# REx Hardware Manual

**Release 2.0/1.1**

Embention Sistemas Inteligentes, S.A.

2026-08-06

# Contents

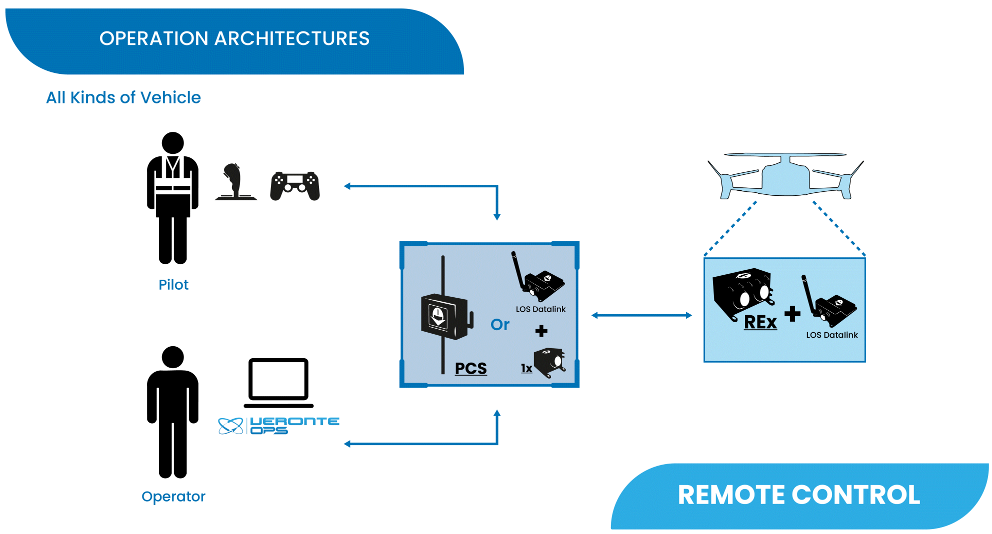
# Scope of Changes

- 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**.

# 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

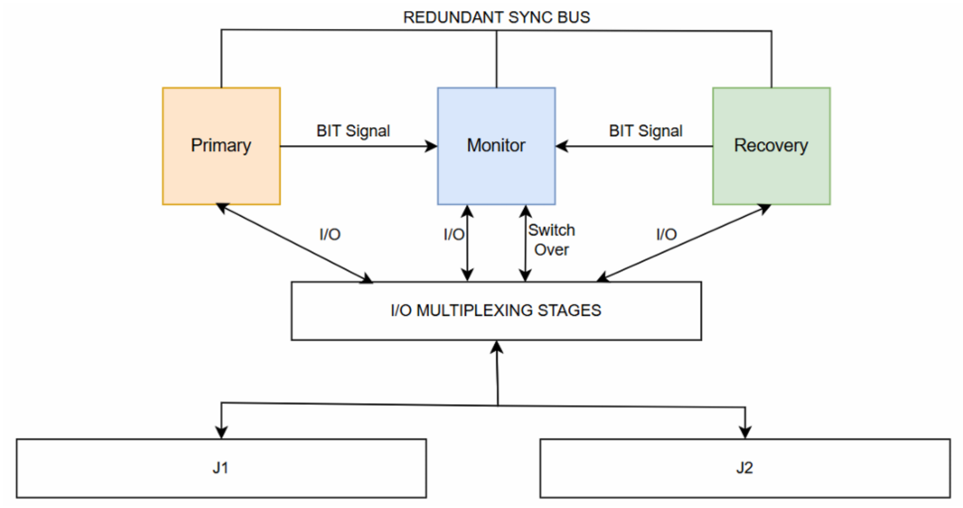
**Autopilot REx** allows aircrafts to perform sensitive flight missions and transport valuable payloads with advanced safety conditions and high reliabilty. By installing a triple redundant core it is possible to extend the mean time between failures in systems. This control module is also suitable for 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.

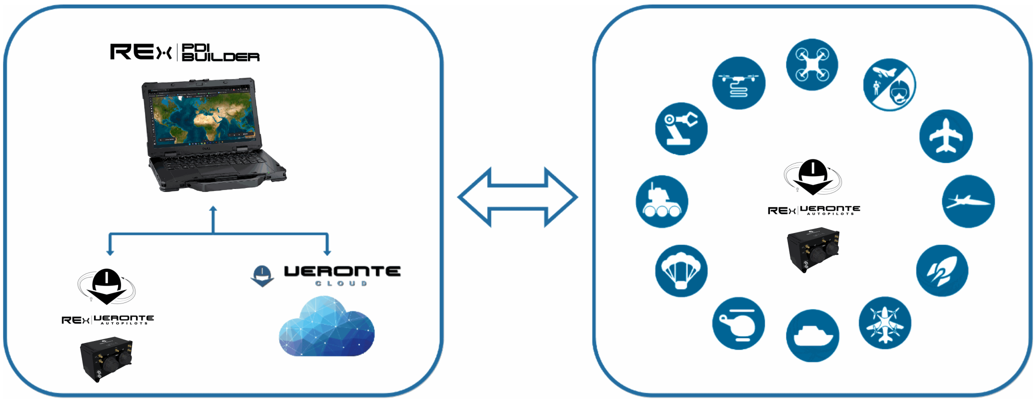



## General diagram

# 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.

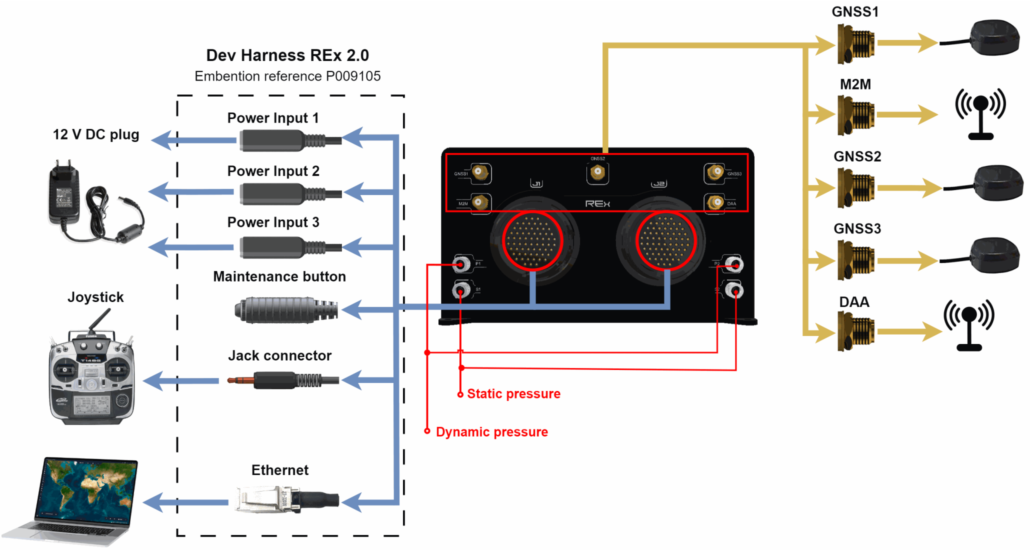



**System Overview**

**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.

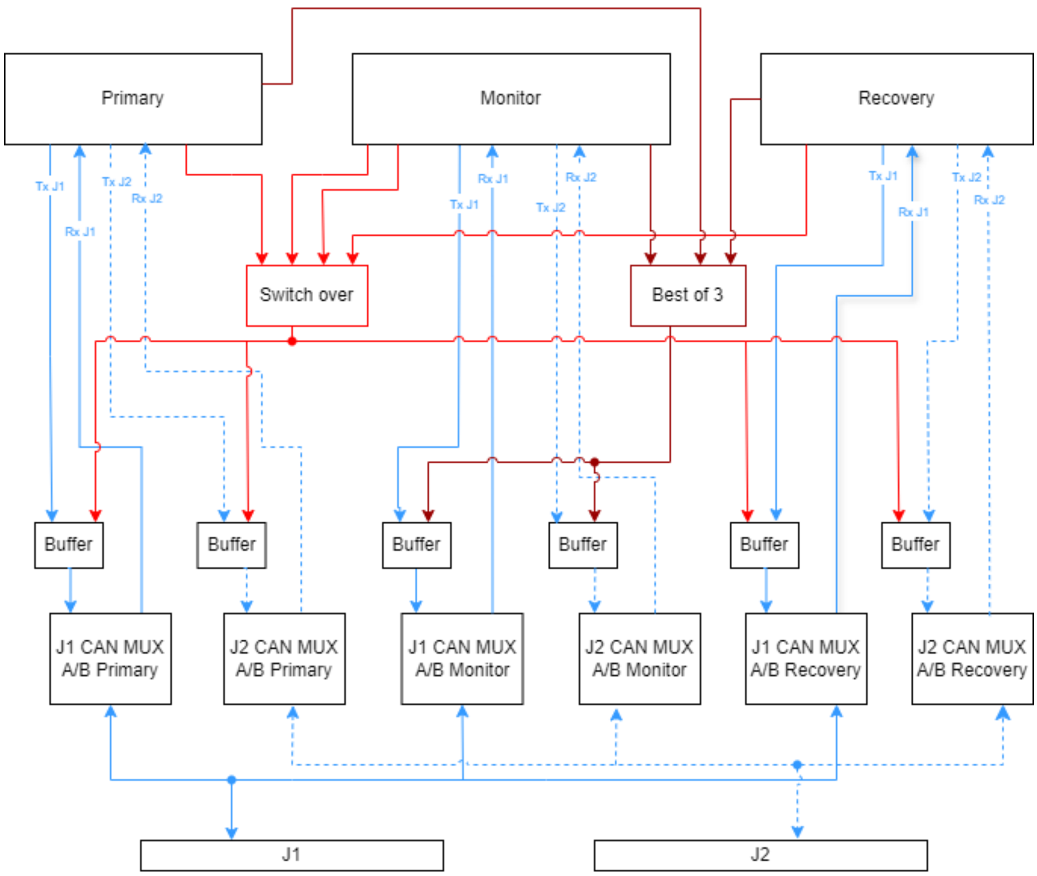
### Multiplexed CAN A and B

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.

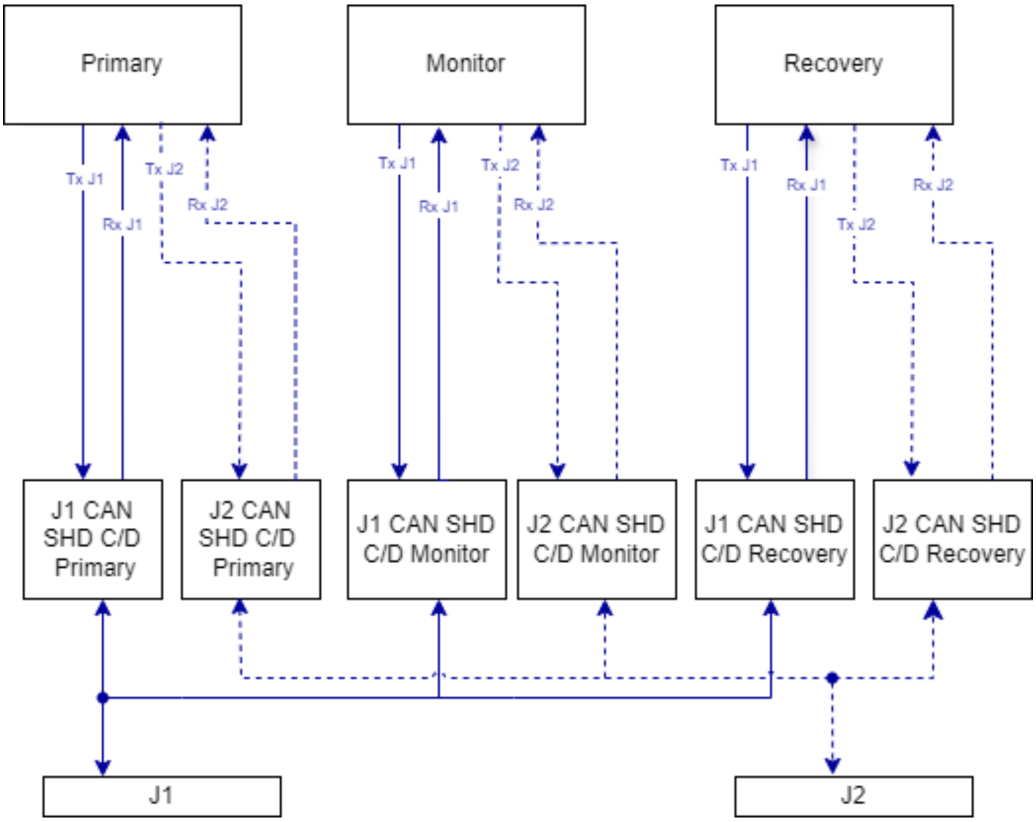
To enable either mode, the **Best of 3** logic requires at least two cores to have the corresponding mode enabled.




**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.



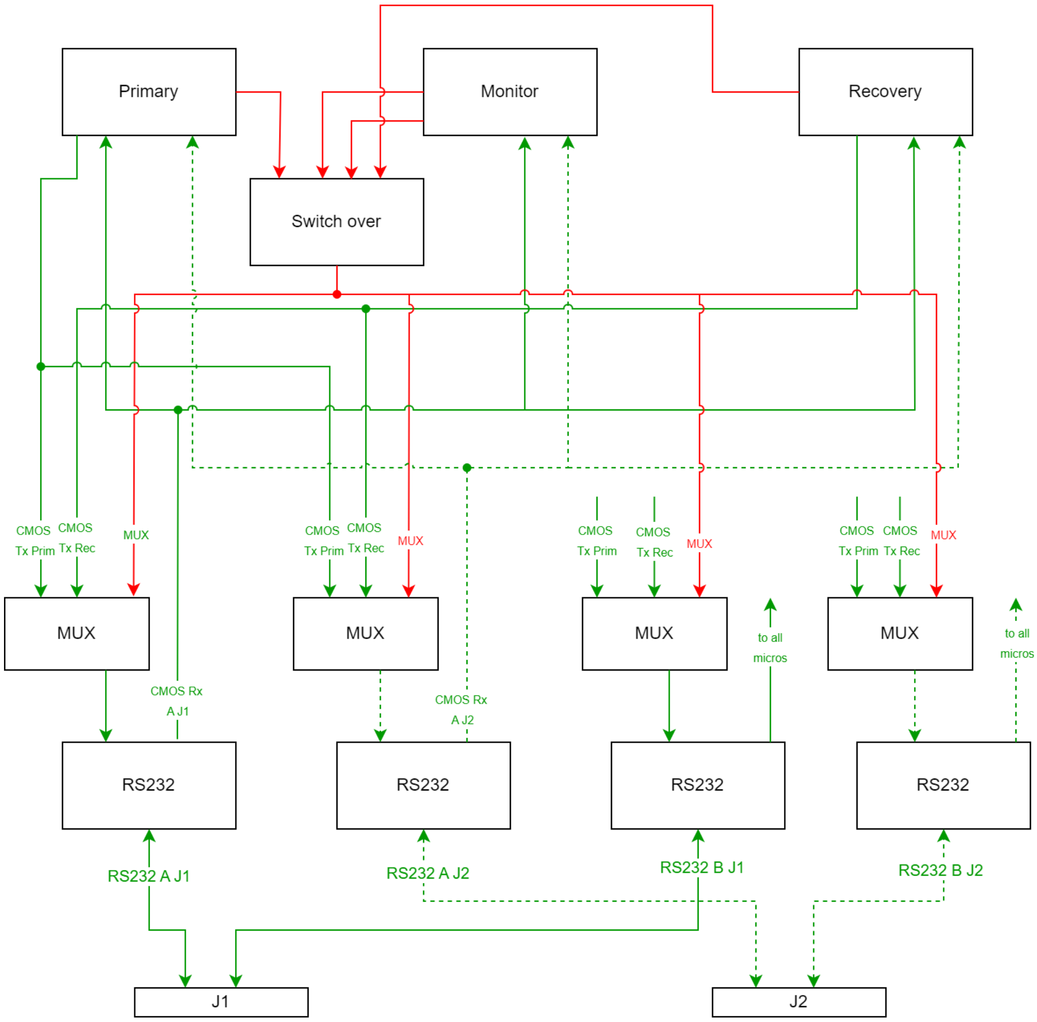

**CAN C and D diagram**

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.

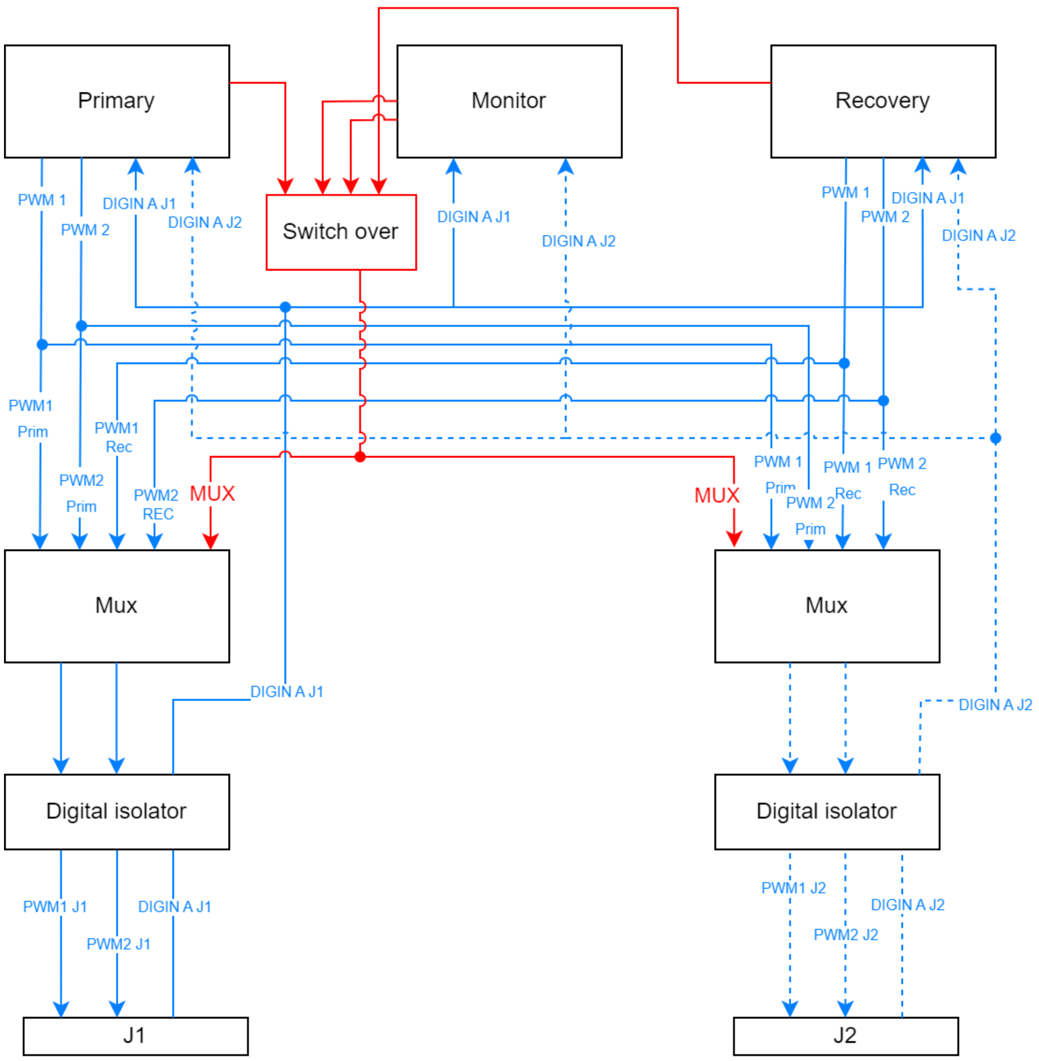



**RS232 diagram. The same architecture applies to RS485 (instead of RS232)**

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.

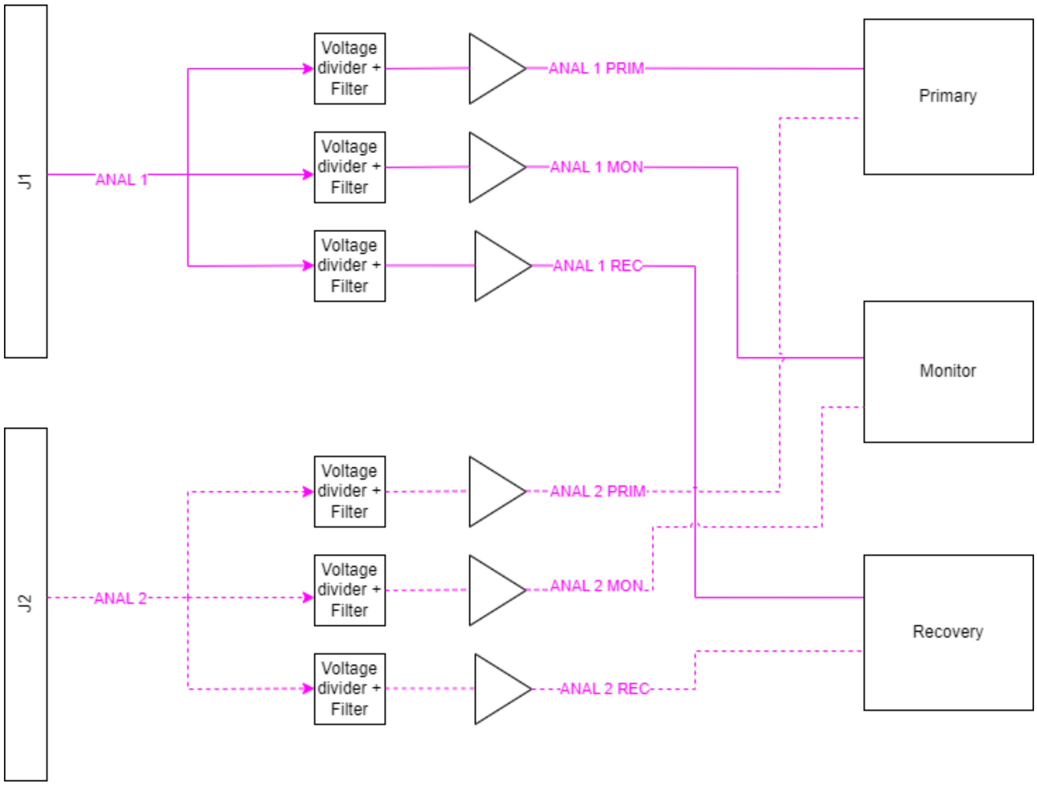



**PWM diagram. The same architecture applies to PWM3, 4 and DIGIN B**

## 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 |
| Maximum shock | 10,000 g | 2,000 g |
| Sensitivity | 10,920 LSB/g for $g_{FS3g}$ 1,365 LSB/g for $g_{FS24g}$ | 262,144,000 LSB/g |
| Update Time | 1 ms | |
| Error | 190 Z axis, 160 X & Y axis µg/Hz (noise density) | 23 µg/Hz (noise density) |
| Offset | ± 20 mg | ± 0.6 mg |

| Gyroscopes (3-axis each one) | | |
|---|---|---|
| **Specification** | **IMU 1** | **IMU 2** |
| Range | 125 to 2,000 °/sec | 500 °/sec |
| Sensitivity | 262 to 16 LSB/°/sec | 2,621,440 to 40 LSB/°/sec |
| Update Time | 1 ms | |
| RMS noise | 0.1 °/sec | 0.08 °/sec |
| Offset | ±1 °/sec | ±0.1 °/sec |

| 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)<br>450 nT (Z axis) | 30 to 15 nT |
| 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 |
| Bias | ±7 Pa |

| GNSS Receivers | | |
|---|---|---|
| **Specification** | **GNSS 1** | **GNSS 2** |
| Constellations | | |

| GNSS Receivers | | | |
|---|---|---|---|
| **Specification** | | **GNSS 1** | **GNSS 2** |
| | | 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 |
| Velocity Accuracy | | 0.03 m/s | 0.03 m/s |
| Update Rate | | **RTK**: Up to 5 Hz | 100 Hz |
| Anti-jamming | | RF interference | |

| GNSS Receivers | | |
|---|---|---|
| **Specification** | **GNSS 1** | **GNSS 2** |
| | 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<br>• PPP-RTK (SPARTN/ CLAS)<br>• DGNSS | • RAIM (Receiver Autonomous Integrity Monitoring) |

## Mechanical and Electrical specifications

| Variable | Value |
|---|---|
| Weight | 737 g<br>With Damping System: + 150 g |

| Variable | Value |
|---|---|
| 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 with dissimilarity |
| I/O | Dual-channel redundant |
| Diagnostics | |

| Variable | Value |
|---|---|
| | 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 | SSMA connector for the GNSS antenna dedicated to the Monitor core |

| Connector | Description |
|---|---|
| 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<br>**Warning**<br>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<br>**Warning**<br>When using ADS-B or Remote ID, there must be an adequate antenna or load connection to the DAA port. |
| PITOT (x2) | Two independent dynamic pressure ports (Int. D. 2.5 mm x Out. D. 4 mm) for |

| Connector | Description |
|---|---|
| | 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:<br>• Gain min 15dB (to compensate signal loss in RF Cable)<br>• Gain max 50 dB<br>• Maximum noise figure 1.5dB<br>• Power supply 3.3V<br>• Max current 20 mA |

| Abbreviation | Autopilot REx connector | Mating connector |
| --- | --- | --- |
| 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<br>• Aircraft integration harness: **[P012954]** Veronte Harness - 66P MIL-DTL-38999 - Male - 50cm |
| J2 | | |

| Abbreviation | Autopilot REx connector | Mating connector |
|---|---|---|
| | MIL-DTL-38999 Series high-density connector (66P) | • Development harness: **[P016262]** Veronte Autopilots: Dev Harness - 66P MIL-DTL-38999<br>• 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

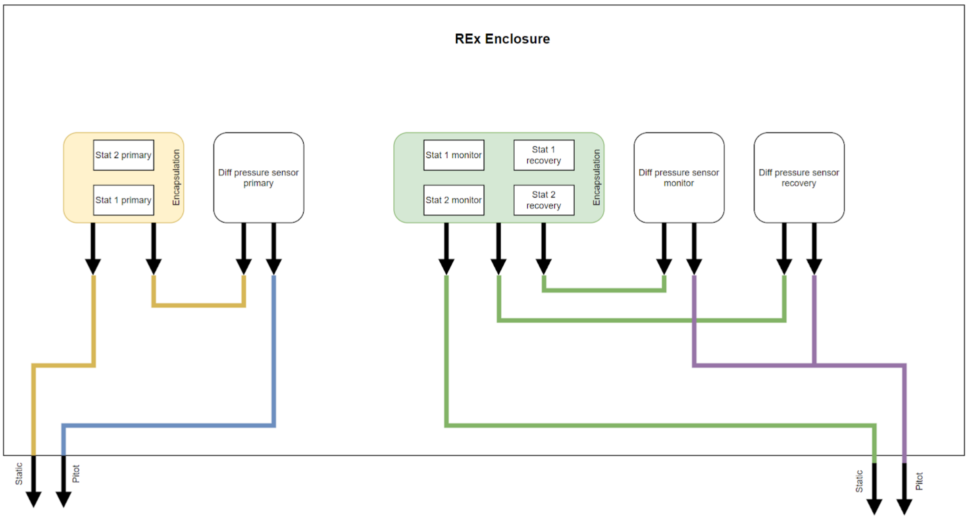
**Veronte Autopilot REx** is covered with an aluminium enclosure with enhanced EMI shielding and IP protection, with 825 g as total weight.

### 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.

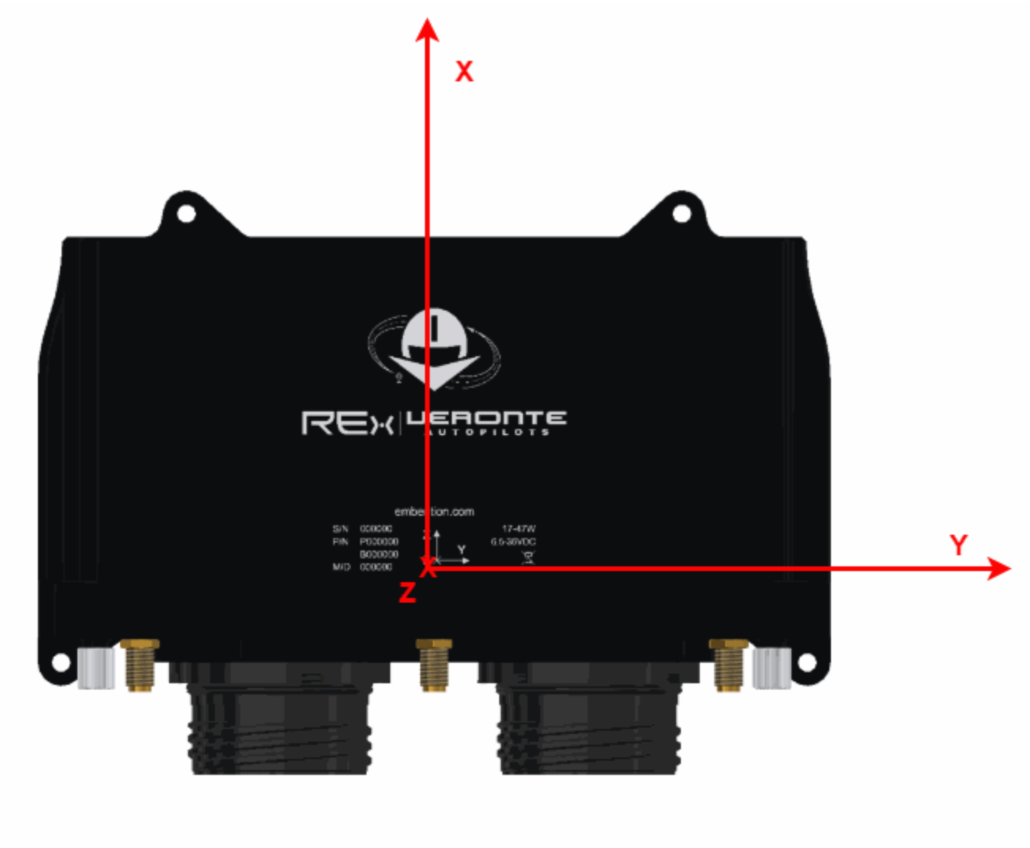
## Location

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

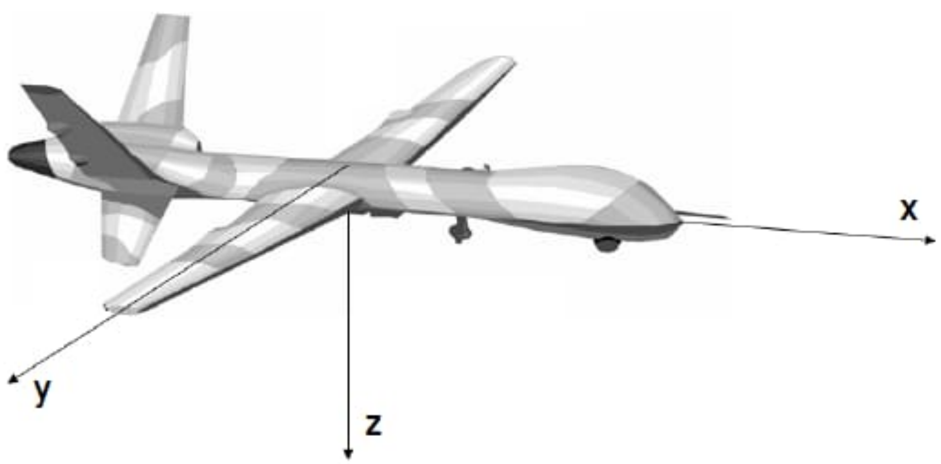
The orientation of **Veronte Autopilot REx** has no restrictions either. It is only required to configure axes respect to the aircraft by means of a rotation matrix or a set of correspondences between axes. The configuration of the orientation can be easily configured using **1x PDI Builder**.

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

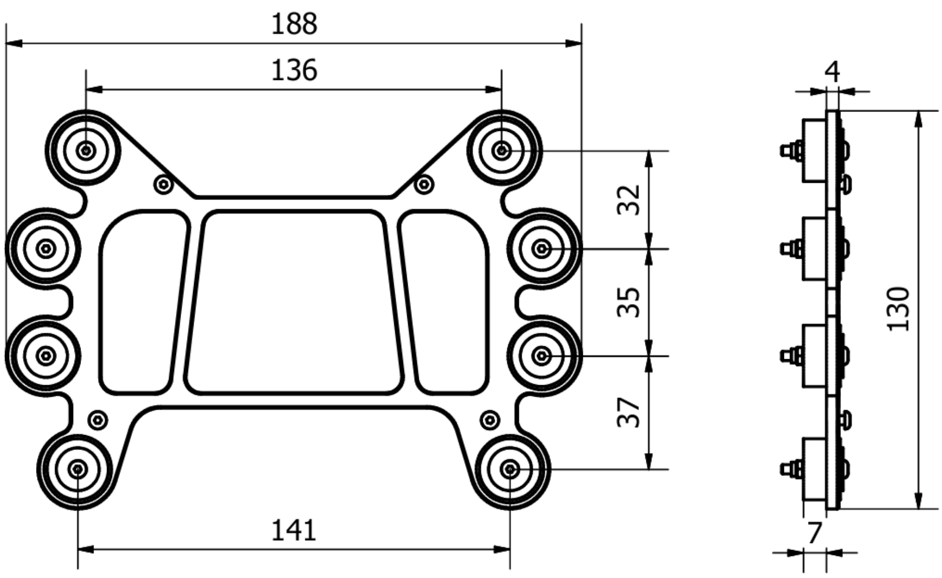
Embention offers the **Damping System** as a solution to isolate **Veronte Autopilot REx** from vibrations.

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

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


**Damping System**

## Dimensions

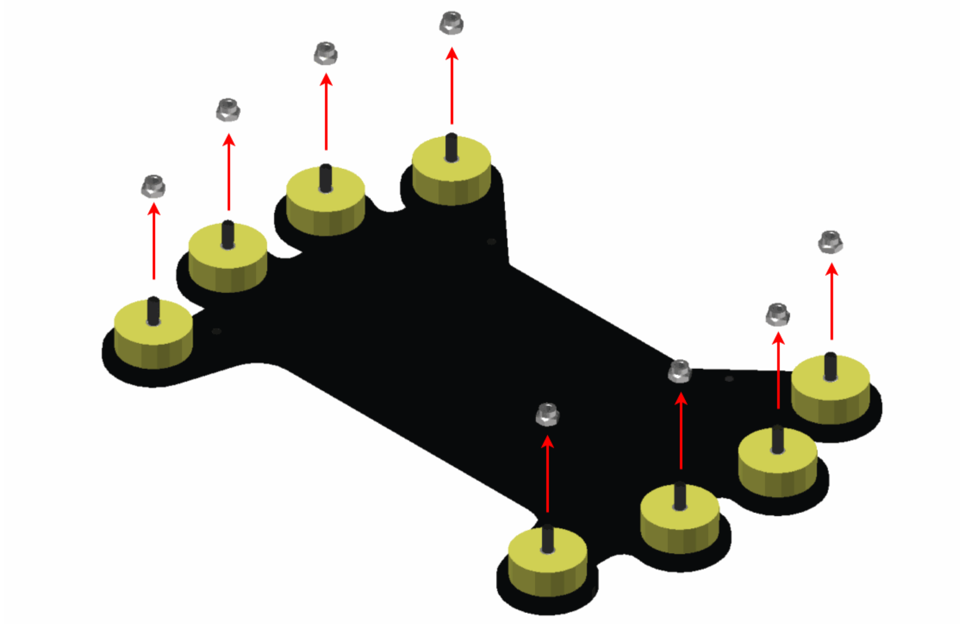



**Damping system dimensions (mm)**

## Assembly steps

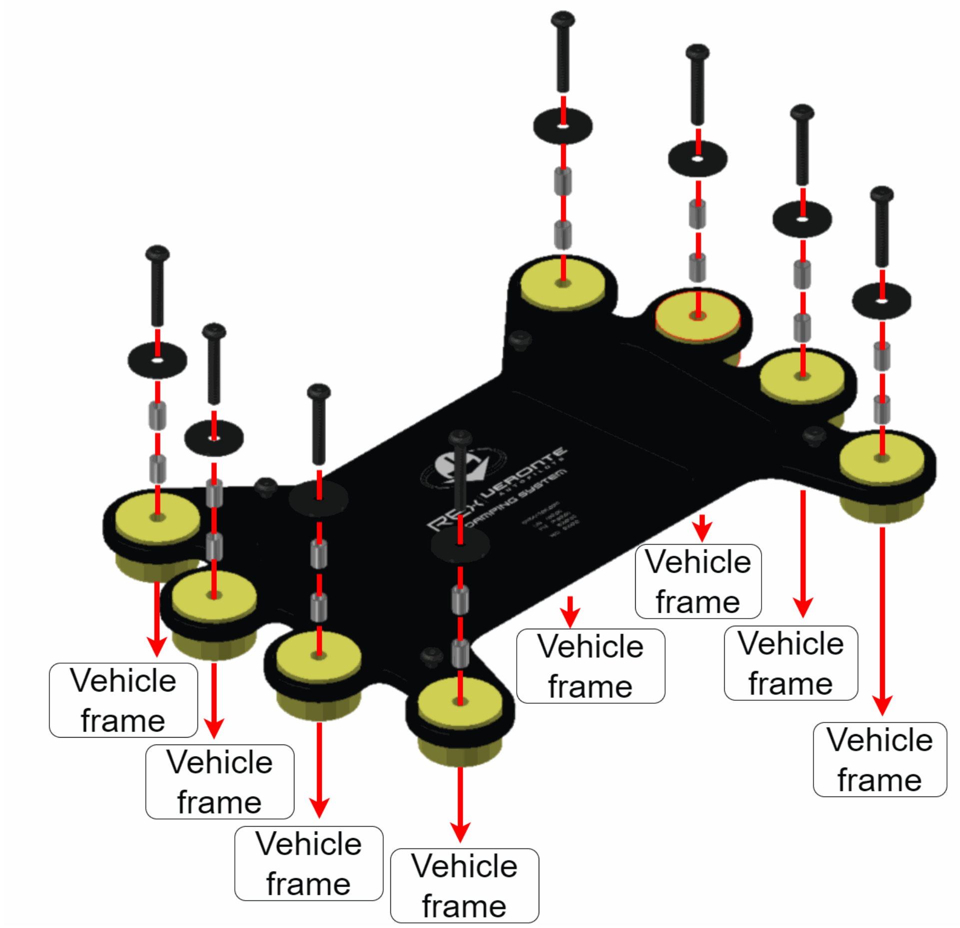
To assemble the Damping System into a vehicle with an **Autopilot REx**, read the following steps.

1. Remove the eight nuts located under the platform.



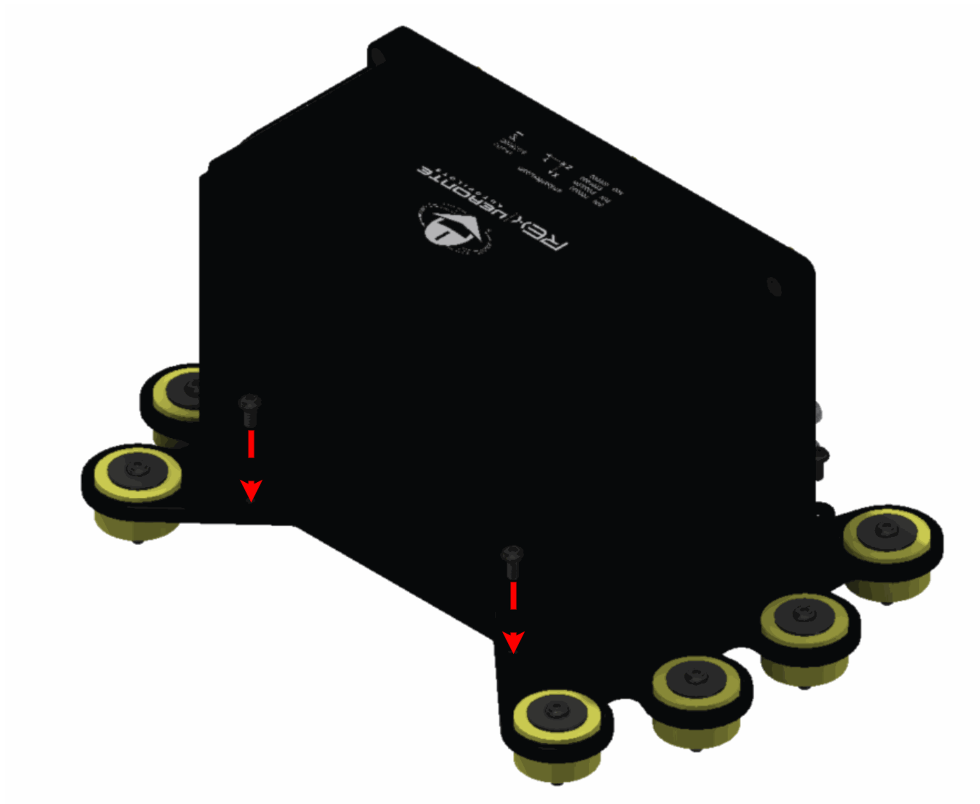
**Step 1**

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

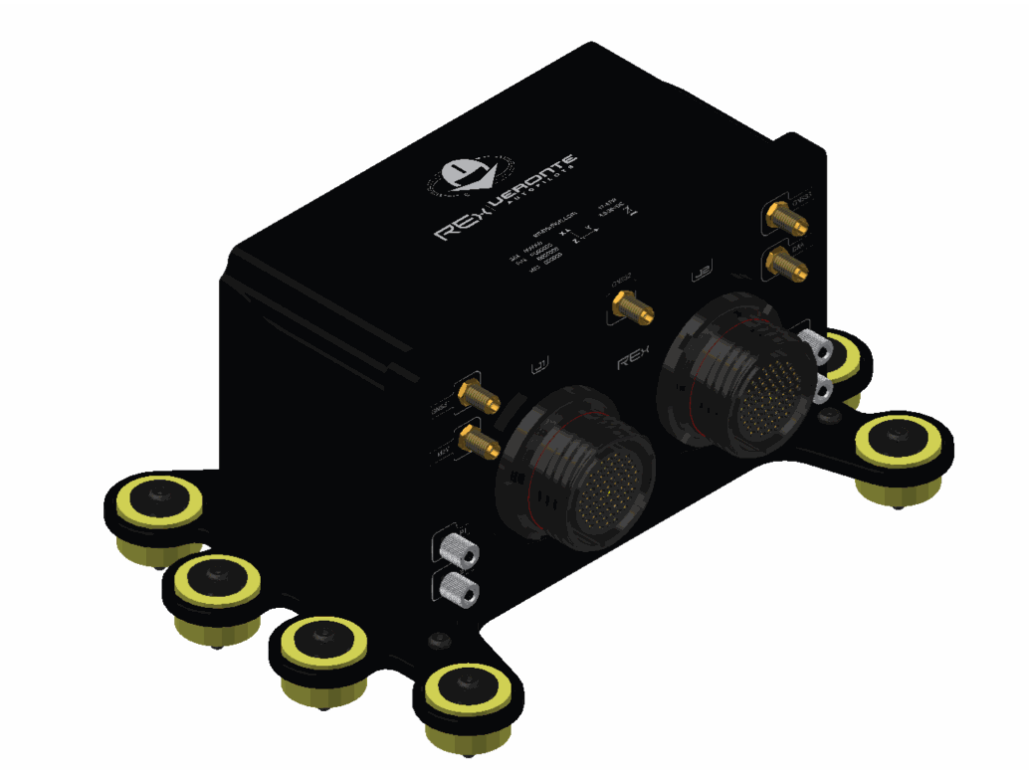



**Step 2**

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<br>**Note**<br>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.

> ⚠ **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 | Supply negative for primary |
| 3 | VIN PRIM | POWER | A | Supply positive for Primary |
| 4 | J1_ATX0_P | OUTPUT | A | J1 ARINC 429 channel 0 |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| | | | | 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 |
| 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 |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| 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 (muxed functionality) |
| 17 | J1_DIGIN_A | INPUT | A | 5V digital input |
| 18 | J1_ARINC_GND | GROUND | A | Negative for ARINC 429 |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| | | | | 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 connector CAN signals |
| 24 | J1_CAN_MUX_B_P | CAN BUS | A | CAN B J1 positive (muxed functionality) |
| 25 | J1_DIGIN_B | INPUT | A | |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| | | | | 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 |
| 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) |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| 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 |
| 38 | - | - | - | - |
| 39 | J1_GND_RS232 | GROUND | A | Negative for RS232 of J1 connector |
| 40 | J1_PWM2 | OUTPUT | A | Digital output 2 of J1 |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| 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 |
| 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 |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| | | | | 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 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 |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| 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 |
| 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 | |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| | | | | 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 |
| 2 | GND REC | GROUND | B | Supply negative for recovery |
| 3 | VIN REC | POWER | B | Supply positive for Recovery |
| 4 | J2_ATX0_P | OUTPUT | B | |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| | | | | 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 |
| 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 |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| | | | | 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 (muxed functionality) |
| 17 | J2_DIGIN_A | INPUT | B | 5V digital input |
| 18 | J2_ARINC_GND | GROUND | B | |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| | | | | 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 connector CAN signals |
| 24 | J2_CAN_MUX_B_P | CAN BUS | B | CAN B J2 positive |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| | | | | (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 |
| 31 | J2_PWM1 | OUTPUT | B | Digital output 1 of J2 |
| 32 | J2_CAN_SHD_C_P | CAN BUS | B | |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| | | | | 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 |
| 38 | - | - | - | - |
| 39 | J2_GND_RS232 | GROUND | B | Negative for RS232 of J2 connector |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| 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 |
| 46 | J2_ARX3_P | INPUT | B | J2 ARINC 429 channel 3 positive input |
| 47 | J2_GND_RS485 | GROUND | B | |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| | | | | 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 negative input |
| 54 | J2_GND_RS232 | GROUND | B | |

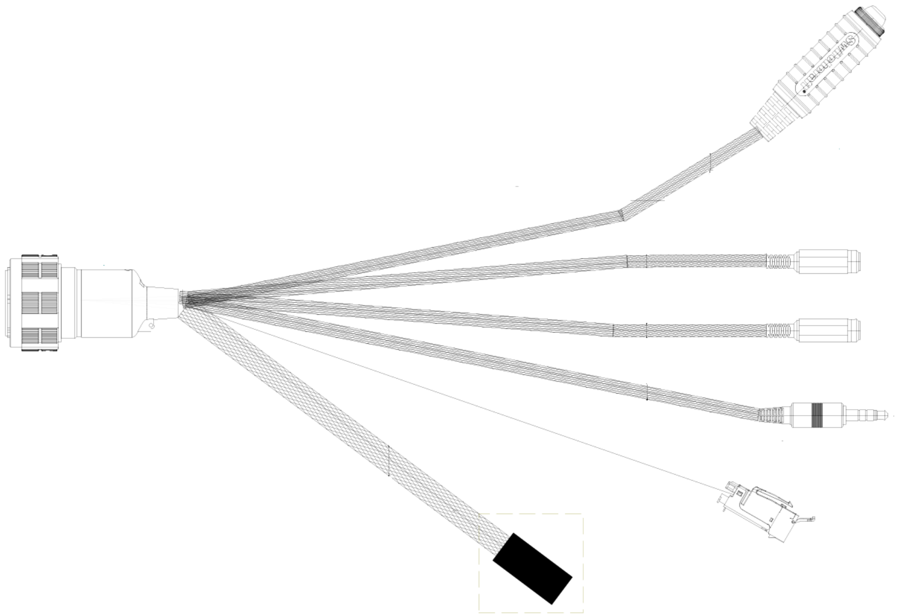
| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| | | | | Negative for RS232 of J2 connector |
| 55 | J2_ETH_CHASSIS | ETH CHASSIS | B | Ethernet chassis, connected to enclosure |
| 56 | J2_RX_N | INPUT | B | Ethernet Rx negative of J2 connector |
| 57 | J2_RX_P | 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 |
| 62 | J2_TX_N | OUTPUT | B | |

| PIN | Signal | Type | Internal Power Domain | Description |
|---|---|---|---|---|
| | | | | 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.

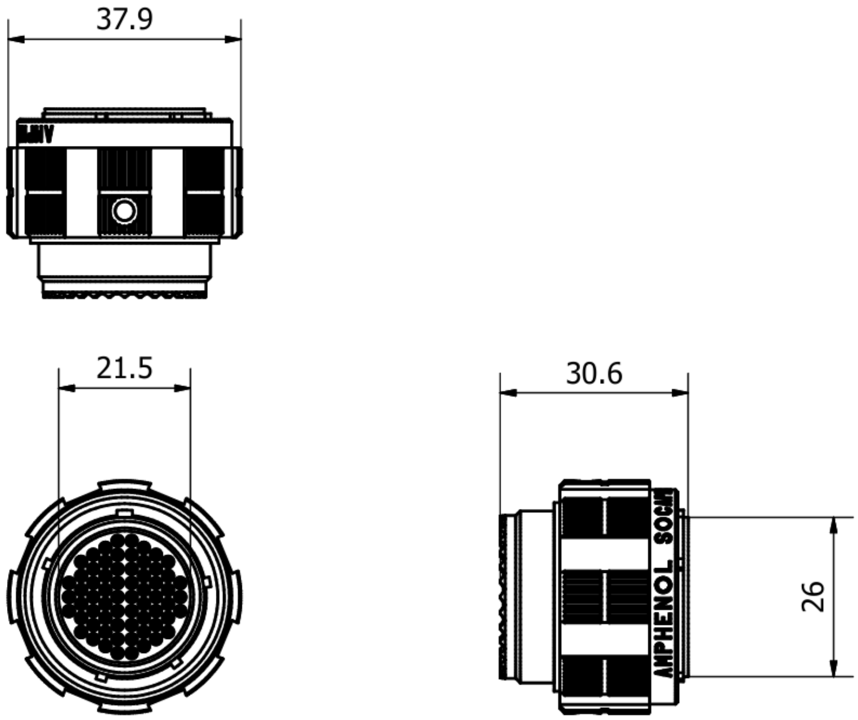
**Veronte Autopilot REx 2.0** has the following compatible harness:



**Harness compatible with REx**

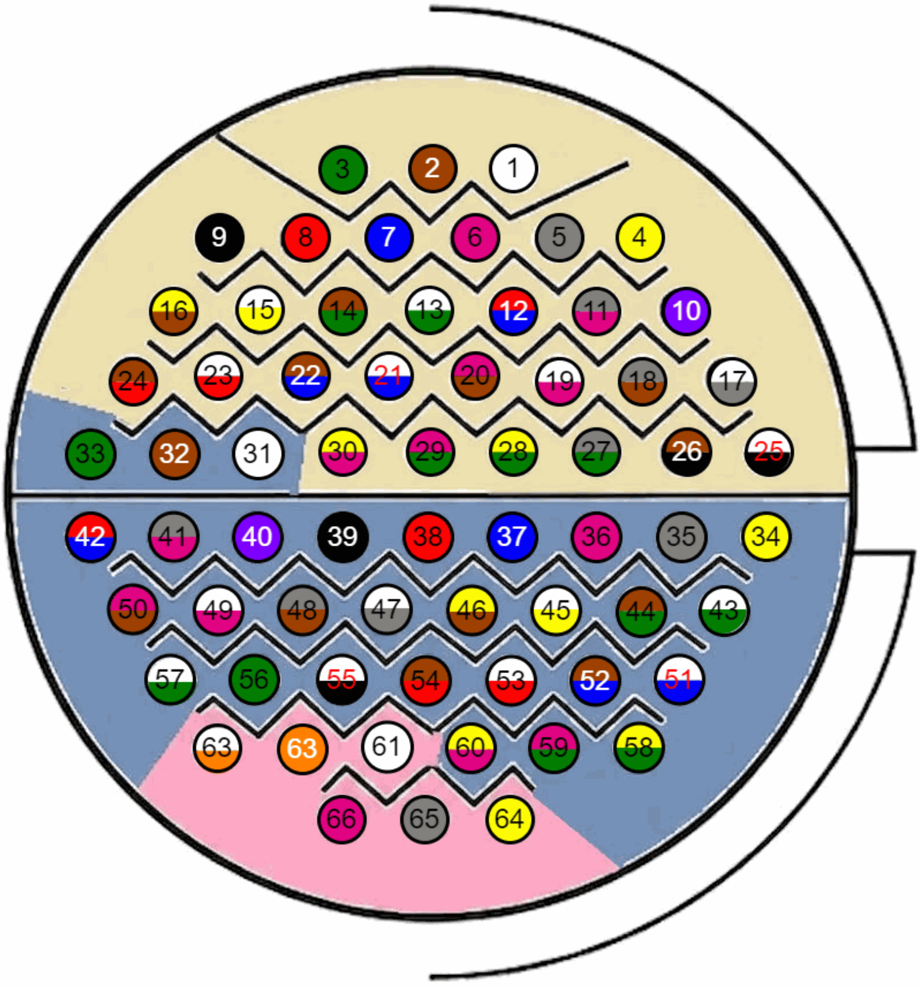
Dimensions

- **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

- `SO_RESET_REC` — Recovery

## Flight Termination System (FTS) & Geocaging

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.

### Geocaging Violation Scenarios

If the aircraft breaches a configured geocage (restricted area), the system behaves according to the current survival state of the cores:

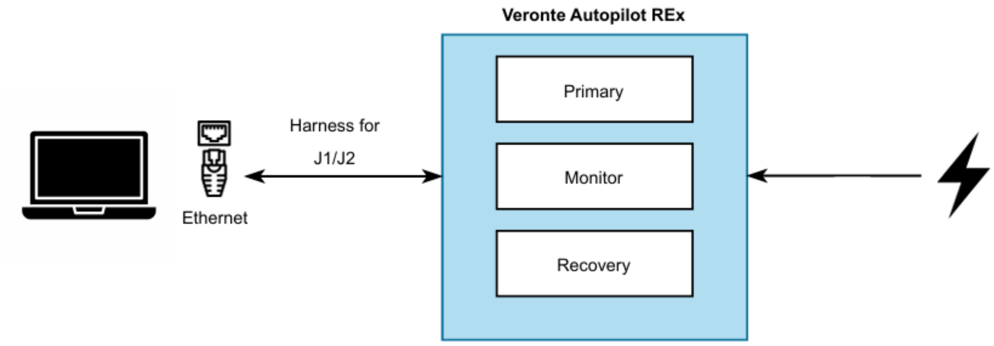
- **All Cores Healthy**: Primary, Monitor, and Recovery are OK. Upon violation, all three stop outputting healthy signals → **FTS Activated**.
- **Primary is Dead**: Recovery is commanding. Upon violation, Recovery stops outputting healthy signals → **FTS Activated**.
- **Recovery is Dead**: Primary is commanding. Upon violation, Primary stops outputting healthy signals → **FTS Activated**.
- **Monitor is Dead**: Primary or Recovery is commanding. Upon violation, the surviving active cores stop outputting healthy signals → **FTS Activated**.

# 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.

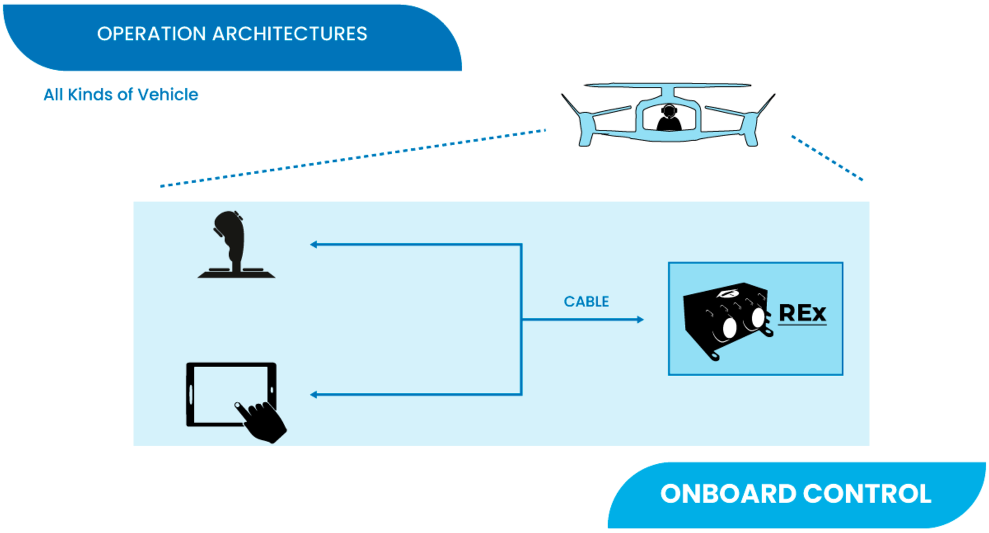
> **Tip**
>
> Most of the following diagrams can be used independently or combined, to create redundant systems or backup solutions.

## Operation Architectures

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

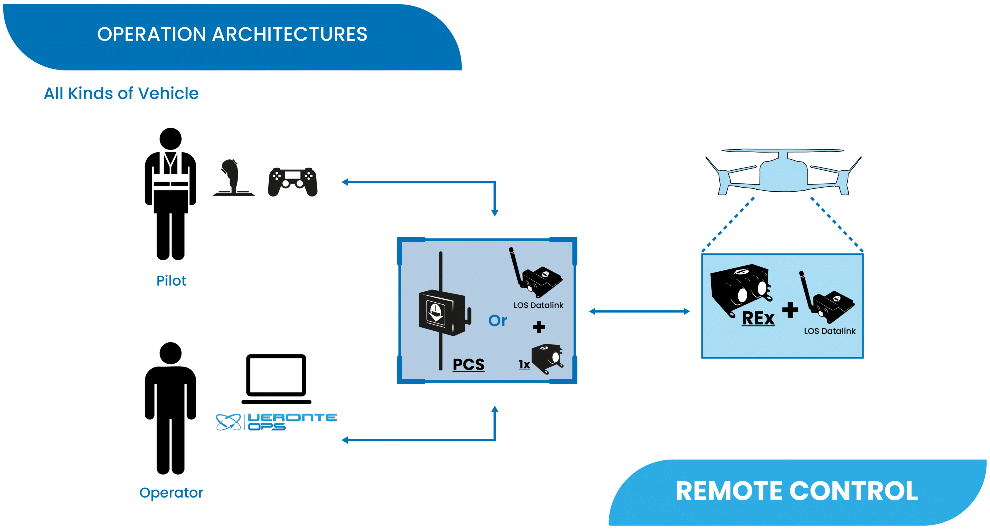
### Onboard Control Setup

**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.

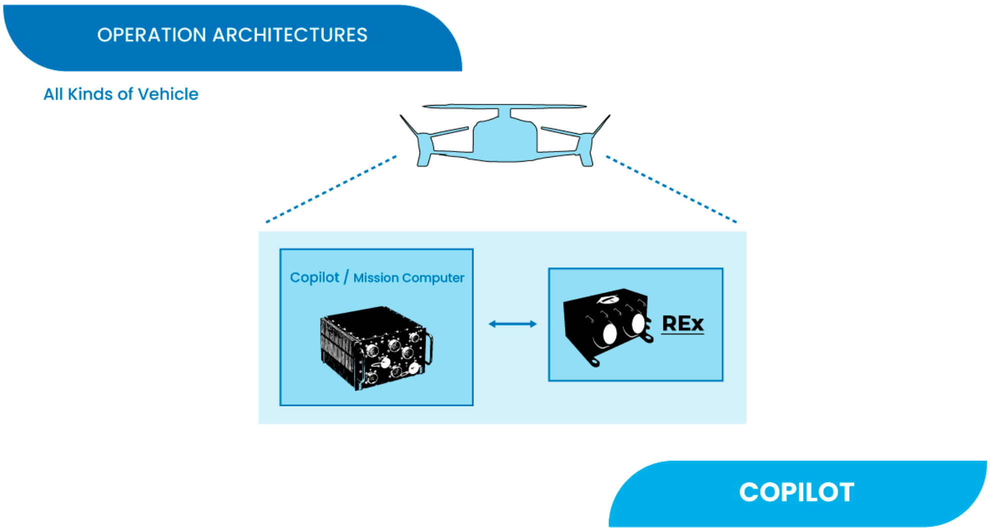



In the standard remote layout, an Operator (Internal Pilot) controls the UAV from the Ground Station using **Veronte Ops**.

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.

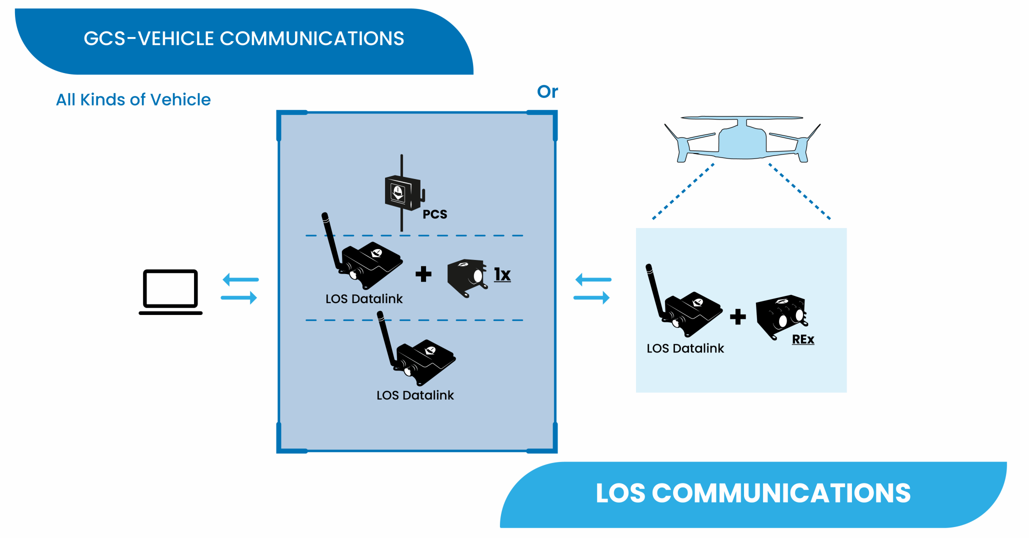


# GCS-Vehicle Communications

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**

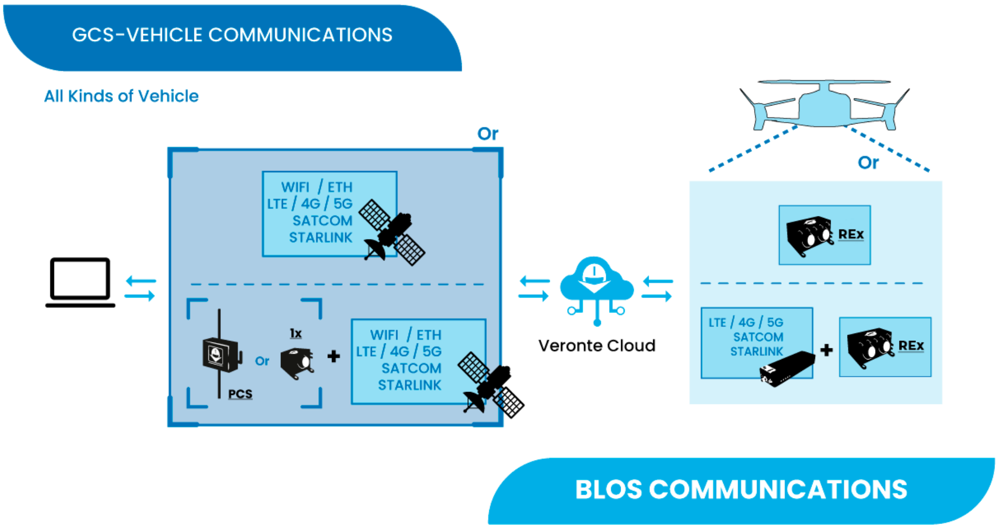
And on the vehicle side, an **Autopilot REx** with an **external LOS Datalink**.

## 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.

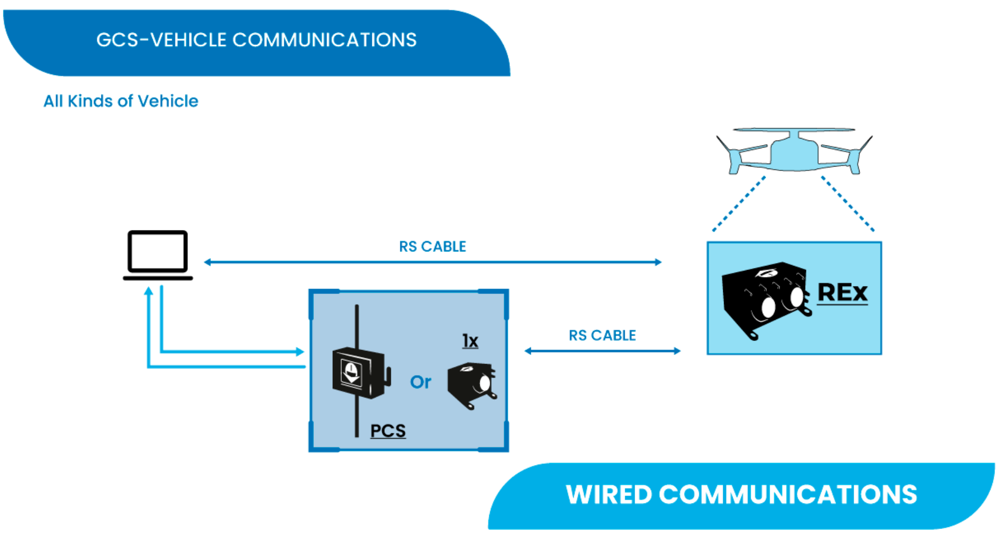
#### Onboard Connectivity Options

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.



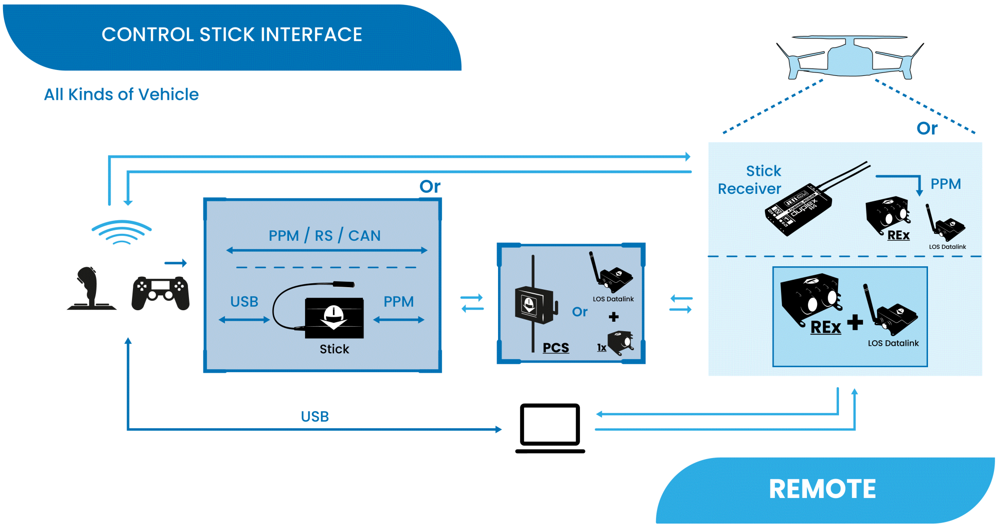
## Control Stick Interface

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



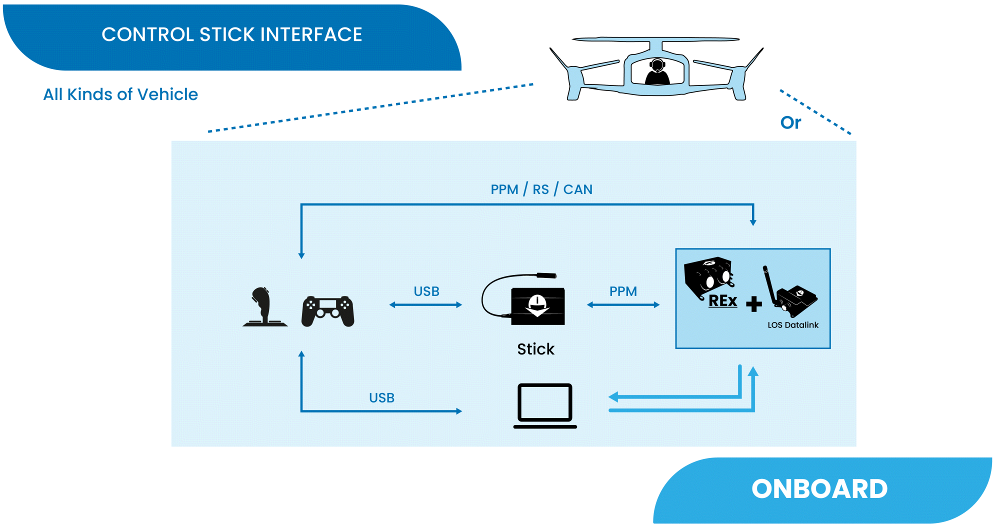

Although the most common way of control is to directly connect a **stick** via **PPM**, **RS** or **CAN** to a control station (**PCS/1x** + LOS Datalink) which then communicates with the onboard autopilot,

- 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**.



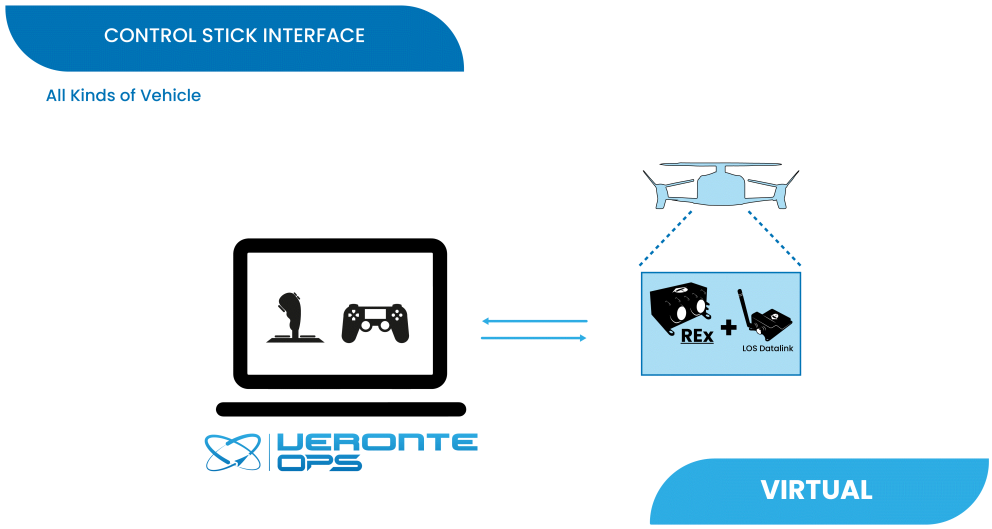

Some examples are:

- 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.



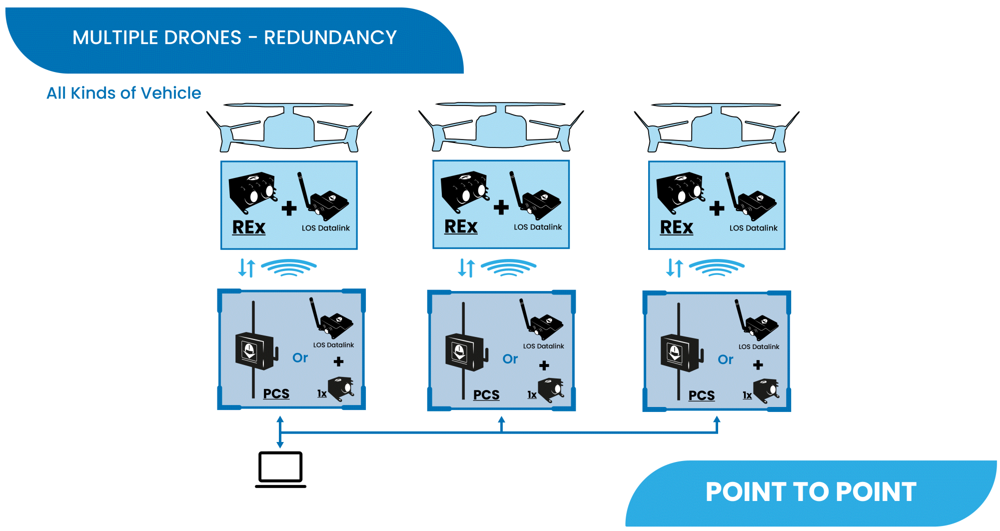

## Multiple Drones/GCS - Redundancy

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.

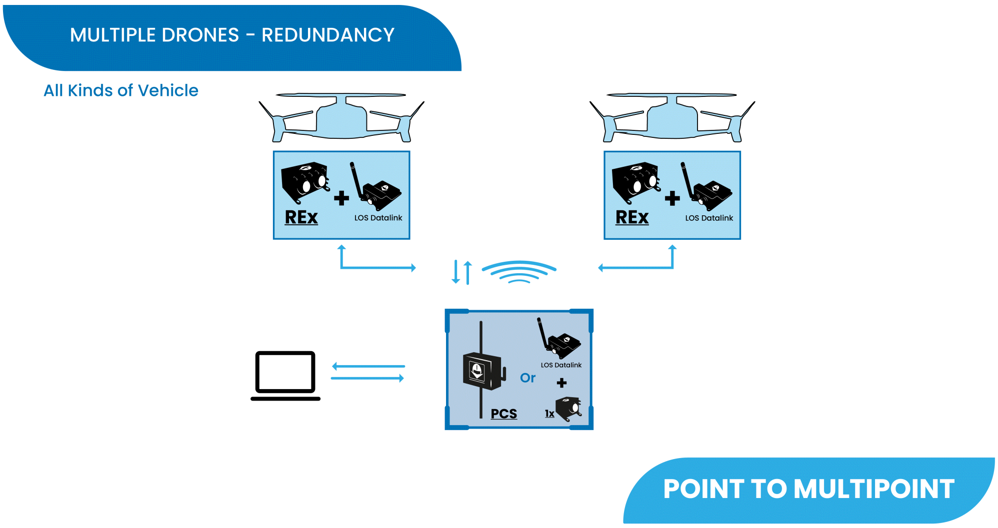
### Multiple Drones - Point to Point

Standard multiplatform setup.



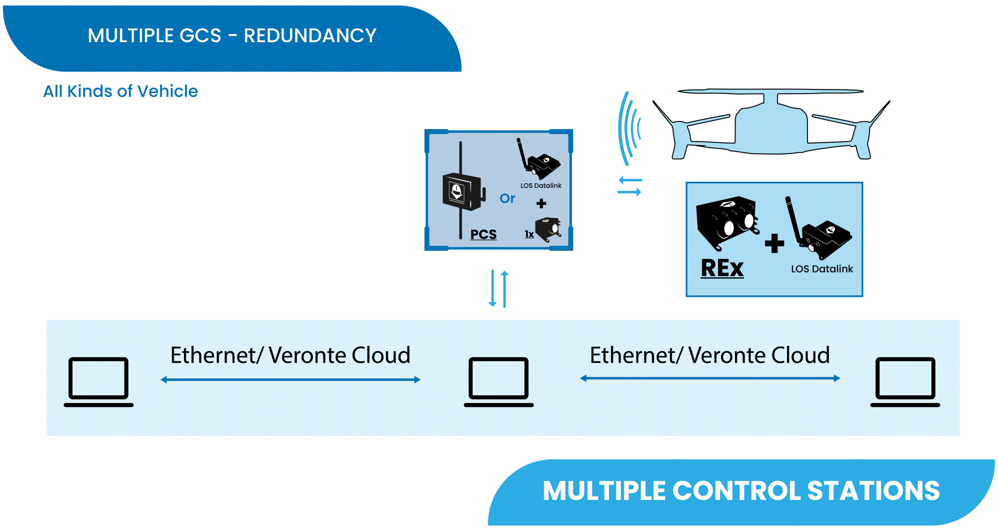
Multiple Drones - Point to Multipoint

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.

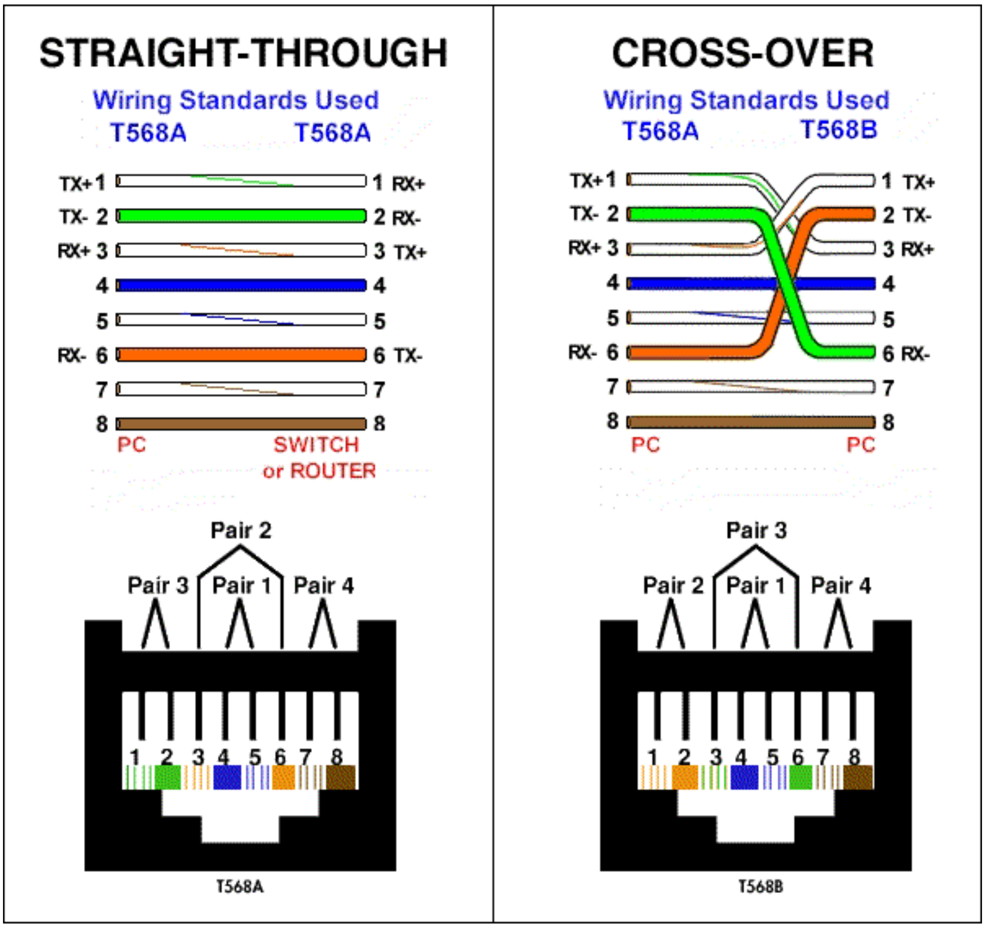
To correctly establish communication between the different PCs via **Ethernet** the following steps should be carried out:

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).

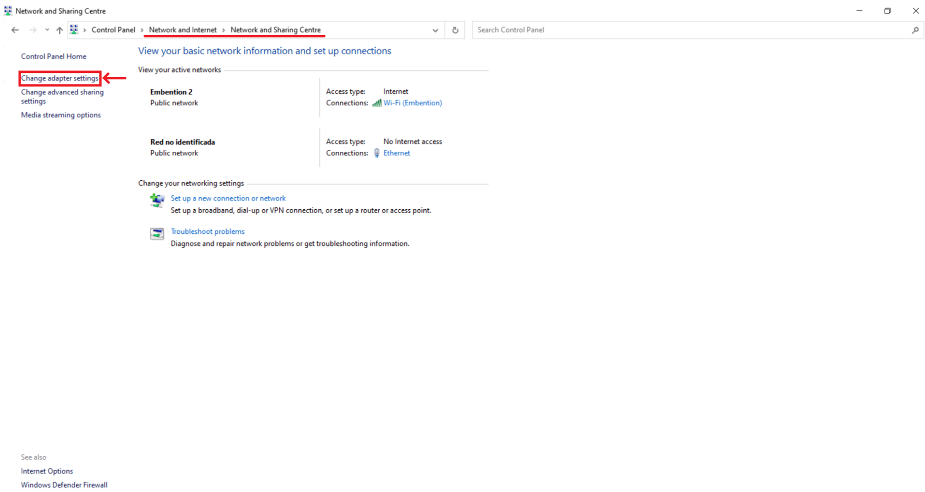
- **Crossover**

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



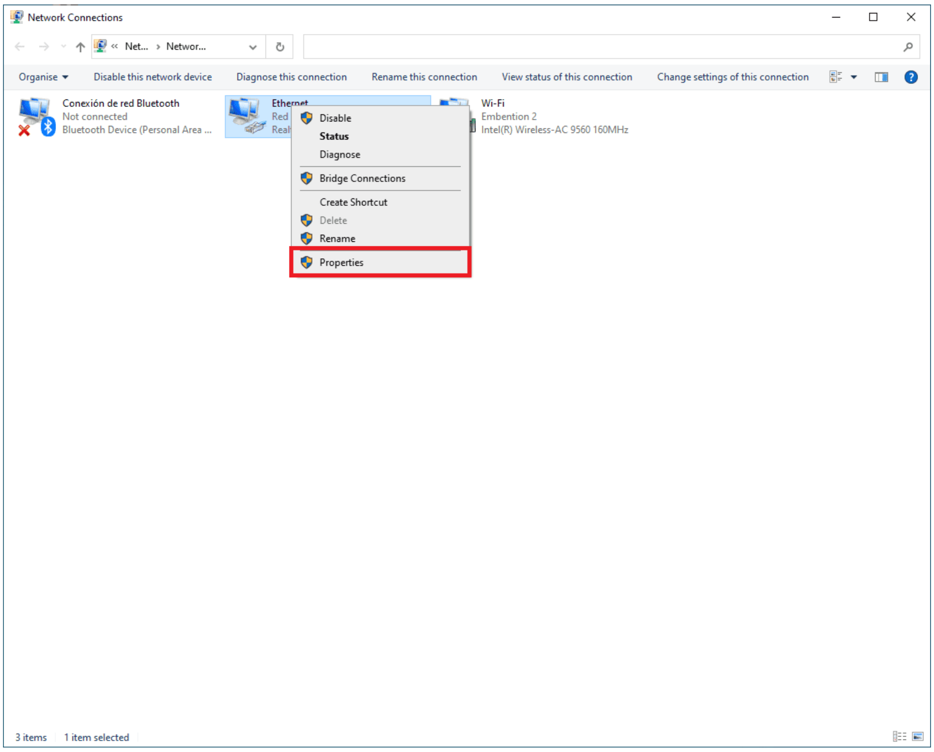

**Straight-Through vs Crossover cables**

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**.



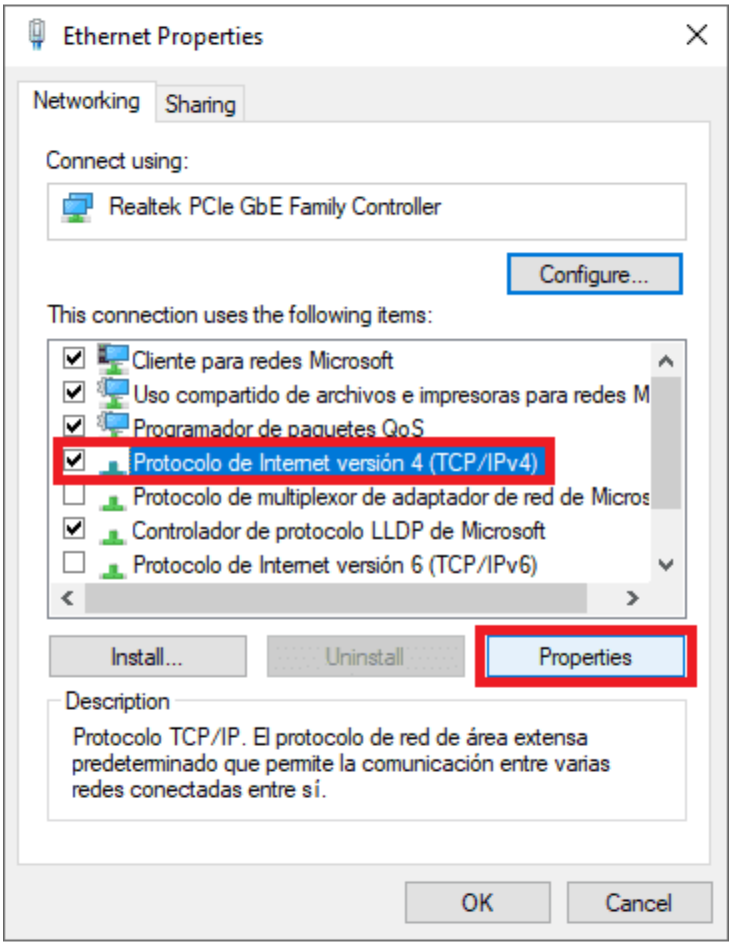

**Ethernet connection 1**

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




**Ethernet connection 2**

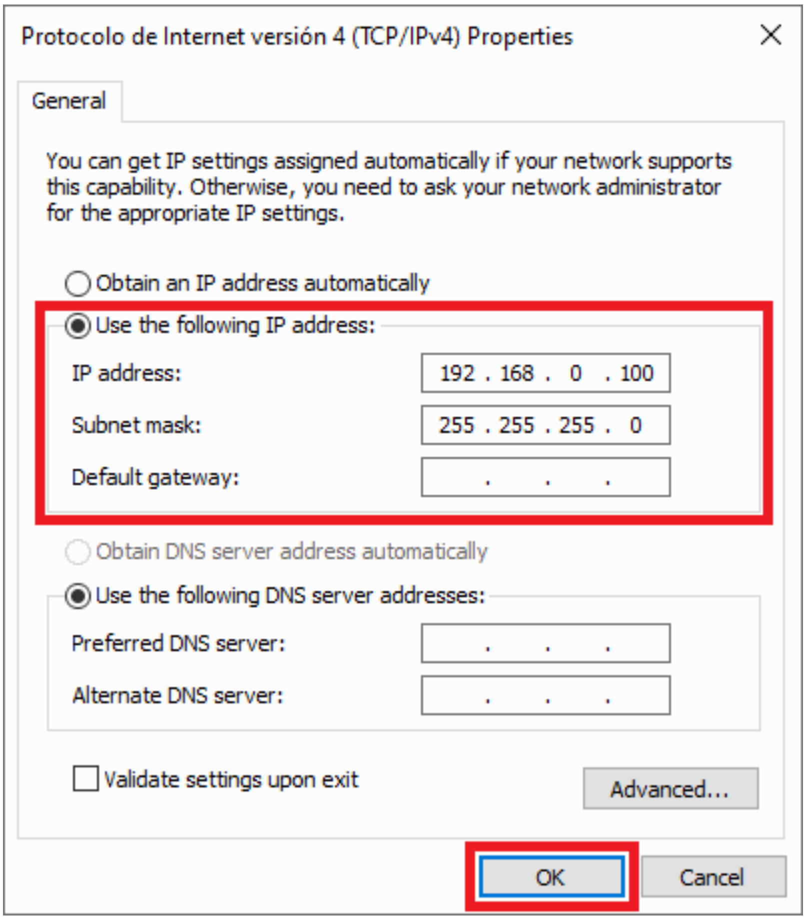
- Select **IPv4** and click **Properties**.




**Ethernet connection 3**

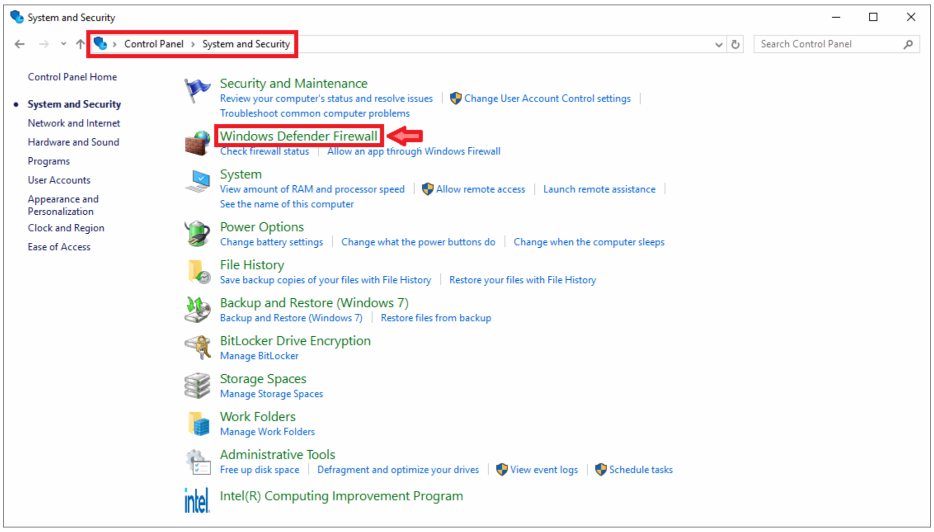
- Set **IP address** to a **static IP** (e.g. 192.168.0.100) and **Subnet mask** to 255.255.255.0. Click **OK**.

> **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.



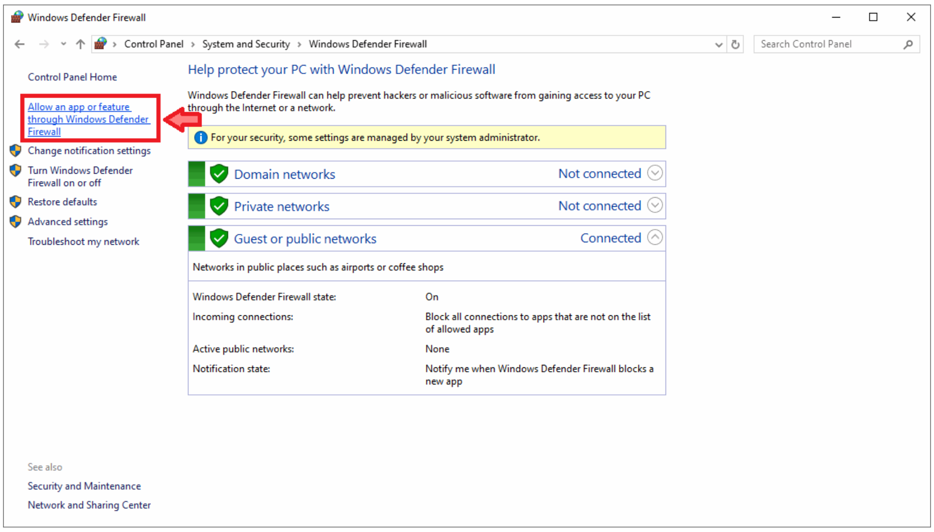

**Ethernet connection 4**

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**.



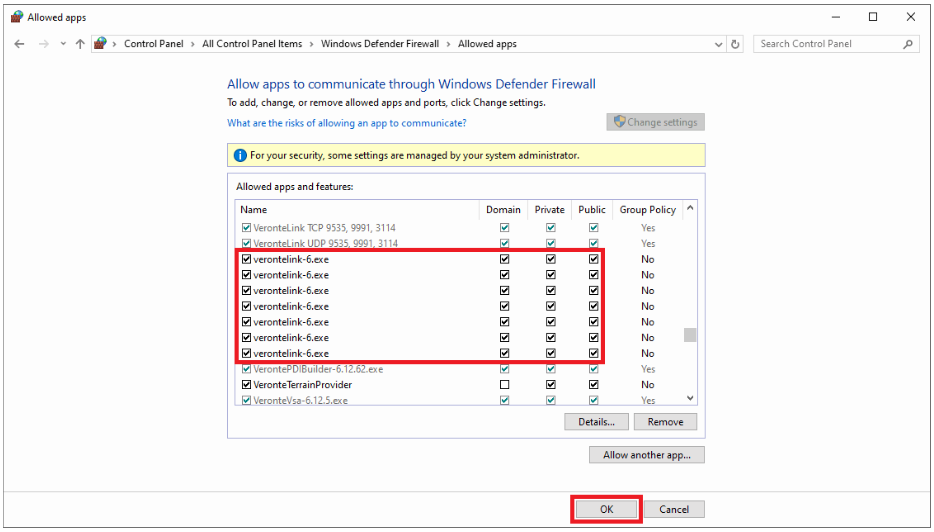

**Windows Firewall 1**

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




**Windows Firewall 2**

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

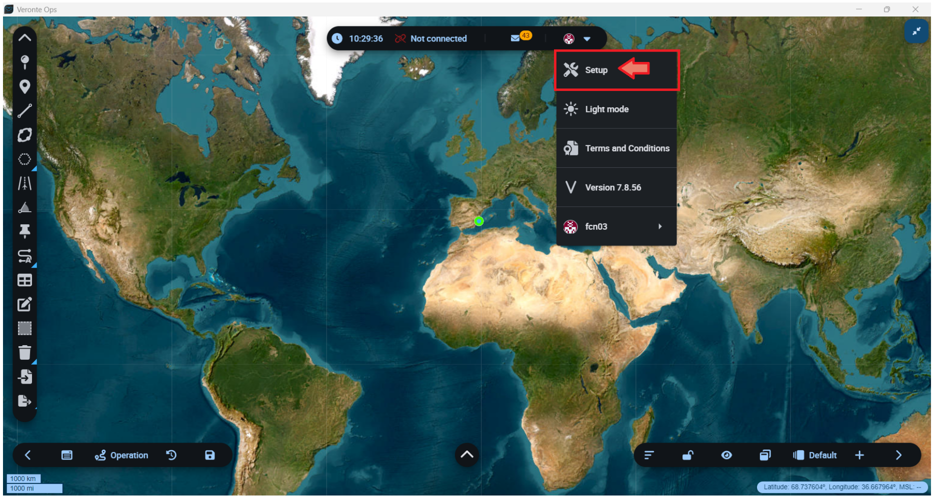



**Windows Firewall 3**

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**.

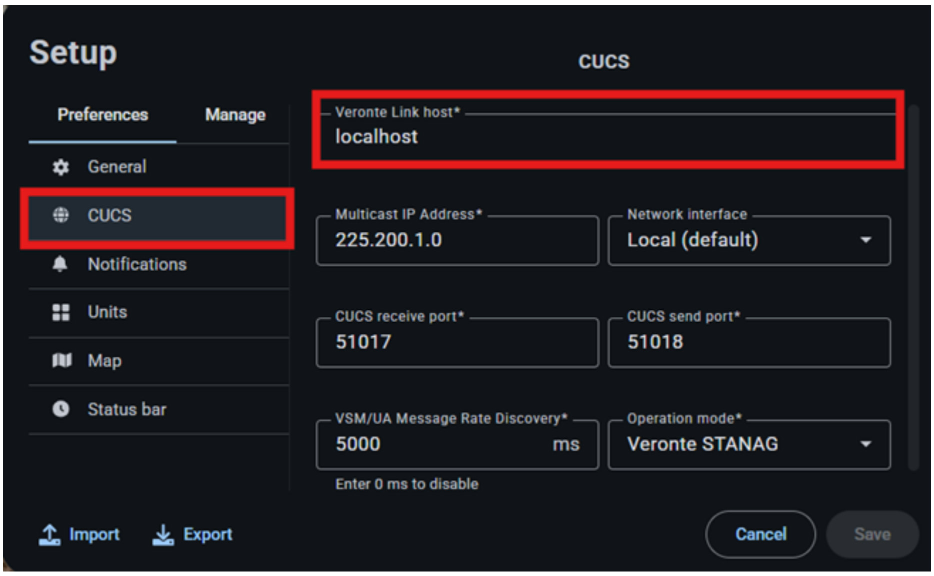

**Veronte Ops - Status bar**

- 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**.

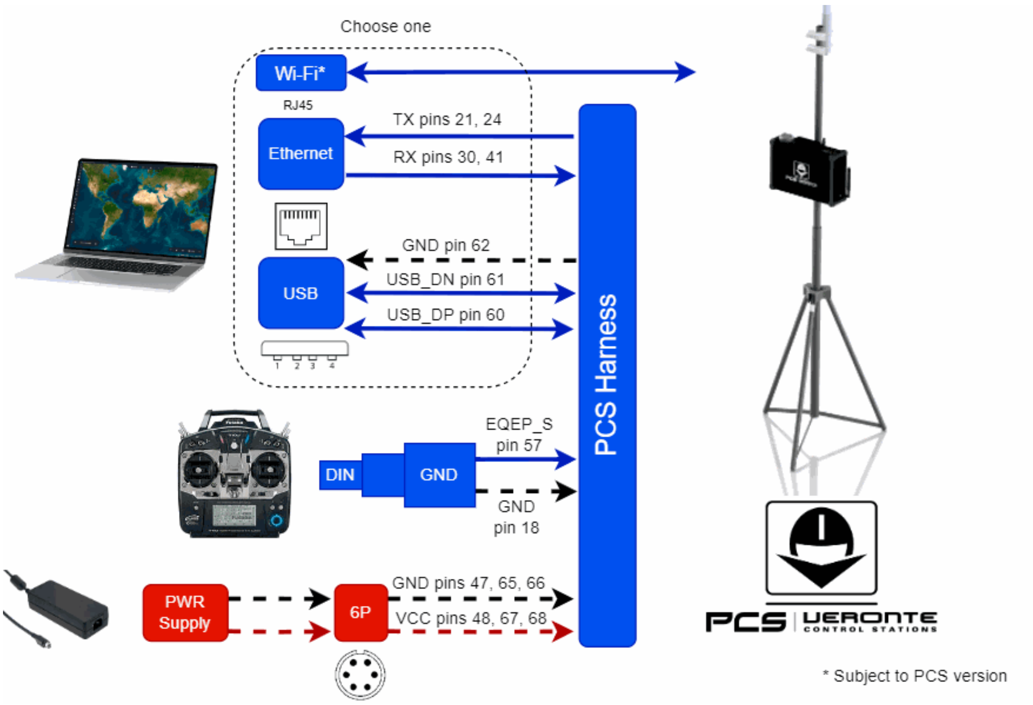
# Integration examples

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

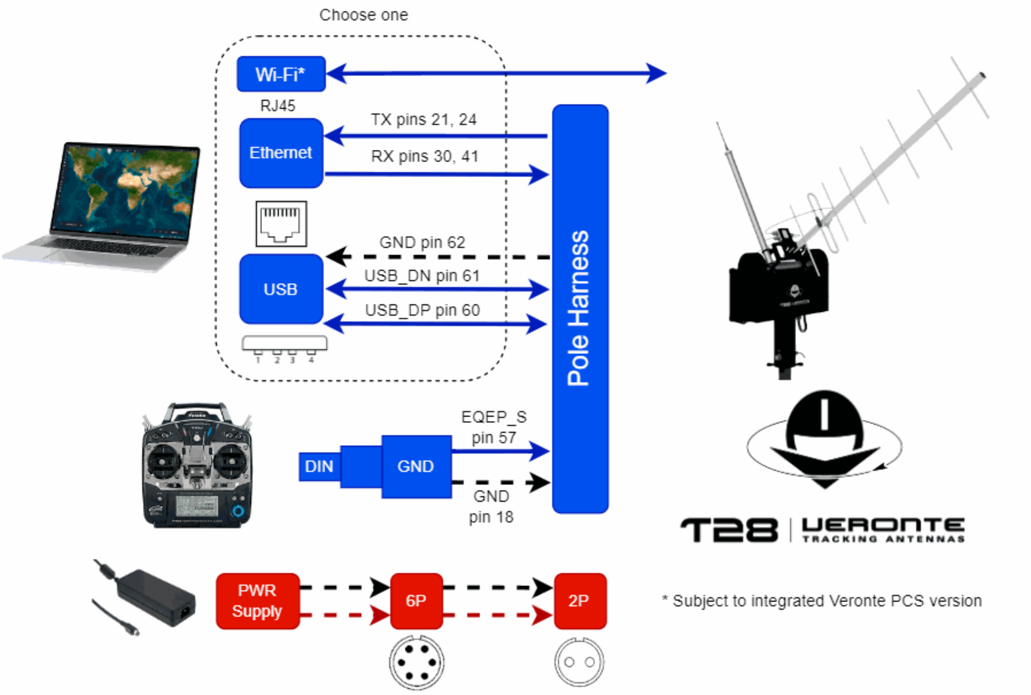
- Connection Examples
- Air Data Sensors
- Datalinks
- Stick

## Connection Examples

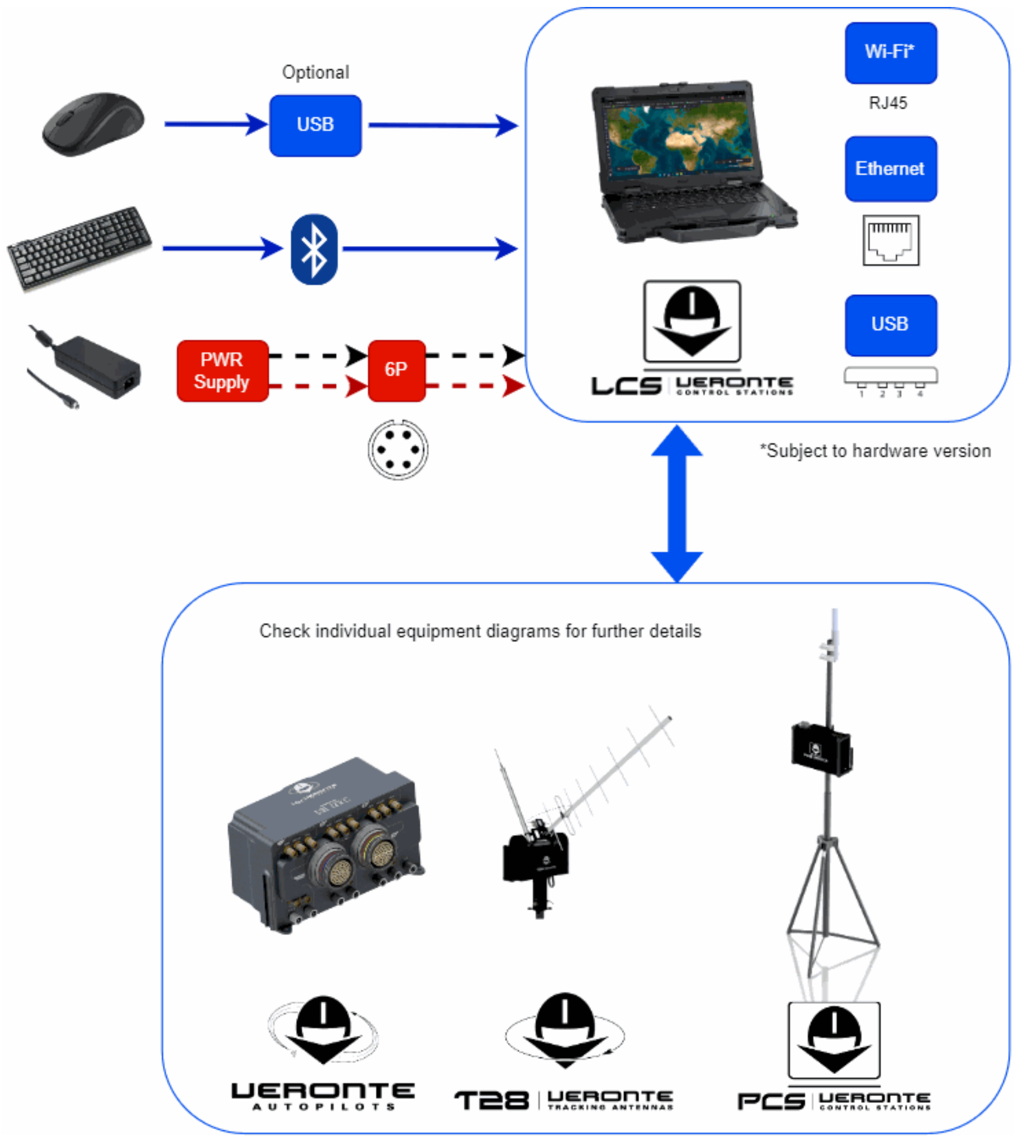
### 1. Ground Stations




**Autopilot REx PCS Ground Station**



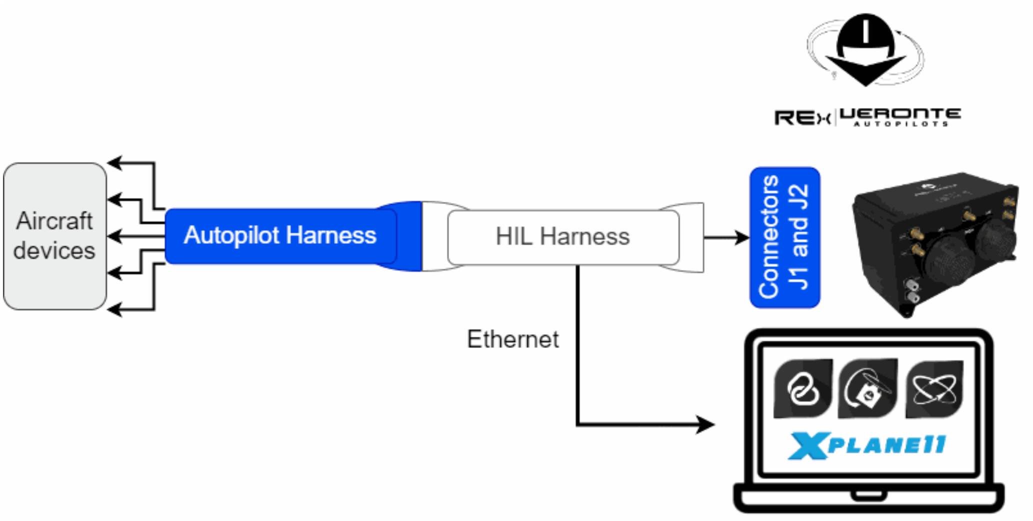

## Autopilot REx Tracker Ground Station



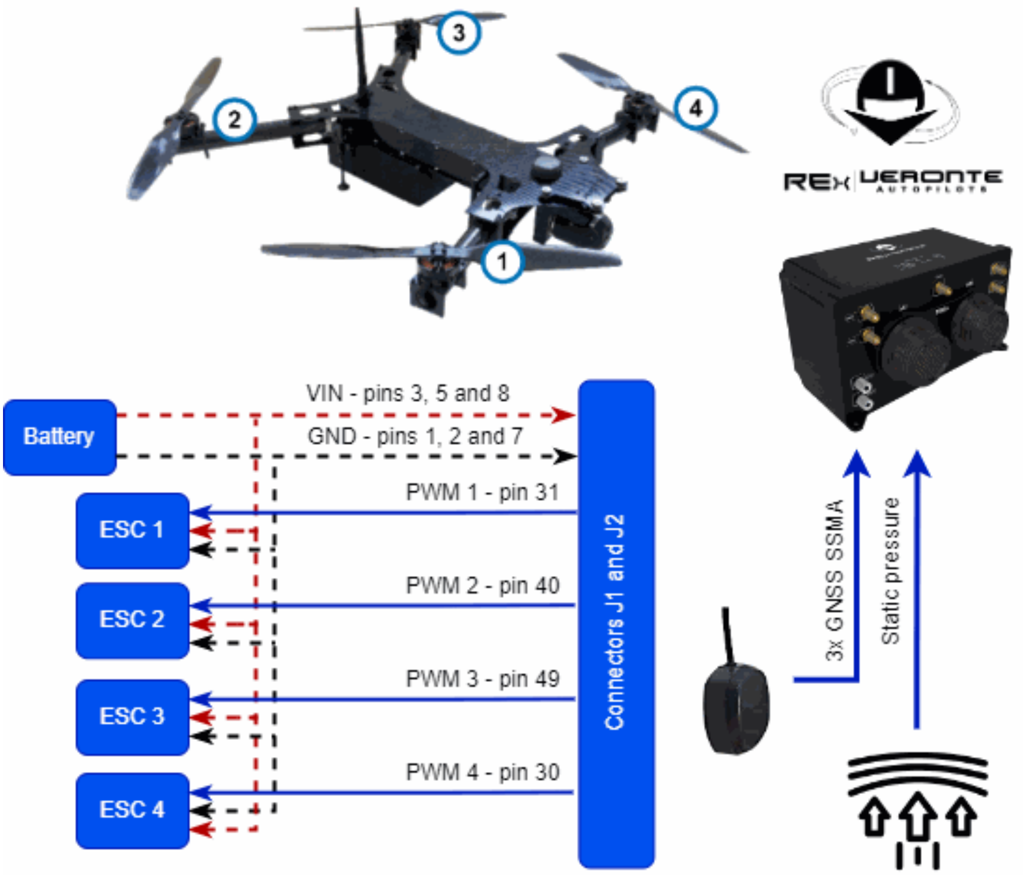
**Autopilot REx LCS Ground Station**

> ⚠ **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)

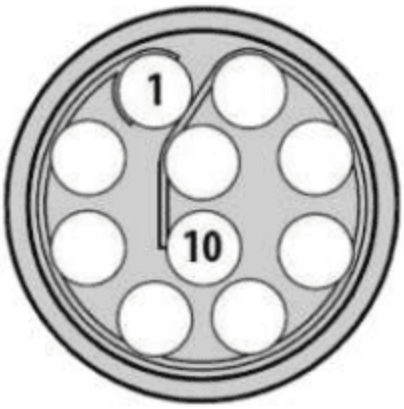
## 1.1. System Layout

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.



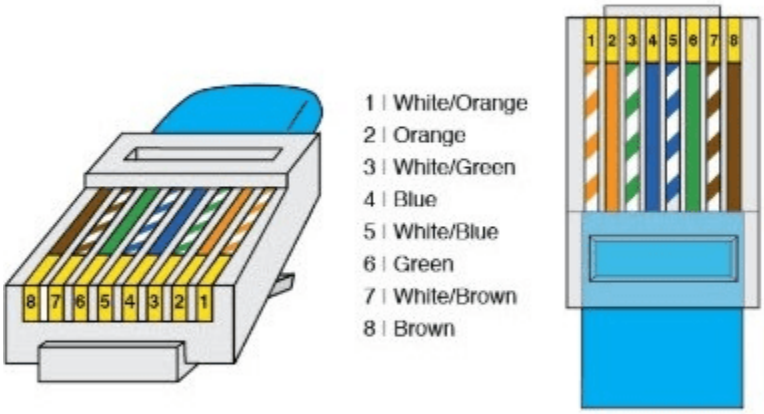

**PRI port connector (mounted in radio)**

- **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**

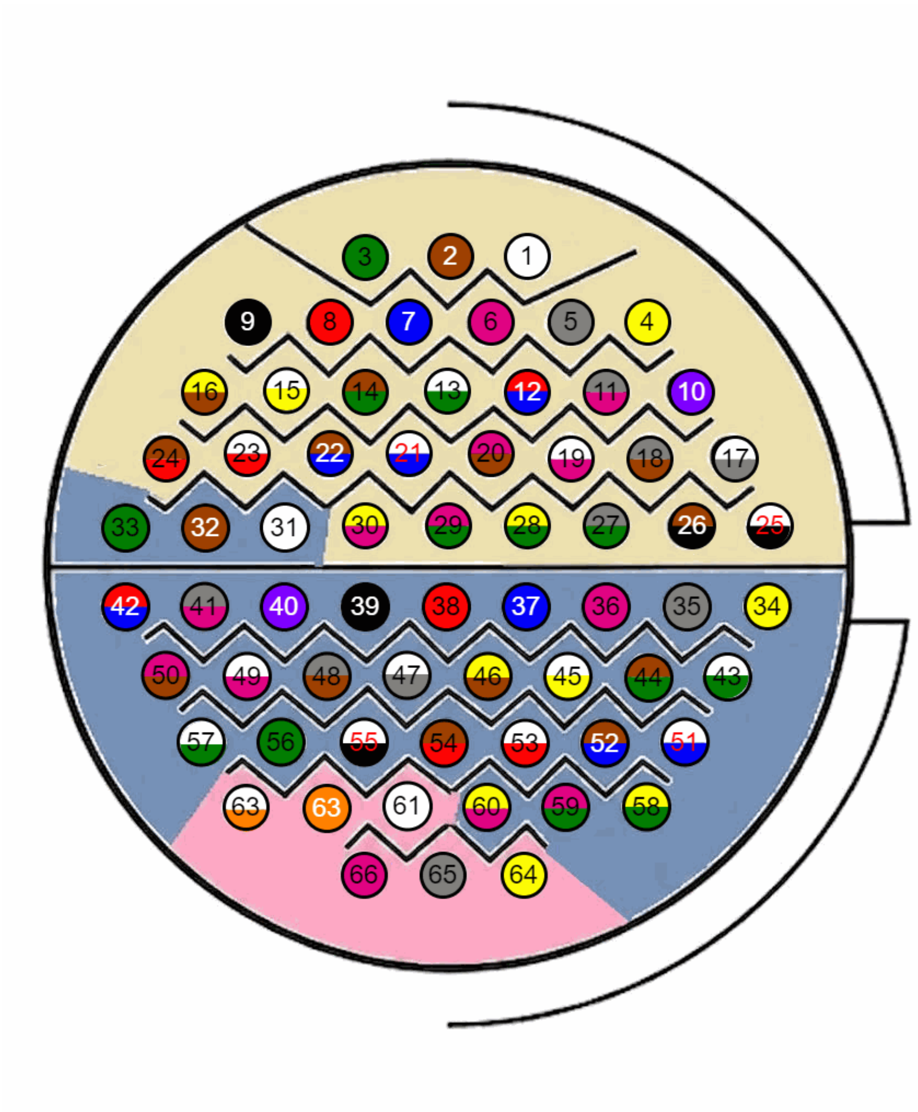



**RJ45 pinout T-568B**

| 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.

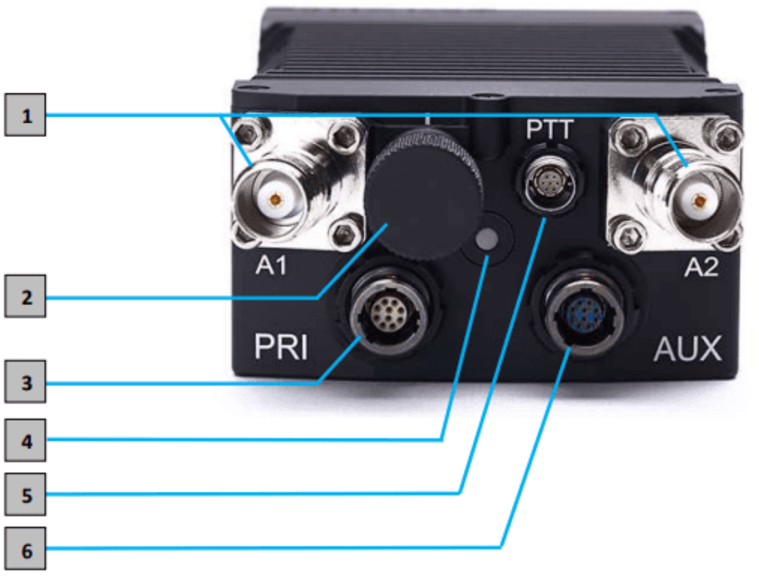



Figure 3 StreamCaster 4200E Ruggedized Enclosure

1 RF Channels 1-2 Connectors [TNC Female]

2 Power Switch [15-Position Rotating]

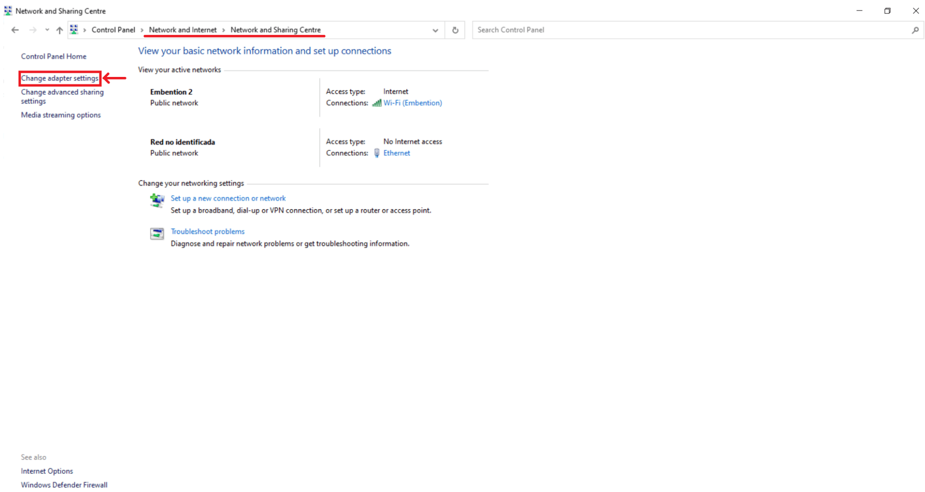
3 Power (EB Version Only, 9-20V), Ethernet, and Serial Port Connector [ODU GK0YAR-P10UC00-000L]

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

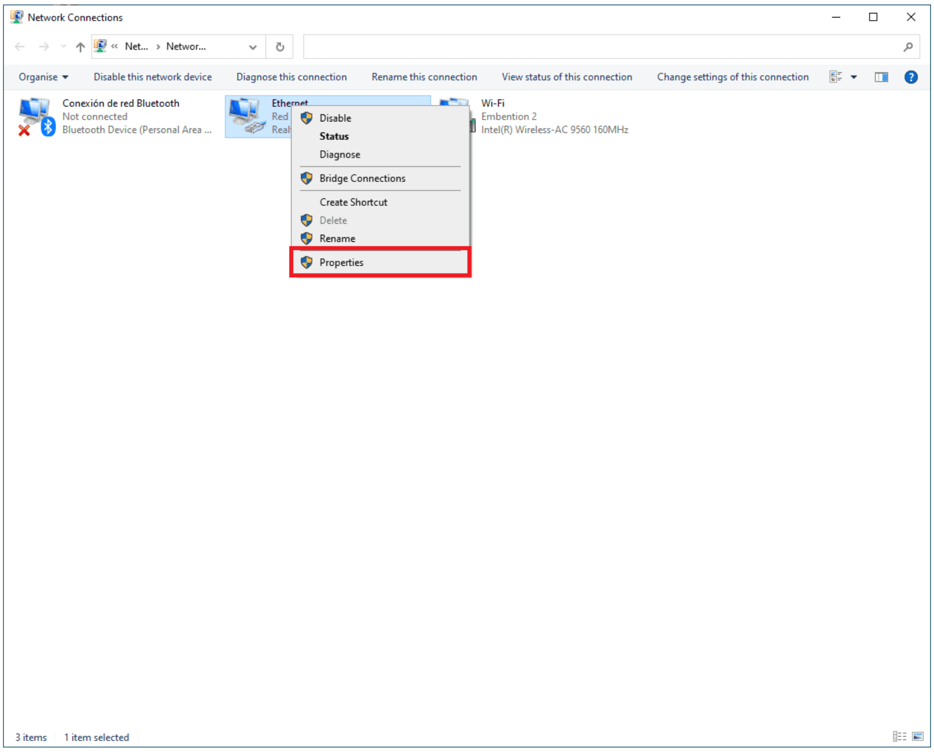
**Silvus connectors**

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**.



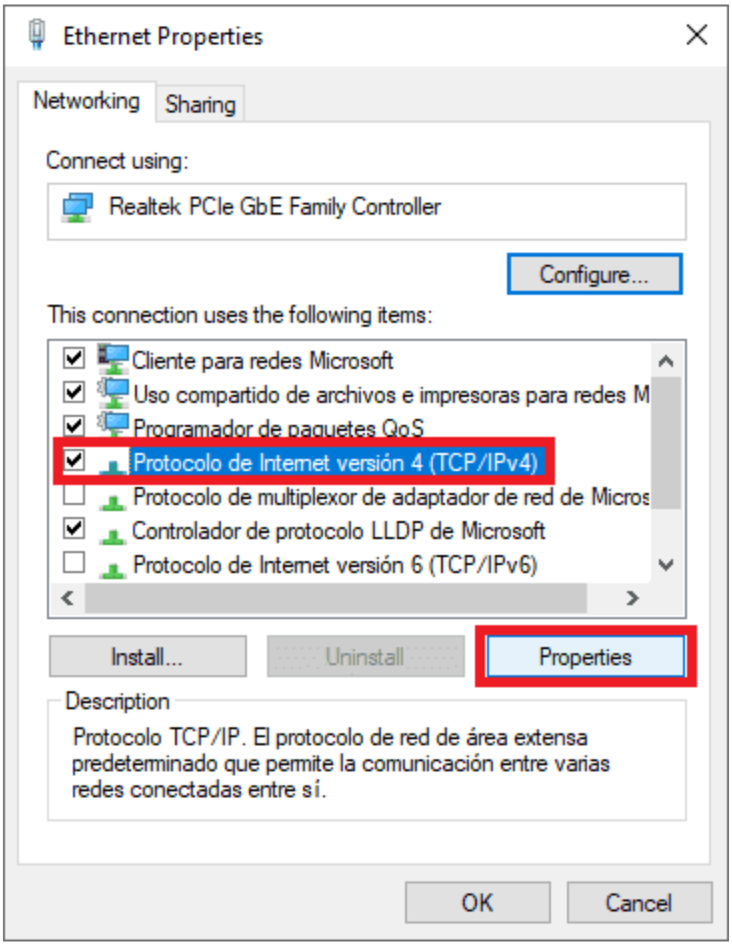

**Ethernet connection 1**

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



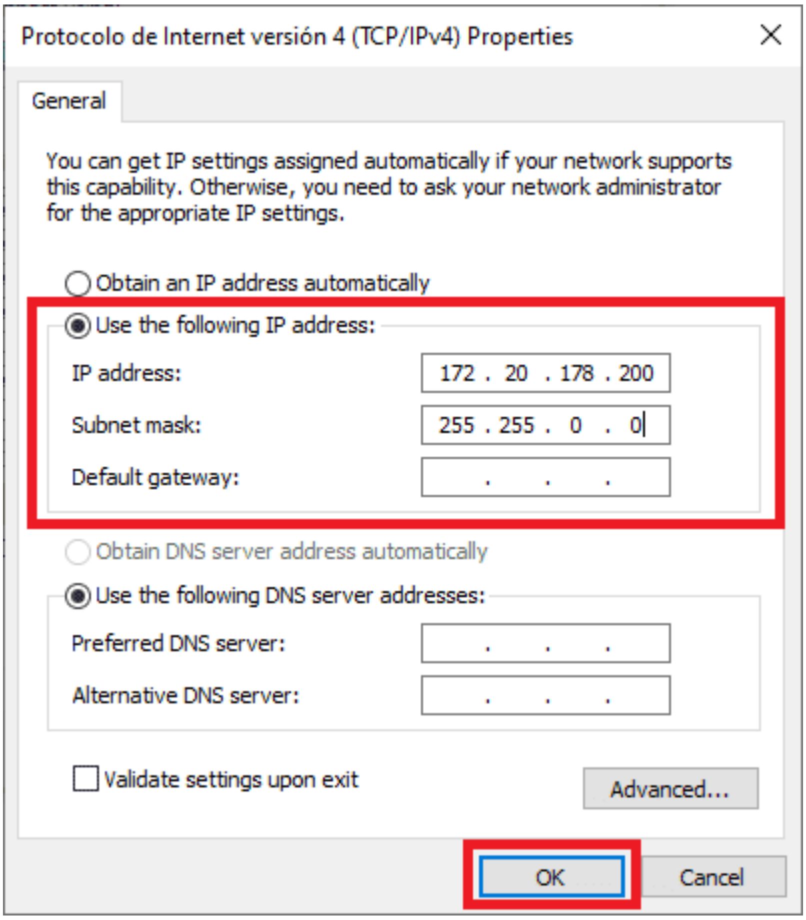

**Ethernet connection 2**

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.

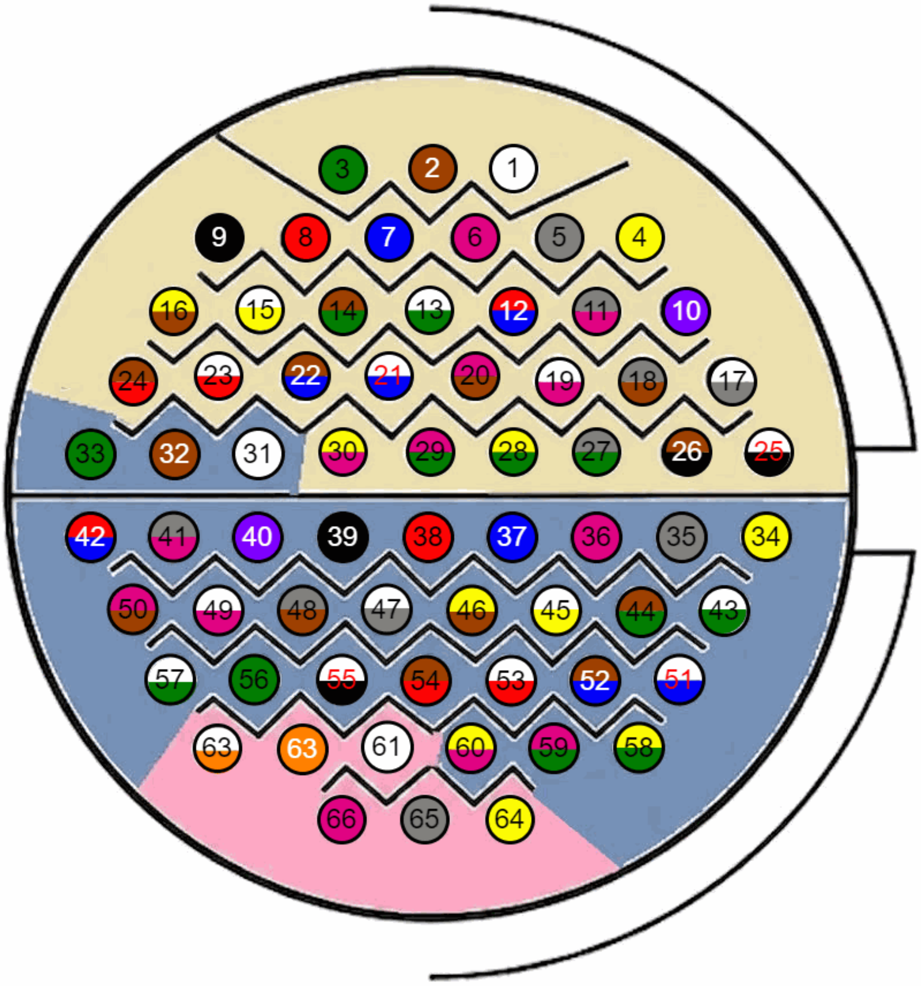
**Connection between radios**

## Stick

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

1. PPM Connection

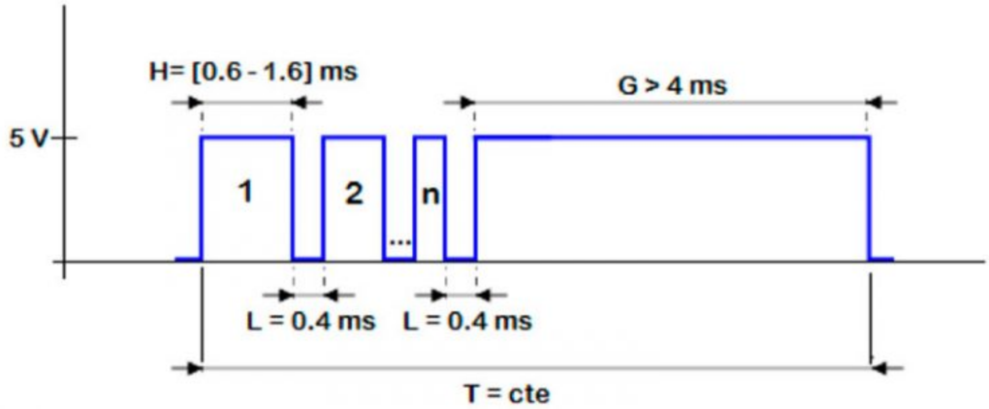
If the PPM level is 3.3V, the following **Autopilot REx** pins can be used:




### 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) |

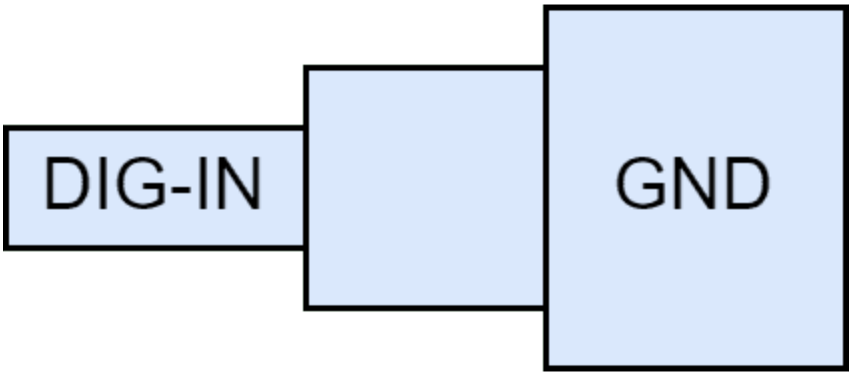
| Connector | PIN | Signal | Type | Use for PPM stick |
|---|---|---|---|---|
| J1 | 25 | J1_DIGIN_B | INPUT | Alternative PPM signal input |
| J1 | 26 | J1_GND_IO | GROUND | Ground for J1 digital inputs |
| **Dev Harness REx 2.0 reference:** Jack connector is wired to J1 pin 17 (J1_DIGIN_A) and J1 pin 29 (J1_GND_IO), as defined in Hardware Installation. | | | | |



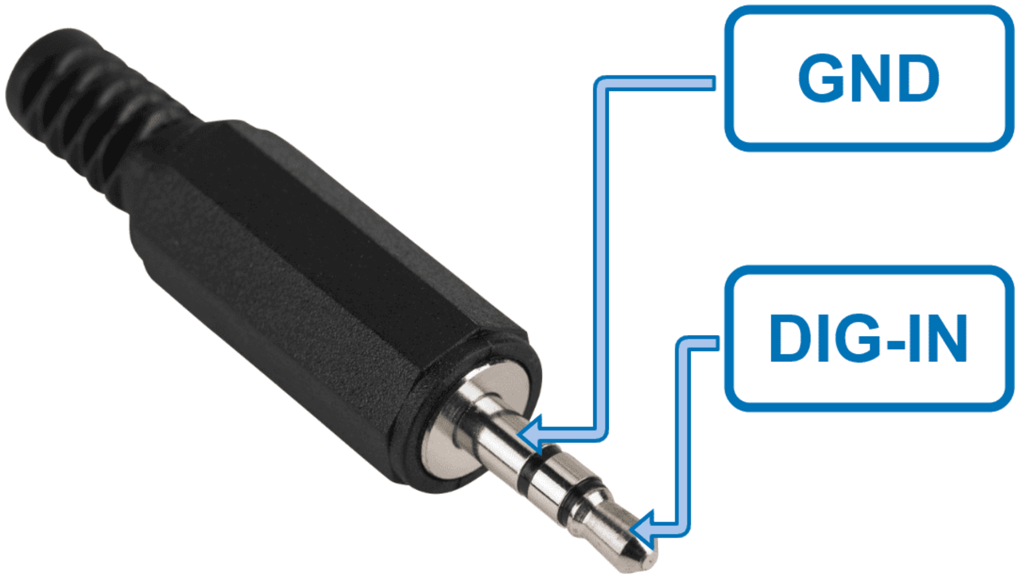

**PPM signal**

> ⚠ **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