

12 V - 400 W adapter based on L4985A, L6699 and SRK2001

Features



- Universal input mains voltage range: from 90 Vac to 264 Vac – frequency from 45 to 65 Hz
- Output voltage: 12 V at 33 A continuous operation
- Overall efficiency at full load: > 89%, according to **ENERGY STAR® 6.1** limit for computer and compliant with **80Plus PLATINUM** level
- Average efficiency: > 89%, according to **European CoC ver. 5 Tier 2** for external power supplies
- Efficiency at 250 mW > 50%, compliant to **EuP lot 6 Tier 2** limit for household and office equipment
- No load mains consumption: < 150 mW at 230 Vac, below **European CoC ver. 5 Tier 2** limit for external power supplies
- Mains harmonics: meets EN-61000-3-2 Class-D and JEITA-MITI Class-D
- EMI: according to EN55022 Class-B
- Safety: meets EN60950 standards
- RoHS compliant

Product status link

EVL400W-80PL

Description

The **EVL400W-80PL** demonstration board is a 12 V - 400 W converter, tailored to the typical specifications of an AC/DC adapter with wide input mains range, very low power consumption at light load and good average efficiency.

It is composed by a motherboard mounting the high voltage power devices, the primary control board mounting the IC controllers L4985A and L6699 and the secondary control board for the synchronous rectification.

The architecture is based on a two-stage approach: a front-end PFC pre-regulator based on a CCM (Continuous Conduction Mode) boost PFC controller using the L4985A, and a downstream LLC resonant half-bridge converter, designed around the L6699.

At the secondary side, synchronous rectification is implemented by means of the SRK2001 that assures a very high rectification efficiency with a reduction in the size of the heatsink required.

The PFC section uses the L4985A, a peak current-mode PFC controller for boost converter with a proprietary multiplier “emulator” which, in addition to the innovative THD optimizers, guarantees very low Total Harmonic Distortion (THD) performance in all operating conditions.

The device operates in quasi-fixed frequency in all operating conditions thanks to a proprietary off-time modulator and includes the high voltage startup block with the circuitry to discharge the X-capacitors of the EMI filter.

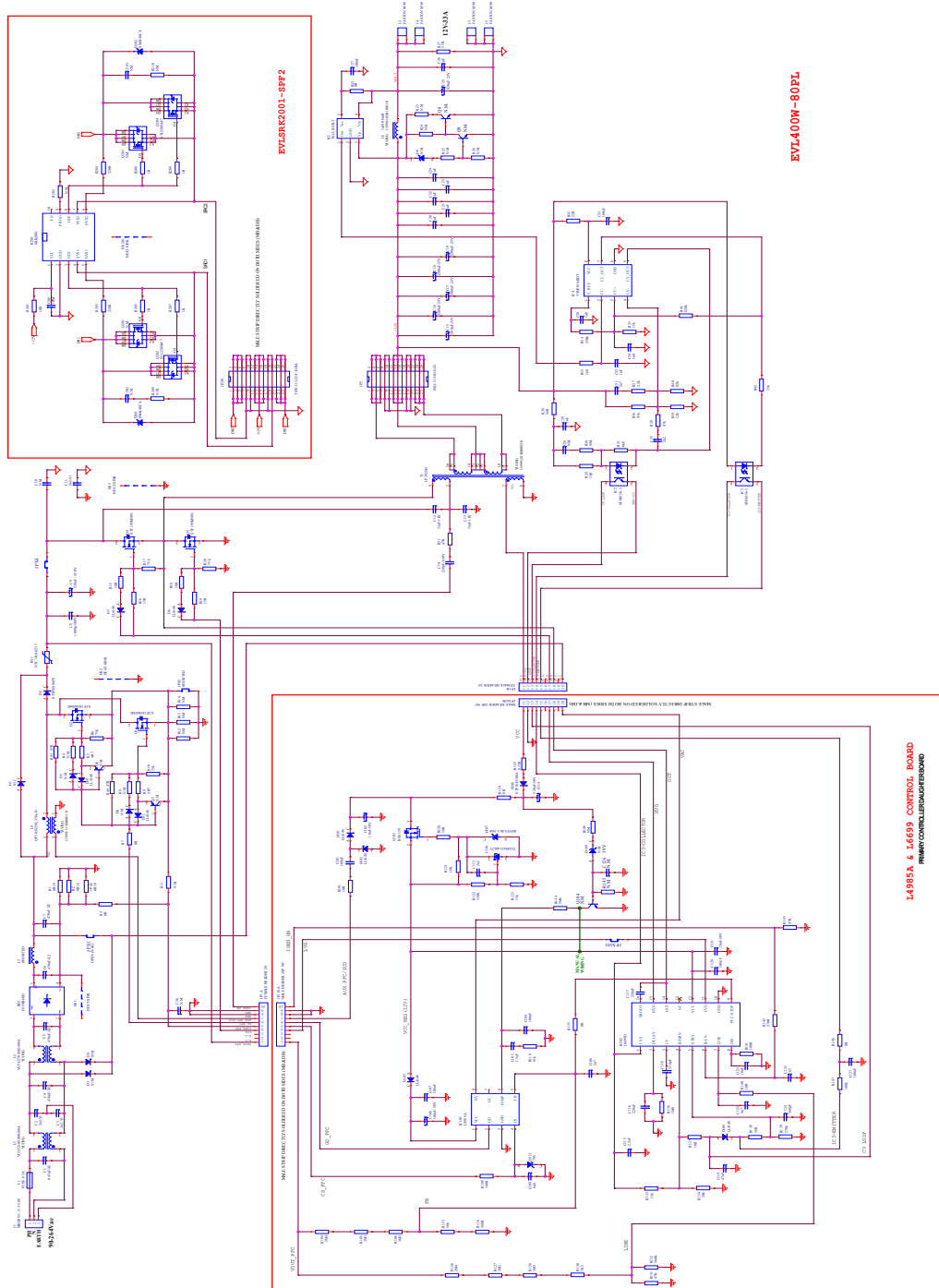
This level of integration allows a low-component count solution for boost PFC pre-regulators.

The LLC section uses the L6699, a double-ended controller specific to series-resonant half-bridge topology. The output voltage regulation is obtained by modulating the operating frequency.

The main focus of this demonstration board is the light-load efficiency, achieved through the burst mode function of both PFC and LLC controllers with the self-adaptive deadtime of the L6699, modulated by the internal logic according to the half-bridge node transition times, which allows the maximization of the transformer magnetizing inductance, reducing the primary current at light load operation.

1 Electrical diagram

Figure 1. EVL400W-80PL electrical diagram



2 Bill of material

Table 1. EVL400W-80PL motherboard BOM

Reference	Value	Description	Manufacturer
BD1	D15XB60H	Single-phase bridge rectifier	Shindengen
C1	0.47uF-X2	X2 - film cap. - R46 series, class X2, 275 Vac, 110°C	Kemet
C2, C3, C11	2n2-Y1	Y1 safety cap.DE1E3KX222M	Murata
C4, C5, C6	470nF-X2	X2 - film cap. - R46 series, class X2, 310 Vac, 110°C	Kemet
C7	470nF-X2	X2 - film cap. - R46 series, class X2, 275 VAC, 110°C	Kemet
C8	1000p-500V	500Vac Cernap - 1206	Vishay
C9	330uF - 450V	Aluminum Elcap - 330uF-450V 20% - LLG2W331MELA45	Nichicon
C10	N.M.	Y1 safety cap.DE1E3KX222M	Murata
C12, C13	33nF-1kV	1kVdc Cap. - B32652A6333	Epcos
C14	220pF-630V	630V Cernap - GRM31A7U2J221JW31	Murata
C15, C16, C17, C18, C19	2200uF-25V	Elcap KZE series-EKZE250ELL222MK35S	Nippon Chemi-Con
C20, C21, C22, C23, C24, C26, C29	1uF	50V Cernap - X7R - 10%	TDK
C25	820uF-25V	25V aluminum cap - EEUTP1E821	Panasonic
C27, C33	100nF	50V Cernap - general purpose	AVX
C36	N.M.	50V Cernap - general purpose	AVX
C28	N.M.	50V Cernap - general purpose	AVX
C30, C34	1n0	50V Cernap - general purpose	AVX
C31	2n7	50V Cernap - general purpose	AVX
C32	1uF	50V Cernap - general purpose	AVX
C35	2n2	50V Cernap - C0G - 10%	AVX
D1	S3J	general purpose rectifier 600V 3A	ON Semi
D2	STTH8S06FP	Ultrafast high voltage rectifier	STMicroelectronics
D3, D4	S1M	General purpose rectifier, SMT	Fairchild
D5, D6	N.M.	High speed signal diode	Vishay
D7, D8, D10, D11	LL4148	High speed signal diode	Vishay
D9	N.M.	High junction temperature Transil™	STMicroelectronics
F1	Fuse 6.3A	Fuse TR5/TE5 250V - 6.3A	Littlefuse
HS1	Heat-sink	Heat sink for BD1	-
HS2	Heat-sink	Heat sink for Q2,Q3,D2	-
HS3	Heat-sink	Heat sink for Q4, Q5	-
IC1	TSC101CILT	High-side current sense amplifier	STMicroelectronics
IC2, IC3	SFH6156-3	Optocoupler, Phototransistor Output, High Reliability, 5300 VRMS	Vishay
IC4	TSM1014AIDT	Low consumption CV/CC controller	STMicroelectronics
JPX1	Open (N.M.)	Wire jumper	-

Reference	Value	Description	Manufacturer
JPX2 (R211 su schema)	0R18	RSMF1TB - metal film res - 1W - 2% - 250ppm/°C	Akaneohm
JPX3	Shorted	Wire jumper (see Mech Parts)	-
JPX4	Shorted	Wire jumper (see Mech Parts)	-
JP1	Female header 20	Female header p.2,54mm PRECI-DIP	-
JP2	SSQ-113-02-G-D	13x2p straight female receptacle SSQ Series	Samtec
J1	MKDSN 1,5/ 3-5,08	PCB term. block, screw conn., PITCH 5.08mm - 3 W.	Phoenix Contact
J2, J3, J4, J5	Faston M 90	Faston - Connector	TE Connectivity
L1	VOTC2109000200A	Input Emi filter 2mHx2 - 4.7A	Yujing
L2	VOTC2708001500A	Input Emi filter 15mHx2 - 3.7A	Yujing
L3	Shorted	Wire jumper (see Mech Parts)	-
L4	QP303825H_370uH	PFC inductor QP3038-25H-370uH-40-70kHz	Yujing
L6	1uH-0.8mR	Output ripple filter inductor	Yujing
Q2, Q3	STF18N60M2	N-Channel power MOSFET	STMicroelectronics
Q4, Q5	STF19NM50N	N-Channel power MOSFET	STMicroelectronics
Q6, Q7	N.M.	PNP general purpose amplifier	Fairchild
Q8, Q9	N.M.	NPN small signal BJT	Vishay
RT1	NTC 1R0-S237	NTC resistor P/N B57237S0109M000	Epcos
R1, R2	0R18	RSMF1TB - metal film res - 1W - 2% - 250ppm/°C	Akaneohm
R3	0R	SMD standard film res - 1/4W - 5% - 250ppm/°C	Vishay
R4, R8, R23, R24, R25, R26	N.M.	SMD standard film res - 1/8W - 5% - 200ppm/°C	Vishay
R5, R9	4R7	SMD standard film res - 1/8W - 5% - 200ppm/°C	Vishay
R6, R10, R17, R20	75k	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R7	0R	SMD standard film res - 1/8W - 5% - 250ppm/°C	Vishay
R11	N.M.	SMD standard film res - 1/4W - 5% - 250ppm/°C	Vishay
R12, R13, R14	N.M.	RSMF1TB - metal film res - 1W - 2% - 250ppm/°C	Akaneohm
R15, R18	10R	SMD standard film res - 1/8W - 5% - 250ppm/°C	Vishay
R16, R19	15R	SMD standard film res - 1/8W - 5% - 250ppm/°C	Vishay
R21	47R	PTH standard film res - 1/8W - 5% - 200ppm/°C	Vishay
R22	0R	SMD standard film res - 1/8W - 5% - 200ppm/°C	Vishay
R27	51K	SMD standard film res - 1/4W - 5% - 250ppm/°C	Vishay
R28	56R	SMD standard film res - 1/8W - 5% - 250ppm/°C	Vishay
R29	3k9	SMD standard film res - 1/8W - 5% - 250ppm/°C	Vishay
R30	N.M.	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R31	6k8	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R32	22R	SMD standard film res - 1/8W - 5% - 200ppm/°C	Vishay
R33	1k0	SMD standard film res - 1/8W - 5% - 250ppm/°C	Vishay
R34	330k	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R35, R42	15k	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R36	91k	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay

Reference	Value	Description	Manufacturer
R37	2.2k	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R38	47k	SMD standard film res - 1/8W - 5% - 250ppm/°C	Vishay
R39	12k	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R40	82k	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R41	820k	SMD standard film res - 1/8W - 5% - 200ppm/°C	Vishay
R43, R44	47R	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
T1	LP3925H	Resonant power transistor - LP3925H	Yujing

Table 2. EVL400W-80PL primary control board BOM

Reference	Value	Description	Manufacturer
C101	100nF	100V Ceracap - general purpose	AVX
C102	10uF-50V	Aluminum Elcap - YXF SERIES - 105°C	Rubycon
C104, C107, C127	100nF	50V Ceracap - general purpose	AVX
C105	1.5uF	50V Ceracap - general purpose	AVX
C106	100uF-50V	Aluminum Elcap - YXF SERIES - 105°C	Rubycon
C108	2n7	50V Ceracap - general purpose	AVX
C122	4n7	50V Ceracap - general purpose	AVX
C109	6n8	50V Ceracap - general purpose	AVX
C113	2n2	50V Ceracap - C0G - 10%	AVX
C114	330uF-50V	Aluminum Elcap - 105°C	Panasonic
C115	2.2uF	25V Ceracap - general purpose	AVX
C116, C117	220nF	25V Ceracap - general purpose	AVX
C118	330pF	50V Ceracap - general purpose	AVX
C119	47nF	50V Ceracap - general purpose	AVX
C120	100nF	50V Ceracap - general purpose	AVX
C121	10uF-50V	50V Ceracap - general purpose	TDK
C123	10nF	50V Ceracap - general purpose	AVX
C124	560pF	50V Ceracap - general purpose	AVX
C125	1n5	50V Ceracap - general purpose	AVX
C126	N.M.	50V Ceracap - X7R - 10%	AVX
D101, D102, D105, D108	LL4148	High speed signal diode	Vishay
D106	STPS1H100A	Power Schottky diode	STMicroelectronics
D107	BZV55-B11-NM	Zener diode	Vishay
D109	N.M.	Zener diode	Diodes
D111	7V5	Zener diode	Vishay
IC101	L4985A	Low consumption CV/CC controller	STMicroelectronics
IC102	L6699D	Improved HV resonant controller	STMicroelectronics
JPX101	Shorted	Wire jumper (see Mech Parts)	-
JP101	Male header 20P 90°	Male haeder p.2,54mm 90°	-
Q103	BSS159	N-CH depletion MOSFET	Infineon

Reference	Value	Description	Manufacturer
Q104	N.M.	NPN small signal BJT	Vishay
R101, R140	10R	SMD standard film res - 1/4W - 1% - 100ppm/°C	Vishay
R104, R126	2M4	SMD standard film res - 1/4W - 1% - 100ppm/°C	Vishay
R105, R106, R127, R128	3M3	SMD standard film res - 1/4W - 1% - 100ppm/°C	Vishay
R108, R141	100R	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R115	56k	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R116	560R	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R118	91k	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R120	10R	SMD standard film res - 1/8W - 5% - 200ppm/°C	Vishay
R121	16K	SMD standard film res - 1/8W - 5% - 200ppm/°C	Vishay
R122	150K	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R123	15k	SMD standard film res - 1/4W - 1% - 100ppm/°C	Vishay
R124	0R	SMD standard film res - 1/4W - 1% - 100ppm/°C	Vishay
R125	0.33R	SMD standard film res - 1/4W - 5% - 250ppm/°C	Vishay
R130	1K5	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R131	47K	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R132	560K	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R133	15k	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R134	20k	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R135, R148	0R	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R136	1M0	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R137	10K	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R138	56R	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R139	270k	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R142	270R	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R143	47R	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
R144	5M6	SMD standard film res - 1/8W - 5% - 200ppm/°C	Vishay
R145, R146	N.M.	SMD standard film res - 1/8W - 5% - 200ppm/°C	Vishay
R147	100k	SMD standard film res - 1/8W - 1% - 100ppm/°C	Vishay
U101	TLVH431AIL3T	1.24V programmable shunt voltage reference	STMicroelectronics

Table 3. EVL400W-80PL EVLSRK2001-SPF BOM

Reference	Value	Description	Manufacturer
C201	10uF	35V Cerecap X5R - general purpose	TDK
C202, C203	N.M.	100V Cerecap - X7R - 10%	TDK
D201, D202	SMAJ40CA	High junction temperature Transil	STMicroelectronics
HS201	Heat-sink	heat sink for Q201, Q202, Q203, Q204	-
IC201	SRK2001	SRK2001 SR controller	STMicroelectronics
JP201	TSW-113-22-F-D- RA	13x2p Right angle male header TSW Series	Samtec
Q201, Q203	N.M.	N-Channel power MOSFET	STMicroelectronics

Reference	Value	Description	Manufacturer
Q202,Q204	STL220N6F7	N-Channel power MOSFET	STMicroelectronics
R201	10R	SMD standard film res - 1/4W - 1% - 100ppm/°C	Vishay
R202	N.M.	SMD standard film res - 1/8W - 5% - 250ppm/°C	Vishay
R203, R204	220R	SMD standard film res - 1/8W - 5% - 250ppm/°C	Vishay
R205, R206, R207, R208	1R	SMD standard film res - 1/8W - 5% - 250ppm/°C	Vishay
R209, R210	N.M.	SMD standard film res - 1/4W -5% - 250ppm/°C	Vishay

Revision history

Table 4. Document revision history

Date	Version	Changes
05-Jul-2022	1	Initial release.
07-Nov-2022	2	Update BOM tables in Section 2



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