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ELECTRONICS



Read the Full  
User Manual



**RTK**

**mosaic-X5**

Quick Start Guide



**RTK mosaic-X5 Quick Start Guide**  
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The background of the page is white with a pattern of thin, red, wavy lines that resemble topographic contour lines or a stylized wave pattern. These lines flow across the page, creating a sense of movement and depth.

## Want to read this on your computer?

Access the Quick Start Guide at:  
[docs.sparkfun.com/SparkFun\\_RTK\\_mosaic-X5](https://docs.sparkfun.com/SparkFun_RTK_mosaic-X5)

# WHICH SETUP SHOULD I SELECT?

- Permanent Ethernet setup..... 1
- Permanent WiFi Setup..... 3
- Connect Using USB-C..... 7

# WHAT'S INCLUDED?



RTK mosaic-X5  
(GPS-23748)



L1/L2/L5 GNSS  
"UFO" Antenna  
(GPS-21801)



Ethernet Cable  
(CAB-08915)



TNC-SMA Cable  
(CAB-21740)



USB-C Cable  
(CAB-15424)



WiFi Antenna  
(WRL-00145)



USB Power Supply  
(TOL-11456)



32GB microSD Card  
(COM-19041)

# YOU WILL NEED



Computer, Phone  
or Tablet



Ethernet network  
or Router

# YOU MAY ALSO NEED



Antenna  
Mounting Hardware  
(KIT-22197)



Antenna  
Magnetic Mount  
(PRT-21257)



# Getting Started

## Using Ethernet

### CONNECT USING ETHERNET

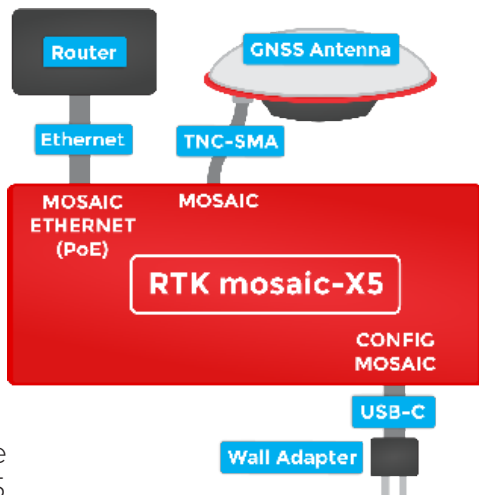
The simplest way to get your RTK mosaic-X5 up and running is to connect it to your Ethernet network or an Ethernet port on your broadband router:

**1. Connect the GNSS antenna.** Inside your RTK mosaic-X5 kit, you will find the L1/L2/L5 GNSS “UFO” antenna. It has a TNC connection. Use the supplied TNC-SMA cable to connect the antenna to the mosaic-X5

**MOSAIC** SMA connection. Make sure the antenna is securely mounted to a structure so that it cannot be moved and has a clear view of the sky. Any movement in the antenna will cause inaccurate readings by RTK rovers.

**2. Connect the RTK mosaic-X5 to your Ethernet network or router.** Use any Ethernet cable to connect the **MOSAIC ETHERNET (PoE)** port to your network or an Ethernet port on your router. If your router provides Power-over-Ethernet (PoE), you’re all set! You should see the red power (PWR) LED light up and text start to scroll up the OLED display. If your router does not provide PoE, move on to step 3.

**3. Provide power.** You can power the RTK mosaic-X5 using the supplied USB power supply (5V 1A). Plug the power supply into the wall. Use the supplied USB-C cable



# Getting Started

## Using Ethernet



to connect the power supply to either the **CONFIG MOSAIC** or the **CONFIG ESP32** USB-C port. It does not matter which. You should see the red power (PWR) LED light up and text start to scroll up the OLED display.

Once the mosaic-X5 has acquired a satellite signal and is connected to the Ethernet network, the OLED will display the antenna's position as Latitude (Lat), Longitude (Long), and Altitude (Alt), and the Ethernet IP (Internet Protocol) network address.

**4. Connect your computer, tablet, or phone** to the same network, open a web browser and navigate to the IP address shown on the OLED display. You should see the mosaic-X5's internal web page. The web page displays a lot of helpful information and can also be used to fully configure the mosaic-X5.

Receiver	Position	Status
mosaic-X5 S/N 3691286	Lat: N40°5'25.0254" 0.004m	Tracked Sats: 45
IP Address: 192.168.2.185	Lon: W105°11'5.3508" 0.004m	Time: 2023-10-05 17:16:41
Uptime: 04 01:12:53	Hgt: 1560.235m 0.008m	Temp: 49.00 °C

Quality Indicators:

- Overall: 10/10
- Main RF power: 10/10
- Main signals: 10/10
- CPU: 10/10
- Base measurements: 10/10





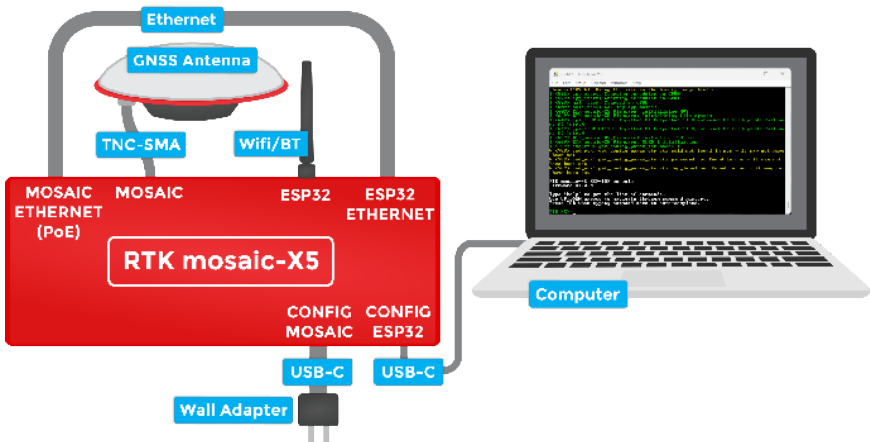
# Getting Started

## Using WiFi

### CONNECT USING WIFI

The RTK mosaic-X5 contains an ESP32-WROVER processor which can act as a Ethernet to WiFi bridge. By linking the **MOSAIC ETHERNET (PoE)** port to the **ESP32 ETHERNET** port and putting the ESP32 firmware into WiFi mode, the mosaic-X5 can join your WiFi network.

**1. Connect the GNSS antenna.** Inside your RTK mosaic-X5 kit, you will find the L1/L2/L5 GNSS “UFO” antenna. It has a TNC connection. Use the supplied TNC-SMA cable to connect the antenna to the mosaic-X5 **MOSAIC SMA** connection. Make sure the antenna is securely mounted to a structure so that it cannot be moved and has a clear view of the sky. Any movement in the antenna will cause inaccurate readings by RTK rovers.



**2. Attach the WiFi antenna.** Screw the supplied WiFi/BT antenna onto the **ESP32 SMA** connection. To minimize wear of the SMA connector, we recommend: holding the antenna body with one hand - to prevent it rotating - while screwing the SMA connector into place with your other hand. If needed, fold the antenna up so the antenna body is vertical.

# Getting Started

Using WiFi



**3. Connect the Ethernet ports.** Connect the two ethernet ports together using the supplied Ethernet cable. If you don't have the original cable, any Ethernet Cable will work. A crossover cable is compatible but not required.

**4. Connect to the CONFIG ESP32 USB port.** To change the ESP32 firmware mode, you need to connect a computer to the **CONFIG ESP32** USB-C port and use a Serial Terminal to change the mode. You may need to install a driver first, so that the CH340 serial interface chip is recognized.

Please follow the QR codes below for more details:



## ***CH340 Drivers***

<https://learn.sparkfun.com/tutorials/908>

## ***Tera Term***

<https://learn.sparkfun.com/terminal-basics/tera-term-windows>



## ***Serial Terminal Basics***

<https://learn.sparkfun.com/terminal-basics>

**5. Open a Serial Terminal.** If you are using Windows, we still recommend Tera Term serial terminal but there are plenty of alternatives. Please see our Serial Terminal Basics tutorial for more details. Open the connection to the CH340 using **115200 baud**.



# Getting Started

## Using WiFi

**6. Put the ESP32 firmware into WiFi mode.** When you have the Serial Terminal open, you should see the **RTK\_X5>** console prompt. If you do not, hit Enter on your keyboard. If needed, click the RESET pushbutton on the front of the RTK mosaic-X5 to restart the ESP32 firmware.

```
COM7 - Tera Term VT
File Edit Setup Control Window Help
header(4096k). Using the size in the binary image header.
(595) app_start: Starting scheduler on CPU0
(599) app_start: Starting scheduler on CPU1
(599) main_task: Started on CPU0
(609) main_task: Calling app_main()
(609) RTK_mosaic-X5_Firmware: Initializing NUS
(649) RTK_mosaic-X5_Firmware: Initializing file system
(649) gpio: GPIO[12]! InputEn: 0! OutputEn: 1! OpenDrain: 0! Pullup: 0! Pulldow
: 0! Intr:0
(649) gpio: GPIO[13]! InputEn: 0! OutputEn: 1! OpenDrain: 0! Pullup: 0! Pulldow
: 0! Intr:0
(659) RTK_mosaic-X5_Firmware: Initialize I2C bus
(669) RTK_mosaic-X5_Firmware: OLED initialization
(759) cmd_rtk: get_config_param_int mode: 1
(759) cmd_rtk: get_config_param_str str ssid not found in nvs - it may not have
been set
(759) cmd_rtk: get_config_param_str str password not found in nvs - it may not
have been set
(769) cmd_rtk: get_config_param_str str log_level not found in nvs - it may not
have been set

RTK_mosaic-X5 ESP-IDF console
Firmware v1.0.0

Type 'help' to get the list of commands.
Use UP/DOWN arrows to navigate through command history.
Press TAB when typing command name to auto-complete.

RTK_X5>
```

Type **help** and hit enter to see the help.

Type **show** to see the current configuration:

```
COM7 - Tera Term VT
File Edit Setup Control Window Help
help
Print the list of registered commands
set [-m <int>] [-s <string>] [-p <string>]
Set the RT mosaic-X5 operating mode plus the WiFi SSID and password
-n, --mode=<int>
mode: 1 = Ethernet (default)
2 = WiFi
-s, --ssid=<string> WiFi SSID
-p, --password=<string> WiFi Password
To set a NULL password, use: --password=%00

show
Show the current configuration

restart
Software reset of the ESP32

log_level <none|error|warn|info|debug|verbose>
Set log level.
<none|error|warn|info|debug|verbose> Log level to set. Abbreviated words are a
ccepted.

RTK_X5> show
mode: 1 (Ethernet)
ssid: sparkfun-guest
password:
log_level: warn
RTK_X5>
```

# Getting Started

Using WiFi



By default the firmware will be in **mode 1 (Ethernet)**. To change the mode to **mode 2 (WiFi)**, type:

```
set -m 2
```

To set the WiFi SSID of the network to connect to:

```
set -s YOUR_SSID
```

Likewise, to set the WiFi password:

```
set -p YOUR_PASSWORD
```

Finally, type **restart** to restart the firmware with the new settings:

```
restart
```



Once the mosaic-X5 has acquired a satellite signal and is connected to the WiFi network, the OLED will display: the antenna's position as Latitude (Lat), Longitude (Long), and Altitude (Alt), as well as the WiFi IP (Internet Protocol) network address.



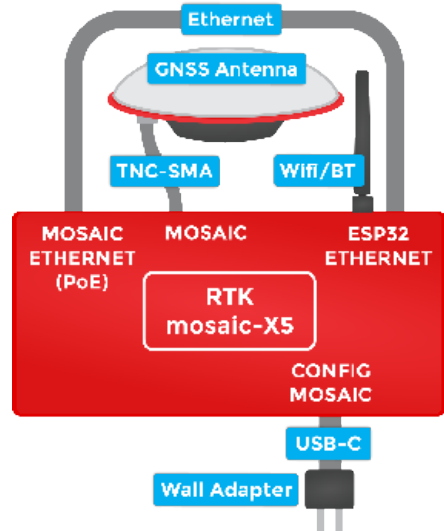
# Getting Started

## Using WiFi

When powering the RTK mosaic-X5 on for the first time, you may see the firmware restart (reboot) several times while it waits for the mosaic-X5 to initialize. This is not an error, you do not need to be concerned.

Connect your computer, tablet or phone to the same WiFi network. Next, navigate to the IP address shown on the OLED display. You should see the mosaic-X5's internal web page. The web page displays a lot of helpful information and can also be used to fully configure the mosaic-X5.

The firmware mode, SSID, and password are stored in (non-volatile) memory. After changing them, you can disconnect the computer and power the RTK mosaic-X5 using the supplied power supply.



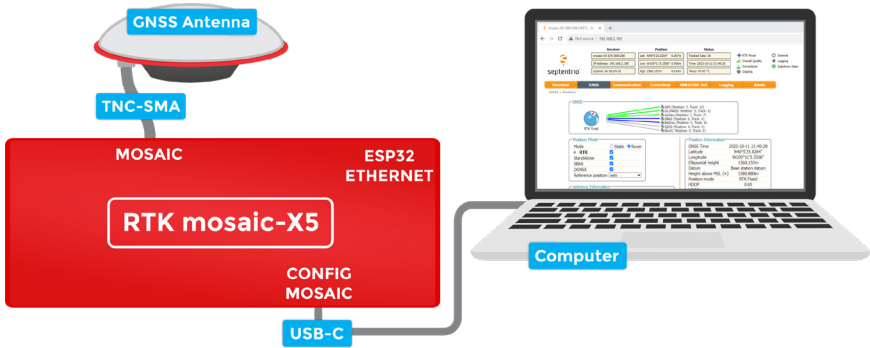
## CONNECT USING USB-C

The mosaic-X5 has a built-in high-speed USB port which supports Ethernet-over-USB. To take advantage of this interface, you need to install the Septentrio drivers.

**1. Connect the GNSS antenna.** Inside your RTK mosaic-X5 kit, you will find the L1/L2/L5 GNSS “UFO” antenna. It has a TNC connection. Use the supplied TNC-SMA cable to connect the antenna to the mosaic-X5 MOSAIC SMA connection.

# Getting Started

Using USB-C



Make sure the antenna is securely mounted to a structure so that it cannot be moved and has a clear view of the sky. Any movement in the antenna will cause inaccurate readings by RTK rovers.

**2. Download and install Septentrio RxTools.** RxTools includes the driver for the USB-C port plus several tools which you can use to control and configure the mosaic-X5, forward data, log data, analyze the log files, convert the log files to other formats, and configure the module for use with other GIS software.



**RxTools**  
<https://www.septentrio.com/en/support/software/rxtools>

**3. Connect the RTK mosaic-X5 to your computer.** Use the supplied USB-C cable to connect the CONFIG MOSAIC port to your computer.

**4. Open the X5 web page.** Open a web browser on your computer and navigate to **192.168.3.1** to view the mosaic-X5's internal web page.

You can now use the RxTools suite to take full advantage of the sophisticated mosaic-X5.



# Common Gotchas

- High-precision GNSS only works with multi-frequency antennas. This means that GPS antenna you got in the early 2000s with your TomTom is not going to work. Please use the SparkFun L1/L2/L5 antenna provided in the RTK mosaic-X5 kit.
- High-precision GNSS works best with a clear view of the sky; it does not work indoors or near a window. GNSS performance is generally not affected by clouds or storms. Trees and buildings can degrade performance but usually only in very thick canopies or very near tall building walls. GNSS reception is very possible in dense urban centers with skyscrapers but high-precision RTK may be impossible.
- The mosaic-X5 reserves the IP (Internet Protocol) subnet address 3 for its USB-C interface; this cannot be changed. If your Ethernet or WiFi network is also using subnet 3 (**192.168.3.nnn**), the mosaic-X5 may appear to have a valid IP address but communication will fail. Please change your Router configuration to use a different subnet.



# Help & Troubleshooting



If you need technical assistance or more information on a product that is not working as you expected, we recommend heading on over to the SparkFun Technical Assistance page for some initial troubleshooting.



## ***Technical Assistance***

[https://www.sparkfun.com/technical\\_assistance](https://www.sparkfun.com/technical_assistance)

If you can't find what you need there, the SparkFun GPS Forum is a great place to ask questions.

## ***SparkFun GPS Forum***

<https://forum.sparkfun.com/viewforum.php?f=116>



If this is your first visit to our forum, you'll need to create a Forum Account to post questions.



## ***Forum Account***

<https://forum.sparkfun.com/ucp.php?mode=register>