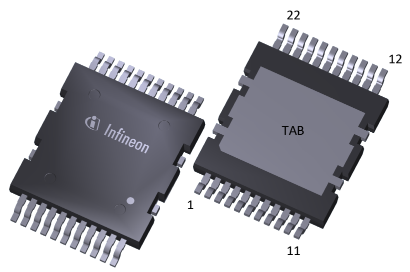
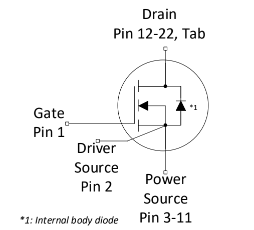
MOSFET

650V CoolMOS™ CFD7A SJ Power Device

650V CoolMOS™ CFD7A is Infineon's latest generation of market leading automotive qualified high voltage CoolMOS™ MOSFETs. In addition to the well-known attributes of high quality and reliability required by the automotive industry, the new CoolMOS™ CFD7A series provides for an integrated fast body diode and can be used for PFC and resonant switching topologies like the ZVS phase-shift full-bridge and LLC.

PG-HDSOP-22





Features

- Latest 650V automotive qualified technology with integrated fast body diode on the market featuring ultra low Q_{rr}
- Lowest FOM $R_{DS(on)}$*Q_g and $R_{DS(on)}$*E_{oss}
- 100% avalanche tested
- Best-in-class $R_{DS(on)}$ in SMD and THD packages

Benefits

- Lower switching losses enabling higher switching frequencies
- High quality and reliability
- Advanced controllability due to kelvin source
- Increased efficiency in light load and full load conditions

Potential applications

Suitable for PFC and DC-DC stages for:

- Unidirectional and bidirectional DC-DC converters,
- On-Board battery Chargers

Product validation

Qualified according to AEC Q101

Please note: For production part approval process (PPAP) release we propose to share application related information during an early design phase to avoid delays in PPAP release. Please contact Infineon sales office. The source and sense source pins are not exchangeable. Their exchange might lead to malfunction. For paralleling 4pin MOSFET devices the placement of the gate resistor is generally recommended to be on the Driver Source instead of the Gate.

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	650	V
$R_{DS(on),max}$	40	mΩ
$Q_{g,typ}$	97	nC
$I_{D,pulse}$	211	A
E_{oss} @ 400V	14.8	µJ
Body diode di_F/dt	1300	A/µs

Type / Ordering Code	Package	Marking	Related Links
IPQC65R040CFD7A	PG-HDSOP-22	65A040F7	see Appendix A

Table of Contents

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	- -	- -	64 40	A	T_C=25°C T_C=100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	211	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	248	mJ	I_D=6.4A; V_{DD}=50V; see table 10
Avalanche current, single pulse	I_{AS}	-	-	6.4	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)	$V_{GS,pulse}$	-30	-	30	V	$f_{repetition}$<=100kHz, t_{pulse} <= 2ns
Power dissipation	P_{tot}	-	-	357	W	T_C=25°C
Storage temperature	T_{stg}	-55	-	150	°C	-
Operating junction temperature	T_j	-40	-	150	°C	-
Mounting torque	-	-	-	n.a.	Ncm	-
Continuous diode forward current	I_S	-	-	64	A	T_C=25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	211	A	T_C=25°C
Reverse diode dv/dt[3]	dv/dt	-	-	70	V/ns	V_{DS}=0...400V, I_{SD}<=24.8A, T_j=25°C see table 8
Maximum diode commutation speed	di_F/dt	-	-	1300	A/µs	V_{DS}=0...400V, I_{SD}<=24.8A, T_j=25°C see table 8

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

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	0.35	°C/W	-
Soldering temperature, reflow soldering allowed	T_{sold}	-	-	260	°C	reflow MSL1

3 Electrical characteristics

at T_j=25°C, unless otherwise specified

Table 4 Static characteristics

For applications with applied blocking voltage > 425 V, it is required that the customer evaluates the impact of cosmic radiation effect in early design phase and contacts the Infineon sales office for the necessary technical support by Infineon.

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	650	-	-	V	V_{GS}=0V, I_D=1mA
Gate threshold voltage[1]	$V_{(GS)th}$	3.5	4	4.5	V	V_{DS}=V_{GS}, I_D=1.24mA
Zero gate voltage drain current	I_{DSS}	- -	- 120	1 -	µA	V_{DS}=650V, V_{GS}=0V, T_j=25°C V_{DS}=650V, V_{GS}=0V, T_j=150°C
Gate-source leakage current	I_{GSS}	-	-	0.1	µA	V_{GS}=20V, V_{DS}=0V
Drain-source on-state resistance	$R_{DS(on)}$	- -	0.034 0.076	0.040 -	Ω	V_{GS}=10V, I_D=24.8A, T_j=25°C V_{GS}=10V, I_D=24.8A, T_j=150°C
Gate resistance	R_G	-	3.8	-	Ω	f=250kHz, open drain

Table 5 Dynamic characteristics

External parasitic elements (PCB layout) influence switching behavior significantly.
Stray inductances and coupling capacitances must be minimized.
For layout recommendations please use provided application notes or contact Infineon sales office.

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	4975	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Output capacitance	C_{oss}	-	75	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Effective output capacitance, energy related[2]	$C_{o(er)}$	-	185	-	pF	V_{GS}=0V, V_{DS}=0...400V
Effective output capacitance, time related[3]	$C_{o(tr)}$	-	1957	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...400V
Turn-on delay time	$t_{d(on)}$	-	34	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=24.8A, R_G=3.3Ω; see table 9
Rise time	t_r	-	10	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=24.8A, R_G=3.3Ω; see table 9
Turn-off delay time	$t_{d(off)}$	-	115	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=24.8A, R_G=3.3Ω; see table 9
Fall time	t_f	-	3	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=24.8A, R_G=3.3Ω; see table 9

[1] We do not recommend using the CoolMOS mentioned in this datasheet to operate in "linear mode". For assessment of potential "linear mode", please contact Infineon sales office.
[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 400V
[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 400V

Table 6 Gate charge characteristics

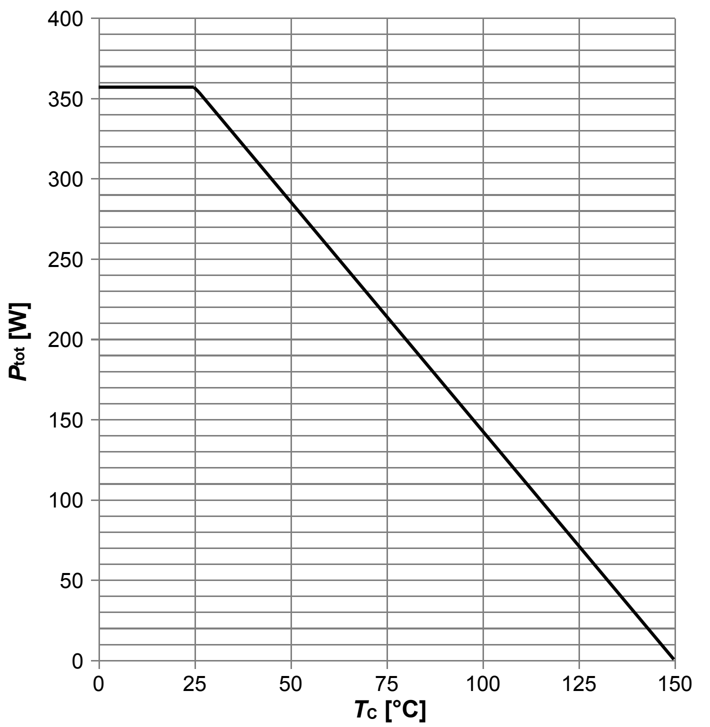
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	29	-	nC	V_{DD}=400V, I_D=24.8A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	29	-	nC	V_{DD}=400V, I_D=24.8A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	97	-	nC	V_{DD}=400V, I_D=24.8A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.7	-	V	V_{DD}=400V, I_D=24.8A, V_{GS}=0 to 10V

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	1.0	-	V	V_{GS}=0V, I_F=24.8A, T_j=25°C
Reverse recovery time	t_{rr}	-	180	-	ns	V_R=400V, I_F=24.8A, di_F/dt=100A/µs; see table 8
Reverse recovery charge	Q_{rr}	-	1.30	-	µC	V_R=400V, I_F=24.8A, di_F/dt=100A/µs; see table 8
Peak reverse recovery current	I_{rrm}	-	11.8	-	A	V_R=400V, I_F=24.8A, di_F/dt=100A/µs; see table 8

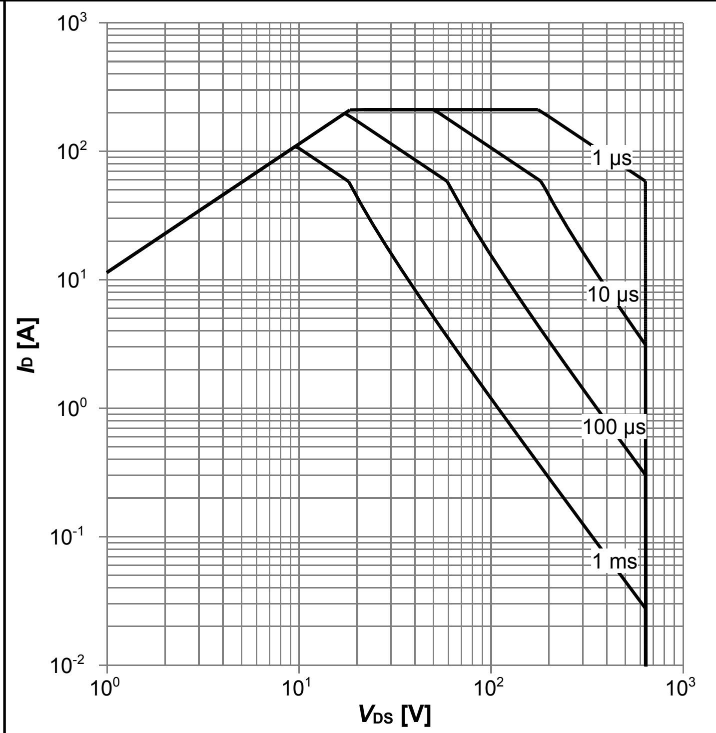
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



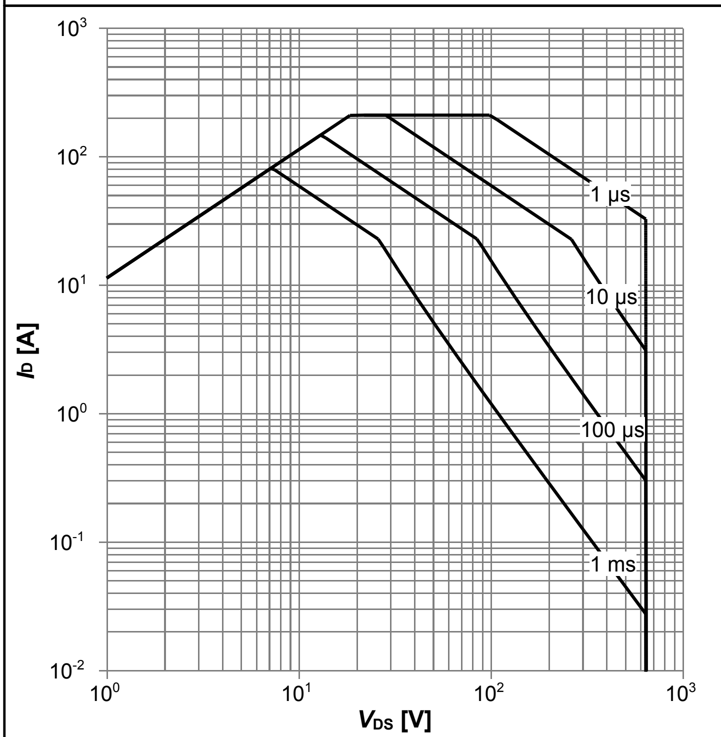
P_{tot}=f(T_C)

Diagram 2: Safe operating area



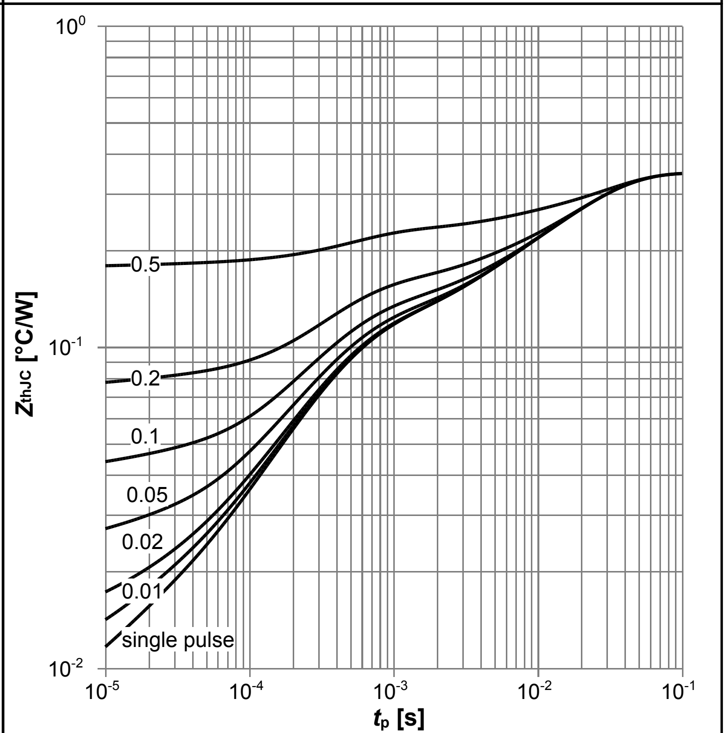
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter: t_p

Diagram 3: Safe operating area



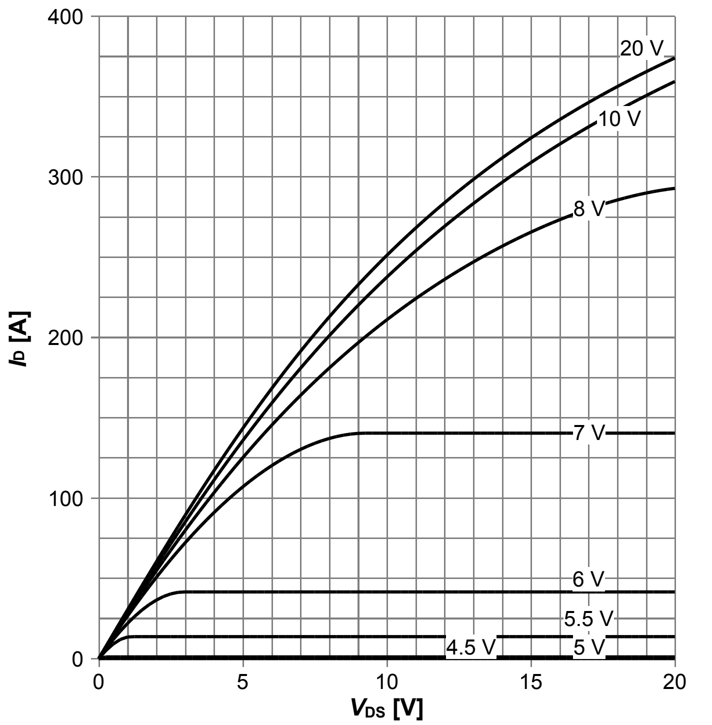
I_D=f(V_{DS}); T_C=80 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



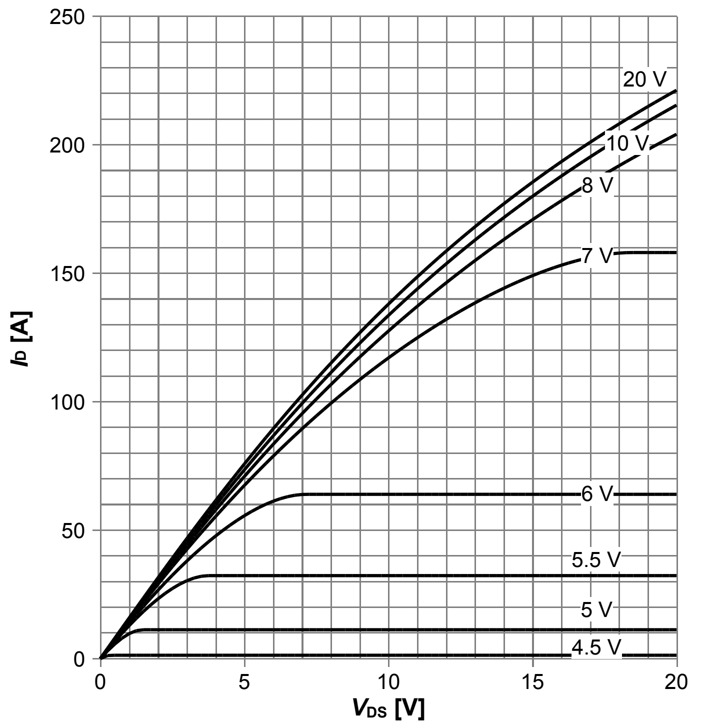
Z_{thJC} =f(t_P); parameter: D=t_p/T

Diagram 5: Typ. output characteristics



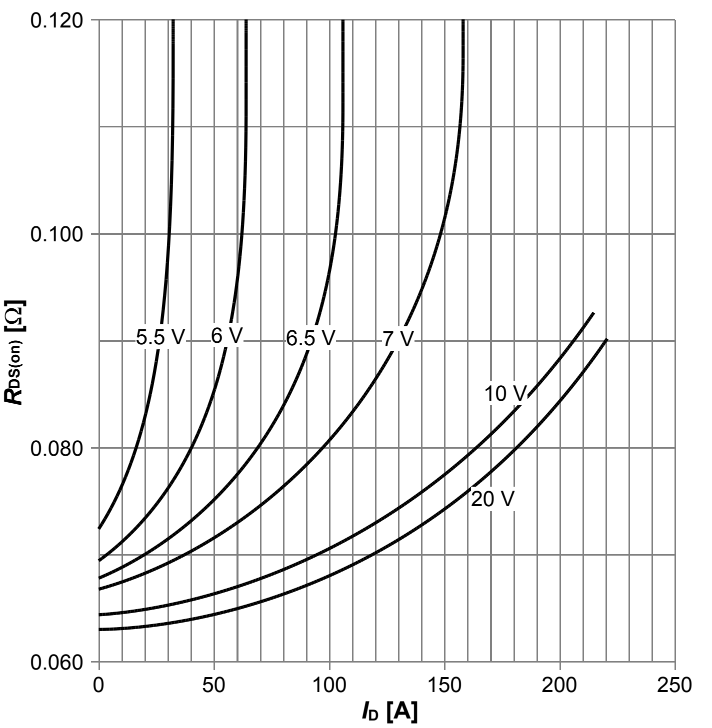
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



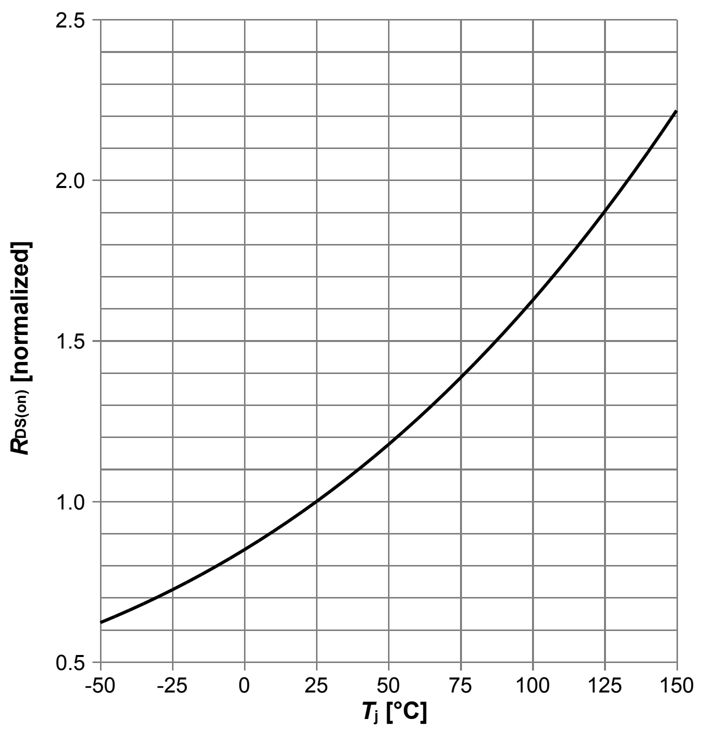
I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}

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



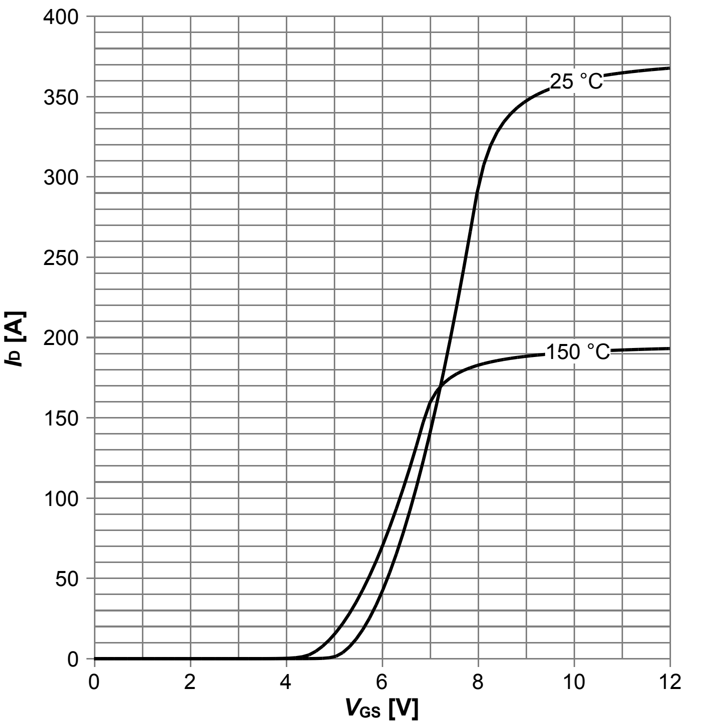
$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



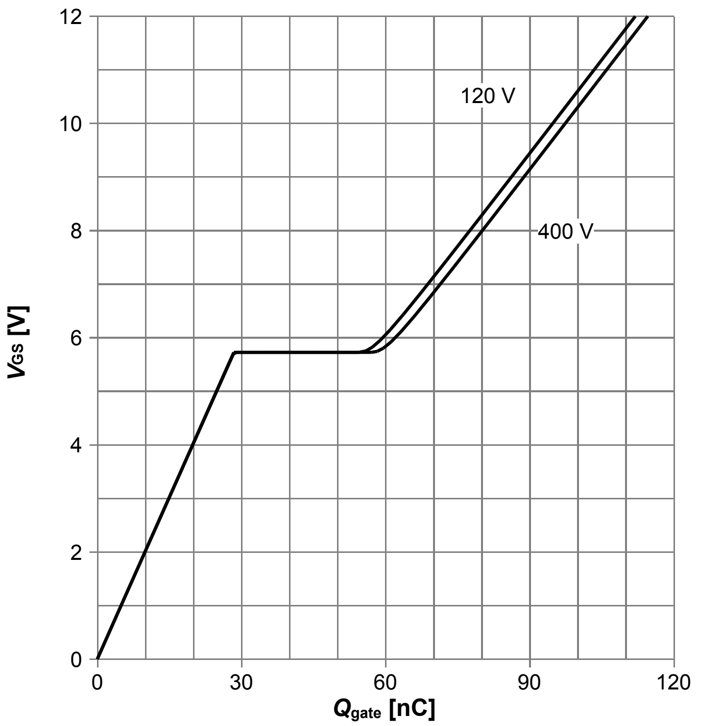
$R_{DS(on)}$=f(T_j); I_D=24.8 A; V_{GS}=10 V

Diagram 9: Typ. transfer characteristics



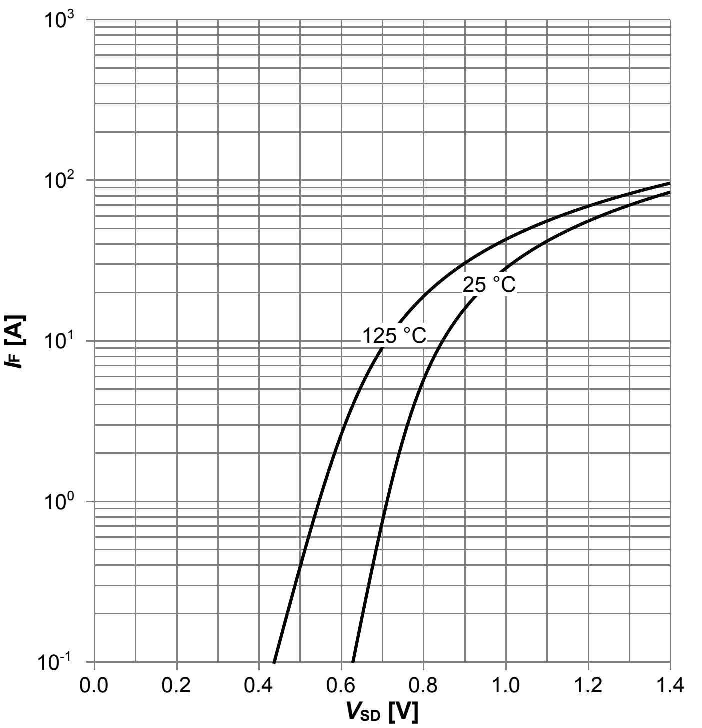
I_D=f(V_{GS}); V_{DS}=20V; parameter: T_j

Diagram 10: Typ. gate charge



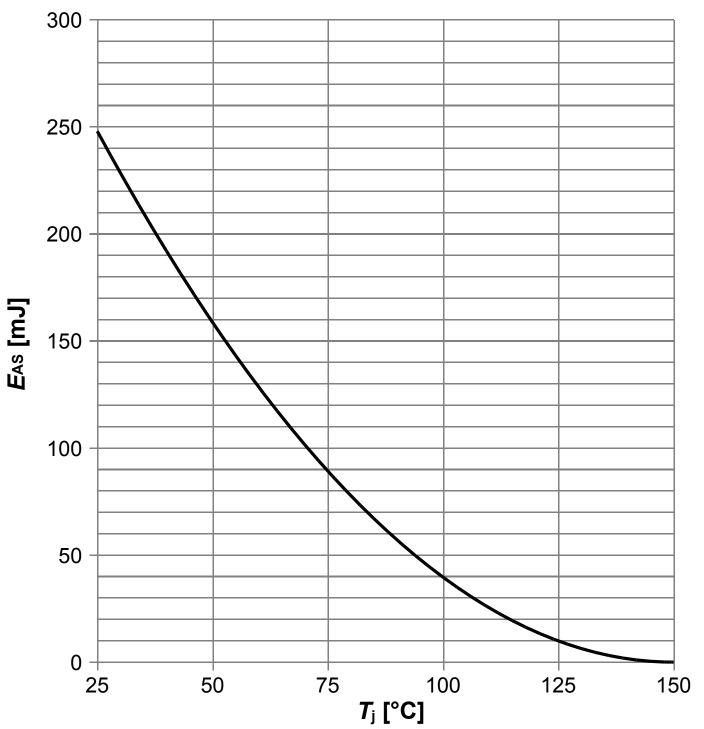
V_{GS}=f(Q_{gate}); I_D=24.8 A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



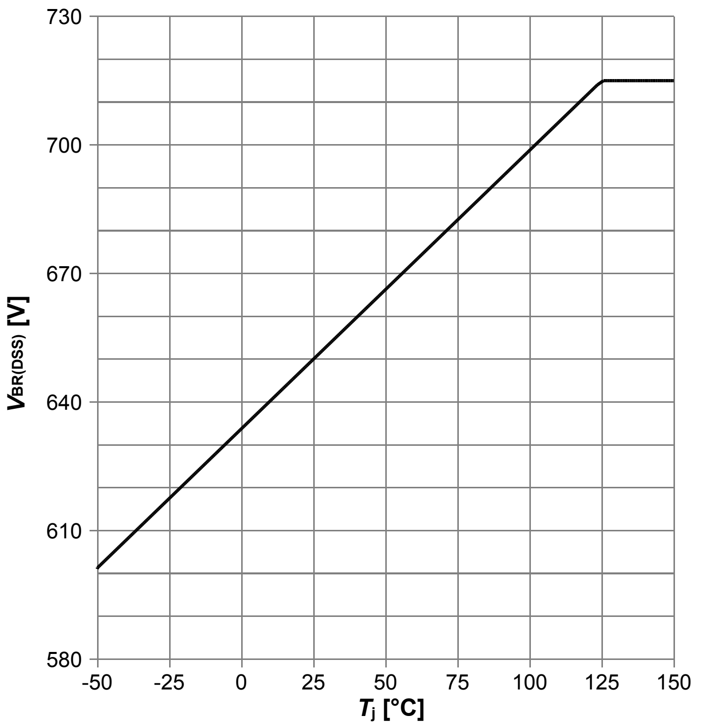
I_F=f(V_{SD}); parameter: T_j

Diagram 12: Avalanche energy



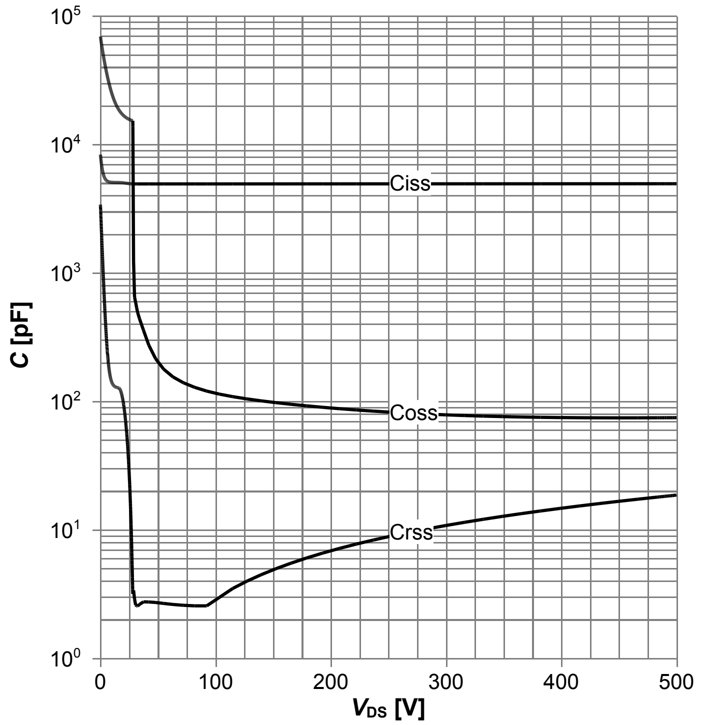
E_{AS}=f(T_j); I_D=6.4 A; V_{DD}=50 V

Diagram 13: Drain-source breakdown voltage



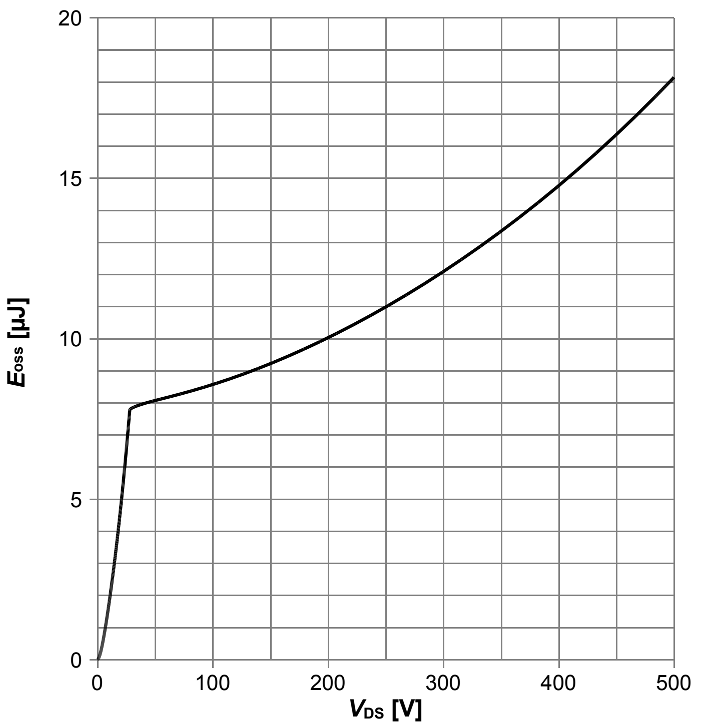
$V_{BR(DSS)}$=f(T_j); I_D=1 mA

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})

5 Test Circuits

Table 8 Diode characteristics

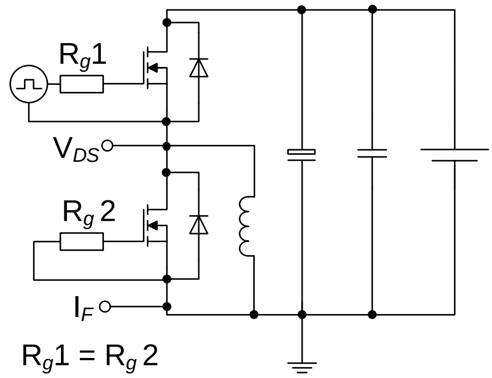
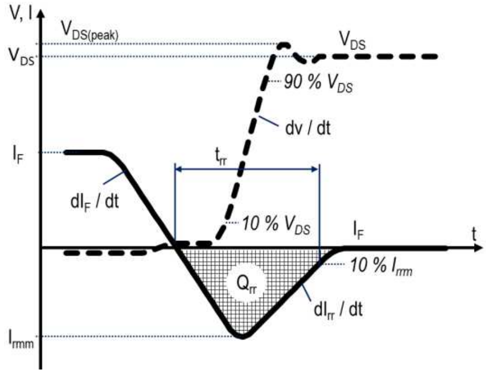
Test circuit for diode characteristics	Diode recovery waveform
	

Table 9 Switching times (ss)

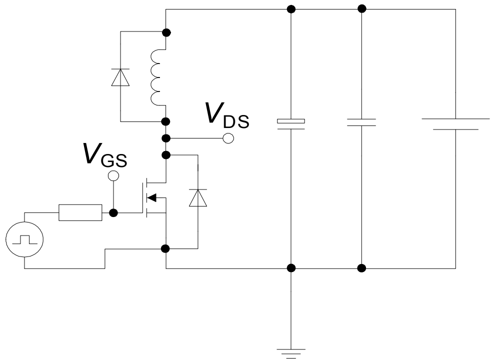
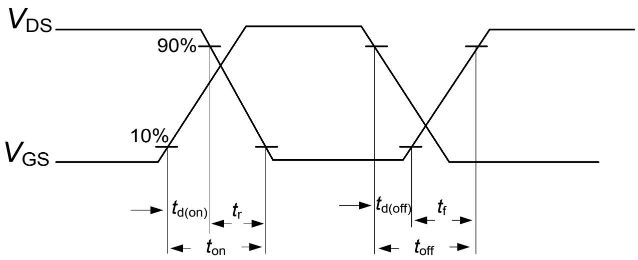
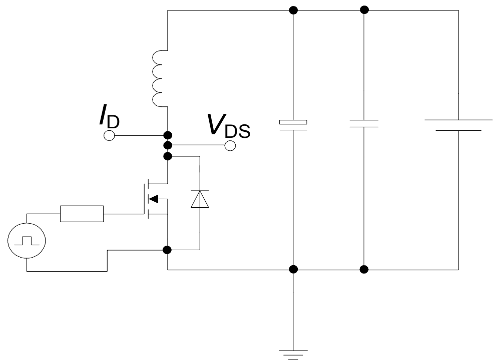
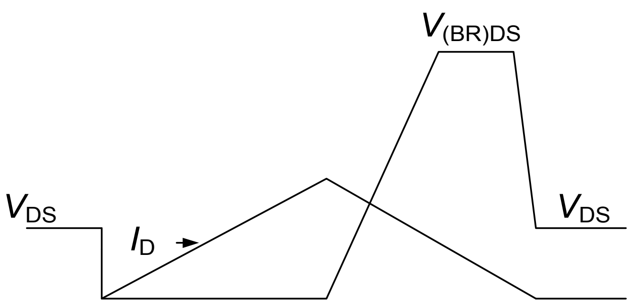
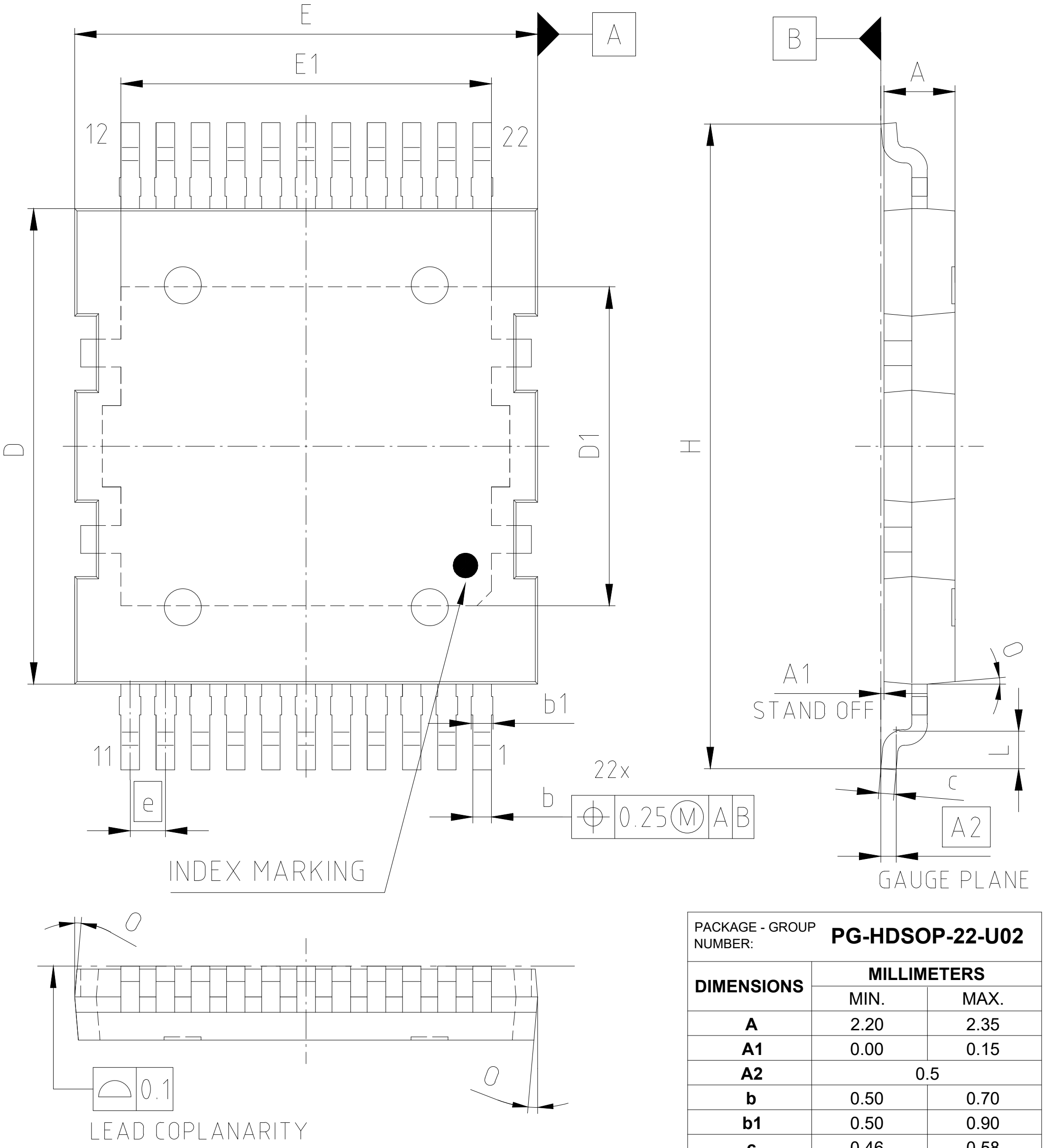
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load (ss)

Unclamped inductive load test circuit	Unclamped inductive waveform
	

6 Package Outlines



PACKAGE - GROUP NUMBER:	PG-HDSOP-22-U02	
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	2.20	2.35
A1	0.00	0.15
A2	0.5	
b	0.50	0.70
b1	0.50	0.90
c	0.46	0.58
D	15.30	15.50
D1	10.23	10.43
E	14.90	15.10
E1	11.91	12.11
e	1.14	
N	22	
H	20.81	21.11
L	1.20	1.40
O	5°	

Figure 1 Outline PG-HDSOP-22, dimensions in mm

7 Appendix A

Table 11 Related Links

- **IFX CoolMOS CFD7A Webpage:** www.infineon.com
- **IFX CoolMOS CFD7A application note:** www.infineon.com
- **IFX CoolMOS CFD7A simulation model:** www.infineon.com
- **IFX Design tools:** www.infineon.com

Revision History

IPQC65R040CFD7A

Revision: 2022-12-02, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2022-12-02	Release of final version

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