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Flexbridge Module

Bluetooth, ANT, NFC wireless module

The 4iiii Flexbridge (FB100) module is a wireless PCB module that provides Bluetooth 5.0 and ANT/ANT+ connectivity for integration with 4iiii's fitness equipment products. It supports standard Bluetooth profiles such as FTMS to allow peripherals to easily integrate data. Flexbridge is not for external sale, but will be used in 4iiii owned products at this time.

Main Flexbridge Features

ANT+:
Provides wireless sensors, fitness leaderboard connectivity.

ANT:
Provides a simple relay mesh network for syncing data between multiple Flexbridge modules.

BLE:
Connects Flexbridge to mobile apps, smart watches, and BLE enabled sensors.

NFC Reader:
The Flexbridge contains an NFC reader to facilitate connection to Apple watches and Samsung Galaxy watches.

Certifications:
Flexbridge (will have) has full RF certifications in North America, Europe, Aus/NZ.

Interface:
The Flexbridge is a surface mounted pcb module, which should be SMT mounted on the host PCB. The host PCB provides the power supply for the Flexbridge. As well, the host PCB sends commands to configure the flexbridge through a UART host controller interface. (Specification available).

Specifications

Supply Voltage:
Min / Typical / Max 3.0 / 3.3 / 3.6 V

Sleep Current:
Flexbridge has a low power sleep mode, drawing less than 30 μA.

Interface Protocol:
4iiii specific HCI protocol.

BLE Frequency:
2402MHz to 2480MHz. See the FB100 Theory of Operation.

ANT+ Frequency:
2457 MHz

ANT Frequency:
2402MHz to 2480MHz. See the FB100 Theory of Operation.

NFC Frequency:
13.56 MHz

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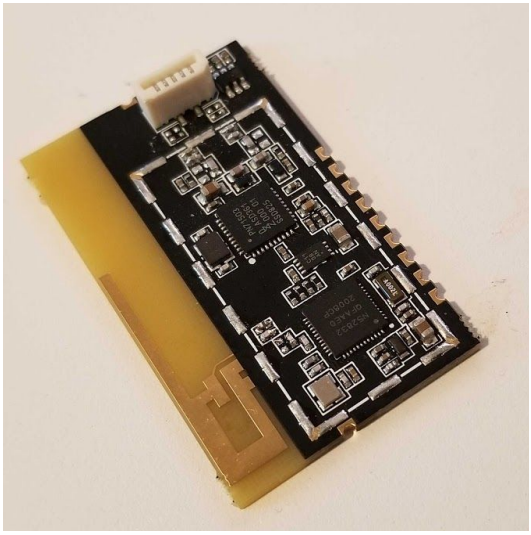
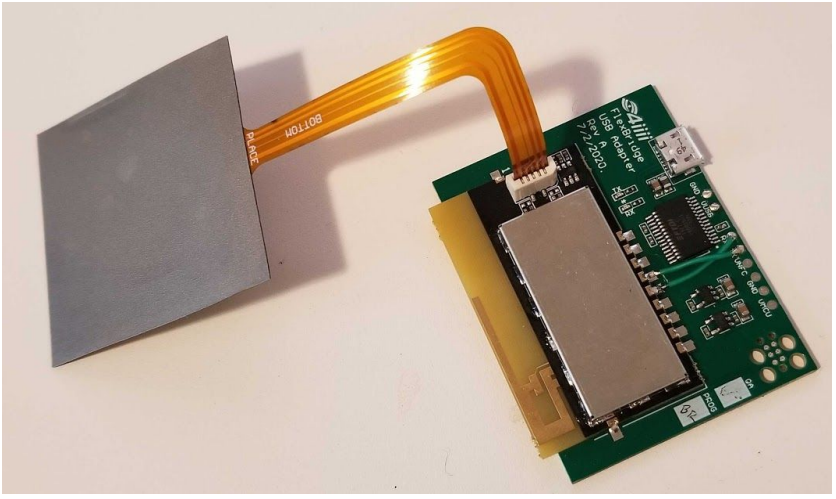
FB100 Operational Description

FCC ID:	ZZN-FB100
IC ID:	9896A-FB100
Model No.(s) Covered :	FB100
Model Name(s):	Flexbridge



FB100 module without shield and NFC antenna to show internal parts



FB100 module with shield, NFC antenna, and mounted on host PCB

Background

The FB100 Flexbridge Module is a printed circuit board mounted wireless module. It gives Bluetooth Low Energy, ANT+, and NFC capabilities to the host system. It receives commands

from the host system through a UART interface. Power is provided from the host PCB, and must be regulated by the host to within the specification.

The Flexbridge can act as a BLE Central, BLE Peripheral, ANT+ transmitter, ANT+ receiver, and NFC Reader simultaneously, depending on the configuration commands from the host.

Environmental

Operating temperature: -20C to +50C
Storage temperature: -30C to + 75C

Electrical

	Note	Min	Nominal	Max	Unit
Supply Voltage	VDD_NFC, VDD_MCU	3.0	3.3	3.6	V
Supply Current	VDD_MCU, shutdown	-	-	20	μA
	VDD_MCU, idle	-	-	1.5	mA
	VDD_MCU, BLE advertising	-	-	10	mA
	VDD_NFC, shutdown	-	-	14	μA
	VDD_NFC, idle	-	-	20	μA
	VDD_NFC, Reader mode	-	-	190	mA
I/O voltage	All IO pins	VDD_MCU-0.3	VDD_MCU	3.6	V
Host Interface	Baud Rate		9600 57600 115200 250000 1000000		
	UART Channel Config		8, n, 1		

RF communication

The FB100 uses a single chip radio transceiver to implement two wireless protocols in the 2.4 GHz band on a common PCB strip line antenna. The two protocols are ANT+ wireless and Bluetooth low energy (BTLE) wireless. The antenna is not alterable by user and is consistent across all models.

The 2.4 GHz radio uses a maximum 0 dBm transmit drive (1mW) for both ANT+ and BLE protocols, conforming to specified occupied bandwidth, frequency accuracy and drift. Frequency deviation is defined as the channel bandwidth about the carrier frequency: ±170kHz. The modulation used is Gaussian Frequency Shift Keying (GFSK).

The FB100 also uses a NFC controller to implement the NFC reader capabilities at 13.56 MHz. It can read NFC Tags of Type 1, 2, 3, 4 or 5, with various modes.

ANT

The unit can support up to 8 independent ANT communication channels open at a time. Each channel can be configured to a different purpose including ANT transmitter (Tx) , or ANT receiver (Rx), and ANT-FS. Channels are shared with the time division multiple access (TDMA) scheme. For data transfer, the frequency switches to anywhere on the 2.4GHz ISM Band (2402MHz-2480MHz) at rates up to 20kbps.

BTLE

BTLE uses frequency hopping to counteract narrowband interference problems. Classic Bluetooth also uses frequency hopping but the details are different; as a result, while both FCC and ETSI classify Bluetooth technology as an FHSS scheme, BTLE is classified as a system using digital modulation techniques or a direct-sequence spread spectrum. The radio maintains one RF link with a single device at multiple frequencies. During advertising mode the frequencies used are 2402MHz, 2426MHz, and 2480MHz. The maximum data rate during advertising is 8kbps. During data transfer the frequencies used are the even multiples of 2MHz from 2402MHz to 2480MHz. The maximum data rate during data transfer is 21.280kbps. Dynamic frequency selection is employed if the current channel used is crowded. It will switch to any of the other data transfer frequencies.

The version of the bluetooth low energy is BT 5.0.

Total 40 channels are used for the BLE radio, the first channle is located at 2402MHz, the last channle is located at 2480MHz, 2MHz space between each two adjacent channels.

The radio modulation type is GFSK, data rate ued for this product is 1Mbps.

NFC

NFC enables contactless communication at 13.56 MHz. NFC operates in a process defined as RF Discovery by NFC Controller Interface. RF Discovery is a cyclical process where the NFC Controller (NFCC) alternates between a Polling Phase, where the NFCC behaves as a reader, and a Listening Phase, where the NFCC behaves as a card or target.

transmission, data can only be transferred at bit rates of 212 or 424 kbps. The modulation scheme for transmission of all technologies is Amplitude Shift Keying (ASK), and the bit coding is Modified Miller scheme.

In the receiving data from a card, the NFCC receives data modulated by the card with subcarrier load modulation at a subcarrier frequency of 13.56MHz / 16. The bit coding in this mode at 106 kbps data rate is Manchester encoding, while at 212, 424, and 848 kbps it is BPSK.

Frequency Control

The FB100 module derives all frequencies from high accuracy crystals tuned to 32.768 KHz tuning fork crystal for real time clock counters and 32.000 MHz for the processor system clock as well as the basis for the internal 2.4 GHz local oscillator for the digitally controlled radio carrier. The NFC controller derives it's CPU clock and NFC carrier frequency from a 27.12 MHz high accuracy crystal.

Power control

The FB100 module should be powered according to the Supply Voltage electrical specifications by the host system. The host could switch the power on and off to the module with no ill effects.

Antennas

2.4 GHz antenna:

The FB100 uses an "F" type strip-line antenna, integral to the PCB, with a nominal gain of 0.0 dBi. The antenna is not user accessible nor is it alterable by the user. The antenna, tuning elements, transmitter and ground plane are consistent for all models described in this document.

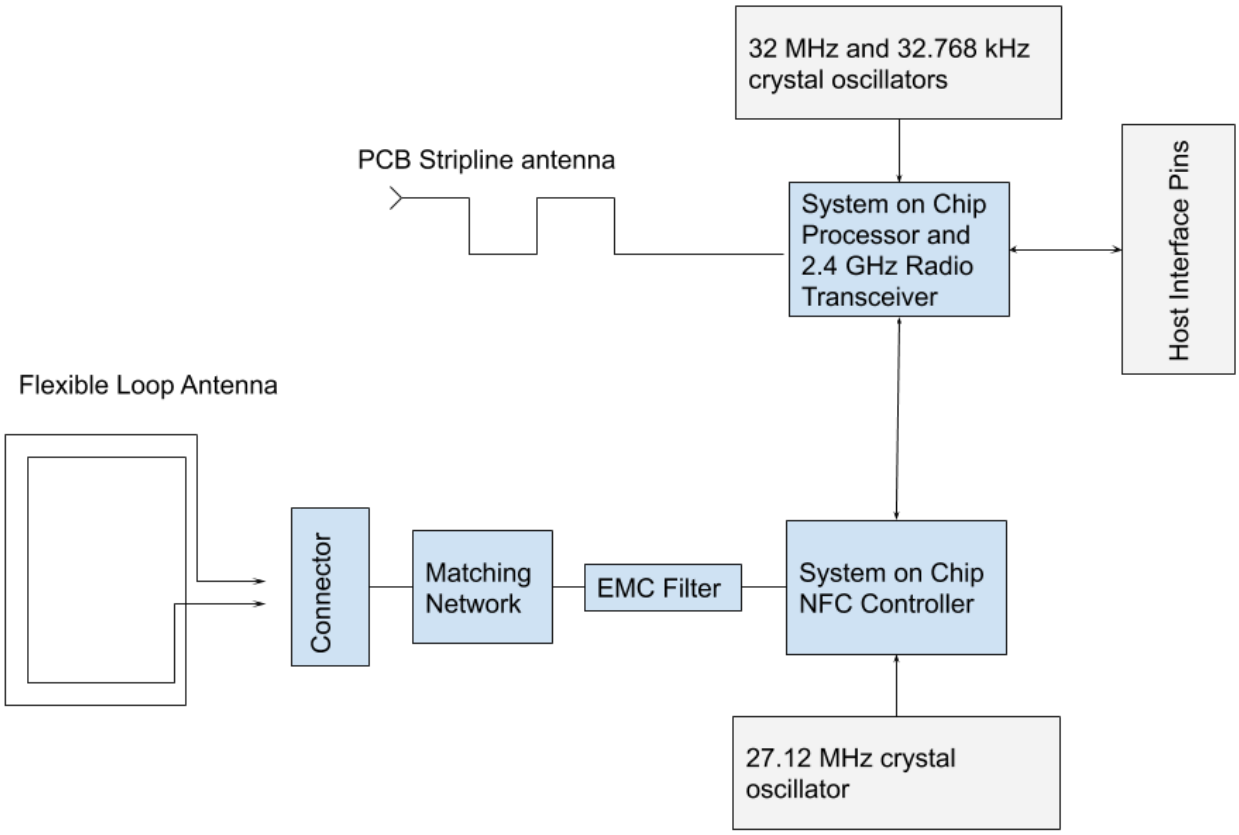
NFC Antenna

The FB100 uses a wire loop antenna, on a separate flexible PCB. The antenna has a ferrite sheet backing to resist environmental detuning effects. The antenna should be mounted inside a plastic enclosure and not accessible to the product's end user. The antenna matching networks, tuning elements, and transmitter are all consistent. The NFC controller employs active regulation of the receive voltages, and current limits the transmit current level.

Shield

The 2.4 GHz transceiver, 2.4 GHz matching network, NFC controller, NFC matching network, NFC EMC network and all crystals are all contained under a shield. The shield is CRS material, 0.2mm thick, with 1.25μm - 3μm tin plating.

Block Diagram



Declaration for Model Conformity

There are no model number variations. All units sold under the model FB100 are consistent. No antenna modifications of any kind are possible by the user or reseller. All units use a common list of components and materials.

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FCC STATEMENT

Model: FB100
FCC ID: ZZN-FB100

Caution: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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.

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.

This equipment can be installed and operated without minimum distance restriction between the radiator and user's body. Because this equipment has been evaluated to meet general RF exposure requirement at 5millimeters distance.

OEM Responsibilities to comply with FCC Regulations

The module has been certified for integration into products only by OEM integrators under the following conditions:
1. The antenna must be installed such that a minimum separation distance as stated above is maintained between the radiator (antenna) and all persons at all times.
2. The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter.

End product labeling:

The final end product must be labeled in a visible area with the following:
"Contains Transmitter Module FCC ID: ZZN-FB100"
Or
"Contains FCC ID: ZZN-FB100"

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ISED Statement

Model: FB100
IC: 9896A-FB100

This device complies with Innovation, Science and Economic Development Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

CAN ICES-3(B)/NMB-3(B)

Le présent appareil est conforme aux CNR Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

(1) il ne doit pas produire de brouillage et (2) l' utilisateur du dispositif doit étre prêt à accepter tout brouillage radioélectrique reçu, même si ce brouillage est susceptible de compromettre le fomctionnement du dispositif.

CAN ICES-3(B)/NMB-3(B)

The device meets the exemption from the routine evaluation limits in section 2.5 of RSS 102 and compliance with RSS-102 RF exposure, users can obtain Canadian information on RF exposure and compliance.

Le dispositif rencontre l'exemption des limites courantes d'évaluation dans la section 2.5 de RSS 102 et la conformité à l'exposition de RSS-102 rf, utilisateurs peut obtenir l'information canadienne sur l'exposition et la conformité de rf.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This equipment should be installed and operated with a minimum distance of 5 millimeters between the radiator and your body.

Cet émetteur ne doit pas être Co-placé ou ne fonctionnant en même temps qu'aucune autre antenne ou émetteur.

Cet équipement devrait être installé et actionné avec une distance minimum de 5 millimètres entre le radiateur et votre corps.

OEM Responsibilities to comply with IC Regulations

The module has been certified for integration into products only by OEM integrators under the following conditions:
1. The antenna must be installed such that a minimum separation distance as stated above is maintained between the radiator (antenna) and all persons at all times.
2. The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter.

End product labeling:

The final end product must be labeled in a visible area with the following:
"Contains Transmitter Module IC: 9896A-FB100"

Or
"Contains IC: 9896A-FB100"

Responsabilité de l'OEM en matière de conformité aux règlements d'IC

Ce module ne peut être intégré dans un produit que s' il est certifié par l' intégrateur OEM dans les conditions suivantes:

1. Lors de l'installation de l'antenne, la distance minimale d'espacement ci - dessus doit être maintenue entre les antennes Radiat eur (antenne) et tout le personnel.

2. Le module émetteur ne doit pas être au même endroit ni fonctionner avec une autre antenne ou un autre émetteur.

Étiquette du produit final:

Le produit final doit porter l'étiquette suivante dans la zone visible:

"Contient le module émetteur IC: 9896A-FB100"
Ou
"Contient IC: 9896A-FB100 "

FlexCertApp User Manual
201119 1.0

Nov 19, 2020

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Table of Contents

Revision History

Rev	Date Created	Description	Author
1.0	20 11 19	Initial document creation	BR

1 Overview

2 Hardware Setup

2. 1 Required Materials

Make sure you have the following materials ready:
1. Micro USB to USB A cable
2. Flexbridge on USB adapter PCB
3. NFC Antenna

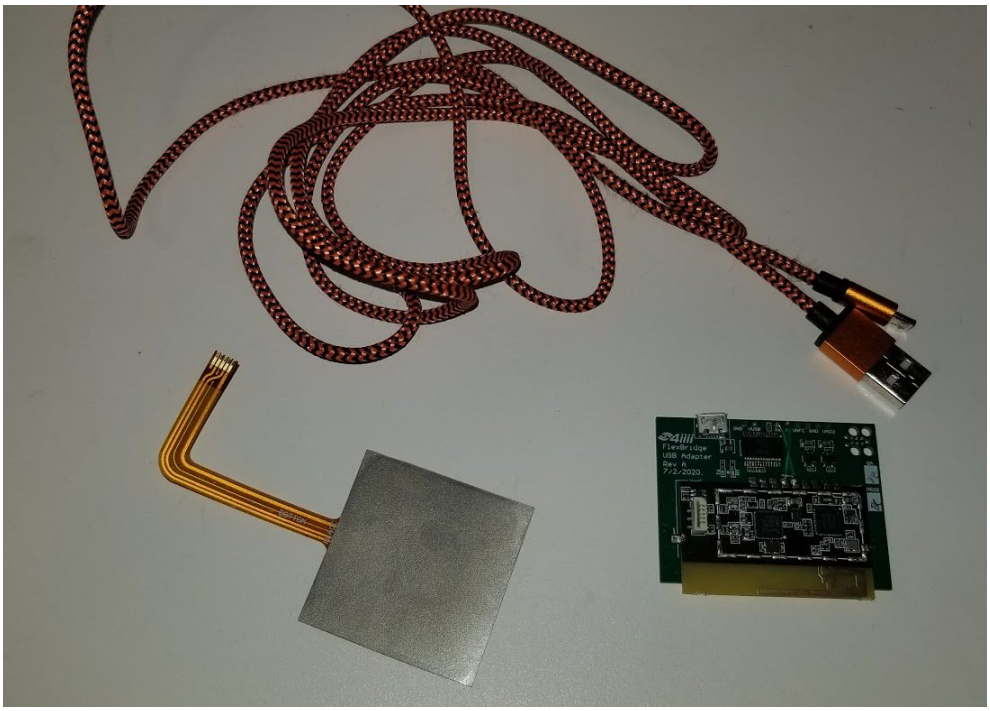


Fig 1. Required materials

2.2 Connect NFC Antenna

Note that this step is optional and only necessary if you want to test the NFC functionality.

1. Insert the NFC antenna cable into the connector on the Flexbridge PCB as shown in the following photo

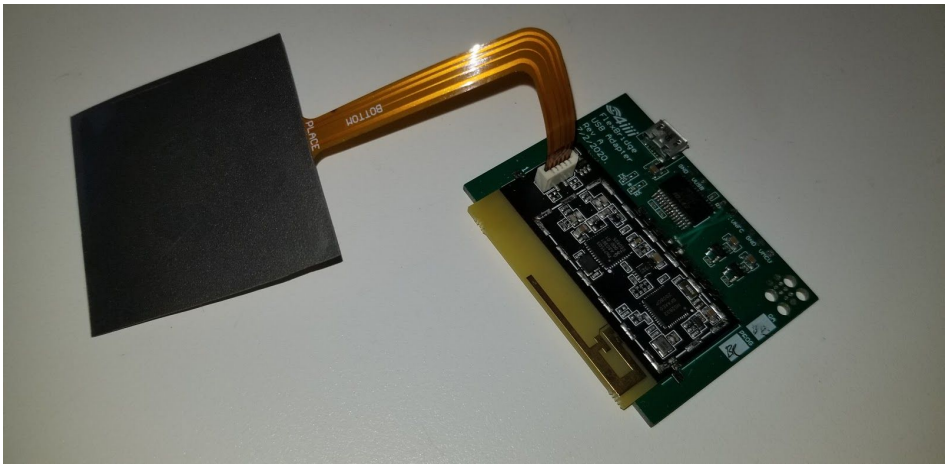


Fig 2. NFC antenna properly inserted into connector

2.3 Connect USB Cable

Connect the USB cable to your Windows computer as shown in the following figure. The red and green LEDs on the USB adapter board should briefly flash.

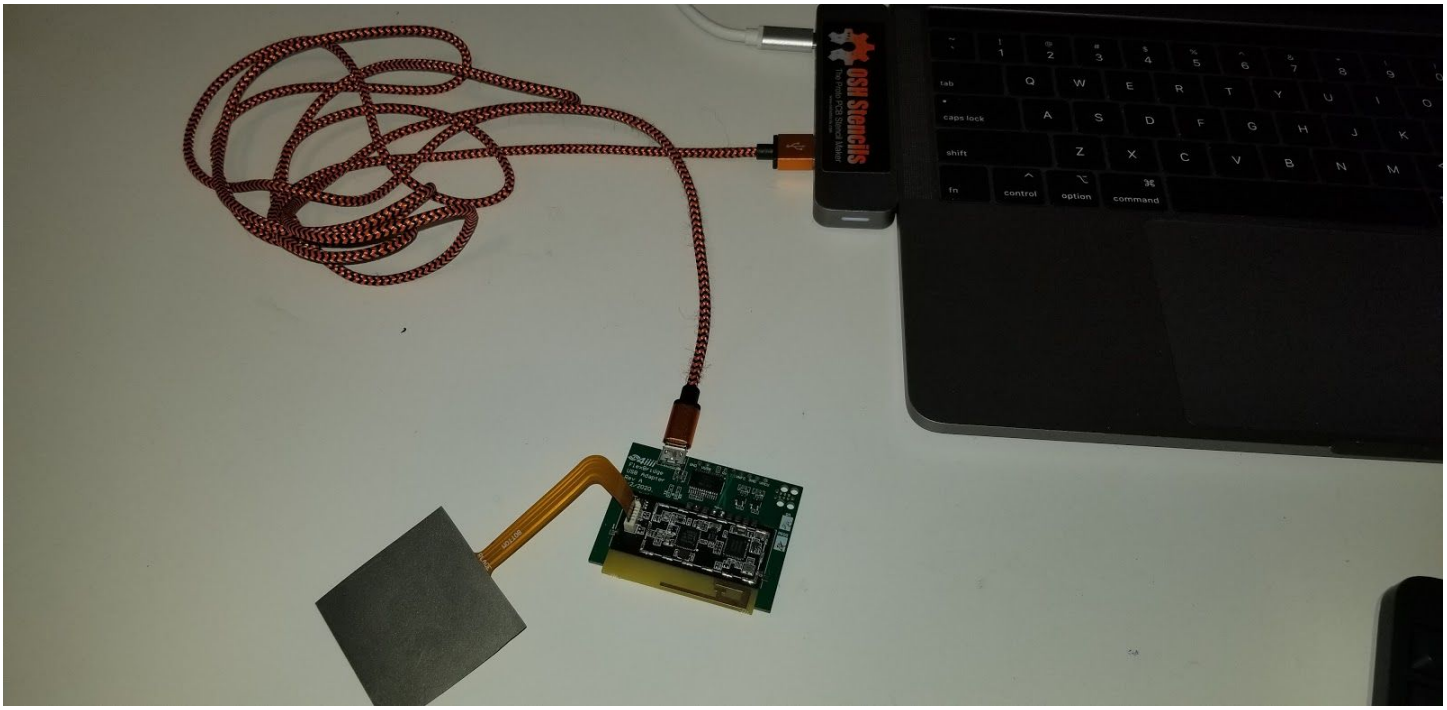
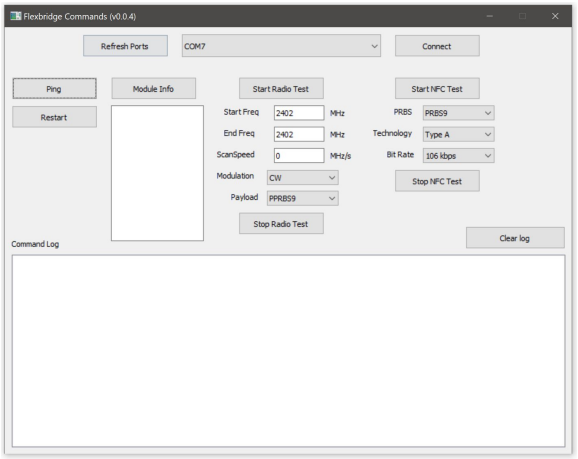


Fig 3. Flexbridge USB adapter fully set up and connected to computer

3. Software Setup

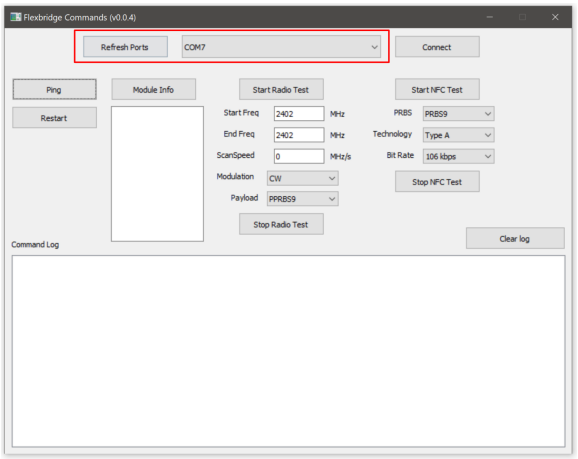
3.1 Launch Application

Run the executable **FlexBridgeCertification.exe**. The following image shows the application.

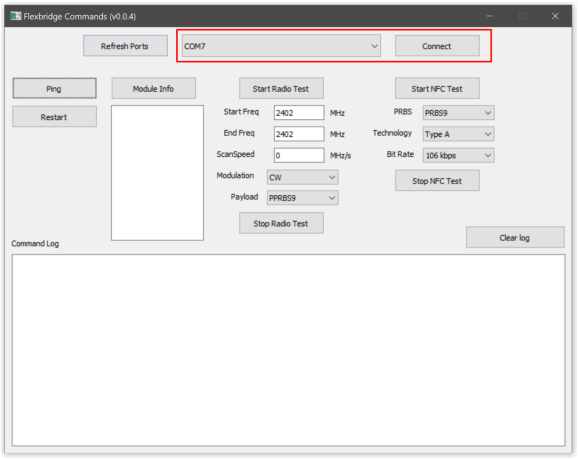


3.2 Connect to Flexbridge Module

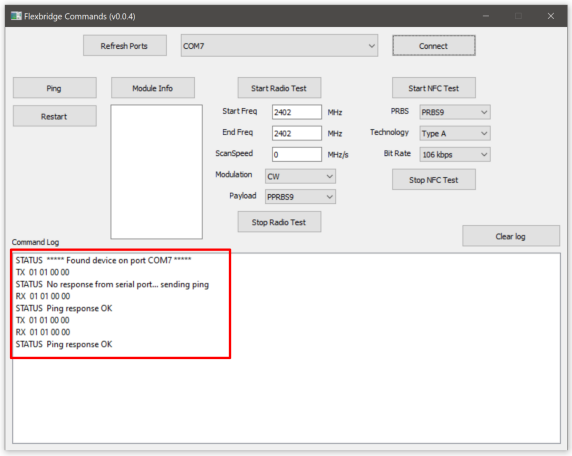
Press the **Refresh Ports** button. This will refresh the list of serial COM ports connected to your PC.



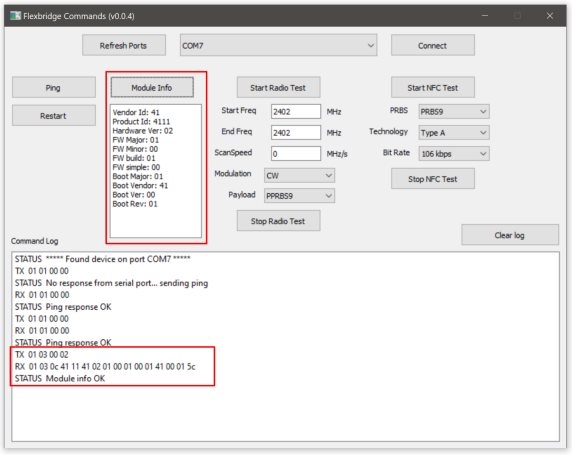
Select the COM port corresponding to the Flexbridge module, and press the **Connect** button.



If the connection is successful, you will see the output in the **Command Log** window show the connection events.



Press the **Module Info** button to command the module to send its hardware, firmware, and bootloader versions.



4 Radio Test Setup

All the radio tests can be executed at a **single frequency**, or they can be swept across multiple frequencies.

IMPORTANT: Before running any test, make sure to press the **Stop Radio Test** button.

4.1 Single Frequency Tests

Set the **ScanSpeed** to 0 MHz/s,
OR
Set the **Start Freq** and the **End Freq** to the same value

4.2 Frequency Sweep Tests

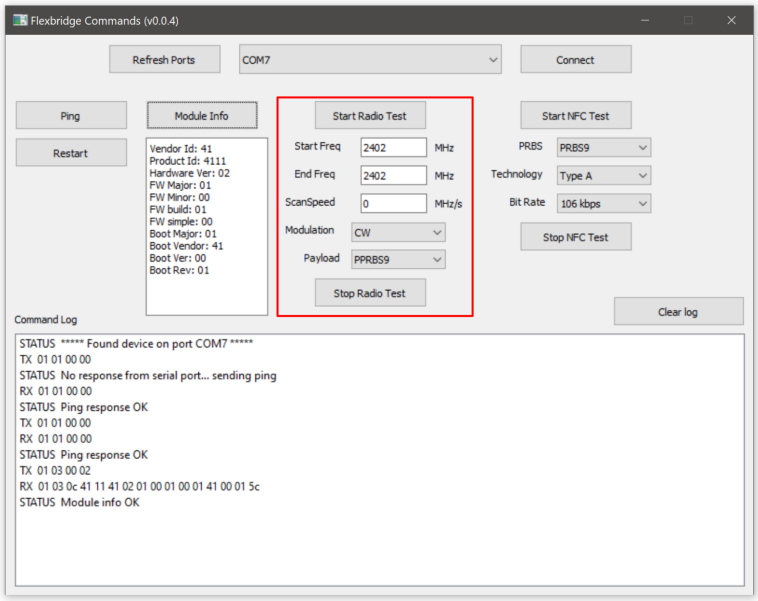
Set the **ScanSpeed** to greater than 0 MHz/s,
AND
Set the **End Freq** to a value greater than the **Start Freq**.

Note that for the frequency sweep, the End Frequency must not be lower than the Start Frequency.

The module will activate the radio at the start frequency and modulation, and increase the frequency at the speed given by the ScanSpeed parameter. When the end frequency is reached, the frequency will start again back at the start frequency.

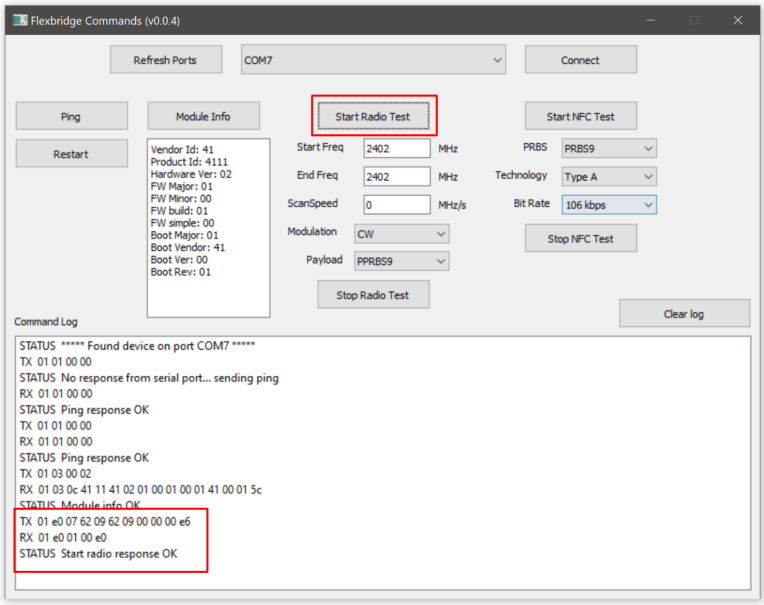
4.3 Constant Carrier Wave Test

This test configures the radio to output a constant carrier wave with no modulation at the given frequency.



IMPORTANT: Before running any test, make sure to press the **Stop Radio Test** button.

1. Select **CW** from the Modulation drop down menu
2. Enter the Start Frequency in MHz in the **Start Freq** input field
3. Enter the End Frequency in MHz in the **Stop Freq** input field
4. Set the ScanSpeed to 0 for a Single Frequency Test, or set it to greater than zero for a Frequency Sweep Test.
5. Payload is ignored or Constant carrier wave test.
6. Press the **Start Radio Test** button. Look for STATUS **Start radio response OK** in the command log.



4.4 ANT Modulation Test

This test configures the radio to test ANT modulation at the given frequencies.

IMPORTANT: Before running any test, make sure to press the **Stop Radio Test** button.

1. Select **ANT** from the Modulation drop down menu
2. Enter the Start Frequency in MHz in the **Start Freq** input field
3. Enter the End Frequency in MHz in the **Stop Freq** input field
4. Set the ScanSpeed to 0 for a Single Frequency Test, or set it to greater than zero for a Frequency Sweep Test.
5. Payload is ignored for ANT test.
6. Press the **Start Radio Test** button. Look for STATUS **Start radio response OK** in the command log.

4.5 BLE DTM Transmit Test

This test configures the radio to operate in DTM transmitter mode at the given frequency. The packet payload length is 255 bytes. The packet interval is calculated based on the Bluetooth Core Specification version 4.2 Vol. 6 Part F Section 4.1.6.

A DTM receiver should be configured to receive the packets and validate the packet error rate, PER.

IMPORTANT: Before running any test, make sure to press the **Stop Radio Test** button.

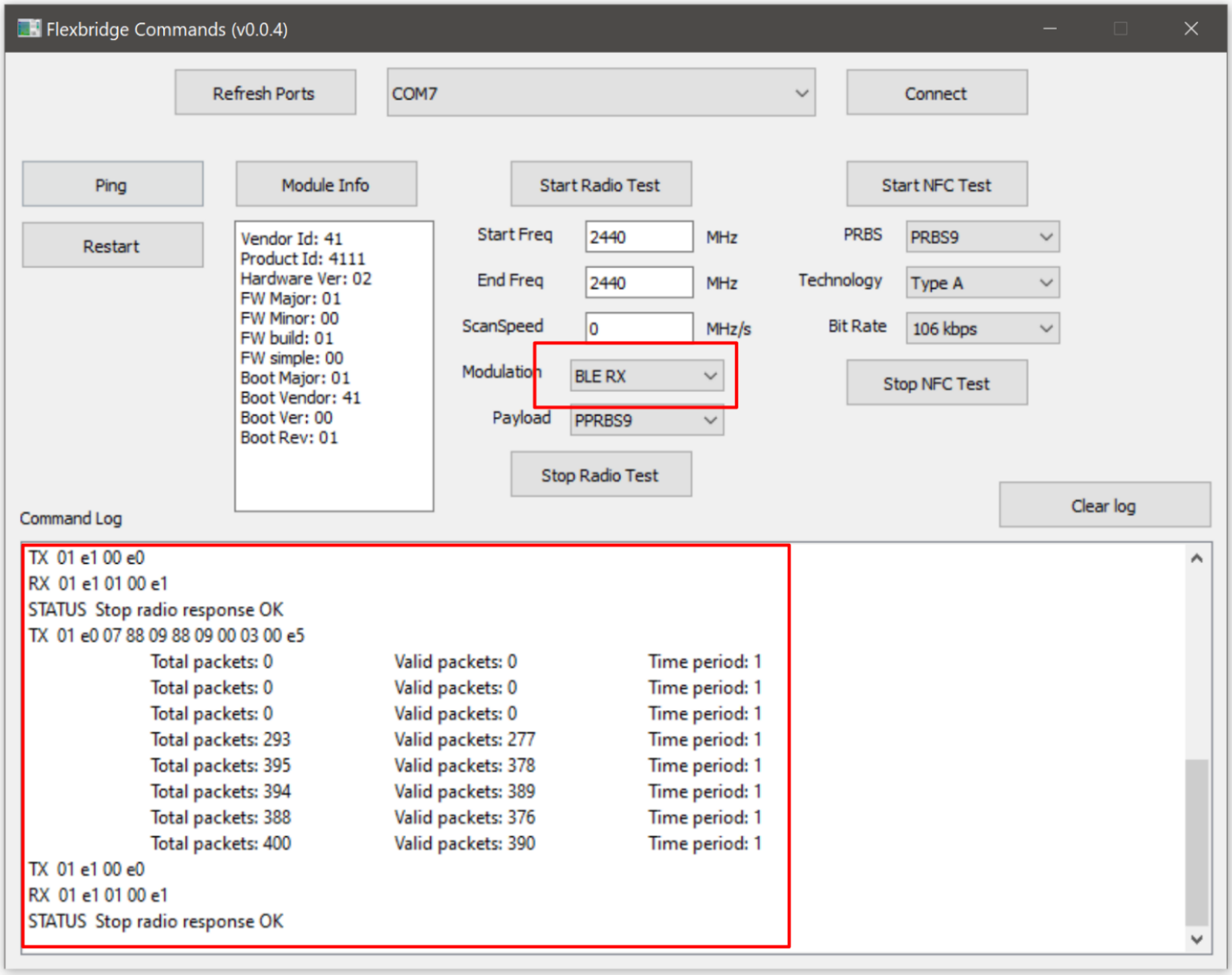
1. Select **BLE** from the Modulation drop down menu.
2. Enter the Start Frequency in MHz in the **Start Freq** input field.
3. Enter the End Frequency in MHz in the **Stop Freq** input field .
4. Set the ScanSpeed to 0 for a Single Frequency Test, or set it to greater than zero for a Frequency Sweep Test.
5. Select the payload type from the **Payload** drop down menu.
6. Press the **Start Radio Test** button. Look for STATUS **Start radio response OK** in the command log.

4.6 BLE DTM Receive Test

This test configures the radio to operate in the DTM receiver mode at the given frequency. The receiver will validate packets and calculate the packet error rate, PER. A separate DTM transmitter should be configured to transmit BLE packets on the test frequency.

IMPORTANT: Before running any test, make sure to press the **Stop Radio Test** button.

1. Select **BLE RX** from the Modulation drop down menu
2. Enter the Start Frequency in MHz in the **Start Freq** input field
3. Enter the End Frequency in MHz in the **Stop Freq** input field
4. Set the ScanSpeed to 0 for a Single Frequency Test, or set it to greater than zero for a Frequency Sweep Test.
5. Select the payload type from the **Payload** drop down menu.
6. Press the **Start Radio Test** button. Look for STATUS **Start radio response OK** in the command log.
7. The PER results are shown in the command log, as shown in the following image.



8. The **Total packets** value shows how many packets were received by the device under test.
9. The **Valid packets** value shows how many packets were valid.

10. The **Time Period** shows the time in seconds corresponding to when those packets were received. Example: Total Packets: 400, Valid Packets: 390, Time Period: 1
    a. 400 packets were received
    b. 390 packets were valid
    c. This is a PER of 10 / 400, or 2.5%
    d. These packets were received over 1 second.

4.7 NFC Test

The NFC Test session can be configured as 3 different technology types:

1. Type A
2. Type B
3. Type F

4.7.1 Type A test

Type A NFC test can be configured with a PRBS9 or PRBS15 payload, and any bit rate from 106, 212, 424, 848 kbps.

4.7.2 Type B test

Type B NFC test can be configured with a PRBS9 or PRBS15 payload, and any bit rate from 106, 212, 424, 848 kbps.

4.7.1 Type F test

Type F NFC test can be configured with a PRBS9 or PRBS15 payload, and any bit rate from 212, or 424 kbps. 106 and 848 kbps are not valid for Type F.