RNWF02 Add On Board User's Guide

EV72E72A

Introduction

The RNWF02 Add On Board is an efficient, low-cost development platform to evaluate and demonstrate the features and functionalities of Microchip's low-power Wi-Fi® RNWF02PC module. It can be used with a Host PC via USB Type-C® without the need of an additional hardware accessory. This is compliant to the mikroBUS™ Standard. The Add On Board can be plugged easily on the host board and can be controlled by the host Microcontroller Unit (MCU) with AT commands through UART.

The RNWF02 Add On Board offers:

- Easy-to-use platform to speed up design concepts to revenue with the low-power Wi-Fi RNWF02PC module:
  - Host PC via USB Type-C interface
  - Host board supporting mikroBUS socket
- RNWF02PC module, which includes a crypto device for a secure and authenticated cloud connection
- RNWF02PC module mounted on the RNWF02 Add On Board as a pre-programmed device

Features

- RNWF02PC Low-Power 2.4 GHz IEEE® 802.11b/g/n-compliant Wi-Fi® Module
- Powered at 3.3V Supply Either by USB Type-C® (Derived Default 3.3V Supply from Host PC) or by Host Board Using mikroBUS Interface
- Easy and Fast Evaluation with On-Board USB-to-UART Serial Converter in PC Companion Mode
- Host Companion Mode Using mikroBUS Socket
- Exposes Microchip Trust&Go CryptoAuthentication™ IC Through mikroBUS Interface for Secure Applications
- LED for Power Status Indication
- Hardware Support for 3-Wire PTA Interface to Support Bluetooth® Co-Existence

Table of Contents

1. Quick References

1.1 Reference Documentation

- *MCP1727 1.5A, Low Voltage, Low Quiescent Current LDO Regulator Data Sheet* (DS21999)
- *mikroBUS Specification* (www.mikroe.com/mikrobus)
- *MCP2200 USB 2.0 to UART Protocol Converter with GPIO* (DS20002228)
- *RNFW02 Wi-Fi Module Data Sheet* (DS70005544)

1.2 Hardware Prerequisites

1. RNWF02 Add On Board(2) (EV72E72A)
2. USB Type-C® compliant cable(1,2)
3. SQI™ SUPERFLASH® KIT 1(2a) (AC243009)
4. For 8-bit host MCU
   a. AVR128DB48 Curiosity Nano(2) (EV35L43A)
   b. Curiosity Nano Base for click boards™(2) (AC164162)
5. For 32-bit host MCU
   a. SAM E54 Xplained Pro Evaluation Kit(2) (ATSAME54-XPRO)
   b. mikroBUS™ Xplained Pro(2) (ATMBUSADAPTER-XPRO)

Notes:

1. For PC Companion mode
2. For host Companion mode
   a. OTA demo

1.3 Software Prerequisites

- MPLAB® Integrated Development Environment (MPLAB X IDE) tool(2)
- MPLAB XC Compilers (MPLAB XC Compilers)(2)
- Python (Python 3.x(1))
  Notes:
  1. For PC Companion mode Out-of-Box (OOB) demo
  2. For host Companion mode development

1.4 Acronyms and Abbreviations

Table 1-1. Acronyms and Abbreviations

Acronyms and Abbreviations	Description
BOM	Bill of Material
DFU	Device Firmware Update
DPS	Device Provisioning Service
GPIO	General Purpose Input Output
I^2C	Inter-Integrated Circuit
IRQ	Interrupt Request
LDO	Low-Dropout
LED	Light Emitting Diode
MCU	Microcontroller Unit
NC	Not Connected

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Acronyms and Abbreviations	Description
OOB	Out of the Box
OSC	Oscillator
PTA	Packet Traffic Arbitration
PWM	Pulse Width Modulation
RTCC	Real Time Clock and Calendar
RX	Receiver
SCL	Serial Clock
SDA	Serial Data
SMD	Surface Mount
SPI	Serial Peripheral Interface
TX	Transmitter
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus

2. Kit Overview

The RNWF02 Add On Board is a plug-in board containing the low-power RNWF02PC module. The signals required for control interface are connected to the on-board connectors of the Add On Board for flexibility and rapid prototyping.

Figure 2-1. RNWF02 Add On Board (EV72E72A) – Top View

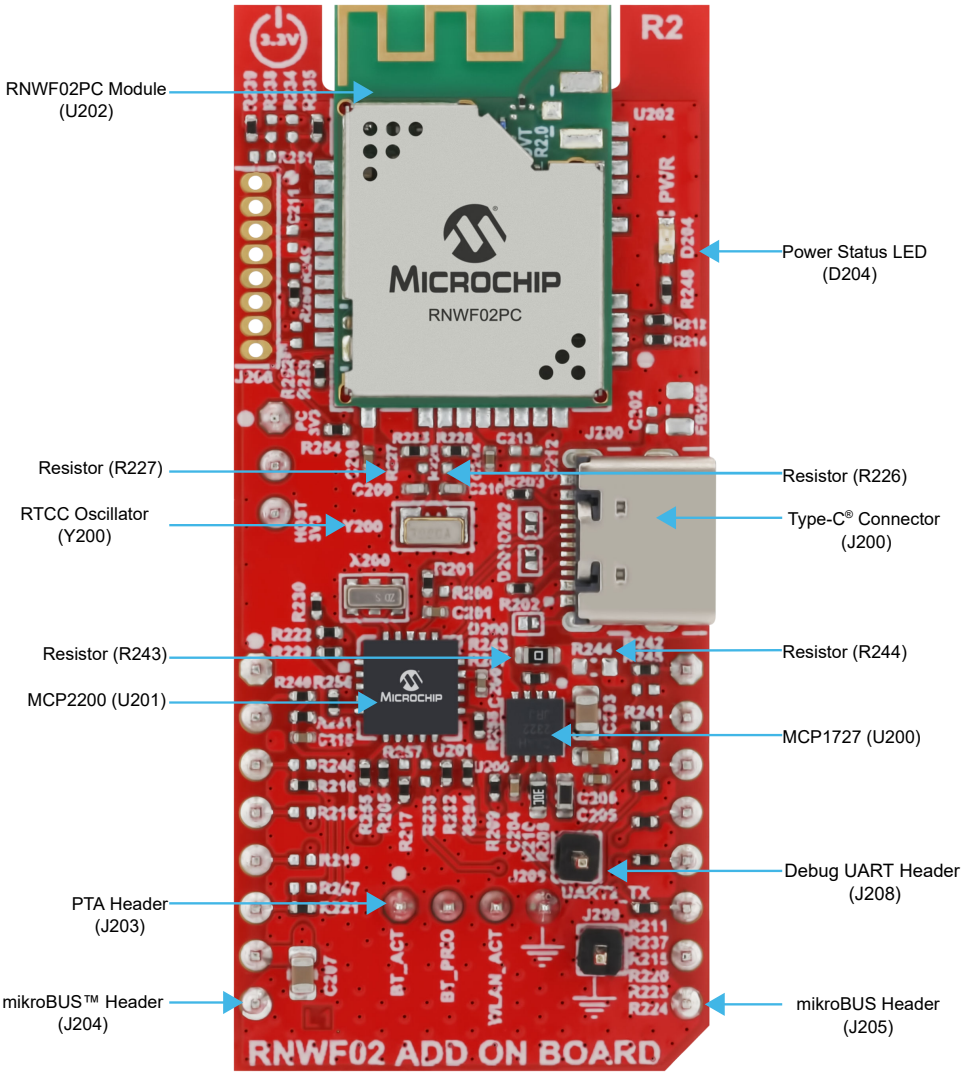
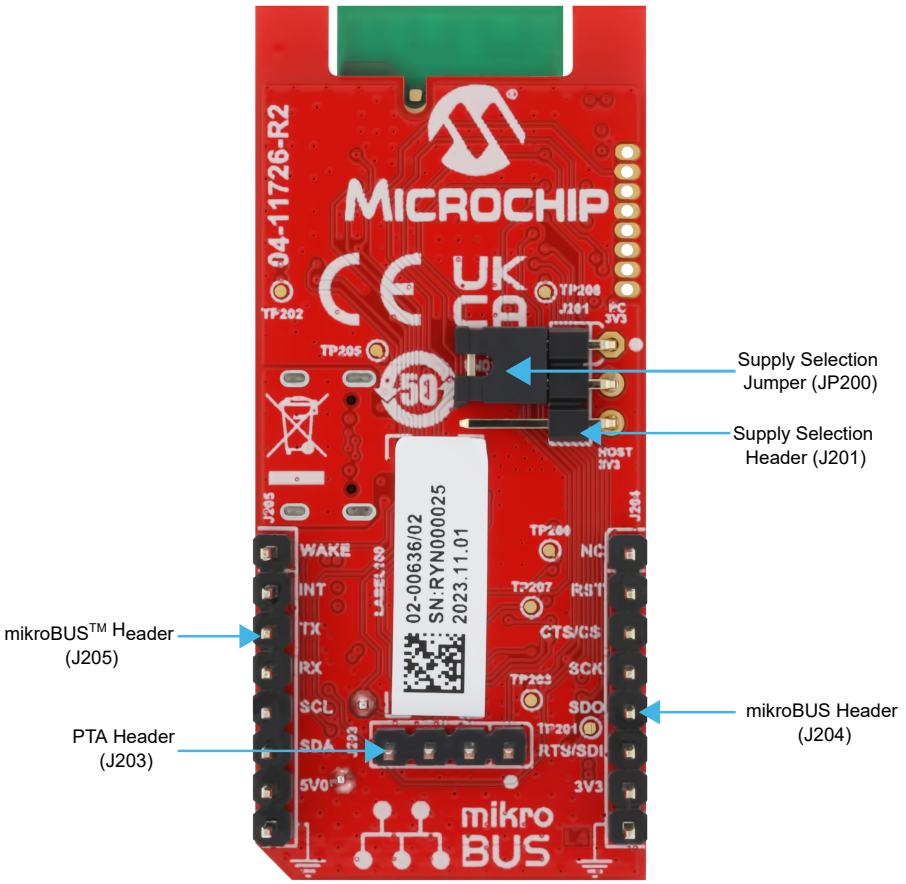


Figure 2-2. RNWF02 Add On Board (EV72E72A) – Bottom View



2.1 Kit Contents

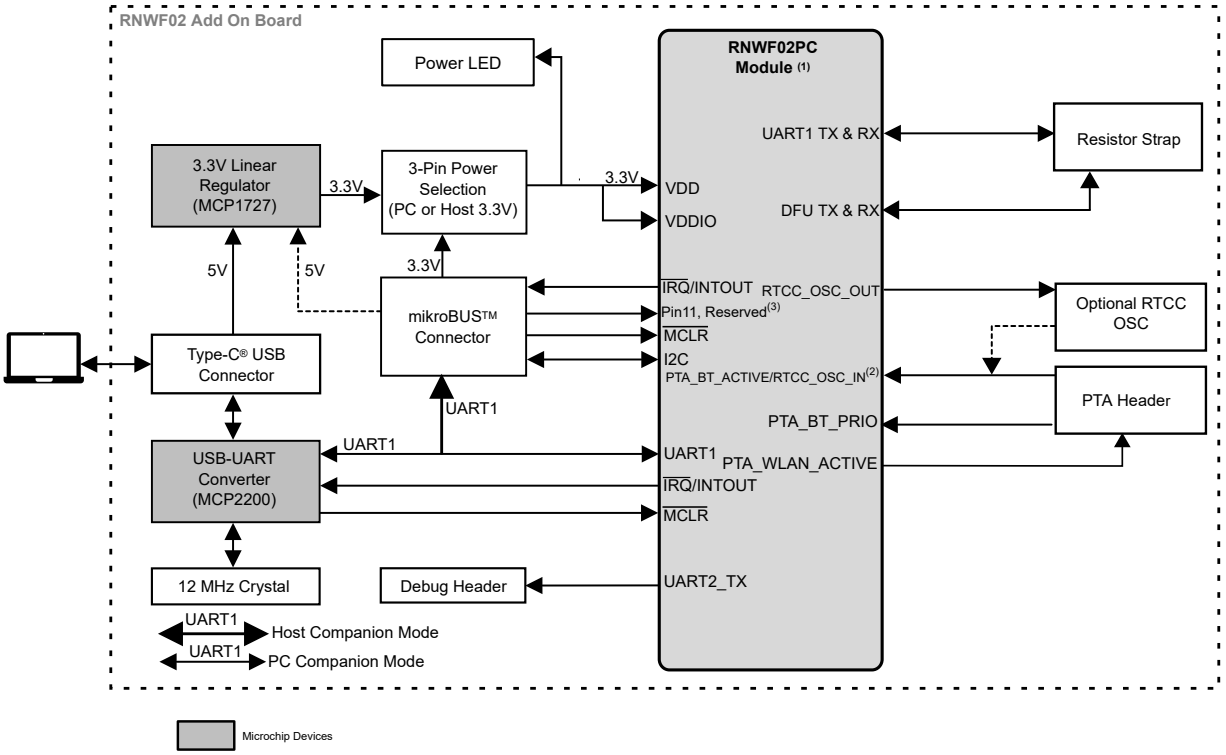
The EV72E72A (RNWF02 Add On Board) kit contains the RNWF02 Add On Board mounted with the RNWF02PC module.

Note: If any of the above items are missing in the kit, go to support.microchip.com or contact your local Microchip Sales office. In this user guide, there is a list of Microchip offices for sales and services provided on the last page.

3. Hardware

This section describes the hardware features of the RNWF02 Add On Board.

Figure 3-1. RNWF02 Add On Board Block Diagram



Notes:

1. Using Microchip's total system solution, which includes complementary devices, software drivers and reference designs, is highly recommended to ensure the proven performance of the RNWF02 Add On Board. For more details, go to support.microchip.com or contact your local Microchip Sales office.
2. PTA functionality is not supported while using the RTCC Oscillator.
3. It is recommended to connect this pin with the Tri-State pin on the host board.

Table 3-1. Microchip Components Used in the RNWF02 Add On Board

S.No.	Designator	Manufacturer Part Number	Description
1	U200	MCP1727T-ADJE/MF	MCHP Analog LDO 0.8V-5V MCP1727T-ADJE/MF DFN-8
2	U201	MCP2200-I/MQ	MCHP Interface USB UART MCP2200-I/MQ QFN-20
3	U202	RNWF02PC-I	MCHP RF Wi-Fi® 802.11 b/g/n RNWF02PC-I

3.1 Power Supply

The RNWF02 Add On Board can be powered using any of the following sources, depending on the use case scenario, but the default supply is from the host PC using a USB Type-C® cable:

1. USB Type-C supply – Jumper (JP200) is connected between J201-1 and J201-2.
   - The USB supplies 5V to Low-Dropout (LDO) MCP1727 (U200) to generate 3.3V supply for the VDD supply pin of RNWF02PC module.

2. Host board 3.3V supply – Jumper (JP200) is connected between J201-3 and J201-2.
   - The host board supplies 3.3V power through the mikroBUS header to the VDD supply pin of the RNWF02PC module.
3. (Optional) Host board 5V supply – There is a provision to supply 5V from the host board with rework (populate R244 and depopulate R243). Do not mount jumper (JP200) on J201 when the host board 5V supply is used.
   - The host board provides 5V supply through the mikroBUS header to the LDO regulator (MCP1727) (U200) to generate 3.3V supply for VDD supply pin of the RNWF02PC module.

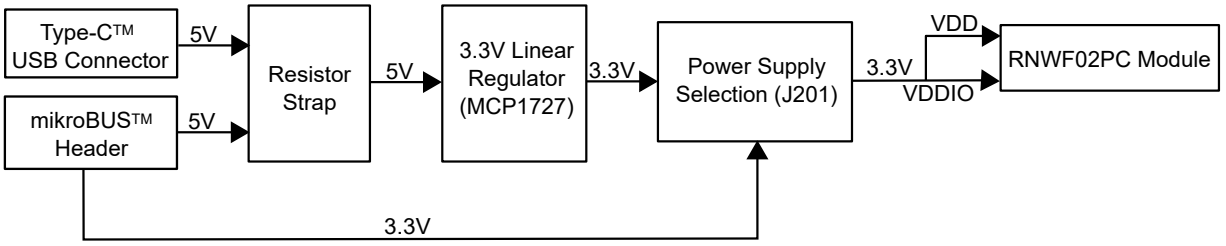
Note: The VDDIO is shorted with the VDD supply of the RNWF02PC module.

Table 3-2. Jumper JP200 Position on J201 Header for the Power Supply Selection

3.3V Generated from USB Power Supply (Default)	3.3V from mikroBUS Interface
JP200 on J201-1 and J201-2	JP200 on J201-3 and J201-2

The following figure illustrates the power supply sources used to power the RNWF02 Add On Board.

Figure 3-2. Power Supply Block Diagram



Notes:

- Remove the supply selection jumper (JP200) present on the supply selection header (J201), then connect an ammeter between J201-2 and J201-3 for external supply current measurement.
- Remove the supply selection jumper (JP200) present on the supply selection header (J201), then connect an ammeter between J201-2 and J201-1 for USB Type-C supply current measurement.

3.1.1 Voltage Regulators (U200)

An on-board voltage regulator (MCP1727) generates 3.3V. This is used only when the Host board or the USB supplies 5V to the RNWF02 Add On Board.

- U200 – Generates 3.3V that powers the RNWF02PC module along with the associated circuits

For more details on MCP1727 voltage regulators, refer to the *MCP17271.5A, Low Voltage, Low Quiescent Current LDO Regulator Data Sheet* (DS21999).

3.2 Firmware Update

The RNWF02PC module comes with pre-programmed firmware. Microchip periodically releases firmware to fix reported issues or to implement the latest feature support. There are two ways to perform regular firmware updates:

- Serial DFU command-based update over UART
- Host-assisted Over-the-Air (OTA) update

Note: For serial DFU and OTA programming guidance, refer to the RNWF02 Application Developer's Guide.

3.3 Mode of Operation

The RNWF02 Add On Board supports two modes of operation:

- PC Companion mode – Using a host PC with on-board MCP2200 USB-to-UART converter
- Host Companion mode – Using a host MCU board with mikroBUS socket via mikroBUS interface

3.3.1 Host PC with On-Board MCP2200 USB-to-UART Converter (PC Companion Mode)

The simplest method for using the RNWF02 Add On Board is to connect it to a host PC that supports USB CDC virtual COM (serial) ports using the on-board MCP2200 USB-to-UART converter. The user can send ASCII commands to the RNWF02PC module using a terminal emulator application. In this case, the PC acts as the host device. The MCP2200 is configured in the Reset condition until the USB supply is plugged in.

Use the following serial terminal settings:

- Baud rate: 230400
- No flow control
- Data: 8 bits
- No parity
- Stop: 1 bit

Note: Press the **ENTER** button in the terminal for command execution.

Table 3-3. RNWF02PC Module Connection to MCP2200 USB-to-UART Converter

Pin on MCP2200	Pin on RNWF02PC Module	Description
TX	Pin19, UART1_RX	RNWF02PC module UART1 receive
RX	Pin14, UART1_TX	RNWF02PC module UART1 transmit
$\overline{RTS}$	Pin16, UART1_$\overline{CTS}$	RNWF02PC module UART1 Clear- to-Send (active-low)
$\overline{CTS}$	Pin15, UART1_ $\overline{RTS}$	RNWF02PC module UART1 Request- to-Send (active-low)
GP0	—	—
GP1	—	—
GP2	Pin4, $\overline{MCLR}$	RNWF02PC module Reset (active-low)
GP3	Pin11, Reserved	Reserved
GP4	Pin13, $\overline{IRQ}$/INTOUT	Interrupt request (active-low) from the RNWF02PC module
GP5	—	—
GP6	—	—
GP7	—	—

3.3.2 Host MCU Board with mikroBUS™ Socket via mikroBUS Interface (Host Companion Mode)

The RNWF02 Add On Board can also be used with the host MCU boards using mikroBUS sockets with the control interface. The following table shows how the pinout on the RNWF02 Add On Board mikroBUS interface corresponds to the pinout on the RNWF02PC module.

Note: Disconnect the USB Type-C® cable in the host Companion mode.

Table 3-4. mikroBUS Socket Pinout Details (J204)

Pin Number J204	Pin on mikroBUS™ Header	Pin Description of mikroBUS Header	Pin on RNWF02PC Module(1)
Pin1	AN	Analog input	—
Pin2	$\overline{RST}$	Reset	Pin4, $\overline{MCLR}$
Pin3	CS	SPI Chip Select	Pin16, UART1_$\overline{CTS}$

.....continued			
Pin Number J204	**Pin on mikroBUS™ Header**	**Pin Description of mikroBUS Header**	**Pin on RNWF02PC Module(1)**
Pin4	SCK	SPI Clock	—
Pin5	MISO	SPI host input client output	—
Pin6	MOSI	SPI host output client input	Pin15, UART1_$\overline{RTS}$
Pin7	+3.3V	3.3V power	+3.3V from host MCU socket
Pin8	GND	Ground	GND

Table 3-5. mikroBUS Socket Pinout Details (J205)

Pin Number J205	Pin on mikroBUS™ Header	Pin Description of mikroBUS Header	Pin on RNWF02PC Module(1)
Pin1(3)	PWM	PWM output	Pin11, Reserved
Pin2	INT	Hardware interrupt	Pin13, $\overline{IRQ}$/INTOUT
Pin3	TX	UART transmit	Pin14, UART1_TX
Pin4	RX	UART receive	Pin19, UART1_RX
Pin5	SCL	I^2C Clock	Pin2, I2C_SCL
Pin6	SDA	I^2C Data	Pin3, I2C_SDA
Pin7	+5V	5V power	NC
Pin8	GND	Ground	GND

Notes:

1. For more details on the RNWF02PC module pins, refer to the *RNWF02 Wi-Fi® Module Data Sheet* (DS70005544).
2. The RNWF02 Add On Board does not support the SPI interface, which is available on the mikroBUS interface.
3. It is recommended to connect this pin with the Tri-State pin on the host board.

3.4 Debug UART (J208)

Use the debug UART2_Tx (J208) to monitor the debug logs from the RNWF02PC module. The user can use a USB-to-UART converter cable to print the debug logs.

Use the following serial terminal settings:

- Baud rate: 460800
- No flow control
- Data: 8 bits
- No parity
- Stop: 1 bit

Note: UART2_Rx is not available.

3.5 PTA Interface (J203)

The PTA interface supports a shared antenna between Bluetooth® and Wi-Fi®. It has the hardware-based 802.15.2-compliant 3-wire PTA interface (J203) to address the Wi-Fi/Bluetooth co-existence.

Note: Refer to the software release notes for additional information.

Table 3-6. PTA Pin Configuration

Header Pin	Pin on RNWF02PC Module	Pin Type	Description
Pin1	Pin21, PTA_BT_ACTIVE/RTCC_OSC_IN	Input	Bluetooth® active
Pin2	Pin6, PTA_BT_PRIORITY	Input	Bluetooth priority
Pin3	Pin5, PTA_WLAN_ACTIVE	Output	WLAN active

.....continued

Header Pin	Pin on RNWF02PC Module	Pin Type	Description
Pin4	GND	Power	Ground

3.6 LED

The RNWF02 Add On Board has one red (D204) Power-on status LED.

3.7 RTCC Oscillator (Optional)

The optional RTCC Oscillator (Y200) 32.768 kHz crystal is connected to the Pin22, RTCC_OSC_OUT and Pin21, RTCC_OSC_IN/PTA_BT_ACTIVE pins of the RNWF02PC module for the Real Time Clock and Calendar (RTCC) application. The RTCC Oscillator is populated; however, the corresponding resistor jumpers (R227) and (R226) are not populated.

Note: The PTA functionality is not supported while using the RTCC Oscillator. Refer to the software release notes for additional information.

4. Out of Box Demo

The RNWF02 Add On Board Out of Box (OOB) demo is based on a Python script that demonstrates MQTT cloud connectivity. The OOB demo uses the AT command interface, through the USB Type-C®, as per the PC Companion mode setup. The OOB demo connects to the MQTT server, and publishes and subscribes to predefined topics. For more details on MQTT cloud connectivity, go to test.mosquitto.org/. The demo supports the following connections:

- Port 1883 – unencrypted and unauthenticated
- Port 1884 – unencrypted and authenticated

The user can be connected to the MQTT server in seconds by providing Wi-Fi® credentials, username and password, depending on the connection type.

For more information on the PC Companion mode OOB demo, go to GitHub - MicrochipTech/RNWFxx_Python_OOB.

5. Appendix A: Reference Circuit

5.1 RNWF02 Add On Board Schematics

Figure 5-1. Supply Selection Header

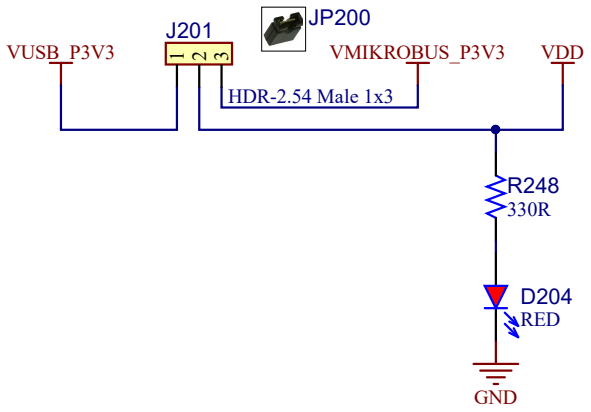


Figure 5-2. Voltage Regulator

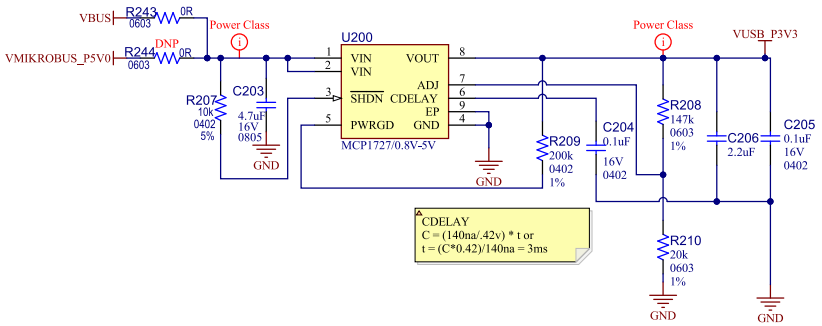


Figure 5-3. MCP2200 USB-to-UART Converter and Type-C USB Connector Section

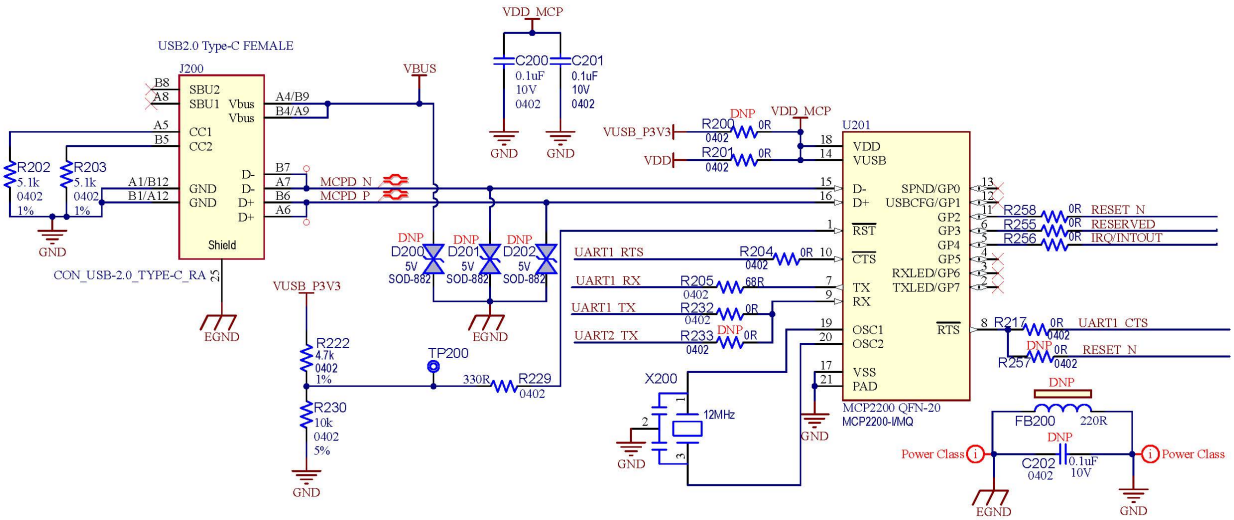


Figure 5-4. mikroBUS Header Section and PTA Header Section

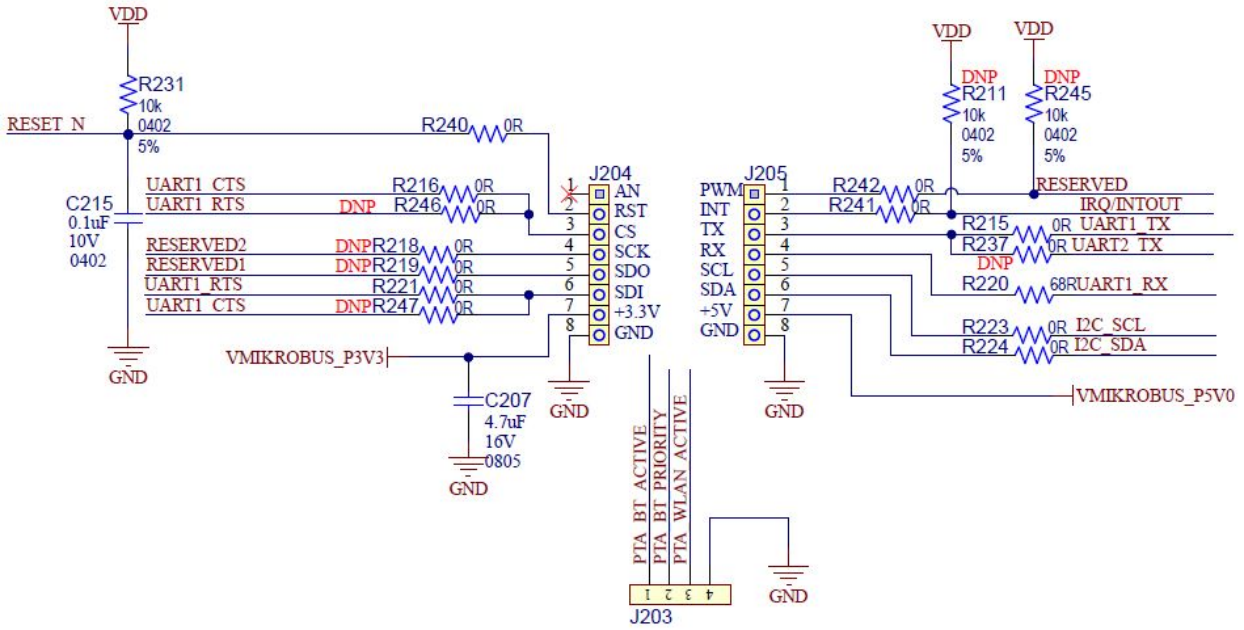
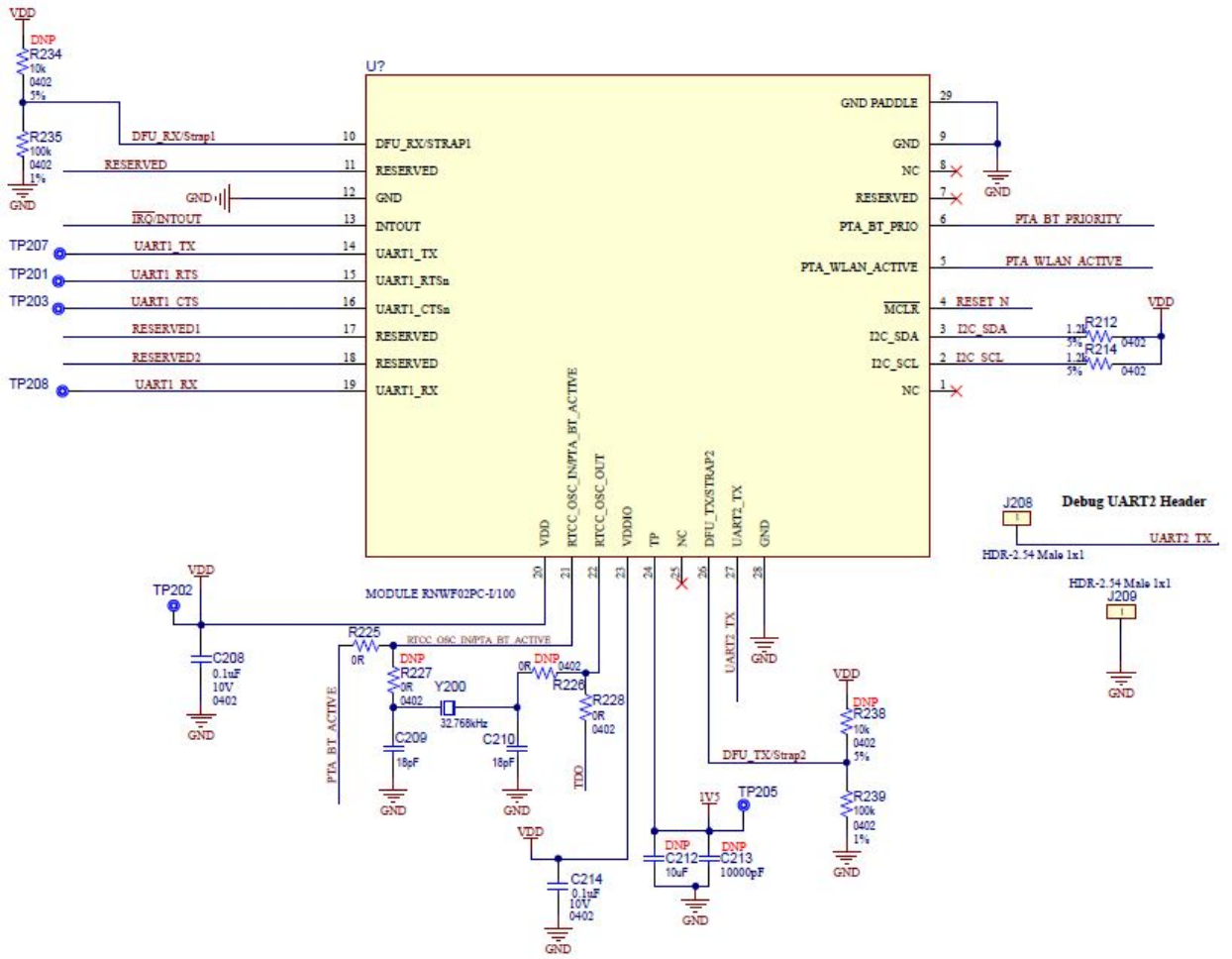


Figure 5-5. RNWF02PC Module Section



5.2 RNWF02 Add On Board Bill of Materials

For the Bill of Materials (BOM) of the RNWF02 Add On Board, go to EV72E72A product web page.

6. Appendix B: Regulatory Approval

This equipment (RNWF02 Add On Board/EV72E72A) is an evaluation kit and not a finished product. It is intended for laboratory evaluation purposes only. It is not directly marketed or sold to the general public through retail; it is only sold through authorized distributors or through Microchip. Using this requires a significant engineering expertise towards understanding of the tools and relevant technology, which can be expected only from a person who is professionally trained in the technology.

Regulatory compliance settings have to follow the RNWF02PC module certifications. The following regulatory notices are to cover the requirements under the regulatory approval.

6.1 United States

The RNWF02 Add On Board (EV72E72A) contains the RNWF02PC module, which has received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C “Intentional Radiators” single-modular approval in accordance with Part 15.212 Modular Transmitter approval.

Contains FCC ID: 2ADHKWIXCS02

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Important: FCC Radiation Exposure Statement
This equipment complies with FCC radiation exposure limits set forth for uncontrolled environment. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 8 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. This transmitter is restricted for use with the specific antenna(s) tested in this application for certification.

CAUTION Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

6.2 Canada

The RNWF02 Add On Board (EV72E72A) contains the RNWF02PC module, which has been certified for use in Canada under Innovation, Science and Economic Development Canada (ISED, formerly Industry Canada) Radio Standards Procedure (RSP) RSP-100, Radio Standards Specification (RSS) RSS-Gen and RSS-247.

Contains IC: 20266-WIXCS02

This device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference;
2. This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

⚠ WARNING

This equipment complies with radio frequency exposure limits set forth by Innovation, Science and Economic Development Canada for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between the device and the user or bystanders.

Cet équipement est conforme aux limites d'exposition aux radiofréquences définies par d'Innovation, Sciences et Développement économique Canada pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre le dispositif et l'utilisateur ou des tiers.

6.3 Europe

This equipment (EV72E72A) has been assessed under the Radio Equipment Directive (RED) for use in European Union countries. The product does not exceed the specified power ratings, antenna specifications and/or installation requirements as specified in the user manual. A Declaration of Conformity is issued for each of these standards and kept on file as described in Radio Equipment Directive (RED).

Simplified EU Declaration of Conformity

Hereby, Microchip Technology Inc. declares that the radio equipment type [EV72E72A] is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at EV72E72A (See *Conformity Documents*).

7. Document Revision History

The document revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

Table 7-1. Document Revision History

Revision	Date	Section	Description
C	09/2024	Hardware	• Updated “WAKE” to “Reserved” in the block diagram • Added note for Reserved
		Host PC with On-Board MCP2200 USB-to-UART Converter (PC Companion Mode)	For GP3 Pin, replaced “INT0/WAKE” by “Reserved”
		Host MCU Board with mikroBUS Socket via mikroBUS Interface (Host Companion Mode)	For “mikroBUS Socket Pinout Details (J205)” Pin 1, replaced “INT0/WAKE” by “Reserved” and added note
		RNWF02 Add On Board Schematics	Updated the schematic diagrams
B	07/2024	Features	Added power supply value as 3.3V
		Hardware Prerequisites	Added: • SQI™ SUPERFLASH® KIT 1 • AVR128DB48 Curiosity Nano • Curiosity Nano Base for Click boards • SAM E54 Xplained Pro Evaluation Kit • Mikrobus Xplained Pro
		Kit Overview	Updated Add On Board top view and bottom view diagram
		Kit Contents	Removed “RNWF02PC Module”
		Hardware	Updated part number and description for “U202”
		Power Supply	• Removed “VDD supply derives VDDIO supply to the RNWF02PC Module”. • Added note • Updated the “Power Supply Block Diagram”
		Host PC with On-Board MCP2200 USB-to-UART Converter (PC Companion Mode)	Added “Serial Terminal settings”
		PTA Interface (J203)	Updated the description and notes
		RTCC Oscillator (Optional)	Updated the notes
		Out of Box Demo	Updated the description
		RNWF02 Add On Board Schematics	Updated all the schematics diagram for this section
		RNWF02 Add On Board Bill of Materials	Added new section along with official web page link
		Appendix B: Regulatory Approval	Added new section with regulatory approval details
A	11/2023	Document	Initial revision

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