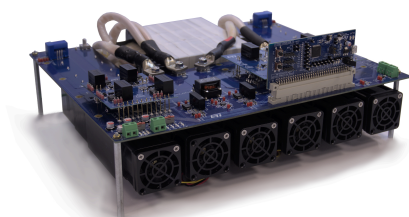


25 kW, dual active bridge bidirectional power converter for EV charging and battery energy storage systems



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

Features

- Dual active bridge DC-DC power converter
 - Nominal DC input voltage: 800 V
 - Nominal DC output voltage: 400 V
 - Nominal power: 25 kW
 - Switching frequency: 100 kHz
 - Peak efficiency: 98.4%
- Key features
 - ACEPACK 2 SiC power modules to optimize integration and thermal dissipation
 - Bidirectional digital power control
 - Extended soft switching mode, enabled by sophisticated modulation techniques
 - Passive elements weight e size reduction thanks to high frequency SiC MOSFETs operation
 - [STGAP2SICS](#) galvanic isolated gate driver for SiC
 - [STM32G474RE](#) MCU for full digital solution
 - Inrush current control and soft startup
- Reference design modular architecture
 - Main power board
 - Driving boards (1xHV side 2xLV side)
 - Control board based on [STM32G474RE](#)

Description

The [STDES-DABBIDIR](#) provides a complete solution for a bidirectional DC-DC power converter.

A dual active bridge topology based on [ACEPACK 2](#) SiC power modules is proposed.

The [STM32G474RE](#) MCU, enabling digital-intensive power control and optimized for mixed-signal applications, is used.

Thanks to the latest generation SiC power module and high-frequency operation (100 kHz), high performance and design optimization are reached.

Soft switching DAB behavior is managed by adaptive modulation techniques, according to the load/voltage variation.

Bidirectional mode operation supports V2G and V2L implementations as well as UPS and battery energy storage applications.

Product summary	
25 kW, dual active bridge bidirectional power converter for EV charging and battery ESS	STDES-DABBIDIR
Firmware for STDES-DABBIDIR	STSW-DABBIDIR
ACEPACK 2 power module, four pack topology, 1200 V, 13 mOhm	A2F12M12W2-F1
Mainstream Arm Cortex-M4	STM32G474RET3
Galvanically isolated 4 A single gate driver for SiC MOSFETs	STGAP2SICSCTR
Applications	EV Charging/Battery Storage Systems for Commercial/Uninterruptible Power Supply (UPS)

1 Block diagram

The DAB DC-DC stage consists of two full-bridges and a 25 kW single magnetic component, including the isolation transformer and the inductance. The hardware modular structure includes the following parts:

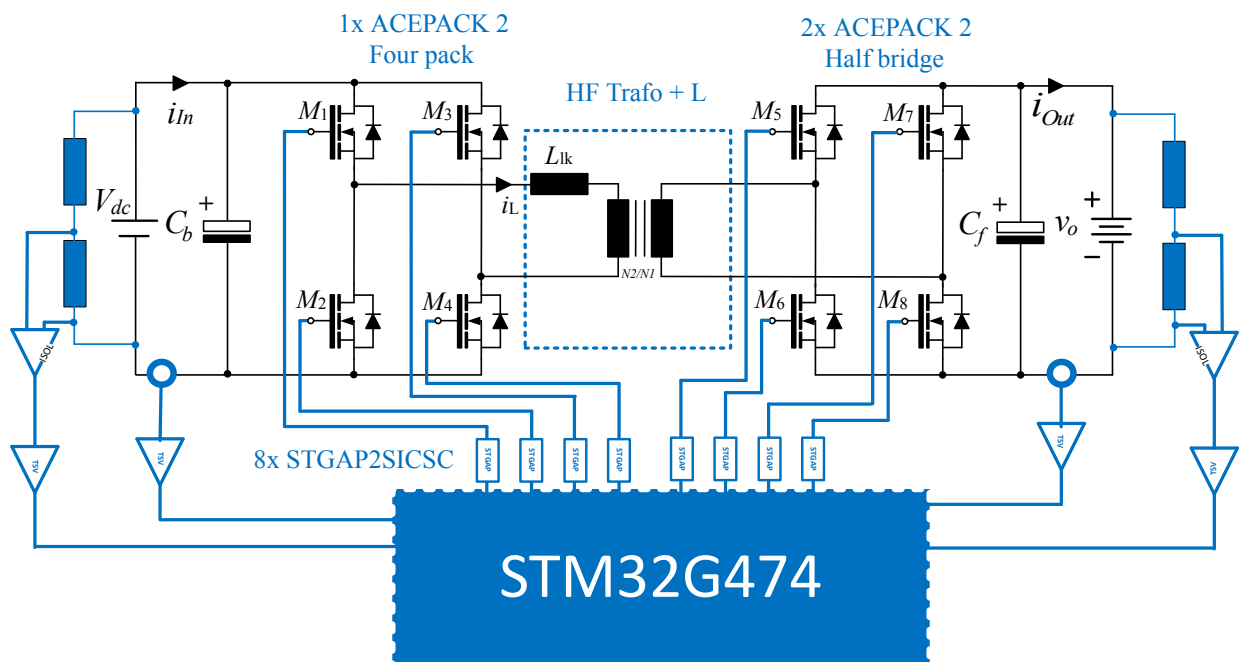
- A main power board with **ACEPACK 2** SiC power modules, an **A2F12M12W2-F1** full bridge for the primary HV side and two half bridges for the secondary LV side. In addition to the power modules, a bulk capacitor, sensing sections, and an auxiliary power supply are also present.
- A driver board for the **ACEPACK 2** full bridge SiC power modules based on the **STGAP2SICS** galvanically isolated 4 A single gate driver for SiC MOSFETs.
- Two driver boards for the **ACEPACK 2** half bridges SiC power modules based on the **STGAP2SICS** galvanically isolated 4 A single gate driver for SiC MOSFETs.
- A control board based on the **STM32G474RET3** microcontroller with connectors for communication and programming, test-points, and status indicators for testing and monitoring.

A dual active bridge, voltage, and current control are proposed for bidirectional power flow according to the topology characteristics. Soft startup procedure and protections are also managed by the MCU.

To extend the soft switching mode at a wide voltage/load range, enhanced modulation techniques are proposed, exploiting the high resolution timer peripheral of the **STM32G474RET3**. Proper modulation technique selection is handled by the MCU according to the power converter operating conditions.

Note: For the half bridge **ACEPACK 2** power module, contact ST.

Figure 1. STDES-DABBIDIR block diagram



2

Schematic diagrams

Figure 2. STDES-DABBIDIR - main board circuit schematic (1 of 6)

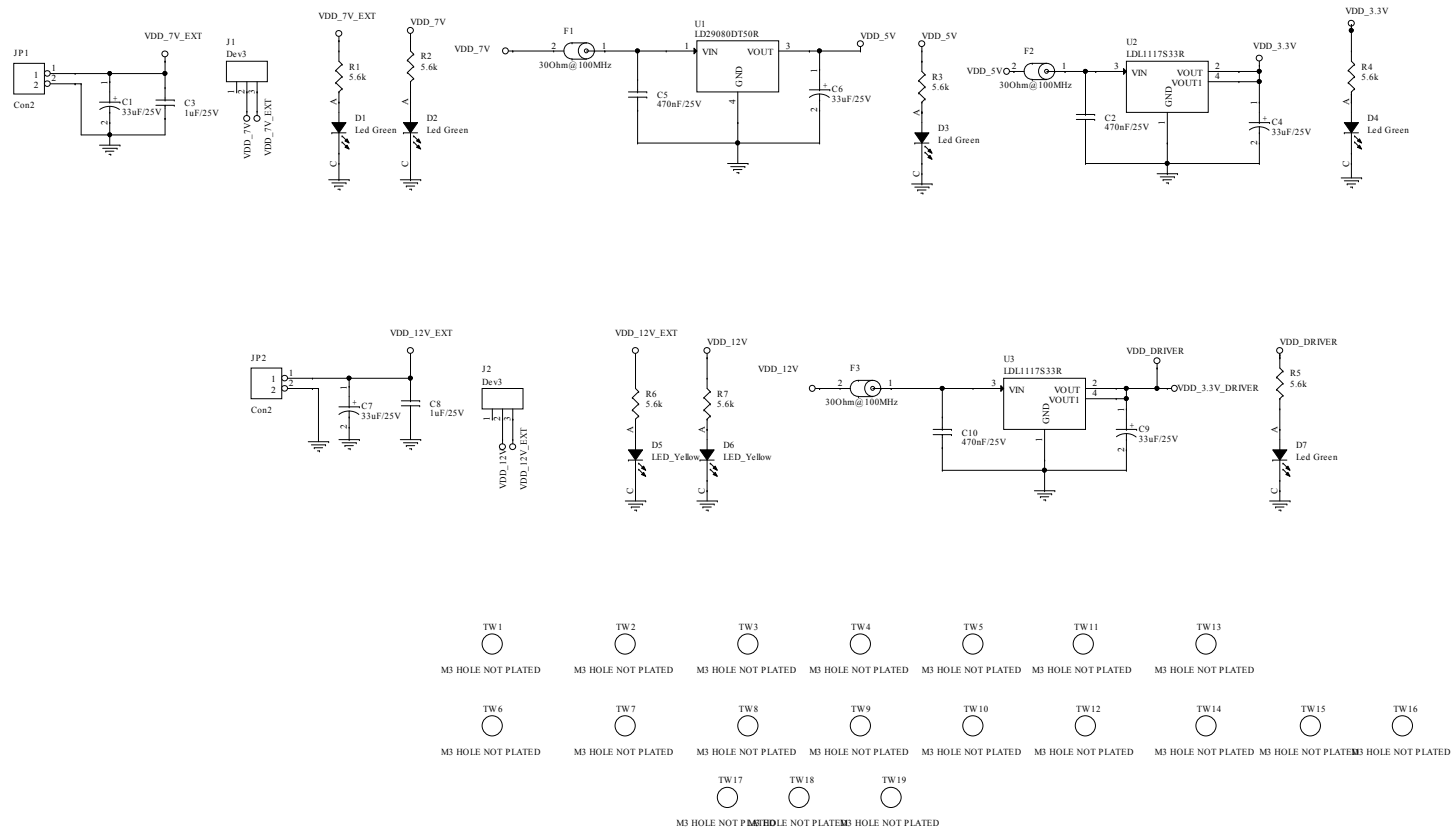
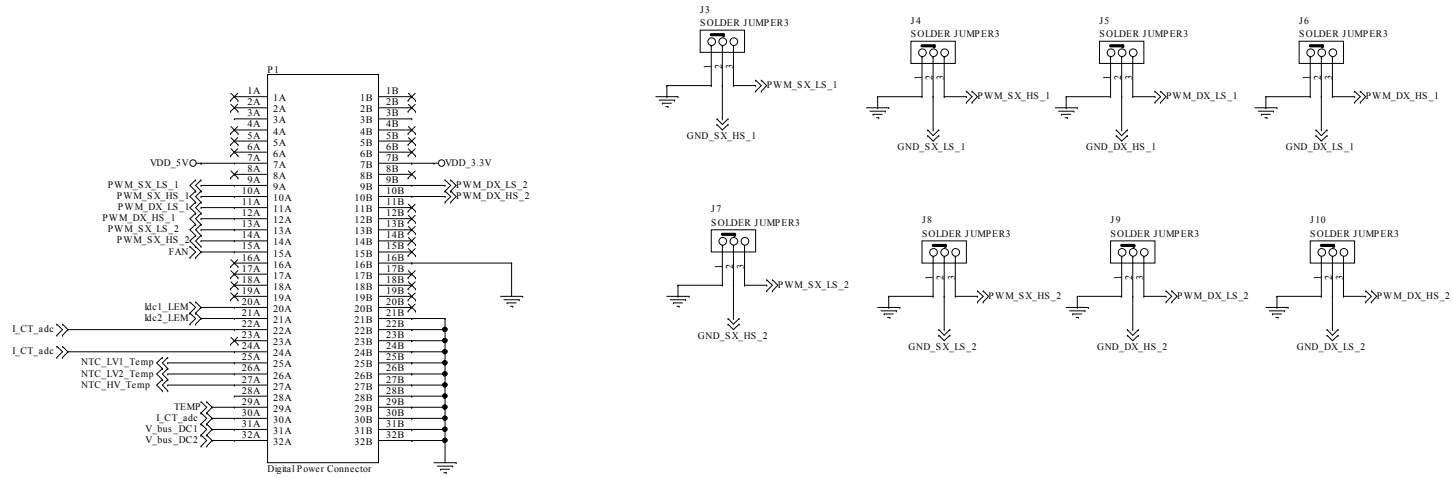


Figure 3. STDES-DABBIDIR - main board circuit schematic (2 of 6)



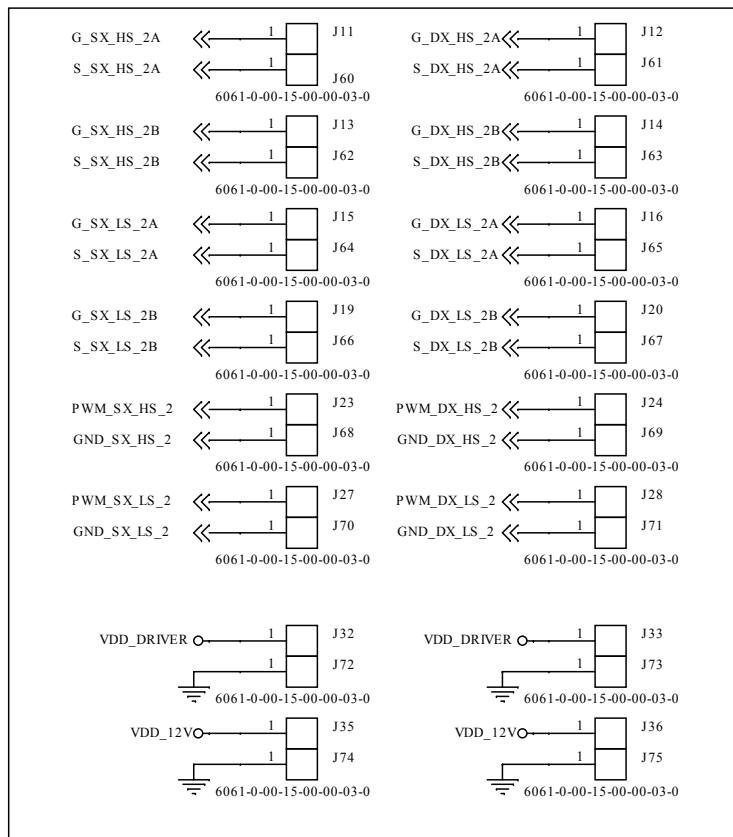
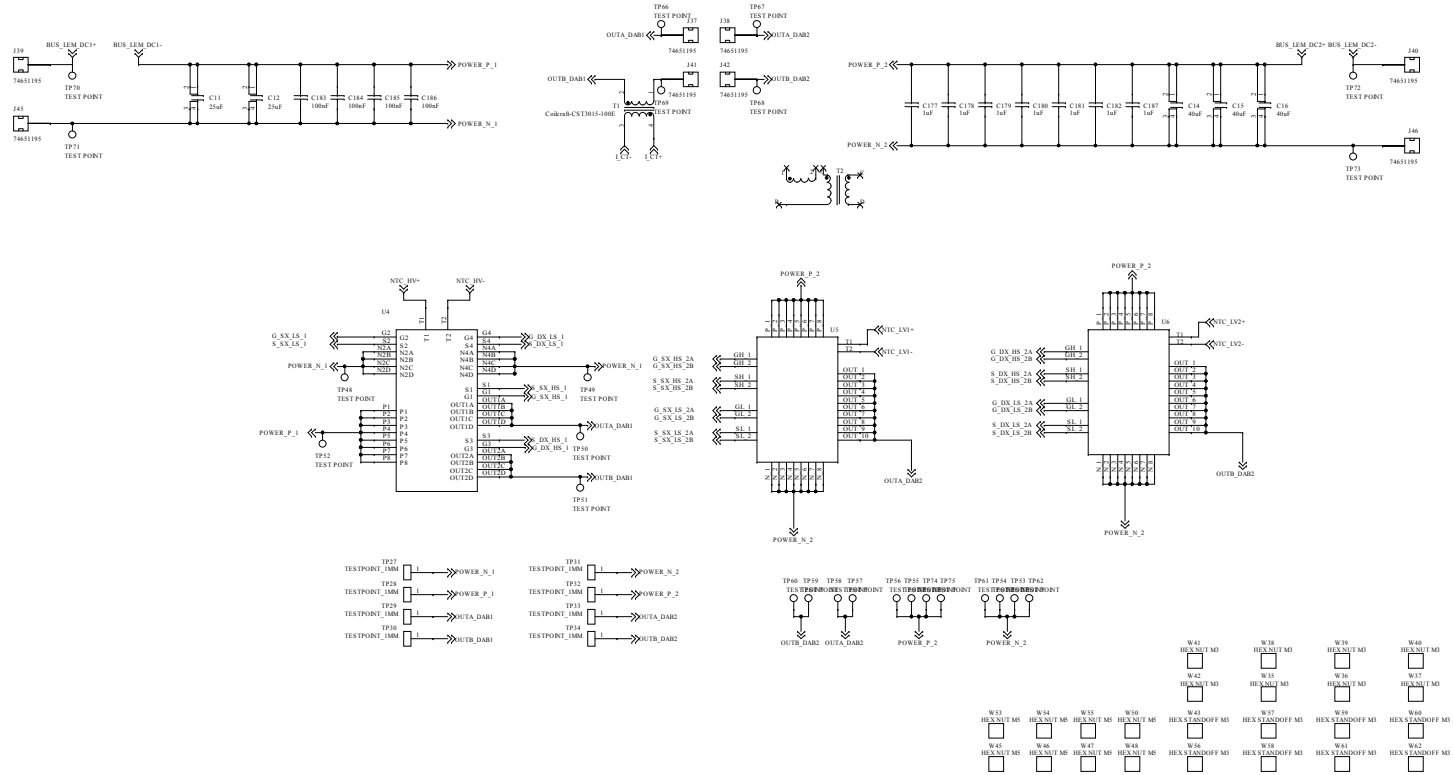


Figure 5. STDES-DABBIDIR - main board circuit schematic (4 of 6)



STDES-DABDIR

Schematic diagrams

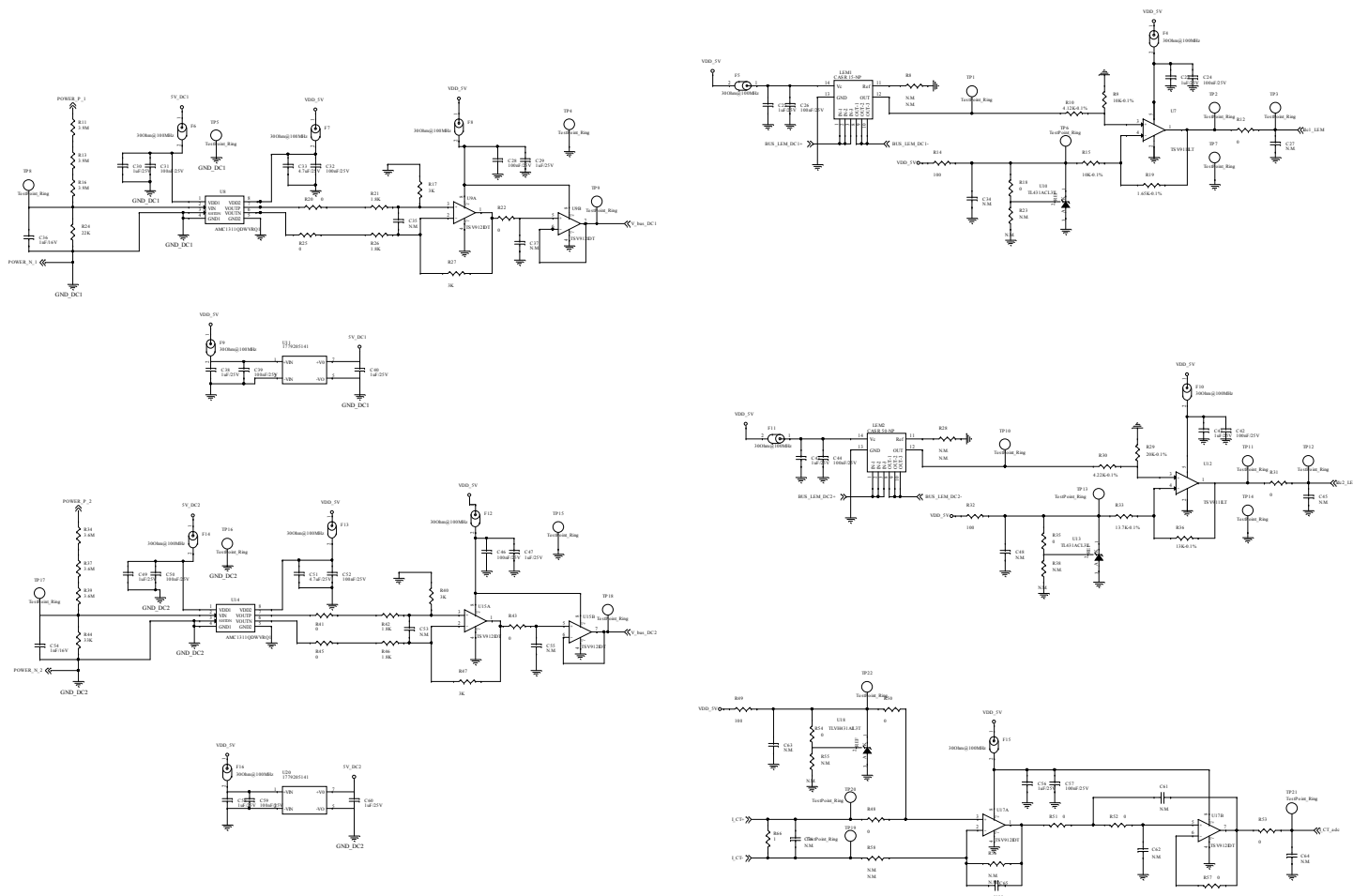


Figure 7. STDES-DABBIDIR - main board circuit schematic (6 of 6)

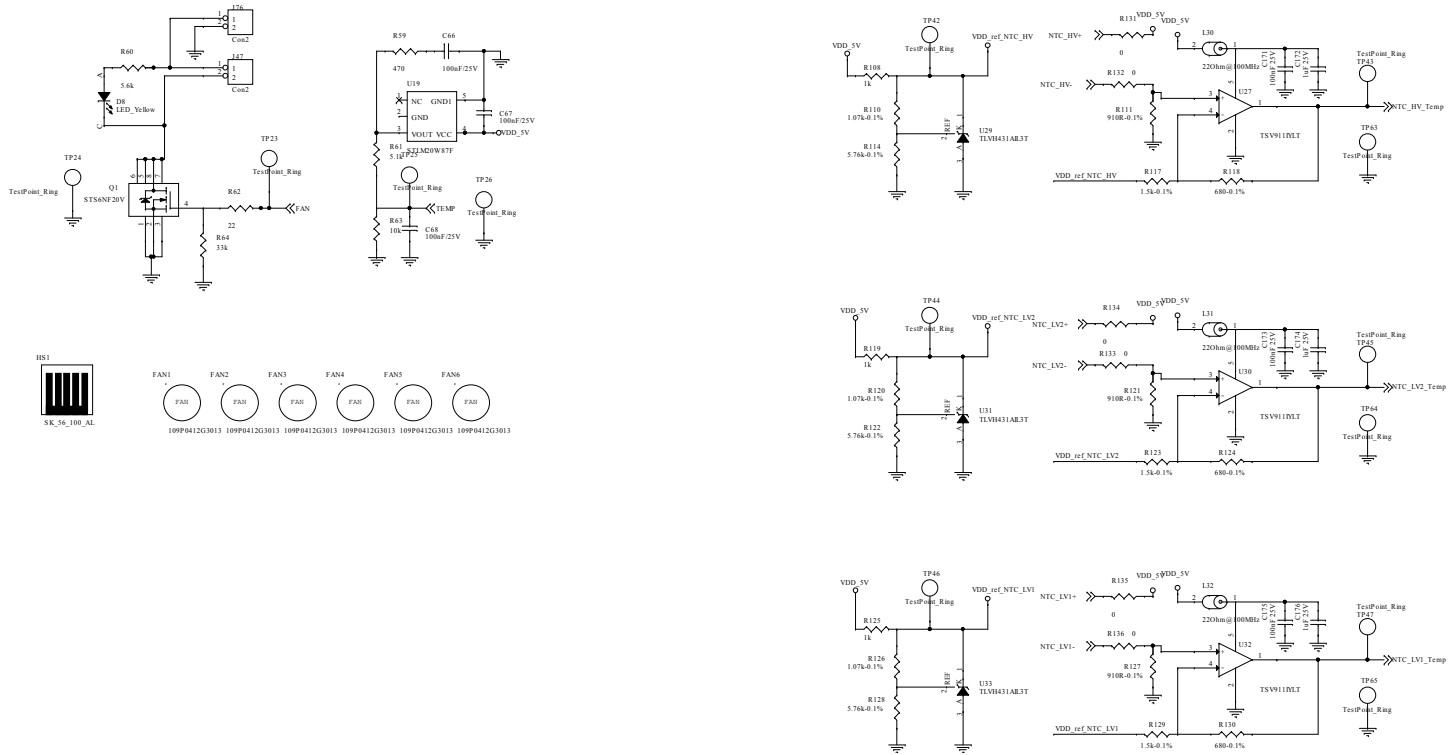


Figure 8. STDES-DABBIDIR - driver board for full bridge circuit schematic

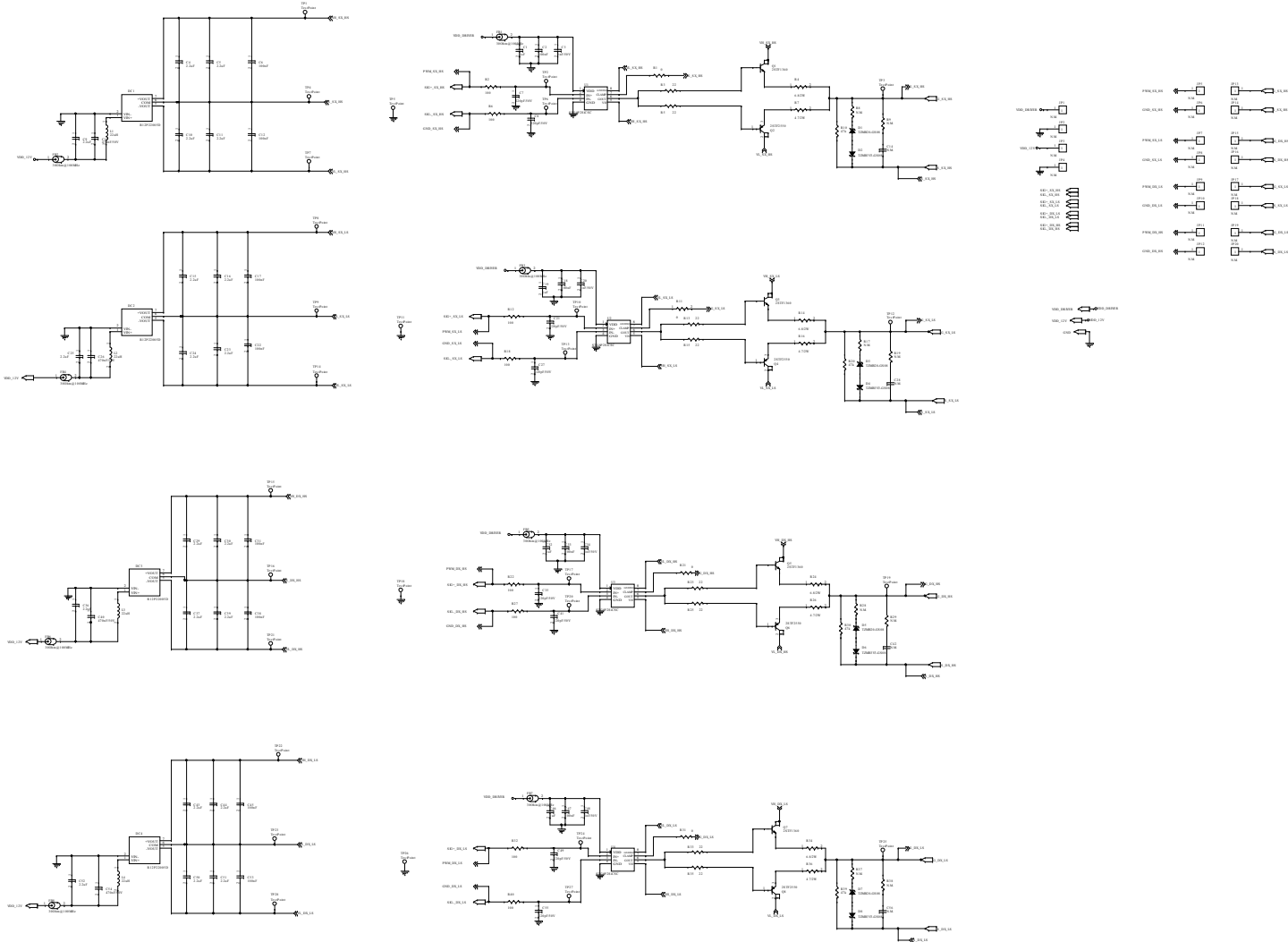


Figure 10. STDES-DABBIDIR - driver board for half bridge circuit schematic (1 of 1)

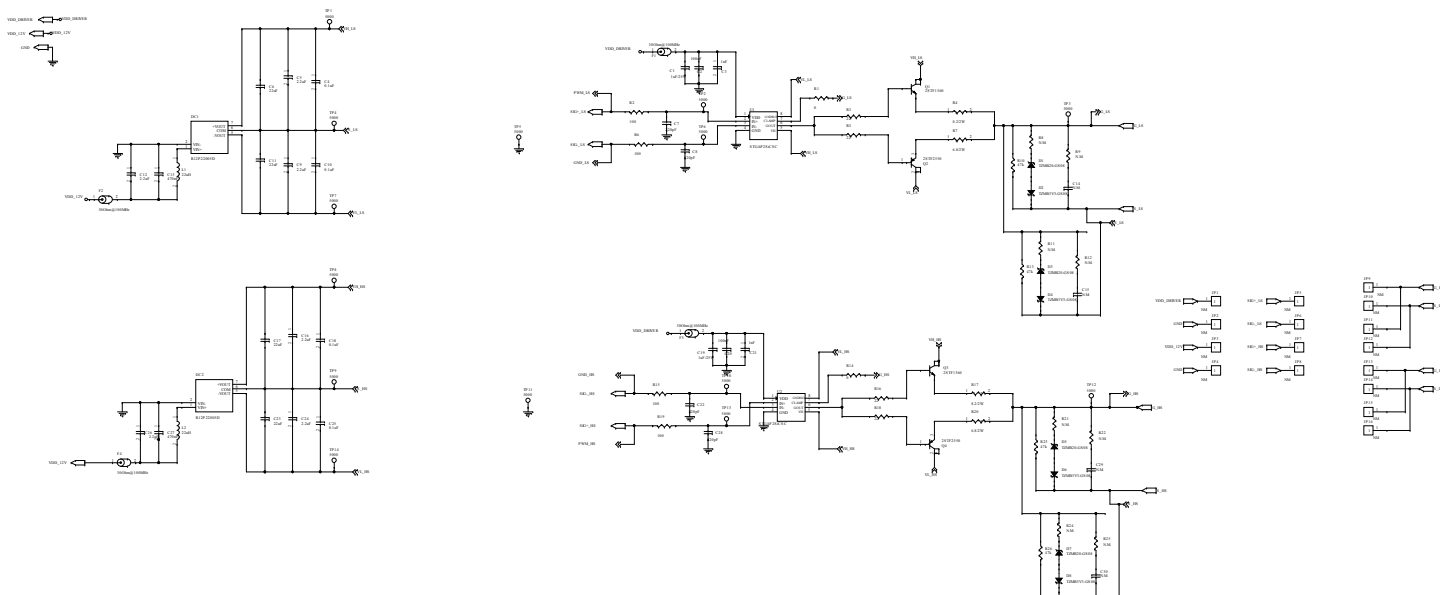
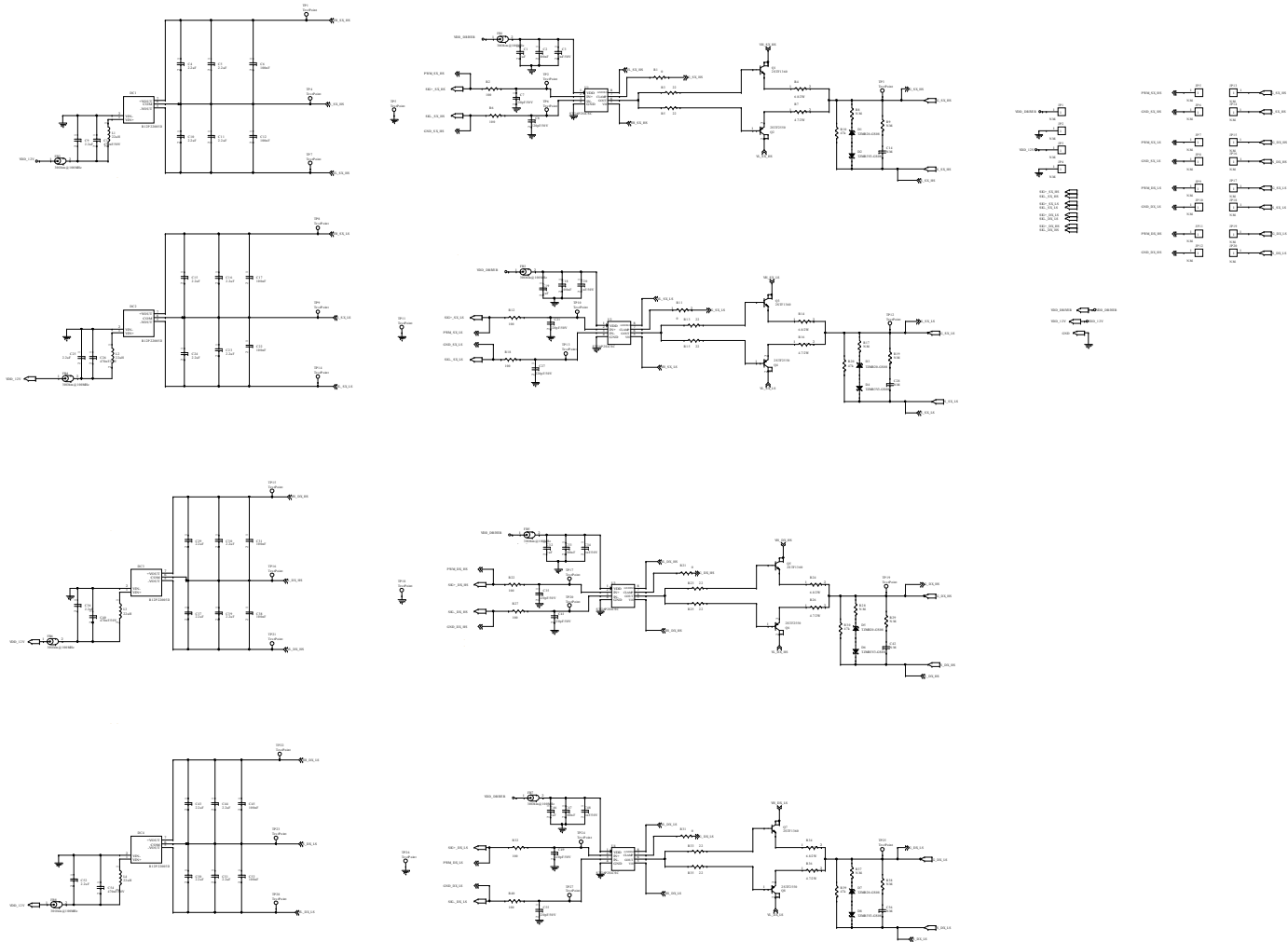


Figure 11. STDES-DABBIDIR - control board circuit schematic



Revision history

Table 1. Document revision history

Date	Revision	Changes
16-Dec-2022	1	Initial release.
05-May-2023	2	Updated Features and Description.
28-Nov-2023	3	Updated cover image and Section 2 Schematic diagrams .

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