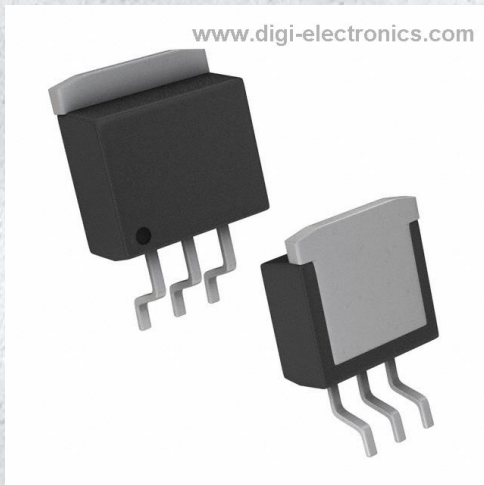


IPB60R230P6ATMA1 Datasheet



<https://www.DiGi-Electronics.com>

DiGi Electronics Part Number	IPB60R230P6ATMA1-DG
Manufacturer	Infineon Technologies
Manufacturer Product Number	IPB60R230P6ATMA1
Description	MOSFET N-CH 600V 16.8A TO263-3
Detailed Description	N-Channel 600 V 16.8A (Tc) 126W (Tc) Surface Mount PG-TO263-3-1



Tel: +00 852-30501935

RFQ Email: Info@DiGi-Electronics.com

DiGi is a global authorized distributor of electronic components.

Purchase and inquiry

Manufacturer Product Number:

IPB60R230P6ATMA1

Series:

CoolMOST™ P6

FET Type:

N-Channel

Drain to Source Voltage (Vdss):

600 V

Drive Voltage (Max Rds On, Min Rds On):

10V

Vgs(th) (Max) @ Id:

4.5V @ 530µA

Vgs (Max):

±20V

FET Feature:

-

Operating Temperature:

-55°C ~ 150°C (Tj)

Supplier Device Package:

PG-T0263-3-1

Base Product Number:

IPB60R

Manufacturer:

Infineon Technologies

Product Status:

Obsolete

Technology:

MOSFET (Metal Oxide)

Current - Continuous Drain (Id) @ 25°C:

16.8A (Tc)

Rds On (Max) @ Id, Vgs:

230mOhm @ 6.4A, 10V

Gate Charge (Qg) (Max) @ Vgs:

31 nC @ 10 V

Input Capacitance (Ciss) (Max) @ Vds:

1450 pF @ 100 V

Power Dissipation (Max):

126W (Tc)

Mounting Type:

Surface Mount

Package / Case:

TO-263-4, D2PAK (3 Leads + Tab), TO-263AA

Environmental & Export classification

Moisture Sensitivity Level (MSL):

1 (Unlimited)

ECCN:

EAR99

REACH Status:

REACH Unaffected

HTSUS:

8541.29.0095



MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ P6

600V CoolMOS™ P6 Power Transistor
IPx60R230P6

Data Sheet

Rev. 2.2
Final

Power Management & Multimarket



600V CoolMOS™ P6 Power Transistor

IPW60R230P6, IPB60R230P6, IPP60R230P6,
IPA60R230P6

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.

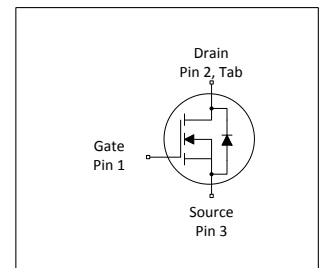
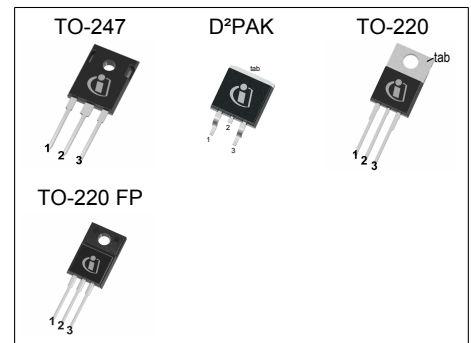


Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	650	V
$R_{DS(on),max}$	230	mΩ
$Q_{g,typ}$	31	nC
$I_{D,pulse}$	48	A
$E_{oss@400V}$	4.2	μJ
Body diode di/dt	500	A/μs

Type / Ordering Code	Package	Marking	Related Links
IPW60R230P6	PG-TO 247	6R230P6	see Appendix A
IPB60R230P6	PG-TO 263		
IPP60R230P6	PG-TO 220		
IPA60R230P6	PG-TO 220 FullPAK		



600V CoolMOS™ P6 Power Transistor
 IPW60R230P6, IPB60R230P6, IPP60R230P6,
 IPA60R230P6

Table of Contents

Description	2
Maximum ratings	4
Thermal characteristics	5
Electrical characteristics	6
Electrical characteristics diagrams	8
Test Circuits	13
Package Outlines	14
Appendix A	18
Revision History	19
Disclaimer	19



600V CoolMOS™ P6 Power Transistor

IPW60R230P6, IPB60R230P6, IPP60R230P6,
IPA60R230P6

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	-	-	16.8 10.7	A	$T_C=25^\circ\text{C}$ $T_C=100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$	-	-	48	A	$T_C=25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}	-	-	352	mJ	$I_D=2.9\text{A}$; $V_{DD}=50\text{V}$; see table 12
Avalanche energy, repetitive	E_{AR}	-	-	0.53	mJ	$I_D=2.9\text{A}$; $V_{DD}=50\text{V}$; see table 12
Avalanche current, repetitive	I_{AR}	-	-	2.9	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-263, TO-247	P_{tot}	-	-	126	W	$T_C=25^\circ\text{C}$
Power dissipation (FullPAK) TO-220FP	P_{tot}	-	-	33	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	-	-	14.5	A	$T_C=25^\circ\text{C}$
Diode pulse current ²⁾	$I_{S,pulse}$	-	-	48	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 10
Maximum diode commutation speed	di/dt	-	-	500	A/ μs	$V_{DS}=0\dots400\text{V}$, $I_{SD}\leq I_S$, $T_j=25^\circ\text{C}$ see table 10
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



600V CoolMOS™ P6 Power Transistor
IPW60R230P6, IPB60R230P6, IPP60R230P6,
IPA60R230P6

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}	-	-	0.99	°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}	-	-	3.8	°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

Table 5 Thermal characteristics TO-263

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	0.99	°C/W	-
Thermal resistance, junction - ambient	R_{thJA}	-	-	62	°C/W	device on PCB, minimal footprint
Thermal resistance, junction - ambient for SMD version	R_{thJA}	-	35	45	°C/W	Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm ² (one layer, 70µm thickness) copper area for drain connection and cooling. PCB is vertical without air stream cooling.
Soldering temperature, wave & reflow soldering allowed	T_{sold}	-	-	260	°C	reflow MSL1



600V CoolMOS™ P6 Power Transistor

IPW60R230P6, IPB60R230P6, IPP60R230P6,
IPA60R230P6

4 Electrical characteristics

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

Table 6 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	$V_{DS}=V_{GS}$, $I_D=0.53\text{mA}$
Zero gate voltage drain current	I_{DSS}	-	-	1	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	$R_{DS(on)}$	-	0.207 0.538	0.230 -	Ω	$V_{GS}=10\text{V}$, $I_D=6.4\text{A}$, $T_j=25^\circ\text{C}$ $V_{GS}=10\text{V}$, $I_D=6.4\text{A}$, $T_j=150^\circ\text{C}$
Gate resistance	R_G	-	4.4	-	Ω	$f=1\text{MHz}$, open drain

Table 7 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	1450	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=100\text{V}$, $f=1\text{MHz}$
Output capacitance	C_{oss}	-	64	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=100\text{V}$, $f=1\text{MHz}$
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$	-	52	-	pF	$V_{GS}=0\text{V}$, $V_{DS}=0\dots400\text{V}$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$	-	220	-	pF	$I_D=\text{constant}$, $V_{GS}=0\text{V}$, $V_{DS}=0\dots400\text{V}$
Turn-on delay time	$t_{d(on)}$	-	12	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=8\text{A}$, $R_G=3.4\Omega$; see table 11
Rise time	t_r	-	7	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=8\text{A}$, $R_G=3.4\Omega$; see table 11
Turn-off delay time	$t_{d(off)}$	-	38	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=8\text{A}$, $R_G=3.4\Omega$; see table 11
Fall time	t_f	-	6	-	ns	$V_{DD}=400\text{V}$, $V_{GS}=13\text{V}$, $I_D=8\text{A}$, $R_G=3.4\Omega$; see table 11

Table 8 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	9	-	nC	$V_{DD}=400\text{V}$, $I_D=8\text{A}$, $V_{GS}=0$ to 10V
Gate to drain charge	Q_{gd}	-	11	-	nC	$V_{DD}=400\text{V}$, $I_D=8\text{A}$, $V_{GS}=0$ to 10V
Gate charge total	Q_g	-	31	-	nC	$V_{DD}=400\text{V}$, $I_D=8\text{A}$, $V_{GS}=0$ to 10V
Gate plateau voltage	$V_{plateau}$	-	6.1	-	V	$V_{DD}=400\text{V}$, $I_D=8\text{A}$, $V_{GS}=0$ 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



600V CoolMOS™ P6 Power Transistor
 IPW60R230P6, IPB60R230P6, IPP60R230P6,
 IPA60R230P6

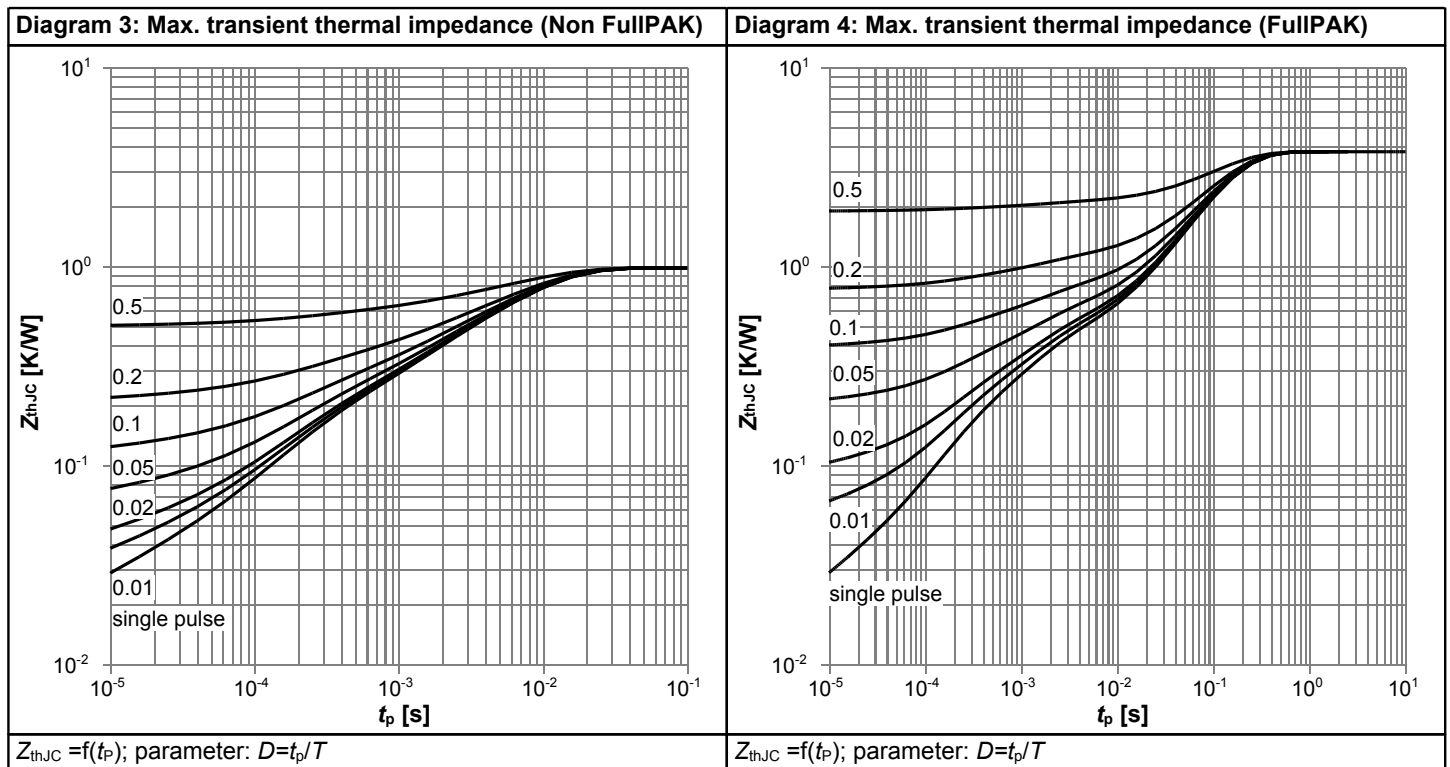
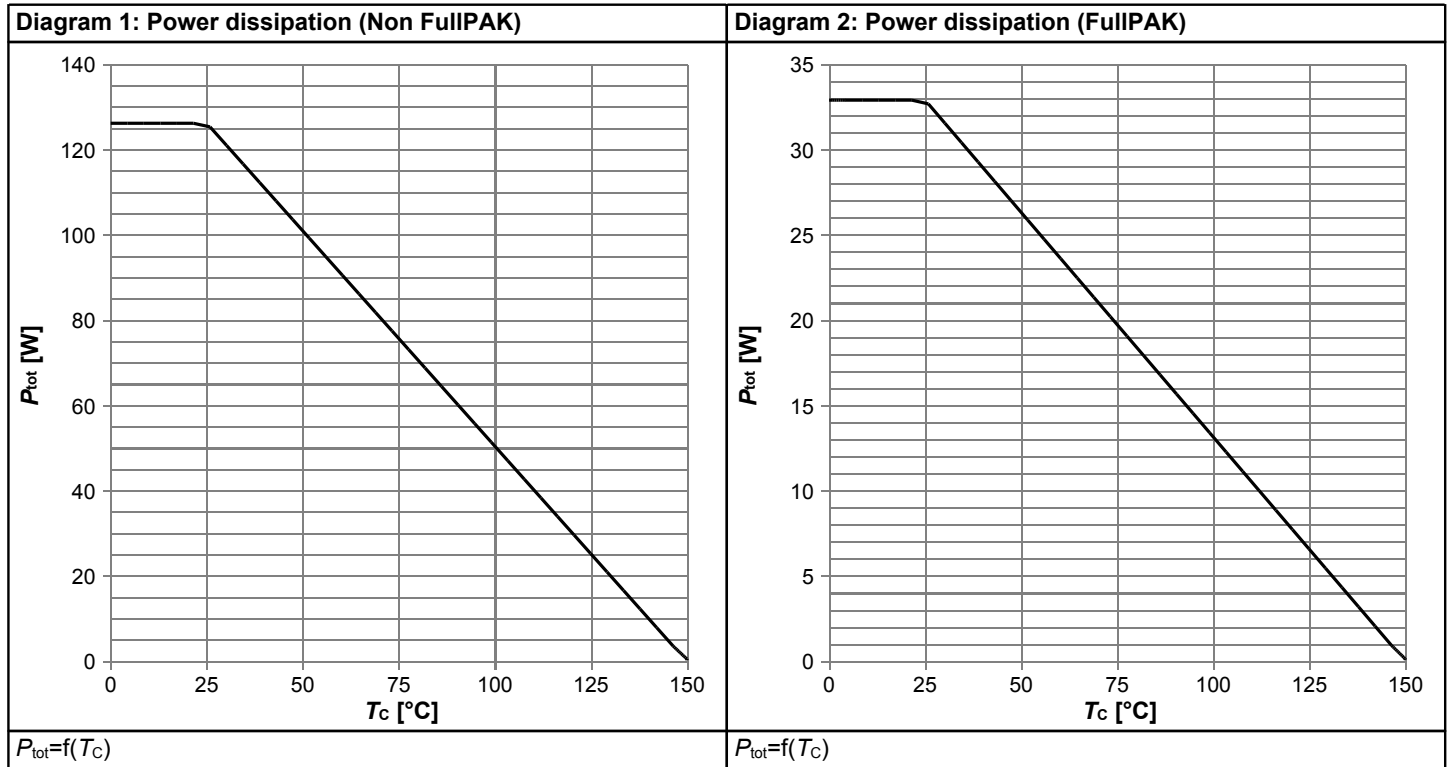
Table 9 Reverse diode characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}	-	0.9	-	V	$V_{GS}=0V, I_F=8A, T_j=25^\circ C$
Reverse recovery time	t_{rr}	-	282	-	ns	$V_R=400V, I_F=8A, di_F/dt=100A/\mu s$; see table 10
Reverse recovery charge	Q_{rr}	-	3.4	-	μC	$V_R=400V, I_F=8A, di_F/dt=100A/\mu s$; see table 10
Peak reverse recovery current	I_{rrm}	-	24	-	A	$V_R=400V, I_F=8A, di_F/dt=100A/\mu s$; see table 10



600V CoolMOS™ P6 Power Transistor
 IPW60R230P6, IPB60R230P6, IPP60R230P6,
 IPA60R230P6

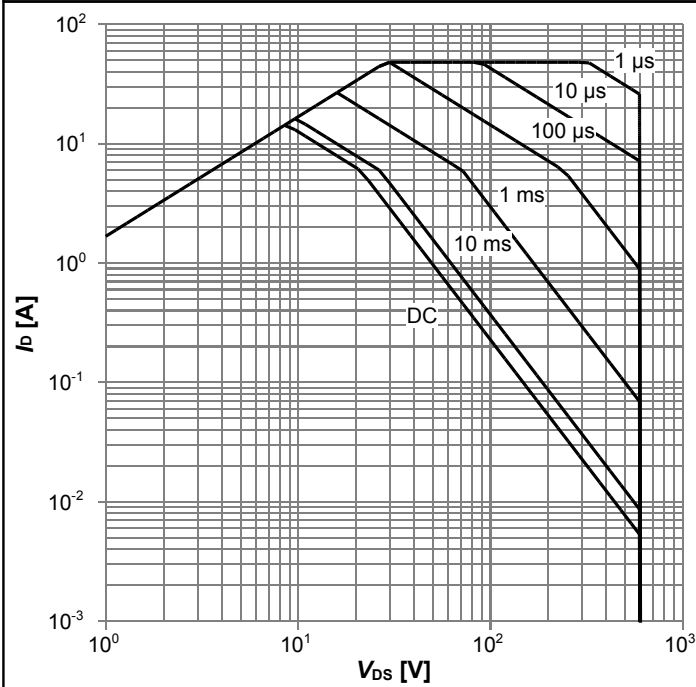
5 Electrical characteristics diagrams





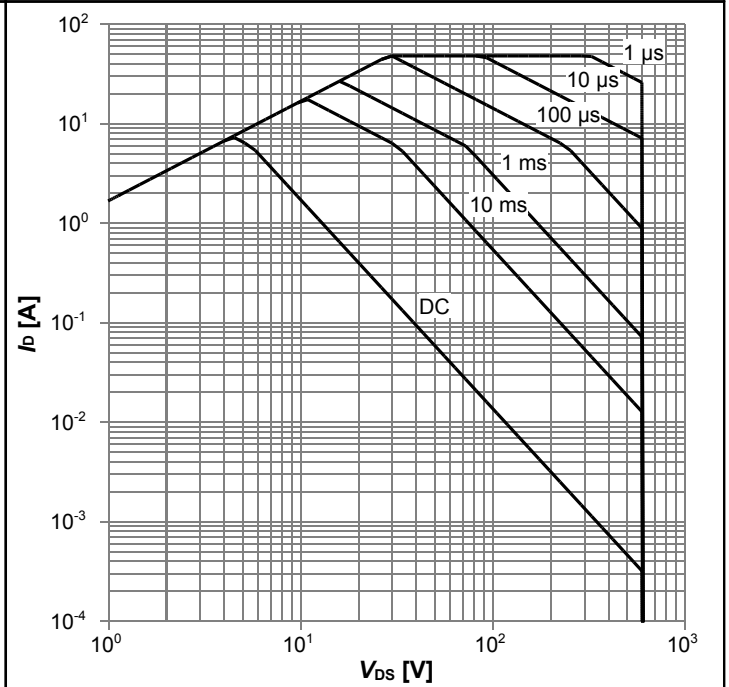
600V CoolMOS™ P6 Power Transistor
 IPW60R230P6, IPB60R230P6, IPP60R230P6,
 IPA60R230P6

Diagram 5: Safe operating area (Non FullPAK)



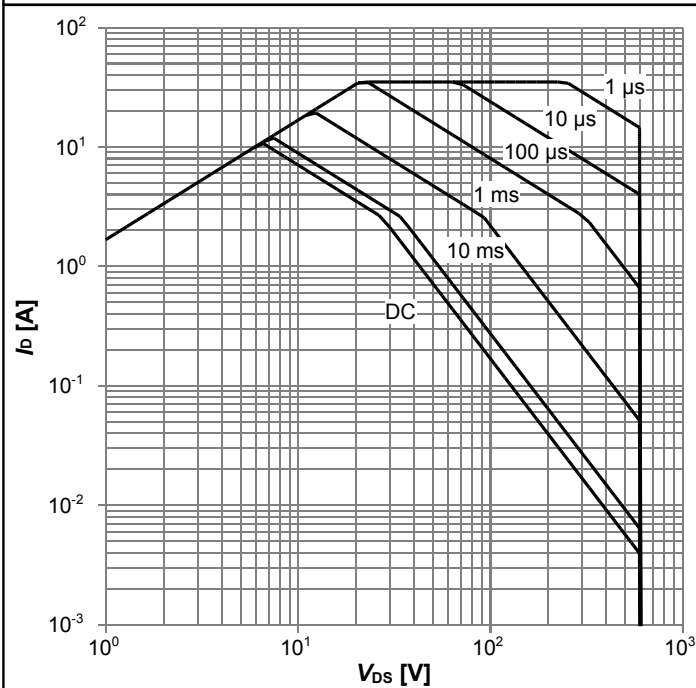
$I_D=f(V_{DS}); T_C=25\text{ °C}; D=0; \text{parameter: } t_p$

Diagram 6: Safe operating area (FullPAK)



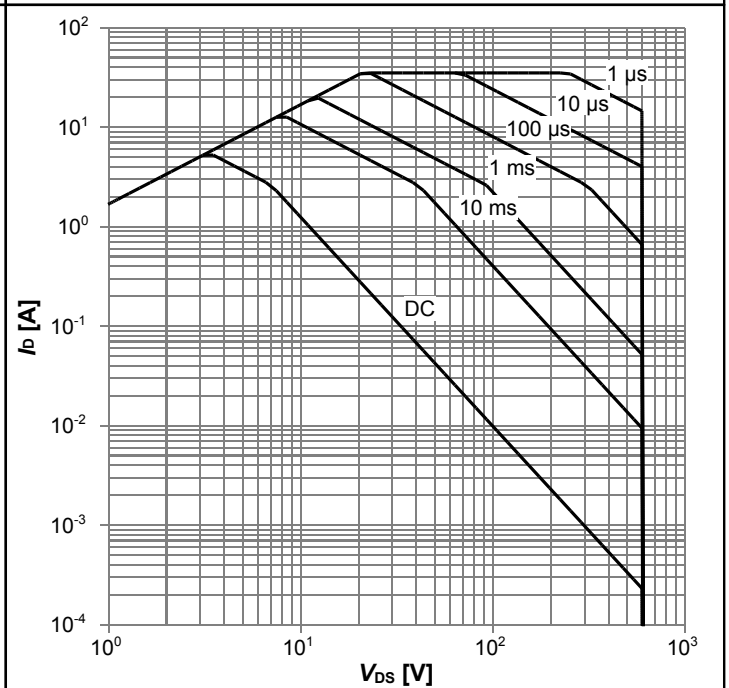
$I_D=f(V_{DS}); T_C=25\text{ °C}; D=0; \text{parameter: } t_p$

Diagram 7: Safe operating area (Non FullPAK)



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

Diagram 8: Safe operating area (FullPAK)

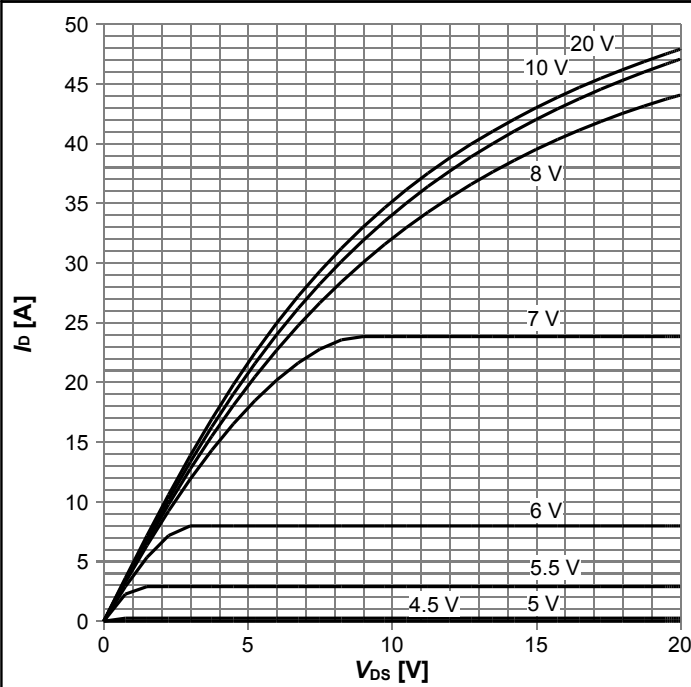


$I_D=f(V_{DS}); T_C=80\text{ °C}; D=0; \text{parameter: } t_p$



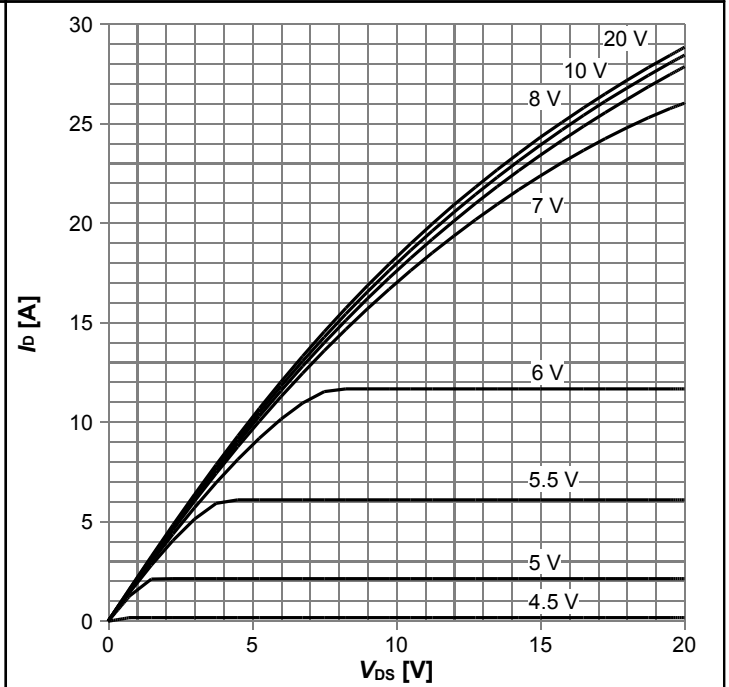
600V CoolMOS™ P6 Power Transistor
 IPW60R230P6, IPB60R230P6, IPP60R230P6,
 IPA60R230P6

Diagram 9: Typ. output characteristics



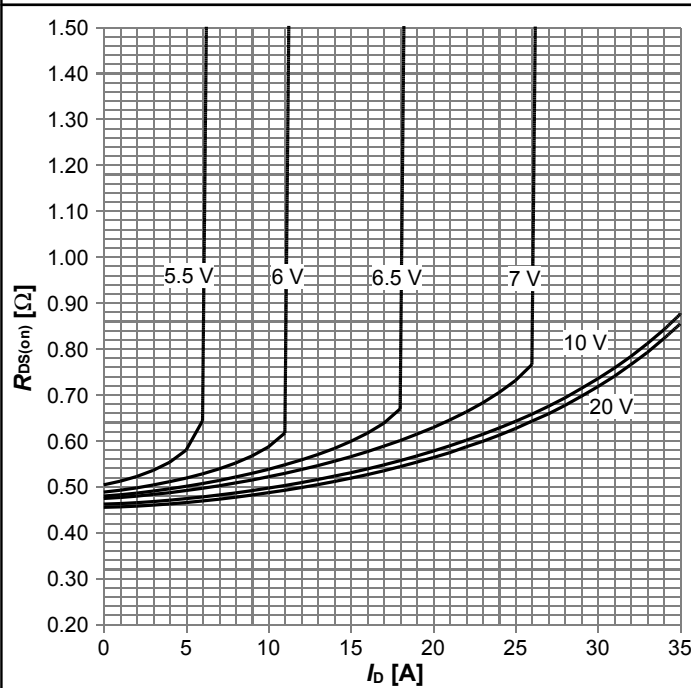
$I_D = f(V_{DS})$; $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 10: Typ. output characteristics



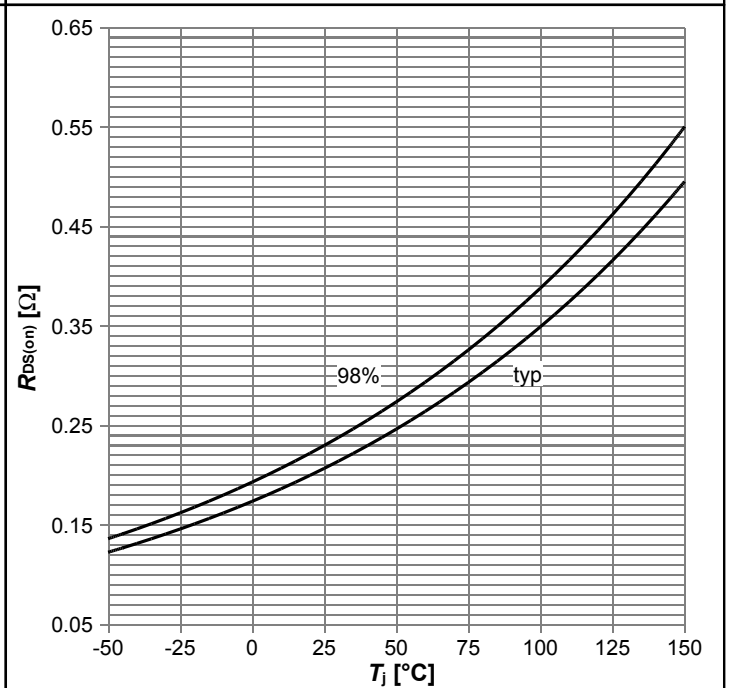
$I_D = f(V_{DS})$; $T_j = 125^\circ\text{C}$; parameter: V_{GS}

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



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

Diagram 12: Drain-source on-state resistance

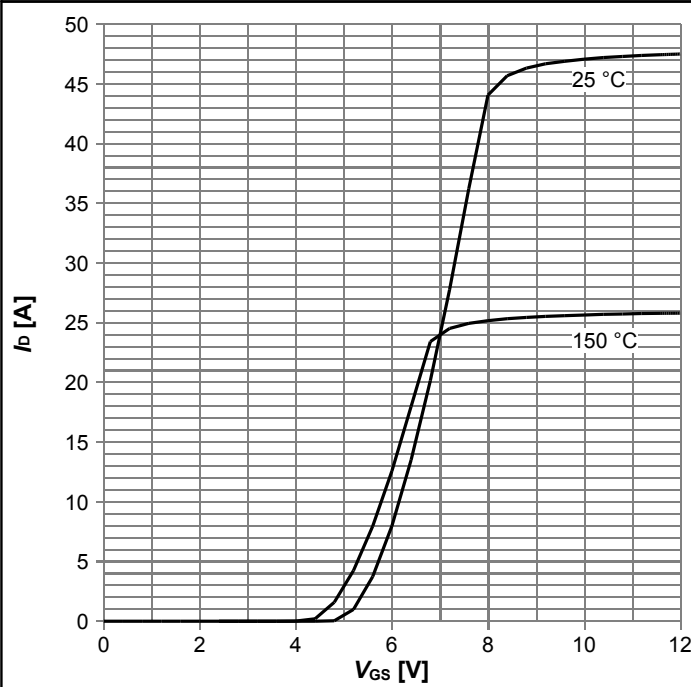


$R_{DS(on)} = f(T_j)$; $I_D = 6.4\text{ A}$; $V_{GS} = 10\text{ V}$



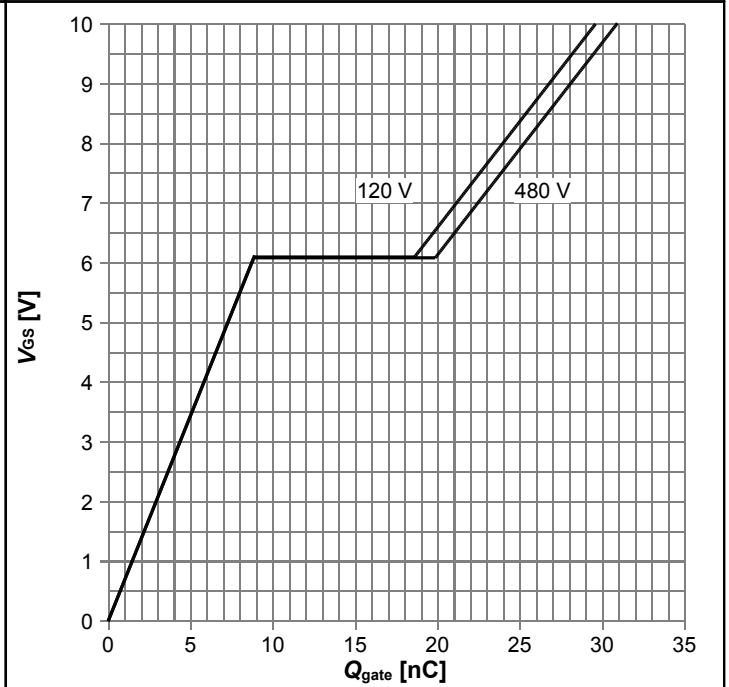
600V CoolMOS™ P6 Power Transistor
 IPW60R230P6, IPB60R230P6, IPP60R230P6,
 IPA60R230P6

Diagram 13: Typ. transfer characteristics



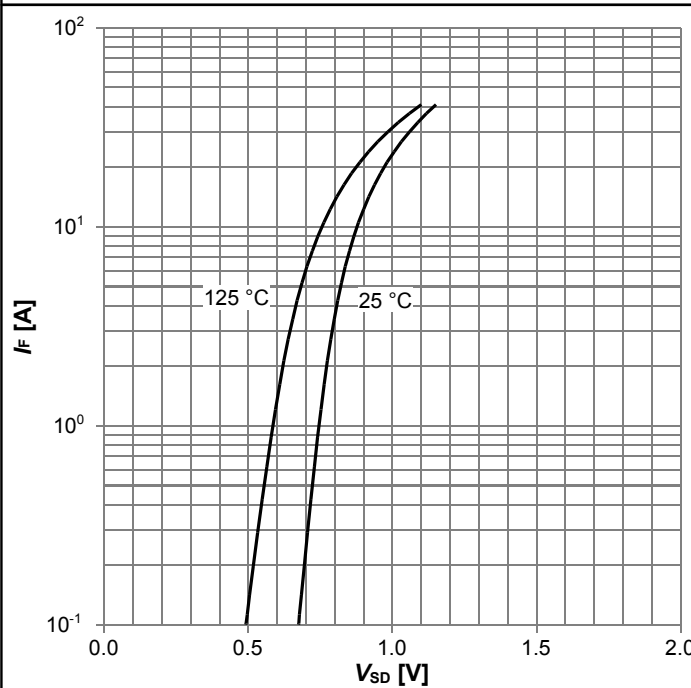
$I_D=f(V_{GS}); V_{DS}=20V; \text{parameter: } T_j$

Diagram 14: Typ. gate charge



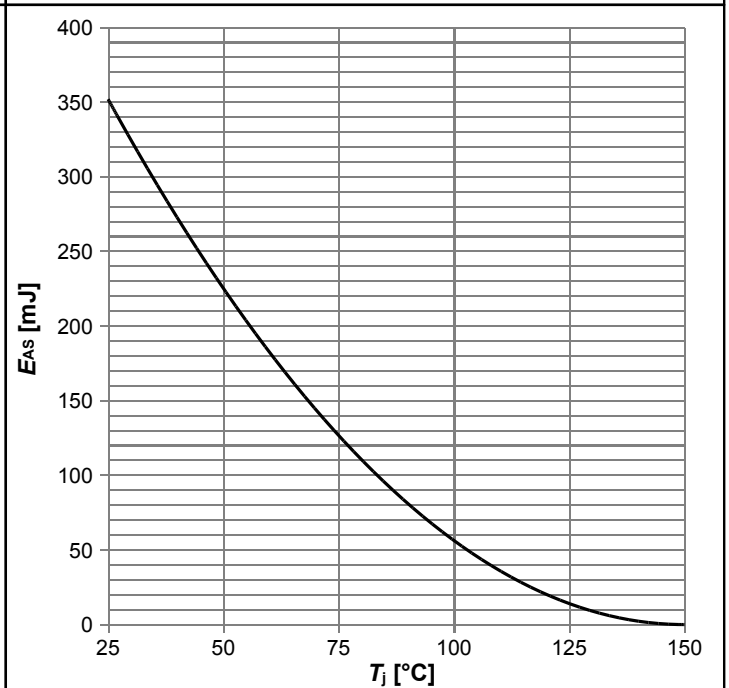
$V_{GS}=f(Q_{gate}); I_D=8.0 \text{ A pulsed}; \text{parameter: } V_{DD}$

Diagram 15: Forward characteristics of reverse diode



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

Diagram 16: Avalanche energy

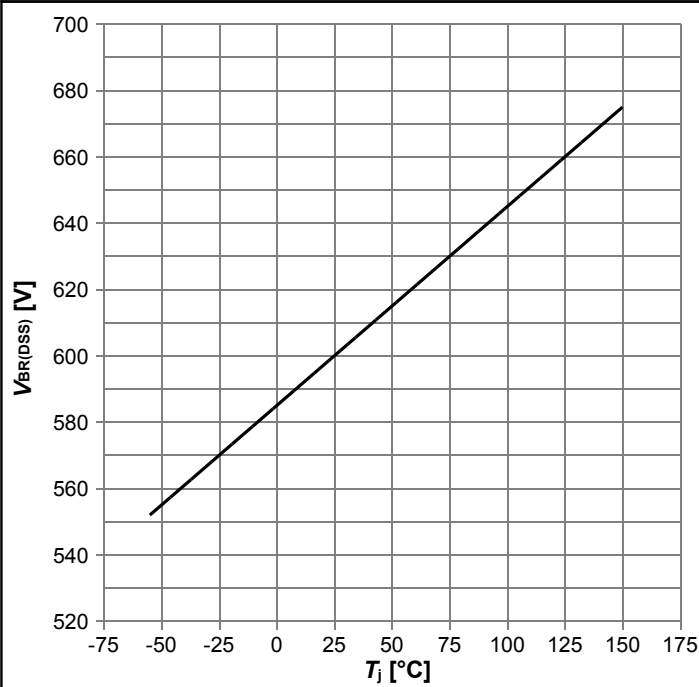


$E_{AS}=f(T_j); I_D=2.9 \text{ A}; V_{DD}=50 \text{ V}$



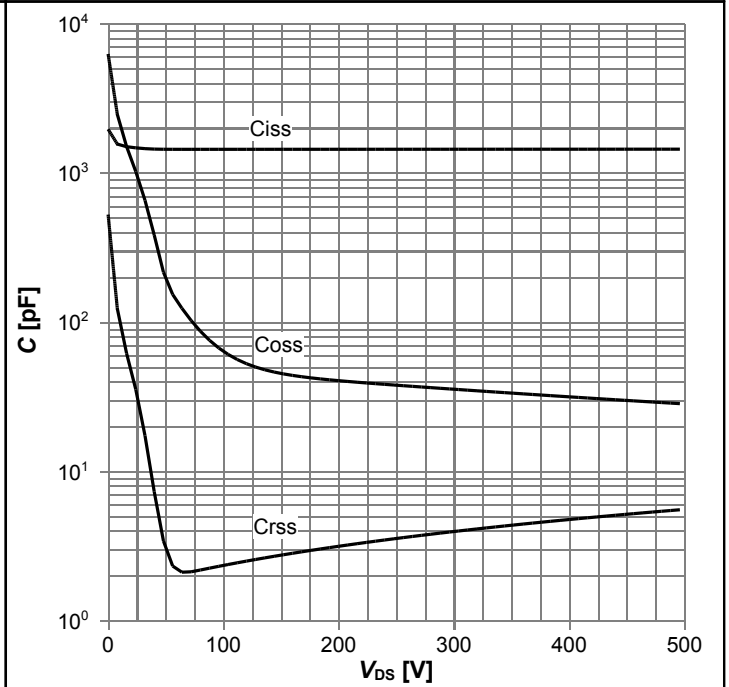
600V CoolMOS™ P6 Power Transistor
 IPW60R230P6, IPB60R230P6, IPP60R230P6,
 IPA60R230P6

Diagram 17: Drain-source breakdown voltage



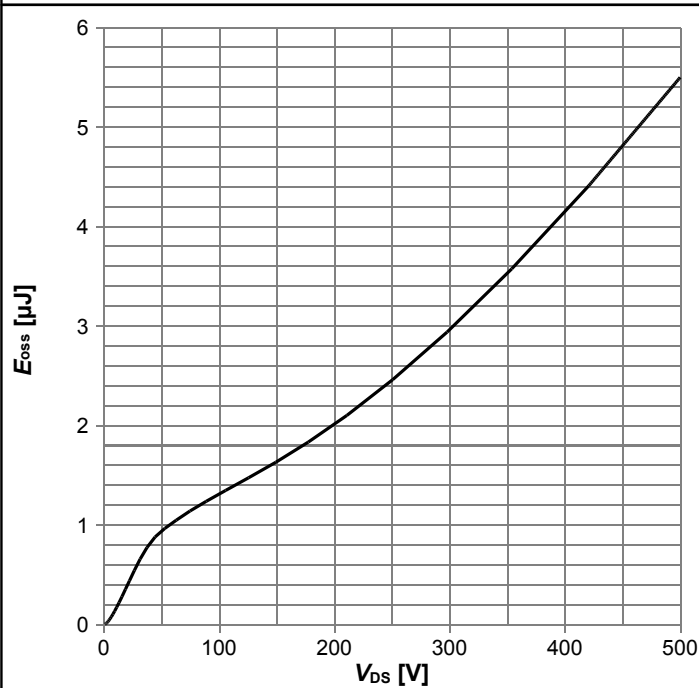
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$

Diagram 18: Typ. capacitances



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

Diagram 19: Typ. Coss stored energy



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



600V CoolMOS™ P6 Power Transistor
 IPW60R230P6, IPB60R230P6, IPP60R230P6,
 IPA60R230P6

6 Test Circuits

Table 10 Diode characteristics

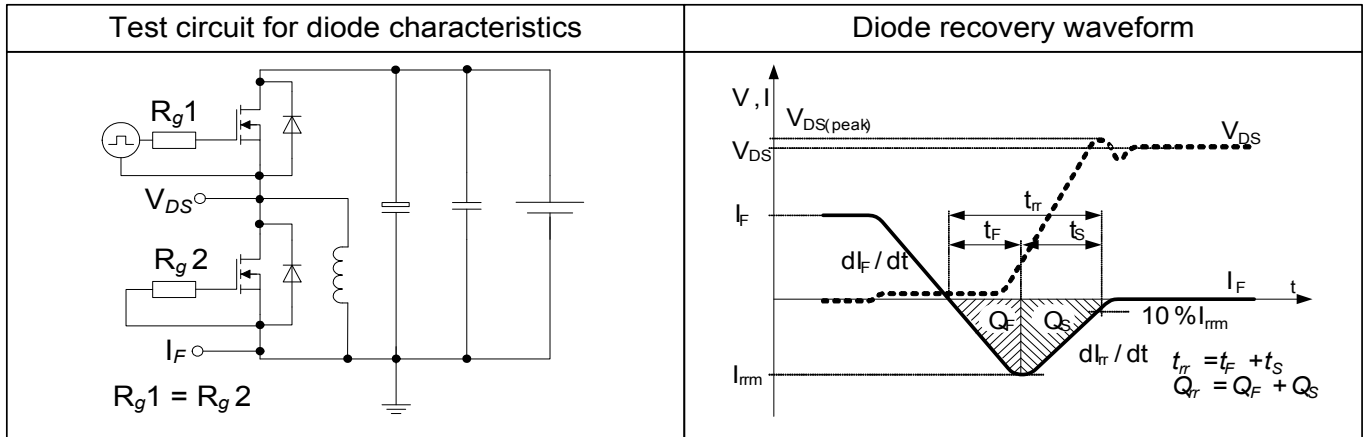


Table 11 Switching times

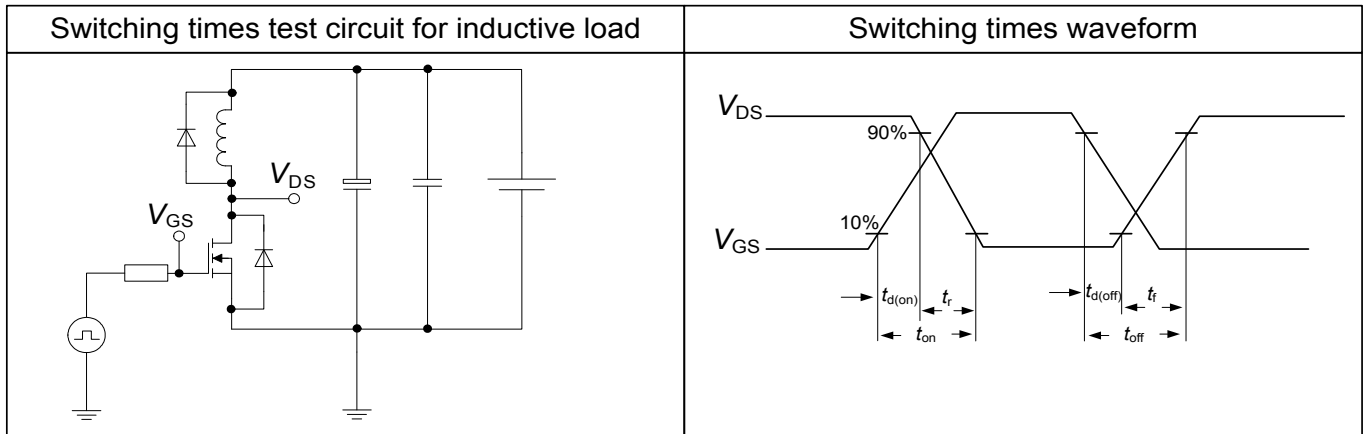
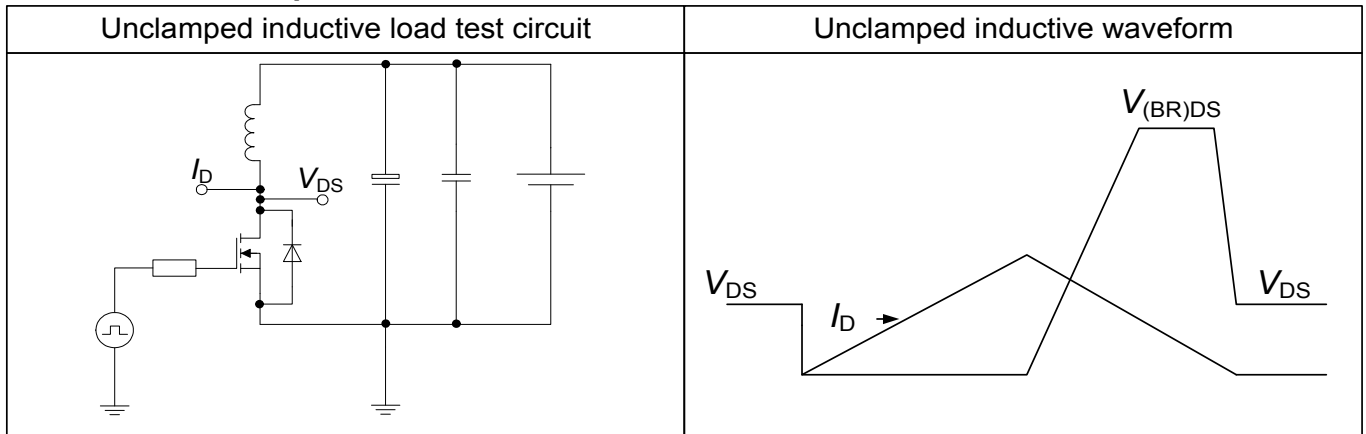


Table 12 Unclamped inductive load





600V CoolMOS™ P6 Power Transistor
 IPW60R230P6, IPB60R230P6, IPP60R230P6,
 IPA60R230P6

7 Package Outlines

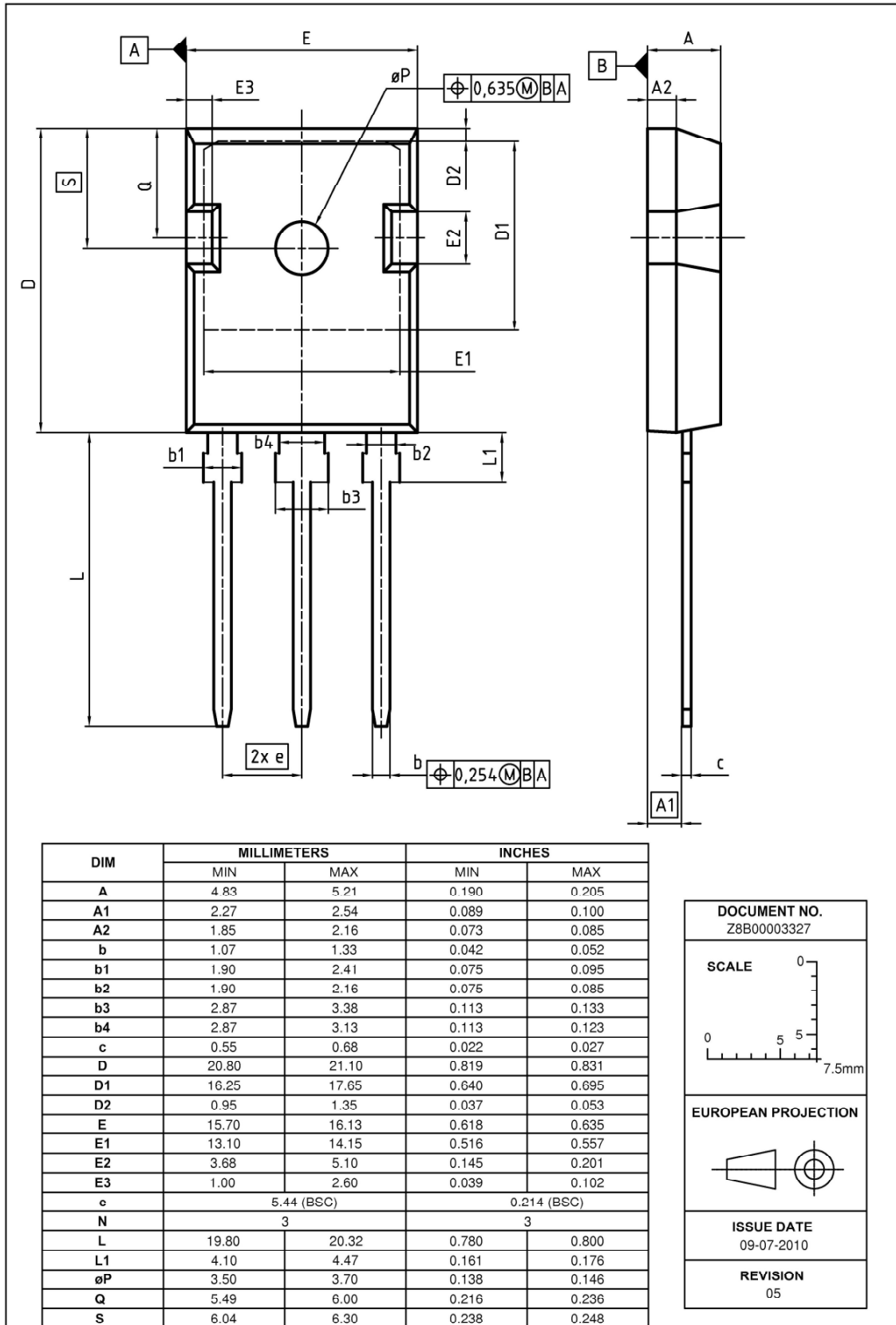


Figure 1 Outline PG-TO 247, dimensions in mm/inches



600V CoolMOS™ P6 Power Transistor
 IPW60R230P6, IPB60R230P6, IPP60R230P6,
 IPA60R230P6

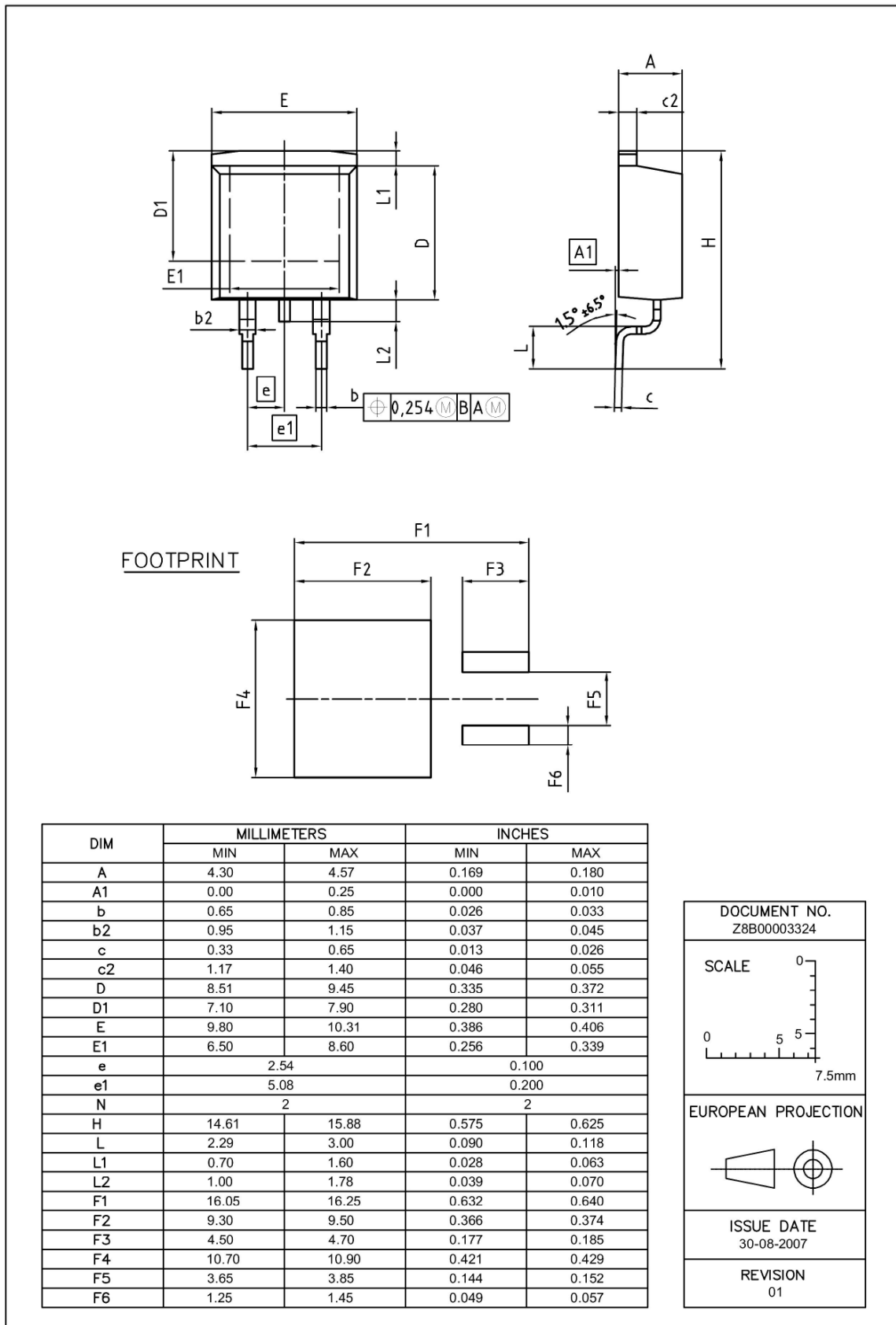


Figure 2 Outline PG-TO 263, dimensions in mm/inches



600V CoolMOS™ P6 Power Transistor
 IPW60R230P6, IPB60R230P6, IPP60R230P6,
 IPA60R230P6

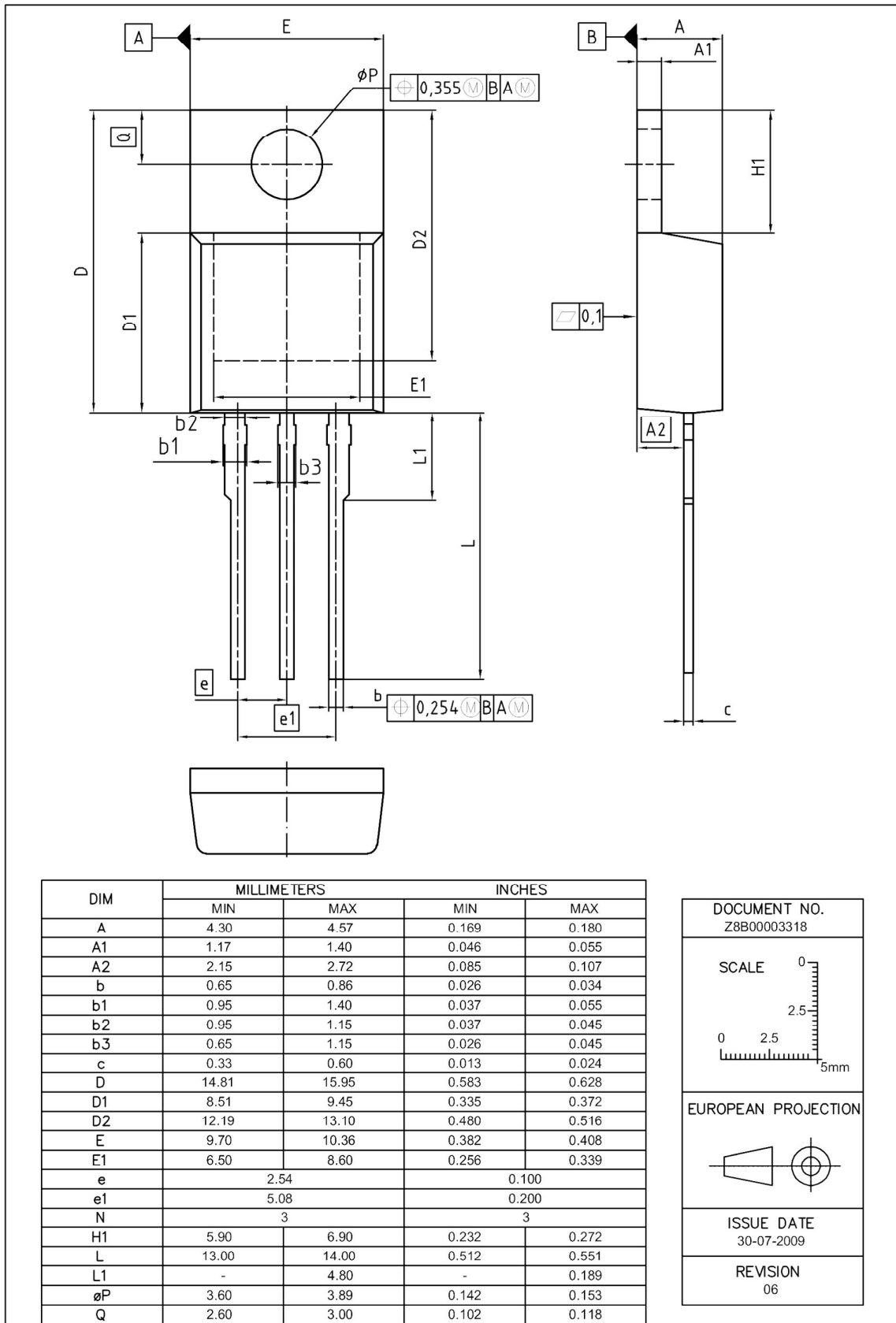
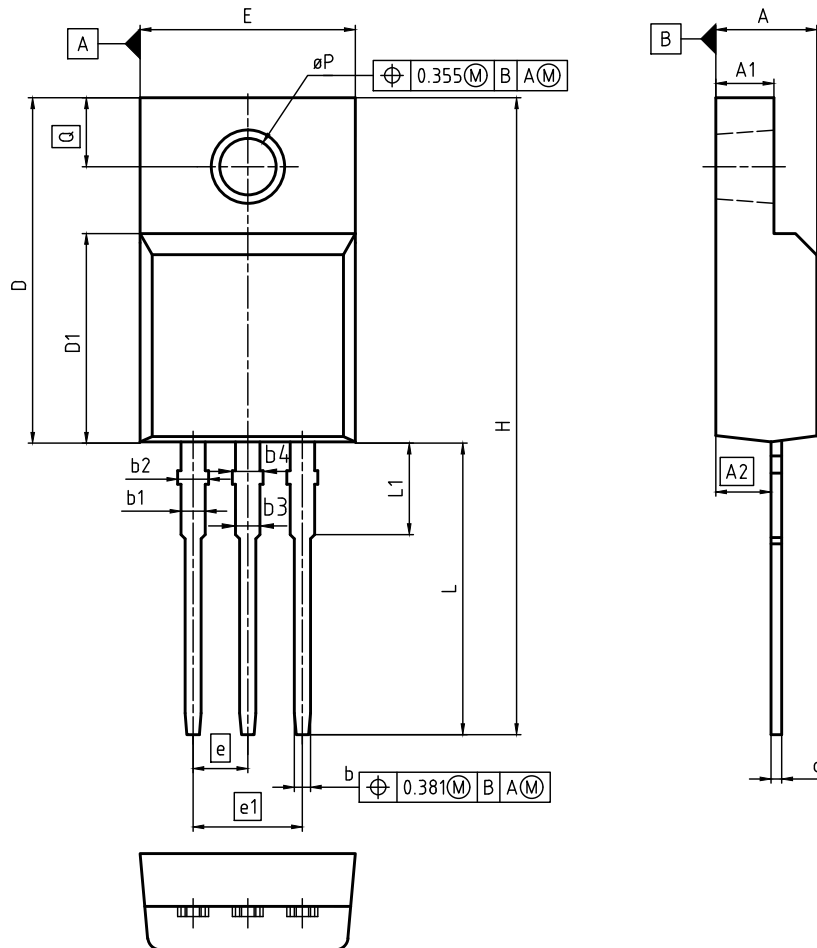


Figure 3 Outline PG-TO 220, dimensions in mm/inches



600V CoolMOS™ P6 Power Transistor
 IPW60R230P6, IPB60R230P6, IPP60R230P6,
 IPA60R230P6



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.50	4.90	0.177	0.193
A1	2.34	2.85	0.092	0.112
A2	2.42	2.86	0.095	0.113
b	0.65	0.90	0.026	0.035
b1	0.95	1.38	0.037	0.054
b2	0.95	1.51	0.037	0.059
b3	0.65	1.38	0.026	0.054
b4	0.65	1.51	0.026	0.059
c	0.40	0.63	0.016	0.025
D	15.67	16.15	0.617	0.636
D1	8.97	9.83	0.353	0.387
E	10.00	10.65	0.394	0.419
e	2.54 (BSC)		0.100 (BSC)	
e1	5.08		0.200	
N	3		3	
H	28.70	29.75	1.130	1.171
L	12.78	13.75	0.503	0.541
L1	2.83	3.45	0.111	0.136
øP	2.95	3.38	0.116	0.133
Q	3.15	3.50	0.124	0.138

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SCALE

EUROPEAN PROJECTION

ISSUE DATE
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04

Figure 4 Outline PG-TO 220 FullPAK, dimensions in mm/inches



8 Appendix A

Table 13 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



600V CoolMOS™ P6 Power Transistor

IPW60R230P6, IPB60R230P6, IPP60R230P6,
IPA60R230P6

Revision History

IPW60R230P6, IPB60R230P6, IPP60R230P6, IPA60R230P6

Revision: 2015-07-10, Rev. 2.2

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2013-12-04	Release of final version
2.1	2013-12-05	Release of multi-package datasheet
2.2	2015-07-10	PG-TO 263 package added

We Listen to Your Comments

Any information within this document that you feel is wrong, unclear or missing at all? Your feedback will help us to continuously improve the quality of this document. Please send your proposal (including a reference to this document) to:

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