

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CoolMOS™ E6 600V

600V CoolMOS™ E6 Power Transistor
IPx60R190E6

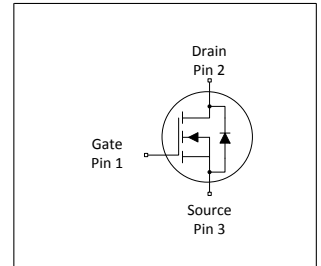
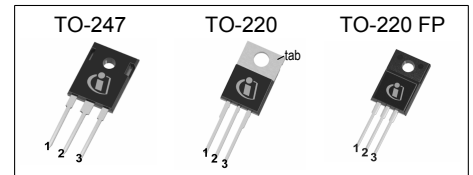
Data Sheet

Rev. 2.2
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™ E6 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 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, Adapter, LCD & PDP TV, Lighting, Server, Telecom and UPS.



Table 1 Key Performance Parameters

Parameter	Value	Unit
$V_{DS} @ T_{j,max}$	650	V
$R_{DS(on),max}$	0.19	Ω
Q_g,typ	63	nC
$I_{D,pulse}$	59	A
$E_{oss} @ 400V$	5.2	μJ
Body diode di/dt	500	A/ μs

Type / Ordering Code	Package	Marking	Related Links
IPW60R190E6	PG-TO 247	6R190E6	see Appendix A
IPP60R190E6	PG-TO 220		
IPA60R190E6	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			20.2	A	$T_C = 25^\circ\text{C}$
				12.8		$T_C = 100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$			59	A	$T_C = 25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}			418	mJ	$I_D = 3.4\text{A}$, $V_{DD} = 50\text{V}$ (see table 11)
Avalanche energy, repetitive	E_{AR}			0.63	mJ	$I_D = 3.4\text{A}$, $V_{DD} = 50\text{V}$
Avalanche current, repetitive	I_{AR}			3.4	A	
MOSFET dv/dt ruggedness	dv/dt			50	V/ns	$V_{DS} = 0 \dots 480\text{V}$
Gate source voltage	V_{GS}	-20		20	V	static
		-30		30		AC ($f > 1\text{ Hz}$)
Power dissipation (non FullPAK) TO-247, TO-220	P_{tot}			151.0	W	$T_C = 25^\circ\text{C}$
Power dissipation (FullPAK) TO-220 FP	P_{tot}			34.0	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, TO-220				60	Ncm	M3 and M3.5 screws
Mounting torque (FullPAK) TO-220 FP				50	Ncm	M2.5 screws
Continuous diode forward current	I_S			17.5	A	$T_C = 25^\circ\text{C}$
Diode pulse current	$I_{S,pulse}$			59	A	$T_C = 25^\circ\text{C}$
Reverse diode dv/dt ³⁾	dv/dt			15	V/ns	$V_{DS} = 0 \dots 400\text{V}$, $I_{SD} \leq I_D$, $T_j = 25^\circ\text{C}$
Maximum diode commutation speed	di_f/dt			500	A/ μs	(see table 9)

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_θ

3 Thermal characteristics

Table 3 Thermal characteristics TO-247, TO-220

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			0.83	°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

Table 4 Thermal characteristics TO-220 FP

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			3.7	°C/W	
Thermal resistance, junction - ambient	R_{thJA}			80	°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 5 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	600			V	$V_{GS} = 0V, I_D = 0.25\text{mA}$
Gate threshold voltage	$V_{GS(th)}$	2.5	3	3.5	V	$V_{DS} = V_{GS}, I_D = 0.63\text{mA}$
Zero gate voltage drain current	I_{DSS}			1	μA	$V_{DS} = 600V, V_{GS} = 0V, T_j = 25^\circ\text{C}$
			10			$V_{DS} = 600V, V_{GS} = 0V, T_j = 150^\circ\text{C}$
Gate-source leakage current	I_{GSS}			100	nA	$V_{GS} = 20V, V_{DS} = 0V$
Drain-source on-state resistance	$R_{DS(on)}$		0.170	0.19	Ω	$V_{GS} = 10V, I_D = 9.5A, T_j = 25^\circ\text{C}$
			0.440			$V_{GS} = 10V, I_D = 9.5A, T_j = 150^\circ\text{C}$
Gate resistance	R_G		6		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}		1400		pF	$V_{GS} = 0V, V_{DS} = 100V, f = 1\text{MHz}$
Output capacitance	C_{oss}		85		pF	
Effective output capacitance, energy related ¹⁾	$C_{o(er)}$		56		pF	$V_{GS} = 0V, V_{DS} = 0 \dots 480V$
Effective output capacitance, time related ²⁾	$C_{o(tr)}$		266		pF	$I_D = \text{constant}, V_{GS} = 0V, V_{DS} = 0 \dots 480V$
Turn-on delay time	$t_{d(on)}$		12		ns	$V_{DD} = 400V, V_{GS} = 13V, I_D = 9.5A, R_G = 3.4\Omega$ (see table 10)
Rise time	t_r		10		ns	
Turn-off delay time	$t_{d(off)}$		90		ns	
Fall time	t_f		8		ns	

Table 7 Gate charge characteristics

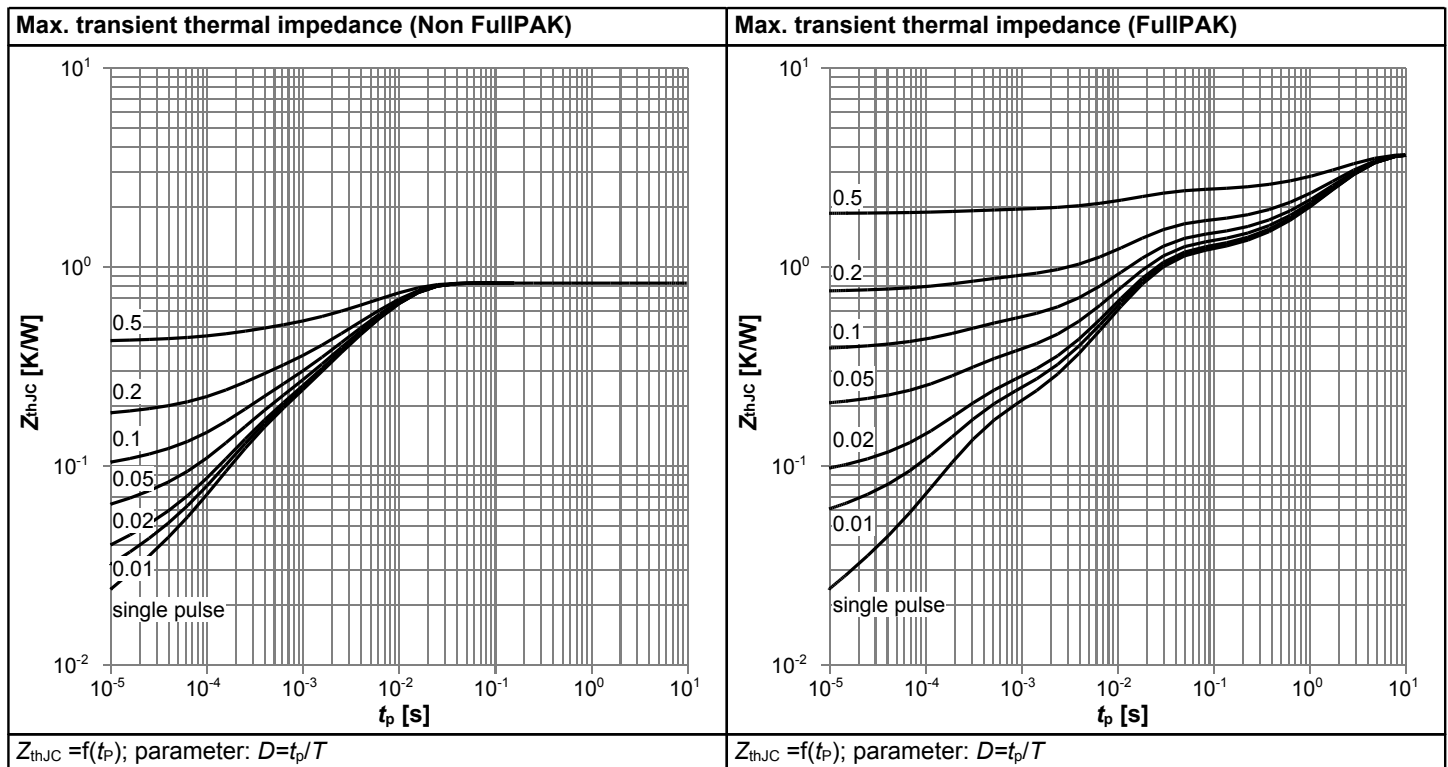
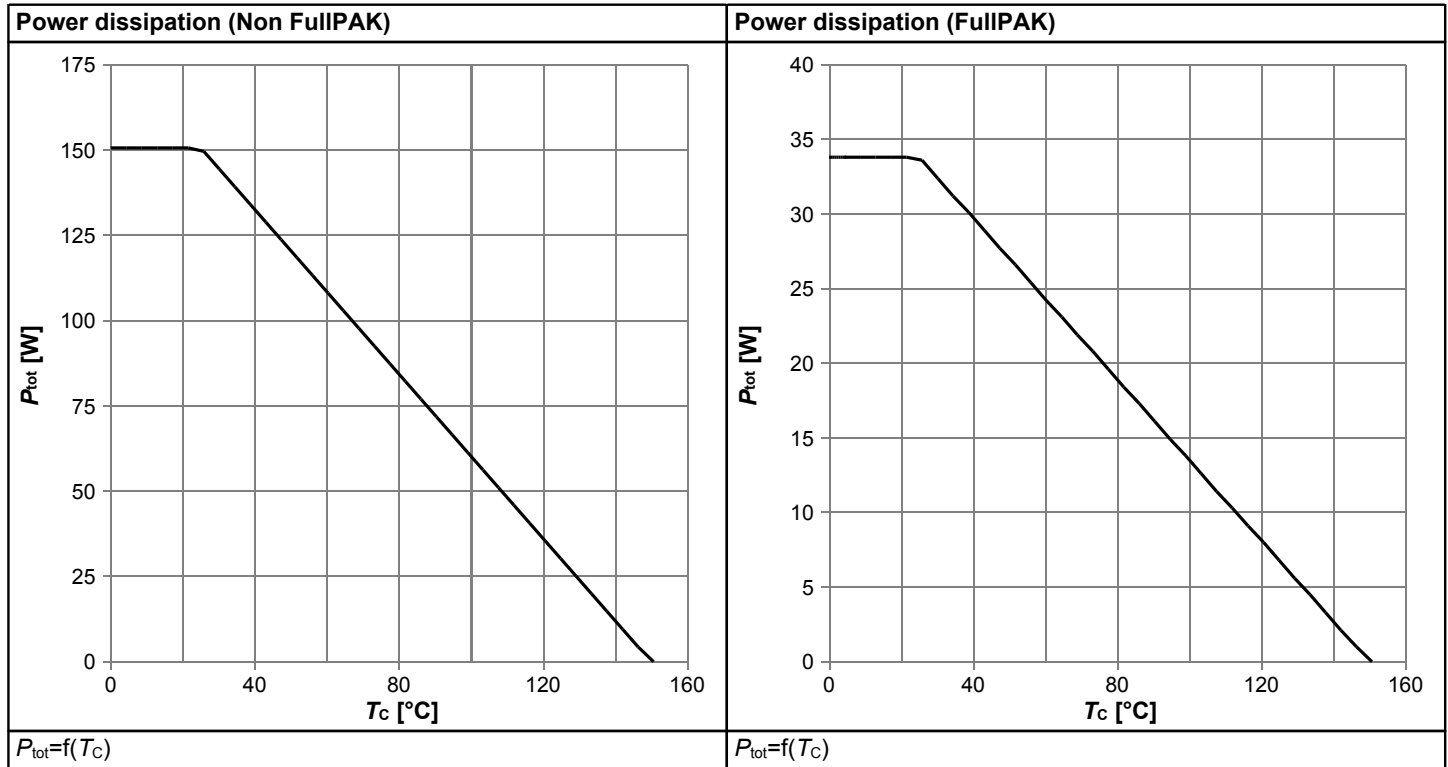
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}		7.6		nC	$V_{DD} = 480V, I_D = 9.5A, V_{GS} = 0 \text{ to } 10V$
Gate to drain charge	Q_{gd}		32		nC	
Gate charge total	Q_g		63		nC	
Gate plateau voltage	$V_{plateau}$		5.4		V	

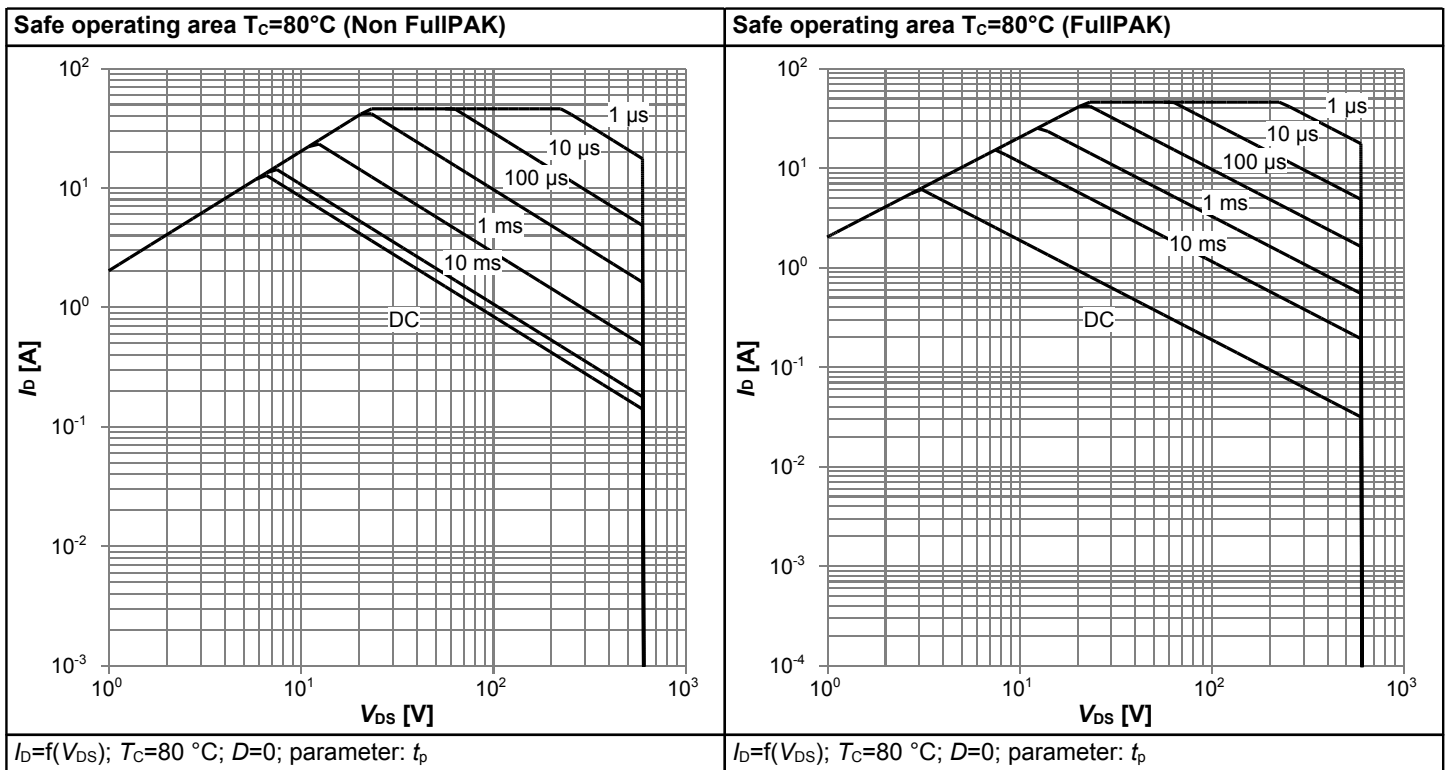
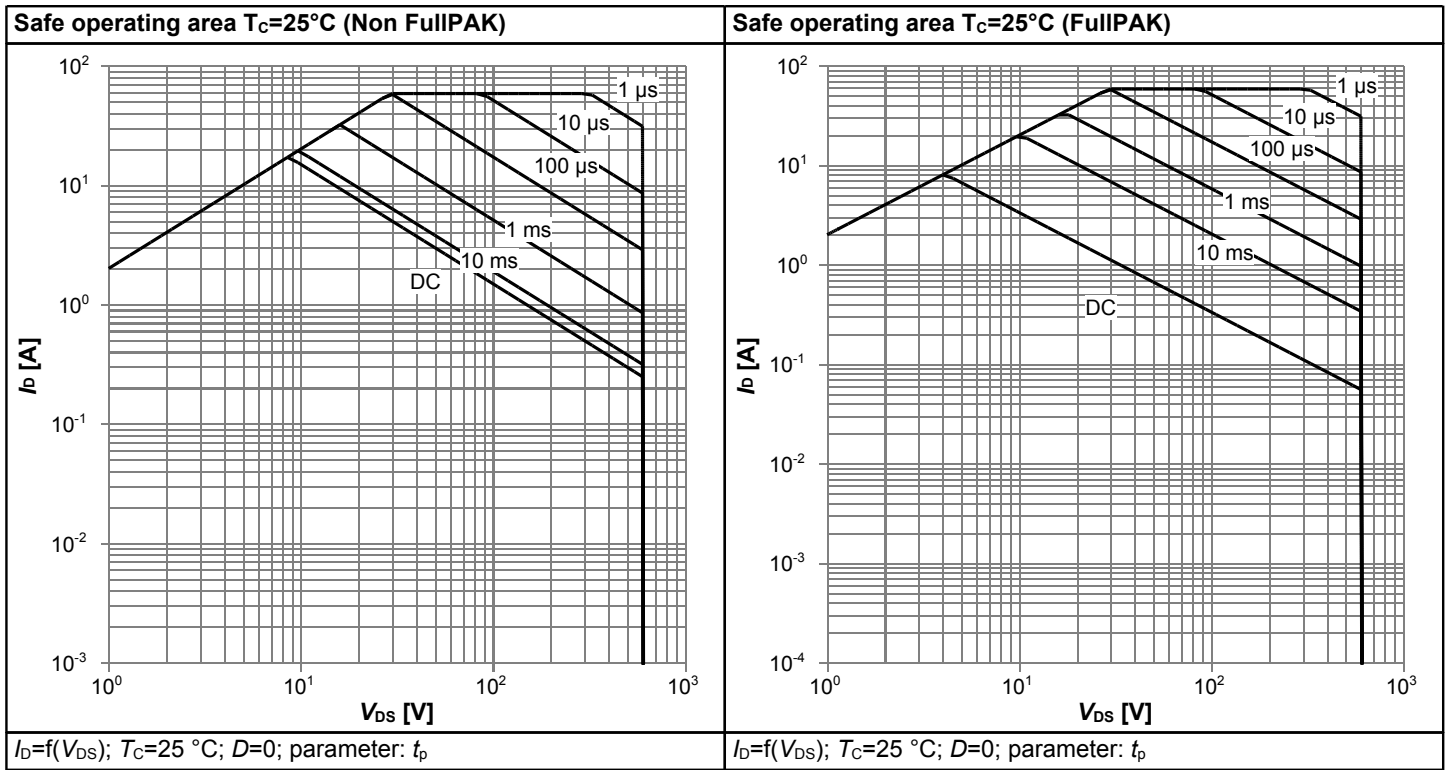
¹⁾ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$
²⁾ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% $V_{(BR)DSS}$

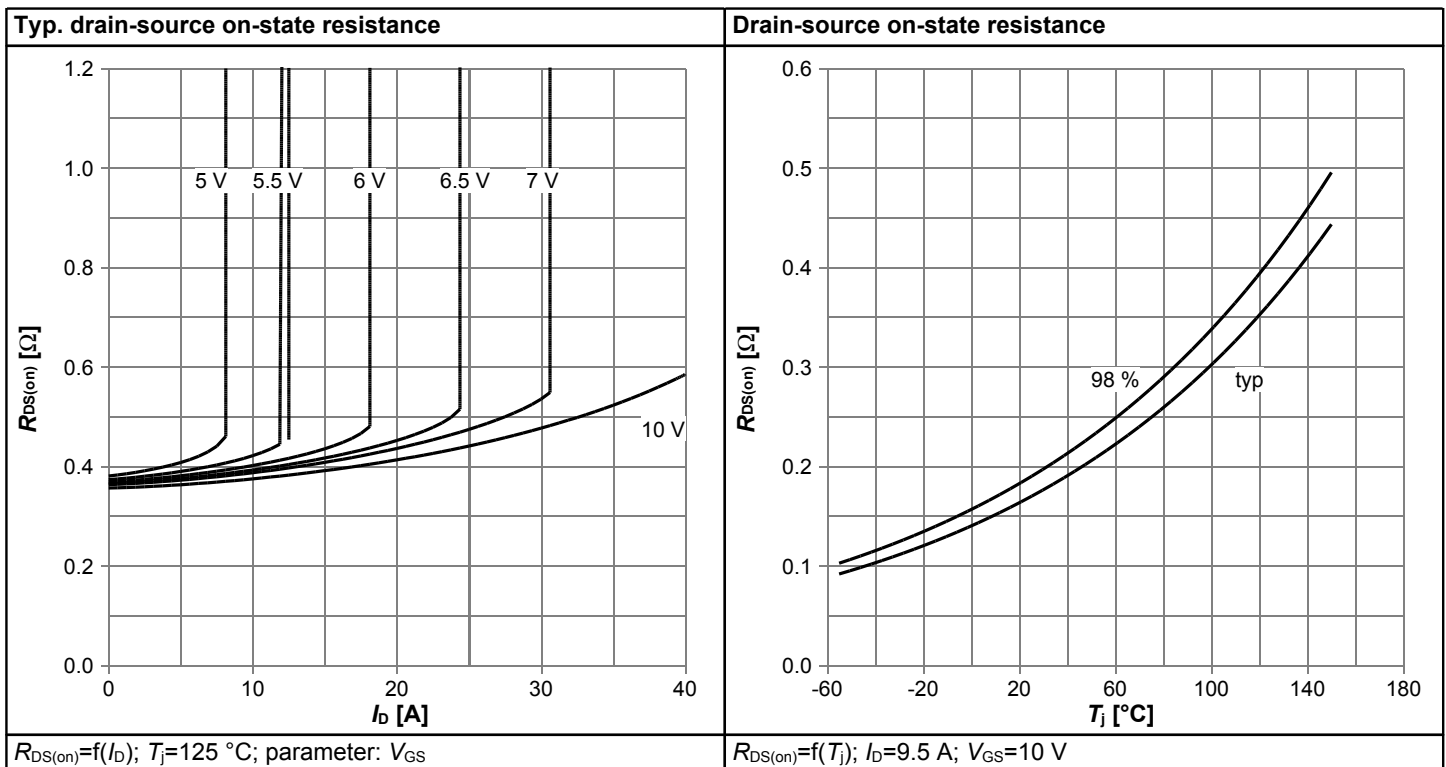
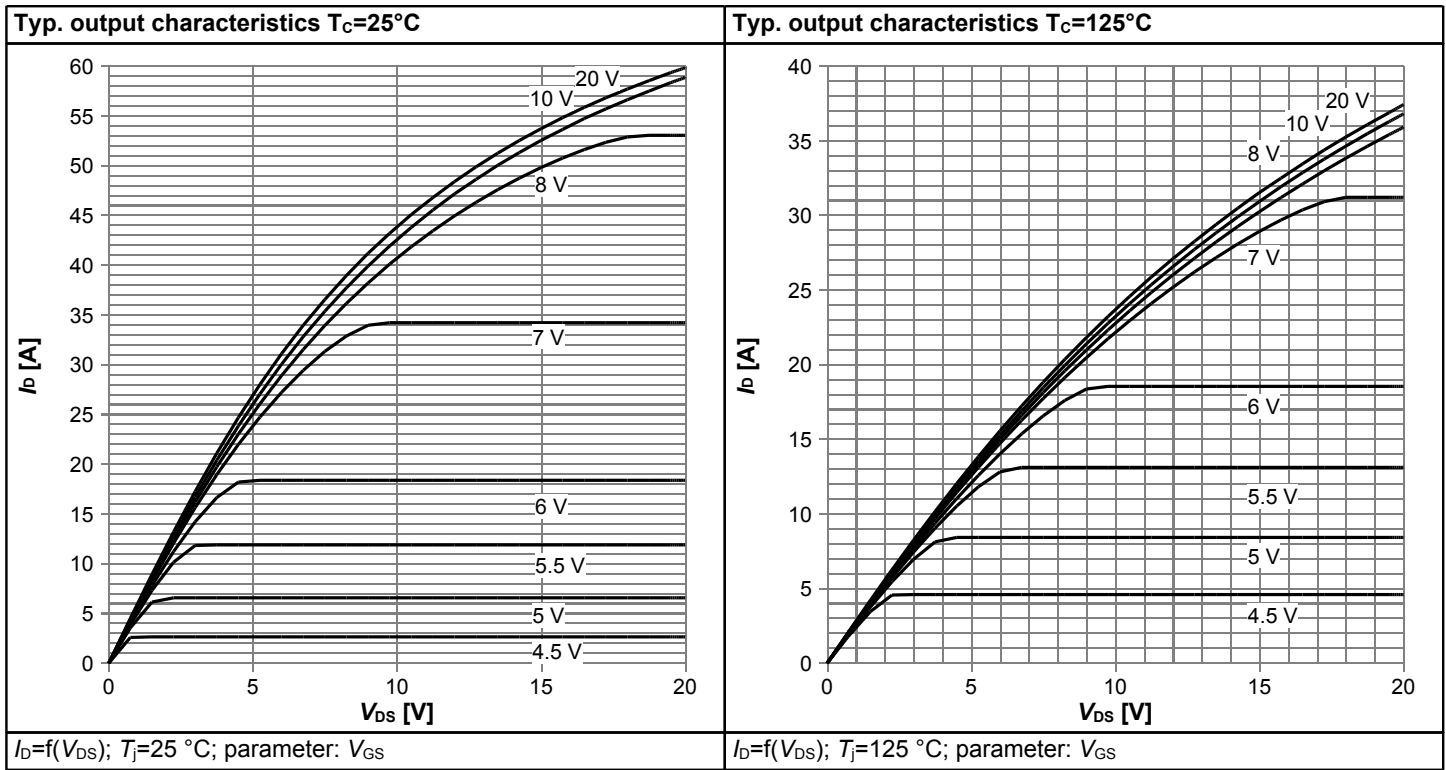
Table 8 Reverse diode characteristics

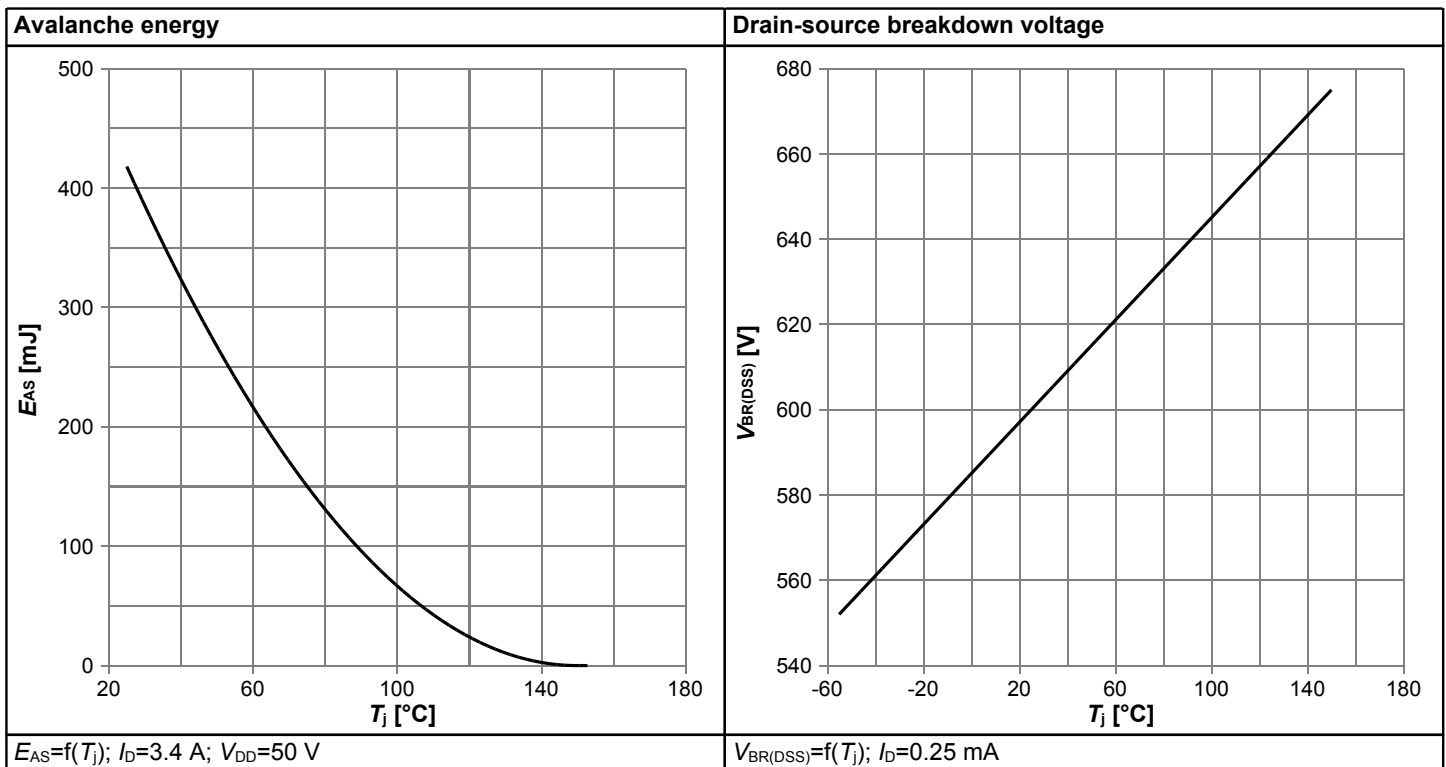
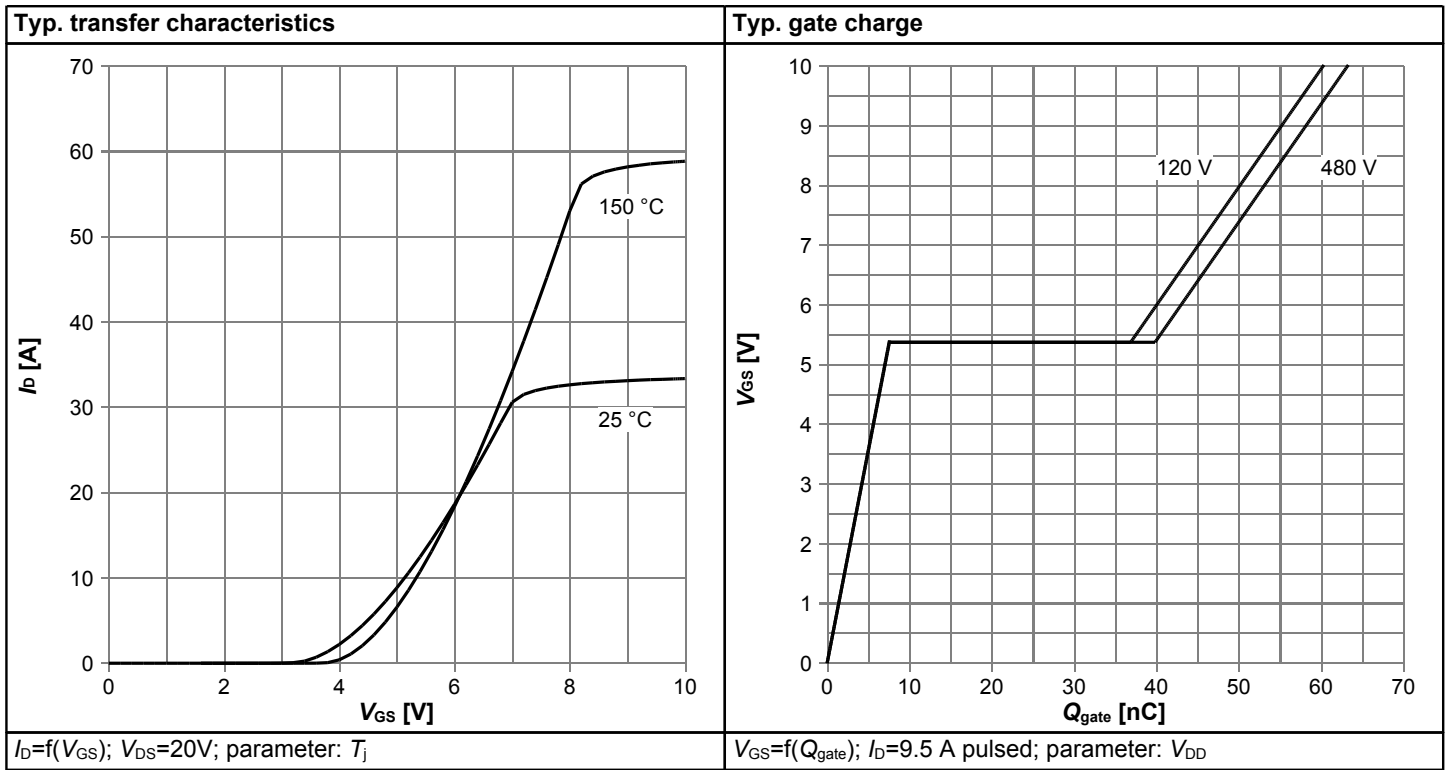
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode forward voltage	V_{SD}		0.9		V	$V_{GS} = 0V, I_F = 9.5A, T_j = 25^\circ C$
Reverse recovery time	t_{rr}		430		ns	$V_R = 400V, I_F = 9.5A,$ $di_F/dt = 100A/\mu s$ (see table 9)
Reverse recovery charge	Q_{rr}		6.9		μC	
Peak reverse recovery current	I_{rrm}		30		A	

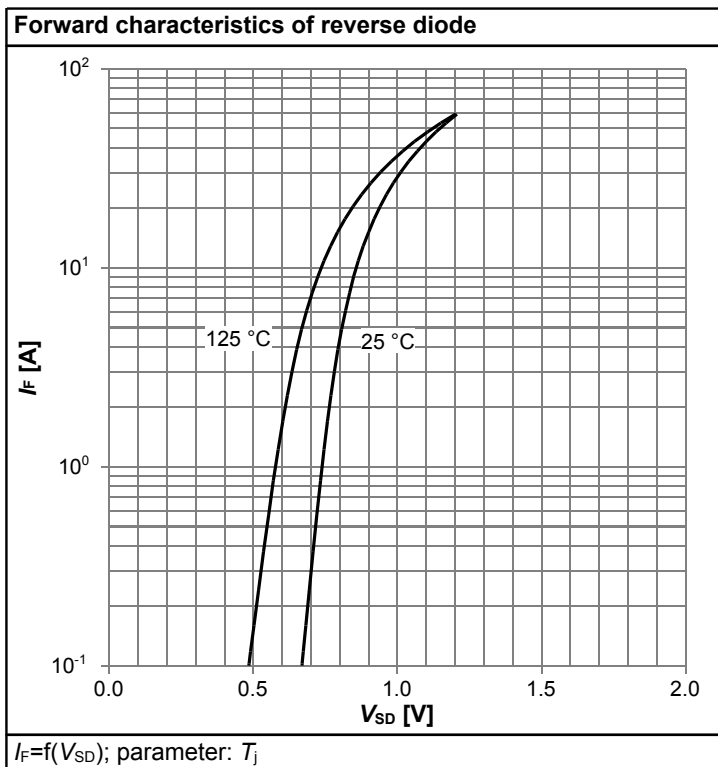
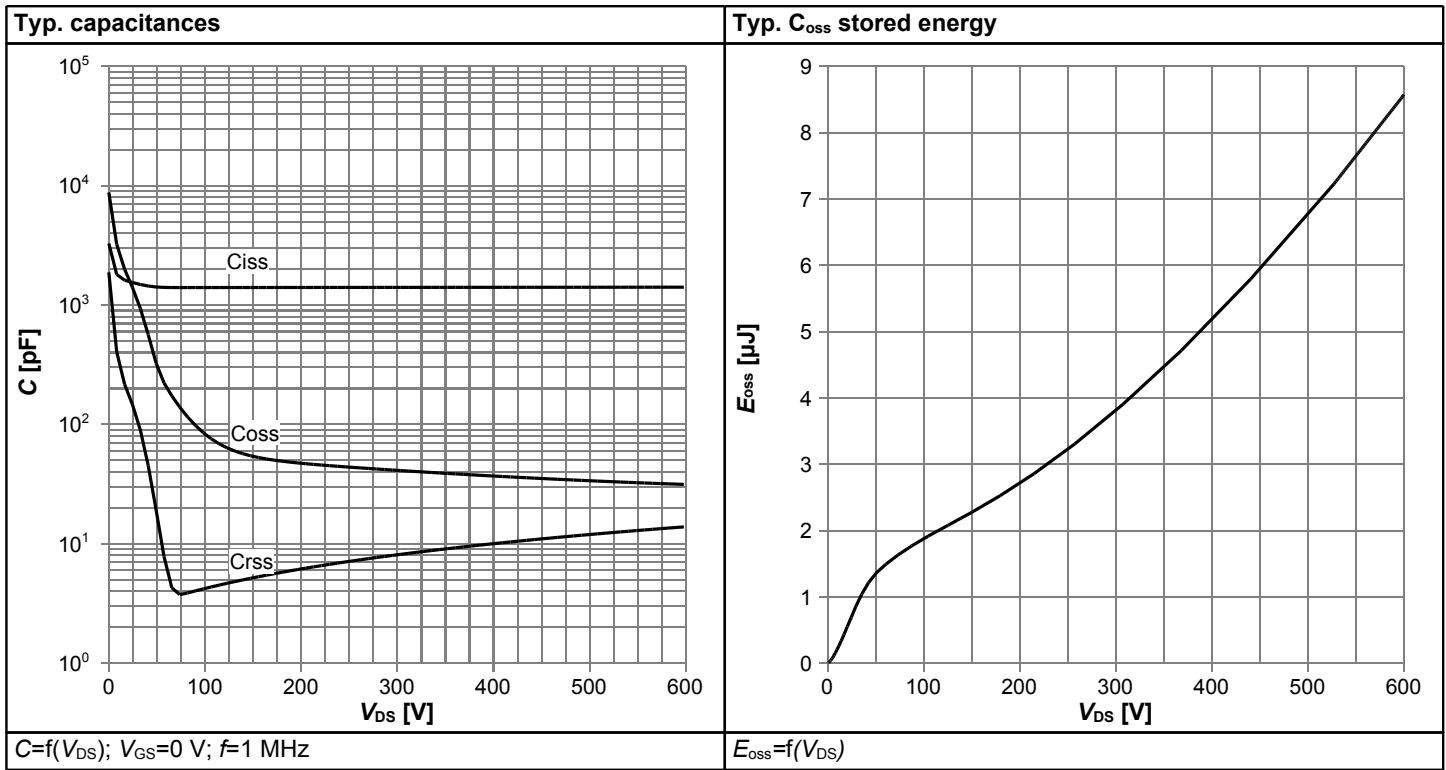
5 Electrical characteristics diagrams











6 Test Circuits

Table 9 Diode characteristics

Test circuit for diode characteristics	Diode recovery waveform

Table 10 Switching times

Switching times test circuit for inductive load	Switching times waveform

Table 11 Unclamped inductive load

Unclamped inductive load test circuit	Unclamped inductive waveform

7 Package Outlines

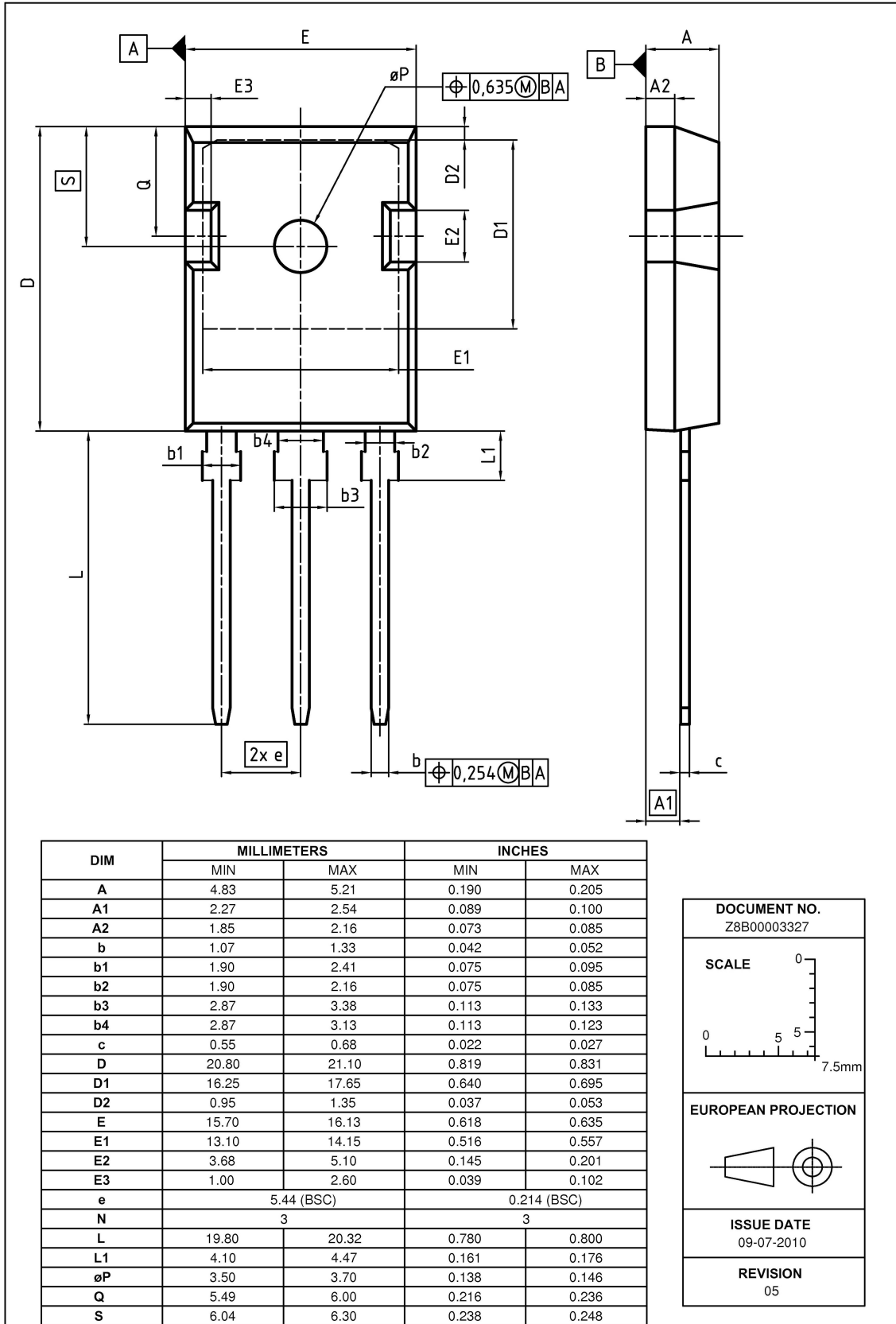


Figure 1 Outline PG-TO 247, dimensions in mm/inches

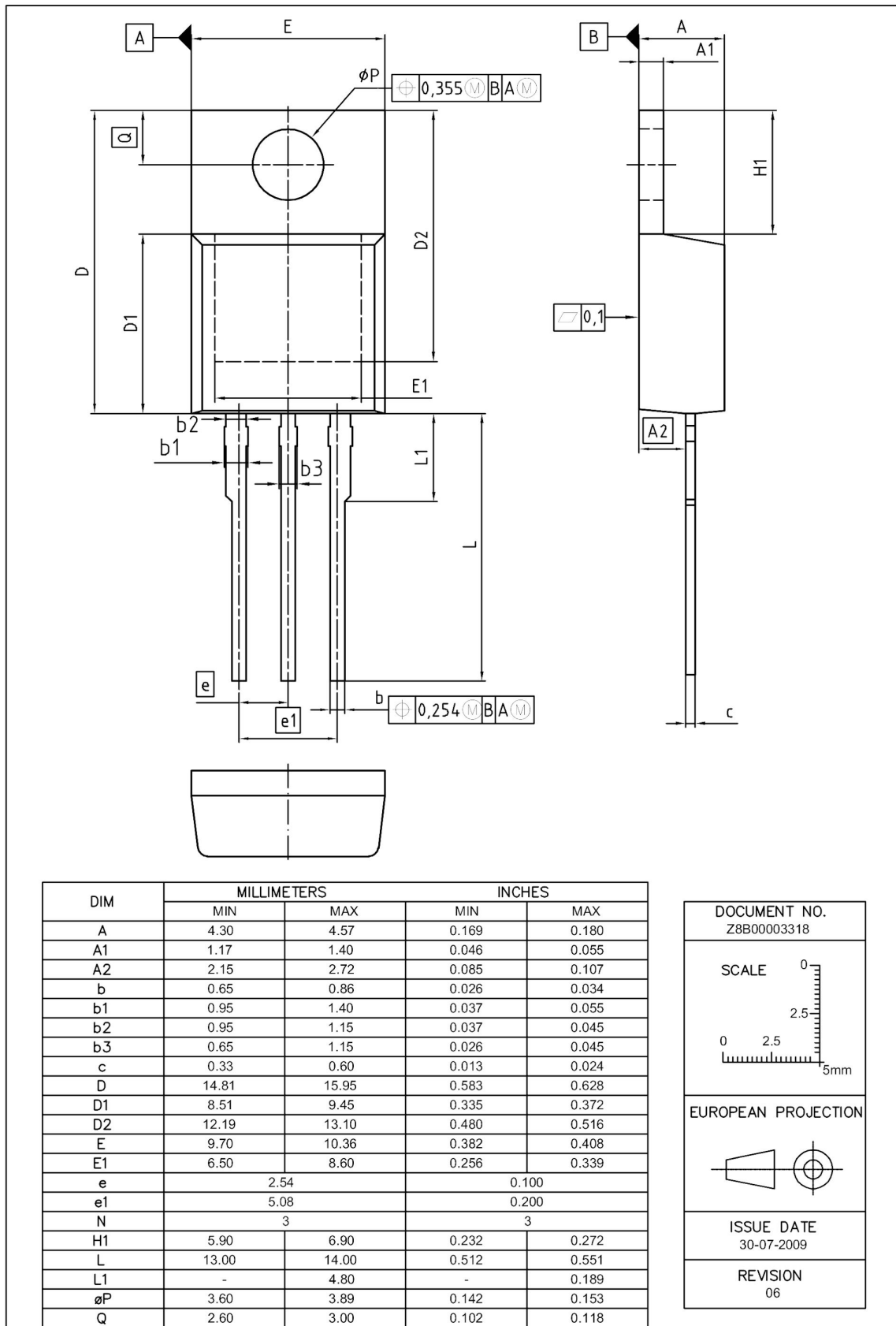


Figure 2 Outline PG-TO 220, dimensions in mm/inches

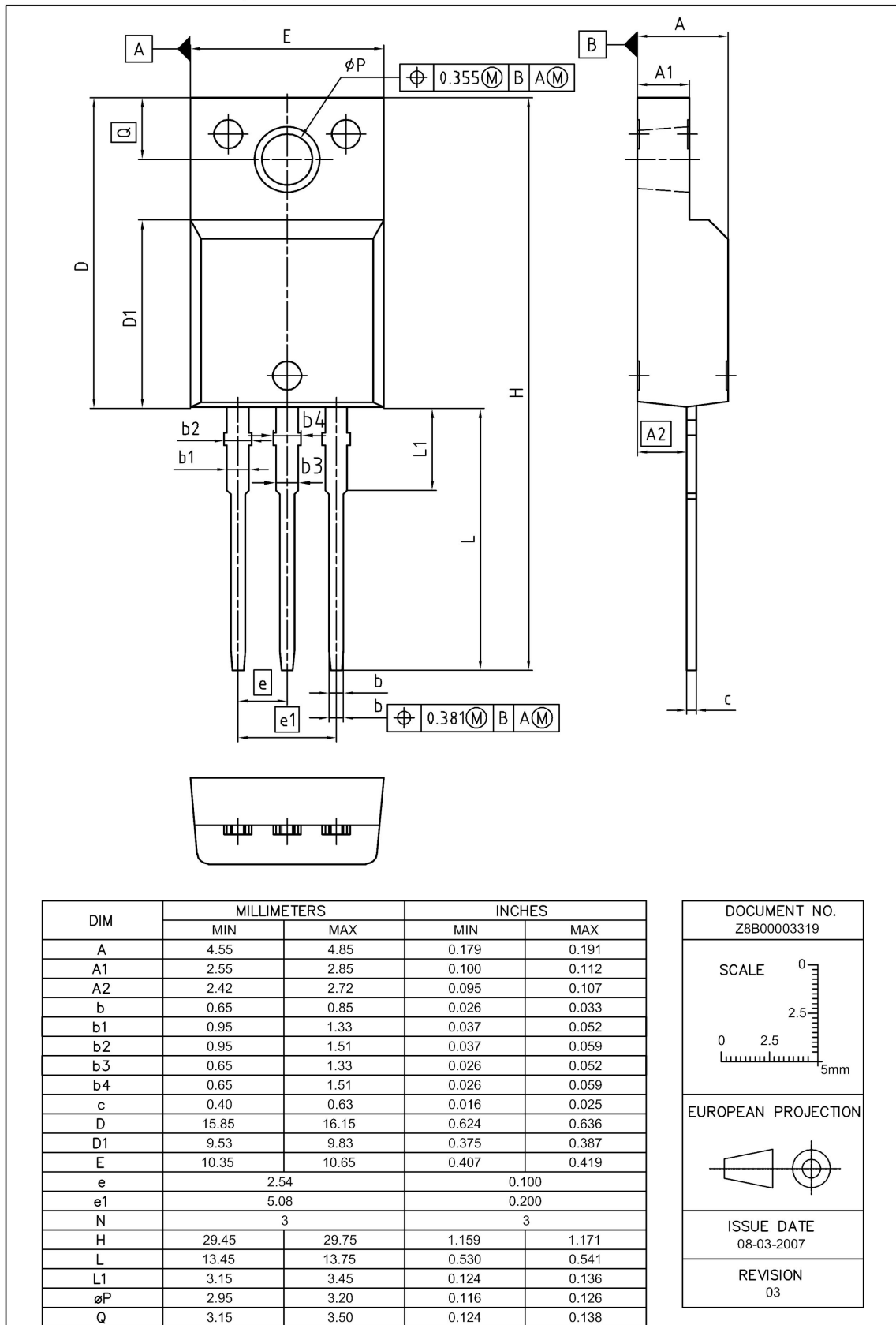


Figure 3 Outline PG-TO 220 FullPAK, dimensions in mm/inches

8 Appendix A

Table 12 Related Links

- IFX CoolMOS Webpage: www.infineon.com
- IFX Design Tools: www.infineon.com

Revision History

IPW60R190E6, IPP60R190E6, IPA60R190E6

Revision: 2014-07-15, Rev. 2.2

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2011-06-08	Release of final data sheet
2.1	2011-09-14	-
2.2	2014-07-15	Package update and table reference correction

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