# KIT_XMC 1400_D C_V 1 Kit user manual

## XMC1400 Drive Card V1.0

## About this document

### Scope and purpose

This document describes how to use the XMC1400 Drive Card for motor control application. It demonstrates the motor control features of the XMC1402 device including the toolchain.

### Intended audience

This document is intended for anyone using the XMC1400 MCU family.

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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 of this board is up to 1000 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.* |

# Table of contents

# 1 Overview

The drive card KIT_XMC1400_DC_V1 houses the following:

- XMC1402 microcontroller
- Power board connector
- Set of position interface circuits with hall and encoder connectors
- USIC interface and an
- Isolated on-board debug interface

The board along with a three-phase inverter demonstrates the capabilities of the XMC1402. The main use case for this board is to demonstrate the motor control features of the XMC1402 device including the tool chain. The focus is safe operation under evaluation conditions. The board is not cost or size optimized and does not serve as a reference design.

## 1.1 Key features

The KIT_XMC1400_DC_V1 board is equipped with the following features:

- Infineon XMC1402 (Arm® Cortex®-M0-based) microcontroller, 200 KB on-chip flash, TSSOP38
- Connection to the power inverter via the power board connector
- Combined hall sensor and encoder interface
- USIC interface connector for connection of UART, SPI, or I2C
- Six LEDs
  - Two Power indicating LEDs
  - One User LED (P0.4)
  - One encoder enables LED
  - Two Debug LEDs (DEBUG, COM)
- Potentiometer, connected to analog input P2.5 (ADC group 1, channel 7)
- Isolated Debug options
  - On-board debugger (SEGGER J-Link LITE) via USB connector
  - Infineon debug connector 16-pin (0.1”) with DriveMonitor USB Stick V2 (KIT_DRIVEMONI_USB_V2),
- Isolated connectivity
  - UART channel of on-board debugger (SEGGER J-Link LITE) via USB connector
- Power supply of MCU domain
  - Via power board connector (5 V)
- Power supply of isolated debug domain
  - Via debug USB connector
  - Via Infineon debug connector 16-pin

## 1.2 Block diagram

Figure 1 shows the functional block diagram of the KIT_XMC1400_DC_V1 board. For more information about the power supply domains, refer to Power supply.

The drive card has the following building blocks:

- One Power board connector
- One set of position interface connectors (HALL, ENCODER)
- Encoder enables signals via GPIOs (P0.10)
- One User LED connected to GPIOs (P0.4)
- Variable resistor (POTI) connected to GPIO P2.5 (ADC group 1, channel 7)
- USIC0 interface connector (P0.10, P0.14, P1.4, P1.5)
- Isolated on-board debugger via debug USB connector (Micro-USB) with UART channel (USIC0, channel 1)
- Optional Infineon debug interface connector for Drive Monitor USB Stick V2 (KIT_DRIVEMONI_USB_V2)

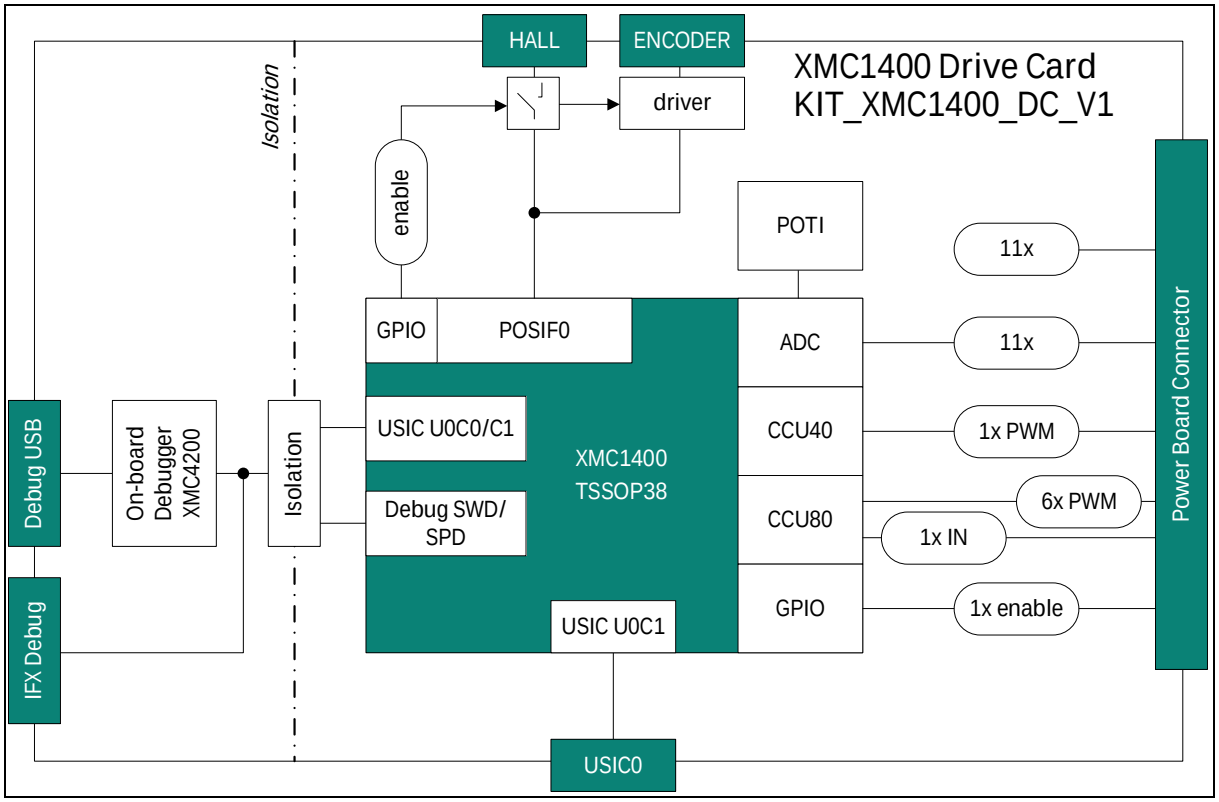


**Figure 1 KIT_XMC1400_DC_V1 block diagram**

# 2 Hardware description

This section gives a detailed description of the hardware and how it is used.

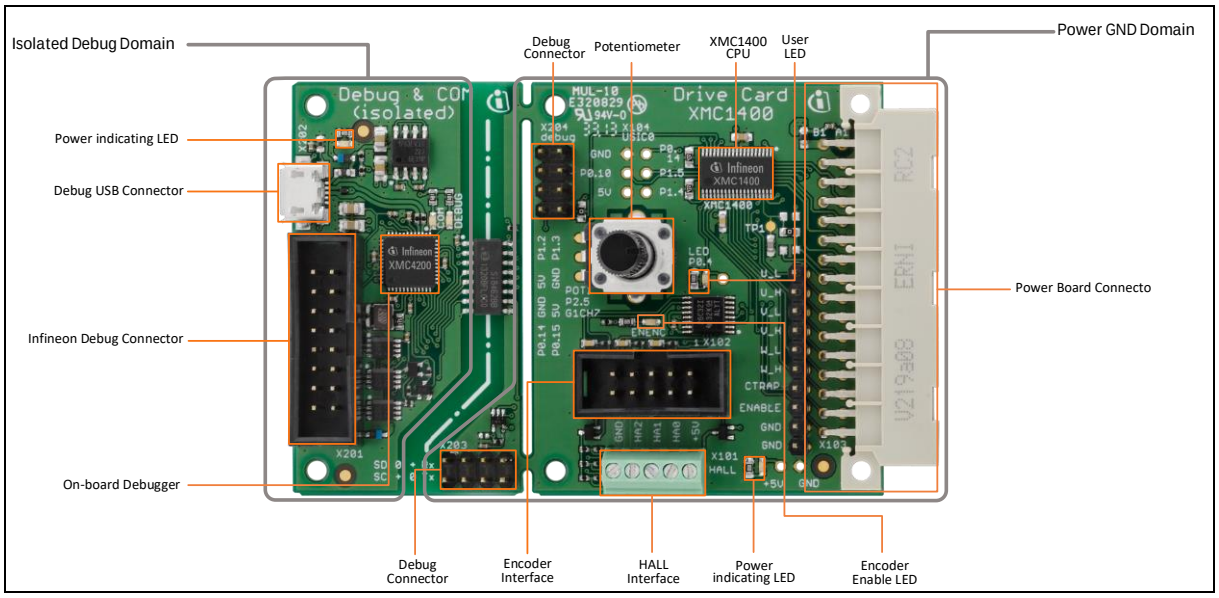


**Figure 2 XMC1400 Drive Card (KIT_XMC1400_DC_V1)**

## 2.1 Power supply

The KIT_XMC1400_DC_V1 board is designed with two galvanically isolated supply domains. On the left side, there is the debug domain, which contains an XMC4200 MCU as an on-board debug controller (OBD) as well as a level shifter to a 5 V debug interface like the drive monitor USB stick (KIT_DRIVEMONI_USB_V2). The debug domain can be powered via the USB plug (5 V) as well as the Infineon debug connector.

In the middle, there is the power GND supply domain, which provides the power supply for the MCU and the peripheral components. This supply domain is usually powered from the power board connector. The current drawn by the drive card at the power GND domain is typically 25 mA.

Two power indicating LEDs are provided on the board (see Figure 3) to indicate the power status of the KIT_XMC1400_DC_V1 board. The LED will be “ON” when the corresponding power rail is powered.

**Table 2 Power status LED’s**

| LED reference | Power rail | Voltage | Note |
|---|---|---|---|
| LED101 | VDD5 | 5 V | Power GND domain must always be ON |
| LED201 | VISO5 | 5 V | The debug supply domain must be ON to use the debug domain |

Figure 3 and Figure 4 show the power supply concept of the drive card.

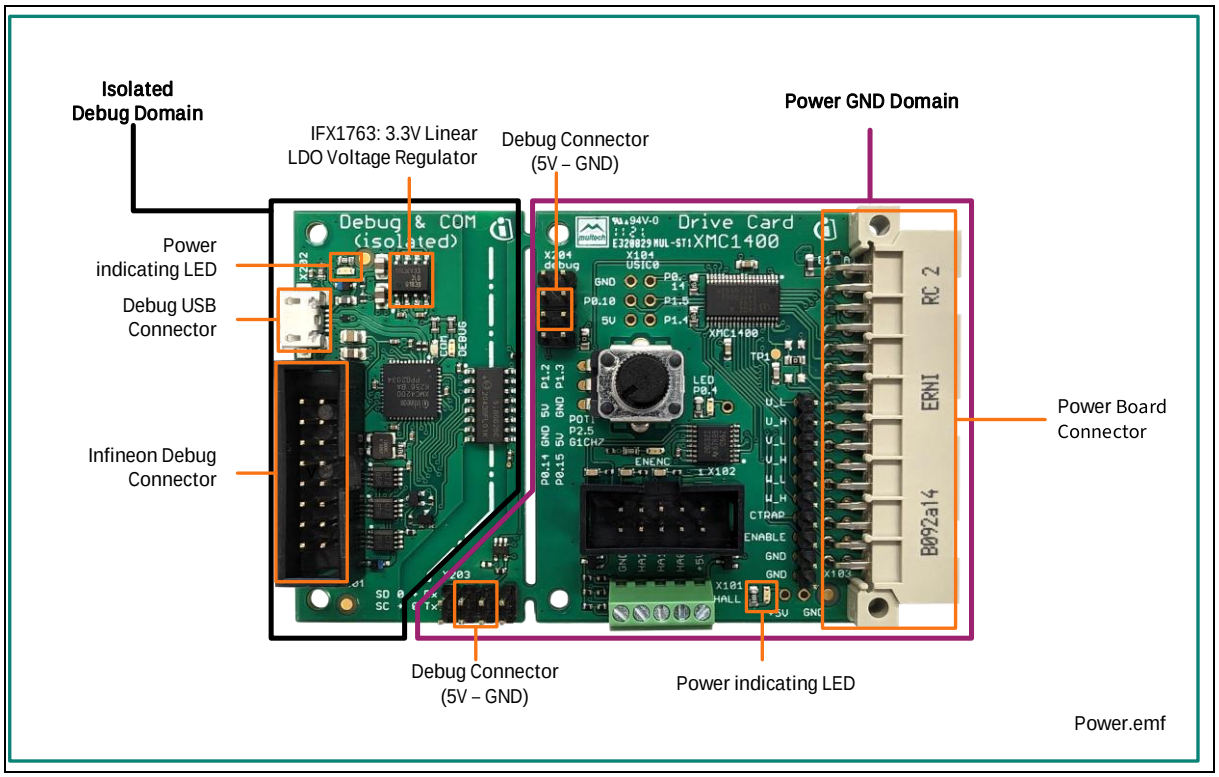


**Figure 3 Power supply concept and powering options**

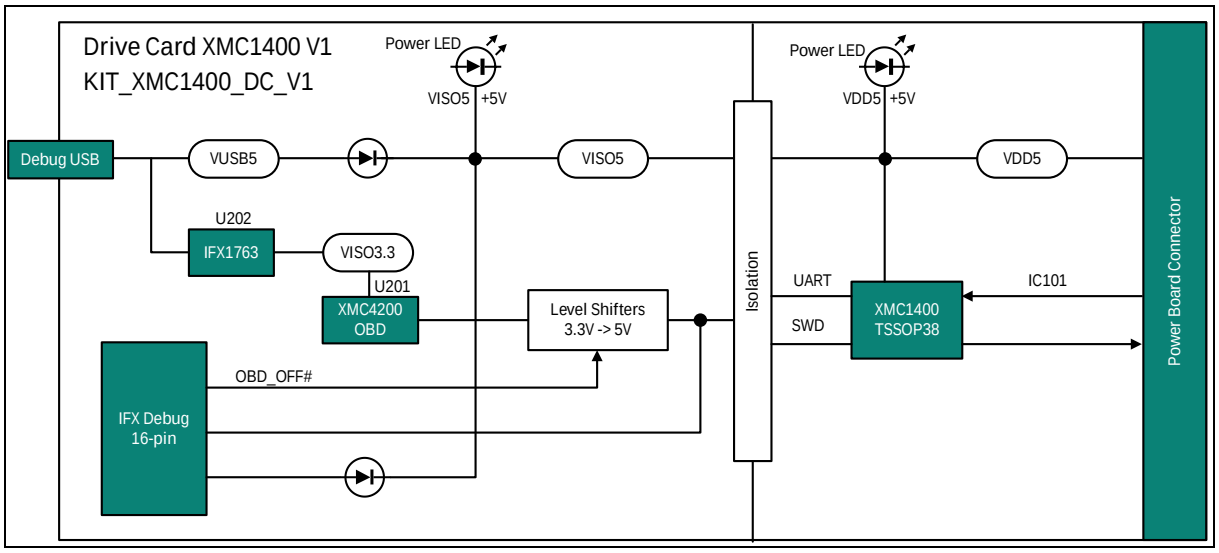


**Figure 4 Block diagram of power supply concept**

## 2.2 Clock generation

An internal oscillator provides the clock signal to the XMC1400 microcontroller. The CPU can be adjusted to a maximum 48 MHz (MCLK) whereas the PWM peripherals can be configured to use double of this clock (PCLK).

## 2.3 Debug interface

The KIT_XMC1400_DC_V1 is designed to use “Serial Wire Debug” (SWD) or “Single Pin Debug” (SPD) as debug interfaces. It supports debugging via different channels, which are galvanically isolated from the power GND supply domain:

- On-board debugger
- Infineon debug connector (16-pin) with debug and UART interface

### 2.3.1 On-board USB debugger

The on-board debugger [1] supports:

- Serial Wire Debug (SWD) [2]
  - SWIO - P0.14 (SWD0)
  - SWCLK - P0.15 (SWD0)

    Or
  - SWIO - P1.3 (SWD1)
  - SWCLK - P1.2 (SWD1)

- Single Pin Debug (SPD) [2]
  - SPD - P0.14 (SPD0)

    Or
  - SPD - P1.3 (SPD1)

- Full Duplex UART communication via a Virtual COM port
  - PC_RXD - P1.2 USIC0CH1.DOUT0
  - PC_TXD - P1.3 USIC0CH1.DX0A

    Or
  - PC_RXD - P0.15 USIC0CH0.DOUT0
  - PC_TXD - P0.14 USIC0CH0.DX0A

[1] **Attention:** The firmware of the on-board debugger requires the latest J-Link driver (V4.62 or higher) and a Serial Port Driver (CDC driver) installed on your computer. Please check “Install J-Link Serial Port Driver” when installing the latest J-Link driver (see Figure 6).

[2] The debug interface type (SPD or SWD) is selected via the boot mode index (BMI) configuration. Changing the BMI is supported by the DAVE™ IDE and the “BMI Get Set” window (see Figure 5).

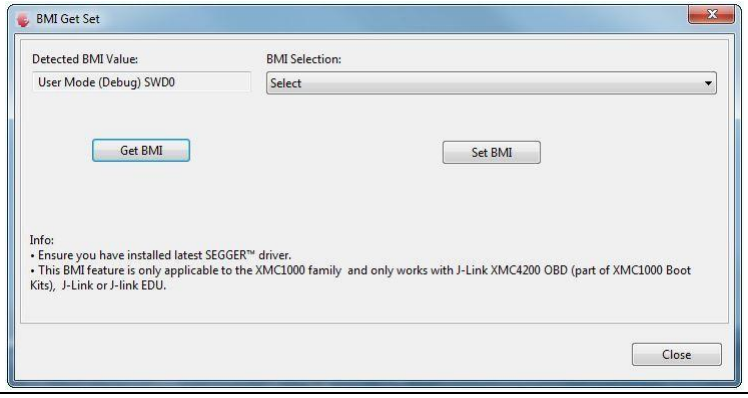


**Figure 5 DAVE™ - "BMI Get Set" for XMC1000 family**

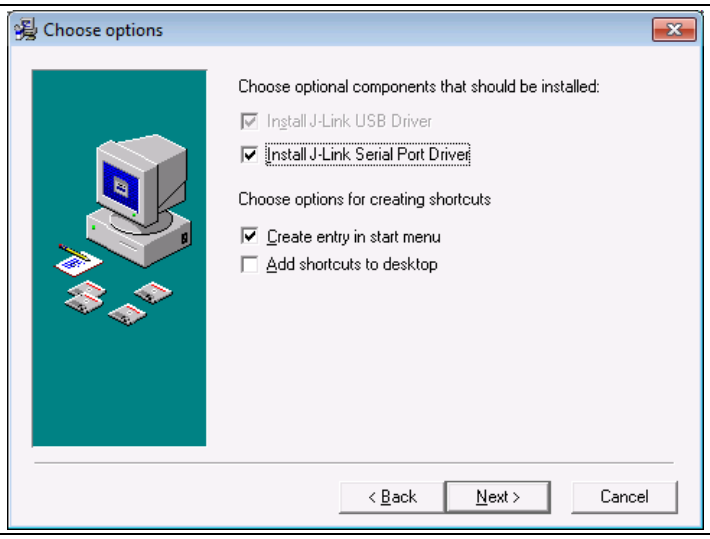


**Figure 6 Installation of Serial Port Driver**

The on-board debugger can be accessed through the Debug USB connector as shown in Figure 7. The Debug LED (LED202) shows the status during debugging.

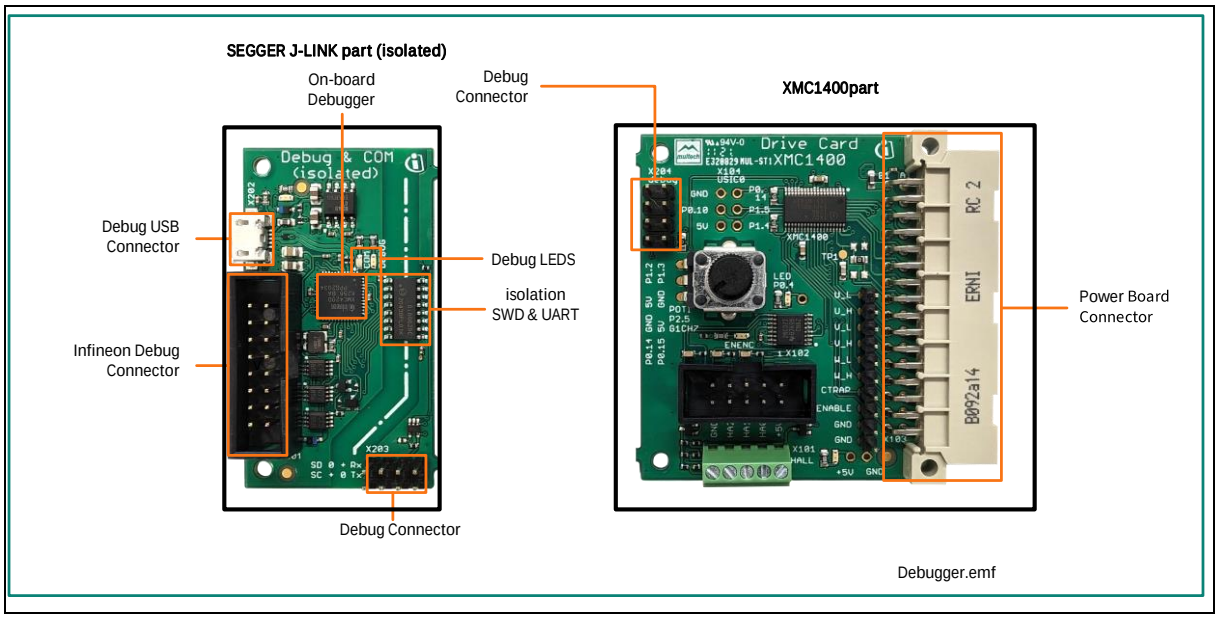


**Figure 7 On-board USB debugger**

When using an external debugger connected to the Infineon debug connector (16-pin), the on-board debugger has to be switched off. This is done by connecting pin 6 of the Infineon debug connector to GNDISO.

## 2.3.2 Debug connector (8-pin)

- The KIT_XMC1400_DC_V1 board supports debugging via SWD and SPD with the OBD as described in the On-board USB debugger section. The pin assignment is provided in a way that both SWD ports (SWD0 and SWD1) can be selected. See Figure 8 for details on pin assignment.

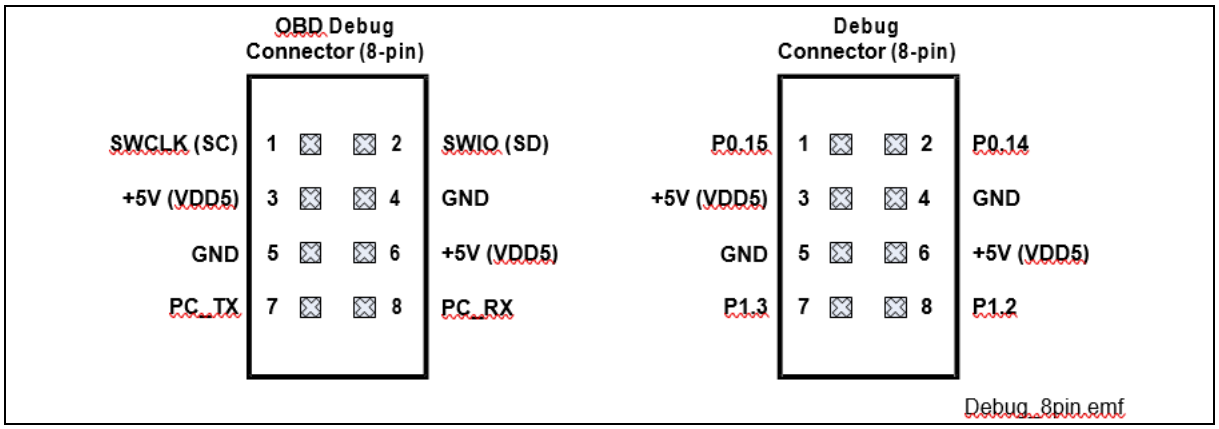


**Figure 8 Pin assignment of debug connector (8-pin)**

The default connection will provide the following set-up:

- Serial Wire Debug (SWD)
  - SWIO/SPD - P0.14 (SWD0)
  - SWCLK - P0.15 (SWD0)

- Full Duplex UART communication via a Virtual COM port
  - PC_RXD - P1.2 USIC0CH1.DOUT0
  - PC_TXD - P1.3 USIC0CH1.DX0A

While breaking off the J-LINK part of the PCB and connecting the debug interface with a ribbon cable, the direct connection will provide the same set-up.

A reverse connection of the debug connector (pin1 to pin8) provides the other set-up:

- Serial Wire Debug (SWD)
  - SWIO/SPD - P1.3 (SWD1)
  - SWCLK - P1.2 (SWD1)

- Full Duplex UART communication via a Virtual COM port
  - PC_RXD - P0.15 USIC0CH0.DOUT0
  - PC_TXD - P0.14 USIC0CH0.DX0A

### 2.3.3 Infineon debug connector (16-pin)

The KIT_XMC1400_DC_V1 board supports debugging via Infineon's device access server (DAS), when using the KIT_DRIVEMONI_USB_V2 as an interface device. The latest release of DAS software can be downloaded from the DAS Tool Interface web page. When using an external debugger, the on-board debugger (OBD) has to be switched off. This is done by connecting pin 6 to GNDISO. KIT_DRIVEMONI_USB_V2 already provides this connection and the OBD is disabled as soon as the connector is plugged in.

Next to the SWD and SPD debug signals, which are provided as unidirectional signals because of the galvanic isolation, UART signals can also be accessed through the Infineon debug connector. Figure 9 shows the pin assignment of the connector. Also, Table 3 lists the signals.

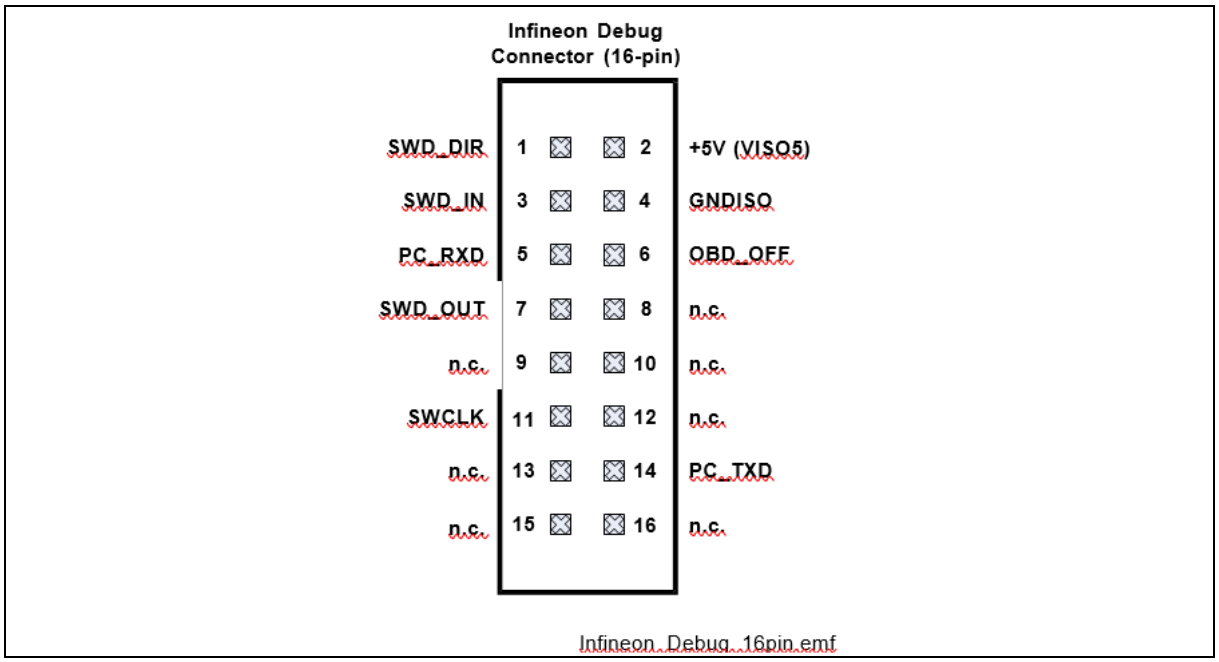


**Figure 9 Infineon debug connector (16-pin)**

**Table 3 Infineon Debug connector description**

| Pin No. | Signal name | I/O | Serial wire debug |
|---|---|---|---|
| 1 | SWD_DIR | O | Defines the direction of SWIO |
| 2 | +5 V (VISO5) | - | +5 V supply of isolated debug domain |
| 3 | SWD_IN | I | Input signal of SWIO |
| 4 | GNDISO | - | Ground of isolated debug domain |
| 5 | PC_RXD | I | UART Receive signal (P1.3, DOUT0 USIC0, channel1) |
| 6 | OBD_OFF# | I | Disable on-board debug device (Low active) |
| 7 | SWD_OUT | O | Output signal of SWIO |
| 8 | n.c. | - | Not connected |
| 9 | n.c. | - | Not connected |
| 10 | n.c. | - | Not connected |
| 11 | SWCLK | O | SWD clock signal |
| 12 | n.c. | - | Not connected |
| 13 | n.c. | - | Not connected |
| 14 | PC_TXD | I | UART Transmit signal (P1.2, DX0A, USIC0, channel1) |
| 15 | n.c. | - | Not connected |
| 16 | n.c. | - | Not connected |

## 2.4 Potentiometer and user LEDs

The KIT_XMC1400_DC_V1 provides a potentiometer, which is connected to ADC group1, channel7, and one user LED (P0.4). Next to the LED, a testpoint is available to connect an oscilloscope's probe for the software-controlled trigger signals.

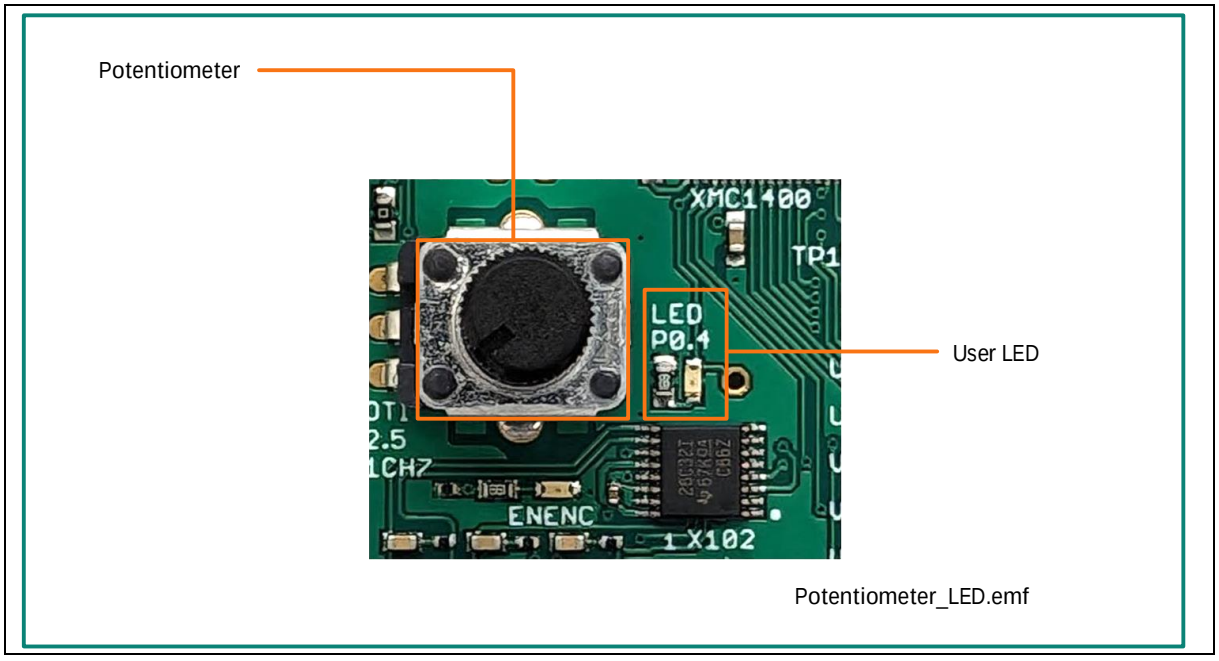


**Figure 10 Potentiometer and LEDs**

**Table 4 Potentiometer**

| Potentiometer | Connected to port pin |
|---|---|
| R103 | P2.5 / G1_CH7 (Group 1, channel 7) |

**Table 5 LEDs**

| User LEDs | Connected to port pin |
|---|---|
| LED102 | P0.4 (LED) |

**Attention:** The testpoints are referenced to the power GND supply domain. Hence, they may carry hazardous voltages.

## 2.5 USIC0 connector

The USIC Interface provides access to USIC 0 channel 0, which supports SPI, UART and I2C communication protocols.

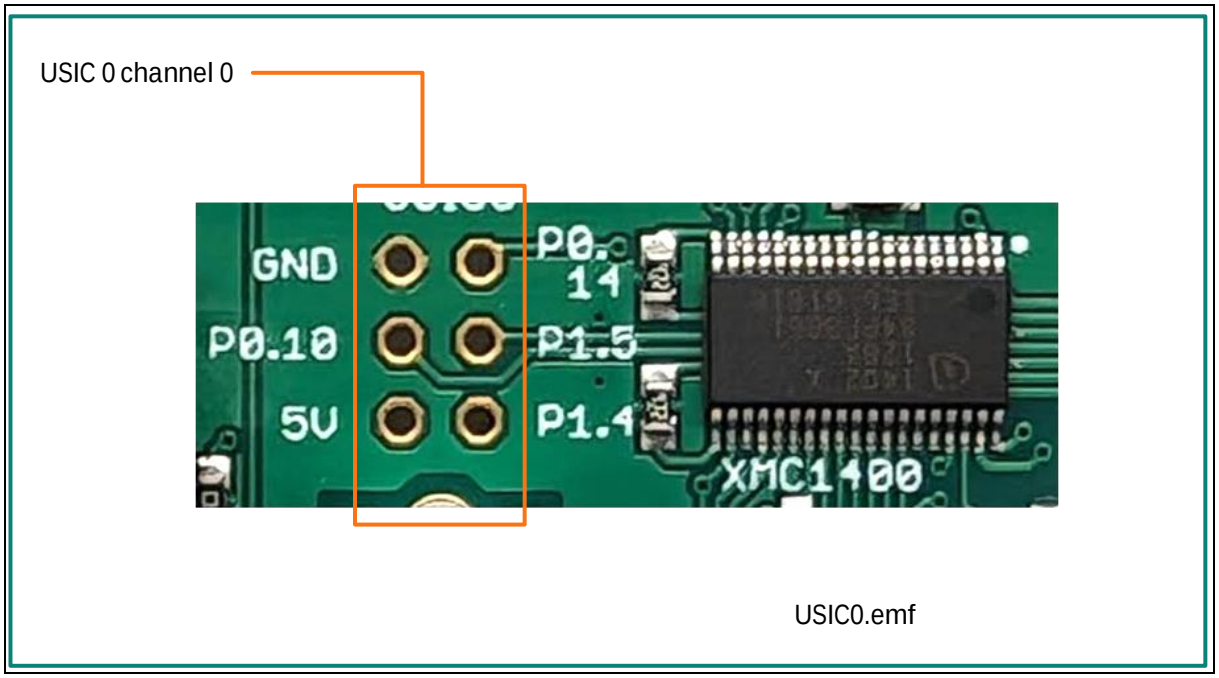


**Figure 11 USIC interface connector**

**Table 6 USIC0 Connector X104**

| Pin | Port | Peripherals | Comment |
|---|---|---|---|
| X104-1 | P1.4 | USIC0_CH0.DX5E | |
| X104-2 | VDD5 | 5 V | |
| X104-3 | P1.5 | USIC0_CH0.DOUT0 | |
| X104-4 | P0.10 | USIC0_CH0.SELO1 / DX2C | Overlaps with ENENC |
| X104-5 | P0.14 | USIC0_CH0.SCLKOUT | Overlaps with SWD0/SPD0 |
| X104-6 | GND | GND | |

## 2.6 Hall sensor and encoder connectors

The KIT_XMC1400_DC_V1 provides two pairs of HALL and incremental encoder connectors as indicated in Figure 12. The encoder interface connector provides a differential input, which is transformed into single-ended signals by an interface IC. The HALL sensor interface provides a pull-up resistor for each HALL sensor signal as well as a power supply for the HALL sensors.

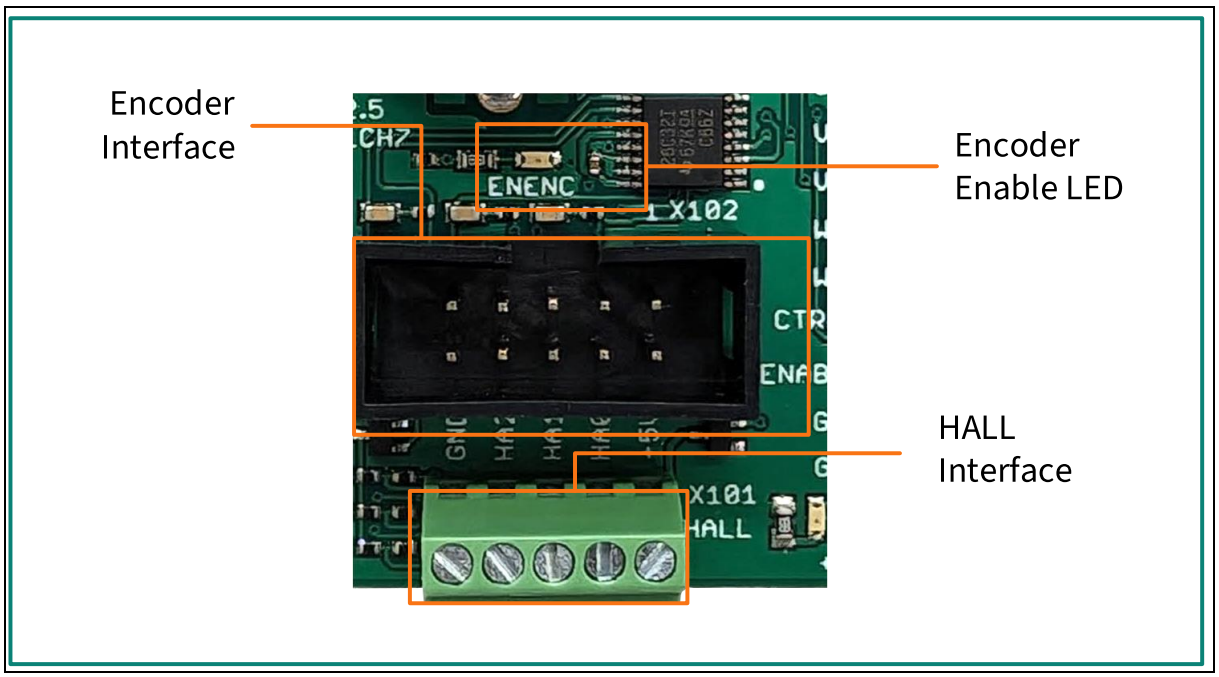


**Figure 12 Hall sensor and encoder connectors**

Both the HALL and the encoder signals are connected to the same POSIF interface. The ENENC signal is used to either enable the output signals of the encoder IC or to activate the power supply and pull-up resistor supply of the HALL sensor interface. As a result, both interfaces can be connected at the same time and the user can select which interface to use. Figure 13 shows the HALL sensor and encoder interface circuitry. See Table 7 for details on pin and peripheral assignment.

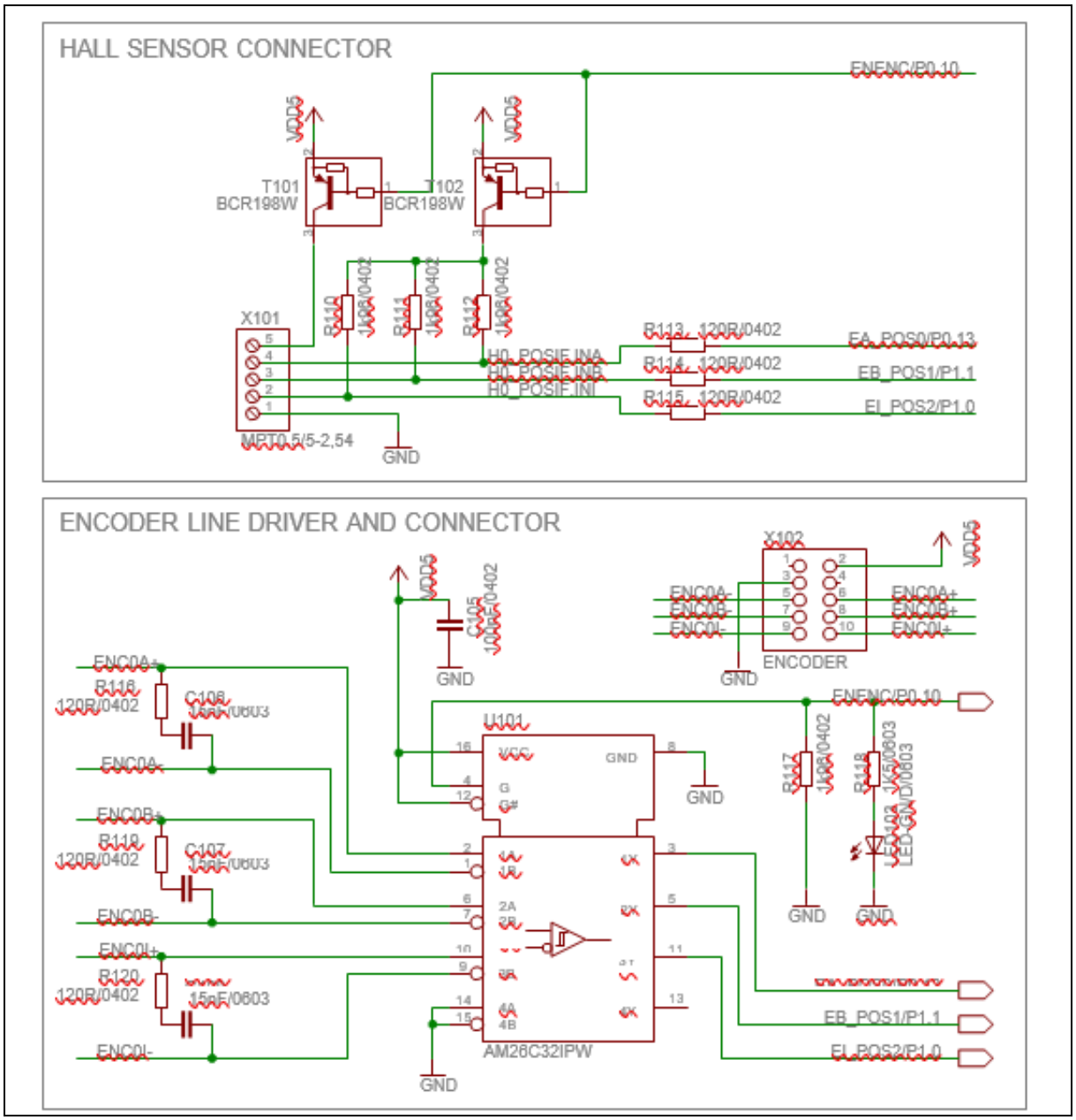


**Figure 13 Hall sensor and encoder interface circuitry**

**Table 7 HALL Sensor and Encoder Interfaces**

| Pin | Port | Peripheral |
|---|---|---|
| **HALL Sensor Interface X101** | | |
| 1 | GND | |
| 2 | P1.0 | POSIF0.IN2A |
| 3 | P1.1 | POSIF0.IN1B |
| 4 | P0.13 | POSIF0.IN0B |
| 5 | VDD5 | HALL sensor power supply |
| **Encoder Interface X102** | | |
| 1 | n.c. | |
| 2 | VDD5 | Encoder power supply |
| 3 | GND | |
| 4 | n.c. | |
| 5 | ENCA- | POSIF0.IN0B |
| 6 | ENCA+ | |
| 7 | ENCB- | POSIF0.IN1B |
| 8 | ENCB+ | |
| 9 | ENCI- | POSIF0.IN2A |
| 10 | ENCI+ | |
| **Enable Encoder** | | |
| LED103 | P0.10 | High: Enable Encoder Interface<br>Low: Enable HALL Interface including supply |

## 2.7 Power board connector

The KIT_XMC1400_DC_V1 board provides a power board connector with all the signals required to control the power inverter. Next to the PWM output signals (CCU4, CCU8) and ADC signals, there are power supply pins for the power GND domain.

Figure 14 shows the power board connector. Table 8 lists the pin and peripheral assignments. In addition, Table 9 lists different use cases for three phase inverters.

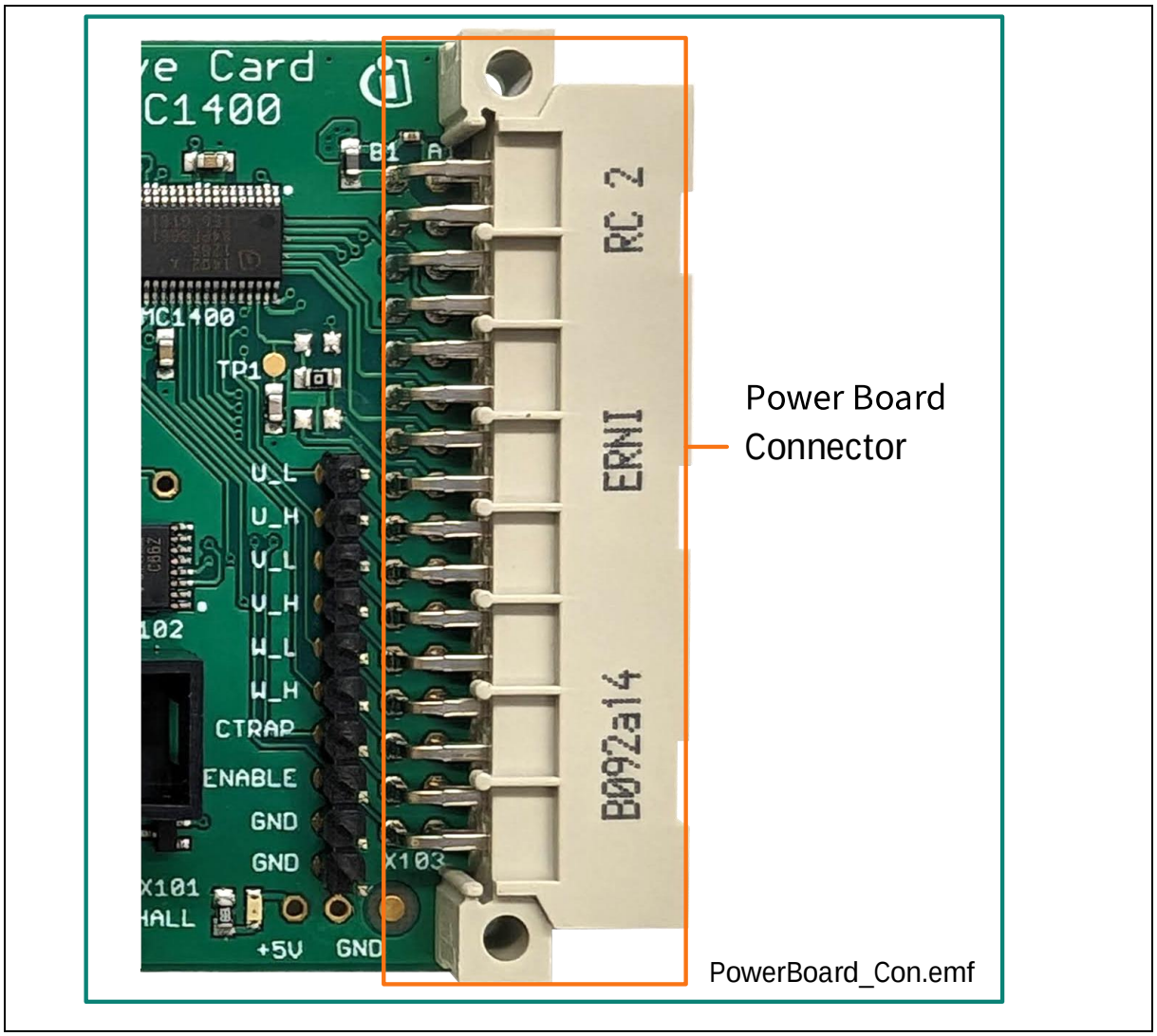


**Figure 14 Power board connector**

**Attention:** The power board connector also provides the power supply to the power GND supply domain; hence, it may carry hazardous voltages.

**Table 8 Power board connector**

| X302 MAB32B2 | Female FAB32Q2 | Function on power inverter | Port | Peripherals | |
|---|---|---|---|---|---|
| A1 | A16 | GND | VSS, VSSP | | |
| A2 | A15 | PFC Gate | P0.5 | CCU40.CC40 | CMP2.OUT |
| A3 | A14 | $I_{PFC}$ | P2.2 | VADC0.G0CH7 | ACMP2.INN |
| A4 | A13 | $V_{PFC}$ | P2.4 | | VADC0.G1CH6 |
| A5 | A12 | $V_{BEMF\_U}$ / $I_U$ (2) | P2.9 | VADC0.G0CH2 | VADC0.G1CH4 |
| A6 | A11 | $V_{BEMF\_V}$ / $I_V$ (2) | P2.10 | VADC0.G0CH3 | VADC0.G1CH2 |
| A7 | A10 | $V_{BEMF\_W}$ / $I_W$ (2) | P2.11 | VADC0.G0CH4 | VADC0.G1CH3 |
| A8 | A9 | I_AVG / $I_{DClink}$ (2) | P2.1 | VADC0.G0CH6 | |
| A9 | A8 | U1_L | - | | |

| X302 MAB32B2 | Female FAB32Q2 | Function on power inverter | Port | Peripherals | |
|---|---|---|---|---|---|
| A10 | A7 | U1_H | - | | |
| A11 | A6 | V1_L | - | | |
| A12 | A5 | V1_H | - | | |
| A13 | A4 | W1_L | - | | |
| A14 | A3 | W1_H | - | | |
| A15 | A2 | CTRAP1 | - | | |
| A16 | A1 | ENPOW1 | - | | |
| B1 | B16 | VCC 5 V | VDD, VDDP | | |
| B2 | B15 | Brake Gate | - | | |
| B3 | B14 | Brake temp | - | | |
| B4 | B13 | $V_{DClink}$ | P2.3 | | VADC0.G1CH5 |
| B5 | B12 | $V_{BEMF\_U}$ / $I_U$ (1) | P2.6 | VADC0.G0CH0 | |
| B6 | B11 | $V_{BEMF\_V}$ / $I_V$ (1) | P2.8 | VADC0.G0CH1 | VADC0.G1CH0 |
| B7 | B10 | $V_{BEMF\_W}$ / $I_W$ (1) | P2.0 | VADC0.G0CH5 | |
| B8 | B9 | $I_{DClink}$ (1) | P2.7 | | VADC0.G1CH1 |
| B9 | B8 | U0_L | P0.1 | CCU80.OUT01 | |
| B10 | B7 | U0_H | P0.0 | CCU80.OUT00 | |
| B11 | B6 | V0_L | P0.6 | CCU80.OUT11 | |
| B12 | B5 | V0_H | P0.7 | CCU80.OUT10 | |
| B13 | B4 | W0_L | P0.9 & P0.3 | CCU80.OUT21 | CCU80.OUT03 |
| B14 | B3 | W0_H | P0.8 & P0.2 | CCU80.OUT20 | CCU80.OUT02 |
| B15 | B2 | CTRAP0 | P0.12 | CCU80.IN0A, IN1A, IN2A, IN3A | |
| B16 | B1 | ENPOW0 | P0.11 | GPIO | |

*Note: Please note that the numbering of the power board connector at the drive card is inverse to the numbering at the power board.*

**Table 9 Use cases of PWM signals**

| X302 (MAB32B2) | Function | Port | Peripheral |
|---|---|---|---|
| **2-level inverter with CCU80** | | | |
| B9 | U0_L | P0.1 | CCU80.OUT01 |
| B10 | U0_H | P0.0 | CCU80.OUT00 |
| B11 | V0_L | P0.6 | CCU80.OUT11 |
| B12 | V0_H | P0.7 | CCU80.OUT10 |
| B13 | W0_L | P0.9 | CCU80.OUT21 |
| B14 | W0_H | P0.8 | CCU80.OUT20 |
| B15 | CTRAP0 | P0.12 | CCU80.IN0A, IN1A, IN2A, IN3A |
| B16 | ENPOW0 | P0.11 | GPIO |
| **2-level inverter with CCU80 (2 slices only)** | | | |
| B9 | U0_L | P0.1 | CCU80.OUT01 |
| B10 | U0_H | P0.0 | CCU80.OUT00 |
| B11 | V0_L | P0.6 | CCU80.OUT11 |
| B12 | V0_H | P0.7 | CCU80.OUT10 |
| B13 | W0_L | P0.3 | CCU80.OUT03 |
| B14 | W0_H | P0.2 | CCU80.OUT02 |
| B15 | CTRAP0 | P0.12 | CCU80.IN0A, IN1A, IN2A, IN3A |
| B16 | Enable0 | P0.11 | GPIO |

# 3 Production data

## 3.1 Schematics

This chapter contains the schematics for the following components of the drive card:

- XMC1402 MCU, Power Supply, HALL and Encoder Interface, USIC0 interface
- Isolated On-board Debugger

The KIT_XMC1400_DC_V1 board has been designed with Eagle. The full PCB design data of this board can also be downloaded from the www.infineon.com/xmc-dev web page.

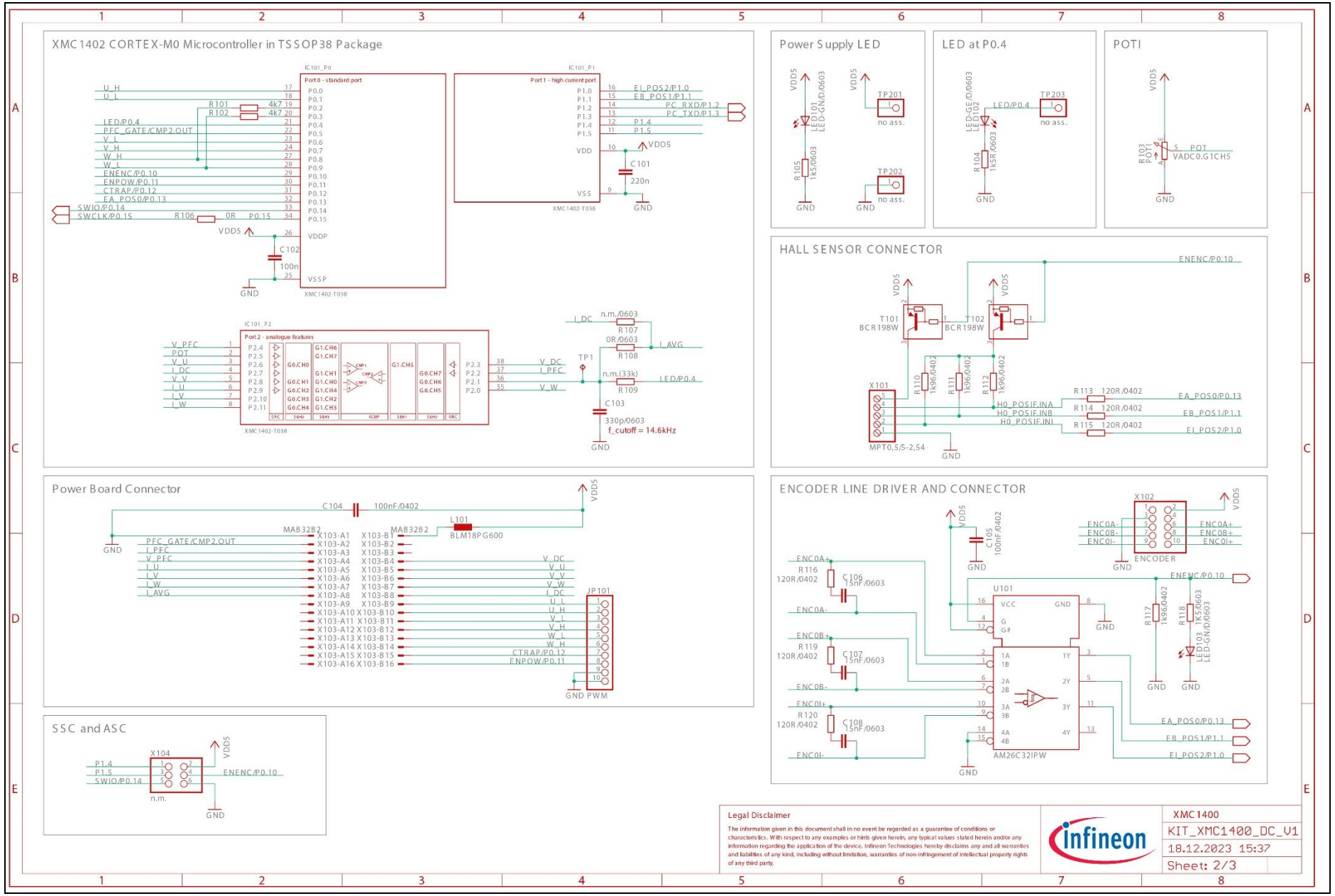


**Figure 15 XMC-1402 MCU, power supply HALL, and encoder interface, USIC0 interface**

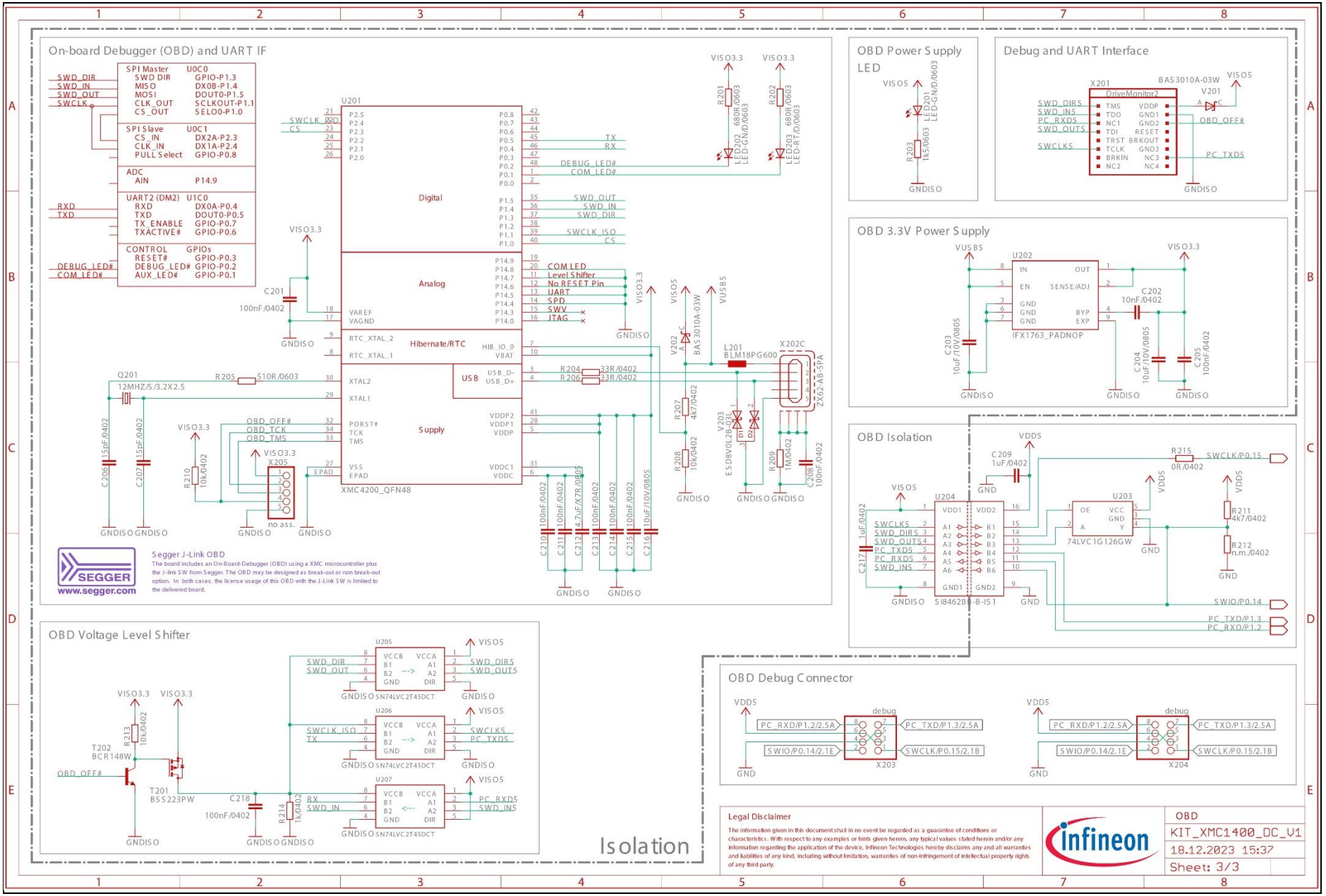


**Figure 16 Isolated on-board debugger**

## 3.2 Component placement

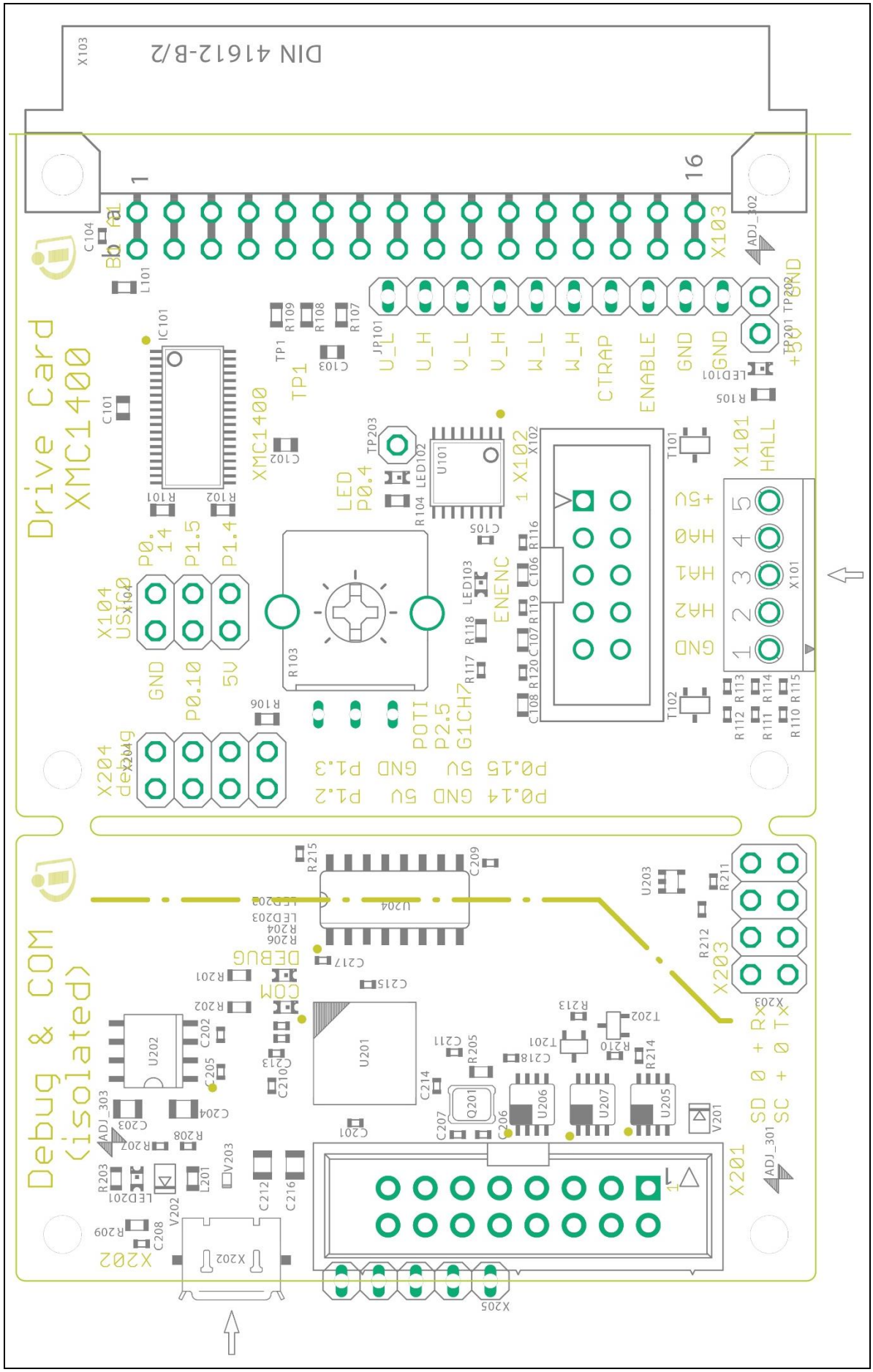


Figure 17 Component placement

## 3.3 Bill of material (BOM)

**Table 10 BOM of KIT_XMC1400_DC_V1 Board**

| Pos. No. | Qty | Value | Device | Reference description |
|---|---|---|---|---|
| 1 | 2 | 4k7 | RESISTOR 0603 | R101, R102 |
| 2 | 1 | 10k | potentiometer | R103 |
| 3 | 1 | 1k5R/0603 | RESISTOR 0603 | R104 |
| 4 | 2 | 1k5/0603 | RESISTOR 0603 | R105, R203 |
| 5 | 1 | 0R | RESISTOR 0603 | R106 |
| 6 | 1 | n.m./0603 | RESISTOR 0603 | R107 |
| 7 | 1 | 0R/0603 | RESISTOR 0603 | R108 |
| 8 | 1 | n.m. (33k) | RESISTOR 0603 | R109 |
| 9 | 4 | 1k96/0402 | RESISTOR 0402 | R110, R111, R112, R117 |
| 10 | 6 | 120R/0402 | RESISTOR 0402 | R113, R114, R115, R116, R119, R120 |
| 11 | 1 | 1K5/0603 | RESISTOR 0603 | R118 |
| 12 | 2 | 680R/0603 | RESISTOR 0603 | R201, R202 |
| 13 | 2 | 33R/0402 | RESISTOR 0402 | R204, R206 |
| 14 | 1 | 510R/0603 | RESISTOR 0603 | R205 |
| 15 | 2 | 4k7/0402 | RESISTOR 0402 | R207, R211 |
| 16 | 3 | 10k/0402 | RESISTOR 0402 | R208, R210, R213 |
| 17 | 1 | 1M/0402 | RESISTOR 0603 | R209 |
| 18 | 1 | n.m./0402 | RESISTOR 0402 | R212 |
| 19 | 1 | 1k/0402 | RESISTOR 0402 | R214 |
| 20 | 1 | 0R/0402 | RESISTOR 0402 | R215 |
| 21 | 1 | 220n | CAPACITOR 0603 | C101 |
| 22 | 1 | 100n | CAPACITOR 0603 | C102 |
| 23 | 1 | 330p/0603 | CAPACITOR 0603 | C103 |
| 24 | 11 | 100 nF/0402 | CAPACITOR 0402 | C104, C105, C201, C205, C208, C210, C211, C213, C214, C215, C218 |
| 25 | 3 | 15 nF/0603 | CAPACITOR 0603 | C106, C107, C108 |
| 26 | 1 | 10 nF/0402 | CAPACITOR 0402 | C202 |
| 27 | 3 | 10 µF/10V/0805 | CAPACITOR 0805K | C203, C204, C216 |
| 28 | 2 | 15 pF/0402 | CAPACITOR 0402 | C206, C207 |
| 29 | 2 | 1 uF/0402 | CAPACITOR 0402 | C209, C217 |
| 30 | 1 | 4.7 µF/X7R/0805 | CAPACITOR 0805K | C212 |
| 31 | 2 | 12 MHz/S/3.2X2.5 | CRYSTAL | Q201 |
| 32 | 2 | BLM18PG600 | FERRIT BEAD | L101, L201 |

| Pos. No. | Qty | Value | Device | Reference description |
|---|---|---|---|---|
| 33 | 4 | LED-GN/D/0603 | LEDCHIPLED 0603 | LED101, LED103, LED201, LED202 |
| 34 | 1 | LED-GE/D/0603 | LEDCHIPLED 0603 | LED102 |
| 35 | 1 | LED-RT/D/0603 | LEDCHIPLED 0603 | LED203 |
| 36 | 2 | BCR198W | TRANSISTOR | T101, T102 |
| 37 | 1 | BSS223PW | TRANSISTOR | T201 |
| 38 | 1 | BCR148W | TRANSISTOR | T202 |
| 39 | 1 | XMC1402_TSSOP38 | INFINEON MCU | IC101 |
| 40 | 1 | IFX1763 | INFINEON LDO | U202 |
| 41 | 1 | AM26C32IPW | ENCODER IC | U101 |
| 42 | 1 | XMC4200_QFN48 | INFINEON MCU | U201 |
| 43 | 1 | Si8462BB-B-IS1 | ISOLATED DIGITAL | U204 |
| 44 | 1 | 74LVC1G126GW | LOGIC | U203 |
| 45 | 3 | SN74LVC2T45DCT | LOGIC | U205, U206, U207 |
| 46 | 2 | BAS3010A-03W | BAT60 | V201, V202 |
| 47 | 1 | ESD8V0L2B-03L | ESD DIODE | V203 |
| 48 | 1 | ZX62-AB-5PA | MICRO-USB | X202 |
| 49 | 1 | W1*10 | CONNECTOR | JP101 |
| 50 | 1 | CONP_2X05 | CONNECTOR | X102 |
| 51 | 1 | MAB32B2 | CONNECTOR | X103 |
| 52 | 1 | MPT0,5/5-2,54 | CONNECTOR | X101 |
| 53 | 2 | W2*4 | CONNECTOR (DEBUG) | X203, X204 |
| 54 | 1 | W2*3 | CONNECTOR (USIC) | X104 |

# Revision history

| Document revision | Date | Description of changes |
|---|---|---|
| ** | 2024-01-24 | Initial release. |

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