User Guide

Vela IF820 Development Kit

Version 1.0

REVISION HISTORY

Version	Date	Notes	Contributors	Approver
1.0	19 Sept 2023	Initial Release	Louis Chang Rikki Horrigan Ryan Erickson Mark Duncombe	Jonathan Kaye

CONTENTS

1 INTRODUCTION

The development kit is designed to support performance validation and software development for projects utilizing our Vela IF820 module. This document is intended to assist manufacturers and related parties with the integration of the Vela IF820 into their host devices. Data in this document is drawn from several sources and includes information found in the Vela IF820 datasheet, Infineon CYW20820 datasheet, and FTDI FT232R datasheet.

IMPORTANT: The information in this document is subject to change. Please visit the Vela IF820 product page for the latest information.

1.1 Purpose and Scope

The purpose of this document is to provide details regarding the setup and configuration of the Vela IF820 mounted on the development board. This document covers a description and design examples of the Vela IF820 DVK board and its features.

1.2 Related Documents

The following documents are available from the Vela IF820 product page:

- Vela IF820 Product Brief
- Vela IF820 Datasheet

1.3 Kit Contents

The product kit contains the following:

Development Board x1	The development board has the required Vela IF820 module already soldered onto it and exposes all the various hardware interfaces available
Power supply	USB Cable – Type A to MicroUSB. This cable is also used for the following: ▪ Bluetooth connectivity via the RP2040 on the DVK when the Vela IF820 is configured for HCI UART interface
RF Antenna	Supplied with development kit part # 453-00172-K1 only. External antenna, 2 dBi, FlexPIFA (Laird part #001-0022) with integral RF coaxial cable with 100 mm length and IPEX-4 compatible RF connector.
Jumper cap x 5	Five jumpers for 2.54 mm pitch headers used on Vela IF820 development board.
Fly leads x 6	Six fly leads for IO pin connection

2 VELA IF820 DEVELOPMENT KIT SPECIFICATIONS

Table 1: Development board specifications

Characteristic	Specifications
Configuration Modes	UART
Host Interfaces	USB
Power supplies	▪ **5V**, which may be provided by either microUSB or an external source connected to specific pin header ▪ **Module VBAT 3.3V**, which may be provided a specific external pin header or microUSB ▪ **Module VDDIO 3.3V**, which may be provided by a specific external pin header or microUSB
Antenna gain	▪ 1 dBi peak gain by integrated antenna variant ▪ 2.3dBi peak gain supported by attached external antenna variant
WakeUp signals	▪ BT_HOST_WAKE ▪ BT_DEV_WAKE
Dimension	72.5 mm x 50 mm x 14.2 mm

3 VELA IF820 DEVELOPMENT KIT – MAIN DEVELOPMENT BOARD

The Vela IF820 development board is a fully-featured evaluation platform for the Vela IF820 module. It allows users to evaluate radio performance as well as the creation of prototypes and application-specific designs.

The Vela IF820 development board utilizes a high-performance **Raspberry Pi RP2040** as a USB interface MCU to provide a USB-UART bridge, on-chip-debug, and I/O control features.

3.1 Key Features

The Vela IF820 development board has the following features:

- Vela IF820 series module soldered onto the development board
  - Integrated chip antenna variant or
  - MHF4 connector variant
- Vela IF820 HCI UART can be interfaced to
  - MicroUSB using the RP2040 USB-UART bridge.
  - External UART Source (using J2 pin 1,3,5,7,9,11 comply with FTDI cable (USB to TTL 232)) after development board already powered.
- On-board 3v3 supplied from either USB (5V) or reserved External pin header(J6) (5V).
- Supports module VDDIO at 3v3
- Two tri-color with white LEDs for user interaction, one connected to the Vela IF820 and the other to the RP2040
- One color LED connected to the Vela IF820 for user programming.
- Ability to measure the Vela IF820 module current (J9)
- Dual row 2.54 mm pitch pin headers which bring out all Vela IF820 module interfaces:
  - SWD
  - GPIOs
  - Wakeup signals.
  - SPI
  - I^2C
  - HCI UART
  - PUART
  - RST
- Qwiic Connector for module I^2C
- MikroE Socket for module SPI, I^2C interface, and also module RST, GPIOs
- I^2C EEPROM connected to RP2040 to store settings
- One user button connected to the module
- One reset button for the module, one reset button for RP2040
- One recovery button for the module to enter download mode
- 16Mbit QSPI Flash with BOOTSEL button for the RP2040 firmware storage

4 Hardware Overview

4.1 Block Diagram

Figure 1 shows the block diagram of the development board.

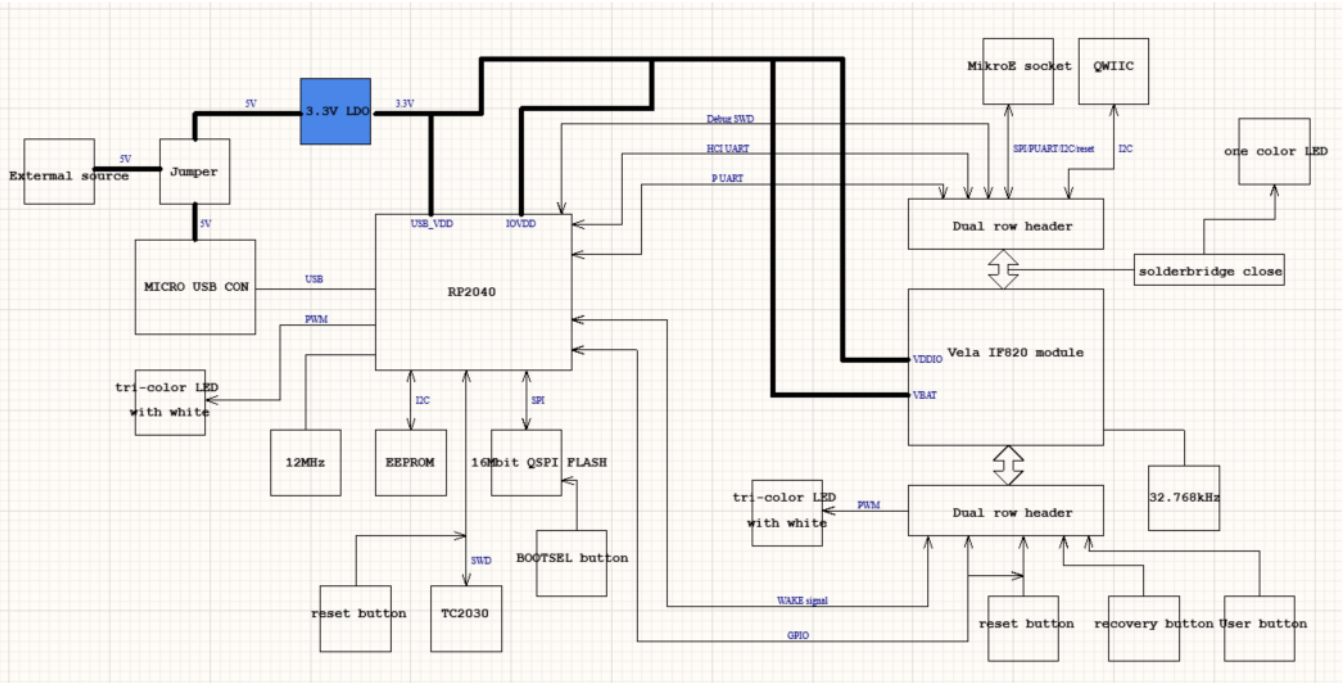


Figure 1: Vela IF820 series module development board block diagram

4.2 Understanding the Development Board

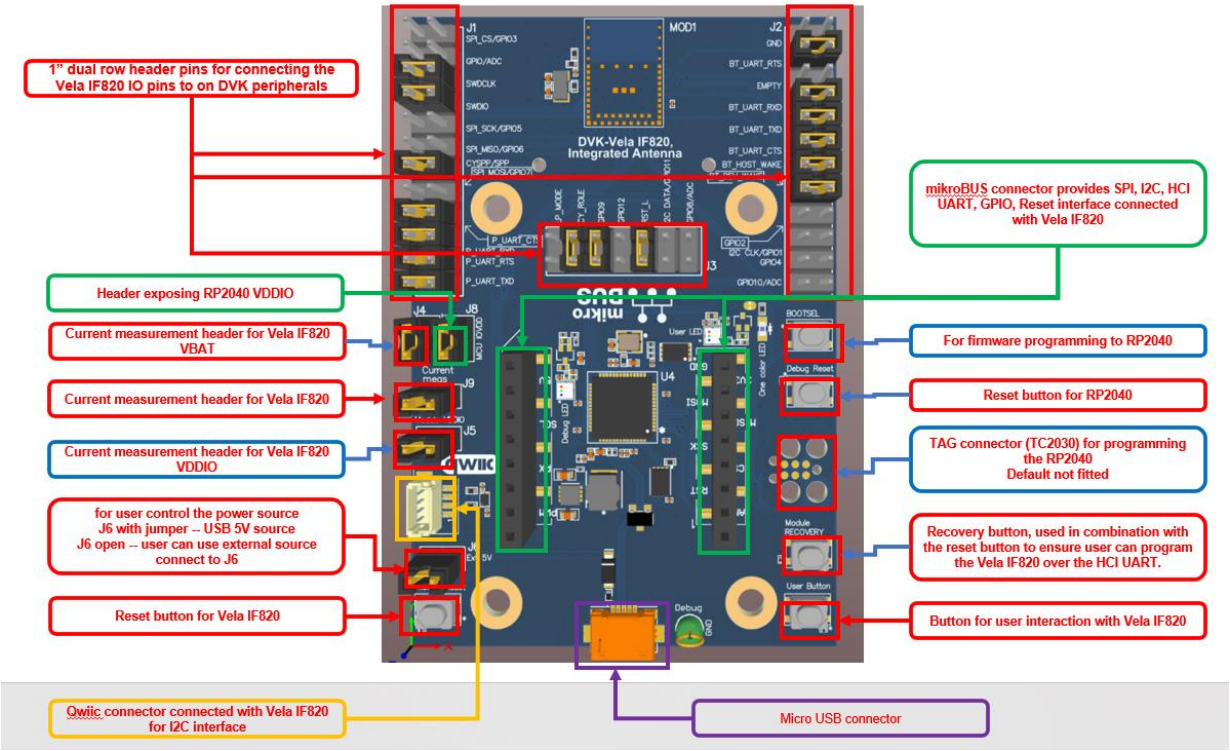


Figure 2: Vela IF820 development board with chip antenna variant

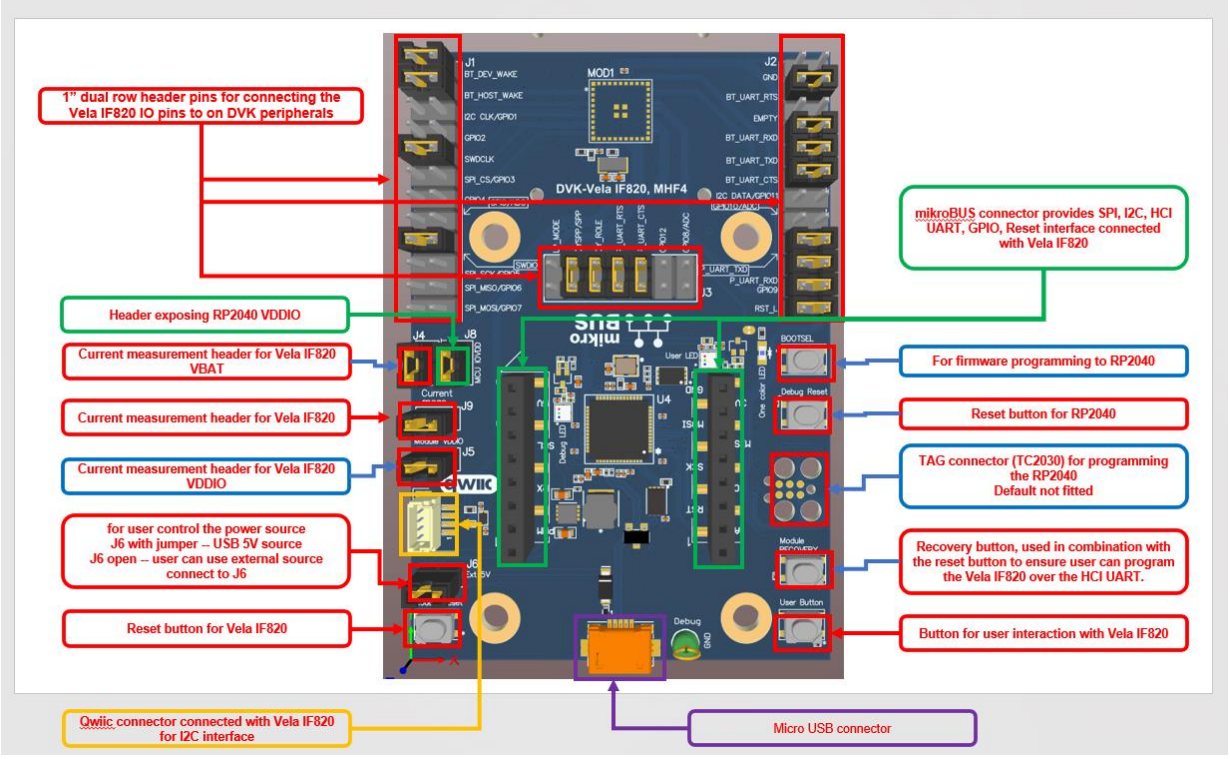


Figure 3: Vela IF820 development board with MHF4 connector variant

4.3 Switches and Connectors

Table 2: Configuration switches and jumpers

Connector	Descriptions
J1,J2,J3	1” dual row header pins for connecting the Vela IF820 IO pins to on DVK peripherals
SW1	Button for user interaction with Vela IF820
SW2	Recovery button, used in combination with the reset button to ensure user can program the Vela IF820 over the HCI UART.
SW301	Reset button for Vela IF820
J6	for user control the power source J6 with jumper -- USB 5V source J6 open -- user can use external source connect to J6
J9	Current measurement header for Vela IF820
J4	Current measurement header for Vela IF820 VBAT
J5	Current measurement header for Vela IF820 VDDIO
J8	Header exposing RP2040 VDDIO
J7	TAG connector (TC2030) for programming the RP2040 Default not fitted
SW4	Reset button for RP2040
SW3	For firmware programming to RP2040
P202	Qwiic connector connected with Vela IF820 for I^2C interface
J201, J202	mikroBUS connector provides SPI, I^2C, HCI UART, GPIO, Reset interface connected with Vela IF820
P900	Micro USB connector

4.4 Dual row 2.54 mm pitch pin headers

1” dual row header pins for connecting the module IO pins to on DVK peripherals like LED, button, mikroBus, etc. Jumpers are installed to work with the on DVK devices or connectors. If the jumpers are removed, then fly leads can be used to connect to off module circuitry or to other on DVK peripherals as needed.

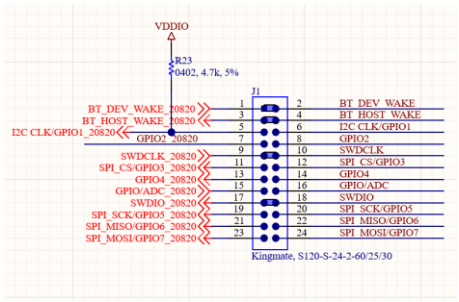
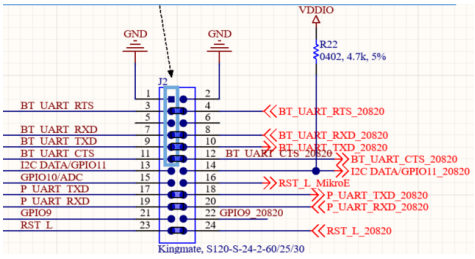
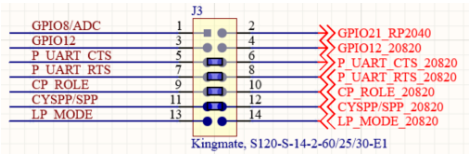
Since there are two types of Vela IF820 (Antenna type and MHF4 type) modules, two DVK variants are required in order to match two different Vela IF 820 modules.

Table 3 shows MHF4 type dual row 2.54mm pitch pin header mapping table.

Note 1**:** Required for dropping an SPP connection in EZ-Serial transparent parse mode.

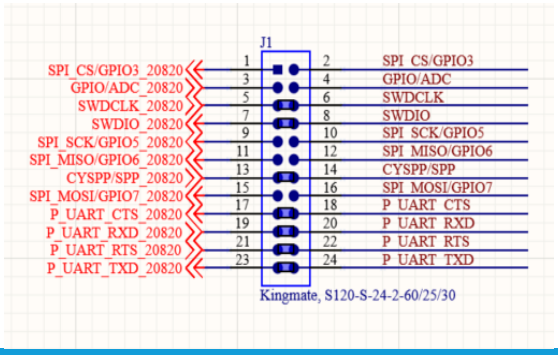
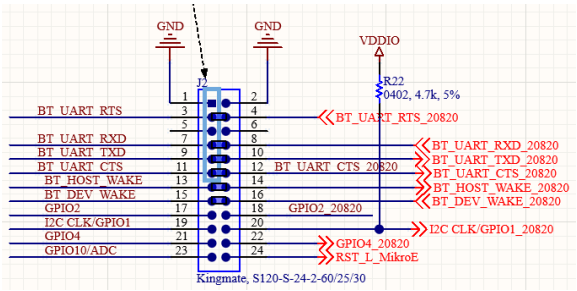
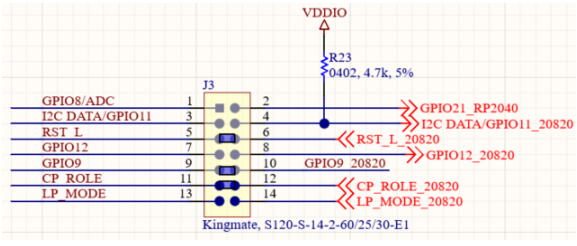
Table 4 shows antenna type dual row 2.54mm pitch pin header mapping table.

Table 3: MHF4 type dual row 2.54mm pitch pin header mapping table

Header Connector	connector.pin	connect to IF820 pin number	IF820 Module pre defined function	Install jumper to work with
	J1.2	1	BT_DEV_WAKE	RP2040
	J1.4	2	BT_HOST_WAKE	RP2040
	J1.6	4	I²C_CLK	MikroE socket and Qwiic
	J1.8	5	GPIO (P4 in CYW20820)	for LED1
	J1.10	6	SWDCLK	RP2040
	J1.12	7	SPI_CS	MikroE socket
	J1.14	8	GPIO (P5 in CYW20820)	MikroE socket
	J1.16	9	GPIO (P8 in CYW20820)	MikroE socket
	J1.18	14	SWDIO	RP2040
	J1.20	15	SPI_SCK	MikroE socket
	J1.22	16	SPI_MISO	MikroE socket
	J1.24	17	SPI_MOSI	MikroE socket
	J2.1	no	GND	no
	J2.3	33	BT_UART_RTS	RP2040
	J2.5	no	empty	no
	J2.7	35	BT_UART_RXD	RP2040
	J2.9	34	BT_UART_TXD	RP2040
	J2.11	36	BT_UART_CTS	RP2040 and recovery button (SW2)
	J2.13	29	I²C_DATA	MikroE socket and Qwiic
	J2.15	28	GPIO (P14 in CYW20820)	MikroE socket
	J2.17	27	P_UART_TXD	RP2040
	J2.19	26	P_UART_RXD	RP2040
	J2.21	25	GPIO (P0 in CYW20820)	for user button (SW1)
	J2.23	24	RST_L	RP2040 and reset button (SW301)
	J3.1	23	GPIO (P27 in CYW20820)	RP2040
	J3.3	30	GPIO (P26 in CYW20820)	MikroE socket
	J3.5	22	P_UART_CTS	RP2040
	J3.7	21	P_UART_RTS	RP2040
	J3.9	20	CP_ROLE	RP2040
	J3.11	19	CYSPP/SPP (Note1)	RP2040
	J3.13	18	LP_MODE	RP2040

Note 1: Required for dropping an SPP connection in EZ-Serial transparent parse mode.

Table 4: Antenna type dual row 2.54mm pitch pin header mapping table

Header Connector	Connector.pin	Connect to IF820 pin number	IF820 Module pre-defined function	Install jumper to work with
	J1.2	6	SPI_CS	MikroE socket
	J1.4	7	GPIO (P8 in CYW20820)	MikroE socket
	J1.6	8	SWDCLK	RP2040
	J1.8	9	SWDIO	RP2040
	J1.10	10	SPI_SCK	MikroE socket
	J1.12	11	SPI_MISO	MikroE socket
	J1.14	12	CYSPP (Note1)	RP2040
	J1.16	13	SPI_MOSI	MikroE socket
	J1.18	14	P_UART_CTS	RP2040
	J1.20	15	P_UART_RXD	RP2040
	J1.22	16	P_UART_RTS	RP2040
	J1.24	17	P_UART_TXD	RP2040
	J2.1	no	GND	no
	J2.3	24	BT_UART_RTS	RP2040
	J2.5	no	empty	no
	J2.7	26	BT_UART_RXD	RP2040
	J2.9	25	BT_UART_TXD	RP2040
	J2.11	27	BT_UART_CTS	RP2040 and recovery button (SW2)
	J2.13	29	BT_HOST_WAKE	RP2040
	J2.15	28	BT_DEV_WAKE	RP2040
	J2.17	37	GPIO (P4 in CYW20820)	for LED1
	J2.19	35	I^2C_CLK	MikroE socket and Qwiic
	J2.21	19	GPIO (P5 in CYW20820)	MikroE socket
	J2.23	18	GPIO (P14 in CYW20820)	MikroE socket
	J3.1	33	GPIO (P27 in CYW20820)	RP2040
	J3.3	35	I^2C_DATA	MikroE socket and Qwiic
	J3.5	34	RST_L	RP2040 and reset button (SW301)
	J3.7	36	GPIO (P26 in CYW20820)	MikroE socket
	J3.9	32	GPIO (P0 in CYW20820)	for user button (SW1)
	J3.11	31	CP_ROLE	RP2040
	J3.13	30	LP_MODE	RP2040

Note 1: Required for dropping an SPP connection in EZ-Serial transparent parse mode.

5 Functional Blocks

5.1 Power Architecture

Figure 4 shows the Vela IF820 development board power supply architecture.

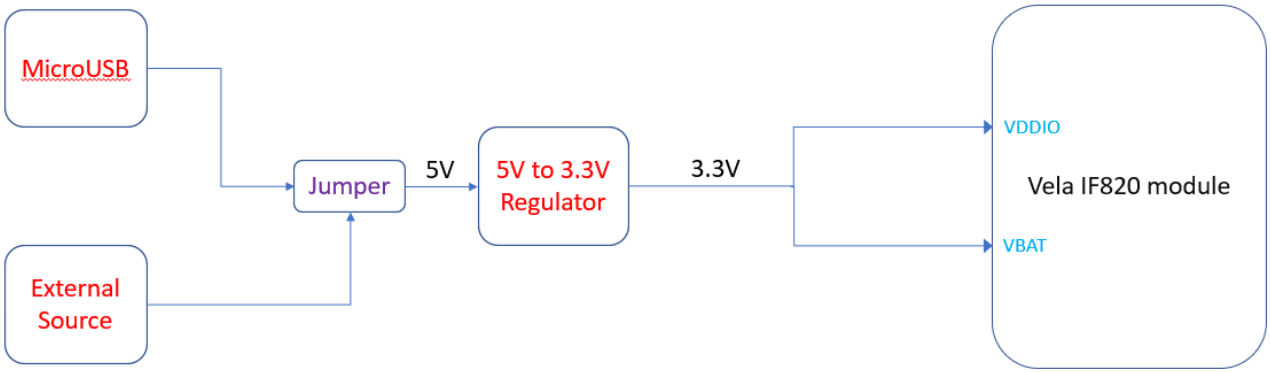


Figure 4: Vela IF820 development board power architecture

The Vela IF820 radio module requires one primary power source that supply all other internal power rails – VBAT and VDDIO. The VDDIO source provides power for the radio IO portions, and the VBAT source provides power for all other radio needs.

The DVK provides 3.3V power for both VDDIO and VBAT by a 5V to 3.3V on board regulator. 5V input can be either supplied from Micro USB or external source by jumper (J6) cap installing or not. Installing the jumper cap on J6 (default) means 5V can be drawn from Micro USB. If an external source is preferred, the jumper should be removed from J6 and an external source should connected to J6.

See **Error! Reference source not found.** for an example of the external 5V power supply through the external source.

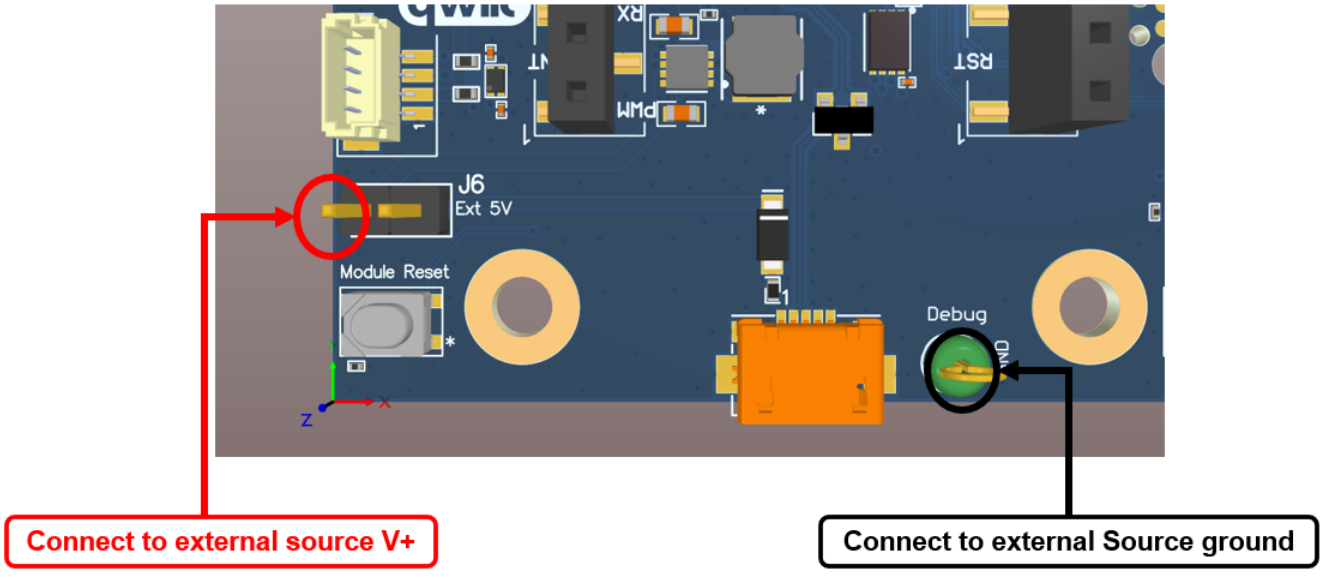


Figure 5: Example of the external 5V power supply through the external source

5.2 Programming the RP2040 Firmware

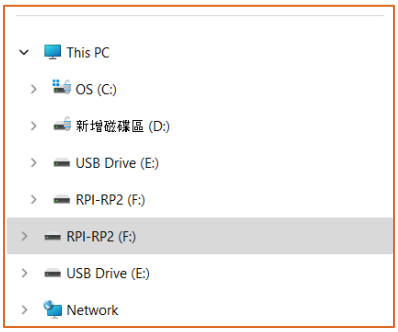
5.2.1 Via Micro USB interface

Programming firmware is done over USB via BOOTSEL mode.

Figure 6: BOOTSEL button

To enter BOOTSEL mode on the RP2040 and load code over USB, the user needs to hold the BOOTSEL button down, and then reset the board in some way. To do so, unplug and then reconnect the USB connector, or press the RP2040 reset button if one is available.

Once in BOOTSEL mode, the user should see a USB storage device show up on their computer named “RPI-RP2“. Drag-and-drop the firmware .uf2 file onto the storage device. The firmware will be loaded and the RP2040 will reset.



5.2.2 Via SWD interface

Programming firmware can also be done via the SWD interface.

Use a Tag-Connect cable to connect with the onboard TC2030 footprint. The SWD interface can then be used to program or debug the RP2040.

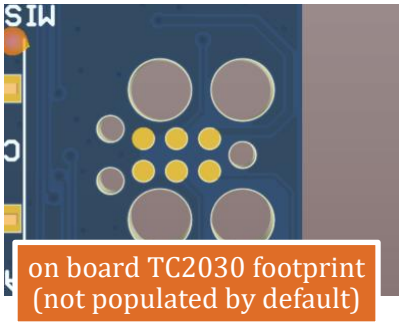
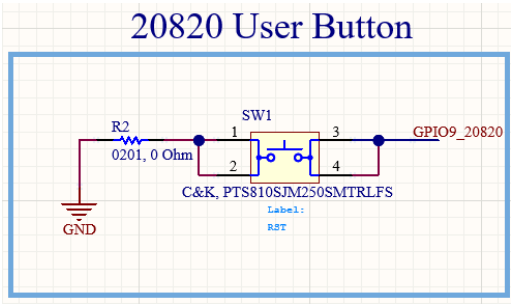


Figure 7: TC2030 footprint

5.3 Miscellaneous

5.3.1 User Button

One push button is reserved for user interaction with Vela IF820. It connects one of the pins of the Vela IF820, mapping to P0 of the CY20820 chipset. Pressing this button grounds this pin. Please see the GPIO pin numbers of the different Vela IF820 module variants in the table below

Header Connector	MHF4 variant	Antenna variant	note
	Vela IF820 pin 25 (P0 of CYW20820)	Vela IF820 pin 32 (P0 of CYW20820)	Jumper should be installed in: ▪ MHF4 variant : J2 pin 21 – 22 ▪ Antenna variant : J3 pin 9 - 10

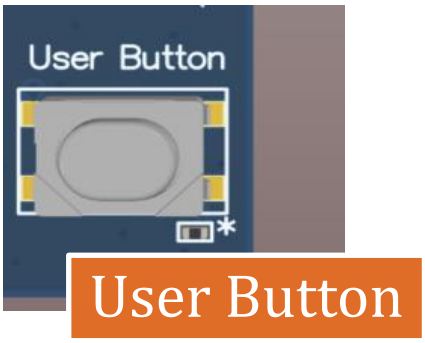


Figure 8: USER button

5.3.2 Tri-color LED (User LED)

One tri-color LED is reserved for user programming with the Vela IF820. It connects to one of the pins of the Vela IF820 module pins, mapping to P4 of the CYW20820 chipset. Please see the GPIO pin in different variants in the table below.

Another tri-color LED is connected to the RP2040 to provide user feedback. The RP2040 LED functions are:

- Flashes white twice when the RP2040 boots
- Flashes blue for UART0 (HCI) TX and RX
- Flashes red for UART1 (EZ-Serial) TX and RX
- Flashes green for USB DAP (debugger) commands

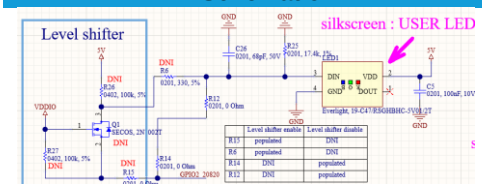
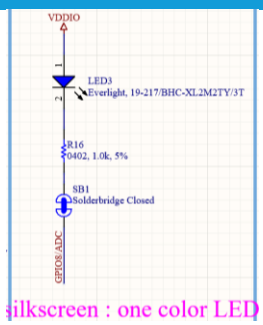
Schematic	MHF4 variant	Antenna variant	note
	Vela IF820 pin 5 (P4 of CYW20820)	Vela IF820 pin 37 (P4 of CYW20820)	Jumper should be installed in: ▪ MHF4 variant : J1 pin 7 – 8 ▪ Antenna variant : J2 pin 17 - 18

Figure 9: Tri-color LED

5.3.3 One color LED

One color LED reserved for user applications with Vela IF820. It connects to one of Vela IF820 module pins, mapping to P27 of CYW20820 chipset. Please see the GPIO pin in different variant in the table below.

Schematic	MHF4 variant	Antenna variant	note
	Vela IF820 pin 23 (P27 of CYW20820)	Vela IF820 pin 33 (P27 of CYW20820)	

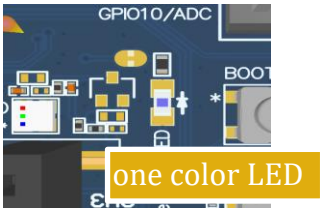
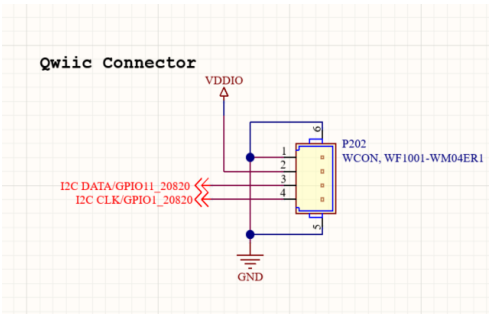


Figure 10: One color LED

5.3.4 Qwiic connector

A Qwiic connector connected to Vela IF820 is reserved for user programming. Mapping table is shown as below.

Header Connector	Connector.pin	Qwiic pre defined function	Note
	P202.1	GND	
	P202.2	VDDIO	3.3V by default
	P202.3	I^2C DATA	jumper should be installed in MHF4 variant : J2 pin 13-14 Antenna variant : J3 pin 3-4 then can work with Vela IF820
	P202.4	I^2C CLK	jumper should be installed in MHF4 variant : J1 pin 5-6 Antenna variant : J2 pin 19-20 the can work with Vela IF820
	P202.5	GND	
	P202.6	GND	

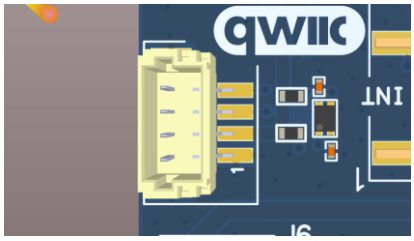


Figure 11: QWIIC connector

5.3.5 MikroE connectors

A MikroE connector is connected to Vela IF820 and is reserved for user programming. Mapping table is shown as below.

Table 5: J202 Pin Map

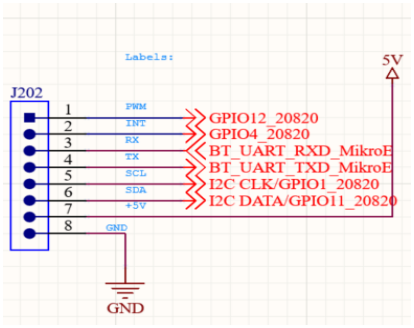
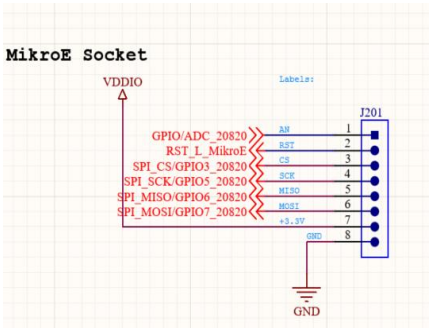
Header Connector	Connector.pin	MikroE pre-defined function	Note
	J202.1	GPIO	Jumper should be installed in: ▪ MHF4 variant : J3 pin 3-4 ▪ Antenna variant : J3 pin 7-8
	J202.2	GPIO	Jumper should be installed in: ▪ MHF4 variant : J1 pin 13- 14 ▪ Antenna variant : J2 pin 21-22
	J202.3	P_UART_RXD	Jumper should be installed in: ▪ MHF4 variant : J2 pin 19- 20 ▪ Antenna variant : J1 pin 19- 20
	J202.4	P_UART_TXD	Jumper should be installed in: ▪ MHF4 variant : J2 pin 17-18 ▪ Antenna variant : J1 pin 23-24
	J202.5	I^2C_CLK	Jumper should be installed in: ▪ MHF4 variant : J1 pin 5-6 ▪ Antenna variant : J2 pin 19-20
	J202.6	I^2C_DATA	Jumper should be installed in: ▪ MHF4 variant : J2 pin 13-14 ▪ Antenna variant : J3 pin 3-4
	J202.7	5V	
	J202.8	GND	

Table 6: J201 Pin Map

Header Connector	Connector Pin	MikroE pre defined function	note
	J201.1	GPIO	Jumper should be installed in ▪ MHF4 variant : J1 pin 15 -16 ▪ Antenna variant : J1 pin 3 - 4
	J201.2	RST_L	Jumper should be installed in ▪ MHF4 variant : J2 pin 23 – 24 ▪ Antenna variant : J3 pin 5 – 6
	J201.3	SPI_CS	Jumper should be installed in ▪ MHF4 variant : J1 pin 11 – 12 ▪ Antenna variant : J1 pin 1 – 2
	J201.4	SPI_SCK	Jumper should be installed in ▪ MHF4 variant : J1 pin 19 – 20 ▪ Antenna variant : J1 pin 9 – 10
	J201.5	SPI_MISO	Jumper should be installed in ▪ MHF4 variant : J1 pin 21 – 22 ▪ Antenna variant : J1 pin 11 – 12
	J201.6	SPI_MOSI	Jumper should be installed in ▪ MHF4 variant : J1 pin 23 – 24 ▪ Antenna variant : J1 pin 15 – 16
	J201.7	VDDIO	3.3V by default
	J201.8	GND	

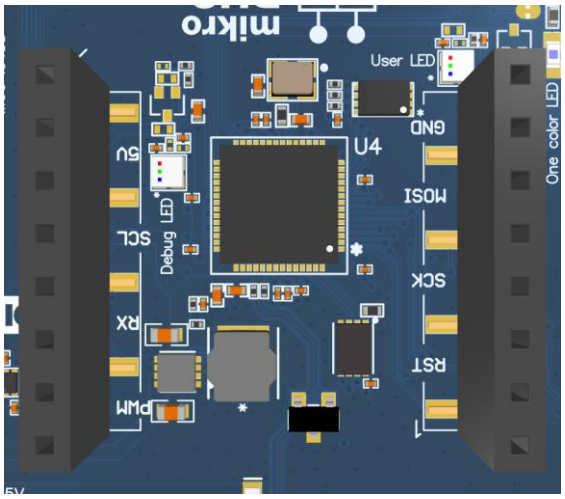


Figure 12: MikroE connector

Please note P-UART function of MikroE connector is workable after hardware version 4.0, checked by reviewing silkscreen on the backside of the DVK, the previous HW version is not functional for this feature.

Figure 13: Version illustration

5.3.5.1 Vela IF820 P-UART function selection between MikroE and RP2040

Default P-UART connection of DVK is to Vela IF820 and RP2040, by the solder bridge as shown in the Figure 14. Once user wants to use P-UART function working with MikroE device, please cut the solder bridge between Vela IF820 and RP2040 for any interference prevented.

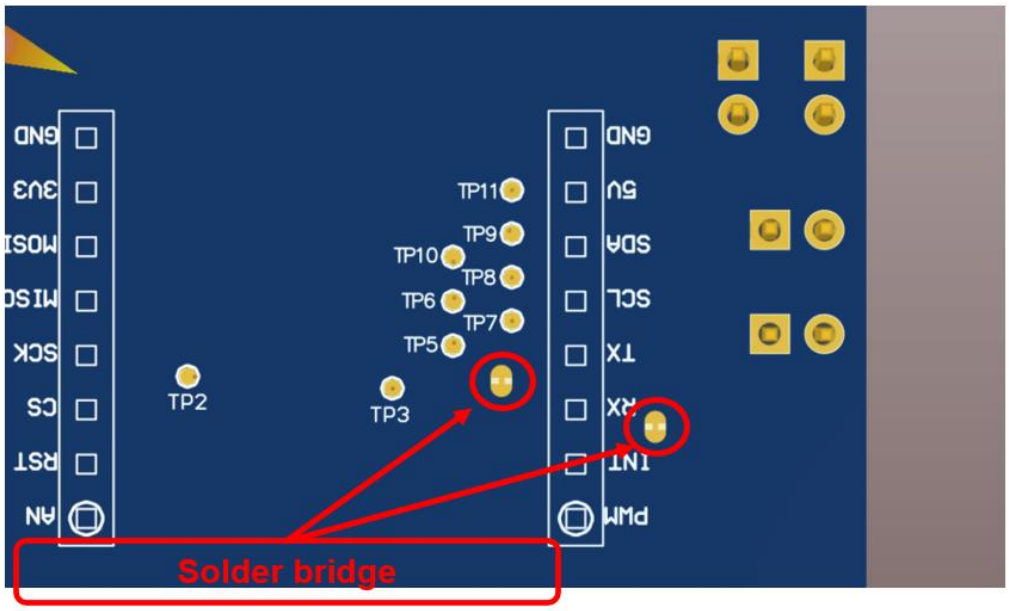


Figure 14: Solder bridge connects Vela IF820 and RP2040

5.3.6 Current measurement

The Vela IF820 development board provides a pin header (J9) to conduct current measurements. To measure current consumption of the Vela IF820 module, uninstall J9 cap and connect a current meter in series with the corresponding header.

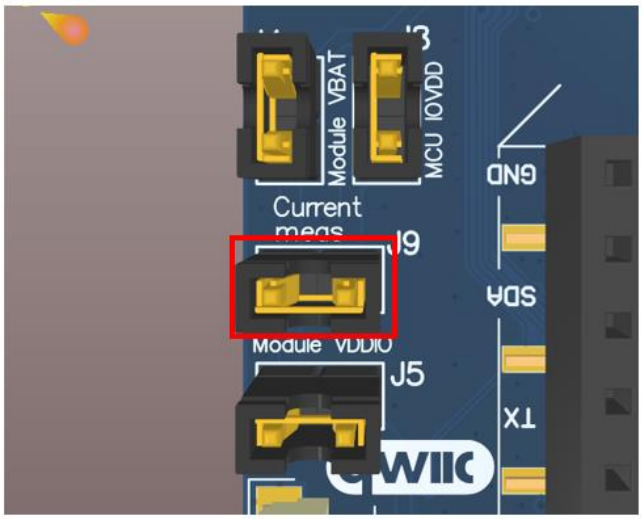


Figure 15: J9 for module current measurement

5.3.7 HOST USB to Vela IF820 HCI UART bridge

The Vela IF820 development board reserves J2 pins 1,3,5,7,9, and 11 to enable USB communication via an external USB to TTL-232 (3.3V) cable. Figure 16 demonstrates how to connect the cable to the J2 header.

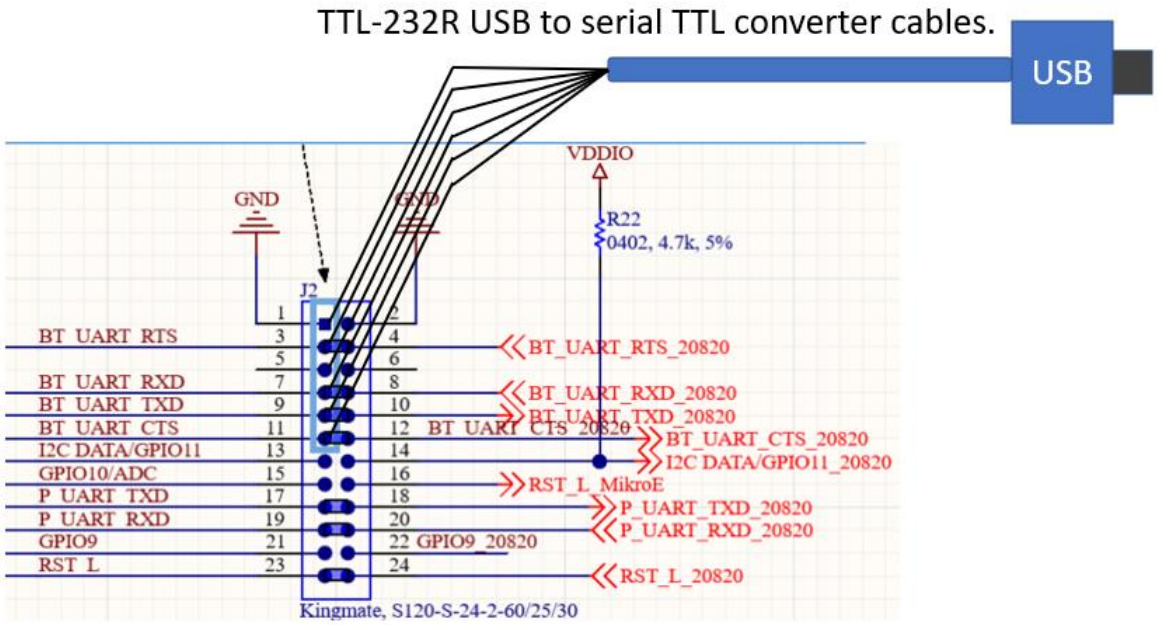


Figure 16: Using USB to TTL-232 (3.3V) cable to connect to Vela IF820 directly

Figure 17 shows a real example of using a USB to TTL-232 (3.3V) cable to connect a laptop to the IF820.

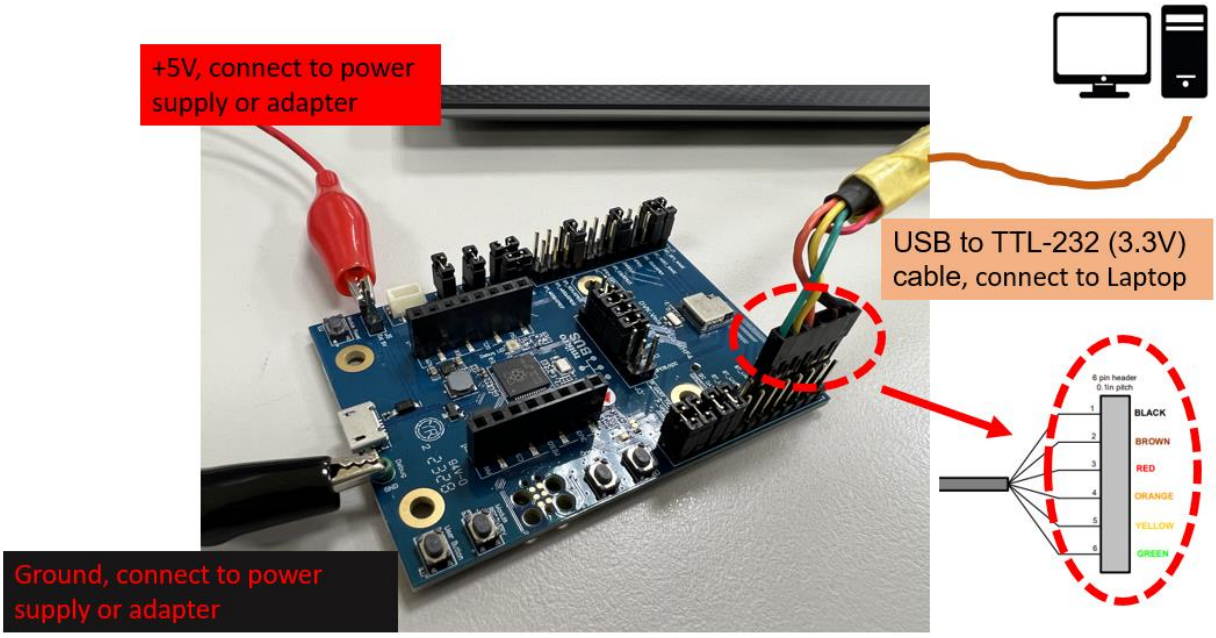


Figure 17: Photo of USB to TTL-232 (3.3V) cable connected to Vela IF820

Table 7 shows how Vela IF820 HCI UART maps to on board pin header, as well as the suggested TTL-232R cable pin.

Table 7: USB mapping

pin number	Vela IF820	TTL-232R cable	TTL-232R cable color
J2.1	GND	GND	Black
J2.3	BT_UART_RTS	HOST_CTS	Brown
J2.5	No connect to IF820	power	Red
J2.7	BT_UART_RXD	HOST_TXD	Orange
J2.9	BT_UART_TXD	HOST_RXD	Yellow
J2.11	BT_UART_CTS	HOST_RTS	Green

5.3.8 HOST USB to Vela IF820 Peripheral UART bridge

Same as HCI UART, the user can use a USB to TTL-232 (3.3V) cable via on board 2.54 mm pitch pin headers to communicate to a laptop and Vela IF820 Peripheral UART. Figure 18 shows a real example of integrated antenna variant and MHF4 variant connection.

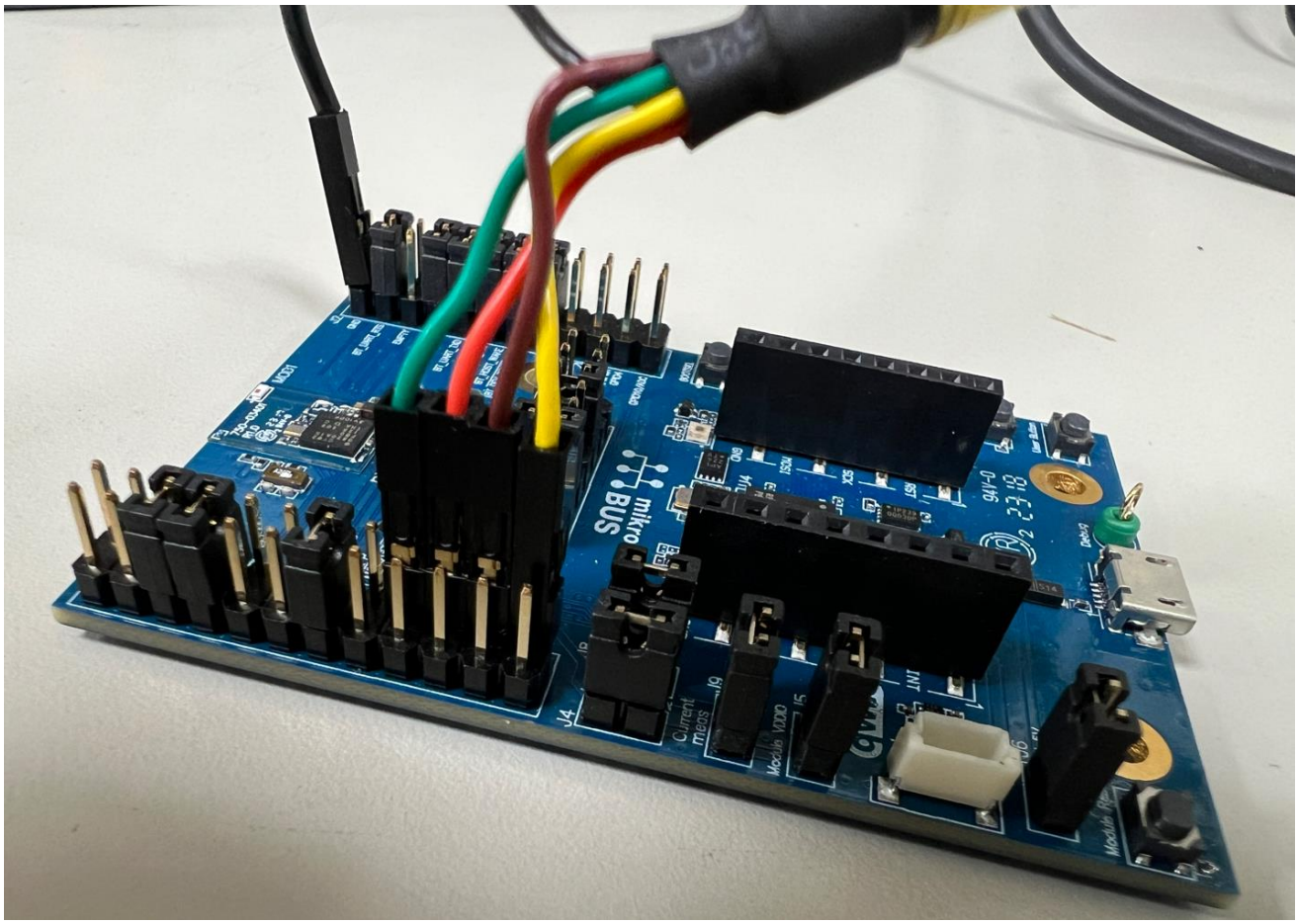


Figure 18: Photo of USB to TTL-232 (3.3V) cable connected to integrated antenna variant Vela IF820 PUART directly

Table 8 shows how Vela IF820 PUART for integrated antenna variant maps to on board pin header, and also TTL-232R cable pin suggested.

Table 8: UART mapping, integrated antenna board

Pin Number	Vela IF820 PUART	TTL-232R cable	TTL-232R cable color
J2.1	GND	GND	Black
J1.22	P_UART_RTS	HOST_CTS	Brown
	No connect to IF820	power	Red
J1.20	P_UART_RXD	HOST_TXD	Orange
J1.24	P_UART_TXD	HOST_RXD	Yellow
J1.18	P_UART_CTS	HOST_RTS	Green

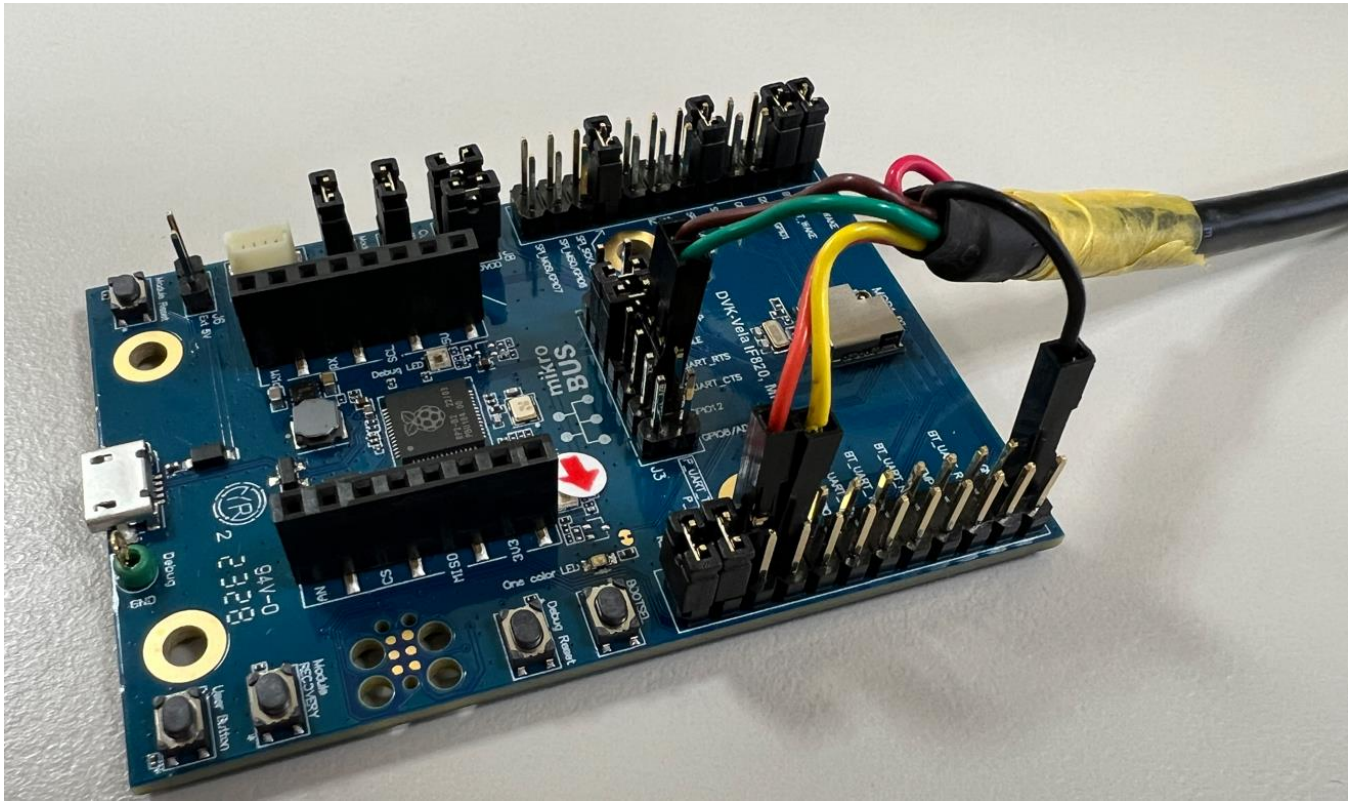


Figure 19: Photo of USB to TTL-232 (3.3V) cable connected to MHF4 variant Vela IF820 PUART directly

Table 9 shows how Vela IF820 PUART for MHF4 variant maps to on board pin header, and also TTL-232R cable pin suggested.

Table 9: UART mapping, MHF4 board

Pin Number	Vela IF820	TTL-232R cable	TTL-232R cable color
J2.1	GND	GND	Black
J3.7	P_UART_RTS	HOST_CTS	Brown
	No connect to IF820	power	Red
J2.19	P_UART_RXD	HOST_TXD	Orange
J2.17	P_UART_TXD	HOST_RXD	Yellow
J3.5	P_UART_CTS	HOST_RTS	Green

6 SOFTWARE

Please see the Vela IF820 series product page for links to the latest software, documentation, drawings, schematics, and more.

7 REFERENCES

1. Infineon-CYW20820-DataSheet-v01_00-EN, 002-24743 Rev. *G, Cypress Semiconductor Corporation.
2. rp2040-datasheet, Raspberry Pi Ltd
3. FT232R, USB UART IC datasheet, FT_000053, Future Technology Devices International Limited.

8 Additional Information

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