WILCS02 Wi-Fi® Link Controller SD Board

EV74A47A

Introduction

The WILCS02 Wi-Fi® Link Controller SD Board is a Secure Digital (SD) card interface board that supports the 2.4 GHz IEEE® 802.11 b/g/n standard. It is designed to demonstrate the features and functionalities of Microchip's low-power Wi-Fi WILCS02PE module.

The WILCS02-SD Board offers:

- WILCS02PE module with WLAN connectivity solution and hardware-based security accelerator
- PCB antenna

Features

- WILCS02PE Module is a Low-Power, 2.4 GHz IEEE® 802.11 b/g/n RF/Baseband/MAC Link Controller Module
- SD/MMCplus Card Connector for Controlling the WILCS02PE Module by a Host MPU Board Using the SDIO Interface
- On-Board USB-to-UART Converter Using Microchip MCP2221A for Debug UART
- Manual Reset Button to Reset the WILCS02PE Module
- Separate Current Measurement Headers for VDD and VDDIO Supply Rails
- Power Supply from a Host MPU Board Through an SD/MMCplus Connector or Test the PC Using a USB Type-C® Cable or External Power Supply
- Hardware-Based 802.15.2 Compliant Three-Wire PTA Interface to Support Wi-Fi®/Bluetooth® Co-existence Using Shared Antenna
- Optional Alternate SPI Connection to MMCplus/SD Card Interface for Controlling the WILCS02PE Module

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1. Quick References

1.1 Reference Documentation

For further details, refer to the following:

- *WILCS02IC and WILCS02 Family Data Sheet* (DS70005557)
- *MCP17271.5A, Low Voltage, Low Quiescent Current LDO Regulator Data Sheet* (DS21999)
- *MCP2221A USB 2.0 to I2C/UART protocol converter with GPIO contains Driver package for DBG UART-USB converter* (DS20005565)

1.2 Prerequisites

- WILCS02 Wi-Fi® Link Controller SD Board (EV74A47A)
- USB Type-C®-compliant cable
- Host MPU board with SD/MMCplus socket support

1.3 Acronyms and Abbreviations

Table 1-1. Acronyms and Abbreviations

Acronyms and Abbreviations	Description
BOM	Bill of Materials
DBG	Debug
GPIO	General Purpose Input/Output
HW	Hardware
LDO	Low-Dropout
LED	Light Emitting Diode
MPU	Microprocessor Unit
NC	Not Connected
OSC	Oscillator
PCB	Printed Circuit Board
PPS	Peripheral Pin Select
PTA	Packet Traffic Arbitration
RX	Receiver
SCL	Serial Clock
SD	Secure Digital
SDA	Serial Data
SDIO	Serial Data input/Output
SMD	Surface Mount Device
SoC	System-on-Chip
SPI	Serial Peripheral Interface
TX	Transmitter
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus

2. Kit Overview

The WILCS02-SD board is a plug-in board containing the low-power WILCS02PE module. This board can be plugged in to any host Microprocessor (MPU) board with SD/MMCplus card connector support. This is targeted for an MPU host running a Linux OS and can be interfaced through the SDIO interface. The WILCS02-SD board has an on-board PTA interface header for the co-existence of the external Bluetooth® device.

Figure 2-1. WILCS02-SD Board (EV74A47A) – Top View

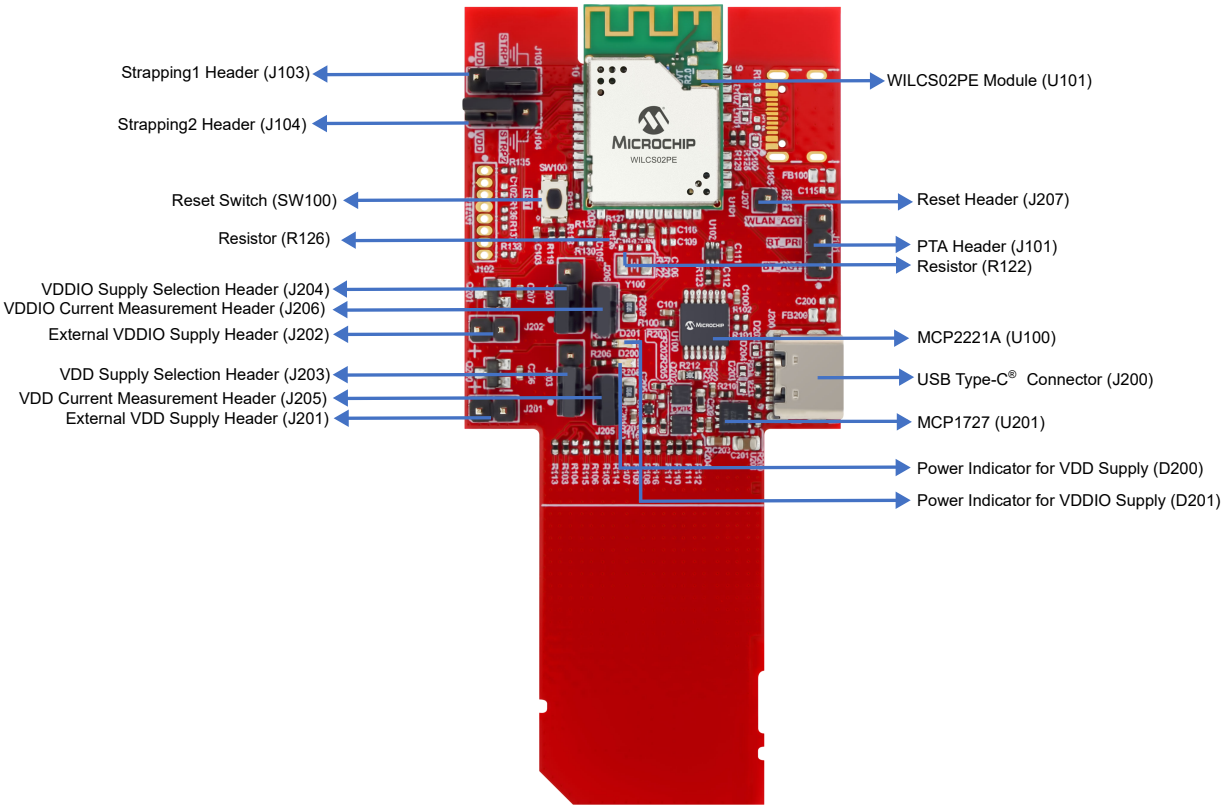
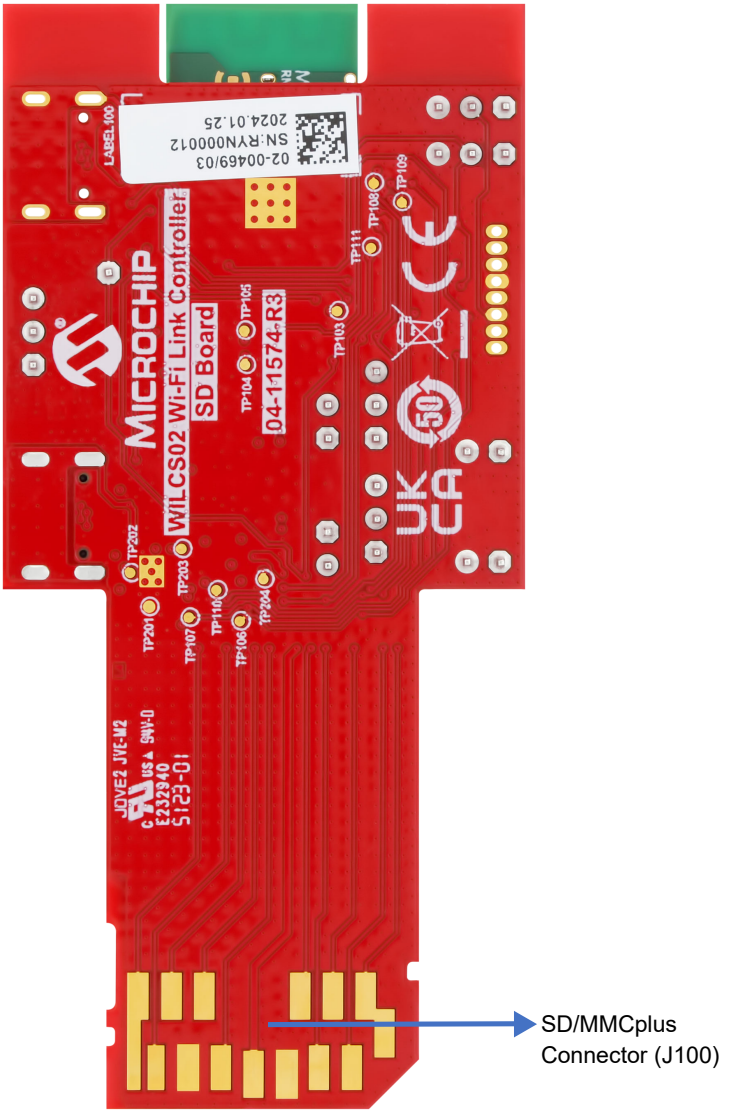


Figure 2-2. WILCS02-SD Board (EV74A47A) – Bottom View



2.1 Kit Contents

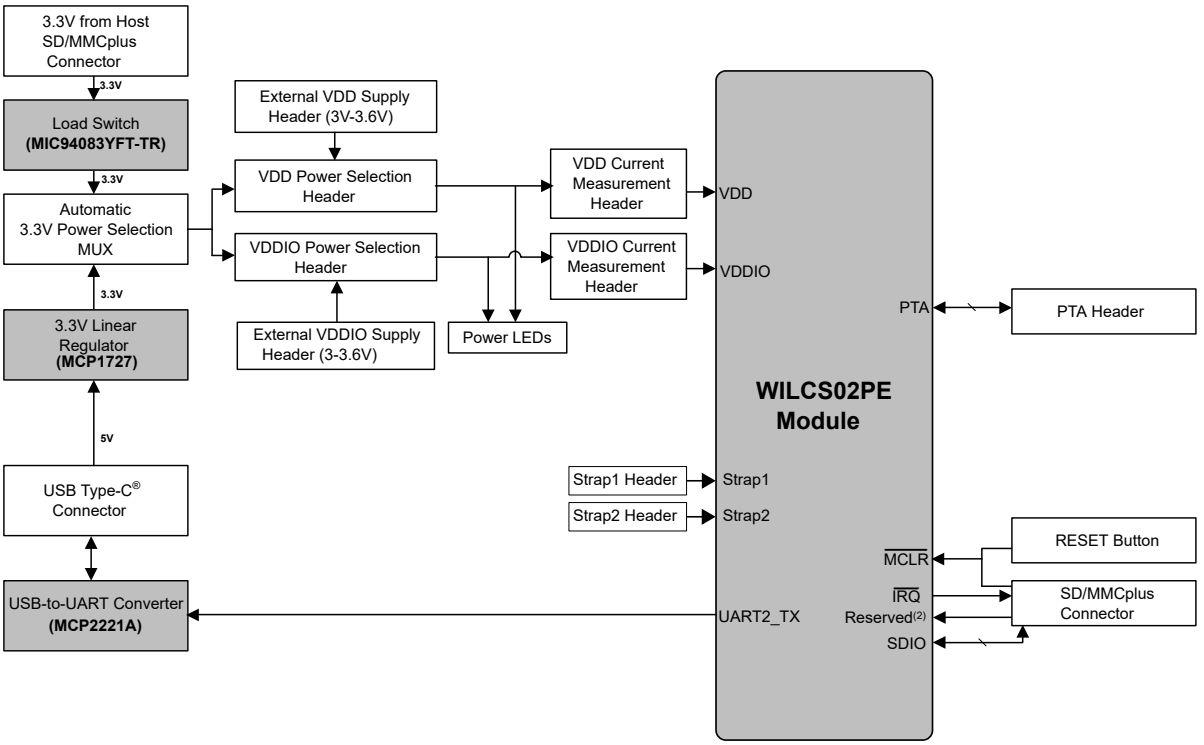
The EV74A47A (WILCS02 Wi-Fi Link Controller SD Board) kit contains the WILCS02 Wi-Fi Link Controller SD Board mounted with the WILCS02PE module.

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 WILCS02-SD board.

Figure 3-1. WILCS02-SD 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 WILCS02-SD boards. For more details, go to support.microchip.com or contact your local Microchip Sales office.
2. It is recommended to connect this pin with the Tri-State pin on the host board.

Table 3-1. Microchip Components Used in WILCS02-SD Board

Designator	Description	Manufacturer Part Number
U100	MCHP INTERFACE USB I^2C UART MCP2221A-I/ST TSSOP-14	MCP2221A-I/ST
U101	MCHP RF WI-FI® 802.11 b/g/n WILCS02PE-I	WILCS02PE-I
U201	MCHP ANALOG LDO 0.8V-5V MCP1727T-ADJE/MF DFN-8	MCP1727T-ADJE/MF
U202	MCHP ANALOG POWER SWITCH 1.7V to 5.5V 2A MIC94083YFT 4-TMLF	MIC94083YFT-TR

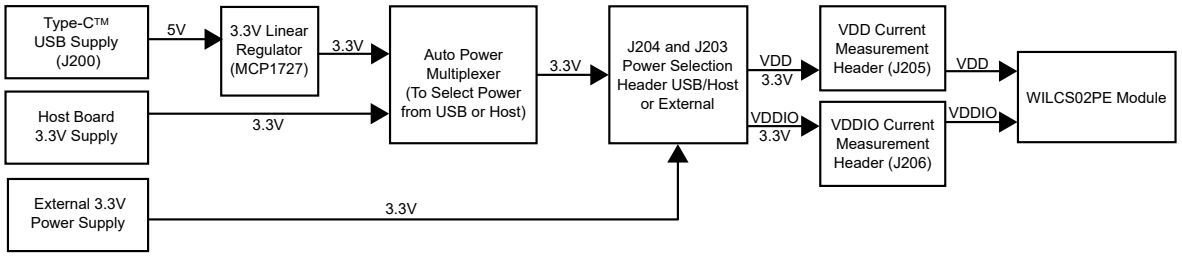
3.1 Power Supply

The WILCS02-SD board can be powered using any of the following sources depending on the use case scenario, but the default supply is from the host board using the SD/MMCplus Connector or from a PC using a USB Type-C® cable:

1. Host board SD 3.3V supply:

- Place the jumper between J203-1 and J203-2 for the 3.3V VDD supply and between J204-1 and J204-2 for the 3.3V VDDIO supply to power the module using the host board via the SDIO interface.

Figure 3-2. Power Supply Block Diagram



2. USB Type-C supply (J200):
   - The debug USB (J200) supplies power to the WILCS02-SD board from the host PC using Type-A male to Type-C USB cable.
   - Place the jumper between J203-1 and J203-2 for the 3.3V VDD supply and between J204-1 and J204-2 for the 3.3V VDDIO supply to power the WILCS02PE module.

   Note: The maximum available current from the debug USB (J200) is limited to 500 mA.
3. External 3.3V Power supply:
   - Place the jumper between J203-2 and J203-3 for the 3.3V VDD supply and between J204-2 and J204-3 for the 3.3V VDDIO supply to power the WILCS02PE module using an external power source.

   Note: The operating voltage range for VDD and VDDIO is: 3.0-3.6V (3.3V Typical).

Table 3-2. Power Selection

Power Supply Signals	3.3V Generated from Host Board Power Supply	3.3V Generated from USB Type-C® Supply	3.3V Generated from External Power Supply
VDD	JP200 on J203-1 and J203-2	JP200 on J203-1 and J203-2	JP200 on J203-2 and J203-3
VDDIO	JP201 on J204-1 and J204-2	JP201 on J204-1 and J204-2	JP201 on J204-2 and J204-3

Note: When the WILCS02-SD board is plugged into the host board SD/MMCplus Connector and the USB Type-C cable is plugged into J200, the 3.3V supply is derived from the 5V USB supply.

3.1.1 Voltage Regulators (U201)

An on-board voltage regulator (MCP1727) generates +3.3V. This is used only when the USB supplies 5V to the WILCS02-SD board.

• U201 – Generates +3.3V that powers the WILCS02PE module along with the associated circuits.

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

3.1.2 Current Measurement Header (J205 and J206)

Use the current measurement header (J205 and J206) to measure the current consumed by the WILCS02PE module using an ammeter.

- Remove resistor (R208), then connect an ammeter between pins 1 and 2 of J205 to measure the VDD current.
- Remove resistor (R209), then connect an ammeter between pins 2 and 3 of J206 to measure the VDDIO current.

3.2 Firmware Update

The WILCS02PE module comes with pre-programmed firmware. Microchip periodically releases firmware to fix reported issues or to implement the latest feature support.

Notes:

1. Remove the jumpers from header J103 and J104 while performing Device Firmware Update (DFU) over UART.
2. For serial DFU and firmware side-loader programming guidance, refer to the WILCS02 Wi-Fi Link Controller Application Developer's Guide.

3.3 Header and Connectors

3.3.1 Standard SD/MMCplus Connector Pin Specification

The following table provides the pin descriptions for the standard MMCplus connector in the SDIO Bus mode.

Table 3-3. Standard SD/MMCplus Connector Pin Details

SD Pin	MMCplus Pin	SDIO Bus Mode
1	1	DATA 3
2	2	CMD
3	3	VSS
4	4	VDD
5	5	SD CLK
6	6	VSS
7	7	DATA 0
8	8	DATA 1
9	9	DATA 2
—	10	DATA 4
—	11	DATA 5
—	12	DATA 6
—	13	DATA 7

3.3.2 WILCS02-SD Board SD/MMCplus Connector

The WILCS02-SD board has a PCB-implemented SD card interface (J100) via the SD/MMCplus connector. This board supports only the SDIO interface; it does not support the MMCplus interface. The unused DATA 5, DATA 6 and DATA 7 pins of the MMCplus connector are connected to $\overline{\text{MCLR}}$, $\overline{\text{IRQ}}$/INTOUT and reserved signal lines.

The following table provides the customized SD/MMCplus connector pin description for the WILCS02PE module.

Table 3-4. SD/MMCplus Connector Pin Description

Pin on SD/MMCplus Connector	Pin on WILCS02PE Module	Function	Description
1	14	SD DATA 3	SDIO DATA 3
2	18	SD CMD	SDIO command
3	12,29,9,28	GND	Ground
4	20,23	HOST_SD_P3V3	3.3V power supply from SD/MMCplus Host board
5	19	SD CLK	SDIO clock
6	12,29,9,28	GND	Ground

.....continued			
Pin on SD/MMCplus Connector	**Pin on WILCS02PE Module**	**Function**	**Description**
7	17	SD DATA 0	SDIO Data 0
8	16	SD DATA 1	SDIO Data 1
9	15	SD DATA 2	SDIO Data 2
10	—	—	—
11	4	RESET	Data 5 line is used to reset the WILCS02PE module
12	13	$\overline{IRQ}$/INTOUT	Data 6 line is used to send Interrupt output from the WILCS02PE module
13(1)	11	Reserved	Reserved

Note:

1. It is recommended to connect this pin with the Tri-State pin on the host board.

3.4 DEBUG Connector (J200)

The WILCS02PE module provides UART2_TX from pin 27, which can be used for printing debug logs. This pin is connected to MCP2221A, on-board USB-to-UART converter. The end user can use the USB Type-C® connector, J200, to connect to the host PC and view the debug logs from the WILCS02PE module in the Serial Terminal. The following are the serial terminal settings:

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

3.5 PTA Interface Header (J101)

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 (J101) to address Wi-Fi/Bluetooth co-existence.

Table 3-5. PTA Pin Configuration

Header Pin	Pin on WILCS02PE Module	Pin Type	Description
Pin1	Pin21, PTA_BT_ACTIVE	Input	Bluetooth® active
Pin2	Pin6, PTA_BT_PRIORITY	Input	Bluetooth priority
Pin3	Pin5, PTA_WLAN_ACTIVE	Output	WLAN active
Pin4	GND	Power	Ground

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

Table 3-6. PTA Resistor Configuration for SDIO

Host Interface	Modification Required in Resistors
SDIO (Default)	**Mounted resistor:** R127, R128 and R129 **Not mounted resistor:** R130, R131 and R132

3.6 Strapping Pin Header

The J103 is the strap 1 header; by default, this is pulled low (with the help of jumper position in between pin 2 and pin 3). This configuration enables the SDIO host interface selection.

For the SPI host interface selection, the jumper position must be in between pin 1 and pin 2 of J103 header.

The following table describes the host interface selection based on the jumper selection of the J103 header.

Table 3-7. Host Interface Selection

Host Interface Selection	J103 (Strap 1) Header
SDIO (Default)	0
SPI	1

Note: The J104 strap 2 pin header is reserved and, by default, pulled high with the jumper position in between pin 1 and pin 2 on the J104 header.

3.7 RESET Switch

The following switch is available on the WILCS02-SD Board :

- Reset switch (SW100) – Connected with the $\overline{\text{MCLR}}$ signal of the WILCS02PE module

In Idle state, the level of the user-configurable switch is pulled high (+3.3V) and, when the switch is pressed, it drives the $\overline{\text{MCLR}}$ line of the WILCS02PE module to low (GND).

Switch Name	Description	Pin on WILCS02PE Module
SW100	Reset switch	$\overline{\text{MCLR}}$

3.8 LEDs

The following are the WILCS02-SD on-board LEDs.

- Power LEDs
  - Red (D200): Power indicator for VDD supply
  - Red (D201): Power indicator for VDDIO supply

3.9 WILCS02PE Module

For more details on the WILCS02PE module pinout details, refer to the *WILCS02IC and WILCS02 Family Data Sheet* (DS70005557).

4. Using SPI Interface

This section describes how to use the SPI interface via the SD/MMCplus connector and wire jumpers of the WILCS02-SD board. The user can follow either Using SPI Interface via SD/MMCplus Connector or Using SPI Interface via Jumper Wires based on their use case scenario.

4.1 Using SPI Interface via SD/MMCplus Connector

The following hardware rework must be done in the WILCS02-SD board to use the SPI interface through the same SD/MMCplus connector.

- Remove resistors R103, R105, R108, R111 and R113 from the WILCS02-SD board
- Populate R104, R106, R109 resistors

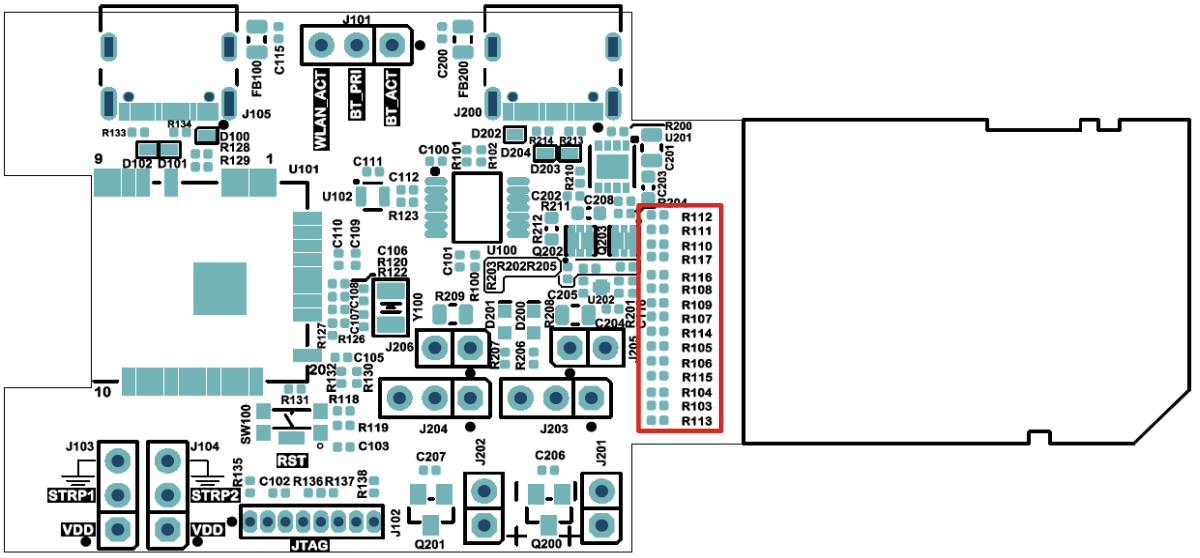
Table 4-1. SPI Connections in WILCS02-SD Board SD/MMCplus Connector

Pin on SD/MMC Connector	SDIO Bus Mode	SPI Connection
1	DATA 3	SPI_$\overline{CS}$
2	CMD	SPI_RXD
3	VSS	Ground
4	VDD	3.3 V Power supply
5	SD CLK	SPI_CLK
6	VSS	Ground
7	DATA 0	SPI_TXD
8	DATA 1	—
9	DATA 2	—
10	—	—
11	$\overline{MCLR}$	$\overline{MCLR}$
12	Device $\overline{IRQ}$/INTOUT	Device $\overline{IRQ}$/INTOUT
13	Reserved	—

Table 4-2. WILCS02-SD Board Resistor Configuration for SDIO/SPI

Peripheral Interface	Modification Required in Resistors
SDIO (Default)	**Mounted resistors:** R103, R105, R107, R108, R110, R111, R113, R114, R116 and R117 **Not mounted resistors:** R104, R106, R109, R112 and R115
SPI	**Mounted resistors:** R104, R106, R107, R109, R110, R107 and R116 **Not mounted resistors:** R103, R105, R108, R111, R112, R113, R117 and R115

Figure 4-1. Position of Required Resistors



4.2 Using SPI Interface via Jumper Wires

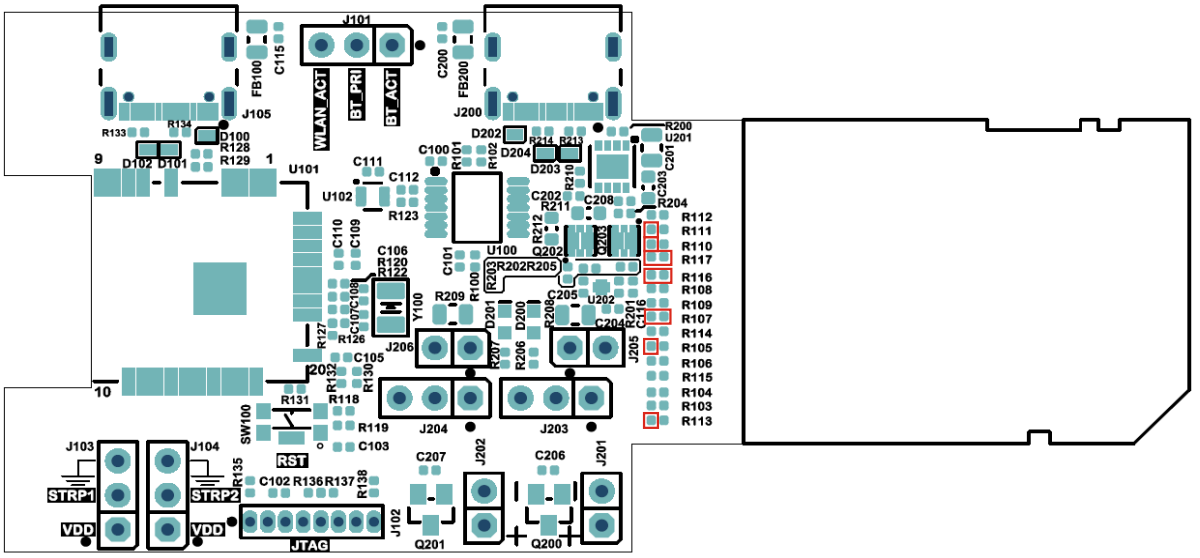
The following hardware (wire jumpers of equal length) rework must be done in the WILCS02-SD board to use the SPI interface rather than the SDIO interface.

Note: The rework below is suggested when the WILCS02-SD board is with default SDIO configuration.

1. Remove resistor R111 and solder the fly wire from the pad of R111 (Highlighted in the below image) to the SPI_$\overline{CS}$ of the host board.
2. Remove resistor R110 and solder the fly wire from the pad of R110 (Highlighted in the below image) to the SPI_RXD of the host board.
3. Remove resistor R105 and solder the fly wire from the pad of R105 (Highlighted in the below image) to the SPI CLK of the host board.
4. Remove resistor R113 and solder the fly wire from the pad of R113 (Highlighted in the below image) to the SPI_TXD of the host board.
   Note: It is recommended to use a short length of the fly wire for the SPI signal line connection.
5. Solder a jumper wire from TP107 or the pad of R116 (see the following figure) to connect it with the interrupt pin of the host board.
6. Use jumper wires to connect $\overline{MCLR}$ from J207 to the corresponding pin of the host board.
7. Solder the fly wire from R107 to the host board 3.3V supply pin to power on the WILCS02-SD board from the host board.

   Note: The user can power on the WILCS02-SD board using a USB Type C® cable as well.
8. Connect a jumper wire from J103 (Pin3) or J104 (Pin3) or solder the jumper wire at TP201 to the Ground of the host board.

Figure 4-2. Accessing SPI Interface Using Jumper Wires



5. Appendix A: Reference Circuit

5.1 WILCS02-SD Board Schematics

Figure 5-1. SD/MMCplus Connector

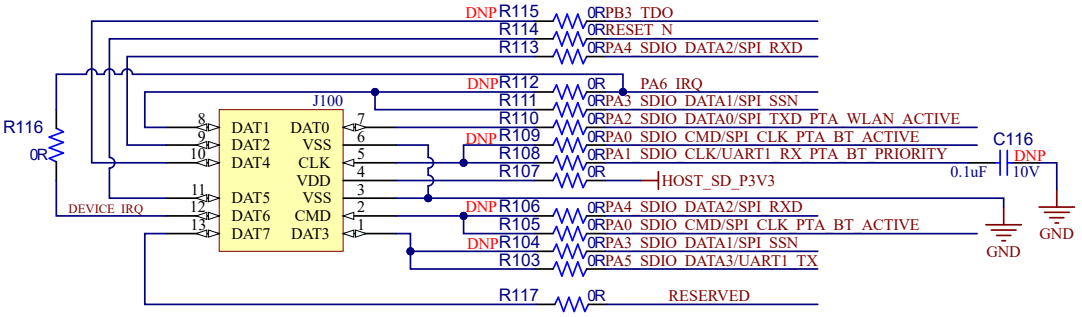


Figure 5-2. Auto Power Distribution Switch for USB and SDIO

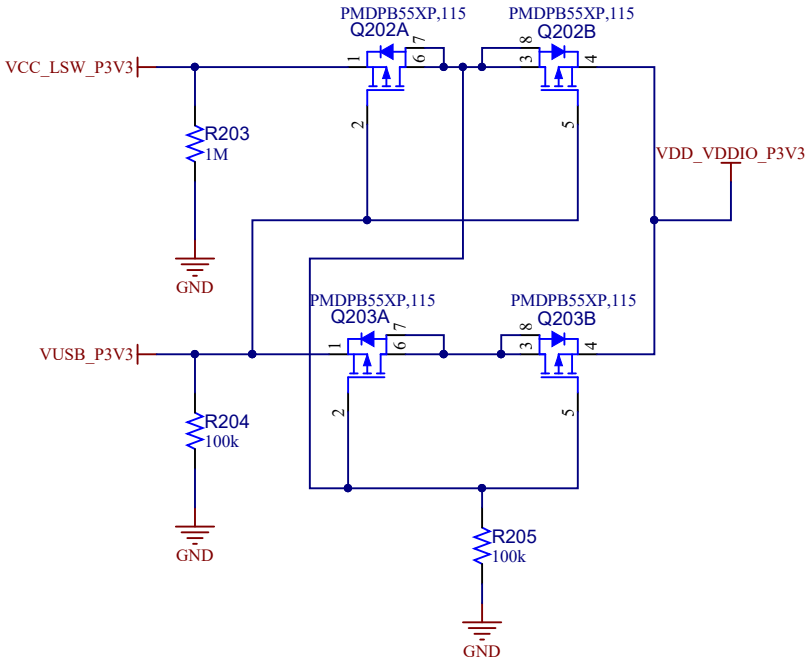


Figure 5-3. 3.3V Regulator

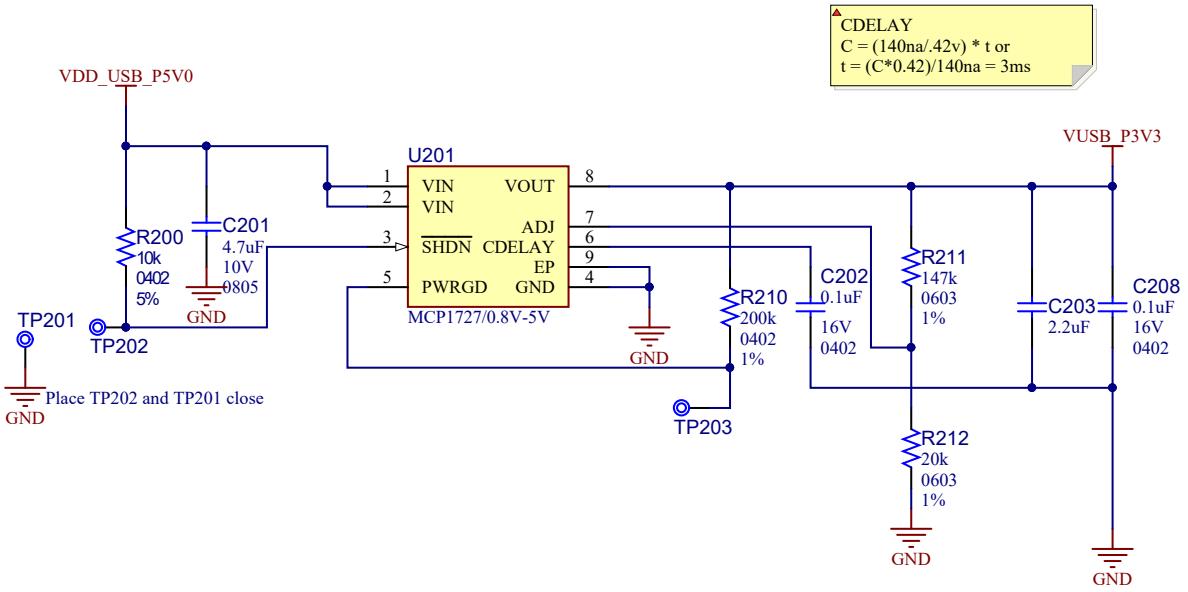


Figure 5-4. USB to UART Converter

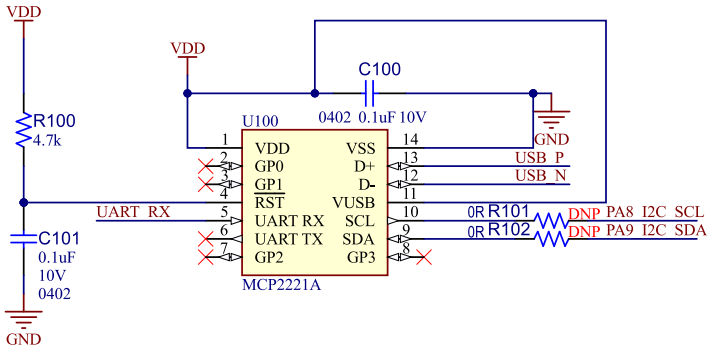


Figure 5-5. RESET Button

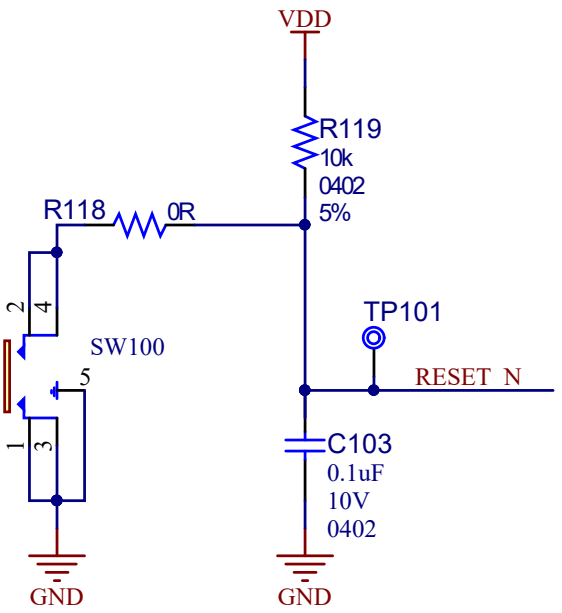


Figure 5-6. Supply and Debug USB Connector

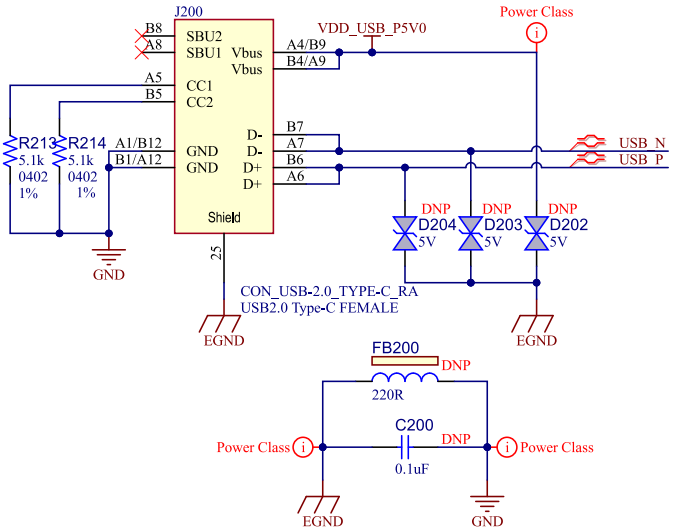


Figure 5-7. Current Measurement Header

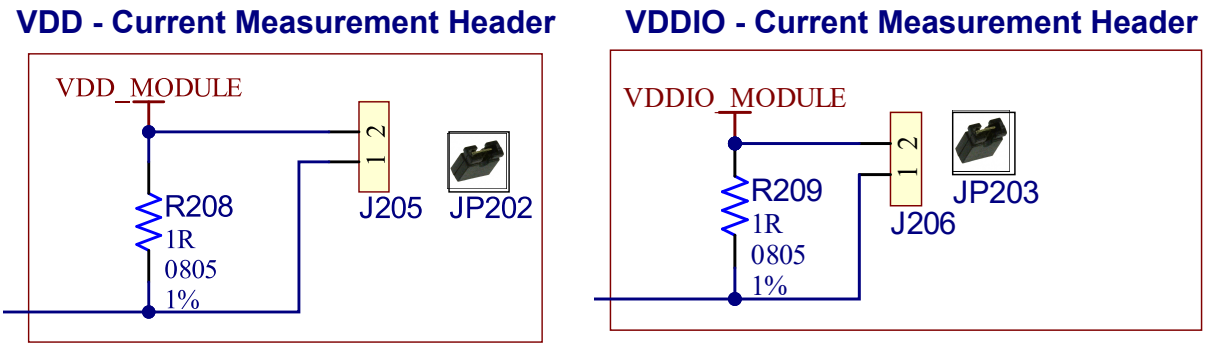


Figure 5-8. PTA Interface Header

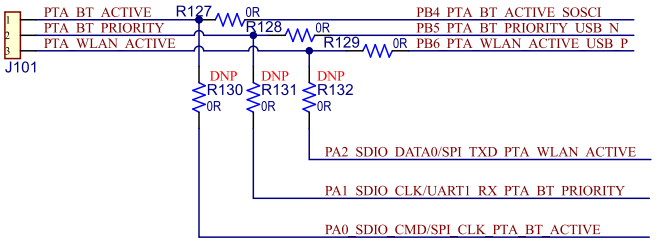
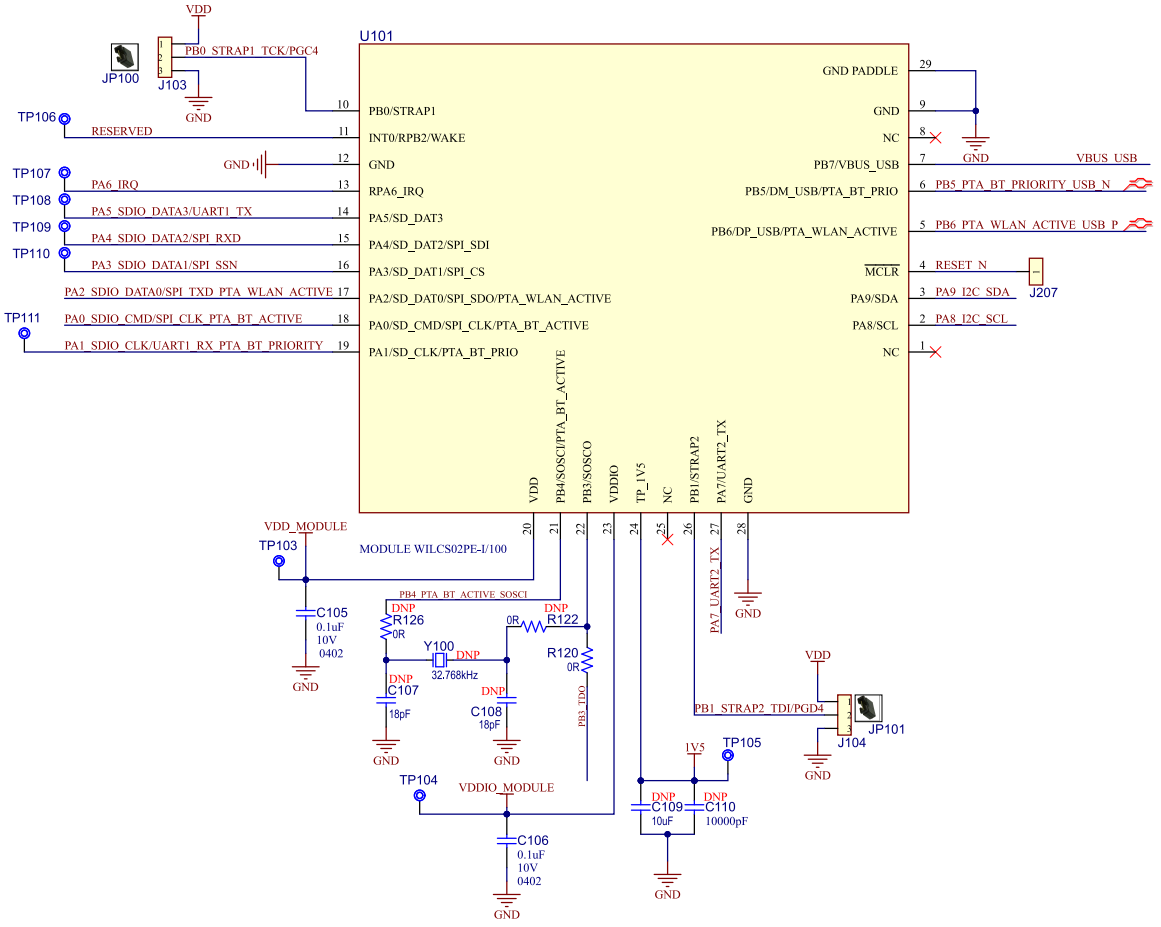


Figure 5-9. WILCS02PE Module



5.2 WILCS02 Wi-Fi® Link Controller SD Board Bill of Materials

For the Bill of Materials (BOM) of the WILCS02 Wi-Fi Link Controller SD Board, go to EV74A47A product web page.

6. Appendix B: Regulatory Approval

This equipment (WILCS02 Wi-Fi® Link Controller SD Board/EV74A47A) 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 WILCS02PE module certifications. The following regulatory notices are to cover the requirements under the regulatory approval.

6.1 United States

The WILCS02 Wi-Fi® Link Controller SD Board (EV74A47A) contains the WILCS02PE 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 WILCS02 Wi-Fi® Link Controller SD Board (EV74A47A) contains the WILCS02PE 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 (EV74A47A) 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 [EV74A47A] is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at EV74A47A (See *Conformity Documents*).

7. Document Revision History

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

Revision	Date	Section	Description
C	09/2024	Hardware	• Updated "WAKE" to "Reserved" in the block diagram • Added note for Reserved
		WILCS02-SD Board SD/MMCplus Connector	• Replaced "Wake" by "reserved signal lines" • For Pin 13, replaced "WAKE" by "Reserved" and added note
		Using SPI Interface via SD/MMCplus Connector	• For Pin 13, replaced "Device Wake" by "Reserved" • Moved "R117" into "Not mounted resistors"
		Using SPI Interface via Jumper Wires	Removed the note for "R117"
		WILCS02-SD Board Schematics	• Updated the SD/MMCplus Connector schematic diagram • Updated the WILCS02PE Module schematic diagram
B	07/2024	Features	Updated
		Acronyms and Abbreviations	Removed "JTAG"
		Reference Documentation	Added web link for the *WILCS02IC and WILCS02 Family Data Sheet*
		Prerequisites	Updated "WILCS02 Wi-Fi® Link Controller SD Board (EV74A47A)"
		Hardware	• Updated the description and manufacturer part number for U101 • Updated "WILCS02-SD Board Block Diagram"
		Power Supply	Reshuffled the order
		Standard SD/MMCplus Connector Pin Specification	Updated the "Connector Pin Details"
		DEBUG Connector (J200)	Updated the terminal settings
		PTA Interface Header (J101)	Updated the description and note
		Kit Overview	Updated WILCS02-SD board top view and bottom view image
		Strapping Pin Header	Added a new section to describe the jumper setting for the SDIO and SPI mode selection
		Using SPI Interface via Jumper Wires	Updated the description
		WILCS02-SD Board Schematics	Updated the following schematics: • USB-to-UART Converter • Supply and Debug USB Connector • PTA Interface Header • WILCS02PE module
		WILCS02 Wi-Fi Link Controller SD Board Bill of Materials	Added a new section along with the official web page link
		Appendix B: Regulatory Approval	Added a new section with regulatory approval details
A	03/2024	Document	Initial revision

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