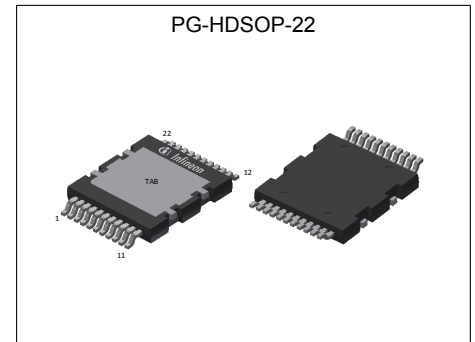


MOSFET

650V CoolMOS™ CFD7 SJ Power Device

The latest 650 V CoolMOS™ CFD7 extends the voltage class offering of the CFD7 family and is a successor to the 650 V CoolMOS™ CFD2. Resulting from improved switching performance and excellent thermal behavior, 650 V CoolMOS™ CFD7 offers highest efficiency in resonant switching topologies, such as LLC and phase-shift-full-bridge (ZVS). As part of Infineon's fast body diode portfolio, this new product series blends all advantages of a fast switching technology together with superior hard commutation robustness. The CoolMOS™ CFD7 technology meets highest efficiency and reliability standards and furthermore supports high power density solutions.



Features

- Ultra-fast body diode
- 650V break down voltage
- Best-in-class $R_{DS(on)}$
- Reduced switching losses
- Low $R_{DS(on)}$ dependency over temperature

Benefits

- Excellent hard commutation ruggedness
- Extra safety margin for designs with increased bus voltage
- Enabling increased power density solutions
- Outstanding light load efficiency in industrial SMPS applications
- Improved full load efficiency in industrial SMPS applications

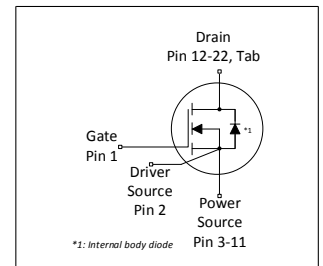
Potential applications

Optimized for phase-shift full-bridge (ZVS), LLC Applications – Server, Telecom, EV Charging, Solar

Product validation

Fully qualified according to JEDEC for Industrial Applications

Please note: 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.



RoHS

Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	700	V
$R_{DS(on),max}$	60	mΩ
$Q_{g,typ}$	65	nC
$I_{D,pulse}$	139	A
$E_{oss} @ 400V$	10.0	μJ
Body diode di_F/dt	1300	A/μs

Type / Ordering Code	Package	Marking	Related Links
IPDQ65R060CFD7	PG-HDSOP-22	65R060F7	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	-	-	45 29	A	$T_C=25^\circ\text{C}$ $T_C=100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$	-	-	139	A	$T_C=25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}	-	-	164	mJ	$I_D=5.1\text{A}$; $V_{DD}=50\text{V}$; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	0.82	mJ	$I_D=5.1\text{A}$; $V_{DD}=50\text{V}$; see table 10
Avalanche current, single pulse	I_{AS}	-	-	5.1	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}	-	-	272	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 ¹⁾	I_S	-	-	45	A	$T_C=25^\circ\text{C}$
Diode pulse current ²⁾	$I_{S,pulse}$	-	-	139	A	$T_C=25^\circ\text{C}$
Reverse diode dv/dt ³⁾	dv/dt	-	-	70	V/ns	$V_{DS}=0\dots400\text{V}$, $I_{SD}\leq 16.4\text{A}$, $T_j=25^\circ\text{C}$ see table 8
Maximum diode commutation speed	diF/dt	-	-	1300	A/ μs	$V_{DS}=0\dots400\text{V}$, $I_{SD}\leq 16.4\text{A}$, $T_j=25^\circ\text{C}$ 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 with identical R_θ .

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	0.46	°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}	-	45	55	°C/W	Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm ² (one layer, 70µm thickness) copper area. Tap exposed to air. 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	$V_{(BR)DSS}$	650	-	-	V	$V_{GS}=0V$, $I_D=1mA$
Gate threshold voltage	$V_{(GS)th}$	3.5	4	4.5	V	$V_{DS}=V_{GS}$, $I_D=0.82mA$
Zero gate voltage drain current ¹⁾	I_{DSS}	-	-	1	μA	$V_{DS}=650V$, $V_{GS}=0V$, $T_j=25^\circ\text{C}$ $V_{DS}=650V$, $V_{GS}=0V$, $T_j=125^\circ\text{C}$
Gate-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS}=20V$, $V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.052 0.115	0.060 -	Ω	$V_{GS}=10V$, $I_D=16.4A$, $T_j=25^\circ\text{C}$ $V_{GS}=10V$, $I_D=16.4A$, $T_j=150^\circ\text{C}$
Gate resistance	R_G	-	5.9	-	Ω	$f=1MHz$, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	3288	-	pF	$V_{GS}=0V$, $V_{DS}=400V$, $f=250kHz$
Output capacitance	C_{oss}	-	51	-	pF	$V_{GS}=0V$, $V_{DS}=400V$, $f=250kHz$
Effective output capacitance, energy related ²⁾	$C_{o(er)}$	-	125	-	pF	$V_{GS}=0V$, $V_{DS}=0...400V$
Effective output capacitance, time related ³⁾	$C_{o(tr)}$	-	1318	-	pF	$I_D=\text{constant}$, $V_{GS}=0V$, $V_{DS}=0...400V$
Turn-on delay time	$t_{d(on)}$	-	34	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=16.4A$, $R_G=5.3\Omega$; see table 9
Rise time	t_r	-	12	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=16.4A$, $R_G=5.3\Omega$; see table 9
Turn-off delay time	$t_{d(off)}$	-	130	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=16.4A$, $R_G=5.3\Omega$; see table 9
Fall time	t_f	-	4	-	ns	$V_{DD}=400V$, $V_{GS}=13V$, $I_D=16.4A$, $R_G=5.3\Omega$; see table 9

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	19	-	nC	$V_{DD}=400V$, $I_D=16.4A$, $V_{GS}=0$ to $10V$
Gate to drain charge	Q_{gd}	-	20	-	nC	$V_{DD}=400V$, $I_D=16.4A$, $V_{GS}=0$ to $10V$
Gate charge total	Q_g	-	65	-	nC	$V_{DD}=400V$, $I_D=16.4A$, $V_{GS}=0$ to $10V$
Gate plateau voltage	$V_{plateau}$	-	5.7	-	V	$V_{DD}=400V$, $I_D=16.4A$, $V_{GS}=0$ to $10V$

¹⁾ Maximum specification is defined by calculated six sigma upper confidence bound

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 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	1.0	-	V	$V_{GS}=0V$, $I_F=16.4A$, $T_J=25^{\circ}C$
Reverse recovery time	t_{rr}	-	141	212	ns	$V_R=400V$, $I_F=16.4A$, $di_F/dt=100A/\mu s$; see table 8
Reverse recovery charge	Q_{rr}	-	0.86	1.72	μC	$V_R=400V$, $I_F=16.4A$, $di_F/dt=100A/\mu s$; see table 8
Peak reverse recovery current	I_{rrm}	-	9.8	-	A	$V_R=400V$, $I_F=16.4A$, $di_F/dt=100A/\mu s$; see table 8

4 Electrical characteristics diagrams

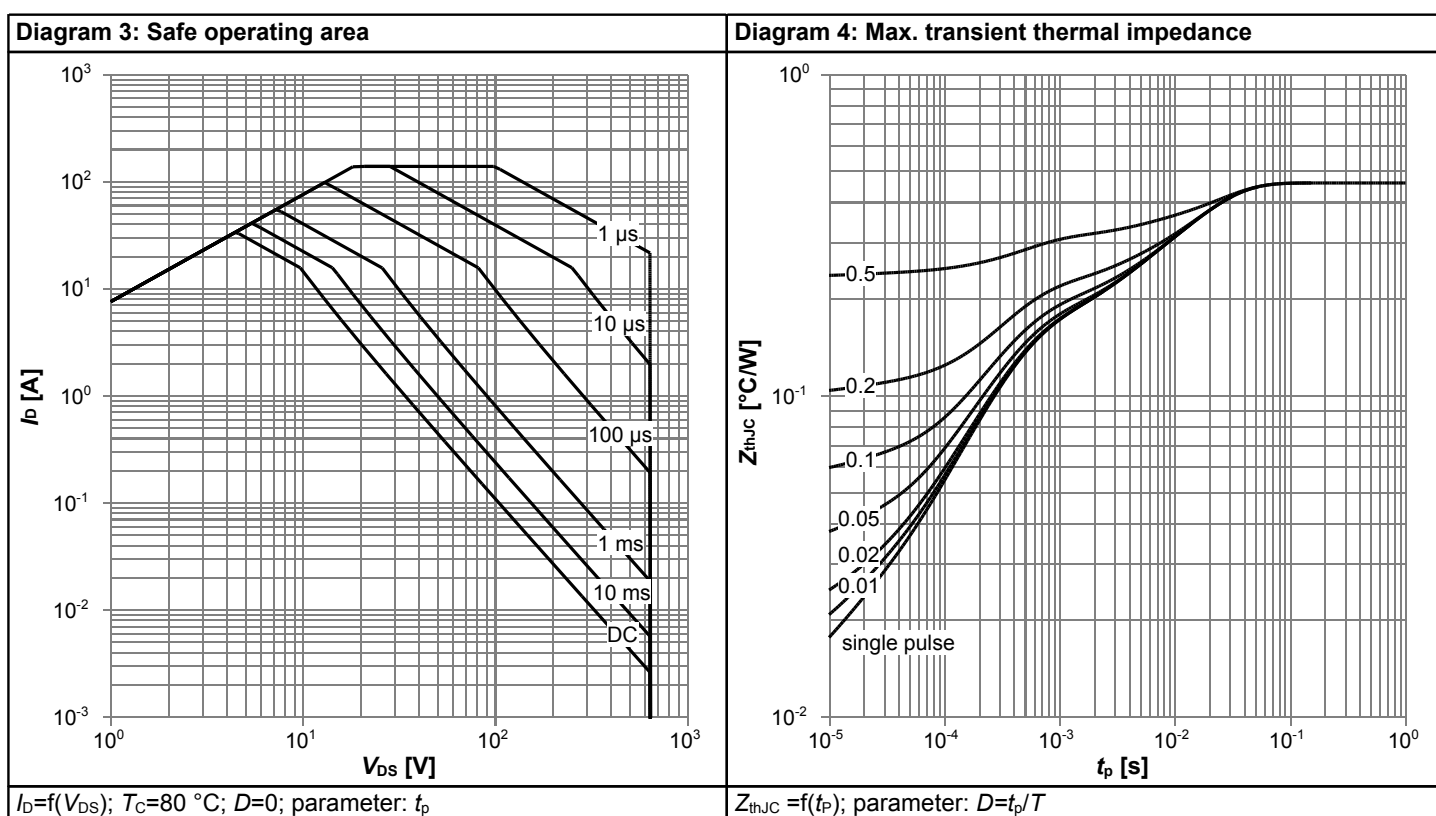
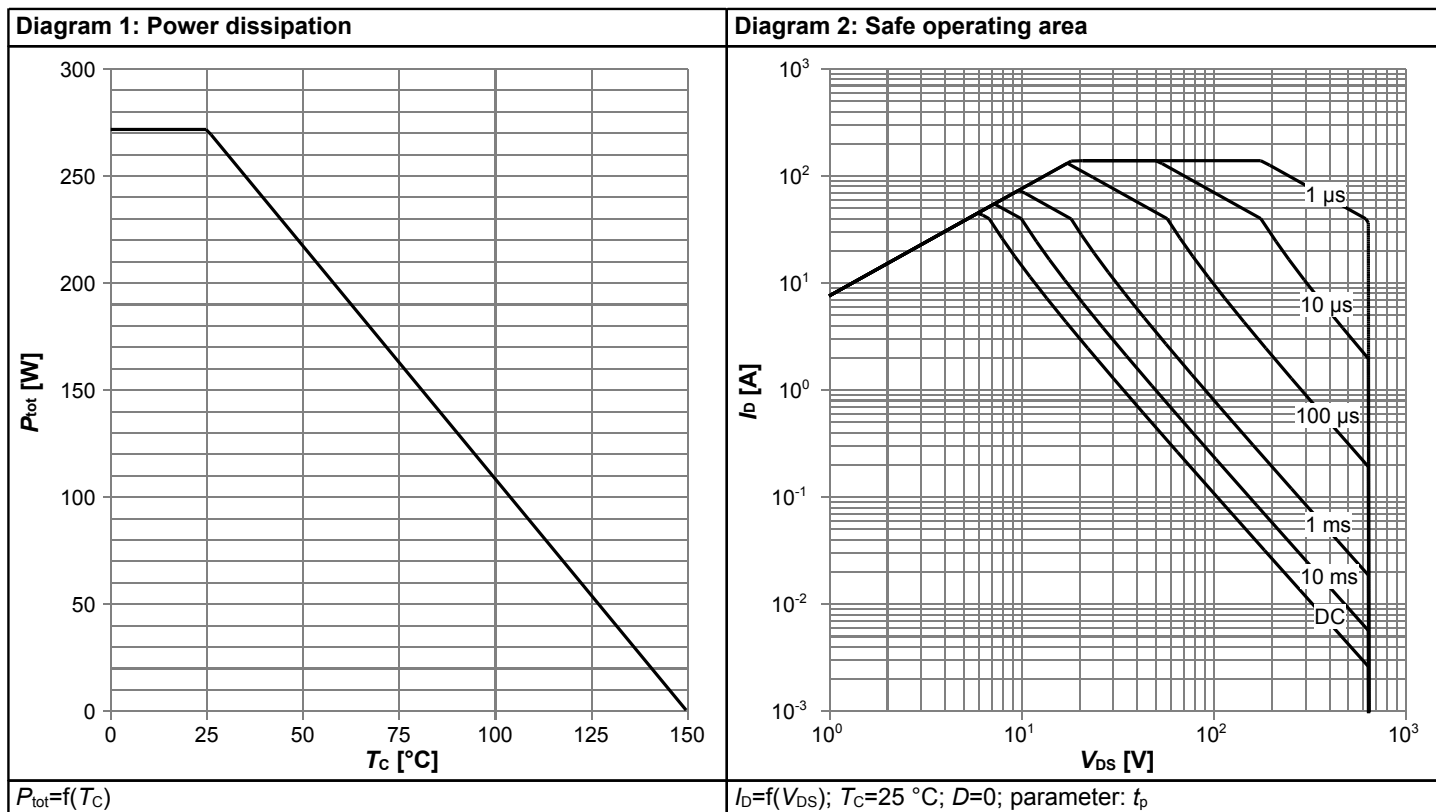
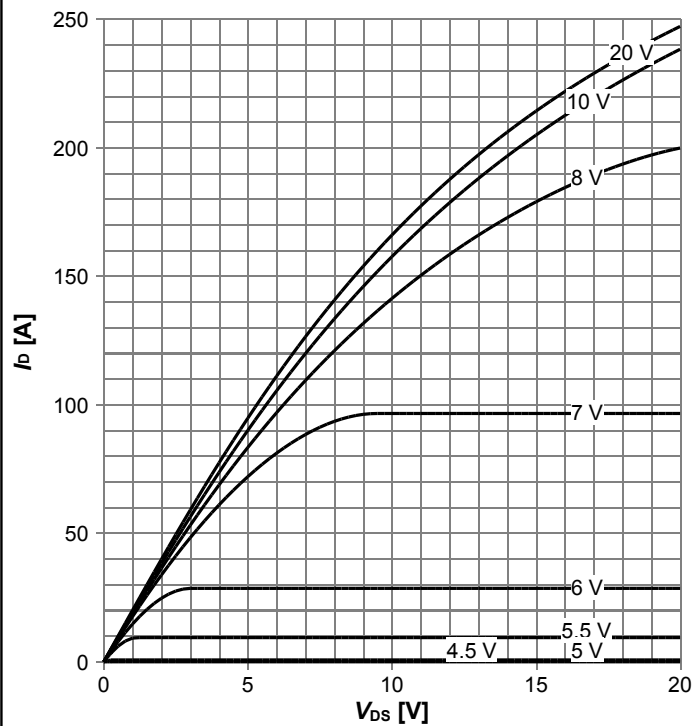
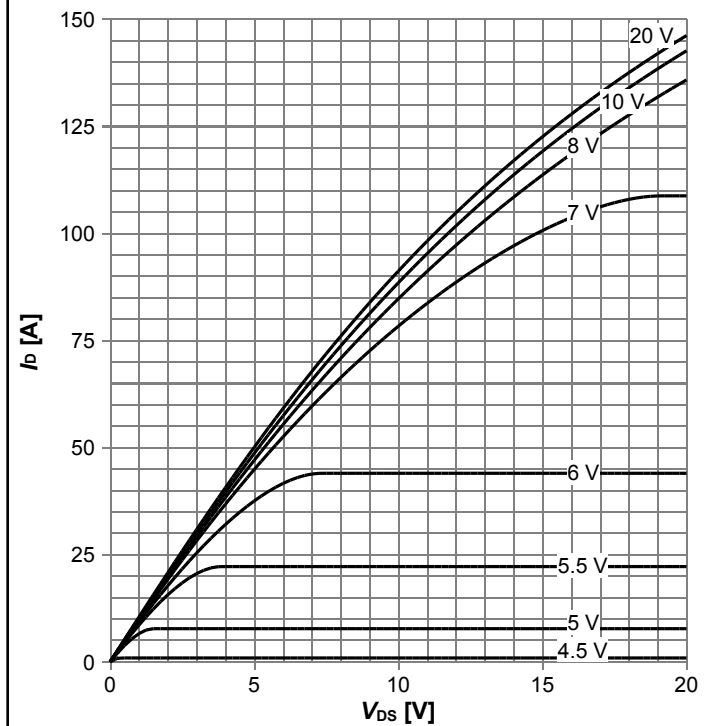


Diagram 5: Typ. output characteristics



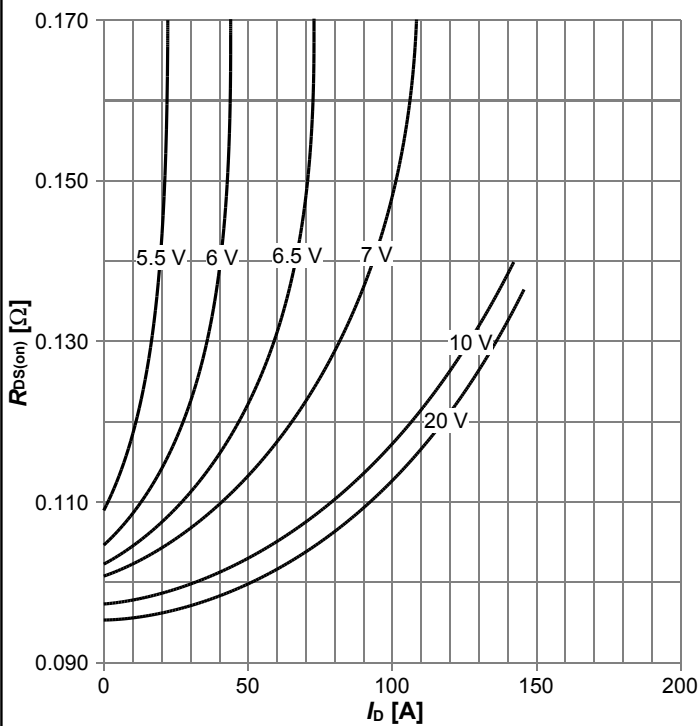
$I_D = f(V_{DS})$; $T_j = 25\text{ °C}$; parameter: V_{GS}

Diagram 6: Typ. output characteristics



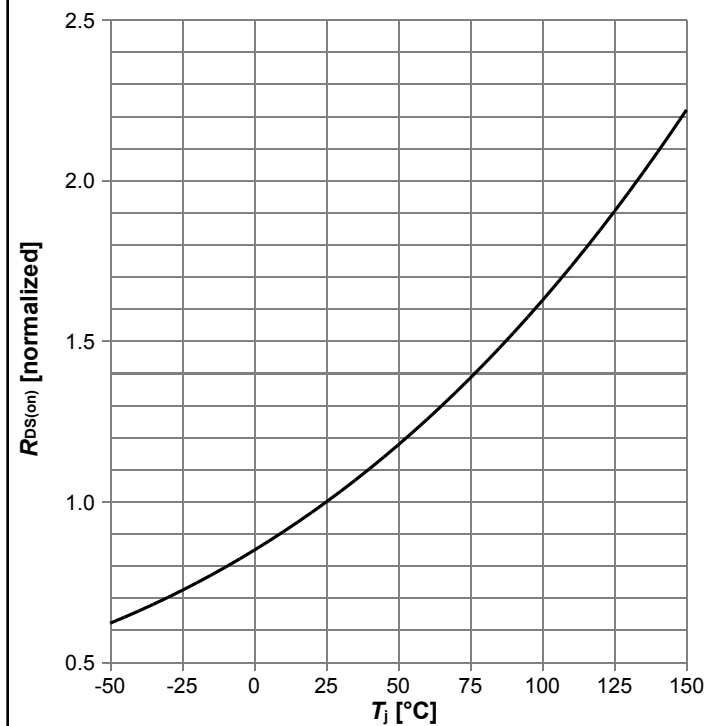
$I_D = f(V_{DS})$; $T_j = 125\text{ °C}$; parameter: V_{GS}

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



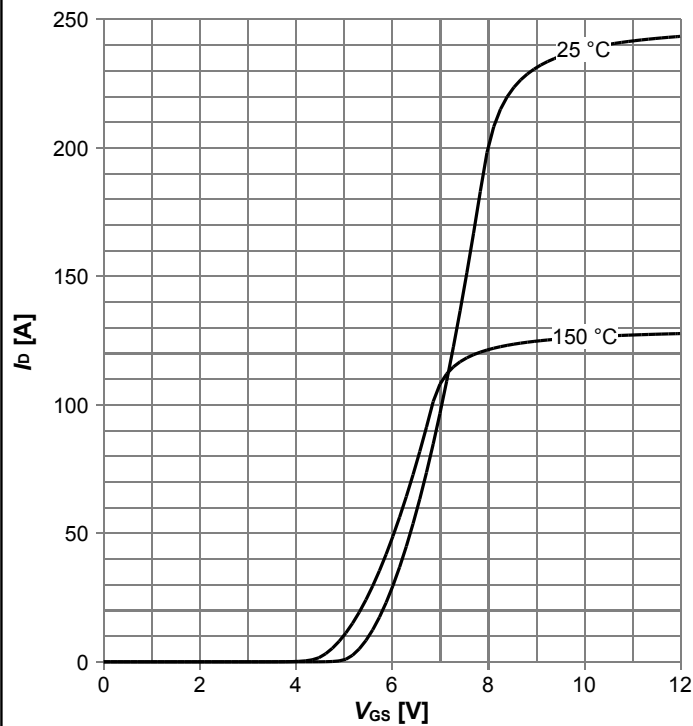
$R_{DS(on)} = f(I_D)$; $T_j = 125\text{ °C}$; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



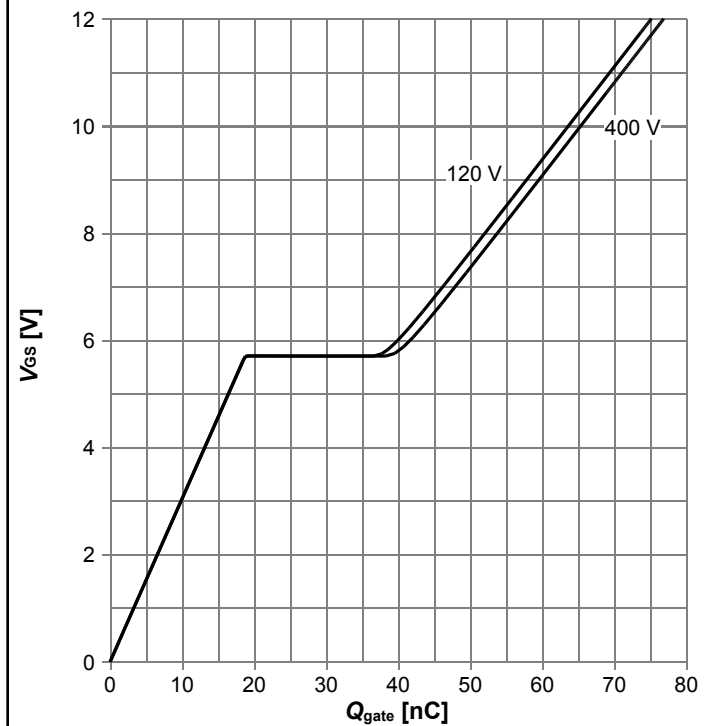
$R_{DS(on)} = f(T_j)$; $I_D = 16.4\text{ A}$; $V_{GS} = 10\text{ V}$

Diagram 9: Typ. transfer characteristics



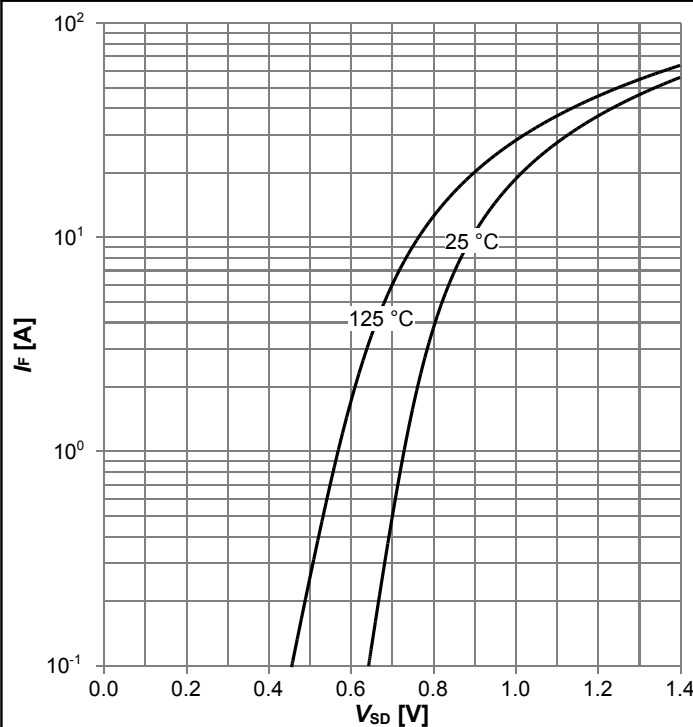
$I_D = f(V_{GS})$; $V_{DS} = 20$ V; parameter: T_j

Diagram 10: Typ. gate charge



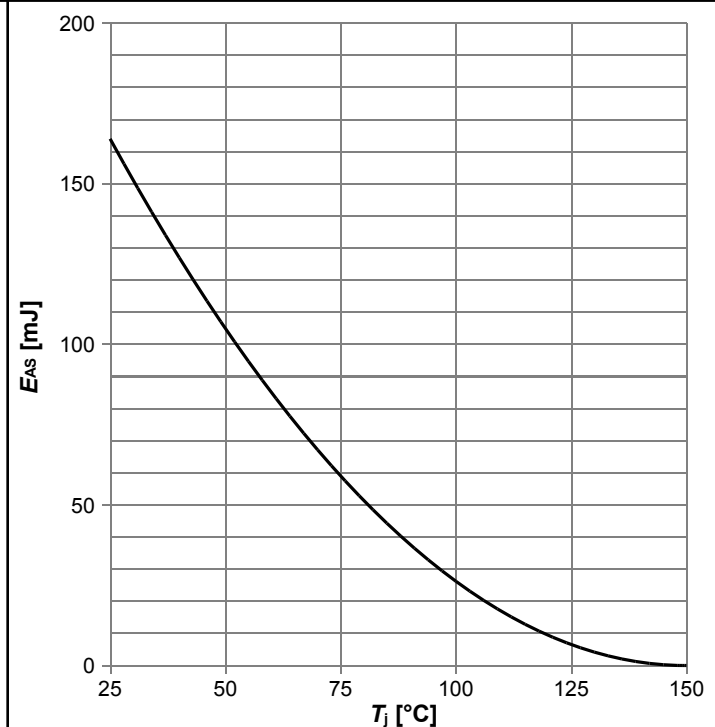
$V_{GS} = f(Q_{gate})$; $I_D = 16.4$ A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



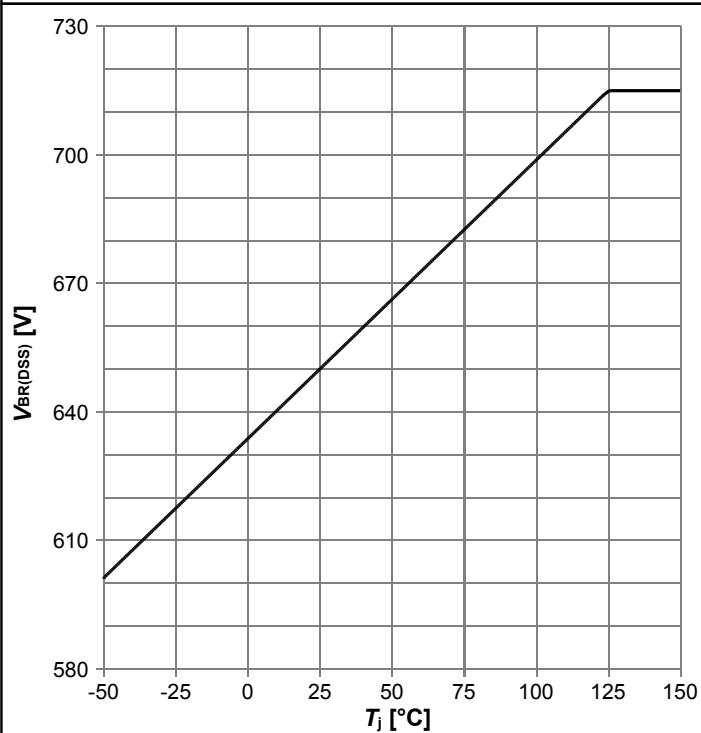
$I_F = f(V_{SD})$; parameter: T_j

Diagram 12: Avalanche energy



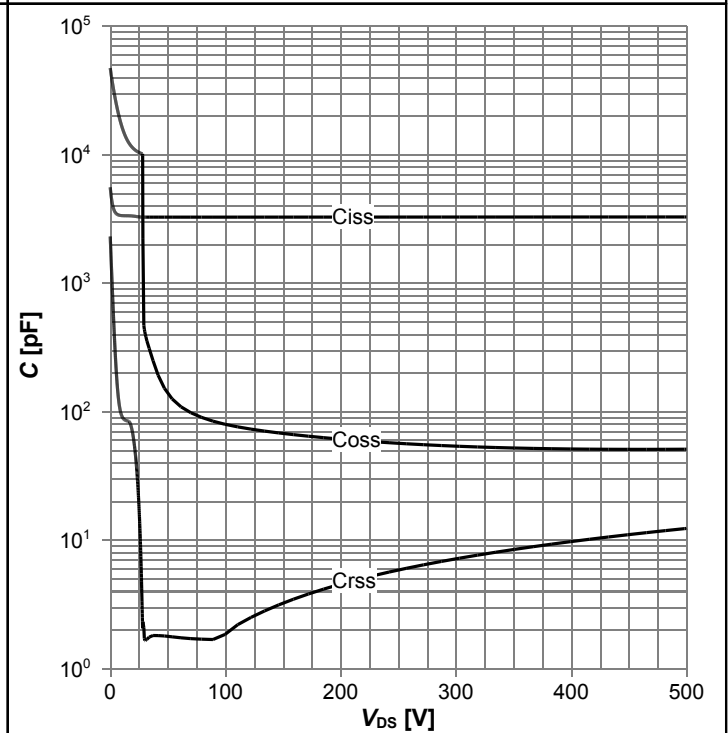
$E_{AS} = f(T_j)$; $I_D = 5.1$ A; $V_{DD} = 50$ V

Diagram 13: Drain-source breakdown voltage



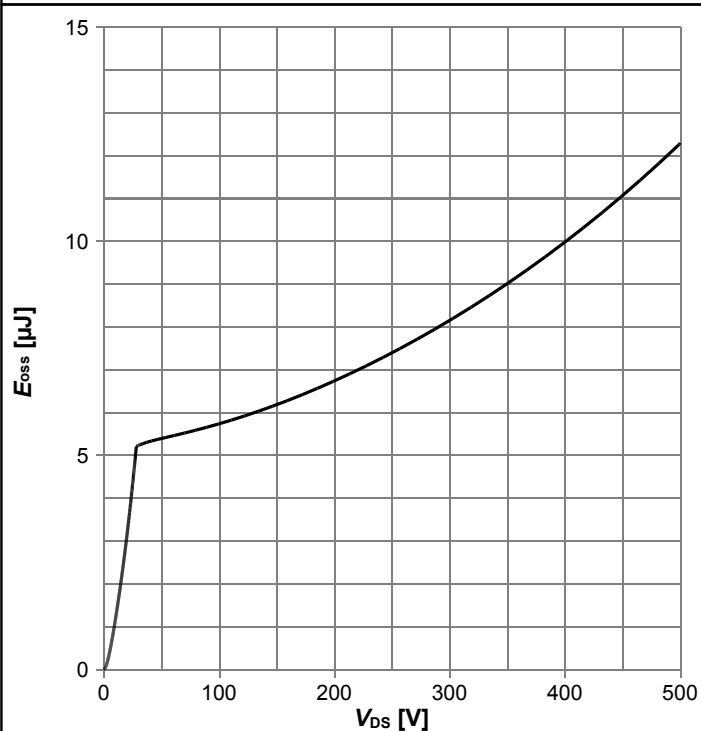
$V_{BR(DSS)} = f(T_J); I_D = 1 \text{ mA}$

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

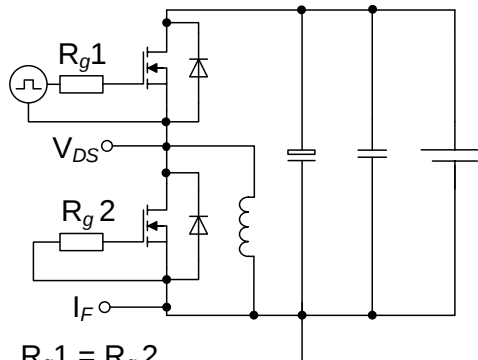
Test circuit for diode characteristics	Diode recovery waveform
 $R_{g1} = R_{g2}$	

Table 9 Switching times (ss)

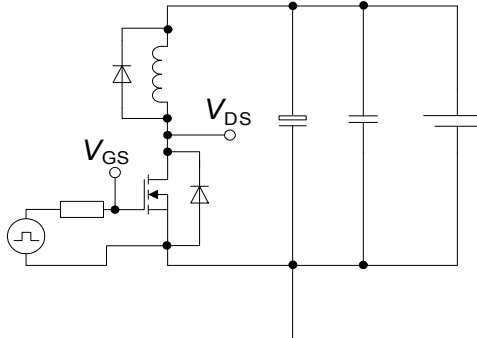
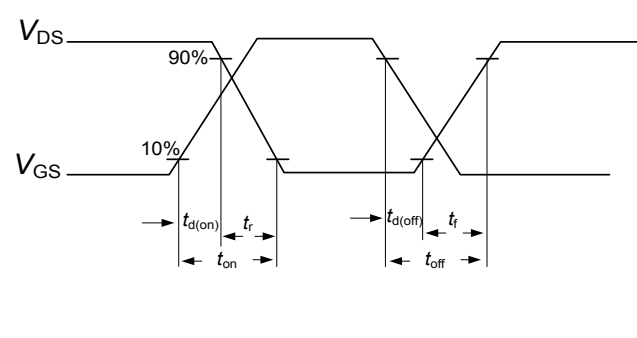
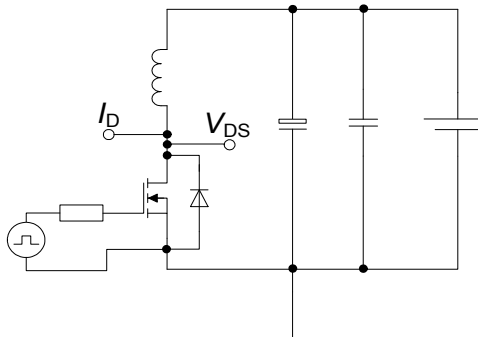
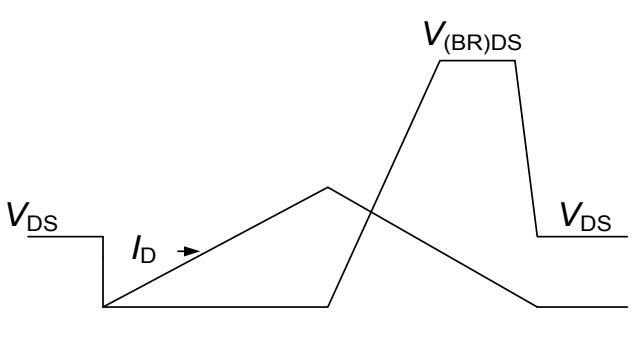
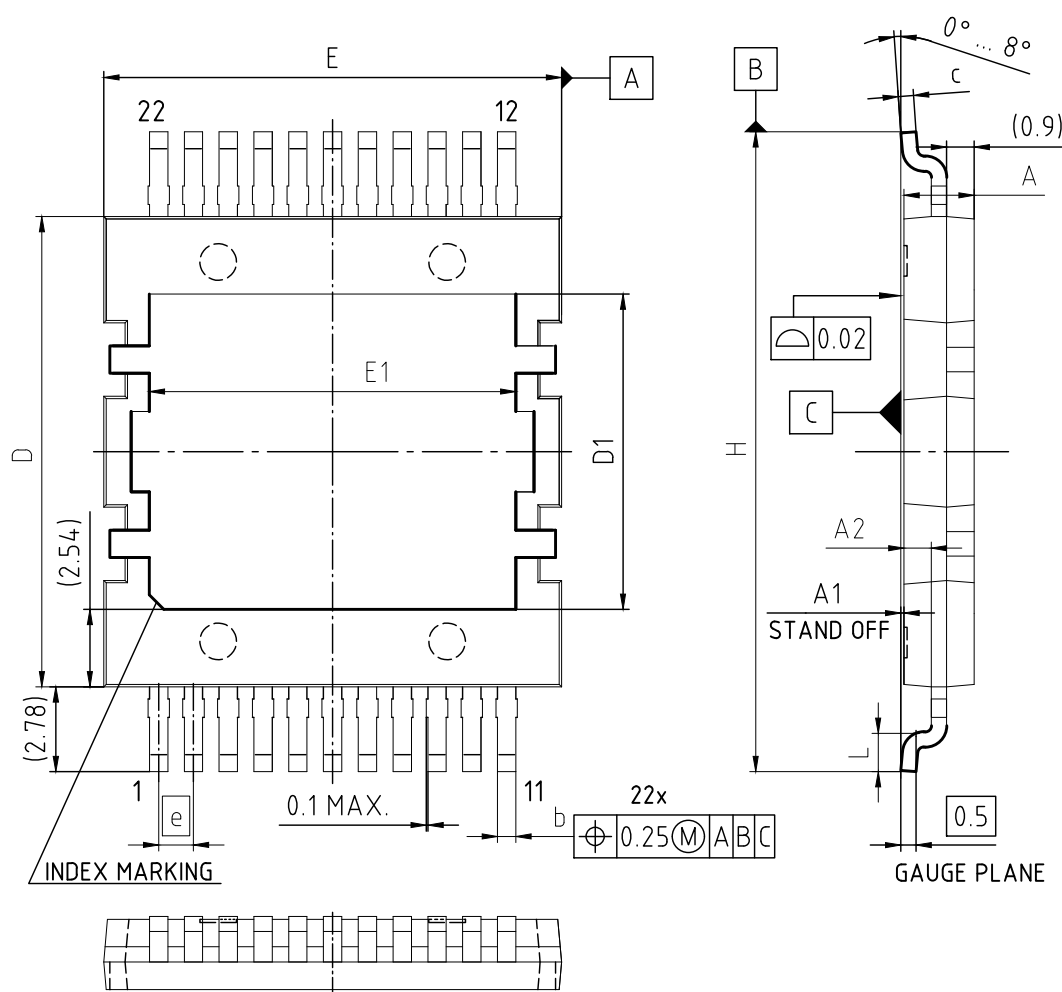
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load (ss)

Unclamped inductive load test circuit	Unclamped inductive waveform
	

6 Package Outlines



NOTES:

1. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-252 AND DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
2. ALL METAL SUFACES ARE TIN PLATED, EXCEPT AREA OF CUT.

DOCUMENT NO. Z8B00184650
REVISION 02
SCALE 5:1 0 1 2 3 4 5mm
EUROPEAN PROJECTION
ISSUE DATE 16.01.2018

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

7 Appendix A

Table 11 Related Links

- **IFX CoolMOS CFD7 650V Webpage:** www.infineon.com
- **IFX CoolMOS CFD7 650V application note:** www.infineon.com
- **IFX CoolMOS CFD7 650V simulation model:** www.infineon.com
- **IFX Design tools:** www.infineon.com

Revision History

IPDQ65R060CFD7

Revision: 2022-08-29, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2022-08-29	Release of final version

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