DRx User Manual

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Embention Sistemas Inteligentes, S.A.

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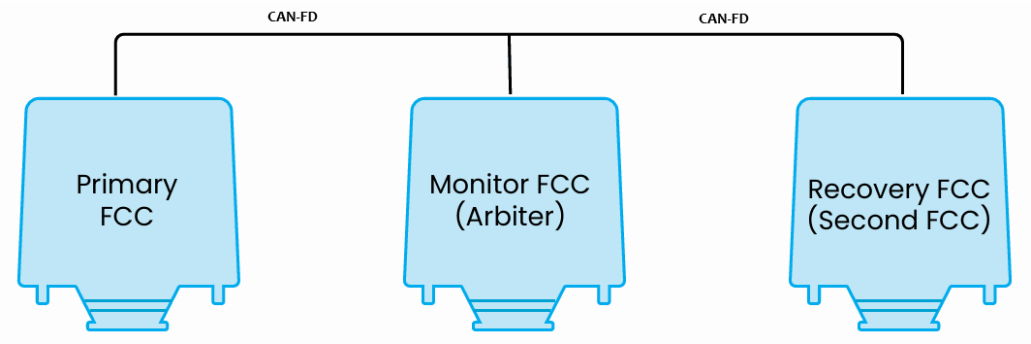
Scope of Changes

- Version 1.0
  - Added:
    - First version issued

Introduction



DRx System

The **DRx** is a high-reliability, redundant avionics system composed of three complete Veronte Autopilots 1x interconnected via **CAN-FD** communication bus. Its architecture distributes specific roles across three distinct hardware units:

- **Primary Unit:** The default command unit that acts as the lead flight controller during standard operations.
- **Recovery Unit:** The backup (failover) unit that assumes command instantly if the Primary unit encounters a failure or exceeds predefined error thresholds.
- **Monitor Unit:** The system supervisor. It does not actively pilot the vehicle; instead, it executes the arbitration algorithm to continuously evaluate system health and assign command authority to the most suitable unit.

The core purpose of the DRx system is to **ensure flight continuity and aircraft safety during critical hardware or software failures** by leveraging the following capabilities:

- **Achieve Fault Tolerance:** It fully absorbs a single hardware failure, protecting the aircraft against sudden power loss, processor freezes, or critical sensor malfunctions.
- **Ensure Operational Transparency:** the system is capable of synchronizing flight phases, pilot stick commands, and telemetry data internally via CAN-FD.

- **Customize Safety Logic:** It allows users to precisely define the exact parameters and thresholds that constitute a failure, having a totally in-house custom arbitration logic program.
- **Mitigate Common-Mode Failures (Heterogeneous Redundancy):** It enables the Primary and Recovery units to utilize entirely different sensor technologies (e.g., distinct radar altimeters), ensuring that a specific sensor defect cannot disable both flight controllers simultaneously.
- **Mitigate Zonal Failures (Distributed Redundancy):** The distributed nature of the architecture ensures that localized physical events, such as fire or structural damage in one section of the aircraft, do not compromise the entire autopilot system or crash the communication infrastructure.

Quick Start

The DRx system comprises three independent Autopilot 1x units. Consequently, the configuration procedures and software tools are identical to those used for a standalone Autopilot 1x. Each of the three internal units must be configured individually using the Veronte Autopilot 1x applications (consult the Veronte Autopilot 1x Software Manual).

To set up and configure the DRx system, please read the Software Installation section of this manual, followed by the Hardware Installation section.

Warnings

- The DRx system features a dedicated synchronization capability required to operate all three units as a unified redundant architecture. Please note that purchasing **three standalone Autopilot 1x units does not enable** this synchronization, and they cannot be configured or utilized as a DRx system.
- The same software version must be installed across the three 1x units. **Firmware version** of `8.2 or higher` is required.
- **Warnings for Veronte Autopilot 1x** also apply to the DRx system. Please read them in the Warnings - Quick Start section of the **1x Hardware Manual**.

Requirements

- Power supply of 6.5 - 36 V for every DRx 1x unit.
- A computer with one Ethernet connection combined with an Ethernet switch, or three dedicated Ethernet ports. Alternatively, USB-to-Ethernet adapter can be used.

Basic Connection for Operation

To review a basic connection example for a Autopilot 1x, which must be replicated for the units within the DRx system, please refer to the Basic Connection Diagram section of the **1x Hardware Manual**.

Firewall Configuration

Users must enable the **UDP port 52000** in the firewall to ensure the correct operation of the **Autopilot 1x Ethernet connection**.

> ⚠ **Warning**
>
> Additional UDP ports may need to be enabled in the firewall to optimize Ethernet performance. Consult the DRx Integration Example section of the **1x PDI Builder** user manual.

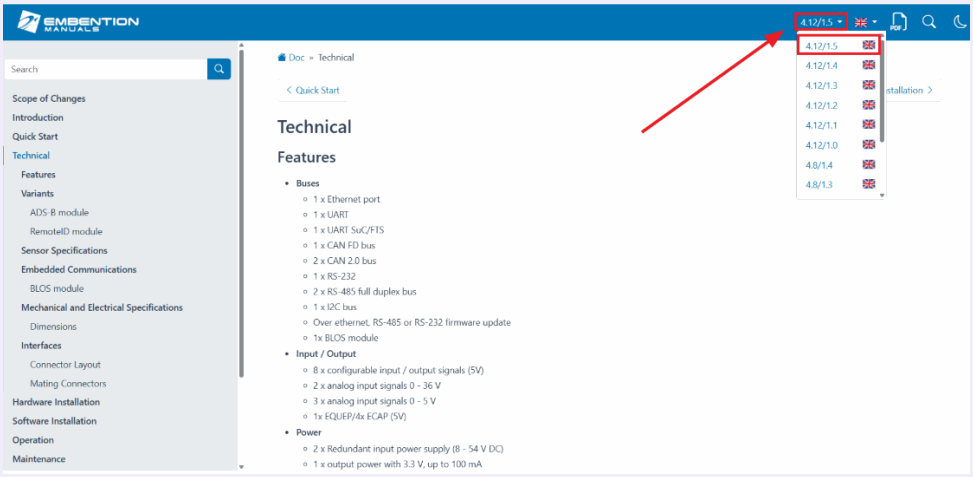
Technical

For technical specifications, please refer to the Technical section of the **1x Hardware Manual**.

Important

Please select the **proper Hardware Version** of the **1x Hardware Manual**. Ensure it is the latest version corresponding to `hardware v4.12`.

DRx can not be implemented in previous versions.



1x Hardware Manual 4.12 version

Hardware Installation

For technical specifications, please refer to the Hardware Installation section of the **1x Hardware Manual**.

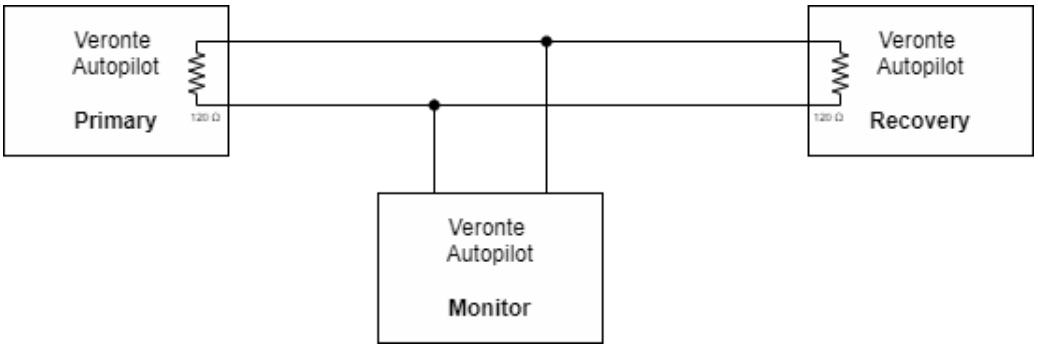
CAN-FD Wiring Connection

To establish communication across the DRx system, the three Autopilot 1x units must be interconnected via the **CAN-FD A** bus line existing in the Autopilots 1x. For detailed pinout specifications of the CAN-FD, please consult the Pinout - Hardware Installation section of the **1x Hardware Manual**.

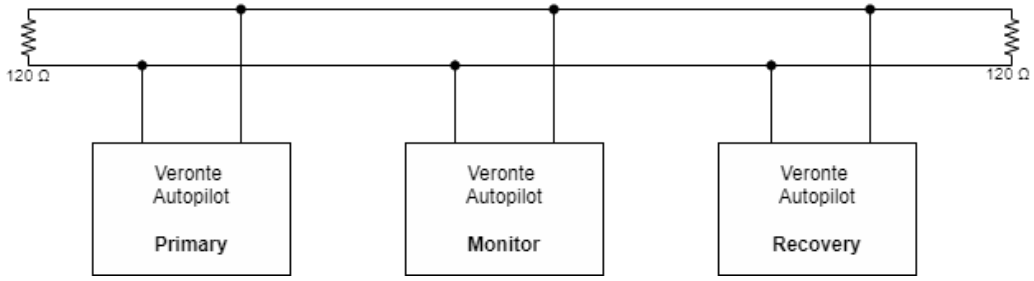
A standard CAN-FD bus requires exactly two **120 Ω termination resistors**, located strictly at the physical extremities of the communication line. Each Autopilot 1x features an integrated 120 Ω resistor that can be enabled or disabled via software configuration (complete integration description in the DRx Integration Example section of the **1x PDI Builder** user manual). This provides the flexibility to implement three different installation topologies:

- **Internal Termination:** Enable the internal resistors only on the two units positioned at the physical ends of the bus.
- **External Termination:** If necessary, disable the internal resistors on all three autopilots and install external 120 Ω resistors at the absolute ends of the aircraft wiring harness.
- **Mixed Termination:** If one autopilot sits at the physical end of the bus but the network extends past the other units to external peripherals, enable the internal resistor only on the extremity autopilot and place an external 120 Ω resistor at the absolute far end of the vehicle's network.

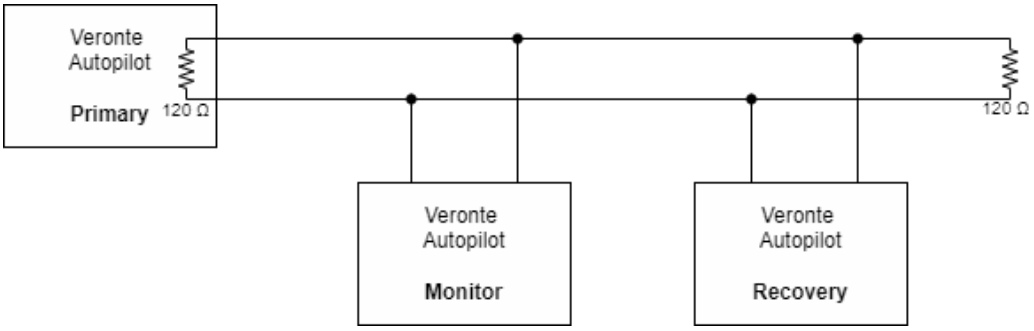
> ⓘ **Note**
>
> **Internal Termination** is strongly recommended if the CAN-FD bus is dedicated exclusively to the internal DRx autopilot units, meaning no other external devices are connected to the network.



CAN-FD connection diagram using internal termination resistors



CAN-FD connection diagram using external termination resistors



CAN-FD connection diagram using mixed termination resistors

Further instructions on how to interconnect multiple autopilots via CAN are detailed in the CAN Wiring Connection - Integration Examples section of the **1x Hardware Manual**.

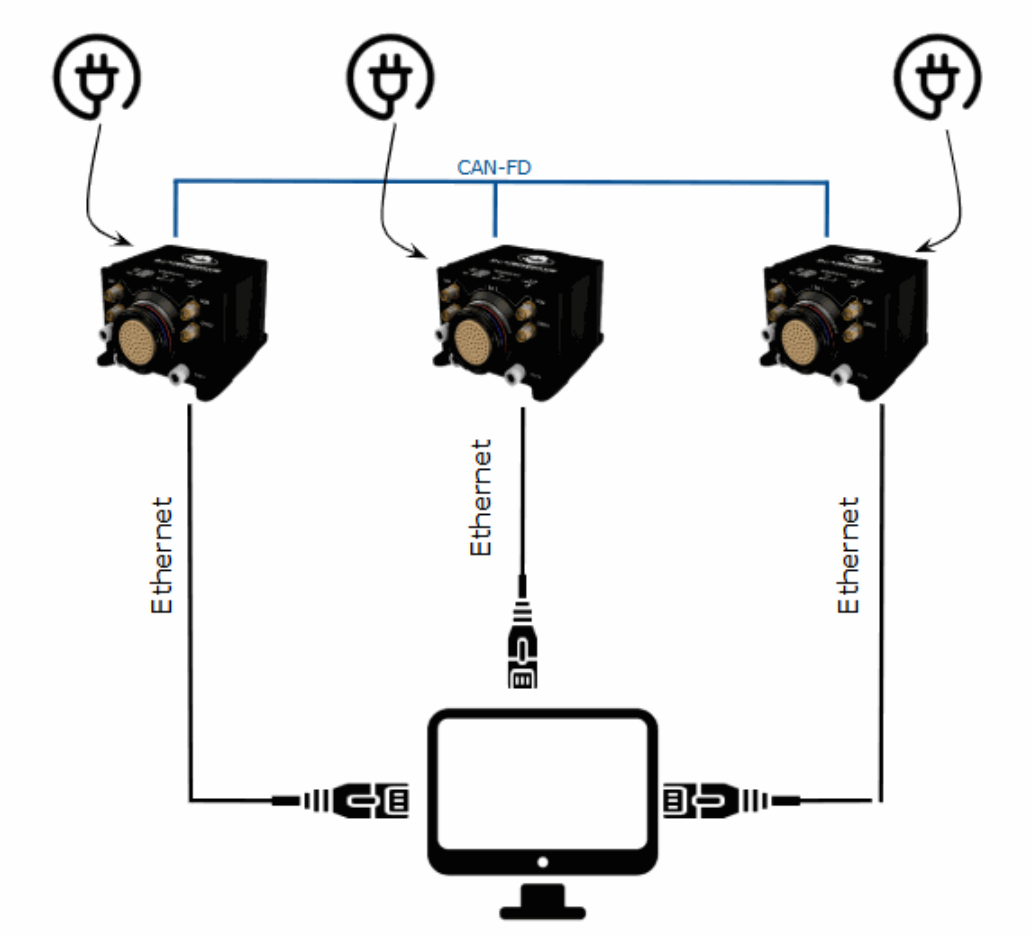
Software Installation

To configure the DRx system, the three 1x units must be connected to a computer. This connection can be established via Ethernet in two ways: by connecting the three autopilots directly to the computer, or by using an Ethernet switch.

In both scenarios, a proper Ethernet configuration must be set up on the computer. To enable the Ethernet connection between the autopilots and the computer, users must strictly follow the the steps described in the Ethernet connection - Software Installation section of the **1x Hardware Manual**.

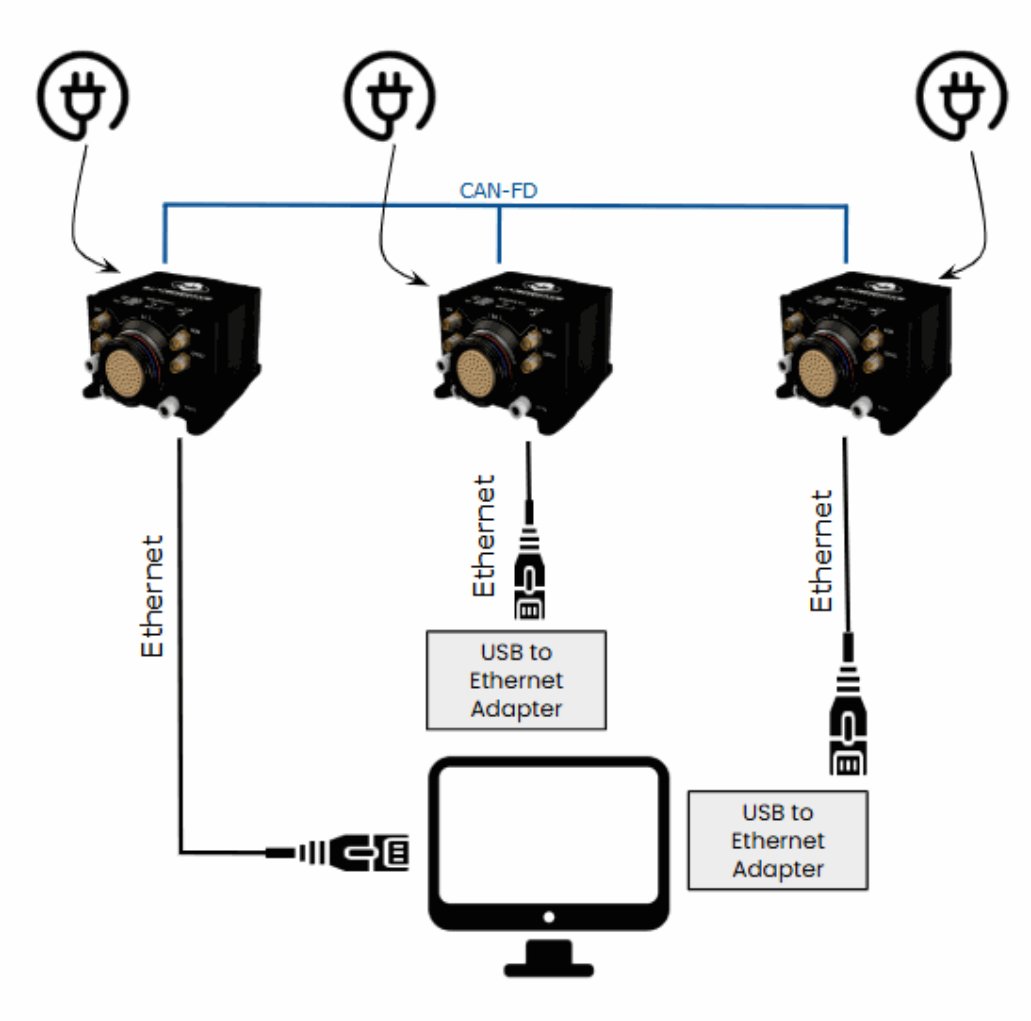
Direct Connection

The following diagram illustrates how to connect a computer to the DRx system for configuration.



Ethernet direct connection

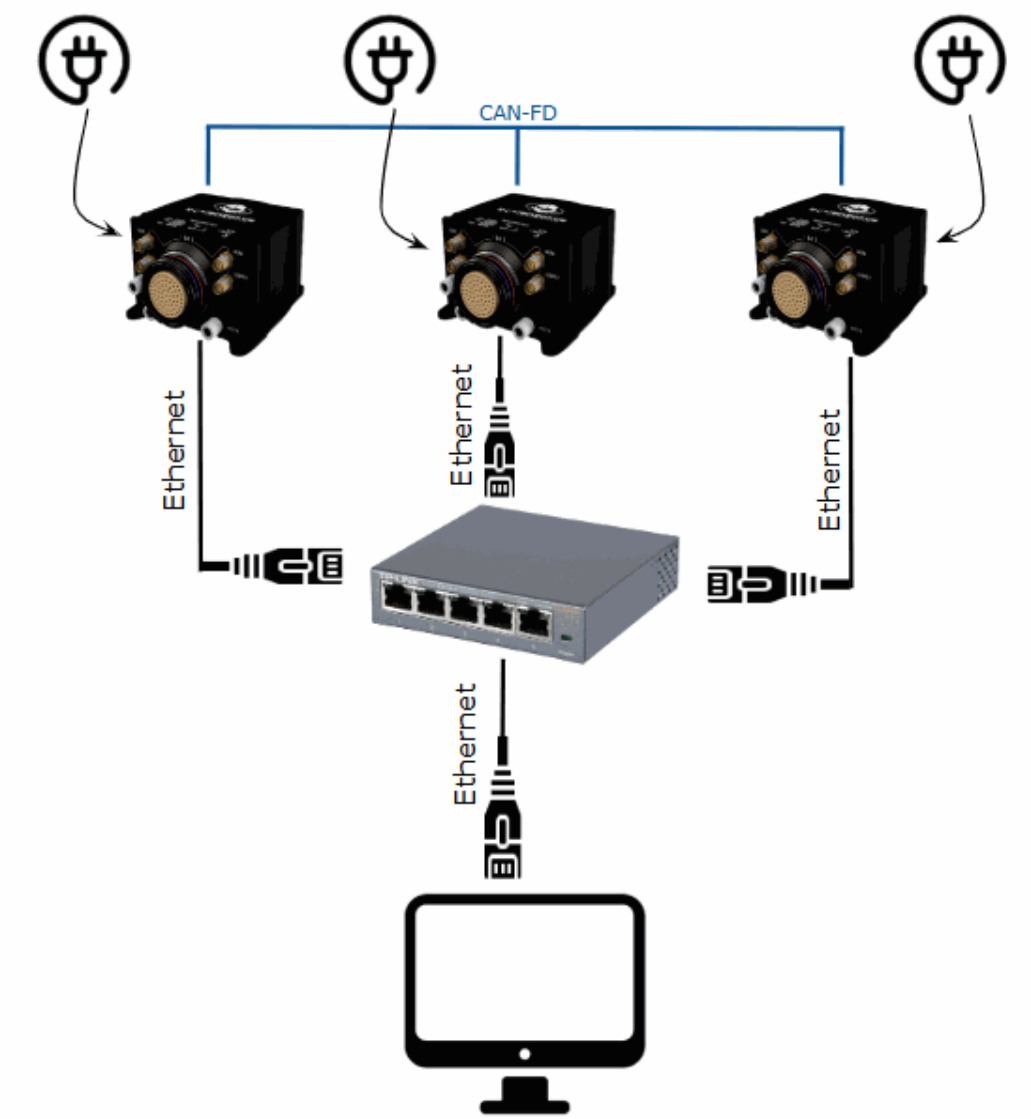
If the computer lacks three Ethernet ports, USB-to-Ethernet adapters can be used.



Ethernet connection using USB adapters

Ethernet Switch Connection

The following diagram illustrates how to connect the DRx to a computer using an Ethernet switch.



Ethernet connection using an Ethernet switch

How to configure DRx

To install the required software and configure each **Veronte Autopilot 1x**, please proceed to the 1x Software Manual.

Maintenance

Preventive maintenance

The DRx system requires the same maintenance and cleaning procedures as the Autopilot 1x. Please refer to the Preventive maintenance section of the **1x Hardware Manual** for detailed instructions.

Software update

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

> ⓘ **Note**
>
> The file with the new software version will be shared with the customer in the **Joint Collaboration Framework** when it is requested.
>
> For more information about the **Joint Collaboration Framework**, read its user manual.

Compatible Devices

The devices compatible with the DRx system are **identical** to those supported by the **Veronte Autopilot 1x**.

A complete list can be found in the Compatible Devices section of the **1x Hardware Manual**.

Integration Examples

Step-by-step Configuration

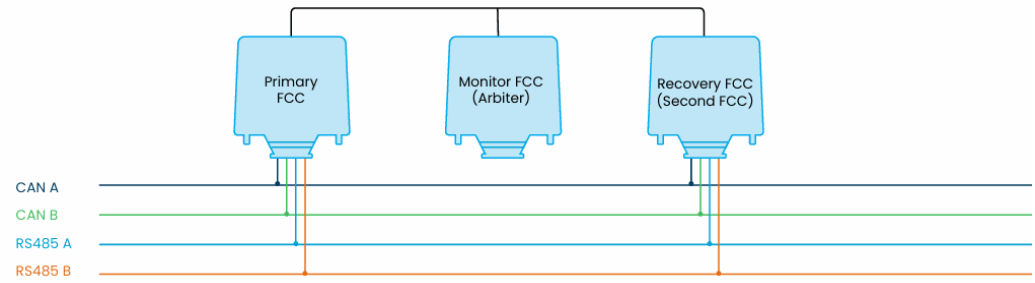
A complete, step-by-step DRx system configuration is detailed in the DRx Integration Example section of the **1x PDI Builder** user manual.

Bus Lane Examples

The following examples highlight the inherent advantages of the DRx as a fully redundant flight control system. By utilizing multiple Flight Control Computers (FCCs), the architecture provides the flexibility needed to design highly fault-tolerant network configurations. These topologies demonstrate how the DRx safeguards the aircraft against critical points of failure, ensuring mission continuity and operational safety.

Redundant Bus Connection

In a redundant bus configuration, both the Primary FCC and the Recovery FCC are connected in parallel to the same shared communication lines (CAN A/B and RS485 A/B). This topology ensures full media redundancy, allowing both flight control computers to have concurrent access to the exact same peripherals and network channels. If one autopilot unit fails, the operational unit maintains uninterrupted communication over the existing buses.

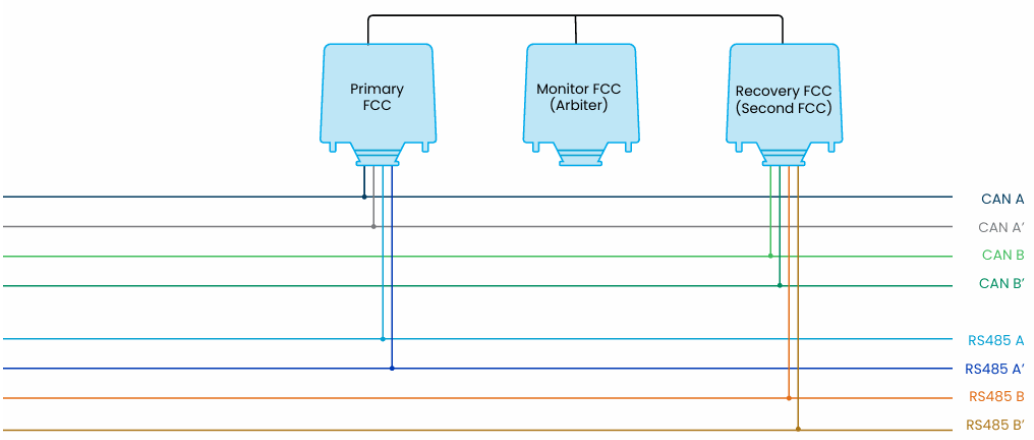


Redundant bus connection topology

Splitted Bus Connection

In a splitted bus configuration, the communication channels are completely segregated between the autopilot units to maximize system isolation. The Primary FCC interfaces exclusively with a dedicated set of lines (CAN A/A' and

RS485 A/A'), while the Recovery FCC manages an entirely independent set (CAN B/B' and RS485 B/B'). This layout ensures that a localized physical fault, such as a short circuit on one bus domain, remains completely isolated and does not compromise the alternative communication network.



Split bus connection topology

Troubleshooting

For any hardware-related issues, please refer to the Troubleshooting section of the **1x Hardware Manual**.

If the issue involves software, please consult the Troubleshooting section of the **1x PDI Builder** user manual.

Acronyms and Definitions

Acronym	Description
CAN	Controller Area Network
CAN-FD	Controller Area Network Flexible Data-Rate
DRx	Distributed Redundant Flight Control System
FCC	Flight Control Computer
HW	Hardware
RS485	Recommended Standard 485
UDP	User Diagram Protocol
USB	Universal Serial Bus

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