

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 $R_{DS(on)} * E_{oss}$ and $R_{DS(on)} * Q_g$.
- 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 4th 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 $R_{DS(on)} * Q_g$ 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 115mm² footprint, whereas previous BIC C7 600V was 40mΩ in 150mm² D²PAK 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

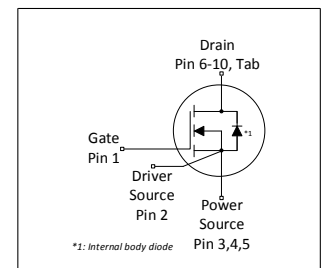
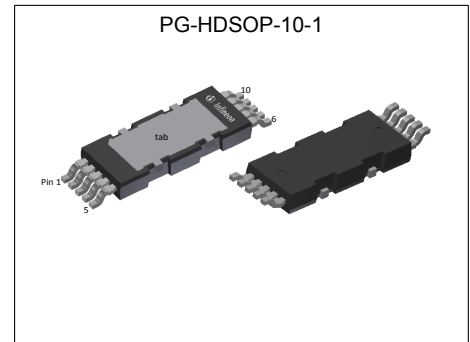
Fully qualified according to JEDEC for Industrial Applications

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 |
| $R_{DS(on),max}$ | 50 | mΩ |
| $Q_{g,typ}$ | 68 | nC |
| $I_{D,pulse}$ | 135 | A |
| $I_{D,continuous} @ T_j < 150^{\circ}C$ | 57 | A |
| $E_{oss@400V}$ | 8.14 | μJ |
| Body diode di/dt | 870 | A/μs |

| Type / Ordering Code | Package | Marking | Related Links |
|----------------------|-------------|----------|----------------|
| IPDD60R050G7 | PG-HDSOP-10 | 60R050G7 | see Appendix A |



RoHS

Table of Contents

| | |
|---|----|
| Description | 1 |
| Maximum ratings | 3 |
| Thermal characteristics | 4 |
| Electrical characteristics | 5 |
| Electrical characteristics diagrams | 7 |
| Test Circuits | 11 |
| Package Outlines | 12 |
| Appendix A | 13 |
| Revision History | 14 |
| Trademarks | 14 |
| Disclaimer | 14 |

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 ¹⁾ | I_D | - | - | 47 30 | A | $T_C=25^\circ\text{C}$ $T_C=100^\circ\text{C}$ |
| Pulsed drain current ²⁾ | $I_{D,pulse}$ | - | - | 135 | A | $T_C=25^\circ\text{C}$ |
| Avalanche energy, single pulse | E_{AS} | - | - | 159 | mJ | $I_D=6.4\text{A}$; $V_{DD}=50\text{V}$; see table 10 |
| Avalanche energy, repetitive | E_{AR} | - | - | 0.80 | mJ | $I_D=6.4\text{A}$; $V_{DD}=50\text{V}$; see table 10 |
| Avalanche current, single pulse | I_{AS} | - | - | 6.4 | 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} | - | - | 278 | 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 | - | - | 47 | A | $T_C=25^\circ\text{C}$ |
| Diode pulse current ²⁾ | $I_{S,pulse}$ | - | - | 135 | A | $T_C=25^\circ\text{C}$ |
| Reverse diode dv/dt ³⁾ | dv/dt | - | - | 25 | V/ns | $V_{DS}=0\dots400\text{V}$, $I_{SD}\leq 9.9\text{A}$, $T_j=25^\circ\text{C}$ see table 8 |
| Maximum diode commutation speed | di/dt | - | - | 870 | A/ μs | $V_{DS}=0\dots400\text{V}$, $I_{SD}\leq 9.9\text{A}$, $T_j=25^\circ\text{C}$ see table 8 |
| Insulation withstand voltage | V_{ISO} | - | - | n.a. | V | V_{rms} , $T_C=25^\circ\text{C}$, $t=1\text{min}$ |

¹⁾ Limited by $T_{j,max}$

²⁾ Pulse width t_p limited by $T_{j,max}$

³⁾ 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} | - | - | 0.45 | °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 ² (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 | $V_{DS}=V_{GS}$, $I_D=0.8\text{mA}$ |
| Zero gate voltage drain current | I_{DSS} | - | - | 1 | μA | $V_{DS}=600\text{V}$, $V_{GS}=0\text{V}$, $T_j=25^\circ\text{C}$ $V_{DS}=600\text{V}$, $V_{GS}=0\text{V}$, $T_j=150^\circ\text{C}$ |
| Gate-source leakage current | I_{GSS} | - | - | 100 | nA | $V_{GS}=20\text{V}$, $V_{DS}=0\text{V}$ |
| Drain-source on-state resistance | $R_{DS(on)}$ | - | 0.043 0.108 | 0.050 - | Ω | $V_{GS}=10\text{V}$, $I_D=15.9\text{A}$, $T_j=25^\circ\text{C}$ $V_{GS}=10\text{V}$, $I_D=15.9\text{A}$, $T_j=150^\circ\text{C}$ |
| Gate resistance | R_G | - | 0.8 | - | Ω | $f=1\text{MHz}$, open drain |

Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|--|--------------|--------|------|------|------|--|
| | | Min. | Typ. | Max. | | |
| Input capacitance | C_{iss} | - | 2670 | - | pF | $V_{GS}=0\text{V}$, $V_{DS}=400\text{V}$, $f=250\text{kHz}$ |
| Output capacitance | C_{oss} | - | 55 | - | pF | $V_{GS}=0\text{V}$, $V_{DS}=400\text{V}$, $f=250\text{kHz}$ |
| Effective output capacitance, energy related ¹⁾ | $C_{o(er)}$ | - | 102 | - | pF | $V_{GS}=0\text{V}$, $V_{DS}=0\dots400\text{V}$ |
| Effective output capacitance, time related ²⁾ | $C_{o(tr)}$ | - | 1050 | - | pF | $I_D=\text{constant}$, $V_{GS}=0\text{V}$, $V_{DS}=0\dots400\text{V}$ |
| Turn-on delay time | $t_{d(on)}$ | - | 22 | - | ns | $V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=15.9\text{A}$, $R_G=3.3\Omega$; see table 9 |
| Rise time | t_r | - | 6 | - | ns | $V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=15.9\text{A}$, $R_G=3.3\Omega$; see table 9 |
| Turn-off delay time | $t_{d(off)}$ | - | 72 | - | ns | $V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=15.9\text{A}$, $R_G=3.3\Omega$; see table 9 |
| Fall time | t_f | - | 3 | - | ns | $V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=15.9\text{A}$, $R_G=3.3\Omega$; see table 9 |

Table 6 Gate charge characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-----------------------|---------------|--------|------|------|------|--|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | Q_{gs} | - | 13 | - | nC | $V_{DD}=400\text{V}$, $I_D=15.9\text{A}$, $V_{GS}=0$ to 10V |
| Gate to drain charge | Q_{gd} | - | 24 | - | nC | $V_{DD}=400\text{V}$, $I_D=15.9\text{A}$, $V_{GS}=0$ to 10V |
| Gate charge total | Q_g | - | 68 | - | nC | $V_{DD}=400\text{V}$, $I_D=15.9\text{A}$, $V_{GS}=0$ to 10V |
| Gate plateau voltage | $V_{plateau}$ | - | 5.0 | - | V | $V_{DD}=400\text{V}$, $I_D=15.9\text{A}$, $V_{GS}=0$ 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} | - | 0.8 | - | V | $V_{GS}=0V, I_F=15.9A, T_j=25^{\circ}C$ |
| Reverse recovery time | t_{rr} | - | 370 | - | ns | $V_R=400V, I_F=15.9A, di_F/dt=100A/\mu s$; see table 8 |
| Reverse recovery charge | Q_{rr} | - | 5.8 | - | μC | $V_R=400V, I_F=15.9A, di_F/dt=100A/\mu s$; see table 8 |
| Peak reverse recovery current | I_{rrm} | - | 33 | - | A | $V_R=400V, I_F=15.9A, di_F/dt=100A/\mu s$; see table 8 |

4 Electrical characteristics diagrams

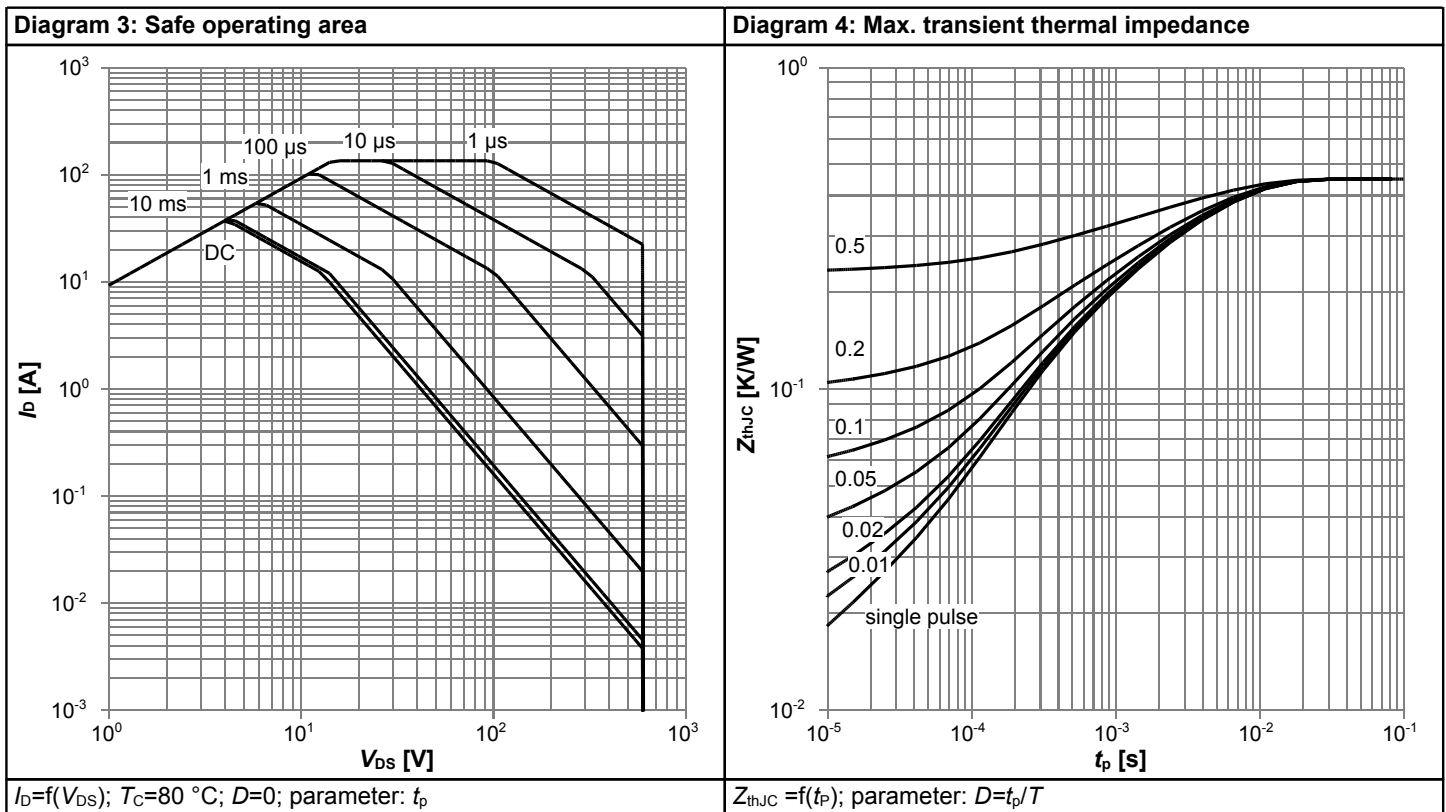
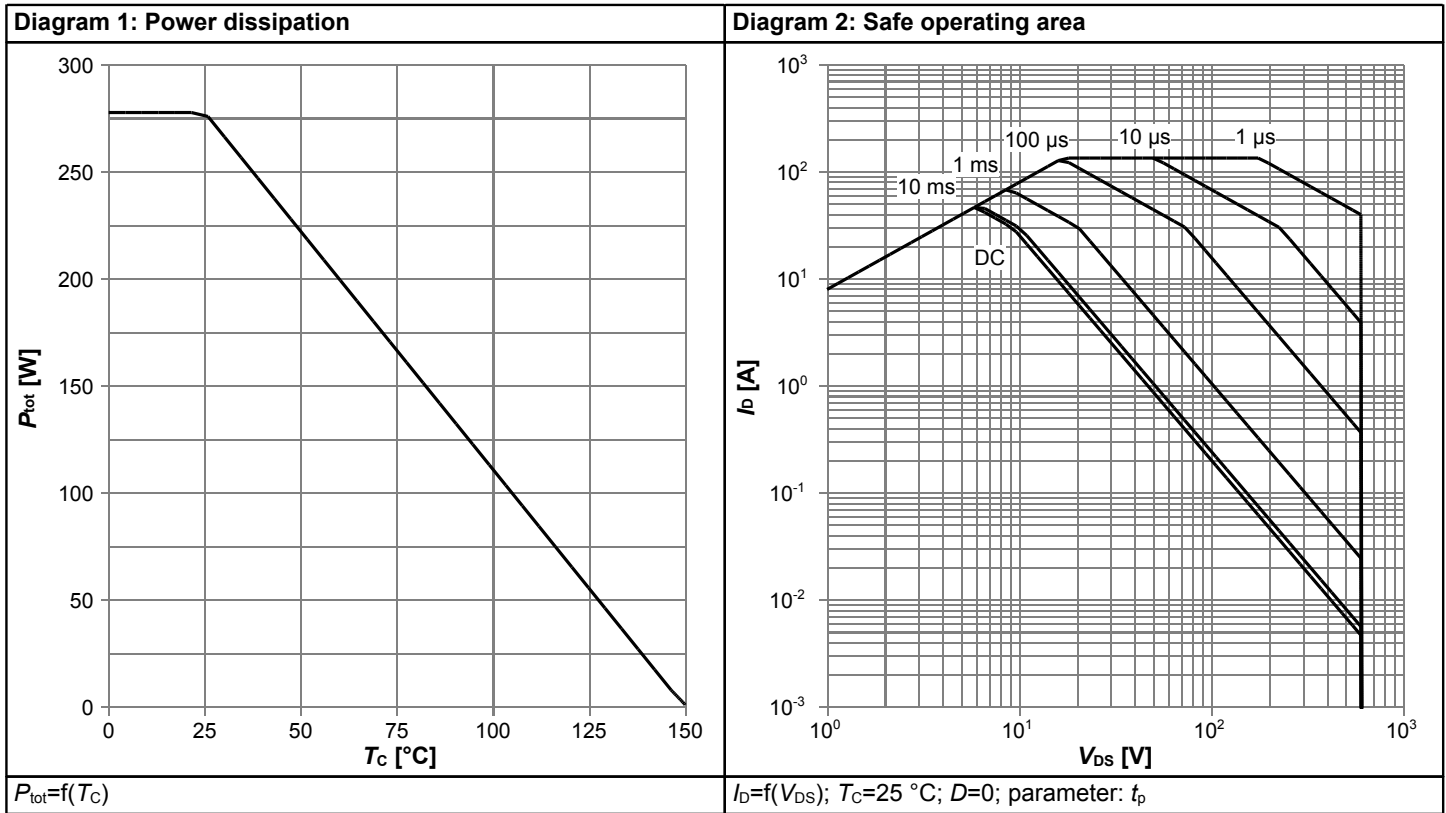
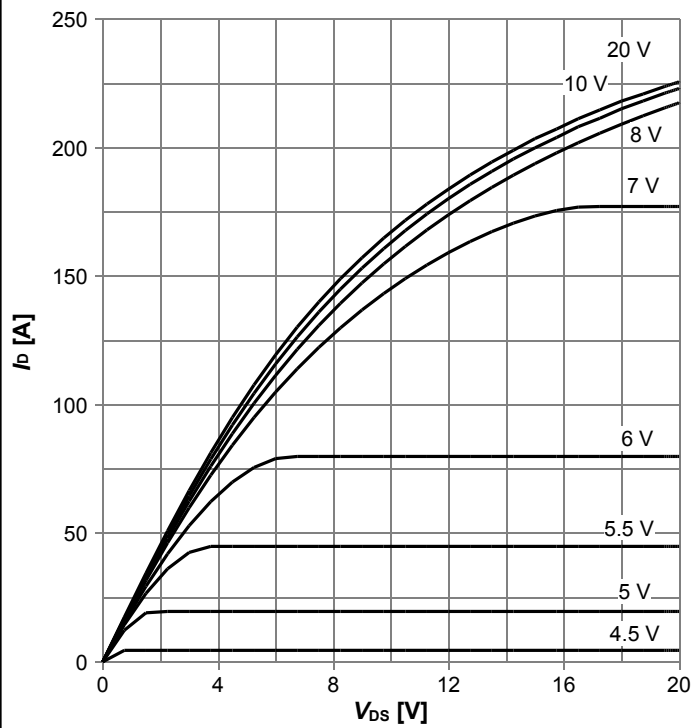
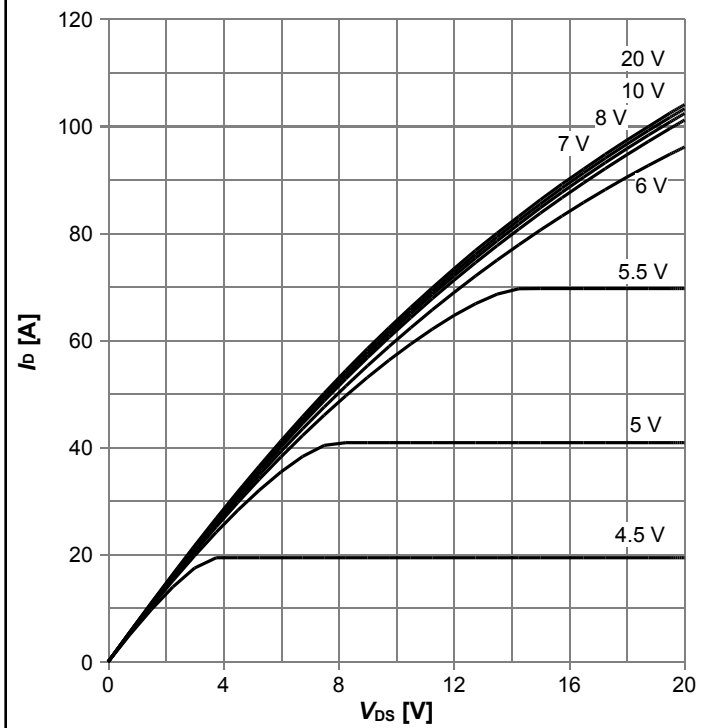


Diagram 5: Typ. output characteristics



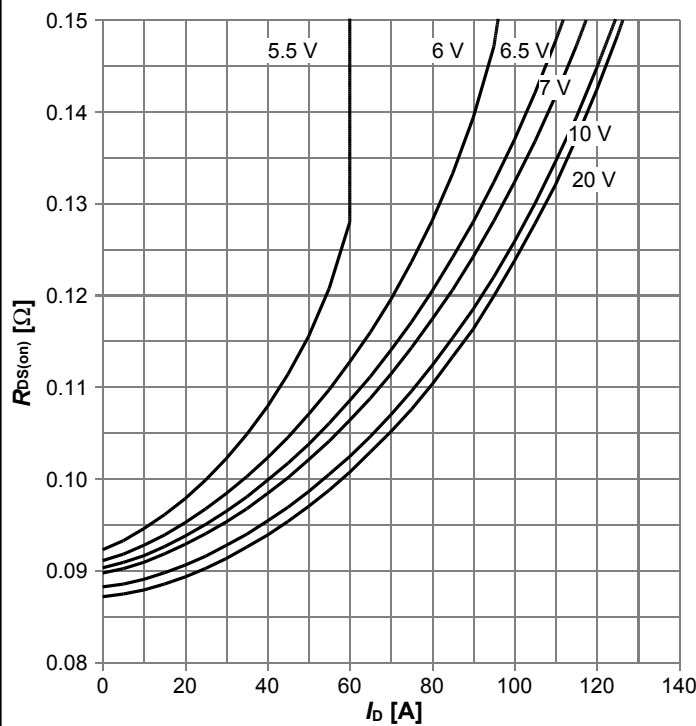
$I_D = f(V_{DS})$; $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 6: Typ. output characteristics



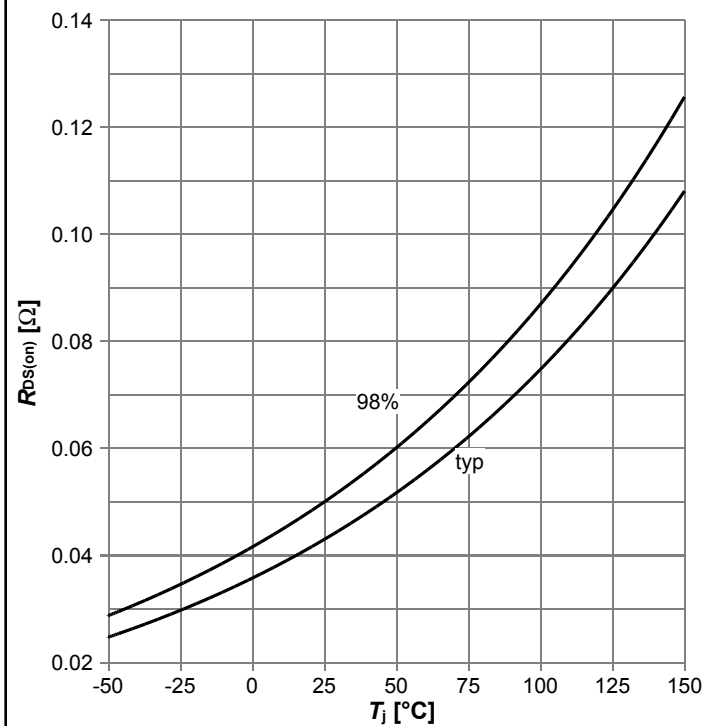
$I_D = f(V_{DS})$; $T_j = 125^\circ\text{C}$; parameter: V_{GS}

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



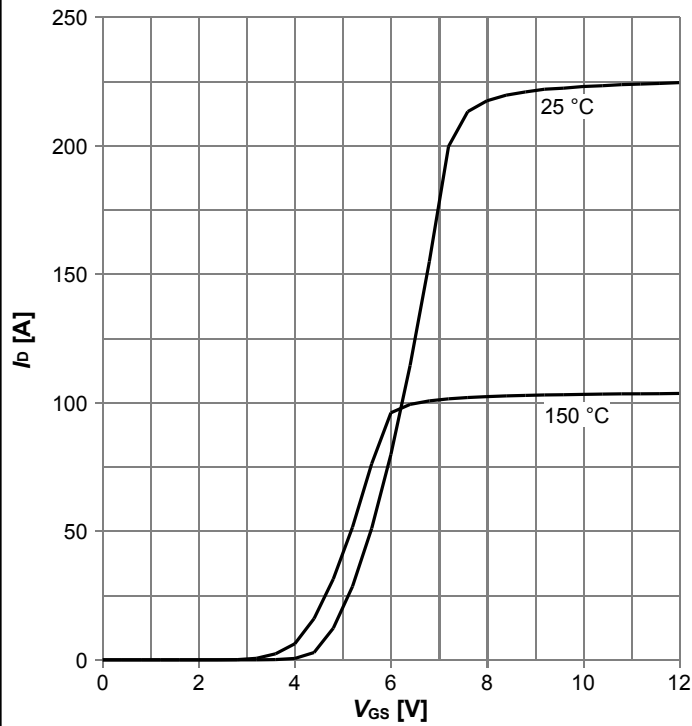
$R_{DS(on)} = f(I_D)$; $T_j = 125^\circ\text{C}$; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



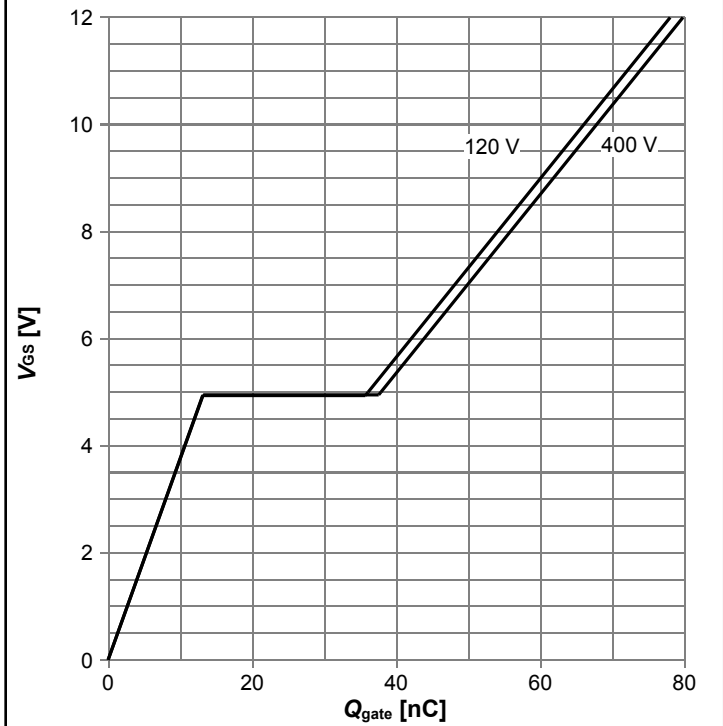
$R_{DS(on)} = f(T_j)$; $I_D = 15.9\text{ A}$; $V_{GS} = 10\text{ V}$

Diagram 9: Typ. transfer characteristics



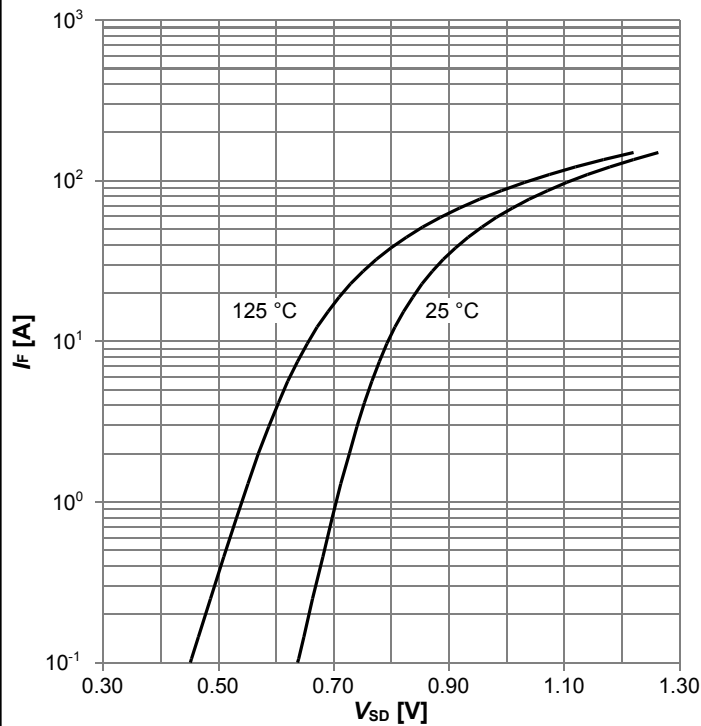
$I_D = f(V_{GS})$; $V_{DS} = 20V$; parameter: T_j

Diagram 10: Typ. gate charge



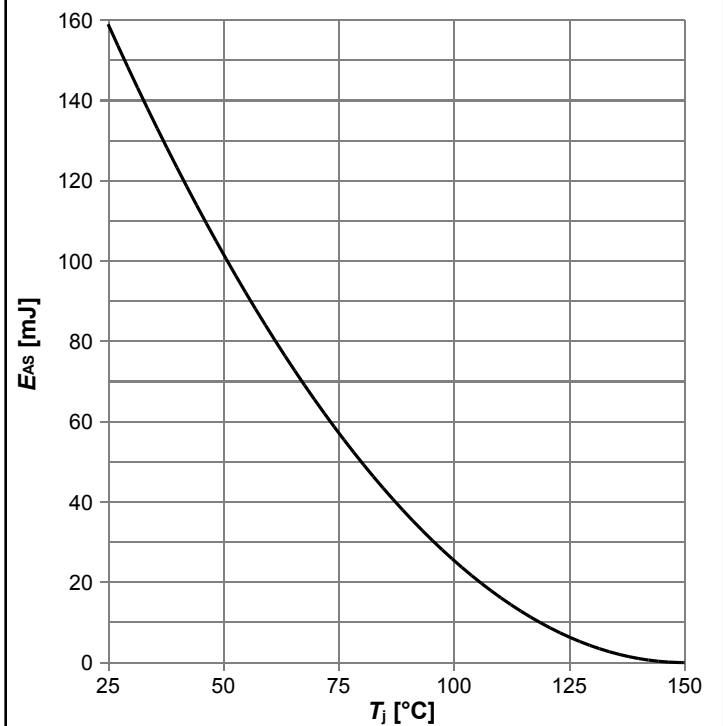
$V_{GS} = f(Q_{gate})$; $I_D = 15.9$ A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



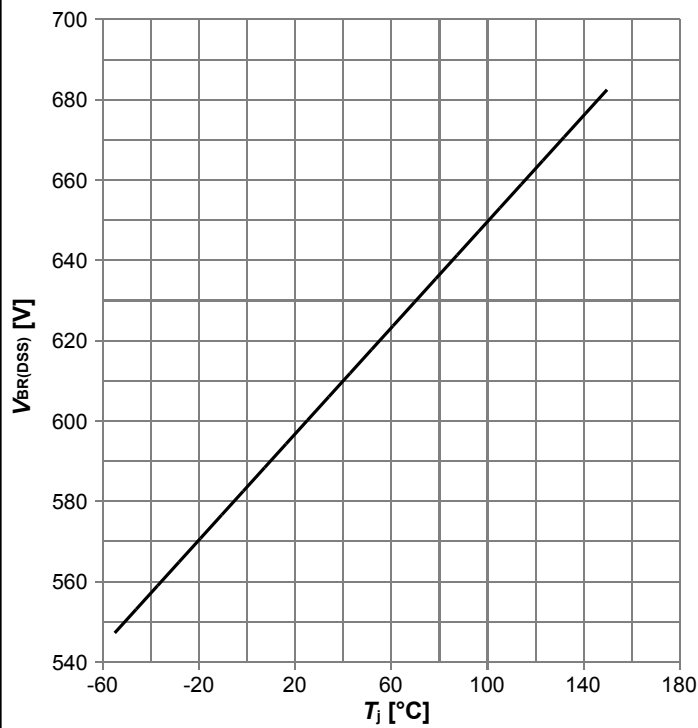
$I_F = f(V_{SD})$; parameter: T_j

Diagram 12: Avalanche energy



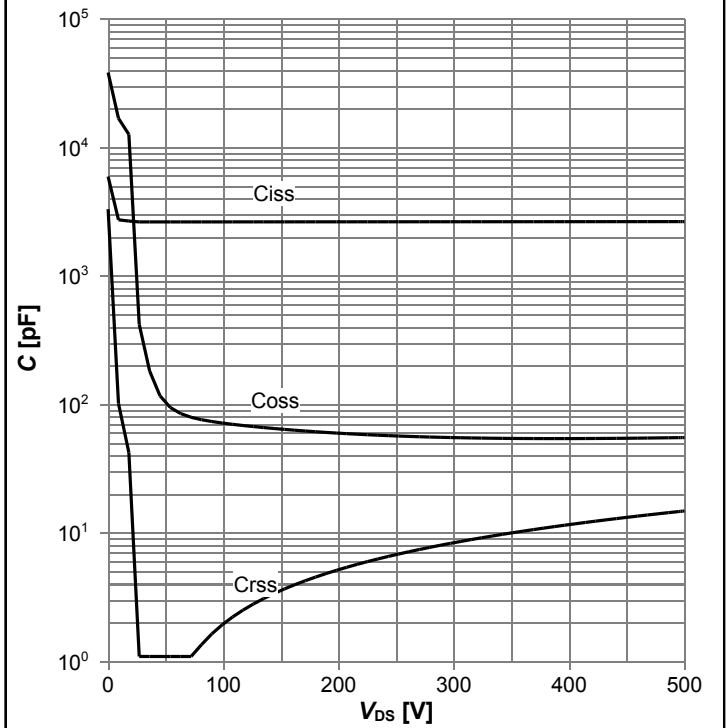
$E_{AS} = f(T_j)$; $I_D = 6.4$ A; $V_{DD} = 50$ V

Diagram 13: Drain-source breakdown voltage



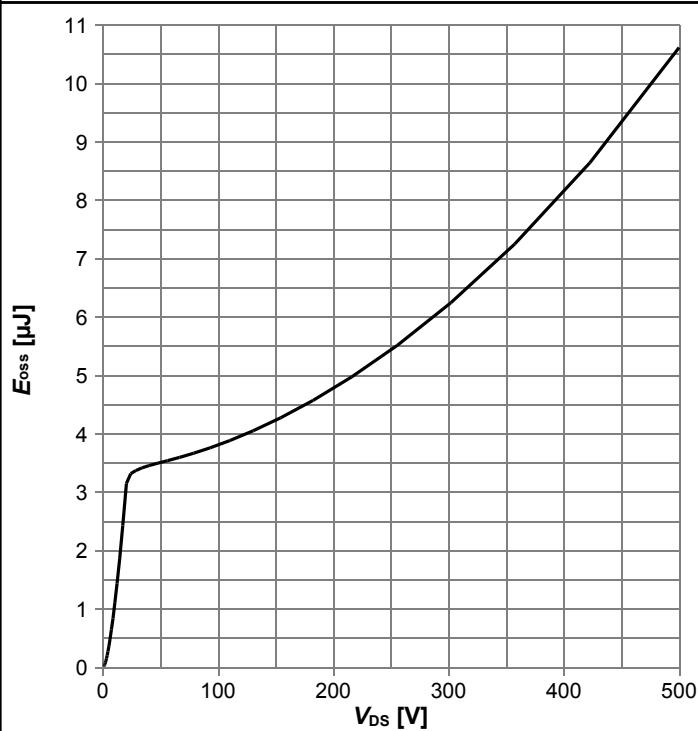
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$

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



Table 9 Switching times



Table 10 Unclamped inductive load



6 Package Outlines

PG-HDSOP-10-1

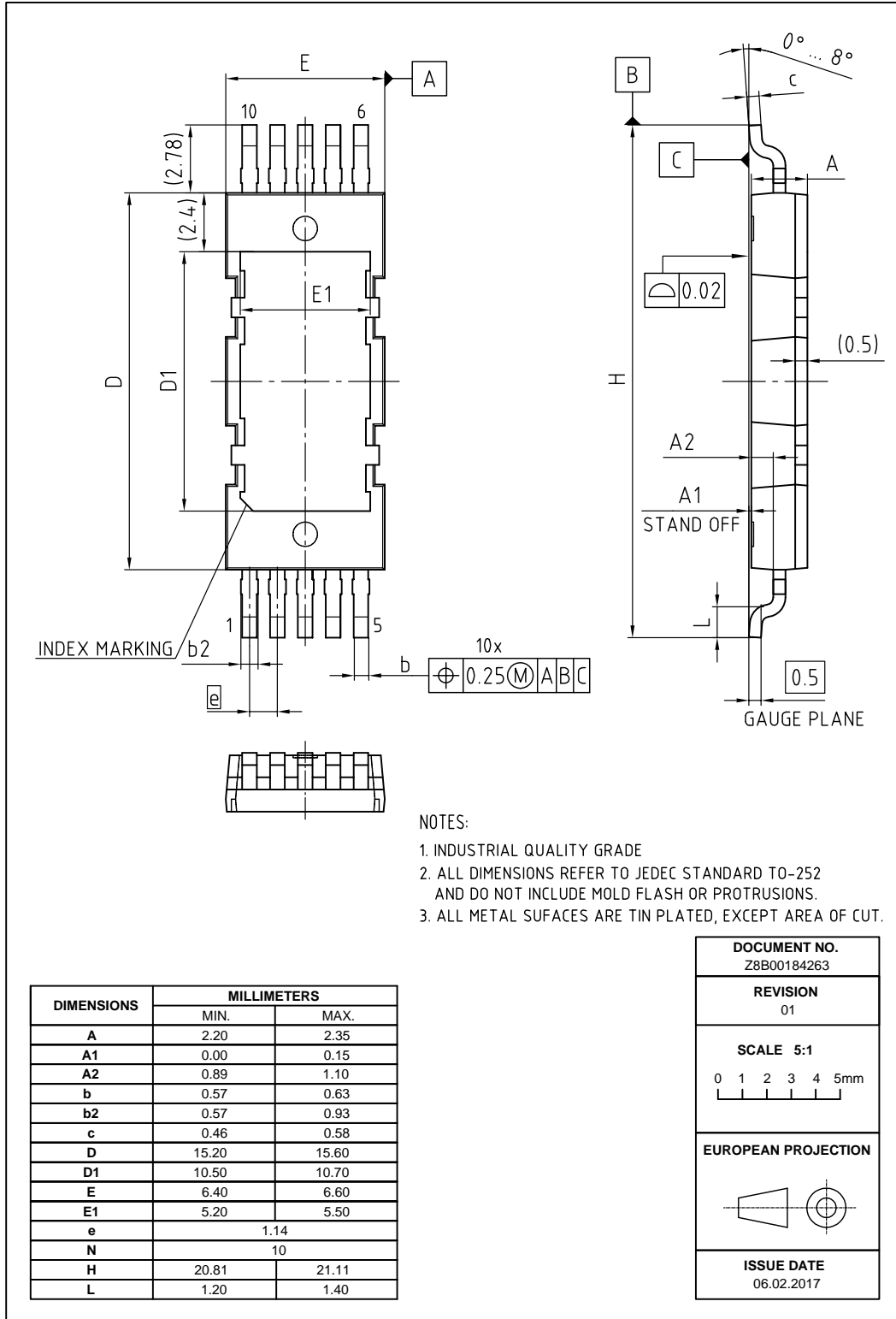


Figure 1 Outline PG-HDSOP-10, dimensions in mm/inches

7 Appendix A

Table 11 Related Links

- IFX CoolMOS™ G7 Webpage: www.infineon.com
- IFX CoolMOS™ G7 application note: www.infineon.com
- IFX CoolMOS™ G7 simulation model: www.infineon.com
- IFX Design tools: www.infineon.com

Revision History

IPDD60R050G7

Revision: 2020-12-15, Rev. 2.2

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 |
| 2.2 | 2020-12-15 | General update of diagrams |

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