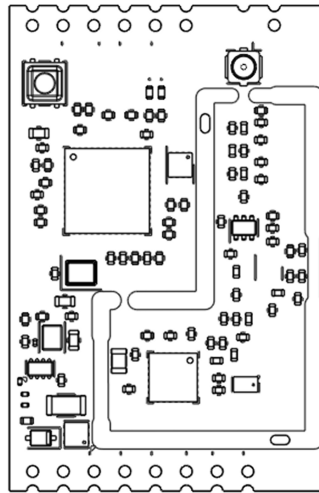




Data link Sine.link mono

User manual

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Safety



Warning: Important safety instructions to be read before installation and use.

Incorrect use can lead to serious injury and will void manufacturer's liability and warranty. It is important for the safety of persons to follow the enclosed instructions.

- Before using the device, read the instruction manual carefully to understand its proper use and maintenance.
- Do not expose to water, moisture, humid and damp environments or extreme temperatures
- Persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, should not be allowed to use this product.
- Use of modification outside the scope of this instruction manual will void warranty.
- Frequently inspect for improper operation.
- Do not use if repair or adjustment is necessary.
- Keep clear when in operation.

FCC statement

Data link

Model: Sine.link mono

FCC ID: 2BTY733002

1. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.
2. This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
3. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
4. To comply with FCC RF exposure requirements, a minimum separation distance of 20 cm must be maintained between the antenna of this device and all persons.
5. This device must be operated with the antennas listed in the "Approved Antenna List" only. The use of any other antennas is strictly prohibited. The maximum permitted antenna gain is 2 dBi.
6. The FCC ID label is located on the bottom side of the device.



Safety rules



Read all safety information before installing, configuring, or operating **Data link Sine.link mono**. Failure to follow these safety guidelines may result in equipment damage, regulatory non-compliance, or unsafe operating conditions.

Table 1. Safety guidelines

Name	Description
Frequency range	Operation is prohibited outside the permitted frequency bands. Use only within the approved frequency range 902 – 928 MHz.
Antenna connection	Never use the device without a properly connected antenna. Operating without an antenna can damage the radio frequency components and may cause regulatory non-compliance.
Device disassembly	Do not attempt to disassemble the device. Opening the device voids warranty and may result in regulatory violations.
Environmental protection	Protect the device from water exposure and mechanical damage. Store and operate in dry conditions within the specified temperature range 0 – 30 °C.
Configuration requirements	Use only the recommended configuration and certified accessories. Unauthorized modifications may affect performance and regulatory compliance.
Antenna and power handling	• Handle antennas carefully to avoid damage to connectors. • Ensure proper power supply voltage (refer to specifications). • Use only approved power adapters and cables. • Disconnect power before making any connections.

1 General information

Data link Sine.link mono are secure, anti-jamming radio communication components designed for control and telemetry transmission in various unmanned systems, including UAVs (Unmanned Aerial Vehicles) and UGVs (Unmanned Ground Vehicles).

Main specification

- Frequency: 902 – 928 MHz.
- Receiver sensitivity: -116 dBm.
- Modulation: LoRa.
- Bitrate: up to 20 kbps.
- Native support for MAVLink, SBUS, and CRSF protocols.
- Maximum transmitter power: 120 mW.
- Maximum voltage: 16 V.
- Interfaces: 2×UART, USB–C (+2×UART).
- Temperature range: 0 – 30 °C.
- Antenna connector: U.FL
- Form factor:
 - Dimensions: 40 mm × 25.8 mm × 2.74 mm.
 - Weight: 3 g.

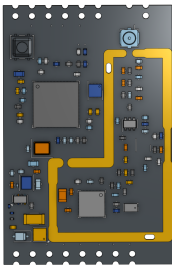
Requirements

- Power supply: 5 V.
- Operating system: Windows, Linux, or macOS for working with the control application.
- Application **LinkApp** for configuring the modems and firmware.
- USB Type-C cable for initial configuration of the modems.

2 Package content

Table 2 shows the contents of the **Data link Sine.link mono** package:

Table 2. Package of the Sine.link data link mono

No	Description	Photo	QTY
1	Data link Sine.link mono		1
2	RN-UFL-SMA6		1

3 Device layout

3.1 Data link Sine.link mono layout

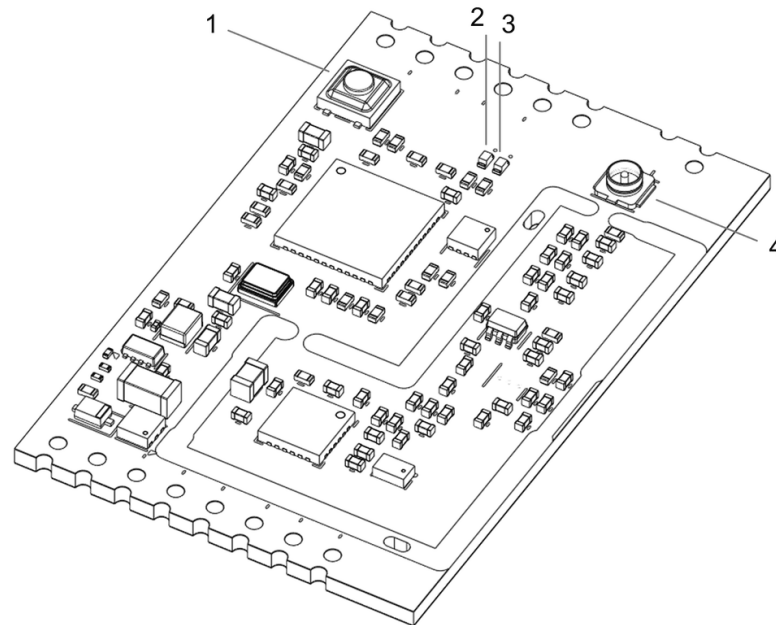


Figure 1. Data link Sine.link mono layout

- | | |
|--------------------------|---------------------------|
| 1. RESET button. | 3. DATA indicator. |
| 2. COM indicator. | 4. U.FL connector. |

Description of device control elements and indicators:

- **RESET button:** firmware update, pairing, settings reset.
- **LED indicators:**
 - **COM** displays connection status: static indication (stable connection), dynamic indication (packet loss, frequency proportional to the level of losses).
 - **DATA** displays transmission activity: dynamic indication during the operation of the bootloader or data exchange.
- **Antenna connector:**
 - U.FL.

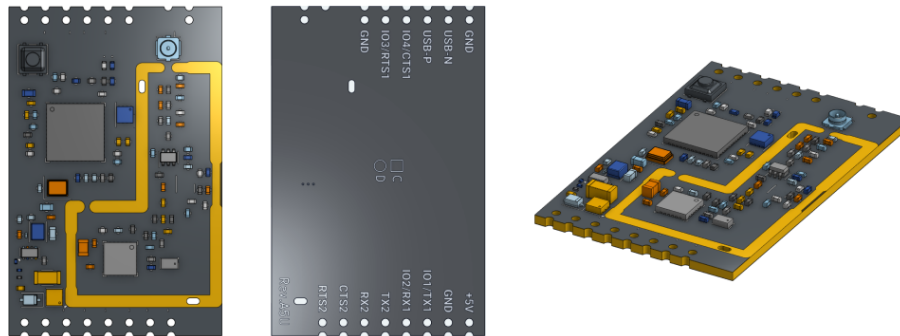


Figure 2. Data link Sine.link mono front, rear, and isometric view

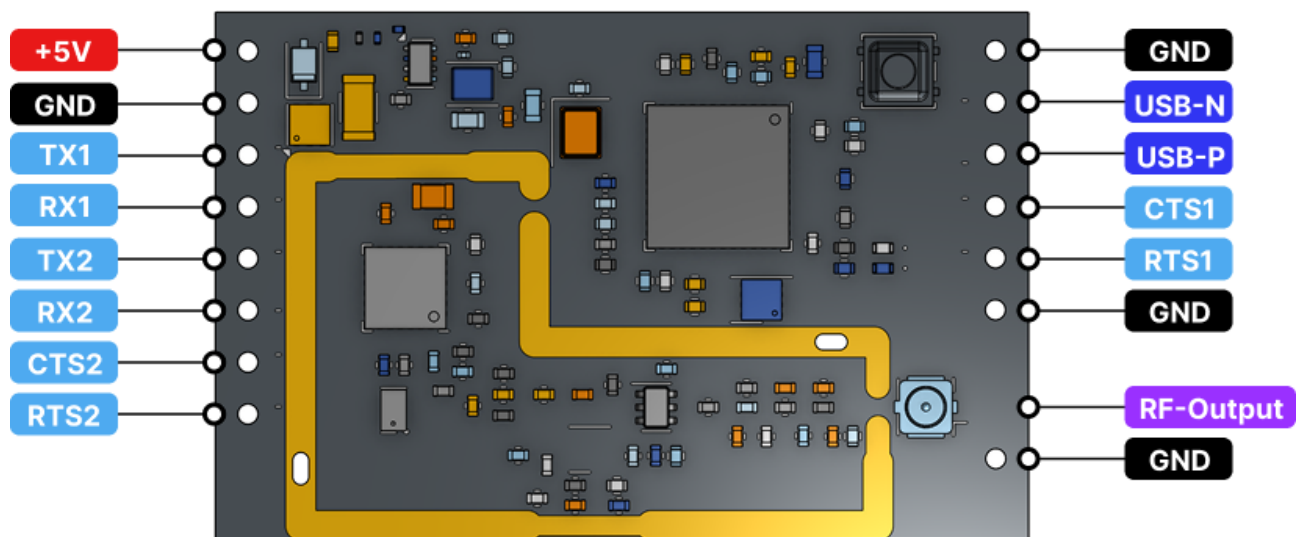


Figure 3. Sine.link mono pinout

Table 3. List of Sine.link mono ports

Port	Pin	Description
UART 1	TX1, RX1, RTS1, CTS1	Main connector, the only one allowing firmware updates via UART.
UART 2	TX2, RX2, RTS2, CTS2	Additional interface for UART communication.
USB	GND, USB-N, USB-P, +5V	(universal connector for power, video, audio, files).
Power	GND, +5V	Input power connector with a voltage range of 4.5–16 V

4 Antenna connection

4.1 Antenna Requirements and Replacement

- Use only antennas designed for the **902–928 MHz** frequency range.
- Ensure compatibility with a **50 Ω** RF port (recommended $VSWR \leq 2$ across).
- Replacement is allowed only with antennas of equivalent bandwidth.
- After any replacement or adjustment:
 - Verify impedance matching (S11/VSWR).
 - Confirm overall communication channel functionality.
- The use of any other antenna type or antennas with higher gain than those listed is strictly prohibited.

4.2 Data link antenna installation guidelines

Data link Sine.link mono

- Antenna Types: **U.FL**.
- Connection Procedure: Screw in the antenna with an **U.FL** female connector until fully tightened.

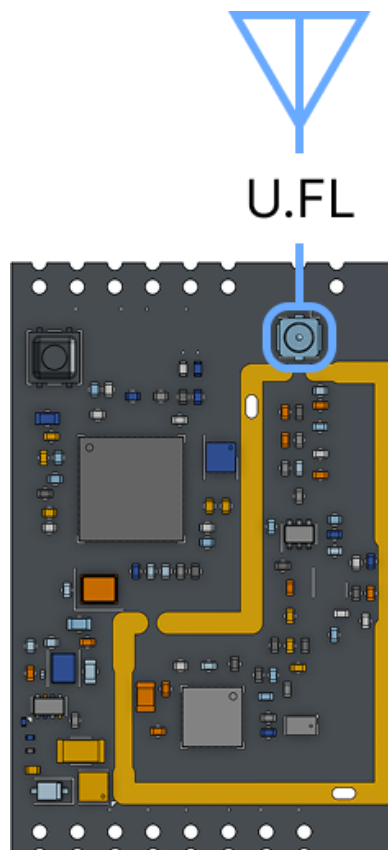


Figure 4. Antenna U.FL connection**4.3 Recommended antennas**

Table 4 lists approved antennas for the **Data link Sine.link mono**.

Table 4. Approved antennas (902 MHz ~ 928 MHz)

MPN	MFR	Type	Frequency	Gain (dBi)	Impec (Ω)	Polariz	Datasheet
S467AH-915S	Nearson Inc.	Whip, Tilt	902 MHz ~ 928 MHz	2	50	Vertical	https://www.nearson.com/assets/pdfs/Antenna/S467XX-915S.pdf
ANT-916-CW-HW	TE Connectivity Linx	Whip, Straight	902 MHz ~ 928 MHz	1.2	50	Vertical	https://www.te.com/commerce/DocumentDelivery/DDEController?Action=srch_rtrv&DocNm=ANT-916-CW-HW&DocType=Data+Sheet&DocLang=English&DocFormat=pdf&PartCntxt=ANT-916-CW-HW

5 Operation recommendations

This section contains technical requirements for the power supply, installation, and operation of **Data link Sine.link mono**. It also includes dimensional drawings for proper integration of the devices into a UAV.

5.1 Technical requirements

5.1.1 Power supply

To ensure proper operation of the modem, a stable power supply is required in accordance with its technical specifications.

Input voltage:

- 4.5–16 V for **Sine.link mono**.



Insufficient power supply will prevent the modem from operating within its specified parameters, which may result in cyclic reboots and connection loss.

5.2 Required software and hardware

In order to effectively configure and operate modems, the following components are necessary:

- **Operating system:** Windows 10/11, macOS, or Linux (Ubuntu 22.04+) for working with the modem control software.
- The **LinkApp software** to configure modems and flash firmware. Available in the manufacturer repository.
- **USB Type-C cable** for initial configuration of modems.

5.3 Rules for operation and installation

5.3.1 Restrictions and prohibitions

To ensure reliable operation and maintain the warranty of the modem, please adhere to the following guidelines:

- **Prohibited:**
 - Disassembling the modem.
 - Performing self-repair on the device.



The modem will not be covered by the warranty in case of unauthorized modification or tampering.

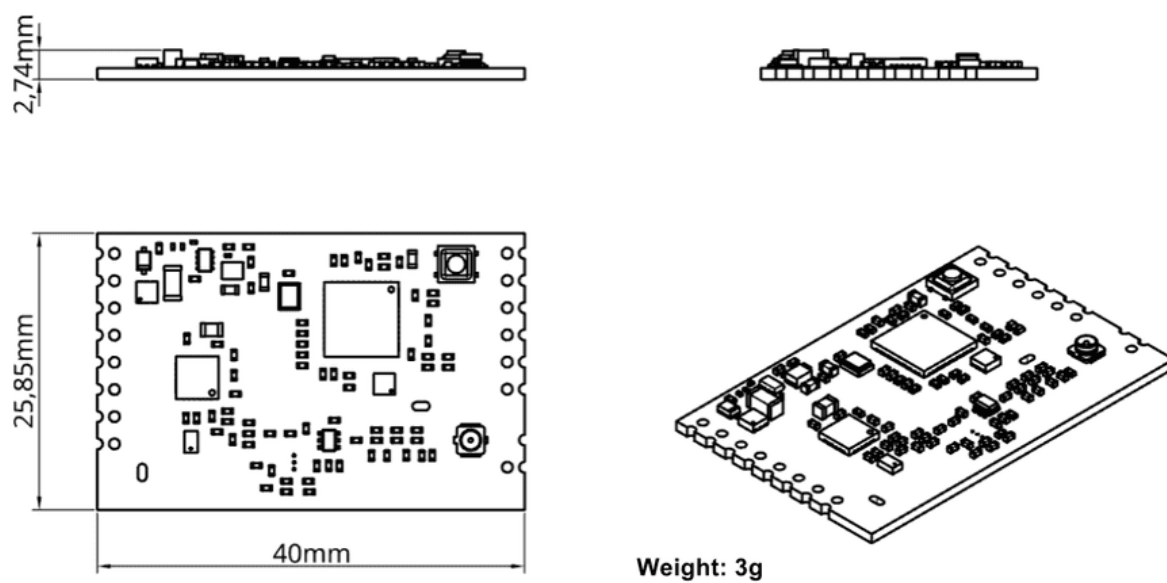


Figure 5. Sine.link mono dimensions

6 LinkApp

LinkApp is the official application for configuring and monitoring **Data link Sine.link mono** modem. It provides complete control over communication parameters, real-time telemetry, spectral analysis, and modem pairing management.

Operating system: Windows x64 Download the application from the official repository.

6.1 Installing LinkApp

Download the appropriate version of the application from the official repository.

6.1.1 Windows (x64)

On first launch, Windows prompts for permission to access network activity. Select **Allow** to continue.

Methods of connecting modems to a PC:

- Ground communication module (**only Data link Sine.link**): USB Type-C.
- Onboard communication module:
 - After pairing—wireless connection (optimal option).
 - Also, optionally—USB Type-C (**Data link Sine.link mono** requires soldering).

6.1.2 Linux

To install the application on **Linux OS**, do the following:

1. Download **FUSE** to run **Applmage** files:

```
sudo add-apt-repository universe  sudo apt install libfuse2
```

2. Add the user to the **dialout** group to give access to **COM ports**:

```
sudo usermod -aG dialout whoami
```

3. Configure **udev rules** for automatic recognition of modems:

```
echo 'SUBSYSTEM=="usb", ENVDEVTYPE=="usb_device",  
ATTRidVendor=="1939",ATTRidProduct=="1945",  
MODE="0666"' | sudo tee /etc/udev/rules.d/99-sine.rules  
sudo systemctl restart udev
```

4. Reboot the system after running the commands.

5. Grant execution permission to the **LinkApp** file in one of the following ways:

- **Terminal:** `chmod +x LinkApp_filename`
- **Graphical interface:** Right-click > **Properties** > **Permissions** > **Allow executing file as program**.

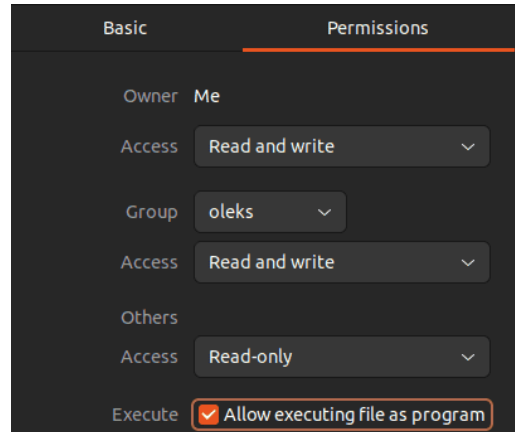


Figure 6. Permission settings

After granting permissions, **LinkApp** can run through:

- **Graphical interface:** Right-click > **Run as program**.
- **Terminal:** `./LinkApp_filename`.

6.1.3 macOS

To install the application on **macOS**, do the following:

1. Move the **LinkApp** file into the **/Applications** directory.
2. Launch **LinkApp** by double-clicking on it.



If system encounters a launch error, go to **System settings > Privacy & Security** > scroll to the bottom of the section > grant permission as indicated in Figure 7.

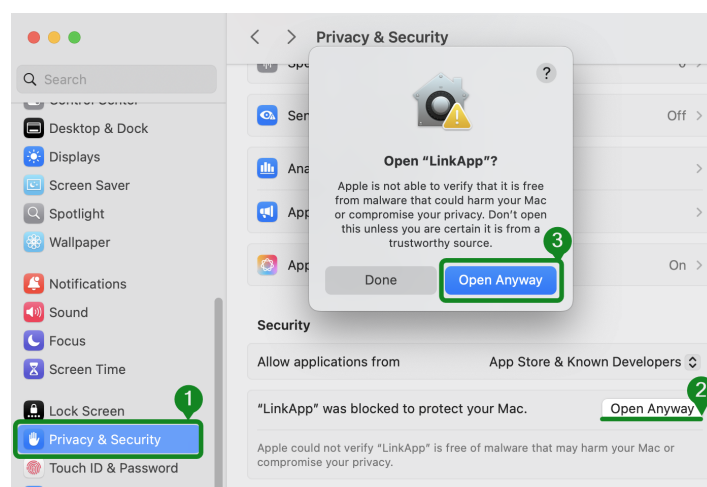


Figure 7. Permission settings

6.2 Working with LinkApp

Connect the **Data link Sine.link mono** module that is located on the ground station (**Master**) to a PC via USB Type-C. The onboard module will appear in the application after pairing (see Section 6.6). Alternatively, connect the onboard module to the PC via USB. Run a **LinkApp**.

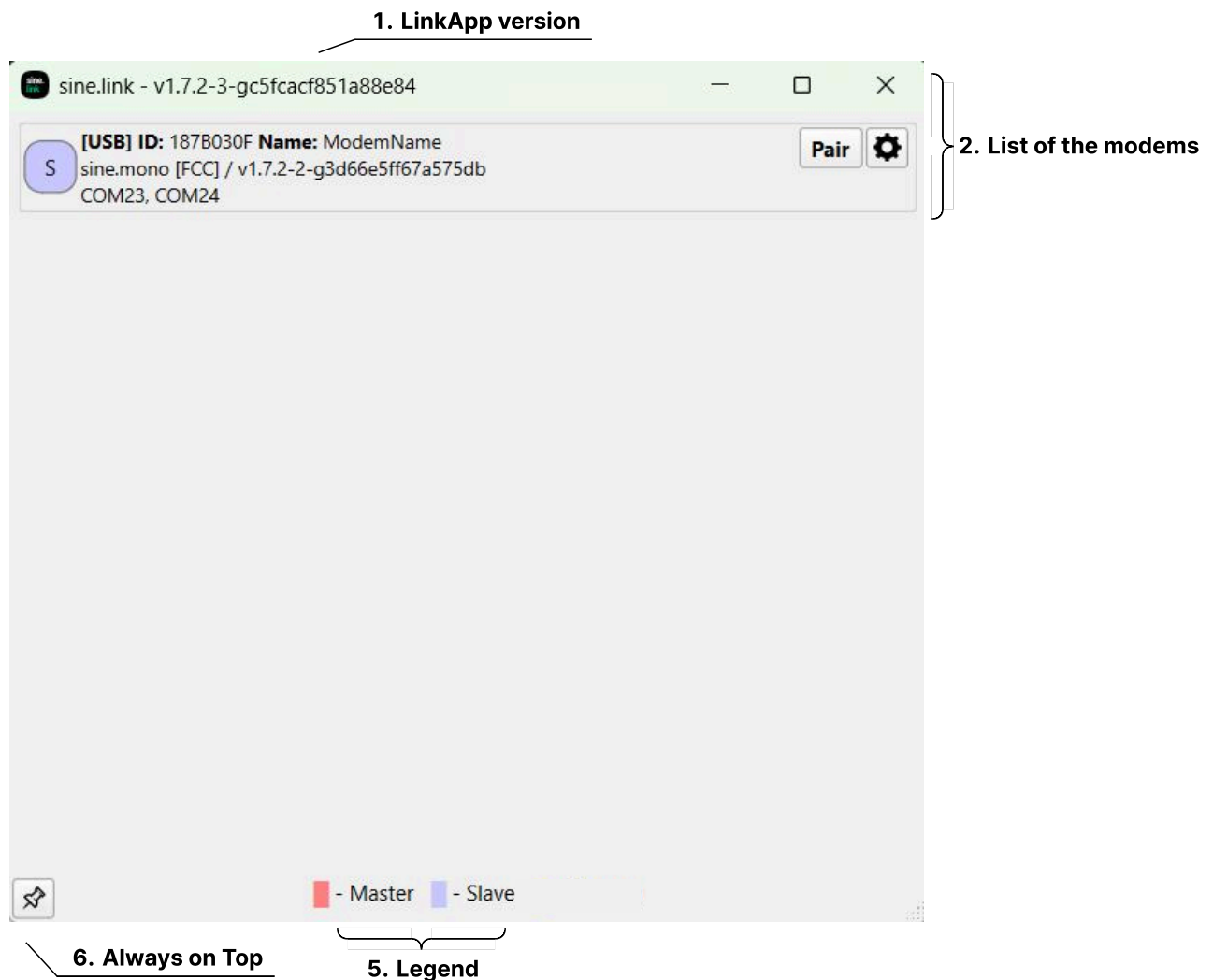


Figure 8. LinkApp window

LinkApp UI elements:

1. Application version.



The application version should always match the firmware version of the modems. Update older devices if their versions differ.

2. List of connected modems and operation options:

3. Modems colours: **Master** (red), **Slave** (blue).
4. **Always on Top**: allows to pin the **LinkApp** window above all other OS windows.

6.3 Modem roles

There are three operational roles of modems for flight systems:

- **Master** is a central control node with a configuration interface.
Can be applied in GSC or repeater.

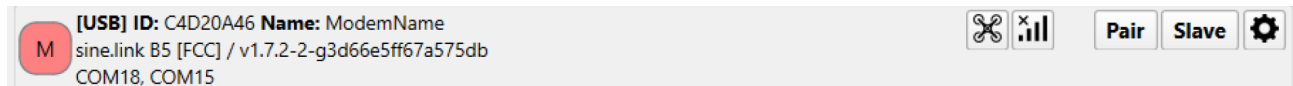


Figure 9. Master role

- **Slave** is a subordinate modem controlled by the **Master**.
Can be applied in UAV or repeater.

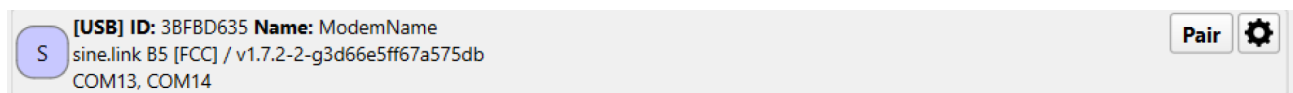


Figure 10. Slave role

6.4 Changing roles

Data link Sine.link mono: supports **Master** (red) and **Slave** (blue) roles.
The default role is **Master**.

Data link Sine.link mono: fixed role as **Slave**.

Methods for changing the role:

- **On the Software side:** ⚙️ > Role > Master/Slave > Save All.

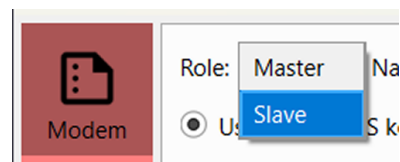


Figure 11. Changing the role

- **On the Hardware side:** Press the **RESET** button during pairing. The first modem in pairing mode becomes the **Master**.

i Applicable only to the data link Sine.link mono modems.

6.5 Unique ID and modem name

Each modem has a unique, unchangeable **ID** and user-defined **name** for identification in the interface. The modem name can be changed through software.

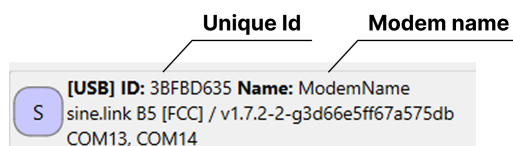


Figure 12. Unique ID and modem name

Naming rules: 1–23 characters (A–Z, a–z, 0–9, “–”, “_”, space). Changing the name of a paired modem requires re-pairing to update it in the list.

6.6 Pairing

The pairing methods are independent of the **AES key** type (Unique/PSK). More information about keys in Section 6.7.

During the pairing procedure, the system performs the exchange of **AES keys** and establishment of a connection.

Pairing methods:

- Through USB via **LinkApp**.
- Wireless pairing using the **RESET** button.
- Pairing during the power-up of the **Slave** modem.
- Pairing by cycling power (3 cycles).

The pairing methods are described below:

6.6.1 USB pairing

To pair modems using USB:

1. Connect both modems to the PC via the **USB** port.
2. **Pair** > select the **Slave** ID from the list.

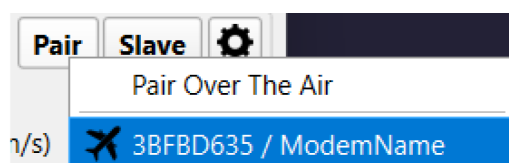


Figure 13. Pairing through the application

i Repeated pairing generates a new AES key.



During remote configuration of the **Slave** modem:

- It is impossible to perform **Reset** on the modem in the **Advanced** tab.

6.6.2 Wireless pairing



The physical **RESET** button on the **Slave** modem is disabled one minute after power-up.

Pairing procedure:

1. Power the first modem.
2. Activate pairing mode: hold down the **RESET** button for 3 seconds until all indicators flash dynamically. The modem is automatically assigned the **Master** role.
3. Alternatively: through **LinkApp**, select **Pair > Pair Over The Air**.
4. Power the second modem.
5. Activate pairing mode of the second modem using the **RESET** button (3 seconds). The modem is automatically assigned the **Slave** role.

6.6.3 Enter pairing mode on power up (only for Slave role)

Automatic entering of a non-paired **Slave** modem in the pairing mode within **3 seconds** after turning on. You can pair **Slave** with the **Master** via **Pair Over The Air** without physical access to **Slave**.

Available three options:

- **Don't allow**: prohibit automatic entry into the pairing mode.
- **Allow once**: allows one-time entry after turning on.
- **Always allow**: always allows automatic entry into the pairing mode.

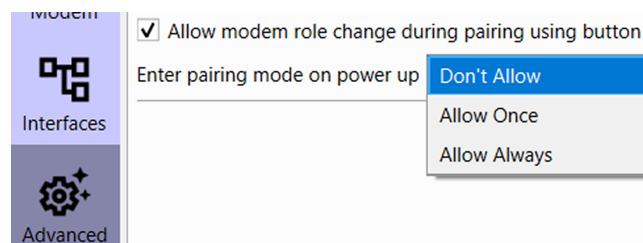


Figure 14. Enabling Enter pairing mode on power up (Slave)



Don't allow is set by default.

6.6.4 Wireless method (by cycling power)

i Only for **Slave** modems. Requires enabling Allow Pairing / Factory Reset using button function.

This method is intended for cases when the physical **RESET** button is not accessible. The pairing function is launched after three rapid power cycles.

Pairing procedure:

1. Switch the first (**Master**) modem into pairing mode using any of the methods:
 - Press and hold the **RESET** button for 3 seconds.
 - Use **Pair Over The Air** in **LinkApp**.
2. In 5 seconds, perform three cycles: disconnect the power for a second, then reconnect. The **Slave** modem will enter pairing mode.

i The cycle counter resets if the modem remains powered for more than 5 seconds. In this case, the procedure must be started again.

6.7 Types of keys: Unique Keys and Pre-Shared Key

Two methods of the AES encryption for pairing modems:

- **Unique Key** is an individual 128-bit AES key automatically generated for each **Master-Slave** pair during the pairing procedure. Provides maximum security and supports up to 32 **Slave** modems per one **Master**.
- **Pre-Shared Key (PSK)** is a standard 128-bit AES key that is used for the **Master** and a group of **Slave** modems simultaneously. Simplifies management of large networks (particularly when working with small UAVs) but reduces the level of security due to using one key for all connections.

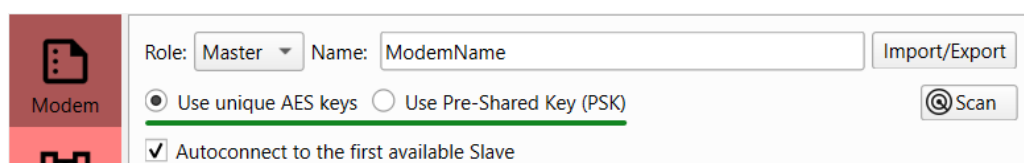


Figure 15. Key selection tab

6.7.1 Unique AES Key

Generation of an individual **AES-128 key** for each pair of **Master-Slave**. A maximum of **32 Slave modems** per one **Master**.

The option **Use unique AES keys** activates:

- **Autoconnect to the first available Slave**—automatic connection.
- A table of paired **Slave** modems.

The screenshot shows the 'Modem' configuration window. On the left, there is a sidebar with 'Modem' and 'Interfaces' tabs. The 'Modem' tab is active. The main area shows the following settings:

- Role: Master (dropdown)
- Name: ModemName (text field)
- Import/Export (button)
- Use unique AES keys (selected radio button) / Use Pre-Shared Key (PSK) (radio button)
- Scan (button with magnifying glass icon)
- Autoconnect to the first available Slave (checked checkbox)

Below these settings is a table with the following columns: Slave Names, Unique ID, AES KEY, and Online. The table is currently empty.

Figure 16. Clear key table

Saved data for each Slave: name, Unique ID, AES key, received frequencies. Displayed in the **Modem** tab (except for received frequencies).

The screenshot shows the 'Modem' configuration window with the same settings as Figure 16. The table below now contains two entries:

Slave Names	Unique ID	AES KEY	Online
ModemName	187B030F	B269FCE863FFE68380DA04B14FDEE8E6	
✓ ModemName	FA04B233	BCC3DA5567FF9E5F5536AFD60DE2898E	

Figure 17. Table of paired modems

6.7.2 Pre-Shared Key

Use of a single **AES-128 key** for all **Slave** modems. Simplifies the management of large numbers of modems.

Limitations:

- Lack of switching between **Slave** modems in real time.
- Reduced level of security compared to **Unique Keys**.

Settings:

1. **Master: Use Pre-Shared Key (PSK)** > generate/enter the key > **Save all**.
The format of the key: 32 symbols (0–9, A–F).

The screenshot shows the 'Modem' configuration window. The 'Role' is set to 'Master'. The 'Use Pre-Shared Key (PSK)' radio button is selected. A text field contains the generated key: A97DC61BA93C668DD9E28A637C274765. There is a 'Generate' button (circular arrow icon) to the right of the text field.

Figure 18. Pre-Shared key generated by Master

2. **Slave: Use Pre-Shared Key (PSK)** > enter the key > **Save all**.

The screenshot shows the 'Modem' configuration window. The 'Role' is set to 'Slave'. The 'Use Pre-Shared Key (PSK)' radio button is selected. A text field contains the key: A97DC61BA93C668DD9E28A637C274765. There is a 'Generate' button (circular arrow icon) to the right of the text field.

Figure 19. Pre-Shared key of a Slave modem

3. During the first setup with **PSK**, reconnect **Master** to establish connection.

6.7.3 Combined use of Unique Keys (Master) + PSK (Slave)

Hybrid configuration consists of **Master** with **Unique AES keys** + several **Slave** modems (one with a **Unique Key**, others with **PSK**). Allows the use of a single **Unique Key** across multiple **Slaves**.

Configuration steps:

1. **Master:** right-click on the AES key of **Master–Slave** pair > **Copy Slave**.

	Slave Names	Unique ID	AES KEY	Online	
✓	ModemName	FA04B233	0CADBDDED038CB8C052D64A6B5EDBAAB5		

Copy Slave

Figure 20. Copying a Slave key

2. Additional **Slave:** **Use Pre–Shared Key (PSK)** > paste copied key > **Save all**.



After being copied to another **Master**, a **Slave** may auto-pair while retaining the previous **Master** unique ID.

6.8 Checking the firmware version

i To update to firmware version 1.7.x, **the bootloader must be updated first.** After updating it, update the modem firmware.

If there is a mismatch between the firmware and **LinkApp** versions, the application will display a message prompting to update it to the correct version.

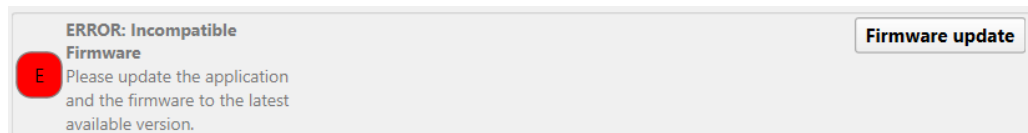


Figure 21. Firmware version error

Information about system components is located in **⚙️ > Firmware**.

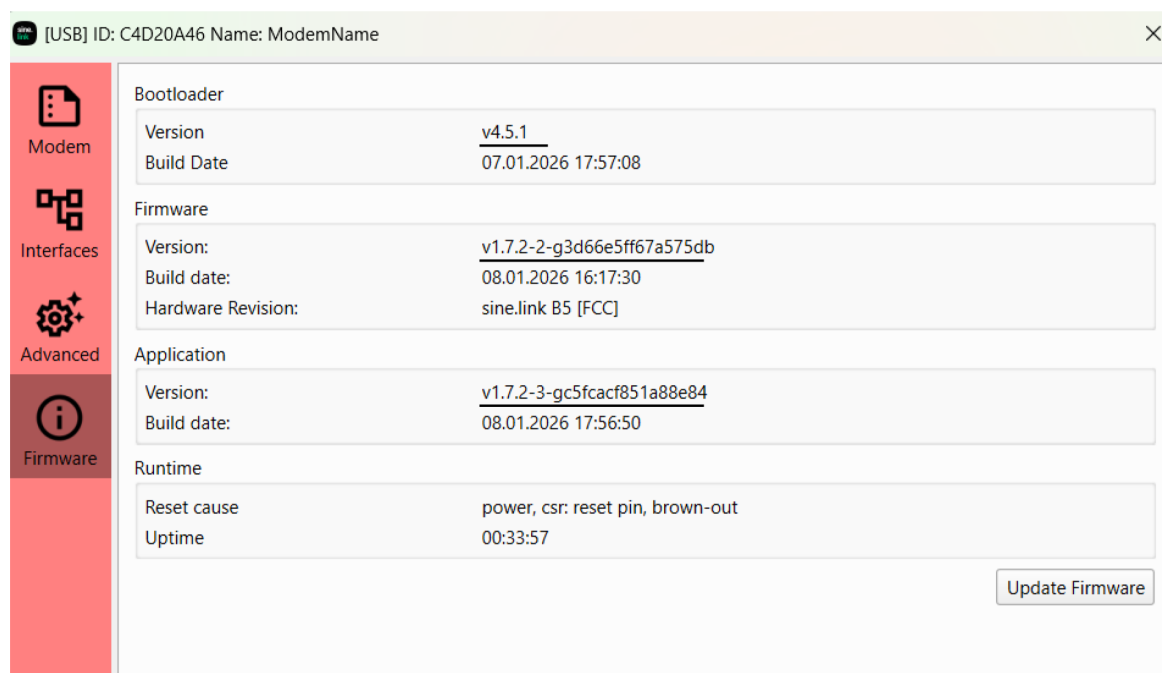


Figure 22. Firmware version in LinkApp

System components:

- **Bootloader** is the modem bootloader version.
- **Firmware** is the modem firmware.
- **Hardware revision** is board revision: **Sine.link**, **Sine.link mono**.
- **Application** is version of **LinkApp**.

6.9 Modem firmware update

For modem updates, use only official firmware files. The latest firmware and software are available in the official repository.

Important requirements for safe firmware update:

- Update both modems firmware and **LinkApp** to the same version.
- Update the **Bootloader** when a new bootloader version is released. A bootloader update is similar to a firmware update. After updating, install the corresponding modem firmware.
- **It is forbidden** to interrupt the update process or disconnect power until the firmware update is complete.
- If downgrading the firmware version, reset the modem before updating (prevents cyclic reboots).

6.10 Update via a USB port

There are two ways to enter update mode via a USB port:

- **Software method:** connect the modem to the PC via a USB cable.
In **LinkApp**, select **⚙️ > Firmware > Firmware update**.
- **Hardware method:** hold the **RESET** button and connect modem to the PC via the USB cable. A dynamic indication of the middle diode and the appearance of a USB drive within 30 seconds indicate successful connection.

Firmware upload:

1. Copy the **RadioLink.encbin** file from the archive to the USB drive.
2. Wait for the copying process to complete and for the drive window to disappear.

6.11 Modem recovery: Firmware installation/recovering

A dynamic middle LED indicates that the device is entering **Bootloader** mode. A possible reason is a lack of firmware or damage to it during the update. Firmware can be uploaded via USB.

Recovery procedure:

1. Connect the modem without firmware to the power supply.
2. Connect a modem with firmware to your PC via USB (regardless of its role).
3. Go to **LinkApp > ⚙️ > Firmware > Firmware update**.

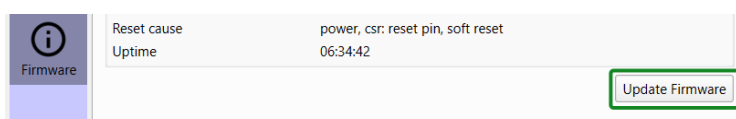


Figure 23. Firmware update button

6.12 Import/Export Modem configuration

Modems starting from version **1.7.x** support import and export of configuration parameters in the **.wire** format.

To access this feature, go to **Modem > Import/Export**:

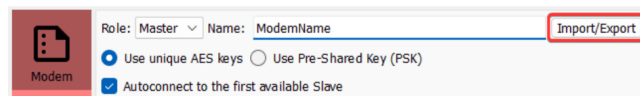


Figure 24. Import/Export configuration

After clicking, the following additional features will be available:

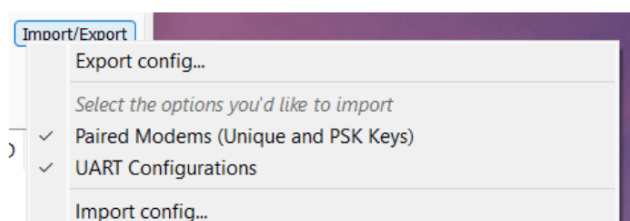


Figure 25. Import/Export options

- **Export config...:** saves the configuration to a file. Automatically created folder, **Sine.link**, is located in the home directory. Saved configurations are automatically displayed in the menu.
- **Import options:** select the parameters for loading (all selected by default):
 - **Paired Modems (Unique and PSK Keys):** import pairing keys and **PSK keys**. Uncheck to exclude.

 **Import overwrites all existing pairing and PSK keys.**

- **UART Configurations:** import UART port settings from the **Interfaces** tab.
- **Both checkboxes unchecked:** all settings except pairing keys and the **UART** configuration are imported.
- **Import config...:** loads the configuration from a file. Use after selecting import options.
- **Version control:** a warning appears if there is a discrepancy between the firmware version of the file and the modem.

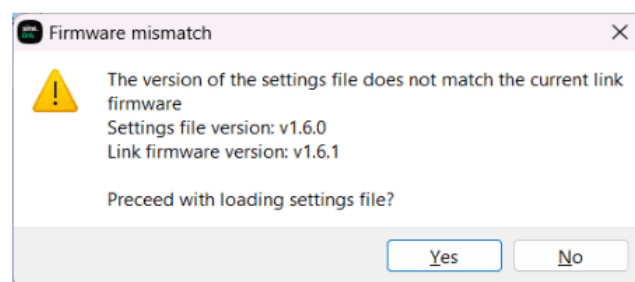


Figure 26. Warning about different firmware versions

Importing configuration between modems with different firmware versions:

- Compatible parameters are loaded automatically.
- Incompatible parameters are ignored when there are significant differences in firmware versions.

6.13 Reset settings

Reset to factory settings can be performed in one of the following ways:

- **Software reset:** in the modem settings, select **Advanced** > **Reset** at the bottom of the page.
- **Hardware reset:** hold the **RESET** button for **10 seconds** on a powered-on modem.
Indication: LEDs flash dynamically, then shine steadily (process complete).

7 Software configuration

7.1 Port mapping

Each modem has 3 physical connectors: 2 hardware UART ports (UART1, UART2) and one USB port, which provides two additional software **UART** interfaces (UART3, UART4). In total, there are 4 UART ports available for mapping. Port mapping **defines data transmission routes** between the Master and Slave modems.

Principle: ports with the same labels (**S1**, **S2**, **S3**, **S4**) form a single transmission channel.

Configuration examples:

- Go to  > **Interfaces**.
- Assign **MAVLink** to UART2 (Master) and UART1 (Slave), then in the dropdown list label both ports as **S1**.
- Assign **SBUS** to UART1 (Master) and UART2 (Slave), then label both ports as **S2**.

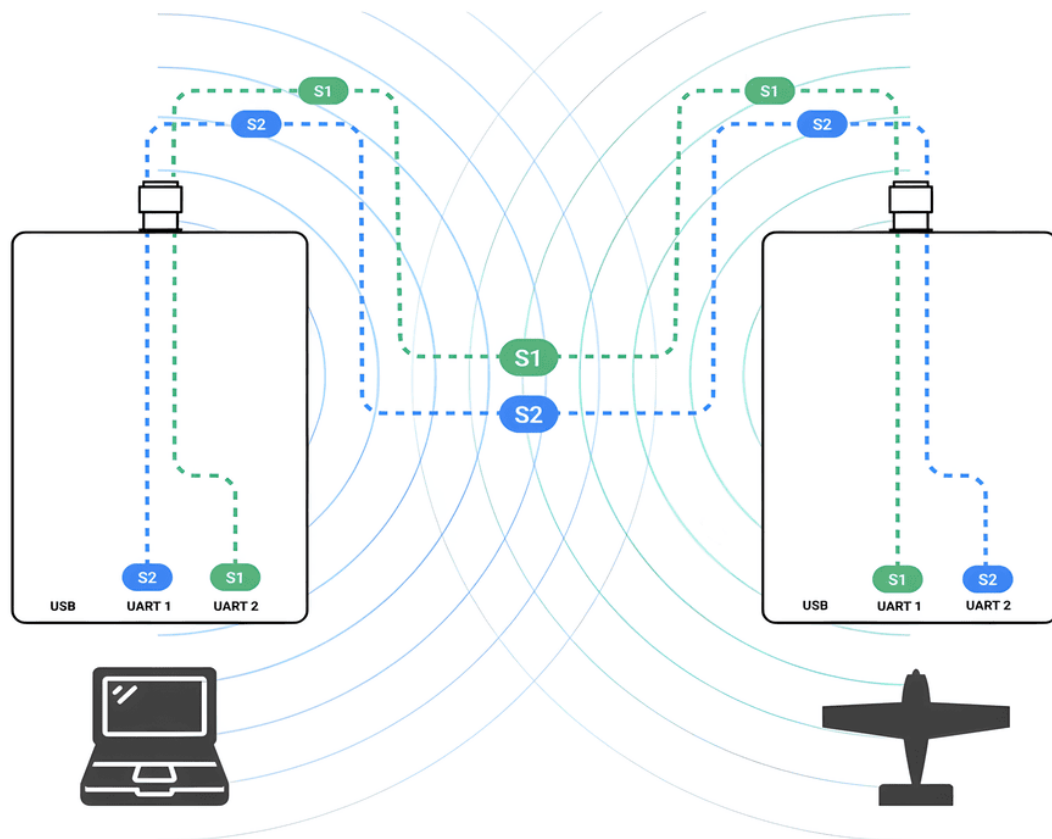


Figure 27. Port mapping scheme

 Correct mapping of UART ports is **critical** for the correct operation of modems.

7.1.1 RTS/CTS, Booster, VBAT

- **RTS/CTS (Flow Control)** is hardware flow control of data used to prevent packet loss. Connection: RTS > CTS, CTS > RTS (crossed).



Available only for the **MAVLink** and **RAW** protocols. Not used for **SBUS** and **CRSF**.

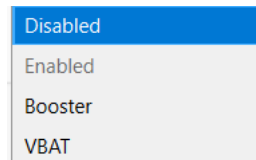


Figure 28. RTS/CTS

Activation in the flight controller (ArduPilot): **BRD_SERx_RTSCS = 1**.



Flow Control support depends on the controller model. Refer to the official documentation.

- **Booster** is mode of compatibility with a bidirectional amplifier **Booster**. The amplifier is intended to increase the range of operation and resistance to electronic warfare (EW) systems.



Please contact the manufacturer for information about **Booster**.

- **VBAT** is mode for correct battery charge display when using a **DC–DC converter**.

7.1.2 Swap RX/TX

Software function that switches the RX/TX pins to fix wrong connections.

Standard connection: modem RX > controller TX, modem TX > controller RX.

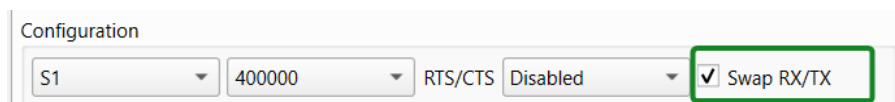


Figure 29. Swap RX/TX

Diagnostics of transmission problems:

1. Activate **Swap RX/TX** on the **Master** modem.
2. Deactivate **Swap RX/TX** on the **Master**, activate them on the **Slave**.
3. Check the integrity of physical UART connections.
4. Activate **Swap RX/TX** on both modems.



This is a critical function for establishing communication. If no data transmission occurs, start diagnostics with this function.

7.2 CRSF protocol

CRSF (Crossfire Serial Protocol) is a digital two-way protocol for exchanging control commands and telemetry via **UART**. Provides low latency and stable communication. Supported on **UART1/UART2** ports. The system provides full telemetry (similar to TBS Crossfire/ExpressLRS).

Number of control channels: 16.

7.2.1 Setting up the transmitter (radio equipment)

Connecting the **Master** modem to the Radiomaster TX16s radio transmitter:

- GND-pin (fourth pin) > GND of the modem.
- S_Port-pin (fifth pin) > Tx-pin of modem.

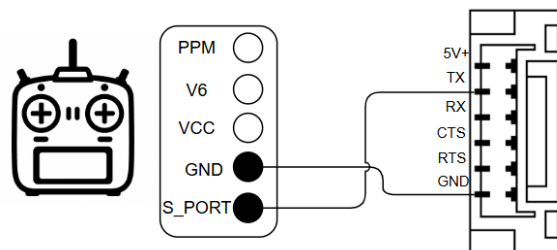


Figure 30. Example of connection to a transmitter using the Radiomaster TX16s and CRSF protocol

In the transmitter settings:

1. Disable the **Internal module**.
2. Enable the **External module**.
3. Select **CRSF**.
4. Set the baud rate to **400 000** in the controller settings and in the **LinkApp** UART settings.

7.2.2 Power output according to the CRSF protocol

The **CRSF** protocol limits power values to a fixed set: 0, 10, 25, 50, 100, 500, 1000, 2000 mW. Actual values of **data links Sine.link/mono** are rounded to the nearest CRSF value on OSD. Example: 1 mW > 0 mW, 20 mW > 25 mW.

More details in [CRSF protocol documentation](#).

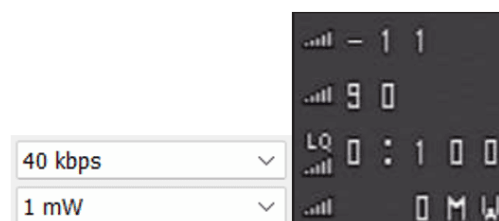


Figure 31. Power output according to the CRSF protocol

7.2.3 Sine.link/mono module setup

CRSF requirements:

- Master: **Data link Sine.link mono.**
- Slave: **Data links Sine.link/mono.**

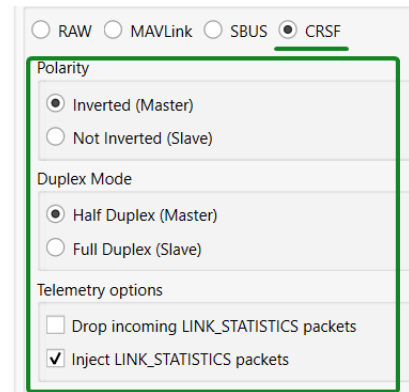
Procedure for setting up modems:

Master:

- Map the selected **UART1** or **UART2** port.
- Select **CRSF** protocol.
- Set speed to **400 000** (same as on transmitter).
- Polarity—Inverted (Master).
- Duplex mode—Half Duplex (Master).
- Telemetry options: **Inject LINK_STATISTICS** packets is selected.

Slave:

- Map the selected **UART1** or **UART2** port.
- Select **CRSF** protocol.
- Set speed to **416 700**.
- Polarity—Not Inverted (Slave).
- Duplex mode—Full Duplex (Slave).
- Telemetry options: **Inject LINK_STATISTICS** packets is selected.



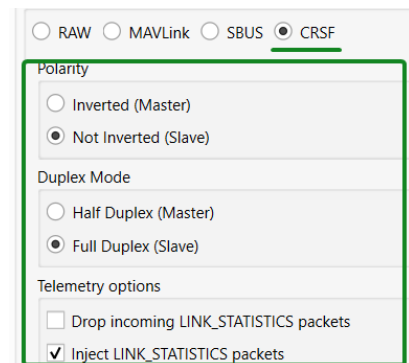
☐ RAW ☐ MAVLink ☐ SBUS ☒ CRSF

Polarity
☒ Inverted (Master)
☐ Not Inverted (Slave)

Duplex Mode
☒ Half Duplex (Master)
☐ Full Duplex (Slave)

Telemetry options
☐ Drop incoming LINK_STATISTICS packets
☒ Inject LINK_STATISTICS packets

Figure 32. Master setup



☐ RAW ☐ MAVLink ☐ SBUS ☒ CRSF

Polarity
☐ Inverted (Master)
☒ Not Inverted (Slave)

Duplex Mode
☐ Half Duplex (Master)
☒ Full Duplex (Slave)

Telemetry options
☐ Drop incoming LINK_STATISTICS packets
☒ Inject LINK_STATISTICS packets

Figure 33. Slave setup

7.3 SBUS protocol

SBUS (Serial Bus) is a digital protocol for transmitting 16 control channels over one line. Protocol characteristics:

- Transmission speed: 100 000.
- Latency: ~20 ms.

7.3.1 Radio transmitter setup

Connecting the Master modem to the Radiomaster TX16s transmitter:

- PPM pin (first pin) > Rx pin of the modem.
- GND pin (fourth pin) > GND of the modem.

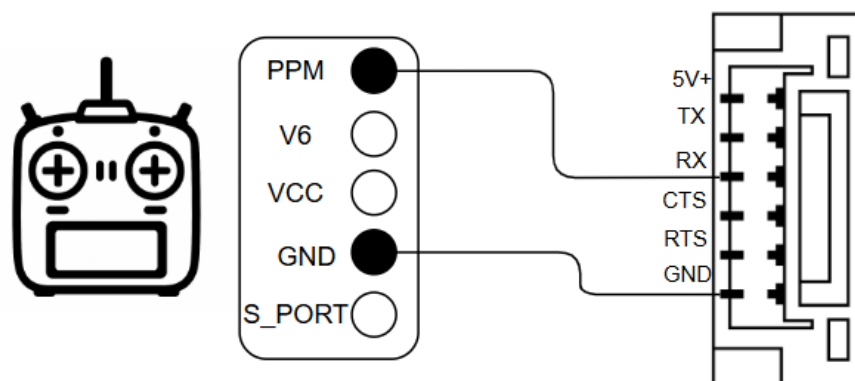


Figure 34. Example of connection to transmitter using Radiomaster TX16s for SBUS protocol

In transmitter settings:

1. Disable the **Internal module**.
2. Enable the **External module**.
3. Select **SBUS** protocol.
4. Set transmission speed: **100 000**.
5. Choose signal polarity: **Inverted (Normal)** or **Non Inverted**. Standard RC transmitters use **Inverted**.

Example configuration:

- Master
 - UART 1: **S1**; Baudrate: **100 000**; Protocol: **SBUS**.
 - UART 3 (USB): **S2**; Protocol: **MAVLink** (for telemetry).
- Slave
 - UART 1: **S1**; Baudrate: **100 000**; Protocol: **SBUS**.
 - UART 2: **S2**; Protocol: **MAVLink**.

Configuration for **ArduPilot**:

- **BRD_ALT_CONFIG**=1: convert the RX of selected SERIALx to SBUS input (RCIN).
- SBUS port (SERIALx): **SERIALx_PROTOCOL**=23.
- **SERIALx_OPTIONS**=3.
- **SERIALx_BAUD**=100 (Matek H743).
- Disable Flow control: **BRD_SER1_RTSCTS**=0.

7.4 MAVLink protocol

MAVLink (Micro Air Vehicle Link) is a bidirectional data exchange protocol between UAVs and ground stations. It transmits telemetry and control commands via UART, UDP/TCP interfaces. The foundation of PX4/ArduPilot systems with structured messages and checksums.

7.4.1 MAVLink configuration in LinkApp

MAVLink configuration:

1. Select **MAVLink** protocol for UART.
2. Enable **RTS/CTS (Flow control)** on both modems to prevent packet loss.
See Section 7.1.1 for more details.
3. Enable **Inject RADIO_STATUS frames** for compatibility with **Mission Planner** and **QGroundControl**.

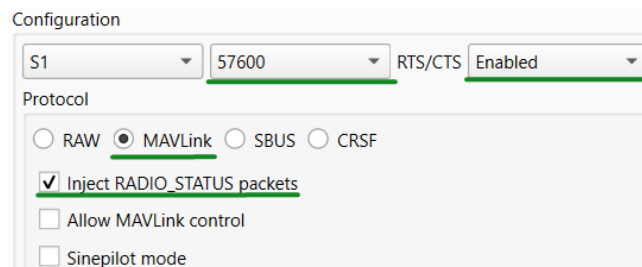


Figure 35. MAVLink configuration in the LinkApp



Some options, such as **Flow control (RTS/CTS)**, may be unavailable for UART3 and UART4 ports since they are implemented at the USB protocol level.

Configuration for **ArduPilot**:

- For telemetry port:
 - **SERIALx_PROTOCOL**=2 (MAVLink2),
 - **SERIALx_BAUD**=57 or 115.
- Enable flow control: **BRD_SERx_RTSCTS**=1.

7.4.2 Controlling the modem via MAVLink (MAVLink Control)

If the Master modem is connected to a PC through a UART port (via USB-UART/TTL converter), controlling the modems and changing their settings in **LinkApp** becomes impossible, unlike when connected via USB. To control the modems, use one of the services that distribute MAVLink packets between different software that need to accept or transmit them. Recommended solutions are **MAVP2P** (Windows), **MAVLink Router** (Linux) and plugins for **MissionPlanner/QGroundControl**.

i Plugins for **MissionPlanner/QGroundControl** can be used as an alternative to **MAVLink Router** and **MAVP2P**. Plugins are located in the official repository.

UART configuration: separate ports for controlling MAVLink and telemetry, or a single shared port for both functions. The SDK is available for integrating into your own software. Contact the manufacturer for details.

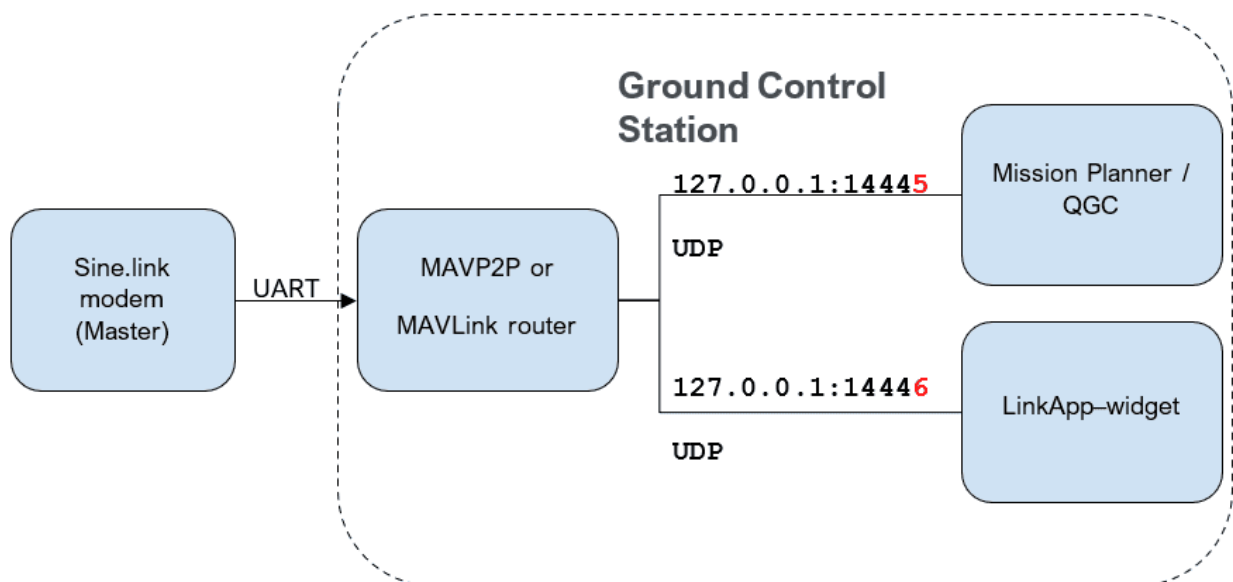


Figure 36. Scheme for modem control via MAVLink



After changing the modem role, applications receive the updated role designation using the **MAVLink** protocol. To ensure that **LinkApp** displays the correct role, restart **LinkApp**.

To activate modem control via MAVLink, select the **Allow MAVLink control** option in the MAVLink settings on **Master**.

Figure 37. Select the Allow MAVLink control option

8 Warranty Statement

Limited Warranty (12 months). *Sine Advanced Engineering, Inc.* warrants that *Data link Sine.link mono (Sine.link)* will be free from defects in materials and workmanship under normal use for 12 months from the date of purchase by the original end-user purchaser in *Big Sky, MT 59716*. If a defect arises and a valid claim is received within the warranty period, *Sine Advanced Engineering, Inc.* will, at its option, (*choose one:*) (A) repair the product using new or refurbished parts; or (B) repair or replace the product with a new or refurbished product of equal or greater functionality. Proof of purchase and the product serial number may be required. This warranty does not cover damage resulting from misuse, accident, unauthorized modification, improper installation, or service by non-authorized personnel. To obtain warranty service, contact docs@sineeng.com or visit <https://sineeng.com>.

State law notice. This warranty gives you specific legal rights, and you may also have other rights that vary by state.

9 Troubleshooting

Table 5 lists the most common issues, their possible causes, and recommended actions.

Table 5. Troubleshooting guide

Issue	Recommended action
No communication	Check antenna connections and power supply.
Poor signal quality	Verify antenna positioning and check for interference sources.
Configuration issues	Reset to factory defaults and reconfigure according to the manual.
Hardware failure	Contact manufacturer — do not attempt self-repair.

9.1 Configuration Verification

After setup, perform the following steps

- Test **data links Sine.link & Sine.link mono** between paired devices.
- Check signal strength indicators.
- Verify data transmission integrity.
- Verify all LED status indicators show normal operation.
- Test the paired devices at the maximum intended operating distance.

10 Revision history

Revision	Date	Description
1.0.0	01/12/26	Initial release.