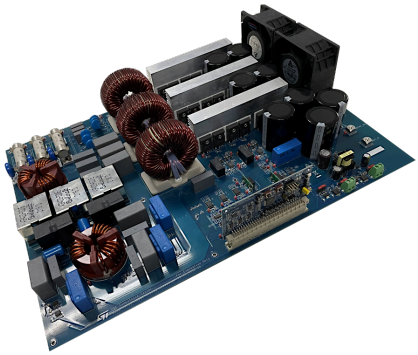
STDES-30KWVRECT

Data brief

30 kW Vienna PFC rectifier reference design with digital control



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

Product summary	
30 kW Vienna PFC rectifier reference design with digital control	STDES-30KWVRECT
Firmware for the 30 kW Vienna PFC rectifier based on the STM32G474RE digital power MCU	STSW-30KWVRECT
Mainstream Arm Cortex-M4 MCU 170 MHz with 512 Kbytes of flash memory	STM32G474RET3
650 V, 18 mOhm typ., 119 A silicon carbide power MOSFET in an HiP247-4 package	SCTWA90N65G2V-4
1200 V, 40 A high surge silicon carbide power Schottky diode	STPSC40H12CWL
Galvanically isolated 4 A single gate driver for SiC MOSFETs	STGAP2SICS
Applications	EV Charging

Features

- Three-phase, three-level AC-DC power converter:
  - Nominal rate for DC voltage: 800 V_{DC}
  - Nominal rate for AC voltage: 400 V_{AC} at 50 Hz
  - Maximum power: 30 kW
  - Power factor: >0.99
  - Inrush current control and soft start-up
  - THD lower than 5% at nominal operation
- Power section based on SiC MOSFETs and SiC diodes:
  - High frequency operation (70 kHz)
  - High efficiency: >98.5%
  - Paralleled SiC MOSFETs for higher power with balanced sharing current
  - Passive element weight and size reduction
- Control section based on the STM32G474RE microcontroller:
  - Control and monitoring interfaces: SWD–UART, I²C, and DACs
  - 64-pin digital power connector
  - LED status as UI
  - Four integrated high-performance op-amps for additional features

Description

The STDES-30KWVRECT reference design introduces a complete digital power solution for high-power three-phase active front end (AFE) rectifier applications based on the three-level Vienna topology.

This platform achieves a peak efficiency of more than 98.5% by using the SCTWA90N65G2V-4 and the STPSC40H12C.

It features a fully digital control with the STM32G474RE mixed-signal high-performance microcontroller, providing the full control of the PF, DC voltage, and soft startup procedure.

The STDES-30KWVRECT achieves a low total harmonic distortion (less than 5% THD at full load) and a high-power factor (higher than 0.99 at full load), providing a high-bandwidth continuous conduction mode (CCM) current regulation.

The STDES-30KWVRECT is a fully assembled kit developed for performance evaluation only, not available for sale.

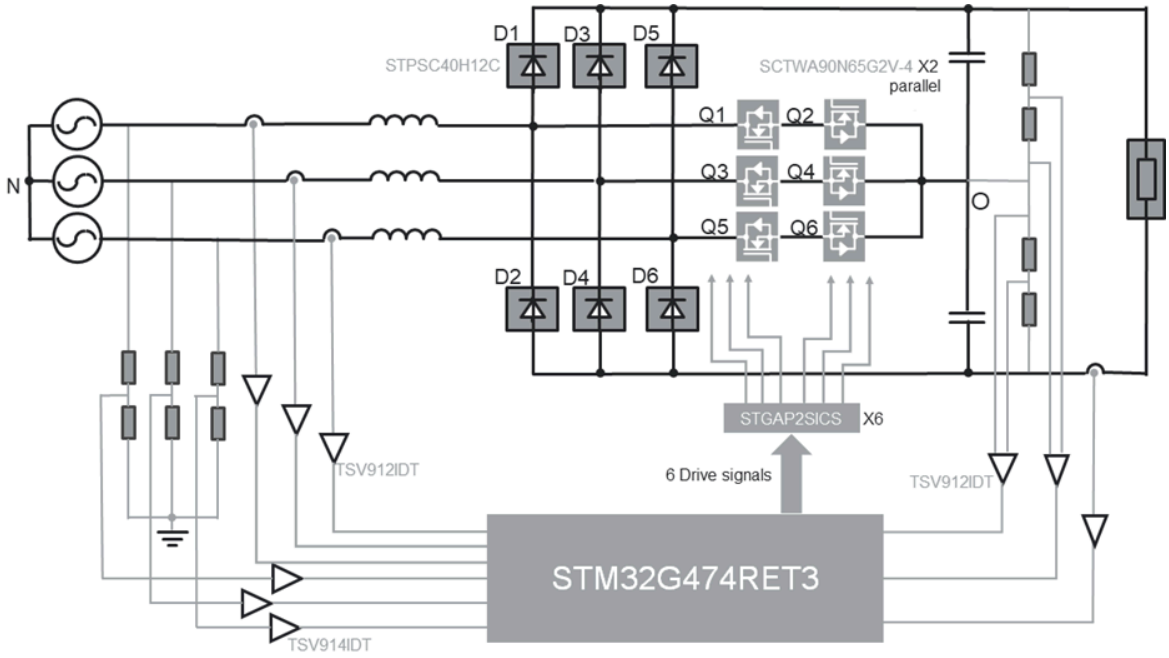
1 Electrical specifications

Table 1. Electrical characteristics

Symbol	Description	Min.	Type	Max.	Units	Comments
$VAC_{(L-L)}$	Input Line-line AC voltage	345	400	460	V	
f_{AC}	Input AC frequency	47	50	63	Hz	
V_{out}	Output voltage	700	800	850	V	
P_{out}	Output power			30	kW	
I_{out}	Output current			37.5	A	VDC=800V
I_{in}	Input current			50	A	$VAC_{(L-L)}$ =350V
η	Peak efficiency			98.56	%	$VAC_{(L-L)}$ =400V, V_{out}=800V
				98.7	%	$VAC_{(L-L)}$ =450V, V_{out}=800V
iTHD	Total harmonic distortion			<5	%	At load >50%
PF	Power factor		0.99			At load >50%
I_{inrush}	Inrush current			30	A	$VAC_{(L-L)}$ =450V

2 Platform overview

Figure 1. **System architecture of three phase Vienna PFC**



3 Schematic diagrams

Figure 2. STDES-30KWVRECT power board circuit schematic (1 of 9)

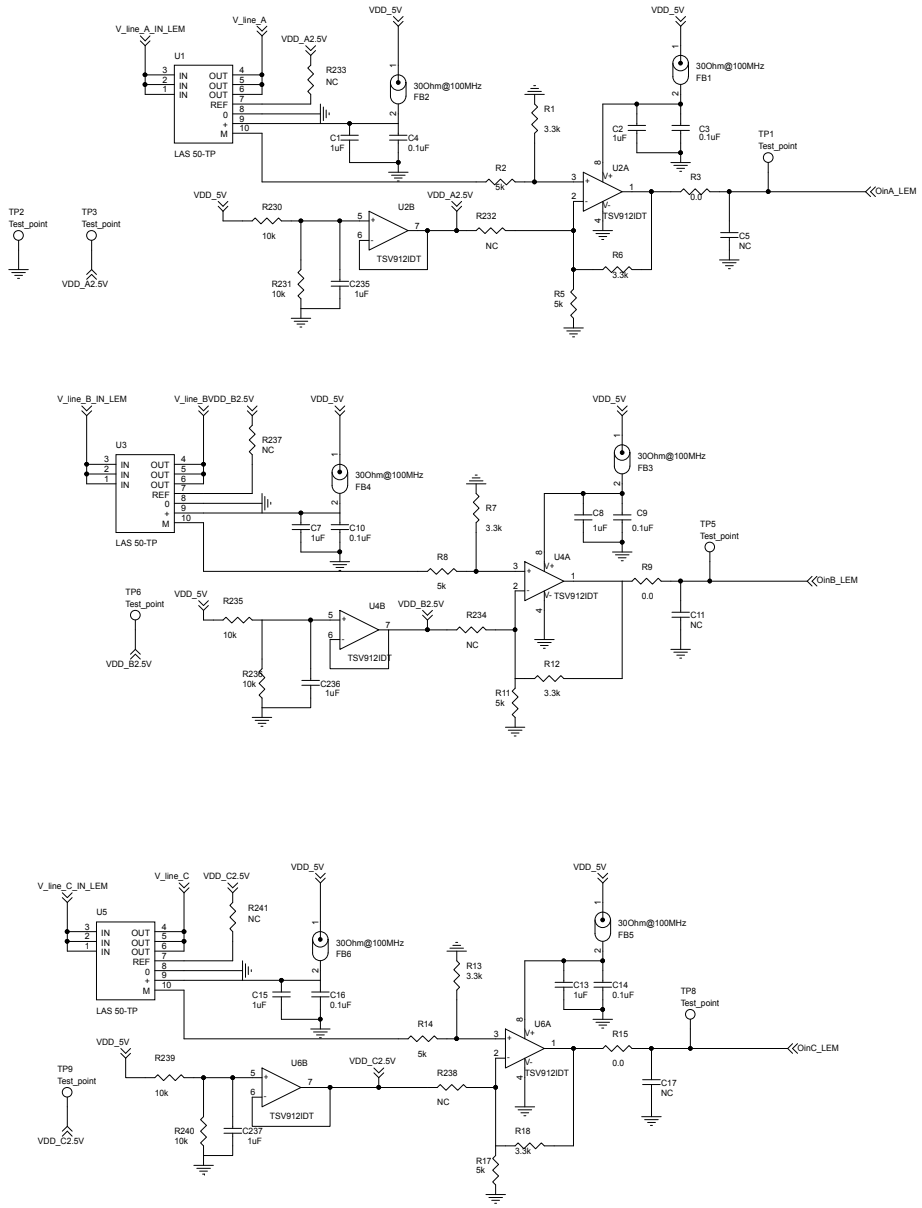


Figure 3. STDES-30KWVRECT power board circuit schematic (2 of 9)

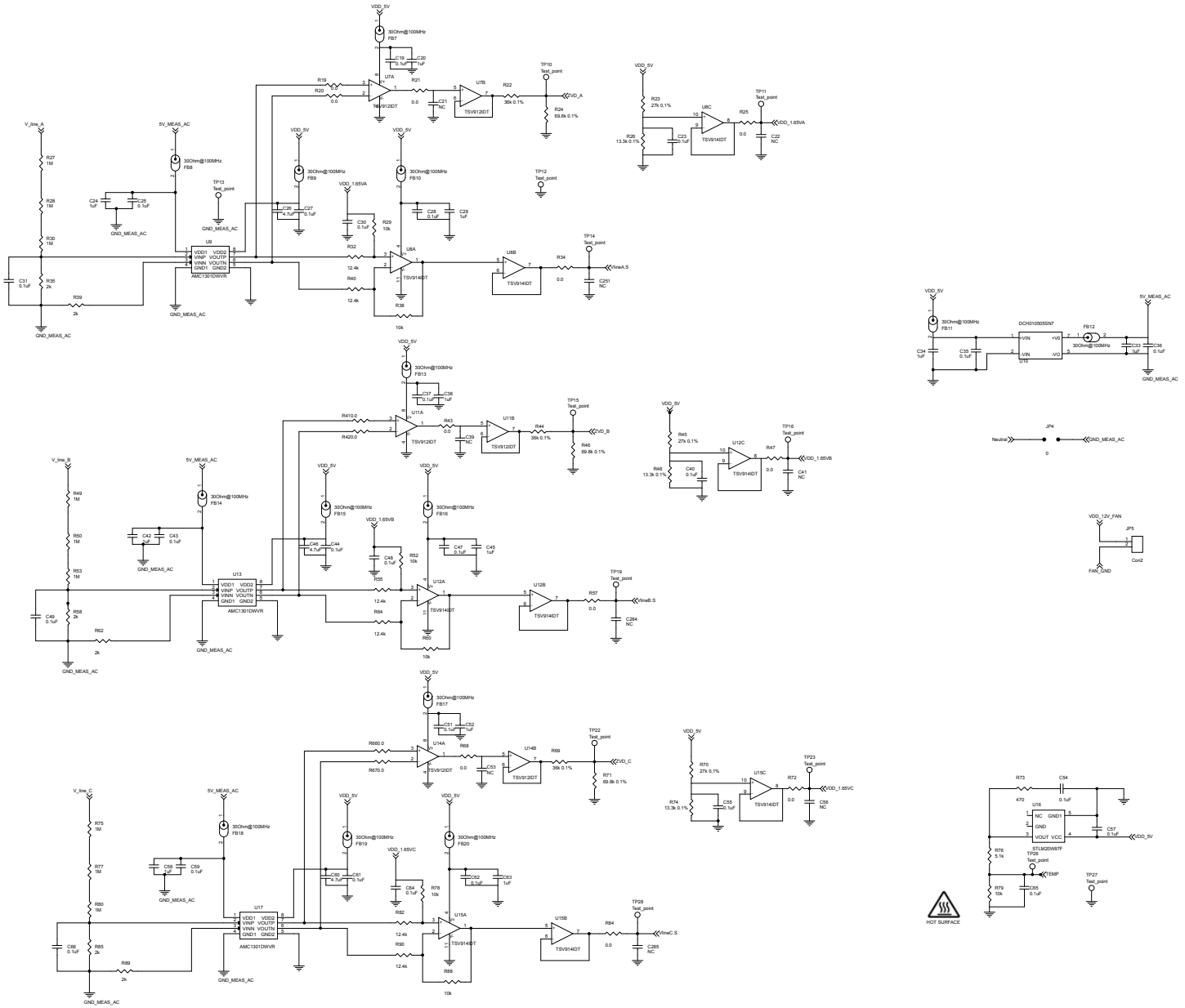


Figure 4. STDES-30KWVRECT power board circuit schematic (3 of 9)

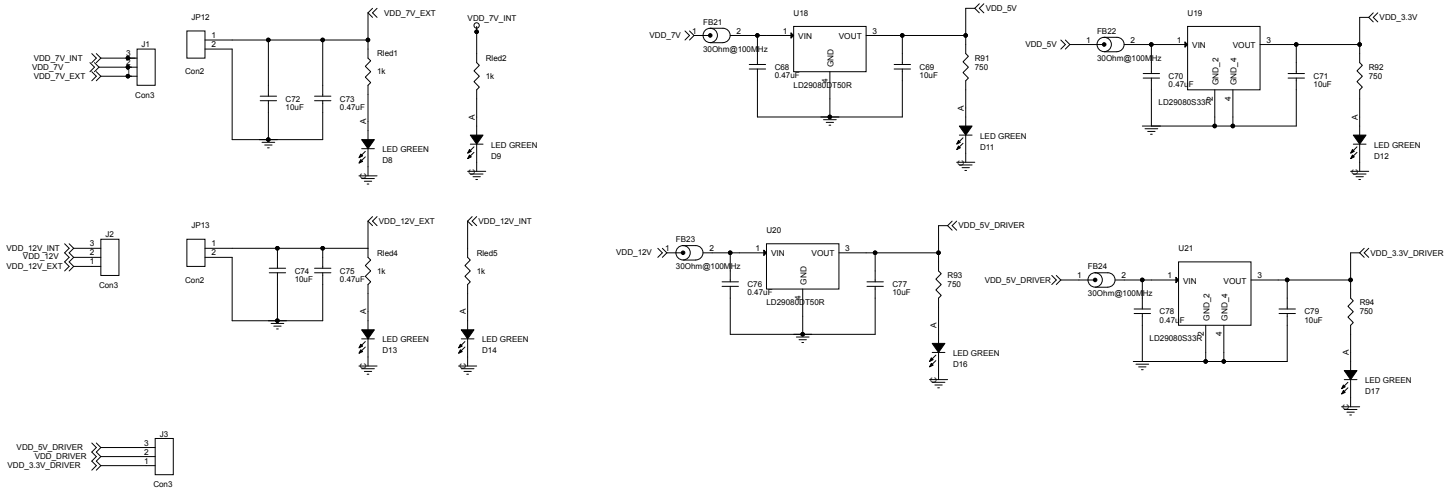


Figure 5. **STDES-30KWVRECT power board circuit schematic (4 of 9)**

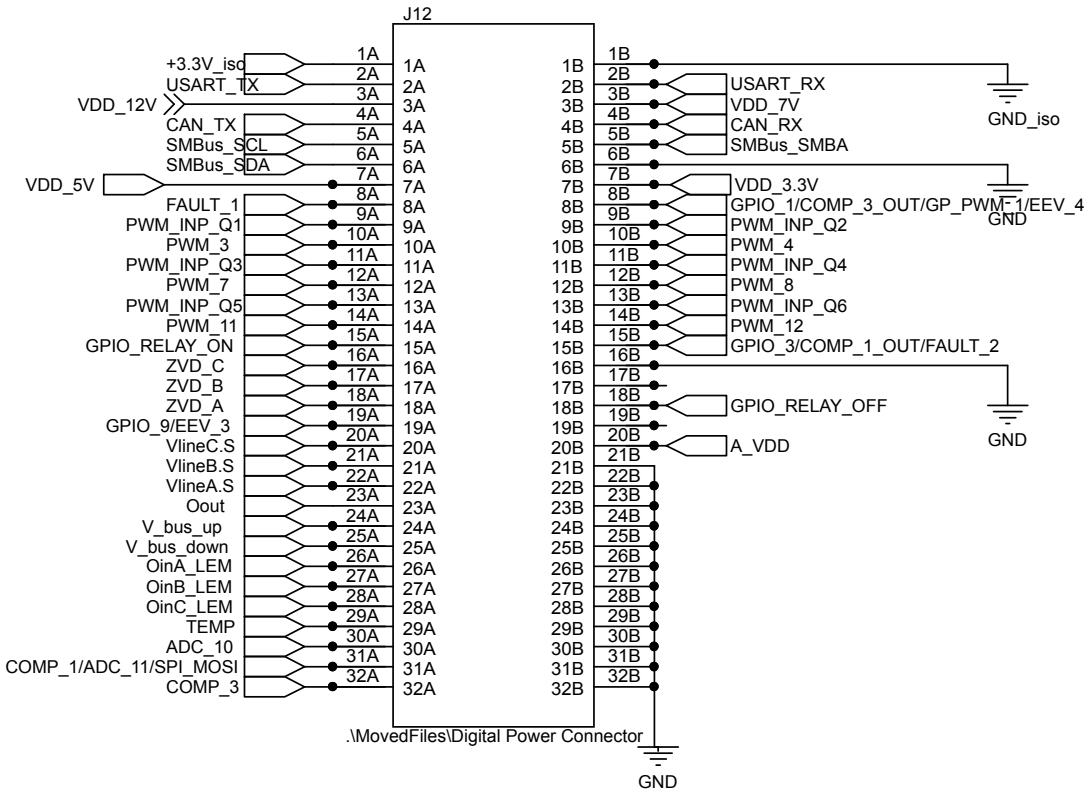


Figure 6. STDES-30KWVRECT power board circuit schematic (5 of 9)

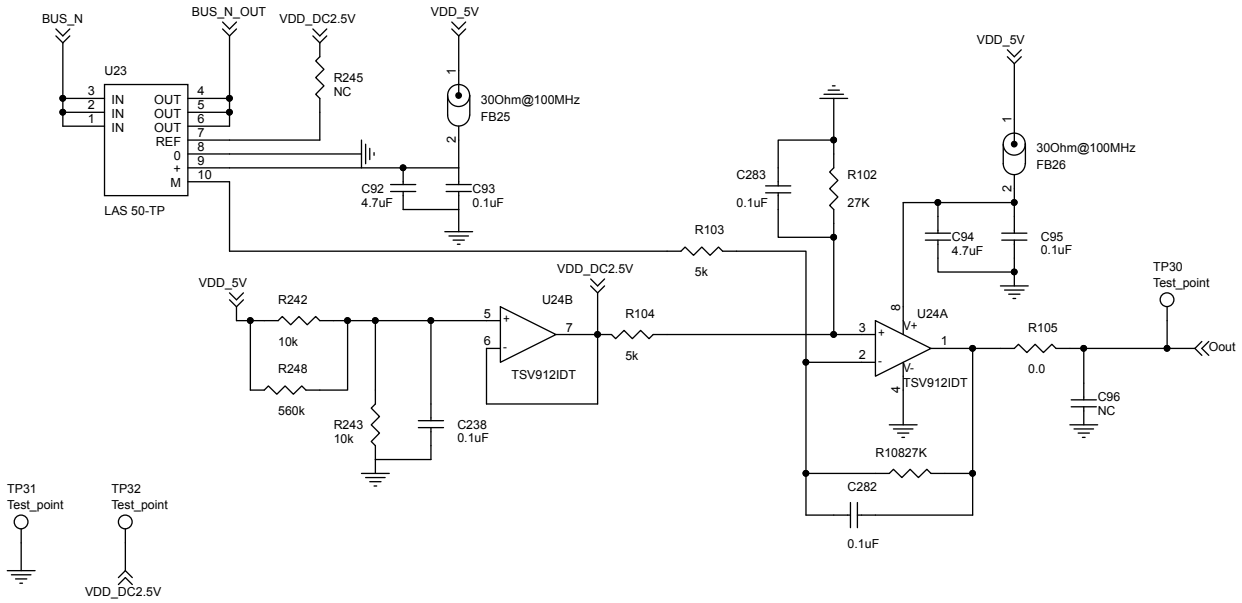
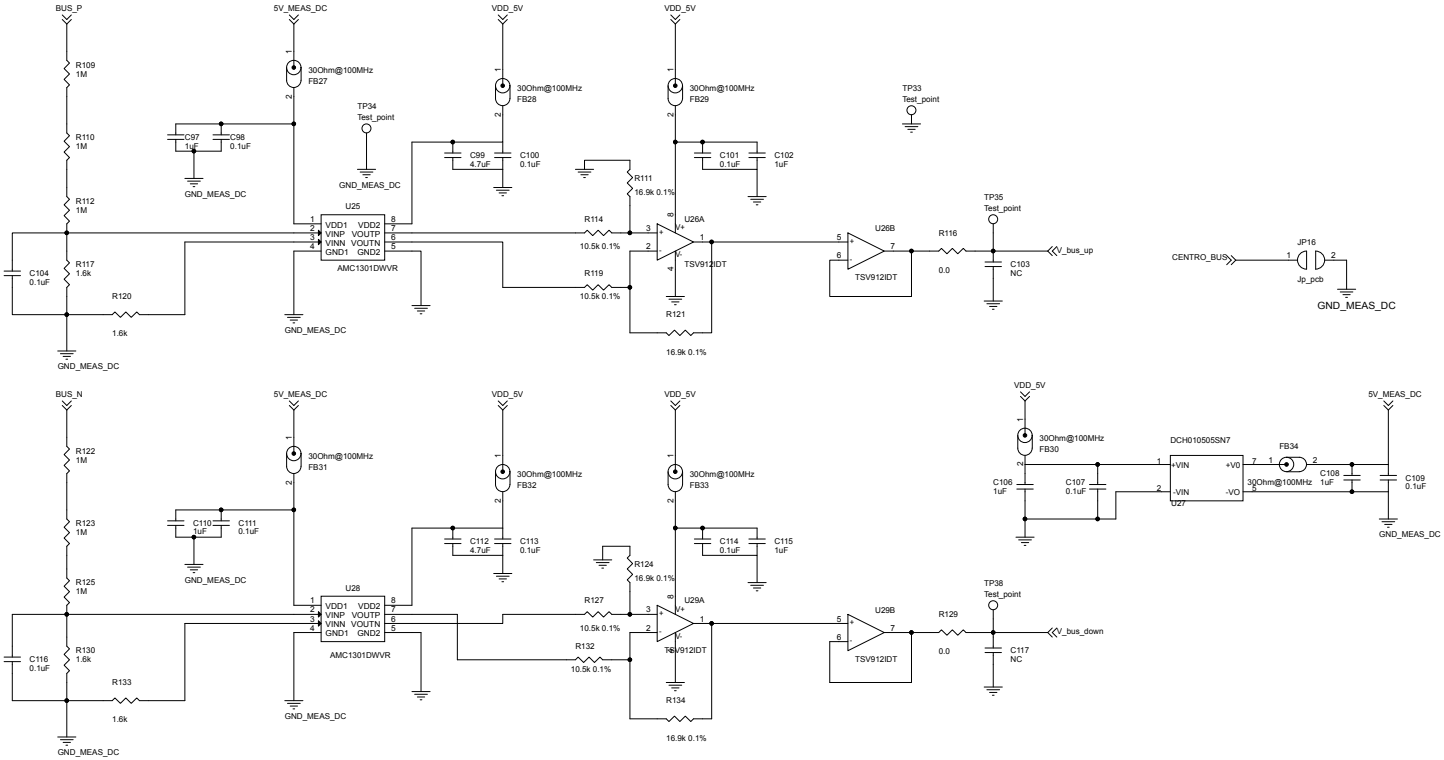


Figure 7. STDES-30KWVRECT power board circuit schematic (6 of 9)



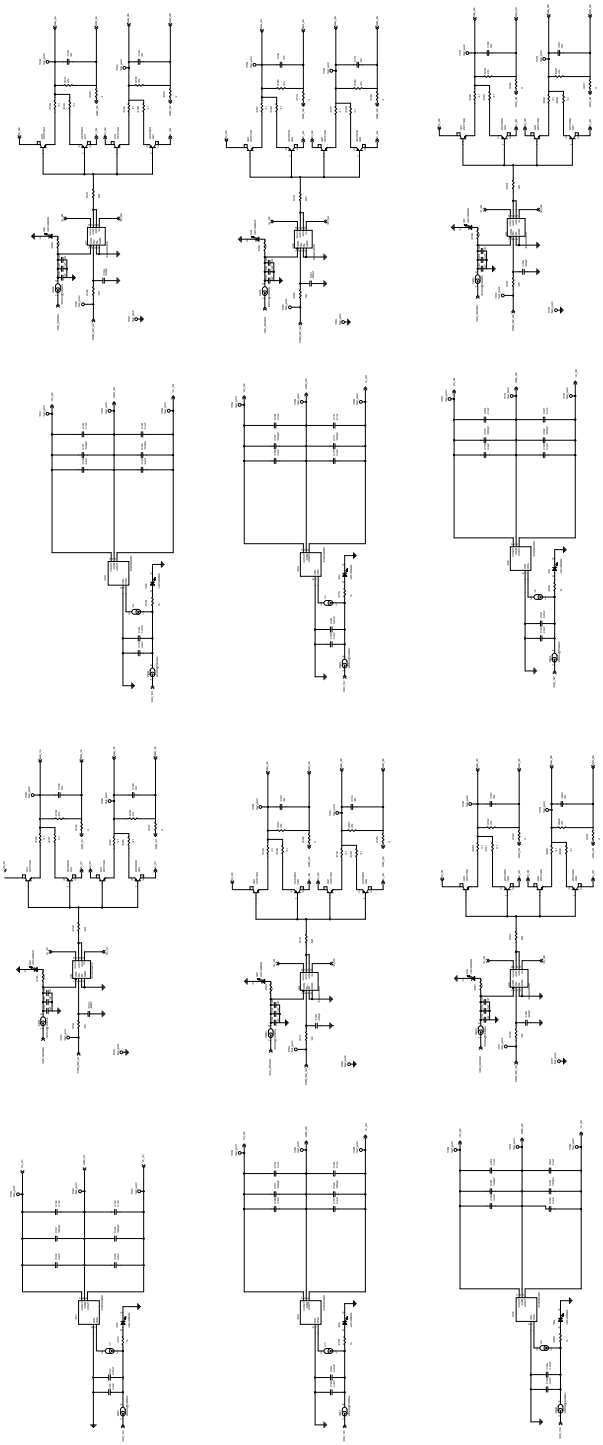


Figure 8. STDES-30KWVRECT power board circuit schematic (7 of 9)

Figure 9. STDES-30KWVRECT power board circuit schematic (8 of 9)

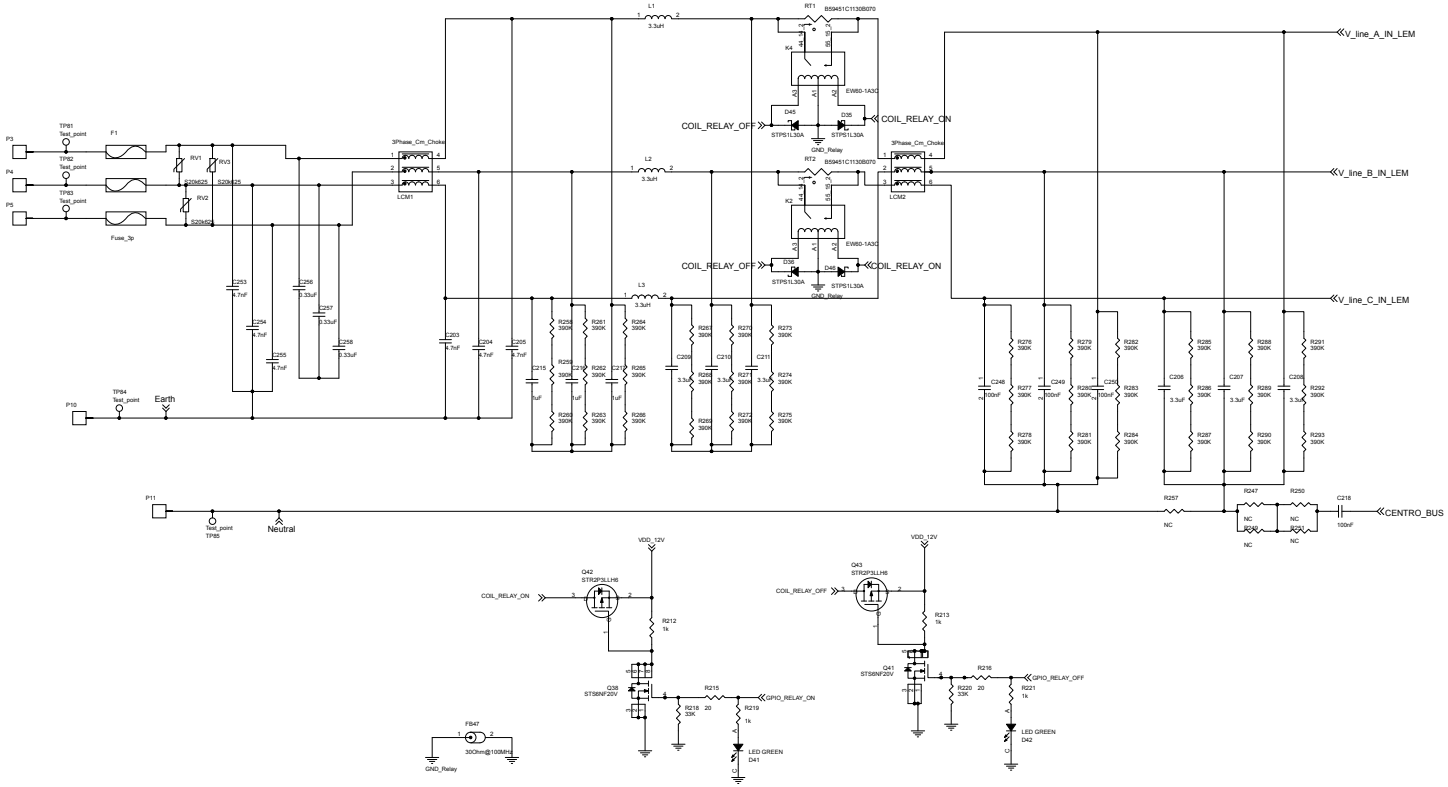


Figure 10. STDES-30KWVRECT power board circuit schematic (9 of 9)

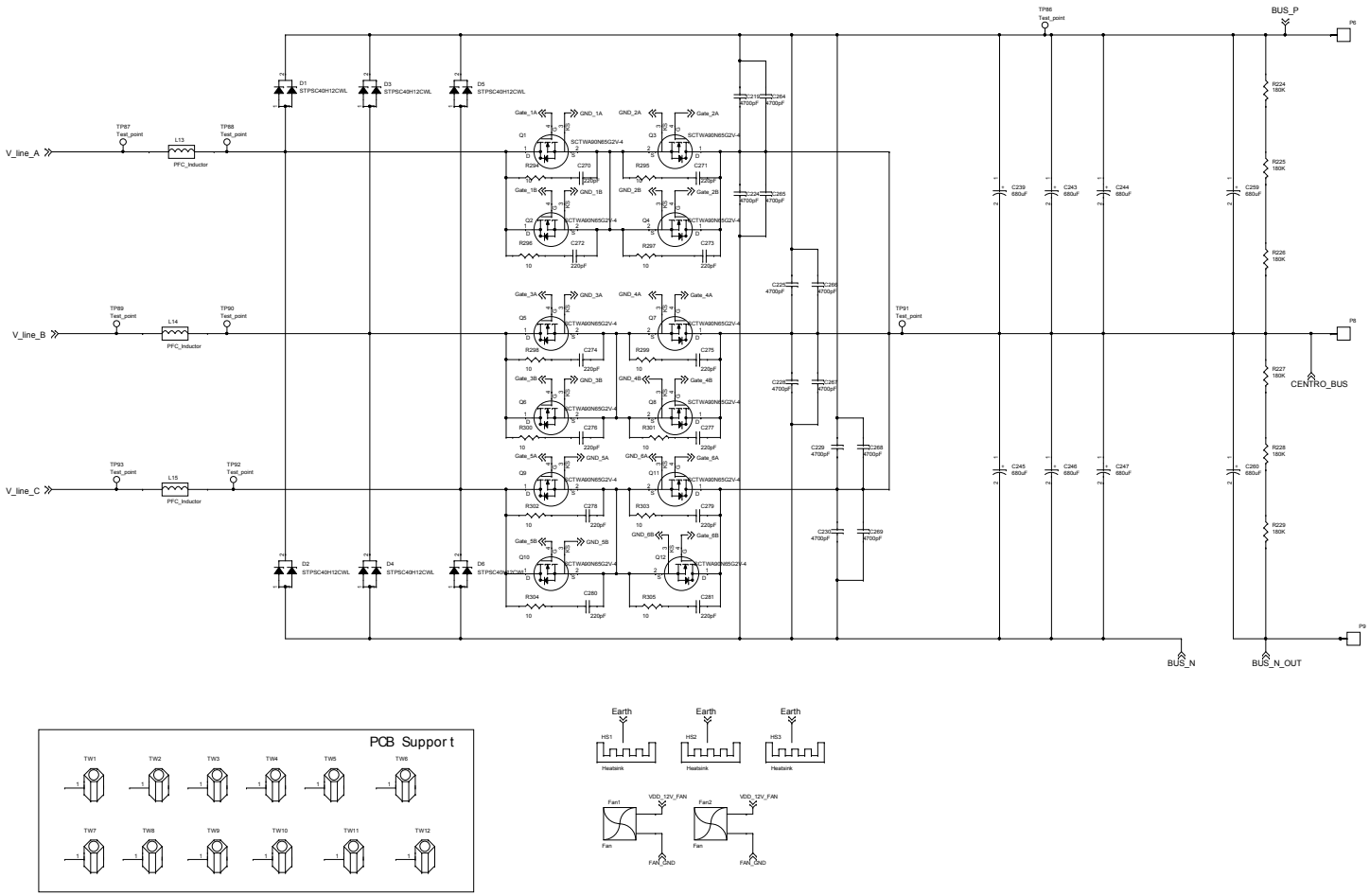
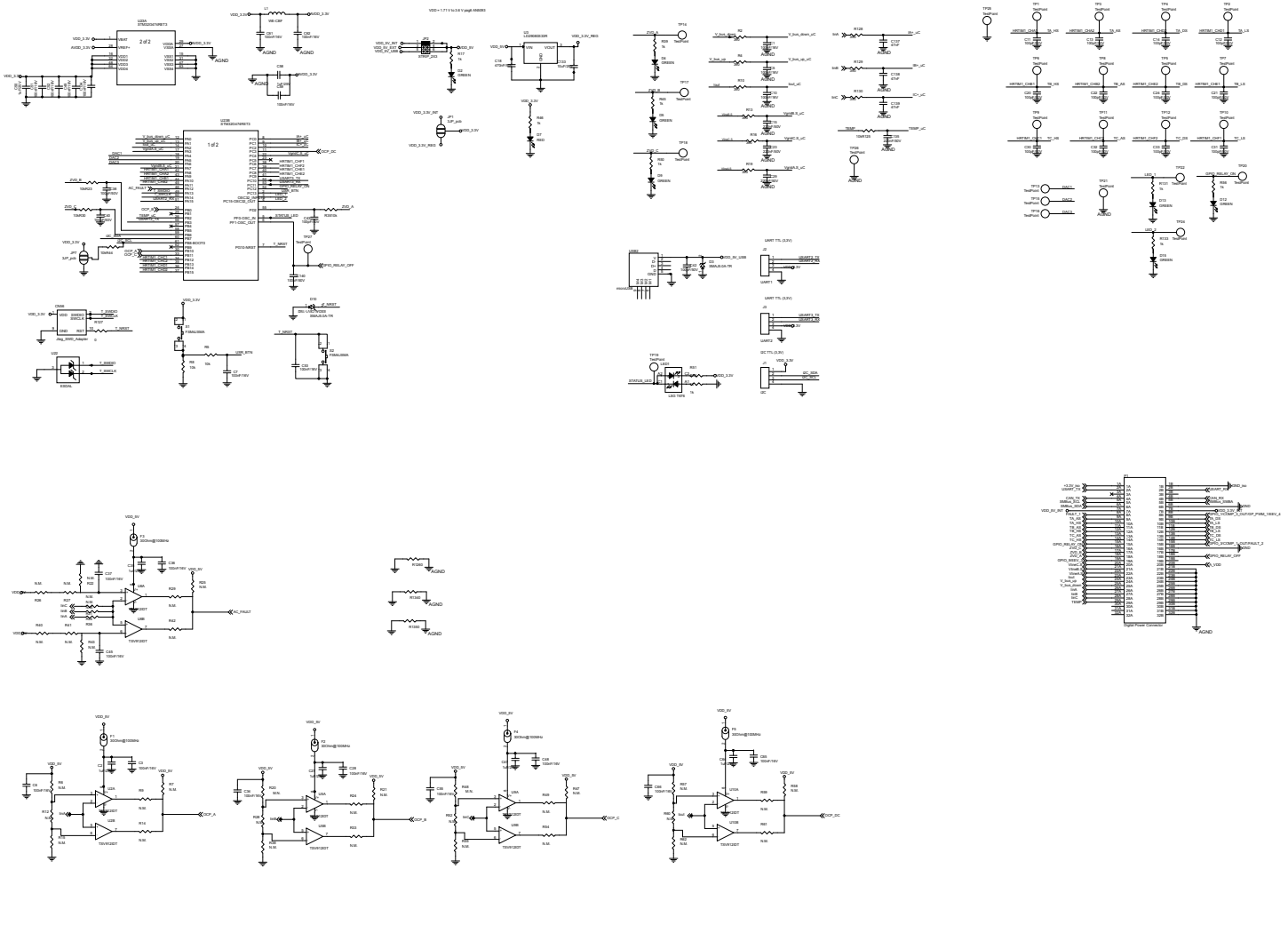


Figure 11. STDES-30KWVRECT control board circuit schematic



Revision history

Table 2. **Document revision history**

Date	Revision	Changes
13-Apr-2022	1	Initial release.