XMC7200-based power conversion control board

REF-CLBXMC7PEC

About this document

Scope and purpose

This user guide describes the XMC7200-based power control board reference design REF-CLBXMC7PEC and its main features, key data, pin assignments, mechanical dimensions, and electrical interfaces.

Intended audience

This document is meant for engineers and technical specialists working on power conversion applications. The concept of this power control board allows to combine it with various power converter stages and use cases, with a special focus on industrial applications.

Reference design

This reference design is not a qualified and certified commercial product. Its hardware does not necessarily meet any safety, EMI, or quality standard (for example, UL, CE) requirements.

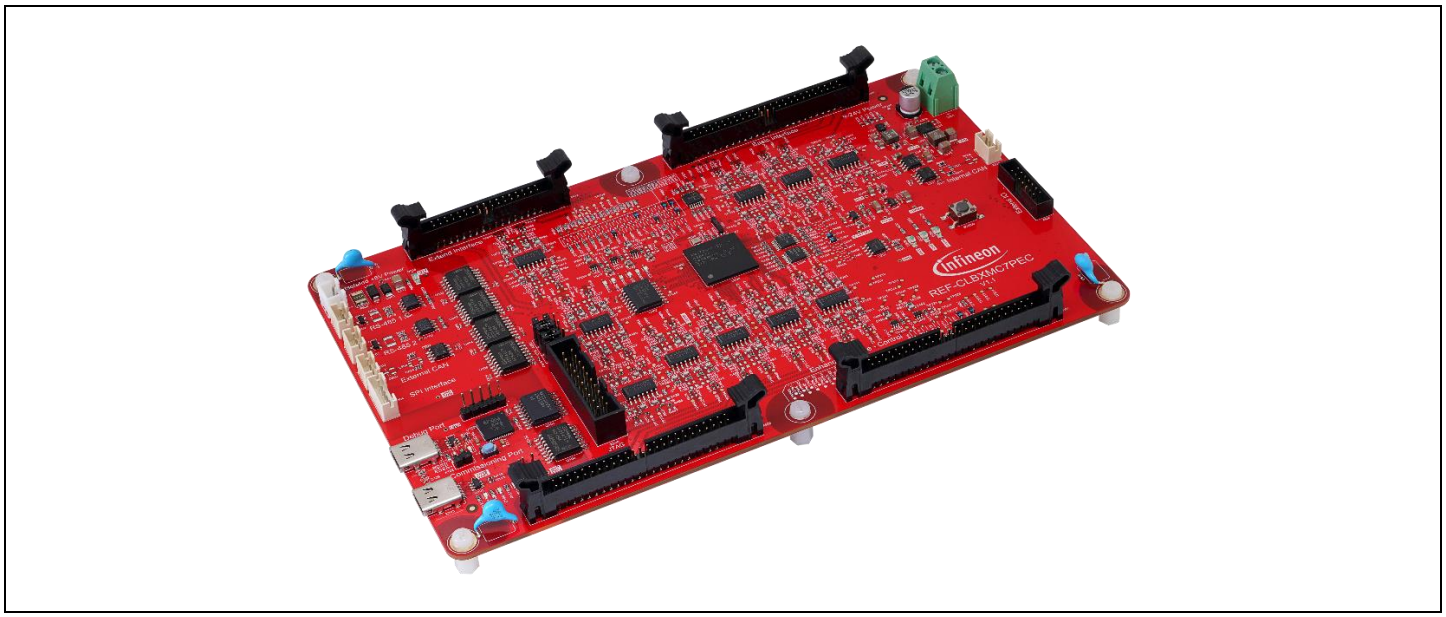

Figure 1 **Power control board REF-CLBXMC7PEC**

Important notice

“Evaluation Boards and Reference Boards” shall mean products embedded on a printed circuit board (PCB) for demonstration and/or evaluation purposes, which include, without limitation, demonstration, reference and evaluation boards, kits and design (collectively referred to as “Reference Board”).

Environmental conditions have been considered in the design of the Evaluation Boards and Reference Boards provided by Infineon Technologies. The design of the Evaluation Boards and Reference Boards has been tested by Infineon Technologies only as described in this document. The design is not qualified in terms of safety requirements, manufacturing and operation over the entire operating temperature range or lifetime.

The Evaluation Boards and Reference Boards provided by Infineon Technologies are subject to functional testing only under typical load conditions. Evaluation Boards and Reference Boards are not subject to the same procedures as regular products regarding returned material analysis (RMA), process change notification (PCN) and product discontinuation (PD).

Evaluation Boards and Reference Boards are not commercialized products, and are solely intended for evaluation and testing purposes. In particular, they shall not be used for reliability testing or production. The Evaluation Boards and Reference Boards may therefore not comply with CE or similar standards (including but not limited to the EMC Directive 2004/EC/108 and the EMC Act) and may not fulfill other requirements of the country in which they are operated by the customer. The customer shall ensure that all Evaluation Boards and Reference Boards will be handled in a way which is compliant with the relevant requirements and standards of the country in which they are operated.

The Evaluation Boards and Reference Boards as well as the information provided in this document are addressed only to qualified and skilled technical staff, for laboratory usage, and shall be used and managed according to the terms and conditions set forth in this document and in other related documentation supplied with the respective Evaluation Board or Reference Board.

It is the responsibility of the customer’s technical departments to evaluate the suitability of the Evaluation Boards and Reference Boards for the intended application, and to evaluate the completeness and correctness of the information provided in this document with respect to such application.

The customer is obliged to ensure that the use of the Evaluation Boards and Reference Boards does not cause any harm to persons or third party property.

The Evaluation Boards and Reference Boards and any information in this document is provided "as is" and Infineon Technologies disclaims any warranties, express or implied, including but not limited to warranties of non-infringement of third party rights and implied warranties of fitness for any purpose, or for merchantability.

Infineon Technologies shall not be responsible for any damages resulting from the use of the Evaluation Boards and Reference Boards and/or from any information provided in this document. The customer is obliged to defend, indemnify and hold Infineon Technologies harmless from and against any claims or damages arising out of or resulting from any use thereof.

Infineon Technologies reserves the right to modify this document and/or any information provided herein at any time without further notice.

Safety precautions

Note: *Please note the following warnings regarding the hazards associated with development systems.*

Table 1 Safety precautions

	**Caution:** *The evaluation or reference board contains parts and assemblies sensitive to electrostatic discharge (ESD). Electrostatic control precautions are required when installing, testing, servicing or repairing the assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with electrostatic control procedures, refer to the applicable ESD protection handbooks and guidelines.*
	**Caution:** *The evaluation or reference board is shipped with packing materials that need to be removed prior to installation. Failure to remove all packing materials that are unnecessary for system installation may result in overheating or abnormal operating conditions.*

Table of contents

1 The control board at a glance

1.1 Introduction

REF-CLBXMC7PEC is a control board that can be used in many power conversion reference designs of Infineon. It enables easy evaluation of power conversion boards and can also be used by the designers to develop their own software. It serves as a rapid prototyping platform. It features an XMC7200 microcontroller, on board debugger, power supply, communication interfaces, protection and signal conditioning circuits.

The reference board was developed to support customers during their initial stages of power electronic systems development.

The key objectives of the board are:

- Support testing of power conversion reference designs
- Simplify testing through easy-to-use GUIs for selected topologies
- Provide flexibility for the user to design and quickly evaluate their software

The control board can support designers during the rapid prototyping stage to evaluate various inverter and DC-DC converter topologies. This can include:

- Interleaved boost DC-DC converter
- Buck-boost DC-DC converter
- CLLC DC-DC converter
- 3-phase DAB DC-DC converter
- B6 3-phase 2-level inverter
- 3-phase 3-level NPC-T inverter
- 3-phase 3-level NPC inverter
- 3-phase 3-level ANPC inverter

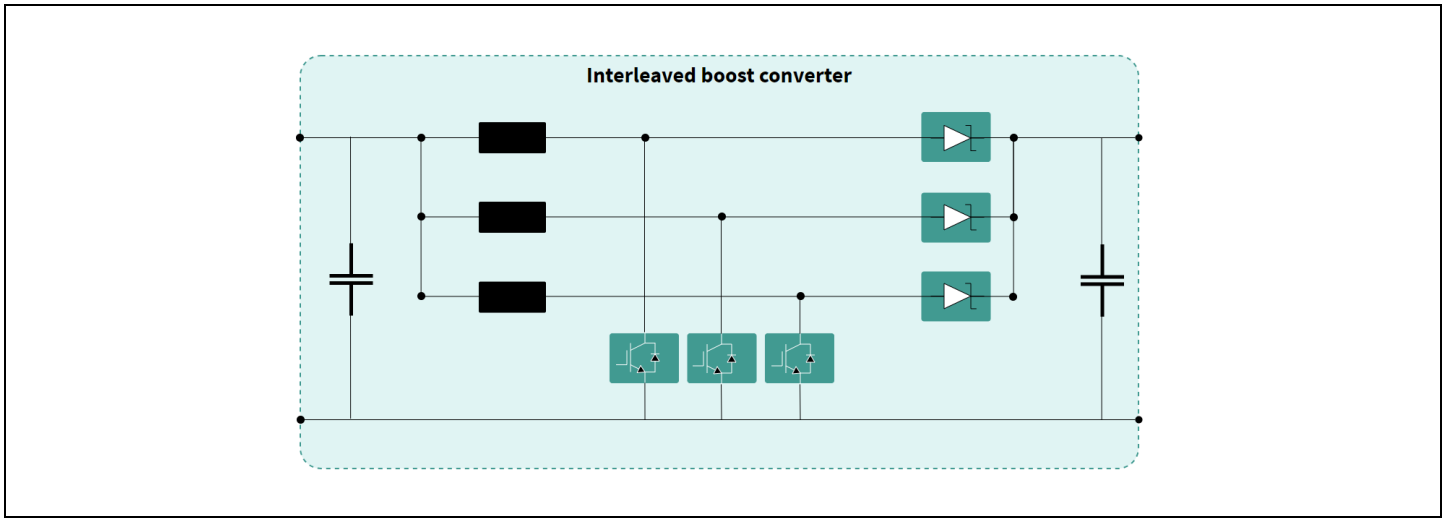

Figure 2 **Interleaved boost converter DC-DC converter**

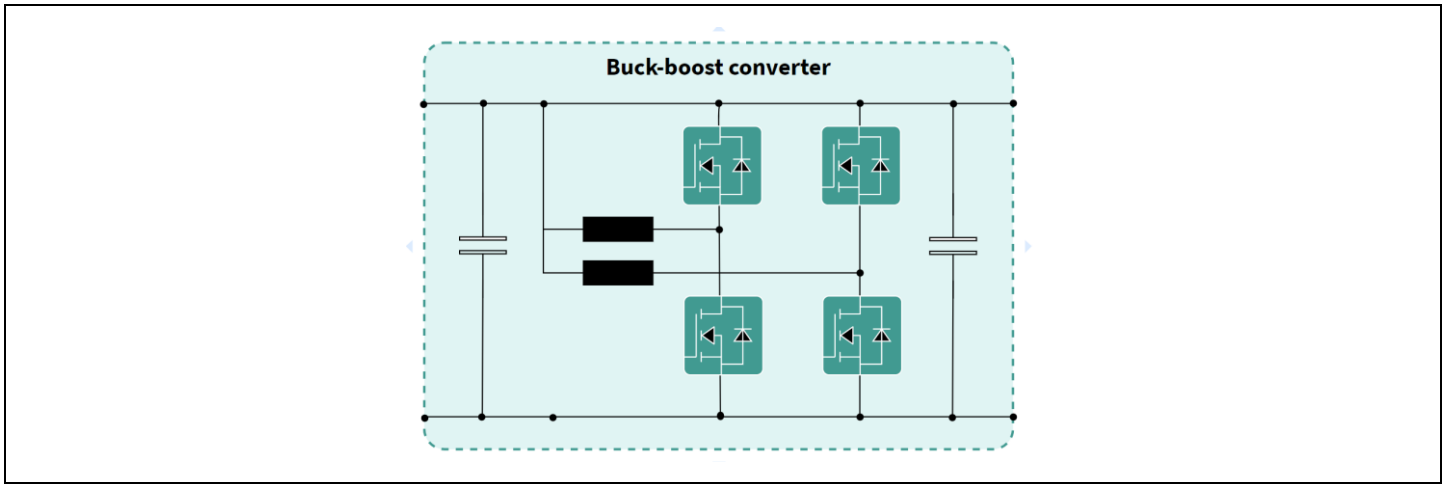

Figure 3 **Buck-boost DC-DC converter**

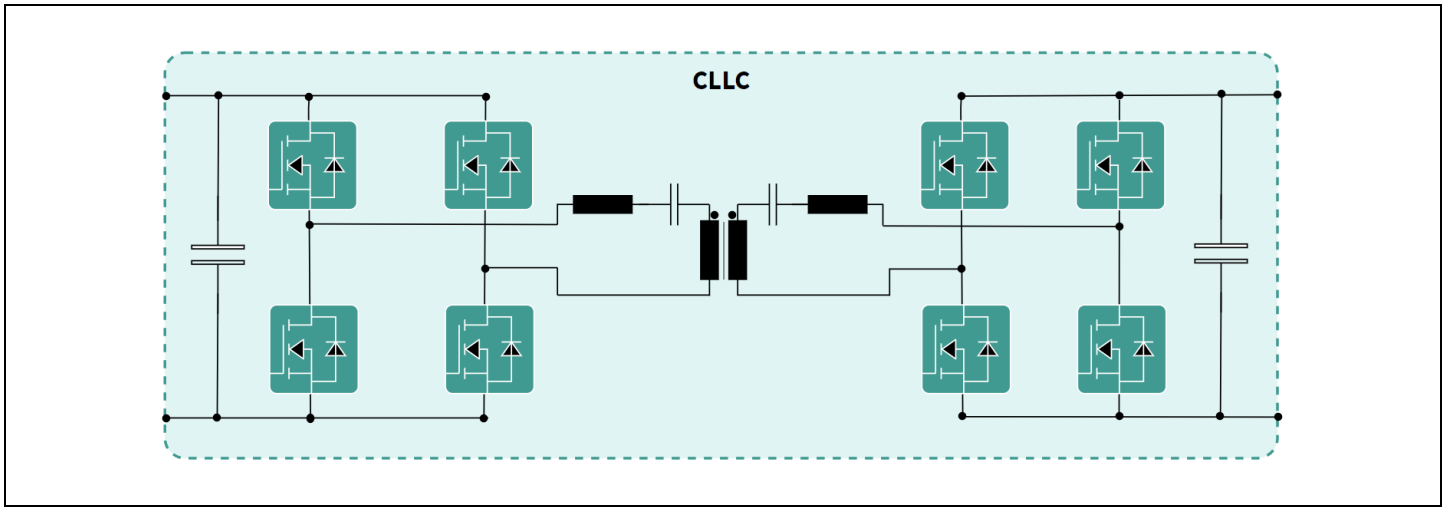

Figure 4 **CLLC DC-DC converter**

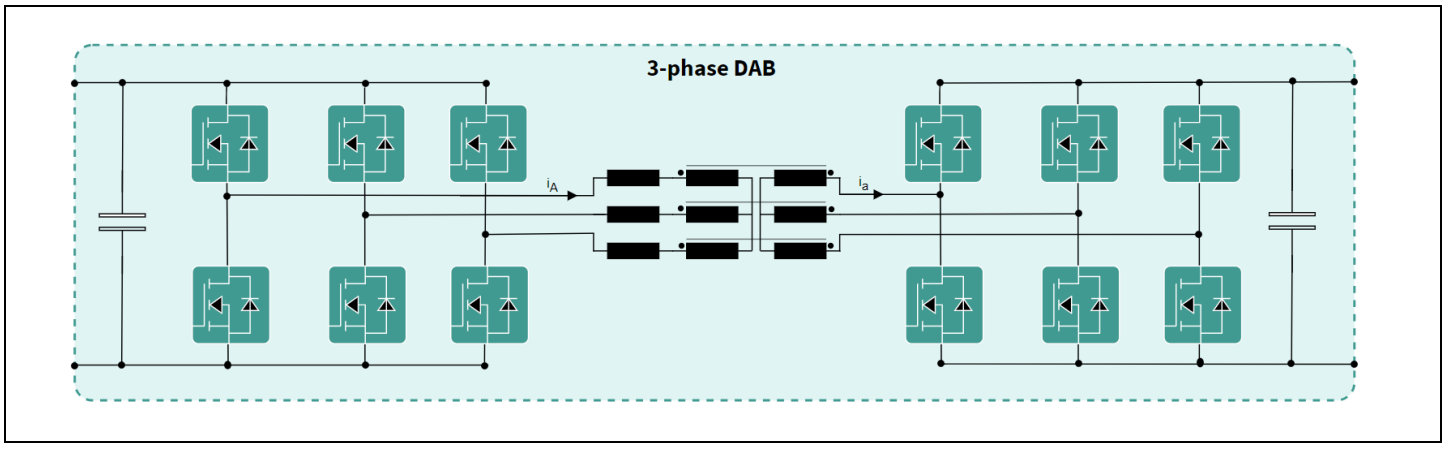

Figure 5 **3-Phase DAB DC-DC converter**

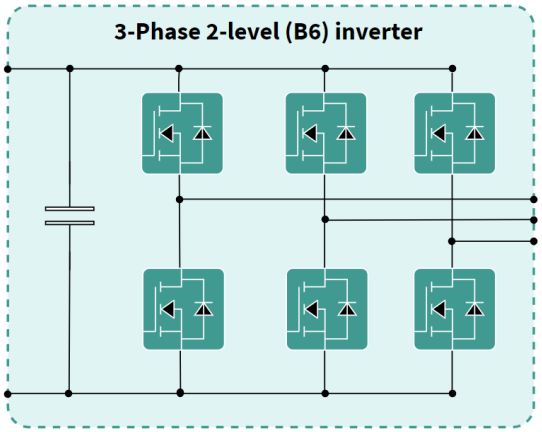

Figure 6 **B6 3-phase 2-level inverter**

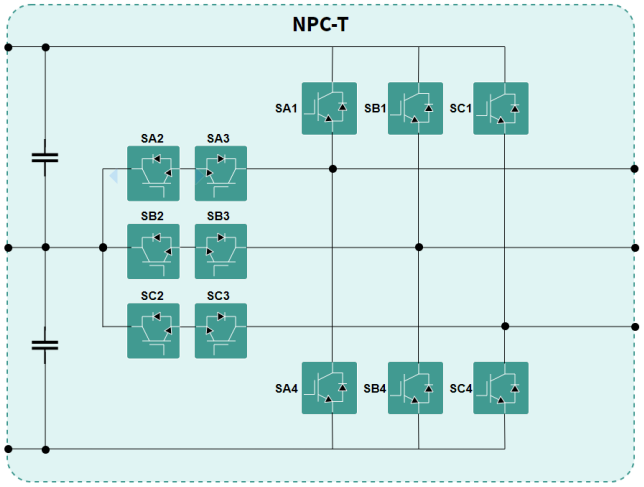

Figure 7 **3-phase 3-level NPC-T inverter**

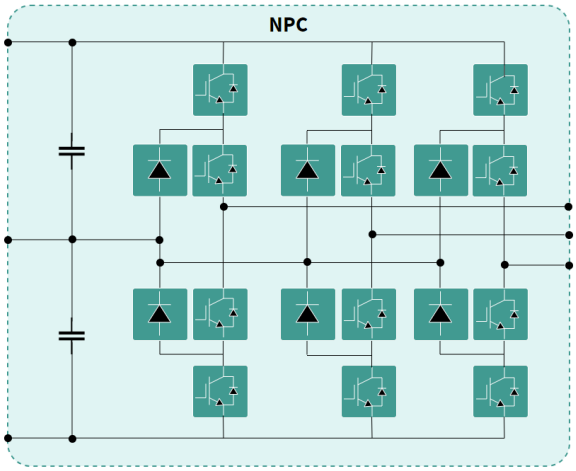

Figure 8 **3-phase 3-level NPC inverter**

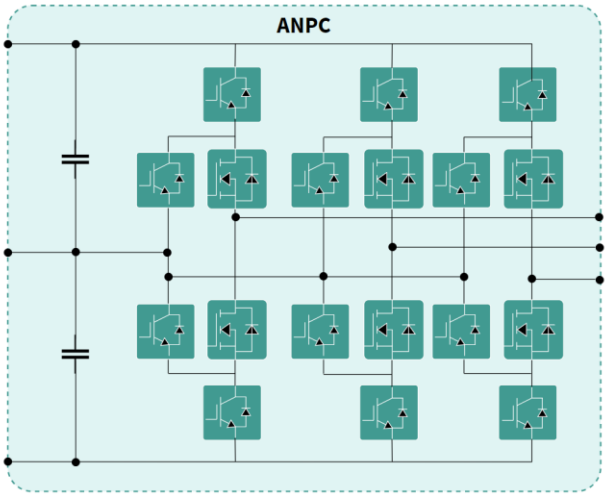

Figure 9 **3-phase 3-level ANPC-T inverter**

1.2 Block diagram

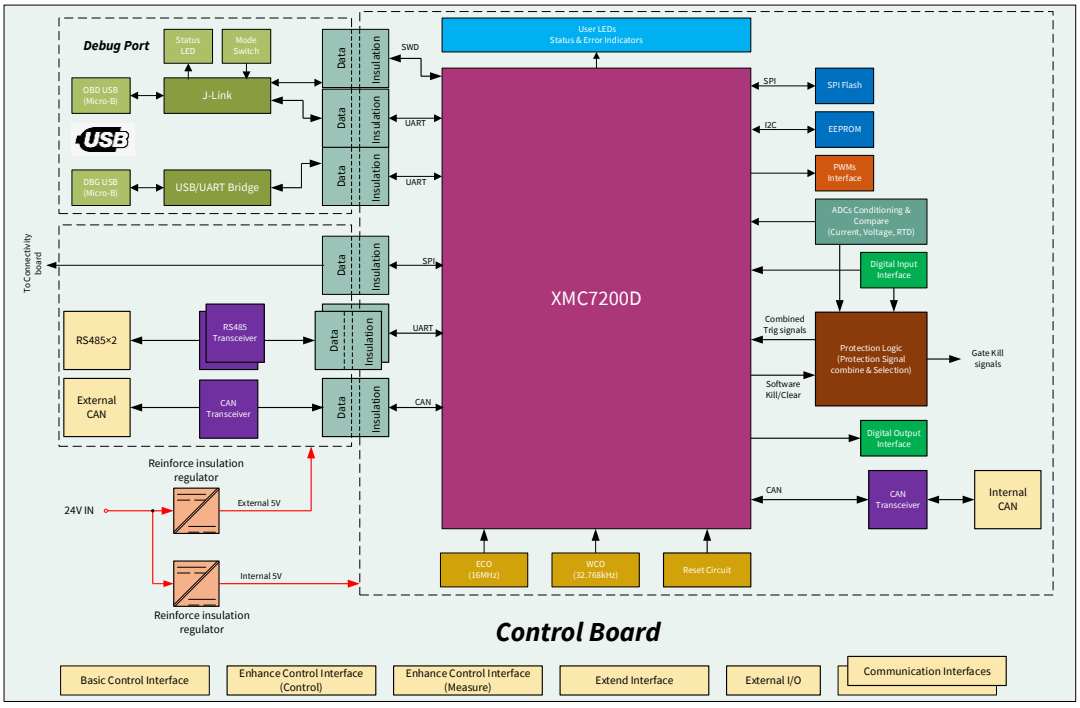

Figure 10 **PEC kit block diagram**

The board offers the following features:

- XMC7200 MCU for power conversion control
- Onboard debugger using both JTAG and UART
- CAN, SPI, I2C and RS485 interfaces
- Flash and EEPROM

- PWM interfaces
- ADCs and signal conditioning circuits
- Digital I/O interfaces
- Protection circuits
- External oscillators

The block diagram shows two step-down converters to convert the 24 V to the voltages needed for the MCU operation. The board itself offers only one of them. It has non-isolated step-down DC-DC converters and LDOs to convert the 24 V to lower voltages which are located on the hot side. The user needs to provide externally another isolated 24 V for the communication interfaces.

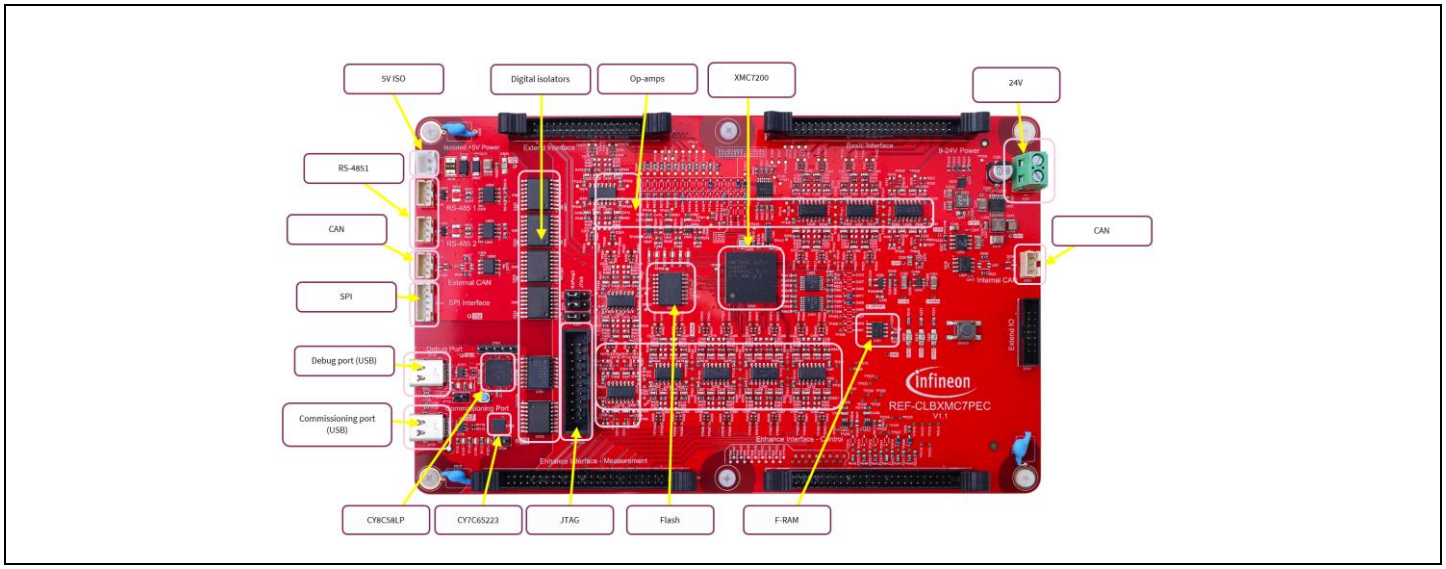

Figure 11 **Board overview**

There are two microcontrollers on the board, see Figure 11. The XMC7200 which is located on the hot side and the CY8C58LP which is located on the cold side and separated by digital isolators from the main MCU for the purpose of debugging.

1.3 Preferred Infineon Components

- XMC7200D-E272K8384AA: 32-bit Arm® Cortex®-M7 MCU
- CY8C5868LTI-LP039: Programmable embedded system-on-chip with 32-bit Arm Cortex-M3 core
- CY7C65223-24LTXI: USB-UART single channel bridge controller
- CY15E064J-SXET: 64-Kbit (8K × 8) Serial (I2C) Automotive-A F-RAM
- S25FL512SAGMFMR10: 512 Mb (64 MB) FL-S Flash
- TLE9350VSJ: High speed CAN FD transceiver
- 4DIR1400H: Digital isolator
- TLS4125D0EPV50: 2.8 MHz synchronous step-down regulator
- TLS205B0: LDO

2 Board functional description

2.1 On-board debugger

CY8C5868LTI microcontroller can be programmed and debugged using the KitProg3 which is an onboard programmer/debugger with USB-UART and USB-I2C functionality. A PSoC 5LP device is used to implement KitProg3 functionality. For more details on the KitProg3 functionality, please refer to the KitProg3 user guide.

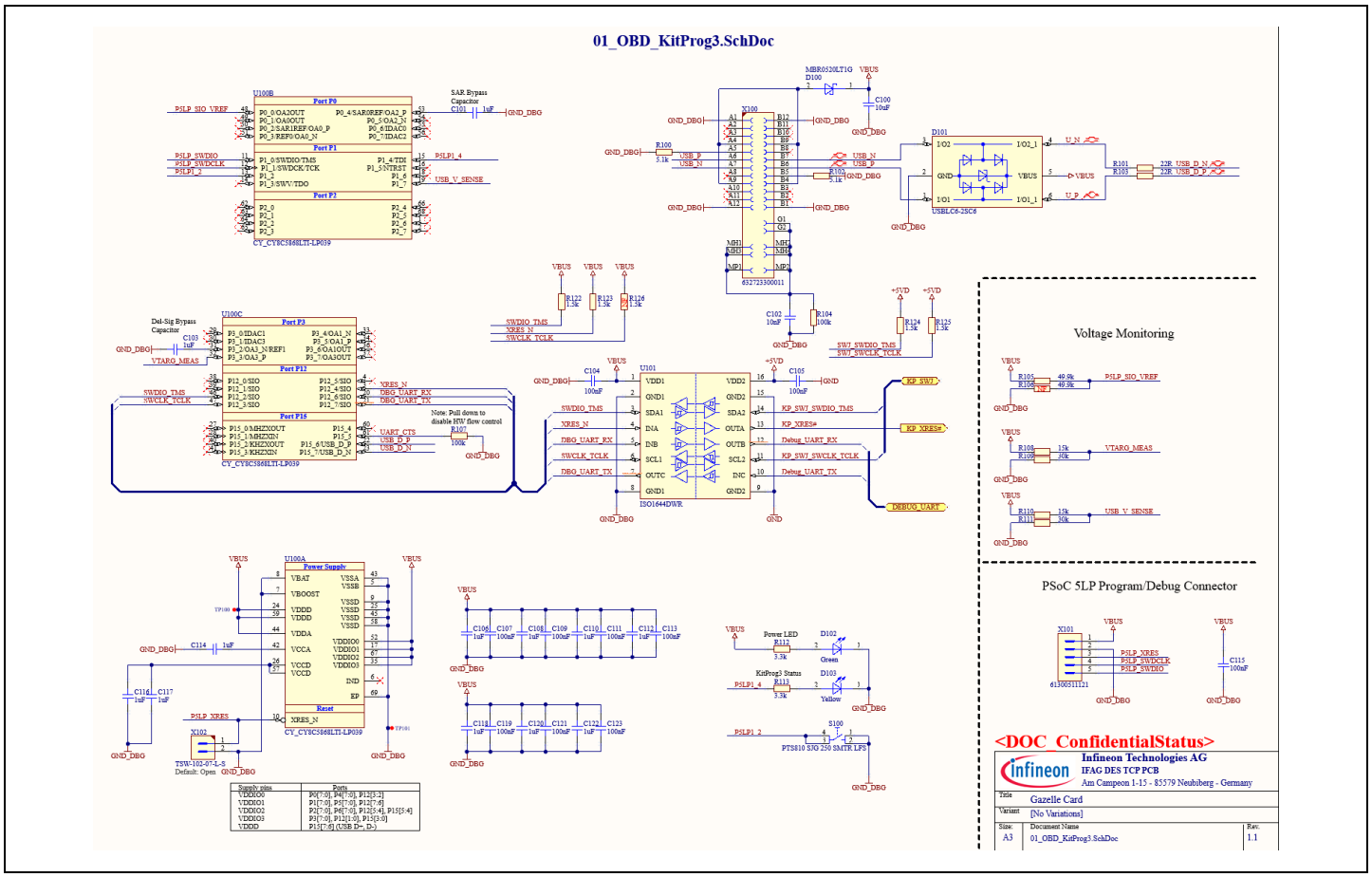

Figure 12 **On board debugger**

A standard JTAG connector is also provided on the board as shown in the following figure.

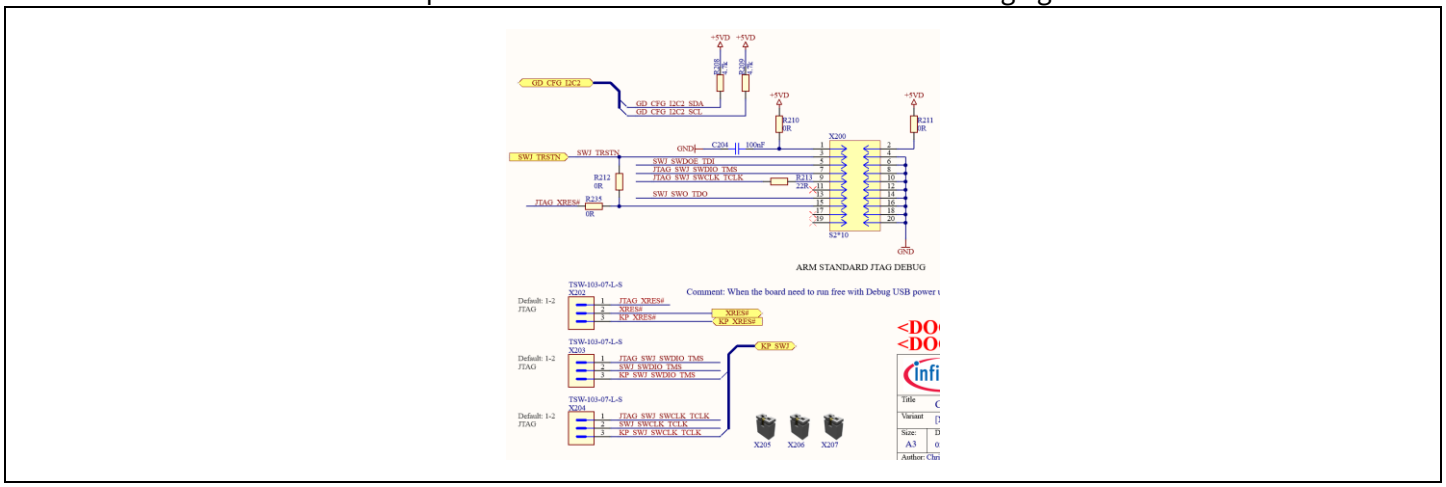

Figure 13 **JTAG connector**

2.2 Getting started after installing the ModusToolbox™ – Beginner

This section describes how to set up the basic hardware and software development environment. It explains:

- How to establish a connection to the board (hardware and software)
- How to run basic code examples on the board

2.2.1 Materials required

- Essential hardware items:
  - Board REF-CLBXMC7PEC (in the package)
  - USB cable (in the package)
  - 24 V DC power supply (arrange separately)
- Essential software item:
  - ModusToolbox™ 3.1 and above to develop code for the board
  - KitProg3 for programming/debugging the board

2.2.2 Set up the hardware

For the initial hardware setup only the board, a PC or laptop with ModusToolbox™ environment, a USB cable, and a 24 V DC power supply are required. Follow these steps:

1. Connect the connector X201 with the 24 V DC power supply. The power supply should not be “on” at this step.
2. Connect the PC or laptop via a USB cable to the USB-C connector of the board.
3. Power on the 24 V DC power supply. When the board is powered, red and green LEDs (D204 & D205) should start blinking and all three green power LEDs (D208, D209, D210) should turn on as seen in Figure 14.

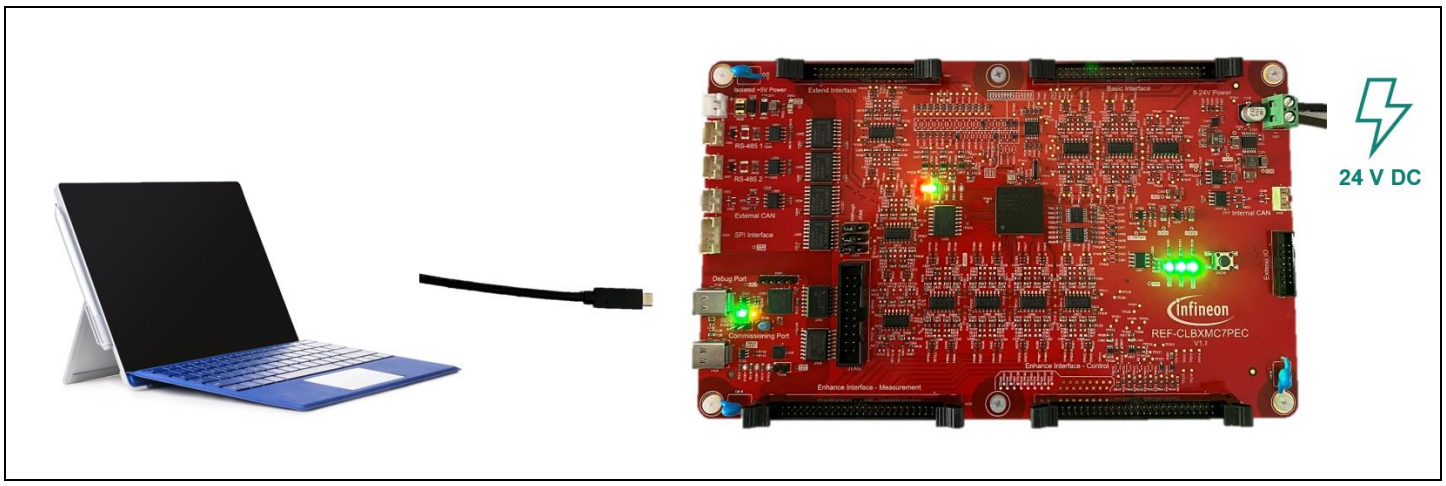

Figure 14 **Board powered on with connections**

2.2.3 Install ModusToolbox™

ModusToolbox™ software is a modern, extensible development environment that supports a wide range of Infineon microcontroller devices, such as PSoC™ Arm® Cortex® microcontrollers, XMC™ industrial microcontrollers, AIROC™ Wi-Fi devices, AIROC™ Bluetooth® devices, and USB-C power delivery microcontrollers.

The first step is to install ModusToolbox™ 3.1 or above as described here.

2.2.4 Locate the code example (CE) and program the Blinky firmware

For the initial software setup, a simple code example (blinking LEDs) is taken from GitHub and downloaded onto the board. The PC or laptop needs to be connected to the Internet to access GitHub. Follow these steps:

1. Open ModusToolbox™ and select your workspace. The default workspace location is a folder named “mtw” in the home directory. You may choose any other location for each workspace.
2. Open project creator by either selecting **File → New → ModusToolbox™** or **Start → New Application** (see Figure 15).

Note: More information on using the project creator can be found here.

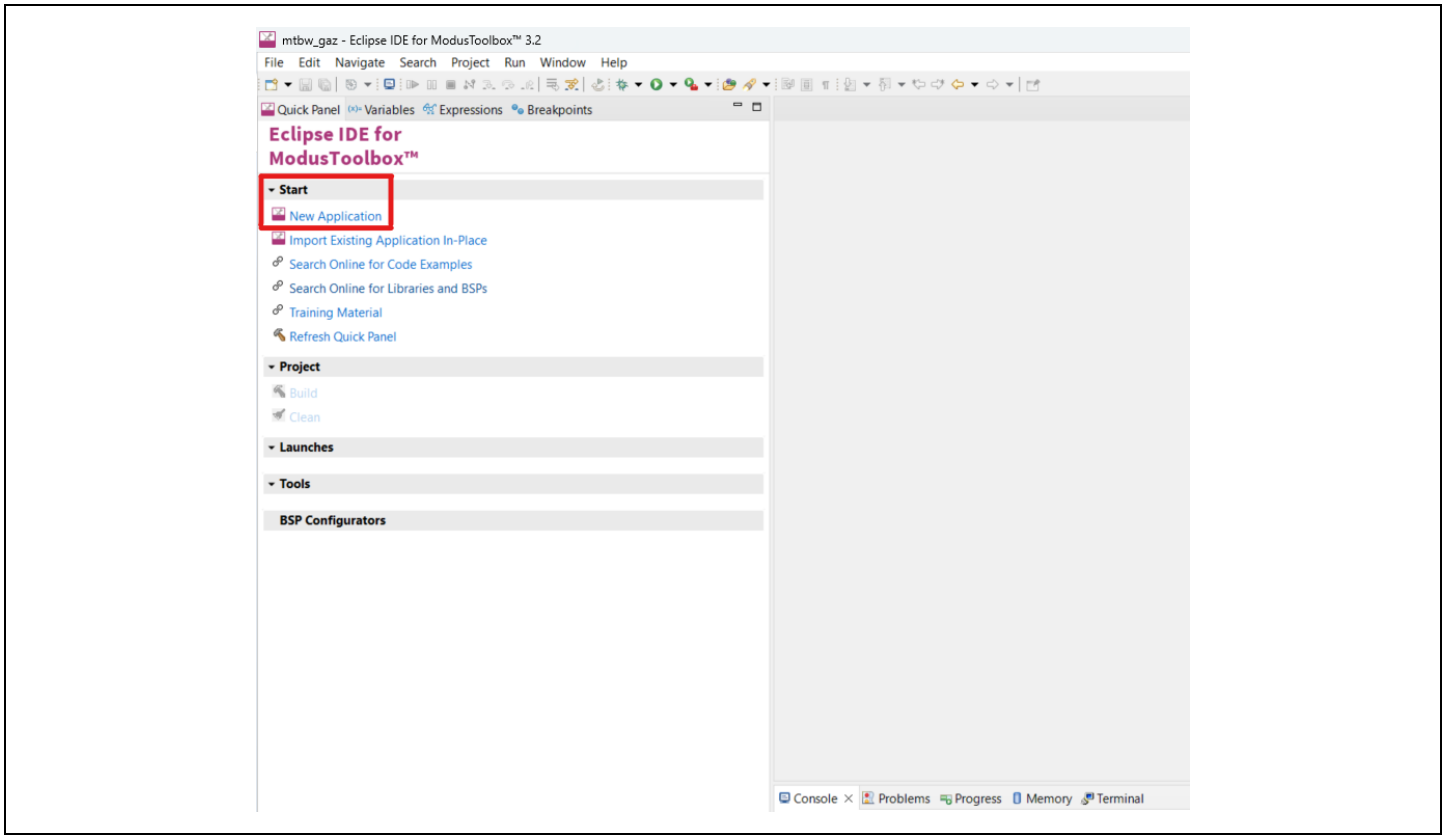

Figure 15 **New application in an empty workspace**

3. Each MCU has its own board support package (BSP). Locate the suitable BSP for the onboard MCU in the respective category – XMC™ BSPs (XMC7200D-E272K8384).

2.2.4.1 Import the Blinky code for the board

4. Select the kit name KIT_REF_CLBXMC7PEC in the category, XMC™ BSPs, and click **Next** (see Figure 16).

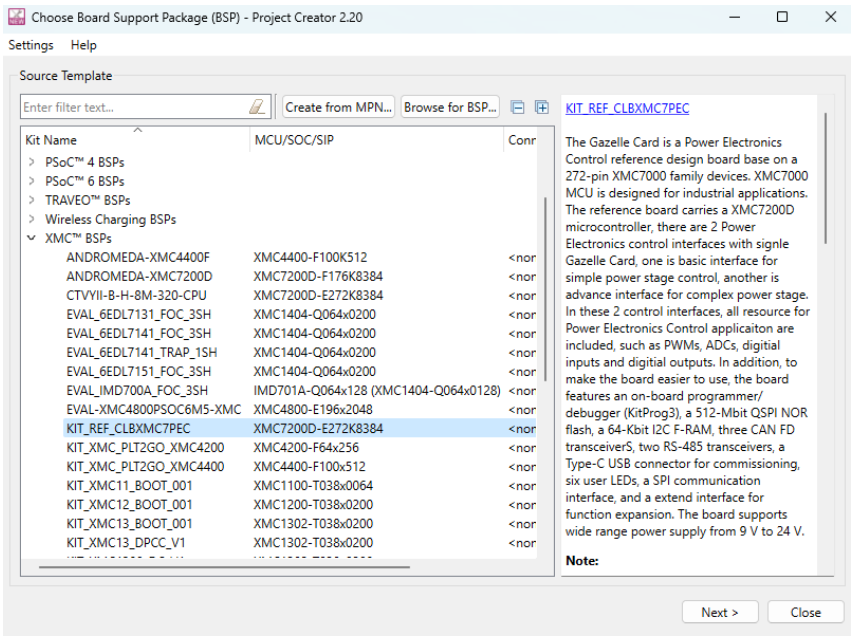

Figure 16 **Select the BSP**

5. Select **Template Application**. To run the Blinky code, “Hello World” must be selected from the Getting Started category. Then, click **Create** to automatically start the import of all necessary items.

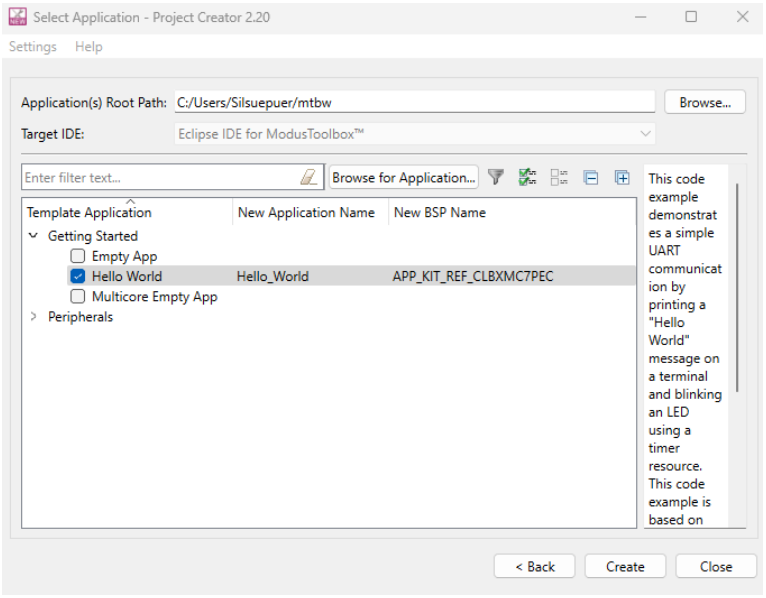

Figure 17 **Select and create the CE**

6. Wait for the import to complete. If no error message appears, the project will be available in your workspace (project explorer). You can also see the status of the project import from the console output as shown in Figure 18.

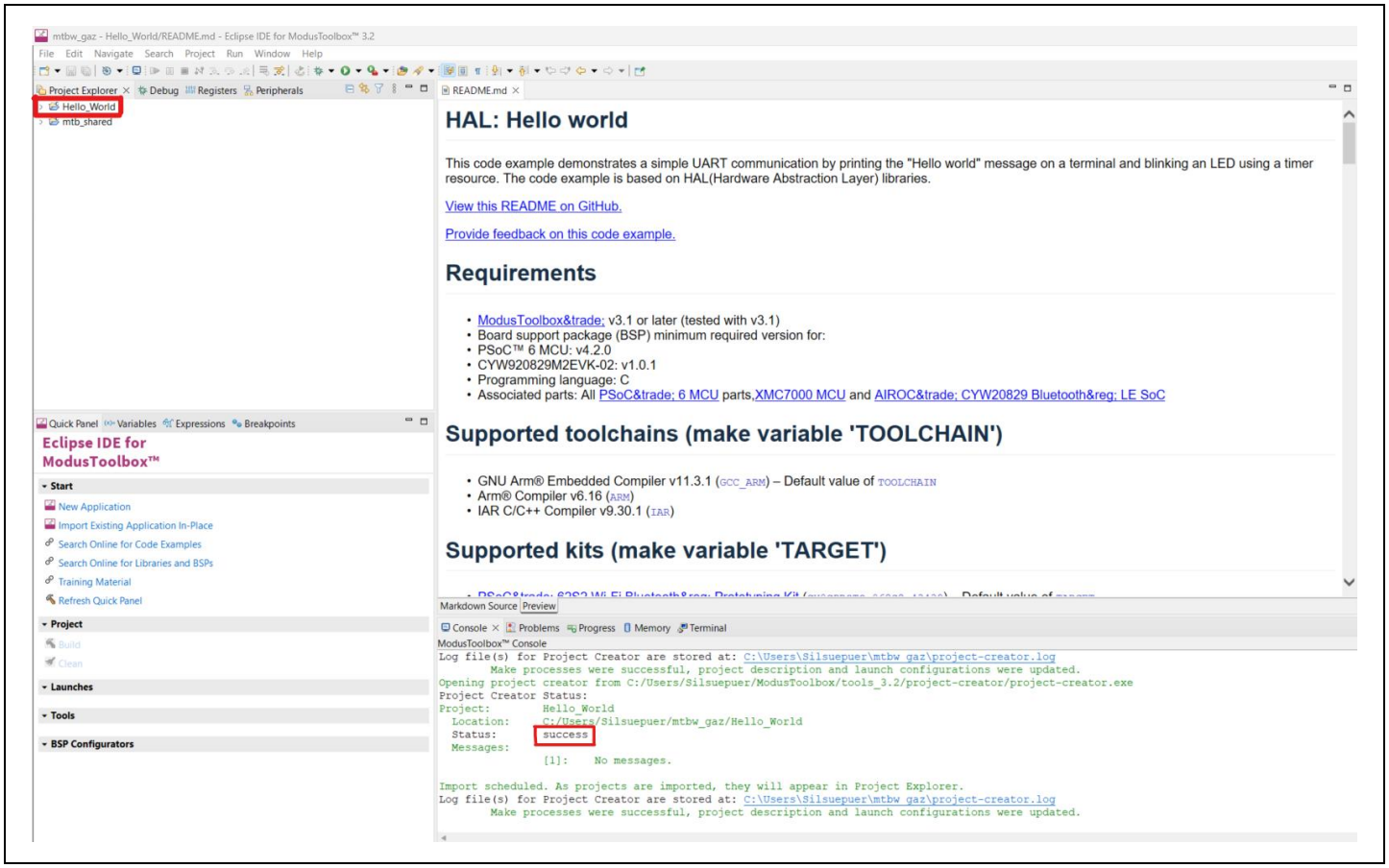

Figure 18 **Importing a new project**

7. Right-click the project **Hello_World** and select **Build Project**.
8. Search for the Hello_World Program (KitProg3_MiniProg4) in the Launches dropdown list and click it. The project will be built and then programmed into the MCU.

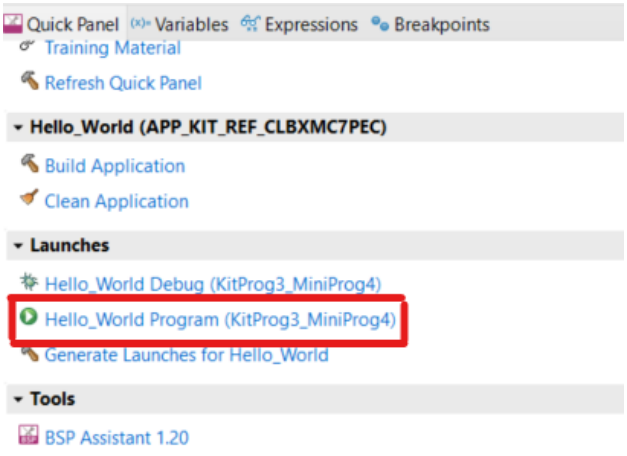

Figure 19 **Program the board**

9. The RGB LED D201 is called Blinky. It should start blinking green after programming the board.

10. A terminal emulator can be used after programming to confirm the “HAL: Hello World! Example” is displayed on the UART terminal as seen in Figure 20. For more details, please refer to the code example’s README file.

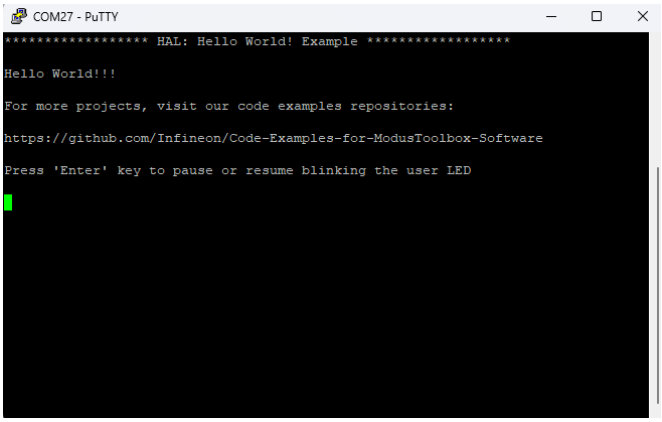

Figure 20 **Terminal output on program startup**

2.2.5 Code example (CE) for PWM generation

For initializing the code example for PWM generation, please repeat the steps 1-4 in the previous section using ModusToolbox™. Then follow the steps below:

1. Select **Template Application**. To run the PWM generation code example, “HAL PWM Square Wave” must be selected from the Peripherals category. Then, click **Create** to automatically start the import of all necessary items.

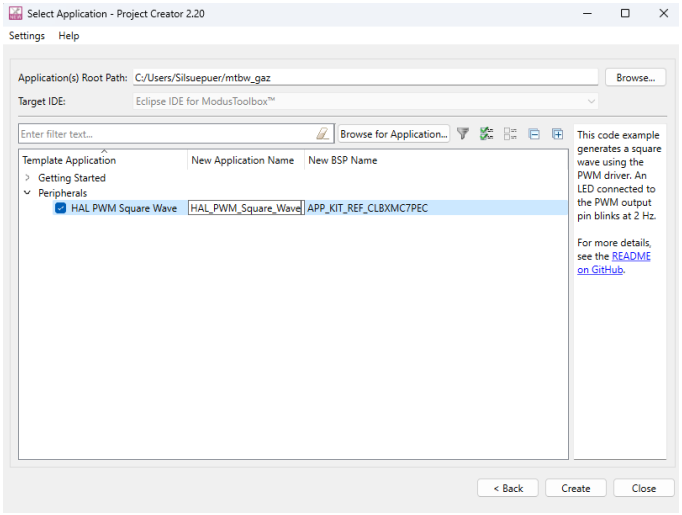

Figure 21 **Select and create the HAL PWM code example**

2. After the import of the code example is complete, you will see the project in your workspace. Right-click the project **HAL_PWM_Square_Wave** and select **Build Project**.

3. Search for the HAL_PWM_Square_Wave Program (KitProg3_MiniProg4) in the Launches dropdown list and click it. The project will be built and then programmed into the MCU.

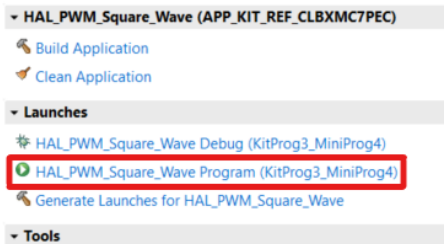

Figure 22 **Program the board with HAL PWM example**

4. After programming, the application starts automatically. The user LED (D201) should blink at half-second intervals (2 Hz).

5. The UART terminal shows the PWM initialization status.

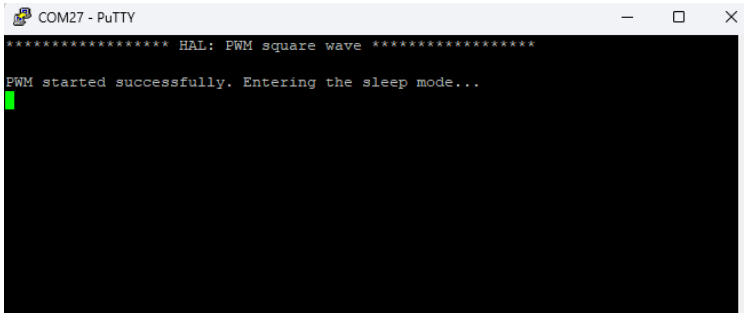

Figure 23 **Terminal output on HAL PWM example startup**

6. Generated PWM signal can also be observed from an oscilloscope by reading the signal from the user LED as seen in Figure 24. It confirms that the user LED blinks at 2 Hz with 50% duty cycle.

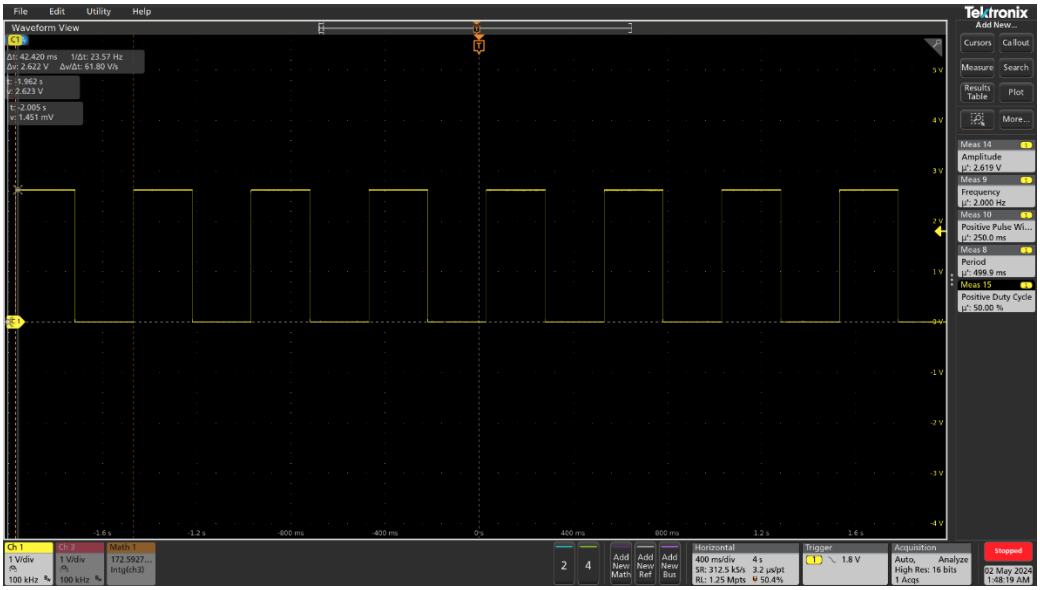

Figure 24 **Generated PWM output**

7. The frequency of the PWM signal and the duty cycle can be adjusted from the main file of the application by changing the macros accordingly.

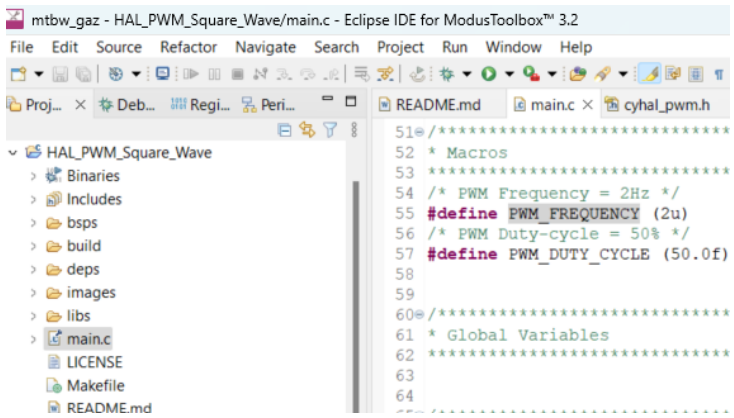

Figure 25 **Macro definitions for PWM signal frequency and duty cycle**

2.3 MCU schematics

The MCU schematics can be seen in the two following figures.

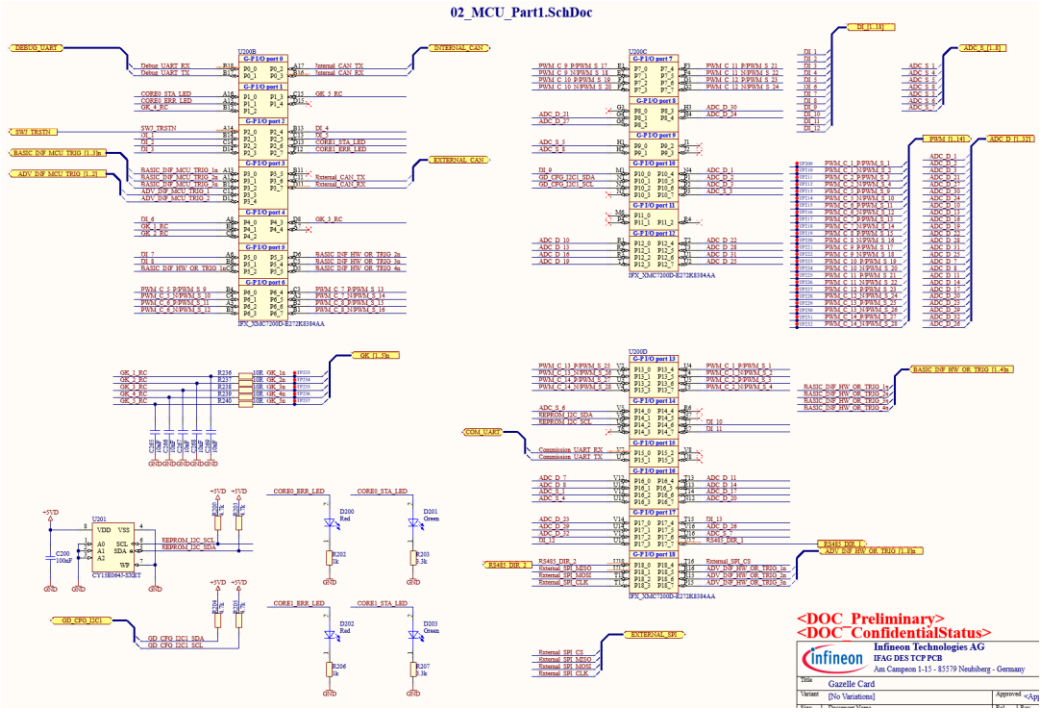

Figure 26 **MCU schematics part 1**

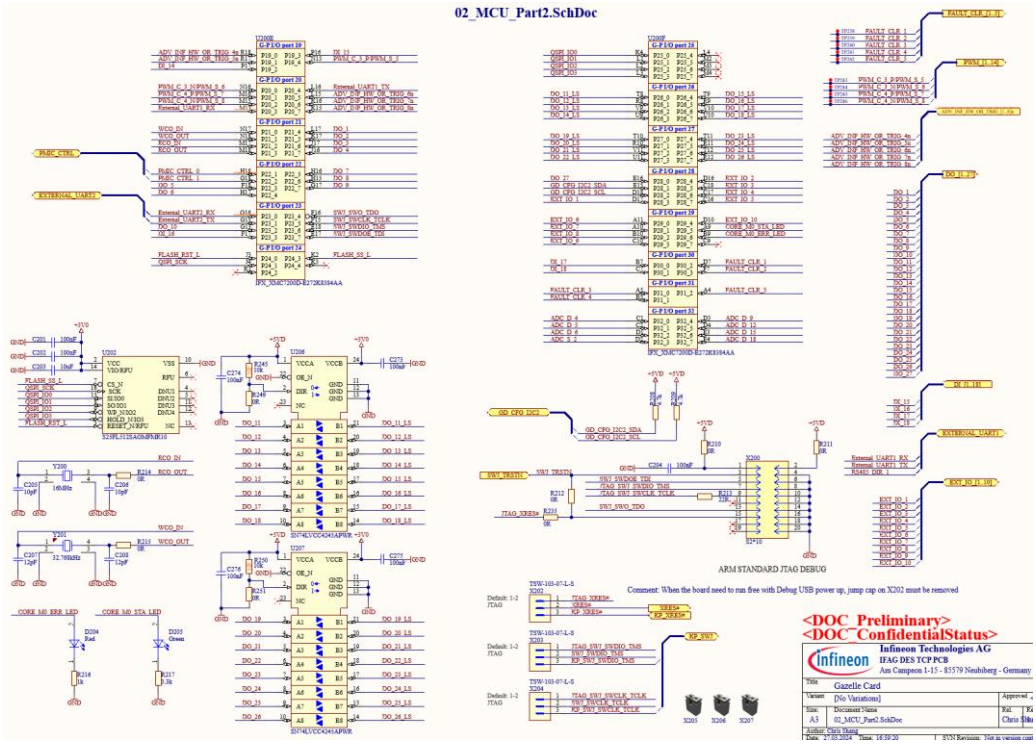

Figure 27 **MCU schematics part 2**

Two external oscillators are added to the MCU externally and can be seen in the following figure:

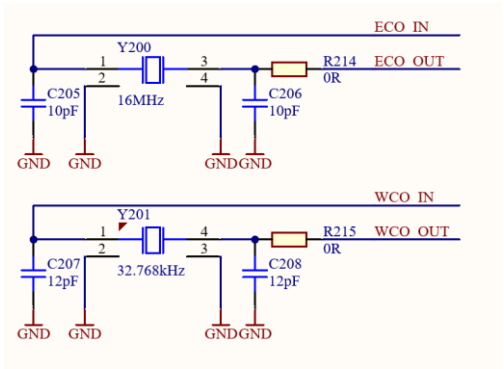

Figure 28 **MCU schematics part 2**

The F-RAM CY15E064J-SXET and the flash memory S25FL512SAGMFMR10 are added externally to the MCU. Their schematics can be seen below.

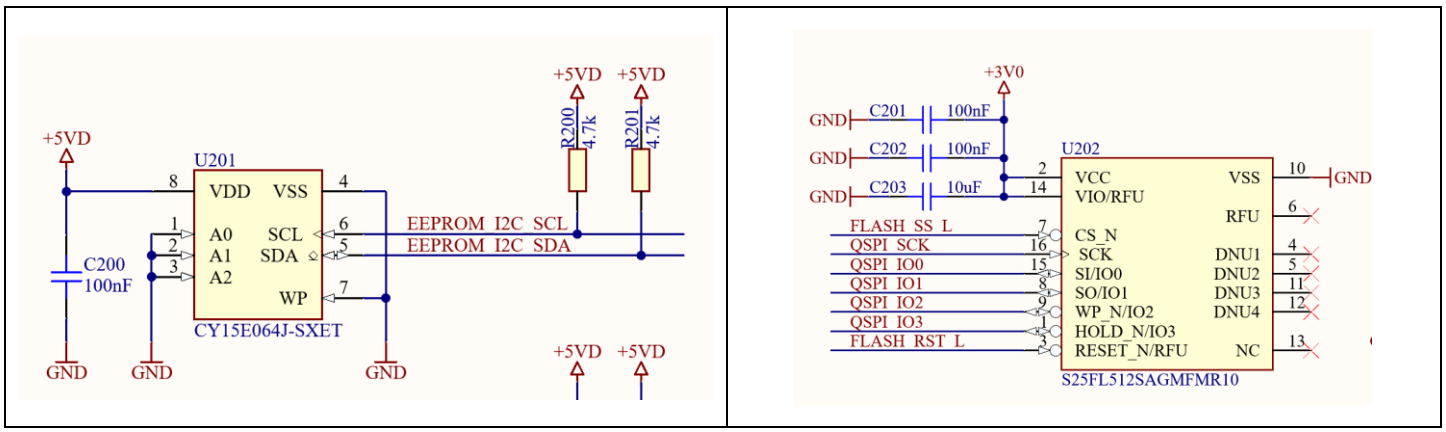

Figure 29 **F-RAM and Flash**

2.4 Power supply

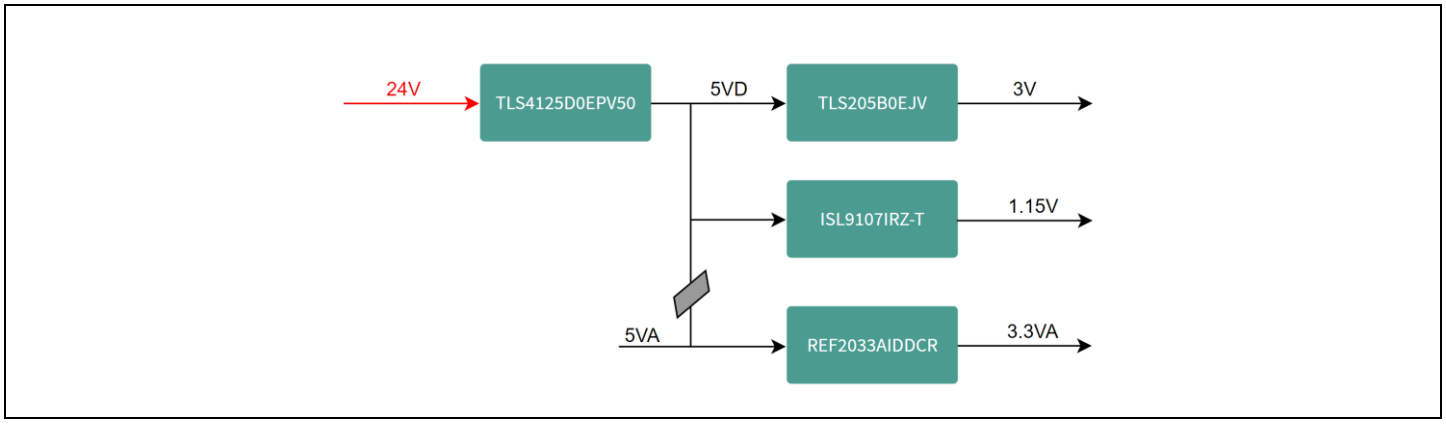

Figure 30 **Onboard power supply**

To power up the stand-alone control card, the user needs to connect an external 24 V power supply through the connector shown in the following figure:

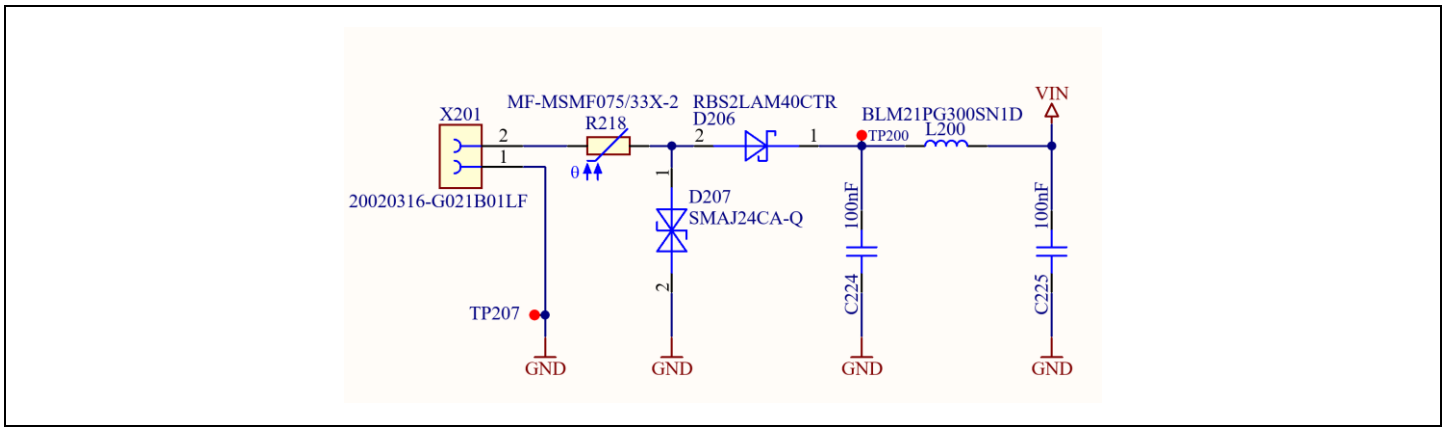

Figure 31 **24 V connector**

The 24 V is then fed to the step-down converters and LDOs shown in figure 9 to provide the MCU with 1.15 V, 5 V and 3 V. It also provides the analog circuitry with 5 V which is connected to the 5 V used for the digital circuits using a ferrite bead.

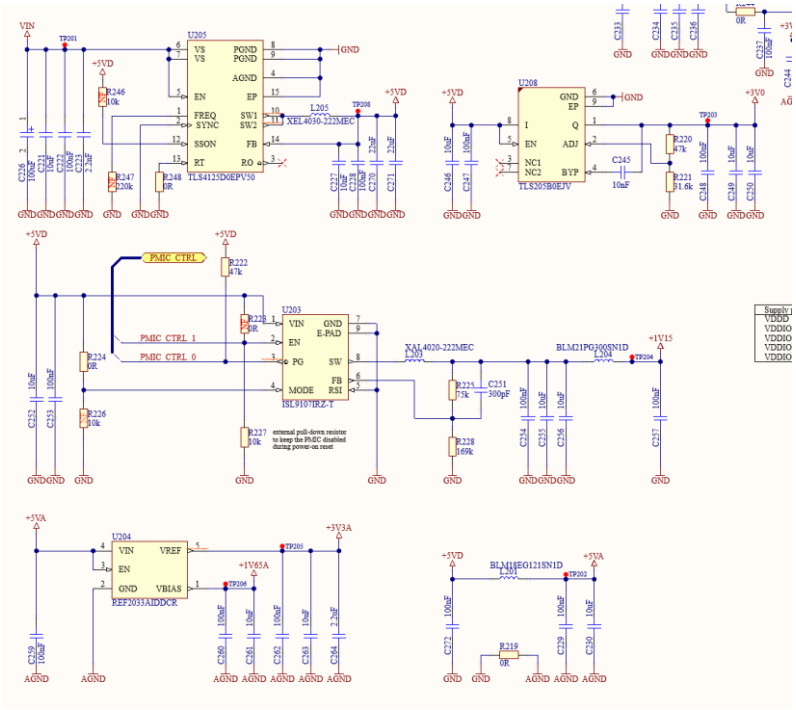

Figure 32 **Step-down DC-DC converters and LDOs**

The 24 V is not needed if the 5 V are provided by the power conversion boards that will be interfaced with this board through the 4 connectors on the edge of the board. These interfaces will be discussed in detail in the connectors section.

2.5 Measurements

The board comes with signal conditioning circuits. It has a total of 40 Op-amps on board to be directly interfaced with the measurement signals coming from the power conversion board.

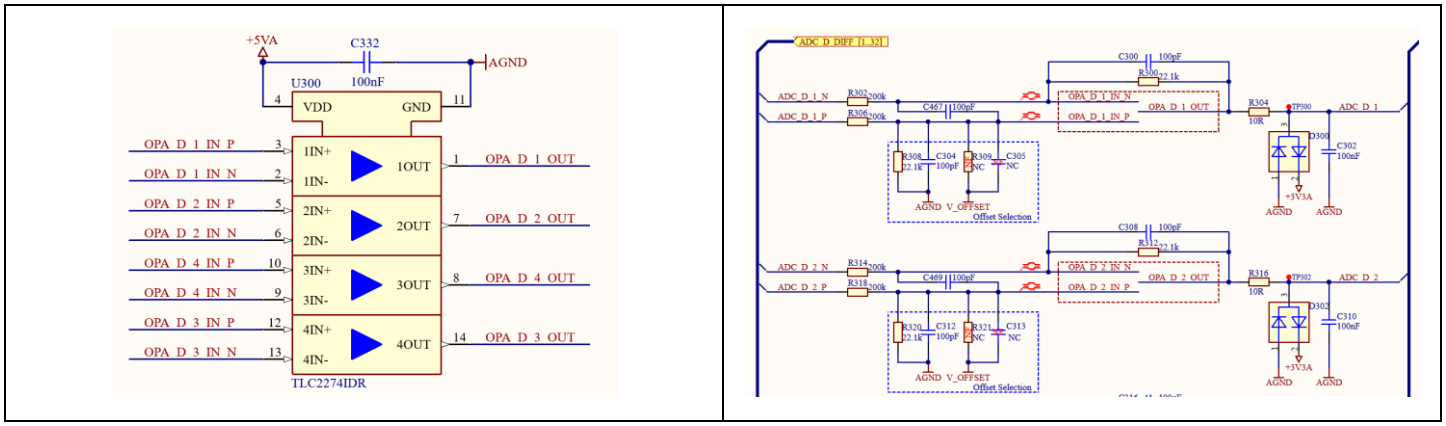

Figure 33 **Op-amps**

The gain values and the filters can be adjusted by the user depending on the need. An offset voltage that is adjustable by changing the values of the resistive voltage divider is also provided.

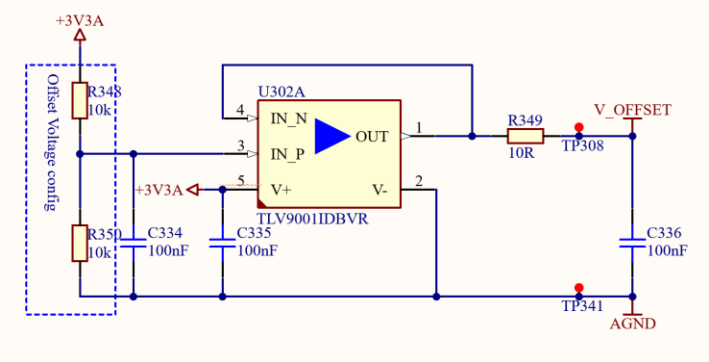

Figure 34 **Offset voltage**

2.6 Protection

The user can choose certain ADC signals to trigger protection functions. This is done by comparing the selected ADC signals to threshold values that are configurable by changing the values of resistive voltage dividers. These signals are then fed to the GPIOs of the MCU.

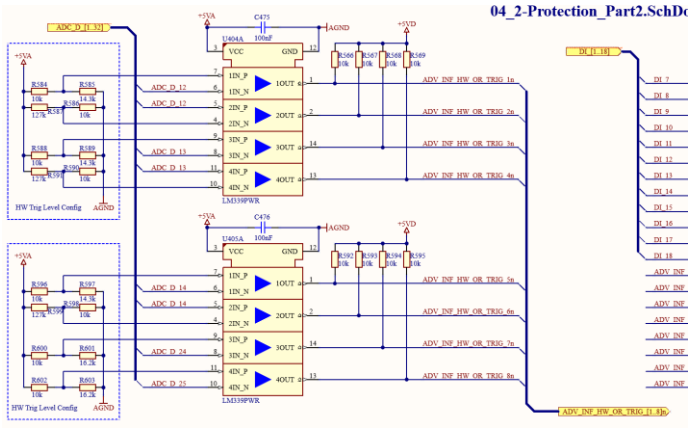

Figure 35 **Hardware trigger level configuration**

These signals along with digital inputs chosen by the user pass through a protection matrix by using diodes and the fault signals are then combined and fed to a latch circuit and then go to the GPIOs of the MCU.

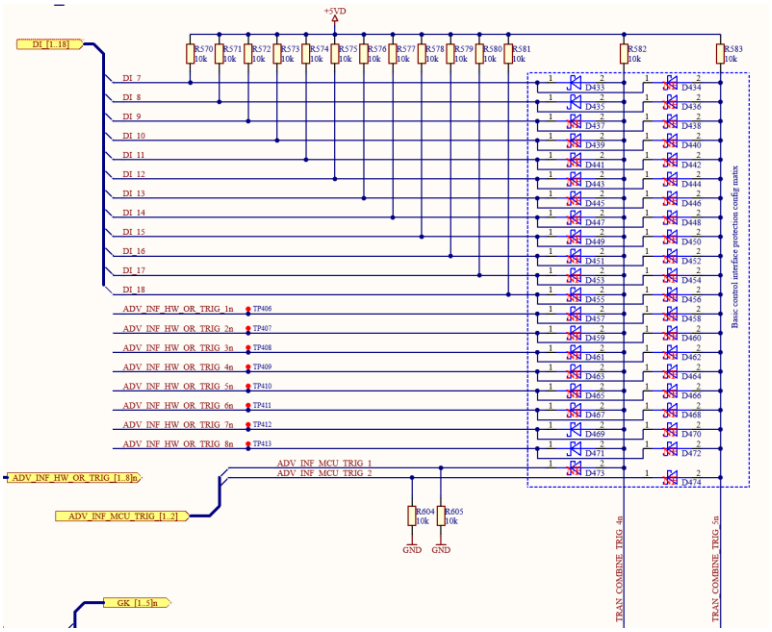

Figure 36 **Protection matrix**

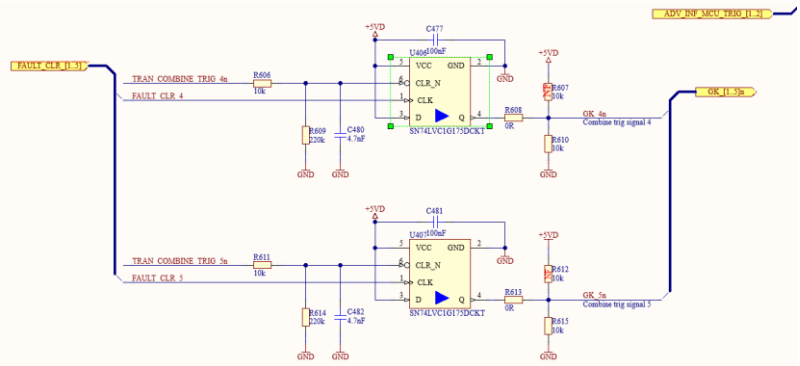

Figure 37 **Flip-flop circuits**

2.7 Communication

Several communication interfaces are provided on the board. These interfaces are:

- 2 RS-485 interfaces (isolated)
- External CAN interface (isolated)
- External SPI interface (isolated)
- Internal CAN interface (non-isolated): useful for interfacing a second control board

The isolation is achieved using digital isolators as seen in the following figures.

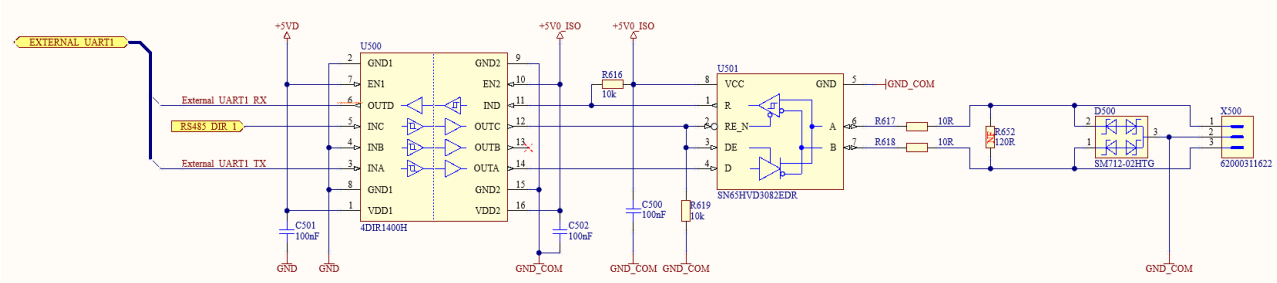

Figure 38 **RS-485 interface**

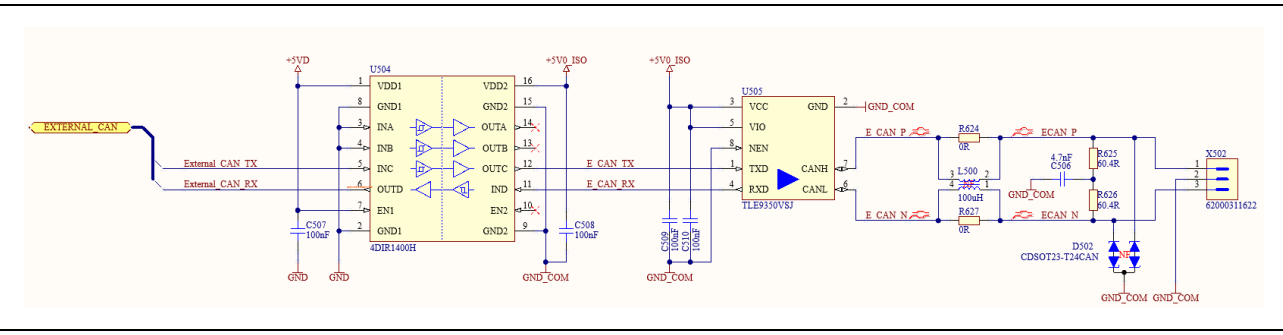

Figure 39 **External CAN interface**

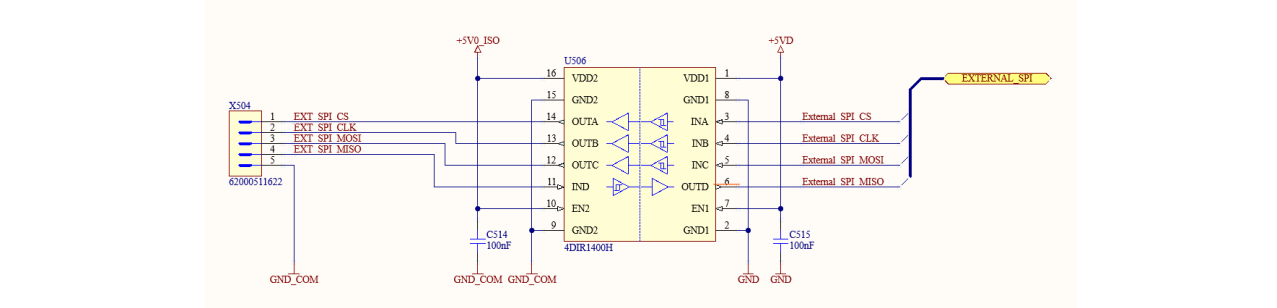

Figure 40 **External SPI interface**

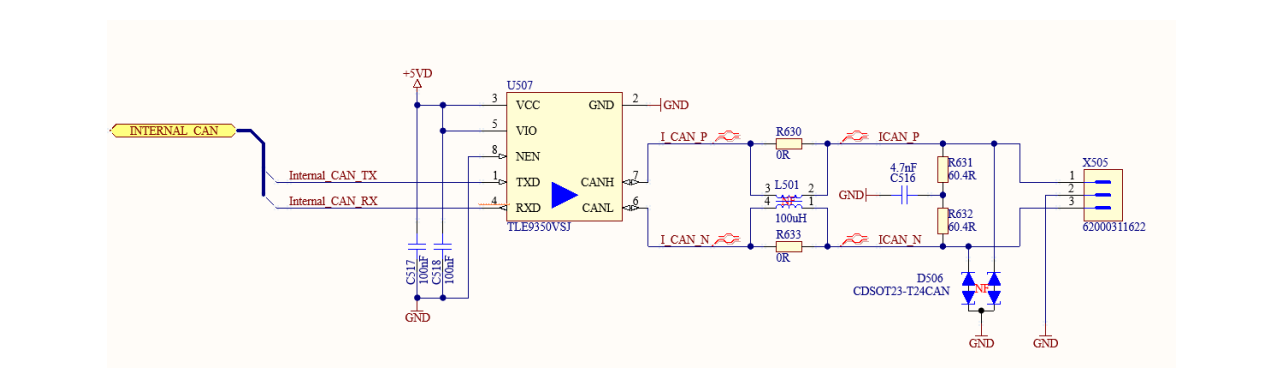

Figure 41 **Internal CAN interface**

A 5 V isolated power supply needs to be provided externally by the user through the connector shown in the following figure.

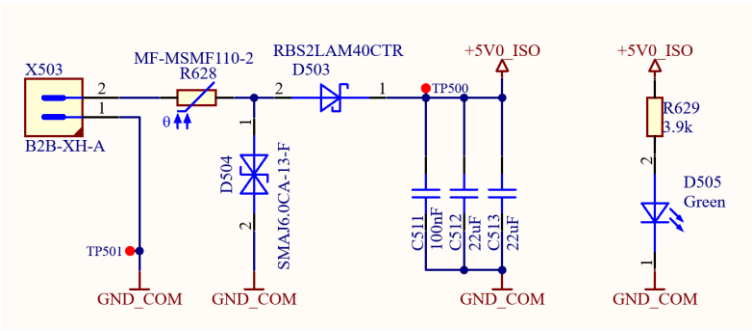

Figure 42 **5 V isolated power supply connector**

3 Signal connectors

There are 4 main connectors to interface the control board with power conversion boards. These connectors are:

- Basic interface
- Enhanced interface-Control
- Enhanced-interface-Measure
- Extended interface

These connectors provide the interface for the measurements and control functions. One example of how to interface the various topologies mentioned in the beginning is shown in the following tables:

Table 2 Basic interface

Basic Interface (Boost with 3 inputs, 2 leg Buck/Boost, PFC)			
No,	**Resource Name**	**Number**	**Comments**
1	PWM (Complementary)	4	1 complementary PWM can also be used as 2 single PWMs
2	PWM (Single)	8	For whole system will totally support 4 PWMs(8 single PWMs), function can be adjust with requirements
3	Differential ADC	8	Max Requirement
4	Signel End ADC	3	For NTC
5	Protection DIs	6	Trig PWMs Stop
6	Other DIs	0	General Purpose
7	Dos	3	General Purpose & Fault Clear
8	I2C	1	Gate driver config

Table 3 Enhanced interface

Enhanced Interface (NPC1, NPC2, ANPC, DAB, B6, CLLC)			
No,	**Resource Name**	**Number**	**Comments**
1	PWM (Complementary)	10	1 complementary PWM can also be used as 2 single PWMs
2	PWM (Single)	20	The whole system will totally support 10 PWMs (20 single PWMs), function can be adjusted with requirements
3	Differential ADC	23	Max Requirement
4	Signel End ADC	3	For NTC
5	Protection DIs	6	Trig PWMs Stop
6	Other DIs	2	General Purpose
7	Dos	5	General Purpose & Fault Clear
8	I2C	1	Gate driver config

Table 4 Communication interface

Communication Interface			
No,	**Resource Name**	**Number**	**Comments**
1	UART	3	EMS *1, Meter * 1, Debug *1
2	CAN	1	BMS
3	SPI	2	Internal communication with connectivity board, Flash
4	I2C	1	EEPROM

Table 5 Extended interface

Extended IO Interface - For external IO Board			
No,	**Resource Name**	**Number**	**Comments**
1	DO	8	Break control, indicators
2	DI	8	Break feedback, emergency stop, Fault reset

Note: In case the 5 V rail is provided through the power conversion boards, the user doesn't need to connect an external 24 V supply to the control board.

The details of the signals on these connectors is shown in the upcoming sub-sections.

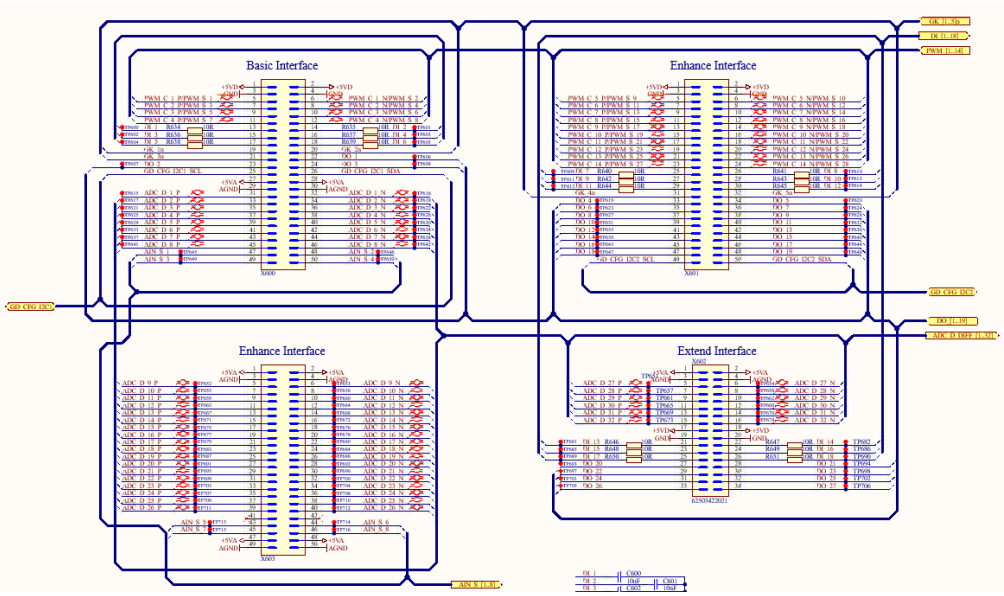

Figure 43 **Protection matrix**

3.1 Basic interface

Table 6 Basic interface signals

Pin	Name	Function description	Comments
1	+5VD	Digtial Power	
2	+5VD	Digtial Power	
3	DGND	Digtial Power	
4	DGND	Digtial Power	
5	PWM_C_1_P/PWM_S_1	Complementary PWM 1 Positive/Single PWM 1	
6	PWM_C_1_N/PWM_S_2	Complementary PWM 1 Negative/Single PWM 2	
7	PWM_C_2_P/PWM_S_3	Complementary PWM 2 Positive/Single PWM 3	
8	PWM_C_2_N/PWM_S_4	Complementary PWM 2 Negative/Single PWM 4	
9	PWM_C_3_P/PWM_S_5	Complementary PWM 3 Positive/Single PWM 5	
10	PWM_C_3_N/PWM_S_6	Complementary PWM 3 Negative/Single PWM 6	

11	PWM_C_4_P/PWM_S_7	Complementary PWM 4 Positive/Single PWM 7	
12	PWM_C_5_N/PWM_S_8	Complementary PWM 4 Negative/Single PWM 8	
13	DI_1	Digtial Input 1 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
14	DI_2	Digtial Input 2 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
15	DI_3	Digtial Input 3 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
16	DI_4	Digtial Input 4 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
17	DI_5	Digtial Input 5 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
18	DI_6	Digtial Input 6 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
19	GK1	Gate Kill 1 to power stage / Enable	
20	GK2	Gate Kill 2 to power stage / Enable	
21	GK3	Gate Kill 3 to power stage / Enable	
22	DO_1	Digtial output 1	Fault Clear, Gate Driver Control
23	DO_2	Digtial output 2	Fault Clear, Gate Driver Control
24	DO_3	Digtial output 3	Fault Clear, Gate Driver Control
25	I2C1_SCL	I2C Bus 1 Clock	Gate Driver Config
26	I2C1_SDA	I2C Bus 2 Clock	Gate Driver Config
27	+5VA	Analog Power	
28	+5VA	Analog Power	
29	AGND	Analog Power	
30	AGND	Analog Power	
31	AIN_D_1_P	Differential Analog Input 1 Positive	With hardware over range trig PWM kill
32	AIN_D_1_N	Differential Analog Input 1 Negative	
33	AIN_D_2_P	Differential Analog Input 2 Positive	With hardware over range trig PWM kill
34	AIN_D_2_N	Differential Analog Input 2 Negative	
35	AIN_D_3_P	Differential Analog Input 3 Positive	With hardware over range trig PWM kill
36	AIN_D_3_N	Differential Analog Input 3 Negative	
37	AIN_D_4_P	Differential Analog Input 4 Positive	
38	AIN_D_4_N	Differential Analog Input 4 Negative	
39	AIN_D_5_P	Differential Analog Input 5 Positive	
40	AIN_D_5_N	Differential Analog Input 5 Negative	
41	AIN_D_6_P	Differential Analog Input 6 Positive	
42	AIN_D_6_N	Differential Analog Input 6 Negative	
43	AIN_D_7_P	Differential Analog Input 7 Positive	With hardware over range trig PWM kill
44	AIN_D_7_N	Differential Analog Input 7 Negative	
45	AIN_D_8_P	Differential Analog Input 8 Positive	
46	AIN_D_8_N	Differential Analog Input 8 Negative	
47	AIN_S_1	Single end Analog Input 1	NTC / Genral purpose
48	AIN_S_2	Single end Analog Input 2	NTC / Genral purpose
49	AIN_S_3	Single end Analog Input 3	NTC / Genral purpose

50	AIN_S_4	Single end Analog Input 4	NTC / Genral purpose

3.2 Enhanced interface-Control

Table 7 Enhanced interface-Control

Pin	Name	Function description	Comments
1	+5VD	Digtial Power	
2	+5VD	Digtial Power	
3	DGND	Digtial Power	
4	DGND	Digtial Power	
5	PWM_C_5_P/PWM_S_9	Complementary PWM 5 Positive/Single PWM 9	
6	PWM_C_5_N/PWM_S_10	Complementary PWM 5 Negative/Single PWM 10	
7	PWM_C_6_P/PWM_S_11	Complementary PWM 6 Positive/Single PWM 11	
8	PWM_C_6_N/PWM_S_12	Complementary PWM 6 Negative/Single PWM 12	
9	PWM_C_7_P/PWM_S_13	Complementary PWM 7 Positive/Single PWM 13	
10	PWM_C_7_N/PWM_S_14	Complementary PWM 7 Negative/Single PWM 14	
11	PWM_C_8_P/PWM_S_15	Complementary PWM 8 Positive/Single PWM 15	
12	PWM_C_8_N/PWM_S_16	Complementary PWM 8 Negative/Single PWM 16	
13	PWM_C_9_P/PWM_S_17	Complementary PWM 9 Positive/Single PWM 17	
14	PWM_C_9_N/PWM_S_18	Complementary PWM 9 Negative/Single PWM 18	
15	PWM_C_10_P/PWM_S_19	Complementary PWM 10 Positive/Single PWM 19	
16	PWM_C_10_N/PWM_S_20	Complementary PWM 10 Negative/Single PWM 20	
17	PWM_C_11_P/PWM_S_21	Complementary PWM 11 Positive/Single PWM 21	
18	PWM_C_11_N/PWM_S_22	Complementary PWM 11 Negative/Single PWM 22	
19	PWM_C_12_P/PWM_S_23	Complementary PWM 12 Positive/Single PWM 23	
20	PWM_C_12_N/PWM_S_24	Complementary PWM 12 Negative/Single PWM 24	
21	PWM_C_13_P/PWM_S_25	Complementary PWM 13 Positive/Single PWM 25	
22	PWM_C_13_N/PWM_S_26	Complementary PWM 13 Negative/Single PWM 26	
23	PWM_C_14_P/PWM_S_27	Complementary PWM 14 Positive/Single PWM 27	

24	PWM_C_14_N/PWM_S_28	Complementary PWM 14 Negative/Single PWM 28	
25	DI_7	Digtial Input 7 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
26	DI_8	Digtial Input 8 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
27	DI_9	Digtial Input 9 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
28	DI_10	Digtial Input 10 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
29	DI_11	Digtial Input 11 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
30	DI_12	Digtial Input 12 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
31	GK4	Gate Kill 4 to power stage / Enable	
32	GK5	Gate Kill 5 to power stage / Enable	
33	DO_4	Digtial output 4	Fault Clear, Gate Driver Control, Relay Control
34	DO_5	Digtial output 5	Fault Clear, Gate Driver Control, Relay Control
35	DO_6	Digtial output 6	Fault Clear, Gate Driver Control, Relay Control
36	DO_7	Digtial output 7	Fault Clear, Gate Driver Control, Relay Control
37	DO_8	Digtial output 8	Fault Clear, Gate Driver Control, Relay Control
38	DO_9	Digtial output 9	Fault Clear, Gate Driver Control, Relay Control
39	DO_10	Digtial output 10	Fault Clear, Gate Driver Control, Relay Control
40	DO_11	Digtial output 11	Fault Clear, Gate Driver Control, Relay Control
41	DO_12	Digtial output 12	Fault Clear, Gate Driver Control, Relay Control
42	DO_13	Digtial output 13	Fault Clear, Gate Driver Control, Relay Control
43	DO_14	Digtial output 14	Fault Clear, Gate Driver Control, Relay Control
44	DO_15	Digtial output 15	Fault Clear, Gate Driver Control, Relay Control
45	DO_16	Digtial output 16	Fault Clear, Gate Driver Control, Relay Control
46	DO_17	Digtial output 17	Fault Clear, Gate Driver Control, Relay Control
47	DO_18	Digtial output 18	Fault Clear, Gate Driver Control, Relay Control

48	DO_19	Digtial output 19	Fault Clear, Gate Driver Control, Relay Control
49	I2C2_SCL	I2C Bus 1 Clock	Gate Driver Config
50	I2C2_SDA	I2C Bus 2 Clock	Gate Driver Config

3.3 Enhanced interface-Measure

Table 8 Enhanced interface-Measure

Pin	Name	Function description	Comments
1	+5VA	Analog Power	
2	+5VA	Analog Power	
3	AGND	Analog Power	
4	AGND	Analog Power	
5	AIN_D_9_P	Differential Analog Input 9 Positive	
6	AIN_D_9_N	Differential Analog Input 9 Negative	
7	AIN_D_10_P	Differential Analog Input 10 Positive	
8	AIN_D_10_N	Differential Analog Input 10 Negative	
9	AIN_D_11_P	Differential Analog Input 11 Positive	
10	AIN_D_11_N	Differential Analog Input 11 Negative	
11	AIN_D_12_P	Differential Analog Input 12 Positive	With hardware over range trig PWM kill
12	AIN_D_12_N	Differential Analog Input 12 Negative	
13	AIN_D_13_P	Differential Analog Input 13 Positive	With hardware over range trig PWM kill
14	AIN_D_13_N	Differential Analog Input 13 Negative	
15	AIN_D_14_P	Differential Analog Input 14 Positive	With hardware over range trig PWM kill
16	AIN_D_14_N	Differential Analog Input 14 Negative	
17	AIN_D_15_P	Differential Analog Input 15 Positive	
18	AIN_D_15_N	Differential Analog Input 15 Negative	
19	AIN_D_16_P	Differential Analog Input 16 Positive	
20	AIN_D_16_N	Differential Analog Input 16 Negative	
21	AIN_D_17_P	Differential Analog Input 17 Positive	
22	AIN_D_17_N	Differential Analog Input 17 Negative	
23	AIN_D_18_P	Differential Analog Input 18 Positive	
24	AIN_D_18_N	Differential Analog Input 18 Negative	
25	AIN_D_19_P	Differential Analog Input 19 Positive	
26	AIN_D_19_N	Differential Analog Input 19 Negative	
27	AIN_D_20_P	Differential Analog Input 20 Positive	
28	AIN_D_20_N	Differential Analog Input 20 Negative	
29	AIN_D_21_P	Differential Analog Input 21 Positive	
30	AIN_D_21_N	Differential Analog Input 21 Negative	
31	AIN_D_22_P	Differential Analog Input 22 Positive	
32	AIN_D_22_N	Differential Analog Input 22 Negative	
33	AIN_D_23_P	Differential Analog Input 23 Positive	
34	AIN_D_23_N	Differential Analog Input 23 Negative	
35	AIN_D_24_P	Differential Analog Input 24 Positive	With hardware over range trig PWM kill
36	AIN_D_24_N	Differential Analog Input 24 Negative	

37	AIN_D_25_P	Differential Analog Input 25 Positive	With hardware over range trig PWM kill
38	AIN_D_25_N	Differential Analog Input 25 Negative	
39	AIN_D_26_P	Differential Analog Input 26 Positive	
40	AIN_D_26_N	Differential Analog Input 26 Negative	
41	NC	NC	NC
42	NC	NC	NC
43	AIN_S_5	Single end Analog Input 1	NTC / Genral purpose
44	AIN_S_6	Single end Analog Input 2	NTC / Genral purpose
45	AIN_S_7	Single end Analog Input 3	NTC / Genral purpose
46	AIN_S_8	Single end Analog Input 4	NTC / Genral purpose
47	+5VA	Analog Power	
48	+5VA	Analog Power	
49	AGND	Analog Power	
50	AGND	Analog Power	

3.4 Extended interface

Table 9 Extended interface

Pin	Name	Function description	Comments
1	+5VA	Analog Power	
2	+5VA	Analog Power	
3	AGND	Analog Power	
4	AGND	Analog Power	
5	AIN_D_27_P	Differential Analog Input 27 Positive	
6	AIN_D_27_N	Differential Analog Input 27 Negative	
7	AIN_D_28_P	Differential Analog Input 28 Positive	
8	AIN_D_28_N	Differential Analog Input 28 Negative	
9	AIN_D_29_P	Differential Analog Input 29 Positive	
10	AIN_D_29_N	Differential Analog Input 29 Negative	
11	AIN_D_30_P	Differential Analog Input 30 Positive	
12	AIN_D_30_N	Differential Analog Input 30 Negative	
13	AIN_D_31_P	Differential Analog Input 31 Positive	
14	AIN_D_31_N	Differential Analog Input 31 Negative	
15	AIN_D_32_P	Differential Analog Input 32 Positive	
16	AIN_D_32_N	Differential Analog Input 32 Negative	
17	+5VD	Digtial Power	
18	+5VD	Digtial Power	
19	DGND	Digtial Power	
20	DGND	Digtial Power	
21	DI_13	Digtial Input 13 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
22	DI_14	Digtial Input 14 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
23	DI_15	Digtial Input 15 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW

24	DI_16	Digtial Input 16 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
25	DI_17	Digtial Input 17 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
26	DI_18	Digtial Input 18 with hardware PWM trig/Genral Purpose	PWM Kill option with MCU or HW
27	DO_20	Digtial output 20	Fault Clear, Gate Driver Control, Relay Control
28	DO_21	Digtial output 21	Fault Clear, Gate Driver Control, Relay Control
29	DO_22	Digtial output 22	Fault Clear, Gate Driver Control, Relay Control
30	DO_23	Digtial output 23	Fault Clear, Gate Driver Control, Relay Control
31	DO_24	Digtial output 24	Fault Clear, Gate Driver Control, Relay Control
32	DO_25	Digtial output 25	Fault Clear, Gate Driver Control, Relay Control
33	DO_26	Digtial output 26	Fault Clear, Gate Driver Control, Relay Control
34	DO_27	Digtial output 27	Fault Clear, Gate Driver Control, Relay Control

4 Board layout

Table 10 Mechanical data

Dimensions	200 mm x 120 mm
No. of layers	8
Copper thickness	35 µm
Weight	

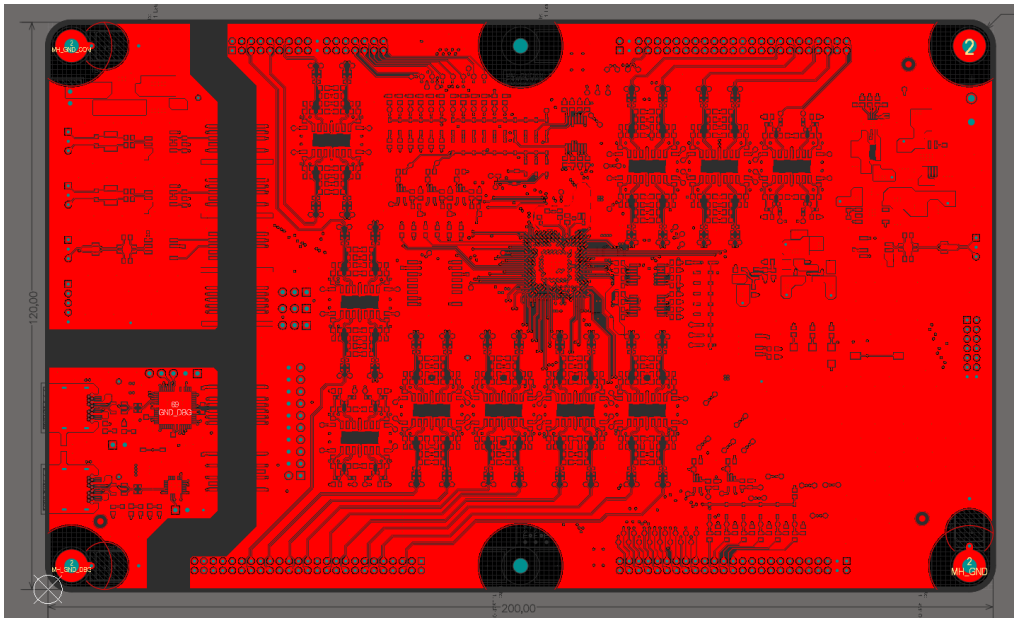

Figure 44 **Layer 1**

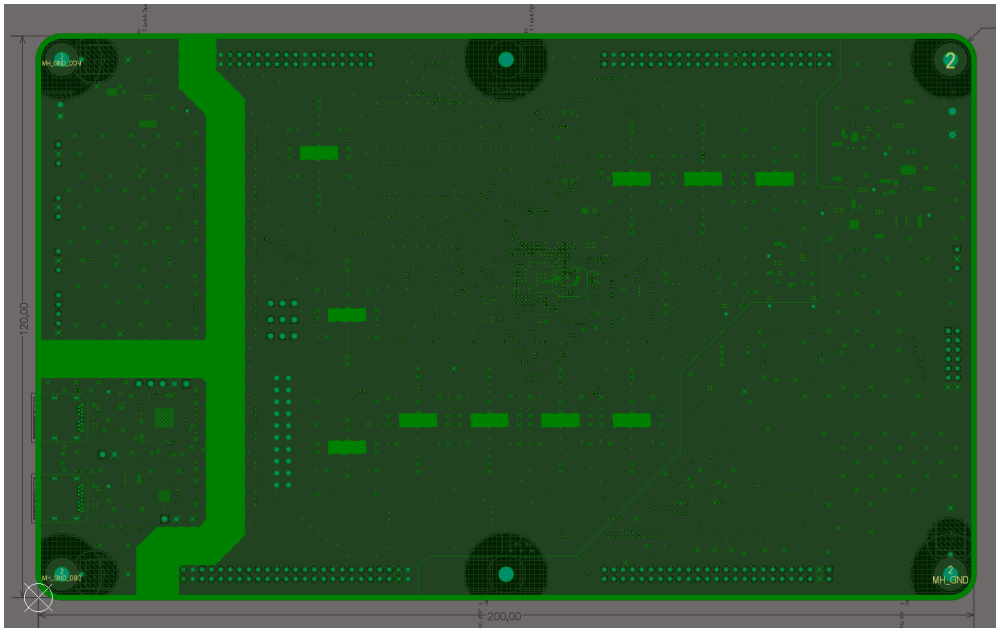

Figure 45 **Layer 2**

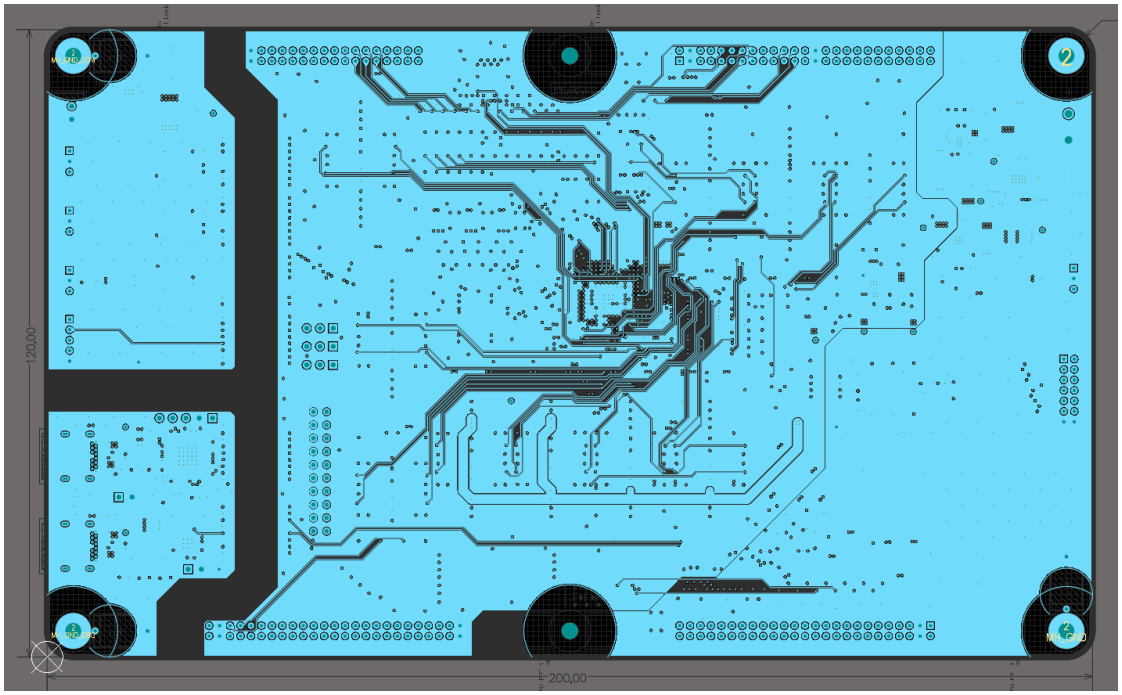

Figure 46 **Layer 3**

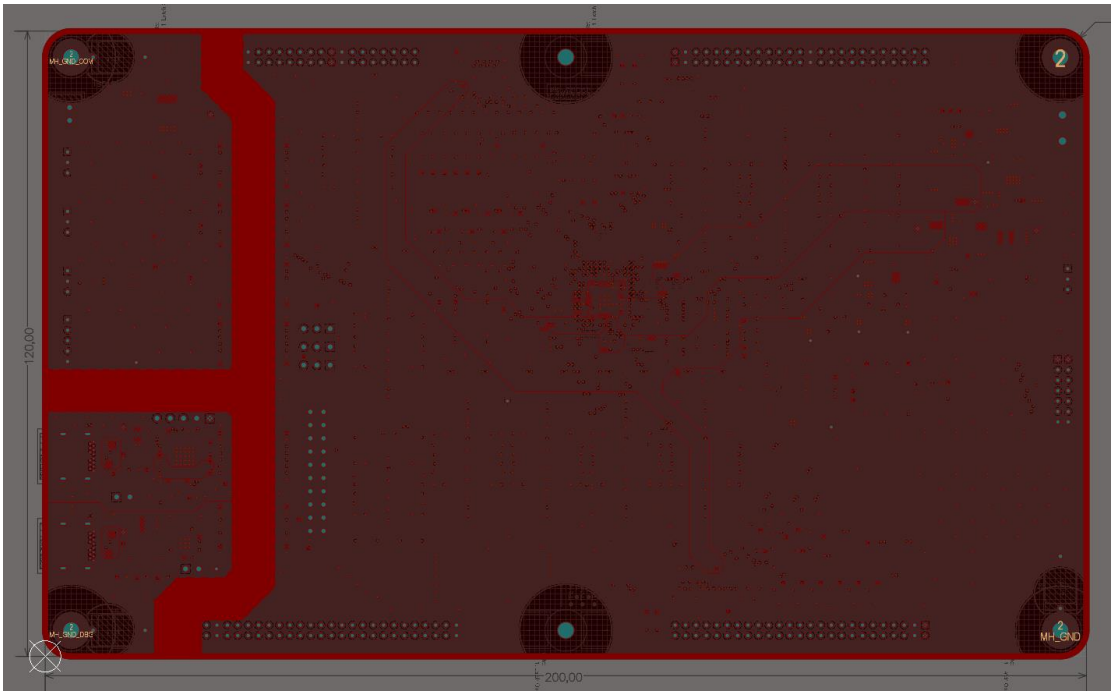

Figure 47 **Layer 4**

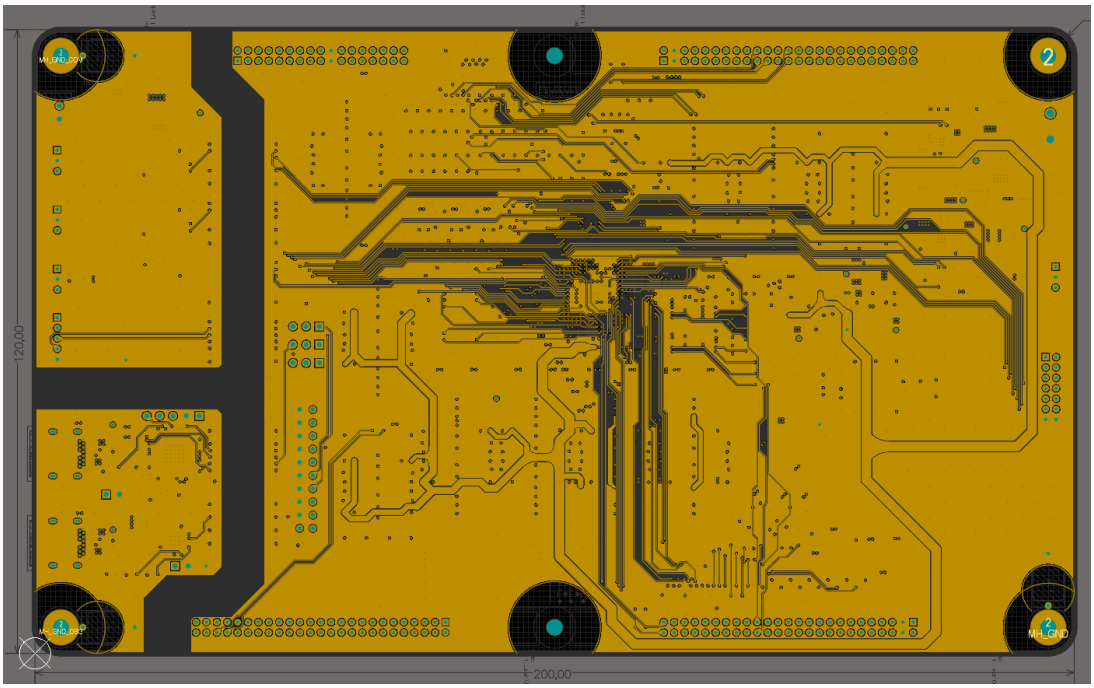

Figure 48 **Layer 5**

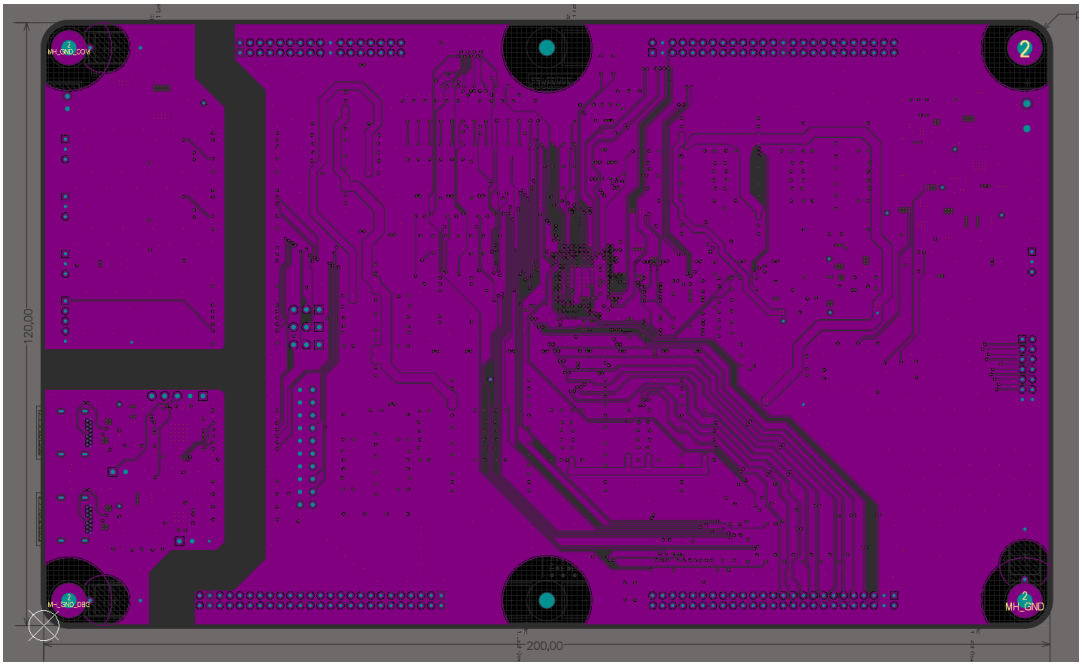

Figure 49 **Layer 6**

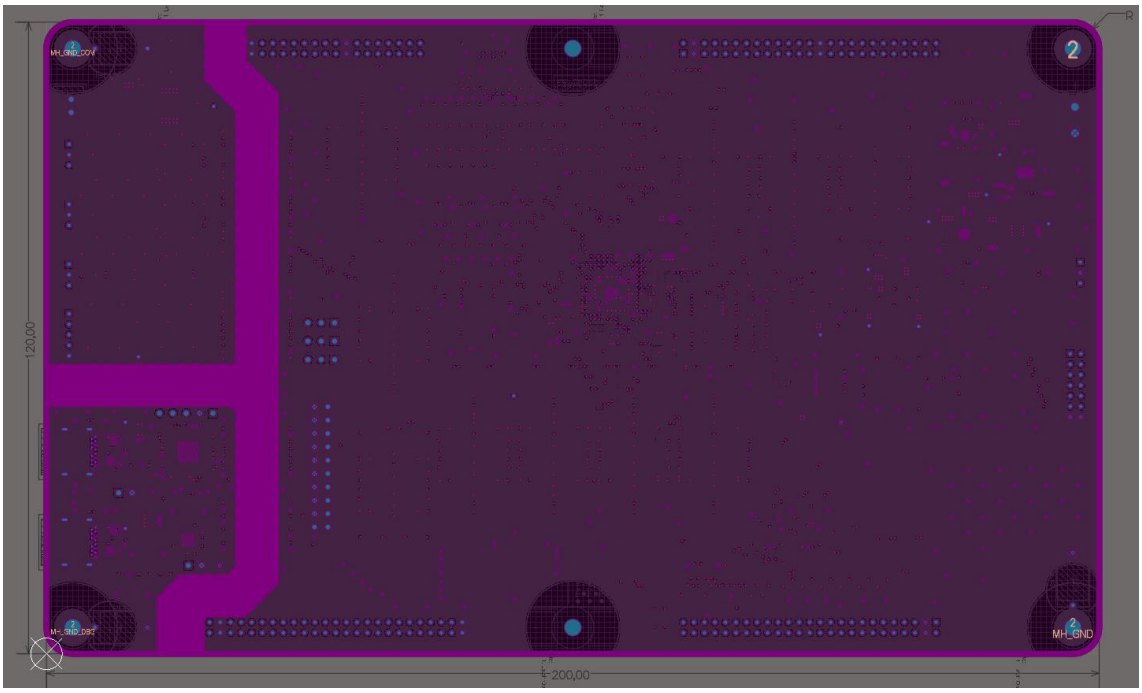

Figure 50 **Layer 7**

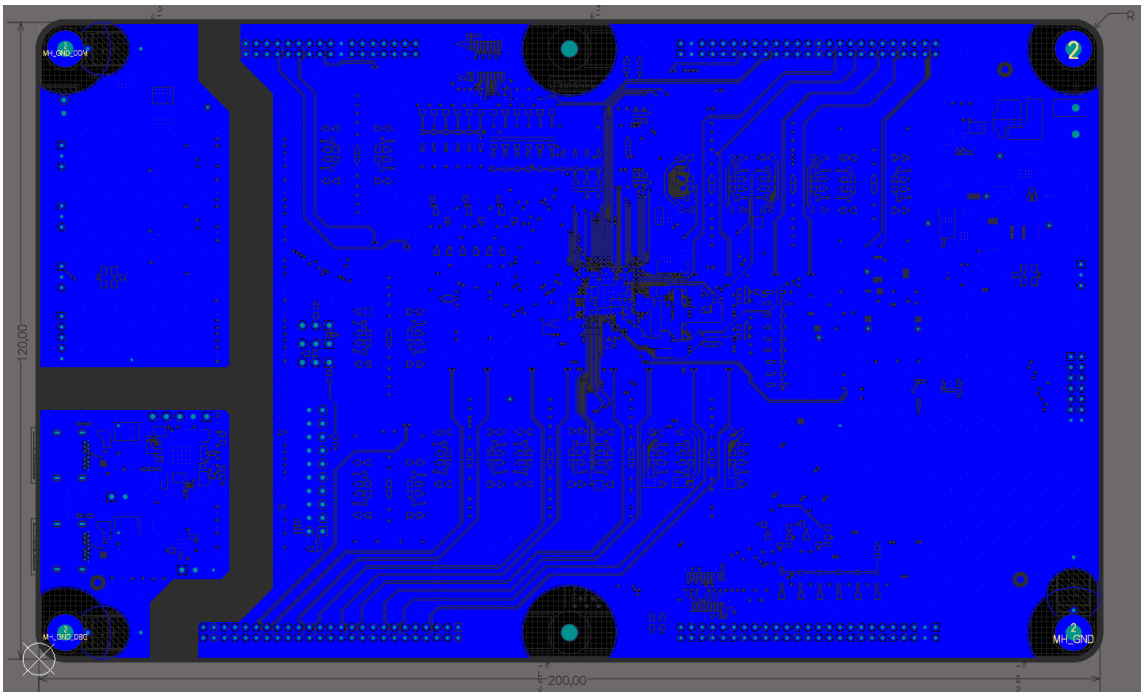

Figure 51 **Layer 8**

4.1 Bill of materials (BoM)

Table 11 BoM

Infineon Products	Description
XMC7200D-E272K8384AA	32-bit Arm® Cortex®-M7 MCU
CY8C5868LTI-LP039	Programmable embedded system-on-chip with 32-bit Arm Cortex-M3 core
CY7C65223-24LTXI	USB-UART single channel bridge controller
CY15E064J-SXET	64-Kbit (8K × 8) Serial (I2C) Automotive-A F-RAM
S25FL512SAGMFMR10	512 Mb (64 MB) FL-S Flash
TLE9350VSJ	High speed CAN FD transceiver
4DIR1400H	Digital isolator
TLS4125D0EPV50	2.8 MHz synchronous step-down regulator
TLS205B0	LDO

Revision history

Document version	Date of release	Description of changes
V.1.0	2024-07-29	Initial release

Edition 2024-07-29

Published by

Infineon Technologies AG

81726 Munich, Germany

Do you have a question about this document?

Email: erratum@infineon.com

Document reference

UG-2024-14

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office **(www.infineon.com).**

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

Trademarks

All referenced product or service names and trademarks are the property of their respective owners.