

# IGO60R070D1

## 600V CoolGaN™ enhancement-mode Power Transistor

### Features

- Enhancement mode transistor – Normally OFF switch
- Ultra fast switching
- No reverse-recovery charge
- Capable of reverse conduction
- Low gate charge, low output charge
- Superior commutation ruggedness
- Qualified for industrial applications according to JEDEC Standards (JESD47 and JESD22)

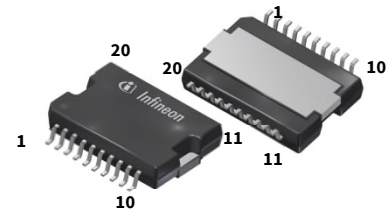
### Benefits

- Improves system efficiency
- Improves power density
- Enables higher operating frequency
- System cost reduction savings
- Reduces EMI

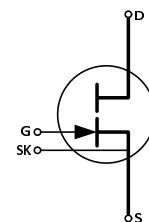
### Applications

Industrial, telecom, datacenter SMPS based on the half-bridge topology (half-bridge topologies for hard and soft switching such as Totem pole PFC, high frequency LLC).

**For other applications:** review CoolGaN™ reliability white paper and contact Infineon regional support



|               |                         |
|---------------|-------------------------|
| Gate          | 9, 10                   |
| Drain         | 13,14,15,16,17,18       |
| Kelvin Source | 8                       |
| Source        | 1,2,3,4,5,6,7, heatslug |
| not connected | 11,12,19,20             |



**Table 1 Key Performance Parameters at  $T_j = 25\text{ °C}$**

| Parameter                | Value | Unit |
|--------------------------|-------|------|
| $V_{DS,max}$             | 600   | V    |
| $R_{DS(on),max}$         | 70    | mΩ   |
| $Q_{G,typ}$              | 5.8   | nC   |
| $I_{D,pulse}$            | 60    | A    |
| $Q_{oss} @ 400\text{ V}$ | 41    | nC   |
| $Q_{rr}$                 | 0     | nC   |



**Table 2 Ordering Information**

| Type / Ordering Code | Package      | Marking  | Related links  |
|----------------------|--------------|----------|----------------|
| IGO60R070D1          | PG-DSO-20-85 | 60R070D1 | see Appendix A |

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# 1 Maximum ratings

at  $T_j = 25\text{ °C}$ , unless otherwise specified. Continuous application of maximum ratings can deteriorate transistor lifetime. For further information, contact your local Infineon sales office.

**Table 3 Maximum ratings**

| Parameter   | Symbol         | Values |      |      | Unit | Note/Test Condition   |
|---|----------------|--------|------|------|------|---|
|   |                | Min.   | Typ. | Max. |      |   |
| Drain source voltage, continuous <sup>1</sup>           | $V_{DS,max}$   | -      | -    | 600  | V    | $V_{GS} = 0\text{ V}$   |
| Drain source destructive breakdown voltage <sup>2</sup> | $V_{DS,bd}$    | 800    | -    | -    | V    | $V_{GS} = 0\text{ V}$ , $I_{DS} = 12.2\text{ mA}$   |
| Drain source voltage, pulsed <sup>2</sup>               | $V_{DS,pulse}$ | -      | -    | 750  | V    | $T_j = 25\text{ °C}$ ; $V_{GS} \leq 0\text{ V}$ ; $\leq 1$ hour of total time   |
|   |                | -      | -    | 650  | V    | $T_j = 125\text{ °C}$ , $V_{GS} \leq 0\text{ V}$ ; $\leq 1$ hour of total time  |
| Switching surge voltage, pulsed <sup>2</sup>            | $V_{DS,surge}$ | -      | -    | 750  | V    | DC bus voltage = 700 V; turn off $V_{DS,pulse} = 750\text{ V}$ ; turn on $I_{D,pulse} = 27\text{ A}$ ; $T_j = 105\text{ °C}$ ; $f \leq 100\text{ kHz}$ , $t \leq 100\text{ secs}$ (10 million pulses) |
| Continuous current, drain source                        | $I_D$          | -      | -    | 31   | A    | $T_C = 25\text{ °C}$ ; $T_j = T_{j,max}$  |
|   |                | -      | -    | 20   |      | $T_C = 100\text{ °C}$ ; $T_j = T_{j,max}$   |
|   |                | -      | -    | 14   |      | $T_C = 125\text{ °C}$ ; $T_j = T_{j,max}$   |
| Pulsed current, drain source <sup>3 4</sup>             | $I_{D,pulse}$  | -      | -    | 60   | A    | $T_C = 25\text{ °C}$ ; $I_G = 26.1\text{ mA}$ ; See Figure 3;   |
| Pulsed current, drain source <sup>4 5</sup>             | $I_{D,pulse}$  | -      | -    | 35   | A    | $T_C = 125\text{ °C}$ ; $I_G = 26.1\text{ mA}$ ; See Figure 4;  |
| Gate current, continuous <sup>4 5 6</sup>               | $I_{G,avg}$    | -      | -    | 20   | mA   | $T_j = -55\text{ °C}$ to $150\text{ °C}$ ;  |
| Gate current, pulsed <sup>4 6</sup>                     | $I_{G,pulse}$  | -      | -    | 2000 | mA   | $T_j = -55\text{ °C}$ to $150\text{ °C}$ ; $t_{PULSE} = 50\text{ ns}$ , $f = 100\text{ kHz}$  |
| Gate source voltage, continuous <sup>6</sup>            | $V_{GS}$       | -10    | -    | -    | V    | $T_j = -55\text{ °C}$ to $150\text{ °C}$ ;  |
| Gate source voltage, pulsed <sup>6</sup>                | $V_{GS,pulse}$ | -25    | -    | -    | V    | $T_j = -55\text{ °C}$ to $150\text{ °C}$ ; $t_{PULSE} = 50\text{ ns}$ , $f = 100\text{ kHz}$ ; open drain   |
| Power dissipation                                       | $P_{tot}$      | -      | -    | 125  | W    | $T_C = 25\text{ °C}$  |
| Operating temperature                                   | $T_j$          | -55    | -    | 150  | °C   |   |

<sup>1</sup> All devices are 100% tested at  $I_{DS} = 12.2\text{ mA}$  to assure  $V_{DS} \geq 800\text{ V}$

<sup>2</sup> Provided as measure of robustness under abnormal operating conditions and not recommended for normal operation

<sup>3</sup> Limits derived from product characterization, parameter not measured during production

<sup>4</sup> Ensure that average gate drive current,  $I_{G,avg}$  is  $\leq 20\text{ mA}$ . Please see figure 27 for  $I_{G,avg}$ ,  $I_{G,pulse}$  and  $I_G$  details

<sup>5</sup> Parameter is influenced by rel-requirements. Please contact the local Infineon Sales Office to get an assessment of your application

<sup>6</sup> We recommend using an advanced driving technique to optimize the device performance. Please see gate drive app note for details

|                                |                  |     |   |     |      |   |
|--------------------------------|------------------|-----|---|-----|------|---|
| Storage temperature            | $T_{\text{stg}}$ | -55 | - | 150 | °C   | Max shelf life depends on storage conditions. |
| Drain-source voltage slew-rate | $dV/dt$          |     |   | 200 | V/ns |   |

## 2 Thermal characteristics

**Table 4 Thermal characteristics**

| Parameter                         | Symbol            | Values |      |      | Unit | Note/Test Condition |
|-----------------------------------|-------------------|--------|------|------|------|---------------------|
|                                   |                   | Min.   | Typ. | Max. |      |                     |
| Thermal resistance, junction-case | $R_{\text{thJC}}$ | -      | -    | 1    | °C/W |                     |
| Reflow soldering temperature      | $T_{\text{sold}}$ | -      | -    | 260  | °C   | MSL3                |

### 3 Electrical characteristics

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

**Table 5 Static characteristics**

| Parameter   | Symbol          | Values     |                |            | Unit          | Note/Test Condition   |
|---|-----------------|------------|----------------|------------|---------------|---|
|   |                 | Min.       | Typ.           | Max.       |               |   |
| Gate threshold voltage  | $V_{GS(th)}$    | 0.9<br>0.7 | 1.2<br>1.0     | 1.6<br>1.4 | V             | $I_{DS} = 2.6\text{ mA}$ ; $V_{DS} = 10\text{ V}$ ; $T_j = 25\text{ °C}$<br>$I_{DS} = 2.6\text{ mA}$ ; $V_{DS} = 10\text{ V}$ ; $T_j = 125\text{ °C}$ |
| Gate-Source reverse clamping voltage                                | $V_{GS, clamp}$ | -          | -              | -8         | V             | $I_{GSS} = -1\text{ mA}$  |
| Drain-Source leakage current  | $I_{DSS}$       | -<br>-     | 1<br>20        | 100<br>-   | $\mu\text{A}$ | $V_{DS} = 600\text{ V}$ ; $V_{GS} = 0\text{ V}$ ; $T_j = 25\text{ °C}$<br>$V_{DS} = 600\text{ V}$ ; $V_{GS} = 0\text{ V}$ ; $T_j = 150\text{ °C}$     |
| Drain-Source leakage current at application conditions <sup>1</sup> | $I_{DSSapp}$    | -          | 60             | -          | $\mu\text{A}$ | $V_{DS} = 400\text{ V}$ ; $V_{GS} = 0\text{ V}$ ; $T_j = 125\text{ °C}$   |
| Drain-Source on-state resistance                                    | $R_{DS(on)}$    | -<br>-     | 0.055<br>0.100 | 0.070<br>- | $\Omega$      | $I_G = 26.1\text{ mA}$ ; $I_D = 8\text{ A}$ ; $T_j = 25\text{ °C}$<br>$I_G = 26.1\text{ mA}$ ; $I_D = 8\text{ A}$ ; $T_j = 150\text{ °C}$             |
| Gate resistance   | $R_{G,int}$     | -          | 0.78           | -          | $\Omega$      | LCR impedance measurement;<br>$f = f_{res}$ ; open drain;   |

**Table 6 Dynamic characteristics**

| Parameter   | Symbol       | Values |       |      | Unit | Note/Test Condition   |
|---|--------------|--------|-------|------|------|---|
|   |              | Min.   | Typ.  | Max. |      |   |
| Input capacitance   | $C_{iss}$    | -      | 380   | -    | pF   | $V_{GS} = 0\text{ V}$ ; $V_{DS} = 400\text{ V}$ ;<br>$f = 1\text{ MHz}$               |
| Output capacitance  | $C_{oss}$    | -      | 72    | -    | pF   | $V_{GS} = 0\text{ V}$ ; $V_{DS} = 400\text{ V}$ ;<br>$f = 1\text{ MHz}$               |
| Reverse Transfer capacitance                              | $C_{rss}$    | -      | 0.3   | -    | pF   | $V_{GS} = 0\text{ V}$ ; $V_{DS} = 400\text{ V}$ ;<br>$f = 1\text{ MHz}$               |
| Effective output capacitance, energy related <sup>2</sup> | $C_{o(er)}$  | -      | 80    | -    | pF   | $V_{DS} = 0\text{ to }400\text{ V}$   |
| Effective output capacitance, time related <sup>3</sup>   | $C_{o(tr)}$  | -      | 102.5 | -    | pF   | $V_{GS} = 0\text{ V}$ ; $V_{DS} = 0\text{ to }400\text{ V}$ ;<br>$I_D = \text{const}$ |
| Output charge   | $Q_{oss}$    | -      | 41    | -    | nC   | $V_{DS} = 0\text{ to }400\text{ V}$   |
| Turn- on delay time                                       | $t_{d(on)}$  | -      | 10    | -    | ns   | see Figure 23   |
| Turn- off delay time                                      | $t_{d(off)}$ | -      | 14    | -    | ns   | see Figure 23   |
| Rise time   | $t_r$        | -      | 8     | -    | ns   | see Figure 23   |
| Fall time   | $t_f$        | -      | 15    | -    | ns   | see Figure 23   |

<sup>1</sup> Parameter represents end of use leakage in applications

<sup>2</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 400 V

<sup>3</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 400 V

**Table 7 Gate charge characteristics**

| Parameter   | Symbol | Values |      |      | Unit | Note/Test Condition                                     |
|-------------|--------|--------|------|------|------|---|
|             |        | Min.   | Typ. | Max. |      |   |
| Gate charge | $Q_G$  | -      | 5.8  | -    | nC   | $I_{GS} = 0$ to 10 mA; $V_{DS} = 400$ V;<br>$I_D = 8$ A |

**Table 8 Reverse conduction characteristics**

| Parameter                     | Symbol        | Values |      |      | Unit | Note/Test Condition            |
|-------------------------------|---------------|--------|------|------|------|--------------------------------|
|                               |               | Min.   | Typ. | Max. |      |                                |
| Source-Drain reverse voltage  | $V_{SD}$      | -      | 2.2  | 2.5  | V    | $V_{GS} = 0$ V; $I_{SD} = 8$ A |
| Pulsed current, reverse       | $I_{S,pulse}$ | -      | -    | 60   | A    | $I_G = 26.1$ mA                |
| Reverse recovery charge       | $Q_{rr}^1$    | -      | 0    | -    | nC   | $I_S = 8$ A, $V_{DS} = 400$ V  |
| Reverse recovery time         | $t_{rr}$      | -      | 0    | -    | ns   |                                |
| Peak reverse recovery current | $I_{rrm}$     | -      | 0    | -    | A    |                                |

## 4 Electrical characteristics diagrams

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

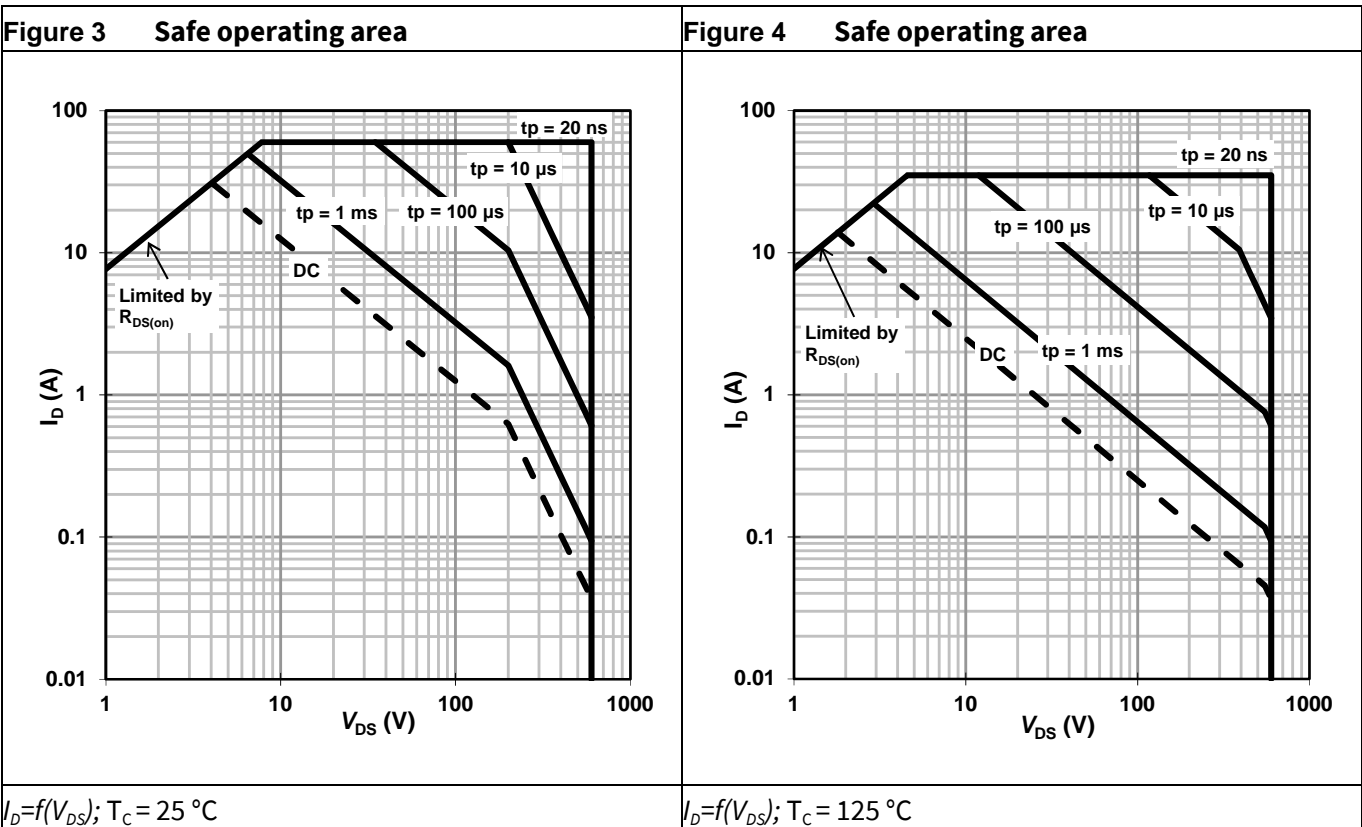
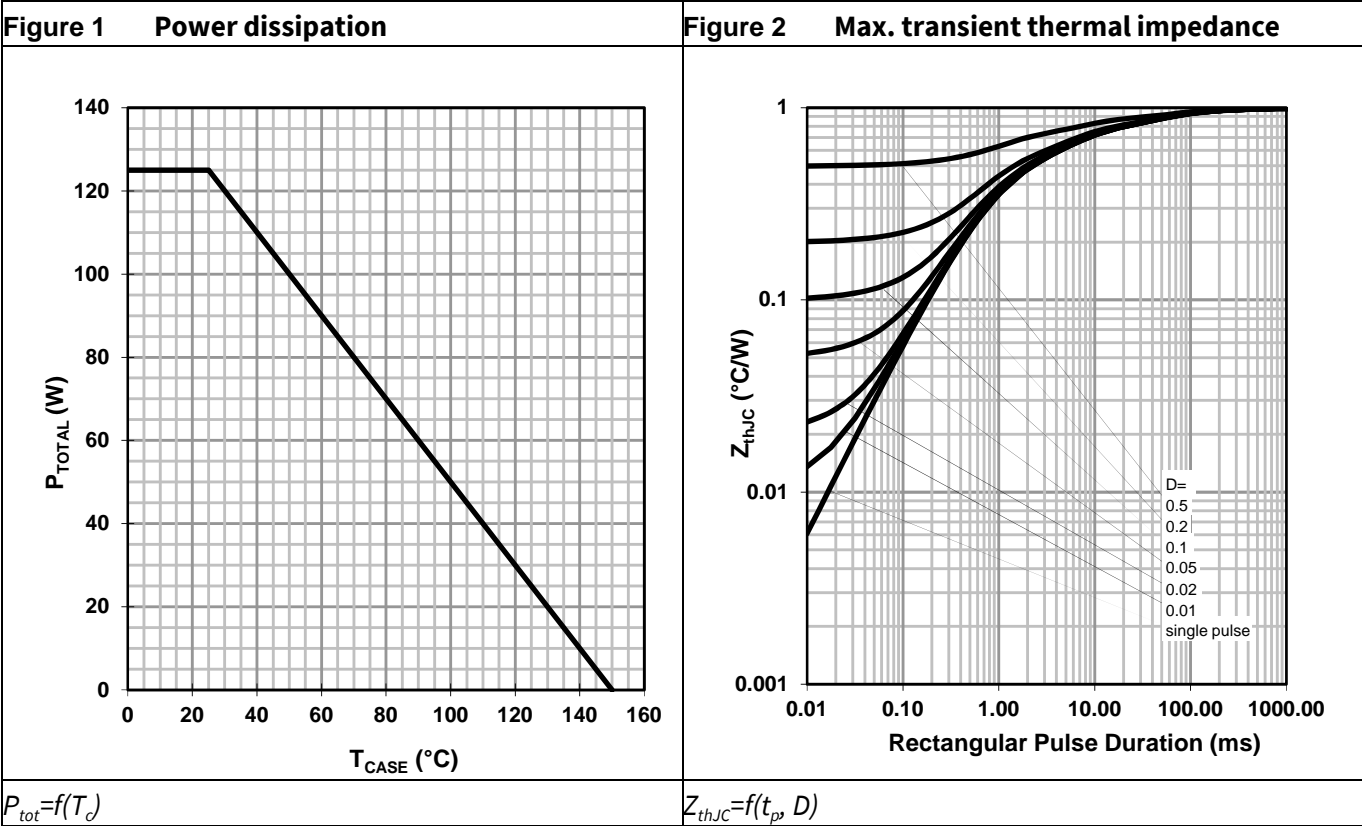
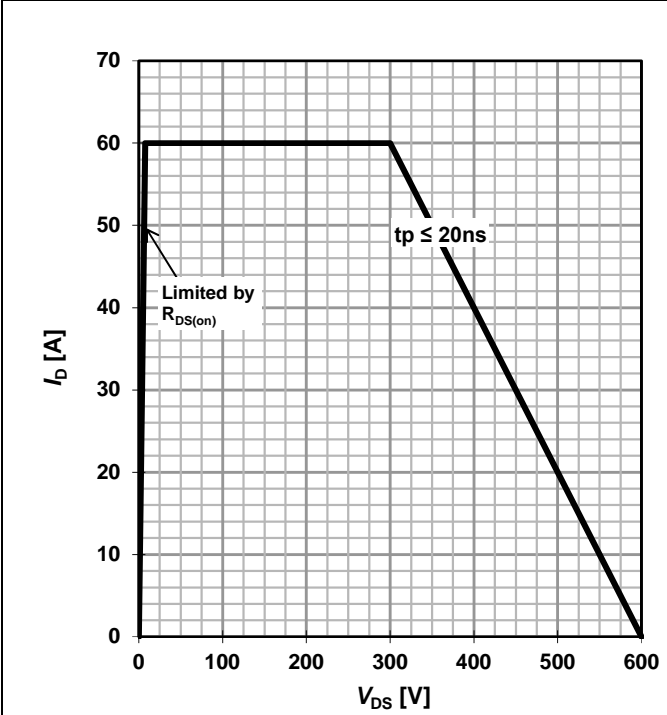
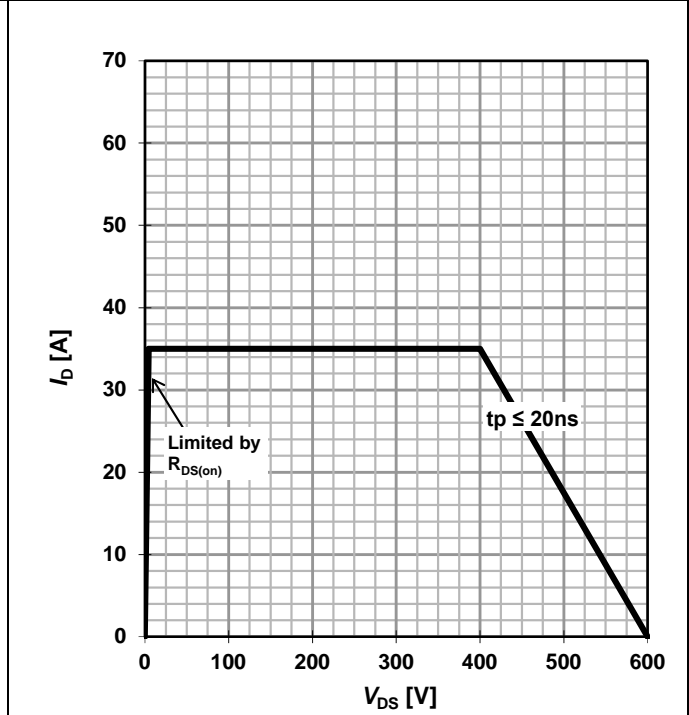


Figure 5 Repetitive safe operating area<sup>1</sup>



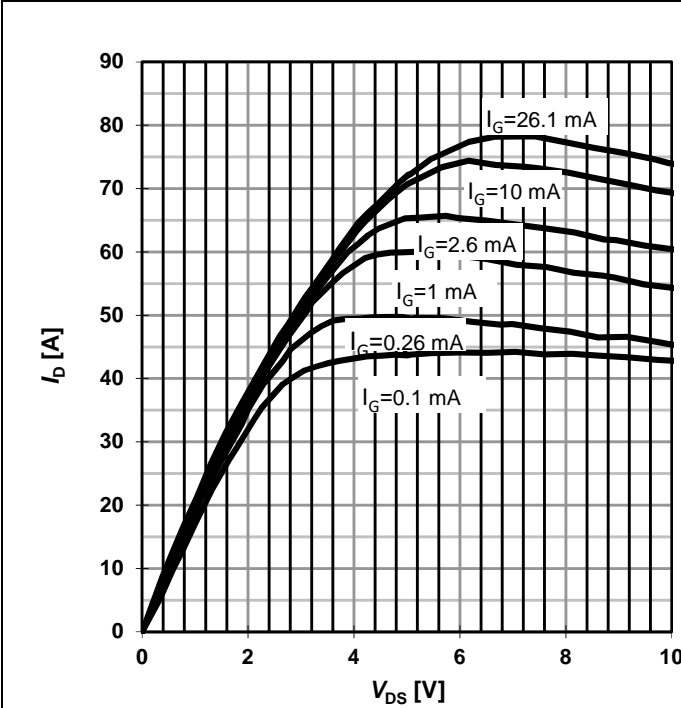
$T_C = 25\text{ °C}; T_J \leq 150\text{ °C}$

Figure 6 Repetitive safe operating area<sup>1</sup>



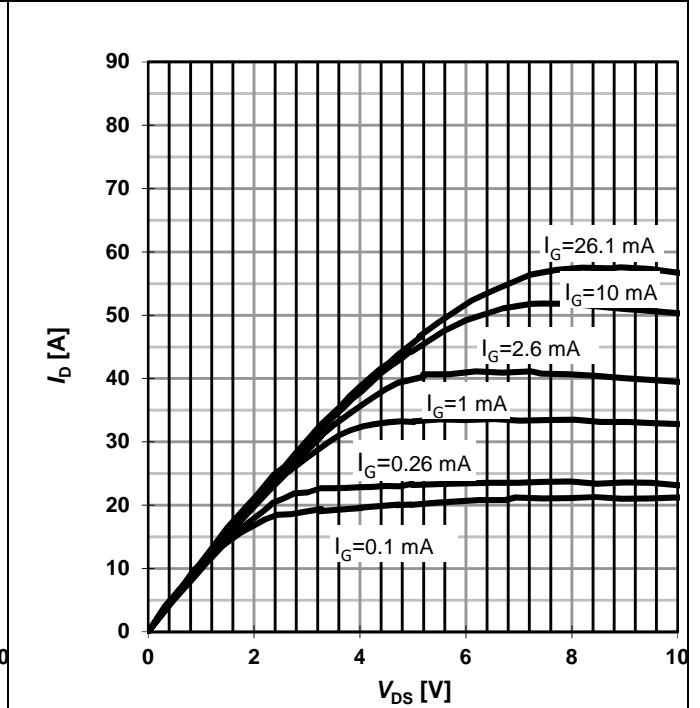
$T_C = 125\text{ °C}; T_J \leq 150\text{ °C}$

Figure 7 Typ. output characteristics



$I_D = f(V_{DS}, I_G); T_J = 25\text{ °C}$

Figure 8 Typ. output characteristics

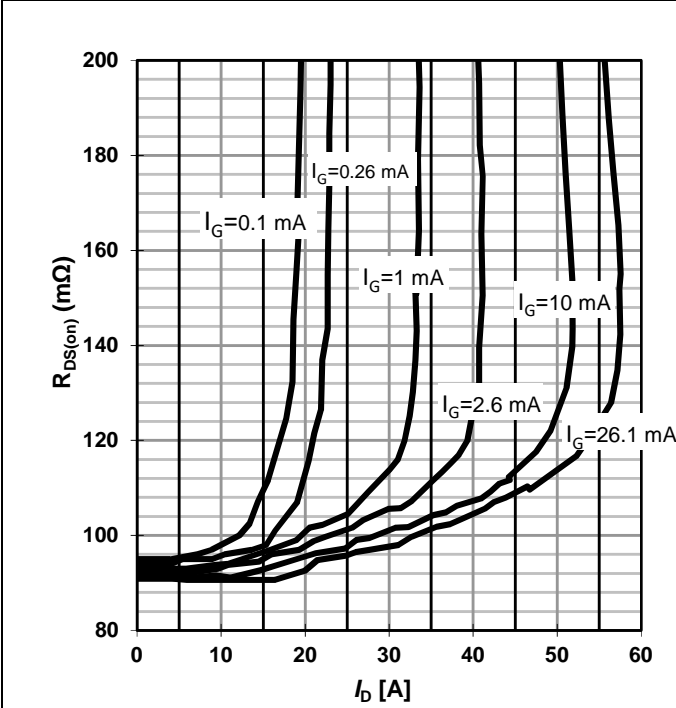


$I_D = f(V_{DS}, I_G); T_J = 125\text{ °C}$

<sup>1</sup> Parameter is influenced by rel-requirements. Please contact the local Infineon Sales Office to get an assessment of your application.

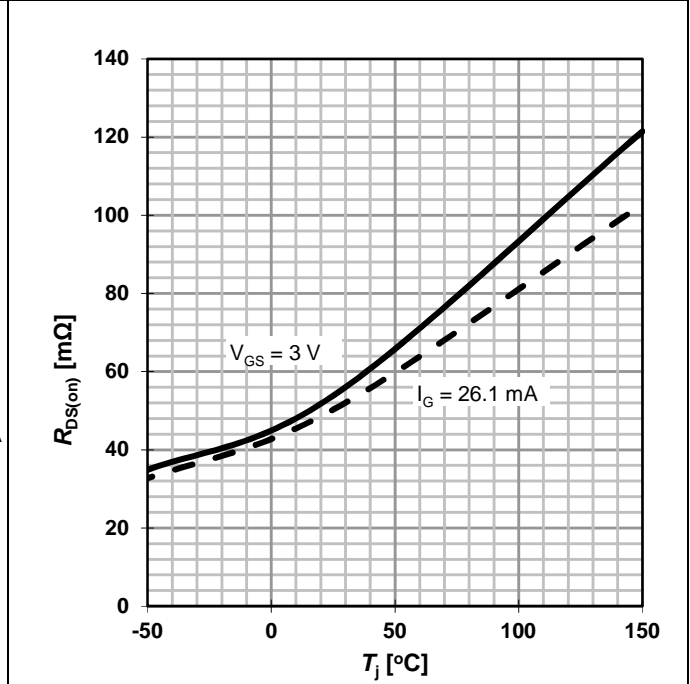


Figure 9 Typ. Drain-source on-state resistance



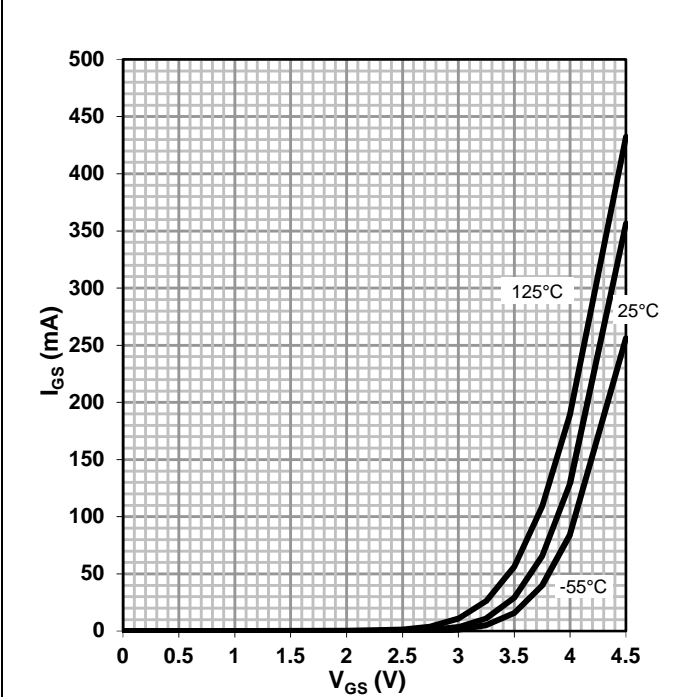
$$R_{DS(on)} = f(I_D, I_G); T_j = 125\text{ °C}$$

Figure 10 Drain-source on-state resistance



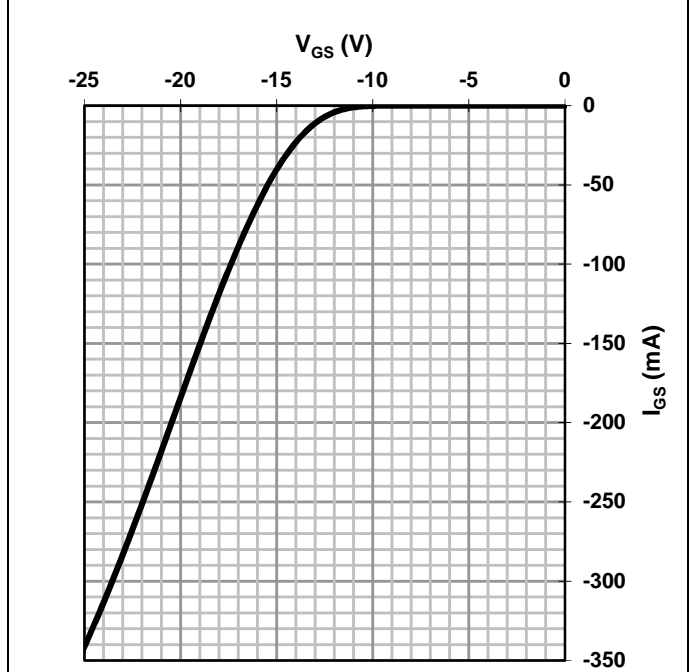
$$R_{DS(on)} = f(T_j); I_D = 8\text{ A}$$

Figure 11 Typ. gate characteristics forward



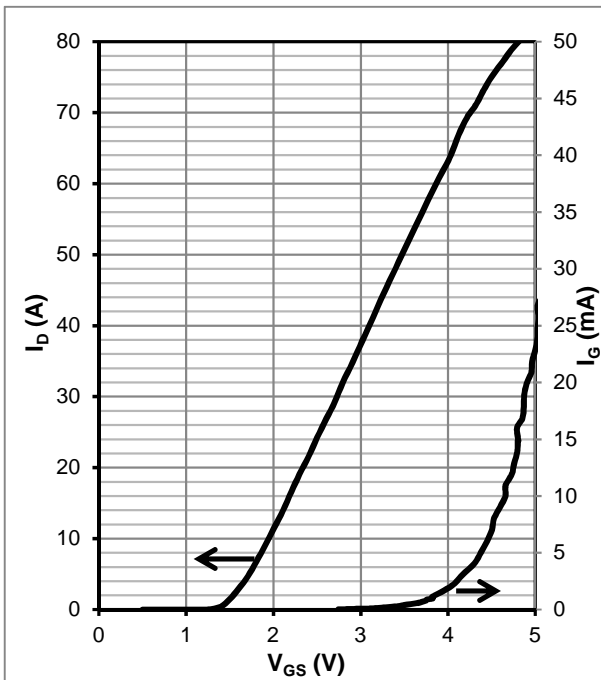
$$I_{GS} = f(V_{GS}, T_j); \text{open drain}$$

Figure 12 Typ. gate characteristics reverse



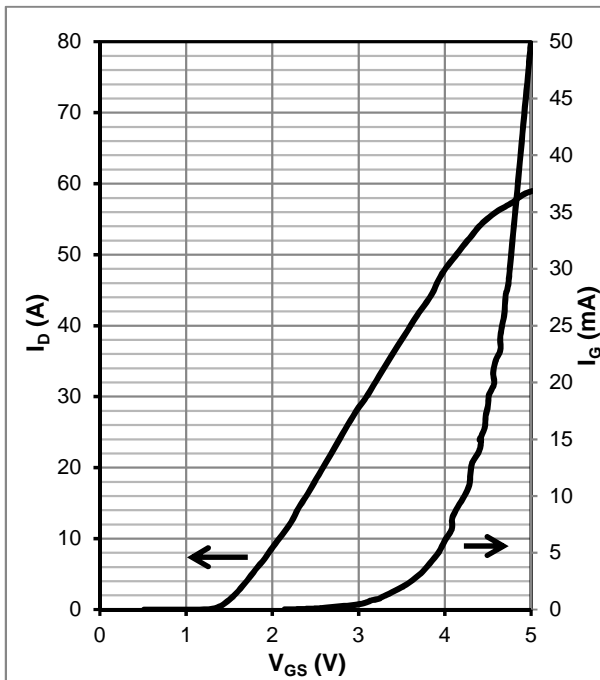
$$I_{GS} = f(V_{GS}); T_j = 25\text{ °C}$$

Figure 13 Typ. transfer characteristics



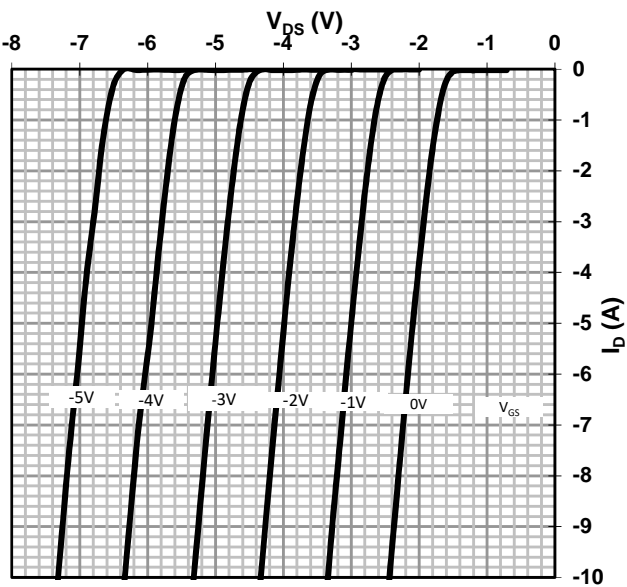
$I_D, I_G = f(V_{GS}); V_{DS} = 8 \text{ V}; T_j = 25 \text{ }^{\circ}\text{C}$

Figure 14 Typ. transfer characteristics



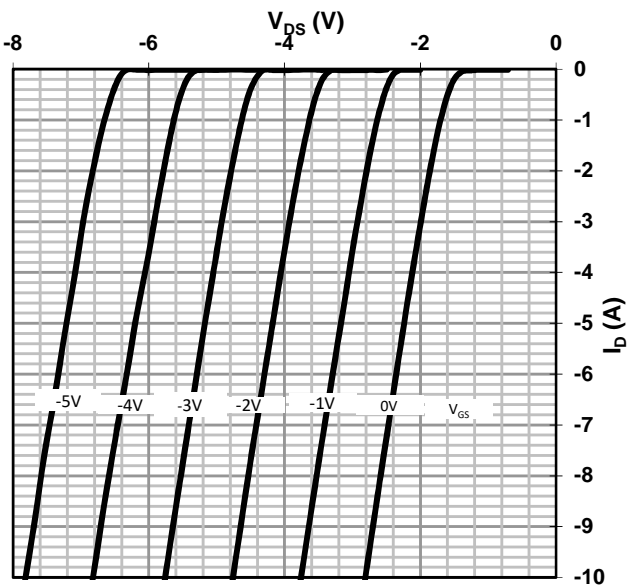
$I_D, I_G = f(V_{GS}); V_{DS} = 8 \text{ V}; T_j = 125 \text{ }^{\circ}\text{C}$

Figure 15 Typ. channel reverse characteristics



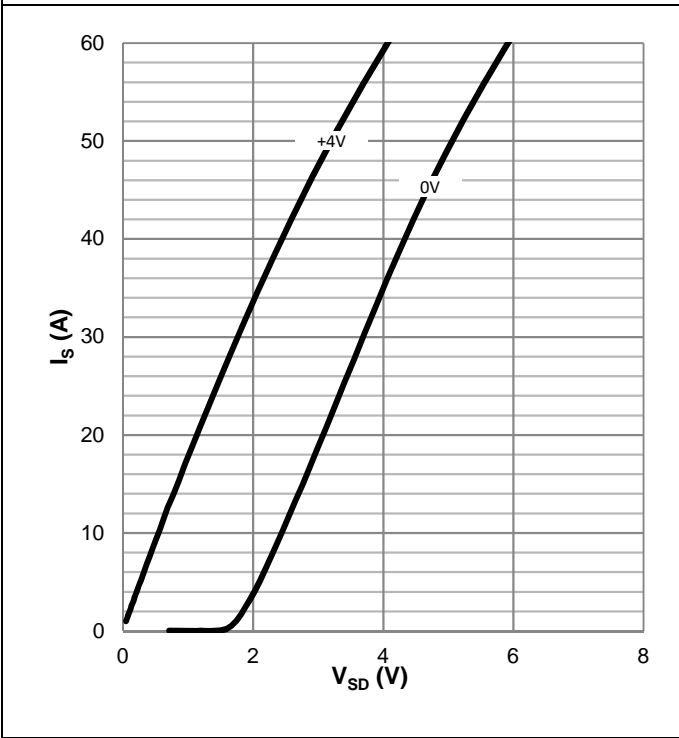
$V_{DS} = f(I_D, V_{GS}); T_j = 25 \text{ }^{\circ}\text{C}$

Figure 16 Typ. channel reverse characteristics



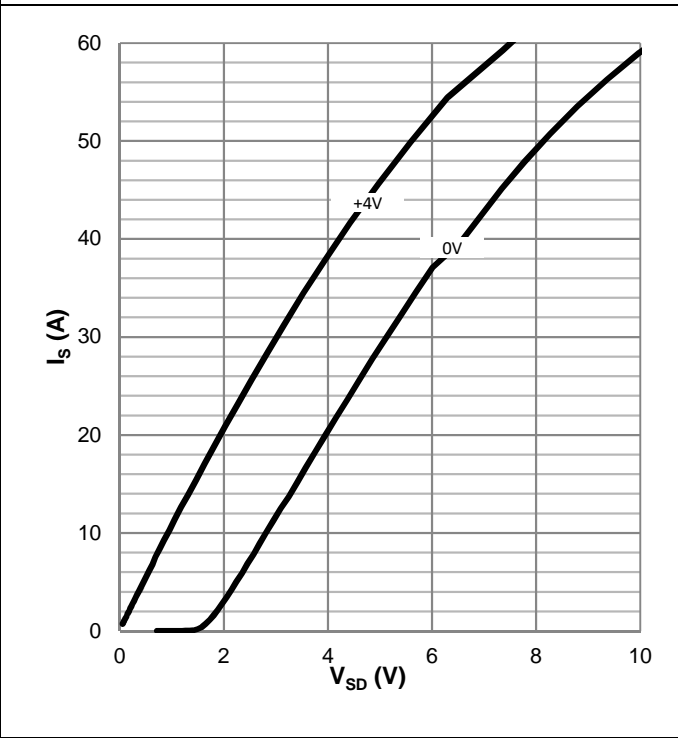
$V_{DS} = f(I_D, V_{GS}); T_j = 125 \text{ }^{\circ}\text{C}$

**Figure 17 Typ. channel reverse characteristics**



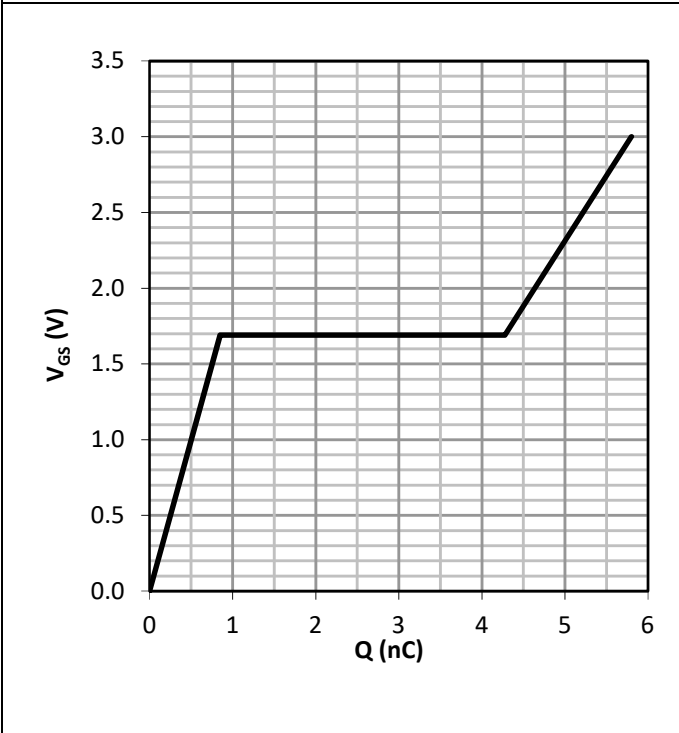
$$I_D = f(V_{DS}, V_{GS}); T_j = 25\text{ °C}$$

**Figure 18 Typ. channel reverse characteristics**



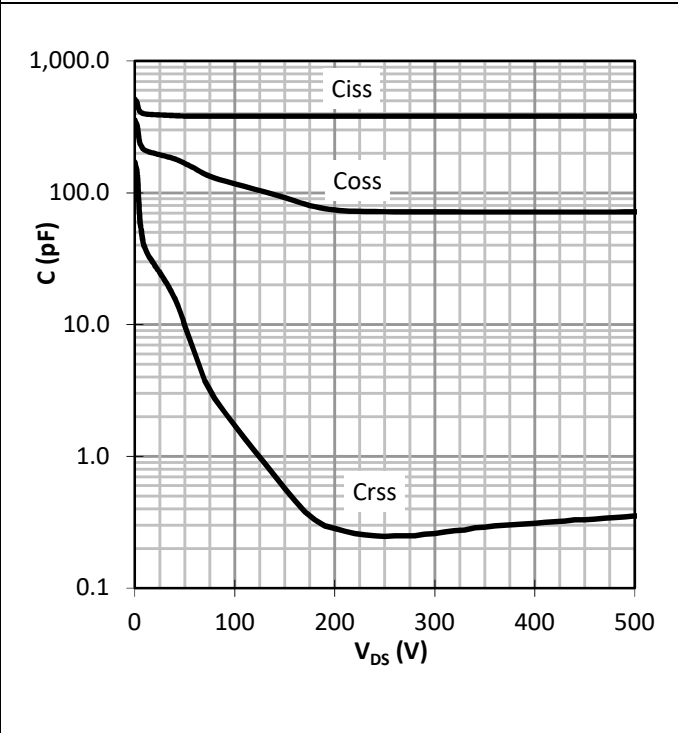
$$I_D = f(V_{DS}, V_{GS}); T_j = 125\text{ °C}$$

**Figure 19 Typ. gate charge**

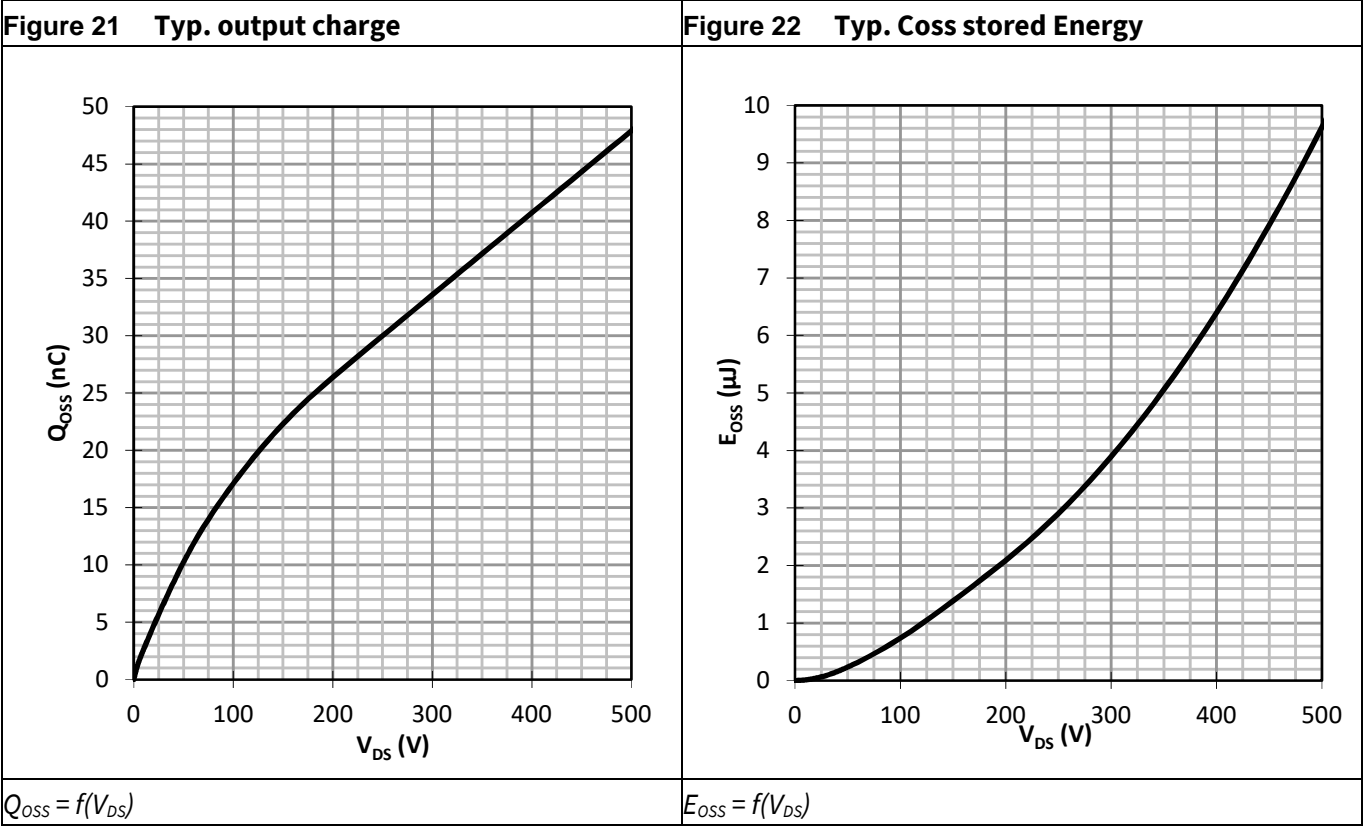


$$V_{GS} = f(Q_G); V_{DCLINK} = 400\text{ V}; I_D = 8\text{ A}$$

**Figure 20 Typ. capacitances**

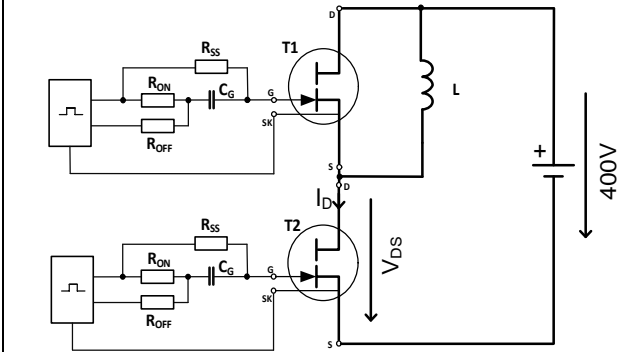


$$C_{XSS} = f(V_{DS})$$



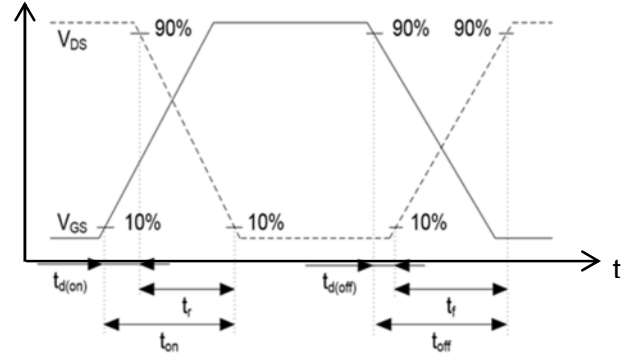
## 5 Test Circuits

**Figure 23 Switching times with inductive load**

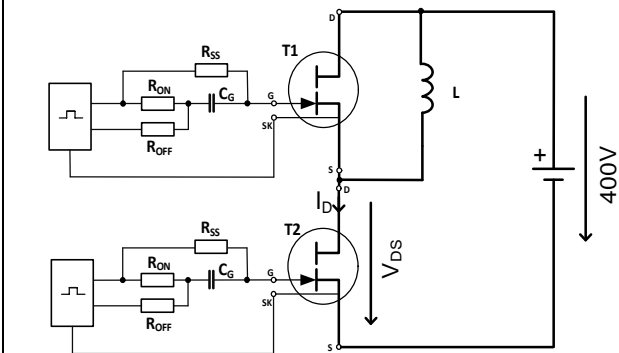


$I_D = 8A$ ,  $R_{ON} = 5\ \Omega$ ;  $R_{OFF} = 5\ \Omega$ ;  $R_{SS} = 300\ \Omega$ ;  
 $C_G = 3.3\ nF$ ;  $V_{DRV} = 12V$

**Figure 24 Switching times waveform**

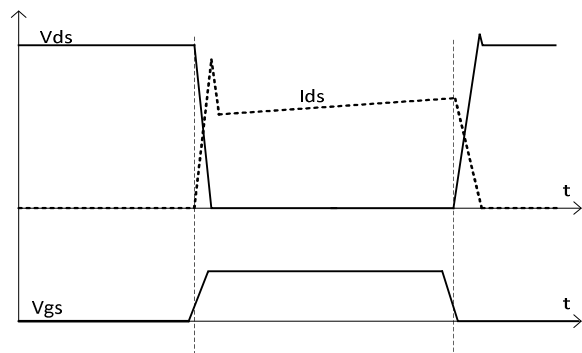


**Figure 25 Reverse Channel Characteristics Test**



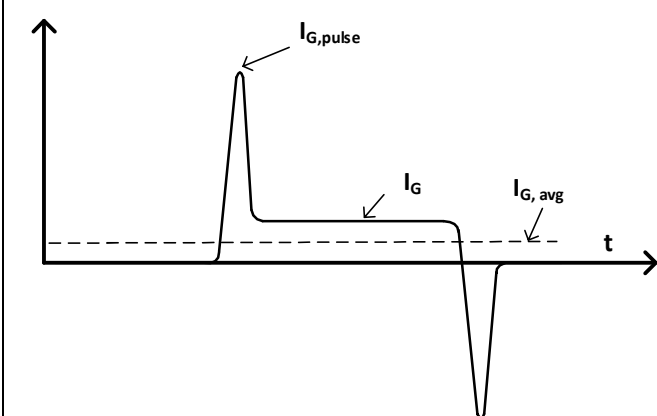
$I_D = 8A$ ,  $R_{ON} = 5\ \Omega$ ;  $R_{OFF} = 5\ \Omega$ ;  $R_{SS} = 300\ \Omega$ ;  
 $C_G = 3.3\ nF$ ;  $V_{DRV} = 12V$

**Figure 26 Typical Reverse Channel Recovery**



The recovery charge is  $Q_{OSS}$  only, no additional  $Q_{rr}$

**Figure 27 Gate current switching waveform**



## 6 Package Outlines

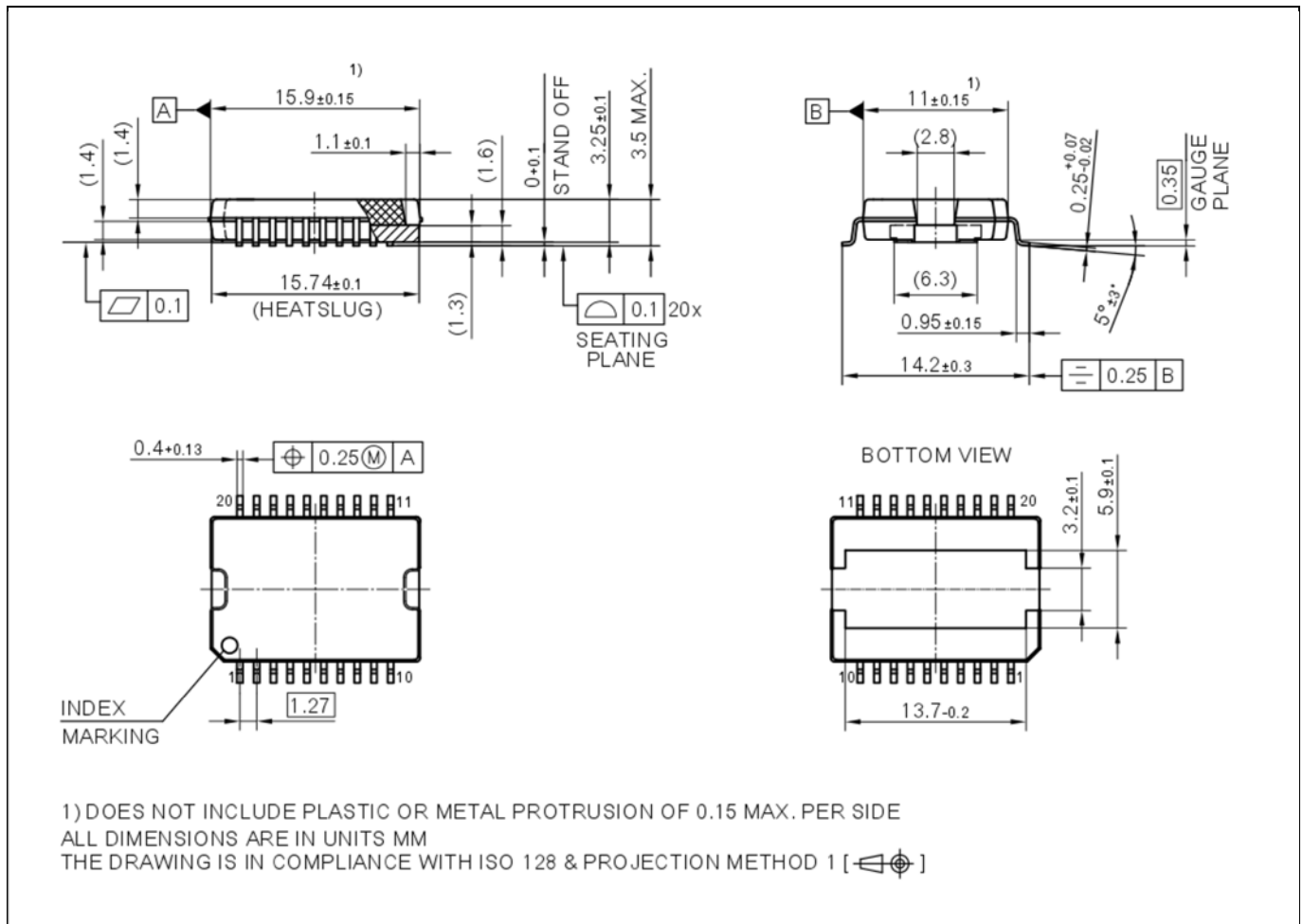


Figure 28 PG-DSO-20-85 Package Outline, dimensions (mm)

## 7 Appendix A

Table 9 Related links

- IFX CoolGaN™ webpage: [www.infineon.com/why-coolgan](http://www.infineon.com/why-coolgan)
- IFX CoolGaN™ reliability white paper: [www.infineon.com/gan-reliability](http://www.infineon.com/gan-reliability)
- IFX CoolGaN™ gate drive application note: [www.infineon.com/driving-coolgan](http://www.infineon.com/driving-coolgan)
- IFX CoolGaN™ applications information:
  - [www.infineon.com/gan-in-server-telecom](http://www.infineon.com/gan-in-server-telecom)
  - [www.infineon.com/gan-in-wirelesscharging](http://www.infineon.com/gan-in-wirelesscharging)
  - [www.infineon.com/gan-in-audio](http://www.infineon.com/gan-in-audio)
  - [www.infineon.com/gan-in-adapter-charger](http://www.infineon.com/gan-in-adapter-charger)

## 8 Revision History

### Major changes since the last revision

| Revision | Date       | Description of change   |
|----------|------------|---|
| 2.0      | 2018-04-24 | Final version release   |
| 2.1      | 2018-10-12 | Updated application section; added Appendix A and Fig. 27; updated maximum rating table footnotes, switching times and figures.   |
| 2.11     | 2020-01-16 | Added $V_{DS,bd}$ , $V_{DS,pulse}$ , $V_{DS,surge}$ specifications in maximum ratings table of page 3   |
| 2.12     | 2021-04-27 | Updated $T_{sold}$ specification to 260°C in table 4; updated $I_{GSS}$ specification at 125°C to -2 mA in table 5; updated switching times and related test conditions |
| 2.13     | 2021-10-26 | Replaced $I_{GSS}$ specification with $V_{GS,clamp}$ in table 5   |

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