

## 11 kW bidirectional battery charger based on three phase two level PFC and isolated DC-DC converter



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

### Features

- PFC stage 3-phase, 2-level bidirectional AC-DC power converter:
  - Rated nominal AC voltage: 400 VAC at 50 Hz
  - Rated nominal DC voltage: 800 VDC
  - Nominal power: 11 kW
 Rectifier mode:
  - Power factor: PF >0.99
  - Inrush current control and soft startup
 Inverter mode:
  - Active and reactive power control
  - Integrated grid connection solution
- DC-DC stage dual active bridge (DAB) power converter:
  - Nominal DC input voltage 800 V
  - Nominal DC output voltage 550 to 850 V
  - DAB: switching frequency 100 kHz
- Power section based on SiC power modules:
  - ACEPACK DMT-32 power module for high integration level
  - High frequency operation for weight and size reduction
  - Bidirectional capabilities
  - DAB soft switching behavior enabled by enhanced modulation techniques management

Product summary	
11 kW bidirectional battery charger based on three phase two level PFC and isolated DC-DC converter	STEVAL-11BID1KCB
Firmware for STEVAL-11BID1KCB	STSW-11BID1KCB
Automotive-grade ACEPACK DMT-32 power module, fourpack topology	M1F45M12W2-1LA
Automotive-grade ACEPACK DMT-32 power module, sixpack topology	M1P45M12W2-1LA
Mainstream Arm Cortex-M4 MCU 170 MHz	STM32G474RET3
Galvanically isolated 4 A dual gate driver	STGAP2SiCD
Application	Battery charger/ Battery storage systems for home/ On board charger (OBC)

### Description

The STEVAL-11BID1KCB is an 11 kW bidirectional battery charger and represents a complete solution for high voltage charging in both the industrial and automotive fields.

It consists of two power stages: a PFC and an isolated DC-DC stage.

The PFC is based on a three-phase full-bridge topology.

The DC-DC section is Dual Active Bridge (DAB) topology.

Both stages are based on the ACEPACK DMT-32 SiC power module.

The board uses two control boards for the PFC and DC-DC stages respectively. The control board is based on the STM32G474RE microcontroller.

The PFC stage operating frequency is 70 kHz. The DC-DC stage is operating at a fixed switching frequency of 100 kHz.

A peak system efficiency of 96% was achieved for the design.

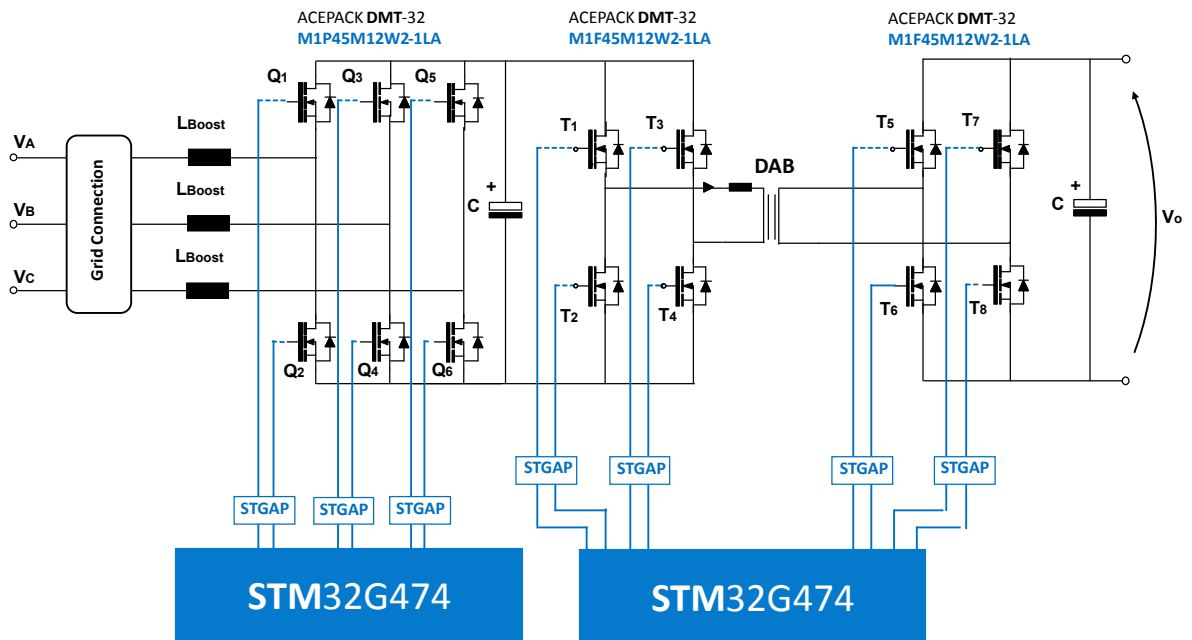
## 1 Block diagram

The STEVAL-11BID1KCB consists of two power stages and an 11 kW single magnetic component, including the isolation transformer and the leakage inductance.

The hardware modular structure consists of the following building blocks:

- A main power board with ACEPACK DMT-32 SiC power modules, sixpack topology M1P45M12W2-1LA for PFC stage, and two M1F45M12W2-1LA for the two sides of DC-DC stage. In addition to the power modules, bulk capacitor, sensing sections and auxiliary power supply are also present.
- A driver board for full bridge and sixpack ACEPACK DMT-32 SiC power modules based on STGAP2SiCD galvanically isolated 4 A dual gate driver for SiC MOSFETs.
- A control board based on the STM32G474RE series of microcontrollers with connectors for communication and programming, test points and status indicators for debugging and monitoring.

**Figure 1. Block diagram for high visual impact**



## 2 Schematic diagrams

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

Figure 2. STEVAL-11BID1PCB circuit schematic (1 of 17)

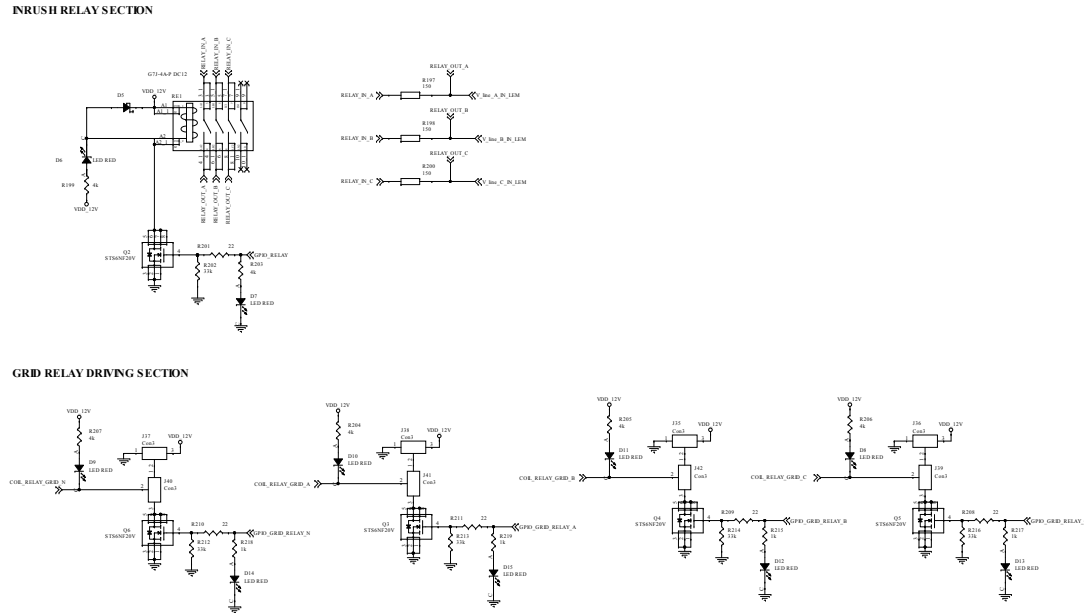


Figure 3. STEVAL-11BID1PCB circuit schematic (2 of 17)

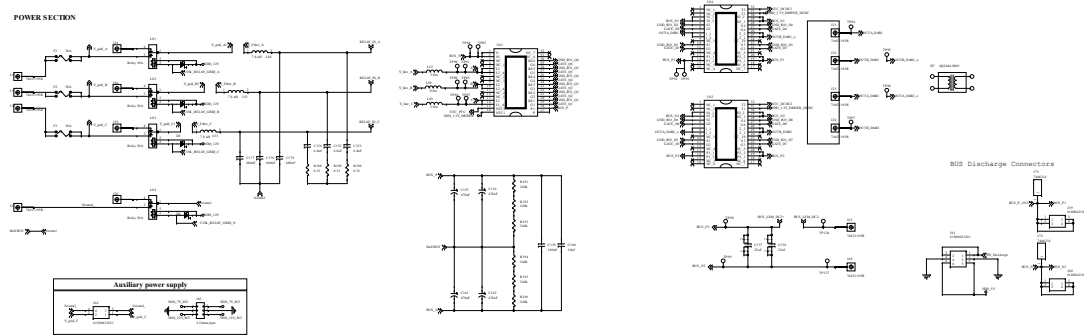


Figure 4. STEVAL-11BID1PCB circuit schematic (3 of 17)

LINE VOLTAGE SENSING

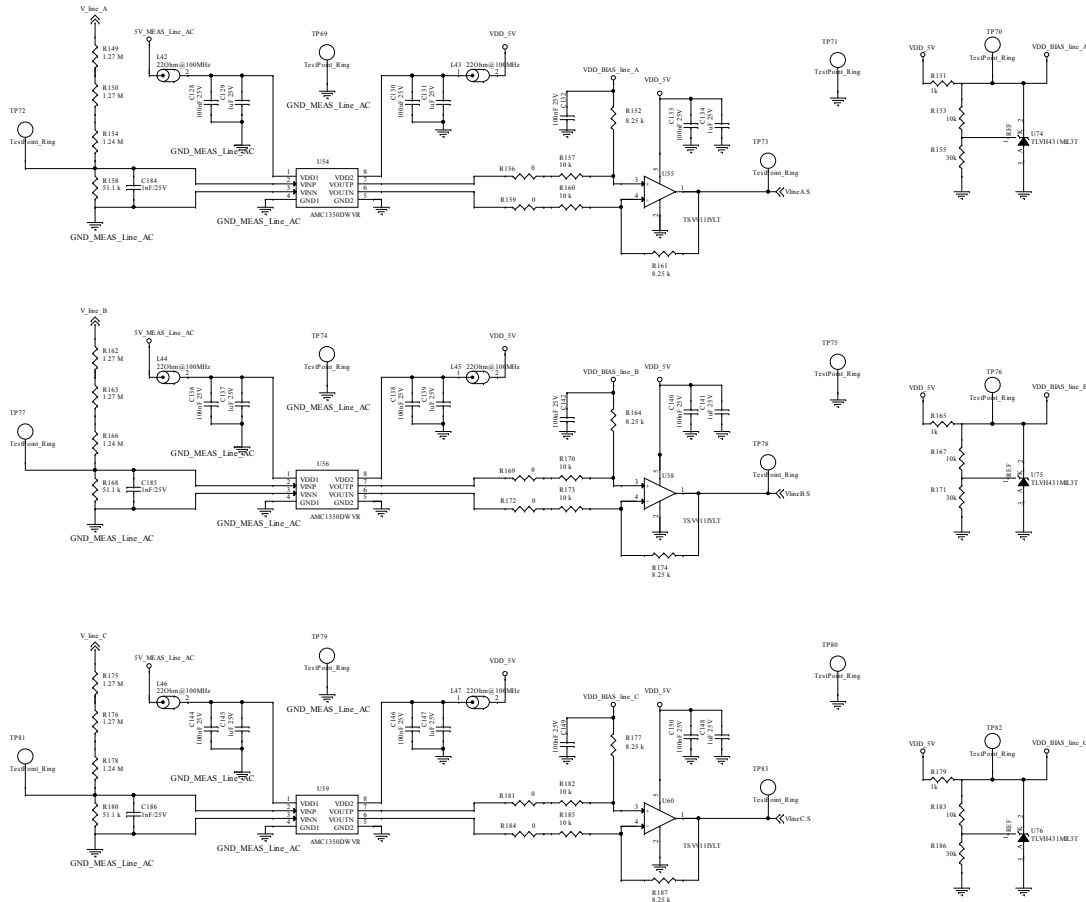


Figure 5. STEVAL-11BID1PCB circuit schematic (4 of 17)

GRID VOLTAGE SENSING

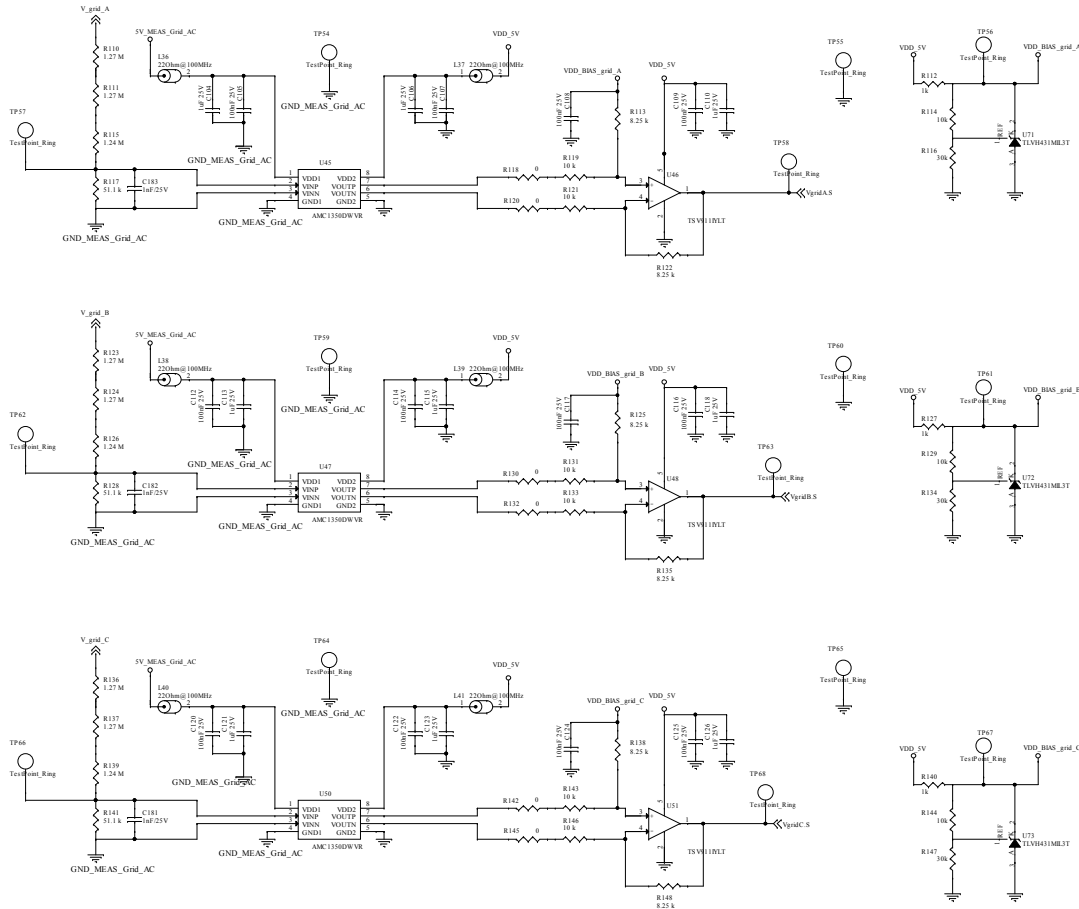


Figure 6. STEVAL-11BID1PCB circuit schematic (5 of 17)

GRID CURRENT SENSING

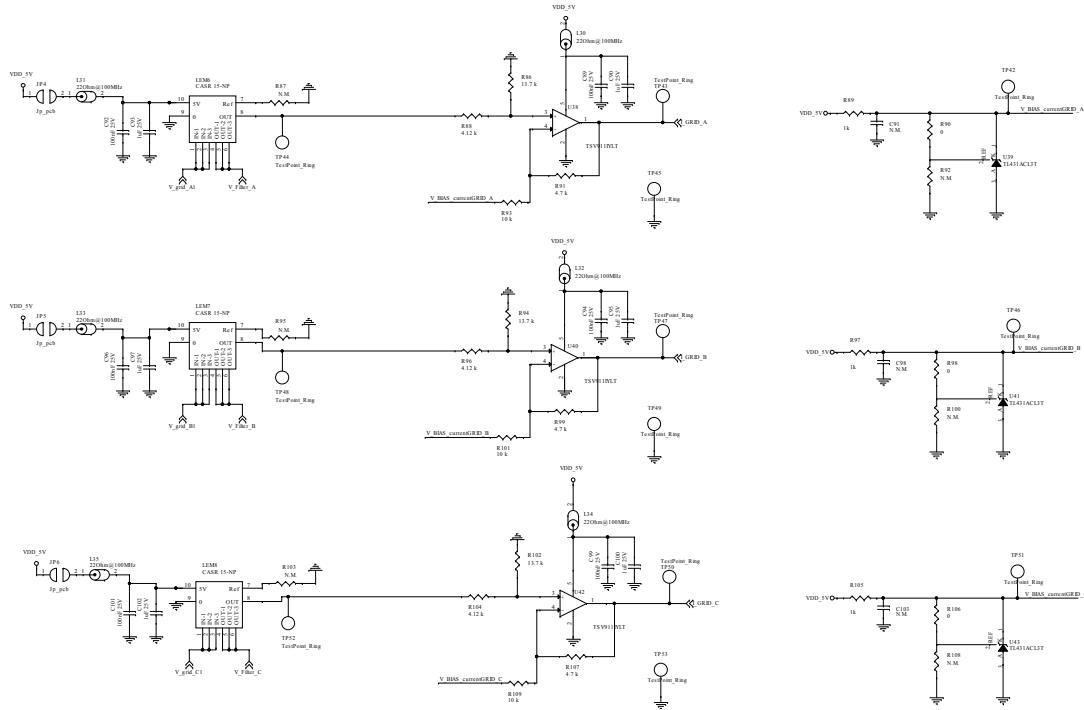
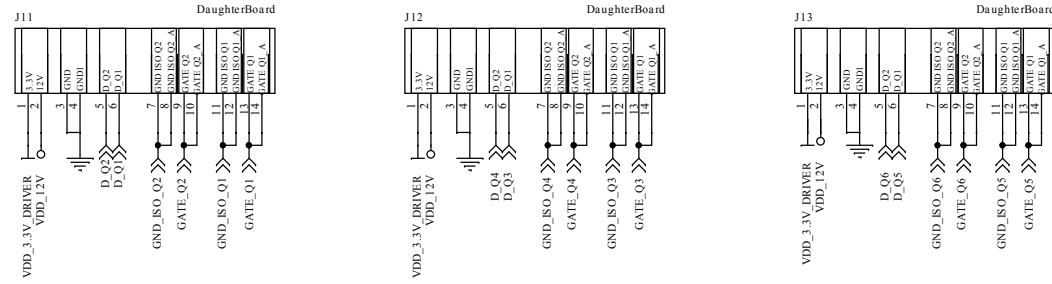


Figure 7. STEVAL-11BID1PCB circuit schematic (6 of 17)

DRIVER BOARD



PULLDOWN RESISTANCES

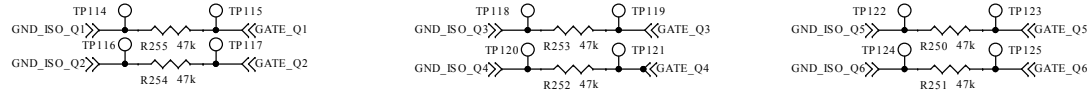


Figure 8. STEVAL-11BID1PCB circuit schematic (7 of 17)

PFC DC VOLTAGE SENSING

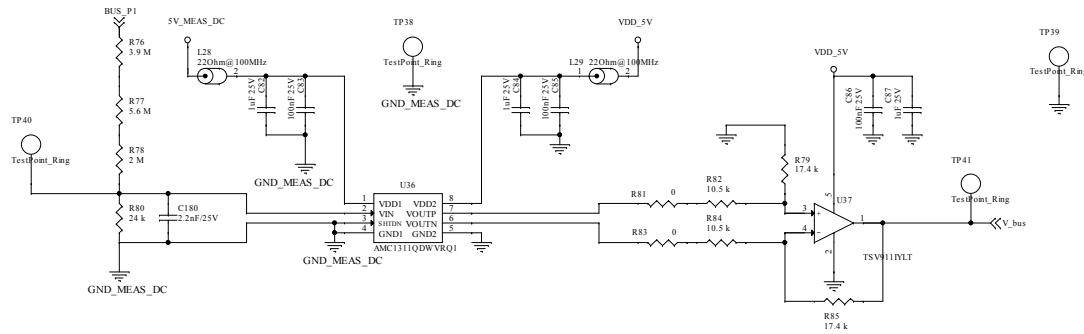


Figure 9. STEVAL-11BID1PCB circuit schematic (8 of 17)

PFC DC CURRENT SENSING

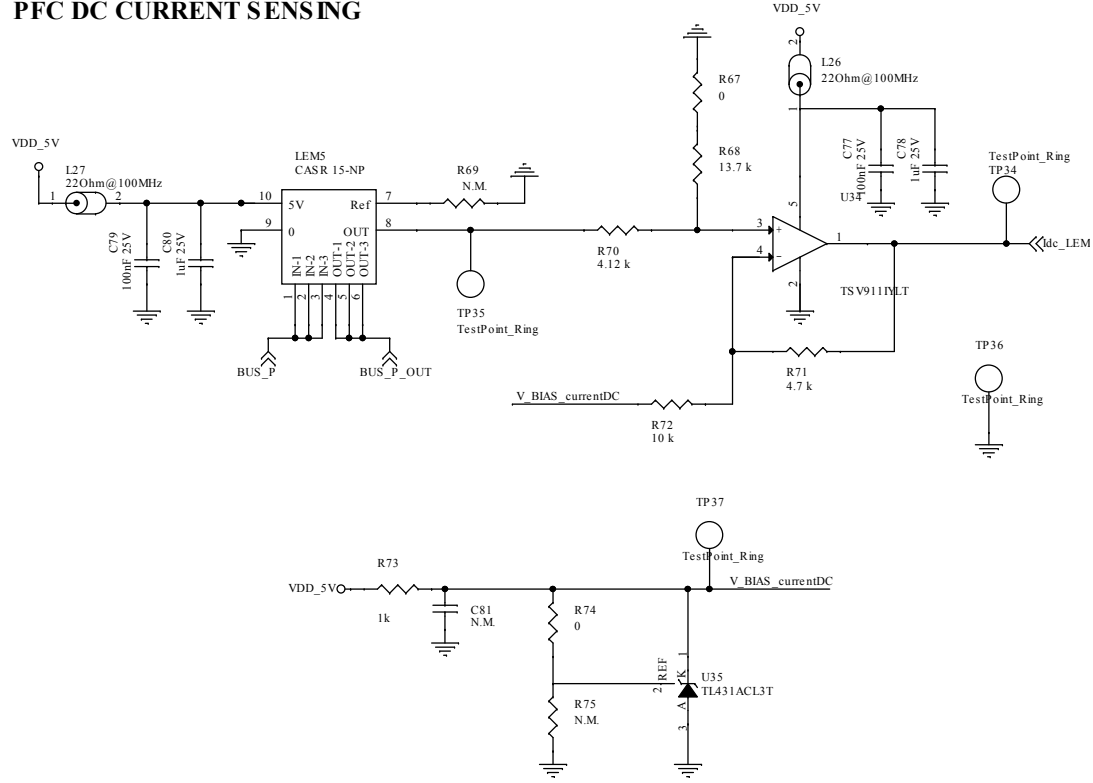
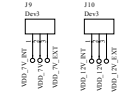
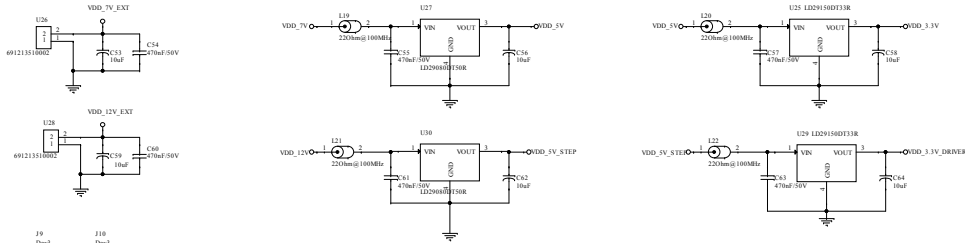
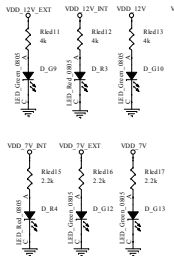


Figure 10. STEVAL-11BID1PCB circuit schematic (9 of 17)

PFC AUXILIARY POWER SUPPLY



LED STATUS



ISO. DC/DC Power Supply for sensing

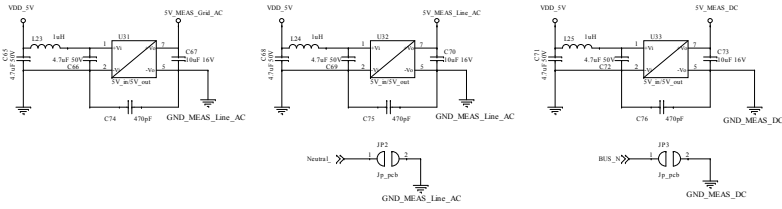


Figure 11. STEVAL-11BID1PCB circuit schematic (10 of 17)

AC CURRENT SENSING

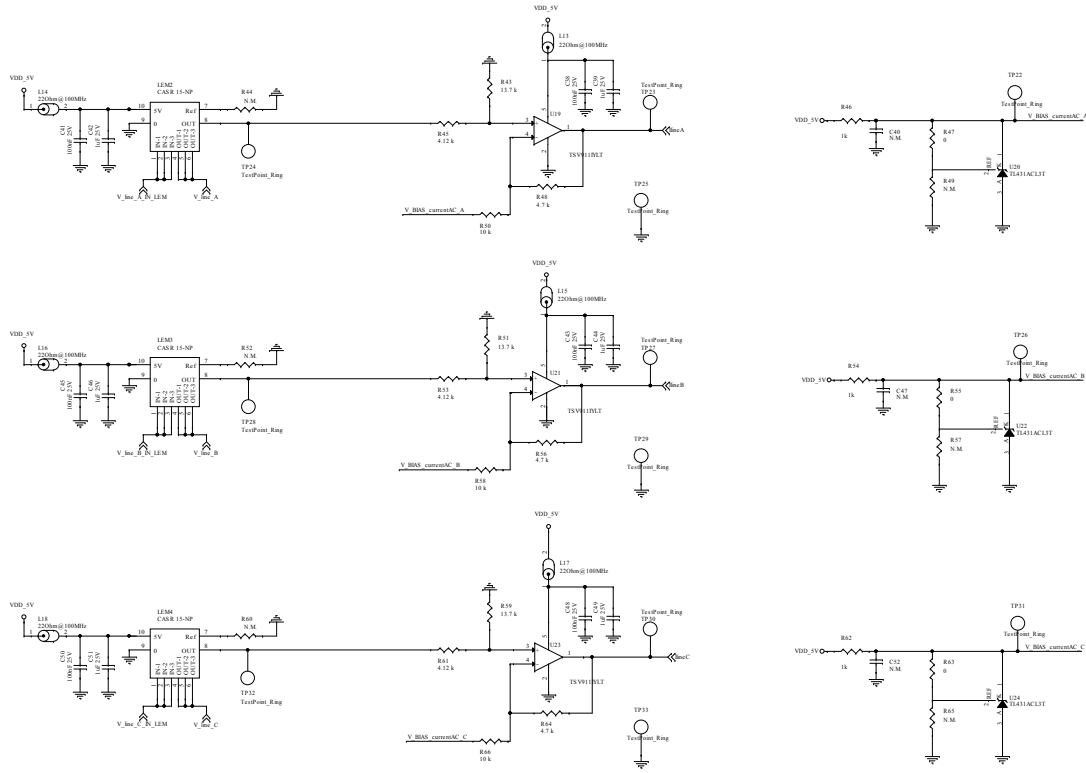


Figure 12. STEVAL-11BID1PCB circuit schematic (11 of 17)

TEMPERATURE SENSING

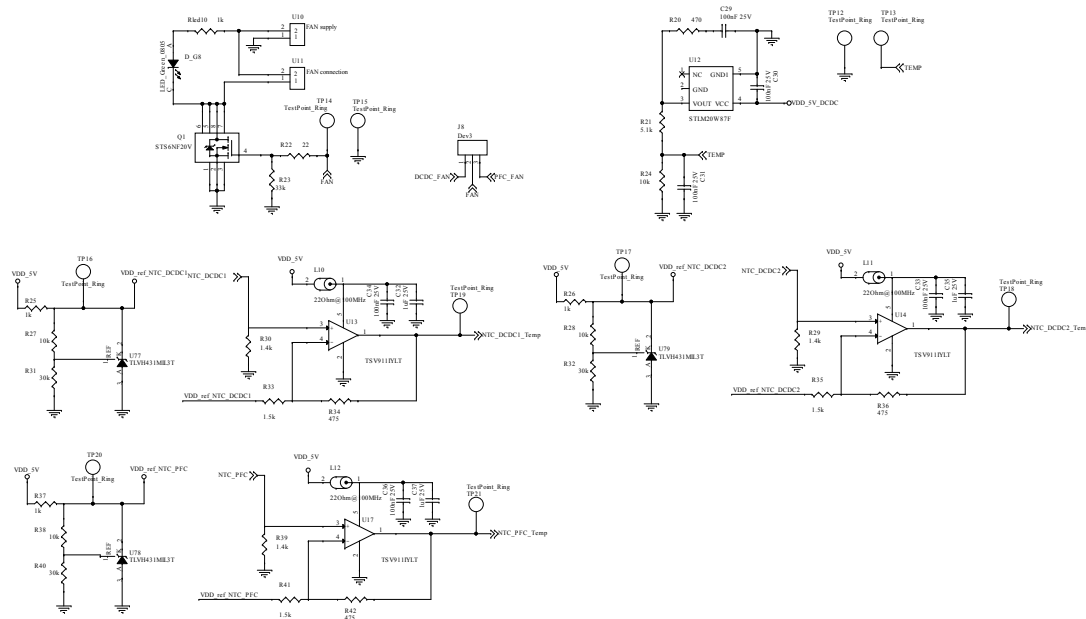


Figure 13. STEVAL-11BID1PCB circuit schematic (12 of 17)

DCDC VOLTAGE SENSING

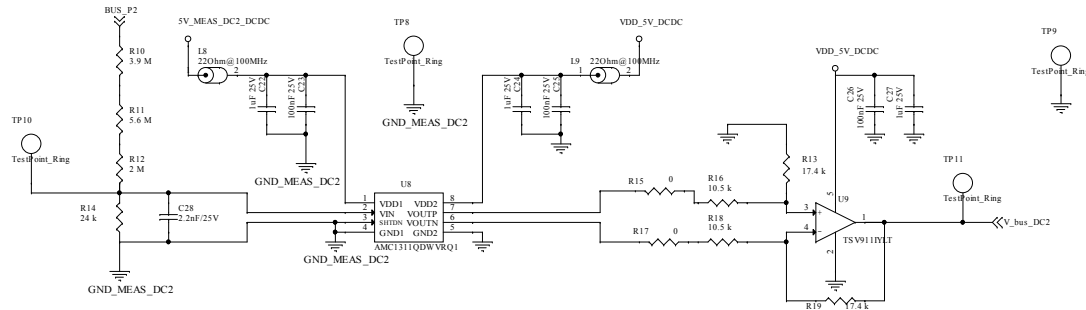
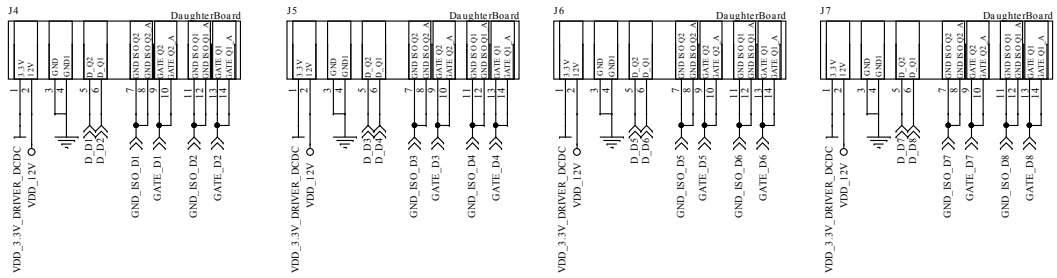


Figure 14. STEVAL-11BD1PCB circuit schematic (13 of 17)

DRIVER BOARD



PULLDOWN RESISTANCES

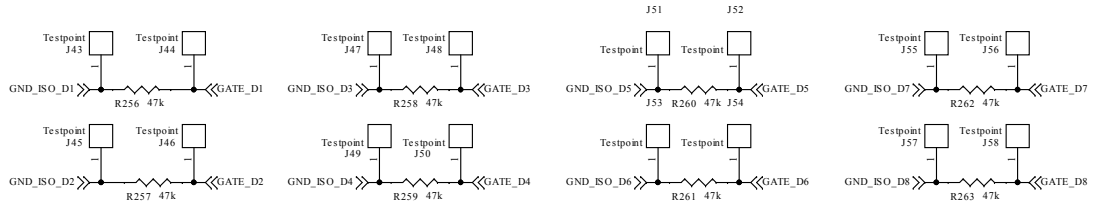


Figure 15. STEVAL-11BD1PCB circuit schematic (14 of 17)

DCDC CURRENT SENSING

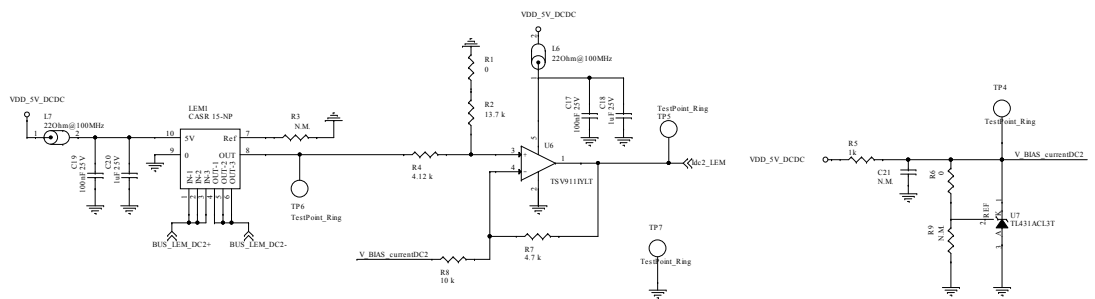
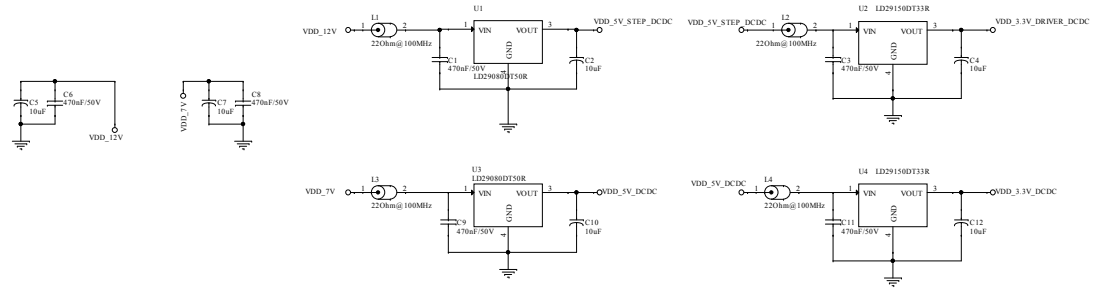


Figure 16. STEVAL-11BID1PCB circuit schematic (15 of 17)

DCDC AUXILIARY POWER SUPPLY



LED STATUS

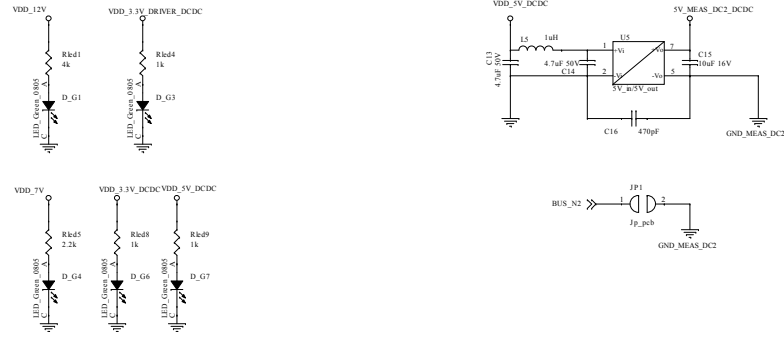


Figure 17. STEVAL-11BID1PCB circuit schematic (16 of 17)

EXTERNAL CONNECTORS

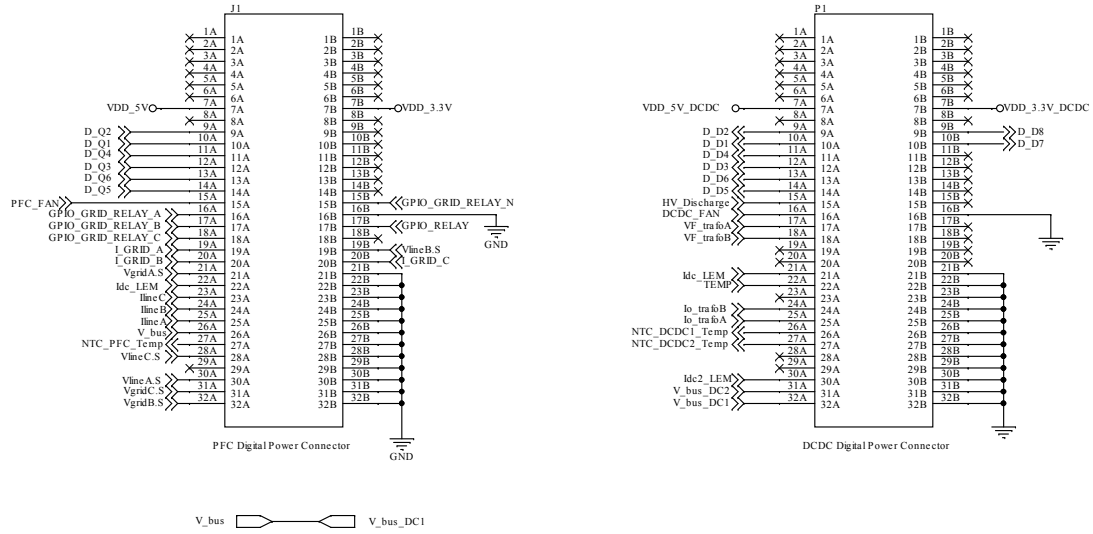




Figure 19. STEVAL-G474V1CB circuit schematic

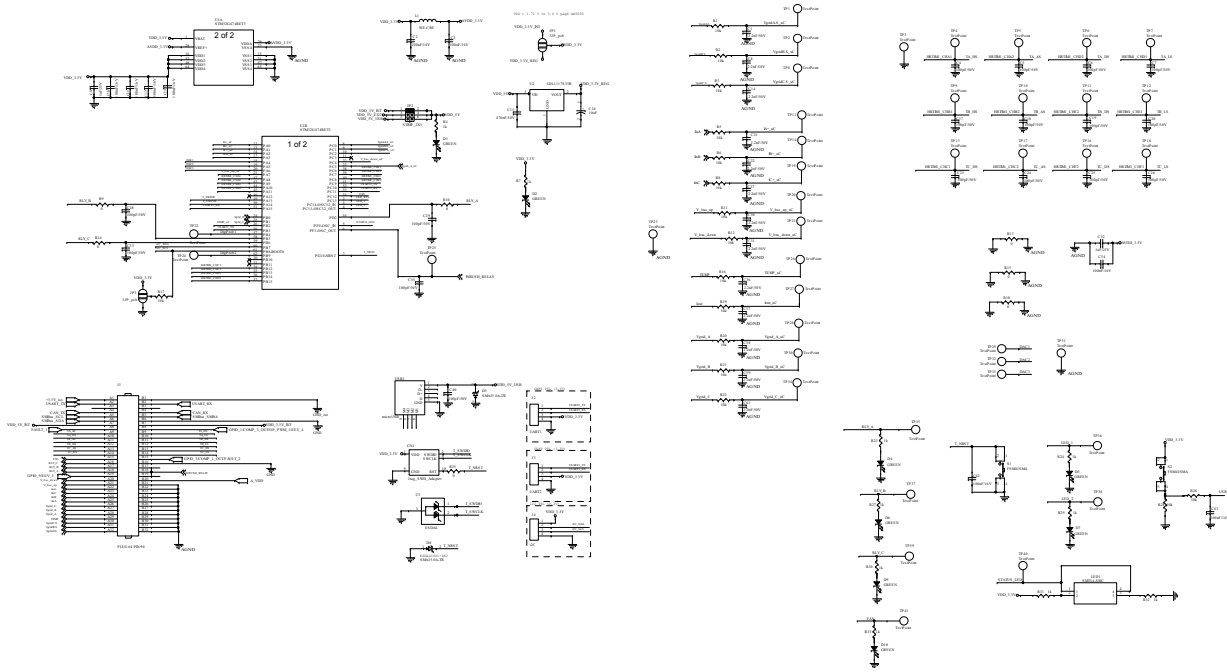
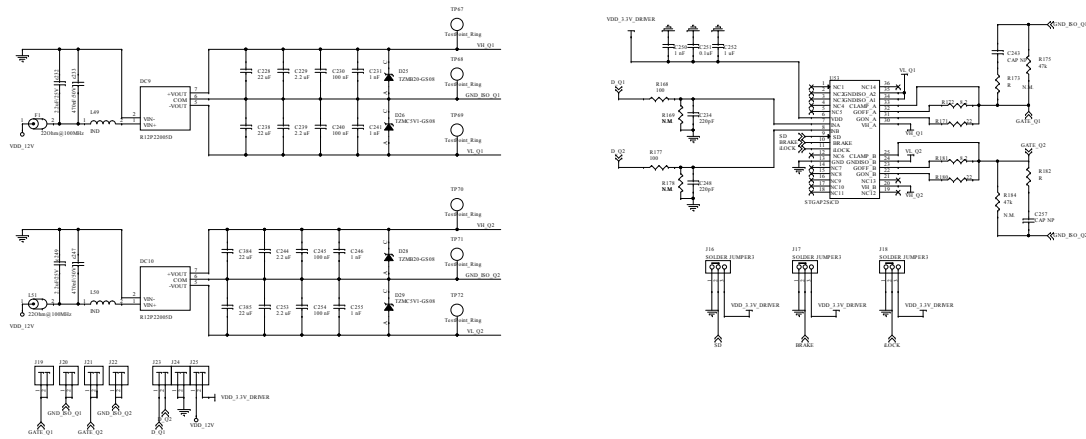


Figure 20. STEVAL-GAP2S1CB circuit schematic





### **3 Custom evaluation boards information**

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*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	Revision	Changes
24-Mar-2025	1	Initial release.
01-Oct-2025	2	Updated cover image and <a href="#">Section Description</a> .

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