MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CFDA Automotive

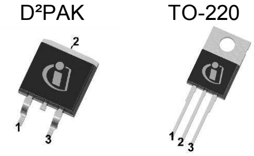
650V CoolMOS™ CFDA Power Transistor
IPx65R660CFDA

Data Sheet

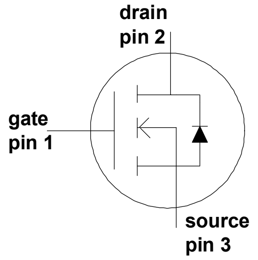
Rev. 2.0
Final

Automotive

1 Description



CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. 650V CoolMOS™ CFDA 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 offering an extremely fast and robust body diode. This combination of extremely low switching, commutation and conduction losses together with highest robustness make especially resonant switching applications more reliable, more efficient, lighter, and cooler.



Features

- Ultra-fast body diode
- Very high commutation ruggedness
- Extremely low losses due to very low FOM Rdson*Qg and Eoss
- Easy to use/drive
- Qualified according to AEC Q101
- Green package (RoHS compliant), Pb-free plating, halogen free for mold compound

Applications

650V CoolMOS™ CFDA is designed for switching applications.

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	650	V
RDS(on),max	0.66	Ω
Qg,typ	20	nC
ID,pulse	17	A
Eoss @ 400V	1.8	µJ
Body diode di/dt	900	A/µs
Qrr	0.2	µC
trr	65	ns
Irrm	4.5	A

Type / Ordering Code	Package	Marking	Related Links
IPB65R660CFDA	PG-TO 263	65F6660A	-
IPP65R660CFDA	PG-TO 220		

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			6	A	T_C = 25°C
				3.8		T_C = 100°C
Pulsed drain current[2]	$I_{D,pulse}$			17	A	T_C = 25°C
Avalanche energy, single pulse	E_{AS}			115	mJ	I_D = 1.2A, V_{DD} = 50V (see table 19)
Avalanche energy, repetitive	E_{AR}			0.21	mJ	I_D = 1.2A, V_{DD} = 50V
Avalanche current, repetitive	I_{AR}			1.2	A	
MOSFET dv/dt ruggedness	dv/dt			50	V/ns	V_{DS} = 0 ... 400V
Gate source voltage	V_{GS}	-20		20	V	static
		-30		30		AC (f > 1 Hz)
Power dissipation (non FullPAK, SMD) TO-220, D²PAK	P_{tot}			62.5	W	T_C = 25°C
Operating and storage temperature	T_j, T_{stg}	-40		150	°C	
Mounting torque (non FullPAK) TO-220				60	Ncm	M3 and M3.5 screws
Continuous diode forward current	I_S			6	A	T_C = 25°C
Diode pulse current	$I_{S,pulse}$			17	A	T_C = 25°C
Reverse diode dv/dt[3]	dv/dt			50	V/ns	V_{DS} = 0 ... 400V, $I_{SD} \le I_D$, T_j = 25°C (see table 17)
Maximum diode commutation speed	di_f/dt			900	A/µs	

[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

3 Thermal characteristics

Table 3 Thermal characteristics TO-220

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

Table 4 Thermal characteristics D²PAK

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			2	K/W	
Thermal resistance, junction - ambient[1]	R_{thJA}			62	K/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 5 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage[1]	$V_{(BR)DSS}$	650			V	V_{GS} = 0V, I_D = 1mA
Gate threshold voltage	$V_{GS(th)}$	3.5	4	4.5	V	V_{DS} = V_{GS}, I_D = 0.2mA
Zero gate voltage drain current	I_{DSS}			1	µA	V_{DS} = 650V, V_{GS} = 0V, T_j = 25°C
			100			V_{DS} = 650V, 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	$R_{DS(on)}$		0.594	0.66	Ω	V_{GS} = 10V, I_D = 3.2A, T_j = 25°C
			1.544			V_{GS} = 10V, I_D = 3.2A, T_j = 150°C
Gate resistance	R_G		6.5		Ω	f = 1MHz, open drain

Table 6 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}		543		pF	V_{GS} = 0V, V_{DS} = 100V, f = 1MHz
Output capacitance	C_{oss}		32		pF	
Effective output capacitance, energy related[2]	$C_{o(er)}$		24		pF	V_{GS} = 0V, V_{DS} = 0 ... 400V
Effective output capacitance, time related[3]	$C_{o(tr)}$		97		pF	I_D = constant, V_{GS} = 0V, V_{DS} = 0 ... 400V
Turn-on delay time	$t_{d(on)}$		9		ns	V_{DD} = 400V, V_{GS} = 13V, I_D = 3.2A, R_G = 6.8Ω (see table 18)
Rise time	t_r		8		ns	
Turn-off delay time	$t_{d(off)}$		40		ns	
Fall time	t_f		10		ns	

Table 7 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}		3.5		nC	V_{DD} = 480V, I_D = 3.2A, V_{GS} = 0 to 10V
Gate to drain charge	Q_{gd}		11		nC	
Gate charge total	Q_g		20		nC	
Gate plateau voltage	$V_{plateau}$		6.4		V	

[1] For applications with applied blocking voltage > 65% of the specified blocking voltage, we recommend to evaluate the impact of the cosmic radiation effect in early design phase. For assessment please contact local Infineon sales office.
[2] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 400V
[3] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 400V

Table 8 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}		65		ns	V_R = 400V, I_F = 3.2A, di_F/dt = 100A/µs (see table 17)
Reverse recovery charge	Q_{rr}		0.2		µC	
Peak reverse recovery current	I_{rrm}		4.5		A	

5 Electrical characteristics diagrams

Table 9

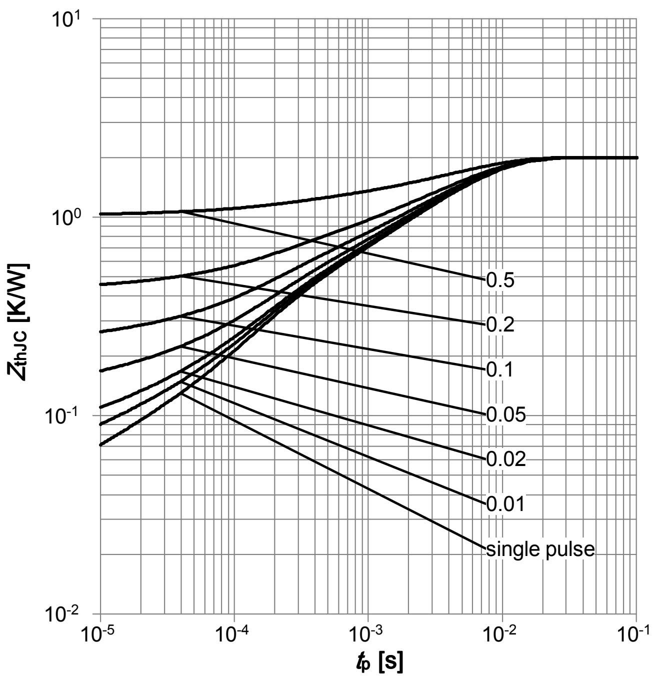
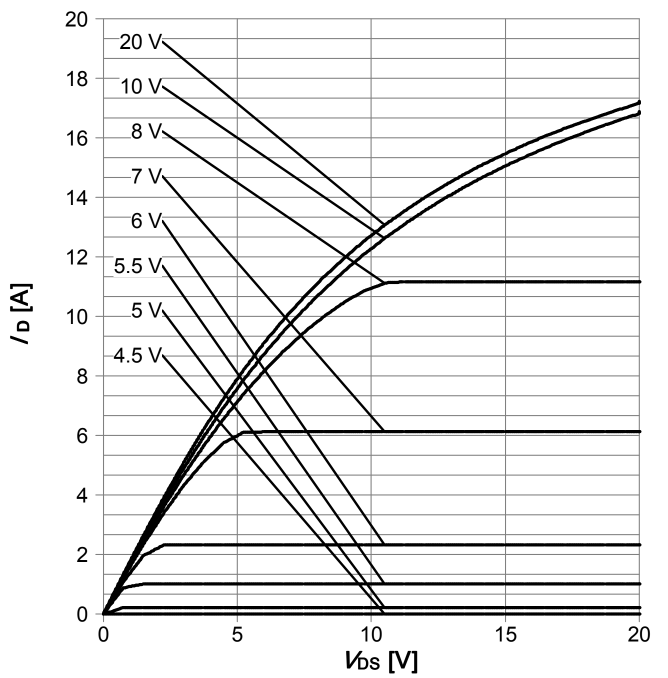
Max. transient thermal impedance	Typ. output characteristics
	
$Z_{thJC}=f(t_P)$; parameter: $D=t_p/T$	$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: V_{GS}

Table 10

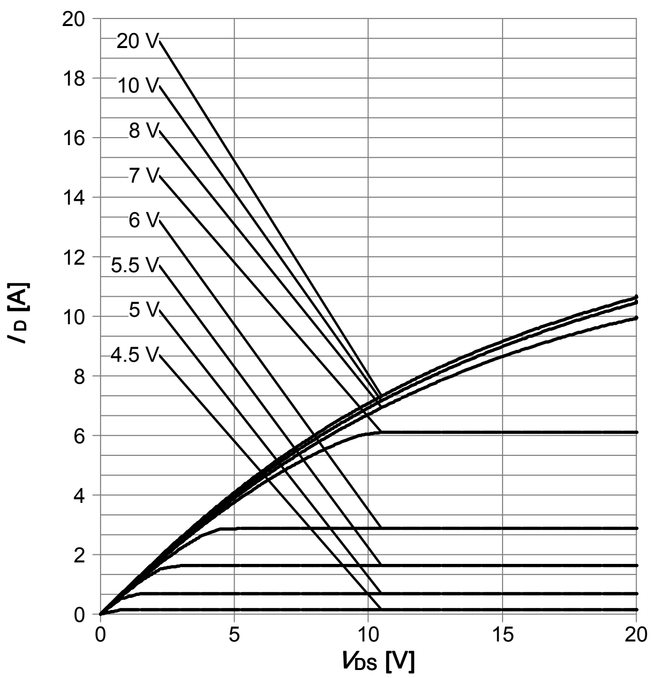
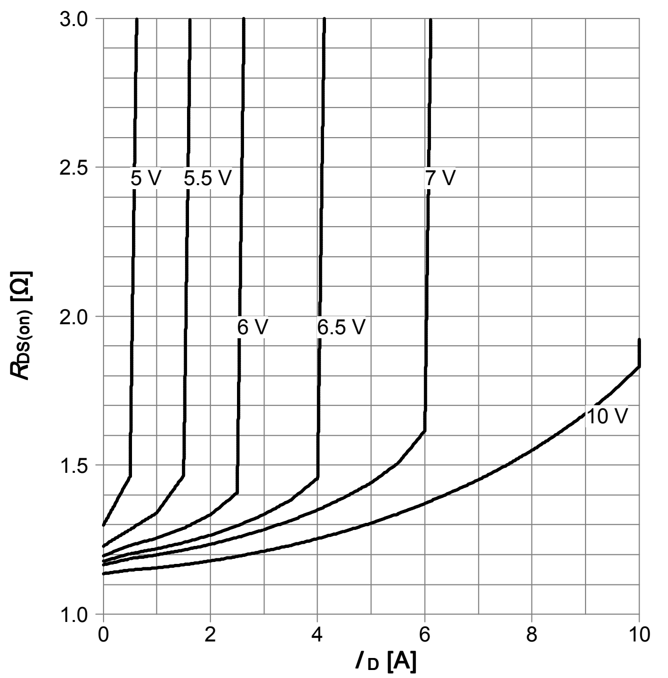
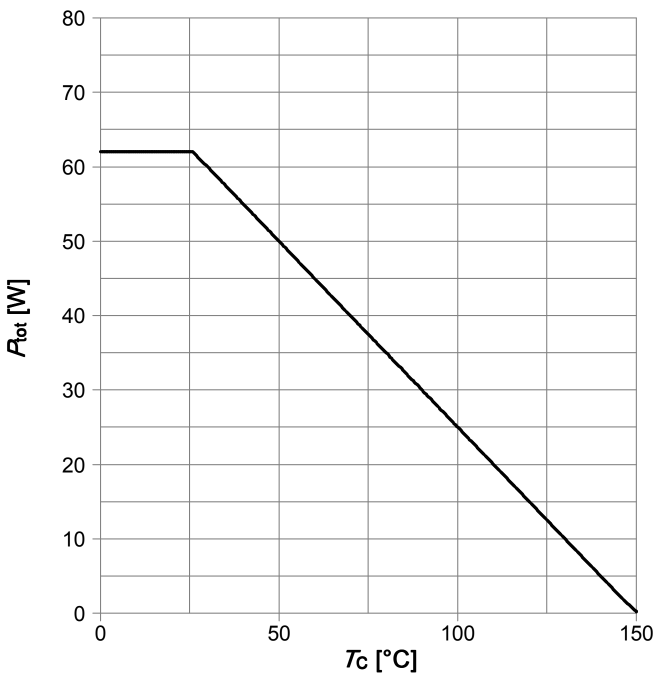
Typ. output characteristics	Typ. drain-source on-state resistance
	
$I_D=f(V_{DS})$; $T_j=125$ °C; parameter: V_{GS}	$R_{DS(on)}=f(I_D)$; $T_j=125$ °C; parameter: V_{GS}

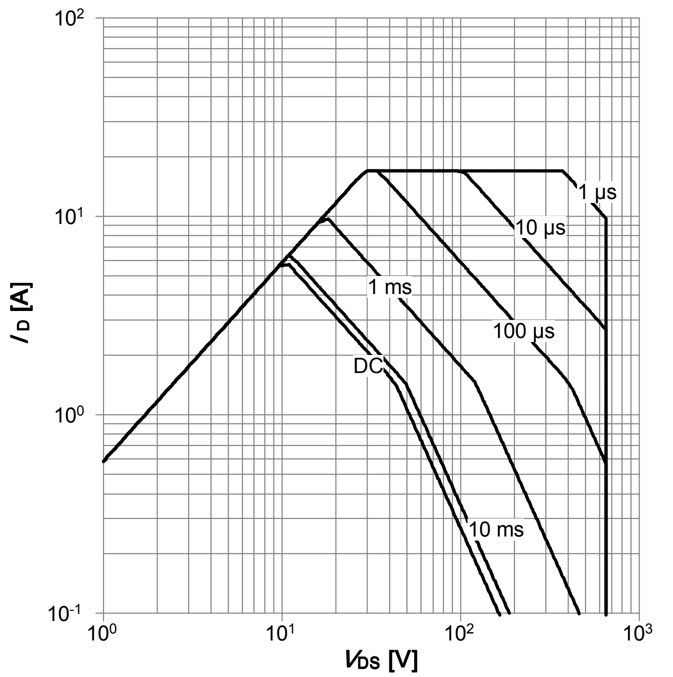
Table 11

Power dissipation



P_{tot}=f(T_C)

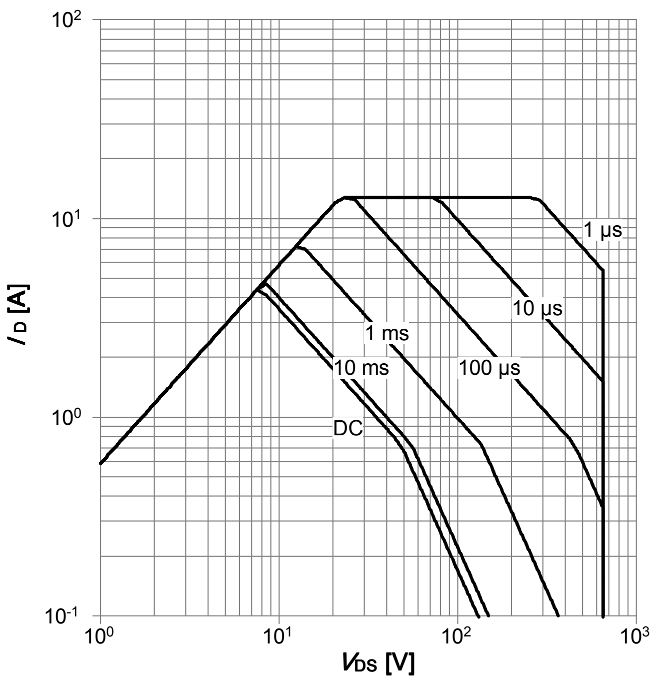
Safe operating area



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

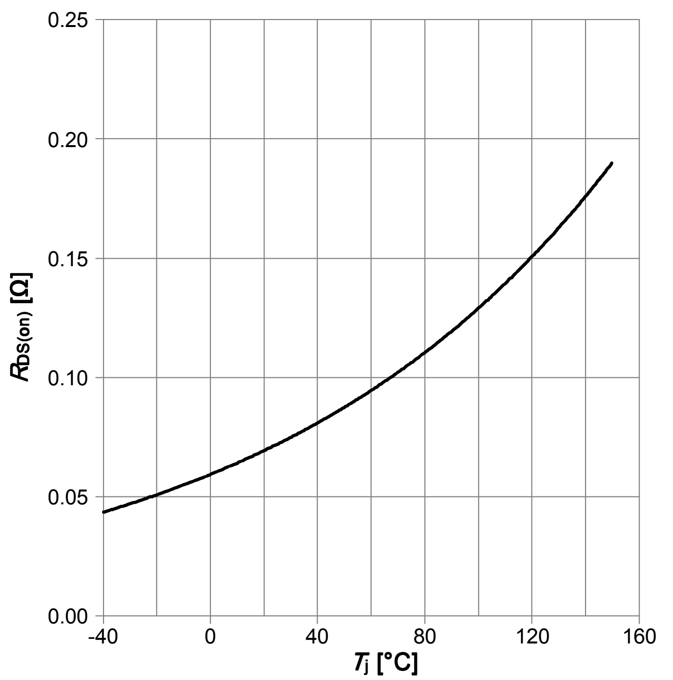
Table 12

Safe operating area



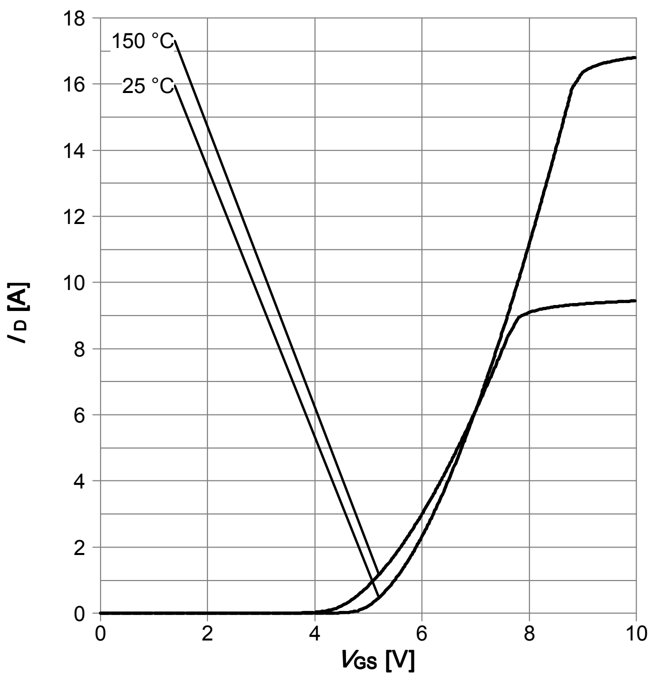
I_D=f(V_{DS}); T_C=80 °C; D=0; parameter: t_p

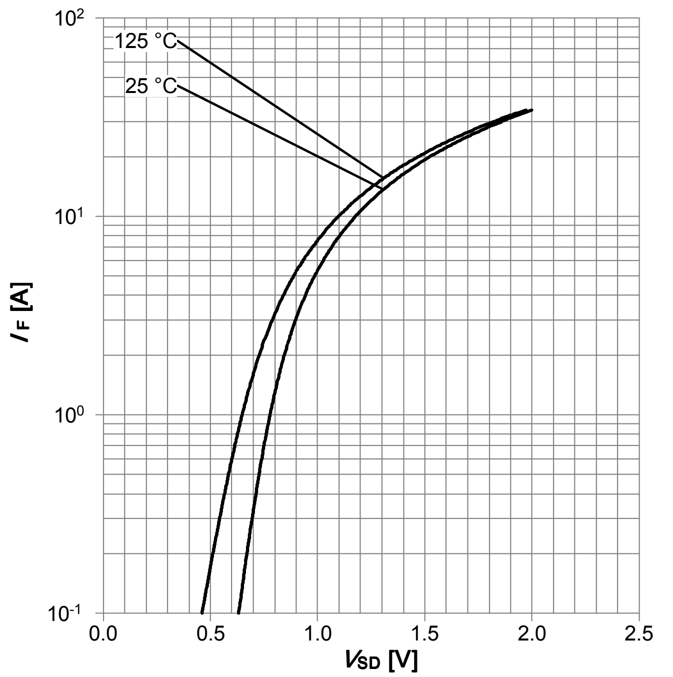
Typ. drain-source on-state resistance



$R_{DS(on)}$=f(T_j); I_D=18.1 A; V_{GS}=10 V

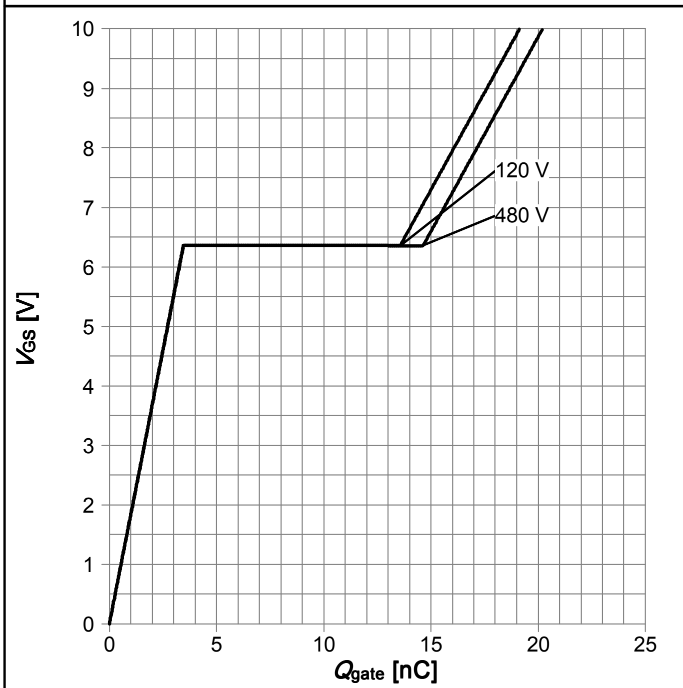
Table 13

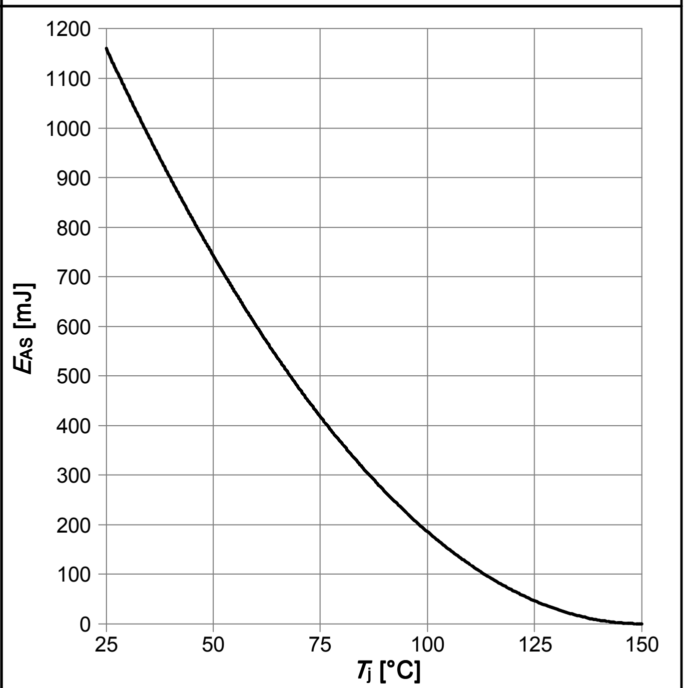
<table>
<tr><th>Typ. transfer characteristics</th><th>Typ. forward characteristics of reverse diode</th></tr>
<tr><td>


</td><td>


</td></tr>
<tr><td>I_D=f(V_{GS}); |V_{DS}|>2|I_D|$R_{DS(on)max}$; parameter: T_j</td><td>I_F=f(V_{SD}); parameter: T_j</td></tr>
</table>

Table 14

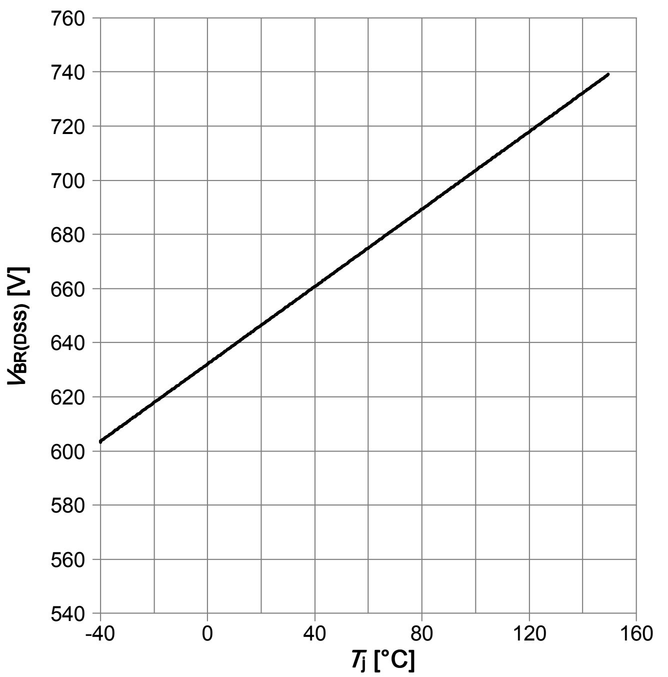
<table>
<tr><th>Typ. gate charge</th><th>Avalanche energy</th></tr>
<tr><td>


</td><td>


</td></tr>
<tr><td>V_{GS}=f(Q_{gate}); I_D=19.2 A pulsed; parameter: V_{DD}</td><td>E_{AS}=f(T_j); I_D=6.6 A; V_{DD}=50 V</td></tr>
</table>

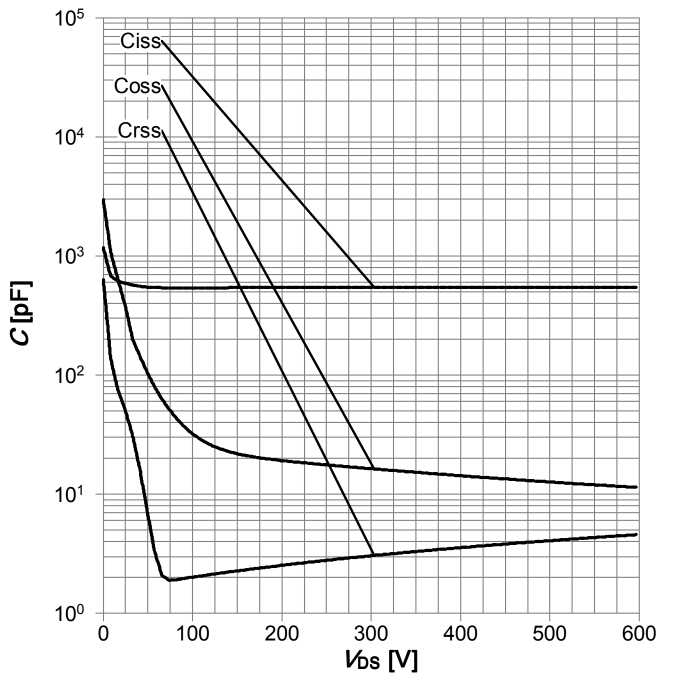
Table 15

Drain-source breakdown voltage



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

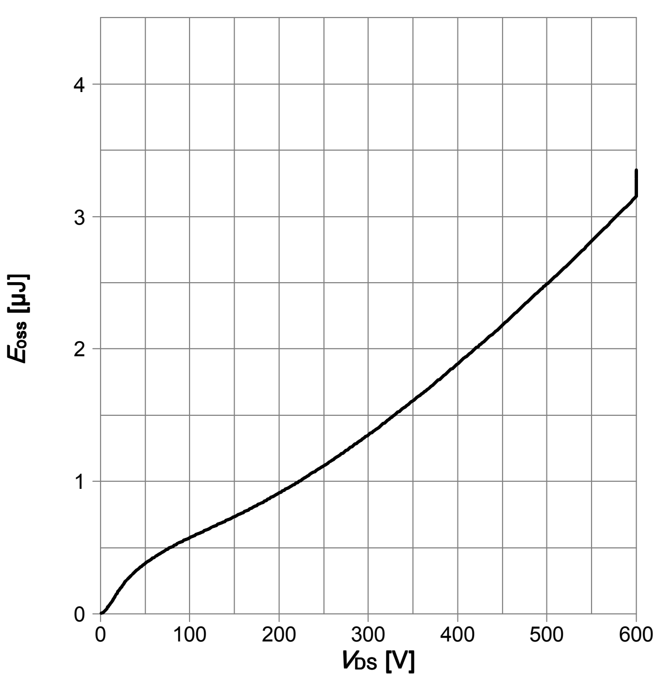
Typ. capacitances



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

Table 16

Typ. Coss stored energy



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

6 Test Circuits

Table 17 Diode characteristics

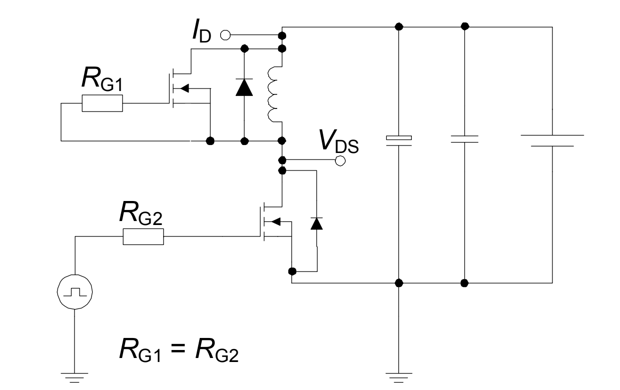
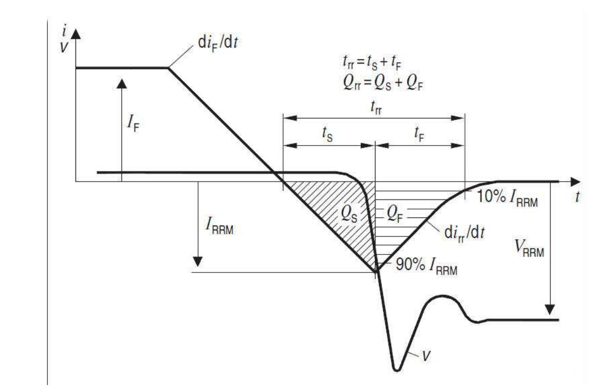
Test circuit for diode characteristics	Diode recovery waveform
	

Table 18 Switching times

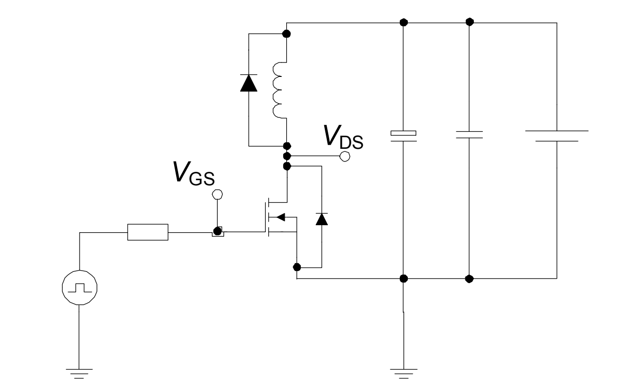
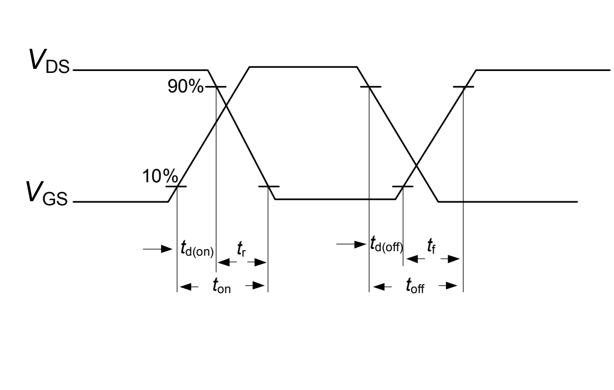
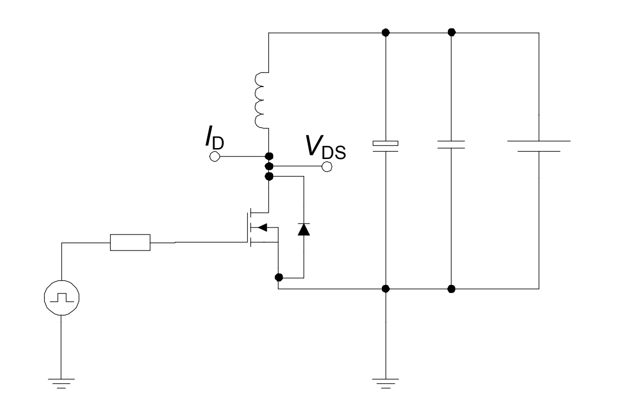
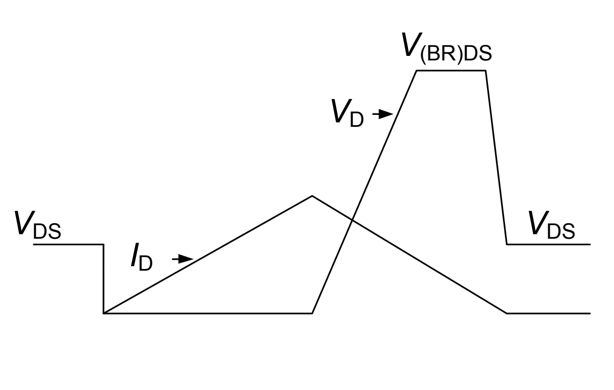
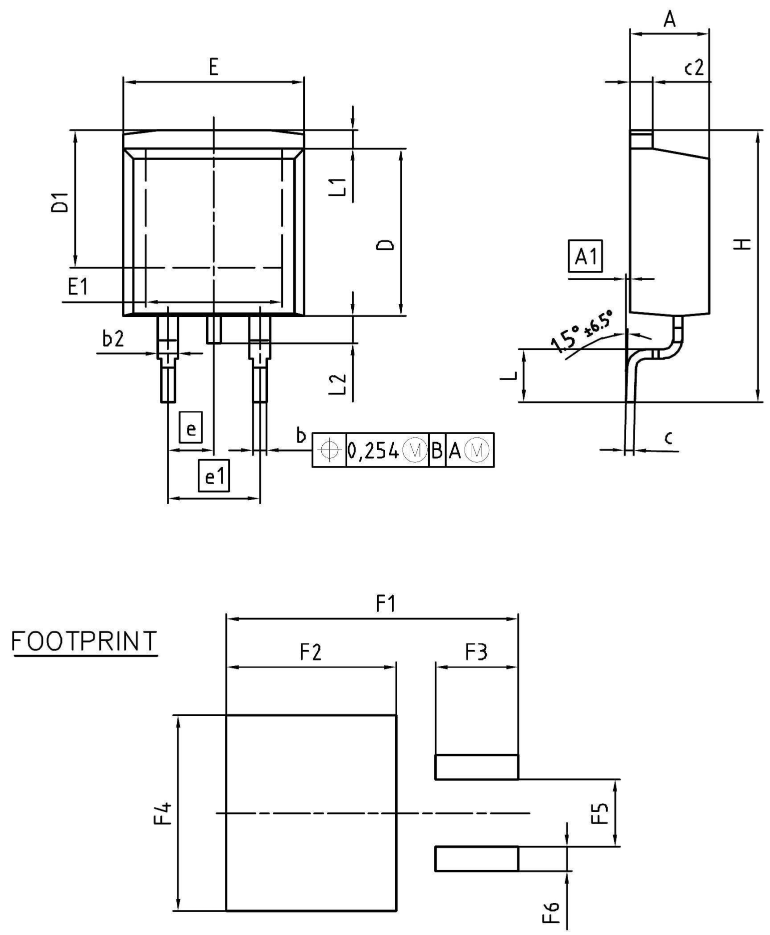
Switching times test circuit for inductive load	Switching times waveform
	

Table 19 Unclamped inductive

Unclamped inductive load test circuit	Unclamped inductive waveform
	

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

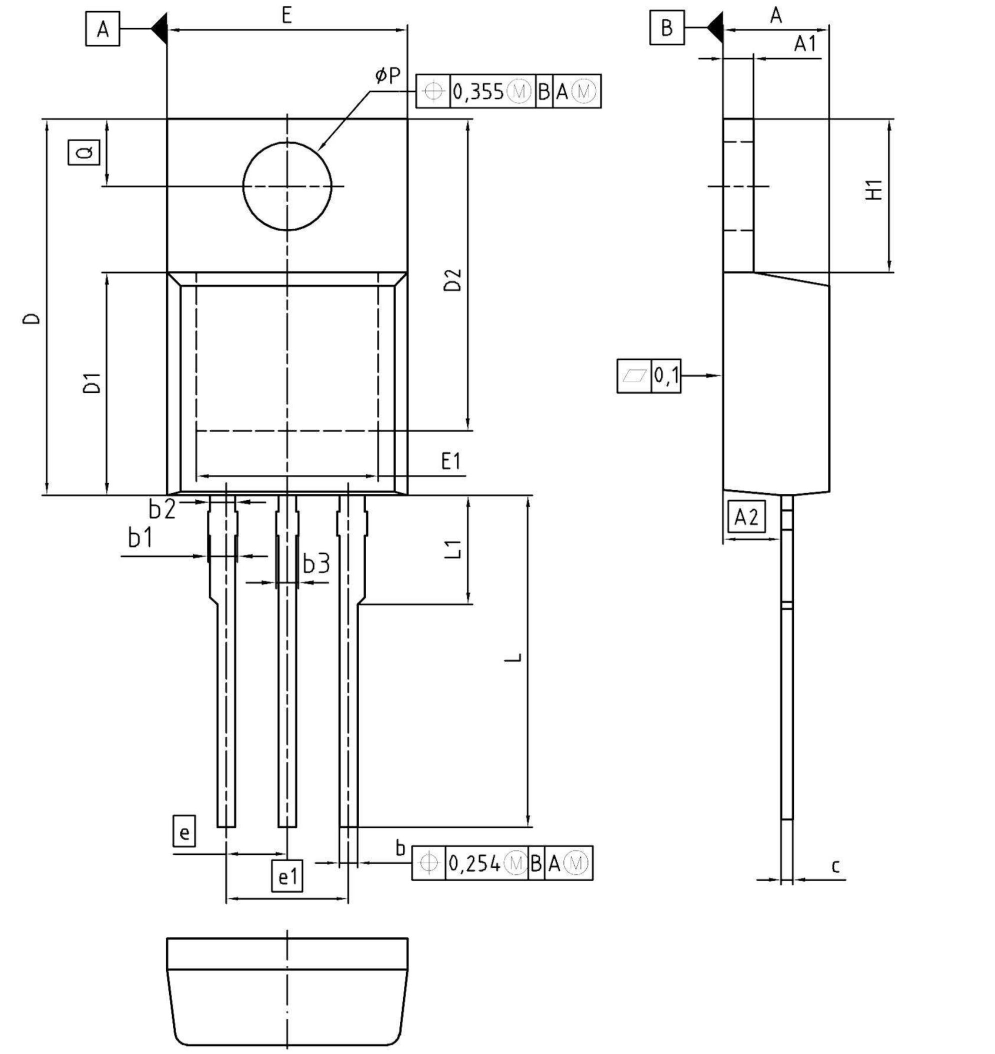
SCALE
0 5 7.5mm

EUROPEAN PROJECTION

ISSUE DATE
30-08-2007

REVISION
01

Figure 1 Outline PG-TO 263, dimensions in mm/inches



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	1.17	1.40	0.046	0.055
A2	2.15	2.72	0.085	0.107
b	0.65	0.86	0.026	0.034
b1	0.95	1.40	0.037	0.055
b2	0.95	1.15	0.037	0.045
b3	0.65	1.15	0.026	0.045
c	0.33	0.60	0.013	0.024
D	14.81	15.95	0.583	0.628
D1	8.51	9.45	0.335	0.372
D2	12.19	13.10	0.480	0.516
E	9.70	10.36	0.382	0.408
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H1	5.90	6.90	0.232	0.272
L	13.00	14.00	0.512	0.551
L1	-	4.80	-	0.189
øP	3.60	3.89	0.142	0.153
Q	2.60	3.00	0.102	0.118

DOCUMENT NO.
Z8B00003318

SCALE 0 2.5 5mm

EUROPEAN PROJECTION

ISSUE DATE
30-07-2009

REVISION
06

Figure 2 Outline PG-TO 220, dimensions in mm/inches

Revision History

IPB65R660CFDA, IPP65R660CFDA

Revision: 2012-03-28, Rev. 2.0

Previous Revision		
Revision	Date	Subjects (major changes since last revision)
2.0	2012-03-28	Final datasheet

Disclaimer ATV

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**

Edition 2011-09-30
Published by
Infineon Technologies AG
81726 München, Germany

Information
For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office (**www.infineon.com**).

Warnings
Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies Office.
Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.