

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ P6

600V CoolMOS™ P6 Power Transistor
IPx60R125P6

Data Sheet

Rev. 2.0
Final

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™ P6 series combines the experience of the leading SJ MOSFET supplier with high class innovation. The offered 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

- Increased MOSFET dv/dt ruggedness
- 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 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.

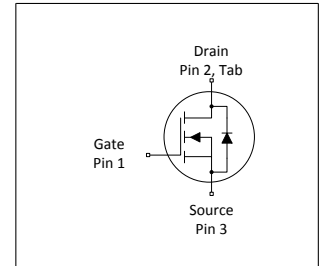
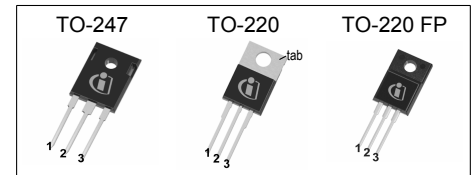


Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	650	V
$R_{DS(on),max}$	125	mΩ
$Q_{g,typ}$	56	nC
$I_{D,pulse}$	87	A
$E_{oss@400V}$	7.2	μJ
Body diode di/dt	300	A/μs

Type / Ordering Code	Package	Marking	Related Links
IPW60R125P6	PG-TO 247	6R125P6	see Appendix A
IPP60R125P6	PG-TO 220		
IPA60R125P6	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 ¹⁾	I_D	-	-	30.0 19.0	A	$T_C=25^\circ\text{C}$ $T_C=100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$	-	-	87	A	$T_C=25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}	-	-	636	mJ	$I_D=5.2\text{A}$; $V_{DD}=50\text{V}$; see table 10
Avalanche energy, repetitive	E_{AR}	-	-	0.96	mJ	$I_D=5.2\text{A}$; $V_{DD}=50\text{V}$; see table 10
Avalanche current, repetitive	I_{AR}	-	-	5.2	A	-
MOSFET dv/dt ruggedness	dv/dt	-	-	100	V/ns	$V_{DS}=0\dots400\text{V}$
Gate source voltage (static)	V_{GS}	-20	-	20	V	static;
Gate source voltage (dynamic)	V_{GS}	-30	-	30	V	AC ($f>1\text{ Hz}$)
Power dissipation (Non FullPAK) TO-220, TO-247	P_{tot}	-	-	219	W	$T_C=25^\circ\text{C}$
Power dissipation (FullPAK) TO-220FP	P_{tot}	-	-	34	W	$T_C=25^\circ\text{C}$
Storage temperature	T_{stg}	-55	-	150	$^\circ\text{C}$	-
Operating junction temperature	T_j	-55	-	150	$^\circ\text{C}$	-
Mounting torque (Non FullPAK) TO-220, TO-247	-	-	-	60	Ncm	M3 and M3.5 screws
Mounting torque (FullPAK) TO-220FP	-	-	-	50	Ncm	M2.5 screws
Continuous diode forward current	I_S	-	-	26.0	A	$T_C=25^\circ\text{C}$
Diode pulse current ²⁾	$I_{S,pulse}$	-	-	87	A	$T_C=25^\circ\text{C}$
Reverse diode dv/dt ³⁾	dv/dt	-	-	15	V/ns	$V_{DS}=0\dots400\text{V}$, $I_{SD}\leq I_S$, $T_j=25^\circ\text{C}$ see table 8
Maximum diode commutation speed	di/dt	-	-	300	A/ μs	$V_{DS}=0\dots400\text{V}$, $I_{SD}\leq I_S$, $T_j=25^\circ\text{C}$ see table 8
Insulation withstand voltage for TO-220FP	V_{ISO}	-	-	2500	V	V_{rms} , $T_C=25^\circ\text{C}$, $t=1\text{min}$

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 (Non FullPAK) TO-220, TO-247

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	0.57	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	62	°C/W	leaded
Soldering temperature, wavesoldering only allowed at leads	T_{sold}	-	-	260	°C	1.6mm (0.063 in.) from case for 10s

Table 4 Thermal characteristics (FullPAK) TO-220FP

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	3.65	°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

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

Table 5 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	600	-	-	V	$V_{GS}=0\text{V}$, $I_D=1\text{mA}$
Gate threshold voltage	$V_{(GS)th}$	3.5	4.0	4.5	V	$V_{DS}=V_{GS}$, $I_D=0.96\text{mA}$
Zero gate voltage drain current	I_{DSS}	-	-	2	μA	$V_{DS}=600$, $V_{GS}=0\text{V}$, $T_j=25^\circ\text{C}$ $V_{DS}=600$, $V_{GS}=0\text{V}$, $T_j=150^\circ\text{C}$
Gate-source leakage current	I_{GSS}	-	-	100	nA	$V_{GS}=20\text{V}$, $V_{DS}=0\text{V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	0.113 0.293	0.125 -	Ω	$V_{GS}=10\text{V}$, $I_D=11.6\text{A}$, $T_j=25^\circ\text{C}$ $V_{GS}=10\text{V}$, $I_D=11.6\text{A}$, $T_j=150^\circ\text{C}$
Gate resistance	R_G	-	1.7	-	Ω	$f=1\text{MHz}$, open drain

Table 6 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	2660	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=100\text{V}$, $f=1\text{MHz}$
Output capacitance	C_{oss}	-	110	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=100\text{V}$, $f=1\text{MHz}$
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$	-	90	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=0\dots400\text{V}$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$	-	398	-	pF	$I_D=\text{constant}$, $V_{GS}=0\text{V}$, $V_{DS}=0\dots400\text{V}$
Turn-on delay time	$t_{d(on)}$	-	14	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=14.5\text{A}$, $R_G=1.7\Omega$; see table 9
Rise time	t_r	-	9	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=14.5\text{A}$, $R_G=1.7\Omega$; see table 9
Turn-off delay time	$t_{d(off)}$	-	44	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=14.5\text{A}$, $R_G=1.7\Omega$; see table 9
Fall time	t_f	-	5	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=14.5\text{A}$, $R_G=1.7\Omega$; see table 9

Table 7 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	16	-	nC	$V_{DD}=400\text{V}$, $I_D=14.5\text{A}$, $V_{GS}=0$ to 10V
Gate to drain charge	Q_{gd}	-	20	-	nC	$V_{DD}=400\text{V}$, $I_D=14.5\text{A}$, $V_{GS}=0$ to 10V
Gate charge total	Q_g	-	56	-	nC	$V_{DD}=400\text{V}$, $I_D=14.5\text{A}$, $V_{GS}=0$ to 10V
Gate plateau voltage	$V_{plateau}$	-	6.1	-	V	$V_{DD}=400\text{V}$, $I_D=14.5\text{A}$, $V_{GS}=0$ to 10V

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 400V

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 400V

Table 8 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	0.9	-	V	$V_{GS}=0V$, $I_F=14.5A$, $T_J=25^{\circ}C$
Reverse recovery time	t_{rr}	-	385	-	ns	$V_R=400V$, $I_F=14.5A$, $di_F/dt=100A/\mu s$; see table 8
Reverse recovery charge	Q_{rr}	-	7	-	μC	$V_R=400V$, $I_F=14.5A$, $di_F/dt=100A/\mu s$; see table 8
Peak reverse recovery current	I_{rrm}	-	32	-	A	$V_R=400V$, $I_F=14.5A$, $di_F/dt=100A/\mu s$; see table 8

5 Electrical characteristics diagrams

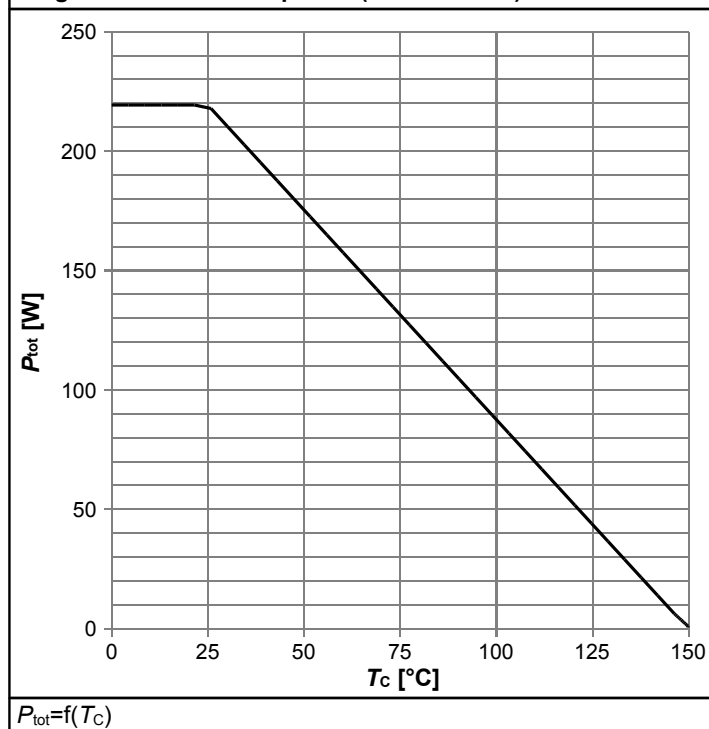
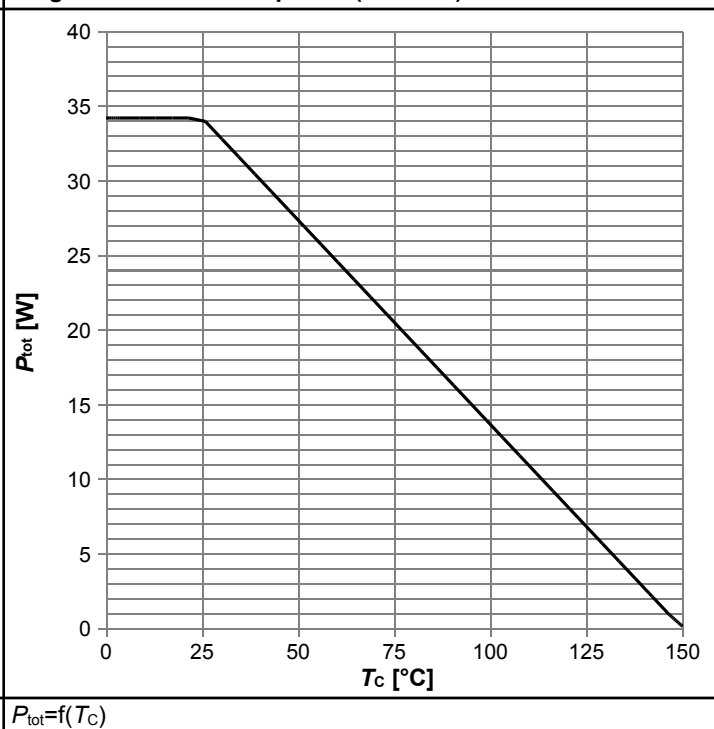
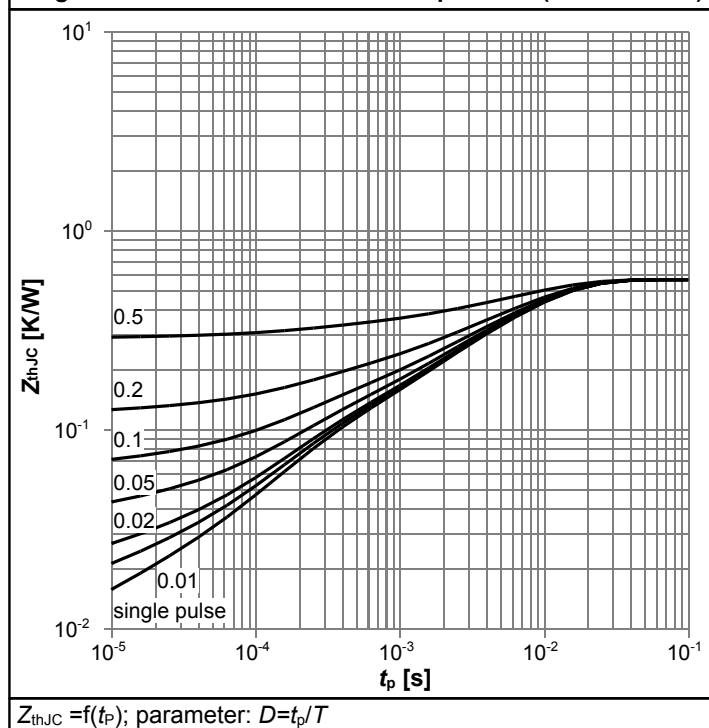
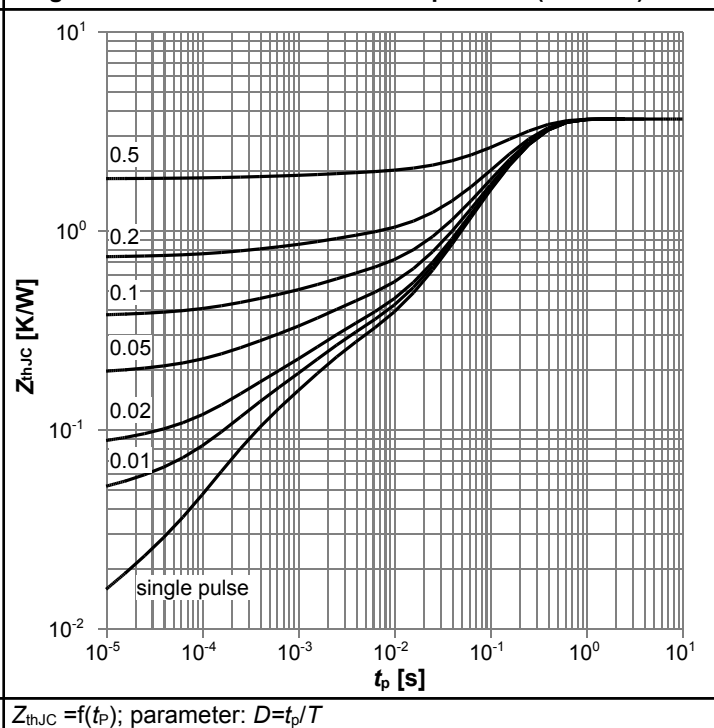
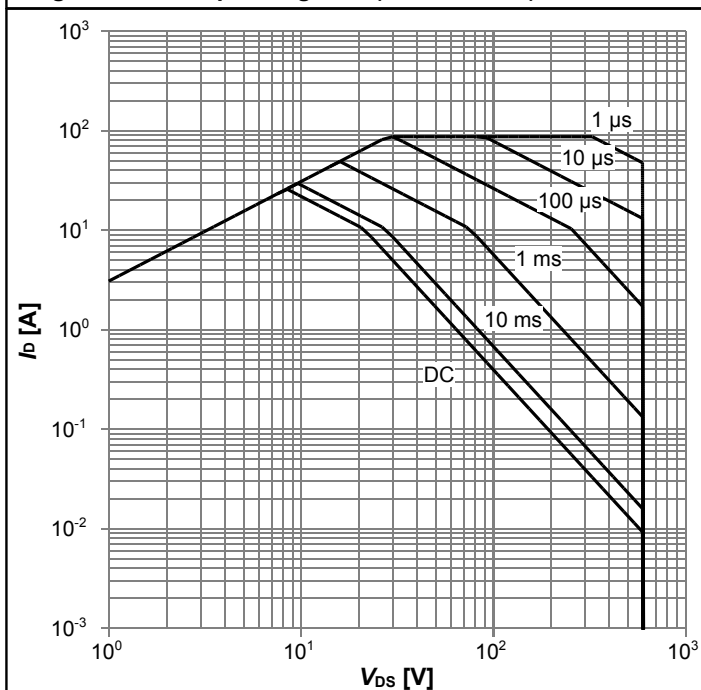
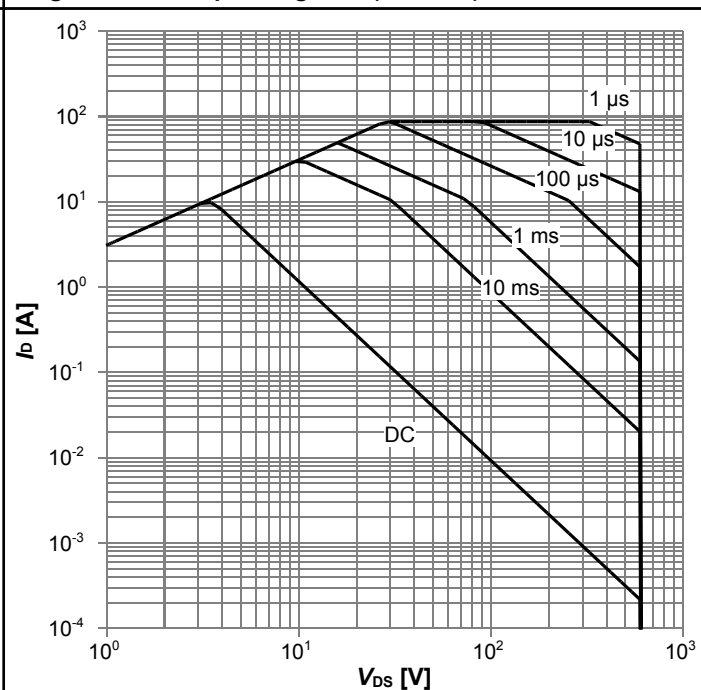
Diagram 1: Power dissipation (Non FullPAK)

Diagram 2: Power dissipation (FullPAK)

Diagram 3: Max. transient thermal impedance (Non FullPAK)

Diagram 4: Max. transient thermal impedance (FullPAK)


Diagram 5: Safe operating area (Non FullPAK)



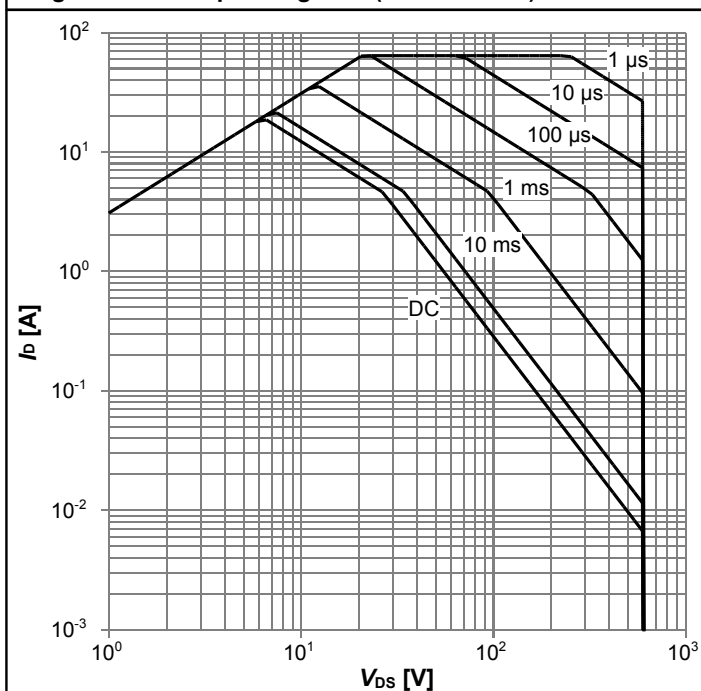
$I_D=f(V_{DS})$; $T_C=25\text{ °C}$; $D=0$; parameter: t_p

Diagram 6: Safe operating area (FullPAK)



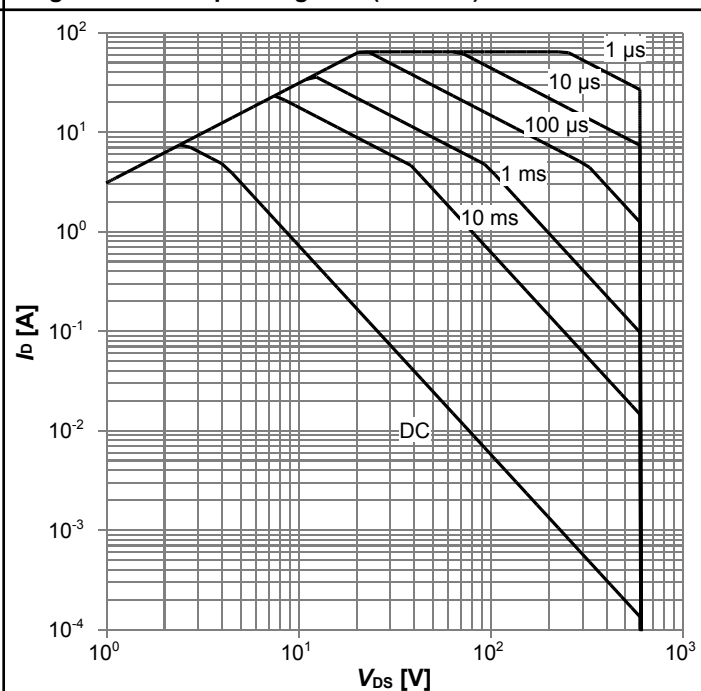
$I_D=f(V_{DS})$; $T_C=25\text{ °C}$; $D=0$; parameter: t_p

Diagram 7: Safe operating area (Non FullPAK)



$I_D=f(V_{DS})$; $T_C=80\text{ °C}$; $D=0$; parameter: t_p

Diagram 8: Safe operating area (FullPAK)



$I_D=f(V_{DS})$; $T_C=80\text{ °C}$; $D=0$; parameter: t_p

Diagram 9: Typ. output characteristics

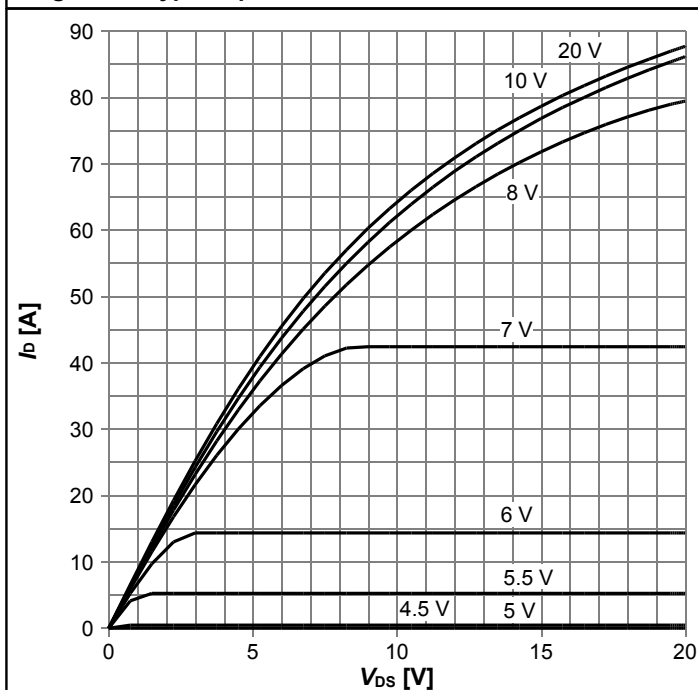

 $I_D = f(V_{DS}); T_J = 25^\circ\text{C}; \text{parameter: } V_{GS}$

Diagram 10: Typ. output characteristics

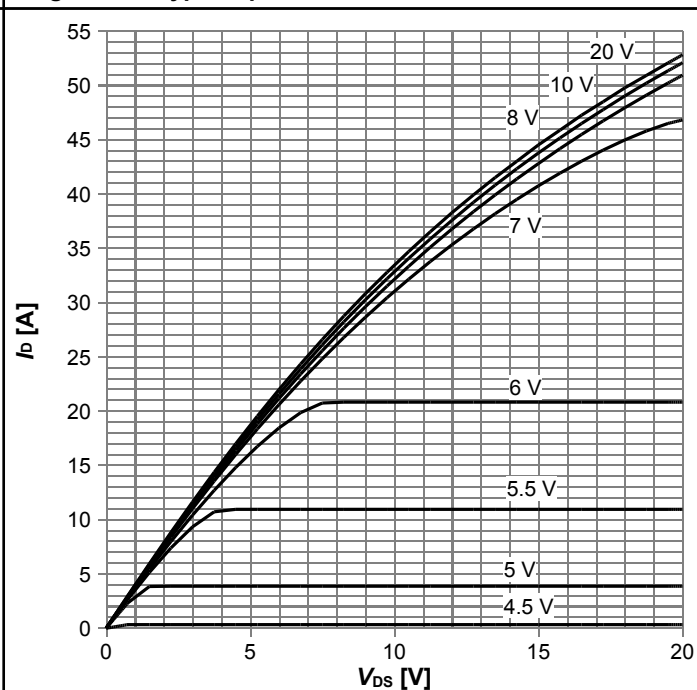

 $I_D = f(V_{DS}); T_J = 125^\circ\text{C}; \text{parameter: } V_{GS}$

Diagram 11: Typ. drain-source on-state resistance

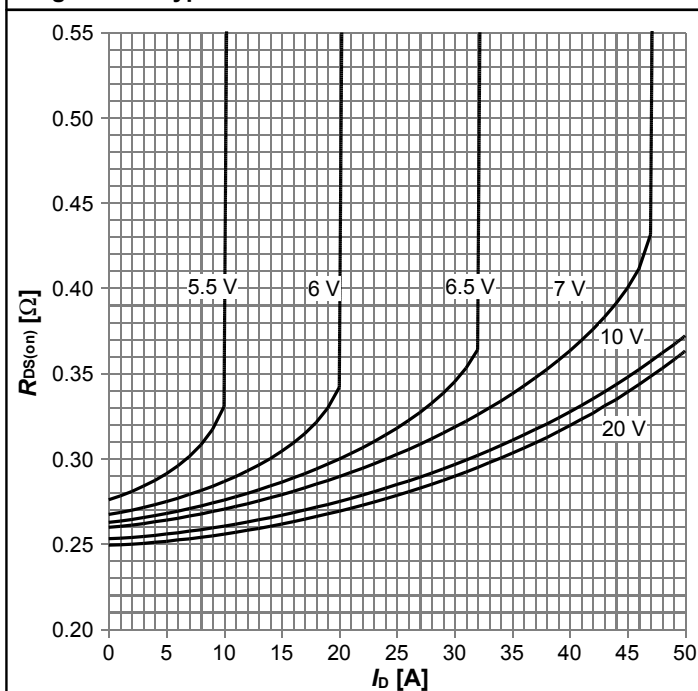

 $R_{DS(on)} = f(I_D); T_J = 125^\circ\text{C}; \text{parameter: } V_{GS}$

Diagram 12: Drain-source on-state resistance

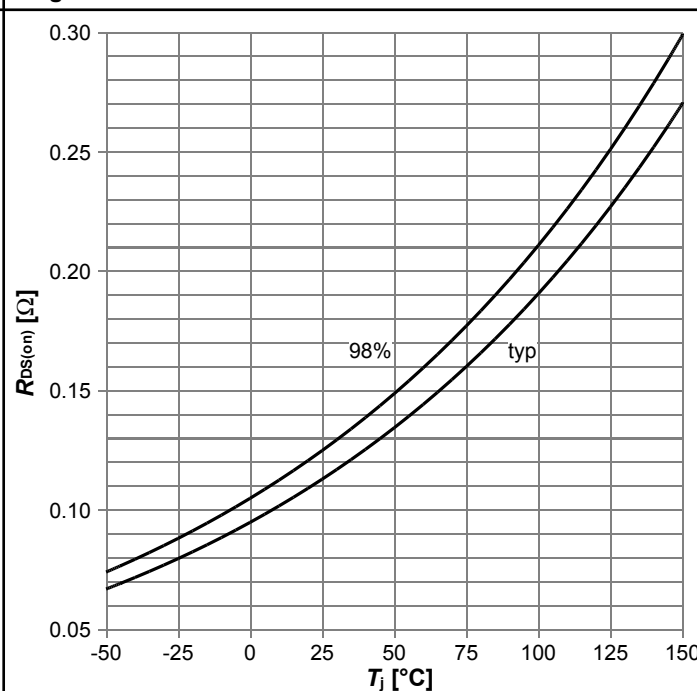

 $R_{DS(on)} = f(T_J); I_D = 11.6\text{ A}; V_{GS} = 10\text{ V}$

Diagram 13: Typ. transfer characteristics

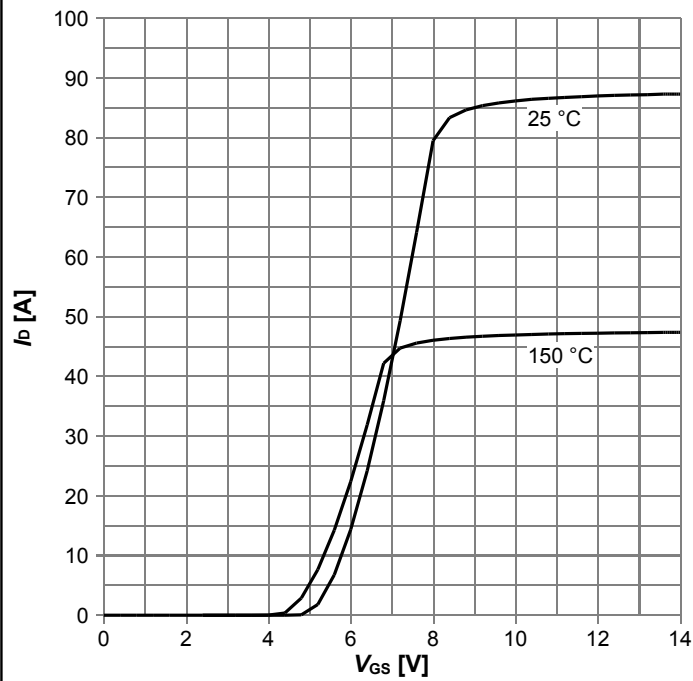

 $I_D = f(V_{GS}); V_{DS} = 20V; \text{parameter: } T_j$

Diagram 14: Typ. gate charge

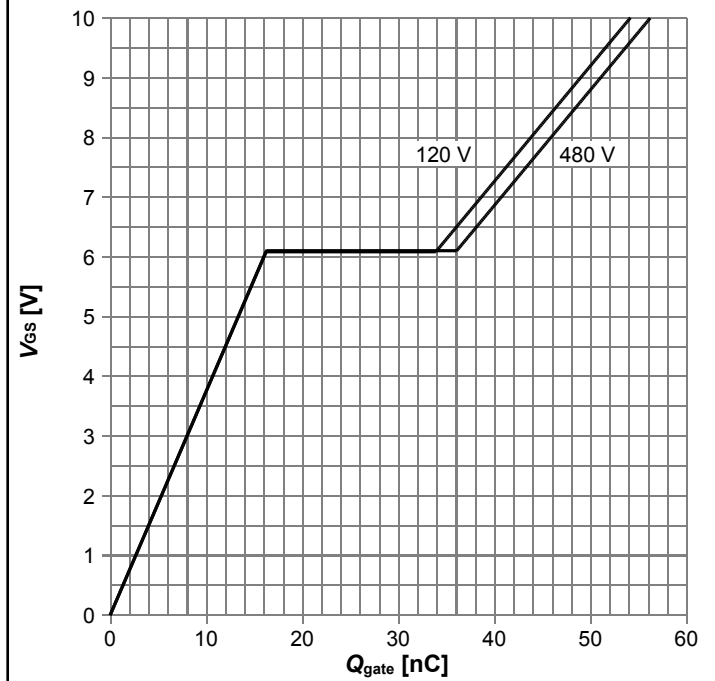

 $V_{GS} = f(Q_{gate}); I_D = 14.5 \text{ A pulsed}; \text{parameter: } V_{DD}$

Diagram 15: Forward characteristics of reverse diode

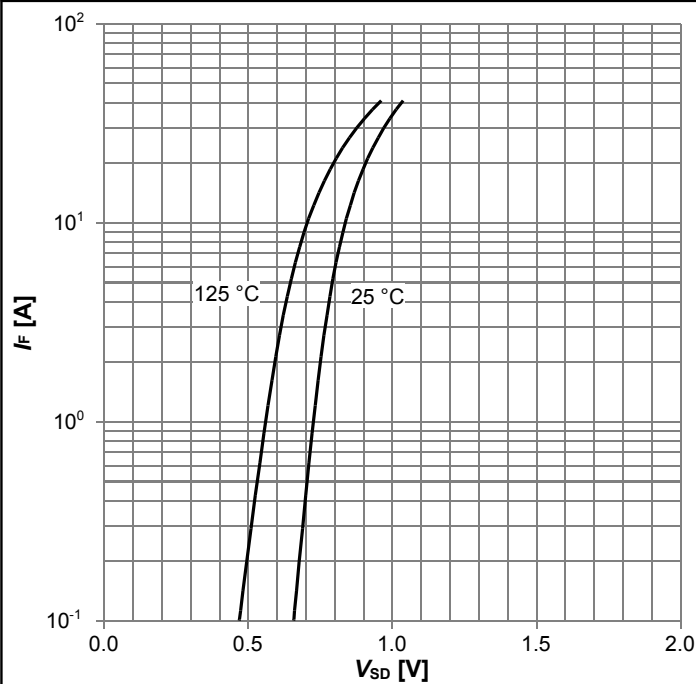

 $I_F = f(V_{SD}); \text{parameter: } T_j$

Diagram 16: Avalanche energy

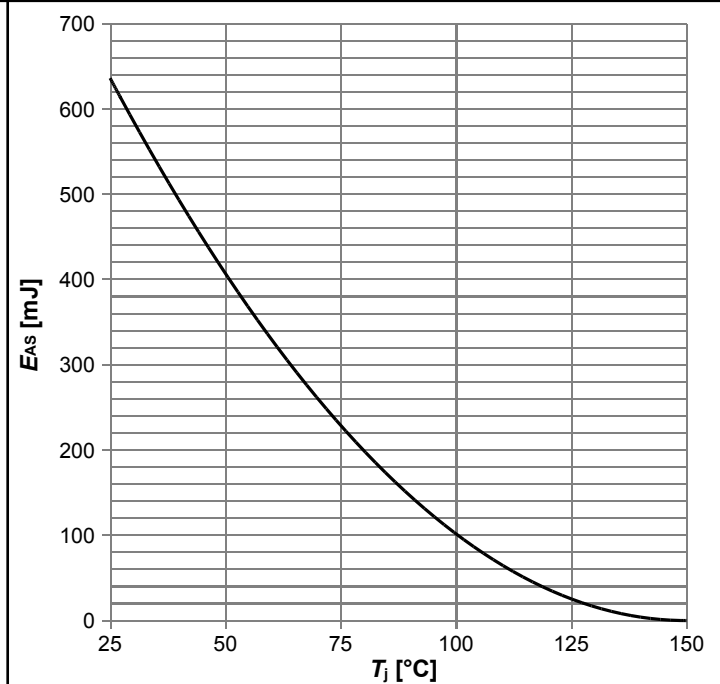
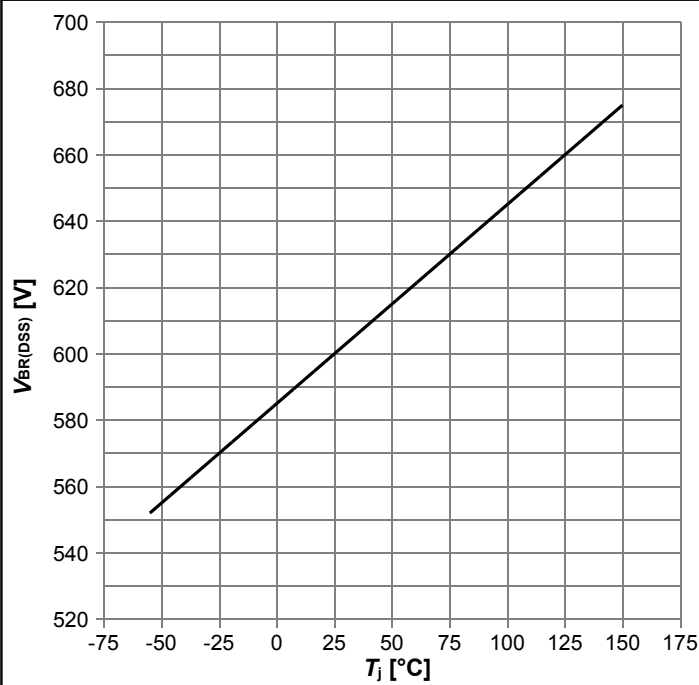
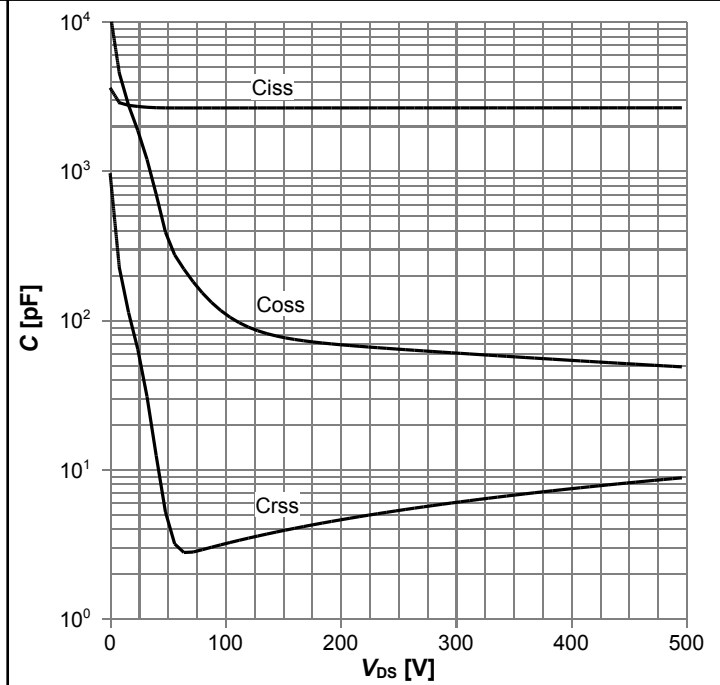

 $E_{AS} = f(T_j); I_D = 5.2 \text{ A}; V_{DD} = 50 \text{ V}$

Diagram 17: Drain-source breakdown voltage



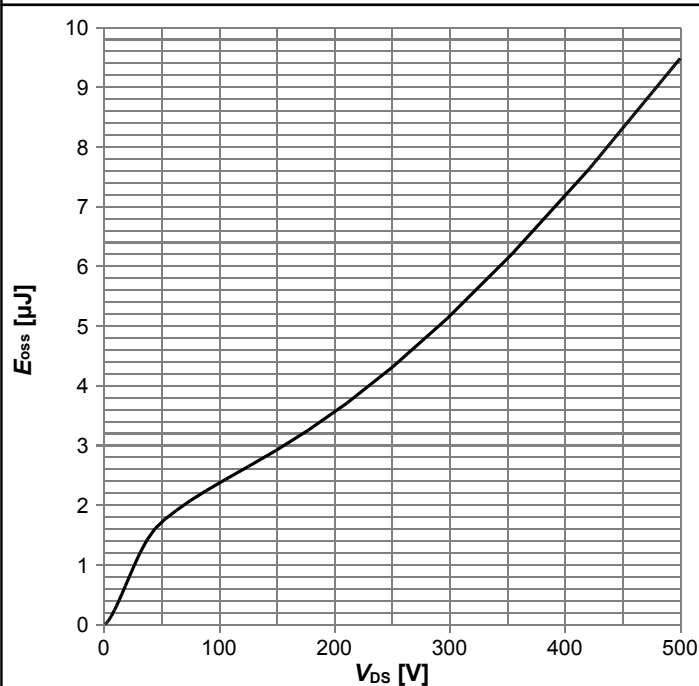
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$

Diagram 18: Typ. capacitances



$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$

Diagram 19: Typ. Coss stored energy



$$E_{oss} = f(V_{DS})$$

6 Test Circuits

Table 9 Diode characteristics

Test circuit for diode characteristics $R_{g1} = R_{g2}$	Diode recovery waveform $t_{rr} = t_F + t_S$ $Q_{rr} = Q_F + Q_S$
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Table 10 Switching times

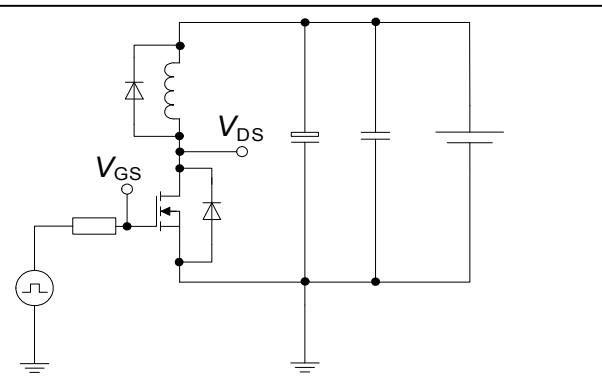
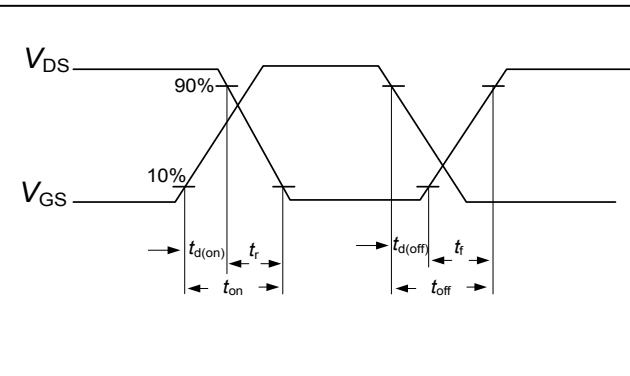
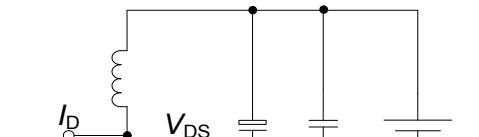
Switching times test circuit for inductive load	Switching times waveform
 The circuit diagram illustrates a MOSFET switching an inductive load. A pulse generator is connected to the gate of the MOSFET through a resistor, with the gate voltage labeled V_{GS}. The MOSFET's drain is connected to an inductive load (represented by an inductor and a diode in parallel) and a DC voltage source. The drain voltage V_{DS} is measured across the load. The load is connected to ground.	 The timing diagram shows the relationship between the drain-source voltage V_{DS} and the gate-source voltage V_{GS} during switching transitions. The V_{GS} waveform is a square wave, and the V_{DS} waveform shows the resulting voltage across the inductive load. Key switching times are marked: $t_{d(on)}$: Delay time from 10% V_{GS} to 90% V_{DS}. t_r: Rise time from 90% V_{DS} to 100% V_{DS}. t_{on}: Total turn-on time from 10% V_{GS} to 100% V_{DS}. $t_{d(off)}$: Delay time from 90% V_{DS} to 10% V_{GS}. t_f: Fall time from 10% V_{GS} to 100% V_{DS}. t_{off}: Total turn-off time from 90% V_{DS} to 10% V_{GS}.

Table 11 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform
	

7 Package Outlines

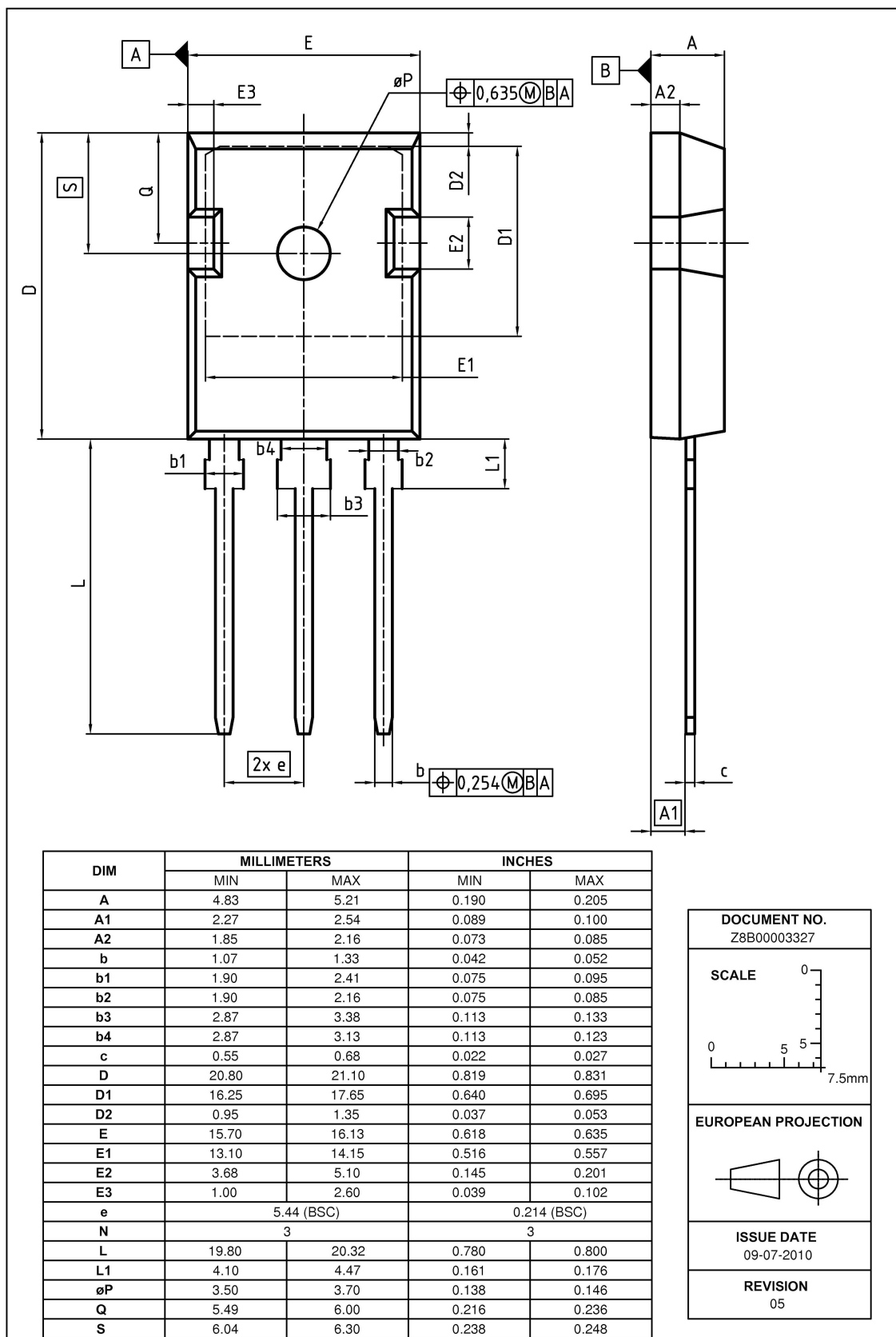


Figure 1 Outline PG-TO 247, dimensions in mm/inches

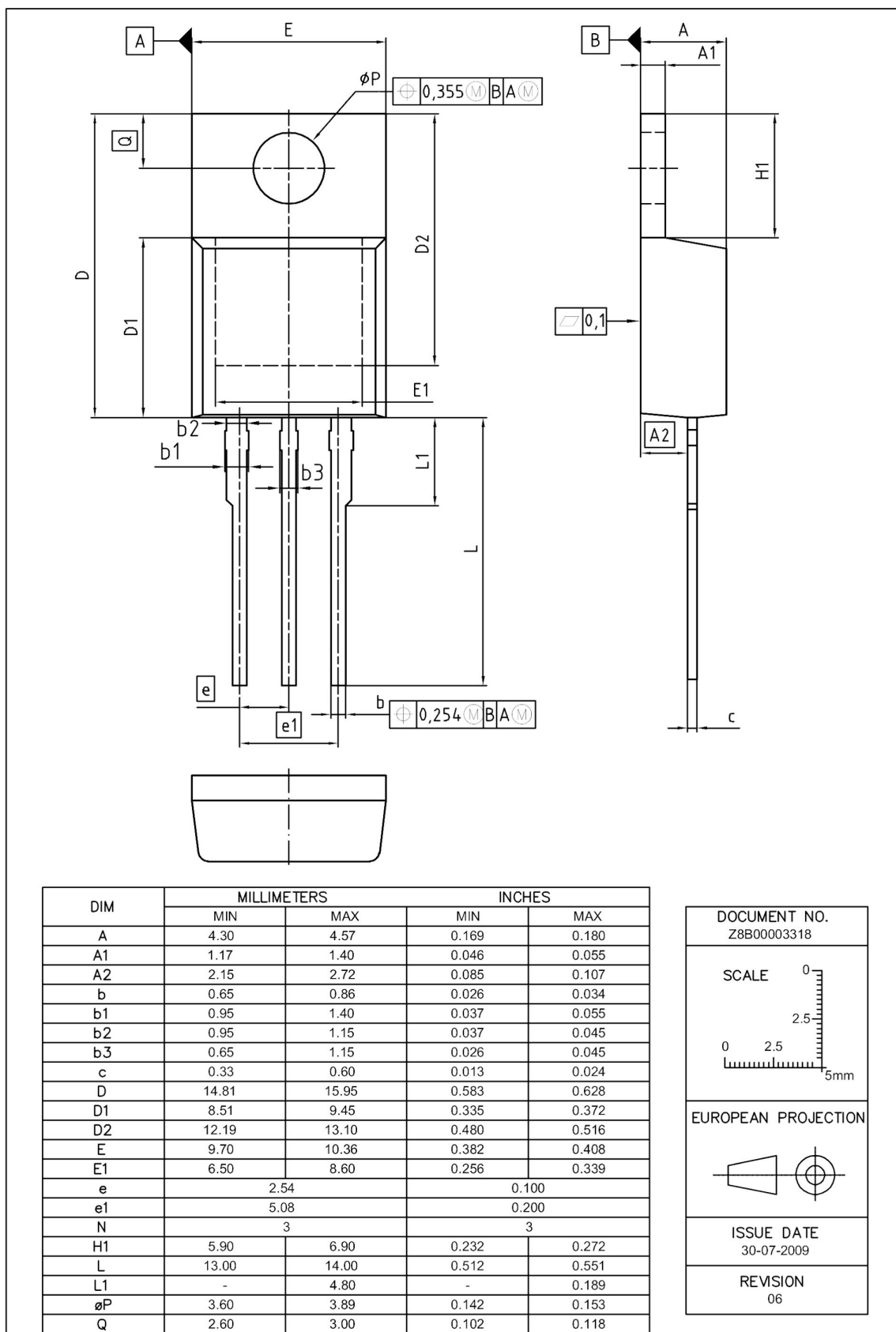


Figure 2 Outline PG-TO 220, dimensions in mm/inches

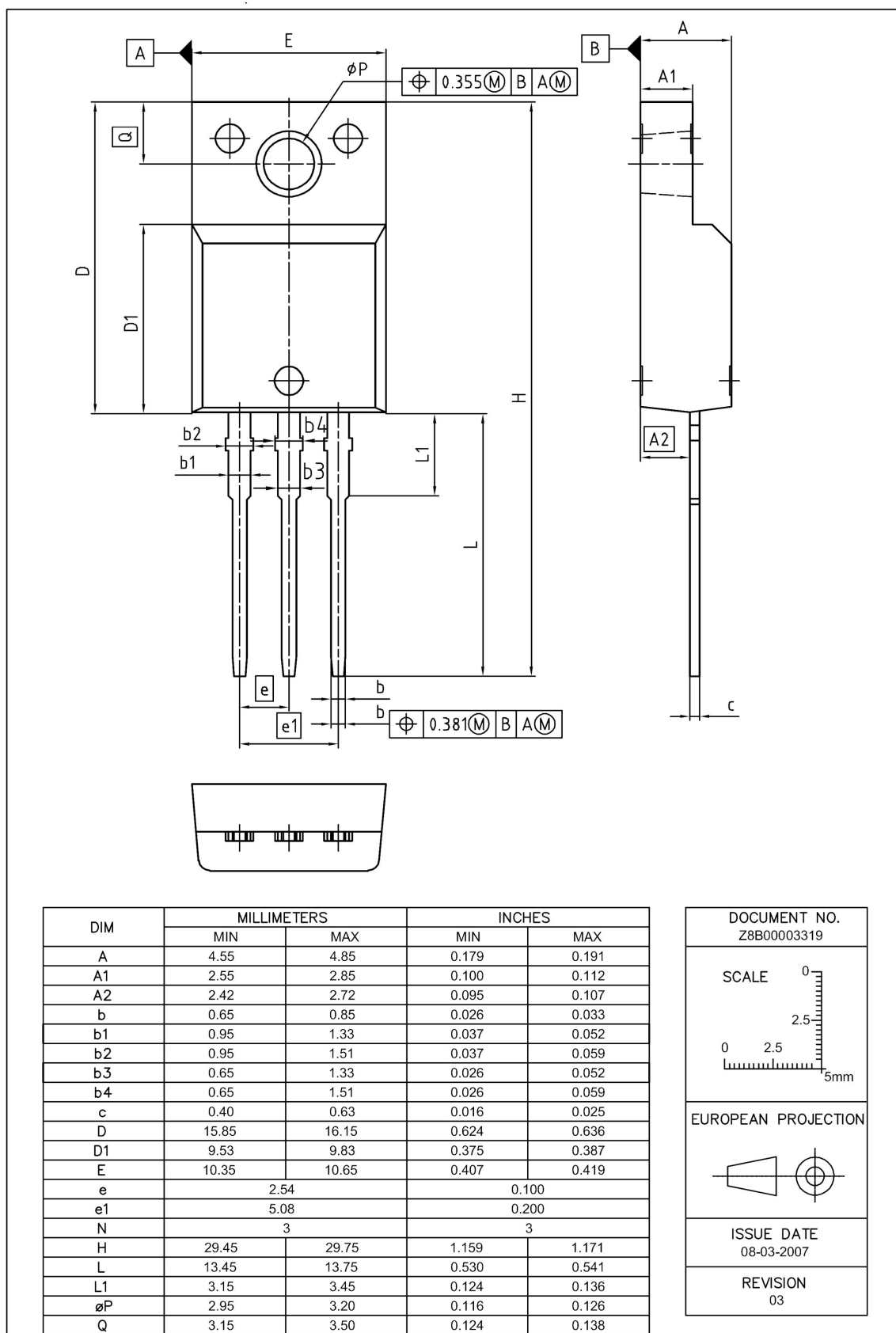


Figure 3 Outline PG-TO 220 FullPAK, dimensions in mm/inches

8 Appendix A

Table 12 Related Links

- IFX CoolMOS™ P6 Webpage: www.infineon.com
- IFX CoolMOS™ P6 application note: www.infineon.com
- IFX CoolMOS™ P6 simulation model: www.infineon.com
- IFX Design tools: www.infineon.com

Revision History

IPW60R125P6, IPP60R125P6, IPA60R125P6

Revision: 2014-03-07, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2014-03-07	Release of final version

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The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support, automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.



**Стандарт
Электрон
Связь**

Мы молодая и активно развивающаяся компания в области поставок электронных компонентов. Мы поставляем электронные компоненты отечественного и импортного производства напрямую от производителей и с крупнейших складов мира.

Благодаря сотрудничеству с мировыми поставщиками мы осуществляем комплексные и плановые поставки широчайшего спектра электронных компонентов.

Собственная эффективная логистика и склад в обеспечивает надежную поставку продукции в точно указанные сроки по всей России.

Мы осуществляем техническую поддержку нашим клиентам и предпродажную проверку качества продукции. На все поставляемые продукты мы предоставляем гарантию .

Осуществляем поставки продукции под контролем ВП МО РФ на предприятия военно-промышленного комплекса России , а также работаем в рамках 275 ФЗ с открытием отдельных счетов в уполномоченном банке. Система менеджмента качества компании соответствует требованиям ГОСТ ISO 9001.

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С нами вы становитесь еще успешнее!

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