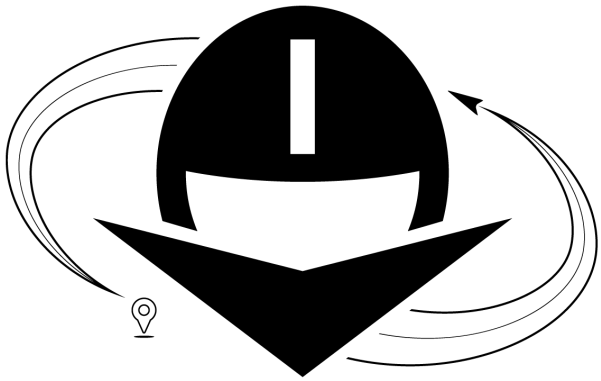
UM.305-1x

Release 4.5

Embention

2024-07-04

CONTENTS



1x | VERONTE AUTOPILOTS

Veronte Autopilot 1x is a miniaturized high reliability avionics system for advanced control of unmanned systems.

CHAPTER

ONE

INTRODUCTION

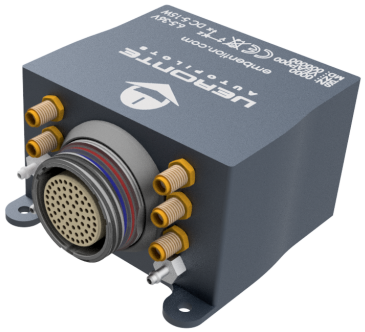


Fig. 1: **Veronte Autopilot 1x 4.5**

Veronte Autopilot 1x is a miniaturized high reliability avionics system for advanced control of unmanned systems. This control system embeds a set of sensors and processors together with LOS and BLOS M2M datalink radio, all with reduced size and weight.

The unique **Plug ´n Fly** control system, Autopilot ads fully autonomous control capabilities to any unmanned system for complete operation, compatible with: UAV, Drone, RPAS, USV, UGV…

Veronte Autopilot 1x is a miniaturized high reliability avionics system for advanced control of unmanned systems. This control system embeds a set of sensors and processors together with LOS and BLOS M2M datalink radio, all with reduced size and weight.

4X Veronte Autopilot is a triple redundant version of Veronte Autopilot. It includes three complete **Autopilots 1x** fully integrated with a dissimilar arbiter for detecting system failures and selecting the module in charge of control.

CHAPTER

TWO

QUICK START

This user manual covers the *mechanical* and *electric* assembly. The software user manual explain how to configure and use the **Veronte Autopilot 1x**.

Veronte Autopilot 1x contains all electronics and sensors required to properly execute all the UAV functions. A Veronte-based FCS contains the following elements:

- A **Veronte Autopilot 1x** as air unit, installed in a vehicle to control. This autopilot executes GNC algorithms in real time in order to accomplish the planned mission and handle the payload.
- Veronte software dedicated to mission planning, configuration and operation. It allows the user to monitor connected UAS in real time, to interact with them and to replay previous missions for post-flight analysis.
- A **BCS** or **PCS** as ground unit, it is linked between Veronte software and **Veronte Autopilot 1x** air unit. They support manual and arcade modes with conventional joysticks.

Veronte applications are different for different software versions:

- `Version 6.4 or lower:` **Veronte Pipe** is employed as unique application to work with Veronte.
- `Version 6.8 or higher:` **Veronte Link** connects the autopilot with a computer, which uses **Veronte Ops** to mission planning, configuration and operation.

2.1 Warnings

- This user manual includes references to manuals for software applications. Select your software version to read them.
- Power out of range can cause irreversible damage to the system. Please read carefully the manual before powering the system.

2.2 Limited Operation Firmware

Veronte Autopilot units are delivered with limited-operation firmware installed and must be updated for enabling unlimited autonomous flight capabilities. **Operation limits** in Veronte Autopilots, with `software version 6.8 or higher`, it can be **checked and unlocked in** Veronte Ops. For more information, read the Veronte Ops manual.

The different operating firmware options available are explained below:

- **Standard Firmware**: Allows fully autonomous operation with no time or distance limitation.

- **Limited-Operation Firmware**: Allows fully autonomous flight performance in LOS (500m) with no time limitations. For BLOS operations (>500m) there is a limitation of 30min autonomous flights. After 30min from leaving LOS (500m) the autopilot can not estimate its position nor fly autonomously.
- **Target Drone/Loitering Munition Firmware**: allows fully autonomous flight performance with no time or distance limitation. This firmware is restricted to 50h operation from the first startup. Once the operation time has expired the unit will not be able to restart.

If you have any questions regarding the firmware capabilities and limitations please contact us at sales@embention.com.

CHAPTER

THREE

TECHNICAL

Veronte Autopilot 1x is a miniaturized high-reliability avionics system for advanced control of unmanned systems. This control system embeds a set of sensors and processors together with LOS, BLOS, M2M and datalink radio, all with reduced size and weight.

3.1 Variants

Veronte Autopilot 1x has two variants:

- **With enclosure:** this variant is provided with an anodized aluminium enclosure, IP protection and an enhanced EMI shielding. A high reliability connector is also provided. The total weight is 190 g.
- **OEM: Autopilot 1x** can be provided as OEM version too, with a reduzed weight of 90g.

3.2 Mechanical Specifications

Variable	Value
Weight (with enclosure and connector)	190 g
Weight (OEM)	90 g
Minimum Temperature	-40 ºC
Maximum Temperature	+55ºC (No convection, ask for increased limits (up to 71ºC))
Max. Internal Temperature	+85ºC
Minimum Pressure	0 kPa
Maximum Pressure	104 kPa
Maximum Dynamic pressure	6 kPa (Ask for increased limits (up to 50kPa))
Protection Rating	IP67 enclosure version
Acceleration Limits (3 axes)	$\pm$2 g to $\pm$16 g (for sustained maneuvers, transitional higher accelerations are possible (e.g. catapult launch). Ask for increased limits.)
Angular Velocity Limits (3 axes)	$\pm$125 deg/s to $\pm$ 2000 deg/s (for sustained maneuvers, transitional higher angular velocities are possible. Ask for increased limits.)

3.2.1 Dimensions

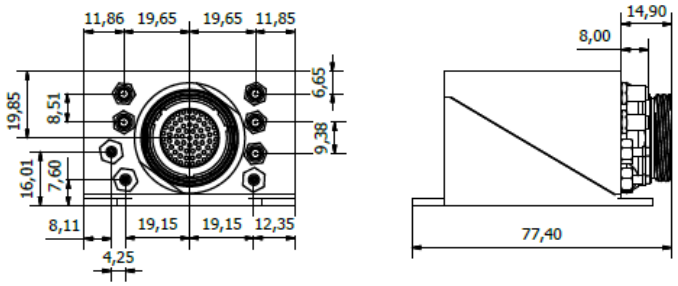


Fig. 1: **With enclosure dimensions**

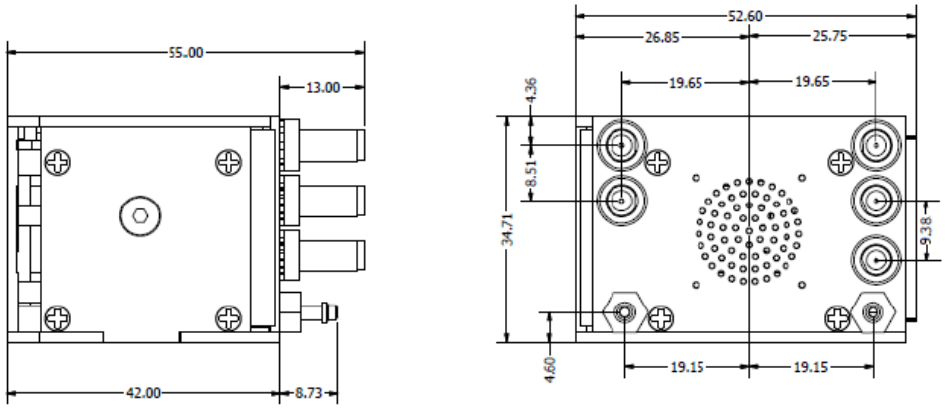


Fig. 2: **OEM dimensions**

3.3 Pressure lines

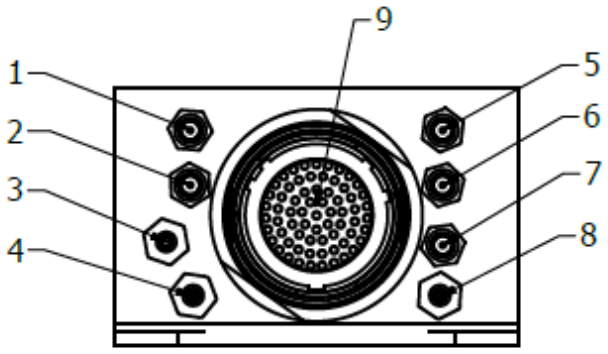
Veronte Autopilot 1x has three pressure input lines, two for static pressure to determine the absolute pressure and one for pitot in order to determine the dynamic pressure.

3.4 Electrical Specifications

Variable	Value
Power Input Magnetic Field Limits (3 axes)	6.5 V to 36 V ±4 to ±16 Gauss
GNSS	72 channels, GPS L1C/A, GLONASS L1OF, BeiDou B1I
Datalink	410 to 480 MHz licensed or FHSS/902-928MHz FHSS/2.4 to 2.483 GHz ISM Band/869.5-869.75 MHz ISM Band

3.5 Interfaces

3.5.1 Connector Layout



Index	Connector
1	LOS SSMA connector
2	GNSS1 SSMA connector
3	Static pressure port (Fitting 5/64in) [for MS56 and DPS310 sensors]
4	Static pressure port (Fitting 5/64in) [for HSC sensor]
5	M2M SSMA connector
6	GNSS2 SSMA connector
7	TPDR (Transponder) SSMA connector
8	Dynamic pressure port (Fitting 5/64in)
9	68-pin connector

For the pressure ports, mating with clamped 2mm internal diameter flexible tubing is recommended.

The two static pressure ports must be used for sensor redundancy (Y tubing connection is strongly recommended).

3.5.2 Mating Connectors

Index	Connector	Mating Connector
1	RF antenna (SSMA Jack Female)	SSMA male Plug, low-loss cable is recommended.
2,6	GNSS antenna (SSMA Jack Female)	SSMA male Plug, low-loss cable is recommended.Active Antenna GNSS: Gain min 15dB (to compensate signal loss in RF Cable) max 50dB, maximum noise figure 1.5dB, power supply 3.3V max current 20 mA
5	M2M antenna (SSMA Jack Female)	SSMA male Plug, low-loss cable is recommended.
7	TPDR antenna (SSMA Jack Female)	SSMA male Plug, low-loss cable is recommended.
9	Connector HEW.LM.368.XLNP	Mating connector P/N: FGW.LM.368.XLCT Mating harness is available on demand.

CHAPTER

FOUR

HARDWARE INSTALLATION

4.1 Mechanical assembly

Veronte Autopilot 1x is manufactured using an anodized aluminium enclosure with enhanced EMI shielding and IP protection. A high reliability connector is also provided. The total weight is 190 g for enclosure version and 90 g for OEM.

4.1.1 Dimensions

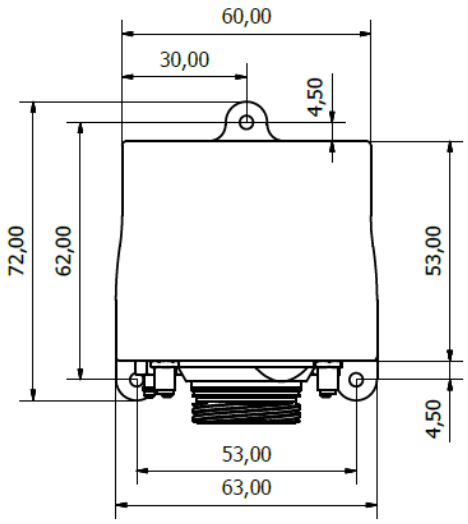


Fig. 1: **Veronte Autopilot 1x dimensions**

M3 screws are recommended for mounting. In saline environments such as coastal and oceanic, the screw material must be stainless steel.

4.1.2 Pressure lines

Pressure Intake
Pressure intakes must be located in order to prevent clogging.
Never install pressure intakes on the propeller flow.
Design pressure tubing path in order to avoid tube constriction.

Static Pressure
It is not recommended to use inside fuselage pressure if it is not properly vented.

Pitot Tube
Pitot tube must be installed facing the airflow.
It is recommended to install it near the aircraft's x axis in order to avoid false measures during manoeuvres.
For low-speed aircraft it is recommended at least 6.3mm tubes to prevent any rain obstruction.

Note: In case of not using an input air connector, it is recommended to remove its corresponding nut. Vibrations may move and damage intake connectors with a nut that is not fixed with a tube.

4.1.3 Location

The location of **Veronte Autopilot 1x** has no restrictions. It is only required to configure its relative position respect to the centre of mass of the aircraft and the GNSS antenna. The configuration of the location of **Veronte Autopilot 1x** can be easily configured reading the manual of the corresponding software.

4.1.4 Orientation

The orientation of **Veronte Autopilot 1x** has no restrictions either. It is only needed to configure axes with respect to the aircraft body axes by means of a rotation matrix or a set of correspondences between axes. The configuration of the orientation can be easily configured reading the manual of the corresponding software.

Axes are printed on the **Autopilot 1x** box. Aircraft coordinates are defined by the standard aeronautical conventions (see image below).

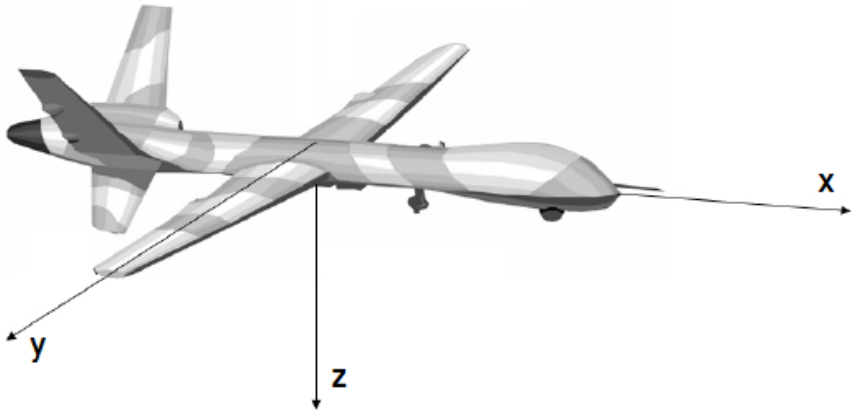


Fig. 2: **Aircraft Coordinates (Standard Aeronautical Convention)**

4.1.5 Vibration Isolation

Although **Veronte Autopilot 1x** rejects noise and high-frequency modes of vibration with electronic filters and internal mechanical filters, there might be situations where external isolation components might be needed.

Autopilot 1x can be mounted in different ways in order to reject the airframe vibration. The simplest way could be achieved by just using double-sided tape on the bottom side of Veronte. Other ways may use some external structure which could be rigidly attached to the airframe and softly attached to Veronte (e.g. foam, silent blocks, aerogel, etc).

The user should take into account that wiring should be loose enough so vibrations may not be transmitted to **Veronte Autopilot 1x**.

In cases where mechanical isolation is not viable, it is possible to use soft engine mounts. It is also recommended when there are other sensible payloads like video cameras or for high vibration engines.

4.2 Antenna Integration

The system uses different kinds of antennas to operate that must be installed on the airframe. Here you can find some advice for obtaining the best performance and for avoiding antenna interferences.

Antenna Installation
Maximize separation between antennas as much as possible.
Keep them far away from alternators or other interference generators.
Always isolate antenna ground panel from the aircraft structure.
Make sure the antenna is securely mounted.
Always use high-quality RF wires minimising the wire length.
Always follow the antenna manufacturer manual.
SSMA connections shall be tightened applying 1 Nm of torque
For all-weather aircraft, insert SSMA lightning protectors.

GNSS Antenna
Antenna top side must point the sky.
Install it on a top surface with direct sky view.
Never place metallic / carbon parts or wires above the antenna.
It is recommended to install it on a small ground plane.
For all-weather aircraft, insert SSMA lightning protectors.

4.3 Electrical

4.3.1 Power

Veronte can use unregulated DC **(6.5V to 36V)**. Pins used for power and ground are the same for both Ground and Air configurations.

LiPo batteries between 2S and 8S can be used without regulation needs. Remaining battery level can be controlled by the internal voltage sensor and by configuring the voltage warnings on the Veronte software.

For higher voltage installations, voltage regulators must be used. For dimensioning voltage regulators take into account that a blocked servo can activate regulator thermal protection.

Warning: Caution!! Power Veronte out of the given range can cause irreversible damage to the system. Please read carefully the manual before powering the system.

Veronte and servos can be powered by the same or different batteries. In case of having more than one battery on the system, a single point ground union is needed to ensure a good performance. The ground signal should be isolated from other noisy ground references (e.g. engines). If all grounds need to be connected, the connection should be made on the negative pole of the battery.

It is recommendable to use independent switches for autopilot and motor/actuators. During the system initialization, the PWM signal will be set to low level (0V), please make sure that actuators/motor connected support this behaviour before installing a single switch for the whole system.

4.3.2 Veronte Autopilot 1x I/O Signals

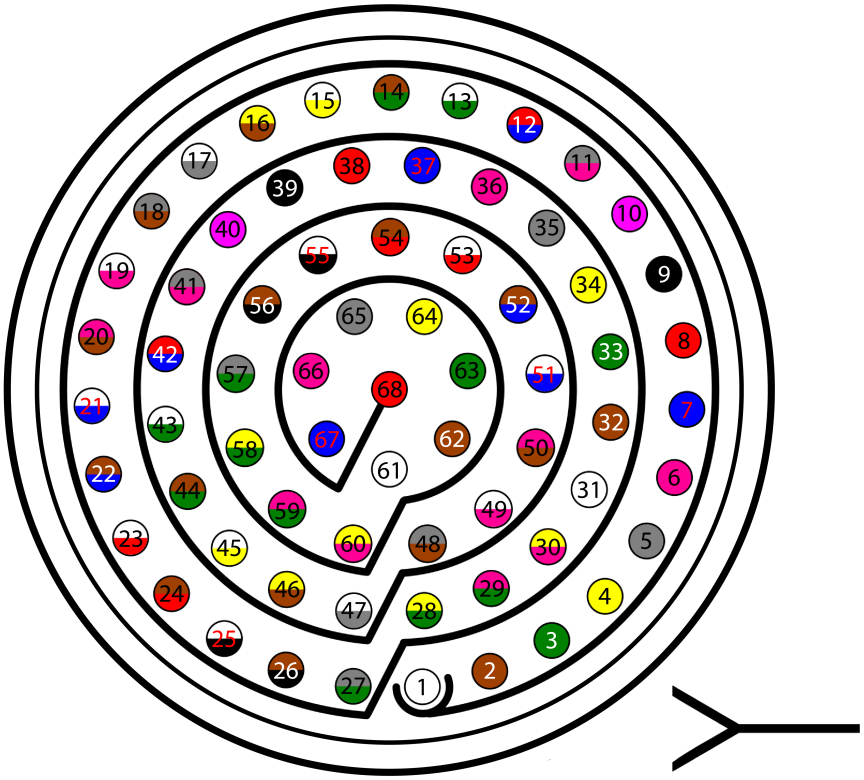


Fig. 3: **68 pin connector for Autopilot 1x (frontal view)**

Pin	Signal	Type	Comments
1	I/O1	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
2	I/O2	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
3	I/O3	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
4	I/O4	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit

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Table 1 – continued from previous page

Pin	Signal	Type	Comments
5	I/O5	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
6	I/O6	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
7	I/O7	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
8	I/O8	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
9	GND	GROUND	Ground signal for actuators 1-8
10	I/O9	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
11	I/O10	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
12	I/O11	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
13	I/O12	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
14	I/O13	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
15	I/O14	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
16	I/O15	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
17	I/O16	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit

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Table 1 – continued from previous page

Pin	Signal	Type	Comments
18	GND	GROUND	Ground signal for actuators 9-16
19	RS 232 TX	Output	RS 232 Output (-13.2V to 13.2V Max, -5.4V to 5.4V Typical). Protected against ESD and short circuit
20	RS 232 RX	Input	RS 232 Input (-25V to 25V Max, -0.6V Low and 2.4V High Threshold). Protected against ESD and short circuit
21	GND	GROUND	Ground signal for buses
22	Analog 4	Input Analog	Input 0-3V. Protected against ESD and short circuit
23	Analog 5	Input Analog	Input 0-3V. Protected against ESD and short circuit
24	GND	GROUND	Ground signal for buses
25	CanA P	I/O	CANbus interface, up to 1Mbps (2.3V Typical, 1.2V-2.3V Differential). Protected against ESD
26	CanA N	I/O	Twisted pair with a 120 Zo recommended (2.3V Typical, 1.2V-2.3V Differential). Protected against ESD
27	GND	GROUND	Ground signal for buses
28	CANB_P	I/O	CANbus interface. It supports data rates up to 1 Mbps. Protected against ESD
29	CANB_N	I/O	Twisted pair with a 120 Zo recommended. Protected against ESD
30	GND	GROUND	Ground signal for buses
31	I2C_CLK	Output	Clk line for I2C bus (0.3V to 3.3V). Protected against ESD and short circuit
32	I2C_DATA	I/O	Data line for I2C bus (0.3V to 3.3V). Protected against ESD and short circuit
33	GND	GROUND	Ground for 3.3V power supply

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Table 1 – continued from previous page

Pin	Signal	Type	Comments
34	3.3V	POWER	3.3V - 100mA power supply. Protected against ESD short circuit with 100mA resettable fuse
35	GND	GROUND	Ground for 5V power supply
36	5V	POWER	5V – 100mA power supply. Protected against ESD short circuit with 100mA resettable fuse
37	GND	GROUND	Ground for analog signals
38	ANALOG_1	Input	Analog input 0-3V. Protected against ESD and short circuit
39	ANALOG_2	Input	Analog input 0-3V. Protected against ESD and short circuit
40	ANALOG_3	Input	Analog input 0-3V. Protected against ESD and short circuit
41	GND	GROUND	Ground for FTS signals
42	FTS1_OUT	Output	Deadman signal from comicro. Protected against ESD and short circuit
43	FTS2_OUT	Output	!SystemOK Bit. Protected against ESD and short circuit
44	GND	GROUND	Ground signal for safety buses
45	V_ARB_TX	Output	Veronte comicro UART output to activate safety mechanism. Protected against ESD and short circuit
46	V_ARB_RX	Input	Veronte comicro UART output to activate safety mechanism. Protected against ESD and short circuit
47	GND	GROUND	Ground signal comicro power supply
48	V_ARB_VCC	POWER	Veronte comicro power (6.5V to 36V). Protected against ESD and reverse polarity

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Table 1 – continued from previous page

Pin	Signal	Type	Comments
49	FTS3_OUT_MPU	Output	MPU alive voting signal, to use with 4xVeronte. It is a Square Wave at [100,125] Hz. Protected against ESD and short circuit
50	OUT_RS485_P	Output	Non-inverted output from RS485 bus (-7V to 12V Max, -2.3V to 2.3V Typical). Protected against ESD and short circuit
51	OUT_RS485_N	Output	Inverted output from RS485 bus (-7V to 12V Max, -2.3V to 2.3V Typical). Protected against ESD and short circuit
52	IN_RS845_N	Input	Inverted input from RS485 bus (-7V to 12V Max, -2.3V to 2.3V Typical). Protected against ESD and short circuit
53	IN_RS845_P	Input	Non-inverted output from RS485 bus (-7V to 12V Max, -2.3V to 2.3V Typical). Protected against ESD and short circuit
54	RS-485_GND	GND	Ground for RS-485 bus
55	EQEP_A	I/O	DIGITAL output / DIGITAL input / Encoder quadrature input A (0-3.3V). Protected against ESD and short circuit
56	EQEP_B	I/O	DIGITAL output / DIGITAL input / Encoder quadrature input B (0-3.3V). Protected against ESD and short circuit WARNING!: Only use it as digital I/O with Veronte units of Hardware version 4.5 or lower
57	EQEP_S	I/O	DIGITAL output / DIGITAL input / Encoder strobe input (0-3.3V). Protected against ESD and short circuit

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Table 1 – continued from previous page

Pin	Signal	Type	Comments
58	EQEP_I	I/O	DIGITAL output / DIGITAL input / Encoder index input A (0-3.3V). Protected against ESD and short circuit
59	GND	GROUND	Ground for encoders
60	V_USB_DP	I/O	Veronte USB data line. Protected against ESD
61	V_USB_DN	I/O	Veronte USB data line. Protected against ESD
62	V_USB_ID	I/O	Veronte USB ID line. Protected against ESD and short circuit
63	FTS_OUT_MPU	Output	Abort mission voting signal from MPU, to use with 4xVeronte. Bit Low (0V) if mission OK. High (3.3V) if mission wants to be terminated. Protected against ESD and short circuit
64	FTS2_OUT_MPU	Output	Abort mission voting signal 2 from MPU, to use with 4xVeronte. Bit Low (0V) if mission OK. High (3.3V) if mission wants to be terminated. Protected against ESD and short circuit
65	GND	GROUND	Veronte ground input
66	ND	GROUND	Veronte ground input
67	VCC	POWER	Veronte power supply (6.5V to 36V). Protected against ESD and reverse polarity. **Warning:** Both pins are common. They MUST be connected to the same power supply.
68	VCC	POWER	

Warning: Remember!! All Veronte's GND pins are common.

To know the differences between version (this one) 4.5 and 4.8, read *Troubleshooting -> Pinout changes from Autopilot 1x 4.5*.

4.3.3 Connector colour code:

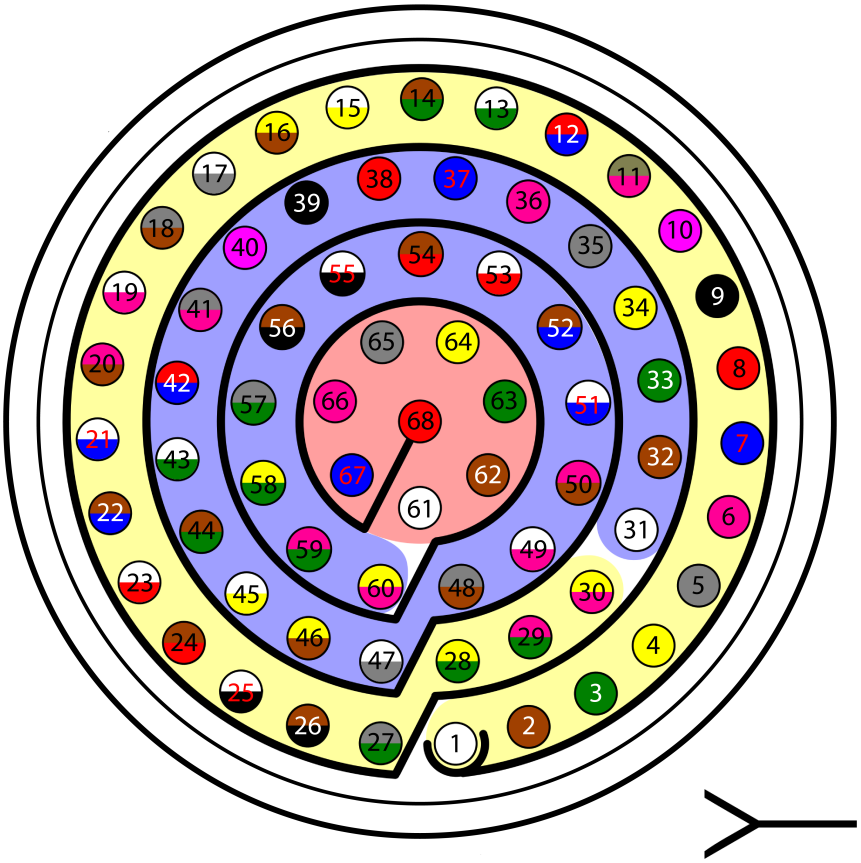

Fig. 4: **Connector HEW.LM.368.XLNP**

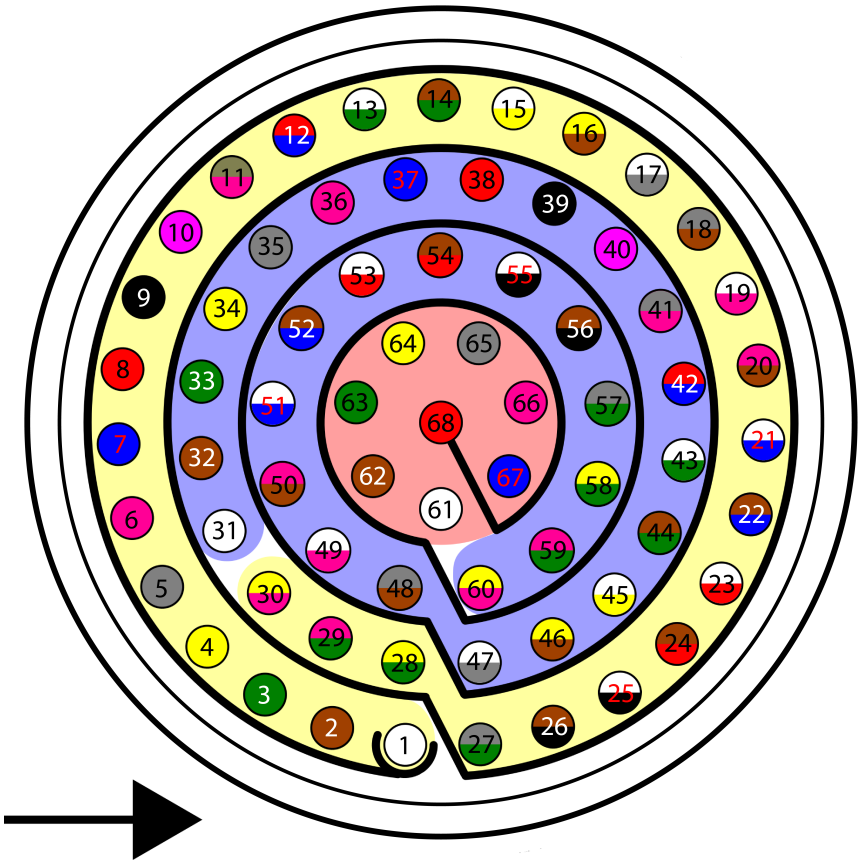

Fig. 5: **Harness plug**

Warning: Check the pin number before connecting. The colour code is repeated 3 times due to the amount of pins. First section (yellow) corresponds to pins 1-30, the second section (blue) to pins 31-60 and the third one (red) to pins 61-68. Pin number increases following the black line of the pictures above: counterclockwise for the connector and clockwise for the plug.

PIN	Color code	PIN	Color code
1	White	35	Gray
2	Brown	36	Pink
3	Green	37	Blue
4	Yellow	38	Red
5	Gray	39	Black
6	Pink	40	Violet
7	Blue	41	Gray – Pink
8	Red	42	Red – Blue
9	Black	43	White – Green
10	Violet	44	Brown – Green
11	Gray – Pink	45	White – Yellow
12	Red – Blue	46	Yellow – Brown
13	White – Green	47	White – Gray

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Table 2 – continued from previous page

PIN	Color code	PIN	Color code
14	Brown – Green	48	Gray – Brown
15	White – Yellow	49	White – Pink
16	Yellow – Brown	50	Pink – Brown
17	White – Gray	51	White – Blue
18	Gray – Brown	52	Brown – Blue
19	White – Pink	53	White – Red
20	Pink – Brown	54	Brown – Red
21	White – Blue	55	White – Black
22	Brown – Blue	56	Brown – Black
23	White – Red	57	Gray – Green
24	Brown – Red	58	Yellow – Green
25	White – Black	59	Pink – Green
26	Brown – Black	60	Yellow – Pink
27	Grey – Green	61	White
28	Yellow – Green	62	Brown
29	Pink – Green	63	Green
30	Yellow – Pink	64	Yellow
31	White	65	Grey
32	Brown	66	Pink
33	Green	67	Blue
34	Yellow	68	Red

4.3.4 Flight Termination System (FTS)

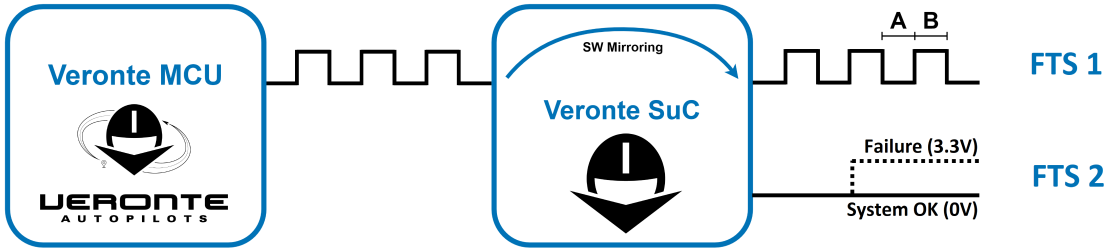


Fig. 6: **Flight Termination System**

Veronte Autopilot 1x integrates two different FTS pins (42 and 43):

FTS1 - Deadman (Pin 42): On this pin, Autopilot 1x outputs a square wave with A = ~5ms and B = ~5ms (3.3V). Its frequency can be higher right after the rebooting (around 300-400Hz), but A and B must be always < 8ms.

FTS2 - !SystemOK (Pin 43): Its output is 0V when the system is working as expected and 3.3V when some error is detected. In detail, pin 43 goes high if A > 8ms or B > 8ms in the deadman signal sent by the Main Processor Unit (MPU).

CHAPTER

FIVE

SOFTWARE INSTALLATION

In order to configure and use **Veronte Autopilot 1x**, there are two ways to connect it to a computer: USB or serial.

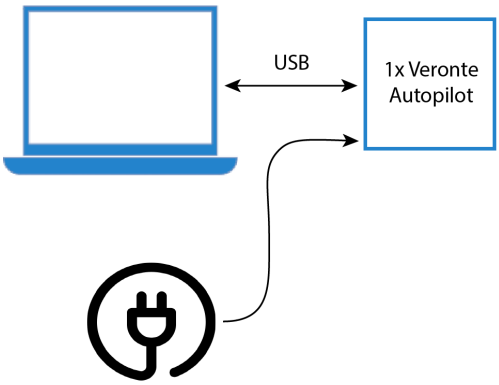


Fig. 1: **USB connection**

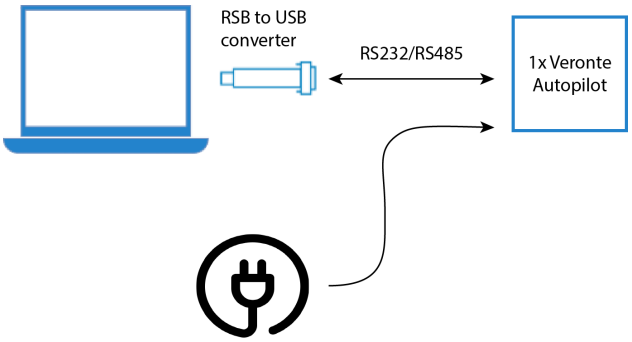


Fig. 2: **Serial connection**

To install the required software and configure **Veronte Autopilot 1x**, read the 1x Software Manual.

CHAPTER

SIX

OPERATION

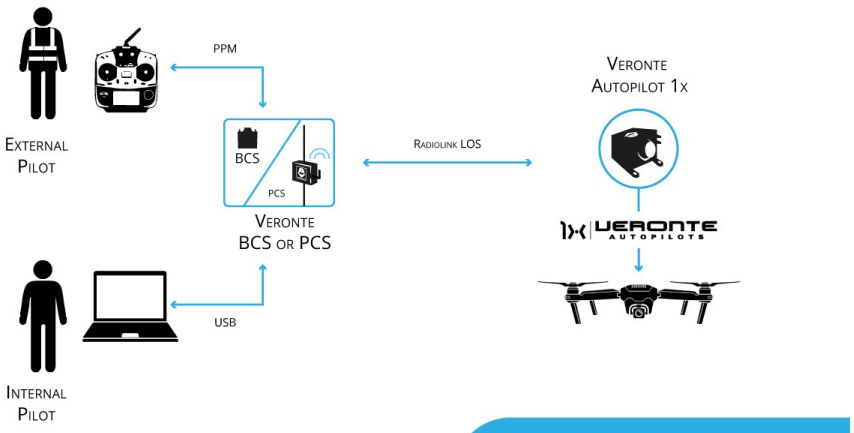
6.1 Flight Control Setups

Veronte Autopilot 1x allows for a wide variety of communication and control solutions to adapt to each mission and platform specifications. This section summarizes a list of recommended options to operate an **Autopilot 1x** in different situations.

Tip: Most of the following diagrams can be used independently or combinated, to create redundant systems or backup solutions.

Note: **BCS** (Basic Control Station) is a **Veronte Autopilot 1x** variant employed only as a ground control station for beginners. Nonetheless, **PCS** (Pole Control Station) is recommended due to its extended range, power and autonomy.

The following image shows the standard Veronte System Layout for operation.



Veronte Standard Layout

In the standard layout, an Operator (Internal Pilot) controls the UAV from the Ground Station using **Veronte Ops**.

Additionally, a Safety Pilot (External Pilot) is connected to the Ground Station using a radio controller. The stick commands are read by the Ground Unit and re-routed to the Air Unit. The Safety Pilot is able to take control of the flight at any point using an **automation**.

While this is the most common setup, there is a wide variety of options, including:

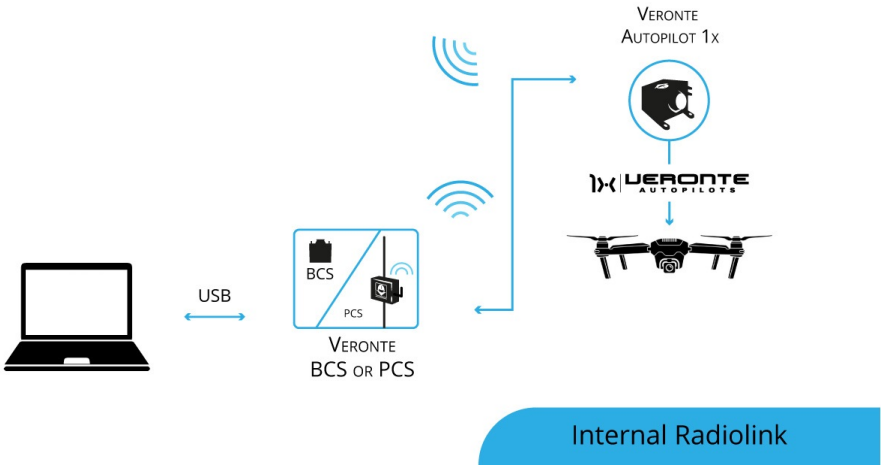
- BLOS communications
- Onboard RC receivers
- Point to Multipoint configurations

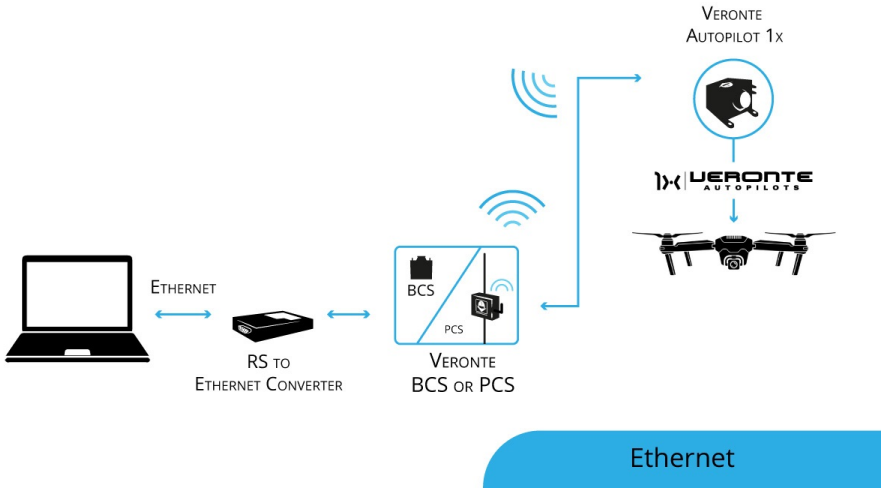
6.2 Air Communications

Communication solutions between air and ground devices.

6.2.1 Line of Sight

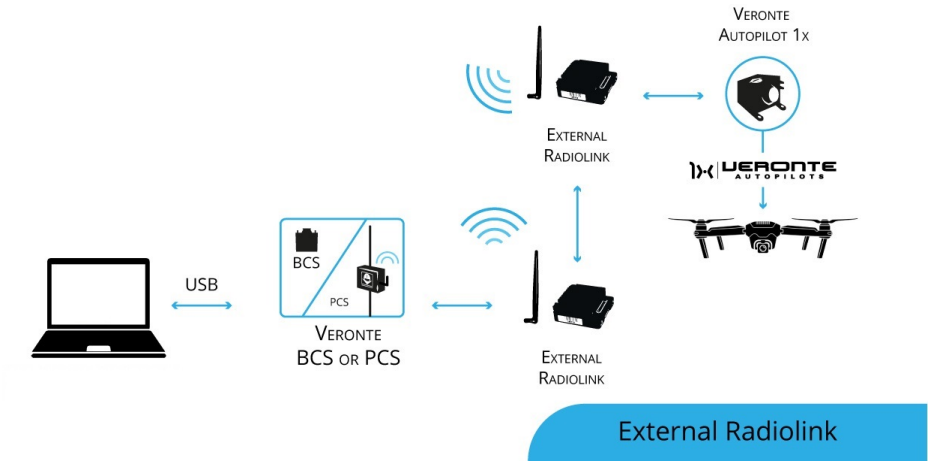
6.2.1.1 Standard setup



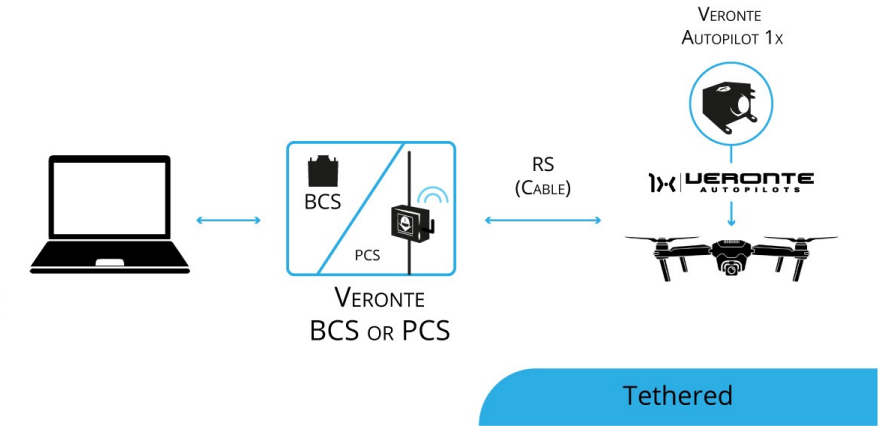


6.2.1.2 External radiolink

For increased range, bandwidth or channels are needed

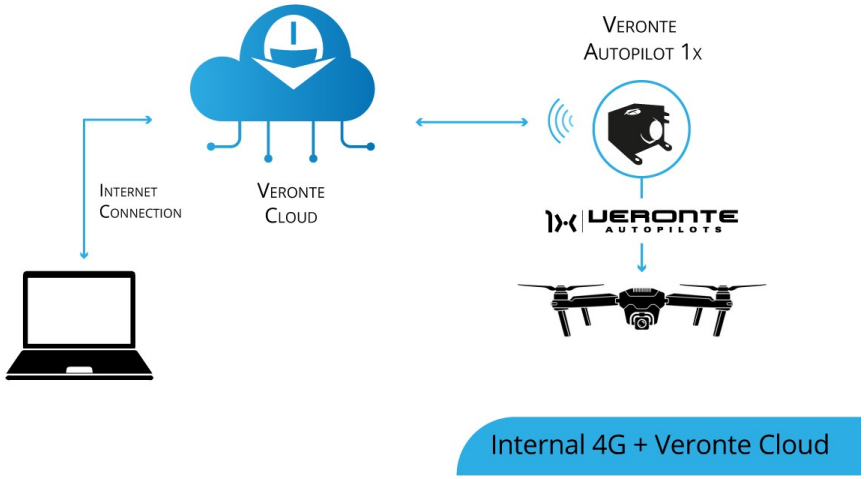


6.2.1.3 Tethered



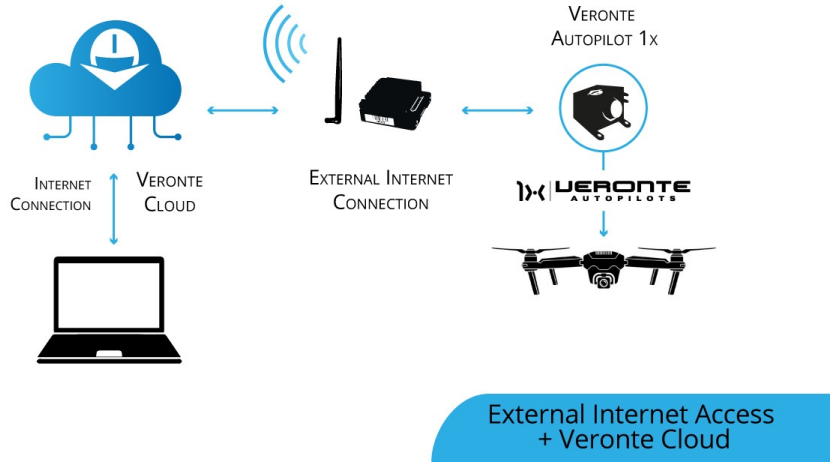
6.2.2 Beyond Line of Sight

6.2.2.1 Internal 4G + Veronte Cloud



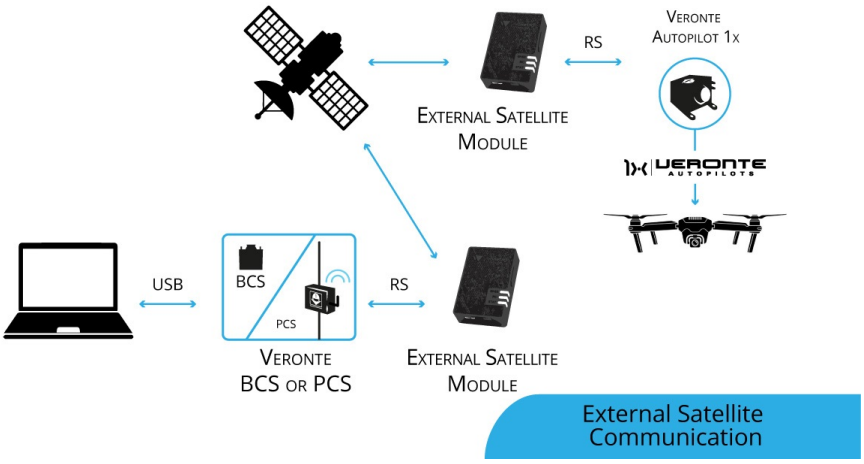
6.2.2.2 External Internet access + Veronte Cloud

For alternative internet access



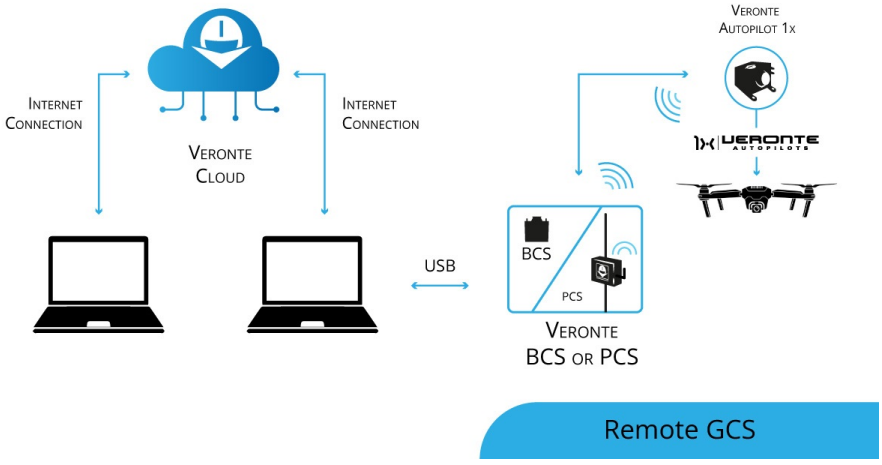
6.2.2.3 External Satellite communication

For maximum reliability



6.2.2.4 Remote GCS

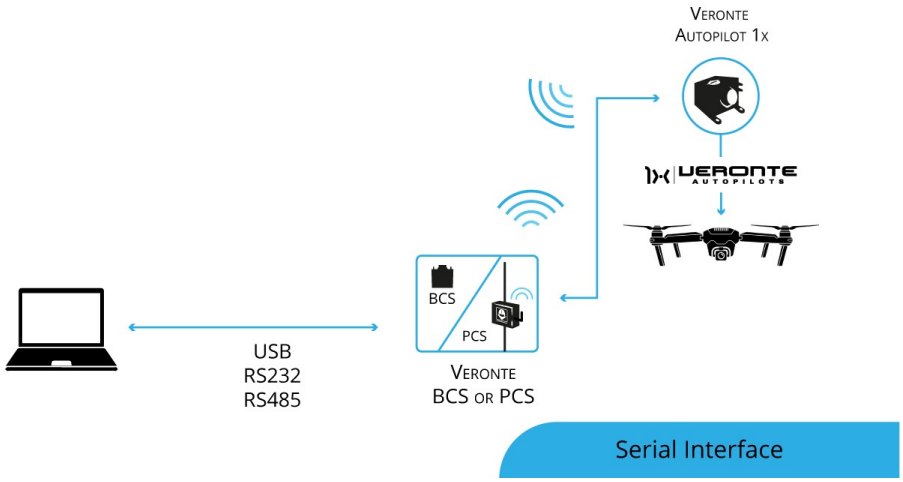
For remote solutions with LOS backup operator



6.3 Ground Communications

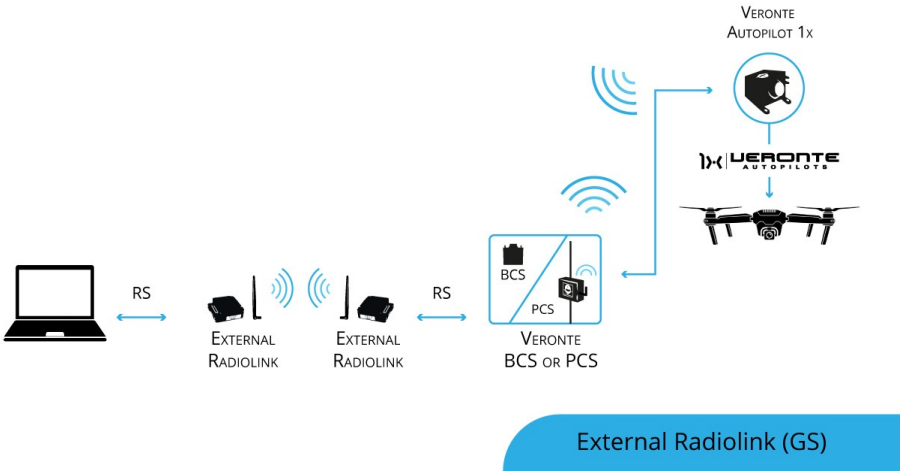
Comunication solutions between the different GS devices

6.3.1 Serial interface



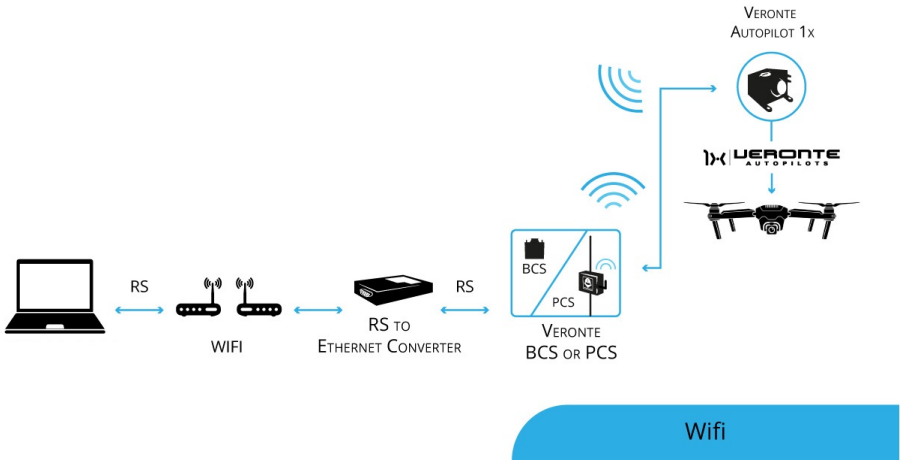
6.3.2 External Radiolink

For modular ground stations.



6.3.3 Wifi

For operation with laptops or tablets.

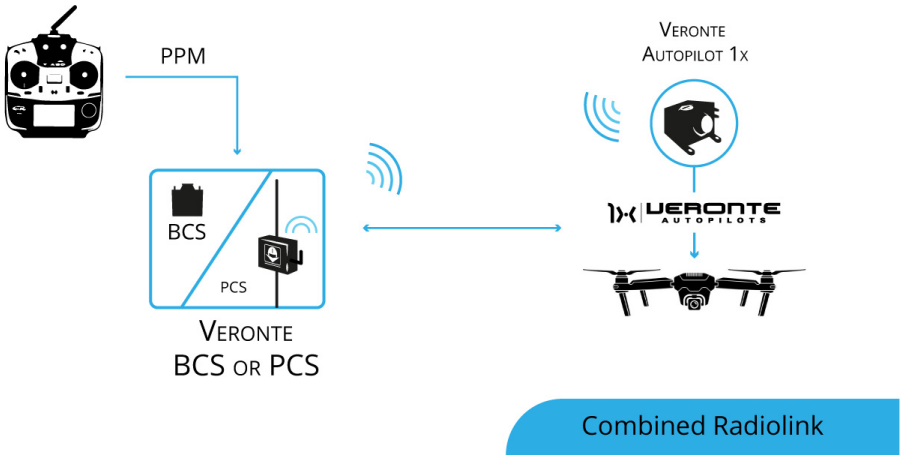


6.4 Manual Control Layouts

Veronte allows for a wide variety of pilot interface solutions in order to interact with manual flight modes, assisted flight modes (arcade) or payloads.

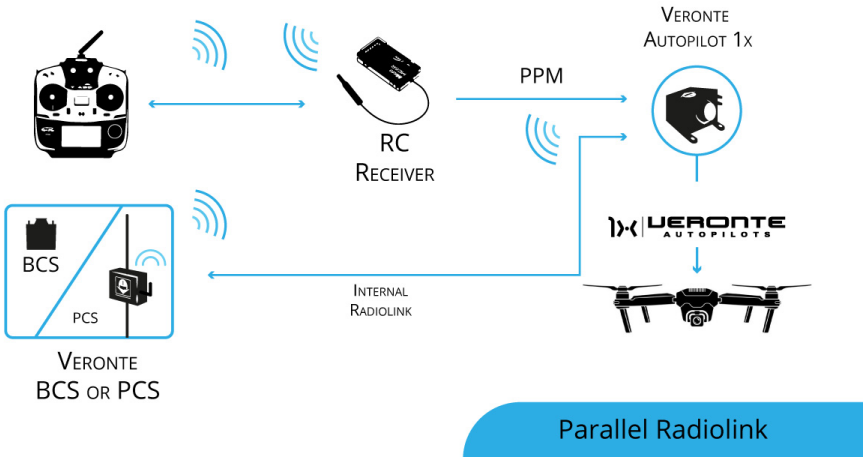
6.4.1 PPM to Ground Unit

Standard setup. Allows the usage of a single radio channel both for stick, control commands and telemetry, minimizing any potential interferences.



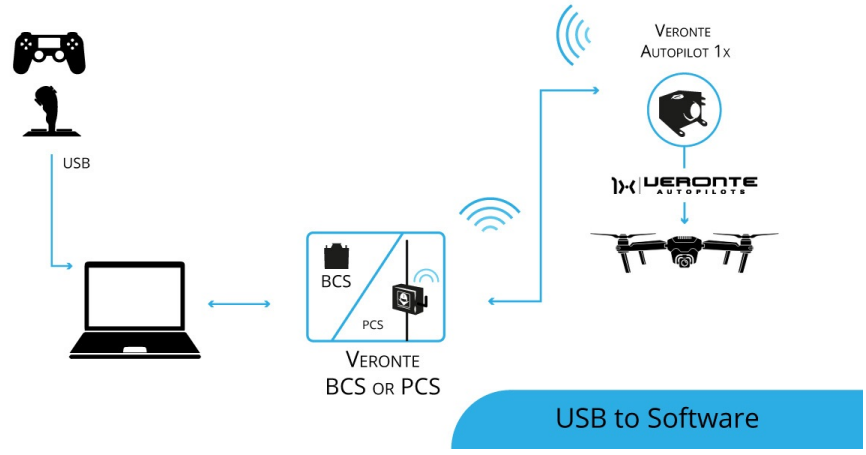
6.4.2 PPM to Air Unit

Allows for a backup manual channel when there is a main channel loss and an emergency manual landing is needed. Recommended for initial developement stages where automatic landing phases are not defined yet.



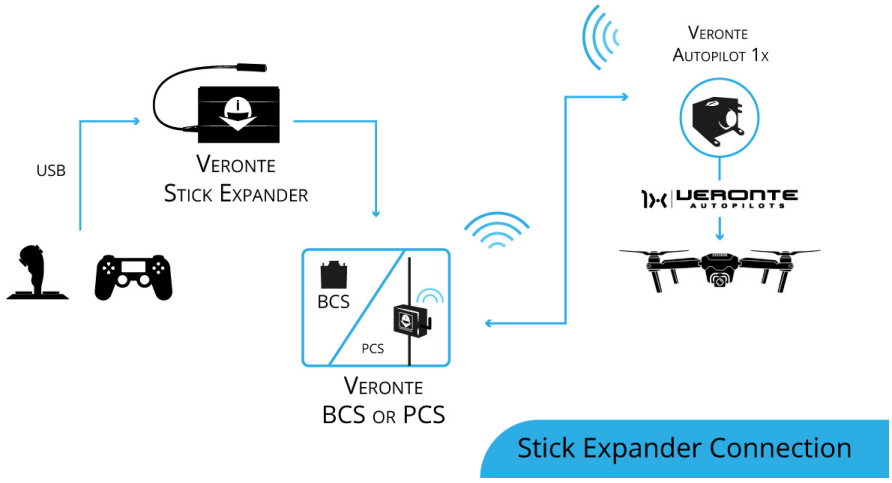
6.4.3 USB to Software

Allows the use of any device that is detected as a remote controller by the operative system



6.4.4 Stick Expander

The **Veronte Stick Expander** allows for the integration of commercial flight station devices and remote controllers. In addition, **Stick Expander** enables the use of USB sticks within the Veronte ecosystem.



6.4.5 Virtual Stick

The Virtual stick feature allows to integrate as a stick controller any device that can interface with **BCS** or Air unit (RS232, RS485, ADC, CAN…) and can provide control reference values.

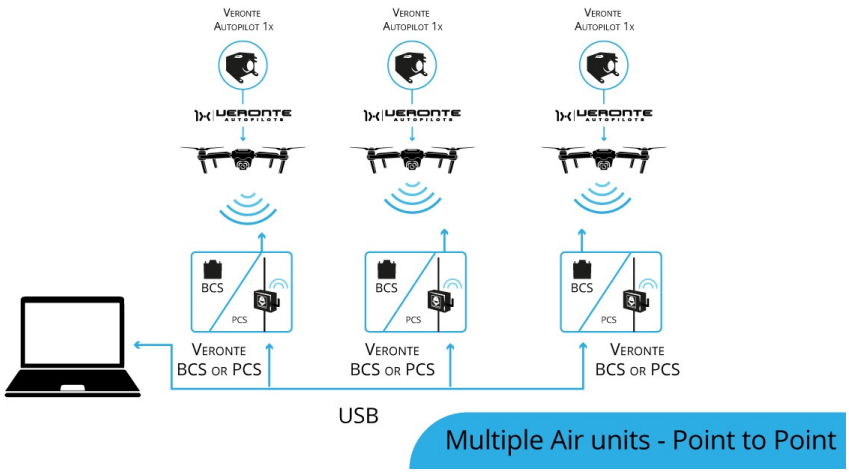
While the configuration is slightly more complex, this feauture allows using a wide variety of devices as flight control interfaces.

6.5 Point to Multipoint Layouts

Due to Veronte's modular configuration, it is possible to integrate several air and ground units within the same network.

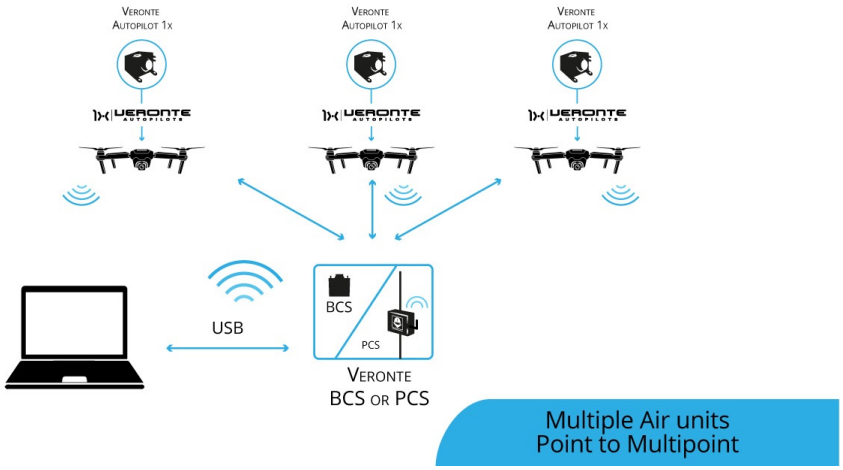
6.5.1 Point to Point

Standard multiplatorm setup.



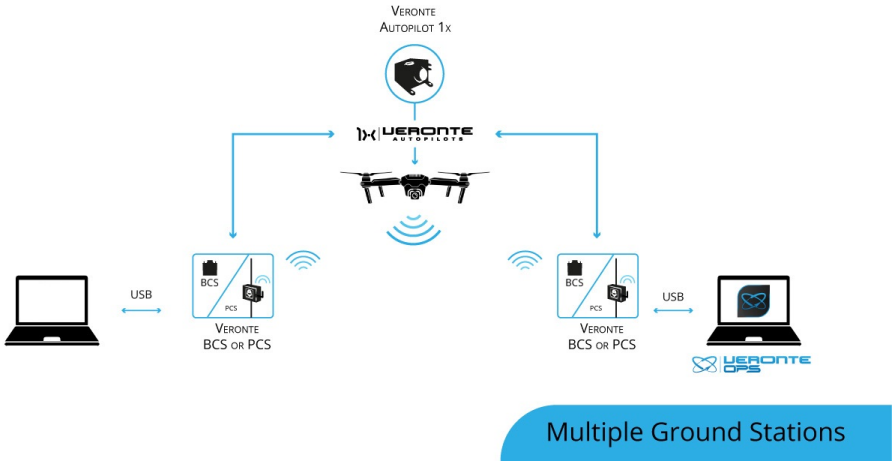
6.5.2 Point to Multipoint with Single Ground Station

Managing several platforms with a single radiolink.



6.5.3 Multipoint to Point with Multiple Ground Stations

For long range operations with several LOS stations.



CHAPTER

SEVEN

MAINTENANCE

7.1 Preventive maintenance

Apart from cleaning, no extra maintenance is required to guarantee the correct operation of the **Veronte Autopilot 1x**.

In order to clean **Veronte Autopilot 1x** properly follow the next recommendations.

- Turn off the device before cleaning.
- Use a clean, soft, damp cloth to clean the unit.
- Do not immerse the unit in water to clean it.

7.2 Software update

To update the software, an additional app is required: Veronte Updater.

Note: The file with the new software version will be uploaded to the FTP folder when requested by the customer.

Warning: Select your version before reading any user manual for software.

CHAPTER

EIGHT

COMPATIBLE DEVICES

Veronte Autopilot 1x can be integrated with any external sensor that shares the communication interface. External sensors can be configured to be considered as part of the sensors fusion. For example, the Magnetometer Honeywell HMR2300-232 can be employed, read the datasheet to obtain more information.

Veronte software is able to detect USB devices such as *joysticks*. The buttons and axis of these devices can be read and configured to send stick information to Veronte Autopilot. In addition, virtual sticks can be defined and configured reading the manual of the corresponding software.

8.1 Servos / Actuators

Company	Comments
	**I/O:** PWM, RS485 full duplex and RS485 half duplex (reduced functions). **Type:** simplex, redundant and OPV.
	**I/O:** PWM and RS485 full duplex. **Type:** simplex and redundant.
	**I/O:** PWM and CAN-BUS. **Type:** lineal actuator and servo.
	**I/O:** PWM, RS232, RS485 and CAN-bus
	**I/O:** PWM, RS232, RS485 and CAN-bus

Other companies
  

8.2 Power Management Units

Company	Comments
EMBENTION	**Veronte product:** BEC
VISION AIR TRONICS	

8.3 Motor Controllers / ESC

Company	Comments
EMBENTION	**Veronte products:** MC110 MC24 MC01
T-MOTOR THE SAFEST PROPULSION SYSTEM	**I/O:** PWM
Currawong ENGINEERING	**I/O:** CAN-bus

Other companies	Comments
Hacker Brushless Motors Industrial Solutions KDE Direct AXi	**I/O:** PWM, RS232, RS485 and CAN-bus

8.4 Altimeters

Company	Comments
JINSTEIN	**I/O:** UD-1 (CAN-bus)
HEXAGON	**I/O:** CAN-bus
lightware optoelectronics	**I/O:** I2C and CAN-bus
GARMIN	**I2C:** PWM **Product:** LIDAR-Lite v3

8.5 Sensors

Company	Comments
EMBENTION	**Magnetometer:** MEX
Honeywell Sensing and Control	**Magnetometer:** HMR2300-232
VECTORNAV Embedded Navigation Solutions	**IMU:** VN-300
MGL AVIONICS	**OAT 428:** *How to use it with Veronte Autopilot 1x*
ublox	**GPS:** ZED-F9P-02B
swiss-airdata www.swiss-airdata.com	
NovAtel	
DYNON	
AEROPROBE Revolutionary Technology	

8.6 Engines

8.7 Jet Engines

8.8 ADS-B

Company	Comments
uAvionix	**Products:** Ping20S (ADS-B Out) Ping1090 (ADS-B IN/OUT)
Sagetech AVIONICS	All products of the following families: MX XP

8.9 Precision Landings

Company	Comments
Internest Autonomous flights in complex environments	LOLAS landing system

8.10 Cameras

Company	Comments
EMBENTION	**Products:** Gimbal 10z Gimbal 30z
OCTOPUS ISR SYSTEMS	
merio UAV PAYLOAD SYSTEMS	
AVT ASCENT VISION TECHNOLOGIES	
NextVision STABILIZED SYSTEMS LTD	
DAEDALEAN APPLIED INTELLIGENCE	Autopilot 1x reads identified objects by their cameras

8.11 LOS Communications

Company	Comments
EMBENTION	**Antenna:** Tracker T28
microhard	**I/O:** RS232 communication tunnel, read the *Microhard integration example*
DTC	**I/O:** RS232 communication tunnel
SiLVUS TECHNOLOGIES	**I/O:** RS232 communication tunnel **Streamcaster radio:** 4200E, read the *Silvus integration example* to know how to use it with Autopilot Veronte 1x
DIGI	**Radio:** To know how to configure Digi radios, read its user guide

8.12 BLOS Communications

Company	Comments
SKYTRAC	**Broadband UAV satcom:** IMS-350 **Midband UAV Datalink and GPS System:** DLS-100
Ground Control	**Satellite communications:** RockBLOCK
satlink	
ATMOSPHERE	Requires Veronte COM

8.13 Control Stations

Company	Comments
EMBENTION	**Products:** MCS PCS

8.14 Transmitters

Company	Comments
Futaba	**Products:** 8J/10J/12K/14SG with 8 channels 12K/14SG with 12 channels T18SZ with 8 channels

8.15 Expansion Modules

Company	Comments
EMBENTION	**Products:** Stick Expander CEX MEX

CHAPTER

NINE

INTEGRATION EXAMPLES

9.1 Connection Examples

Ground station examples

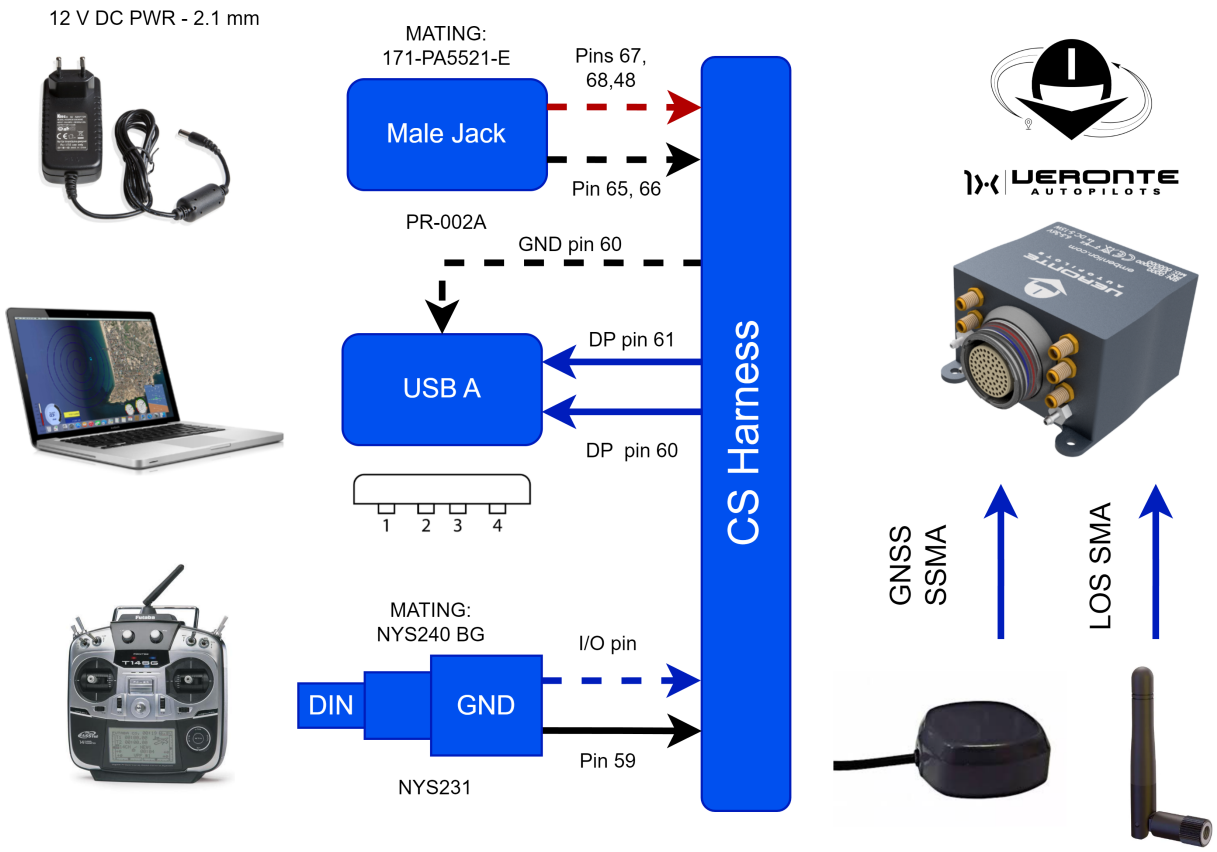


Fig. 1: **Basic Autopilot 1x Ground Station**

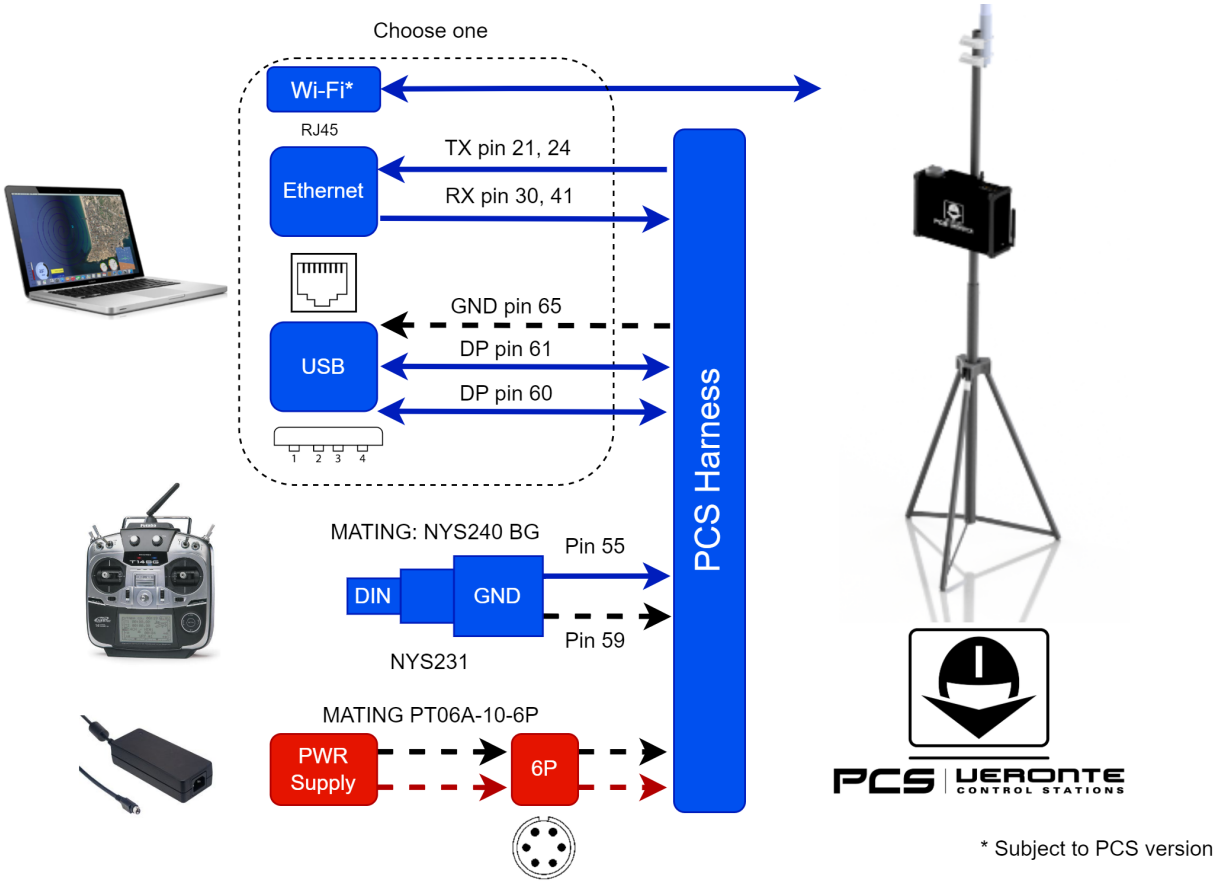


Fig. 2: **Autopilot 1x PCS Ground Station**

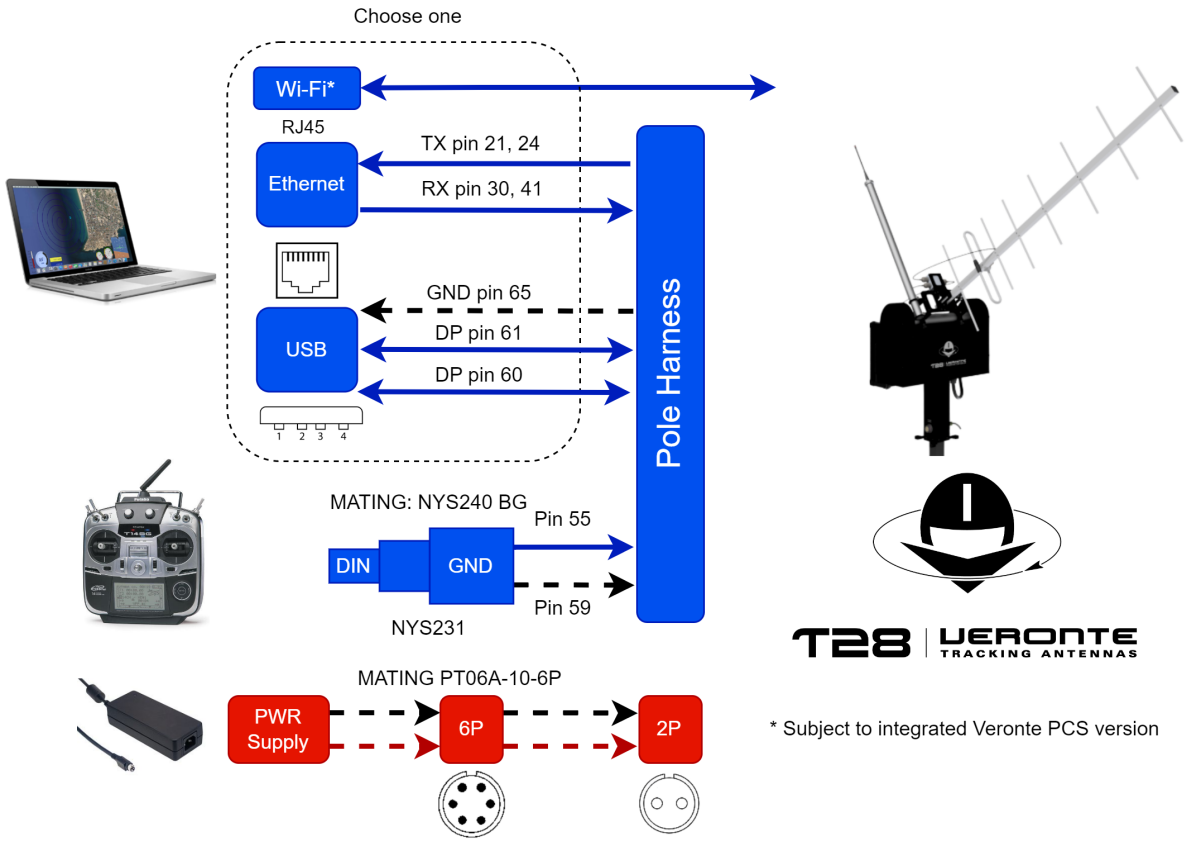


Fig. 3: **Autopilot 1x Tracker Ground Station**

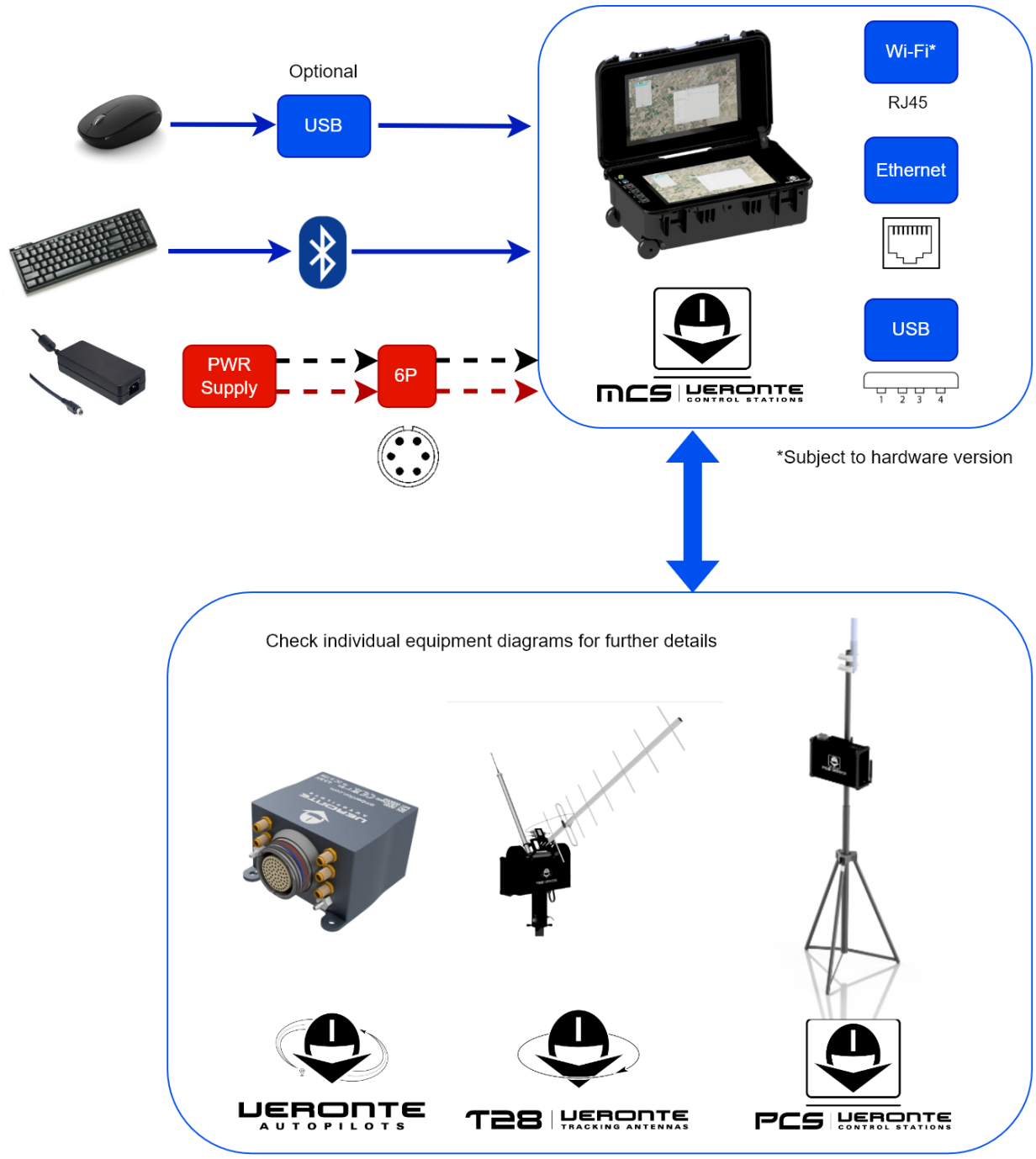


Fig. 4: **Autopilot 1x MCS Ground Station**

Warning: Veronte Autopilot 1x equipment harnesses have specific pin layouts. Only use their own matting connectors, do NOT mix harnesses: misuse can lead to destruction.

Aircraft examples

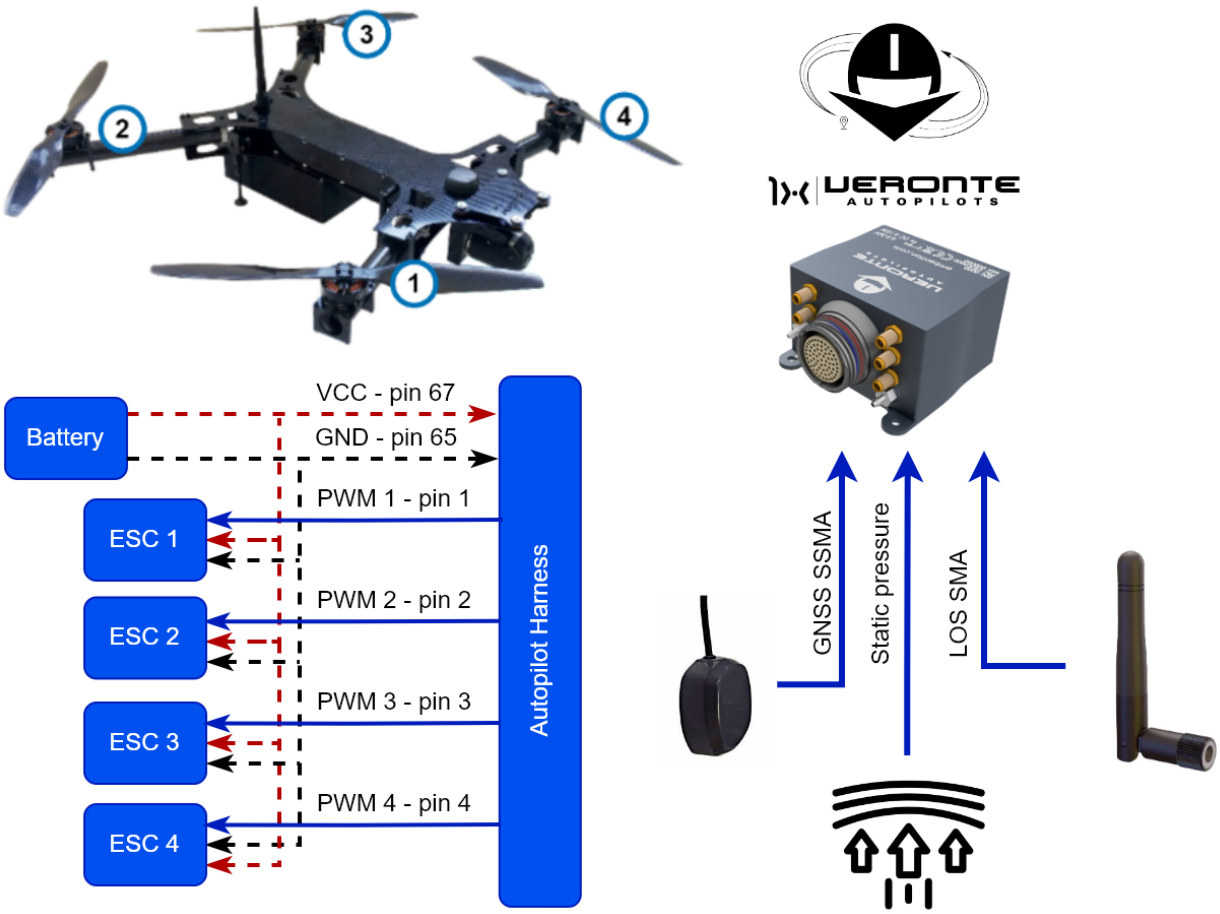


Fig. 5: **Multicopter**

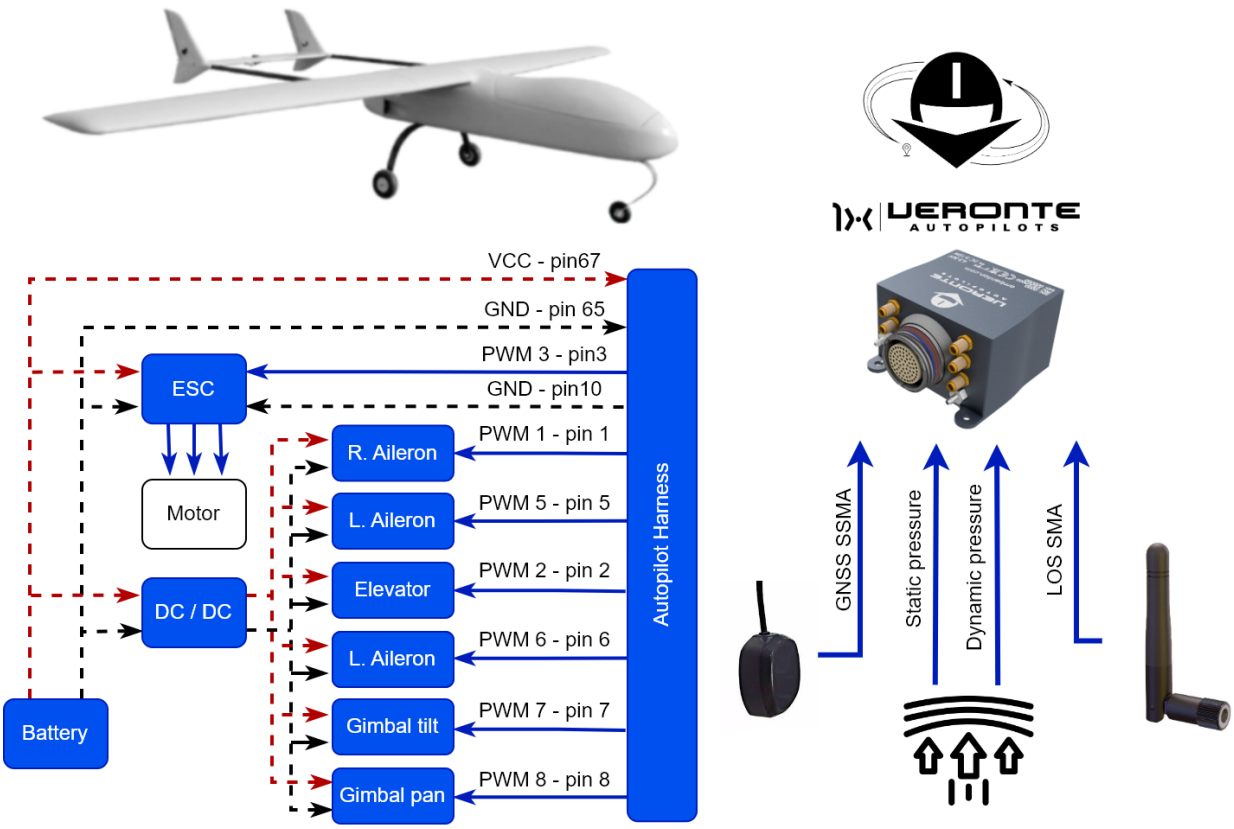


Fig. 6: **Fixed Wing Airplane**

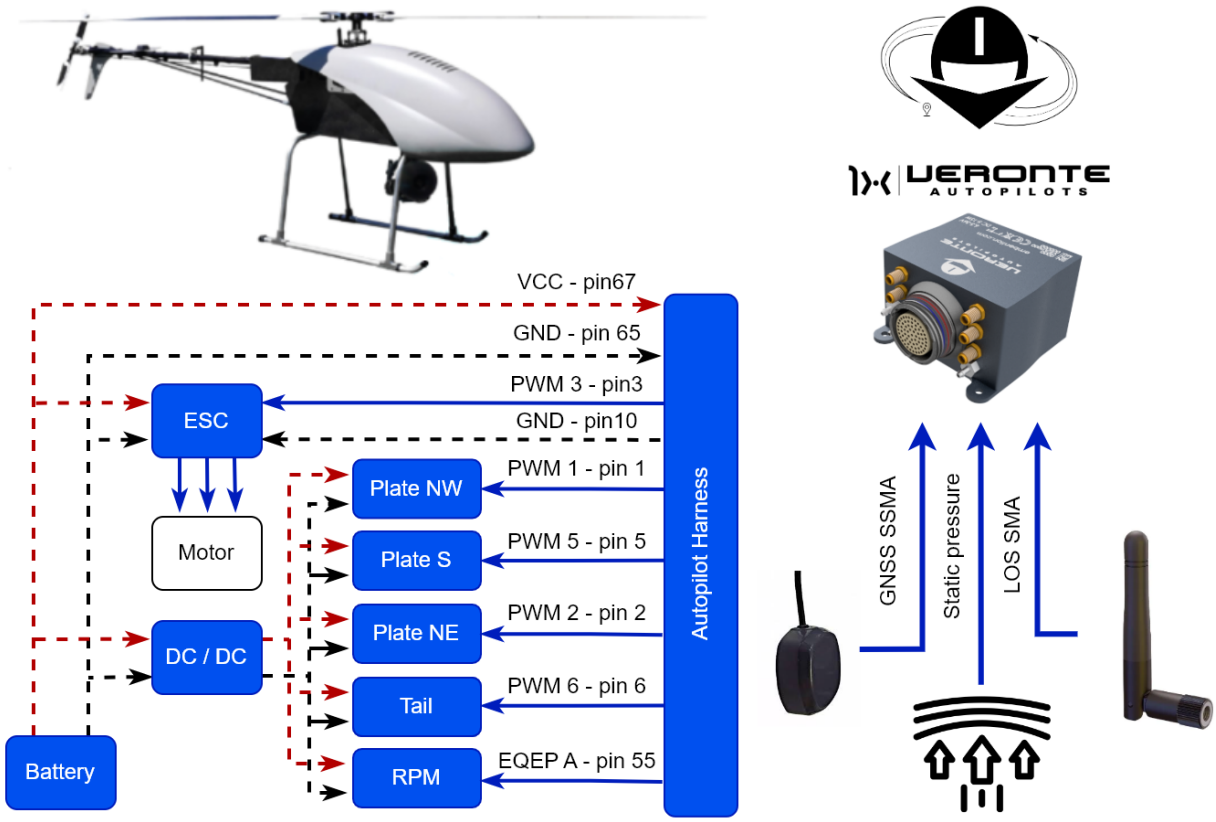


Fig. 7: **Helicopter**

9.2 Radios

9.2.1 Microhard internal radio

Internal Microhard radios can stablish communication between Veronte Autopilots.

The necessary configuration of Microhard radios for proper communication between them and autopilots 1x is described in the Integration examples -> Microhard internal radio section of the 1x PDI Builder manual.

9.2.2 DTC (Domo Tactical) radio (SOL8SDR-C model)

9.2.2.1 System Layout

It is possible to operate DTC radios in two different ways, with or without amplifiers.

- **DTC**

  The following image shows the standard connection between DTC radios and Autopilot 1x for operation:

Fig. 8: **DTC radios and Autopilot 1x operation**

- **DTC + Amplifier**

Note: Amplifier information: **AMPD5W** model, 5W Linear RF Power Amplifier.

The following image shows the standard connection between DTC radios, amplifiers and Autopilot 1x for operation:

Fig. 9: **DTC + amplifier radios and 1x operation**

9.2.2.2 Hardware Installation

Depending on the action to be taken, different hardware installations are possible:

1. To **configure a DTC radio** it is required to carry out the installation of the ethernet and power connection:

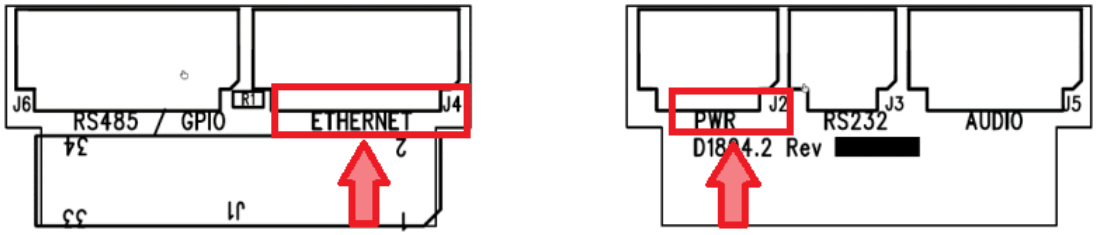


Fig. 10: **DTC D1804 Gecko breakout PCB**

- **Ethernet**

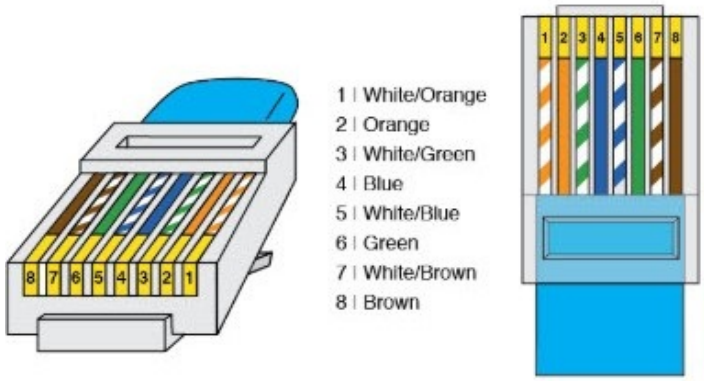


Fig. 11: **RJ45 pinout T-568B**

J4 (Ethernet) - D1804 Gecko breakout PCB		RJ45 Connector (T-568B)		
PIN N°	Signal	PIN N°	Signal	Color
1	Ethernet MDIP0	1	TX+	Orange-White
2	Ethernet MDIN0	2	TX-	Orange
3	Ethernet MDIP1	3	RX+	Green-White
4	Ethernet MDIN1	6	RX-	Green

- **Power supply**

Fig. 12: **Female DC Power Jack connector**

J2 (PWR) - D1804 Gecko breakout PCB		Power connector
PIN N°	Signal	Signal
1	VIN	Power +
2	VIN	
3	GND	Power -
4	GND	

The full connection should look like this:

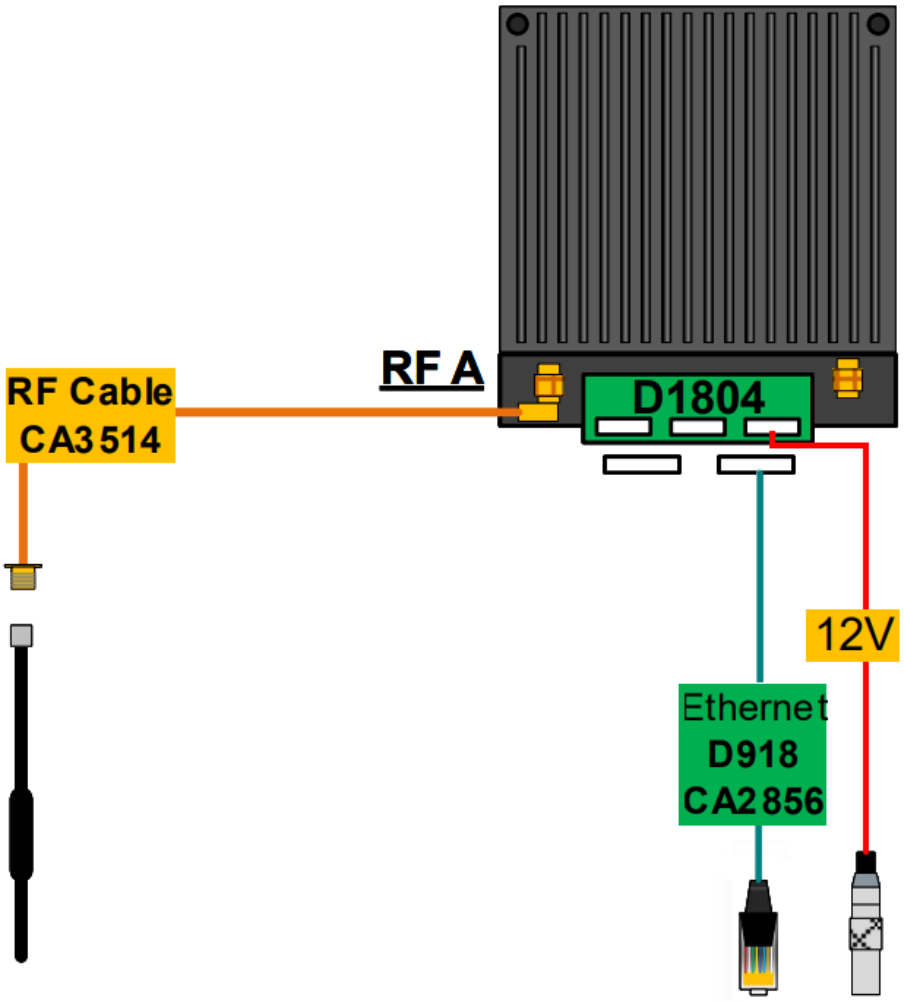


Fig. 13: **DTC connection - Configuration**

2. To **configure a DTC + amplifier radio** it is required to carry out the installation of the ethernet, power and amplifier connection:

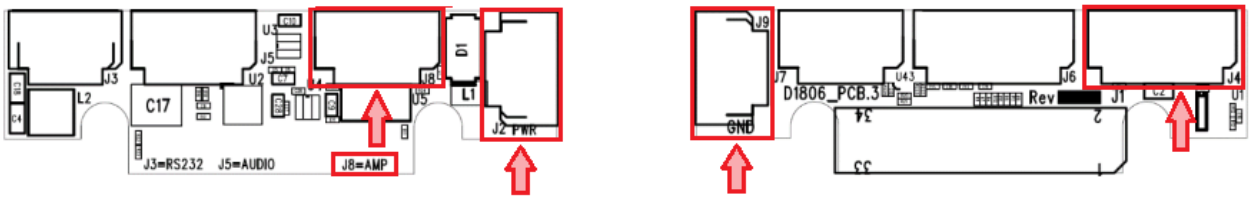


Fig. 14: **DTC D1806 Gecko active breakout PCB**

- **Ethernet**

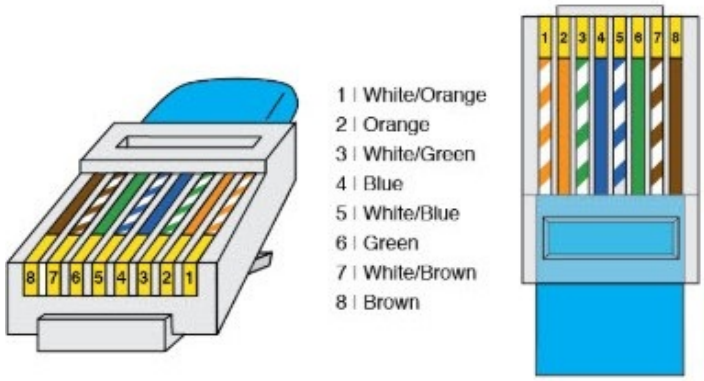


Fig. 15: **RJ45 pinout T-568B**

J4 (Ethernet) - D1806 Gecko active breakout PCB		RJ45 Connector (T-568B)		
PIN N°	Signal	PIN N°	Signal	Color
1	Ethernet MDIP0	1	TX+	Orange-White
2	Ethernet MDIN0	2	TX-	Orange
3	Ethernet MDIP1	3	RX+	Green-White
4	Ethernet MDIN1	6	RX-	Green

- **Power supply**

Fig. 16: **Female DC Power Jack connector**

J2 (PWR) - D1806 Gecko active breakout PCB		Power connector
PIN N°	Signal	Signal
1	VIN	Power +
2	VIN	
3	VIN	
4	VIN	
5	VIN	
6	VIN	

J9 (GND) - D1806 Gecko active breakout PCB		Power connector
PIN N°	Signal	Signal
1	GND	Power -
2	GND	
3	GND	
4	GND	
5	GND	
6	GND	

- **Amplifier**

Fig. 17: **Amplifier AMPD5W**

J8 (AMP) - D1806 Gecko active breakout PCB		AMPD5W Connector	
PIN N°	Signal	PIN N°	Signal
1	5V_SDA	6	5V_SDA
2	GND	3	GND
4	5V_SCL	5	5V_SCL
7	PA_TDD	7	PA_TDD

J2 (PWR) - D1806 Gecko active breakout PCB		AMPD5W Connector	
PIN N°	Signal	PIN N°	Signal
1	VIN	1 & 2	Power +
2	VIN		
3	VIN		
4	VIN		
5	VIN		
6	VIN		

J9 (GND) - D1806 Gecko active breakout PCB		AMPD5W Connector	
PIN N°	Signal	PIN N°	Signal
1	GND	3 & 4	Power -
2	GND		
3	GND		
4	GND		
5	GND		
6	GND		

The full connection should look like this:

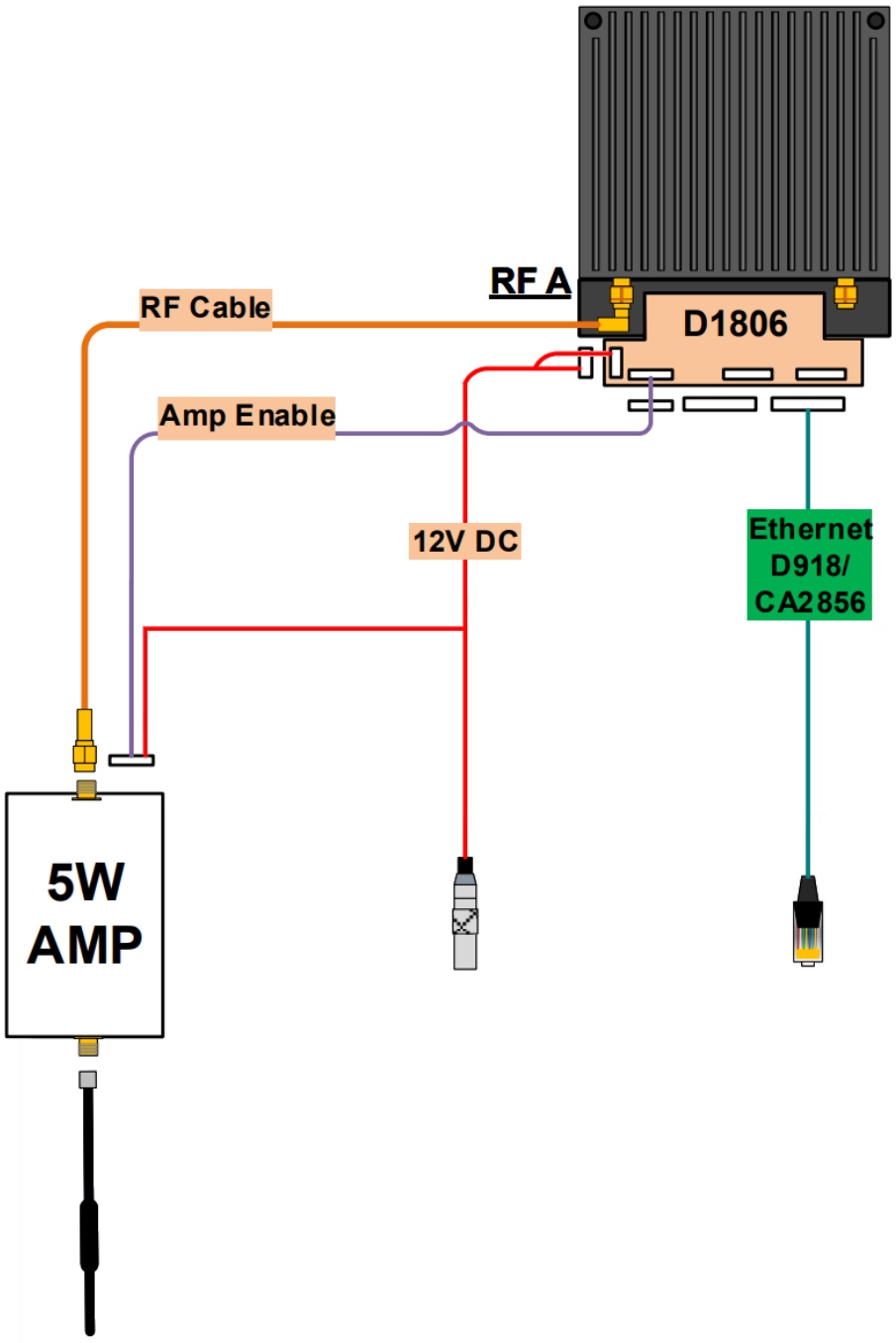


Fig. 18: **DTC + amplifier connection - Configuration**

3. To **connect a DTC radio to a Veronte Autopilot 1x** the following installation must be carried out:

   As, the connection of a DTC radio to a Veronte Autopilot 1x must be made via **RS-232**, the connection will be the same as in the configuration case (1), but adding the wiring to RS-232 port.

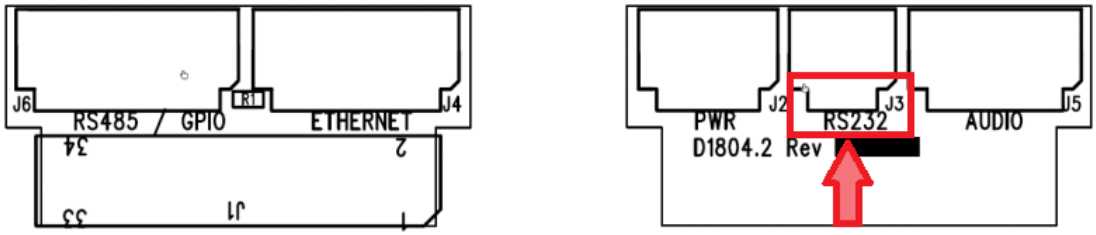


Fig. 19: **DTC D1804 Gecko breakout PCB - J3 (RS232)**

This RS-232 should be connected to the RS-232 of Autopilot 1x Harness.

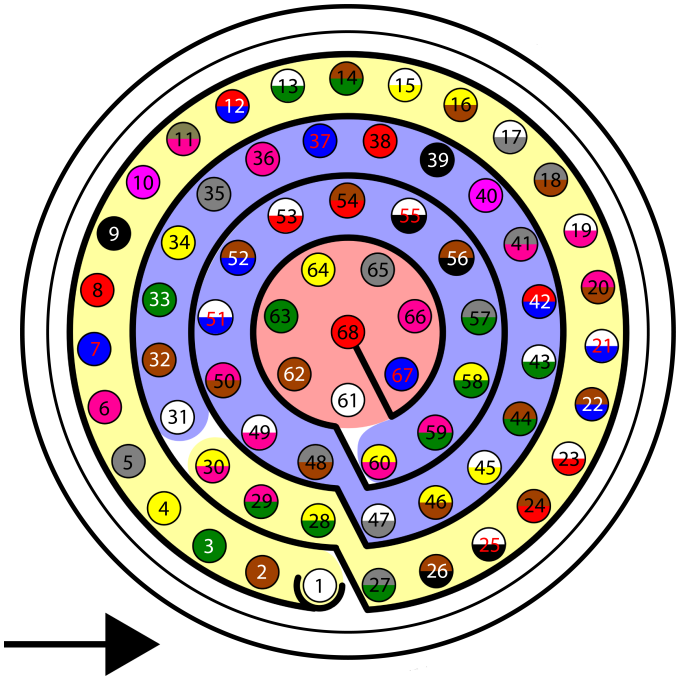


Fig. 20: **Harness plug**

J3 (RS232) - D1804 Gecko breakout PCB		Harness - Autopilot 1x		
PIN N°	Signal	PIN N°	Signal	Color
2	RS232 RX	19	RS 232 TX	White-Pink
1	RS232 TX	20	RS 232 RX	Pink-Brown
3	GND	21	GND	White-Blue

The full connection should look like this:

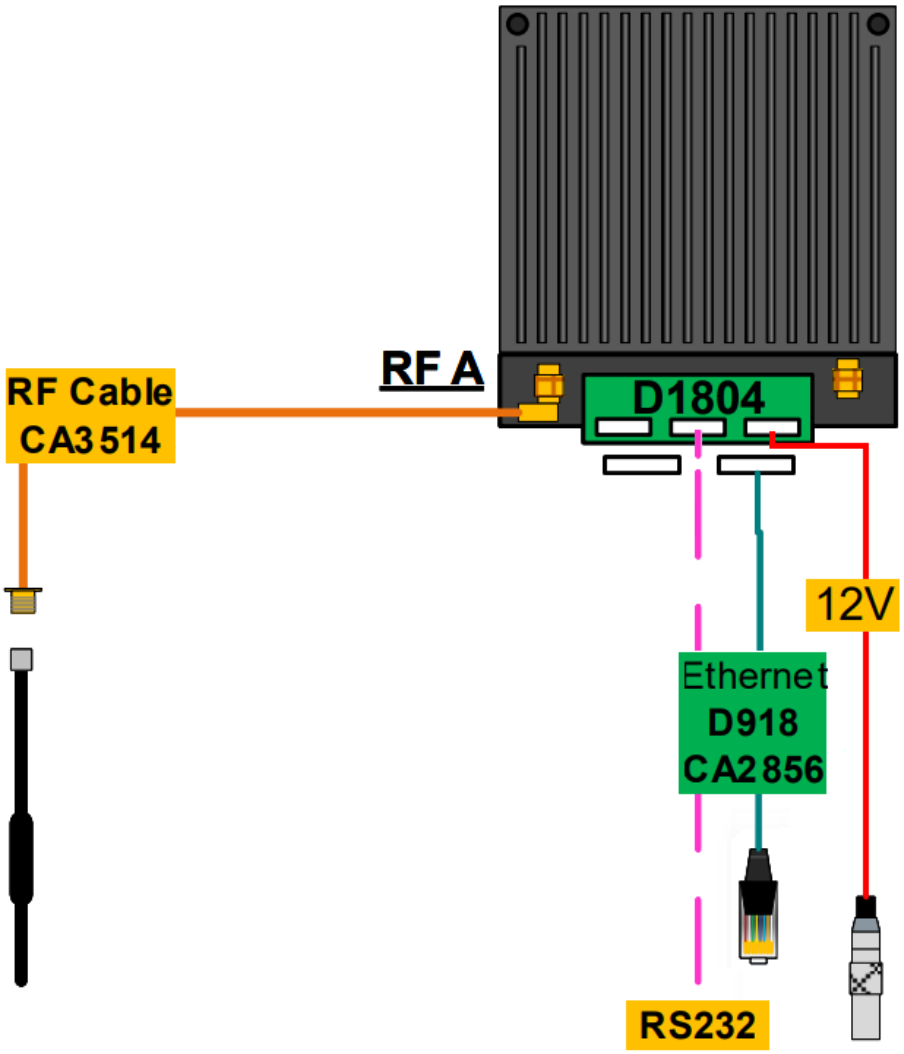


Fig. 21: **DTC connection - Veronte Autopilot 1x**

4. To **connect a DTC + amplifier radio to a Veronte Autopilot 1x** the following installation must be carried out:

   As, the connection of a DTC radio to a Veronte Autopilot 1x must be made via **RS-232**, the connection will be the same as in the configuration case (2), but adding the wiring to RS-232 port.

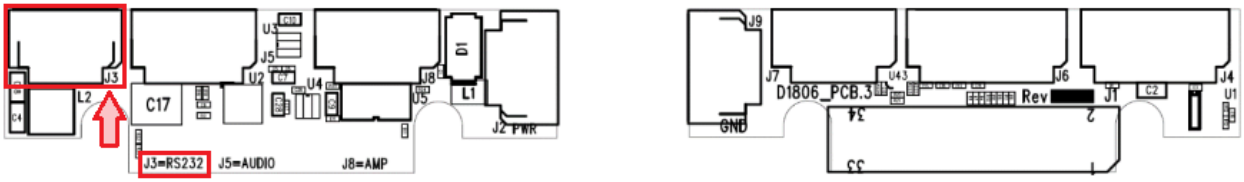


Fig. 22: **DTC D1806 Gecko active breakout PCB - J3 (RS232)**

This RS-232 should be connected to the RS-232 of Autopilot 1x Harness.

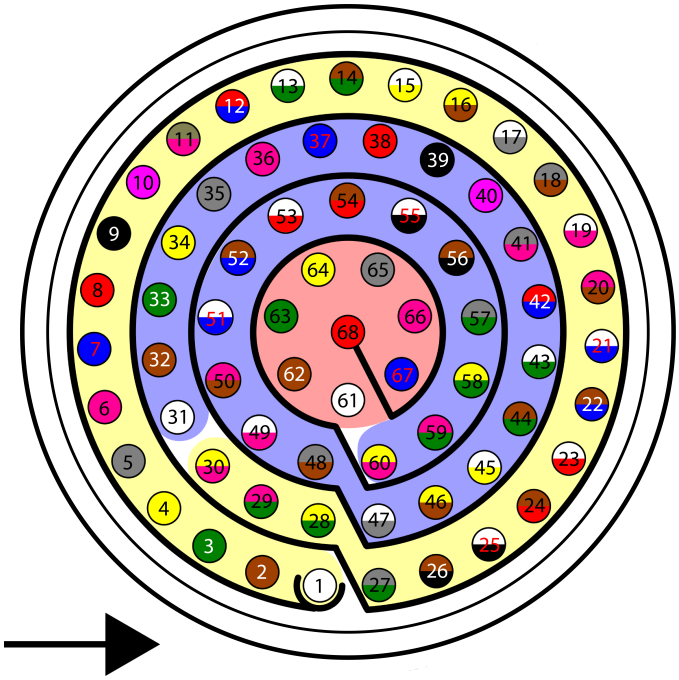


Fig. 23: **Harness plug**

J3 (RS232)- D1806 Gecko active breakout PCB		Harness - Autopilot 1x		
PIN N°	Signal	PIN N°	Signal	Color
2	RS232 RX	19	RS 232 TX	White-Pink
1	RS232 TX	20	RS 232 RX	Pink-Brown
3	GND	21	GND	White-Blue

The full connection should look like this:

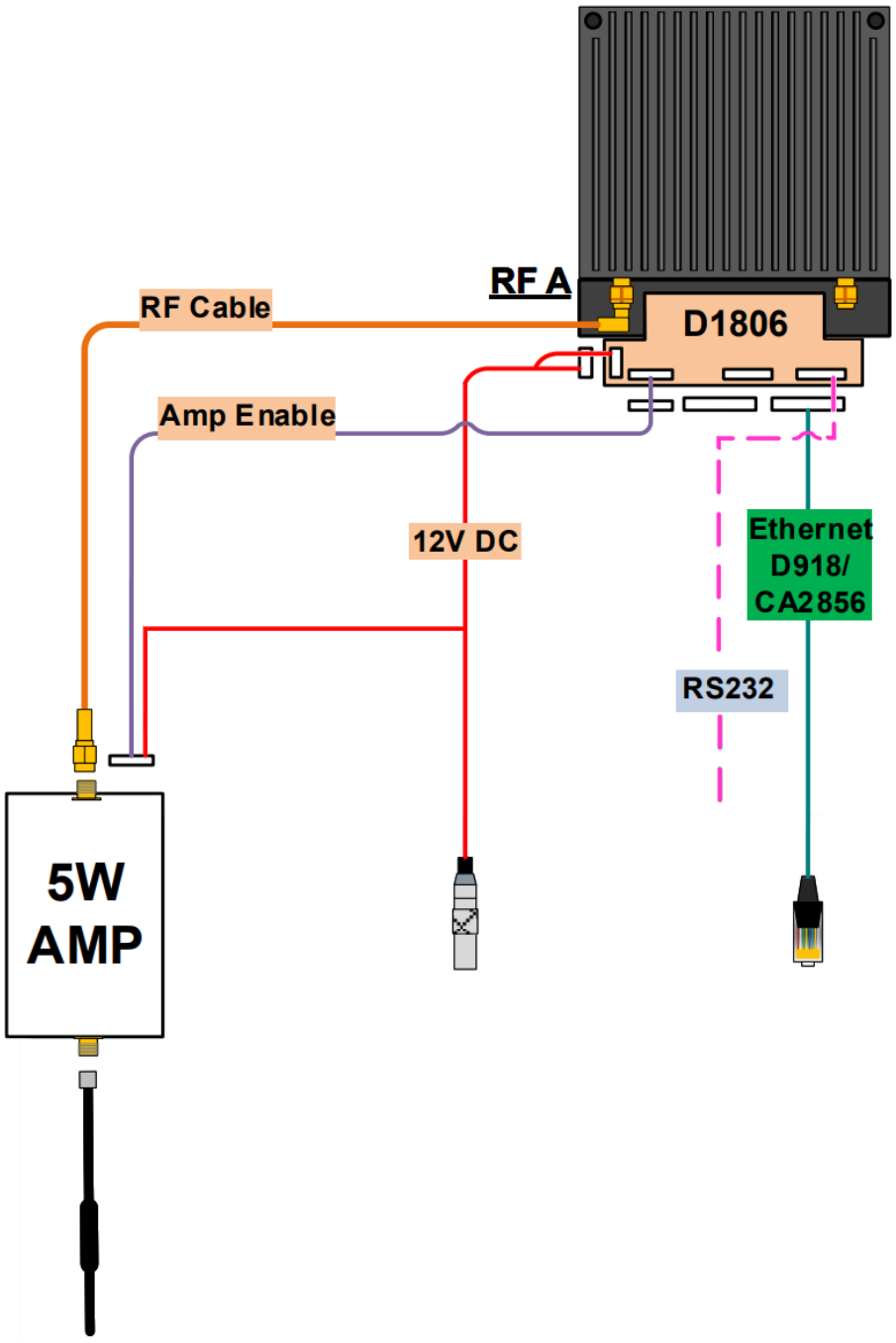


Fig. 24: **DTC + amplifier connection - Veronte Autopilot 1x**

Caution: It is also possible to **calibrate** the **power output** of DTC radios and DTC + amplifier radios.

However, the radios are shipped with a factory calibration, it is **strongly recommended to not modify this calibration**. If the user wishes to modify it, please contact support@embention.com.

9.2.2.3 DTC radio configuration

- **First Steps**

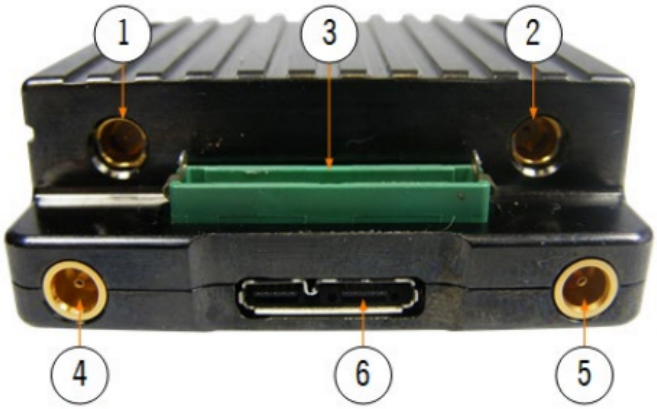


Fig. 25: **DTC ports**

– **DTC without amplifier**

1. Connect to (1) an SMP to SMA RF cable (this is the default transmit output).
2. Connect this SMA RF cable to a 2.4 GHz antenna.
3. Connect to (3) the **D1804 Gecko breakout PCB** supplied with the unit.
4. Connect J2 (**PWR**) of the **D1804 PCB** to 12V power.
5. In order to access the web browser control application, connect J4 (**ETHERNET**) of the **D1804 PCB** to a PC or network Ethernet port via CA2856 and D918.

Note: The connections should look like this:

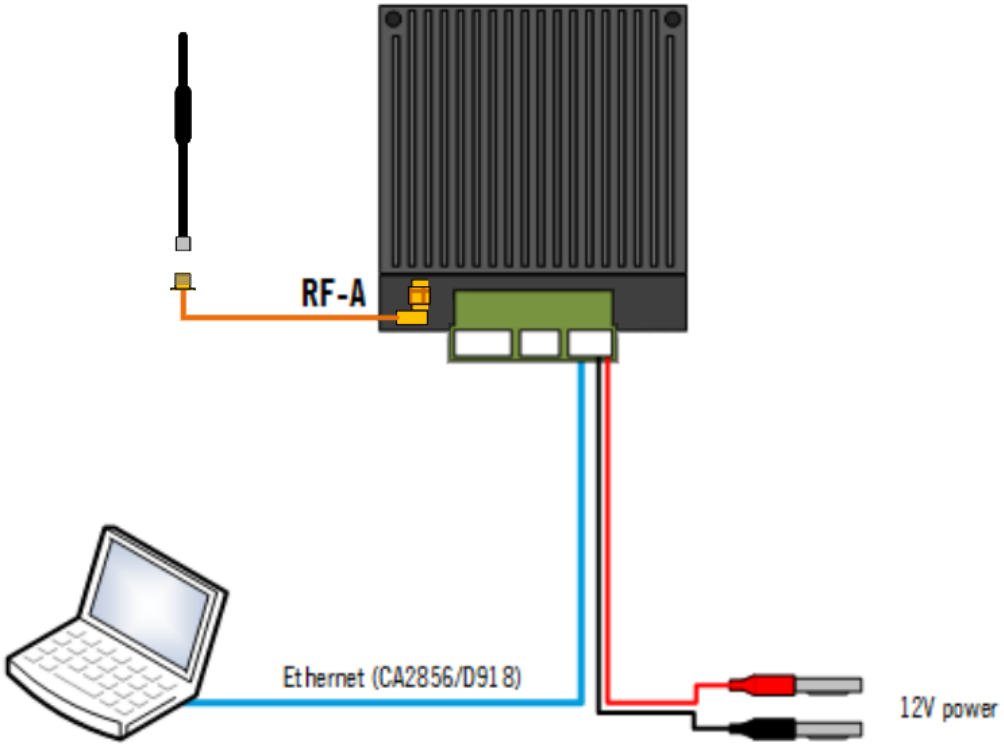


Fig. 26: **First Steps connection**

6. Make sure computer is set to static IP address on same subnet as radio. The following substeps clarify how to set the IP adress:
   1. Open network and sharing menu and click **Change adapter settings**.

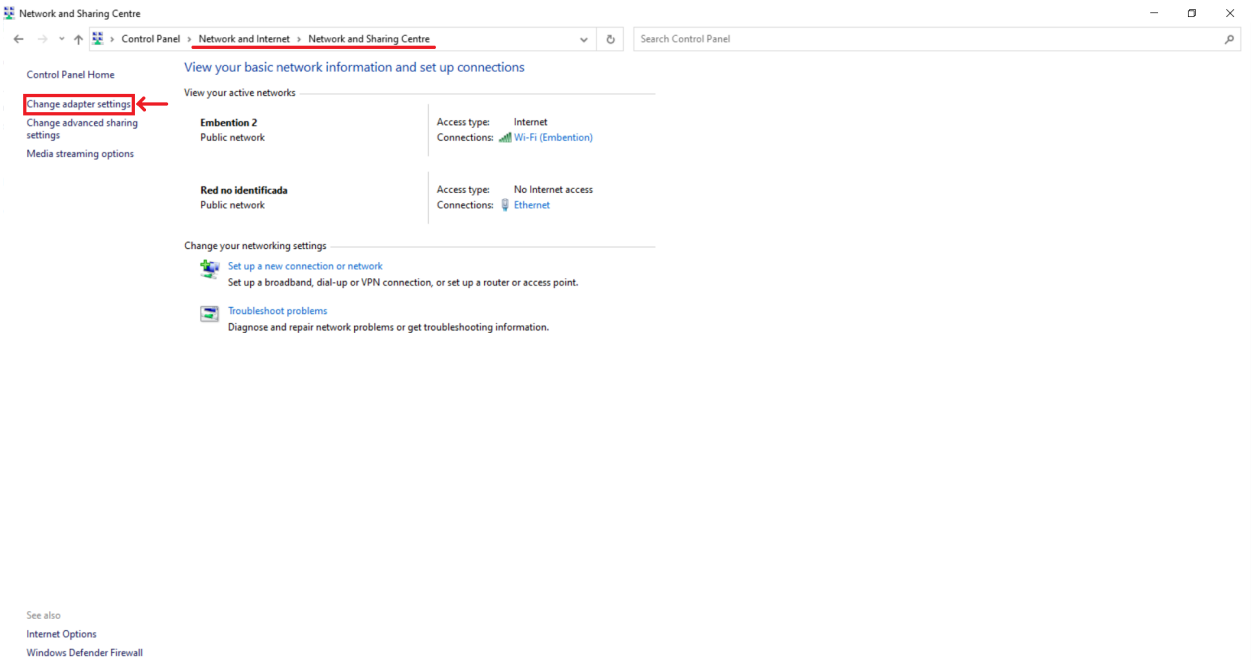


Fig. 27: **Ethernet connection 1**

2. Select **Local Area Connection**, right click, and select **Properties**.

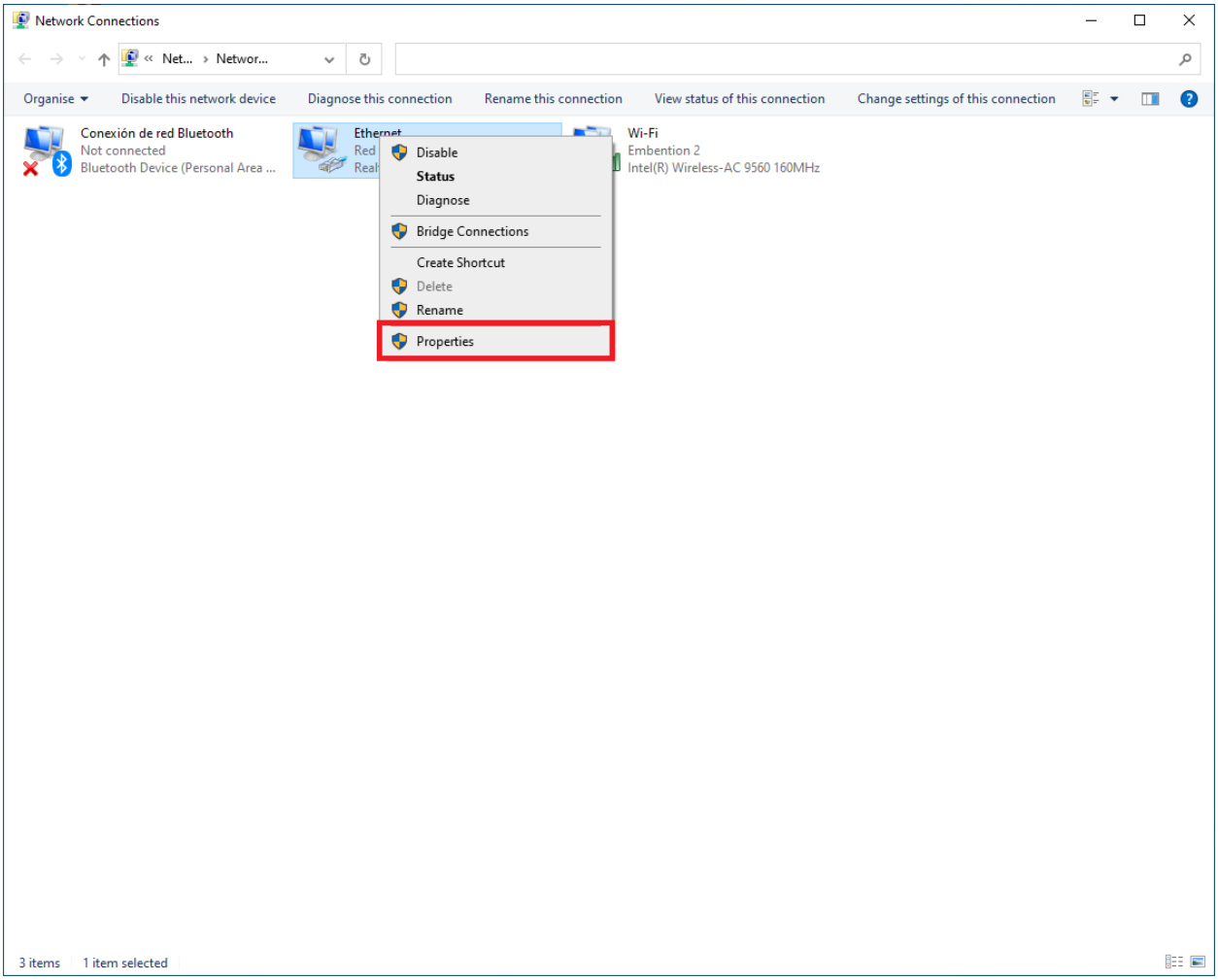


Fig. 28: **Ethernet connection 2**

3. Select **IPv4** and click **Properties**.

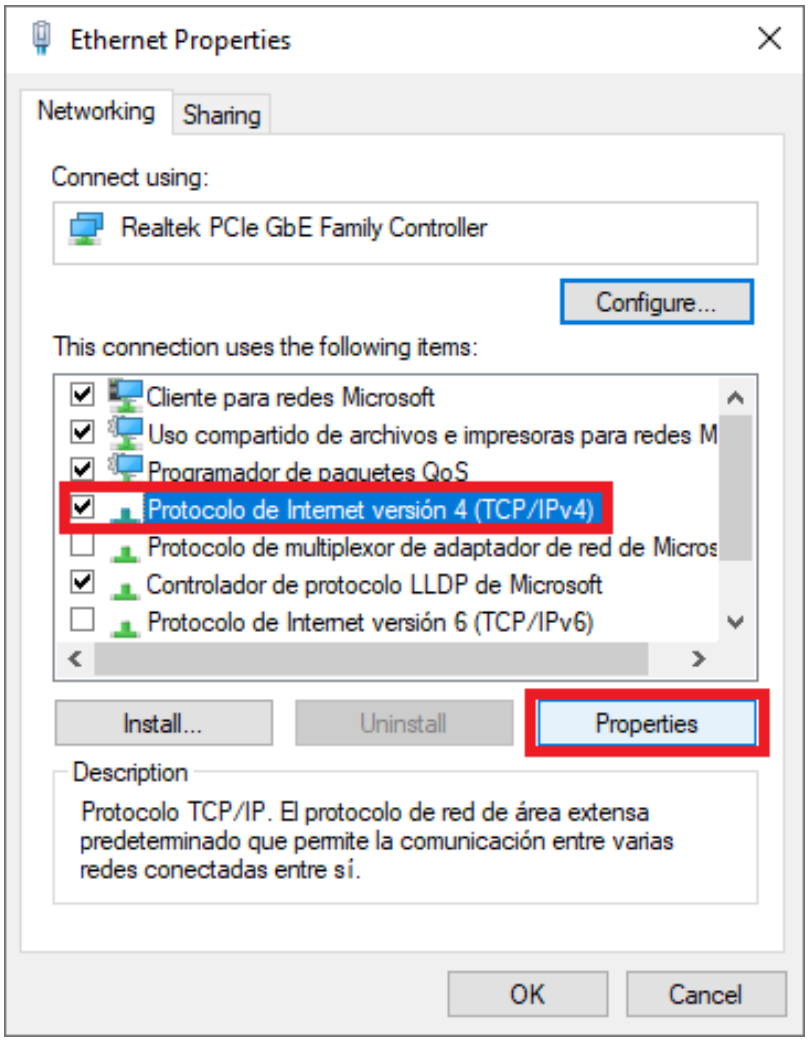


Fig. 29: **Ethernet connection 3**

4. Set **IP address** to 192.168.8.YY (e.g. if the IP of the radio is 192.168.8.95, set the IP 192.168.8.92) and **Subnet mask** to 255.255.255.0. Click **OK**.

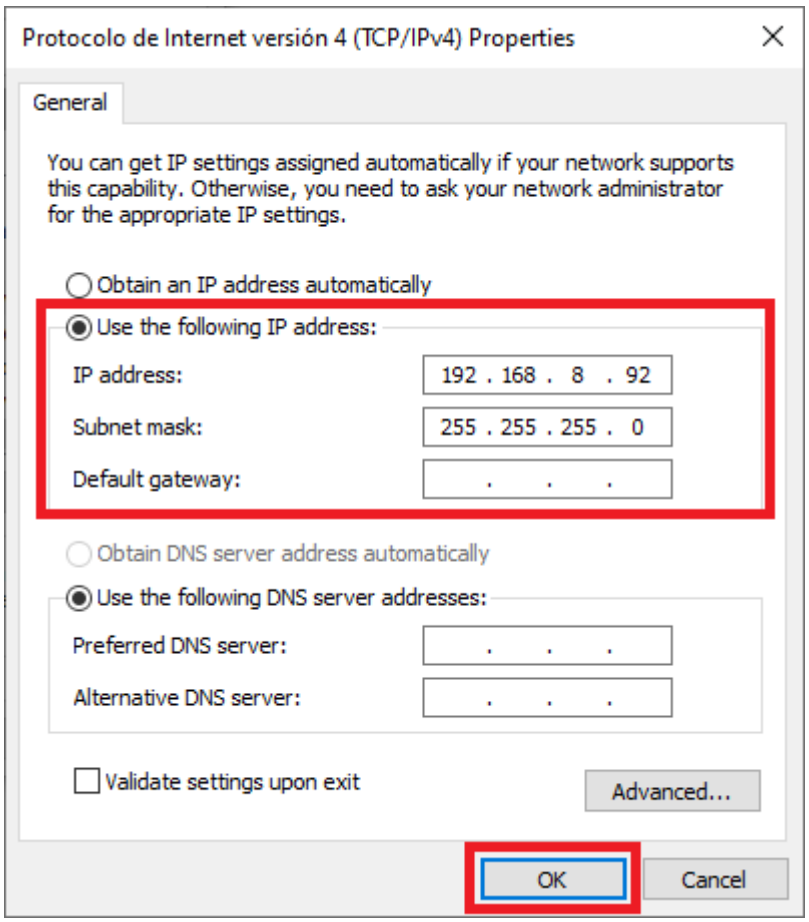


Fig. 30: **Ethernet connection 4**

7. First, it is necessary to have the '**Domo Node Finder**' software installed.
8. Open **Domo Node Finder** and the connected radios will appear here as *SOL8SDR*.

   By default, *0.0.0.0* is the IP address of the radio:

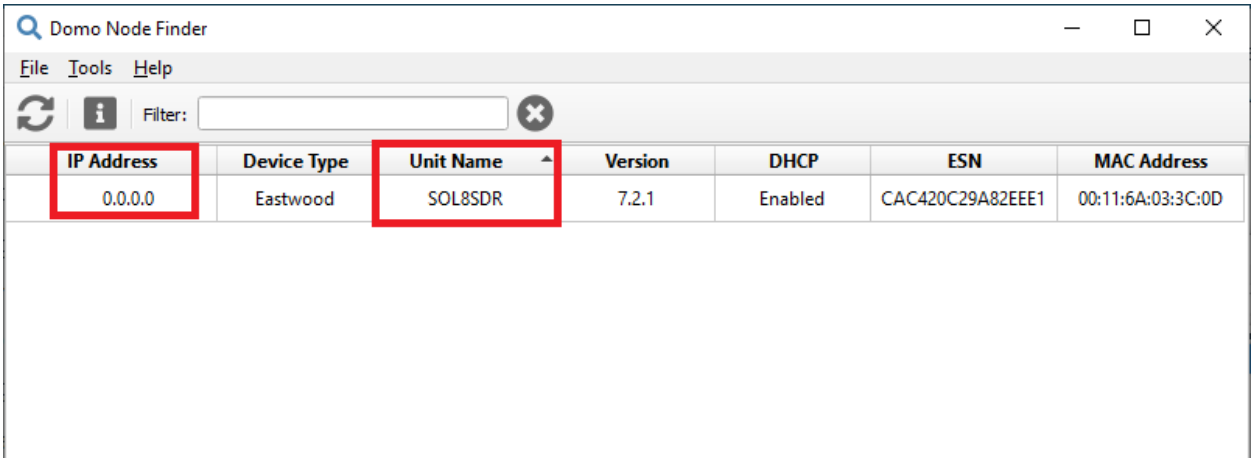


Fig. 31: **Domo Node Finder - Default IP address**

9. To configure the IP address, **right-click** the IP address and select **Configure Network** to disable the DHCP setting and set the following **static IP address**:

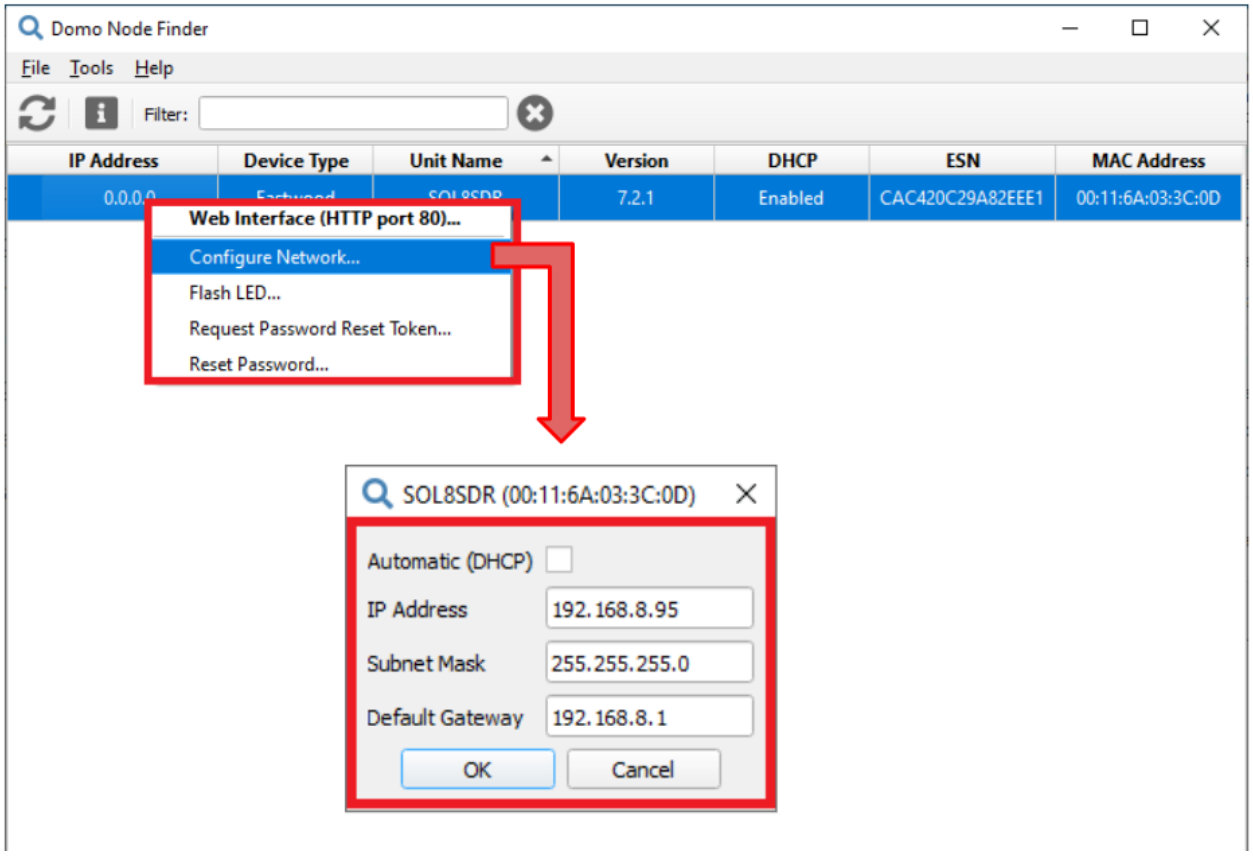


Fig. 32: **Domo Node Finder - IP address configuration**

To confirm the change, click the  icon to update the IP address.

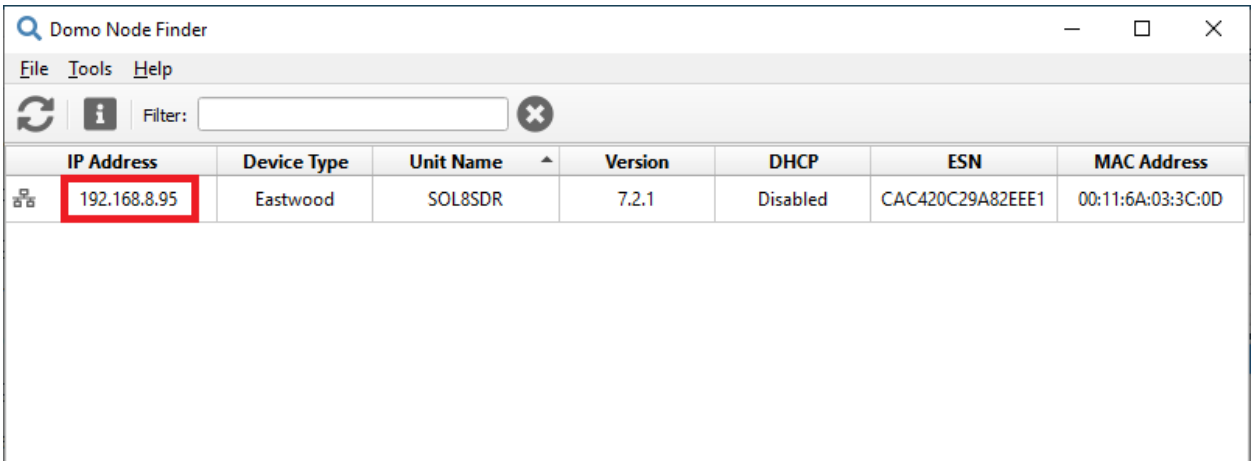


Fig. 33: **Domo Node Finder - Configured IP address**

Note: This IP address, **192.168.8.95**, is related to the radio linked to the **BCS unit**. For the radio linked to the **air unit**, the IP address should be **192.168.8.96**.

10. To open the DTC web browser control application, users can **right-click** the **IP address** and select **WEB Interface (HTTP port 80)**, **double-click** on the **IP address** or enter the IP address of the SOL8SDR-C on the address bar of a web browser.

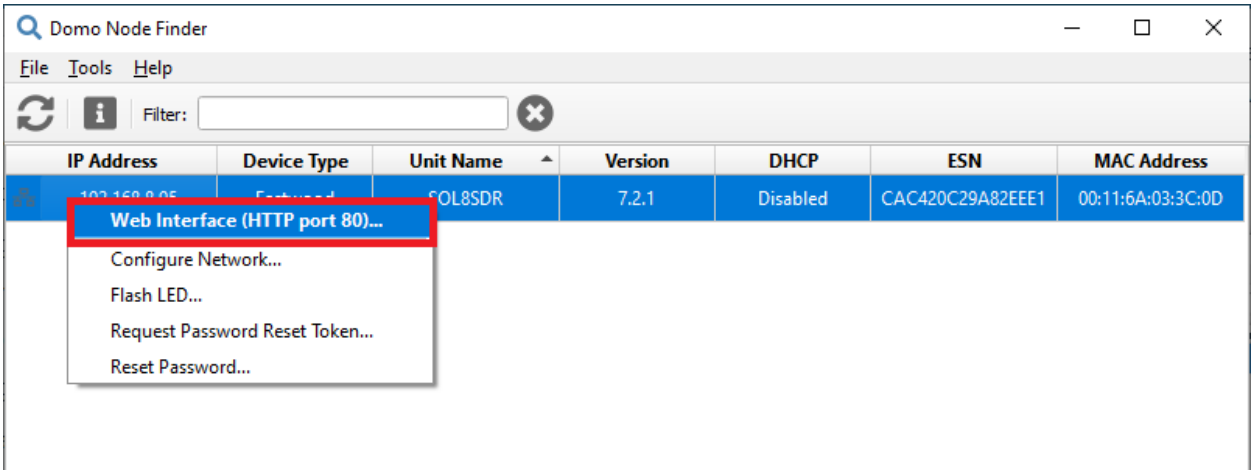


Fig. 34: **Domo Node Finder - Open Web Browser Application**

Note: Although the application should work with any web browser, DTC recommends the use of Internet Explorer, Google Chrome or Firefox.

11. An authentication required dialogue box will open. Leave the **Username blank** and enter the **Password** as **Eastwood**.

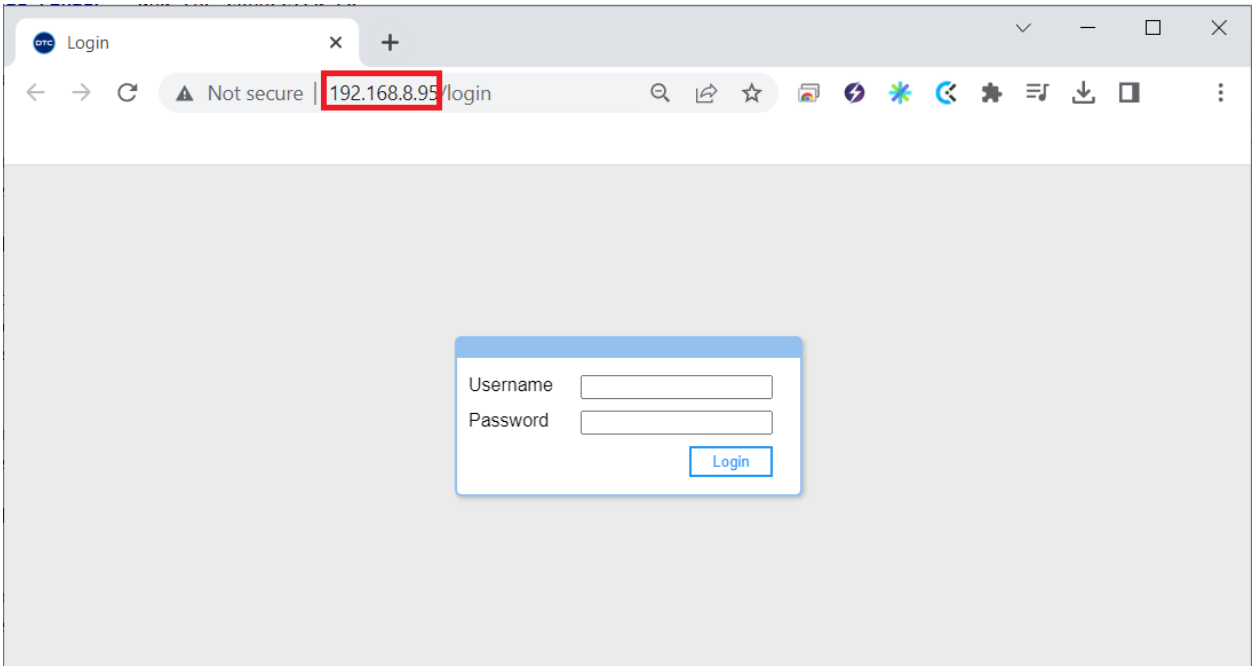


Fig. 35: **Domo Node Finder - Open Web Browser Application**

12. Click **Login** and the web browser control application will open.

– **DTC with amplifier**

1. Connect to (1) an SMP to SMA RF cable (this is the default transmit output).
2. Connect this **SMA RF cable** to the amplifier **RF IN port**.
3. Connect a 2.4 GHz **antenna** to the amplifier **RF OUT port**.
4. Connect to (3) the **D1806 Gecko active breakout PCB**.
5. Connect J4 (**ETHERNET**) of the **D1806 PCB** to a PC or network Ethernet port via CA2856 and D918.
6. Connect J2 (**PWR**) and J9 (**GND**) of the **D1806 PCB** to 12V power.
7. Connect J8 (**AMP**) of the **D1806 PCB** to the control cable from the amplifier connector.

Note: The connections should look like this:

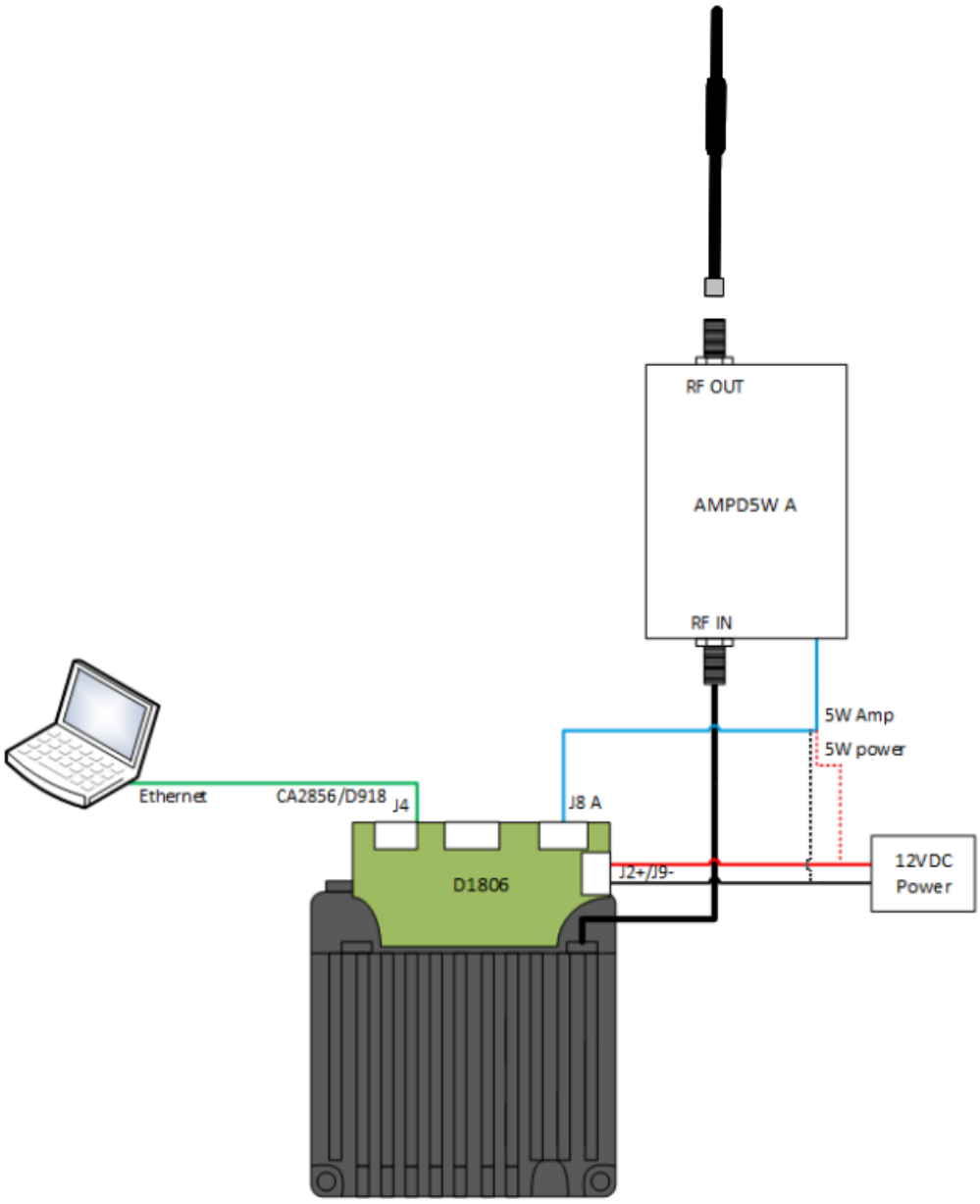


Fig. 36: **First Steps connection + amplifier**

8. Now the steps to follow are the same as **from step 6. of a DTC without amplifier**, described above.

- **Point-to-Point configuration**
  - **Basic radio configuration**

    Once the website has been accessed, follow the steps below which show the parameters that need to be

modified for a correct operation and pairing of the radios.

Note: This is an example of the radio configuration linked to a **BCS** unit.

Note: After making any changes, the application will 'ask' to *Save* or *Cancel* the changes. An example is shown below:

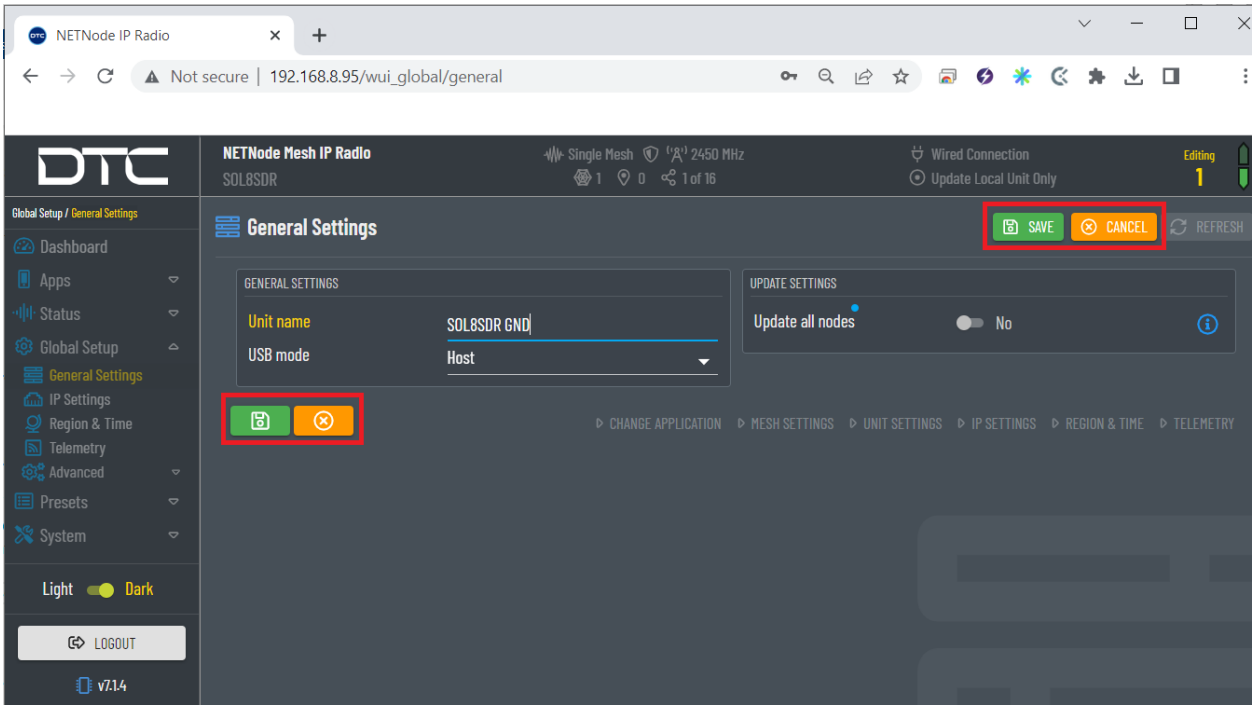


Fig. 37: **Save or Cancel changes**

1. Global Setup → **General Settings**: To easily identify each radio in a mesh, the user can rename the radio as desired:

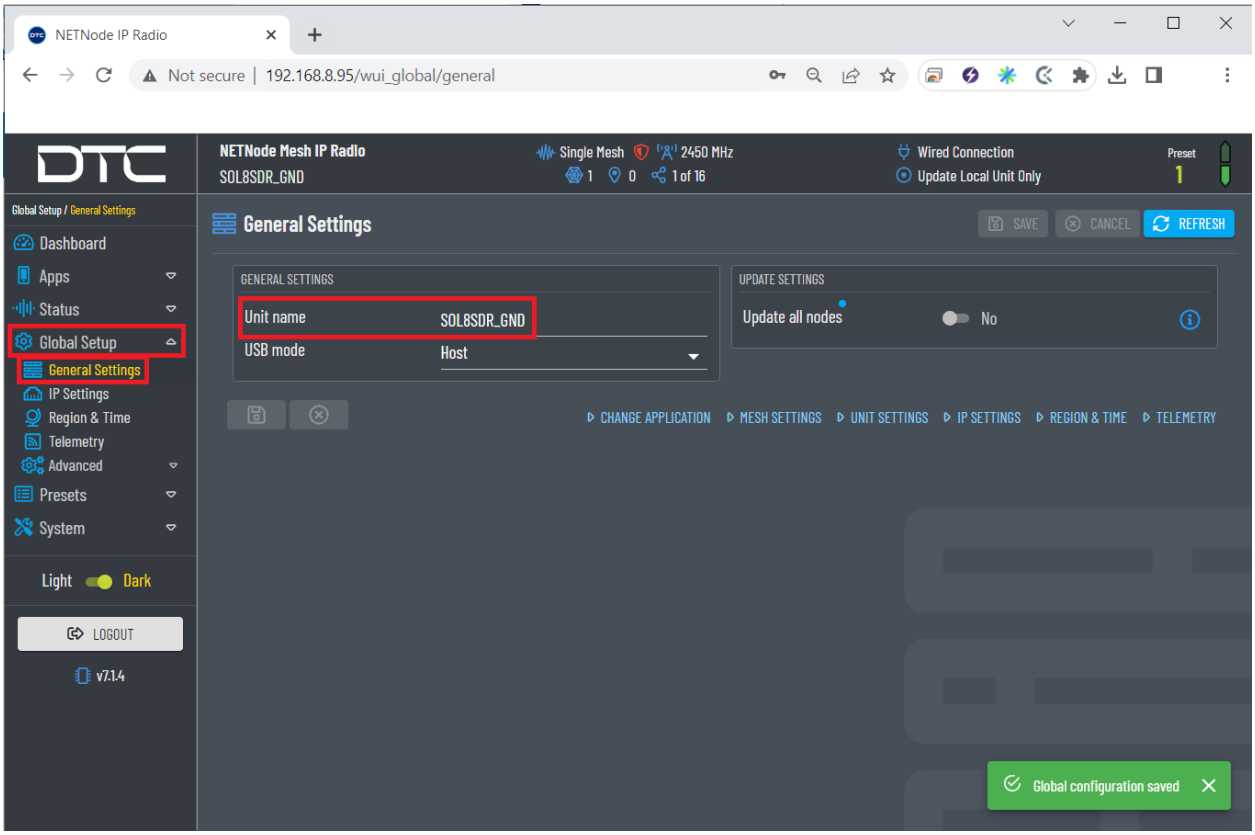


Fig. 38: **General settings configuration**

Note: The radio related to the air unit also has its own personalised name:

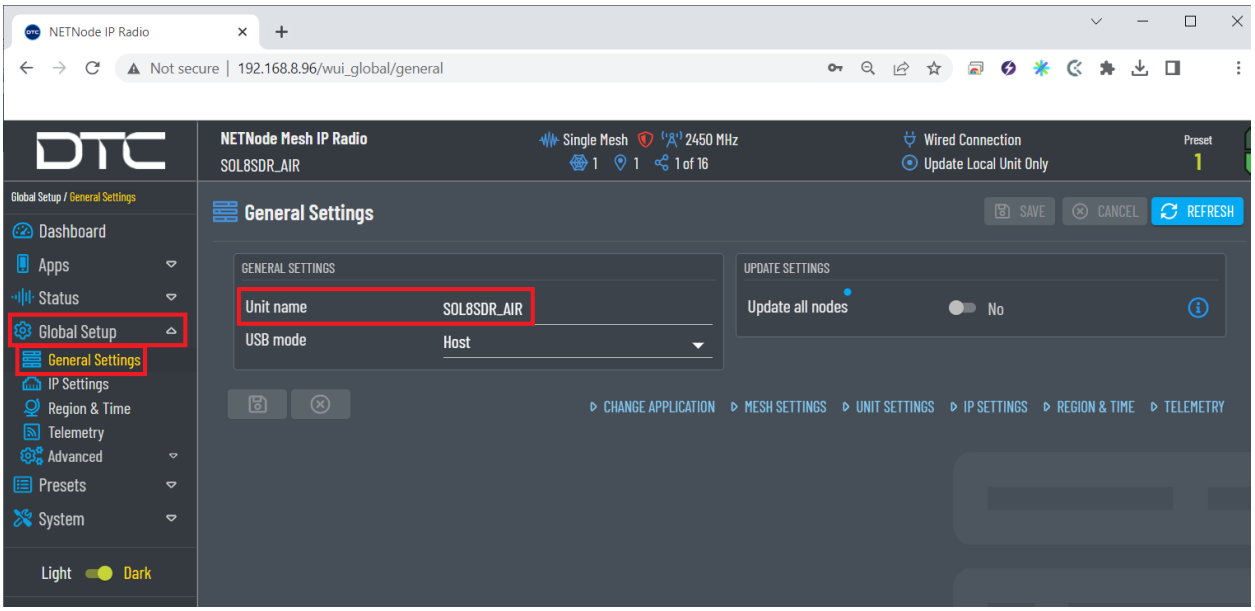


Fig. 39: **General settings air configuration**

2. Presets.

   * **Mesh Settings**: Some of the parameters configured in this menu are always displayed at the top of the application.

> **Caution:** It is recommended that software for all devices in a Mesh network should be at the same version to avoid potential compatibility issues.

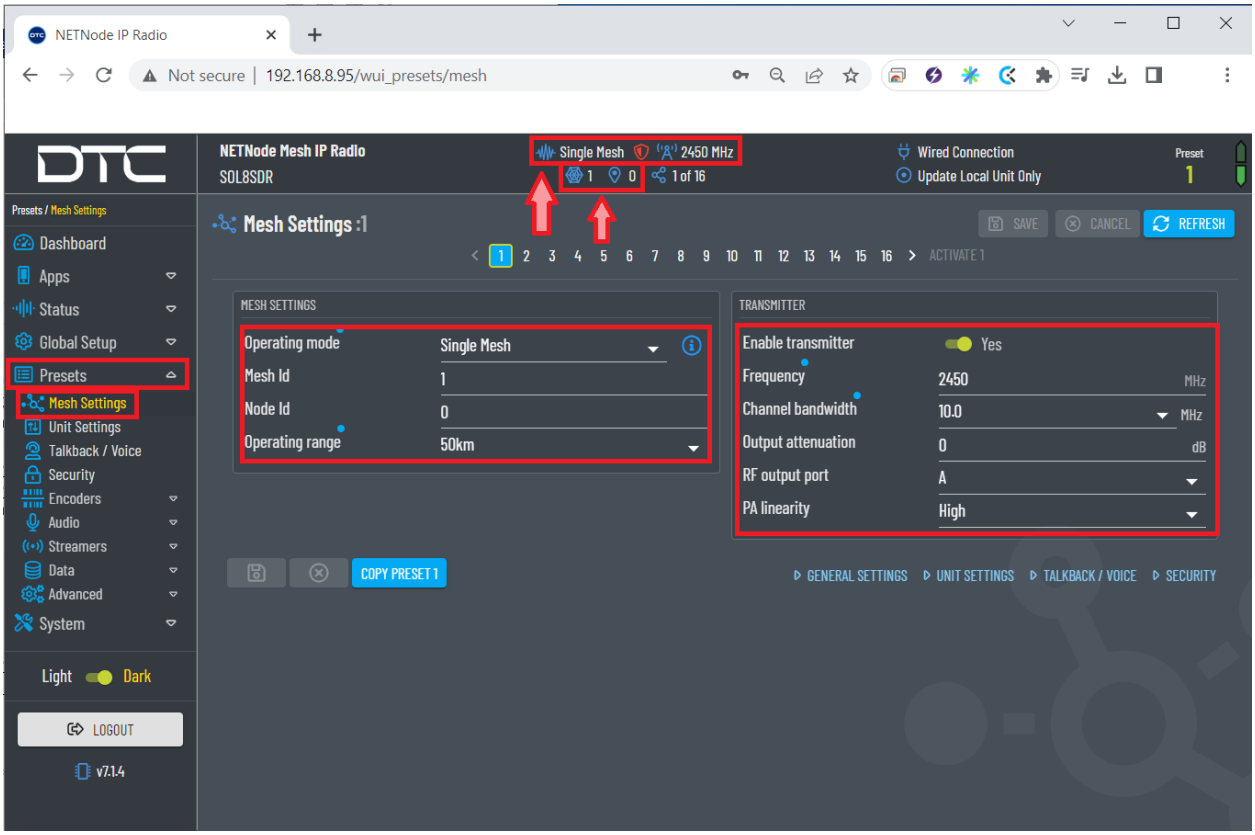


Fig. 40: **Mesh settings configuration**

- **Operation mode**: Select **Single Mesh**.
- **Mesh ID**: The **Mesh ID must be the same on all units in the Mesh network**. The Mesh ID tells the unit which network it belongs to, for example, all NETNodes on Mesh ID 1 will communicate with each other. The Mesh ID must be set to a **non-zero value**.
- **Node Id**: The **node ID must be unique in the Mesh network** for each device.

> **Note:** A node can automatically reassign its Node ID at power up if it finds a conflict with an existing node.

- **Operating range**: A larger range allows the Mesh network to operate over a bigger distance at the expense of bitrate.
- **Enable transmitter**: Set the checkbox to switch the RF power on.

- **Frequency**: Set the desired transmission frequency. **2450 MHz recommended**.

> **Warning:** Be careful when choosing the frequency. The user may see interference with the Wifi frequency band, consult the radio spectrum.

- **Channel bandwith**: Select the desired bandwidth from the drop-down list. Lower bandwidths provide greater range at the expense of data throughput. **10 MHz is recommended**.
- **Output attenuation**: The **level of attenuation** in **dB** that is applied to the output (from 0 to 32). **0 dB of attenuation is recommended**
- **RF output port**: The transmitter has two COFDM antennas, A and B. **A is selected as the output antenna by default**, but the user can select A or both if required.
- **PA linearity**: **High linearity** improves the COFDM shoulder performance at the expense of power consumption.

  Usually used when working with power amplifiers which must have excellent shoulder performance to operate, or for improved adjacent channel performance.

> **Warning:** To ensure proper communication between the two radios, the radio linked to the **air unit must have these same 'Mesh settings' except for the Node Id**, as each node in the mesh has its own Id (starting with Id 0):

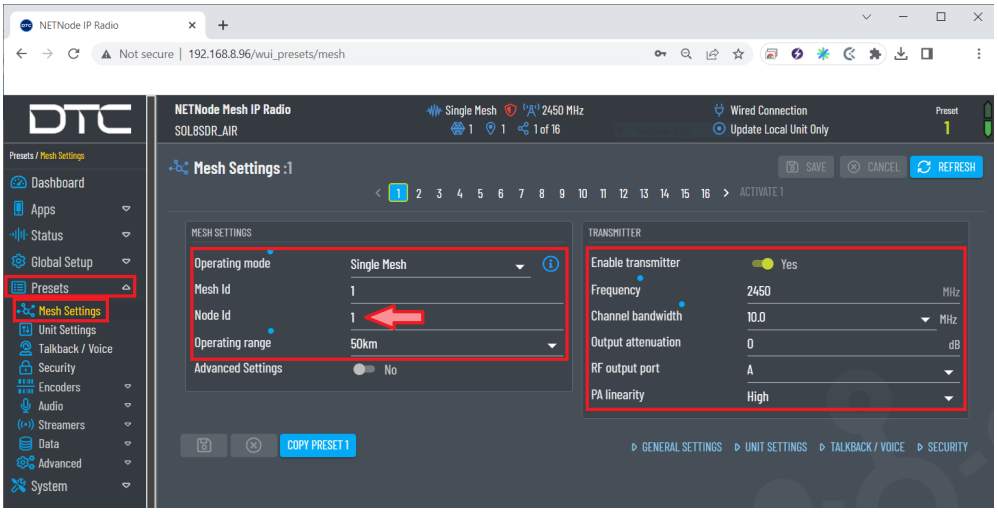


Fig. 41: **Mesh settings air configuration**

Moreover, there are up to **16 different preset configurations that can be setup**.

All these settings are made for preset 1, which is highlighted with a blue background in the 'Mesh settings' tab to indicate that it is active. In addition, a '**preset indicator**' with the current present is always displayed at the top right of the application, as shown in the figure below.

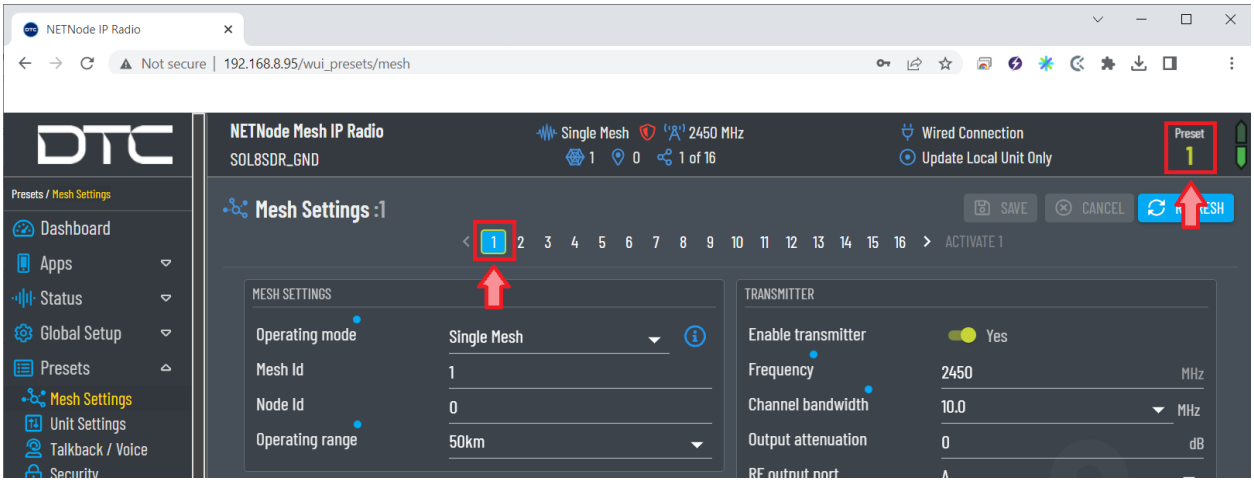


Fig. 42: **Current preset configuration**

* **Unit Settings**:

  External Power Enable: There is an external power output which can be used to supply 12VDC (1A) to an external device. This could be a camera, GPS antenna or other device.

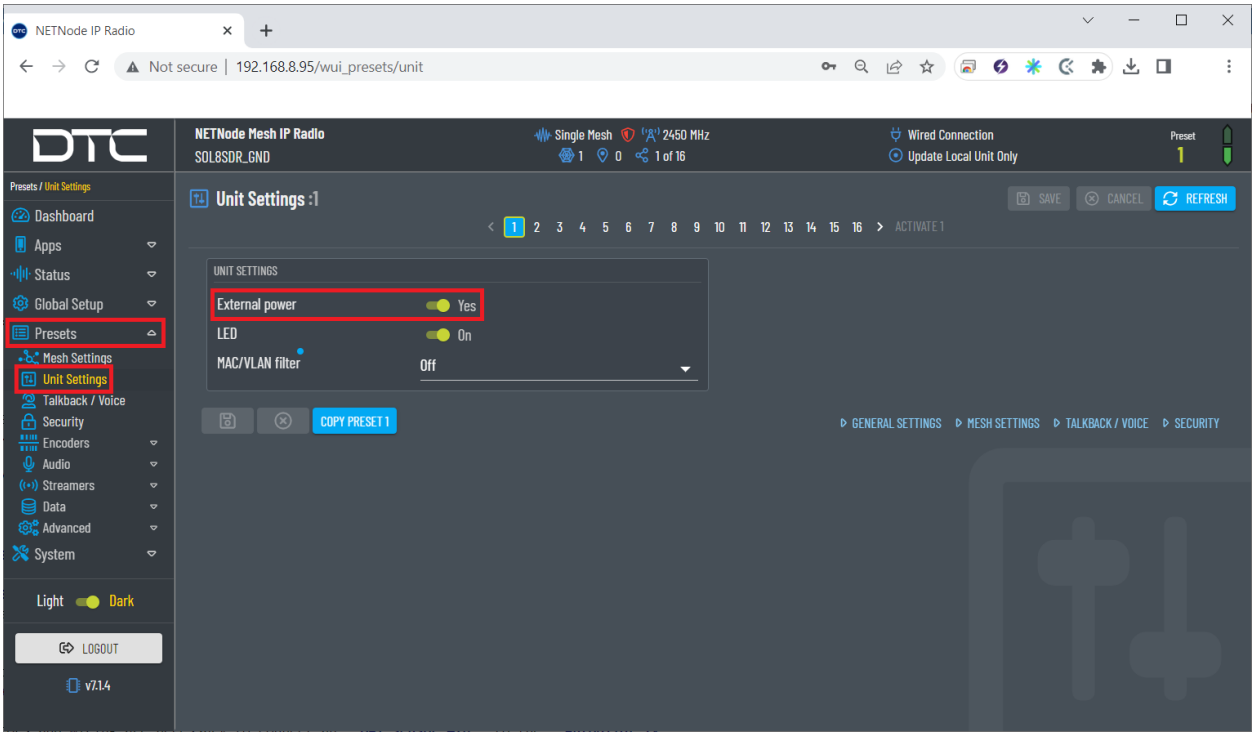


Fig. 43: **Unit settings configuration**

3. **Data** → **RS232 #1**: In this menu the parameters of the RS232 port and the network settings are configured:

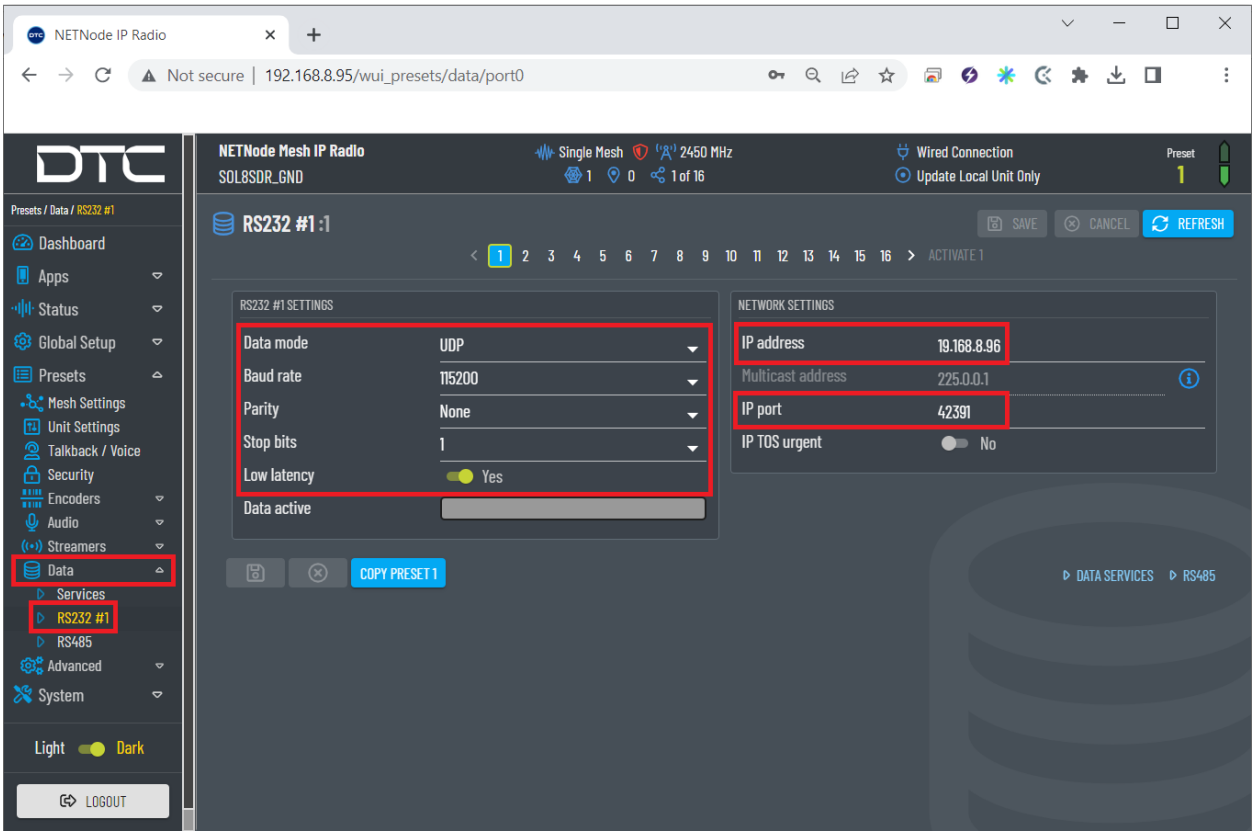


Fig. 44: **RS232 #1 configuration**

* **Data mode**: **UDP** option is recommended. UDP packets are sent out and the system does not expect a reply. There is no way that the sending device can tell if the data arrived at the destination.
* The value of the **Baud rate**, **Parity** and **Stop Bits** parameters must be the same as those configured in the Veronte software:.

Note: The data is assumed to be 8 bits.

---

* **Low latency**: Low latency will minimise delay at the expense of bitrate, so if set, data tranfer will be less prone to bursts. **Yes is recommended**.
* **IP address**: This should be the address of the radio receiving the data on the other end of the RS-232. In this case, as the **radio connected to the BCS unit** is being configured, the **IP of the radio linked to the air unit will be set**.
* **IP port**: This set an IP port to and from which the data will be transferred. It must be **the same for both radios**.

Important: For the **radio connected to the air unit**, the IP address to be configured is the **address of the radio linked to the BCS unit**.

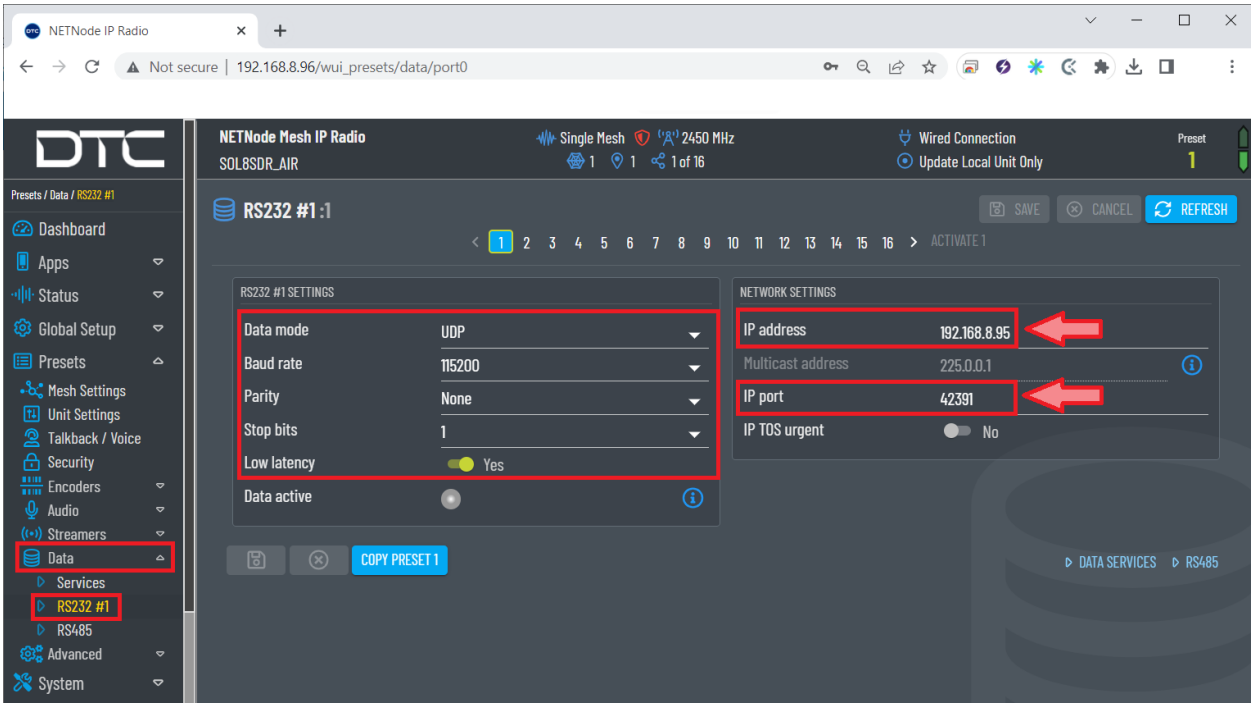


Fig. 45: **RS232 #1 air unit configuration**

4. **System** → **Maintenance**: This menu allows to import and export radio configurations.

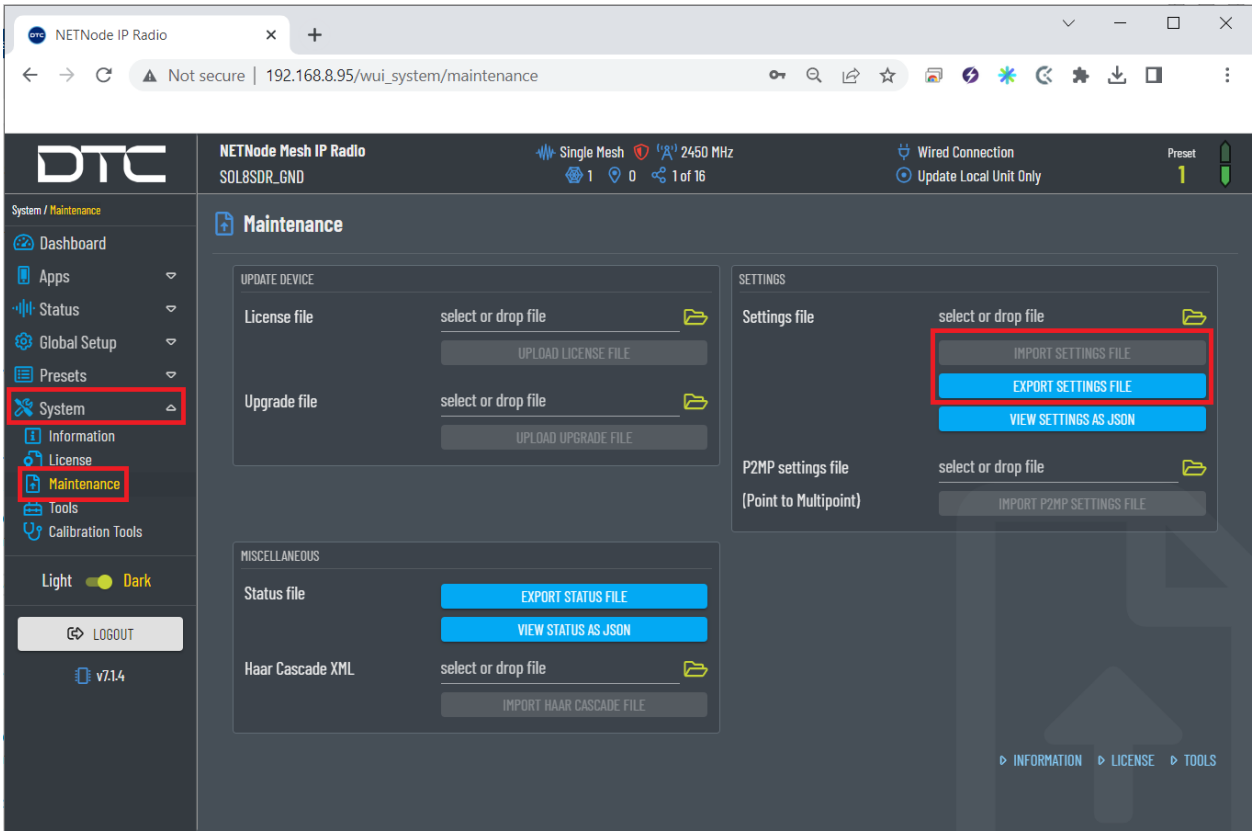


Fig. 46: **Maintenance configuration**

To **import** a configuration into the radio, it is first necesarry to choose a configuration from the local storage by clicking on the  icon. Then, the 'import button' will already be available (colored in blue) to click on and consequently import the selected configuration. An example is shown below:

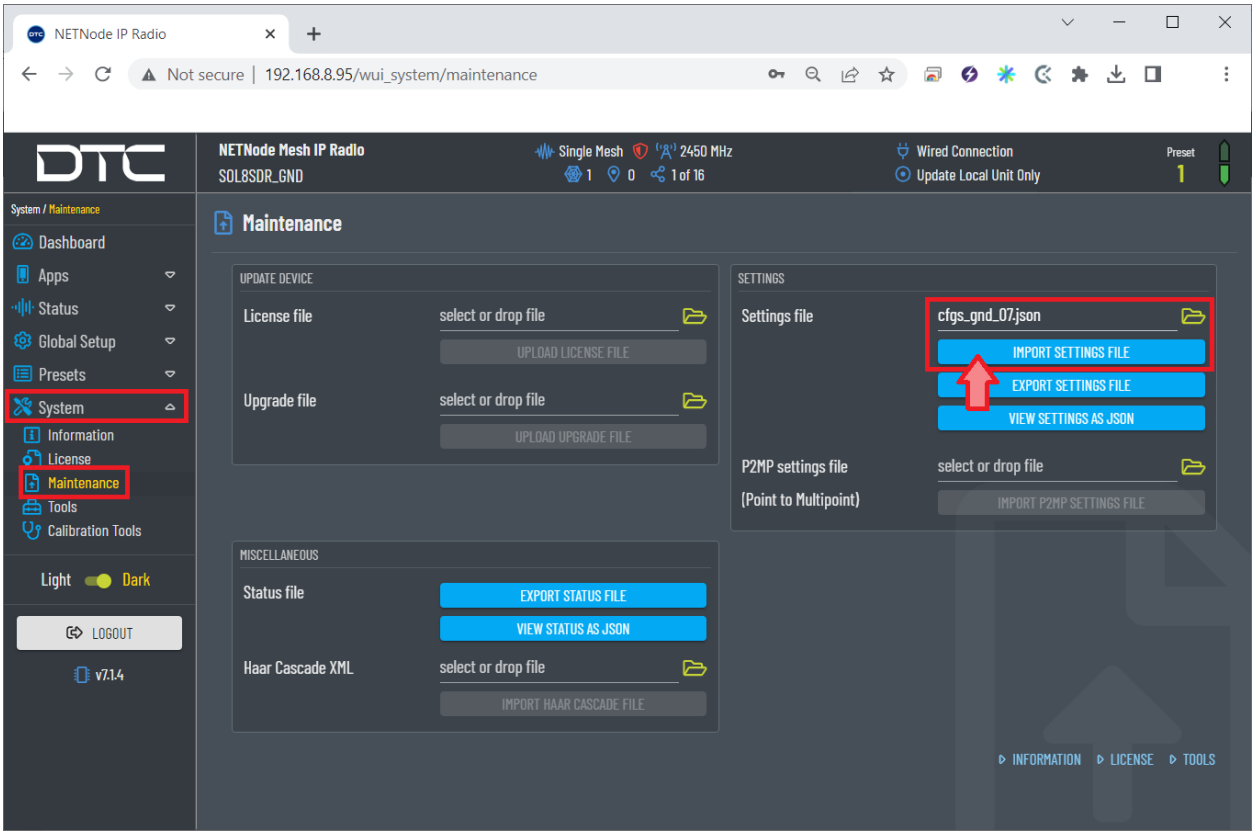


Fig. 47: **Configuration selected**

– **Paired radios**

Once both radios have been configured with these settings, they should be paired. Therefore, if we connect them to the power supply and only one of them to the computer, we can access the Domo Node Finder software or directly the Web Browser control application to check if they are correctly paired.

∗ **Domo Node Finder** software

When 2 radios are paired, they will both appear here:

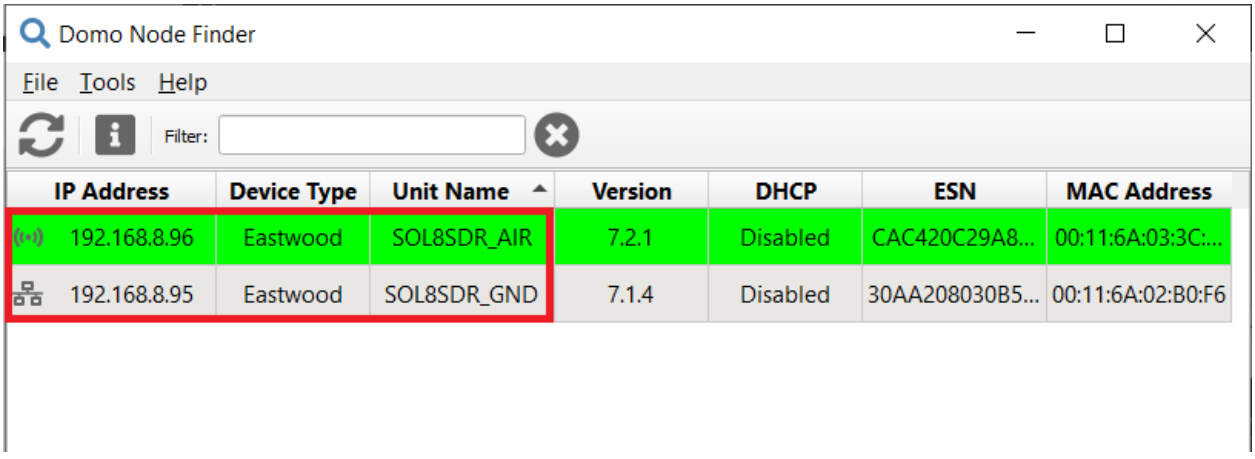


Fig. 48: **Domo Node Finder - Radios paired**

As can be seen in the figure above, the connection type of each radio is indicated with different icons:

- icon for the radio that is wiredly connected to the PC.
- icon for the radio that is connected by link.

* **Web Browser control application**

When two radios are paired, this can be seen/checked directly in the '**Dashboard**' of both radios.

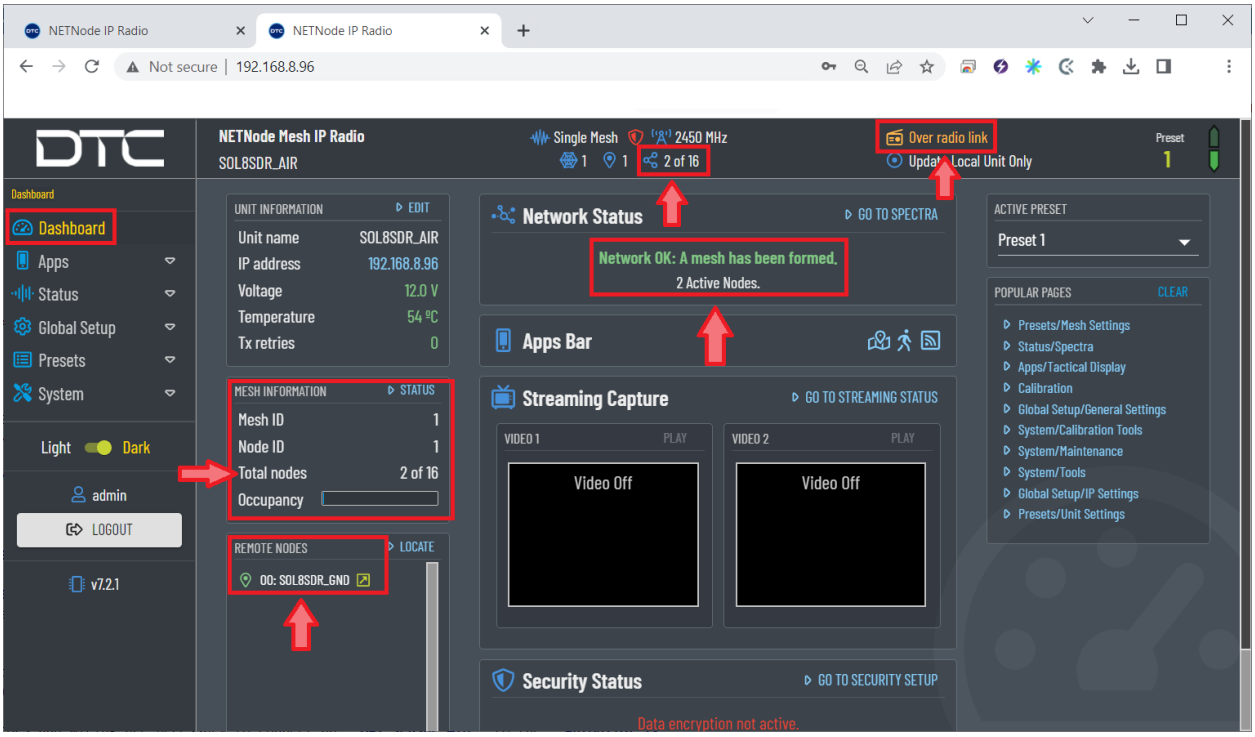


Fig. 49: **Radios paired - Dashboard**

Furthermore, it can be seen that the above figure is related to the radio that is connected by link, as it is indicated at the top of the application with the label *Over radio link*.

- **Apps** → **Tactical Display**: Here the user can check the connection and the quality of the signal connection of both radios:

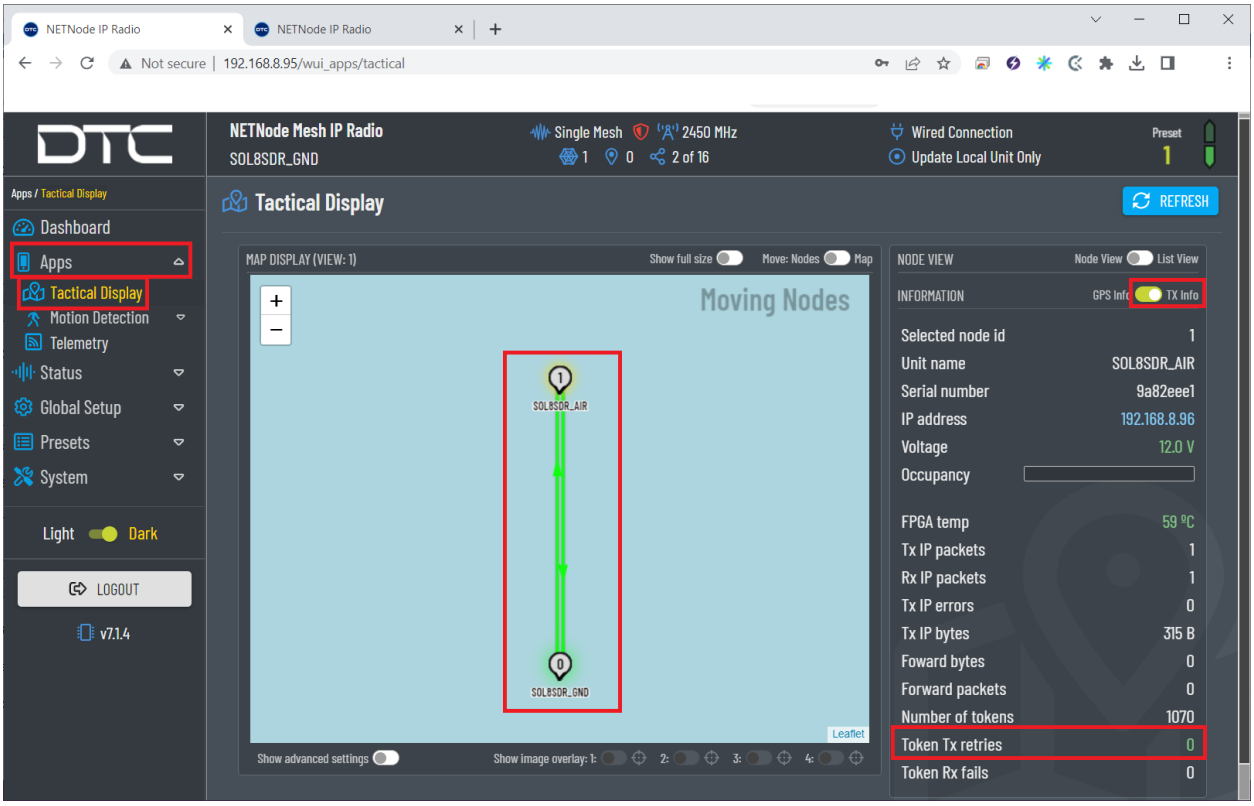


Fig. 50: **Radios paired - Tactical Display**

- **Map display**: The color of the link between nodes indicates the quality of the signal. The colors range from green (reliable link) to red (unreliable link). If no link is displayed, it means that communication has been lost.
- **TX info**: TX info should be selected to check the quality of the signal connection.
- **Token Tx retries**: In a Mesh network, transmission is arbitrated by passing a token between nodes. This tab displays the number of token retries that have been needed for each node. It must be **0 with occasional 1 for a proper communication**.

> **Caution:** Higher values will have an undesirable effect on system performance. If problems occur, check for interference and that there is no other Mesh system operating on the same or adjacent frequency.

- **Point-to-Multipoint configuration**

  It is possible that the user wants to make a point-to-multipoint radio connection, i.e. there will be one radio sending commands to several radios, so there will be at least 3 radios.

  The following is the configuration required for this type of connection.

  – **Radio configuration**

    The modifications to be made to the basic configuration explained above for the point-to-point application are detailed below.

Note: This example has been made with 3 radios (3 nodes in a mesh).

1. **Presets** → **Mesh Settings**: The **Node ID** must be different for each node in the mesh.

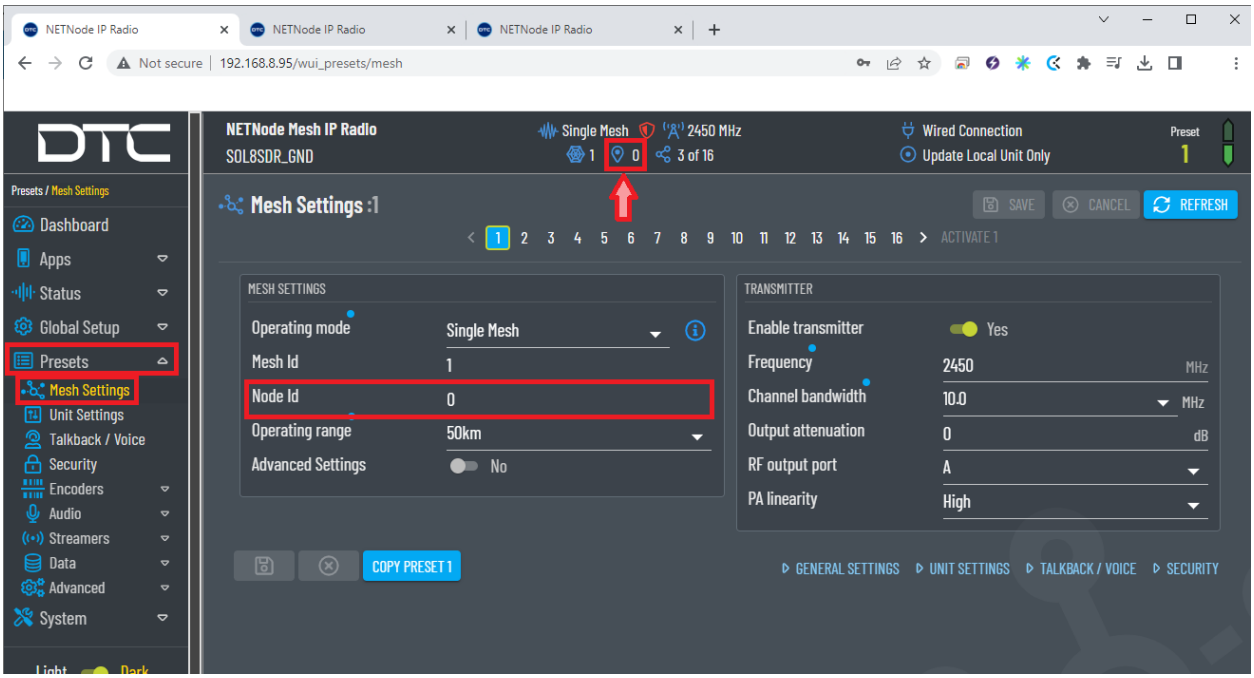


Fig. 51: **Mesh settings ground configuration**

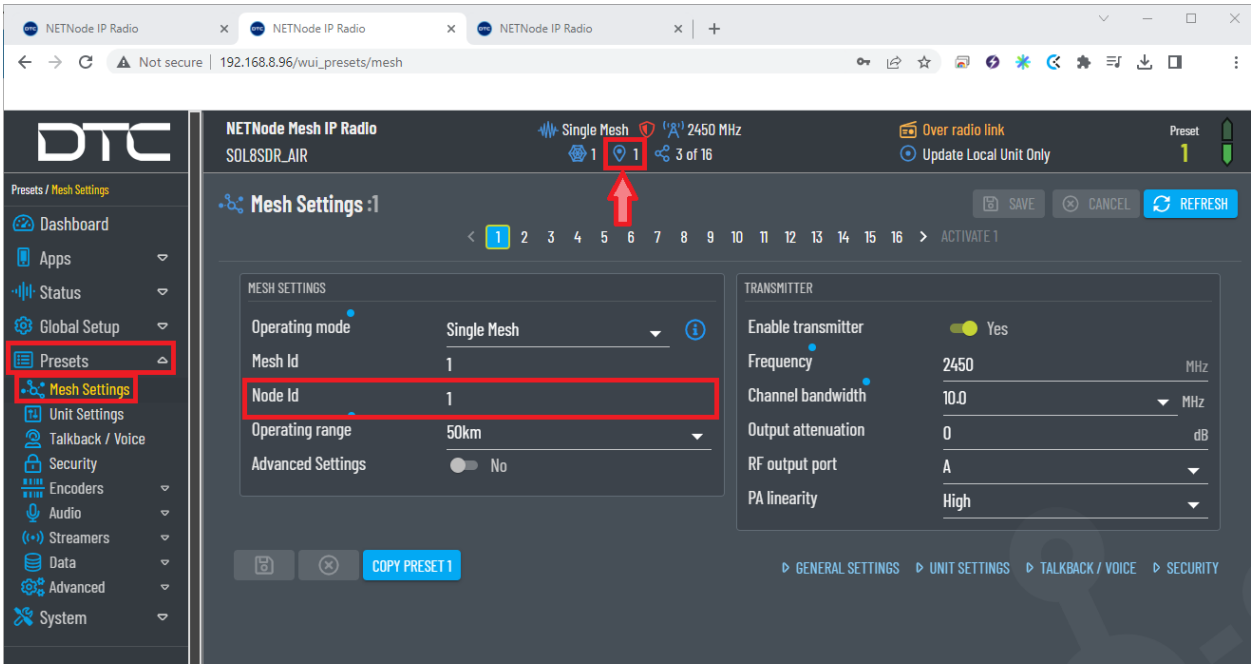


Fig. 52: **Mesh settings air configuration**

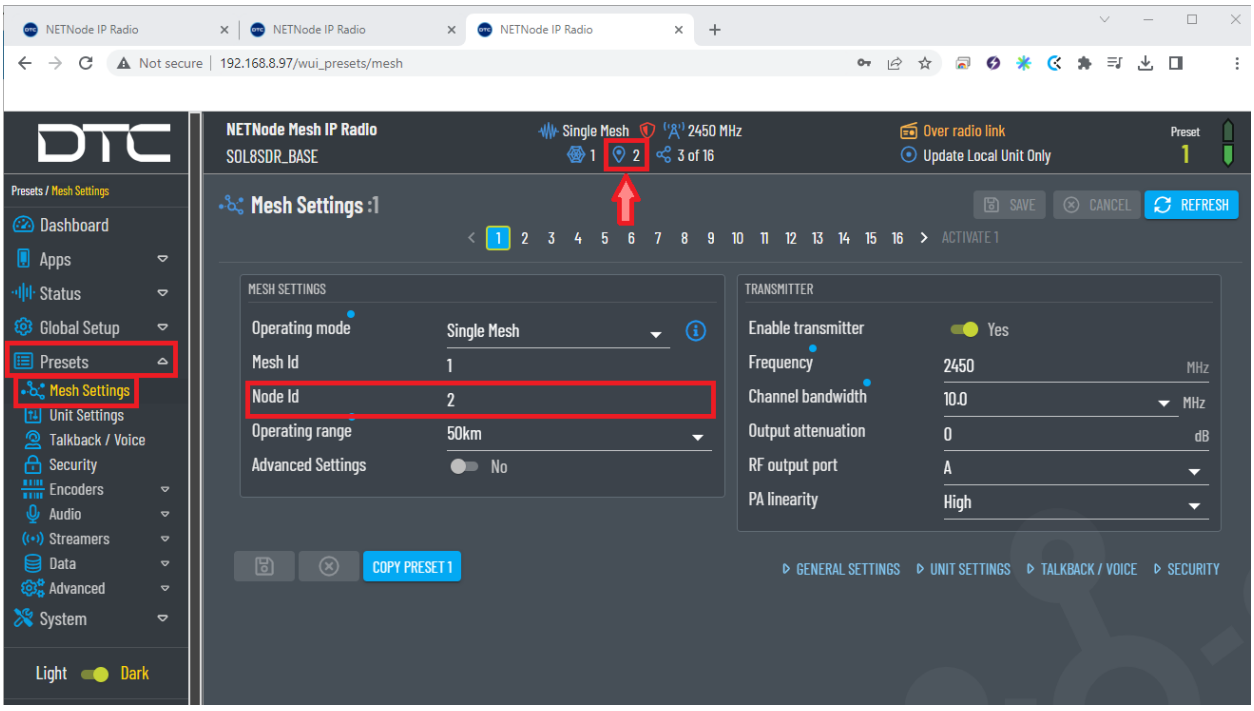


Fig. 53: **Mesh settings base configuration**

In the figures above, the user can see that the node ID is displayed at the top of the application at all times.

2. **Data** → **RS232 #1**: The **Multicast** data mode must be configured. This data mode allows a single node to send RS232/RS485 data to multiple nodes in the system. And it also creates a unicast data return channel.

   The **radio linked to the BCS unit** is configured as the 'Point' that sends the commands.

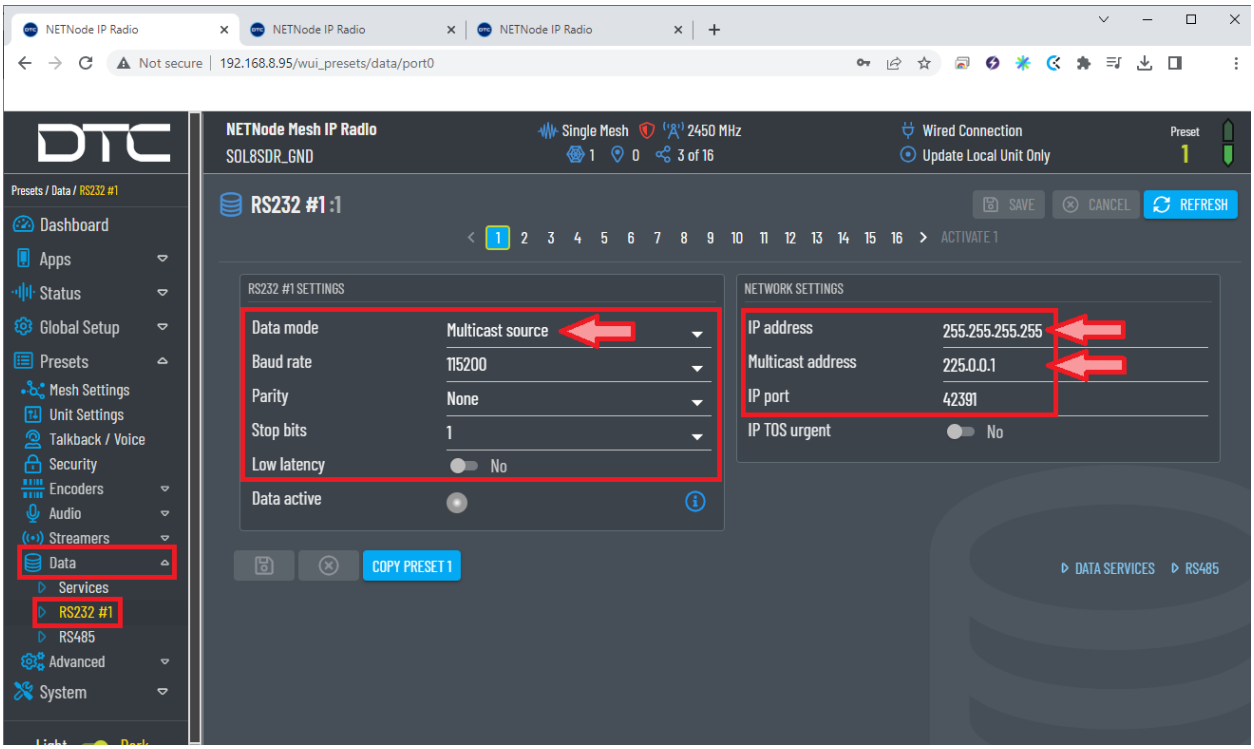


Fig. 54: **RS232 #1 ground configuration**

* **Data mode**: **Multicast source** must be selected.
* **IP address**: To send the data to all receivers the IP address must set to **255.255.255.255**.
* **Multicast address**: It must be **the same for all radios**, avoiding the 244.0.0.X address range. The address must be different from any multicast streaming and data channels.

Then, the **radios linked to the air and base units** receive those commands:

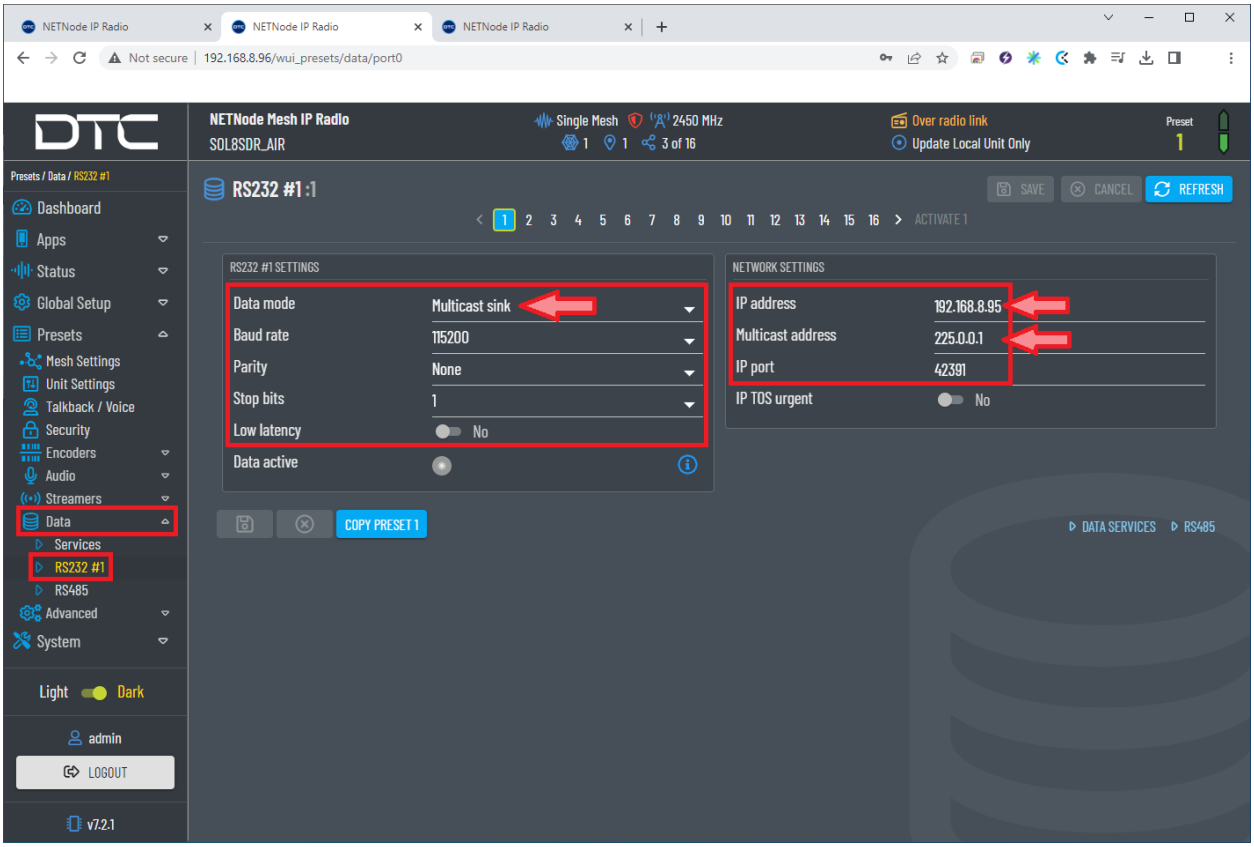


Fig. 55: **RS232 #1 air unit configuration**

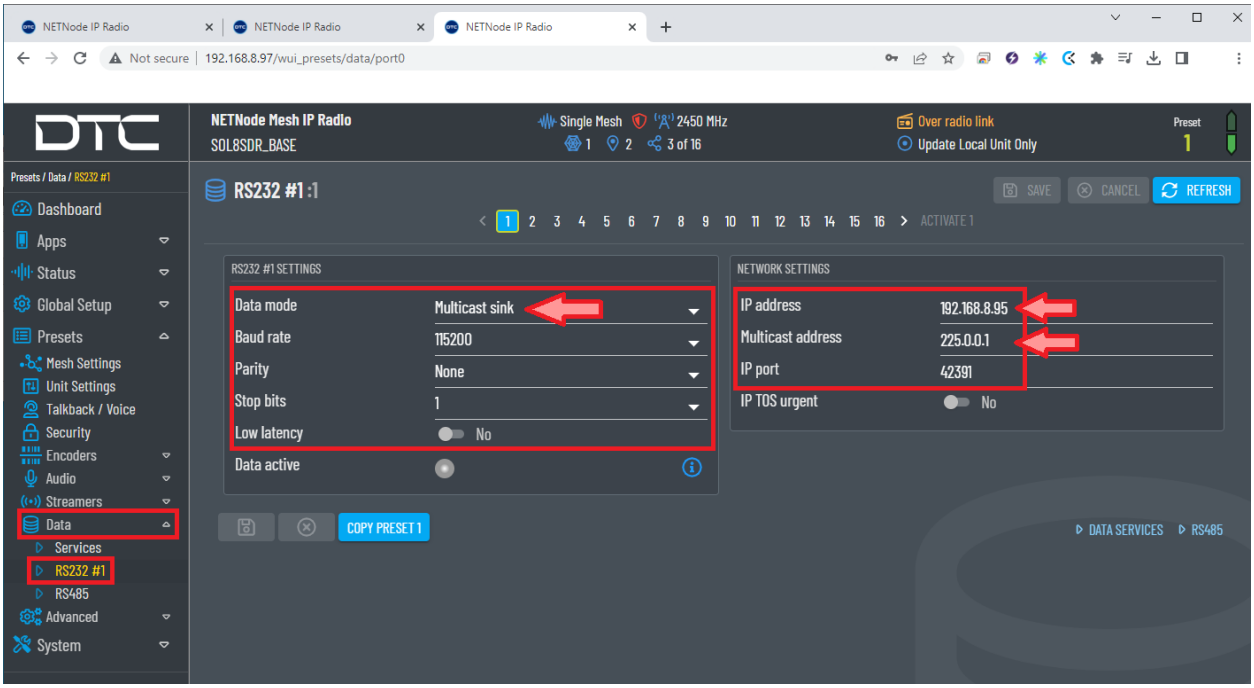


Fig. 56: **RS232 #1 base unit configuration**

- **Data mode**: **Multicast sink** must be selected.
- **IP address**: The IP address of the **radio linked to the BCS unit** is set.
- **Multicast address**: It must be **the same for all radios**, avoiding the 244.0.0.X address range.

  The address must be different from any multicast streaming and data channels.

– **Paired radios**

Once the radios have been configured with these settings, they should be paired. Therefore, if we connect them to the power supply and only one of them to the computer, we can access the Domo Node Finder software or directly the Web Browser control application to check if they are correctly paired.

- **Domo Node Finder** software

  When 3 radios are paired, they will appear here:

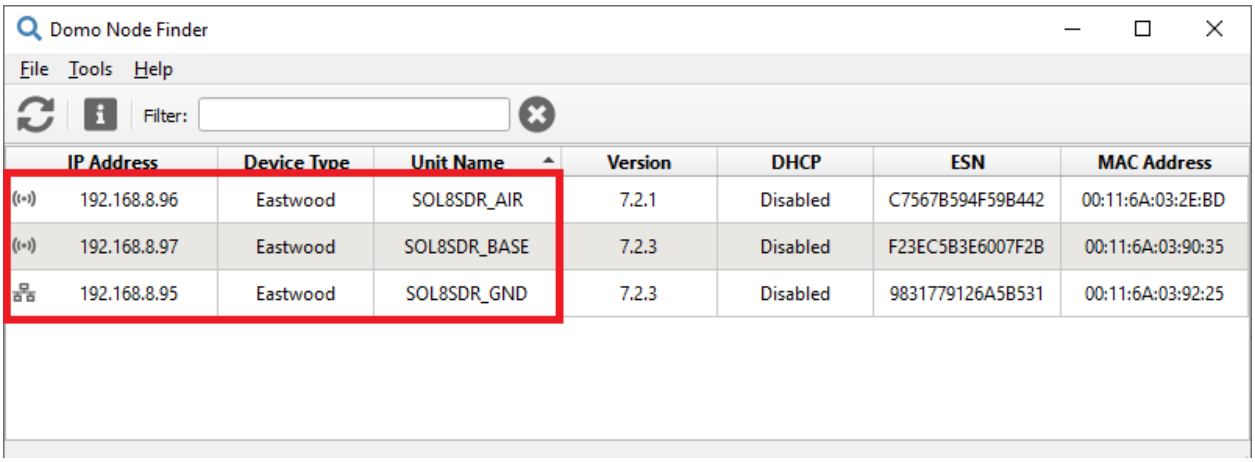


Fig. 57: **Domo Node Finder - 3 radios paired**

As can be seen in the figure above, there is 1 radio wiredly connected to the PC and 2 radios connected by link.

- **Web Browser control application**

  When 3 radios are paired, this can be seen/checked directly in the '**Dashboard**' of the three radios.

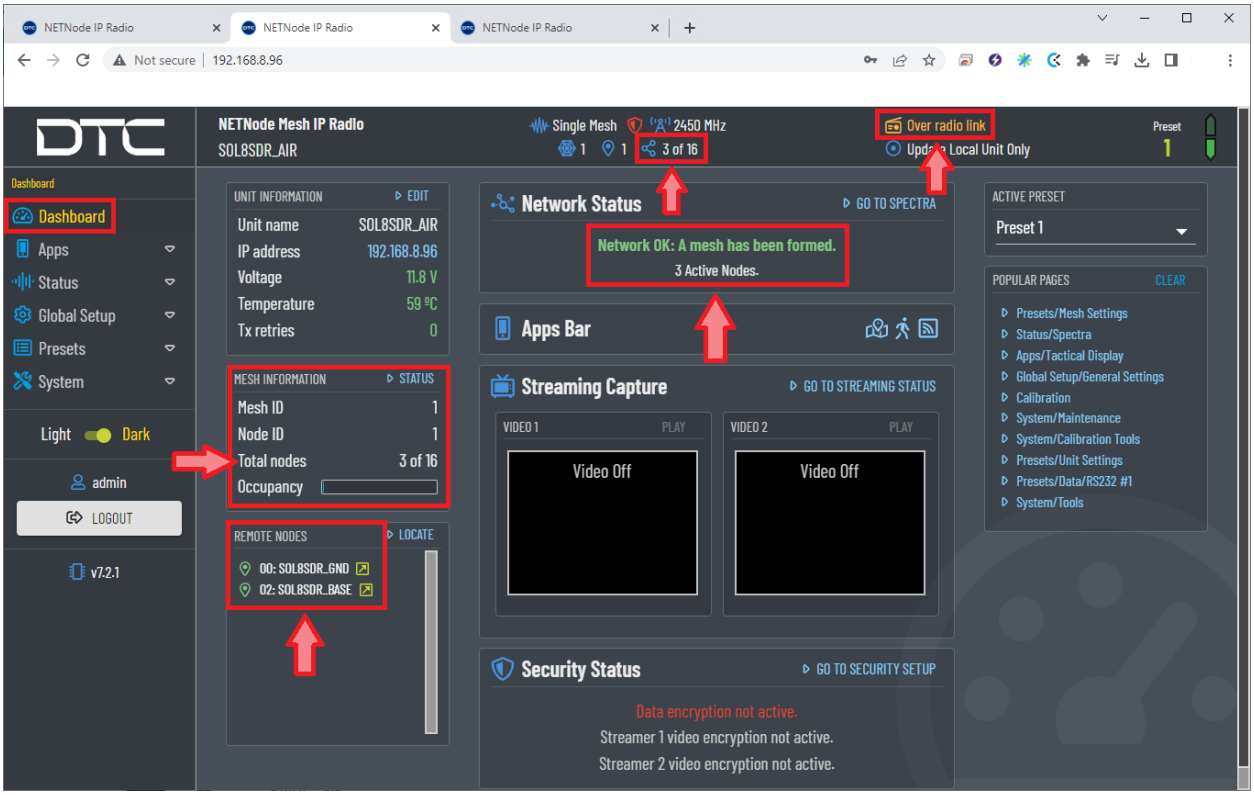


Fig. 58: **Radios paired - Dashboard**

Furthermore, it can be seen that the above figure is related to a radio that is connected by link, as it is indicated at the top of the application with the label *Over radio link*.

- **Apps** → **Tactical Display**: Here the user can check the connection and the quality of the signal connection of the radios:

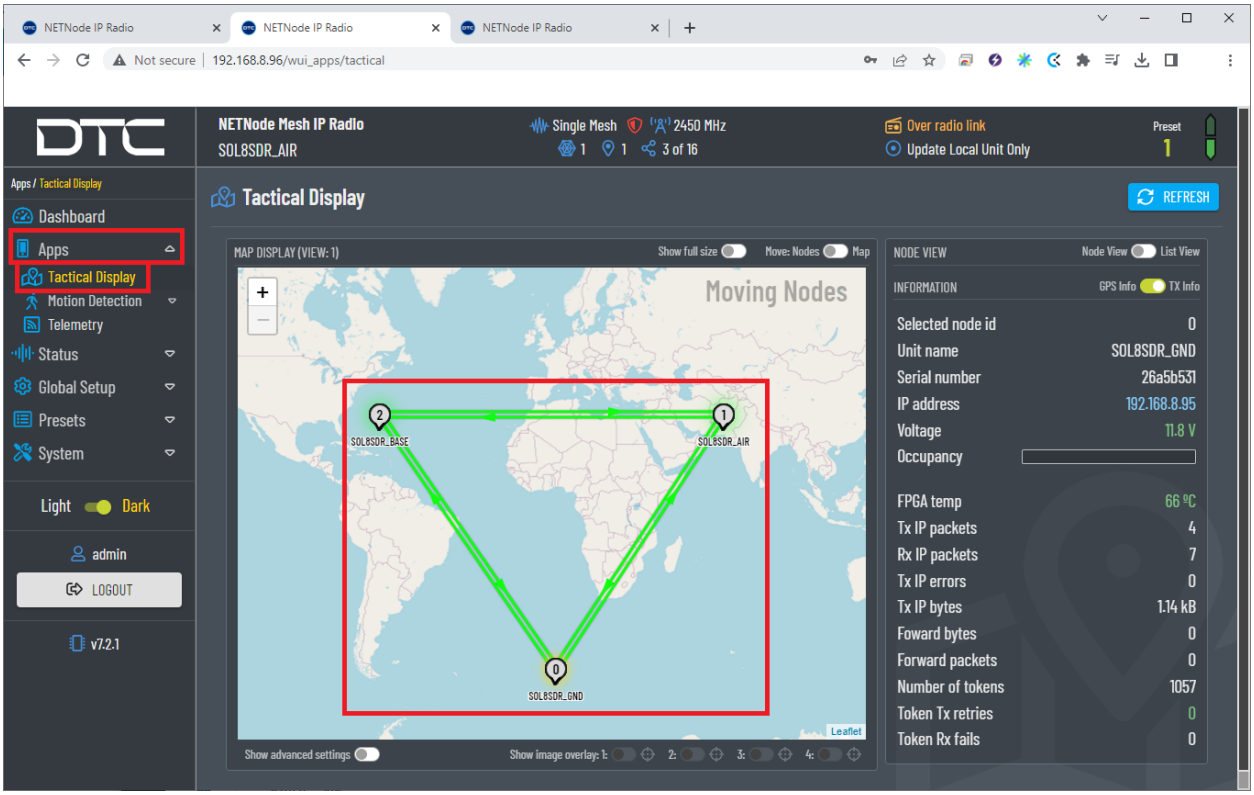


Fig. 59: **Radios paired - Tactical Display**

For more information on the configuration of DTC radios, please refer to the DTC documentation.

9.2.2.4 DTC radio configuration in autopilot

The necessary configuration of **Veronte Autopilot 1x** for DTC radios require different applications, according to the software version:

`6.8 or higher:` use **1x PDI Builder** reading its user manual. Go to Integration examples -> External radios section.

9.2.3 Silvus radio (StreamCaster 4200E model)

9.2.3.1 System Layout

The following image shows the standard connection between Silvus radios and Autopilot 1x for operation:

Fig. 60: **Silvus and 1x connection**

9.2.3.2 Hardware Installation

A wiring configuration of the PRI cable connected to the PRI port of the radio is required, in order to connect to the power supply, ethernet and RS-232.

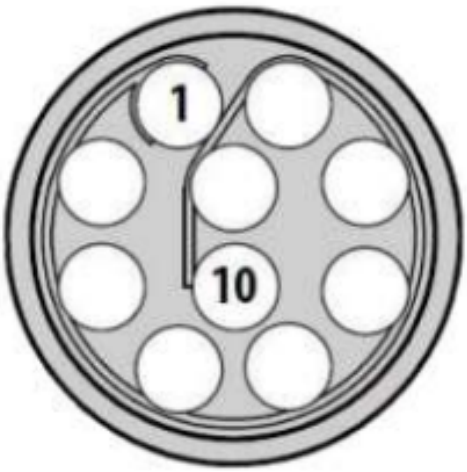


Fig. 61: **PRI port connector (mounted in radio)**

- **Power supply**

Fig. 62: **Female DC Power Jack connector**

PRI port connector - Silvus radio		Power connector
Pin number	Signal	Signal
2	GND IN	Power -
3	VCC IN	Power +

- **Ethernet**

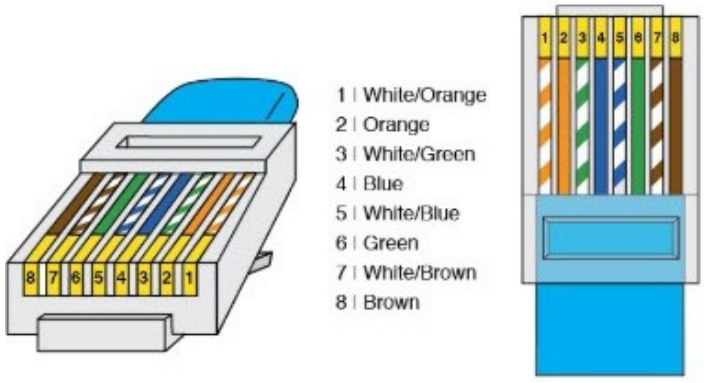


Fig. 63: **RJ45 pinout T-568B**

PRI port connector - Silvus radio		RJ45 Connector (T-568B)		
PIN N°	Signal	PIN N°	Signal	Color
4	ETH0_MX2N (RX-)	6	RX-	Green
5	ETH0_MX2P (RX+)	3	RX+	Green-White
6	ETH0_MX1P (TX+)	1	TX+	Orange-White
10	ETH0_MX1N (TX-)	2	TX-	Orange

- **RS-232**

  The RS-232 from the PRI cable should be connected to the RS-232 of Autopilot 1x Harness.

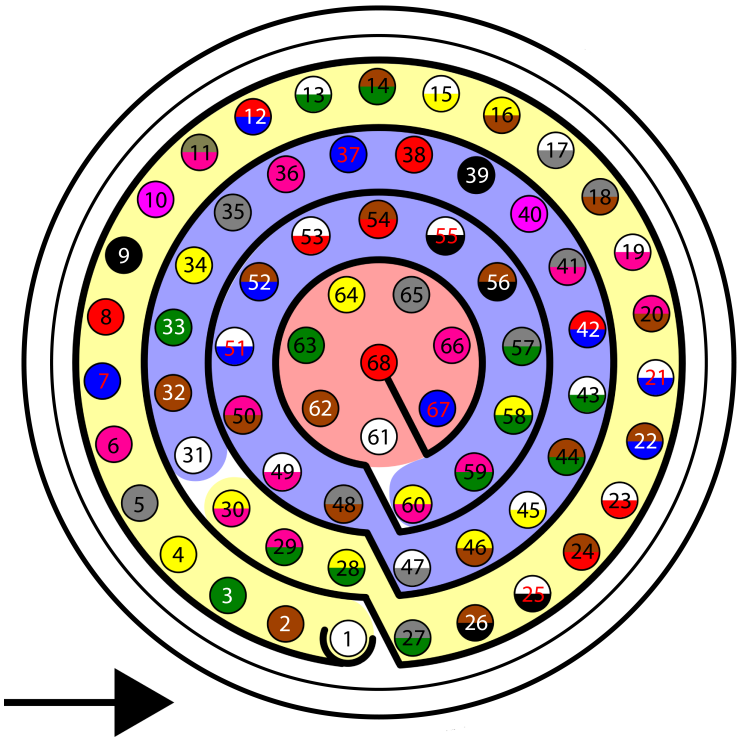


Fig. 64: **Harness plug**

PRI port connector - Silvus radio		Harness - Autopilot 1x		
PIN N°	Signal	PIN N°	Signal	Color
7	RS232_RXD	19	RS 232 TX	White-Pink
8	RS232_TXD	20	RS 232 RX	Pink-Brown
9	GND	21	GND	White-Blue

9.2.3.3 Silvus radio configuration

This section shows a basic configuration of the Silvus radio.

- **First Steps**
  1. Connect antennas (or attenuators) with male TNC ends to 2 RF ports.
  2. Connect power supply to power port on PRI cable.
  3. Connect non-forked female side of PRI cable to radio's PRI port.

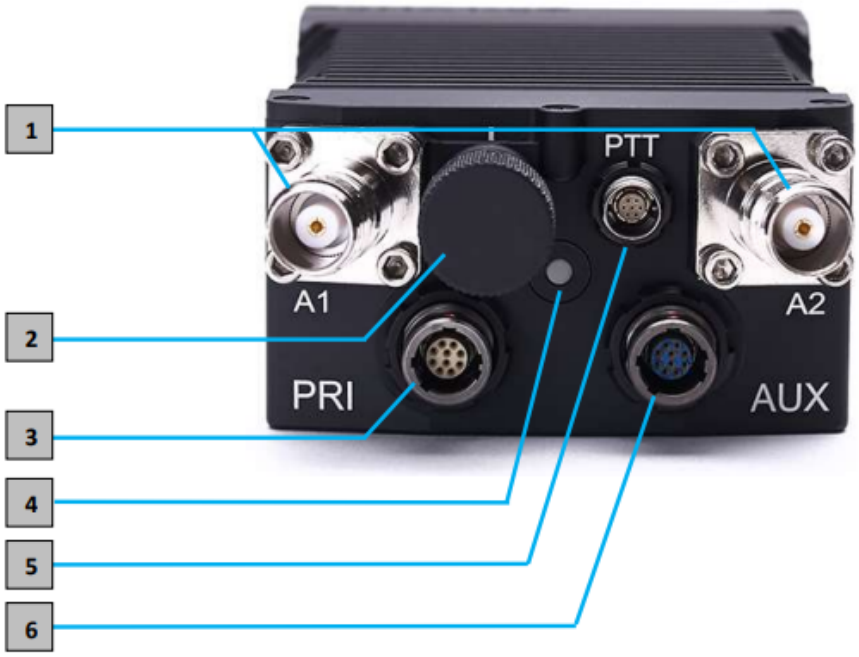


Figure 3 StreamCaster 4200E Ruggedized Enclosure

1 RF Channels 1-2 Connectors [TNC Female]

2 Power Switch [15-Position Rotating]

3 Power (EB Version Only, 9-20V), Ethernet, and Serial Port Connector [ODU GK0YAR-P10UC00-000L]

4 Bi-Color Status LED

- Red – Radio is in the process of booting up
- Flashing Green – Radio is fully booted but not wirelessly connected to any other radio
- Green – Radio is wirelessly connected to at least one other radio

Fig. 65: **Silvus connectors**

4. When looking at the rotary multi position switch from the top, pull the knob towards you while rotating the knob towards the 1 position. This turns radio on. LED indicator will turn to fix red.
5. In order to access the StreamScape graphical user interface (GUI), connect Ethernet (RJ45) connector of PRI cable to Ethernet port of laptop/computer.
6. Make sure computer is set to static IP address on same subnet as radio. The following substeps clarify how to set the IP adress:
    1. Open network and sharing menu and click **Change adapter settings**.

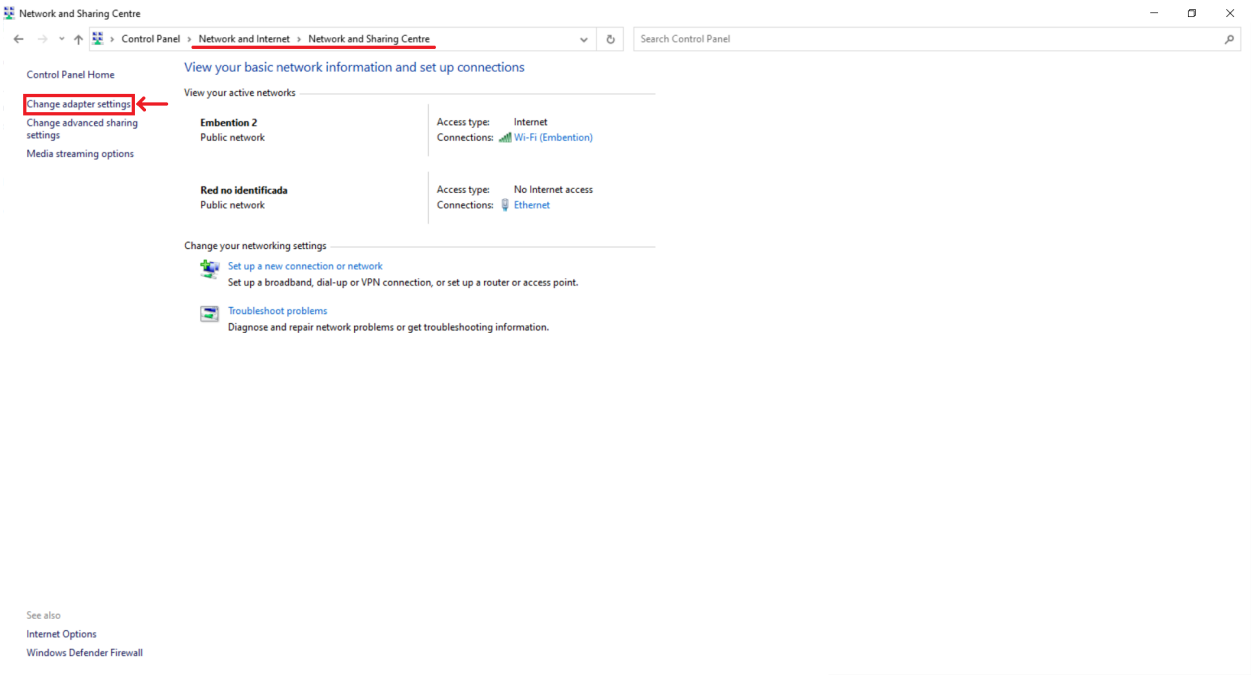


Fig. 66: **Ethernet connection 1**

2. Select **Local Area Connection**, right click, and select **Properties**.

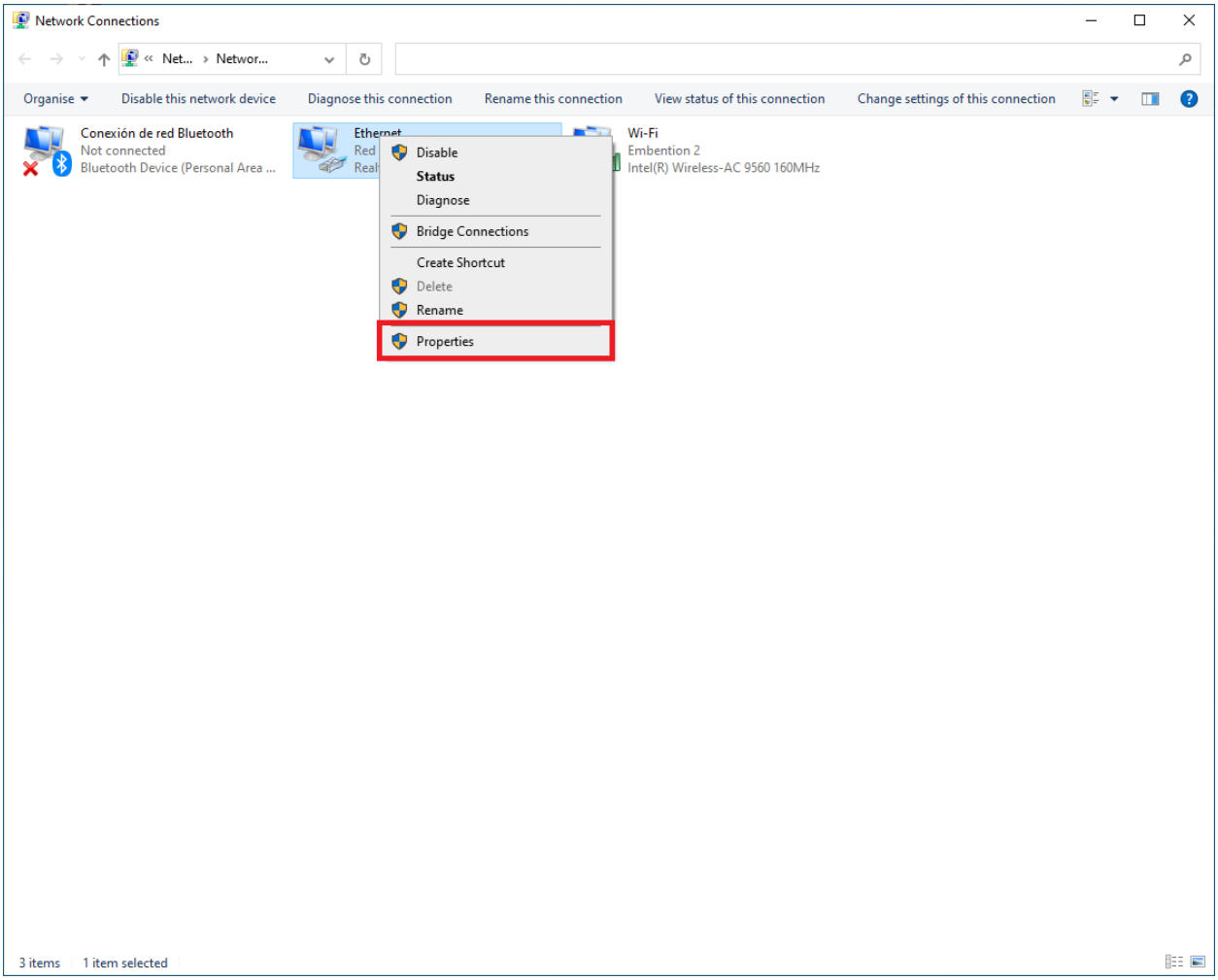


Fig. 67: **Ethernet connection 2**

3. Select **IPv4** and click **Properties**.

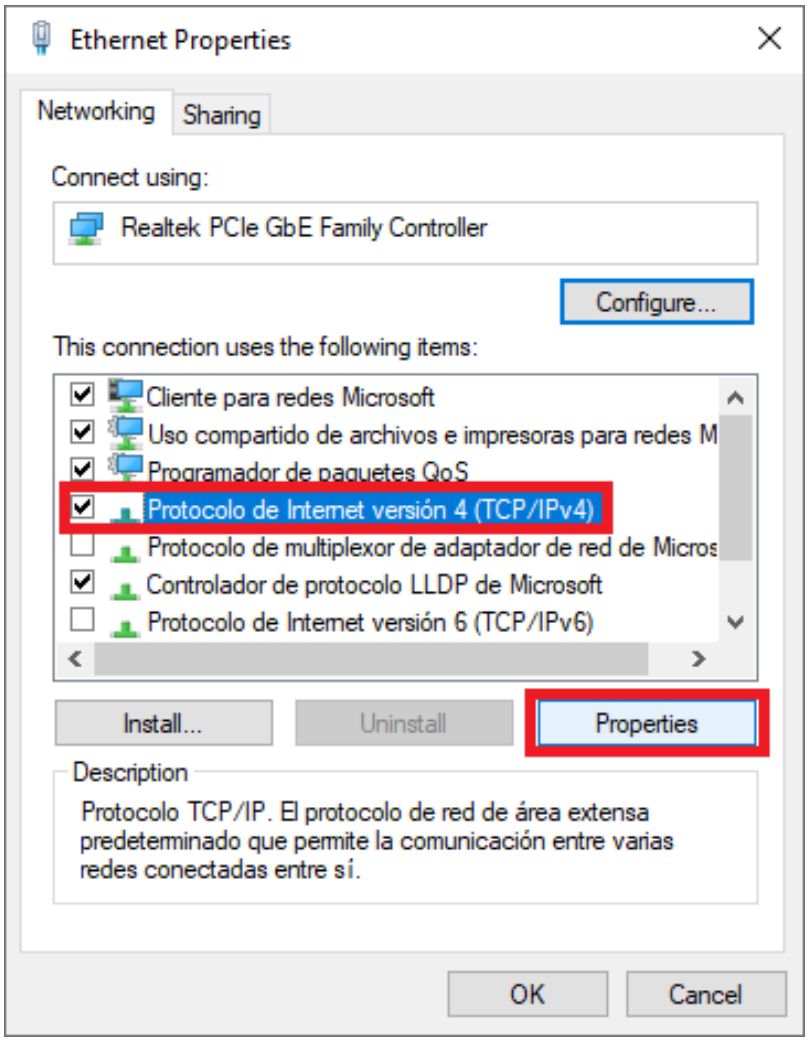


Fig. 68: **Ethernet connection 3**

4. Set **IP address** to 172.20.XX.YY (e.g. if the IP of the radio is 172.20.178.203, set the IP 172.20.178.200) and **Subnet mask** to 255.255.0.0. Click **OK**.

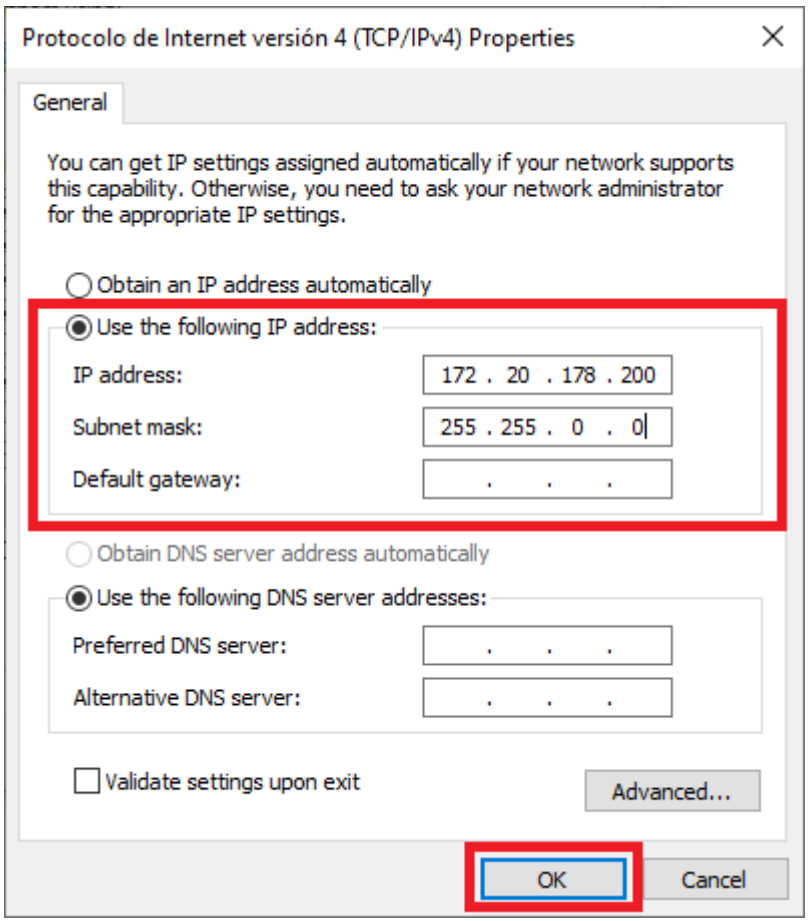


Fig. 69: **Ethernet connection 4**

7. Wait for LED indicator to turn to blinking green.
8. Access **StreamScape** GUI in web browser. To access, enter IP address of radio into web browser and press enter.

Note: Latest version of Firefox or Google Chrome are preferred. Internet Explorer or others are not recommended.

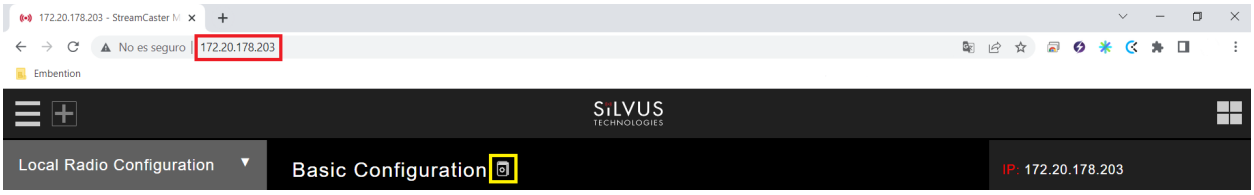


Fig. 70: **Silvus initial menu**

9. User manual can be accessed by clicking the book icon in the GUI (Next to **Basic Configuration** in the previous screenshot).

- **Basic radio configuration**

Once the website has been accessed, follow the steps below which show the parameters that need to be modified for correct operation and pairing of the radios.

Note: This is an example of the radio configuration linked to a 1x air unit.

Note: After making changes to each window, it is important to click on "Save and apply".

1. Basic Configuration.

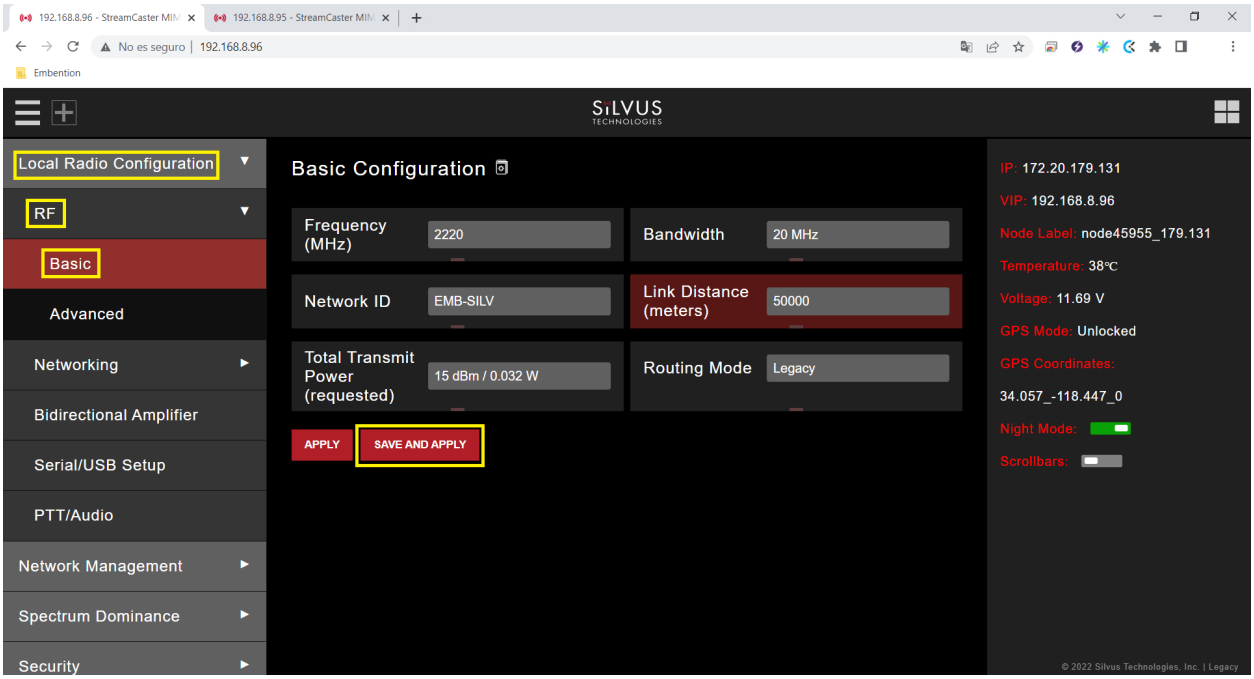


Fig. 71: **Basic configuration panel**

– **Frequency (MHZ)**: This defines the frequency of the signal. There is a drop-down menu for frequency selection. We recommend 2220 MHz.

Warning: Be careful when choosing the frequency. The user may see interference with the Wifi frequency band, consult the radio spectrum.

– **Bandwith**: This defines the RF bandwidth of the signal. Default value.

– **Network ID**: Network ID allows for clusters of radios to operate in the same channel, but remain independent. **A radio with a given Network ID will only communicate with other radios with the same Network ID**.

– **Link Distance (meters)**: Set to an approximate maximum distance between any two nodes in meters. It is important to set the link distance to allow enough time for packets to propagate over the air. **It is recommended to set the link distance 10-15% greater than the actual maximum distance**.

– **Total Transmit Power (requested)**: This defines the total power of the signal (power is divided equally between the radio antenna ports). Set the appropriate power for each application. The power

that has been set is small, as it is sufficient for our tests.

- **Routing Mode**: As *Large Network* mode requires a license and is not available outside USA, we set *Legacy* mode.

2. Advanced configuration.

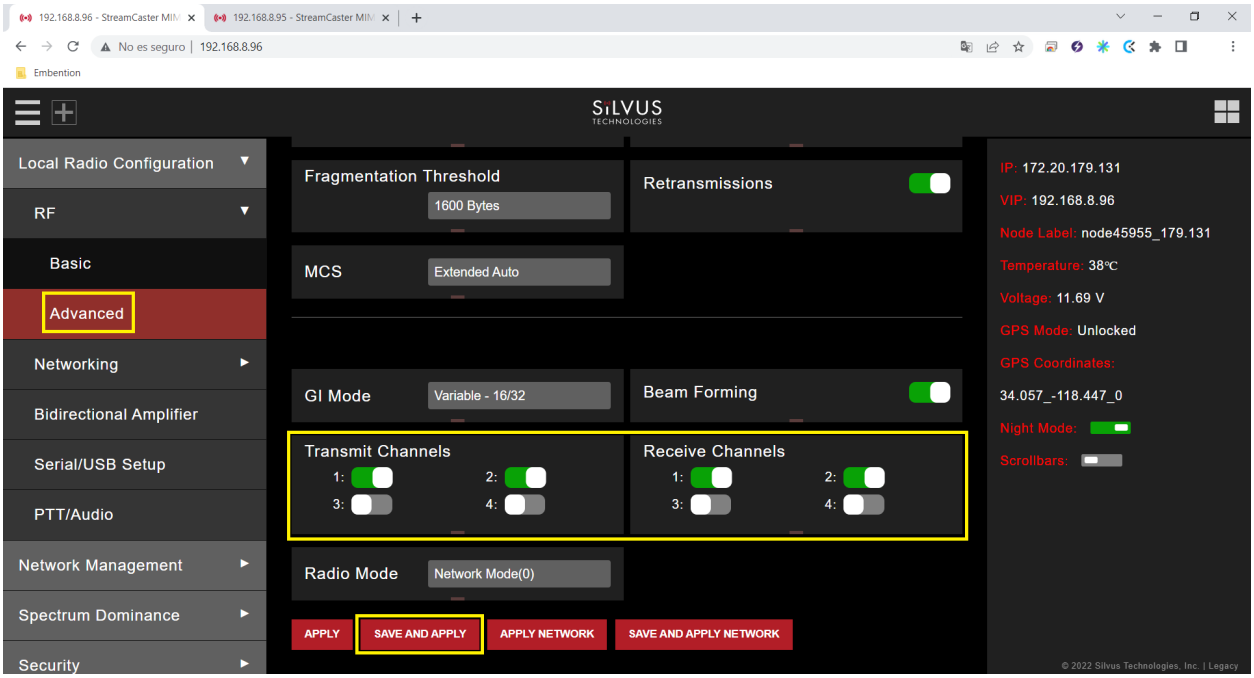


Fig. 72: **Advanced configuration panel**

- **Transmit/Receive Channels**: Allows user to enable or disable each channel on the radio for TX/RX (each RF port is a channel). We have enabled both channels.

3. Networking. Multicast.

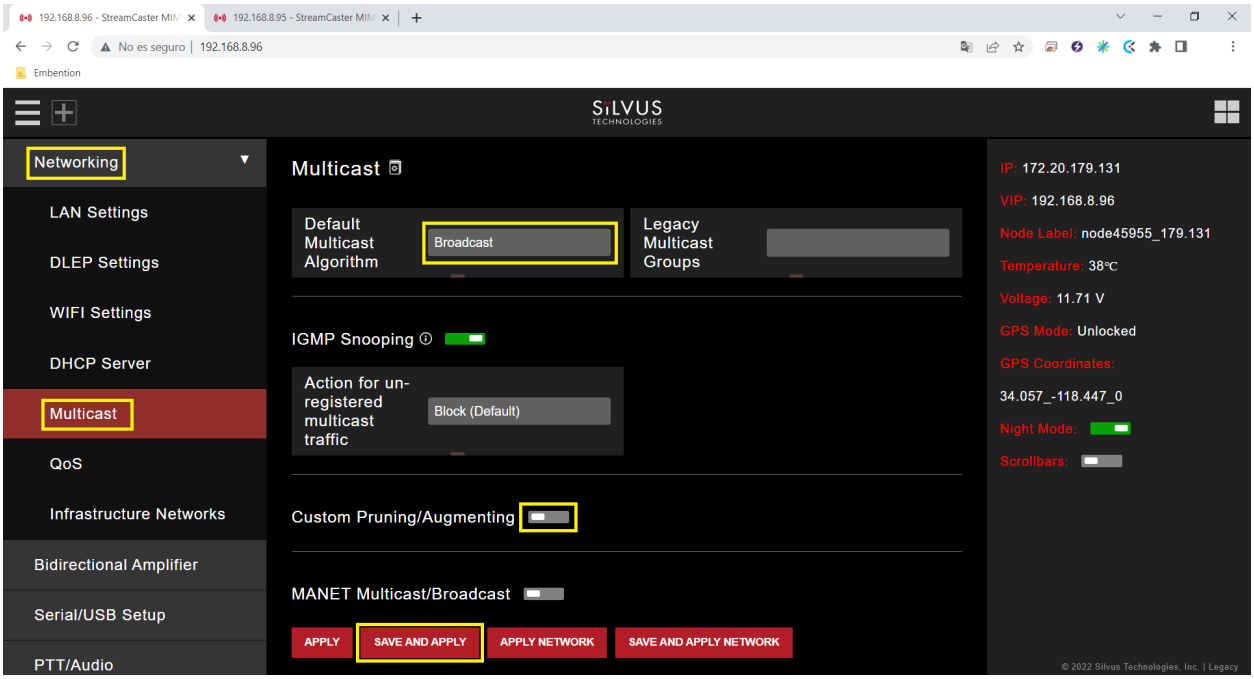


Fig. 73: **Multicast panel**

- **Default Multicast Algorithm**: Broadcast.
- **Custom Pruning/Augmenting**: Disable.

4. Serial/USB Setup

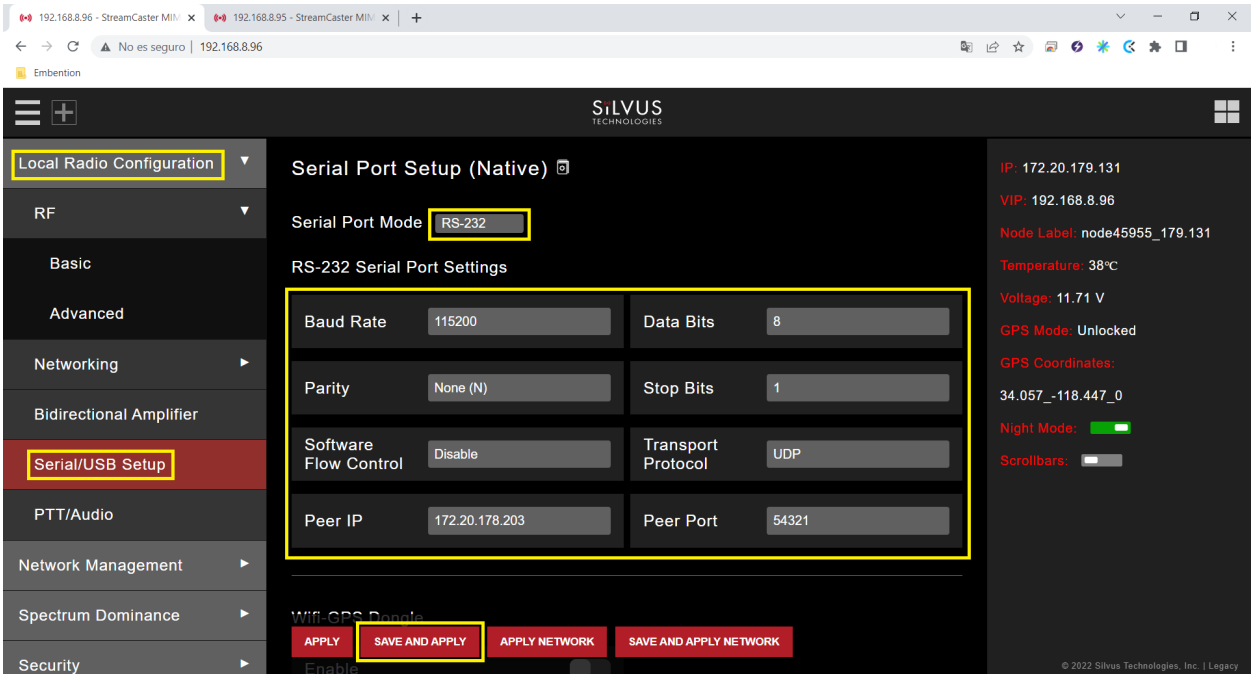


Fig. 74: **RS-232 settings**

- **Serial Port Setup**: RS-232.

- RS-232 Serial Port Settings
  - The value of the **Baudrate**, **Data Bits**, **Parity** and **Stop Bits** parameters must be the same as those configured in the Veronte software:.
  - **Software Flow Control**: Disable.
  - **Transport Protocol**: We recommend **UDP**. If no data loss can be tolerated, change this setting to TCP on the radio corresponding to the 1x **air** unit.
  - **Peer IP**: This should be the IP address of the radio on the other end of the RS-232. In this example, we must set the IP address of the radio linked to the GND unit.

Note: Both radios (the one connected to the GND unit and the one connected to the AIR unit) have the same configuration except for the **Peer IP**.

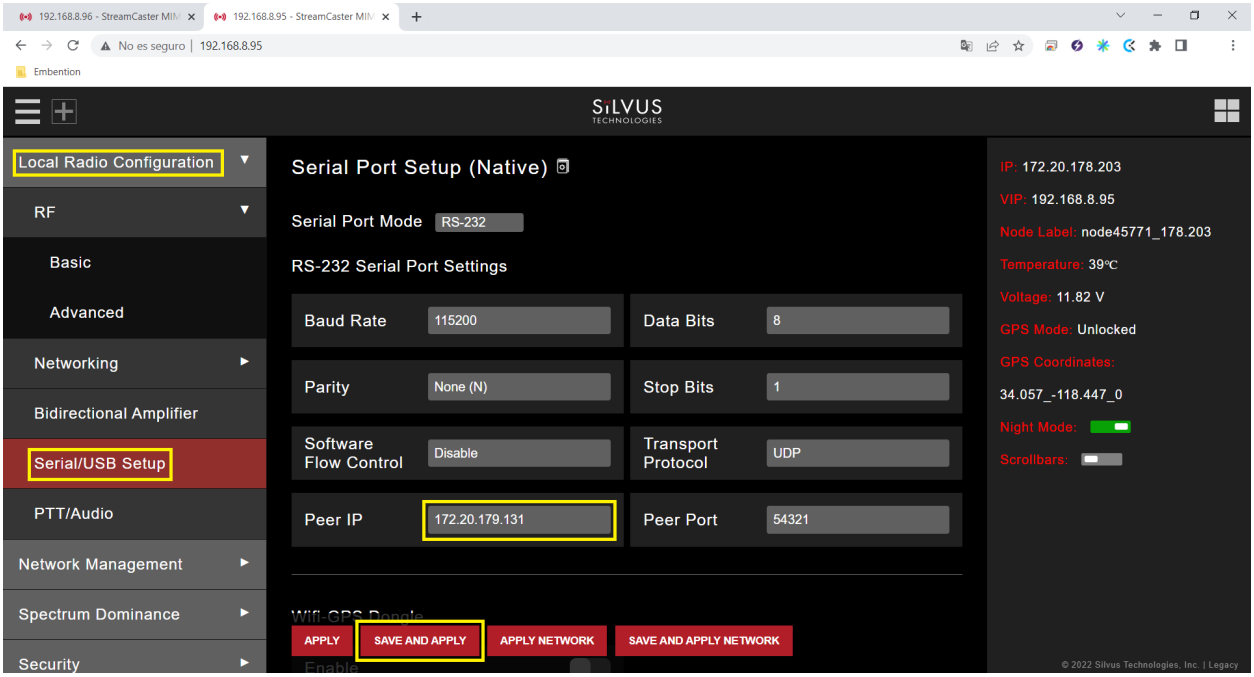


Fig. 75: **Peer IP in radio linked to the GND unit**

In addition to these settings, different configurations can be stored in the same radio, on the **Multi-Position Switch** panel. The user can select the one that will work, with the radio's switch position.

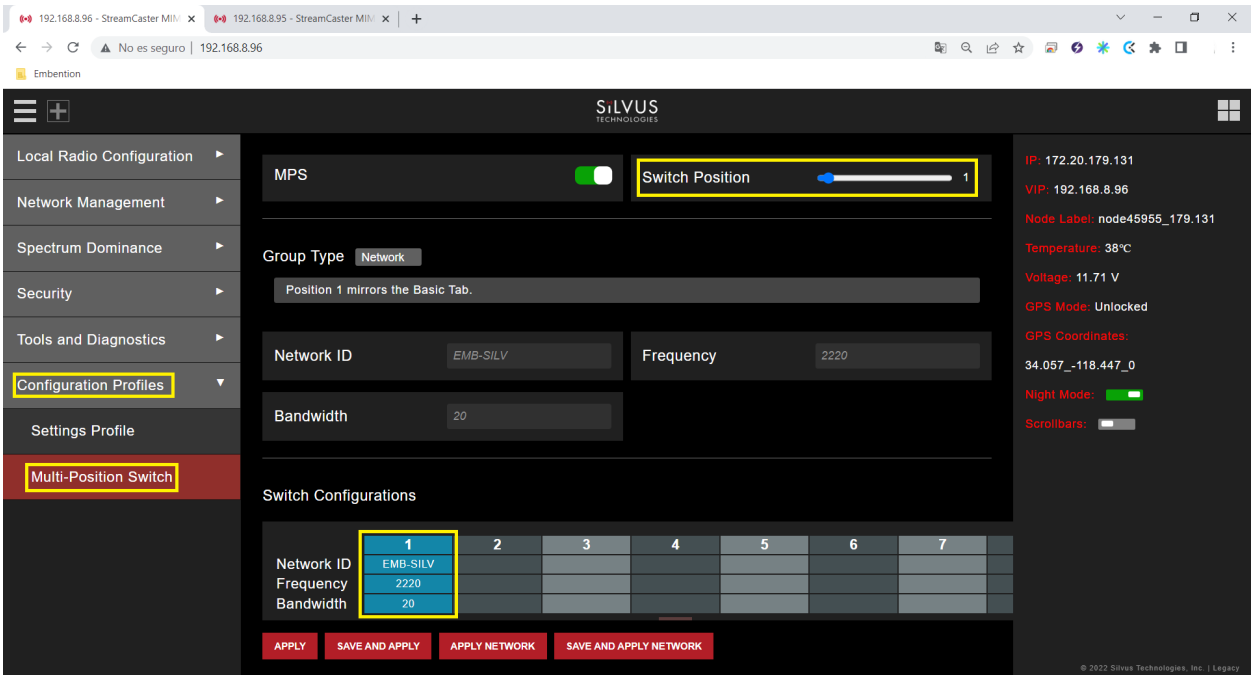


Fig. 76: **Multi-Position Switch panel**

In this example only one configuration has been created.

With the above settings the configuration is finished. Furthermore, this configuration can be saved and downloaded in the **Settings Profile** window of the Configuration Profiles section.

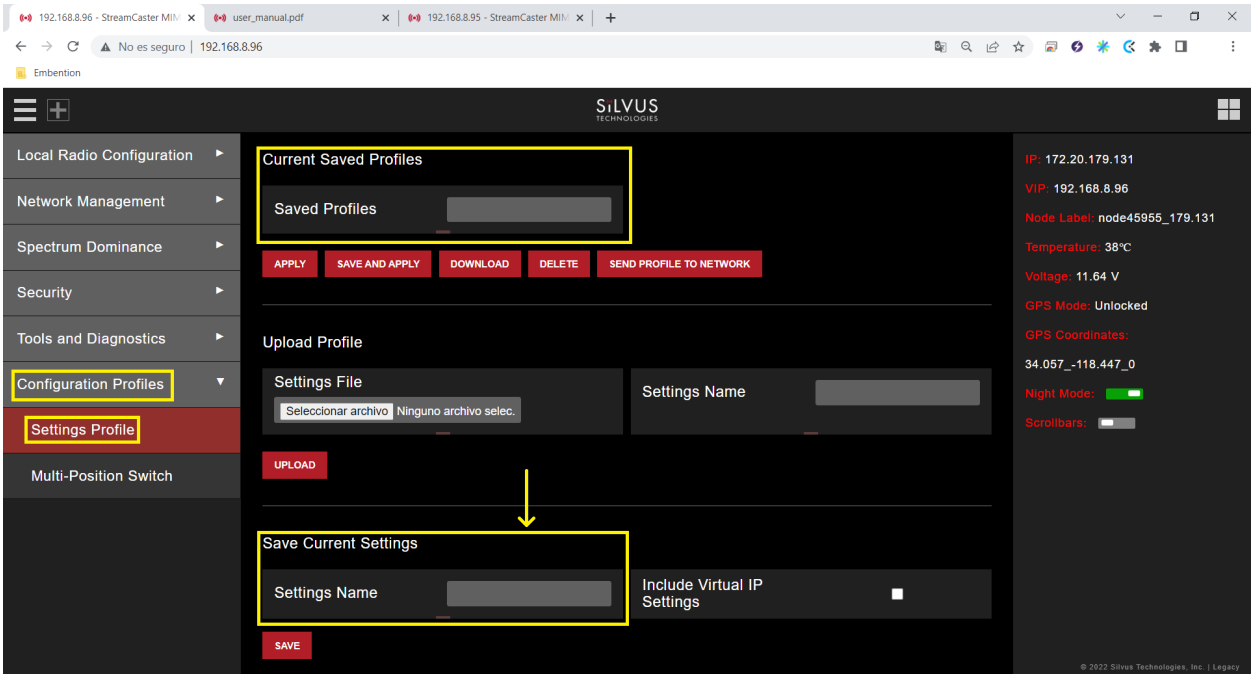


Fig. 77: **Settings Profile panel**

Before downloading the configuration, it is necessary to save it.

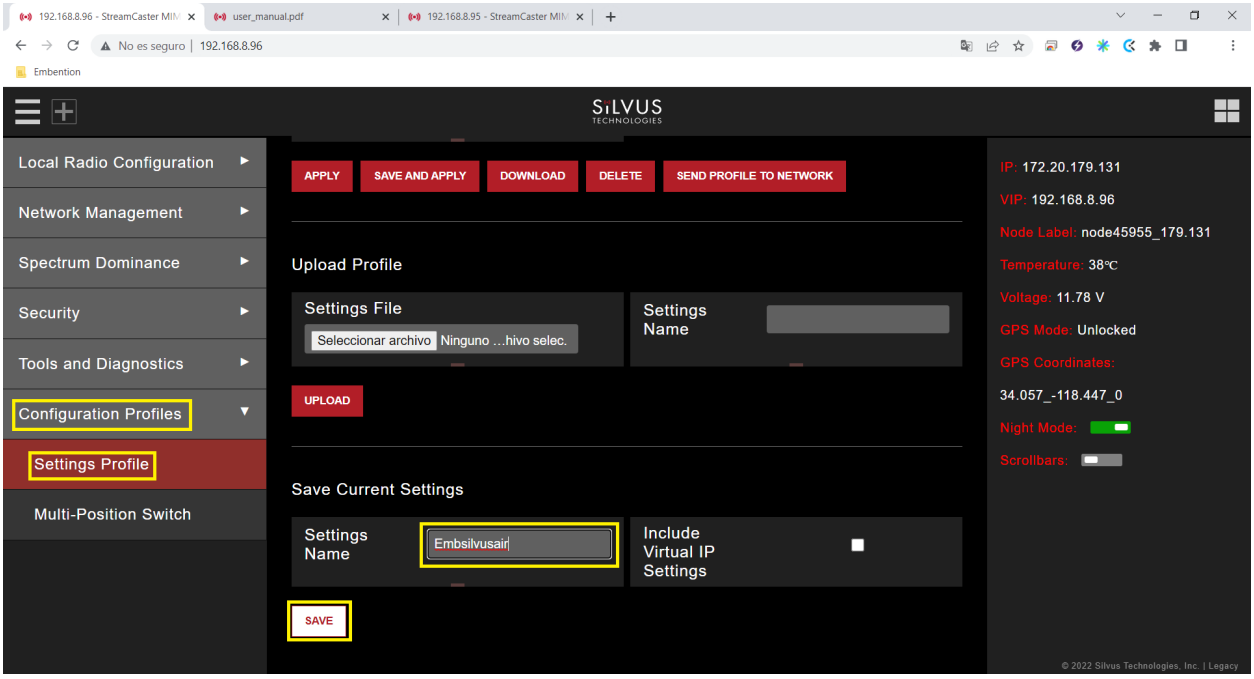


Fig. 78: **Save settings**

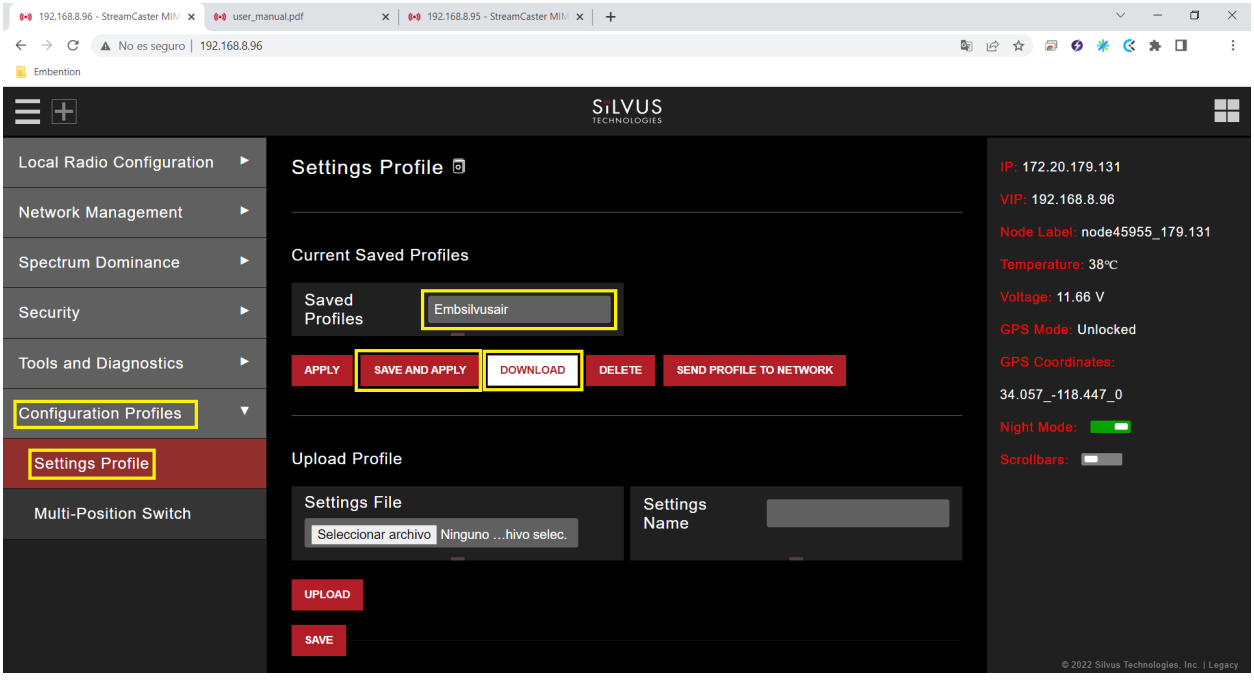


Fig. 79: **Download settings**

After configuring both radios with these settings they should be paired. Therefore, if we connect them to the power supply, when we switch them on, the LED will turn from fix red to fix green, this indicates that it is

connected to at least one radio. Also, if we connect only one of them to the computer, we can access the **StreamScape** GUI of both.

And, in the **Network Topology** window of the Network Management section, we can see the link between them.

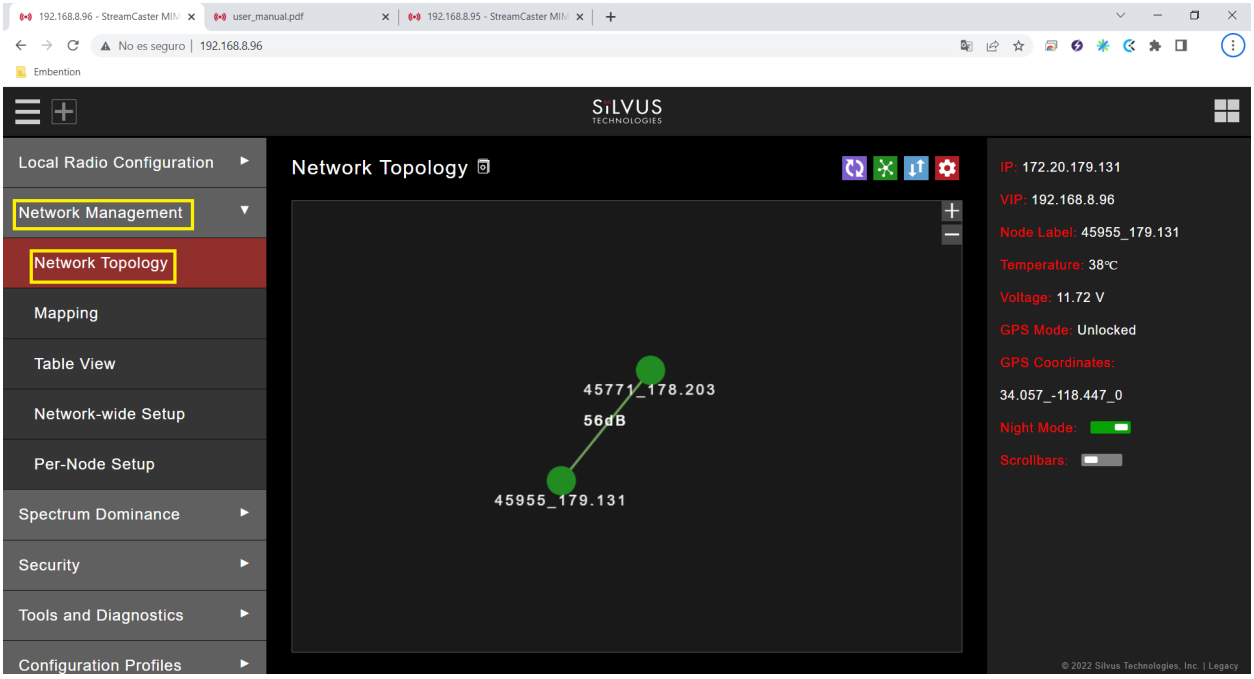


Fig. 80: **Connection between radios**

9.2.3.4 Silvus radio configuration in autopilot

The necessary configuration of **Veronte Autopilot 1x** for Silvus radios require different applications, according to the software version:

`6.8 or higher:` use **1x PDI Builder** reading its user manual. Go to Integration examples -> External radios section.

`6.4 or lower:` use **Veronte Pipe** reading the Veronte Autopilot manual. Go to Veronte Autopilot -> Silvus Radio Configuration.

9.3 External Sensors

9.3.1 OAT sensor 428 of MGL Avionics

Fig. 81: **OAT sensor 428**

The **OAT sensor 428** of MGL Avionics is an analogical temperature sensor that measures temperatures from -55°C to 150°C. It changes the voltage according to the temperature measured and therefore the connection to the autopilot is performed using the ADC pins.

9.3.1.1 Hardware installation

The following resistors and wiring are necessary to connect an **OAT sensor 428** to the **Autopilot 1x**:

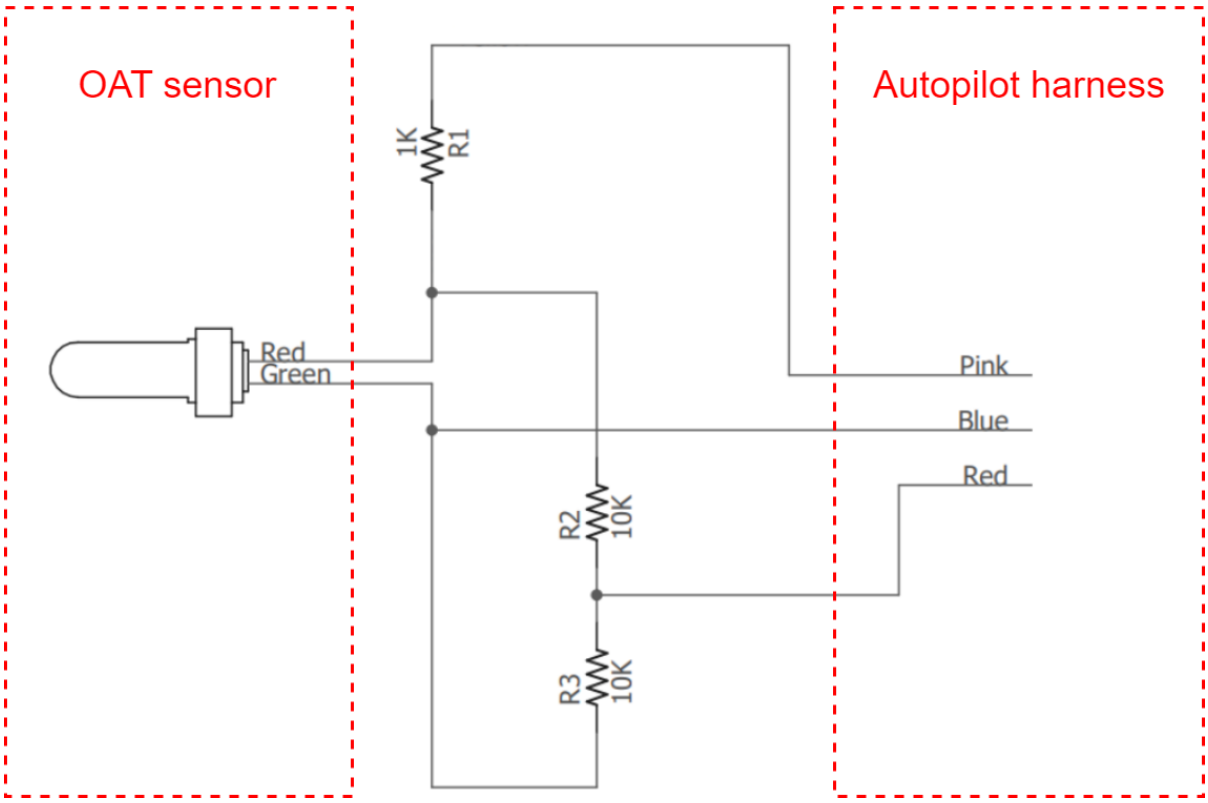


Fig. 82: **OAT sensor wiring**

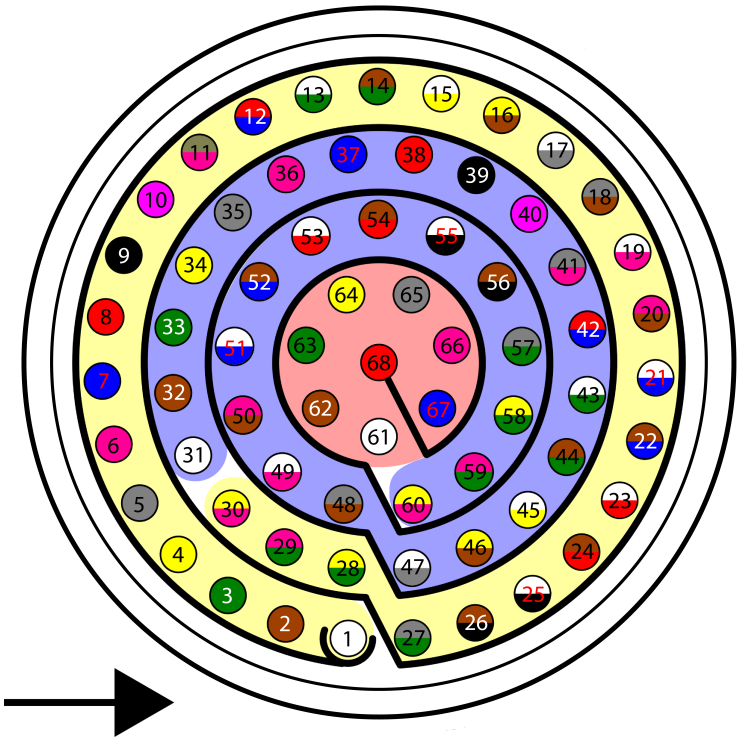


Fig. 83: **Harness pinout**

Autopilot 1x Connections		
Pin number	Signal	Harness wire colour
36	5V	Pink
37	GND	Blue
38	ANALOG_1	Red

9.3.1.2 Software installation

Once connected the **OAT sensor**, the temperature can be monitored with Veronte software using the variables ADC1 to ADC5.

The necessary configuration of **Veronte Autopilot 1x** for OAT sensors require different applications, according to the software version:

`6.8 or higher:` use **1x PDI Builder** reading its user manual. Go to 1x PDI Builder manual -> Integration Examples.

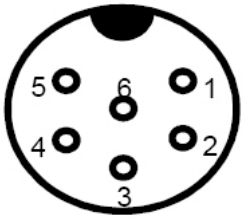
9.4 Joysticks

To use the joystick in the system, connect the PPMout of the trainer port to a digital input of Veronte Autopilot 1x and configure that digital input in the corresponding software.

If the PPM level is 3.3V, pins 1-8, 10-17 and 55-58 pins can be used.

Veronte is compatible with standard Pulse Positon Modulation (PPM) signals, Futaba radios between 8 and 12 channels are recommended.

Fig. 84: **Futaba T10 Joystick**

Pin	Designation	Connector
SHIELD	GROUND	
1	$V_{ENCODER}$	
2	PPM_{OUT}	
3	PPM_{IN}	
4	V_{ENC2}	
5	$V_{BATTERY}$	
6	UNKNOWN	

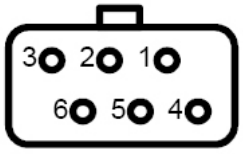
Pin	Designation	Connector
1	NC	
2	GROUND	
3	PPM_{OUT}	
4	$V_{BATTERY}$	
5	$V_{ENCODER}$	
6	PPM_{IN}	

Fig. 85: **Futaba T10 pinout**

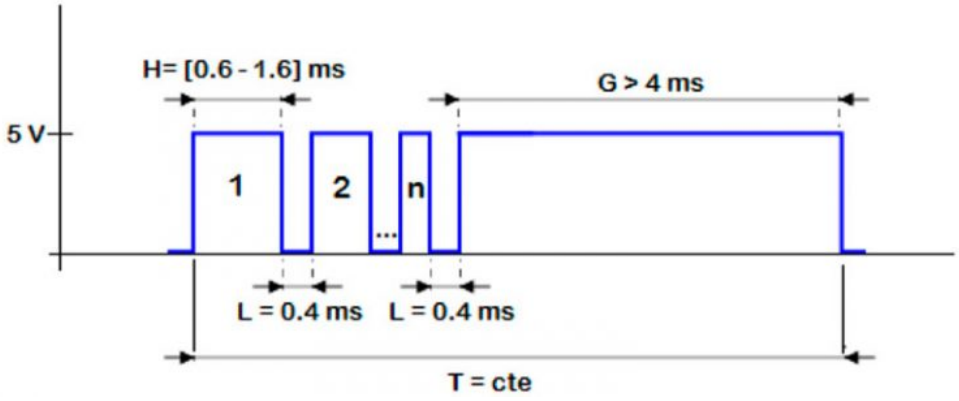


Fig. 86: **PPM signal**

As default, channel 8 is reserved for manual / auto switch. High level is used for automatic flight and low level for manual control. This channel can be configured on Veronte software.

Warning: Caution!! PPM signal must be into the Veronte voltage ranges. Some joysticks may need an adaptation board, please ask our team to check compatibility.

Veronte connector for CS is provided with 3.5mm stereo plug connector as follows:

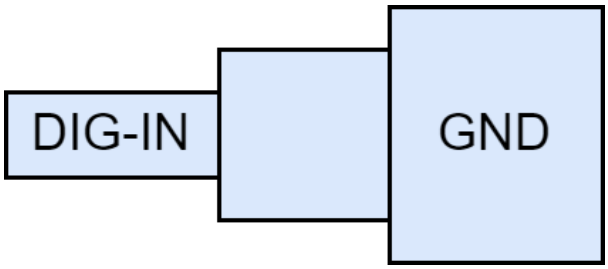


Fig. 87: **PPM pinout**

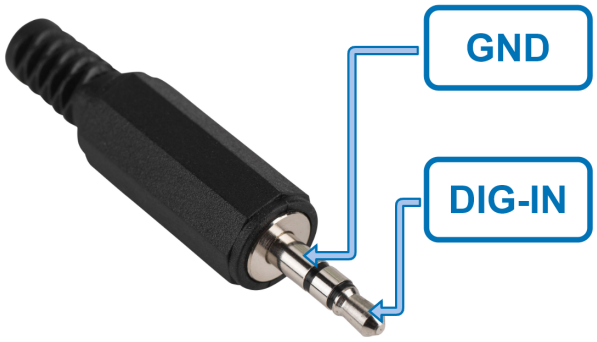


Fig. 88: **PPM connector**

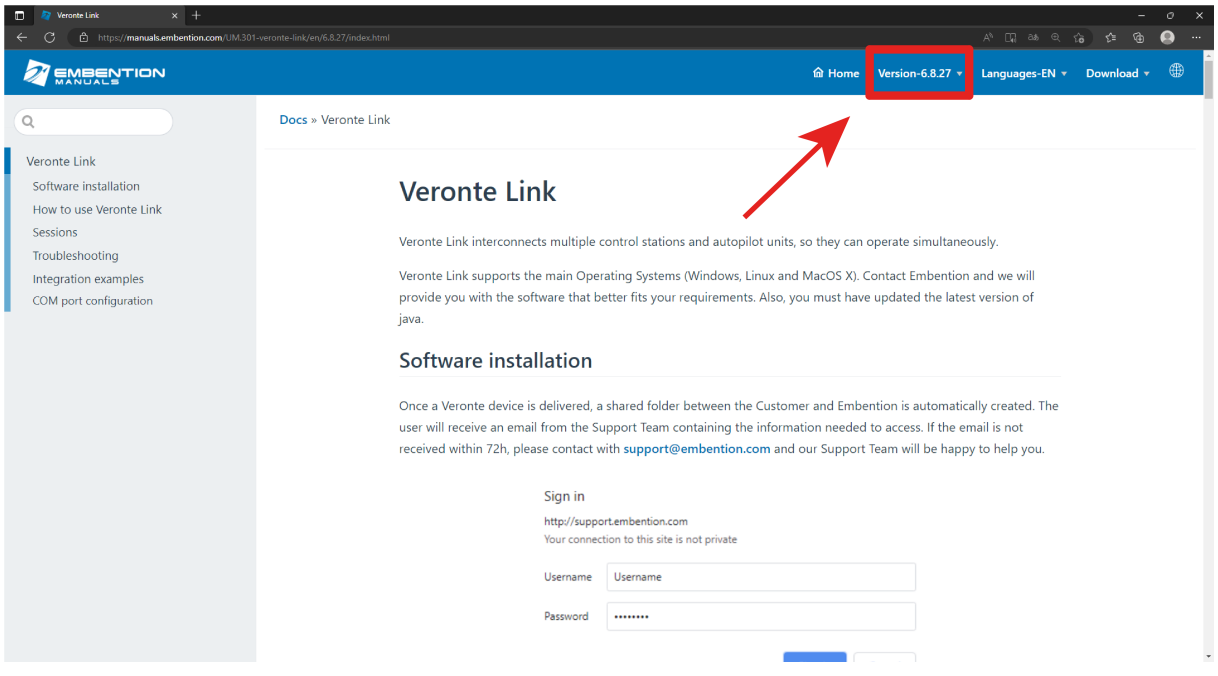
CHAPTER

TEN

TROUBLESHOOTING

In case of any issue with software, read the Troubleshooting section of the manual for the corresponding software.

Warning: Select your version before reading any user manual for software. The following image shows where to select a version from any Embention user manual.



10.1 Maintenance mode

Maintenance mode is the main troubleshooting tool that **Veronte Autopilot 1x** puts at the user disposal. While in **maintenance mode**, all communication channels are enabled by default, so it is possible to connect with **Autopilot 1x** through any of its configuration interfaces, no matter its current configuration.

The main use of **maintanance mode** is to solve issues related to the current configuration, mainly related with communication or memory writting issues.

While in **maintenance mode**, it is possible to perform actions such as force the load of a new configuration file or format the SD card.

If at some point the communication with **Autopilot 1x** is lost, it is possible to use **maintenance mode** to go back to a previous state of the configuration (as long as it was exported previously), format the SD card to start over or update the unit's firmware.

Tip: It is heavily recommended to always use **maintenance mode** to load a new configuration that is very different from the current one.

10.2 How to enter in maintenance mode

There are two ways to enter in **maintenance mode**: using software or forcing it.

10.2.1 Using software to enter in maintenance mode

To enter in **maintenance mode** using software, read the maintenance mode section of the manual for the corresponding software.

10.2.2 Forcing maintenance mode

There are two ways to force the maintenance mode: using power supply or using the I2C pins.

10.2.2.1 Using the power supply to force maintenance mode

When communication with the unit is lost, it is possible to active **maintenance mode** by power input.

In order to active **maintenance mode**, power cycle the **Veronte Autopilot 1x** repetively with a period of 1 second. After 30 cycles, the autopilot will enter in **maintenance mode**.

Autopilot 1x might enter in **maintenance mode** if a problem with the power supply is detected upon boot up (voltage or current is out of range).

Fig. 1: **How to power cycle an autopilot**

10.2.2.2 Using the I2C pins to enter in maintenance mode

To enter in **maintenance mode** with I2C, connect both I2C pins each other, then power up the **Veronte Autopilot 1x**. Both pins are I2C_CLK (number 31) and I2C_DATA (number 32) according to the *pinout*.

10.3 Pinout changes from Autopilot 1x 4.8

The pinout for `4.5` and `4.8` versions are very similar, but they have several differences. To prevent any confusion, the following table shows the pinout for both versions. The different pins are marked with ⚠, all the rest have the same function.

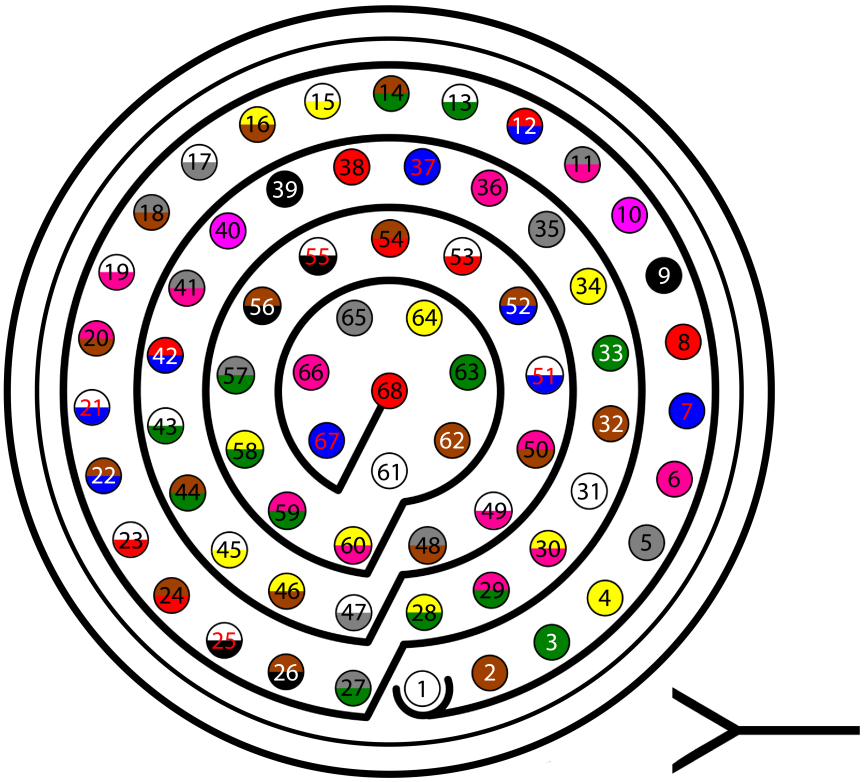


Fig. 2: **68 pin connector for both versions**

Pin	Signal	Type	Comments
1	I/O1	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
2	I/O2	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
3	I/O3	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
4	I/O4	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
5	I/O5	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit

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Table 1 – continued from previous page

Pin	Signal	Type	Comments
6	I/O6	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
7	I/O7	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
8	I/O8	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
9	GND	GROUND	Ground signal for actuators 1-8
10	I/O9	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
11	I/O10	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
12	I/O11	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
13	I/O12	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
14	I/O13	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
15	I/O14	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
16	I/O15	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
17	I/O16	I/O	PWM / Digital I/O signal (0-3.3V). Protected against ESD and short circuit
18	GND	GROUND	Ground signal for actuators 9-16

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Table 1 – continued from previous page

Pin	Signal	Type	Comments
19	RS 232 TX	Output	RS 232 Output (-13.2V to 13.2V Max, -5.4V to 5.4V Typical). Protected against ESD and short circuit
20	RS 232 RX	Input	RS 232 Input (-25V to 25V Max, -0.6V Low and 2.4V High Threshold). Protected against ESD and short circuit
21	GND	GROUND	Ground signal for buses
22	Analog 4	Input Analog	Input 0-3.3V. Protected against ESD and short circuit
23	Analog 5	Input Analog	Input 0-3.3V. Protected against ESD and short circuit
24	GND	GROUND	Ground signal for buses
25	CanA P	I/O	CANbus interface, up to 1Mbps (2.3V Typical, 1.2V-2.3V Differential). Protected against ESD
26	CanA N	I/O	Twisted pair with a 120 ohms Zo recommended (2.3V Typical, 1.2V-2.3V Differential). Protected against ESD
⚠ 27	`4.5:` GND	`4.5:` GROUND	`4.5:` Ground signal for buses
	`4.8:` 4XV_WD	`4.8:` I/O	`4.8:` Reserved. Do not connect
28	CANB_P	I/O	CANbus interface. It supports data rates up to 1 Mbps. Protected against ESD
29	CANB_N	I/O	Twisted pair with a 120 ohms Zo recommended. Protected against ESD
30	GND	GROUND	Ground signal for buses
31	I2C_CLK	Output	Clk line for I2C bus (0.3V to 3.3V). Protected against ESD and short circuit
32	I2C_DATA	I/O	Data line for I2C bus (0.3V to 3.3V). Protected against ESD and short circuit
33	GND	GROUND	Ground for 3.3V power supply

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Table 1 – continued from previous page

Pin	Signal	Type	Comments
34	3.3V	POWER	3.3V - 100mA power supply. Protected against ESD short circuit with 100mA resettable fuse
35	GND	GROUND	Ground for 5V power supply
36	5V	POWER	5V – 100mA power supply. Protected against ESD short circuit with 100mA resettable fuse
37	GND	GROUND	Ground for analog signals
38	ANALOG_1	Input	Analog input 0-3.3V. Protected against ESD and short circuit
39	ANALOG_2	Input	Analog input 0-3.3V. Protected against ESD and short circuit
40	ANALOG_3	Input	Analog input 0-3.3V. Protected against ESD and short circuit
⚠ 41	`4.5:` GND	`4.5:` GROUND	`4.5:` Ground for FTS signals
	`4.8:` 4XV_A	`4.8:` I/O	`4.8:` Reserved. Do not connect
42	FTS1_OUT	Output	Deadman signal from comicro. Protected against ESD and short circuit
43	FTS2_OUT	Output	!SystemOK Bit. Protected against ESD and short circuit
⚠ 44	`4.5:` GND	`4.5:` GROUND	`4.5:` Ground signal for safety buses
	`4.8:` 4XV_B	`4.8:` I/O	`4.8:` Reserved. Do not connect
⚠ 45	`4.5:` V_ARB_TX	`4.5:` Output	`4.5:` Veronte comicro UART output to activate safety mechanism. Protected against ESD and short circuit
	`4.8:` UARTA_TX	`4.8:` Output	`4.8:` Microcontroller UART
⚠ 46	`4.5:` V_ARB_RX	`4.5:` Input	`4.5:` Veronte comicro UART output to activate safety mechanism. Protected against ESD and short circuit
	`4.8:` UARTA_RX	`4.8:` Input	`4.8:` Microcontroller UART

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Table 1 – continued from previous page

Pin	Signal	Type	Comments
47	GND	GROUND	Ground signal comicro power supply
48	V_ARB_VCC	POWER	Veronte comicro power (6.5V to 36V). Protected against ESD and reverse polarity
49	FTS3_OUT_MPU	Output	MPU alive voting signal, to use with 4xVeronte. It is a Square Wave at [100,125] Hz. Protected against ESD and short circuit
50	OUT_RS485_P	Output	Non-inverted output from RS485 bus (-7V to 12V Max, -2.3V to 2.3V Typical). Protected against ESD and short circuit
51	OUT_RS485_N	Output	Inverted output from RS485 bus (-7V to 12V Max, -2.3V to 2.3V Typical). Protected against ESD and short circuit
52	IN_RS845_N	Input	Inverted input from RS485 bus (-7V to 12V Max, -2.3V to 2.3V Typical). Protected against ESD and short circuit
53	IN_RS845_P	Input	Non-inverted output from RS485 bus (-7V to 12V Max, -2.3V to 2.3V Typical). Protected against ESD and short circuit
54	RS-485_GND	GND	Ground for RS-485 bus
55	EQEP_A	I/O	DIGITAL output / DIGITAL input / Encoder quadrature input A (0-3.3V). Protected against ESD and short circuit
56	EQEP_B	I/O	DIGITAL output / DIGITAL input / Encoder quadrature input B (0-3.3V). Protected against ESD and short circuit WARNING!: Only use it as digital I/O with Veronte units of Hardware version 4.5 or lower

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Pin	Signal	Type	Comments
57	EQEP_S	I/O	DIGITAL output / DIGITAL input / Encoder strobe input (0-3.3V). Protected against ESD and short circuit
58	EQEP_I	I/O	DIGITAL output / DIGITAL input / Encoder index input A (0-3.3V). Protected against ESD and short circuit
59	GND	GROUND	Ground for encoders
60	V_USB_DP	I/O	Veronte USB data line. Protected against ESD
61	V_USB_DN	I/O	Veronte USB data line. Protected against ESD
⚠ 62	`4.5:` V_USB_ID	`4.5:` I/O	`4.5:` Veronte USB ID line. Protected against ESD and short circuit
	`4.8:` USB_SHIELD	`4.8:` GND	`4.8:` USB cable shielding
63	FTS_OUT_MPU	Output	Abort mission voting signal from MPU, to use with 4xVeronte. Bit Low (0V) if mission OK. High (3.3V) if mission wants to be terminated. Protected against ESD and short circuit
64	FTS2_OUT_MPU	Output	Abort mission voting signal 2 from MPU, to use with 4xVeronte. Bit Low (0V) if mission OK. High (3.3V) if mission wants to be terminated. Protected against ESD and short circuit
65	GND	GROUND	Veronte ground input
66	GND	GROUND	Veronte ground input
67	VCC	POWER	Veronte power supply (6.5V to 36V). Protected against ESD and reverse polarity. **Warning:** Both pins are common. They MUST be connected to the same power supply.
68	VCC	POWER	

Warning: Remember!! All GND pins are common.

CHAPTER

ELEVEN

ACRONYMS AND DEFINITIONS

11.1 Acronyms

16 VAR	16 Bits variables (Integers)
32 VAR	32 Bits variables (Reals)
ADC	Analog to Digital Converter
ADSB	Automatic Dependent Surveillance–Broadcast
AGL	Above Ground Level
AoA	Angle of Attack
ARC	Arcade Mode
AUTO	Automatic Mode
BIT	Bit Variables
BLOS	Beyond Line Of Sight
CAN	Controller Area Network
CAP	Capture Module
CMB	Climb Phase
CRU	Cruise Phase
DC	Direct Current
DGPS	Differential GPS
ECAP	Enhanced CAP
ECEF	Earth Centered – Earth Fixed
EGNOS	European Geostationary Navigation Overlay Service
EKF	Extended Kalman Filter
ESC	Electronic Speed Controller
FCS	Flight Control System
FHSS	Frequency Hopping Spread Spectrum
FLR	Flare Phase
FTS	Flight Termination System
GIS	Geographical Information System
GND	Ground
GNSS	Global Navigation Satellite Systems
GPIO	General Purpose Input Output
GPS	Global Positioning System
GS	Ground Speed
GS	Ground Segment
HLD	Hold Phase
HUM	Hardware User Manual
I2C	Inter-Integrated Circuit

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IAS	Indicated Air Speed
ID	Identification
IMU	Inertial Measurement Unit
ISM	Industrial Scientific and Medical
LED	Light-Emitting Diode
LND	Landing Phase
LOS	Line Of Sight
M2M	Machine To Machine
MSL	Mean Sea Level
OPV	Optionally Piloted Vehicle
PFD	Primary Flight Display
PID	Proportional Integral Derivative
PPM	Pulse Position Modulation
PWM	Pulse Width Modulation
QNH	Barometric atmospheric pressure adjusted to sea level
RC	Radio Control Mode
RF	Radio Frequency
RPAS	Remotely Piloted Aircraft System
RPM	Revolutions Per Minute
RS 232	Recommended Standard 232
RS 485	Recommended Standard 485
RX	Reception
SMA	SubMiniature Version A Connector
SSMA	Miniature-SMA
STB	Standby Phase
SU	Servo-Output matrix
SUM	Software User Manual
TAS	True Air Speed
TKO	TakeOff Phase
TX	Transmission
UART	Universal asynchronous receiver-transmitter
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle
US	Output-Servo matrix
VTOL	Vertical TakeOff and Landing
WGS 84	World Geodetic System 84
WP	Waypoint

11.2 Definitions

- **Control Phase:** The operation is divided into phases in which the UAV has a specific performance. Each of this phases is called a control phase.
- **Control Channel:** It is each of the signals used to control a behaviour or action.
- **Control Mode:** It is possible to make a manual control of the UAV by stick, assisted control and fully automatic control.
- **Actuator:** It is a mechanic device to provide force to move or "act" another mechanical device.

CHAPTER

TWELVE

CONTACT DATA

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