microLink

User and Installation Guide

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1 Revision History

Revision	Date	Comments
A	6/23/2019	Initial release
B	07/17/2019	Modified the FCC and added the IC regulatory statement
C	08/09/2019	Updated the skyStation statistics definitions and modified for uav files updating
D	08/12/2019	Updated the FCC and IC statements per the TCB
E	08/28/2019	Updated the RF exposure limits per the TCB
F	12/18/2019	Added Updating instructions for skyStation and microLink radios
G	7/21/2020	Updated configuration item descriptions. Updated firmware upgrade instructions.
H	10/27/2020	Add Transmit and Receive Masking configuration instructions.
I	1/25/2021	Quick Start and Here2 appendices moved to separate documents. Updated screen captures. Added remote configuration instructions.
J	5/15/2021	Corrected USER connector pin-out table. Updated skyLinkApp and web page screenshots.
K	07/12/2021	Updated images for skyStation 2.

2 Limited Warranty

uAvionix products are warranted to be free from defects in material and workmanship for one year from purchase. For the duration of the warranty period, uAvionix, at its sole option, will repair or replace any product which fails under normal use. Such repairs or replacement will be made at no charge to the customer for parts or labor, provided that the customer shall be responsible for any transportation cost.

This warranty does not apply to cosmetic damage, consumable parts, damage caused by accident, abuse, misuse, water, fire or flood, damage caused by unauthorized servicing, or product that has been modified or altered.

IN NO EVENT, SHALL UAVIONIX BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUSE OR INABILITY TO USE THE PRODUCT OR FROM DEFECTS IN THE PRODUCT. SOME STATES DO NOT ALLOW THE EXCLUSION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU.

Warranty Service

Warranty repair service shall be provided directly by uAvionix.

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4 Introduction

microLink is an aviation grade, miniature, Beyond Visual Line Of Sight (BVLOS) data link radio specifically designed for long range, robust, Unmanned Aircraft Systems (UAS) telemetry data links. Ideal for size, weight, power and performance sensitive applications, microLink operates in the 902-928MHz license-free ISM band.

5 Specification

5.1 microLink Radio Technology

- Dual radio architecture for true diversity
  - Path (spatial) diversity
  - Frequency diversity
  - Polarization gain
- Dynamic Medium and Multiple access, time and position synchronized, to support 100s of simultaneous links
  - Adaptive time and frequency spreading
- Global Positioning System (GPS) Coordinated Universal Time (UTC) link synchronization
- Status, integrity and health monitoring
- Environmental RTCA/DO-160G
- Software RTCA/DO-178C Level C
- Complex Hardware RTCA/DO-254 Level C
- FCC 47 CFR Part 15.247 ID 2AFFTC2XISM

Radio Specifications	
Band	902-928MHz ISM Band
Architecture	Dual Diversity Radios
Transmit Power	1W (4W EIRP)
Spreading	Code and Frequency
Bandwidth	200kHz
Receiver Sensitivity	
User Receiver	-118dBm
Control Receiver	-121dBm
Doppler Capture Range	±16kHz

5.2 Regulatory Statements

5.2.1 FCC Statement

FCC ID: 2AFFTC2XISM

This device meets the FCC requirements for RF exposure in public or uncontrolled environments.

Changes or modifications 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.

5.2.2 Industry Canada Statement

IC ID: 25261-C2XISM

In order to comply with FCC / ISED RF Exposure requirements, this device must be installed to provide at least 20 cm separation from the human body at all times.

Afin de se conformer aux exigences d'exposition RF FCC / ISED, cet appareil doit être installé pour fournir au moins 20 cm de séparation du corps humain en tout temps.

This device complies with Industry Canada's licence-exempt RSSs. 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.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1) l'appareil ne doit pas produire de brouillage;

2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

5.3 Ground Radio System (GRS) – skyStation

- All-Weather Network-Ready microLink GRS
- TCP and UDP Power Over Ethernet (POE) connectivity.
- IP67 grade enclosure.
- Dual Dipole Antennas
- Pole Mounting Kit

Specification	Value
Input Power	POE 13W Peak
Size	122x82x60mm
Weight	500 grams
Operating Temp	-45 to 70°C
Interfaces	
User	
Protocol	TCP or UDP
Control	
Protocol	TCP or UDP
Timing/Position	
Position	Internal
Environmental	
DO-160G	Temperature Cat B2

5.4 Airborne Radio System (ARS)

- Transparent serial user data interface
- Plug and play with Ardupilot PixHawk autopilot
- Dual MMCX antenna connectors
- Supports NMEA/UBX GPS Sensors such as HERE2 and microFYX

USER Interface (top connector)

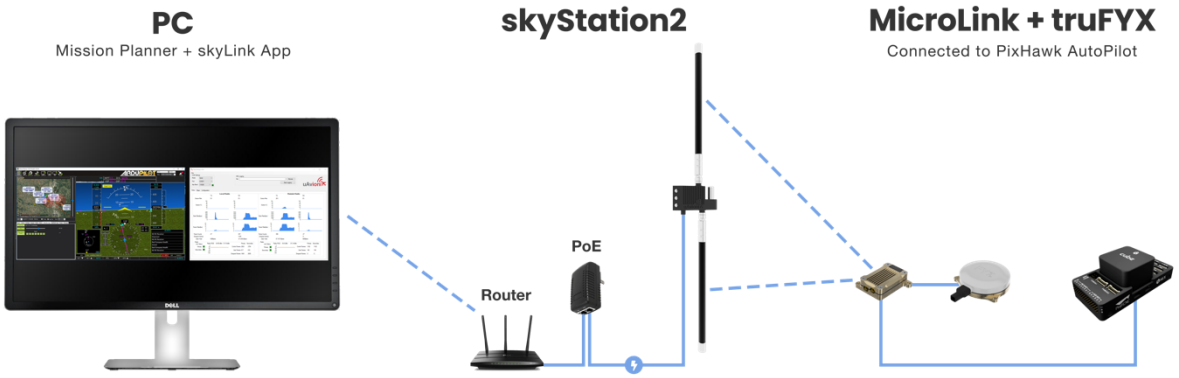
Pin	Type	Physical	Port
1	5V	5V	
2	RXD	IN	Telem
3	TXD	OUT	Telem
4	RFU		
5	RFU		
6	GND		

Timing/Position, Control Interface (bottom connector)

Pin	Type	Physical	Port
1	5V	5V	
2	RXD	IN	GPS
3	UTC	IN	1PPS
4	RXD	IN	Control
5	TXD	OUT	Control
6	GND		

The USER interface is the data connection to the auto pilot. The Control interface is for changing settings like frequency hop tables, serial port parameters, etc.

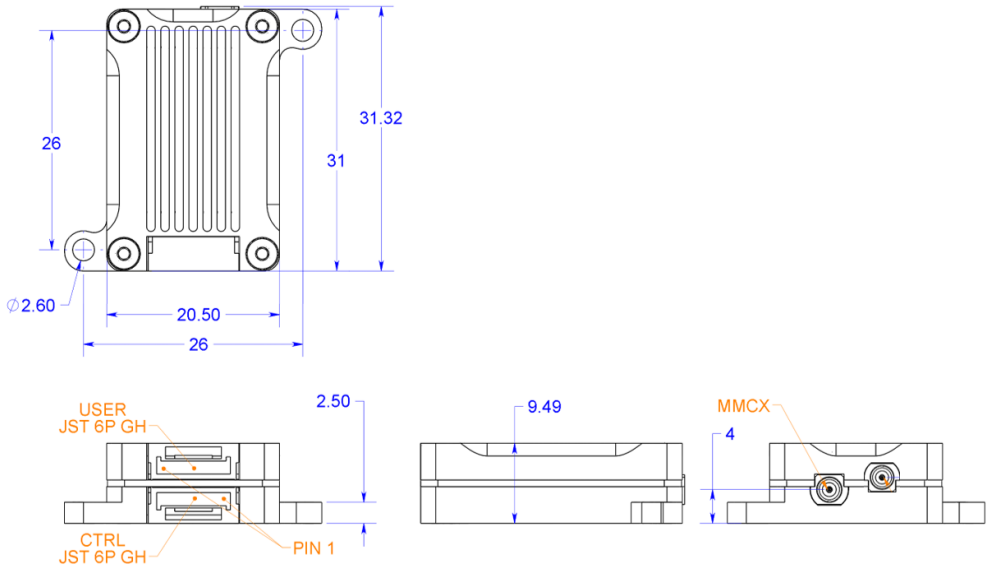
5.5 Typical System Configuration



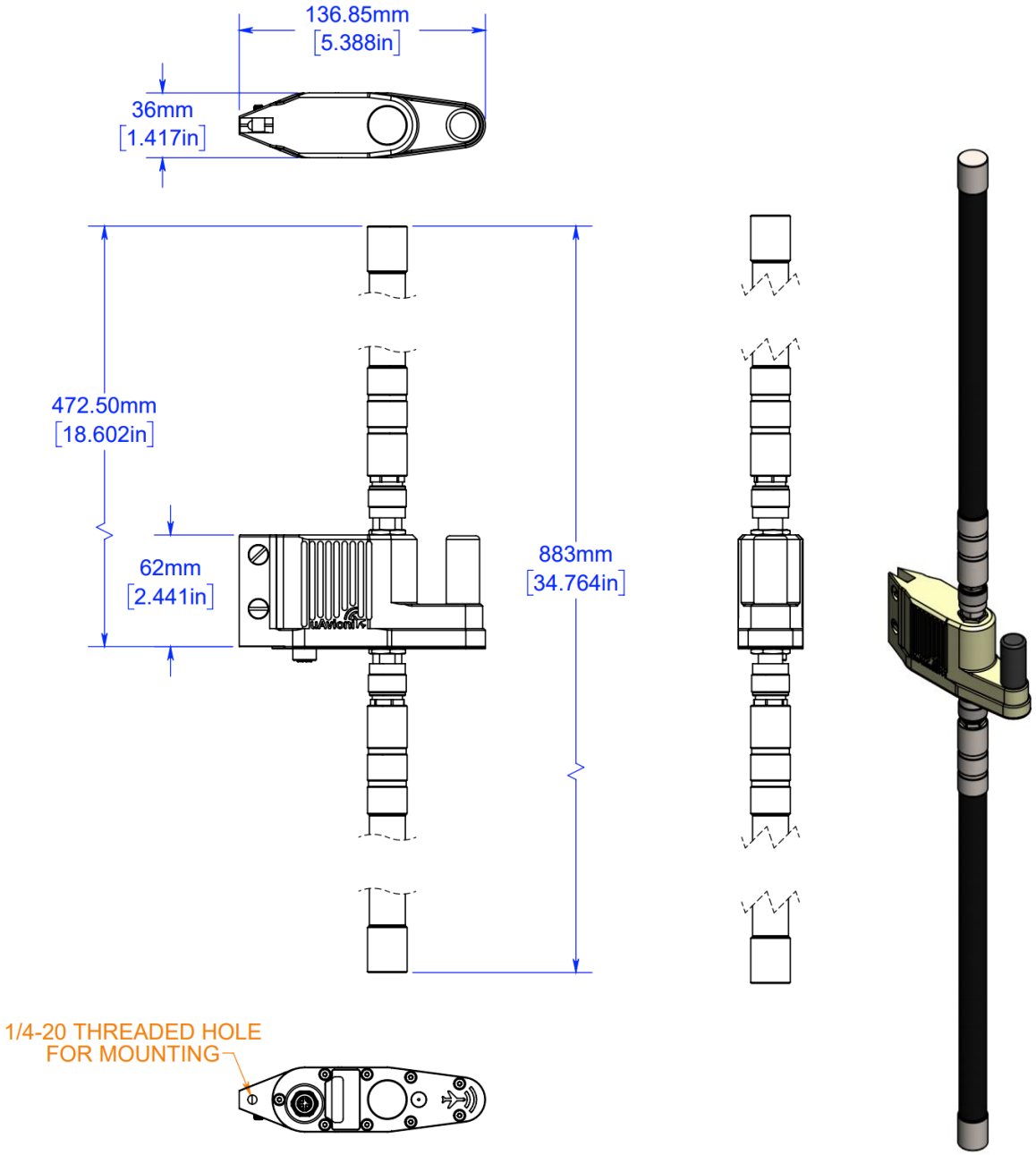
Ordering Part Numbers	
skyStation 2	UAV-1005539-001
microLink	UAV-1002868-001
GPS Options	
microFYX kit	UAV-1002500-001
HERE2 kit	UAV-1002956-001
Replacement Parts	
MMCX 100mm	UAV-1003063-001
MMCX 200mm	UAV-1003063-002
GH 6p Cable	UAV-1003061001
GH 8p Cable	UAV-1003062-001

5.6 Mechanical Specifications

Airborne Radio System (ARS)



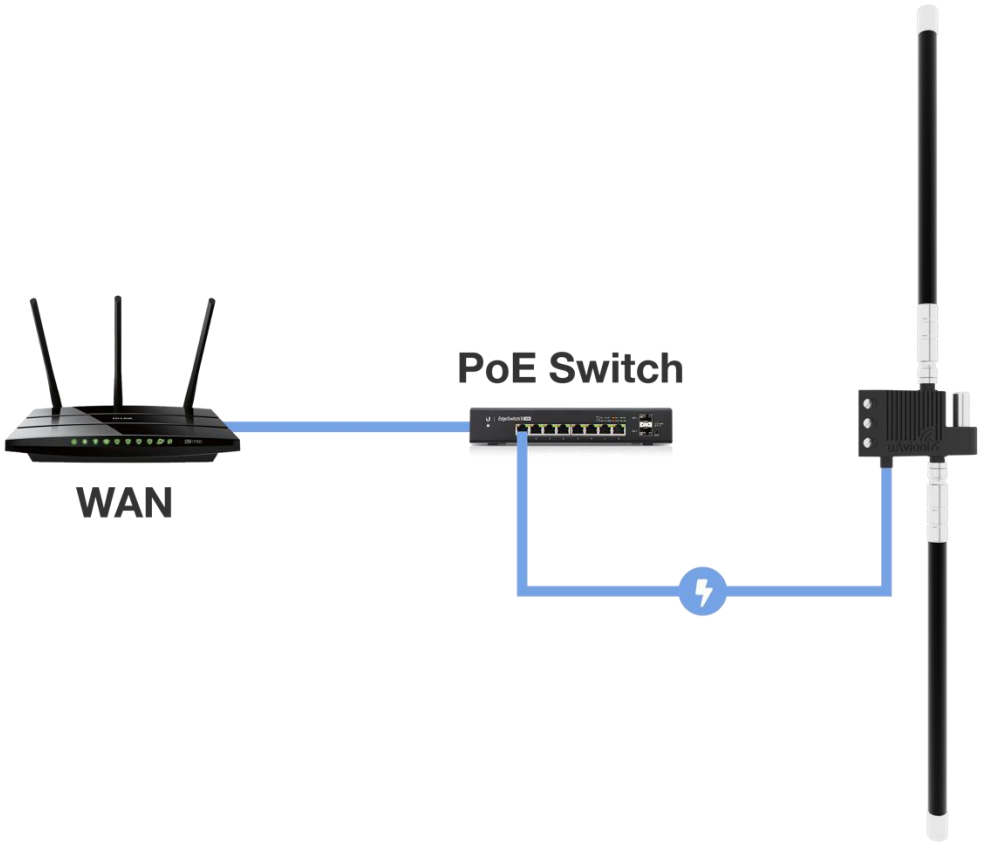
GRS


136.85mm
[5.388in]
36mm
[1.417in]
472.50mm
[18.602in]
62mm
[2.441in]
883mm
[34.764in]
1/4-20 THREADED HOLE
FOR MOUNTING

6 Configuration

6.1 skyStation

Connect skyStation to a POE switch or POE power injector.

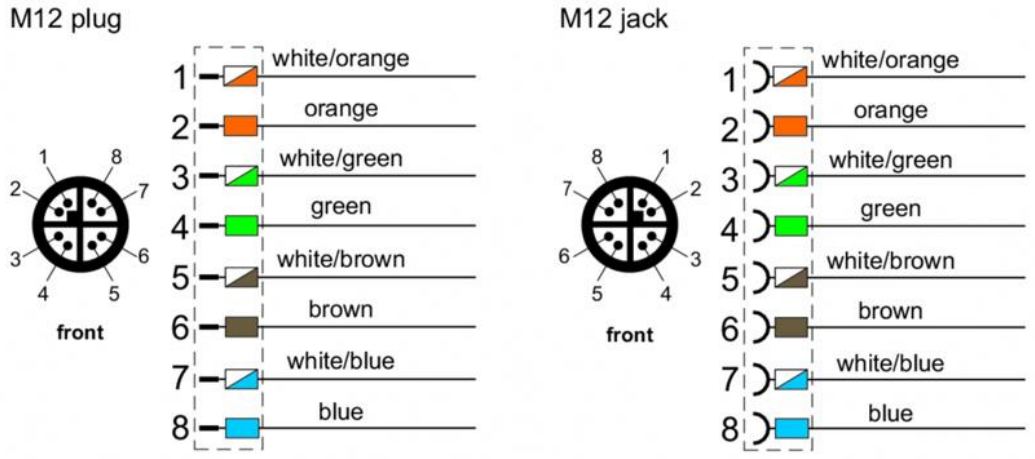


6.2 Connection to the POE Network

The skyStation connects to a network via POE using an M12 X-Coded connector.

POE Specifications:

Parameter	Value
Standard	803.3af (802.3at Type1)
Maximum power	15.4W
Voltage Range	37 – 57V
Maximum Current	350mA
Maximum Cable Resistance	20Ω
Supported Cabling	Shielded Cat 3 and Shielded Cat 5
Supported Modes	Mode A (endspan), Mode B (midspan)
Power Management	Power Class 0
Maximum Cable Length	100 meters



Caution!

Absolute maximum DC voltage +57 V. A higher DC voltage value will permanently damage the equipment!

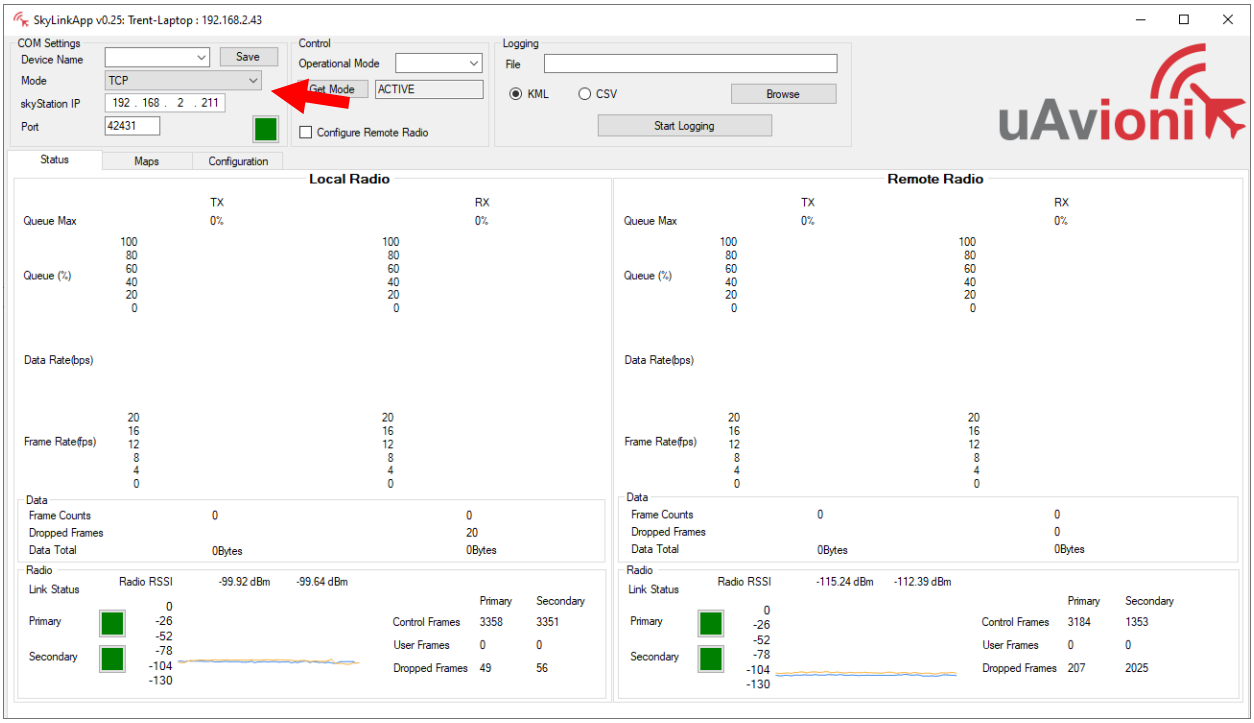
6.3 skyStation Start-up and Connection

To setup the microLink and skyStation quickly with default configuration, see the “microLink Quick Start Guide.pdf”. Connect the skyStation to a POE capable network switch. At power-up an IP address will be assigned to the skyStation by the local DHCP server. By default, the skyStation will start broadcasting the User channel information on TCP port 42430 and the Control channel information on port 42431. An IP Scan can be used to find the IP address of the skyStation. MAC addresses are printed on the skyStation.

6.3.1 Run skyLinkApp.exe

In the skyLinkApp.exe, configure the COM Settings to TCP, enter the IP address of the skyStation, and enter the default Control port 42431. When the data arrives, skyLinkApp.exe will begin graphing the radio link statistics.

NOTE: If you are not able to connect to the skyStation it is likely your firewall is blocking the broadcast on port 42431. Please setup your firewall to allow skyLinkApp.exe broadcast access to port 42431.



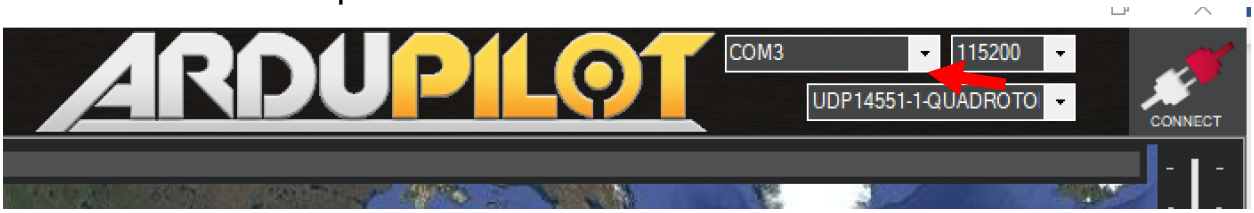
6.3.2 Connecting to Mission Planner

Download and install Mission Planner from:

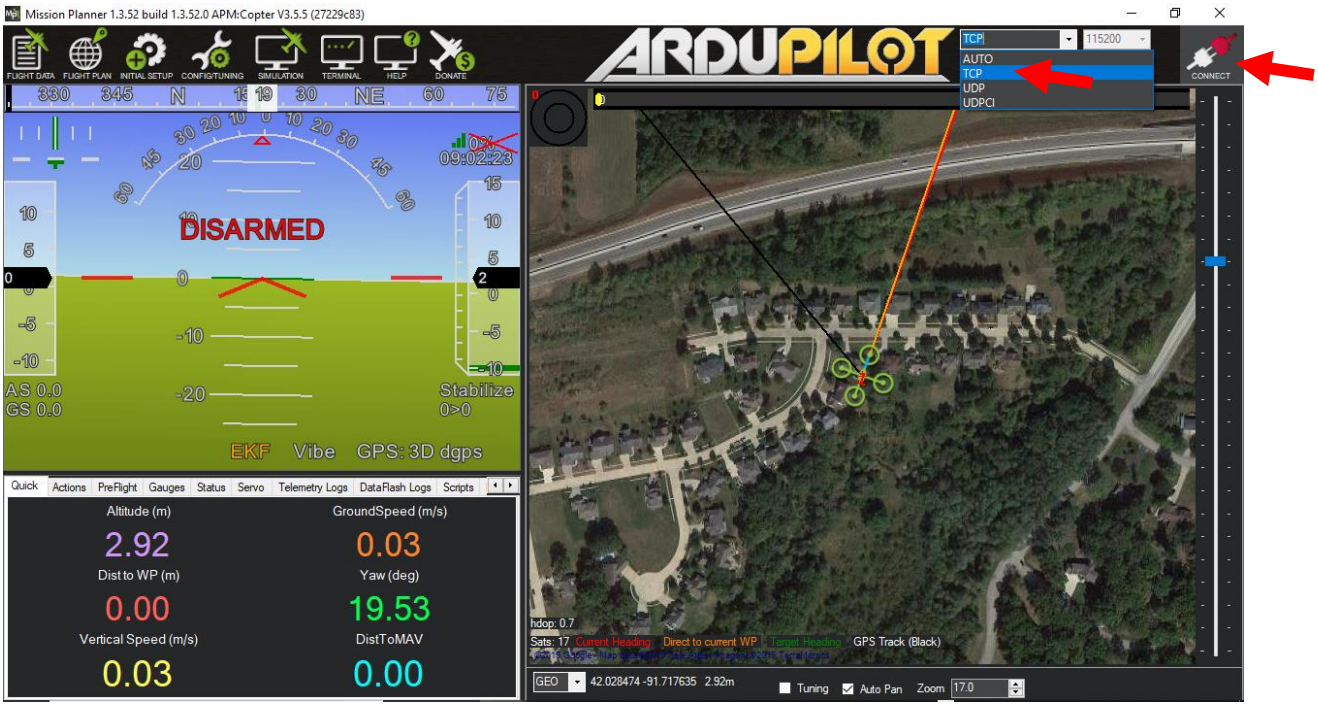
http://firmware.ardupilot.org/Tools/MissionPlanner/

http://ardupilot.org/planner/docs/mission-planner-installation.html

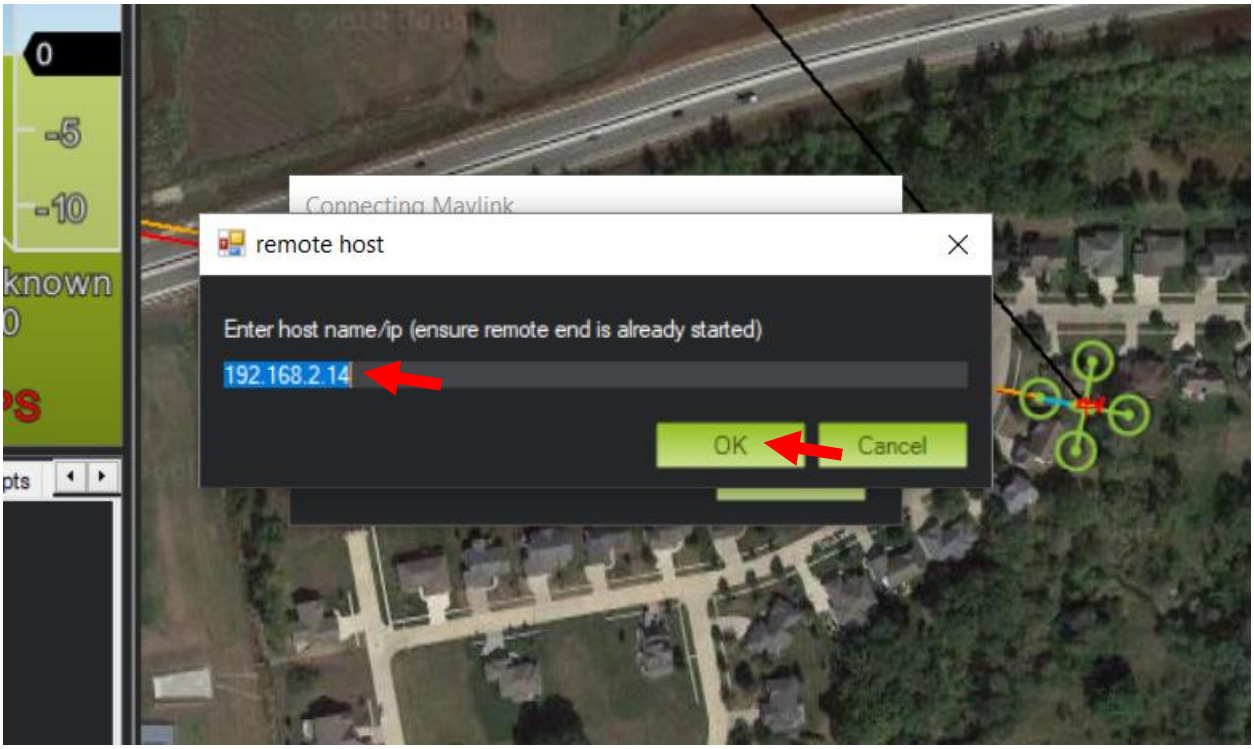
Verify that the flight controller and skyStation are powered and running and that skyLinkApp.exe is receiving data. Run Mission Planner and select the communications drop down menu.



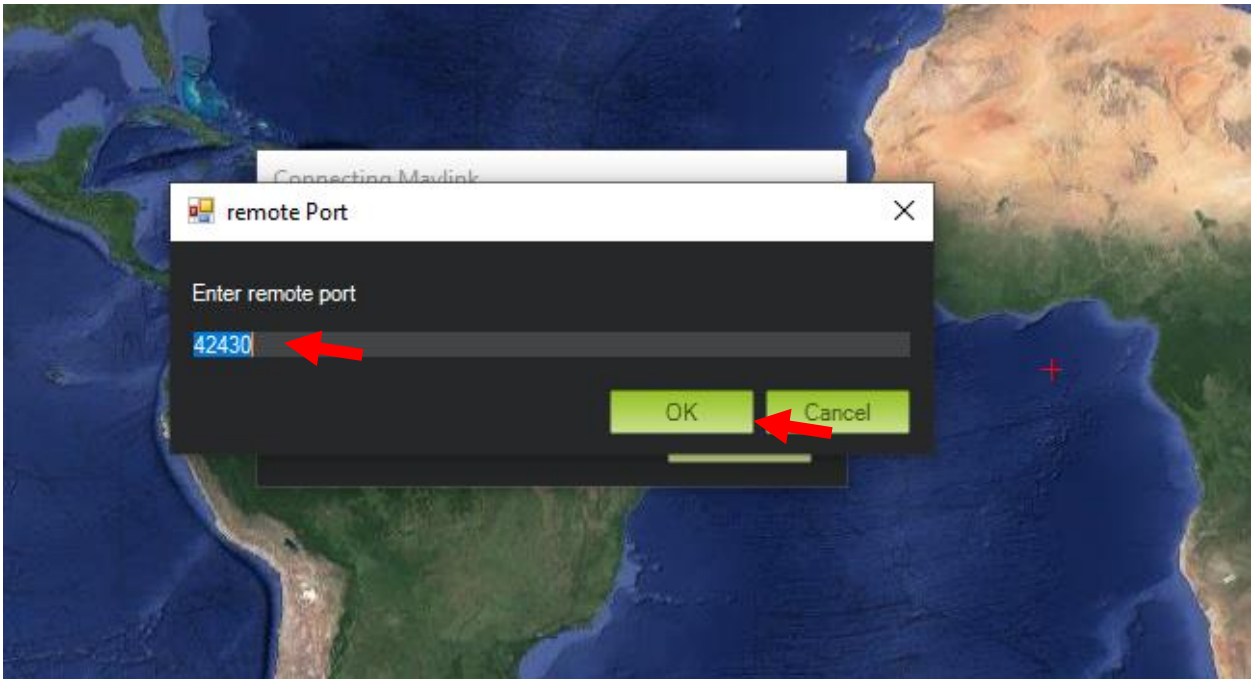
Select TCP as the communication mode and hit the Connect button on the upper right-hand corner.



Enter the skyStation IP address as found earlier in skyLinkApp.exe and click OK.



Enter port 42430 which is the skyStation default TCP port for Mission Planner and click OK.

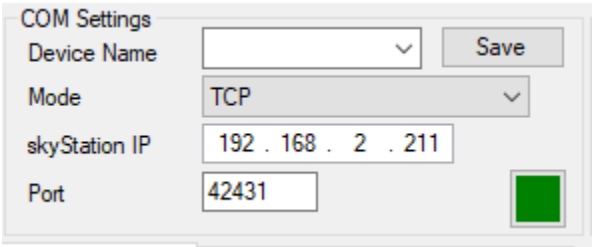


The TCP connection will now take off and you will see the system retrieving parameters as follows for the flight controller.

The skyStation is now in place and ready to host missions.

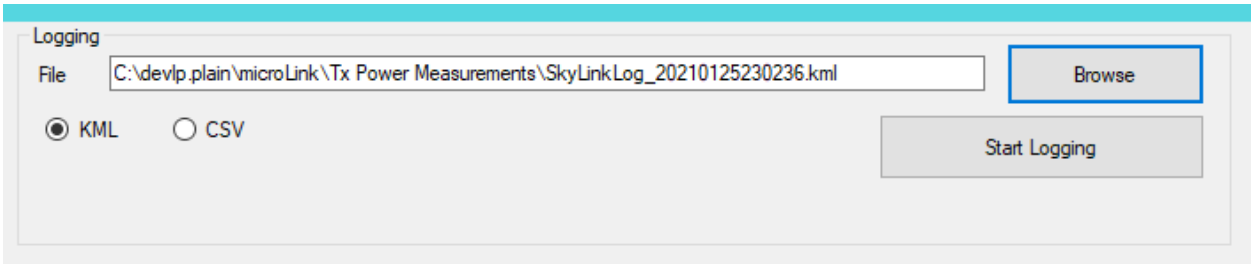
6.3.3 skyLinkApp.exe

skyLinkApp.exe is the uAvionix Control channel monitoring application used for showing Status, Maps, and Configuration information. It can be connected to the skyStation in TCP mode and the ports are configurable for network flexibility. The port selection must match the skyStation Configuration page setup and the IP address is always the IP address of the skyStation.



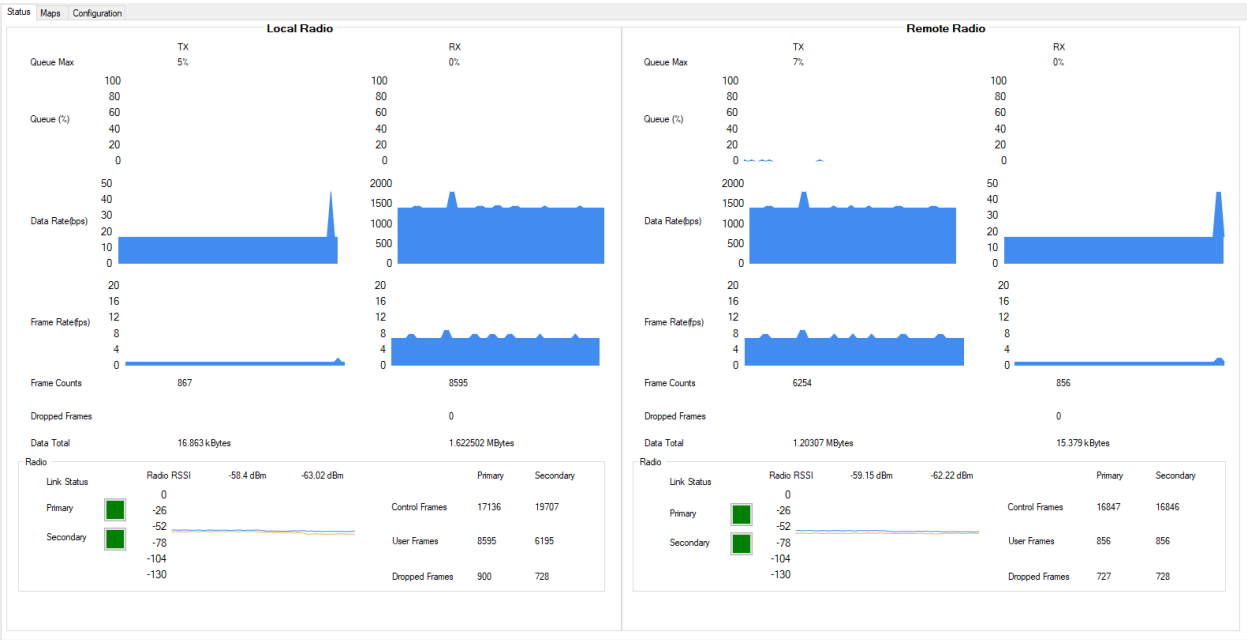
The Device Name field allows the user to enter a name for a set of connection parameters and save them for easy switching between radio connections. Just type in a name and press Save.

There is also a KML logging feature for importation into mapping software Logging may also be captured in comma separated value (CSV) format.



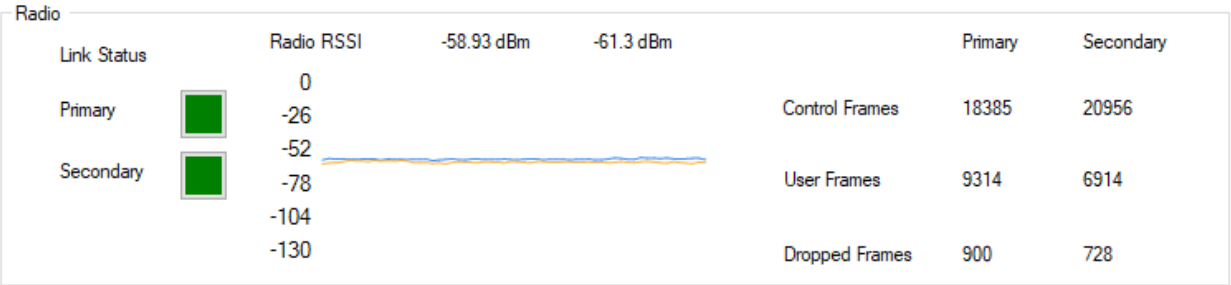
6.3.4 Status Tab

The status data is shown for both the local and the remote radios. It contains both transmit and receive information for the local and remote radios. This information includes memory queue depth information, transmit and receive data rates, frame rates, dropped frames and data totals. It also shows the RSSI's on the primary and secondary radios for both the local and remote radios giving the user comprehensive information on the state of the system.



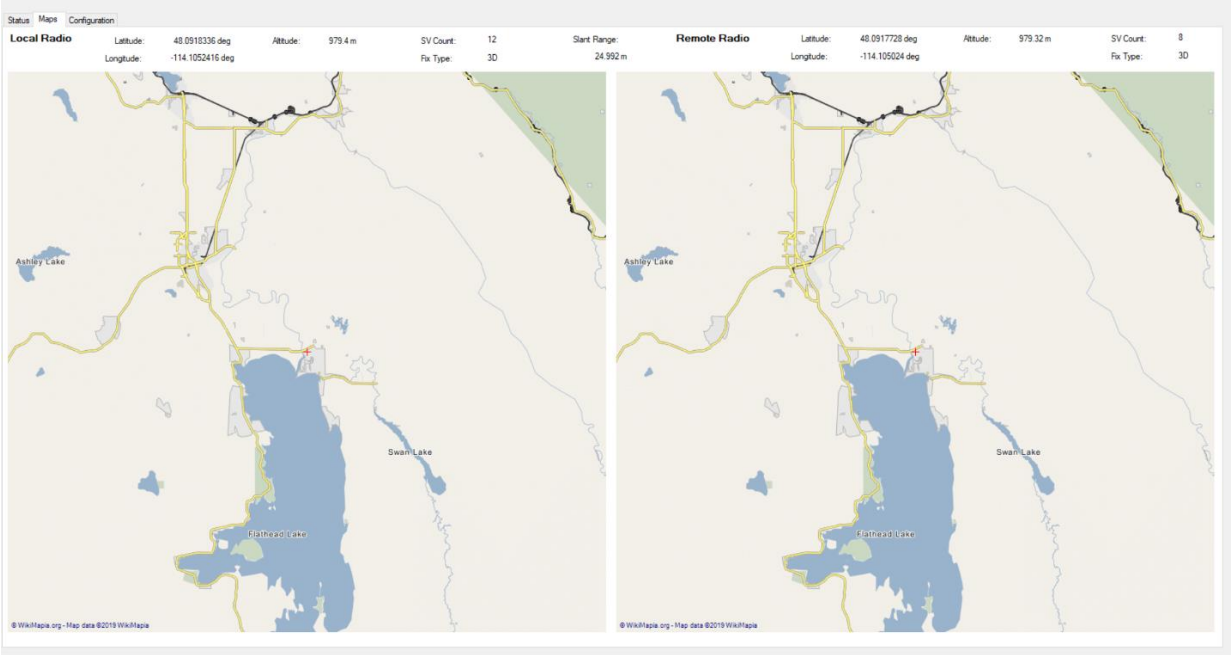
Radio throughput and statistics detail shown below.

RSSI detail shown below.



6.3.5 Maps Tab

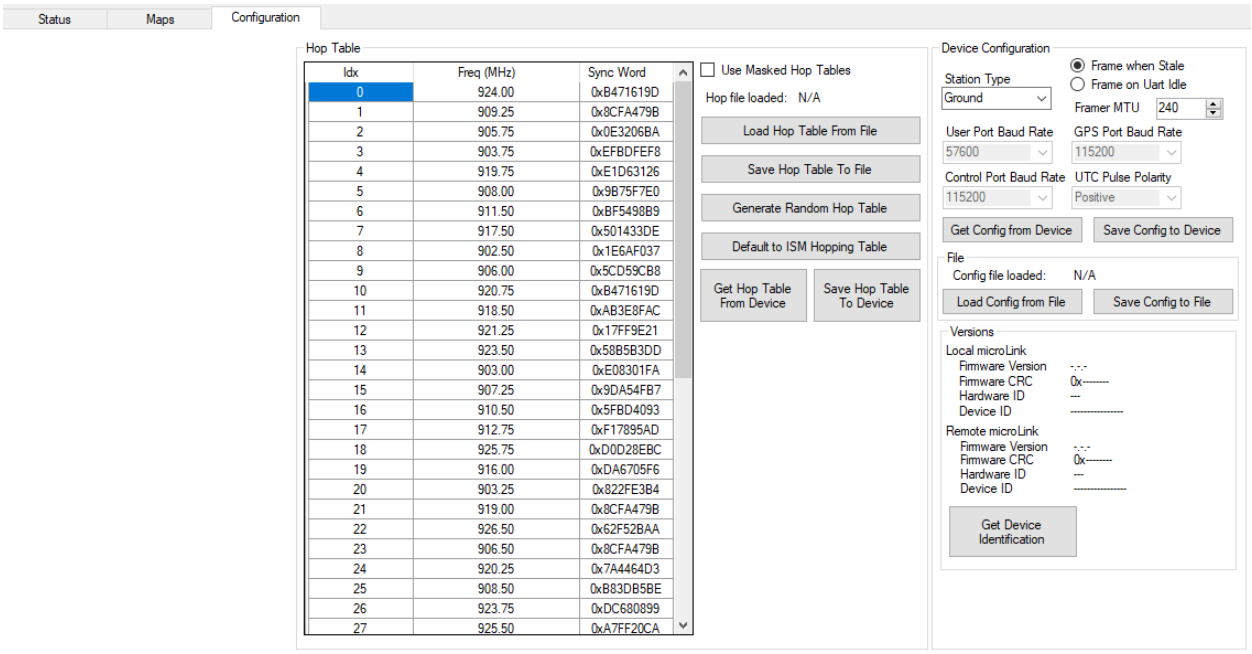
skyLinkApp.exe has a mapping tab for mapping the local radio skyStation radio as well as the remote aircraft radio. It includes latitude, longitude, altitude, GPS fix type, Slant Range and SV count.



6.3.6 Configuration Tab

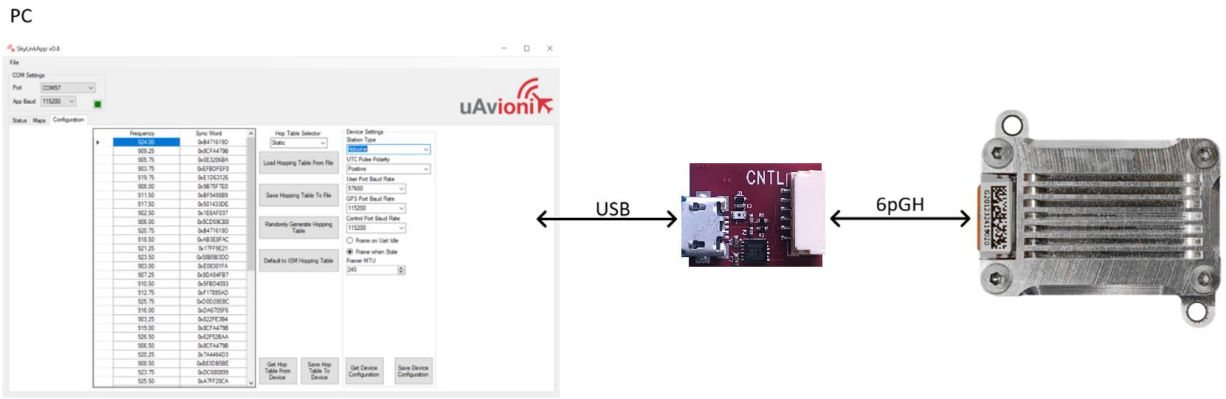
skyLinkApp.exe also contains a Configuration tab. This tab is used for device settings and setup as well as system selecting the hop table scheme for the system. Hop tables can be read from and written to a file in JSON format. Configuration parameters can be read from and written to a file in JSON format.

The Configuration tab also contains a device identification field. The “Get Device Identification” button will display the Firmware version, CRC, Hardware ID and Serial Number of the directly connected device as well as the remotely connected device, if present.

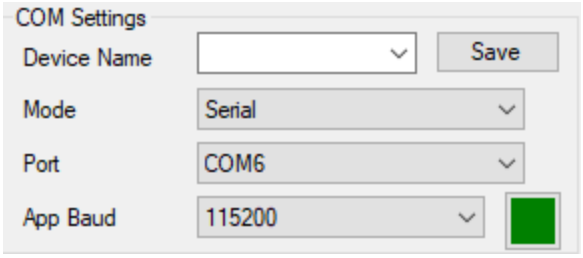


6.3.6.1 Airborne Radio System (ARS) Configuration

Connect the microLink radio to your PC using the USB to serial adapter board marked CNTL. The CNTL board connects to the radio's bottom connector. Note that a GPS signal is not required to perform configuration operations on the radio.

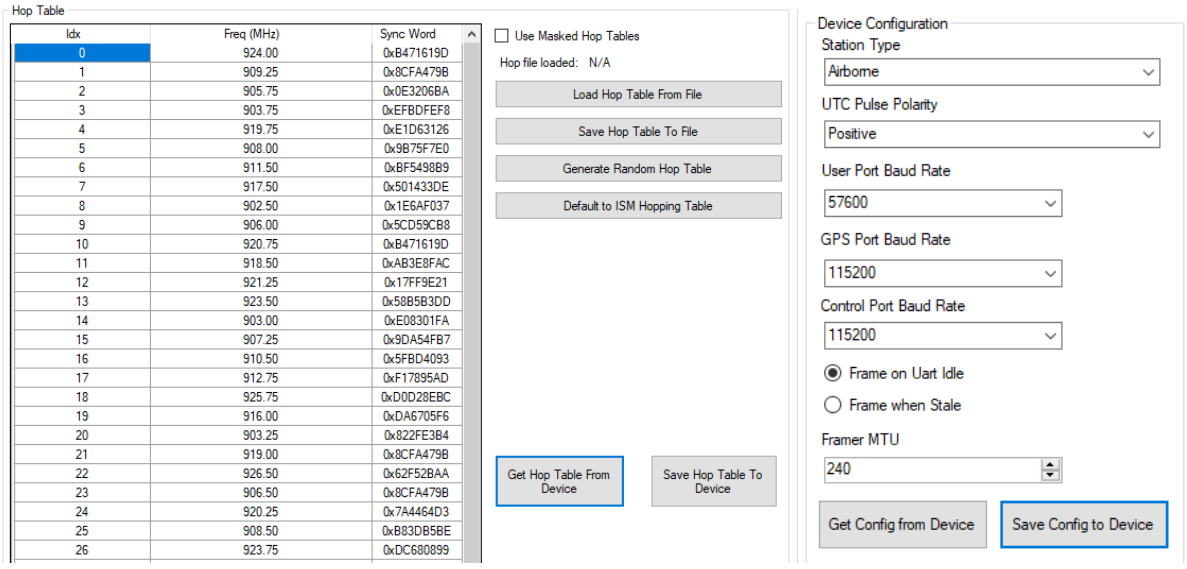


Select COM Port and set the App Baud to 115200.



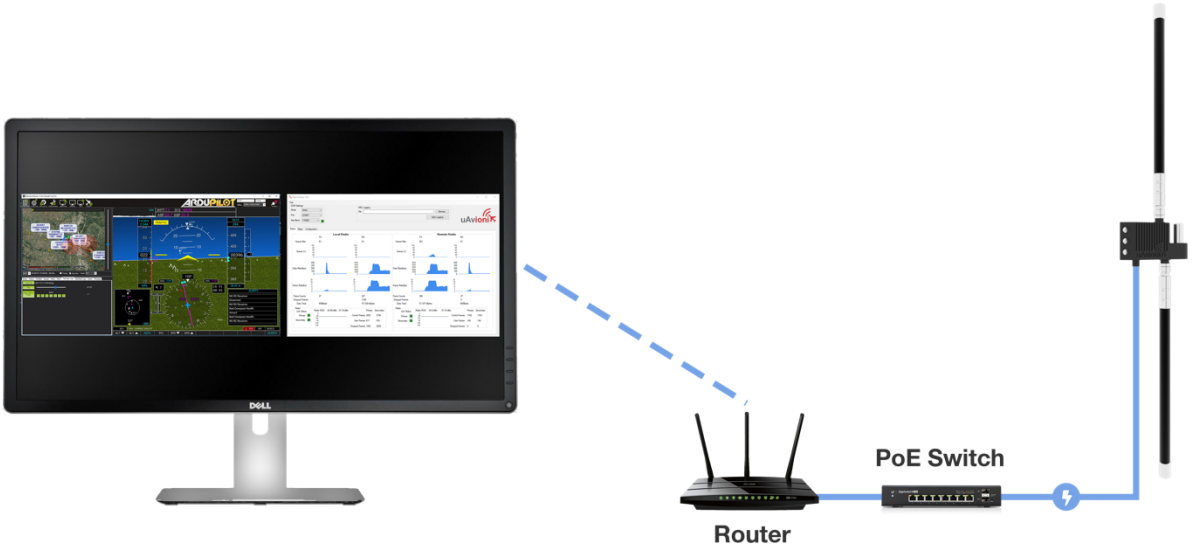
On the Configuration Tab:

- Default to ISM Hopping Table
- Save Hop Table to Device
    - Station Type: Airborne (Do not modify)
    - UTC Pulse Polarity: Positive (Do not modify)
    - User Port Baud Rate: 57600
    - GPS Port Baud Rate: 115200 (Do not modify)
    - Control Port Baud Rate: 115200
    - Check Frame When Stale
    - Framer MTU: 240
- Save Device Configuration

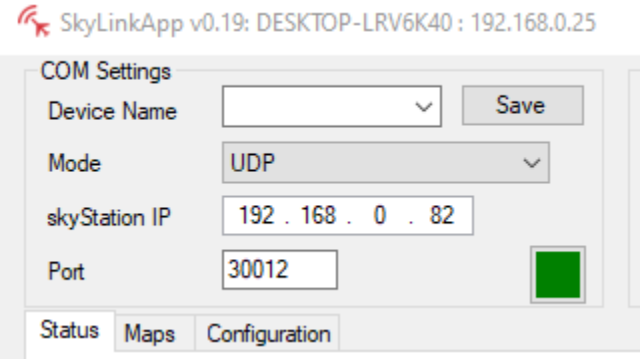


6.3.6.2 Ground Radio System (GRS) Configuration

Connect as shown below then run the skyLinkApp.

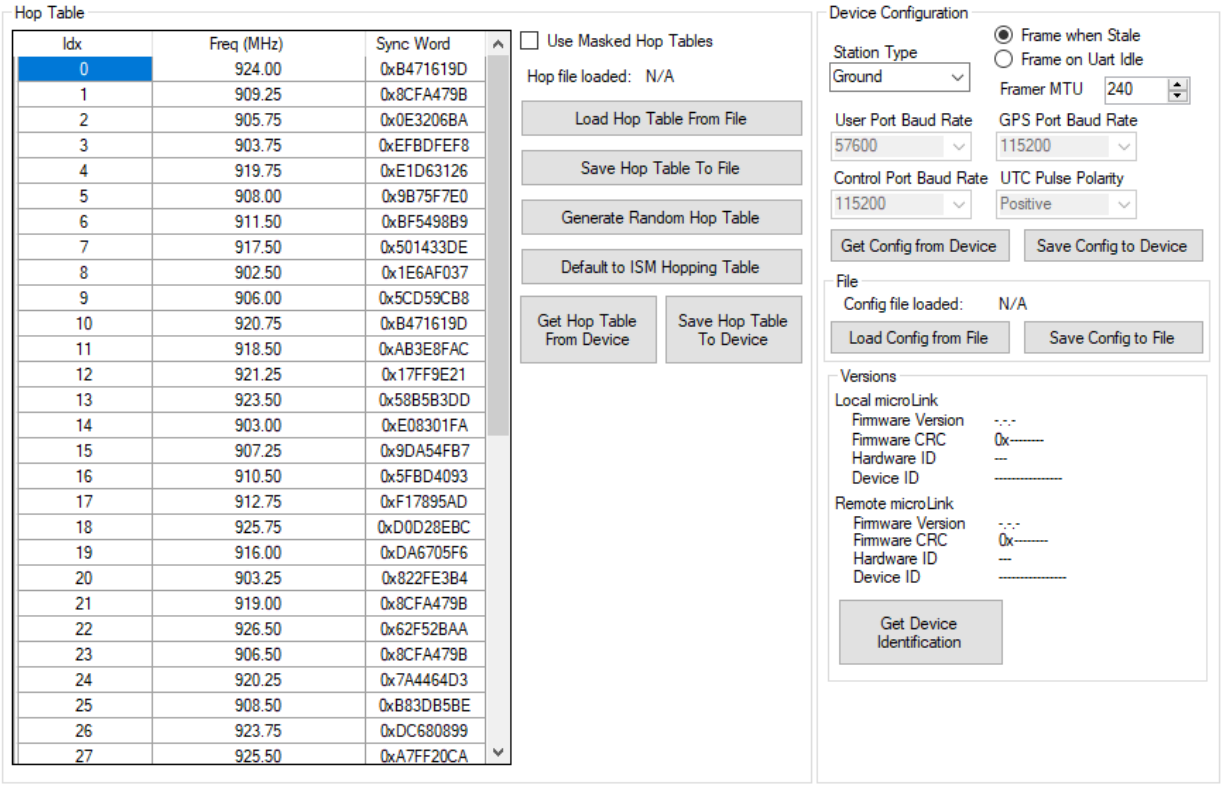


Select Port and set UDP / TCP as configured.



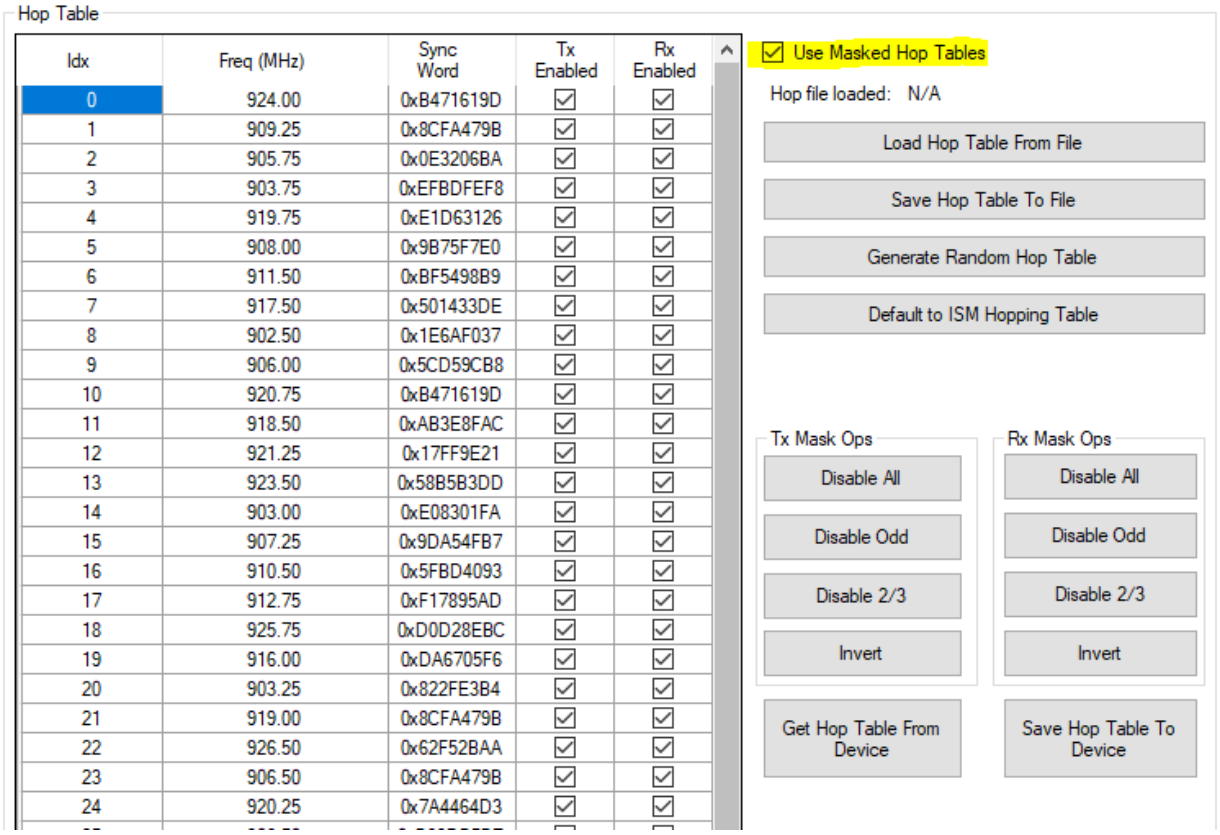
On the Configuration Tab:

- Default to ISM Hopping Table
- Save Hop Table to Device
    - Station Type: Ground (Do not modify)
    - UTC Pulse Polarity: Positive (Do not modify)
    - User Port Baud Rate: 57600
    - GPS Port Baud Rate: 115200 (Read only)
    - Control Port Baud Rate: 115200 (Read only)
    - Check Frame When Stale
    - Framer MTU: 240
- Save Device Configuration



6.3.6.3 Hop Masking

The radio can be configured to not transmit and/or not receive on a given hop. To enable the controls for this feature, check the “Use Masked Hop Tables” checkbox on the configuration tab.



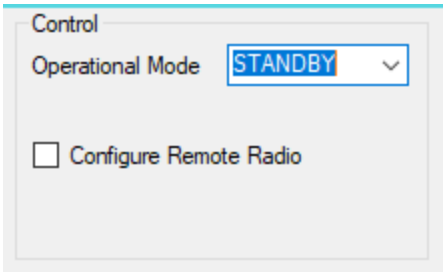
Two new columns, Tx Enabled and Rx Enabled will appear and 8 new buttons for mask manipulation will appear.

To select which hops to enable or disable, simply check or uncheck the check box in the Hop Table. The buttons provide useful shortcuts to speed up the manipulation of all 50 hops. Once the selection is final, press “Save Hop Table to Device to save it in non-volatile memory on the device. To save a hop table that will be applied to multiple devices, press “Save Hop Table to File”. To recall a saved hop table, press “Load Hop Table From File”. Note that pressing “Save Hop Table To Device” is required to push a loaded hop table to the device.

6.3.6.4 Standby and Active

To place the radio into a non-transmitting state, use the “Operational Mode” input box in the Control section at the top of skyLinkApp to select ‘STANDBY’. This causes the radio to stop all transmissions indefinitely. To return to normal operation, choose ‘ACTIVE’. By default, the input box is empty and when skyLinkApp launches it leaves the current

ACTIVE/STANDBY state untouched. Note that the Hop Table masking will return to its saved configuration when returning to ACTIVE from STANDBY.



6.3.6.5 Remote Configuration

Over the air or Remote Configuration is possible. This may be useful when the airborne radio is installed on an aircraft and it is difficult to remove it for configuration. To use the Remote Configuration feature first establish an RF link between the air and ground radios. In the COM Settings box, select a connection to the skyStation. With the skyStation connection established, check the “Configure Remote Radio” box in the Control section. Parameters that can be configured remotely will be highlighted in a sky-blue color. Note that the operational mode of the remote radio can be changed as well. Also note that some configuration changes will cause the RF link to be lost so it is not recommended to use this feature during flight.

6.4 skyStation Configuration and Health Webpage

The skyStation IP address can be determined by accessing the local DHCP server and reviewing the connected devices or by using industry accepted network scanning tools. Directions for each DHCP server, router, or network scanning tool differ. Refer to the instruction manual for these devices or tools to help determine the IP address assigned to the skyStation. The MAC address for each skyStation can be found on the device housing.

The following pages can be viewed in your web browser.

Note 192.168.0.82 is an example IP address of the skyStation. You must replace this address with the skyStation IP address as assigned on your network.

- skyStation base URL:

  http://192.168.0.82/

  Displays Health statistics, position and version information. Use to program the target UDP address and Port number.

- skyStation status URL:

  http://192.168.0.82/api/v1/stats

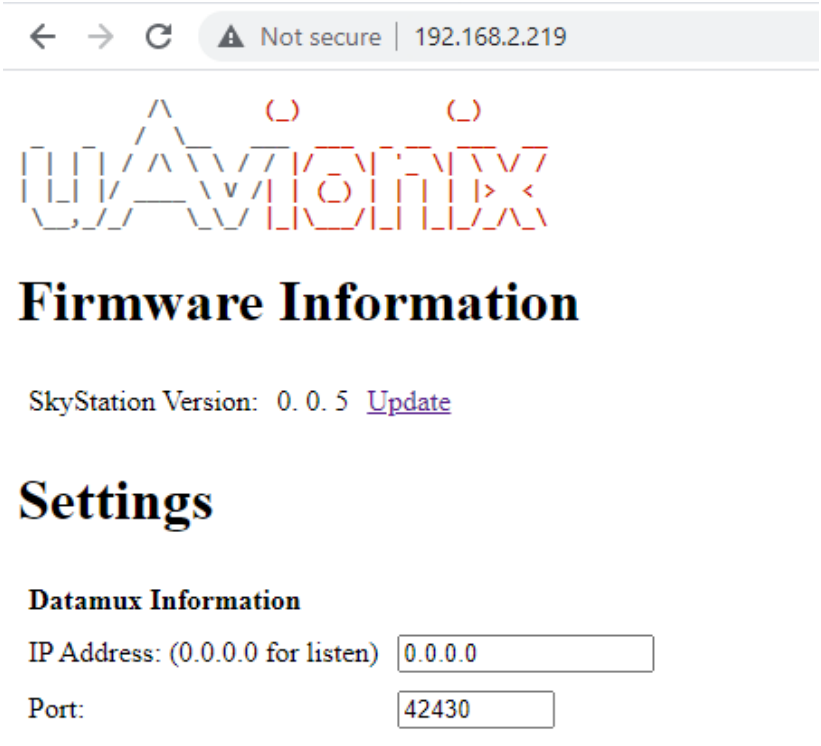
  Displays the status json sentence.

- skyStation update URL:

  http://192.168.0.82/update

  Interface to update skyStation firmware.

The base URL displays configuration items as well as dynamic skyStation health statistics. The defaults for the User and Control channel connections are shown. All parameters can also be modified to fit your network needs.


Not secure | 192.168.2.219
Firmware Information
SkyStation Version: 0. 0. 5 Update
Settings
Datamux Information
IP Address: (0.0.0.0 for listen) 0.0.0.0
Port: 42430
Network Configuration
Save
Status Information
Name Value
Up Time 31s
GPS Fix 3
Num GPS Sats 10
Latitude 47.9999968
Longitude -114
GPS Altitude 3088
PPS Detected true

6.4.1 Configuration Items

Configuration Item	Description
Data Mux IP Address	When this parameter is 0.0.0.0, the skyStation will act as a TCP server and listen for incoming connections. Alternatively, if this address is a valid IP address, the skyStation will act as a TCP client and will attempt to connect to a TCP server listening on [User TCP IP Address : User TCP Port]. 0.0.0.0 is the default setting for this parameter.
Data Mux Port	This is the port number used for the User connection. Typically, the ground control software uses the User connection to communicate with the aircraft. The skyStation listens on this port and forwards any received TCP datagrams from ethernet to the aircraft. Any User connection data coming from the aircraft will be sent as an ethernet TCP datagram to [User TCP IP Address : User TCP Port]. The default User port is 42430. The Control port will always be User port +1. The default Control port is 42431. skyLink app connects to the Control port of the skyStation.

When you modify any configuration item, press the Save button to store the changes. These fields are non-volatile and persist through power cycles.

Example User port and Control port values are shown below. The Control port number will automatically set to be +1 of the configured User port number.

Configured User Port #	Automatic Control Port #
42430	42431
42431	42432
30012	30013
00001	00002

6.4.2 Status

The Status Information section shows real time statistics updated once every 2 seconds. It will show skyStation Up Time, GPS and PPS metrics.

Status Information

Name	Value
Up Time	21m:42s
GPS Fix	3
Num GPS Sats	9
Latitude	48.0000032
Longitude	-113.9999872
GPS Altitude	3087
PPS Detected	true

6.5 Updating Devices

The following sections outline the steps to update the firmware on the microLink radios and the skyStation. There are two updating procedures, one for the skyStation firmware and one for the airborne radio. You will need to download the PingBootFlasher.exe to update the airborne radio. Updating the skyStation is done via web interface.

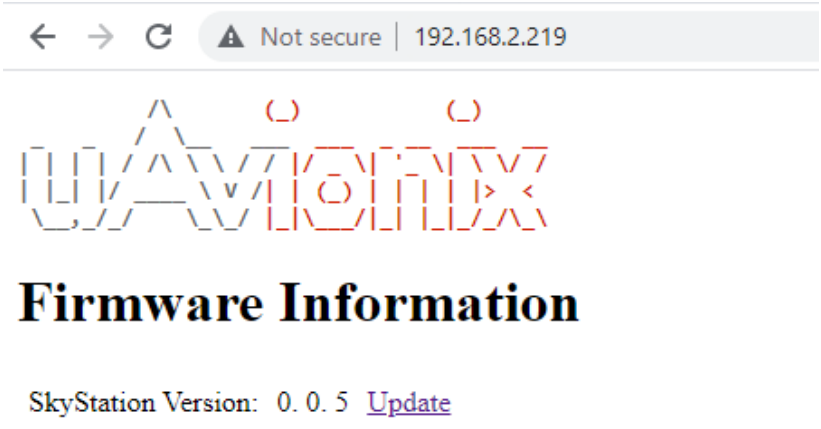
6.5.1 Updating skyStation

Download and save the “UAV” skyStation firmware image (e.g., UAV-1004343-001-SkyStation-0_1_4-513f8ff.uav) onto a Mac or PC. Use the Chrome web browser. Other web browsers may have compatibility problems.

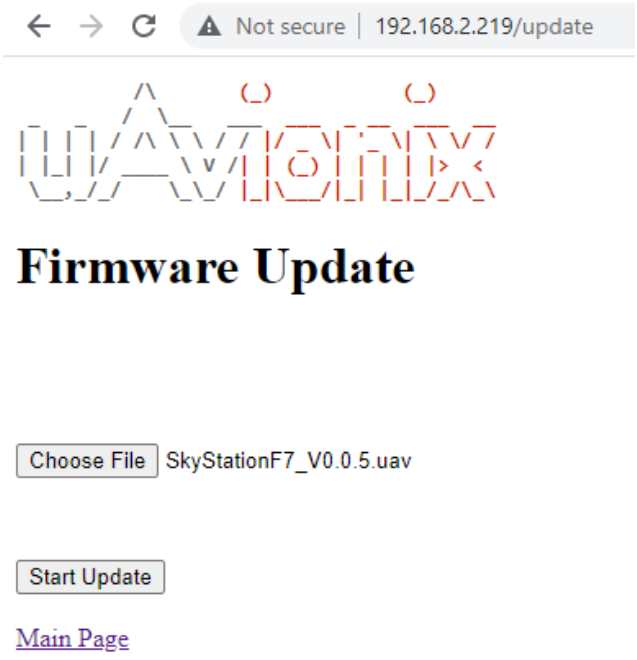
Connect the skyStation to the network via POE.

If not known, use a network scanning software to find the IP address of the skyStation. The MAC address will be labelled on the bottom of the skyStation.

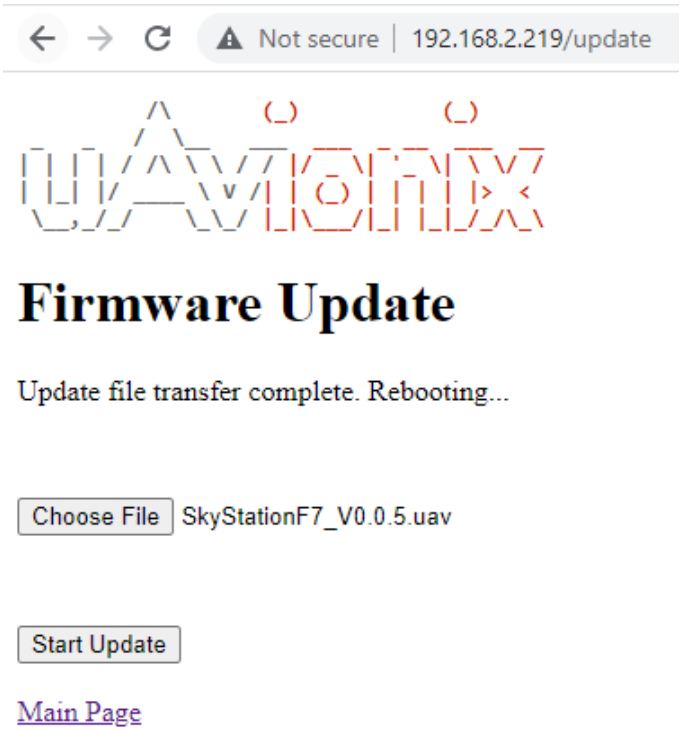
When the IP address is known, open a web browser and in the URL search bar enter the IP address. Click the Update link next to the version number.



Choose the appropriate file to upload and click Start Update.



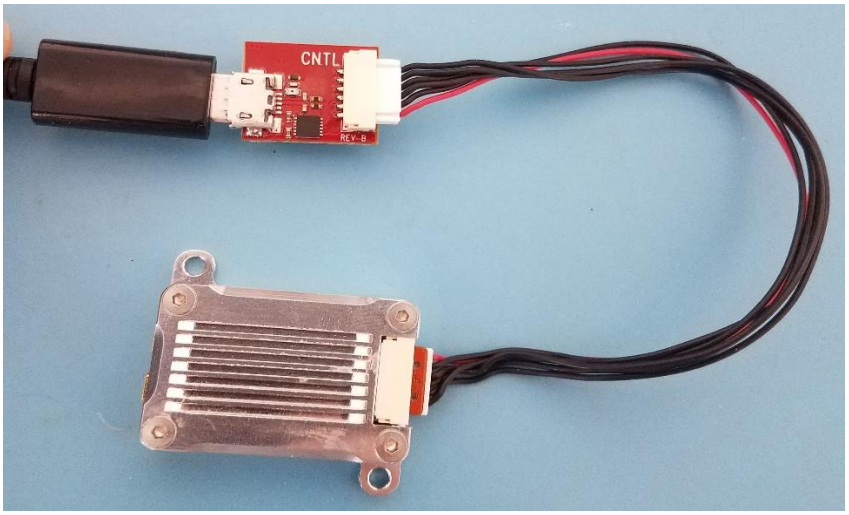
DO NOT power off the skyStation or close the web browser until the update is complete.



When the file transfer is complete, click the Main Page link to return to the skyStation Configuration Webpage. The version number on the Configuration Webpage should reflect the firmware version uploaded.

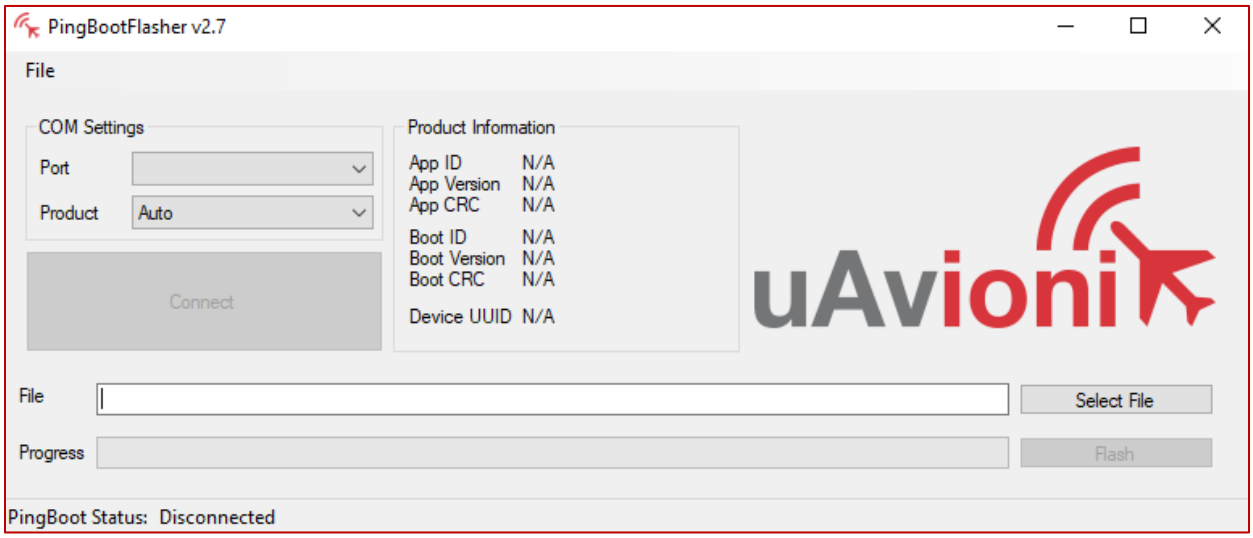
6.5.2 Updating Airborne microLink Radio

Connect the microLink airborne radio to a Mac or PC using the supplied “CNTL” USB to Serial adapter, 6 pin GH cable, and a micro-USB cable. Connect the microLink radio through the Control port (bottom connector).



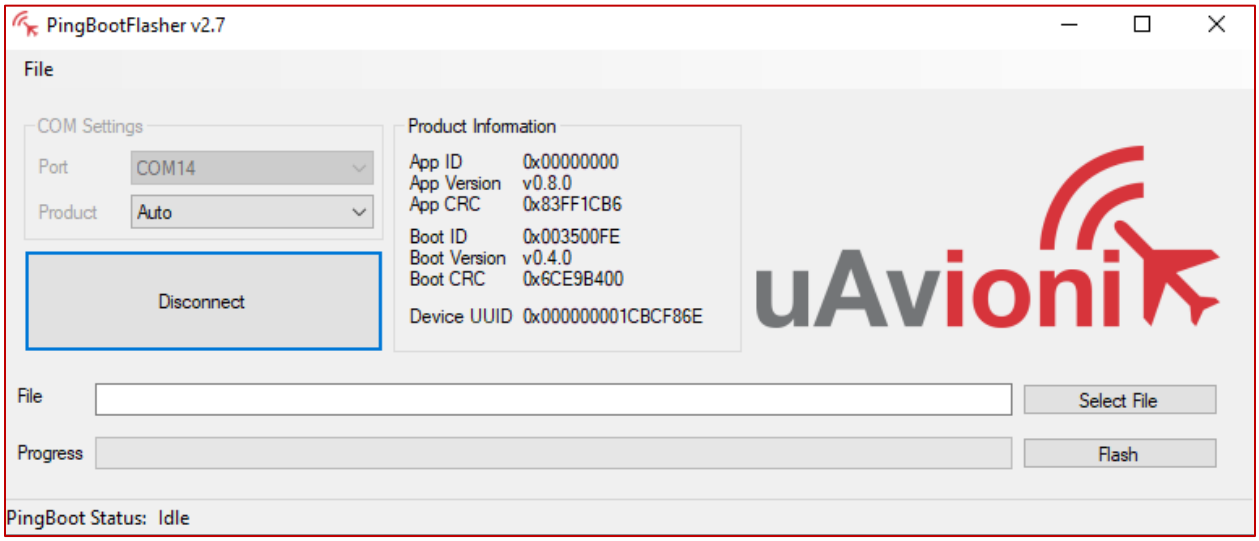
Download the PingBootFlasher (v2.7) software and the most recent microLink firmware onto a Mac or PC.

Run the PingBootFlasher software and connect to the microLink radio by selecting the correct COM port on the “Port” dropdown then press connect.

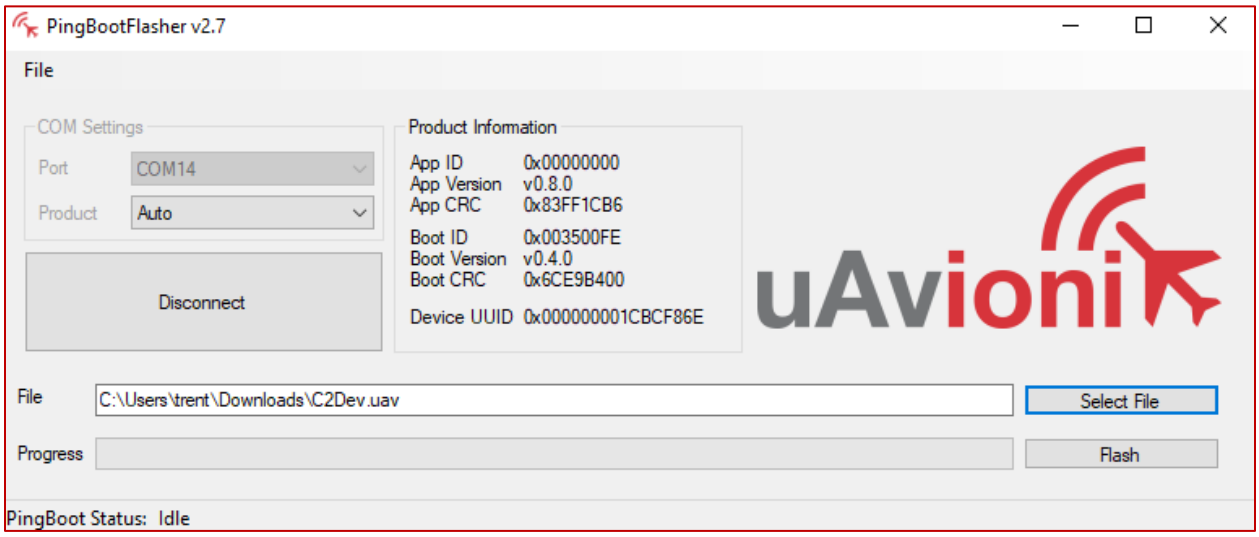


When connected you will see the current Application ID, version, and CRC as well as the Bootloader ID, version, and CRC and “PingBoot Status: Idle”

on the PingBootFlasher software. If these do not appear try unplugging and reinserting the cable from the radio.



Click “Select File” and select the downloaded microLink firmware. Then click “Flash”



DO NOT DISCONNECT THE MICROLINK RADIO OR CLOSE THE PING BOOT FLASHER UNTIL UPDATE IS COMPLETE

When update is complete, unplug the microLink radio and plug it back into the Mac or PC.

Reconnect the PingBootFlasher to the microLink radio and verify the App Version has updated.