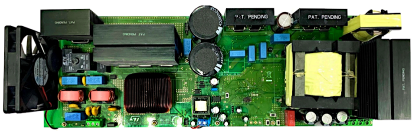
STDES-2KW5CH48V

Data brief

2.5 kW - 48 V battery charger reference design for industrial light electric vehicles (LEVs)



Fully assembled board developed for performance evaluation only, not available for sale

Product summary	
2.5 kW industrial LEV battery charger	STDES-2KW5CH48V
CCM PFC Controller	L4984D
Improved high-voltage resonant controller	L6599AD
Mainstream Arm Cortex-M0 USB line MCU with 128 Kbytes of flash memory, 48 MHz CPU, USB, CAN and CEC functions	STM32F072CBT6
N-channel 650 V, 0.056 Ohm typ., 42 A MDmesh M5 Power MOSFET in TO-247 package	STW57N65M5
N-channel 600 V, 48 mOhm typ., 58 A MDmesh DM6 Power MOSFET in a TO-LL package	STO67N60DM6
650 V, 20 A dual High Surge Silicon Carbide Power Schottky Diode	STPSC20H065CW
VIPerPlus family: Energy saving 6W high voltage converter with direct feedback	VIPER16HN
Applications	EV Charging

Features

- Multichemistry battery charger design
- CCM PFC and FB LLC converter
- Maximum output power: 2.5 kW
- Input voltage: 85–265 V_{AC}
- Output voltage: 40–60 V with maximum current limited to 42 A
- Mixed analog and digital control
- Peak efficiency: 93.75% end-to-end
- Soft start
- Comprehensive safety mechanism

Description

The STDES-2KW5CH48V reference design offers a charging solution mainly for industrial light electric vehicles (LEVs), such as e-scooters, e-bikes, e-rickshaws, forklifts, micro e-cars. It is also suitable for AGV robots and power tools.

The charger implements two charging profiles: one for Li-ion batteries and the other one for lead-acid batteries, corresponding to the latest trends of battery charging.

The charger design is based on a boost power factor correction (PFC) circuit, controlled by the L4984D that provides high PF of greater than 0.9, followed by a DC-DC circuit based on a full-bridge LLC resonant power converter, controlled by the L6599A. For the output rectification, diodes have been chosen with an LLC transformer secondary winding using the center tapped configuration.

The design features an STM32F072CB microcontroller to control the power stages and the battery charging profiles and to manage protections and the user interface.

MDmesh M5 power MOSFETs and SiC diodes are used in the PFC stage. MDmesh DM6 power MOSFETs are used for the LLC stage.

The primary and secondary sections are supplied by an off-line flyback circuit based on the VIPER16. This circuit provides regulated voltages to the microcontroller, the gate driver ICs, and the signal conditioning circuitry.

Formal testing and measurement results confirm the ability of performance of ST power products, combined with comprehensive digital control, to deliver high efficiency, power factor near unity, and low THD across wide input voltage and load conditions.

1 Overview

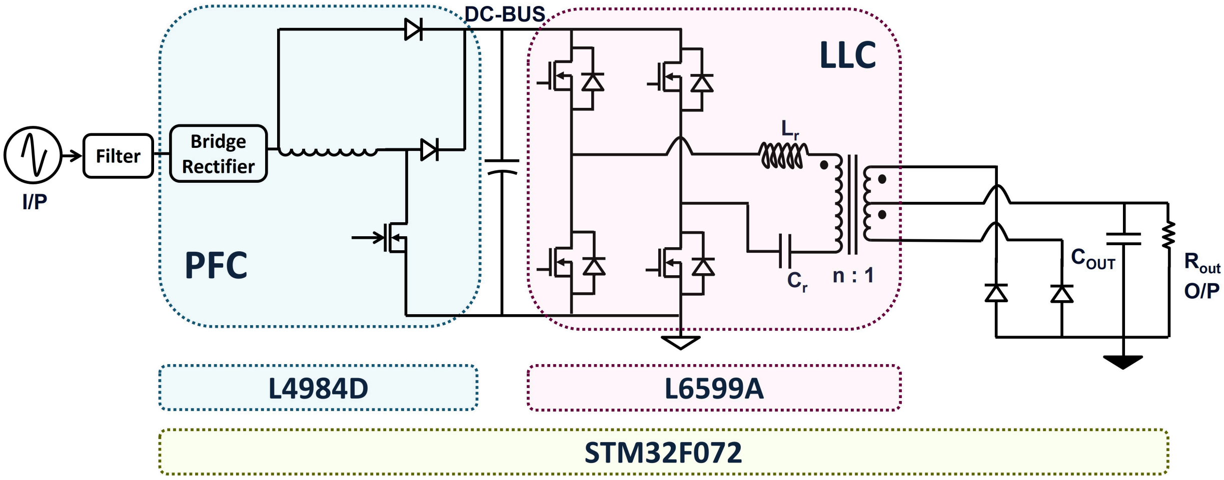


Figure 1. **STDES-2KW5CH48V block diagram**

The STDES-2KW5CH48V power stages are controlled through dedicated analog controllers and through a microcontroller, which manages the application according to your requirements.

The STDES-2KW5CH48V works with an input mains voltage from 85 to 265 V_{AC}. It can provide an output power of up to 2.5 kW when the input voltage is above 180 V_{AC}. Below this threshold, the output power capability derates down to 1.25 kW. The reference design adjusts the output power delivery parameters according to the EU or the US input voltage, sensed through the isolated amplifier.

The PFC and full-bridge LLC power stages are referred to the primary ground, while the LLC controller and the microcontroller are referred to the secondary ground.

For information about the charger status and settings, LEDs are positioned on the PCB. If an error occurs or a protection is triggered, the on-board D5 LED blinks. The D5 LED blink count varies for the different errors/ protections. To reprogram the microcontroller, apply +12 V DC on the J4 connector. Use the IAR Embedded Workbench for Arm (ver.9.10 or higher) or any other appropriate programming tool to program and debug.

2 Schematic diagrams

Figure 2. STDES-2KW5CH48V circuit schematic (1 of 8)

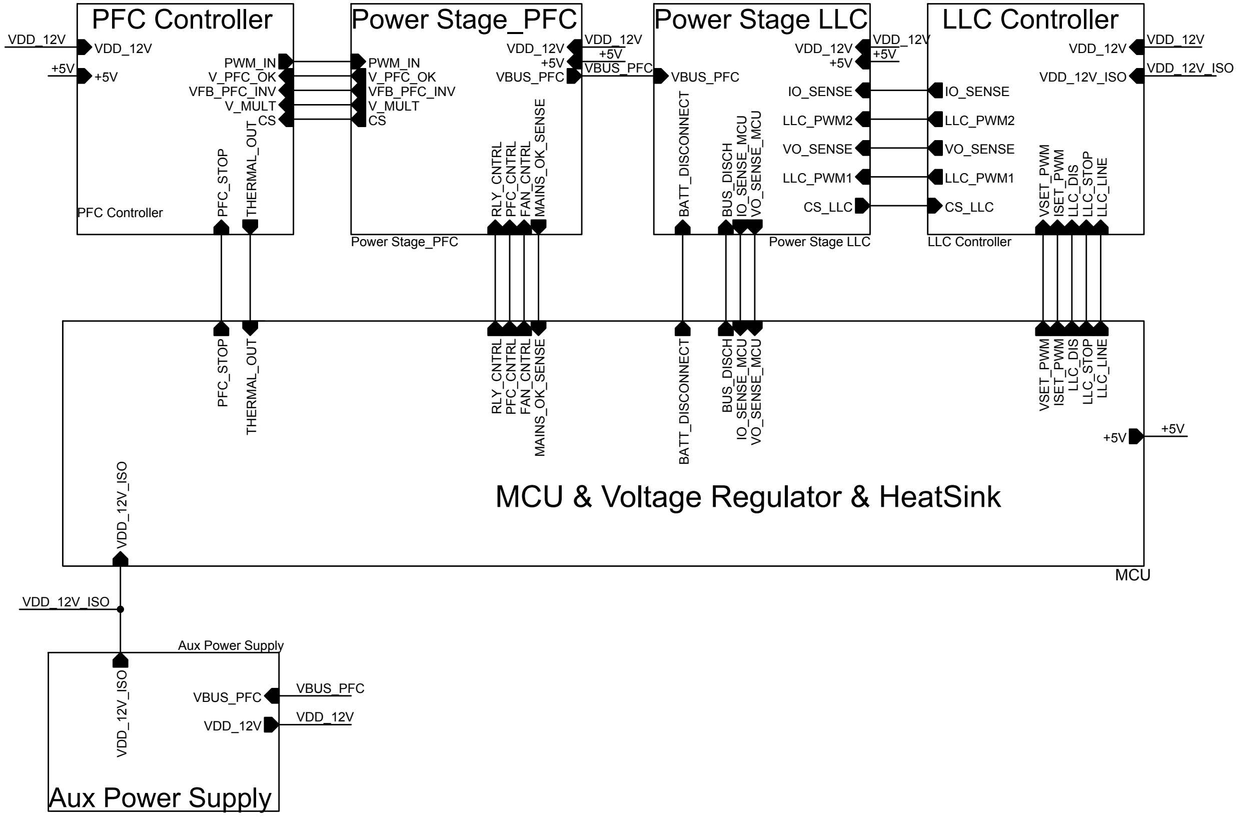


Figure 3. **STDES-2KW5CH48V circuit schematic (2 of 8)**

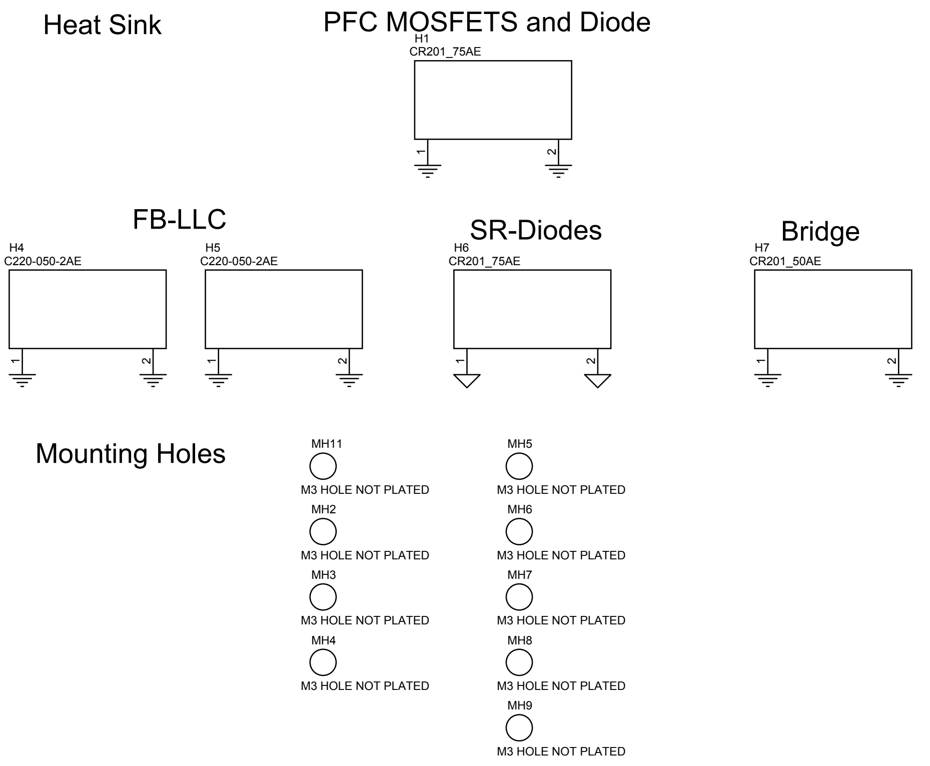


Figure 4. **STDES-2KW5CH48V circuit schematic (3 of 8)**

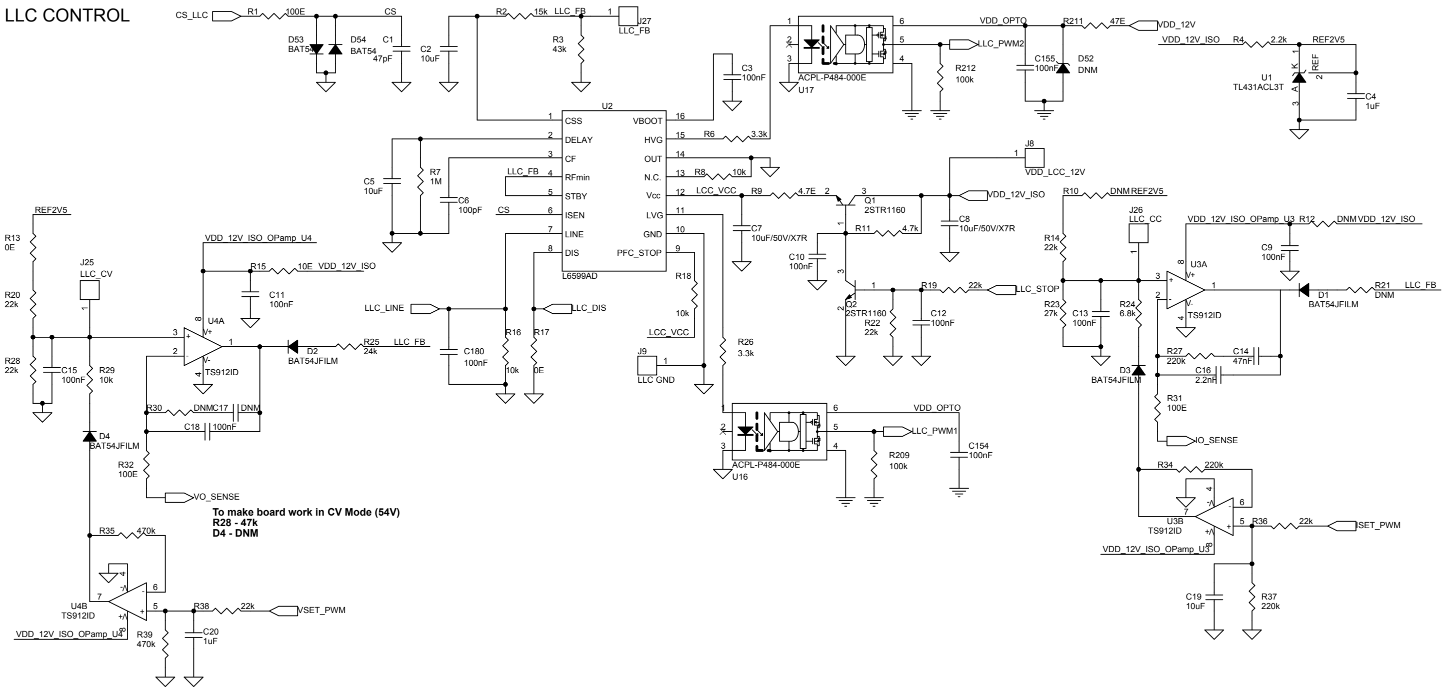


Figure 5. STDES-2KW5CH48V circuit schematic (4 of 8)

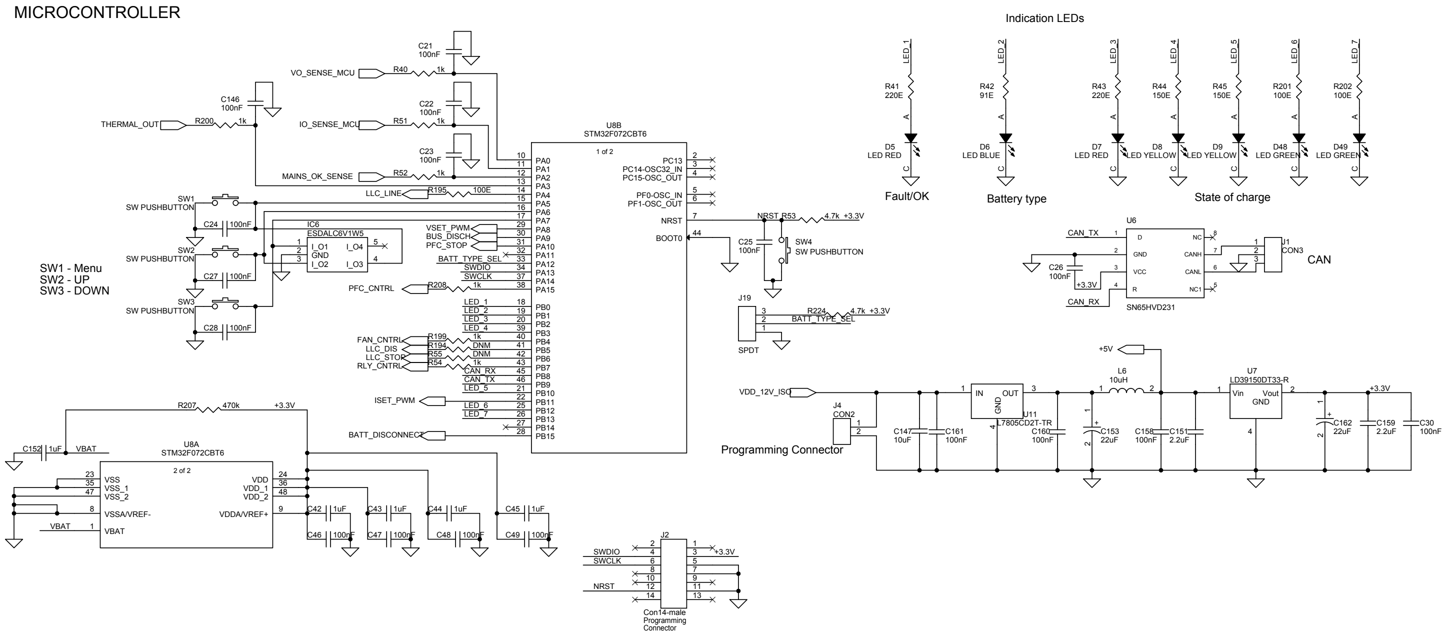


Figure 6. STDES-2KW5CH48V circuit schematic (5 of 8)

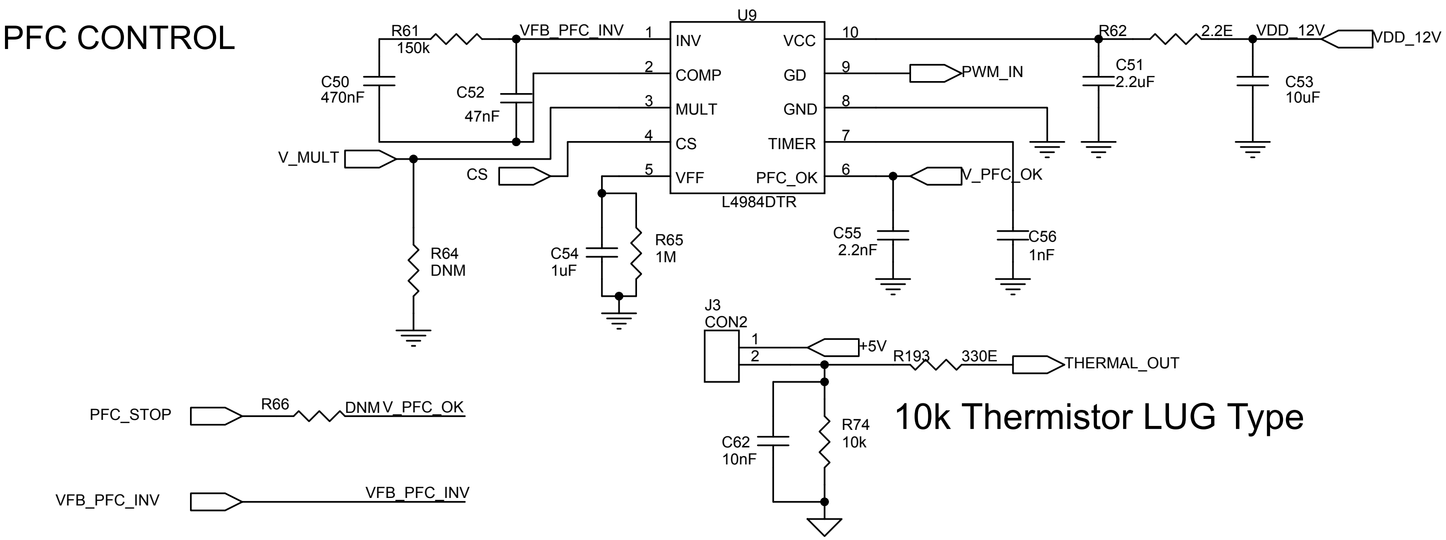


Figure 7. STDES-2KW5CH48V circuit schematic (6 of 8)

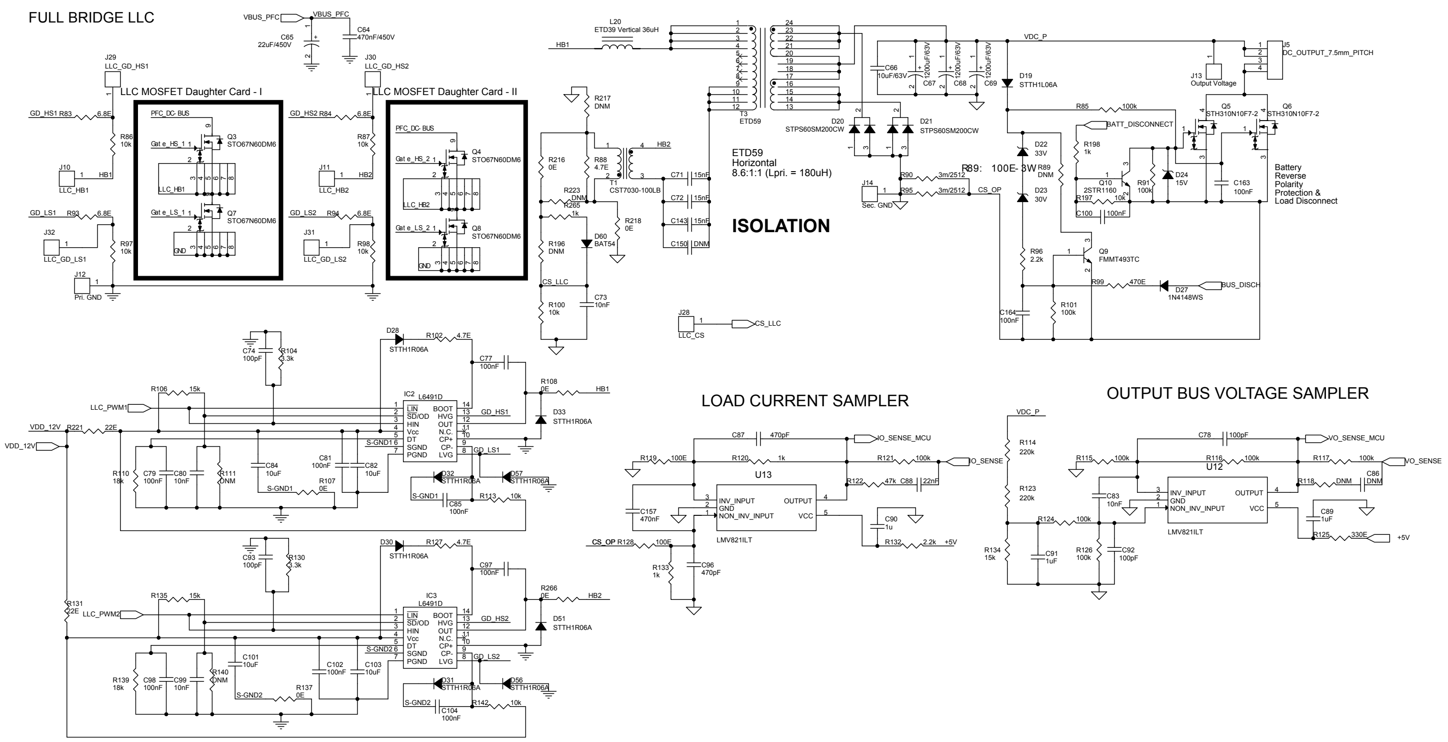


Figure 8. STDES-2KW5CH48V circuit schematic (7 of 8)

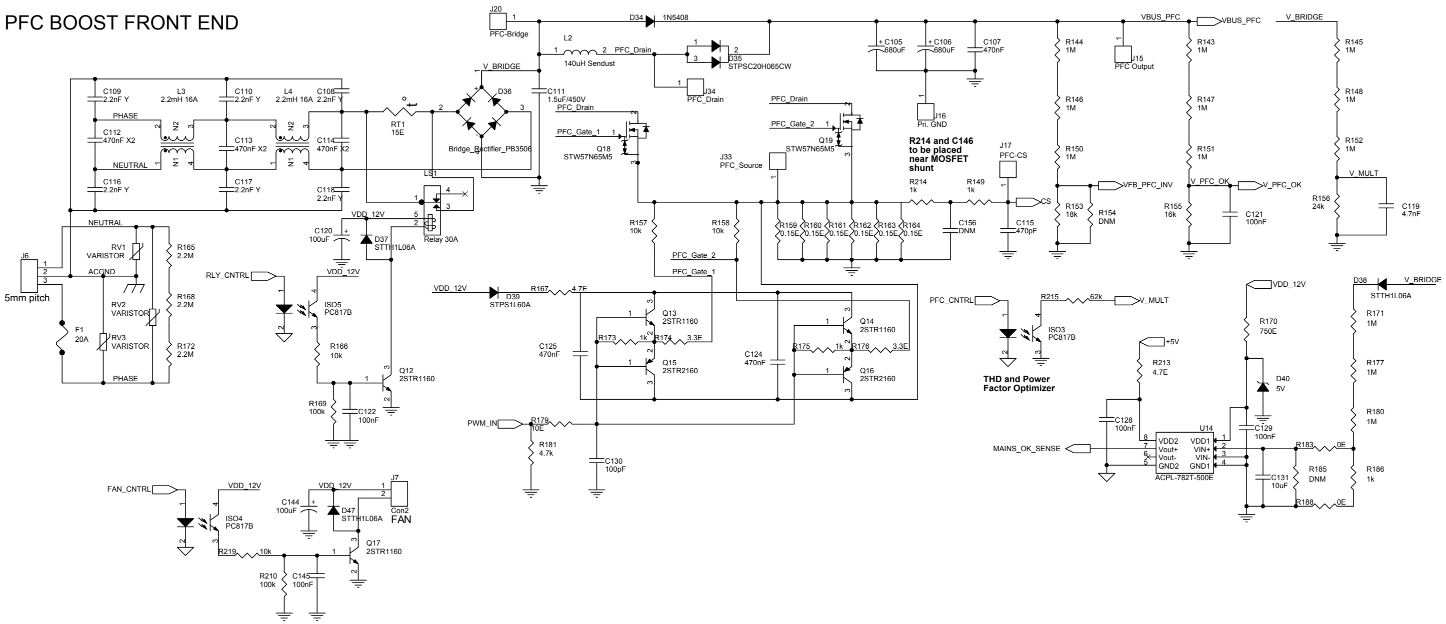
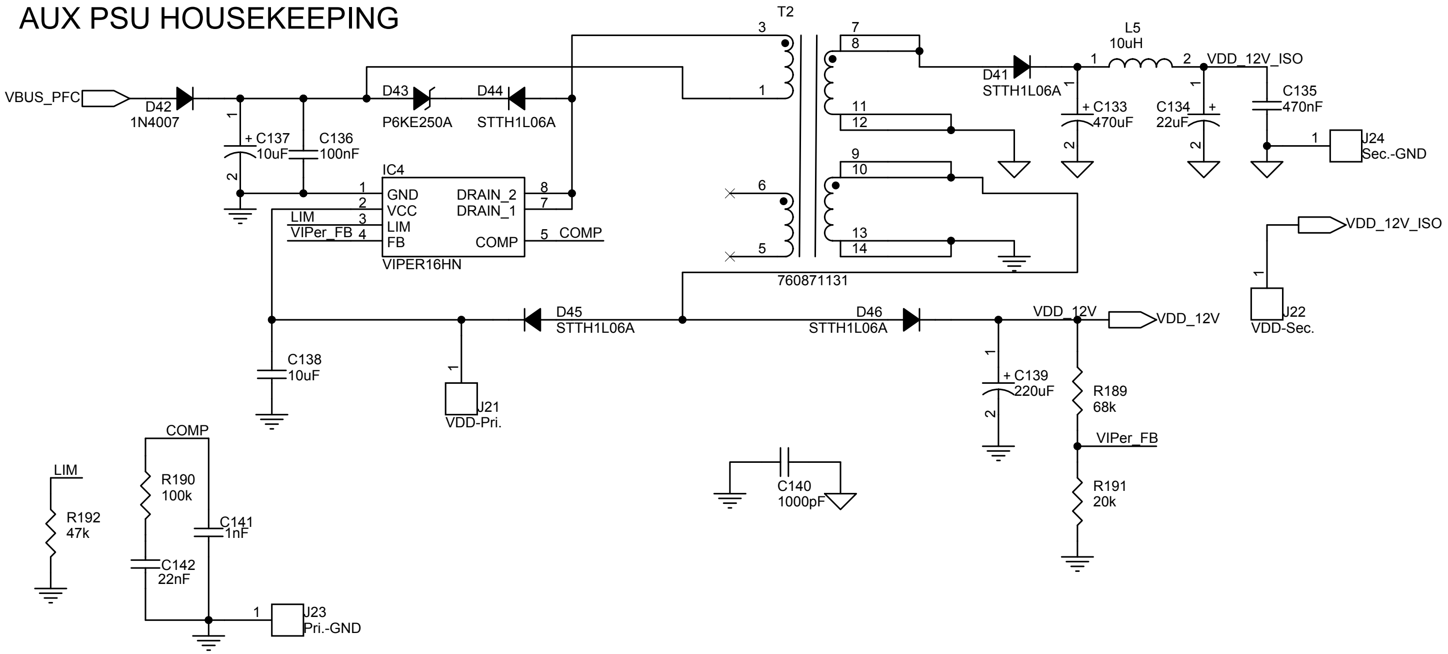


Figure 9. **STDES-2KW5CH48V circuit schematic (8 of 8)**



Revision history

Table 1. Document revision history

Date	Revision	Changes
19-Oct-2022	1	Initial release.
11-Nov-2022	2	Updated cover page description.