

MOSFET

600V CoolMOS™ CM8 Power Transistor

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

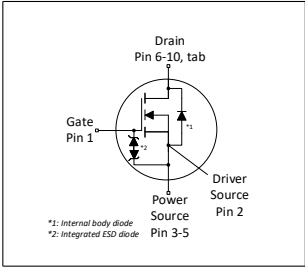
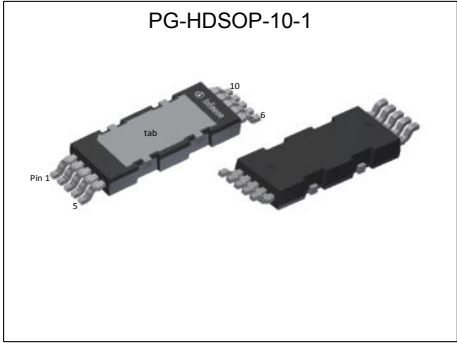
Fully qualified according to JEDEC for Industrial Applications

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    |
| $R_{DS(on),max}$     | 180   | mΩ   |
| $Q_{g,typ}$          | 17    | nC   |
| $I_{D,pulse}$        | 48    | A    |
| $E_{oss} @ 400V$     | 2.4   | μJ   |
| Body diode $di_F/dt$ | 1300  | A/μs |
| ESD class (HBM)      | 2     | -    |

| Type / Ordering Code | Package     | Marking  | Related Links  |
|----------------------|-------------|----------|----------------|
| IPDD60R180CM8        | PG-HDSOP-10 | 60R180C8 | see Appendix A |



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## 1 Maximum ratings

at  $T_j = 25^\circ\text{C}$ , unless otherwise specified

**Table 2 Maximum ratings**

| Parameter                               | Symbol        | Values |      |          | Unit             | Note / Test Condition                                                                        |
|-----------------------------------------|---------------|--------|------|----------|------------------|----------------------------------------------------------------------------------------------|
|                                         |               | Min.   | Typ. | Max.     |                  |                                                                                              |
| Continuous drain current <sup>1)</sup>  | $I_D$         | -      | -    | 21<br>13 | A                | $T_C=25^\circ\text{C}$<br>$T_C=100^\circ\text{C}$                                            |
| Pulsed drain current <sup>2)</sup>      | $I_{D,pulse}$ | -      | -    | 48       | A                | $T_C=25^\circ\text{C}$                                                                       |
| Avalanche energy, single pulse          | $E_{AS}$      | -      | -    | 28       | mJ               | $I_D=2.7\text{A}$ ; $V_{DD}=50\text{V}$ ; see table 10                                       |
| Avalanche energy, repetitive            | $E_{AR}$      | -      | -    | 0.14     | mJ               | $I_D=2.7\text{A}$ ; $V_{DD}=50\text{V}$ ; see table 10                                       |
| Avalanche current, single pulse         | $I_{AS}$      | -      | -    | 2.7      | A                | -                                                                                            |
| MOSFET dv/dt ruggedness                 | dv/dt         | -      | -    | 120      | V/ns             | $V_{DS}=0\dots400\text{V}$                                                                   |
| Gate source voltage (static)            | $V_{GS}$      | -20    | -    | 20       | V                | static;                                                                                      |
| Gate source voltage (dynamic)           | $V_{GS}$      | -30    | -    | 30       | V                | AC ( $f>1\text{ Hz}$ )                                                                       |
| Power dissipation                       | $P_{tot}$     | -      | -    | 169      | W                | $T_C=25^\circ\text{C}$                                                                       |
| Storage temperature                     | $T_{stg}$     | -55    | -    | 150      | $^\circ\text{C}$ | -                                                                                            |
| Operating junction temperature          | $T_j$         | -55    | -    | 150      | $^\circ\text{C}$ | -                                                                                            |
| Extended operating junction temperature | $T_j$         | 150    | -    | 175      | $^\circ\text{C}$ | $\leq 50\text{ h}$ in the application lifetime                                               |
| Mounting torque                         | -             | -      | -    | -        | Ncm              | -                                                                                            |
| Continuous diode forward current        | $I_S$         | -      | -    | 21       | A                | $T_C=25^\circ\text{C}$                                                                       |
| Diode pulse current <sup>2)</sup>       | $I_{S,pulse}$ | -      | -    | 48       | A                | $T_C=25^\circ\text{C}$                                                                       |
| Reverse diode dv/dt <sup>3)</sup>       | dv/dt         | -      | -    | 70       | V/ns             | $V_{DS}=0\dots400\text{V}$ , $I_{SD}\leq 21\text{A}$ , $T_j=25^\circ\text{C}$<br>see table 8 |
| Maximum diode commutation speed         | di/dt         | -      | -    | 1300     | A/ $\mu\text{s}$ | $V_{DS}=0\dots400\text{V}$ , $I_{SD}\leq 21\text{A}$ , $T_j=25^\circ\text{C}$<br>see table 8 |
| Insulation withstand voltage            | $V_{ISO}$     | -      | -    | n.a.     | V                | $V_{rms}$ , $T_C=25^\circ\text{C}$ , $t=1\text{min}$                                         |

<sup>1)</sup> Limited by  $T_{j,max}$ .

<sup>2)</sup> Pulse width  $t_p$  limited by  $T_{j,max}$

<sup>3)</sup> Identical low side and high side switch with identical  $R_\theta$

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter                                              | Symbol     | Values |      |      | Unit | Note / Test Condition                                                                                                                                                  |
|--------------------------------------------------------|------------|--------|------|------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                        |            | Min.   | Typ. | Max. |      |                                                                                                                                                                        |
| Thermal resistance, junction - case                    | $R_{thJC}$ | -      | -    | 0.74 | K/W  | -                                                                                                                                                                      |
| Thermal resistance, junction - ambient                 | $R_{thJA}$ | -      | -    | 62   | K/W  | device on PCB, minimal footprint                                                                                                                                       |
| Thermal resistance, junction - ambient for SMD version | $R_{thJA}$ | -      | 55   | 60   | K/W  | Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm <sup>2</sup> (one layer, 70μm thickness) copper area. Tap exposed to air. PCB is vertical without air stream cooling. |
| Soldering temperature, reflow soldering allowed        | $T_{sold}$ | -      | -    | 260  | °C   | reflow MSL1                                                                                                                                                            |

### 3 Electrical characteristics

at  $T_j=25^\circ\text{C}$ , 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        | $V_{DS}=V_{GS}$ , $I_D=0.14mA$                                                                                |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | -              | 1          | $\mu A$  | $V_{DS}=600V$ , $V_{GS}=0V$ , $T_j=25^\circ\text{C}$<br>$V_{DS}=600V$ , $V_{GS}=0V$ , $T_j=150^\circ\text{C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | -              | 1.6        | $\mu A$  | $V_{GS}=20V$ , $V_{DS}=0V$                                                                                    |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 0.150<br>0.331 | 0.180<br>- | $\Omega$ | $V_{GS}=10V$ , $I_D=5.6A$ , $T_j=25^\circ\text{C}$<br>$V_{GS}=10V$ , $I_D=5.6A$ , $T_j=150^\circ\text{C}$     |
| Gate resistance                  | $R_G$         | -      | 12             | -          | $\Omega$ | $f=1MHz$                                                                                                      |

**Table 5 Dynamic characteristics**

| Parameter                                                  | Symbol       | Values |      |      | Unit | Note / Test Condition                                                         |
|------------------------------------------------------------|--------------|--------|------|------|------|-------------------------------------------------------------------------------|
|                                                            |              | Min.   | Typ. | Max. |      |                                                                               |
| Input capacitance                                          | $C_{iss}$    | -      | 743  | -    | pF   | $V_{GS}=0V$ , $V_{DS}=400V$ , $f=250kHz$                                      |
| Output capacitance                                         | $C_{oss}$    | -      | 11   | -    | pF   | $V_{GS}=0V$ , $V_{DS}=400V$ , $f=250kHz$                                      |
| Effective output capacitance, energy related <sup>1)</sup> | $C_{o(er)}$  | -      | 30   | -    | pF   | $V_{GS}=0V$ , $V_{DS}=0...400V$                                               |
| Effective output capacitance, time related <sup>2)</sup>   | $C_{o(tr)}$  | -      | 301  | -    | pF   | $I_D=\text{constant}$ , $V_{GS}=0V$ , $V_{DS}=0...400V$                       |
| Turn-on delay time                                         | $t_{d(on)}$  | -      | 17.2 | -    | ns   | $V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=2.8A$ ,<br>$R_G=10.0\Omega$ ; see table 9 |
| Rise time                                                  | $t_r$        | -      | 6    | -    | ns   | $V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=2.8A$ ,<br>$R_G=10.0\Omega$ ; see table 9 |
| Turn-off delay time                                        | $t_{d(off)}$ | -      | 88.4 | -    | ns   | $V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=2.8A$ ,<br>$R_G=10.0\Omega$ ; see table 9 |
| Fall time                                                  | $t_f$        | -      | 12.8 | -    | ns   | $V_{DD}=400V$ , $V_{GS}=13V$ , $I_D=2.8A$ ,<br>$R_G=10.0\Omega$ ; see table 9 |

**Table 6 Gate charge characteristics**

| Parameter             | Symbol        | Values |      |      | Unit | Note / Test Condition                            |
|-----------------------|---------------|--------|------|------|------|--------------------------------------------------|
|                       |               | Min.   | Typ. | Max. |      |                                                  |
| Gate to source charge | $Q_{gs}$      | -      | 5    | -    | nC   | $V_{DD}=400V$ , $I_D=2.8A$ , $V_{GS}=0$ to $10V$ |
| Gate to drain charge  | $Q_{gd}$      | -      | 7    | -    | nC   | $V_{DD}=400V$ , $I_D=2.8A$ , $V_{GS}=0$ to $10V$ |
| Gate charge total     | $Q_g$         | -      | 17   | -    | nC   | $V_{DD}=400V$ , $I_D=2.8A$ , $V_{GS}=0$ to $10V$ |
| Gate plateau voltage  | $V_{plateau}$ | -      | 6.1  | -    | V    | $V_{DD}=400V$ , $I_D=2.8A$ , $V_{GS}=0$ to $10V$ |

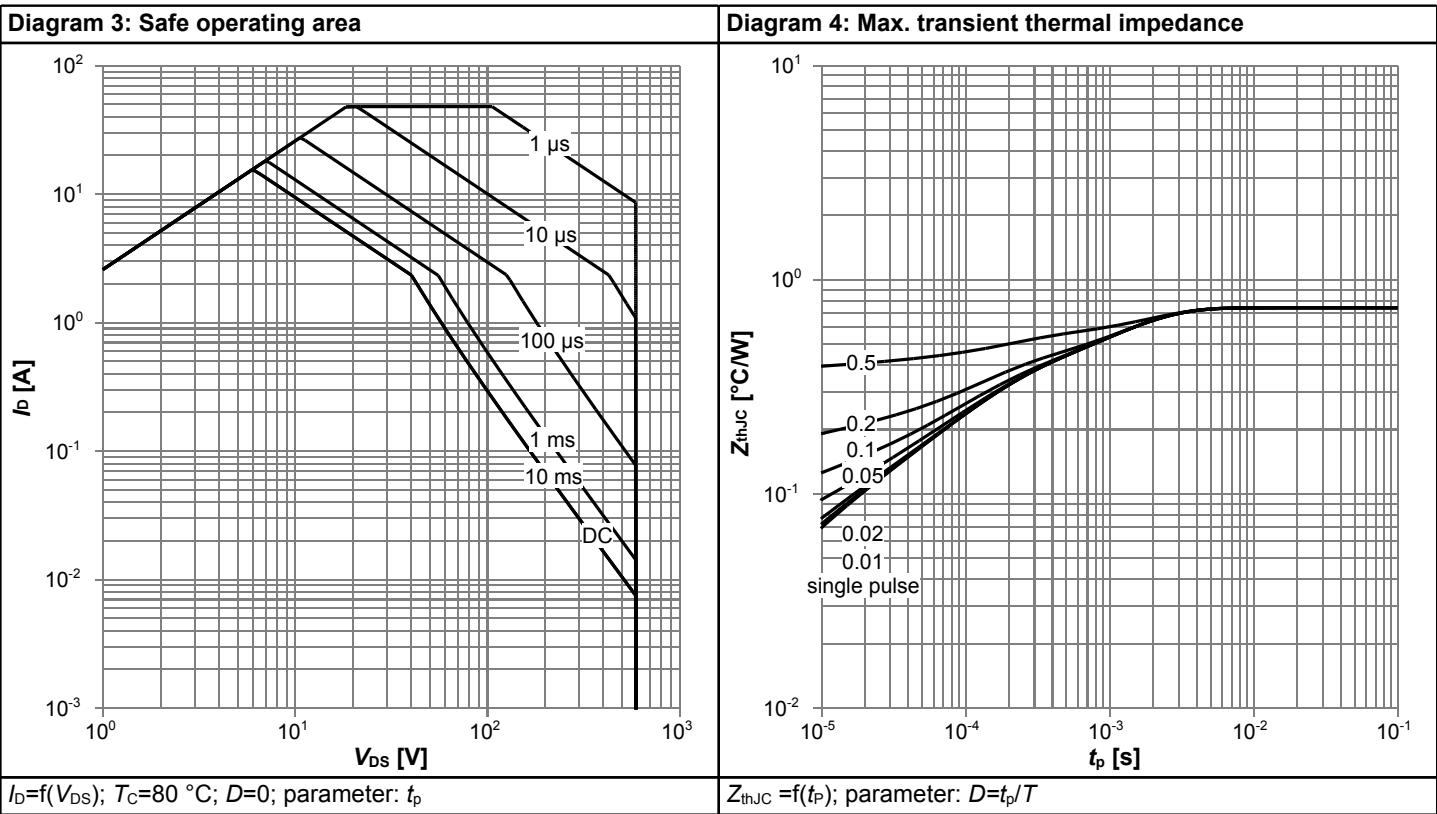
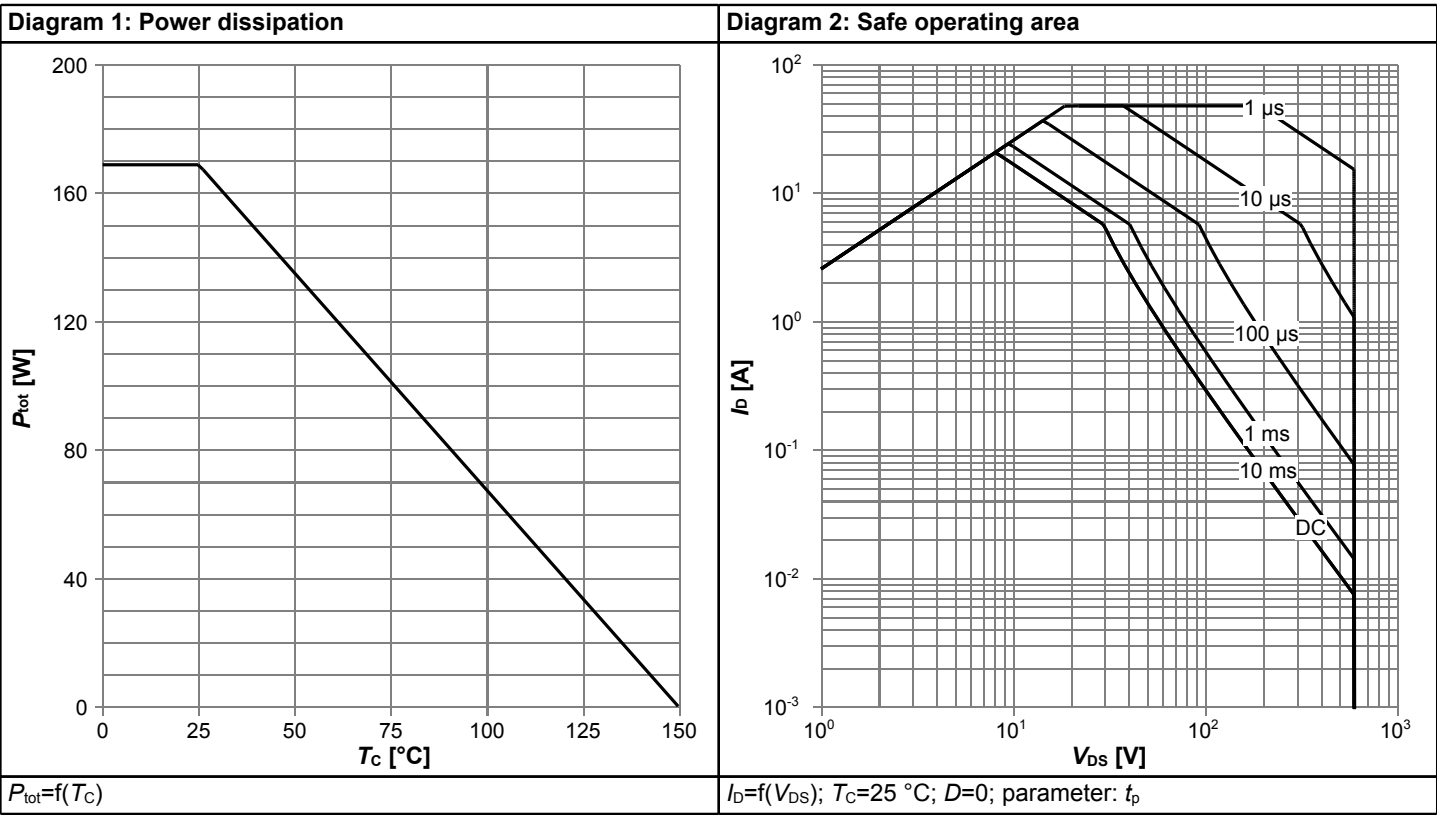
<sup>1)</sup>  $C_{o(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 400V

<sup>2)</sup>  $C_{o(tr)}$  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       | $V_{GS}=0V$ , $I_F=2.8A$ , $T_J=25^{\circ}C$                 |
| Reverse recovery time         | $t_{rr}$  | -      | 62.0 | 77   | ns      | $V_R=400V$ , $I_F=2.8A$ , $di_F/dt=100A/\mu s$ ; see table 8 |
| Reverse recovery charge       | $Q_{rr}$  | -      | 0.18 | 0.27 | $\mu C$ | $V_R=400V$ , $I_F=2.8A$ , $di_F/dt=100A/\mu s$ ; see table 8 |
| Peak reverse recovery current | $I_{rrm}$ | -      | 6.0  | -    | A       | $V_R=400V$ , $I_F=2.8A$ , $di_F/dt=100A/\mu s$ ; see table 8 |

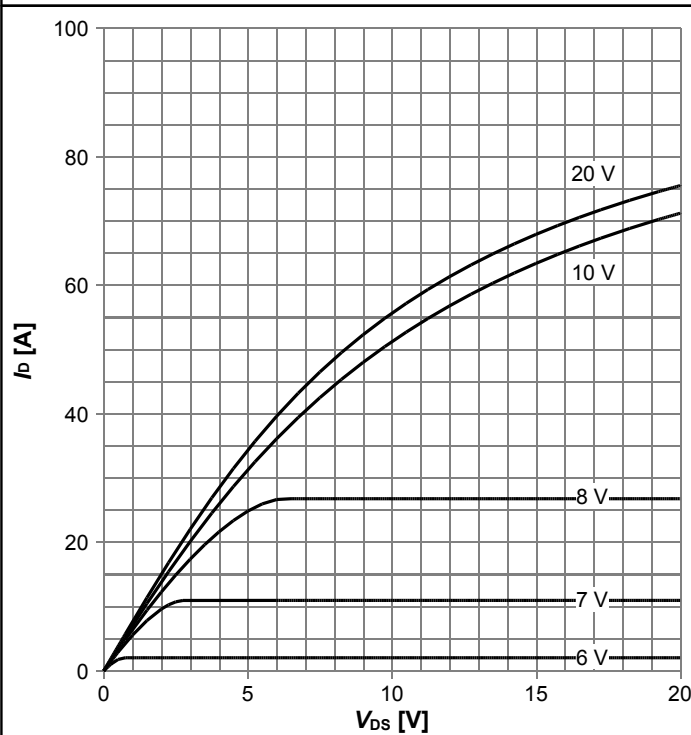
#### 4 Electrical characteristics diagrams



# 600V CoolMOS™ CM8 Power Transistor

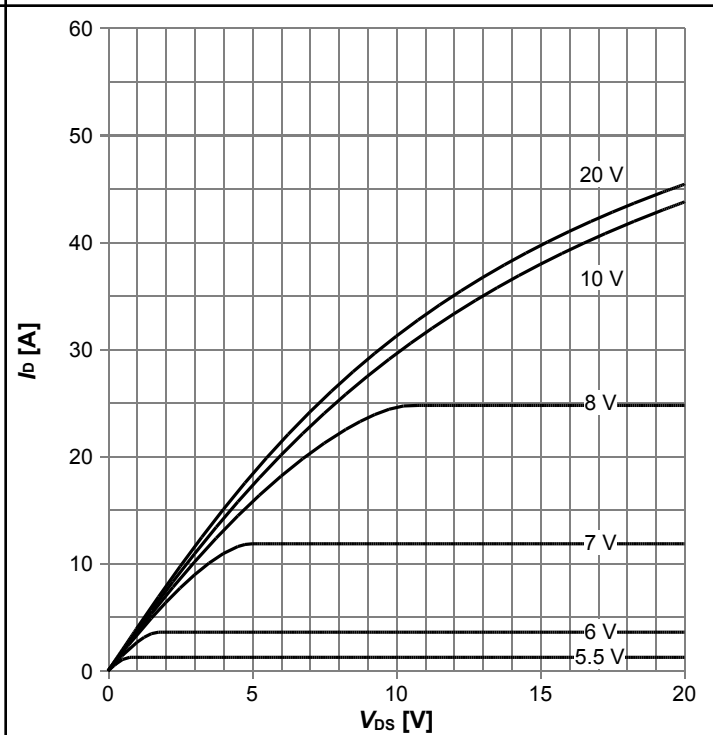
## IPDD60R180CM8

Diagram 5: Typ. output characteristics



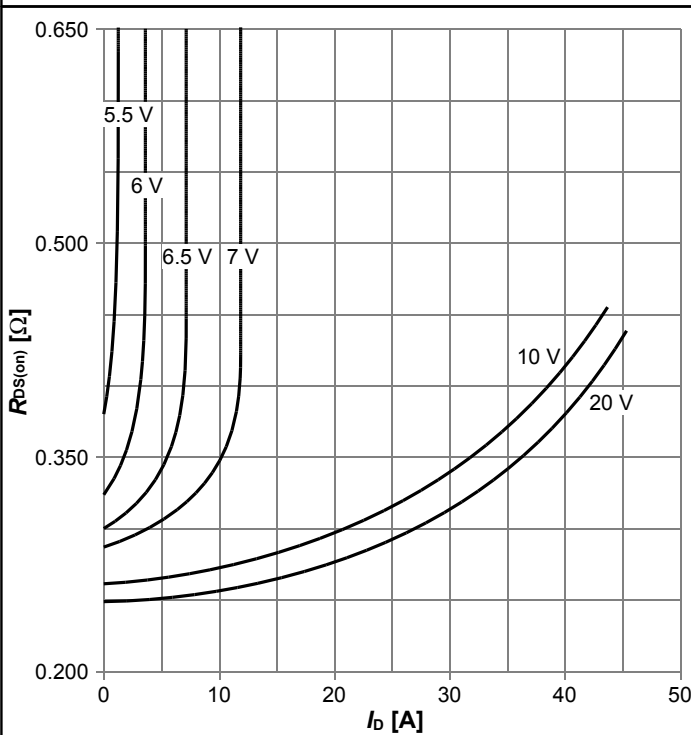
$I_D = f(V_{DS})$ ;  $T_J = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. output characteristics



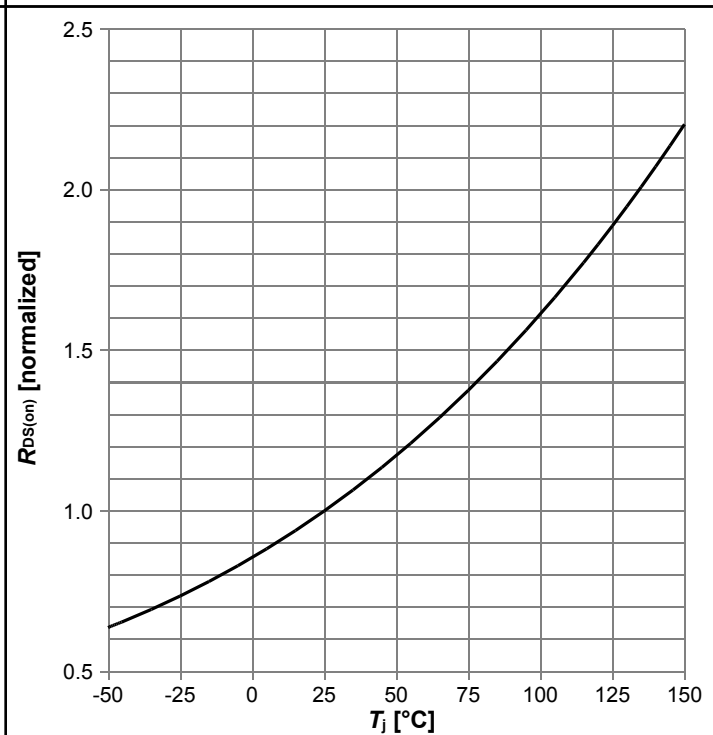
$I_D = f(V_{DS})$ ;  $T_J = 125^\circ\text{C}$ ; parameter:  $V_{GS}$

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



$R_{DS(on)} = f(I_D)$ ;  $T_J = 125^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 8: Drain-source on-state resistance



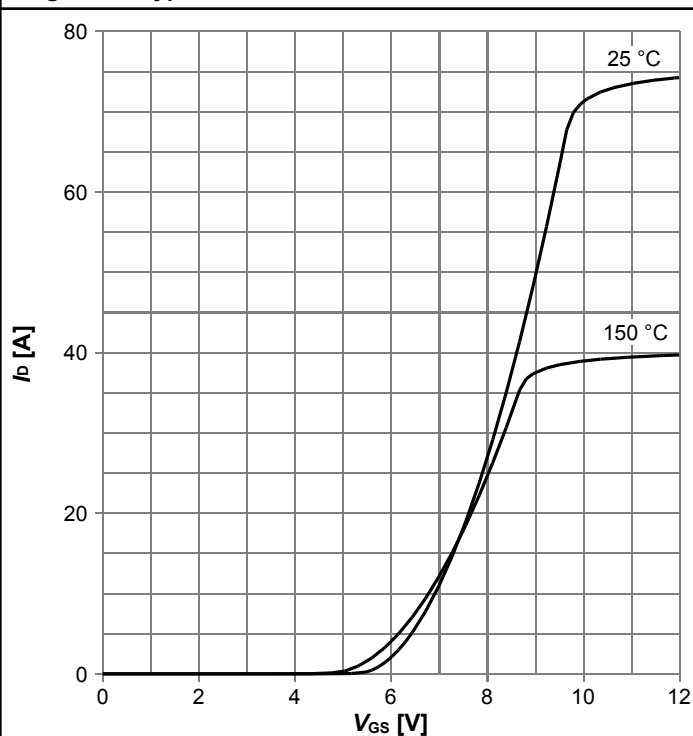
$R_{DS(on)} = f(T_J)$ ;  $I_D = 5.6\text{ A}$ ;  $V_{GS} = 10\text{ V}$



# 600V CoolMOS™ CM8 Power Transistor

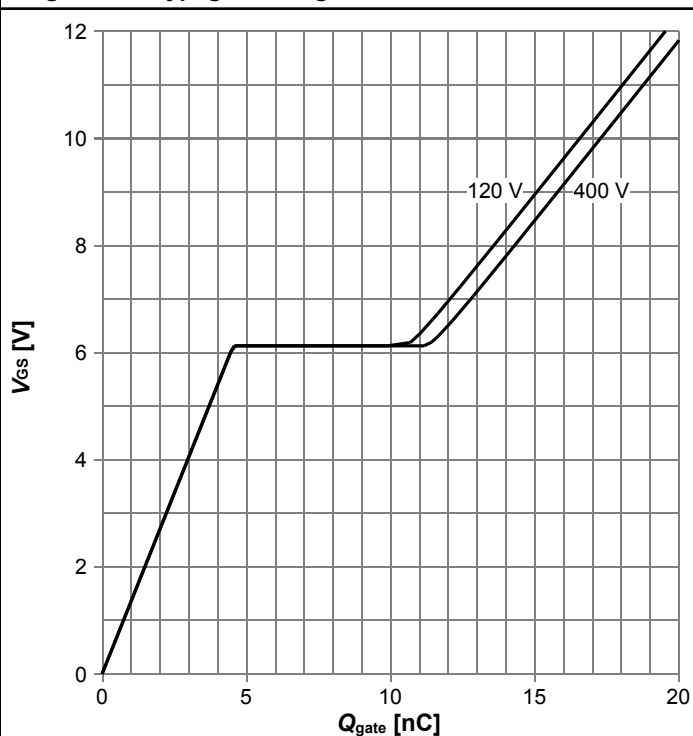
## IPDD60R180CM8

Diagram 9: Typ. transfer characteristics



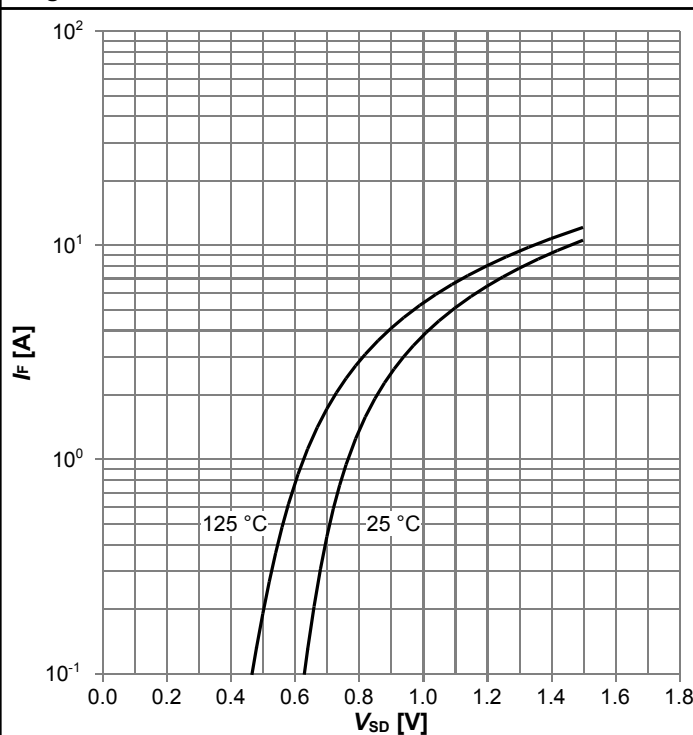
$I_D = f(V_{GS})$ ;  $V_{DS} = 20\text{ V}$ ; parameter:  $T_j$

Diagram 10: Typ. gate charge



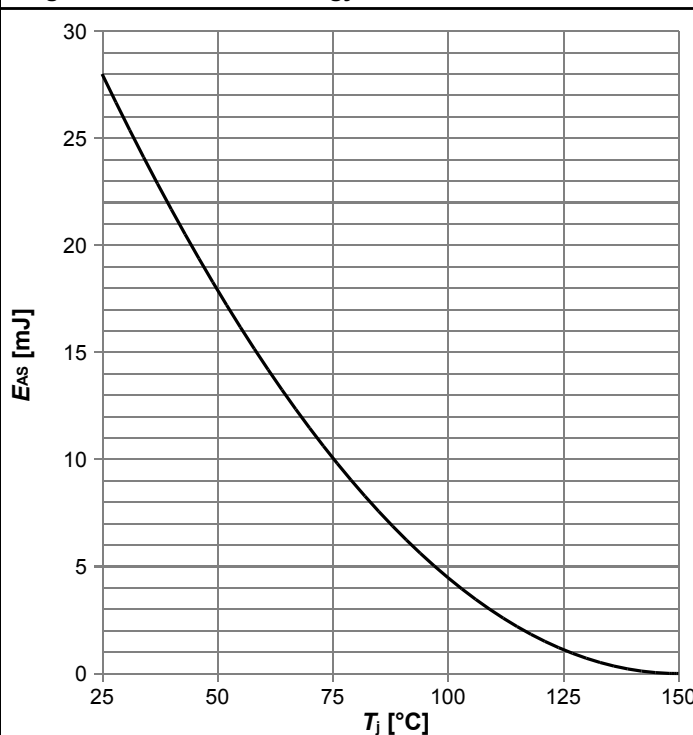
$V_{GS} = f(Q_{gate})$ ;  $I_D = 2.8\text{ A}$  pulsed; parameter:  $V_{DD}$

Diagram 11: Forward characteristics of reverse diode



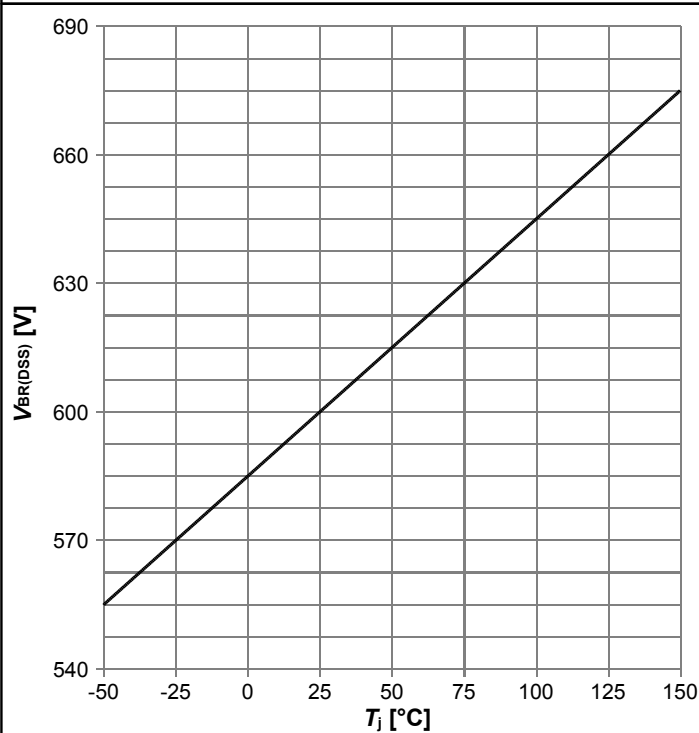
$I_F = f(V_{SD})$ ; parameter:  $T_j$

Diagram 12: Avalanche energy



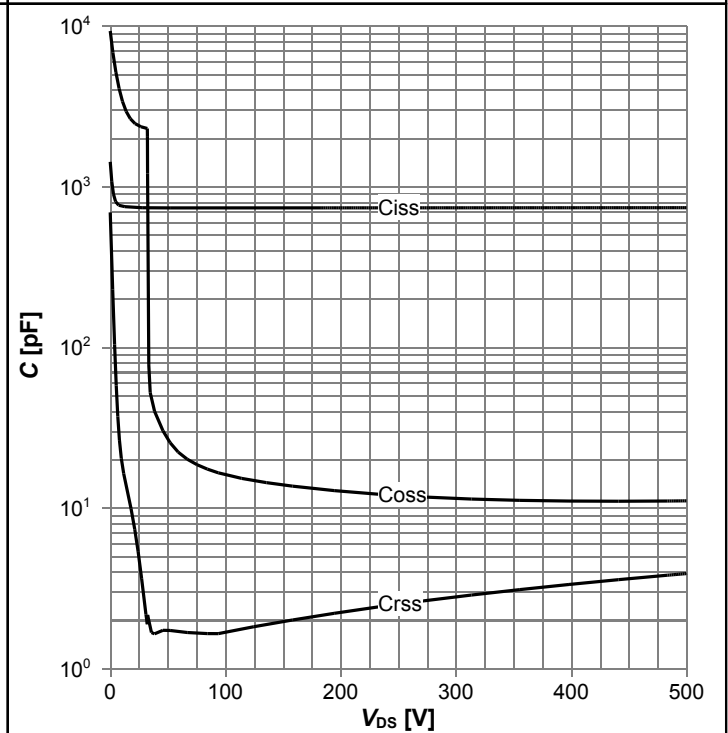
$E_{AS} = f(T_j)$ ;  $I_D = 2.7\text{ A}$ ;  $V_{DD} = 50\text{ V}$

Diagram 13: Drain-source breakdown voltage



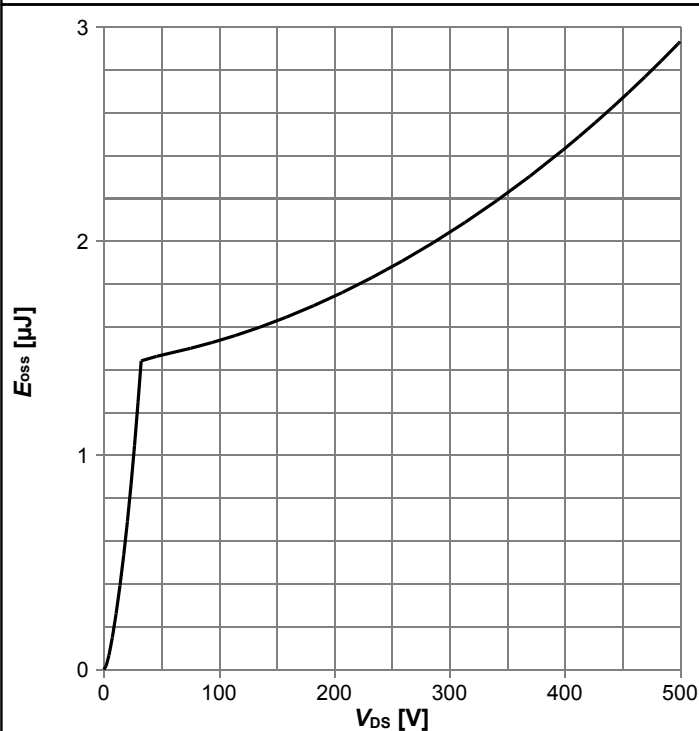
$V_{BR(DSS)} = f(T_J); I_D = 1 \text{ mA}$

Diagram 14: Typ. capacitances



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

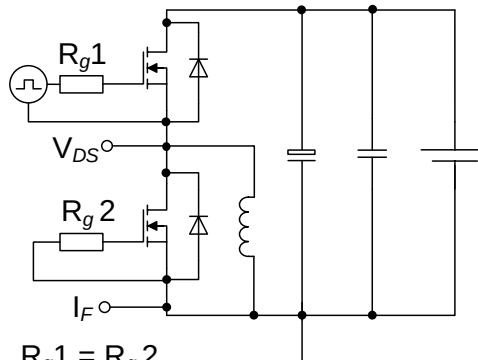
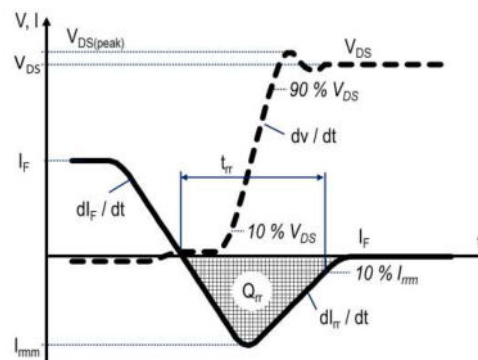
Diagram 15: Typ.  $C_{oss}$  stored energy



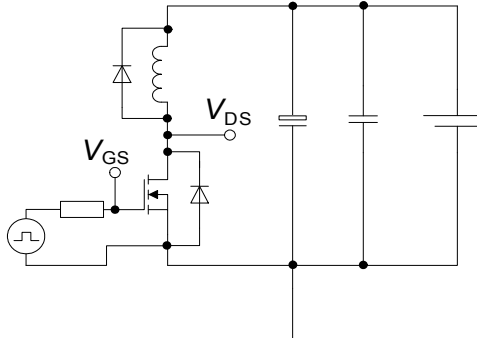
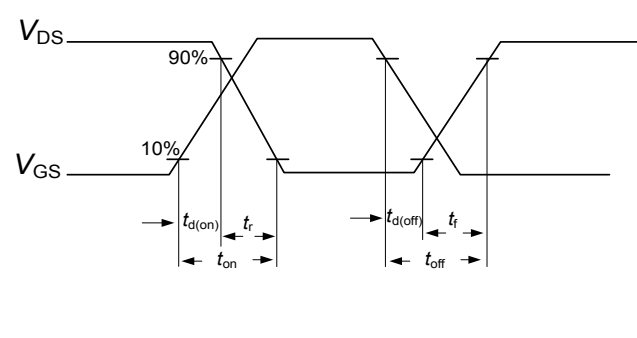
$E_{oss} = f(V_{DS})$

## 5 Test Circuits

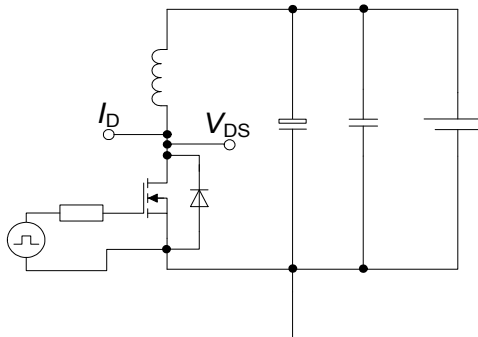
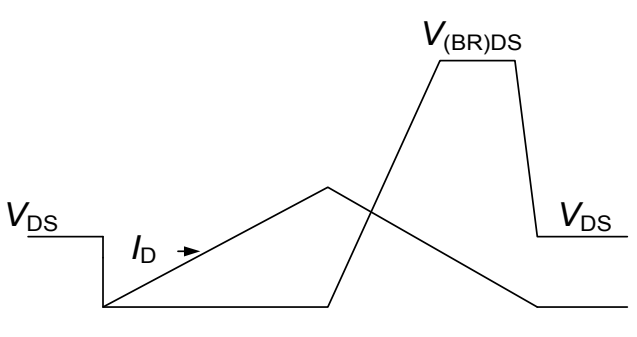
**Table 8 Diode characteristics**

| Test circuit for diode characteristics                                                                                | Diode recovery waveform                                                            |
|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
|  <p><math>R_{g1} = R_{g2}</math></p> |  |

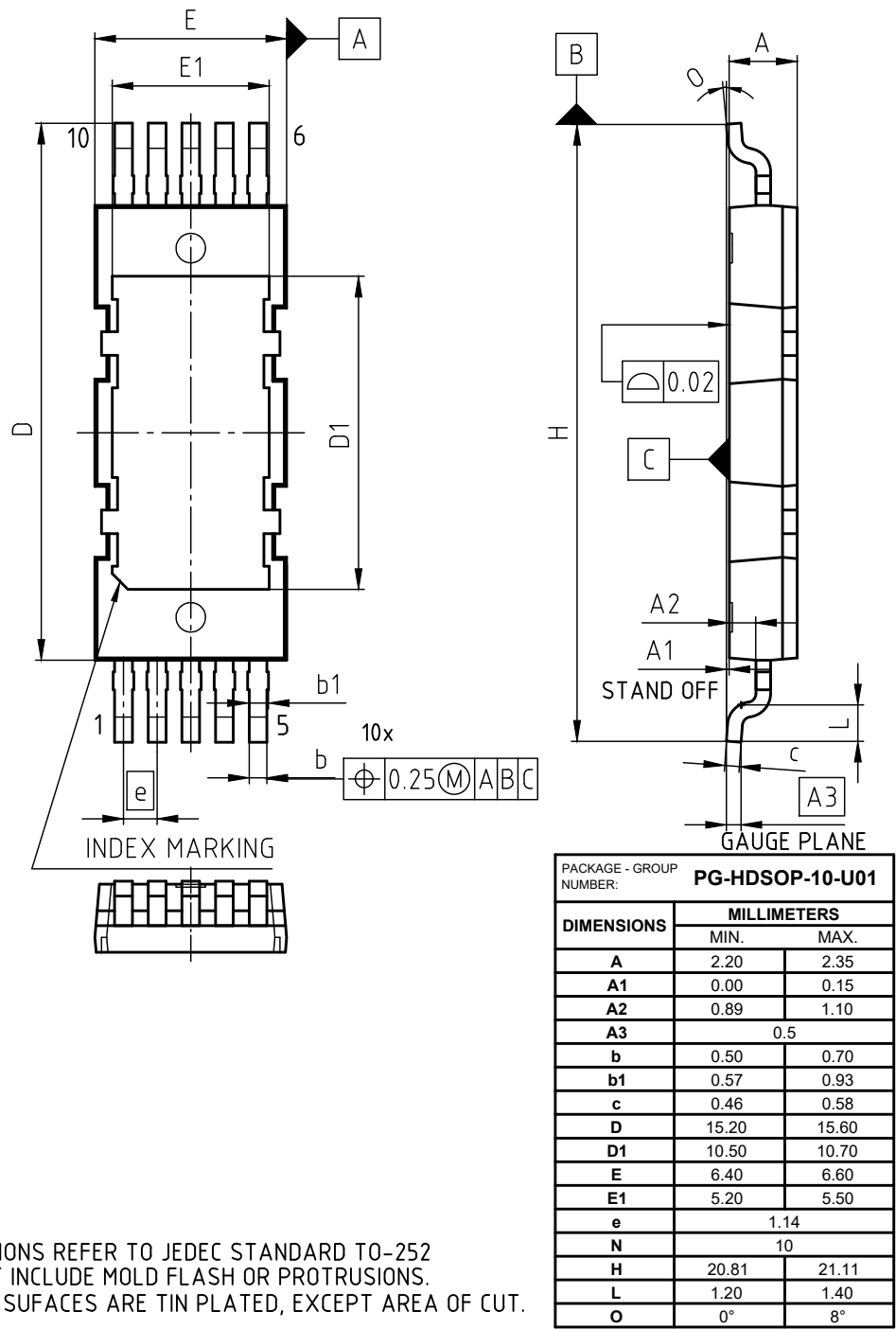
**Table 9 Switching times (ss)**

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

**Table 10 Unclamped inductive load (ss)**

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

## 6 Package Outlines



NOTES:

1. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-252 AND DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
2. ALL METAL SURFACES ARE TIN PLATED, EXCEPT AREA OF CUT.

Figure 1 Outline PG-HDSOP-10, dimensions in mm

## **7 Appendix A**

### **Table 11 Related Links**

- **IFX CoolMOS CM8 Webpage:** [www.infineon.com](http://www.infineon.com)
- **IFX CoolMOS CM8 application note:** [www.infineon.com](http://www.infineon.com)
- **IFX CoolMOS CM8 simulation model:** [www.infineon.com](http://www.infineon.com)
- **IFX Design tools:** [www.infineon.com](http://www.infineon.com)

## Revision History

IPDD60R180CM8

**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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