# EVAL-XMC4800PSOC6M5 user guide

## IoT drive card with M5 MADK interface

## About this document

### Scope and purpose

This user guide provides an overview of the EVAL-XMC4800PSOC6M5 IoT (Internet of Things) drive card with M5 interface. It includes information about the main hardware and software features, key data, pin assignments, and mechanical dimensions of EVAL-XMC4800PSOC6M5 along with instructions on how to run the board.

The EVAL-XMC4800PSOC6M5 is a controller board that fits Infineon's modular application design kits (MADK) with M5 connectors. In enables easy evaluation of the supported MADKs and can be used for designing software extensions using ModusToolbox™. It comes with XMC4800 for inverter and motor control and PSoC™ 62 for web-based system configuration including Wi-Fi connectivity. This enables touch-free control and configuration during testing.

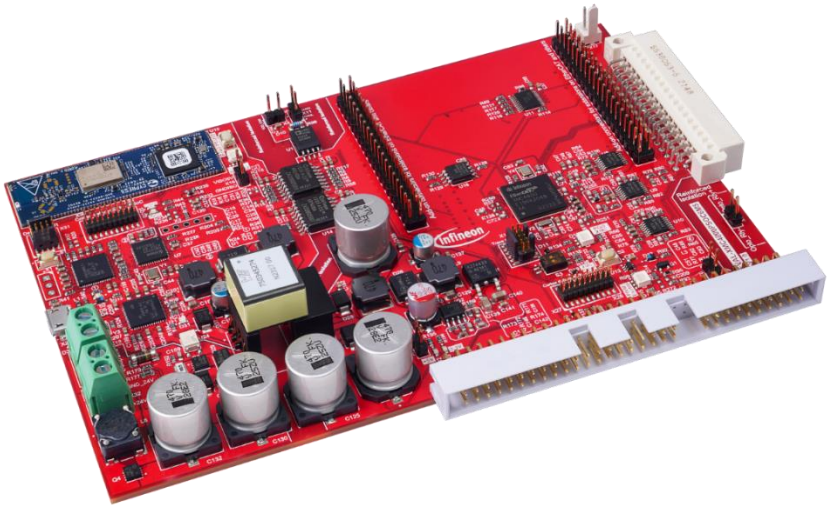
### Intended audience

This user guide is intended for power electronic engineers and software engineers familiar with power electronics who want to test Infineon's inverter and motor control boards in a simple way or want to develop their own test cases, including HW (hardware) and SW (software), quickly.

### Evaluation board

This board is to be used during the design-in process for evaluating and measuring characteristic curves, and for checking datasheet specifications.

*Note: PCB (printed circuit board) and auxiliary circuits are NOT optimized for final customer design. This is evaluation board and should be used under lab environment only.*



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# Safety precautions

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

**Table 1 Safety precautions**

| | |
|---|---|
| | **Warning:** *The DC link potential connecting to this board may be up to 720 VDC. When measuring voltage waveforms by oscilloscope, high voltage differential probes must be used. Failure to do so may result in personal injury or death.* |
| | **Warning:** *The evaluation or reference board contains DC bus capacitors which take time to discharge after removal of the main supply. Before working on the drive system, wait five minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.* |
| | **Warning:** *The evaluation or reference board is connected to the grid input during testing. Hence, high-voltage differential probes must be used when measuring voltage waveforms by oscilloscope. Failure to do so may result in personal injury or death. Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels.* |
| | **Warning:** *Remove or disconnect power from the drive before you disconnect or reconnect wires, or perform maintenance work. Wait five minutes after removing power to discharge the bus capacitors. Do not attempt to service the drive until the bus capacitors have discharged to zero. Failure to do so may result in personal injury or death.* |
| | **Caution:** *The heat sink and device surfaces of the evaluation or reference board may become hot during testing. Hence, necessary precautions are required while handling the board. Failure to comply may cause injury.* |
| | **Caution:** *Only personnel familiar with the drive, power electronics and associated machinery should plan, install, commission and subsequently service the system. Failure to comply may result in personal injury and/or equipment damage.* |
| | **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:** *A drive that is incorrectly applied or installed can lead to component damage or reduction in product lifetime. Wiring or application errors such as undersizing the motor, supplying an incorrect or inadequate AC supply, or excessive ambient temperatures may result in system malfunction.* |
| | **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.* |

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# 1 The board at a glance

The EVAL-XMC4800PSOC6M5 is a controller board that fits modular application design kits (MADK) with M5 connectors. In enables easy evaluation of the supported MADKs and can be used for designing own software extensions using ModusToolbox™. It comes with XMC4800 for inverter and motor control and PSoC 6 for web-based system configuration including Wi-Fi connectivity. The board includes two onboard debuggers for both MCUs (microcontroller unit), power supply, OPTIGA™ TrustM security solution, Quad-SPI NOR, flash, and interfaces to connect encoder/resolver, and EtherCAT.

This evaluation board was developed to support customers during their initial steps designing applications and evaluating Infineon products. The software has been developed using the ModusToolbox™ development platform.

The key objectives of the board are:

- Support testing and evaluation of M5 connector-based MADKs
- Simplify testing through an easy-to-use embedded graphical user interface (GUI) accessible via Wi-Fi
- Provide the flexibility to design own test cases in hardware and software quickly

The evaluation board offers a wide range of options in hardware and software. It is useful for power electronic engineers and software engineers familiar with power electronics.

The design was tested as described in this document.

This evaluation board is not a commercial product. It is solely intended for evaluation and testing purposes. In particular, it should not be used for reliability testing or production.

## 1.1 Delivery content

The detailed ordering information is listed in Table 2.

**Table 2 Delivery content**

| Base part number | Standard pack | | Orderable part number |
|---|---|---|---|
| | Form | Quantity | |
| EVAL-XMC4800PSOC6M5 | Boxed | 1 | |

## 1.2 Block diagram

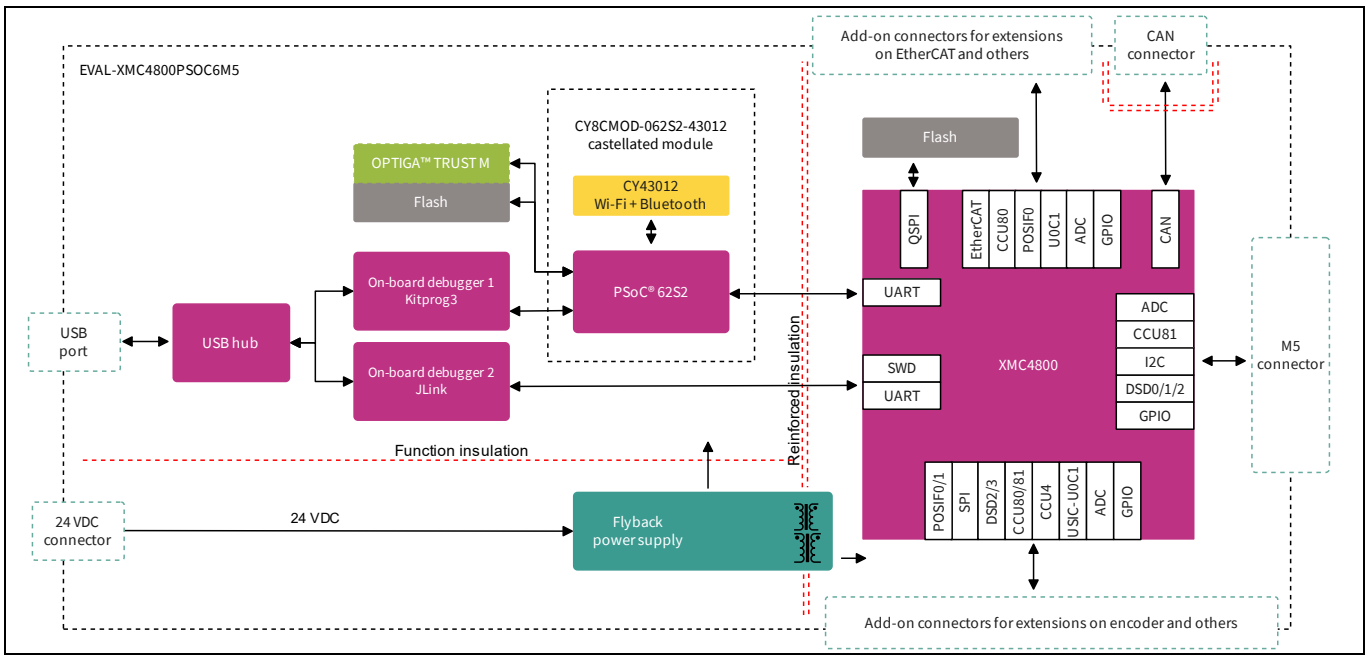



**Figure 1 Block diagram of EVAL-XMC4800PSOC6M5**

The board is divided in four main sections:

- XMC4800 MCU
- PSoC™ 62 MCU and Wi-Fi/BT (Bluetooth) combo chip
- Onboard debuggers
- Onboard power supply

## 1.3 Main features

The evaluation board has the following features:

- XMC4800 for inverter and motor control
- PSoC™ 62 MCU + Murata 1LV module including Wi-Fi connectivity and embedded GUI
- Reinforced isolation between the two MCUs
- ModusToolbox™ enabled
- Onboard USB debugger/programmer for both MCUs
- Onboard 24 V/15 W flyback DC/DC
- Onboard OPTIGA™ TrustM security solution
- Interface to MADKs with M5 connector
- Interface connectors for EtherCAT add-on and external encoder/resolver circuitries
- CAN interface

## 1.4 Board parameters and technical data

**Table 3 Board specifications of EVAL-XMC4800PSOC6M5**

| Parameter | Symbol | Conditions/Comments | Value | Unit |
|---|---|---|---|---|
| Power supply 1 – Flyback power supply (refer to Figure 2 for pin assignment of each coil) | | | | |
| Input voltage | $V_{in}$ | | 24 | VDC |
| Output voltage 1 (Pin 1, 2) | $V_{out1}$ | | 5 | V |
| Max. output current 1 (Pin 1, 2) | $I_{out1max}$ | | 750 | mA |
| Output voltage 2 (Pin 14, 15) | $V_{out2}$ | | 15 | V |
| Max. output current 2 (Pin 14, 15) | $I_{out2max}$ | | 500 | mA |
| Output voltage 3 (Pin 12, 10) (Pin 13, 10) | $V_{out3}$ | | ±15 | V |
| Max. output current 3 (Pin 12, 10) (Pin 13, 10) | $I_{out3max}$ | | 200 | mA |
| **PCB characteristics** | | | | |
| Dimension | Dimension | Length × Width × Height | 166.5×111.5×3.5 | mm |
| Material | Material | | FR4 | |
| **System environment** | | | | |
| Ambient temperature | $T_a$ | Non-condensing, maximum RH (relative humidity) of 95% | 0 ~ 50 | °C |

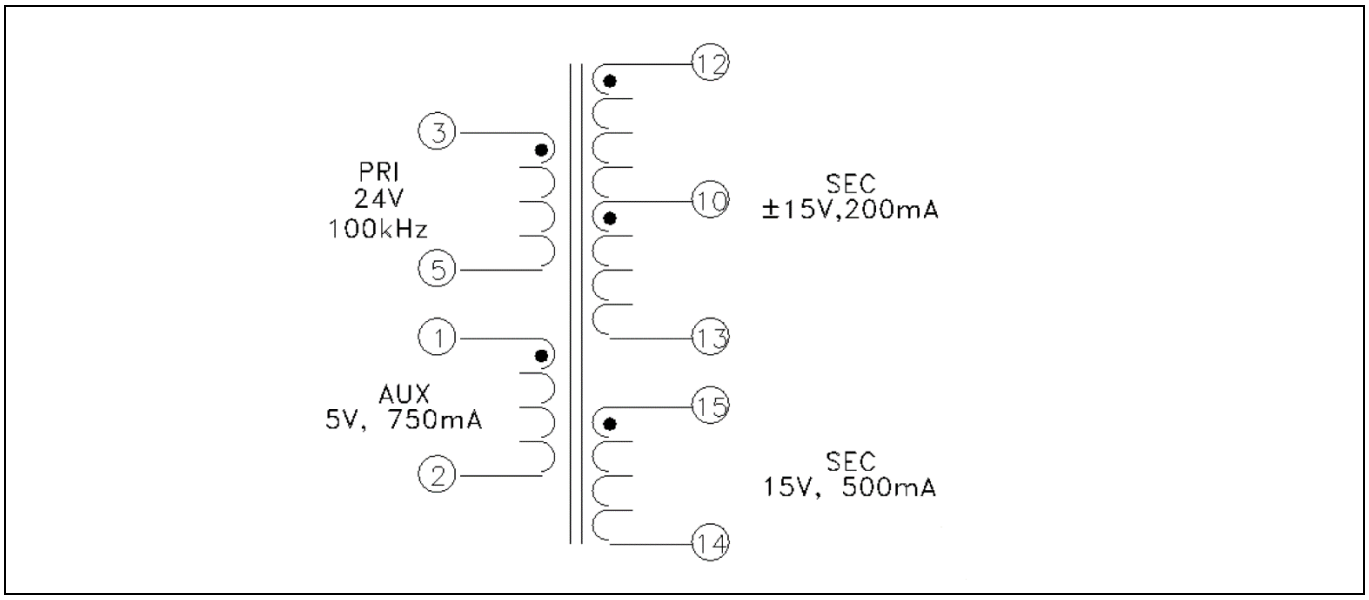



**Figure 2 Pin assignment on the flyback transformer**

# 2 System and functional description

This chapter provides information on how to make the board and system work.

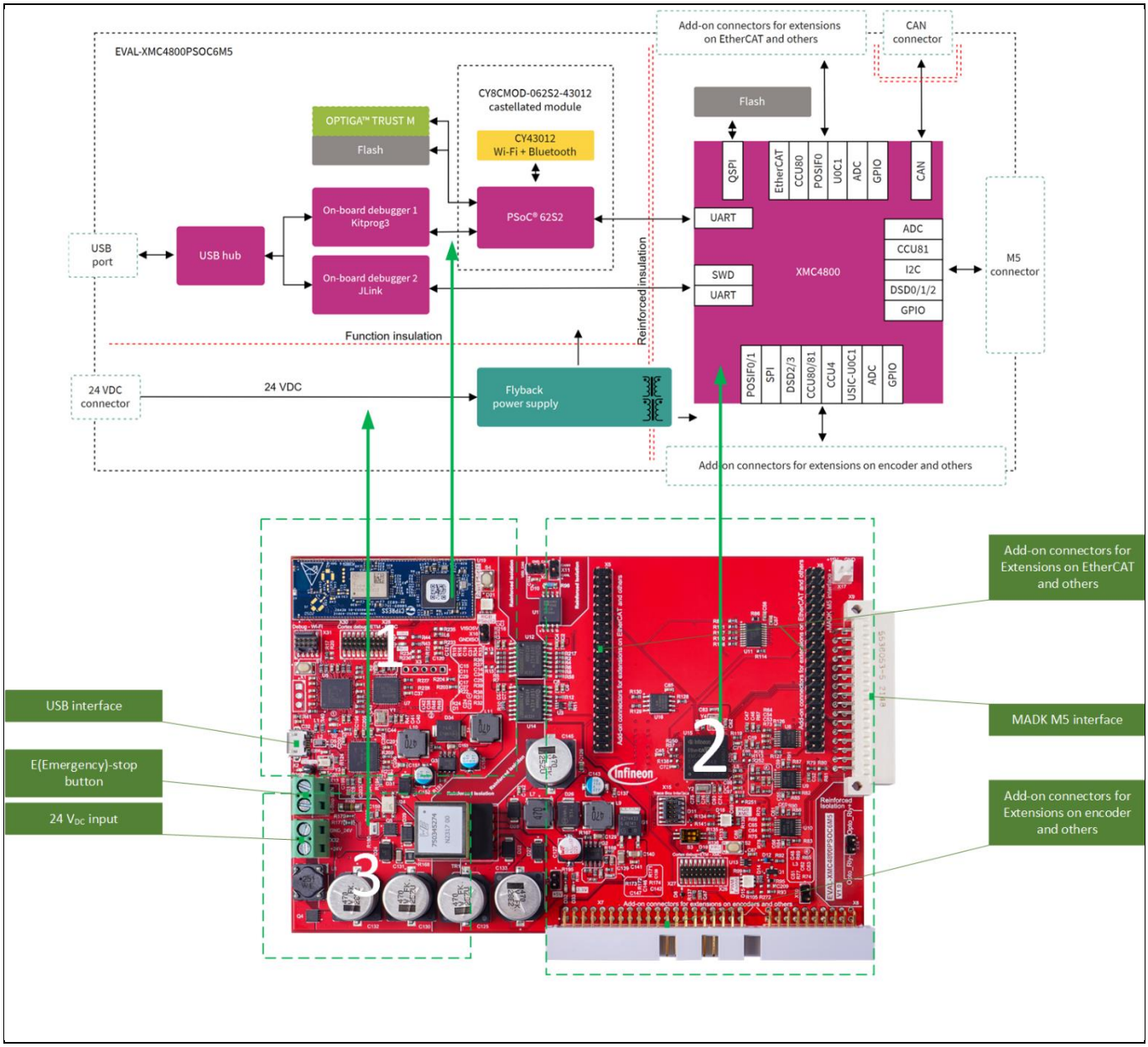



**Figure 3 Functional blocks and interface on the board**

The board contains two controllers, PSOC™ 62 and XMC4800. Based on these two controllers, the board can be divided into two functional sections and power supply.

1. PSOC™ 62 and surrounding circuits

   Focuses on connectivity such as Wi-Fi/Bluetooth and debuggers for both 2 MCUs.

2. XMC4800 and surrounding circuits

   Focuses on working as power electronics controller and connectivity for industry, such as CAN/EtherCAT. Can extend the interface for different kinds of encoders.

3. Flyback power supply

Main power supply for the whole board (24 V DC input from the lab power supply). Refer to Section 2.5.3 for details.

## 2.1 Materials required

- Essential hardware items:
  - EVAL-XMC4800PSOC6M5 board (in the package)
  - USB cables (in the package)
  - 24 V power supply (arrange separately)
- Optional hardware items:
  - EtherCAT add-on board (https://www.infineon.com/cms/en/product/evaluation-boards/kit_xmc48_relax_ecat_v1/)
  - Power boards with M5 interface
- Essential software items:
  - ModusToolbox™ 3.0 and above to develop code for the board
  - Cypress™ programmer to program the binary code for PSoC™ 62 MCU on the board
  - XMCFlasher to program the binary code for XMC4800 MCU on the board. J-Flash lite in SEGGER JLink software package is an alternative solution for XMC4800 programming

## 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 a basic code on the board (blinking LEDs)

### 2.2.1 Materials required

- Essential hardware items:
  - Board EVAL-XMC4800PSOC6M5
  - USB cables
  - 24 V DC power supply (arrange separately)
- Essential software item:
  - ModusToolbox™ 3.0 and above to develop code for the board

*Note: The process to integrate into ModusToolBox™ may be delayed, if you do not find the board listed in the board support package (BSP) as shown in Figure 6, please wait for a few days.*

### 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 laboratory power supply are required (see Figure 4). Follow these steps:

1. Connect the connector X32 with the 24 V DC laboratory 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 micro connector of the board.
3. Power on the 24 V power supply. LEDs, as shown in the Figure 4, light up.

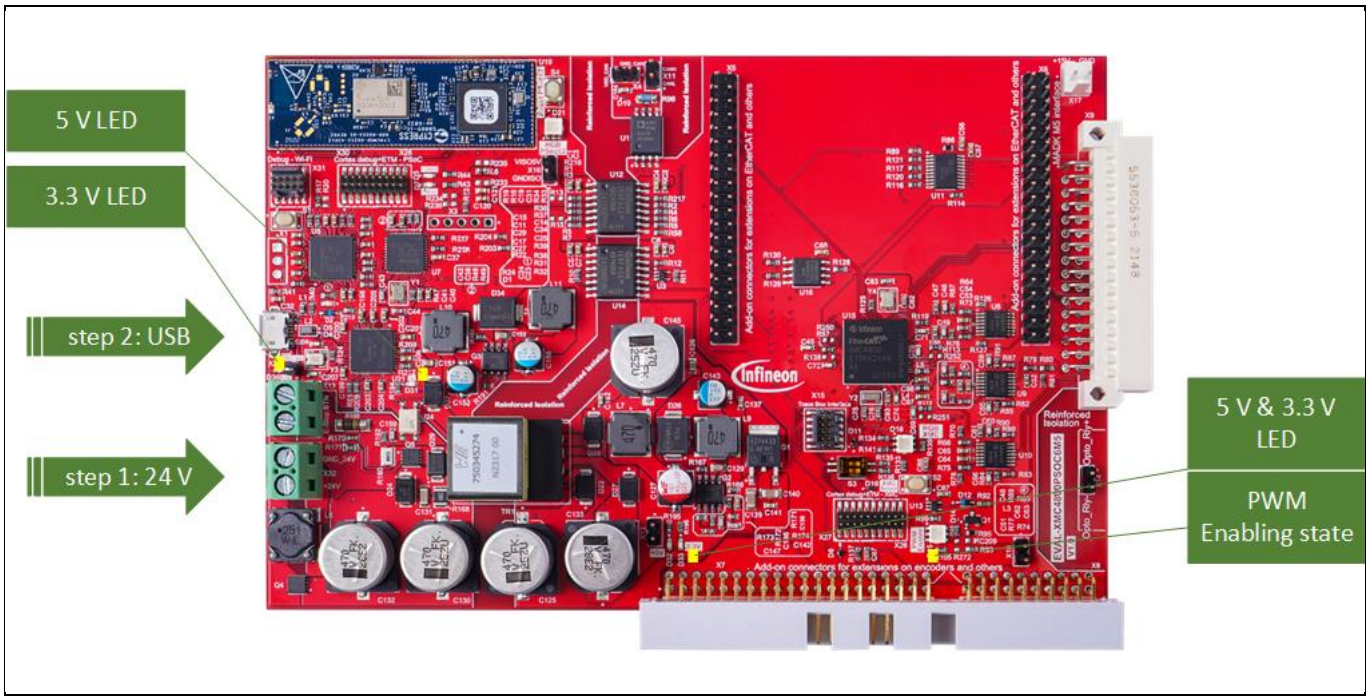



**Figure 4 Hardware connection**

### 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™ 3.0 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™.
2. Open project creator by either selecting **File** →**New** →**ModusToolbox™** or **Start** → **New Application** (see Figure 5).

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

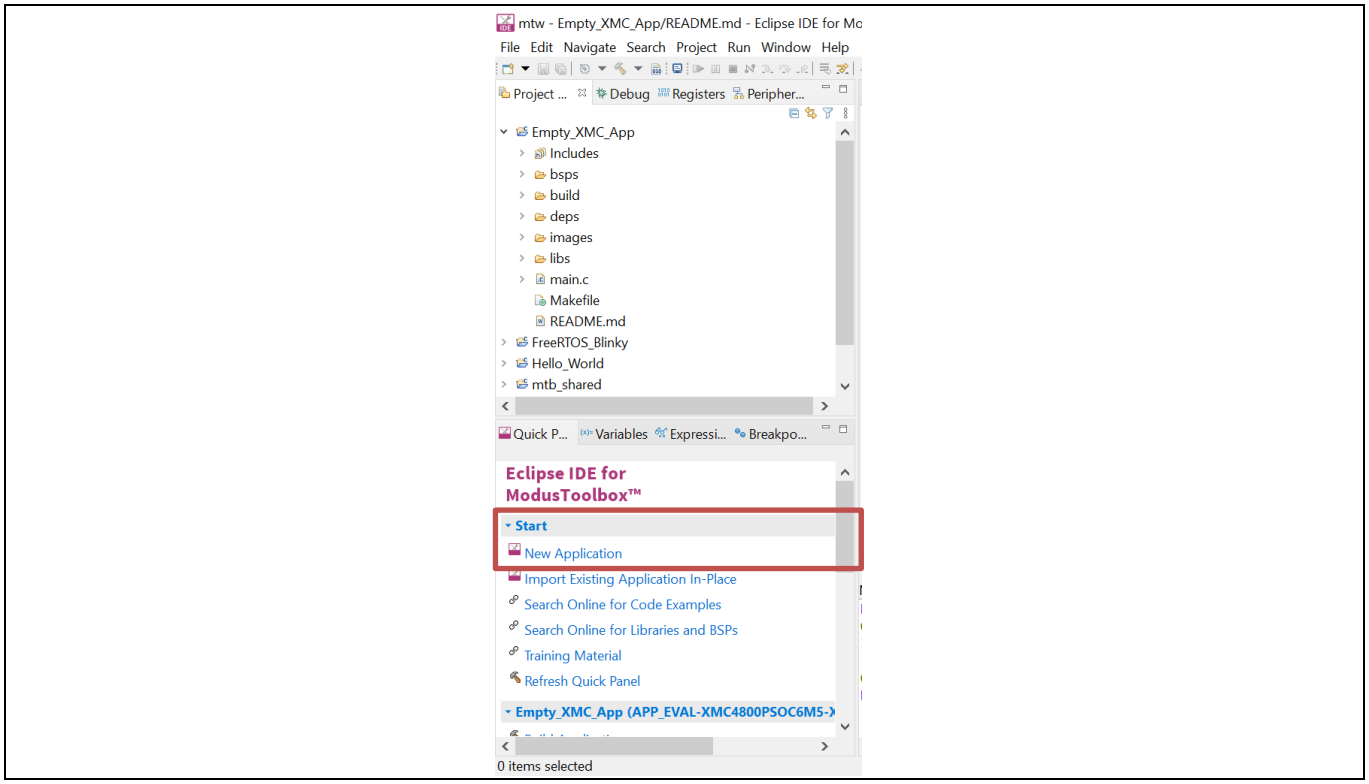



**Figure 5 New application**

3. Each MCU has its own board support package (BSP). Locate the suitable BSPs for the onboard MCUs in the respective category—PSoC™ 62 BSPs (CY8C624ABZI-S2D44) and XMC™ BSPs (XMC4800-E196F2048).

### 2.2.4.1 Import the Blinky code for PSoC™ 62.

4. Select the kit name EVAL-XMC4800PSOC6M5-PSOC6 in the category, PSoC™ 62 BSPs, and click **Next** (see Figure 6).

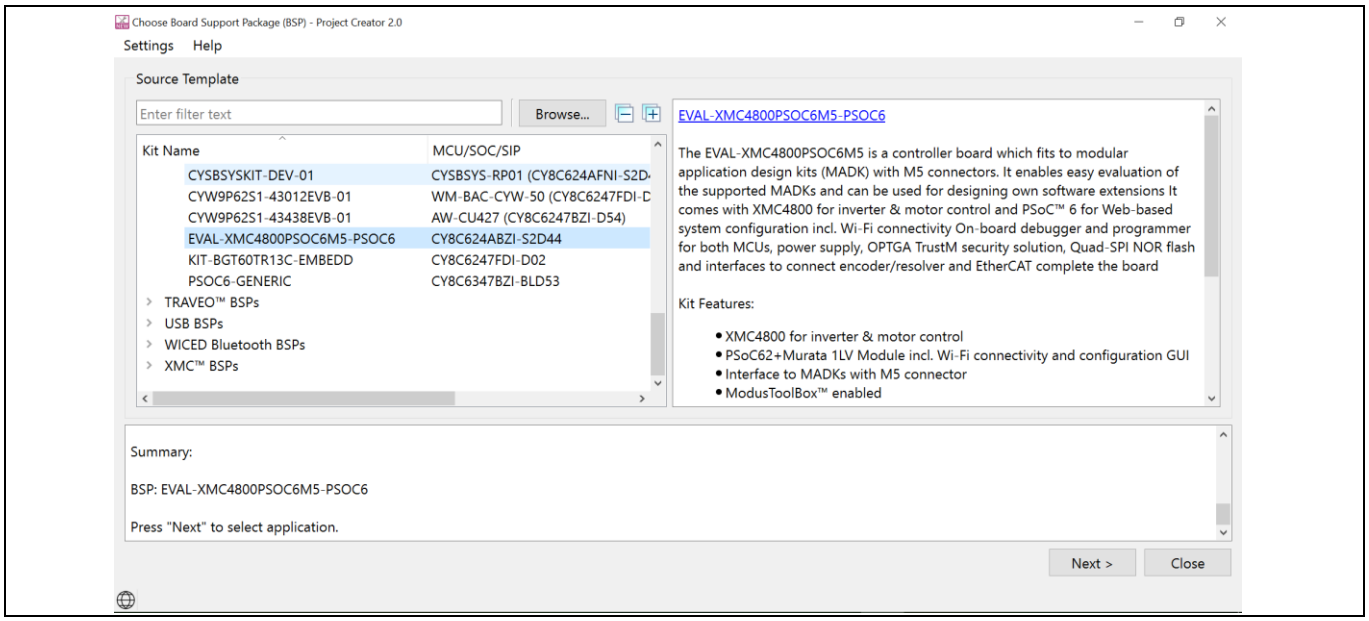



**Figure 6 Select the BSP**

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.

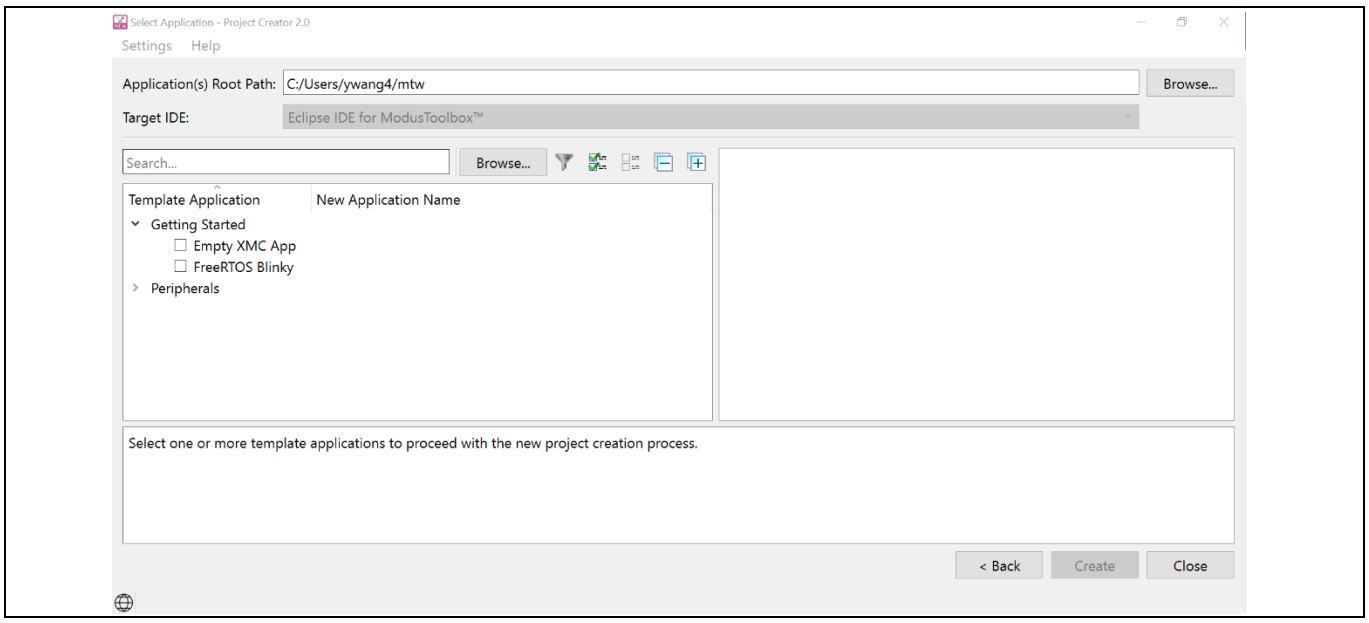



**Figure 7 Select and create the CE**

6. Wait for the import to complete. If no error message appears, the project will be available in your workspace (project explorer) as shown in Figure 8.

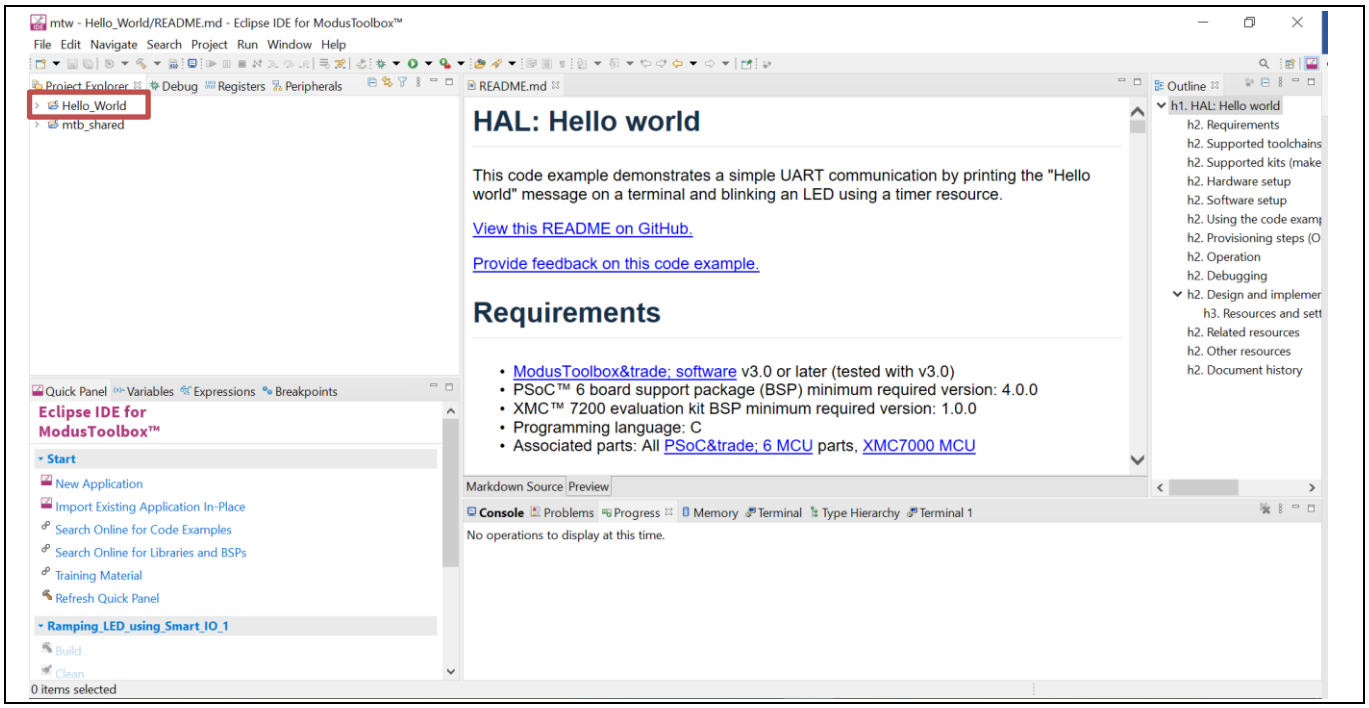



**Figure 8 Create a new project**

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.

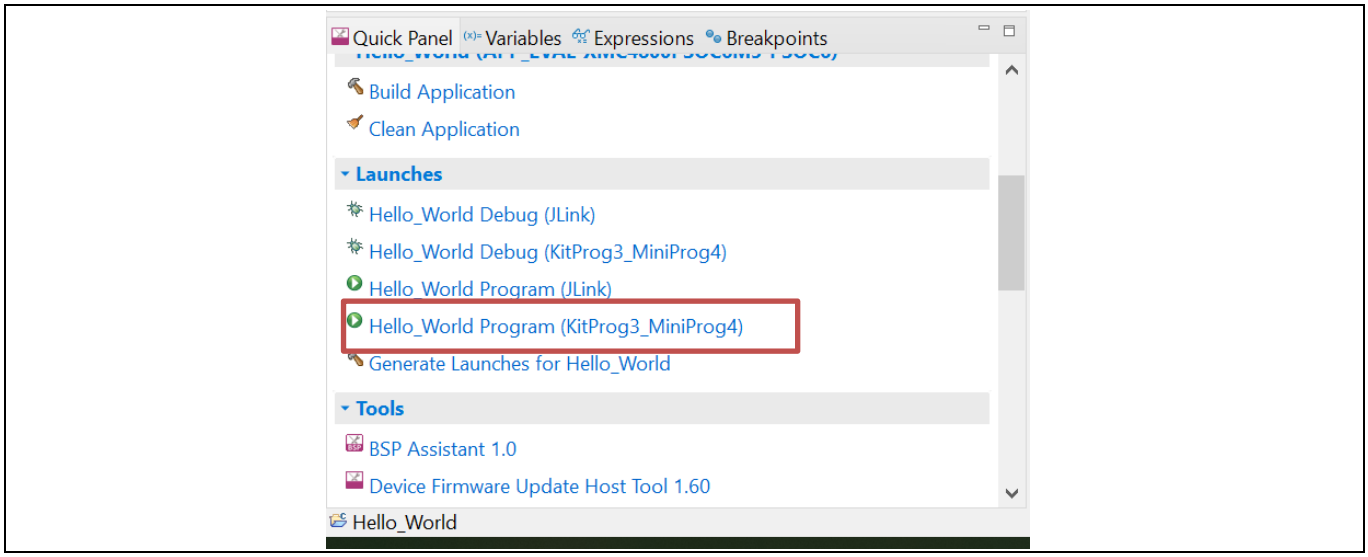



**Figure 9 Program PSoC™ 62**

The RGB LED D21, shown in Figure 14, is called Blinky.

### 2.2.4.2 Import the Blinky code of XMC4800

9. Return to the Source Template window (see Step 5) and select the kit name EVAL-XMC4800PSOC6M5-XMC from the XMC™ BSPs category. Click **Next** (see Figure 10).

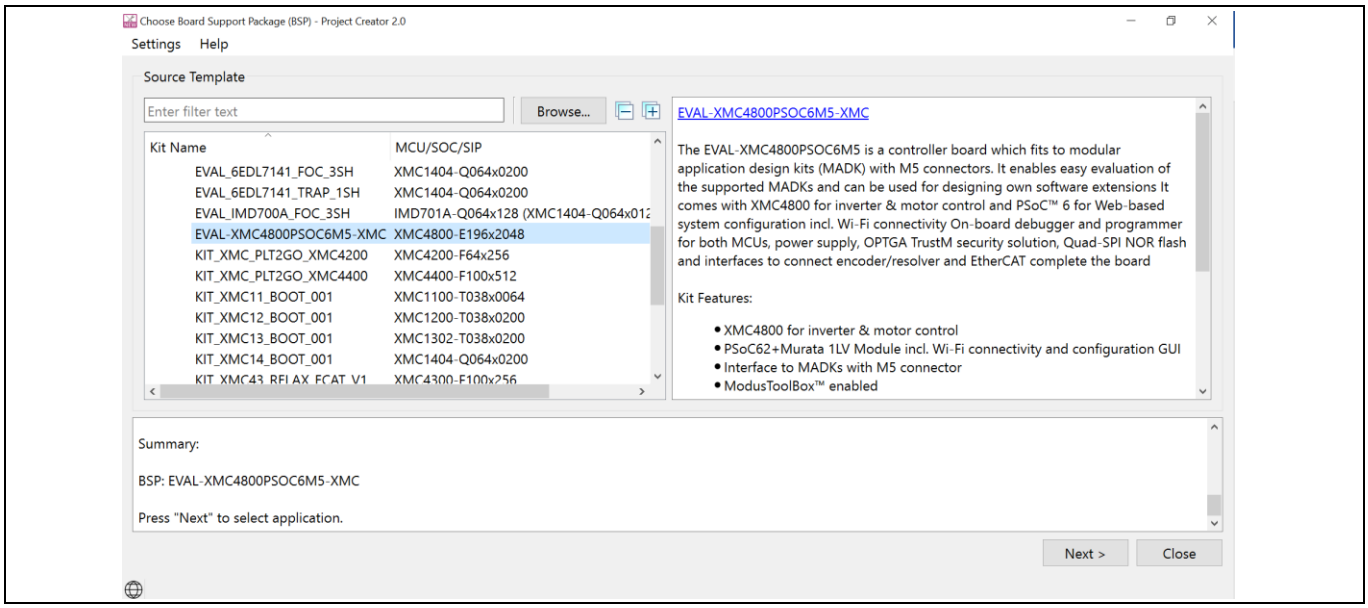



**Figure 10 Select the BSP**

10. To run the Blinky code, select **FreeRTOS Blinky** from the Getting started category under Template Application. Then, click **Create** to automatically start the import of all necessary items.

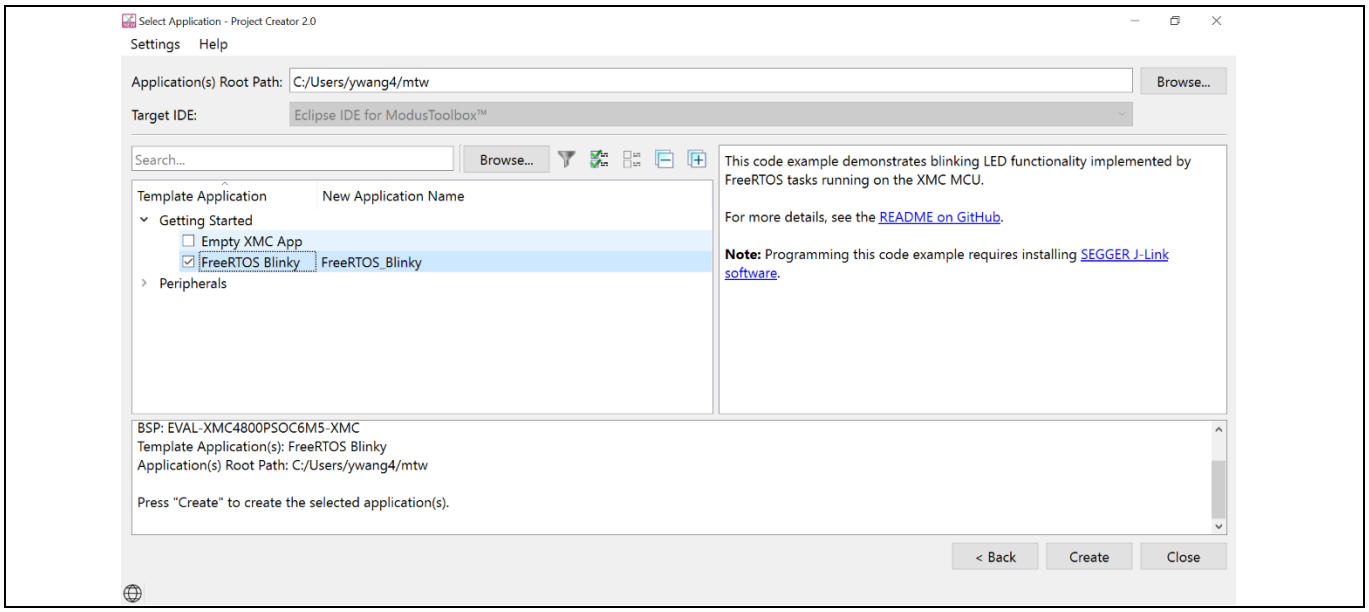



**Figure 11 Select and create the CE**

11. Wait for the import to complete. If no any error message appears, the project will be available in your workspace (project explorer) as shown in Figure 12.

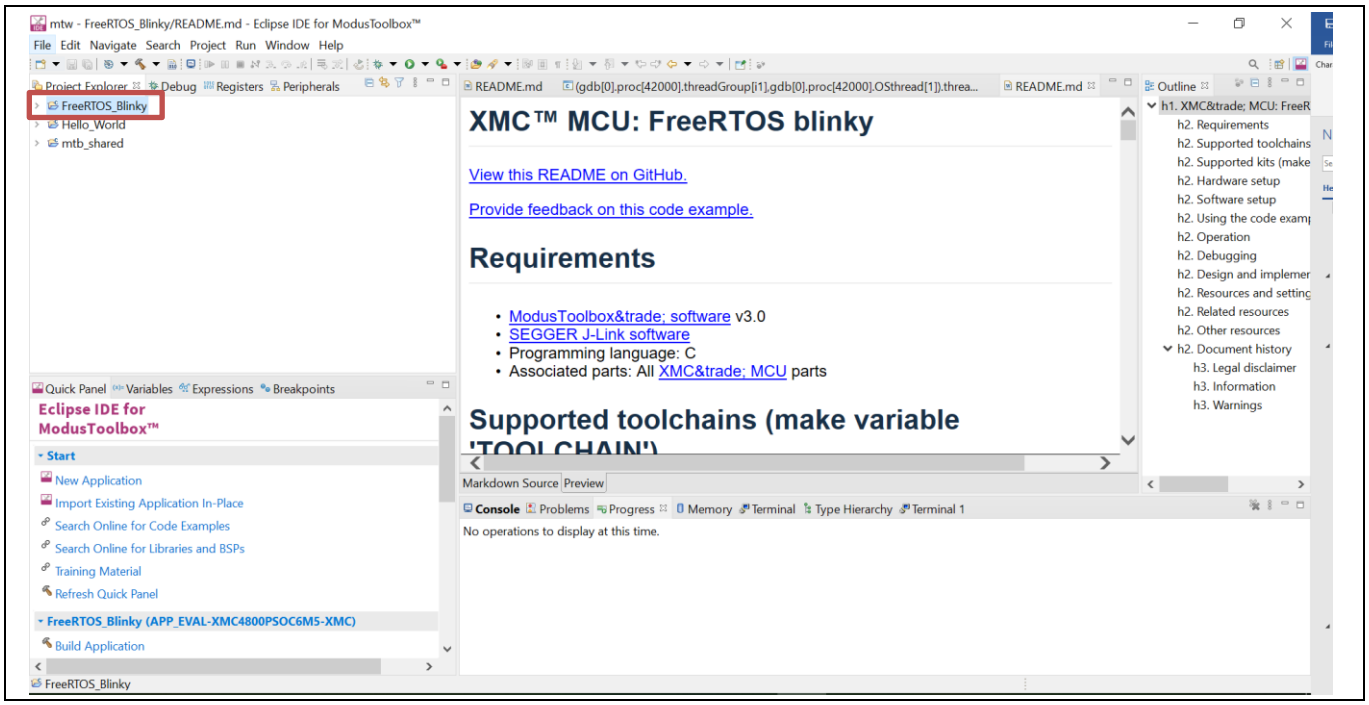



**Figure 12 Create a new project.**

12. Right-click the project **FreeRTOS_Blinky** and select **Build Project**. FreeRTOS_Blinky Program (JLink) will appear in the Launches dropdown list.
13. Click it. The project will be built and programmed into the MCU.

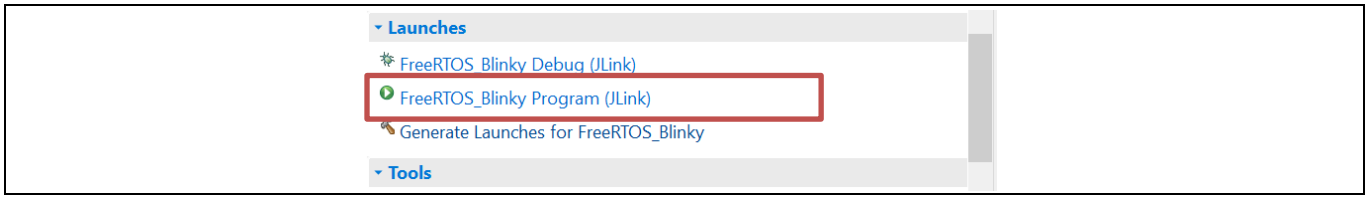



**Figure 13 Program PSoC™ 62**

14. RGB LED D18, shown in Figure 14, is Blinky.

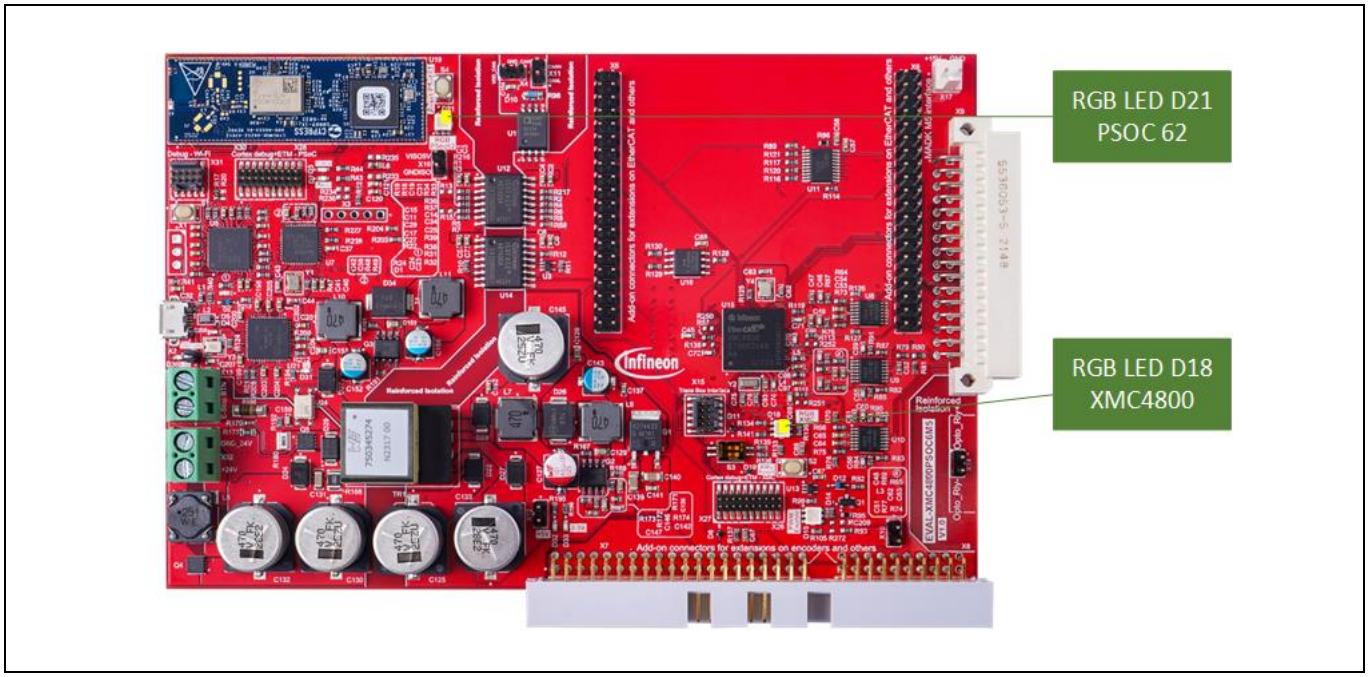



**Figure 14 RGB LED D18/D21**

## 2.3 Programming existing hexadecimal (hex) code without ModusToolBox™

For some user cases, user do not need to do any coding task, so that they do not have willing to install integrated development environment (IDE) which is large and complex, such as ModusToolBox™, for this kind of the user case, directly use programmer to flash the MCUs is the better choice. In this section, we introduce how to use programmer to flash the MCUs.

### 2.3.1 Materials required

- Essential hardware items:
  - Board EVAL-XMC4800PSOC6M5
  - USB cables
  - 24 V power supply (arrange separately)
- Essential software items:
  - CypressTM programmer
  - XMCFlasher (J-Flash lite in SEGGER JLink software package is an alternative solution)

### 2.3.2 Set up the hardware

Hardware setup is the same as described in Section 2.2.2.

### 2.3.3 Obtain the hex file

Get the hexadecimal files for each MCU, whose endfix is .hex, they can be either gotten from the embedded software project, under build or debug folder most of the time, or download from internet, for example: compiled hex file in application case as section 2.4.

After obtaining the hex file, refer to Section 2.3.4 on how to program it.

### 2.3.4 Program with programmer software

The programmer softwares of PSoC™ and XMC are needed to be downloaded from IDC first. Please use the following links:

- Cypress™ programmer
- XMCFlasher (J-Flash lite in SEGGER JLink software package is an alternative solution)

Those 2 programmer softwares are an alternative solution for programming the compiled hex file. However, note that the Cypress programmer can only program PSoC™ 62, and the XMCFlasher can only program XMC4800 on the board.

Here is the brief instruction on how to use these programmers. For more details, refer to the user manual of each programmer.

#### 2.3.4.1 Programming PSoC™ 62 using Cypress™ programmer

1. Connect to the board via the USB cable and choose a probe/kit. As the board uses the same configuration as kit CY8CKIT-062S2-43012, you can use it directly if available. You can also use Kitprog3 or Miniprog4 if available in the list.

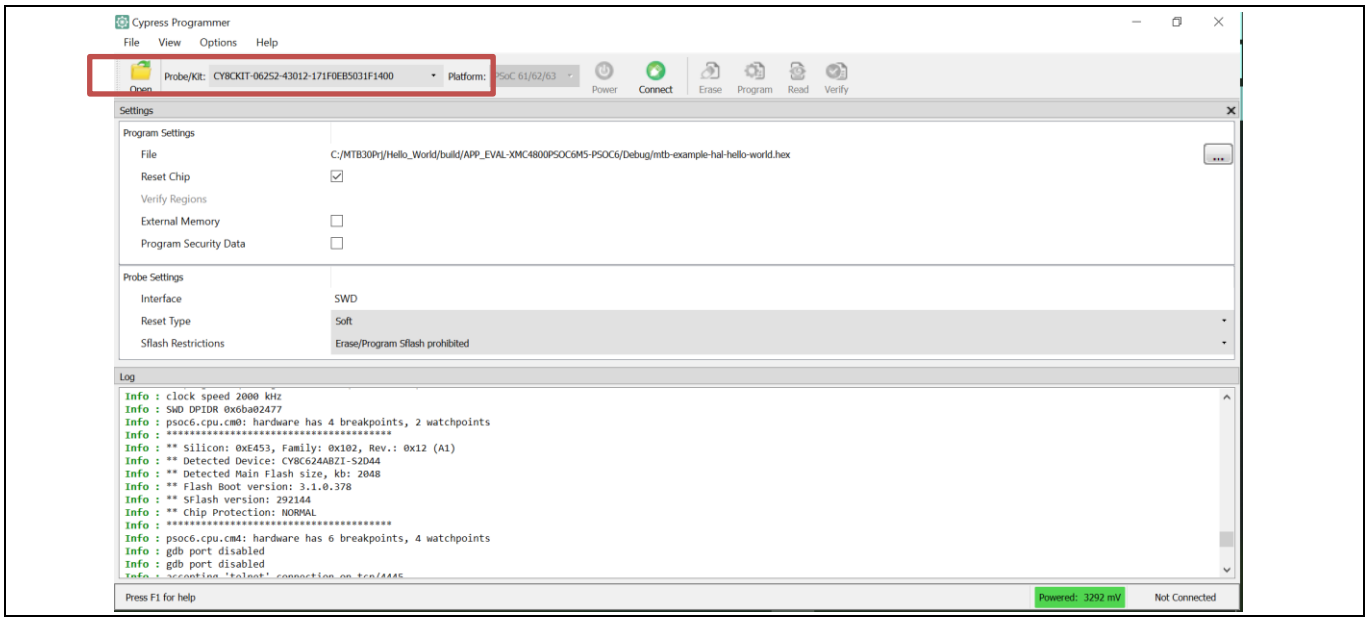



**Figure 15 Select the probe/kit**

2. Select **File** → **Open** or click **Open** and select the hex file on the PC.
3. Select **File** → **Connect** or click **Connect** to connect the probe/kit.

4. Select **File** → **Program** or click **Program** to finish programming **PSoC™ 62**. A green status indicator appears as shown in Figure 16 or refer to the Log for status.

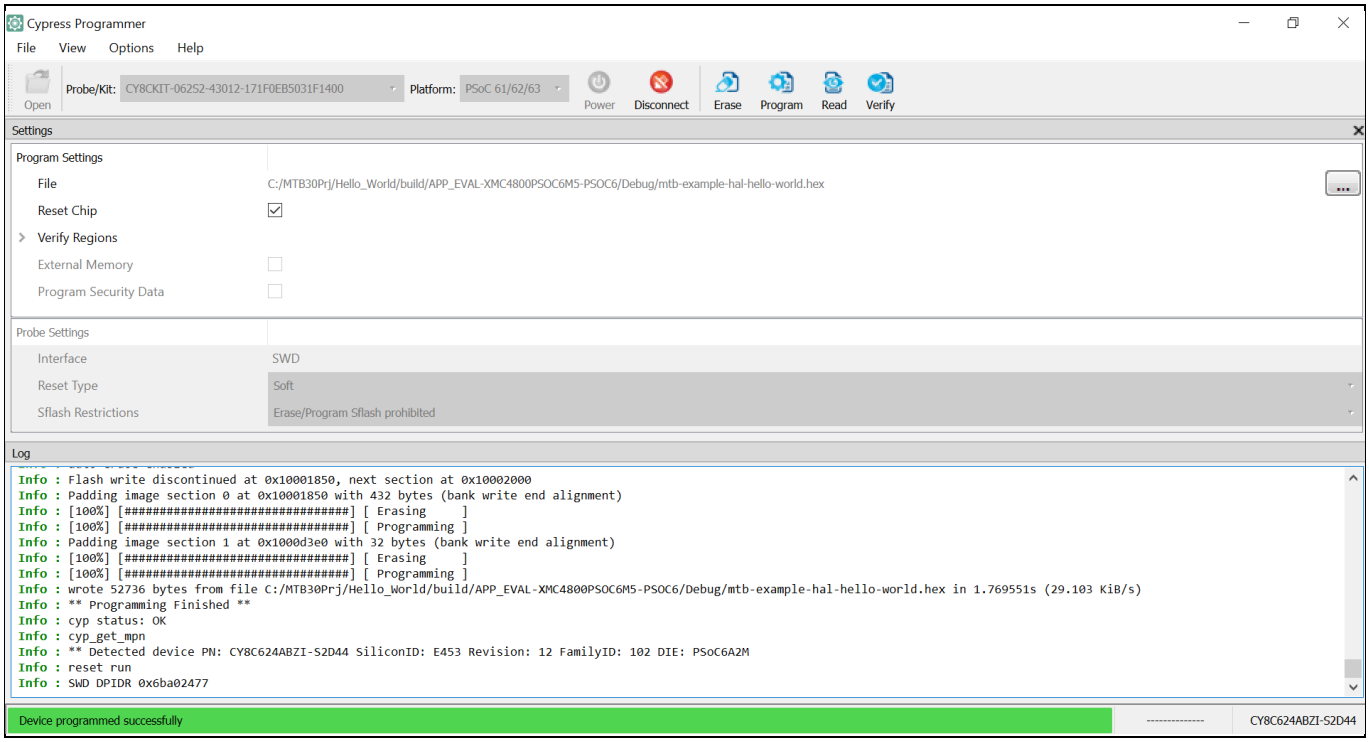



**Figure 16 Notification when programming completes successfully**

## 2.3.4.2 Programming XMC4800 using XMCFlasher

1. Ensure that the board is powered and well connected via the USB cable, then choose **XMCFlasher** from the Start menu or open the XMCFlasher.jar (default location is C:\Infineon\Tools\XMCFlasher\...) and click **Connect**. The Select Device Name to Connect dialog box in Figure 17 opens.
2. Select the device name XMC4800-2048 as shown Figure 17. The connection status changes to connected and a Unique Chip ID is displayed (each onboard debugger has a unique ID) as shown in Figure 18.

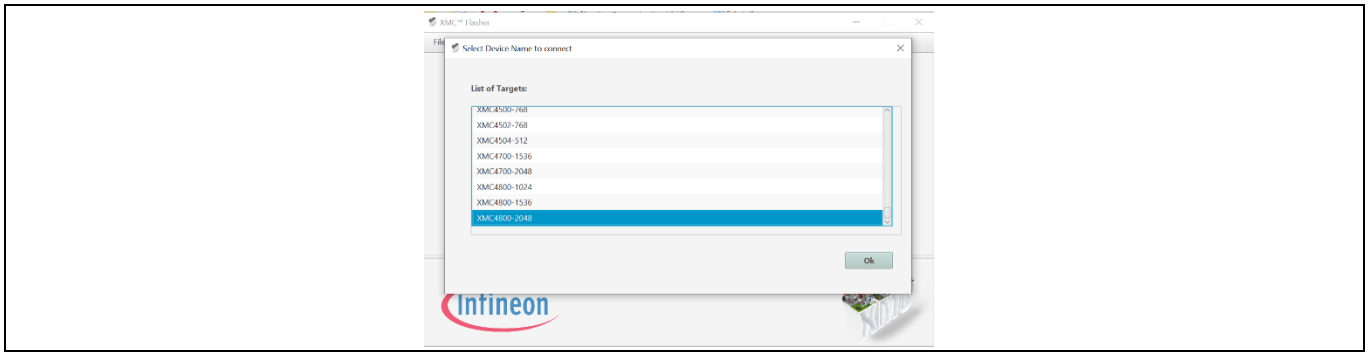



**Figure 17** Select a device name to connect

3. Click **Select File** to select the hex file on your PC (see Section 2.3.3) and click **Program**. When the programming completes successfully, a message is displayed as shown in Figure 19.

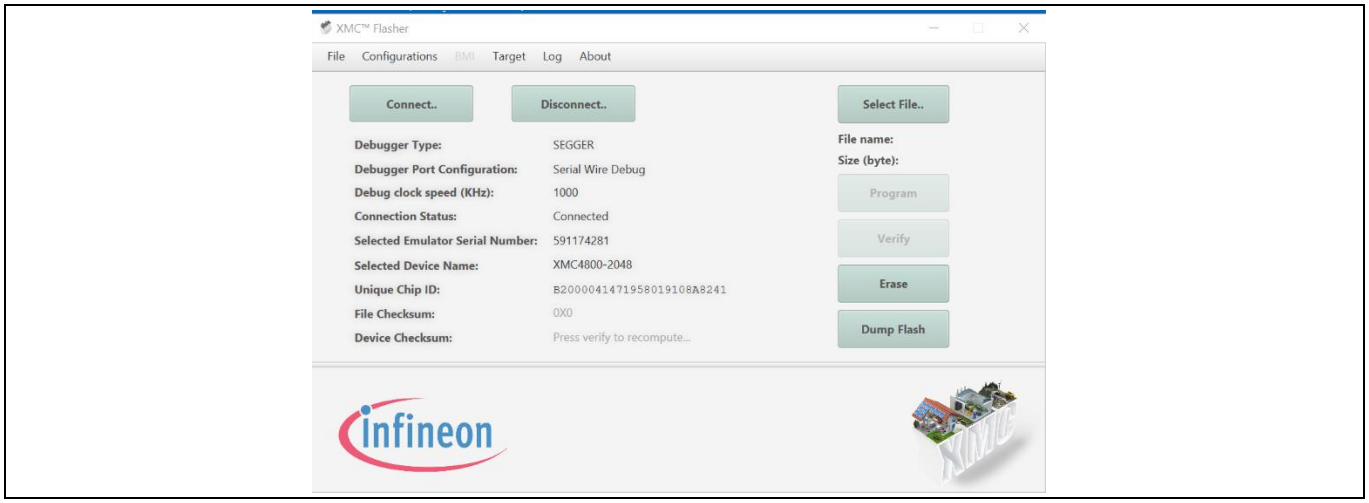



**Figure 18 XMCFlasher**

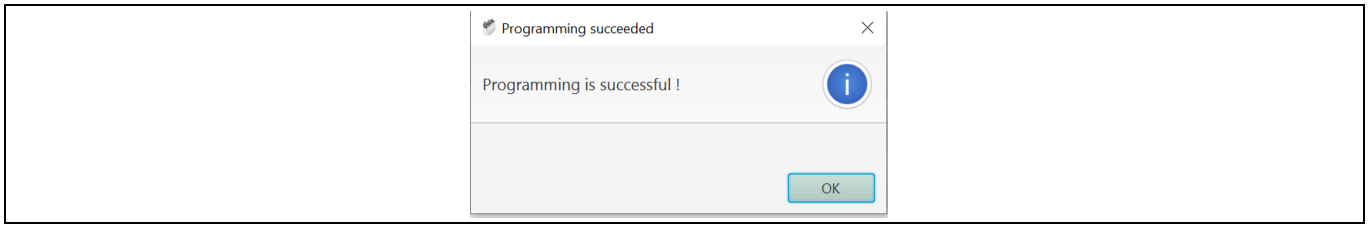



**Figure 19 Notification about successful programming**

For more information about the XMCFlasher, please refer to the installation instructions in the installation folder.

### 2.3.5 Check the blinking LEDs

If the hex files are programmed successful, the LEDs D18/D21, shown in Figure 14, will blink.

## 2.4 Application case 1: Double-pulse test generator for the power board

EVAL-XMC4800PSOC6M5 can be connected to the EVAL-PS-DP-MAIN M5 board to implement the double-pulse test as a pulse generator.

### 2.4.1 Materials required

- Essential hardware items:
  - Board EVAL-XMC4800PSOC6M5
  - USB cables
  - 24 V power supply (arrange separately)
  - Emergency stop button (arrange separately)
  - EVAL-PS-DP-MAIN M5 (double-pulse mother board) and one daughter board
- Essential software items:
  - Cypress™ programmer
  - XMCFlasher (J-Flash lite in SEGGER JLink software package is an alternative solution)

### 2.4.2 Set up the hardware

Connect the hardware as shown in Figure 20. The USB cable is used for programming; after the programming is done, the USB cable will not be required.

The emergency stop button should be connected to the connector through normally closed contacts. When the button is pressed down, the contacts will open and PWM (pulse width modulator) signals will be blocked by the circuit. Refer to Section 2.5.5.5 for more information.

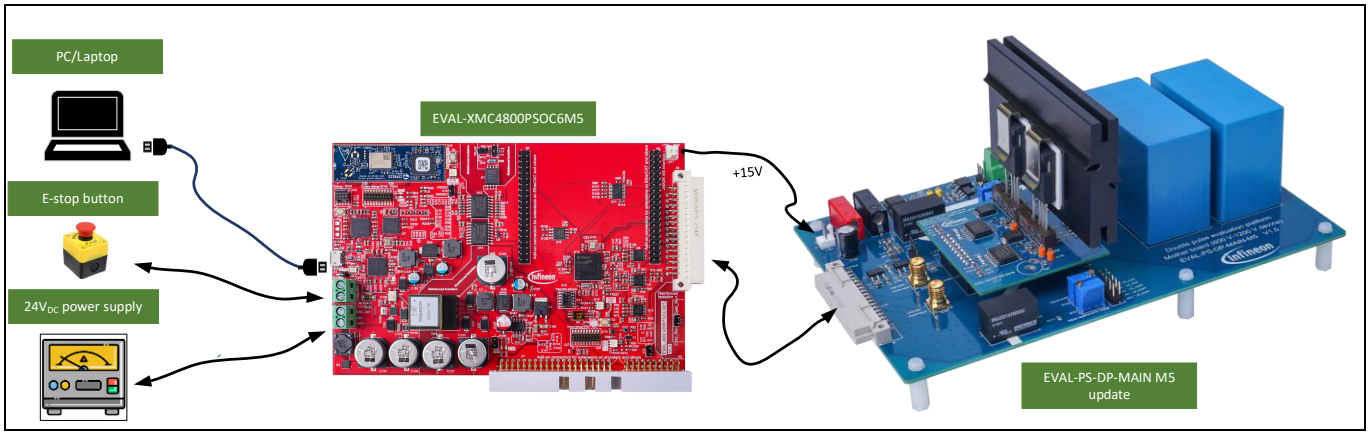



**Figure 20 Set up the hardware**

### 2.4.3 Obtain the hex file

The code is delivered with an exe file (DP4800PSOC62_EVL_P1S0AE.exe) available on Infineon developer center. In this case, the code in the PSoC™ 62 works as the GUI and host, the code in the XMC4800 generates the pulses for the power board. Download the DP4800PSOC62_EVL_P1S0AE, it will unzip below files on your PC then refer to Section 2.3.4 on how to program the hex code.

- DPPSOC62_EVL_D1S0A_v1.0.0.hex
- DP4800_EVL_D1S0A_v1.0.0.hex

*Note: Version number of code may vary due to updates.*

### 2.4.4 Program the hex code

Refer to Section 2.3.4 on how to program the hex code. Then, use the Cypress™ programmer to program DPPSOC62_EVL_D1S0A_v1.0.0.hex.

*Note: Parts of the double- pulse PSoC 62 code are saved in the external QSPI flash. Therefore, to ensure that the code runs correctly, check the external memory option and select **Erase/program entire Sflash allowed** in the Cypress programmer, as shown in Figure 21. This setting has to be done before clicking **Connect**.*

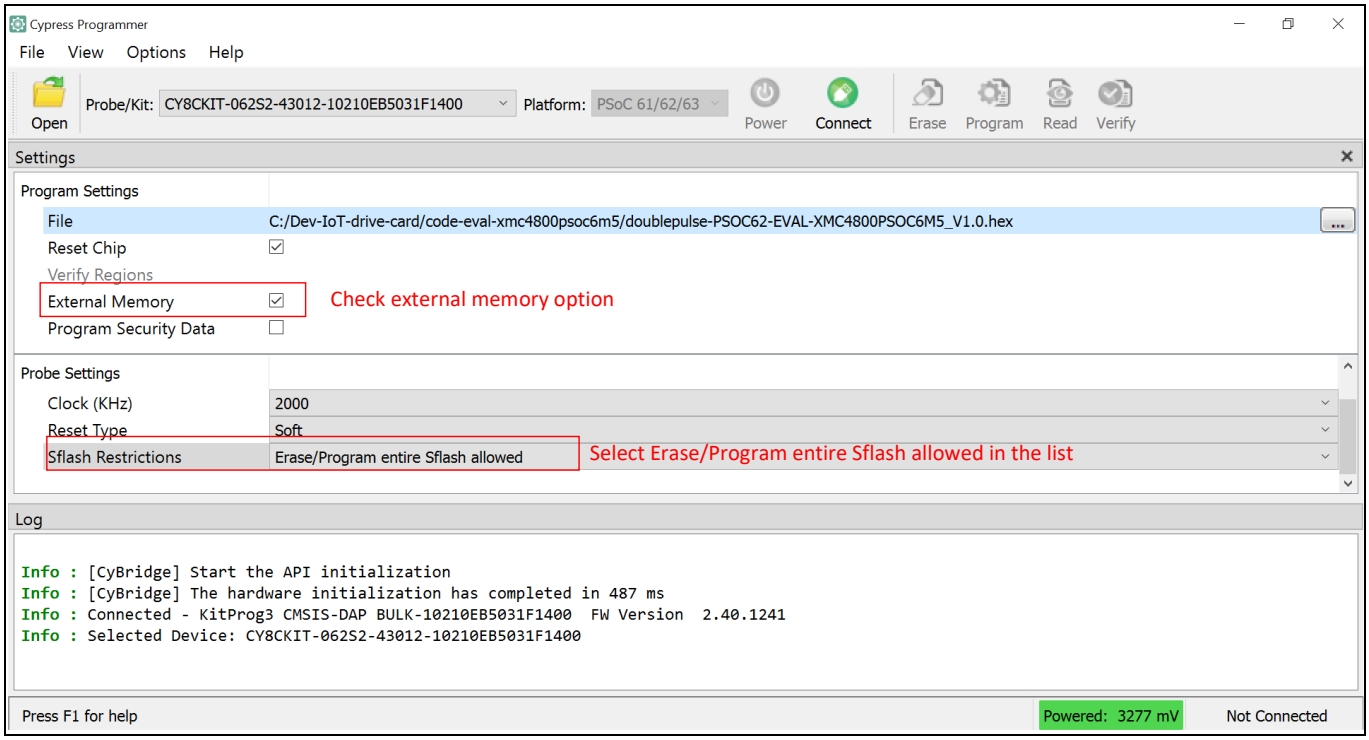



**Figure 21 Additional settings for programming the double-pulse PSoC62 code**

– Use XMCFlasher (or SEGGER J-Flash Lite) to program DP4800_EVL_D1S0A_v1.0.0.hex.

.

### 2.4.5 Implementing double-pulse testing

After programming is complete, a viable Wi-Fi 'EVAL-XMC4800PSOC6M5' will appear in your list of available networks, as shown in Figure 22.

1. Enter 'Infineon' as the network security key and click **Next** to connect. You will be connected to the board via AP (access point) mode.

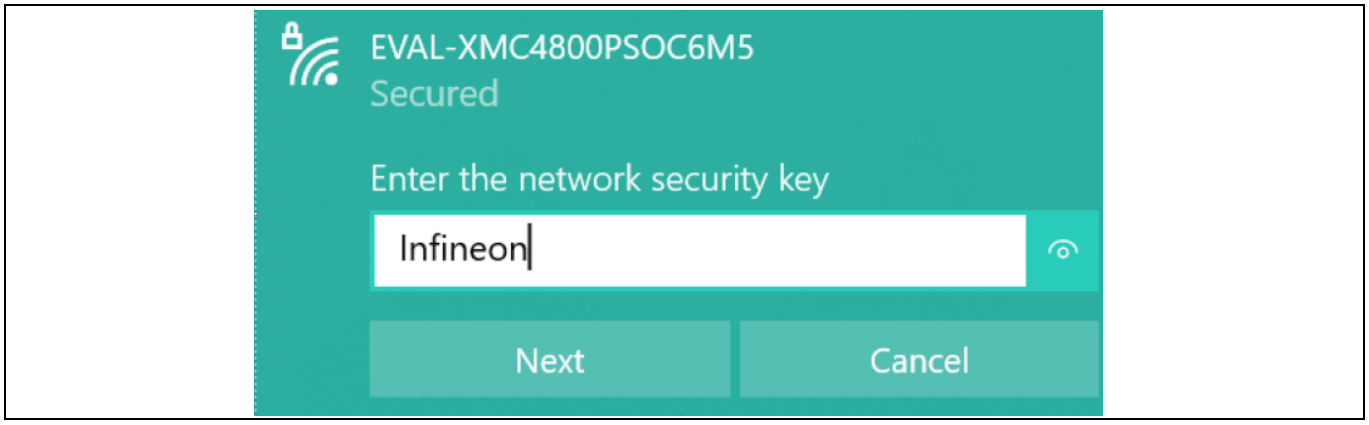



**Figure 22 Log in to the Wi-Fi server**

2. Open the web browser on your PC. Type the web address 'http://192.168.0.2' and press **Enter**, the System Overview page of the GUI will open (see Figure 23).

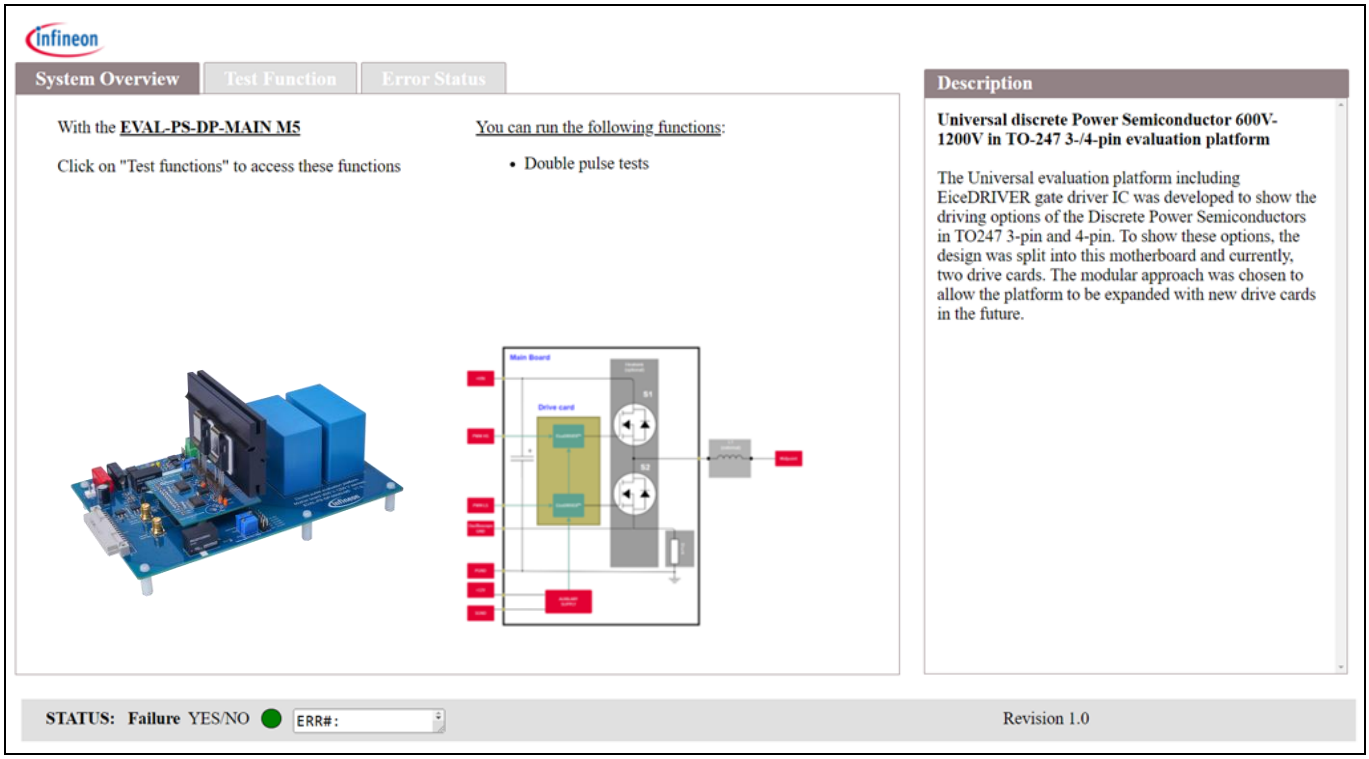



**Figure 23 System overview page of the GUI**

3. Set the parameters in Double Pulse tab. If no faults appear, click **Trigger** to start the double-pulse.

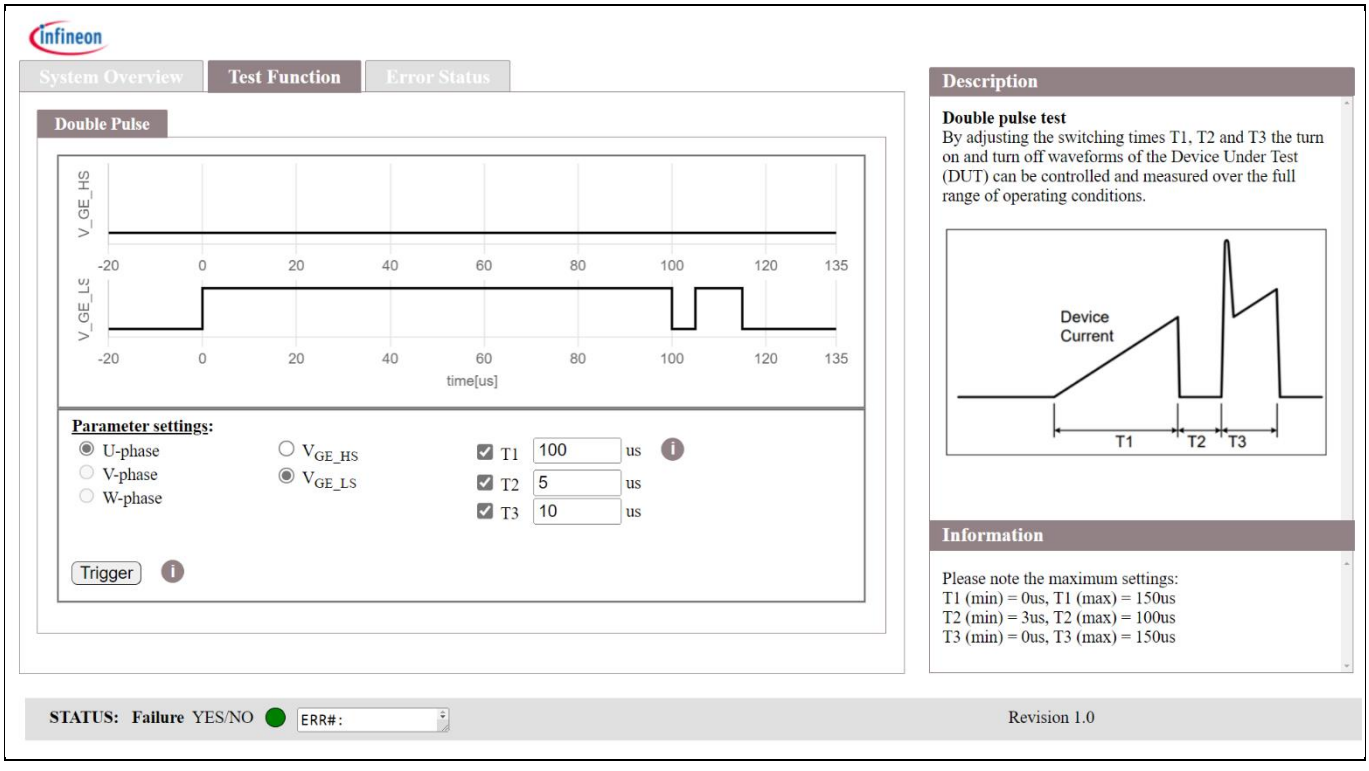



**Figure 24 Double pulse test page**

4. If any fault occurs, the indicator at the bottom will turn red. You can check the Error Status tab (see Figure 25) for more information.

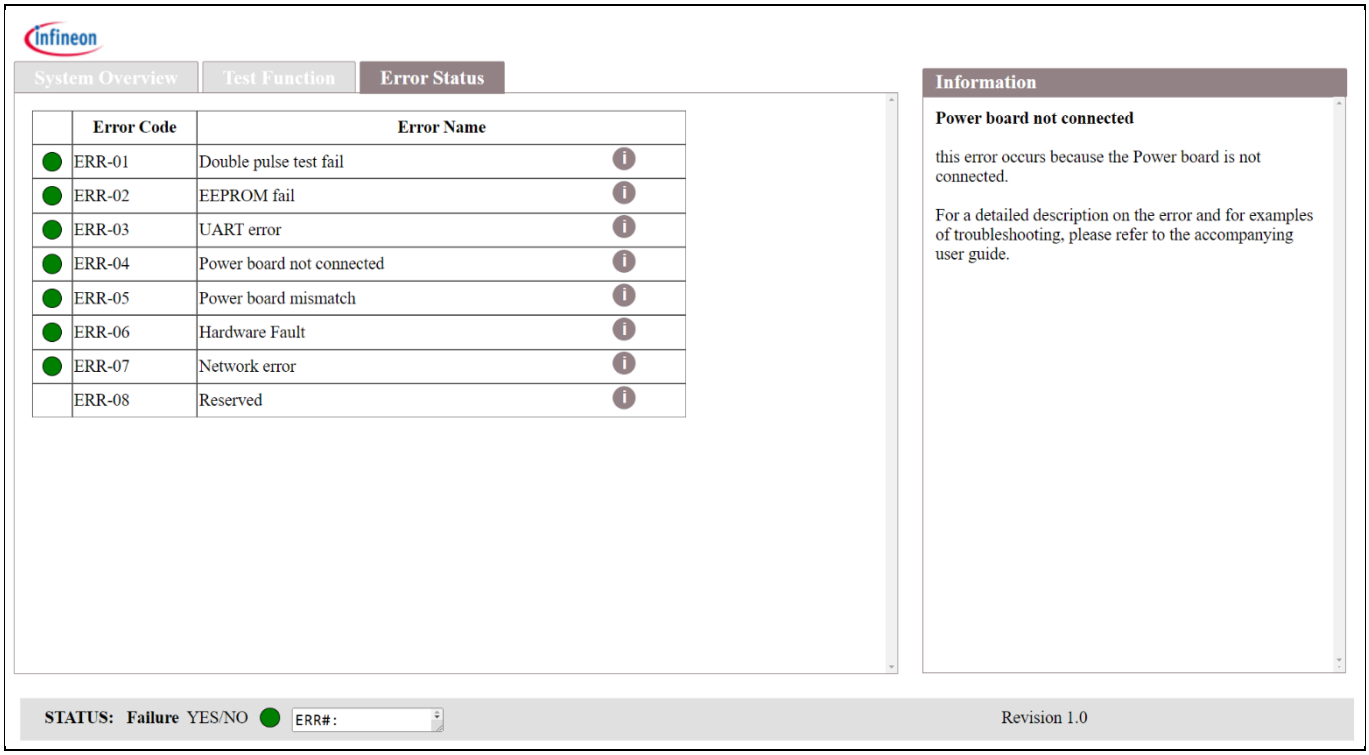



**Figure 25 The Error Status tab**

## 2.5 Detailed description of the hardware functional blocks

### 2.5.1 Isolation barrier

XMC4800 connects to the power stage, therefore, to keep users safe when they are working with the board isolation has been designed between the different functional sections as listed in Table 4. The insulation level for both signals and power supplies is the same.

**Table 4 Insulation level between sections**

| | USB | PSoC™ 62 + CYW43012 | XMC4800 | 24 V input |
|---|---|---|---|---|
| **USB** | - | Same potential | Reinforced insulation | Functional insulation |
| **PSoC™ 62 + CYW43012** | Same potential | - | Reinforced insulation | Functional insulation |
| **XMC4800** | Reinforced insulation | Reinforced insulation | - | Reinforced insulation |
| **24 V input** | Functional insulation | Functional insulation | Reinforced insulation | - |

***Attention:*** ***Both add-on connectors on the board are connected directly to XMC4800's ground. To avoid electrical shocks, users who need to extend the functions using these two connectors should consider providing reinforced insulation for sections that people may touch.***

## 2.5.2 The debugger interface

### 2.5.2.1 Onboard debuggers (OBDs)

As shown in Figure 1, there are two MCUs for users to develop functions on the board. One is the PSoC™ 62 that works on the interface and connection, and the other is XMC4800 that works on power electronics control realization. Both MCUs have onboard debuggers— KitProg3 for PSoC™ 62 and J-Link for XMC4800. Both these OBDs are connected to a USB hub so that only one USB interface is required to keep both the OBDs online without any manual switching.

After the USB is connected, COM ports for each OBD can be found in the Device Manger under Ports (COM & LPT) group. The COM number is assigned by your PC automatically.

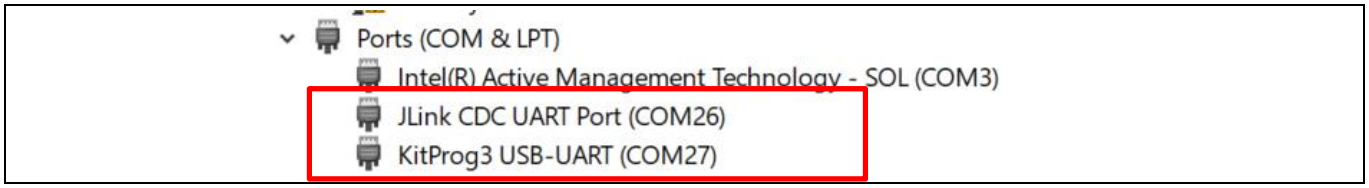



**Figure 26 COM ports of the OBDs**

Detailed introduction to all functional blocks of OBDs is provided below:

1. USB hub

The USB hub is designed to help users use both the OBDs easily, such that only one USB cable is enough and no manual switching is required. The upstream port connects to the USB port and the downstream port connects to Kitprog3 and J-Link respectively for PSoC™ 62 and XMC4800.

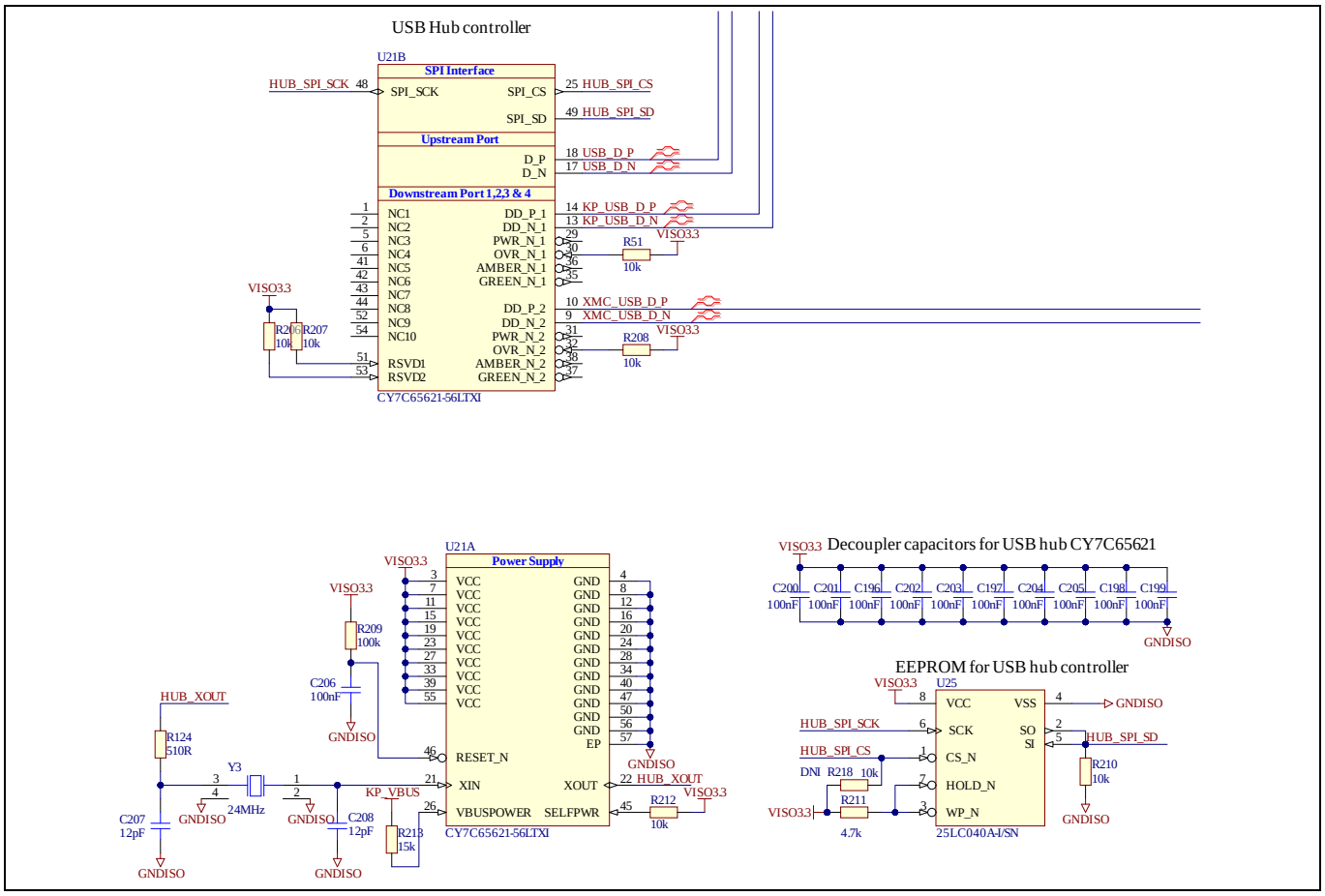



**Figure 27 Schematics of the USB hub**

2. PSoC™ 62 OBD

PSoC™ 62 can be programmed and debugged using the OBD, KitProg3. KitProg3 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, see the KitProg3 User Guide.

Please refer to the full schematic of the board for more details.

3. XMC4800 OBD

The OBD J-Link supports:

- Serial wire debug (SWD)
- Full duplex, universal asynchronous receiver transmitter (UART) communication via a virtual COM port

*Note: The XMC4800 OBD has reinforced insulation with XMC4800 via digital isolators to keep users safe.*

### 2.5.2.2 The Tracebox interface

XMC4800 has an additional debug interface called Tracebox. The Tracebox interface serves as a uniform interface for all Infineon/MOTEON electronics and should always be used with this assignment. This enables simple and safe debugging.

***Attention: Tracebox does not have reinforced insulation. Do NOT use it for 380 $V_{AC}$ and above systems.***

The following interfaces are provided:

- Serial wire debug (SWD)
- Serial peripheral interface (SPI)
- UART
- PWM

Table 5 lists the signal designations of the Tracebox MTN DUT connector as well as the directions of the individual signals.

**Table 5**

| Interface | Signal Tracebox | Tracebox | DUT | DUT pin# | XMC pinout |
|---|---|---|---|---|---|
| SWD | SWCLK/TCK_DUT | OUT | IN | 4 | SWCLK/TCK_DUT |
| | SWDIO/TMS_DUT | IN/OUT | IN/OUT | 2 | SWDIO/TMS_DUT |
| | RESET#_DUT | OUT | IN | 10 | RESET |
| SPI | SPI SPI_CLK_DUT | IN | OUT | 8 | U0C1S.CLKOUT(P6.2) |
| | SPI_SS_DUT | IN | OUT | 9 | U0C1.SELO0(P6.1) |
| | SPI_MOSI_DUT | IN | OUT | 6 | U0C1.DOUT0(P3.13) |
| | SPI_MISO_DUT | OUT | IN | 7 | U0C1.DX0C(P6.3) |
| UART | UART_RX_DUT | IN | OUT | 12 | U1C0.DX0C(P2.15) |
| | UART_TX_DUT | OUT | IN | 11 | U1C0.DOUT0(P2.14) |
| PWM | PWM_OUT_DUT | OUT | IN | 5 | CCU42_IN1A(P3.5) |
| PWR | VDDP | IN | OUT | 1 | |
| | GND | - | - | 3 | |

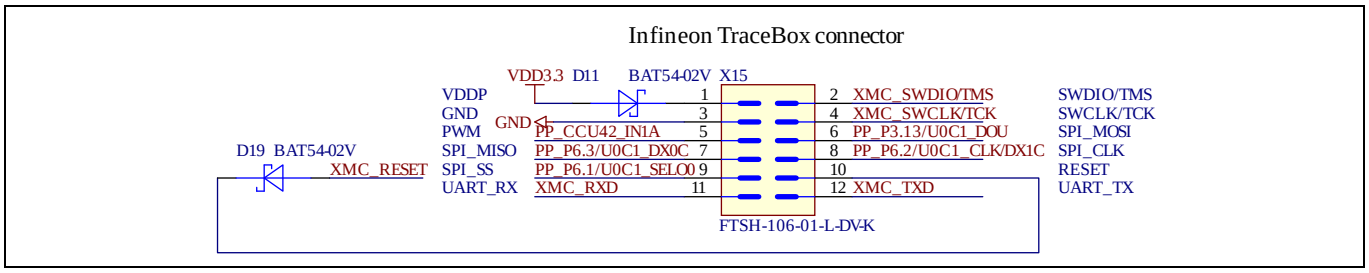



**Figure 28 Schematic of the Tracebox interface**

*Note: To make UART on X15 work, de-solder R217 which is next to U12. Otherwise, it may conflict with the UART on the OBD.*

### 2.5.2.3 The standard debug interface

The MCUs —PSoC™ 62 and XMC4800—on the board support both the standard Cortex-M debug connector and the Cortex debug + Embedded Trace Macrocell (ETM) connector, since the pin1-10 is the same with 2 connectors, and we overlap the 2 connectors on the PCB and do not mount anyone, users who want to use this interface could solder corresponding connector themselves.

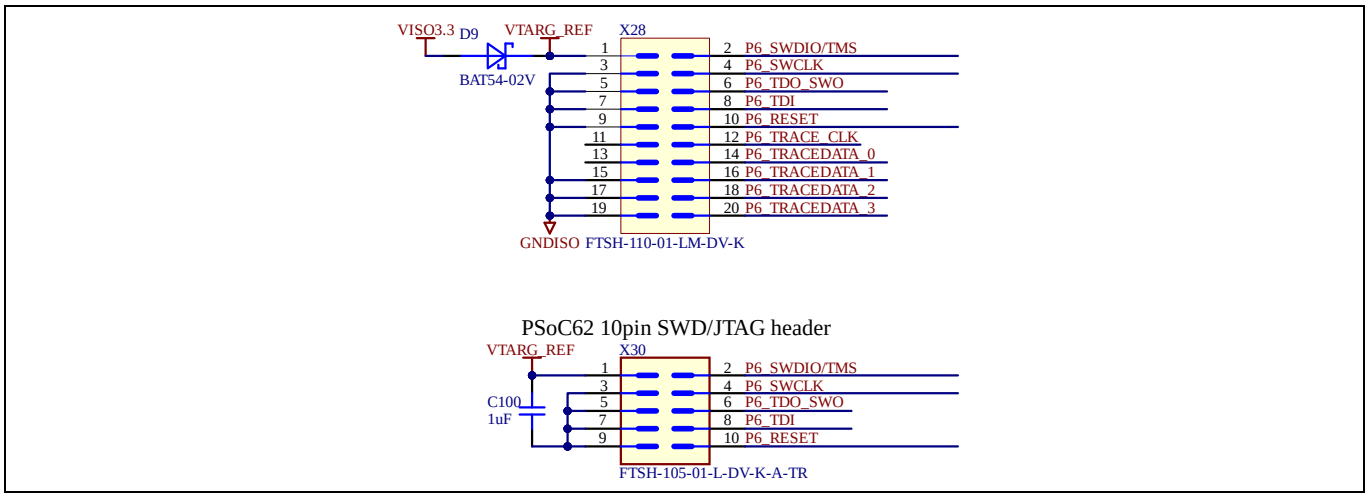



**Figure 29 PSoC™ 62 Cortex-M debug and ETM connector**

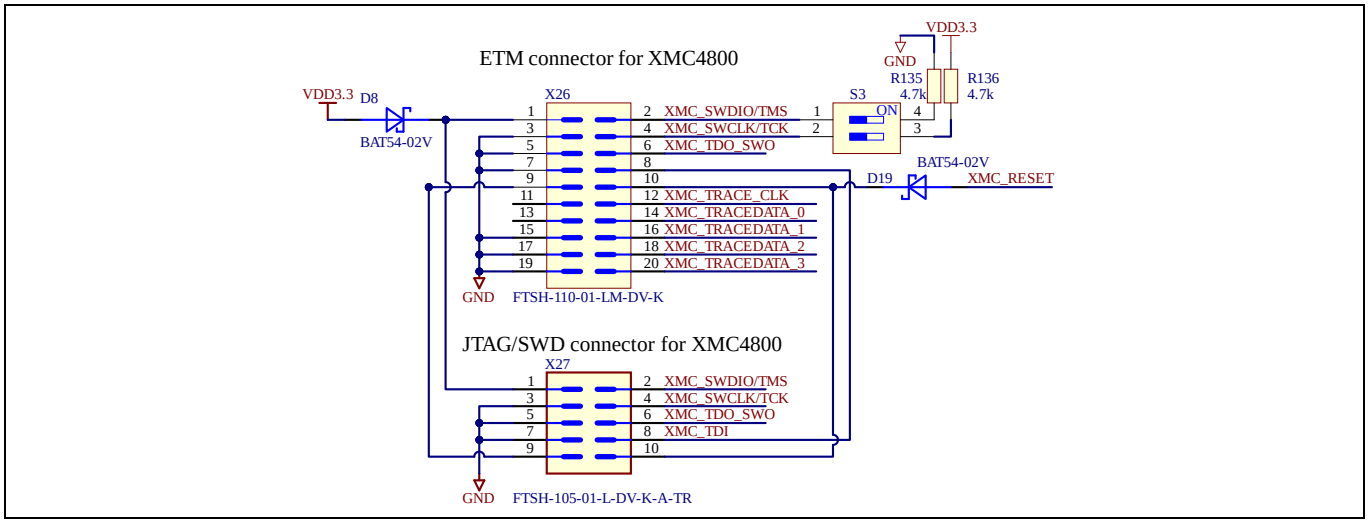



**Figure 30 XMC4800 Cortex-M debug and ETM connector**

***Attention:*** ***The standard debug interface connects directly to XMC4800. Please ensure that the insulation level of the debug cable meets the system requirements.***

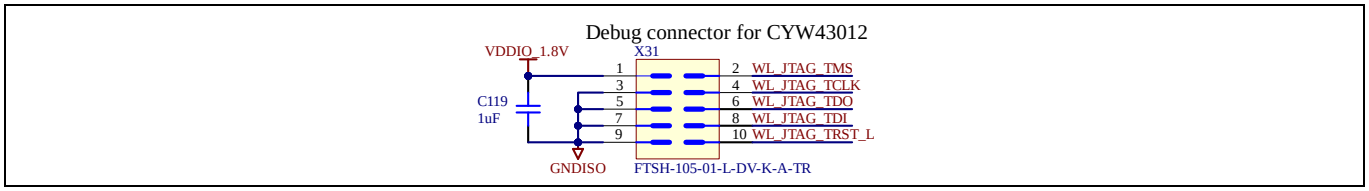



**Figure 31 CYW43012 10-pin SWD/JTAG header**

Figure 31 shows the 10-pin debug header for CYW43012. Refer to CY8CMOD-062S2-43012 for more details.

## 2.5.3 Power supplies

This section explains how the board is powered and works.

As shown in Figure 32, the three main sections are isolated from each other.

There are two power sources for the board, each with a different power section:

- The USB port

  USB can only power the section that has the same ground with it, i.e., the USB hub, OBDs, PSoC™ 62 and CYW43012. Other section cannot be powered by it.

- 24 V input

  The 24 V input connects to a flyback power supply that can generate power for all the components on the board. Therefore, to make all sections of the board work a 24 V input is essential.

The M5 interface has a 5 V input pin that connects it to the analog-digital convertor (ADC) port to ensure that the power stage is powered up and has enough power for the EVAL-XMC4800PSOC62M5.

For technical data about the power supply, refer to Section 1.4.

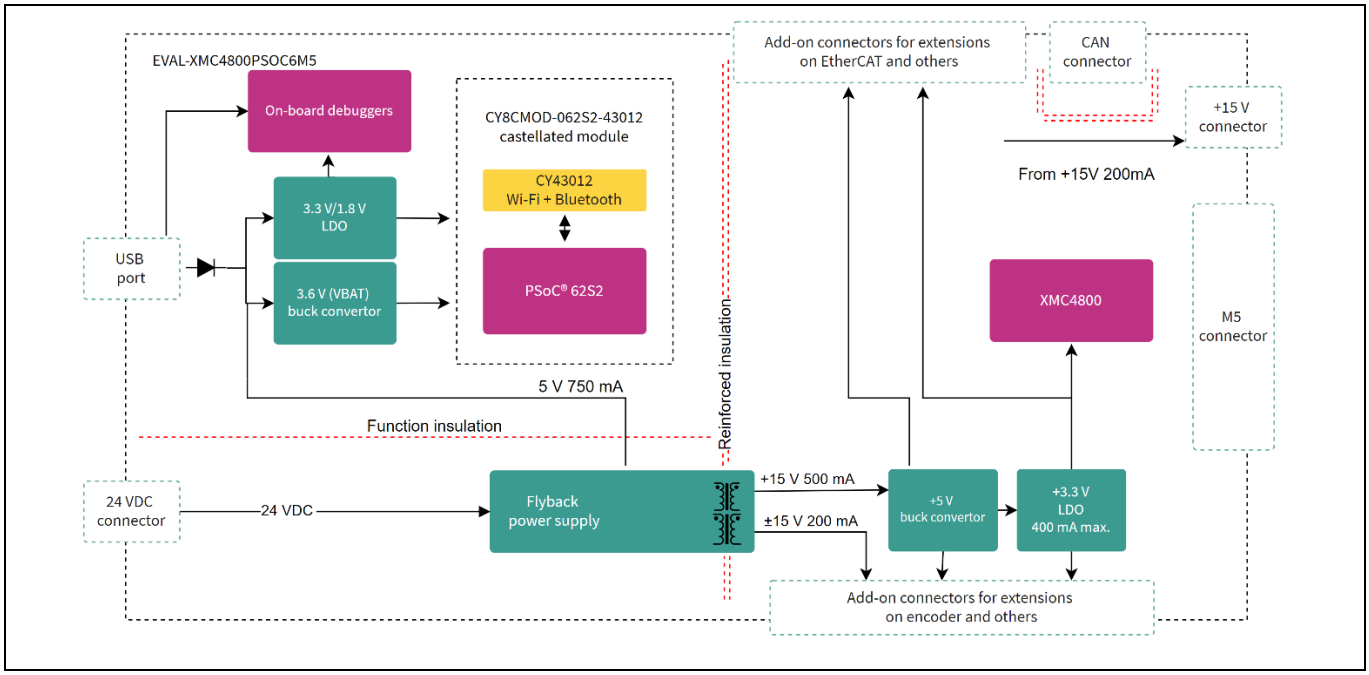



**Figure 32 Block diagram of power supply on the board**

### 2.5.3.1 Flyback power supply

Figure 33 shows the schematic of the flyback power supply section. An Infineon smart boost controller, TLE8386-2EL, is used as the controller of the circuit and a 5 V output is used to achieve close-loop feedback. The flyback transformer is designed with reinforced insulation between the primary and secondary side. Refer to Table 6 and Section 2.5.1 for more details.

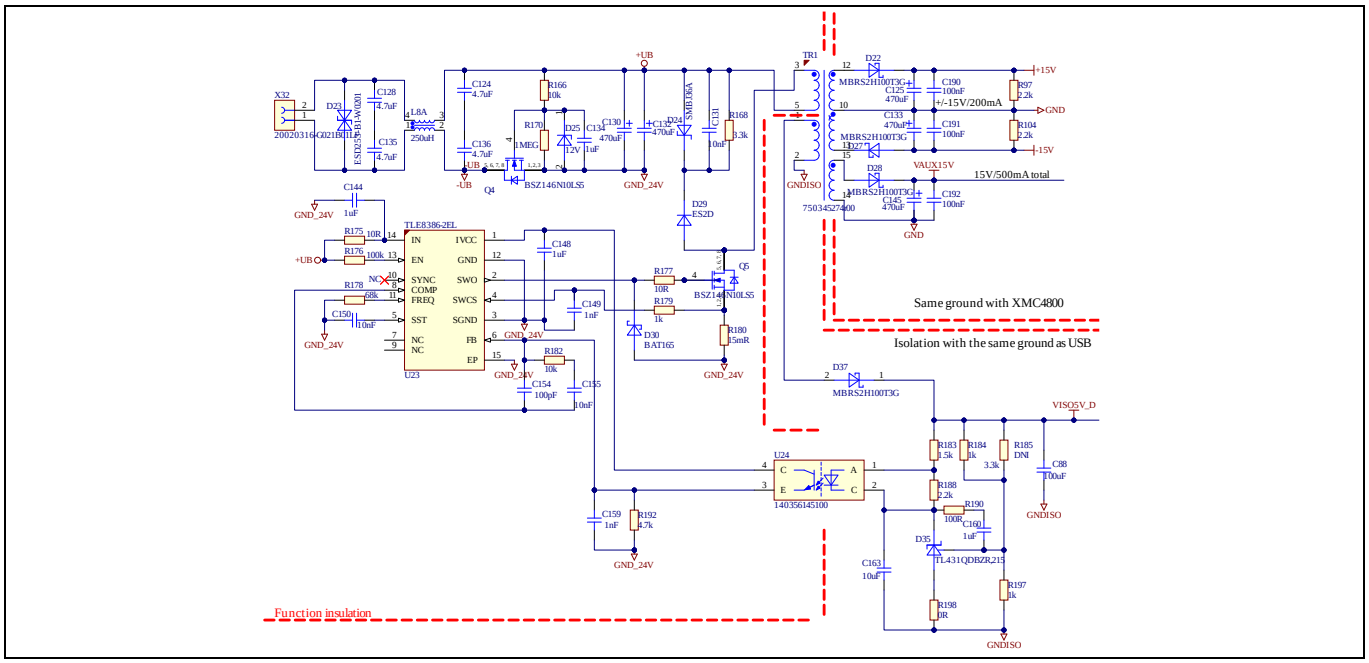



**Figure 33 Flyback power supply**

The circuit has reverse protection (R166/R170/D25/C134/Q4) to prevent incorrect input polarity. Using 24 VDC to power the circuit is recommended.

**Table 6 Insulation levels**

| | 24 V | +5 V | +15 V/ ±15 V |
|---|---|---|---|
| **24 V** | - | Functional insulation | Reinforced insulation |
| **+5 V** | Functional insulation | - | Reinforced insulation |
| **+15 V/ ±15 V** | Reinforced insulation | Reinforced insulation | - |

## 2.5.3.2 Power supplies in the PSoC™ 62 section

As shown in Figure 32, the USB hub, OBDs, PSoC™ 62, CYW43012, and the surrounding circuits refer to the same potential. They are powered either by the flyback power supply or by an USB. Using flyback is recommended as it delivers more power.

3.3 V and 1.8 V powers the MCU and CYW43012. TLS205B0EJV and TLE42774D V33 are used here.

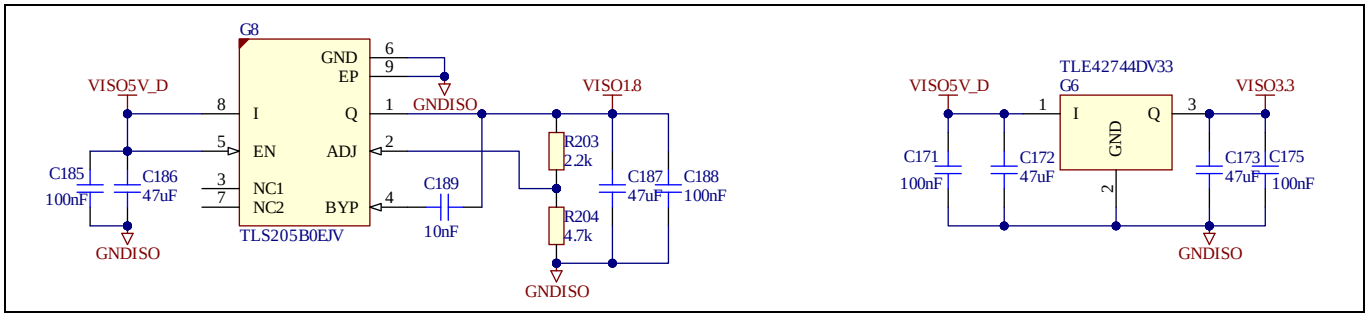



**Figure 34 3.3 V and 1.8 V Low dropout regulator (LDO)**

A buck converter, TLE8366EV, is used for $V_{BAT}$ as CYW43012 consumes more than 500 mA peak. It is a PWM step-down DC/DC converter with an integrated 1.8 A power switch in a small PG-DSO-8 package with an exposed pad.

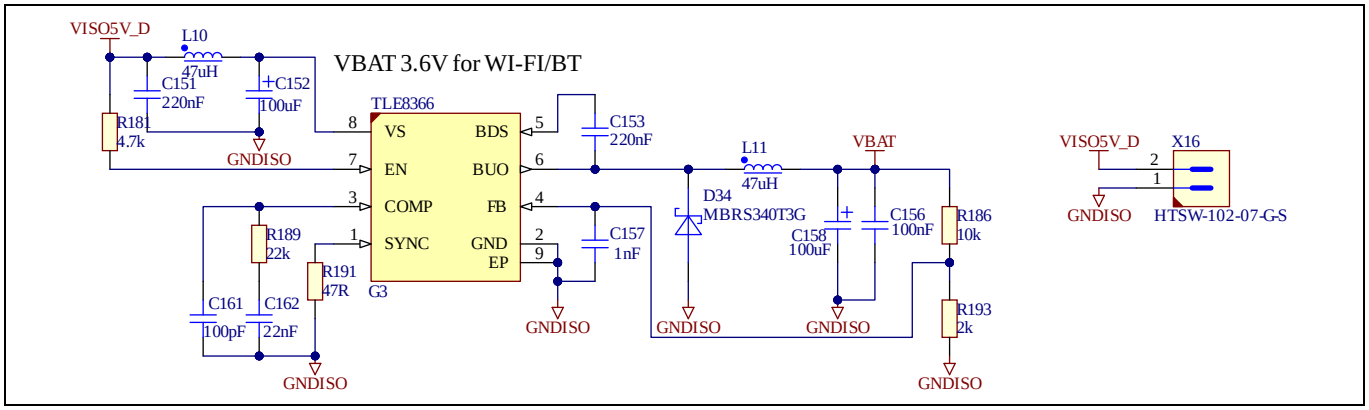



**Figure 35 $V_{BAT}$ (3.6 V) step-down converter**

### 2.5.3.3 Power supply in the XMC4800 section

As shown in Figure 32, XMC4800, the circuit around it, the add-on packs, and M5 connectors refer to the same potential. Their power comes from the flyback power supply. As shown in Figure 33, ±15 V is for the add-on packs X8(encoder and others) and connector X17. +5 V / +3.3 V come from +15 V.

G2 is a step-down converter, and it generates 5 V for this section. As discussed in Section 2.5.3.2, the step-down converter TLE8366EV is used here.

G1 is the LDO TLE42774D V33 that generates 3.3 V for XMC4800, the surrounding circuits, and the add-on packs.

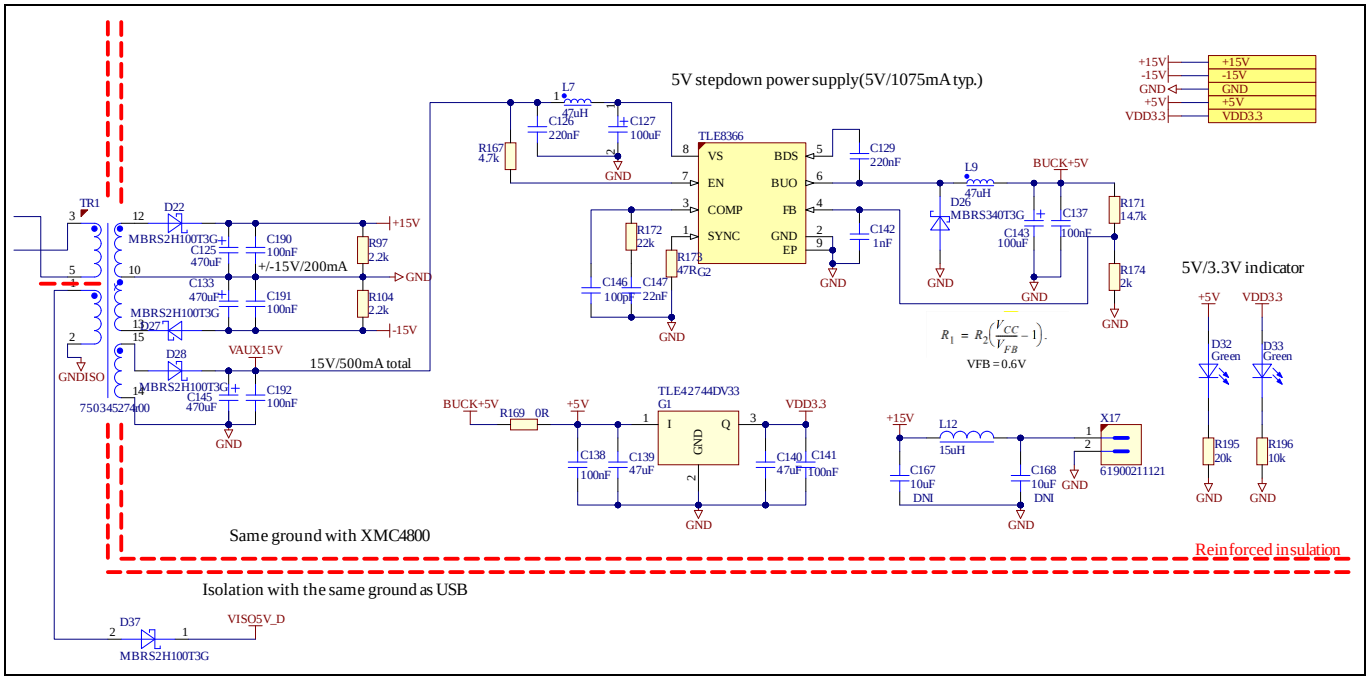



**Figure 36 Power supply for the XMC4800 section**

### 2.5.4 Function blocks around PSoC™ 62

#### 2.5.4.1 CY8CMOD-062S2-4312 (PSoC™ 62, WIFI, and Bluetooth (BT))

CY8CMOD-062S2-43012 is a castellated PCB module that consists mainly of PSoC™ 62 MCU, CY8C624ABZI-S2D44, and CYW43012 devices. The module also houses a 2.45 GHz/5 GHz dual-band chip antenna, an RF switch for antenna diversity, a low power oscillator (LPO) for CYW43012, a crystal oscillators for PSoC 6 MCU, modulation and integration capacitors to support CapSense, and other passive components required for the proper working of PSoC™ 62 MCU and CYW43012. Pre-certified, type 1 LV module with CYW43012 from Murata, LBEE59B1LV, is used for ease of development. The antenna used is 2450AD14A5500 dual band 2.45 GHz/5 GHz mini chip antenna from Johanson. The castellated PCB module has 137 castellated pads that are used for different voltage rails and I/O signals of PSoC™ 62 MCU and CYW43012.

For more information, see the PSoC™ 62 MCU webpage, Murata Type 1 LV webpage, and the datasheet for CY8CMOD-062S2-4312.

#### 2.5.4.2 OPTIGA™ Trust M security chip

The OPTIGA™ Trust M is a high-end security solution that provides an anchor of trust for connecting IoT devices to the cloud, giving every IoT device its own unique identity. This pre-personalized turnkey solution offers secured, zero-touch onboarding, and the high performance needed for quick cloud access.

OPTIGA™ Trust M offers a wide range of security features, making it ideal for industrial and building automation applications, smart homes, and connected consumer devices.

SLS32AIA010ML, which has an extended temperature range of -40 to +105°C for harsh industrial environments, is mounted on the board with three pins connected to the PSoC™ 62 MCU, which are I2C interface and a GPIO P12.2 (reset signal).

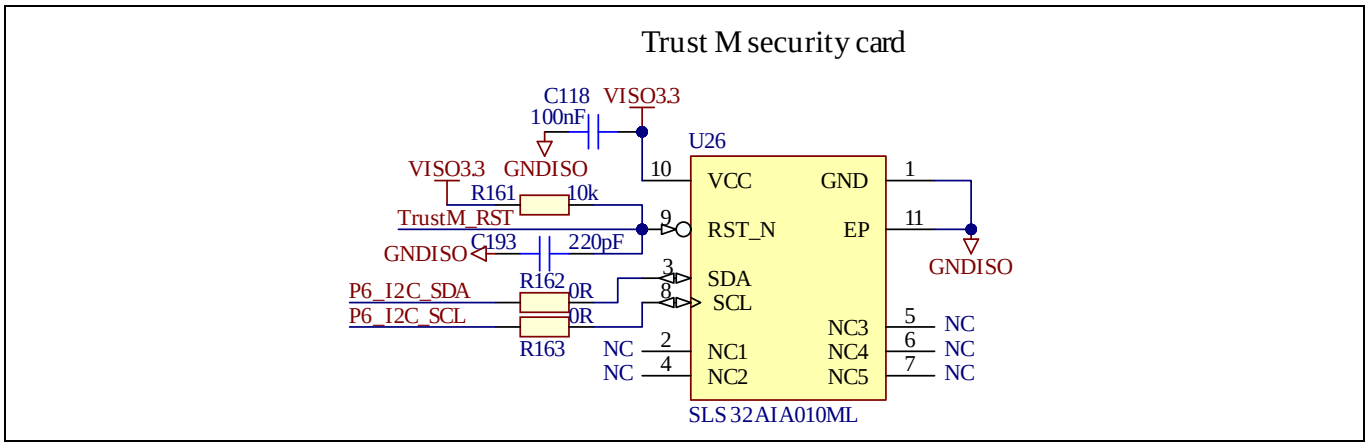



**Figure 37 Schematics of OPTIGA™ Trust M**

#### 2.5.4.3 Flash

The PSoC™ 62 connects to a Cypress not or (NOR) flash memory (S25FL512SDSMFM013) of 512 Mb capacity. The NOR flash is connected to the Quad-SPI interface of the PSoC™ 62 MCU device.

The NOR flash device can be used for both data and code with execute-in-place (XIP) support and encryption.

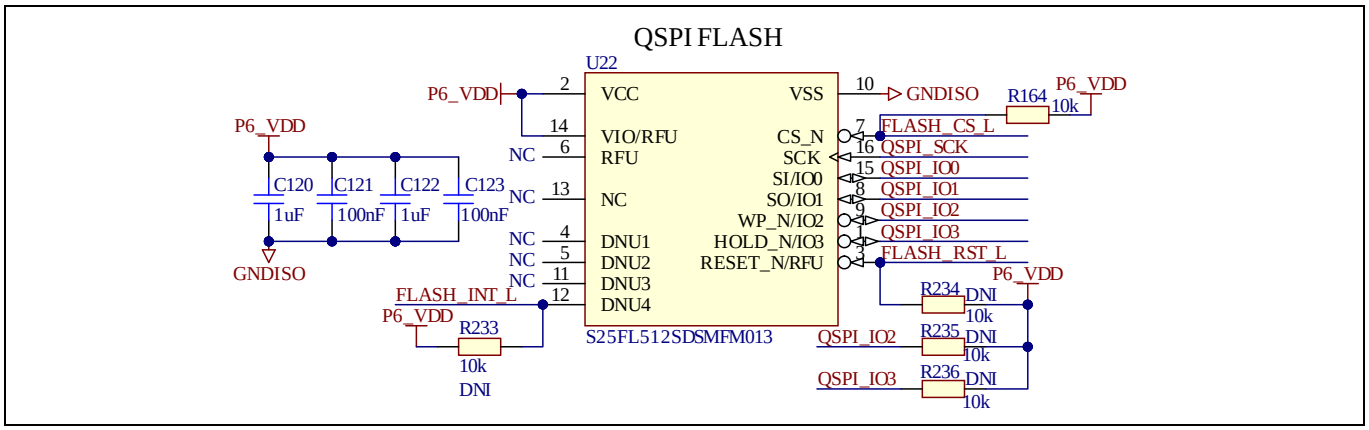



**Figure 38 Schematics of flash**

### 2.5.4.4 User LED and RGB LED for PSoC™ 62 MCU

The board provides one RGB LED, each color of which is assigned to a User_LED number. The port pins are listed in Table 7. Refer to Figure 14 for the location of the RGB LED on the board.

**Table 7 Pin assignment for RGB LED**

| LED | PSoC™ 62 Pin |
|---|---|
| RGB-Red/User_LED1 | P1.1 |
| RGB-Green/User_LED | P0.5 |
| RGB-Blue/User_LED2 | P7.3 |

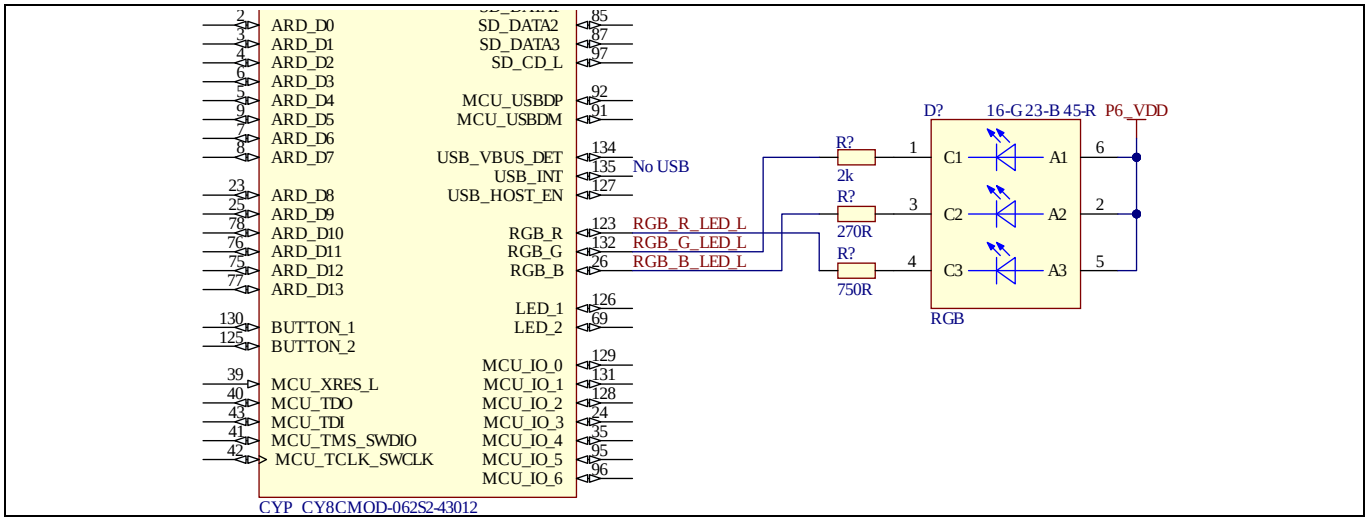



**Figure 39 RGB LED – PSoC™ 62 MCU**

## 2.5.5 Function blocks around XMC4800

### 2.5.5.1 Controller for power electronics - XMC4800

The XMC4800 device is a member of the XMC4000 family of microcontrollers based on the Arm® Cortex®-M4 processor core. The growing complexity of today's energy efficient, embedded control applications demands microcontroller solutions with higher performance CPU cores featuring digital signal process (DSP) and float

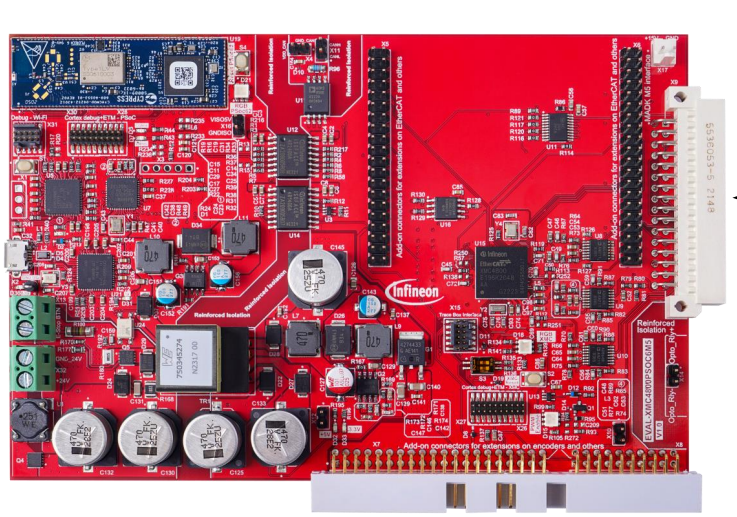
point unit (FPU) capabilities. The XMC4800 family of microcontrollers are based on Infineon's decades of experience in the industrial market and provide an optimized solution to meet the performance challenges of today's embedded control applications. It is the first ever EtherCAT ® node on an Arm® Cortex®-M microcontroller with an on-chip flash and analog/mixed signal capabilities. More details on XMC4800 can be found here.

As shown in Figure 1, XMC4800-E196F2048 on the board is the main controller for power electronics, and plays the role of the CAN and EtherCAT communication as well. To extend to as many peripherals as possible, the 196-pin ball grid array (BGA) package is used.

### 2.5.5.2 M5 interface

M5 is one of Infineon's defined standard interface for modular application design kit (MADK) boards. Figure 40 shows the position of M5 connector on the board, and Figure 41 provides the definition of an M5 interface.

*Note: Prefix '/' in the signal name that means low-level effectiveness.*



Upper row Lower row

| B1 | A1 | | | | | |
|---|---|---|---|---|---|---|
| | | B1 | +5V | A1 | GND |
| | | B2 | BRAKING_GATE | A2 | PFC_GATE |
| | | B3 | THERMISTOR | A3 | VAC_U/IPFC |
| | | B4 | VDCLINK | A4 | VAC_V/VPFC |
| | | B5 | I_U_BITSTREAM | A5 | I_U_ADC |
| | | B6 | I_V_BITSTREAM | A6 | I_V_ADC |
| | | B7 | I_W_BITSTREAM | A7 | I_W_ADC |
| | | B8 | DSD CLK | A8 | VAC_W/NTC_BR |
| | | B9 | PWM_UL | A9 | CPU_STO_ACK |
| | | B10 | PWM_UH | A10 | RELAY_CONTROL |
| | | B11 | PWM_VL | A11 | STO_SIGNAL |
| | | B12 | PWM_VH | A12 | BRD_INFO2 |
| | | B13 | PWM_WL | A13 | I2C_DATA |
| | | B14 | PWM_WH | A14 | I2C_CLK |
| | | B15 | /FAULT | A15 | /STO_BTN |
| | | B16 | RDY | A16 | BRD_INFO1 |

**Figure 40 M5 connector on the board**

| Male (Controller) | Female (Power) | Definition | Type of signal | Direction of signal | Description |
|---|---|---|---|---|---|
| A16 | A1 | BRD_INFO1 | ADC | To micro | Resistor divider to detect power board |
| A15 | A2 | /STO_BTN | IO | To micro | signal from STO button of power board |
| A14 | A3 | I2C_CLK | I2C | From micro | I2C interface for gate driver configuration |
| A13 | A4 | I2C_DATA | I2C | Bi-Dir | I2C interface for gate driver configuration |
| A12 | A5 | BRD_INFO2 | ADC | To micro | Extention backup for BRD_INFO1 |
| A11 | A6 | STO_SIGNAL | IO | From micro | IO which can enable the power board's aux power supply |
| A10 | A7 | RELAY_CONTROL | PWM | From micro | Relay control for soft start circuit |
| A9 | A8 | CPU_STO_ACK | IO | Bi-Dir | combine the signals of gate driver ready |
| A8 | A9 | VAC_W/NTC_BR | ADC | To micro | Analog signal to ADC |
| A7 | A10 | I_W_ADC | ADC | To micro | Phase W current, analog signal to ADC |
| A6 | A11 | I_V_ADC | ADC | To micro | Phase V current, analog signal to ADC |
| A5 | A12 | I_U_ADC | ADC | To micro | Phase U current, analog signal to ADC |
| A4 | A13 | VAC_V/VPFC | ADC | To micro | Analog signal for line voltage |
| A3 | A14 | VAC_U/IPFC | ADC | To micro | Analog signal for line voltage or line current |
| A2 | A15 | PFC_GATE | PWM | From micro | PFC gate signal |
| A1 | A16 | GND | GND | | Ground |
| B16 | B1 | RDY | IO | Bi-Dir | Ready pins for gate driver |
| B15 | B2 | /FAULT | IO | To micro | Fault signals from gate driver |
| B14 | B3 | PWM_WH | PWM | From micro | PWM signal, phase W, high side |
| B13 | B4 | PWM_WL | PWM | From micro | PWM signal, phase W, low side |
| B12 | B5 | PWM_VH | PWM | From micro | PWM signal, phase V, high side |
| B11 | B6 | PWM_VL | PWM | From micro | PWM signal, phase V, low side |
| B10 | B7 | PWM_UH | PWM | From micro | PWM signal, phase U, high side |
| B9 | B8 | PWM_UL | PWM | From micro | PWM signal, phase U, low side |
| B8 | B9 | DSD CLK | DS_CLK | From micro | Clock signal for Delta-Sigma modulator |
| B7 | B10 | I_W_BITSTREAM | DS Bitstream | To micro | Bit stream signal from Delta-sigma modulator |
| B6 | B11 | I_V_BITSTREAM | DS Bitstream | To micro | Bit stream signal from Delta-sigma modulator |
| B7 | B12 | I_U_BITSTREAM | DS Bitstream | To micro | Bit stream signal from Delta-sigma modulator |
| B4 | B13 | VDCLINK | ADC | To micro | DC bus voltage sense |
| B3 | B14 | THERMISTOR | ADC | To micro | Voltage signal from thermistor |
| B2 | B15 | BRAKING_GATE | PWM | From micro | Braking gate signal |
| B1 | B16 | +5 V | PWR | To micro | +5 V from power board |

**Figure 41 M5 definition**

BRD_INFO1(A16) and BRD_INFO2(A12) are used to detect the power stage type by pre-defined voltage level. Take EVAL-PS-DP-MAIN M5 for example: BRD_INFO1 is 1 V, and BRD_INFO2 is 0 V.

### 2.5.5.3 Add-on connectors for extensions on EtherCAT and others

X5 and X6 are the add-on connectors for user extension on EtherCAT and other customizations. An XMC EtherCAT physical layer device (PHY) board that is part of XMC4800 Relax EtherCAT (KIT_XMC48_RELAX_ECAT_V1) can be mounted on it.

*Note: The resistors shown in Figure 43 are not installed on the board by default. Users who want to use these pins need to mount them first.*

*Note: EtherCAT software solution is not part of EVAL-XMC4800PSOC6M5.*

**Figure 42 XMC EtherCAT PHY board**

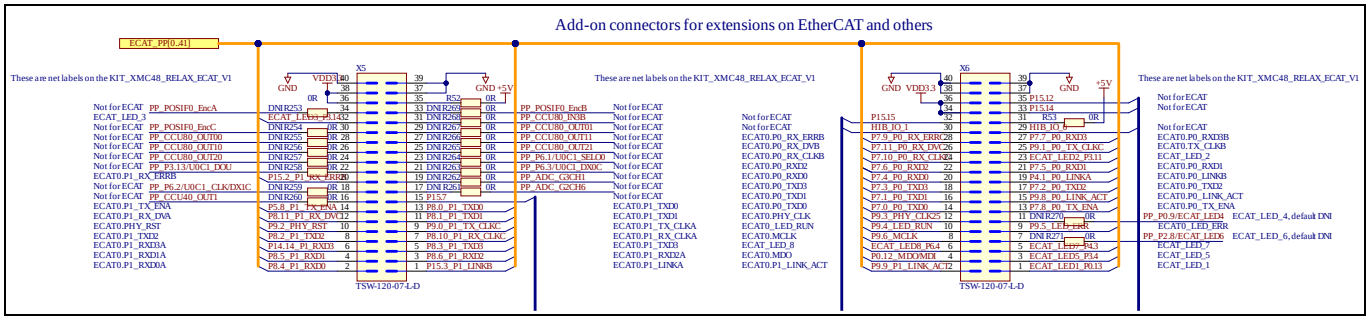



**Figure 43 Add-on connectors for extensions on EtherCAT and others**

### 2.5.5.4 Add-on connectors for extensions on encoder and others

The board provides another set of add-on connectors, X7 and X8. They provide the possibility of extension for different type of encoders such as Hall/Incremental encoder/Sincos encoder/resolver, and others by customers.

The following peripherals are used here for the add-on connectors:

- 1 CH SPI

- 4 pairs of CCU80 output
- 3 pairs of CCU81 output
- POSIF0/1
- 2 CHs DSD
- 1 CCU4 input and output
- 1 CCU8 input
- ADCs
- GPIOs

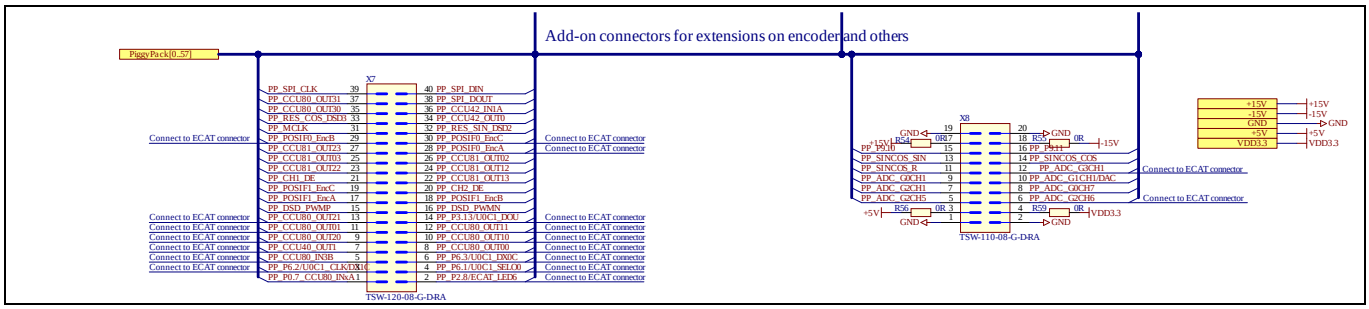



**Figure 44 Add-on connectors for extensions on encoder and others**

## 2.5.5.5 Enabling circuits

Enabling circuits protect users in emergency. They block the PWM signals routing through U11 (shown in Figure 46), as listed in Table 8, when “disable” is triggered. These circuits have two different trigger sources, one from the M5 interface (power boards), and another from X13 (users need to connect a normally closed E-stop button) on the board. The trigger logic of the enabling circuit is displayed in Table 9.

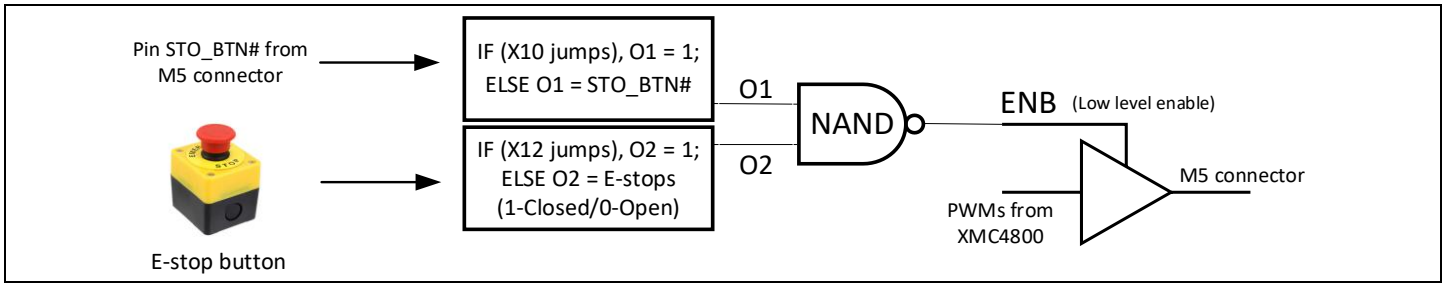



**Figure 45 Enabling circuits’ trigger logic**

**Table 8 Enabling circuit controlled signals**

| SN | Pins on the M5 connector (male) | Signal definition |
|---|---|---|
| 1 | B14 | PWM_WH |
| 2 | B13 | PWM_WL |
| 3 | B12 | PWM_VH |
| 4 | B11 | PWM_VL |
| 5 | B10 | PWM_UH |
| 6 | B9 | PWM_UL |

| SN | Pins on the M5 connector (male) | Signal definition |
|---|---|---|
| 7 | A2 | PFC_GATE |
| 8 | B2 | BRAKING_GATE |

### Trigger source 1

Signal STO_BTN# is the IO signal from the power board via the M5 interface (/STO_BTN in Figure 41). When the signal reaches a low level, the enabling signal of U11 switches to low and blocks PWM signals.

***Attention:*** ***Trigger source 1 can by bypassed by jumper X10 (Figure 47). Before bypassing it, make sure personnel safety is maintained.***

### Trigger source 2

Use a normally closed E-stop button to connect to the connector X13 is recommended. In case of an emergency, press down the emergency stop button (contact will open and stay). This will trigger the protection and block PWM signals.

***Attention:*** ***Trigger source 2 can by bypassed by jumper X12 (Figure 47). Before bypassing it, make sure personnel safety is maintained.***

### Status indicator

When the enabling protection is triggered, the RGB LED (D15 in Figure 47) is used as an indicator—green for enable and red for disable.

**Table 9 True table of enabling circuit**

| STO_BTN# | X13 (connect a normally closed E-stop button) | PWM signal |
|---|---|---|
| High | Button released | Enable |
| Low | Button released | Disable |
| High | Button pressed | Disable |
| Low | Button pressed | Disable |

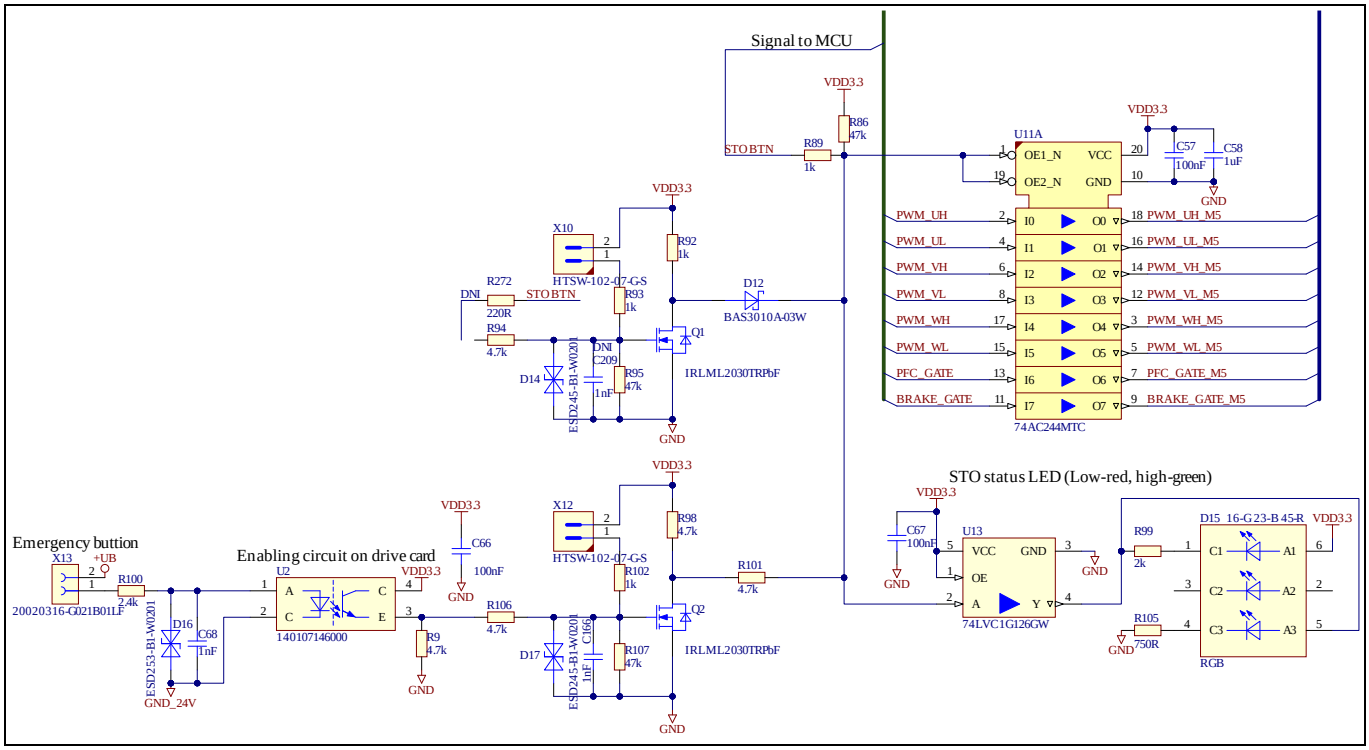



**Figure 46 Enabling circuit schematic**

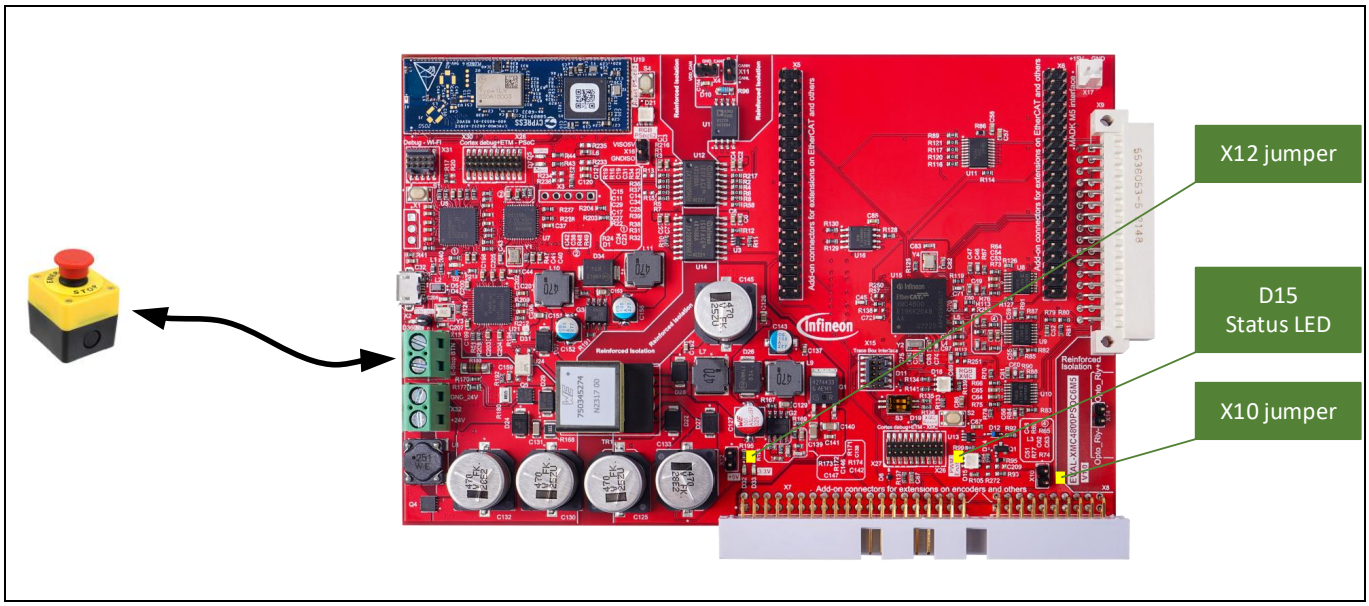



**Figure 47 E-stop button connection, jumper, and status LED on the board**

### 2.5.5.6 Flash

The XMC4800 connects to a Cypress NOR flash memory (S25FL064LABMFI010) of 64 Mb capacity. The NOR flash is connected to the Quad-SPI interface of the XMC4800 MCU.

The NOR flash device can be used for both data and code with execute-in-place (XIP) support and encryption.

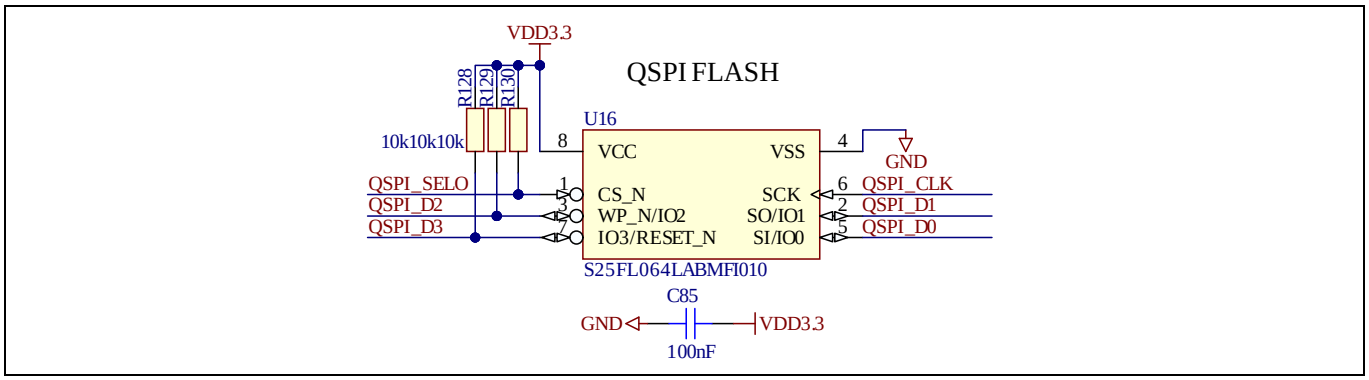



**Figure 48 Schematics of flash**

## 2.5.5.7 Controller area network (CAN) interface

The board provides one channel-reinforced, isolated CAN interface with a 120 Ω termination resistor. An extra power supply with reinforced insulation with the board is required to power the differential via the connector X4.

*Note: X4 can jump to X16 with 5 V power supply if the safety of the connection with the setup can be confirmed because 5 V on X16 uses the same ground as USB and PSoC™ 62. Refer to Figure 50 for this solution.*

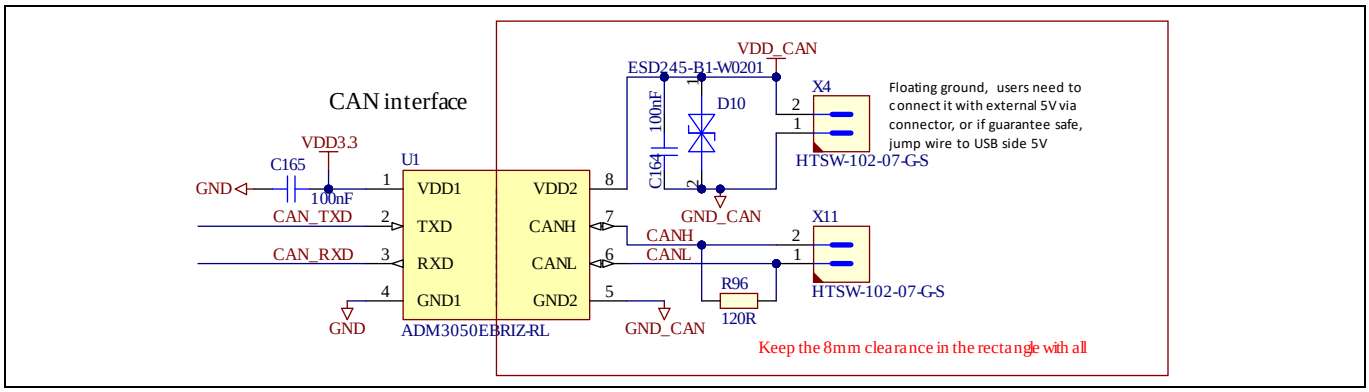



**Figure 49 Schematic of CAN**

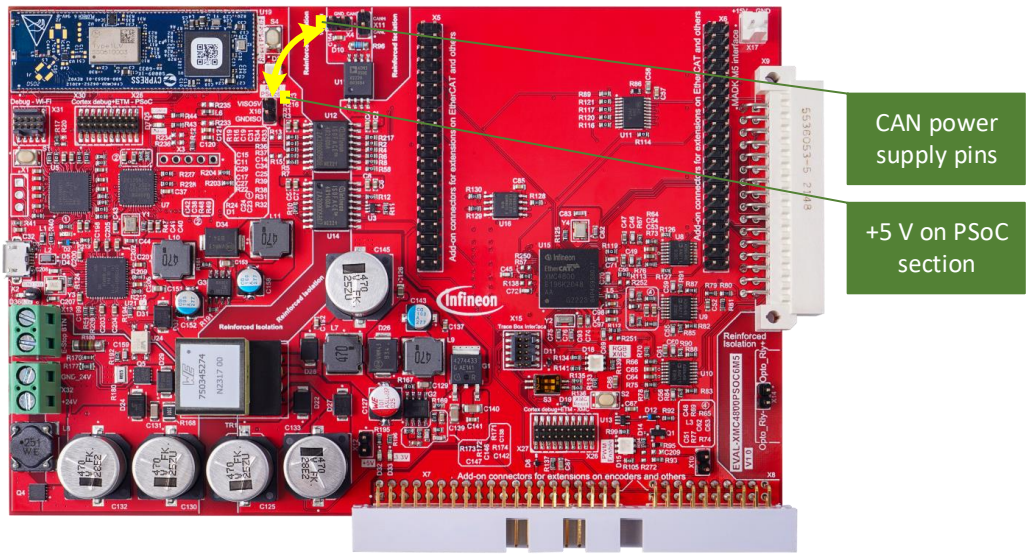



**Figure 50 Jumper power as note information**

### 2.5.5.8 User LED and RGB LED for XMC4800

The board provides one RGB LED, each color of which is assigned to a User_LED number, the port pins are listed in Table 10. Refer to Figure 14 for the location of the RGB LED on the board.

**Table 10 Pin assignment for the RGB LED**

| LED | XMC4800 Pin |
|---|---|
| RGB-Red/User_LED2 | P5.9 |
| RGB-Green/User_LED | P4.0 |
| RGB-Blue/User_LED1 | P3.2 |

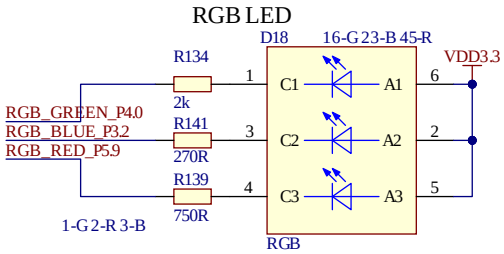



**Figure 51 RGB LED – XMC4800**

### 2.5.5.9 Level shifters for analog signals

The board is designed to connect the power board with 0–5 V analog signal, but XMC4800 is a 3.3 V MCU. Therefore, all analog signals coming from the M5 connector are connected via level shifters. The level shifter ratio from power board signals towards MCU is 0.662.

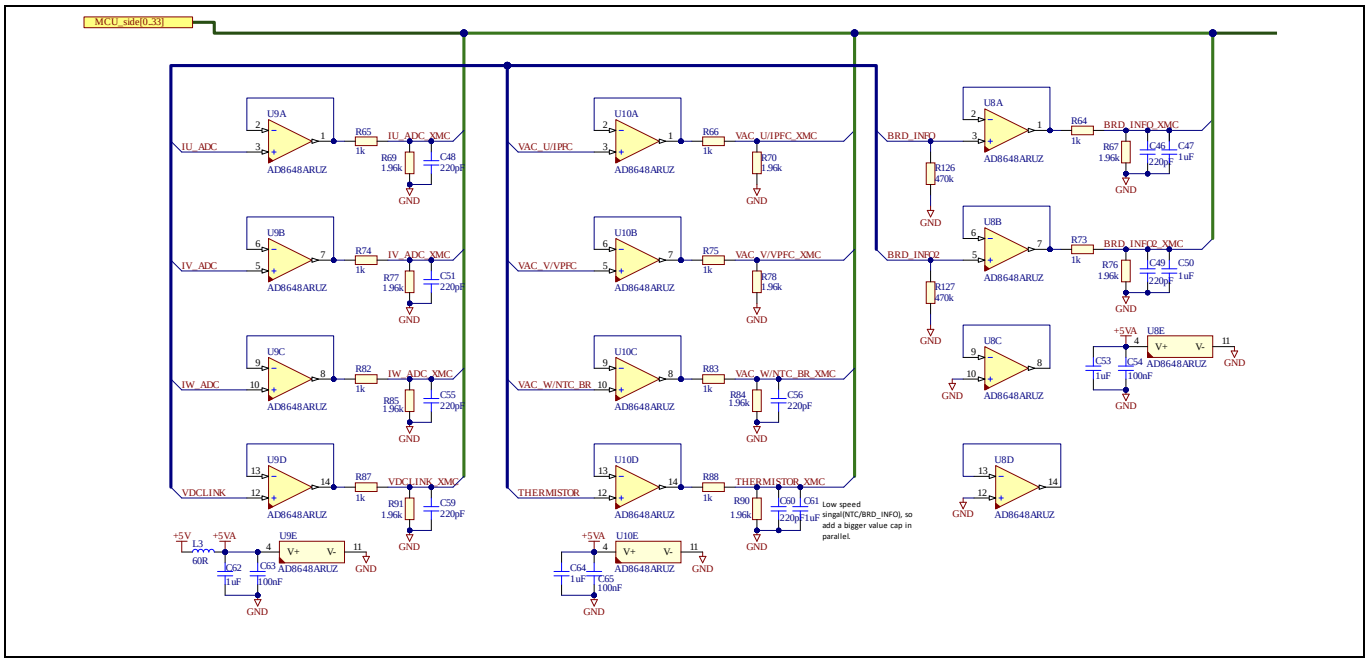



**Figure 52 Level shifters for analog signals**

## 2.5.5.10 Opto-relay

The board provides an opto-relay of more than 8 mm clearance. Output of the relay is isolated from other sections of the board.

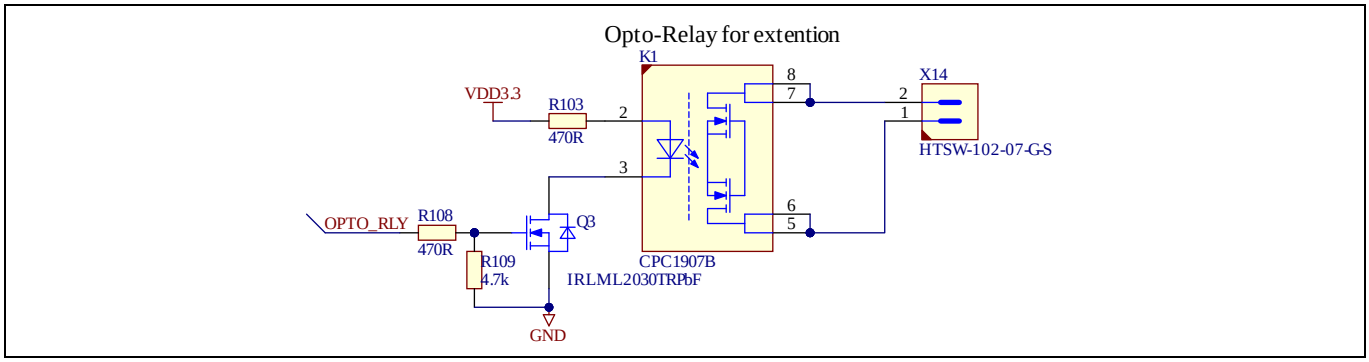



**Figure 53 Opto-relay on the board**

## 2.5.6 Digital isolators between sections

The Infineon 4DIRx4xxH ISOFACE™ quad-channel digital isolator family supports data rates up to 40 Mbps and ensures robust data communication over a wide ambient operating temperature range (-40 °C to +125°C) and across production spread. Infineon's robust coreless transformer (CT) technology guarantees high immunity against system noise (common mode transient immunity (CMTI) of min. 100 kV/µs) and withstands up to 5700 $V_{rms}$ isolation voltage (VISO). Four data channels in a PG-DSO-16 wide-body 300 mil package allow for simplified and high-power density designs and improve system efficiency with low power consumption. Product variants with different channel configurations and fail-safe default output states are available.

The board uses two pieces of ISOFACE™ isolator to provide eight channel signals—4DIR2400H for UART signals in two channels (one channel is UART between PSoC™ 62 and XMC4800 and another channel is XMC4800 OBD UART), and 4DIR1400H for OBD SWD signals of XMC4800. The details are shown in Figure 54.

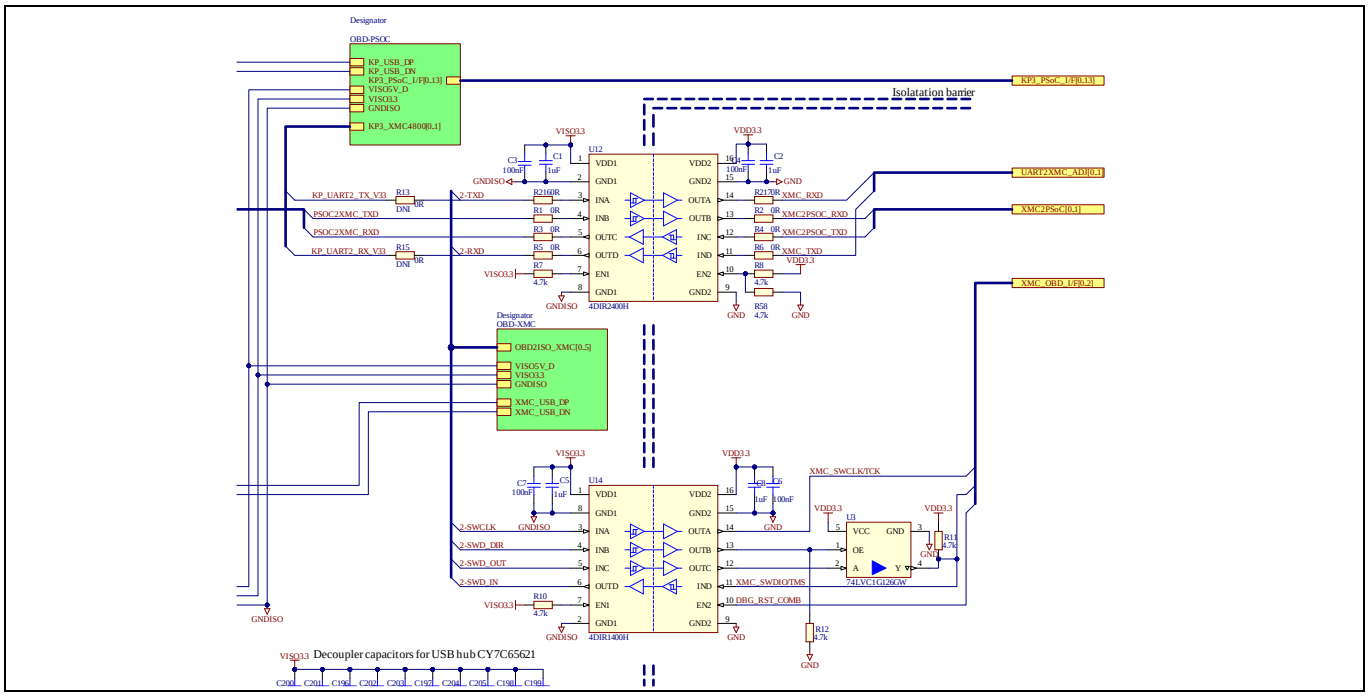



**Figure 54 Digital isolators between sections**

## 2.6 Information on available M5 power board

Please visit:

- EVAL-M5-IMZ120R-SIC
- EVAL-PS-DP-MAIN M5

More boards will be released on the website in the future, please visit http://www.infineon.com/MADK for the latest information.

# 3 System design

This section provides the complete details of the schematics, layout, and connectors. Please note that the schematics, routing, and Gerber files are done in Altium® Designer. Users interested in the original project files or pdf files can visit the board's webpage at www.Infineon.com.

## 3.1 Schematics

The major function blocks are introduced in Section 2.5. Users interested in further details can download the design files after logging in to their myInfineon account on the board's webpage.

## 3.2 PCB layout

The board is designed in eight layers, 158.5 mm × 105 mm in dimension. Including the pins outside the board, the dimension is 166.5 mm × 111.5 mm with a copper thickness of 1 oz. (35 µm). Details of the PCB can be downloaded from the board's webpage as well.

## 3.3 Bill of material

The complete bill of material is available in the download section of Infineon's homepage. Login credentials are required to download this material. The following is a list of only some major Infineon components on the board.

**Table 11 BOM of the most important/critical parts of the reference board**

| S. No. | Ref Designator | Description | Manufacturer | Manufacturer P/N |
|---|---|---|---|---|
| 1 | D2, D12 | Medium Power AF Schottky Diode | Infineon Technologies | BAS3010A-03W |
| 2 | D3, D4, D5, D10, D14, D17 | Bi-directional ESD protection device | Infineon Technologies | ESD245-B1-W0201 |
| 3 | D8, D9, D11, D19 | Silicon Schottky Diode, Single Configuration 0.6 LS (nH) | Infineon Technologies | BAT54-02V |
| 4 | D16, D23 | Bi-directional TVS Protection Device | Infineon Technologies | ESD253-B1-W0201 |
| 5 | D30 | Medium Power AF Schottky Diode | Infineon Technologies | BAT165 |
| 6 | G1, G6 | Low Dropout Linear Voltage Regulator, 3.3 V Output | Infineon Technologies | TLE42744DV33 |
| 7 | G2, G3 | 1.8A DC/DC Step-Down Voltage Regulator Adjustable | Infineon Technologies | TLE8366EV |
| 8 | G8 | Micropower, low noise, low dropout voltage regulator, designed for use in battery-powered systems, the low quiescent current of 30 µA makes it an ideal choice | Infineon Technologies | TLS205B0EJV |
| 9 | Q1, Q2, Q3 | HEXFET Power MOSFET VDS 30V | Infineon Technologies | IRLML2030TRPbF |
| 10 | Q4, Q5 | OptiMOS 5 Power-Transistor, 100V | Infineon Technologies | BSZ146N10LS5 |
| 11 | U5 | Programmable System-on-Chip (PSoC) | Infineon Technologies | CY8C5868LTI-LP039 |
| 12 | U7 | Microcontroller Series for Industrial Applications | Infineon Technologies | XMC4200-Q48K256 BA |
| 13 | U12, U14 | ISOFACE Digital Isolator 2 Forward 2 Reverse Channel Configuration, ISOFACE Digital Isolator 3 Forward 1Reverse Channel Configuration | Infineon Technologies | 4DIR2400H, 4DIR1400H |
| 14 | U15 | XMC4000 Family Microcontroller for Industrial Applications, ARM Cortex-M4, 32-bit processor core, Flash 2048 Kbytes, RAM 352 Kbytes (Temperature Range -40°C to 85°C) | Infineon Technologies | XMC4800-E196F2048 |
| 15 | U16 | IC FLASH 64MBIT SPI/QUAD 8SOIC | Infineon Technologies | S25FL064LABMFI010 |

| S. No. | Ref Designator | Description | Manufacturer | Manufacturer P/N |
|---|---|---|---|---|
| 16 | U19 | PSoC 62S2 Wi-Fi BT Pioneer Kit | Infineon Technologies | CY8CMOD-062S2-43012 |
| 17 | U21 | Low Power USB 2.0 Hub Controller Family | Infineon Technologies | CY7C65621-56LTXI |
| 18 | U22 | 512 Mb (64 MB), 3.0 V SPI Flash Memory | Infineon Technologies | S25FL512SDSMFM013 |
| 19 | U23 | Basic Smart Boost Controller | Infineon Technologies | TLE8386-2EL |
| 20 | U26 | OPTIGA Trust M | Infineon Technologies | SLS 32AIA010ML |

# 4 Reference and appendices

## 4.1 References

[1] Infineon Technologies AG. XMC4700 XMC4800 Reference Manual (2016) V1.03 www.infineon.com

[2] Infineon Technologies AG. XMC4700/XMC4800 Data Sheet (2018) V1.01 www.infineon.com

[3] Infineon Technologies AG. PSoC 6 MCU: CY8C62x8, CY8C62xA Datasheet (2021) www.infineon.com

[4] Infineon Technologies AG. Eclipse IDE for ModusToolbox™ user guide (2023) Rev.*L www.infineon.com

[5] Infineon Technologies AG. Board's user's manual KIT_XMC4400_DC_V1 (2013) V1.0 www.infineon.com

[6] Infineon Technologies AG. Board's user's manual XMC4800 Relax EtherCAT kit (2016) V1.2 www.infineon.com

[7] Infineon Technologies AG. CY8CKIT-062S2-43012, PSoC 62S2 Wi-Fi BT Pioneer Kit Guide (2021) Rev.*G V1.2 www.infineon.com

## 4.2 Additional information

Infineon components on the board are listed in Table 12. Customers can visit the corresponding webpage for more information.

**Table 12 Additional information on tools and Infineon components**

| Base part number | Package | Standard pack | | Orderable part number |
|---|---|---|---|---|
| | | Form | Quantity | |
| XMC4800-E196F2048 | PG-LFBGA-196 | TRAY | 1134 | XMC4800E196F2048AAXQMA1 |
| CY8C624ABZI-S2D44 | PG-VFBGA-124 | TRAY | 260 | CY8C624ABZI-S2D44 |
| CY8CMOD-062S2-43012 | - | TRAY | 10 | CY8CMOD-062S2-43012 |
| TLE8386-2EL | PG-SSOP-14 | TAPE & REEL | 2500 | TLE83862ELXUMA1 |
| TLS205B0EJV | PG-DSO-8 | TAPE & REEL | 2500 | TLS205B0EJVXUMA1 |
| TLE42774D V33 | PG-TO252-3 | TAPE & REEL | 2500 | TLE42744DV33ATMA1 |
| TLE8366 | PG-DSO-8 | TAPE & REEL | 2500 | TLE8366EVXUMA1 |
| SLS32AIA010ML | PG-USON-10 | TAPE & REEL | 4000 | SLS32AIA010MLUSON10XTMA2 |
| ESD245-B1-W0201 | SG-WLL-2-3 | TAPE & REEL | 15000 | ESD245B1W0201E6327XTSA1 |
| ESD253-B1-W0201 | SG-WLL-2-3 | TAPE & REEL | 15000 | ESD253B1W0201E6327XTSA1 |
| S25FL512SDSMFM013 | PG-DSO-16 | TAPE & REEL | 1450 | S25FL512SDSMFM013 |
| S25FL064LABMFI010 | PG-DSO-8 | TAPE & REEL | 2800 | S25FL064LABMFI010 |
| CY7C65621-56LTXI | PG-VQFN-56 | TRAY | 2600 | CY7C65621-56LTXI |
| 4DIR1400H | PG-DSO-16 wide-body | TAPE & REEL | 1500 | 4DIR1400HXUMA1 |
| 4DIR2400H | PG-DSO-16 wide-body | TAPE & REEL | 1500 | 4DIR2400HXUMA1 |
| CY8C5868LTI-LP039 | PG-VQFN-68 | TRAY | 520 | CY8C5868LTI-LP039 |
| XMC4200-Q48K256 BA | PG-VQFN-48 | TAPE & REEL | 2500 | XMC4200Q48K256BAXUMA1 |

| Base part number | Package | Standard pack | | Orderable part number |
|---|---|---|---|---|
| | | Form | Quantity | |
| BSZ146N10LS5 | PG-TSDSON-8 | TAPE & REEL | 5000 | BSZ146N10LS5ATMA1 |

# Revision history

| Document version | Date of release | Description of changes |
|---|---|---|
| 1.0 | 2023-09-27 | Initial version |
| | | |
| | | |

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**Edition 2023-09-27**

**Published by**

**Infineon Technologies AG**

**81726 Munich, Germany**

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**UG-2023-07**

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