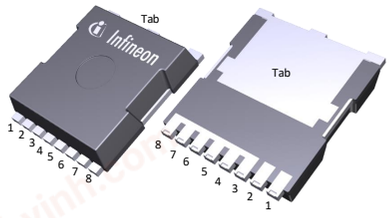
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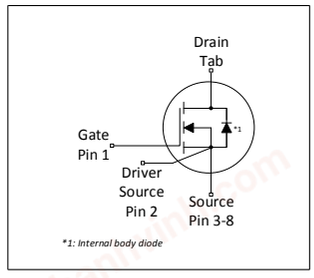
MOSFET

600V CoolMOS™ G7 SJ Power Device

HSOF



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 $R_{DS(on)}$*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.
- TOLL package has inbuilt 4th pin Kelvin Source configuration and low parasitic source inductance (~1nH).
- TOLL package is MSL1 compliant, total Pb-free and has easy visual inspection grooved leads.
- TOLL 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.
- Increased economies of scale by use in PFC and PWM topologies in the application
- C7 Gold can reach 28mΩ in in TOLL 115mm^2 footprint, whereas previous BIC C7 600V was 40mΩ in 150mm^2 D^{2}PAK 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.

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
$R_{DS(on),max}$	28	mΩ
$Q_{g.typ}$	123	nC
$I_{D,pulse}$	245	A
$I_{D,continuous}$ @ T_j<150°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°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°C T_C=100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	245	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	288	mJ	I_D=7.7A; V_{DD}=50V; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	1.44	mJ	I_D=7.7A; V_{DD}=50V; see table 10
Avalanche current, single pulse	I_{AS}	-	-	7.7	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	120	V/ns	V_{DS}=0...400V
Gate source voltage (static)	V_{GS}	-20	-	20	V	static;
Gate source voltage (dynamic)	V_{GS}	-30	-	30	V	AC (f>1 Hz)
Power dissipation	P_{tot}	-	-	391	W	T_C=25°C
Storage temperature	T_{stg}	-55	-	150	°C	-
Operating junction temperature	T_j	-55	-	150	°C	-
Mounting torque	-	-	-	n.a.	Ncm	-
Continuous diode forward current	I_S	-	-	75	A	T_C=25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	245	A	T_C=25°C
Reverse diode dv/dt[3]	dv/dt	-	-	25	V/ns	V_{DS}=0...400V, I_{SD}<=11.8A, T_j=25°C see table 8
Maximum diode commutation speed	di_f/dt	-	-	1000	A/µs	V_{DS}=0...400V, I_{SD}<=11.8A, T_j=25°C see table 8
Insulation withstand voltage	V_{ISO}	-	-	n.a.	V	V_{rms}, T_C=25°C, t=1min

[1] Limited by $T_{j\,max}$.
[2] Pulse width t_p limited by $T_{j,max}$
[3] Identical low side and high side switch

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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 6cm² (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

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3 Electrical characteristics

at T_j=25°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=1.44mA
Zero gate voltage drain current	I_{DSS}	- -	- 10	1 -	µA	V_{DS}=600, V_{GS}=0V, T_j=25°C V_{DS}=600, V_{GS}=0V, T_j=150°C
Gate-source leakage current	I_{GSS}	-	-	100	nA	V_{GS}=20V, V_{DS}=0V
Drain-source on-state resistance	$R_{DS(on)}$	- -	0.024 0.060	0.028 -	Ω	V_{GS}=10V, I_D=28.8A, T_j=25°C V_{GS}=10V, I_D=28.8A, T_j=150°C
Gate resistance	R_G	-	0.85	-	Ω	f=1MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	4820	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Output capacitance	C_{oss}	-	99	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Effective output capacitance, energy related[1)]	$C_{o(er)}$	-	184	-	pF	V_{GS}=0V, V_{DS}=0...400V
Effective output capacitance, time related[2)]	$C_{o(tr)}$	-	1900	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...400V
Turn-on delay time	$t_{d(on)}$	-	28	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=28.8A, R_G=1.8Ω; see table 9
Rise time	t_r	-	9	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=28.8A, R_G=1.8Ω; see table 9
Turn-off delay time	$t_{d(off)}$	-	100	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=28.8A, R_G=1.8Ω; see table 9
Fall time	t_f	-	2.8	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=28.8A, R_G=1.8Ω; 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}=400V, I_D=28.8A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	44	-	nC	V_{DD}=400V, I_D=28.8A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	123	-	nC	V_{DD}=400V, I_D=28.8A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.0	-	V	V_{DD}=400V, I_D=28.8A, 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

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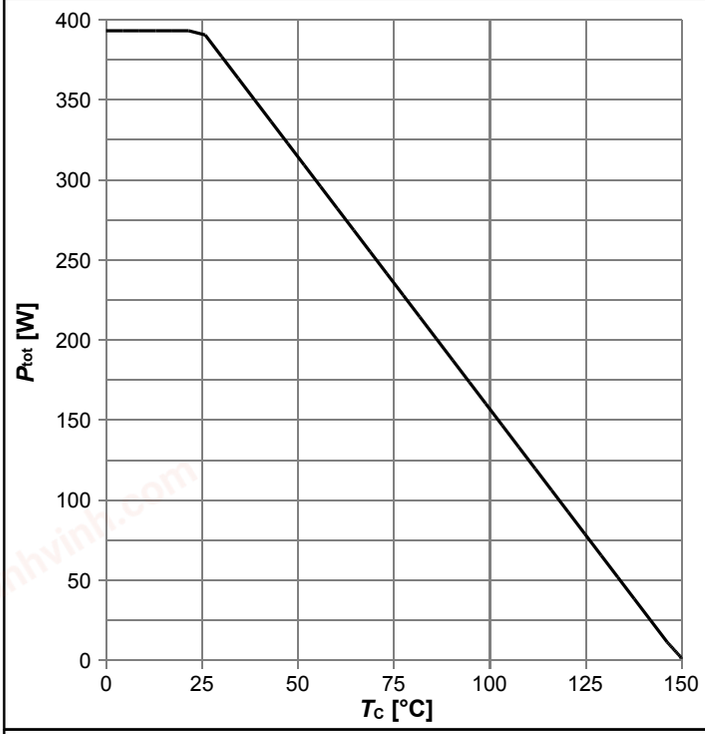
Table 7 Reverse diode characteristics

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°C
Reverse recovery time	t_{rr}	-	440	-	ns	V_R=400V, I_F=28.8A, di_F/dt=100A/µs; see table 8
Reverse recovery charge	Q_{rr}	-	8.7	-	µC	V_R=400V, I_F=28.8A, di_F/dt=100A/µs; see table 8
Peak reverse recovery current	I_{rrm}	-	39	-	A	V_R=400V, I_F=28.8A, di_F/dt=100A/µs; see table 8

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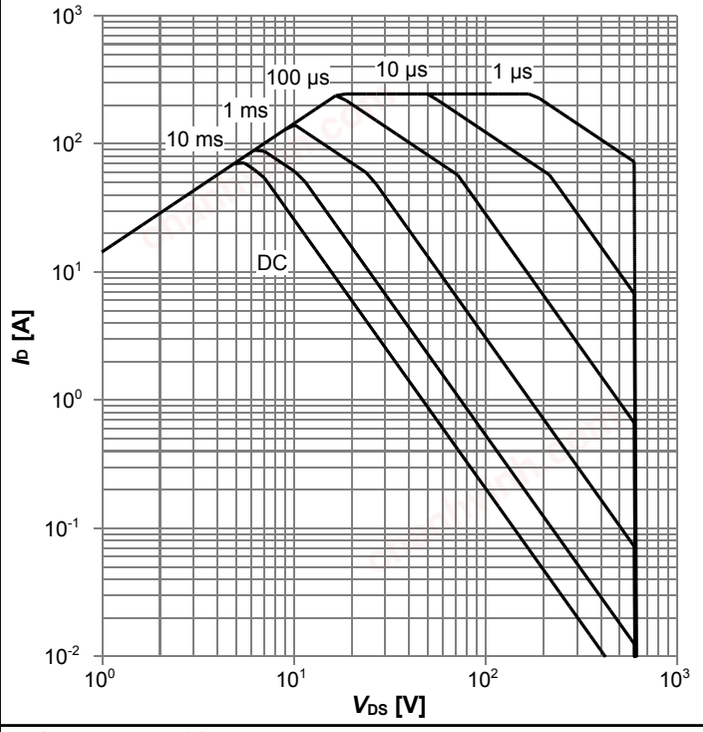
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



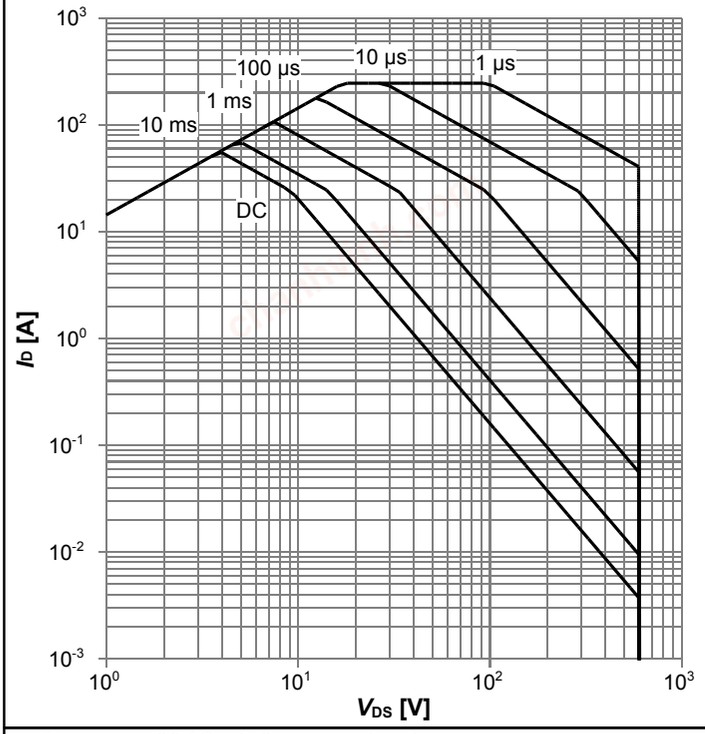
P_{tot}=f(T_C)

Diagram 2: Safe operating area



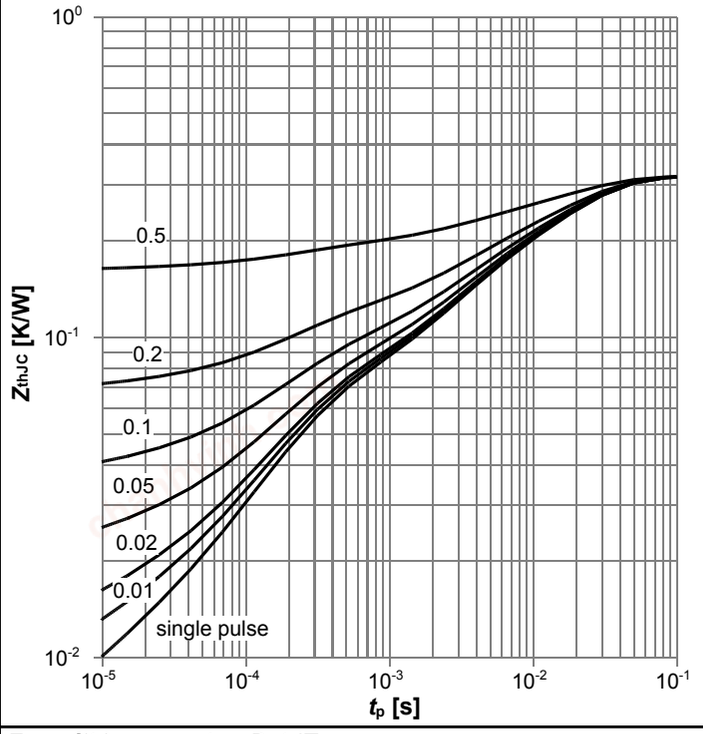
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter: t_p

Diagram 3: Safe operating area



I_D=f(V_{DS}); T_C=80 °C; D=0; parameter: t_p

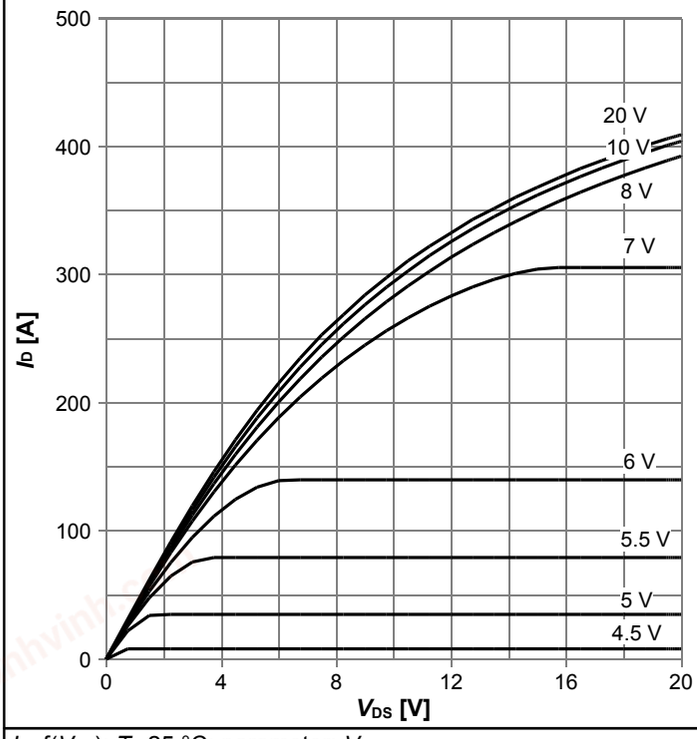
Diagram 4: Max. transient thermal impedance



Z_{thJC} =f(t_P); parameter: D=t_p/T

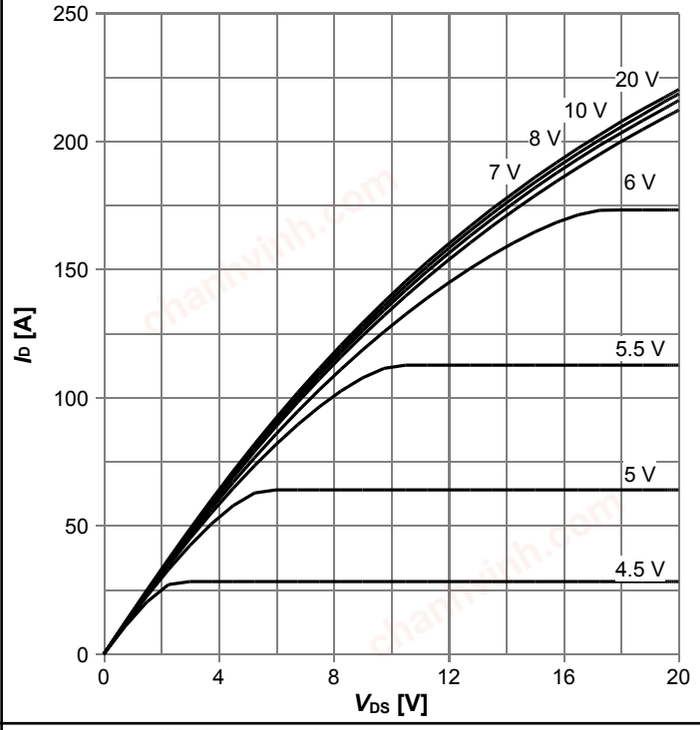
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Diagram 5: Typ. output characteristics



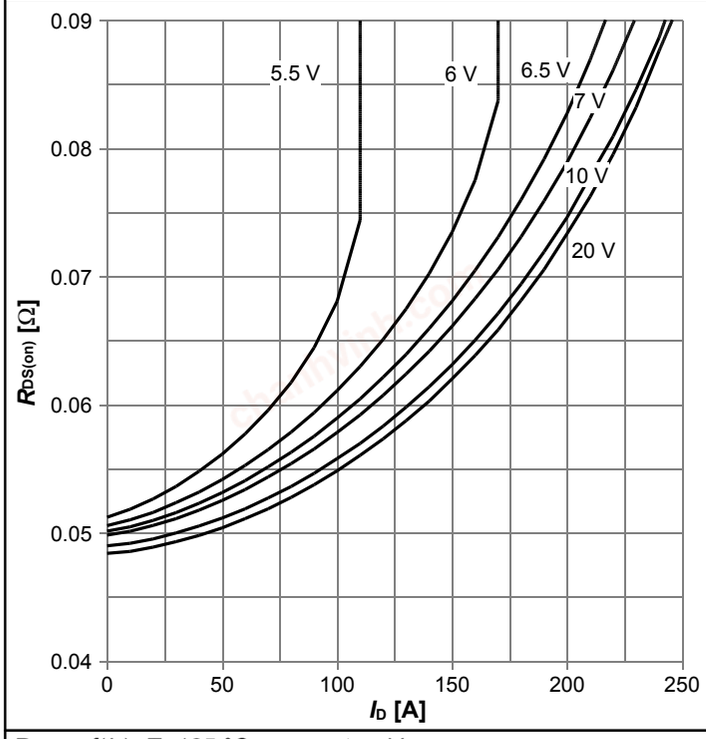
$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



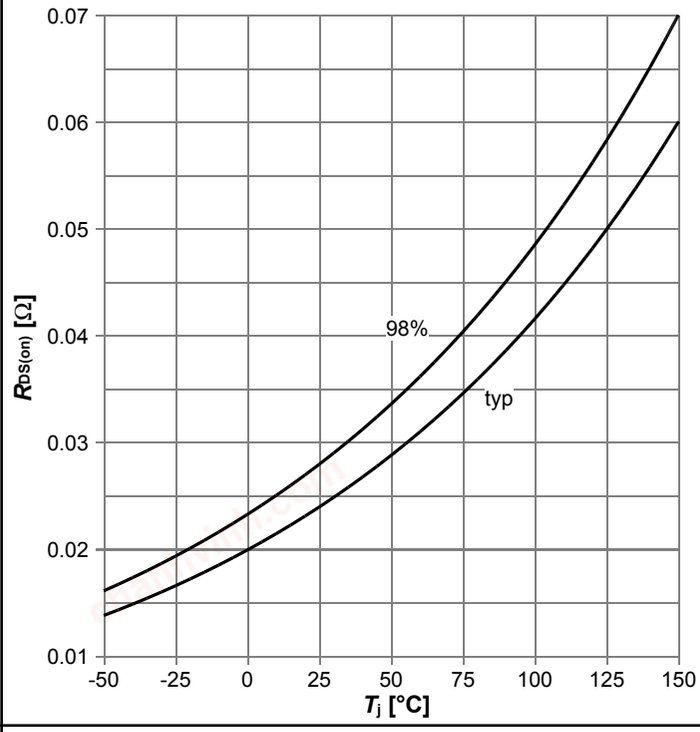
$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: V_{GS}

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



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

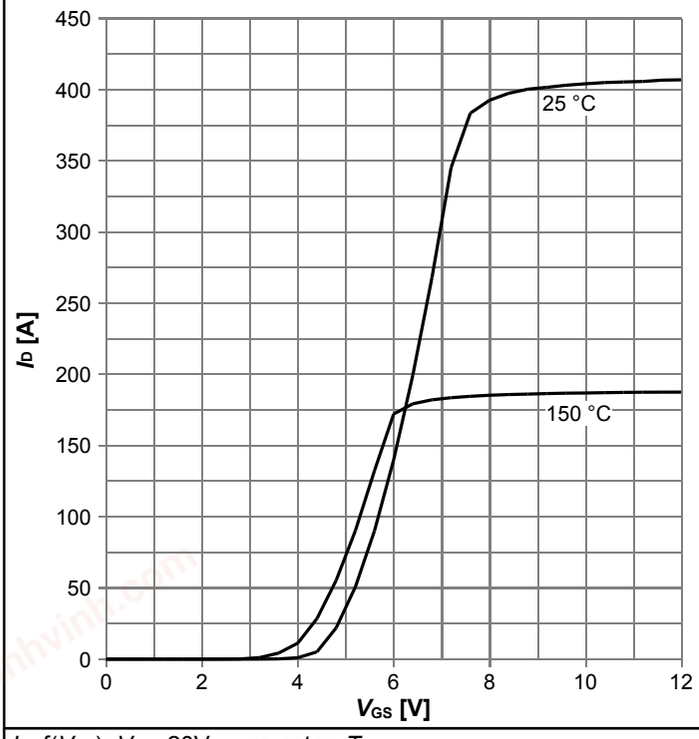
Diagram 8: Drain-source on-state resistance



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

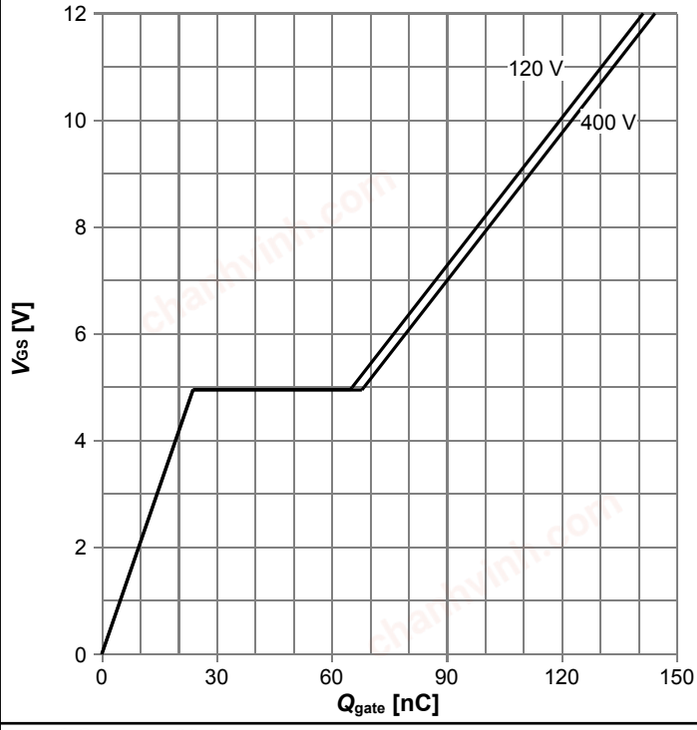
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Diagram 9: Typ. transfer characteristics



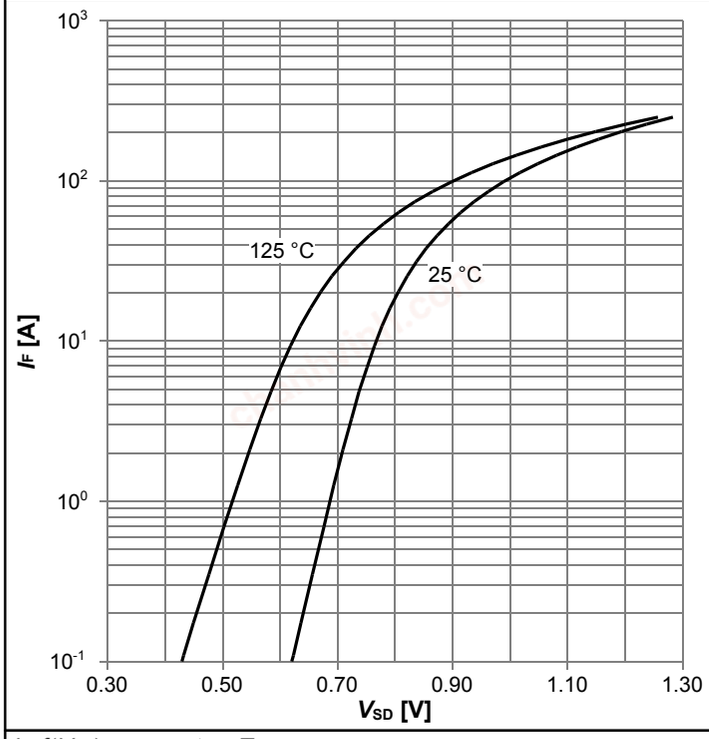
I_D=f(V_{GS}); V_{DS}=20V; parameter: T_j

Diagram 10: Typ. gate charge



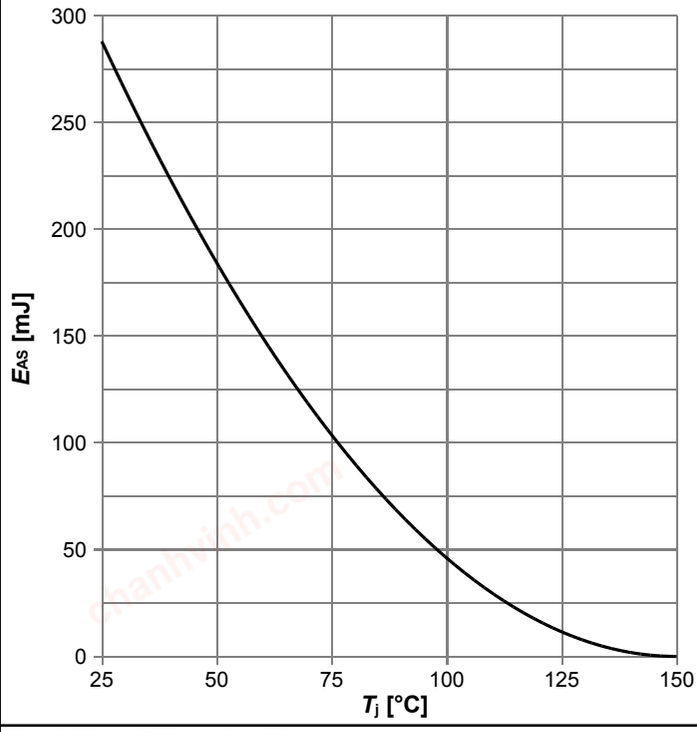
V_{GS}=f(Q_{gate}); I_D=28.8 A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



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

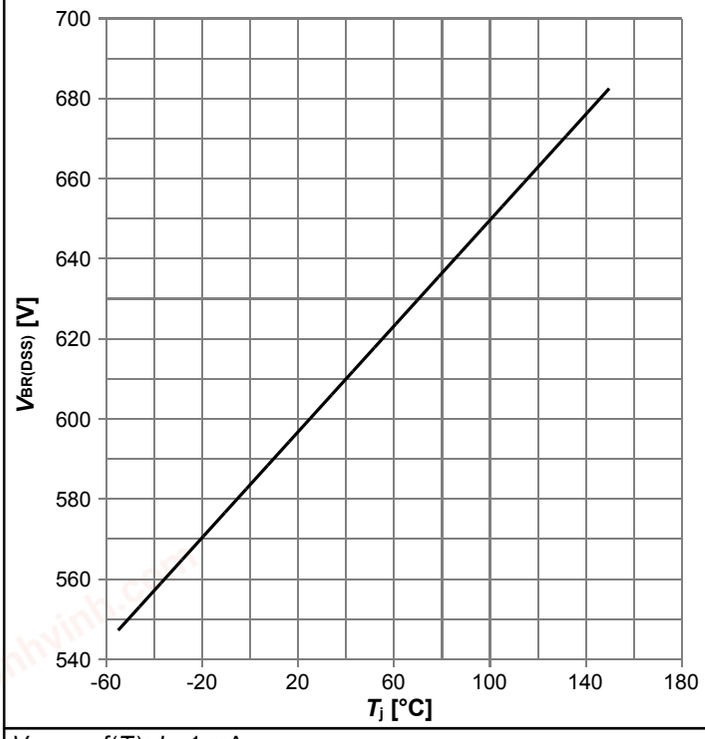
Diagram 12: Avalanche energy



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

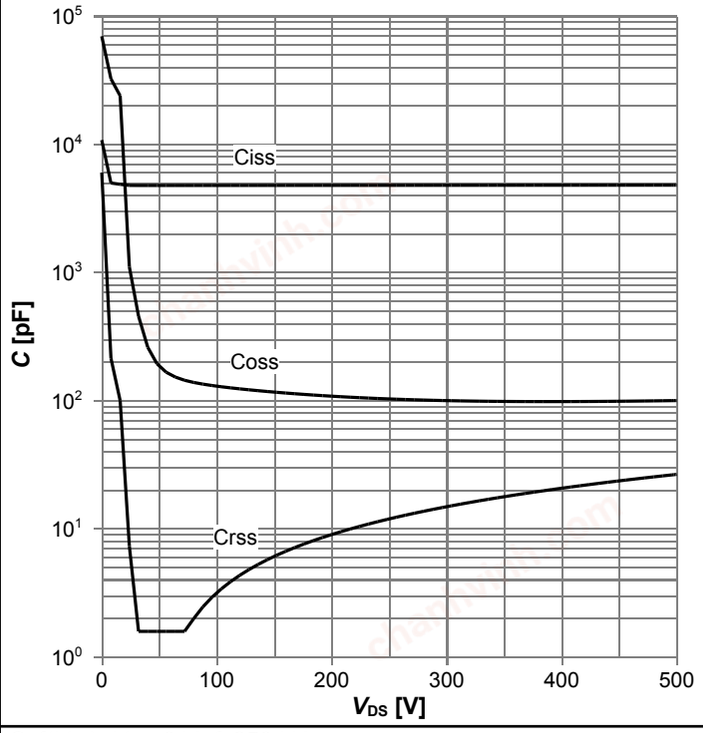
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Diagram 13: Drain-source breakdown voltage



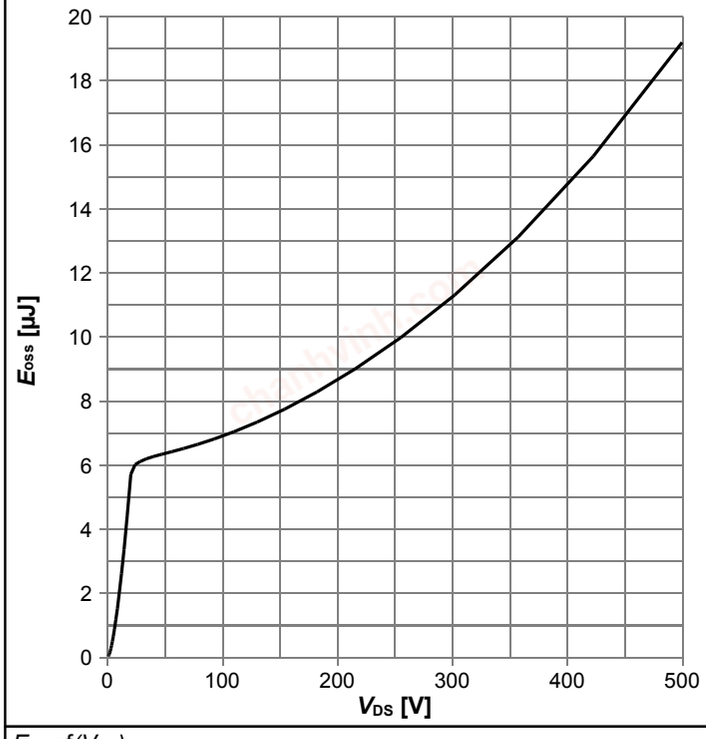
$V_{BR(DSS)}$=f(T_j); I_D=1 mA

Diagram 14: Typ. capacitances



C=f(V_{DS}); V_{GS}=0 V; f=250 kHz

Diagram 15: Typ. Coss stored energy



E_{oss}=f(V_{DS})

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5 Test Circuits

Table 8 Diode characteristics

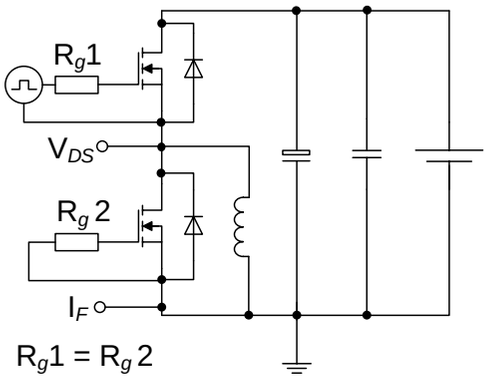
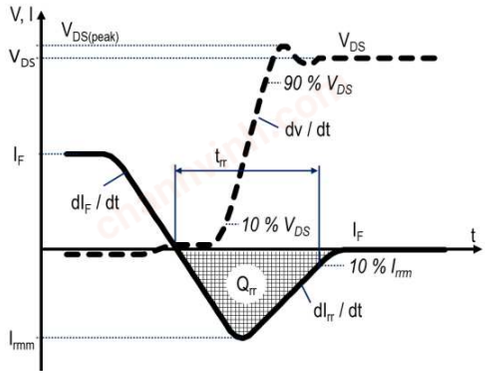
Test circuit for diode characteristics	Diode recovery waveform
	

Table 9 Switching times (ss)

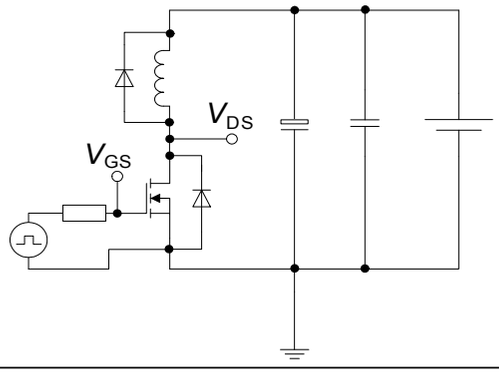
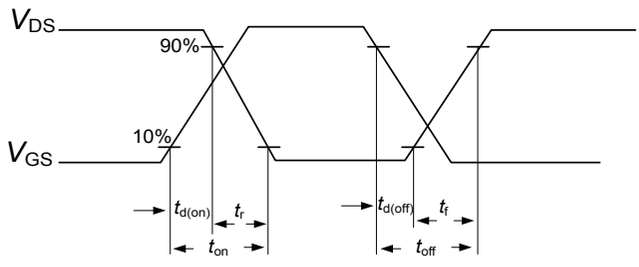
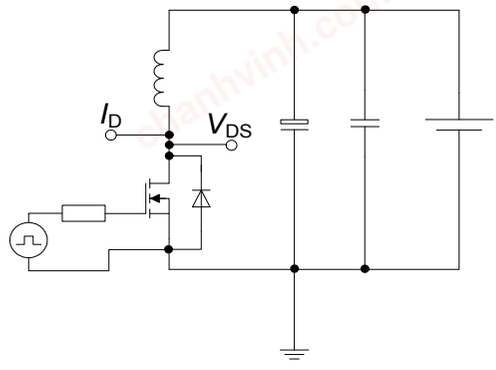
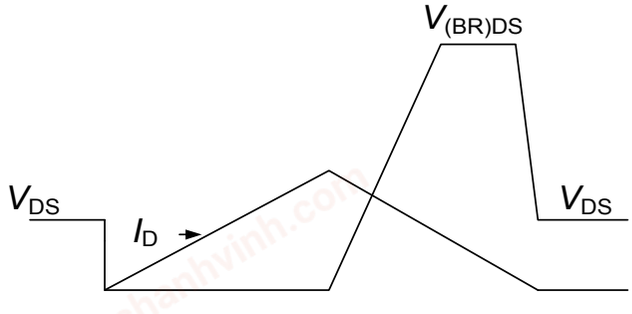
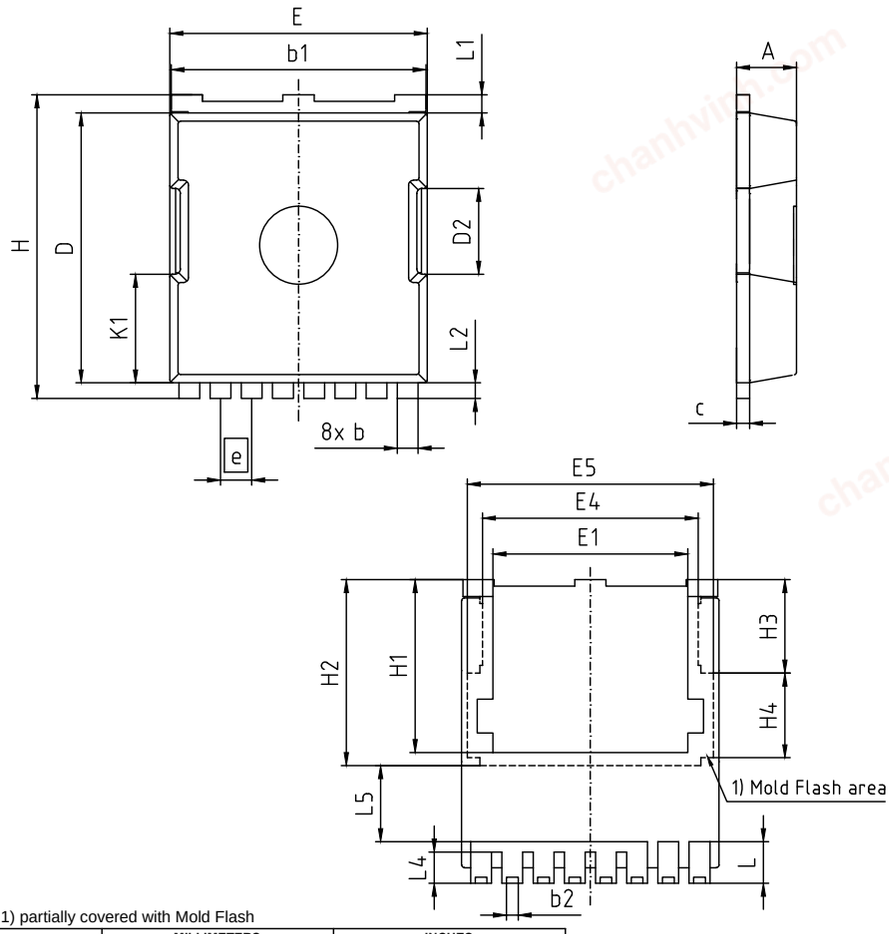
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load (ss)

Unclamped inductive load test circuit	Unclamped inductive waveform
	

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6 Package Outlines



1) partially covered with Mold Flash

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.20	2.40	0.087	0.094
b	0.70	0.90	0.028	0.035
b1	9.70	9.90	0.382	0.390
b2	0.42	0.50	0.017	0.020
c	0.40	0.60	0.016	0.024
D	10.28	10.58	0.405	0.416
D2	3.30		0.130	
E	9.70	10.10	0.382	0.398
E1	7.50		0.295	
E4	8.50		0.335	
E5	9.46		0.372	
e	1.20 (BSC)		0.047 (BSC)	
H	11.48	11.88	0.452	0.468
H1	6.55	6.75	0.258	0.266
H2	7.15		0.281	
H3	3.59		0.141	
H4	3.26		0.128	
N	8		8	
K1	4.18		0.165	
L	1.40	1.80	0.055	0.071
L1	0.50	0.90	0.020	0.035
L2	0.50	0.70	0.020	0.028
L4	1.00	1.30	0.039	0.051
L5	2.62	2.81	0.103	0.111

DOCUMENT NO.
Z8B00176939

SCALE
0 2 0 2 4mm

EUROPEAN PROJECTION

ISSUE DATE
28-04-2015

REVISION
01

Figure 1 Outline PG-HSOF-8, dimensions in mm/inches

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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

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Revision History

IPT60R028G7

Revision: 2020-10-27, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2016-12-15	Release of final version
2.1	2020-10-27	Content update diagram 2,3,4,7,8 and format update

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