

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

CFDA Automotive

650V CoolMOS™ CFDA Power Transistor
IPx65R190CFDA

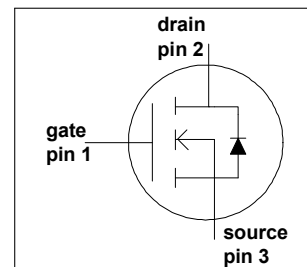
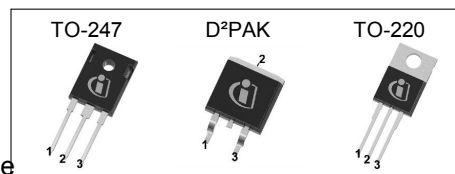
Data Sheet

Rev. 2.0
Final

Automotive

1 Description

CoolMOS™ is a revolutionary technology for high voltage power MOSFETs, designed according to the superjunction (SJ) principle and pioneered by Infineon Technologies. 650V CoolMOS™ CFDA 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 offering an extremely fast and robust body diode. This combination of extremely low switching, commutation and conduction losses together with highest robustness make especially resonant switching applications more reliable, more efficient, lighter, and cooler.



Features

- Ultra-fast body diode
- Very high commutation ruggedness
- Extremely low losses due to very low FOM $R_{ds(on)} \cdot Q_g$ and E_{oss}
- Easy to use/drive
- Qualified according to AEC Q101
- Green package (RoHS compliant), Pb-free plating, halogen free for mold compound



Applications

650V CoolMOS™ CFD is especially suitable for resonant switching PWM stages for e.g. PC Silverbox, LCD TV, Lighting, Server, Telecom and Solar.



Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	650	V
$R_{DS(on),max}$	0.19	Ω
Q_g,typ	68	nC
$I_D,pulse$	57.2	A
$E_{oss @ 400V}$	5.7	μJ
Body diode di/dt	900	A/ μs
Q_{rr}	0.7	μC
t_{rr}	120	ns
I_{rrm}	7.5	A

Type / Ordering Code	Package	Marking	Related Links
IPW65R190CFDA	PG-TO 247	65F6190A	-
IPB65R190CFDA	PG-TO 263		
IPP65R190CFDA	PG-TO 220		

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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			17.5	A	$T_C = 25^\circ\text{C}$
				11		$T_C = 100^\circ\text{C}$
Pulsed drain current ²⁾	$I_{D,pulse}$			57.2	A	$T_C = 25^\circ\text{C}$
Avalanche energy, single pulse	E_{AS}			484	mJ	$I_D = 3.5\text{A}$, $V_{DD} = 50\text{V}$
Avalanche energy, repetitive	E_{AR}			0.7	mJ	$I_D = 3.5\text{A}$, $V_{DD} = 50\text{V}$
Avalanche current, repetitive	I_{AR}			3.5	A	
MOSFET dv/dt ruggedness	dv/dt			50	V/ns	$V_{DS} = 0 \dots 400\text{V}$
Gate source voltage	V_{GS}	-20		20	V	static
		-30		30		AC ($f > 1\text{ Hz}$)
Power dissipation (non FullPAK, SMD) TO-247, TO-220, D ² PAK	P_{tot}			151	W	$T_C = 25^\circ\text{C}$
Operating and storage temperature	T_j, T_{stg}	-40		150	$^\circ\text{C}$	
Mounting torque (non FullPAK) TO-247, TO-220				60	Ncm	M3 and M3.5 screws
Continuous diode forward current	I_S			17.5	A	$T_C = 25^\circ\text{C}$
Diode pulse current	$I_{S,pulse}$			57.2	A	$T_C = 25^\circ\text{C}$
Reverse diode dv/dt ³⁾	dv/dt			50	V/ns	$V_{DS} = 0 \dots 400\text{V}$, $I_{SD} \leq I_D$, $T_j = 25^\circ\text{C}$ (see table 17)
Maximum diode commutation speed	di/dt			900	A/ μs	

¹⁾ Limited by $T_{j\max}$

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 TO-247, TO-220

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			0.83	K/W	
Thermal resistance, junction - ambient	R_{thJA}			62	K/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 D²PAK¹⁾

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}			0.83	K/W	
Thermal resistance, junction - ambient ²⁾	R_{thJA}			62	K/W	SMD version, device on PCB, minimal footprint
			35			SMD version, device on PCB, 6cm ² cooling area
Soldering temperature, wave- & reflowsoldering allowed	T_{sold}			260	°C	reflow MSL

¹⁾ TO-263

²⁾ Device on 40mm*40mm*1.5mm one layer epoxy PCB FR4 with 6cm² copper area (thickness 70µm) for drain connection. PCB is vertical without air stream cooling.

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 ¹⁾	$V_{(BR)DSS}$	650			V	$V_{GS} = 0V$, $I_D = 1mA$
Gate threshold voltage	$V_{GS(th)}$	3.5	4	4.5	V	$V_{DS} = V_{GS}$, $I_D = 0.7mA$
Zero gate voltage drain current	I_{DSS}			1	μA	$V_{DS} = 650V$, $V_{GS} = 0V$, $T_j = 25^\circ\text{C}$
			200			$V_{DS} = 650V$, $V_{GS} = 0V$, $T_j = 150^\circ\text{C}$
Gate-source leakage current	I_{GSS}			100	nA	$V_{GS} = 20V$, $V_{DS} = 0V$
Drain-source on-state resistance	$R_{DS(on)}$		0.171	0.19	Ω	$V_{GS} = 10V$, $I_D = 7.3A$, $T_j = 25^\circ\text{C}$
			0.445			$V_{GS} = 10V$, $I_D = 7.3A$, $T_j = 150^\circ\text{C}$
Gate resistance	R_G		1		Ω	$f = 1MHz$, open drain

Table 6 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}		1850		pF	$V_{GS} = 0V$, $V_{DS} = 100V$, $f = 1MHz$
Output capacitance	C_{oss}		86		pF	
Effective output capacitance, energy related ²⁾	$C_{o(er)}$		70		pF	$V_{GS} = 0V$, $V_{DS} = 0 \dots 400V$
Effective output capacitance, time related ³⁾	$C_{o(tr)}$		336		pF	$I_D = \text{constant}$, $V_{GS} = 0V$, $V_{DS} = 0 \dots 400V$
Turn-on delay time	$t_{d(on)}$		12		ns	$V_{DD} = 400V$, $V_{GS} = 13V$, $I_D = 11A$, $R_G = 3.4\Omega$
Rise time	t_r		8.4		ns	
Turn-off delay time	$t_{d(off)}$		53.2		ns	
Fall time	t_f		6.4		ns	

Table 7 Gate charge characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}		12		nC	$V_{DD} = 480V$, $I_D = 11A$, $V_{GS} = 0 \text{ to } 10V$
Gate to drain charge	Q_{gd}		37		nC	
Gate charge total	Q_g		68		nC	
Gate plateau voltage	$V_{plateau}$		6.4		V	

¹⁾ For applications with applied blocking voltage >65% of the specified blocking voltage, we recommend to evaluate the impact of the cosmic radiation effect in early design phase. For assessment please contact local Infineon sales office.

²⁾ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 400V

³⁾ $C_{o(tr)}$ 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	$V_{GS} = 0V, I_F = 11A, T_j = 25^\circ C$
Reverse recovery time	t_{rr}		120		ns	$V_R = 400V, I_F = 11A,$ $di_F/dt = 100A/\mu s$
Reverse recovery charge	Q_{rr}		0.5		μC	
Peak reverse recovery current	I_{rrm}		7.6		A	

5 Electrical characteristics diagrams

Table 9

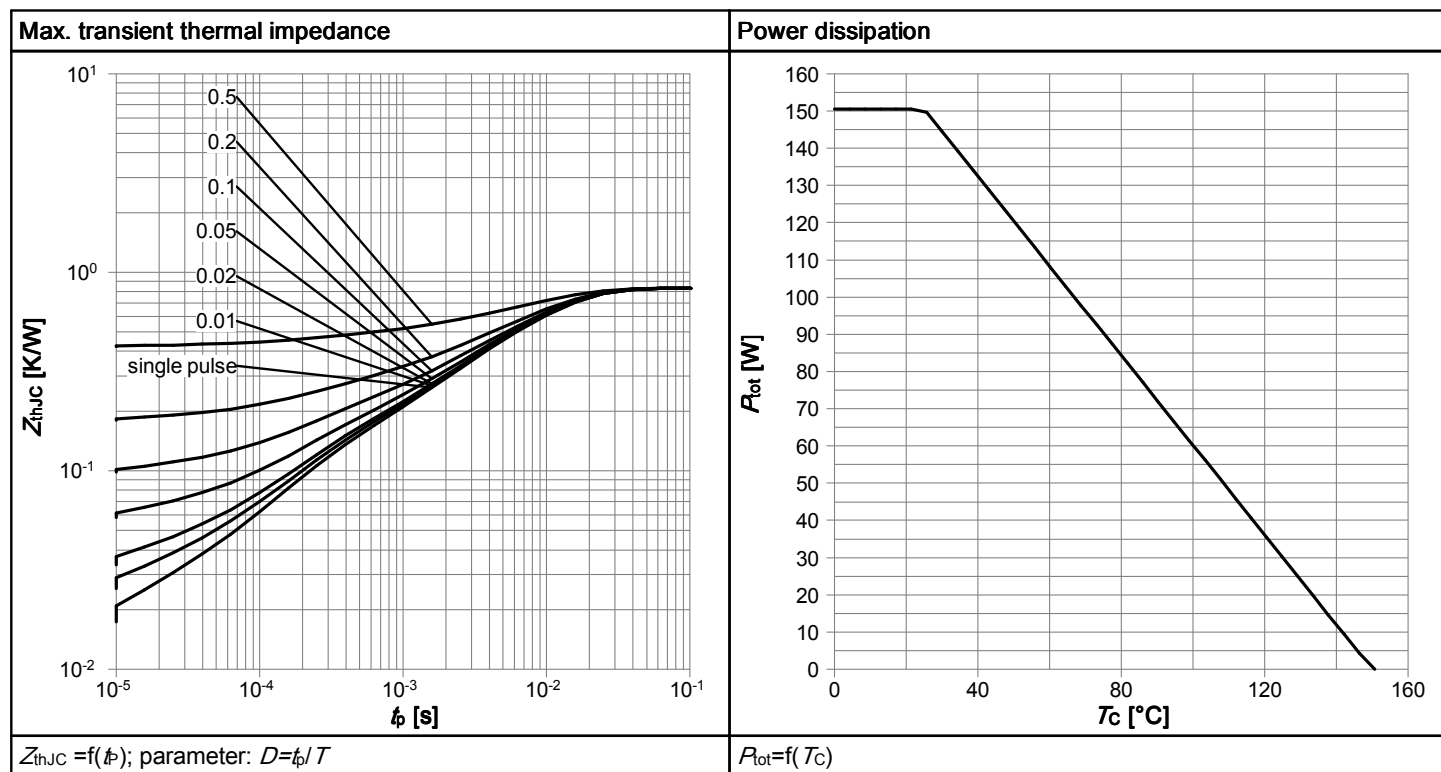


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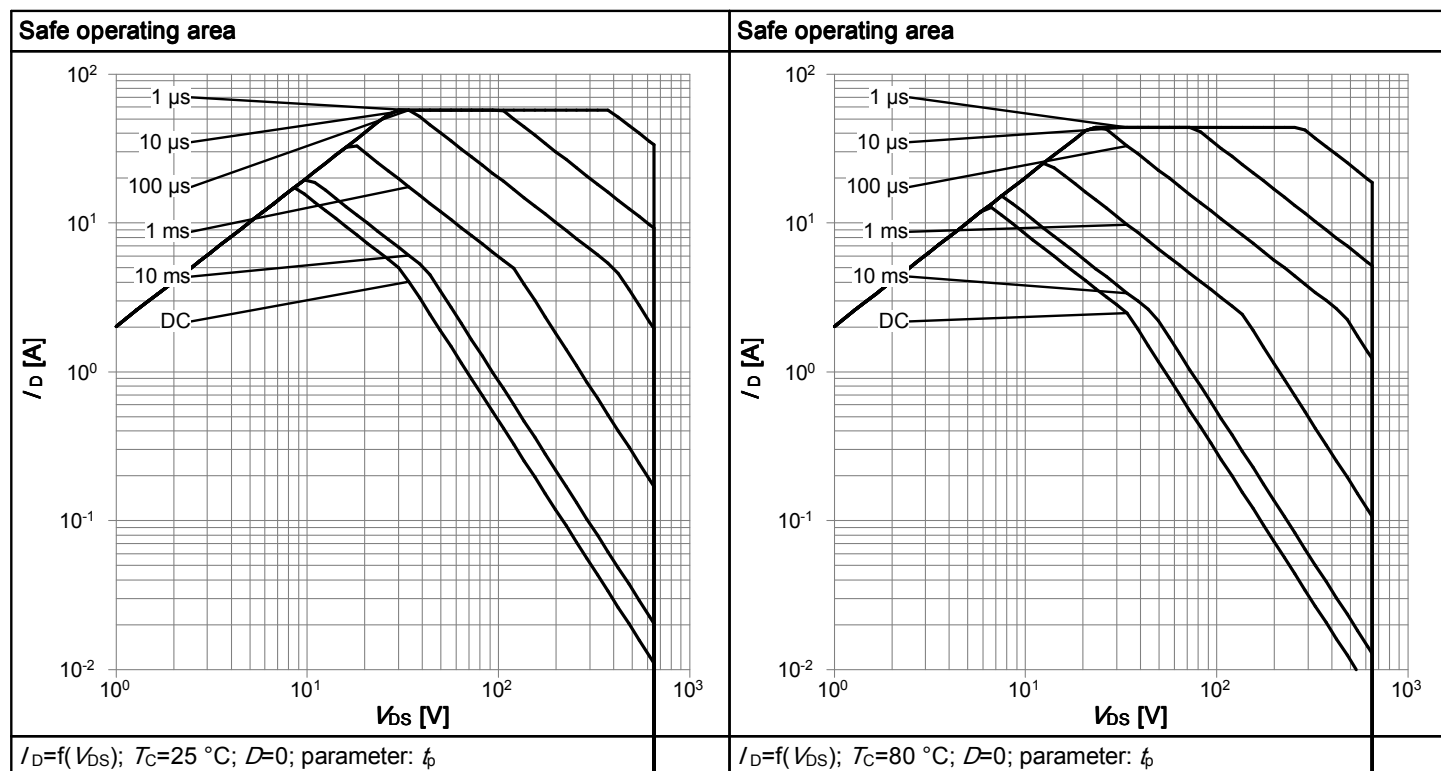


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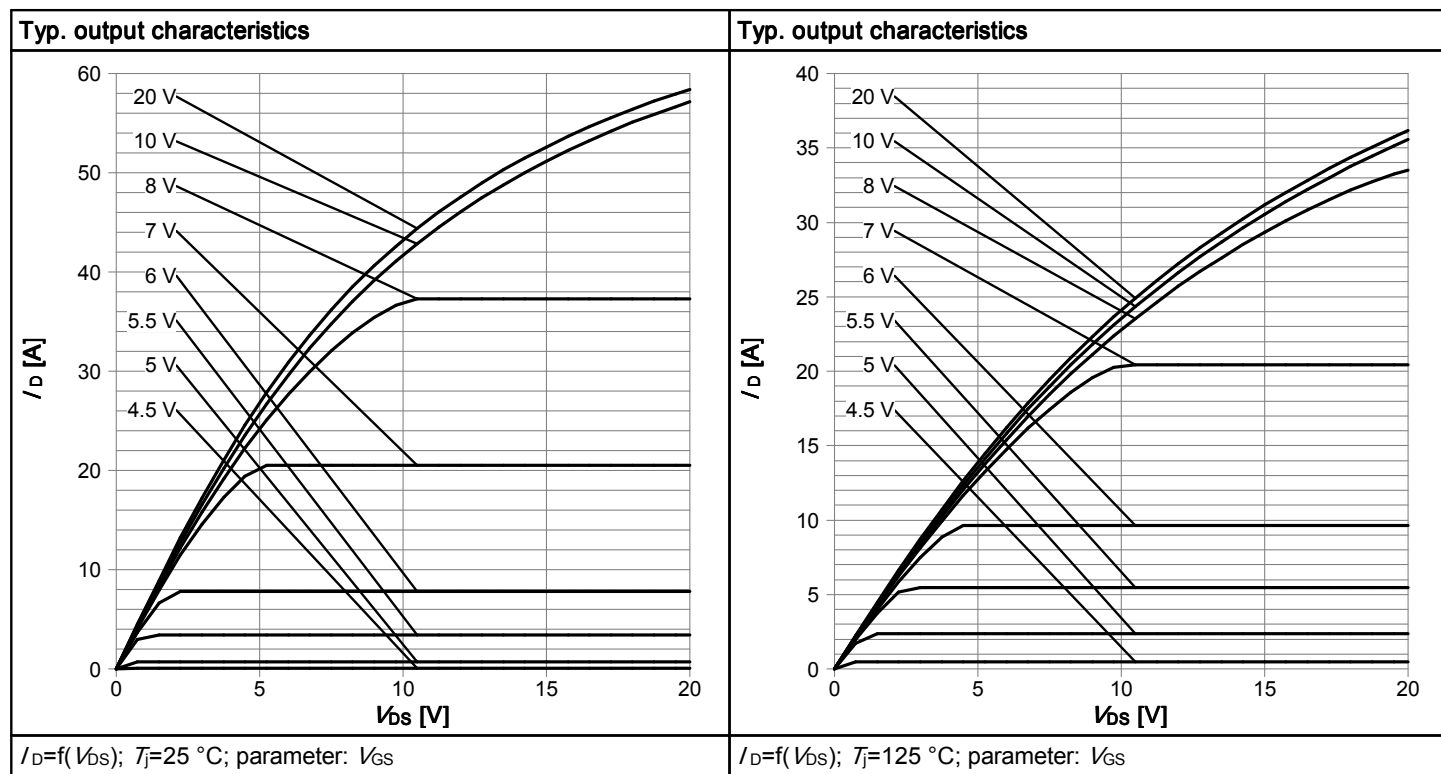


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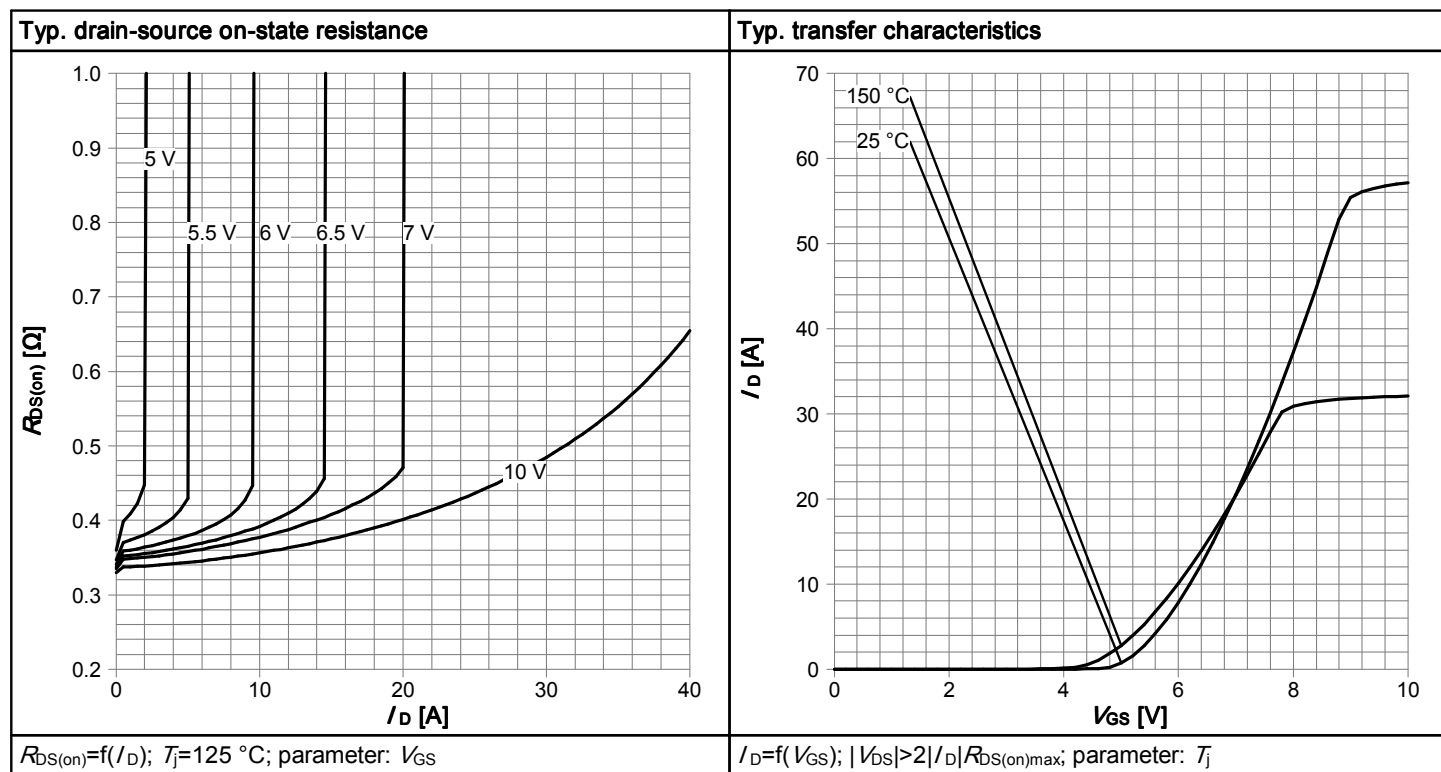


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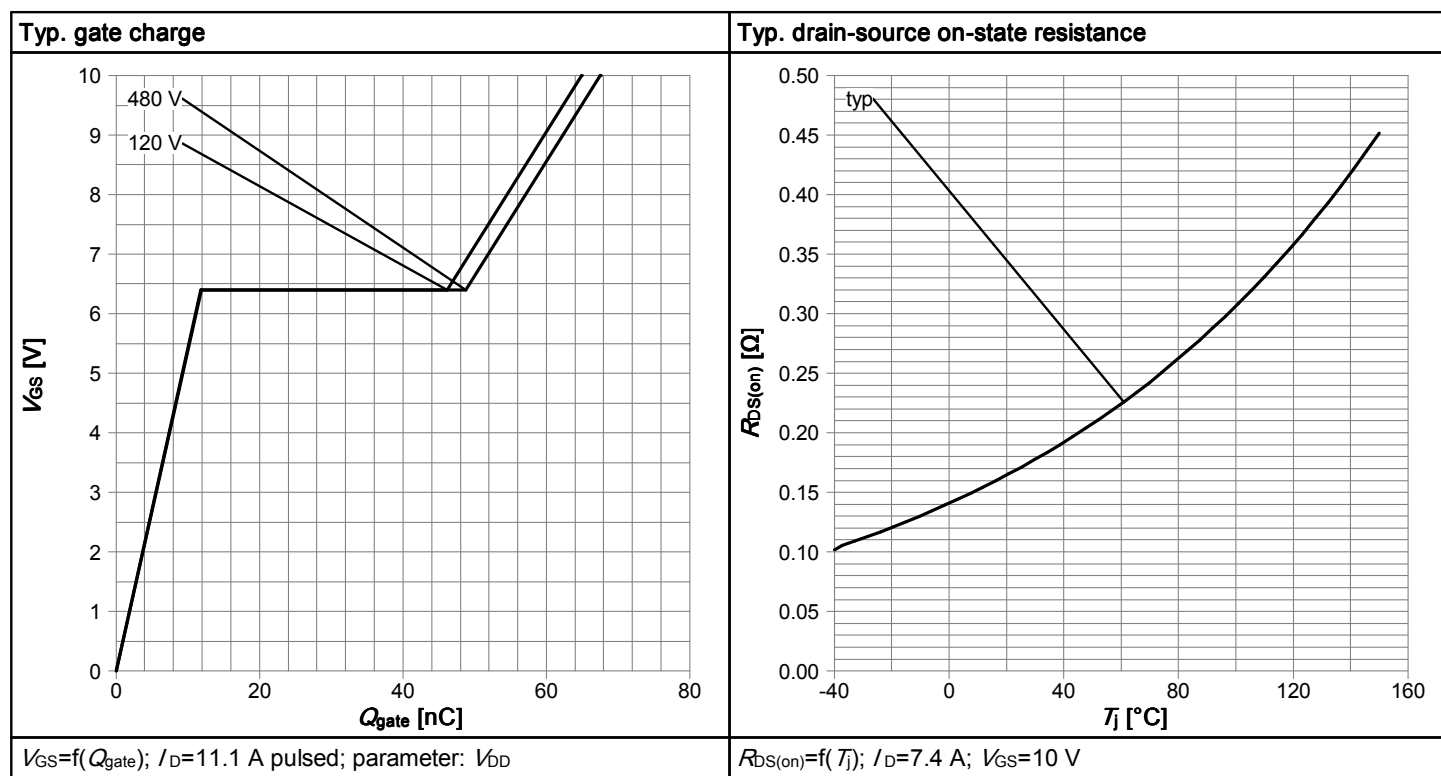


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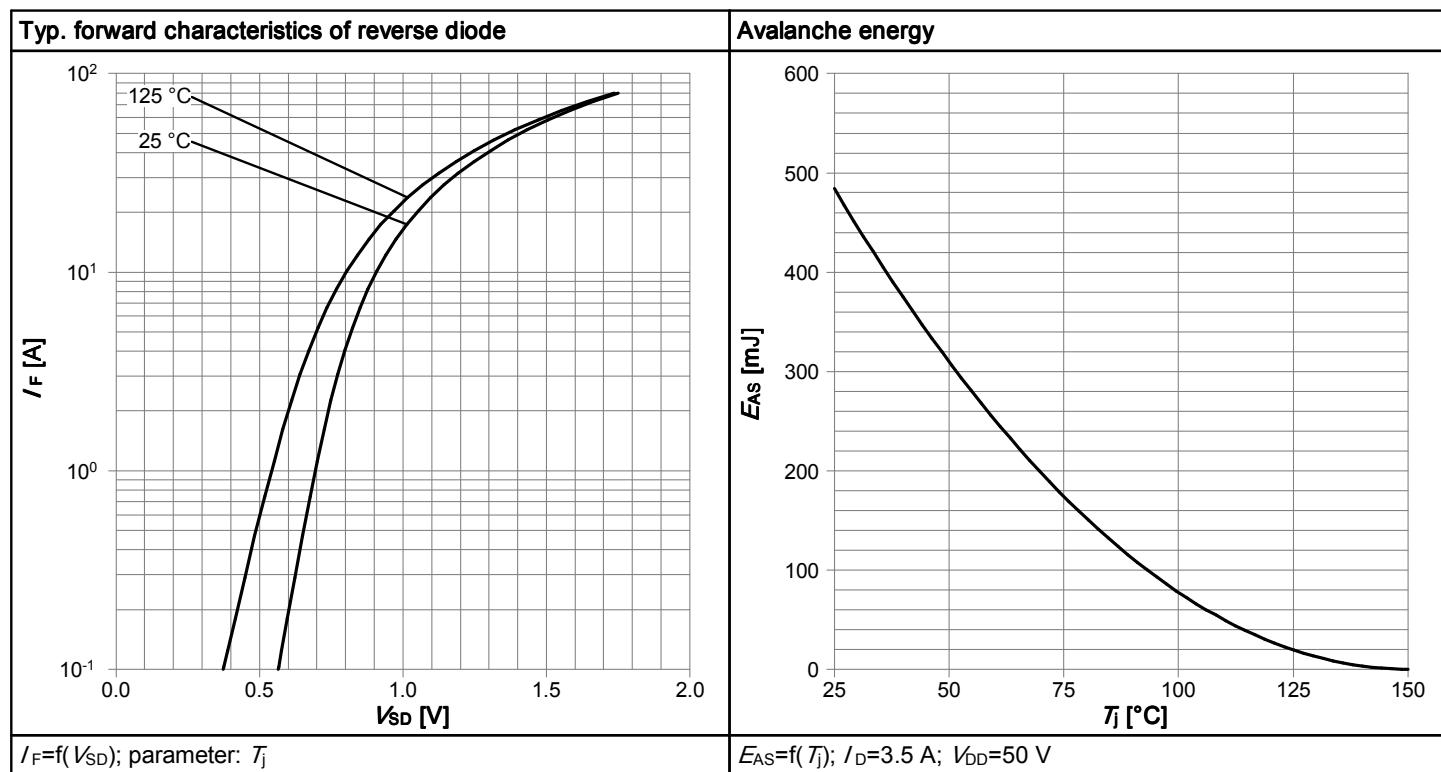


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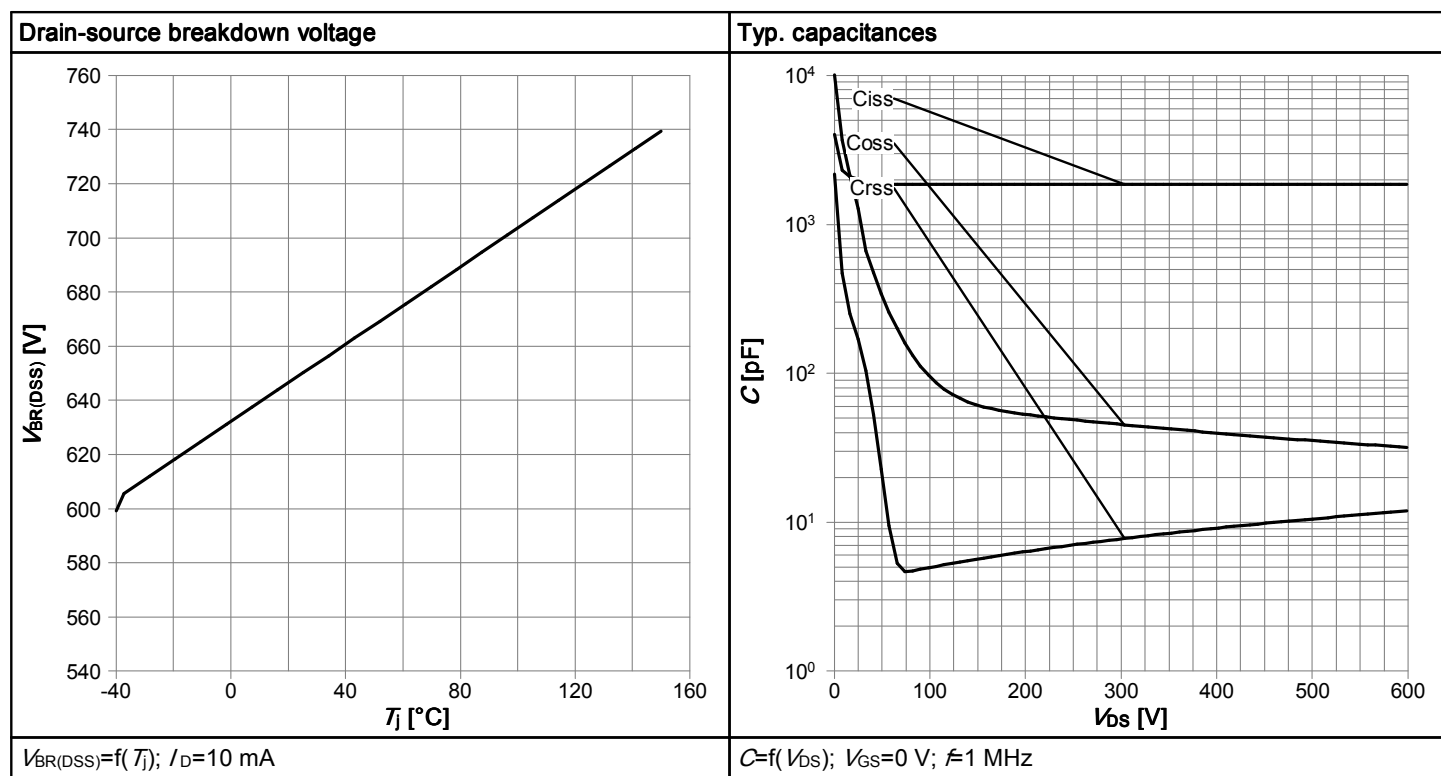
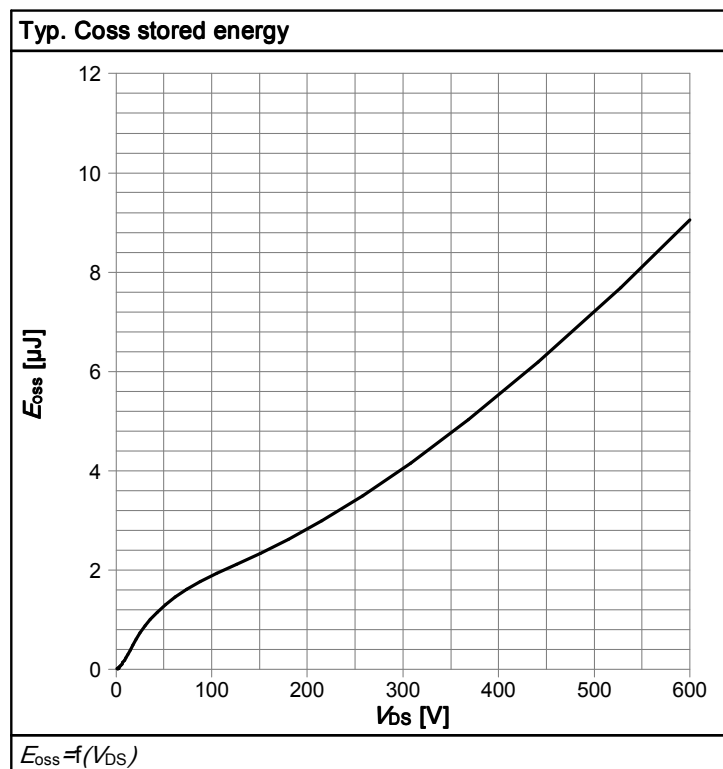


Table 16



6 Test Circuits

Table 17 Diode characteristics

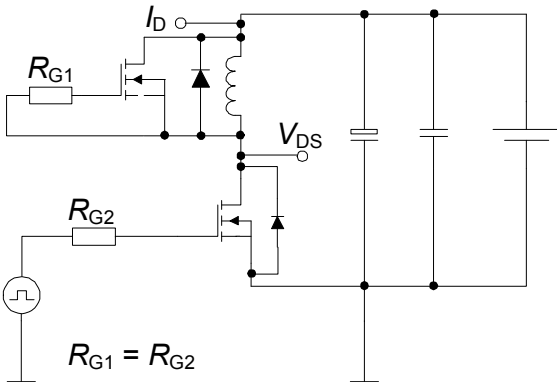
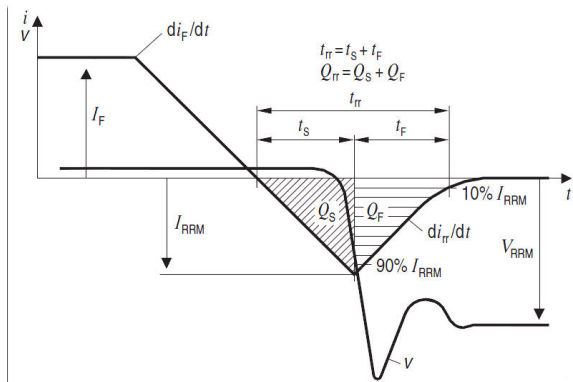
Test circuit for diode characteristics	Diode recovery waveform
 $R_{G1} = R_{G2}$	 i v di_F/dt I_F I_{RRM} Q_S Q_F di_{rr}/dt $10\% I_{RRM}$ V_{RRM} t_s t_{rr} t_F $90\% I_{RRM}$ V $t_{rr} = t_s + t_F$ $Q_{rr} = Q_S + Q_F$

Table 18 Switching times

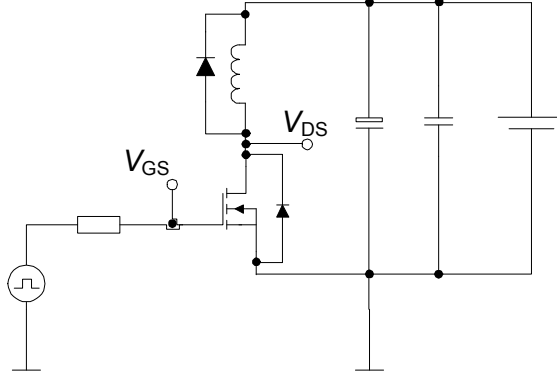
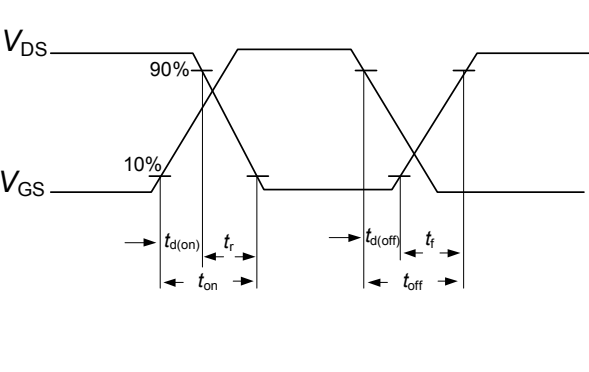
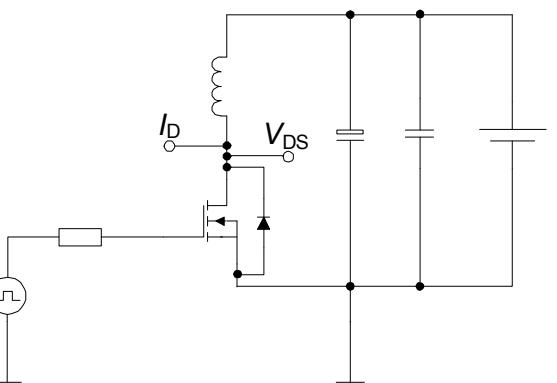
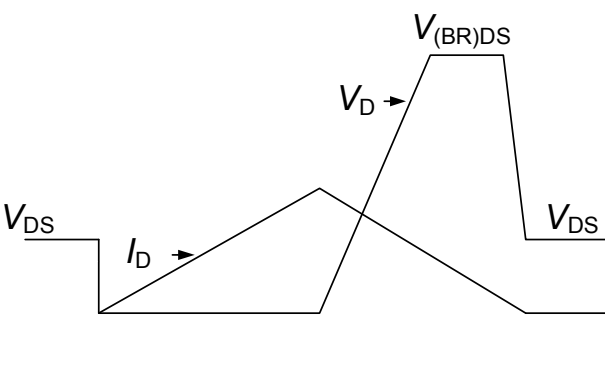
Switching times test circuit for inductive load	Switching times waveform
	 V_{DS} V_{GS} 90% 10% $t_{d(on)}$ t_r t_{on} $t_{d(off)}$ t_f t_{off}

Table 19 Unclamped inductive

Unclamped inductive load test circuit	Unclamped inductive waveform
	 $V_{(BR)DS}$ V_D V_{DS} I_D

7 Package Outlines

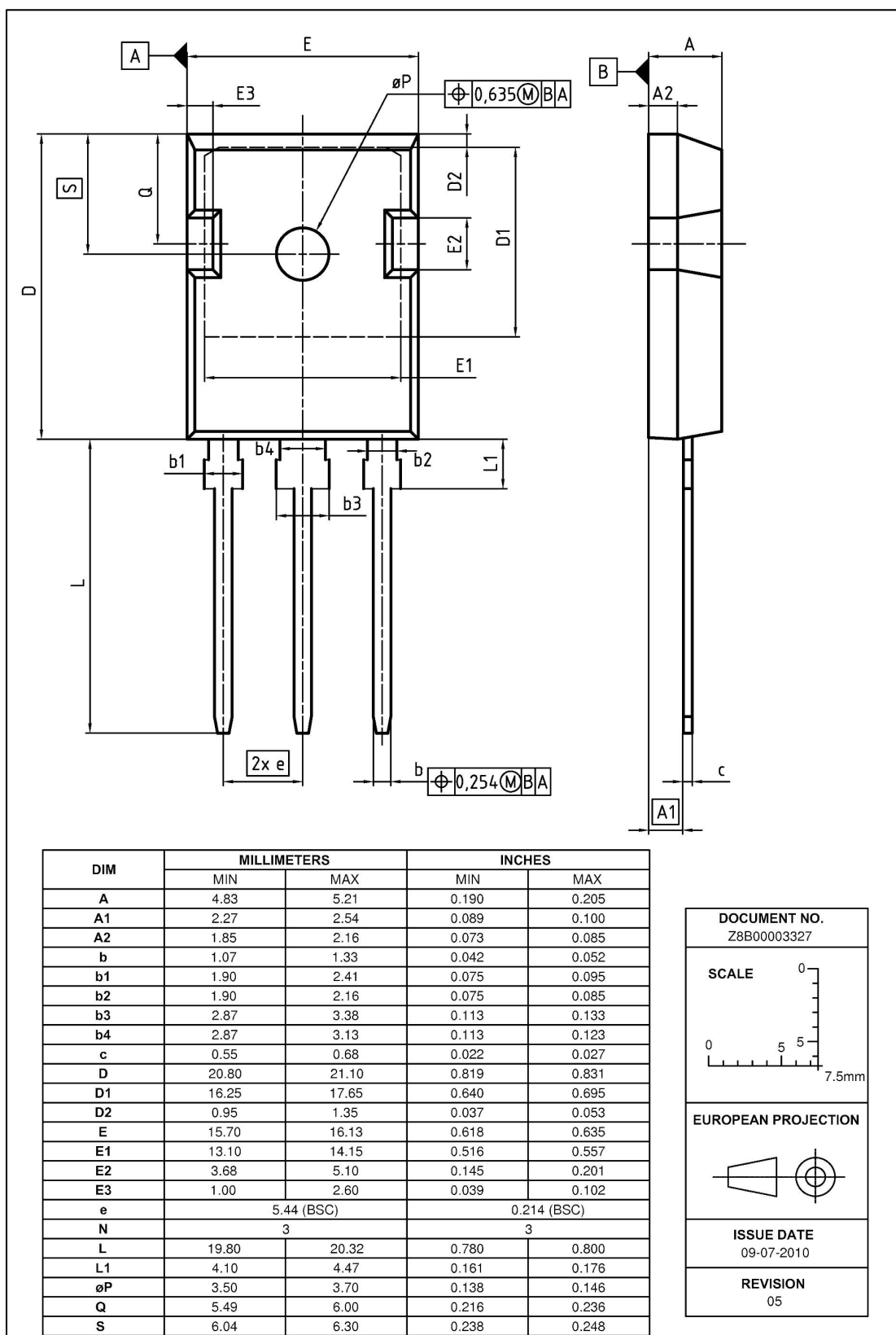
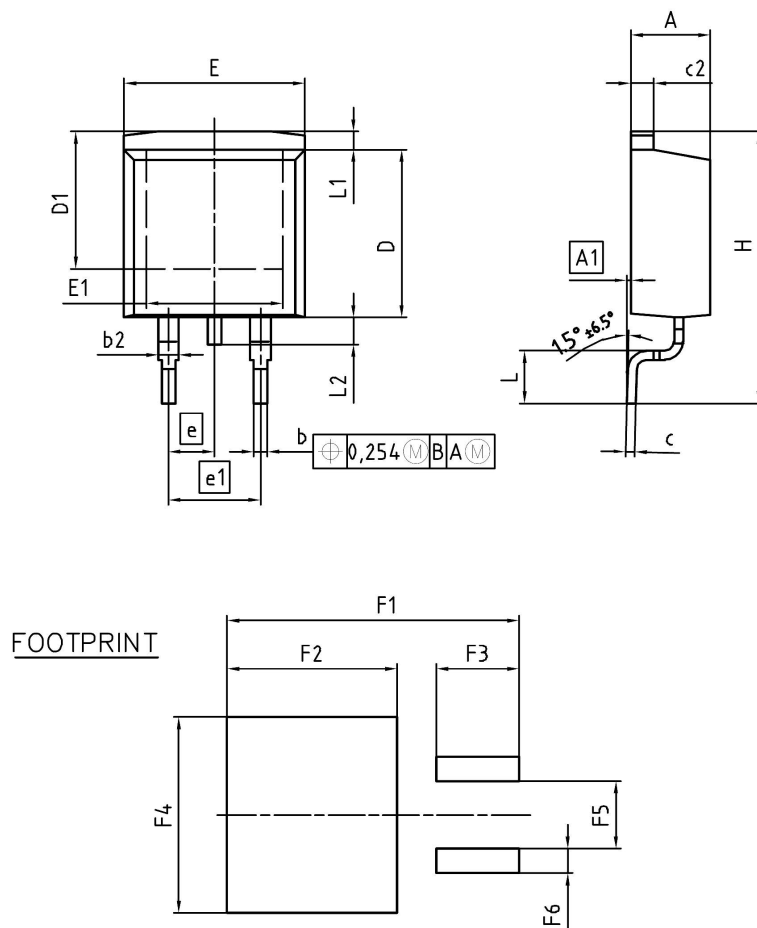


Figure 1 Outline PG-TO 247, dimensions in mm/inches



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	0.00	0.25	0.000	0.010
b	0.65	0.85	0.026	0.033
b2	0.95	1.15	0.037	0.045
c	0.33	0.65	0.013	0.026
c2	1.17	1.40	0.046	0.055
D	8.51	9.45	0.335	0.372
D1	7.10	7.90	0.280	0.311
E	9.80	10.31	0.386	0.406
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	2		2	
H	14.61	15.88	0.575	0.625
L	2.29	3.00	0.090	0.118
L1	0.70	1.60	0.028	0.063
L2	1.00	1.78	0.039	0.070
F1	16.05	16.25	0.632	0.640
F2	9.30	9.50	0.366	0.374
F3	4.50	4.70	0.177	0.185
F4	10.70	10.90	0.421	0.429
F5	3.65	3.85	0.144	0.152
F6	1.25	1.45	0.049	0.057

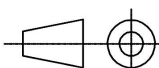
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Figure 2 Outline PG-TO 263, dimensions in mm/inches

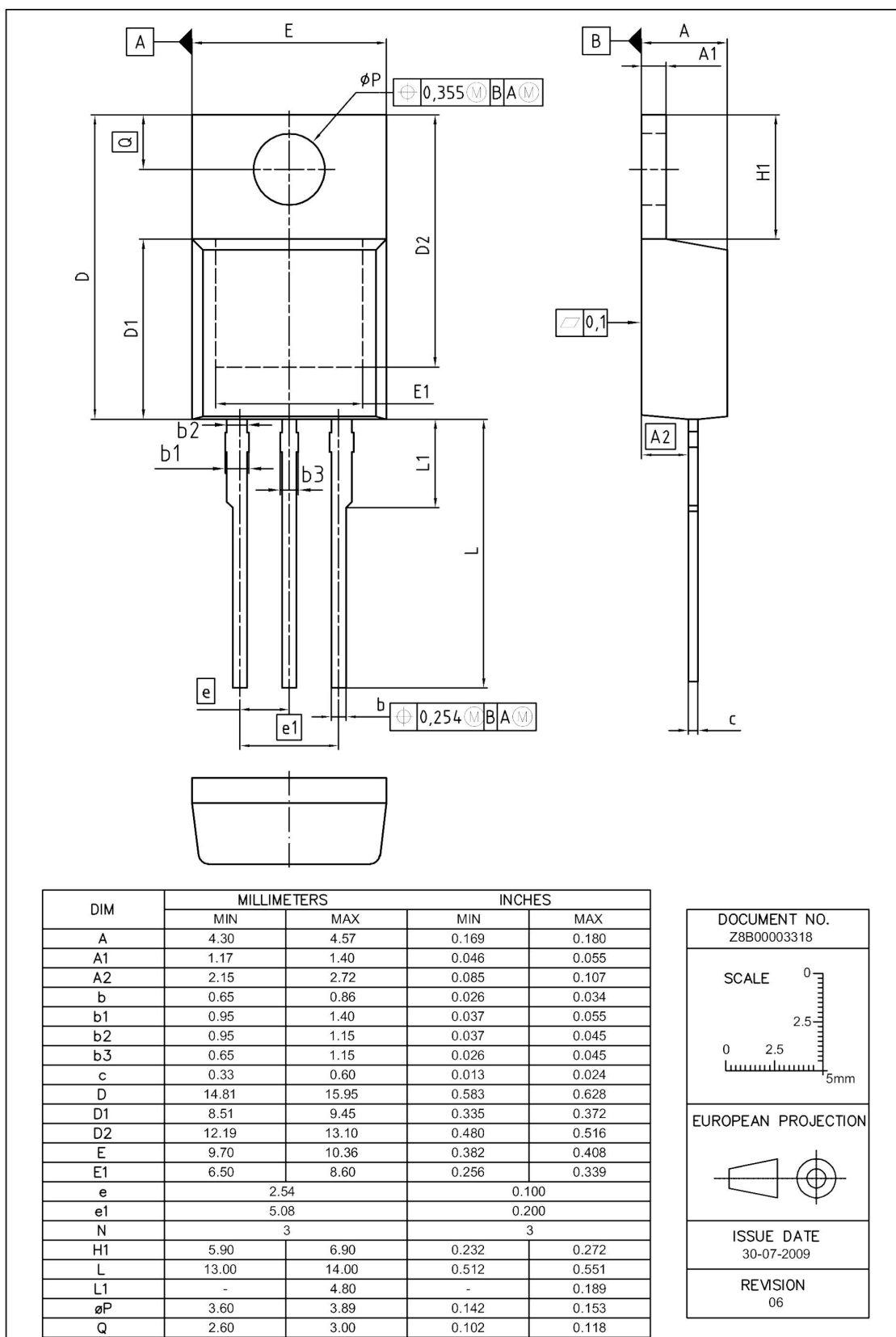


Figure 3 Outline PG-TO 220, dimensions in mm/inches

Revision History

IPW65R190CFDA, IPB65R190CFDA, IPP65R190CFDA

Revision: 2012-07-12, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2012-07-12	Preliminary

Disclaimer ATV

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