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MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ C7

650V CoolMOS™ C7 Power Transistor
IPB65R045C7

Data Sheet

Rev. 2.1
Final

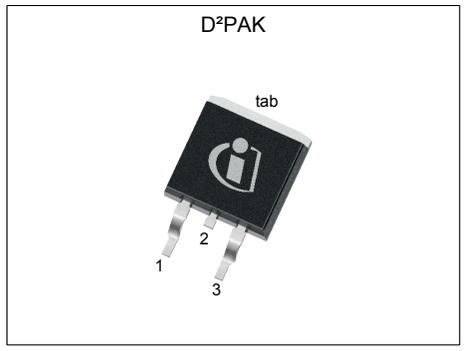
Power Management & Multimarket

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1 Description

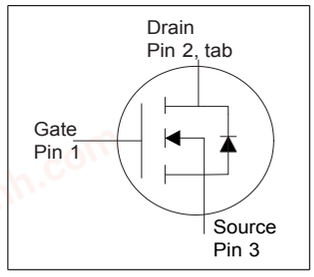
CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies.

CoolMOS™ C7 series combines the experience of the leading SJ MOSFET supplier with high class innovation. The product portfolio provides all benefits of fast switching superjunction MOSFETs offering better efficiency, reduced gate charge, easy implementation and outstanding reliability.



Features

- Increased MOSFET dv/dt ruggedness
- Better 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
- Easy to use/drive
- Pb-free plating, halogen free mold compound
- Qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)



Benefits

- Enabling higher system efficiency
- Enabling higher frequency / increased power density solutions
- System cost / size savings due to reduced cooling requirements
- Higher system reliability due to lower operating temperatures

Applications

PFC stages and hard switching PWM stages for e.g. Computing, Server, Telecom, UPS and Solar.

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} @ $T_{j,max}$	700	V
$R_{DS(on),max}$	45	mΩ
$Q_{g.typ}$	93	nC
$I_{D,pulse}$	212	A
E_{oss}@400V	11.7	µJ
Body diode di/dt	60	A/µs

Type / Ordering Code	Package	Marking	Related Links
IPB65R045C7	PG-TO 263	65C7045	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	- -	- -	46 29	A	T_C=25°C T_C=100°C
Pulsed drain current [2]	$I_{D,pulse}$	-	-	212	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	249	mJ	I_D=12A; V_{DD}=50V
Avalanche energy, repetitive	E_{AR}	-	-	1.25	mJ	I_D=12A; V_{DD}=50V
Avalanche current, single pulse	I_{AS}	-	-	12.0	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	100	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	-	-	46	A	T_C=25°C
Diode pulse current [2]	$I_{S,pulse}$	-	-	212	A	T_C=25°C
Reverse diode dv/dt [3]	dv/dt	-	-	1.5	V/ns	V_{DS}=0...400V, I_{SD}<=I_S, T_j=25°C
Maximum diode commutation speed	di_f/dt	-	-	60	A/µs	V_{DS}=0...400V, I_{SD}<=I_S, T_j=25°C
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

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3 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

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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	$V_{(BR)DSS}$	650	-	-	V	V_{GS}=0V, I_D=1mA
Gate threshold voltage	$V_{(GS)th}$	3	3.5	4	V	V_{DS}=V_{GS}, I_D=1.25mA
Zero gate voltage drain current	I_{DSS}	- -	- 20	2 -	µA	V_{DS}=650, V_{GS}=0V, T_j=25°C V_{DS}=650, 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	$R_{DS(on)}$	- -	0.040 0.096	0.045 -	Ω	V_{GS}=10V, I_D=24.9A, T_j=25°C V_{GS}=10V, I_D=24.9A, T_j=150°C
Gate resistance	R_G	-	0.85	-	Ω	f=1MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	4340	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Output capacitance	C_{oss}	-	70	-	pF	V_{GS}=0V, V_{DS}=400V, f=250kHz
Effective output capacitance, energy related [1]	$C_{o(er)}$	-	146	-	pF	V_{GS}=0V, V_{DS}=0...400V
Effective output capacitance, time related [2]	$C_{o(tr)}$	-	1630	-	pF	I_D=constant, V_{GS}=0V, V_{DS}=0...400V
Turn-on delay time	$t_{d(on)}$	-	20	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=24.9A, R_G=3.3Ω
Rise time	t_r	-	14	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=24.9A, R_G=3.3Ω
Turn-off delay time	$t_{d(off)}$	-	82	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=24.9A, R_G=3.3Ω
Fall time	t_f	-	7	-	ns	V_{DD}=400V, V_{GS}=13 V, I_D=24.9A, R_G=3.3Ω

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	23	-	nC	V_{DD}=400V, I_D=24.9A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	30	-	nC	V_{DD}=400V, I_D=24.9A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	93	-	nC	V_{DD}=400V, I_D=24.9A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.4	-	V	V_{DD}=400V, I_D=24.9A, 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

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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=24.9A, T_j=25°C
Reverse recovery time	t_{rr}	-	725	-	ns	V_R=400V, I_F=46A, di_F/dt=60A/µs
Reverse recovery charge	Q_{rr}	-	13	-	µC	V_R=400V, I_F=46A, di_F/dt=60A/µs
Peak reverse recovery current	I_{rrm}	-	36	-	A	V_R=400V, I_F=46A, di_F/dt=60A/µs

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5 Electrical characteristics diagrams

Table 8

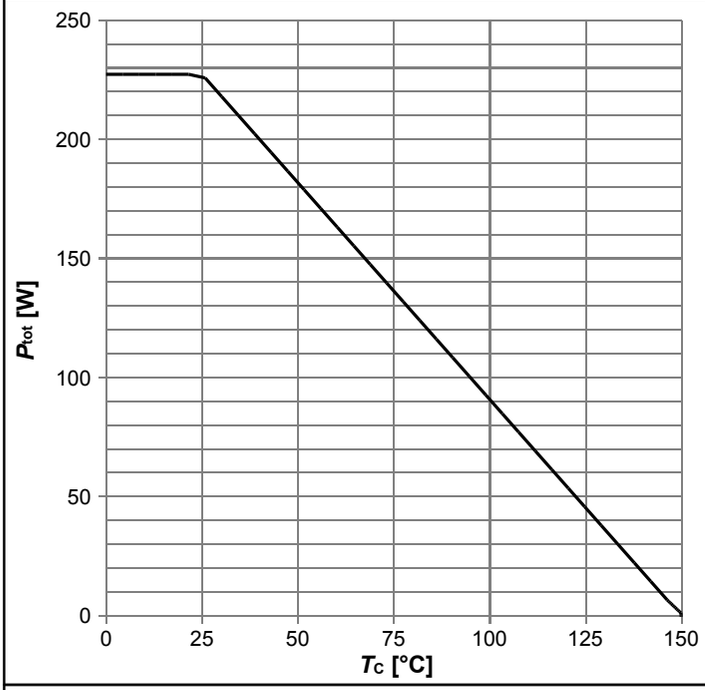
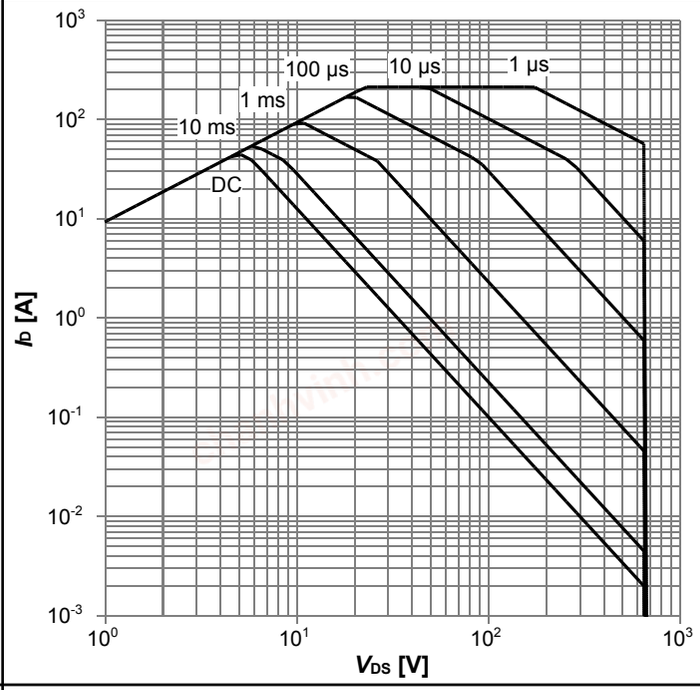
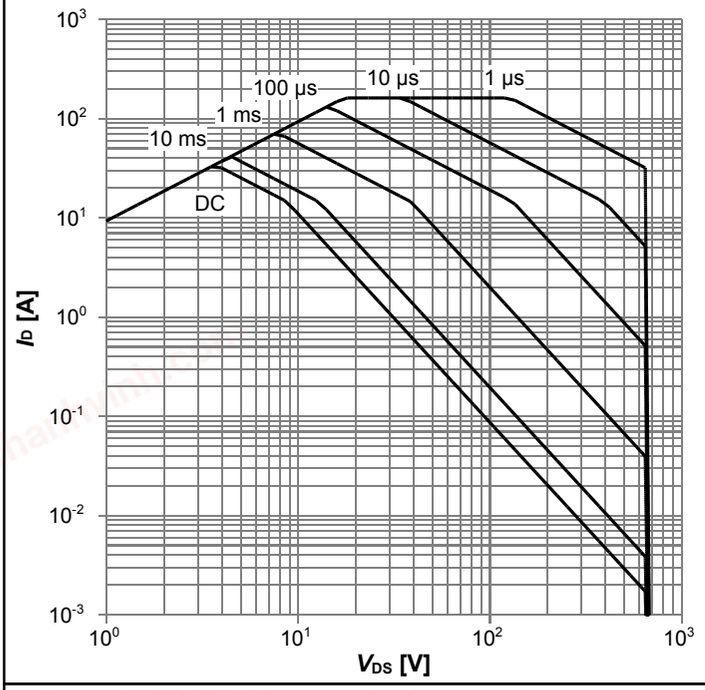
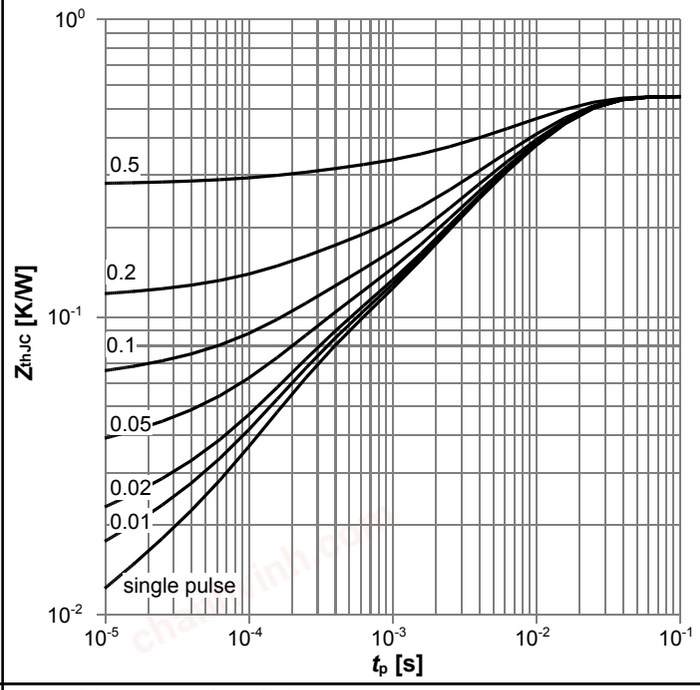
Diagram 1: Power dissipation	Diagram 2: Safe operating area
	
$P_{tot}=f(T_C)$	$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: t_p

Table 9

Diagram 3: Safe operating area	Diagram 4: Max. transient thermal impedance
	
$I_D=f(V_{DS})$; $T_C=80$ °C; $D=0$; parameter: t_p	$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$

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Table 10

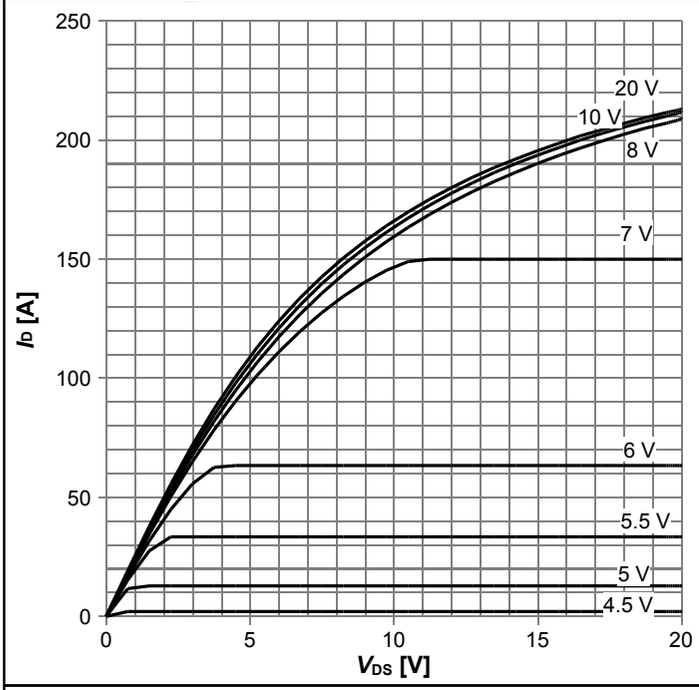
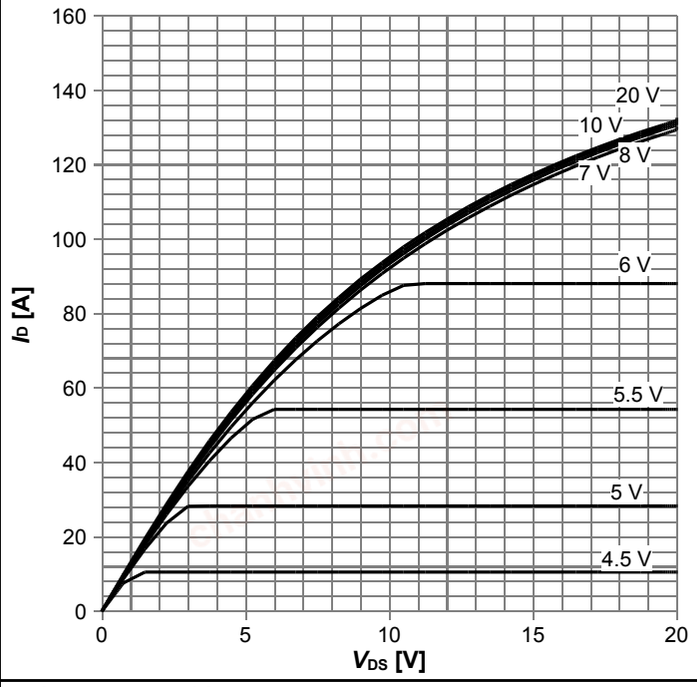
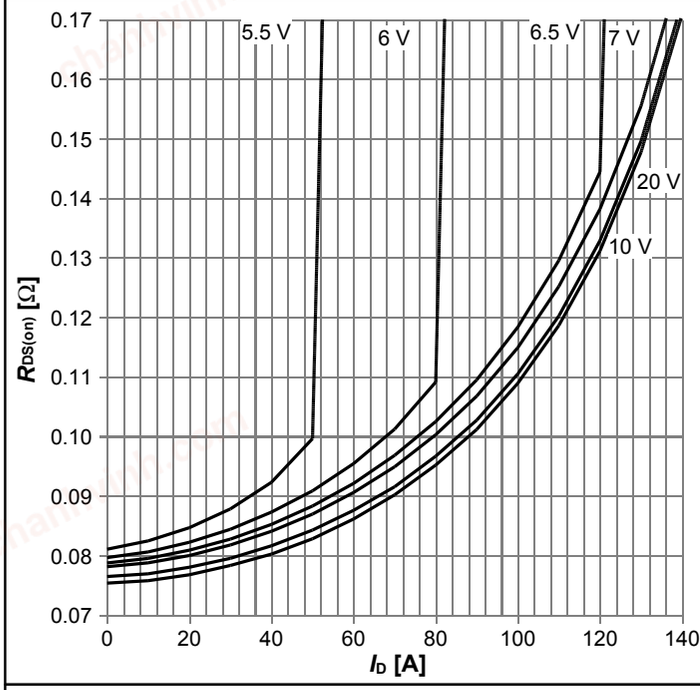
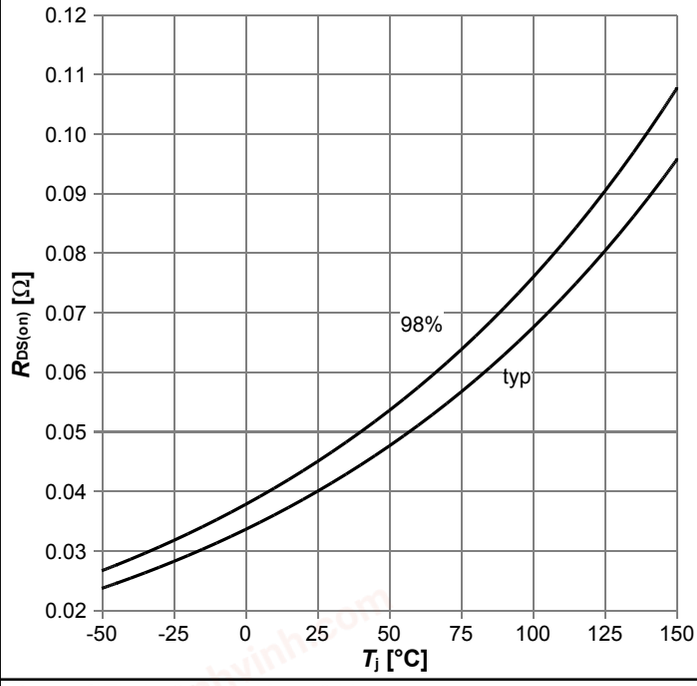
Diagram 5: Typ. output characteristics	Diagram 6: Typ. output characteristics
	
$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}	$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: V_{GS}

Table 11

Diagram 7: Typ. drain-source on-state resistance	Diagram 8: Drain-source on-state resistance
	
$R_{DS(on)}=f(I_D)$; $T_j=125$ °C; parameter: V_{GS}	$R_{DS(on)}=f(T_j)$; $I_D=24.9$ A; $V_{GS}=10$ V

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Table 12

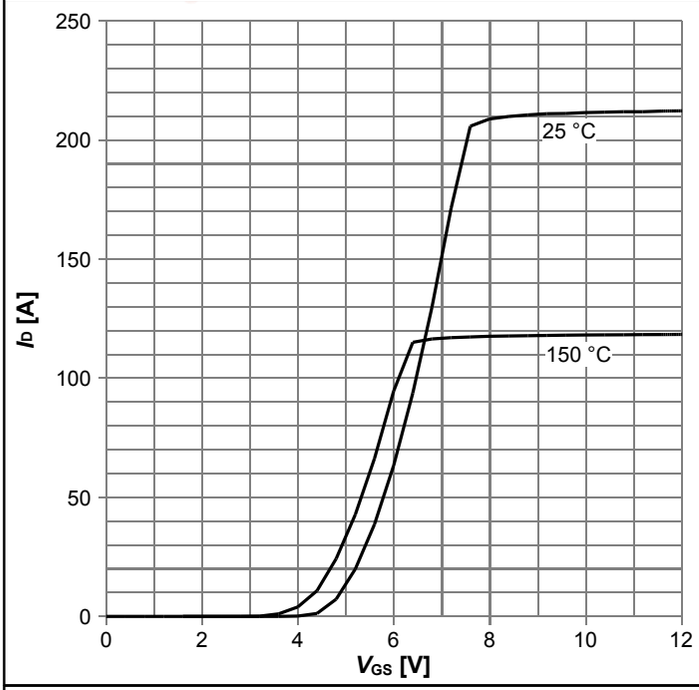
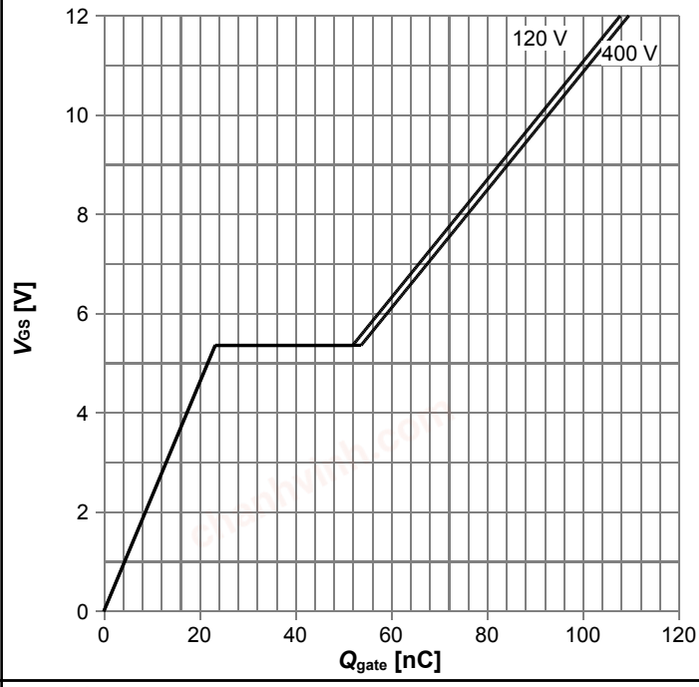
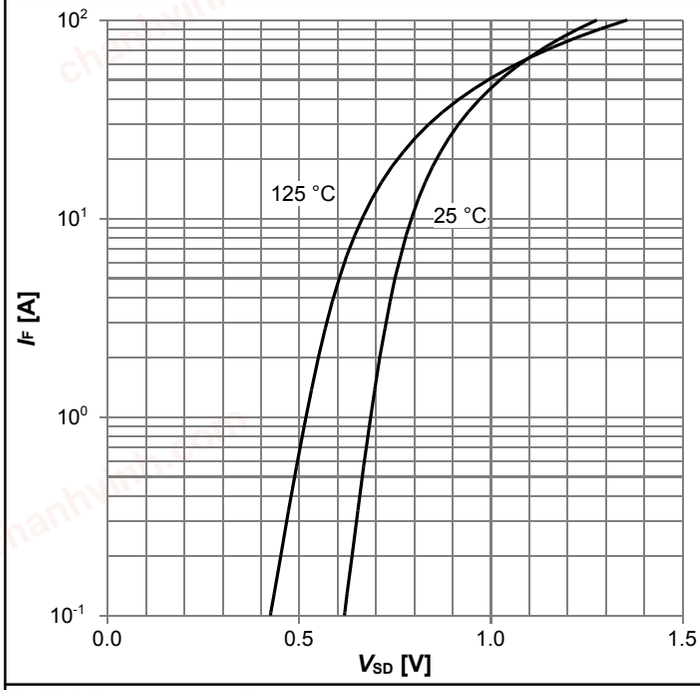
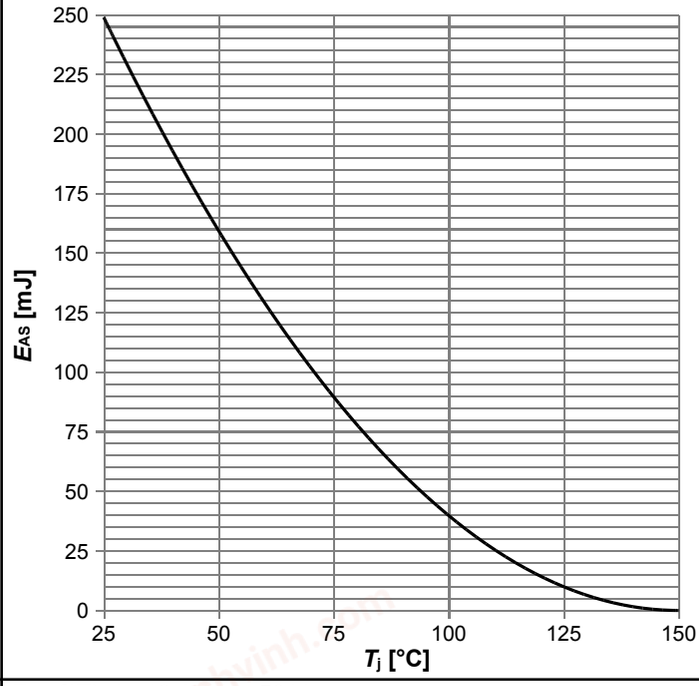
Diagram 9: Typ. transfer characteristics	Diagram 10: Typ. gate charge
	
I_D=f(V_{GS}); V_{DS}=20V; parameter: T_j	V_{GS}=f(Q_{gate}); I_D=24.9 A pulsed; parameter: V_{DD}

Table 13

Diagram 11: Forward characteristics of reverse diode	Diagram 12: Avalanche energy
	
I_F=f(V_{SD}); parameter: T_j	E_{AS}=f(T_j); I_D=12 A; V_{DD}=50 V

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Table 14

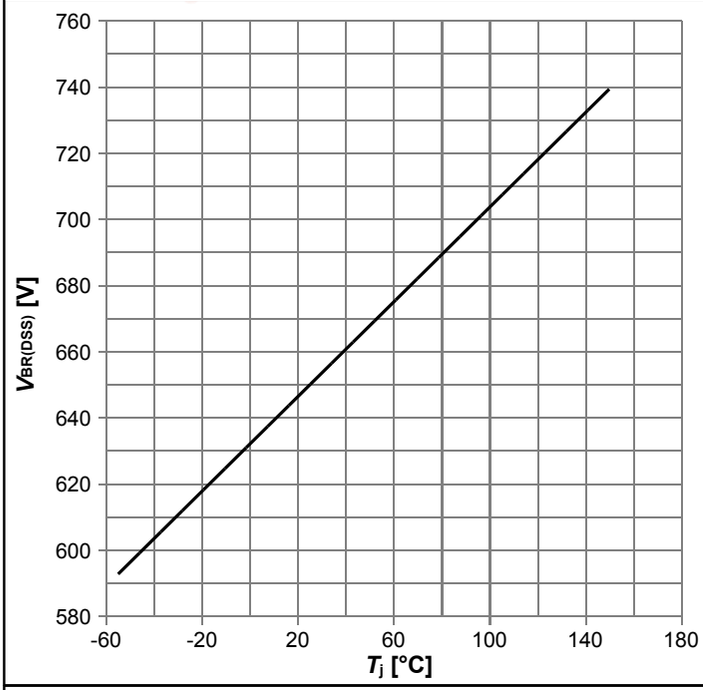
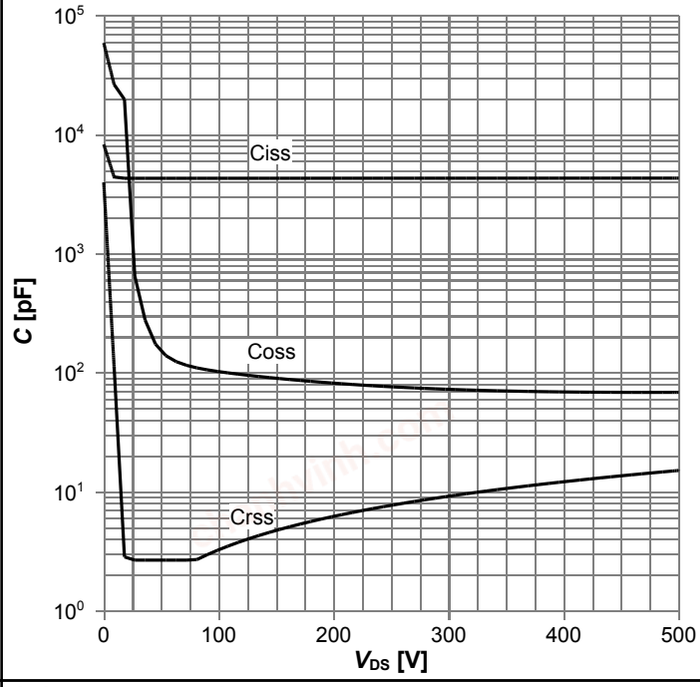
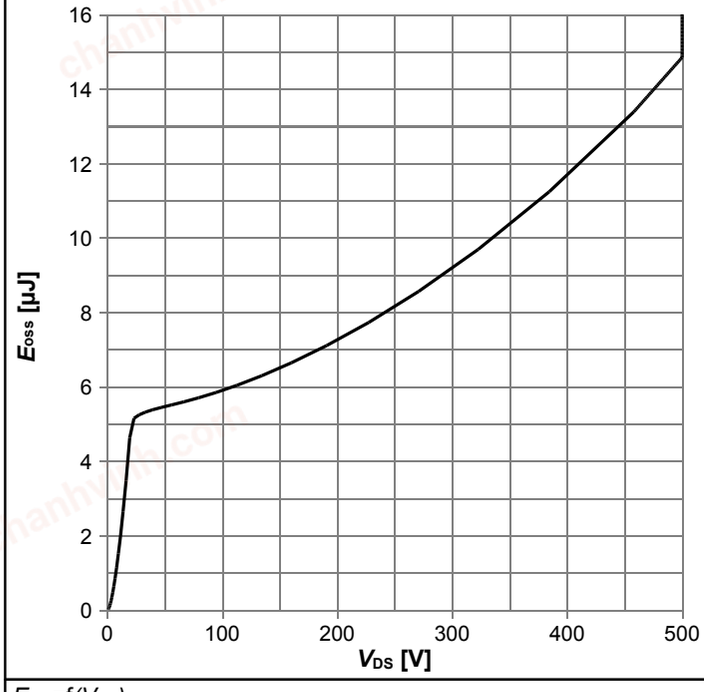
Diagram 13: Drain-source breakdown voltage	Diagram 14: Typ. capacitances
	
$V_{BR(DSS)}$=f(T_j); I_D=1 mA	C=f(V_{DS}); V_{GS}=0 V; f=250 kHz

Table 15

Diagram 15: Typ. Coss stored energy

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

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6 Test Circuits

Table 16 Diode characteristics

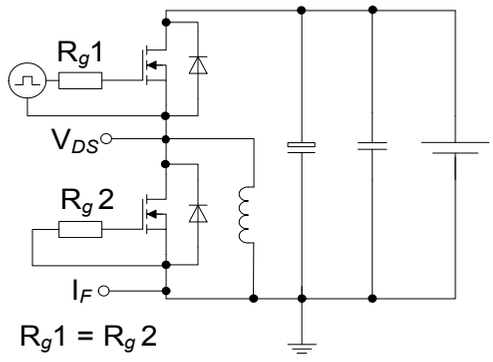
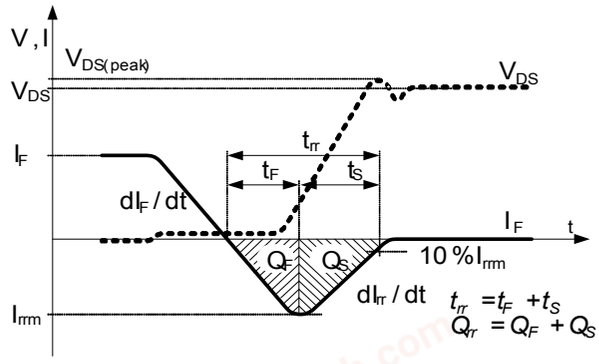
Test circuit for diode characteristics	Diode recovery waveform
	

Table 17 Switching times

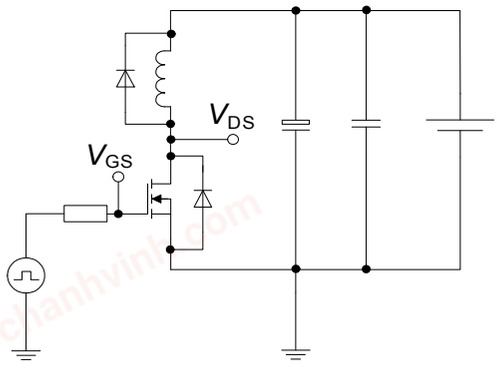
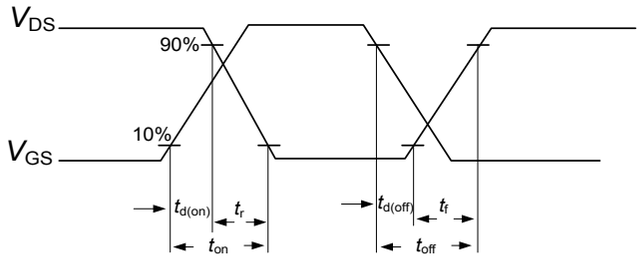
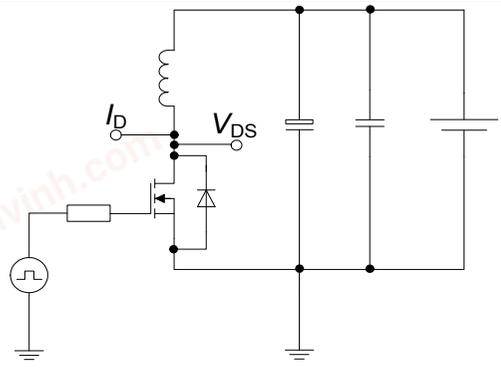
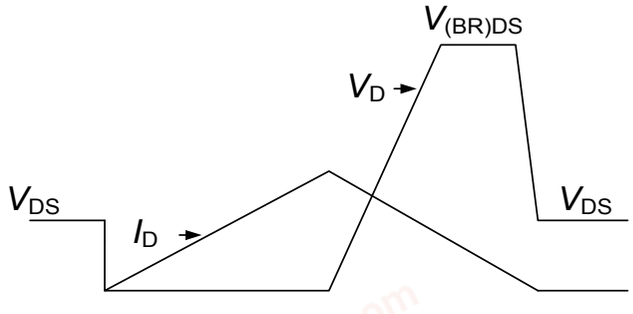
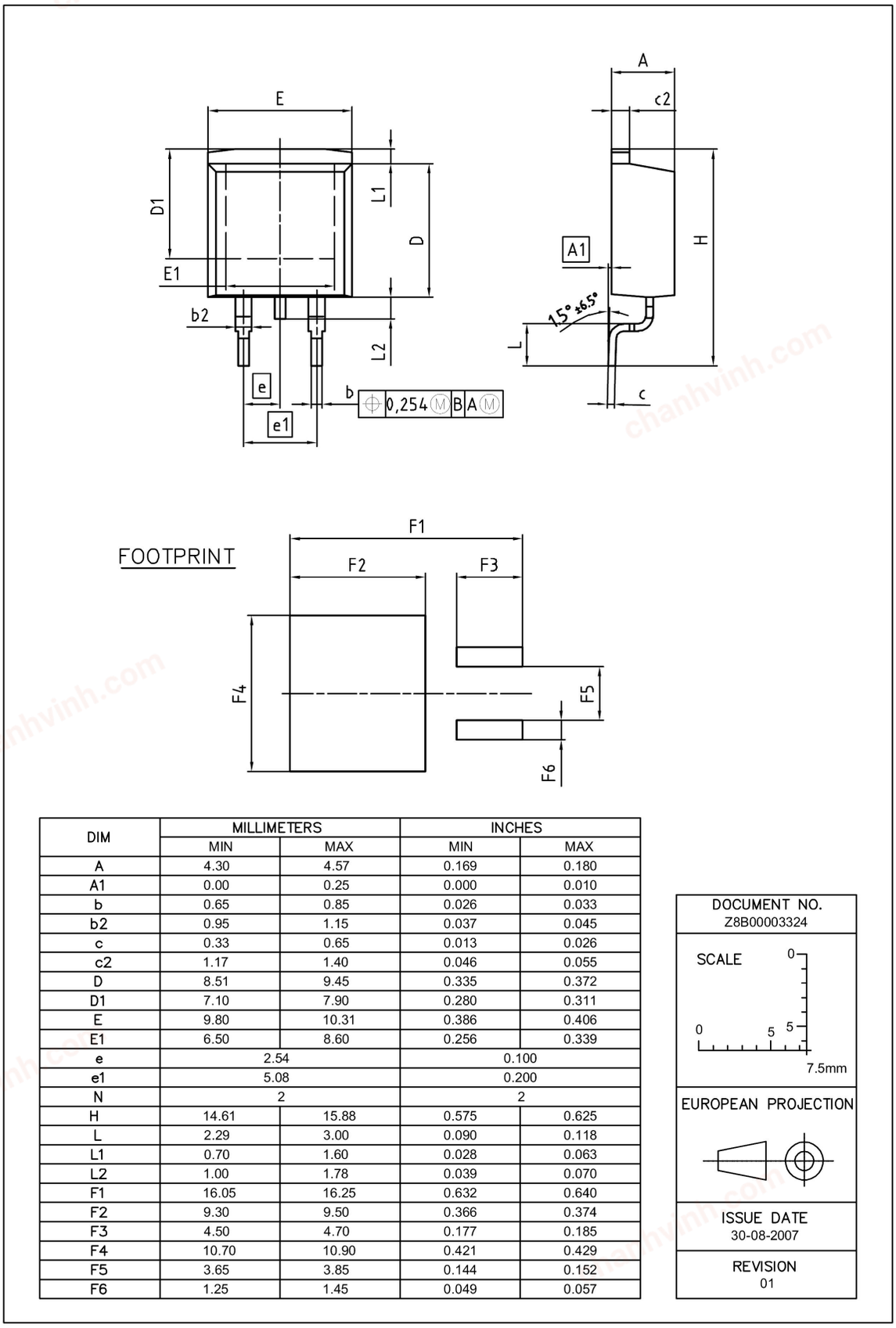
Switching times test circuit for inductive load	Switching times waveform
	

Table 18 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

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7 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-TO 263, dimensions in mm/inches

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8 Appendix A

Table 19 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

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Revision History

IPB65R045C7

Revision: 2013-04-30, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2013-04-18	Release of final version
2.1	2013-04-30	Body diode di/dt update

We Listen to Your Comments
Any information within this document that you feel is wrong, unclear or missing at all? Your feedback will help us to continuously improve the quality of this document. Please send your proposal (including a reference to this document) to:
erratum@infineon.com

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