REx Hardware Manual

Release 2.0/1.3

Embention Sistemas Inteligentes, S.A.

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Scope of Changes

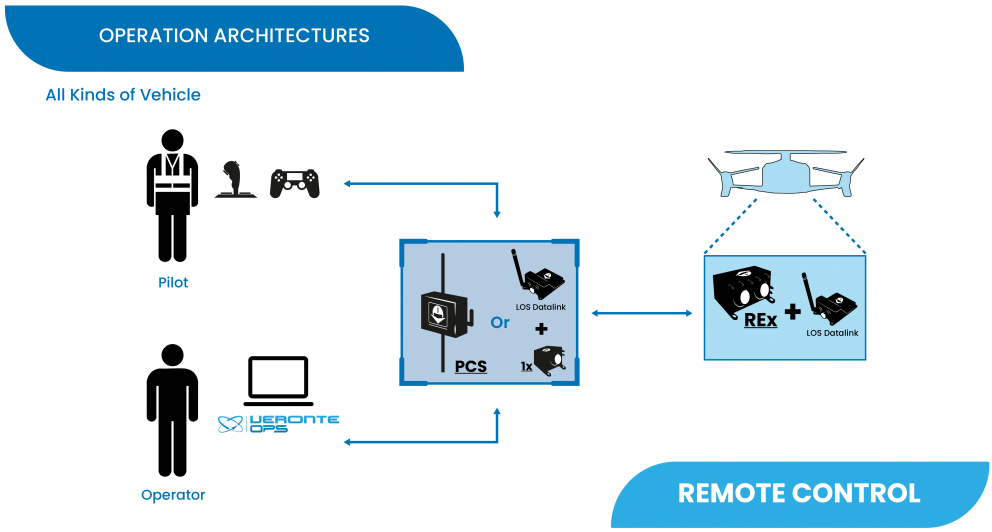
- Version 1.0
  - Added:
    - First version issued.
- Version 1.1
  - Added:
    - Maintenance button to the Connections Diagram and Troubleshooting.
  - Fixed:
    - Corrected the REx weight to **737 g**.
    - Antenna Integration - Hardware Installation changed minimum supply voltage to **5 V**.
- Version 1.2
  - Added:
    - 'Important' about the position of the **master keyway** of the connectors in Pinout - Hardware Installation section.
  - Changed:
    - Accelerometers and Gyroscopes tables in Sensor Specifications section.
- Version 1.3
  - Removed:
    - **Geocaging** subsection from Flight Termination System (FTS) section.

Introduction



Veronte Autopilot REx

Veronte Autopilot REx is a miniaturized high reliability avionics system for advanced control of **unmanned systems**. This control system embeds a state-of-the-art suite of sensors and processors together with BLOS M2M datalink radio, all with reduced size and weight.



Veronte Autopilot REx is designed to control any unmanned vehicle, either aircraft such as: multirotors, helicopters, airplanes, VTOL, blimps... as well as ground vehicles, surface vehicles or many others. Custom flight phases and control channels provide support for any aircraft layout and performance by using the same software and hardware for: UAS, RPAS, Drone, USV / ASV, UGV...

Applications

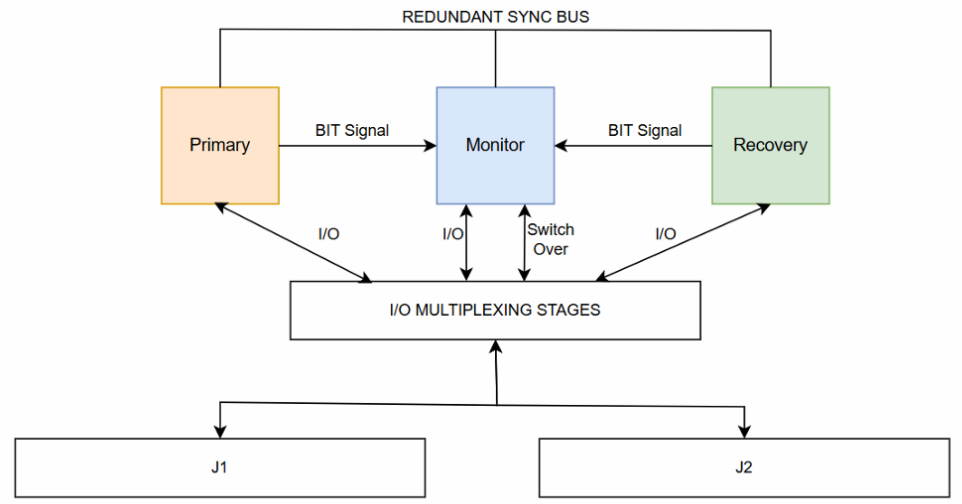
Autopilot REx allows aircrafts to perform sensitive flight missions and transport valuable payloads with advanced safety conditions and high reliabilty. By installing a triple redundant core it is possible to extend the mean time between failures in systems. This control module is also suitable for both, fail-safe and fail-operational missions, extending the operability of the system.

Control diagram

Veronte Autopilot REx is a **triple redundant** autopilot built around a **Primary–Monitor–Recovery** architecture, with three independent and dissimilar cores, each with its own sensor suite, running in parallel within a single enclosure.

The **Primary** core executes the GNC commands. The **Monitor** runs its own GNC and continuously audits the health of the other cores, selecting the core in charge of control. If the Primary fails, the **Recovery** core takes over via hardware multiplexers, providing a seamless switchover that is transparent to the aircraft.

All external I/O is duplicated across two independent connectors, **J1** and **J2**, so that the complete loss of a cable or harness never interrupts communication with external peripherals.

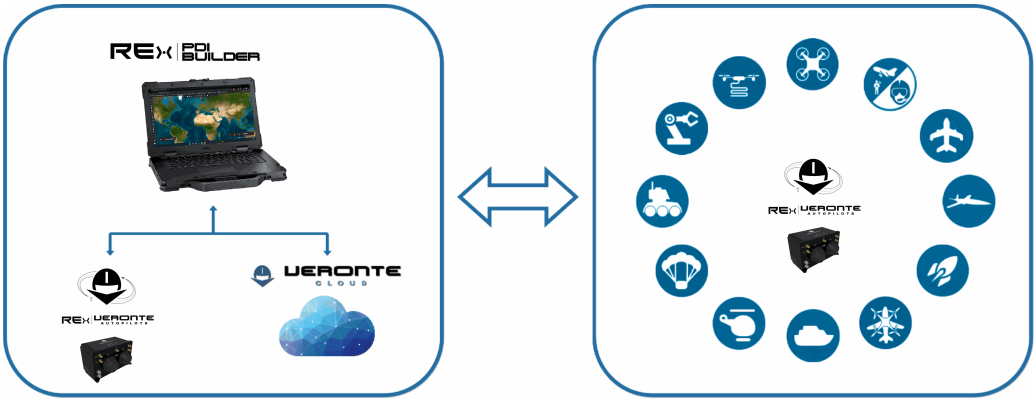


General diagram

Quick Start

This user manual covers the mechanical aircraft-mounting and electrical assembly. This document includes references to install and configure software.

Veronte Autopilot REx is the main element in our FCS for UAV.

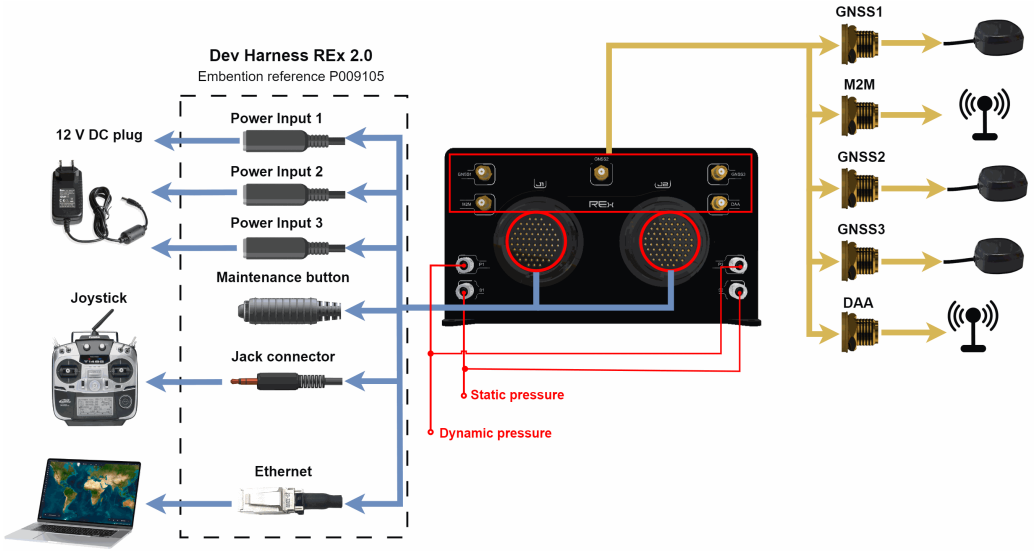


System Overview

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

- A **Veronte Autopilot REx** installed in a vehicle to be controlled. This autopilot executes GNC algorithms in real time to accomplish the planned mission and transport the payload.
- **Veronte Ops** - 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.
- An Autopilot 1x **GND unit** or **PCS** linked between **Veronte Ops** and **Veronte Autopilot REx**. They support manual and arcade modes with conventional joysticks.

Basic Connection Diagram



> **⚠ Warning**
>
> To power all three Autopilot REx cores, connect both J1 and J2. The Primary core power input is on J1, while the Recovery core power input is on J2 (Power Input 3). A single harness can be used to connect the Autopilot REx to the computer, but all three cores must be powered for the three units to be displayed in Veronte Link and available for configuration.

For further information on the Dev Harness REx 2.0 connectors, refer to the Dev Harness REx 2.0 - Hardware Installation section of the present manual.

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.
- Users **must not power on a Veronte Autopilot REx** without **a suitable antenna** or **50 Ω load** connected to the DAA SSMA if the unit has an ADS-B and/or 4G module activated.

> **Danger**
>
> This may damage the Autopilot REx unit.

Firewall Configuration

Users must enable **UDP port 52000** in the firewall to ensure the correct operation of the **Autopilot REx Ethernet** connection.

> ⓘ **Note**
>
> This configuration might need to be performed by the cybersecurity manager of your company.

Technical

General description

Veronte REx is a flight control unit derived from the **Veronte 4x**. Its architecture includes three independent and dissimilar processors that manage the autopilot. Unlike the **Veronte 4x**, where the three internal processors are identical **Veronte 1x** units, in the REx each core has a specific role inside the autopilot: **Primary**, **Monitor** and **Recovery**.

- **Primary:** The main processing unit executing GNC commands.
- **Monitor:** Executing its own GNC, it checks system health and selects the core in control.
- **Recovery:** Takes control in case of failures, ensuring redundancy and safe operation.

Each **Veronte Autopilot REx** contains all the electronics and sensors needed to control the UAV, executing in real time the guidance, navigation and control (GNC) algorithms for the carrying airframe and processing the onboard sensor signals to command the propulsion and actuation systems.

Control diagrams

CAN bus

The Veronte Autopilot REx includes up to 8 CAN FD ports that can be configured as 8 independent buses or as 4 redundant channels. CAN A and B are multiplexed buses routed through J1 and J2. CAN C and D are shared buses routed through J1 and J2.

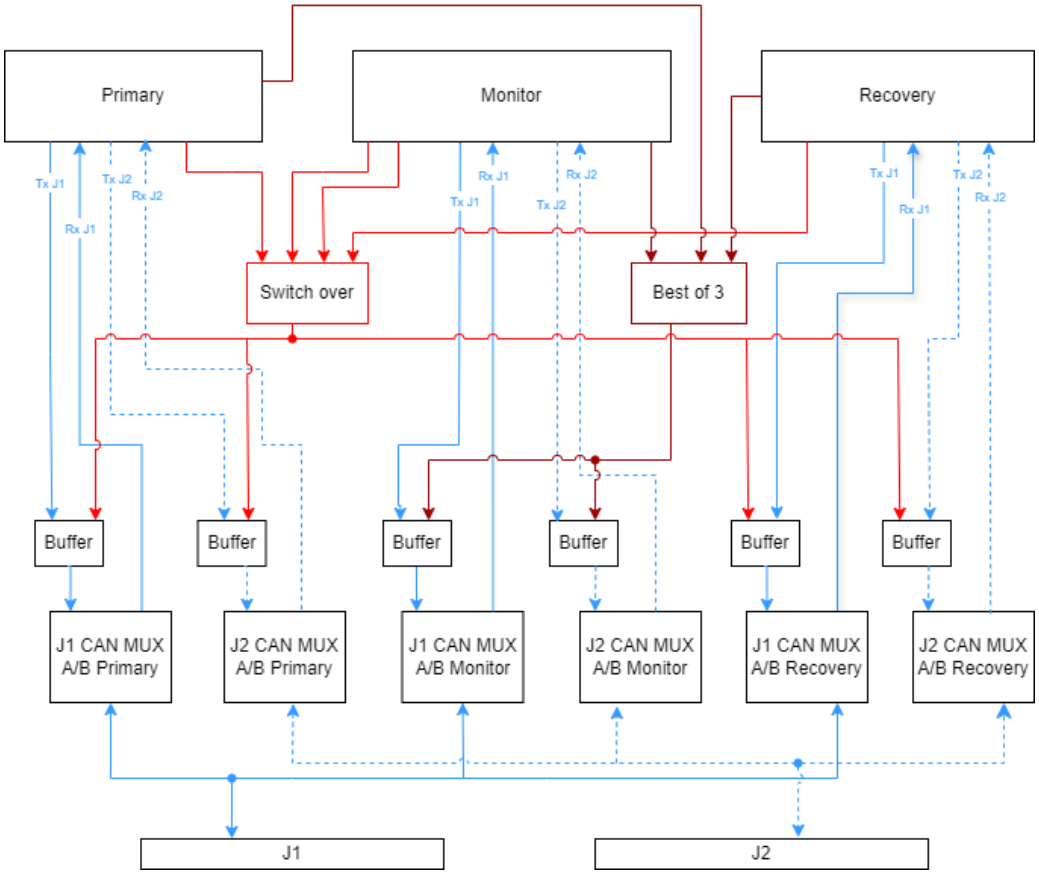
Multiplexed CAN A and B

By default, **CAN A and B** are multiplexed. This means that all three cores can receive CAN messages, but only one core can be in command. The **Monitor** manages the core in command through the **Switch over** block. When this mode is active, only the **Primary** or **Recovery** core can be in command.

These buses can be configured through the **Best of 3** block to allow more than one core to transmit at the same time. Each core can be configured for one of the following modes:

- **Primary and Recovery:** Both the Primary and Recovery cores have Tx enabled at the same time.
- **Primary, Recovery and Monitor:** The Primary, Recovery and Monitor cores have Tx enabled at the same time. In this case, the bus operates as a standard shared bus.

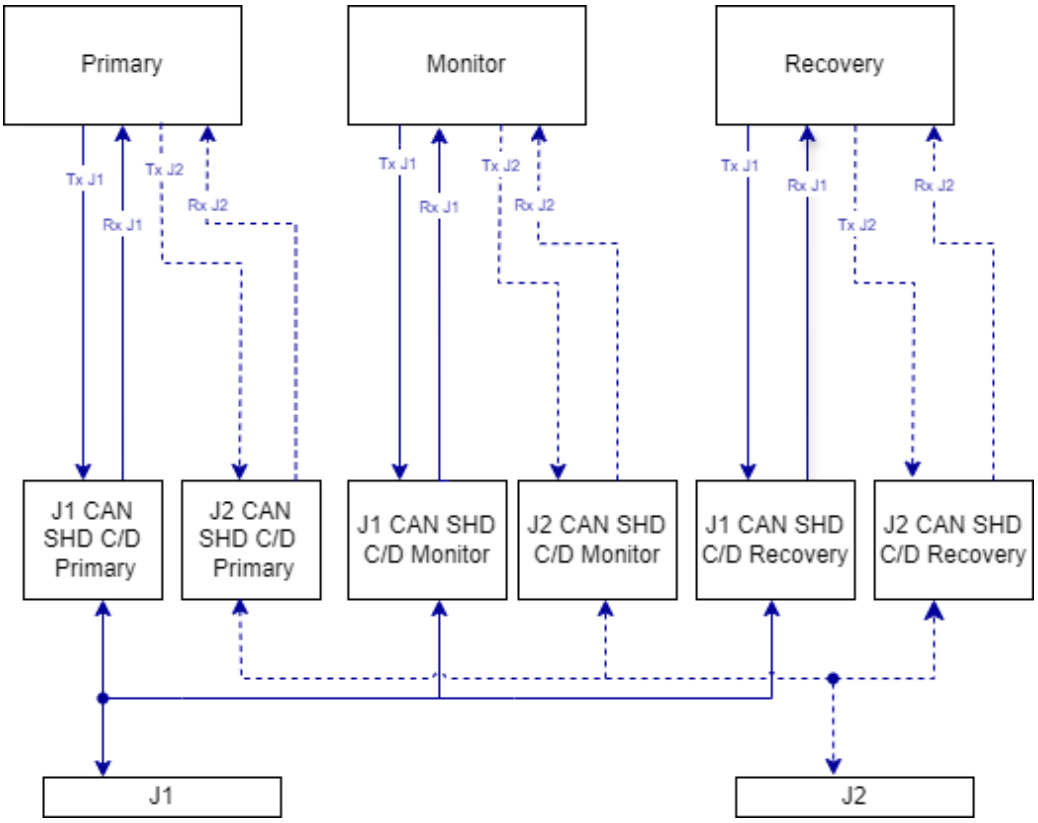
To enable either mode, the **Best of 3** logic requires at least two cores to have the corresponding mode enabled.



CAN A and B diagram

Shared CAN C and D

CAN C and D are fully shared buses. Each core connects directly to its own transceiver on J1 and J2, transmitting and receiving on the bus without arbitration or multiplexing.



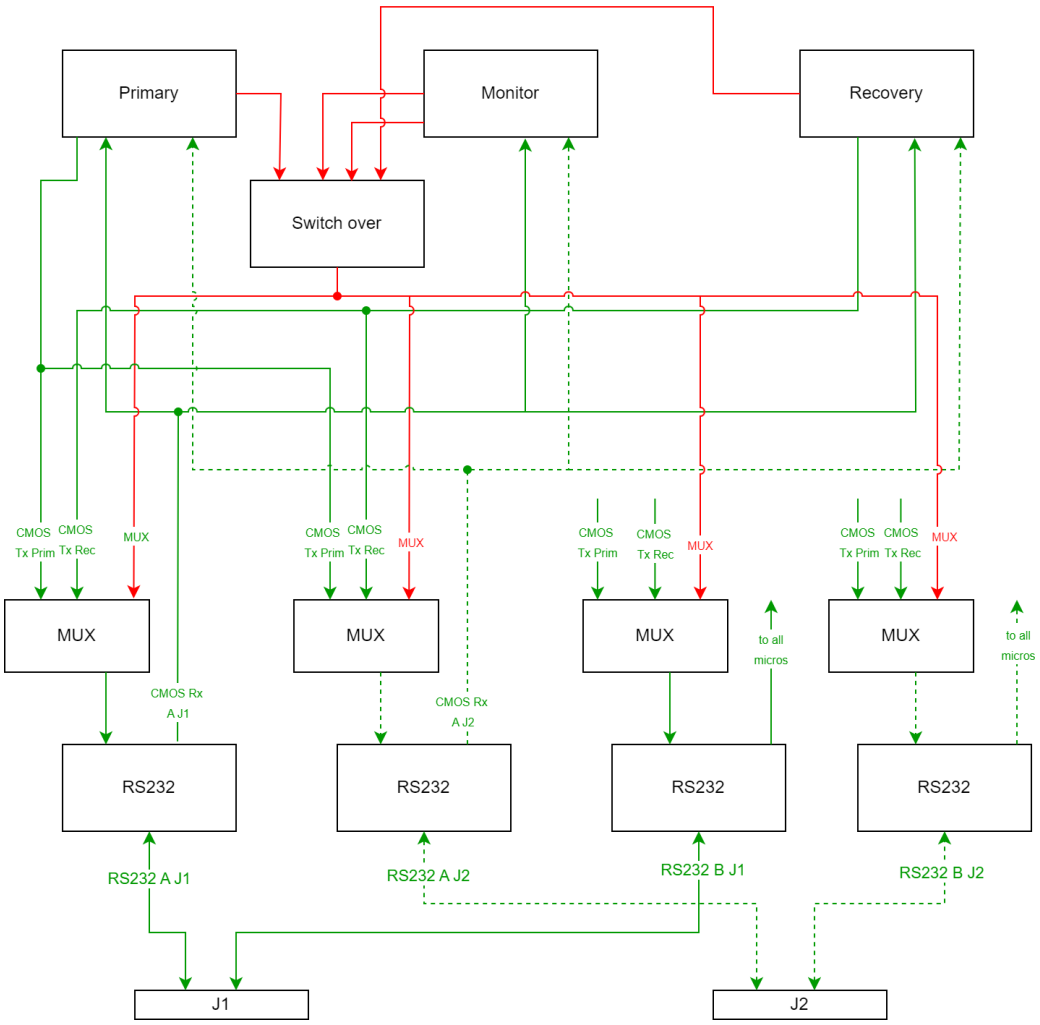
CAN C and D diagram

RS232 and RS485

The system includes 2x RS232 and 2x RS485 ports, both of them redundant and available through J1 (2x RS232 & 2x RS485) and J2 connector (2x RS232 & 2x RS485).

As shown in the diagram, transmission is multiplexed: Primary and Recovery provide their own transmit line (**CMOS Tx**) to a **MUX**, and the **Switch over** block selects which core actually transmits through the RS232 (or RS485) transceiver towards the connector. Reception is shared, so the incoming data reaches all three cores simultaneously. This muxed-Tx / shared-Rx scheme is replicated for the ports on J1 and J2.

> ⓘ **Note**
>
> Unlike CAN, the RS232 ports on J1 and J2 are the same bus because the same Tx signal is routed to both connectors. For example, CAN A on J1 and CAN A on J2 are independent buses.

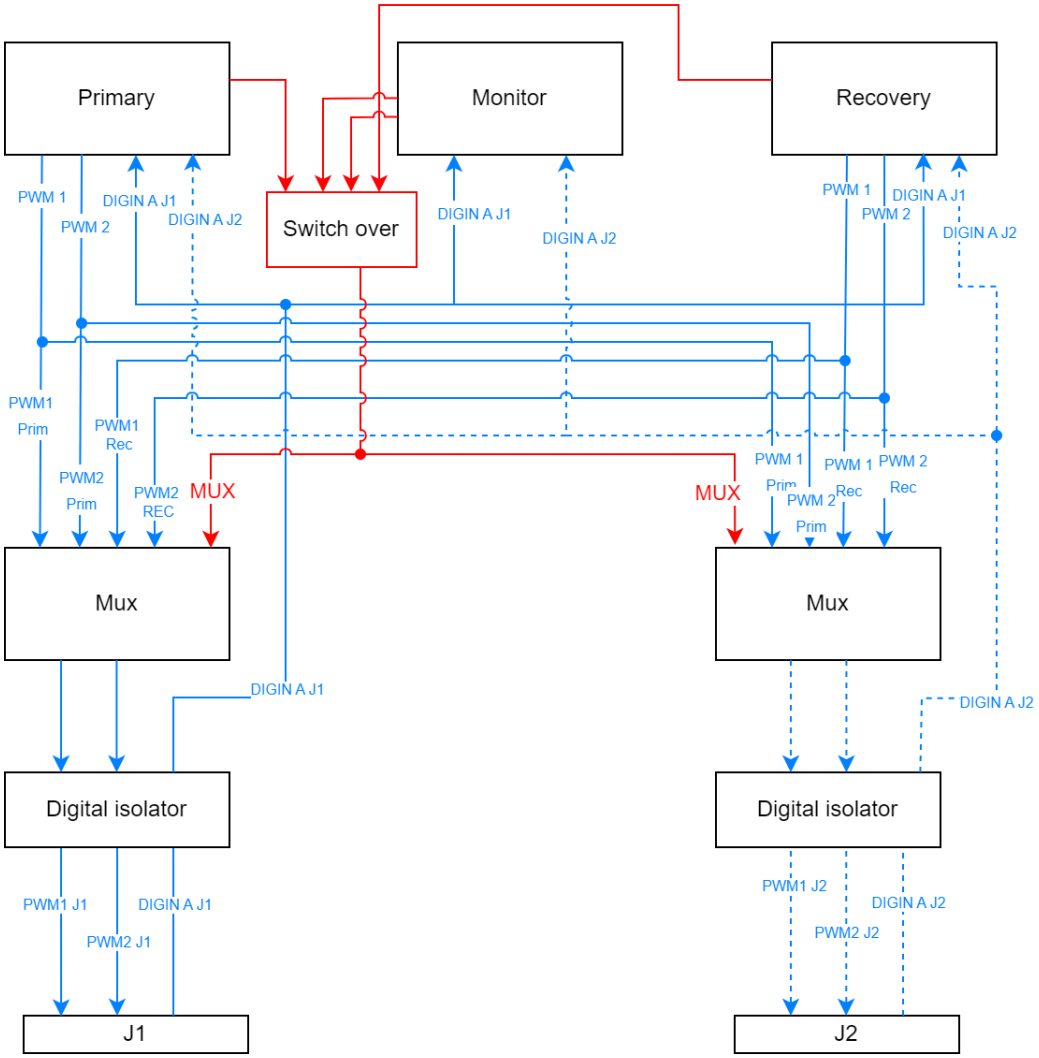


RS232 diagram. The same architecture applies to RS485 (instead of RS232)

PWM / Digital outputs

4 redundant digital outputs are included in REx. These 4 signals are available in both J1 (4x PWM) and J2 (4x PWM) connectors and can be configured as a PWM signal or a generic 5V digital output.

The diagram shows how each output is generated: Primary and Recovery provide their PWM lines to a **Mux** that, commanded by the **Switch over** block, forwards only the signals from the core currently in command. The selected outputs then pass through a **digital isolator** before reaching the connector, protecting the autopilot from electrical faults on the actuator side. The same path exists on J1 and J2, and the shared 5V digital inputs (**DIGIN**) are routed back to the cores.

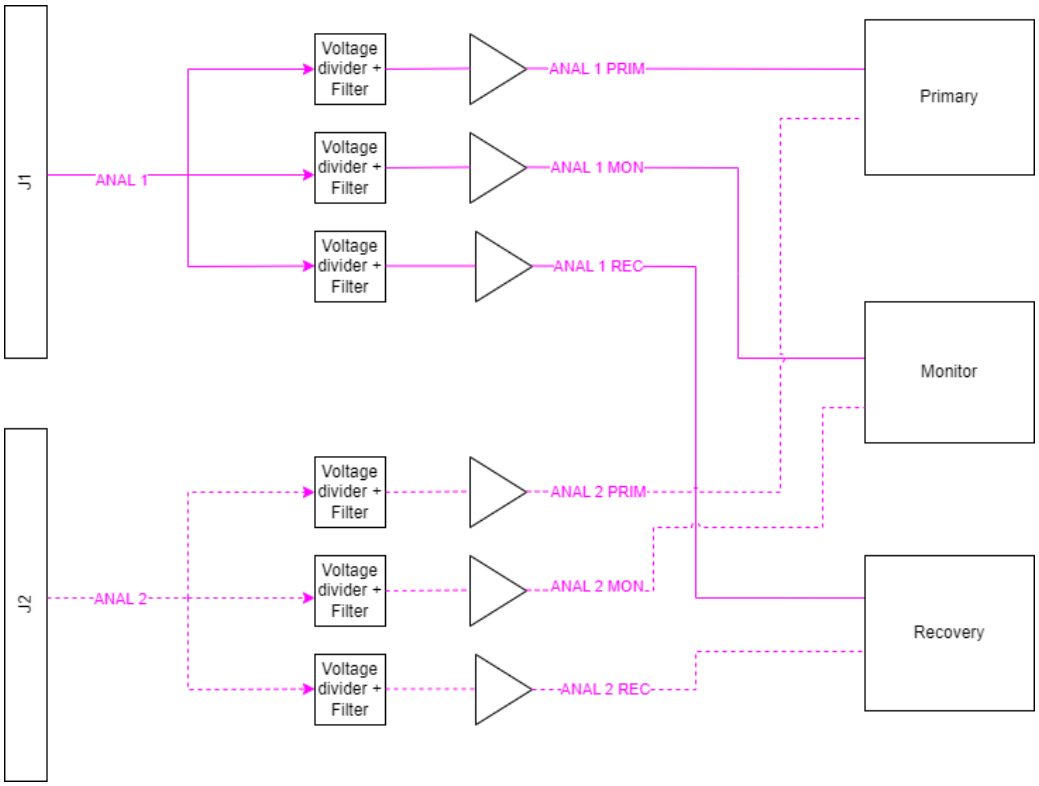


PWM diagram. The same architecture applies to PWM3, 4 and DIGIN B

Analog inputs

The Veronte Autopilot REx includes 6 Analog signal inputs (3x J1 & 3x J2) that can be used as independent signals or as 3 redundant channels. Voltage inputs are available as follows: 2x5V, 2x12V, 2x54V.

Each analog input is shared among the three cores with independent signal conditioning: as shown in the diagram, the input coming from the connector (e.g. **ANAL 1** on J1) is split into three identical stages — a **voltage divider + filter** followed by a buffer amplifier — one per core (**PRIM**, **MON** and **REC**). This lets all three cores read the same external signal simultaneously while keeping their measurement chains isolated from each other.



Analog inputs diagram. The same architecture applies to ANAL 3 to ANAL 6

Digital inputs

4x 5V Digital inputs are also available (2x J1 & 2x J2), being possible to use them as 4 independent channels or as 2x redundant inputs.

Ethernet

The Veronte Autopilot REx includes 2x Ethernet ports for datalink communications and configuration. One port is available on each connector (J1 & J2) and both are shared through an internal switch.

ARINC 429

The Veronte Autopilot REx includes 4x ARINC 429 Tx ports, 2x J1 and 2x J2, that can be configured as 4 independent ports or as 2x redundant signals. For ARINC 429 reception, there are 8 inputs available, being 4 of them available in J1 and 4 available on J2.

Redundancy and safety

- **Primary-Monitor-Recovery architecture:** The three cores run in parallel, each with its own sensor suite and its own GNC processing. The

Monitor continuously checks the health and consistency of the other cores. If the Primary fails or asserts its self-exclusion signal, the Monitor switches control to the Recovery core through hardware multiplexers, keeping the transition transparent to the actuators.

- **No single point of failure:** Physical and functional isolation between cores (independent power rails, dedicated sensor suites and isolated buses) prevents a fault in one lane — or a self-exclusion signal — from affecting the others, keeping the system fail-operational.
- **Dual-channel I/O redundancy:** Every bus available on connector J1 is duplicated on connector J2 as an isolated secondary lane. A wiring fault or the loss of one connector does not interrupt data flow between the cores and external peripherals.
- **Redundant power supply:** The REx exposes two independent power inputs on connector J1 and two on connector J2. This cross-linked scheme allows the autopilot to be fed from separate batteries or regulators through different connectors, so the loss of a harness or a single power rail does not interrupt operation.

Veronte Autopilot REx also includes a separate flight termination voting logic, completely dissimilar and implemented in simple hardware, whose purpose is to give the internal cores a way to decide whether a flight termination signal should be activated or not. This arbitration between cores is handled by a voting circuit called **Switch Over (SO)**, described in detail in the Switch Over — Fault Handling section of this manual.

Operation modes

The **Veronte Autopilot REx** offers an adaptable operational framework designed to meet rigid aerospace certification standards, combining different software environments and hardware topologies while keeping a certified fail-operational safety net.

Redundancy deployment architectures

By using the same core technology in different configurations, integrators can choose between two deployment topologies:

- **Embedded redundancy:** A single **Veronte Autopilot REx** unit provides the complete triple-redundant, fail-operational system on its own, with all redundancy managed internally as described in the Redundancy and safety section. This is the most optimized solution for low-SWaP platforms (e.g. tactical UAVs), simplifying the wiring harness while meeting DAL-B standards.
- **Distributed redundancy (DRx):** Two or more REx units are installed in geographically different zones of the airframe (e.g. nose and tail), interconnected via redundant high-speed buses to share health status and sensor data. This protects against zonal failures (localized damage, fire or interference): if one unit is lost, another located in a safe zone takes over flight authority instantaneously.

Variants

Variant name	Reference
With remote ID	P006146
With ADS-B	P006147

Sensor Specifications

The **Veronte Autopilot REx** sensor suite provides dedicated sensor sets and isolation for each internal core. Each of the three cores is equipped with its own sensors — IMUs (accelerometers and gyroscopes), magnetometers, barometers (static pressure), differential pressure sensors (dynamic pressure) and GNSS — supporting independent GNC processing and reducing the impact of faults in an individual sensor chain. External sensors can also be integrated.

> **Note**
>
> All three cores use the same types of sensors, except for GNSS: the Primary and Recovery cores use GNSS 1, while the Monitor core uses GNSS 2.

Accelerometers (3-axis each one)		
Specification	**IMU 1**	**IMU 2**
Range	Up to ±24 g (configurable)	±8 g
Sensitivity	10,920 LSB/g for g_{FS3g} 1,365 LSB/g for g_{FS24g}	1,200 LSB/g (16 bits) 78,643,200 LSB/g (32 bits)
In-Run Bias Stability	< 30 µg	3.6 µg
Angular Random Walk	0.05 m/s/√h	0.02 m/sec/√hr
Noise Density	160 µg/√Hz	110 µg/√Hz rms

Gyroscopes (3-axis each one)		
Specification	**IMU 1**	**IMU 2**
Range		±500 °/sec

Gyroscopes (3-axis each one)		
Specification	**IMU 1**	**IMU 2**
	±125 to ±2,000 °/sec	
Sensitivity	262 to 16 LSB/°/sec	40 LSB/°/sec (16 bits) 2,621,440 LSB/°/sec (32 bits)
In-Run Bias Stability	< 2 °/h	2.5 °/h
Angular Random Walk	0.1 °/√h	0.15 °/√hr
Noise Density	0.014 °/s/√Hz	0.003 °/s/√Hz rms

Magnetometers		
Specification	**Magnetometer 1**	**Magnetometer 2**
Range	±2000 µT	±800 µT
Sensitivity	±100 µT	50 to 13 nT
RMS Noise	190 nT (X & Y axis) 450 nT (Z axis)	30 to 15 nT

Magnetometers		
Specification	**Magnetometer 1**	**Magnetometer 2**
Offset	±2 µT	-

Static Pressure		
Specification	**Sensor 1**	**Sensor 2**
Range	1,000 - 120,000 Pa	30,000 - 120,000 Pa
Band Error	250 Pa	100 Pa
Resolution	1.2 to 6.5 Pa	6 Pa
Update Time	0.5 to 8.22 ms	27.6 ms

Dynamic Pressure Sensor	
Specification	**Pitot**
Range	25,000 to 125,000 Pa
Band Error	±250 Pa
Resolution	±22 Pa
Update Time	5 ms

Dynamic Pressure Sensor	
Specification	**Pitot**
Bias	±7 Pa

GNSS Receivers			
Specification		**GNSS 1**	**GNSS 2**
Constellations		BeiDou, Galileo, GLONASS, GPS, NavIC, QZSS	BeiDou, Galileo, GLONASS, GPS, NavIC, QZSS, SBASS
Bands		L1 C/A, L2C, L1OF, L2OF, E1 B/C, E5a, B1I, B3I	L1 C/A, L2C, B1I, B1C, E1, L1 C/B, L5
RTK Support		Yes (via PPP-RTK with SPARTN/ CLAS)	Yes
RTK Position Accuracy	Horizontal	0.006 m + 1 ppm	0.006 m + 0.5 ppm
	Vertical	0.01 m + 1 ppm	0.01 m + 1 ppm
SBAS Position Accuracy	Horizontal	0.6 m	0.6 m
	Vertical	1.0 m	0.8 m

GNSS Receivers		
Specification	**GNSS 1**	**GNSS 2**
Velocity Accuracy	0.03 m/s	0.03 m/s
Update Rate	**RTK**: Up to 5 Hz	100 Hz
Anti-jamming	RF interference and jamming detection and reporting	AIM+ Premium Industry leading anti-jamming
Anti-spoofing	Spoofing detection and reporting	Anti-spoofing interference monitoring
Advanced Functions	• RTK Moving base capable • PPP-RTK (SPARTN/ CLAS) • DGNSS	• RAIM (Receiver Autonomous Integrity Monitoring)

Mechanical and Electrical specifications

Variable	Value
Weight	737 g With Damping System: + 150 g
Operating temperature	-40 ºC to 65 ºC
Storage temperature	-55 ºC to 85 ºC
Protection Rating	IP67
Power input voltage	8 to 54 V
Power consumption	Up to 17.47 W
Maximum acceleration	32 g
Connectors	MIL-DTL-38999 Series
Protections	Reverse polarity, short circuit, EMI/ EMC
Redundancy	Triple redundancy

Variable	Value
	with dissimilarity
I/O	Dual-channel redundant
Diagnostics	Switch-over, multiplexers, and BIT
FTS (Flight Termination System)	Independent fail-safe in case of total failure
Software	Veronte OS DO178C DAL B or custom code
Hardware	DO254 DAL B

Dimensions

Veronte Autopilot REx dimensions (mm)

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

Interfaces

Connector layout

The **Veronte Autopilot REx** exposes two main high-density connectors (**J1** and **J2**) for all flight-critical I/O, plus dedicated SSMA antenna ports for GNSS, M2M and DAA, and pressure ports for pitot and static sensing. J1 and J2 are wired as a dual-channel configuration, so the complete loss of one connector or harness does not prevent the autopilot from commanding actuators or

receiving telemetry. For the electrical pinout of J1 and J2 see the Pinout - Hardware Installation section of this manual.



Veronte Autopilot REx connectors

Connector	Description
J1	MIL-DTL-38999 high-density connector for flight-critical I/O (primary channel of the dual-channel scheme)
J2	MIL-DTL-38999 high-density connector for flight-critical I/O (secondary channel of the dual-channel scheme)
GNSS1	SSMA connector for the GNSS antenna dedicated to the Primary core
GNSS2	

Connector	Description
	SSMA connector for the GNSS antenna dedicated to the Monitor core
GNSS3	SSMA connector for the GNSS antenna dedicated to the Recovery core
M2M	SSMA connector for the internal 4G LTE module, used for BVLOS operations **Warning** If the BLOS module is enabled, a suitable antenna must be connected to this port. The 4G Antenna with the Embention reference **P000112** is recommended.
DAA	SSMA connector for the embedded Remote ID or ADS-B (In & Out) module **Warning** When using ADS-B or Remote ID, there must be an adequate antenna or load connection to the DAA port.

Connector	Description
PITOT (x2)	Two independent dynamic pressure ports (Int. D. 2.5 mm x Out. D. 4 mm) for redundant airspeed sensing
STATIC (x2)	Two independent static pressure ports (Int. D. 2.5 mm x Out. D. 4 mm) for redundant altitude sensing

Mating connectors

Abbreviation	Autopilot REx connector	Mating connector
GNSS	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) • Gain max 50 dB • Maximum noise figure 1.5dB • Power supply 3.3V

Abbreviation	Autopilot REx connector	Mating connector
		• Max current 20 mA
DAA	SSMA Jack female for ADS-B or Remote ID antenna	SSMA male Plug, low-loss cable is recommended
M2M	SSMA Jack female for M2M (4G LTE) antenna	
J1	MIL-DTL-38999 Series high-density connector (66P)	• Development harness: **[P016262]** Veronte Autopilots: Dev Harness - 66P MIL-DTL-38999 • Aircraft integration harness: **[P012954]** Veronte Harness - 66P MIL-

Abbreviation	Autopilot REx connector	Mating connector
		DTL-38999 - Male - 50cm
J2	MIL-DTL-38999 Series high-density connector (66P)	• Development harness: **[P016262]** Veronte Autopilots: Dev Harness - 66P MIL-DTL-38999 • Aircraft integration harness : **[P012954]** Veronte Harness - 66P MIL-DTL-38999 - Male - 50cm

Environmental test - DO160

The **Veronte Autopilot REx** is engineered to meet the DO-160G standards required for aeronautical certification, ensuring reliability in the most hostile flight conditions.

Beyond environmental durability, the REx is hardened against electromagnetic threats, featuring high-level EMI/EMC shielding and HIRF protection to prevent interference from high-power transmitters.

Hardware Installation

Mechanical

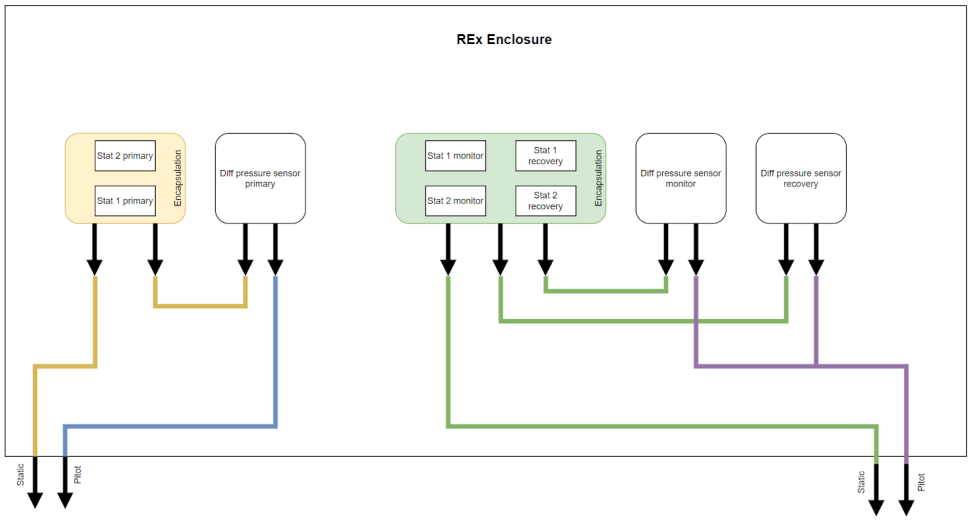
Veronte Autopilot REx is covered with an aluminium enclosure with enhanced EMI shielding and IP protection, with 825 g as total weight.

Pressure lines

Veronte Autopilot REx has four pressure input lines; two for static pressure to determine the absolute pressure and two for pitot in order to determine the dynamic pressure.

For the fittings it is recommended to use a polyurethane tube of 2.5 mm inner diameter and 4 mm outer diameter.

- **Pressure Intake**
  - Pressure intakes must be located in order to prevent clogging.
  - Do not 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 6.3 mm tubes to prevent any rain obstruction.



Pressure Ports Diagram

The diagram above shows how the four external ports (2 static + 2 pitot) are distributed among the internal sensors of the three cores. The lines are grouped into two independent pneumatic channels, each with one static and one pitot port: one channel feeds the **Primary** core, while the other is shared by the **Monitor** and **Recovery** cores. Within each core, static pressure is measured by two redundant encapsulated barometers (**Stat 1** and **Stat 2**), and dynamic pressure is obtained from a dedicated **differential pressure sensor** referenced between the pitot and static lines.

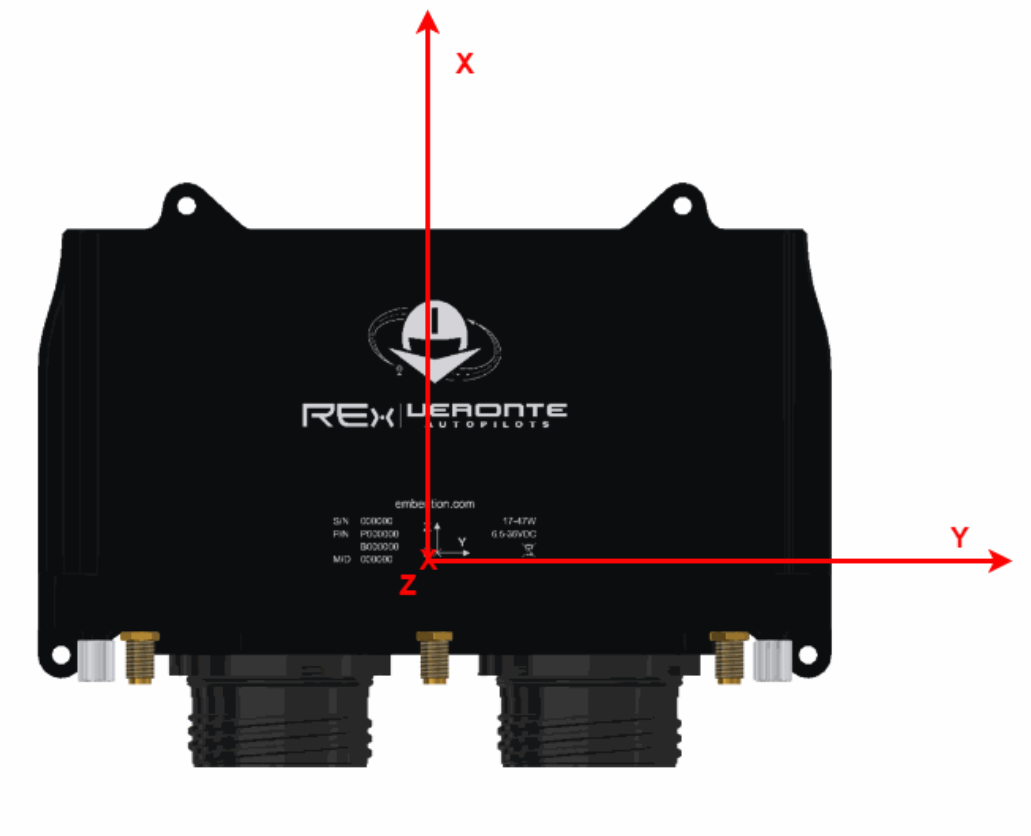
Location

The location of **Veronte Autopilot REx** 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.

Orientation

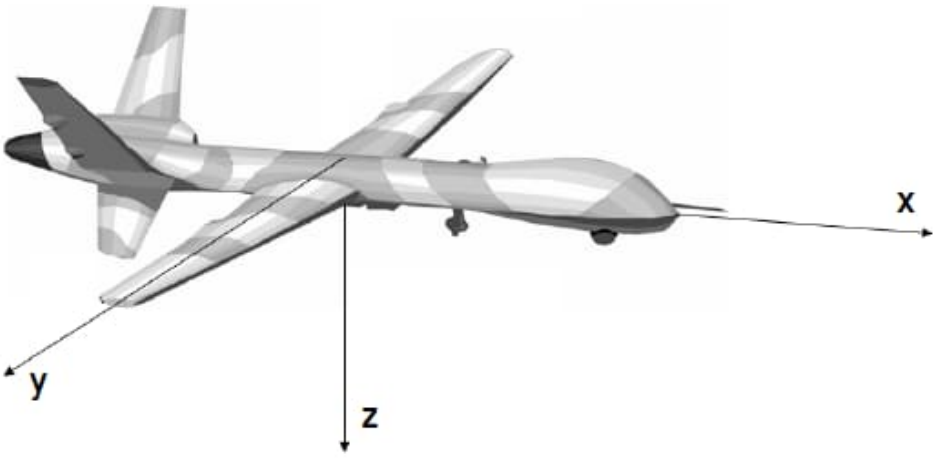
The orientation of **Veronte Autopilot REx** has no restrictions either. It is only required to configure axes respect to the aircraft by means of a rotation matrix or a set of correspondences between axes. The configuration of the orientation can be easily configured using **1x PDI Builder**.

Axes are printed on the **Autopilot REx** box, as shown below.



REx axis

Aircraft coordinates are defined by the standard aeronautical conventions, shown in the following figure.



Aircraft Coordinates (Standard Aeronautical Convention)

Vibration Isolation

Although **Veronte Autopilot REx** rejects noise and high-frequency vibration modes with electronic filters, there may be situations where external isolation is needed.

Autopilot REx can be mounted in different ways in order to reject the airframe vibration, but it is recommended to use the Damping System designed for that purpose. It covers a wide frequency range of different aircraft types.

> **Note**
>
> The user should take into account that wiring should be loose enough so that vibrations are not transmitted to **Autopilot REx**.

Damping System

Embention offers the **Damping System** as a solution to isolate **Veronte Autopilot REx** from vibrations.

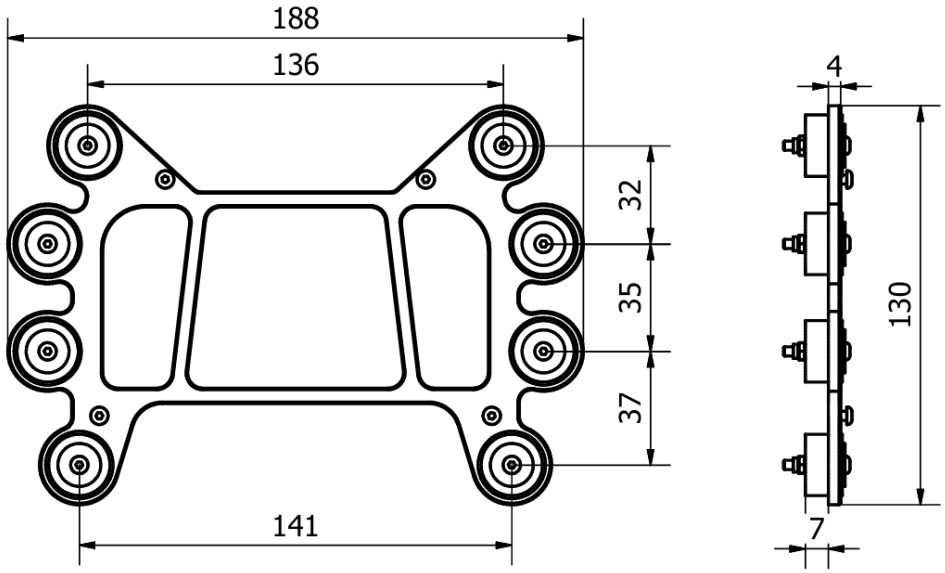
> **Important**
>
> Only effective with **Autopilot REx** in horizontal position.

This damping system weighs approximately **150 g**.



Damping System

Dimensions

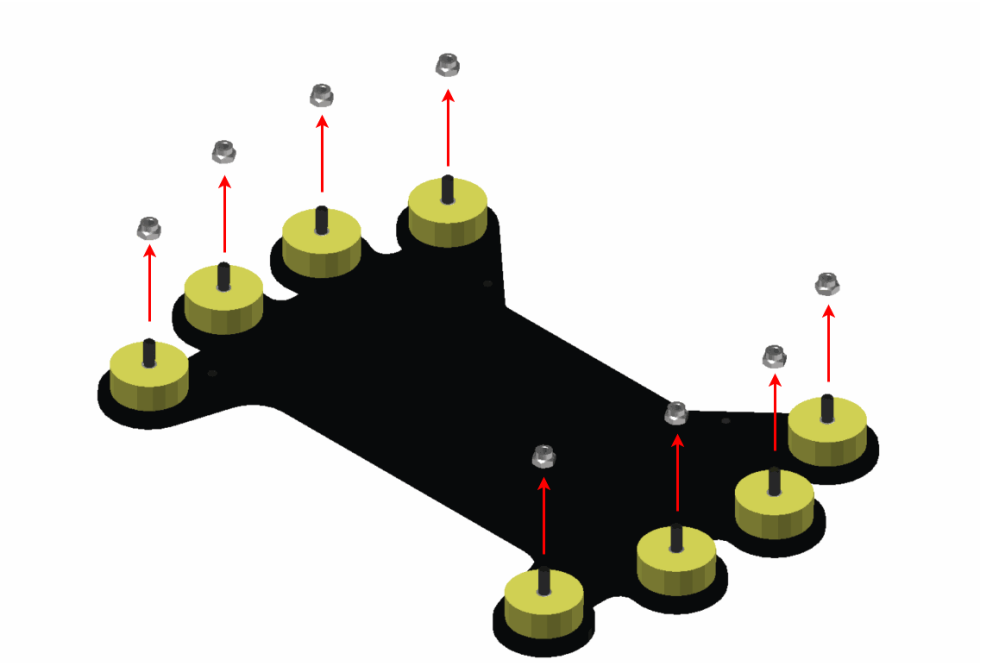


Damping system dimensions (mm)

Assembly steps

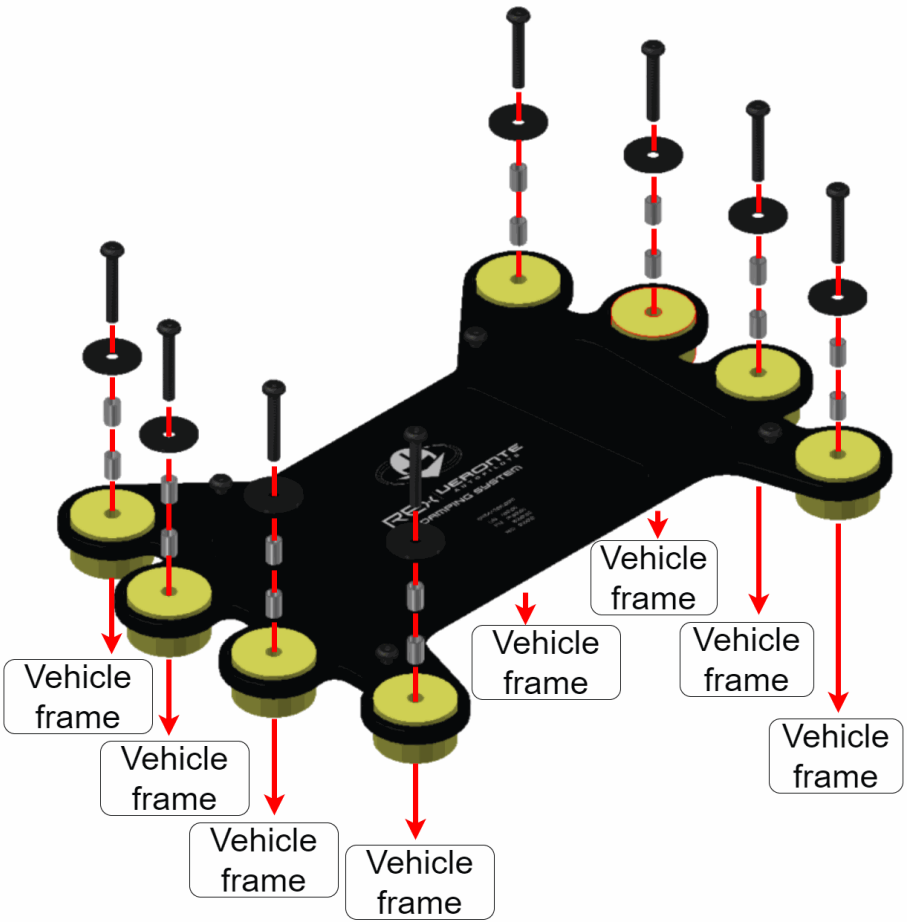
To assemble the Damping System into a vehicle with an **Autopilot REx**, read the following steps.

1. Remove the eight nuts located under the platform.



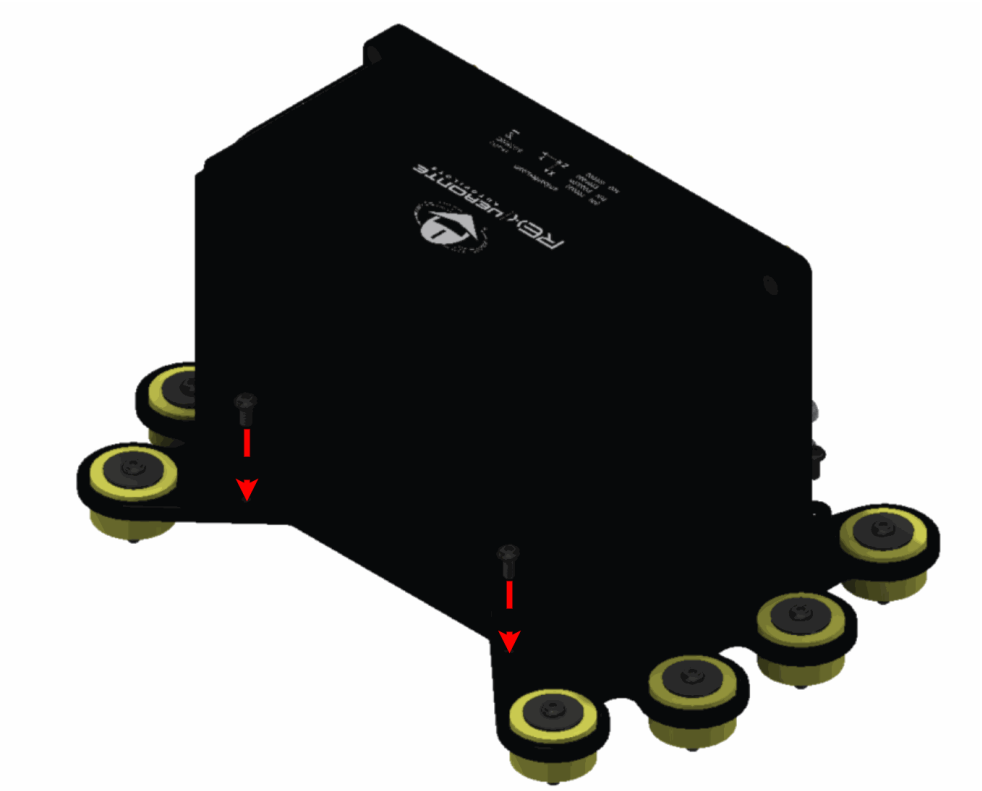
Step 1

2. Screw the platform on the aircraft frame. The included screws have M3.



Step 2

3. Screw the **Autopilot REx** on the **Damping system**.





Step 3



Result

Antenna Integration

The system uses different kinds of antenna to operate, they 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 antennas far away from alternators or other interference generators.
  - Always isolate the antenna ground panel from the aircraft structure.
  - Make sure antennas are securely mounted.
  - Always use high-quality RF wires minimising the wire length.
  - Always follow the antenna manufacturer manual.
  - SSMA connections shall be tightened applying 1Nm of torque.
  - For all-weather aircraft, insert SSMA lightning protectors.
- **GNSS Antenna**
  - Antenna top side must point to the sky.
  - Install them on a top surface with direct sky view.
  - Never place wires or parts made of metal or carbon above the antenna.

- It is recommended to install antennas on a small ground plane.
- For all-weather aircrafts, insert SSMA lightning protectors.

- **Recommended specifications for GNSS antennas**

Specifications	Range
Antenna frequency L1	1561.098 MHz to 1602 MHz
Antenna frequency L2	1207.14 MHz to 1246 MHz
Amplifier gain	17 dB to 35 dB
Out-of-band rejection	40 dB **Note** Higher values are preferable. 30 dB is considered the minimum acceptable value.
Polarization	RHCP (Right-Hand Circular Polarization)
Minimum supply voltage	5 V
	50 mA

Specifications	Range
Maximum supply current	

Electrical

Power supply

Autopilot REx can use unregulated DC (8 V to 54 V). All power supply pins are not common. It is possible to supply them with different voltages since they are internally protected with diodes. Nonetheless, all power supply pins must be connected to a power supply, in order to guarantee that **Autopilot REx** will work in case of failing one of them. These pins are summarized in the following table:

Connector	PIN	Signal
Connector J1	3	VIN PRIM
	5	VIN MON
	8	VIN PRIM
Connector J2	3	VIN REC
	5	VIN MON
	8	VIN REC

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

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**
>
> Power **Veronte Autopilot REx** out of the given range can cause irreversible damage to the system. Please read carefully the manual before powering the system.

Autopilots and servos can be powered by the same or different batteries. In case there are 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 system ground references (e.g. engines).

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

Power Domains

Veronte Autopilot REx implements a cross-linked, quad-input power scheme with **two independent power inputs on Connector J1** and **two on Connector J2**. This allows the autopilot to be fed from separate battery or regulator sources across different connectors, so that the loss of an entire cable harness or of a single power rail never interrupts operation.

The four inputs are internally organized in two **redundant power domains** (**A** and **B**), electrically isolated from each other:

- **Connector J1** and all its associated peripherals are powered by **Power Domain A**.
- **Connector J2** and all its associated peripherals are powered by **Power Domain B**.

This separation enables redundancy management against internal power failures. For example, if the aircraft requires measuring a critical temperature from an external device, the user can connect two analog sensors to inputs on different power domains (one on J1 and one on J2) so that the measurement remains available even if one domain fails.

Pinout

> **⚠ Warning**
>
> Pins can transfer 2 A as maximum current.

> **Important**
>
> The **master keyway** of the connectors is located at the **9 o'clock position** (rotated 90º counterclockwise), instead of the 12 o'clock position commonly used by convention. In this position, the keyway is easy to locate when looking at the **Autopilot REx** from above once it is installed.

> **⚠ Warning**
>
> Check the pin number before connecting. The color code is repeated 2 times due to the amount of pins, except for pins 56 and 57. First section (yellow) corresponds to pins 1-30, the second section (blue) to pins 31-60. A third one (pink) with a different color pattern corresponds to pins 61-66.

Connector J1 pinout

PIN	Signal	Type	Internal Power Domain	Description
1	GND MON	GROUND	A	Supply negative for monitor, connected together with J2 pin 1
2	GND PRIM	GROUND	A	

PIN	Signal	Type	Internal Power Domain	Description
				Supply negative for primary
3	VIN PRIM	POWER	A	Supply positive for Primary
4	J1_ATX0_P	OUTPUT	A	J1 ARINC 429 channel 0 positive output
5	VIN MON	POWER	A	Supply positive for Monitor, connected together with J2 pin 5
6	J1_ARX0_P	INPUT	A	J1 ARINC 429 channel 0 positive input
7	GND PRIM	GROUND	A	Supply negative for primary
8	VIN PRIM	POWER	A	Supply positive for Primary

PIN	Signal	Type	Internal Power Domain	Description
9	J1_CAN_MUX_A_P	CAN BUS	A	CAN A J1 positive (muxed functionality)
10	J1_ATX0_N	OUTPUT	A	J1 ARINC 429 channel 0 negative output
11	J1_ATX1_P	OUTPUT	A	J1 ARINC 429 channel 1 positive output
12	J1_ARX1_P	INPUT	A	J1 ARINC 429 channel 1 positive input
13	J1_ARX0_N	INPUT	A	J1 ARINC 429 channel 0 negative input
14	ANALOG IN 1	INPUT	A	Analog input 1 (0V..5V)
15	ANALOG IN 3	INPUT	A	Analog input 3 (0V..12V)
16	J1_CAN_MUX_A_N	CAN BUS	A	CAN A J1 negative

PIN	Signal	Type	Internal Power Domain	Description
				(muxed functionality)
17	J1_DIGIN_A	INPUT	A	5V digital input
18	J1_ARINC_GND	GROUND	A	Negative for ARINC 429 inputs of J1 connector
19	J1_ATX1_N	OUTPUT	A	J1 ARINC 429 channel 1 negative output
20	J1_ARX1_N	INPUT	A	J1 ARINC 429 channel 1 negative input
21	J1 ANALOG GND	GROUND	A	Negative for all J1 connector analog signals
22	ANALOG IN 5	INPUT	A	Analog input 5 (0V..54V)
23	J1_CAN_GND	CAN GROUND	A	Negative for all J1

PIN	Signal	Type	Internal Power Domain	Description
				connector CAN signals
24	J1_CAN_MUX_B_P	CAN BUS	A	CAN B J1 positive (muxed functionality)
25	J1_DIGIN_B	INPUT	A	5V digital input
26	J1 GND IO	GROUND	A	Negative for PWMs and Digital inputs of J1 connector
27	-	-	-	-
28	J1_ARINC_GND	GROUND	A	Negative for ARINC 429 inputs of J1 connector
29	J1 GND IO	GROUND	A	Negative for Opendrain FTS output of J1
30	J1_PWM4	OUTPUT	A	Digital output 4 of J1

PIN	Signal	Type	Internal Power Domain	Description
31	J1_PWM1	OUTPUT	A	Digital output 1 of J1
32	J1_CAN_SHD_C_P	CAN BUS	A	CAN C J1 positive (shared functionality)
33	J1_CAN_MUX_B_N	CAN BUS	A	CAN B J1 negative (muxed functionality)
34	J1_FTS	OUTPUT OPEN-DRAIN	A	Flight termination system of J1
35	J1_INB_485_N	INPUT	A	J1 RS485 B negative input
36	J1_ARX2_P	INPUT	A	J1 ARINC 429 channel 2 positive input
37	J1_ARX2_N	INPUT	A	J1 ARINC 429 channel 2 negative input

PIN	Signal	Type	Internal Power Domain	Description
38	-	-	-	-
39	J1_GND_RS232	GROUND	A	Negative for RS232 of J1 connector
40	J1_PWM2	OUTPUT	A	Digital output 2 of J1
41	J1_CAN_SHD_C_N	CAN BUS	A	CAN C J1 negative (shared functionality)
42	J1_CAN_SHD_D_P	CAN BUS	A	CAN D J1 positive (shared functionality)
43	J1_INB_485_P	INPUT	A	J1 RS485 B positive input
44	J1_OUTB_485_N	OUTPUT	A	J1 RS485 B negative output
45	J1_GND_RS485	GROUND	A	Negative for RS485 of J1 connector

PIN	Signal	Type	Internal Power Domain	Description
46	J1_ARX3_P	INPUT	A	J1 ARINC 429 channel 3 positive input
47	J1_GND_RS485	GROUND	A	Negative for RS485 of J1 connector
48	J1_CAN_GND	GROUND	A	Negative for all J1 connector CAN signals
49	J1_PWM3	OUTPUT	A	Digital output 3 of J1
50	J1_CAN_SHD_D_N	CAN BUS	A	CAN D J1 negative (shared functionality)
51	J1_OUTB_485_P	OUTPUT	A	J1 RS485 B positive output
52	J1_INA_485_P	INPUT	A	J1 RS485 A positive input
53	J1_ARX3_N	INPUT	A	J1 ARINC 429 channel 3

PIN	Signal	Type	Internal Power Domain	Description
				negative input
54	J1_GND_RS232	GROUND	A	Negative for RS232 of J1 connector
55	J1_ETH_CHASSIS	ETH CHASSIS	A	Ethernet chassis, connected to enclosure
56	J1_RX_N	INPUT	A	Ethernet Rx negative of J1 connector
57	J1_RX_P	INPUT	A	Ethernet Rx positive of J1 connector
58	J1_INA_485_N	INPUT	A	J1 RS485 A negative input
59	J1_OUTA_485_N	OUTPUT	A	J1 RS485 A negative output
60	J1_RS232_TX_A	OUTPUT	A	RS232 A Tx of J1
61	J1_RS232_TX_B	OUTPUT	A	RS232 B Tx of J1

PIN	Signal	Type	Internal Power Domain	Description
62	J1_TX_N	OUTPUT	A	Ethernet Tx negative of J1 connector
63	J1_TX_P	OUTPUT	A	Ethernet Tx positive of J1 connector
64	J1_OUTA_485_P	OUTPUT	A	J1 RS485 A positive output
65	J1_RS232_RX_A	INPUT	A	RS232 A Rx of J1
66	J1_RS232_RX_B	INPUT	A	RS232 B Rx of J1

Connector J2 pinout

PIN	Signal	Type	Internal Power Domain	Description
1	GND MON	GROUND	B	Supply negative for monitor, connected together with J1 pin 1

PIN	Signal	Type	Internal Power Domain	Description
2	GND REC	GROUND	B	Supply negative for recovery
3	VIN REC	POWER	B	Supply positive for Recovery
4	J2_ATX0_P	OUTPUT	B	J2 ARINC 429 channel 0 positive output
5	VIN MON	POWER	B	Supply positive for Monitor, connected together with J1 pin 5
6	J2_ARX0_P	INPUT	B	J2 ARINC 429 channel 0 positive input
7	GND REC	GROUND	B	Supply negative for recovery
8	VIN REC	POWER	B	Supply positive for recovery

PIN	Signal	Type	Internal Power Domain	Description
9	J2_CAN_MUX_A_P	CAN BUS	B	CAN A J2 positive (muxed functionality)
10	J2_ATX0_N	OUTPUT	B	J2 ARINC 429 channel 0 negative output
11	J2_ATX1_P	OUTPUT	B	J2 ARINC 429 channel 1 positive output
12	J2_ARX1_P	INPUT	B	J2 ARINC 429 channel 1 positive input
13	J2_ARX0_N	INPUT	B	J2 ARINC 429 channel 0 negative input
14	ANALOG IN 2	INPUT	B	Analog input 2 (0V..5V)
15	ANALOG IN 4	INPUT	B	Analog input 4 (0V..12V)
16	J2_CAN_MUX_A_N	CAN BUS	B	CAN A J2 negative

PIN	Signal	Type	Internal Power Domain	Description
				(muxed functionality)
17	J2_DIGIN_A	INPUT	B	5V digital input
18	J2_ARINC_GND	GROUND	B	Negative for ARINC 429 inputs of J2 connector
19	J2_ATX1_N	OUTPUT	B	J2 ARINC 429 channel 1 negative output
20	J2_ARX1_N	INPUT	B	J2 ARINC 429 channel 1 negative input
21	J2 ANALOG GND	GROUND	B	Negative for all J2 connector analog signals
22	ANALOG IN 6	INPUT	B	Analog input 6 (0V..54V)
23	J2_CAN_GND	GROUND	B	Negative for all J2

PIN	Signal	Type	Internal Power Domain	Description
				connector CAN signals
24	J2_CAN_MUX_B_P	CAN BUS	B	CAN B J2 positive (muxed functionality)
25	J2_DIGIN_B	INPUT	B	5V digital input
26	J2 GND IO	GROUND	B	Negative for PWMs and Digital inputs of J2 connector
27	-	-	-	-
28	J2_ARINC_GND	GROUND	B	Negative for ARINC 429 inputs of J2 connector
29	J2 GND IO	GROUND	B	Negative for Opendrain FTS output of J2
30	J2_PWM4	OUTPUT	B	Digital output 4 of J2

PIN	Signal	Type	Internal Power Domain	Description
31	J2_PWM1	OUTPUT	B	Digital output 1 of J2
32	J2_CAN_SHD_C_P	CAN BUS	B	CAN C J2 positive (shared functionality)
33	J2_CAN_MUX_B_N	CAN BUS	B	CAN B J2 negative (muxed functionality)
34	J2_FTS	OUTPUT OPEN-DRAIN	B	Flight termination system of J2
35	J2_INB_485_N	INPUT	B	J2 RS485 B negative input
36	J2_ARX2_P	INPUT	B	J2 ARINC 429 channel 2 positive input
37	J2_ARX2_N	INPUT	B	J2 ARINC 429 channel 2 negative input

PIN	Signal	Type	Internal Power Domain	Description
38	-	-	-	-
39	J2_GND_RS232	GROUND	B	Negative for RS232 of J2 connector
40	J2_PWM2	OUTPUT	B	Digital output 2 of J2
41	J2_CAN_SHD_C_N	CAN BUS	B	CAN C J2 negative (shared functionality)
42	J2_CAN_SHD_D_P	CAN BUS	B	CAN D J2 positive (shared functionality)
43	J2_INB_485_P	INPUT	B	J2 RS485 B positive input
44	J2_OUTB_485_N	OUTPUT	B	J2 RS485 B negative output
45	J2_GND_RS485	GROUND	B	Negative for RS485 of J2 connector

PIN	Signal	Type	Internal Power Domain	Description
46	J2_ARX3_P	INPUT	B	J2 ARINC 429 channel 3 positive input
47	J2_GND_RS485	GROUND	B	Negative for RS485 of J2 connector
48	J2_CAN_GND	GROUND	B	Negative for all J2 connector CAN signals
49	J2_PWM3	OUTPUT	B	Digital output 3 of J2
50	J2_CAN_SHD_D_N	CAN BUS	B	CAN D J2 negative (shared functionality)
51	J2_OUTB_485_P	OUTPUT	B	J2 RS485 B positive output
52	J2_INA_485_P	INPUT	B	J2 RS485 A positive input
53	J2_ARX3_N	INPUT	B	J2 ARINC 429 channel 3

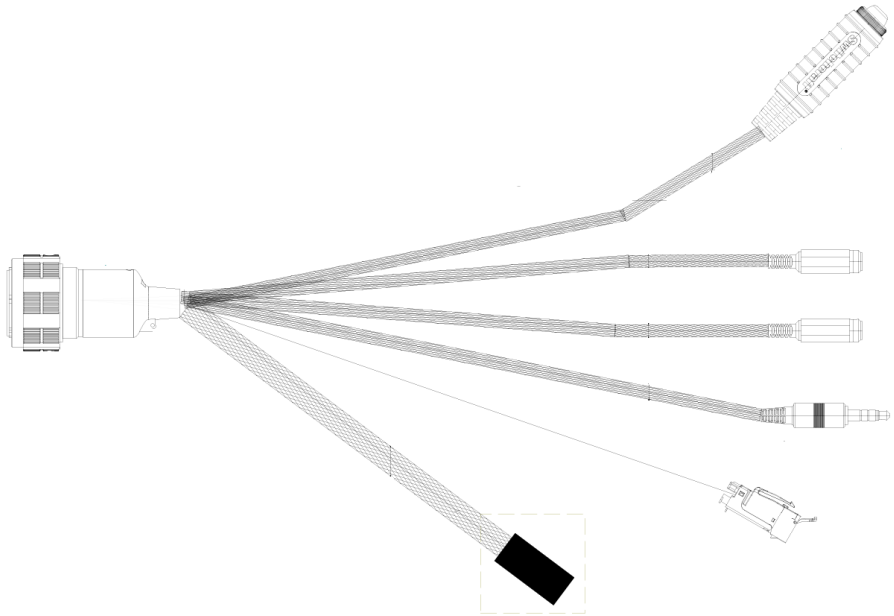
PIN	Signal	Type	Internal Power Domain	Description
				negative input
54	J2_GND_RS232	GROUND	B	Negative for RS232 of J2 connector
55	J2_ETH_CHASSIS	ETH CHASSIS	B	Ethernet chassis, connected to enclosure
56	J2_RX_N	INPUT	B	Ethernet Rx negative of J2 connector
57	J2_RX_P	INPUT	B	Ethernet Rx positive of J2 connector
58	J2_INA_485_N	INPUT	B	J2 RS485 A negative input
59	J2_OUTA_485_N	OUTPUT	B	J2 RS485 A negative output
60	J2_RS232_TX_A	OUTPUT	B	RS232 A Tx of J2
61	J2_RS232_TX_B	OUTPUT	B	RS232 B Tx of J2

PIN	Signal	Type	Internal Power Domain	Description
62	J2_TX_N	OUTPUT	B	Ethernet Tx negative of J2 connector
63	J2_TX_P	OUTPUT	B	Ethernet Tx positive of J2 connector
64	J2_OUTA_485_P	OUTPUT	B	J2 RS485 A positive output
65	J2_RS232_RX_A	INPUT	B	RS232 A Rx of J2
66	J2_RS232_RX_B	INPUT	B	RS232 B Rx of J2

Harnesses

A wire harness is a structured assembly of cables and connectors used to organize and manage wiring in electrical and electronic systems. It is designed to ensure a tidy and secure installation of cables, preventing tangles, electromagnetic interference, and facilitating maintenance.

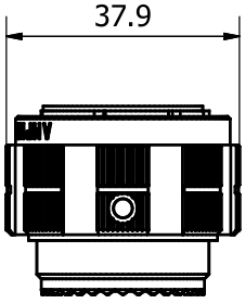
Veronte Autopilot REx 2.0 has the following compatible harness:

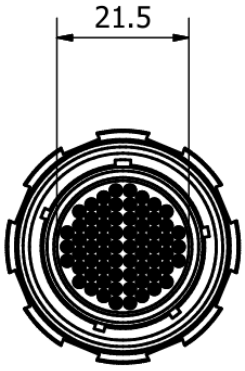


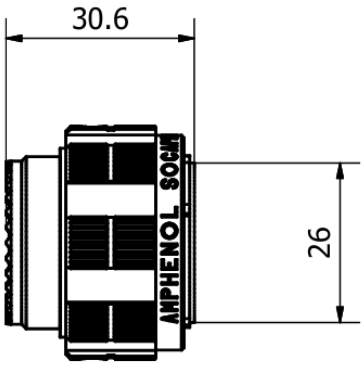
Harness compatible with REx

Dimensions

- **Cables length:** 50 cm
- **Harness plug dimensions:**

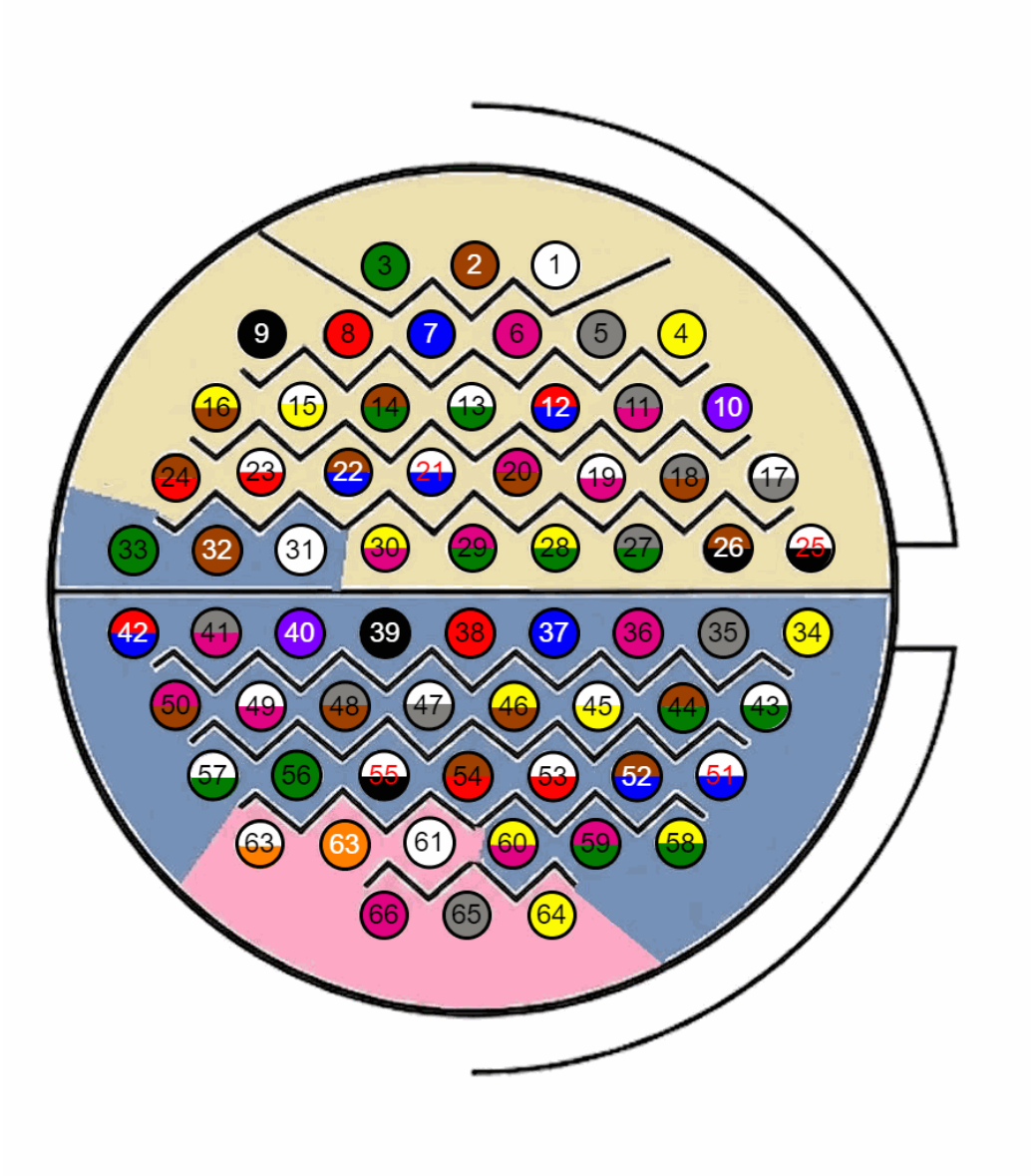






Harness connector (cm)

Pinout



Harness plug - FGW.LM.368.XLCT (frontal view)

Veronte Harness - 66P MIL-DTL-38999 - Male - 50cm

The pinout of this harness is the same as the pinout above. The **color code** of the harness wires is given below.

> ⚠ **Warning**
>
> Check the pin number before connecting. The color code is repeated 2 times due to the amount of pins, except for pins 56 and 57. First section (yellow) corresponds to pins 1-30, the second section (blue) to pins 31-60. A third one (pink) with a different color pattern corresponds to pins 61-66.

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
14	Brown - Green	48	Gray - Brown

PIN	Color Code	PIN	Color Code
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	Green
23	White - Red	57	White - Green
24	Brown - Red	58	Yellow - Green
25	White - Black	59	Pink - Green
26		60	

PIN	Color Code	PIN	Color Code
	Brown - Black		Yellow - Pink
27	Gray - Green	61	White
28	Yellow - Green	62	Orange
29	Pink - Green	63	White - Orange
30	Yellow - Pink	64	Yellow
31	White	65	Gray
32	Brown	66	Pink
33	Green		
34	Yellow		

Veronte Autopilots: Dev Harness - 66P MIL-DTL-38999

The pinout of this harness is the same as the pinout above. In addition, this harness has some connectors already implemented for easy operation. Below is detailed information on which pins these connectors are connected to:

Connector	PIN	Signal
Power Input 1	1	GND_MON
	5	VIN_MON

Connector	PIN	Signal
Power Input 2	2 and 7	GND_PRIM
	3 and 8	VIN_PRIM
Jack connector	17	J1_DIGIN_A
	29	J1_GND_IO
Ethernet	55	J1_ETH_CHASSIS
	56	J1_RX_N
	57	J1_RX_P
	62	J1_TX_N
	63	J1_TX_P

Switch Over — Fault Handling

The Veronte REx is designed to be fully immune to any Single Point of Failure (SPOF) regarding flight control. The system relies on a robust hardware-level Switch-Over (SO) logic that manages the transition of command authority between the Primary, Monitor, and Recovery cores.

Hardware Signals for State Determination

The SO logic receives 8 critical hardware signals to continuously evaluate the operational state of the system:

- **Controller Health Inputs (per core)**: Each controller provides dual-redundant health status indicators to the SO logic:
  - **Watchdog Signal (Pulsed)**: A dynamic "heartbeat" signal verifying the real-time execution of the controller’s software.
  - **Health Status (Discrete)**: A static digital signal (Permanent High/Low) serving as a secondary hardware-level integrity check.
- **Monitor Command Arbitration**: Beyond its own health signals, the Monitor utilizes two dedicated control lines to dictate command authority to the SO logic:
  - **Arbitration Signals**: A differential pair (a primary signal and its logical complement) instructing the SO logic which controller should be "In Command."
  - **Integrity Check**: The use of complementary signals ensures that a single-point failure (such as a short to ground or VCC) on these lines cannot cause an unintended command switch.

Switch-Over Operational Scenarios

The SO logic evaluates the aforementioned signals to execute the following logic:

- **Normal Operations**: All controllers are healthy. The Monitor arbitrates and explicitly assigns command authority.
- **Primary Controller Failures**:
  - Total Failure: Both "healthy" signals are de-asserted. The SO logic automatically transitions command to the Recovery unit.
  - Partial Failure: Only one "healthy" signal fails. The Monitor’s decision takes precedence. If the Monitor detects a true functional failure, it triggers the switch to Recovery. If it detects no functional fault, the system assumes a localized PCB/trace issue and maintains the current command state to prevent unnecessary switching.

- **Recovery Controller Failures**:
  - Total Failure: Both signals are lost. The SO logic physically inhibits any transition to the Recovery command.
  - Partial Failure: The system follows the same logic as a partial Primary failure (assumes a hardware trace issue rather than a functional fault).
- **Monitor Controller Failures**:
  - Total Failure (Standalone): Both signals are lost. The system assumes the Primary and Recovery are healthy. The currently active autopilot retains command authority, bypassing any further arbitration from the Monitor.
  - Partial Failure: Only one signal fails. It is treated as a hardware-level integrity issue. The Monitor's logic is still considered valid, and it is not flagged as a functional failure.
- **Simultaneous / Cascading Failures**:
  - Monitor & Primary Failure: If the Monitor fails first, and the Primary subsequently fails, the SO logic automatically transitions to the Recovery unit, regardless of the Monitor's last known state.
  - Triple Point Failure: If the Monitor, Primary, and Recovery units all fail simultaneously, the Flight Termination System (FTS) is automatically activated.

SO Latching

Once the Switch Over circuit transfers command from the **Primary** to the **Recovery**, a hardware latch keeps the Recovery in control even if the Primary is later restored, preventing spurious switchbacks.

To release the latch and hand authority back to the Primary, a **best-of-three** consensus circuit combines a dedicated request line from each core. When the three cores agree that the switchback is safe, the latch is released. This behaviour is configurable from the apps.

Each core exposes its release request on **GPIO148** as an output signal (`High` = latch ON, `Low` = latch OFF):

- `SO_RESET_PRIM` — Primary
- `SO_RESET_MON` — Monitor

- `S0_RESET_REC` — Recovery

Flight Termination System (FTS)

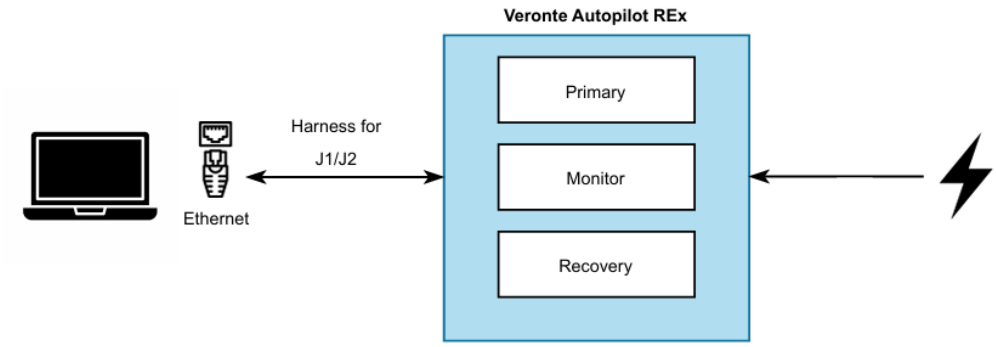
The FTS is directly tied to the system's "System Error" bit. Triggering a System Error sets the core's "healthy" signals to a fault status. If the designated number of cores drop their healthy signals, the hardware Voting Stage triggers the physical FTS.

Software Installation

Connections to computer

In **Veronte Autopilot REx**, its three internal cores (**Primary**, **Monitor** and **Recovery**) are accessed through a shared Ethernet link, so only one connection to the computer is required.

The autopilot exposes duplicated I/O on two independent connectors, **J1** and **J2**. Either connector can be used to reach the computer through the corresponding harness, and the **Autopilot REx** must be powered while it is being configured.



Ethernet connection to Autopilot REx

If there is any doubt about electrical connections, check the Connector J1 pinout and the Connector J2 pinout in this manual.

> **Important**
>
> Each internal core (**Primary**, **Monitor** and **Recovery**) will be identified by software applications as a different device, even though they share the same physical Ethernet connection.

Software manual

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

Operation

Types of operations

Veronte Autopilot REx is an advanced system designed to enable the operation of autonomous vehicles, offering three control modes: automatic, assisted, and manual. This versatile autopilot can be used in both uncrewed and manned vehicles, integrating a **FLY-BY-WIRE** system that ensures precise and safe control at all times.

One of the main advantages of the Veronte Autopilot REx is its configurability, allowing it to be adapted for different operational needs. Depending on the chosen configuration, the system can handle various types of takeoff, such as runway or catapult launches, among others.

Veronte Ops is the Veronte application dedicated to operating the system, providing an intuitive interface for mission management and monitoring. Additionally, for more flexibility, the system can also be operated through VCP (Veronte Communication Protocol), enabling the creation of custom control stations or integration with onboard mission computers for more specific or advanced applications.

In summary, **Autopilot REx** stands out for its versatility, ease of integration, and customization options, offering a comprehensive solution for a wide range of autonomous vehicle applications.

In addition, for the different types of operations, the user may need to make different connections, configurations and/or integrations with external devices with **Veronte Autopilot REx**. Therefore:

- Examples of how to integrate **Autopilot REx** with external devices such as datalinks are detailed in the Datalinks - Integration examples section of the present manual.

Please take a look at these sections for further explanations.

This section summarizes a list of possible options to operate an **Autopilot REx** in different situations.

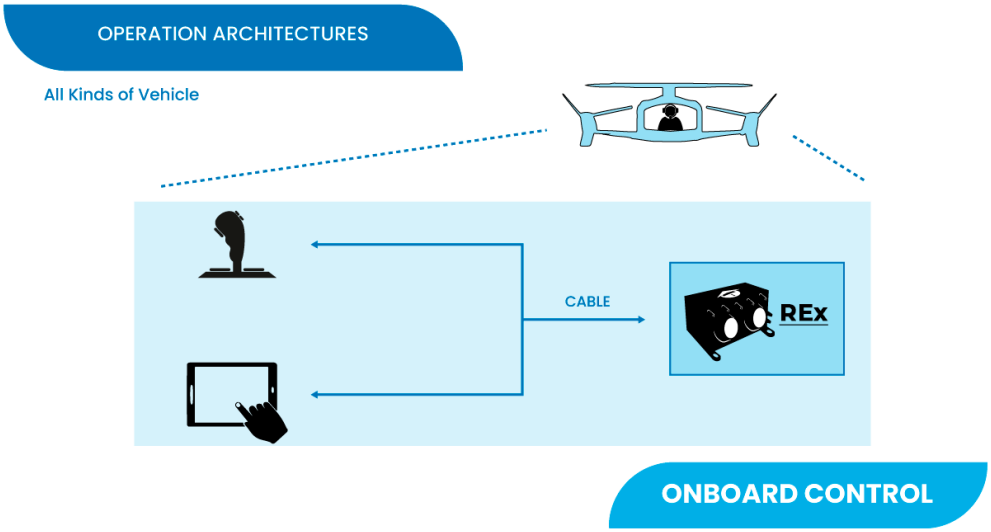
> **Tip**
>
> Most of the following diagrams can be used independently or combined, to create redundant systems or backup solutions.

Operation Architectures

Veronte Autopilot REx allows for a wide variety of communication and control solutions to adapt to each mission and platform specifications.

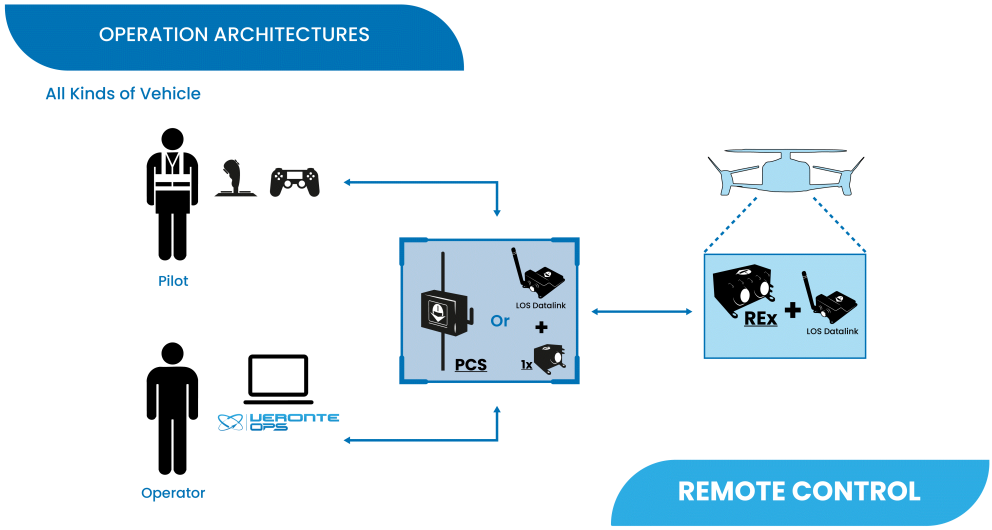
Onboard Control Setup

REx allows to control aircrafts (such as eVTOLs) by pilots on board in a flight deck. Pilots can use as controller joysticks, computers, tablets or any device able to communicate through PPM, CAN Bus, RS232 or RS485.



Remote Control Setup

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

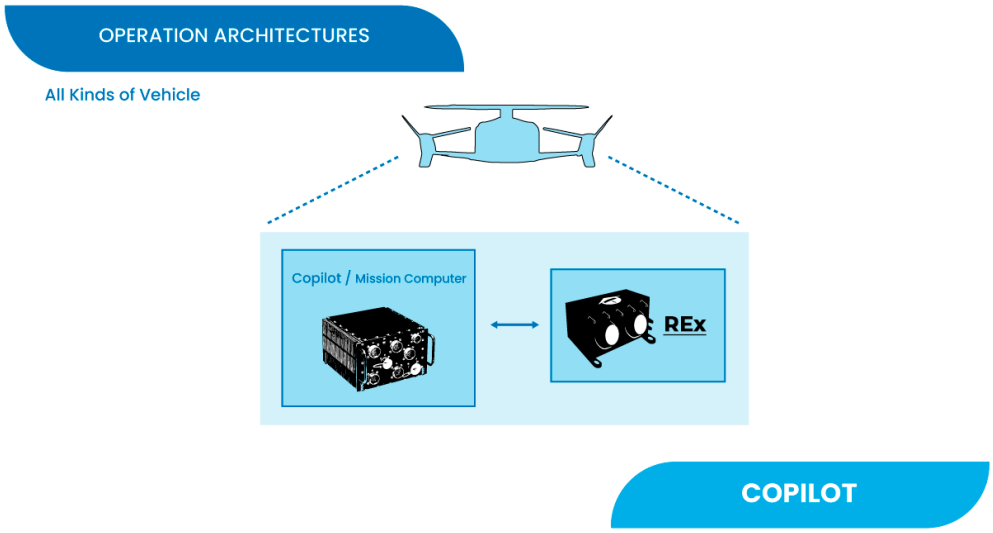


In the standard remote layout, an Operator (Internal Pilot) controls the UAV from the Ground Station using **Veronte Ops**.

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.

Copilot Control Setup

Veronte system allows integration with onboard mission computers for more specific or advanced applications.

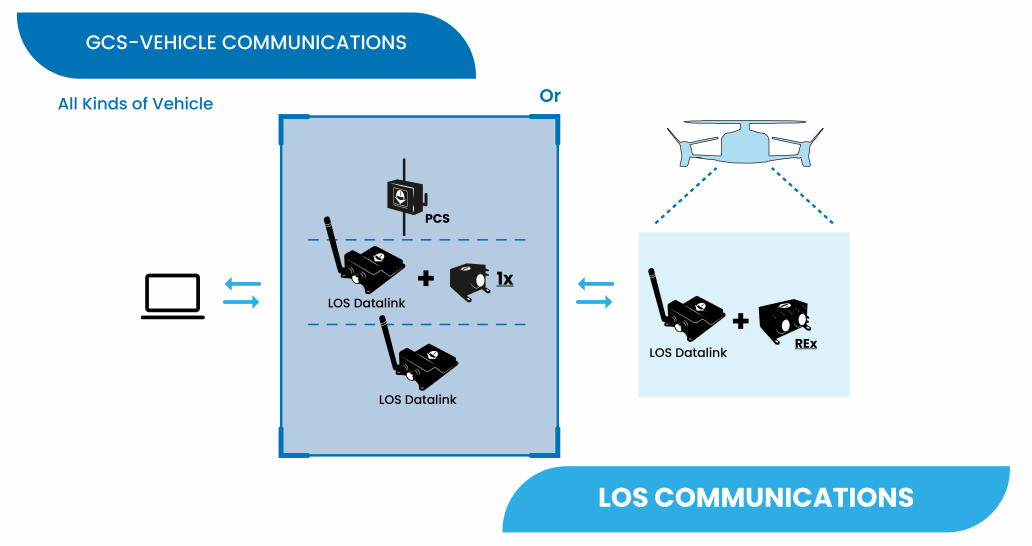


GCS-Vehicle Communications

The following are some examples and possible solutions for establishing communication between the ground control station and the vehicle.

LOS Communications

The following diagram shows the different options of GCS and in-vehicle solutions to establish correct Line of Sight (LOS) communications between them.



Depending on the requirements and needs of their mission, users can choose as GCS:

- **PCS**
- **Autopilot 1x** with an **external LOS Datalink**
- **LOS Datalink**

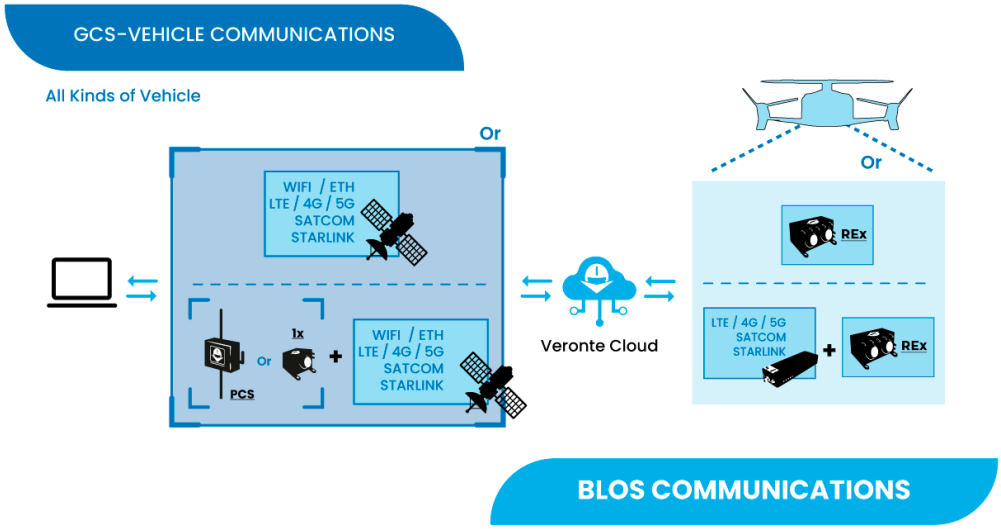
And on the vehicle side, an **Autopilot REx** with an **external LOS Datalink**.

BLOS Communications

Veronte Cloud enables secure and efficient Beyond Line of Sight (BLOS) communication between the autopilot onboard a vehicle and the control station. It supports various communication methods, offering a flexible architecture to suit different operational requirements:

- **Autopilot REx Internal Module**: Embedded **4G** module within **Autopilot REx**.

- **LTE/4G/5G Module**: External LTE module for wireless communication.
- **Satcom Module**: Satellite communications device for global coverage.
- **Starlink**: High-bandwidth, global communications module.



These communication methods can be used both at the **ground control station** and **onboard**, enabling seamless switching between methods or simultaneous use for redundancy and enhanced reliability. They can also be combined to meet specific project requirements.

Control Station Connectivity Options

The control station connects to **Veronte Cloud** through two primary methods:

- **Option A: Direct PC Internet Connection**
  The **control station PC** connects directly to the Internet for communication with **Veronte Cloud**. This can be achieved using any available means of Internet communication:
  - Ethernet or Wi-Fi
  - LTE/4G/5G
  - Satellite Communication (Satcom)
  - Starlink
- **Option B: Connection via Veronte PCS/1x**
  The **control station PC** connects to the **Veronte PCS/1x module**, which manages the connection to the BLOS datalink module. The **PCS/1x** module supports:
  - Its **internal 4G module** for direct connectivity.

- **External communication modules** (LTE/4G/5G, Satcom, Starlink, etc.).
  This setup enhances communication reliability by leveraging Veronte's dedicated hardware for connection management and enabling the use of additional sensors integrated within the **PCS/1x** module.

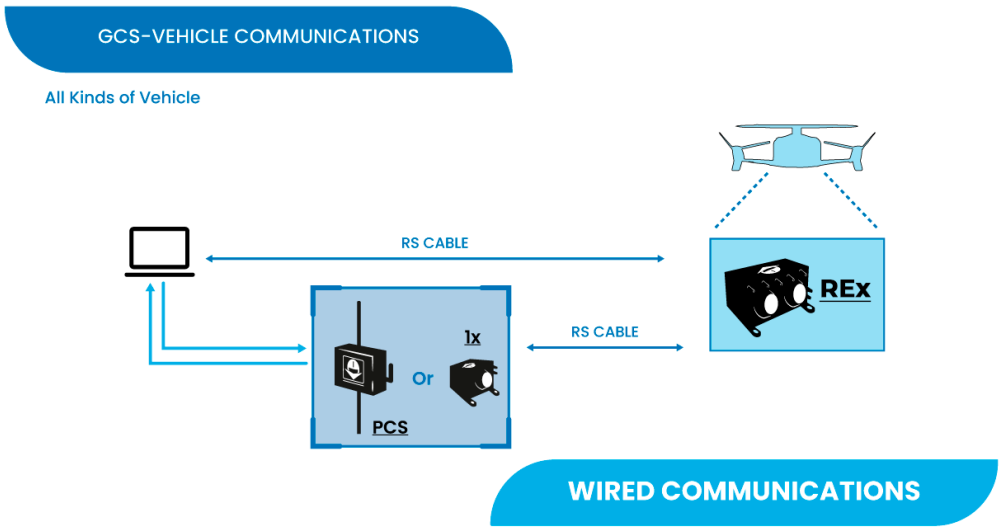
Onboard Connectivity Options

For onboard BLOS communications, **Veronte Autopilot REx** system offers two main methods:

- **Option C: Internal 4G Module in Veronte Autopilot REx**
  Autopilot REx comes equipped with an internal 4G module that connects directly to **Veronte Cloud**. This option is compact and does not require additional external hardware.
- **Option D: External Module Connected to Autopilot REx**
  The autopilot can integrate an **external communication module** (LTE/4G/5G, Satcom, Starlink, etc.) to enable BLOS communication with **Veronte Cloud**. This provides flexibility and allows for customization based on specific mission or environmental needs.

Wired Communications

For operations where the control station is directly connected to the onboard autopilot by cable.



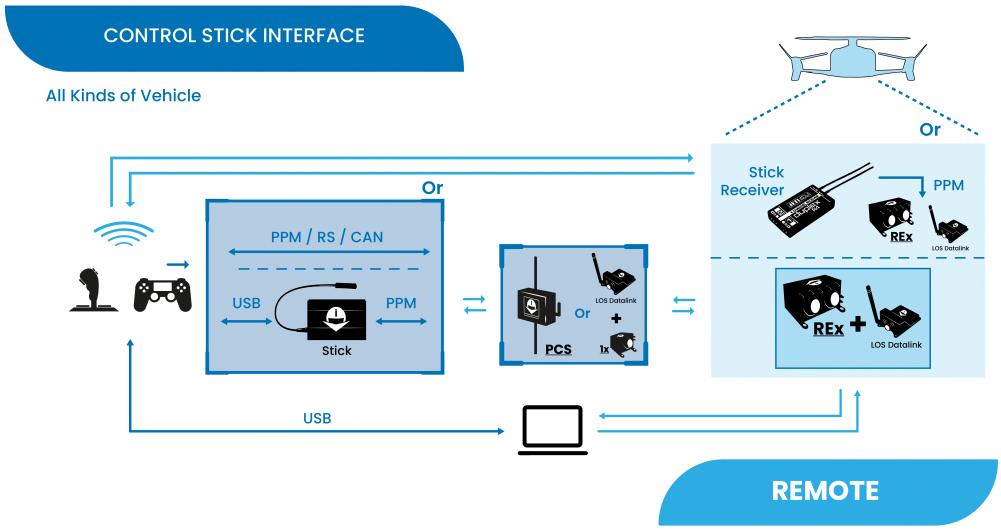
Control Stick Interface

This section presents the different types of manual control from stick to the onboard autopilot.

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

Remote Control Stick

A wide variety of controllers can be used to pilot manually aircrafts, such as RC transmitters, pedals, sticks or buttons. Veronte software allows the use of any device that is detected as a remote controller by the operating system



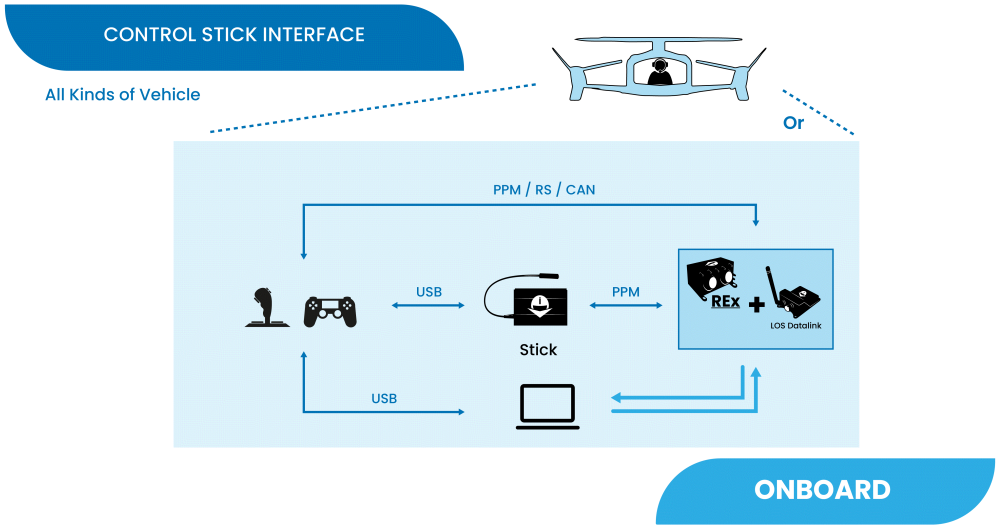
Although the most common way of control is to directly connect a **stick** via **PPM**, **RS** or **CAN** to a control station (**PCS/1x** + LOS Datalink) which then communicates with the onboard autopilot,

- It is possible to establish a link connection between a stick and a **stick receiver** integrated in the vehicle, which is connected via **PPM** to **Autopilot REx**. This allows for a backup manual channel when there is a main channel loss and an emergency manual landing is needed. Recommended for initial development stages where automatic landing phases are not defined yet.
- A **Veronte Stick** allows the connection of **USB sticks** to a control station (**PCS/1x** + LOS Datalink), converting **USB to PPM**. Then, the GCS communicates with the onboard autopilot for control.

- A **USB stick** can be connected directly to the **PC** to establish communication with the onboard autopilot for control.

Onboard Control Stick

In operations with pilots onboard in a flight deck (such as eVTOLs), the sticks can directly control the vehicle's **Autopilot REx**.



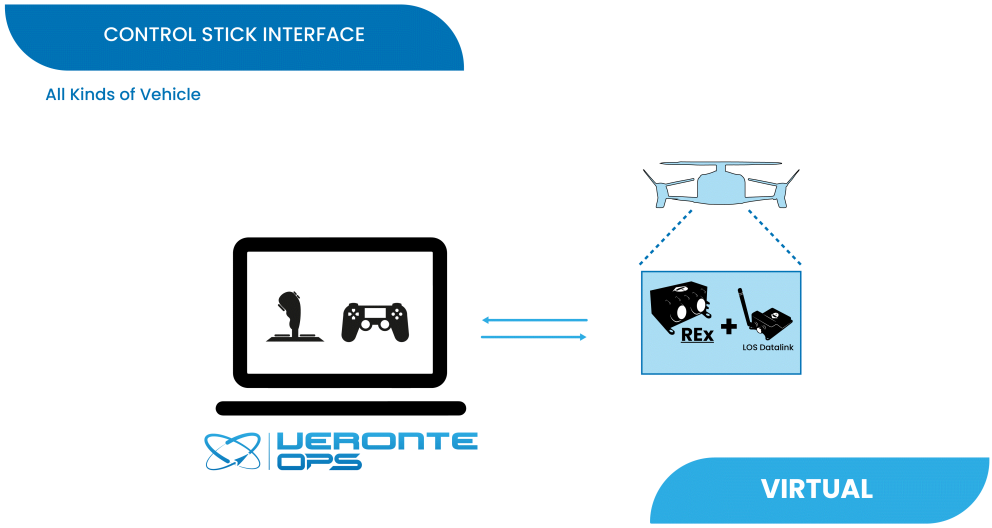
Some examples are:

- To directly connect a stick via **PPM**, **RS** or **CAN** to the autopilot.
- To use a **Veronte Stick** that converts **USB to PPM**, allowing connection between **USB sticks** and the autopilot.
- Connect a **USB stick** to a **PC** which establishes communication with the autopilot.

Virtual Stick

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

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



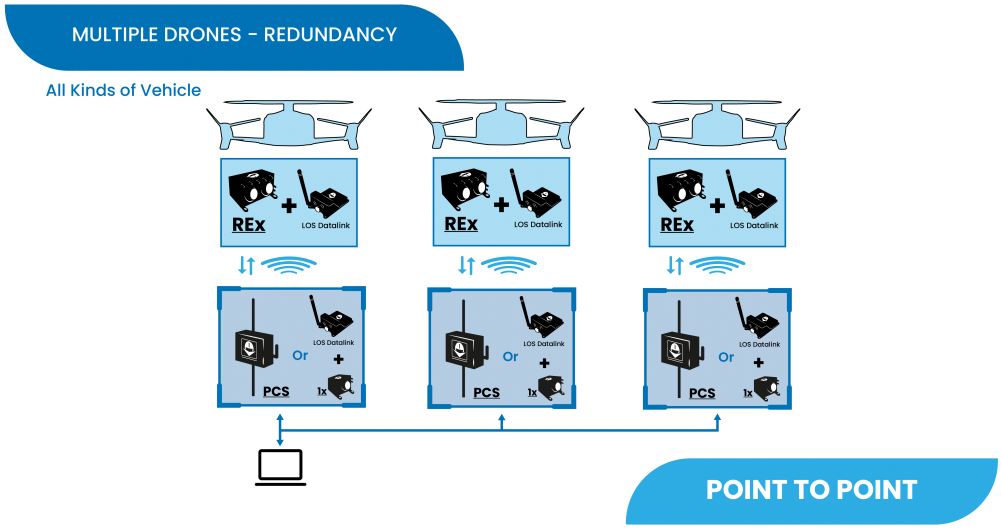
Multiple Drones/GCS - Redundancy

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

> **Note**
>
> Users are free to combine the different multiple drones solutions with the multiple GCS solutions.

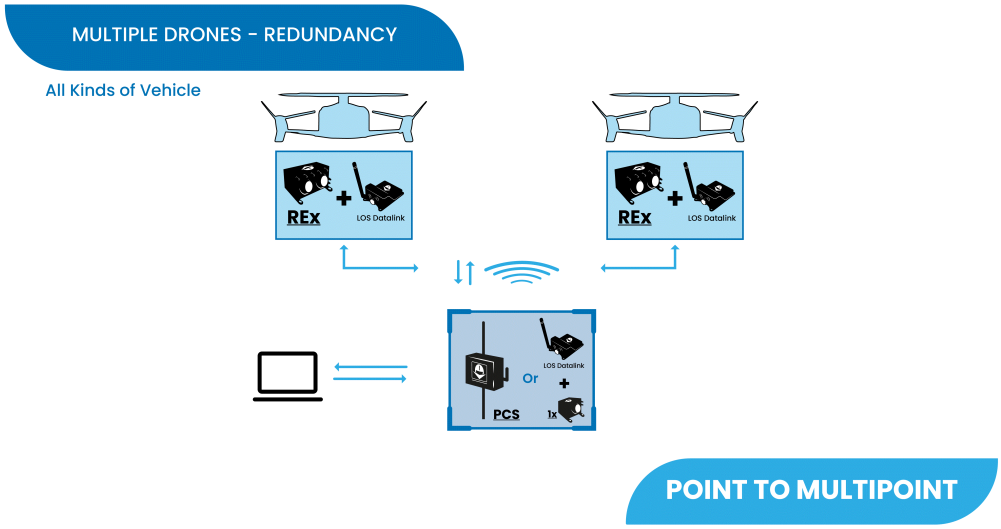
Multiple Drones - Point to Point

Standard multiplatform setup.



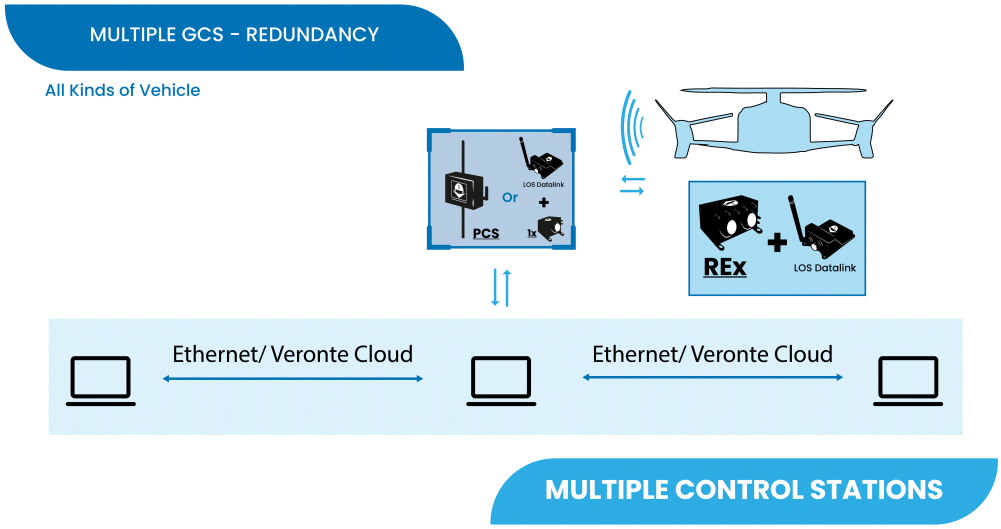
Multiple Drones - Point to Multipoint

Managing several platforms with a single radiolink.



Multiple GCS

For long range operations with several LOS stations.



For remote solutions with LOS backup operator, **Veronte Cloud** allows the connection between PCs.

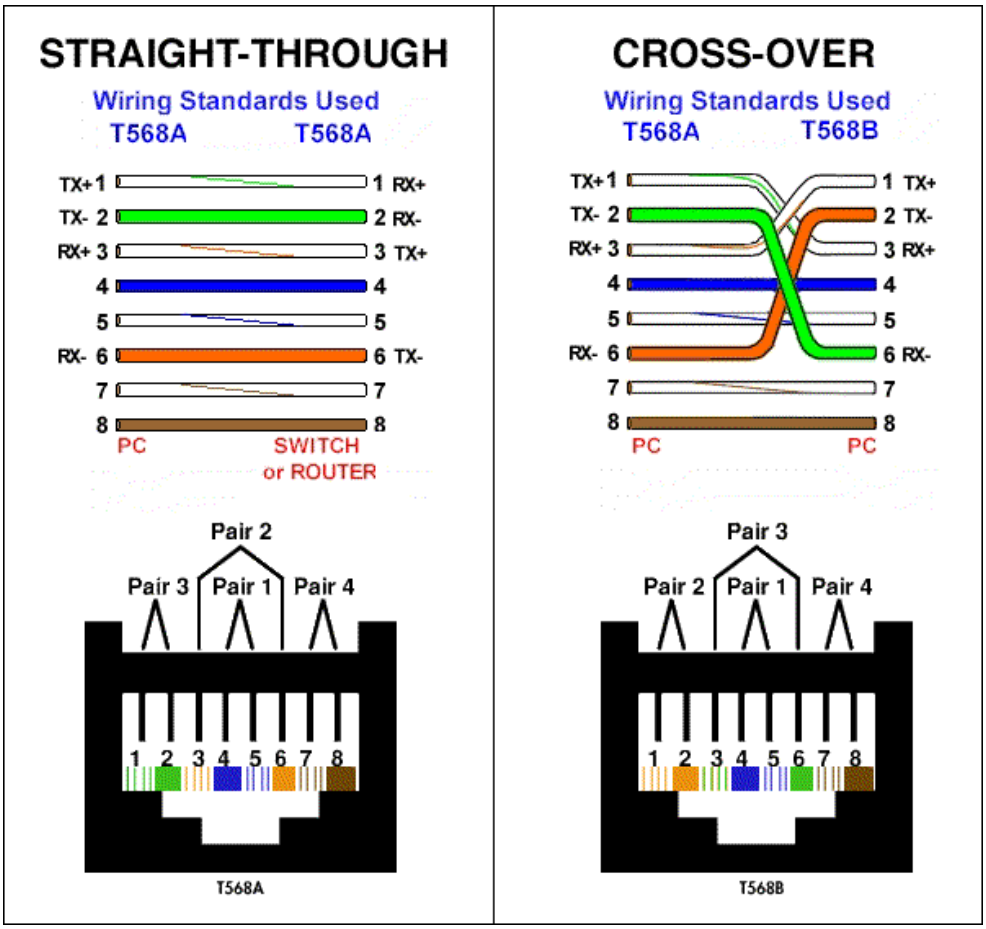
To correctly establish communication between the different PCs via **Ethernet** the following steps should be carried out:

1. Make the **physical connection** with ethernet cables, the two different types of ethernet cables can be used:
    - **Straight-Through**

Connect each PC to an **ethernet switch** with its Straight-Through ethernet cable (i.e. users will need 2 cables).

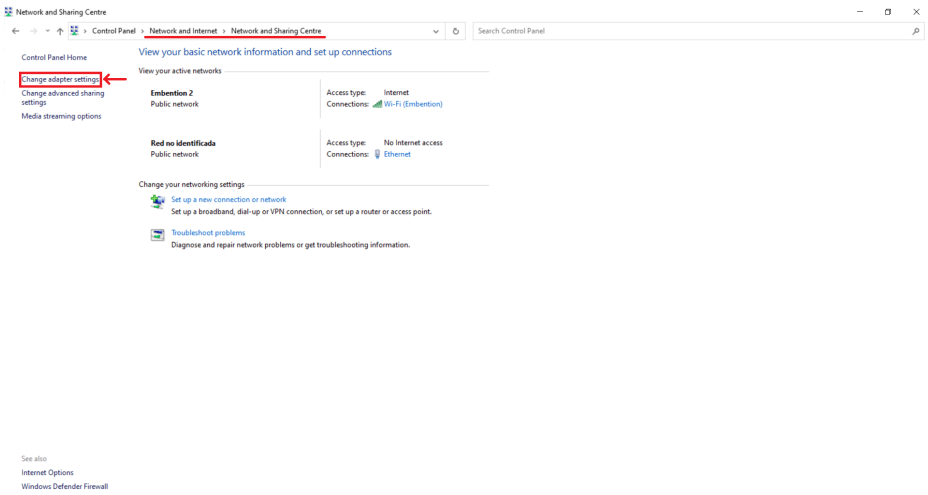
- **Crossover**

  Connect the PCs directly to each other with a crossover ethernet cable.



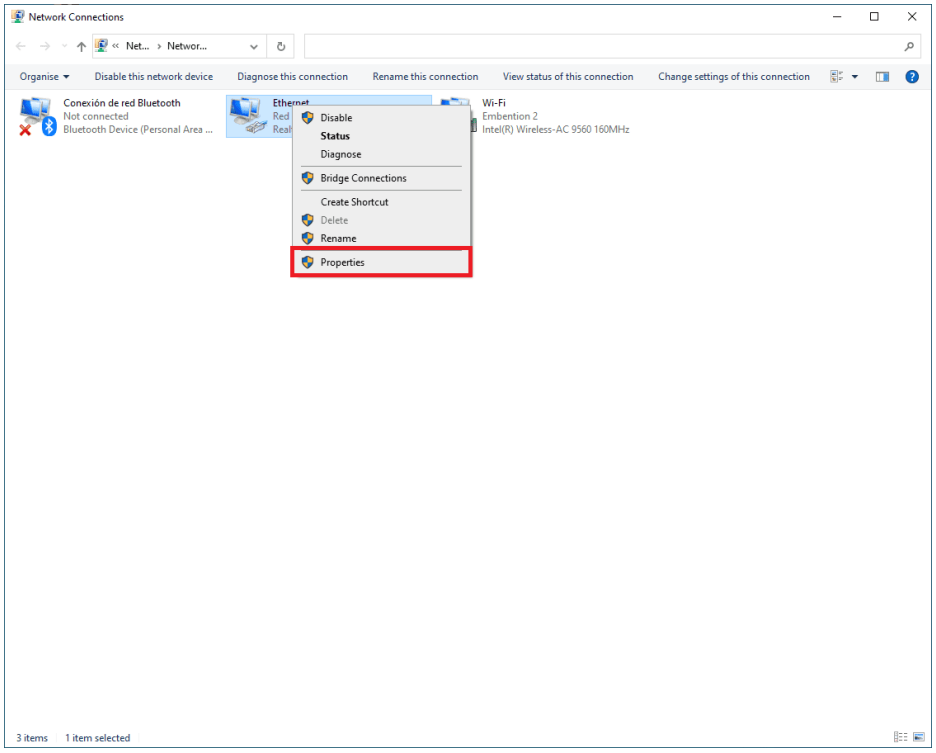
Straight-Through vs Crossover cables

2. On each PC, change the ethernet adapter settings to a static IP so that both are on the same subnet. To do this:
   - In the **Control Panel**, go to **Network and Internet**.
   - Open **Network and Sharing Centre** menu and click **Change adapter settings**.



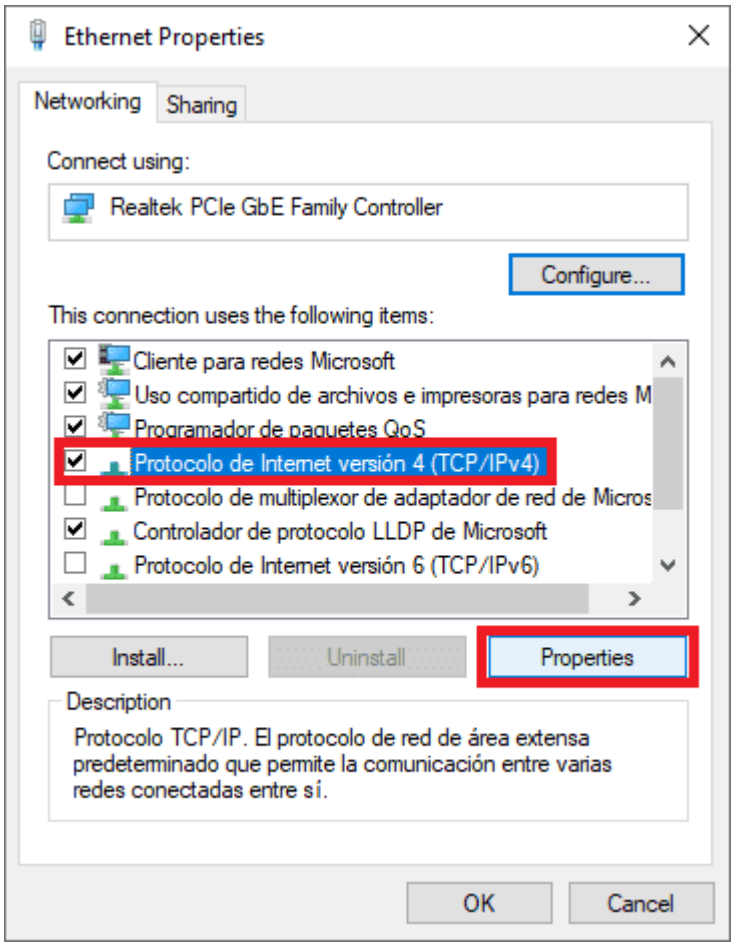
Ethernet connection 1

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



Ethernet connection 2

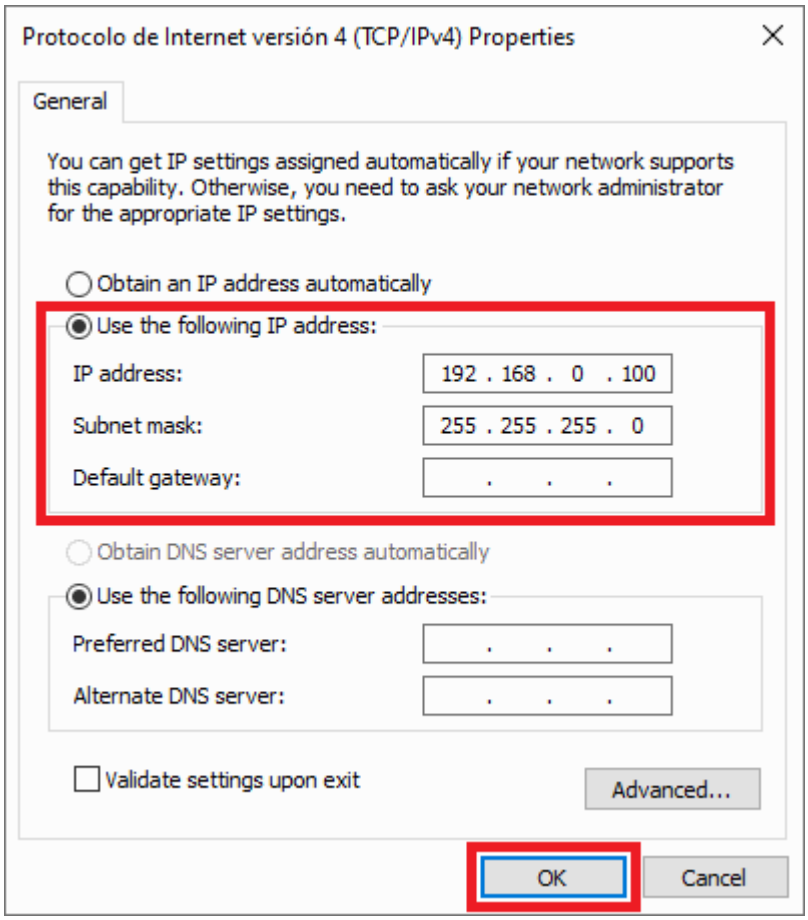
- Select **IPv4** and click **Properties**.



Ethernet connection 3

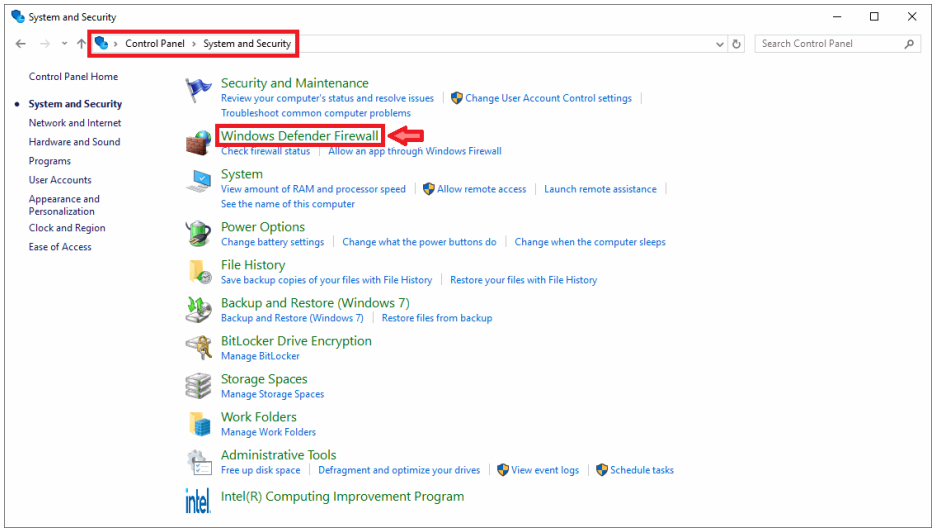
- Set **IP address** to a **static IP** (e.g. 192.168.0.100) and **Subnet mask** to 255.255.255.0. Click **OK**.

> **Important**
>
> If on this PC the IP address is set to 192.168.0.100, on the other PCs, the IP address must be set to **192.168.0.XXX** (e.g. 192.168.8.234), so that they are on the same subnet.



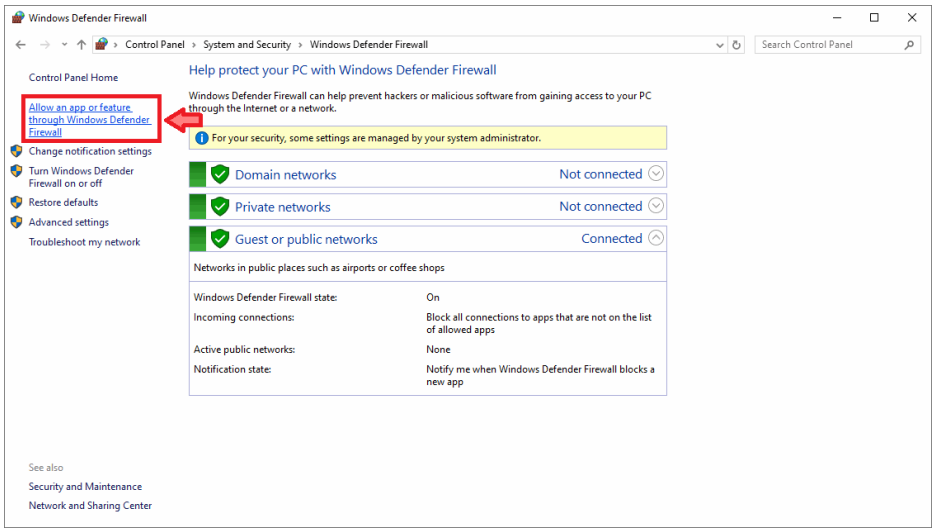
Ethernet connection 4

3. Allow **VeronteLink** to go through the Firewall on the PC that will run it, hereafter PC primary. To do so:
    - In the **Control Panel**, go to **System and Security**.



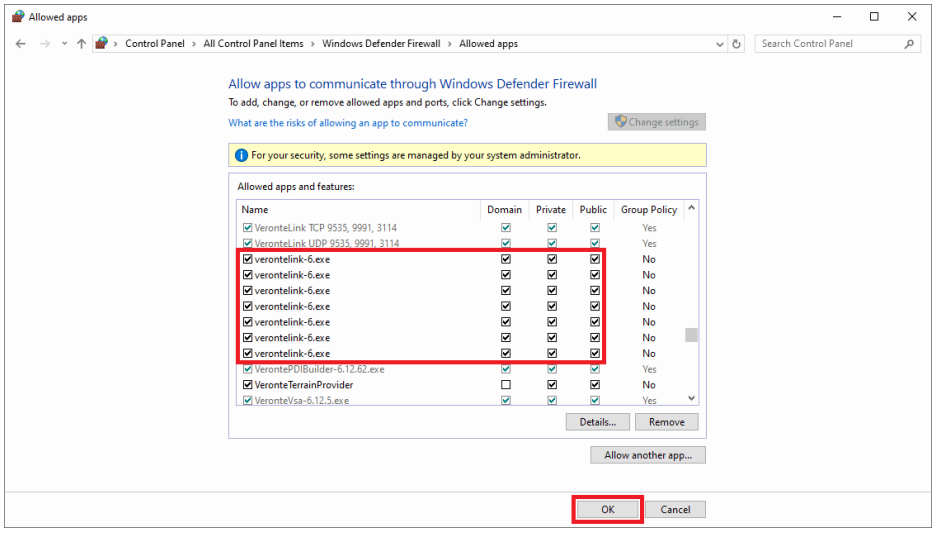
Windows Firewall 1

    - Open **Windows Defender Firewall** and click on **Allow an app through Windows Defender Firewall**.



Windows Firewall 2

- Check that **Veronte Link** app is **allowed**.



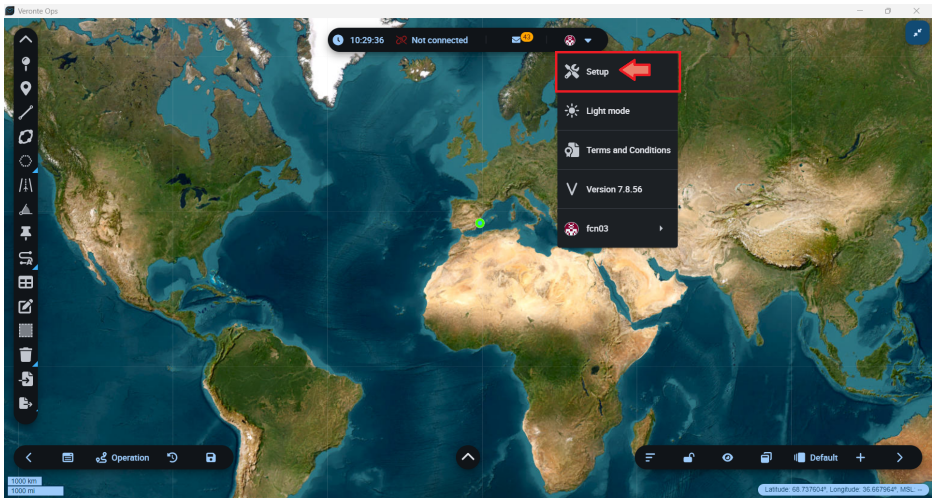
Windows Firewall 3

4. On the PC secondary, in **Veronte Ops** change the **Veronte Link Host** option setting to the **IP of the PC primary**. To do this:
   - Open **Veronte Ops**.
   - In the **Status bar**, click the **arrow** on the right of the bar to display a **drop-down menu**.



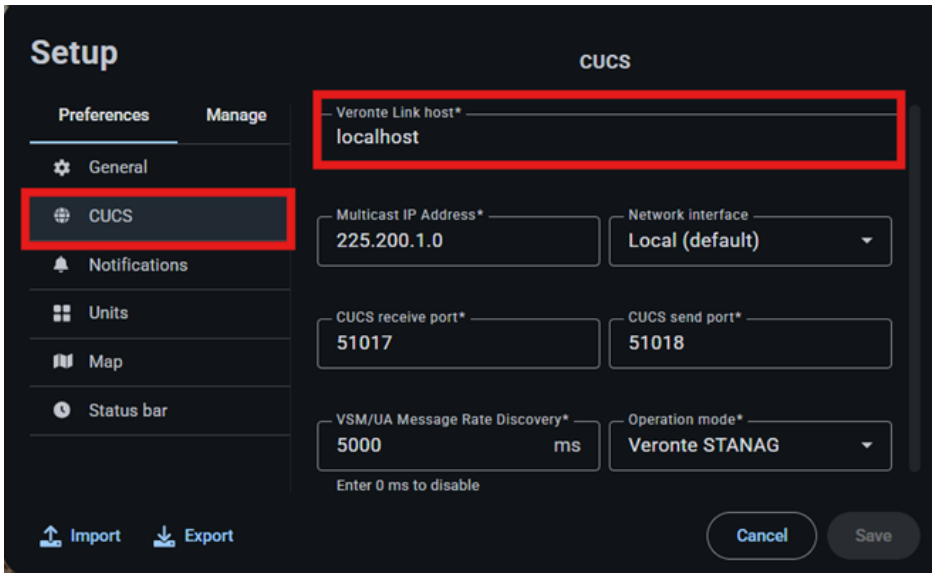
Veronte Ops - Status bar

- In it, open the **Setup** menu.



Veronte Ops - Setup menu

- Next, go to the **Veronte Link Host** settings.
- Change the IP localhost to the IP of the PC primary.



Veronte Ops - Veronte Link Host settings

For more information on these settings, refer to the Setup - Veronte Ops configuration section of the **Veronte Ops** user manual.

5. Finally, **Autopilot 1x** connected to the PC primary should be seen in the **Veronte Ops** open on this PC, as well as on the PC secondary.
   If users have any problems when trying to connect **Veronte Ops** to **Veronte Link**, refer to the Connecting to Veronte Link - Troubleshooting section of the **Veronte Ops** user manual.

If after following the steps described above users are not able to operate in this way, please contact support team by opening a **Ticket** in your Joint Collaboration Framework.

Preparation for operation

Here the user will find different checklists that the Embention team considers useful to follow as a guideline before performing an operation.

> **Important**
>
> This is only an **example**, it may vary depending on the operation to be performed and the user's platform.

1. Hardware revision
2. Software revision
3. Functional system test
4. Equipment checklist
5. Revision and checks pre-flight
6. Post-flight revision

Maintenance

Preventive maintenance

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

In order to clean **Veronte Autopilot REx** 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.

Software update

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

Compatible Devices

Since **Veronte Autopilot REx** is based on **Veronte Autopilot 1x**, both products have the same compatible devices. To know more, read the Compatibles Devices section of the **1x Hardware Manual**.

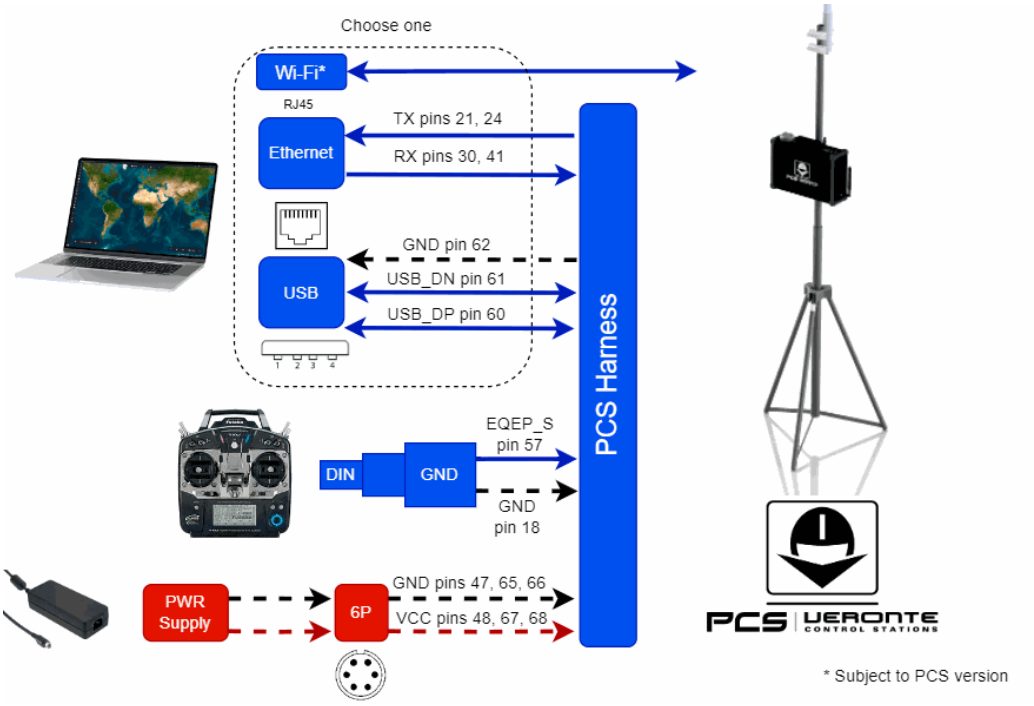
Integration examples

The step-by-step instructions for the following external devices will be explained in detail in the following sections:

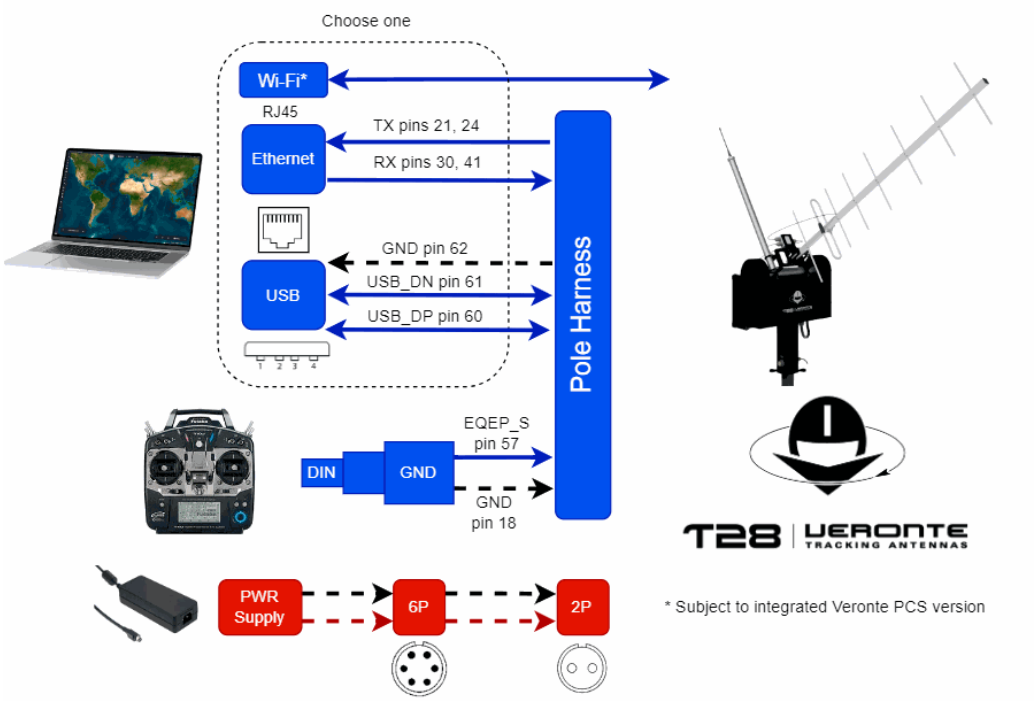
- Connection Examples
- Air Data Sensors
- Datalinks
- Stick

Connection Examples

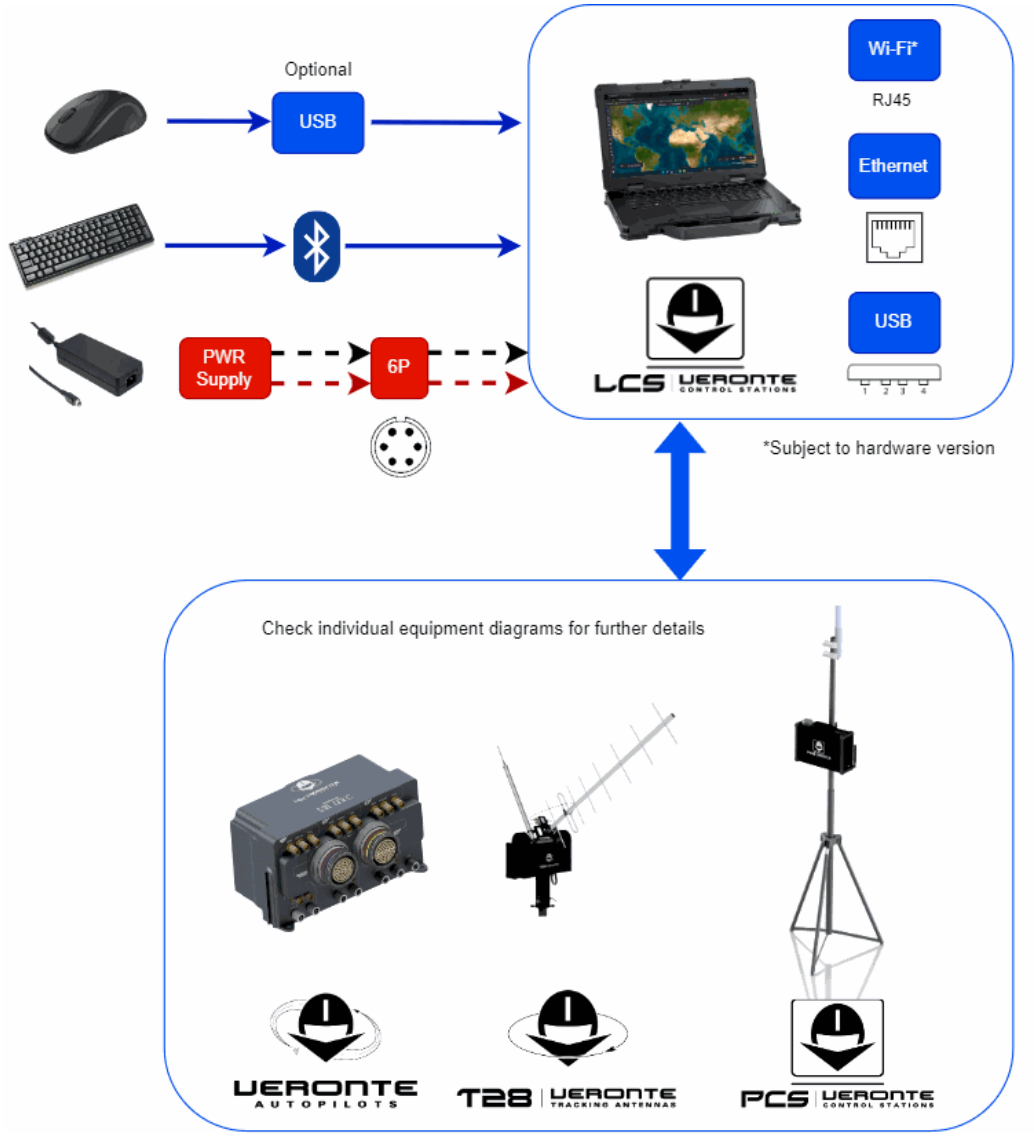
1. Ground Stations



Autopilot REx PCS Ground Station



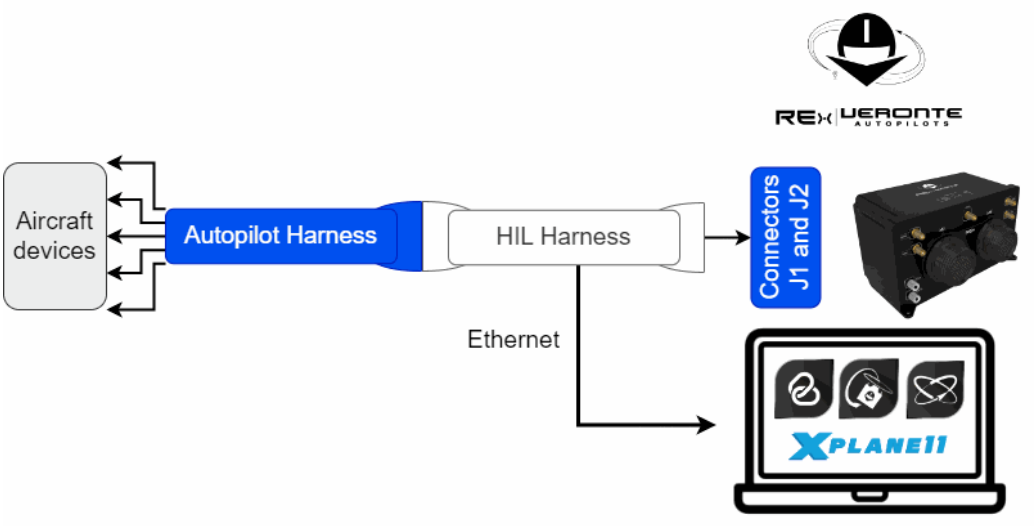
Autopilot REx Tracker Ground Station



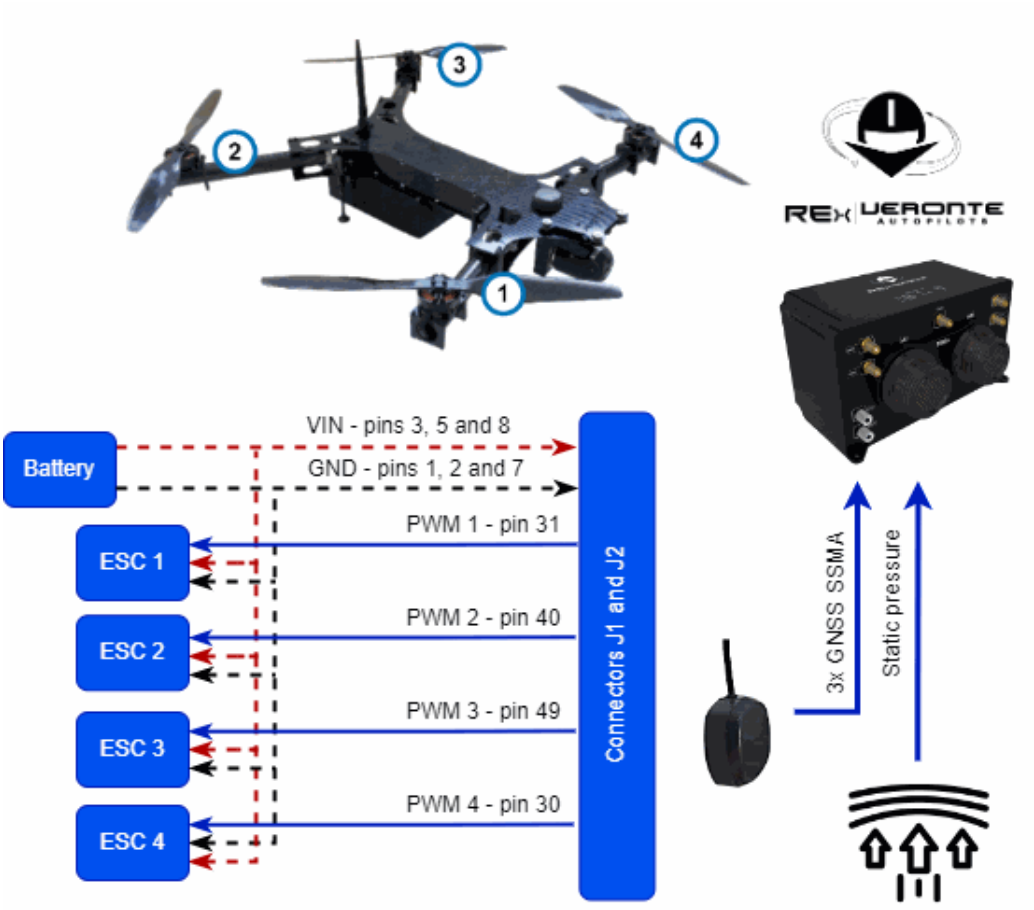
Autopilot REx LCS Ground Station

> ⚠ **Warning**
>
> **Veronte Autopilot REx** equipment harnesses have specific pin layouts. Only use their own matting connectors, do NOT mix harnesses: misuse may lead to destruction.

2. Aircrafts



HIL Harness



Multicopter

Air Data Sensors

1. Temperature sensor LM335

LM335 sensor

The **LM335** is an analogical temperature sensor that measures temperatures from -40°C to 100°C.

It changes the voltage according to the temperature measured and therefore the connection to the autopilot is performed using the ADC pins.

The following wiring is necessary to connect a sensor to the autopilot:

LM335 sensor - REx wiring diagram

The **LM335** sensor can share voltage supply with the **Autopilot REx**. However, the impedance of the resistor **R** must vary with the voltage; since the sensor requires a forward current between 0.4 and 5 mA to operate. We recommend

to use a resistor as high as possible complying with the folllowing equation:

$$\frac{V_{in} - 2.33}{5 \cdot 10^{-3}} < R < \frac{V_{in} - 3.73}{5 \cdot 10^{-4}}$$

Where **R** is the value of the resistor (ohms) and **Vin** is the supply voltage (V). The following table shows a list of examples of a tested resistor for each voltage supply. Obtaining an error average of 1.5 °C.

Vin (V)	R (kohms)
8	7
16	22
34	54
54	90

The **Vout** pin has to be connected to an analog input of the **Main connector**.

Connector J1 harness pinout

- Users must choose one **analog** pin to connect:

Connector J1 harness			LM335 sensor
PIN	**Signal**	**Color code**	**Signal**
14	ANALOG IN 1	Brown - Green	Vout
15	ANALOG IN 3	White - Yellow	

Connector J1 harness			LM335 sensor
PIN	**Signal**	**Color code**	**Signal**
22	ANALOG IN 5	Brown - Blue	
44	ANALOG IN 2	Brown - Green	
45	ANALOG IN 4	White - Yellow	
52	ANALOG IN 6	Brown - Blue	

- Users must use the **supply voltage** according to the Autopilot REx being used:

Connector J1 harness			LM335 sensor
PIN	**Signal**	**Color code**	**Signal**
3	VIN PRIM	Green	V+
5	VIN MON	Gray	
8	VIN PRIM	Red	

- Users must choose one **ground** pin to use:

Connector J1 harness			**LM335 sensor**
PIN	**Signal**	**Color code**	**Signal**
1	GND MON	White	GND
2	GND PRIM	Brown	
7	GND PRIM	Blue	
26	J1 GND IO	Brown - Black	
29	J1 GND IO	Pink - Green	

Once connected, the temperature can be monitored in **1x PDI Builder** by using the variables ADC0 to ADC4. The wiring explained previously obtains a relationship of Temperature and **Vout** as follows:

$$T = V_{out} \cdot 100 - 273$$

Where **T** is the measured temperature (in °C, since 273 is substracted in the formula) and **Vout** the output voltage of the previous circuit.

Datalinks

1. Silvus radio (StreamCaster 4200E model)

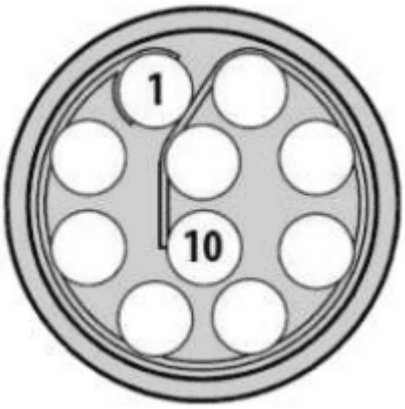
1.1. System Layout

The following image shows the standard connection between **Silvus** radios and **Autopilot REx** for operation:

Silvus and REx connection

1.2. 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.



PRI port connector (mounted in radio)

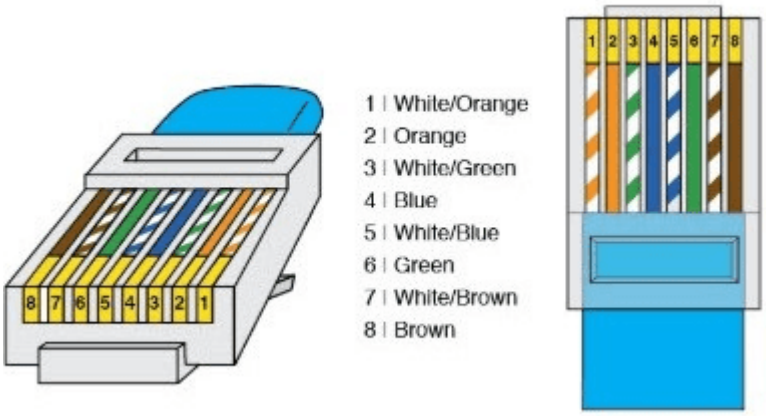
- **Power supply**



Female DC Power Jack connector

PRI port connector - Silvus radio		Power connector
PIN	**Signal**	**Signal**
2	GND IN	Power -
3	VCC IN	Power +

- **Ethernet**

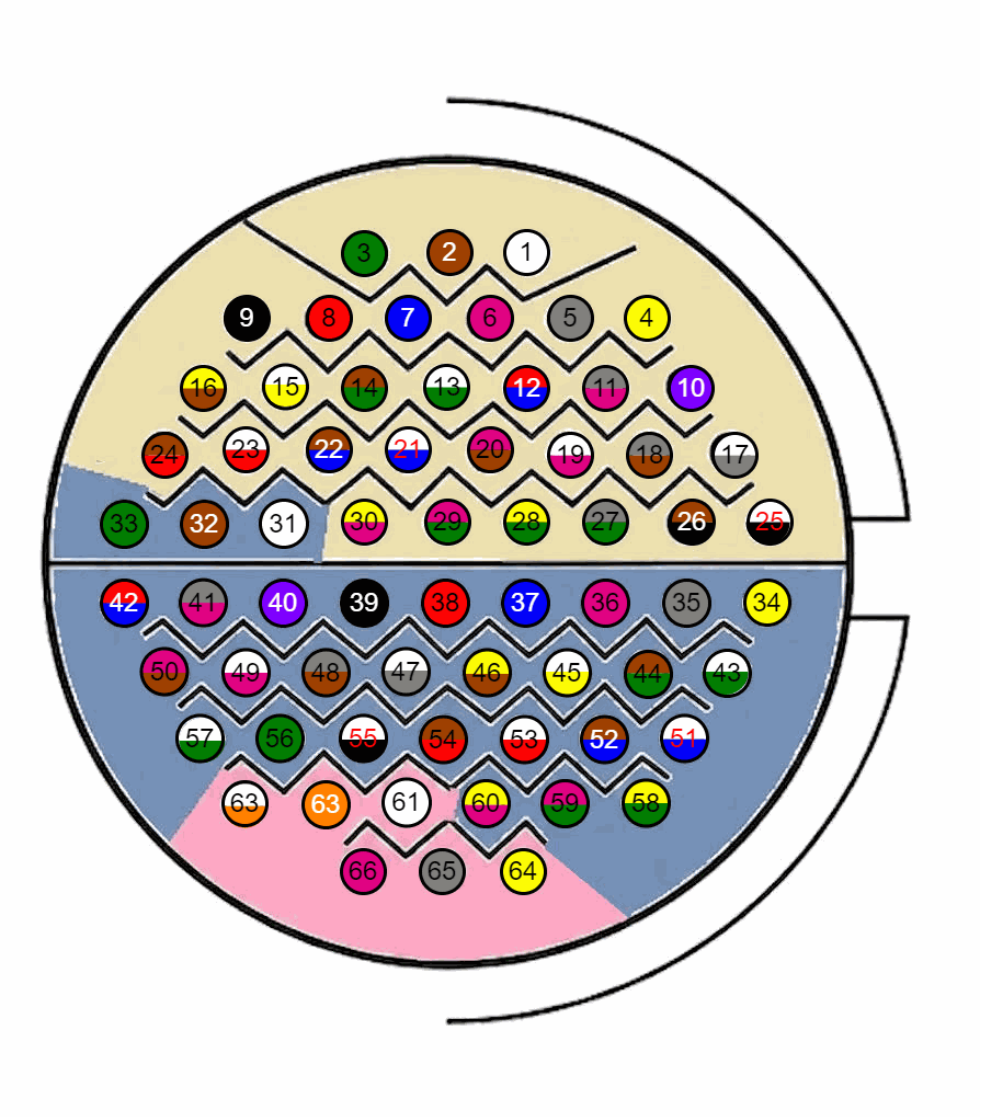


RJ45 pinout T-568B

PRI port connector - Silvus radio		RJ45 Connector (T-568B)		
PIN	**Signal**	**PIN**	**Signal**	**Color code**
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 **Main Connector** with **Veronte Harness Blue 68P**.



Main connector harness pinout

PRI port connector - Silvus radio		Veronte Harness - Autopilot REx		
PIN	**Signal**	**PIN**	**Signal**	**Color code**
7	RS232_RXD	60	J1_RS232_TX_A	Yellow-Pink
8	RS232_TXD	65	J1_RS232_RX_A	Gray
9	GND	54	J1_GND_RS232	

PRI port connector - Silvus radio		Veronte Harness - Autopilot REx		
PIN	**Signal**	**PIN**	**Signal**	**Color code**
				Brown-Red

1.3. Silvus radio configuration

This section shows a basic configuration for **Silvus** radios.

1.3.1. 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.

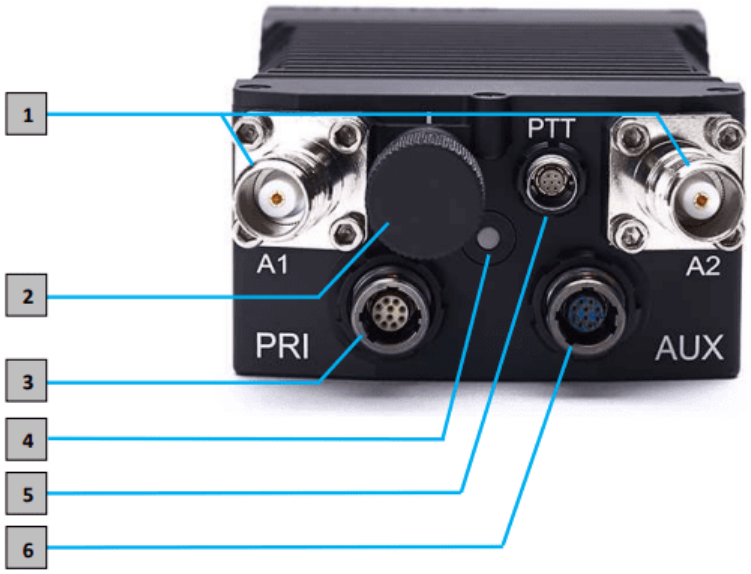


Figure 3 StreamCaster 4200E Ruggedized Enclosure

1 RF Channels 1-2 Connectors [TNC Female]

2 Power Switch [15-Position Rotating]

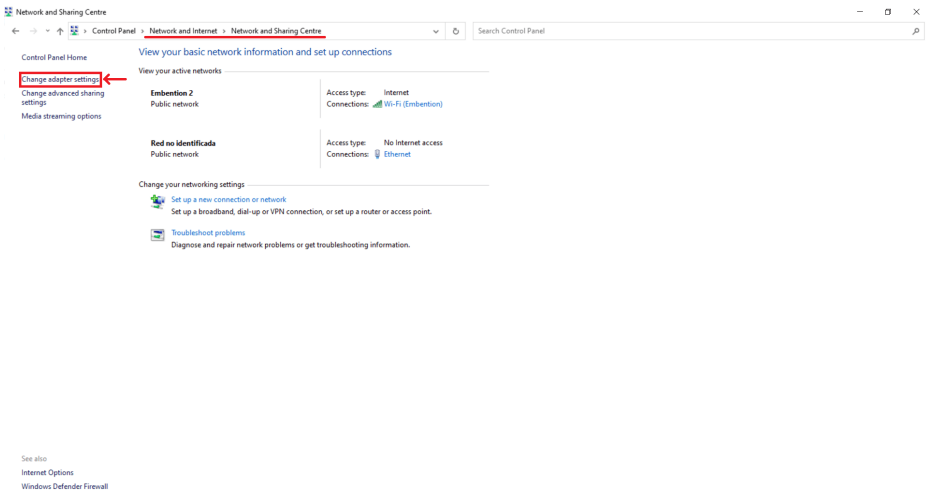
3 Power (EB Version Only, 9-20V), Ethernet, and Serial Port Connector [ODU GK0YAR-P10UC00-000L]

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

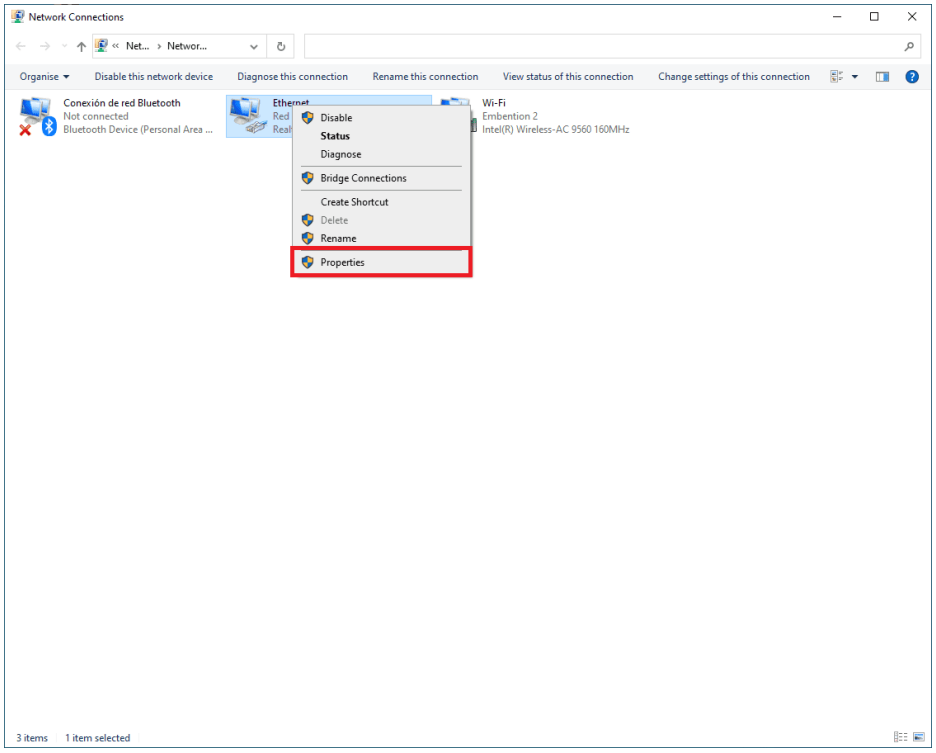
Silvus connectors

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**.



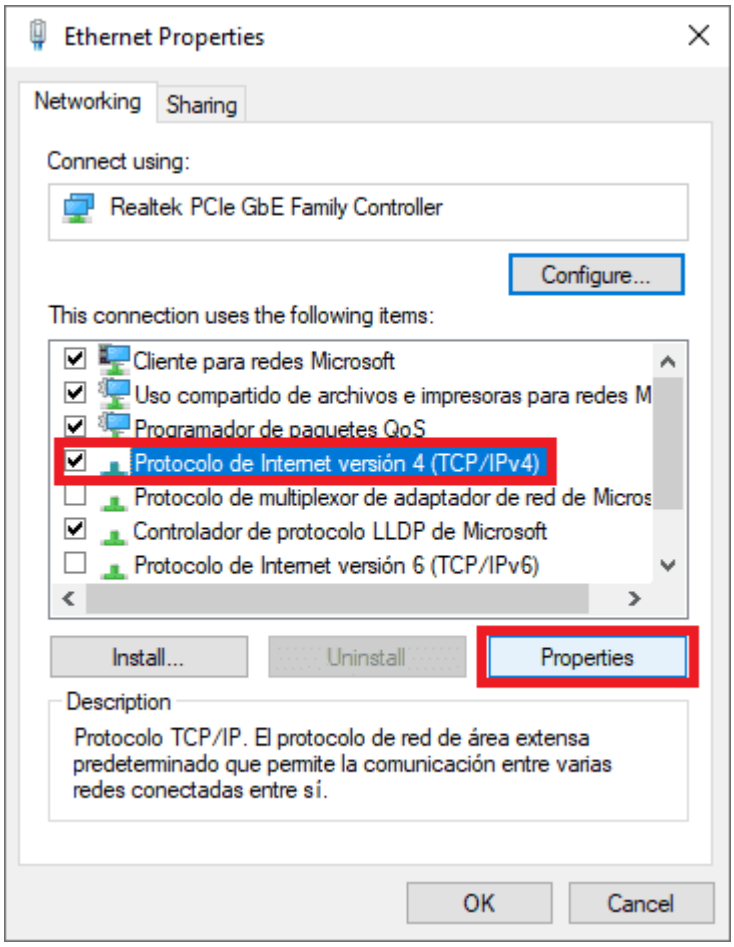
Ethernet connection 1

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



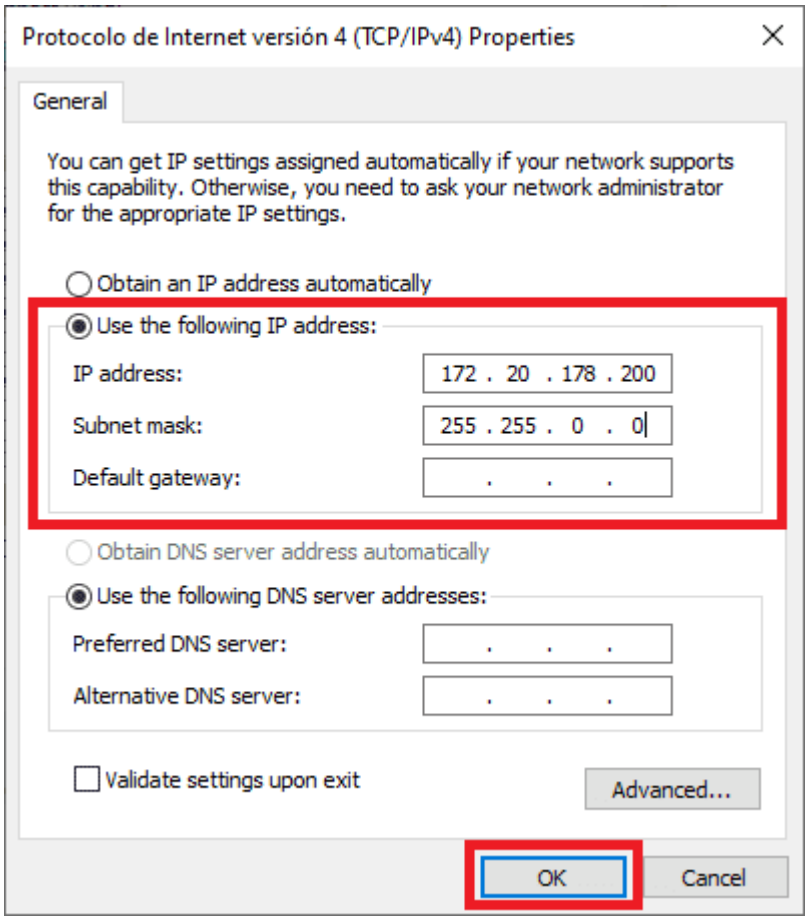
Ethernet connection 2

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



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**.



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.

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).

1.3.2. 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 REx air unit.

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

1. Basic Configuration.

   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 independently. **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.

   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.

   Multicast panel

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

4. Serial/USB Setup

   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 1x PDI Builder 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 REx **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 ground 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**.
>
> **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.

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.

Settings Profile panel

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

Save settings

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.

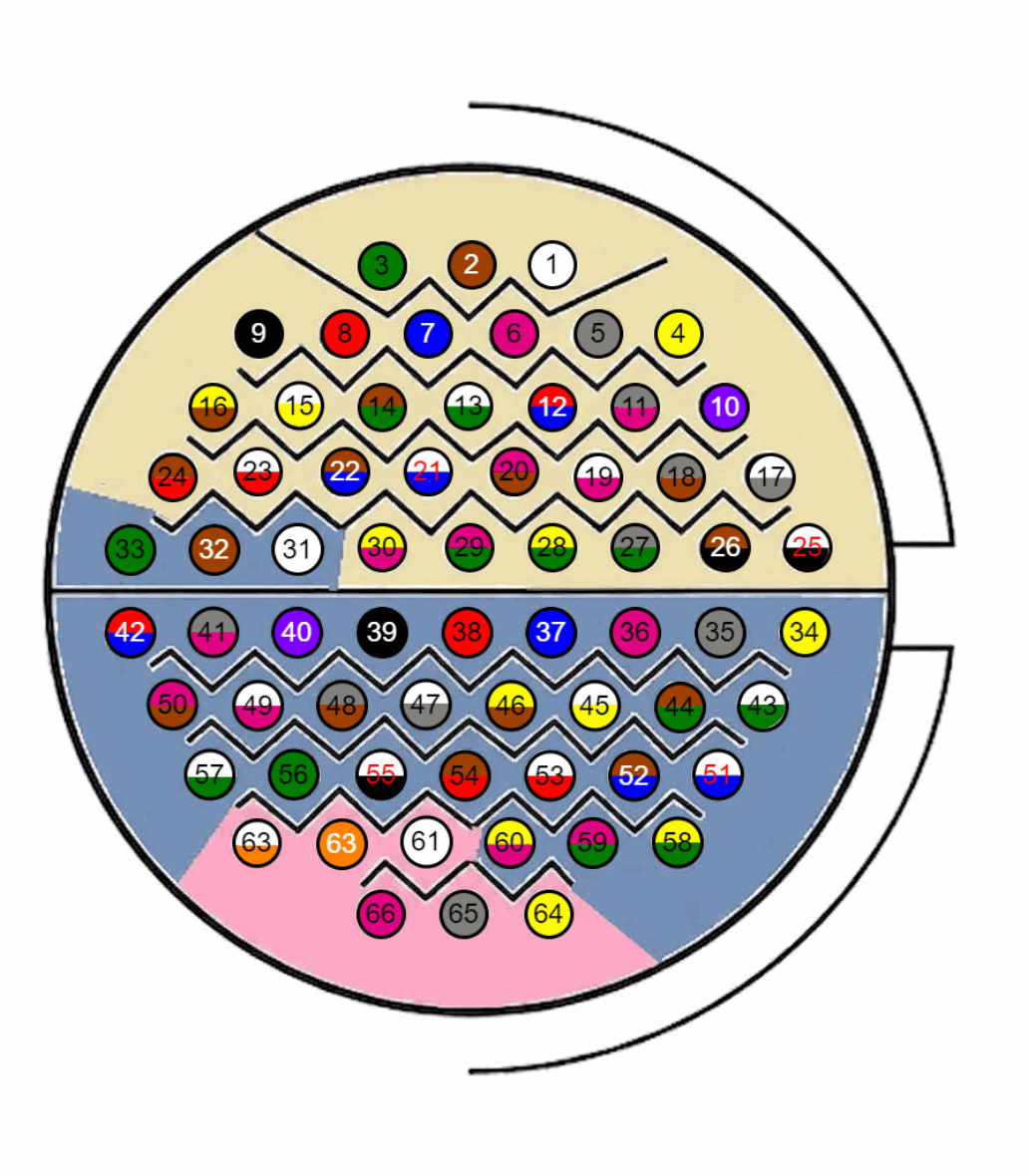
Connection between radios

Stick

Veronte Autopilot REx is compatible with joysticks that use PPM, CAN bus, USB, Serial, etc.

1. PPM Connection

If the PPM level is 3.3V, the following **Autopilot REx** pins can be used:

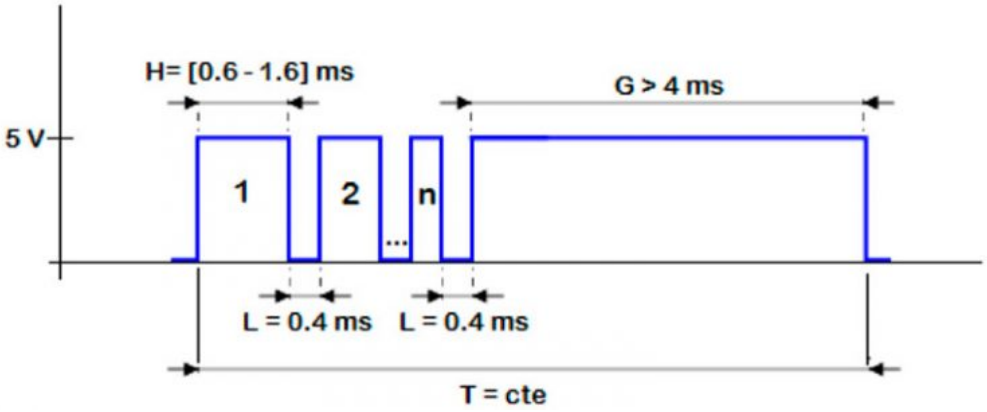


Connector J1 harness pinout

Connector	PIN	Signal	Type	Use for PPM stick
J1	17	J1_DIGIN_A	INPUT	PPM signal input (recommended on Dev Harness jack)
J1	29	J1_GND_IO	GROUND	PPM ground (used on Dev Harness jack)

Connector	PIN	Signal	Type	Use for PPM stick
J1	25	J1_DIGIN_B	INPUT	Alternative PPM signal input
J1	26	J1_GND_IO	GROUND	Ground for J1 digital inputs

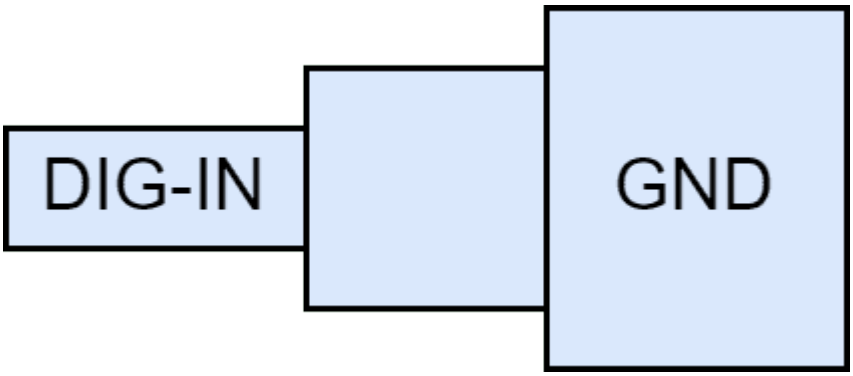
Dev Harness REx 2.0 reference: Jack connector is wired to J1 pin 17 (J1_DIGIN_A) and J1 pin 29 (J1_GND_IO), as defined in Hardware Installation.



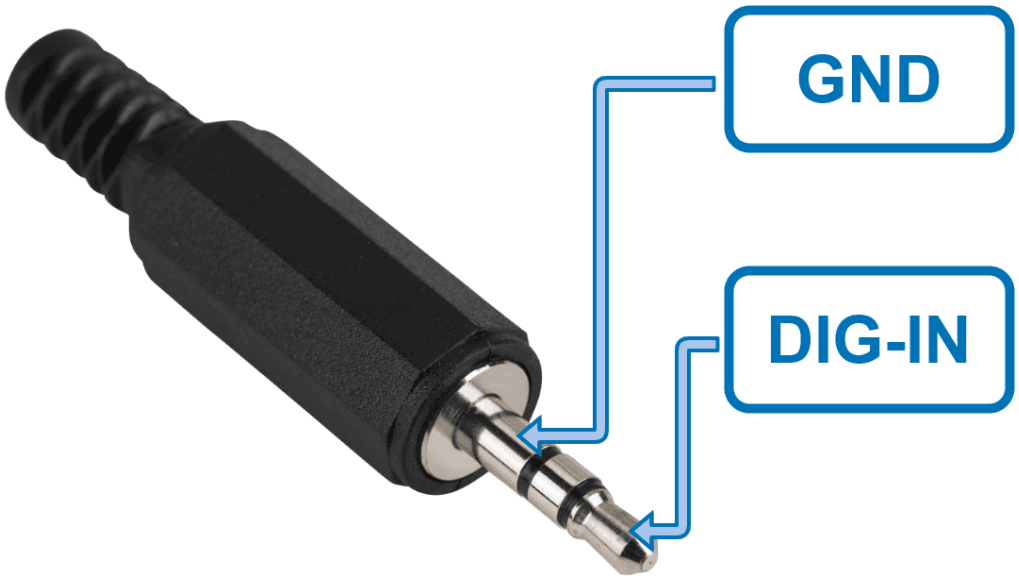
PPM signal

> ⚠ **Caution**
>
> PPM signal must be into the **Veronte Autopilot REx** voltage ranges. Some joysticks may need an adaptation board, please ask our team to check compatibility.

Connector for harness is provided with 3.5 mm stereo plug connector as follows:



PPM pinout



PPM connector

- To use the joystick with **PPM** in the system, connect the PPMout of the trainer port to a digital input of **Veronte Autopilot REx** and configure that digital input according to the PPM Stick - Integration examples section of the **1x PDI Builder** user manual.

2. CAN Connection

For joystick integrations using **CAN bus**, use the following pins from **Hardware Installation**:

Connector	PIN	Signal	Type	Use for CAN stick
J1	9	J1_CAN_MUX_A_P	CAN BUS	CAN A positive (muxed)
J1	16	J1_CAN_MUX_A_N	CAN BUS	CAN A negative (muxed)
J1	24	J1_CAN_MUX_B_P	CAN BUS	CAN B positive (muxed)
J1	33	J1_CAN_MUX_B_N	CAN BUS	CAN B negative (muxed)
J1	23, 48	J1_CAN_GND	GROUND	CAN ground

3. Serial Connection

For joystick integrations using **Serial**, use **RS232** and/or **RS485** according to your joystick interface:

Connector	PIN	Signal	Type	Use for Serial stick
J1	60	J1_RS232_TX_A	OUTPUT	RS232 A TX
J1	65	J1_RS232_RX_A	INPUT	

Connector	PIN	Signal	Type	Use for Serial stick
				RS232 A RX
J1	61	J1_RS232_TX_B	OUTPUT	RS232 B TX
J1	66	J1_RS232_RX_B	INPUT	RS232 B RX
J1	39, 54	J1_GND_RS232	GROUND	RS232 ground
J1	52, 58	J1_INA_485_P / J1_INA_485_N	INPUT	RS485 A input pair
J1	64, 59	J1_OUTA_485_P / J1_OUTA_485_N	OUTPUT	RS485 A output pair
J1	43, 35	J1_INB_485_P / J1_INB_485_N	INPUT	RS485 B input pair
J1	51, 44	J1_OUTB_485_P / J1_OUTB_485_N	OUTPUT	RS485 B output pair

Connector	PIN	Signal	Type	Use for Serial stick
J1	45, 47	J1_GND_RS485	GROUND	RS485 ground

- When using a **USB joystick**, the software installation with **Autopilot REx** is detailed in the USB joystick - Integration examples section of the **1x PDI Builder** user manual.
- For joysticks with signals **different from PPM or USB**, read the Virtual Stick - Integration examples section of the **1x PDI Builder** user manual.

Troubleshooting

Maintenance mode

Maintenance mode is the main recovery mode that Veronte system puts at the user disposal. The main use of **maintenance mode** is to solve issues related to the current configuration, mainly related with communication or memory writing issues.

While in **maintenance mode**, **all communication channels are enabled** by default, so it is possible to connect to **Autopilot REx** through any of its configuration interfaces, regardless of the current configuration. This allows re-establishing communications with the device in case they have been lost for any reason.

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

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

Autopilot REx is built around a **triple redundant Primary–Monitor–Recovery** architecture. The procedures described below apply to **Autopilot REx** as a whole.

How to enter in maintenance mode

To enter in **maintenance mode** by software, read the Maintenance Mode - Troubleshooting section of the **REx PDI Builder** user manual.

> **Note**
>
> **Veronte Autopilots: Dev Harness - 66P MIL-DTL-38999** (Embention reference `P016262`) has already included a button to easily enter maintenance mode.
>
> To enter maintenance mode, press and release the button.

Acronyms and Definitions

Acronyms

Acronym	Description
16 VAR	16 Bits variables (Integers)
32 VAR	32 Bits variables (Reals)
ADC	Analog to Digital Converter
AGL	Above Ground Level
AoA	Angle of Attack
ARC	Arcade Mode
AUTO	Automatic Mode
BIT	Bit Variables
CAN	Controller Area Network
CAP	Capture Module
CMB	CliMb Phase
CRU	CRuise Phase
DAA	Detect And Avoid
DC	Direct Current

Acronym	Description
DGPS	Differential GPS
ECAP	Enhanced CAP
ECEF	Earth Centered – Earth Fixed
EGNOS	European Geostationary Navigation Overlay Service
EKF	Extended Kalman Filter
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	

Acronym	Description
	General Purpose Input Output
GPS	Global Positioning System
GS	Ground Segment
GS	Ground Speed
HLD	Hold Phase
HUM	Hardware User Manual
I2C	Inter-Integrated Circuit
IAS	Indicated Air Speed
ID	Identification
ISM	Industrial Scientific and Medical
LED	Light-Emitting Diode
LND	Landing Phase
M2M	Machine To Machine
MSL	Mean Sea Level
NC	No Connect
OAT	

Acronym	Description
	Outside Air Temperature
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

Acronym	Description
RX	Reception
SMA	SubMiniature Version A Connector
SSMA	Miniature-Sized Connector
STB	Standby Phase
SU	Servo-Output matrix
SUM	Software User Manual
TAS	True Air Speed
TKO	TakeOff Phase
TPDR	TransPonDeR
TX	Transmission
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle
US	Output-Servo matrix
VTOL	Vertical TakeOff and Landing
WGS 84	World Geodetic System 84

Acronym	Description
WP	Waypoint

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 behavior 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.

Contact Data

For support-related inquiries, customers have access to a dedicated portal through the Joint Collaboration Framework. This platform facilitates communication and ensures traceability of all support requests, helping us to address your needs efficiently.

For other questions or general inquiries, you can reach us via email at sales@embention.com or by phone at (+34) 965 115 421