RF-310

Detects, classifies, and locates drones and their remote controls and communicates directly to the cloud or local network.

ENGLISH

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Content

1 Safety

1.1 Symbols

Symbol	Explanation
NOTICE	Indicates a situation which, if not avoided, can result in property damage
ⓘ	Information that is important for a specific goal, but is not safety-relevant
☐	Indicates a requirement for meeting a specific goal
✔	Desired result
⊗	A problem that might occur
🔧	Action to resolve a problem

1.2 Intended Use

The RF-310 is a passive, network-attached sensor for the detection and direction finding of radio frequencies (RF) and Wi-Fi signals. The RF-310 detects targeted radio signals, classifies them, and identifies their direction. Combined with two or more Dedrone RF sensors, it can determine the position of a drone and remote controls by the RF signals. The RF-310 sends the data and an alert via LAN connection to the DedroneTracker System.

The RF-310 is intended for civil, commercial, and private use in conjunction with a DedroneTracker System. The RF-310 is suitable for outdoor use.

Use this product only in accordance with the information provided in the enclosed documentation and with the locally applicable legal standards and directives. Any other application may cause personal injury or property damage.
Any use of the product other than that described in the intended use section does not qualify as appropriate. The enclosed documentation is an integral part of this product. Keep the documentation in a convenient place for future reference and observe all instructions therein.

The type label must remain permanently attached to the product.

Compliance Information Statement FCC and IC

The RF-Sensor RF-310 complies with Industry Canada license-exempt RSS standard(s) and complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

Note: 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.

Modifications: Any modifications made to this device that are not approved by Dedrone Holdings Inc. may void the authority granted to the user by the FCC to operate this equipment.

⚠️ **Caution!**
To prevent permanent exposure, the device should be installed and operated with a minimum distance of 20 cm (7.87 in) between the device and your body.

1.3 Safety Information

Read, follow and retain all of the following safety instructions. Heed all warnings on the unit and in the operating instructions before operation.

Warning! Setup should be carried out by trained personnel only, in accordance with the national electric code, ANSI/NSPA, and all local country codes.

Do not attempt to service this device yourself. Refer all servicing to qualified service personnel. This device has no user-serviceable internal parts. Whenever any damage to the device has occurred, unplug the devices from the power source by disconnecting the patch cable and refer servicing to qualified service personnel. Such damages can be:
- the patch cable is damaged
- an object has fallen on the device
- the device has been dropped, or its enclosure has been damaged
- the device does not operate normally when the user follows the operating instructions correctly

Adjust only those controls specified in the operating instructions. Improper adjustment of other controls may cause damage to the unit.

Despite careful construction, electrical devices can cause fires. Do not mount the RF-310 in areas containing highly flammable materials or gases. Do not mount the RF-310 in a potentially explosive atmosphere.

Do not install product near any heat sources such as radiators, heaters, exhaust air systems or other equipment (including amplifiers) that produce heat.

2 The RF-310

The RF-310 is a passive, network-attached sensor for the detection and direction finding of radio frequencies (RF) and Wi-Fi signals. The RF-310 detects targeted radio signals, classifies them and identifies their direction. In combination with two or more Dedrone RF sensors it is able to determine the position of a drone and remote controls by the RF signals. the RF-310 sends the data, along with an alert via LAN connection to the DedroneTracker System.
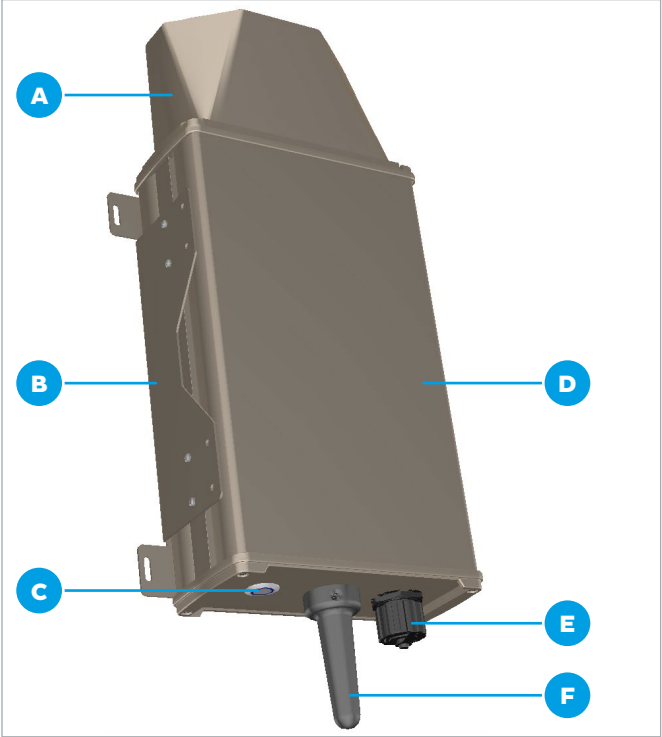
A	Antenna cover
B	Universal mount
C	Activation button
D	RF-310
E	Network socket
F	Antenna cover

It scans a wide frequency band for radio frequencies and classifies them. The data is recorded and available on the user interface DedroneTracker UI.

3 Unpacking

This equipment should be unpacked and handled with care. Check the exterior of the packaging for visible damage. If an item appears to have been damaged in shipment, notify the shipper immediately.

4 Scope of Delivery

Verify that all the parts listed in the scope of delivery are included. If any items are missing, notify your Dedrone Partner.

Do not use this product if any component appears to be damaged. Please contact Dedrone in the event of damaged goods.

1 x RF-310

1 x RF pole mount (preassembled)

4 x Strap

1x Outdoor ethernet cable, 32 ft (10 m)

1x Bag with the 5 parts of the outdoor housing for prewired RJ45 cordset and a quick manual

1x Installation manual

1x Safety information

1x Product registration document (this information is only needed for a cloud based sensor operation
and is provided by an enclosed document or online by the Dedrone Service)

The original packing carton is the safest container in which to transport the unit and must be used if returning
the unit for service. Save it for possible future use.

5 Select the Mounting Place

5.1 Mounting Location

The position of the RF-310 has strong impact to the detection range. The RF-310 is intended for an installation
on top of a pole. Make sure that a suitable pole is available (diameter from 1.5" (38 mm)).

The detection is the precondition for the direction finding.

5.1.1 Detection Conditions

For ideal results the location should fulfill the following conditions:

☐ **Clear view over the area**

☐ **Exposed, elevated position: 10 ft (3 m) minimum, 33 ft (10 m) recommended**

Do not install the device nearby the following objects:

- **Metal surfaces or coated glass**
  Disturbs the detection and prevents the localization.

- **Walls**
  These shade the detection area and prevent classification of signals behind the wall.

- **Base station and other strong signal sources**
  The detected signals are getting interfered.

- **Any excessive heat sources**

- **Any overhead power lines, power circuits, high-voltage lines or electrical lights**
  Electrical discharge can damage the device.

Select a secure installation location and mounting position for the device. Ideally, this is a location where the
device cannot be interfered with, either intentionally or accidentally.

> ⓘ   **Note the properties of each RF-310**. This is needed for the correct configuration and for
> service.
>
> We recommend the table in the appendix. The following information is important:
>
> - Serial Number
>
> - GPS position (longitude and latitude)
>
> - Horizontal angle

5.1.2 Direction Finding and Localization Conditions

For accurate localization results, follow the guidance below in addition to the Detection Conditions (see chapter 5.1.1 Detection Conditions, page 7).

The position is determined by the intersection of at least two bearings. Therefore minimum two RF-310 sensors are
required for localization, but we recommend at least three RF-310 sensors as this significantly reduces localization errors.

For best localization results, all RF-310 sensor should be installed at the same height.

Position of the sensors to each other

To localize a drone an intersection of the bearings from at least two sensors is needed.
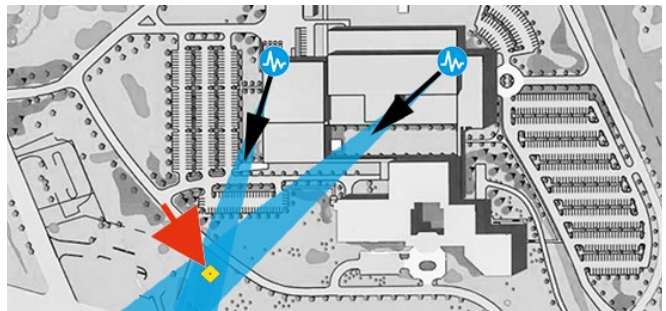
Localization is not possible in the case where two RF-310s are aligned.

This is the blind area of two sensors.

Both RF-310s detects a direction in alignment to the left. The overlapping area covers the complete bearing of the other RF-310. The position can't be determined.
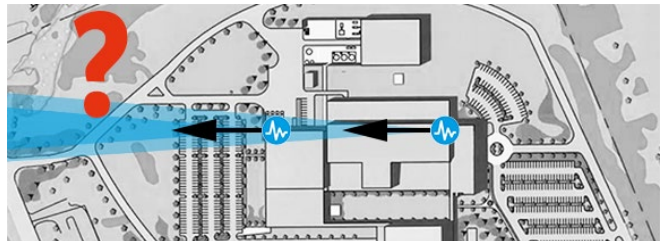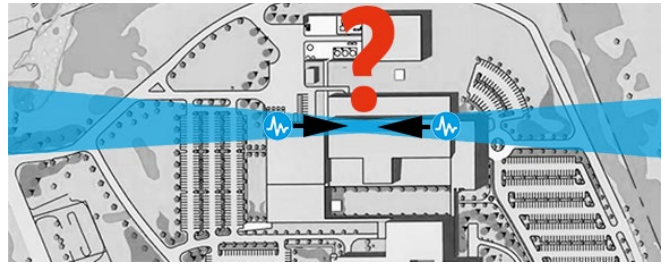

Both RF-310s detect a direction in alignment to the right. The overlapping area covers the complete bearing of the other RF-310. The position can't be determind.
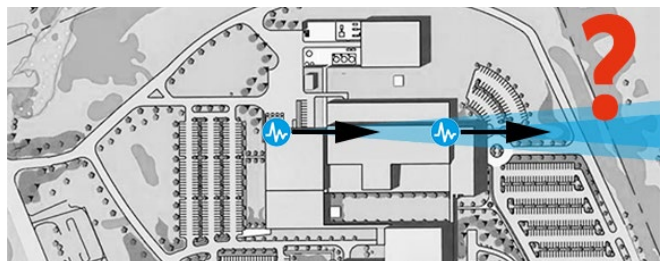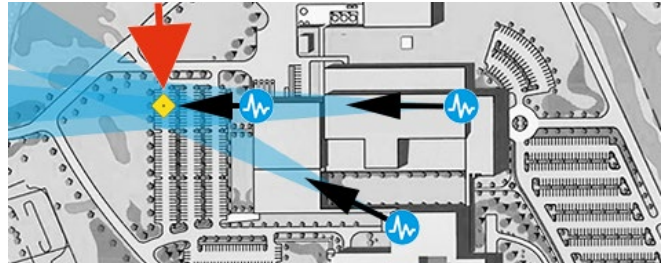
❌ Both RF-310s detect a direction against each other. No exact position can be determined.
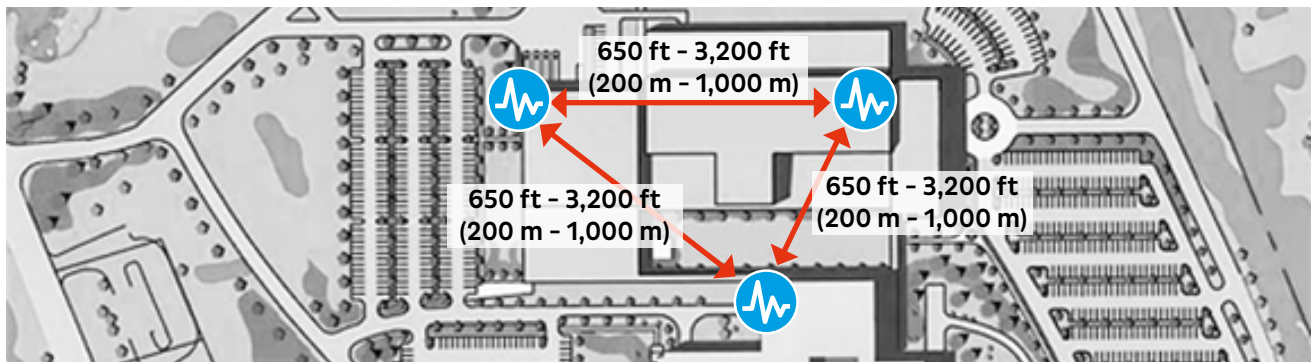

✅ With three RF-310s there is no blind area. The third RF-310s can always verify the area of intersection.

Distances between the RF-310s

The distance between the RF-310 usually should be 650 ft to 3,200 ft (200 m to 1,000 m).

650 ft – 3,200 ft
(200 m – 1,000 m)

650 ft – 3,200 ft
(200 m – 1,000 m)

650 ft – 3,200 ft
(200 m – 1,000 m)

Distance between the RF-310s

☐ For the best result, Dedrone strongly recommends a distance of **1,650 ft to 2,600 ft (500 m to 800 m)**.
☐ Choose the position depending on your monitoring focus. Increase the distance between the sensors to increase the accuracy at further distances.
☐ Localization accuracy increases as the drone gets closer to the sensors.
☐ For large installations with sensor distances of more than 3,200 ft (1,000 m) to each other a special sensor configuration in the DedroneTracker user interface is necessary. Please contact the Dedrone Support.

## 5.2 Mounting Location

Mounting Surface

- Make sure the selected mounting surface is capable of supporting the combined weight of the RF-310 (12.4 lb (5.6 kg)) and the pole under all expected conditions of load, vibration, and temperature.

Mounting Orientation

- Important for a good result is the vertical alignment of the device. Do not tilt the device.

5.3 Overvoltage Protection

For safe mounting in an exposed position overvoltage protection must be observed. Ensure that the mast is connected to the lightning conductor of the building and there is a metallic contact between the mast mount and the mast. The lightning conductor must be installed at least 1.5 m above the RF–310.
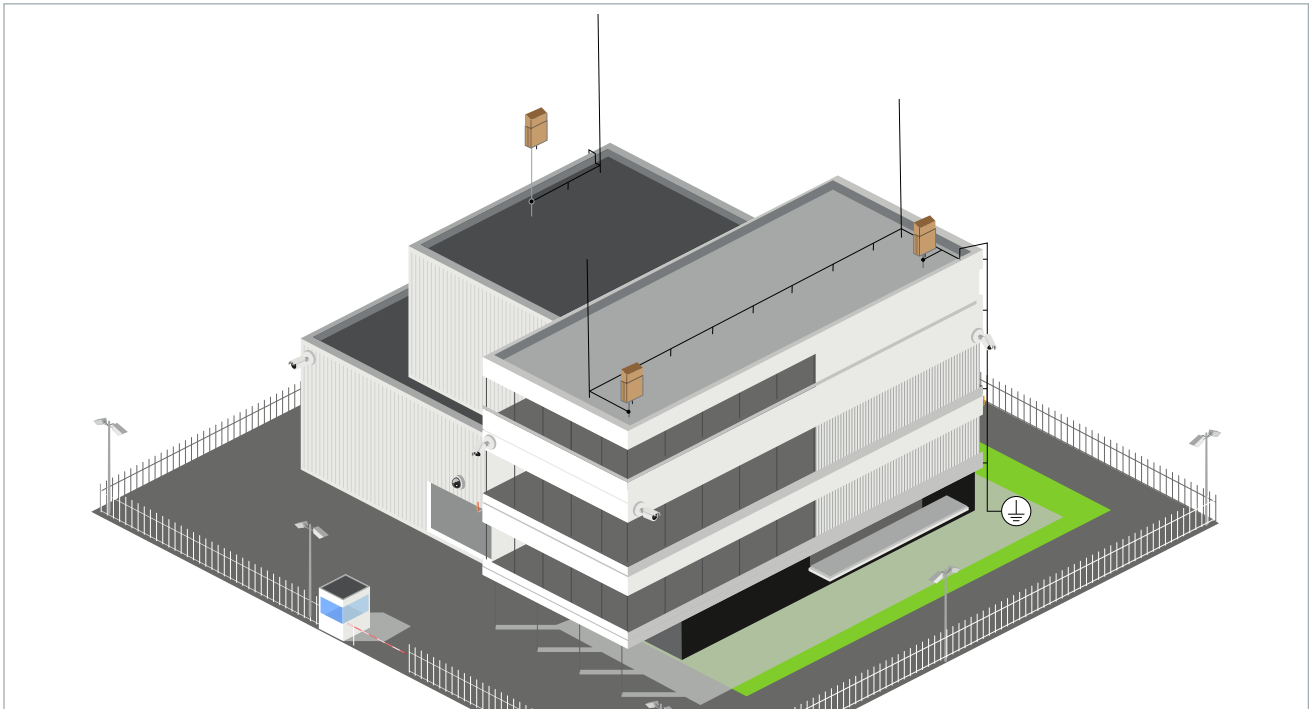
Lightning Protection Installation with RF–310s

Ensure that the location has the appropriate clearance from power and lightning conductors, in accordance with NEC725 and NEC800 (CEC Rule 16-224 and CEC Section 60 and Section 810 of the National Electrical Code, ANSI/NFPA No.70).

6 Installation

6.1 Power Supply

The RF–310 does not need any additional power supply connection. The power supply is provided by the connected switch with activated active PoE IEEE 802.3bt (60 W).

☐   Make sure, that your network has activated active PoE IEEE 802.3bt (60 W).

Note: Data transfer is only possible with a suitable PoE switch.

6.2 Required Tools

☐   Socket wrench: 7 mm ($^9/_{32}$")
☐   Screwdriver Torx TX20
☐   Crimping tool
     For an environmentally sealed connection to the RF–310, it's necessary to crimp the supplied connector to the laid patch cable (see chapter 6.4 Cable Preparation, page 11).
☐   Ladder or lift truck, depending on the mounting location
☐   For wall mount: Drilling machine, screwdriver, suitable screws, and washer
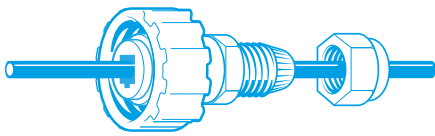☐   **Recommendation:** GPS device

6.3 Cable Requirements

Type	Cat-6 Patch Cable Recommendation: **Cat-7 Patch Cable**
Maximum Length	328 ft (100 m) For longer distances a PoE extender is required
External Diameter	3.5 mm – 7.5 mm

6.4 Cable Preparation

For a weather resistant connection to the RF-310, it is necessary to crimp the supplied environmentally sealed Ethernet connector to the patch cable.

Procedure:

1	Cut the RJ45 plug off the laid cable. Keep the cut off plug, to check the wiring standard later.
2	Screw the gland off the connector body.
3	Thread the gland nut and the connector body onto the cable.
4	Remove the cable jacket carefully. Therefore take care not to damage the braid and foil.
5	Fold back the braid and foil over the cable jacket. Note: 25 mm (1") of free conductors are needed.
6	Unravel the conductors, sort the conductors in the required wiring standard (568-A or 568-B), and push the conductors all the way in the plug. The required wiring standard can be checked on the previous cut-off RJ45 plug.
7	Crimp the RJ45 plug with the crimping tool.
8	Push down the latching clip of the plug and press the connector body all the way to the stop over the RJ45 plug.
9	Put the gland nut over the connector body and screw down the gland nut on the connector body.

Table in step 6:

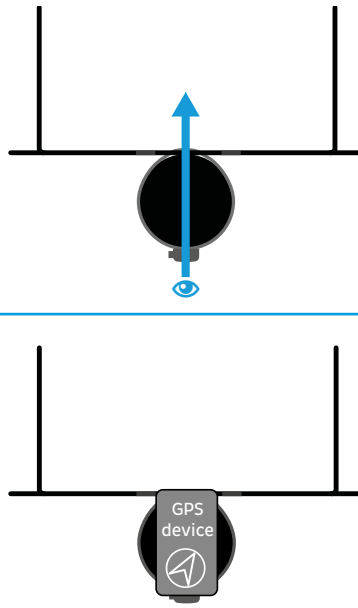| Position	**568-A**	**568-B**
1	White/Green	White/Orange
2	Green	Orange
3	White/Orange	White/Green
4	Blue	Blue
5	White/Blue	White/Blue
6	Orange	Green
7	White/Brown	White/Brown
8	Brown	Brown

Front face view

6.5 Mount sensor

The RF-310 can be mounted on all poles from 1.5" (38 mm) thick or on walls. Mounting differs depending on the thickness of the mast and wall mounting.
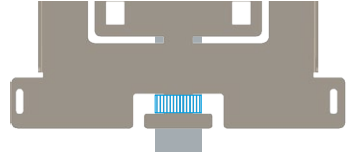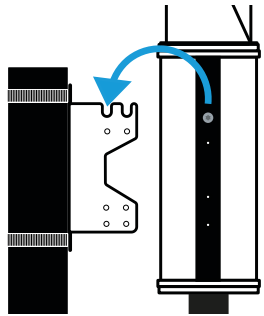
6.5.1 Mount sensor on a thin pole (1.5" to 3")

Requirements:

☐   Desired mounting place fulfills the requirements (see chapter 5 Select the Mounting Place, page 7).

☐   Diameter of the pole: 1.5" to 3" (38 mm to 75 mm)

Procdure:

1	Unscrew the six lower screws (TX20) on both sides and unhook the sensor out of the mount.
2	Lay a strap around the pole and close it to a loose ring. Therefore put the strap in the slash under the screw and tighten it with the socket wrench 7 mm ($^9/_{32}$"). The strap-ring hangs loosen at the pole.
3	Hook the T-lash of the mount in the strap.
4	ⓘ **An accurate alignment of the sensor is a prerequisite for a good direction finding result.** Most critical is the configuration of the GPS position and the horizontal angle of each RF-310. If the installation and configuration are not accurate, the direction finding could be strongly divergent. There are two ways to align the sensor accurately:
4a	Align the sensor by a landmark: • Choose a prominent landmark in the area which is visible (corner of a building, etc.). • Look over the pole and RF-310 and align the sensor to the prominent landmark. This is necessary for the correct orientation of the sensor in the sitemap of the DedroneTracker UI (see chapter 7.2 Connect and Configure the RF-310 to your Dedrone Cloud, page 18).
4b	Align the sensor with a GPS device or compass: • Place the GPS device or compass on the RF-310 and check the orientation of the RF-310. • Read the GPS position in degrees (for example, "52.516295" and "13.377653"). • Find the horizontal angle (azimuth) in degrees (0 = north, 90 = east, 180 = south, 270 = west). • Note the values in the table (see chapter 11 Appendix, page 21).

5	Tighten the strap accordingly to fix the mount.
6	Lay a second straps around the pole below the sensor and close it to a loosen ring. Therefore put the strap in the slash under the screw and tighten it with the socket wrench 7 mm ($^9/_{32}$ ") . ✔ The strap-ring hangs loosen at the pole.
7	Hook the strap into the lower T lash and tighten the strap accordingly.
8	Hook the sensor in the lower position of the mount and fix it with the six screws in the lower position to the mount.
9	Make sure that the pole is grounded (see chapter 5.3 Overvoltage Protection, page 10).
10	Connect the patch cable to the RF-310 and turn the connector gland until it is locked (for a correct cable preparation see 6.4 Cable Preparation, page 11). ✔ If the patch cable is connected to the network, the RF-310 boots automatically and after approximately 10 second the blue button at the RF-310 illuminates, indicating that the hardware is ready. ✖ The patch cable is connected to the network and the RF-310 does not boot automatically after approximately 15 seconds? 🔧 Push the blue button and wait for it to illuminate. 🔧 Make sure that **active PoE+ (802.3bt)** is activated in your network.

6.5.2 Mount sensor on a thick pole (from 3")

Requirements:

☐ Desired mounting place fulfills the requirements (see chapter 5 Select the Mounting Place, page 7).

☐ Diameter of the pole: 3" (75 mm) and thicker

Procdure:

1	Unscrew the six lower screws (TX20) on both sides and unhook the sensor out of the mount.	
2	Hold the mount to the pole and bend the inner lashes to it, so they lie flat on it.	
3	Run straps through both slashes of the mount and around the pole. Do not tighten the straps too much so that the mount can still be aligned.	
4	ⓘ **An accurate alignment of the sensor is a prerequisite for a good direction finding result.** Most critical is the configuration of the GPS position and the horizontal angle of each RF‑310. If the installation and configuration are not accurate, the direction finding could be strongly divergent. There are two ways to align the sensor accurately:	
4a	Align the sensor by a landmark: • Choose a prominent landmark in the area which is visible (corner of a building, etc.). • Look over the pole and RF‑310 and align the sensor to the prominent landmark. This is necessary for the correct orientation of the sensor in the sitemap of the DedroneTracker UI (see chapter 7.2 Connect and Configure the RF‑310 to your Dedrone Cloud, page 18).	

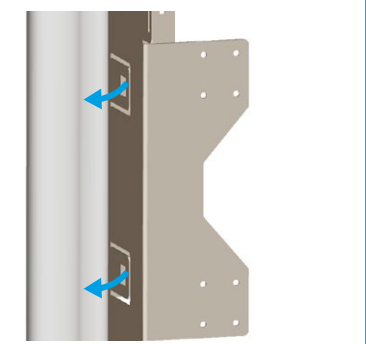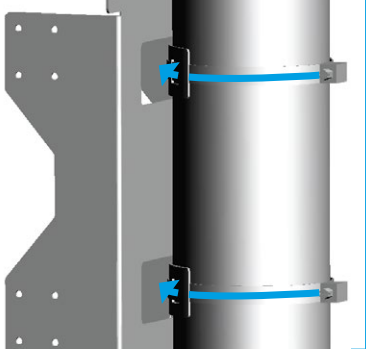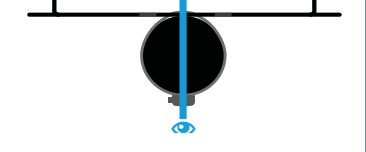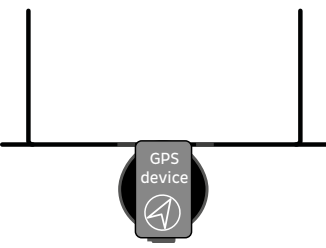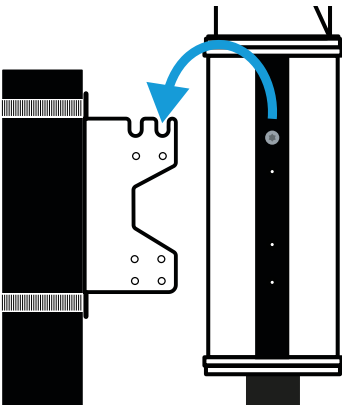|	
4b	Align the sensor with a GPS device or compass: • Place the GPS device or compass on the RF-310 and check the orientation of the RF-310. • Read the GPS position in degrees (for example, "52.516295" and "13.377653"). • Find the horizontal angle (azimuth) in degrees (0 = north, 90 = east, 180 = south, 270 = west). • Note the values in the table (see chapter 11 Appendix, page 21).
5	Tighten the strap accordingly to fix it to the mount.
6	Hook the sensor in the higher position of the mount and fix it with the six screws in the lower position to the mount.
7	Make sure that the pole is grounded (see chapter 5.3 Overvoltage Protection, page 10).
8	Connect the patch cable to the RF-310 and turn the connector gland until it is locked (for a correct cable preparation see 6.4 Cable Preparation, page 11). ✔ If the patch cable is connected to the network, the RF-310 boots automatically and after approximately 10 second the blue button at the RF-310 illuminates, indicating that the hardware is ready. ✘ The patch cable is connected to the network and the RF-310 does not boot automatically after approximately 15 seconds? 🔧 Push the blue button and wait for it to illuminate. 🔧 Make sure that **active PoE+ (802.3bt)** is activated in your network.

6.5.3 Mount sensor on a wall

Additionally required tools and mounting material (not included in the scope of delivery):

☐ Drilling machine

☐ Screwdriver

☐ GPS device

☐ 4 screws, suitable for the support surface and the weight of the sensor (diameter: minimum 6 mm)

☐ 4 washers, suitable for the screws (outer diameter: minimum 18 mm)

☐ Where necessary, 4 screw anchors suitable for the support surface and the screws

Precondition

☐ Desired mounting place fulfills the requirements (see chapter 5 Select the Mounting Place, page 7).

Procdure:

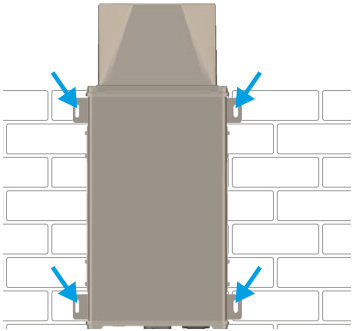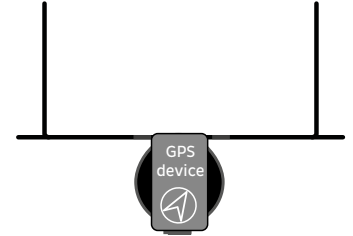|	
1	Align the sensor with the mount horizontally on the wall and mark the position of the 4 drill holes. Therefore make sure, the antenna cover extends over the wall. Otherwise the sensor is shielded by the wall.
2	Set the sensor aside and drill the marked holes.
3	Secure the sensor horizontally using screws and washers.
4	ⓘ **An accurate alignment of the sensor is a prerequisite for a good direction finding result.** Most critical is the configuration of the GPS position and the horizontal angle of each RF-310. If the installation and configuration are not accurate, the direction finding could be strongly divergent. • Place the GPS device or compass on the RF-310 and check the orientation of the RF-310. • Read the GPS position in degrees (for example, "52.516295" and "13.377653"). • Find the horizontal angle (azimuth) in degrees (0 = north, 90 = east, 180 = south, 270 = west). • Note the values in the table (see chapter 11 Appendix, page 21).
5	Connect the patch cable to the RF-310 and turn the connector gland until it is locked (for a correct cable preparation see 6.4 Cable Preparation, page 11). ✔ If the patch cable is connected to the network, the RF-310 boots automatically and after approximately 1 second the blue button at the RF-310 illuminates, indicating that the hardware is ready. ✘ The patch cable is connected to the network and the RF-310 does not boot automatically after approximately 1 second? 🔧 Push the blue button and wait for it to illuminate. 🔧 Make sure that **active PoE+ (802.3bt)** is activated in your network.

7 Integrate the RF-310 in your DedroneTracker

The integration procedure of the RF-310 in your DedroneTracker depends on the system type:

• On premises installations using your local DedroneTracker Server (see chapter 7.1 Integrate the RF-310 in your on prem DedroneTracker Server, page 17).

• Dedrone Cloud installations do not require any additional infrastructur and are connected to the Dedrone Cloud (see chapter 7.2 Connect and Configure the RF-310 to your Dedrone Cloud, page 18).

7.1 Integrate the RF-310 in your on prem DedroneTracker Server

To connect to the RF-310 DHCP services are required that automatically assign an IP address to the RF-310. If the RF-310 and the DedroneTracker Server are in the same Layer2 network they can be connected directly. If the RF-310 and the DedroneTracker Server are in different networks refer to the Dedrone Planning Manual or consult your network administrator.

Requirements:

- ☐ RF-310 is installed
- ☐ The power supply is working and the button at the RF-310 illuminates blue
- ☐ RF-310 is connected to the network
- ☐ The IP address of the DedroneTracker Server is known

Procedure:

1	Start your web-browser and enter the address of your DedroneTracker Server. For an optimal use, Dedrone recommends Chrome or Firefox.
2	Log in the DedroneTracker UI as an administrator or configurator. The default login credentials are: User: **admin** Password: **dedrone** ✔ The DedroneTracker user interface appears.
3	Choose **OPTIONS** > **Site Configuration**.
4	Choose [**Add device**] > **Discover devices**. ✔ The window **Discovered Sensors** appears.
5	Select the desired RF-310 and choose [**OK**]. ✔ The RF-310 appears in the Site Explorer.
6	To sort the RF-310 in the Site Explorer, drag and drop the element to the desired position.
7	Choose [**Save changes**]. ✔ The window **Site Configuration** disappears.
8	Choose **OPTIONS** > **Map Editor** and choose the RF-310.
9	ⓘ **An accurate alignment of the sensor and configuration in the DedroneTracker are prerequisites for a good direction finding result.** If the sensor was aligned via a prominent landmark, drag and drop the sensor symbol to the installed position and move the arrow to the chosen prominent landmark. If the sensor was aligned via a GPS device, choose the element on the map and enter the noted values in the fields **Latitude**, **Longitude** and **Azimuth**.
10	To lock the settings, choose the option **Lock settings**.
11	Choose [**Save changes**]. ✔ The window **Map Editor** disappears.

ⓘ For further information consult chapter "First Steps" of the integrated online help in the DroneTacker UI.

7.2 Connect and Configure the RF-310 to your Dedrone Cloud

Requirements:

☐ RF-310 is installed.

☐ The power supply is working and the LED at the RF-310 illuminates blue.

☐ RF-310 is connected to the Dedrone Cloud

☐ The address of your Dedrone Cloud access is known (provided by Dedrone).

☐ The registration key of the sensor is available (provided by Dedrone).

Procedure:

1	Start your web-browser and enter the address of your Dedrone Cloud. For optimal performance it is recommended to use the latest version of Chrome or Firefox.
2	Log in the DedroneTracker UI as an administrator or configurator.
3	Choose **OPTIONS** > **Site Configuration**.
4	Choose [**Add device**] > **Register device.** ✔ The window **Register device** appears.
5	Enter the registration key of your sensor and choose [**OK**]. ✔ The RF-310 appears in the Site Explorer. ✔ The RF-310 is getting placed automatically on the map via GPS, but needs to be aligned (see following steps).
6	To sort the RF-310 in the Site Explorer, drag and drop the element to the desired position.
7	Choose **OPTIONS** > **Map Editor** and choose the RF-310.
8	ⓘ **An accurate alignment of the sensor and configuration in the DedroneTracker are prerequisites for a good direction finding result.** • If the sensor was aligned during the installation via a prominent landmark, move the arrow to the chosen prominent landmark. • If the sensor was aligned during the installation via a GPS device, enter the azimuth value in the field **Azimuth**.
9	To lock the settings, choose the option **Lock settings**.
10	Choose [**Save changes**]. ✔ The menu **Map Editor** closes.

In step 4, the **Register device** window shows:

Register device ✕

Registration key: [   ]

Cancel   OK

9 Cleaning

| NOTICE | **Wrong cleaner damages the housing** |

The wrong cleaner can damage the housing or antenna of the RF-310. Never use glass cleaner or other solvent
cleaners to clean the RF-310.

- Use solvent-free cleaner to clean the RF-310.

8 Decommissioning

8.1 Shut down the RF-310

| NOTICE | **RF-310 breaks** |

By disconnecting the cable of the power supply without shut down the RF-310, the RF-310 could break.

- Always shut down the RF-310 before disconnecting the cable.

You have the possibility to shut down the RF-310 via the DedroneTracker user interface or directly on the sensor.

Shut down via DedroneTracker user interface:

1	Log in to the DedroneTracker user interface.
2	Choose **OPTIONS** > **Site Configuration**.
3	Right-click on the desired RF-310.
4	Choose **System** > **Shutdown device.**

Shut down directly at the RF-310:

	Briefly press the activation button at the RF-310.
	The RF-310 shuts down and the blue light goes out.

8.2 Dismantling

Hot surface due to permanent sunlight
The surface of the RF-310 may become hot from permanent strong sunlight.

- Wear safety gloves when dismantling the device.

8.3 Disposal

Dispose the RF-310 at the end of its service life in accordance with the disposal regulations for electronic waste which apply at the installation location at that time. Alternatively, send it back to Dedrone Holdings, Inc. with shipping paid by sender, and labeled "ZUR ENTSORGUNG" ("FOR DISPOSAL").

10 Technical Data

Range (line of sight)	Under normal conditions 1.25 mi (2.0 km) for most drones Under ideal conditions up to 3.1 mi (5 km) for specific drones
Device Type	Sensor[1]
Radio Frequency	Omnidirectional, passive detection, classification, and direction finding
L x W x H	7" x 3.7" x 20.2" (195 mm x 155 mm x 515 mm)
Weight (including mast mount)	12.4 lb (5.6 kg)
Ingress Protection Rating	IP65[2]
Operating Temperature	–4 °F to +131 °F (–20 °C to +55 °C)
Power Supply on Premises Operation	PoE IEEE 802.3bt (60 W)
Power Supply Cellular Operation	AC 100–240V 50/60 Hz max. 1 A
Power Consumption	24 W (typical)
Communication Technologies	Ethernet
Connectivity	Via LAN to existing IT infrastructure
Configuration, Operation, and Alarms	Via browser-based DedroneTracker software (software version >= 5.0.9 and valid license)
Software Updates	Firmware and DedroneDNA updates via a DedroneTracker instance

[1] pole not included

[2] No ingress of dust; complete protection against contact (dust tight). Water projected by a nozzle (6.3 mm) against enclosure from any direction shall have no harmful effects.

11 Appendix

Serial number (see prouct plate)	GPS position (in degree, e.g. 52.516295, 13.377653)	Horizontal angle (azimuth) in degrees: 0 = north, 90 = east, 180 = south, 270 = west
	longitude: latitude:	
	longitude: latitude:	
	longitude: latitude:	
	longitude: latitude:	
	longitude: latitude:	
	longitude: latitude:	
	longitude: latitude:	
	longitude: latitude:	
	longitude: latitude:	
	longitude: latitude:	
	longitude: latitude:	
	longitude: latitude:	

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