

# MOSFET

Metal Oxide Semiconductor Field Effect Transistor

## CoolMOS™ CE

500V CoolMOS™ CE Power Transistor  
IPx50R500CE

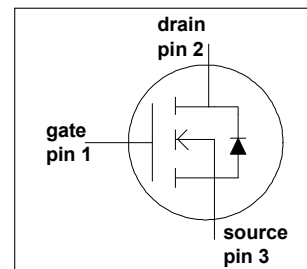
## Data Sheet

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. CoolMOS™ CE series combines the experience of the leading SJ MOSFET supplier with high class innovation while representing a cost appealing alternative compared to standard MOSFETs in target applications. 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, LCD & PDP TV and Lighting.



**Table 1 Key Performance Parameters**

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	550	V
$R_{DS(on),max}$	0.5	$\Omega$
$Q_{g,typ}$	18.7	nC
$I_{D,pulse}$	24	A
$E_{oss@400V}$	2.02	$\mu J$
Body diode $di/dt$	500	A/ $\mu s$

Type / Ordering Code	Package	Marking	Related Links
IPP50R500CE	PG-TO 220	5R500CE	see Appendix A
IPA50R500CE	PG-TO 220 FullPAK		



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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>	$I_D$	-	-	7.6 4.8	A	$T_C = 25^\circ\text{C}$ $T_C = 100^\circ\text{C}$
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	-	-	24	A	$T_C = 25^\circ\text{C}$
Avalanche energy, single pulse	$E_{AS}$	-	-	129	mJ	$I_D = 2.9\text{A}$ ; $V_{DD} = 50\text{V}$
Avalanche energy, repetitive	$E_{AR}$	-	-	0.20	mJ	$I_D = 2.9\text{A}$ ; $V_{DD} = 50\text{V}$
Avalanche current, repetitive	$I_{AR}$	-	-	2.9	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	50	V/ns	$V_{DS} = 0 \dots 400\text{V}$
Gate source voltage	$V_{GS}$	-20 -30	-	20 30	V	static; AC ( $f > 1\text{ Hz}$ )
Power dissipation (non FullPAK) TO-220	$P_{tot}$	-	-	57	W	$T_C = 25^\circ\text{C}$
Power dissipation (FullPAK) TO-220FP	$P_{tot}$	-	-	28	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-220	-	-	-	60	Ncm	M3 and M3.5 screws
Mounting torque (FullPAK) TO-220FP	-	-	-	50	Ncm	M2.5 screws
Continuous diode forward current	$I_S$	-	-	6.6	A	$T_C = 25^\circ\text{C}$
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$	-	-	24.0	A	$T_C = 25^\circ\text{C}$
Reverse diode dv/dt <sup>3)</sup>	dv/dt	-	-	15	V/ns	$V_{DS} = 0 \dots 400\text{V}$ , $I_{SD} \leq I_S$ , $T_j = 25^\circ\text{C}$ , $t_{cond} < 2\mu\text{s}$
Maximum diode commutation speed <sup>3)</sup>	di/dt	-	-	500	A/ $\mu\text{s}$	$V_{DS} = 0 \dots 400\text{V}$ , $I_{SD} \leq I_S$ , $T_j = 25^\circ\text{C}$ , $t_{cond} < 2\mu\text{s}$
Insulation withstand voltage for TO-220 FullPAK	$V_{ISO}$	-	-	2500	V	$V_{rms}$ , $T_C = 25^\circ\text{C}$ , $t = 1\text{min}$

## 3 Thermal characteristics

**Table 3 Thermal characteristics (non FullPAK) TO-220**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	$R_{thJC}$	-	-	2.19	$^\circ\text{C/W}$	-
Thermal resistance, junction - ambient	$R_{thJA}$	-	-	62	$^\circ\text{C/W}$	leaded
Soldering temperature, wavesoldering only allowed at leads	$T_{sold}$	-	-	260	$^\circ\text{C}$	1.6mm (0.063 in.) from case for 10s

<sup>1)</sup> Limited by  $T_{j,max}$ . Maximum duty cycle  $D=0.75$

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

<sup>3)</sup>  $V_{DClink}=400\text{V}$ ;  $V_{DS,peak} < V_{(BR)DSS}$ ; identical low side and high side switch with identical  $R_G$

**Table 4 Thermal characteristics (FullPAK) TO-220FP**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	$R_{thJC}$	-	-	4.46	°C/W	-
Thermal resistance, junction - ambient	$R_{thJA}$	-	-	80	°C/W	leaded
Soldering temperature, wavesoldering only allowed at leads	$T_{sold}$	-	-	260	°C	1.6mm (0.063 in.) from case for 10s

## 4 Electrical characteristics

**Table 5 Static characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	500	-	-	V	$V_{GS}=0V, I_D=1mA$
Gate threshold voltage	$V_{(GS)th}$	2.50	3	3.50	V	$V_{DS}=V_{GS}, I_b=0.2mA$
Zero gate voltage drain current	$I_{DSS}$	-	-	1	μA	$V_{DS}=500V, V_{GS}=0V, T_j=25°C$ $V_{DS}=500V, V_{GS}=0V, T_j=150°C$
Gate-source leakage current	$I_{GSS}$	-	-	100	nA	$V_{GS}=20V, V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.45	0.50	Ω	$V_{GS}=13V, I_D=2.3A, T_j=25°C$ $V_{GS}=13V, I_D=2.3A, T_j=150°C$
Gate resistance	$R_G$	-	3	-	Ω	≠1 MHz, open drain

**Table 6 Dynamic characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	$C_{iss}$	-	433	-	pF	$V_{GS}=0V, V_{DS}=100V, f=1MHz$
Output capacitance	$C_{oss}$	-	31	-	pF	$V_{GS}=0V, V_{DS}=100V, f=1MHz$
Effective output capacitance, energy related <sup>1)</sup>	$C_{o(er)}$	-	25	-	pF	$V_{GS}=0V, V_{DS}=0...400V$
Effective output capacitance, time related <sup>2)</sup>	$C_{o(tr)}$	-	100	-	pF	$I_b=constant, V_{GS}=0V, V_{DS}=0...400V$
Turn-on delay time	$t_{d(on)}$	-	6	-	ns	$V_{DD}=400V, V_{GS}=13V, I_b=2.9A, R_G=3.4Ω$
Rise time	$t_r$	-	5	-	ns	$V_{DD}=400V, V_{GS}=13V, I_b=2.9A, R_G=3.4Ω$
Turn-off delay time	$t_{d(off)}$	-	30	-	ns	$V_{DD}=400V, V_{GS}=13V, I_b=2.9A, R_G=3.4Ω$
Fall time	$t_f$	-	12	-	ns	$V_{DD}=400V, V_{GS}=13V, I_b=2.9A, R_G=3.4Ω$

<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 80%  $V_{(BR)DSS}$ 
<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 80%  $V_{(BR)DSS}$

**Table 7 Gate charge characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	$Q_{gs}$	-	2.3	-	nC	$V_{DD}=400V, I_D=2.9A, V_{GS}=0$ to 10V
Gate to drain charge	$Q_{gd}$	-	10	-	nC	$V_{DD}=400V, I_D=2.9A, V_{GS}=0$ to 10V
Gate charge total	$Q_g$	-	18.7	-	nC	$V_{DD}=400V, I_D=2.9A, V_{GS}=0$ to 10V
Gate plateau voltage	$V_{plateau}$	-	5.3	-	V	$V_{DD}=400V, I_D=2.9A, V_{GS}=0$ to 10V

**Table 8 Reverse diode characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	$V_{SD}$	-	0.85	-	V	$V_{GS}=0V, I_F=2.9A, T_f=25^\circ C$
Reverse recovery time	$t_{rr}$	-	180	-	ns	$V_R=400V, I_F=2.9A, di_F/dt=100A/\mu s$
Reverse recovery charge	$Q_{rr}$	-	1.2	-	$\mu C$	$V_R=400V, I_F=2.9A, di_F/dt=100A/\mu s$
Peak reverse recovery current	$I_{rrm}$	-	12	-	A	$V_R=400V, I_F=2.9A, di_F/dt=100A/\mu s$

## 5 Electrical characteristics diagrams

Table 9

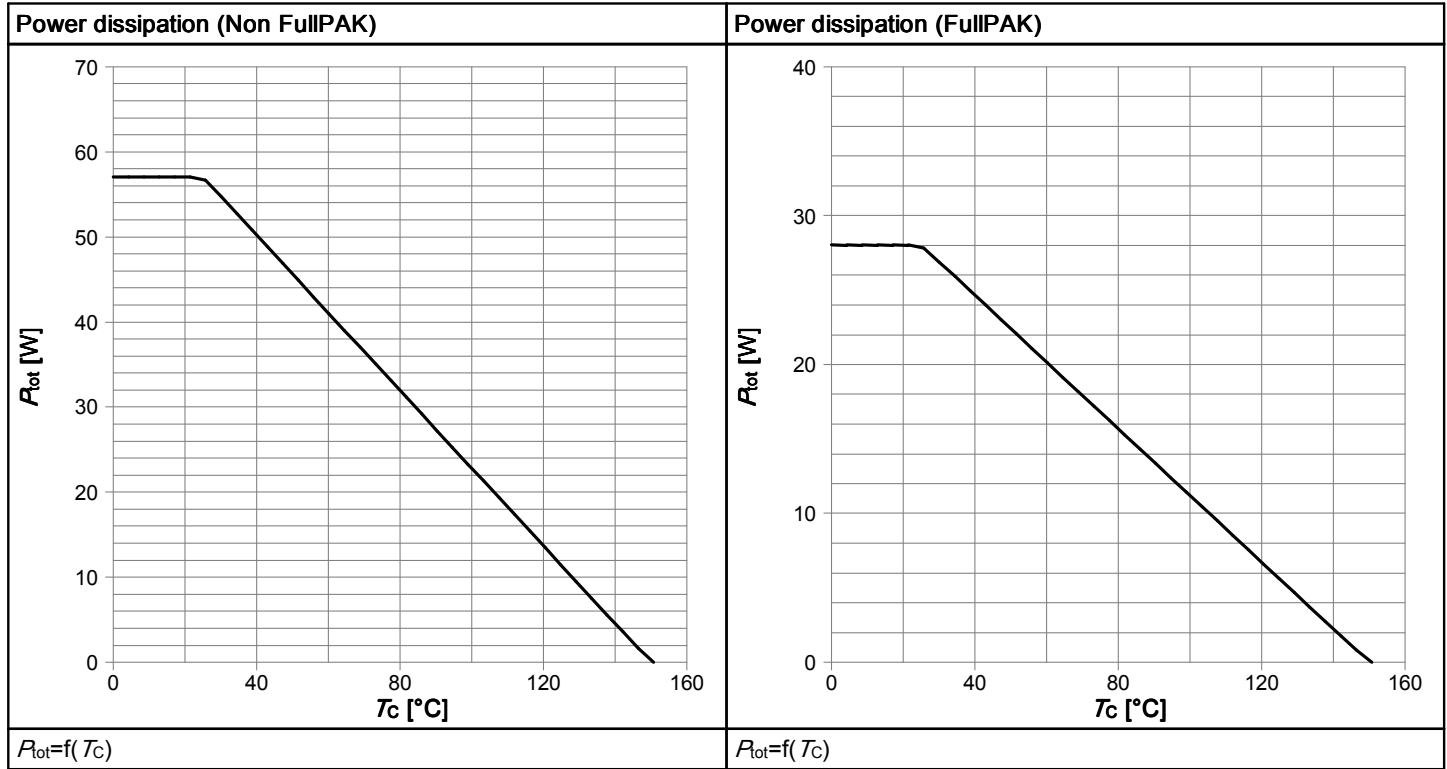


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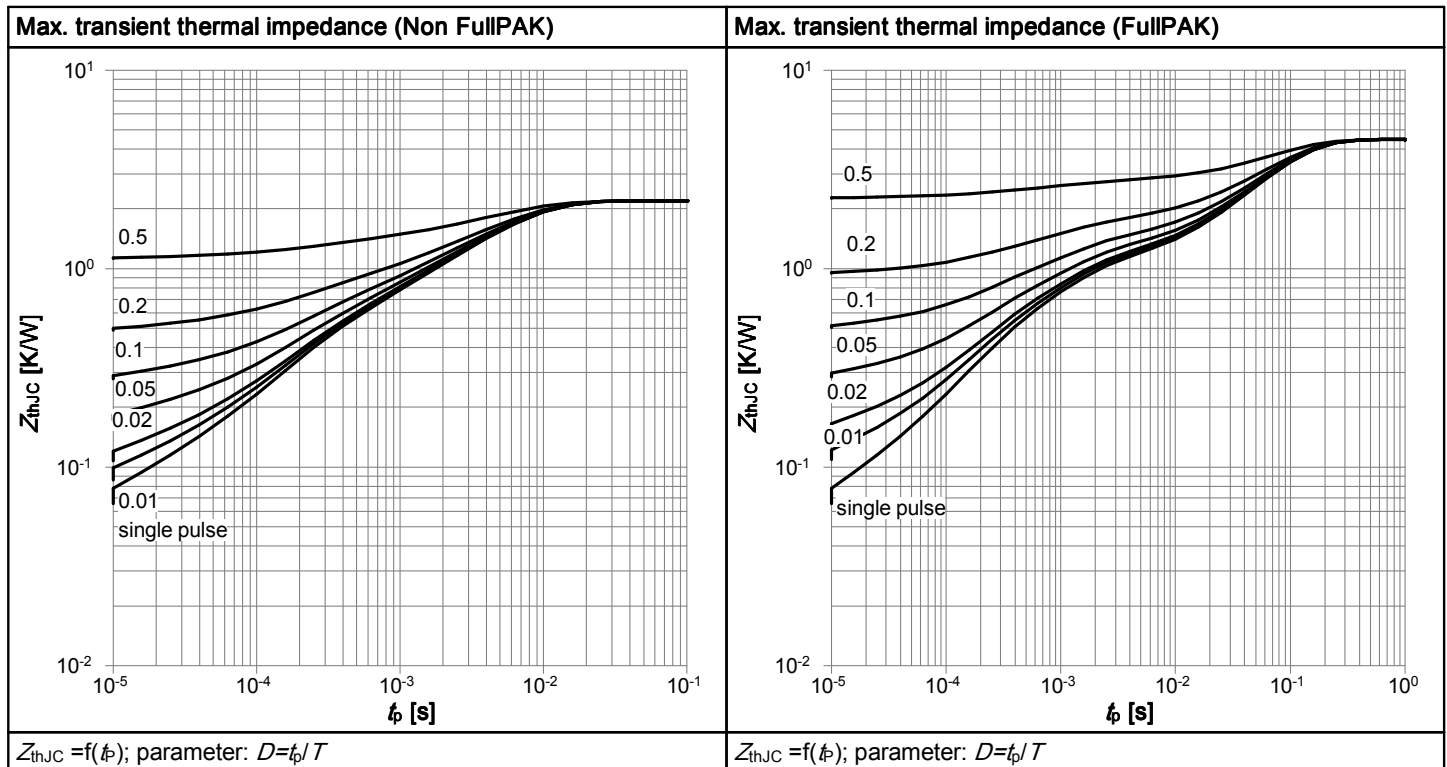


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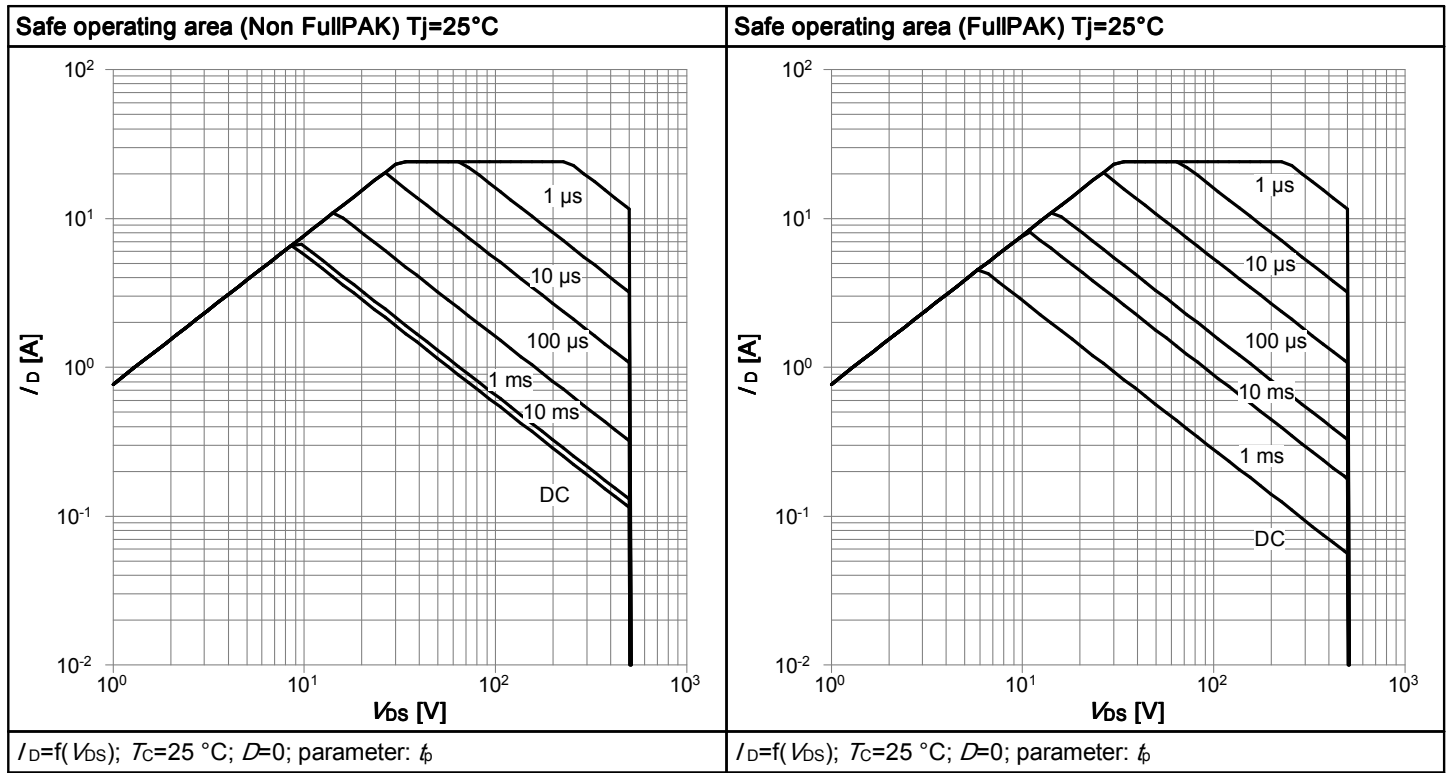


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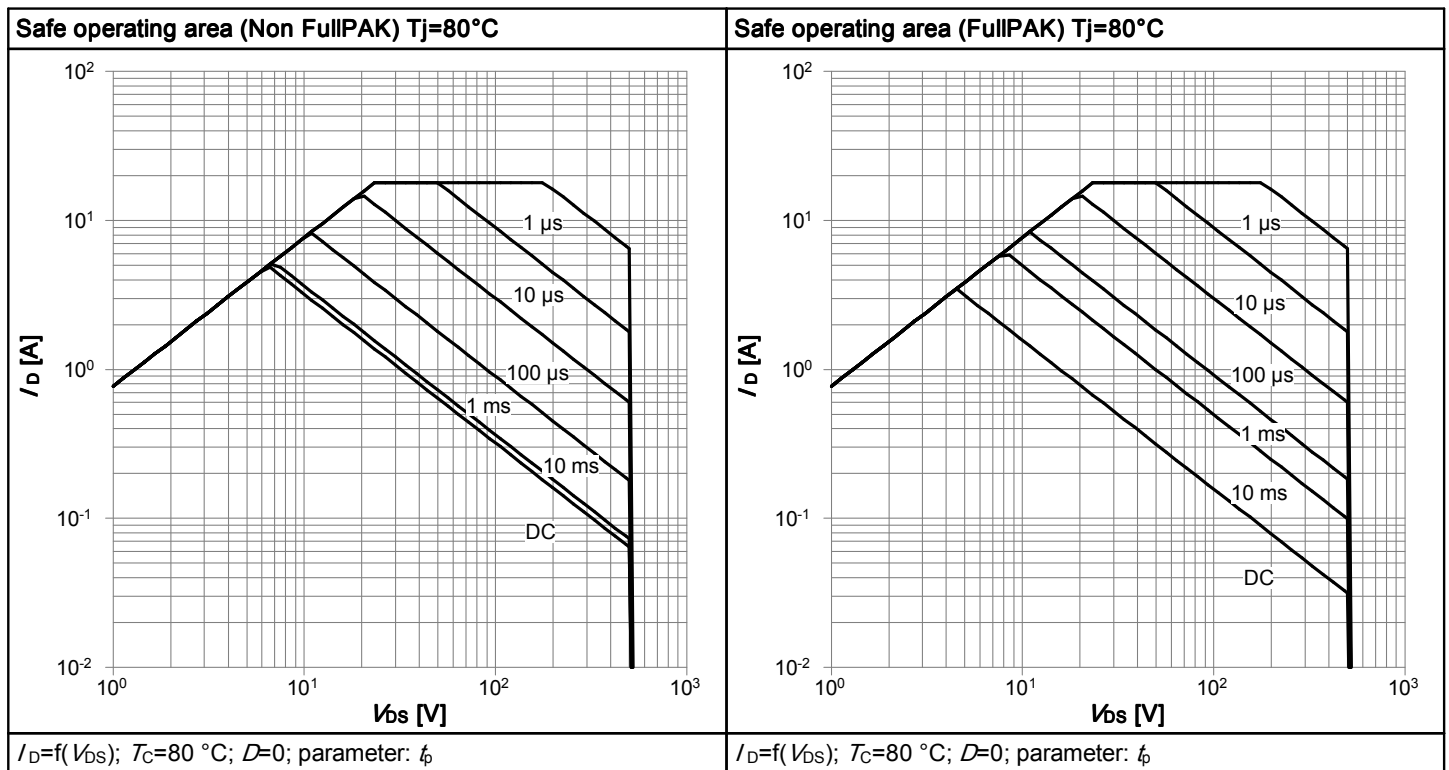




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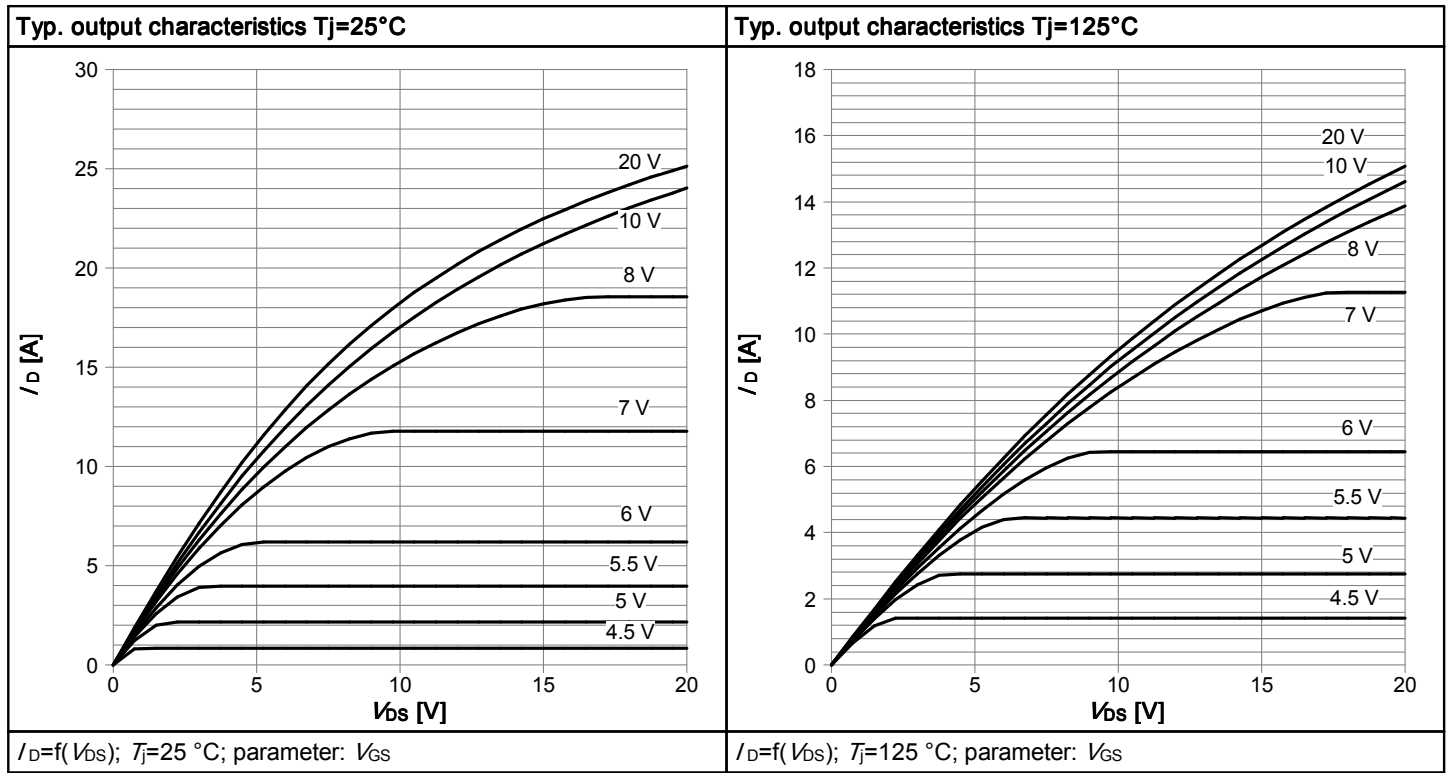


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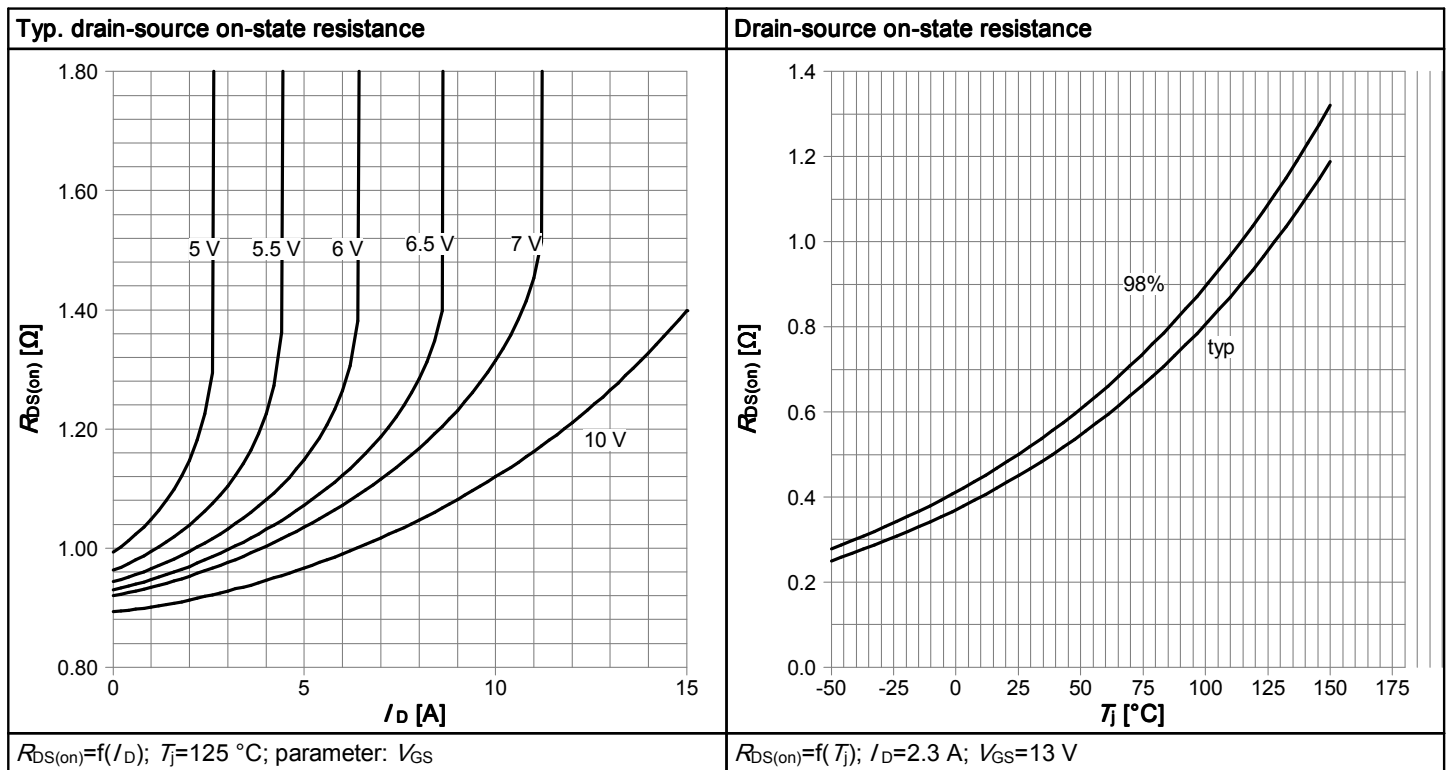


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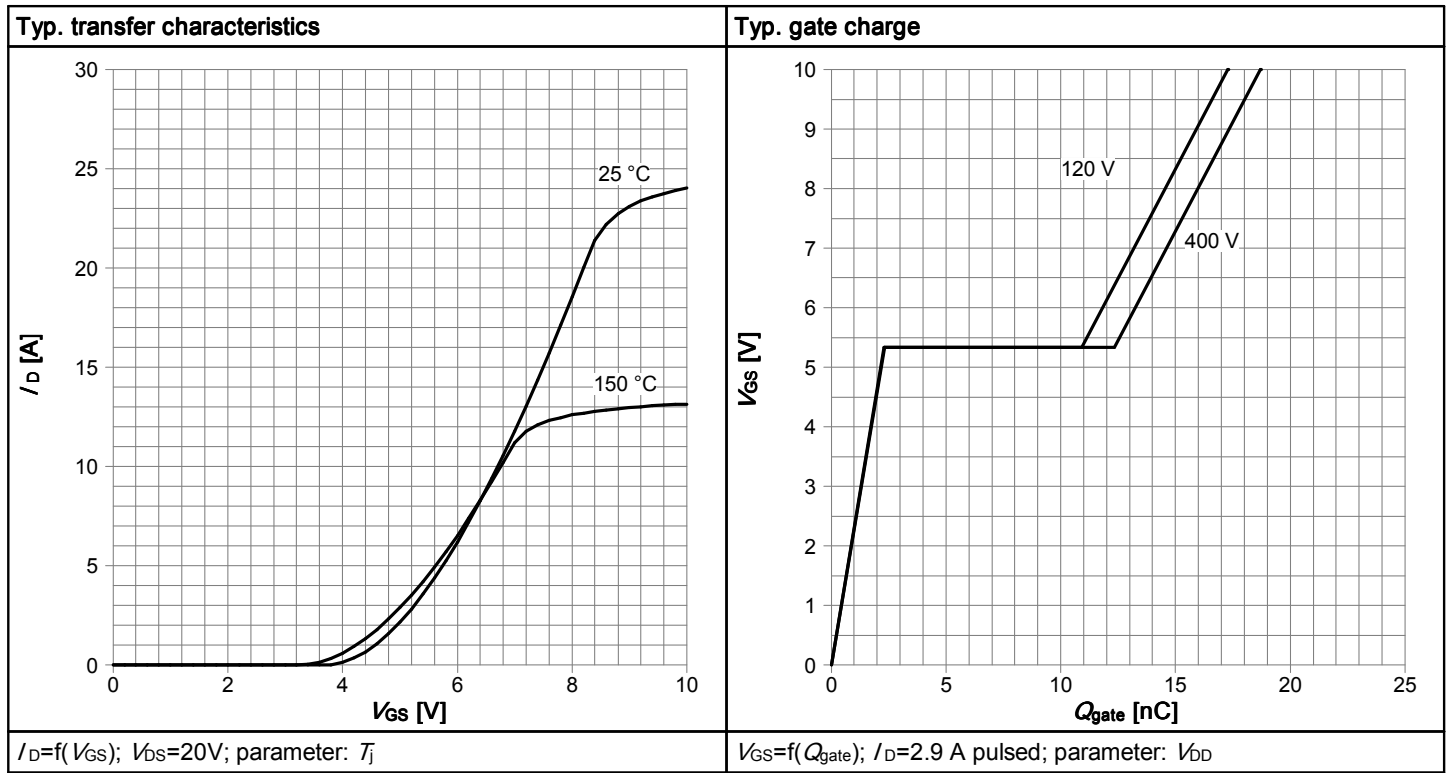


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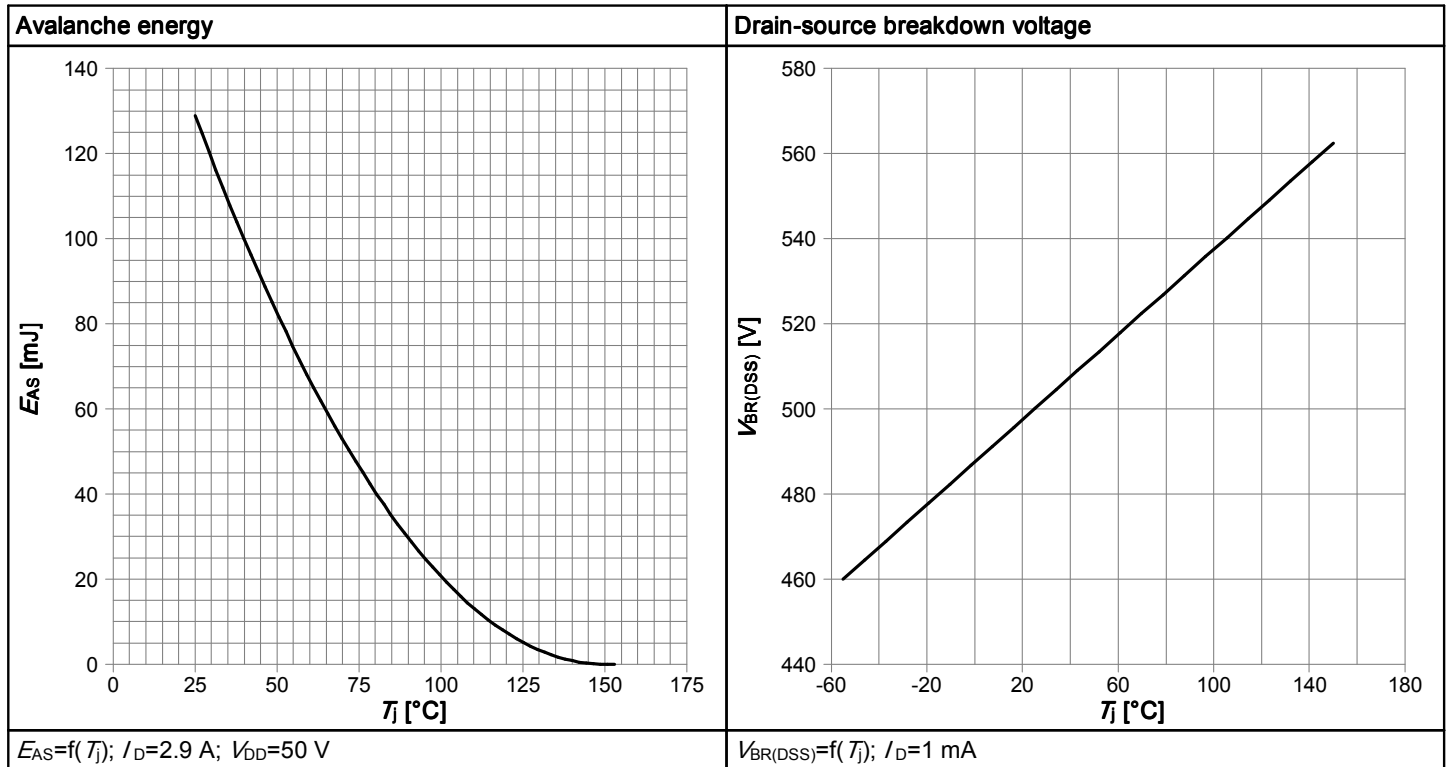


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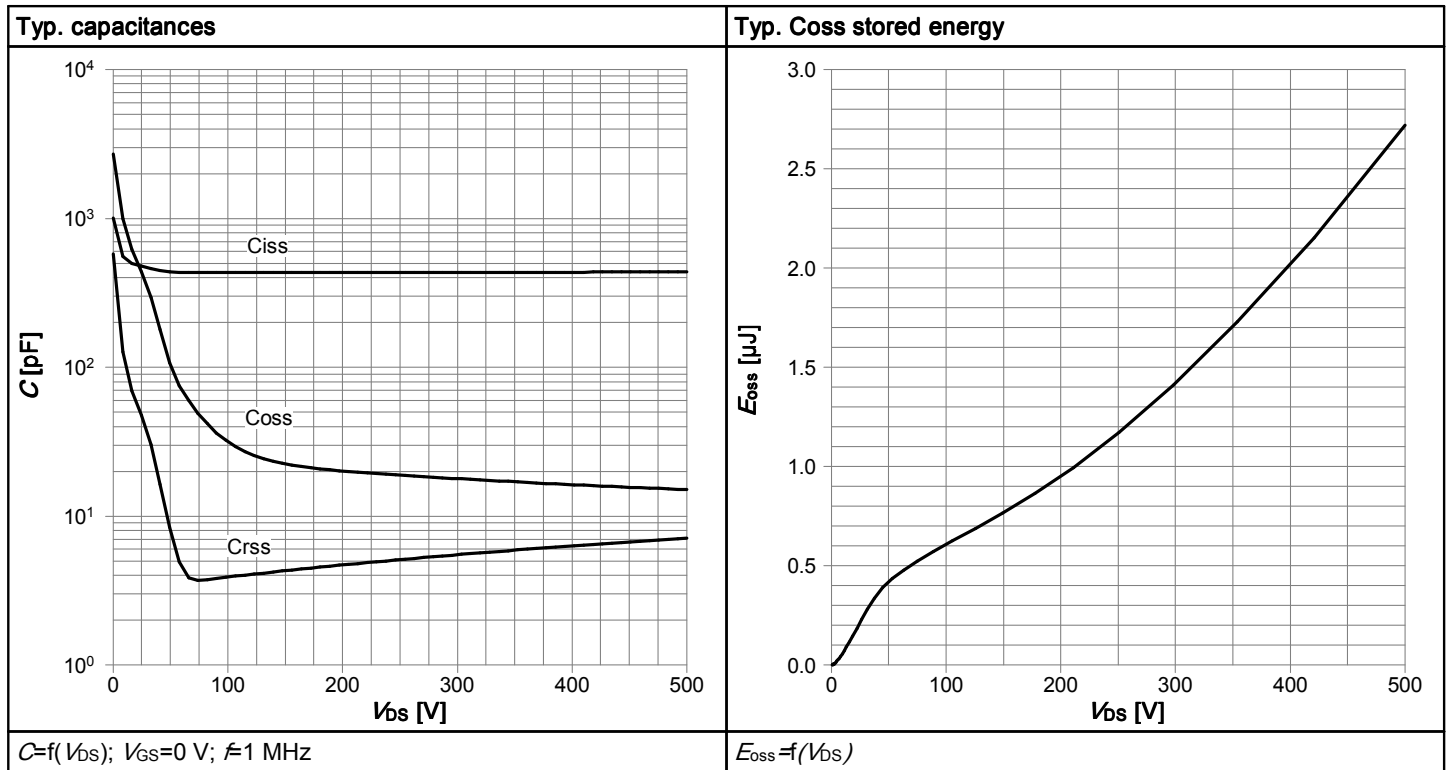
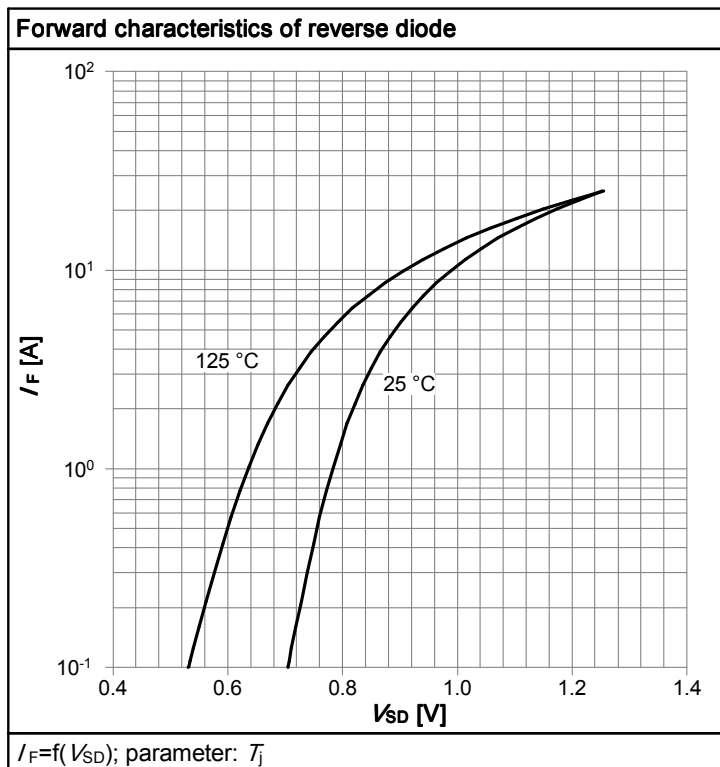
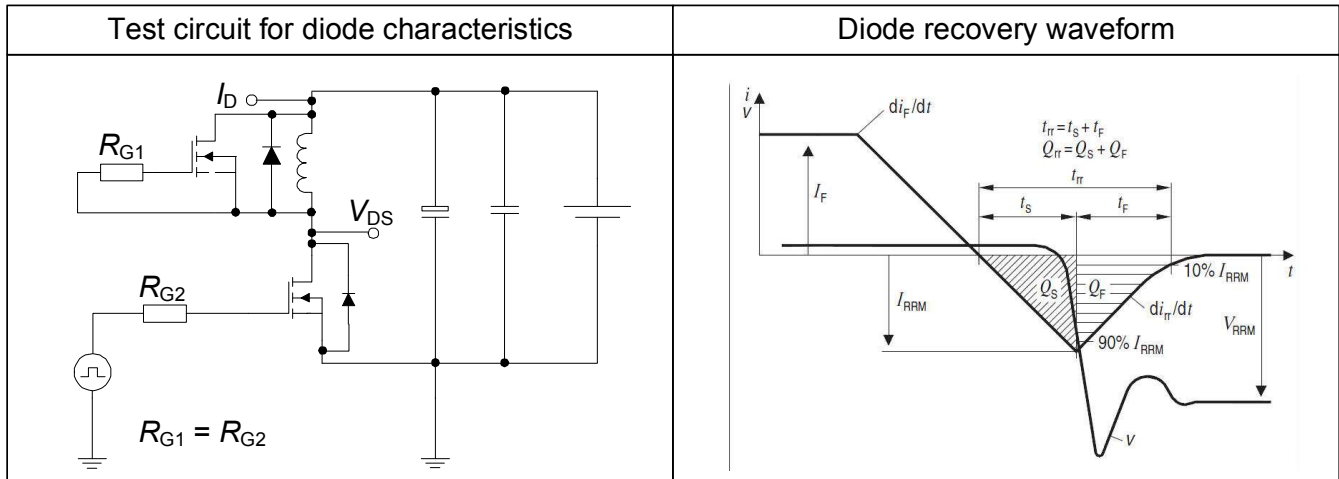
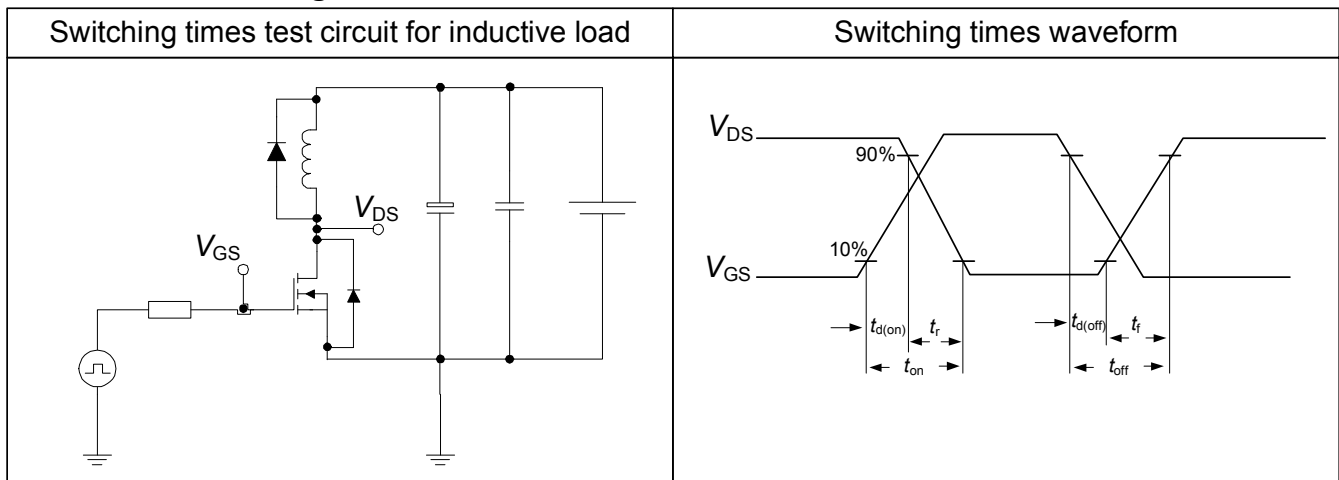
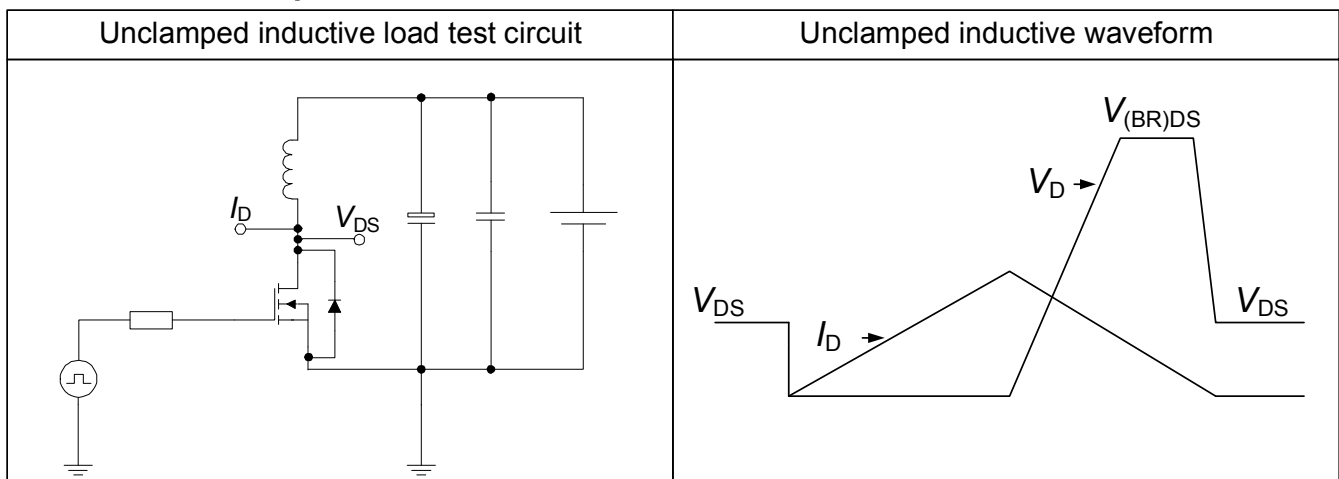


Table 18



## 6 Test Circuits

**Table 19 Diode characteristics**

**Table 20 Switching times**

**Table 21 Unclamped inductive**


## 7 Package Outlines

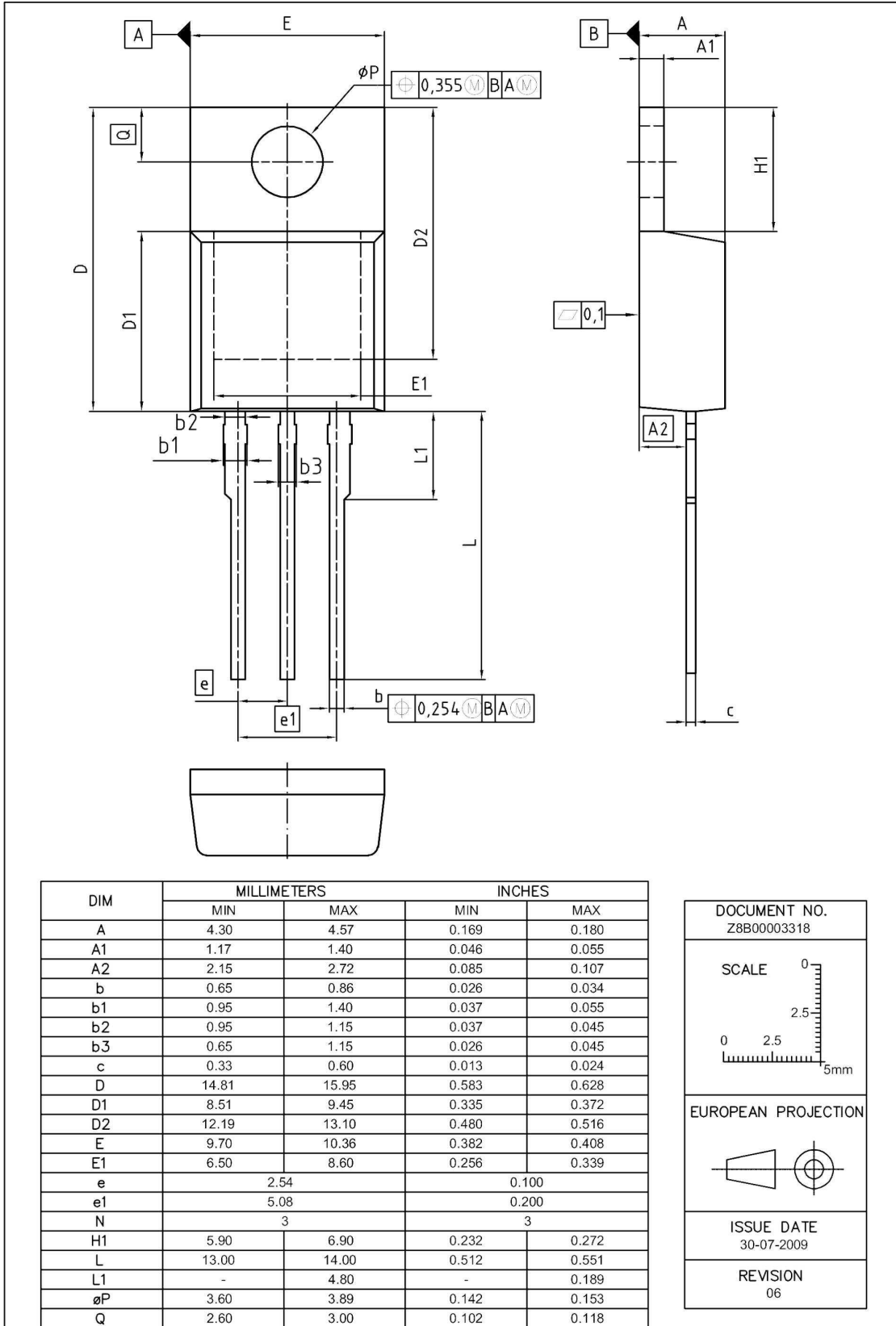


Figure 1 Outline PG-TO 220, dimensions in mm/inches

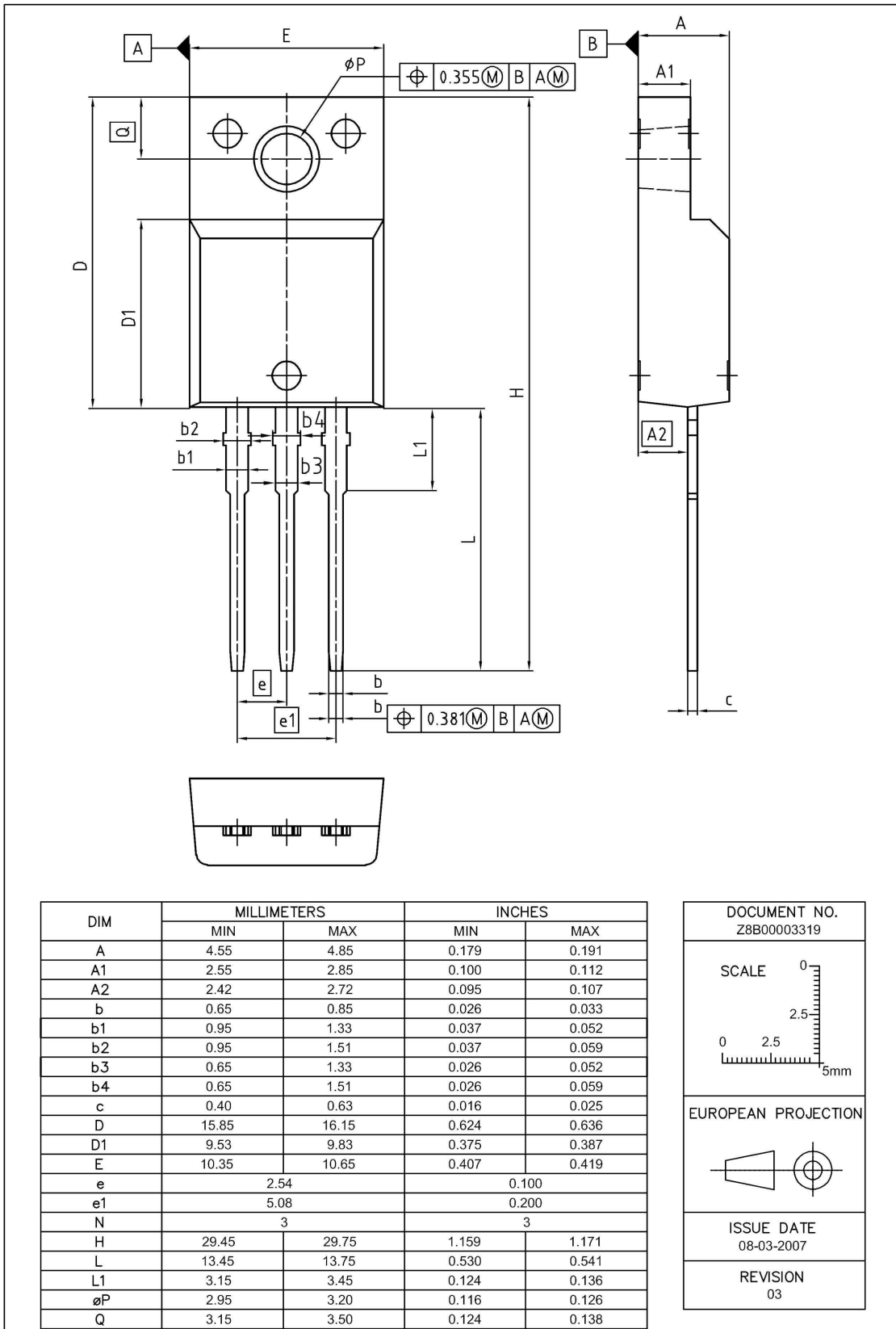


Figure 2 Outline PG-TO 220 FullPAK, dimensions in mm/inches

## 8 Appendix A

### Table 22 Related Links

- **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

IPP50R500CE, IPA50R500CE

**Revision: 2012-06-28, Rev. 2.0**

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2012-06-28	Release of final version

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