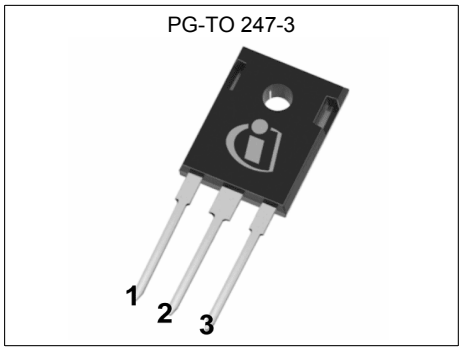
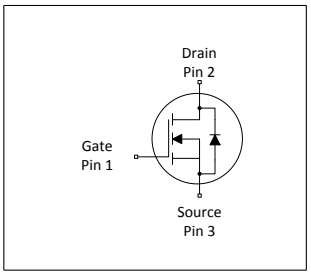
MOSFET

600V CoolMOS™ CSFD Power Transistor



CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. The IPW60R037CSFD is an optimized device tailored to address the off board EV charging market segment.
Thanks to low gate charge (Q_g) and improved switching behavior it offers highest efficiency in the targeted market. In addition to that it comes along with an integrated fast body diode and tremendously reduced reverse recovery charge (Q_{rr}) leading to highest reliability in resonant topologies. Due to these features the IPW60R037CSFD meets the efficiency and reliability standards of the off board EV charging station market and furthermore supports high power density solutions.



Features

- Fast body diode
- Industry-leading reverse recovery charge (Q_{rr})
- Lowest FOM $R_{DS(on)}$*Q_g and $R_{DS(on)}$*E_{oss}
- Cost optimization

Benefits

- Excellent hard commutation ruggedness and reliability in soft switching applications
- Highest efficiency with outstanding ease-of-use / performance trade-off
- Enabling increased power density solutions
- Balanced price / performance ratio for the EV charging market

Potential applications

Suiteable for Soft & Hard Switching topologies
Optimized for phase-shift full-bridge (ZVS), LLC & PFC Applications – EV Charging

Product Validation: Qualified for industrial applications according to the relevant tests of JEDEC47/20/22

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
$R_{DS(on),max}$	37	mΩ
$Q_{g,typ}$	136	nC
$I_{D,pulse}$	236	A
E_{oss} @ 400V	15.6	µJ
Body diode di_F/dt	1300	A/µs

Type / Ordering Code	Package	Marking	Related Links
IPW60R037CSFD	PG-TO 247-3	60R037CS	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	- -	- -	54 34	A	T_C=25°C T_C=100°C
Pulsed drain current[2)]	$I_{D,pulse}$	-	-	236	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	277	mJ	I_D=7.8A; V_{DD}=50V; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	1.39	mJ	I_D=7.8A; V_{DD}=50V; see table 10
Avalanche current, single pulse	I_{AS}	-	-	7.8	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}	-	-	245	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	-	-	54	A	T_C=25°C
Diode pulse current[2)]	$I_{S,pulse}$	-	-	236	A	T_C=25°C
Reverse diode dv/dt[3)]	dv/dt	-	-	70	V/ns	V_{DS}=0...400V, I_{SD}<=54A, T_j=25°C see table 8
Maximum diode commutation speed	di_F/dt	-	-	1300	A/µs	V_{DS}=0...400V, I_{SD}<=54A, 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 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}	-	-	0.51	°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	$V_{(BR)DSS}$	600	-	-	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=1.63mA
Zero gate voltage drain current	I_{DSS}	- -	- 38	1 -	µA	V_{DS}=600V, V_{GS}=0V, T_j=25°C V_{DS}=600V, V_{GS}=0V, T_j=125°C
Gate-source leakage current	I_{GSS}	-	-	100	nA	V_{GS}=20V, V_{DS}=0V
Drain-source on-state resistance	$R_{DS(on)}$	- -	0.031 0.070	0.037 -	Ω	V_{GS}=10V, I_D=32.6A, T_j=25°C V_{GS}=10V, I_D=32.6A, T_j=150°C
Gate resistance	R_G	-	3.9	-	Ω	f=1MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	5623	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Output capacitance	C_{oss}	-	104	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Effective output capacitance, energy related[1)]	$C_{o(er)}$	-	195	-	pF	V_{GS}=0V, V_{DS}=0...400V
Effective output capacitance, time related[2)]	$C_{o(tr)}$	-	2023	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...400V
Turn-on delay time	$t_{d(on)}$	-	53	-	ns	V_{DD}=400V, V_{GS}=10V, I_D=16A, R_G=5.3Ω; see table 9
Rise time	t_r	-	30	-	ns	V_{DD}=400V, V_{GS}=10V, I_D=16A, R_G=5.3Ω; see table 9
Turn-off delay time	$t_{d(off)}$	-	196	-	ns	V_{DD}=400V, V_{GS}=10V, I_D=16A, R_G=5.3Ω; see table 9
Fall time	t_f	-	6	-	ns	V_{DD}=400V, V_{GS}=10V, I_D=16A, 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}	-	30	-	nC	V_{DD}=400V, I_D=16A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	47	-	nC	V_{DD}=400V, I_D=16A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	136	-	nC	V_{DD}=400V, I_D=16A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.4	-	V	V_{DD}=400V, I_D=16A, V_{GS}=0 to 10V

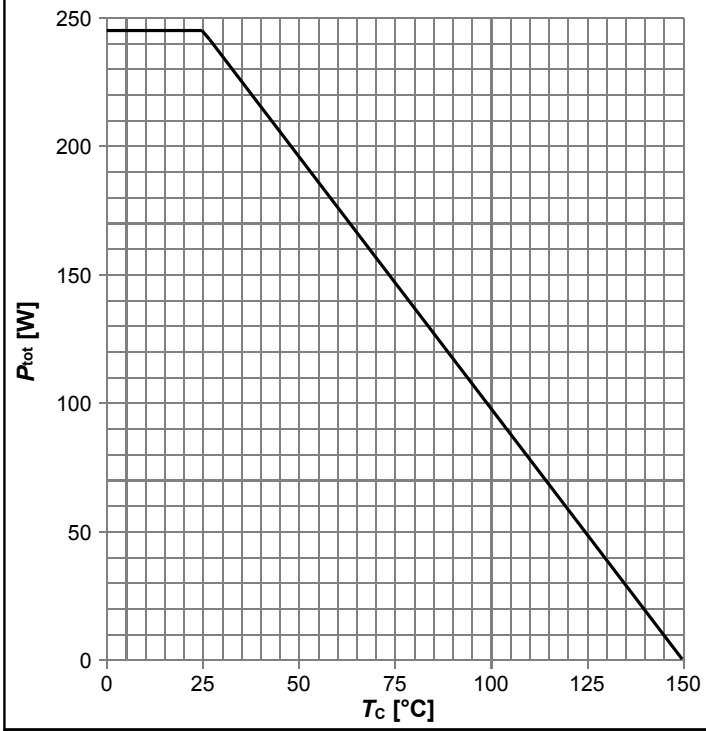
[1)] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 400V
[2)] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 400V

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	1.0	-	V	V_{GS}=0V, I_F=32.6A, T_j=25°C
Reverse recovery time	t_{rr}	-	168	-	ns	V_R=400V, I_F=16A, di_F/dt=100A/µs; see table 8
Reverse recovery charge	Q_{rr}	-	0.94	-	µC	V_R=400V, I_F=16A, di_F/dt=100A/µs; see table 8
Peak reverse recovery current	I_{rrm}	-	8.9	-	A	V_R=400V, I_F=16A, di_F/dt=100A/µs; see table 8

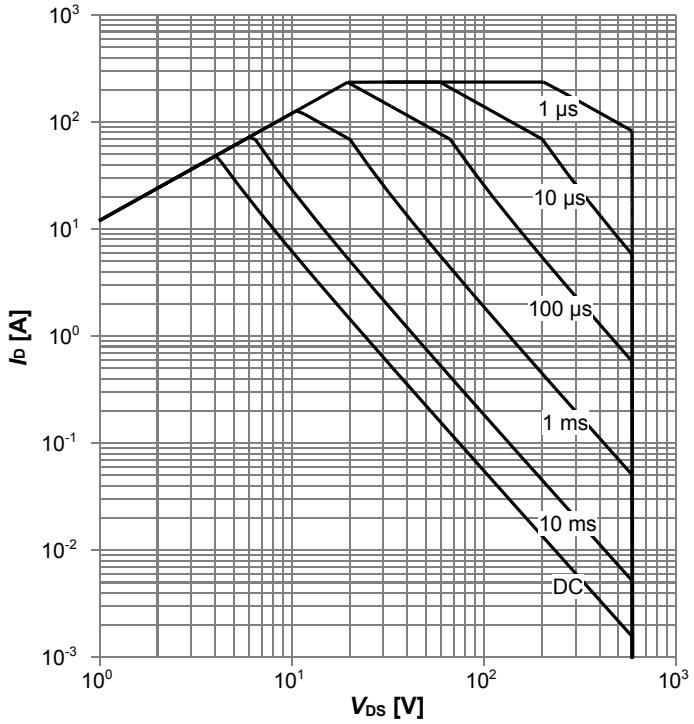
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



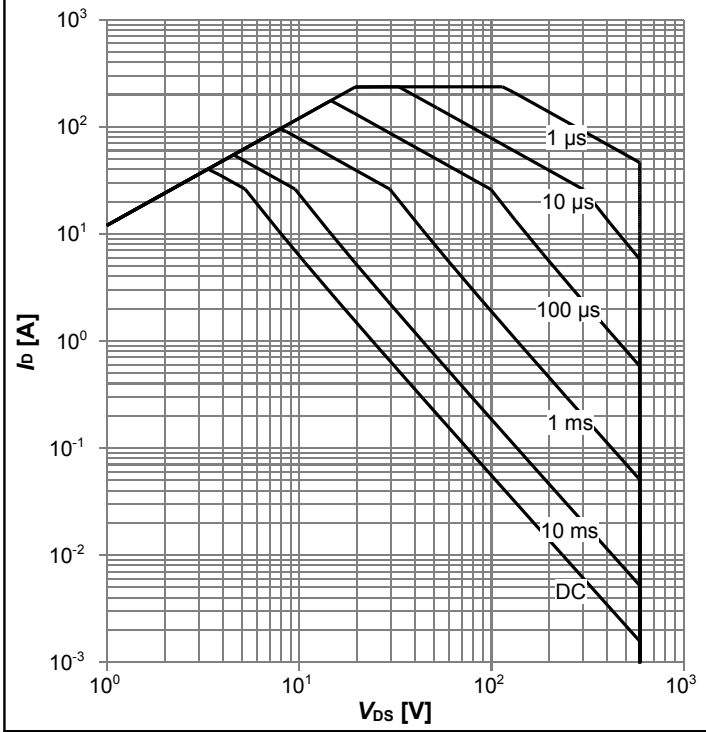
$P_{tot}=f(T_C)$

Diagram 2: Safe operating area



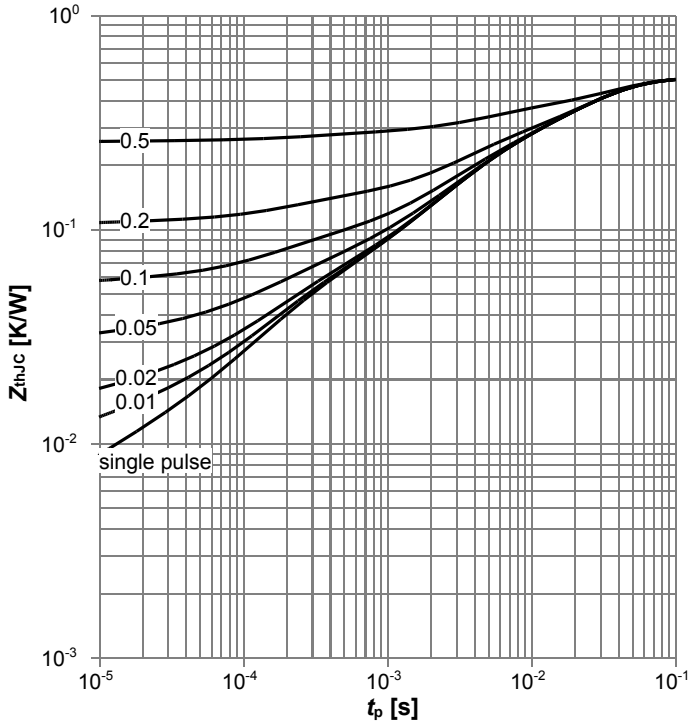
$I_D=f(V_{DS})$; T_C=25 °C; D=0; parameter: t_p

Diagram 3: Safe operating area



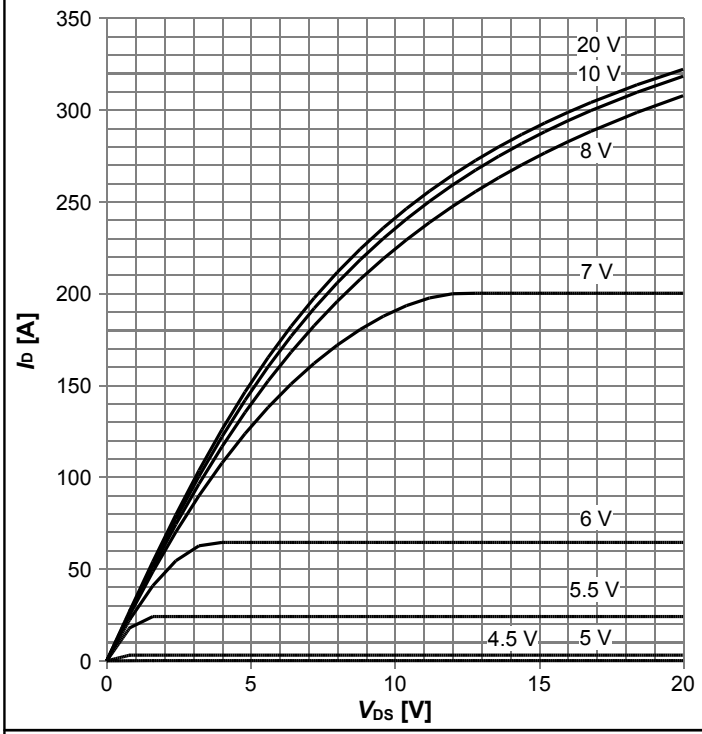
$I_D=f(V_{DS})$; T_C=80 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



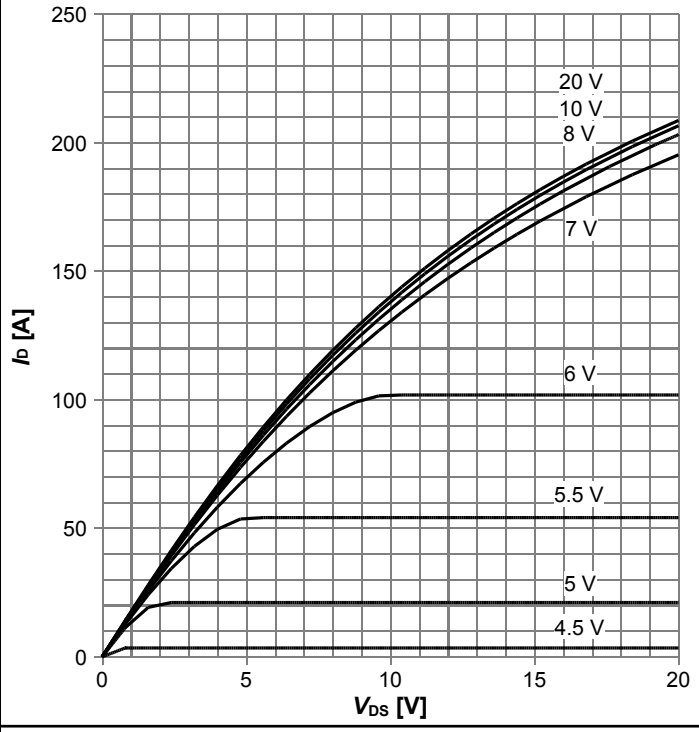
$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

Diagram 5: Typ. output characteristics



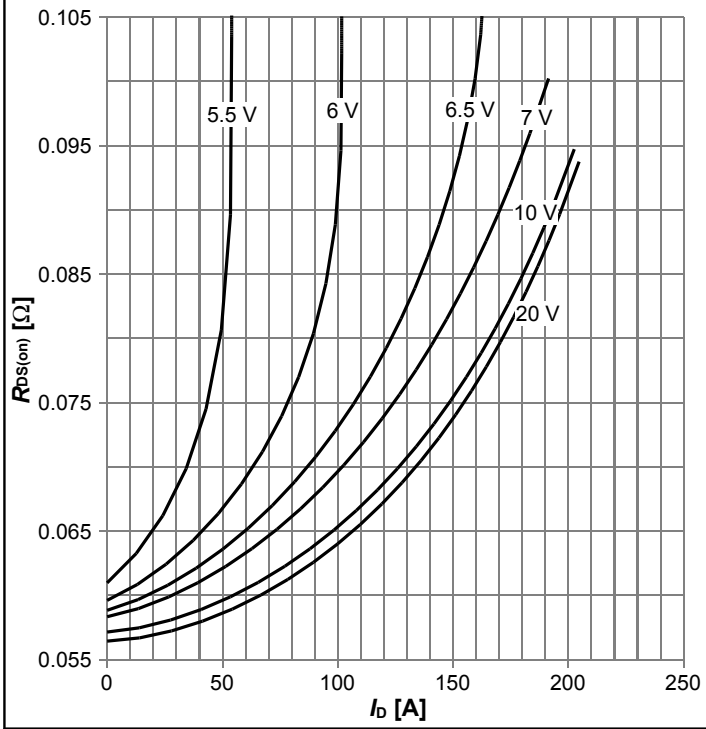
$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



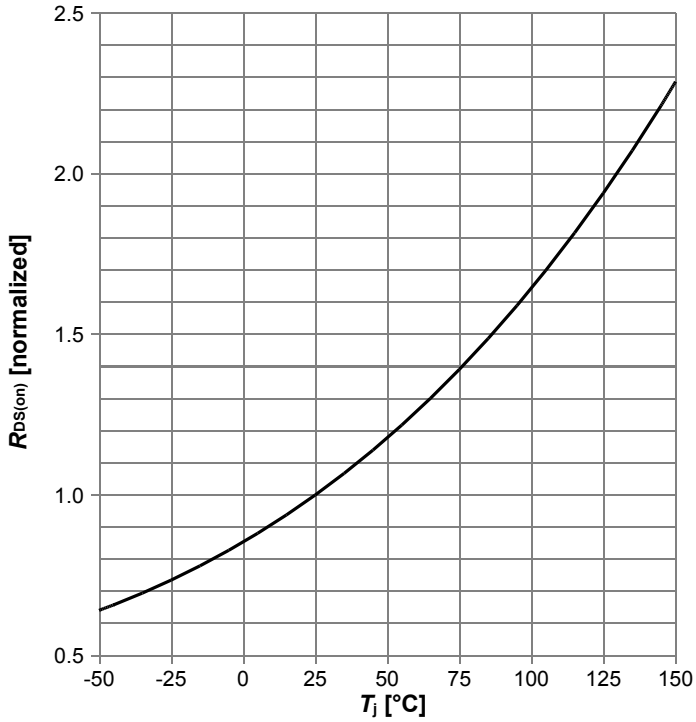
$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: V_{GS}

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



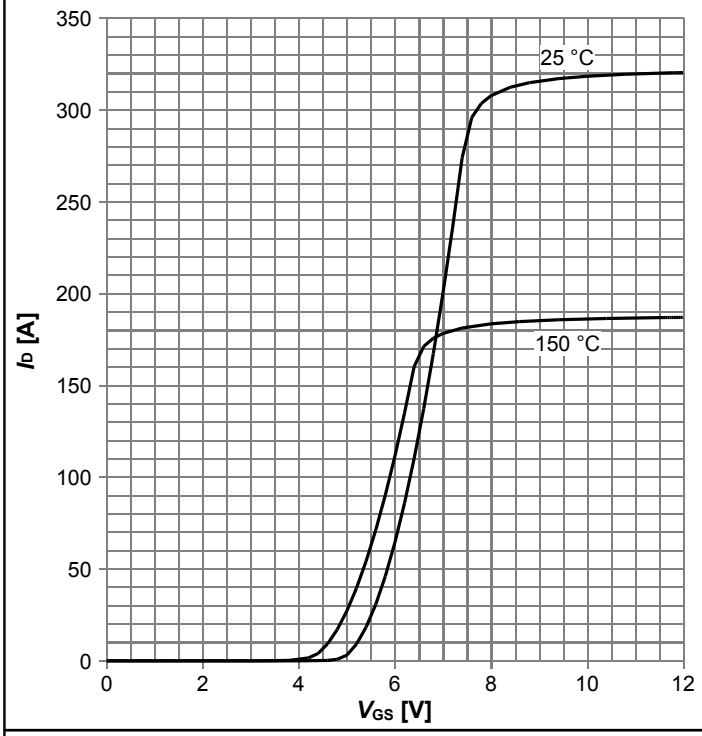
$R_{DS(on)}=f(I_D)$; $T_j=125$ °C; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



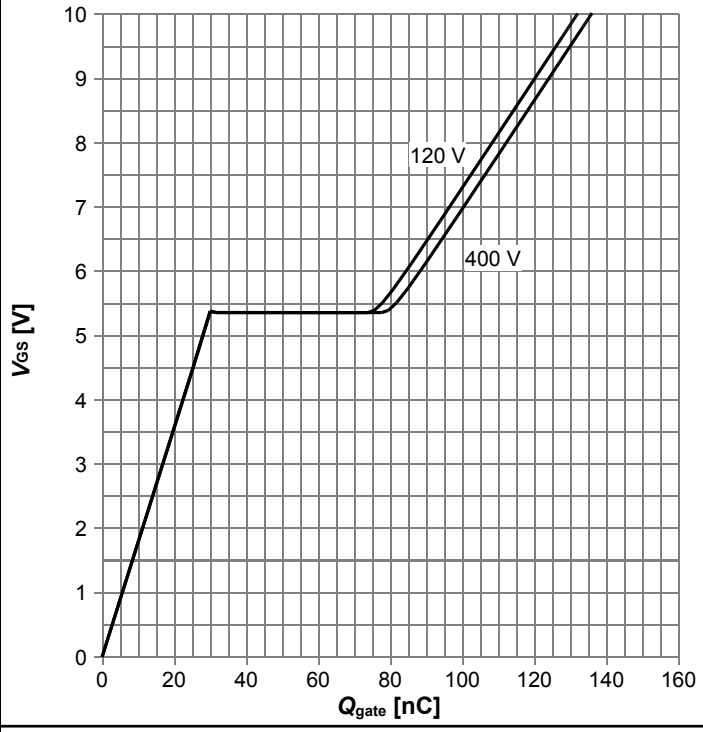
$R_{DS(on)}=f(T_j)$; $I_D=32.6$ A; $V_{GS}=10$ V

Diagram 9: Typ. transfer characteristics



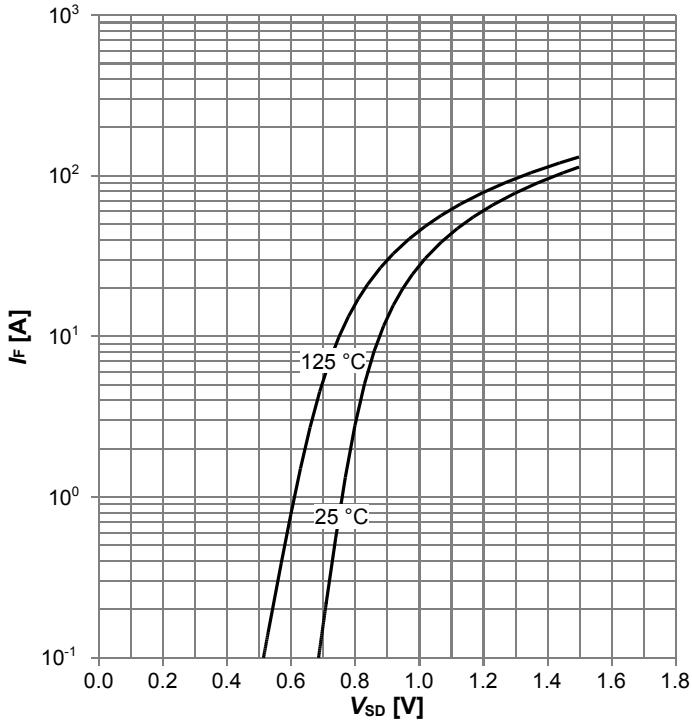
I_D=f(V_{GS}); V_{DS}=20V; parameter: T_j

Diagram 10: Typ. gate charge



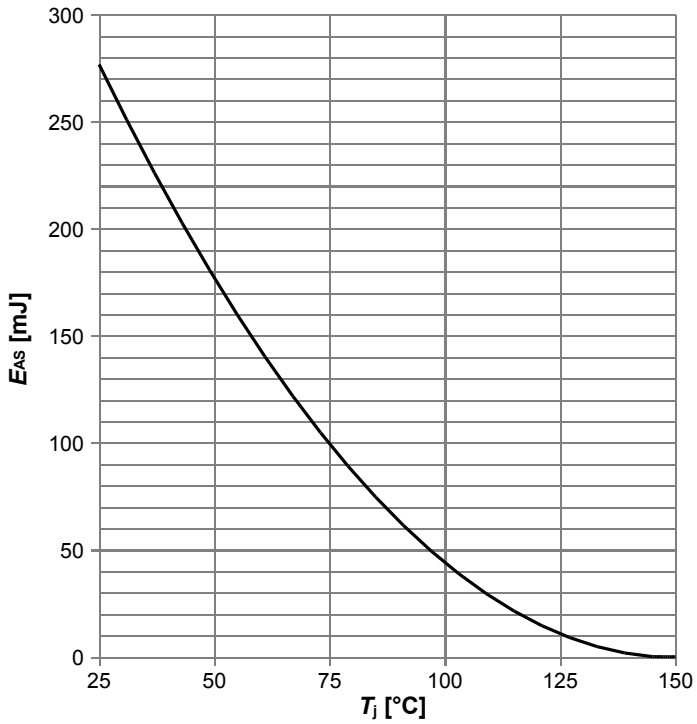
V_{GS}=f(Q_{gate}); I_D=16.0 A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



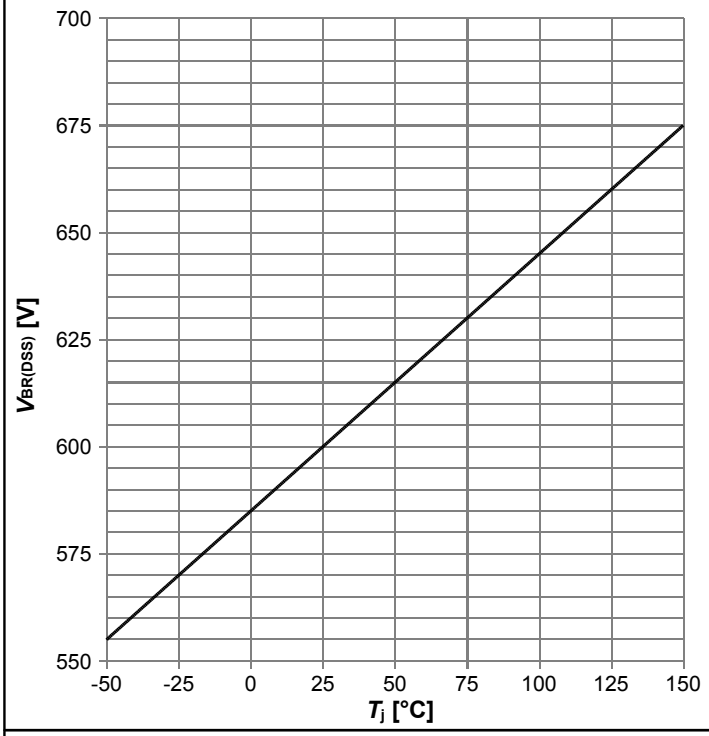
I_F=f(V_{SD}); parameter: T_j

Diagram 12: Avalanche energy



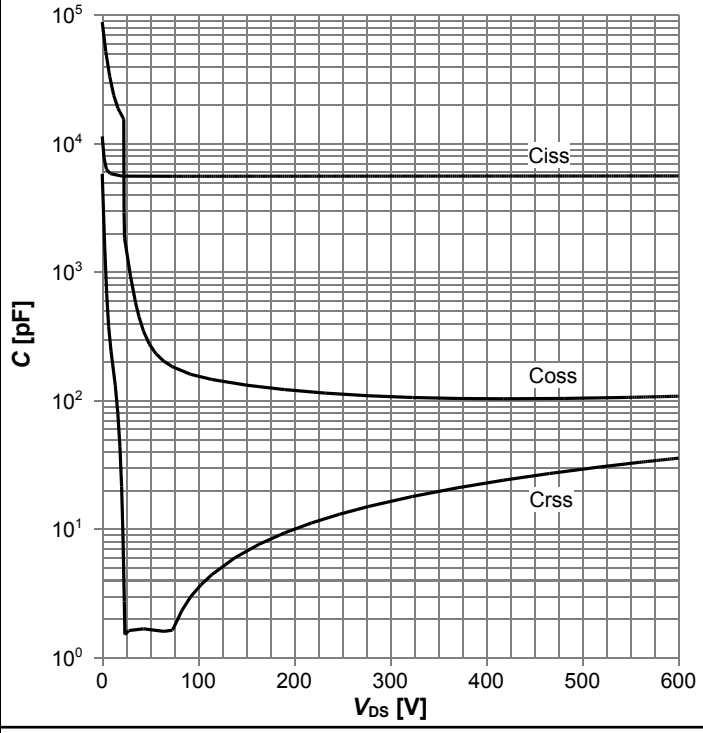
E_{AS}=f(T_j); I_D=7.8 A; V_{DD}=50 V

Diagram 13: Drain-source breakdown voltage



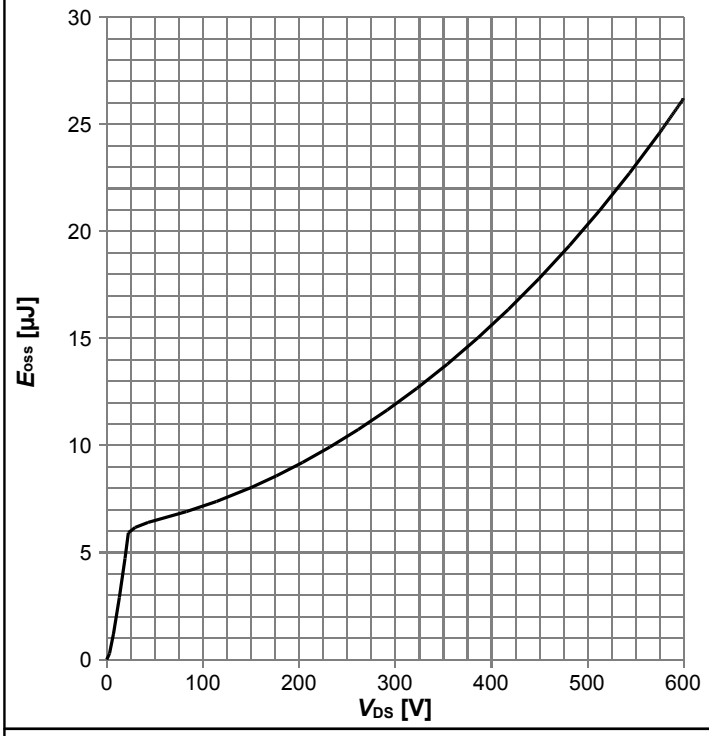
$V_{BR(DSS)}$=f(T_j); I_D=1 mA

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

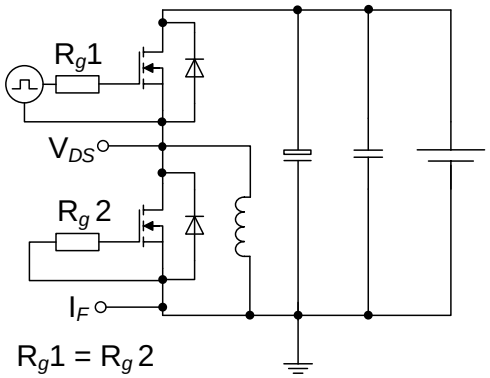
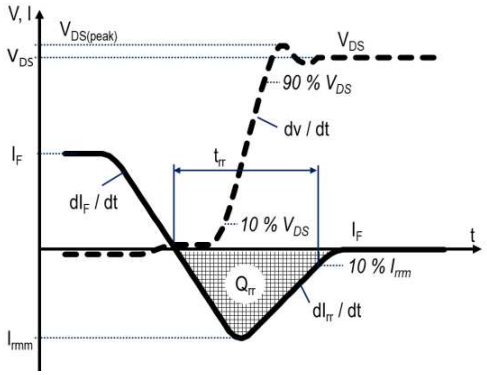
Test circuit for diode characteristics	Diode recovery waveform
	

Table 9 Switching times

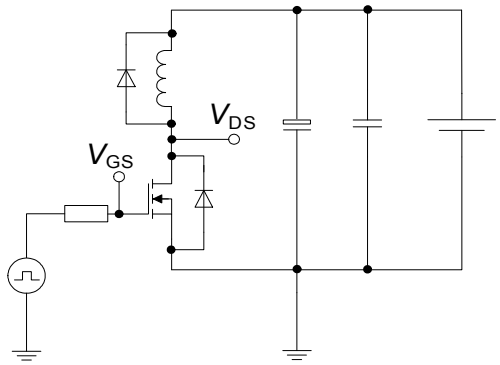
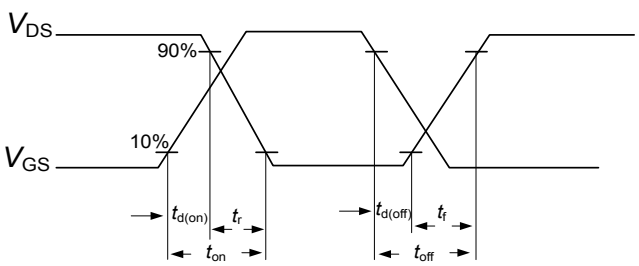
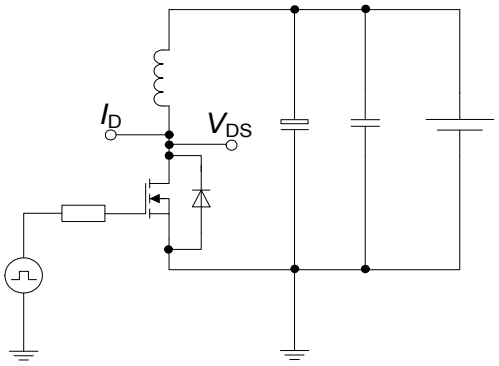
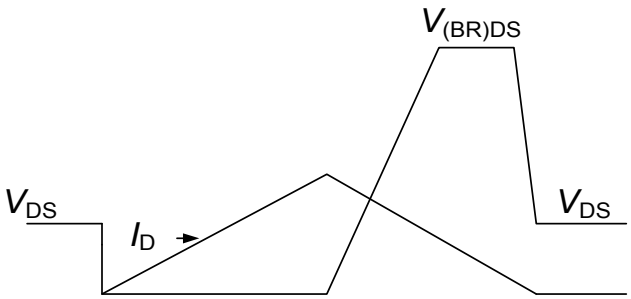
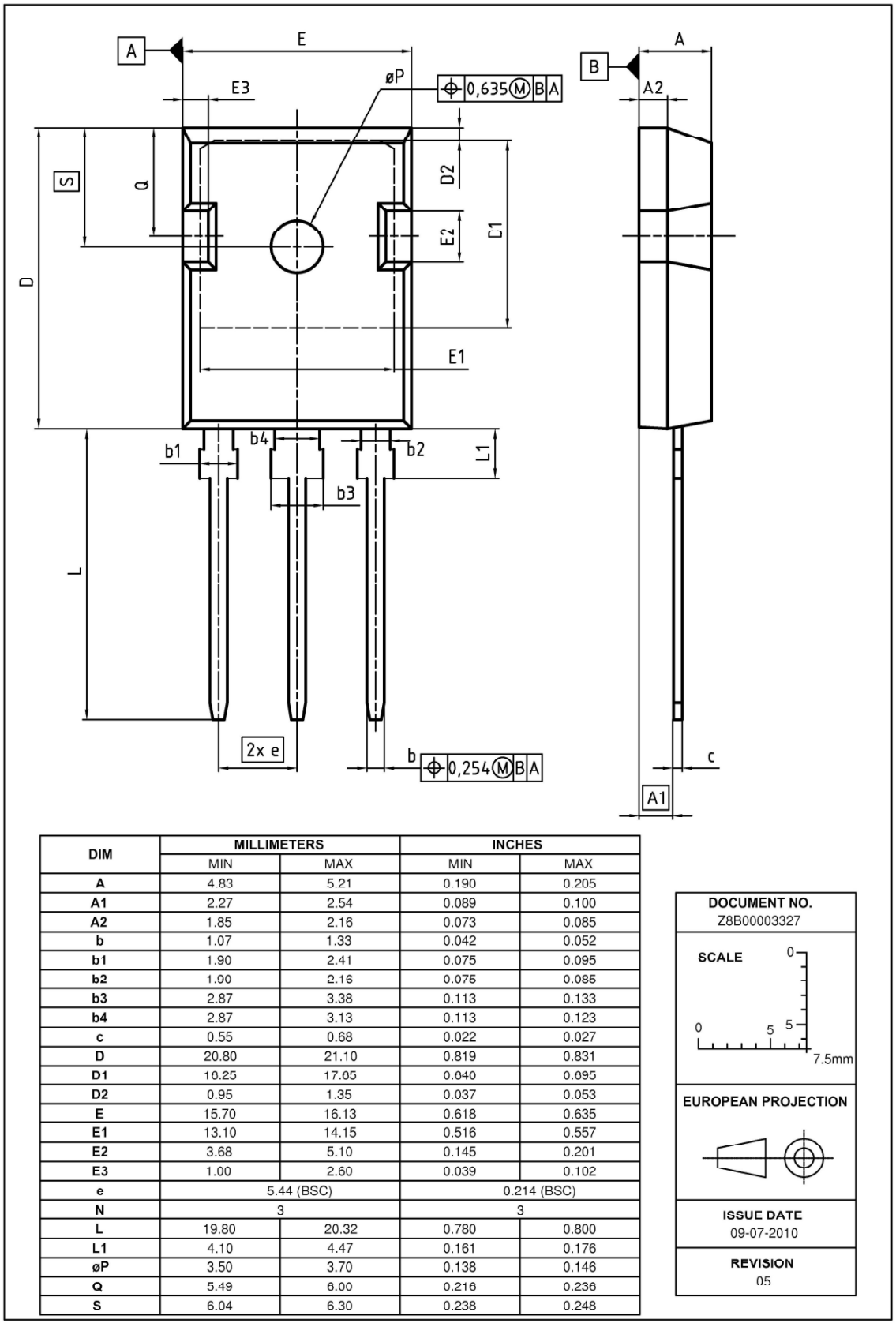
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

6 Package Outlines



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	0.190	0.205
A1	2.27	2.54	0.089	0.100
A2	1.85	2.16	0.073	0.085
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.95	1.35	0.037	0.053
E	15.70	16.13	0.618	0.635
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.00	2.60	0.039	0.102
e	5.44 (BSC)		0.214 (BSC)	
N	3		3	
L	19.80	20.32	0.780	0.800
L1	4.10	4.47	0.161	0.176
øP	3.50	3.70	0.138	0.146
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

DOCUMENT NO.
Z8B00003327

SCALE 0 5 5 7.5mm

EUROPEAN PROJECTION

ISSUE DATE
09-07-2010

REVISION
05

Figure 1 Outline PG-TO 247-3, dimensions in mm/inches

7 Appendix A

Table 11 Related Links

- **IFX CoolMOS Webpage:** www.infineon.com
- **IFX Design tools:** www.infineon.com

Revision History

IPW60R037CSFD

Revision: 2017-12-11, Rev. 2.0

Previous Revision		
Revision	Date	Subjects (major changes since last revision)
2.0	2017-12-11	Release of final version

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