# EVL599IND-250W

Application note

# 250W-24V AC/DC converter using L6462A, STNRG599A and SRK2001A controllers

## Introduction

The EVL599IND-250W demonstration board is a 250 W / 24 V AC-DC converter dedicated to any kind of industrial application. The high efficiency and small size make the board very suitable when available space is limited.

The architecture is based on a two-stage approach: a front end transition mode PFC preregulator and a downstream LLC resonant half bridge converter. At secondary, the synchronous rectification allows an overall efficiency improvement with a very low external component count. The converter consists of a motherboard, with power factor correction stage and LLC resonant tank stage, and three daughterboards. Two daughterboards are at the primary side: one with the active bridge and one with the PFC power MOSFET . The third daughterboard, on the secondary side, is for the SRK2001A and its synchronous rectification MOSFETs.

The power factor correction stage is built on the L6462A, a new transition mode power factor controller, without input voltage sensing. The LLC resonant tank stage is built on the STNRG599A, that implements a novel control method, in which the control variable is the phase shift, that is, the angle between the half bridge voltage and the zero-crossing of the resonant current.

The board does not have heat sinks on the primary side and has very reduced dimensions .

The main features of L6462A are minimal component count, simple design, high efficiency and very low input current distortion (THD) under all operating conditions. It includes a set of protections to ensure a high level of reliability: output overvoltage, overcurrent, inductor saturation detection and feedback failure detection.

The STNRG599A integrated HV startup allows powering both ICs from AC mains for proper power-up, without the need of auxiliary standby supplies. It includes a set of protections and functions: overcurrent and short-circuit, an input voltage monitor allowing the LLC converter startup with correct sequencing (DC brown-in), preventing operation with too low input voltage (DC brown-out), hard switching prevention and anticapacitive protection, safe start procedure and adaptive dead time.

Both controllers can operate in burst mode at low/light load.

# 1 Main characteristics and converter architecture

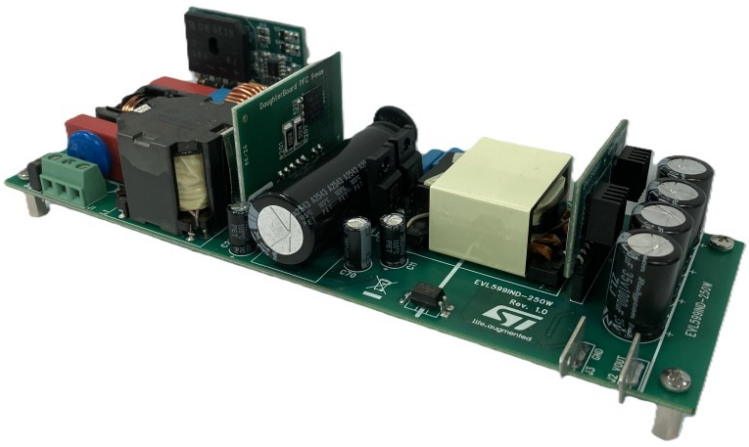
The main features and performances of EVL599IND-250W are listed hereinafter.

**Table 1. EVL599IND-250W characteristics**

| Parameter | Value |
|---|---|
| AC input voltage | 90 ÷ 265 Vac / 45 ÷ 65 Hz |
| DC output voltage | 24.0 V at 10.4 A, continuous operation |
| Rated output power | 250 W |
| Peak power | 300 W, applied for 20 ms every 500 ms |
| Avg. efficiency (at 25,50,75,100% of full load) | > 90% at 115 / 230 Vac |
| Efficiency at 150 mW | > 50% at 115 / 230 Vac |
| No load mains consumption | < 140 mW at 115 / 230 Vac |
| Operating frequency at full load for LLC stage | 260 ±10 kHz |
| Mains harmonics according to | EN-61000-3-2 Class-D and JEITA-MITI, Class-D |
| EMI | According to EN55022 Class-B |
| Board size | W x H: 165 mm x 65 mm. Max. height: 28 mm. |
| Power density | 13.7 W/inch$^3$ |

The picture of the board is shown in the Figure 1.

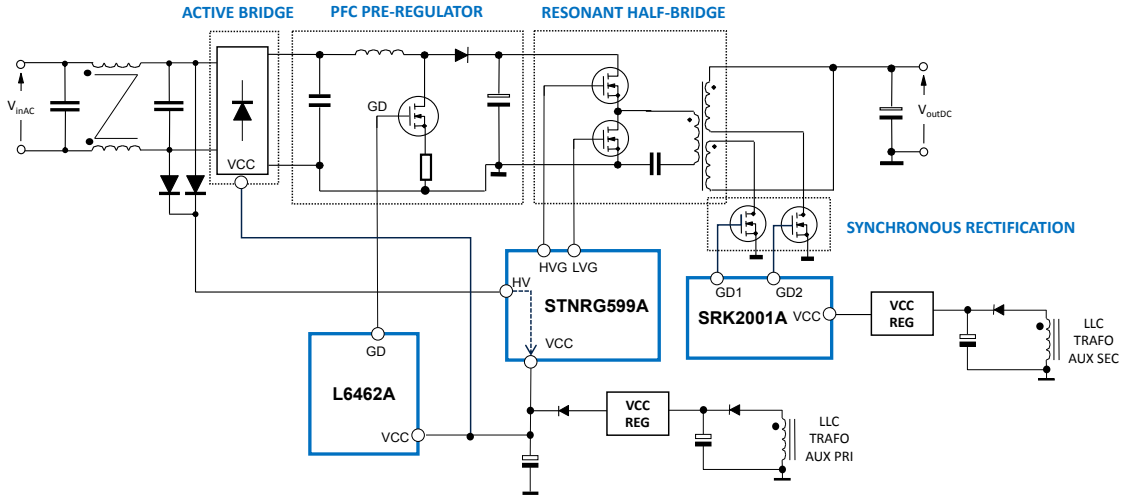
**Figure 1. EVL599IND-250W evaluation board**



The Figure 2 shows the block diagram of the board. The EVL599IND-250W board is a two-stage converter: a front end transition mode PFC preregulator and a downstream LLC resonant half bridge converter.

The power stage of the power factor correction (PFC), controlled by the L6462A IC, is a boost converter connected to the output of the active bridge rectifier. It is composed of the boost inductor L1, the power switch located on the dedicated daughterboard, the output diode D2, and the output electrolytic capacitor C2. To meet EMC standards, the board is equipped with an input EMI filter that cuts the switching noise coming from the boost stage: L2, C4 and C8 filters the common-mode emissions while L3, C7 and C59 reduce the differential-mode emissions. The 300 V varistor R3, connected between the line and the neutral, protects the circuit against high input-voltage transients, while the fuse F1 operates if a board failure causes an overcurrent or a short circuit on the mains. NTC resistor R1 in series with the output diode limits the inrush current when the converter is plugged. The bypass diode D1 precharges the output capacitors, limiting the inrush current into the boost inductor/output diode.

Figure 2. **EVL599IND-250W functional block diagram**




The LLC power stage is controlled by the STNRG599A IC. The device integrates all the functions necessary to operate the resonant converter with 50% duty cycle and variable working frequency, based on a novel proprietary method called Phase Shift Control (PSC). The output voltage regulation is obtained by directly controlling the phase shift among the half bridge voltage and the resonant tank current. PSC is characterized by a good relationship between the controlled variable (the phase shift) and the power transferred by the converter. This aspect gives the novel method two advantages: good input voltage ripple rejection and low sensitivity to component tolerances.

The output voltage control loop is based on the CV input of the SEA05L, while the CC input of the IC is unused although the board is designed to allow implementing an output current control loop to manage overload.

To achieve high efficiency, synchronous rectification is implemented at the secondary side, by SRK2001A IC, which to minimize the no-load power consumption, two design measures have been implemented. First, instead of using the output voltage, 24 V, to bias the optocoupler photodiode and to supply the linear regulator that feeds the SRK2001A and the error amplifier based on the SEA05L, a lower voltage, 12 V, by a secondary auxiliary winding, is used. Second, the active bridge, which is beneficial at high load but too dissipative at low load, is turned off during burst-mode operation.

# 2 Efficiency and no load power consumption

The following table and figures show the overall efficiency of the EVL599IND-250W board at heavy, medium and light loads. A warm-up time of about 15 minutes was kept between each measurement point, starting from the lowest load. The input power was measured using a power meter with a voltage probe at the AC input connector of the board. The board was loaded by an active load set in CC mode with output voltage sensing. The output voltage and power were read on the active load display. The ambient temperature was approximately 25°C.

**Table 2. Efficiency from 5% to 100% of load**

| Output load | 230 Vac / 50 Hz | | | 115 Vac / 60 Hz | | | 90 Vac / 60 Hz | | |
|---|---|---|---|---|---|---|---|---|---|
| (100% = 10.4 A) | Pin | Pout | η | Pin | Pout | η | Pin | Pout | η |
| [%] | [W] | [W] | [%] | [W] | [W] | [%] | [W] | [W] | [%] |
| 5% | 14.08 | 12.53 | 88.99 | 14.10 | 12.53 | 88.87 | 14.26 | 12.50 | 87.66 |
| 10% | 27.80 | 25.01 | 89.96 | 27.82 | 25.01 | 89.90 | 27.97 | 25.00 | 89.38 |
| 25% | 67.70 | 62.39 | 92.16 | 68.0 | 62.36 | 91.71 | 69.2 | 62.73 | 90.68 |
| 50% | 132.8 | 124.61 | 93.83 | 133.5 | 124.65 | 93.37 | 135.4 | 125.74 | 92.87 |
| 75% | 197.0 | 186.67 | 94.76 | 197.7 | 185.42 | 93.79 | 202.3 | 187.45 | 92.66 |
| 100% | 262.3 | 248.00 | 94.55 | 268.3 | 249.95 | 93.16 | 274.1 | 249.71 | 91.11 |
| Average of 100%, 75%, 50%, 25% | | | 93.83 | | | 93.01 | | | 91.83 |

**Figure 3. Efficiency at medium/heavy loads**

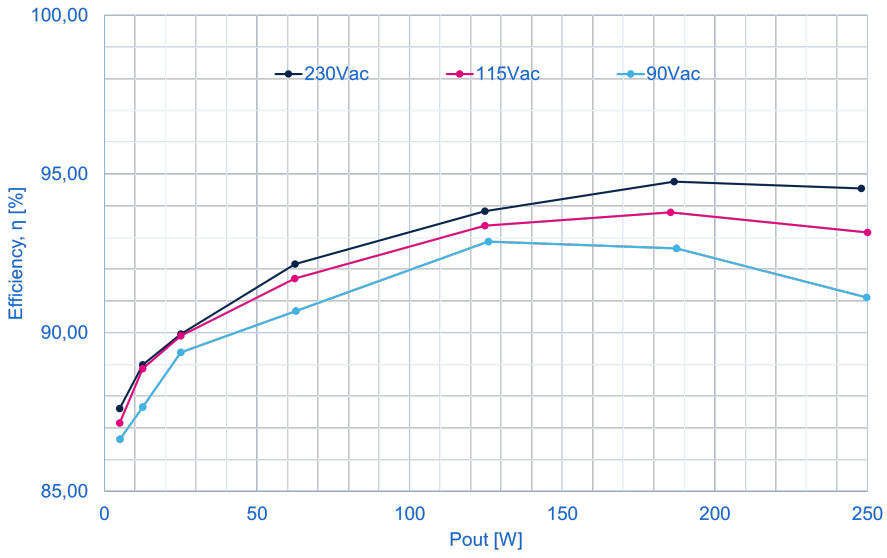


Figure 4. **Efficiency at light loads**

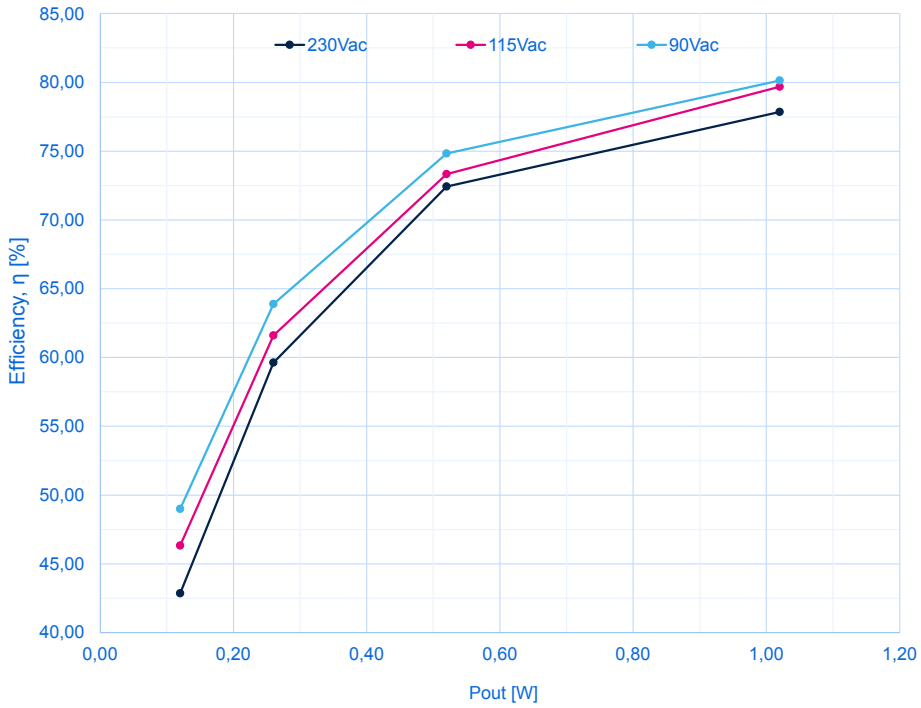



Table 3 shows the no-load power consumption of the EVL599IND-250W board measured at the nominal, minimum and maximum mains voltages. The measure is an average over 36 sec. and the value is taken after about 10 min. of operation at the test condition.

Table 3. **No load power consumption**

| Vac [V] | Pin [mW] |
|---|---|
| 90 / 60 Hz | 105 |
| 115 /60Hz | 110 |
| 230 / 50 Hz | 125 |
| 265 / 50 Hz | 130 |

# 3 THD and PF measurement

As a check of the overall performance of the PFC stage of the adapter, the total harmonic distortion and the power factor have been measured against the mains voltage, at full load. The results are summarized in the following Table 4.

**Table 4. Total harmonic distortion and power factor**

| Output load | 230 Vac / 50 Hz | | 115 Vac / 60 Hz | |
|---|---|---|---|---|
| [%] | THD [%] | PF [·] | THD [%] | PF [·] |
| 10 | 22.00 | 0.67 | 7.00 | 0.95 |
| 20 | 10.10 | 0.84 | 6.20 | 0.98 |
| 25 | 7.40 | 0.89 | 6.00 | 0.99 |
| 40 | 4.90 | 0.95 | 4.00 | 0.99 |
| 50 | 4.30 | 0.96 | 3.60 | 0.99 |
| 60 | 4.00 | 0.97 | 2.50 | 0.99 |
| 80 | 3.60 | 0.98 | 1.90 | 0.99 |
| 100 | 3.20 | 0.99 | 2.00 | 0.99 |

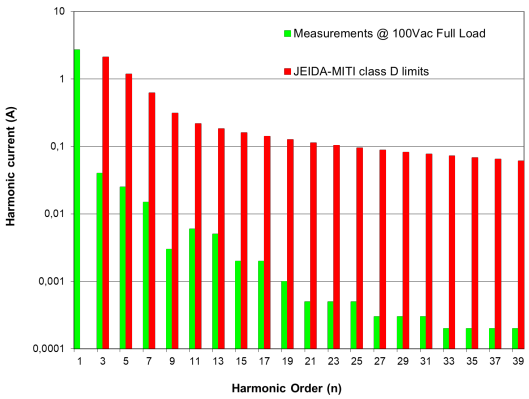
# 4 Harmonic content measurement

The board has been tested according to the European standard EN-61000-3-2 Class-D and Japanese standard JEITA-MITI Class-D, at the nominal input voltage mains. Results are reported in the following figures.

**Figure 5. Compliance to EN-61000-3-2 Class D**


THD = 3.20%, PF = 0.99, Pin = 265 W

**Figure 6. Compliance to JEITA-MITI Class D**




THD = 2.00%, PF = 0.99, Pin = 270 W

# 5 Test results

## 5.1 Start up

Figure 7 and Figure 8 show the startup operation at full load (265 Vac) and open load (90 Vac), respectively. The startup sequence consists of the following steps:

1. When the AC voltage is applied, the embedded high-voltage startup block of STNRG599A begins operating and raises the VCC voltage that is the power supply line for both controllers.
2. When VCC > VCC_ON_L6462A ≈ 11.3 V, the PFC stage starts working, while the LLC stage is off because its VCC_ON is about 16.5 V.
3. Since the PFC is unloaded, its output voltage, VDC_Bulk, rises to the OVP threshold (430 V) at which the PFC operation is stopped.
4. Meanwhile, the VCC voltage rises to VCC_ON_STNRG599A ≈ 16.5 V: the LLC stage starts operation, bringing the output voltage of the adapter, VOUT, to the regulation value (24 V).

**Figure 7. Start up at 90 Vac and open load**

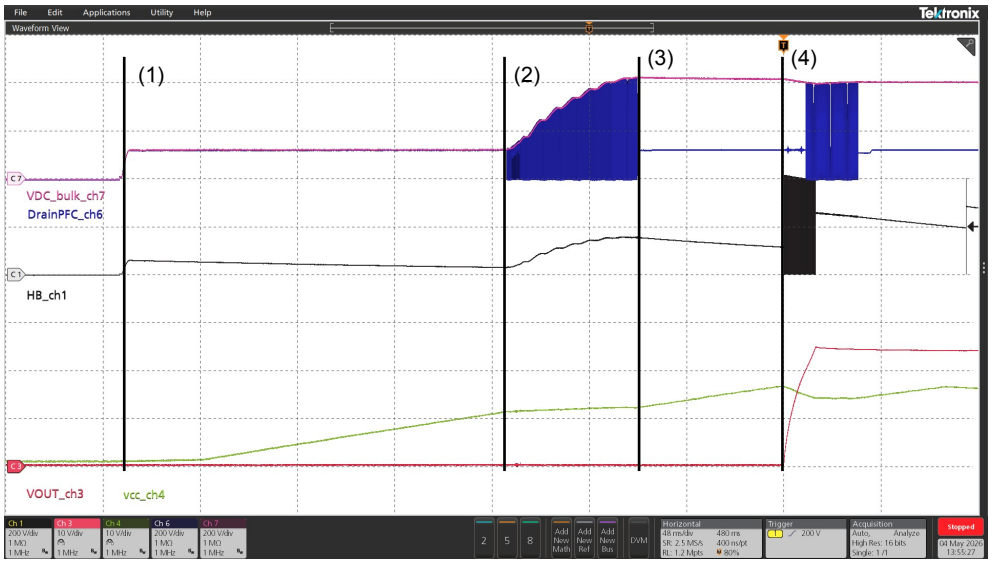



**Figure 8. Start up at 265 Vac and full load**

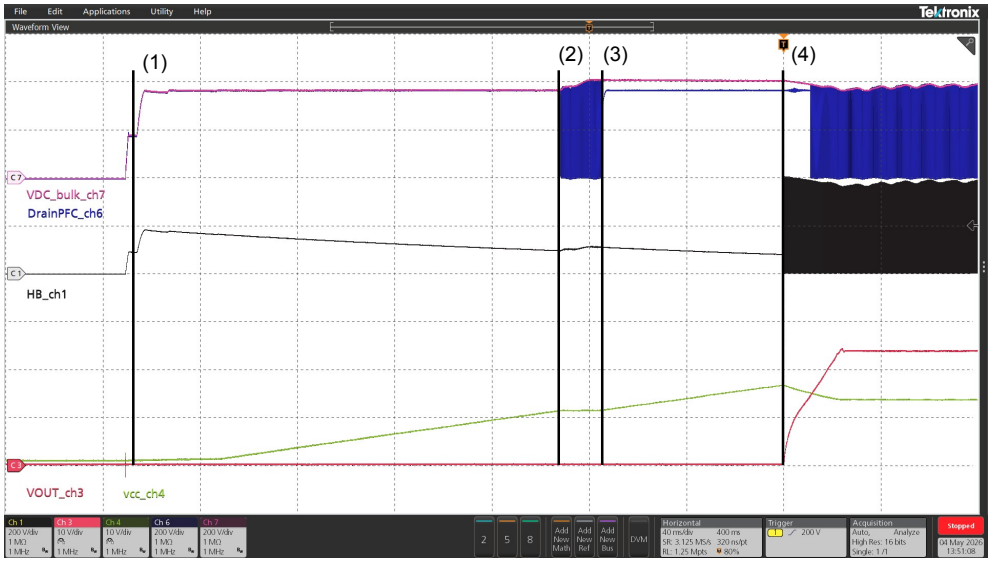


Figure 9 shows the soft start function of STNRG599A in action. The control sweeps the variable under control, that is the phase shift between the half-bridge voltage edge and the zero-crossing of the resonant tank current, from a larger value to a smaller value until the control loop takes over. The soft-start procedure helps keep the initial resonant tank current at low levels and avoid excessive inrush current to the output.

**Figure 9. Soft Start procedure of LLC stage (230 Vac - full load)**

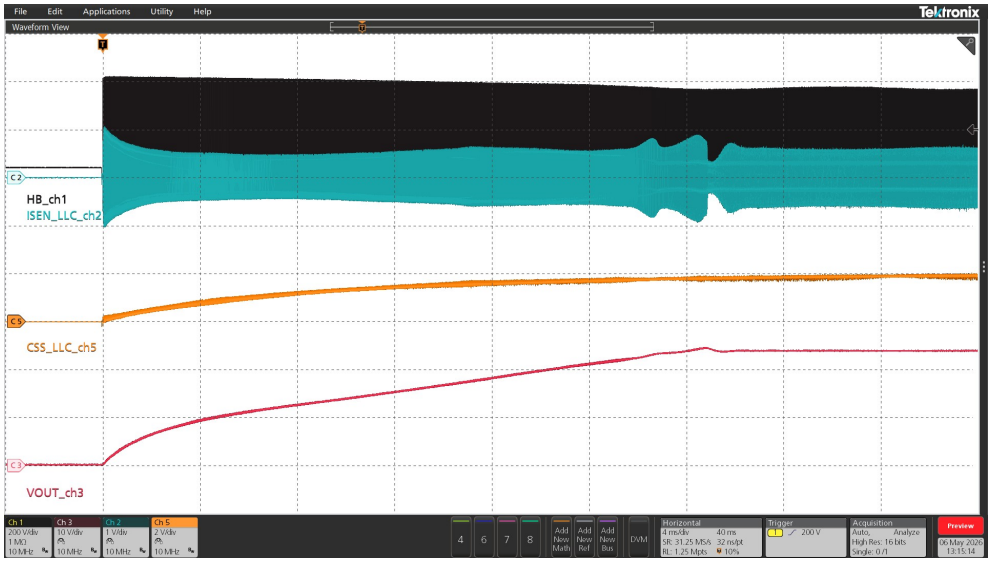
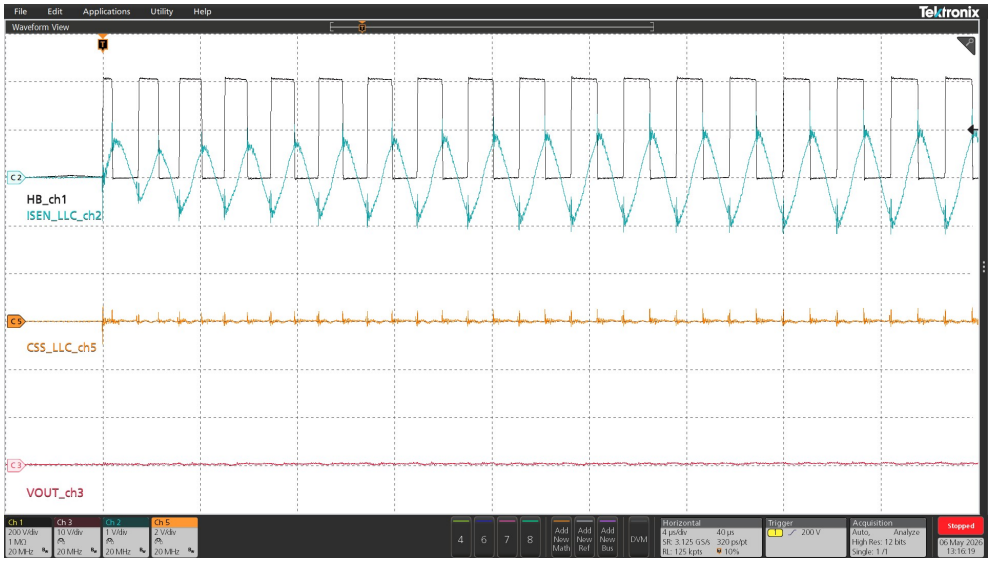



Figure 10 shows the soft start procedure during initial cycles. The hard-switching prevention (HSP) and the soft-start functions of STNRG599A allow a startup procedure without a hard switching event.

**Figure 10. Detail of the first cycles of the LLC stage (230 Vac - full load)**



## 5.2 Steady state operation

The following section provides the main waveforms of the EVL599IND-250W board in steady-state operation: the drain and gate voltage of the power switch, for the PFC stage, and the half bridge node voltage and the resonant tank current, as voltage at ISEN_LLC_pin, for the LLC stage.

Figure 11 shows the steady state operation at heavy loads. Both stages of the converter work in continuous switching to deliver the required power from the AC mains to the output load. The PFC stage turns on the power switch on the first valley (TM operation). The LLC stage works around the LLC resonant frequency.

**Figure 11. Steady state at 100% load (115 Vac)**

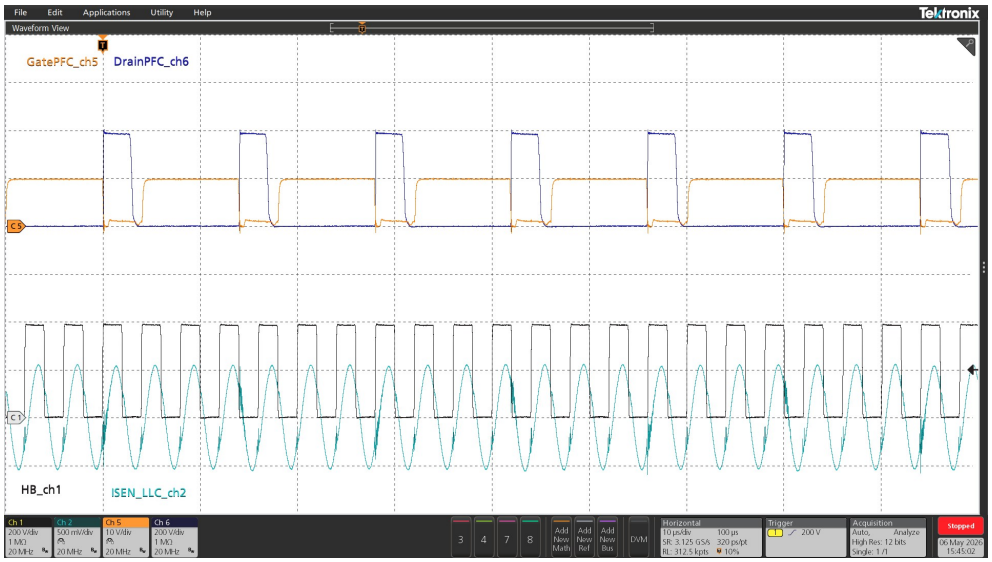



Figure 12 shows the steady state operation at moderate loads. Both stages of the converter work in continuous switching. The PFC stage turns on the power switch on the third valley (TM operation + Valley skipping). The LLC stage works around the LLC resonant frequency also at moderate loads.

**Figure 12. Steady state at 30% load (115 Vac)**

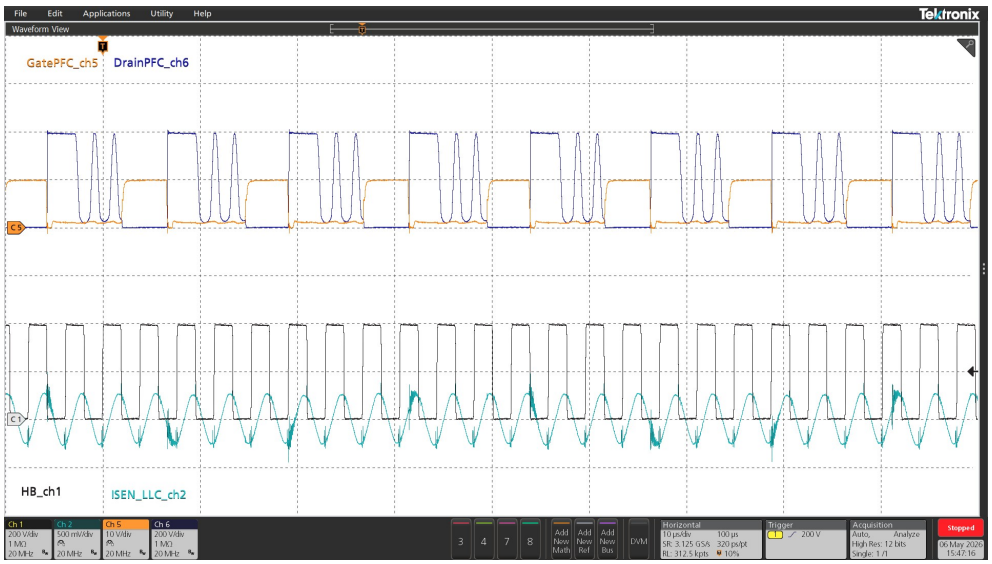
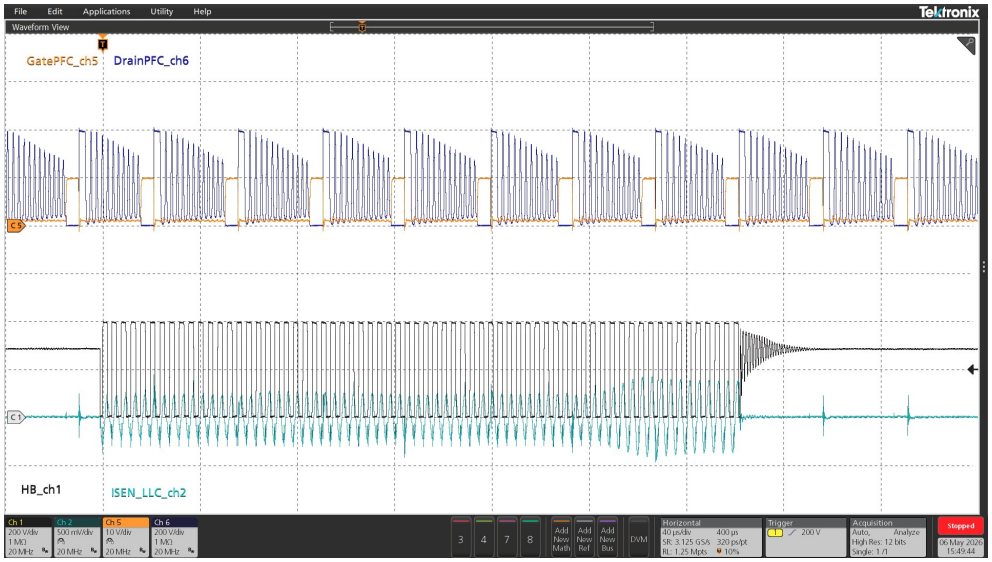


Figure 13 shows the steady state operation at light loads. The PFC stage still works in continuous switching, because of the low mains voltage, and turns on the power switch after skipping multiple valleys. The LLC stage works in burst mode operation. The LLC stage enters in burst mode operation when the output load is less than about 25% of the full load.

**Figure 13. Steady state at 15% load (115 Vac )**




At no load both stages of the converter work in burst mode. Figure 14 shows burst mode operation of the PFC stage. Figure 15 shows burst mode operation of the LLC stage.

**Figure 14. Steady state at no load (115 Vac) – PFC stage**

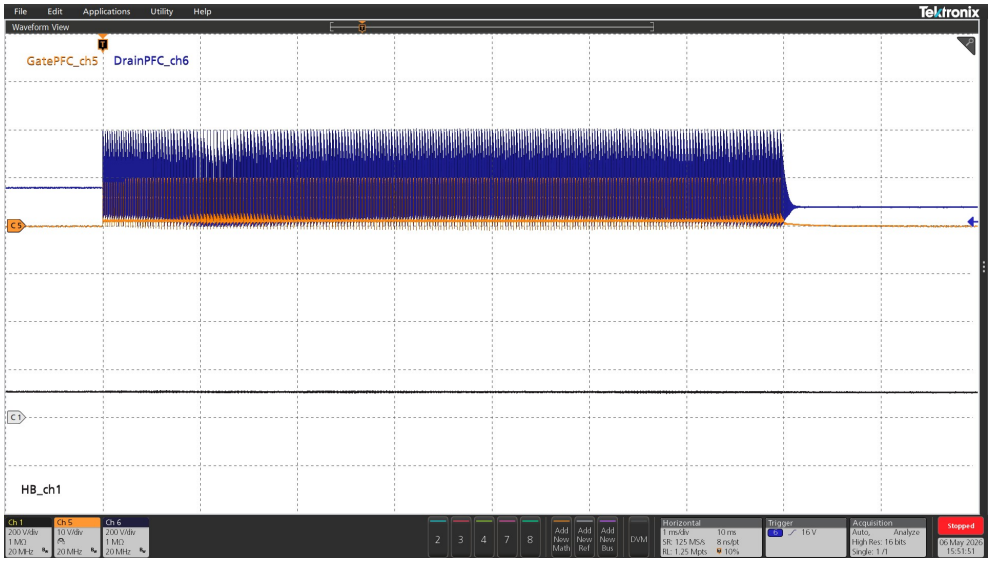
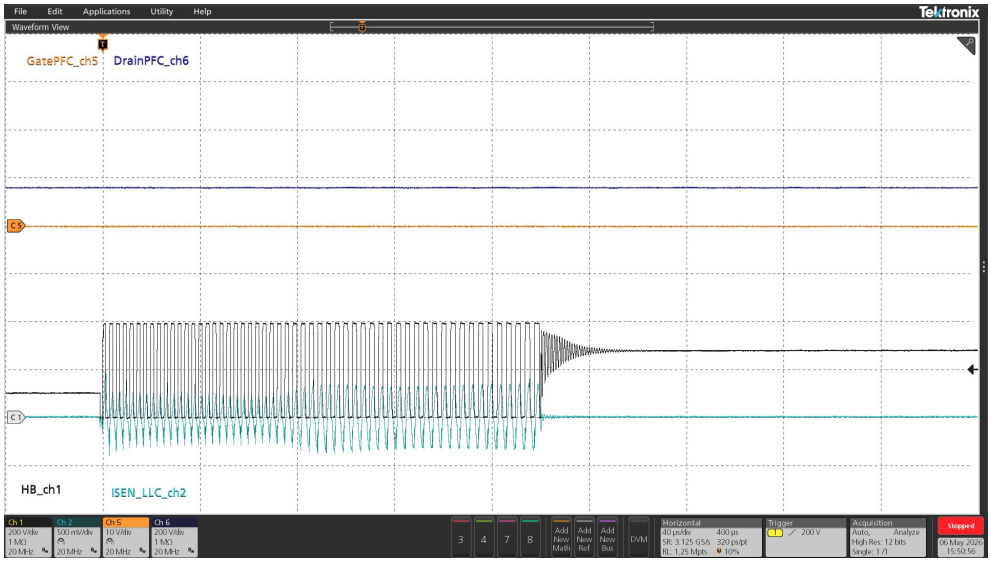


Figure 15. **Steady state at no load (115 Vac) – LLC stage**



## 5.3 Dynamic load response

EVL599IND-250W has been exposed to dynamic loads to measure the output voltage variation. In detail, when load is changed at 2.5 A/usec, from full to open and vice versa, the output voltage variation is about 0.5 / -1.0 V compared with the output voltage value at full load. The output voltage variation caused by a dynamic load remains within the range of 24 V ± 5%.

Figure 16 shows a dynamic load where the load changes every 1 sec.

**Figure 16. Load step: 1 s/1 s (230 Vac)**

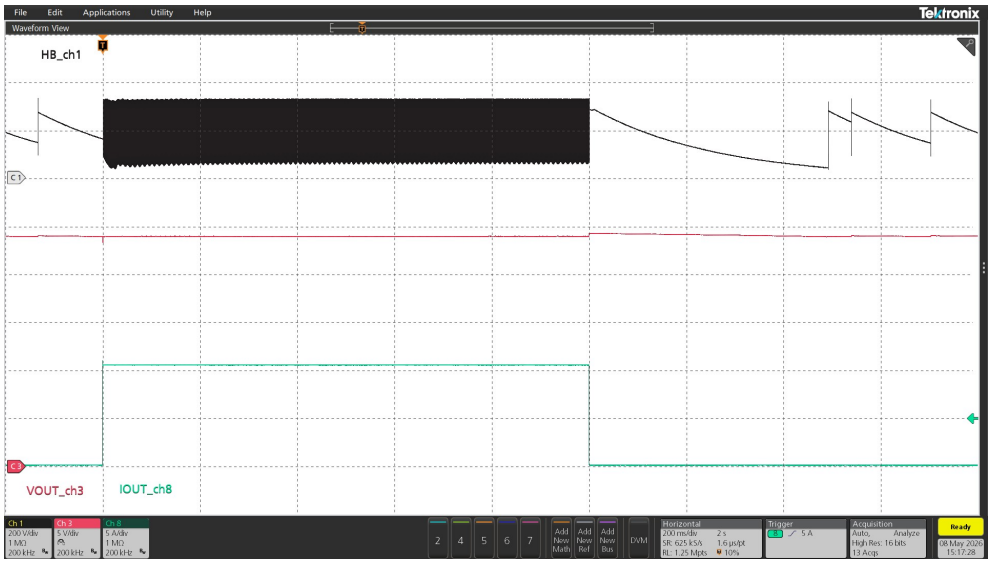



Figure 17 shows a dynamic load where the load changes every 100 msec .

**Figure 17. Load step: 100 ms/100 ms (230 Vac)**

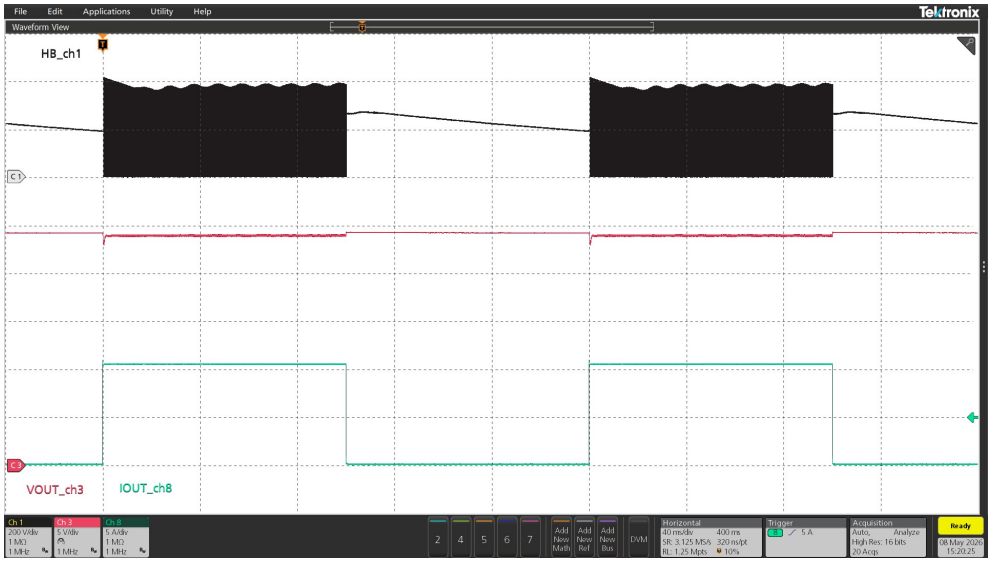
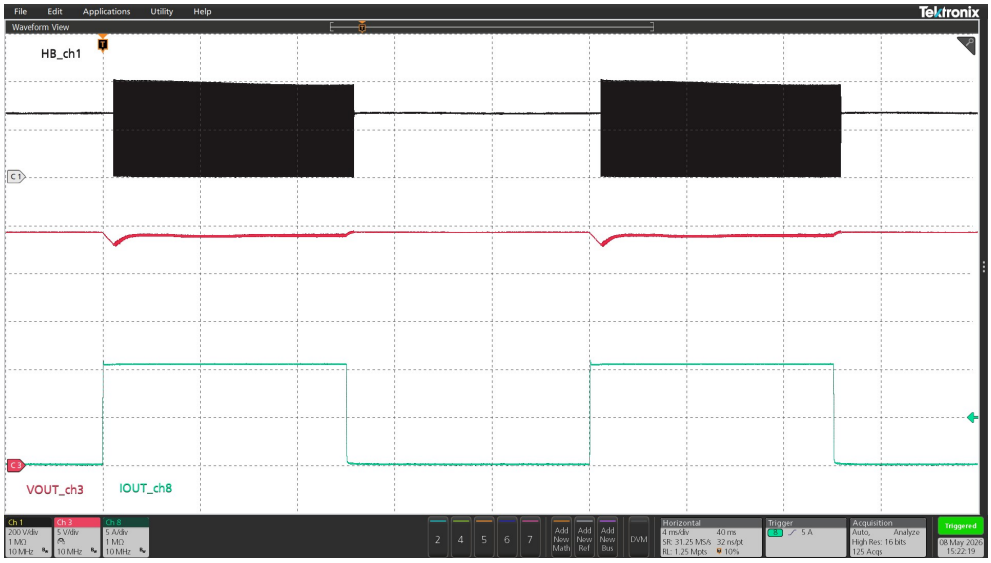


Figure 18 shows a dynamic load where the load changes every 10 msec.

**Figure 18. Load step: 10 ms/10 ms (230 Vac)**



## 5.4 AC mains removal and AC mains dip

Figure 19 shows the behavior of the adapter when the AC mains is removed, while operating at full load and 230 Vac.

1) The input voltage is disconnected, and the bulk voltage starts linearly decreasing because of the LLC operation that is keeping the output voltage regulated.

2) The DC brown-out threshold, that is about 280 V, is reached and the LLC stage is turned off: the bulk capacitor remains charged while the output voltage falls to 0 V.

3) The ICs power supply voltage, that started decreasing after about 350 ms from the DC brown-out event, reaches the turn-off value of the PFC control IC, VCC_OFF_L6462A ≈ 8.5 V , and also the PFC stage stops switching.

**Figure 19. AC Mains removal at full load (230 Vac)**

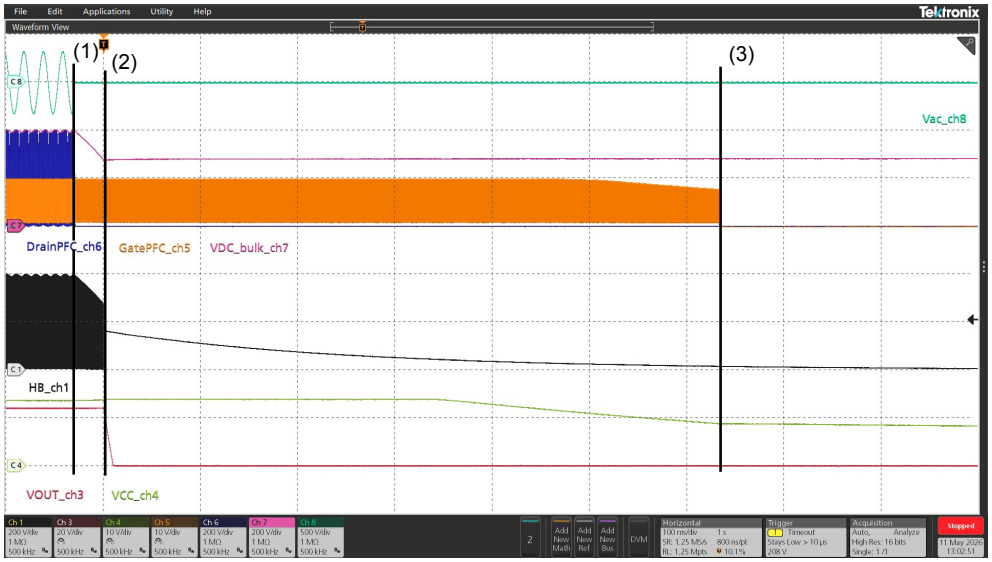



Figure 20 focuses on the main waveforms of the LLC stage after a mains disconnection event at full load and 230 Vac.

The DC bulk voltage starts decreasing, to maintain the output voltage regulation, while, correspondingly, the resonant current increases. Before the DC brown-out occurs, the resonant current amplitude triggers the OCP1 threshold (ISEN>0.87 V): the soft start capacitor is partially discharged, which causes the loss of the output voltage regulation as effect of the limited input power.

Figure 20. **AC Mains removal at full load (230 Vac): LLC stage**

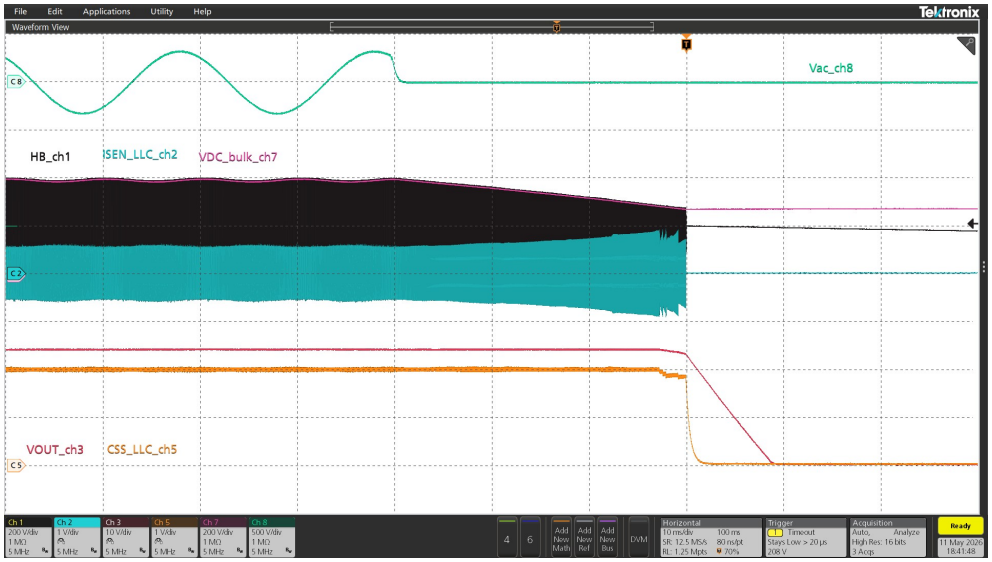
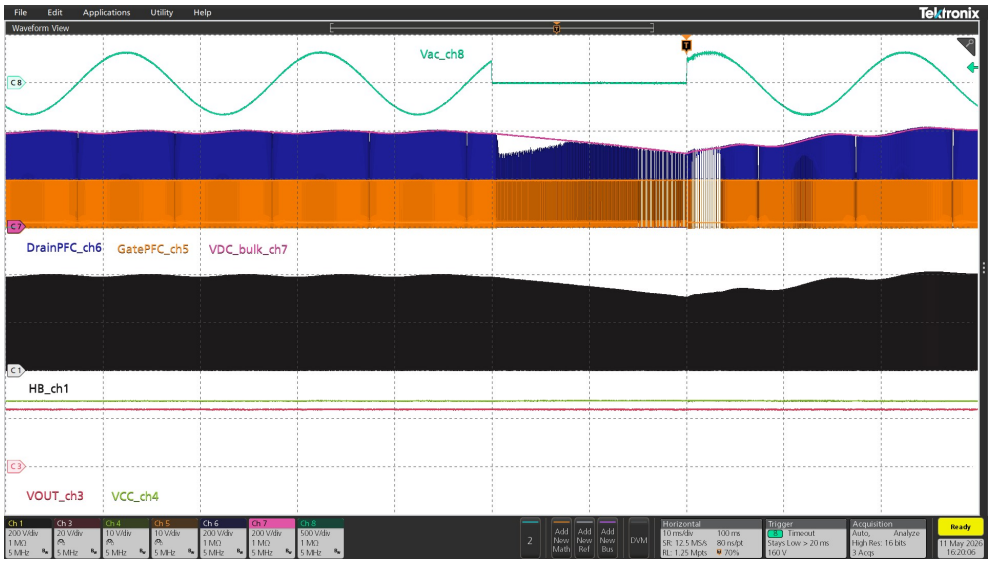



Figure 21 shows a 0% mains voltage dip test that lasts for one cycle at full load and 230 Vac on the EVL599IND-250W board: the bulk voltage is obviously decreased, but the output voltage regulation is kept.

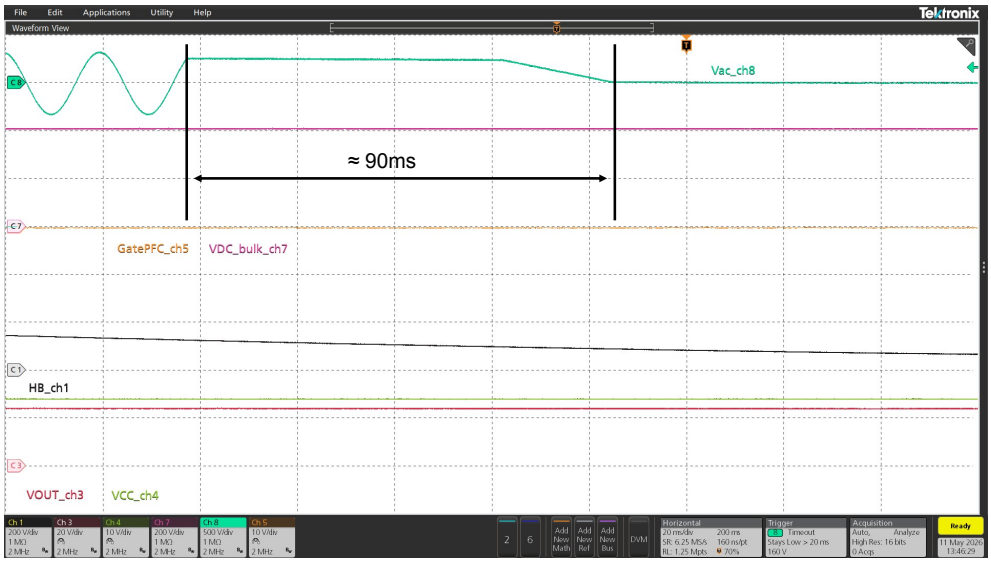
Figure 21. **0% Mains dip, 1 cycle, at full load (230 Vac)**



## 5.5 XCAP function

As the converter is turn-off by mains disconnection, the XCAP function plays the essential role of bringing the mains input of the converter at a safe voltage level for the user. Waveforms in Figure 22 show the operation of the XCAP function integrated in STNRG599: at mains disconnection the Cx are discharged within the safety limit in less than a hundred milliseconds.

**Figure 22. XCAP function at open load (230 Vac)**



## 5.6 Line transitions at full load

The EVL599IND-250W board has been tested against AC line transient, from 90 Vac to 265 Vac and vice versa, while operating at full load. The bulk voltage regulation is recovered in about one cycle or eight cycles of the mains voltage, when the low / high or the high / low AC line transient is applied, respectively. In both cases, the output voltage variation is negligible. Main operating signals are shown in the following Figure 23 and Figure 24.

**Figure 23. Line transitions at full load: 90 Vac → 265 Vac**

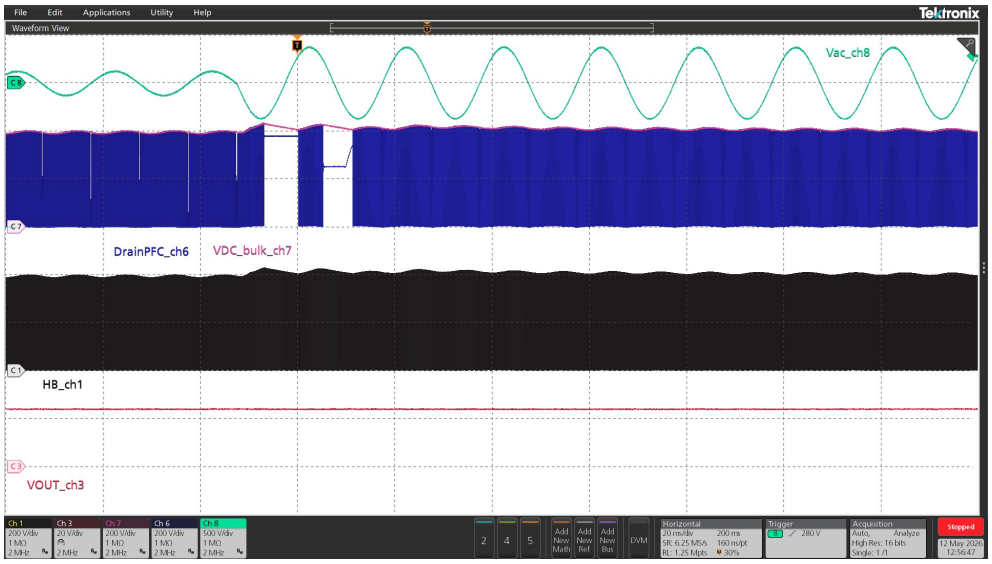
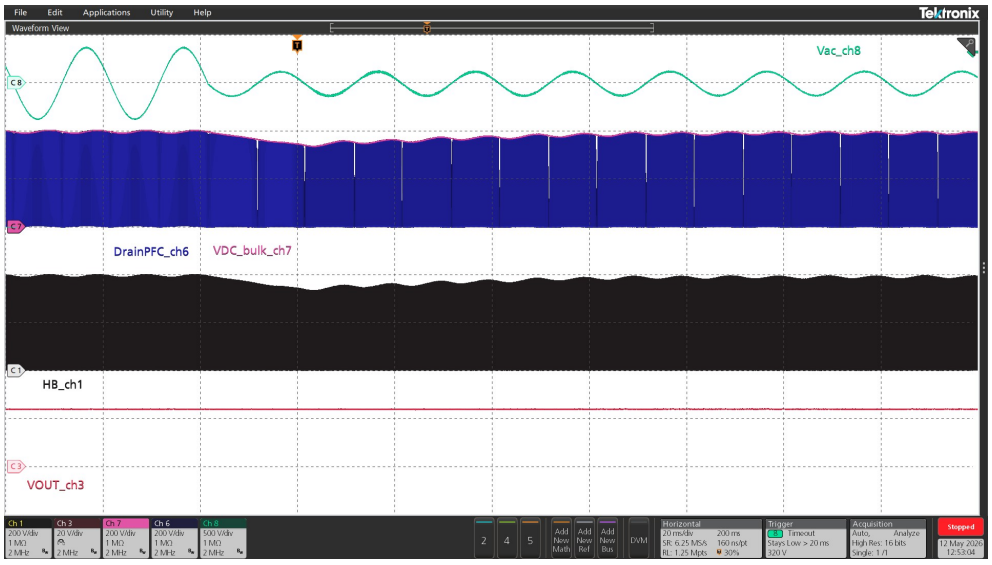



**Figure 24. Line transitions at full load: 265 Vac → 90 Vac**



## 5.7 Overcurrent protection

Figure 25 shows the operation of the converter when a short circuit applied at the output of the EVL599IND-250W board. The resonant tank current rises quickly to high levels. When the ISEN_LLC signal exceeds the OCP2 threshold (ISEN > 1.5 V), the switching activity stops immediately, and the restart procedure begins as shown in the following Figure 26: the soft-start capacitor at pin CSS is fully discharged while the capacitor at pin DELAY is charged to about 1.75 V, then it discharges into the resistor connected in parallel. After about 700 ms, DELAY voltage has reached the restart threshold (240 mV, typ): meanwhile, the output short circuit has been removed, so the adapter can restart normal operation. If the output short circuit were still there when DELAY reaches 1.75 V again, then the turn-off procedure (immediate stop switching, CSS discharged, DELAY charged) would take place and the resulting operation would be hiccup. During a hiccup, restart of normal operation would occur when the output short circuit is removed.

**Figure 25. Short-circuit applied and removed**

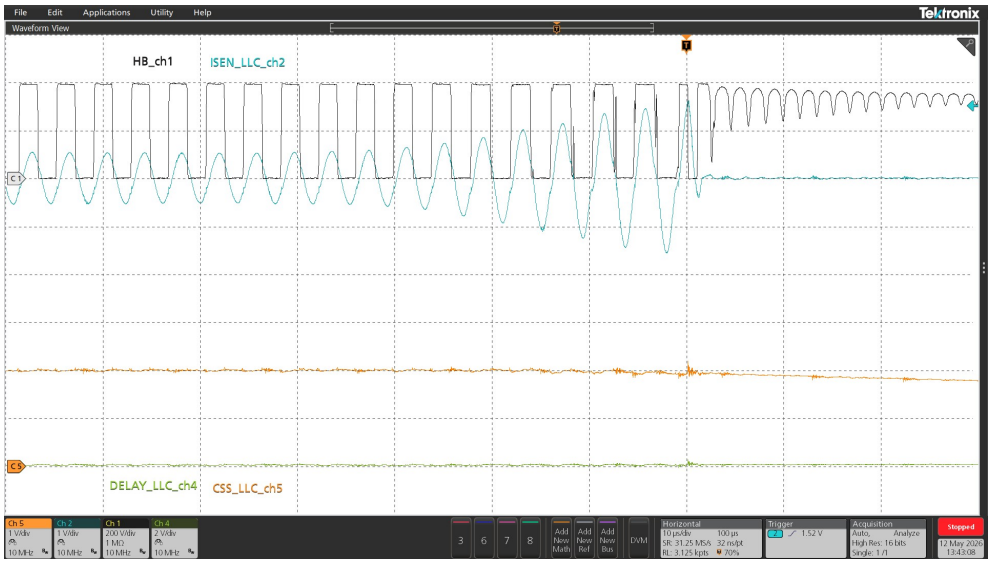
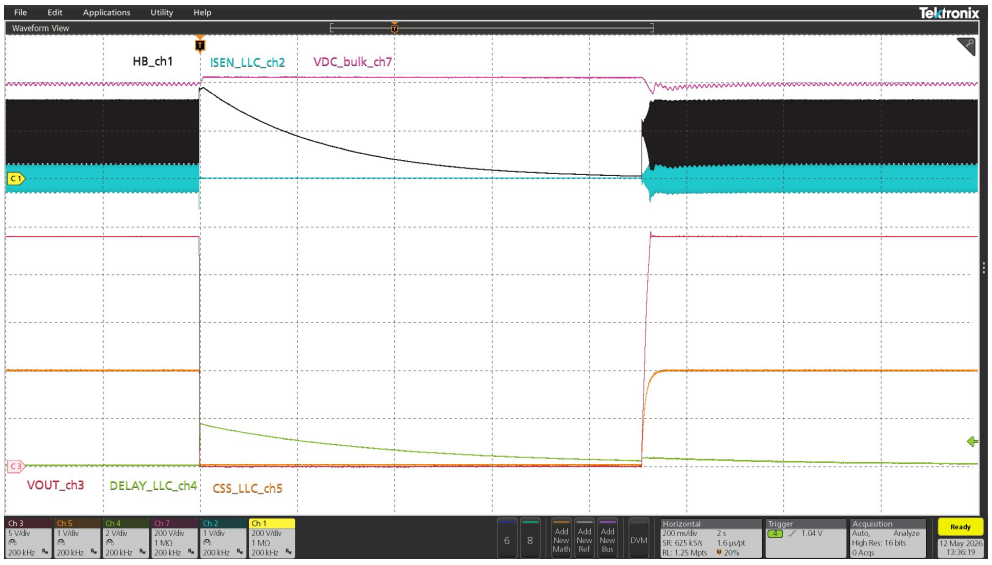



**Figure 26. Restart after OCP2 event**



# 6 EMI precompliance

A precompliance test was performed on conducted emissions. The following figures show the average and quasi-peak measurements of conducted emissions at full load and nominal mains voltages for both the conductors (phase and neutral), compared to the EN55022-Class B limits. The measurement was performed with the board earth terminal connected.

**Figure 27. 115 Vac / full load – PHASE**

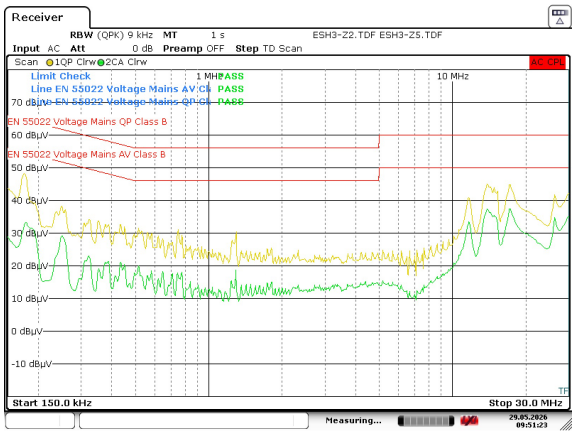



**Figure 28. 230 Vac / full load – PHASE**

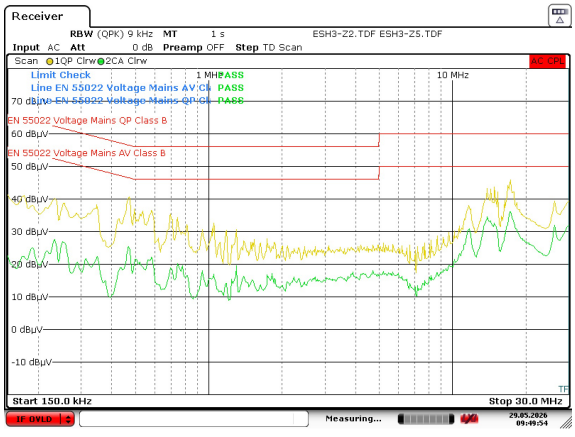



**Figure 29. 115 Vac / full load – NEUTRAL**

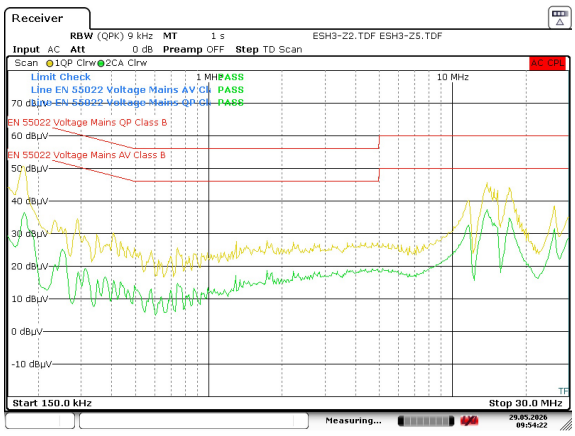
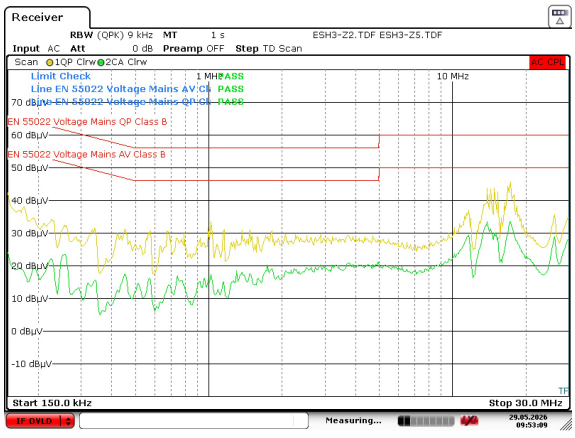



**Figure 30. 230 Vac / full load – NEUTRAL**



# 7 Thermal map

Figure 31 shows the thermal maps of the top side of EVL599IND-250W board after about 1h at 115 Vac / 250 W. Temperatures of the most relevant elements have been taken and highlighted in the Table 5 that follows. The room temperature was around 25°C.

**Figure 31. Thermal map at 115 Vac / 10.4 A, uncooled**

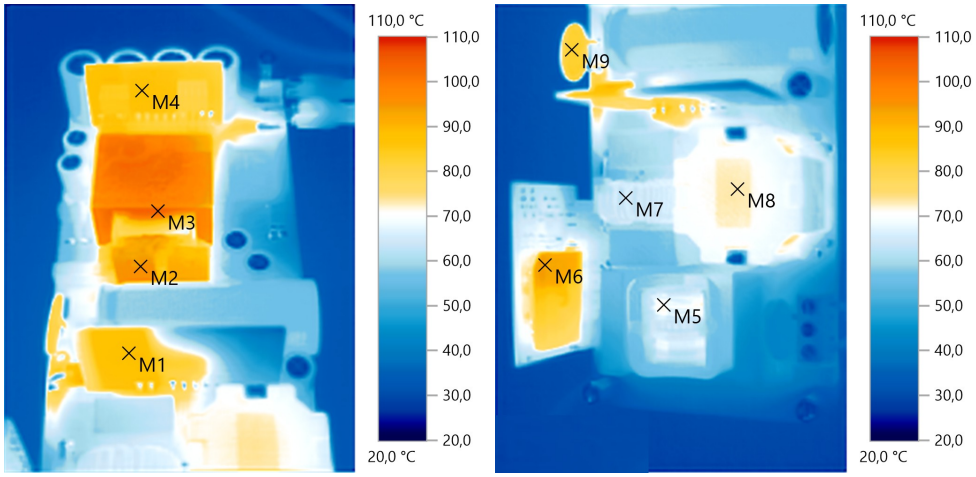
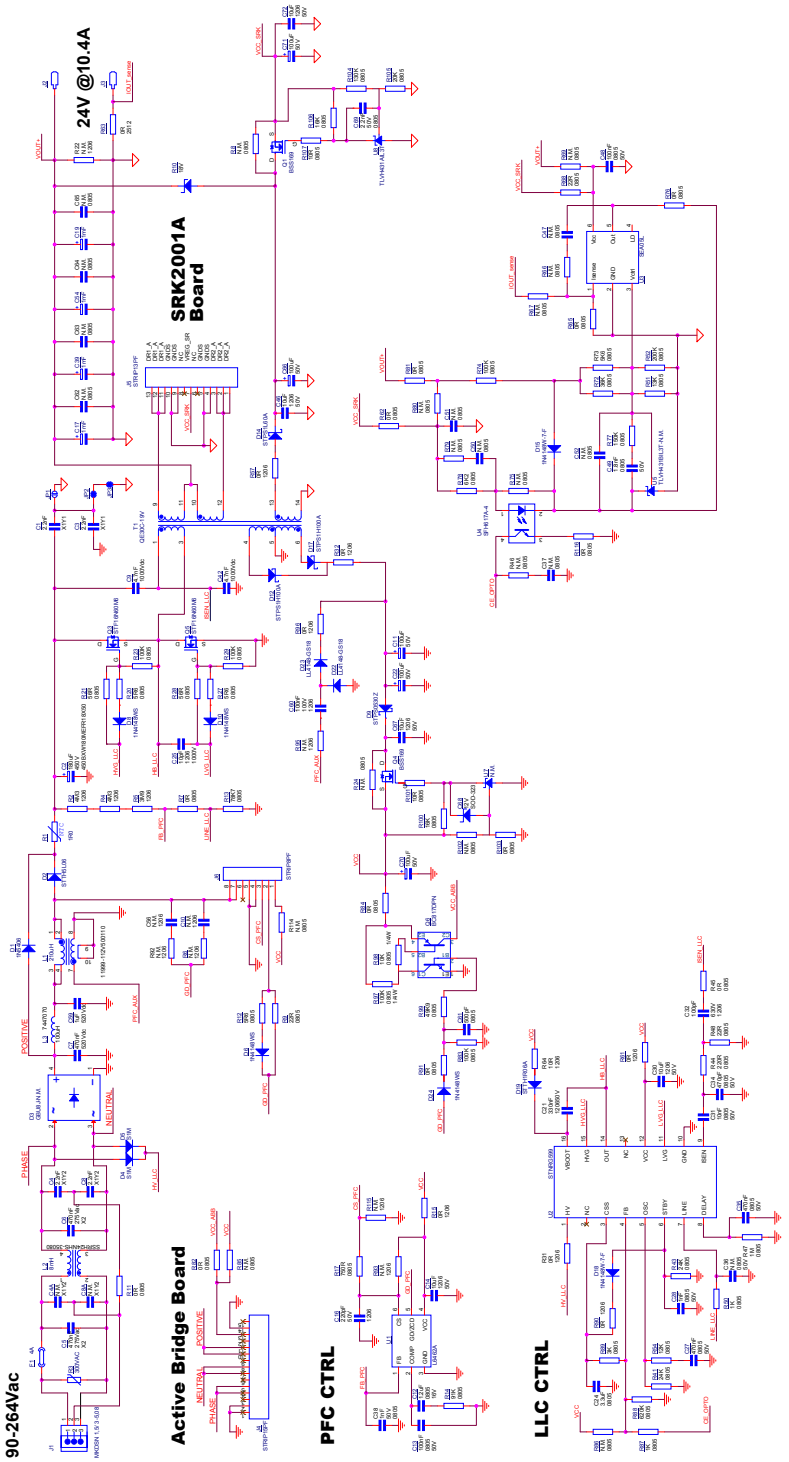



**Table 5. Temperature measurements**

| Point | Sch. Ref. | Description | T [°C] |
|---|---|---|---|
| M1 | | PFC power Mosfet daughterboard | 88 |
| M2 | Q3 | LLC power Mosfet | 96 |
| M3 | T1 | LLC trafo | 104 |
| M4 | | Synchronous rectifiers daughterboard | 88 |
| M5 | L2 | Input common-mode choke | 71 |
| M6 | | Active Bridge daughterboard | 94 |
| M7 | L3 | EMI inductor | 66 |
| M8 | L1 | PFC inductor | 73 |
| M9 | R1 | NTC resistor | 83 |

# 8 Evaluation board schematics

Figure 32. **EVL599IND-250W motherboard schematic**



The following table describes the connectivity of the motherboard.

**Table 6. EVL599IND-250W connectors**

| Reference | Type | Description |
|---|---|---|
| J1 | Screw connector terminal | AC input voltage (90-264Vac) |
| J2 | Male "faston" connector | Output voltage: positive terminal |
| J3 | Male "faston" connector | Output voltage: negative terminal |

**Figure 33. Active Bridge daughterboard schematic**

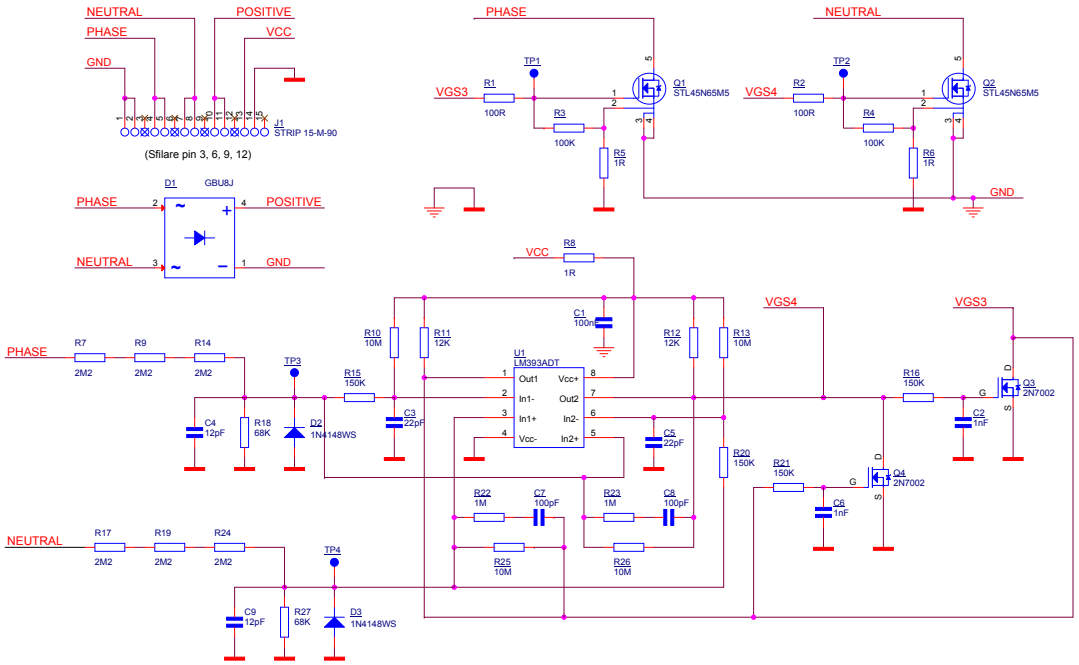


Figure 34. **PFC power MOSFET daughterboard schematic**

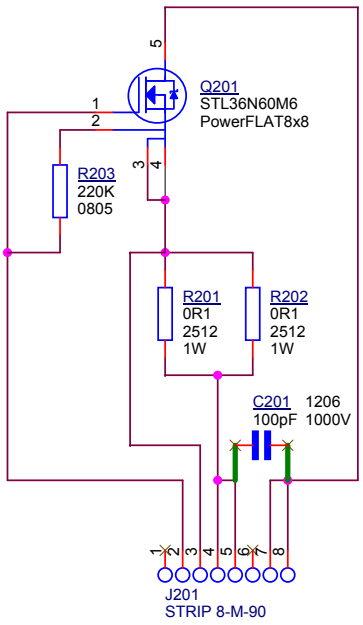
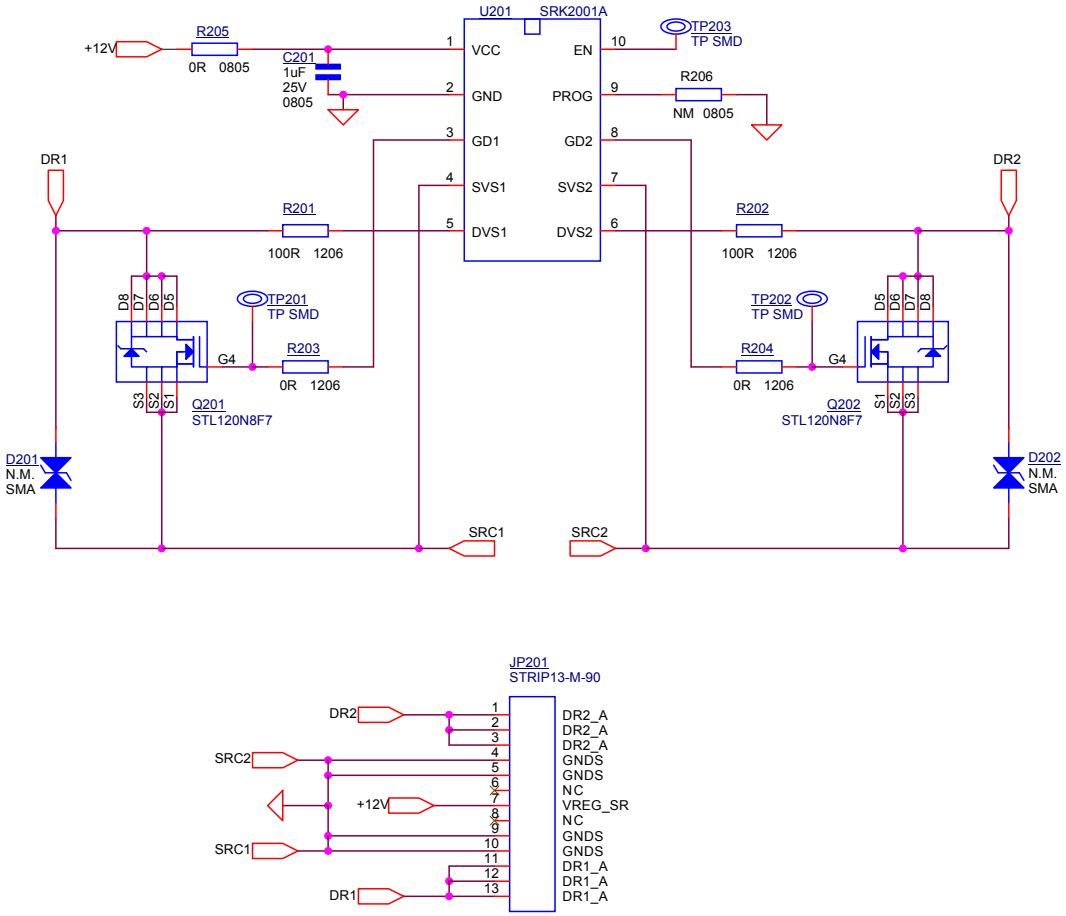



Figure 35. **SRK2001A daughterboard schematic**



# 9 Evaluation board layout

In the following figures, the layout of the motherboard and of the three daughterboards are shown. Top and bottom are both observed from top. Pictures are out of scale. The size of the motherboard is 165 x 65 $mm^2$, the size of the active bridge daughterboard is 40 x 27 $mm^2$, the size of the PFC power MOSFET daughterboard is 45 x 27$mm^2$ and the size of the SRK2001A daughterboard is 35 x 23 $mm^2$.

**Figure 36. EVLG599IND-250W motherboard layout – top and bottom sides**

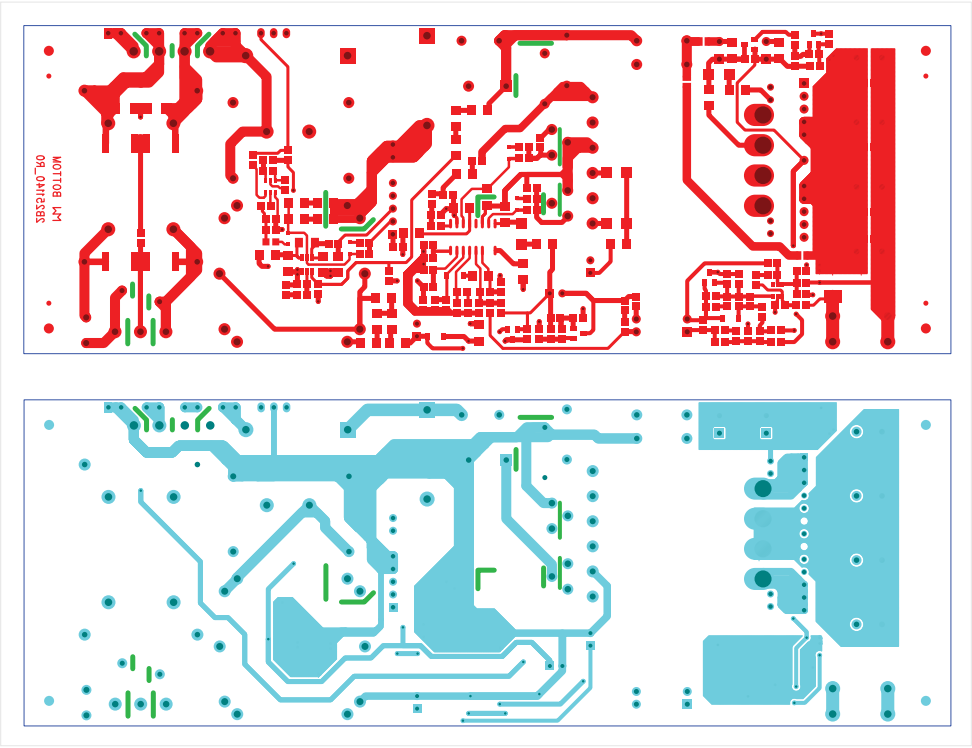


Figure 37. **Active bridge daughterboard layout – top and bottom sides**

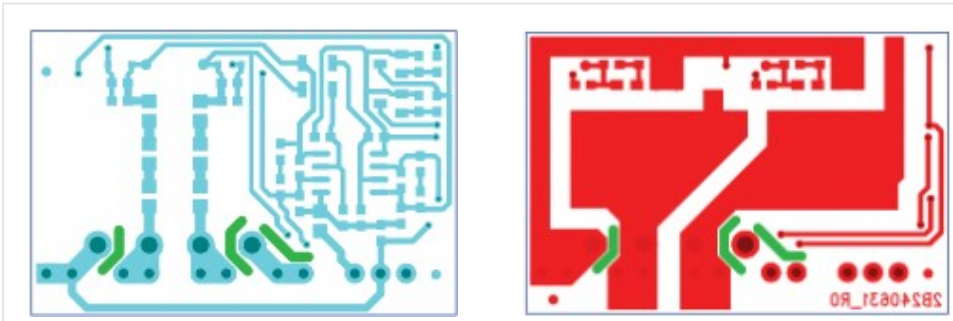


Figure 38. **PFC power MOSFET daughterboard layout – top and bottom sides**

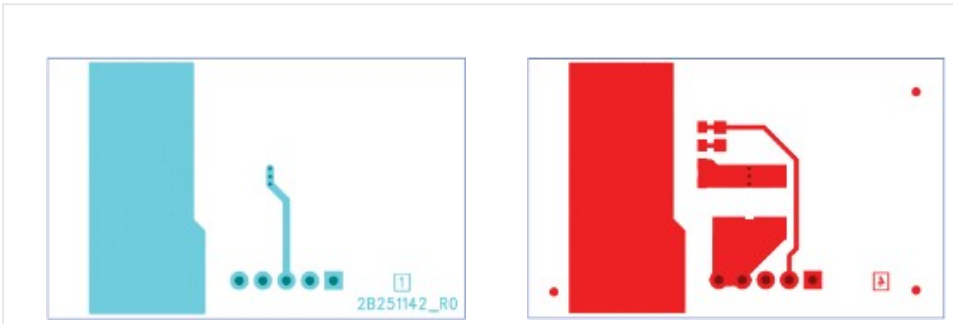
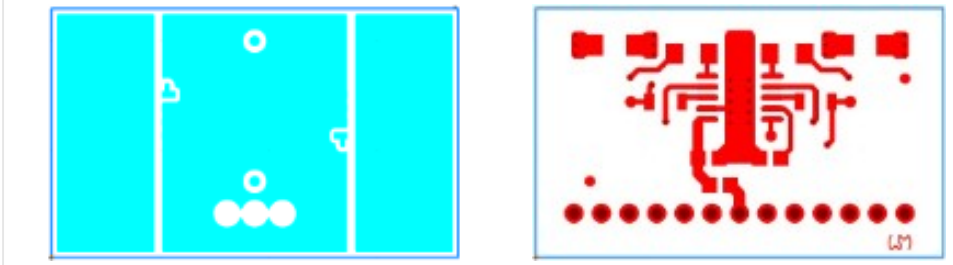



Figure 39. **SRK2001A daughterboard layout – top and bottom sides**



# 10 Evaluation board assy/silk

In the following figures, the assy and the silk of the motherboard and of the three daughterboards are shown. Top is observed from top, while bottom is observed from bottom. Pictures are out of scale.

**Figure 40. EVLG599IND-250W motherboard assy/silk – top and bottom sides**

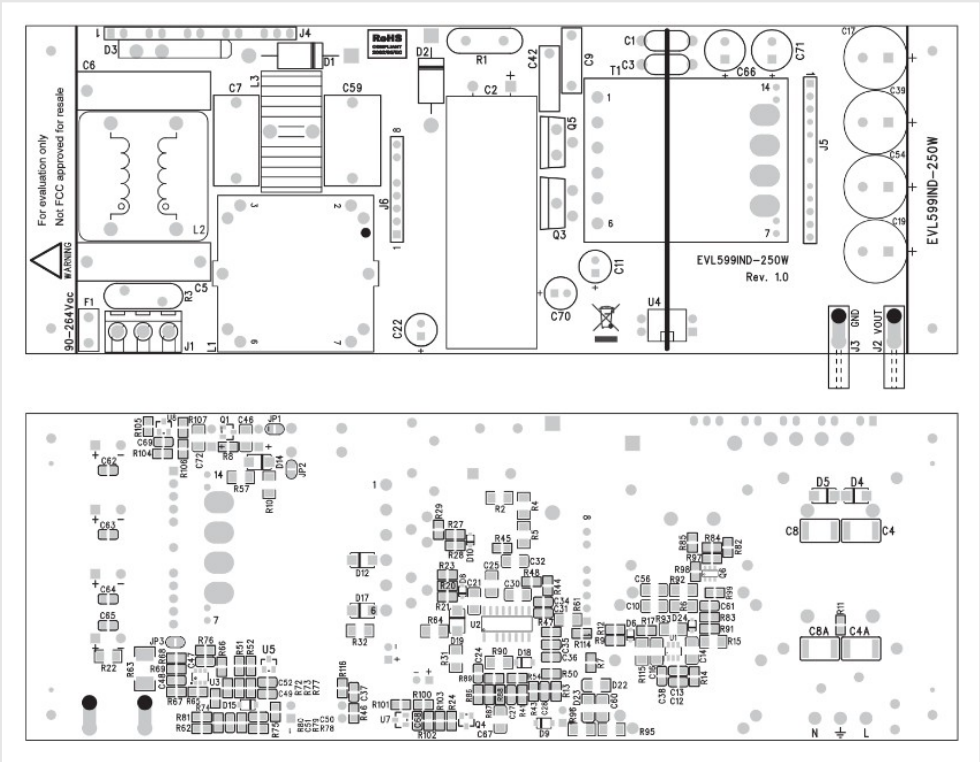


Figure 41. **Active bridge daughterboard assy/silk – top and bottom sides**

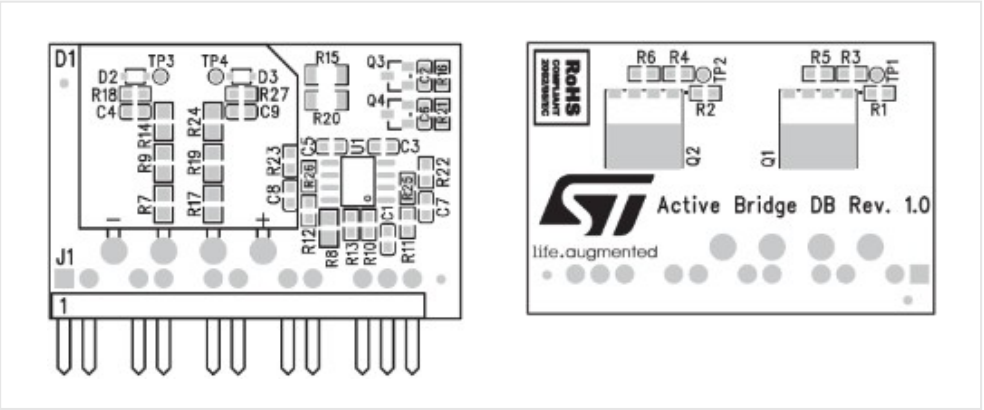



Figure 42. **PFC power MOSFET daughterboard assy/silk – top and bottom sides**

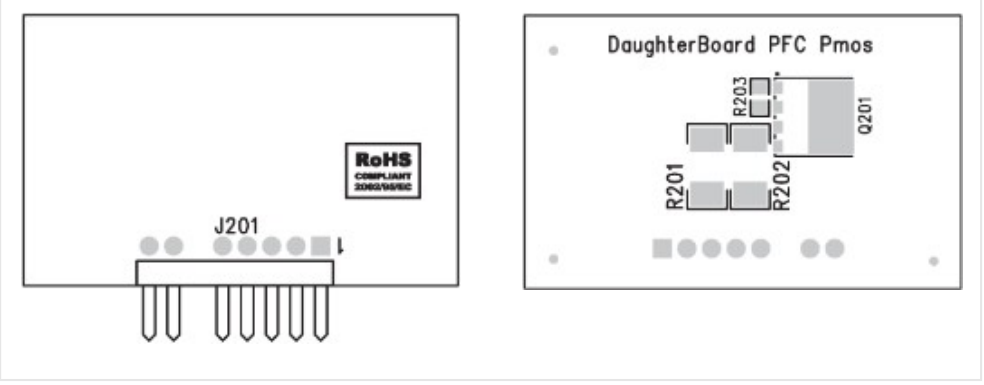
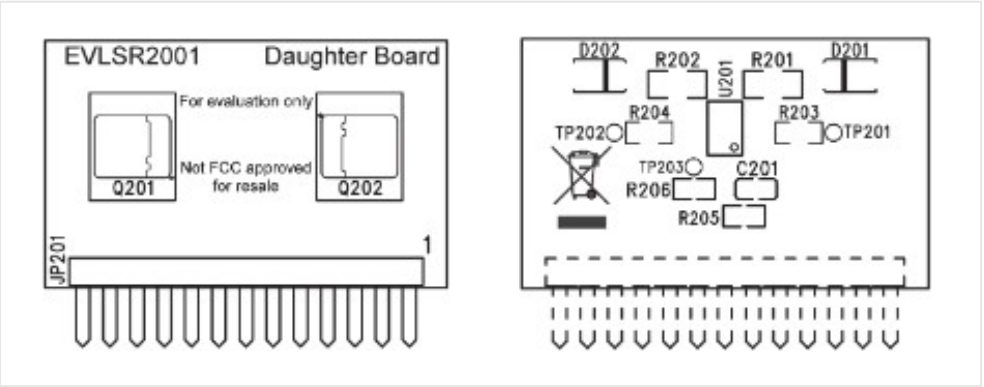



Figure 43. **SRK2001A daughterboard assy/silk – top and bottom sides**



# 11 Bill of materials

Table 7. **EVL599IND-250W motherboard**

| Ref. | Value | Package | Description | Manufacturer |
|---|---|---|---|---|
| C1 | 2.2 nF | Pitch 10.0 mm | Radial X1, Y1 safety ceramic capacitor - 250 V - DE1E3RA222MN4AN01F | Murata |
| C2 | 180µF | D18 - P7.5 - H50 mm | Radial electrolytic capacitor - 450 V - 450BXW180MEFR18X50<br>Radial electrolytic capacitor - 450 V - S8602414810301 | Rubycon<br>Würth Elektronik |
| C3 | 2.2 nF | Pitch 10.0 mm | Radial X1, Y1 safety ceramic capacitor - 250 V - DE1E3RA222MN4AN01F | Murata |
| C4 | 2.2 nF | 2211 | SMD X1Y2 safety ceramic capacitor - 250 V - 8853522130151 | Würth Elektronik |
| C4A | N.M. | 2211 | | |
| C5 | 470 nF | 7.0×26.0x14.5 mm p.22.5 mm | Radial polypropylene metallized capacitor - 275 Vac - 890324026014 | Würth Elektronik |
| C6 | 470 nF | 7.0×26.0x14.5 mm p.22.5 mm | Radial polypropylene metallized capacitor - 275 Vac - 890324026014 | Würth Elektronik |
| C7 | 470 nF | 9.0 × 18.0 p.15 mm | Radial polypropylene metallized capacitor - 520 Vdc - B32672Z5474K000 | EPCOS |
| C8 | 2.2 nF | 2211 | SMD X1Y2 safety ceramic capacitor - 250 V - 8853522130151 | Würth Elektronik |
| C8A | N.M. | 2211 | | |
| C9 | 4.7 nF | 4.0 x 13.0 p10 mm | Radial polypropylene metallized capacitor - 1000 Vdc - B32641B0472K | EPCOS |
| C10 | N.M. | 1206 | Ceramic capacitor 1 kV, general purpose | |
| C11 | 100 µF | D8.0 - H11.5 - P3.5 mm | Radial electrolytic capacitor Low ESR - 50 V - 50YXJ100M8X11.5<br>Radial electrolytic capacitor Low ESR - 50 V - 860040674004 | Rubycon<br>Würth Elektronik |
| C12 | 1.2 µF | 0805 | SMD multilayer ceramic capacitor - 16 V - C0805C125K4RACTU | KEMET |
| C13 | 100 nF | 0805 | SMD multilayer ceramic capacitor - 50 V - C0805C104K5RACTU | KEMET |
| C14 | 10 µF | 1206 | SMD multilayer ceramic capacitor - 50 V - CL31B106KBHNNNE | SAMSUNG |
| C16 | 220 pF | 1206 | SMD multilayer ceramic capacitor - 50 V - 12065A221JAT2A | AVX |
| C17 | 1 mF | Radial 12.5x20 mm | Radial electrolytic capacitor - 35 V - 35ZLJ1000M12.5X20<br>Radial electrolytic capacitor - 35 V - 860040577031 | Rubycon<br>Würth Elektronik |
| C19 | 1 mF | Radial 12.5x20 mm | Radial electrolytic capacitor - 35 V - 35ZLJ1000M12.5X20<br>Radial electrolytic capacitor - 35 V - 860040577031 | Rubycon<br>Würth Elektronik |
| C21 | 330 nF | 1206 | SMD multilayer ceramic capacitor - 50 V - C1206C334K5RACTU | KEMET |
| C22 | 100 µF | D8.0 - H11.5 - P3.5 mm | Radial electrolytic capacitor Low ESR - 50 V - 50YXJ100M8X11.5<br>Radial electrolytic capacitor Low ESR - 50 V - 860040674004 | Rubycon<br>Würth Elektronik |
| C24 | 3.3 µF | 0805 | SMD multilayer ceramic capacitor - 50 V - C2012X6S1H335K125AC | TDK |

| Ref. | Value | Package | Description | Manufacturer |
|---|---|---|---|---|
| C25 | 10 pF | 1206 | SMD multilayer ceramic capacitor - 1000 V - CC1206JKNPOCBN100 | Yageo |
| C27 | 470 nF | 0805 | SMD multilayer ceramic capacitor - 50 V - C0805C474K5RACTU | KEMET |
| C28 | 1 nF | 0805 | SMD multilayer ceramic capacitor - 50 V - C0805C102K5RACTU | KEMET |
| C30 | 10 µF | 1206 | SMD multilayer ceramic capacitor - 50 V - CL31B106KBHNNNE | SAMSUNG |
| C31 | 1 nF | 0805 | SMD multilayer ceramic capacitor - 50 V | |
| C32 | 100 pF | 1206 | SMD multilayer ceramic capacitor - 630 V - GRM31A7U2J101JW31D | Murata |
| C34 | 470 pF | 0805 | SMD multilayer ceramic capacitor - 50 V - C0805C471J5GACTU | KEMET |
| C35 | 470 nF | 0805 | SMD multilayer ceramic capacitor - 50 V - C0805C474K5RACTU | KEMET |
| C36 | N.M. | 0805 | SMD multilayer ceramic capacitor - 50 V | |
| C37 | N.M. | 0805 | SMD multilayer ceramic capacitor - 50 V | |
| C38 | 1 nF | 0805 | SMD multilayer ceramic capacitor - 50 V - C0805C102K5RACTU | KEMET |
| C39 | 1 mF | Radial 12.5x20 mm | Radial electrolytic capacitor - 35 V - 35ZLJ1000M12.5X20<br>Radial electrolytic capacitor - 35 V - 860040577031 | Rubycon<br>Würth Elektronik |
| C42 | 4.7 nF | 4.0 x 13.0 p10 mm | Radial polypropylene metallized capacitor - 1000 Vdc - B32641B0472K | EPCOS |
| C46 | 10 µF | 1206 | SMD multilayer ceramic capacitor - 50 V - CL31B106KBHNNNE | SAMSUNG |
| C47 | N.M. | 0805 | SMD multilayer ceramic capacitor - 50 V | |
| C48 | 100 nF | 0805 | SMD multilayer ceramic capacitor - 50 V - C0805C104K5RACTU | KEMET |
| C49 | 1.8 nF | 0805 | SMD multilayer ceramic capacitor - 50 V | |
| C50 | N.M. | 0805 | SMD multilayer ceramic capacitor - 50 V | |
| C51 | N.M. | 0805 | SMD multilayer ceramic capacitor - 50 V | |
| C52 | N.M. | 0805 | SMD multilayer ceramic capacitor - 50 V | |
| C54 | 1 mF | Radial 12.5x20 mm | Radial electrolytic capacitor - 35 V - 35ZLJ1000M12.5X20<br>Radial electrolytic capacitor - 35 V - 860040577031 | Rubycon<br>Würth Elektronik |
| C56 | N.M. | 1206 | Ceramic capacitor, 1 kV, general purpose | |
| C59 | 1µF | 11.0 × 18.0 p.15 mm | Radial polypropylene film capacitor - 520 Vdc - B32672Z5105K000 | EPCOS |
| C60 | 100 nF | 1206 | SMD multilayer ceramic capacitor - 100 V - CGA5H2X8R2A104K115AA | TDK |
| C61 | 500 pF | 0805 | SMD multilayer ceramic capacitor - 50 V - 08055A501GAT2A | AVX |
| C62 | N.M. | 0805 | Ceramic capacitor, 50 V, X7R, 10% | |
| C63 | N.M. | 0805 | Ceramic capacitor, 50 V, X7R, 10% | |
| C64 | N.M. | 0805 | Ceramic capacitor, 50 V, X7R, 10% | |
| C65 | N.M. | 0805 | Ceramic capacitor, 50 V, X7R, 10% | |
| C66 | 100 µF | D 8.0 - H 11.5 - P. 3.5 mm | Radial electrolytic capacitor Low ESR - 50 V - 50YXJ100M8X11.5 | Rubycon<br>Würth Elektronik |

| Ref. | Value | Package | Description | Manufacturer |
|---|---|---|---|---|
| | | | Radial electrolytic capacitor Low ESR - 50 V - 860040674004 | |
| C67 | 10 µF | 1206 | SMD multilayer ceramic capacitor - 50 V - CL31B106KBHNNNE | SAMSUNG |
| C68 (1) | BZX384 | SOD-323 | SMD zener diode - 12 V - 0.3 W | Nexperia |
| C69 | 2.2 nF | 0805 | SMD multilayer ceramic capacitor - 50 V - GRM2165C1H222JA01D | Murata |
| C70 | 100 µF | D 8.0 - H 11.5 - P. 3.5 mm | Radial electrolytic capacitor Low ESR - 50 V - 50YXJ100M8X11.5<br>Radial electrolytic capacitor Low ESR - 50 V - 860040674004 | Rubycon<br>Würth Elektronik |
| C71 | 100 µF | D 8.0 - H 11.5 - P. 3.5 mm | Radial electrolytic capacitor Low ESR - 50 V - 50YXJ100M8X11.5<br>Radial electrolytic capacitor Low ESR - 50 V - 860040674004 | Rubycon<br>Würth Elektronik |
| C72 | 10 µF | 1206 | SMD multilayer ceramic capacitor - 50 V - CL31B106KBHNNNE | SAMSUNG |
| D1 | 1N5406 | DO-201A | Rectifier - 3A - 600 V | Vishay Semiconductors |
| D2 | STTH5L06 | DO-201AD | Fast rectifier - 5A - 600 V | STMicroelectronics |
| D3 | N.M. | STYLE GBU | Single phase bridge rectifier - 600 V - GBU8J | ONSEMI |
| D4 | S1M | SMA (DO-214AC) | General-purpose rectifier - 1000 V | FAIRCHILD |
| D5 | S1M | SMA (DO-214AC) | General-purpose rectifier - 1000 V | FAIRCHILD |
| D6 | 1N4148WS | SOD-323 | SMD Fast switching rectifier - 0.35A - 100 V | On semi |
| D8 | 1N4148WS | SOD-323 | SMD Fast switching rectifier - 0.35A - 100 V | On semi |
| D9 | STPS0530Z | SOD-123 | SMD Schottky rectifier - 0.5A - 30 V | STMicroelectronics |
| D10 | 1N4148WS | SOD-323 | SMD Fast switching rectifier - 0.35A - 100 V | On semi |
| D12 | STPS1H100A | SMA (DO-214AC) | SMD Schottky rectifier - 1A - 100 V | STMicroelectronics |
| D14 | STPS1L60A | SMA (DO-214AC) | SMD low drop power Schottky rectifier - 1A - 60 V | STMicroelectronics |
| D15 | 1N4148W-7-F | SOD-123 | SMD rectifier - 0.3A - 100 V | DIODES |
| D17 | STPS1H100A | SMA (DO-214AC) | SMD Schottky rectifier - 1A - 100 V | STMicroelectronics |
| D18 | 1N4148W-7-F | SOD-123 | SMD rectifier - 0.3A - 100 V | DIODES |
| D19 | STTH1R06A | SMA (DO-214AC) | SMD rectifier - 1A - 600 V | STMicroelectronics |
| D22 | LL4148-GS18 | MiniMELF | SMD rectifier - 0.30A - 100 V | Vishay Semiconductors |
| D23 | LL4148-GS18 | MiniMELF | SMD rectifier - 0.30A - 100 V | Vishay Semiconductors |
| D24 | 1N4148WS | SOD-323 | SMD fast switching rectifier - 0.35A - 100 V | On semi |
| F1 | 4A | 8.5X4 mm | Radial lead time-lag fuse - 4A - 300 V - 36914000000 | Littelfuse |
| JP1 | SMD jumper | 2p MEDIUM | Jumper_SMD | |
| JP2 | SMD jumper | 2p MEDIUM | Jumper_SMD | |
| JP3 | SMD jumper | 2p MEDIUM | Jumper_SMD | |
| J1 | MKDSN 1.5/ 3-5,08 | P. 5.08 mm | Screw connector terminal, single row - 400 V - 1729131 | Phoenix Contact |
| J2 | Faston_90_6.35 | DWG | Connector faston male 6,35 mm right Angle - 928814-1 | TE Connectivity |
| J3 | Faston_90_6.35 | DWG | Connector faston male 6,35 mm right angle - 928814-1 | TE Connectivity |
| L1 | 210 µH | DWG | PFC inductor - QP2925V - 11999-112V500110 | YUJING |
| L2 | 8 mH | DWG | Common-mode power Line choke - 3.5A - 250 V - SSRH24NHS-35080 | KEMET |

| Ref. | Value | Package | Description | Manufacturer |
|---|---|---|---|---|
| L3 | 100 µH | Radial | WE-FI leaded toroidal Line choke - 6A - 7447070 | Würth Elektronik |
| Q1 | BSS169H6327XTSA1 | SOT23 | SMD N-channel MOSFET depletion mode - 0.17A - 100 V | Infineon Technologies |
| Q3 | STF16N60M6 | TO220FP | N-channel power MOSFET - 12A | STMicroelectronics |
| Q4 | BSS169H6327XTSA1 | SOT23 | SMD N-channel MOSFET - 0.17A | Infineon technologies |
| Q5 | STF16N60M6 | TO220FP | N-channel power MOSFET - 12A | STMicroelectronics |
| Q6 | BC817DPN | TSOP6 | SMD NPN/PNP general-purpose double transistor - 0.5A - 45 V | Nexperia |
| R1 | 1R0 | D. 15 x 7<br>pitch 7.5 mm | Radial thermistor NTC - 9A - 3 W - B57237S0109M | EPCOS |
| R2 | 4M3 | 1206 | SMD resistor - 1/4W - RC1206FR-074M3L | Yageo |
| R3 | 300 Vac | 14 mm-DISC | Metal oxide radial varistor - 300 V - B72214S0301K101 | EPCOS |
| R4 | 4M3 | 1206 | SMD resistor - 1/4W - RC1206FR-074M3L | Yageo |
| R5 | 3M9 | 1206 | SMD resistor - 1/4W - RC1206FR-073M9L | Yageo |
| R6 | N.M. | 1206 | SMD resistor - 1/4W | |
| R7 | 0R | 0805 | SMD resistor - 1/8W - RC0805JR-070RL | Yageo |
| R8 | N.M. | 0805 | SMD resistor - 150 V - 1/8W | |
| R9 | 22R | 0805 | SMD resistor - 150 V - 1/8W | |
| R10(1) | BZV55-C18 | DO-213AA-2 | SMD zener diode - 18 V - 0.5 W | NXP |
| R11 | 0R | 0805 | SMD resistor - 1/8W - RC0805JR-070RL | Yageo |
| R12 | 5R6 | 0805 | SMD resistor - 150 V - 1/8W | |
| R13 | 78K7 | 0805 | SMD resistor - 1/8W - RC0805FR-0778K7L | Yageo |
| R14 | 91 K | 0805 | SMD resistor - 150 V - 1/8W - RC0805FR-0791KL | Yageo |
| R15 | 0R | 1206 | SMD resistor - 200 V - 1/4W - RC1206JR-070RL | Yageo |
| R17 | 750R | 0805 | SMD resistor - 150 V - 1/8W | |
| R20 | 5R6 | 0805 | SMD resistor - 150 V - 1/8W | |
| R21 | 56R | 0805 | SMD resistor - 150 V - 1/8W | |
| R22 | N.M. | 1206 | SMD resistor - 1/4W | |
| R23 | 100 K | 0805 | SMD resistor - 150 V - 1/8W - RC0805FR-07100KL | |
| R24 | N.M. | 0805 | SMD resistor - 1/8W | Vishay |
| R27 | 5R6 | 0805 | SMD resistor - 150 V - 1/8W | |
| R28 | 56R | 0805 | SMD resistor - 150 V - 1/8W | |
| R29 | 100 K | 0805 | SMD resistor - 150 V - 1/8W - RC0805FR-07100KL | |
| R31 | 0R | 1206 | SMD resistor - 200 V - 1/4W - RC1206JR-070RL | Yageo |
| R32 | 0R | 1206 | SMD resistor - 200 V - 1/4W - RC1206JR-070RL | Yageo |
| R41 | 24 K | 0805 | SMD resistor - 150 V - 1/8W | |
| R43 | 24 K | 0805 | SMD resistor - 150 V - 1/8W | |
| R44 | 220R | 0805 | SMD resistor - 150 V - 1/8W - RC0805FR-07220RL | Yageo |
| R45 | 0R | 0805 | SMD resistor - 150 V - 1/8W - RC0805JR-070RL | Yageo |
| R46 | N.M. | 0805 | SMD resistor - 150 V - 1/8W | |
| R47 | 1M | 0805 | SMD resistor - 150 V - 1/8W - RC0805FR-071ML | Yageo |
| R48 | 22R | 0805 | SMD resistor - 150 V - 1/8W | |
| R50 | 1 K | 0805 | SMD resistor - 150 V - 1/8W - RC0805FR-071KL | Yageo |

| Ref. | Value | Package | Description | Manufacturer |
|---|---|---|---|---|
| R51 | 13 K | 0805 | SMD resistor - 150 V - 1/8W - RC0805FR-0713KL | Yageo |
| R52 | 200 K | 0805 | SMD resistor - 150 V - 1/8W - CRCW0805200KFKEA | Vishay Semiconductors |
| R54 | 12 K | 0805 | SMD resistor - 150 V - 1/8W | |
| R57 | 0R | 1206 | SMD resistor - 200 V - 1/4W - RC1206JR-070RL | Yageo |
| R61 | 0R | 1206 | SMD resistor - 200 V - 1/4W - RC1206JR-070RL | Yageo |
| R62 | 0R | 0805 | SMD resistor - 150 V - 1/8W - RC0805JR-070RL | Yageo |
| R63 | 0R | 2512 | SMD resistor - 250 V - 3W - 3522ZR | TE Connectivity |
| R64 | 10R | 1206 | SMD resistor - 200 V - 1/4W | |
| R65 | 0R | 0805 | SMD resistor - 150 V - 1/8W - RC0805JR-070RL | Yageo |
| R66 | N.M. | 0805 | SMD resistor - 150 V - 1/8W | |
| R67 | N.M. | 0805 | SMD resistor - 150 V - 1/8W | |
| R68 | 22R | 0805 | SMD resistor - 150 V - 1/8W | |
| R69 | N.M. | 0805 | SMD resistor - 150 V - 1/8W | |
| R72 | 36 K | 0805 | SMD resistor - 150 V - 1/8W - RC0805FR-0736KL | Yageo |
| R73 | 5K6 | 0805 | SMD resistor - 150 V - 1/8W | |
| R74 | 100 K | 0805 | SMD resistor - 150 V - 1/8W - RC0805FR-07100KL | |
| R75 | N.M. | 0805 | SMD resistor - 150 V - 1/8W | |
| R76 | 0R | 0805 | SMD resistor - 150 V - 1/8W - RC0805JR-070RL | Yageo |
| R77 | 150 K | 0805 | SMD resistor - 1/10W - MC01W08051150K | MULTICOMP |
| R78 | 6K2 | 0805 | SMD resistor - 150 V - 1/8W | |
| R79 | N.M. | 0805 | SMD resistor - 150 V - 1/8W | |
| R80 | N.M. | 0805 | SMD resistor - 150 V - 1/8W | |
| R81 | 0R | 0805 | SMD resistor - 150 V - 1/8W - RC0805JR-070RL | Yageo |
| R82 | 0R | 0805 | SMD resistor - 1/8W - RC0805JR-070RL | Yageo |
| R83 | 100 K | 0805 | SMD resistor - 150V - 1/8W - RC0805FR-07100KL | |
| R84 | 0R | 0805 | SMD resistor - 1/8W - RC0805JR-070RL | Yageo |
| R85 | N.M. | 0805 | SMD resistor - 1/8W | Vishay |
| R86 | N.M. | 0805 | SMD resistor - 1/8W | Vishay |
| R87 | 1 K | 0805 | SMD resistor - 150V - 1/8W - RC0805FR-071KL | Yageo |
| R88 | 620 K | 0805 | SMD resistor - 150 V - 1/8W - RC0805FR-07620KL | Yageo |
| R89 | 3 K | 0805 | SMD resistor - 1/8W - RC0805FR-073KL | Yageo |
| R90 | 0R | 1206 | SMD resistor - 200 V - 1/4W - RC1206JR-070RL | Yageo |
| R91 | 0R | 0805 | SMD resistor - 1/8W - RC0805JR-070RL | Yageo |
| R92 | N.M. | 1206 | SMD resistor - 1/4W | |
| R93 | N.M. | 1206 | SMD resistor - 1/4W | |
| R95 | N.M. | 1206 | SMD resistor - 200 V - 1/4W | |
| R96 | 0R | 1206 | SMD resistor - 200 V - 1/4W - RC1206JR-070RL | Yageo |
| R97 | 100 K | 0805 | SMD resistor automotive - 1/4W - ERJ-P06F1003V | PANASONIC |
| R98 | 10K | 0805 | SMD resistor - 1/4W - RNCP0805FTD10K0 | Stackpole Electronics |
| R99 | 49K9 | 0805 | SMD resistor - 1/10W | |
| R100 | 16 K | 0805 | SMD resistor - 150 V - 1/8W | |

| Ref. | Value | Package | Description | Manufacturer |
|---|---|---|---|---|
| R101 | 10R | 0805 | SMD resistor - 150 V - 1/8W | |
| R102 | N.M. | 0805 | SMD resistor - 1/10W | |
| R103 | 0R | 0805 | SMD resistor - 150 V - 1/8W - RC0805JR-070RL | Yageo |
| R104 | 130K | 0805 | SMD resistor - 150 V - 1/8W | |
| R105 | 20 K | 0805 | SMD resistor - 150 V - 1/8W - RC0805FR-0720KL | Yageo |
| R106 | 16 K | 0805 | SMD resistor - 150 V - 1/8W | |
| R107 | 10R | 0805 | SMD resistor - 150 V - 1/8W | |
| R114 | N.M. | 0805 | SMD resistor - 1/8W | Vishay |
| R115 | N.M. | 1206 | SMD resistor - 1/4W | |
| R116 | 0R | 0805 | SMD resistor - 150 V - 1/8W - RC0805JR-070RL | Yageo |
| T1 | QE30C-19V | DWG | Resonant transformer - 11999-348V500110 | YUJING |
| U1 | L6462A | SOT23-6L | Single-Phase transition-mode PFC controller | STMicroelectronics |
| U2 | STNRG599 | SOIC16 | LLC resonant controller | STMicroelectronics |
| U3 | SEA05L | SOT23-6L | Advanced CV/CC controller with LED driver | STMicroelectronics |
| U4 | SFH617A-4 | DIP4 | Optocoupler | Vishay Semiconductors |
| U5 | N.M. | SOT23 | Volt. Ref. adjustable shunt - 0.06A - TLVH431BIL3T | STMicroelectronics |
| U7 | N.M. | SOT23 | Volt. Ref. adjustable shunt - 0.06A - TLVH431AIL3T | STMicroelectronics |
| U8 | TLVH431AIL3T | SOT23 | Volt. Ref. adjustable shunt - 0.06A | STMicroelectronics |

1. *Zener diode mounted on resistor or capacitor footprint*

**Table 8. Active Bridge daughterboard**

| Reference | Value | Description | Package | Manufacturer |
|---|---|---|---|---|
| C1 | 100nF | SMD multilayer ceramic capacitor: 50V +/-20% - C0603C104M5RACTU | 0603 | KEMET |
| C2 | 1nF | SMD multilayer ceramic capacitor: 50 V +/-10% | 0603 | |
| C3 | 22pF | SMD multilayer ceramic capacitor: 50 V +/-5% | 0603 | |
| C4 | 12pF | SMD multilayer ceramic capacitor: 50 V +/-5% - C1608C0G1H120J080AA | 0603 | TDK |
| C5 | 22pF | SMD multilayer ceramic capacitor: 50 V +/-5% | 0603 | |
| C6 | 1 nF | SMD multilayer ceramic capacitor: 50 V +/-10% | 0603 | |
| C7 | 100pF | SMD multilayer ceramic capacitor: 50 V +/-5% - C1608NP01H101J080AA | 0603 | TDK |
| C8 | 100pF | SMD multilayer ceramic capacitor: 50 V +/-5% - C1608NP01H101J080AA | 0603 | TDK |
| C9 | 12pF | SMD multilayer ceramic capacitor: 50 V +/-5% - C1608C0G1H120J080AA | 0603 | TDK |
| D1 | GBU8J | Single phase bridge rectifier: 600 V 8A | STYLE GBU | On semi |
| D2 | 1N4148WS | SMD fast switching rectifier: 100 V 0.35A | SOD-323 | On semi |
| D3 | 1N4148WS | SMD fast switching rectifier: 100 V 0.35A | SOD-323 | On semi |
| J1 | STRIP 15-M-90 | Male strip 1x15 pins 90° pitch 2,54 mm: - 61301511021 | | Würth Elektronik |
| Q1 | STL45N65M5 | SMD N-channel power MOSFET : 650V 22.5A | PowerFLAT8x8 | STMicroelectronics |
| Q2 | STL45N65M5 | SMD N-channel power MOSFET : 650 V 22.5A | PowerFLAT8x8 | STMicroelectronics |
| Q3 | 2N7002 | SMD N-channel MOSFET : 0.18A | SOT23 | On semi |

| Reference | Value | Description | Package | Manufacturer |
|---|---|---|---|---|
| Q4 | 2N7002 | SMD N-channel MOSFET : 0.18A | SOT23 | On semi |
| R1 | 100R | SMD resistor: 1/10W 1% - RC0603FR-07100RL | 0603 | Yageo |
| R2 | 100R | SMD resistor: 1/10W 1% - RC0603FR-07100RL | 0603 | Yageo |
| R3 | 100 K | SMD resistor: 150 V 1/10W 1% - CRG0603F100K | 0603 | TE Connectivity |
| R4 | 100 K | SMD resistor: 150 V 1/10W 1% - CRG0603F100K | 0603 | TE Connectivity |
| R5 | 1R | SMD resistor: 1/16W 1% | 0603 | |
| R6 | 1R | SMD resistor: 1/16W 1% | 0603 | |
| R7 | 2M2 | SMD resistor: 1/8W 1% - RC0805FR-072M2L | 0805 | Yageo |
| R8 | 1R | SMD resistor: 150 V 1/8W 1% - WR08W1R00FTL | 0805 | Walsin |
| R9 | 2M2 | SMD resistor: 1/8W 1% - RC0805FR-072M2L | 0805 | Yageo |
| R10 | 10M | SMD resistor: 1/10W 1% - CRCW060310M0FKEA | 0603 | Vishay Semiconductors |
| R11 | 12K | SMD resistor: 50 V 1/16W 1% - MC0063W0603112K | 0603 | MULTICOMP |
| R12 | 12K | SMD resistor: 50V 1/16W 1% - MC0063W0603112K | 0603 | MULTICOMP |
| R13 | 10M | SMD resistor: 1/10W 1% - CRCW060310M0FKEA | 0603 | Vishay Semiconductors |
| R14 | 2M2 | SMD resistor: 1/8W 1% - RC0805FR-072M2L | 0805 | Yageo |
| R15 | 150 K | SMD resistor: 200 V 1/4W 1% - RC1206FR-07150KL | 1206 | Yageo |
| R16 | 150 K | SMD resistor: 1/10W 1% - CRCW0603150KFKEA | 0603 | Vishay Semiconductors |
| R17 | 2M2 | SMD resistor: 1/8W 1% - RC0805FR-072M2L | 0805 | Yageo |
| R18 | 68K | SMD resistor: 1/10W 1% - RC0603FR-0768KL | 0603 | Yageo |
| R19 | 2M2 | SMD resistor: 1/8W 1% - RC0805FR-072M2L | 0805 | Yageo |
| R20 | 150 K | SMD resistor: 200 V 1/4W 1% - RC1206FR-07150KL | 1206 | Yageo |
| R21 | 150 K | SMD resistor: 1/10W 1% - CRCW0603150KFKEA | 0603 | Vishay Semiconductors |
| R22 | 1M | SMD resistor: 150 V 1/10W 1% - CRG0603F1M0 | 0603 | TE Connectivity |
| R23 | 1M | SMD resistor: 150 V 1/10W 1% - CRG0603F1M0 | 0603 | TE Connectivity |
| R24 | 2M2 | SMD resistor: 1/8W 1% - RC0805FR-072M2L | 0805 | Yageo |
| R25 | 10M | SMD resistor: 1/10W 1% - CRCW060310M0FKEA | 0603 | Vishay Semiconductors |
| R26 | 10M | SMD resistor: 1/10W 1% - CRCW060310M0FKEA | 0603 | Vishay Semiconductors |
| R27 | 68K | SMD resistor: 1/10W 1% - RC0603FR-0768KL | 0603 | Yageo |
| U1 | LM393ADT | SMD low-power, dual-voltage comparator: 2V to 36V | SO-8 | STMicroelectronics |

**Table 9. PFC power MOSFET daughterboard**

| Reference | Value | Description | Package | Manufacturer |
|---|---|---|---|---|
| C201 | 100 pF | SMD multilayer ceramic capacitor: 1000V 10% - 102R18W101KV4E | 1206 | Johanson |
| J201 | STRIP 8-M-90 | Male strip 1x8 pins 90° pitch 2,54 mm: - 61300811021 | | Würth Elektronik |
| Q201 | STL36N60M6 | SMD N-channel power MOSFET : 600 V 25A | PowerFLAT8x8 | STMicroelectronics |
| R201 | 0R1 | SMD resistor: 1W 1% - PT2512FK-070R1L | 2512 | Yageo |
| R202 | 0R1 | SMD resistor: 1W 1% - PT2512FK-070R1L | 2512 | Yageo |
| R203 | 220K | SMD resistor: 150 V 1/8W 1% | 0805 | |

Table 10. **SRK2001A daughterboard**

| Reference | Value | Description | Package | Manufacturer |
|---|---|---|---|---|
| C201 | 1µF | SMD multilayer ceramic capacitor: 25V +/-10% | 0805 | |
| D201 | N.M. | SMD transient bidirectional voltage rectifier | SMA | |
| D202 | N.M. | SMD transient bidirectional voltage rectifier | SMA | |
| HS1 | HEATSINK | Heatsink black anodized aluminum 71°K/W for SMD (8x10x6mm): - ICK SMD F 10 SA | | Fischer Elektronik |
| HS2 | HEATSINK | Heatsink black anodized aluminum 71°K/W for SMD (8x10x6mm): - ICK SMD F 10 SA | | Fischer Elektronik |
| JP201 | STRIP13-M-90 | 13p right Angle Male header: - 61304011021_G | | Würth Elektronik |
| Q201 | STL120N8F7 | N-channel power MOSFET : 80V 120A | PowerFLAT 5x6 | STMicroelectronics |
| Q202 | STL120N8F7 | N-channel power MOSFET : 80V 120A | PowerFLAT 5x6 | STMicroelectronics |
| R201 | 100R | SMD resistor: 200 V 1/4W 1% - RC1206FR-07100RL | 1206 | Yageo |
| R202 | 100R | SMD resistor: 200 V 1/4W 1% - RC1206FR-07100RL | 1206 | Yageo |
| R203 | 0R | SMD resistor: 200 V 1/4W 5% - RC1206JR-070RL | 1206 | Yageo |
| R204 | 0R | SMD resistor: 200 V 1/4W 5% - RC1206JR-070RL | 1206 | Yageo |
| R205 | 0R | SMD resistor: 150 V 1/8W 5% - RC0805JR-070RL | 0805 | Yageo |
| R206 | N.M. | SMD resistor: 1/8W 1% | 0805 | Yageo |
| U201 | SRK2001A | SRK2001A SR controller | SSOP10 | STMicroelectronics |

# 12 PFC inductor specification

The main characteristics of the PFC inductor are:

- Core type: QP2925 - 3C95
- Coil former: Vertical type, 8 pins
- Ferrite grounding: grounded by two clamps fixed to core and soldered to PCB
- Min. operating frequency: 40 kHz
- Primary inductance (pin 1.2 – 3.4): 210 µH ±10%
- Maximum primary peak current: 9.6 A
- Maximum primary rms current: 3.9 A

**Figure 44. PFC inductor: electrical diagram**

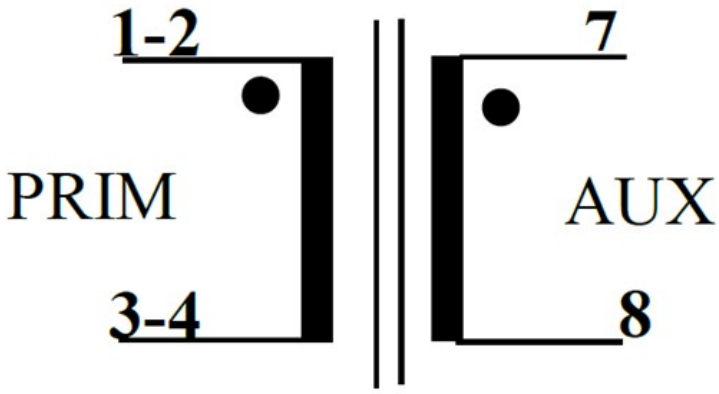
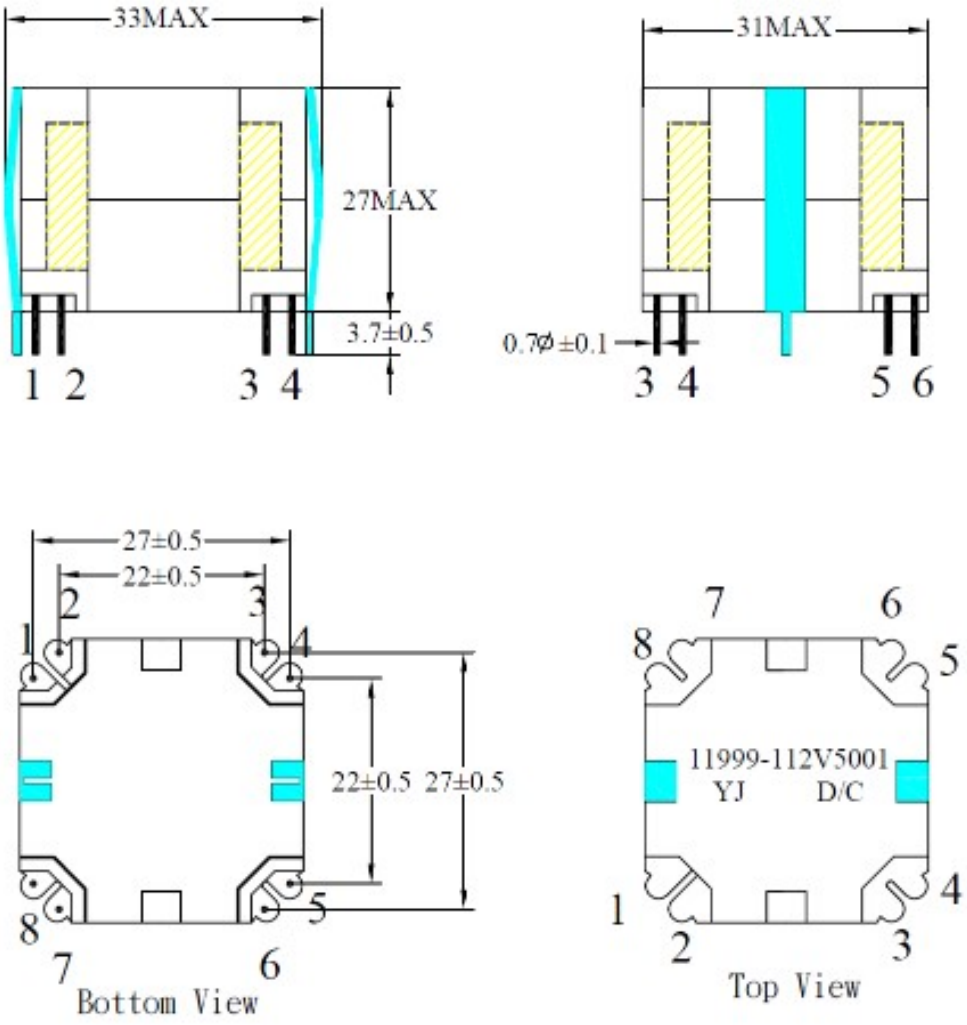



**Table 11. PFC inductor: winding characteristic**

| Pins | Windings | Number of turns |
|---|---|---|
| 1.2 – 3.4 | PRIMARY | 40 |
| 7 - 8 | AUX | 4 |

Figure 45. **PFC inductor: mechanical drawing (unit: mm)**



# 13 LLC transformer specification

The main characteristics of the LLC transformer are:

- Core type: QE30 - DMR95B
- Min. operating frequency: 180 kHz
- Typical operating frequency: 260 kHz
- Primary inductance: 210 µH ± 10% at 100 kHz-1.0 V
- Leakage inductance: 40 µH ± 10% at 100 kHz-1.0 V (measured between pins 1/3, short N4 and N5 windings)
- Mains insulation: acc. to EN62368.

**Figure 46. LLC transformer: electrical diagram**

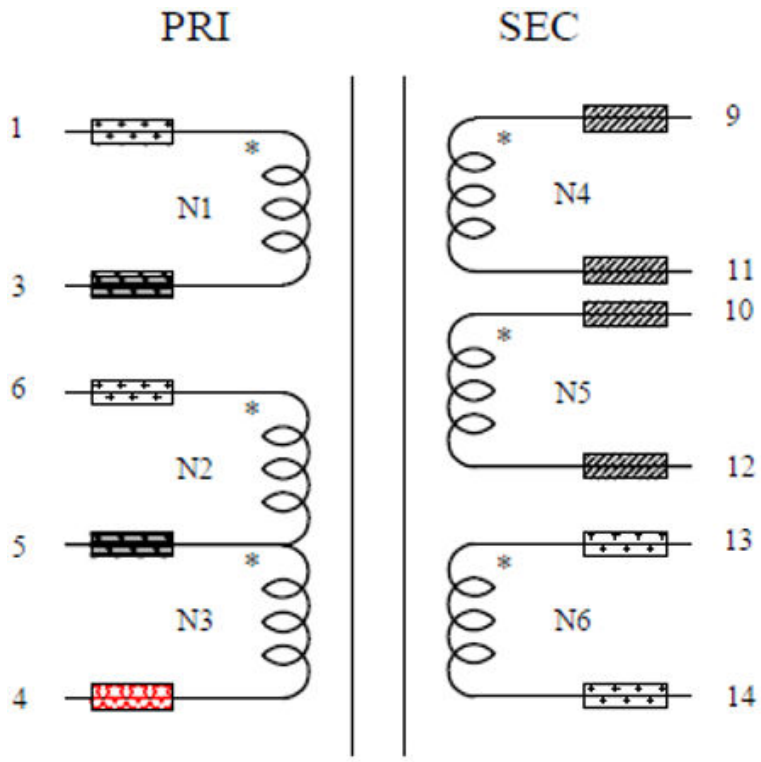
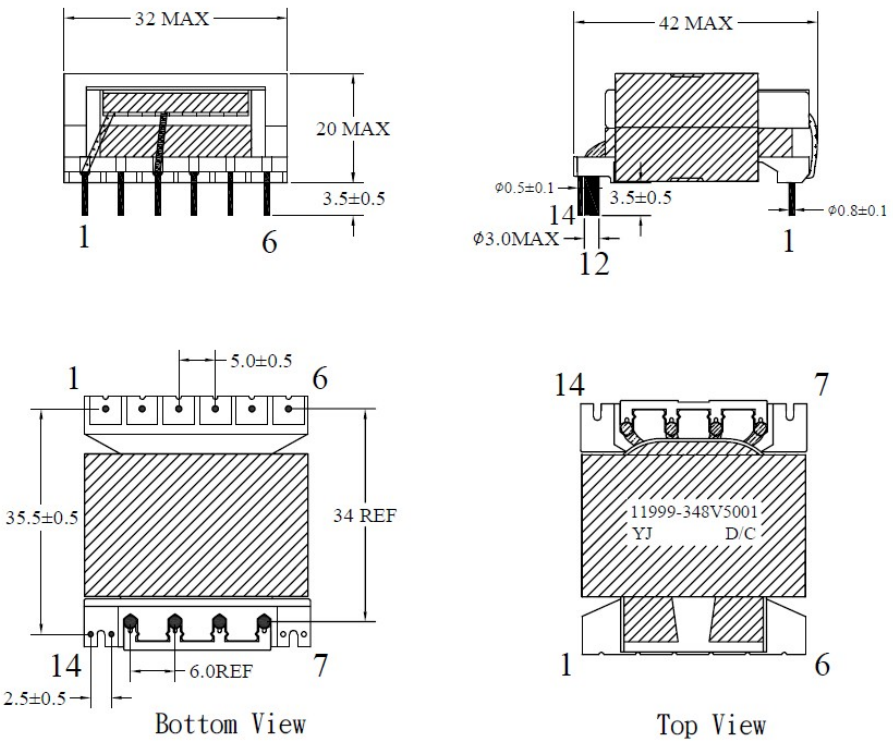



**Table 12. LLC transformer: winding characteristic**

| Pins | Windings | $I_{RMS}$ [A] | Number of turns |
|---|---|---|---|
| 1 – 3 | N1: PRIMARY | 2.0 | 18 |
| 6 – 5 | N2: AUX PRIMARY | 0.05 | 2 |
| 5 – 4 | N3: AUX PRIMARY | 0.05 | 2 |
| 9 – 11 | N4: SEC. A | 10.5 | 2 |
| 10 – 12 | N5: SEC. B | 10.5 | 2 |
| 13 – 14 | N6: AUX SEC. | 0.05 | 1 |

Figure 47. **LLC transformer: mechanical drawing (unit: mm)**



# 14 References

L6462A datasheet: DS14885 on www.st.com
STNRG599A datasheet: DS15052 on www.st.com
SRK2001A datasheet: DS11726 on www.st.com

# Revision history

Table 13. **Document revision history**

| Date | Version | Changes |
|---|---|---|
| 09-Jul-2026 | 1 | Initial release. |

# Contents

# List of tables

# List of figures

**IMPORTANT NOTICE – 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.

In the event of any conflict between the provisions of this document and the provisions of any contractual arrangement in force between the purchasers and ST, the provisions of such contractual arrangement shall prevail.

The 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 acknowledgment.

The 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 the 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.

If the purchasers identify an ST product that meets their functional and performance requirements but that is not designated for the purchasers' market segment, the purchasers shall contact ST for more information.

ST and the ST logo are trademarks of ST. For additional information about ST trademarks, refer to www.st.com/trademarks. 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.