EV58E84A

PIC32CXMTC-DB HW User's Guide

Introduction

The PIC32CXMTC-DB (EV58E84A) is a demonstration board for the PIC32CXMTC Series from Microchip Technology Inc. This is a system-on-chip solution for residential smart meter applications built around dual 32-bit Arm® Cortex® -M4F processors. The user application runs in Core 0 at a maximum frequency of 200 MHz and the metrology library runs in Core 1 up to 240 MHz. The dual Arm Cortex-M4F architecture allows the integration of the application layer, communications layers and metrology functions in a single device. The board includes a Poly-phase (ATSENSE-301) Energy Metering Analog Front End with three voltage and four current sense channels. Current channels are designed to interface with current transformers, Rogowski coils and shunt current sensors. It can also interface with communications devices such as PLC and/or RF modules.

Target demonstrations summary:

- Metrology performance verification
- Dual-Core Cortex-M4F solution for meter firmware integration
- RF or PLC communication through modules plugged on dedicated extension ports

This user's guide introduces the PIC32CXMTC-DB Demonstration Board and how to get started with the board.

Contents

The Demonstration Kit includes the following:

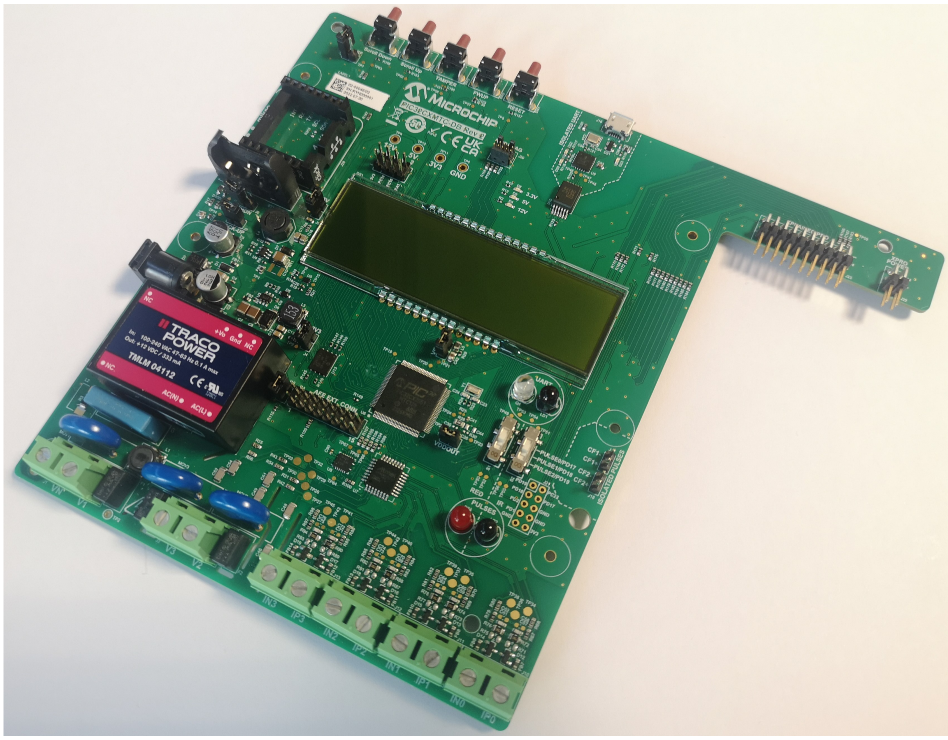
- One PIC32CXMTC-DB board in an enclosure
- One Micro A/B-type USB cable
- One Plug-in adapter for programming/debugging boards with small 10-pin 0.05 inch connector by means of a 20-pin 1 inch connector
- One 12V AC/DC wall mount adapter with interchangeable plugs

Features

The PIC32CXMTC-DB board includes the following features:

- Dual Arm Cortex-M4F core (application and metrology)
- 3-Phase AFE ATSENSE301 (3 voltages and 4 currents) with network divider and filters
- Voltage range measurement is from 90 Vac to 264 Vac. It can be extended to 291 Vac removing the power supply (U1)
- Current range measurement depends on the current sensor used and the configuration of the internal PGAs. The current sensor input channels come populated with 3.24Ω burden resistors for a current transformer (CT)
- Compliant with CT, Shunt or Rogowski Coil sensors
- Battery-backed real-time clock and power supply monitor
- 64 Mbit Quad IO SPI Flash memory for meter data storage and firmware update
- User Interfaces:
  - Isolated UART interface by USB bridge
  - Opto-Port interface compliant with ANSI C12.20 protocol for AMR
  - Isolated access to metering pulses (Wh, VARh, A^2h) by an Opto-Port and/or an isolated interface
  - Extension connector for External AFE connection such as MCP3910

  - Custom Liquid Crystal Display dedicated for Microchip metering platform
  - Interface for Xplained PRO boards (such as ATREB215-XPRO and PL460-EK) with XPRO Power Header and mikroBUS™ standard add-on boards
- Safety case to handle the board without electrical shock risk



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1. Evaluation Kit Specifications

1.1 Safety Recommendations

The demonstration board is intended for further engineering, development, demonstration or evaluation purposes only and is not for commercial use. Therefore, the demonstration board is not fault tolerant and is not designed or manufactured with protective considerations, including but not limited to product safety measures typically found in finished commercial goods.

The board can be powered directly from mains grid (90-264 Vac), which can cause PERSONAL INJURY, DEATH OR PHYSICAL DAMAGE. Therefore, exercise caution when testing these devices. The user must be a skilled person[1] in the practice and art of high voltage circuitry in order to utilize the circuits in the board. It is highly recommended that the user have qualifications or be certified for handling AC power, COMMON SENSE IS ENCOURAGED. The user agrees not to use the board in any situation where damage or injury to persons, property or business could occur. Furthermore, the board is NOT FOR RESALE/COMMERCIAL USE AND MUST BE STRICTLY OPERATED IN A WELL-CONTROLLED LABORATORY ENVIRONMENT.

Note:

1. According to EN 62368-1, a skilled person is a term applied to persons who have training or experience in the equipment technology, particularly in knowing the various energies and energy magnitudes used in the equipment. Skilled persons are expected to use their training and experience to recognize energy sources capable of causing pain or injury and to take action for protection from injury from those energies. Skilled persons must also be protected against unintentional contact or exposure to energy sources capable of causing injury.

DANGER Not all the board is isolated from mains. To avoid damage of instruments, do not connect any probe (i.e., debugger, oscilloscopes) to the non-isolated area of the board when the board is connected to mains.

The mains signal is identified in the enclosure with the symbol: ⚡.

WARNING To avoid user access to dangerous parts, PIC32CXMTC-DB must always be used within its enclosure. USB and Pulse Outputs connectors are accessible without electrical shock risk due to provided optical isolation.

WARNING If supplying the board via an external DC source, the socket-outlet must be easily accessible.

For any hardware components and/or jumper configuration changes, the board must be switched off and disconnected from the electrical network.

Attention: Be wary of the AC/DC Flyback power supply as it keeps its mains voltage charge for some time after disconnection from the mains grid. Also, notice that this board does not have any switch on the mains connection to turn it on or off.

The board must not be subjected to high electrostatic potentials.

Tip: It is strongly recommended to use a grounding strap or similar ESD protective device when handling the board in hostile ESD environments (offices with synthetic carpet, for example). Avoid touching the component pins or any other metallic element on the board.

This board can be used with coin batteries, which are highly contaminating products. Used batteries must always be recycled or safely treated and disposed.

Important: Microchip does not assume any responsibility for the consequences arising from any improper use of this board.

1.2 Electrical and Board Characteristics

This section contains information about the PIC32CXMTC-DB power supply requirements and consumption. For more details about the power supply system, refer to 3.3.4. Power Supply System. Additionally, this section contains a table with the main board characteristics.

Two options are available to power-up the PIC32CXMTC-DB board:

- Powering the on-board AC power supply through an external AC source in the J1 connector
- Powering through an external DC power supply connected to the J3 connector

Table 1-1. Power Supply Requirements

Electrical Parameter	Power Source	Value
Input Voltage	AC Connector, J1	90 – 264 Vac, 47 – 63 Hz
Maximum Input Current	AC Connector, J1	115 Vac: 110 mA 230 Vac: 70 mA
Input Voltage	DC Jack Connector, J3	+12 Vdc
Maximum Input Current	DC Jack Connector, J3	18W / 12 Vdc = 1.5A

Table 1-2. Board Characteristics

Characteristic	Specification
Operating Temperature	-40°C to +85°C[1]
Relative Humidity	0 to 85% (non-condensing)
Board Dimensions	192 mm × 161 mm × 25 mm
RoHS Status	RoHS 3 Compliant
China RoHS Status	EFUP50
REACH Status	REACH Compliant

Note:

1. The DS1 and U1 components of the board may have reduced performance or become damaged even when operating in this temperature range. The operating temperature for DS1 is -25°C to +60°C and U1 is -30°C to +85°C.

2. Getting Started

Unpack and inspect the kit carefully.

Figure 2-1. PIC32CXMTC-DB Kit

The board is inside an enclosure made of polycarbonate UL 94 V-0 (271 mm x 170 mm x 60 mm). The board can be accessed by opening the enclosure through both quick-release catches using a screwdriver. The board is mounted on a panel over the base. Take the board out of the PCB spacers to release the board from the enclosure.

Figure 2-2. Open the Enclosure

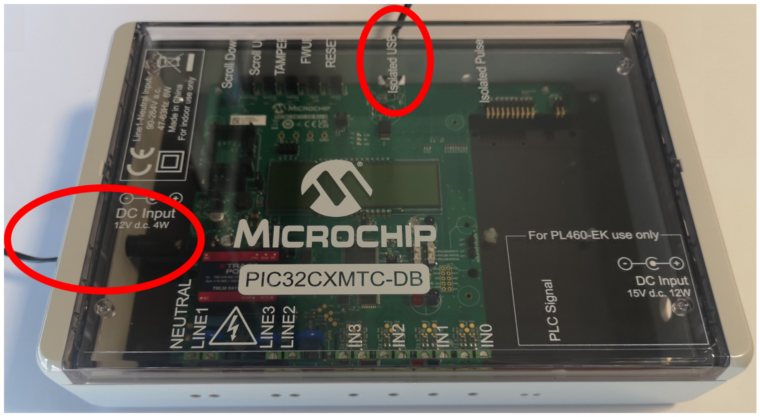

The transparent lid allows the status of the output LEDs and the LCD display to be checked with the enclosure closed.

Once the board is powered, the PIC32CXMTC-DB runs the pre-programmed Microchip Demo Meter application.

For a further description of the application firmware and its functionality, refer to the PIC32CXMTx-DB Getting Started User Guide and the Metering Demo and Developer User Guide.

To connect the USB cable to J16 or the AC/DC wall adapter to J3, it is not necessary to open the enclosure.

Figure 2-3. Connection of AC/DC Wall Adapter and USB



However, it is necessary to open the enclosure to connect an AC power source (mains grid) to the J1 connector. Once the connections are made, remember to close the enclosure before connecting it to mains.

Figure 2-4. Connection of AC Power Source

WARNING When the board is connected to the mains grid, there is a risk of PERSONAL INJURY OR PHYSICAL DAMAGE. Make sure that the enclosure is closed before connecting the board to the mains grid and do not open the lid.

Important: Remember that it is not necessary to open the enclosure for the proper functioning of the board. However, if you need to open the enclosure and manipulate the board, make sure that it is disconnected from mains.

2.1 Code and Technical Support

Firmware developers can run the given example code, and also implement their own applications based on the provided firmware stacks.

Note that the latest software code, documentation and support materials are available on www.microchip.com.

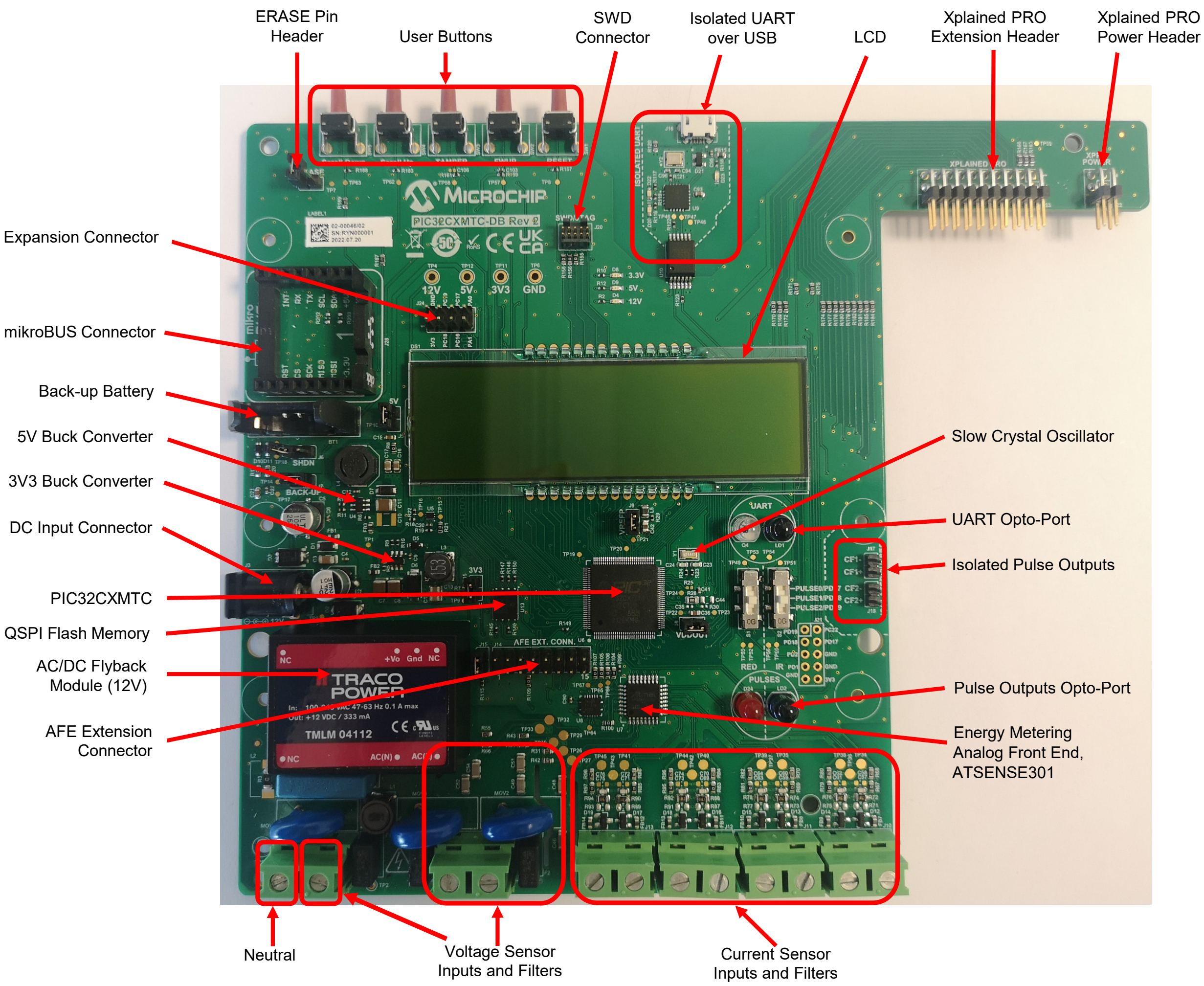
For any technical support requests, visit support.microchip.com.

3. PIC32CXMTC-DB Board

3.1 Overview

This section summarizes the PIC32CXMTC-DB board design. It provides a high-level description of the board, such as power supply, MCU, metrology AFE, memory, peripherals and interface board. This document is not intended to provide detailed documentation about the processor or any other component used. It is expected that the user will refer to the appropriate documents of those devices to access detailed information.

Figure 3-1. PIC32CXMTC-DB Board Description



3.2 Features List

The PIC32CXMTC-DB board includes the following features:

- PIC32CX2051MTC128 SoC:
  - Application/Host Core (CM4-C0)
  - Metrology/Coprocessor Core (CM4-C1)
  - Security and Cryptography
  - Dual-Core Shared System Controller
- Poly-phase (ATSENSE-301(H)) Energy Metering Analog Front End for Microchip MCUs and Metrology Library:

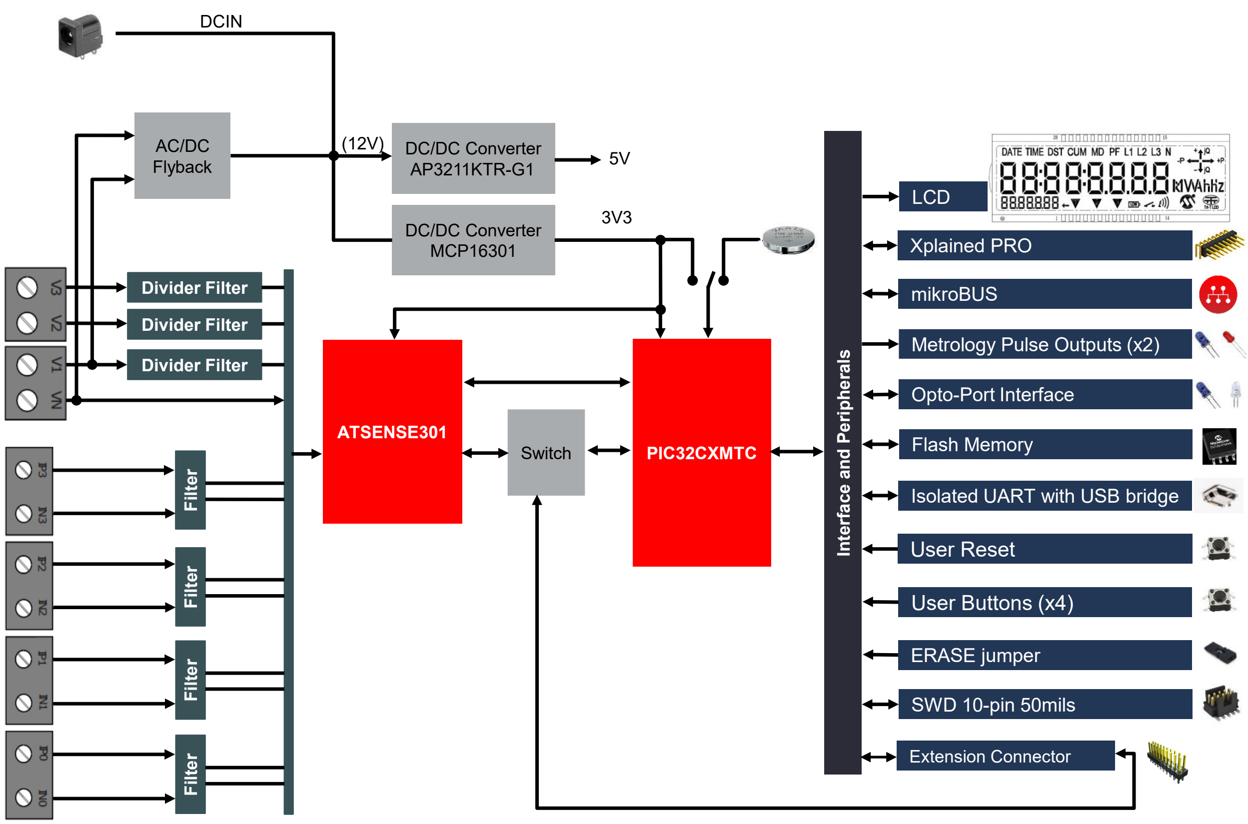
- Compliant with Class 0.2 Standards (ANSI C12.20-2002 and IEC 62053-22)
- Seven Sigma-Delta ADC Measurement Channels: Three Voltages, Four Currents, 102 dB Dynamic Range
- Current Channels with Pre-Gain (x1, x2, x4, x8) Supports Shunt, Current Transformer and Rogowski Coil

- Measurement Circuits of Voltage (90-264 Vac) and Current compatible with different current sensors
- On-board AC power supply to supply a 3.3V buck converter for the digital circuitry and a 5V buck converter to supply 5V for the mikroBUS and Xplained PRO interfaces
- A supply monitor to sense the 12V power supply output levels
- Peripherals:
  - 64-Mbit Serial Quad I/O (SQI) Flash Memory
  - Display LCD (8 common lines and 20 segments)
  - Reset, Tamper, Force Wake-Up, Scroll Down and Scroll Up buttons
  - Chip Erase jumper
- Interfaces:
  - Isolated UART interface by USB bridge
  - Isolated UART signals by an Opto-Port Interface
  - Metrology Pulses Outputs (Isolated and Optocoupled)
  - SWD/JTAG debugging port
  - Xplained PRO connector with Power connector
  - mikroBUS add-on connector

3.2.1 Block Diagram

The following figure shows the block diagram of the PIC32CXMTC-DB board.

Figure 3-2. PIC32CXMTC-DB Block Diagram

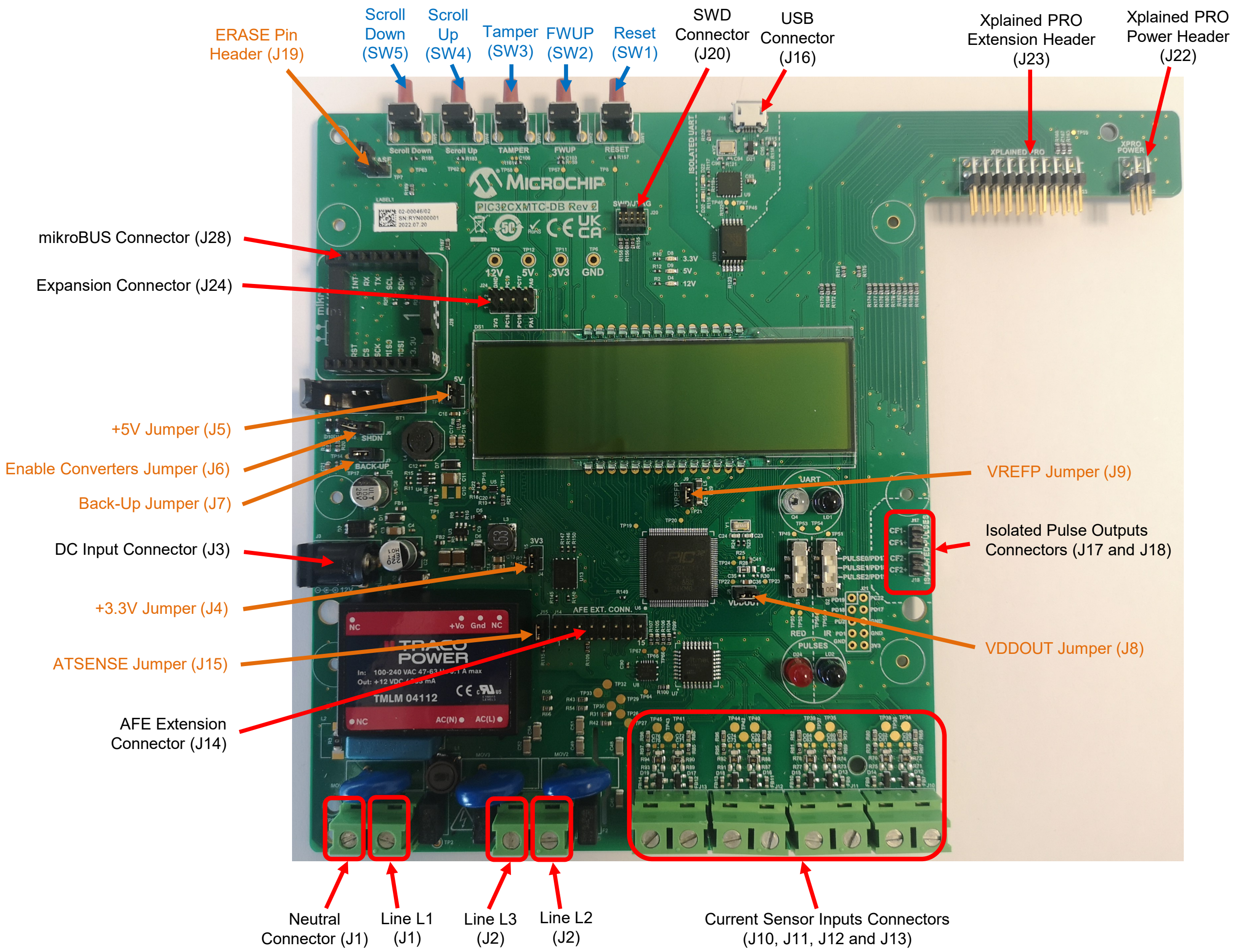


3.2.2 Interface Connection

The PIC32CXMTC-DB board includes hardware interfaces such as jumpers, connectors and buttons.

The following figure shows an overview of the connectors, jumpers and buttons of the PIC32CXMTC-DB board.

Figure 3-3. PIC32CXMTC-DB Connectors, Button and Jumpers Overview



3.2.2.1 Connectors

The PIC32CXMTC-DB board includes the following connectors:

1. Line Voltage Connector (for an AC grid), J1.

Table 3-1. Line Voltage Connector (for an AC grid), J1

Pin	Signal Name	Description
1	N	Neutral (VN in PCB)
2	L1	Line 1 (V1 in PCB)

2. Line Voltage Connector (for an AC grid), J2.

Table 3-2. Line Voltage Connector (for an AC grid), J2

Pin	Signal Name	Description
1	L3	Line 3 (V3 in PCB)
2	L2	Line 2 (V2 in PCB)

3. DC Input Connector, J3.

Table 3-3. DC Input Connector, J3

Pin	Signal Name	Description
1	12V_IN	DC Input voltage (+12V)
2	GND	Ground
3	—	—

4. Current Sensor Input 0 Connector (for Neutral), J10.

Table 3-4. Current Sensor Input 0 Connector, J10

Pin	Signal Name	Description
1	IN0	Current channel 0, negative input
2	IP0	Current channel 0, positive input

5. Current Sensor Input 1 Connector (for Line 1 voltage), J11.

Table 3-5. Current Sensor Input 1 Connector, J11

Pin	Signal Name	Description
1	IN1	Current channel 1, negative input
2	IP1	Current channel 1, positive input

6. Current Sensor Input 2 Connector (for Line 2 voltage), J12.

Table 3-6. Current Sensor Input 2 Connector, J12

Pin	Signal Name	Description
1	IN2	Current channel 2, negative input
2	IP2	Current channel 2, positive input

7. Current Sensor Input 3 Connector (for Line 3 voltage), J13.

Table 3-7. Current Sensor Input 3 Connector, J13

Pin	Signal Name	Description
1	IN3	Current channel 3, negative input
2	IP3	Current channel 3, positive input

8. AFE Extension Connector, J14.

Table 3-8. AFE Extension Connector, J14

Pin	Signal Name	Description
1	+3V3	3.3V power
2	+5V	5V power
3	+3V3	3.3V power
4	+5V	5V power
5	GND	Ground
6	GND	Ground
7	MCP3910_PD5	PIC32CXMTC Signal (MCSPI_SPCK)

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Pin	**Signal Name**	**Description**
8	MCP3910_PD6	PIC32CXMTC Signal (MCSPI_MISO)
9	MCP3910_PD8	PIC32CXMTC Signal (MCSPI_MOSI1/MCSPI_NPCS0)
10	MCP3910_PD7	PIC32CXMTC Signal (MCSPI_MOSI0)
11	PD9	PIC32CXMTC Signal (MCSPI_MOSI2)
12	PD10	PIC32CXMTC Signal (MCSPI_MOSI3)
13	GND	Ground
14	PD11	PIC32CXMTC Signal (MCSPI_NPCS3)
15	+12V	12V power
16	GND	Ground

9. Micro-B Female USB Connector, J16.

Table 3-9. USB Device Connector, J16

Pin	Signal Name	Description
0	EARTH	Shield
1	VUSB	5V power
2	D-	Data Minus
3	D+	Data Plus
4	ID	On the Go Identification
5	GND_ISO	Isolated Reference

10. Isolated Pulse Outputs Connectors, J17 and J18.

Table 3-10. Isolated Pulse Outputs Connector, J17

Pin	Signal Name	Description
1	CF1-	Negative isolated pulse
2	CF1+	Positive isolated pulse

Table 3-11. Isolated Pulse Outputs Connector, J18

Pin	Signal Name	Description
1	CF2-	Negative isolated pulse
2	CF2+	Positive isolated pulse

11. JTAG/SWD 10-pin Dual Row Connector for PIC32CXMTC, J20.

Table 3-12. SWD Connector, J20

Pin	Mnemonic	Description
1	VCC	This is the target reference voltage. It is used to check if the target has power, to create the logic-level reference for the input comparators, and to control the output logic levels to the target. It is normally fed from V_{CC} on the target board and must not have a series resistor
2	SWDIO/TMS	Serial Wire Input Output/Test Mode Select. JTAG mode set input of target CPU. This pin should be pulled up on the target. Output signal that sequences the target's JTAG state machine, sampled on the rising edge of the TCK signal
3	GND	Ground
4	SWCLK/TCK	Serial Wire Clock/Test Clock. JTAG clock signal to target CPU (output timing signal, for synchronizing test logic and control register access)
5	GND	Ground
6	SWO/TDO	Serial Wire Output / Test Asynchronous Data Out from target CPU
7	KEY	—
8	NC/TDI	Not Connected/Test Data Input. JTAG data input of target CPU (serial data output line, sampled on the rising edge of the TCK signal). It is recommended that this pin is pulled to a defined state on the target board
9	GND Detect	Ground
10	nRESET	JTAG Reset (active-low output signal that resets the target). Output from the JTAG debug probe to the Reset signal on the target JTAG port. This pin is normally pulled HIGH on the target to avoid unintentional resets when there is no connection

12. Xplained PRO Power Header, J22.

Table 3-13. Xplained PRO Power Header, J22

Pin	Signal Name	Description
1	GND	Ground
2	5V	External 5V input (optional)
3	3V3	Regulated 3.3V
4	5V	Regulated 5V

13. Xplained PRO Extension Header, J23.

Table 3-14. Xplained PRO Extension Header, J23

Pin	Mnemonic	Description
1	—	Test Point
2	GND	Reference Ground
3	ADC+	Analog to digital converter, alternatively positive part of differential ADC
4	ADC-	Analog to digital converter, alternatively negative part of differential ADC
5	GPIO1	General purpose I/O
6	GPIO2	General purpose I/O

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Pin	Mnemonic	Description
7	PWM+	Pulse width modulation, alternatively positive part of differential PWM
8	PWM-	Pulse width modulation, alternatively negative part of differential PWM
9	IRQ/GPIO	Interrupt request line and/or general purpose I/O
10	SS/GPIO	Serial select for SPI and/or general purpose I/O
11	TWD	I^2C Data
12	TWCK	I^2C Clock
13	RXD	UART Receiver
14	TXD	UART Transmitter
15	SS	SPI Chip Select
16	MOSI	SPI Host Output Client Input
17	MISO	SPI Host Input Client Output
18	SCK	SPI Clock
19	GND	Reference Ground
20	VCC	3.3V power for extension board

14. Expansion Connector, J24.

Table 3-15. Expansion Connector, J24

Pin	Signal Name	Description
1	+3V3	3.3V power
2	GND	Ground
3	PC18	PIC32CXMTC Signal (FLEXCOM6_IO2 (SPCK))
4	PC19	PIC32CXMTC Signal (FLEXCOM6_IO3 (CS0))
5	PC16	PIC32CXMTC Signal (FLEXCOM6_IO0 (MOSI))
6	PC17	PIC32CXMTC Signal (FLEXCOM6_IO1 (MISO))
7	PA1	PIC32CXMTC Signal (FLEXCOM6_IO1 (RX))
8	PA0	PIC32CXMTC Signal (FLEXCOM6_IO0 (TX))

15. mikroBUS add-on Board Connector, J28.

Table 3-16. mikroBUS Connector, J28

Pin	Mnemonic	Description
1	AN	Analog Input
2	RST	Reset
3	CS	SPI Chip Select
4	SCK	SPI Clock
5	MISO	SPI Host Input Client Output
6	MOSI	SPI Host Output Client Input

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Pin	Mnemonic	Description
7	+3V3	VCC: 3.3V power
8	GND	Reference Ground
9	GND	Reference Ground
10	+5V	VCC: 5V power
11	SDA	I^2C Data
12	SCL	I^2C Clock
13	TX	UART Transmit
14	RX	UART Receive
15	INT	Hardware Interrupt
16	PWM	PWM

3.2.2.2 Jumper Configuration

The following table describes the functionality of the jumpers.

Table 3-17. Jumper Configuration

Jumper	Label	Default Setting	Function
J4	3V3	Closed	3.3V current measurement
J5	5V	Closed	5V current measurement
J6	SHDN	Open	To enable 3.3V and 5V converters despite SHDN command
J7	BACK-UP	Closed	3V3_BACK-UP current measurement
J8	VDDOUT	Closed	VDDOUT current measurement
J9	VREFP Selection	Closed	VREFP selection between internal or external voltage reference • Opened = Internal voltage reference[1] • Closed = External voltage reference
J15	ATSENSE	Closed	To select Energy Metering AFE (ATSENSE301 or MCP3910)
J19	ERASE	Open	Erase PIC32CXMTC firmware code

Note:

1. **⚠WARNING** If the ADC is configured (via SW) to use the internal voltage regulator as a positive reference (VREFP), the jumper must be removed to avoid a short circuit.

3.2.2.3 Test Points

Several Test Points are available to provide test measurement capabilities to some of the nets in the board. A list of accessible Test Points is described below:

Table 3-18. Test Point Probes

Reference	Function
TP2	Line 1
TP4	+12V
TP5	Neutral
TP6	GND
TP11	+3V3
TP12	+5V

Table 3-19. Test Point Pads

Reference	Function	Reference	Function
TP1	+12V	TP40	IP2
TP3	Flyback Converter Output	TP41	IP3
TP7	Erase	TP42	GND
TP8	RESET	TP43	GND
TP9	+3V3	TP44	IN2
TP10	+5V	TP45	IN3
TP13	Coin Cell Battery	TP46	Isolated UART TX
TP14	3V3 Back-Up (next to coin battery)	TP47	Isolated UART RX
TP15	Active-Low, Open-Drain Output	TP48	GND
TP16	Input voltage monitored	TP49	Opto-Isolated UART RX
TP17	GND	TP50	LED VISIBLE
TP18	GND	TP51	Opto-Isolated UART TX
TP19	VDD3V3	TP52	GND
TP20	VDDLCD	TP53	GND
TP21	VREFP	TP54	GND
TP22	VDDOUT	TP55	LED IR
TP23	VDDPLL	TP56	GND
TP24	3V3 Back-up	TP57	FWUP
TP25	VP1 before RC Filter	TP58	Tamper
TP26	VP1	TP59	Xplained PRO, pin 1
TP27	GND	TP60	PD15
TP28	VP2 before RC Filter	TP61	PD3
TP29	VP2	TP62	Scroll Up
TP30	GND	TP63	Scroll Down

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Reference	Function	Reference	Function
TP31	VP3 before RC Filter	TP64	AFE Switch, PD8
TP32	VP3	TP65	AFE Switch, PD6
TP33	GND	TP66	AFE Switch, PD7
TP34	IP0	TP67	AFE Switch, PD5
TP35	IP1	TP68	PD12
TP36	GND	TP69	PD13
TP37	GND	TP70	PD14
TP38	IN0	TP71	PD16
TP39	IN1	—	—

3.3 Hardware Description - System

3.3.1 PIC32CXMTC

The Microchip PIC32CXMTC provides a system-on-chip solution for applications such as poly-phase smart meters. The device offers up to class 0.2 metrology accuracy within the industrial temperature range and it is compliant with ANSI C12.20-2002 and IEC 62053-22 standards.

The PIC32CXMTC is a seamless extension of the Microchip PIC32CX. It belongs to a family of microcontrollers and solutions for smart grid security and communication applications. This metrology-enabled family offers an unprecedented level of integration and flexibility around dual 32-bit Arm Cortex-M4F processors running at a maximum speed of 200 MHz for the Application core, and up to 240 MHz for the Metrology core. It includes up to 2048 Kbytes of embedded Flash, 512 Kbytes of embedded SRAM for the application, on-chip cache (16 Kbytes for instruction and 8 Kbytes for data) and 48 Kbytes of embedded SRAM for the metrology code/data.

The peripheral set includes an extensive set of embedded cryptographic features, anti-tampers, Floating Point Unit (FPU), Memory Protection Unit (MPU), FLEXCOM peripherals supporting I2C, SPI, UART/USART interfaces, three PWMs for pulse output functions, 12-channel general purpose 32-bit timers, 12-bit ADC, analog comparators, a battery backed-up RTC and a segmented LCD Controlller.

The PIC32CXMTC-DB is equipped with a PIC32CX2051MTC128 device in 128-pin EP-TQFP (14 mm x 14 mm x 1.0 mm, 0.4 mm pitch).

Figure 3-4. PIC32CXMTC Microcontroller Schematic

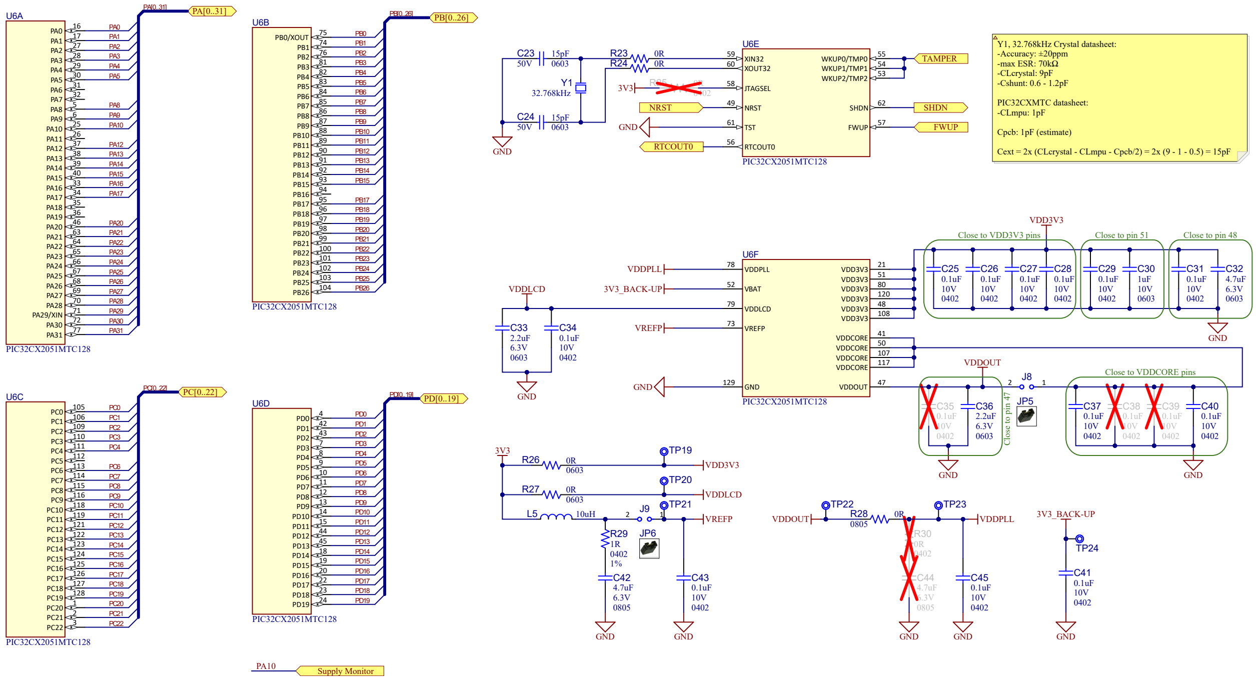
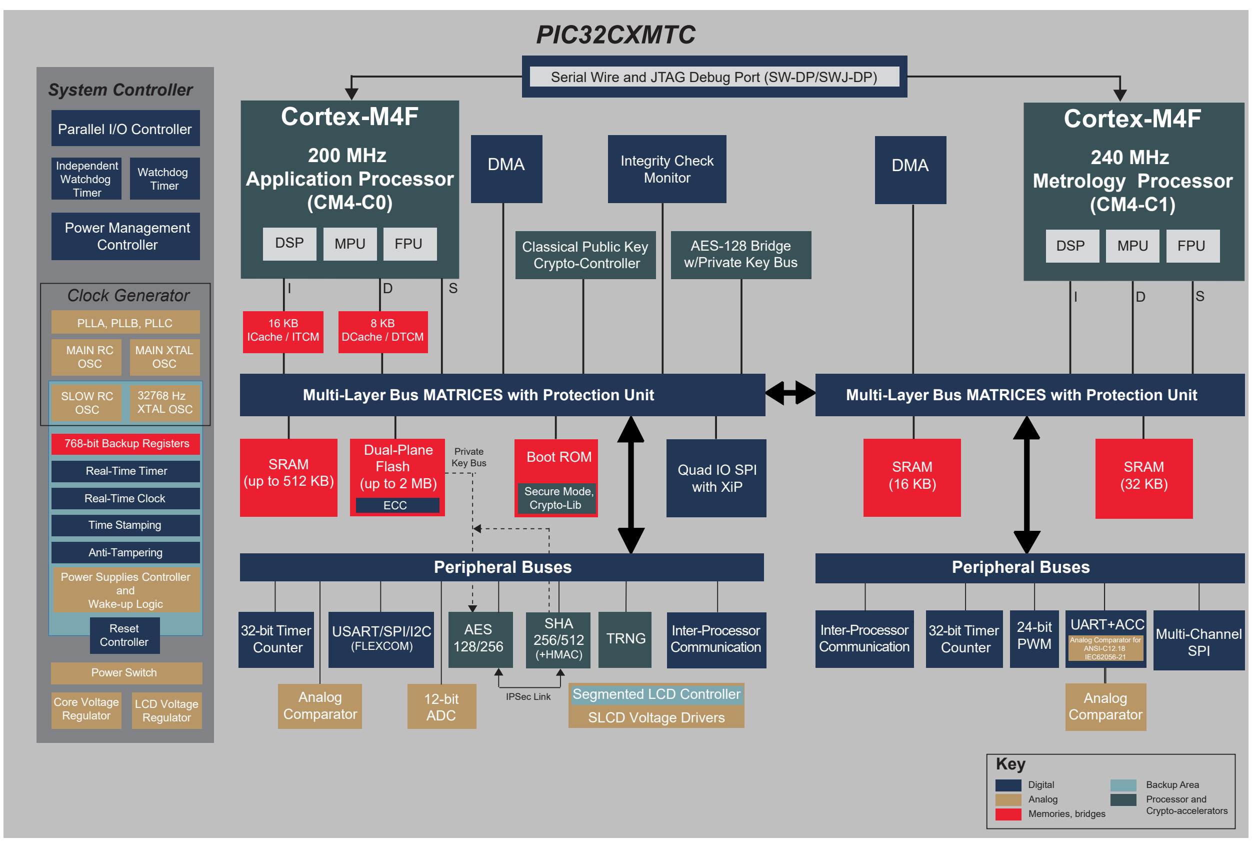


Figure 3-5. PIC32CXMTC Block Diagram



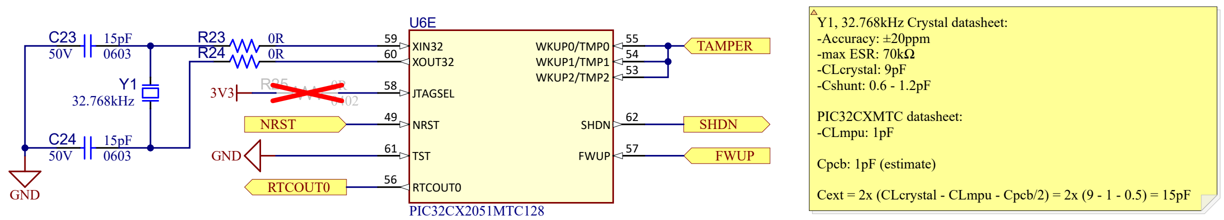
Refer to the PIC32CXMTC Data Sheet for more information.

3.3.2 Clock Circuitry

The PIC32CXMTC generates its necessary clocks based on a slow clock (SLCK) oscillator running at 32.768 kHz.

By default, a low-power 32.768 kHz crystal oscillator, Y1, is assembled. For more information about this crystal, refer to the VMK3-9001-32K7680000 Data Sheet.

Figure 3-6. Crystal Oscillators Schematic



Refer to the PIC32CXMTC Data Sheet for more information about recommendations for crystal selection.

3.3.3 Reset

Three reset sources for the PIC32CXMTC-DB can be used:

- Power-On Reset function, embedded in the PIC32CXMTC device
- User push button reset, SW1
- SWD/JTAG reset from an in-circuit emulator

3.3.4 Power Supply System

The PIC32CXMTC-DB board can be powered by several power sources. The board can be supplied through:

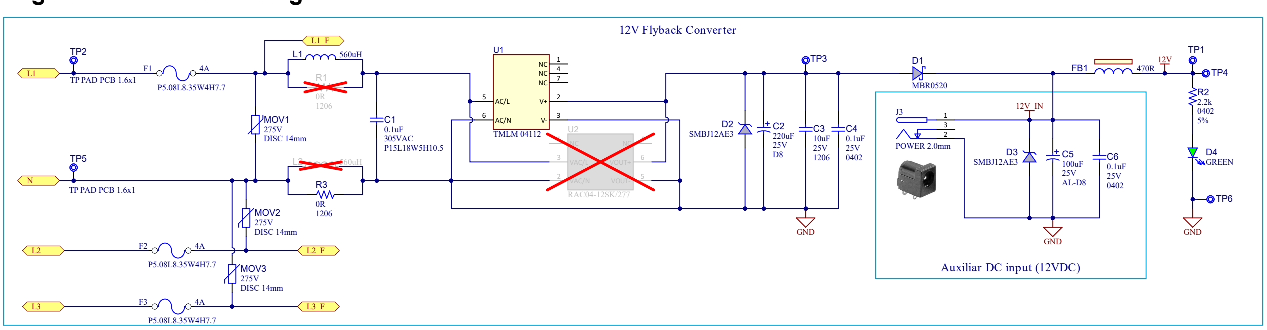
- An AC power source (mains grid) from 90 to 264 Vac and from 47 to 63 Hz, connected to the J1 connector
- A +12V DC power source via a 2.1 mm center-positive plug into the power jack connector of the board (J3). The recommended output rating of the power adapter is 1.5A

The PIC32CXMTC-DB board has three voltage rails:

- +12V to power the 3.3V and 5V converters
- +3.3V to power the IC devices, such as PIC32CXMTC, SST26VF064B, AFE Extension connector and some interfaces
- +5V to power the mikroBUS, Xplained PRO and AFE Extension connectors

The 12V voltage rail is obtained from the on-board Flyback Solution when the board is connected to mains (L1 and Neutral) or by an external +12V DC power source.

Figure 3-7. 12V Rail Design

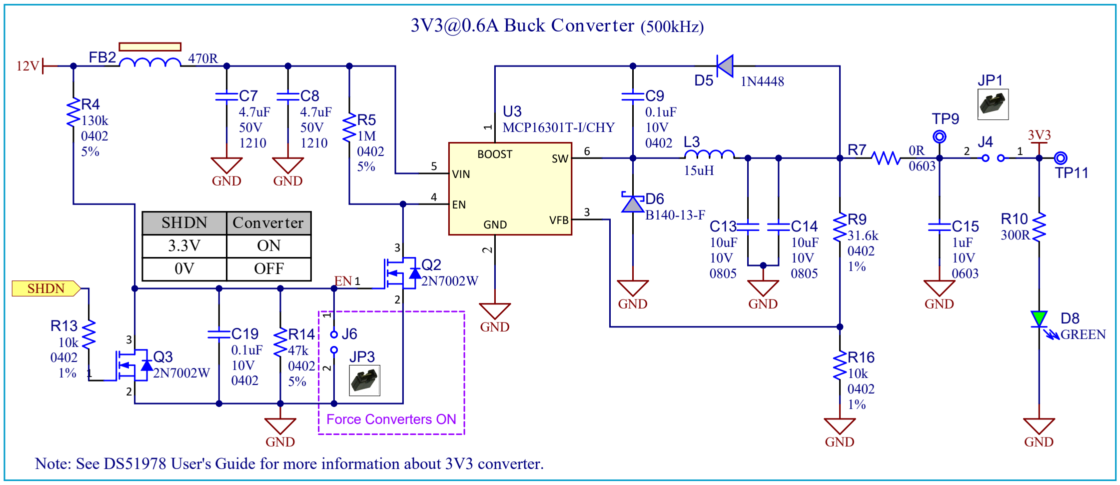


Attention: This demonstration kit provides a 12V 18W isolator AC/DC wall adapter with enough current rating to supply the board and any other boards connected in several interfaces. Use the Globtek reference provided to avoid safety and/or EMC issues.

Tip: Supplying the board via an external DC source, such as the 12V 18W isolator AC/DC wall adapter provided, and disconnecting the voltage inputs from the mains and the Vsense connectors eliminates the risk of an electrical shock when handling the board (e.g., software debugging).

The +3.3V voltage rail is obtained from the Microchip MCP16301 buck converter. For a further description about the buck converter, see the MCP16301/H High-Voltage Input Integrated Switch Step-Down Regulator Data Sheet.

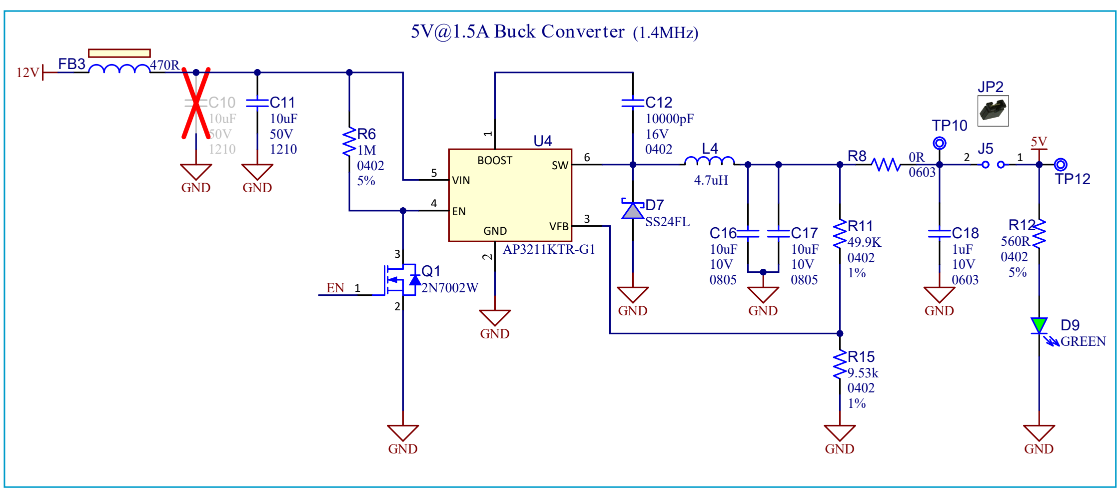
Figure 3-8. 3.3V Buck Converter Design



There are two test points, TP9 and TP11, and one LED, D8, on the voltage rail to check whether the power supply is operating properly. The jumper, J4, allows measuring the current on the 3.3V rail.

The +5V voltage rail is obtained from the buck converter. Another LED, D9, and two test points, TP10 and TP12, are connected to the voltage rail to check whether the power supply is operating properly. The jumper, J5, allows measuring the current on the 5V rail.

Figure 3-9. 5V Buck Converter Design

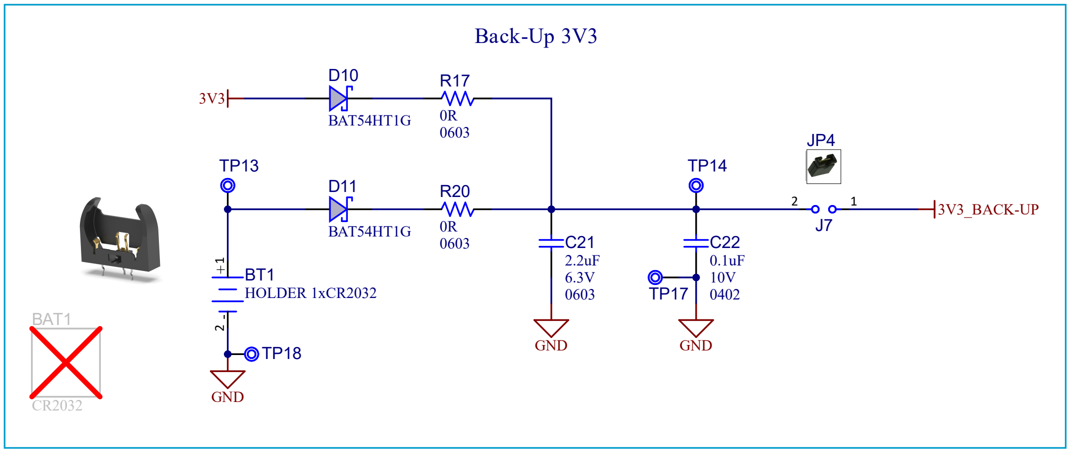


The processor manages the SHDN signal to shut down both buck converters and makes the processor enter Backup mode and the board enter a Power-Down mode. The SHDN signal controls the ENABLE signal of converters through a simple scheme with a FET (Field Effect Transistor). The SHDN signal can be disabled when the shunt JP3 is placed in J6; then, converters are always enabled. Note that using the SHDN pin when entering Backup mode is optional. See the Power Supply and Power Control section of the PIC32CXMTC Product Data Sheet.

A 3V coin battery holder, BT1, is included to insert a CR2032 battery to supply VBAT voltage. It allows the microcontroller to be supplied even if a Brown-Out event occurs. The system is able to detect this event (see the Power Supply Monitor schematic below) and the embedded firmware may then switch to a Low-power mode to reduce power consumption to a minimum. . While in Backup mode, the board can be woken up by action on the SW2 button (Force Wake-Up) or SW3 button (Tamper), which signals the MCU to resume operations.

See the Power Supply and Power Control section of the PIC32CXMTC Product Data Sheet for further descriptions about Backup mode and possible other wake-up sources.

Figure 3-10. 3.3V Back-Up Voltage Schematic



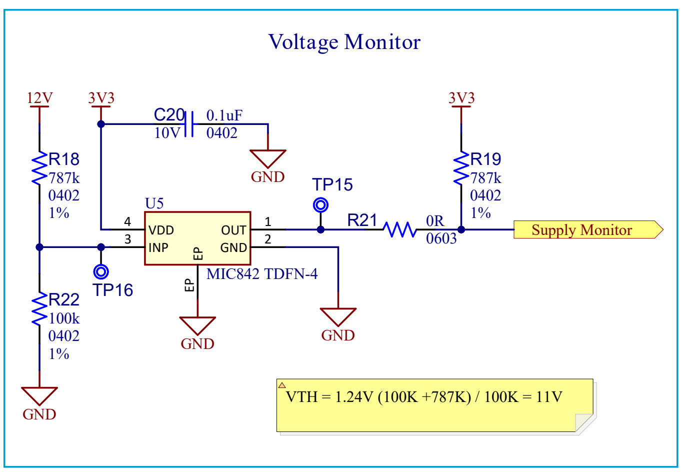
The jumper, J7, allows measuring the current on the back-up rail.

Attention: The CR2032 coin battery is not provided with the kit.

The MIC842 is intended for voltage monitoring applications. It is a micro-power, precision-voltage comparator with an on-chip voltage reference. External resistors are used to set the voltage monitor threshold. When the threshold is crossed, the outputs switch polarity.

The MIC842 incorporates a voltage reference and comparator with fixed internal hysteresis; two external resistors are used to set the switching threshold voltage.

Figure 3-11. Voltage Monitoring Schematic



For more information, refer to the MIC842 Data Sheet and MIC842 webpage.

3.3.5 Analog Front End Signals

The board includes connectors for all the metrology inputs (currents and voltages) as well as the input networks needed to protect, adapt the levels and filter the signals before connecting them to the A/D converter inputs.

3.3.5.1 Input Connectors for Metrology

The nodes IPx, INx, Vx and VN are tied to 7.62 mm pitch connectors. Cables from 12 AWG type down to 30 AWG type can be connected into them. The connection matrix is:

- Line Voltage VN: Connected to Pin 1 of connector J1
- Line Voltage V1: Connected to Pin 2 of connector J1
- Line Voltage V2: Connected to Pin 2 of connector J2
- Line Voltage V3: Connected to Pin 1 of connector J2
- External Current Sensor on VN: Connected to Pins 1 and 2 of connector J10
- External Current Sensor on V1: Connected to Pins 1 and 2 of connector J11
- External Current Sensor on V2: Connected to Pins 1 and 2 of connector J12
- External Current Sensor on V3: Connected to Pins 1 and 2 of connector J13

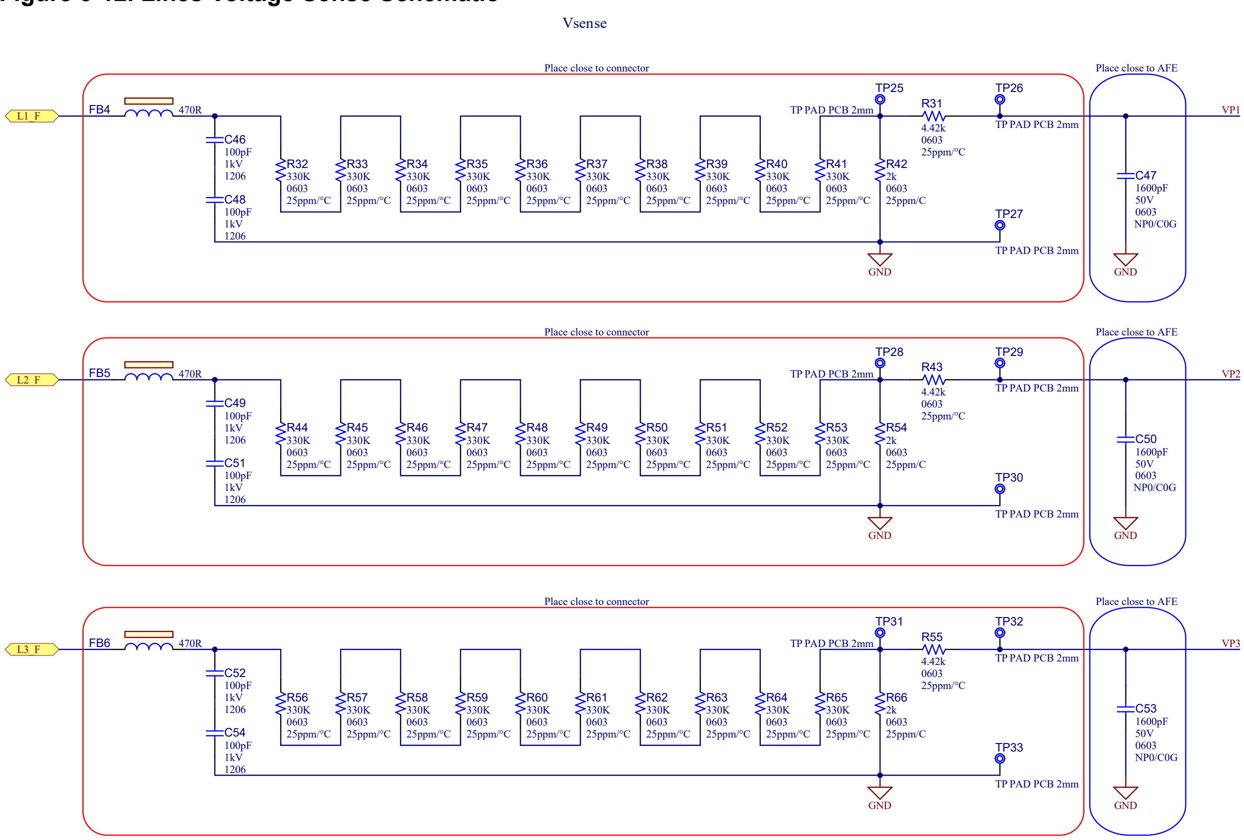
3.3.5.2 Live Voltages Sense Inputs

Live voltages are connected to two connectors (J1 and J2). These lines are connected to the inputs of the A/D converter through a resistor divider with a ratio of 0.6057V/1000V. The TCR of the resistors is 25 ppm/ºC.

The three inputs (L1, L2 and L3) have the same resistor divider schematic and layout. The metering ground reference, GND, is connected to the Line Voltage input VN.

Important: The resistors installed by default in the divider (ratio of 0.6057V/1000V) allow a maximum input voltage of 291 Vrms. To measure higher input voltage values, the resistor divider ratio must be reduced. Also, take into account the AC power supply input range (from 90 to 264 Vac and from 47 to 63 Hz). For operation outside this range, the AC power supply (U1) must be reomved to avoid damaging it.

Figure 3-12. Lines Voltage Sense Schematic



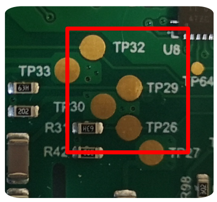
An anti-aliasing filter is required for band-limiting the input signals. Typically, a single-pole RC filter is sufficient for metrology applications. The filter is tuned with the following component values:

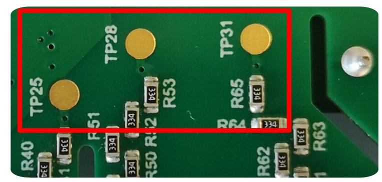
- R31, R43 and R55: 4.42 kΩ, 1%, 25 ppm/ºC
- C47, C50 and C53: 1600 pF NP0/COG

Some test points close to the resistor dividers allow monitoring the input voltage value at the A/D converter inputs of ATSENSE:

- TP25: VP1 before RC Filter input measuring referring to GND
- TP26: VP1 input measuring referring to GND
- TP28: VP2 before RC Filter input measuring referring to GND
- TP29: VP2 input measuring referring to GND
- TP31: VP3 before RC Filter input measuring referring to GND
- TP32: VP3 input measuring referring to GND

Figure 3-13. VP1, VP2 and VP3 Test Points





3.3.5.3 Current Sensor Inputs

The PIC32CXMTC-DB is compatible with various types of current sensors. It is possible to use an arbitrary combination of the following current sensors, subject to input voltage specifications:

- Current Transformers (CT)
- Shunt Resistors
- Rogowski Coils

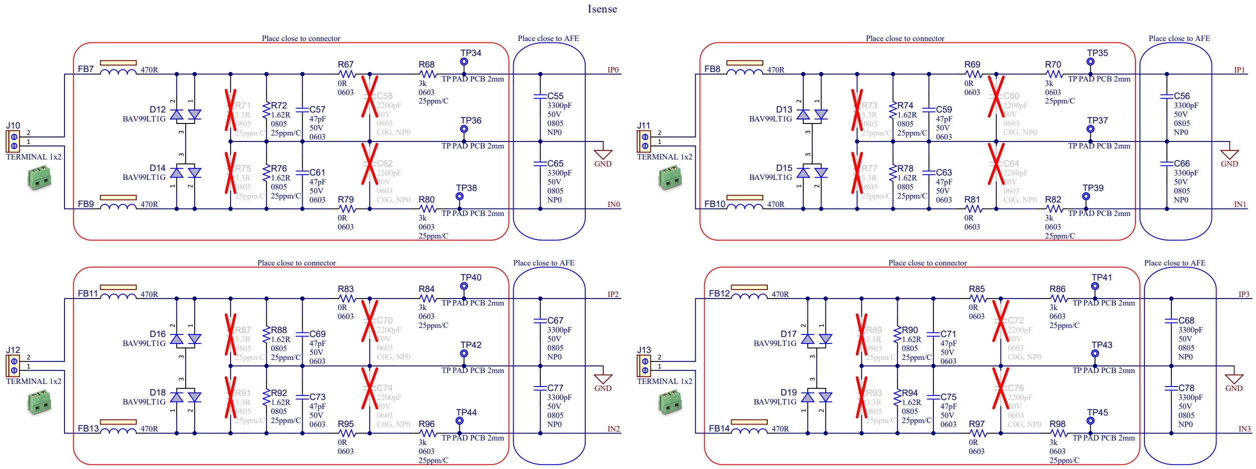
⚠WARNING A shunt resistor must be placed in series with the line to be measured, then connected to the measurement inputs. The demonstration board is referred to neutral; therefore, a shunt resistor can only be used in neutral line. Using a shunt resistor to measure currents in lines 1, 2 or 3 will damage the board and it is dangerous for the user.

Attention: Note that this kit does not include any CT, Rogowski coils or Shunt current sensors.

Each current sensor (CT, Shunt or Rogowski Coil) must be connected to two positions of the same connector. The current input lines are distributed to an A/D converter through a configurable filter whose function is to adapt the chosen current sensor. Both inputs have the same filter configuration and layout. Their ground reference is GND.

Important: By default, the PIC32CXMTC-DB board is configured to host a current transformer. The board is populated with resistors R72, R74, R76, R78, R88, R90, R92 and R94 of 1.62Ω to fit a standard 200A CT with 1:2000 turn ratio. Using default installed burden resistors of 3.24Ω (2 × 1.62Ω), a 2000:1 CT ratio will allow a max of 240A. (240 Arms × √2 × 3.24Ω/2000 = 0.55 Vpk).

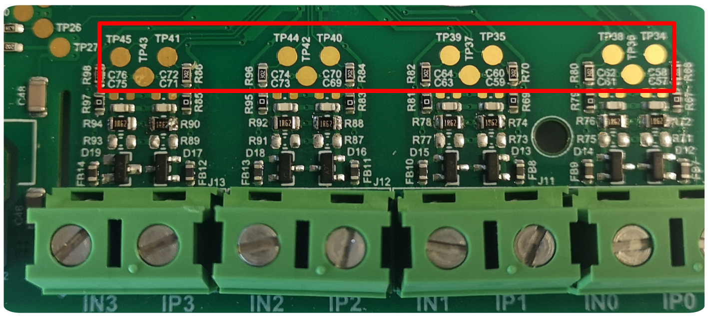
Figure 3-14. IPx and INx Current Sense Schematic



Some test points close to the A/D converter inputs allow monitoring the input voltage value at the A/D converter inputs corresponding to the current:

- TP34: IP0 input measurement referring to GND
- TP38: IN0 input measurement referring to GND
- TP35: IP1 input measurement referring to GND
- TP39: IN1 input measurement referring to GND
- TP40: IP2 input measurement referring to GND
- TP44: IN2 input measurement referring to GND
- TP41: IP3 input measurement referring to GND
- TP45: IN3 input measurement referring to GND

Figure 3-15. IPx and INx Test Points



3.3.5.3.1 Current Sensor Inputs Configuration when Using Current Transformer

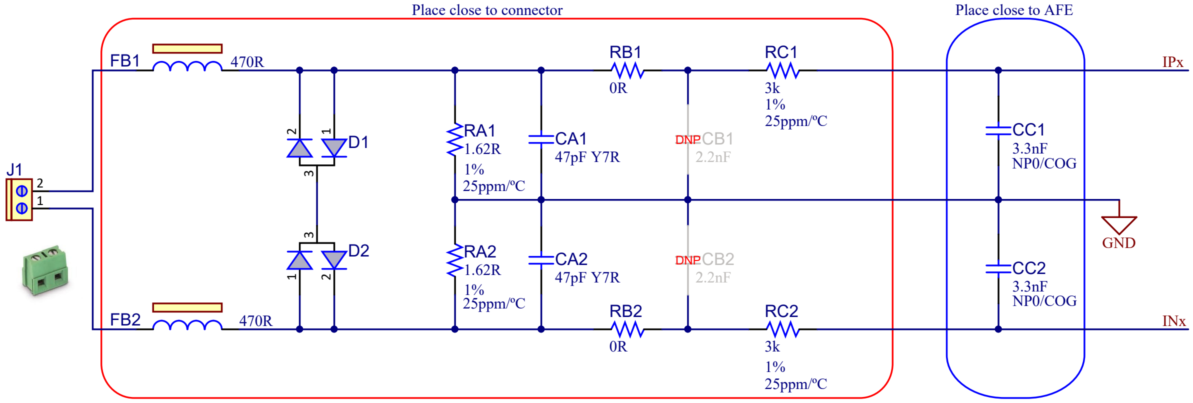
Current transformers (CTs) provide a simple and yet accurate means to sense the current flow in power conductors.

The external load applied to the secondary of a CT is called the burden (or load). Default burden resistors RA1/RA2 connected to the CT are each 1.62Ω (1%) for a total burden resistance of 3.24Ω. As an example, when used with a 2000:1 ratio CT, a 240 Arms primary current would develop the max input voltage of 0.55 Vpk (240 Arms × √2 × 3.24Ω/2000 = 0.55 Vpk).

Attention: This burden resistor is sometimes integrated inside the Current Transformer.

⚠WARNING An open circuit in a CT can cause a dangerous overvoltage at the secondary terminals of the CT. Ensure that the burden resistor is connected (or integrated inside the CT), and do not remove the protective diodes D12, D13, D14, D15, D16, D17, D18 and D19.

Figure 3-16. IPx and INx Current Sense Schematic when Using CT



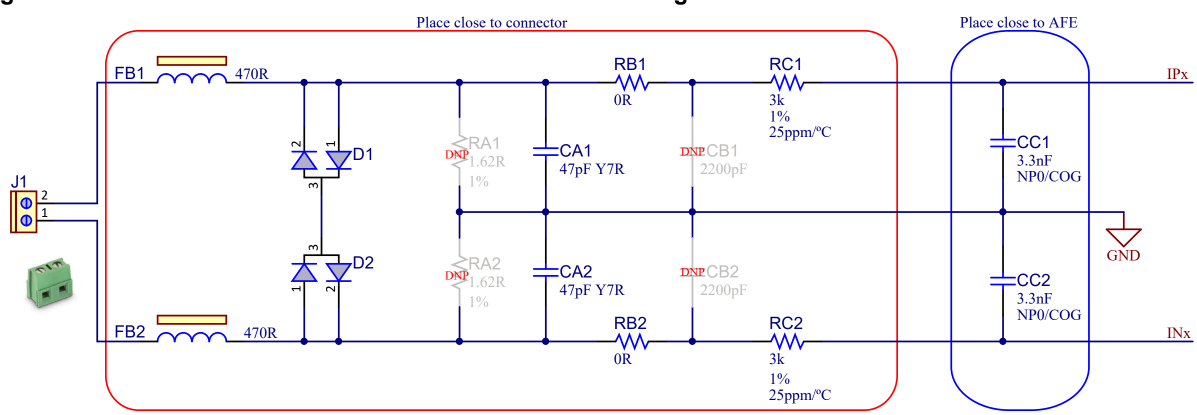
An anti-aliasing filter is required for band-limiting the input signals. Typically, a single-pole RC filter is sufficient for metrology applications. For CT operation, the filter must be tuned with the following component values:

- RA1, RA2 = 1.62Ω, 1%, 25 ppm/ºC
- RB1, RB2 = 0Ω
- RC1, RC2 = 3 kΩ, 1%, 25 ppm/ºC
- CA1, CA2 = 47 pF Y7R
- CB1, CB2 = Do Not Populate
- CC1, CC2 = 3.3 nF NP0/COG
- D1, D2 = Si Junction diodes

3.3.5.3.2 Current Sensor Inputs Configuration when Using Shunt

The Shunt Resistor technique uses a small (shunt) resistor placed in the path of the load current. When the load current flows through this resistance, a small voltage drop is developed across it. This voltage drop is measured by an input of the AFE, which converts it into the corresponding current consumption.

Figure 3-17. IPx and INx Current Sense Schematic when Using Shunt



⚠WARNING A shunt resistor must be placed in series with the line to be measured, then connected to the measurement inputs. The demonstration board is referred to neutral; therefore, a shunt resistor can only be used in the neutral line. Using a shunt resistor to measure currents in lines 1, 2 or 3 will damage the board, and it is dangerous for the user.

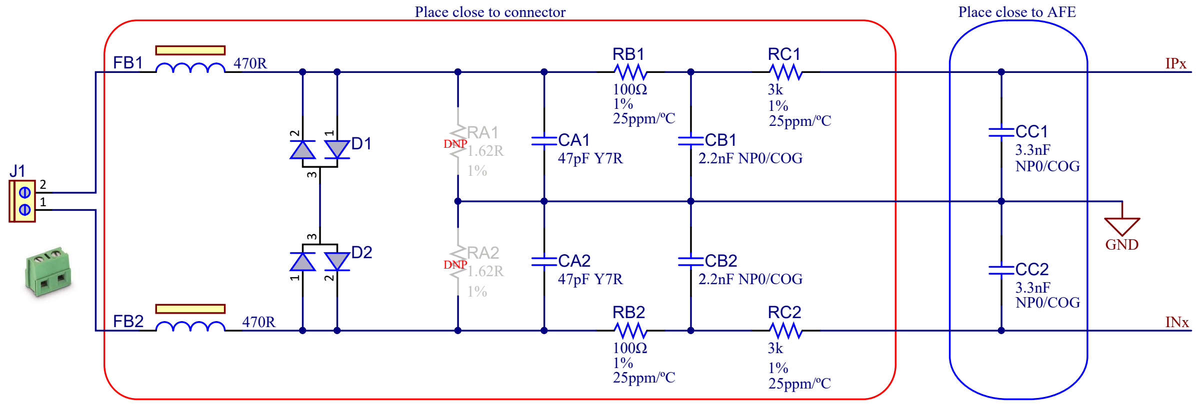
For Shunt operation, the input network must only provide a first-order low-pass filter. The filter must be tuned with the following component values:

- RA1, RA2 = Do Not Populate
- RB1, RB2 = 0Ω
- RC1, RC2 = 3 kΩ, 1%, 25 ppm/ºC
- CA1, CA2 = 47 pF Y7R
- CB1, CB2 = Do Not Populate
- CC1, CC2 = 3.3 nF NP0/COG
- D1, D2 = Si Junction diodes (recommended)

3.3.5.3.3 Current Sensor Inputs Configuration when Using Rogowski Coil

The Rogowski Coil is a sensor used for the measurement of the current. This class of coils achieves very good results even for currents with a large variation range. However, they generate an output signal in the time-differentiated form. In this case, an integrator function (available in the Microchip metrology library running in Core 1) must be added to get the corresponding current value.

Figure 3-18. IPx and INx Current Sense Schematic when Using Rogowski Coil



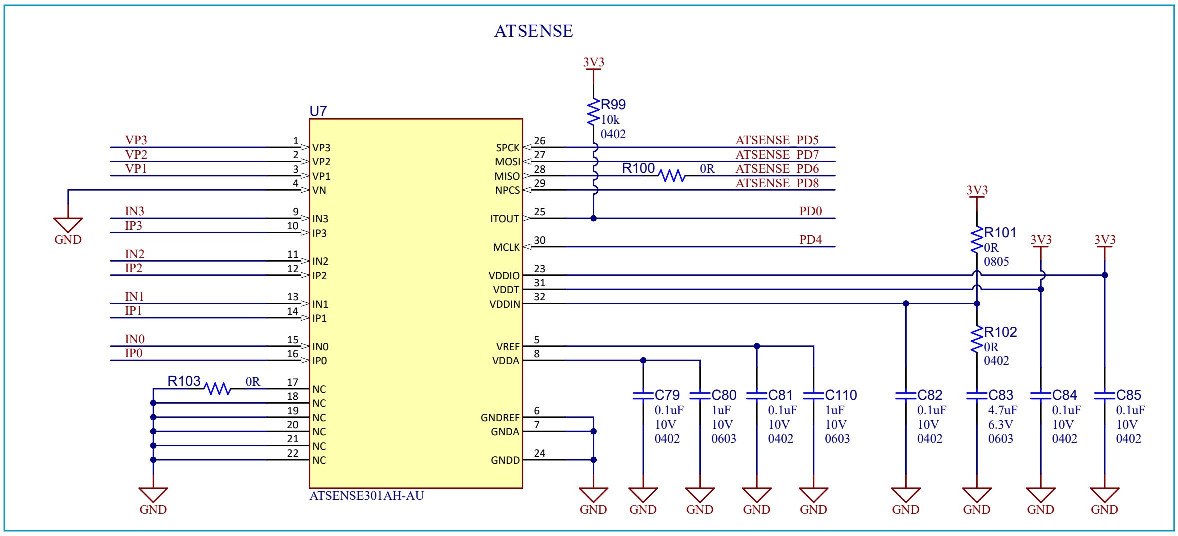
When using Rogowski coils for current sensing, a two pole anti-aliasing filter must be mounted. The filter must be tuned with the following component values:

- RA1, RA2 = Do Not Populate
- RB1, RB2 = 100Ω, 1%, 25 ppm/ºC
- RC1, RC2 = 3 kΩ, 1%, 25 ppm/ºC
- CA1, CA2 = 47 pF Y7R
- CB1, CB2 = 2.2 nF NP0/COG
- CC1, CC2 = 3.3 nF NP0/COG
- D1, D2 = Si Junction diodes (recommended)

3.3.6 ATSENSE301 Interfacing

ATSENSE-301 (H) is a multi-channel analog front end device that integrates seven simultaneously sampled Sigma-Delta A/D converters, a high-precision voltage reference with up to 10 ppm/ºC temperature stability (H-versions), a programmable current signal amplification, a temperature sensor and an SPI interface. Designed to support energy measurement applications in combination with the Microchip's PIC32CXMTC device family that features two dedicated Cortex-M4F processors and metrology library and a variety of sensors including Shunt, Current Transformer and Rogowski coils, the ATSENSE-301(H) achieves ANSI C12.20-2002 and IEC 62053-22 metering accuracy classes of up to 0.2% over 3000:1 current range.

Figure 3-19. ATSENSE301 Schematic



ATSENSE301 needs external capacitors for supplies decoupling. Capacitors must be placed as close as possible to the component.

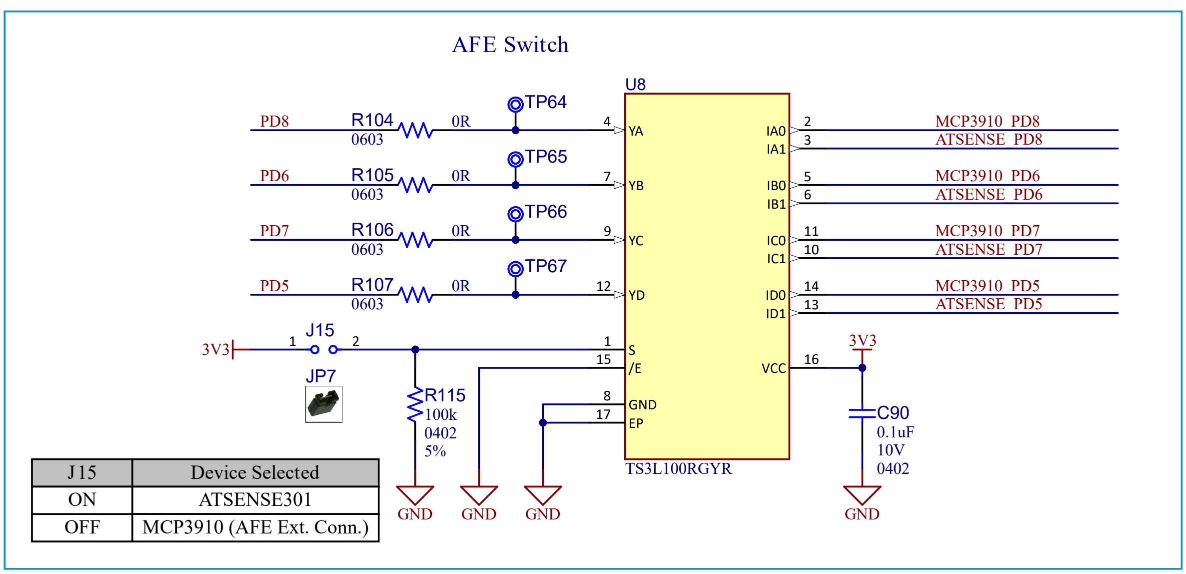
For more information, refer to the ATSENSE-301 (H) Data Sheet.

3.3.6.1 External AFE Interface

MCSPI Interface is shared between ATSENSE (Default Mode) and external AFE such as MCP3910 device. The MCP3910 is a 3V dual channel Analog-Front-End (AFE) containing two simultaneous sampling Delta-Sigma Analog-to-Digital Converters (ADC), two PGAs, phase delay compensation block, internal voltage reference, modulator output block, and high speed 20 MHz SPI compatible serial interface. For poly-phase shunt-based energy meters, the MCP3910 2-wire serial interface greatly reduces system cost by requiring only a single bidirectional isolator per phase. The MCP3910 is capable of interfacing with a variety of voltage and current sensors, including shunts, current transformers, Rogowski coils and Hall effect sensors.

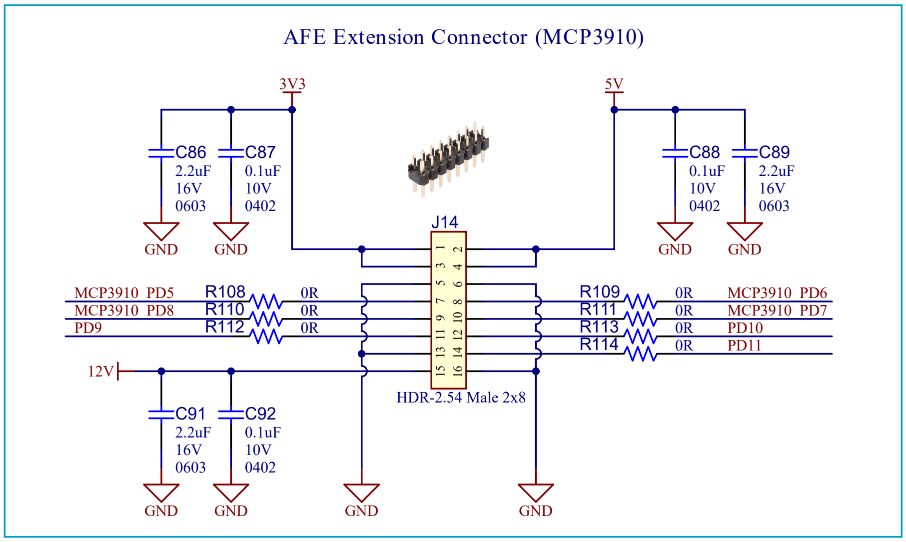
A switch allows redirection of the MCSPI signals to an external connector. A shunt on J15 enables the AFE desired.

Figure 3-20. AFE Switch Schematic



J15	Device Selected
ON	ATSENSE301
OFF	MCP3910 (AFE Ext. Conn.)

Figure 3-21. AFE Extension Connector Schematic



For more information about the AFE Extension Connector, refer to Table 3-8 or to the MCP3910 ADC Evaluation Board webpage.

3.4 Hardware Description – Interface and Peripherals

3.4.1 Isolated UART to USB Interface

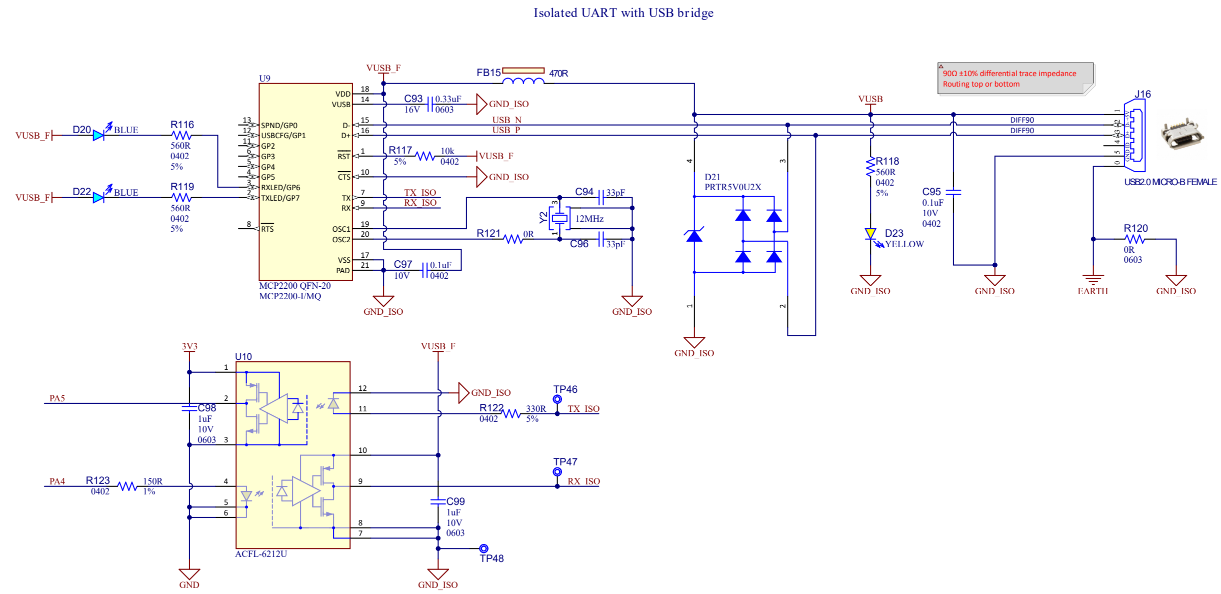
The PIC32CXMTC-DB features an isolated UART to USB bridge by means of micro USB type B connector (J16). This MCP2200 device is used to convert the UART signal to USB levels to ease PC connectivity (USB 2.0, full speed) for debugging purposes or to communicate with the application. For more information, refer to the MCP2200 Data Sheet.

Important: For the proper function of the MCP2200, an initial configuration was achieved for this board design: Enable TX/RX LEDs and invert UART Polarity (UPOL). MCP2200 was configured using the configuration utility tool or the DLL provided in the MCP2200 webpage. No further action by the user is required.

There are two blue LEDs that show the USB activity (D20 shows RX messages and D22 shows TX messages).

A high-speed optocoupler provides the isolation between the board connected to mains and the USB host.

Figure 3-22. Debug UART over USB Circuit



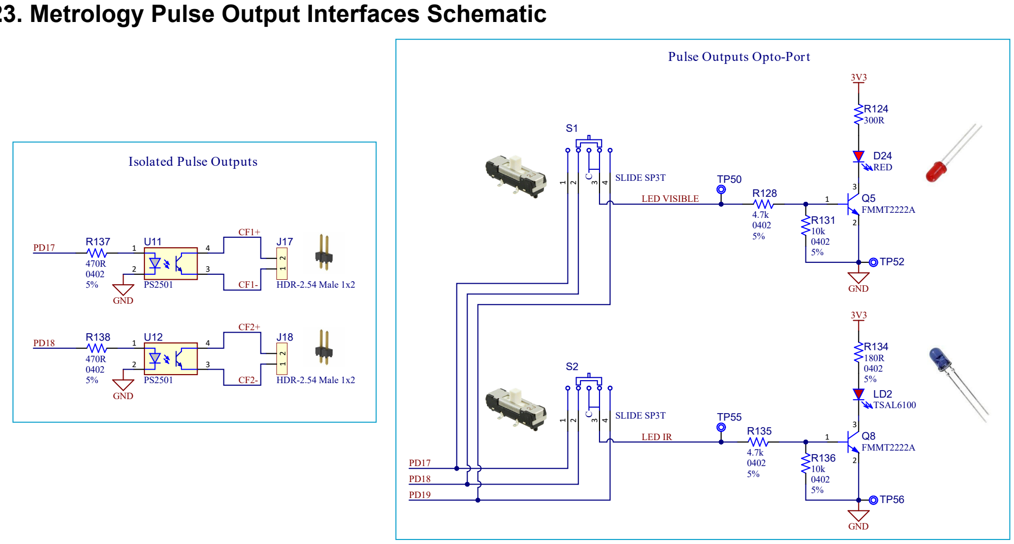
Tip: The drivers necessary to download according to your Operating System are located here: MCP2221 Windows Driver.

3.4.2 Metrology Pulses Outputs and UART Opto-Port Interface

The PIC32CXMTC-DB board integrates several measurement points for the pulse outputs (PD17, PD18 and PD19) available with the PIC32CXMTC device. The methods for pulse measurements are:

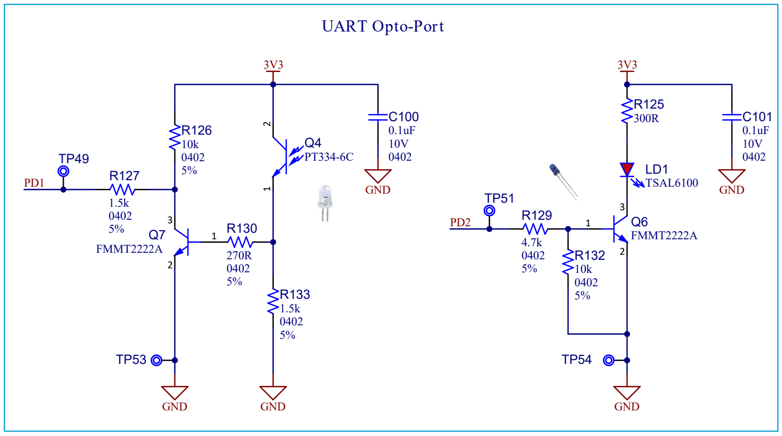
- Isolated Pulse Outputs: Wh, VARh and A^{2}h pulses can be measured (with isolation) on J17 or J18 connectors in Differential mode. They are isolated from mains.
- Opto-Port Pulse Outputs: a red LED (D24) and an infrared LED (LD2) allow measurement of the Wh, VARh and A^{2}h pulses by means of switching a slide switch (S1 or S2 depending on the LED).
- Non-Isolated Pulse Outputs: the test points TP50 and TP55 allow measurement of the pulses directly (not isolated) in Single-ended mode.

Figure 3-23. Metrology Pulse Output Interfaces Schematic



The PIC32CXMTC-DB board features a UART Opto-port interface, made up of an infrared emitting diode and a phototransistor, to communicate with external devices during handheld AMR (Automatic Meter Reading).

Figure 3-24. UART through Opto-Port Interface Schematic

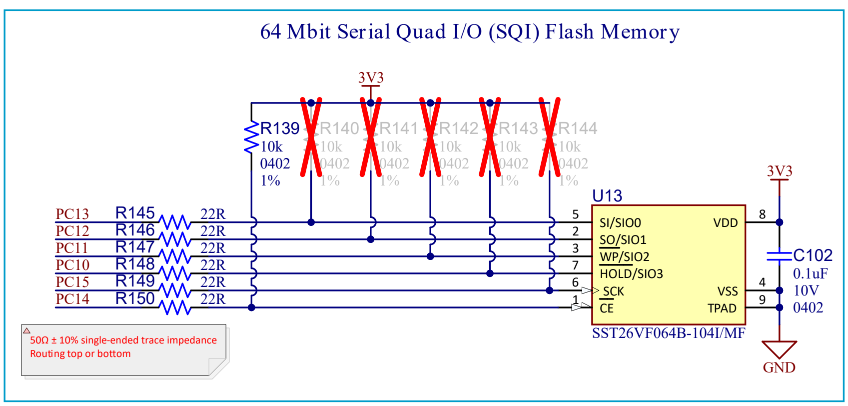


3.4.3 QSPI Flash Memory

The PIC32CXMTC-DB board features one Quad Serial Peripheral Interface (QSPI) 64-Mbit Flash memory SST26VF064B-104I/MF, U13. The SST26VF064B SQI Flash device utilizes a 4-bit multiplexed I/O serial interface to boost performance at low power while maintaining full command-set compatibility to traditional Serial Peripheral Interface (SPI) protocols. The four bus signals are a clock input (SCK), a serial data input (SI), a serial data output (SO) and a chip select (CE#). For more information about SST26VF064B, refer to the SST26VF064B product webpage.

The QSPI bus is a synchronous serial data link that provides communication with external devices in Host mode. The QSPI can be used in SPI mode to interface with serial peripherals (such as ADCs, DACs, LCD controllers, CAN controllers and sensors) or in Serial Memory mode to interface with serial Flash memories. With the support of the Quad SPI protocol, the QSPI allows the system to use high-performance serial Flash memories, which are small and inexpensive, instead of larger and more expensive parallel Flash memories.

Figure 3-25. QSPI Flash Memory Schematic



3.4.4 LCD Display

The PIC32CXMTC-DB integrates an LCD customized for the smart metering application field. This LCD is driven directly by the PIC32CXMTC generating the driving signals for the 8 common lines and the 20 segments. The LCD layout and its relative pinout are described below:

Figure 3-26. LCD Layout

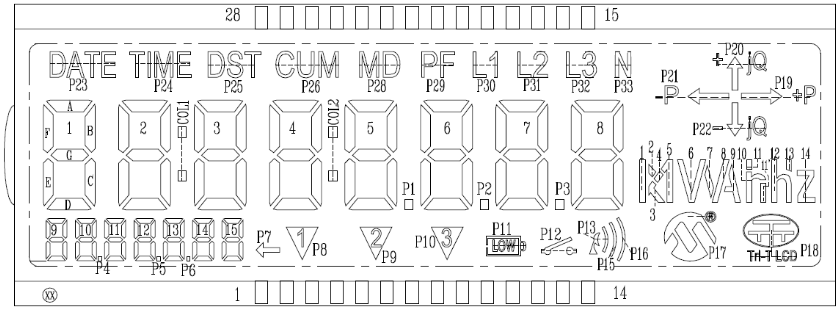


Figure 3-27. LCD Schematic

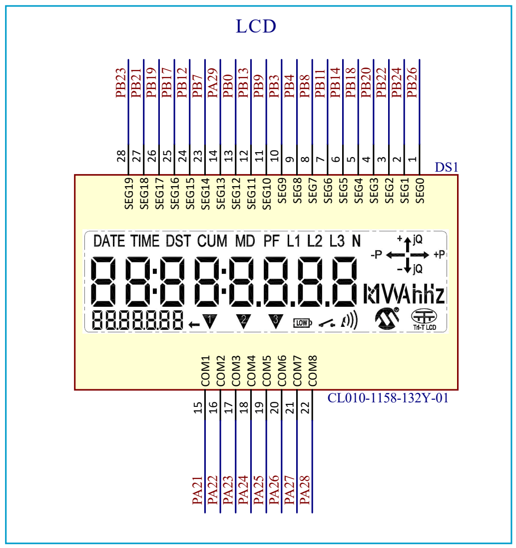


Table 3-20. LCD Pinout

Pin No	Pin Name	PIO	Pin No	Pin Name	PIO
1	Segment 0	PB26	15	COM1	PA21
2	Segment 1	PB24	16	COM2	PA22
3	Segment 2	PB22	17	COM3	PA23
4	Segment 3	PB20	18	COM4	PA24
5	Segment 4	PB18	19	COM5	PA25
6	Segment 5	PB14	20	COM6	PA26
7	Segment 6	PB11	21	COM7	PA27
8	Segment 7	PB8	22	COM8	PA28
9	Segment 8	PB4	23	Segment 14	PB7
10	Segment 9	PB3	24	Segment 15	PB12
11	Segment 10	PB9	25	Segment 16	PB17
12	Segment 11	PB13	26	Segment 17	PB19
13	Segment 12	PB0	27	Segment 18	PB21
14	Segment 13	PA29	28	Segment 19	PB23

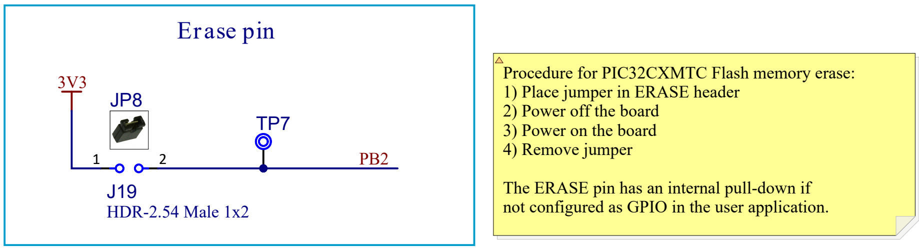
Table 3-21. LCD Pinout vs Segment

PIN	COM1	COM3	COM3	COM4	COM5	COM6	COM7	COM8
1	15A	15B	15F	15G	15C	15E	15D	P8
2	14A	14B	14F	14G	14C	14E	14D	P7
3	13A	13B	13F	13G	13C	13E	13D	P6
4	12A	12B	12F	12G	12C	12E	12D	P5
5	11A	11B	11F	11G	11C	11E	11D	—
6	10A	10B	10F	10G	10C	10E	10D	P4
7	9A	9B	9F	9G	9C	9E	9D	—
8	P2	6D	6C	6E	6G	6B	6F	6A
9	P3	7D	7C	7E	7G	7B	7F	7A
10	P9	8D	8C	8E	8G	8B	8F	8A
11	P10	P11	P12	P13	P15	P16	P17	—
12	8	7	6	5	4	3	2	1
13	P18	9	11	10	11’	12	13	14
14	P30	P31	P32	P33	P20	P19	P21	P22
15	COM1	—	—	—	—	—	—	—
16	—	COM2	—	—	—	—	—	—
17	—	—	COM3	—	—	—	—	—
18	—	—	—	COM4	—	—	—	—
19	—	—	—	—	COM5	—	—	—
20	—	—	—	—	—	COM6	—	—
21	—	—	—	—	—	—	COM7	—
22	—	—	—	—	—	—	—	COM8
23	—	—	P29	P28	P26	P25	P24	P23
24	P1	5D	5C	5E	5G	5B	5F	5A
25	COL2	4D	4C	4E	4G	4B	4F	4A
26	—	3D	3C	3E	3G	3B	3F	3A
27	COL1	2D	2C	2E	2G	2B	2F	2A
28	—	1D	1C	1E	1G	1B	1F	1A

3.4.5 Chip Erase

The 1x2 pin-header J19 labelled as “ERASE” is connected to the PIC32CXMTC erase pin (PB2) and 3.3V. This header can be used to reinitialize the Flash content (and some of its NVM bits) to an erased state (all bits read as logic level 1) by placing a shunt (JP8) on the header, powering down and powering up the board. After a while, it is recommended that the ERASE jumper be removed. Refer to the PIC32CXMTC Data Sheet for more information.

Figure 3-28. Erase Pin Schematic



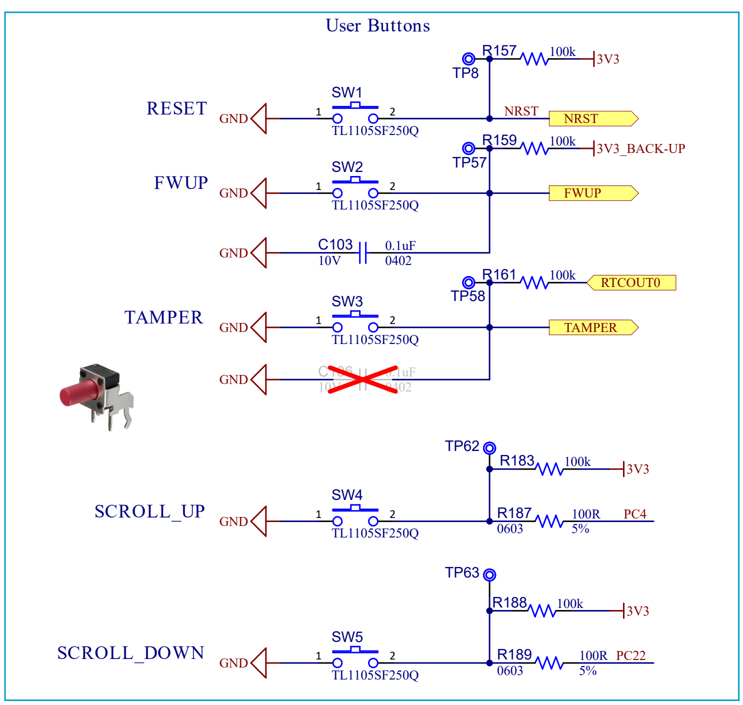
The ERASE status can be monitored through the TP7 test point.

3.4.6 User Buttons

The PIC32CXMTC-DB board is equipped with five user buttons. The push buttons consist of momentary push button switches mounted directly on the board. When any switch is depressed, it will cause low (zero) to appear at the associated input pin.

- Reset. Besides the reset conditions managed by the Reset Controller peripheral of the PIC32CXMTC, such as Power-on Reset and brown-out monitor, a user can manually reset the PIC32CXMTC by using the Reset push button, SW1.
- Force Wake-Up. Wake up from Backup mode can be done through the Force Wake-up (FWUP) pin by pushing the push button, SW2.
- Tamper. Tamper button SW3 allows simulating a tampering event. This pin can also be used as a wake-up function.
- Scroll-Up and Scroll-Down. Scroll-Up and Scroll-Down buttons SW4 and SW5 are used in the pre-programmed Demo Meter application to navigate through the menu.

Figure 3-29. Buttons Schematic

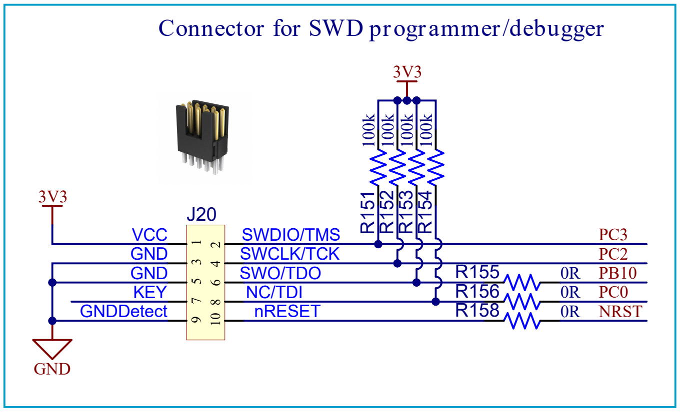


3.4.7 JTAG/SWD Interface

The PIC32CXMTC-DB board includes a SWD (Serial Wire Debug)/JTAG interface port to provide debug level access to the system-on-chip. It also embeds a serial wire trace. This connector provides the required interface for in-circuit emulators, like the Microchip J-32 Debug Probe, J-Link Debug Probe, MPLAB® PICKit™ 4 or the MPLAB® ICD 4 (the Debugger Adapter Board is necessary for the MPLAB In-Circuit Debuggers) supporting the connected PIC32CXMTC device. The SW-DP/JTAG port is a 10-pin, dual-row, 0.05-inch male connector (J20). To use an in-circuit emulator with 20-pin JTAG port, the JTAG adapter for 20 to 10 pins included in the kit may be required.

Refer to the PIC32CXMTC Data Sheet for a further description of the SWD debug port.

Figure 3-30. SWD Connection Schematic



⚠WARNING	The board is not isolated from mains, so it is very important to provide proper isolation when using the SWD interface with an external probe. See the next paragraph for more information.

In-circuit emulator connection scheme:

- Through a USB Isolator when the PIC32CXMTC-DB is powered directly from mains (see Figure 3-31) and/or Vsense inputs are connected.
- Directly to the SWD connector when the PIC32CXMTC-DB is powered through an AC/DC Wall Adapter (see Figure 3-32) and Vsense inputs are not connected. The entire board is isolated from mains.

Figure 3-31. J-32 Debug Probe Connection Scheme (Mains Source)

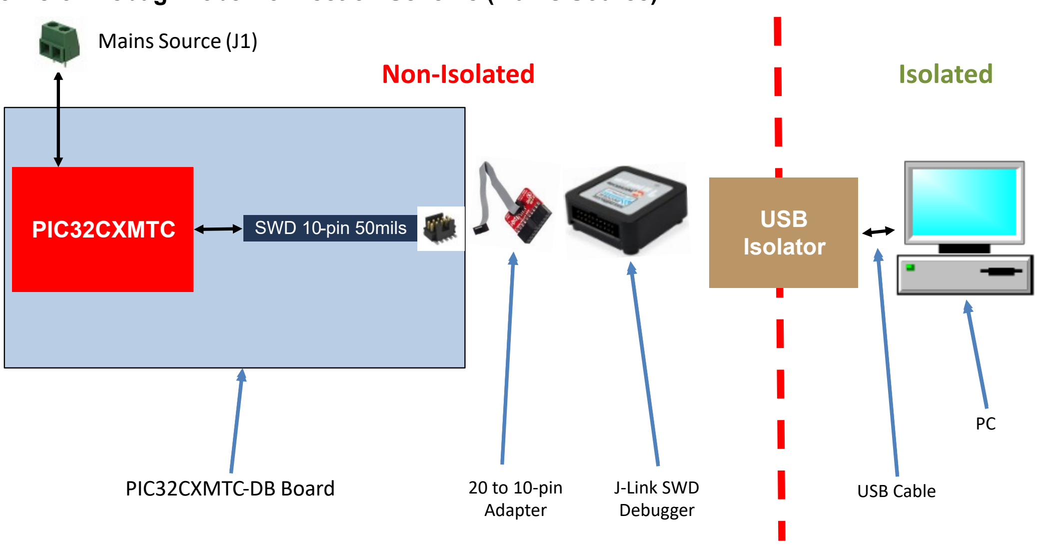
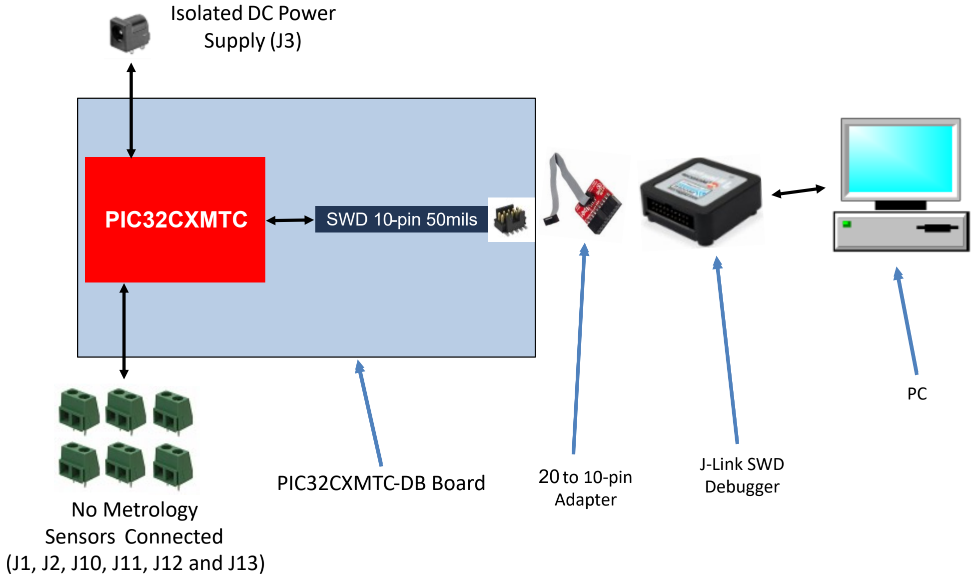


Figure 3-32. J-32 Debug Probe Connection Scheme (ACDC Wall Adapter Source)



Attention: Note that neither the in-circuit emulator nor the USB isolator are included in the PIC32CXMTC-DB kit.

3.4.8 Xplained PRO Extension Header

The PIC32CXMTC-DB hosts a dual-row, 20-pin male connector (J23) to interface with standard Xplained PRO extension boards. The Xplained PRO connector is Microchip's proprietary interface port intended to connect different evaluation platforms from AVR and Arm microcontrollers. Refer to Table 3-14 for more information about the connector.

The power header, J22, can be used as supply for extension boards. Refer to Table 3-13 for more information about the connector.

Figure 3-33. Xplained PRO Headers Schematic

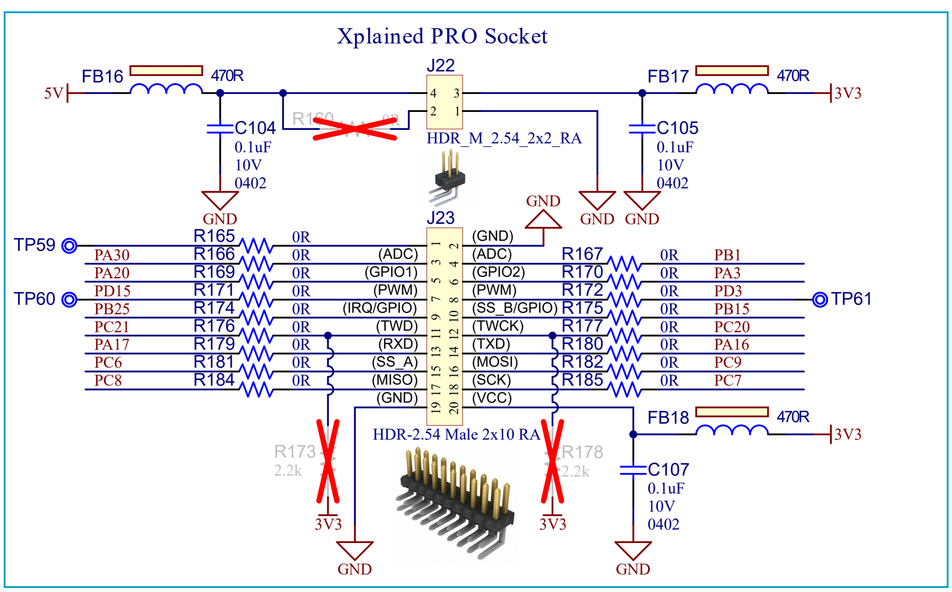


Table 3-22. Xplained PRO Extension Header Pin Assignment

Pin No	Signal	PIO	Pin No	Signal	PIO
1	—	—	2	GND	GND
3	ADC+	PA30	4	ADC-	PB1
5	GPIO1	PA20	6	GPIO2	PA3
7	PWM+	PD15	8	PWM-	PD3
9	IRQ/GPIO	PB25	10	SS/GPIO	PB15
11	TWD	PC21	12	TWCK	PC20
13	RXD	PA17	14	TXD	PA16
15	SS	PC6	16	MOSI	PC9
17	MISO	PC8	18	SCK	PC7
19	GND	GND	20	VCC	3V3

⚠WARNING The Xplained PRO connector is not isolated from mains.

The Xplained PRO connector allows the connection of a wide range of modules. Typically, the electricity meters require communications capabilities, which could be added by connecting RF or PLC modules, such as the ATREB215-XPRO or PL460-EK kits from Microchip.

3.4.9 mikroBUS Socket

The PIC32CXMTC-DB hosts a mikroBUS socket (J28). The mikroBUS standard defines the main board sockets and add-on boards used for interfacing the microprocessor with integrated modules featuring a proprietary pin configuration. For details, refer to the mikroBUS specification.

Figure 3-34. mikroBUS Interface Schematic

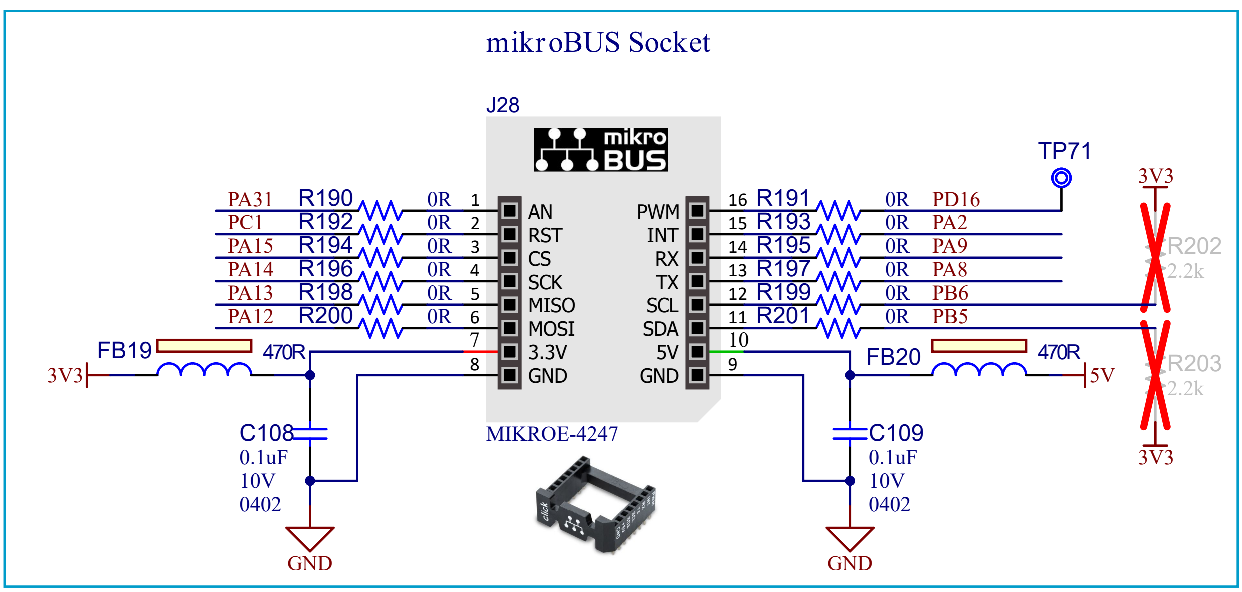


Table 3-23. mikroBUS Connector Pin Assignment

Pin No	Signal	PIO	Pin No	Signal	PIO
1	AN	PA31	16	PWM	PD16
2	RST	PC1	15	INT	PA2
3	CS	PA15	14	RX	PA9
4	SCK	PA14	13	TX	PA8
5	MISO	PA13	12	SCL	PB6
6	MOSI	PA12	11	SDA	PB5
7	+3.3V	3V3	10	+5V	5V
8	GND	GND	9	GND	GND

⚠WARNING The mikroBUS connector is not isolated from mains.

The mikroBUS connector allows for the connection of a wide range of modules for communications, sensoring or power management applications out of the main scope for this board.

3.4.10 Expansion Connector

The PIC32CXMTC-DB hosts an expansion connector, 8-pin male connector (J24) to have the FLEXCOM6 signals available. Refer to the PIC32CXMTC Data Sheet for more information.

Figure 3-35. Expansion Connector Schematic

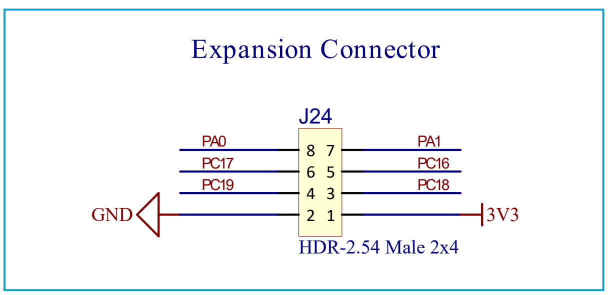


Table 3-24. Expansion Connector Pin Assignment

Pin No	Signal	PIO	Pin No	Signal	PIO
1	+3.3V	3V3	2	GND	GND
3	FLEXCOM6_IO2 (SPCK)	PC18	4	FLEXCOM6_IO3 (CS0)	PC19
5	FLEXCOM6_IO0 (MOSI)	PC16	6	FLEXCOM6_IO1 (MISO)	PC17
7	FLEXCOM6_IO1 (RX)	PA1	8	FLEXCOM6_IO0 (TX)	PA0

⚠WARNING The expansion connector is not isolated from mains.

4. Ordering Information

Table 4-1. Demo Board Ordering Information

Ordering Code	Board Marking
EV58E84A	PIC32CXMTC-DB

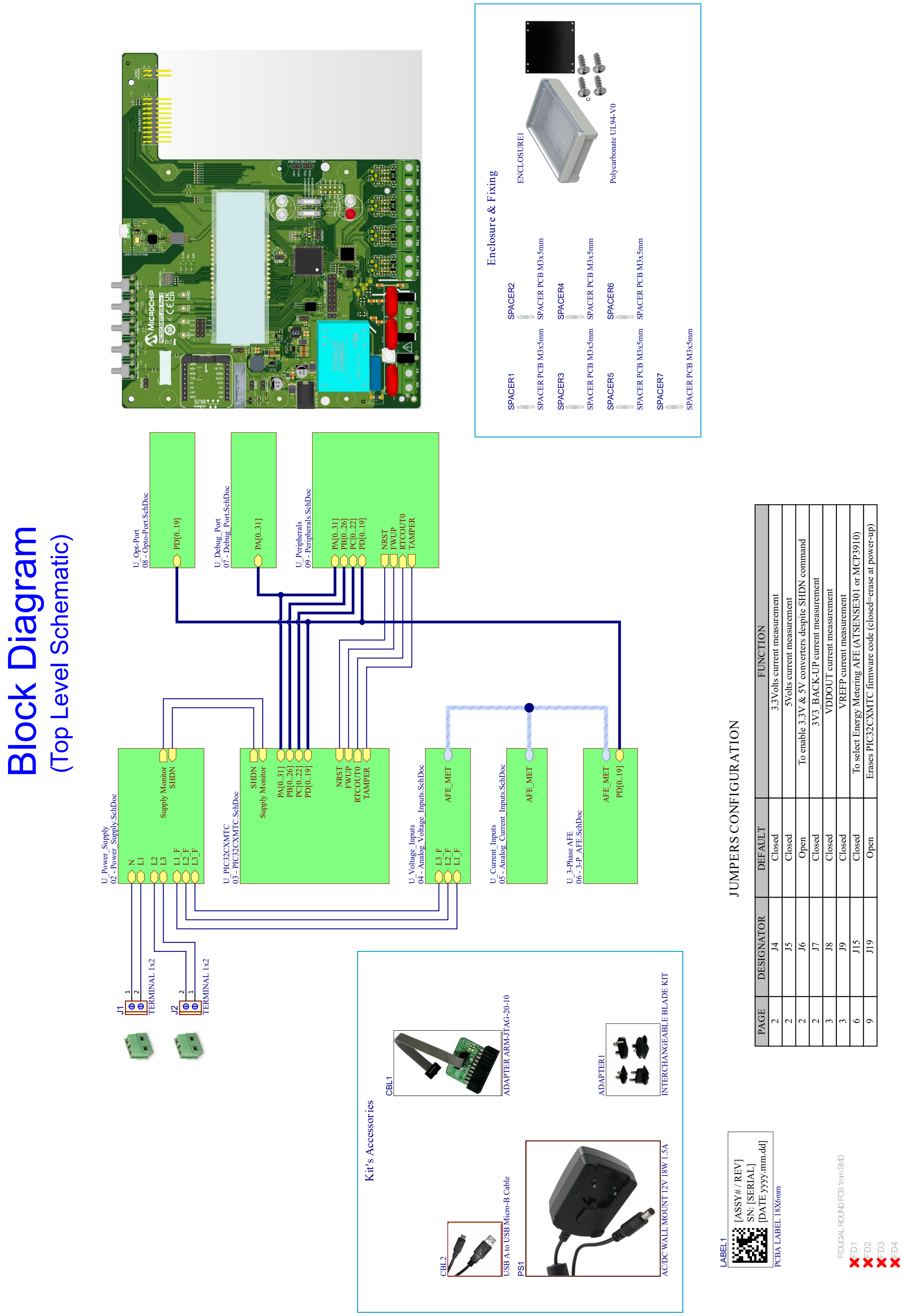
5. Appendix. Schematics and Layouts

5.1 PIC32CXMTC-DB Schematics

This section contains the following schematics for the PIC32CXMTC-DB board:

- Block Diagram Schematic, Figure 5-1
- Power Supply Schematic, Figure 5-2
- PIC32CXMTC Schematic, Figure 5-3
- Analog Voltage Inputs Schematic, Figure 5-4
- Analog Current Inputs Schematic, Figure 5-5
- Energy Metering Analog Front End Schematic, Figure 5-6
- Debug Port Schematic, Figure 5-7
- Opto-Ports Schematic, Figure 5-8
- Interface and Peripherals PIC32CXMTC Schematic, Figure 5-9

Figure 5-1. Block Diagram Schematic



JUMPERS CONFIGURATION

PAGE	DESIGNATOR	DEFAULT	FUNCTION
2	J4	Closed	3.3Volts current measurement
2	J5	Closed	5Volts current measurement
2	J6	Open	To enable 3.3V & 5V converters despite SHDN command
2	J7	Closed	3V3_BACK-UP current measurement
3	J8	Closed	VDDOUT current measurement
3	J9	Closed	VREFP current measurement
6	J15	Closed	To select Energy Metering AFE (ATSENSE301 or MCP3910)
9	J19	Open	Erases PIC32CXMTC firmware code (closed=erase at power-up)

Figure 5-2. Power Supply Schematic

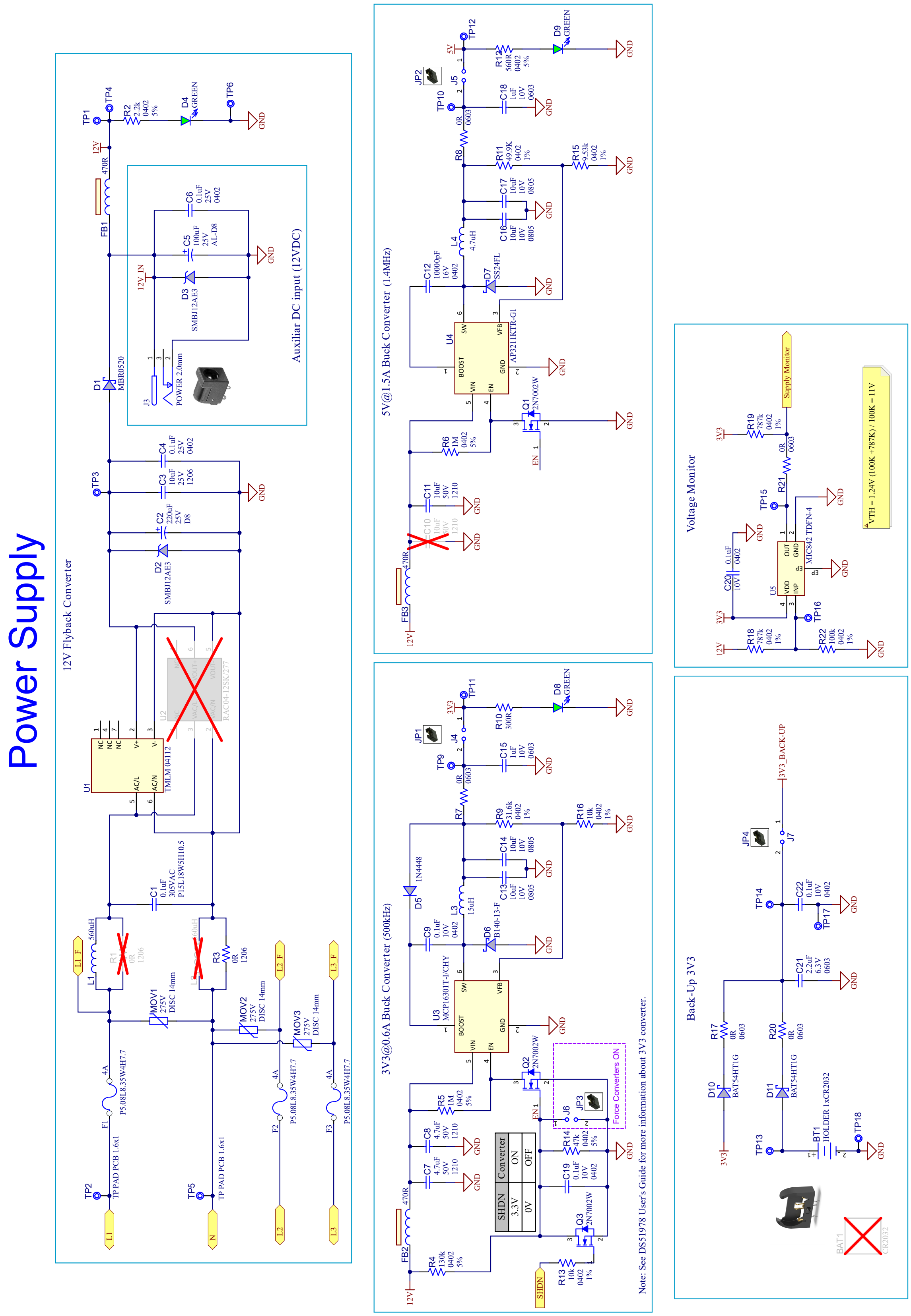


Figure 5-3. PIC32CXMTC Schematic

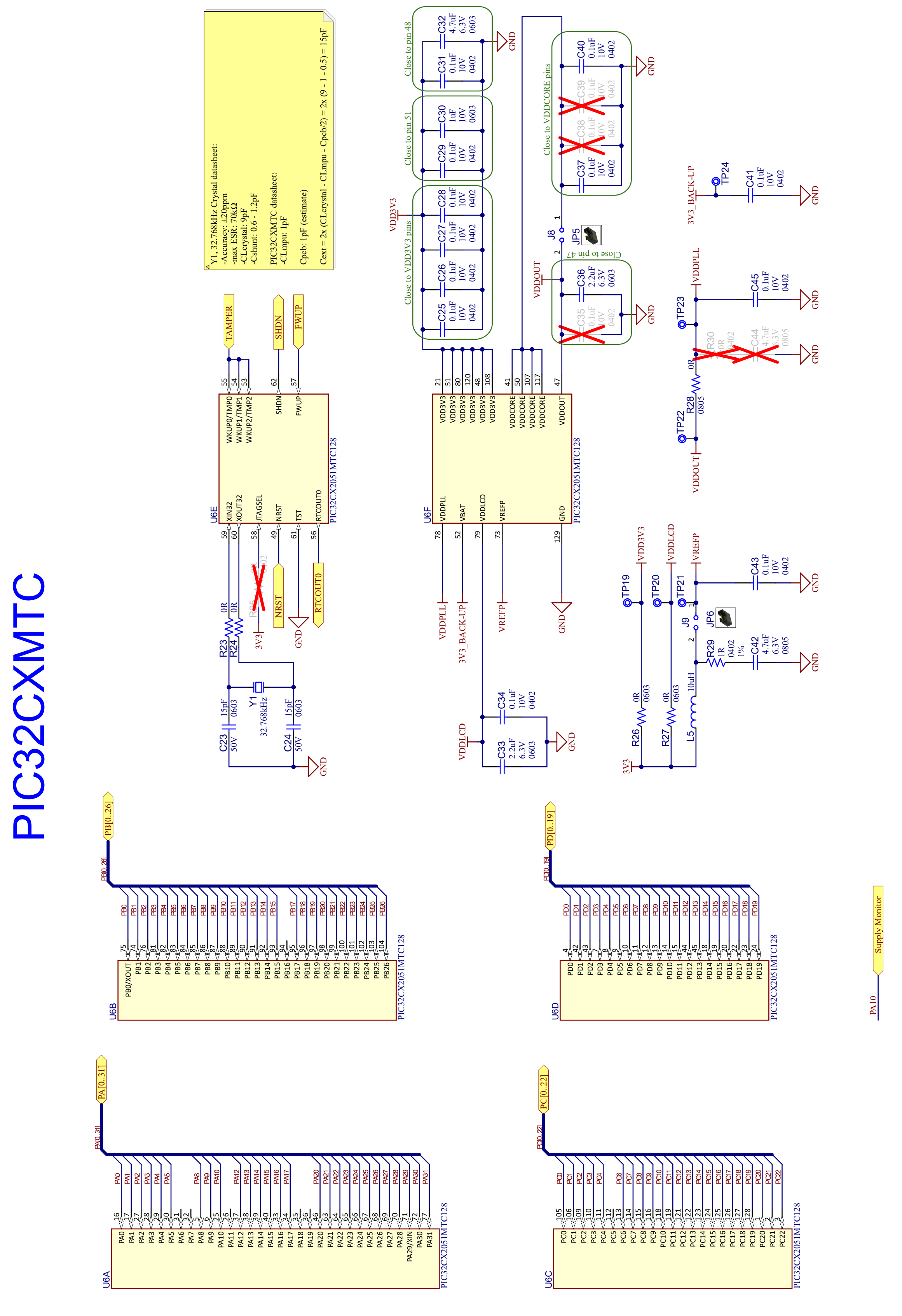


Figure 5-4. Analog Voltage Inputs Schematic

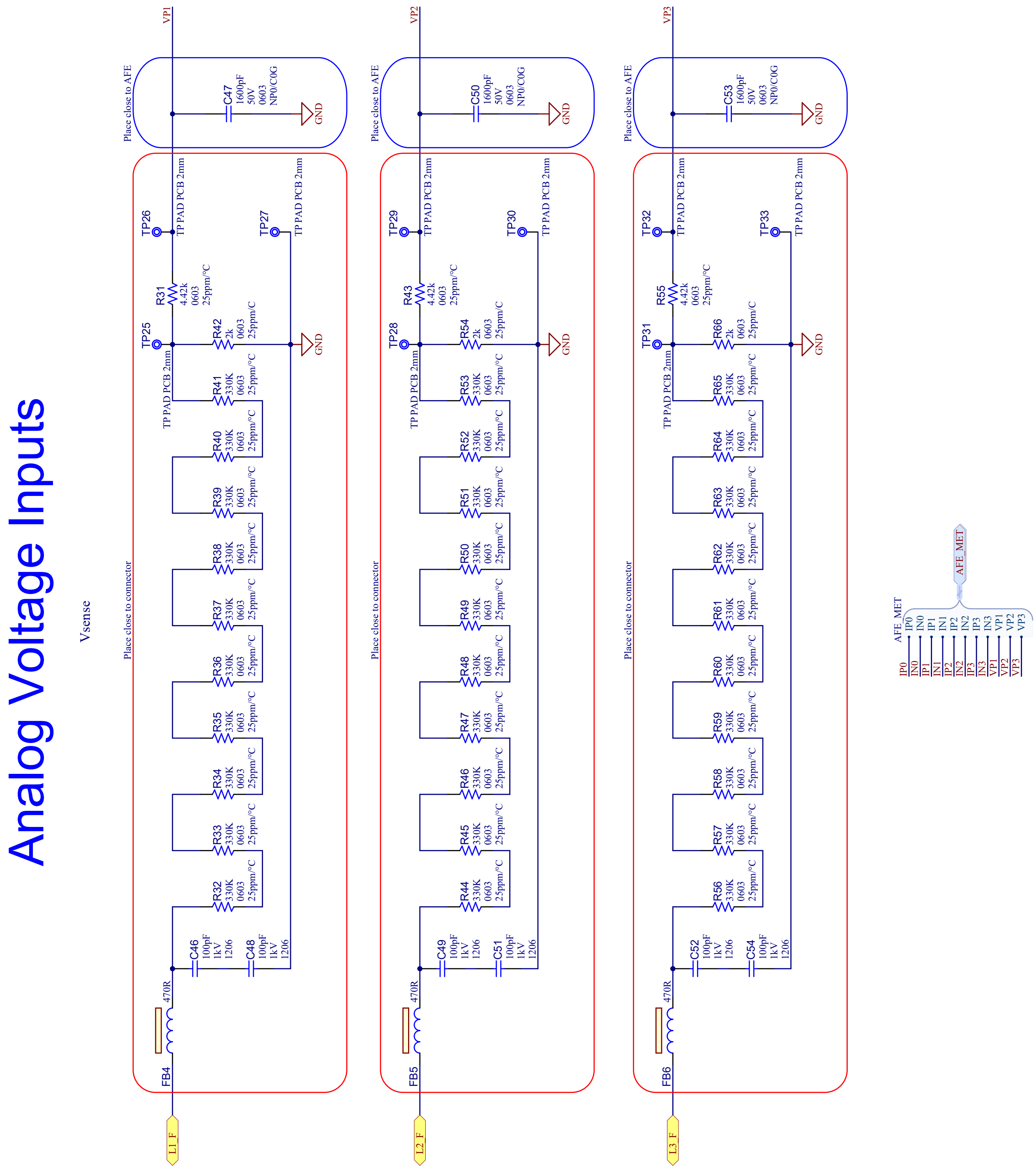


Figure 5-5. Analog Current Inputs Schematic

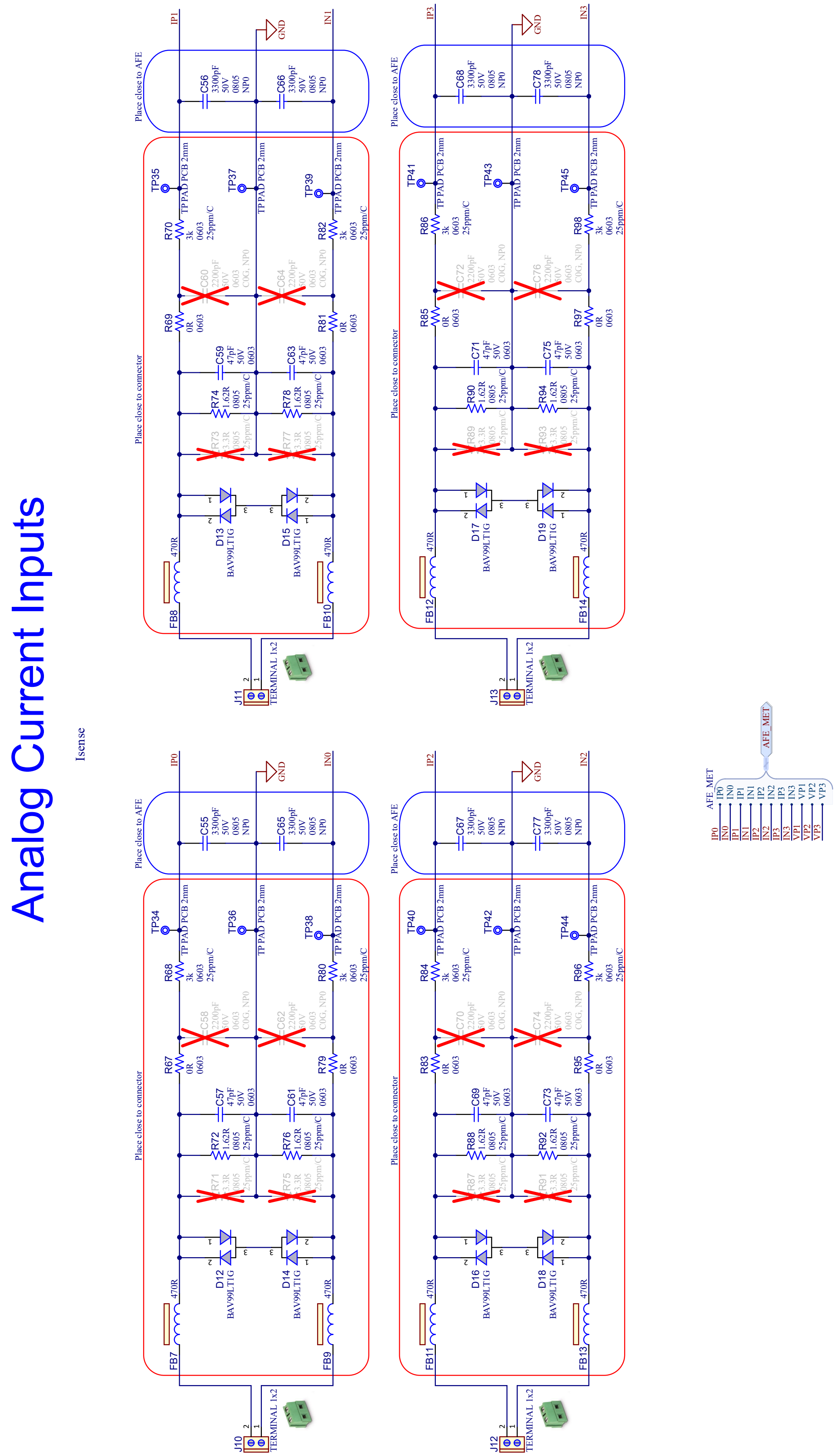


Figure 5-6. Energy Metering Analog Front End Schematic

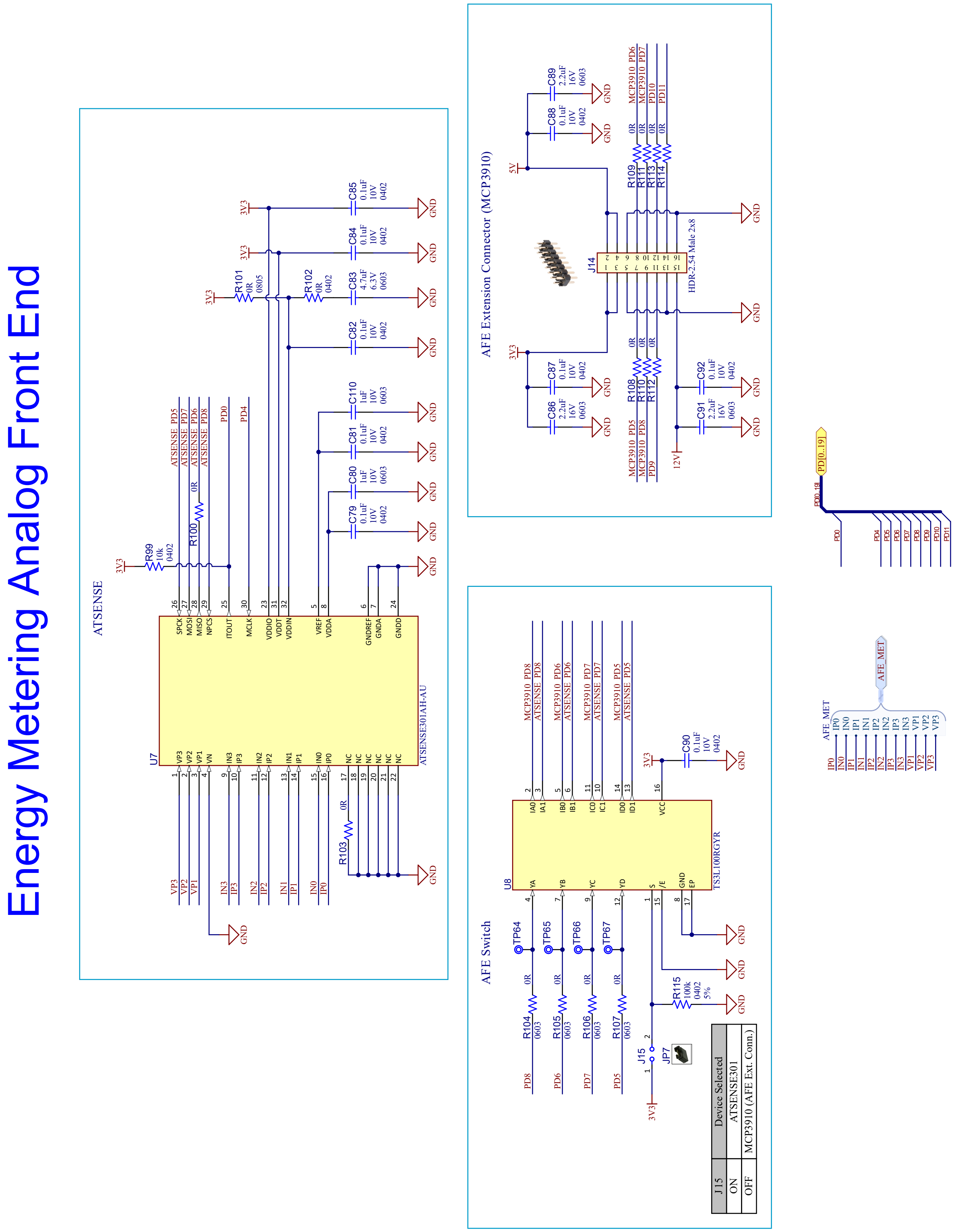


Figure 5-7. Debug Port Schematic

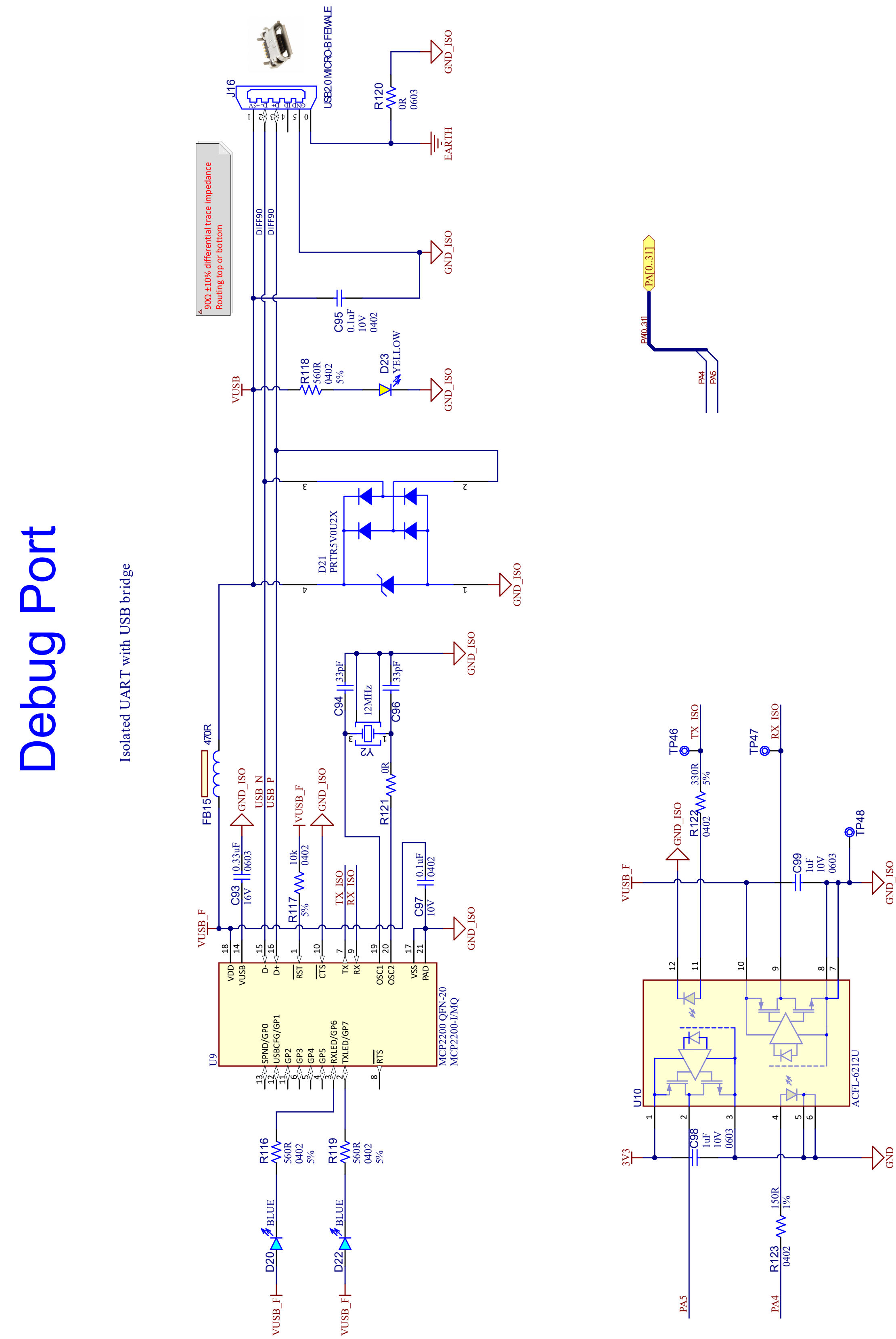


Figure 5-8. Opto-Ports Schematic

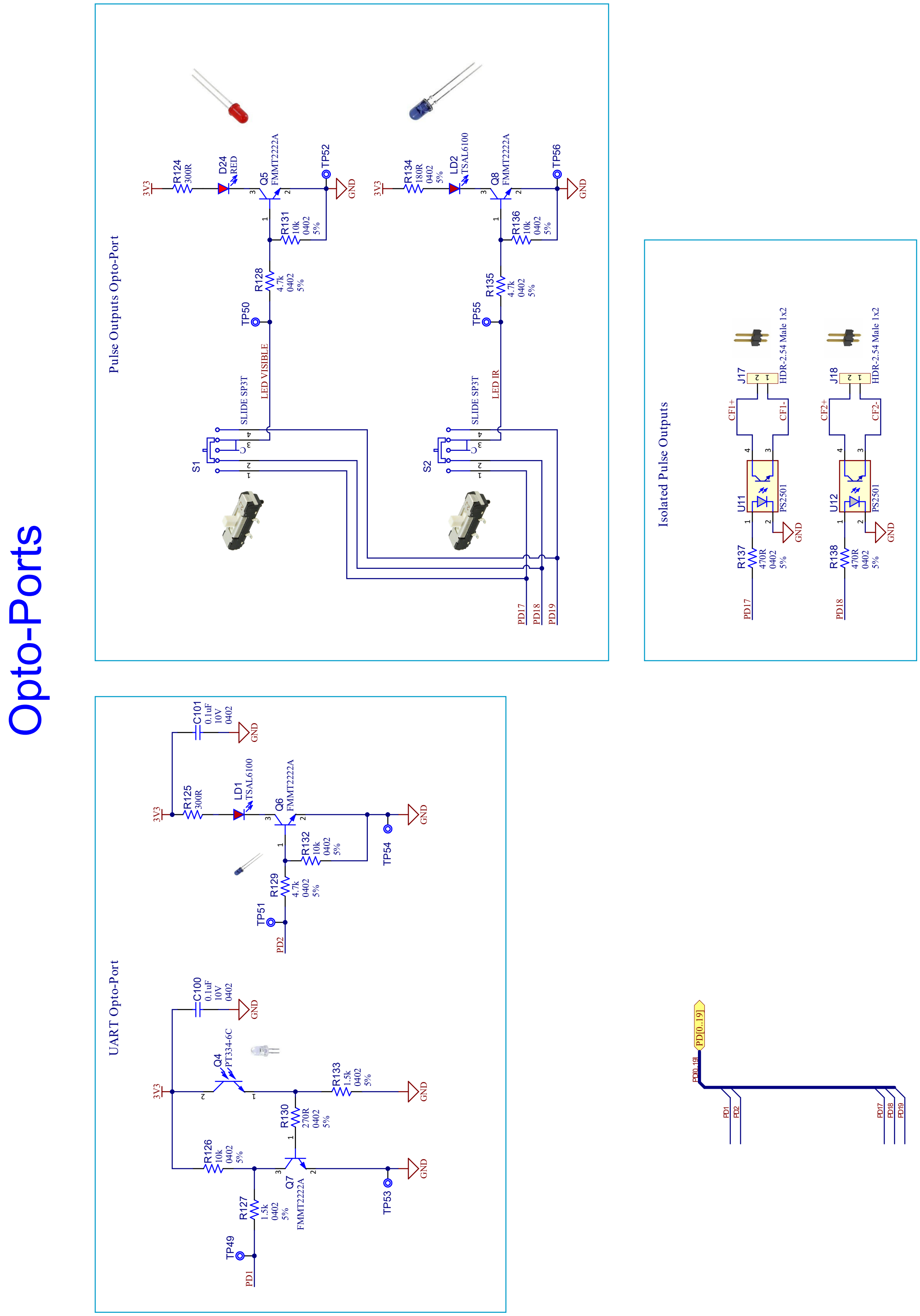
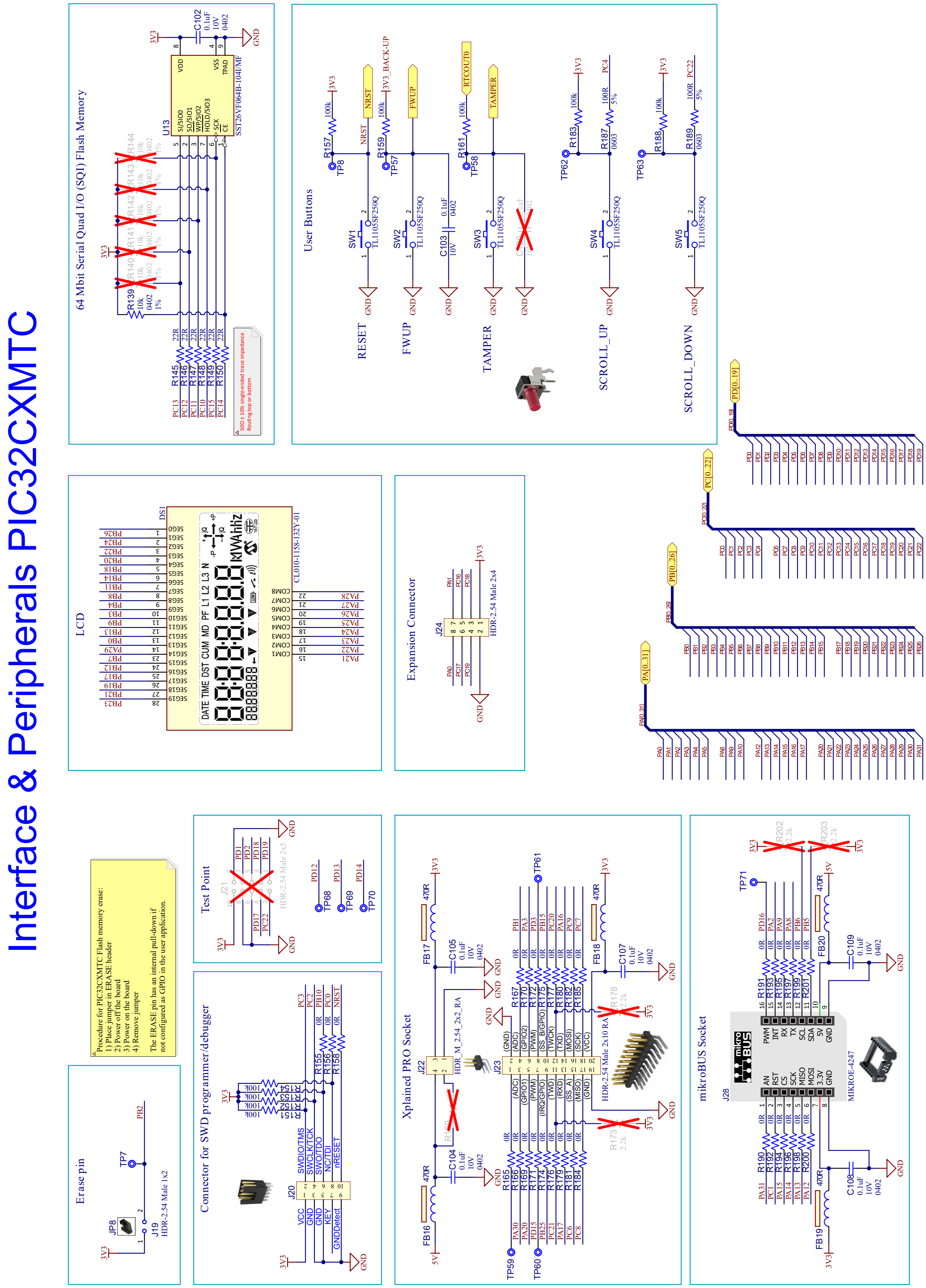


Figure 5-9. Interface and Peripherals PIC32CXMTC Schematic



5.2 PIC32CXMTC-DB Layout

This section contains the layout graphics for the PIC32CXMTC-DB board:

- Layer 1: Top Layer, Figure 5-10
- Layer 2: Mid Layer 1, Figure 5-11
- Layer 3: Mid Layer 2, Figure 5-12
- Layer 4: Bottom Layer, Figure 5-13
- Top Components Placement, Figure 5-14
- Bottom Components Placement, Figure 5-15

Figure 5-10. PIC32CXMTC-DB Layout: Top Layer

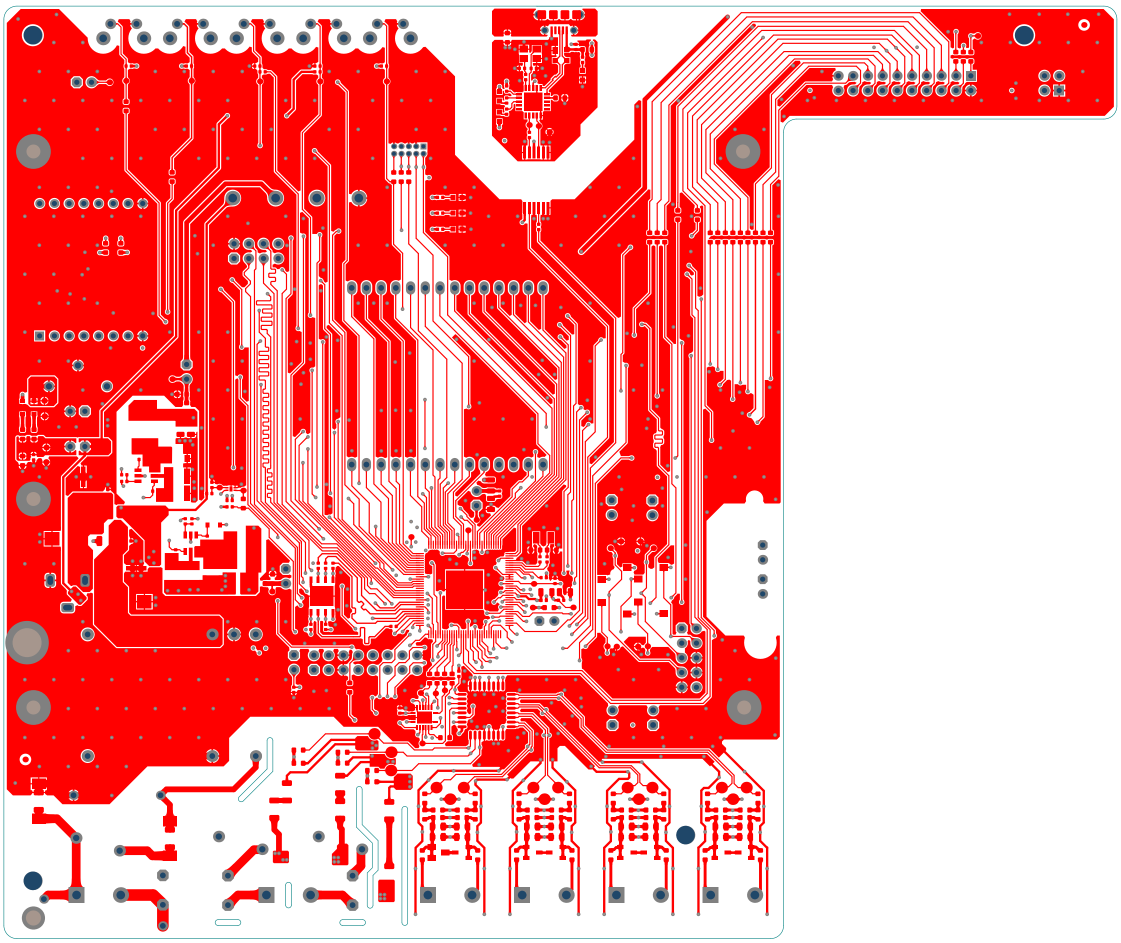


Figure 5-11. PIC32CXMTC-DB Layout: Mid Layer 1 (Ground)

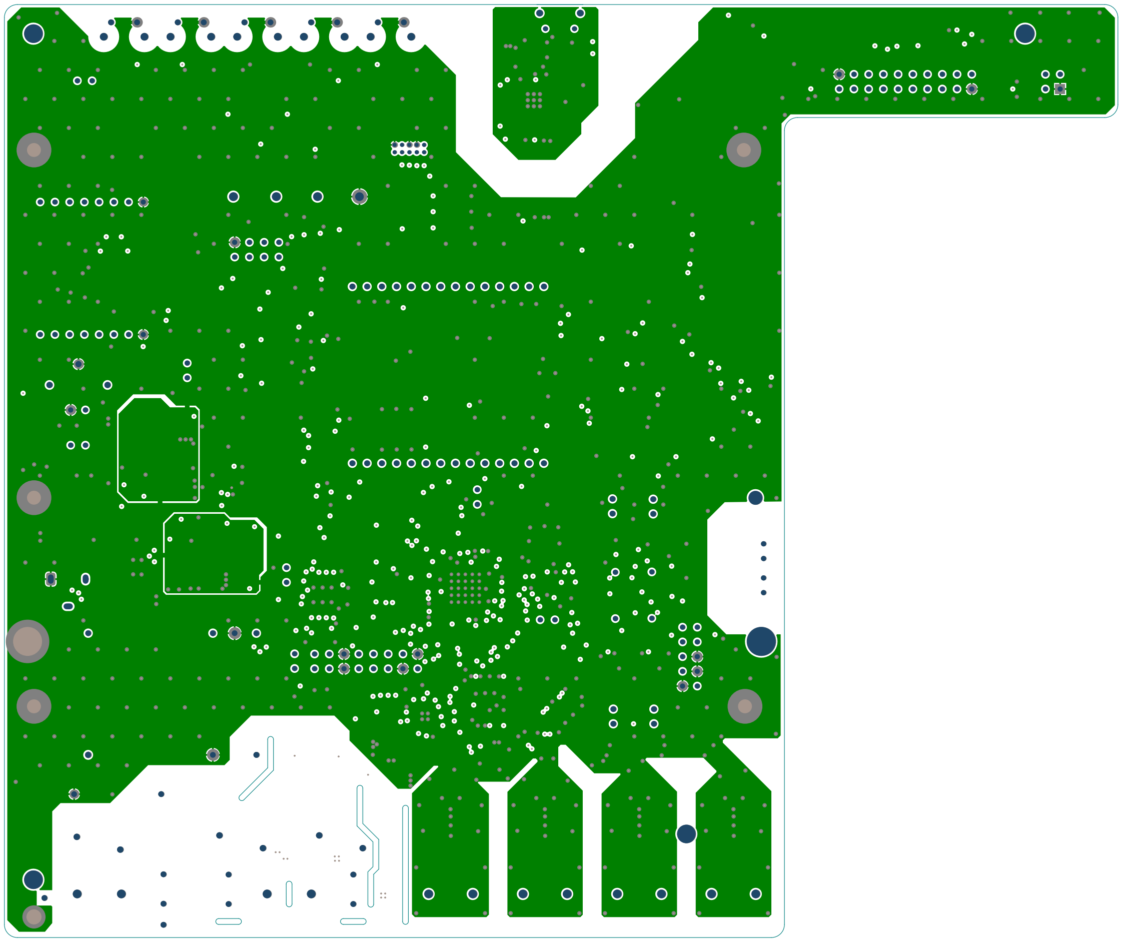


Figure 5-12. PIC32CXMTC-DB Layout: Mid Layer 2 (Power Supplies)

Figure 5-13. PIC32CXMTC-DB Layout: Bottom Layer

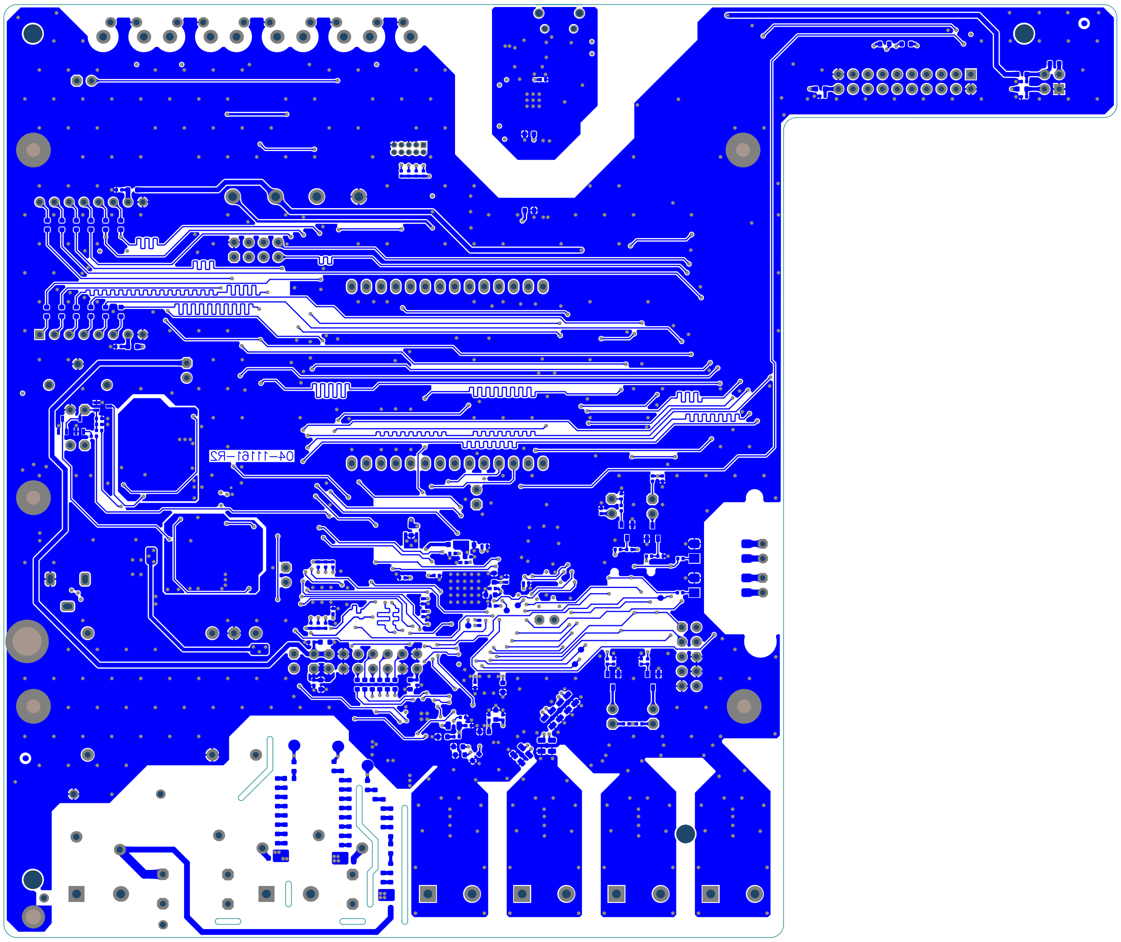


Figure 5-14. PIC32CXMTC-DB Layout: Top Silkscreen

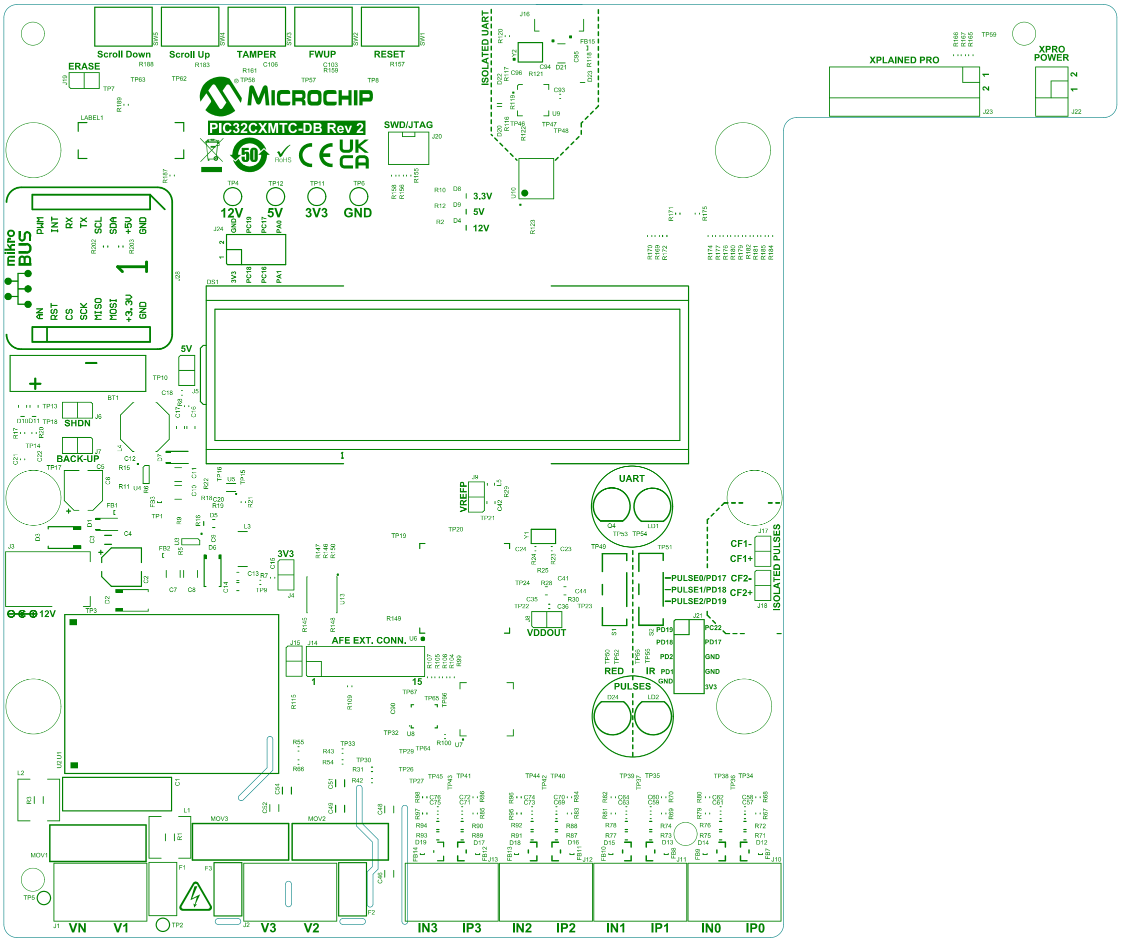
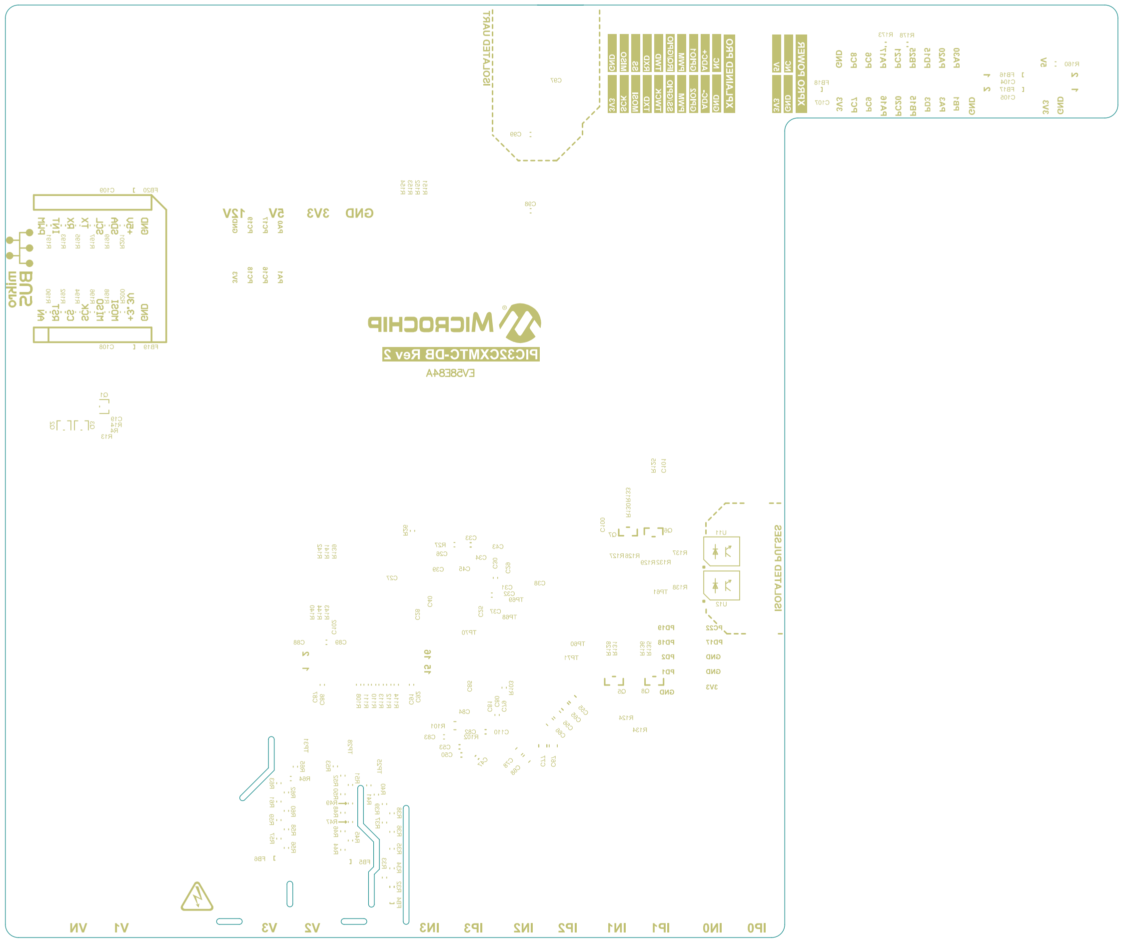


Figure 5-15. PIC32CXMTC-DB Layout: Bottom Silkscreen



6. References

The following documents are recommended as a supplemental reference resource:

- PIC32CXMTC Data Sheet, reference DS60001779, on the Microchip website
- PIC32CXMTx-DB Getting Started User Guide, on the Microchip website
- Metering Demo and Developer User Guide, on the Microchip website
- SMBJ5.0 thru SMBJ170A, CA, e3 and SMBG5.0 thru SMBG170A, CA, e3 Data Sheet, on the Microchip website
- MCP16301/H High-Voltage Input Integrated Switch Step-Down Regulator Data Sheet, reference DS20005004, on the Microchip website
- MCP16301 High Voltage Buck Converter 600mA Demo Board User's Guide, reference DS51978, on the Microchip website
- MIC841/2 Data Sheet, reference DS20005758, on the Microchip website
- VMK3/VMK4 Data Sheet, reference DS20006440, on the Microchip website
- ATSENSE-301(H) Data Sheet, reference DS60001524 on the Microchip website
- MCP2200 Data Sheet, reference DS20002228, on the Microchip website
- SST26VF064B Data Sheet, reference DS20005119, on the Microchip website
- mikroBUS Standard specifications, 2015

7. Revision History

7.1 Rev C - 12/2022

Document	Minor updates throughout. Added ordering code. Update all the figures according to PIC32CXMTC-DB Rev 2.
4. Ordering Information	Added section.

7.2 Rev B - 04/2022

Document	Minor changes in the document. Update the document according to PIC32CXMTC-DB Rev 2.

7.3 Rev A - 01/2022

Document	Initial release.

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