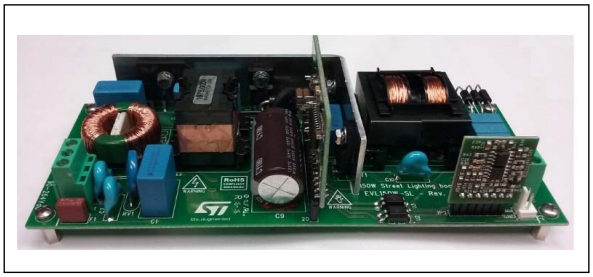
# EVL150W-HVSL

## 150 V - 150 W LED driver using the STCMB1 transition mode PFC and HBR resonant tank combo controller

**Data brief**



## Features

- Universal input mains range: 90 to 264 Vac - frequency 45 to 65 Hz
- Half-bridge topology: LCC
- Max. output voltage and current: 150 V at 1 A continuous operation
- No-load mains consumption: < 0.5 W
- THD < 10% at 230 Vac from 25 to 100% of the full load
- No need of auxiliary SMPS (Viper or equivalent)
- Efficiency: >91% at full load
- No electrolytic capacitors for long term reliability
- Conducted EMC: within EN55022-Class-C limits
- Safety: meets EN60950
- Dimming: analog, resistive, PWM (open collector)
- Feedback loops: constant current and constant voltage
- Protections: LED short-circuit, LED string open, regulation loop failure
- Dimensions: 69x157 mm, 28 mm components maximum height
- PCB: double side, 70 µm, FR-4, mixed PTH/SMT

## Description

The EVL150W-HVSL is an evaluation board of a 150 W / 1 A LED driver with wide input mains range. The electrical specification is tailored on a typical high-power street lighting application.

It is based on a two-stage architecture, consisting of a front-end PFC pre-regulator and a downstream half-bridge resonant tank converter. The pre-regulator is a transition mode PFC based on constant ON time control, while the resonant converter is an LCC tank that is more suitable than LLC tank to build a current source.

Both stages are based on the new STCMB1 combo controller that integrates, in the same device, a transition mode PFC controller and a half-bridge resonant controller.

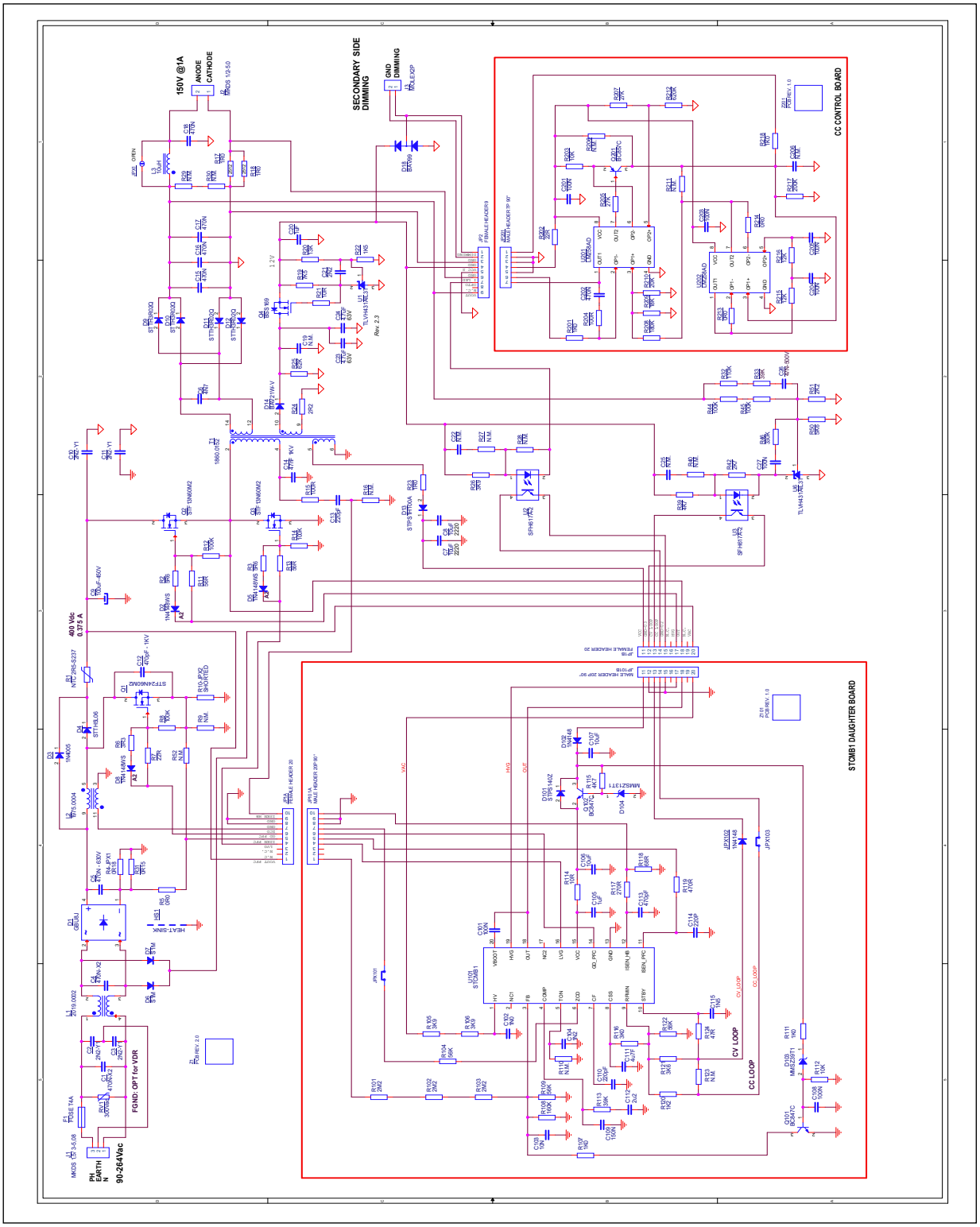
Thanks to the STCMB1, the main features of this design are high efficiency, no-load input power consumption is very low, reduced harmonics compliant with the EN61000-3-2 Class-C, and EMI within the relevant EN55022 limits.

Another noticeable feature of this LED driver is the extremely **wide dimming capability**, actually the board can regulate the current from maximum level down to less than 10% with analog dimming and to 1% in PWM dimming. The PWM dimming is perfectly flicker free, because even in the case of very low current, it is kept continuous (DC) in the LED and thus independent of the frequency of the PWM dimming signal.

The board also has protection features in case of overload, short-circuit, open loop by each section. For this particular application, all protections in case of intervention have an auto-restart functionality.

# 1 Electrical diagram

**Figure 1. Electrical diagram**



# 2 Bill of material

**Table 1. EVL150W-HVSL Evaluation board: bill of material (Rev. 2.3)**

| Ref. | Value | Case | Description | Supplier |
|---|---|---|---|---|
| C1 | 470N-X2 | 9.0 × 18.0 p15mm | X2 - FILM CAP - B32922C3474K | EPCOS |
| C2 | 2N2-Y1 | p10mm | Y1 SAFETY CAP. DE1E3KX222M | MURATA |
| C3 | 2N2-Y1 | p10mm | Y1 SAFETY CAP. DE1E3KX222M | MURATA |
| C4 | 470N-X2 | 9.0 × 18.0 p15mm | X2 - FILM CAP - B32922C3474K | EPCOS |
| C5 | 470N - 630V | 8.5 x 26.5 p22.5mm | 630V - FILM CAP - B32673Z6474K | EPCOS |
| C6 | 4N7 | 5.0 x 13.0 p10mm | 450VAC - FILM CAP - B32651A7472K | EPCOS |
| C7 | 10uF | 2220 | CERCAP - 50V - X7R - 20% | TDK |
| C8 | 10uF | 2220 | CERCAP - 50V - X7R - 20% | TDK |
| C9 | 100uF-450V | DIA 18 x 35.5 mm | Aluminium ELCAP - CY series - 105°C | NICHICON |
| C10 | 2N2-Y1 | p10mm | Y1 SAFETY CAP. DE1E3KX222M | MURATA |
| C11 | 2N2-Y1 | p10mm | Y1 SAFETY CAP. DE1E3KX222M | MURATA |
| C12 | 470pF - 1KV | 1206 | 1KV CERCAP - X7R - 10% | MURATA |
| C13 | 220pF | 1206 | 630V CERCAP - GRM31A7U2J220JW31 | MURATA |
| C14 | 47nF 1KV | 7.0 x 18.0 p15mm | 1KV - FILM CAP - B32652A0473K | EPCOS |
| C15 | 470N | 6.0x13 p10 mm | MKT FILM CAP - B32521C3474M - 250V - 20% | EPCOS |
| C16 | 470N | 6.0x13 p10 mm | MKT FILM CAP - B32521C3474M - 250V - 20% | EPCOS |
| C17 | 470N | 6.0x13 p10 mm | MKT FILM CAP - B32521C3474M - 250V - 20% | EPCOS |
| C18 | 470N | 6.0x13 p10 mm | MKT FILM CAP - B32521C3474M - 250V - 20% | EPCOS |
| C19 | N.M. | 1210 | CERCAP - 50V - X7R - 20% | TDK |
| C20 | 1uF | 1206 | CERCAP - 50V - X7R - 20% | TDK |
| C21 | 2N2 | 0805 | 50V CERCAP - C0G - 10% | AVX |
| C22 | N.M. | 0805 | Not mounted | |
| C23 | 4.7uF | 8.5x7.2 p5 mm | MKS2 FILM CAP - MKS2C044701M00 - 63V - 5% | WIMA |
| C24 | 4.7uF | 8.5x7.2 p5 mm | MKS2 FILM CAP - MKS2C044701M00 - 63V - 5% | WIMA |
| C25 | N.M. | 0805 | Not mounted | |
| C26 | 47N-500V | 1206 | CERCAP - 500V - X7R - 10% | KEMET |
| C27 | 100N | 0805 | CERCAP - 50V - X7R - 10% | KEMET |

**Table 1. EVL150W-HVSL Evaluation board: bill of material (Rev. 2.3) (continued)**

| Ref. | Value | Case | Description | Supplier |
|---|---|---|---|---|
| C101 | 100N | 1206 | 50V CERCAP - general purpose - X7R - 10% | TDK |
| C102 | 1N0 | 1206 | 2 KV CERCAP - X7R - 10% | EPCOS |
| C103 | 10N | 0805 | 50V CERCAP - general purpose - X7R - 10% | TDK |
| C104 | 1N2 | 0805 | 50V CERCAP - general purpose - X7R - 10% | EPCOS |
| C105 | 1uF | 1206 | 50V CERCAP - general purpose - X7R - 10% | TDK |
| C106 | 10uF | 1206 | CERCAP - 25V - X7R - 20% | TDK |
| C107 | 10uF | 2220 | CERCAP - 50V - X7R - 20% | TDK |
| C108 | 100N | 0805 | CERCAP - 50V - X7R - 10% | TDK |
| C109 | 150N | 0805 | 50V CERCAP - general purpose - X7R - 10% | TDK |
| C110 | 220pF | 0805 | 50V CERCAP - general purpose - COG - 5% | EPCOS |
| C111 | 4u7F | 1206 | 16V CERCAP - general purpose - X7R - 10% | TDK |
| C112 | 2u2 | 1206 | 16V CERCAP - general purpose - X7R - 10% | TDK |
| C113 | 470pF | 0805 | 50V CERCAP - general purpose - COG - 5% | EPCOS |
| C114 | 220P | 0805 | 50V CERCAP - general purpose - COG - 5% | EPCOS |
| C115 | 1N5 | 0805 | 50V CERCAP - general purpose - COG - 5% | EPCOS |
| C201 | 100N | 0805 | CERCAP - 50V - X7R - 10% | KEMET |
| C202 | 470N | 0805 | CERCAP - 25V - C0G - 10% | AVX |
| C203 | 100N | 0805 | CERCAP - 50V - X7R - 10% | KEMET |
| C204 | 100N | 0805 | CERCAP - 50V - X7R - 10% | KEMET |
| C205 | 100N | 0805 | CERCAP - 50V - X7R - 10% | KEMET |
| C206 | N.M. | 0805 | Not mounted | |
| D1 | GBU8J | STYLE GBU | Single phase bridge rectifier | VISHAY |
| D2 | 1N4148WS | SOD-323 | High speed signal diode | VISHAY |
| D3 | 1N4005 | DO-41 DO - 41 | General purpose rectifier | VISHAY |
| D4 | STTH5L06 | DO-201 | Ultrafast high voltage rectifier | STMicroelectronics |
| D5 | 1N4148WS | SOD-323 | High speed signal diode | VISHAY |
| D6 | S1M | DO214AC | General purpose rectifier, SMT | FAIRCHILD |
| D7 | S1M | DO214AC | General purpose rectifier, SMT | FAIRCHILD |

**Table 1. EVL150W-HVSL Evaluation board: bill of material (Rev. 2.3) (continued)**

| Ref. | Value | Case | Description | Supplier |
|---|---|---|---|---|
| D8 | 1N4148WS | SOD-323 | High speed signal diode | VISHAY |
| D9 | STTH3R02Q | DO-15 | Ultra fast rectifier | STMicroelectronics |
| D10 | STTH3R02Q | DO-15 | Ultra fast rectifier | STMicroelectronics |
| D11 | STTH3R02Q | DO-15 | Ultra fast rectifier | STMicroelectronics |
| D12 | STTH3R02Q | DO-15 | Ultra fast rectifier | STMicroelectronics |
| D13 | STPS1H100A | SMA | Power SCHOTTKY diode | STMicroelectronics |
| D14 | BAV21W-V | SOD-123 | Small signal diode high voltage | VISHAY |
| D18 | BAV99 | SOT-23 | Dual small signal diode | VISHAY |
| D101 | STPS140Z | SOD-123 | Power SCHOTTKY diode | STMicroelectronics |
| D102 | 1N4148 | DO-35 | Fast switching diode | VISHAY |
| D103 | MMSZ39T1 | SOD-123 | 39 V Zener diode | ONSEMI |
| D104 | MMSZ13T1 | SOD-123 | 13V Zener diode | ONSEMI |
| F1 | FUSE T4A | 8.5x4 p.5.08mm | FUSE 4A - TIME LAG - 3921400 | LITTLEFUSE |
| HS1 | HEAT-SINK | DWG | Heatsink for D1, Q1, Q2, Q3 | |
| J1 | MKDS 1,5/ 3-5,08 | DWG | PCB TERM. BLOCK, SCREW CONN., PITCH 5MM - 3 W. | PHOENIX CONTACT |
| J2 | MKDS 1/2-5.0 | DWG | PCB TERM. BLOCK, SCREW CONN., PITCH 5MM - 2 W. | PHOENIX CONTACT |
| J3 | MOLEX2P | HEADER 2.54 | Male header 2.54mm - 2P | MOLEX |
| JP1A | Female header 20 | DWG | Female header p.2,54mm PRECI-DIP | |
| JP1B | Female header 20 | DWG | Female header p.2,54mm PRECI-DIP | |
| JP2 | Female header 9 | DWG | Female header p.2,54mm PRECI-DIP | |
| JP101A | Male header 20P 90° | DWG | Male header p.2,54mm 90° | |
| JP101B | Male header 20P 90° | DWG | Male header p.2,54mm 90° | |
| JP201 | Male header 7P 90° | DWG | Male header p.2,54mm 90° | |
| JPX1 | JUMPER | SHORTED | | |
| JPX101 | SHORTED | | Wire jumper | |
| JPX102 | 1N4148 | DO-35 | Fast switching diode | VISHAY |
| JPX103 | SHORTED | | Wire jumper (See mech part) | |
| L1 | 2019.0002 | DWG | Input EMI filter | MAGNETICA |
| L2 | 1975.0004 | DWG | PFC inductor - 0.31mH - PQ26/25 | MAGNETICA |
| L3 | 10uH | dia 8.8, p 5 mm | Drum coil RFB0807-100 | COILCRAFT |

Table 1. EVL150W-HVSL Evaluation board: bill of material (Rev. 2.3) (continued)

| Ref. | Value | Case | Description | Supplier |
|---|---|---|---|---|
| Q1 | STF24N60M2 | TO-220FP | N-Channel Power MOSFET | STMicroelectronics |
| Q2 | STF13N60M2 | TO-220FP | N-Channel Power MOSFET | STMicroelectronics |
| Q3 | STF13N60M2 | TO-220FP | N-Channel Power MOSFET | STMicroelectronics |
| Q4 | BSS169 | SOT-23 | N-CH depletion MOSFET | INFINEON |
| Q101 | BC847C | SOT-23 | Small signal NPN BJT | VISHAY |
| Q102 | BC847C | SOT-23 | Small signal NPN BJT | VISHAY |
| Q201 | BC857C | SOT-23 | PNP small signal BJT | VISHAY |
| R1 | NTC 2R5-S237 | DWG | NTC resistor P/N B57237S0259M000 | EPCOS |
| R2 | 5R6 | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R3 | 5R6 | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R4-JPX1 | 0R18 | PTH | RSMF1TB - METAL FILM RES - 1W - 2% - 200ppm/°C | AKANEOHM |
| R5 | 0R0 | 0805 | SMD standard film RES - 1/8W - 5% - 200ppm/°C | VISHAY |
| R6 | 3R3 | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R7 | 22R | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R8 | 100K | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R9 | N.M. | PTH | Not mounted | |
| R10-JPX2 | SHORTED | PTH | Wire jumper | |
| R11 | 56R | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R12 | 100K | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R13 | 56R | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R14 | 100K | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R15 | 100R | 1206 | SMD standard film RES - 1/4W - 1% - 100ppm/°C | VISHAY |
| R16 | N.M. | 0805 | Not mounted | |
| R17 | 1R0 | 2512 | SMD current sense resistor - 1W - 1% | PANASONIC |
| R18 | 1R0 | 2512 | SMD current sense resistor - 1W - 1% | PANASONIC |
| R19 | 7K5 | 0805 | SMD standard film RES - 1/8W - 5% - 200ppm/°C | VISHAY |

**Table 1. EVL150W-HVSL Evaluation board: bill of material (Rev. 2.3) (continued)**

| Ref. | Value | Case | Description | Supplier |
|---|---|---|---|---|
| R20 | 13K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R21 | 10R | 0805 | SMD standard film RES - 1/8W - 5% - 200ppm/°C | VISHAY |
| R22 | 1K5 | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R23 | 1R0 | 1206 | SMD standard film RES - 1/4W - 1% - 100ppm/°C | VISHAY |
| R24 | 2R2 | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R25 | 62K | 0805 | SMD standard film RES - 1/8W - 5% - 200ppm/°C | VISHAY |
| R26 | 3K9 | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R27 | N.M. | 0805 | Not mounted | |
| R28 | N.M. | 0805 | Not mounted | |
| R29 | N.M. | 1206 | Not mounted | |
| R30 | N.M. | 1206 | Not mounted | |
| R31 | 0R15 | PTH | RSMF1TB - metal film RES - 1W - 2% - 200ppm/°C | AKANEOHM |
| R32 | 110K | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R33 | 39K | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R39 | 4K7 | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R40 | N.M. | 0805 | Not mounted | |
| R42 | 2K7 | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R44 | 100K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R45 | 100K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R46 | 330K | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R50 | 5K6 | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R51 | 2K2 | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R52 | N.M. | 0805 | Not mounted | |

Table 1. EVL150W-HVSL Evaluation board: bill of material (Rev. 2.3) (continued)

| Ref. | Value | Case | Description | Supplier |
|---|---|---|---|---|
| R101 | 2M2 | 1206 | SMD standard film RES - 1/4W - 1% - 100ppm/°C | VISHAY |
| R102 | 2M2 | 1206 | SMD standard film RES - 1/4W - 1% - 100ppm/°C | VISHAY |
| R103 | 2M2 | 1206 | SMD standard film RES - 1/4W - 1% - 100ppm/°C | VISHAY |
| R104 | 56K | 1/4W | PTH standard film RES - 1/4W - 5% - 250ppm/°C | VISHAY |
| R105 | 3K9 | 1206 | SMD standard film RES - 1/4W - 5% - 200ppm/°C | VISHAY |
| R106 | 3K9 | 1206 | SMD standard film RES - 1/4W - 5% - 200ppm/°C | VISHAY |
| R107 | 1K0 | 0805 | SMD standard film RES - 1/8W - 5% - 200ppm/°C | VISHAY |
| R108 | 160K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R109 | 56K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R110 | N.M. | 0805 | Not mounted | |
| R111 | 1K0 | 0805 | SMD standard film RES - 1/8W - 5% - 200ppm/°C | VISHAY |
| R112 | 10K | 0805 | SMD standard film RES - 1/8W - 5% - 200ppm/°C | VISHAY |
| R113 | 39K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R114 | 10R | 1206 | SMD standard film RES - 1/4W - 5% - 250ppm/°C | VISHAY |
| R115 | 4K7 | 0805 | SMD standard film RES - 1/8W - 5% - 200ppm/°C | VISHAY |
| R116 | 3K0 | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R117 | 270R | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R118 | 68R | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R119 | 470R | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R120 | 1K2 | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R121 | 3K6 | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |

**Table 1. EVL150W-HVSL Evaluation board: bill of material (Rev. 2.3) (continued)**

| Ref. | Value | Case | Description | Supplier |
|---|---|---|---|---|
| R122 | 56K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R123 | N.M. | 0805 | Not mounted | |
| R124 | 47R | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R201 | 1K0 | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R202 | 22R | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R203 | 10K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R204 | 100R | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R205 | 27K | 0805 | SMD standard film RES - 1/8W - 5% - 250ppm/°C | VISHAY |
| R206 | N.M. | 0805 | Not mounted | |
| R207 | 27K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R208 | 180K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R209 | 18K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R210 | 20K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R211 | N.M. | 0805 | Not mounted | |
| R212 | 620K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R213 | 0R0 | 0805 | SMD standard film RES - 1/8W - 5% - 200ppm/°C | VISHAY |
| R214 | 0R0 | 0805 | SMD standard film RES - 1/8W - 5% - 200ppm/°C | VISHAY |
| R215 | 12K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R216 | 12K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R217 | 200K | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| R218 | 1K0 | 0805 | SMD standard film RES - 1/8W - 1% - 100ppm/°C | VISHAY |
| RV1 | 300Vac | dia.15x5 p7.5 mm | 300V METAL OXIDE VARISTOR - B72214S0301K101 | EPCOS |

**Table 1. EVL150W-HVSL Evaluation board: bill of material (Rev. 2.3) (continued)**

| Ref. | Value | Case | Description | Supplier |
|---|---|---|---|---|
| T1 | 1860.0152 | DWG | Resonant transformer | MAGNETICA |
| U1 | TLVH431AIL3T | SOT23-3L | 1.24V programmable shunt voltage reference | STMicroelectronics |
| U2 | SFH617A-2 | DIP-4 - 10.16MM | Optocoupler | VISHAY |
| U3 | SFH617A-2 | DIP-4 - 10.16MM | Optocoupler | VISHAY |
| U6 | TLVH431AIL3T | SOT23-3L | 1.24V programmable shunt voltage reference | STMicroelectronics |
| U101 | STCMB1 | SO20W | TM PFC & LLC resonant combo controller | STMicroelectronics |
| U201 | LM258AD | SO-8 | Low power dual OP AMP | STMicroelectronics |
| U202 | LM258AD | SO-8 | Low power dual OP AMP | STMicroelectronics |
| Z1 | PCB REV. 2.0 | | STCMB1 power board | |
| Z101 | PCB REV. 1.0 | | STCMB1 daughterboard | |
| Z201 | PCB REV. 1.0 | | CC control board | |

# 3 Revision history

**Table 2. Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 04-Oct-2017 | 1 | Initial release |
| 29-Mar-2019 | 2 | Features and description update. |