

## MOSFET

### 500V CoolMOS™ CE Power Transistor

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. CoolMOS™ CE is a price-performance optimized platform enabling to target cost sensitive applications in Consumer and Lighting markets by still meeting highest efficiency standards. The new series provides all benefits of a fast switching Superjunction MOSFET while not sacrificing ease of use and offering the best cost down performance ratio available on the market.

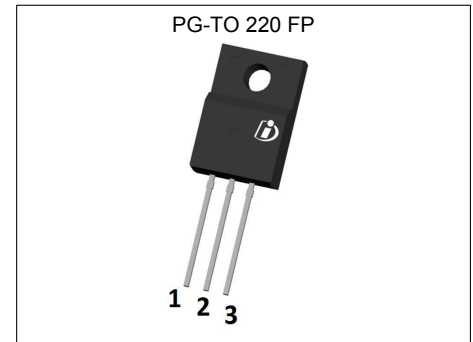
### Features

- 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 standard grade applications

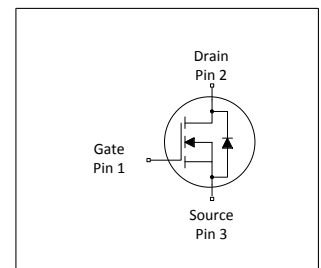
### Applications

PFC stages, hard switching PWM stages and resonant switching stages for e.g. PC Silverbox, Adapter, LCD & PDP TV and indoor lighting.

*Please note: For MOSFET paralleling the use of ferrite beads on the gate or separate totem poles is generally recommended.*



PG-TO 220 FP



**Table 1 Key Performance Parameters**

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	550	V
$R_{DS(on),max}$	0.5	$\Omega$
$I_D$	11.1	A
$Q_{g,typ}$	18.7	nC
$I_{D,pulse}$	24	A
$E_{oss} @ 400V$	2.02	$\mu J$

Type / Ordering Code	Package	Marking	Related Links
IPAN50R500CE	PG-TO 220 FullPAK - Narrow Lead	50S500CE	see Appendix A

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## 1 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>	$I_D$	-	-	11.1 7.0	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 (Full PAK)	$P_{tot}$	-	-	28.0	W	$T_C=25^\circ\text{C}$
Operating and storage temperature	$T_j, T_{stg}$	-40	-	150	$^\circ\text{C}$	-
Mounting torque	-	-	-	50	Ncm	M2.5 screws
Continuous diode forward current	$I_S$	-	-	4.6	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	$V_{DS} = 0\dots 400\text{V}$ , $I_{SD} \leq I_S$ , $T_j=25^\circ\text{C}$
Maximum diode commutation speed <sup>3)</sup>	$di_f/dt$	-	-	500	A/ $\mu\text{s}$	$V_{DS} = 0\dots 400\text{V}$ , $I_{SD} \leq I_S$ , $T_j=25^\circ\text{C}$
Insulation withstand voltage for TO-220 FullPAK	$V_{ISO}$	-	-	2500	V	$V_{rms}$ , $T_C=25^\circ\text{C}$ , $t=1\text{min}$

## 2 Thermal characteristics

**Table 3 Thermal characteristics TO220 Full PAK**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	$R_{thJC}$	-	-	4.46	$^\circ\text{C/W}$	-
Thermal resistance, junction - ambient	$R_{thJA}$	-	-	80	$^\circ\text{C/W}$	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  $T_{j,max} < 150^\circ\text{C}$ , Maximum Duty Cycle  $D = 0.5$ , TO220 equivalent

<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  $R_G$

### 3 Electrical characteristics

**Table 4 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	$V_{DS}=V_{GS}, I_D=0.2mA$
Zero gate voltage drain current	$I_{DSS}$	-	-	1	$\mu A$	$V_{DS}=500V, V_{GS}=0V, T_j=25^\circ C$ $V_{DS}=500V, V_{GS}=0V, T_j=150^\circ C$
Gate-source leakage current	$I_{GSS}$	-	-	100	nA	$V_{GS}=20V, V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.45	0.50	$\Omega$	$V_{GS}=13V, I_D=2.3A, T_j=25^\circ C$ $V_{GS}=13V, I_D=2.3A, T_j=150^\circ C$
Gate resistance	$R_G$	-	3	-	$\Omega$	$f=1\text{ MHz, open drain}$

**Table 5 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	$I_D=constant, V_{GS}=0V, V_{DS}=0...400V$
Turn-on delay time	$t_{d(on)}$	-	6	-	ns	$V_{DD}=400V, V_{GS}=13V, I_D=2.9A,$ $R_G=3.4\Omega$
Rise time	$t_r$	-	5	-	ns	$V_{DD}=400V, V_{GS}=13V, I_D=2.9A,$ $R_G=3.4\Omega$
Turn-off delay time	$t_{d(off)}$	-	30	-	ns	$V_{DD}=400V, V_{GS}=13V, I_D=2.9A,$ $R_G=3.4\Omega$
Fall time	$t_f$	-	12	-	ns	$V_{DD}=400V, V_{GS}=13V, I_D=2.9A,$ $R_G=3.4\Omega$

**Table 6 Gate charge characteristics**

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

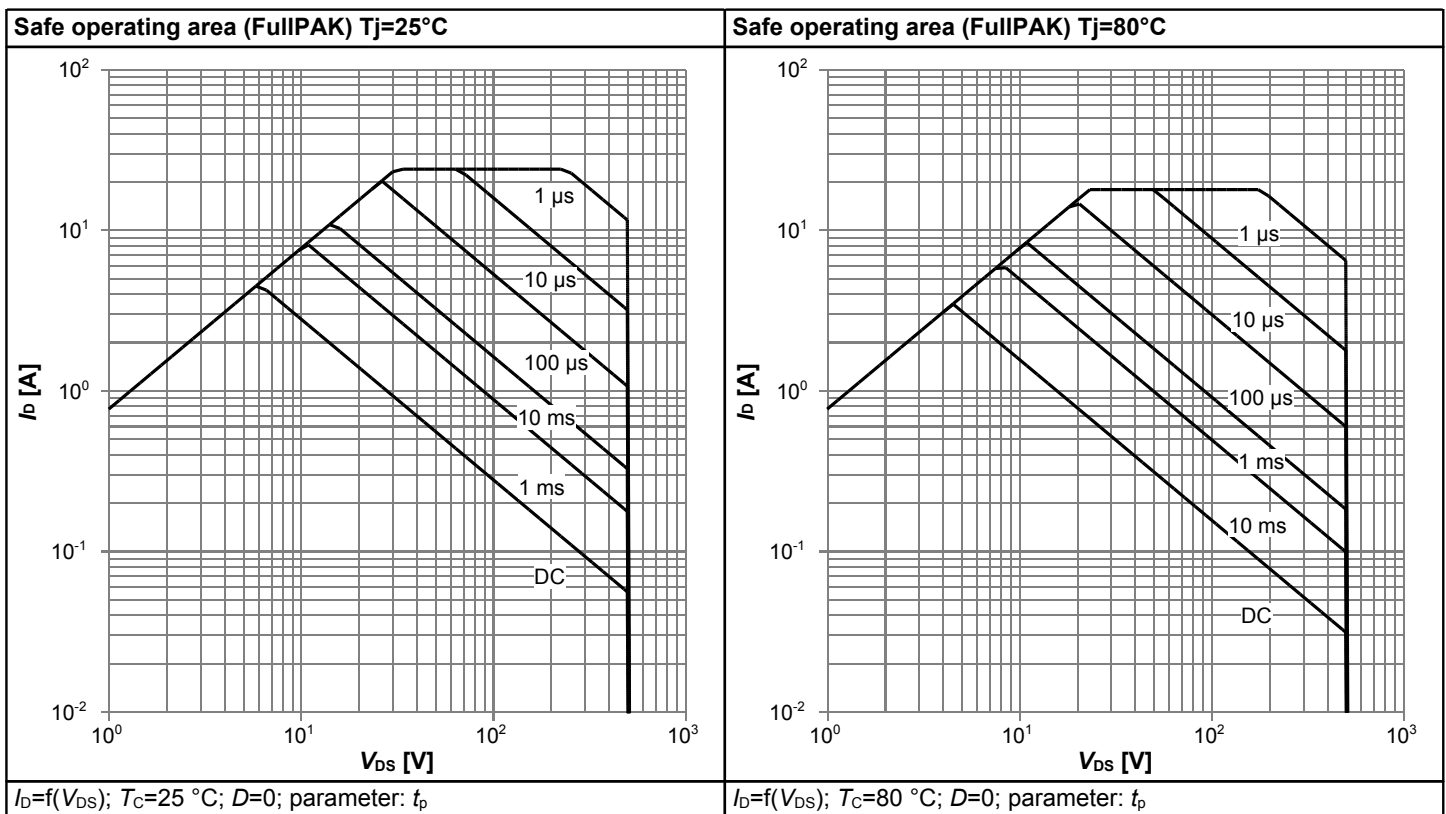
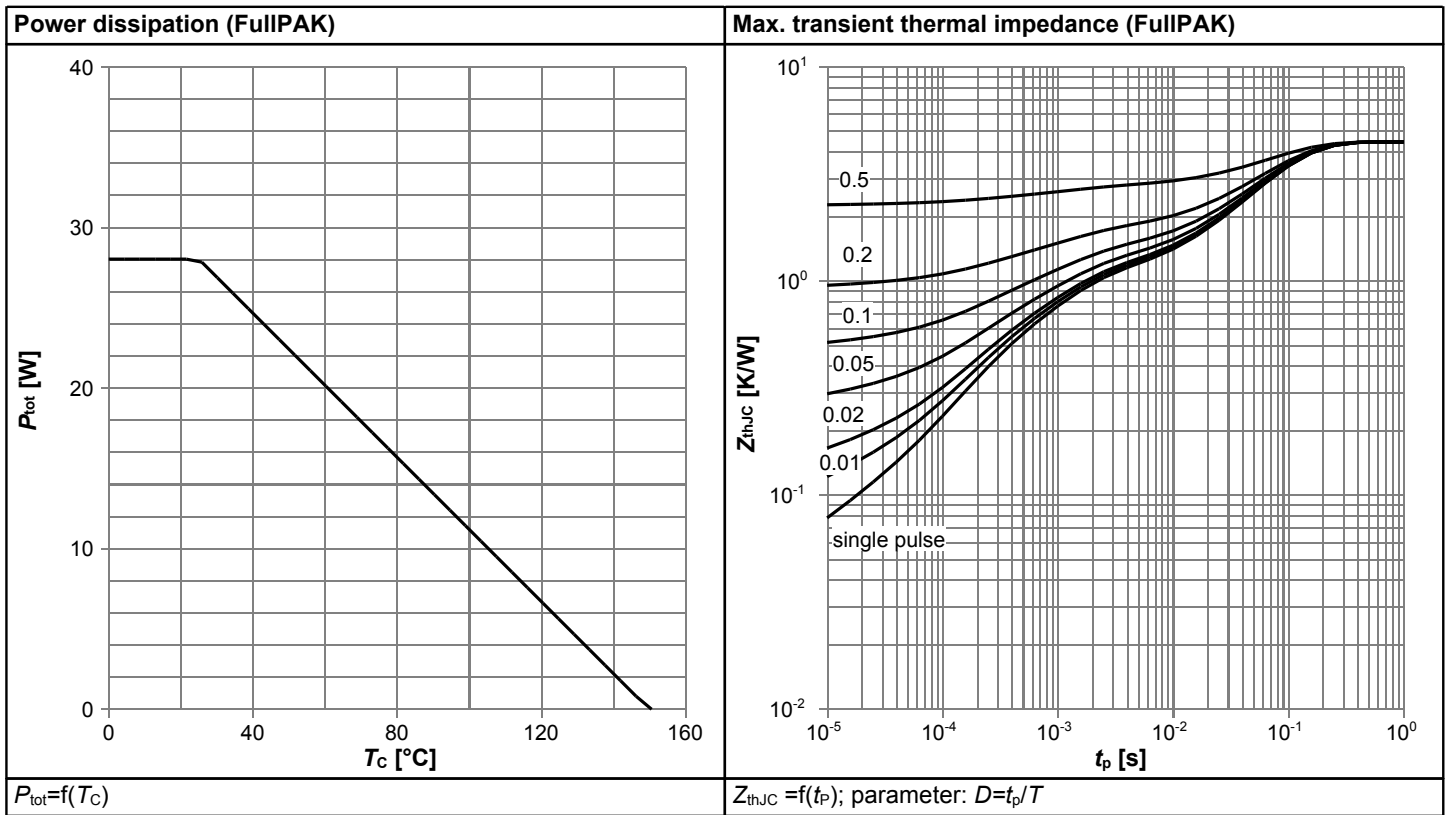
<sup>1)</sup>  $C_{o(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 400V

<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

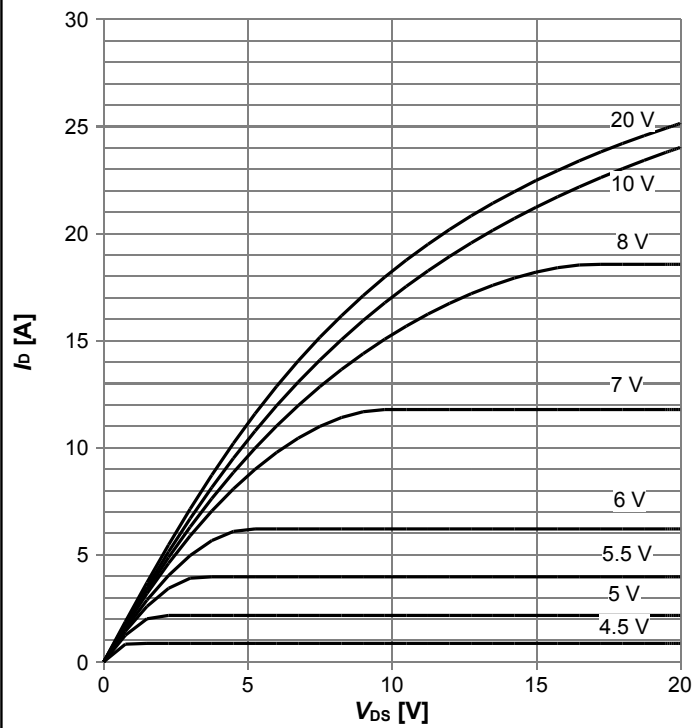
**Table 7 Reverse diode characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	$V_{SD}$	-	0.85	-	V	$V_{GS}=0V, I_F=2.9A, T_j=25^\circ C$
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	$V_R=400V, I_F=2.9A, di_F/dt=100A/\mu s$

### 4 Electrical characteristics diagrams

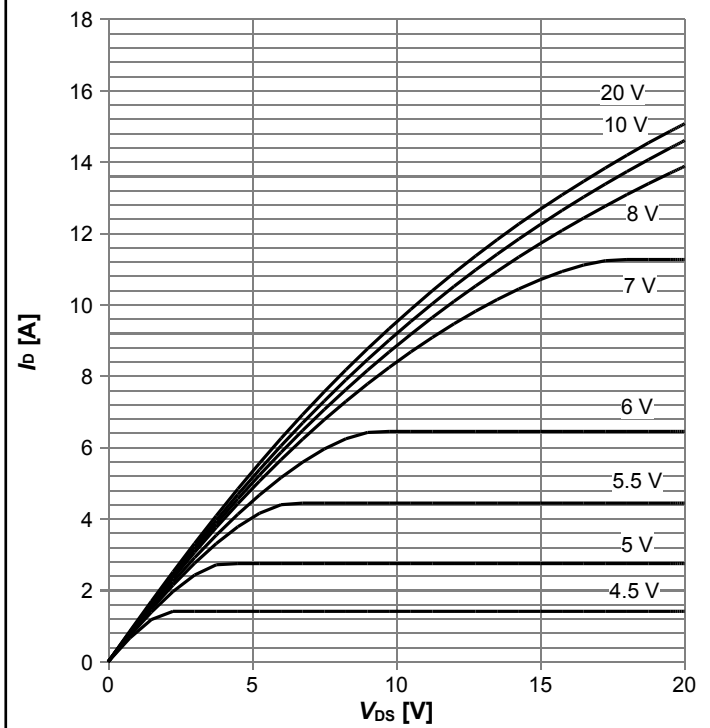


Typ. output characteristics  $T_j=25^\circ\text{C}$



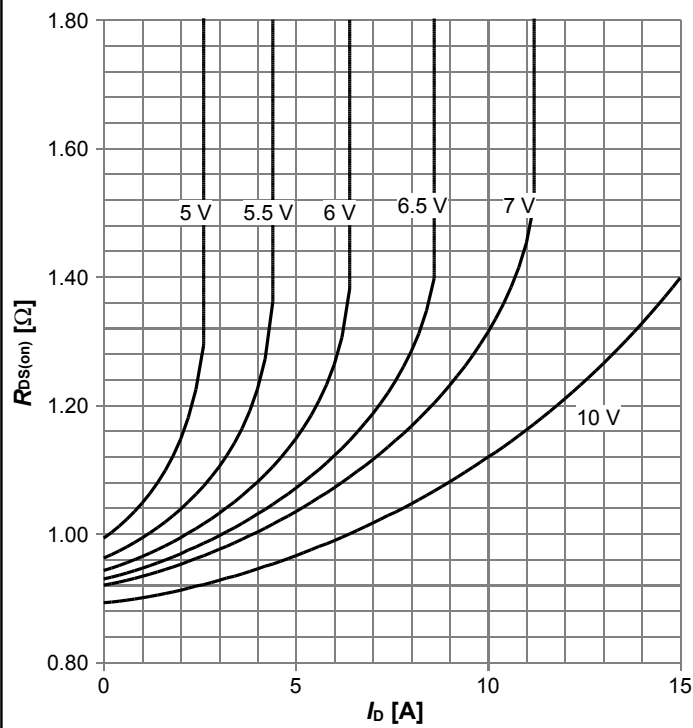
$I_D=f(V_{DS}); T_j=25^\circ\text{C};$  parameter:  $V_{GS}$

Typ. output characteristics  $T_j=125^\circ\text{C}$



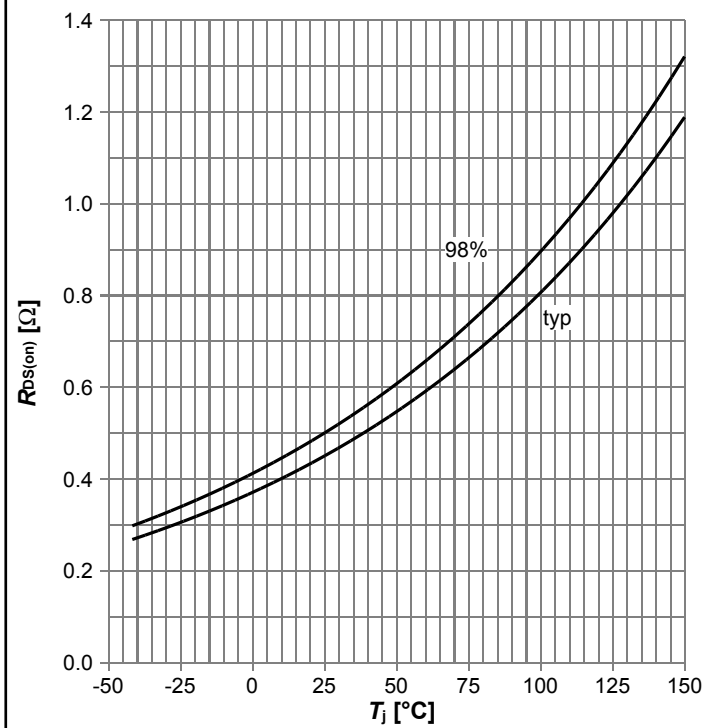
$I_D=f(V_{DS}); T_j=125^\circ\text{C};$  parameter:  $V_{GS}$

Typ. drain-source on-state resistance



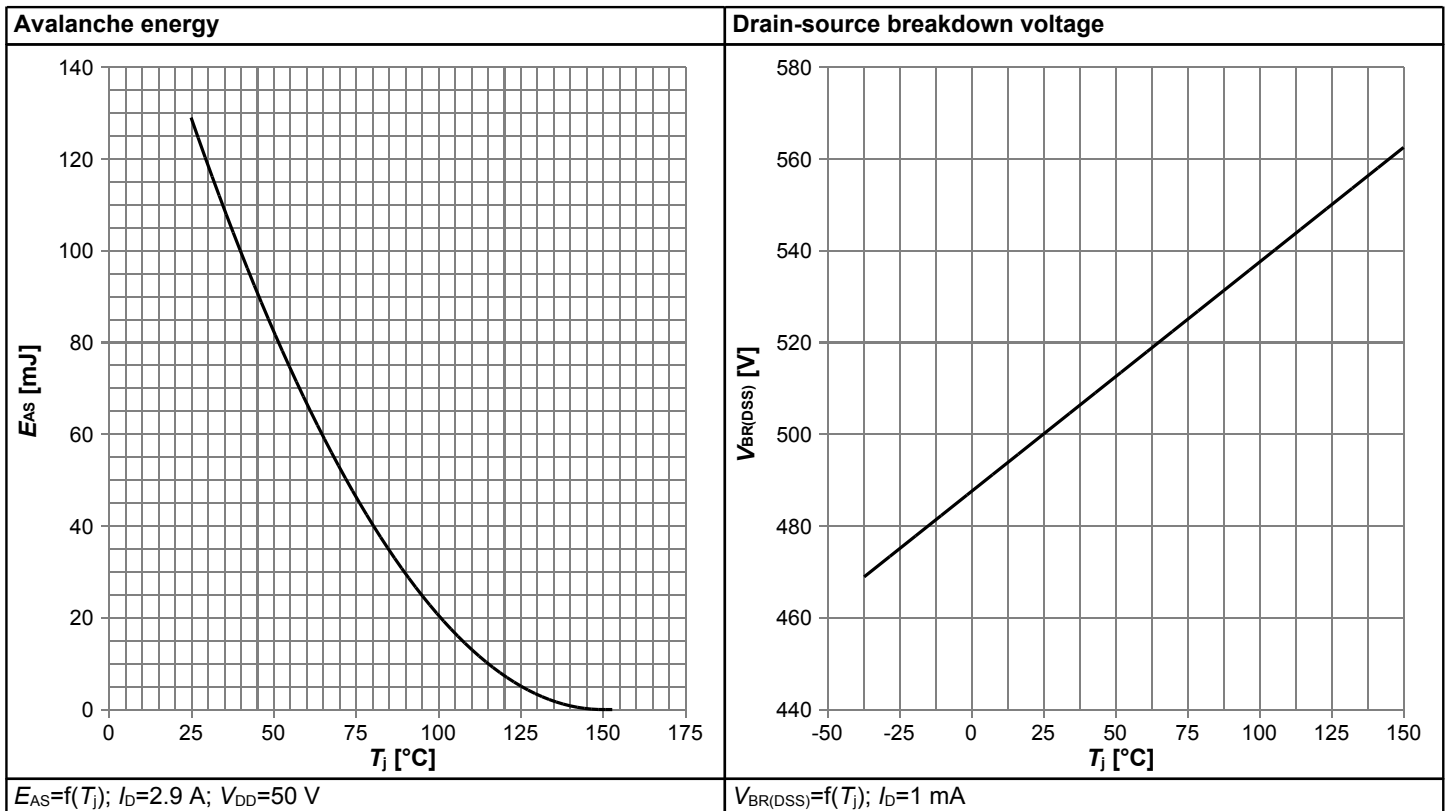
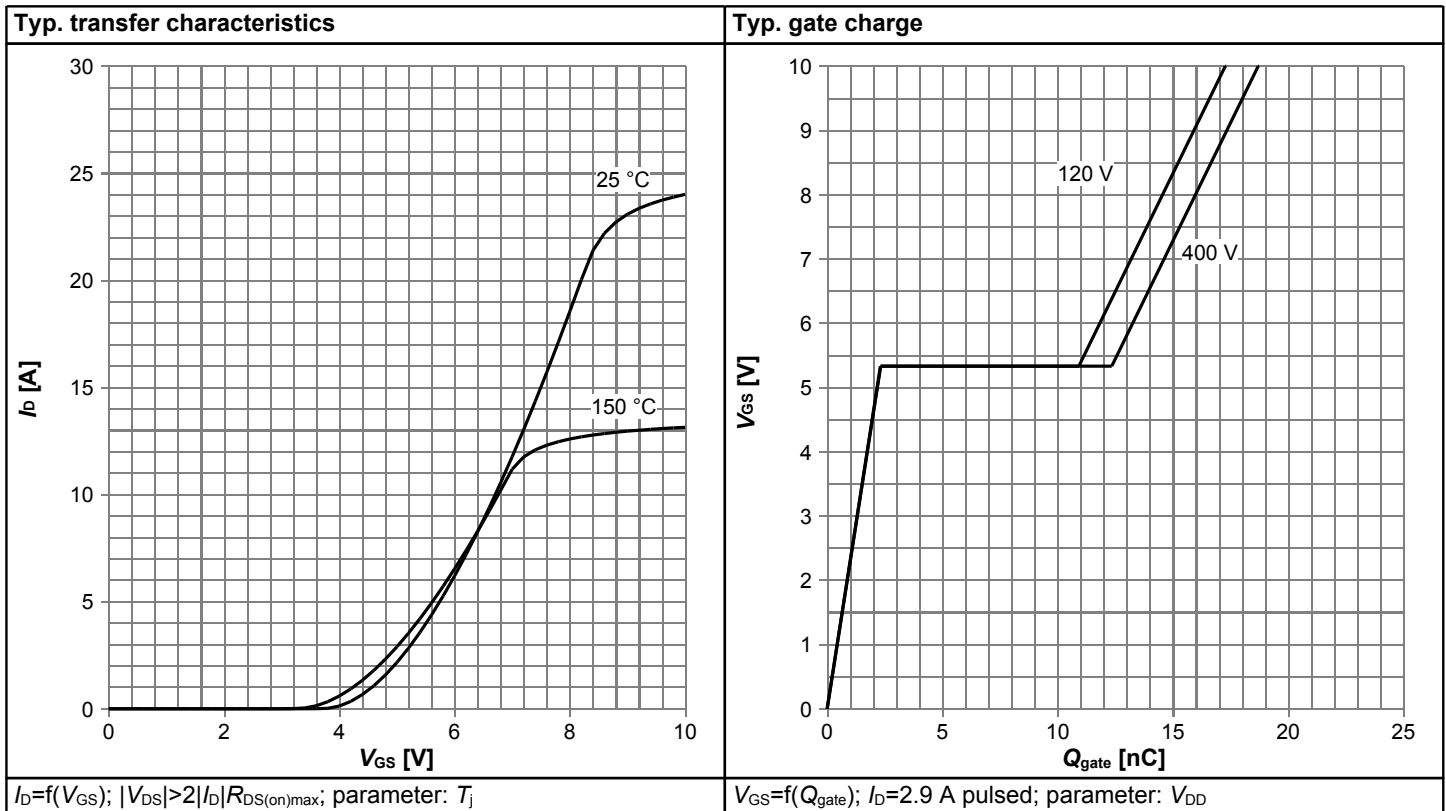
$R_{DS(on)}=f(I_D); T_j=125^\circ\text{C};$  parameter:  $V_{GS}$

Drain-source on-state resistance



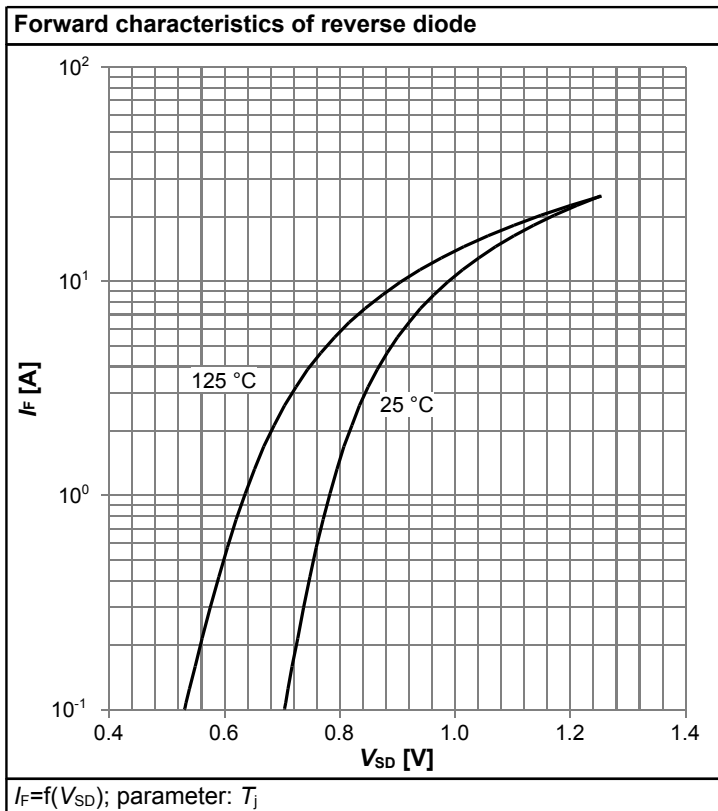
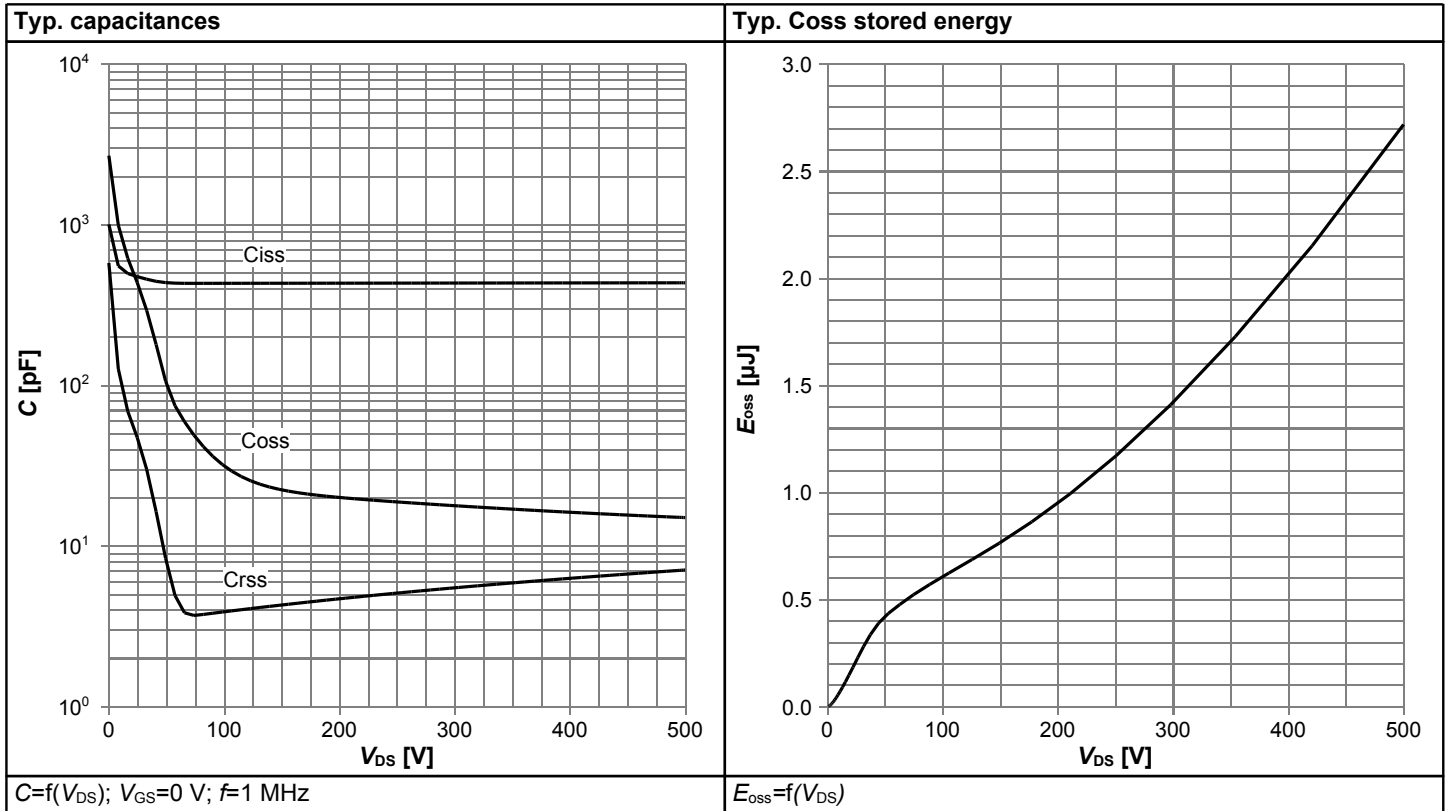
$R_{DS(on)}=f(T_j); I_D=2.3\text{ A}; V_{GS}=13\text{ V}$

# 500V CoolMOS™ CE Power Transistor IPAN50R500CE





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## 5 Test Circuits

**Table 8 Diode characteristics**

Test circuit for diode characteristics	Diode recovery waveform
<p><math>R_{g1} = R_{g2}</math></p>	<p><math>t_{rr} = t_F + t_S</math>  <math>Q_{rr} = Q_F + Q_S</math></p>

**Table 9 Switching times**

Switching times test circuit for inductive load	Switching times waveform

**Table 10 Unclamped inductive load**

Unclamped inductive load test circuit	Unclamped inductive waveform

**6 Package Outlines**

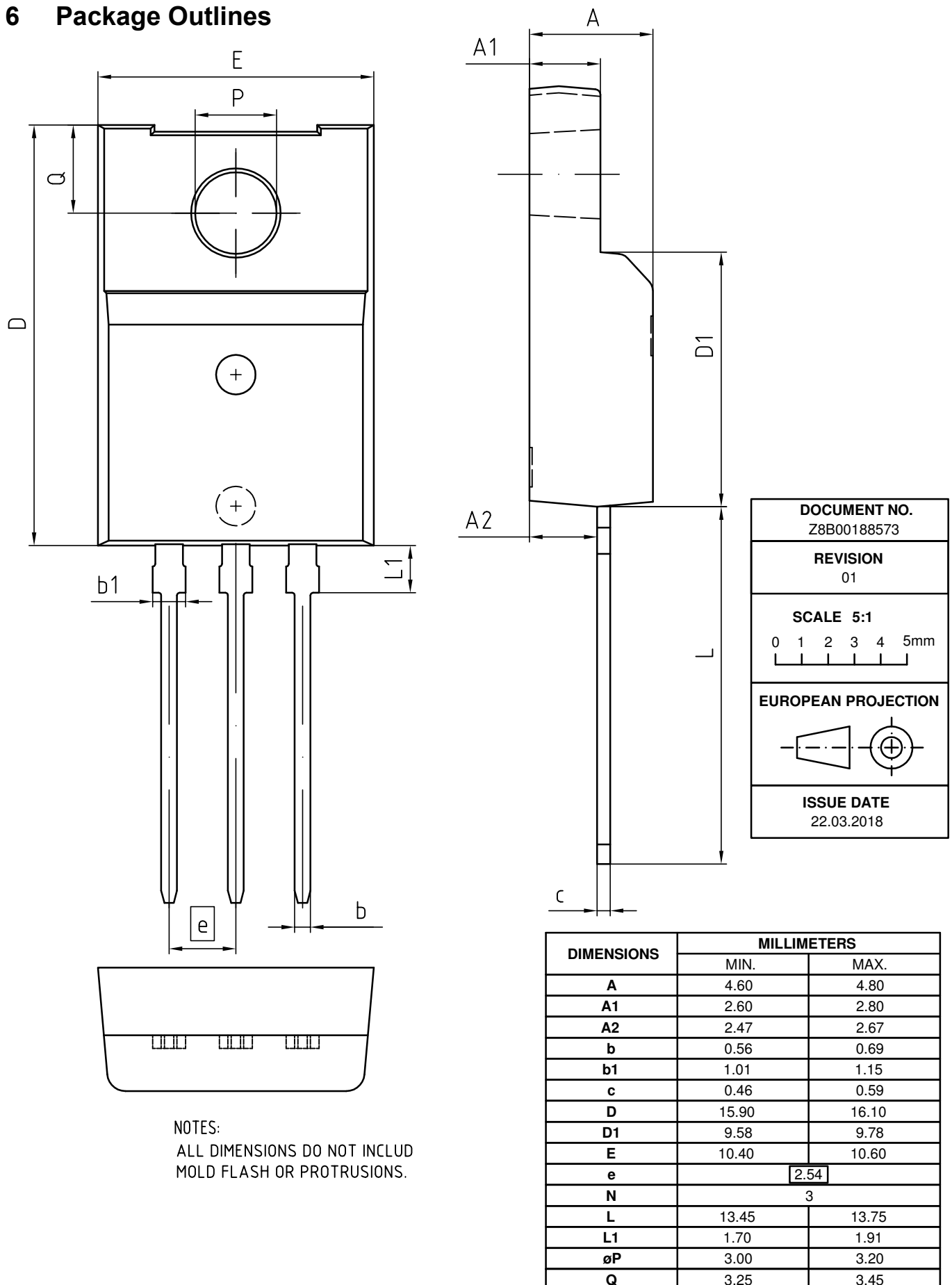


Figure 1 Outline PG-TO 220 FullPAK - Narrow Lead, dimensions in mm

## 7 Appendix A

### Table 11 Related Links

- IFX CoolMOS Webpage: [www.infineon.com](http://www.infineon.com)
- IFX Design tools: [www.infineon.com](http://www.infineon.com)

## Revision History

IPAN50R500CE

**Revision: 2018-05-14, Rev. 2.4**

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2016-06-13	Updated ID ratings
2.2	2016-11-28	Revised package drawing on page 11
2.3	2018-04-26	Revised package drawing
2.4	2018-05-14	Part Marking update

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