MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ C6 600V

600V CoolMOS™ C6 Power Transistor
IPU60R950C6

Data Sheet

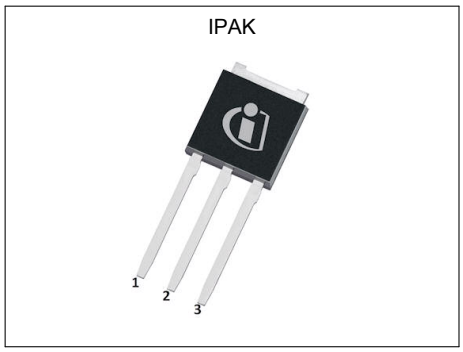
Rev. 2.1
Final

Industrial & Multimarket

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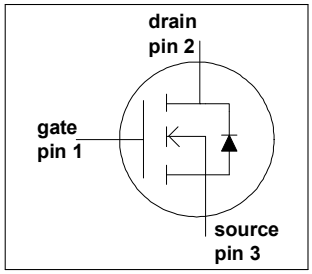
1 Description

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
- 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	0.95	Ω
Qg,typ	13	nC
ID,pulse	12	A
Eoss @ 400V	1.3	µJ
Body diode di/dt	500	A/µs

Type / Ordering Code	Package	Marking	Related Links
IPU60R950C6	PG-TO 251	6R950C6	see Appendix A

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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			4.4	A	T_C = 25°C
				2.8		T_C = 100°C
Pulsed drain current[2]	$I_{D,pulse}$			12	A	T_C = 25°C
Avalanche energy, single pulse	E_{AS}			46	mJ	I_D = 0.8A, V_{DD} = 50V (see table 18)
Avalanche energy, repetitive	E_{AR}			0.13	mJ	I_D = 0.8A, V_{DD} = 50V
Avalanche current, repetitive	I_{AR}			0.8	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			3.9	A	T_C = 25°C
Diode pulse current	$I_{S,pulse}$			12	A	T_C = 25°C
Reverse diode dv/dt[3]	dv/dt			15	V/ns	V_{DS} = 0 ... 480V, $I_{SD} \le I_D$, T_j = 25°C (see table 16)
Maximum diode commutation speed	di_f/dt			500	A/µs	
Power dissipation	P_{tot}			37	W	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

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3 Thermal characteristics

Table 3 Thermal characteristics IPAK

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			3.41	°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.

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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 = 0.13mA
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	$R_{DS(on)}$		0.860	0.95	Ω	V_{GS} = 10V, I_D = 1.5A, T_j = 25°C
			2.220			V_{GS} = 10V, I_D = 1.5A, T_j = 150°C
Gate resistance	R_G		16		Ω	f = 1MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}		280		pF	V_{GS} = 0V, V_{DS} = 100V, f = 1MHz
Output capacitance	C_{oss}		21		pF	
Effective output capacitance, energy related[1)]	$C_{o(er)}$		14		pF	V_{GS} = 0V, V_{DS} = 0 ... 480V
Effective output capacitance, time related[2)]	$C_{o(tr)}$		57		pF	I_D = constant, V_{GS} = 0V, V_{DS} = 0 ... 480V
Turn-on delay time	$t_{d(on)}$		10		ns	V_{DD} = 400V, V_{GS} = 10V, I_D = 1.9A, R_G = 12.2Ω (see table 17)
Rise time	t_r		8		ns	
Turn-off delay time	$t_{d(off)}$		60		ns	
Fall time	t_f		13		ns	

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}		1.5		nC	V_{DD} = 480V, I_D = 1.9A, V_{GS} = 0 to 10V
Gate to drain charge	Q_{gd}		6.5		nC	
Gate charge total	Q_g		13		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% $V_{(BR)DSS}$

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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 = 1.9A, T_j = 25°C
Reverse recovery time	t_{rr}		220		ns	V_R = 400V, I_F = 1.9A, di_F/dt = 100A/µs (see table 16)
Reverse recovery charge	Q_{rr}		1.5		µC	
Peak reverse recovery current	I_{rrm}		12		A	

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5 Electrical characteristics diagrams

Table 8

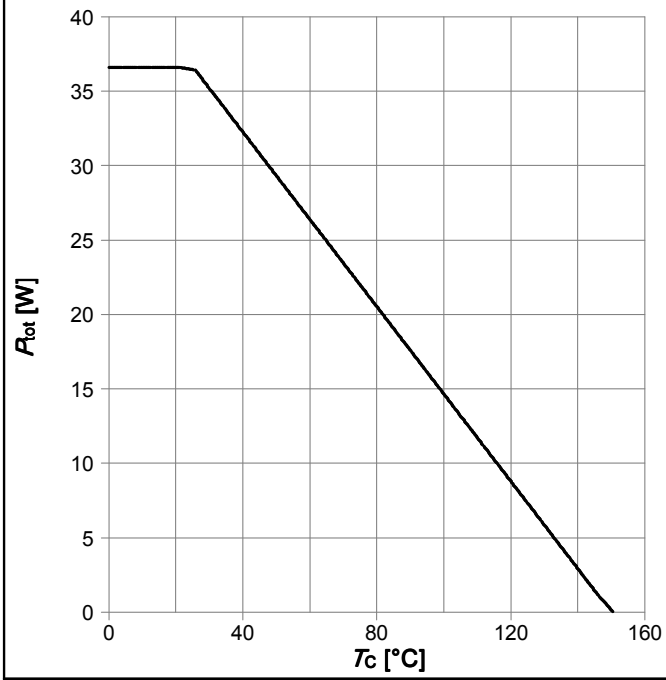
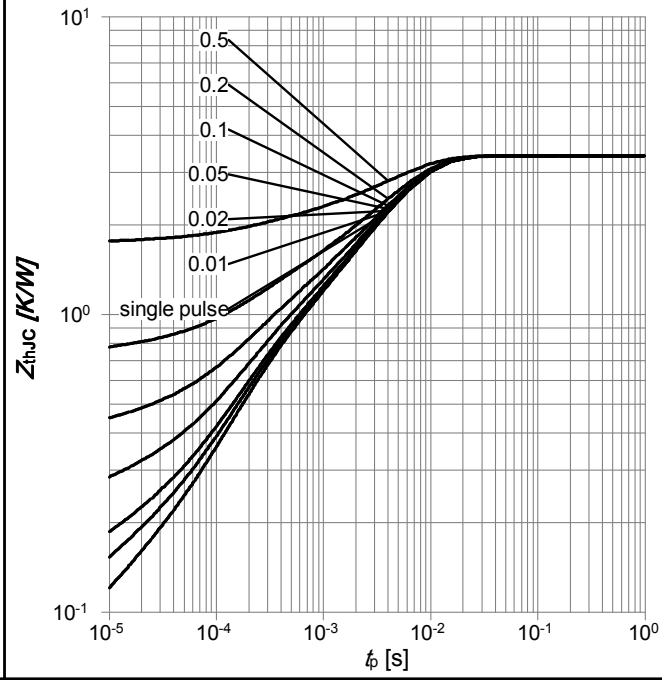
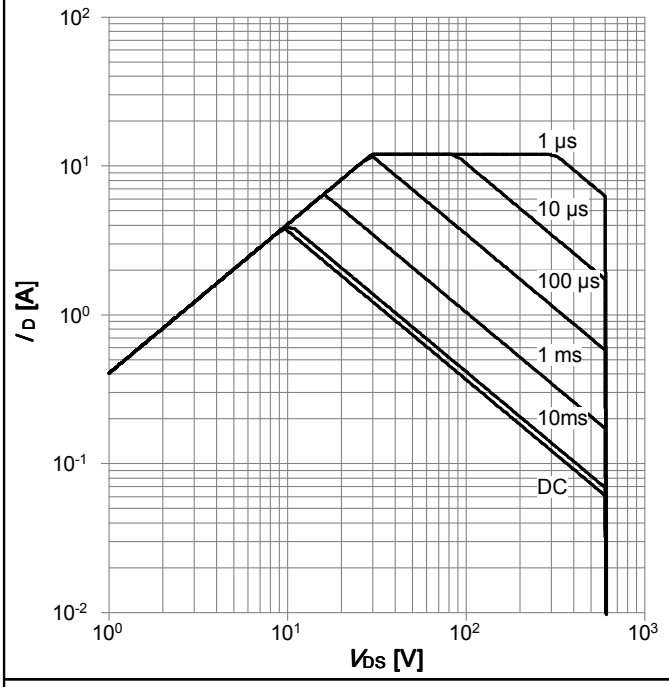
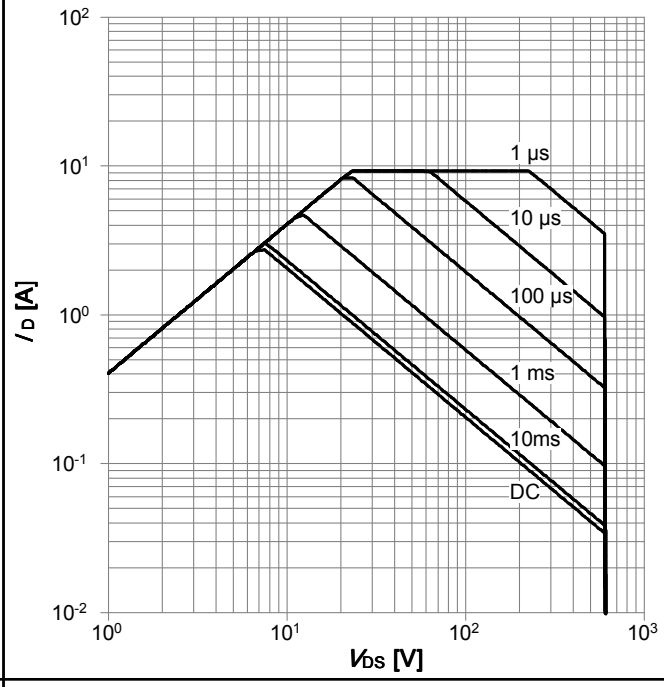
Power dissipation	Max. transient thermal impedance
	
$P_{tot}=f(T_C)$	$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

Table 9

Safe operating area (limited by on-state resistance)	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	$I_D=f(V_{DS})$; V_{GS}>7V; T_C=80 °C; D=0; parameter: t_p

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Table 10

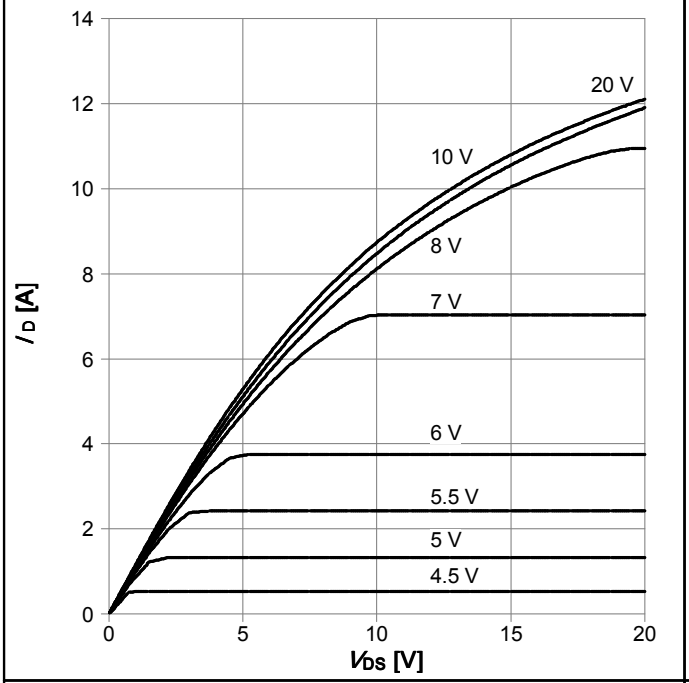
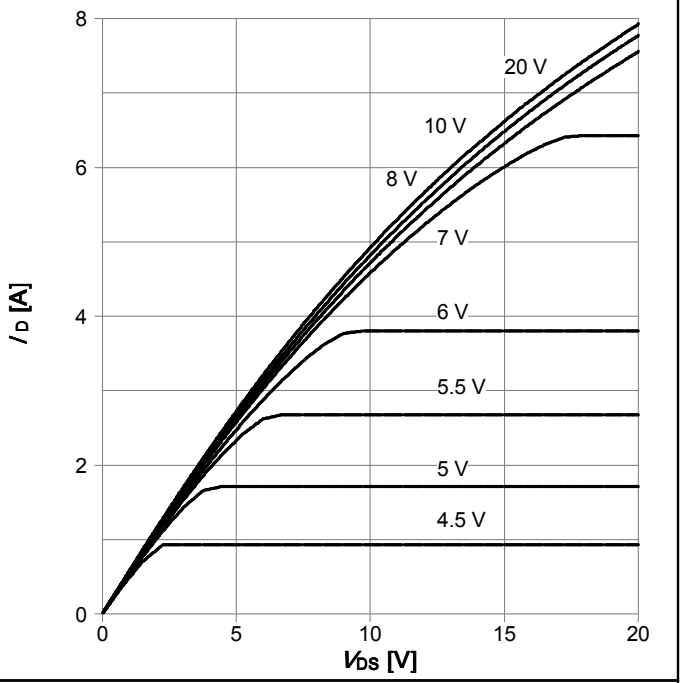
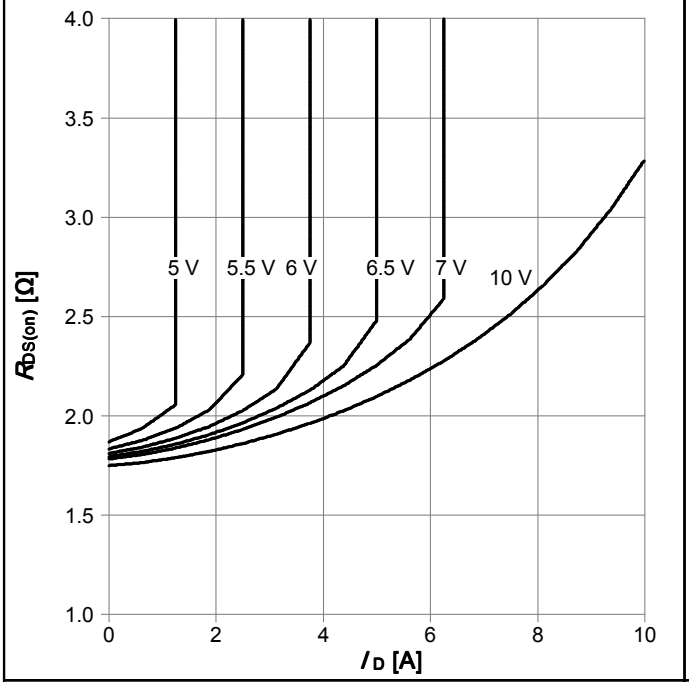
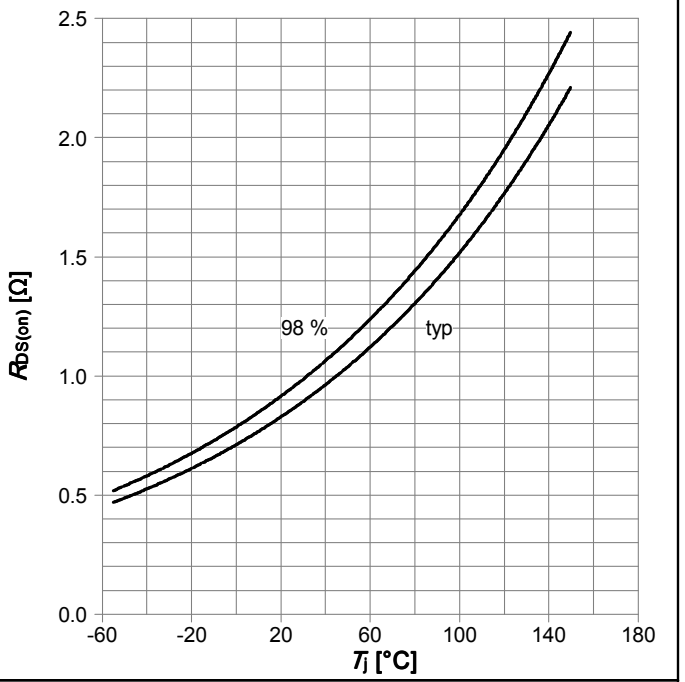
Typ. output characteristics	Typ. output characteristics
	
$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}	$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: V_{GS}

Table 11

Typ. drain-source on-state resistance	Drain-source on-state resistance
	
$R_{DS(on)}=f(I_D)$; $T_j=125$ °C; parameter: V_{GS}	$R_{DS(on)}=f(T_j)$; $I_D=1.5$ A; $V_{GS}=10$ V

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Table 12

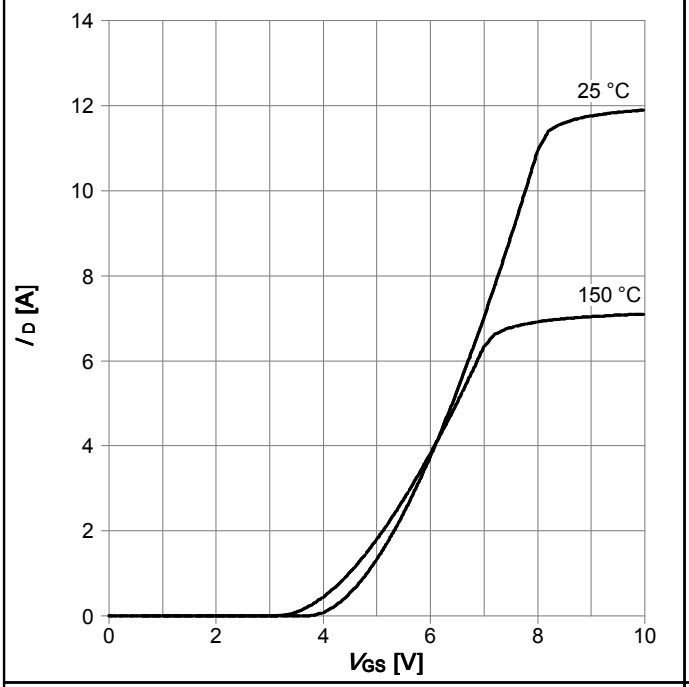
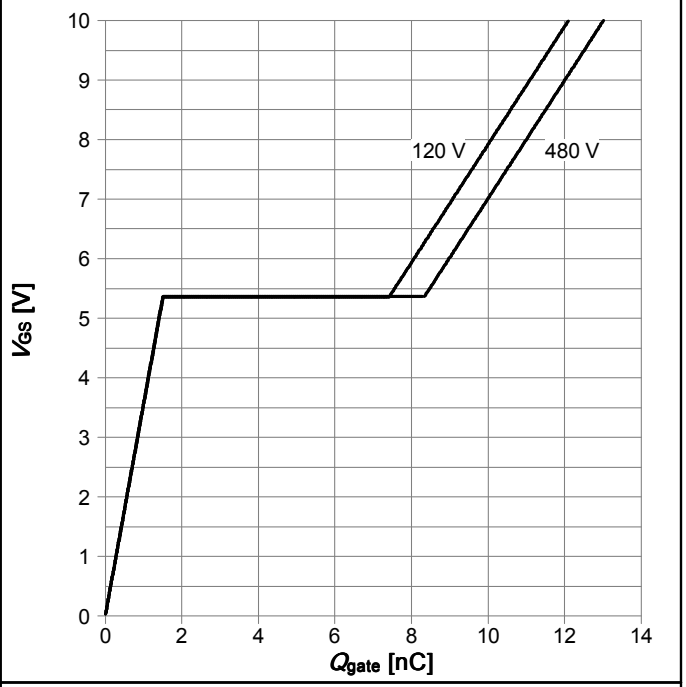
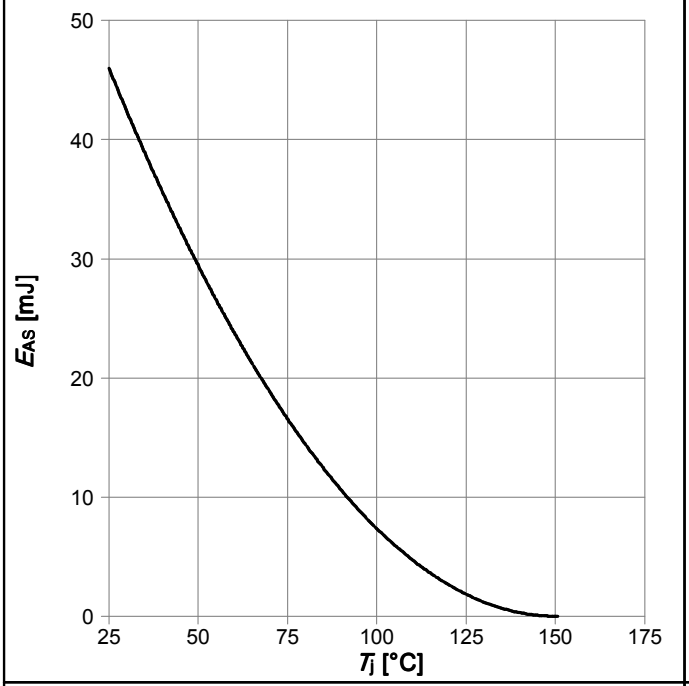
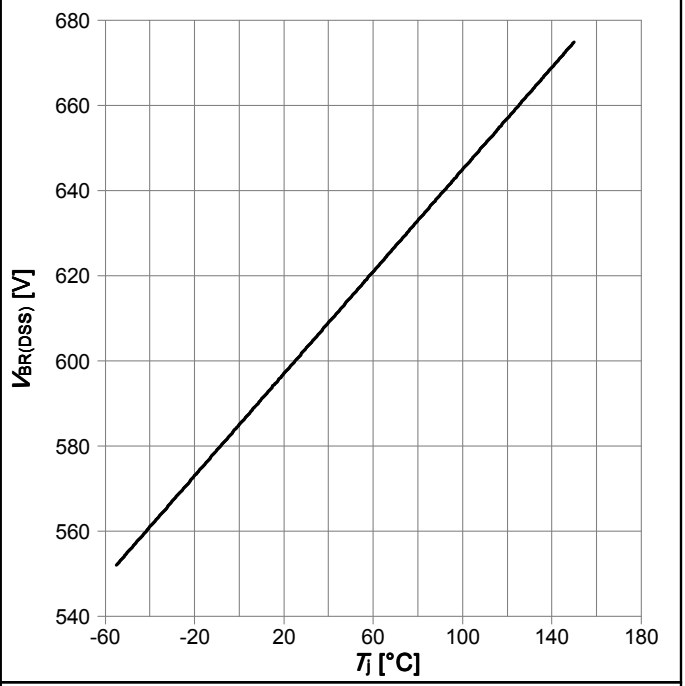
Typ. transfer characteristics	Typ. gate charge
	
$I_D=f(V_{GS})$; $V_{DS}=20$ V	$V_{GS}=f(Q_{gate})$; $I_D=1.9$ A pulsed; parameter: V_{DD}

Table 13

Avalanche energy	Drain-source breakdown voltage
	
$E_{AS}=f(T_j)$; $I_D=0.8$ A; $V_{DD}=50$ V	$V_{BR(DSS)}=f(T_j)$; $I_D=0.25$ mA

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Table 14

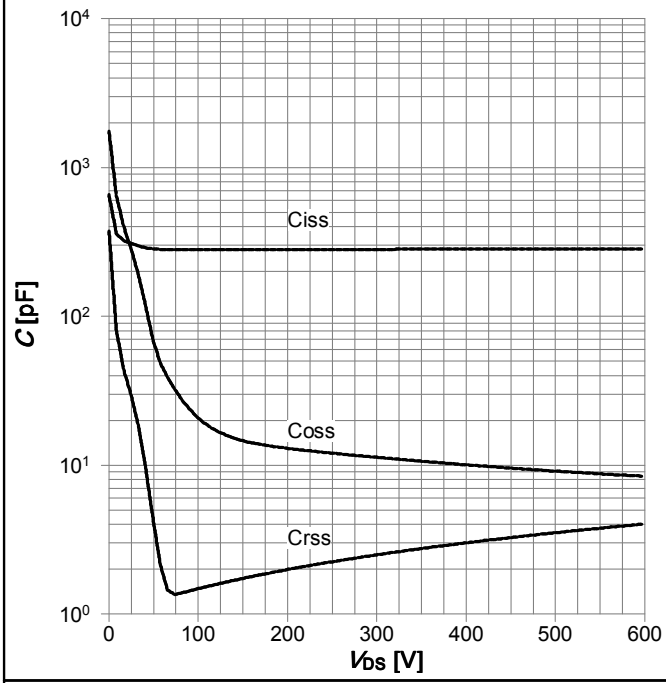
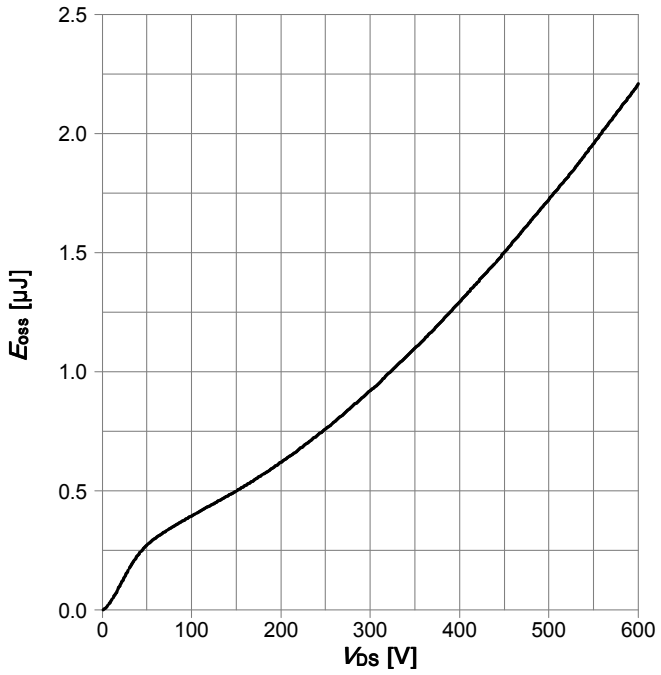
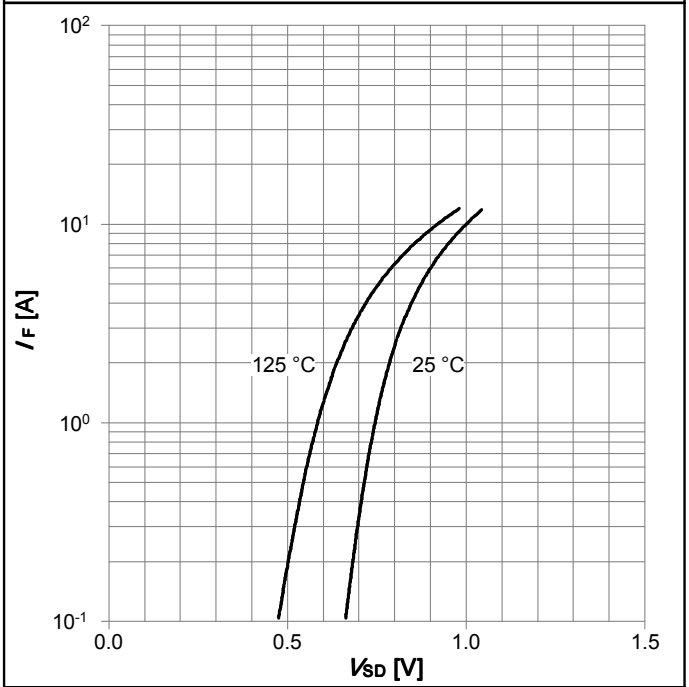
Typ. capacitances	Typ. C_{oss} stored energy
	
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz	E_{oss}=f(V_{DS})

Table 15

Forward characteristics of reverse diode

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

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6 Test Circuits

Table 16 Diode characteristics

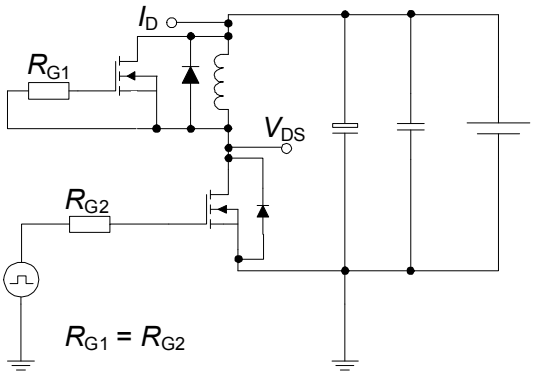
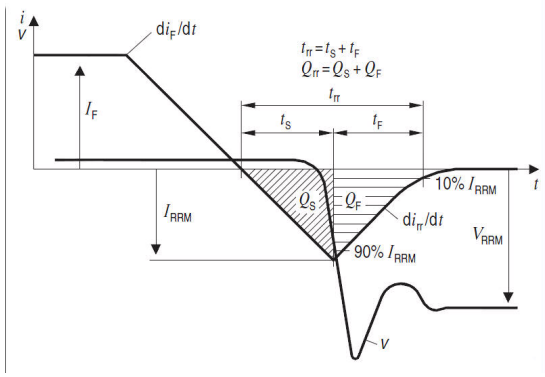
Test circuit for diode characteristics	Diode recovery waveform
	

Table 17 Switching times

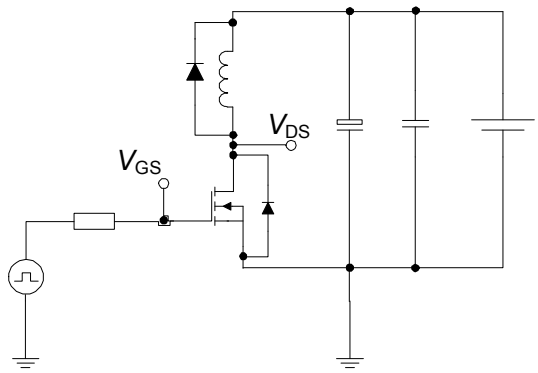
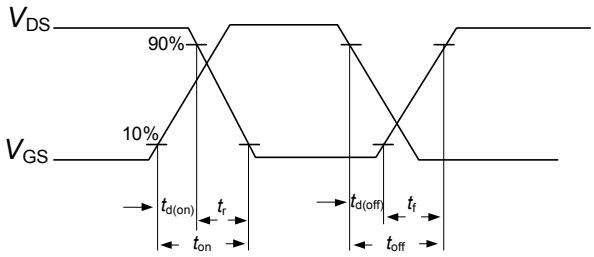
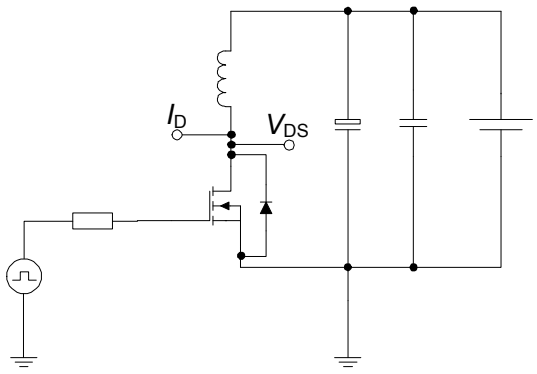
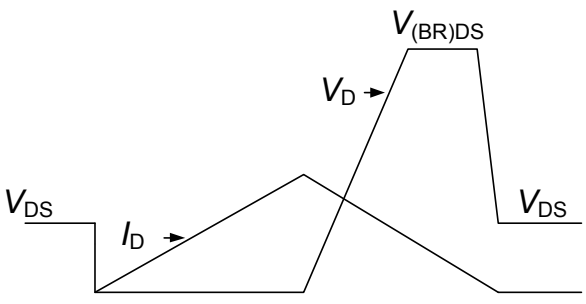
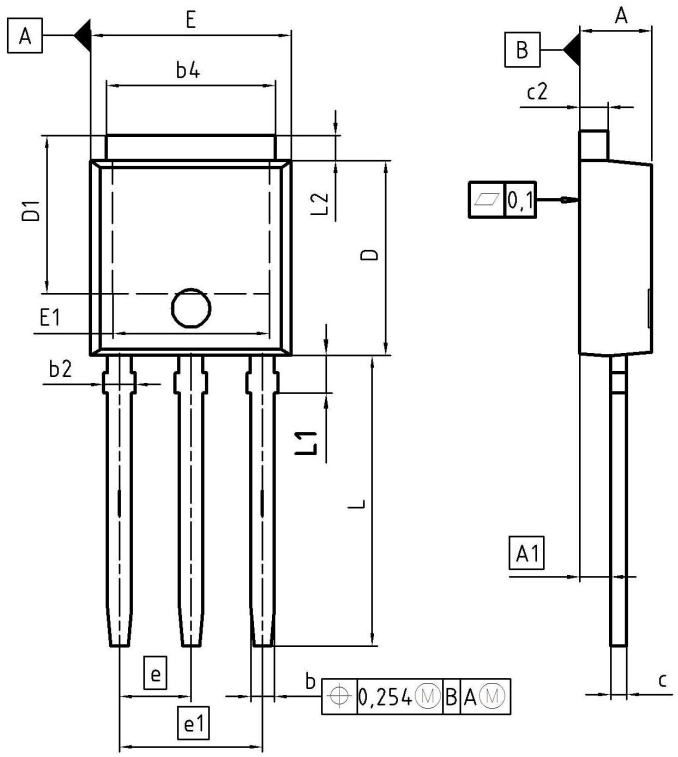
Switching times test circuit for inductive load	Switching times waveform
	

Table 18 Unclamped inductive

Unclamped inductive load test circuit	Unclamped inductive waveform
	

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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.
Z8B00003330

SCALE 0 2.0 0 2.0 4mm

EUROPEAN PROJECTION

ISSUE DATE
19-03-2008

REVISION
03

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

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8 Appendix A

Table 19 Related Links

- **IFX C6 Product Brief:**

  http://www.infineon.com/dgdl/Product+Brief+600V+CoolMOS+C6+.pdf?folderId=db3a3043156fd5730115939eb6b506db

- **IFX C6 Portfolio:**
  http://www.infineon.com/cms/en/product/findProductTypeByName.html?q=ip*c6

- **IFX CoolMOS Webpage:**
  http://www.infineon.com/cms/en/product/channel.html?channel=ff80808112ab681d0112ab6a628704d8

- **IFX Design Tools:**
  http://www.infineon.com/cms/en/product/promopages/designtools/index.html

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Revision History

IPU60R950C6

Revision: 2012-02-02, Rev. 2.1

Previous Revision		
Revision	Date	Subjects (major changes since last revision)
2.1	2012-02-02	Final datasheet release

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