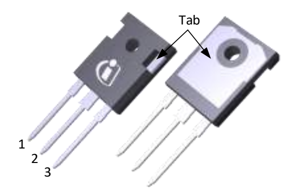
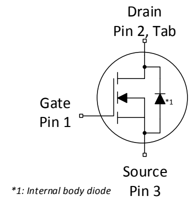
MOSFET

950V CoolMOS™ PFD7 SJ Power Device

The latest 950V CoolMOS™ PFD7 series sets a new benchmark in the super junction (SJ) technologies. This technology is designed to address Lighting and Industrial SMPS applications by combining best-in-class performance with state-of-the-art ease of use. Compared to the CoolMOS™ P7 families, the PFD7 offers an integrated ultra-fast body diode enabling usage in resonant topologies with markets lowest reverse recovery charge (Qrr).

PG-TO247-3





Features

- Integrated ultra-fast body diode
- Best-in-class reverse recovery charge Q_{rr}
- Best-in-class FOM $R_{DS(on)}$ * E_{oss}, reduced Q_g, C_{iss}, and C_{oss}
- Best-in-class $V_{(GS)th}$ of 3V and smallest $V_{(GS)th}$ variation of ±0.5V
- Integrated fast body diode
- Best-in-class CoolMOS™ quality and reliability
- Fully optimized portfolio
- Best-in-class $R_{DS(on)}$ in THD and SMD packages
- ESD protection min. Class 2 (HBM)

Benefits

- Excellent hard commutation robustness enabling usage in resonant topologies
- Extra safety margin for designs with increased bus voltage
- Enabling increased power density solutions
- Improved full load efficiency in industrial SMPS applications
- Price competitiveness over previous CoolMOS™ families
- Improved production yield by reducing ESD related failures

Potential applications

- Suitable for hard & soft switching topologies
- Optimized for usage in LLC and ZVS topologies
- PFC & LLC applications in Lighting and Industrial SMPS

Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ T_j = 25 °C	950	V
$R_{DS(on),max}$	130	mΩ
$Q_{g,typ}$	141	nC
I_D	36.5	A
E_{oss} @ 500V	9.5	µJ
Body diode di_F/dt	1300	A/µs
Q_{oss} @ 500V	0.33	µC

Type / Ordering Code	Package	Marking	Related Links
IPW95R130PFD7	PG-TO247-3	95R130D7	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	- -	- -	36.5 23.1	A	T_C=25°C T_C=100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	150	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	100	mJ	I_D=3.8A; V_{DD}=50V; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	0.77	mJ	I_D=3.8A; V_{DD}=50V; see table 10
Avalanche current, single pulse	I_{AS}	-	-	3.8	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}	-	-	227	W	T_C=25°C
Storage temperature	T_{stg}	-55	-	150	°C	-
Operating junction temperature	T_j	-55	-	150	°C	-
Mounting torque	-	-	-	60	Ncm	M3 and M3.5 screws
Continuous diode forward current	I_S	-	-	26	A	T_C=25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	150	A	T_C=25°C
Reverse diode dv/dt[3]	dv/dt	-	-	70	V/ns	V_{DS}=0...400V, I_{SD}<=26A, T_j=25°C see table 8
Maximum diode commutation speed	di_F/dt	-	-	1300	A/µs	V_{DS}=0...400V, I_{SD}<=26A, 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 $T_{j,max}$. Maximum Duty Cycle D = 0.50
[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}	-	-	0.55	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	62	°C/W	leaded
Thermal resistance, junction - ambient for SMD version	R_{thJA}	-	-	-	°C/W	n.a.
Soldering temperature, wavesoldering only allowed at leads	T_{sold}	-	-	260	°C	1.6mm (0.063 in.) from case for 10s

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	$V_{(BR)DSS}$	950	-	-	V	V_{GS}=0V, I_D=1mA
Gate threshold voltage	$V_{(GS)th}$	2.5	3	3.5	V	V_{DS}=V_{GS}, I_D=1.25mA
Zero gate voltage drain current	I_{DSS}	- -	- 100	1 -	µA	V_{DS}=950V, V_{GS}=0V, T_j=25°C V_{DS}=950V, 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	$R_{DS(on)}$	- -	0.1 0.27	0.13 -	Ω	V_{GS}=10V, I_D=25.1A, T_j=25°C V_{GS}=10V, I_D=25.1A, T_j=150°C
Gate resistance	R_G	-	0.9	-	Ω	f=250kHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	4170	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Output capacitance	C_{oss}	-	53	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Effective output capacitance, energy related[1]	$C_{o(er)}$	-	88	-	pF	V_{GS}=0V, V_{DS}=0...400V
Effective output capacitance, time related[2]	$C_{o(tr)}$	-	894	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...400V
Turn-on delay time	$t_{d(on)}$	-	25	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=25.1A, R_G=5.3Ω; see table 9
Rise time	t_r	-	14	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=25.1A, R_G=5.3Ω; see table 9
Turn-off delay time	$t_{d(off)}$	-	118	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=25.1A, R_G=5.3Ω; see table 9
Fall time	t_f	-	3.6	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=25.1A, R_G=5.3Ω; 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}=760V, I_D=25.1A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	43	-	nC	V_{DD}=760V, I_D=25.1A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	141	-	nC	V_{DD}=760V, I_D=25.1A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	4.5	-	V	V_{DD}=760V, I_D=25.1A, V_{GS}=0 to 10V

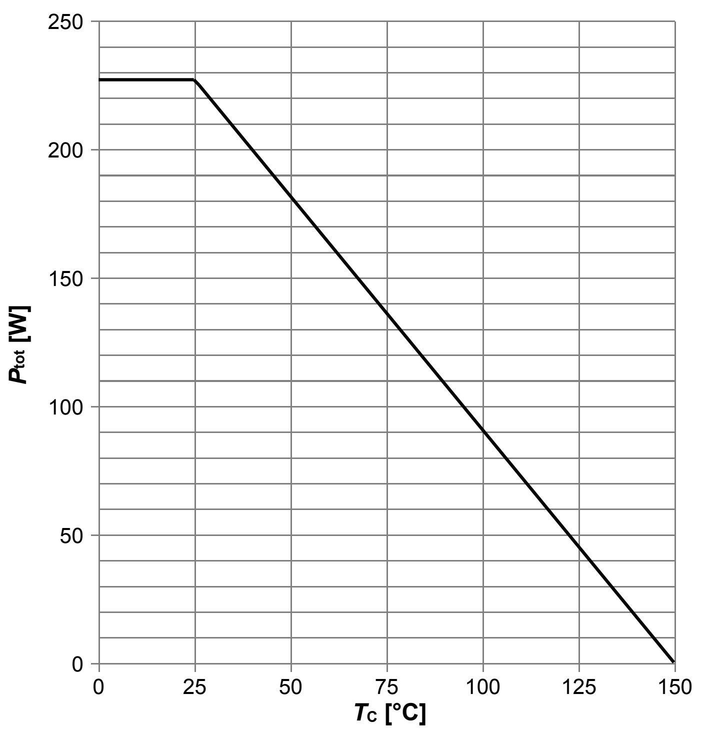
[1] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 400V
[2] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 400V

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	1.1	-	V	V_{GS}=0V, I_F=25.1A, T_j=25°C
Reverse recovery time	t_{rr}	-	153	-	ns	V_R=400V, I_F=25.1A, di_F/dt=100A/µs; see table 8
Reverse recovery charge	Q_{rr}	-	1.10	-	µC	V_R=400V, I_F=25.1A, di_F/dt=100A/µs; see table 8
Peak reverse recovery current	I_{rrm}	-	14.0	-	A	V_R=400V, I_F=25.1A, di_F/dt=100A/µs; see table 8

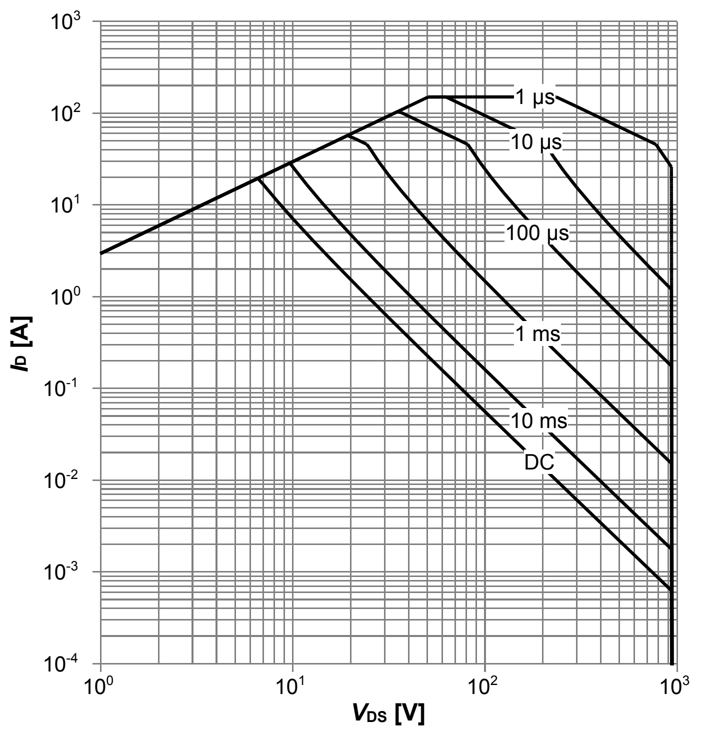
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



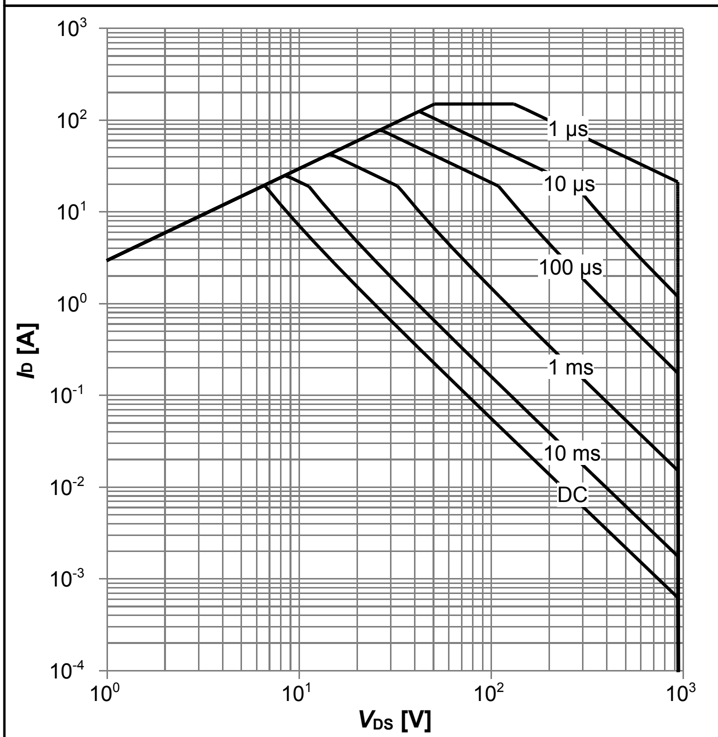
P_{tot}=f(T_C)

Diagram 2: Safe operating area



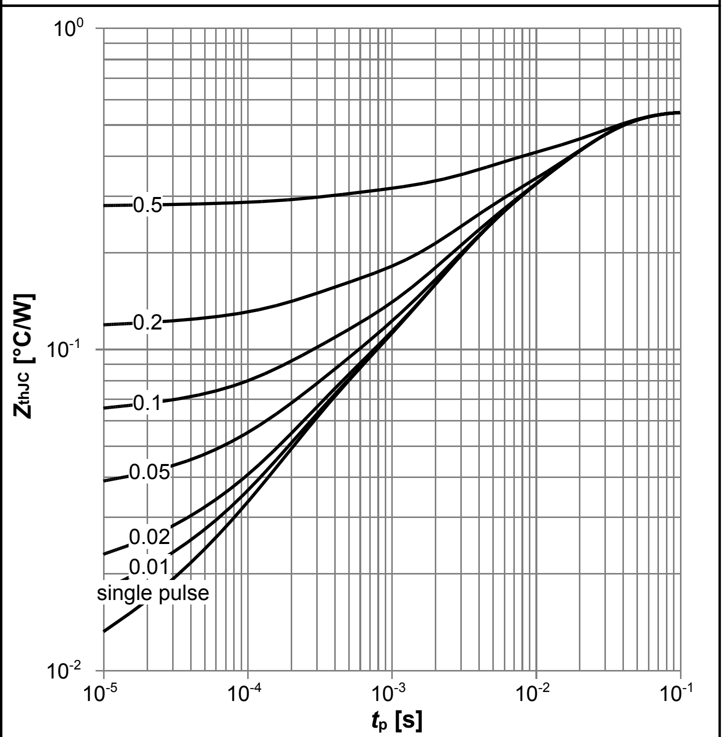
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter: t_p

Diagram 3: Safe operating area



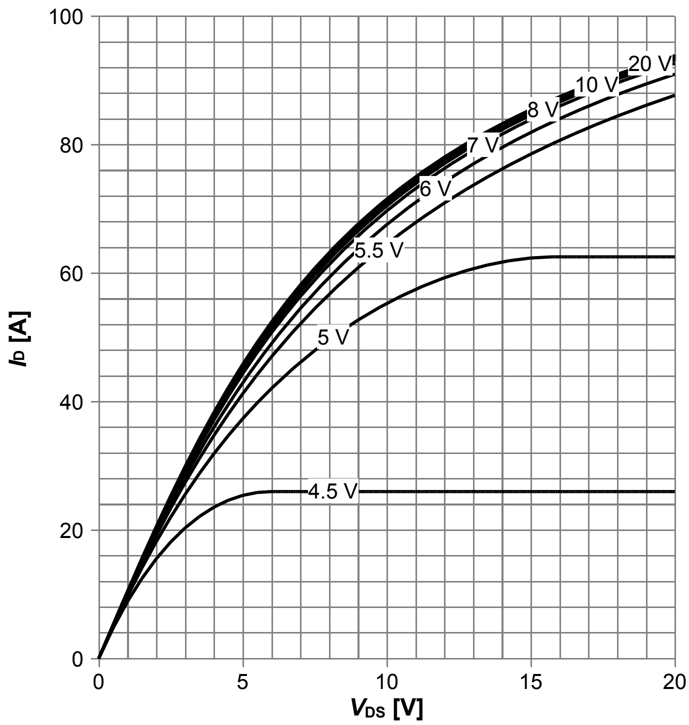
I_D=f(V_{DS}); T_C=80 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



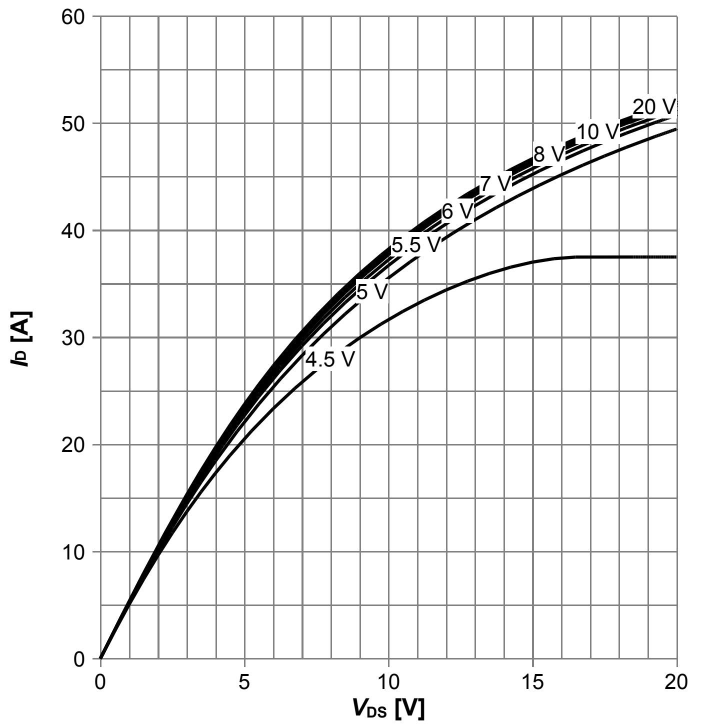
Z_{thJC} =f(t_P); parameter: D=t_p/T

Diagram 5: Typ. output characteristics



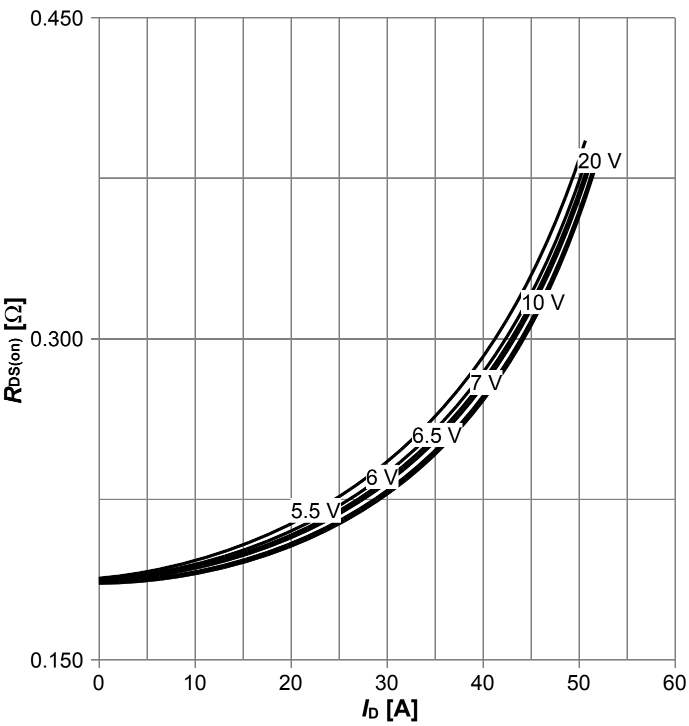
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



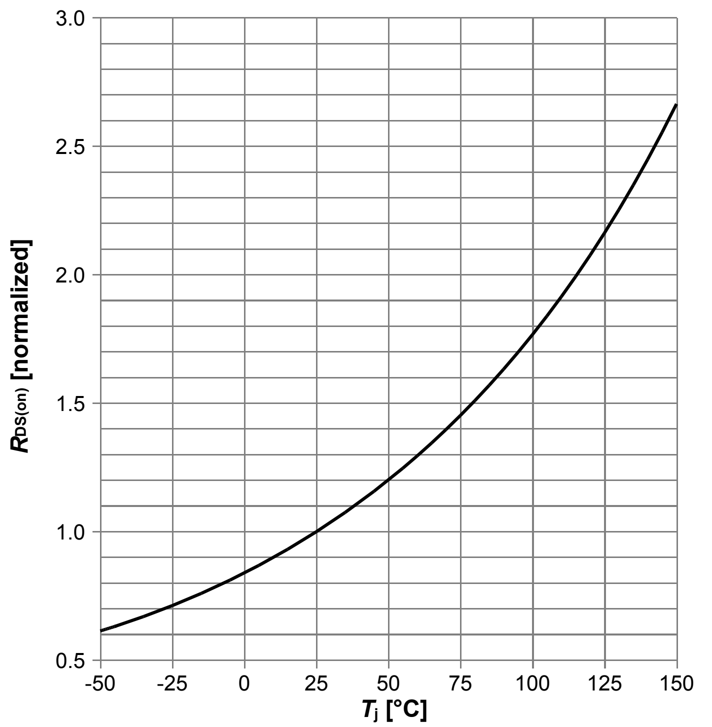
I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}

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



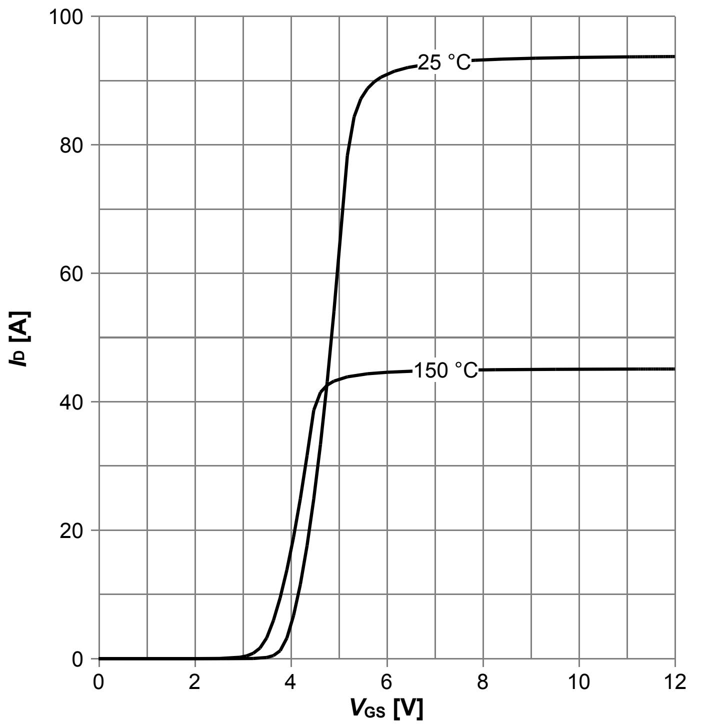
$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



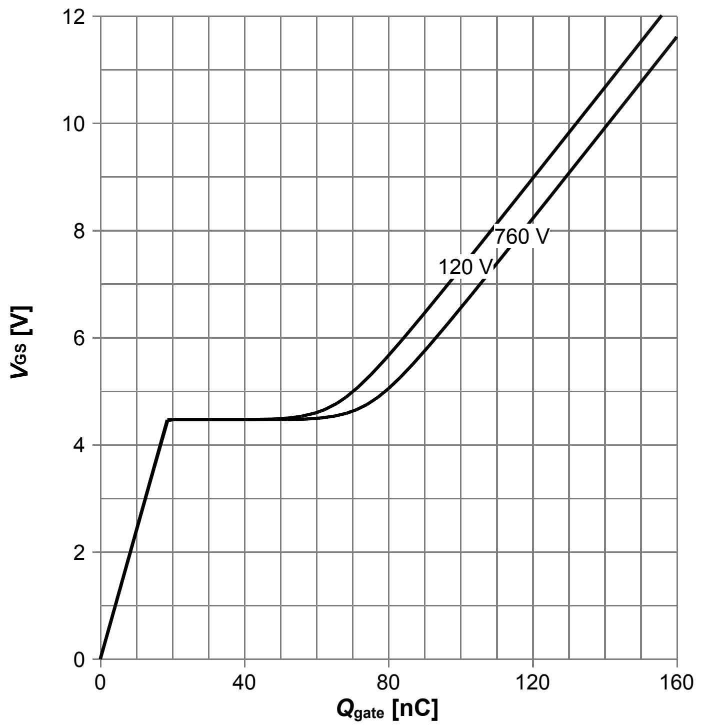
$R_{DS(on)}$=f(T_j); I_D=25.1 A; V_{GS}=10 V

Diagram 9: Typ. transfer characteristics



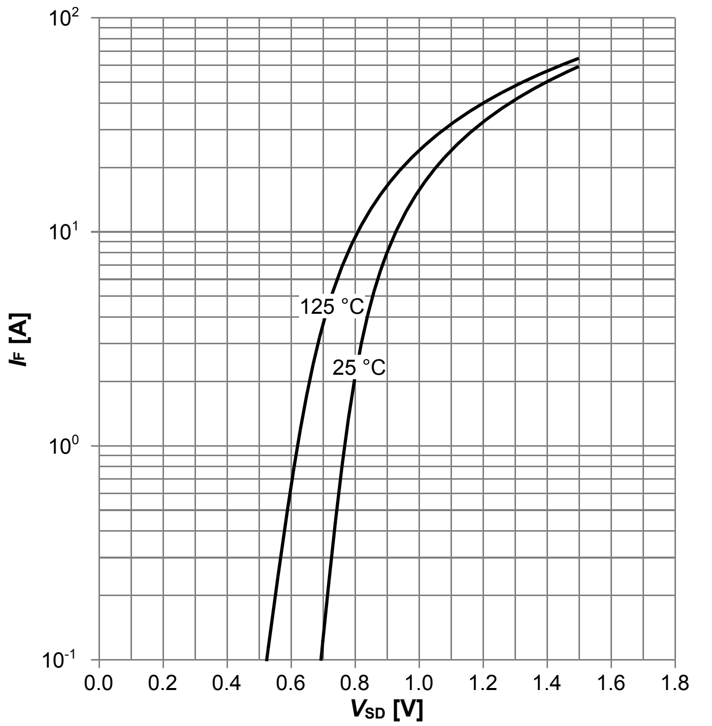
I_D=f(V_{GS}); V_{DS}=20V; parameter: T_j

Diagram 10: Typ. gate charge



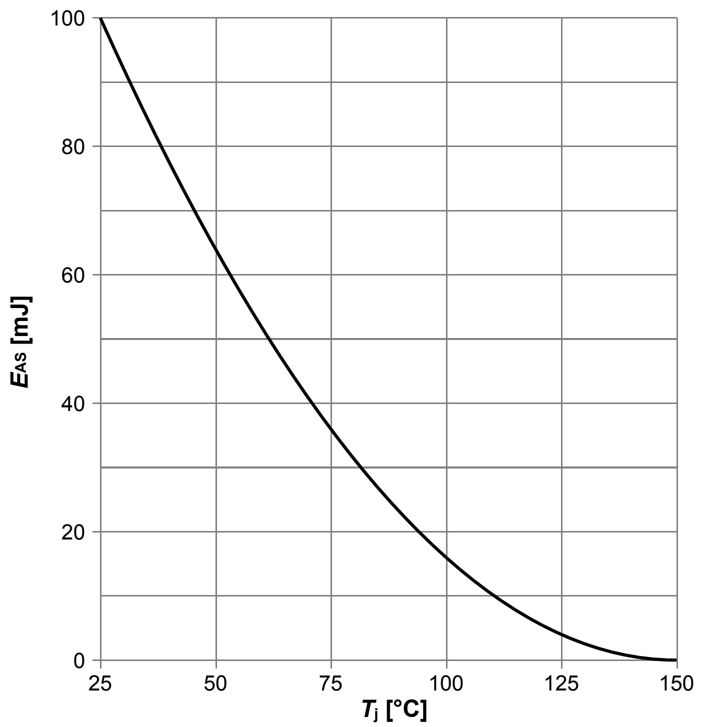
V_{GS}=f(Q_{gate}); I_D=25.1 A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



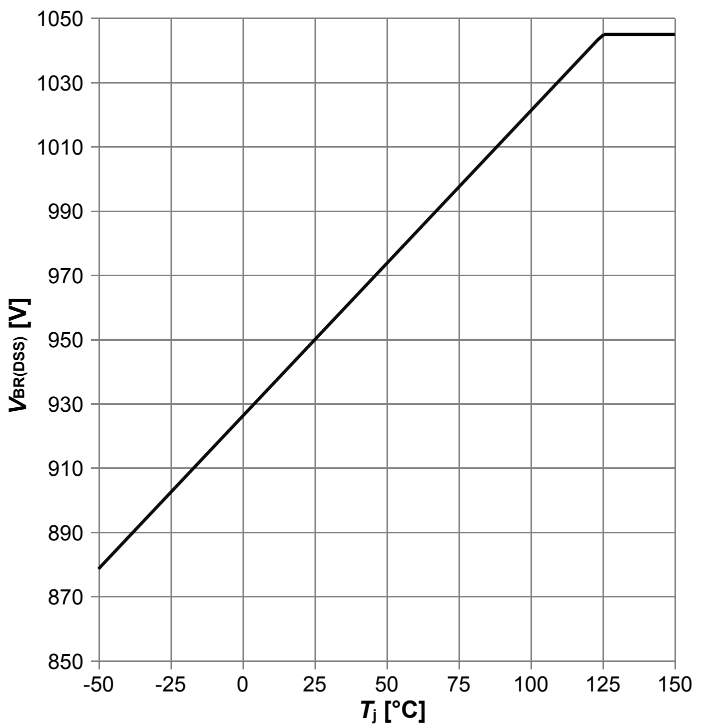
I_F=f(V_{SD}); parameter: T_j

Diagram 12: Avalanche energy



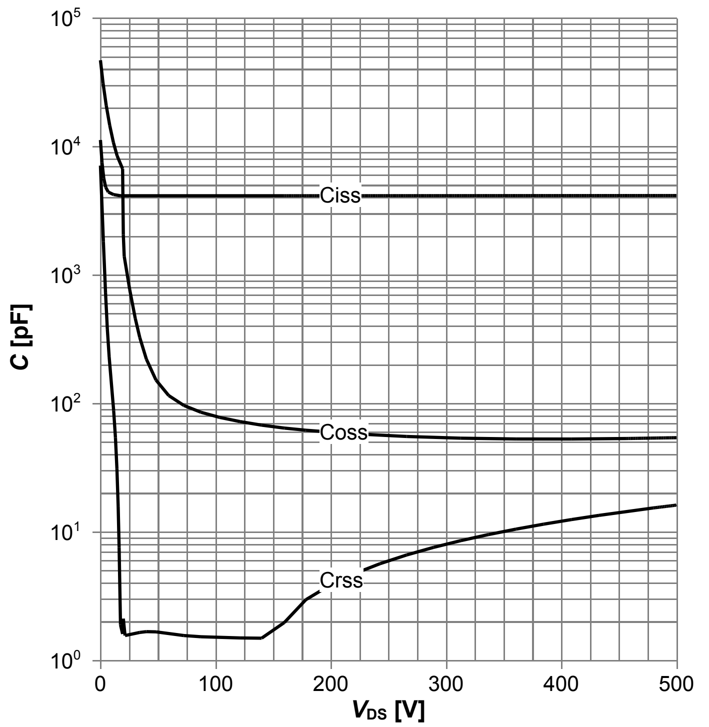
E_{AS}=f(T_j); I_D=3.8 A; V_{DD}=50 V

Diagram 13: Drain-source breakdown voltage



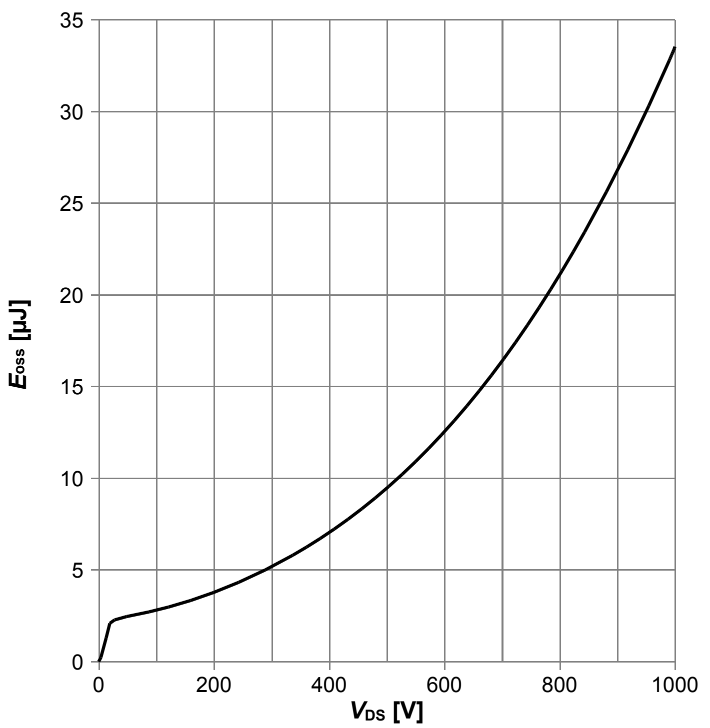
$V_{BR(DSS)}$=f(T_j); I_D=1 mA

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

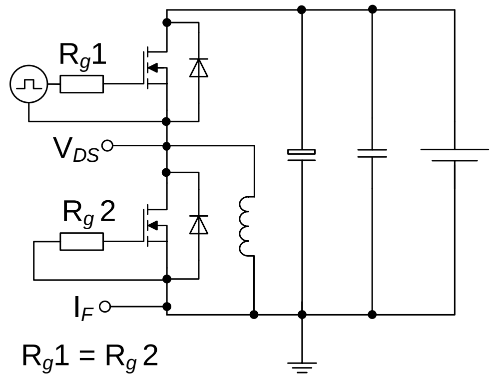
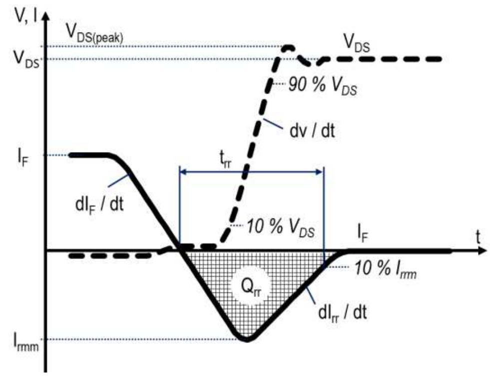
Test circuit for diode characteristics	Diode recovery waveform
	

Table 9 Switching times

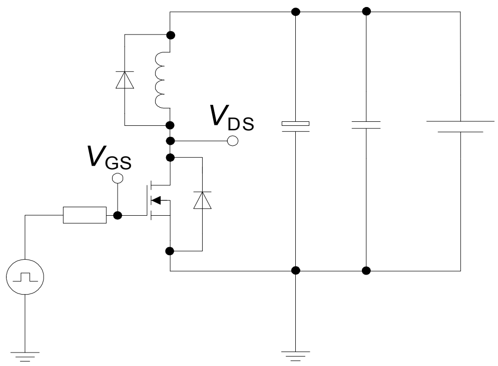
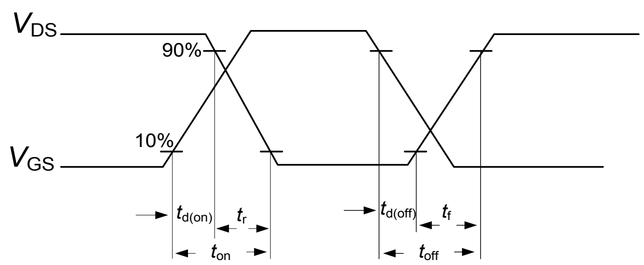
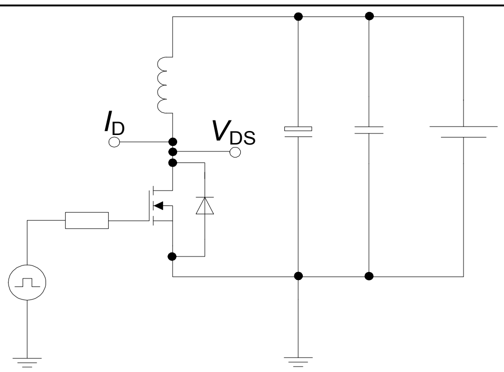
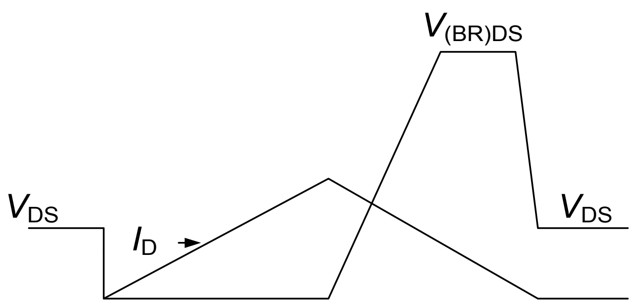
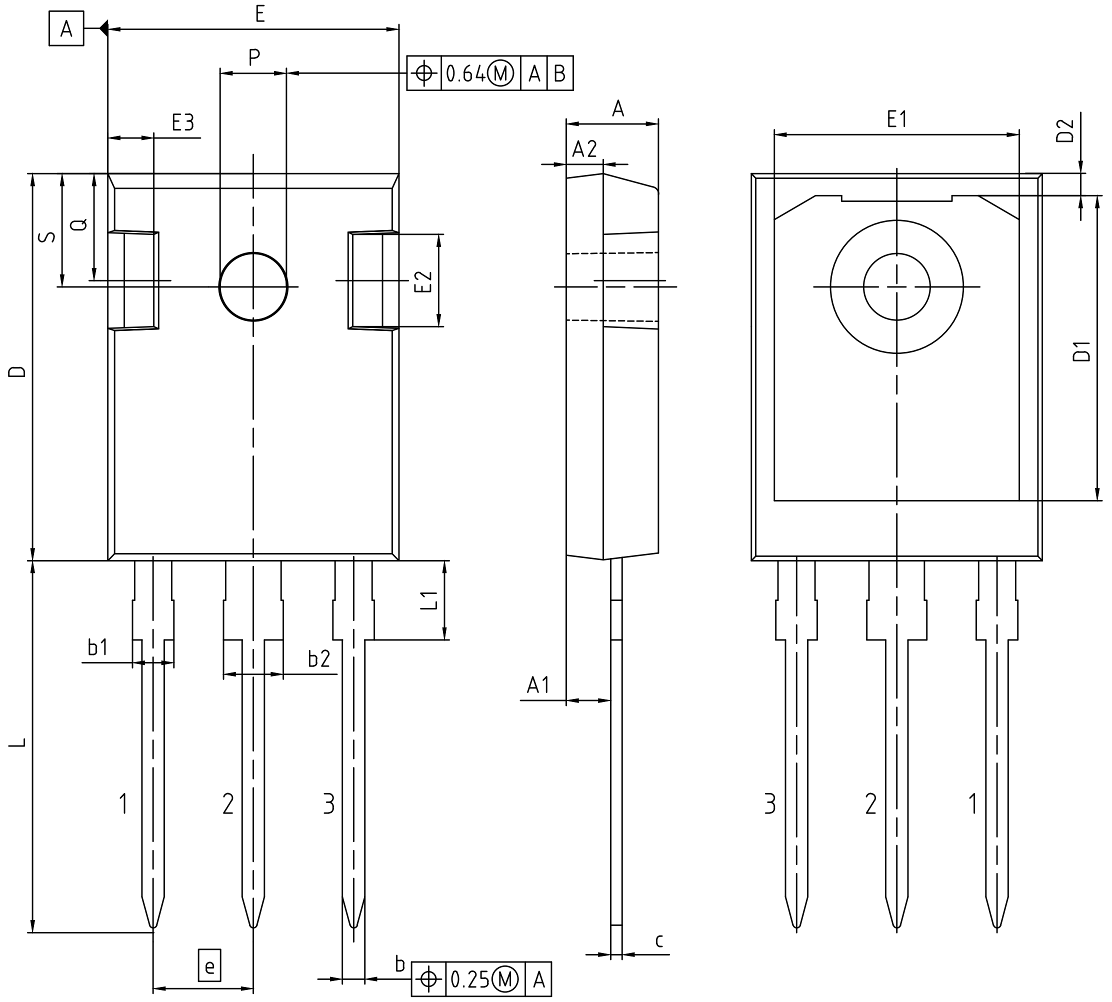
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

6 Package Outlines



DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.70	5.30
A1	2.20	2.60
A2	1.50	2.50
b	1.00	1.40
b1	1.60	2.41
b2	2.57	3.43
c	0.38	0.89
D	20.70	21.50
D1	13.08	17.65
D2	0.51	1.35
E	15.50	16.30
E1	12.38	14.15
E2	3.40	5.10
E3	1.00	2.60
e	5.44	
L	19.80	20.40
L1	3.85	4.50
P	3.50	3.70
Q	5.35	6.25
S	6.04	6.30

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REVISION
06

SCALE 3:1
0 1 2 3 4 5mm

EUROPEAN PROJECTION

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Figure 1 Outline PG-TO247-3, dimensions in mm

7 Appendix A

Table 11 Related Links

- **IFX CoolMOS PFD7 950V Webpage:** www.infineon.com
- **IFX CoolMOS PFD7 950V application note:** www.infineon.com
- **IFX CoolMOS PFD7 950V simulation model:** www.infineon.com
- **IFX Design tools:** www.infineon.com

Revision History

IPW95R130PFD7

Revision: 2022-04-22, Rev. 2.1

Previous Revision		
Revision	Date	Subjects (major changes since last revision)
2.0	2022-03-18	Release of final version
2.1	2022-04-22	Modified features

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