

# MOSFET

## 600V CoolMOS™ G7 SJ Power Device

The C7 GOLD series (G7) for the first time brings together the benefits of the C7 GOLD CoolMOS™ technology, 4 pin Kelvin Source capability and the improved thermal properties of the DDPAK package to enable a possible SMD solution for high current topologies such as PFC up to 3kW.

### Features

- C7 Gold gives best in class FOM  $R_{DS(on)} \cdot E_{oss}$  and  $R_{DS(on)} \cdot Q_g$ .
- Suitable for hard and soft switching (PFC and high performance LLC)
- C7 Gold technology enables best in class  $R_{DS(on)}$  in smallest footprint.
- DDPAK package has inbuilt 4<sup>th</sup> pin Kelvin Source configuration and low parasitic source inductance (~3nH).
- DDPAK package is MSL1 compliant, total Pb-free and has easy visual inspection leads.
- DDPAK SMD package combined with lead free die attach process enables improved thermal performance ( $R_{th}$ ).

### Benefits

- C7 Gold FOM  $R_{DS(on)} \cdot Q_g$  is 15% better than previous C7 600V enabling faster switching leading to higher efficiency.
- Possibility to increase economies of scales by usage in PFC and PWM topologies in the application.
- C7 Gold can reach 50mΩ in DDPAK 115mm<sup>2</sup> footprint, whereas previous BIC C7 600V was 40mΩ in 150mm<sup>2</sup> D<sup>2</sup>PAK footprint.
- Reducing parasitic source inductance by Kelvin Source improves efficiency by faster switching and ease of use due to less ringing.
- DDPAK package is easy to use and has the highest quality standards.
- Improved thermals enable SMD DDPAK package to be used in higher current designs than has been previously possible.

### Potential applications

PFC stages and PWM stages (TTF, LLC) for high power/performance SMPS e.g. Computing, Server, Telecom, UPS and Solar.

### Product validation

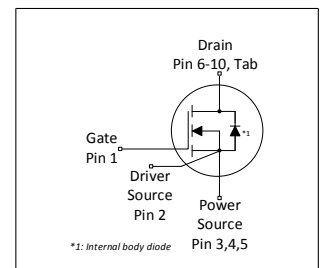
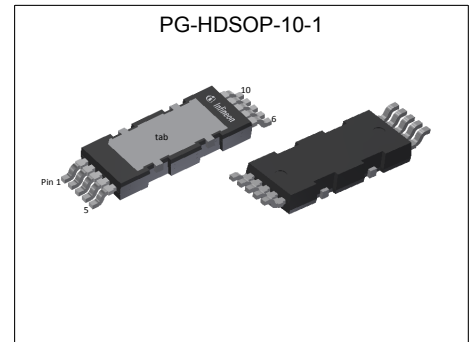
Fully qualified according to JEDEC for Industrial Applications

*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    |
| $R_{DS(on),max}$                       | 150   | mΩ   |
| $Q_{g,typ}$                            | 23    | nC   |
| $I_{D,pulse}$                          | 45    | A    |
| $I_{D,continuous} @ T_j < 150^\circ C$ | 23    | A    |
| $E_{oss@400V}$                         | 2.74  | μJ   |
| Body diode di/dt                       | 700   | A/μs |

| Type / Ordering Code | Package     | Marking  | Related Links  |
|----------------------|-------------|----------|----------------|
| IPDD60R150G7         | PG-HDSOP-10 | 60R150G7 | see Appendix A |



RoHS

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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> | $I_D$         | -      | -    | 16<br>10 | A                | $T_C=25^\circ\text{C}$<br>$T_C=100^\circ\text{C}$                                             |
| Pulsed drain current <sup>2)</sup>     | $I_{D,pulse}$ | -      | -    | 45       | A                | $T_C=25^\circ\text{C}$                                                                        |
| Avalanche energy, single pulse         | $E_{AS}$      | -      | -    | 53       | mJ               | $I_D=3.3\text{A}$ ; $V_{DD}=50\text{V}$ ; see table 10                                        |
| Avalanche energy, repetitive           | $E_{AR}$      | -      | -    | 0.26     | mJ               | $I_D=3.3\text{A}$ ; $V_{DD}=50\text{V}$ ; see table 10                                        |
| Avalanche current, single pulse        | $I_{AS}$      | -      | -    | 3.3      | 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                      | $P_{tot}$     | -      | -    | 95       | W                | $T_C=25^\circ\text{C}$                                                                        |
| Storage temperature                    | $T_{stg}$     | -55    | -    | 150      | $^\circ\text{C}$ | -                                                                                             |
| Operating junction temperature         | $T_j$         | -55    | -    | 150      | $^\circ\text{C}$ | -                                                                                             |
| Mounting torque                        | -             | -      | -    | n.a.     | Ncm              | -                                                                                             |
| Continuous diode forward current       | $I_S$         | -      | -    | 16       | A                | $T_C=25^\circ\text{C}$                                                                        |
| Diode pulse current <sup>2)</sup>      | $I_{S,pulse}$ | -      | -    | 45       | A                | $T_C=25^\circ\text{C}$                                                                        |
| Reverse diode dv/dt <sup>3)</sup>      | dv/dt         | -      | -    | 25       | V/ns             | $V_{DS}=0\dots400\text{V}$ , $I_{SD}\leq 5.2\text{A}$ , $T_j=25^\circ\text{C}$<br>see table 8 |
| Maximum diode commutation speed        | di/dt         | -      | -    | 700      | A/ $\mu\text{s}$ | $V_{DS}=0\dots400\text{V}$ , $I_{SD}\leq 5.2\text{A}$ , $T_j=25^\circ\text{C}$<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

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter                                              | Symbol     | Values |      |      | Unit | Note / Test Condition                                                                                                                                                               |
|--------------------------------------------------------|------------|--------|------|------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                        |            | Min.   | Typ. | Max. |      |                                                                                                                                                                                     |
| Thermal resistance, junction - case                    | $R_{thJC}$ | -      | -    | 1.32 | °C/W | -                                                                                                                                                                                   |
| Thermal resistance, junction - ambient                 | $R_{thJA}$ | -      | -    | 62   | °C/W | device on PCB, minimal footprint                                                                                                                                                    |
| Thermal resistance, junction - ambient for SMD version | $R_{thJA}$ | -      | 35   | 45   | °C/W | Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm <sup>2</sup> (one layer, 70µm thickness) copper area for drain connection and cooling. PCB is vertical without air stream cooling. |
| Reflow soldering temperature                           | $T_{sold}$ | -      | -    | 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             | $V_{GS}=0\text{V}$ , $I_D=1\text{mA}$                                                                                                         |
| Gate threshold voltage           | $V_{(GS)th}$  | 3      | 3.5            | 4          | V             | $V_{DS}=V_{GS}$ , $I_D=0.26\text{mA}$                                                                                                         |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | -              | 1          | $\mu\text{A}$ | $V_{DS}=600\text{V}$ , $V_{GS}=0\text{V}$ , $T_j=25^{\circ}\text{C}$<br>$V_{DS}=600\text{V}$ , $V_{GS}=0\text{V}$ , $T_j=150^{\circ}\text{C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | -              | 100        | nA            | $V_{GS}=20\text{V}$ , $V_{DS}=0\text{V}$                                                                                                      |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 0.129<br>0.323 | 0.150<br>- | $\Omega$      | $V_{GS}=10\text{V}$ , $I_D=5.3\text{A}$ , $T_j=25^{\circ}\text{C}$<br>$V_{GS}=10\text{V}$ , $I_D=5.3\text{A}$ , $T_j=150^{\circ}\text{C}$     |
| Gate resistance                  | $R_G$         | -      | 0.8            | -          | $\Omega$      | $f=1\text{MHz}$ , open drain                                                                                                                  |

**Table 5 Dynamic characteristics**

| Parameter                                                  | Symbol       | Values |      |      | Unit | Note / Test Condition                                                                         |
|------------------------------------------------------------|--------------|--------|------|------|------|-----------------------------------------------------------------------------------------------|
|                                                            |              | Min.   | Typ. | Max. |      |                                                                                               |
| Input capacitance                                          | $C_{iss}$    | -      | 902  | -    | pF   | $V_{GS}=0\text{V}$ , $V_{DS}=400\text{V}$ , $f=250\text{kHz}$                                 |
| Output capacitance                                         | $C_{oss}$    | -      | 19   | -    | pF   | $V_{GS}=0\text{V}$ , $V_{DS}=400\text{V}$ , $f=250\text{kHz}$                                 |
| Effective output capacitance, energy related <sup>1)</sup> | $C_{o(er)}$  | -      | 34   | -    | pF   | $V_{GS}=0\text{V}$ , $V_{DS}=0\ldots400\text{V}$                                              |
| Effective output capacitance, time related <sup>2)</sup>   | $C_{o(tr)}$  | -      | 350  | -    | pF   | $I_D=\text{constant}$ , $V_{GS}=0\text{V}$ , $V_{DS}=0\ldots400\text{V}$                      |
| Turn-on delay time                                         | $t_{d(on)}$  | -      | 17   | -    | ns   | $V_{DD}=400\text{V}$ , $V_{GS}=13\text{V}$ , $I_D=5.3\text{A}$ , $R_G=10\Omega$ ; see table 9 |
| Rise time                                                  | $t_r$        | -      | 5    | -    | ns   | $V_{DD}=400\text{V}$ , $V_{GS}=13\text{V}$ , $I_D=5.3\text{A}$ , $R_G=10\Omega$ ; see table 9 |
| Turn-off delay time                                        | $t_{d(off)}$ | -      | 56   | -    | ns   | $V_{DD}=400\text{V}$ , $V_{GS}=13\text{V}$ , $I_D=5.3\text{A}$ , $R_G=10\Omega$ ; see table 9 |
| Fall time                                                  | $t_f$        | -      | 6    | -    | ns   | $V_{DD}=400\text{V}$ , $V_{GS}=13\text{V}$ , $I_D=5.3\text{A}$ , $R_G=10\Omega$ ; 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   | $V_{DD}=400\text{V}$ , $I_D=5.3\text{A}$ , $V_{GS}=0$ to $10\text{V}$ |
| Gate to drain charge  | $Q_{gd}$      | -      | 8    | -    | nC   | $V_{DD}=400\text{V}$ , $I_D=5.3\text{A}$ , $V_{GS}=0$ to $10\text{V}$ |
| Gate charge total     | $Q_g$         | -      | 23   | -    | nC   | $V_{DD}=400\text{V}$ , $I_D=5.3\text{A}$ , $V_{GS}=0$ to $10\text{V}$ |
| Gate plateau voltage  | $V_{plateau}$ | -      | 5.0  | -    | V    | $V_{DD}=400\text{V}$ , $I_D=5.3\text{A}$ , $V_{GS}=0$ to $10\text{V}$ |

<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         | $V_{SD}$  | -      | 0.8  | -    | V       | $V_{GS}=0V$ , $I_F=5.3A$ , $T_J=25^{\circ}C$                 |
| Reverse recovery time         | $t_{rr}$  | -      | 245  | -    | ns      | $V_R=400V$ , $I_F=5.3A$ , $di_F/dt=100A/\mu s$ ; see table 8 |
| Reverse recovery charge       | $Q_{rr}$  | -      | 2.2  | -    | $\mu C$ | $V_R=400V$ , $I_F=5.3A$ , $di_F/dt=100A/\mu s$ ; see table 8 |
| Peak reverse recovery current | $I_{rrm}$ | -      | 19   | -    | A       | $V_R=400V$ , $I_F=5.3A$ , $di_F/dt=100A/\mu s$ ; see table 8 |

## 4 Electrical characteristics diagrams

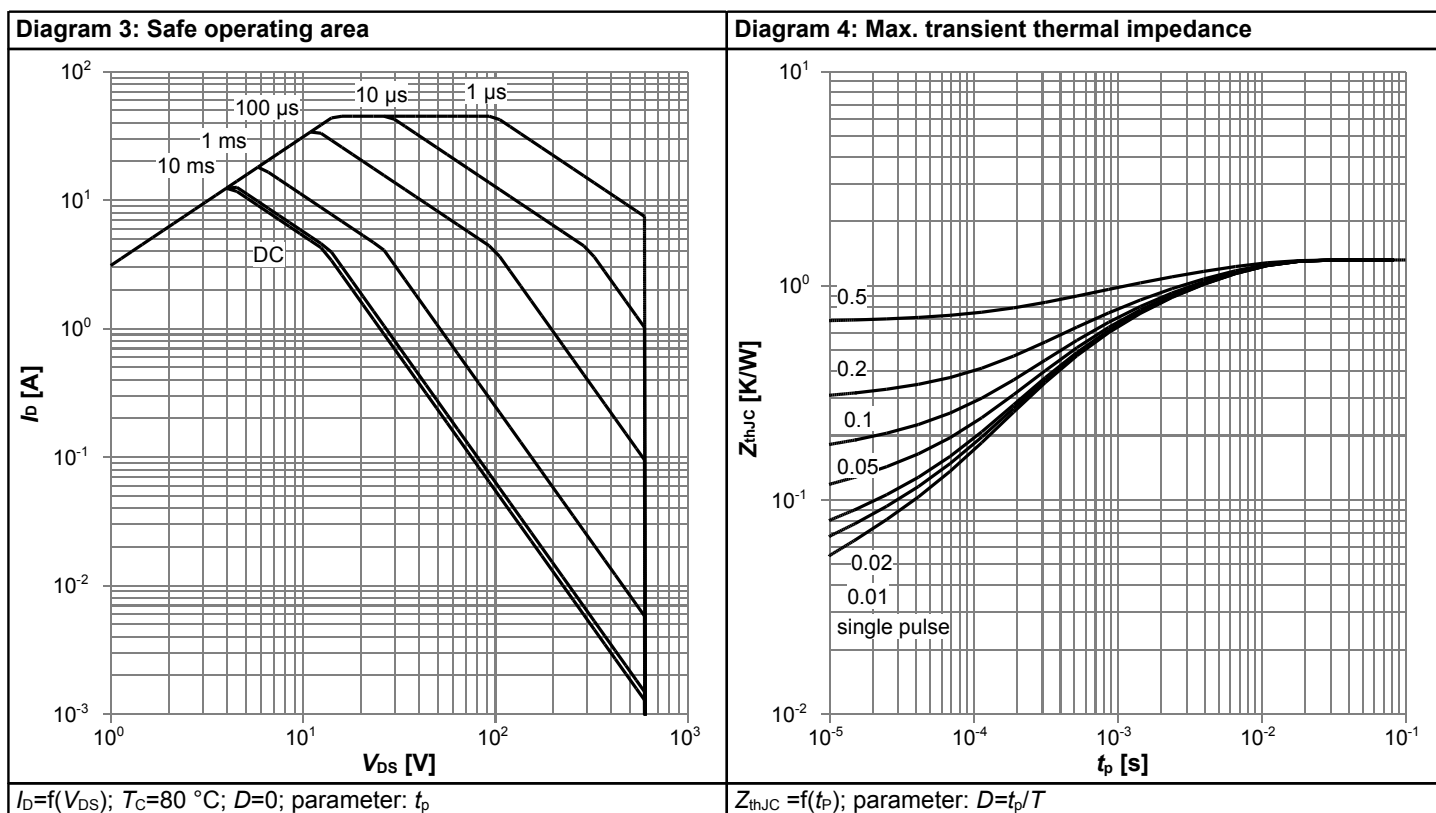
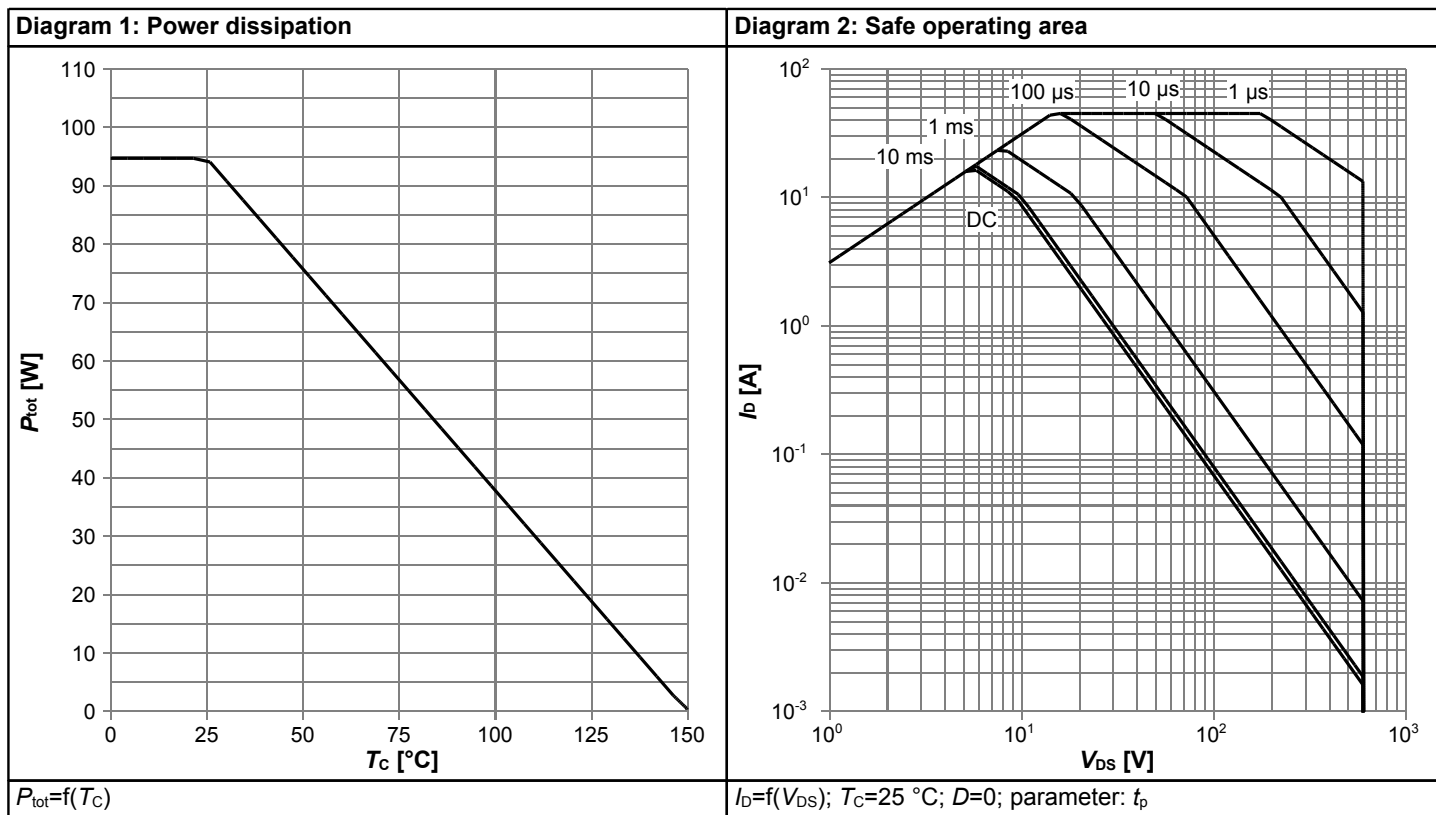
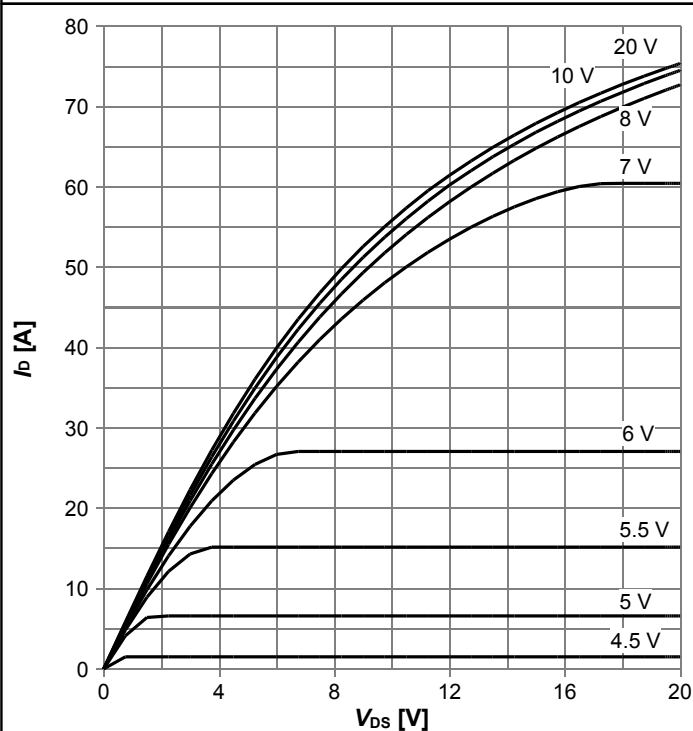
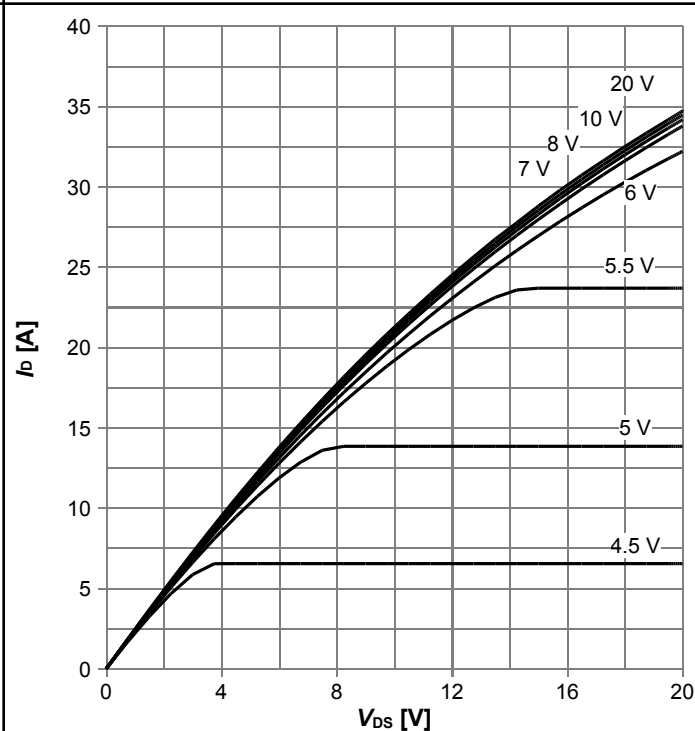


Diagram 5: Typ. output characteristics



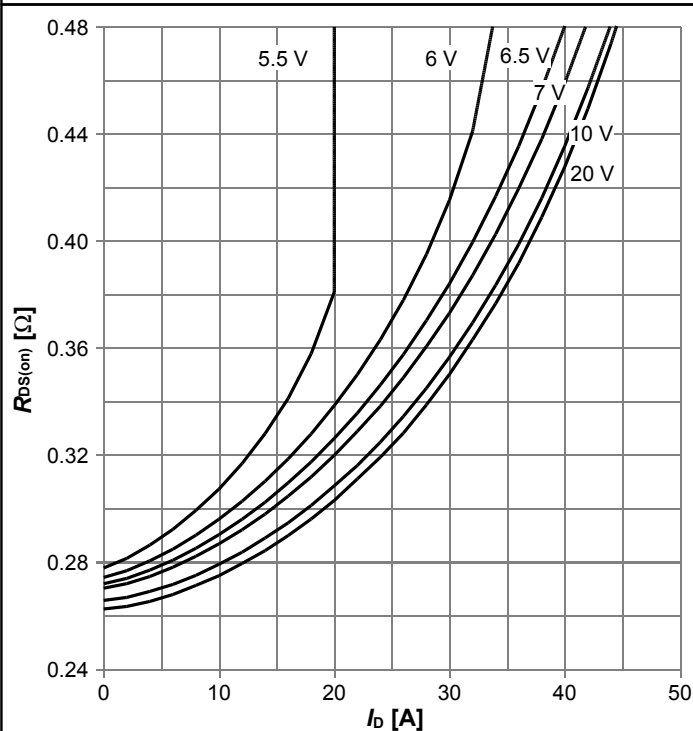
$I_D = f(V_{DS})$ ;  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. output characteristics



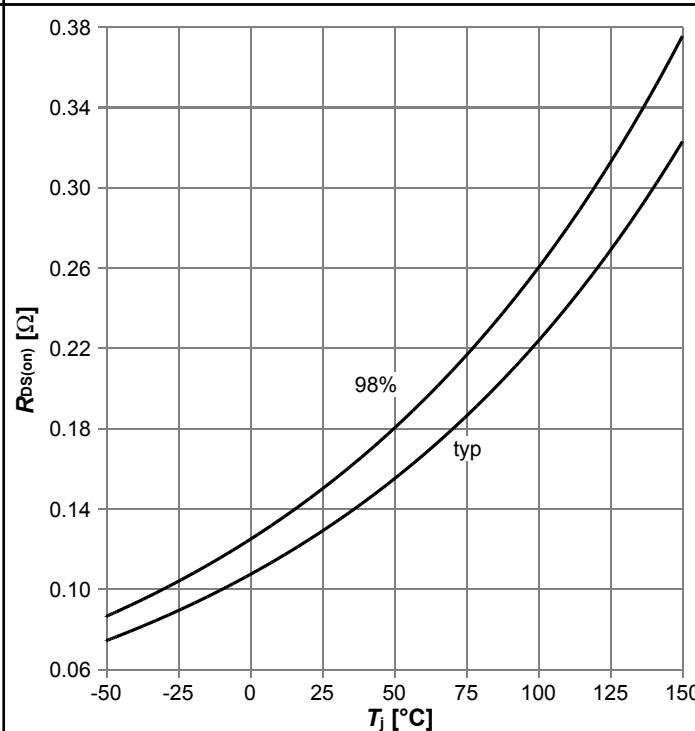
$I_D = f(V_{DS})$ ;  $T_j = 125^\circ\text{C}$ ; parameter:  $V_{GS}$

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



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

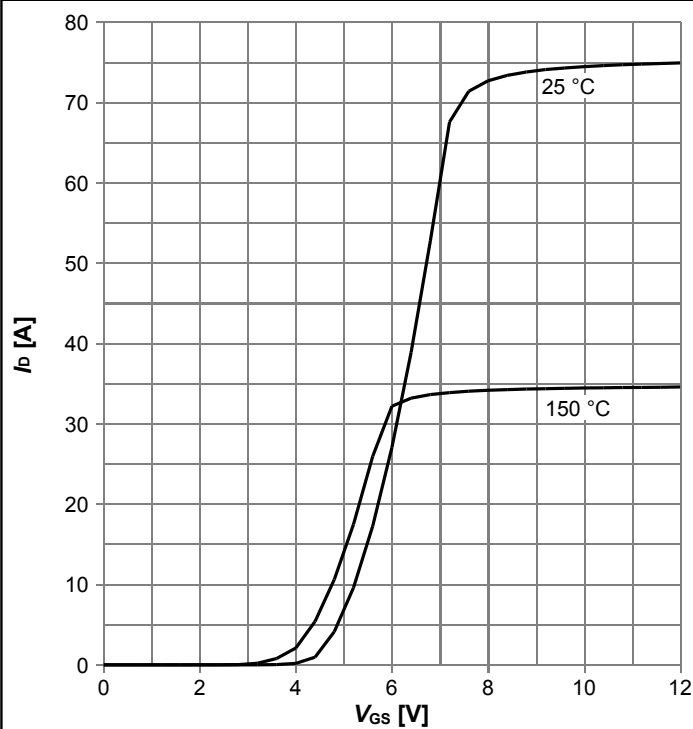
Diagram 8: Drain-source on-state resistance



$R_{DS(on)} = f(T_j)$ ;  $I_D = 5.3\text{ A}$ ;  $V_{GS} = 10\text{ V}$

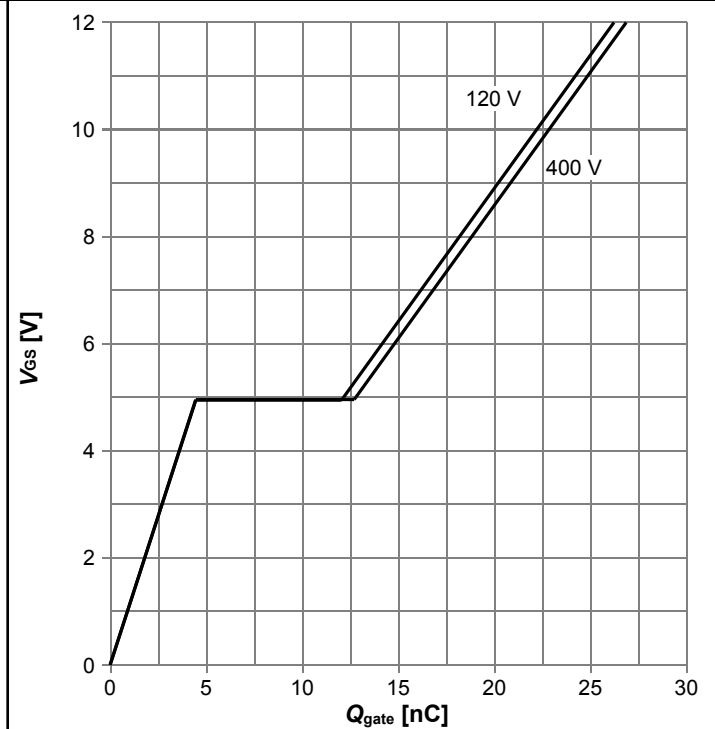


**Diagram 9: Typ. transfer characteristics**



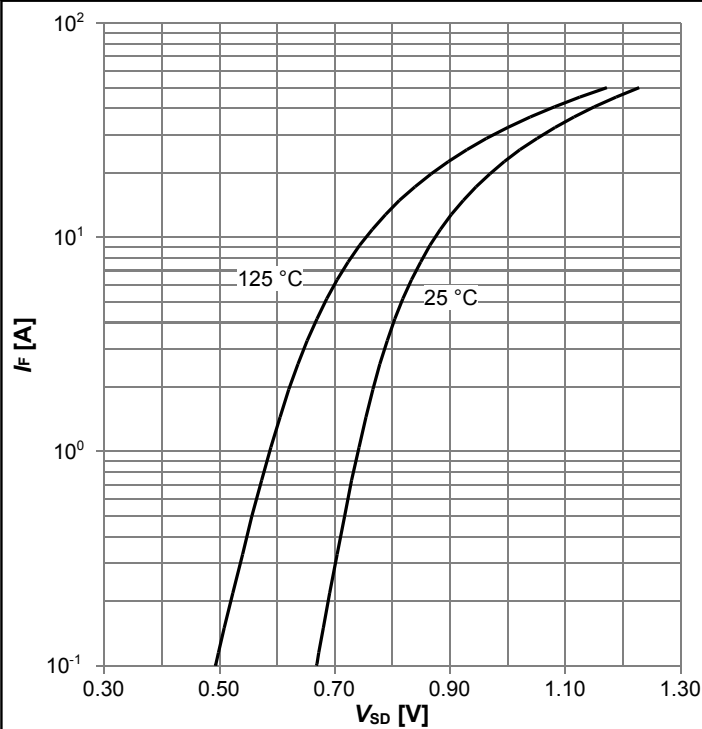
$I_D = f(V_{GS})$ ;  $V_{DS} = 20$  V; parameter:  $T_j$

**Diagram 10: Typ. gate charge**



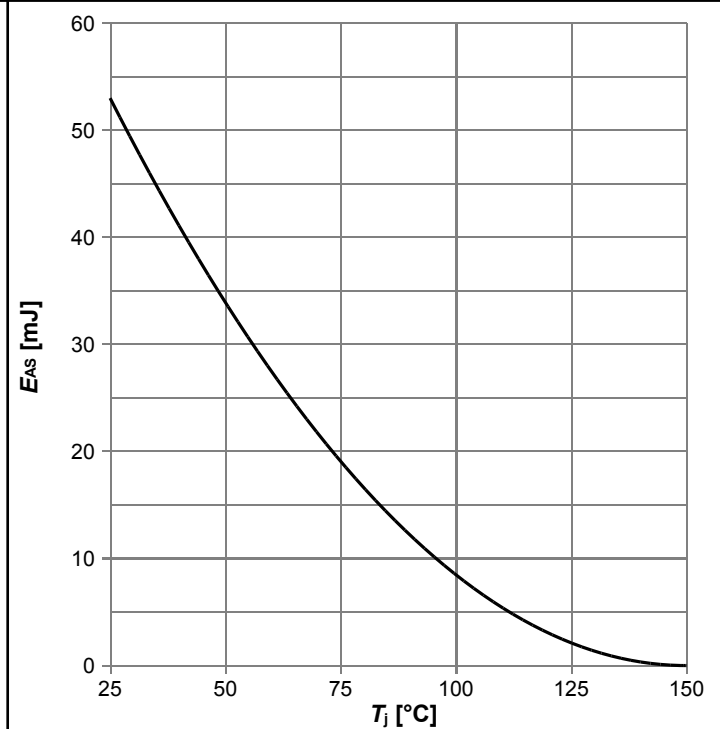
$V_{GS} = f(Q_{gate})$ ;  $I_D = 5.3$  A pulsed; parameter:  $V_{DD}$

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



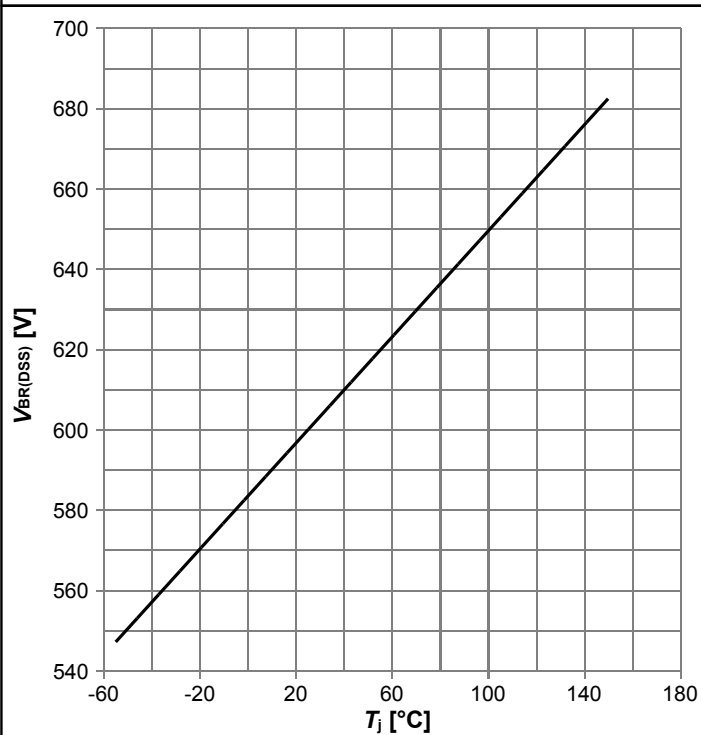
$I_F = f(V_{SD})$ ; parameter:  $T_j$

**Diagram 12: Avalanche energy**



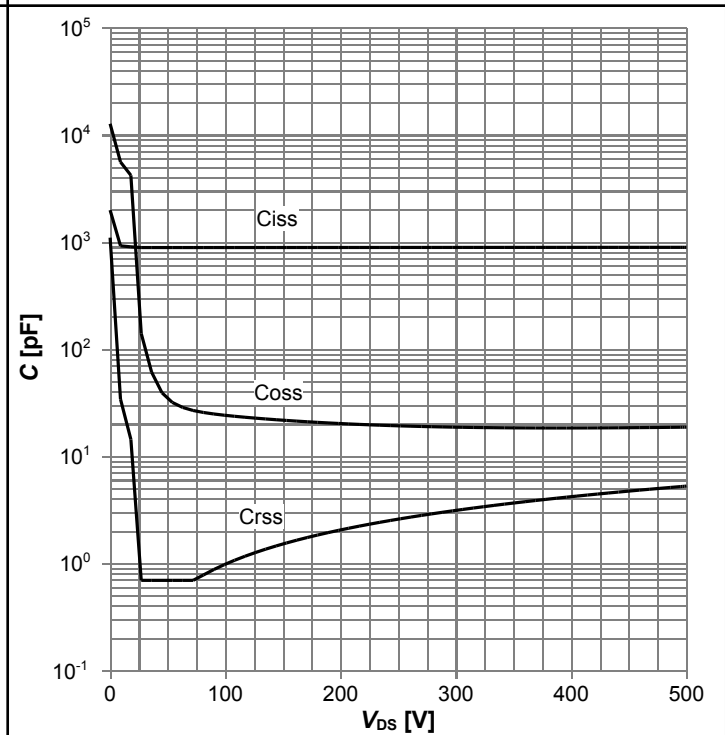
$E_{AS} = f(T_j)$ ;  $I_D = 3.3$  A;  $V_{DD} = 50$  V

Diagram 13: Drain-source breakdown voltage



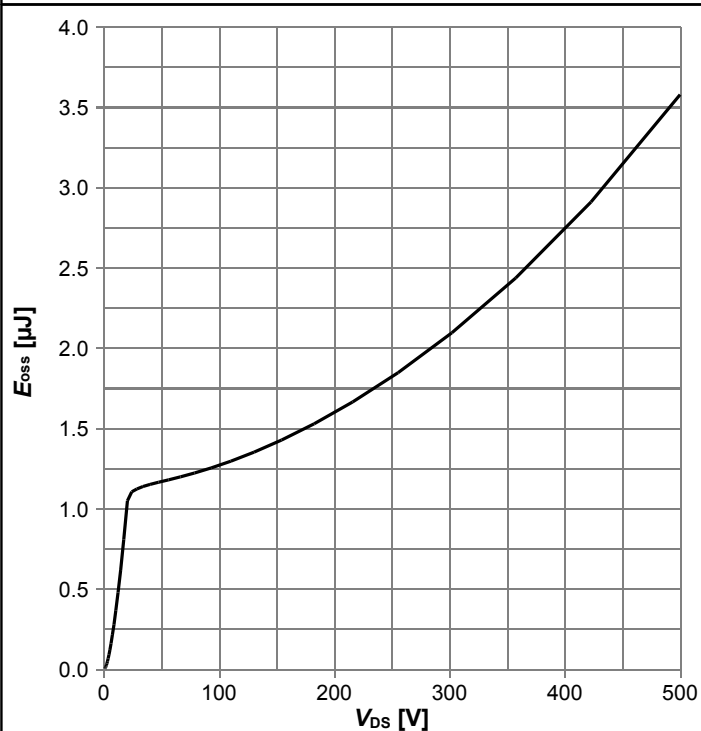
$V_{BR(DSS)} = f(T_J); I_D = 1 \text{ mA}$

Diagram 14: Typ. capacitances



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

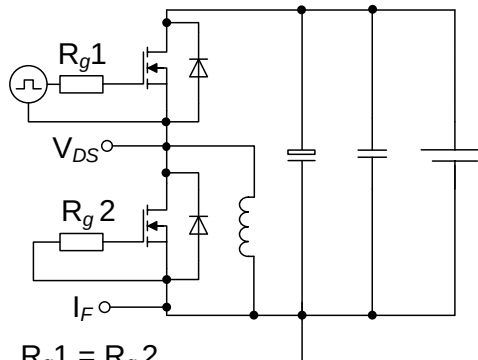
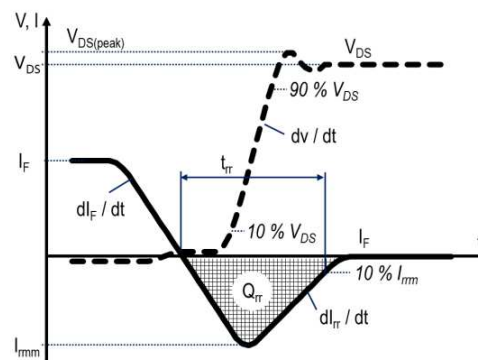
Diagram 15: Typ. Coss stored energy



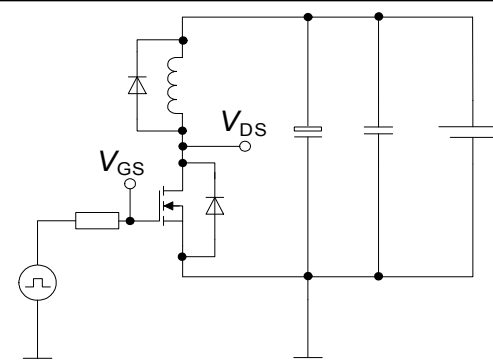
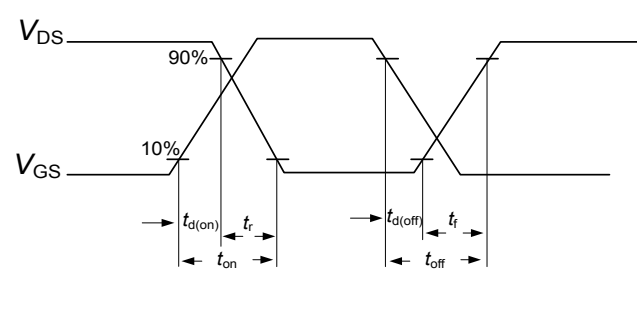
$E_{oss} = f(V_{DS})$

## 5 Test Circuits

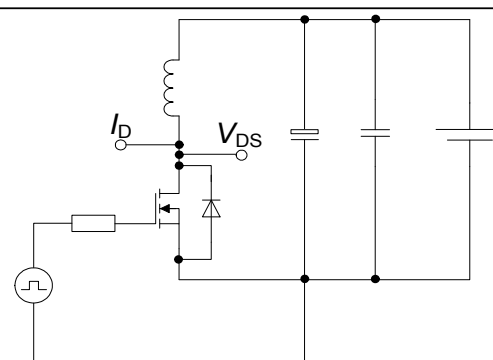
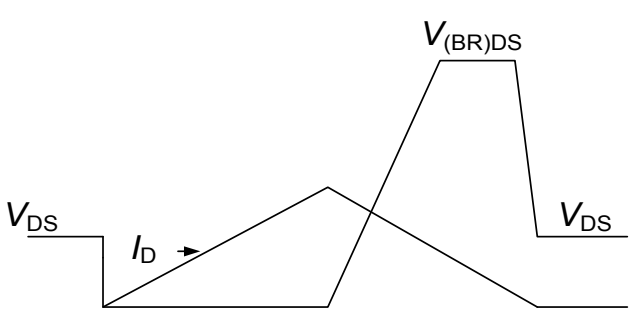
**Table 8 Diode characteristics**

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

**Table 9 Switching times**

| 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

### PG-HDSOP-10-1

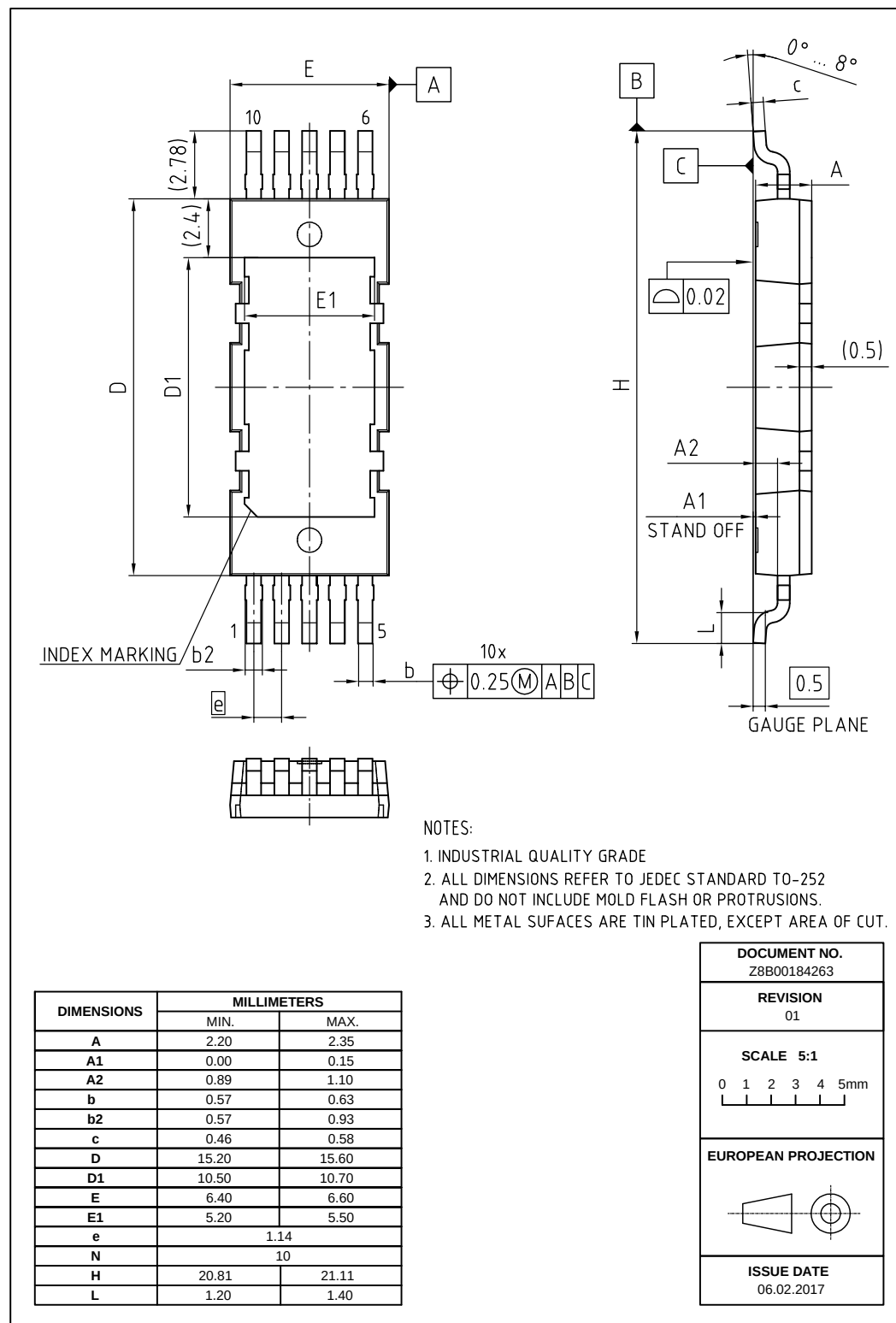


Figure 1 Outline PG-HDSOP-10, dimensions in mm/inches

## 7 Appendix A

Table 11 Related Links

- IFX CoolMOS™ G7 Webpage: [www.infineon.com](http://www.infineon.com)
- IFX CoolMOS™ G7 application note: [www.infineon.com](http://www.infineon.com)
- IFX CoolMOS™ G7 simulation model: [www.infineon.com](http://www.infineon.com)
- IFX Design tools: [www.infineon.com](http://www.infineon.com)

## Revision History

IPDD60R150G7

Revision: 2020-10-27, Rev. 2.1

### Previous Revision

| Revision | Date       | Subjects (major changes since last revision)       |
|----------|------------|----------------------------------------------------|
| 2.0      | 2018-01-05 | Release of final version                           |
| 2.1      | 2020-10-27 | Content update diagram 2,3,4,7,8 and format update |

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