

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 TOLL 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.
- TOLL package has inbuilt 4th pin Kelvin Source configuration and low parasitic source inductance (~1nH).
- TOLL package is MSL1 compliant, total Pb-free, has easy visual inspection grooved leads and is qualified for industrial applications according to JEDEC(J-STD20 and JESD22).
- TOLL 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.
- Increased economies of scale by use in PFC and PWM topologies in the application
- C7 Gold can reach 28mΩ in in TOLL 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.
- TOLL package is easy to use and has the highest quality standards.
- Improved thermals enable SMD TOLL package to be used in higher current designs than has been previously possible.

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.

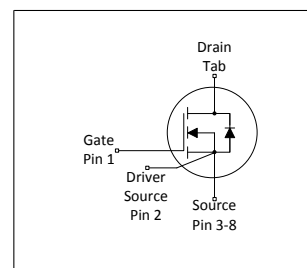


Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	650	V
$R_{DS(on),max}$	28	mΩ
$Q_{g,typ}$	123	nC
$I_{D,pulse}$	245	A
$I_{D,continuous} @ T_j < 150^{\circ}C$	87	A
$E_{oss@400V}$	14.7	μJ
Body diode di/dt	1000	A/μs

Type / Ordering Code	Package	Marking	Related Links
IPT60R028G7	PG-HSOF-8	60R028G7	see Appendix A

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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 ¹⁾	I_D	-	-	75 47	A	$T_C=25^\circ\text{C}$ $T_C=100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$	-	-	245	A	$T_C=25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}	-	-	288	mJ	$I_D=7.7\text{A}$; $V_{DD}=50\text{V}$; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	1.44	mJ	$I_D=7.7\text{A}$; $V_{DD}=50\text{V}$; see table 10
Avalanche current, single pulse	I_{AS}	-	-	7.7	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}	-	-	391	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	-	-	75	A	$T_C=25^\circ\text{C}$
Diode pulse current ²⁾	$I_{S,pulse}$	-	-	245	A	$T_C=25^\circ\text{C}$
Reverse diode dv/dt ³⁾	dv/dt	-	-	25	V/ns	$V_{DS}=0\dots400\text{V}$, $I_{SD}\leq 11.8\text{A}$, $T_j=25^\circ\text{C}$ see table 8
Maximum diode commutation speed	di/dt	-	-	1000	A/ μs	$V_{DS}=0\dots400\text{V}$, $I_{SD}\leq 11.8\text{A}$, $T_j=25^\circ\text{C}$ 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}	-	-	0.32	°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 ² (one layer, 70µm thickness) copper area for drain connection and cooling. PCB is vertical without air stream cooling.
Soldering temperature, wave- & reflow soldering allowed	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	$V_{DS}=V_{GS}$, $I_D=1.44\text{mA}$
Zero gate voltage drain current	I_{DSS}	-	-	1	μA	$V_{DS}=600$, $V_{GS}=0\text{V}$, $T_j=25^\circ\text{C}$ $V_{DS}=600$, $V_{GS}=0\text{V}$, $T_j=150^\circ\text{C}$
Gate-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS}=20\text{V}$, $V_{DS}=0\text{V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.024 0.060	0.028 -	Ω	$V_{GS}=10\text{V}$, $I_D=28.8\text{A}$, $T_j=25^\circ\text{C}$ $V_{GS}=10\text{V}$, $I_D=28.8\text{A}$, $T_j=150^\circ\text{C}$
Gate resistance	R_G	-	0.85	-	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}	-	4820	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=400\text{V}$, $f=250\text{kHz}$
Output capacitance	C_{oss}	-	99	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=400\text{V}$, $f=250\text{kHz}$
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$	-	184	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=0\ldots400\text{V}$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$	-	1900	-	pF	$I_D=\text{constant}$, $V_{GS}=0\text{V}$, $V_{DS}=0\ldots400\text{V}$
Turn-on delay time	$t_{d(on)}$	-	28	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=28.8\text{A}$, $R_G=1.8\Omega$; see table 9
Rise time	t_r	-	9	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=28.8\text{A}$, $R_G=1.8\Omega$; see table 9
Turn-off delay time	$t_{d(off)}$	-	100	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=28.8\text{A}$, $R_G=1.8\Omega$; see table 9
Fall time	t_f	-	2.8	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=28.8\text{A}$, $R_G=1.8\Omega$; see table 9

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	24	-	nC	$V_{DD}=400\text{V}$, $I_D=28.8\text{A}$, $V_{GS}=0$ to 10V
Gate to drain charge	Q_{gd}	-	44	-	nC	$V_{DD}=400\text{V}$, $I_D=28.8\text{A}$, $V_{GS}=0$ to 10V
Gate charge total	Q_g	-	123	-	nC	$V_{DD}=400\text{V}$, $I_D=28.8\text{A}$, $V_{GS}=0$ to 10V
Gate plateau voltage	V_{plateau}	-	5.0	-	V	$V_{DD}=400\text{V}$, $I_D=28.8\text{A}$, $V_{GS}=0$ 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	$V_{GS}=0V$, $I_F=28.8A$, $T_J=25^{\circ}C$
Reverse recovery time	t_{rr}	-	440	-	ns	$V_R=400V$, $I_F=28.8A$, $di_F/dt=100A/\mu s$; see table 8
Reverse recovery charge	Q_{rr}	-	8.7	-	μC	$V_R=400V$, $I_F=28.8A$, $di_F/dt=100A/\mu s$; see table 8
Peak reverse recovery current	I_{rrm}	-	39	-	A	$V_R=400V$, $I_F=28.8A$, $di_F/dt=100A/\mu s$; see table 8

4 Electrical characteristics diagrams

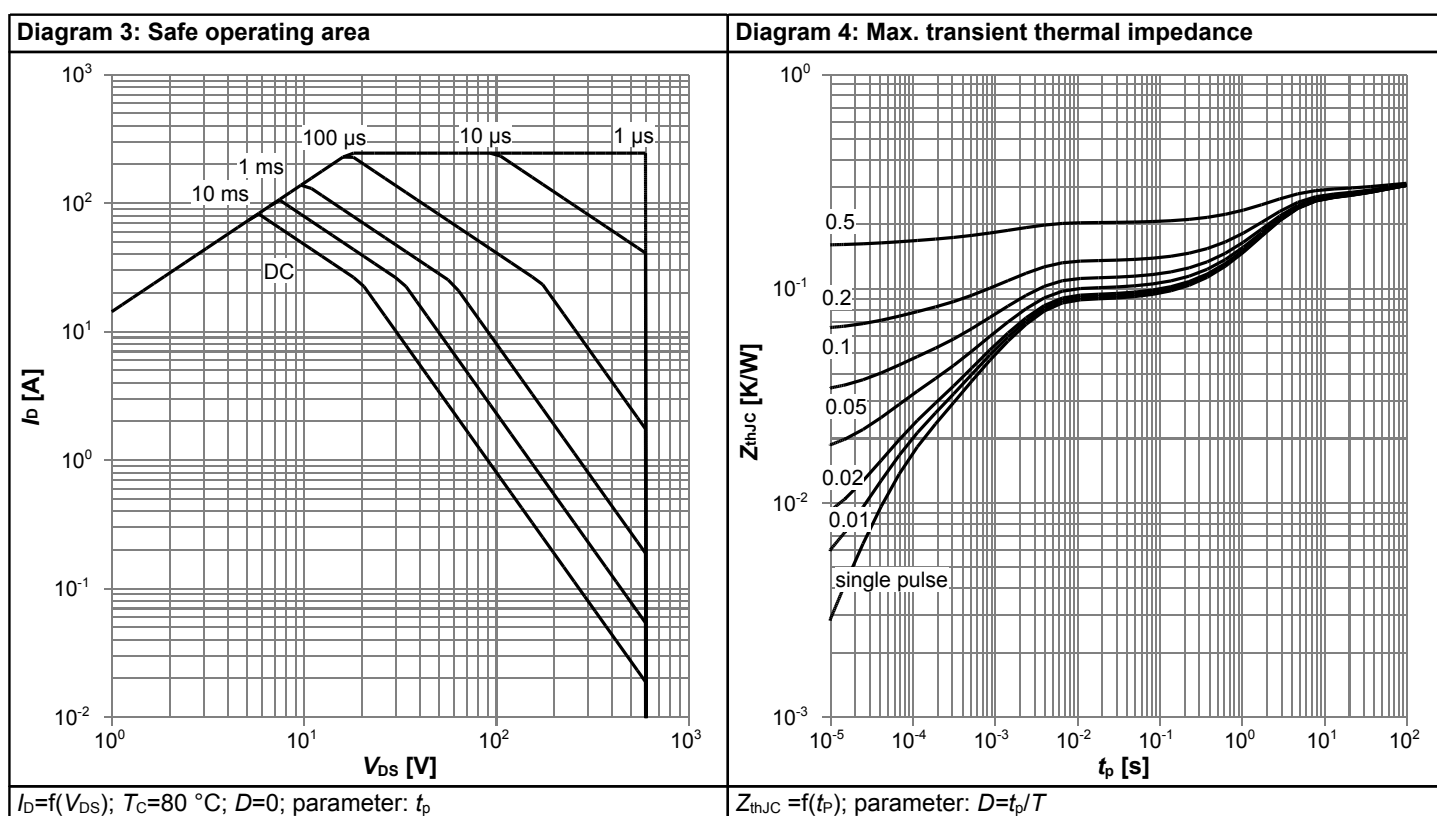
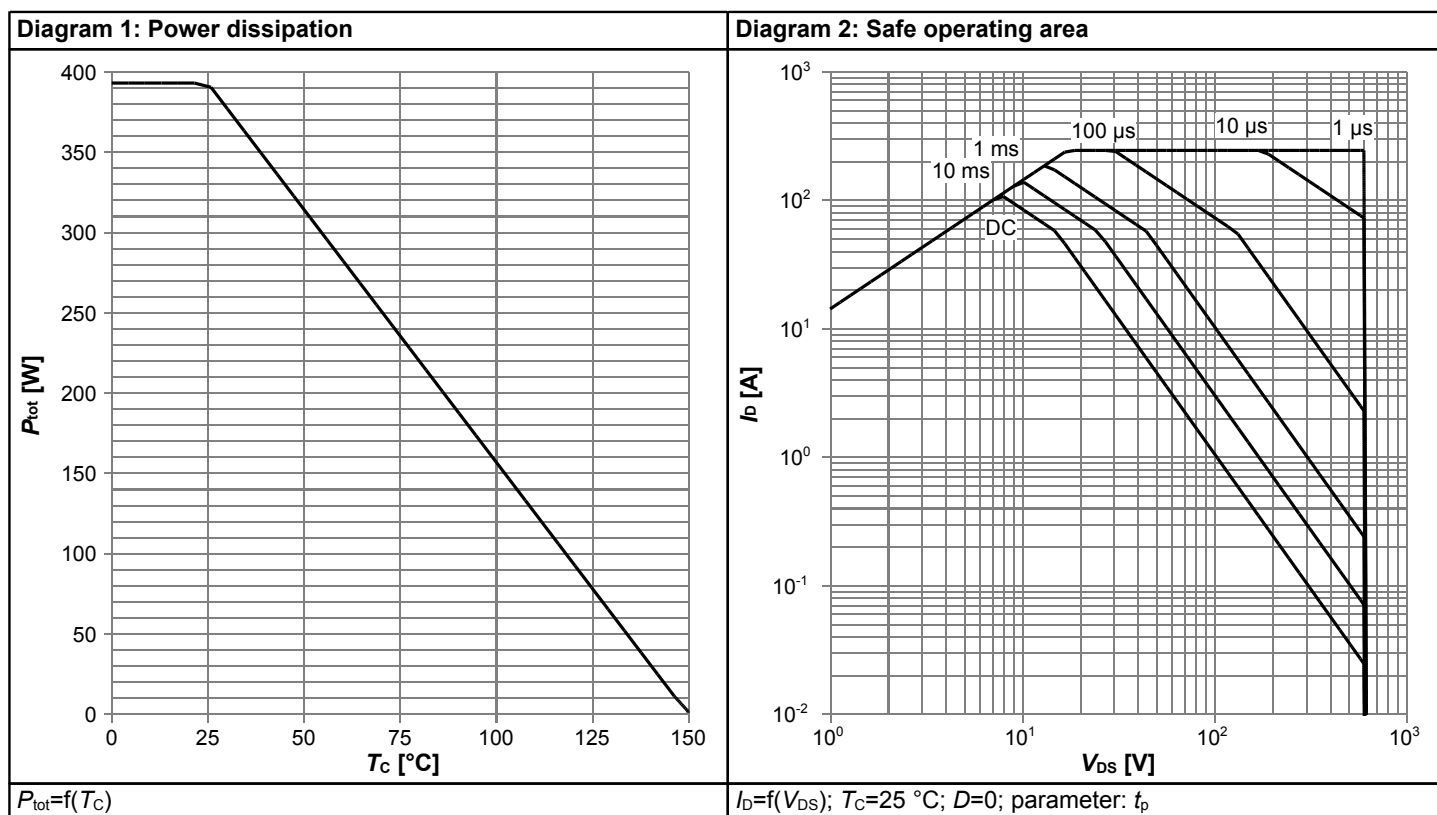
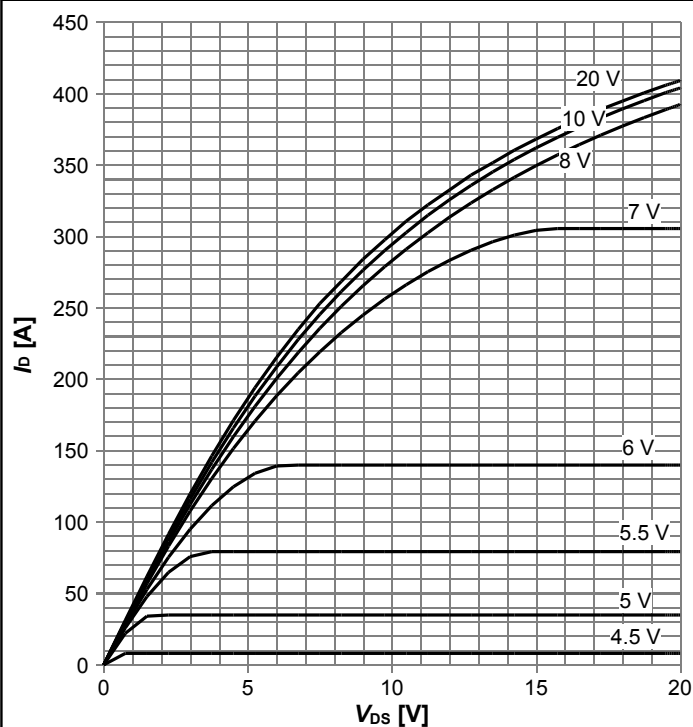
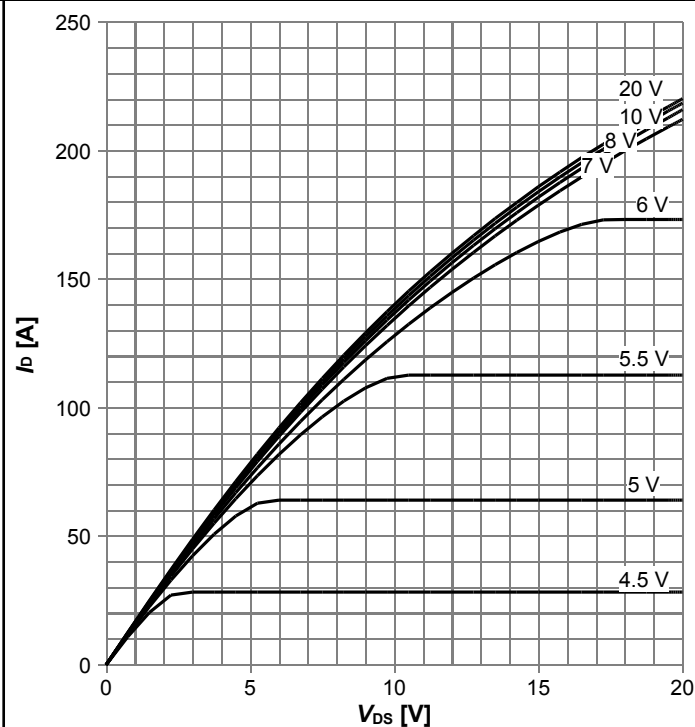


Diagram 5: Typ. output characteristics



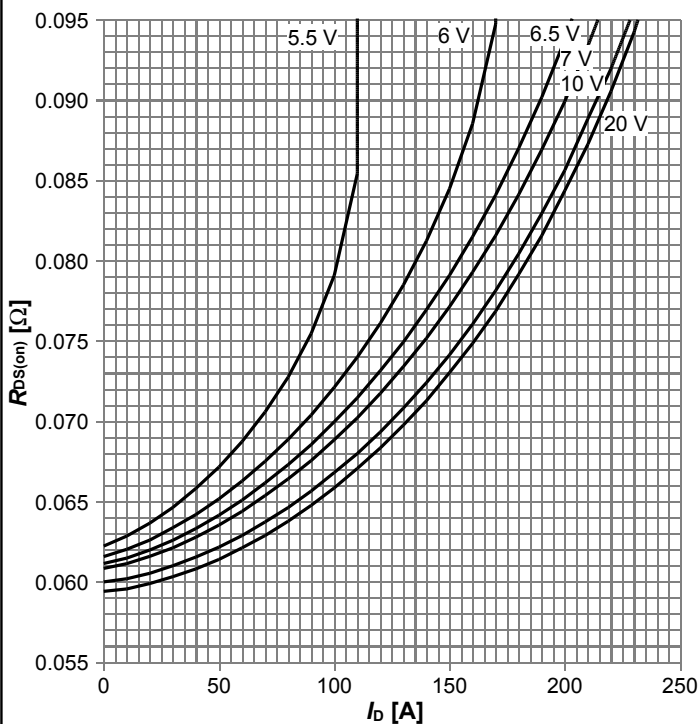
$I_D = f(V_{DS})$; $T_j = 25\text{ °C}$; parameter: V_{GS}

Diagram 6: Typ. output characteristics



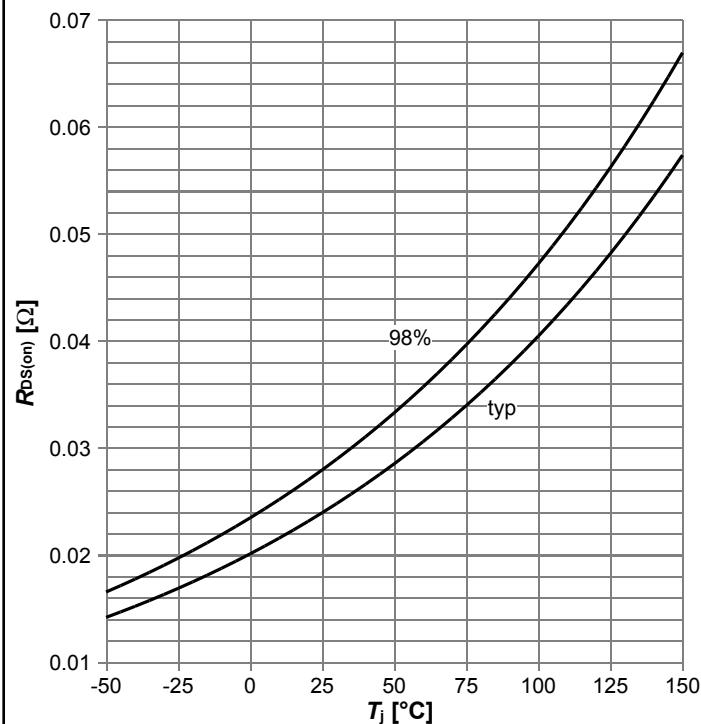
$I_D = f(V_{DS})$; $T_j = 125\text{ °C}$; parameter: V_{GS}

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



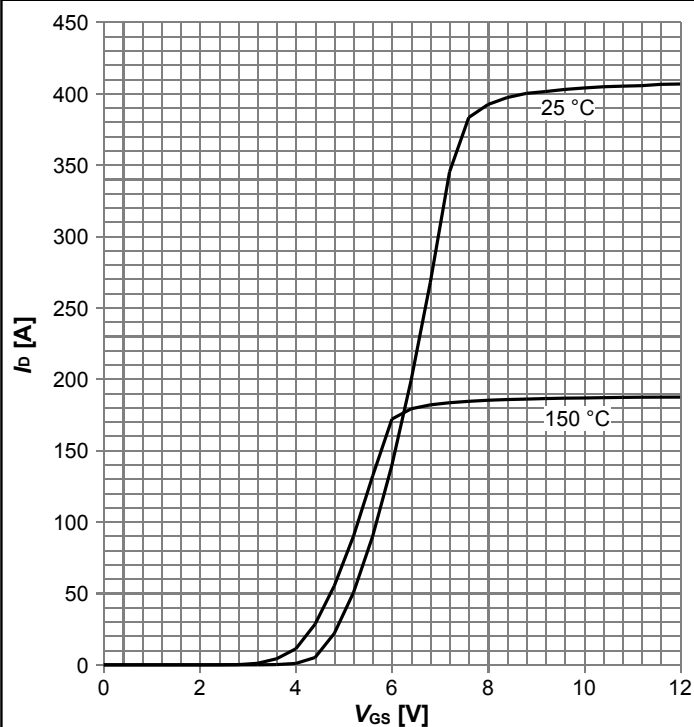
$R_{DS(on)} = f(I_D)$; $T_j = 125\text{ °C}$; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



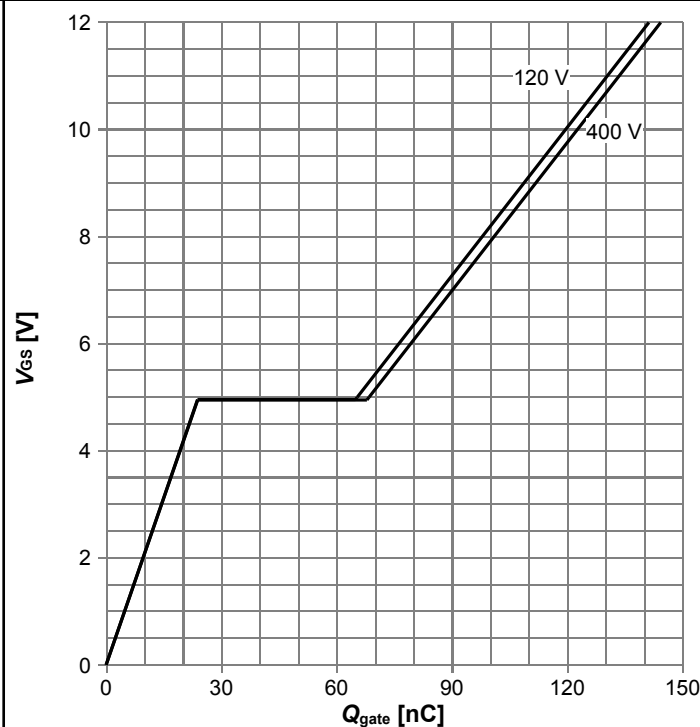
$R_{DS(on)} = f(T_j)$; $I_D = 28.8\text{ A}$; $V_{GS} = 10\text{ V}$

Diagram 9: Typ. transfer characteristics



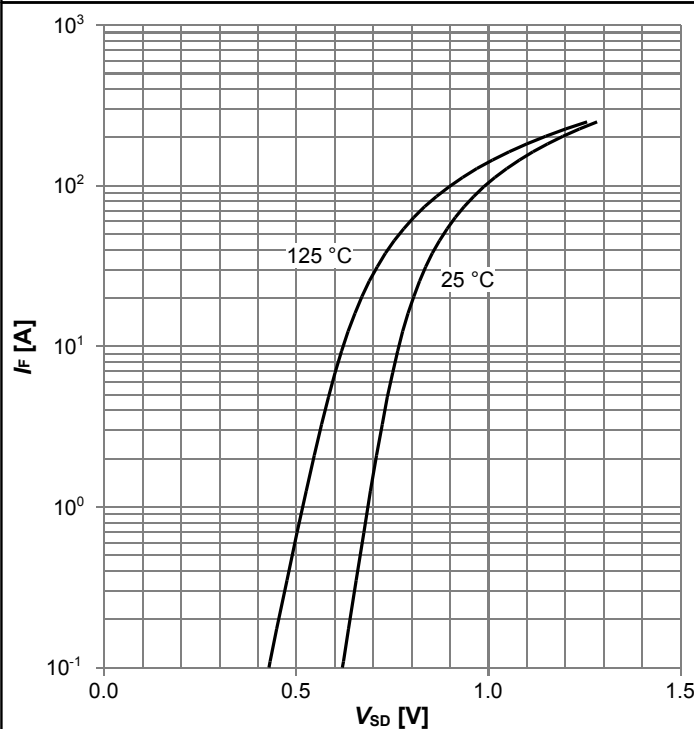
$I_D = f(V_{GS})$; $V_{DS} = 20V$; parameter: T_j

Diagram 10: Typ. gate charge



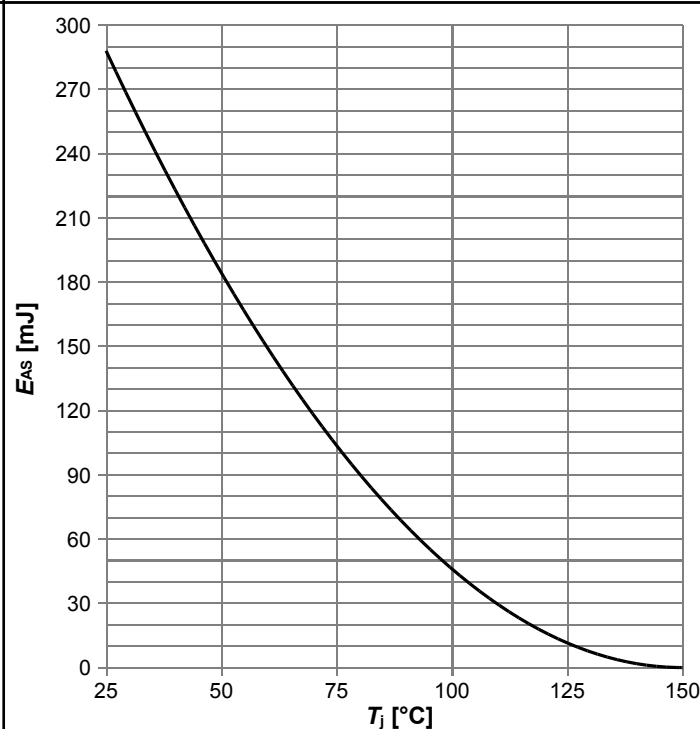
$V_{GS} = f(Q_{gate})$; $I_D = 28.8$ A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



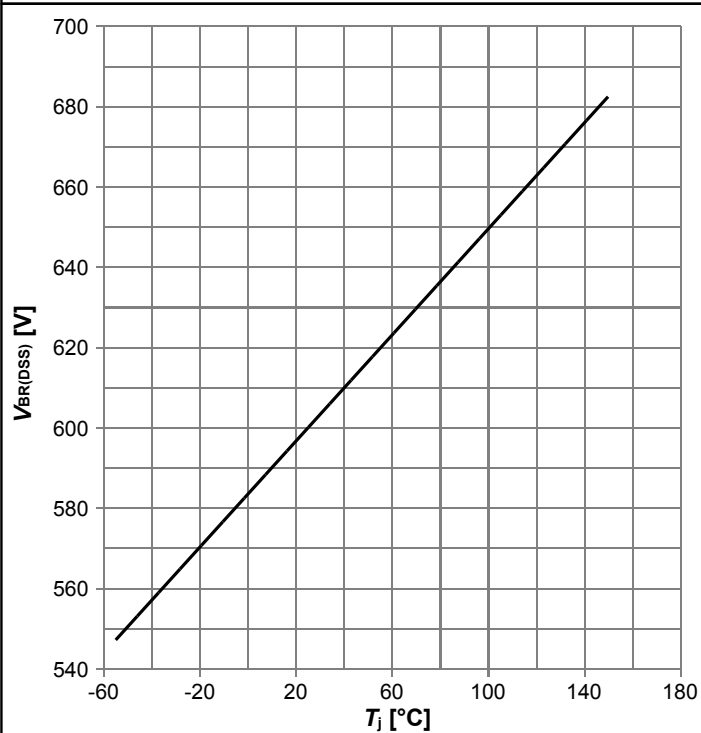
$I_F = f(V_{SD})$; parameter: T_j

Diagram 12: Avalanche energy



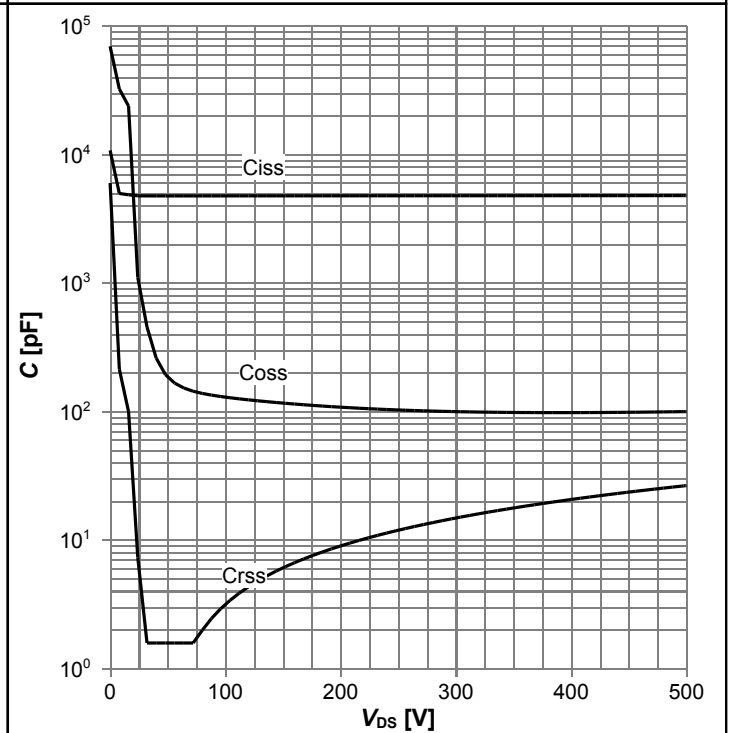
$E_{AS} = f(T_j)$; $I_D = 7.7$ A; $V_{DD} = 50$ V

Diagram 13: Drain-source breakdown voltage



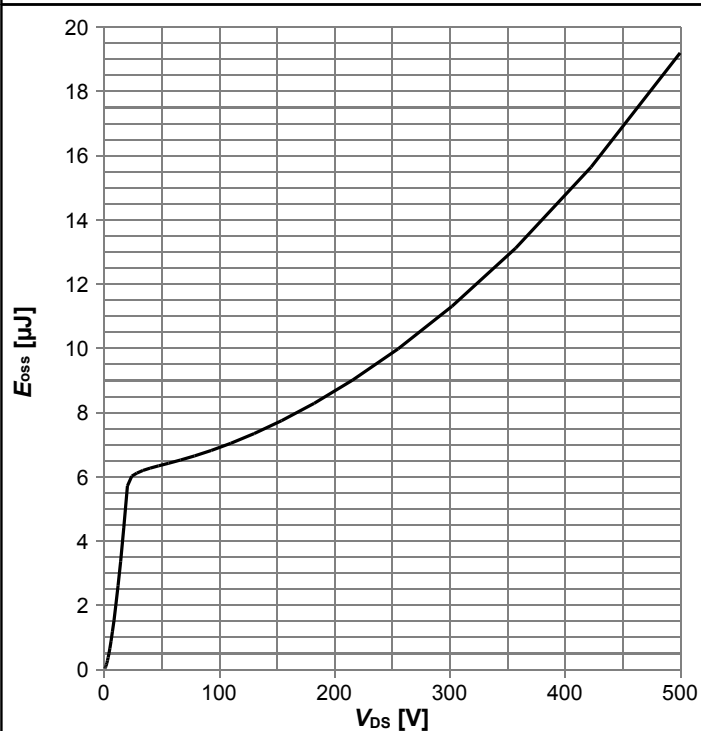
$V_{BR(DSS)} = f(T_J); I_D = 1 \text{ mA}$

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

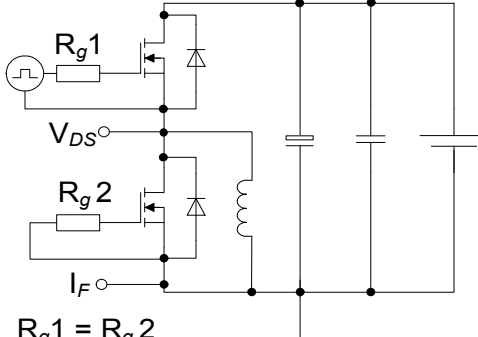
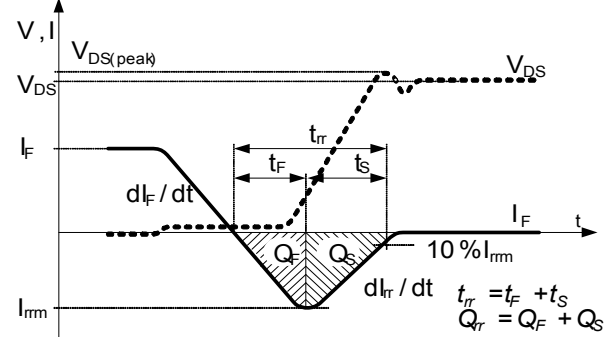
Test circuit for diode characteristics	Diode recovery waveform
 $R_{g1} = R_{g2}$	 $t_{tr} = t_F + t_S$ $Q_{rr} = Q_F + Q_S$

Table 9 switching times (ss)

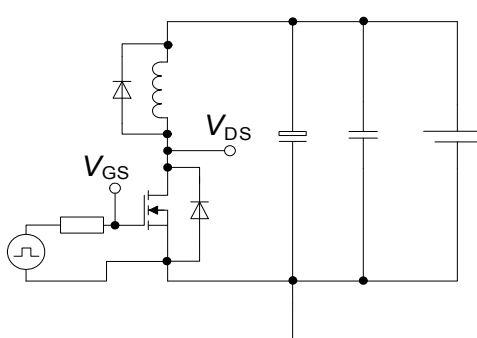
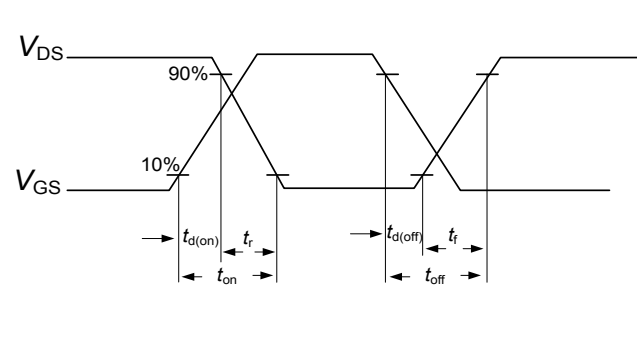
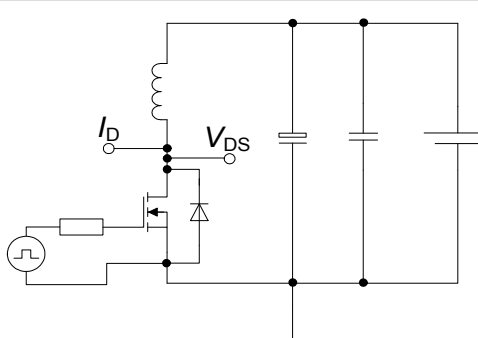
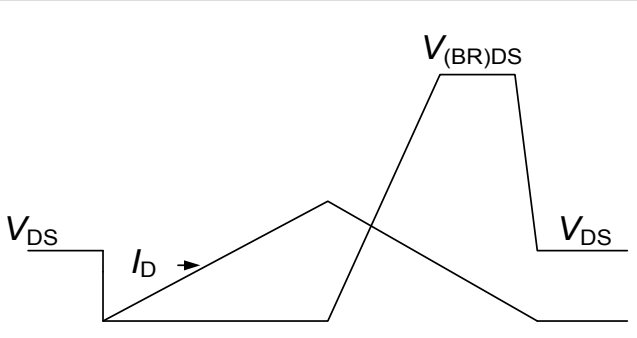
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load (ss)

Unclamped inductive load test circuit	Unclamped inductive waveform
	

6 Package Outlines

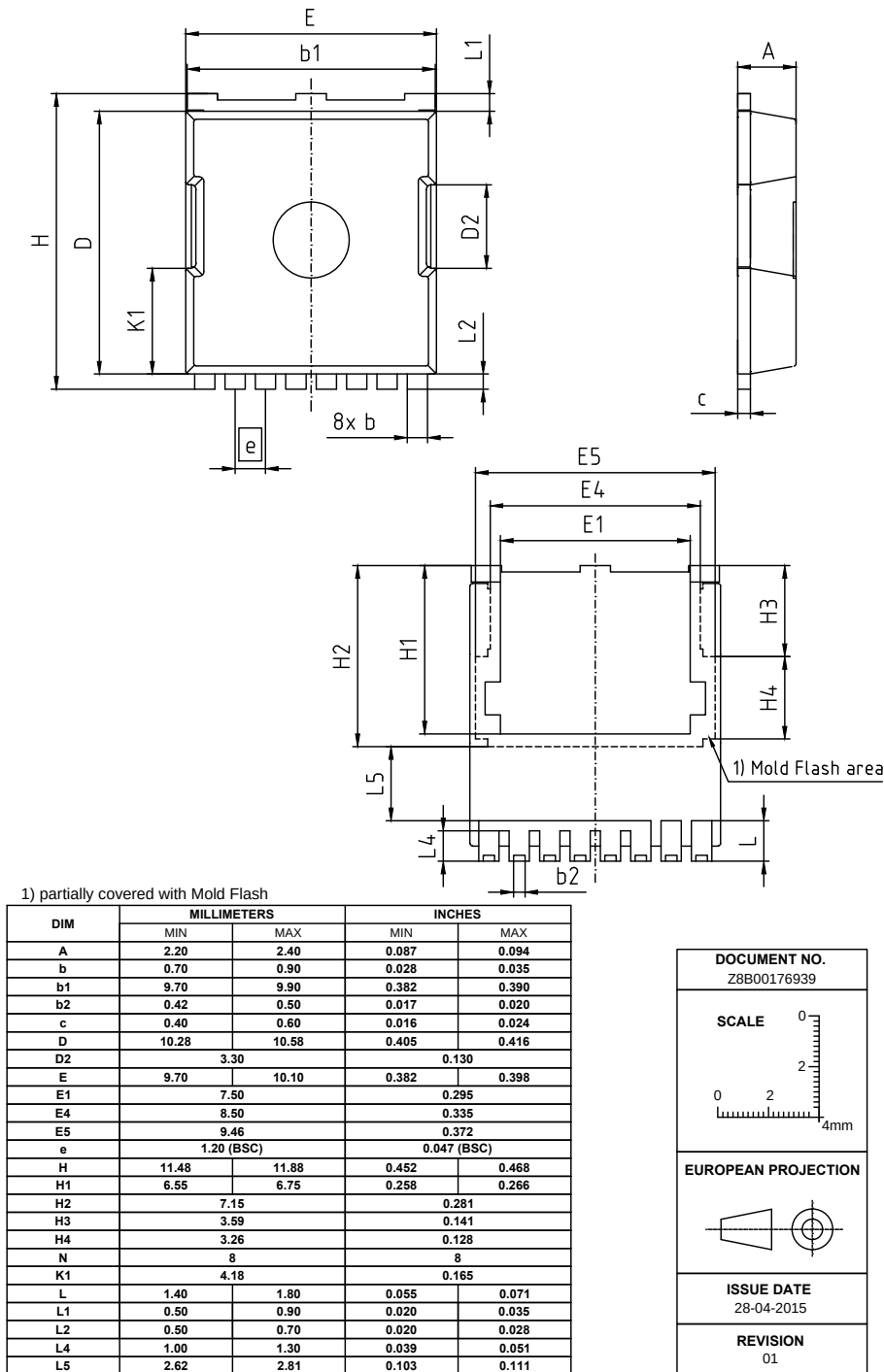


Figure 1 Outline PG-HSOF-8

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

IPT60R028G7

Revision: 2016-12-15, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2016-12-15	Release of final version

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