

MOSFET

600V CoolMOS™ G7 Power Transistor

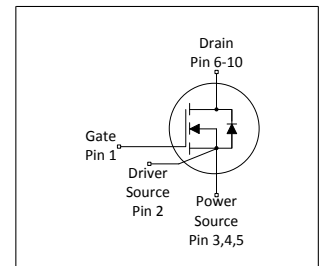
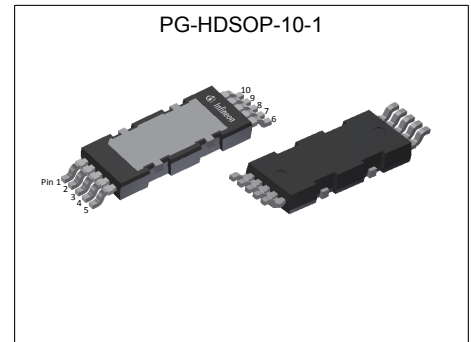
The C7 GOLD series (G7) for the first time brings together the benefits of the C7 GOLD CoolMOS™ technology, 4 pin Kelvin Source capability and the improved thermal properties of the DDPACK package to enable a possible SMD solution for high current topologies such as PFC up to 3kW.

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.
- DDPACK package has inbuilt 4th pin Kelvin Source configuration and low parasitic source inductance (~3nH).
- DDPACK package is MSL1 compliant, total Pb-free, has easy visual inspection leads and is qualified for industrial applications according to JEDEC 47/20/22.
- DDPACK 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 DDPACK 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.
- DDPACK package is easy to use and has the highest quality standards.
- Improved thermals enable SMD DDPACK 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.

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

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	$V_{GS}=0V$, $I_D=1mA$
Gate threshold voltage	$V_{(GS)th}$	3	3.5	4	V	$V_{DS}=V_{GS}$, $I_D=0.8mA$
Zero gate voltage drain current	I_{DSS}	-	-	1	μA	$V_{DS}=600V$, $V_{GS}=0V$, $T_j=25^\circ\text{C}$ $V_{DS}=600V$, $V_{GS}=0V$, $T_j=150^\circ\text{C}$
Gate-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS}=20V$, $V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.043 0.108	0.050 -	Ω	$V_{GS}=10V$, $I_D=15.9A$, $T_j=25^\circ\text{C}$ $V_{GS}=10V$, $I_D=15.9A$, $T_j=150^\circ\text{C}$
Gate resistance	R_G	-	0.8	-	Ω	$f=1MHz$, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	2670	-	pF	$V_{GS}=0V$, $V_{DS}=400V$, $f=250kHz$
Output capacitance	C_{oss}	-	55	-	pF	$V_{GS}=0V$, $V_{DS}=400V$, $f=250kHz$
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$	-	102	-	pF	$V_{GS}=0V$, $V_{DS}=0...400V$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$	-	1050	-	pF	$I_D=\text{constant}$, $V_{GS}=0V$, $V_{DS}=0...400V$
Turn-on delay time	$t_{d(on)}$	-	22	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=15.9A$, $R_G=3.3\Omega$; see table 9
Rise time	t_r	-	6	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=15.9A$, $R_G=3.3\Omega$; see table 9
Turn-off delay time	$t_{d(off)}$	-	72	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=15.9A$, $R_G=3.3\Omega$; see table 9
Fall time	t_f	-	3	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=15.9A$, $R_G=3.3\Omega$; 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	$V_{DD}=400V$, $I_D=15.9A$, $V_{GS}=0$ to $10V$
Gate to drain charge	Q_{gd}	-	24	-	nC	$V_{DD}=400V$, $I_D=15.9A$, $V_{GS}=0$ to $10V$
Gate charge total	Q_g	-	68	-	nC	$V_{DD}=400V$, $I_D=15.9A$, $V_{GS}=0$ to $10V$
Gate plateau voltage	$V_{plateau}$	-	5.0	-	V	$V_{DD}=400V$, $I_D=15.9A$, $V_{GS}=0$ 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

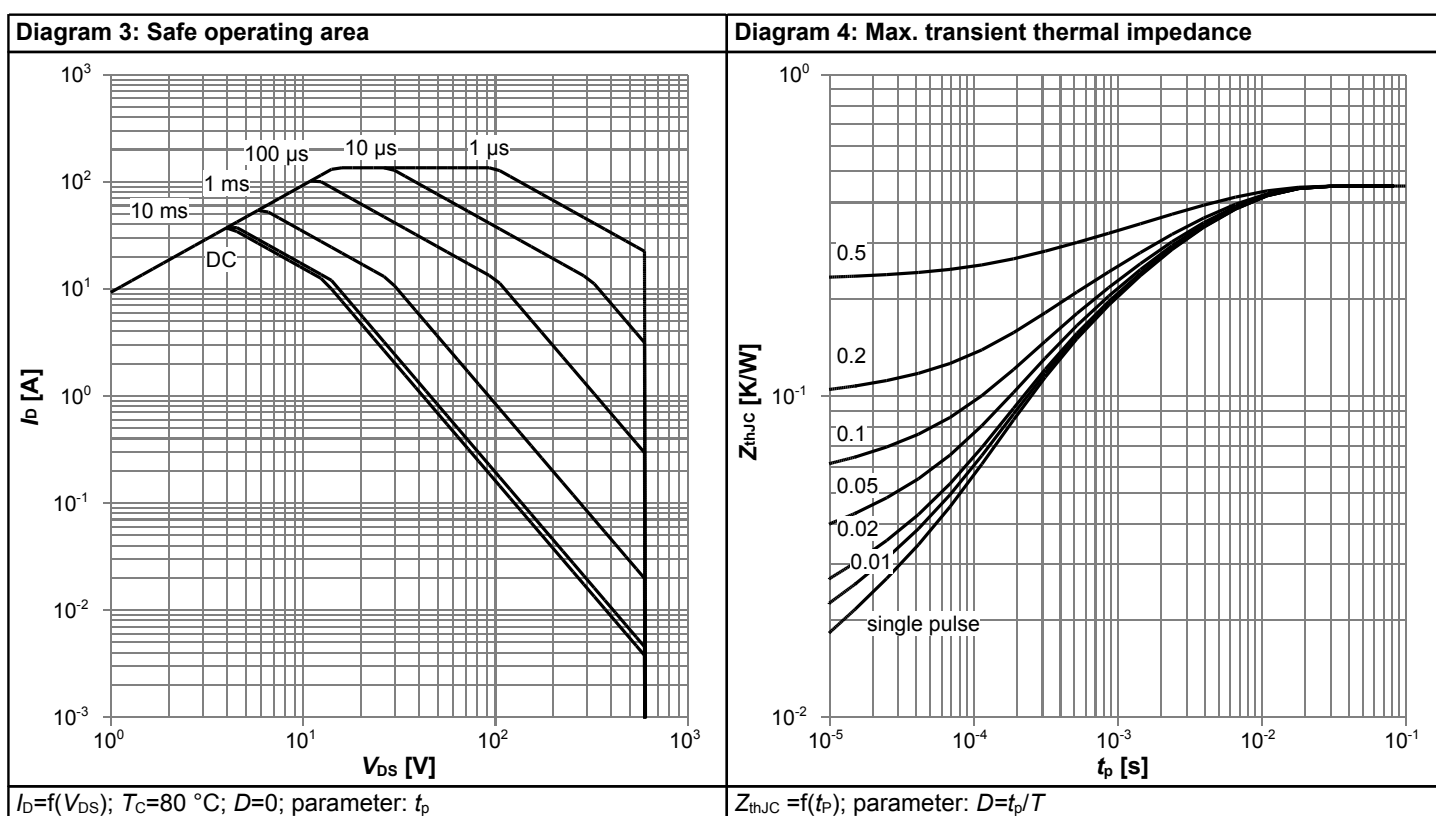
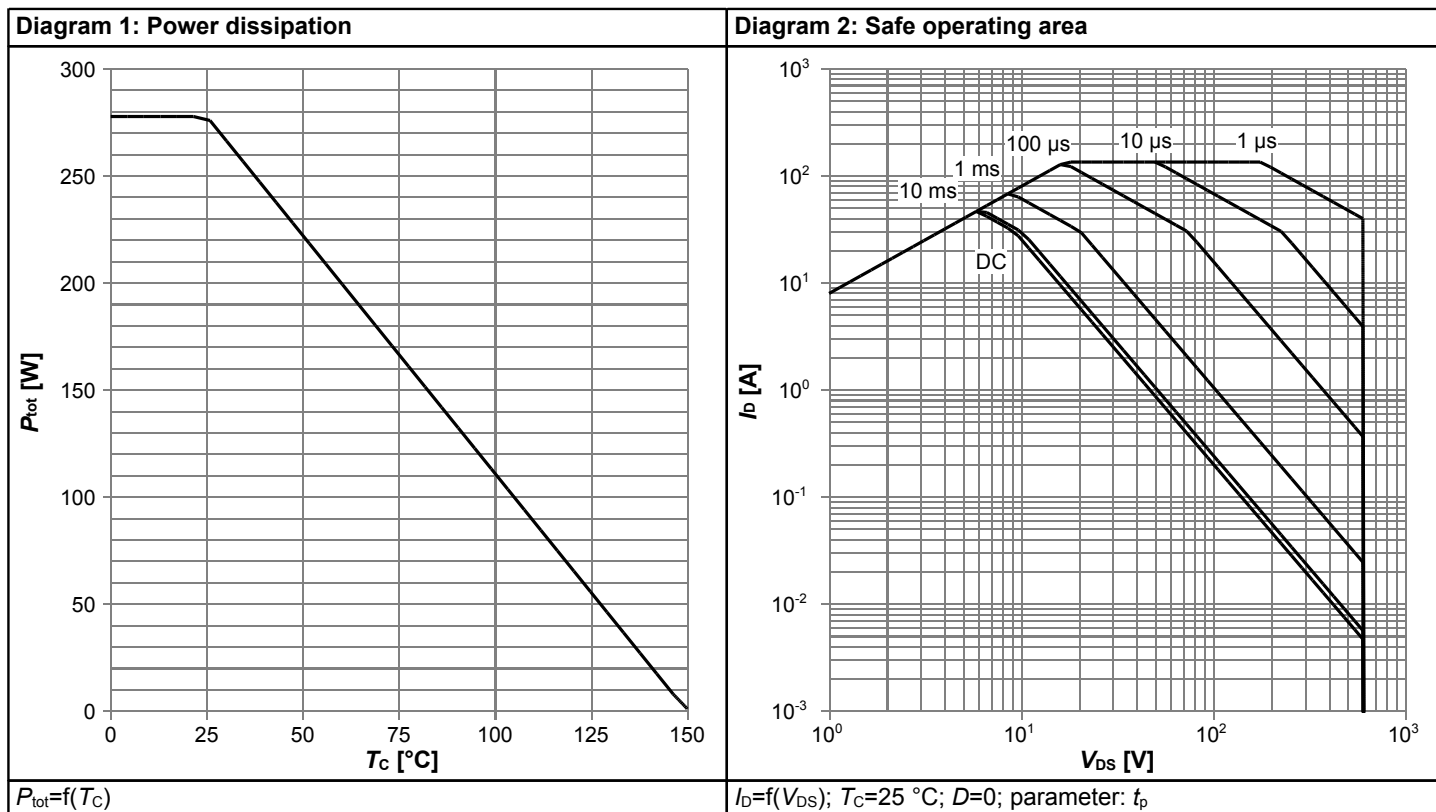
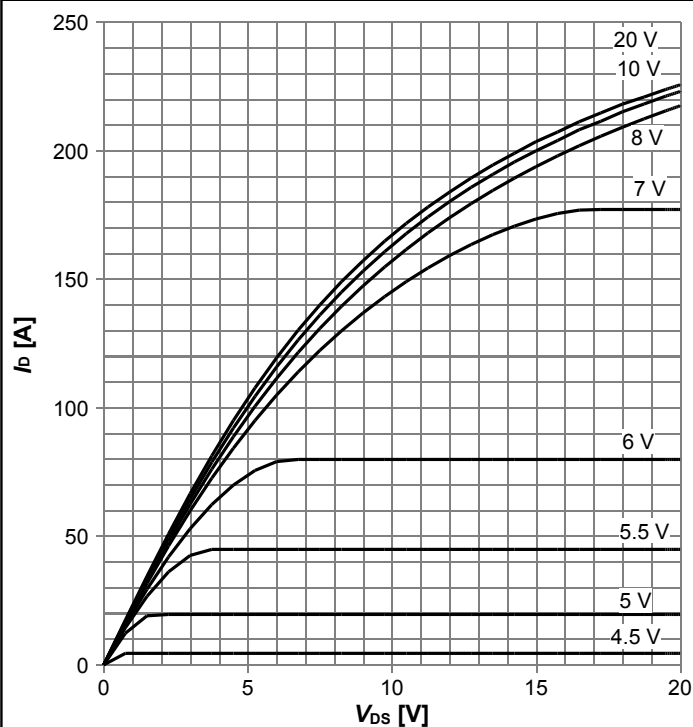
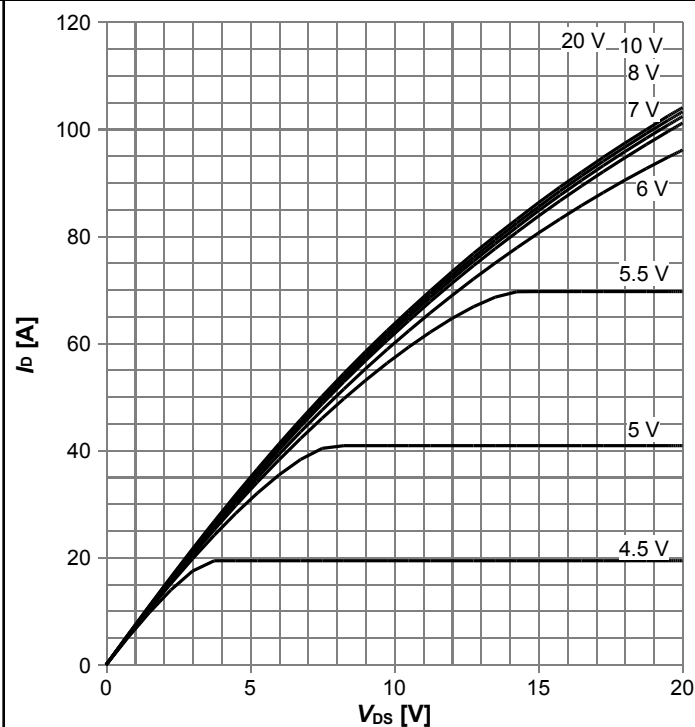


Diagram 5: Typ. output characteristics



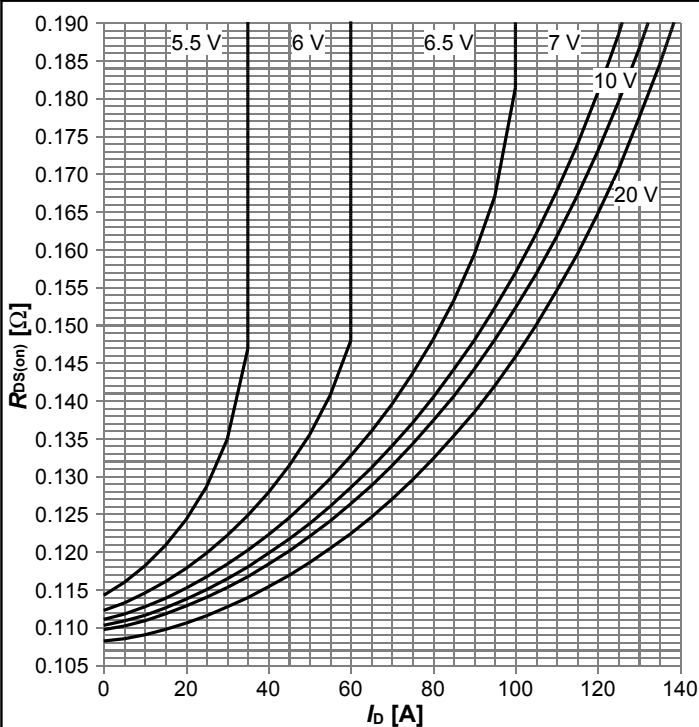
$I_D = f(V_{DS})$; $T_J = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 6: Typ. output characteristics



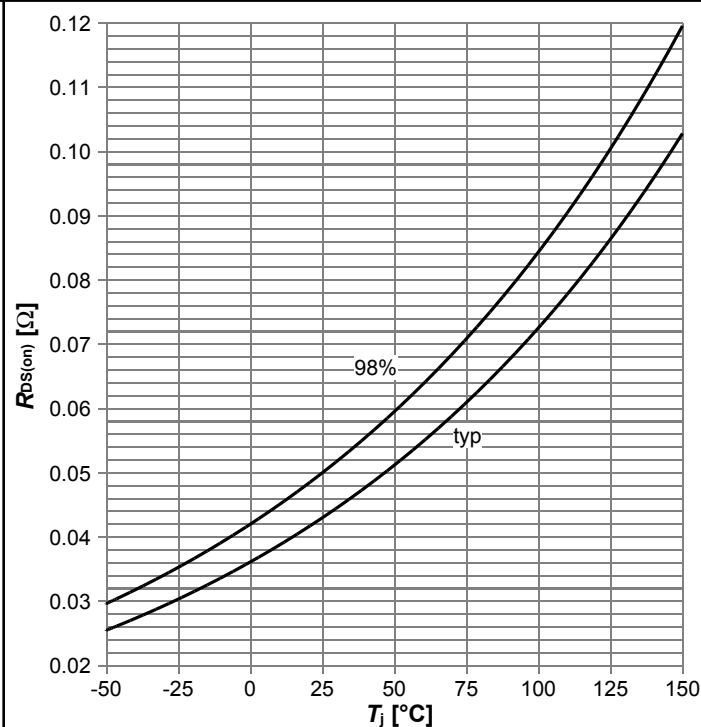
$I_D = f(V_{DS})$; $T_J = 125^\circ\text{C}$; parameter: V_{GS}

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



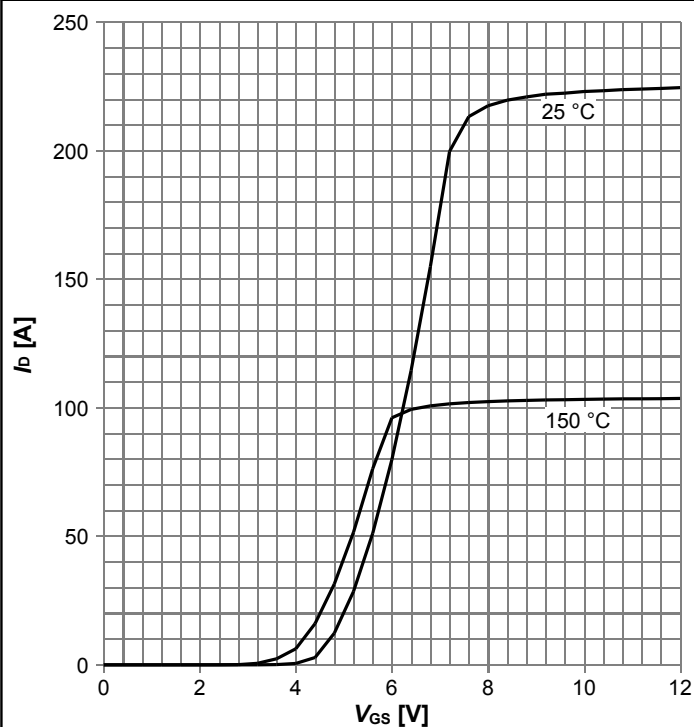
$R_{DS(on)} = f(I_D)$; $T_J = 125^\circ\text{C}$; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



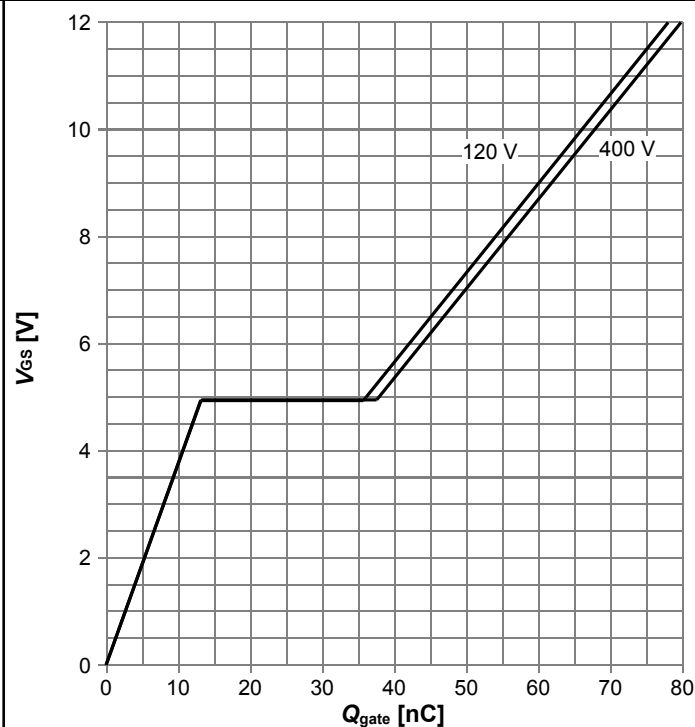
$R_{DS(on)} = f(T_J)$; $I_D = 15.9\text{ A}$; $V_{GS} = 10\text{ V}$

Diagram 9: Typ. transfer characteristics



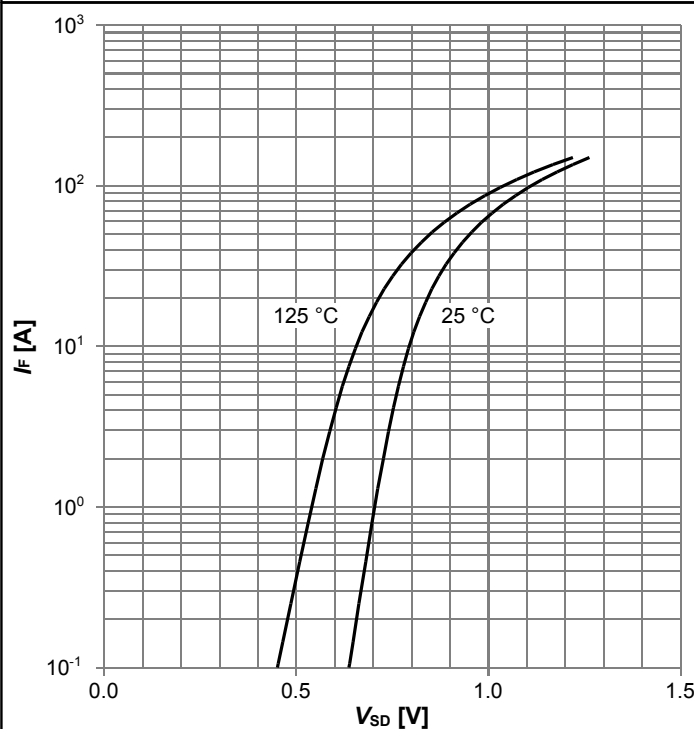
$I_D = f(V_{GS})$; $V_{DS} = 20V$; parameter: T_j

Diagram 10: Typ. gate charge



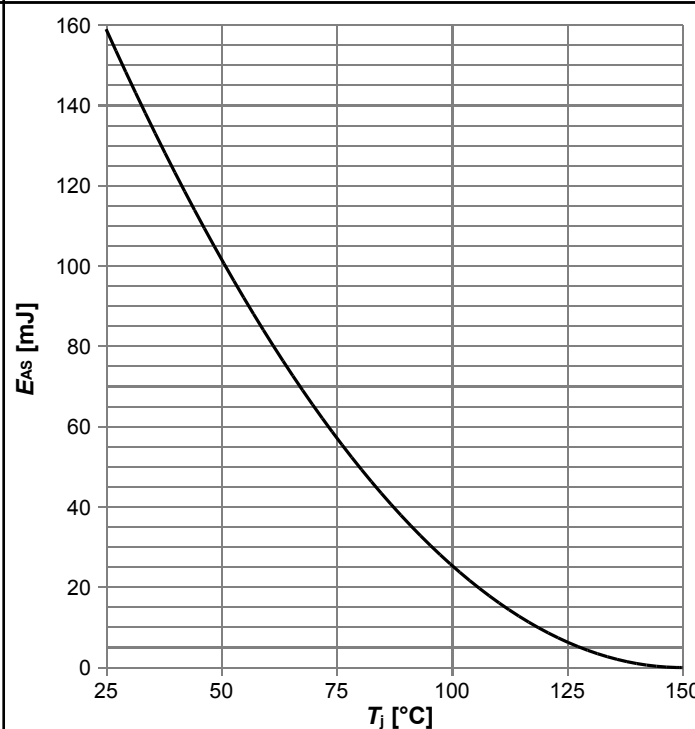
$V_{GS} = f(Q_{gate})$; $I_D = 15.9$ A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



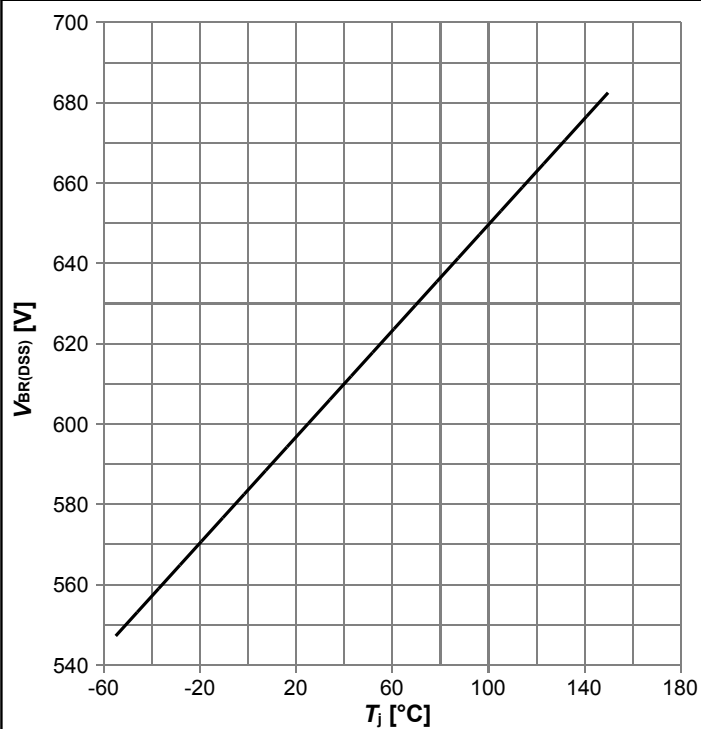
$I_F = f(V_{SD})$; parameter: T_j

Diagram 12: Avalanche energy



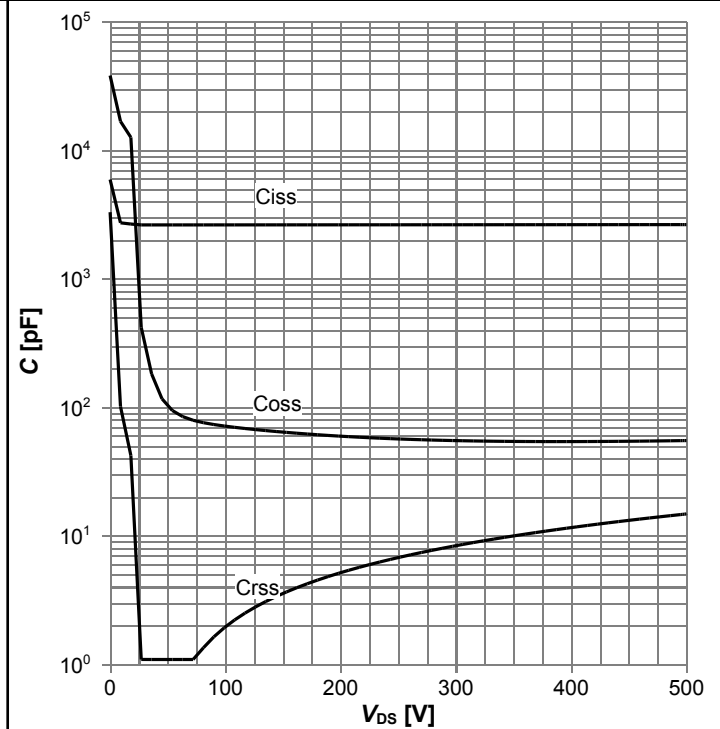
$E_{AS} = f(T_j)$; $I_D = 6.4$ A; $V_{DD} = 50$ V

Diagram 13: Drain-source breakdown voltage



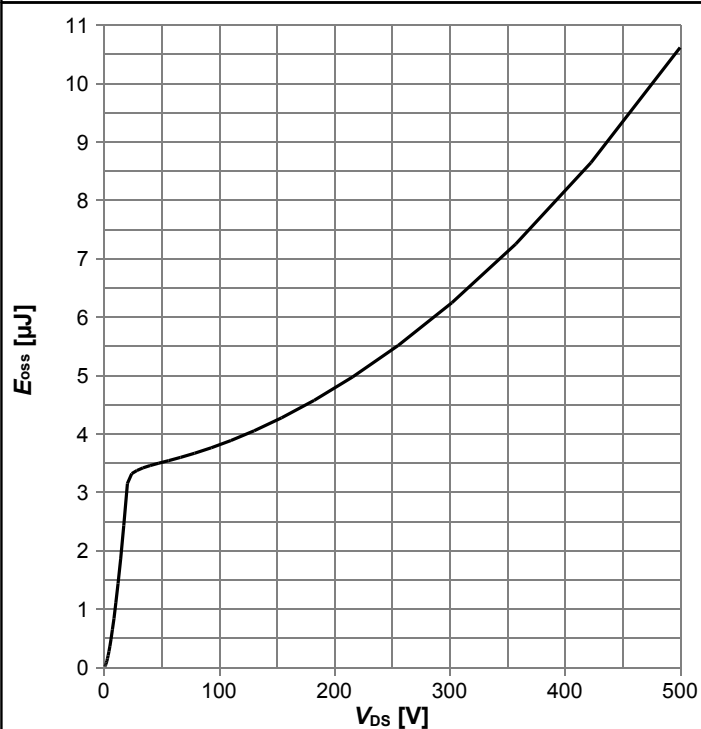
$V_{BR(DSS)} = f(T_J); I_D = 1 \text{ mA}$

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

Test circuit for diode characteristics	Diode recovery waveform
 $R_{g1} = R_{g2}$	

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

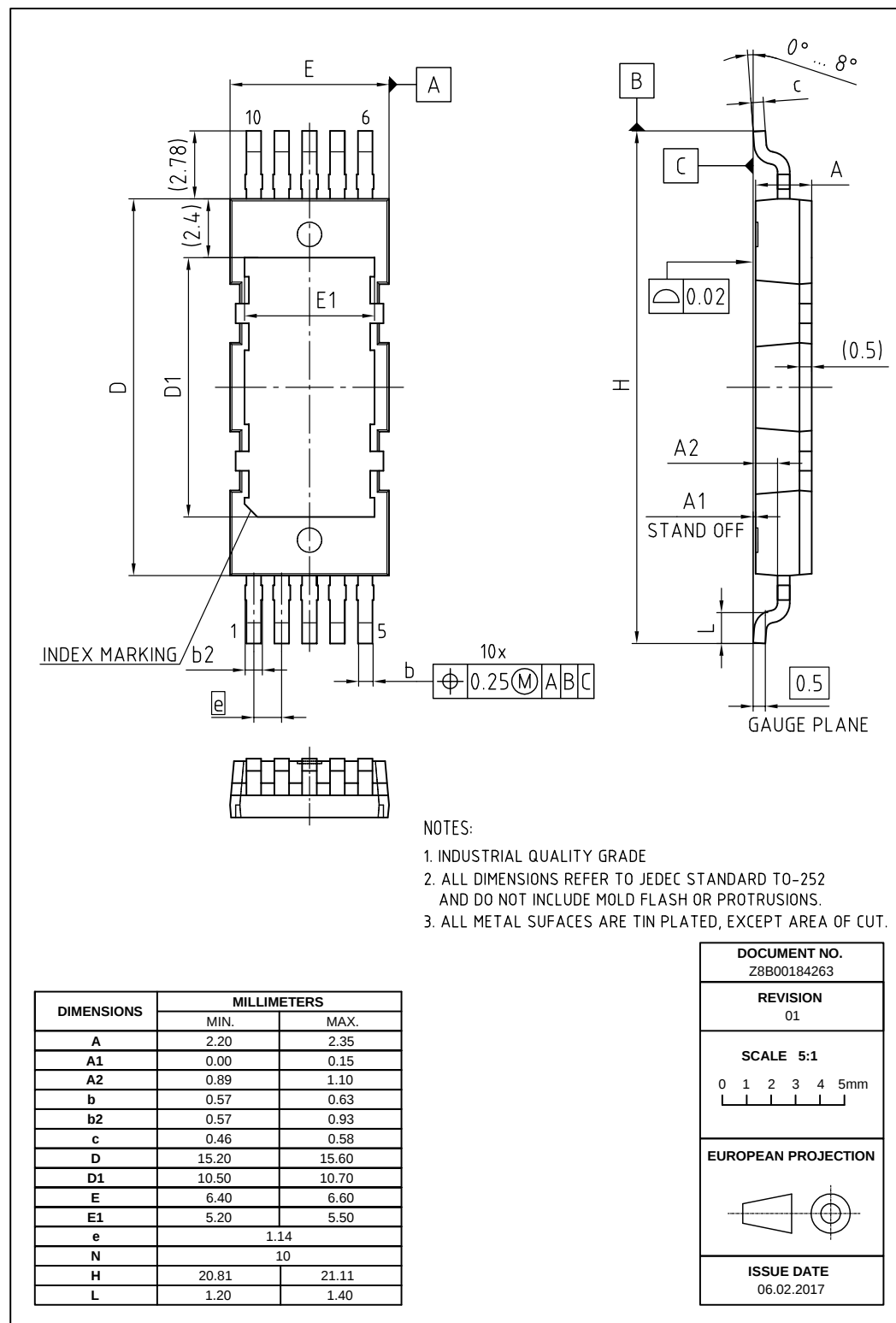


Figure 1 Outline PG-HDSOP-10, dimensions in mm/inches

7 Appendix A

Table 11 Related Links

- IFX CoolMOS™ G7 Webpage: www.infineon.com
- 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: 2018-01-05, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2018-01-05	Release of final version

Trademarks of Infineon Technologies AG

AURIX™, C166™, CanPAK™, CIPOS™, CoolGaN™, CoolMOS™, CoolSET™, CoolSiC™, CORECONTROL™, CROSSAVE™, DAVE™, DI-POL™, DrBlade™, EasyPIM™, EconoBRIDGE™, EconoDUAL™, EconoPACK™, EconoPIM™, EiceDRIVER™, eupec™, FCOS™, HITFET™, HybridPACK™, Infineon™, ISOFACE™, IsoPACK™, i-Wafer™, MIPAQ™, ModSTACK™, my-d™, NovalithIC™, OmniTune™, OPTIGA™, OptiMOS™, ORIGA™, POWERCODE™, PRIMARION™, PrimePACK™, PrimeSTACK™, PROFET™, PRO-SiL™, RASIC™, REAL3™, ReverSave™, SatRIC™, SIEGET™, SiPMOS™, SmartLEWIS™, SOLID FLASH™, SPOC™, TEMPFET™, thinQ!™, TRENCHSTOP™, TriCore™.

Trademarks updated August 2015

Other Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

We Listen to Your Comments

Any information within this document that you feel is wrong, unclear or missing at all? Your feedback will help us to continuously improve the quality of this document. Please send your proposal (including a reference to this document) to:
erratum@infineon.com

Published by

Infineon Technologies AG
81726 München, Germany
© 2017 Infineon Technologies AG
All Rights Reserved.

Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

Information

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office (www.infineon.com).

Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support, automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.