

# MOSFET

Metal Oxide Semiconductor Field Effect Transistor

## CoolMOS™ CFD2 650V

650V CoolMOS™ CFD2 Power Transistor  
IPW65R041CFD

## Data Sheet

Rev. 2.0  
Final

Industrial & Multimarket

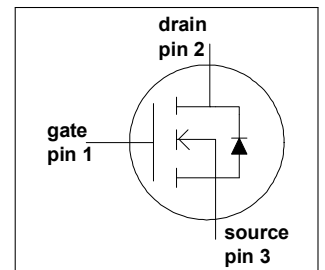
## 1 Description

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. 650V CoolMOS™ CFD2 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  $R_{ds(on)} \cdot Q_g$  and  $E_{oss}$
- Easy to use/drive
- Pb-free plating, Halogen free mold compound
- Qualified for industrial grade applications according to JEDEC (J-STD20 and JESD22)



## Applications

650V CoolMOS™ CFD2 is especially suitable for resonant switching PWM stages for e.g. PC Silverbox, LCD TV, Lighting, Server, Telecom 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
$R_{DS(on),max}$	0.041	$\Omega$
$Q_g,typ$	300	nC
$I_D,pulse$	255	A
$E_{oss} @ 400V$	22.5	$\mu J$
Body diode $di/dt$	900	A/ $\mu s$
$Q_{rr}$	1.9	$\mu C$
$t_{rr}$	250	ns
$I_{rrm}$	15	A

Type / Ordering Code	Package	Marking	Related Links
IPW65R041CFD	PG-TO 247	65F6041	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 <sup>1)</sup>	$I_D$			68.5	A	$T_C = 25^\circ\text{C}$
				43.3		$T_C = 100^\circ\text{C}$
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$			255	A	$T_C = 25^\circ\text{C}$
Avalanche energy, single pulse	$E_{AS}$			2185	mJ	$t_b = 13.7\text{A}$ , $V_{DD} = 50\text{V}$
Avalanche energy, repetitive	$E_{AR}$			3.31	mJ	$t_b = 13.7\text{A}$ , $V_{DD} = 50\text{V}$
Avalanche current, repetitive	$I_{AR}$			13.7	A	
MOSFET dv/dt ruggedness	dv/dt			50	V/ns	$V_{DS} = 0 \dots 400\text{V}$
Gate source voltage	$V_{GS}$	-20		20	V	static
		-30		30		AC ( $f > 1\text{ Hz}$ )
Power dissipation (non FullPAK) TO-247	$P_{tot}$			500.0	W	$T_C = 25^\circ\text{C}$
Operating and storage temperature	$T_j, T_{stg}$	-55		150	$^\circ\text{C}$	
Mounting torque (non FullPAK) TO-247				60	Ncm	M3 and M3.5 screws
Continuous diode forward current	$I_S$			68.5	A	$T_C = 25^\circ\text{C}$
Diode pulse current	$I_{S,pulse}$			255	A	$T_C = 25^\circ\text{C}$
Reverse diode dv/dt <sup>3)</sup>	dv/dt			50	V/ns	$V_{DS} = 0 \dots 400\text{V}$ , $t_{SD} \leq t_b$ , $T_j = 25^\circ\text{C}$
Maximum diode commutation speed	$di_f/dt$			900	A/ $\mu\text{s}$	

<sup>1)</sup> Limited by  $T_{j\text{ max}}$ .

<sup>2)</sup> Pulse width  $t_p$  limited by  $T_{j\text{ max}}$

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

### 3 Thermal characteristics

**Table 3 Thermal characteristics TO-247**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	$R_{thJC}$			0.25	°C/W	
Thermal resistance, junction - ambient	$R_{thJA}$			62	°C/W	leaded
Soldering temperature, wavesoldering only allowed at leads	$T_{sold}$			260	°C	1.6 mm (0.063 in.) from case for 10s

## 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	$V_{GS(th)}$	3.5	4	4.5	V	$V_{DS} = V_{GS}, I_D = 3.3mA$
Zero gate voltage drain current	$I_{DSS}$			3.5	$\mu A$	$V_{DS} = 650V, V_{GS} = 0V, T_j = 25^\circ C$
			1000			$V_{DS} = 650V, V_{GS} = 0V, T_j = 150^\circ C$
Gate-source leakage current	$I_{GSS}$			100	nA	$V_{GS} = 20V, V_{DS} = 0V$
Drain-source on-state resistance	$R_{DS(on)}$		0.037	0.041	$\Omega$	$V_{GS} = 10V, I_D = 33.1A, T_j = 25^\circ C$
			0.096			$V_{GS} = 10V, I_D = 33.1A, T_j = 150^\circ C$
Gate resistance	$R_G$		0.7		$\Omega$	$f = 1MHz, \text{open drain}$

**Table 5 Dynamic characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	$C_{iss}$		8400		pF	$V_{GS} = 0V, V_{DS} = 100V, f = 1MHz$
Output capacitance	$C_{oss}$		400		pF	
Effective output capacitance, energy related <sup>1)</sup>	$C_{o(er)}$		288		pF	$V_{GS} = 0V, V_{DS} = 0 \dots 400V$
Effective output capacitance, time related <sup>2)</sup>	$C_{o(tr)}$		1485		pF	$I_D = \text{constant}, V_{GS} = 0V, V_{DS} = 0 \dots 400V$
Turn-on delay time	$t_{d(on)}$		34		ns	$V_{DD} = 400V, V_{GS} = 13V, I_D = 49.6A, R_G = 1.8\Omega$
Rise time	$t_r$		28		ns	
Turn-off delay time	$t_{d(off)}$		127		ns	
Fall time	$t_f$		8		ns	

**Table 6 Gate charge characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	$Q_{gs}$		54		nC	$V_{DD} = 480V, I_D = 49.6A, V_{GS} = 0 \text{ to } 10V$
Gate to drain charge	$Q_{gd}$		165		nC	
Gate charge total	$Q_g$		300		nC	
Gate plateau voltage	$V_{plateau}$		6.5		V	

<sup>1)</sup>  $C_{o(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 400V

<sup>2)</sup>  $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 400V

**Table 7 Reverse diode characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	$V_{SD}$		1		V	$V_{GS} = 0V, I_F = 49.6A, T_j = 25^\circ C$
Reverse recovery time	$t_{rr}$		250		ns	$V_R = 400V, I_F = 49.6A, dI/dt = 100A/\mu s$
Reverse recovery charge	$Q_{rr}$		1.9		$\mu C$	
Peak reverse recovery current	$I_{rrm}$		15		A	

## 5 Electrical characteristics diagrams

Table 8

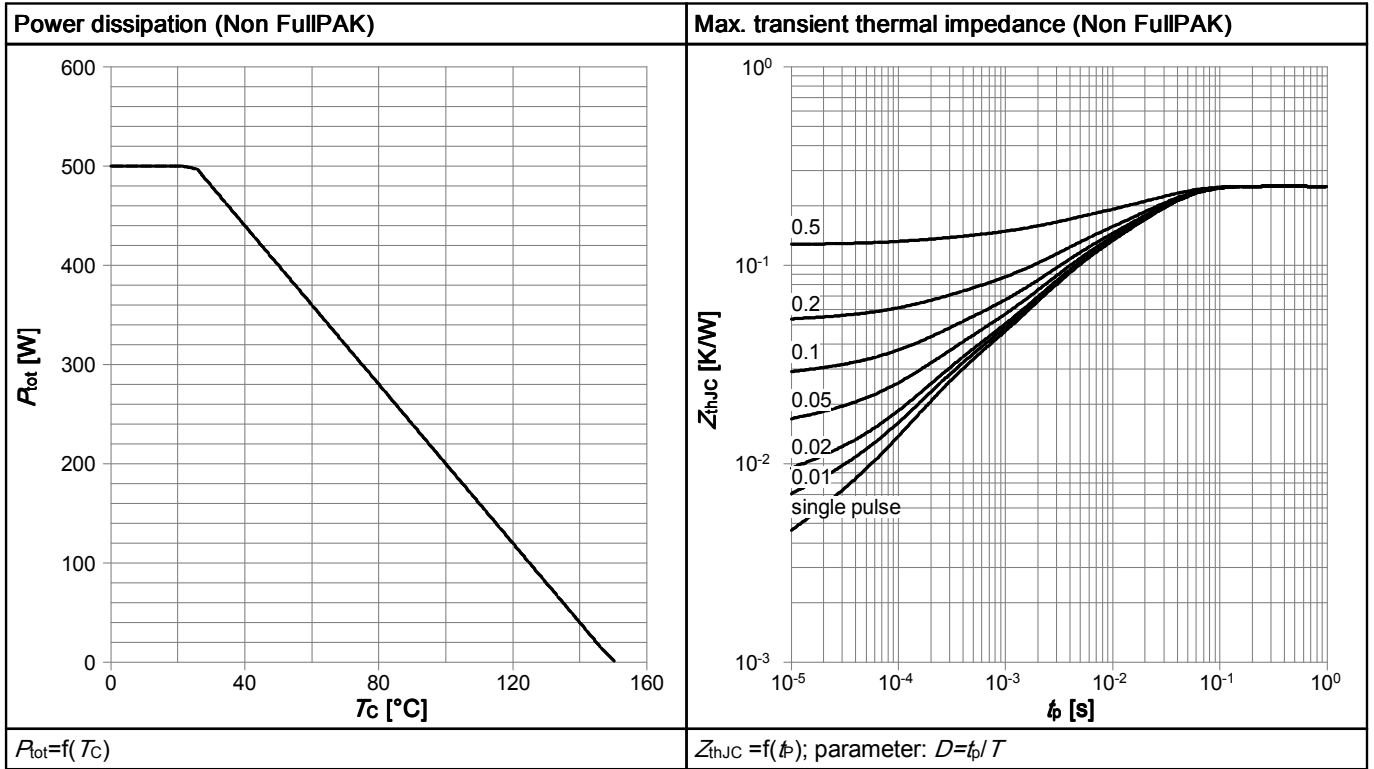


Table 9

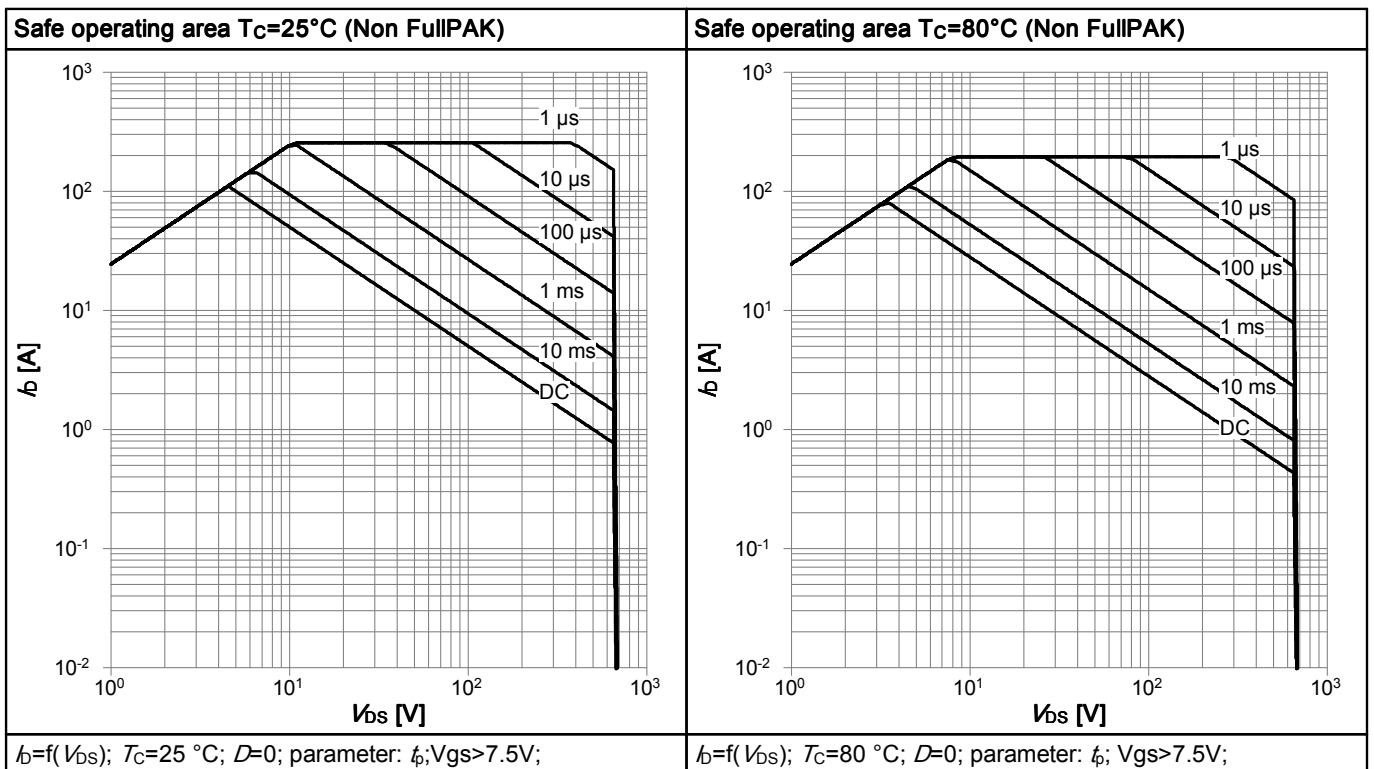




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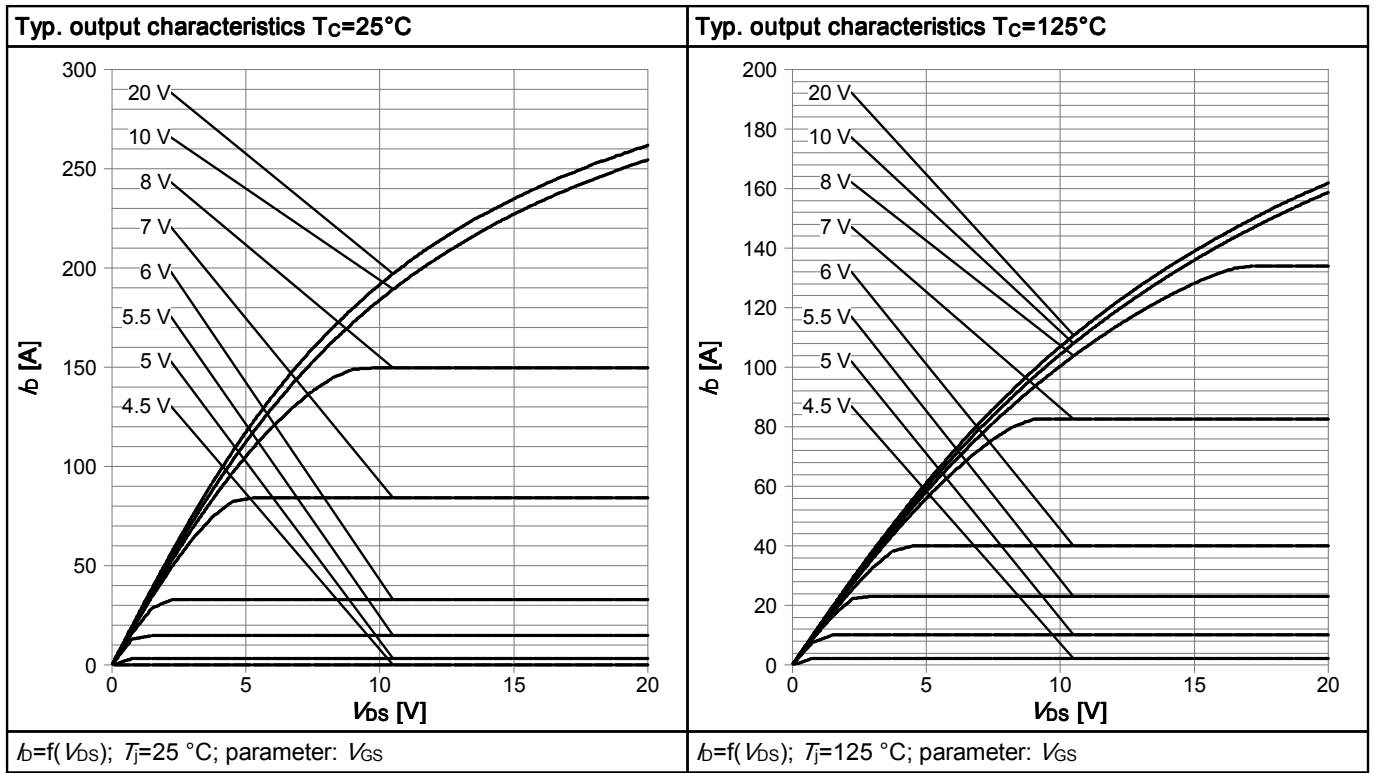


Table 11

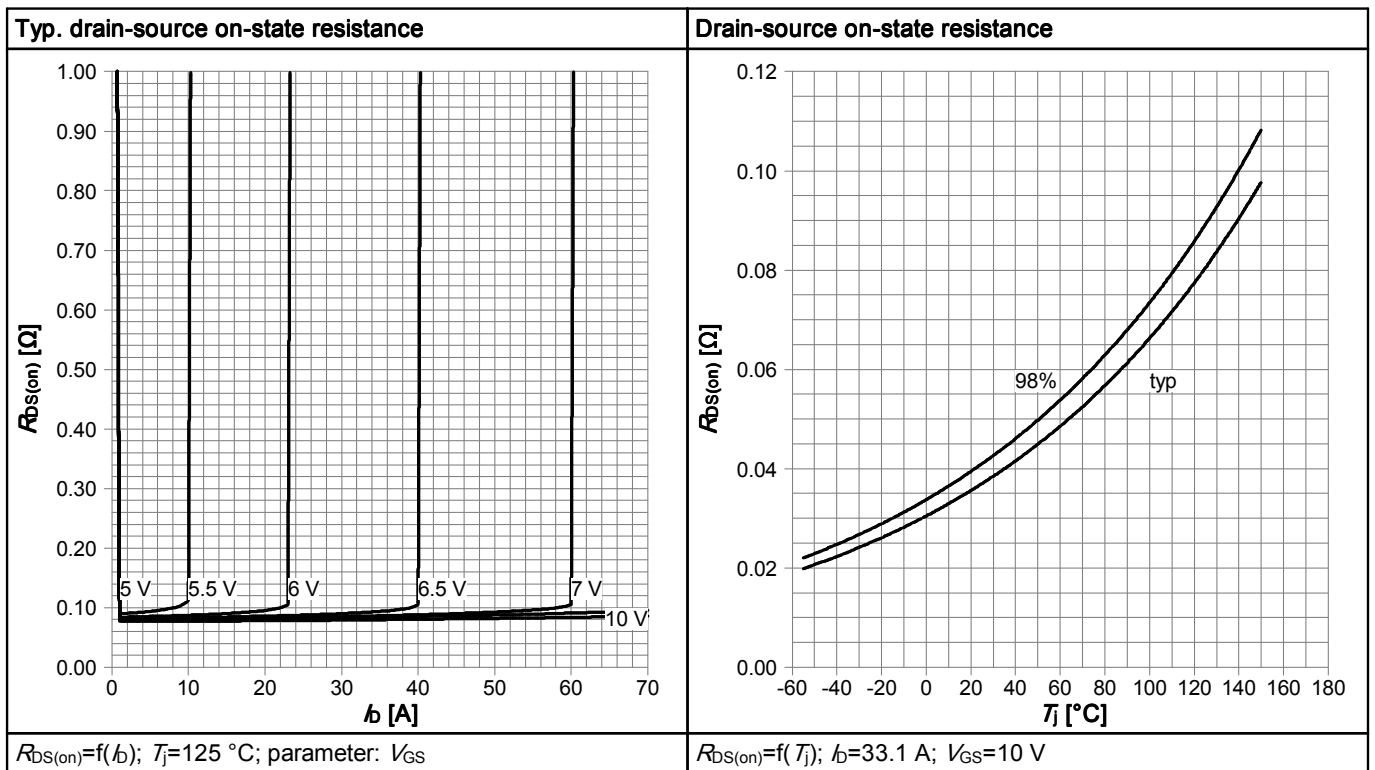


Table 12

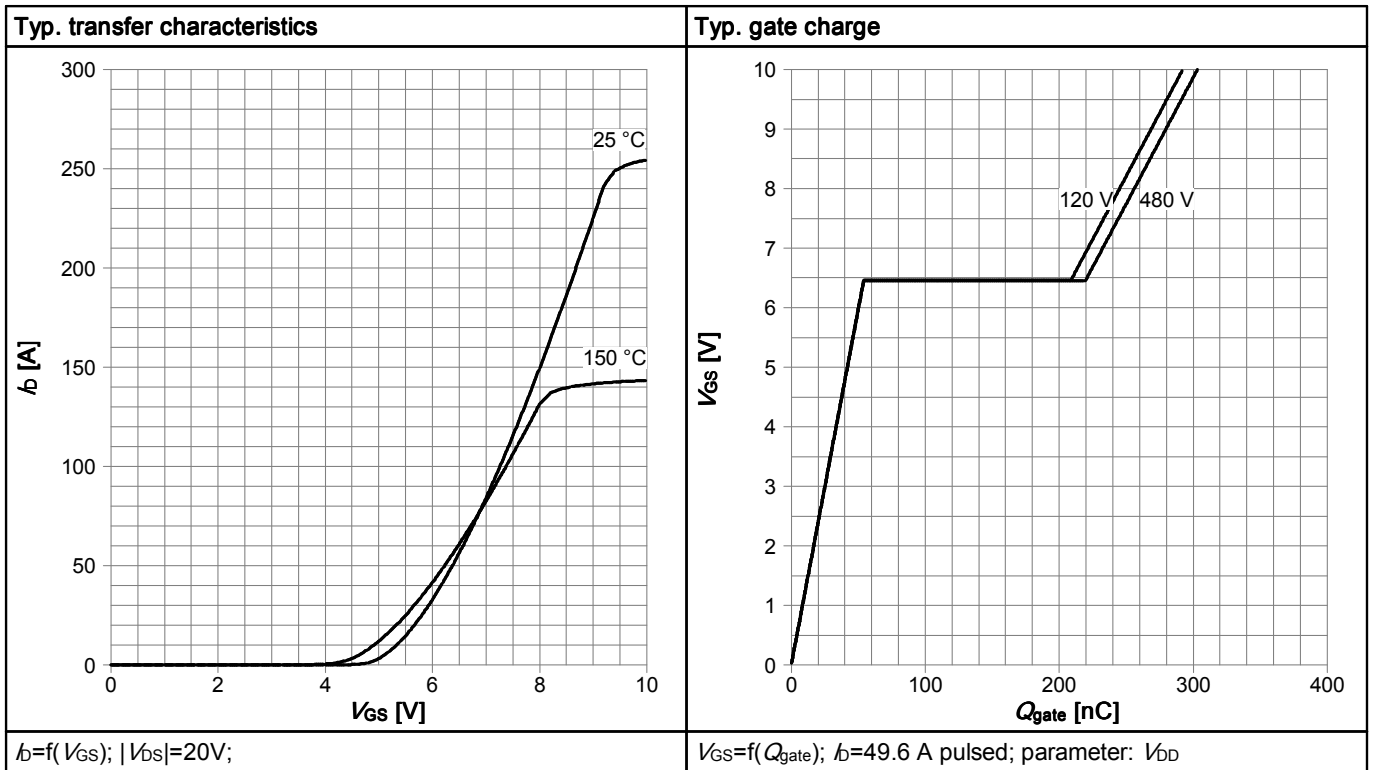


Table 13

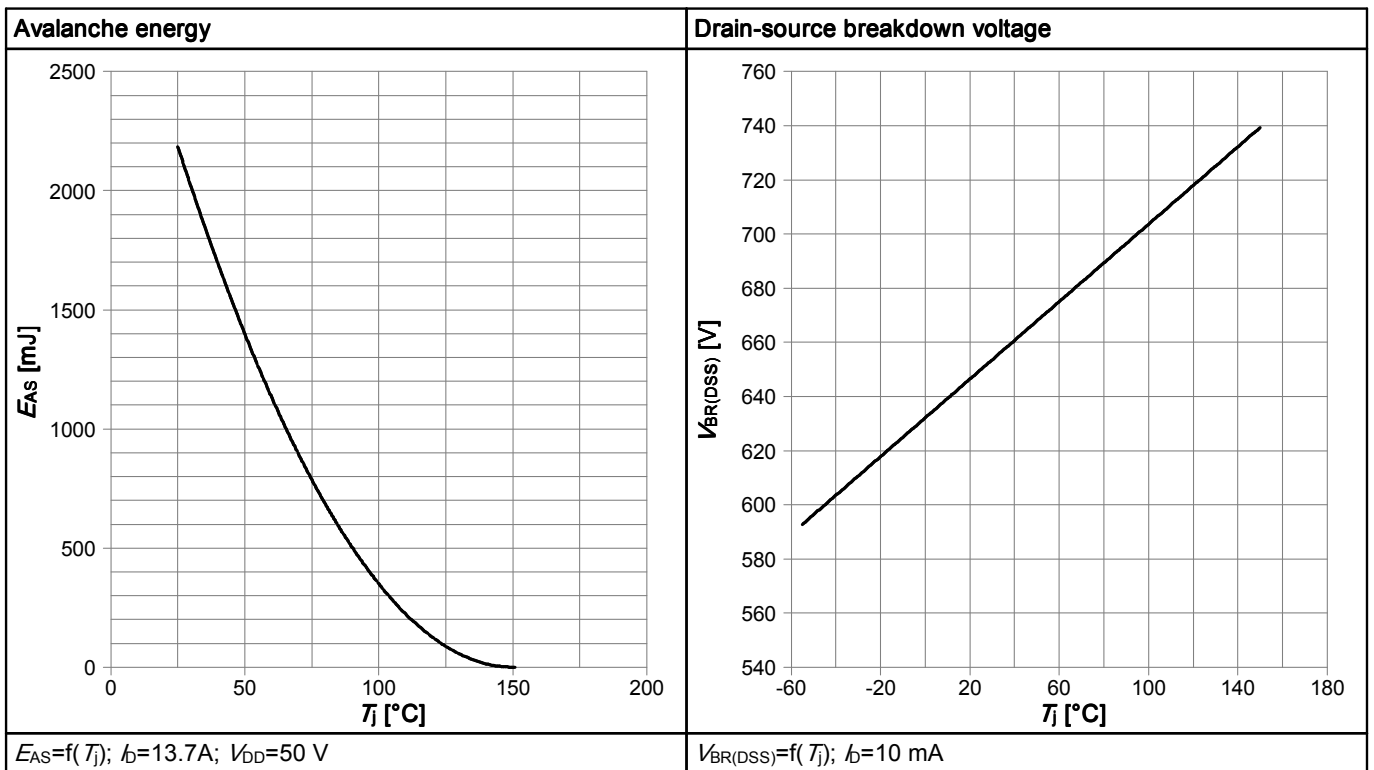


Table 14

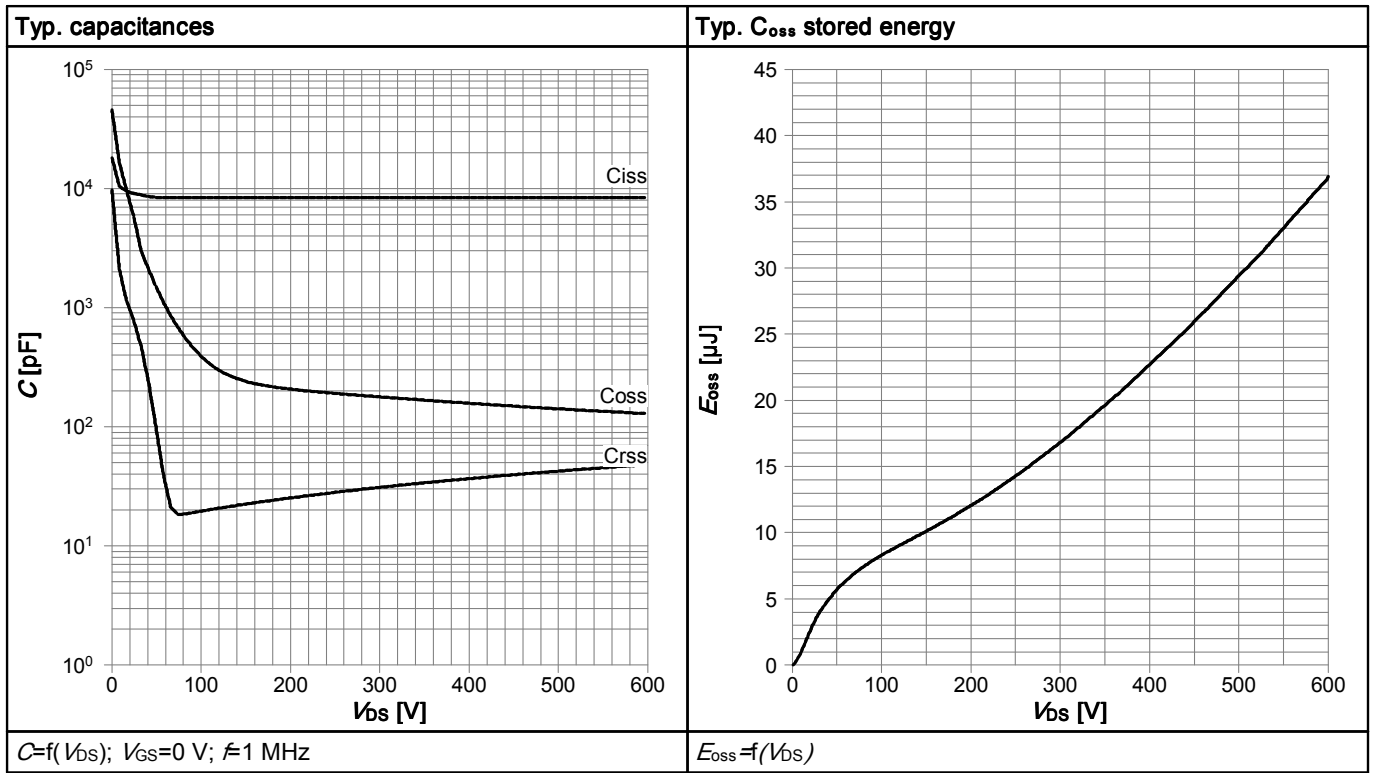
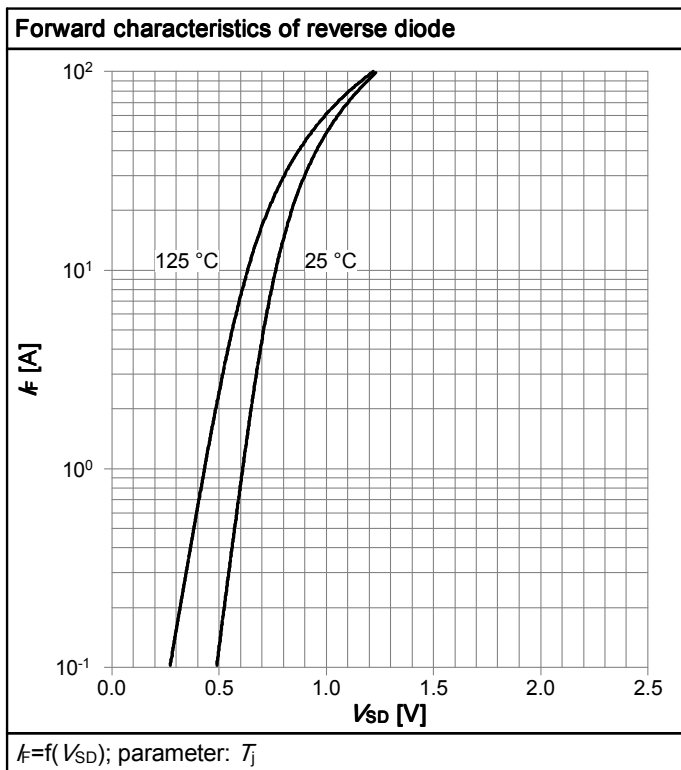
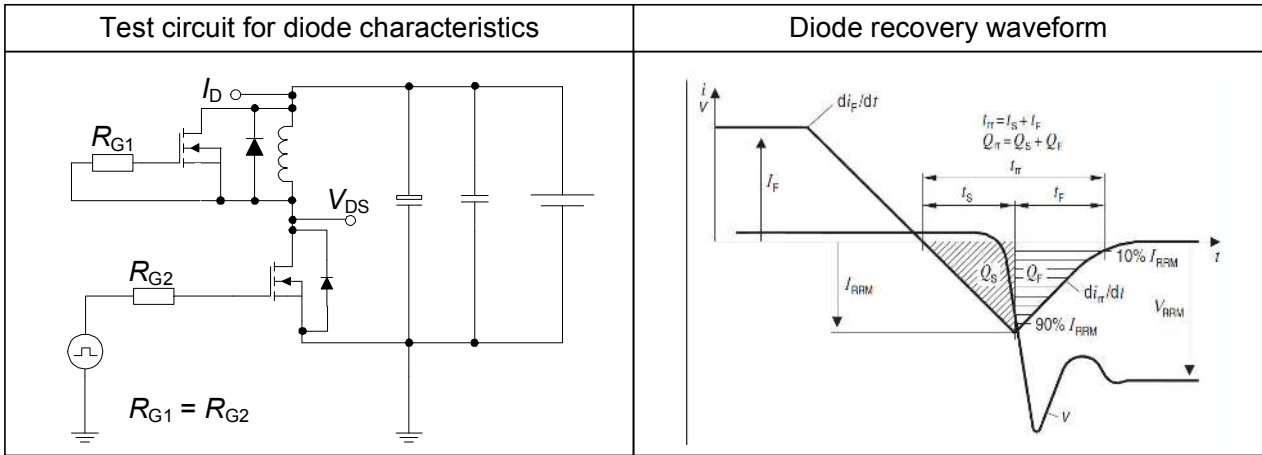


Table 15

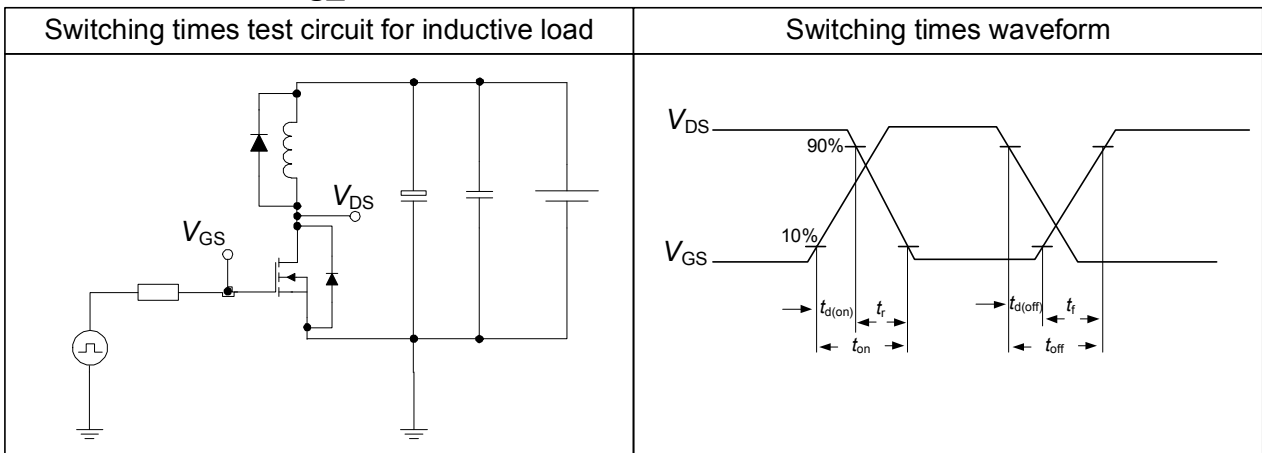


## 6 Test Circuits

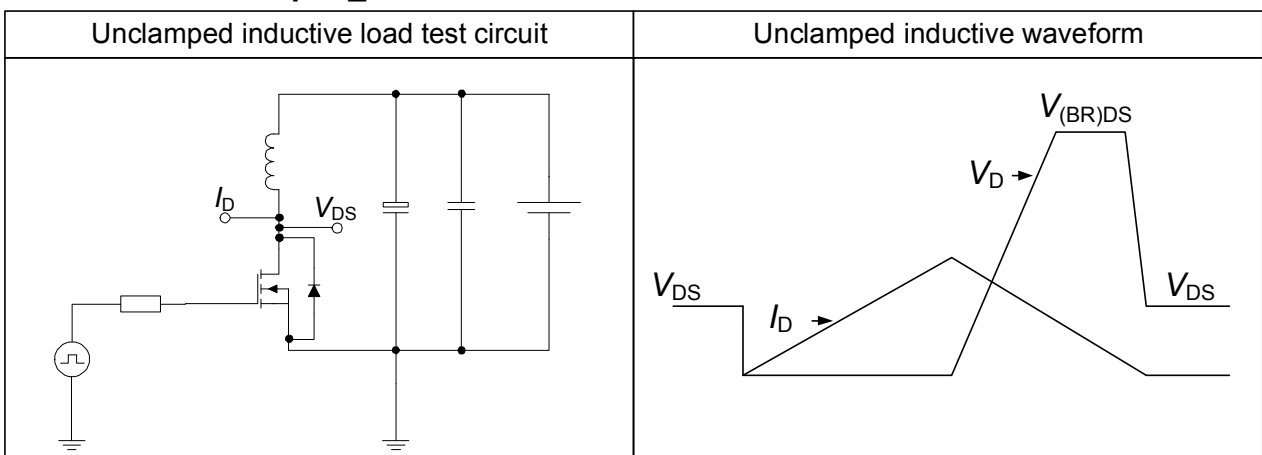
**Table 16 Diode\_characteristics**



**Table 17 Switching\_times**



**Table 18 Unclamped\_inductive**



### 7 Package Outlines

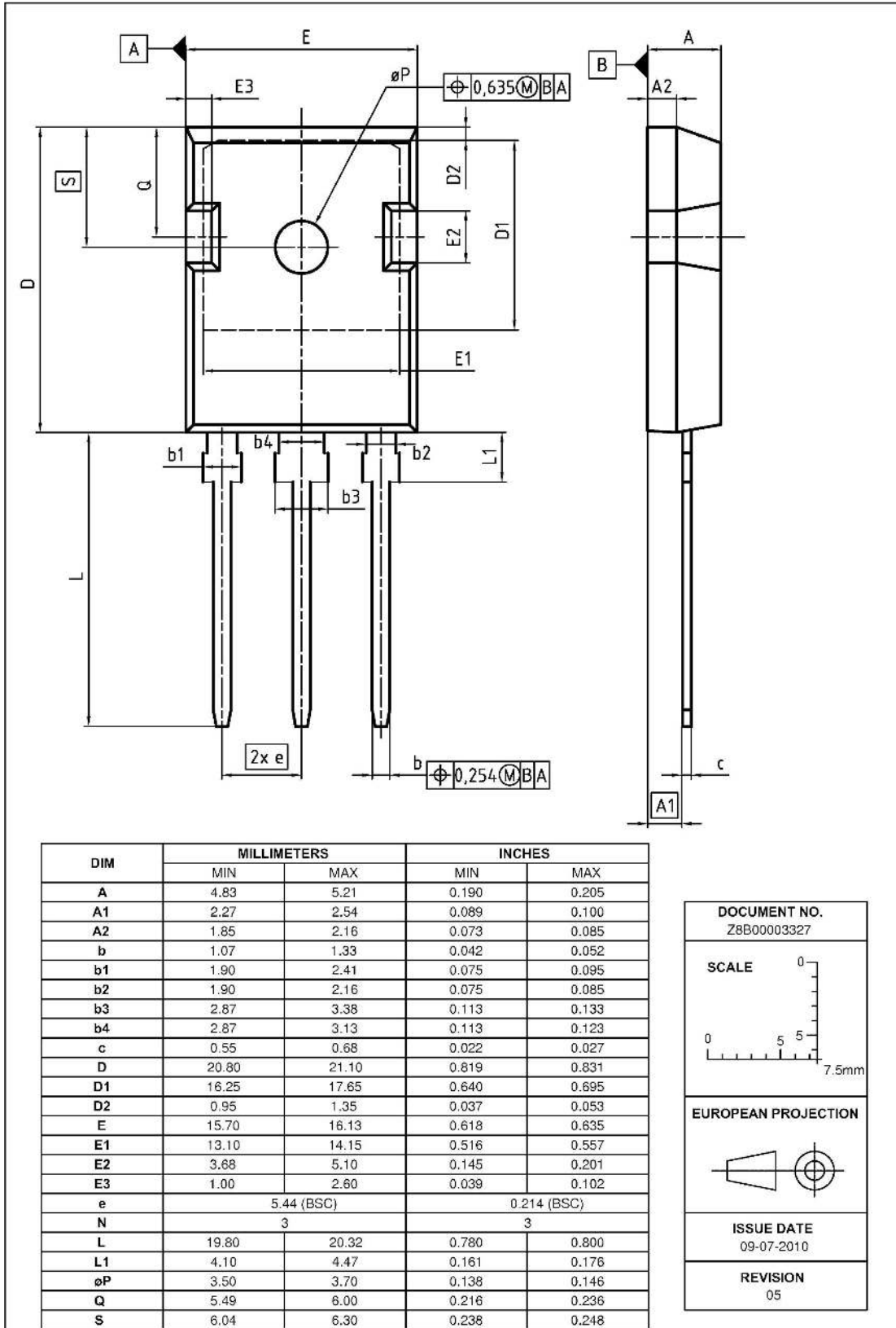


Figure 1 Outline PG-TO 247, dimensions in mm/inches

## 8 Appendix A

### Table 19 Related Links

- **IFX Design Tools:**  
<http://www.infineon.com/cms/en/product/promopages/designtools/index.html>
- **IFX CoolMOS Webpage:**  
<http://www.infineon.com/cms/en/product/channel.html?channel=ff80808112ab681d0112ab6a628704d8>

## Revision History

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IPW65R041CFD

**Revision: 2011-10-13, Rev. 2.0**

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Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2011-10-13	release of final datasheet

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