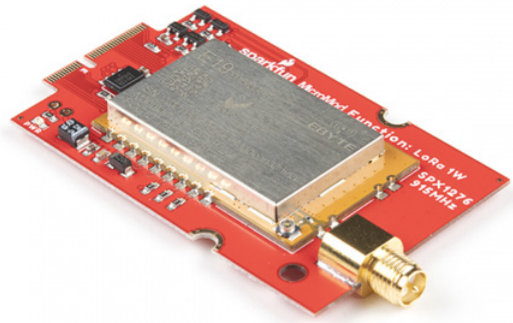
1W LoRa MicroMod Function Board

Introduction

Frequency Operation
This LoRa module can only be used in the **915MHz** LoRaWAN frequency band *(i.e. 902 to 928 MHz)*. It is not compatible with other frequency bands; double check the frequency band used in your region. Check out these resources from The Things Network for an **unofficial** summary of regional radio regulations and list of the regional frequency plans.

The 1W LoRa MicroMod Function Board adds LoRa capabilities to your MicroMod project. It is intended to be used in conjunction with a MicroMod processor board and a MicroMod main board, which provides the electrical interface between a processor board and the function board(s).



SparkFun MicroMod LoRa Function Board
WRL-18573

Match up the board's M.2 edge connector to the slot of the M.2 connector and secure the function board with the screws provided with the main board.

Utilizing the 915M30S LoRa module from EBYTE, which is a 1W (30dBm) transceiver based around the SX1276 from Semtech. There is a robust edge mount RP-SMA connector for large LoRa (915MHz) antennas; with modification, a U.FL connector is also available. We've successfully tested a 12 miles line-of-sight transmission with this module *(user results may vary)*.

With the MicroMod standardization, users no longer need to cross-reference schematics with datasheets, while fumbling around with jumper wires. Simply, match up the function board's M.2 edge connector to the slot of the M.2 connector on the main board and secure the function board with screws. All connections are hardwired to compatible pins of the processor board and the pin connections are standardized for the processor boards.

Required Materials

To get started, users will need a few of the items listed below. *(You may already have a some of these items; read through the guide and modify your cart accordingly.)*

MicroMod Processor Board

A processor board is required for the MicroMod system to operate. Users can choose a processor board, based upon their needs, to attach to the MicroMod M.2 connector of the main board. Below, are few options:

SparkFun MicroMod Artemis Processor
◉ DEV-16401

SparkFun MicroMod Teensy Processor
◉ DEV-16402

SparkFun MicroMod nRF52840 Processor
◉ WRL-16984

SparkFun MicroMod STM32 Processor
○ DEV-17713

MicroMod Main Board

A main board provides the electrical connections between the function and processor boards to operate. Users can choose a main board based upon their needs. Below, are few options:

SparkFun MicroMod Main Board - Single
DEV-18575

SparkFun MicroMod Main Board - Double
DEV-18576

Required Hardware

A Phillips screw driver is necessary to attach the processor board and function board(s) to the main board. Additionally, a USB-C cable is needed to connect the main board to a computer. The LoRa function board also requires a LoRa antenna for the transceiver to operate.

USB 3.1 Cable A to C - 3 Foot
CAB-14743

SparkFun Mini Screwdriver
TOL-09146

Below, is a selection of our 915MHz frequency band RP-SMA antennas.

Pycom LoRa and Sigfox Antenna Kit - 915MHz
WRL-14676

915MHz LoRa Antenna RP-SMA - 1/2 Wave 2dBi
WRL-14876

915MHz LoRa Antenna RP-SMA - 1/4 Wave 2dBi

◉ WRL-14875

Optional Hardware

A LoRa gateway provides internet connection for LoRaWAN network. Below are a few options from our LoRa product category.

Nebra Outdoor HNT Hotspot Miner (915MHz)

○ WRL-17844

LoRa Raspberry Pi 4 Gateway with Enclosure

○ WRL-16447

Nebra Indoor HNT Hotspot Miner (915MHz)

✱ WRL-17843

Users can also use other LoRa boards for peer-to-peer communication. Below are a few options from our LoRa product category.

SparkFun Pro RF - LoRa, 915MHz (SAMD21)
WRL-15836

SparkFun LoRa Thing Plus - expLoRaBLE
WRL-17506

Interface Cable RP-SMA to U.FL
WRL-00662

915MHz LoRa Antenna RP-SMA - 1/4 Wave 2dBi
WRL-14875

To modify the jumpers, users will need soldering equipment and/or a knife.

Solder Lead Free - 100-gram Spool
TOL-09325

Chip Quik No-Clean Flux Pen - 10mL
TOL-14579

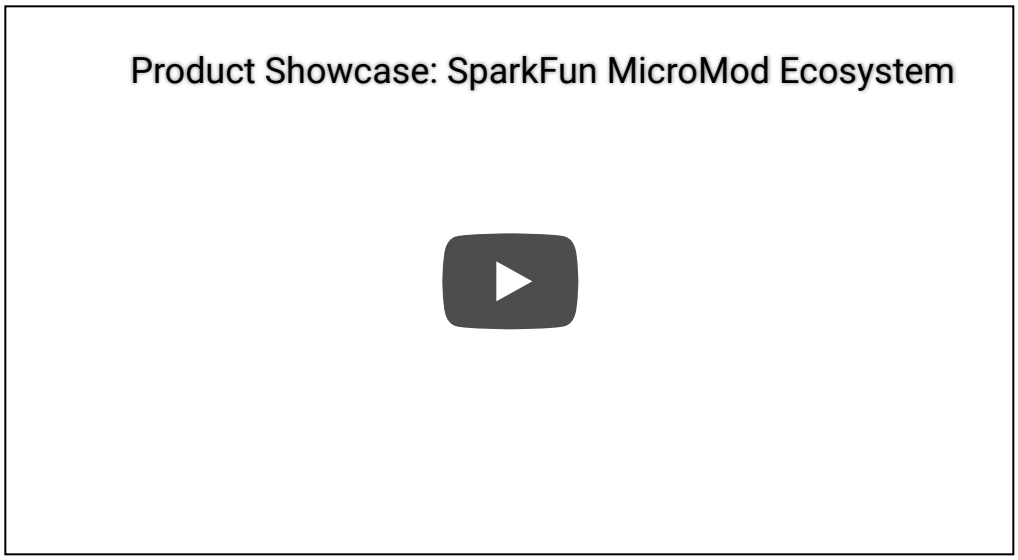
Weller WLC100 Soldering Station
TOL-14228

Hobby Knife
TOL-09200

Suggested Reading

The MicroMod ecosystem is a unique way to allow users to customize their project to their needs. Click on the banner below for more information.

MicroMod



For users who aren't familiar with the following concepts, we also recommend reading the following tutorials before continuing.

Serial Communication
Asynchronous serial communication concepts: packets, signal levels, baud rates, UARTs and more!

Serial Peripheral Interface (SPI)
SPI is commonly used to connect microcontrollers to peripherals such as sensors, shift registers, and SD cards.

Pulse Width Modulation

An introduction to the concept of Pulse Width Modulation.

Logic Levels

Learn the difference between 3.3V and 5V devices and logic levels.

I2C

An introduction to I2C, one of the main embedded communications protocols in use today.

Analog vs. Digital

This tutorial covers the concept of analog and digital signals, as they relate to electronics.

Processor Interrupts with Arduino

What is an interrupt? In a nutshell, there is a method by which a processor can execute its normal program while continuously monitoring for some kind of event, or interrupt. There are two types of interrupts: hardware and software interrupts. For the purposes of this tutorial, we will focus on hardware interrupts.

SparkFun expLoRaBLE Hookup Guide

Check out our latest LoRaWAN development board with Bluetooth capabilities! With this guide, we'll get you passing data to The Things Network in no time.

Getting Started with MicroMod

Dive into the world of MicroMod - a compact interface to connect a microcontroller to various peripherals via the M.2 Connector!

Designing with MicroMod

This tutorial will walk you through the specs of the MicroMod processor and carrier board as well as the basics of incorporating the MicroMod form factor into your own PCB designs!

MicroMod Main Board Hookup Guide

The MicroMod Main Board - Single and Double are specialized carrier boards that allow you to interface a Processor Board with a Function Board(s). The modular system allows you to add an additional feature(s) to a Processor Board with the help of a Function Board(s). In this tutorial, we will focus on the basic functionality of the Main Board - Single and Main Board - Double.

Installing an Arduino Library

How do I install a custom Arduino library? It's easy! This tutorial will go over how to install an Arduino library using the Arduino Library Manager. For libraries not linked with the Arduino IDE, we will also go over manually installing an Arduino library.

Installing Arduino IDE

A step-by-step guide to installing and testing the Arduino software on Windows, Mac, and Linux.

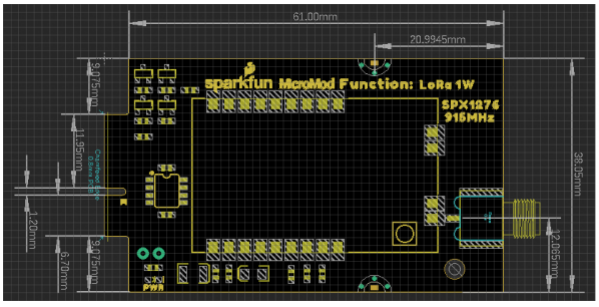
Installing Board Definitions in the Arduino IDE

How do I install a custom Arduino board/core? It's easy! This tutorial will go over how to install an Arduino board definition using the Arduino Board Manager. We will also go over manually installing third-party cores, such as the board definitions required for many of the SparkFun development boards.

Hardware Overview

Board Dimensions

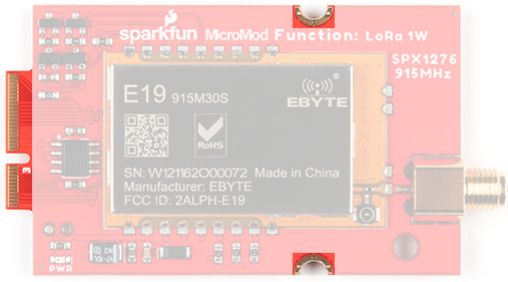
The overall board dimensions are roughly 65 x 35 mm with an approximate 6 mm protrusion of the RP-SMA antenna connector.



The dimensions for the LoRa MicroMod Function Board. (Click to enlarge)

M.2 Edge Connector and Screw Slots

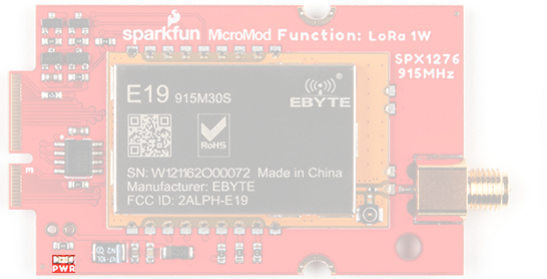
Like other function and processor boards, there is a polarized M.2 edge connector, which provides a standardized electrical connection. The attachment points for the screws prevent users from connecting a processor board into a function board slot and vice-versa.



The Micromod M.2 edge connector and screw slots on the LoRa Function Board. (Click to enlarge)

Power

There is a power status LED to help make sure that your LoRa function board is getting (5V) power. Power is provided through the *(MicroMod)* M.2 edge connector. The LoRa module is meant to run on **5V** with **3.3V** logic levels. A jumper is available on the back of the board to remove power to the LED for low-power applications (*see the **Jumpers** section below*).



Power LED on the LoRa MicroMod Function Board. (Click to enlarge)

E19-915M30S LoRa Module

> **Note:** The range verification was performed in a clear and open area (direct line-of-sight) with a 5dBi antenna gain, height of 2.5m, and data rate 0.3 kbps. Users results may vary.

The Chengdu Ebyte E19-915M30S RF transceiver module is a 1W 915MHz LoRa module, based on the SX1276 from Semtech. It is FCC, CE, and RoHS certified and has been tested up to a range of 10km by the manufacturer. PLease refer to the datasheet for more details.

- Global license free ISM 915MHz band
- 1W maximum transmission power
    - Software multi-level adjustable
- 256Byte FIFO data buffer

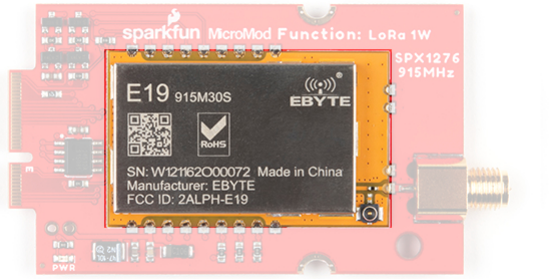
SX1276

The E19-915M30S transceiver is based on the SX1276 chip from Semtech. Please refer to the datasheet for more details.

Part Number	SX1276
Frequency Range	137 - 1020 MHz
Spreading Factor	6 - 12
Bandwidth	7.8 - 500 kHz
Effective Bitrate	.018 - 37.5 kbps
Est. Sensitivity	-111 to -148 dBm

Characteristic	Description
Operating Voltage	3.3 - 5.5 V
Current Consumption	630 mA (TX)) 23 mA (RX)) 3 µA (Sleep)
Operating Temperature	-40 - 85 °C

Operating Humidity[1]	10 - 90%
Communication Interface	SPI (0 - 10 Mbps)
Logic Level	3.3 V
Frequency Range	900 - 931 MHz
Transmit Power	28.5 - 30 dBm (max)
Modulation	LoRa, FSK, GFSK, MSK, GMSK, OOK
Data Rate	FSK: 1.2 - 300 kbps LoRa: 0.018 - 37.5 kbps
Antenna Impedance	50 Ω



The E19-915M30S RF transceiver module on the LoRa MicroMod Function Board. (Click to enlarge)

Pin Connections

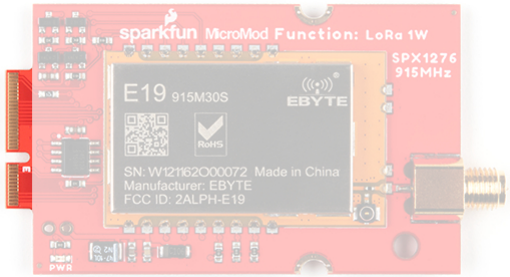
Below is a table of the pin connections available on the E19-915M30S RF transceiver module. However, not all the pins listed are utilized by the LoRa function board *(see the **Function Board Pinout Table** section below)*.

Pin #	Pin Name	I/O Direction	Pin Description
1	GND		Ground
2	DIO5	Input/Output	Configurable IO port （Please refer to the SX1276 datasheet).
3	DIO4	Input/Output	Configurable IO port （Please refer to the SX1276 datasheet).
4	DIO3	Input/Output	Configurable IO port （Please refer to the SX1276 datasheet).
5	DIO2	Input/Output	Configurable IO port （Please refer to the SX1276 datasheet).
6	DIO1	Input/Output	Configurable IO port （Please refer to the SX1276 datasheet).
7	DIO0	Input/Output	Configurable IO port （Please refer to the SX1276 datasheet).
8	RST	Input	Reset

9	GND		Ground
10	GND		Ground
11	VCC	Input	Power supply: 4.75~5.5V (Ceramic filter capacitoris advised to add)
12	SCK	Input	SPI - Clock Signal
13	MISO	Output	SPI - Data from Peripheral Device
14	MOSI	Input	SPI - Data to Peripheral Device
15	NSS	Input	SPI - Chip Select
16	TXEN	Input	Radio frequency switch control, make sure the TXEN pin is in high level, RXEN pin is in low level when transmitting.
17	RXEN	Input	Radio frequency switch control, make sure the RXEN pin is in high level, TXEN pin is in low level when receiving.
18	GND		Ground
19	ANT		Antenna
20	GND		Ground
21	GND		Ground
22	GND		Ground

MicroMod Edge Connector

The MicroMod M.2 edge connector provides a standardized interface for the pin connection of a function board.



The Micromod M.2 edge connector on the LoRa Function Board. (Click to enlarge)

Function Board Pinout Table

The tables below outline the pin on the M2. edge connector and their functions.

MICROMOD FUNCTION BOARD PINOUT TABLE

MICROMOD GENERAL PINOUT TABLE

MICROMOD GENERAL PIN DESCRIPTIONS

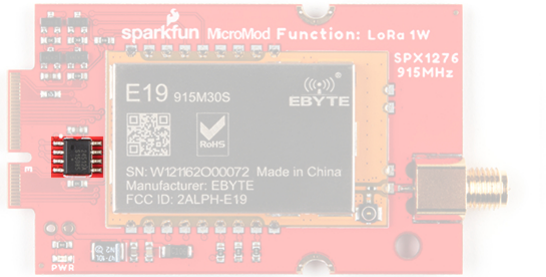
AUDIO	UART	GPIO/BUS	I²C	SDIO	SPI0	Dedicated

LoRa Func. Board Pin	Function	Bottom Pin	Top Pin	Functions		LoRa Func. Board Pin
	(Not Connected)	-	**75**	GND		
	VIN	**74**	**73**	3.3V		3.3V IN
VCC IN	VIN	**72**	**71**	Power EN		Power EN
	-	**70**	**69**	-		
	-	**66**	**65**	-		
	-	**64**	**63**	-		
	-	**62**	**61**	F7		
	-	**60**	**59**	F6		LoRa DIO2
	-	**58**	**57**	F5		LoRa DIO1
	-	**56**	**55**	F4		LoRa RST
	-	**54**	**53**	F3		LoRa RX EN
	-	**52**	**51**	F2	PWM	LoRa TX EN
	-	**50**	**49**	F1	SPI_CS0	LoRa NSS (CS)
	-	**48**	**47**	F0	INT	LoRa DIO0
	-	**46**	**45**	GND		
	-	**44**	**43**	-		
	-	**42**	**41**	-		
EEPROM WP	-	**40**	**39**	GND		
	A0	**38**	**37**	USBHOST_D-		
EEPROM A0	EEPROM_A0	**36**	**35**	USBHOST_D+		
EEPROM A1	EEPROM_A1	**34**	**33**	GND		

EEPROM A2	EEPROM_A2	**32**	**31**	Module Key		
	Module Key	**30**	**29**	Module Key		
	Module Key	**28**	**27**	Module Key		
	Module Key	**26**	**25**	Module Key		
	Module Key	**24**	**23**	I2C_INT		
		22	**21**	I2C_SCL		EEPROM SCL
		20	**19**	I2C_SDA		EEPROM SDA
	UART_CTS	**18**	**17**			
	UART_RTS	**16**	**15**	UART_RX		
		14	**13**	UART_TX		
		12	**11**			GND
		10	**9**			
		8	**7**	SPI_CIPO		LoRa SDO
		6	**5**	SPI_COPI		LoRa SDI
		4	**3**	SPI_SCK		LoRa SCK
		2	**1**	GND		

EEPROM

There is an I^2C serial EEPROM on the LoRa function board. It has been reserved for future use, but users have access to it. A jumper is available on the back of the board to write protect the EEPROM (see the **Jumpers** section below).



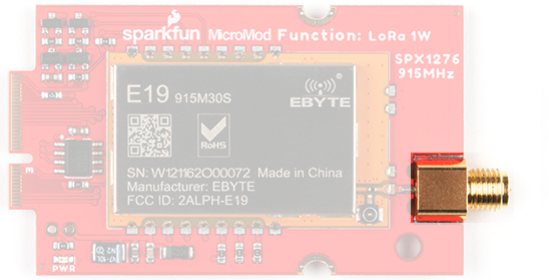
EEPROM on the LoRa MicroMod Function Board. (Click to enlarge)

RP-SMA Antenna Connector

Warning: Users should attach the antenna before powering their LoRa function board. Transmitting without an antenna connected may potentially damage the transceiver module.

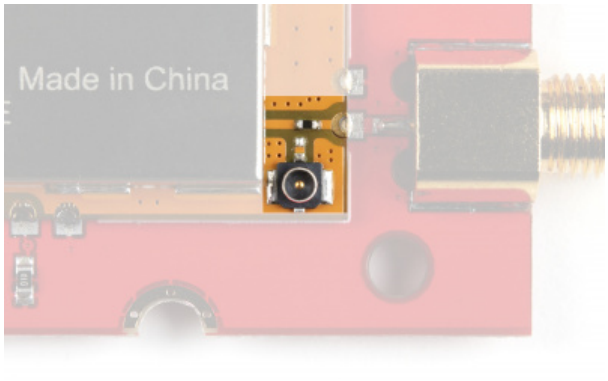
The LoRa function board features a sturdy RP-SMA antenna connector for users to attach an antenna of their choice. While this antenna connector is fairly robust, users should not expect to leverage a lot of weight off of it.

The edge-type antenna connector allows for the threads to protrude just beyond the edge of the board. Along with the dimensions of the LoRa function board, this feature is designed so that the connection also extends past the edge of the main board that the function board interfaces with; and is therefore, well suited to be used with an enclosure.



RP-SMA antenna connector on the LoRa MicroMod Function Board. (Click to enlarge)

Note: Users who wish to use the u.FL connector can modify the position of this 0Ω resistor. Due to the size and position of the resistor, we only recommended for highly experience soldering experts attempt this modification. More novice users could potentially damage their LoRa function board if they attempt this modification.



Antenna select jumper on the E19-915M30S RF transceiver module. (Click to enlarge)

Jumpers

There are three jumpers available on the LoRa function board.

LED Power

For more low power projects, the `PWR` jumper can be cut to remove power from the red power LED.

LED power jumper on the LoRa MicroMod Function Board. (Click to enlarge)

Current Measurement

For users who would like to measure the current going to LoRa function board, the `MEAS` jumper can be cut and used for measurements. This jumper is only connected to the **5V** power, which is used by only the E19-915M30S RF transceiver module and power LED.

Current measurement jumper on the LoRa MicroMod Function Board. (Click to enlarge)

EEPROM Write Protection

To permanently write protect the EEPROM on the LoRa function board, users can bridge the `WP` jumper.

EEPROM WP jumper on the LoRa MicroMod Function Board. (Click to enlarge)

Software Overview

Getting Started with MicroMod

For those unfamiliar with the MicroMod ecosystem, be sure to review the Getting Started with MicroMod guide. Also, make sure that the correct board definitions are installed in the Arduino IDE, for the associated processor board.

Getting Started with MicroMod

OCTOBER 21, 2020

Dive into the world of MicroMod - a compact interface to connect a microcontroller to various peripherals via the M.2 Connector!

Programming

Note: Make sure that the correct board definitions are installed in the Arduino IDE, for the connected processor board. Depending on the processor board, users may need to install drivers *(if they have not done so already)*. For help installing board definitions, use the MicroMod processor boards landing page and review the associated hookup guide for that hardware.

Installing Board Definitions in the Arduino IDE

SEPTEMBER 9, 2020

How do I install a custom Arduino board/core? It's easy! This tutorial will go over how to install an Arduino board definition using the Arduino Board Manager. We will also go over manually installing third-party cores, such as the board definitions required for many of the SparkFun development boards.

Arduino Library

Note: The example for this tutorial assumes users have the latest version of the Arduino IDE installed. If this is your first time using Arduino, please review our tutorial on installing the Arduino IDE. If you have not previously installed an Arduino library, please check out our installation guide:

Installing an Arduino Library

JANUARY 11, 2013

How do I install a custom Arduino library? It's easy! This tutorial will go over how to install an Arduino library using the Arduino Library Manager. For libraries not linked with the Arduino IDE, we will also go over manually installing an Arduino library.

SparkFun External EEPROM Arduino Library

We've written a library to easily get setup and read/write data on the EEPROM. You can install this library through the Arduino Library Manager. Search for **SparkFun External EEPROM Arduino Library** and you should be able to install the latest version. If you prefer manually downloading the libraries from the GitHub repository, you can grab them here:

DOWNLOAD THE SPARKFUN EXTERNAL EEPROM ARDUINO LIBRARY

For more details on this Arduino library and its use, please refer to the Serial EEPROM hookup guide:

Reading and Writing Serial EEPROMs

AUGUST 11, 2017

EEPROM is a great way to add extra memory to your microcontroller project. Wait 'til you see how easy it is to use!

RadioLib Arduino Library

This RadioLib library provides support for peer-to-peer RF communication with the 1W LoRa MicroMod Function Board. Users can install this library through the Arduino Library Manager. Search for **RadioLib** and you should be able to install the latest version. If you prefer manually downloading the libraries from the GitHub repository, you can grab them here:

DOWNLOAD THE RADIOLIB ARDUINO LIBRARY

Note: Peer-to-peer refers to direct RF communication using a specific modulation protocol *(similar to a 2-way walkie talkie)*; and is not to be confused with a mesh network or LoRaWAN network integration.

For more details on this Arduino library, check out the Arduino reference page, the API refernce page, and GitHub repository. Additional specifics of the library that users may be interested in can be found in the links below:

- GitHub Wiki page
  - Basics Library Usage
  - Advanced Details:
    - FSK Modulation - Standard Configuration
    - LoRa Modulation - Standard Configuration
    - Power Amplifier Configuration
  - SX1726 Examples

Hadware Assembly

For those unfamiliar with the MicroMod ecosystem, be sure to review the Getting Started with MicroMod guide.

Getting Started with MicroMod

OCTOBER 21, 2020

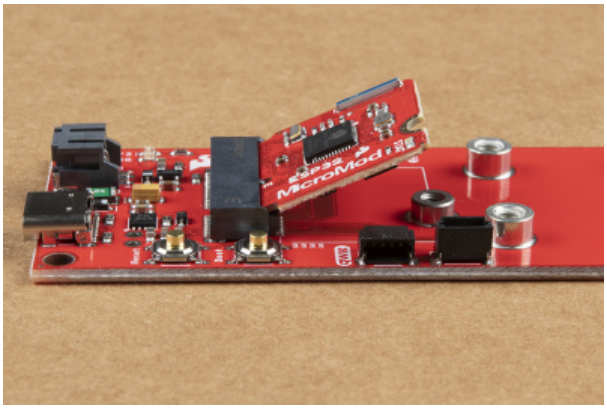
Dive into the world of MicroMod - a compact interface to connect a microcontroller to various peripherals via the M.2 Connector!

Processor Board and Main Board

To get started users will need a compatible processor and main board. Insert the MicroMod processor board into the M.2 socket for the processor board at an angle, with its edge connector aligned to the matching slots.

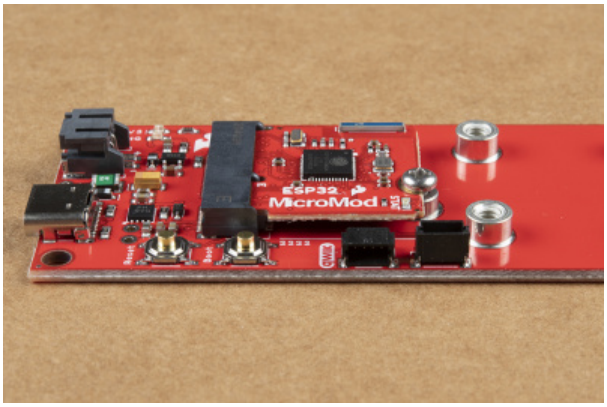
> **Note:** The dimensions of the processor board's edge connector prevents it from mating with the slots of the M.2 socket in reverse. As an extra safeguard, the screw insert is spaced to only match the screw key of MicroMod processor boards.

When inserted properly, the processor board will rest at an angle:



Inserting a processor board into the M.2 socket. (Click to enlarge)

To secure the processor board, gently hold down on the board and attach the M.2 screw with a Phillip's head (PH0 or PH1) screw driver. Below, is an example of an assembled MicroMod system:



A processor board attached to the MicroMod Qwiic Carrier Board. (Click to enlarge)

Function Board and Main Board

> **Warning:** The LoRa module is susceptible to electrostatic discharge. Therefore, it is recommended that users a static discharge strap, like the one included in the iFixit Pro Tech Toolkit.

Static discharge strap in the upper righthand corner. (Click to enlarge)

Users should also address any humidity and temperature concerns, when utilizing the LoRa function board.

Note: The dimensions of the function board's edge connector prevents it from mating with the slots of the M.2 socket in reverse. As an extra safeguard, the screw inserts are spaced to only match the screw key of MicroMod function board.

Similarly to the processor board, insert the MicroMod function board into the M.2 socket for the function board at an angle, with its edge connector aligned to the matching slots.

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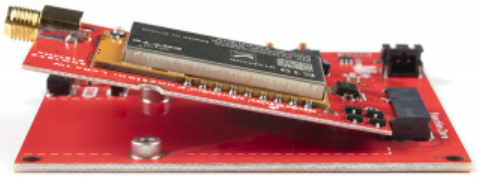

Inserting a function board into the M.2 socket. (Click to enlarge)

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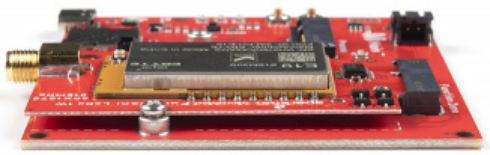


A function board attached to the MicroMod Main Board. (Click to enlarge)

Don't forget to attach the antenna for the LoRa function board. Transmitting or powering the LoRa module without an attached antenna has the potential to permanently damage the transceiver.

Fully assembled main board with processor board and function board. (Click to enlarge)

Main Board Example - Pin Connection Table

This table summarizes the pins utilized on the LoRa function board's MicroMod edge connector and their connections to the main board's processor pins; based on the slot that the LoRa function board is inserted to.

Function Board Pin Name	MicroMod Pin Number	I/O Direction	Description	Main Board's Processor Pin	
				Slot 0	Slot 1
VCC	72	Input	Power supply: 4.75~5.5V • Power LED • Transceiver's Power	-	
3.3V	73	Input	Power supply: 3.3V • EEPROM's Power • Logc-level conversion	-	
GND	11	-	Ground	-	
Power Enable	71	Input	Controls the 3.3V power	68	66
SCK	3	Input	SPI - Clock signal for transceiver	SCK (57)	

CIPO	7	Output	SPI - Data from transceiver	CIPO (59)	
COPI	5	Input	SPI - Data to transceiver	COPI (61)	
NSS	49 (F1)	Input	SPI - Chip select for transceiver	CS0 (55)	CS1 (70)
RST	55 (F4)	Input	Resets transceiver	G1 (42)	G6 (71)
DIO0	47 (F0)	Input Output	Transceiver's configurable IO （Please refer to the SX1276 datasheet).	D0 (10)	D1 (18)
DIO1	57 (F5)	Input Output	Transceiver's configurable IO （Please refer to the SX1276 datasheet).	G2 (44)	G7 (69)
DIO2	59 (F6)	Input Output	Transceiver's configurable IO （Please refer to the SX1276 datasheet).	G3 (46)	G8 (62)
TXEN	51 (F2)	Input	Transceiver's RF control switch: The TXEN pin is in high level, RXEN pin is in low level when transmitting.	PWM0 (32)	PWM1 (47)
RXEN	53 (F3)	Input	Transceiver's RF control switch: The RXEN pin is in high level, TXEN pin is in low level when receiving.	G0 (40)	G5 (73)
SCL	21	Input	I^2C - Clock signal for EEPROM	SCL (14)	
SDA	19	Input Output	I^2C - Data signal for EEPROM	SDA (12)	
EEPROM WP	40	Input	Controls the write protection pin for the EEPROM. Pull low to enable.	?	
EEPROM A0	6	Input	Controls EEPROM's I^2C address configuration.	-	
EEPROM A1	4	Input	Controls EEPROM's I^2C address configuration.	-	
EEPROM A2	2	Input	Controls EEPROM's I^2C address configuration.	-	

Programming

To program the processor board utilized on the Main Board; connect the board to a computer with a USB-C cable. Depending on the processor board, users may need to install drivers *(if they have not done so already)*.

Note: Make sure that the correct board definitions are installed in the Arduino IDE, for the selected processor board. For help installing board definitions, use the MicroMod processor boards landing page and review the associated hookup guide for that hardware.

Installing Board Definitions in the Arduino IDE

SEPTEMBER 9, 2020

How do I install a custom Arduino board/core? It's easy! This tutorial will go over how to install an Arduino board definition using the Arduino Board Manager. We will also go over manually installing third-party cores, such as the board definitions required for many of the SparkFun development boards.

Examples

Peer-to-Peer Communication

Note: The example codes assume that the LoRa function board is inserted into the `Fucntion Zero` slot of the main board.

The example codes below, allow users to communicate between two LoRa function boards. Simply download, extract the files, and upload the code the main board with associated processor and function boards.

DOWNLOAD THE LORA FUNCTION BOARD EXAMPLE CODES

Additional examples have also been provided for users who may have an expLoRable (LoRa Thing Plus) board.

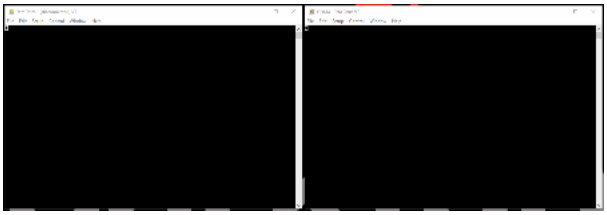
DOWNLOAD THE EXPLORABLE EXAMPLE CODES

The example codes were tested under the following parameters:

- **Arduino IDE** version: 1.8.16
    - *If not using the Teensy* - Windows App Store version 1.8.51.0
- **RadioLib** Library version: 4.6.0
- MicroMod Processor Boards and Arduino Cores:

Processor	Board Definition
RP2040	**Arduino Mbed OS RP2040 Boards** version: 2.5.2
ESP32	**esp32** version: 2.0.0
STM32	**SparkFun STM32 Boards** version: 2.0.0
Artemis	**SparkFun Apollo3 Boards** version: 2.1.1
SAMD51	**SparkFun SAMD Boards (dependency Arduino SAMD Boards version 1.8.1)** version: 1.8.5 ◦ Requires - **Arduino SAMD Boards (32-bit ARM Cortex-M0+)** version: 1.8.11
nRF52840	**[DEPRECATED - Please install standalone packages] Arduino Mbed OS Boards** version: 1.3.1
Teensy	**Teensyduino** version: 1.55

Once uploaded, users can open the serial monitor to view the progress of the data transmission or reception. When using the RP2040 processor board, the example code will wait until the Serial Monitor is opened to execute the code and transmit/receive data.



An example of the data transmission between an expLoRaBLE board and the LoRa MicroMod Function Board in the Serial Monitor. (Click to enlarge)

Code Breakdown

In order to get the built-in example for the RadioLib library working, a few changes needed to be made. Below, is a short explanation of the modifications made to the example code that we provide (see above), to include compatibility with all the available processor boards.

CS Pin Definition

The SPI library for the Arduino IDE, by default expects the chip select pin to be defined as `PIN_SPI_SS`. However, this pin definition is different for the ESP32 and Artemis (Apollo3) Arduino cores. Therefore, the code below was inserted to allow the code to compile for all the various processor boards.

```
// Redefine CS Pin Name
// SPI_CS0:     ESP32
// SS:          ESP32, nRF, RP2040
// SPI_CS:      Artemis
// PIN_SPI_SS:  STM32, SAMD51, nRF, RP2040

#ifndef PIN_SPI_SS
    // For Artemis
    #ifdef SS
        #define PIN_SPI_SS SPI_CS
    #endif
    // For ESP32
    #ifdef SPI_CS0
        #define PIN_SPI_SS SS
    #endif
#endif
```

MicroMod Pin Names

Unfortunately, for the RP2040 MicroMod processor board hasn't been included in the MbedOS Arduino core; current progress is `on hold` *(please refer to this issue in the GitHub repository)*. However, with the modifications below, the RP2040 Pico board definition can be used.

By using the RP2040 Pico board definition, the generic MicroMod processor board's pin names obviously can't be used. Therefore, all the pins must be declared by their GPIO pin numbers. In addition, the default pin connections for the SPI bus on the RP2040 MicroMod processor board differs from the RP2040 Pico. To accommodate for the different pin connections, a custom SPI object was created and passed into the library.

```
// SX1276 pin connections:
//       | SLOT 0 | SLOT 1 |
//=========================
// cs    |   CS0  |   CS1  |
// dio0  |   D0   |   D1   |
// dio1  |   G2   |   G7   |
// dio2  |   G3   |   G8   |
// rst   |   G1   |   G6   |
// tx_en |  PWM0  |  PWM1  |
// rx_en |   G0   |   G5   |

#if defined(ARDUINO_RASPBERRY_PI_PICO)
    // MM RP2040 Processor Board (Using RP2040 Pico board definition)
    int pin_cs = 21;
    int pin_dio0 = 6;
    int pin_tx_enable = 13;
    int pin_rx_enable = 16;
    int pin_nrst = 17;
    int pin_dio1 = 18;

    // Redefine SPI pins
    int miso = 20;
    int mosi = 23;
    int sck = 22;

    // Custom SPI object
    MbedSPI SPI_mm(miso, mosi, sck);

    SX1276 radio = new Module(pin_cs, pin_dio0, pin_nrst, pin_dio1, SPI_mm);

#else
```

Similarly to the RP2040, the Teensy MicroMod processor board definition doesn't include the generic MicroMod processor board pin names yet *(we are currently working on this update)*. Therefore, all the pins must be declared by their pin numbers.

```
    #if defined(ARDUINO_TEENSY_MICROMOD)
        // MM Teensy Processor Board
        int pin_cs = 10;
        int pin_dio0 = 4;
        int pin_tx_enable = 3;
        int pin_rx_enable = 40;
        int pin_nrst = 41;
        int pin_dio1 = 42;

    #else
```

RP2040 Special Consideration

As mentioned above, a custom SPI object was created and passed into the library for the RP2040 MicroMod processor board. However, the library doesn't initialize the SPI bus when it is passed in. Therefore, the `setup()` loop includes a modification to start the SPI bus operation.

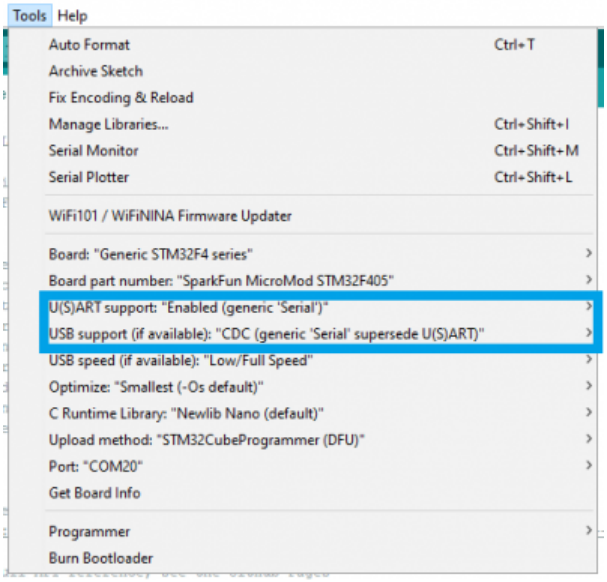
In our testing, the RP2040 MicroMod processor board had issues with the printouts on the serial port. Adding a `while()` statement to wait for the serial port to be accessed by the Serial Monitor, resolved the issue.

```
#if defined(ARDUINO_RASPBERRY_PI_PICO)
    // Wait for serial monitor/port to open
    while (!Serial){
        ; // wait for serial port
    }

    // Start SPI bus
    SPI_mm.begin();
#endif
```

Enabling the STM32 Serial Port

When uploading to the provided example code (see above) to the STM32 MicroMod processor board, users will need to enable the serial port on the processor board. Otherwise, when the Serial Monitor is opened, nothing will appear. The following settings must be used in the in the `Tools` drop down menu:



The STM32 MicroMod processor board settings in the `Tools` drop-down menu to enable the microcontroller's serial port. (Click to enlarge)

Resources and Going Further

For more information on the SparkFun 1W LoRa Function Board, check out the links below:

Hardware Documentation:

- Schematic
- Eagle Files
- Board Dimensions
- Datasheet (E19-915M30S)
    - Datasheet (SX1276)
- Arduino Libraries:
    - SparkFun External EEPROM Arduino Library
    - RadioLib Arduino Library
- GitHub Hardware Repo

MicroMod Documentation:

- Getting Started with MicroMod
- Designing with MicroMod
- MicroMod Info Page
- MicroMod Forums

Looking for more inspiration? Check out these other tutorials related to MicroMod.

Getting Started with MicroMod

Dive into the world of MicroMod - a compact interface to connect a microcontroller to various peripherals via the M.2 Connector!

MicroMod Artemis Processor Board Hookup Guide

Get started with the Artemis MicroMod Processor Board in this tutorial!

MicroMod All The Pins (ATP) Carrier Board

Access All The Pins (ATP) of the MicroMod Processor Board with the Carrier Board!

SparkFun MicroMod Input and Display Carrier Board Hookup Guide

A short Hookup Guide to get started with the SparkFun MicroMod Input and Display Carrier Board

MicroMod Machine Learning Carrier Board Hookup Guide

Get hacking with this tutorial on our Machine Learning Carrier Board!

MicroMod STM32 Processor Hookup Guide

Get started with the MicroMod Ecosystem and the STM32 Processor Board!

MicroMod Update Tool Hookup Guide

Follow this guide to learn how to use the MicroMod Update Tool to interact directly with the UART on the MicroMod Asset Tracker's SARA-R5. Using this board you can talk directly to the module using u-blox's m-center software as well as update the firmware using EasyFlash.

MicroMod WiFi Function Board - ESP32 Hookup Guide

The MicroMod ESP32 Function Board adds additional wireless options to MicroMod Processor Boards that do not have that capability. This special function board acts as a coprocessor that takes advantage of Espressif's ESP32 WROOM to add WiFi and Bluetooth® to your applications.