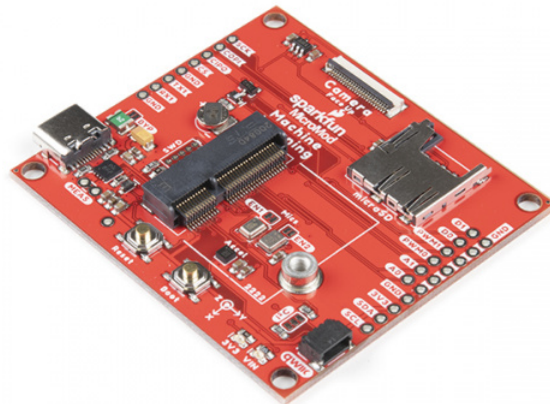


# MicroMod Machine Learning Carrier Board Hookup Guide

## Introduction

The MicroMod Machine Learning Carrier Board combines some of the features of our SparkFun Edge Board and SparkFun Artemis boards, but allows you the freedom to explore with any processor in the MicroMod lineup without the need for a central computer or web connection. Voice recognition, always-on voice commands, gesture, or image recognition are possible with TensorFlow applications. An on board accelerometer and Qwiic ports allow you even more flexibility.

Let's dive in, get a good look at what's available to us, and go over a few quick examples!



## SparkFun MicroMod Machine Learning Carrier Board

DEV-16400

Product Showcase: SparkFun MicroMod Ecosystem





## Required Materials

IN addition to your Machine Learning carrier board, you'll need a processor board to get started. Here we use the Artemis Processor Board, but there are a number of others you can choose from.



SparkFun MicroMod Artemis Processor

© DEV-16401



SparkFun MicroMod SAMD51 Processor

© DEV-16791

You'll also need a USB-C cable to connect the Carrier to your computer and if you want to add some Qwiic breakouts to your MicroMod project you'll want at least one Qwiic cable to connect it all together. Below are some options for both of those cables:



SparkFun Qwiic Cable Kit

© KIT-15081



Reversible USB A to C Cable - 2m

© CAB-15424



## USB 3.1 Cable A to C - 3 Foot

● CAB-14743

Along with a processor and the pertinent cables and accessories, if you want to take full advantage of the features of the Machine Learning Carrier Board, you will need a microSD card:



## microSD Card - 16GB (Class 10)

● COM-15051

## Suggested Reading

The SparkFun MicroMod ecosystem is a unique way to allow users to customize their project to their needs. Do you want to send your weather data via a wireless signal (eg. Bluetooth or WiFi)? There's a MicroMod processor for that. Looking to instead maximize efficiency and processing power? You guessed it, there's a MicroMod processor for that.

# MicroMod

*MicroMod Ecosystem*

We also recommend taking a look through the following tutorials if you are not familiar with the concepts covered in them:





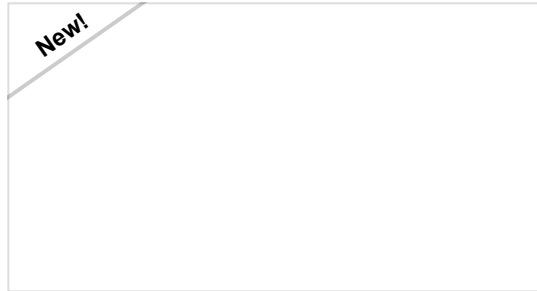
## Getting Started with MicroMod

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!



## Designing with MicroMod

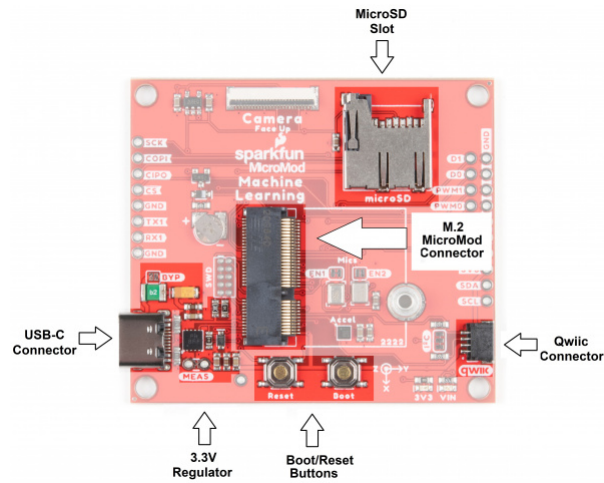
This tutorial will walk you through the specs of the MicroMod processor and carrier board as well as the basics of incorporating the MicroMod form factor into your own PCB designs!

# Hardware Overview

## Common Components

Most SparkFun MicroMod Carriers will have some common components and all MicroMod Carriers will have the keyed M.2 MicroMod Connector to plug your processor into. The photo and list below outline some of the components you can expect on most SparkFun MicroMod Carriers.

- **M.2 MicroMod Connector** - This special keyed M.2 connector lets you install your MicroMod Processor of choice on your Machine Learning Carrier Board.
- **USB-C Connector** - Connect to your computer to program your Processor and also can provide power to your MicroMod system.
- **3.3V Regulator** - Provides a regulated **3.3V** and sources up to **1A**.
- **Qwiic Connector** - The standard Qwiic connector so you can add other Qwiic devices to your MicroMod system.
- **Boot/Reset Buttons** - Push buttons to enter Boot Mode on Processor boards and to Reset your MicroMod circuit.
- **microSD Slot** - Insert a microSD card for reading and writing data.

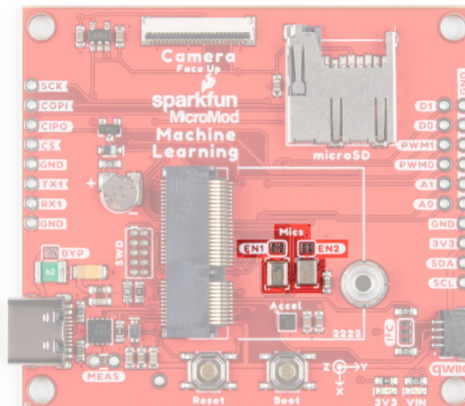


## Machine Learning MicroMod Carrier Board Specific Components

### Digital MEMS Microphones

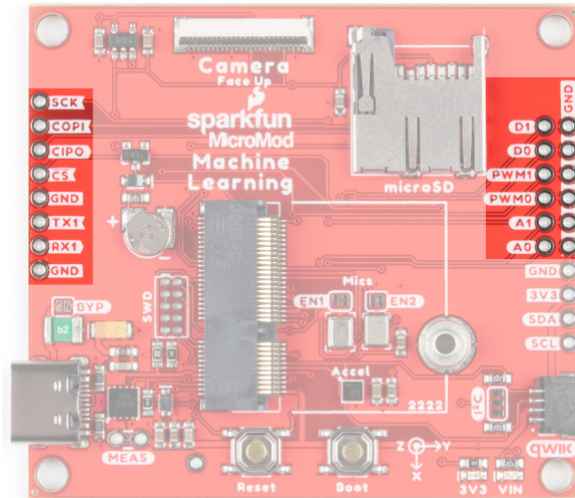
What's better than ONE microphone? TWO!

- Microphone 1 supports a PDM interface and is enabled by default. To disable this mic, cut the EN1 jumper. For more information on this microphone, refer to the datasheet [here](#).
- Microphone 2 supports an I2S interface and is disabled by default. To enable EN2, solder the jumper pads to close the circuit. For more information on this microphone, refer to the datasheet [here](#).



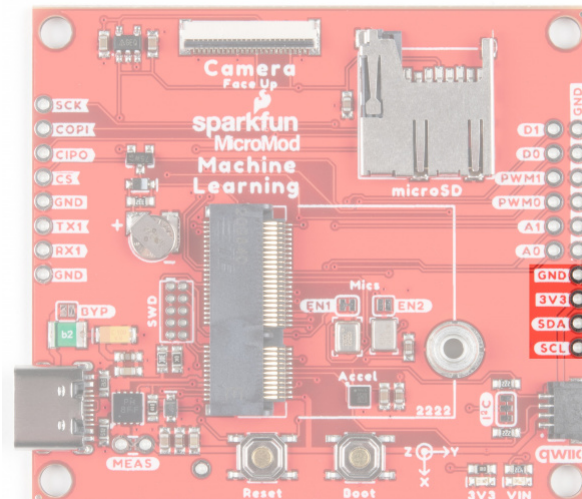
### GPIO

Along the sides of the Machine Learning Carrier Board, we've broken out dedicated PTHs for UART, digital, analog, pulse width modulation, and SPI. You may also notice that we've included a ground rail on the right side of the board.



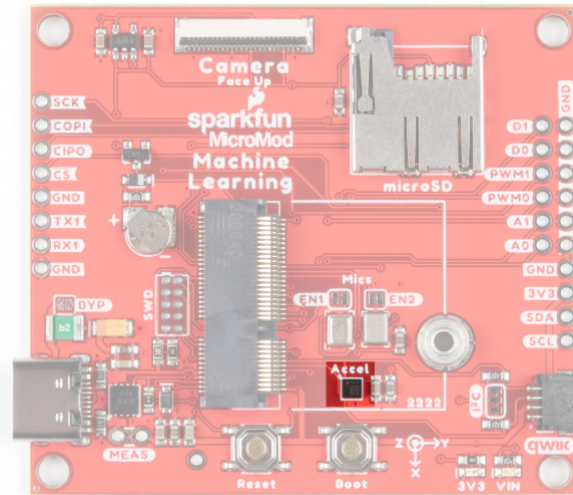
## I<sup>2</sup>C Specific GPIO

Additionally, we've broken out the I<sup>2</sup>C SDA and SCL lines, with 3V3 and GND to complete your I<sup>2</sup>C functionality. These are primary I<sup>2</sup>C pins - they are connected to the Qwiic connector.



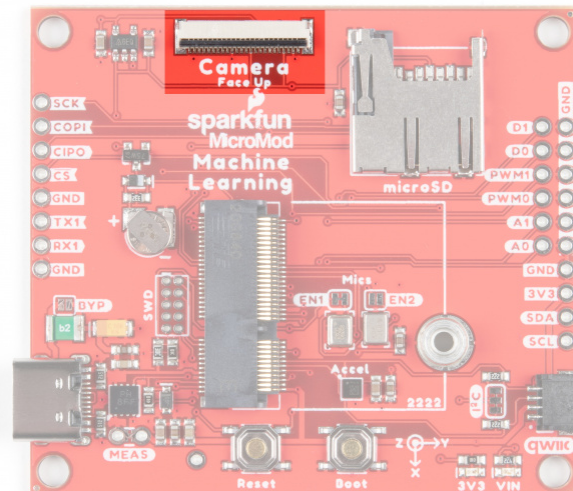
## Accelerometer

The LIS2DH12 is an ultra-low-power, high performance, three-axis linear accelerometer belonging to the “femto” family with digital I<sup>2</sup>C/SPI serial interface standard output. If you need more detail on this little guy, refer to the [Datasheet here](#).



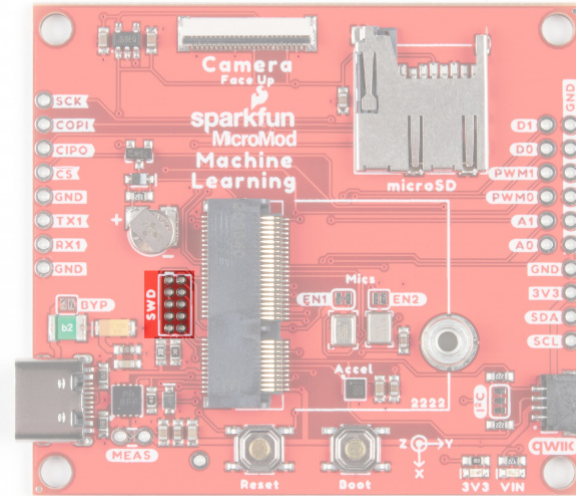
## Camera Connector

With this 24 pin connector, you can add image recognition to your machine learning board by popping in the Himax CMOS Imaging Camera.



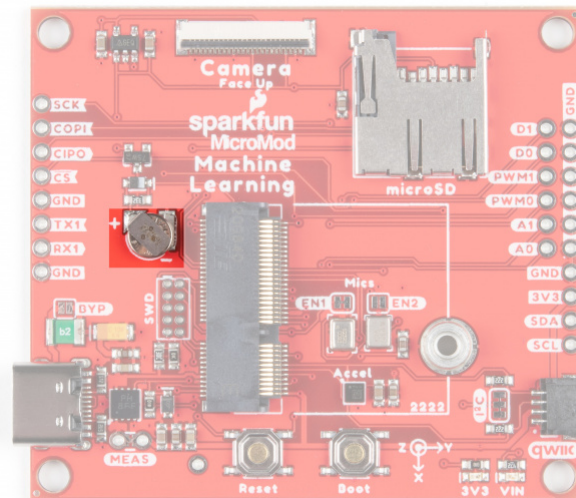
## JTAG

An unpopulated JTAG footprint is available for more advanced users who need breakpoint level debugging. We recommend checking out our JTAG section for the compatible male header and a compatible JTAG programmer and debugger.



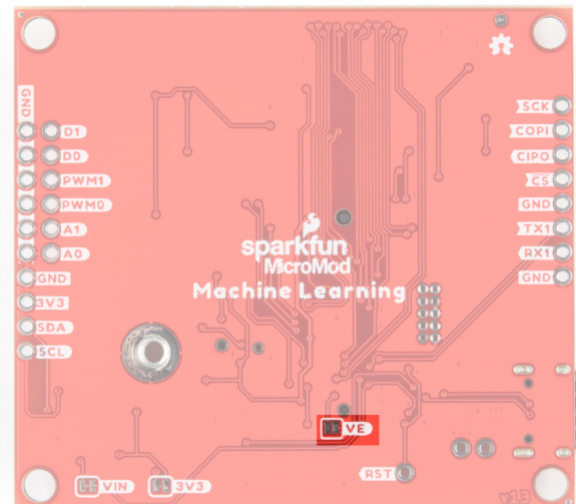
### RTC Battery

We've included a 3V Lithium Rechargeable Battery as a backup power source.



### Jumpers

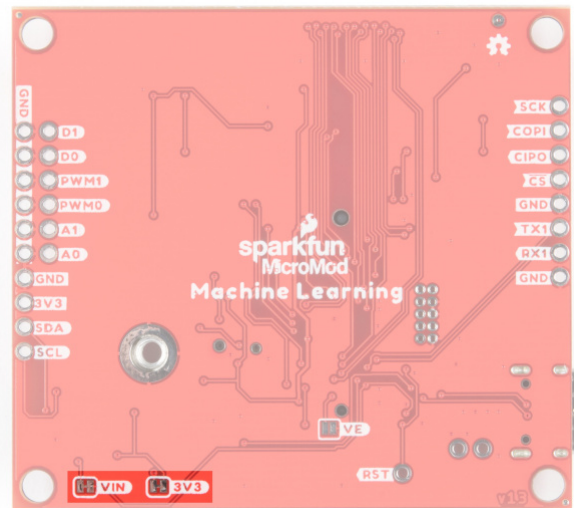
VE Jumper



VIN and 3V3 Jumpers

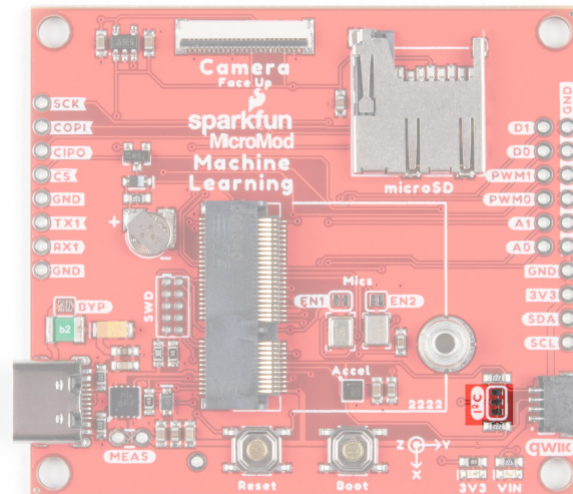


Cutting these jumpers will disable the VIN and 3V3 LEDs on the front of the board.



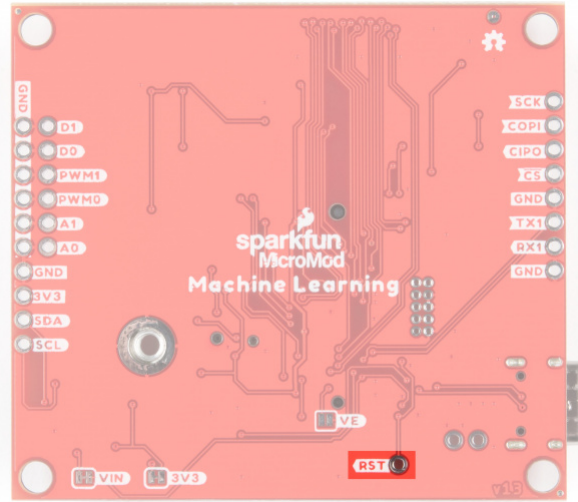
## I<sup>2</sup>C Jumper

If you are daisy-chaining multiple Qwiic devices, you will want to cut this jumper; if multiple sensors are connected to the bus with the pull-up resistors enabled, the parallel equivalent resistance could create too strong of a pull-up for the bus to operate correctly. As a general rule of thumb, disable all but one pair of pull-up resistors if multiple devices are connected to the bus. To disable the pull up resistors, use an X-acto knife to cut the joint between the highlighted jumper pads.



## RESET PTH

Need an external reset button? These PTH allow you to tie in to the reset functionality.



## Machine Learning MicroMod Carrier Pin Functionality

**Note:** You may not recognize the COPI/CIPO labels for SPI pins. SparkFun is working to move away from using MISO/MOSI to describe signals between the controller and the peripheral. Check out this page for more on our reasoning behind this change.

### MACHINE LEARNING CARRIER PINOUT TABLE

MICROMOD GENERAL PINOUT TABLE

MICROMOD GENERAL PIN DESCRIPTIONS

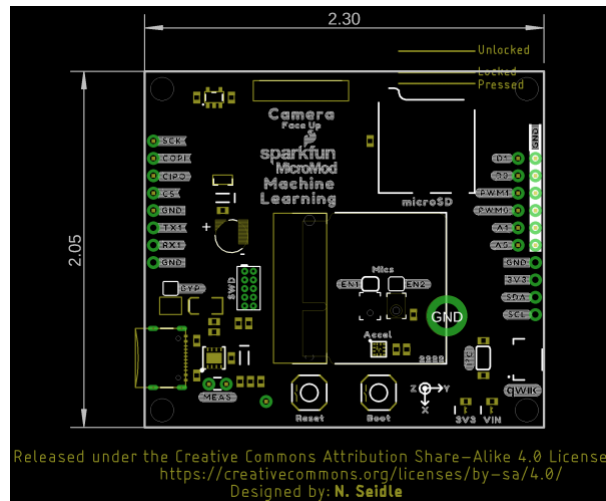
AUDIO	UART	GPIO/BUS	I <sup>2</sup> C	SDIO	SPI0	Dedicated
-------	------	----------	------------------	------	------	-----------

Name	Bottom Pin	Top Pin	Name
(Not Connected)	75		GND
	74	73	CAMERA_D5
RTC_3V	72	71	CAMERA_D6
	70	69	CAMERA_D7
	66	65	CAMERA_HSYNC
	64	63	CAMERA_VSYNC
	62	61	SPI_CIPO
	60	59	SPI_COPI

		<b>58</b>	<b>57</b>	SPI_SCK	
	CAMERA_MCLK	<b>56</b>	<b>55</b>	SPI_CS	
CAMERA_PCLK	I2S_SD	<b>54</b>	<b>53</b>		
PDM_DAT	I2S_WS	<b>52</b>	<b>51</b>		
PDM_CLK	I2S_SCK	<b>50</b>	<b>49</b>	BATT_VIN/3	
	CAMERA_D4	<b>48</b>	<b>47</b>	PWM1	CAM_VDD
	CAMERA_D3	<b>46</b>	<b>45</b>		
	CAMERA_D2	<b>44</b>	<b>43</b>		
	CAMERA_D1	<b>42</b>	<b>41</b>		
	CAMERA_D0	<b>40</b>	<b>39</b>		
	A1	<b>38</b>	<b>37</b>		
	A0	<b>34</b>	<b>33</b>		
	PWM0	<b>32</b>	<b>31</b>		
		<b>24</b>	<b>23</b>	SWDIO	
		<b>22</b>	<b>21</b>	SWDCK	
		<b>20</b>	<b>19</b>	RX1	
CAMERA_TRIG	D1	<b>18</b>	<b>17</b>	TX1	
	CAMERA_INT	<b>16</b>	<b>15</b>		
	I <sup>2</sup> C_SCL	<b>14</b>	<b>13</b>		
	I <sup>2</sup> C_SDA	<b>12</b>	<b>11</b>	BOOT	
HEADER_CS	D0	<b>10</b>	<b>9</b>	VIN	
		<b>8</b>	<b>7</b>	GND	
	RESET	<b>6</b>	<b>5</b>	USB_D-	
	3.3V_EN	<b>4</b>	<b>3</b>	USB_D+	
	3.3V	<b>2</b>	<b>1</b>	GND	

## Board Dimensions

The Machine learning Carrier Board measures 2.3 inches by 2.05 inches.

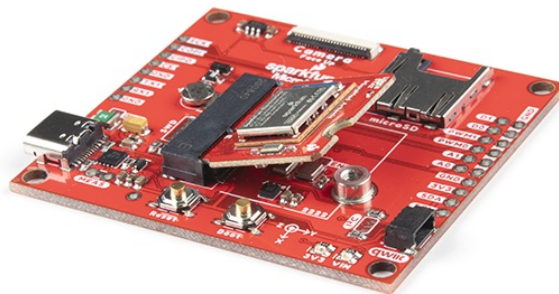


## Hardware Hookup

To get started with the Machine Learning Carrier Board, you'll need a compatible processor board. Here we are using the MicroMod Artemis Processor Board.

Align the top key of the MicroMod Artemis Processor Board to the screw terminal of the Machine Learning Carrier Board and angle the board into the socket. Insert the board at an angle into the M.2 connector.

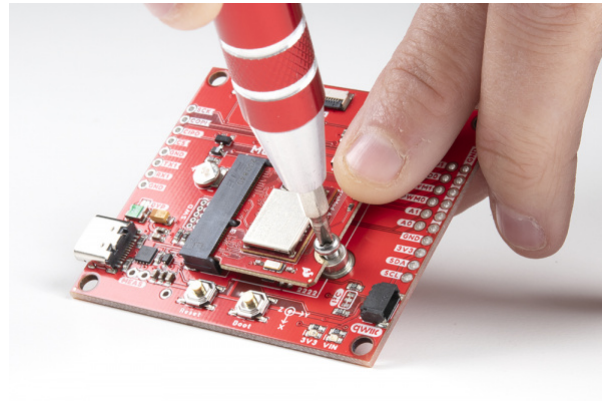
**Note:** There is no way to insert the processor backward since the key prevents it from mating with the M.2 connector and as an extra safeguard to prevent inserting a processor that matches the key, the mounting screw is offset so you will not be able to secure an improperly connected processor board.



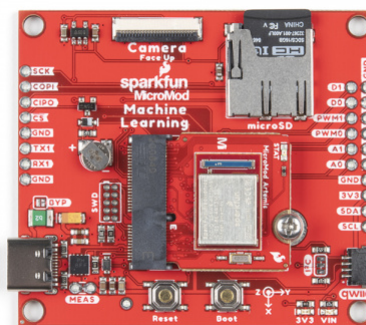
The Processor Board will stick up at an angle, as seen here:



Once the board is in the socket, gently hold the MicroMod Processor Board down and tighten the screw with a Phillip's head.



Once the board is secure, your assembled MicroMod system should look similar to the image below!



## Connecting Everything Up

With your processor inserted and secured it's time to connect your carrier board to your computer using the USB-C connector on the Carrier. Depending on which carrier you choose and which drivers you already have installed, you may need to install drivers.

**Note:** Make sure that for whatever processor board you choose, you have the correct board definitions installed.

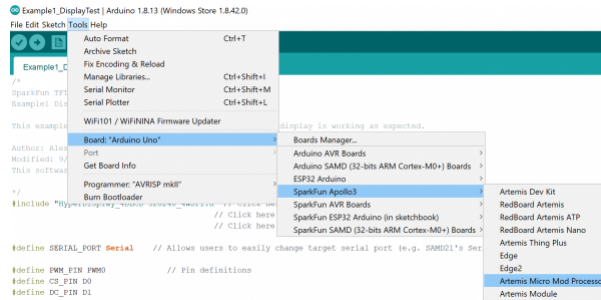
For this particular tutorial, we are using the MicroMod Artemis Processor Board. Board definitions for this processor board can be found in the Software Setup and Programming section of the MicroMod Artemis Processor Board Hookup Guide.

If you are using a different processor board, go to our MicroMod Processor Boards landing page, find your processor board, and head on over to that tutorial for help installing your board definition.

## Example 1: Blink

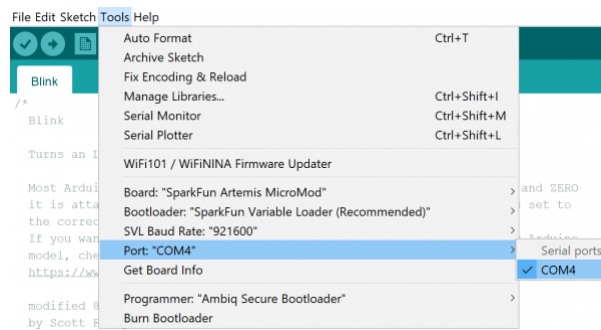
**Note:** This example assumes you are using the latest version of the Arduino IDE on your desktop. If this is your first time using Arduino, please review our tutorial on installing the Arduino IDE. If you have not previously installed an Arduino library, please check out our installation guide.

To get started uploading code and working with your Machine Learning Carrier Board, make sure you have the MicroMod Artemis board definition selected under your **Tools > Board** menu (or whatever processor you've chosen to use).



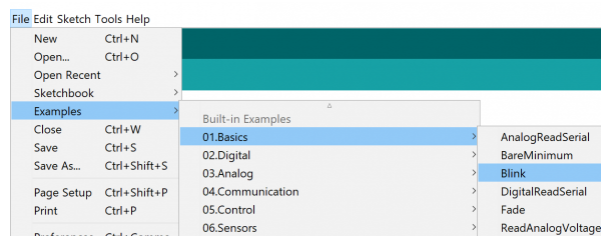
*Having a hard time seeing? Click the image for a closer look.*

Then select your serial port under the **Tools > Port** menu.



## Loading Blink

Let's start with something basic - let's blink an LED. Go to **File->Examples->01.Basics->Blink**.



*Having a hard time seeing? Click the image for a closer look.*

With everything setup correctly, upload the code! Once the code finishes transferring, you should see the STAT LED on the Artemis Processor Board begin to blink!

If the blue LED remains off, it's probably still sitting in the bootloader. After uploading a sketch, you may need to **tap the reset button** to get your MicroMod Artemis to run the sketch.

Look at all the blinks!



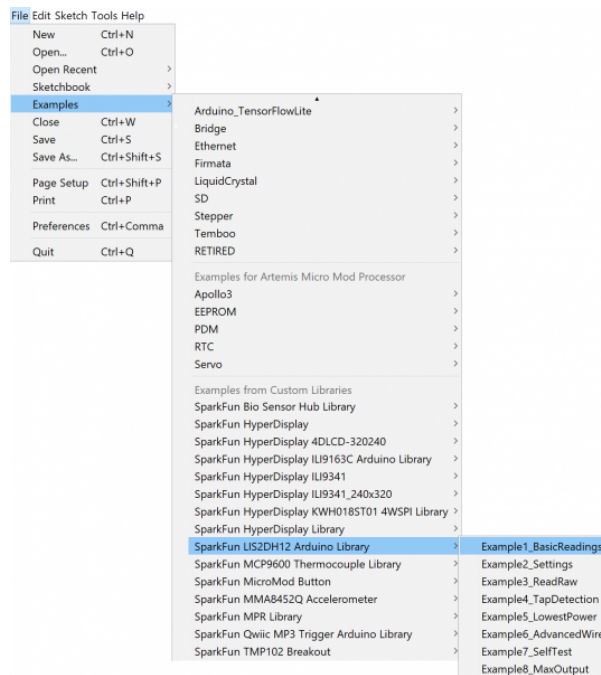
## Example 2: Accelerometer

**Note:** This example assumes you are using the latest version of the Arduino IDE on your desktop. 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.

SparkFun has written a library to work with the LIS2DH12 Accelerometer that's included on this board. You can obtain this library through the Arduino Library Manager by searching for "LIS2DH12". Find the one written by SparkFun Electronics and install the latest version. If you prefer downloading libraries manually, you can grab them from the GitHub Repository. We've linked the datasheet for the accelerometer in the Resources and Going Further section, but if you'd like it handy, you can also refer to it here.

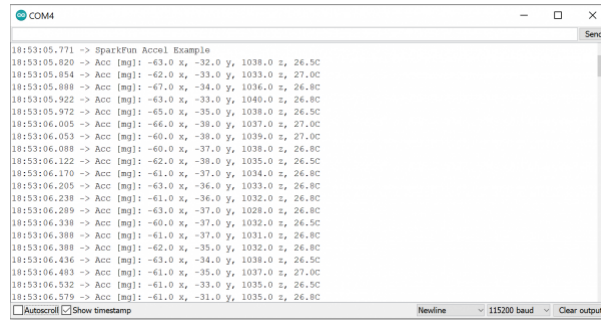
[SPARKFUN LIS2DH12 ARDUINO LIBRARY GITHUB](#)

With your library installed, navigate to the examples located under **File->Examples->SparkFun LIS2DH12 Arduino Library**. Let's load up **Example1\_BasicReadings** to get you started.



*Having a hard time seeing? Click the image for a closer look.*

Making sure you have the correct board and port selected, go ahead and upload your code. Once the code finishes transferring, **open the serial monitor** and set the baud rate to **115200**. You should see x y and z locations flying by, telling you the directions the accelerometer is reading!



```
COM4
SparkFun Accel Example
18:53:05.771 -> SparkFun Accel Example
18:53:05.820 -> Acc [mg]: -63.0 x, -32.0 y, 1039.0 z, 26.5C
18:53:05.954 -> Acc [mg]: -62.0 x, -33.0 y, 1035.0 z, 27.0C
18:53:05.808 -> Acc [mg]: -67.0 x, -34.0 y, 1036.0 z, 26.8C
18:53:05.922 -> Acc [mg]: -63.0 x, -33.0 y, 1040.0 z, 26.8C
18:53:05.972 -> Acc [mg]: -65.0 x, -35.0 y, 1039.0 z, 26.5C
18:53:06.005 -> Acc [mg]: -66.0 x, -38.0 y, 1037.0 z, 27.0C
18:53:06.053 -> Acc [mg]: -60.0 x, -38.0 y, 1039.0 z, 27.0C
18:53:06.088 -> Acc [mg]: -60.0 x, -37.0 y, 1039.0 z, 26.8C
18:53:06.122 -> Acc [mg]: -62.0 x, -38.0 y, 1035.0 z, 26.5C
18:53:06.170 -> Acc [mg]: -61.0 x, -37.0 y, 1034.0 z, 26.8C
18:53:06.205 -> Acc [mg]: -63.0 x, -36.0 y, 1035.0 z, 26.8C
18:53:06.238 -> Acc [mg]: -61.0 x, -36.0 y, 1032.0 z, 26.8C
18:53:06.289 -> Acc [mg]: -63.0 x, -37.0 y, 1028.0 z, 26.8C
18:53:06.338 -> Acc [mg]: -60.0 x, -37.0 y, 1032.0 z, 26.5C
18:53:06.389 -> Acc [mg]: -61.0 x, -37.0 y, 1031.0 z, 26.8C
18:53:06.388 -> Acc [mg]: -62.0 x, -35.0 y, 1032.0 z, 26.8C
18:53:06.436 -> Acc [mg]: -63.0 x, -34.0 y, 1038.0 z, 26.5C
18:53:06.483 -> Acc [mg]: -61.0 x, -35.0 y, 1037.0 z, 27.0C
18:53:06.532 -> Acc [mg]: -61.0 x, -33.0 y, 1035.0 z, 26.5C
18:53:06.579 -> Acc [mg]: -61.0 x, -31.0 y, 1035.0 z, 26.8C
Autoscroll Show timestamp Newline 115200 baud Clear output
```

*Having a hard time seeing? Click the image for a closer look.*

## Troubleshooting

### Need help?

If your product is not working as you expected or you need technical assistance or information, head on over to the SparkFun Technical Assistance page for some initial troubleshooting.

If you don't find what you need there, the SparkFun Forums are a great place to find and ask for help. If this is your first visit, you'll need to create a Forum Account to search product forums and post questions.

### SparkFun MicroMod Forums

## Resources and Going Further

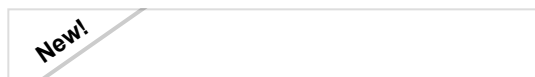
Want more information on the SparkFun Machine Learning Carrier Board? Check out these links!

- Schematic (PDF)
- Eagle Files (ZIP)
- GitHub Hardware Repo
- Accelerometer Datasheet
- Default PDM Microphone Datasheet
- Microphone 2 I2S Datasheet

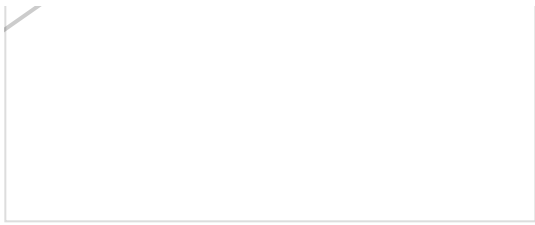
MicroMod Documentation:

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

Looking for some project inspiration using your Machine Learning Carrier Board? The tutorials below can help you get started!

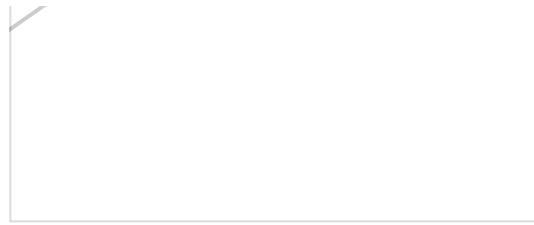




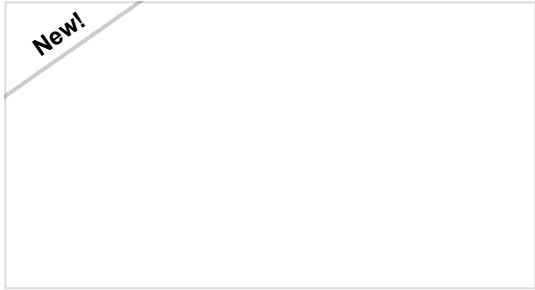


### MicroMod ESP32 Processor Board Hookup Guide

A short Hookup Guide to get started with the SparkFun MicroMod ESP32 Processor Board



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 Data Logging Carrier Board Hookup Guide

Get started with some customizable MicroMod data logging with the Data Logging Carrier Board.