Never stop thinking

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS C6

600V CoolMOS™ C6 Power Transistor
IPD60R2K0C6

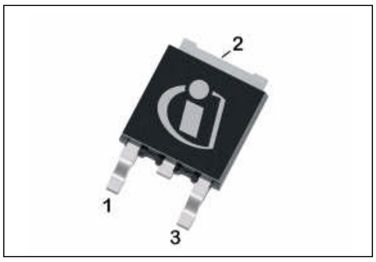
Data Sheet

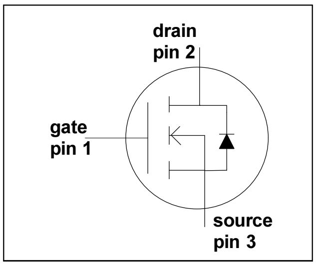
Rev. 2.0, 2010-07-20
Final

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 R_{dson}*Q_g and E_{oss}
- Very high commutation ruggedness
- Easy to use/drive
- JEDEC[1)] qualified, Pb-free plating

Applications

PFC stages, hard switching PWM stages and resonant switching PWM stages for e.g. PC Silverbox, Adapter, LCD & PDP TV, 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} @ $T_{j,max}$	650	V
$R_{DS(on),max}$	2.0	Ω
$Q_{g,typ}$	6.7	nC
$I_{D,pulse}$	6	A
E_{oss} @ 400V	0.76	µJ
Body diode di/dt	500	A/µs

Type / Ordering Code	Package	Marking	Related Links
IPD60R2K0C6	PG-TO252	6R2K0C6	IFX C6 Product Brief IFX C6 Portfolio IFX CoolMOS Webpage IFX Design tools

1) J-STD20 and JESD22

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=0.4 A, V_{DD}=50 V (see table 17)
Avalanche energy, repetitive	E_{AR}	-	-	0.06		I_D=0.4 A, V_{DD}=50 V
Avalanche current, repetitive	I_{AR}	-	-	0.4	A	
MOSFET dv/dt ruggedness	dv/dt	-	-	50	V/ns	V_{DS}=0...480 V
Gate source voltage	V_{GS}	-20	-	20	V	static
		-30		30		AC (f>1 Hz)
Power dissipation	P_{tot}	-	-	22.3	W	T_C=25 °C
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[2]	$I_{S,pulse}$	-	-	6	A	T_C=25 °C
Reverse diode dv/dt[3]	dv/dt	-	-	15	V/ns	V_{DS}=0...480 V, $I_{SD} \leq I_D$, T_j=125 °C
Maximum diode commutation speed[3]	di_f/dt			500	A/µs	(see table 18)

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

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	5.6	°C/W	
Thermal resistance, junction - ambient	R_{thJA}	-	-	62		SMD version, device on PCB, minimal footprint
			35			SMD version, device on PCB, 6cm^2 cooling area[1)]
Soldering temperature, wave- & reflowsoldering allowed	T_{sold}	-	-	260	°C	reflow MSL1

1) Device on 40mm*40mm*1.5 epoxy PCB FR4 with 6cm^2 (one layer, 70µm thick) copper area for drain connection. PCB is vertical without air stream cooling

4 Electrical characteristics

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}=0 V, I_D=0.25 mA
Gate threshold voltage	$V_{GS(th)}$	2.5	3	3.5		V_{DS}=V_{GS}, I_D=0.06 mA
Zero gate voltage drain current	I_{DSS}	-	-	1	µA	V_{DS}=600 V, V_{GS}=0 V, T_j=25 °C
		-	10	-		V_{DS}=600 V, V_{GS}=0 V, T_j=150 °C
Gate-source leakage current	I_{GSS}	-	-	100	nA	V_{GS}=20 V, V_{DS}=0 V
Drain-source on-state resistance	$R_{DS(on)}$	-	1.80	2.0	Ω	V_{GS}=10 V, I_D=0.76 A, T_j=25 °C
		-	4.68	-		V_{GS}=10 V, I_D=0.76 A, T_j=150 °C
Gate resistance	R_G	-	12	-	Ω	f=1 MHz, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	140	-	pF	V_{GS}=0 V, V_{DS}=100 V, f=1 MHz
Output capacitance	C_{oss}	-	12	-		
Effective output capacitance, energy related[1)]	$C_{o(er)}$	-	8.5	-		V_{GS}=0 V, V_{DS}=0...480 V
Effective output capacitance, time related[2)]	$C_{o(tr)}$	-	30	-		I_D=constant, V_{GS}=0 V V_{DS}=0...480V
Turn-on delay time	$t_{d(on)}$	-	7	-	ns	V_{DD}=400 V, V_{GS}=10 V, I_D=0.9 A, R_G= 12.2 Ω (see table 16)
Rise time	t_r	-	7	-		
Turn-off delay time	$t_{d(off)}$	-	30	-		
Fall time	t_f	-	50	-		

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 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}=480 V, I_D=0.9 A, V_{GS}=0 to 10 V
Gate to drain charge	Q_{gd}	-	3.6	-		
Gate charge total	Q_g	-	6.7	-		
Gate plateau voltage	$V_{plateau}$	-	5.4	-	V	

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}=0 V, I_F=0.9 A, T_j=25 °C
Reverse recovery time	t_{rr}	-	180	-	ns	V_R=400 V, I_F=0.9 A, di_F/dt=100 A/µs (see table 18)
Reverse recovery charge	Q_{rr}	-	0.67	-	µC	
Peak reverse recovery current	I_{rrm}	-	7.1	-	A	

5 Electrical characteristics diagrams

Table 8

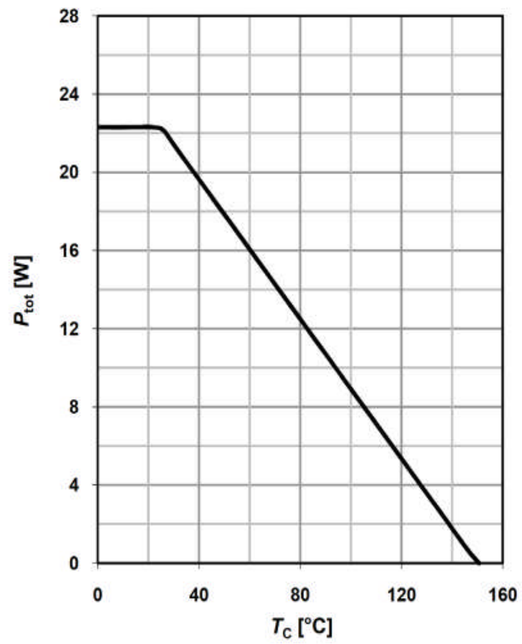
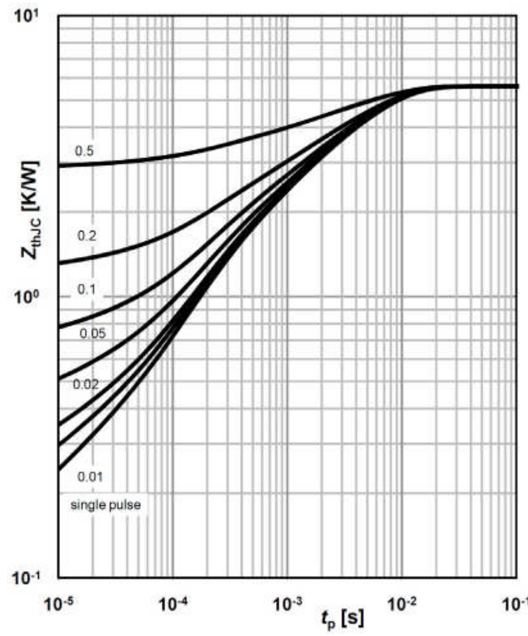
Power dissipation	Max. transient thermal impedance
	
P_{tot} = f(T_C)	$Z_{(thJC)}$=f(tp); parameter: D=t_p/T

Table 9

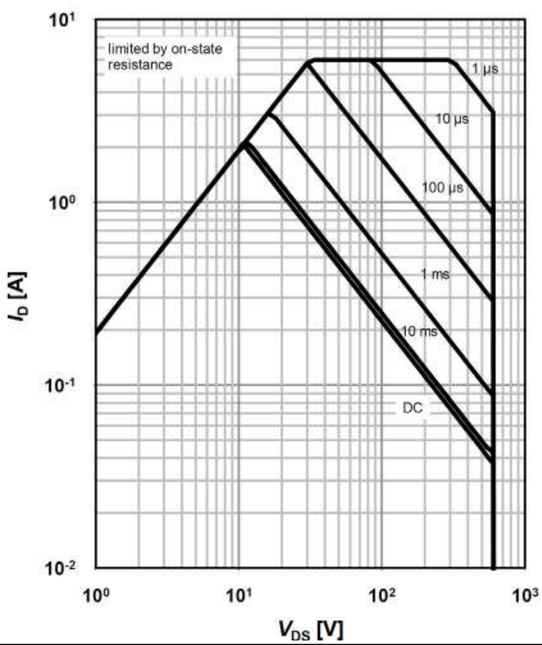
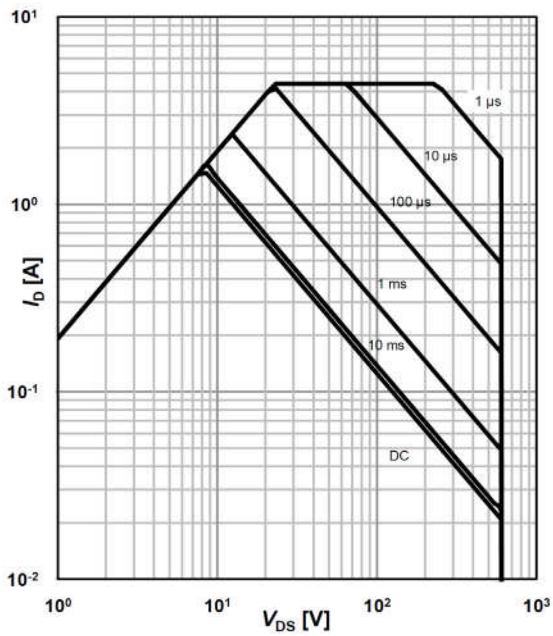
Safe operating area T_C=25 °C	Safe operating area T_C=80 °C
	
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter t_p	I_D=f(V_{DS}); T_C=80 °C; D=0; parameter t_p

Table 10

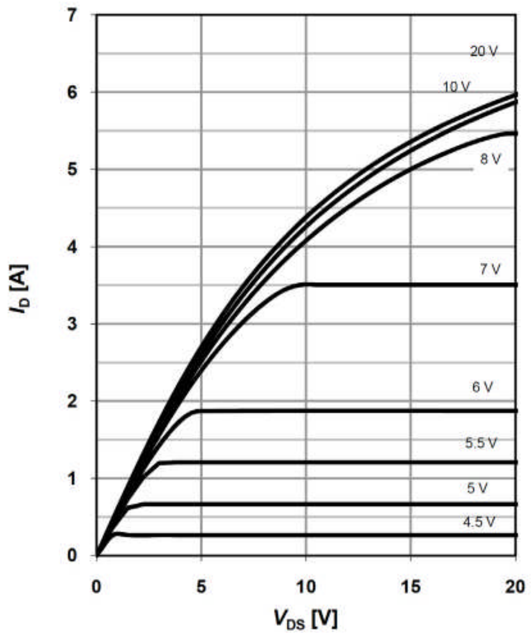
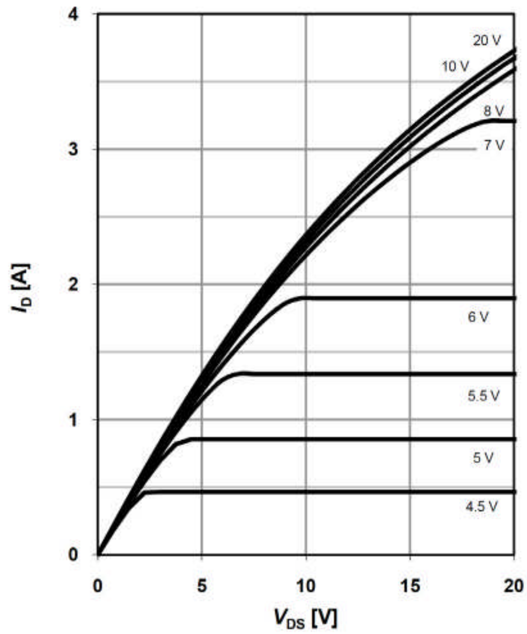
<table>
<tr><th>Typ. output characteristics T_j=25 °C</th><th>Typ. output characteristics T_j=125 °C</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}</td><td>I_D=f(V_{DS}); T_j=125 °C; parameter: V_{GS}</td></tr>
</table>

Table 11

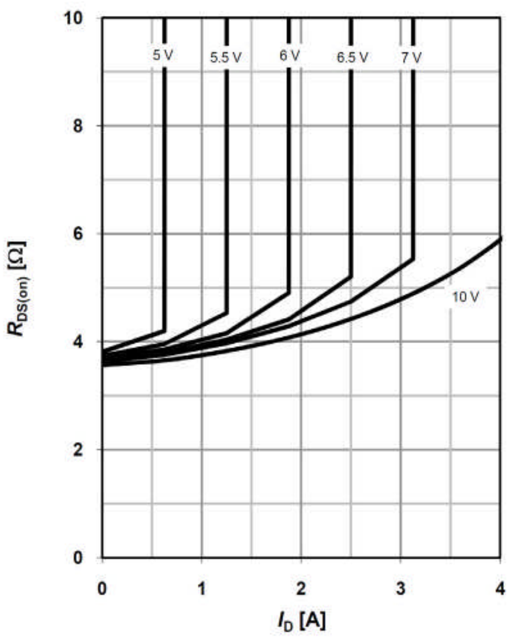
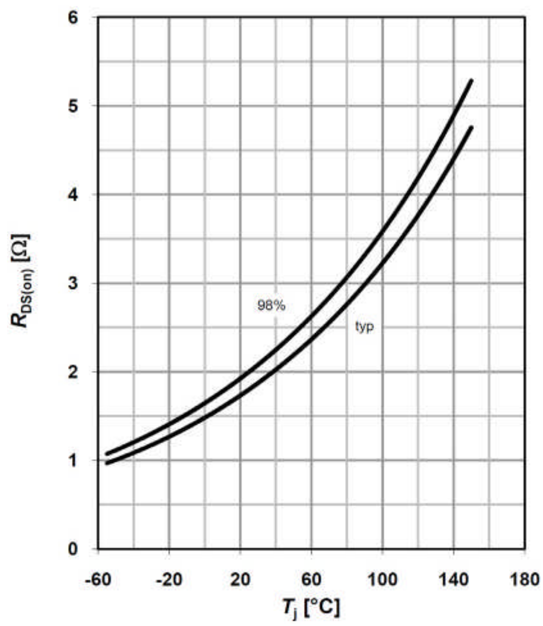
<table>
<tr><th>Typ. drain-source on-state resistance</th><th>Drain-source on-state resistance</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>$R_{DS(on)}$=f(I_D); T_j=125 °C; parameter: V_{GS}</td><td>$R_{DS(on)}$=f(T_j); I_D=0.76 A; V_{GS}=10 V</td></tr>
</table>

Table 12

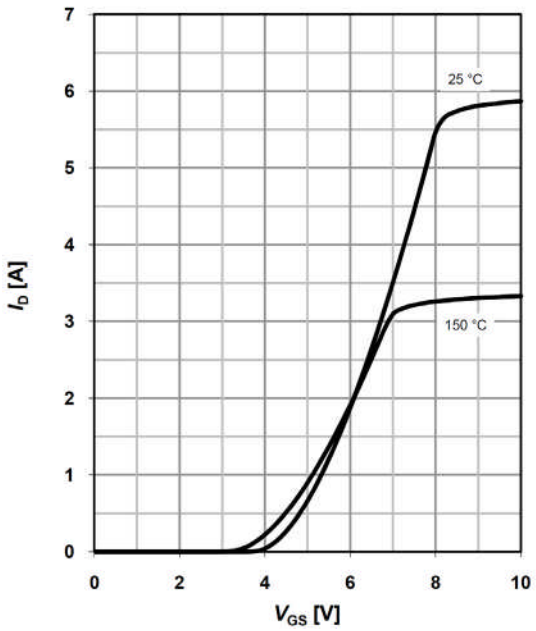
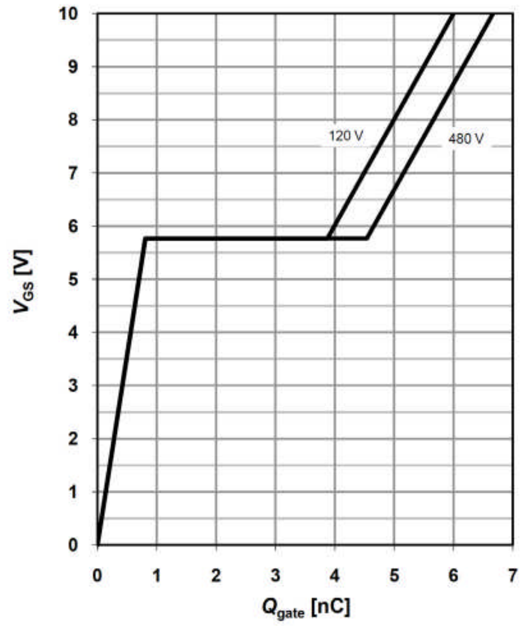
<table>
<tr><th>Typ. transfer characteristics</th><th>Typ. gate charge</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>I_D=f(V_{GS}); V_{DS}=20V</td><td>V_{GS}=f(Q_{gate}), I_D=0.9 A pulsed</td></tr>
</table>

Table 13

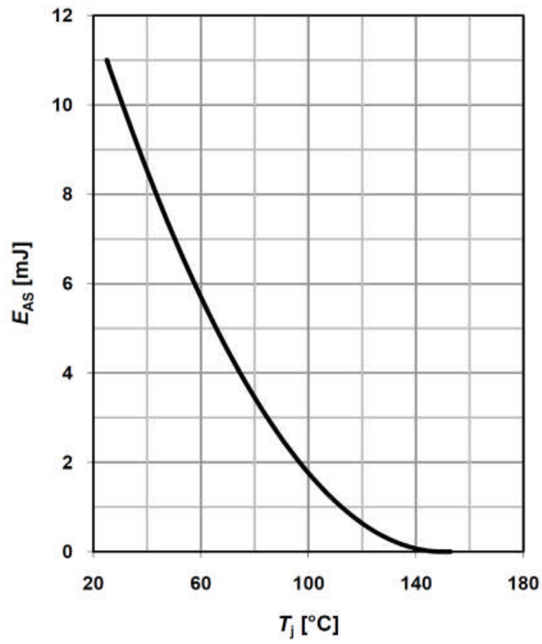
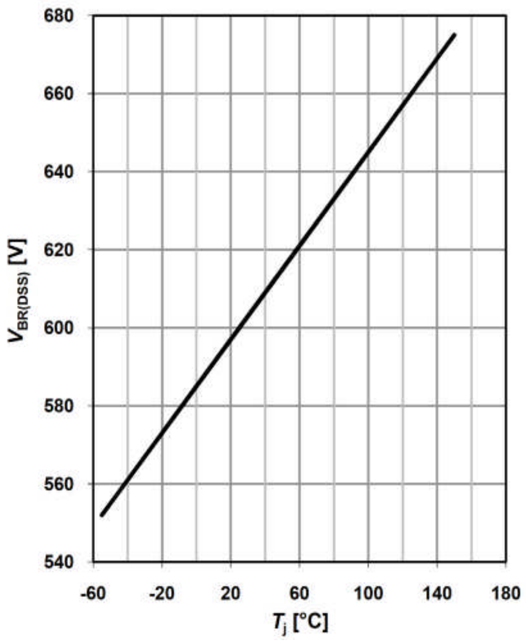
<table>
<tr><th>Avalanche energy</th><th>Drain-source breakdown voltage</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>E_{AS}=f(T_j); I_D=0.4 A; V_{DD}=50 V</td><td>$V_{BR(DSS)}$=f(T_j); I_D=0.25 mA</td></tr>
</table>

Table 14

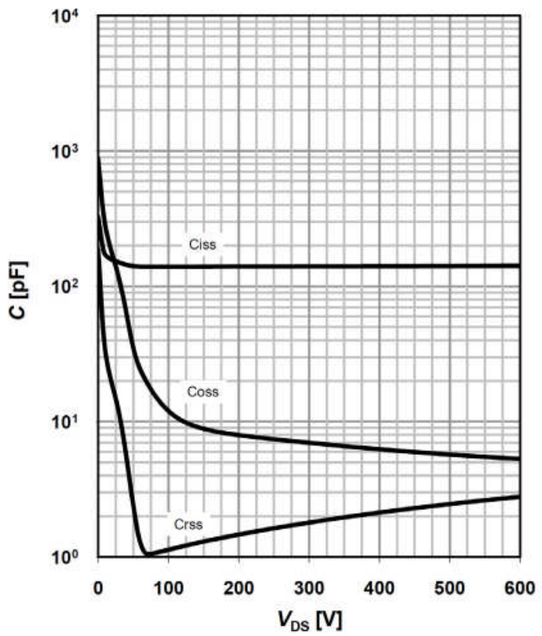
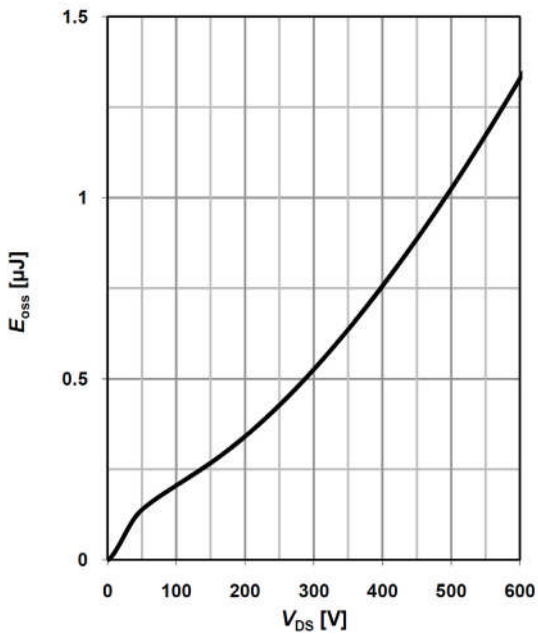
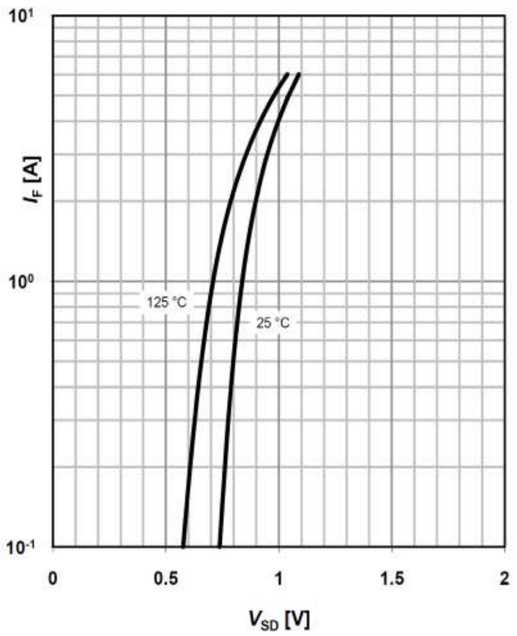
Typ. capacitances	Typ. C_{oss} stored energy
	
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz	E_{oss}=f(V_{DS})

Table 15

Forward characteristics of reverse diode

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

6 Test circuits

Table 16 Switching times test circuit and waveform for inductive load

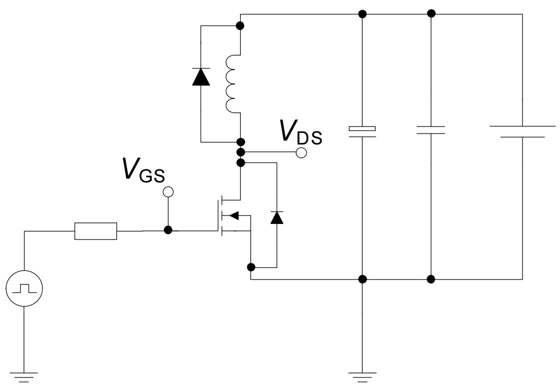
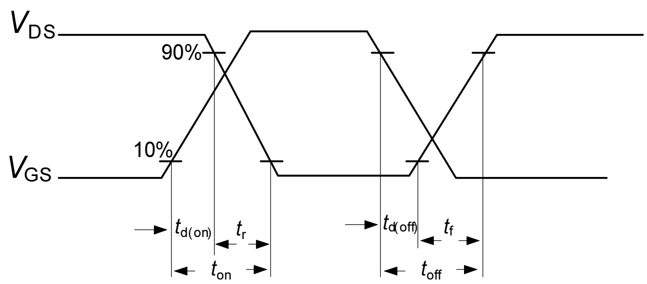
Switching times test circuit for inductive load	Switching time waveform
	

Table 17 Unclamped inductive load test circuit and waveform

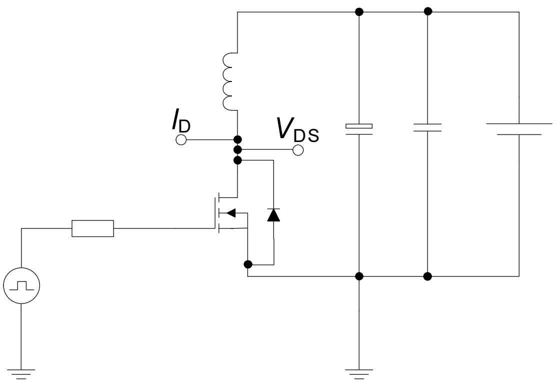
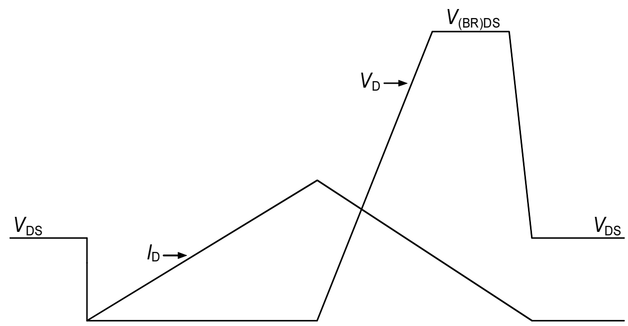
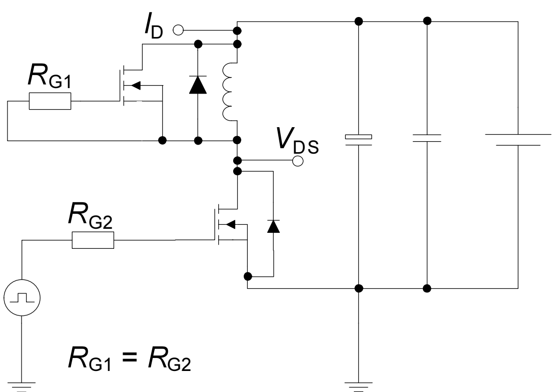
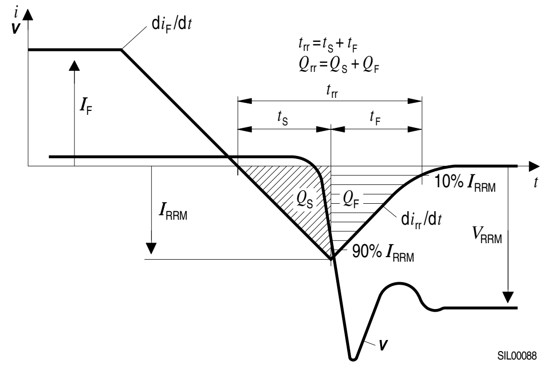
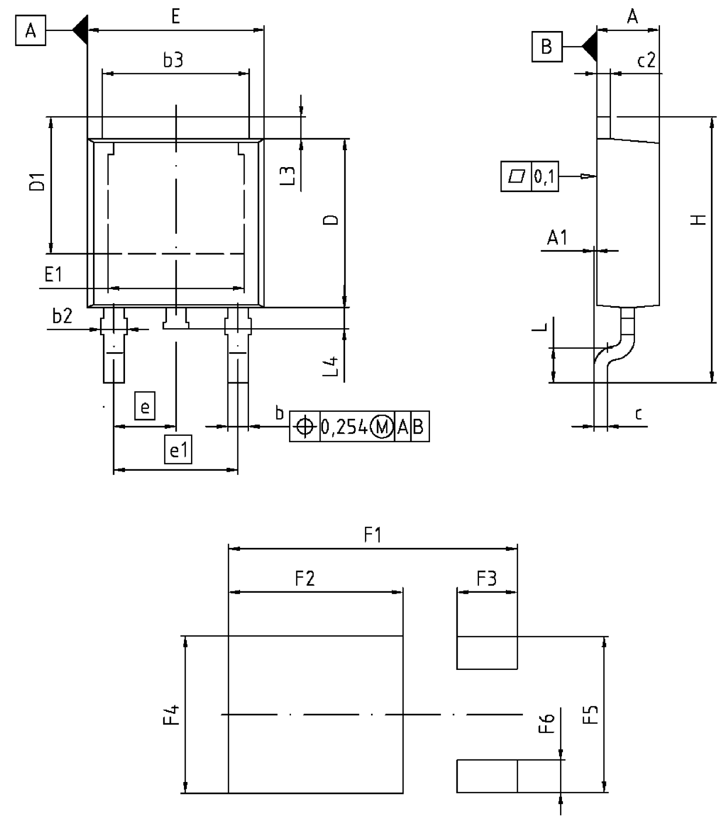
Unclamped inductive load test circuit	Unclamped inductive waveform
	

Table 18 Test circuit and waveform for diode characteristics

Test circuit for diode characteristics	Diode recovery waveform
	

7 Package outlines



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.16	2.41	0.085	0.095
A1	0.00	0.15	0.000	0.006
b	0.64	0.89	0.025	0.035
b2	0.65	1.15	0.026	0.045
b3	5.00	5.50	0.197	0.217
c	0.46	0.60	0.018	0.024
c2	0.46	0.98	0.018	0.039
D	5.97	6.22	0.235	0.245
D1	5.02	5.84	0.198	0.230
E	6.40	6.73	0.252	0.265
E1	4.70	5.21	0.185	0.205
e	2.29		0.090	
e1	4.57		0.180	
N	3		3	
H	9.40	10.48	0.370	0.413
L	1.18	1.70	0.046	0.067
L3	0.90	1.25	0.035	0.049
L4	0.51	1.00	0.020	0.039
F1	10.50	10.70	0.413	0.421
F2	6.30	6.50	0.248	0.256
F3	2.10	2.30	0.083	0.091
F4	5.70	5.90	0.224	0.232
F5	5.66	5.86	0.223	0.231
F6	1.10	1.30	0.043	0.051

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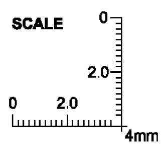
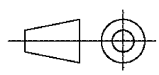
SCALE



EUROPEAN PROJECTION



ISSUE DATE
19-10-2007

REVISION
03

Figure 1 Outlines TO-252, dimensions in mm/inches

8 Revision History

CoolMOS C6 600V CoolMOS™ C6 Power Transistor

Revision History: 2010-07-20, Rev. 2.0	
Previous Revision:	
Revision	**Subjects (major changes since last revision)**
2.0	Release of final data sheet

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