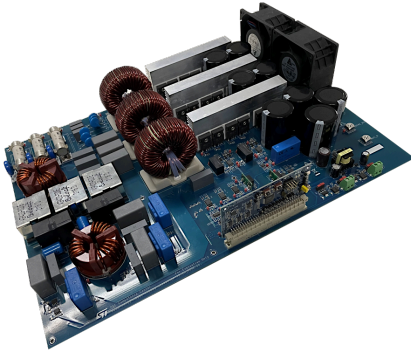


30 kW Vienna PFC rectifier reference design with digital control



Fully assembled board developed for performance evaluation only, [not available for sale](#)

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.

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

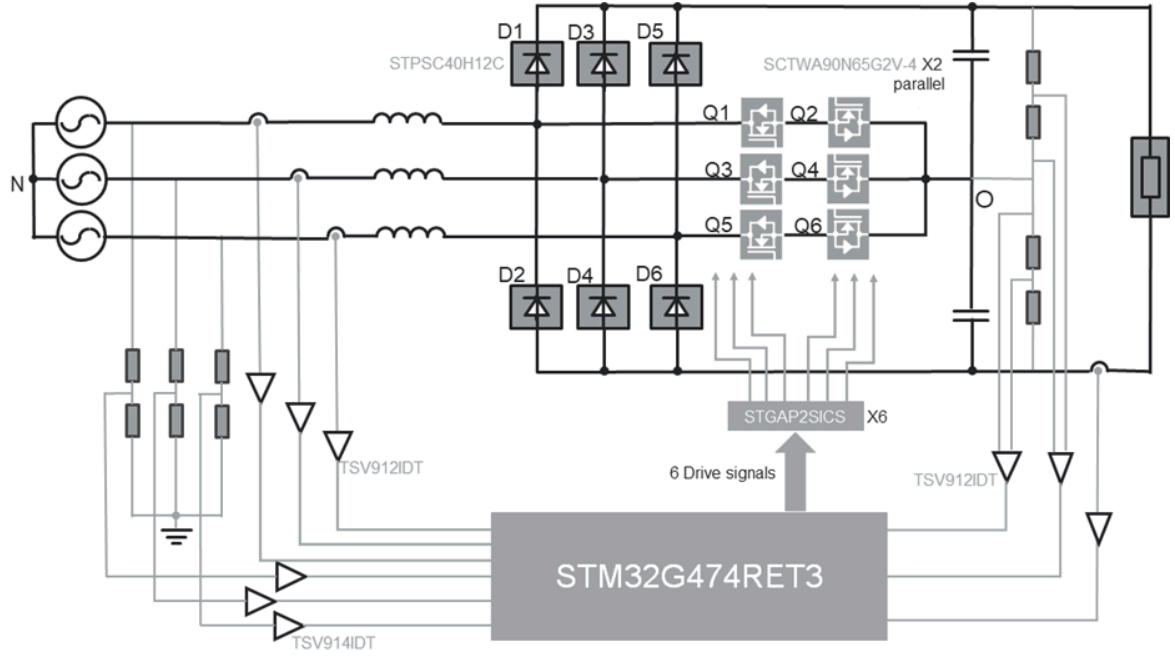
1 Electrical specifications

Table 1. Electrical characteristics

Symbol	Description	Min.	Type	Max.	Units	Comments
$V_{AC(L-L)}$	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	$V_{AC(L-L)} = 350V$
η	Peak efficiency			98.56	%	$V_{AC(L-L)} = 400V, V_{out} = 800V$
				98.7	%	$V_{AC(L-L)} = 450V, V_{out} = 800V$
iTHD	Total harmonic distortion			<5	%	At load >50%
PF	Power factor		0.99			At load >50%
I_{inrush}	Inrush current			30	A	$V_{AC(L-L)} = 450V$

2 Platform overview

Figure 1. System architecture of three phase Vienna PFC



3 Schematic diagrams

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

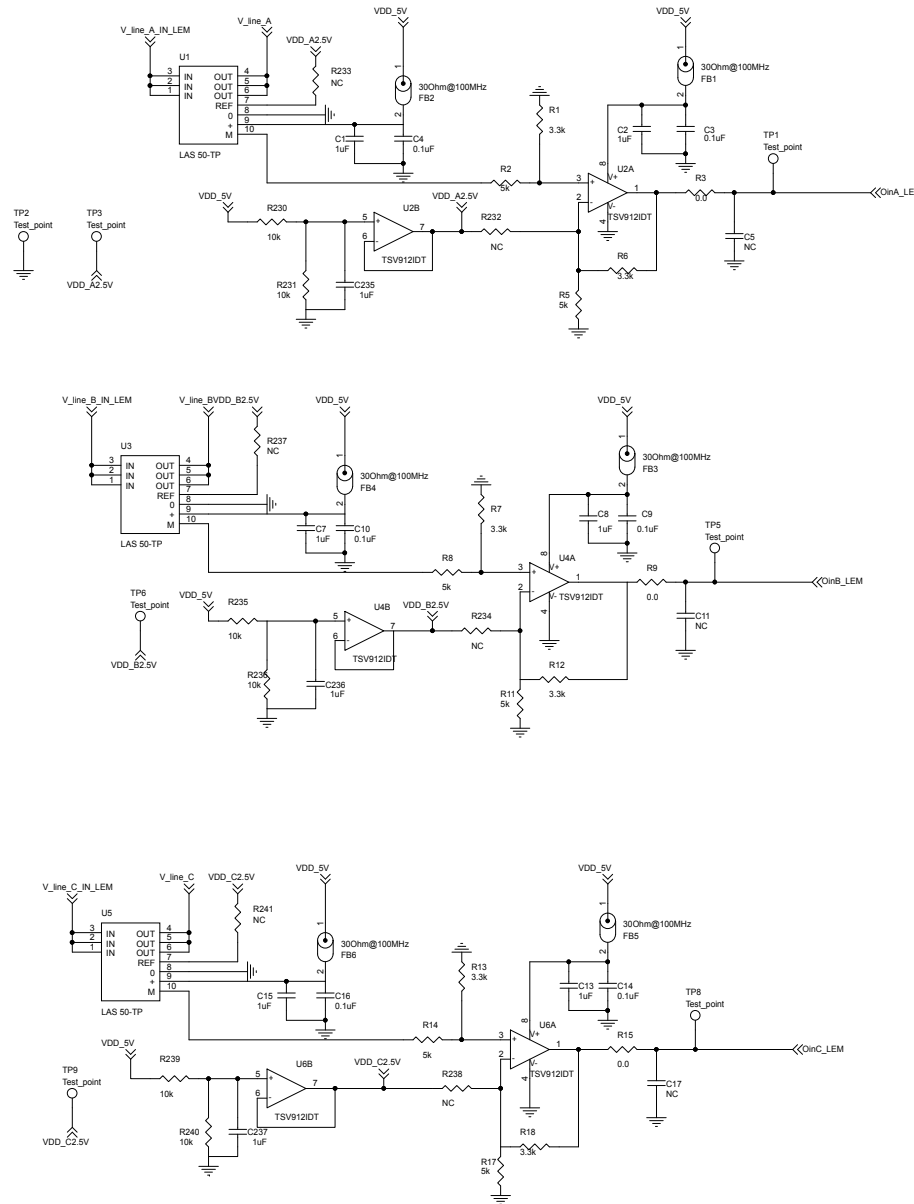


Figure 3. STDES-30KWRECT power board circuit schematic (2 of 9)

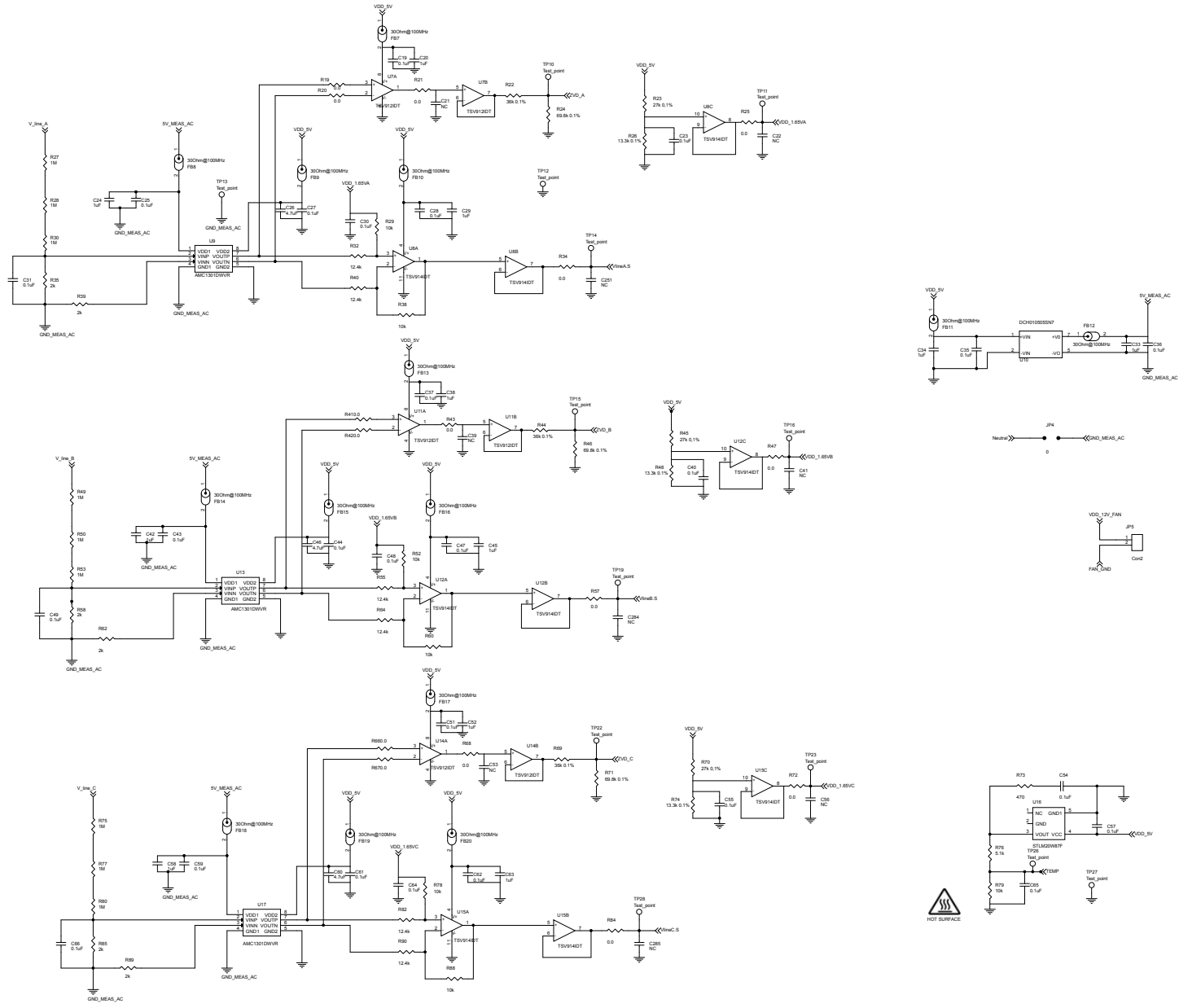


Figure 4. STDES-30KWRECT power board circuit schematic (3 of 9)

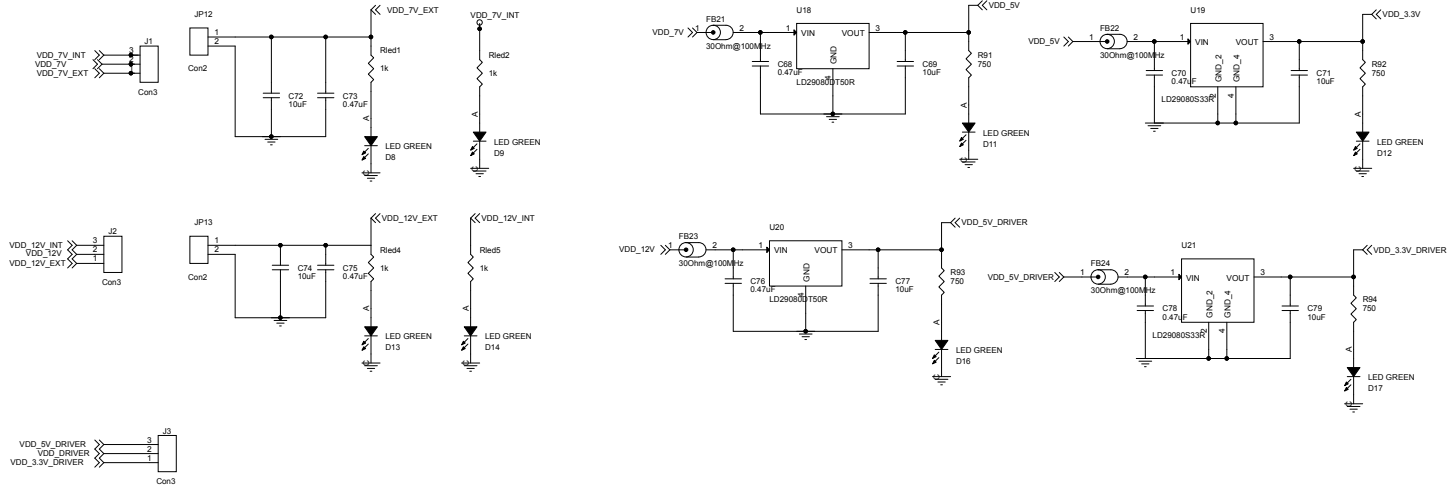


Figure 5. STDES-30KWRECT power board circuit schematic (4 of 9)

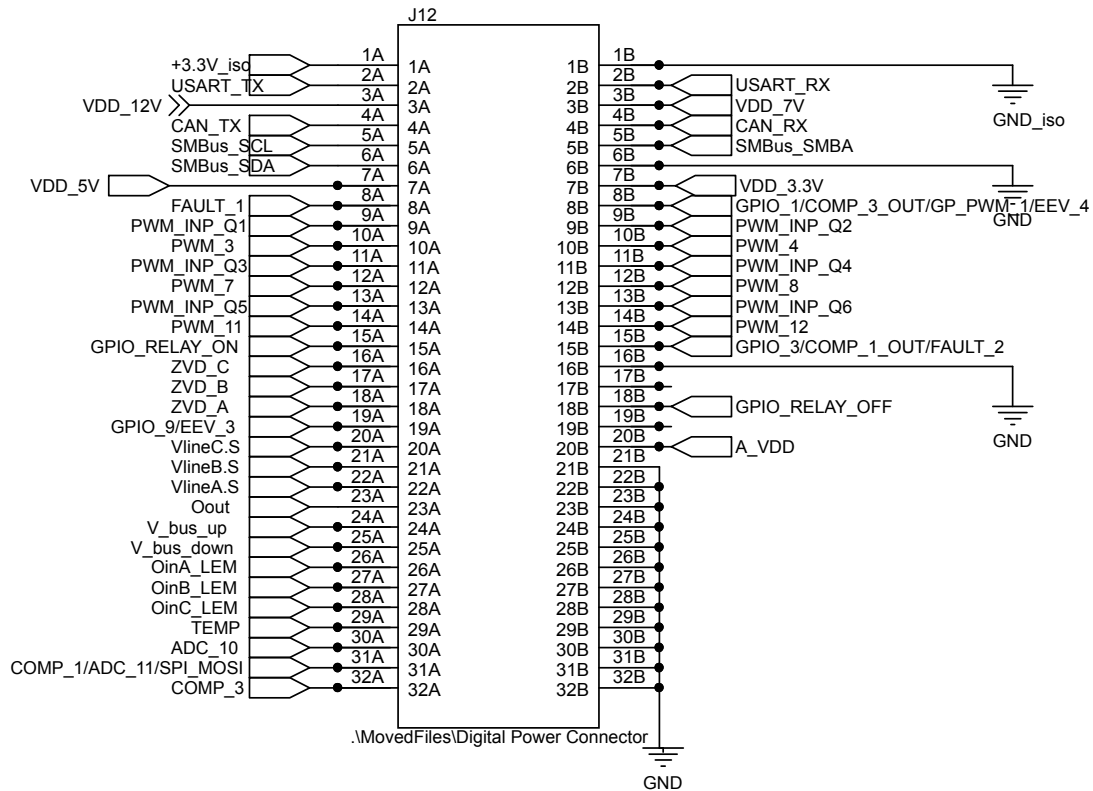


Figure 6. STDES-30KWRECT power board circuit schematic (5 of 9)

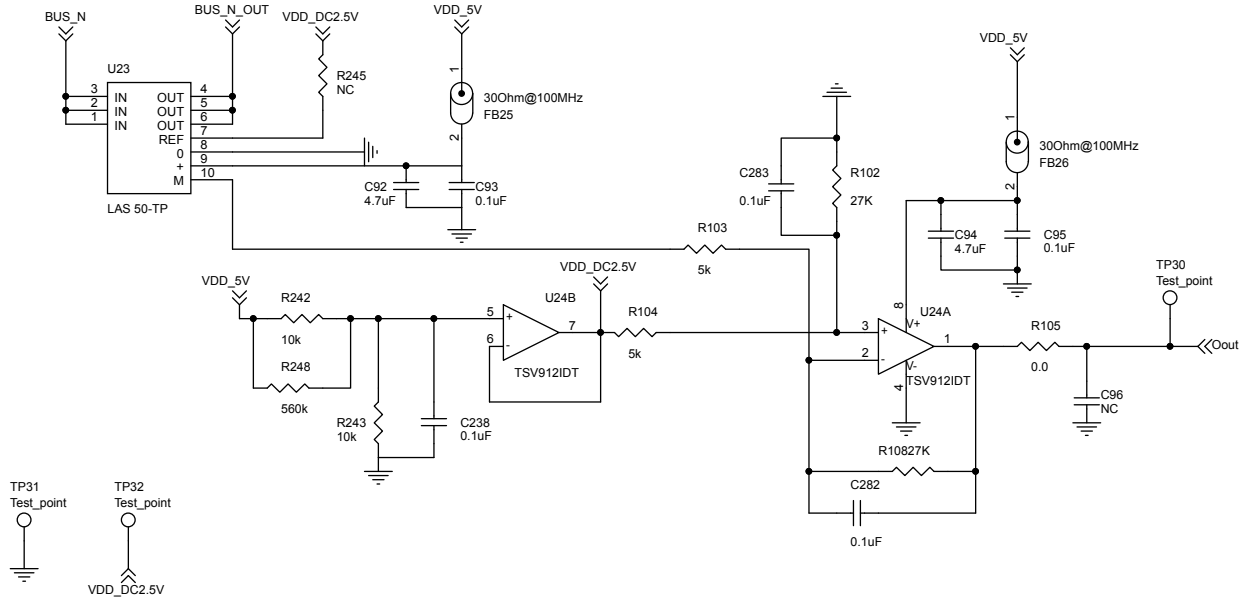


Figure 7. STDES-30KWRECT power board circuit schematic (6 of 9)

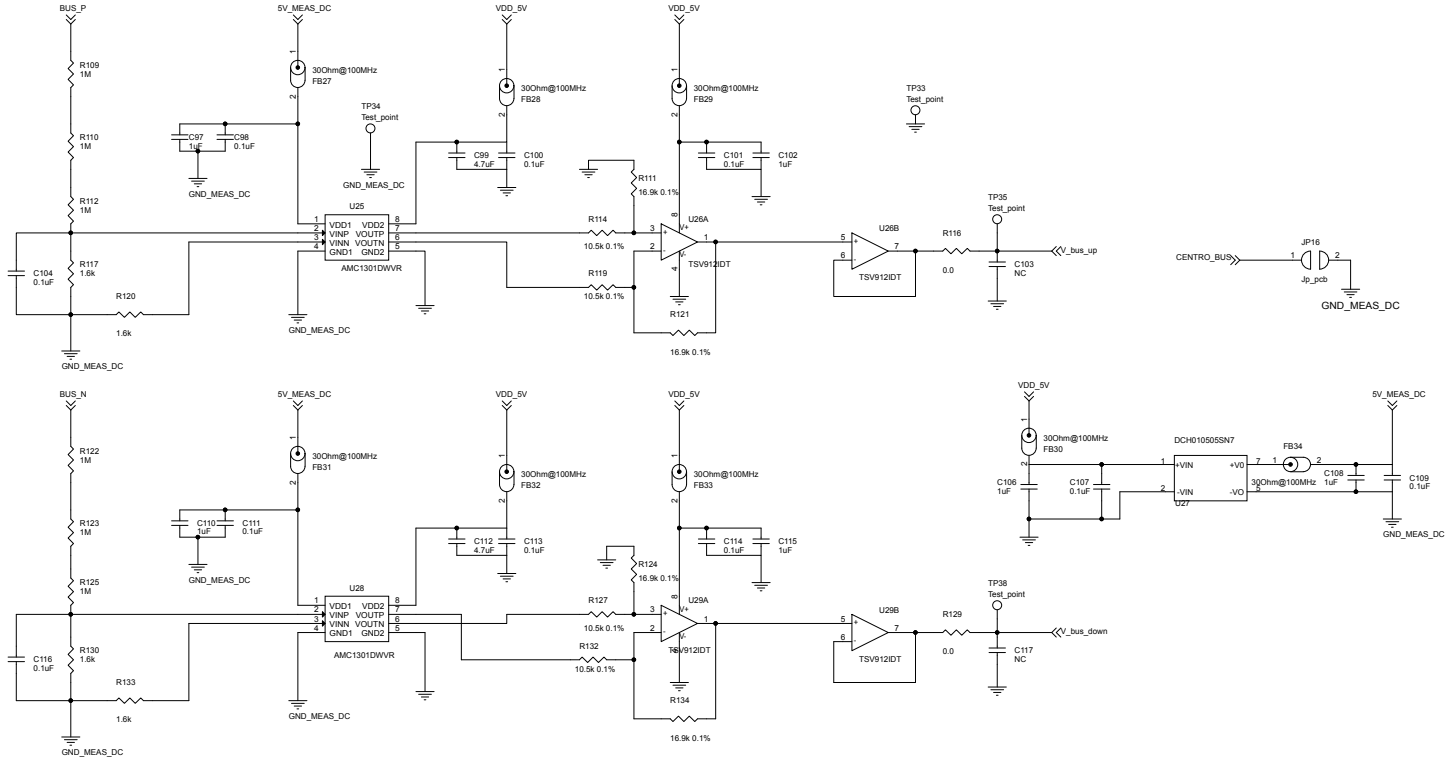


Figure 8. STDES-30KWVRECT power board circuit schematic (7 of 9)

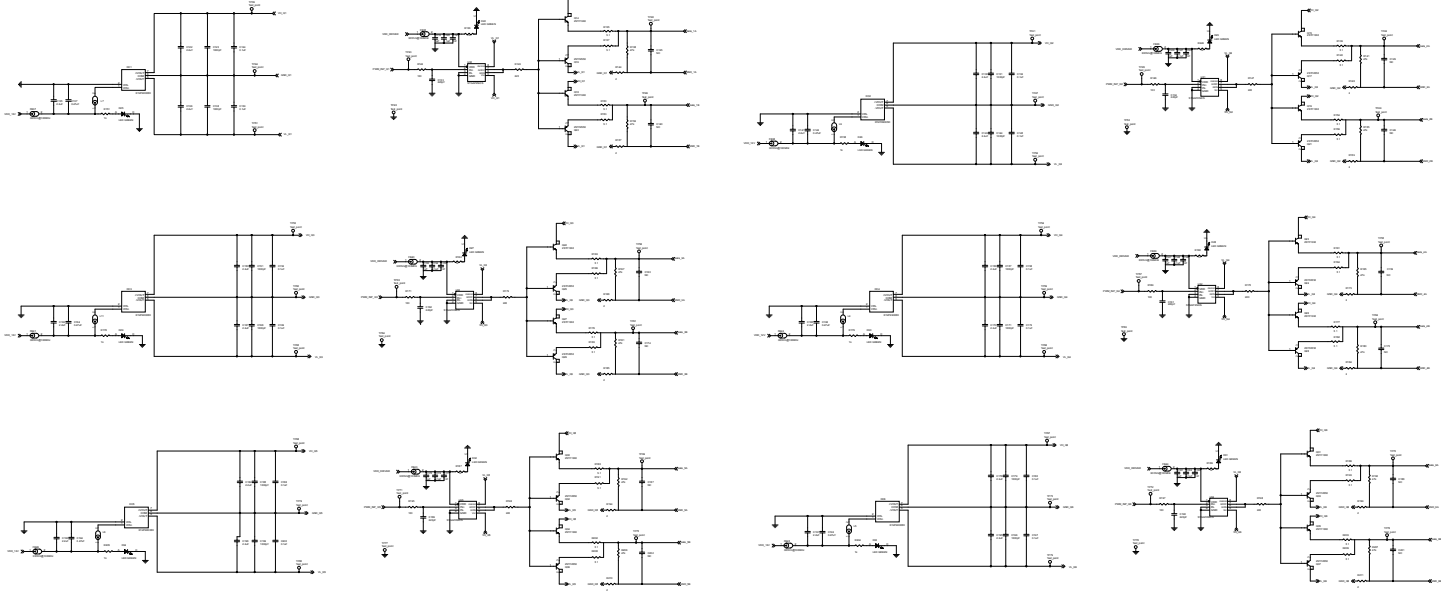


Figure 9. STDES-30KWRECT power board circuit schematic (8 of 9)

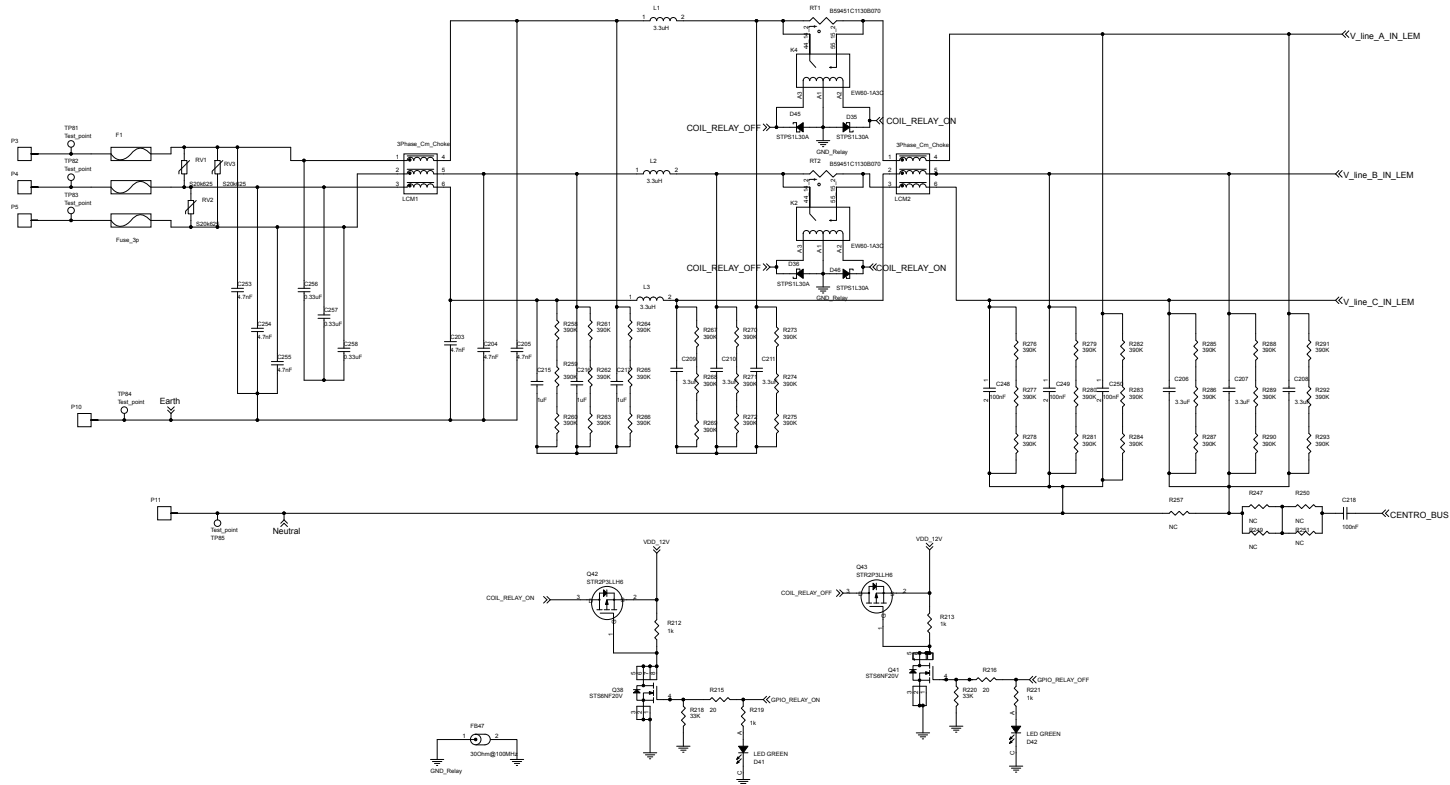


Figure 10. STDES-30KWRECT power board circuit schematic (9 of 9)

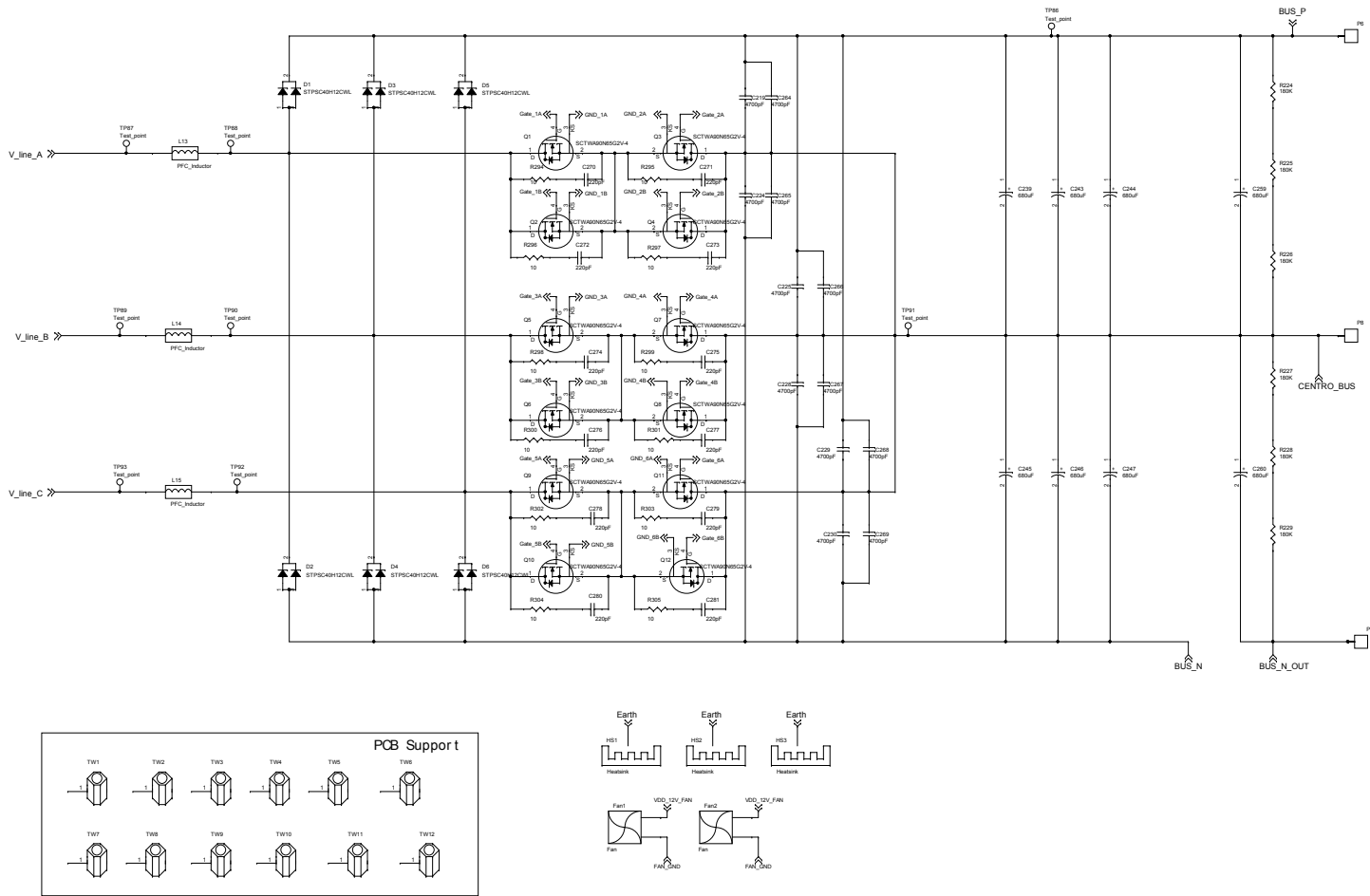
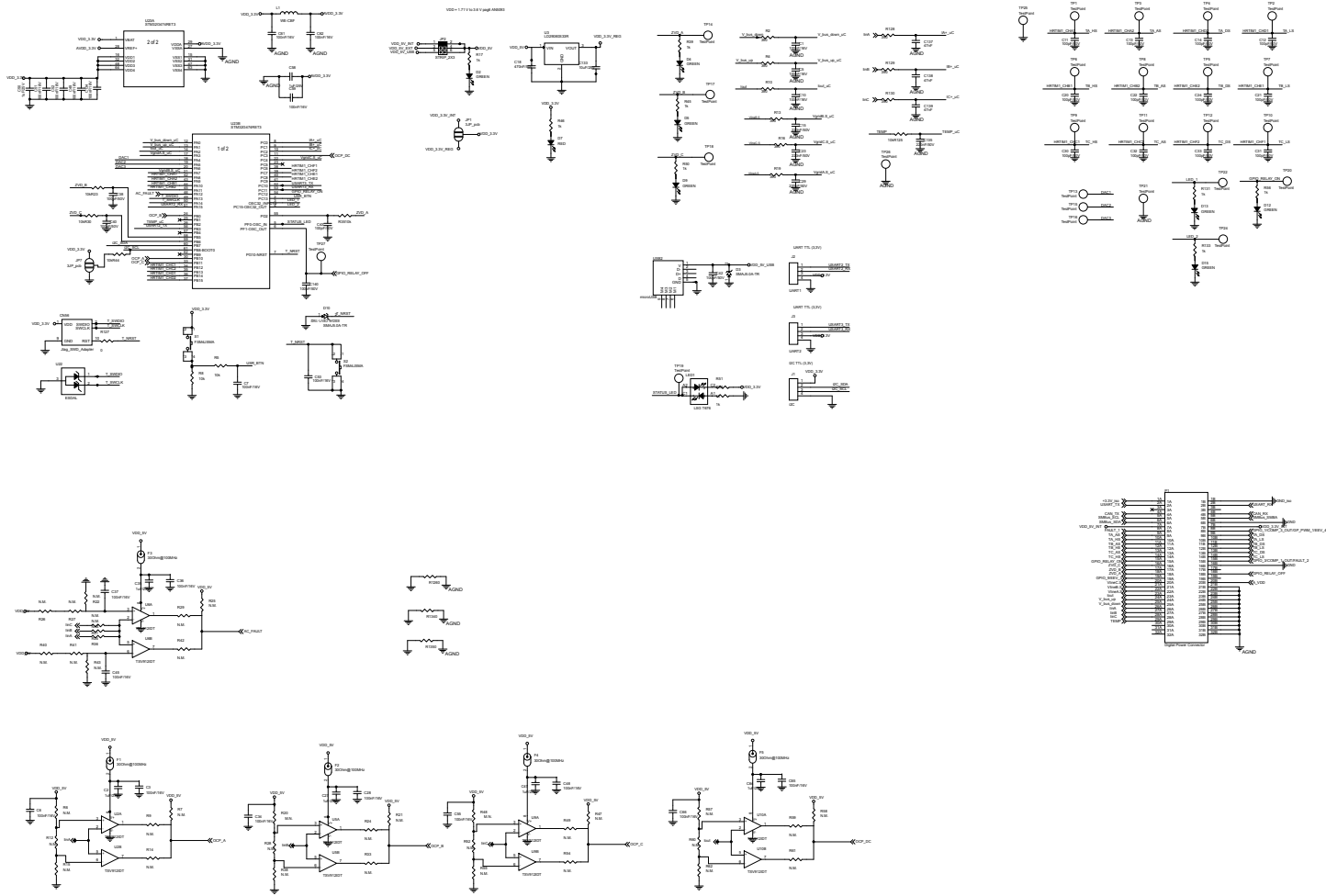


Figure 11. STDES-30KWRECT control board circuit schematic



Revision history

Table 2. Document revision history

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

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