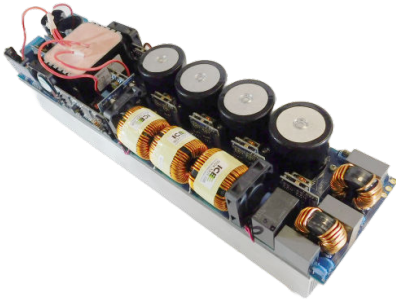


## 7 kW bidirectional AC-DC converter for ESS and industrial charger, full SiC-based



The picture shown is for illustration purpose only.  
Actual product may vary depending on buyer's selection and availability.

### Features

- Open-frame power density: 4 kW/l (66 W/inch<sup>3</sup>)
- Cooling: natural air convection

#### Charger Mode

- Input voltage range:  $V_{in} = 90 - 265 \text{ Vac}$
- Line frequency range:  $f = 47 - 63 \text{ Hz}$
- Max input current: 32 Arms at 230 Vac
- Input rated power: 7.2 kW at 230 Vac
- Output voltage range:  $V_o = 550 - 850 \text{ Vdc}$
- THD < 5 % and PF > 0.99 at full load
- Switching frequency of PFC: 65 kHz
- Resonant frequency of CLLC: 200 kHz
- Peak efficiency > 96.5 %

#### Inverter Mode

- Input voltage range:  $V_o = 550 - 850 \text{ Vdc}$
- Output voltage range:  $V_{in} = 90 - 265 \text{ Vac}$
- Input rated power: 3.6 kW
- Resonant frequency of DC/DC: 200 kHz
- Switching frequency of DC/AC: 65 kHz
- Peak efficiency > 95 %

### Description

The **STEVAL-7BIDIRCB** is a solution for a 7 kW bidirectional charger, consisting of two stages:

1) bidirectional three-channel interleaved totem pole PFC working at fixed frequency in continuous conduction mode (CCM). The three-channel interleaved PFC architecture guarantees the highest efficiency in a wide load range.

2) bidirectional resonant full bridge CLLC with synchronous rectification. The CLLC uses frequency modulation to regulate the output.

The two stages are digitally controlled by two STM32G474RET6 microcontrollers that are mounted in a single control card.

The power stage is fully composed by ST's SiC power MOSFETs, driven by STGAP SiC dedicated gate drivers with galvanic isolation. Thanks to a modular system architecture in combination with the HU3PAK package, a power density of 4 kW/l is achieved.

The PFC operates at a switching frequency of 65 kHz and the CLLC operates at variable frequency from 180 kHz to 600 kHz.

Thanks to the excellent switching performance of the SiC GEN3 and its  $R_{ds(on)}$  temperature stability, a peak efficiency of 96.7% is achieved in charger mode.

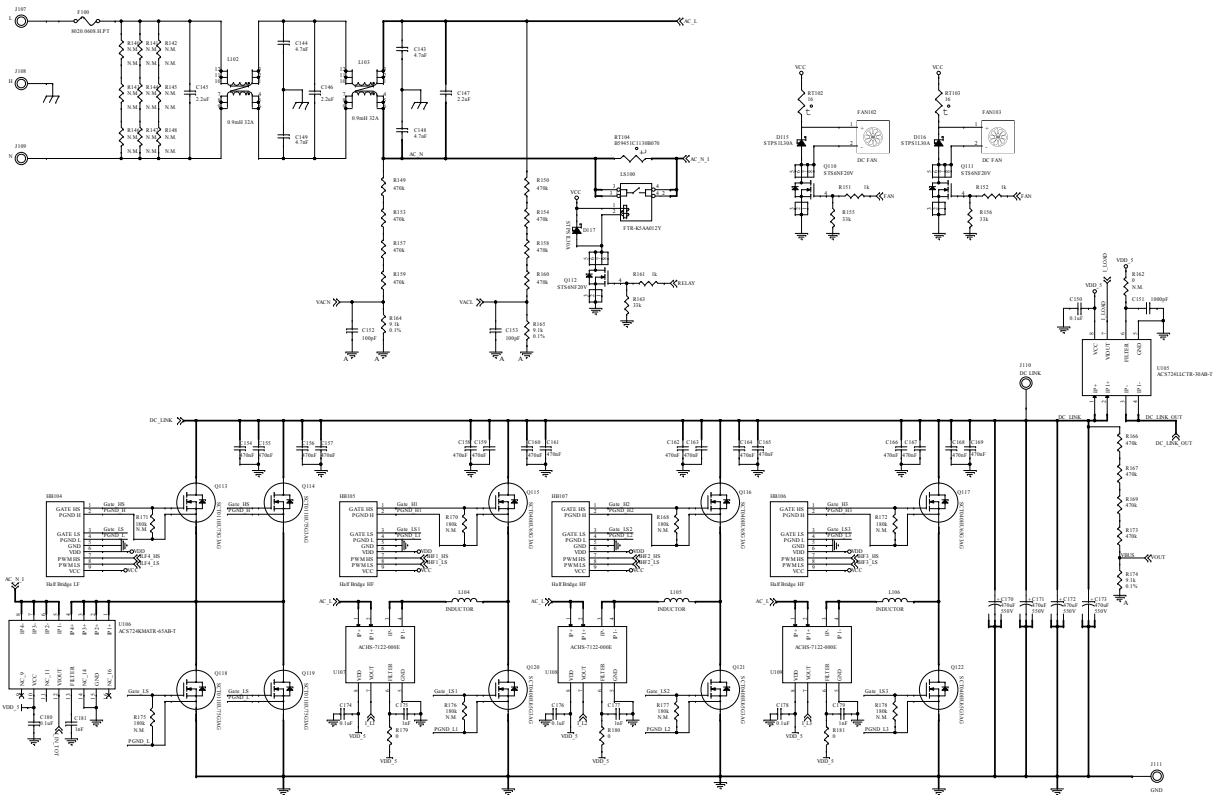
The solution is also suitable to implement a solar integrated ESS, thanks to provision for MPPT stage connection.

Product summary	
7 kW bidirectional AC-DC converter for ESS and industrial charger, full SiC-based	<a href="#">STEVAL-7BIDIRCB</a>
Automotive-grade silicon carbide Power MOSFET 650 V, 40 mOhm typ., 30 A in an HU3PAK package	<a href="#">SCT040HU65G3AG</a>
Mainstream Arm Cortex-M4 MCU 170 MHz with 512 Kbytes of Flash memory	<a href="#">STM32G474RET6</a>
Galvanically isolated 4 A single gate driver for SiC MOSFETs	<a href="#">STGAP2SiCSN</a> <a href="#">STGAP2SiCSAC</a> <a href="#">STGAP2SiCSANC</a>
Automotive 38 V, 5 W synchronous iso-buck converter	<a href="#">A69861TR</a>
Automotive 38 V, 1.5 A synchronous step-down switching regulator with 30 $\mu\text{A}$ quiescent current	<a href="#">A6986F3V3</a> <a href="#">A6986F5V</a>
Applications	<a href="#">Battery Storage Systems for Home On Board Charger (OBC)</a>

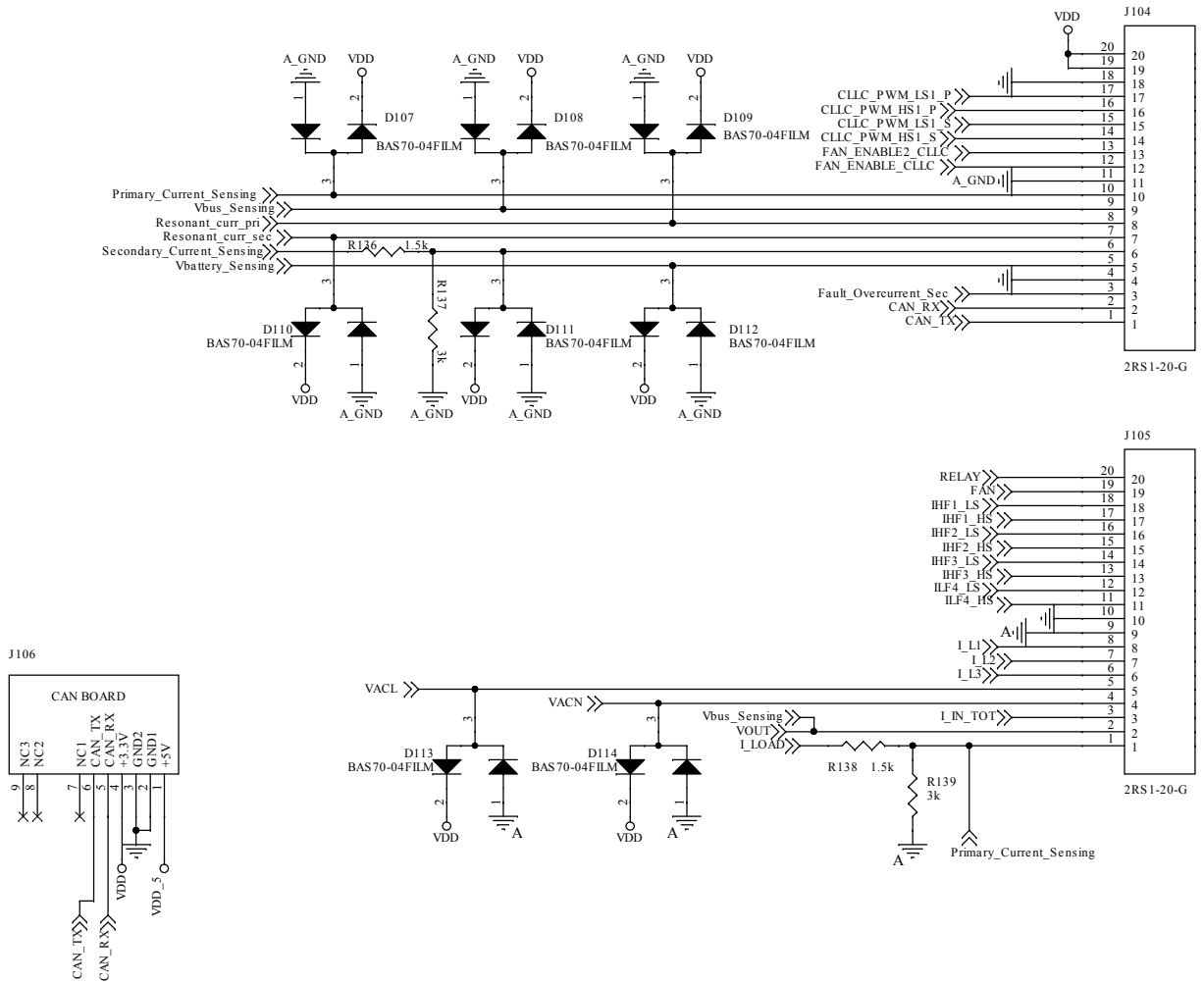
# 1 Schematic diagrams

*Notice: These schematics are for illustration purpose only. Actual product may vary depending on buyer's selection and availability.*

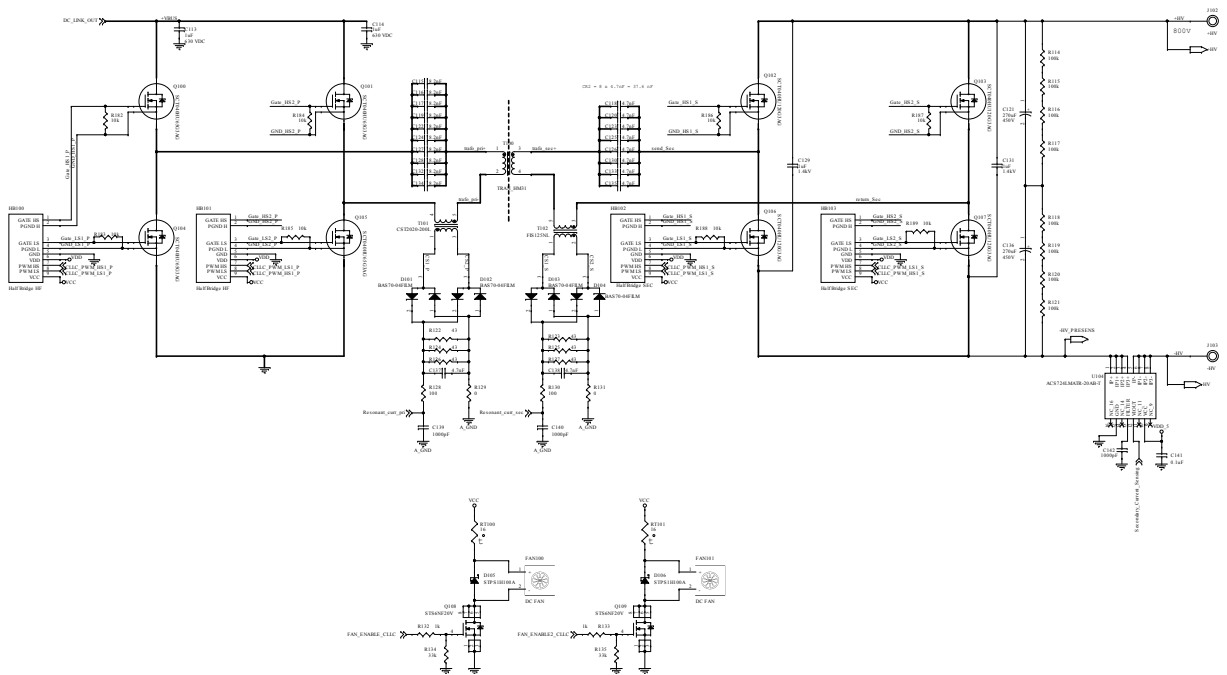
**Figure 1. STEVAL-7BIDIRCB - Power board (1 of 5)**



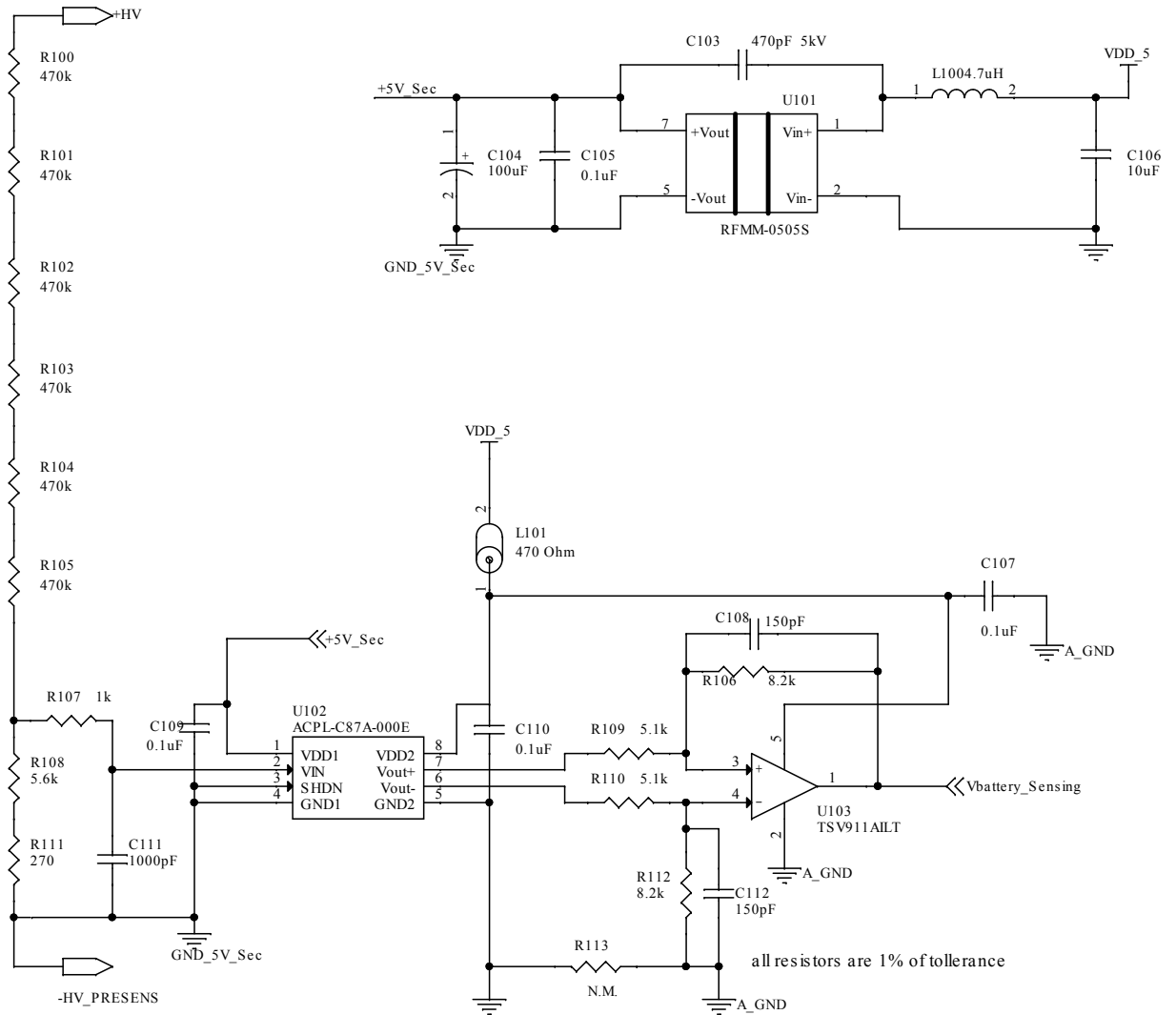
**Figure 2. STEVAL-7BIDIRCB - Power board (2 of 5)**



**Figure 3. STEVAL-7BIDIRCB - Power board (3 of 5)**

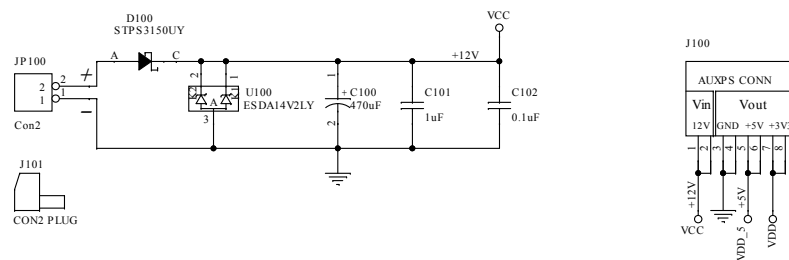


**Figure 4. STEVAL-7BIDIRCB - Power board (4 of 5)**

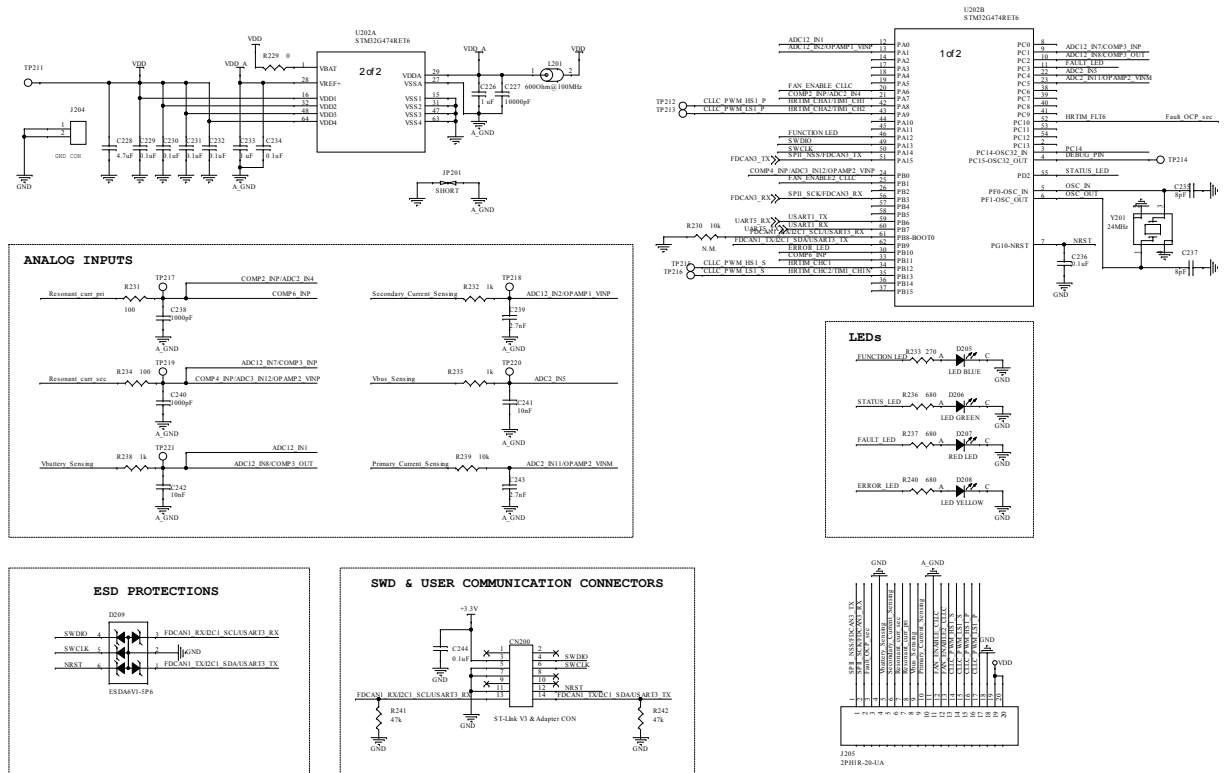


**Figure 5. STEVAL-7BIDIRCB - Power board (5 of 5)**

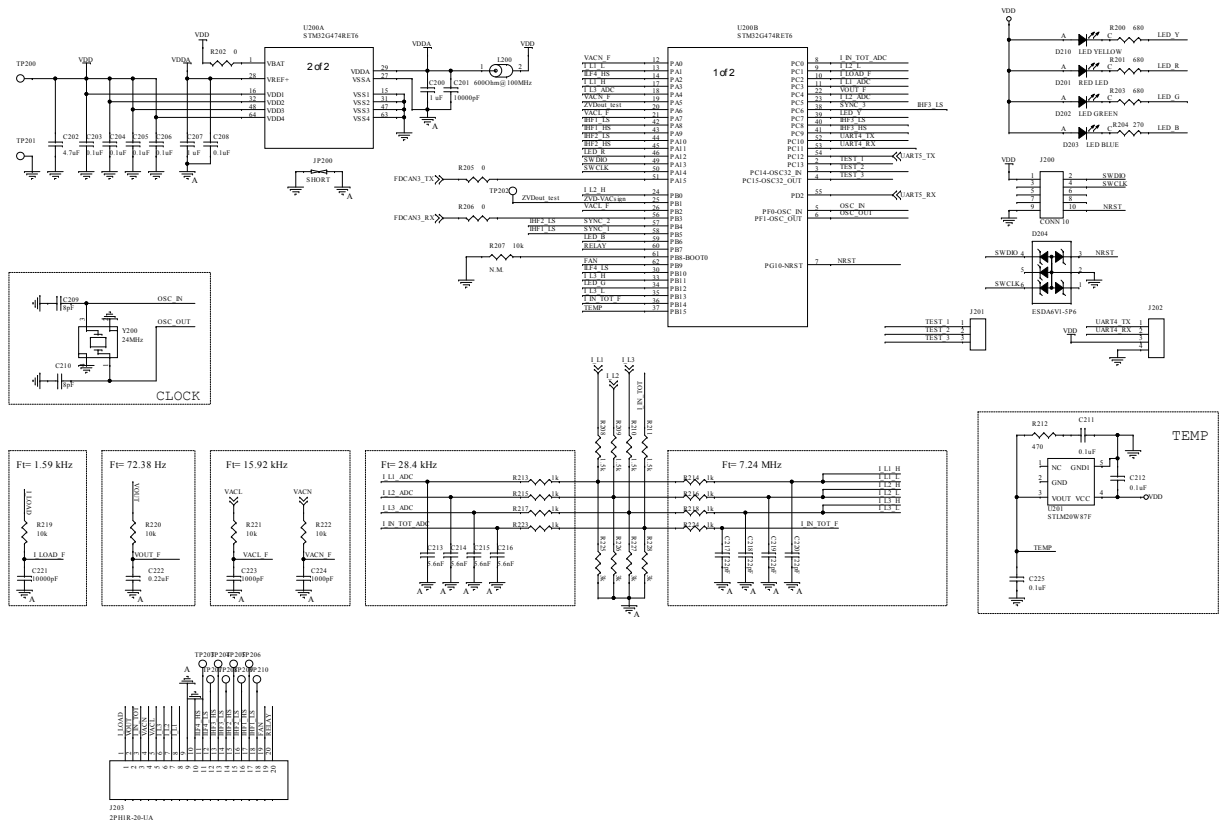
EXTERNAL 12V SUPPLY VOLTAGE



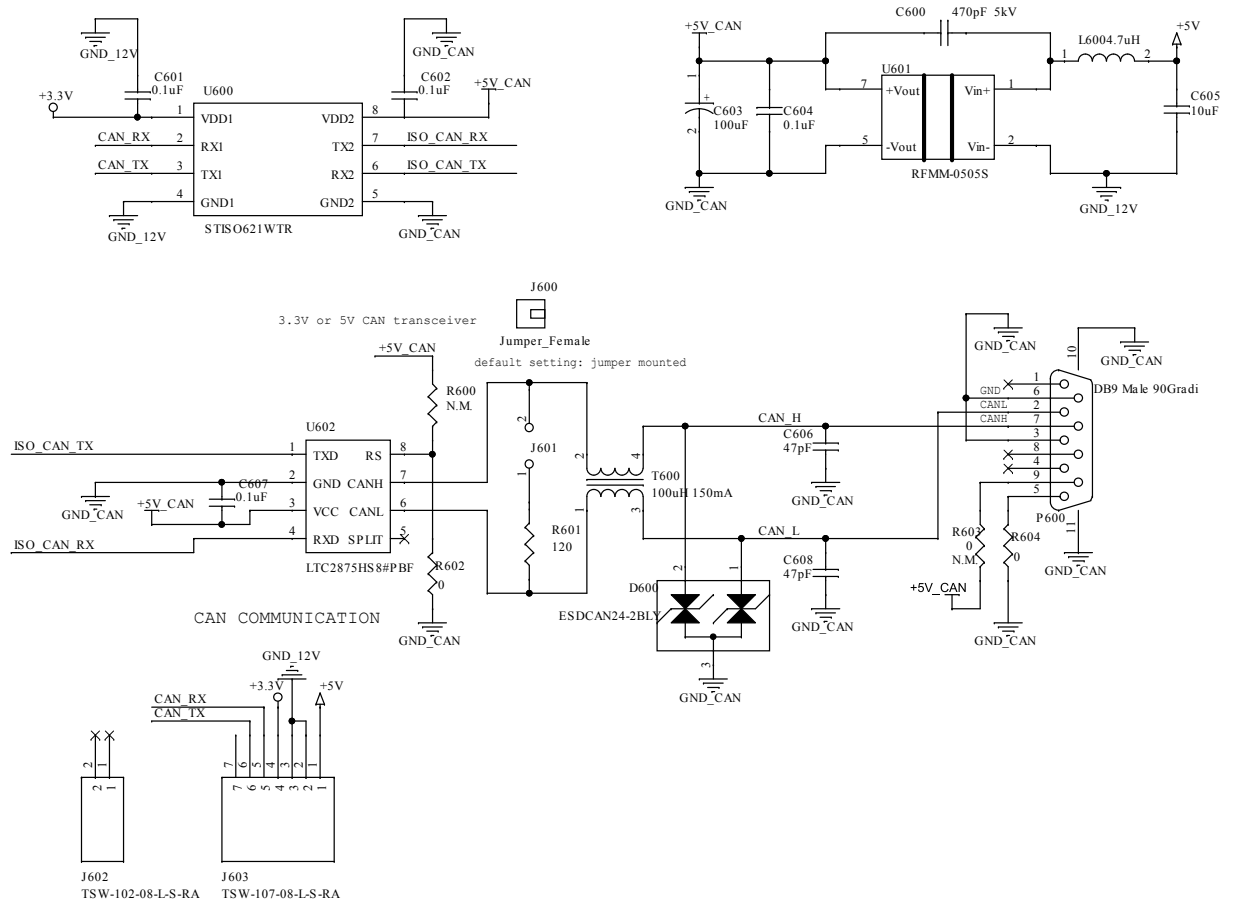
**Figure 6. STEVAL-7BIDIRCB - Control board (1 of 2)**



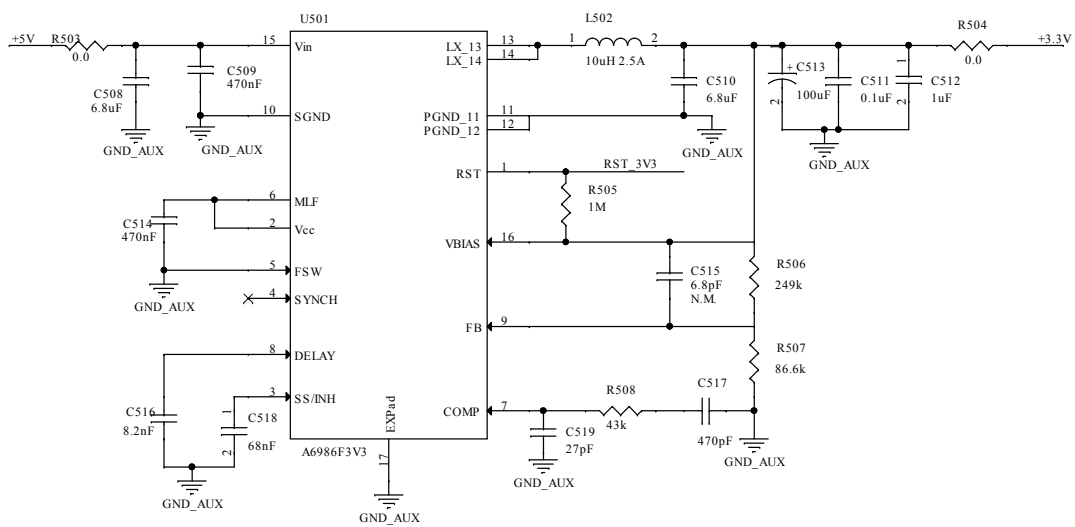
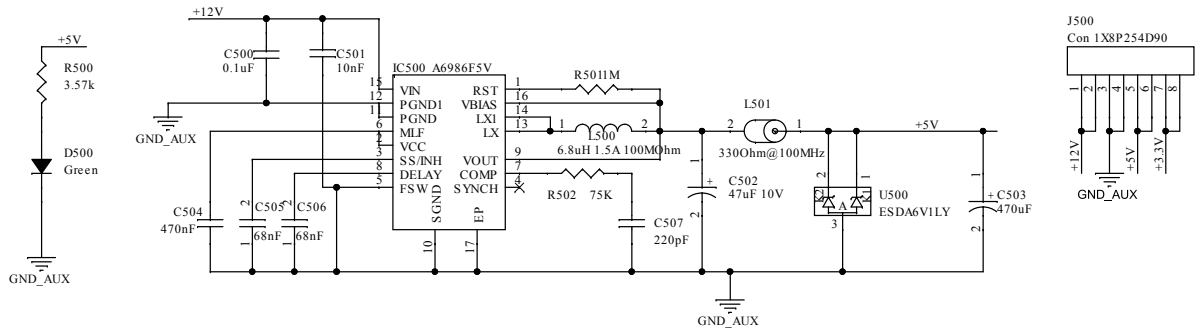
**Figure 7. STEVAL-7BIDIRCB - Control board (2 of 2)**



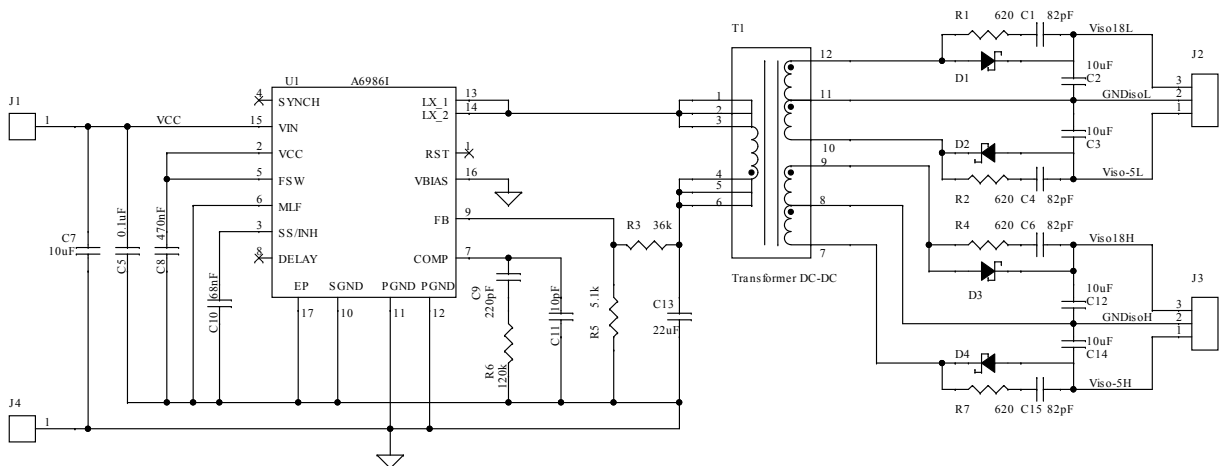
**Figure 8. STEVAL-7BIDIRCB - CAN module**



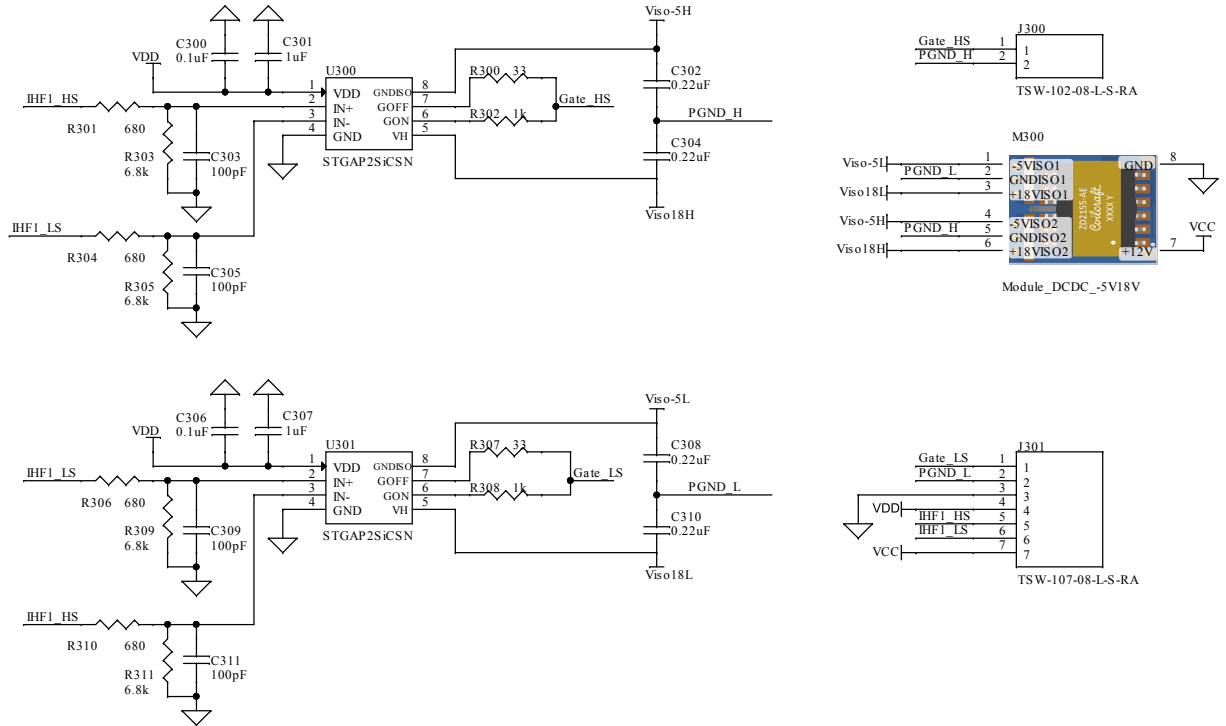
**Figure 9. STEVAL-7BIDIRCB - Auxiliary power supply**



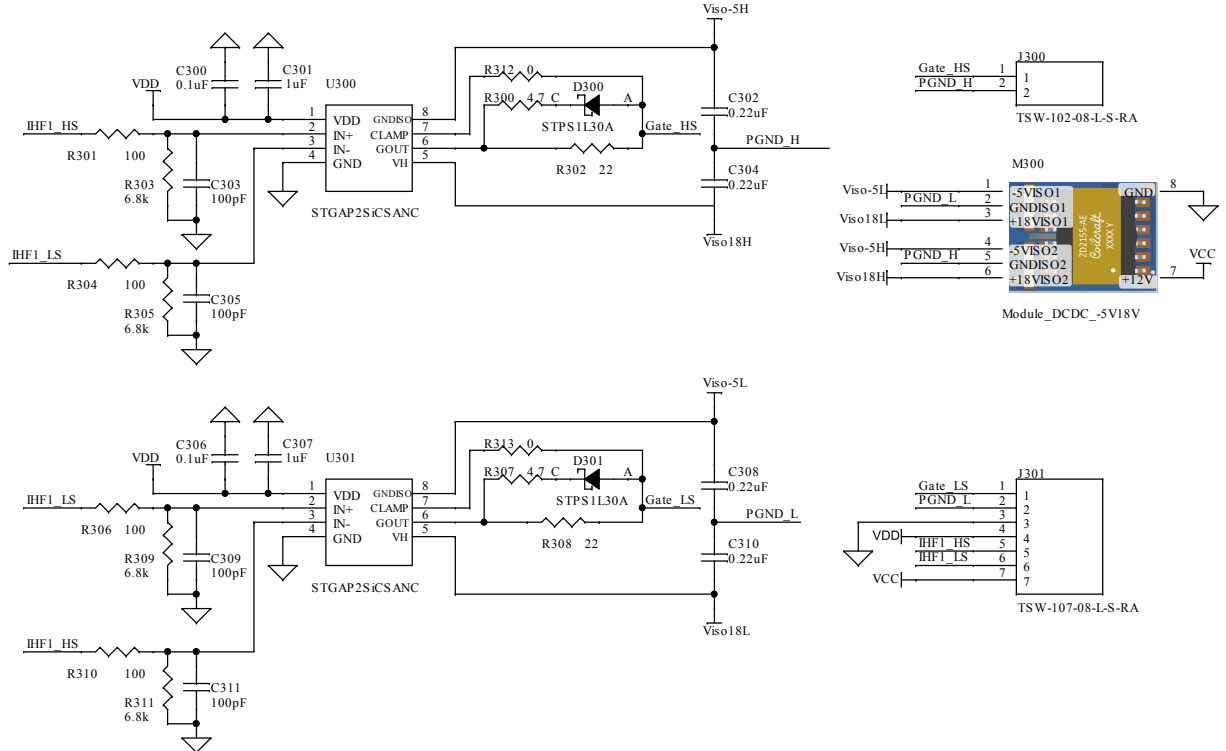
**Figure 10. STEVAL-7BIDIRCB - Gate driver auxiliary power supply**



**Figure 11. STEVAL-7BIDIRCB - Low frequency half bridge gate driver**

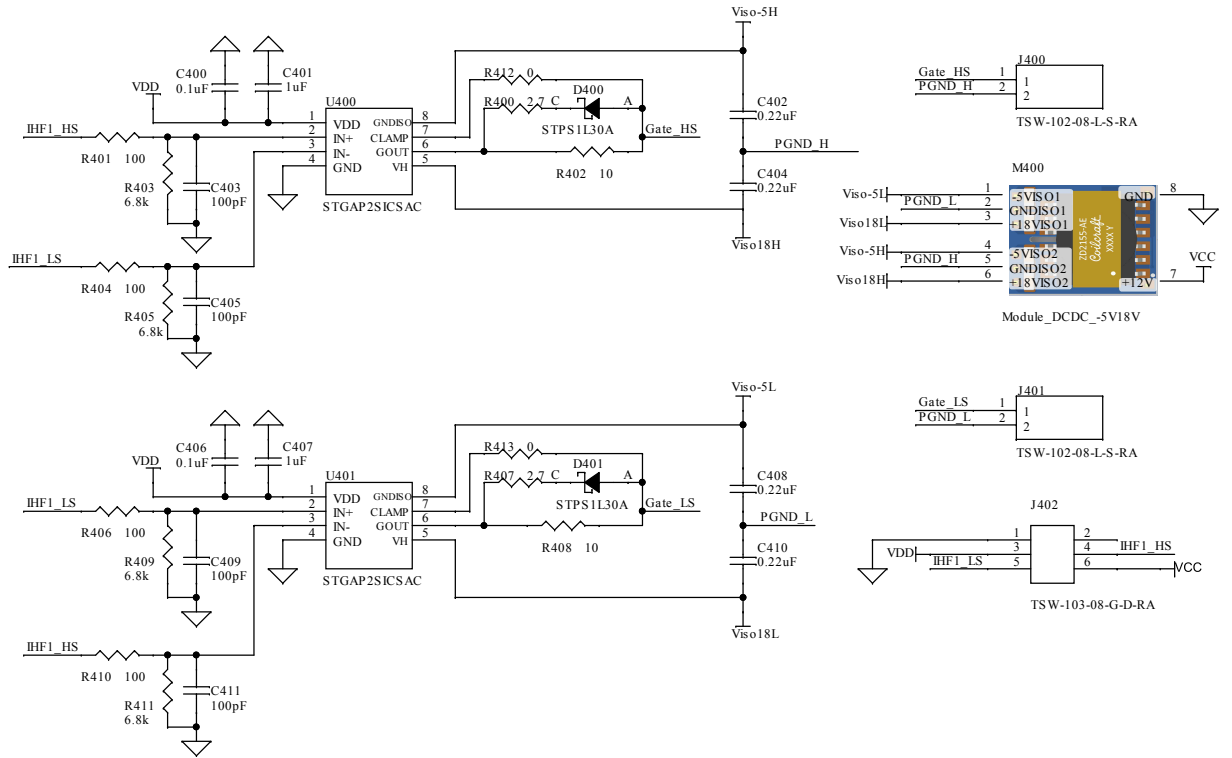


**Figure 12. STEVAL-7BIDIRCB - High frequency half bridge gate driver**





**Figure 13. STEVAL-7BIDIRCB - High voltage half bridge gate driver**



## **2 Custom evaluation boards information**

---

*Notice: These evaluation boards are custom designed and built, in small quantities, according to specific requests from customers and are destined for evaluation and testing of ST products in a research and development setting. Please contact ST to provide your specific requests and get your custom built board(s).*

## Revision history

**Table 1. Document revision history**

Date	Version	Changes
07-Dec-2023	1	Initial release.

**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. 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.

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 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.

ST and the ST logo are trademarks of ST. For additional information about ST trademarks, refer to [www.st.com/trademarks](http://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.

© 2023 STMicroelectronics – All rights reserved