MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ C6 600V

600V CoolMOS™ C6 Power Transistor
IPU60R2K0C6

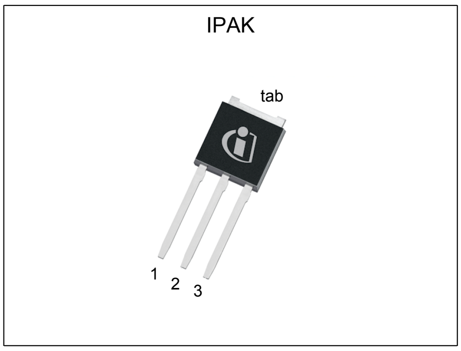
Data Sheet

Rev. 2.2
Final

Industrial & Multimarket

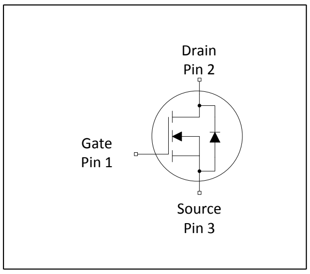
1 Description

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. CoolMOS™ C6 series combines the experience of the leading SJ MOSFET supplier with high class innovation. The resulting devices provide all benefits of a fast switching SJ MOSFET while not sacrificing ease of use. Extremely low switching and conduction losses make switching applications even more efficient, more compact, lighter and cooler.



Features

- Extremely low losses due to very low FOM Rdson*Qg and Eoss
- Very high commutation ruggedness
- Easy to use/drive
- Pb-free plating, Halogen free mold compound
- Qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)



Applications

PFC stages, hard switching PWM stages and resonant switching PWM stages for e.g. PC Silverbox, Adapter, LCD & PDP TV, Lighting, Server, Telecom, UPS.

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j\,max}$	650	V
RDS(on),max	2	Ω
Qg,typ	6.7	nC
ID,pulse	6	A
Eoss @ 400V	0.76	µJ
Body diode di/dt	500	A/µs

Type / Ordering Code	Package	Marking	Related Links
IPU60R2K0C6	PG-TO 251	6R2K0C6	see Appendix A

Table of Contents

2 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			2.4	A	T_C = 25°C
				1.5		T_C = 100°C
Pulsed drain current[2]	$I_{D,pulse}$			6	A	T_C = 25°C
Avalanche energy, single pulse	E_{AS}			11	mJ	I_D = 0.4A, V_{DD} = 50V (see table 10)
Avalanche energy, repetitive	E_{AR}			0.06	mJ	I_D = 0.4A, V_{DD} = 50V
Avalanche current, repetitive	I_{AR}			0.4	A	
MOSFET dv/dt ruggedness	dv/dt			50	V/ns	V_{DS} = 0 ... 480V
Gate source voltage	V_{GS}	-20		20	V	static
		-30		30		AC (f > 1 Hz)
Operating and storage temperature	T_j, T_{stg}	-55		150	°C	
Continuous diode forward current	I_S			2.1	A	T_C = 25°C
Diode pulse current	$I_{S,pulse}$			6	A	T_C = 25°C
Reverse diode dv/dt[3]	dv/dt			15	V/ns	V_{DS} = 0 ... 480V, $I_{SD} \leq I_D$, T_j = 25°C (see table 8)
Maximum diode commutation speed	di_f/dt			500	A/µs	
Power dissipation	P_{tot}			22.3		T_C=25°C

[1] Limited by $T_{j\,max}$. Maximum duty cycle D=0.75
[2] Pulse width t_p limited by $T_{j\,max}$
[3] Identical low side and high side switch with identical R_G

3 Thermal characteristics

Table 3 Thermal characteristics IPAK

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			5.6	°C/W	
Thermal resistance, junction - ambient[1)]	R_{thJA}			62	°C/W	SMD version, device on PCB, minimal footprint
			35			SMD version, device on PCB, 6cm² cooling area
Soldering temperature, wave- & reflowsoldering allowed	T_{sold}			260	°C	reflow MSL

[1)] Device on 40mm*40mm*1.5mm one layer epoxy PCB FR4 with 6cm² copper area (thickness 70µm) for drain connection. PCB is vertical without air stream cooling.

4 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 = 0.25mA
Gate threshold voltage	$V_{GS(th)}$	2.5	3	3.5	V	V_{DS} = V_{GS}, I_D = 0.1mA
Zero gate voltage drain current	I_{DSS}			1	µA	V_{DS} = 600V, V_{GS} = 0V, T_j = 25°C
			10			V_{DS} = 600V, 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	$R_{DS(on)}$		1.800	2	Ω	V_{GS} = 10V, I_D = 0.8A, T_j = 25°C
			4.680			V_{GS} = 10V, I_D = 0.76A, T_j = 150°C
Gate resistance	R_G		12		Ω	f = 1MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}		140		pF	V_{GS} = 0V, V_{DS} = 100V, f = 1MHz
Output capacitance	C_{oss}		12		pF	
Effective output capacitance, energy related[1]	$C_{o(er)}$		8.5		pF	V_{GS} = 0V, V_{DS} = 0 ... 480V
Effective output capacitance, time related[2]	$C_{o(tr)}$		30		pF	I_D = constant, V_{GS} = 0V, V_{DS} = 0 ... 480V
Turn-on delay time	$t_{d(on)}$		7		ns	V_{DD} = 400V, V_{GS} = 10V, I_D = 0.9A, R_G = 12.2Ω (see table 9)
Rise time	t_r		7		ns	
Turn-off delay time	$t_{d(off)}$		30		ns	
Fall time	t_f		50		ns	

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}		0.8		nC	V_{DD} = 480V, I_D = 0.9A, V_{GS} = 0 to 10V
Gate to drain charge	Q_{gd}		3.6		nC	
Gate charge total	Q_g		6.7		nC	
Gate plateau voltage	$V_{plateau}$		5.4		V	

[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 80% $V_{(BR)DSS}$

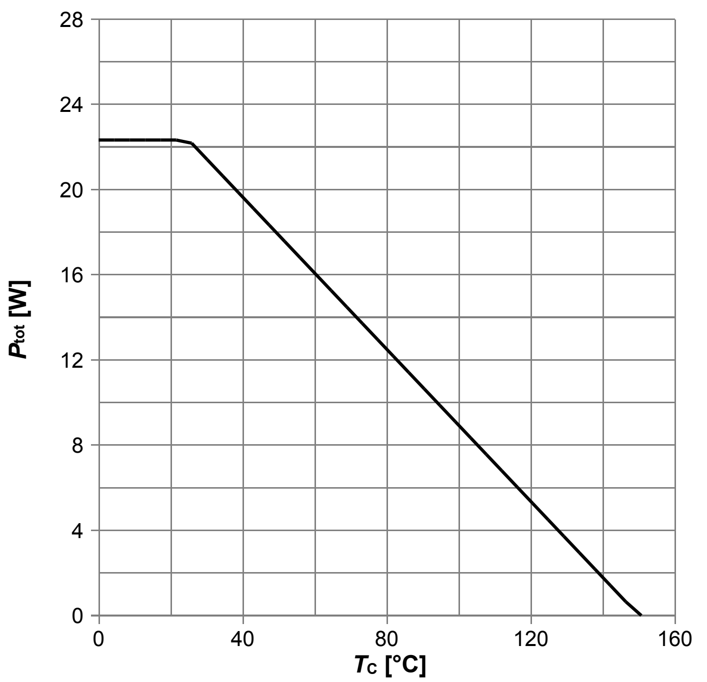
[2] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$

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 = 0.9A, T_j = 25°C
Reverse recovery time	t_{rr}		180		ns	V_R = 400V, I_F = 0.9A, di_F/dt = 100A/µs (see table 8)
Reverse recovery charge	Q_{rr}		0.67		µC	
Peak reverse recovery current	I_{rrm}		7.1		A	

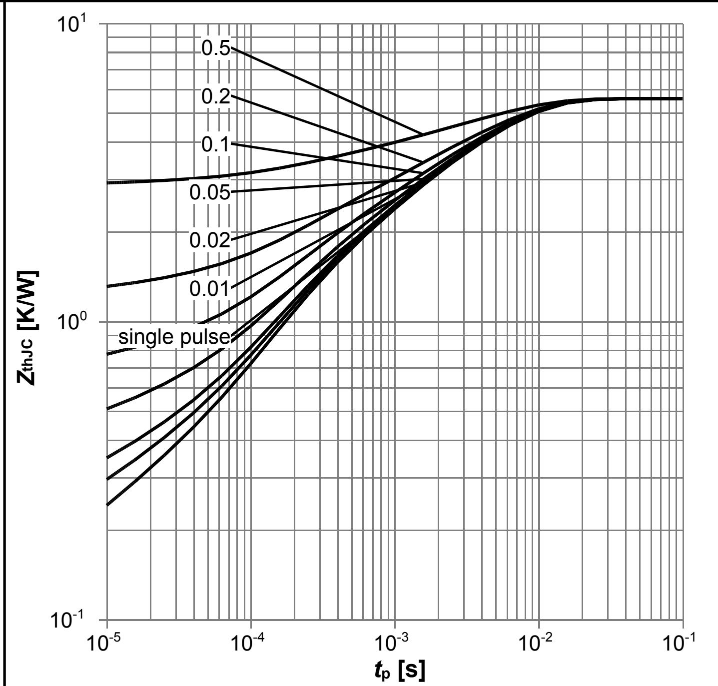
5 Electrical characteristics diagrams

Power dissipation



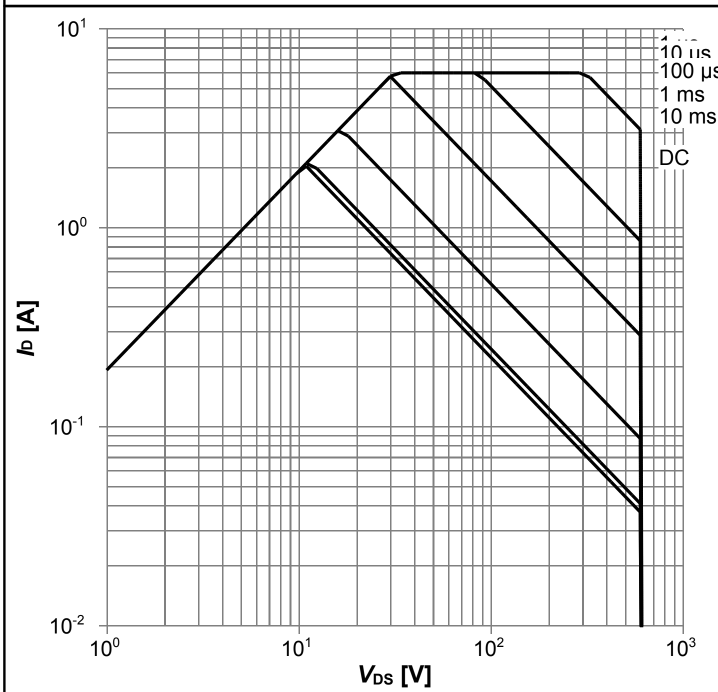
P_{tot}=f(T_C)

Max. transient thermal impedance



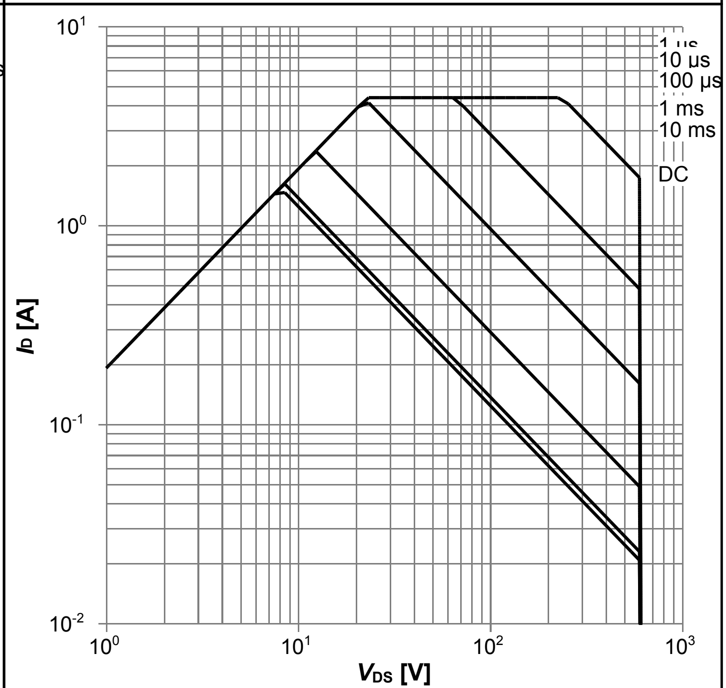
Z_{thJC} =f(t_P); parameter: D=t_p/T

Safe operating area (limited by on-state resistance)



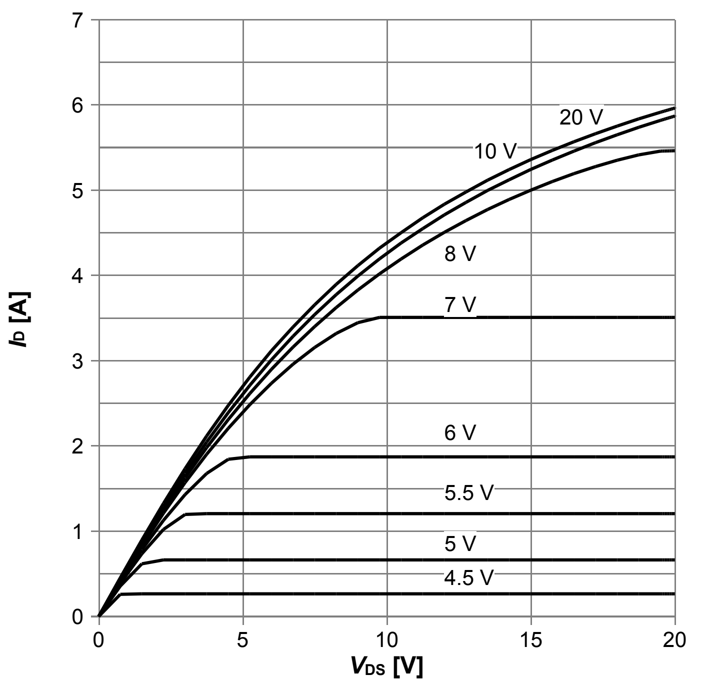
I_D=f(V_{DS}); V_{GS}>7V; T_C=25 °C; D=0; parameter: t_p

Safe operating area (limited by on-state resistance)



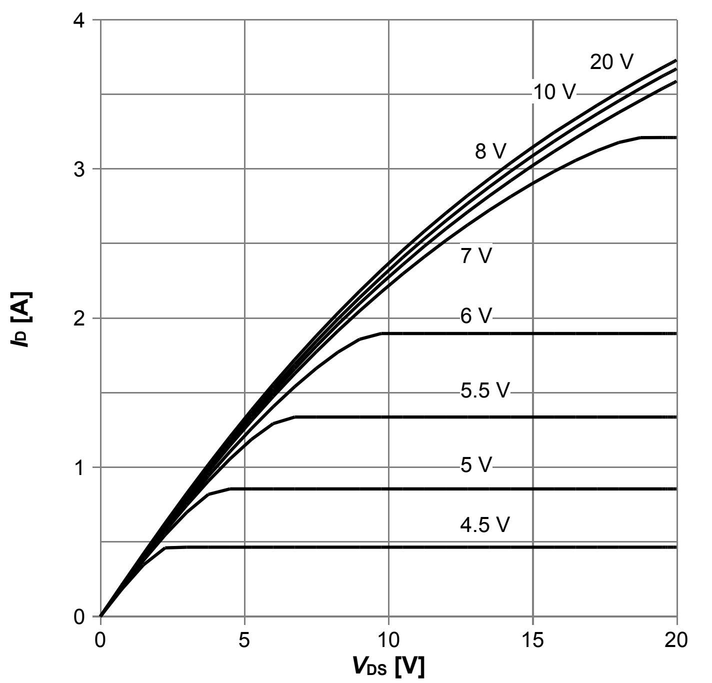
I_D=f(V_{DS}); V_{GS}>7V; T_C=80 °C; D=0; parameter: t_p

Typ. output characteristics



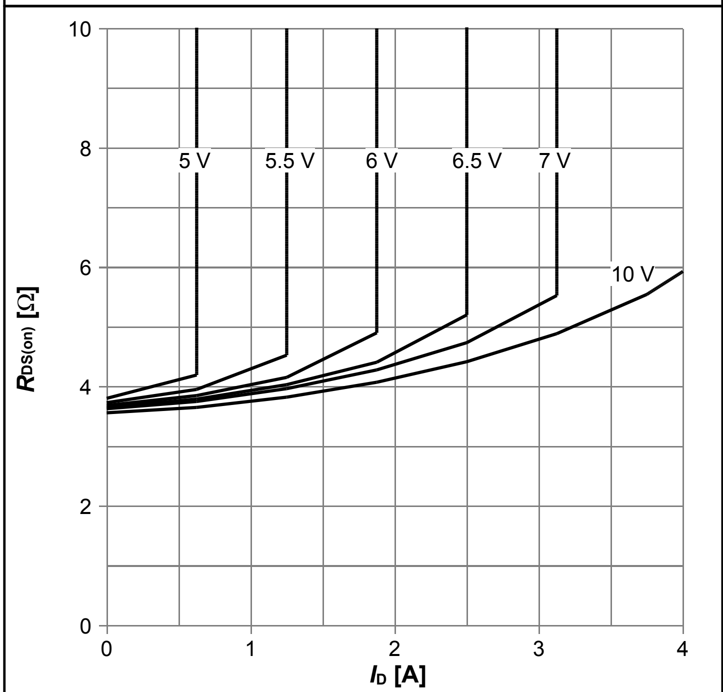
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}

Typ. output characteristics



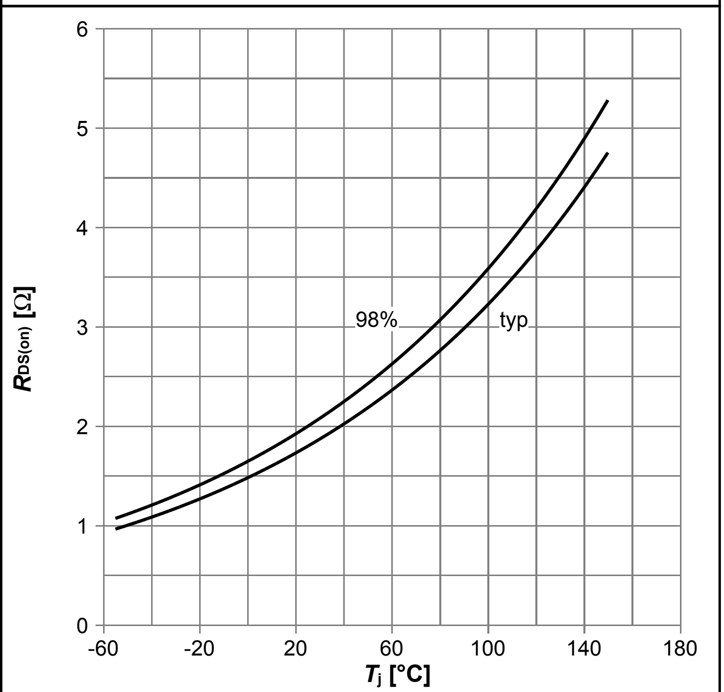
I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}

Typ. drain-source on-state resistance



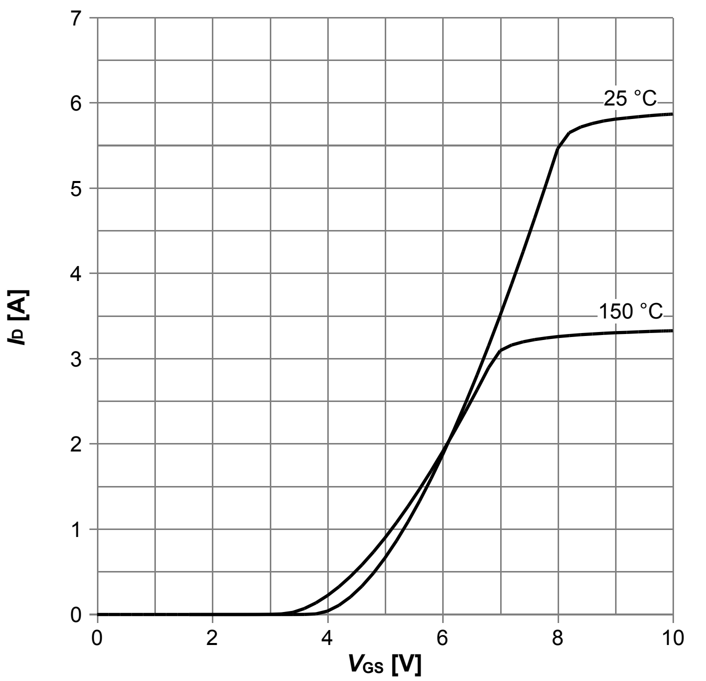
$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}

Drain-source on-state resistance



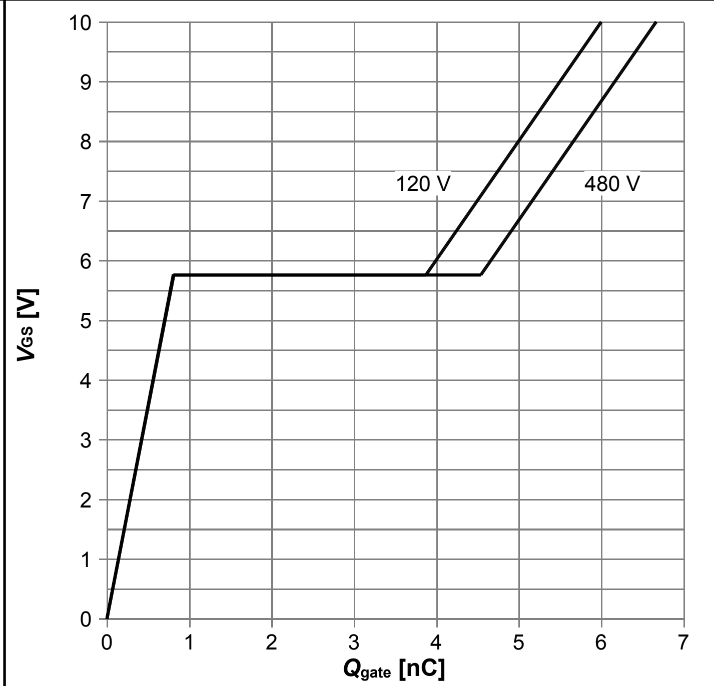
$R_{DS(on)}$=f(T_j); I_D=0.76 A; V_{GS}=10 V

Typ. transfer characteristics



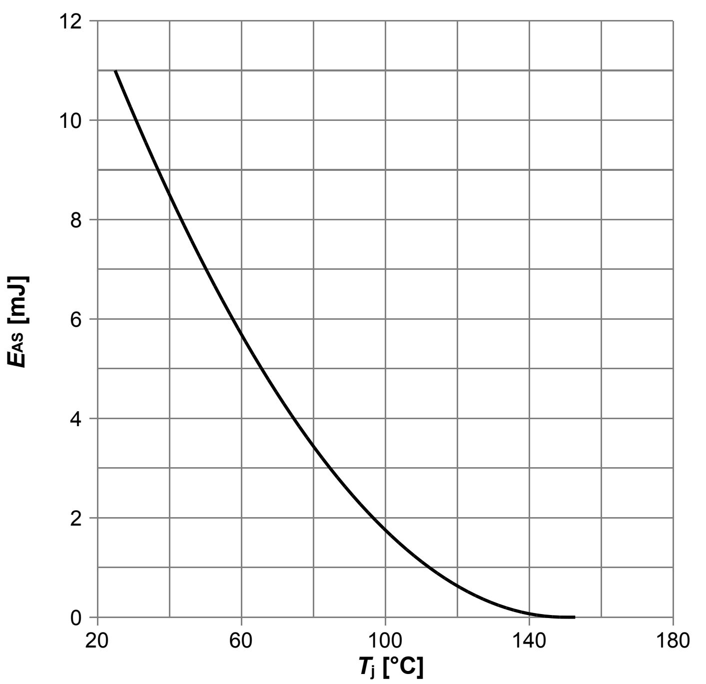
I_D=f(V_{GS}); V_{DS}=20V

Typ. gate charge



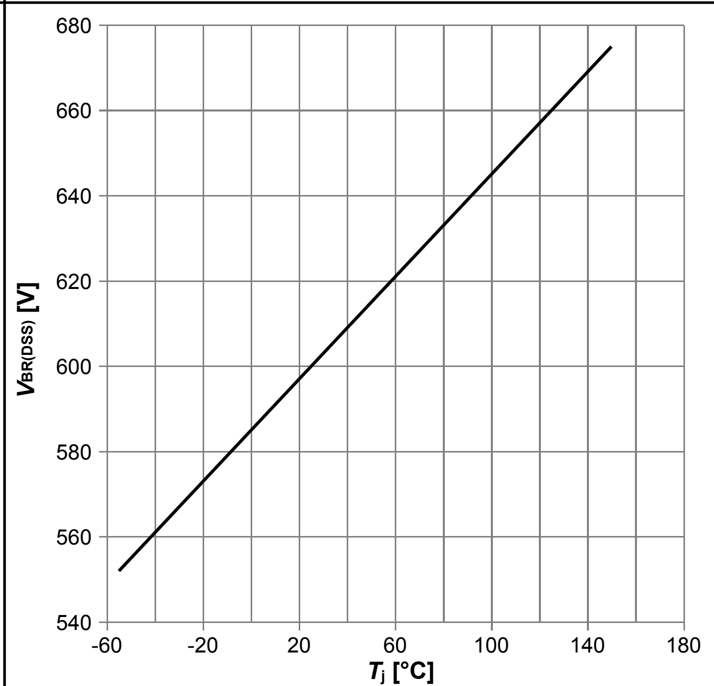
V_{GS}=f(Q_{gate}); I_D=0.9 A pulsed

Avalanche energy



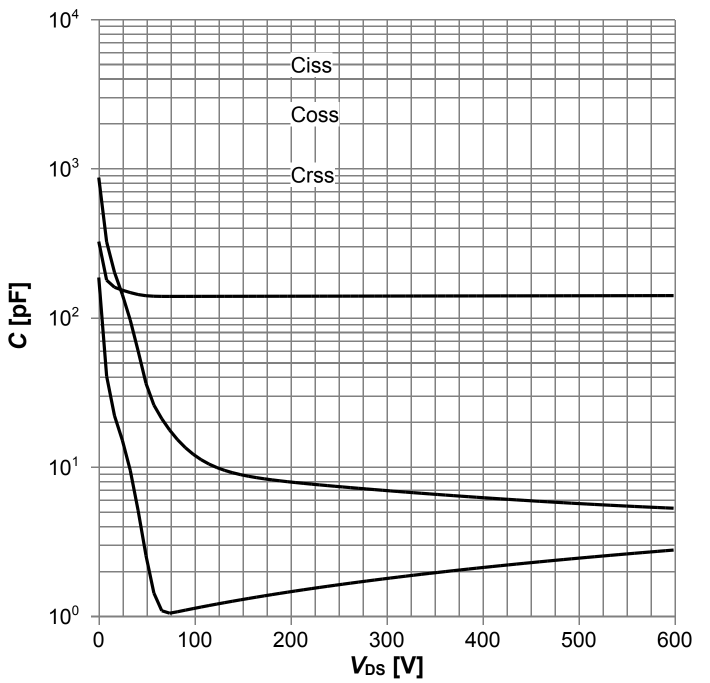
E_{AS}=f(T_j); I_D=0.4 A; V_{DD}=50 V

Drain-source breakdown voltage



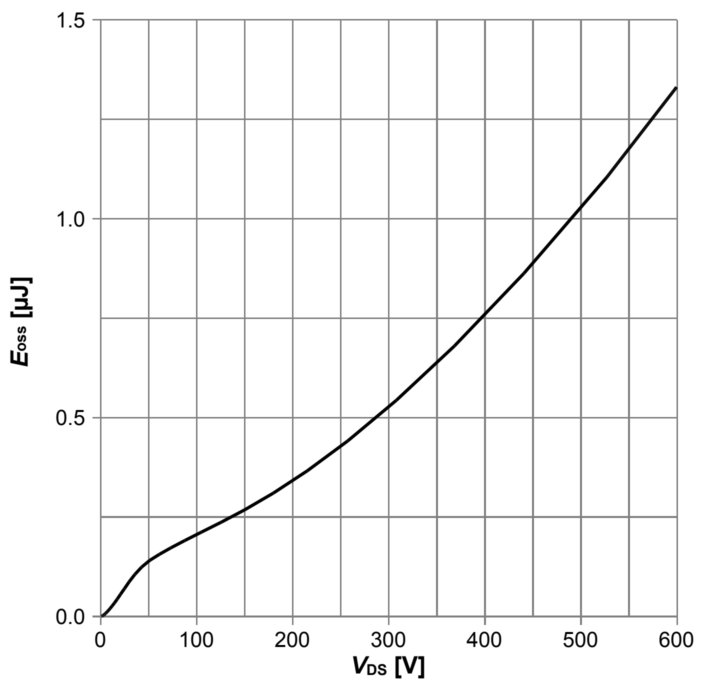
$V_{BR(DSS)}$=f(T_j); I_D=0.25 mA

Typ. capacitances



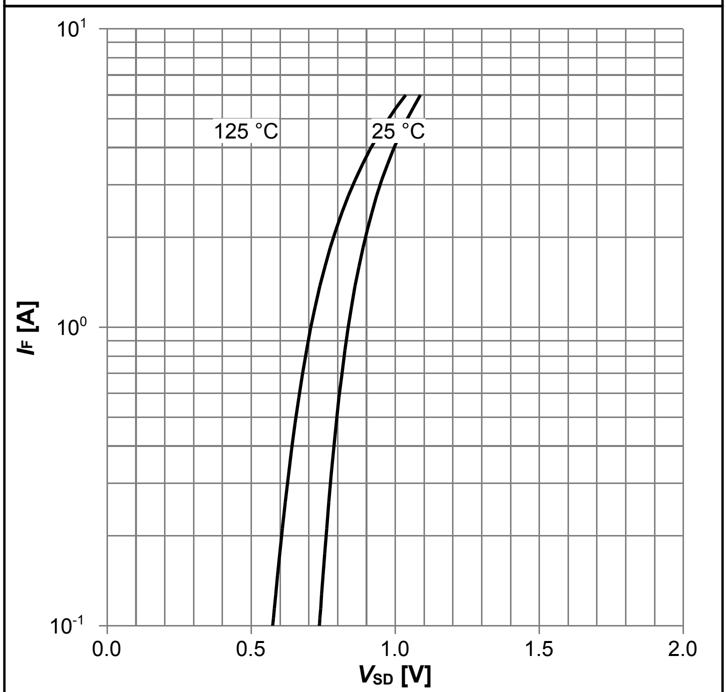
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz

Typ. C_{oss} stored energy



E_{oss}=f(V_{DS})

Forward characteristics of reverse diode



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

6 Test Circuits

Table 8 Diode characteristics

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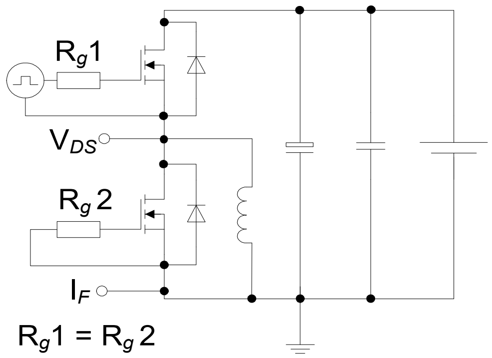
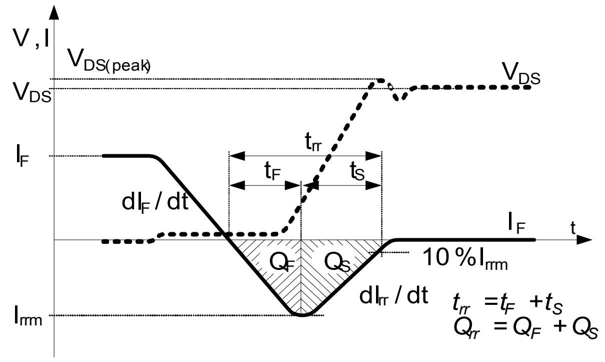
<tr><th>Test circuit for diode characteristics</th><th>Diode recovery waveform</th></tr>
<tr><td>
</td><td>
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Table 9 Switching times

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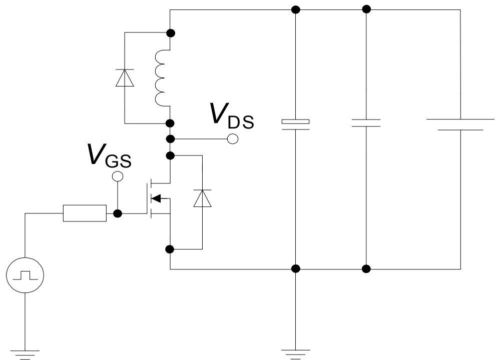
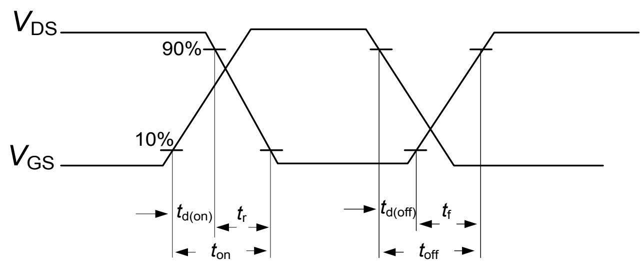
<tr><th>Switching times test circuit for inductive load</th><th>Switching times waveform</th></tr>
<tr><td>
</td><td>
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Table 10 Unclamped inductive load

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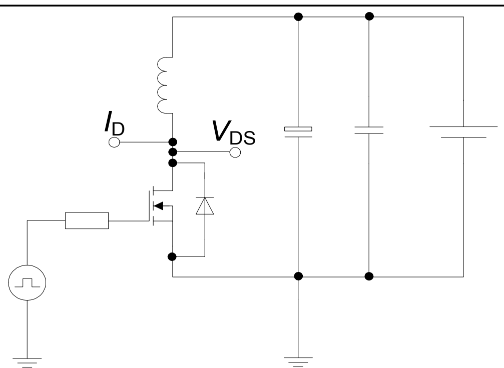
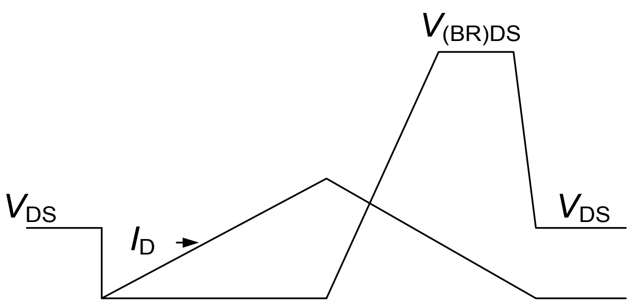
<tr><th>Unclamped inductive load test circuit</th><th>Unclamped inductive waveform</th></tr>
<tr><td>
</td><td>
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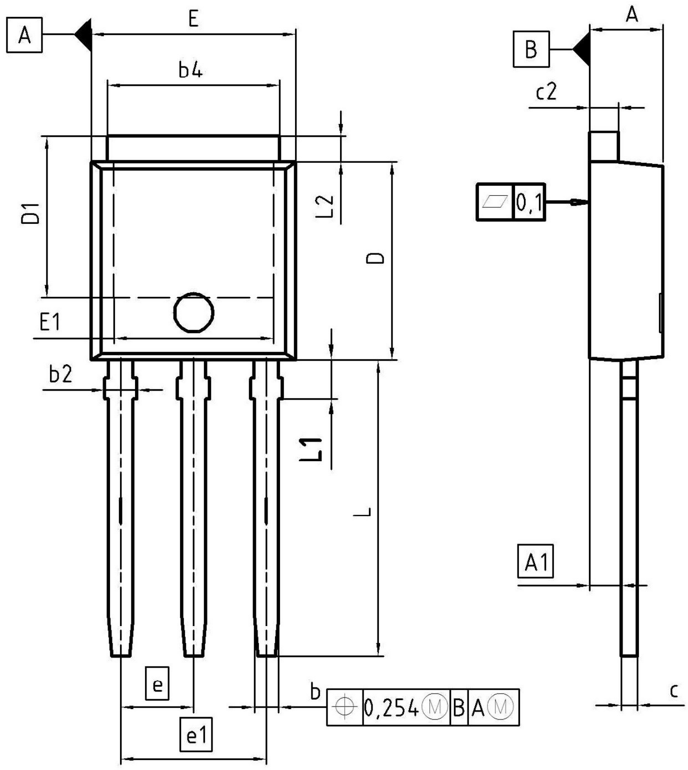
7 Package Outlines



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.16	2.41	0.085	0.095
A1	0.90	1.14	0.035	0.045
b	0.64	0.89	0.025	0.035
b2	0.65	1.15	0.026	0.045
b4	4.95	5.50	0.195	0.217
c	0.46	0.60	0.018	0.024
c2	0.46	0.89	0.018	0.035
D	5.97	6.22	0.235	0.245
D1	5.04	5.77	0.198	0.227
E	6.35	6.73	0.250	0.265
E1	4.70	5.21	0.185	0.205
e	2.29		0.090	
e1	4.57		0.180	
N	3		3	
L	8.89	9.65	0.350	0.380
L1	1.90	2.29	0.075	0.090
L2	0.89	1.37	0.035	0.054

DOCUMENT NO.
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SCALE 0 2.0 4mm

EUROPEAN PROJECTION

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REVISION
03

Figure 1 Outline PG-TO 251, dimensions in mm/inches

8 Appendix A

Table 11 Related Links

- **IFX C6 Product Brief:** www.infineon.com
- **IFX C6 Portfolio:** www.infineon.com
- **IFX CoolMOS Webpage:** www.infineon.com
- **IFX Design Tools:** www.infineon.com

Revision History

IPU60R2K0C6

Revision: 2015-10-09, Rev. 2.2

Previous Revision		
Revision	Date	Subjects (major changes since last revision)
2.1	2012-02-02	Final datasheet release
2.2	2015-10-09	Updated with Halogen free information

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