MOSFET

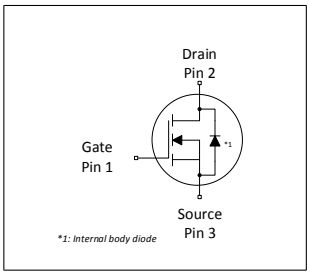
600V CoolMOS™ C7 Power Device

PG-TO 220 FP

CoolMOS™ C7 is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies.

600V CoolMOS™ C7 series combines the experience of the leading SJ MOSFET supplier with high class innovation.

The 600V C7 is the first technology ever with $R_{DS(on)}$*A below 1Ohm*mm².



Features

- Suitable for hard and soft switching (PFC and high performance LLC)
- Increased MOSFET dv/dt ruggedness to 120V/ns
- Increased efficiency due to best in class FOM $R_{DS(on)}$*E_{oss} and $R_{DS(on)}$*Q_g
- Best in class $R_{DS(on)}$ /package

Benefits

- Increased economies of scale by use in PFC and PWM topologies in the application
- Higher dv/dt limit enables faster switching leading to higher efficiency
- Enabling higher system efficiency by lower switching losses
- Increased power density solutions due to smaller packages
- Suitable for applications such as server, telecom and solar
- Higher switching frequencies possible without loss in efficiency due to low Eoss and Qg

Potential applications

PFC stages and PWM stages (TTF, LLC) for high power/performance SMPS e.g. Computing, Server, Telecom, UPS and Solar.

Product validation

Fully qualified according to JEDEC for Industrial Applications

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
$R_{DS(on),max}$	60	mΩ
$Q_{g.typ}$	68	nC
$I_{D,pulse}$	135	A
$I_{D,continuous}$ @ T_j<150°C	54	A
E_{oss}@400V	8.1	µJ
Body diode di/dt	420	A/µs

Type / Ordering Code	Package	Marking	Related Links
IPA60R060C7	PG-TO 220 FullPAK	60C7060	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	- -	- -	16 10	A	T_C=25°C T_C=100°C
Pulsed drain current[2)]	$I_{D,pulse}$	-	-	135	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	159	mJ	I_D=6.4A; V_{DD}=50V; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	0.80	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}	-30	-	30	V	AC (f>1 Hz)
Power dissipation	P_{tot}	-	-	34	W	T_C=25°C
Storage temperature	T_{stg}	-55	-	150	°C	-
Operating junction temperature	T_j	-55	-	150	°C	-
Mounting torque	-	-	-	50	Ncm	M2.5 screws
Continuous diode forward current	I_S	-	-	16	A	T_C=25°C
Diode pulse current[2)]	$I_{S,pulse}$	-	-	135	A	T_C=25°C
Reverse diode dv/dt[3)]	dv/dt	-	-	20	V/ns	V_{DS}=0...400V, I_{SD}<=9.9A, T_j=25°C see table 8
Maximum diode commutation speed	di_f/dt	-	-	420	A/µs	V_{DS}=0...400V, I_{SD}<=9.9A, T_j=25°C see table 8
Insulation withstand voltage	V_{ISO}	-	-	2500	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

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	3.69	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	80	°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	3.5	4	V	V_{DS}=V_{GS}, I_D=0.8mA
Zero gate voltage drain current	I_{DSS}	- -	- 10	1 -	µA	V_{DS}=600, V_{GS}=0V, T_j=25°C V_{DS}=600, 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	$R_{DS(on)}$	- -	0.052 0.115	0.060 -	Ω	V_{GS}=10V, I_D=15.9A, T_j=25°C V_{GS}=10V, I_D=15.9A, T_j=150°C
Gate resistance	R_G	-	0.8	-	Ω	f=1MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	2850	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Output capacitance	C_{oss}	-	54	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Effective output capacitance, energy related[1]	$C_{o(er)}$	-	101	-	pF	V_{GS}=0V, V_{DS}=0...400V
Effective output capacitance, time related[2]	$C_{o(tr)}$	-	1050	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...400V
Turn-on delay time	$t_{d(on)}$	-	15.5	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=15.9A, R_G=3.3Ω; see table 9
Rise time	t_r	-	11	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=15.9A, R_G=3.3Ω; see table 9
Turn-off delay time	$t_{d(off)}$	-	79	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=15.9A, R_G=3.3Ω; see table 9
Fall time	t_f	-	4	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=15.9A, R_G=3.3Ω; see table 9

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	14	-	nC	V_{DD}=400V, I_D=15.9A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	23	-	nC	V_{DD}=400V, I_D=15.9A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	68	-	nC	V_{DD}=400V, I_D=15.9A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.0	-	V	V_{DD}=400V, I_D=15.9A, V_{GS}=0 to 10V

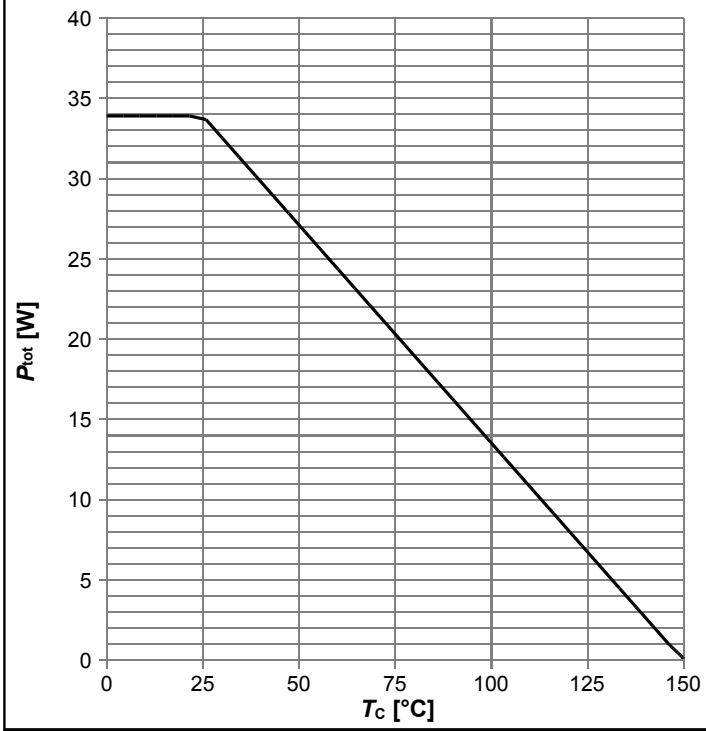
[1] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 400V
[2] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 400V

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	0.9	-	V	V_{GS}=0V, I_F=15.9A, T_j=25°C
Reverse recovery time	t_{rr}	-	390	-	ns	V_R=400V, I_F=15.9A, di_F/dt=100A/µs; see table 8
Reverse recovery charge	Q_{rr}	-	6	-	µC	V_R=400V, I_F=15.9A, di_F/dt=100A/µs; see table 8
Peak reverse recovery current	I_{rrm}	-	32	-	A	V_R=400V, I_F=15.9A, di_F/dt=100A/µs; see table 8

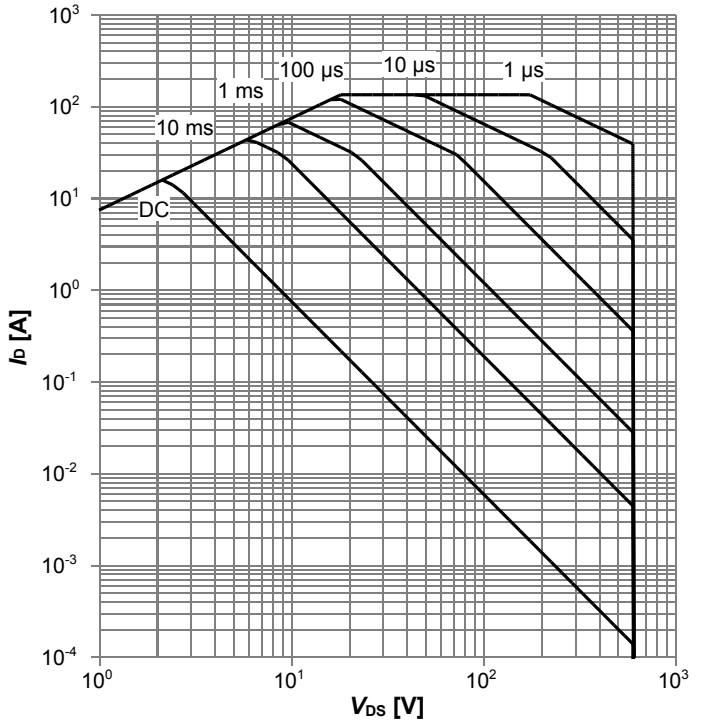
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



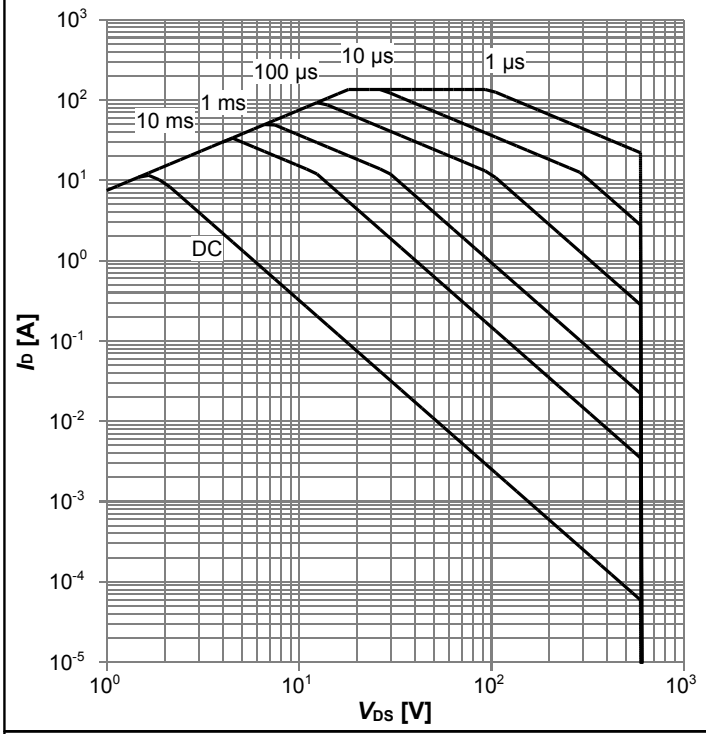
$P_{tot}=f(T_C)$

Diagram 2: Safe operating area



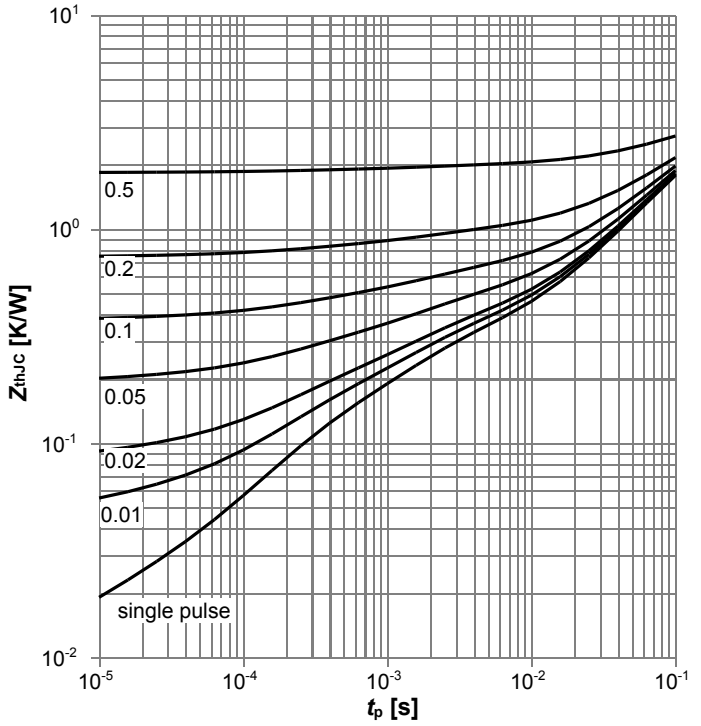
$I_D=f(V_{DS})$; T_C=25 °C; D=0; parameter: t_p

Diagram 3: Safe operating area



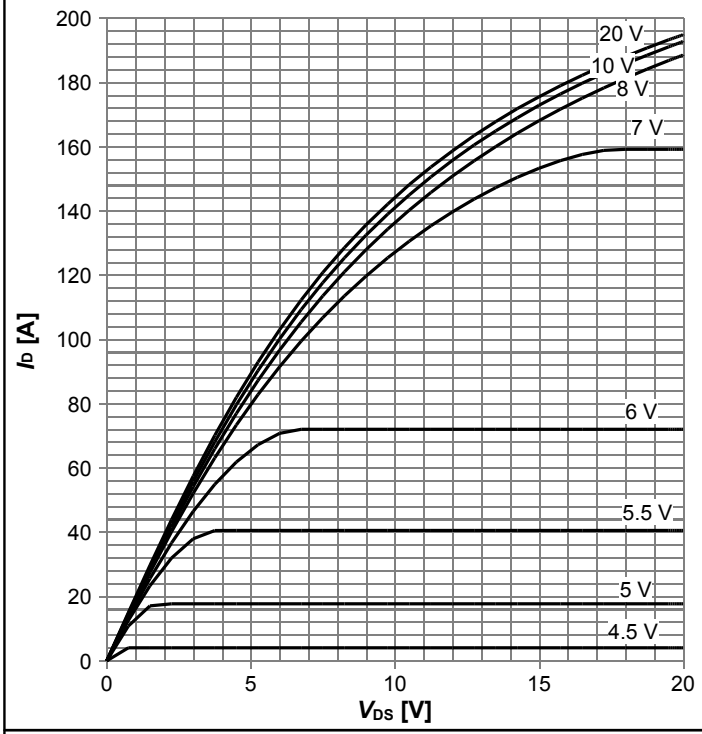
$I_D=f(V_{DS})$; T_C=80 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



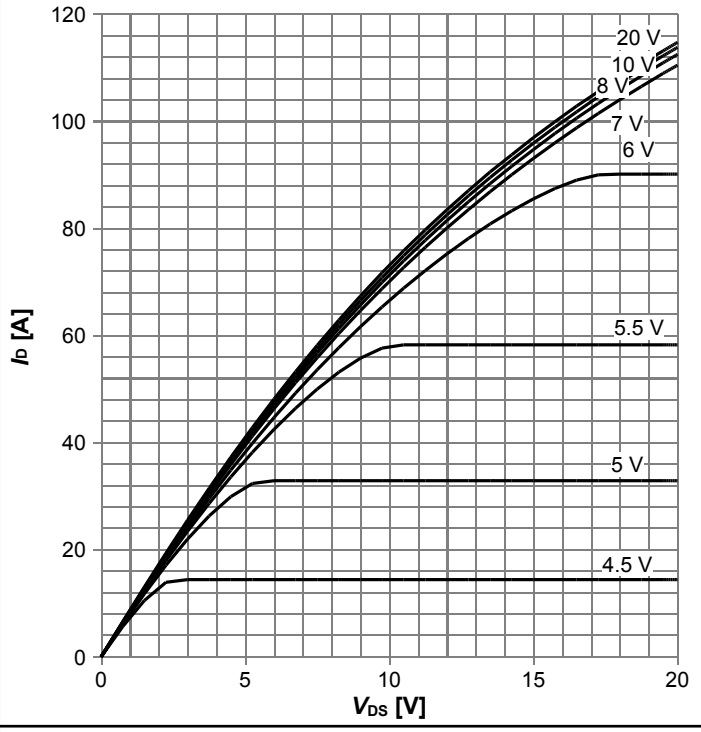
$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

Diagram 5: Typ. output characteristics



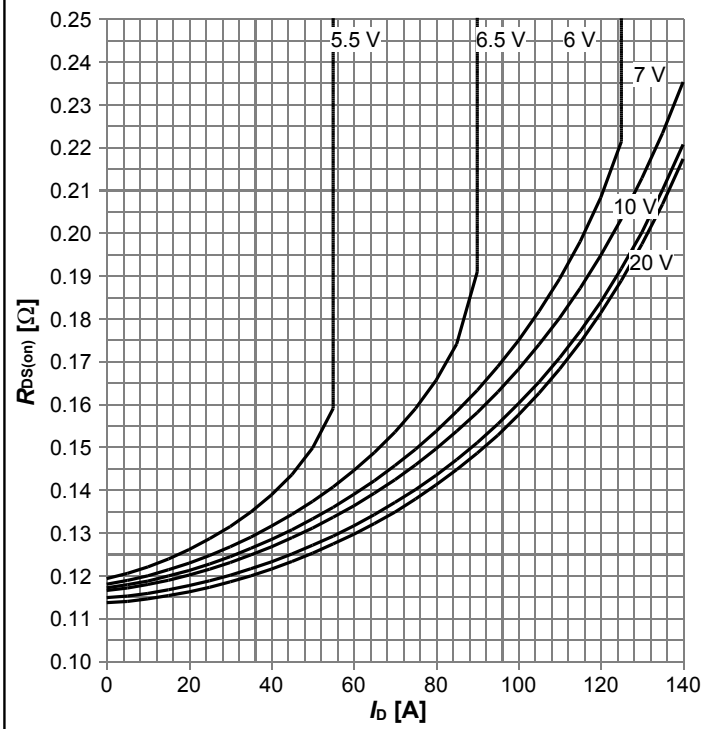
$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



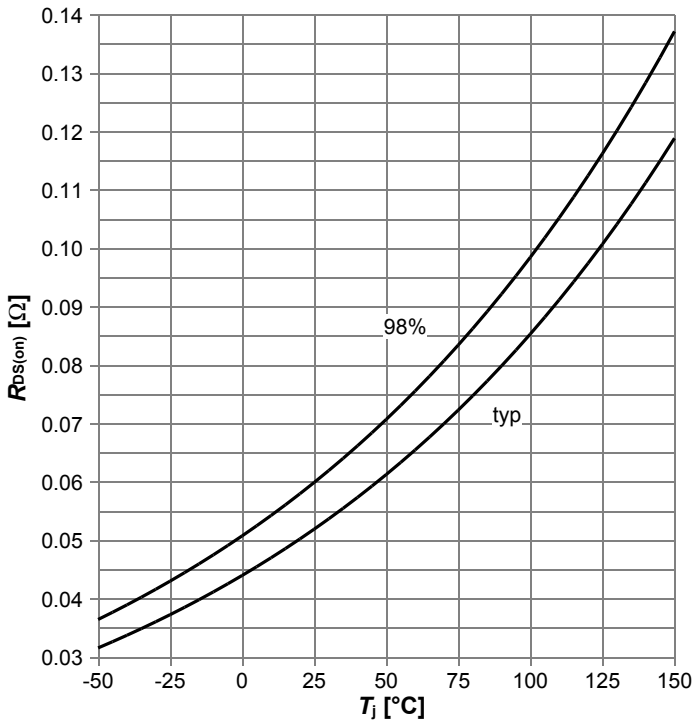
$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: V_{GS}

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



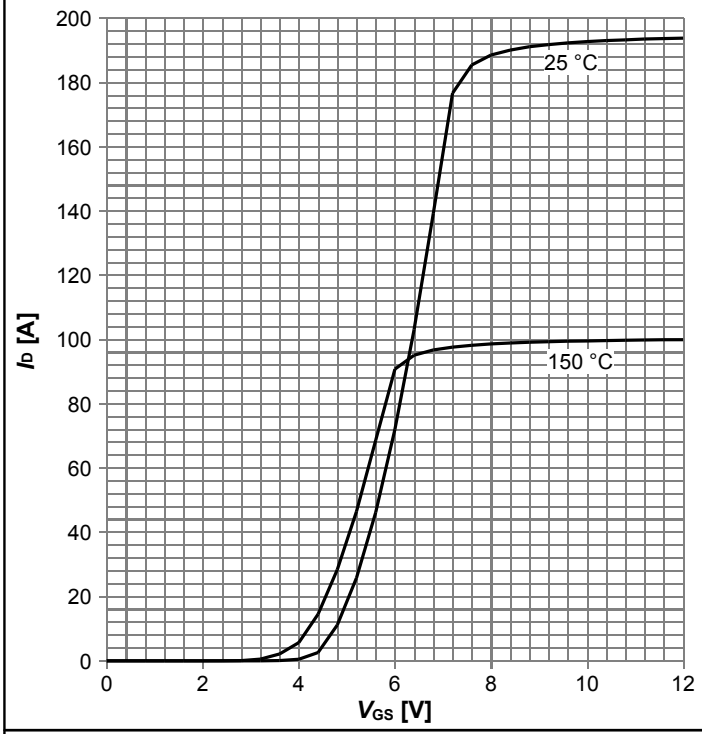
$R_{DS(on)}=f(I_D)$; $T_j=125$ °C; parameter: V_{GS}

Diagram 8: Drain-source on-state resistance



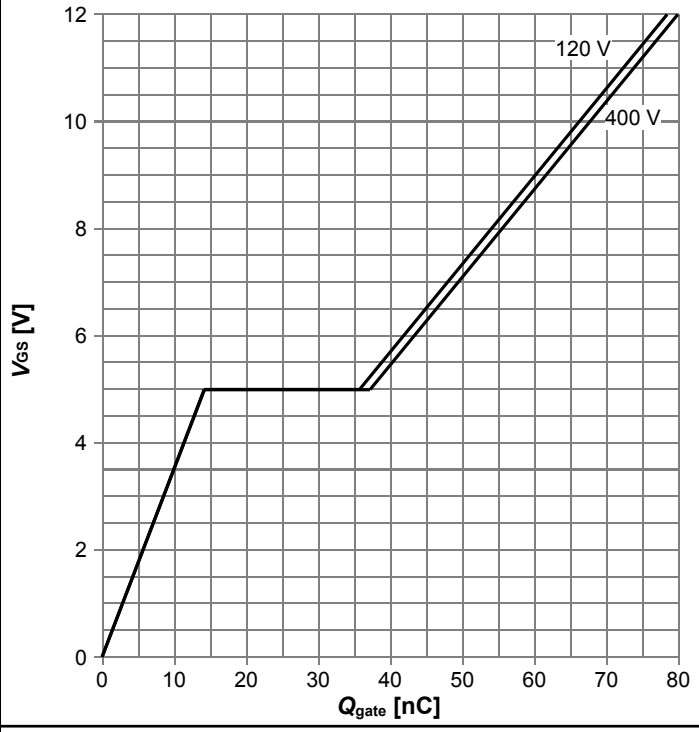
$R_{DS(on)}=f(T_j)$; $I_D=15.9$ A; $V_{GS}=10$ V

Diagram 9: Typ. transfer characteristics



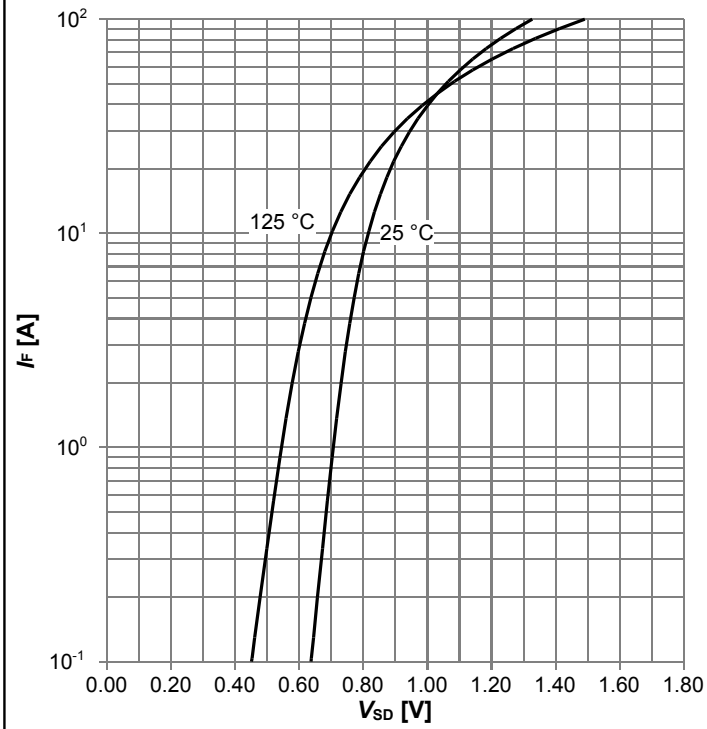
$I_D=f(V_{GS})$; V_{DS}=20V; parameter: T_j

Diagram 10: Typ. gate charge



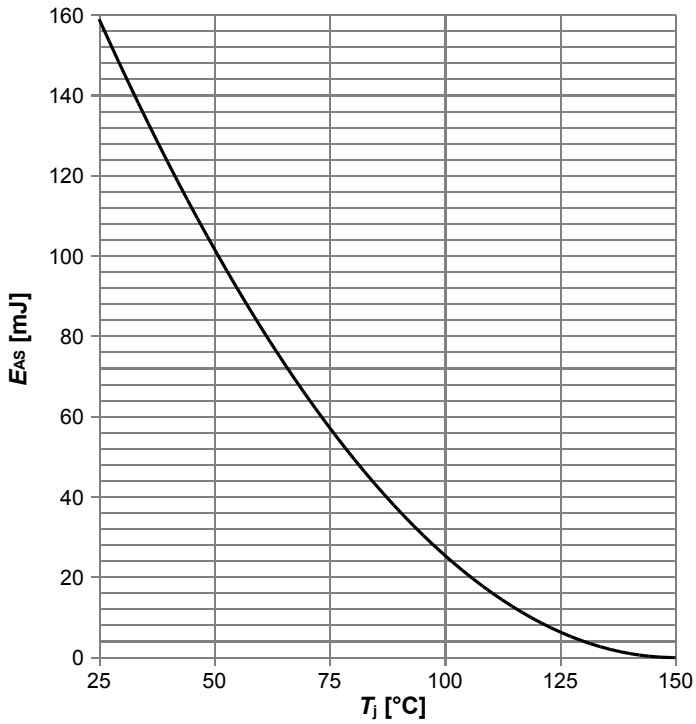
$V_{GS}=f(Q_{gate})$; I_D=15.9 A pulsed; parameter: V_{DD}

Diagram 11: Forward characteristics of reverse diode



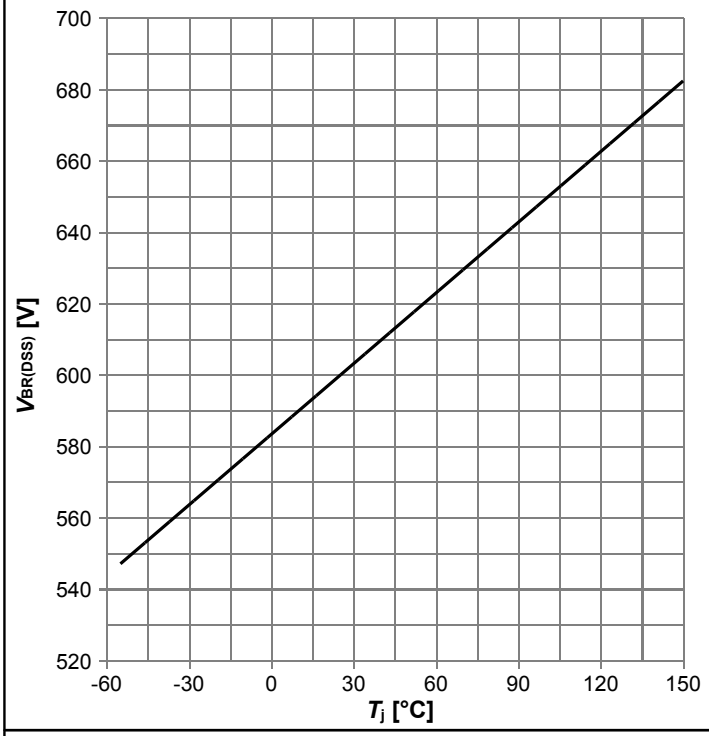
$I_F=f(V_{SD})$; parameter: T_j

Diagram 12: Avalanche energy



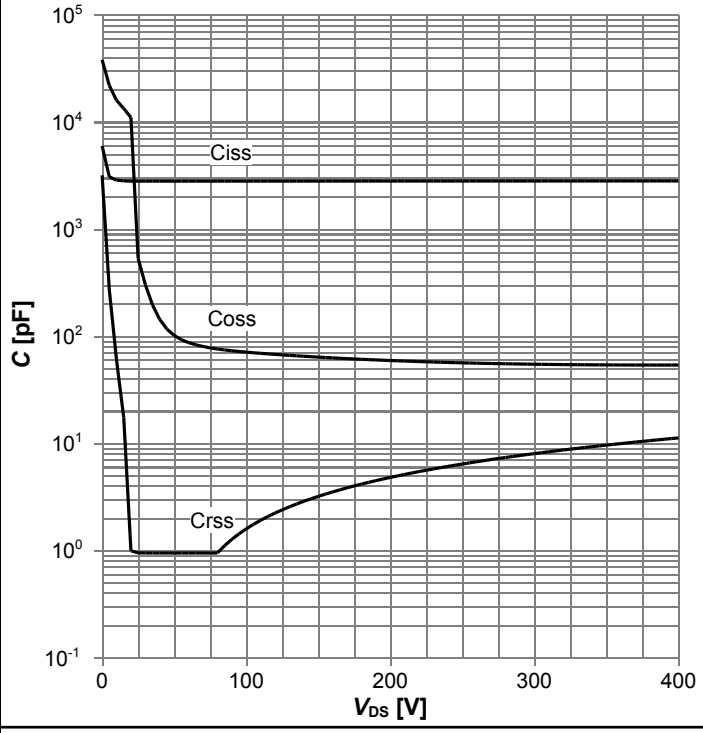
$E_{AS}=f(T_j)$; I_D=6.4 A; V_{DD}=50 V

Diagram 13: Drain-source breakdown voltage



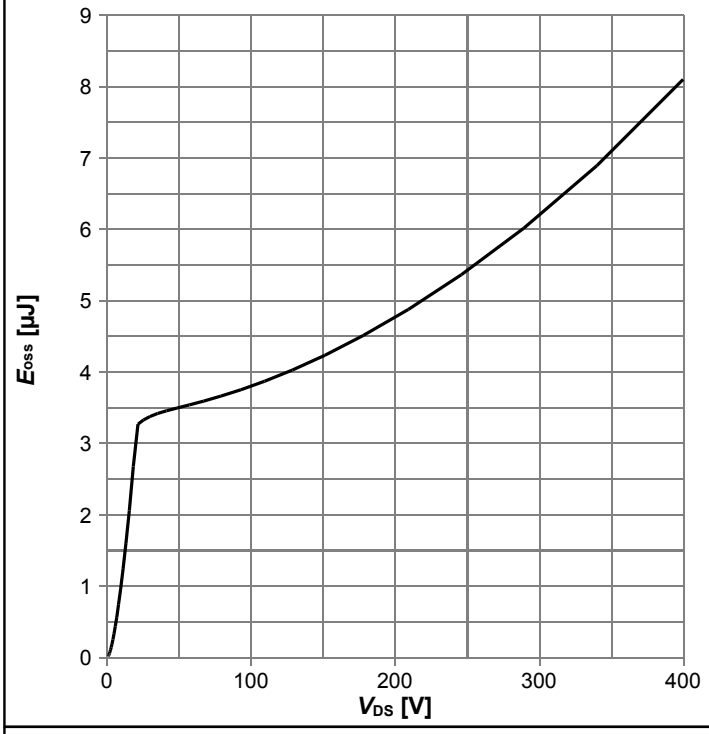
$V_{BR(DSS)}$=f(T_j); I_D=1 mA

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

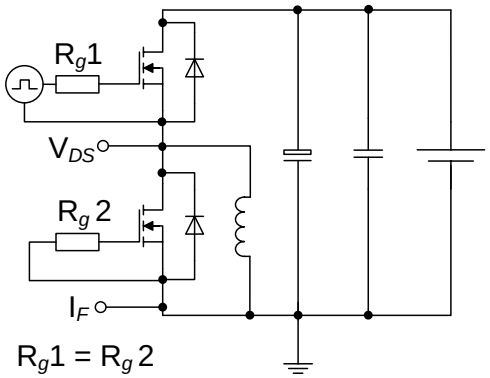
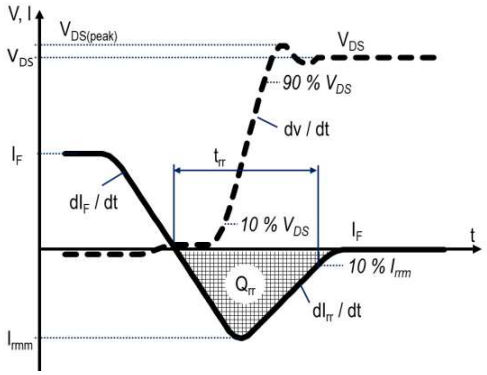
Test circuit for diode characteristics	Diode recovery waveform
	

Table 9 Switching times

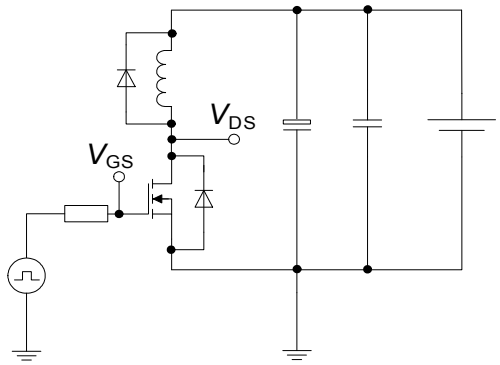
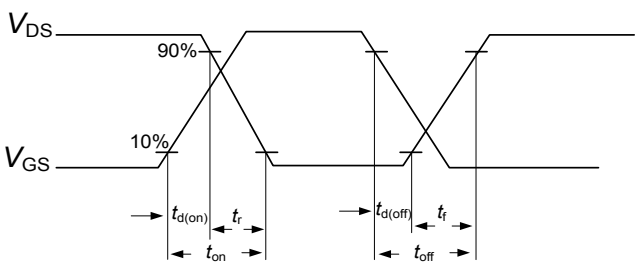
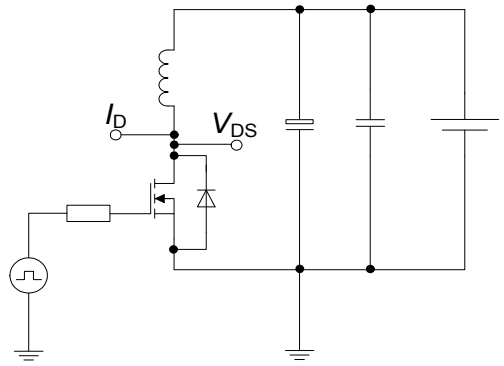
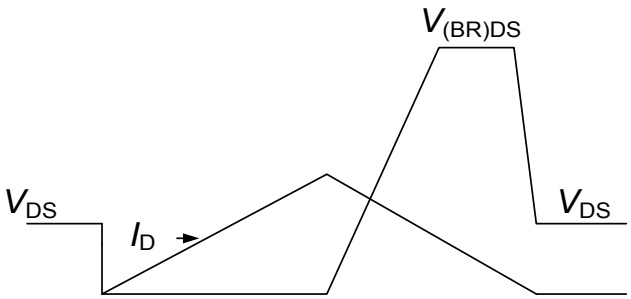
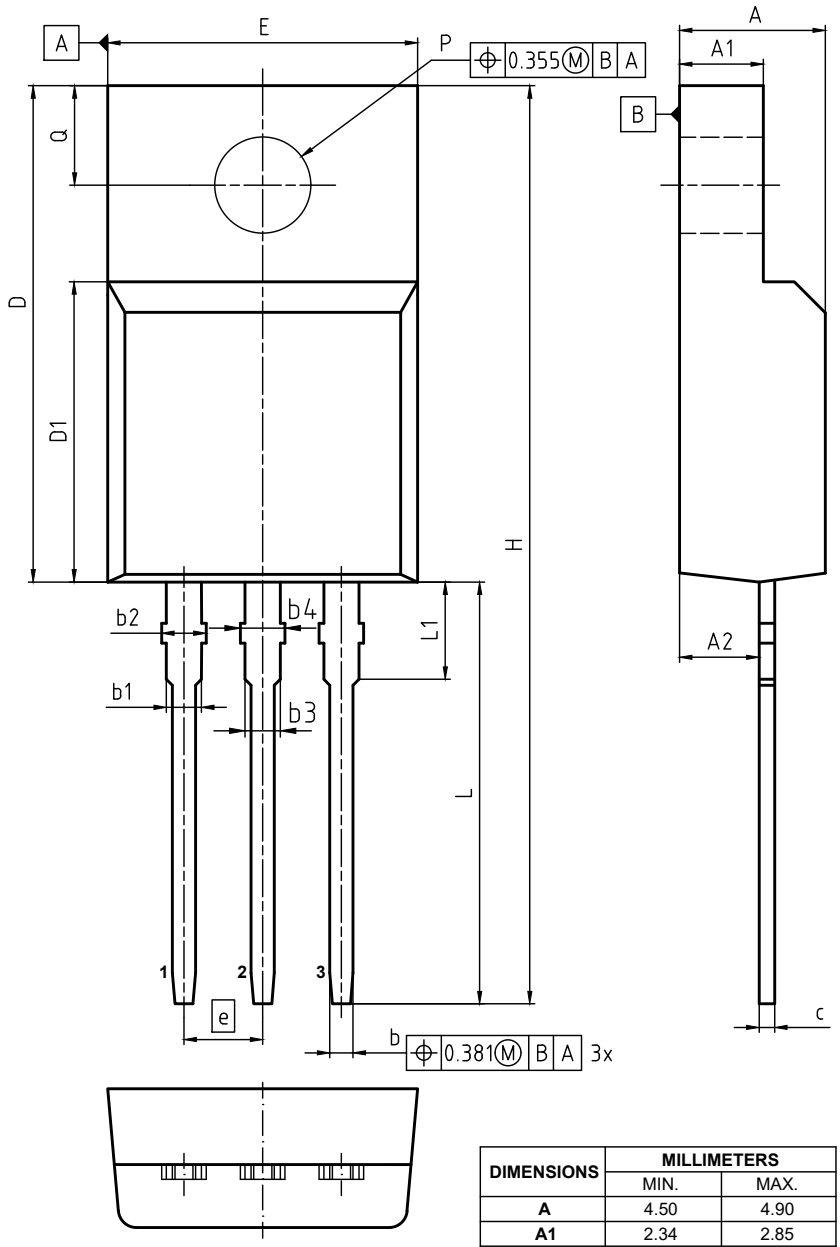
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

6 Package Outlines



NOTES:
DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS
GATE BURRS ARE LESS THAN 0.5 mm

DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.50	4.90
A1	2.34	2.85
A2	2.42	2.86
b	0.65	0.90
b1	0.95	1.38
b2	0.95	1.51
b3	0.65	1.38
b4	0.65	1.51
c	0.40	0.63
D	15.67	16.15
D1	8.97	9.83
E	10.00	10.65
e	2.54	
H	28.70	29.75
L	12.78	13.75
L1	2.83	3.45
øP	3.00	3.30
Q	3.15	3.50

DOCUMENT NO.	Z8B00003319
REVISION	10
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SCALE 5:1	0 1 2 3 4 5mm
EUROPEAN PROJECTION	

Figure 1 Outline PG-TO 220 FullPAK, dimensions in mm

7 Appendix A

Table 11 Related Links

- **IFX CoolMOS™ C7 Webpage:** www.infineon.com
- **IFX CoolMOS™ C7 application note:** www.infineon.com
- **IFX CoolMOS™ C7 simulation model:** www.infineon.com
- **IFX Design tools:** www.infineon.com

Revision History

IPA60R060C7

Revision: 2020-01-29, Rev. 2.1

Previous Revision		
Revision	Date	Subjects (major changes since last revision)
2.0	2015-12-01	Release of final version
2.1	2020-01-29	Updated package drawing, symbol ID and product validation

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