

IGOT60R070D1

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)

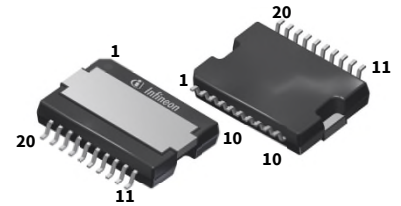
Benefits

- 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 |

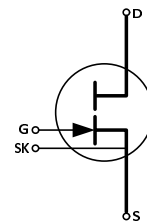


Table 1 Key Performance Parameters at T_j = 25 °C

| 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 V} | 41 | nC |
| Q _{rr} | 0 | nC |

Table 2 Ordering Information

| Type / Ordering Code | Package | Marking | Related links |
|----------------------|--------------|----------|----------------|
| IGOT60R070D1 | PG-DSO-20-87 | 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 ¹ | $V_{DS,max}$ | - | - | 600 | V | $V_{GS} = 0\text{ V}$ |
| Drain source destructive breakdown voltage ² | $V_{DS,bd}$ | 800 | - | - | V | $V_{GS} = 0\text{ V}$, $I_{DS} = 12.2\text{ mA}$ |
| Drain source voltage, pulsed ² | $V_{DS,pulse}$ | - | - | 750 | V | $T_j = 25\text{ °C}$; $V_{GS} \leq 0\text{ V}$; ≤ 1 hour of total time |
| | | - | - | 650 | V | $T_j = 125\text{ °C}$, $V_{GS} \leq 0\text{ V}$; ≤ 1 hour of total time |
| Switching surge voltage, pulsed ² | $V_{DS,surge}$ | - | - | 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 ^{3 4} | $I_{D,pulse}$ | - | - | 60 | A | $T_C = 25\text{ °C}$; $I_G = 26.1\text{ mA}$; See Figure 3; |
| Pulsed current, drain source ^{4 5} | $I_{D,pulse}$ | - | - | 35 | A | $T_C = 125\text{ °C}$; $I_G = 26.1\text{ mA}$; See Figure 4; |
| Gate current, continuous ^{4 5 6} | $I_{G,avg}$ | - | - | 20 | mA | $T_j = -55\text{ °C}$ to 150 °C ; |
| Gate current, pulsed ^{4 6} | $I_{G,pulse}$ | - | - | 2000 | mA | $T_j = -55\text{ °C}$ to 150 °C ; $t_{PULSE} = 50\text{ ns}$, $f = 100\text{ kHz}$ |
| Gate source voltage, continuous ⁶ | V_{GS} | -10 | - | - | V | $T_j = -55\text{ °C}$ to 150 °C ; |
| Gate source voltage, pulsed ⁶ | $V_{GS,pulse}$ | -25 | - | - | V | $T_j = -55\text{ °C}$ to 150 °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 | |

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

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

³ Limits derived from product characterization, parameter not measured during production

⁴ 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

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

⁶ We recommend using an advanced driving technique to optimize the device performance. Please see gate drive application note for details

| | | | | | | |
|--------------------------------|-----------|-----|---|-----|------|---|
| Storage temperature | T_{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_{thJC} | - | - | 1 | °C/W | |
| Reflow soldering temperature | T_{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 0.7 | 1.2 1.0 | 1.6 1.4 | V | $I_{DS} = 2.6\text{ mA}; V_{DS} = 10\text{ V}; T_j = 25\text{ °C}$ $I_{DS} = 2.6\text{ mA}; V_{DS} = 10\text{ V}; T_j = 125\text{ °C}$ |
| Gate-Source reverse clamping voltage | $V_{GS, clamp}$ | - | - | -8 | V | $I_{GSS} = -1\text{ mA}$ |
| Drain-Source leakage current | I_{DSS} | - | 1 20 | 100 - | μA | $V_{DS} = 600\text{ V}; V_{GS} = 0\text{ V}; T_j = 25\text{ °C}$ $V_{DS} = 600\text{ V}; V_{GS} = 0\text{ V}; T_j = 150\text{ °C}$ |
| Drain-Source leakage current at application conditions ¹ | I_{DSSapp} | - | 60 | - | μA | $V_{DS} = 400\text{ V}; V_{GS} = 0\text{ V}; T_j = 125\text{ °C}$ |
| Drain-Source on-state resistance | $R_{DS(on)}$ | - | 0.055 0.100 | 0.070 - | Ω | $I_G = 26.1\text{ mA}; I_D = 8\text{ A}; T_j = 25\text{ °C}$ $I_G = 26.1\text{ mA}; I_D = 8\text{ A}; T_j = 150\text{ °C}$ |
| Gate resistance | $R_{G,int}$ | - | 0.78 | - | Ω | LCR impedance measurement; $f = f_{res}$; open drain; |

Table 6 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note/Test Condition |
|---|--------------|--------|-------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | C_{iss} | - | 380 | - | pF | $V_{GS} = 0\text{ V}; V_{DS} = 400\text{ V};$ $f = 1\text{ MHz}$ |
| Output capacitance | C_{oss} | - | 72 | - | pF | $V_{GS} = 0\text{ V}; V_{DS} = 400\text{ V};$ $f = 1\text{ MHz}$ |
| Reverse Transfer capacitance | C_{rss} | - | 0.3 | - | pF | $V_{GS} = 0\text{ V}; V_{DS} = 400\text{ V};$ $f = 1\text{ MHz}$ |
| Effective output capacitance, energy related ² | $C_{o(er)}$ | - | 80 | - | pF | $V_{DS} = 0\text{ to }400\text{ V}$ |
| Effective output capacitance, time related ³ | $C_{o(tr)}$ | - | 102.5 | - | pF | $V_{GS} = 0\text{ V}; V_{DS} = 0\text{ to }400\text{ V};$ $I_D = \text{const}$ |
| 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 |

¹ Parameter represents end of use leakage in applications

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

³ $C_{o(tr)}$ 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; $I_D = 8$ A |

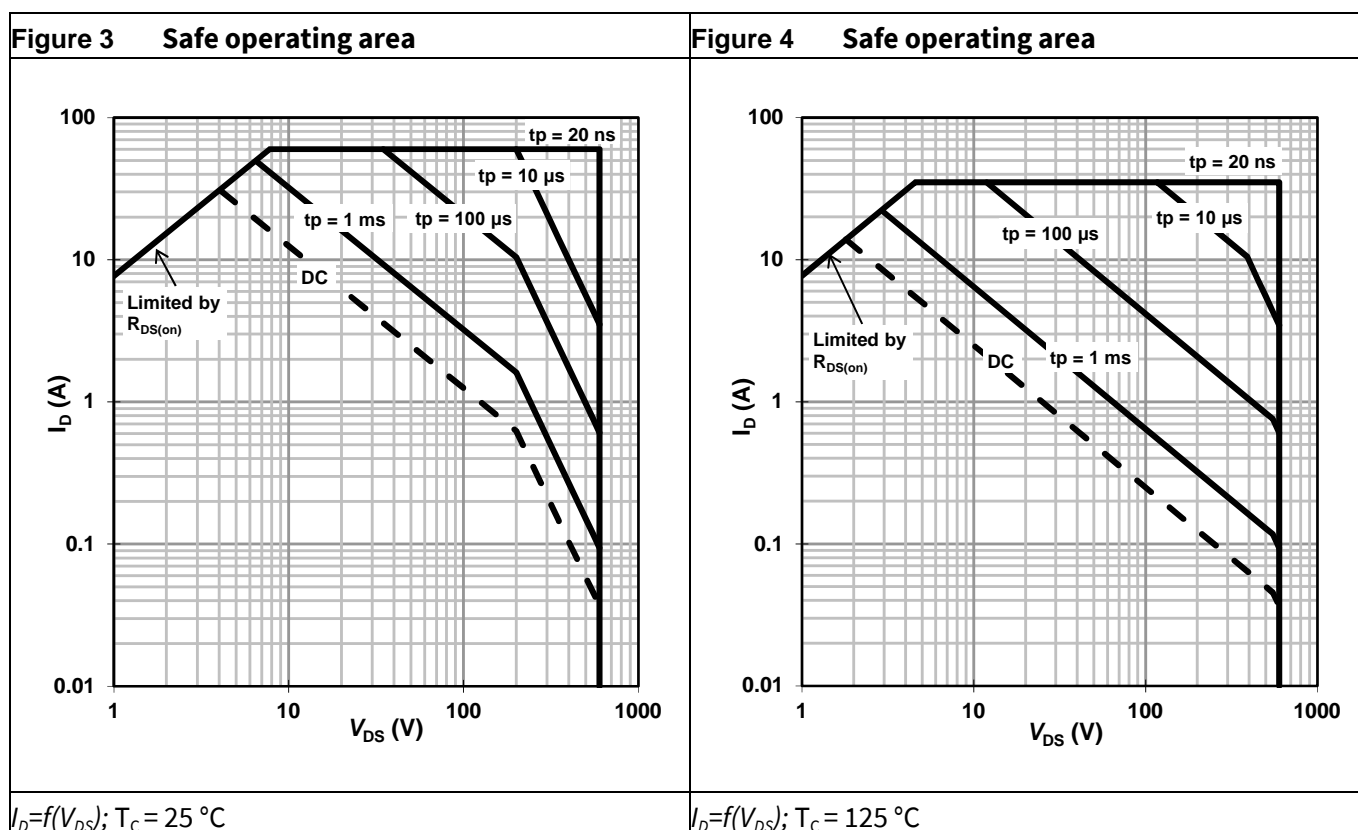
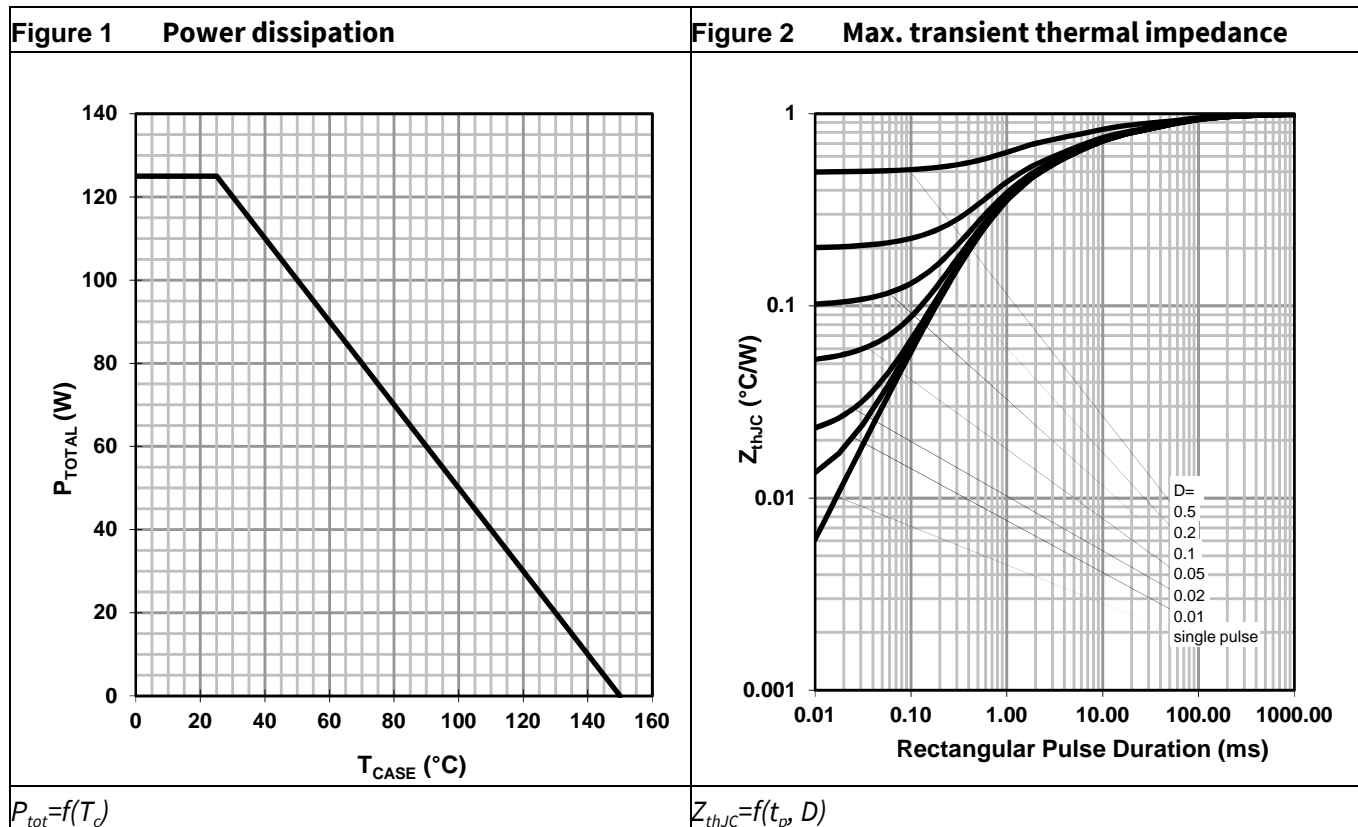
Table 8 Reverse conduction characteristics

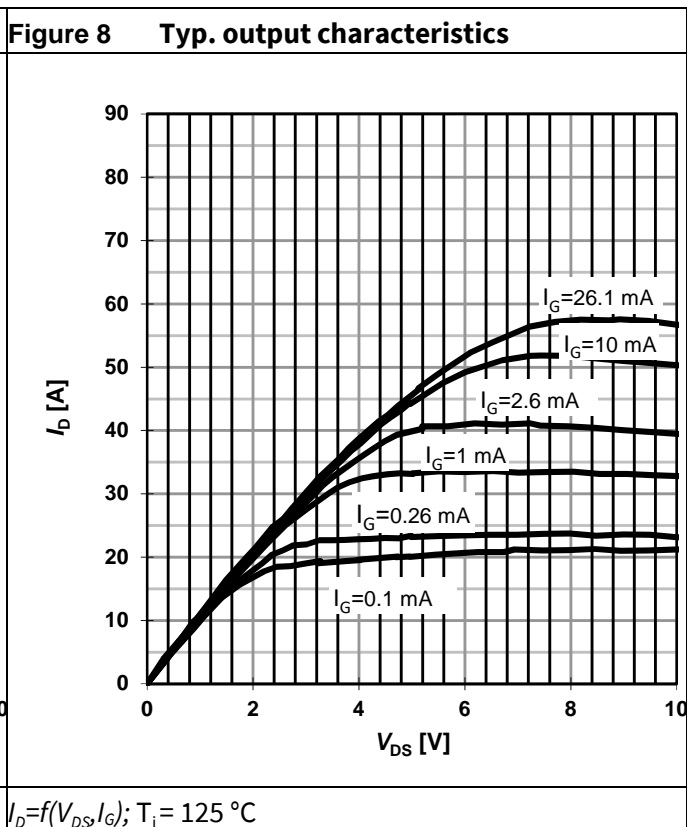
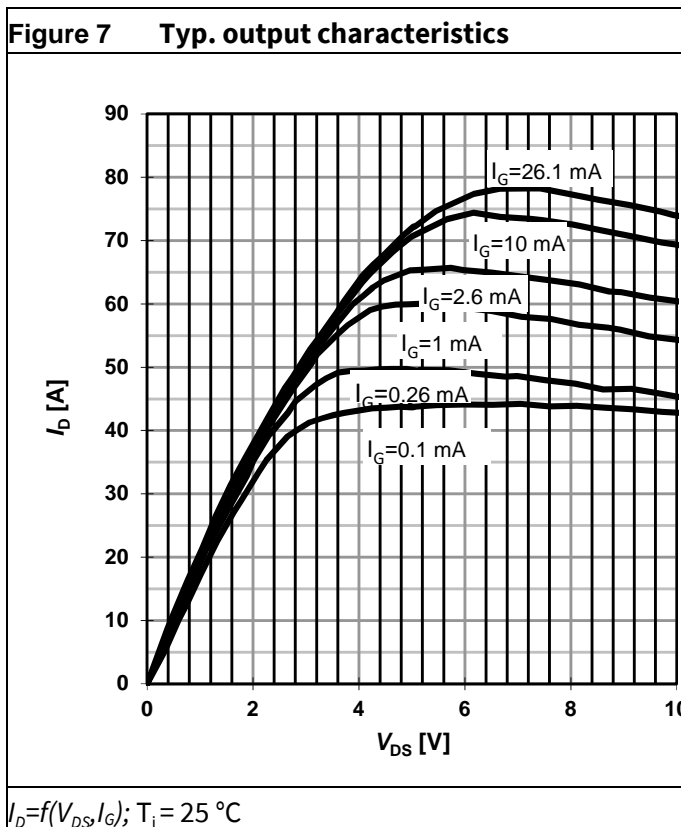
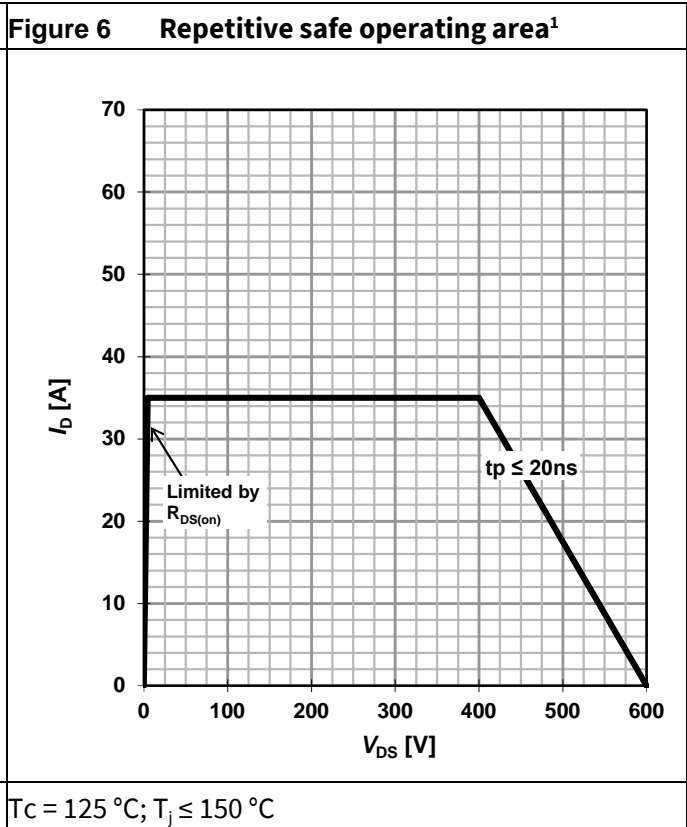
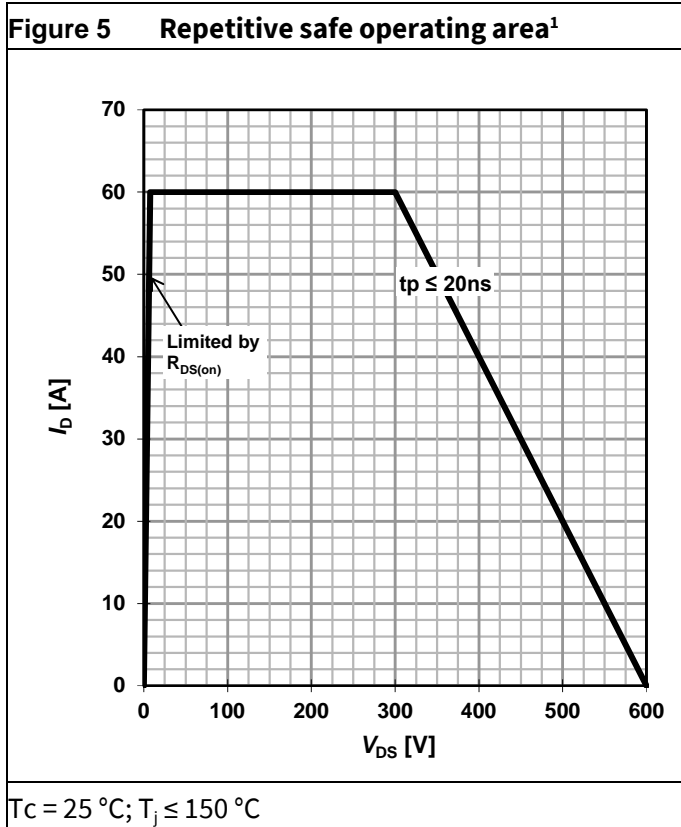
| Parameter | Symbol | Values | | | Unit | Note/Test Condition |
|-------------------------------|---------------|--------|------|------|------|--------------------------------|
| | | Min. | Typ. | Max. | | |
| Source-Drain reverse voltage | V_{SD} | - | 2.2 | 2.5 | V | $V_{GS} = 0$ V; $I_{SD} = 8$ A |
| 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 | |

¹ Excluding Q_{oss}
Final Data Sheet

4 Electrical characteristics diagrams

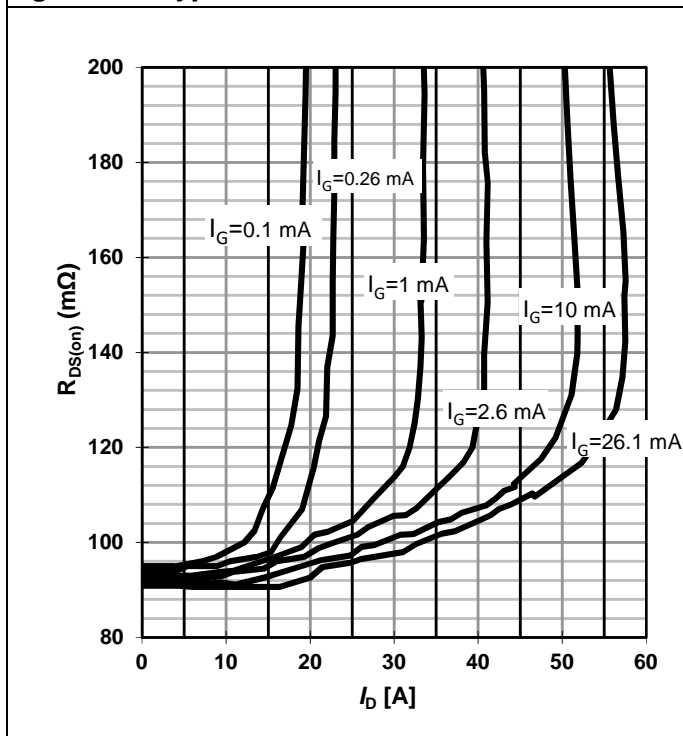
at $T_j = 25\text{ °C}$, unless specified otherwise





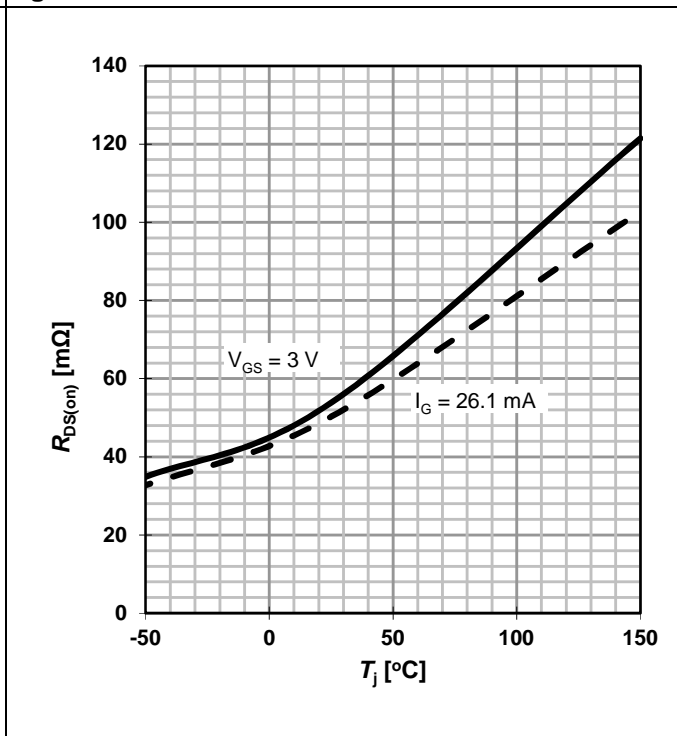
¹ Parameter is influenced by rel-requirements. Please contact the local Infineon Sales Office to get an assessment of your application.

Figure 9 Typ. Drain-source on-state resistance



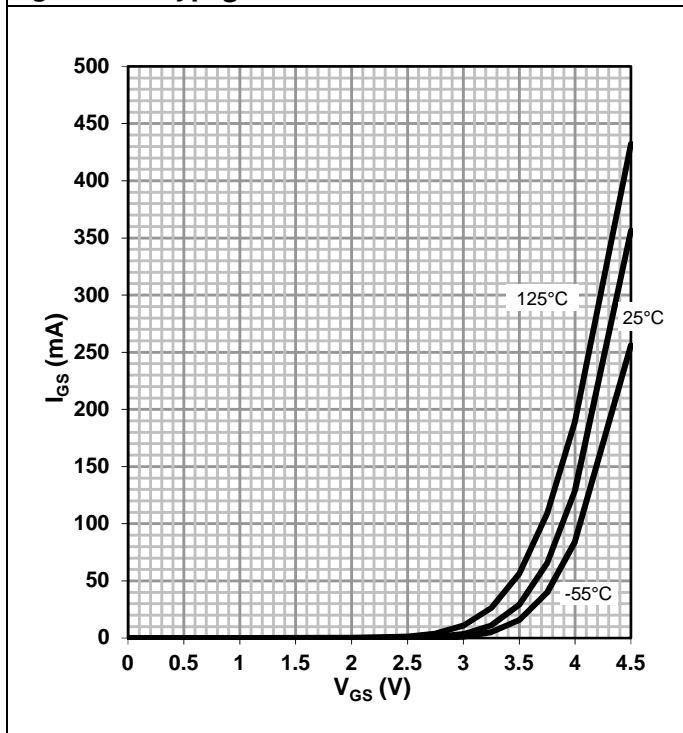
$R_{DS(on)} = f(I_D, I_G); T_j = 125^\circ\text{C}$

Figure 10 Drain-source on-state resistance



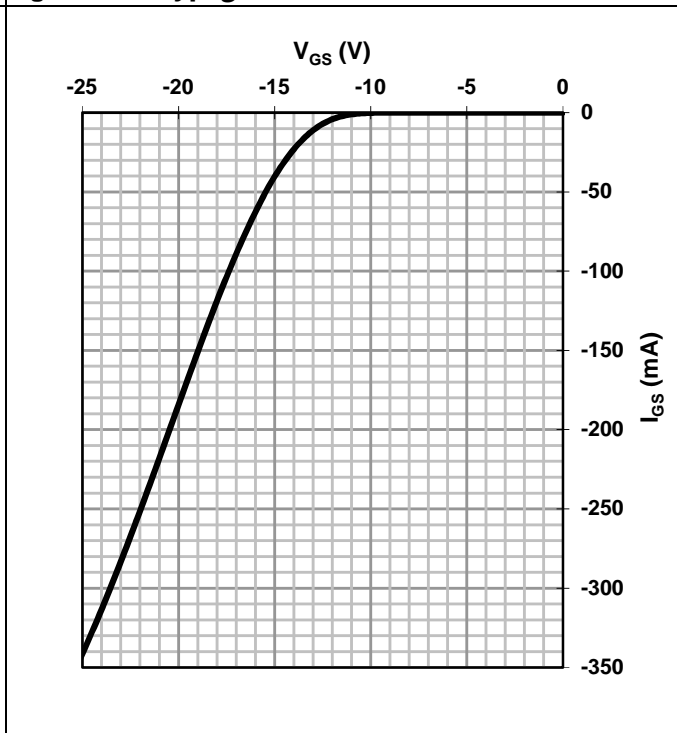
$R_{DS(on)} = f(T_j); I_D = 8$ A

Figure 11 Typ. gate characteristics forward



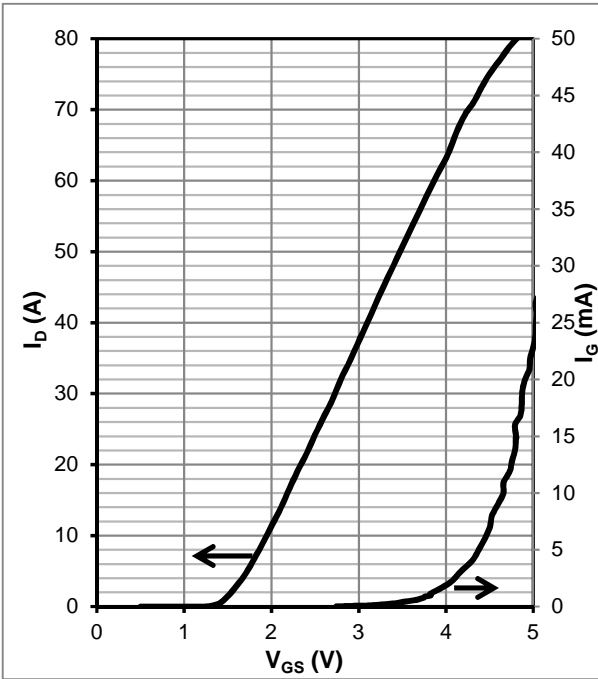
$I_{GS} = f(V_{GS}, T_j);$ open drain

Figure 12 Typ. gate characteristics reverse



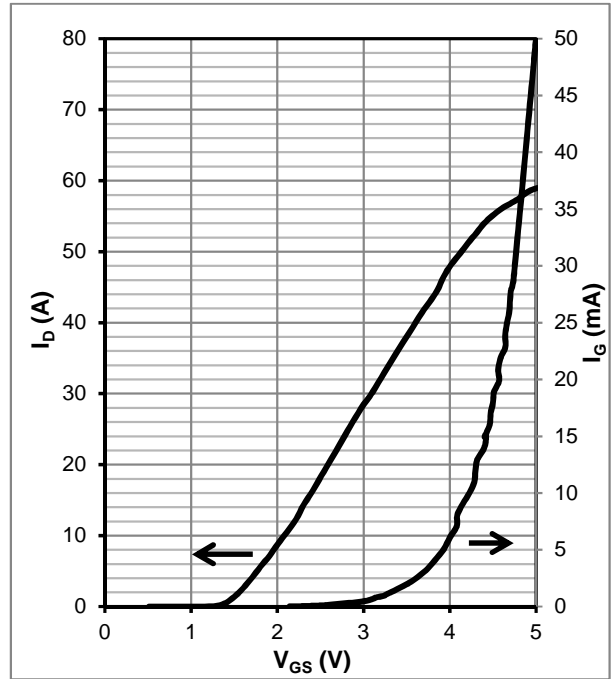
$I_{GS} = f(V_{GS}); T_j = 25^\circ\text{C}$

Figure 13 Typ. transfer characteristics



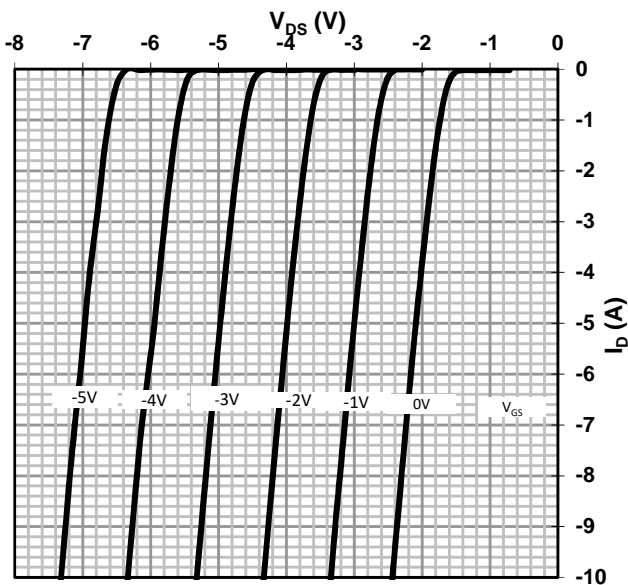
$I_D, I_G = f(V_{GS}); V_{DS} = 8 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$

Figure 14 Typ. transfer characteristics



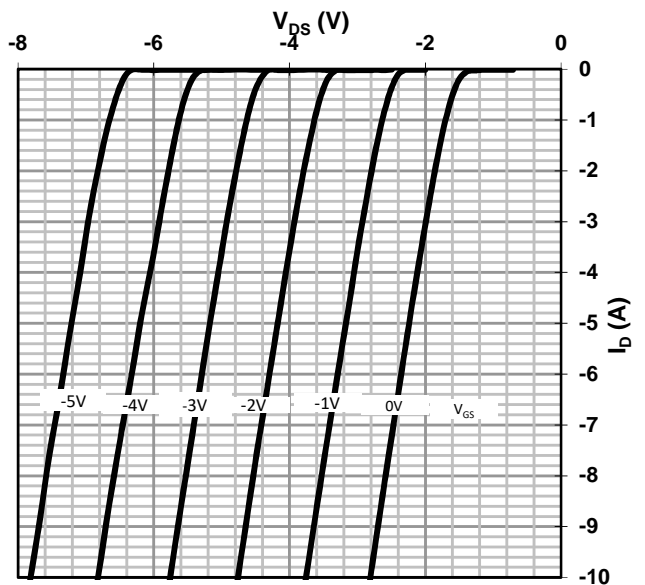
$I_D, I_G = f(V_{GS}); V_{DS} = 8 \text{ V}; T_j = 125 \text{ }^\circ\text{C}$

Figure 15 Typ. channel reverse characteristics



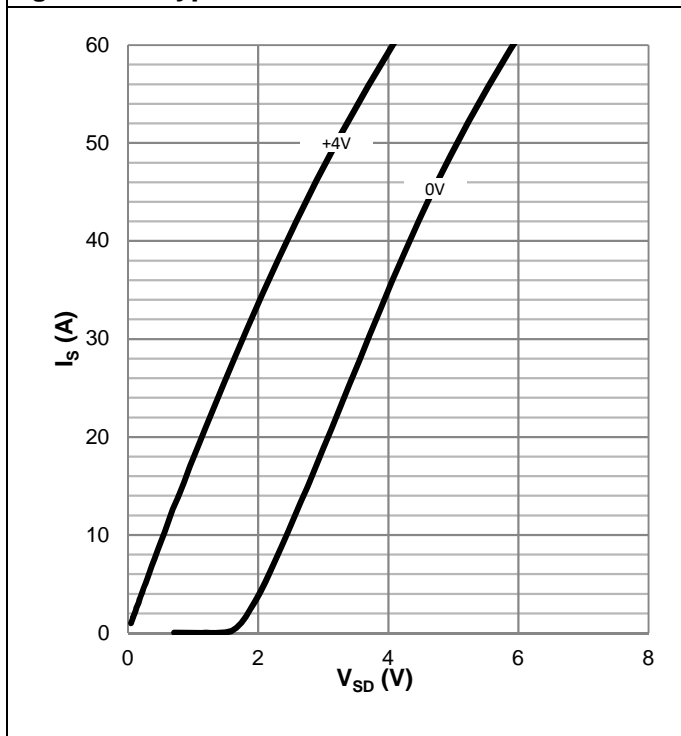
$V_{DS} = f(I_D, V_{GS}); T_j = 25 \text{ }^\circ\text{C}$

Figure 16 Typ. channel reverse characteristics



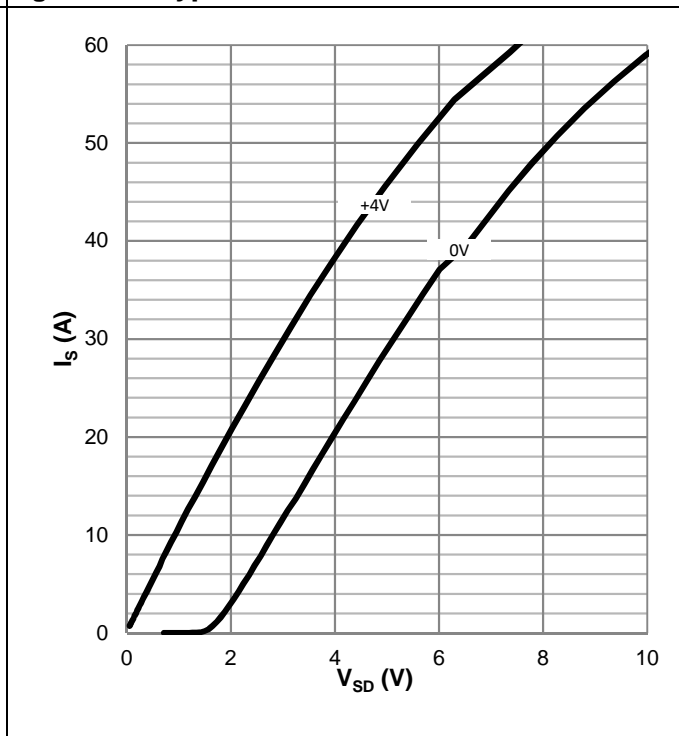
$V_{DS} = f(I_D, V_{GS}); T_j = 125 \text{ }^\circ\text{C}$

Figure 17 Typ. channel reverse characteristics



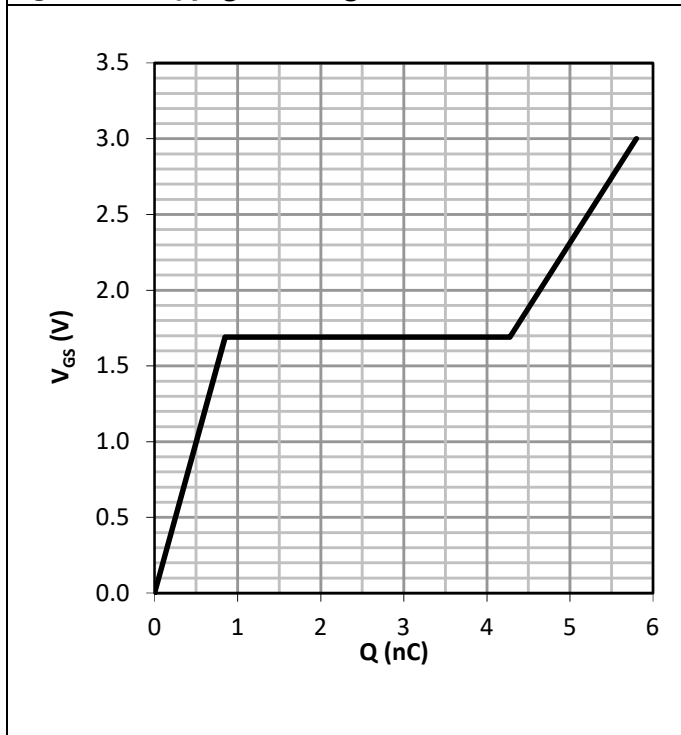
$I_D = f(V_{DS}, V_{GS}); T_j = 25\text{ °C}$

Figure 18 Typ. channel reverse characteristics



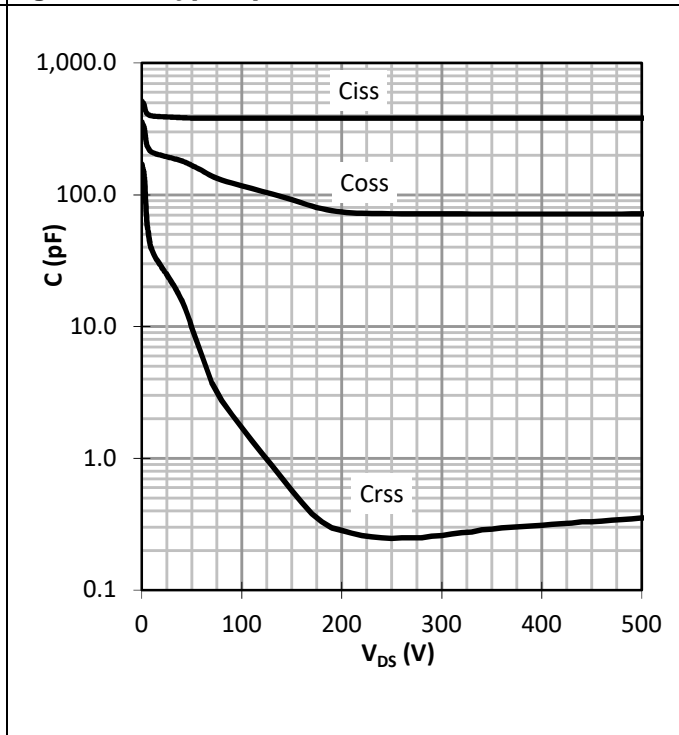
$I_D = f(V_{DS}, V_{GS}); T_j = 125\text{ °C}$

Figure 19 Typ. gate charge

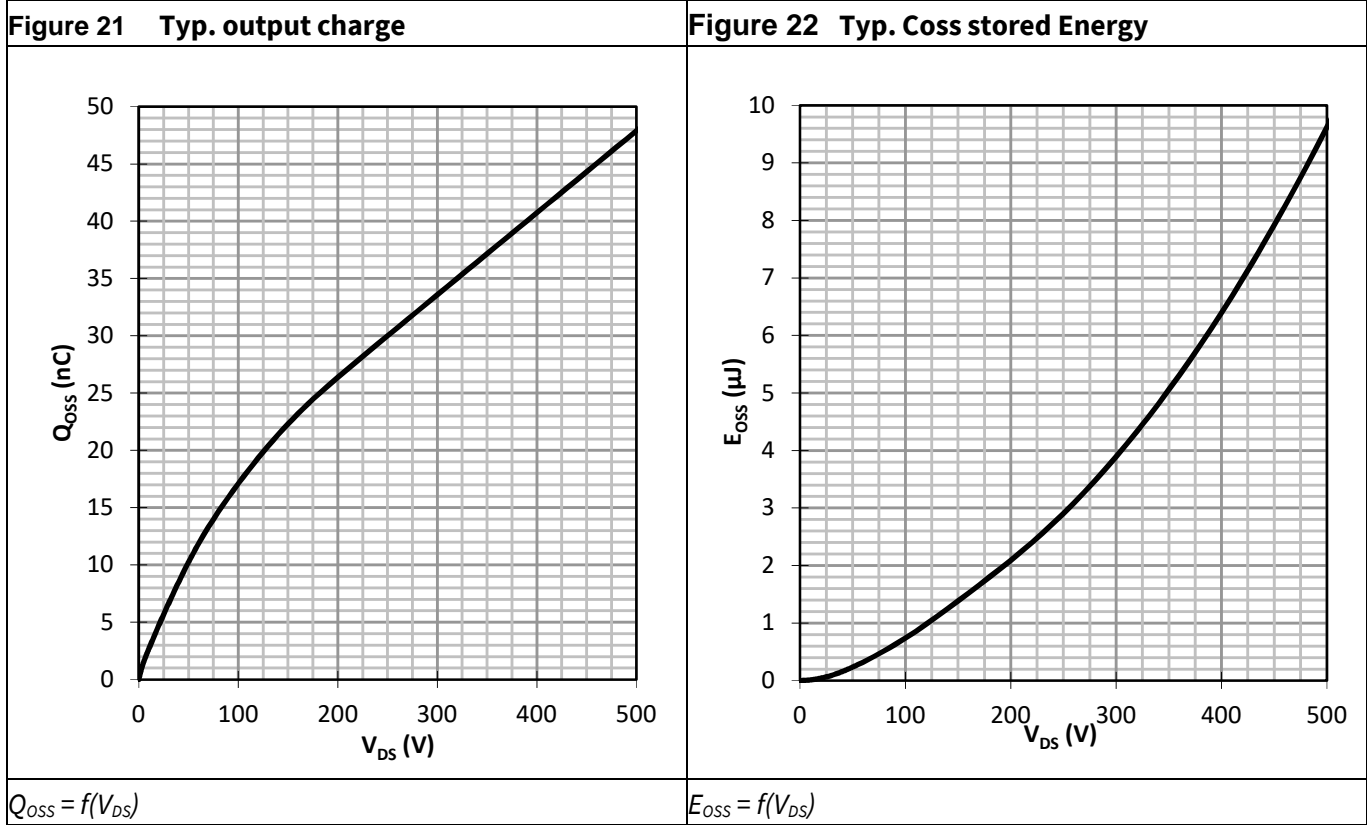


$V_{GS} = f(Q_G); V_{DCLINK} = 400\text{ V}; I_D = 8\text{ A}$

Figure 20 Typ. capacitances

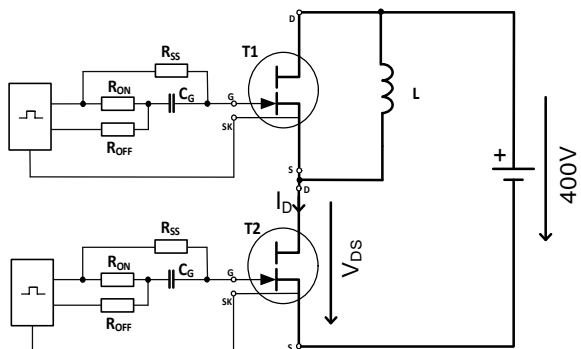


$C_{xSS} = f(V_{DS})$



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

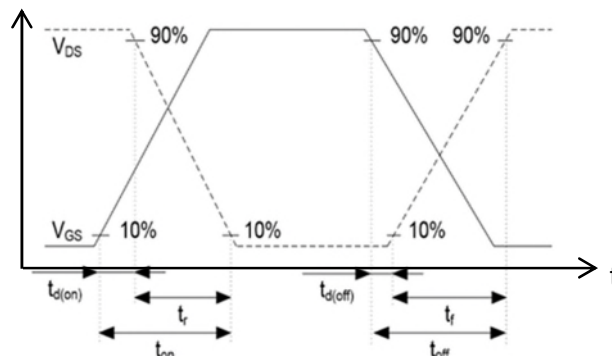
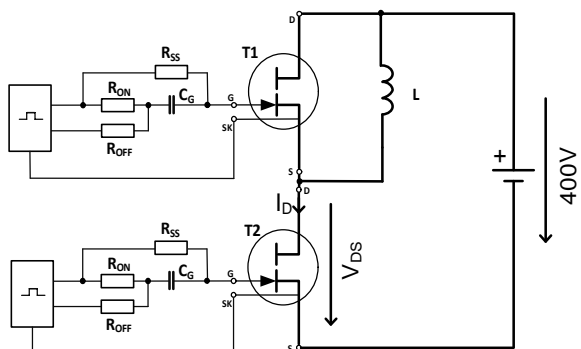
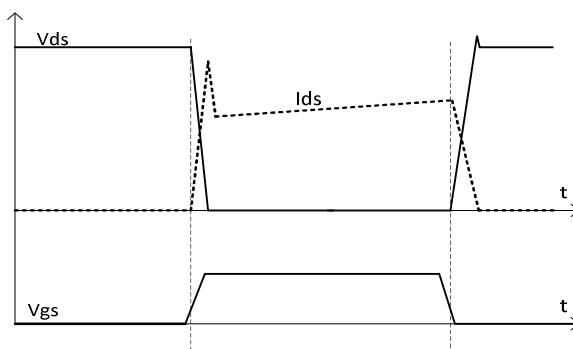


Figure 25 Reverse Channel Characteristics Test



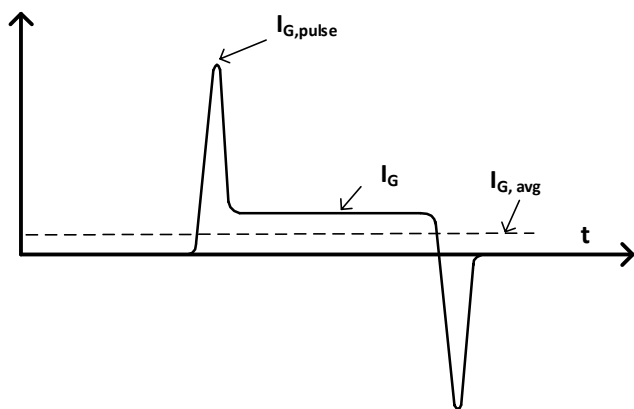
$I_D = 8A$, $R_{ON} = 5\ \Omega$; $R_{OFF} = 5\ \Omega$; $R_{SS} = 300\ \Omega$;
 $C_G = 3.3\ nF$; $V_{DRV} = 12V$

Figure 26 Typical Reverse Channel Recovery



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

Figure 27 Gate current switching waveform



7 Appendix A

Table 9 Related links

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

8 Revision History

Major changes since the last revision

| Revision | Date | Description of changes |
|----------|------------|---|
| 2.0 | 2018-04-24 | Final version release |
| 2.1 | 2018-07-23 | Updated DSO-20-87 package outline drawing in page14 |
| 2.11 | 2018-10-12 | Updated application section; added Appendix A and Fig. 27; updated maximum rating table footnotes, switching times and figures |
| 2.12 | 2020-01-16 | Added $V_{DS,dd}$, $V_{DS,pulse}$, $V_{DS,surge}$ specifications in maximum ratings table of page3 |
| 2.13 | 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 |
| 2.14 | 2021-10-26 | Replaced I_{GSS} specification with $V_{GS,clamp}$ in table 5 |

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