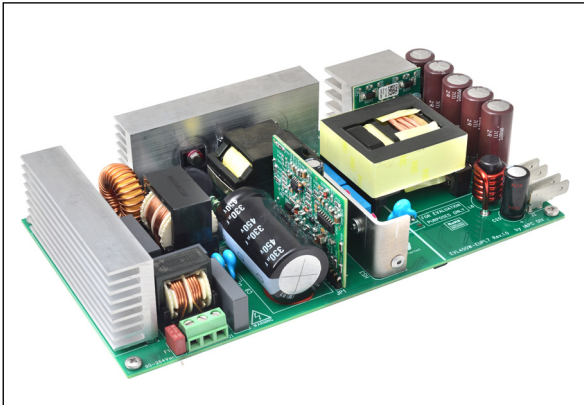


## 12 V - 400 W adapter based on L4984, L6699 and SRK2001

Data brief



### 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 computers
- Certified as **80Plus PLATINUM level at 115 Vac and GOLD level at 230 Vac** in the CLEAResult Plug Load Solutions website<sup>(1)</sup>
- Average efficiency: > 89%, according to **European CoC ver. 5 Tier 2** for external power supplies
- Efficiency at 250 mW > 50%, well above **EuP lot 6 Tier 2** limit for household and office equipment

1. CLEAResult Plug Load Solutions site is owned and maintained by CLEAResult - the largest provider of energy efficiency programs and services in North America:  
<https://www.plugloadsolutions.com/80PlusPowerSuppliesDetail.aspx?id=238&type=4>

- No load mains consumption: < 150 mW at 230 Vac, well below **European CoC ver. 5 Tier 2** limit for external power supplies
- Mains harmonics: meets EN61000-3-2 Class-D and JEITA-MITI Class-D
- EMI: according to EN55022 Class-B
- Safety: meets EN60950 standards
- RoHS compliant

### Description

The EVL400W-EUPL7 demonstration board is a 12 V - 400 W converter, tailored for the typical specification of an AC/DC adapter with wide input mains range, very low power consumption at light load and good average efficiency.

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 L4984, 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 consequent small Heat Sink required.

The PFC section uses a proprietary LM-FOT (line-modulated fixed-off-time) that allows control methodology at fixed frequency operation for boost PFC converters as long as its operating in CCM.

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.

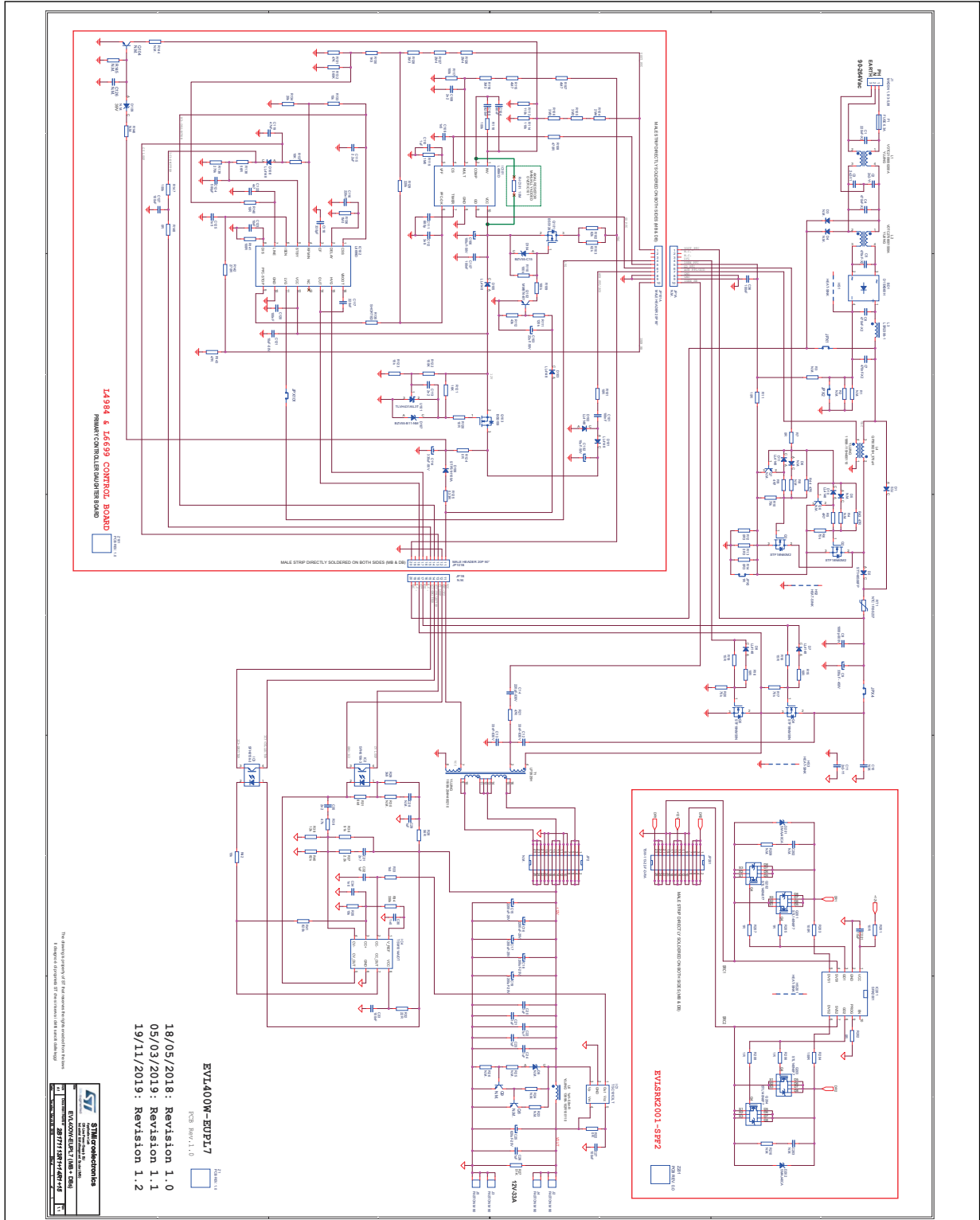
The main focus of this demonstration board is the light-load efficiency, achieved through the burst mode function of both PFC and LLC controllers with the self-adaptive deadtime of the L6699, modulated by the internal logic according to the

half-bridge node transition times, which allows the maximization of the transformer magnetizing inductance, reducing the primary current at light load operation.

An active high voltage start-up circuitry based on a depletion MOSFET provides a very fast start-up time and minimizes the residual consumption during normal operation to a negligible level.

# 1 Electrical diagram

Figure 1. EVL400W-EUPL7 electrical diagram



## 2 Bill of material

Table 1. EVL400W-EUPL7 motherboard BOM

Reference	Value	Description	Package	Manuf. code	Manufacturer
BD1	D15XB60H	Single phase bridge rectifier	5S	D15XB60H	SHINDENGEN
C1	220nF-X2	X2 - film cap - R46 series, class X2, 310 Vac, 110°C	6 x 26.5 h 15 p22.5mm	R463N322000M1M	KEMET
C2, C3, C11	2n2-Y1	Y1 safety cap. DE1E3KX222M	p10mm	DE1E3KX222M	MURATA
C4, C5, C6	470nF-X2	X2 - film cap - R46 series, class X2, 310 Vac, 110°C	7 x 26.5 p22.5mm	R463N347000N0M	KEMET
C7	470nF-X2	X2 - film cap - R46 series, class X2, 275 VAC, 110°C	10 x 18 h16 p15mm	R46KI347000N0M	KEMET
C8	1000p-500V	500Vac CERCAP - 1206	1206		VISHAY
C9	330uF - 450V	Aluminum ELCAP - 330uF-450V 20% - LLG2W331MELA45	DIA 25 x 45 mm	LLG2W331MELA45	NICHICON
C10	N.M.	Y1 safety cap. DE1E3KX222M	p10mm	DE1E3KX222M	MURATA
C12, C13	33nF-630V	630Vdc cap. - B32652A6333	5 x 18 h10.5 p15mm	B32652A6333	EPCOS
C14	220pF-630V	630V CERCAP - GRM31A7U2J221JW31	1206		MURATA
C15, C16, C17, C18, C19	2200uF-25V	ELCAP KZE series- EKZE250ELL222MK35S	12.5 x 35mm	EKZE250ELL222MK35S	NIPPON CHEMI-CON
C20, C21, C22, C23, C24, C26, C29	1uF	50V CERCAP - X7R - 10%	1206		TDK
C25	820uF-25V	25V aluminum cap - EEUTP1E821	DIA 10 x 20mm	EEUTP1E821	PANASONIC
C27, C33, C36	100nF	50V CERCAP - general purpose	805		AVX
C28	N.M.	50V CERCAP - general purpose	805		AVX
C30, C34	1n0	50V CERCAP - general purpose	805		AVX
C31	2n7	50V CERCAP - general purpose	805		AVX
C32	1uF	50V CERCAP - general purpose	805		AVX
C35	2n2	50V CERCAP - C0G - 10%	805		AVX
D1	S3J	General purpose rectifier 600V 3A	SMC (DO-214AB)	S3J	ON SEMI
D2	STTH8S06FP	Ultrafast high voltage rectifier	TO220FPAC		STMicroelectronics
D3, D4	N.M.	General purpose rectifier, SMT	DO214AC		FAIRCHILD
D5, D6	N.M.	High speed signal diode	MINIMELF SOD-80		VISHAY

Table 1. EVL400W-EUPL7 motherboard BOM (continued)

Reference	Value	Description	Package	Manuf. code	Manufacturer
D7, D8, D10, D11	LL4148	High speed signal diode	MINIMELF SOD-80		VISHAY
D9	N.M.	High junction temperature Transil™	MINIMELF SOD-80		STMicroelectronics
F1	FUSE 6.3A	Fuse TR5/TE5 250V - 6.3A	8.5x4 p.5.08mm		LITTLEFUSE
HS1	HEAT-SINK	Heat Sink for BD1	PADA_8359_85		
HS2	HEAT-SINK	Heat Sink for Q2,Q3,D2	PADA_8359_85		
HS3	HEAT-SINK	Heat Sink for Q4, Q5	DWG		
IC1	TSC101CILT	High side current sense amplifier	SOT23-5		STMicroelectronics
IC2, IC3	SFH6156-3	Optocoupler, Phototransistor Output, High Reliability, 5300 VRMS	SMD-4	SFH6156-3	VISHAY
IC4	TSM1014AIDT	Low consumption CV/CC controller	SO-8		STMicroelectronics
JPX1, JPX2, JPX4	SHORTED	Wire jumper (see Mech Parts)	PTH		
JPX3	1R	RSMF1TB - metal film res - 1W - 2% - 250ppm/°C	PTH	RSMF1TB 1R0 G PB-FREE	AKANEOHM
JP1	N.M.	Female header p.2,54mm PRECI-DIP	DWG		
JP2	N.M.	13x2p Straight Female Receptacle SSQ Series	13x2 p2.54mm	SSQ-113-02-G-D	SAMTEC
J1	MKDSN 1,5/ 3-5,08	PCB TERM. BLOCK, SCREW CONN., PITCH 5.08mm - 3 W.	DWG		PHOENIX CONTACT
J2, J3, J4, J5	FASTON M 90	FASTON - CONNECTOR	FASTON PCB	63951-1	TE Connectivity
L1	VOTC2109000 200A	Input EMI filter 2mHx2 - 4.7A	22 x 21 mm	VOTC210900020 0A	YUJING
L2	VOTC2708001 500A	Input EMI filter 15mHx2 - 3.7A	28 x 24.5 mm	VOTC270800150 0A	YUJING
L3	LSR2306-1	51uH-6A DM Inductor	DWG	LSR2306-1	DELTA ELECTRONICS
L4	QP303825H_3 70uH	PFC inductor QP3038-25H-370uH-40-70kHz	DWG	11999-115H400110	YUJING
L6	1uH-0.8mR	Output ripple filter inductor	p 16mm - dia 14mm	13999-102R100110	YUJING
Q2, Q3	STF18N60M2	N-channel Power MOSFET	TO-220FP		STMicroelectronics
Q4, Q5	STF19NM50N	N-channel Power MOSFET	TO-220FP		STMicroelectronics
Q6, Q7	N.M.	PNP general purpose amplifier	SOT-23		FAIRCHILD
Q8, Q9	N.M.	NPN small signal BJT	SOT-23		VISHAY

Table 1. EVL400W-EUPL7 motherboard BOM (continued)

Reference	Value	Description	Package	Manuf. code	Manufacturer
RT1	NTC 1R0-S237	NTC resistor P/N B57237S0109M000	DWG	B57237S0109M	EPCOS
R1, R2	N.M.	Not mounted	PTH		
R3	N.M.	SMD standard film res - 1/4W - 5% - 250ppm/°C	1206		VISHAY
R4, R8, R23, R24, R25, R26	N.M.	SMD standard film res - 1/8W - 5% - 200ppm/°C	805		VISHAY
R5, R9	4R7	SMD standard film res - 1/8W - 5% - 200ppm/°C	805		VISHAY
R6, R10, R17, R20	75k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R7	0R	SMD standard film res - 1/8W - 5% - 250ppm/°C	805		VISHAY
R11	10R	SMD standard film res - 1/4W - 5% - 250ppm/°C	1206		VISHAY
R12, R13, R14	0R3	RSMF1TB - metal film res - 1W - 2% - 250ppm/°C	PTH	RSMF1TB 0R30 G PB-FREE	AKANEOHM
R15, R18	10R	SMD standard film res - 1/8W - 5% - 250ppm/°C	805		VISHAY
R43, R44	47R	SMD standard film res - 1/8W - 5% - 250ppm/°C	805		VISHAY
R16, R19	15R	SMD standard film res - 1/8W - 5% - 250ppm/°C	805		VISHAY
R21	47R	PTH standard film res - 1/8W - 5% - 200ppm/°C	PTH		VISHAY
R22	0R	SMD standard film res - 1/8W - 5% - 200ppm/°C	805		VISHAY
R27	51K	SMD standard film res - 1/4W - 5% - 250ppm/°C	1206		VISHAY
R28	56R	SMD standard film res - 1/8W - 5% - 250ppm/°C	805		VISHAY
R29	3k9	SMD standard film res - 1/8W - 5% - 250ppm/°C	805		VISHAY
R30	N.M.	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R31	6k8	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R32	22R	SMD standard film res - 1/8W - 5% - 200ppm/°C	805		VISHAY
R33	1k0	SMD standard film res - 1/8W - 5% - 250ppm/°C	805		VISHAY

Table 1. EVL400W-EUPL7 motherboard BOM (continued)

Reference	Value	Description	Package	Manuf. code	Manufacturer
R34	330k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R35, R42	15k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R36	91k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R37	2.2k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R38	47k	SMD standard film res - 1/8W - 5% - 250ppm/°C	805		VISHAY
R39	12k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R40	82k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R41	820k	SMD standard film res - 1/8W - 5% - 200ppm/°C	805		VISHAY
T1	LP3925H	Resonant power transformer - LP3925H	DWG	11999-204H400210	YUJING

Table 2. EVL400W-EUPL7 control board BOM

Reference	Value	Description	Package	Manuf. code	Manufacturer
C101	100nF	100V CERCAP - general purpose	1206		AVX
C102	10uF-50V	Aluminum ELCAP - YXF series - 105°C	DIA 5.0 x 11 p2mm	50YXF10MEFC5 X11	RUBYCON
C103	22uF-50V	50V-ELCAP SK Type tol 20%	DIA 5 x 11 p 2mm	SK050M0022B2F -0511	YAGEO
C104	68nF	50V CERCAP - general purpose	805		AVX
C105	820nF	25V CERCAP - general purpose	1206		AVX
C106	100uF-50V	Aluminum ELCAP - YXF series - 105°C	DIA 8 x 11.5 p3.5mm	50YXF100MEFC8 X11.5	RUBYCON
C107, C127	100nF	50V CERCAP - general purpose	805		AVX
C108, C113	2n2	50V CERCAP - C0G - 10%	805		AVX
C109, C125	1n5	50V CERCAP - general purpose	805		AVX
C110	1uF	CERCAP - 25V - X7R - 10%	805		AVX
C111	680p	50V CERCAP - general purpose	805		AVX
C112	3n9	50V CERCAP - general purpose	805		AVX
C114	330uF-50V	Aluminum ELCAP - 105°C	DIA10 x 16 p5mm	ECA-1HHG331	PANASONIC
C115	2.2uF	25V CERCAP - general purpose	1206		AVX

Table 2. EVL400W-EUPL7 control board BOM (continued)

Reference	Value	Description	Package	Manuf. code	Manufacturer
C116, C117	220nF	25V CERCAP - general purpose	805		AVX
C118	330pF	50V CERCAP - general purpose	805		AVX
C119	47nF	50V CERCAP - general purpose	805		AVX
C120	100nF	50V CERCAP - general purpose	1206		AVX
C121	10uF-50V	50V CERCAP - general purpose	1210	C3225X7S1H106 M250AB	TDK
C122	4n7	50V CERCAP - general purpose	805		AVX
C123	10nF	50V CERCAP - general purpose	805		AVX
C124	560pF	50V CERCAP - general purpose	805		AVX
C126	N.M.	50V CERCAP - X7R - 10%	805		AVX
D101, D102, D103, D105, D108	LL4148	High speed signal diode	MINIMELF SOD-80		VISHAY
D104	BZV55-C15	ZENER diode	MINIMELF SOD-80		VISHAY
D106	STPS1H100A	Power Schottky diode	SMA-DO- 214AC		STMicroelectr onics
D107	BZV55-B11-NM	ZENER diode	MINIMELF SOD-80		VISHAY
D109	N.M.	ZENER diode	SOD-123		DIODES
IC101	L4984D	CCM PFC CONTROLLER	SSOP10		STMicroelectr onics
R-IC101	10M	1/8W Axial Resistor	PTH		VISHAY
IC102	L6699D	Improved HV resonant controller	SO-16		STMicroelectr onics
JPX101	SHORTED	Wire jumper	PTH		
JP101	MALE HEADER 20P 90°	Male header p.2,54mm 90°	DWG		
Q101	BSS126	N-CH depletion MOSFET	SOT-23	BSS126	INFINEON
Q102	MMBT4401	NPN small signal BJT	SOT-23		VISHAY
Q103	BSS159	N-CH depletion MOSFET	SOT-23	BSS159	INFINEON
Q104	N.M.	NPN small signal BJT	SOT-23		VISHAY
R101, R140	10R	SMD standard film res - 1/4W - 1% - 100ppm/°C	1206		VISHAY
R102, R103	62k	SMD standard film res - 1/4W - 1% - 100ppm/°C	1206		VISHAY
R104, R126	2M4	Standard film res - 1/8W - 1% - 100ppm/°C	PTH		VISHAY



Table 2. EVL400W-EUPL7 control board BOM (continued)

Reference	Value	Description	Package	Manuf. code	Manufacturer
R105, R106, R116, R128	2M4	SMD standard film res - 1/4W - 1% - 100ppm/°C	1206		VISHAY
R127	2M4	SMD standard film res - 1/4W - 1% - 100ppm/°C	1206		VISHAY
R107, R115	4M7	SMD standard film res - 1/4W - 1% - 100ppm/°C	1206		VISHAY
R108	470R	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R109	100k	SMD standard film res - 1/4W - 5% - 250ppm/°C	1206		VISHAY
R110, R117, R118, R147	100k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R111	120k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R112	43k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R113, R114	110k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R119, R136	1M0	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R120	10R	SMD standard film res - 1/8W - 5% - 200ppm/°C	805		VISHAY
R121	16K	SMD standard film res - 1/8W - 5% - 200ppm/°C	805		VISHAY
R122	150K	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R123	15k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R124	0R	SMD standard film res - 1/4W - 5% - 250ppm/°C	1206		VISHAY
R125	0.33R	SMD standard film res - 1/4W - 5% - 250ppm/°C	1206		VISHAY
R129	220k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R130	1K5	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R131	47K	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R132	560K	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R133	15k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY

Table 2. EVL400W-EUPL7 control board BOM (continued)

Reference	Value	Description	Package	Manuf. code	Manufacturer
R134	20k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R135	SHORTED	Wire jumper	PTH		
R137	10K	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R138	56R	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R139	270k	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R141	100R	SMD standard film res - 1/8W - 5% - 200ppm/°C	805		VISHAY
R142	270R	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R143	47R	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
R144, R145, R146	N.M.	SMD standard film res - 1/8W - 5% - 200ppm/°C	805		VISHAY
R148	0R	SMD standard film res - 1/8W - 1% - 100ppm/°C	805		VISHAY
U101	TLVH431AIL3T	1.24V programmable shunt voltage reference	SOT-23		STMicroelectronics

Table 3. EVL400W-EUPL7 rectification board BOM

Reference	Value	Description	Package	Manuf. code	Manufacturer
C201	10uF	35V CERCAP X5R - general purpose	1206		TDK
C202, C203	N.M.	100V CERCAP - X7R - 10%	1206		TDK
D201, D202	SMAJ40CA	High junction temperature Transil™	DO-214AC		STMicroelectronics
HS201	Heat Sink	Heat Sink for Q201,Q202,Q203,Q204	DWG		
IC201	SRK2001	SRK2001 SR controller	SSOP10	SRK2001	STMicroelectronics
JP201	TSW-113-22-F-D-RA	13x2p right angle male header TSW series	13x2 p2.54mm	TSW-113-22-F-D-RA	SAMTEC
Q201, Q202, Q203, Q204	STL140N6F7	N-channel Power MOSFET	PowerFLAT 5x6	STL140N6F7	STMicroelectronics
R201	10R	SMD standard film res - 1/4W - 1% - 100ppm/°C	1206		VISHAY
R202	0R	SMD standard film res - 1/8W - 5% - 250ppm/°C	805		VISHAY

Table 3. EVL400W-EUPL7 rectification board BOM (continued)

Reference	Value	Description	Package	Manuf. code	Manufacturer
R203, R204	100R	SMD standard film res - 1/8W - 5% - 250ppm/°C	805		VISHAY
R205, R206, R207, R208	1R	SMD standard film res - 1/8W - 5% - 250ppm/°C	805		VISHAY
R209, R210	N.M.	SMD standard film res - 1/4W - 5% - 250ppm/°C	1206		VISHAY

### 3 Revision history

Table 4. Document revision history

Date	Revision	Changes
22-May-2019	1	Initial release
31-May-2019	2	Updated cover image on page 1
05-Dec-2019	3	Updated Features <a href="#">on page 1</a> . Changed R127 from 3.3 M $\Omega$ to 2.4 M $\Omega$ on the Schematic ( <a href="#">Figure 1. on page 3</a> ) and in the BOM ( <a href="#">Table 2. on page 7</a> ).Rev 3

**IMPORTANT NOTICE – PLEASE READ CAREFULLY**

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2019 STMicroelectronics – All rights reserved

## X-ON Electronics

Largest Supplier of Electrical and Electronic Components

*Click to view similar products for* [Power Management IC Development Tools](#) *category:*

*Click to view products by* [STMicroelectronics](#) *manufacturer:*

Other Similar products are found below :

[EVAL-ADM1168LQEBZ](#) [EVB-EP5348UI](#) [MIC23451-AAAYFL EV](#) [MIC5281YMME EV](#) [DA9063-EVAL](#) [ADP122-3.3-EVALZ](#) [ADP130-0.8-EVALZ](#) [ADP130-1.2-EVALZ](#) [ADP130-1.5-EVALZ](#) [ADP130-1.8-EVALZ](#) [ADP1712-3.3-EVALZ](#) [ADP1714-3.3-EVALZ](#) [ADP1715-3.3-EVALZ](#) [ADP1716-2.5-EVALZ](#) [ADP1740-1.5-EVALZ](#) [ADP1752-1.5-EVALZ](#) [ADP1828LC-EVALZ](#) [ADP1870-0.3-EVALZ](#) [ADP1871-0.6-EVALZ](#) [ADP1873-0.6-EVALZ](#) [ADP1874-0.3-EVALZ](#) [ADP1882-1.0-EVALZ](#) [ADP199CB-EVALZ](#) [ADP2102-1.25-EVALZ](#) [ADP2102-1.875EVALZ](#) [ADP2102-1.8-EVALZ](#) [ADP2102-2-EVALZ](#) [ADP2102-3-EVALZ](#) [ADP2102-4-EVALZ](#) [ADP2106-1.8-EVALZ](#) [ADP2147CB-110EVALZ](#) [AS3606-DB](#) [BQ24010EVM](#) [BQ24075TEVM](#) [BQ24155EVM](#) [BQ24157EVM-697](#) [BQ24160EVM-742](#) [BQ24296MEVM-655](#) [BQ25010EVM](#) [BQ3055EVM](#) [NCV891330PD50GEVB](#) [ISLUSBI2CKIT1Z](#) [LM2744EVAL](#) [LM2854EVAL](#) [LM3658SD-AEV/NOPB](#) [LM3658SDEV/NOPB](#) [LM3691TL-1.8EV/NOPB](#) [LM4510SDEV/NOPB](#) [LM5033SD-EVAL](#) [LP38512TS-1.8EV](#)