

SafePilot CAT ROT - CAT I

MANUAL



SafePilot

Introduction

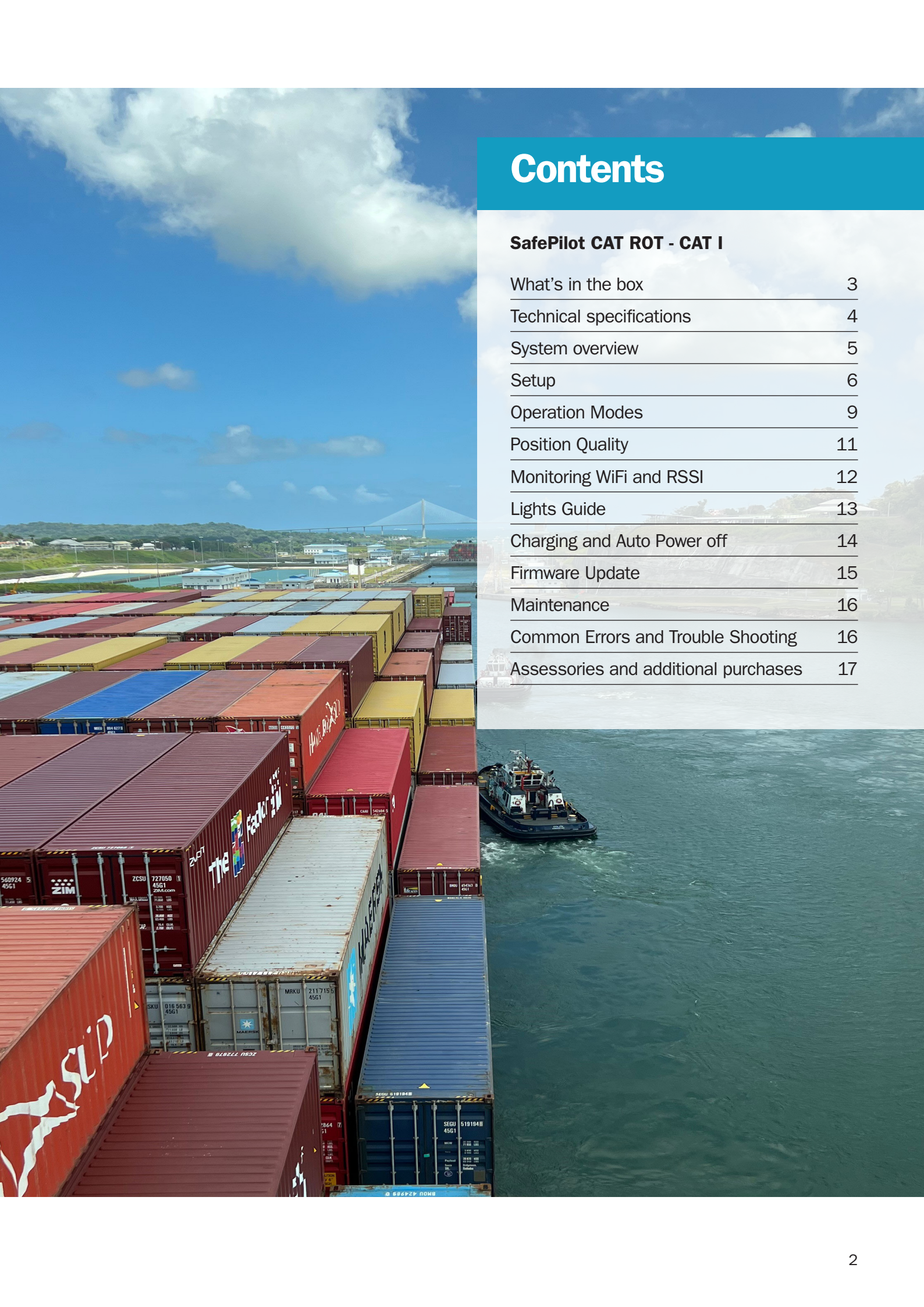
To fully utilize the CAT ROT v5 and CAT I v5 navigation system and all its features safely and easily, please read this manual carefully.

The CAT ROT v5 and CAT I v5 series facilitate a wireless connection between the AIS pilot plug and a portable piloting display. It also has the added benefit of a rate gyro and microprocessor, improving the standard data coming from the AIS pilot plug. In addition to good-quality rate of turn (ROT) data, the system provides additional decimal degrees to the heading information to make it more precise and reliable.

Advanced firmware provides calculations that ensure a solid inertial platform needed for crucial positioning predictions, especially in critical turns. In addition, independent position, speed, and course are provided to make the system capable of port and docking operations.

Often, if the position data is derived from the pilot plug, which relies solely on the ship's instrumentation, it can lead to inaccuracies. Sometimes, the offsets entered into the AIS transponder are wrong, or the quality of the GPS receiver is mediocre, which leads to poor reception and, thereby, an unstable showing of the position. The CAT I is a professional stand-alone Global Navigation Satellite System (GNSS) receiver that delivers Real-time kinematic positioning (RTK) with an accuracy of 0.01m and a speed accuracy of 1cm/sec. It tracks all available satellite constellations, giving its output data a very high precision regarding precision and speed. In addition, it utilizes a Satellite-Based Augmentation System (SBAS) used for Differential Global Positioning Systems (DGPS), which supplements and enhances the positional data available from the GNSS. Applying DGPS can significantly increase the accuracy of the GPS data, which can prove to be important in certain types of operations.





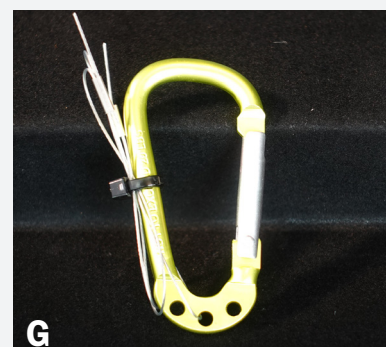
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What's in the box

2 pcs. Quick guide	A
1 pc. CAT ROT v5 PPU	B
1 pc. CAT I v5 PPU	C
1 pcs. Y-cable with USB-C	D
1 pcs. USB-C charging cables	E
2 pc. USB-C charger with EU, UK, US, Japan and AUS adapters.	F
1 pcs. Lanyard	G



Technical specifications

CAT I:

Wi-Fi

- | Client for CAT ROT Access point: IEEE 802.11 b/g/n with single band
- | Range: 200m line of Sight

GNSS

- | Tracked Systems: GPS / QZSS, Galileo, GLONASS, BeiDou.
- | Frequencies: L1C/A, L2C, L1OF, L2OF, E1B/C, E5b, B1I, B2I
- | Interference Mitigation: Spoofing and Jamming detection
- | Position Accuracy: RTK: 0.01m +/- 1ppm, SBAS: 0.6m +/- 1ppm, Stand Alone: 3m +/- 1ppm
- | Speed Accuracy: 1 cm/sec

NETWORK DGNSS CORRECTIONS (NTRIP)

- | Protocol: Networked Transport of RTCM via Internet Protocol (NTRIP)

CAT ROT:

Wi-Fi

- | Access Point: IEEE 802.11 b/g/n with single band
- | Number of clients: 8
- | Security: WPA2
- | Range: 200m Line of sight

PILOT PLUG INTERFACE

- | Automatically polarity correction
- | Automatically Rx/Tx correction
- | Simultaneous pilot plug Connection/Charge
- | Heading Accuracy: 0.1 degrees
- | Rate of Turn Accuracy: 0.1°/min.

COMMON:

MECHANICAL

- | Weight: 400g
- | Dimensions: 138 x 100 x 25mm
- | Battery Life: 30 hours
- | Charge time: 3 hours
- | Battery: 3.6V/7AH
- | Humidity: 100%
- | Temp. range -20 - 50 °C / -4 - 122 °F

System overview

The system comprises two units: CAT ROT and CAT I

CAT ROT gets the Automatic Identification System (AIS) information from the pilot plug but uses its built-in rate gyro to compute the output information about the rate of turn. The rate gyro also adds a decimal to the heading sent out by the pilot plug, but since the AIS message does not support this, a separate heading message is transmitted

CAT I provide position, speed, and course independent of the information from instruments installed on the vessel. The RTK accuracy provided by the CAT I is possible due to the corrections obtained from the SafePilot software. Two different ways are available to acquire these corrections. A SafePilot server can gather the data from a local reference station installed in the port. Alternatively, the SafePilot software can be linked to an NTRIP server, which is then providing the corrections. NTRIP, which stands for Networked Transport of RTCM via Internet Protocol, is a protocol for transmitting real-time GNSS correction data over the Internet, enhancing position accuracy for autonomous navigation



Setup

To fully utilize the CAT ROT – CAT I navigation system and all its features, it is of utmost importance to find a proper location for the CAT I unit. Due to the layout and the extensive amount of equipment found on many vessels, this can sometimes be challenging. To prevent inaccurate readings caused by poor signals, it is essential always to follow the guidelines listed below:

- The CAT I must have a clear view of the sky, meaning any obstructions cannot be above or near the unit
- Always be cautious not to position the device in areas where multipath reflection may occur. This can happen when the signal bounces off various objects, such as a building or the ship's equipment
- Keep the CAT I at least 3 meters (10 feet) from vertical obstructions like the wheelhouse
- Maintain a distance of at least 0.5 meters (1½ feet) between the CAT I and obstacles such as antennas. (If the antenna transmits at high power, it may disrupt satellite tracking!)
- Make sure that nothing is above the CAT I, such as railings and rain covers made of metal and wood. Most plastics are transparent to GNSS Signals
- Placing the CAT I directly on a metal floor can cause multipath reflections and degrade Wi-Fi performance. Keep it at least 30 cm (1 foot) above the floor whenever possible, or try finding another location
- Even though the CAT I has magnets underneath, it is recommended that the mounting brackets be used anyway. The brackets will prevent the CAT I from sliding even on flat surfaces since the combined magnetic field makes the magnets stick even more

The following section includes images illustrating suitable and unsuitable locations for the CAT ROT and directions on connecting the CAT I to the pilot plug.



This is a very good location for the CAT I, as the area around the unit is clear and free of obstacles



In the pictures above, a significant portion of the sky is obstructed by the vertical wall and the wheelhouse adjacent to the unit. Moreover, the wall and wheelhouse may cause multipath interference.



Due to the proximity of numerous antennas, this location is not suitable for the CAT I.



CAT ROT is connected to the pilot plug and placed on a horizontal surface.

Operation Mode

The CAT ROT & CAT I v5 have two different operational modes, which can be used depending on conditions and situations requiring their function. The different ways of usage will be reviewed in the following section:

1. Using CAT ROT as Pilot Plug Repeater

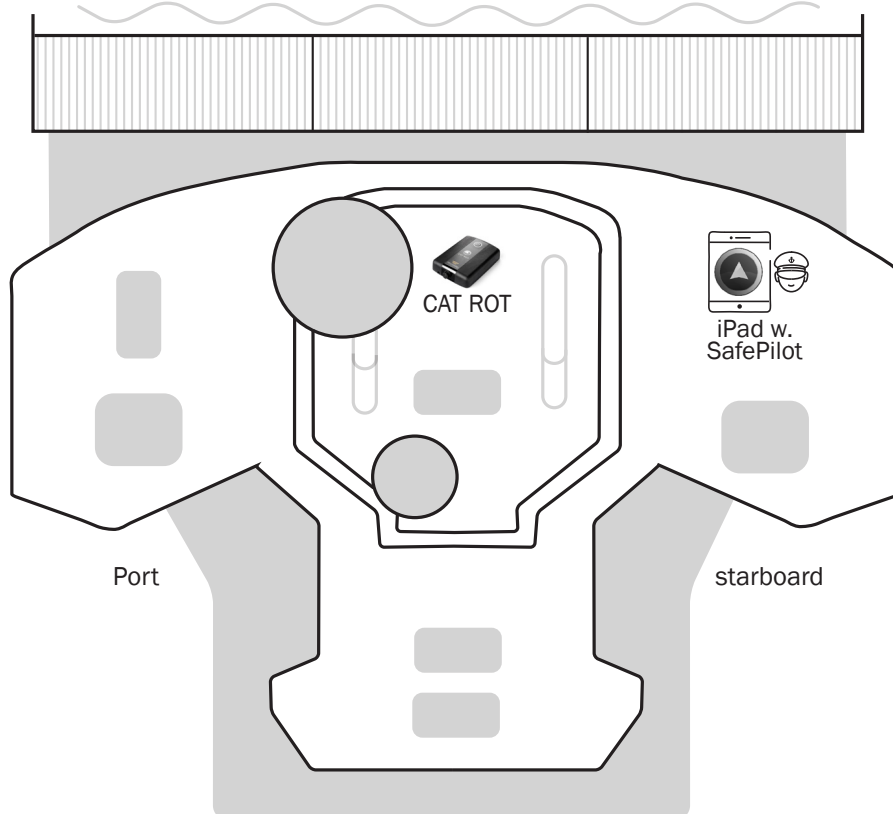
In the simplest use case, the CAT ROT will act as a Pilot Plug Repeater. It will overcome the shortcomings of the AIS pilot plug data format by generating an accurate real-time rate of turn and providing the missing decimal readings to the heading data via an integrated rate sensor, intelligent processing, and an advanced Kalman filter integrated into the unit.

Due to frequent instrument inaccuracies, please note that relying solely on the ship's instrumentation may lead to inaccuracies in reading the ship's position and speed. This is why it is recommended that the CAT ROT with a CAT I be utilized for most operations. This way, an independent position, speed, course, heading, and rate of turn is provided.

To use the system in mode 1, please follow the steps below:

- Turn on the CAT ROT with a short press of the button on the top of the device
- Connect the CAT ROT to the pilot plug with the supplied cable.
- Make sure the unit is placed on a horizontal surface to achieve a reliable rate of turn
- Connect an iPad to the network "CAT ROT (4-xxxx)" with password "86912255" and open up SafePilot.
- To ensure reliability in the Wi-Fi performance, placing the CAT ROT, as shown in the layout below, with the arrow pointing towards the bridge-wing where the pilot is located during ducking, is important.

NOTE: The signal is strongest in the direction of the arrow.



2. Using CAT ROT and CAT I as a stand-alone system

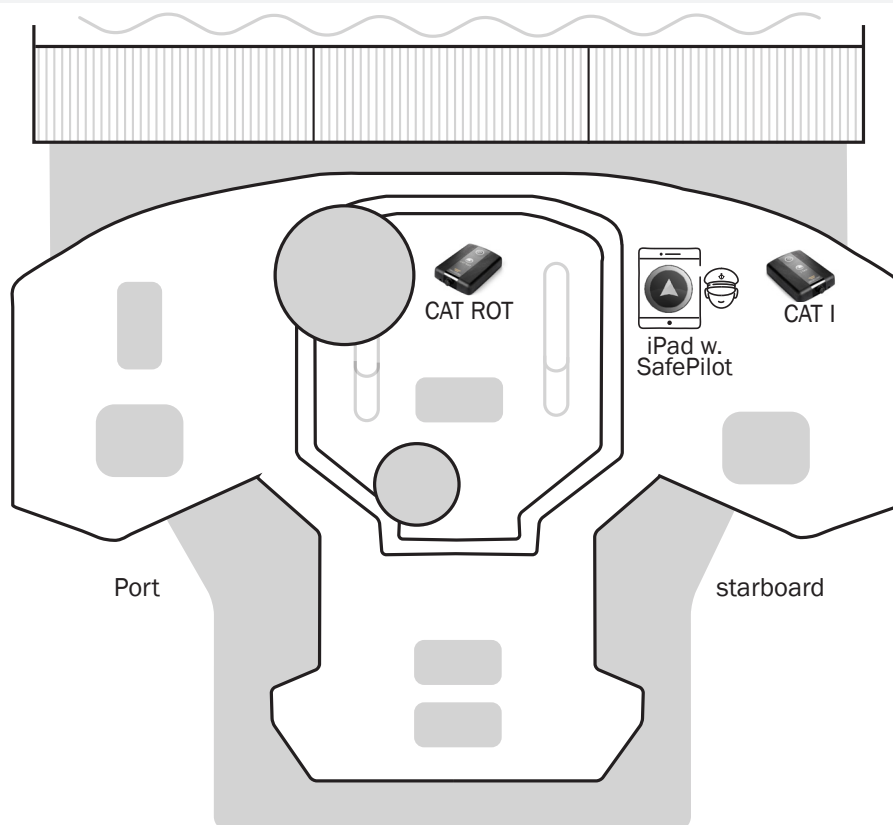
In this mode, the two devices will work as a pair, with CAT ROT as a Pilot plug repeater and the CAT I placed outside on the bridge wing. Besides the accuracy in rate of turn provided in mode 1, using the system in this way will provide very accurate data on position, course over ground and speed, independent from the ship's instrumentation.

To use the system in mode 2, please follow the steps below:

- Turn the CAT ROT unit on by pressing the button until it flashes blue
- Then turn on the CAT / I unit by pressing the button for 4 seconds until it flashes purple
- Wait a few moments until they both flash green simultaneously. This indicates that they have paired

- Connect the CAT ROT to the pilot plug with the supplied cable.
- Make sure the units are placed on a horizontal surface to achieve a reliable rate of turn
- Connect an iPad to the network "CAT ROT (4-xxxx)" with password "86912255" and open up SafePilot
- To ensure a strong and reliable Wi-Fi performance, placing the CAT ROT and CAT I as shown in the diagram below is important. The arrows should be pointing towards each other, so the arrow on the CAT ROT points towards the bridge-wing where the CAT I and the pilot are located during docking.

NOTE: The signal is strongest in the direction of the arrow



Position Quality

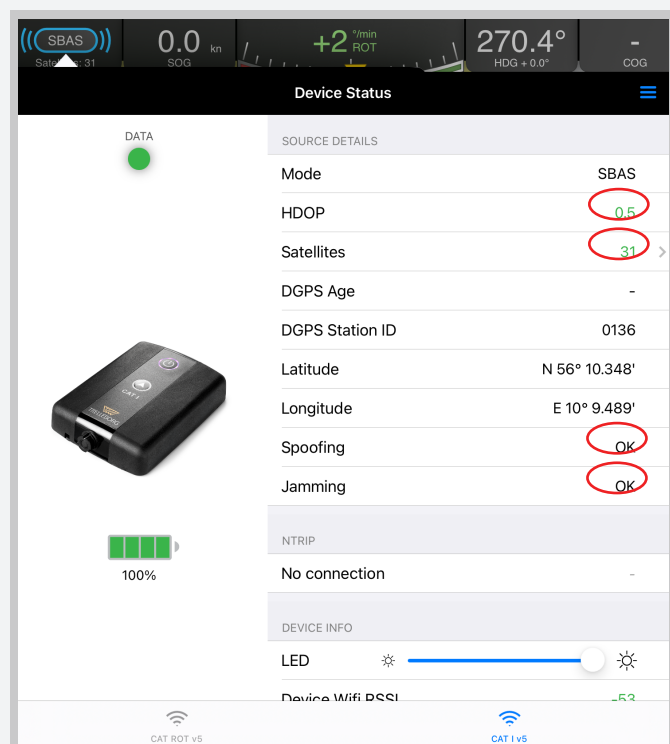
The Device Status window in the SafePilot software provides valuable information about the quality of position, speed, and heading computations. To access it, tap the quality indicator  on the left side of the top bar

The information from the different units is shown in separate windows. To switch between these, tap either CAT ROT or CAT I  in the bottom bar of the Device Status window. The values displayed in these windows indicate whether the CAT I is placed appropriately or should be moved to a better location and whether it is in contact with the CAT ROT.

When evaluating the placement of each unit, it's important to consider the general guidelines listed in the "Setup" section above.

General Guidelines for the CAT I unit:

- The unit should be able to connect to more than 20 satellites
- HDOP (horizontal dilution of precision) value must not exceed 1.5
- Both the spoofing and jamming status should be OK
- At least three satellites should have an SNR (signal-to-noise ratio) beyond 45 dB



Satellites			
GPS			
NMEA ID	Elevation	Azimuth	SNR
19	38 °	276 °	46 dB
21	12 °	149 °	35 dB
23	-	-	-
25	6 °	10 °	33 dB
28	24 °	44 °	37 dB
29	-	-	-
30	-	-	-
31	32 °	82 °	38 dB
32	-	-	-
Galileo			
NMEA ID	Elevation	Azimuth	SNR
2	9 °	357 °	37 dB
4	2 °	216 °	25 dB
7	15 °	49 °	40 dB
10	44 °	301 °	46 dB
12	67 °	279 °	43 dB
19	54 °	189 °	42 dB
25	4 °	310 °	43 dB
26	2 °	138 °	34 dB
29	63 °	87 °	47 dB
30	1 °	45 °	38 dB
33	47 °	152 °	46 dB
GLONASS			

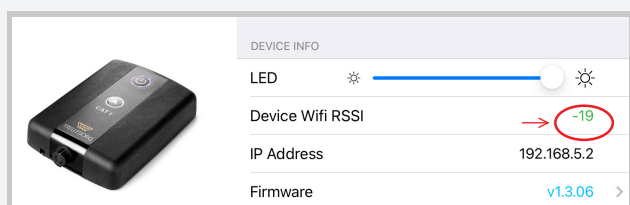
Monitoring WiFi and RSSI

Maintaining a stable WiFi connection between the different units is essential for ensuring reliable and high-quality data reception. The strength of the signal can be monitored in the Device Status window under the “Device WiFi RSSI” point. This reference point will show if the connection is strong or has issues.

The signal quality is categorized into three levels:

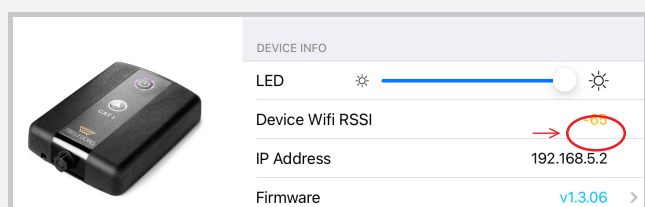
Green (Signal Strength: -60 or better):

A green indicator signifies a stable connection; no further action is needed



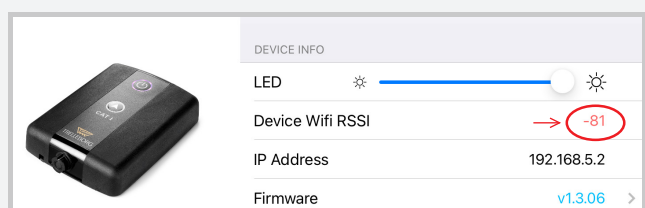
Yellow (Signal Strength: Between -60 and -75):

A yellow indicator means the connection is weaker than preferred. In such cases, relocating the CAT I units to a better position for improved WiFi signal strength is advisable.



Red (Signal Strength: Below -75):

A red indicator means the WiFi connection is too weak. The units must be relocated to an area with a stronger signal (preferably above -60) for reliable connectivity.

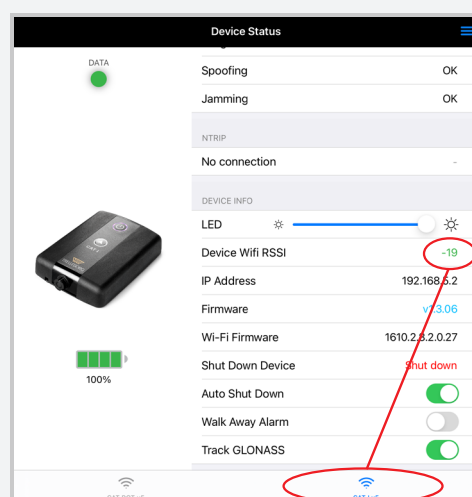


The location of the information to check the signal strength may vary depending on the mode in which the system is being used. However, the key takeaway is that it is essential to monitor the client unit or units closely.

The following provides a brief overview of which unit or units to monitor when used in different modes:

Mode 1: In this mode, the CAT ROT unit is directly connected to the pilot plug. This eliminates the need for WiFi and monitoring the connection.

Mode 2: In the second mode, the CAT ROT unit is the client to the CAT I unit which is connected to the pilot plug and provides the signal. In this case, the signal strength can be monitored in the Device Status window when it displays the status for the CAT I unit, as shown in the screen capture below:



If the signal gets lost, it may be necessary to turn the unit with the lost signal off and on again to regain the connection.

Lights Guide

CAT ROT:

	Steady Blue	GPS/AIS position OK
	Slow Flashing Blue	No GPS/AIS position
	Steady Red	Fully Charged
	Fast Flashing Red	Low Battery
	Slow Flashing Red	Charging
	Simultaneous Flashing Green	CAT ROT - CAT I Paired

CAT I:

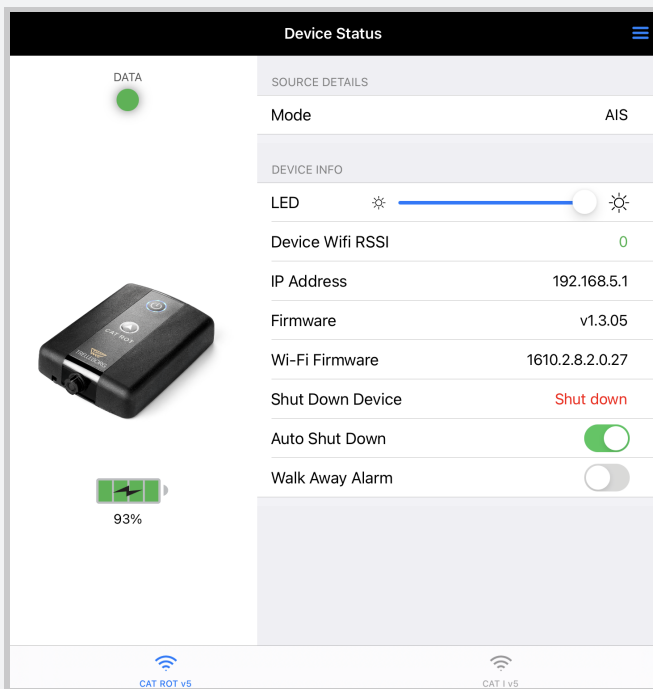
	Steady Purple	WiFi Connected, position OK
	Fast Flashing Purple	Not Connected to CAT ROT
	Slow Flashing Purple	No GPS position
	Steady Red	Fully Charged
	Fast Flashing Red	Low Battery
	Slow Flashing Red	Charging
	Simultaneous Flashing Green	CAT ROT - CAT I Paired

Charging and Auto Power off

To offer high flexibility, the CAT ROT - CAT / I features two charging options: via cable or with a wireless charge pad.

Cable Charging

When the charging cable is connected, the CAT ROT - CAT I flashes red, indicating that charging is in progress. When the unit is fully charged, the light switches from flashing to lighting up in solid red. The SafePilot software displays the current battery level and whether the unit is charging.



The CAT ROT - CAT I is fully functional while charging. It supports up to USB PD 3.0, USB HVDCCP, and QuickCharge 3.0. When fast-charging is used, the CAT ROT - CAT I battery charges from zero to 100% in approximately 3 hours.

Wireless Charging

When using wireless charging, the CAT ROT - CAT I units should be placed at the center of a wireless charging pad that supports Qi charging. The button on top of the unit will start flashing red, indicating it is charging. When the unit is fully charged, the light switches from flashing to lighting up in solid red.

The units are fully functional while charging, and the progress can be tracked in the SafePilot software. The battery load percentage is shown along with a lightning symbol indicating that the charging is ongoing.

Auto Power off

It is possible to enable/disable the feature, as required, through SafePilot software.

Either of the CAT ROT / CAT I Units will turn off automatically under certain conditions.

If the following conditions are met, the unit will turn off. This will also occur when the devices are connected to a Pilot Plug or charger.

CAT ROT:

- If no heading has been achieved for 30 minutes
- If no clients are registered, on the Wi-Fi Network for 30 minutes

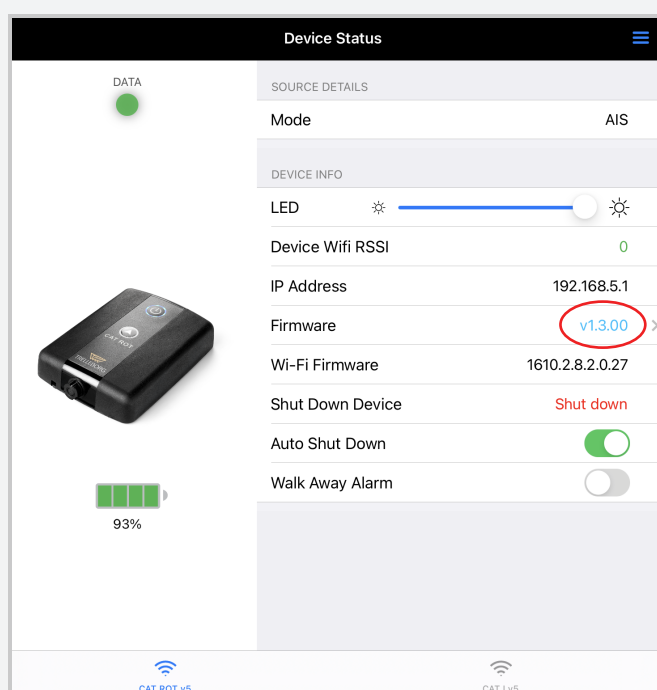
CAT I:

- If not connected to the CAT ROT Unit for 30 minutes
- If no valid position is achieved for 30 minutes

Firmware Update

It is recommended that CAT ROT and CAT I devices always be updated to the latest firmware version

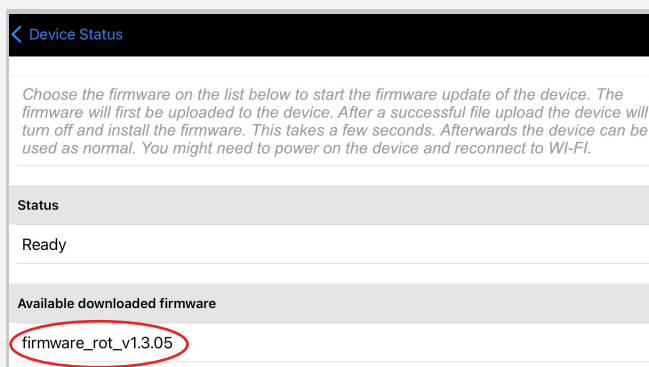
When an update is available, it will be displayed in the GPS Status view window, and the version currently installed will be marked blue.



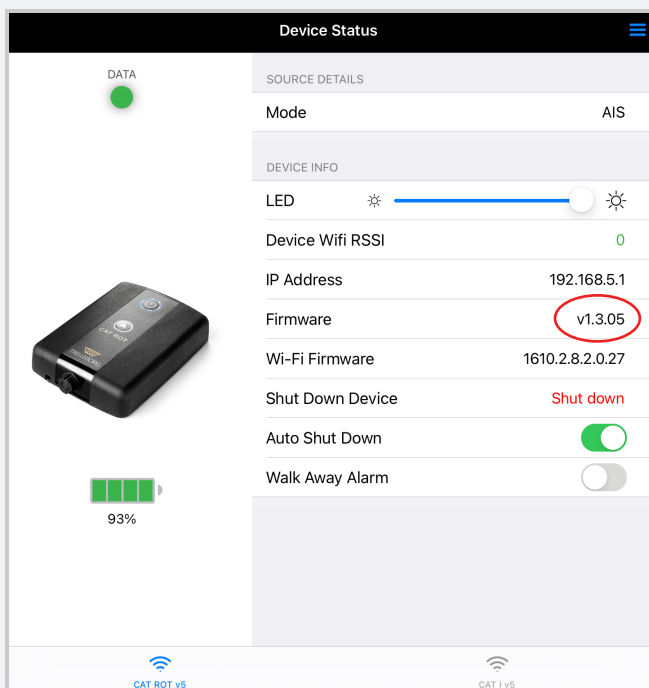
The update can be done Over the Air (OTA) by following the steps below:

- Turn on the CAT ROT, and CAT I
- Connect to its Wi-Fi and open SafePilot.
- To update the firmware, tap on the firmware field in the GPS Status view window. A new window will appear showing the available firmware.

- Tap on the new firmware version, and the device will start updating



- After the update is completed, the new firmware version will be marked in black in the GPS Status view window



Maintenance

To ensure the CAT ROT and CAT I units remains in great condition, please keep the following in mind:

- Keep the CAT ROT and CAT I clean and dry while stored.
- The battery level should be maintained at 50-60% if the device is not used for an extended period of time
- All cables need regular inspection, and the connectors must be checked to ensure they are clean

COMMON ERRORS & TROUBLESHOOTING



No Wi-Fi connection to iPad:

- Do not place the iPad on a metal surface, as this may affect its ability to connect to WiFi.
- Make sure the iPad is placed centrally on the bridge and that there are no obstacles within close proximity of the antenna
- Ensure compliance with the Wi-Fi signal guidelines in the “Operation Mode” section

Units not pairing:

- Turn off all units and place them in close proximity to each other
- Turn on the CAT ROT by pressing the power button. It will start flashing blue. Wait 5 seconds until it begins to flash blue more slowly
- Turn on the CAT I by pressing the power button until it flashes purple. The unit should start flashing green synchronously with the CAT ROT within 5 seconds

No position is shown:

- Confirm that the CAT I is connected to the CAT ROT. The CAT I will be fast flashing purple if not connected
- Make sure the arrows on the two units point towards each other

No RTK position:

- Make sure the NTRIP file is filled in correctly, and ensure that the iPad has a stable connection to the cellular network

The TRELLEBORG MARINE SYSTEMS SafePilot systems are designed as a secondary navigational aid and do not relieve the user (pilot, captain, navigator, etc.) of their professional responsibility and navigational skills. Correct use, knowledge, and understanding of the performance and limitations of the SafePilot systems are the sole and only responsibility of the user.

It is important to note that the SafePilot systems and software do not override or substitute the navigation system (charts, ECDIS) installed on board as required by law.

Assessories and additional purchases



SafePilot Software

The SafePilot is a user-friendly software available as an app for iPad and Apple Watch. It handles key tasks such as navigation data, planning functions, route and arrival times, recording, chart handling, predictions, and history. Additionally, it offers specialized functions for docking and alignment, lock operations, weather data, and AUKC, among others.

To learn more about SafePilot or purchase the software, don't hesitate to contact Trelleborg Marine & Infrastructure or visit our website, which has additional information.



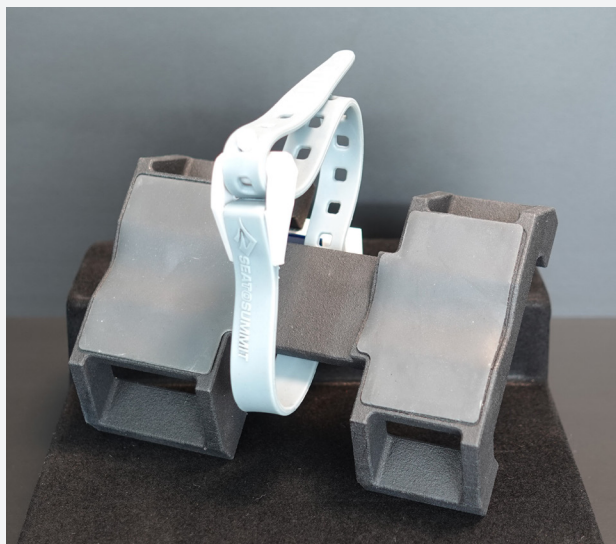
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ABOUT
SAFEPILOT



Cat extender

The Cat Extender can be used in conjunction with the Cat Rot and Cat

I units. When used together, the Cat Extender will serve as the Wi-Fi access point. If positioned in the center of the ship, the extender will offer robust and dependable Wi-Fi coverage across the entire bridge wing, even on large vessels like ULCVs.



Mounting Bracket

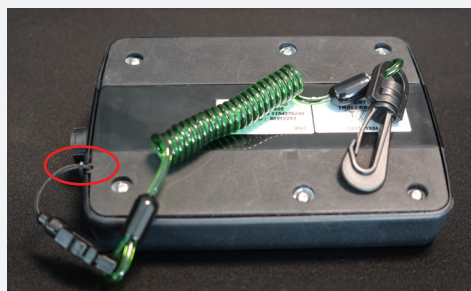
If a suitable flat horizontal surface is not available

to place the CAT I unit, using the mounting brackets designed for it is an easy and efficient way to fit the unit onto a railing or pipe.

When the CAT MAX is fitted to the brackets, the combined magnetic fields from the bracket and the CAT I itself make the magnets stick even more. Because of this, it can also be recommended that the brackets be used when the unit is mounted on a flat surface.

Lanyard

The CAT I features a bottom mounting hole for attaching a safety lanyard, as illustrated in the image below.



GET IN TOUCH

Technical support

Website

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Trelleborg is a world leader in engineered polymer solutions that seal, damp and protect critical applications in demanding environments. Its innovative solutions accelerate performance for customers in a sustainable way.

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