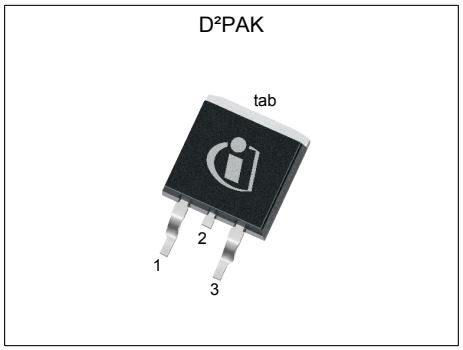
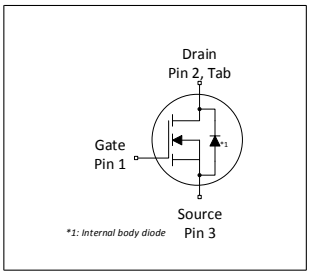
MOSFET

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).





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
IPB95R130PFD7	PG-TO263-3	95R130D7	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	- -	- -	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	-	-	-	-	Ncm	-
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	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

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

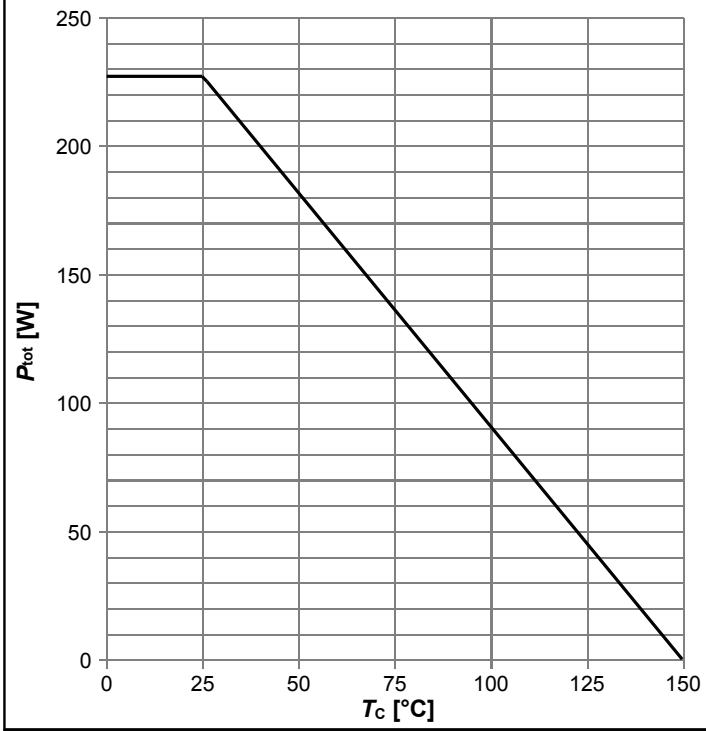
[1] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 400V
[2] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 400V

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

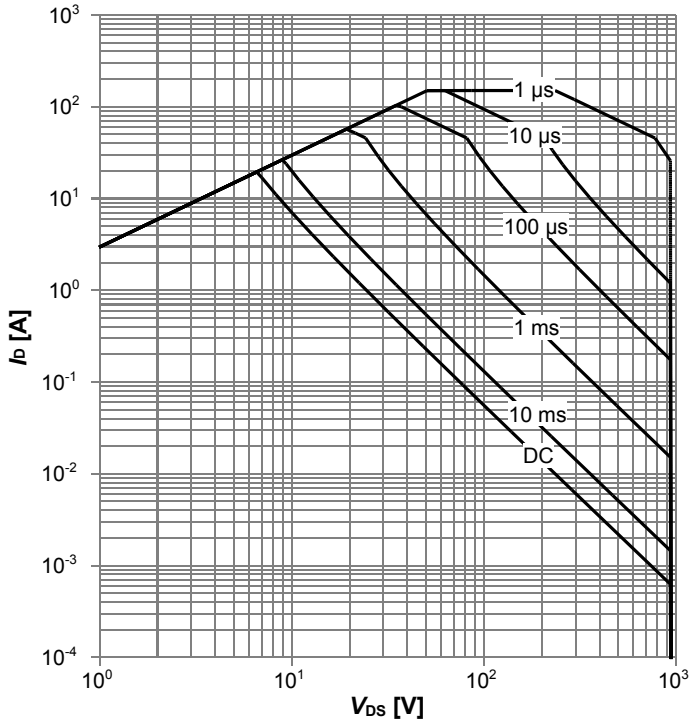
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



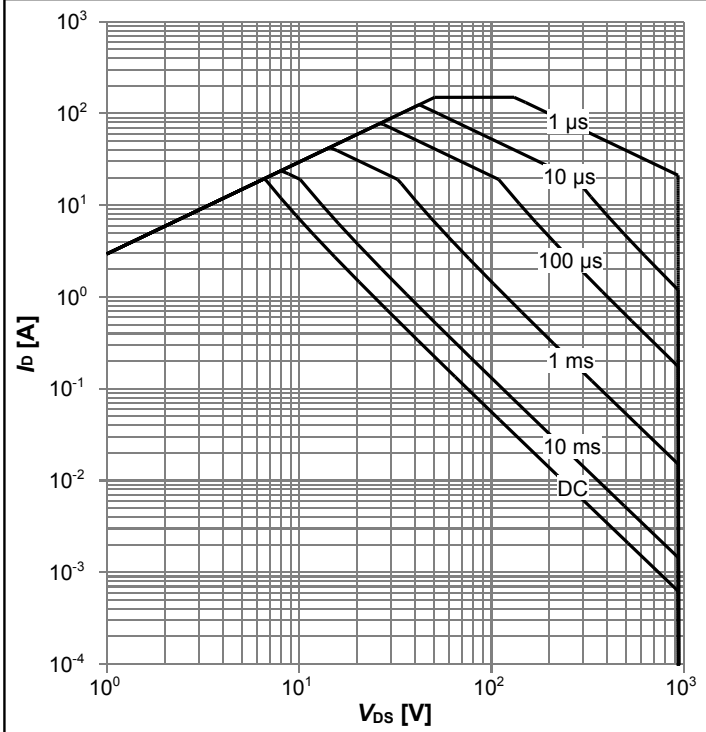
$P_{tot}=f(T_C)$

Diagram 2: Safe operating area



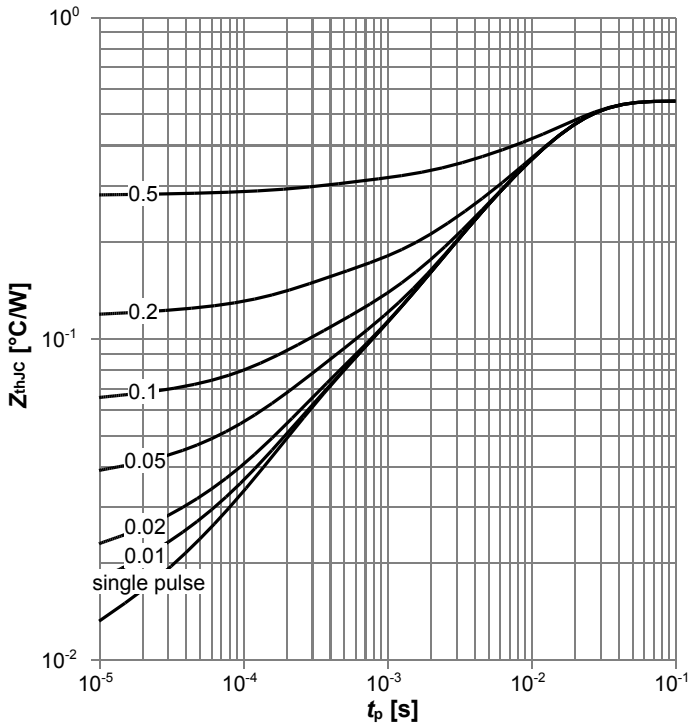
$I_D=f(V_{DS})$; T_C=25 °C; D=0; parameter: t_p

Diagram 3: Safe operating area



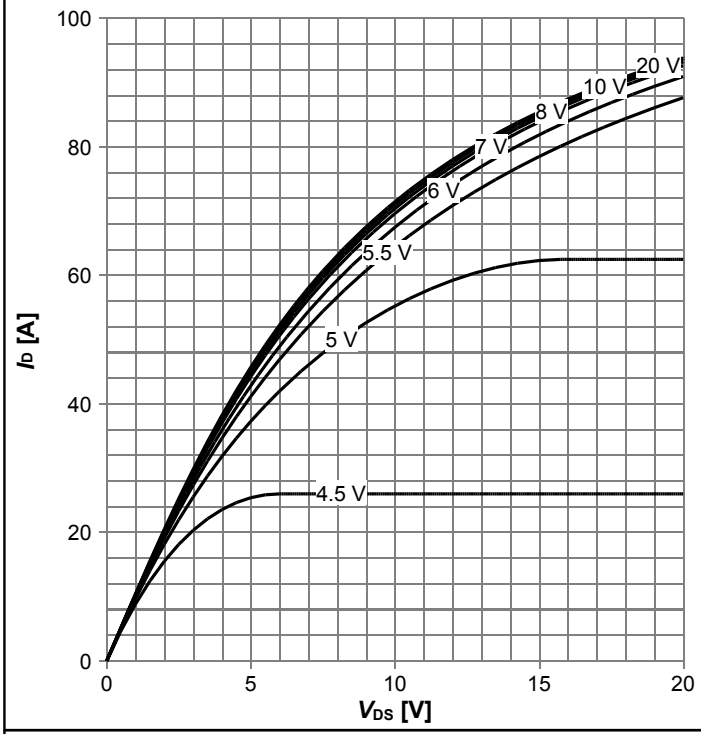
$I_D=f(V_{DS})$; T_C=80 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



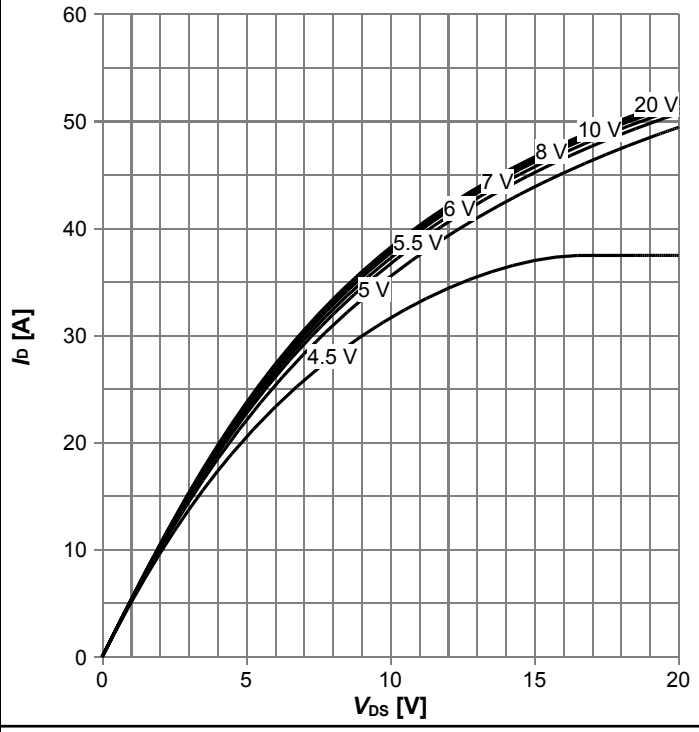
$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

Diagram 5: Typ. output characteristics



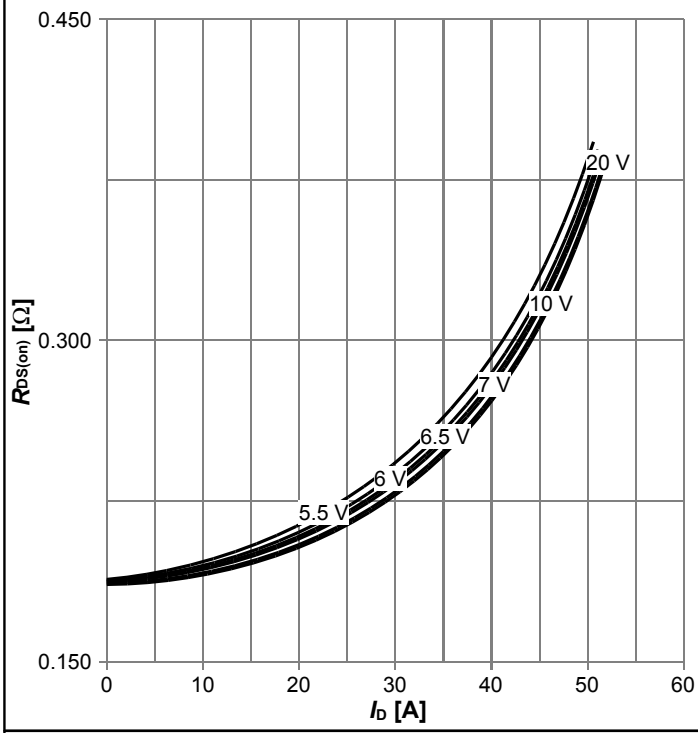
$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



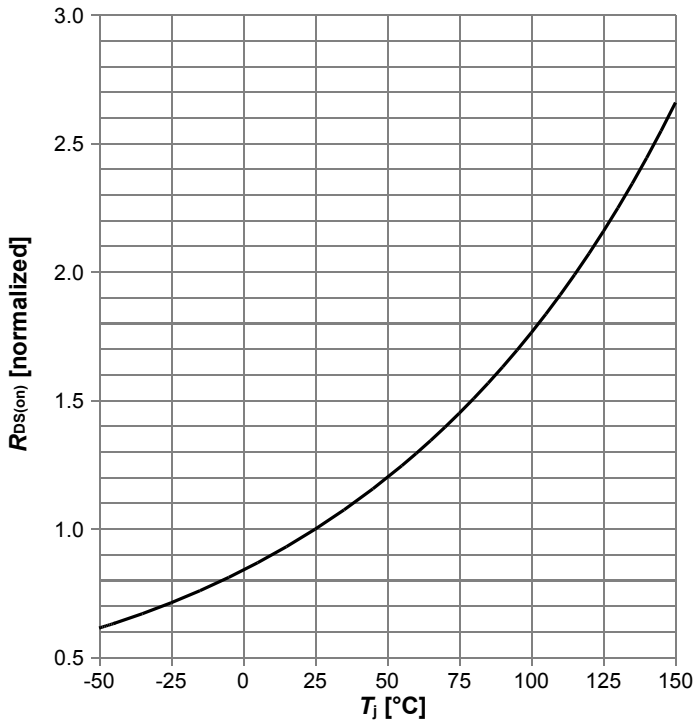
$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: V_{GS}

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



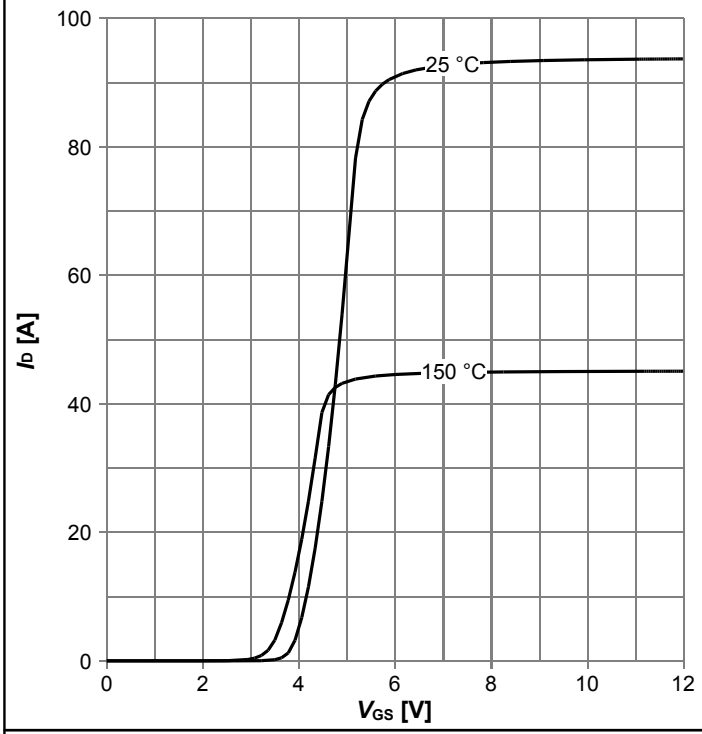
$R_{DS(on)}=f(I_D)$; $T_j=125$ °C; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



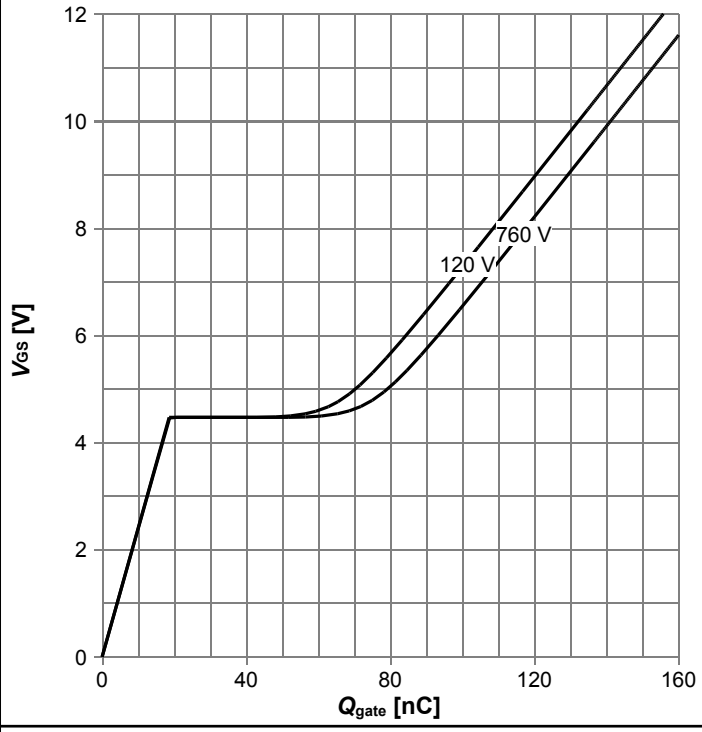
$R_{DS(on)}=f(T_j)$; $I_D=25.1$ A; $V_{GS}=10$ V

Diagram 9: Typ. transfer characteristics



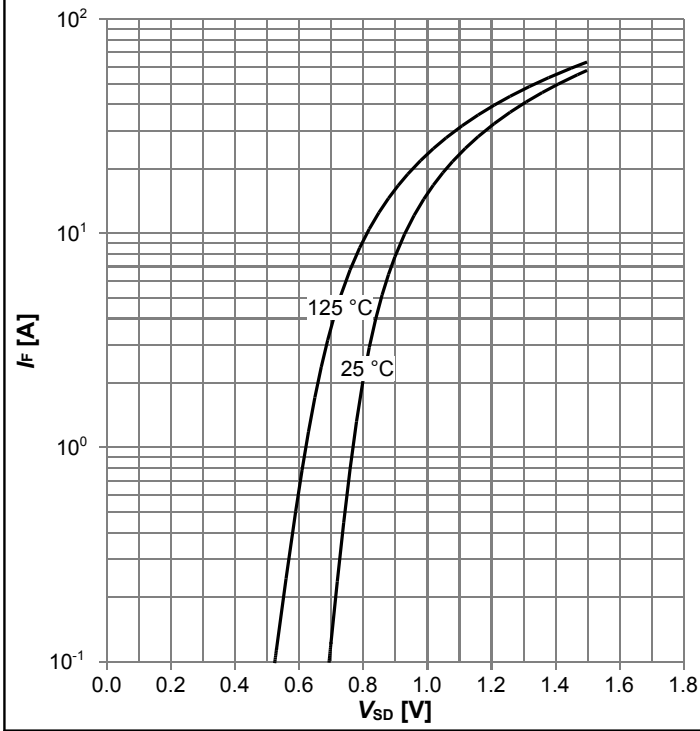
$I_D=f(V_{GS})$; V_{DS}=20V; parameter: T_j

Diagram 10: Typ. gate charge



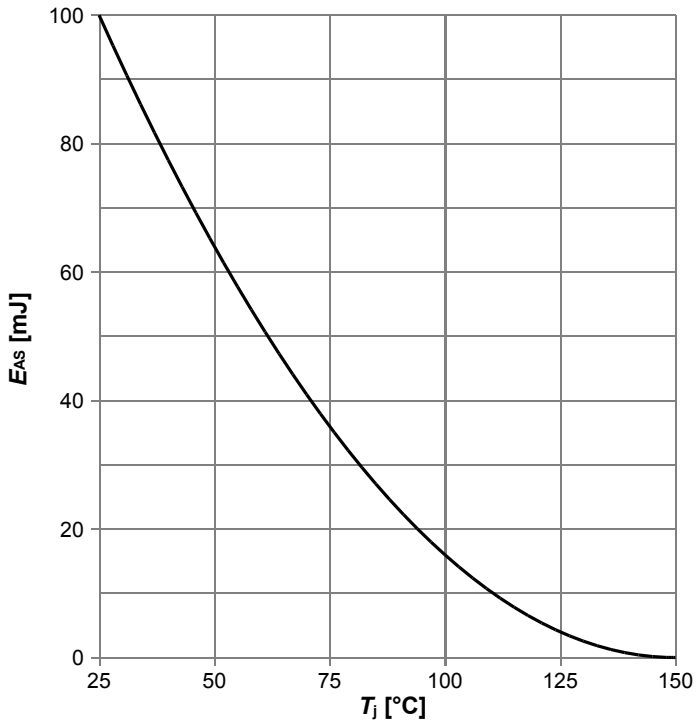
$V_{GS}=f(Q_{gate})$; I_D=25.1 A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



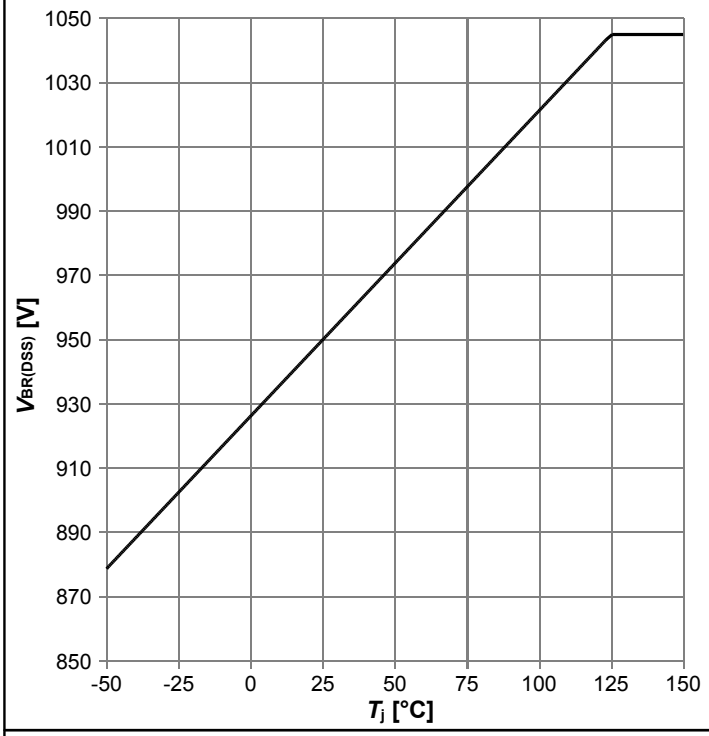
$I_F=f(V_{SD})$; parameter: T_j

Diagram 12: Avalanche energy



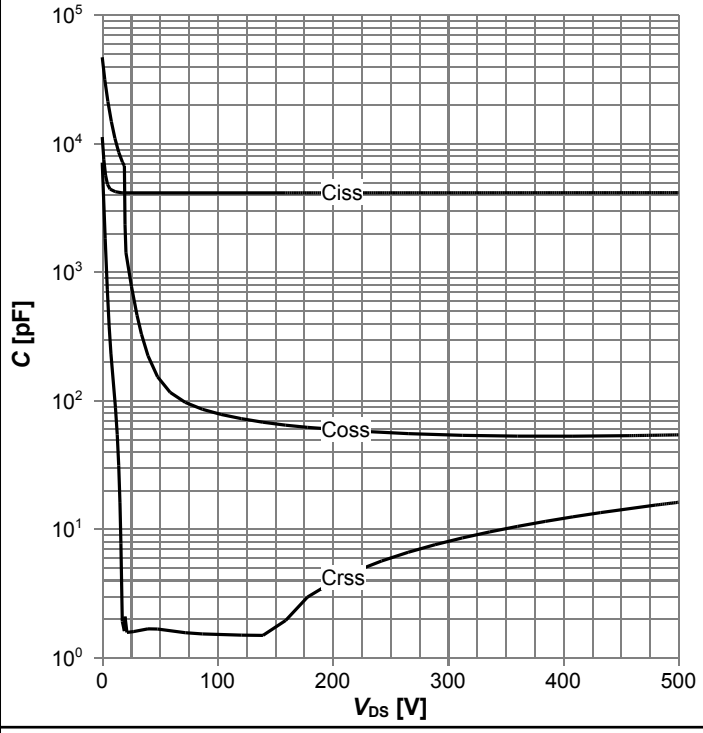
$E_{AS}=f(T_j)$; I_D=3.8 A; V_{DD}=50 V

Diagram 13: Drain-source breakdown voltage



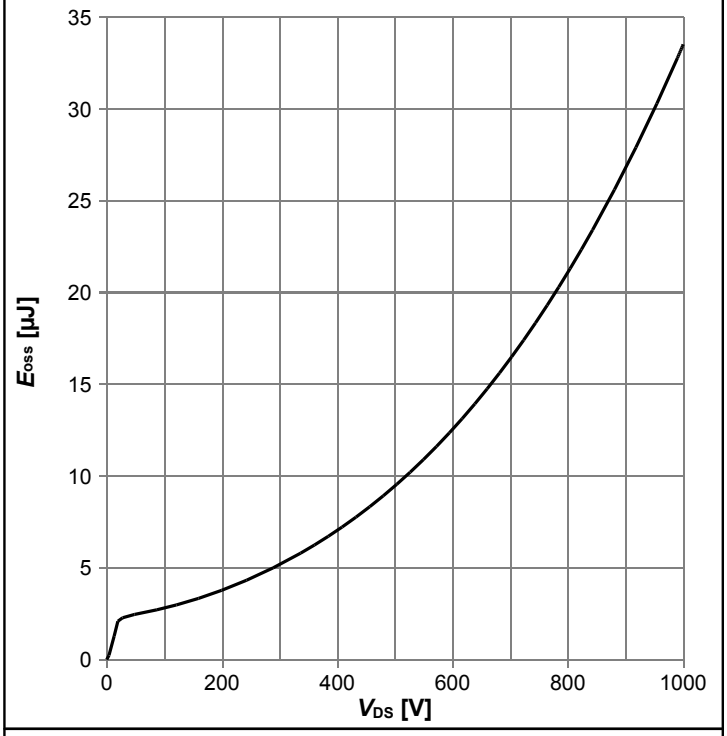
$V_{BR(DSS)}$=f(T_j); I_D=1 mA

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

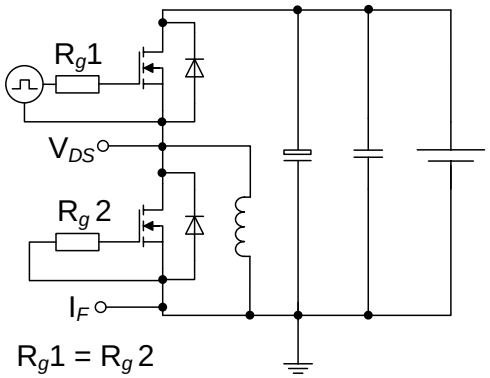
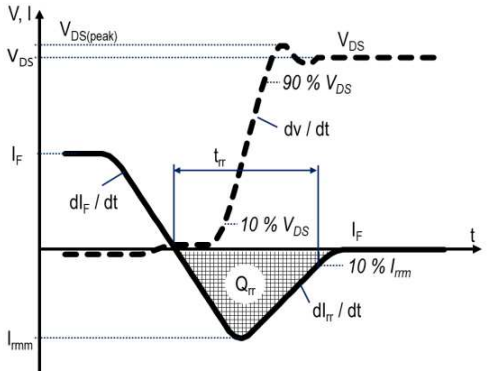
Test circuit for diode characteristics	Diode recovery waveform
	

Table 9 Switching times

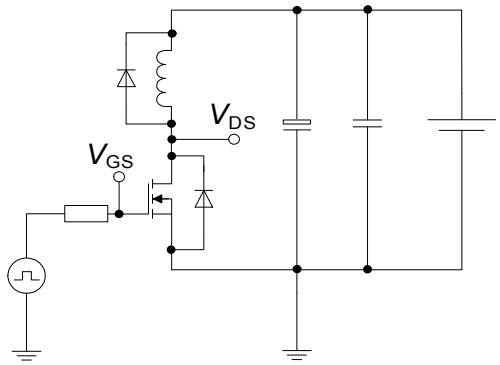
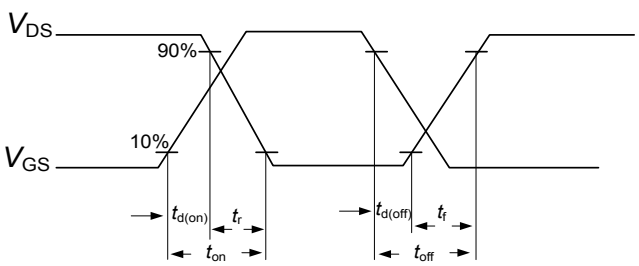
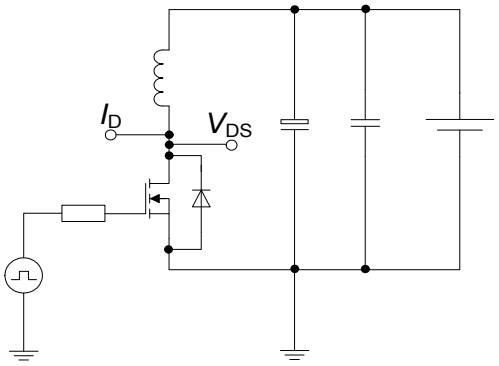
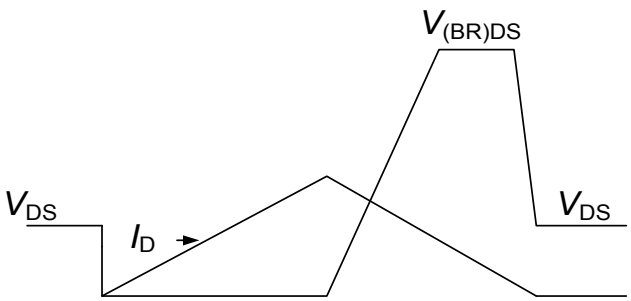
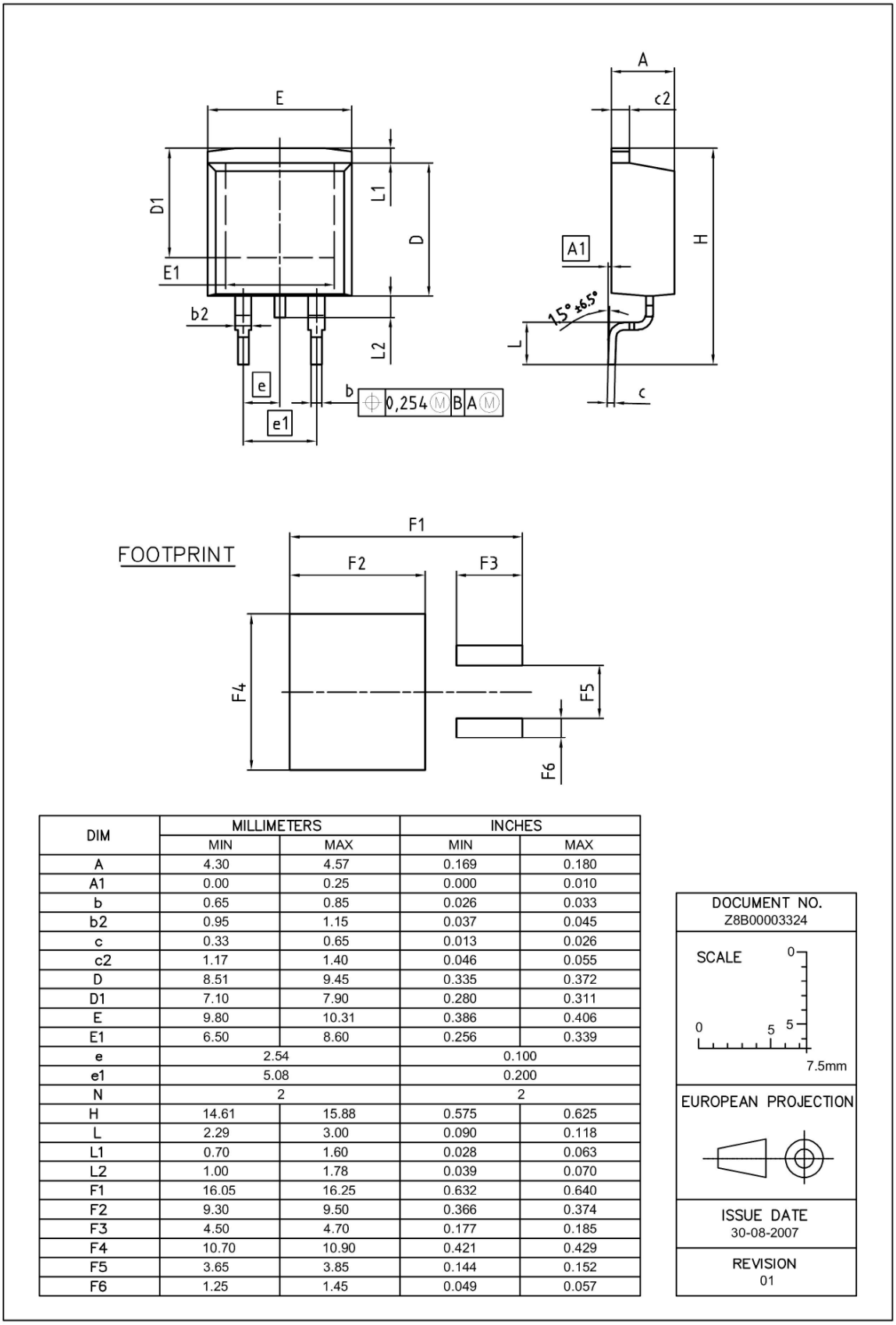
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

6 Package Outlines



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	0.00	0.25	0.000	0.010
b	0.65	0.85	0.026	0.033
b2	0.95	1.15	0.037	0.045
c	0.33	0.65	0.013	0.026
c2	1.17	1.40	0.046	0.055
D	8.51	9.45	0.335	0.372
D1	7.10	7.90	0.280	0.311
E	9.80	10.31	0.386	0.406
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	2		2	
H	14.61	15.88	0.575	0.625
L	2.29	3.00	0.090	0.118
L1	0.70	1.60	0.028	0.063
L2	1.00	1.78	0.039	0.070
F1	16.05	16.25	0.632	0.640
F2	9.30	9.50	0.366	0.374
F3	4.50	4.70	0.177	0.185
F4	10.70	10.90	0.421	0.429
F5	3.65	3.85	0.144	0.152
F6	1.25	1.45	0.049	0.057

DOCUMENT NO.
Z8B00003324

SCALE 0 5 5 7.5mm

EUROPEAN PROJECTION

ISSUE DATE
30-08-2007

REVISION
01

Figure 1 Outline PG-TO263-3, dimensions in mm/inches

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

IPB95R130PFD7

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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