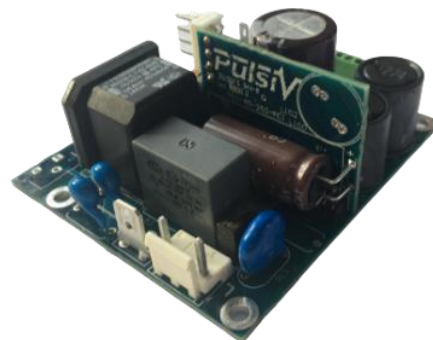


PSV-EBAD-150-DS

150W AC to DC Front-End Evaluation Board

SPECIFICATION:

• Output Power (Max):	150W
• Input Voltage Range:	85 – 265VAC
• HVDC Range:	65 - 380VDC
• Peak Efficiency:	99.5%
• Average Efficiency:	97.5%
• Emissions (EN55032 Class B):	Pass



TECHNICAL FEATURES:

• Hold Up Circuit:	✓
• Half Active Bridge:	✓
• X-Cap Discharge:	✓
• Inrush Current Eliminated:	✓

SUITABLE DC-DC CONVERTERS:

• Flyback:	✓
• Forward Converter:	✓
• Asymmetric Half-Bridge:	✓
• LLC:	X

PULSIV OSMIUM TECHNOLOGY:

Pulsiv OSMIUM technology is an AC to DC front-end conversion method that applies intelligence to an active valley fill approach and delivers a combination of game changing benefits in power electronics designs.

It significantly improves performance at low loads to increase overall average efficiency, reduce energy consumption and deliver a totally flat efficiency profile across all load conditions.

Pulsiv OSMIUM technology can be used with a variety of industry standard DC-DC converters including Flybacks, Forward Converters, & Asymmetric Half Bridge solutions. Wherever needed, it also delivers Power Factor Correction as standard.

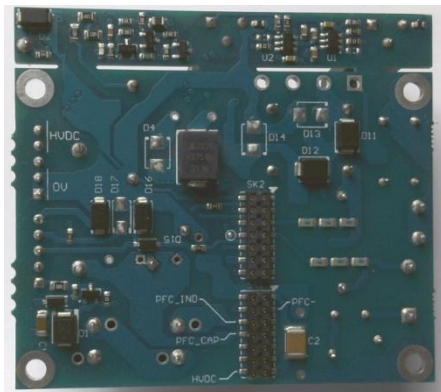
CONTENTS

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3. CONTROLLER CARD PIN CONNECTIONS
4. SCHEMATIC
5. BILL OF MATERIALS
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1. DESCRIPTION

The **PSV-EBAD-150-DS** is an AC to DC front-end evaluation board which allows you to quickly evaluate our power conversion technology for any application up to **150W**. It supports universal input and can be adapted to test various circuit configurations. Simply connect a suitable DC-DC converter on the HVDC output to produce a complete power supply prototype.

2. MOTHERBOARD PIN CONNECTIONS:



PLEASE NOTE: The 13.5V supply shares the same ground as HVDC and Pulsiv recommends using an isolated 13.5V source (18V maximum, 12V minimum).

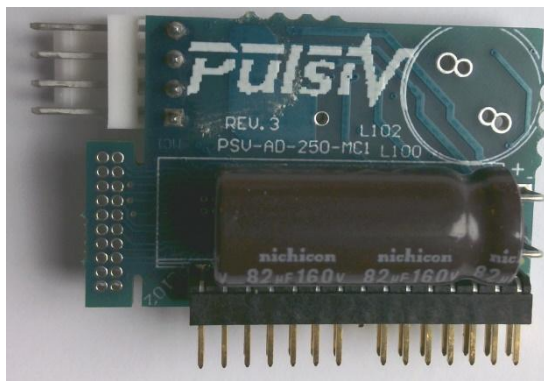
#	Connector	Signal	Description
1	PL4	L	Mains Live voltage input
2	PL4	N	Mains Neutral input

#	Connector	Signal	Description
1	PL3	0V	OSMIUM 0V output to DC/DC stage
2	PL3	0V	OSMIUM 0V output to DC/DC stage
4	PL3	+DC	High-voltage PFC output to DC/DC stage
5	PL3	+DC	High-voltage PFC output to DC/DC stage

#	Connector	Signal	Description
1	PL5	+13.5V	+12V to +18V input required 13.5V recommended
2	PL5	0V	0v input for +13.5V supply
3	PL5	PFC_EN	Digital input to disable (low) the PFC circuit
4	PL5	BULK_EN	External hold up thyristor gate signal
5	PL5	VGRID_OK	Digital output to signal grid condition

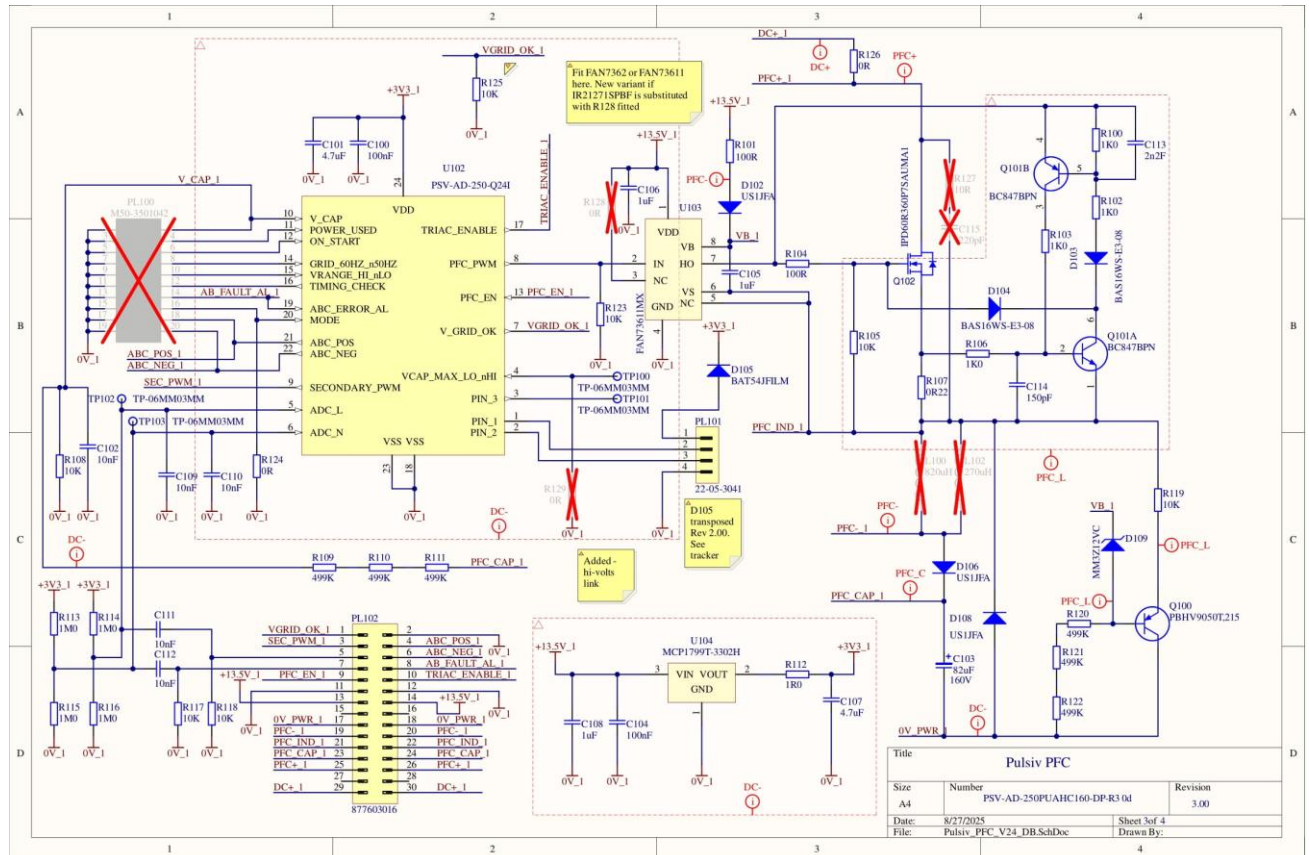
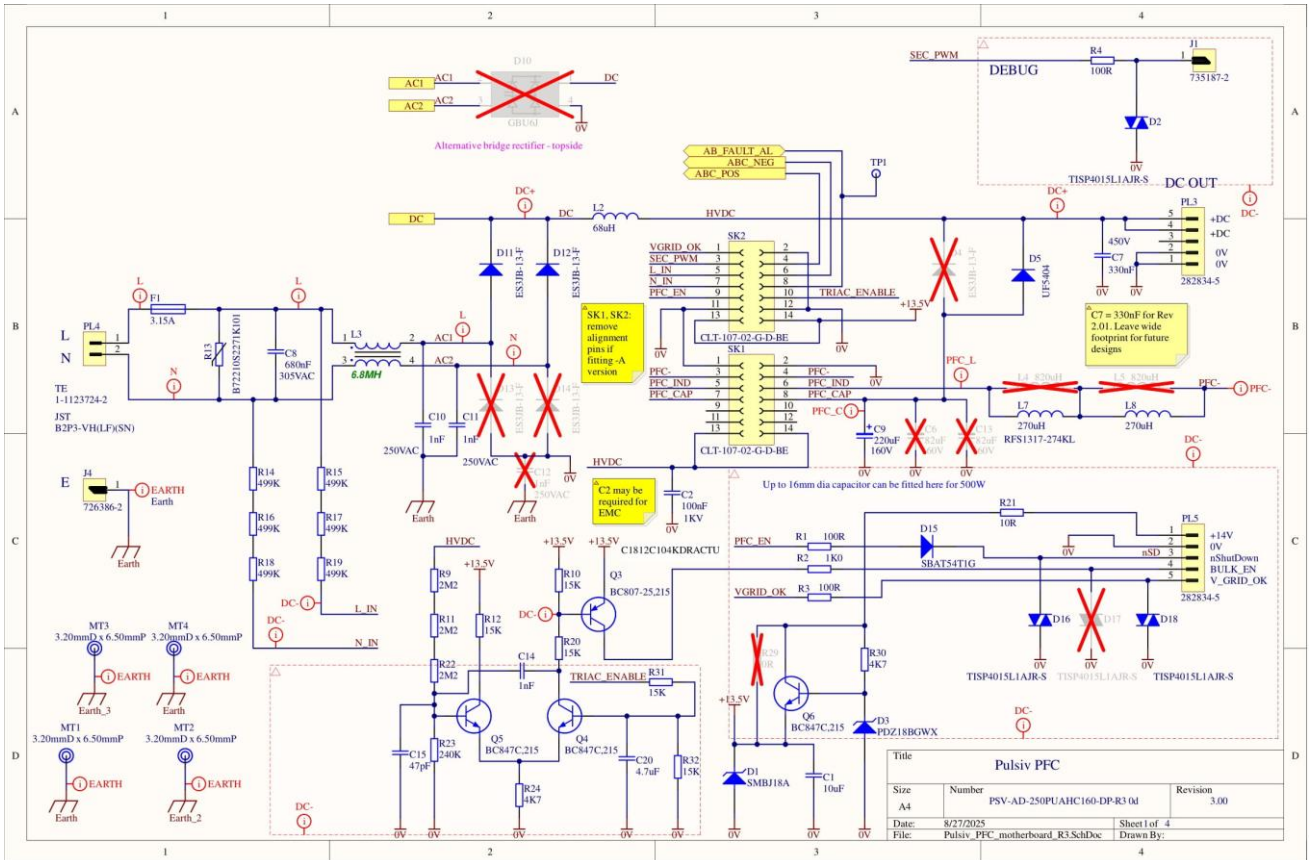
#	Connector	Signal	Description
1	J4	E	Mains Earth input
1	J1	SECONDARY_PWM	Digital output for auxiliary power supply

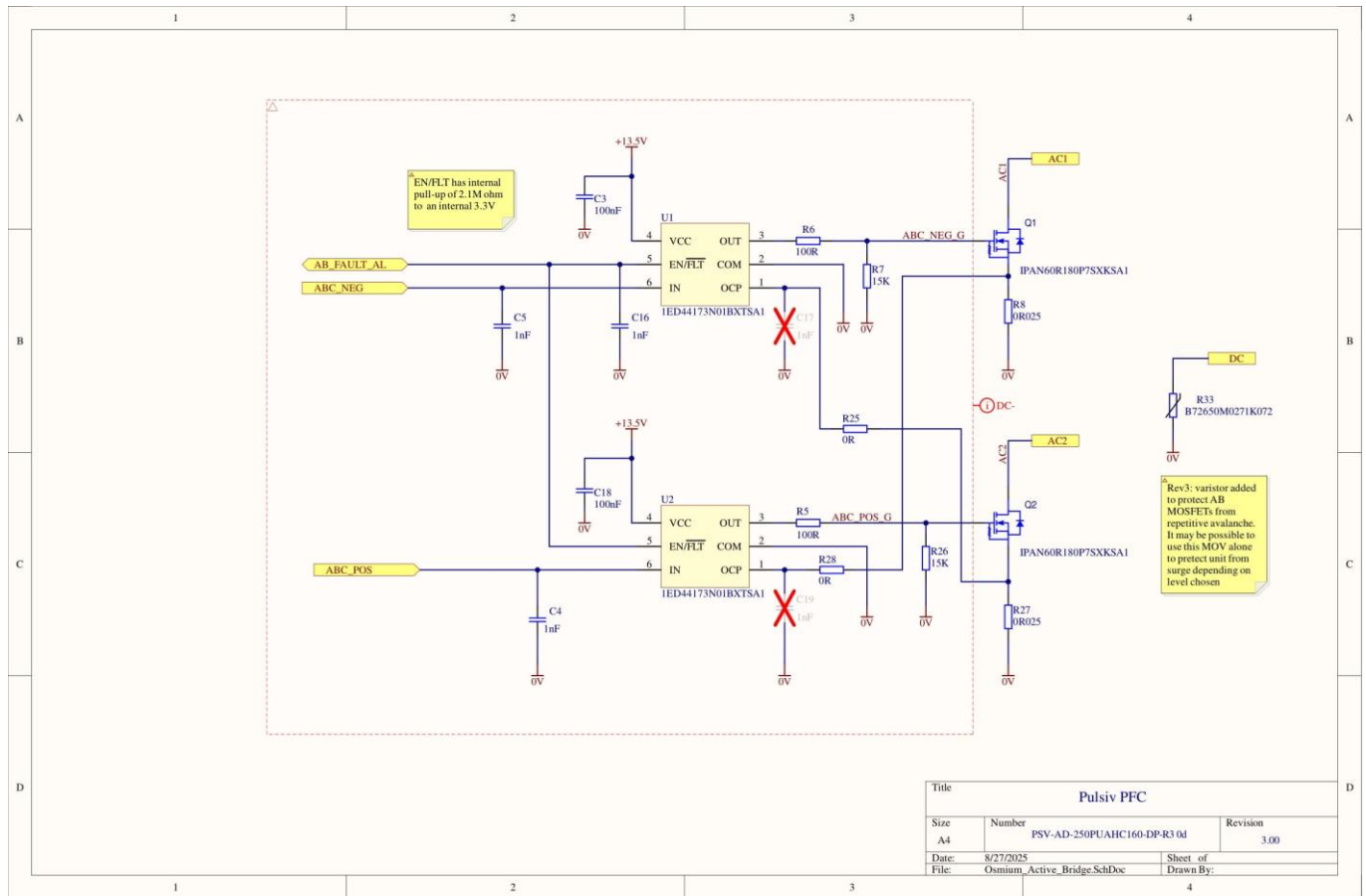
3. CONTROLLER CARD PIN CONNECTIONS:



#	Connector	Signal	Description
1	PL102	VGRID_OK	Digital output to signal Grid condition
2	PL102	0V	0V for the system
3	PL102	SECONDARY_PWM	Digital output for auxiliary power supply
4	PL102	ABC_POS	Digital output for active bridge circuit
5	PL102	Lin	Scaled analogue input from mains Live voltage
6	PL102	ABC_NEG	Digital output for active bridge circuit
7	PL102	Nin	Scaled analogue input from mains Neutral
8	PL102	AB_FAULT_AL	Active bridge fault detect
9	PL102	PFC_EN	Enable PFC circuit to function (low to disable)
10	PL102	TRIAC_ENABLE	Used for additional holdup capacitor if required
11	PL102	0V	0V for the digital system
12	PL102	0V	0V for the digital system
13	PL102	13.5V	13.5V input required
14	PL102	13.5V	13.5V input required
15	PL102	-	Not Connected
16	PL102	-	Not Connected
17	PL102	0V	0V for power system
18	PL102	0V	0V for power system
19	PL102	PFC-	PFC circuit connection
20	PL102	PFC-	PFC circuit connection
21	PL102	PFC_IND	PFC circuit connection
22	PL102	PFC_IND	PFC circuit connection
23	PL102	PFC_CAP	PFC circuit connection
24	PL102	PFC_CAP	PFC circuit connection
25	PL102	-	Not Connected
26	PL102	-	Not Connected
27	PL102	-	Not Connected
28	PL102	-	Not Connected
29	PL102	HVDC	Output voltage
30	PL102	HVDC	Output voltage

4. SCHEMATIC

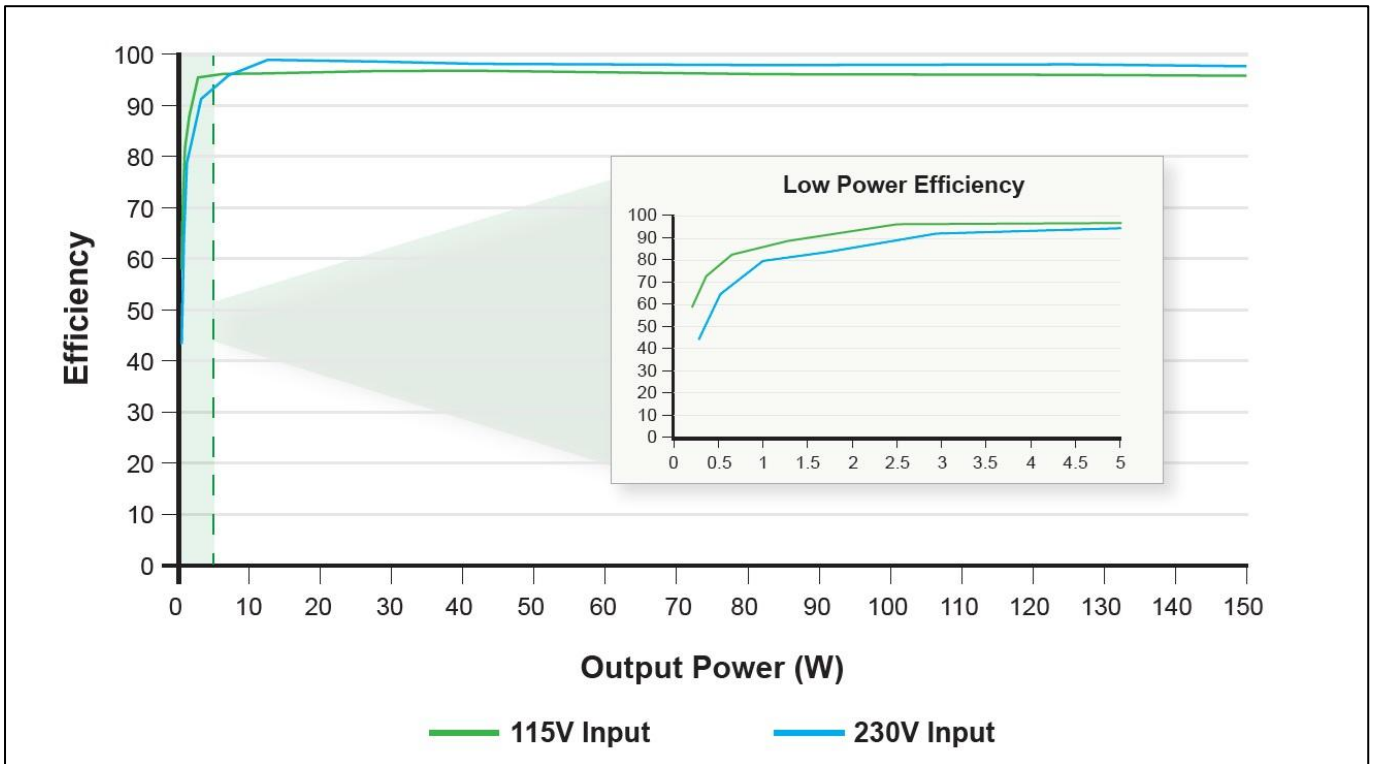




5. BILL OF MATERIALS

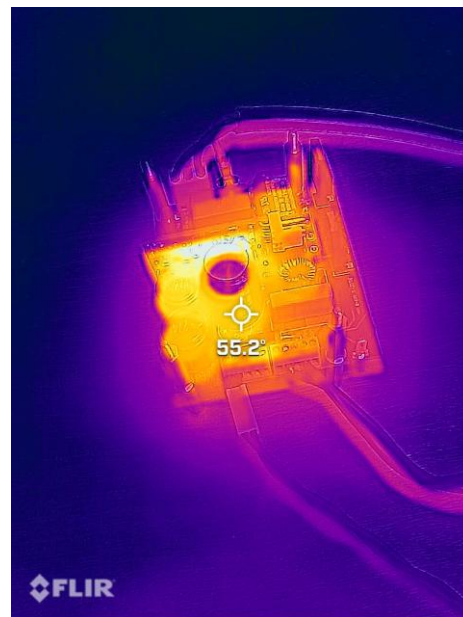
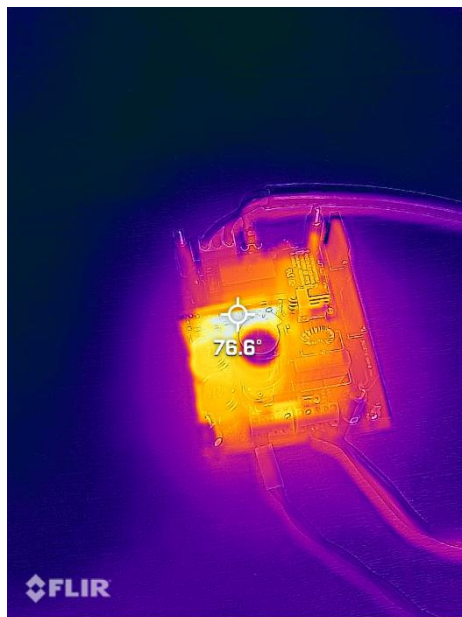
Description	Designator	Quantity	MANUF#1	MANUF PN#1
CAP 1206 X7R 10UF 25V 10% -55/+125	C1		1 TAIYO YUDEN	TMK316B7106KL-TD
CAP 1812 X7R 100NF 1KV 10% -55/+125	C2		1 KEMET	C1812X104KDRACU
CAP 0603 X7R 100NF 50V 10% -55/+125	C3, C18, C104		3 TDK CORPORATION	CGA3E2X7R1H104K080AA
CAP 0603 X7R 1N0F 50V 10% -55/+125	C4, C5, C14, C16		4 TDK	CGA3E2X7R1H102K080AA
CAP PTH PP 0.33uF 450V 10% -55/+125	C7		1 EPCOS	B32672P4334K000
CAP PTH PP 0.68uF 305VAC 10% -40/+110	C8		1 EPCOS	B32922C3684K189
CAP ELEC RAD 220uF 160V 20% -40/+105	C9		1 NICHICON	UCS2C221MHD1TN
CAP PTH CER XY 1nF 250VAC 20% -20/+125	C10, C11		2 KEMET	C901U102MYVDBA7317
CAP 0603 COG 47pF 50V 10% -55/+125	C15		1 YAGEO	CC0603JRNPO9BN470
CAP 0805 X7R 4U7F 25V 10% -55/+125	C20, C101, C107		3 YAGEO	CC0805KKX7R88B475
CAP 0402 X7R 100NF 16V 10% -55/+125	C100		1 MURATA	GCM155R71C104KA55D
CAP 0402 X7R 10NF 16V 10% -55/+125	C102, C109, C110, C111, C112		5 TAIYO YUDEN	EMF105B7103KVHF
CAP ELEC RAD 82uF 160V 20% -40/+105	C103		1 UNI CHEMI-CON	EKKJ161ELL820M125S
CAP 0805 X7R 1U0F 25V 10% -55/+125	C105, C106, C108		3 KEMET	C0805C105K3RECAUTO
CAP 0402 X7R 2.2NF 50V 10% -55/+125	C113		1 WALSHIN	0402B222K500CT
CAP 0402 COG 150PF 50V 5% -55/+125	C114		1 KEMET	CD0402C151J5GACTU
DIO TVS 18V 600W UNIDIRECTIONAL DO214AA	D1		1 VISHAY	SMB18D-M3/H
DIO THYRISTOR SURGE PROTECT 8V 120A SMA	D2, D16, D18		3 BOURNS	TISP4015L1AJR-S
DIO ZENER 18V 625mW SOD-123	D3		1 NEXPERIA	PDZ18BGWX
DIO RECTIFIER 1000V 3A DO-201AV	D5		1 DIOTEC SEMI	UF5404
DIO RECTIFIER 600V 3A SMB	D11, D12		2 DIODES	ES3JB-13-F
DIO SCHOTTKY 30V 200MA SOD123	D15		1 ONSEMI	SBAT54T1G
DIO RECTIFIER 600V 1A SOD-123FL	D102, D106, D108		3 ON SEMI	US1JFA
DIO GEN PURP 100V 0.2A SOD323-2 +150	D103, D104		2 VISHAY	BAS16WS-E3-08
DIO SINGLE 40V 0.3A SOD323 +150	D105		1 ST MICRO	BAT54JFILM
DIO ZENER 12V 200mW SOD323FL	D109		1 ONSEMI	MM3Z12VC
FUS PTH MINI 3.15A 250V	F1		1 BEL FUSE	0697A3150-01
CON 1W SPADE TERMINAL TAB 2.8MM ST	J1		1 TE	735187-2
CON 1W SPADE TERMINAL TAB 6.3MM ST	J4		1 TE	726386-2
IND FER 68uH 2A 20% -40/+105	L2		1 WE	7447033
IND CHOKE 6.8mH@ 10kHz 1A 300V -40/+100	L3		1 SCHAFFNER	RN218-1-7-02-6M8
IND SHD PWR 270uH2.05A 10% -40/+85	L7, L8		2 COILCREAFT	RFS1317-274KL
CON 5W TE 2.54MM W-T-B TERM BLOCK ST	PL3, PL5		2 TE	282834-5
CON 2W ST PWR POL 7.92MM PTH	PL4		1 TE	1-1123724-2
CON 4W MOLEX 2.54mmP RA TIN FRICTION LOCK	PL101		1 MOLEX	22-05-3041
CON 30W MILLI-GRID HDR 2.0mmP RA PTH	PL102		1 MOLEX	877603016
TRN MOSFET N-CH 650V 18A TO220V -40/+150	Q1, Q2		2 INFINEON	IPAN60R180P75XKSA1
TRN PNP 45V 500MA SOT23 -55/+150	Q3		1 NEXPERIA	BC807-25,215
TRN NPN 45V 100MA SOT23 -65/+150	Q4, Q5, Q6		3 NEXPERIA	BC847C,215
TRN PNP 500V 150MA SOT23 -55/+150	Q100		1 NEXPERIA	PBHV9050T,215
TRN NPN/PNP GEN PURP X2 45V 0.1A SOT23-6	Q101		1 NEXPERIA	BC847BPN,115
TRN MOSFET N-CH 600V 9A TO252-3 -40/+150	Q102		1 INFINEON	IPD60R360P7SAUMA1
RES 0603 TF 100R 1% 0.1W -55/+150	R1, R3, R4, R5, R6, R101, R104		7 STACKPOLE ELECTRONICS	RMCF0603FT100R
RES 0603 TF 1K0 1% 0.1W -55/+150	R2		1 VISHAY	CRCW06031K00FKEA
RES 0603 TF 15K 1% 0.1W -55/+155	R7, R10, R12, R20, R26, R31, R32		7 YAGEO	RC0603FR-0715KL
RES 0603 TF 0.025R 1% 0.33W -55/+155	R8, R27		2 PANASONIC	ERJ-3BWFR025V
RES 0805 TF 2M2 1% 0.125W -55/+155	R9, R11, R22		3 YAGEO	RC0805FR-072M2L
RES 0805 TF 499K 1% 0.25W -55/+155	R14, R15, R16, R17, R18, R19, R109, R110, R111, R120, R121, R122		12 KOA SPEER	RK73H2ATTD4993F
RES 0805 TF 10R 1% 0.125W -55/+155	R21		1 YAGEO	RC0805FR-0710RL
RES 0603 TF 240K 1% 0.1W -55/+155	R23		1 YAGEO	RC0603FR-07240KL
RES 0603 TF 4K7 1% 0.1W -55/+155	R24, R30		2 YAGEO	RT0603FRE074K7L
RES 0603 TF 0R 0.1W -55/+155	R25, R28, R29, R124		4 YAGEO	RC0603JR-070RL
VAR TVS 275VAC 400A 3225	R33		1 EPCOS	B72650M0271K072
RES 0402 TF 1K0 1% 0.062W -55/+155	R100, R102, R103, R106		4 ROHM	SFR01M2PF1001
RES 0402 TF 10K 1% 0.062W -55/+155	R105, R108, R117, R118, R119, R123, R125		7 VISHAY	CRCW040210K0FKEDC
RES 1210 TF 0.3R 1% 500mW -55/+155	R107		1 YAGEO	RL1210FR-070R22L
RES 0603 TF 1R0 1% 0.25W -55/+155	R112		1 TE	RC0603FR-071RL
RES 0402 TF 1M0 1% 0.062W -55/+155	R113, R114, R115, R116		4 VISHAY	CRCW04021M00FKEDC
RES 0805 TF 0R 0.125W -55/+155	R126		1 YAGEO	RC0805JR-070RL
CON 14W BE LOW PROFILE SK 2.00MM SMT	SK1, SK2		2 SAMTEC	CLT-107-02-G-D-BE
TRN MOSFET PWR DRIVE 2.6A NON-INV -40/+125	U1, U2		2 INFINEON	1ED44173N01BXTSA1
IC PSV-AD-250-Q24I	U102		1 PULSIV	PSV-AD-250-Q24I
IC FAN73611 PWR MAN GATE DRIVER 20V SOP-8	U103		1 ON SEMI	FAN73611MX
IC MCP1799T-3302H LDO 3.3V 80mA -40/+150	U104		1 MICROCHIP	MCP1799T-3302H

6. EFFICIENCY

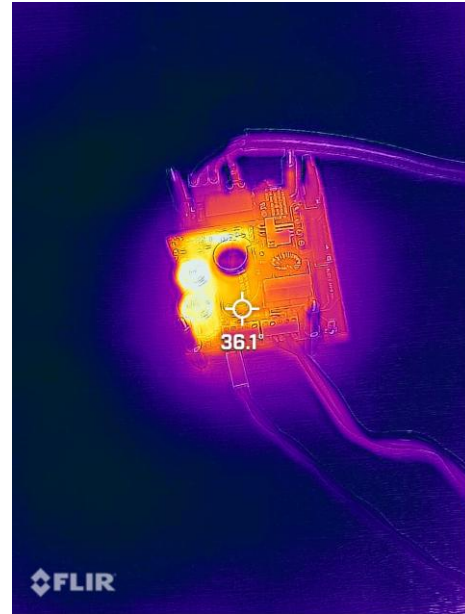
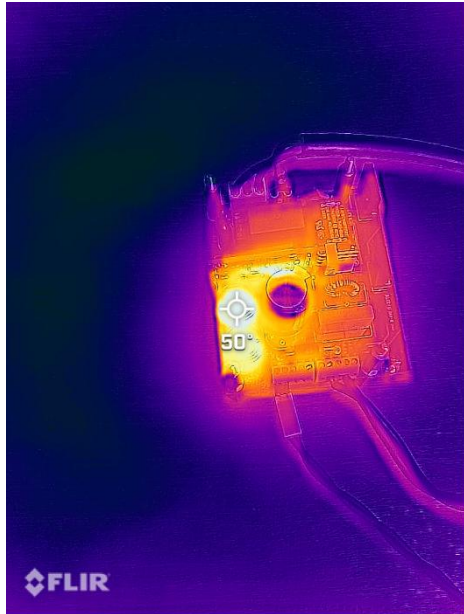


7. THERMAL PERFORMANCE

To showcase thermal performance, an image of the PSV-EBAD-150-DS (with active bridge) is shown below for a Flyback load running at 113W with a 115V supply. The hot spot at 76 Celsius is Q102; which has no heatsink or thermal vias. The calculated loss of Q102 is approximately 1W which has an expected thermal rise of 60 degrees. The capacitor temperature is 55 Celsius.



Running at 113W from a 230V supply, the capacitor temperatures are reduced from 55 Celsius to 36 Celsius and the MOSFET temperature is reduced from 76 Celsius to 50 Celsius. The losses move from the MOSFET to the bobbin chokes. By using lower $R_{ds(on)}$ MOSFETs or a customised choke, these losses can be reduced, and efficiencies increased.



8. EMISSIONS

Produced on behalf of

*Pulsiv Ltd
Milton Hall, Ely Road, Milton
Cambridge, England, CB24 6WZ*

By

Electromagnetic Testing Services Limited
Pratts Fields
Lubberhedges Lane
Stebbing, Dunmow
Essex, CM6 3BT
England, U K

Registered in England, No. 269 6255
Registered Office: Pratts Fields, Lubberhedges Lane, Stebbing, Dunmow, Essex, CM6 3BT, England, U K

Tel. +44 (0) 1371 856061 / (0) 1371 856144 E-mail: info@etsemc.co.uk Web Site: www.etsemc.co.uk

This laboratory is:

- UKAS Accredited Testing Laboratory Number 4416
Scope of Accreditation may be found at:
<https://search.ukas.com/#/tabbed/search?q=electromagnetic%20testing%20services&ati=1>
- F.C.C. (Federal Communications Commission) listed as per the requirements of section 2.948 of the Code Of Federal Regulations CFR 47 for Parts 15 & 18 under Test Firm Registration 361375, Designation Number UK0016
<https://apps.fcc.gov/oetcf/eas/reports/TestFirmSearchResult.cfm>

Approved by the Vehicle Certification Agency for testing Automotive Products, certificate number: VCA-TS-0037
<https://www.vehicle-certification-agency.gov.uk/vehicletype/technical-service-designations.asp>

Distribution: 01 *Pulsiv Ltd*
 02 Electromagnetic Testing Services Limited

Tested By: Test Engineer	Anthony Rogers 
Approved and Authorised By:	George Vassila Technical Director 
Prepared by:	Sarah Jones 

Electromagnetic emissions and immunity tests were carried out on a *Pulsiv Ltd, Pulsiv PFC Development System, PSV-AD-250-DS, PSV-AD-150-DS & PSV-AD-50-DS* unit to assess compliance against the requirements of:

EN55032, Class B (emissions)

This Standard is covered under the ETS LTD UKAS Accreditation Flexible Scope

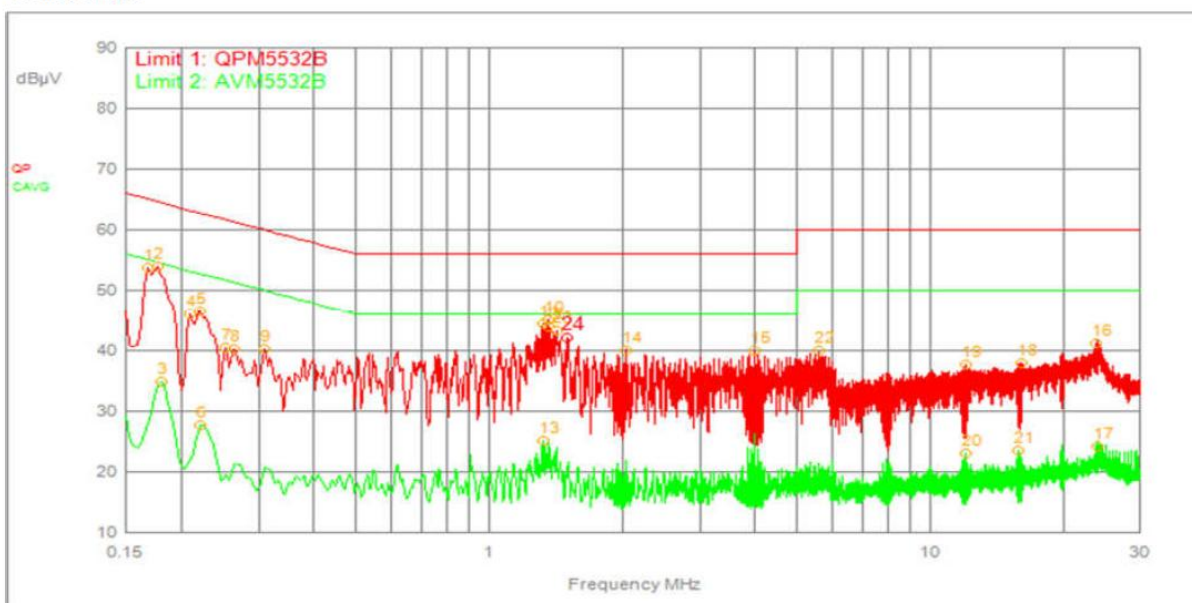
The results obtained indicate compliance with the test limits of the above standards as follows:

Emissions Tests	Standard	Status
Emission Standard for Multimedia Equipment	EN55032, Class B	Complied
Conducted Emissions AC Port	EN55032, Class B	Complied

PSV-AD-250-DS (225 Ohm Load) -250W

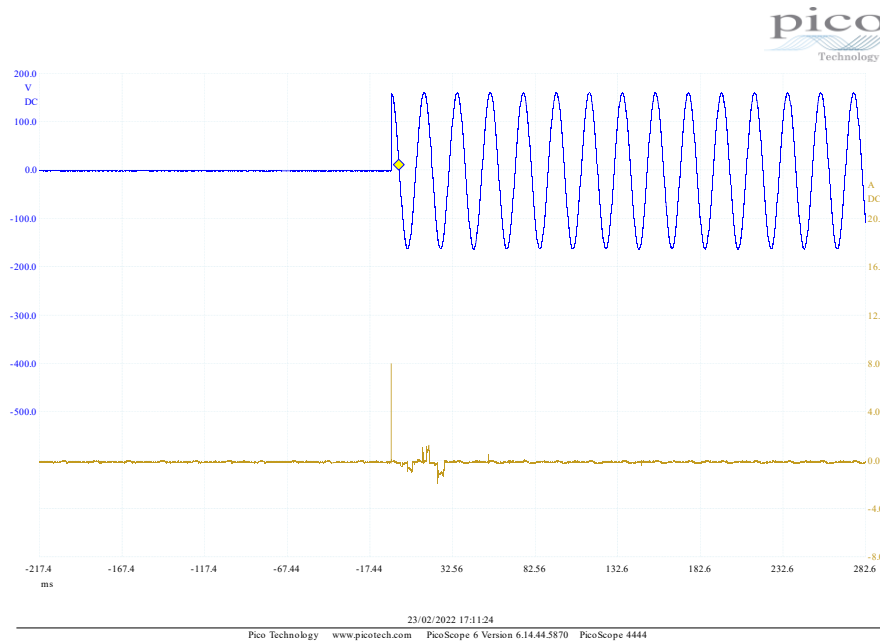
Test File	Detector	Port	Frequency (MHz)	Level (dBuV)	Margin (dB)	Result
C304CEL3	Average	Live	0.180	34.8	-19.7	Pass
C304CEN3	Average	Neutral	1.359	31.3	-14.7	Pass
C304CEL3	Quasi Peak	Live	0.177	54.0	-10.6	Pass
C304CEN3	Quasi Peak	Neutral	1.359	47.8	-8.2	Pass

C304CEL3

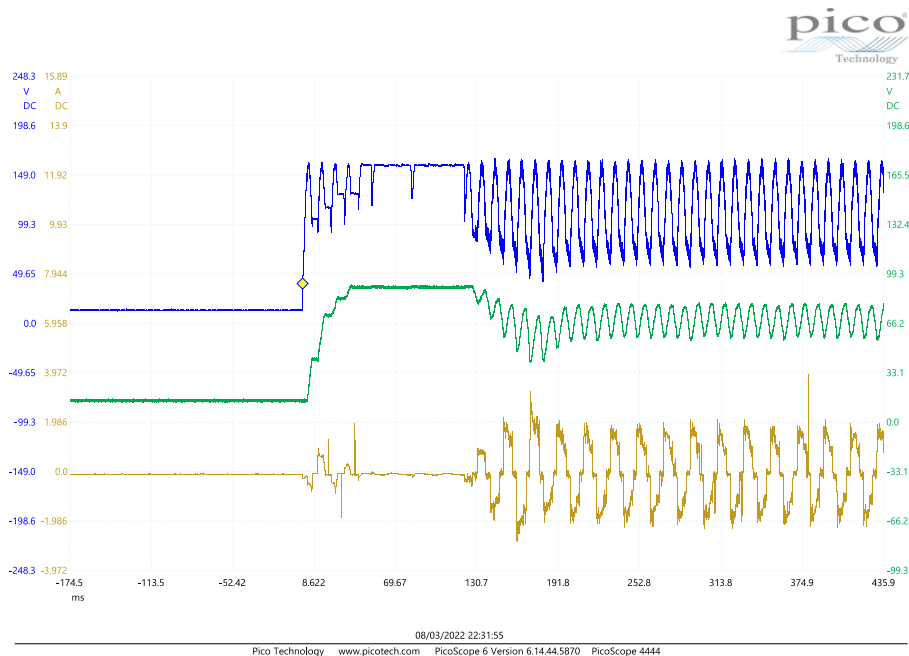


9. INRUSH CURRENT MEASUREMENTS

The current spike shown is caused by the X capacitor and the voltage slew rate of the test equipment. It is less than 100uS and does not count towards inrush current as measured using industry standard techniques and guidelines.



10. LOW VOLTAGE START-UP

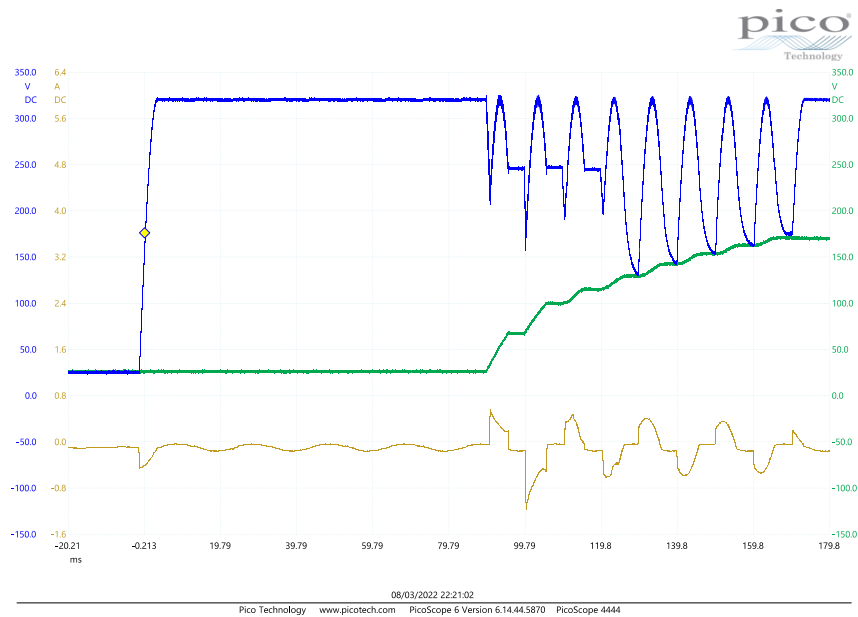


Blue = HVDC

Green = Potential Difference on C9

Brown = Line Current

11. HIGH VOLTAGE START-UP

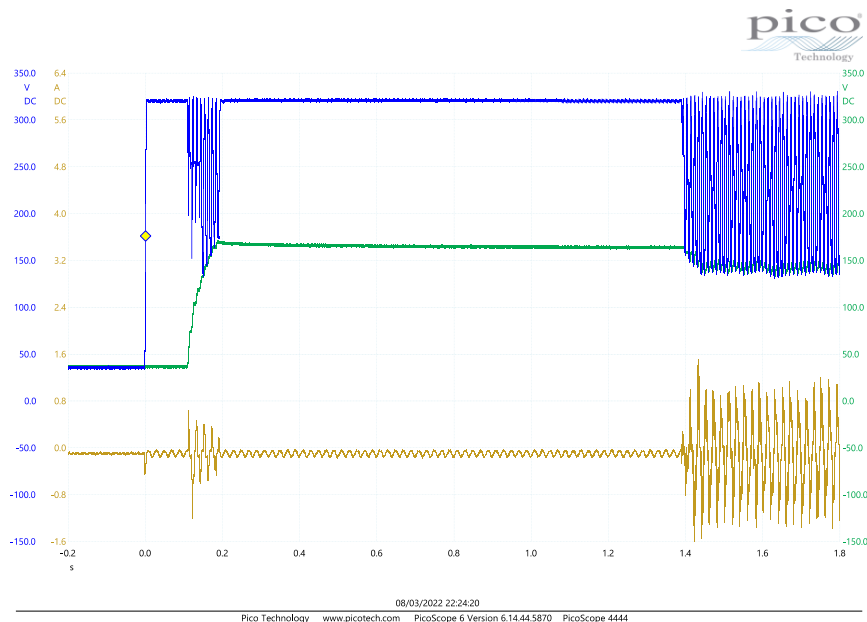


Blue = HVDC

Green = Potential Difference on C9

Brown = Line Current

12. HIGH VOLTAGE STEADY STATE



Blue = HVDC

Green = Potential Difference on C9

Brown = Line Current

13. PART NUMBER CONFIGURATION

Part Number	PSV	-	EBAD	-	xx	-	DS
Descriptor	1		2		3		4

Descriptor		Meaning
1	Brand	PSV = Pulsiv
2	Type	EBAD = AC to DC evaluation board
3	Power (W)	Maximum Output Power (W)
4	Options	DS = Front-end only evaluation board

EXAMPLE PART NUMBER:

PSV-EBAD-150-DS

EXAMPLE PART NUMBER DESCRIPTION:

Pulsiv AC to DC front-end evaluation board with an output power of 150W (max).

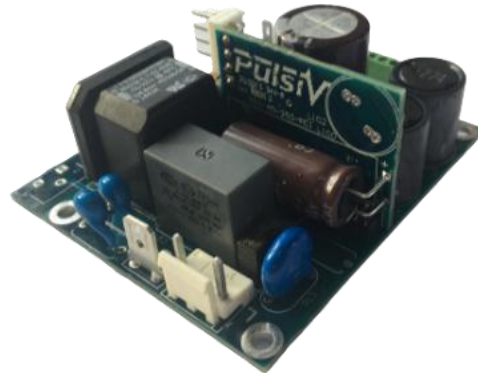
14. MECHANICAL DIMENSIONS

LENGTH = 70mm (2.76in)

WIDTH = 70mm (2.76in)

HEIGHT = 30mm (1.18in)

WEIGHT = 80 g



15. IMPORTANT NOTICE & DISCLAIMER

PULSIV LIMITED (“PULSIV”) PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

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- (1) selecting the appropriate Pulsiv products for your application,
- (2) designing, validating and testing your application, and
- (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

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16. USEFUL LINKS

- Technical Support: [CLICK HERE](#)
- Evaluation Boards: AC to DC Front-End Only [CLICK HERE](#)
- Evaluation Boards: Full AC to DC Power Supplies [CLICK HERE](#)
- Reference Designs: AC to DC Front-End Only [CLICK HERE](#)
- Reference Designs: Full AC to DC Power Supplies [CLICK HERE](#)
- White Papers [CLICK HERE](#)
- Tutorial Videos [CLICK HERE](#)
- Distributors [CLICK HERE](#)
- Contact Pulsiv [CLICK HERE](#)