

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS E6 650V

650V CoolMOS™ E6 Power Transistor
IPD65R250E6

Data Sheet

Rev. 2.1
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 $R_{ds(on)} \cdot Q_g$ and E_{oss}
- Very high commutation ruggedness
- Easy to use/drive
- Pb-free plating, Halogen free mold compound
- 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 and UPS.

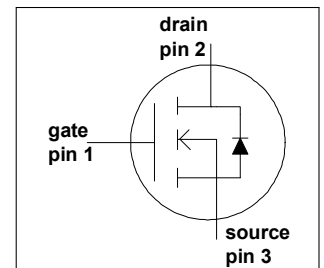
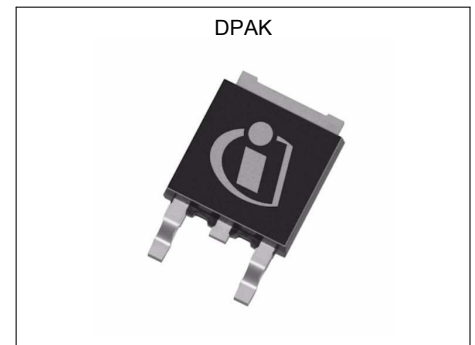


Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j \max}$	700	V
$R_{DS(on), \max}$	0.25	Ω
Q_g, typ	45	nC
I_D, pulse	46	A
$E_{oss} @ 400V$	3.7	μJ
Body diode di/dt	500	A/ μs

Type / Ordering Code	Package	Marking	Related Links
IPD65R250E6	PG-TO 252	65E6250	see Appendix A

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2 Maximum ratings

at $T_j = 25^\circ\text{C}$, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current ¹⁾	I_D			16.1	A	$T_C = 25^\circ\text{C}$
				11.3		$T_C = 100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$			46	A	$T_C = 25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}			290	mJ	$I_b = 2.4\text{A}$, $V_{DD} = 50\text{V}$
Avalanche energy, repetitive	E_{AR}			0.44	mJ	$I_b = 2.4\text{A}$, $V_{DD} = 50\text{V}$
Avalanche current, repetitive	I_{AR}			2.4	A	
MOSFET dv/dt ruggedness	dv/dt			50	V/ns	$V_{DS} = 0 \dots 480\text{V}$
Gate source voltage	V_{GS}	-20		20	V	static
		-30		30		AC ($f > 1\text{ Hz}$)
Power dissipation (non FullPAK)	P_{tot}			208	W	$T_C = 25^\circ\text{C}$
Operating and storage temperature	T_j, T_{stg}	-55		150	$^\circ\text{C}$	
Mounting torque (non FullPAK)				60	Ncm	M3 and M3.5 screws
Continuous diode forward current	I_S			17.9	A	$T_C = 25^\circ\text{C}$
Diode pulse current	$I_{S,pulse}$			46	A	$T_C = 25^\circ\text{C}$
Reverse diode dv/dt ³⁾	dv/dt			15	V/ns	$V_{DS} = 0 \dots 400\text{V}$, $I_{SD} \leq I_b$, $T_j = 25^\circ\text{C}$
Maximum diode commutation speed	di/dt			500	A/ μs	

¹⁾ Limited by $T_{j\text{ max}}$. Maximum duty cycle $D=0.75$

²⁾ Pulse width t_p limited by $T_{j\text{ max}}$

³⁾ $V_{peak} < V_{(BR)DSS}$, $T_j < T_{j\text{ max}}$, identical low and high side switch with same R_g

3 Thermal characteristics

Table 3 Thermal characteristics DPAK

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			0.6	°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, 6cm ² cooling area
Soldering temperature, wave- & reflowsoldering allowed	T_{sld}			260	°C	reflow MSL
Thermal resistance, junction - ambient ²⁾	R_{thJA}		35		°C/W	SMD version, device on PCB, 6cm ² cooling area

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.

²⁾ 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 $T_j = 25^\circ\text{C}$, 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	3.5	V	$V_{DS} = V_{GS}$, $I_D = 0.44mA$
Zero gate voltage drain current	I_{DSS}			1	μA	$V_{DS} = 650V$, $V_{GS} = 0V$, $T_j = 25^\circ\text{C}$
			10			$V_{DS} = 650V$, $V_{GS} = 0V$, $T_j = 150^\circ\text{C}$
Gate-source leakage current	I_{GSS}			100	nA	$V_{GS} = 20V$, $V_{DS} = 20V$
Drain-source on-state resistance	$R_{DS(on)}$		0.23	0.25	Ω	$V_{GS} = 10V$, $I_D = 4.4A$, $T_j = 25^\circ\text{C}$
			0.59			$V_{GS} = 10V$, $I_D = 4.4A$, $T_j = 150^\circ\text{C}$
Gate resistance	R_G		7		Ω	$f = 1MHz$, open drain

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}		950		pF	$V_{GS} = 0V$, $V_{DS} = 100V$, $f = 1MHz$
Output capacitance	C_{oss}		60		pF	
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$		40		pF	$V_{GS} = 0V$, $V_{DS} = 0 \dots 480V$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$		183		pF	$I_D = \text{constant}$, $V_{GS} = 0V$, $V_{DS} = 0 \dots 480V$
Turn-on delay time	$t_{d(on)}$		11		ns	$V_{DD} = 400V$, $V_{GS} = 13V$, $I_D = 6.6A$, $R_G = 3.4\Omega$
Rise time	t_r		9		ns	
Turn-off delay time	$t_{d(off)}$		76		ns	
Fall time	t_f		9		ns	

Table 6 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}		5		nC	$V_{DD} = 480V$, $I_D = 6.6A$, $V_{GS} = 0 \text{ to } 10V$
Gate to drain charge	Q_{gd}		24		nC	
Gate charge total	Q_g		45		nC	
Gate plateau voltage	$V_{plateau}$		5.5		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% $V_{(BR)DSS}$

Table 7 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}		0.9		V	$V_{GS} = 0V, I_F = 6.6A, T_J = 25^{\circ}C$
Reverse recovery time	t_{rr}		260		ns	$V_R = 400V, I_F = 6.6A,$ $dI_F/dt = 100A/\mu s$
Reverse recovery charge	Q_{rr}		2.4		μC	
Peak reverse recovery current	I_{rrm}		18		A	

5 Electrical characteristics diagrams

Table 8

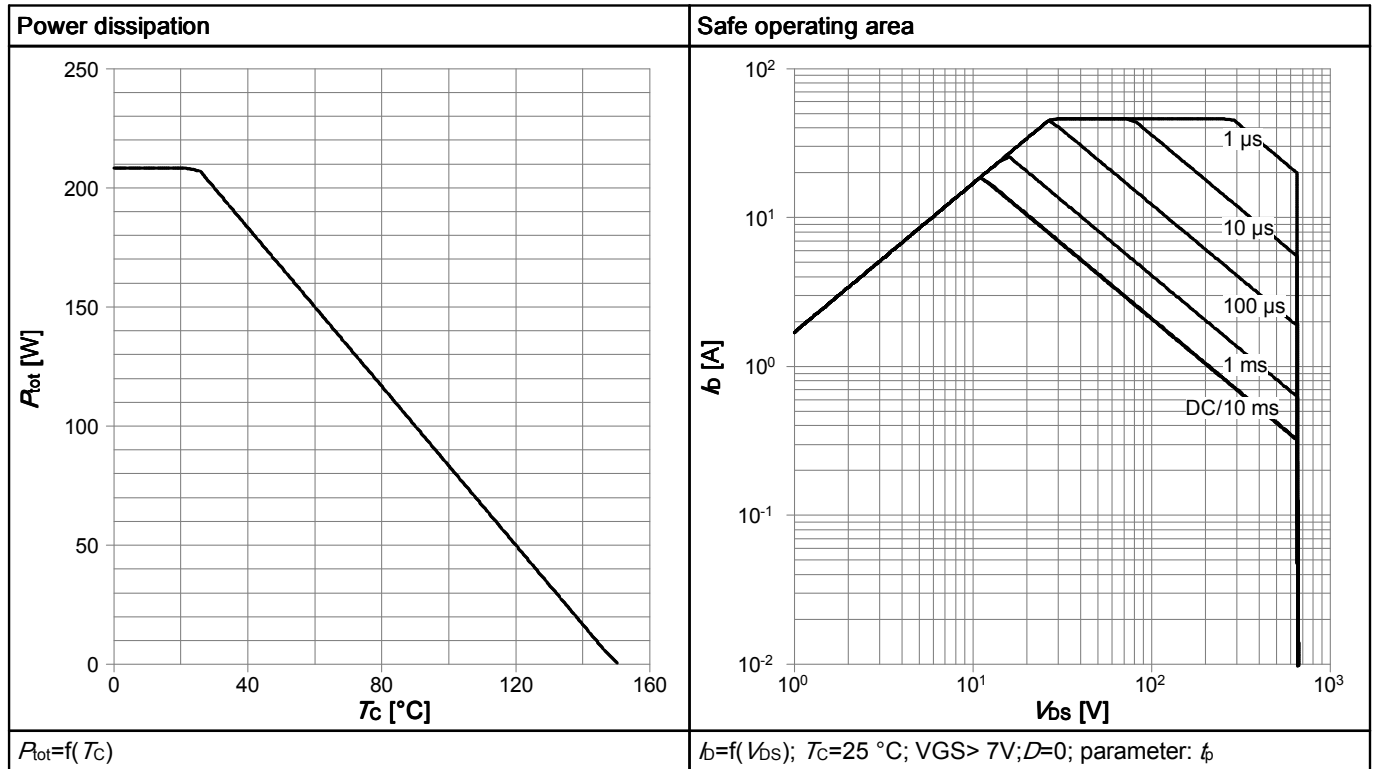


Table 9

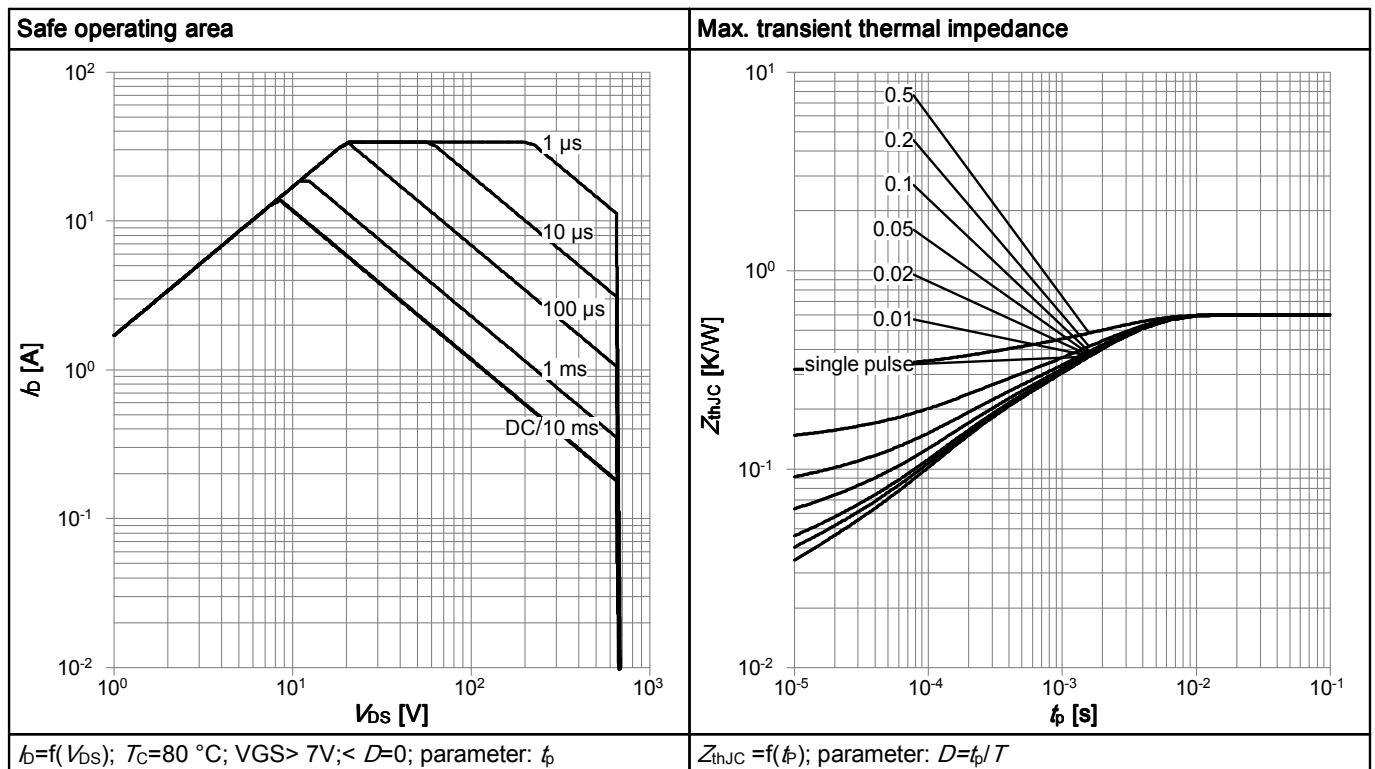


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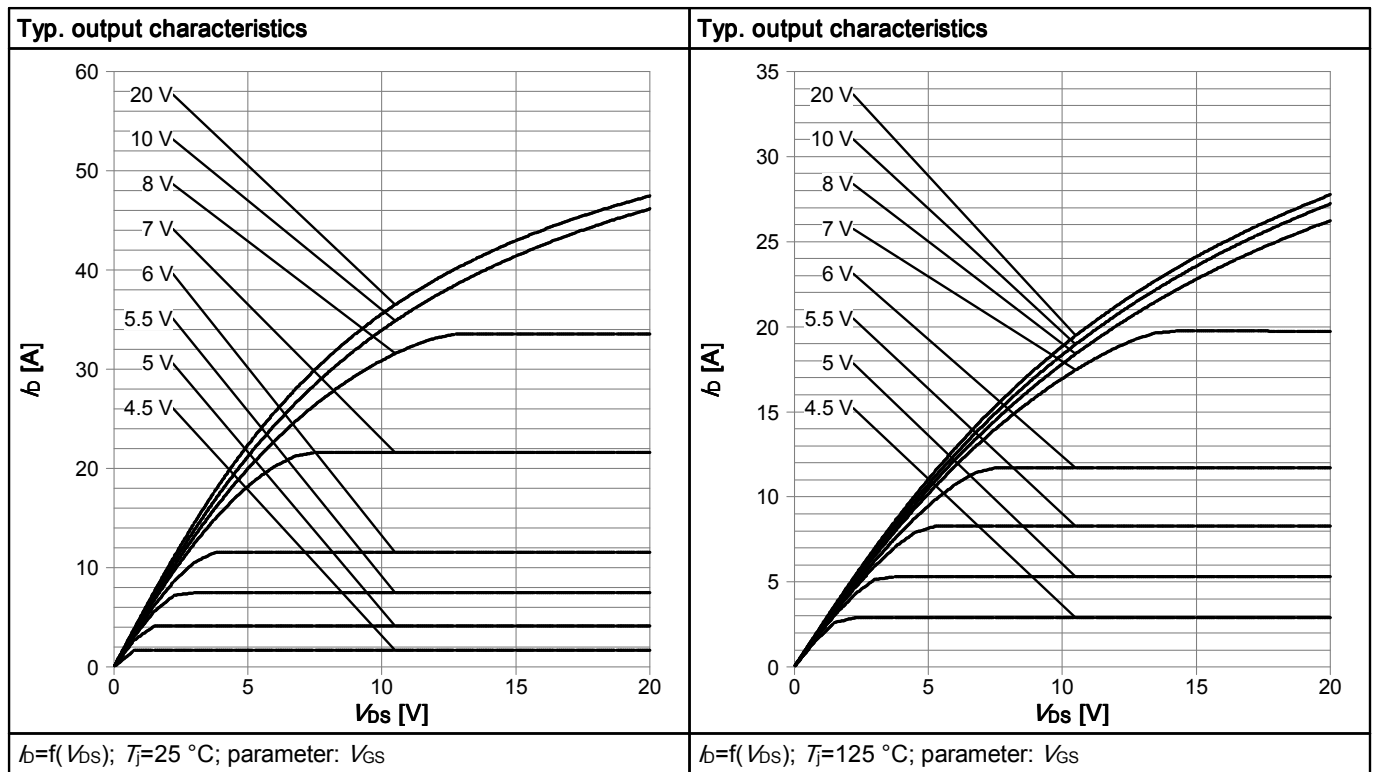


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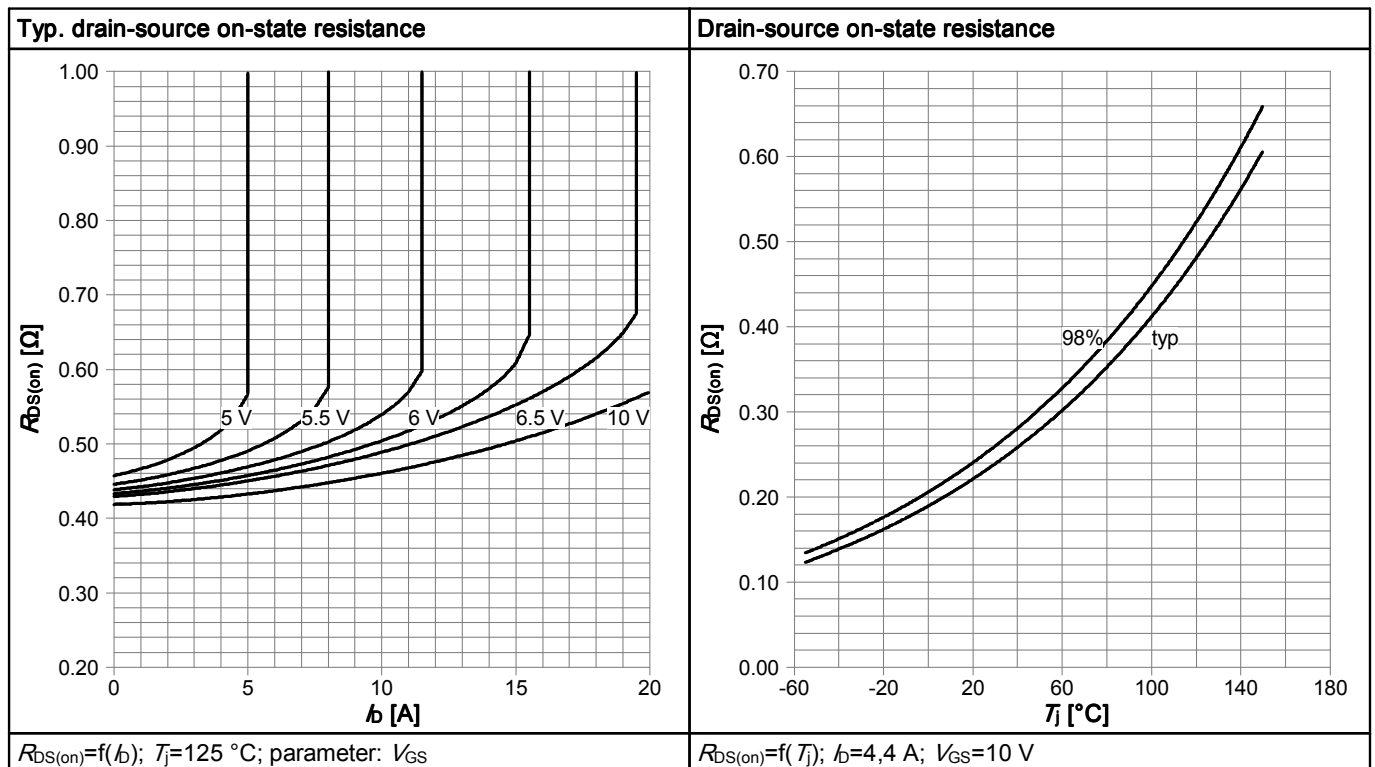


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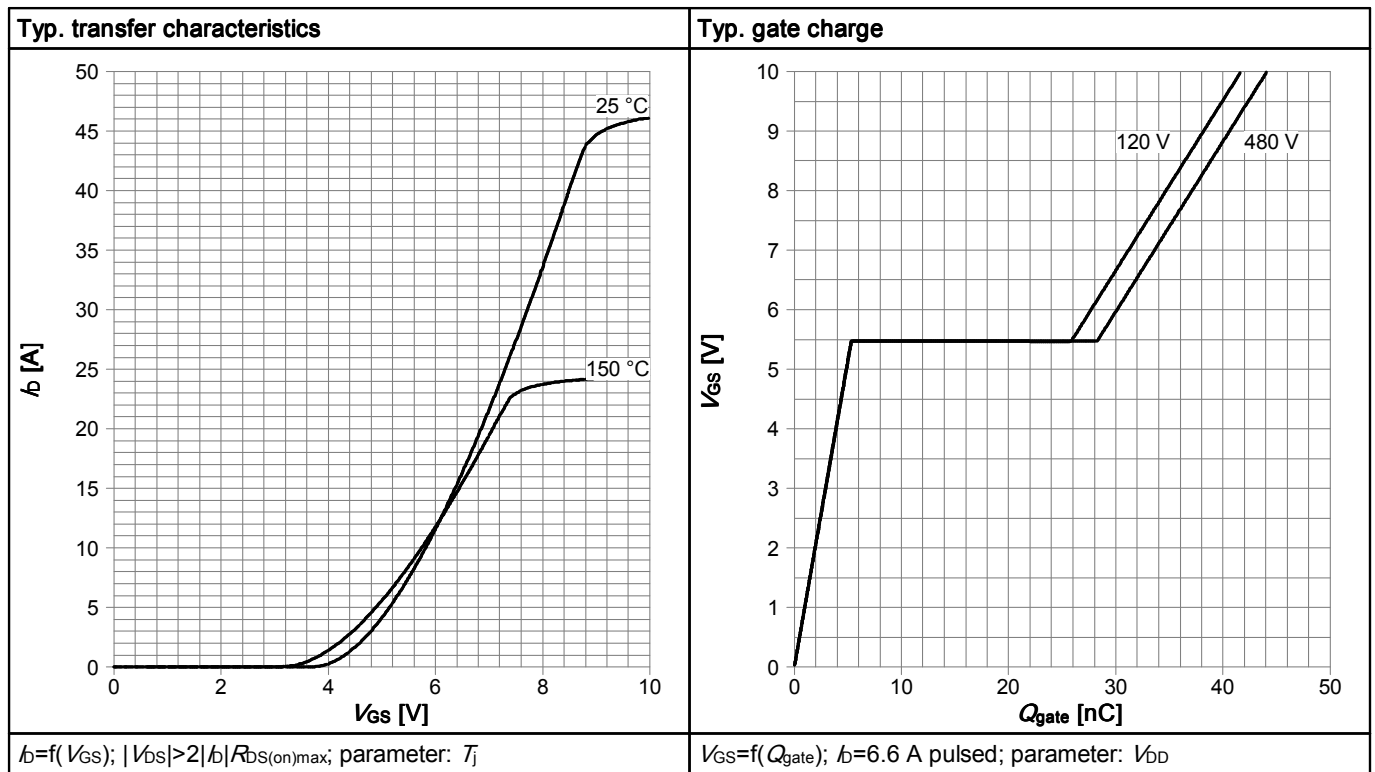


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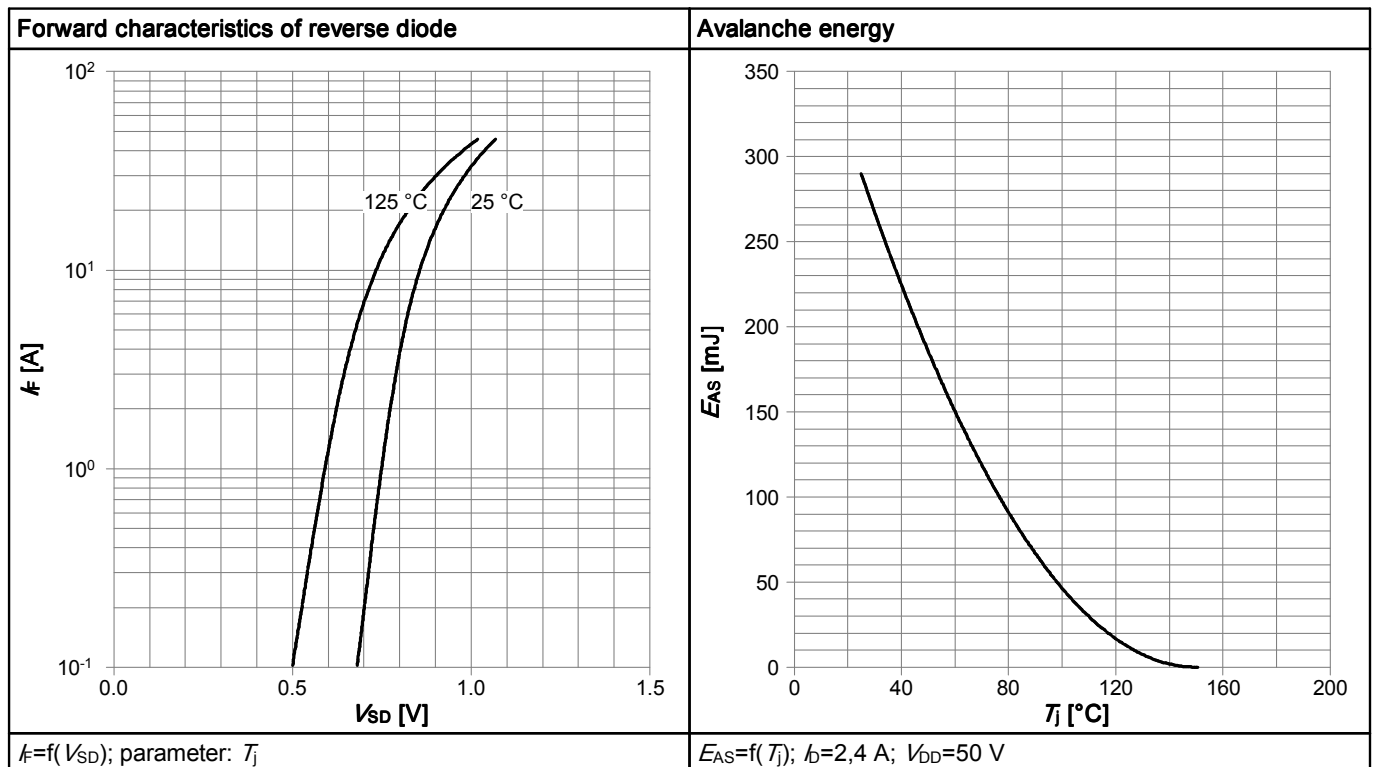


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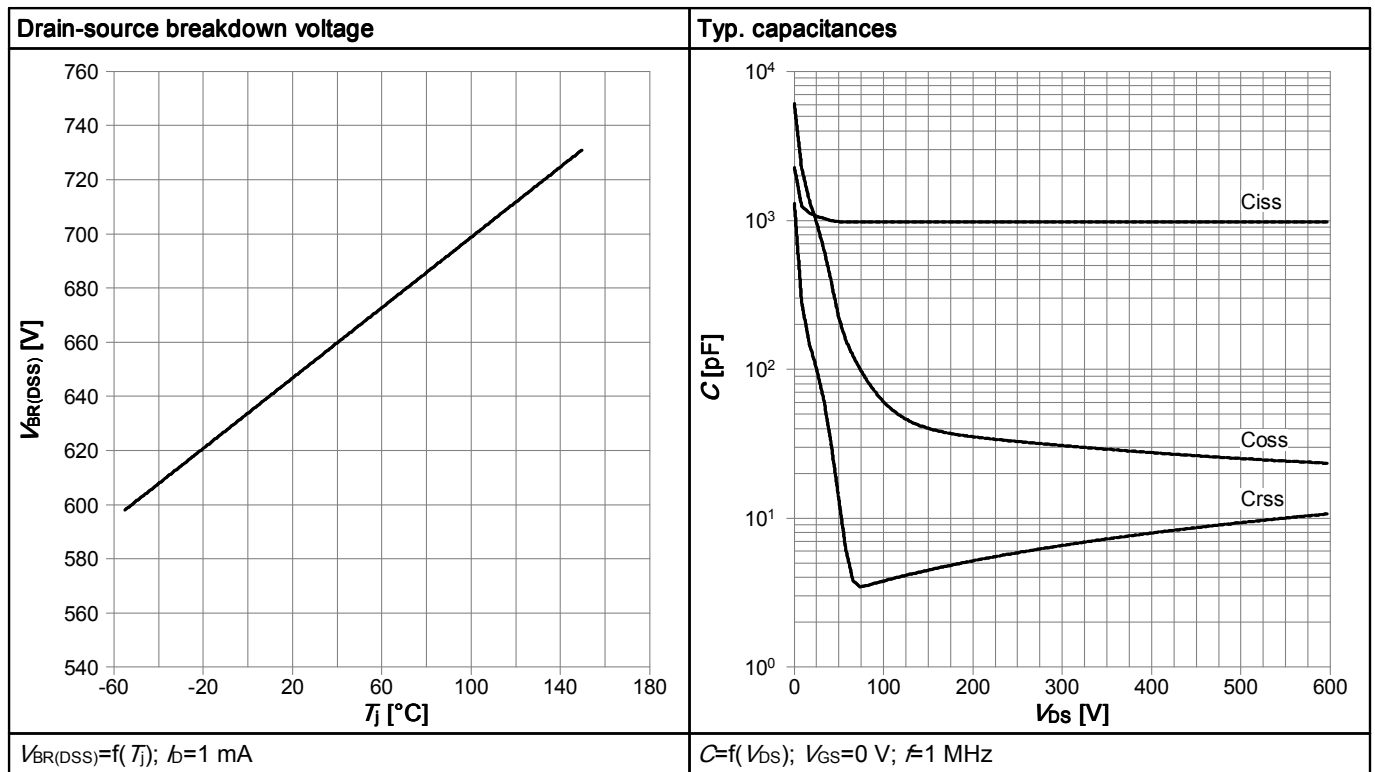
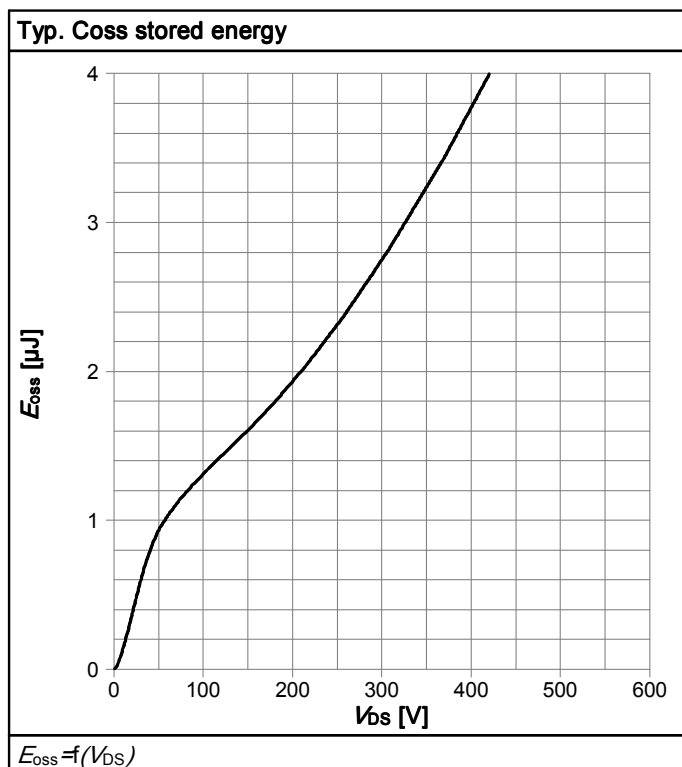


Table 15



6 Test Circuits

Table 16 Diode_characteristics

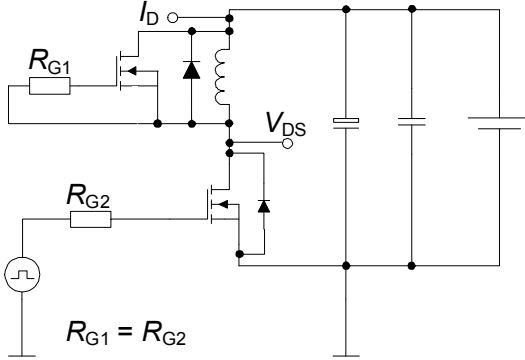
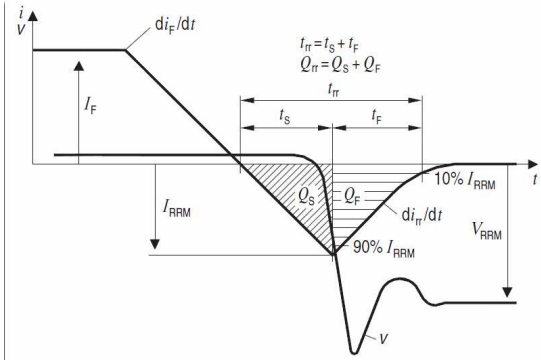
Test circuit for diode characteristics	Diode recovery waveform
 $R_{G1} = R_{G2}$	 $t_{rr} = t_s + t_f$ $Q_{rr} = Q_s + Q_f$

Table 17 Switching_times

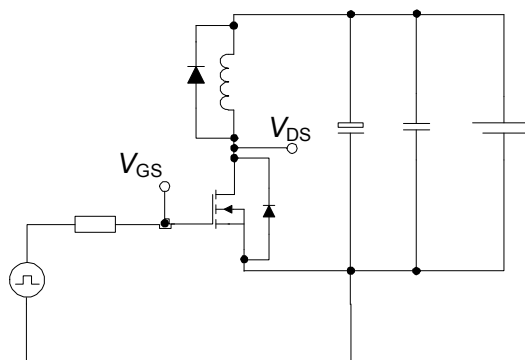
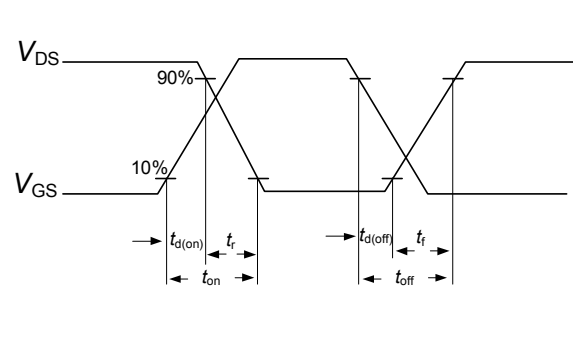
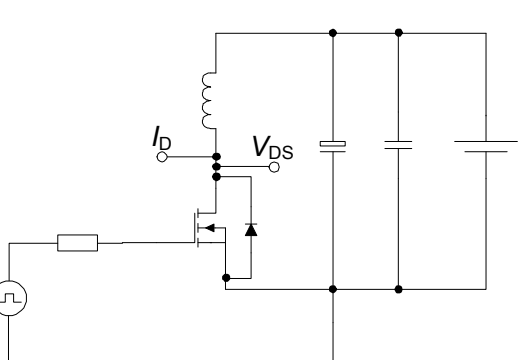
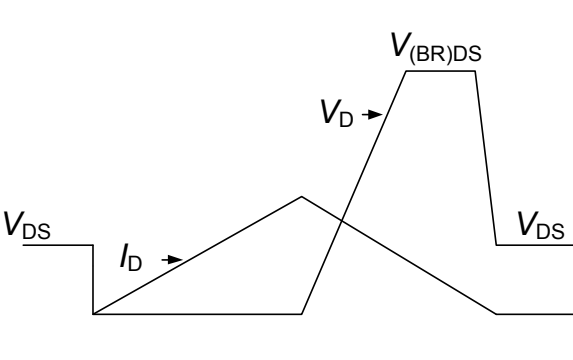
Switching times test circuit for inductive load	Switching times waveform
	

Table 18 Unclamped_inductive

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 Package Outlines

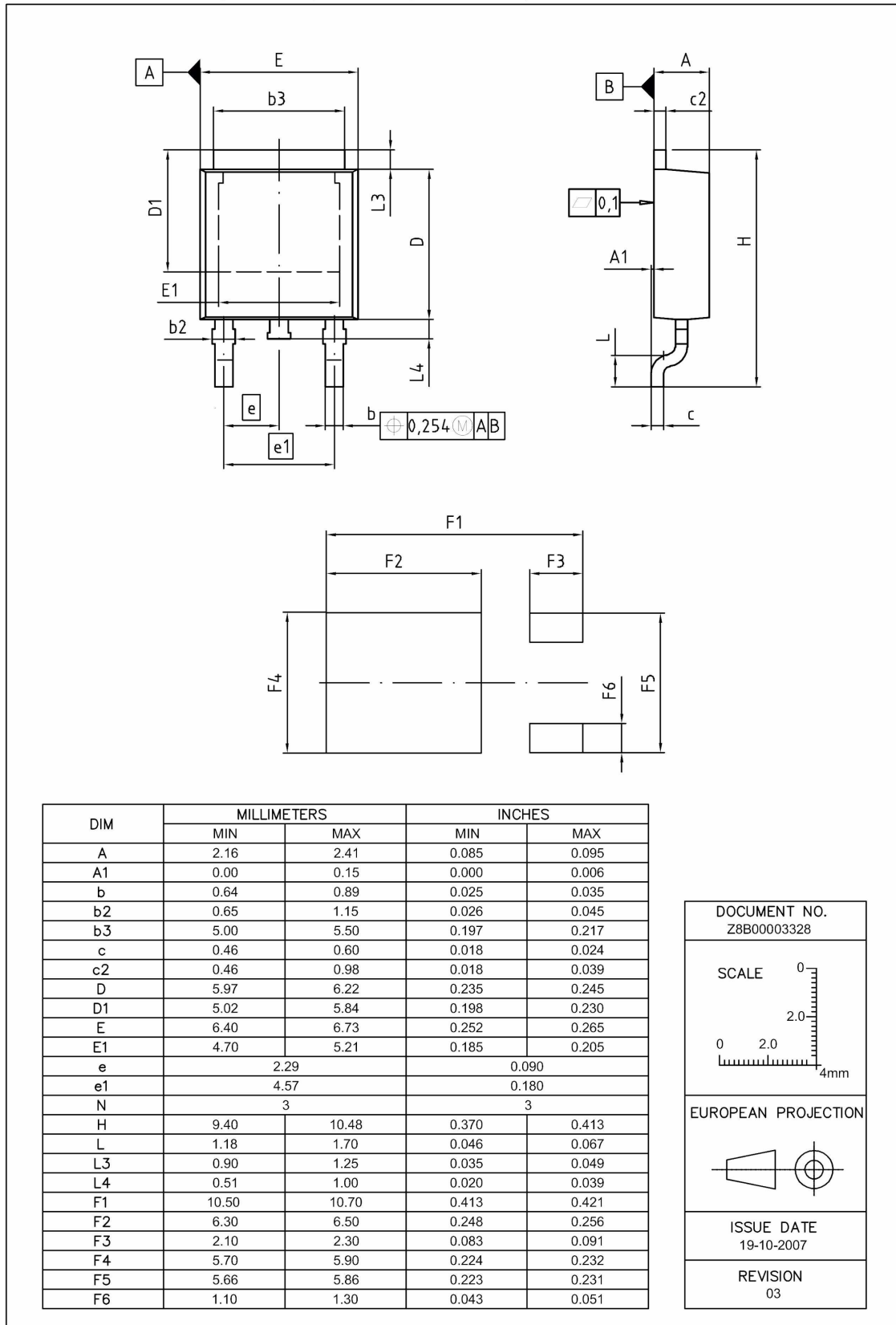


Figure 1 Outline PG-TO 252, dimensions in mm/inches

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>

Revision History

IPD65R250E6

Revision: 2011-07-08, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2011-07-08	release of final datasheet

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