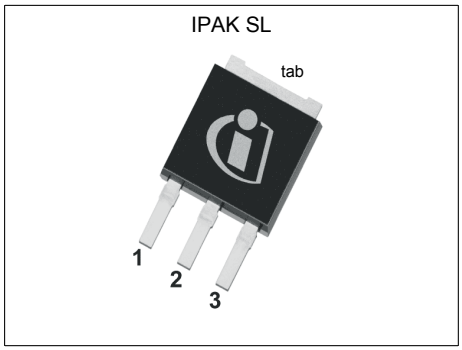
MOSFET

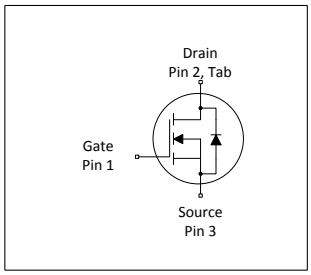
650V CoolMOS™ E6 Power Transistor

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. CoolMOS™ E6 series combines the experience of the leading SJ MOSFET supplier with high class innovation. The resulting devices provide all benefits of a fast switching Superjunction 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
- JEDEC qualfied, Pb-free plating, Halogen free mold compound



Potential applications

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

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
$R_{DS(on),max}$	600	mΩ
$Q_{g.typ}$	23	nC
$I_{D,pulse}$	18	A
E_{oss}@400V	2	µJ
Body diode di/dt	500	A/µs

Type / Ordering Code	Package	Marking	Related Links
IPS65R600E6	PG-TO 251-3	65E6600	see Appendix A

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Table of Contents

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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	- -	- -	7.3 4.6	A	T_C=25°C T_C=100°C
Pulsed drain current[2]	$I_{D,pulse}$	-	-	18	A	T_C=25°C
Avalanche energy, single pulse	E_{AS}	-	-	142	mJ	I_D=1.3A; V_{DD}=50V; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	0.21	mJ	I_D=1.3A; V_{DD}=50V; see table 10
Avalanche current, repetitive	I_{AR}	-	-	1.3	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	50	V/ns	V_{DS}=0...480V
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}	-	-	63	W	T_C=25°C
Storage temperature	T_{stg}	-55	-	150	°C	-
Operating junction temperature	T_j	-55	-	150	°C	-
Continuous diode forward current	I_S	-	-	6.3	A	T_C=25°C
Diode pulse current[2]	$I_{S,pulse}$	-	-	18	A	T_C=25°C
Reverse diode dv/dt[3]	dv/dt	-	-	15	V/ns	V_{DS}=0...400V, I_{SD}<=I_S, T_j=25°C see table 8
Maximum diode commutation speed	di_f/dt	-	-	500	A/µs	V_{DS}=0...400V, I_{SD}<=I_S, T_j=25°C see table 8

[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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2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	2	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	62	°C/W	leaded
Soldering temperature, wavesoldering only allowed at leads	T_{sold}	-	-	260	°C	1.6mm (0.063 in.) from case for 10s

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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	$V_{(BR)DSS}$	650	-	-	V	V_{GS}=0V, I_D=1mA
Gate threshold voltage	$V_{(GS)th}$	2.5	3.0	3.5	V	V_{DS}=V_{GS}, I_D=0.21mA
Zero gate voltage drain current	I_{DSS}	- -	- 10	1 -	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	$R_{DS(on)}$	- -	0.54 1.40	0.60 -	Ω	V_{GS}=10V, I_D=2.1A, T_j=25°C V_{GS}=10V, I_D=2.1A, T_j=150°C
Gate resistance	R_G	-	10.5	-	Ω	f=1MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	440	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Output capacitance	C_{oss}	-	30	-	pF	V_{GS}=0V, V_{DS}=100V, f=1MHz
Effective output capacitance, energy related[1]	$C_{o(er)}$	-	21	-	pF	V_{GS}=0V, V_{DS}=0...480V
Effective output capacitance, time related[2]	$C_{o(tr)}$	-	88	-	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}=13V, I_D=3.2A, R_G=6.8Ω; see table 9
Rise time	t_r	-	8	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=3.2A, R_G=6.8Ω; see table 9
Turn-off delay time	$t_{d(off)}$	-	64	-	ns	V_{DD}=400V, V_{GS}=13V, I_D=3.2A, R_G=6.8Ω; see table 9
Fall time	t_f	-	11	-	ns	V_{DD}=400V, V_{GS}=13 V, I_D=3.2A, R_G=6.8Ω; see table 9

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	2.75	-	nC	V_{DD}=480V, I_D=3.2A, V_{GS}=0 to 10V
Gate to drain charge	Q_{gd}	-	12	-	nC	V_{DD}=480V, I_D=3.2A, V_{GS}=0 to 10V
Gate charge total	Q_g	-	23	-	nC	V_{DD}=480V, I_D=3.2A, V_{GS}=0 to 10V
Gate plateau voltage	$V_{plateau}$	-	5.5	-	V	V_{DD}=480V, I_D=3.2A, 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 480V
[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 480V

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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=3.2A, T_j=25°C
Reverse recovery time	t_{rr}	-	270	-	ns	V_R=400V, I_F=3.2A, di_F/dt=100A/µs; see table 8
Reverse recovery charge	Q_{rr}	-	2	-	µC	V_R=400V, I_F=3.2A, di_F/dt=100A/µs; see table 8
Peak reverse recovery current	I_{rrm}	-	13	-	A	V_R=400V, I_F=3.2A, di_F/dt=100A/µs; see table 8

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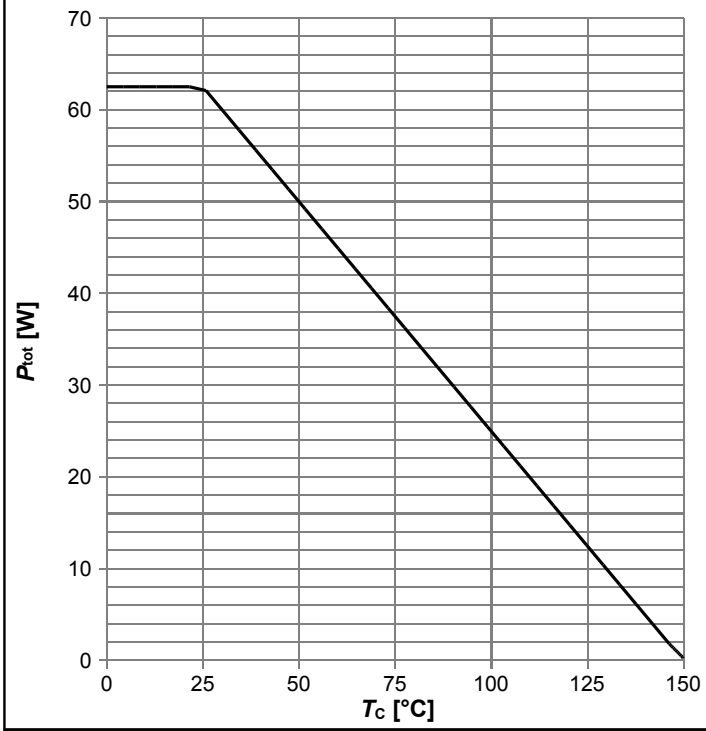
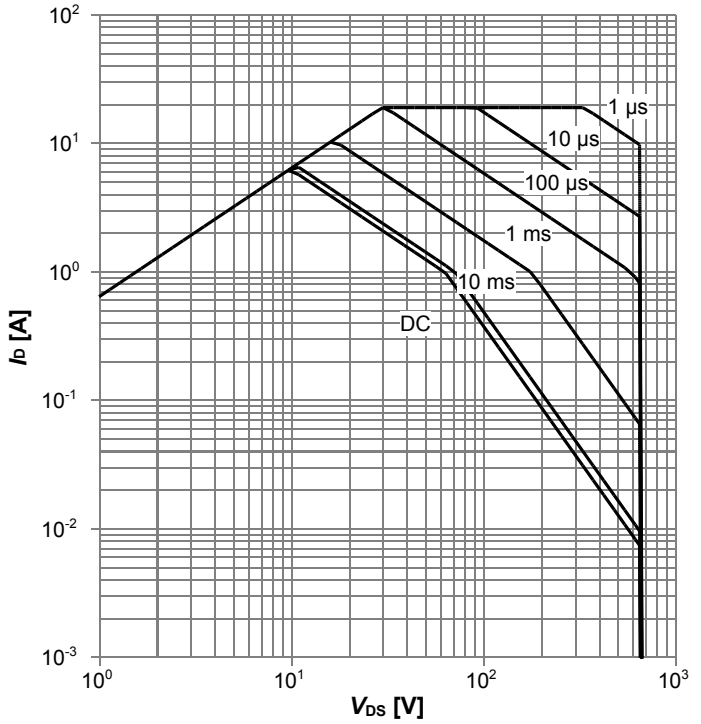
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



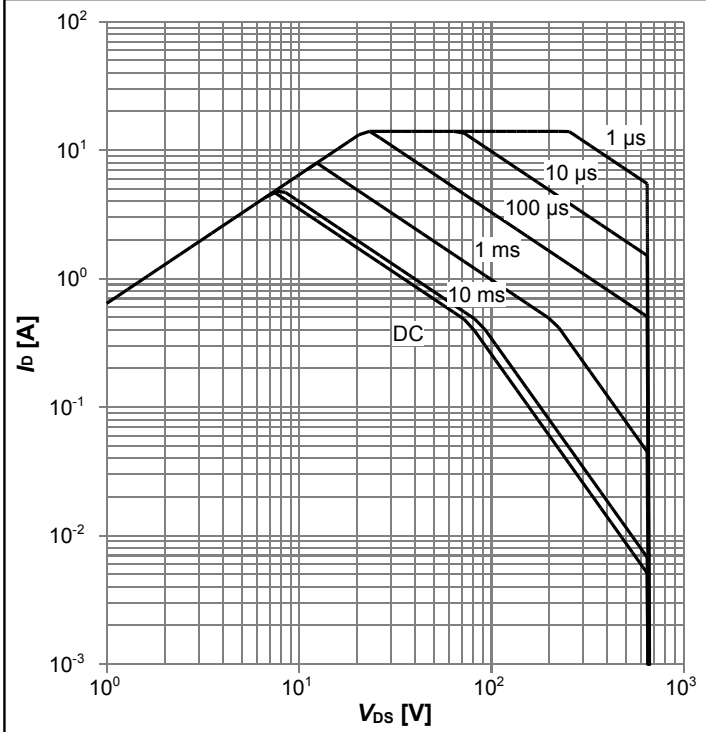
$P_{tot}=f(T_C)$

Diagram 2: Safe operating area



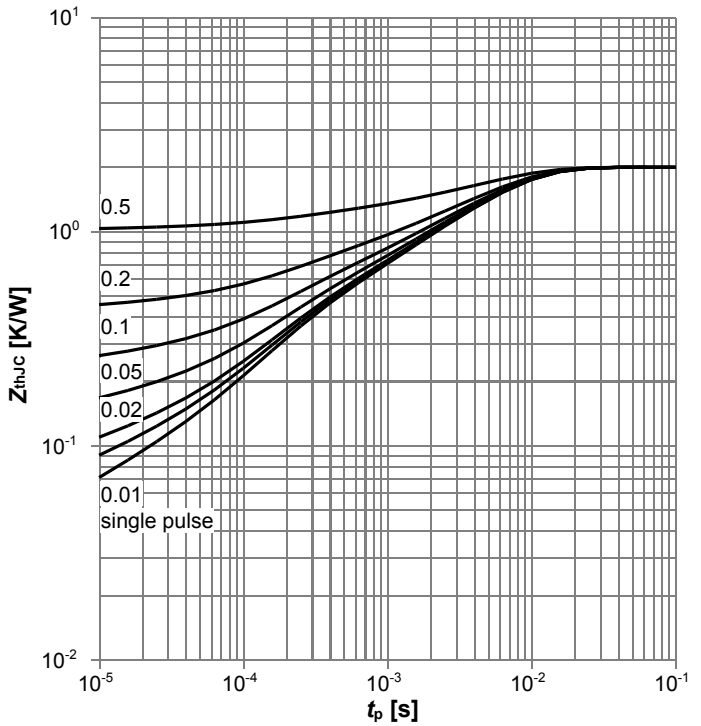
$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: t_p

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: $D=t_p/T$

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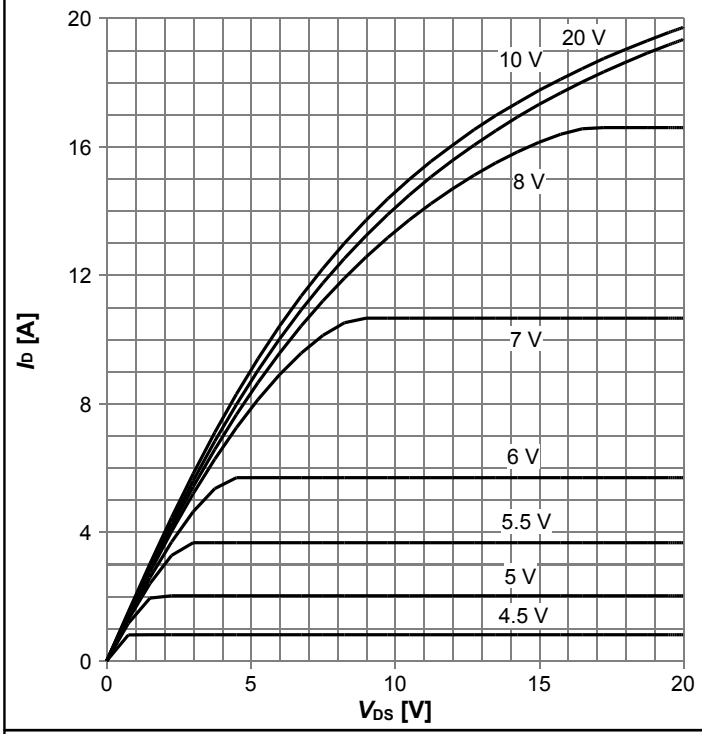
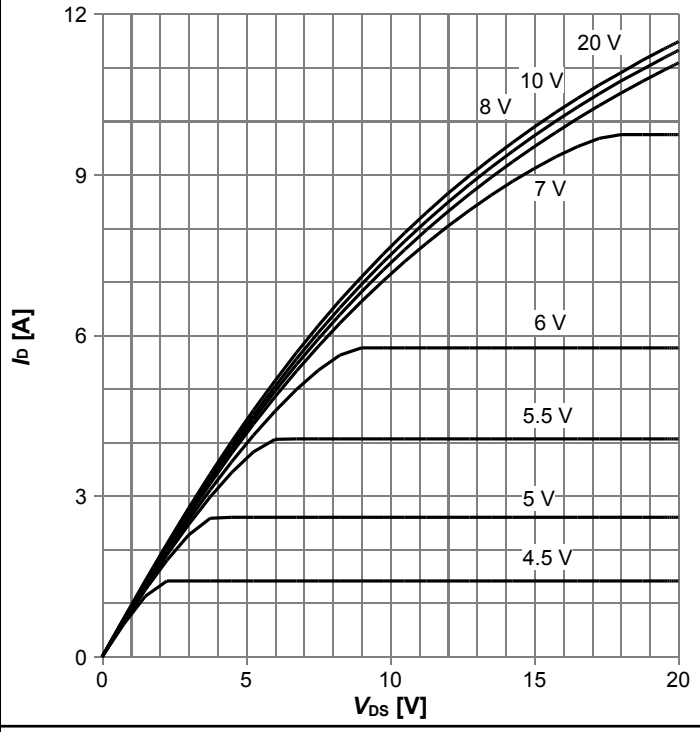
Diagram 5: Typ. output characteristics



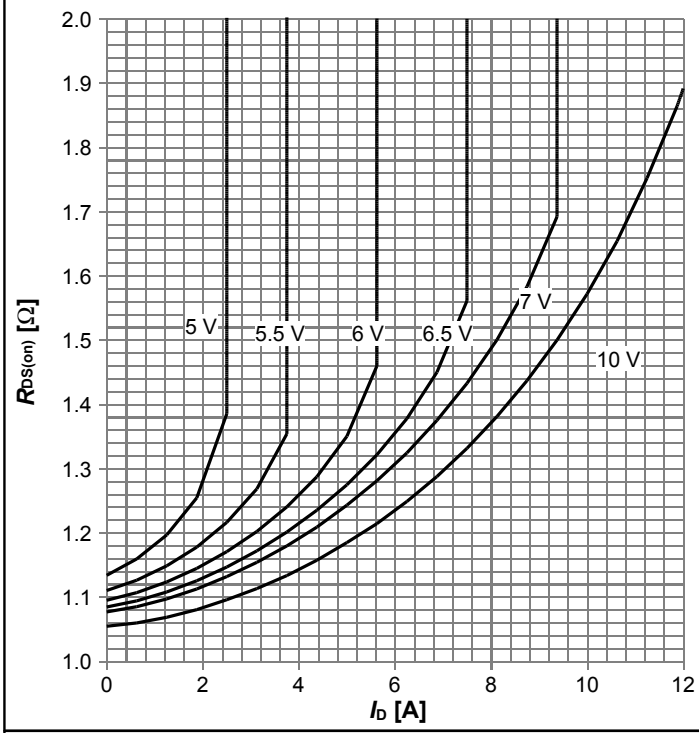
$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}

Diagram 6: Typ. output characteristics



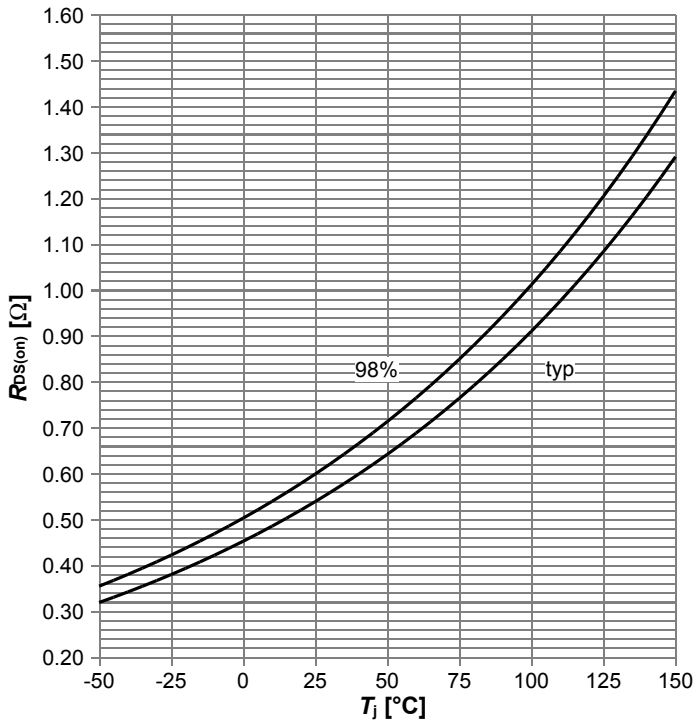
$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: V_{GS}

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



$R_{DS(on)}=f(T_j)$; $I_D=2.1$ A; $V_{GS}=10$ V

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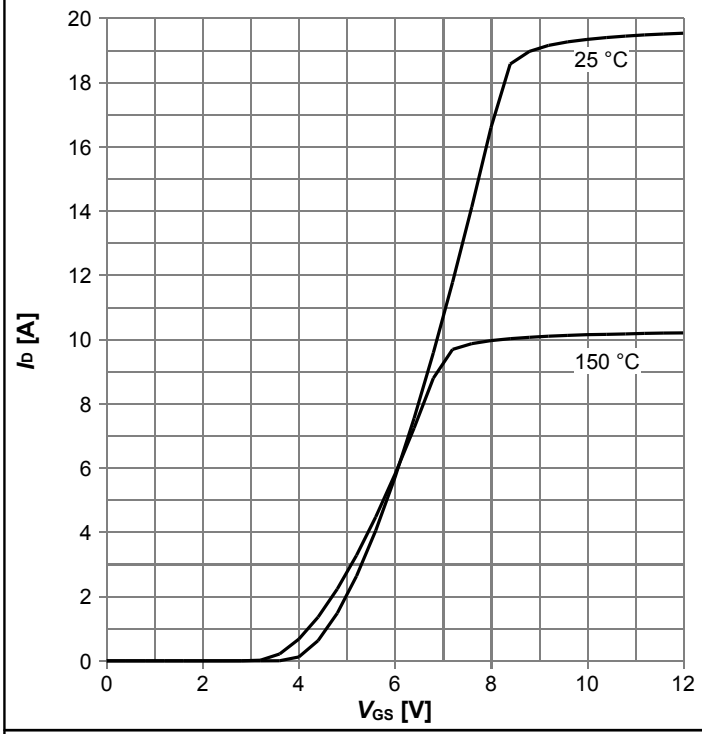
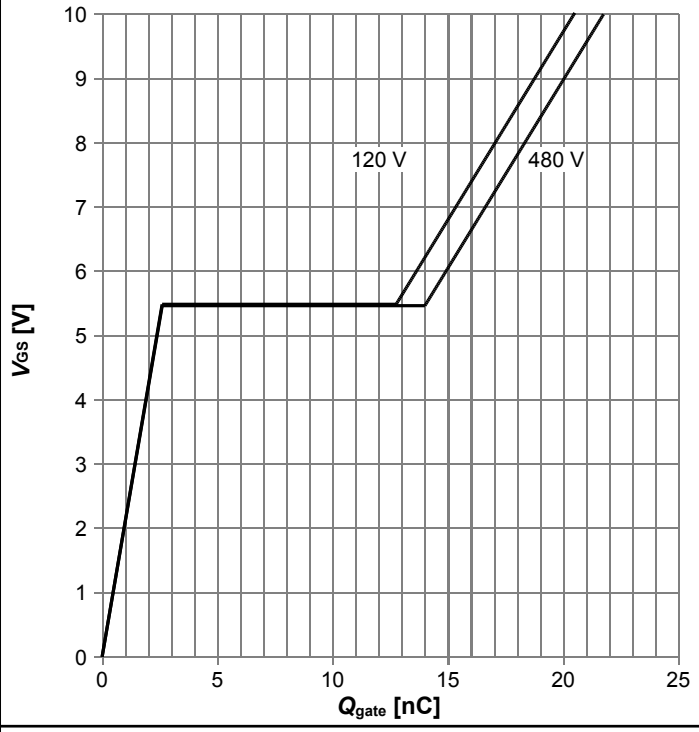
Diagram 9: Typ. transfer characteristics



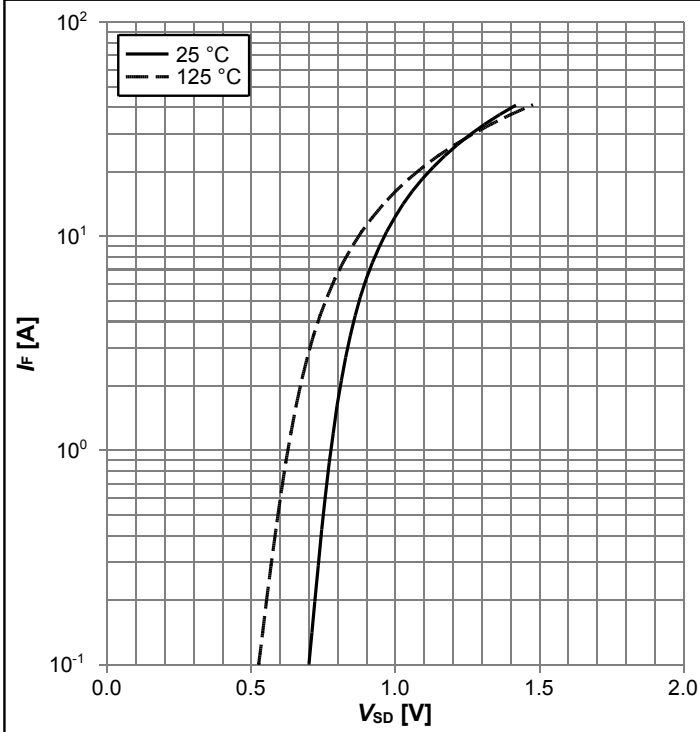
$I_D=f(V_{GS})$; V_{DS}=20V; parameter: T_j

Diagram 10: Typ. gate charge



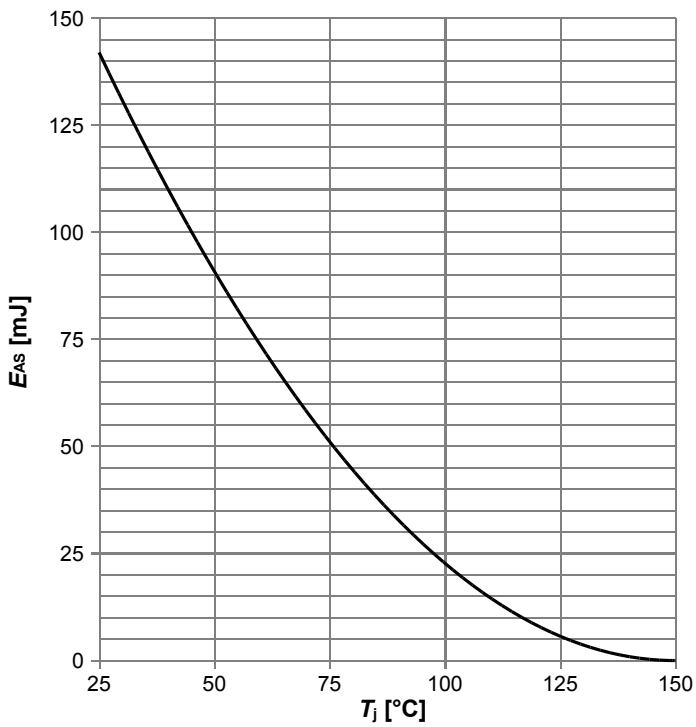
$V_{GS}=f(Q_{gate})$; I_D=3.2 A pulsed; parameter: V_{DD}

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=1.3 A; V_{DD}=50 V

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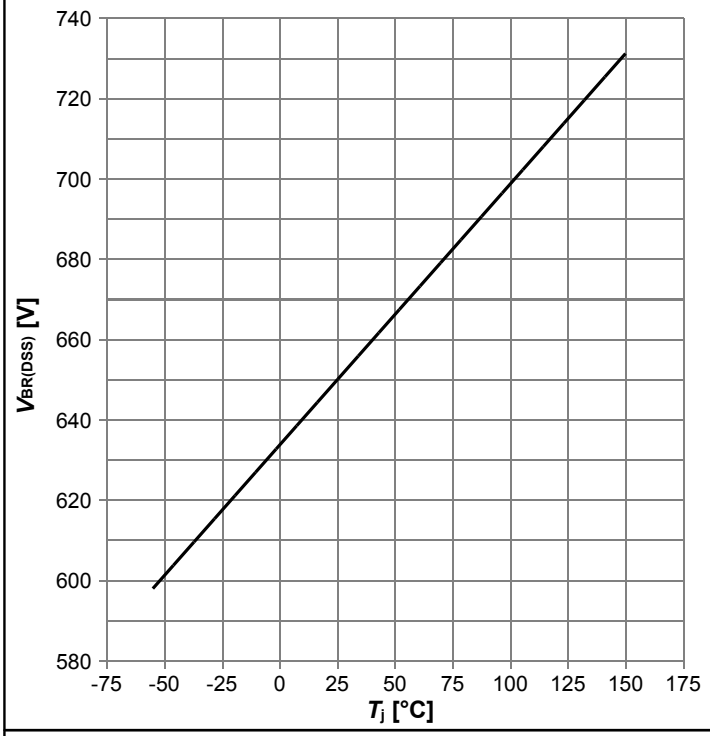
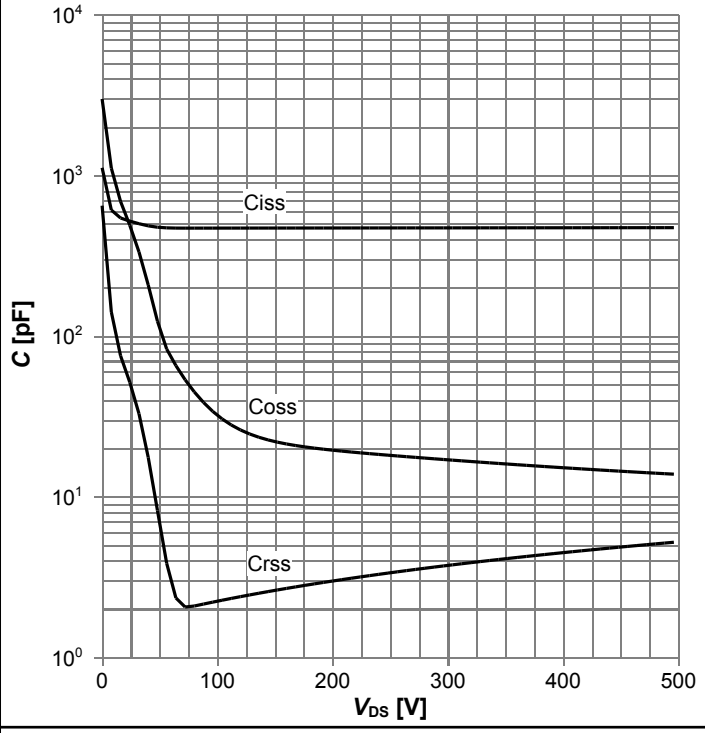
Diagram 13: Drain-source breakdown voltage



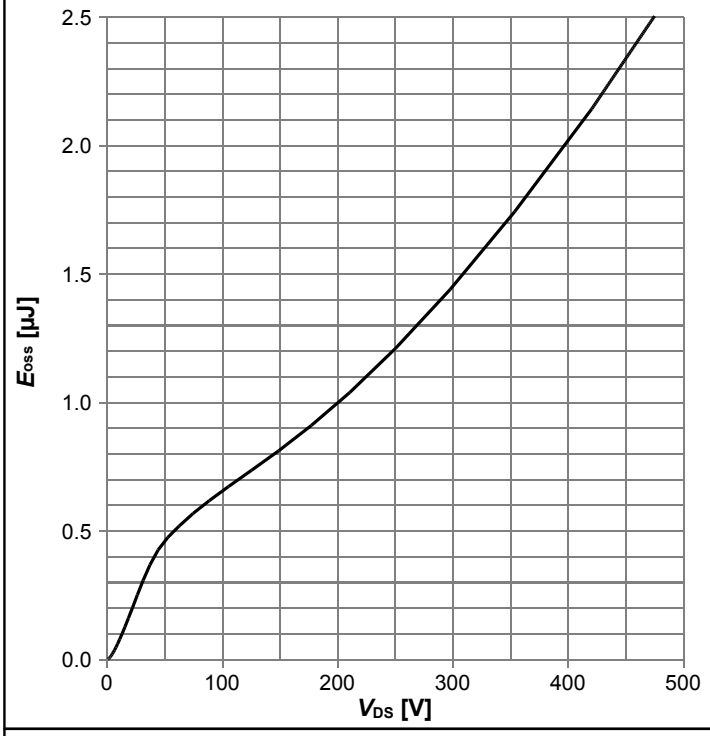
$V_{BR(DSS)}$=f(T_j); I_D=1.0 mA

Diagram 14: Typ. capacitances



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

Diagram 15: Typ. Coss stored energy



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

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5 Test Circuits

Table 8 Diode characteristics

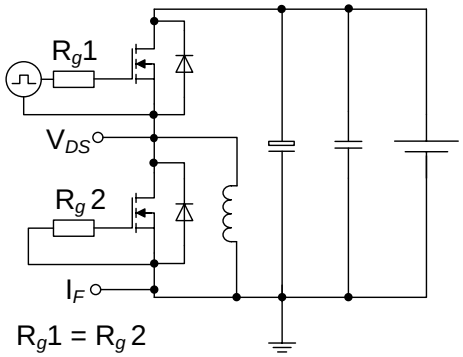
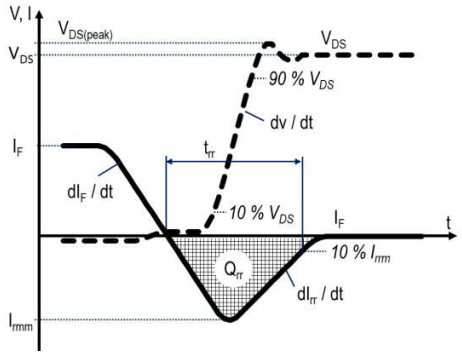
Test circuit for diode characteristics	Diode recovery waveform
	

Table 9 Switching times

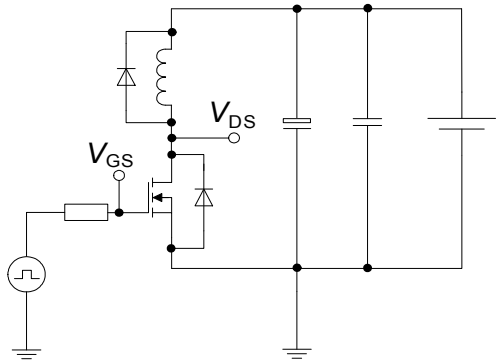
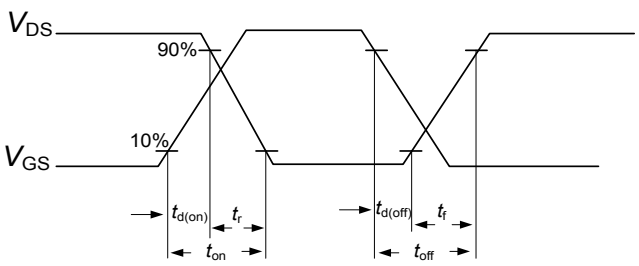
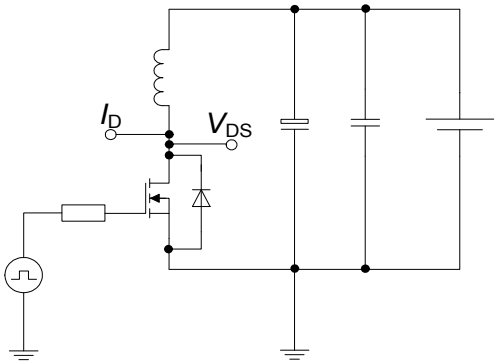
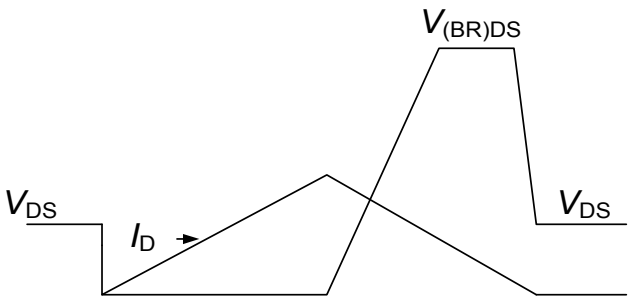
Switching times test circuit for inductive load	Switching times waveform
	

Table 10 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

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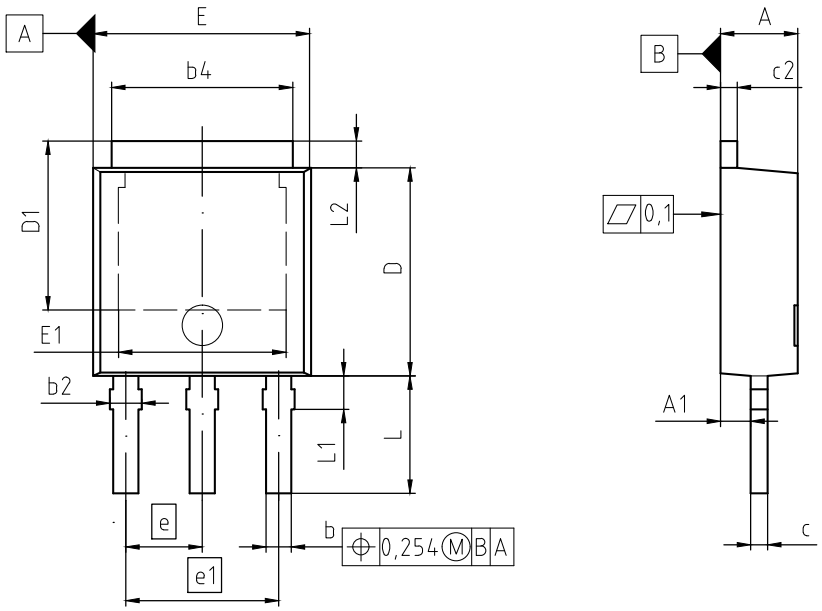
6 Package Outlines



NOTES:

1. INDUSTRIAL QUALITY GRADE
2. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-251 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.20	2.35	0.087	0.093
A1	0.80	1.14	0.031	0.044
b	0.64	0.89	0.026	0.033
b2	0.65	1.15	0.026	0.045
b4	5.20	5.50	0.205	0.217
c	0.46	0.59	0.018	0.023
c2	0.46	0.89	0.018	0.023
D	6.00	6.22	0.236	0.245
D1	5.04	5.55	0.198	0.219
E	6.45	6.70	0.254	0.264
E1	4.60	5.10	0.181	0.201
e	2.28		0.090	
e1	4.56		0.180	
N	3		3	
L	3.00	3.60	0.118	0.142
L1	0.80	1.20	0.031	0.047
L2	0.90	1.25	0.035	0.049

DOCUMENT NO.
Z8B00003329

SCALE
0 2.0 4mm

EUROPEAN PROJECTION

ISSUE DATE
01-04-2016

REVISION
07

Figure 1 Outline PG-TO 251-3, dimensions in mm/inches

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7 Appendix A

Table 11 Related Links

- **IFX CoolMOS™ E6 Webpage:** www.infineon.com
- **IFX CoolMOS™ E6 application note:** www.infineon.com
- **IFX CoolMOS™ E6 simulation model:** www.infineon.com
- **IFX Design tools:** www.infineon.com

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Revision History

IPS65R600E6

Revision: 2017-07-27, Rev. 2.1

Previous Revision		
Revision	Date	Subjects (major changes since last revision)
2.0	2015-04-23	Release of final version
2.1	2017-07-27	Updated package drawing on page 12

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