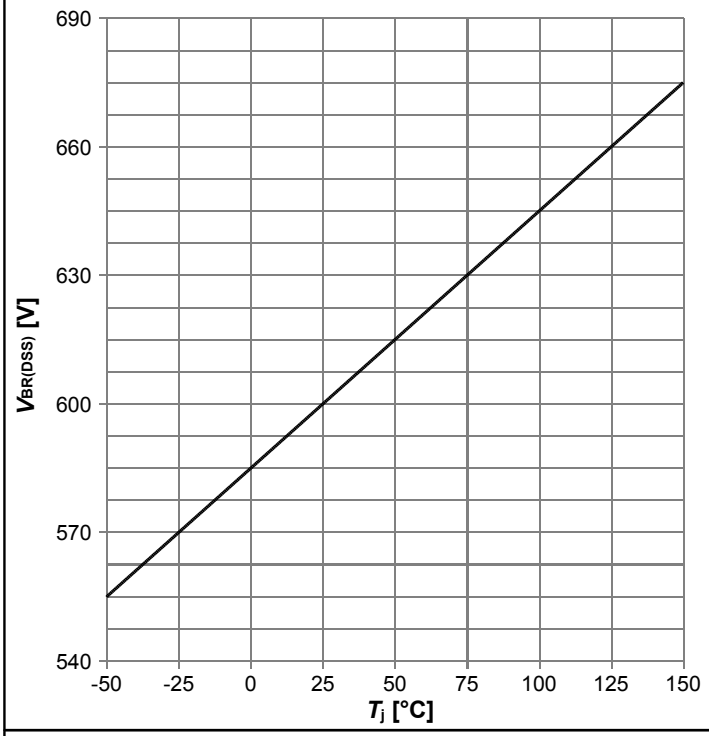

$I_F=f(V_{SD})$; parameter: $T_j$

**Diagram 12: Avalanche energy**



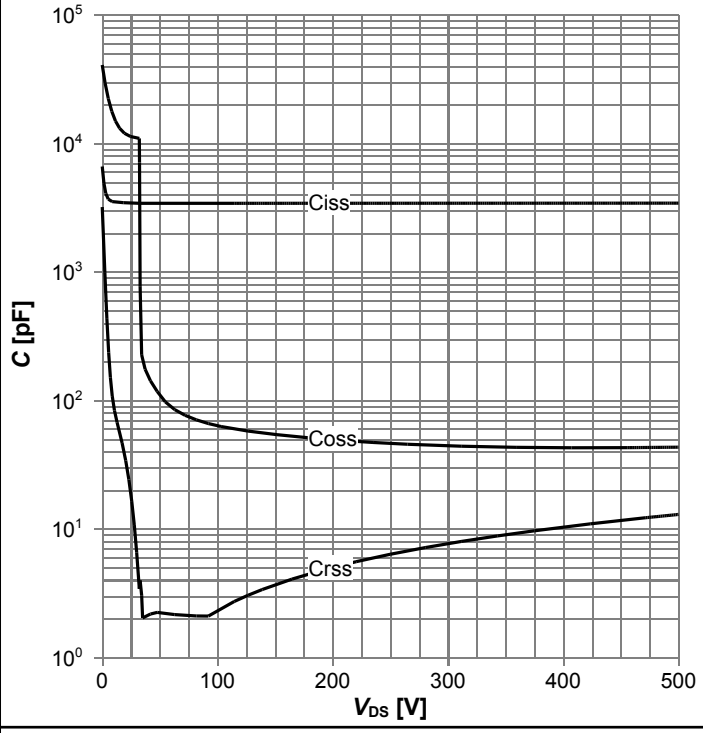

$E_{AS}=f(T_j)$; $I_D$=7.8 A; $V_{DD}$=50 V

**Diagram 13: Drain-source breakdown voltage**



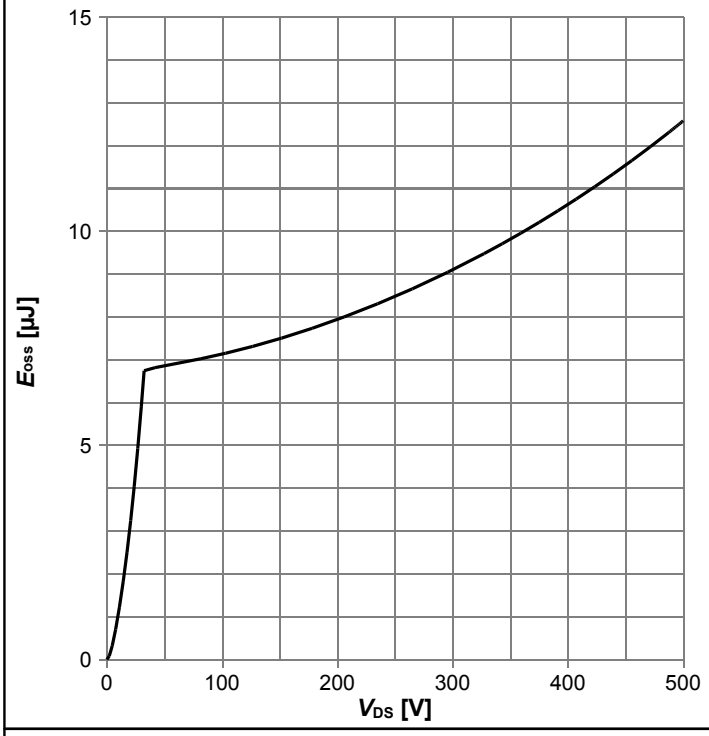

$V_{BR(DSS)}$=f($T_j$); $I_D$=1 mA

**Diagram 14: Typ. capacitances**




$C$=f($V_{DS}$); $V_{GS}$=0 V; $f$=250 kHz

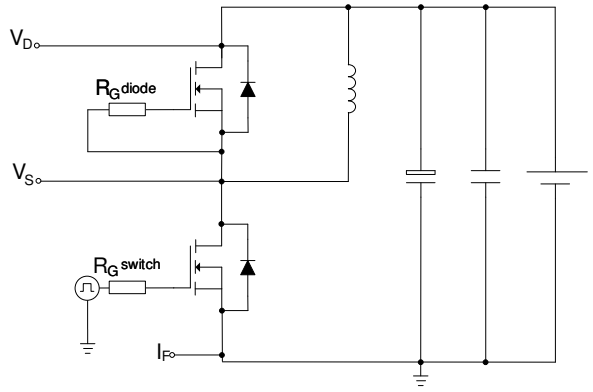
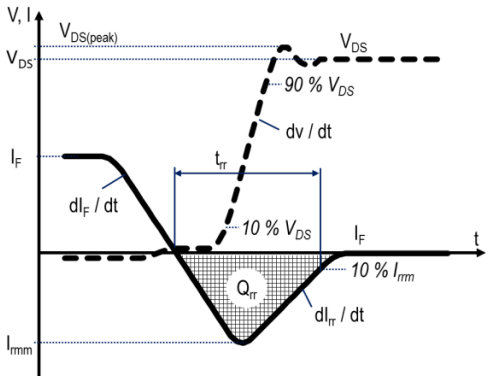
**Diagram 15: Typ. Coss stored energy**




$E_{oss}$=f($V_{DS}$)

# 5 Test Circuits

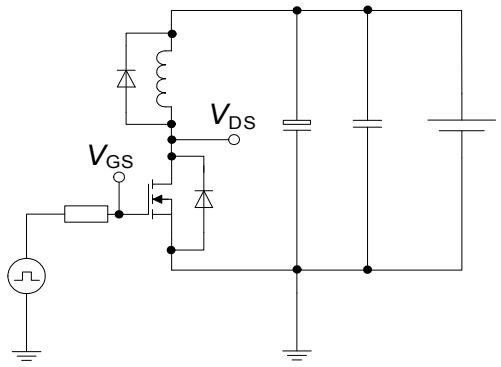
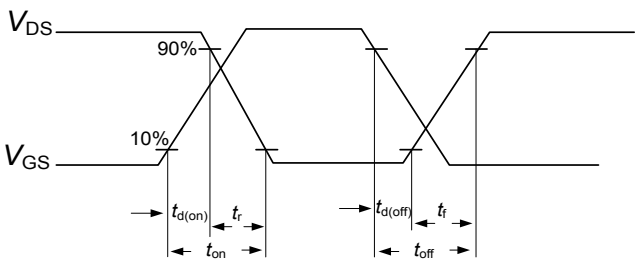
## Table 8 Diode characteristics (C8)

| Test circuit for diode characteristics | Diode recovery waveform |
|---|---|
|  |  |





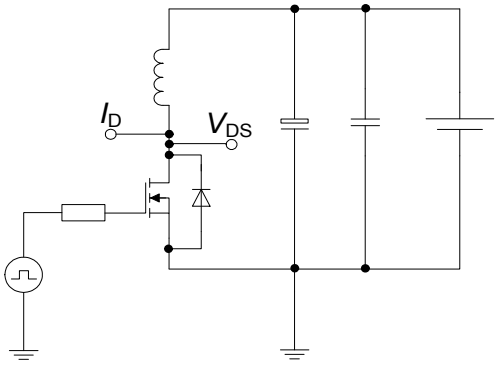
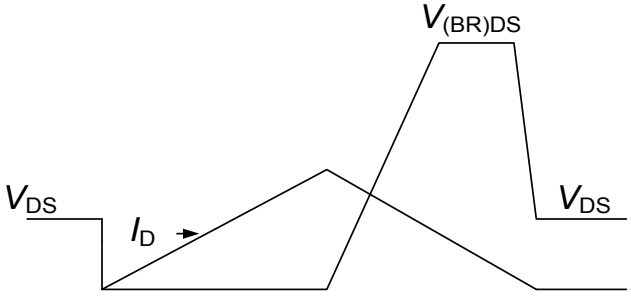
## Table 9 Switching times

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

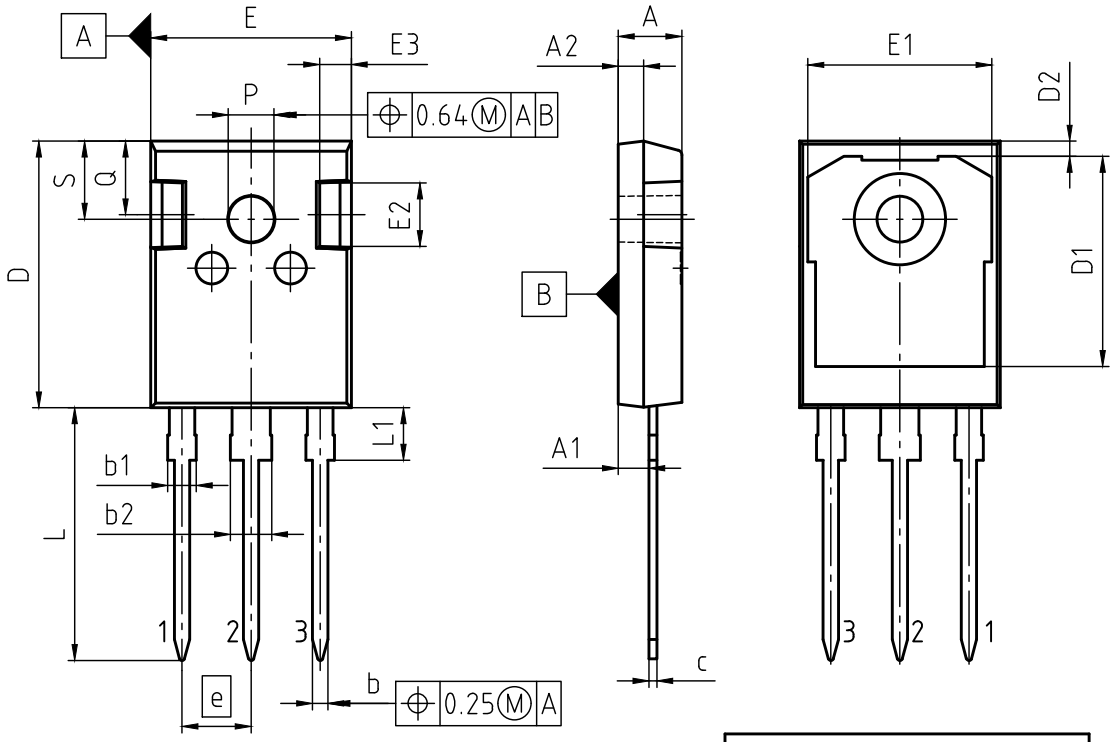




## Table 10 Unclamped inductive load

| Unclamped inductive load test circuit | Unclamped inductive waveform |
|---|---|
|  |  |

## 6 Package Outlines




| PACKAGE - GROUP NUMBER: | PG-TO247-3-U06 | |
|---|---|---|
| **DIMENSIONS** | **MILLIMETERS** | |
| | MIN. | MAX. |
| **A** | 4.83 | 5.21 |
| **A1** | 2.27 | 2.54 |
| **A2** | 1.85 | 2.16 |
| **b** | 1.07 | 1.33 |
| **b1** | 1.90 | 2.41 |
| **b2** | 2.87 | 3.38 |
| **c** | 0.55 | 0.68 |
| **D** | 20.80 | 21.10 |
| **D1** | 16.25 | 17.65 |
| **D2** | 0.95 | 1.35 |
| **E** | 15.70 | 16.13 |
| **E1** | 13.10 | 14.15 |
| **E2** | 3.68 | 5.10 |
| **E3** | 1.00 | 2.60 |
| **e** | 5.44 | |
| **N** | 3 | |
| **L** | 19.80 | 20.32 |
| **L1** | 4.10 | 4.47 |
| **øP** | 3.50 | 3.70 |
| **Q** | 5.49 | 6.00 |
| **S** | 6.04 | 6.30 |

NOTE:
DIMENSIONS DO NOT INCLUDE MOLDFLASH; PROTRUSION OR GATE BURRS

**Figure 1 Outline PG-TO247-3, dimensions in mm**

# 7 Appendix A

## Table 11 Related Links

- **IFX CoolMOS CM8 Webpage:** www.infineon.com
- **IFX CoolMOS CM8 application note:** www.infineon.com
- **IFX CoolMOS CM8 simulation model:** www.infineon.com
- **IFX Design tools:** www.infineon.com

## Revision History

IPW60R037CM8

**Revision: 2024-03-21, Rev. 2.1**

| Previous Revision | | |
|---|---|---|
| Revision | Date | Subjects (major changes since last revision) |
| 2.0 | 2023-10-25 | Release of final version |
| 2.1 | 2024-03-21 | Update of $R_{thJC}$ |



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