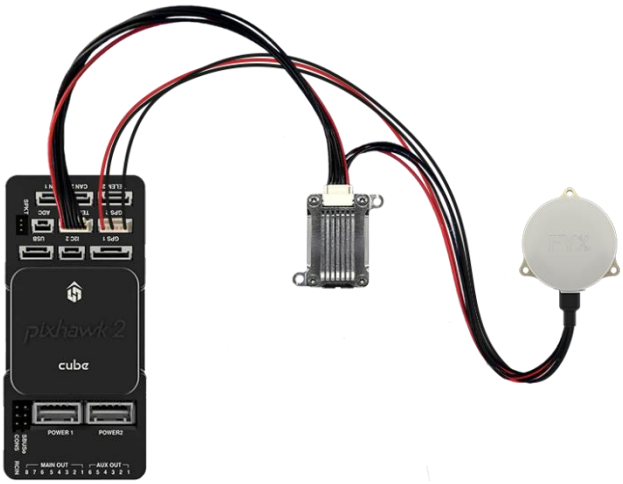
microLink

User and Installation Guide



UAV-1003064-001 Rev N

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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.
M	9/7/2021	New integration image with Pixhawk and ardupilot parameters. All updated instructions and images for using radio ID link.
N	9/20/2021	Update integration instructions for Pixhawk with new GPS connection and dual GPS connection.

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

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

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

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)

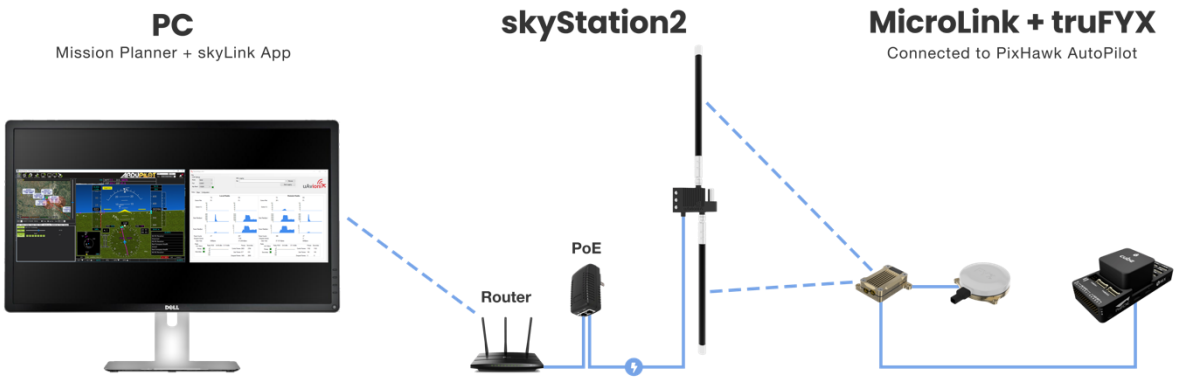
Pin	Type	Physical	Port
1	5V	5V	
2	RXD	IN	TELEM
3	TXD	OUT	TELEM
4	RFU		
5	RFU		
6	GND		

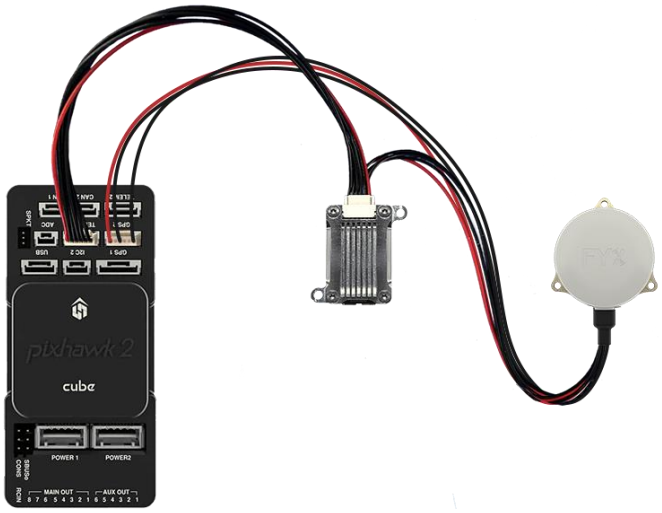
Timing/Position, CTRL Interface (bottom connector)

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

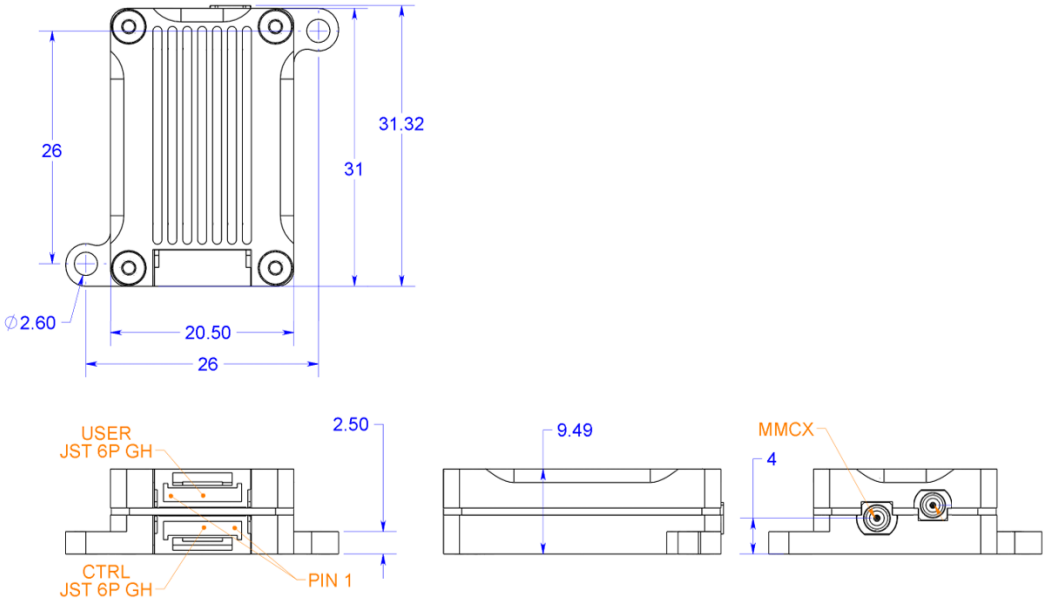




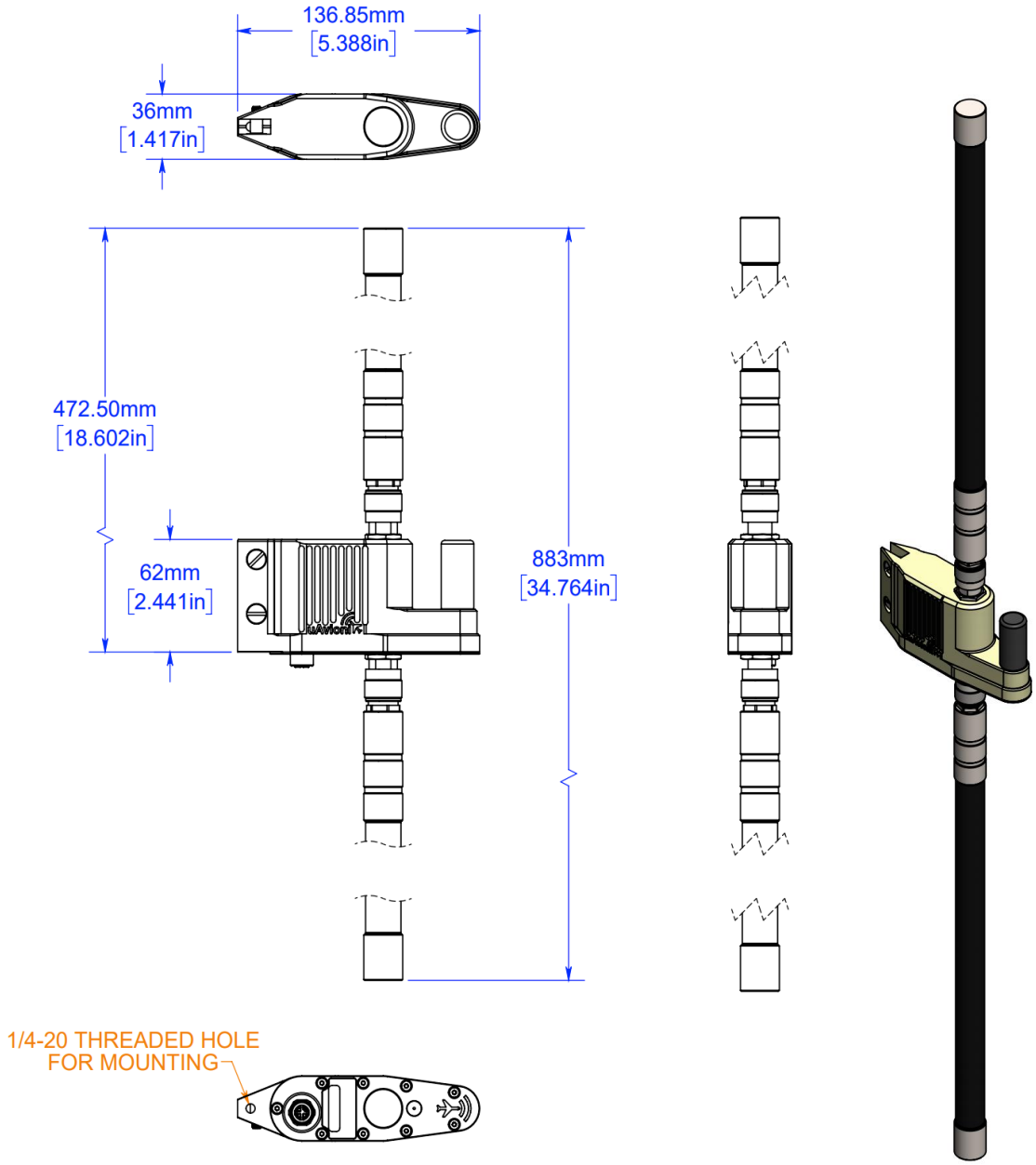
Ordering Part Numbers	
skyStation 2	UAV-1005539-001
microLink	UAV-1002868-001
GPS Options	
microFYX kit	UAV-1002500-001
HERE2 kit	UAV-1002956-001
Replacement Parts	
MMCX 100mm	UAV-1003063-001
MMCX 200mm	UAV-1003063-002
GH 6p Cable	UAV-1003061001
GH 8p Cable	UAV-1003062-001

5.6 Mechanical Specifications

Airborne Radio System (ARS)



Ground Radio System (GRS) – skyStation

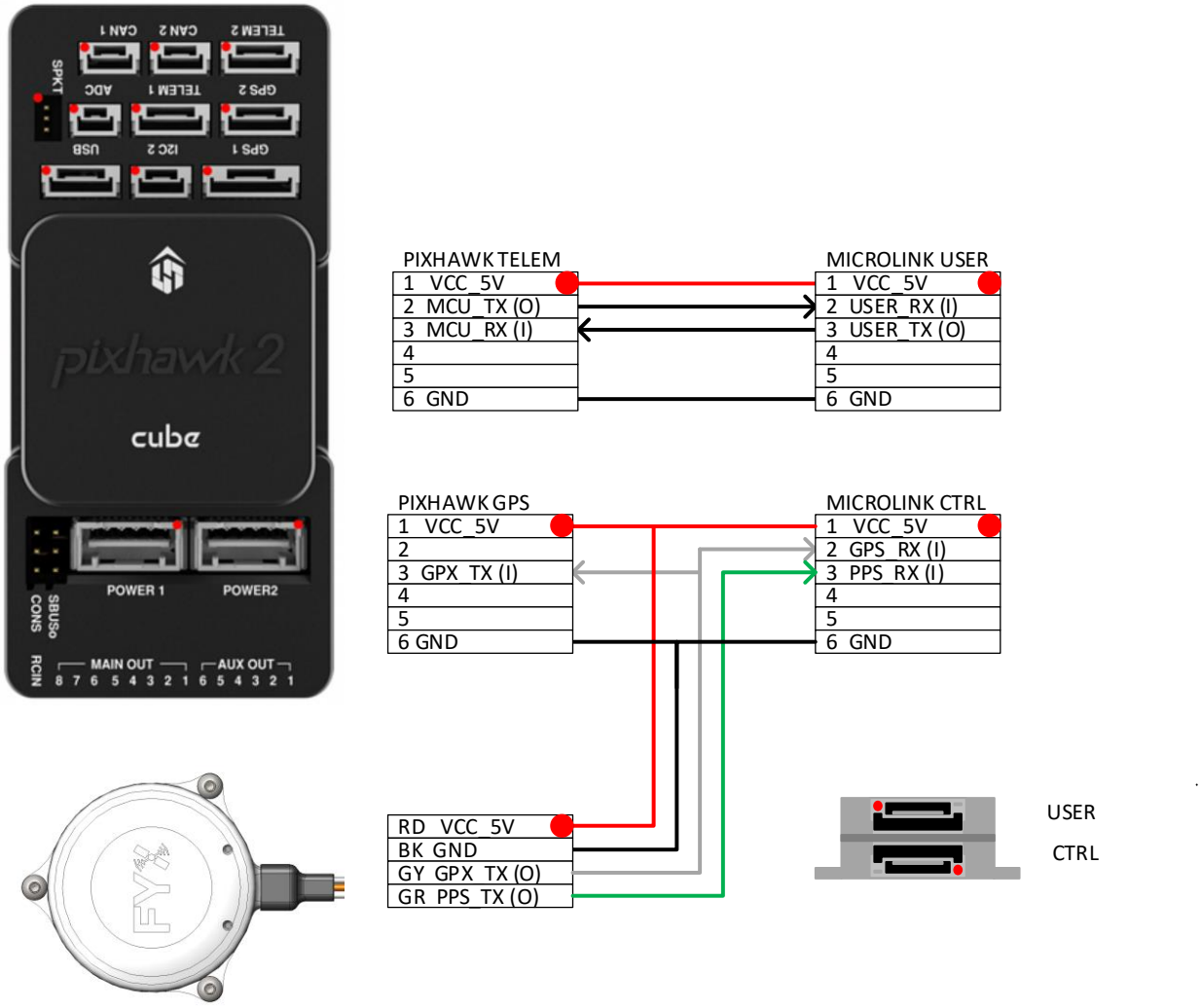


6 Configuration

6.1 MicroLink

Connect the microLink ARS to an available telemetry point on the Pixhawk Autopilot. The microFYX provides GPS and PPS to both the microLink and the Pixhawk through the GPS 2 port (serial 4).

6.1.1 Wiring



6.1.2 Mission Planner Configuration

The following parameters need to be configured in Mission Planner when using microLink. The serial port depends on which telemetry port the microLink is connected to. For this instance, microLink is connected to Telem1

Function	Parameter	Value	Description
microLink C2 Control	SERIAL 1::BAUD	57	Baud rate = 57600
	SERIAL 1::PROTOCOL	1	Protocol type Mavlink

The following parameters need to be configured in mission planner when using the microFYX as the primary GPS on GPS 2 (serial 4)

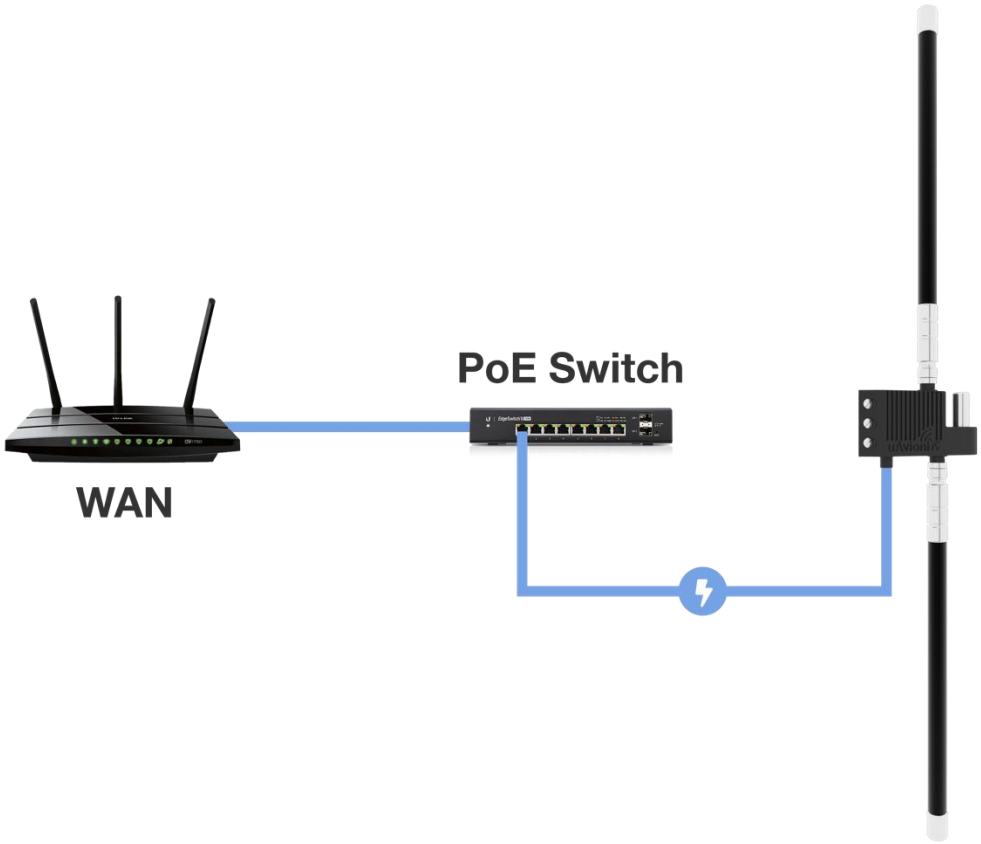
Function	Parameter	Value	Description
GPS	GPS_AUTO_CONFIG	2 *	Enable GPS Auto Config
	GPS_SAVE_CONFIG	2*	Enable GPS Save Config
	GPS_TYPE	5	GPS = NMEA
	SERIAL4_BAUD	115	Baud Rate = 115200
	SERIAL4_PROTOCOL	5	Serial 4 = GPS
	BRD_SAFETYENABLE	0	Disable Safety Switch
	SERIAL3_BAUD	57	Baud Rate = 57600
	SERIAL3_PROTOCOL	1	MAVLINK 1

The following parameters need to be configured in Mission Planner when using the microFYX and Here2 GPS in a dual GPS configuration. microFYX is on GPS 2 (serial 4) and the Here2 GPS is on GPS 1 (serial 3).

Function	Parameter	Value	Description
GPS	GPS_AUTO_CONFIG	2 *	Enable GPS Auto Config
	GPS_SAVE_CONFIG	2*	Enable GPS Save Config
	GPS_TYPE	1	GPS = AUTO (Here 2)
	GPS_TYPE2	5	GPS = NMEA (microFYX)
	SERIAL3_BAUD	38	Baud = 38400 (Here 2)
	SERIAL3_PROTOCOL	5	Serial 3 = GPS (Here 2)
	SERIAL4_BAUD	115	Baud Rate = 115200 (microFYX)
	SERIAL4_PROTOCOL	5	Serial 4 = GPS (microFYX)
	BRD_SAFETYENABLE	0	Disable Safety Switch

6.2 skyStation

Connect skyStation to a POE switch or POE power injector.

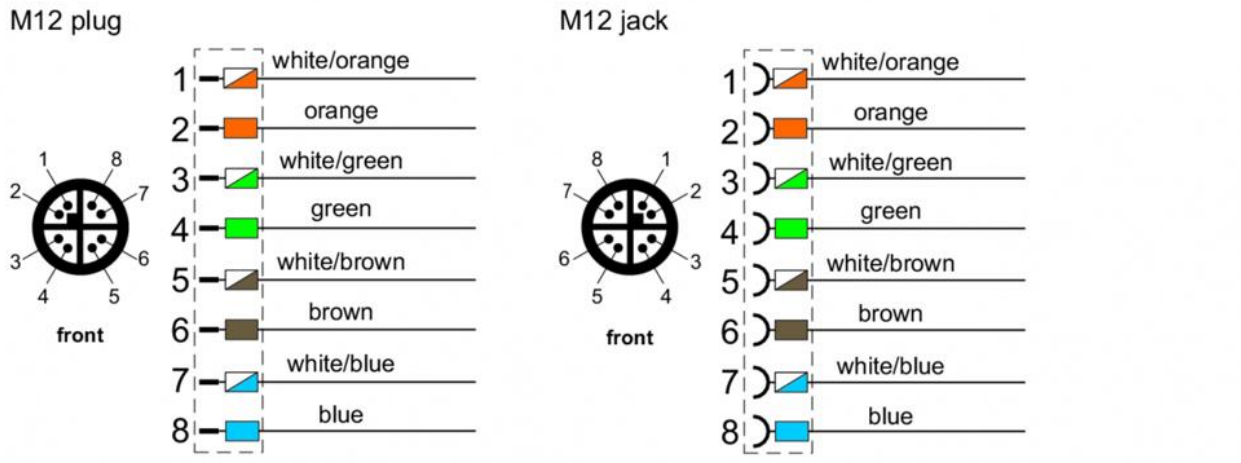


6.3 Connection to the POE Network

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!

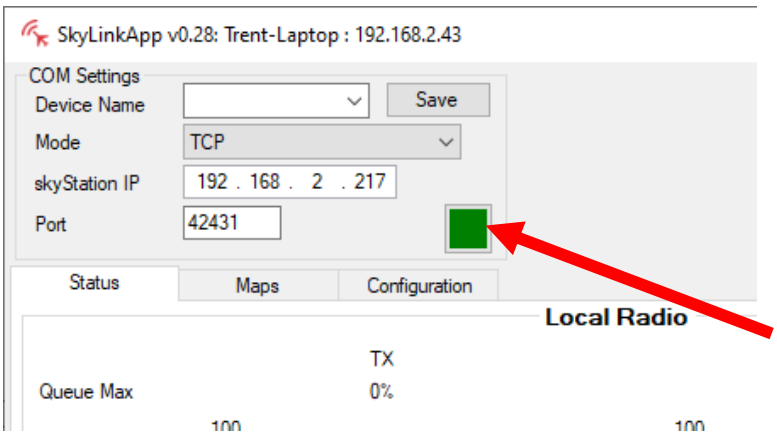
6.4 skyStation Start-up and Connection

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 accept TCP connections for 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 label.

See section 6.6.4 for configuring the network settings on skyStation.

6.4.1 Run skyLinkApp.exe

Included in your document and software package is SkyLinkApp. Run the skyLinkApp.exe, configure the Mode Settings to TCP, enter the IP address of the skyStation, and enter the default Control port 42431. The Status box in the upper left-hand corner will turn green indicating a successful connection to the skyStation.



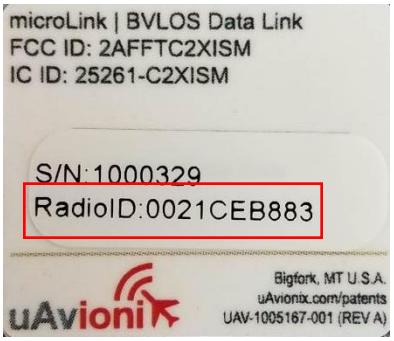
NOTE: If you are not able to connect to the skyStation it is likely your firewall is blocking access on port 42431. Please setup your firewall to allow skyLinkApp.exe TCP access on port 42431.

Please see section 6.6.4 to change or view the network configuration settings on the skyStation. See section 6.4 for more details on the skyLinkApp.

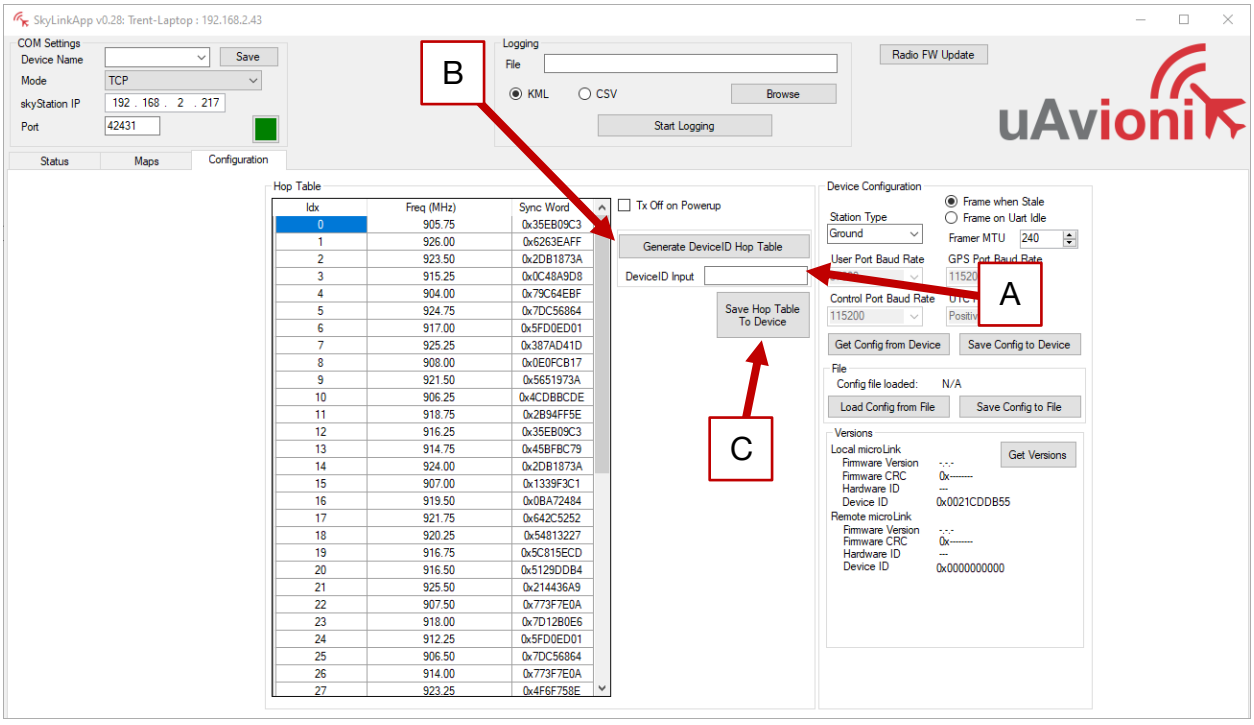
6.4.2 Configure Hop Table

Once connected via the SkyLinkApp, go to the Configuration tab.

At first power up the user may need to configure the Hop Table to link with the microLink. On the label on the back of the microLink is a Rradio ID.



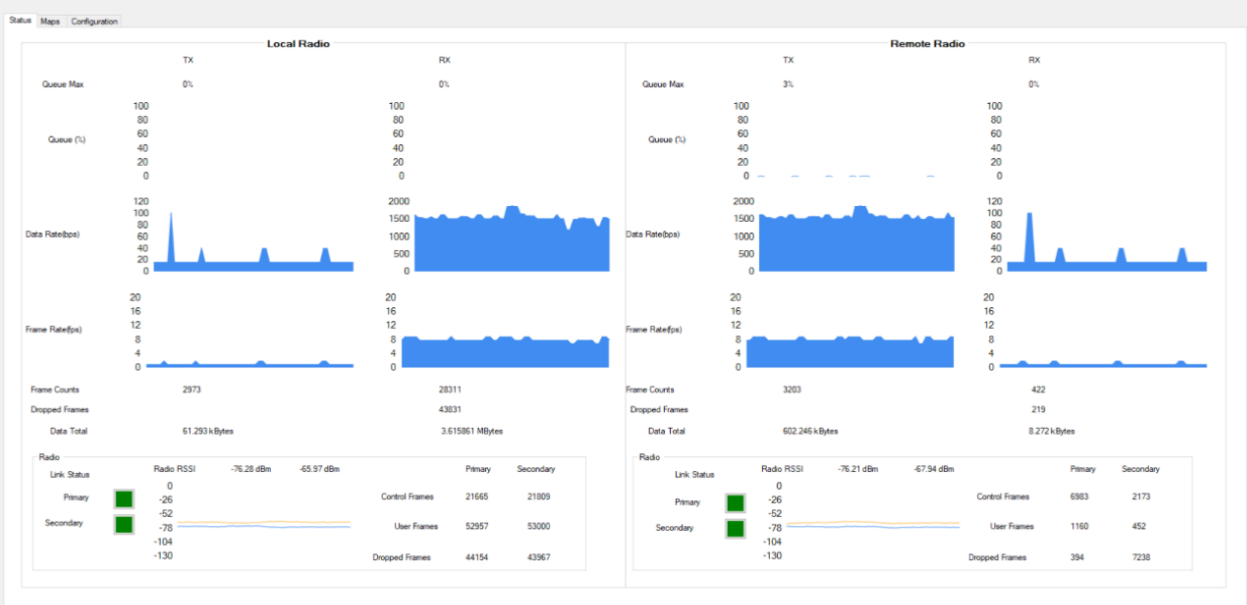
A. Enter the Radio ID into the “Radio ID Input” field on the SkyLinkApp.
B. Press the “Generate “Radio ID Hop Table” button
C. Press “Save Hop Table To Radio”



The skyStation and microLink now share the same unique Hop Table.

6.4.3 Verify Link

To verify link go to the Status Tab of the skyLinkApp. When the data arrives, skyLinkApp will begin graphing the radio link statistics.



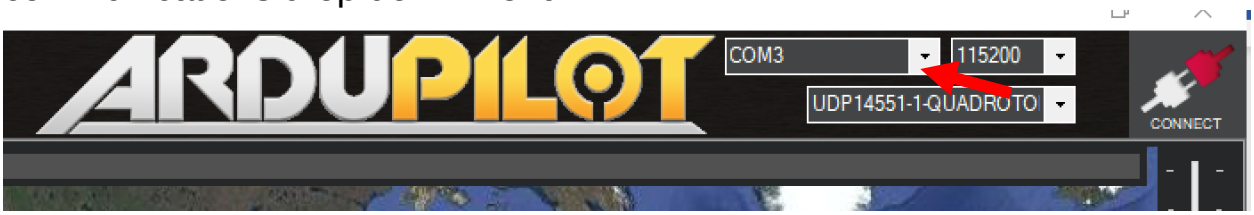
6.4.4 Connecting to Mission Planner

Download and install Mission Planner from:

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

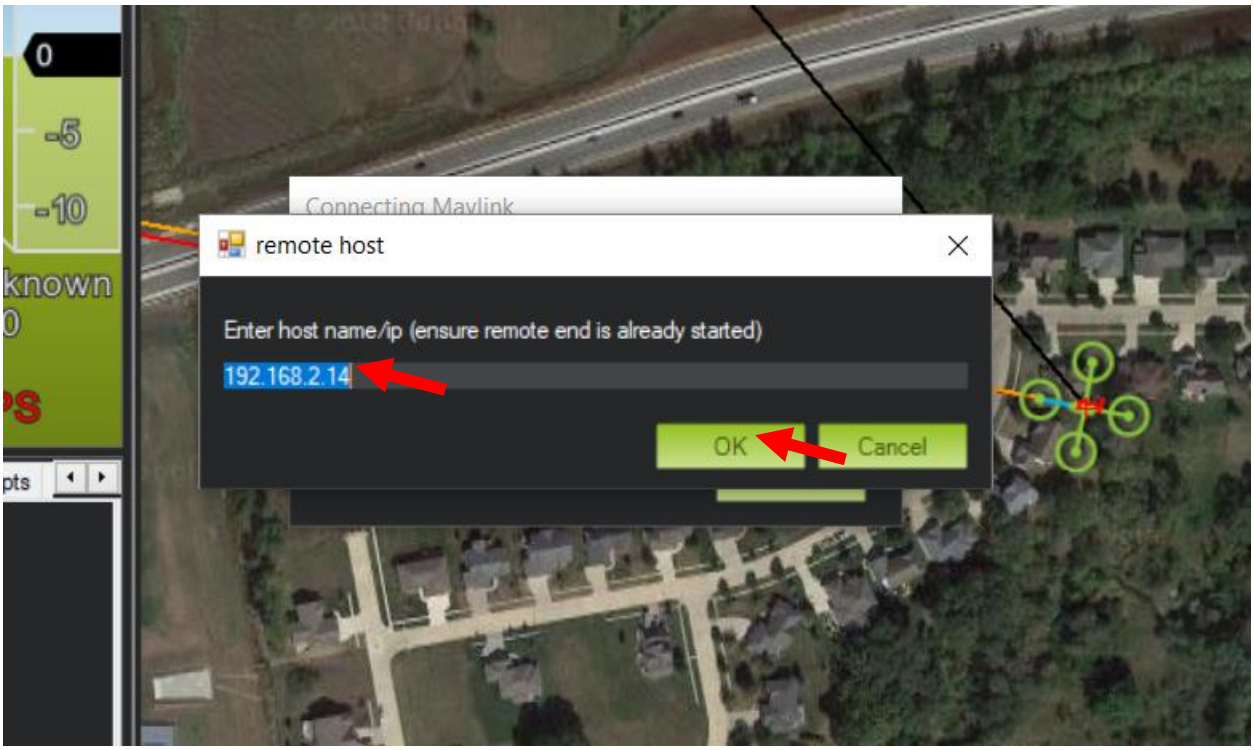
http://ardupilot.org/planner/docs/mission-planner-installation.html

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.

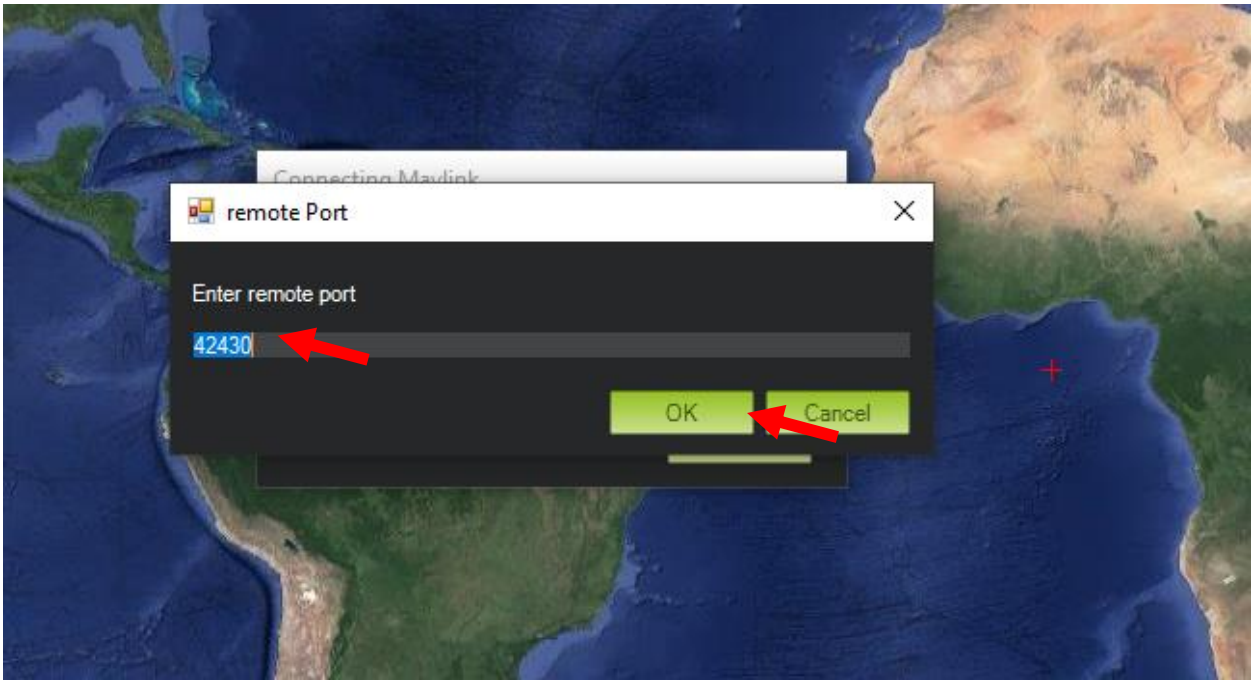


Select TCP as the communication mode and hit the Connect button on the upper right-hand corner.

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.

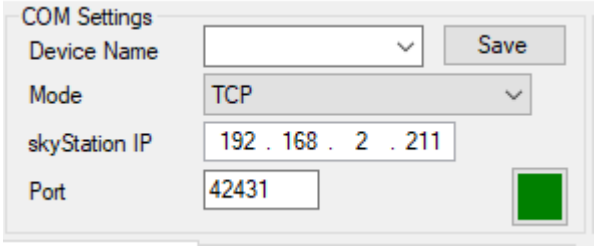


The TCP connection will now take off and you will see the system retrieving parameters as follows for the flight controller.

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

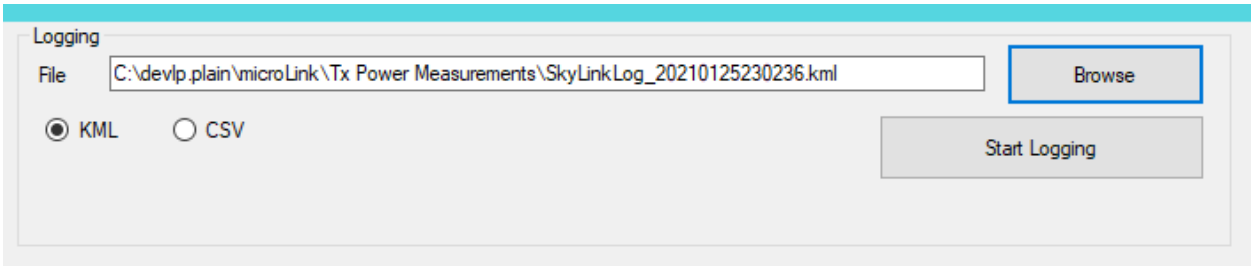
6.5 skyLinkApp

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.



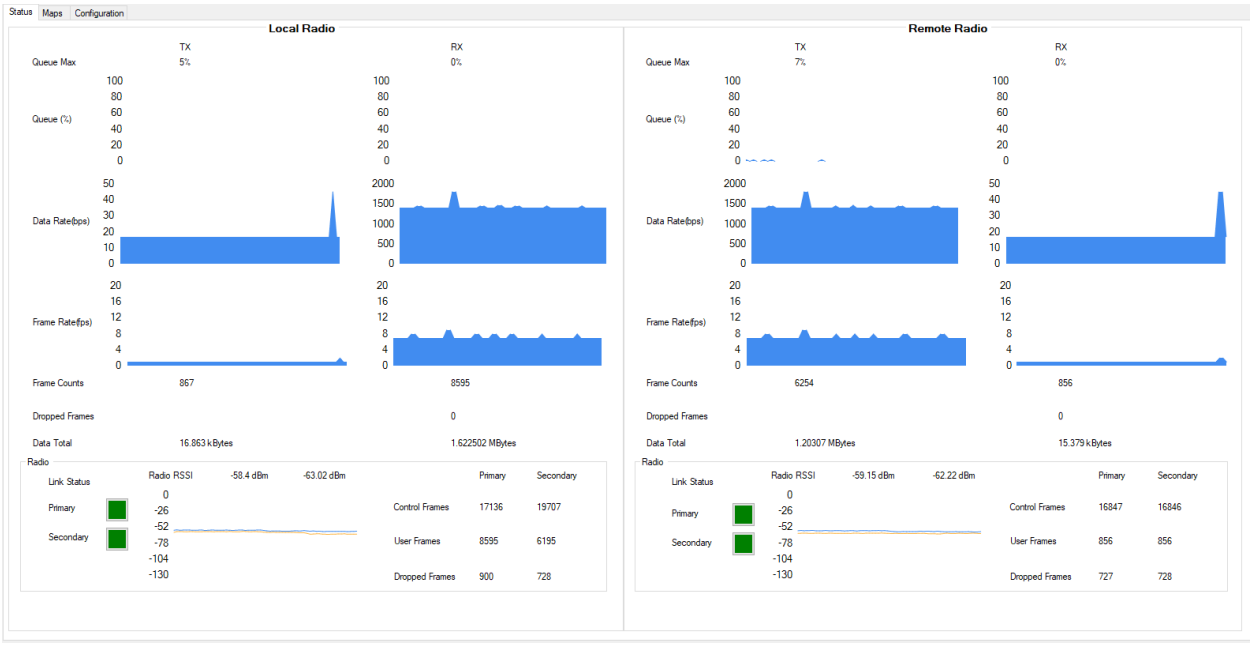
The Device Name field allows the user to enter a name for a set of connection parameters and save them for easy switching between radio connections. Just type in a name and press Save.

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



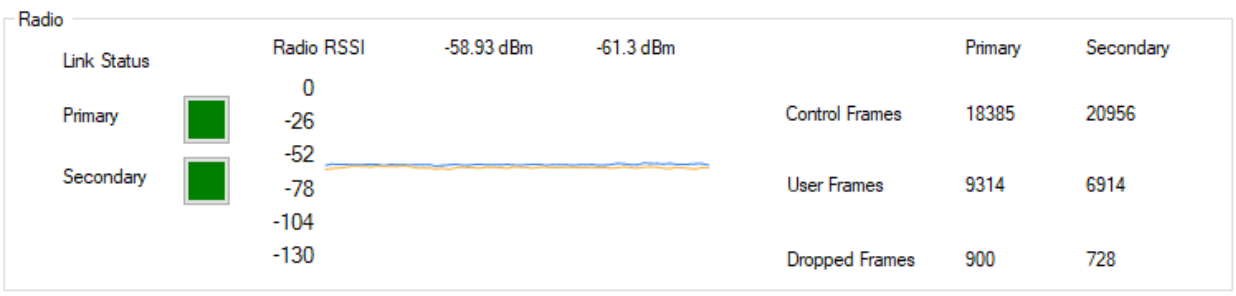
6.5.1 Status Tab

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.



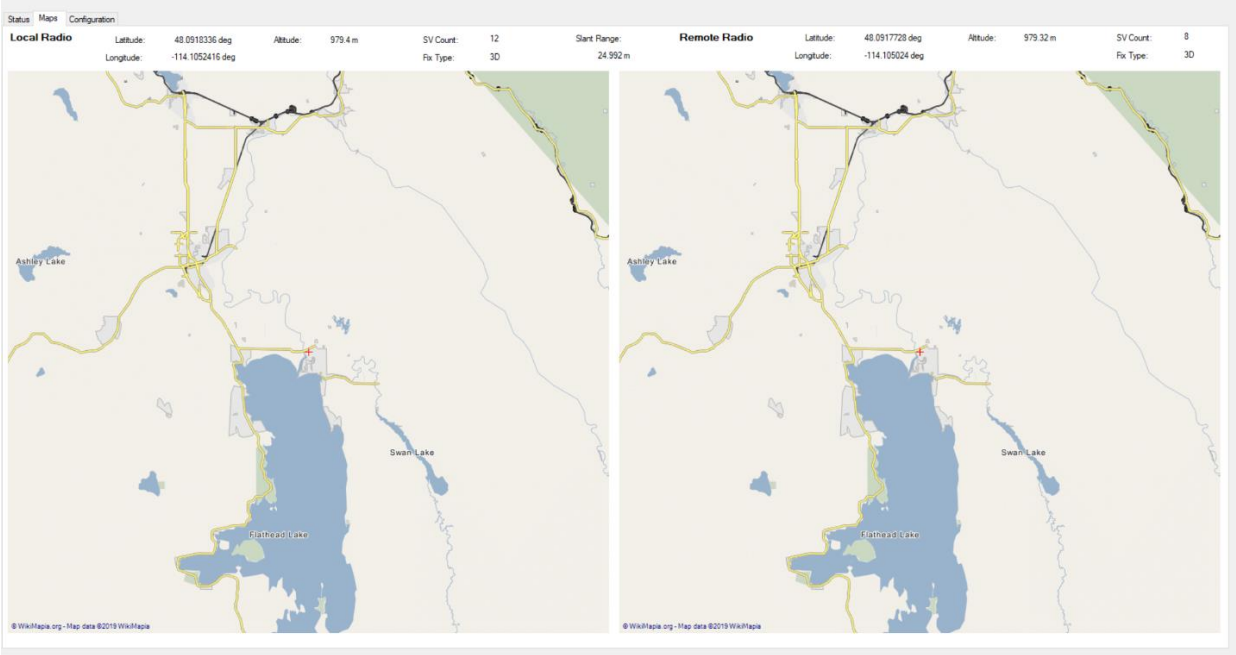
Radio throughput and statistics detail shown below.

RSSI detail shown below.



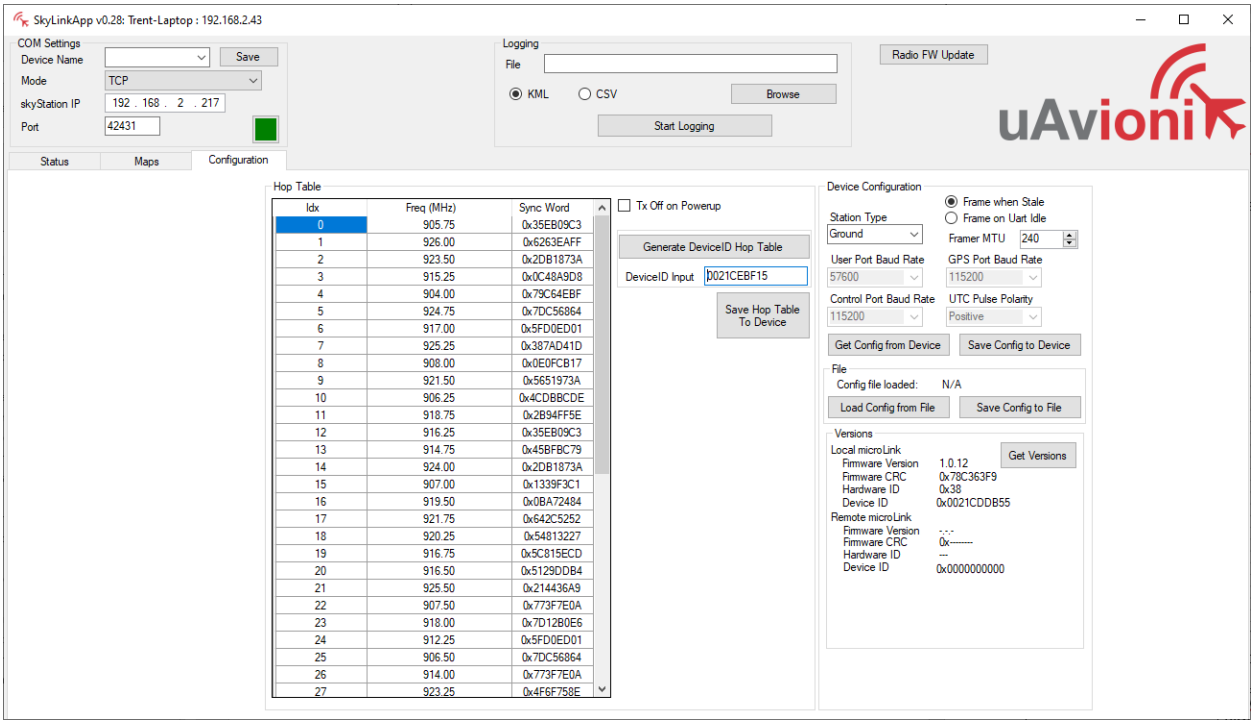
6.5.2 Maps Tab

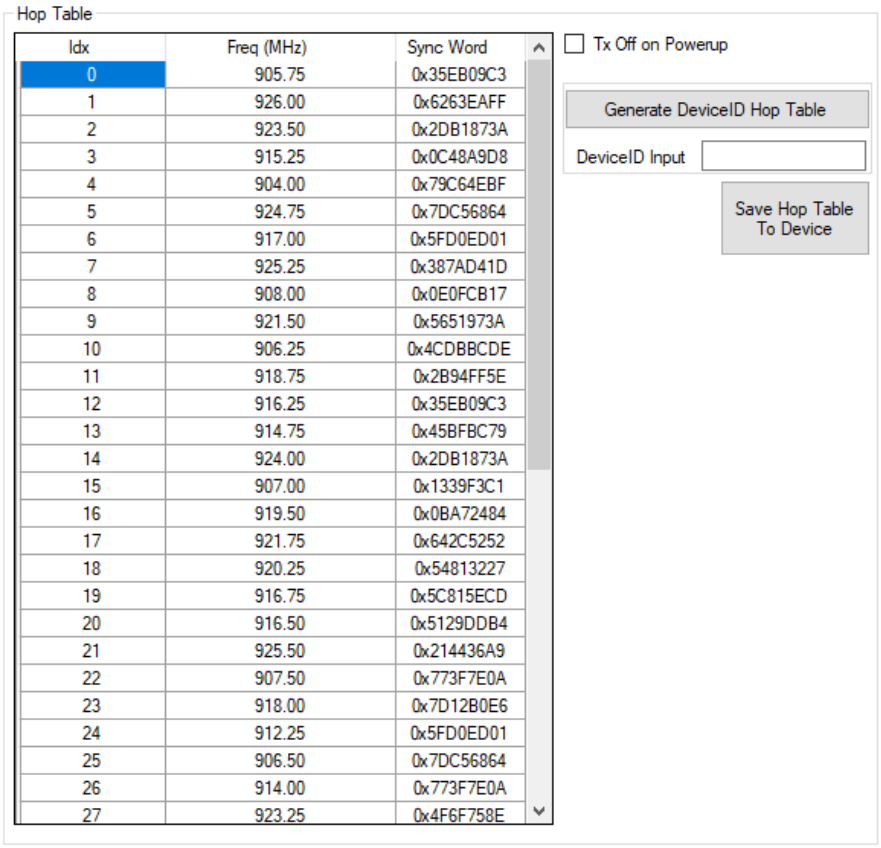
skyLinkApp.exe has a mapping tab for mapping the local radio skyStation radio as well as the remote aircraft radio. It includes latitude, longitude, altitude, GPS fix type, Slant Range and SV count.



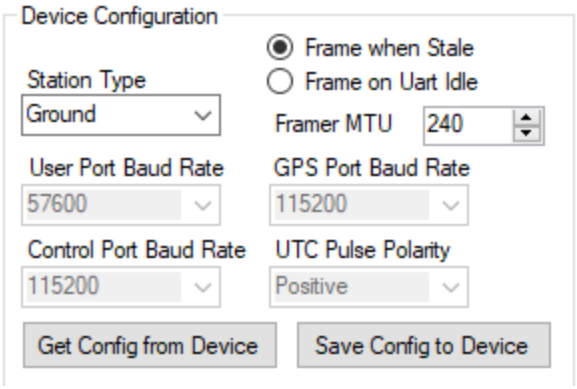
6.5.3 Configuration Tab

skyLinkApp.exe also contains a Configuration page. This page is used for device settings and setup as well as selecting the hop table scheme for the system.

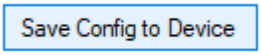




Generate DeviceID Hop Table	Generates the Hop Table per the Radio ID input
DeviceID Input 0021CEBF15	Radio ID input allows the user to enter the airborne radio ID to match Hop Tables.
Save Hop Table To Device	Saves the Hop Table currently displayed in the Hop Table window to the device.

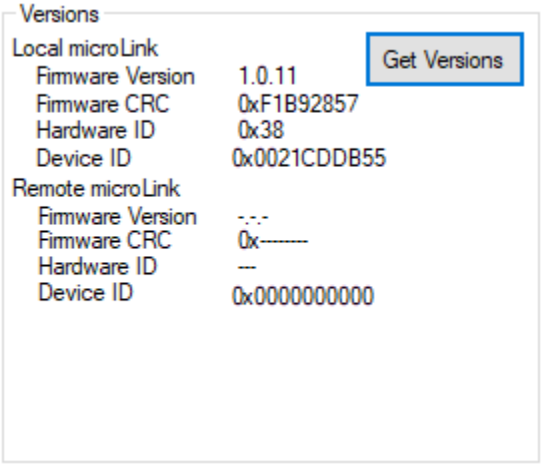


The Device Configuration window shows the current device settings for the radio in the skyStation. Clicking the 

button will pull the configuration parameters currently stored on the device and display them in the window. Clicking the 

button will push any new configuration parameters to the device.

The File window allows the user to save or load all the Configuration parameters to a PC.



The Versions window shows the microLink radio information for both the Local radio, and the Remote radio when a Link has been made.

6.6 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 nnn.nnn.nnn.nnn is the IP address of the skyStation.

- skyStation base URL:

  http://nnn.nnn.nnn.nnn/

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

- skyStation status URL:

  http://nnn.nnn.nnn.nnn/stats

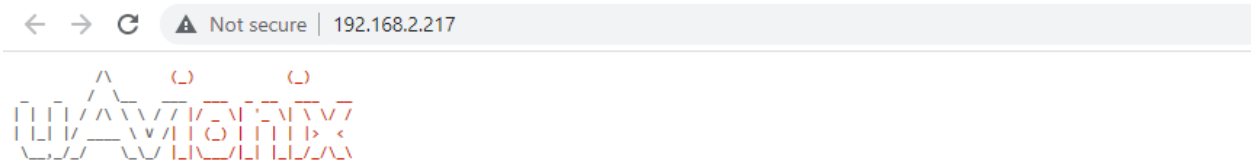
  Displays the status json sentence.

- skyStation update URL:

  http://nnn.nnn.nnn.nnn/update

  Provides ability 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 is shown. All parameters can also be modified to fit your network needs.



Firmware Information

SkyStation Version:	V 0. 0.10	Update
Radio Version:	V1.0.11	
Node ID:	0x21CDDB55	

Settings

Skyline Information

Websocket URL:

Datamux Information

IP Address: (0.0.0.0 for listen) 0.0.0.0

User Port: 42430

Control Port: 42431

Network Configuration

Save

Status Information

Name	Value
Up Time	7h:33m:28s
GPS Fix	3
Num GPS Sats	9
Latitude	48.0914496
Longitude	-114.1049344
GPS Altitude	2956
PPS Detected	true
SkyLine Up Time	0s
User Skt Up Time	0s
Ctrl Skt Up Time	37m:8s
Mission Timeout	0

6.6.1 Firmware Information

The skyStation firmware version, microLink radio version and the microLink radio ID associated are displayed here. The user can update the skyStation through the webpage by clicking the “update” link and the microLink Radio through the SkyLinkApp. see section 6.6.5 and 6.6.6.

6.6.2 Configuration Items

Configuration Item	Description
Skyline Websocket URL	When using Skyline or a websocket to manage missions, the mission data will be forwarded through to the URL address entered in this field.
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 User 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].
Data Mux Control Port	This is the port number used for the Control connection. The Control connection is used for device configuration and device monitoring. The skyStation will forward all local data metrics through this port.

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

6.6.3 Status

The Status Information section shows real time statistics updated once every second. It will show skyStation Up Time, GPS and PPS metrics. It will also show SkyLine metrics when connected through to the websocket.

Status Information

Name	Value
Up Time	7h:43m:57s
GPS Fix	3
Num GPS Sats	10
Latitude	48.0914496
Longitude	-114.1049344
GPS Altitude	2957
PPS Detected	true
SkyLine Up Time	0s
User Skt Up Time	0s
Ctrl Skt Up Time	47m:37s
Mission Timeout	0

6.6.4 Network Configuration

Clicking the Network Configuration link on the main landing page will forward you to the Network Configuration page where the user can adjust the network connectivity settings used by the skyStation when a DHCP server is not available.

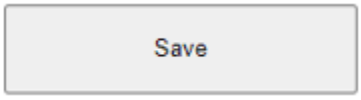
Network Configuration

IP Address:	192.168.1.1
Subnet Mask:	255.255.255.0
Gateway Address:	0.0.0.0
DNS Server Address:	0.0.0.0

Save

Main Page

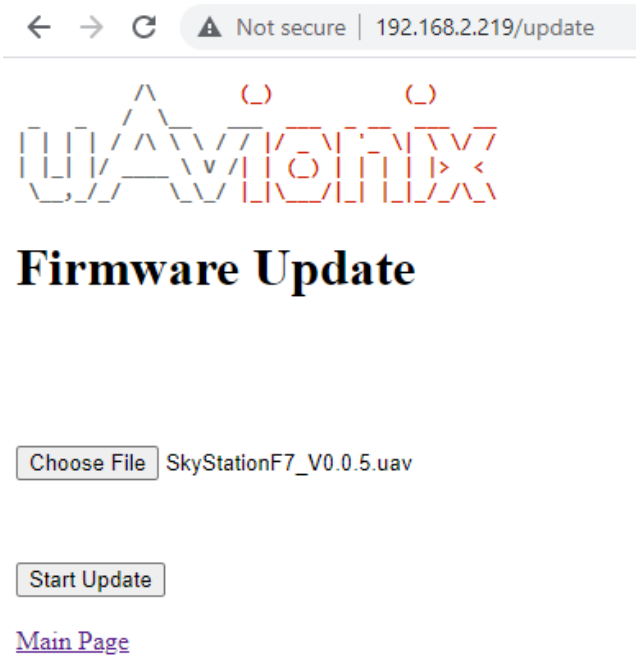
Configuration Item	Description
IP Address	This is the IP address number of the skyStation which will be used when a DHCP server is not available. The network administrator should assign this number.
Subnet Mask	Mask used with the skyStation IP address to differentiate between local and remote subnet destinations.
Gateway IP Address	Address used to send packets out of the local network.
DNS Address	IP address of the Domain Name Service.



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

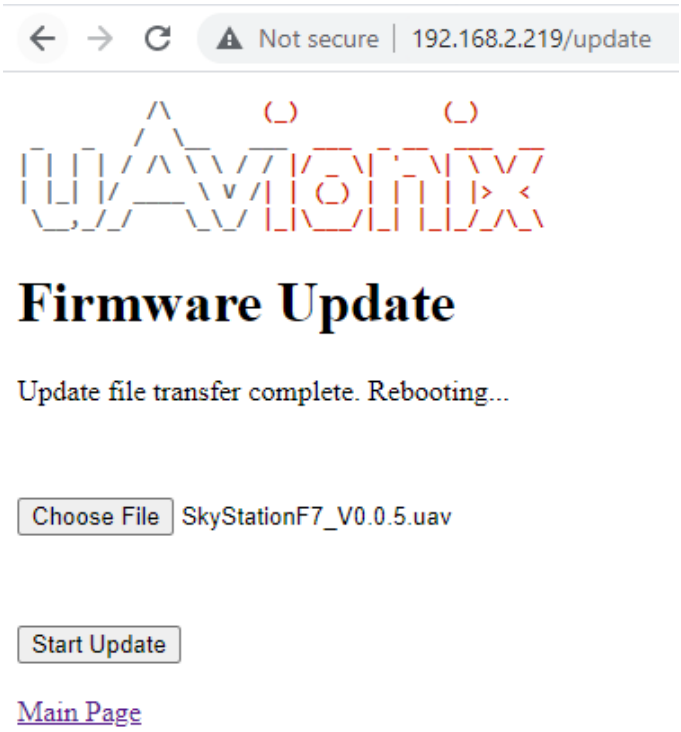
6.6.5 skyStation Update

The firmware on the skyStation can be updated through the skyStation Configuration Webpage by clicking 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.



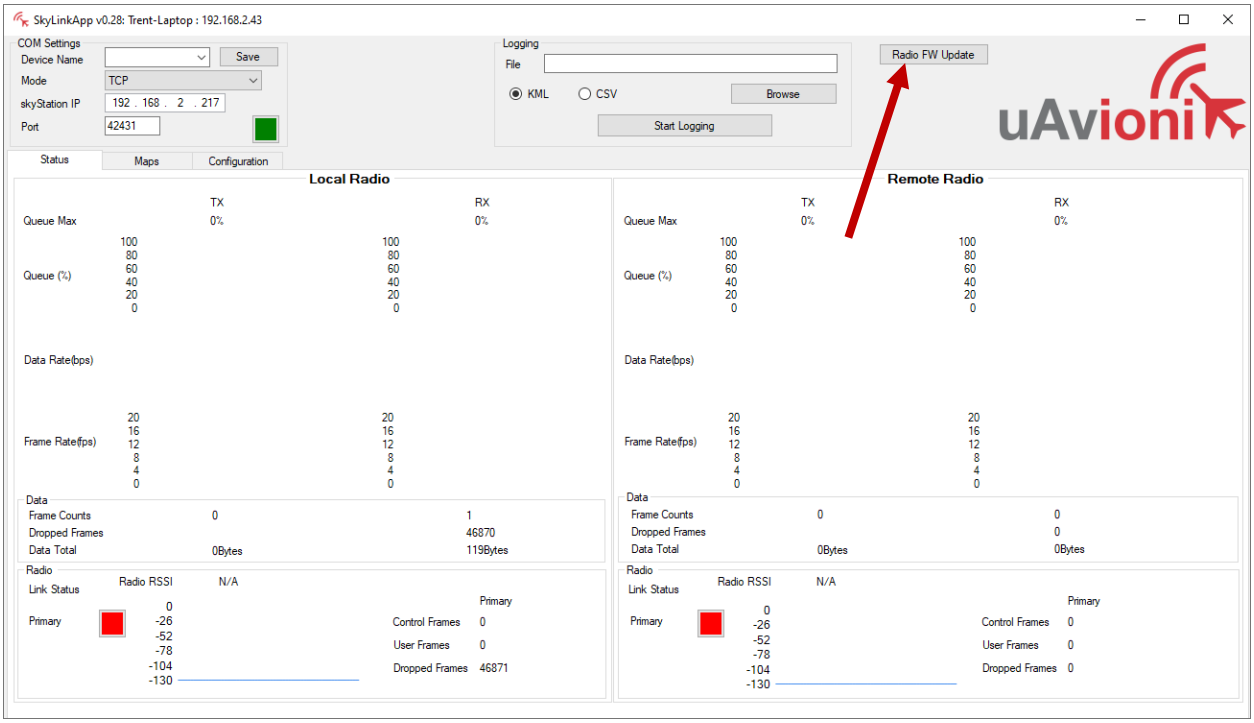
When the file transfer is complete, click the Main Page link to return to the skyStation Configuration Webpage*. The version number on the Configuration Webpage should reflect the firmware version uploaded.

* The reboot of the skystation could take up to 45s to complete

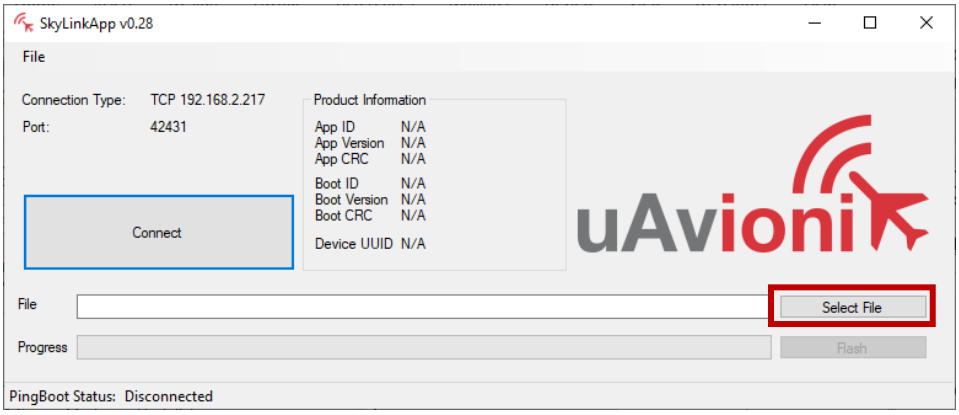
6.6.6 microLink Update

The microLink Radio on the skyStation can be updated using the SkyLinkApp. First connect the SkyLinkApp to the skyStation following the steps in section 6.4.

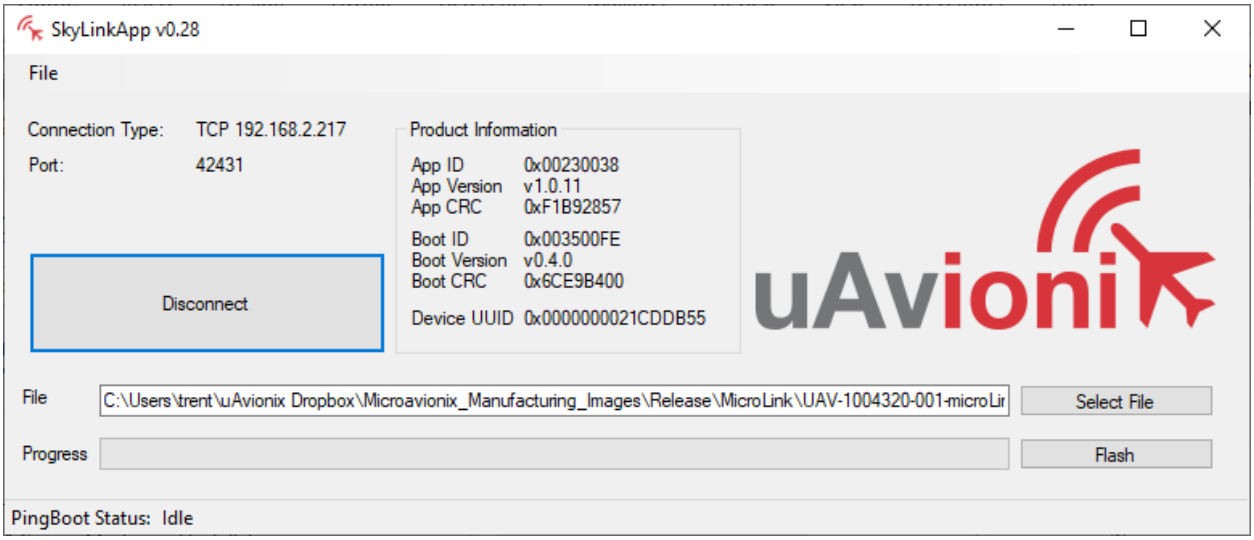
In the upper right hand corner click the “Radio FW Update” button.



A new window will open. First click “Select File” and select the correct firmware file to upload.



Then click the “Connect” button. The Product Information window will populate with radio information when a connection is made, and the PingBoot Status in the bottom left will change to “Idle”



Click “Flash” DO NOT power off or disconnect the device until the flash is complete.