TRELLEBORG MARINE AND INFRASTRUCTURE

# SafePilot P3

INSTALLATION MANUAL

SafePilot

# Introduction

**Please read this manual carefully before starting to install the SafePilot P3.**

The SafePilot P3 is a fixed installed navigation system for Pilots. It is independent of the vessel and provides all relevant information to the pilot. SafePilot P3 is developed in response to the recent advisory issued by the Panama Canal Authority (ACP) requiring a new positioning system for Neopanamax vessels.

Providing position, speed, course, heading, rate of turn and AIS data in high accuracy and with an update rate of 1 Hz on a Wi-Fi network, SafePilot P3 enables the pilot to use an iPad connected to the WiFi while inside the wheelhouse and outside on the bridge wings. It provides pilots with access to the most reliable data related to vessel positioning and movement.

Being independent, SafePilot P3 is not connected to any sensors onboard the vessel and in case of a blackout on the vessel, the system has got a built-in battery power backup which will power the system for a minimum of 5 hours.

SafePilot P3 system is a GNSS positioning system with additional features including high position and heading accuracy and AIS reception.

It is important to follow the installation instructions of all parts included in this system since every part has an important function and compromising the instructions might cause a system malfunction.

SafePilot P3 Navigation system is pre-approved by the ACP.

# Contents

**SafePilot P3**


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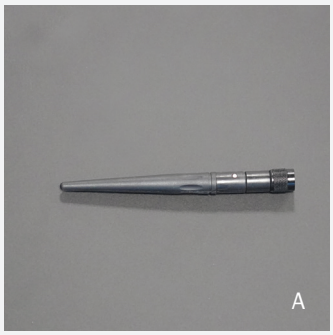
# What's in the box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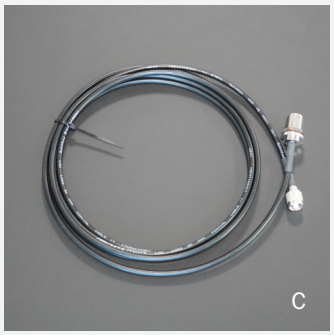
B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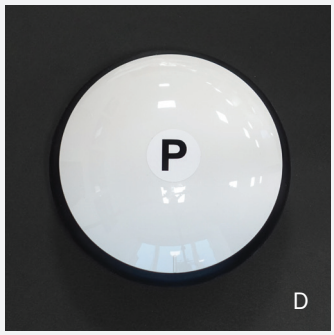

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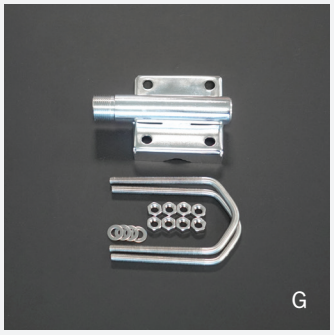
E

F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H

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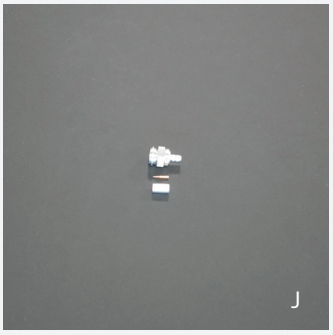
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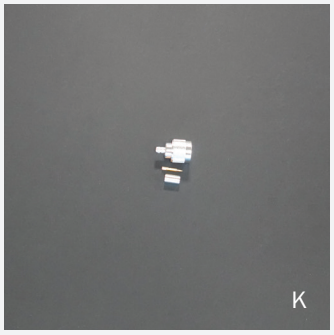
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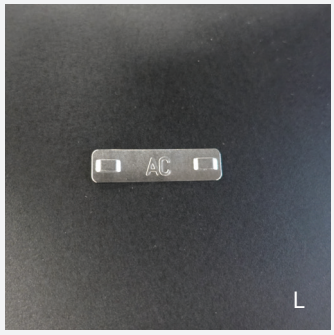

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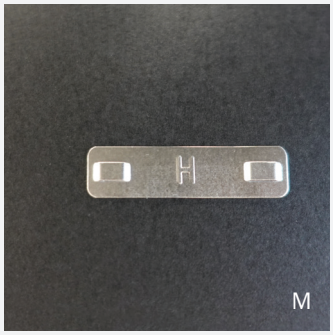

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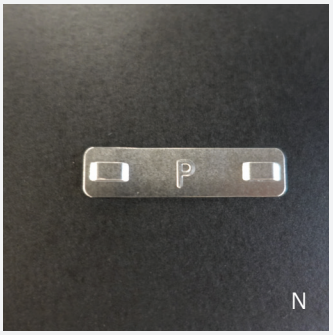

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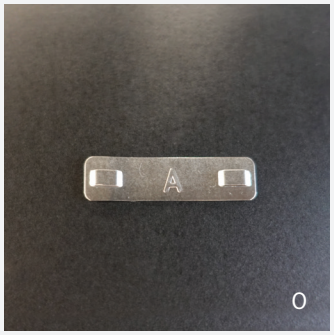

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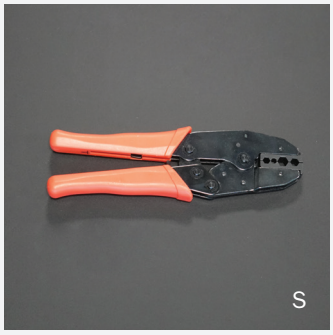
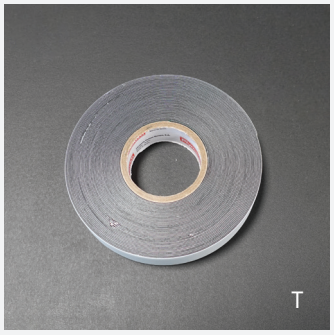


## SAFEPILOT P3 UNIT CONSIST OF:

1 pc. Wi-Fi antenna – 3dBi. . . . . .A

1 pc. Wi-Fi antenna – 9dBi. . . . . B

1 pc. Wi-Fi antenna cable for roof installation (3m). . . . . C

1 pc. GNSS antenna “P” . . . . . D

1 pc. GNSS antenna “H” . . . . . .E

1 pc. UHF-VHF Antenna . . . . . .F

2 pcs. Mounting bracket for GNSS antenna . . . G

1 pc. Mounting bracket for AIS antenna . . . . . H

1 pc. Coaxial cable for GNSS and AIS antennas (135m) . . . . . I

5 pcs. TNC-connector for GNSS coaxial cable . . . . . .J

3 pc. N-Connector for AIS coaxial cable . . . . . K

1 pc. Cable tag for AC . . . . . .L

2 pcs. Cable tag for HDG antenna . . . . . M

2 pcs. Cable tag for POS antenna . . . . . N

2 pcs. Cable tag for AIS antenna . . . . . O

1 pc. Installation guide (This document) . . . . . .P

1 pc. Type plate with QR code . . . . . Q

1 pc. Cable ties (100 pcs). . . . . R

1 pc. Coax Connector Crimp tool . . . . . S

1 pc. 10m Vulcanizing tape . . . . . .T

1 pc. SafePilot P3 positioning unit . . . . . U

1 pc. iPad with SafeCaptain. . . . . .V

1 pc. USB stick with related documentation . . W

14 pc. Metal cable tie for Cable tags . . . . . .X

# Technical specifications

## GNSS

SafePilot P3 includes a dual-antenna GNSS receiver, able to compute a highly accurate heading and position. Below is the specification for the GNSS receiver and GNSS antennas.

## GNSS ANTENNAS

- Frequencies: L1, L2, L5, G1, G2, G3, E1, E5a, E5b, E6, B1, B2, B2a, B3, L5 and L6.
- Gain: ≥ 37 dB
- Noise Figure: 1.8 dB typ. @ 25 °C
- VSWR: <1.8
- Operating Temperature: – 45°C to 85°C
- Mechanical Vibration: MIL-STD-810E – Test method 514.5
- Shock & Drop: MIL-STD-810G – Test method 516.6
- Salt Fog: MIL-STD-810G – Test method 509.6
- Low Pressure – Altitude: MIL-STD-810F – Test method 500.5
- IP Rating: (housing) IP69K

## GNSS RECEIVER

- 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: 1m
- Heading Accuracy@10m Antenna Separation: 0.02 degrees
- Speed Accuracy: 1 cm/sec
- Rate of Turn Accuracy: 0.1°/min

## DGNSS CORRECTIONS

SafePilot P3 can receive DGNSS Corrections from either UHF or over Wi-Fi using NTRIP. The specifications of the two are:

## UHF

- Frequency: 454.325 MHz
- RF Protocol: Pacific Crest FST
- DGNSS Corrections Protocol: RTCMv3

## NETWORK DGNSS CORRECTIONS (NTRIP)

- Protocol: Networked Transport of RTCM via Internet Protocol (NTRIP)
- UDP Port: 2102

## VHF/UHF ANTENNA

- VSWR at 146-162.50MHz: <1.5 (VHF / AIS)
- VSWR at 454.325 MHz: <4.0 (UHF)

## AIS RECEIVER

- Dual Frequency: 161.975 & 162.025MHz (Class A & B receiver)
- Receiver Sensitivity: <-110dBm @ 20% packet error rate

## COAX CABLES

- Operating Temperature: – 40°C to 80°C
- Total loss signal cables: Max. 17dB

## INERTIAL MOTION UNIT (IMU)

SafePilot P3 includes intelligent filtering, that can provide Heading, Rate of Turn and Dead Reckoning if GNSS signals are obstructed.

- Gyro Bias Instability: ≤ 1.2°/hr
- Angular Random Walk: ≤ 0.08°/√hr
- 6 Degree OF Freedom: Triple Gyroscopes

## Wi-Fi

- Access Point: IEEE 802.11 b/g/n with single band
- Number of clients: 8
- Security: WPA2

The location of the Wi-Fi antenna is crucial to meet the specification of >-70dBm at all conning positions. For instructions, please see instructions in the following section.

## POWER

- Input Voltage: 90-240VAC (50/60Hz)
- Current: 400mA @ 12VDC.
- Power: 10W Max.
- Weight: 2.5kg
- Battery backup: > 5 hours of operation

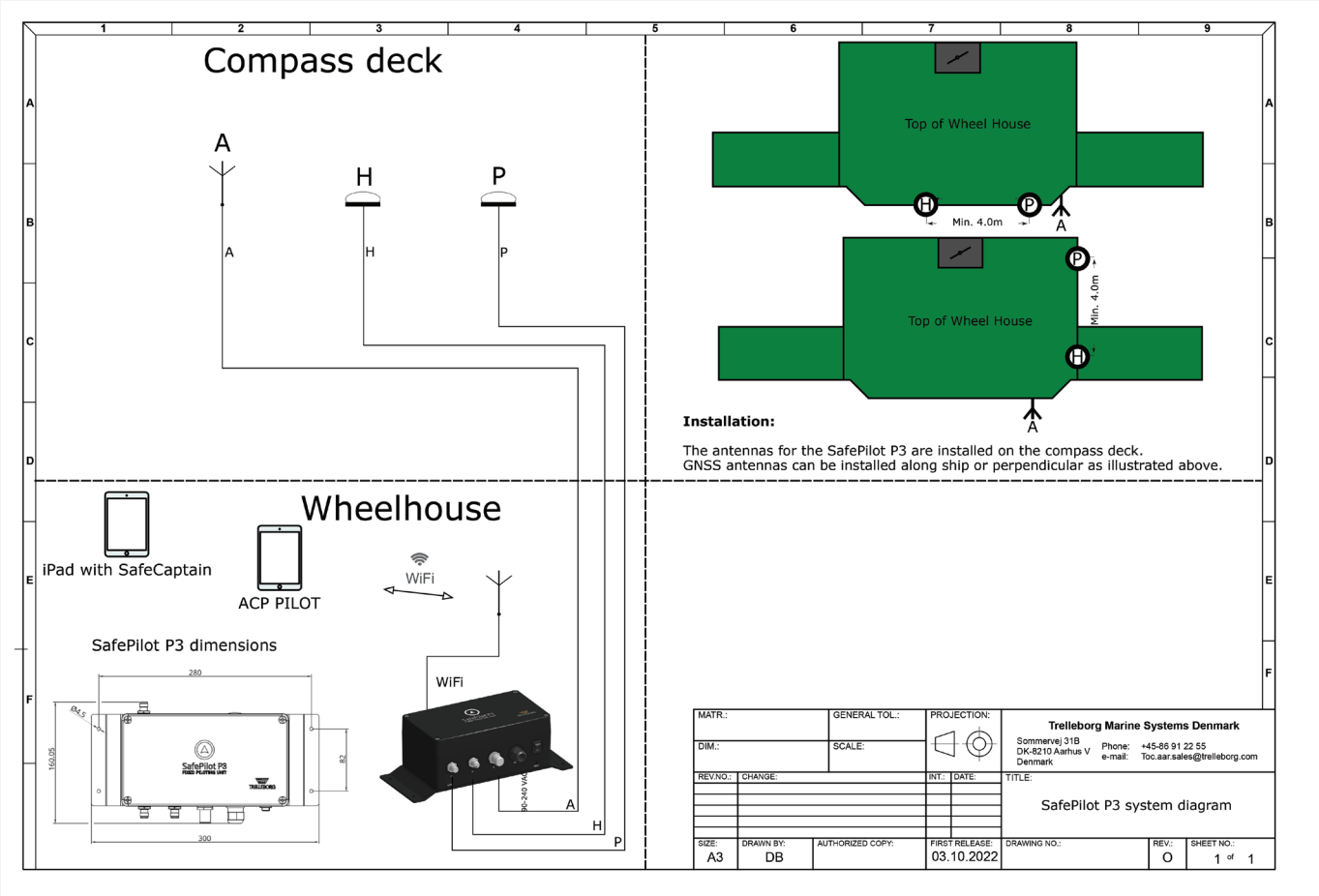
# System overview

The figure below shows a typical system overview of a SafePilot P3 installation, with the SafePilot P3 unit is located inside the wheelhouse. The WiFi antenna is placed centrally inside the bridge with a clear view of both bridge wings (to ensure a stable connection to the Pilot's navigation tablet).

Three coaxial cables are run to the compass deck, connecting to three different antennas. The three antennas are one GNSS antenna (P) for computing the Position, one GNSS antenna (H) for computing the Heading, and one combined UHF&AIS antenna for the built-in AIS receiver and UHF radio.

The SafePilot P3 unit is powered by 90-240VAC and has an internal backup battery that can operate for 5 hours in case of a blackout.

The following sections will provide a comprehensive description and guidelines for installing the system.




*System overview of a SafePilot P3 system*

## INSTALLATION INSTRUCTIONS

Please read this entire chapter carefully before beginning the installation of the SafePilot P3.

### PLANNING OF INSTALLATION:

Before beginning the actual installation, it is important to take some considerations into account.

1. **Locate a suitable place for the SafePilot P3 box inside the wheelhouse.**

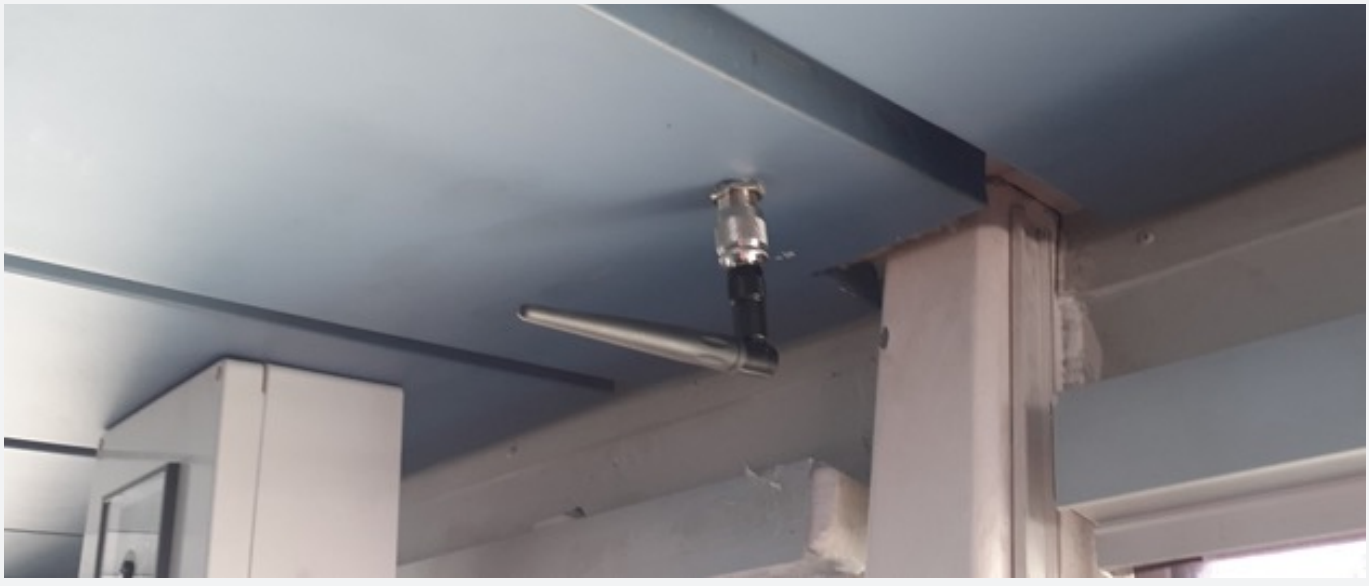
   **a.** The P3 unit must be mounted correctly to measure the correct Roll and Pitch values. The default orientation of the P3 unit is with the cable entries (connectors) pointing towards the bow of the vessel when the box is mounted horizontally. Please refer to Appendix 6 for the default orientation.

   **b.** Alternatively, the unit can be fitted on a wall but in this case the unit needs calibration for Rate of turn, Roll and Pitch. Please refer to Appendix 6 for the allowed orientation.

   **c.** The Wi-Fi antenna must be placed centrally on the bridge, close to the centre, with a clear view of both bridge wings. The pilots will be operating their iPads on both bridge wings, and they need a stable and strong Wi-Fi connection. A 3m long cable is provided to make the installation through the ceiling possible. The hole should be 13mm in diameter.

   **d.** To comply with ACP's specifications, the Wi-Fi antenna must be placed centrally with no obstructions in the vicinity; therefore, find a good place for the P3 Unit in the wheelhouse.

   **e.** The SafePilot P3 must be accessible for service technicians. Preferably it is mounted near a roof hatch or on the hatch itself.



*WiFi-antenna connected to the P3 Unit*

2. **Locate a way to run cables from the top of the wheelhouse to the location of the SafePilot P3 unit.**

3. **Locate space on top of the wheelhouse to place the GNSS antennas, preferably a railing.**

When considering where to mount the two GNSS antennas, follow these recommendations:

**a.** Two brackets are included with the system and can be mounted on either a horizontal or vertical pipe. The minimum pipe diameter must be 24mm, and the maximum is 46mm, as shown in the illustration below.

**b.** The SafePilot P3 uses two GNSS antennas, one named “P” and another named “H,” to compute position and heading.

**c.** Ensure there is a clear view of the sky where the antennas are installed. The satellites are located more than 20,000 km above earth so obstructions may reduce system performance.

**d.** Mount the brackets on the railing accommodating one of the following requirements: one on the port side (P) and the other on the starboard side (H), or one at the stern (P) and the other at the bow (H). The antennas must be positioned in a straight line, either perpendicular to or parallel to the ship.

**e.** The two antennas must be separated by at least 4m (preferably 10m). Please take this into consideration when planning where to install them.

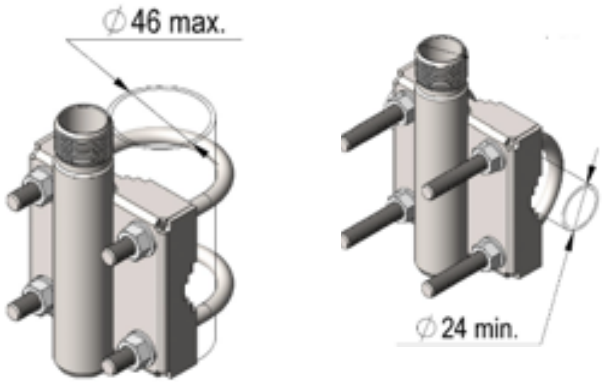
4. **Locate space on compass deck to place the AIS antenna, preferably an antenna post.**

**a.** Choose a location to mount the antennas that is quiet from a radio frequency standpoint. This spot should provide an unobstructed view of the horizon and be positioned at a considerable height.

**b.** Ensure the antenna is installed at least one meter away from other electronics and antennas, especially active TV antennas. Ideally, increase this distance.

**c.** The antenna must be installed vertically.

In the following sections, additional guidelines will be provided for installing the equipment.



# Installation

**After doing a thorough planning of the installation, you are now ready to install the equipment. Please follow the instructions in this chapter very carefully!**

## INSTALLING BRACKETS AND ANTENNAS:

**1.** Mount the brackets for the GNSS antenna (Part G) at the suitable locations you have found.

**a.** Ensure the antennas are located at least 4 meters apart, preferably 10 meters.

**b.** Ensure they are located along or perpendicular (eg 1 Port & 1 starboard, or 1 aft & 1 fore) to the ship. See Figure 1.

**c.** Use two nuts and one washer on each bolt to prevent self-loosening, as shown in the photo above

**2.** Install the GNSS antenna “P” (Part D) onto the bracket on the starboard side or in the aft position.

**3.** Mount the GNSS antenna “H” (Part E) on the bracket to the port side or in the forward position.

**4.** At the appropriate location for the AIS antenna (Part F), install the mounting bracket for the AIS antenna (Part H).

**a.** As before, use two nuts and one washer on each bolt to prevent self-loosening!

## RUN THE COAXIAL CABLES

120m of coaxial cable (Part I) is delivered with the system which should be sufficient. This cable needs to be cut to length, one for each antenna and connected with a connector at both ends. A crimp tool (Part S) to do so are included in the system. Please follow the following guidelines.

**5.** Measure the required length of cable for the GNSS Antenna “P” (Part D) to connect to the P3 unit inside the wheelhouse. Cut the coax cable (Part I) to that length.

- **a.** Make sure to have 3-5 meters of slack cable per coax cable.

**6.** Take one end of the cut coaxial cable for the GNSS antenna “P” (Part D) and crimp the TNC connector (Part J) to it.

- **a.** Refer to the guidelines in Appendix 2 and/ or watch the video on the provided USB stick.
- **b.** Use a multimeter to ensure there is no connection between the pin and the connector body.

- **c.** Connect the TNC connector to the antenna.
- **d.** Apply self-vulcanizing tape (Part T) to the joint to ensure the connection is waterproof.

**7.** Ensure proper cable management by securing the cable to the railing with cable ties (Part R).

**8.** Run the cable through the wheelhouse’s ceiling to the location where the P3 unit is to be placed.

**9.** Attach the cable tag for the POS antenna (Part N) to both ends of the cable.

10. Measure the required length of the cable for the GNSS Antenna “H” (Part E) to connect it to the P3 unit located inside the wheelhouse. Cut the coaxial cable (Part I) to this length.

    **a.** Make sure to have 3-5 meters of slack cable per coax cable.

11. Take one end of the cut Coax cable for GNSS Antenna “H” (Part E), and crimp TNC Connector (Part J) to the cable.

    **a.** Refer to the guidelines in Appendix 2 and/or watch the video on the provided USB stick.

    **b.** Use a multimeter to ensure there is no connection between the pin and the connector body.

    **c.** Connect the TNC connector to the antenna.

    **d.** Apply self-vulcanizing tape (Part T) to the joint to ensure the connection is waterproof.

12. Ensure proper cable management by securing the cable to the railing with cable ties (Part R).

13. Run the cable through the wheelhouse’s ceiling to the location where the P3 unit is to be placed.

14. Attach the cable tag for the POS antenna (Part M) to both ends of the cable.

15. Measure the required length of cable for the AIS antenna (Part F) to connect to the P3 unit inside the wheelhouse. Cut the coax cable (Part I) to this length.

    **a.** Make sure to have 3-5 meters of slack cable per coax cable.

**16.** Take one end of the cut Coax cable for AIS Antenna (Part F), and crimp N-Connector (Part K) to the cable.

**a.** Refer to the guidelines in Appendix 3 and/ or watch the video on the provided USB stick.

**b.** Use a multimeter to ensure there is no connection between the pin and the connector body.

**c.** Connect the N-connector to the antenna.

**d.** Apply self-vulcanizing tape (Part T) to the joint to ensure the connection is waterproof.

**17.** Ensure proper cable management by securing the cable to the railing with cable ties (Part R).

**18.** Make sure to have 3-5m of slack cable by the antenna in case it needs to be moved later.

**19.** Run the cable through the ceiling of the wheelhouse to the location where the P3 unit is to be placed.

**20.** Attach the Cable tag for the AIS antenna (Part O) to both ends of the cable.

## INSTALL THE P3 UNIT INSIDE THE WHEELHOUSE

**21.** Attach the P3 unit (Part U) to the designated location using the four included screws.

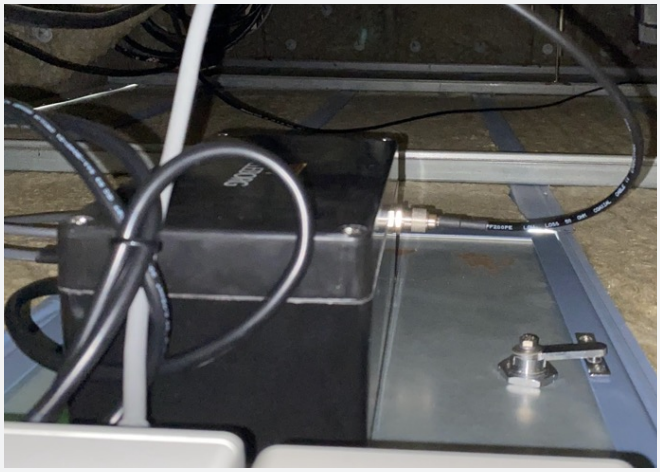
**a.** Make sure the place it is mounted is as free of vibrations as possible.

**b.** The box must be oriented with the antenna connectors towards the bow of the ship.

**22.** Find the coaxial cable labeled “POS” (Part N).

**a.** Crimp the TNC-connector (Part J) to the cable, following the instructions in Appendix 2 and/or the video found on the USB stick (Part W).

**b.** Connect the TNC-connector to the port labeled “P” on the P3 Unit.



**23.** Find the coaxial cable labeled “HDG” (Part M)

**a.** Crimp the TNC-connector (Part J) to the cable, following the instructions in Appendix 2 and/or the video found on the USB stick.

**b.** Connect the TNC-connector to the port labeled “H” on the P3 Unit.

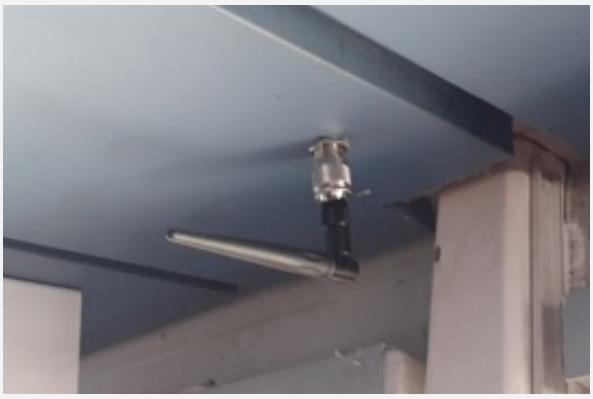
**24.** Find the coaxial cable labeled “AIS” (Part O)

**a.** Crimp N-Connector (Part K) to the cable, following tthe instructions in Appendix 3 and/or the video found on the USB stick.

**b.** Connect the N-connector to the port labeled “A” on the P3 Unit.

**25.** Locate an appropriate position to install the Wi-Fi antenna (Part A) using the supplied cable (Part C).

**a.** Drill a 13mm hole in the roof and mount the TNC-connector to the roof.



**26.** Connect the other end of the cable (Part C) to the TNC-connector on the P3 Unit labled “Wi-Fi”

**27.** Connect the power cable from the P3 Unit to the appliance plug that matches your ship’s outlets.

**a.** Connect this to power (90-240VAC).

**b.** Power on the device and verify that the LED is flashing green.

## FINISHING UP

**28.** Check that cables has been secured with cable ties and that all connectors has been.

**29.** Locate the QR Code (Part Q) and place it in the wheelhouse, near the pilot plug, positioned for easy visibility by the ACP pilot.

**a.** The crew onboard must know where to find the QR code if the pilot asks when boarding the ship.

**30.** Take photographs of all parts of the installation. These images may be needed if you contact support or a technician.

**a.** Picture of the location and mount of the P3 unit

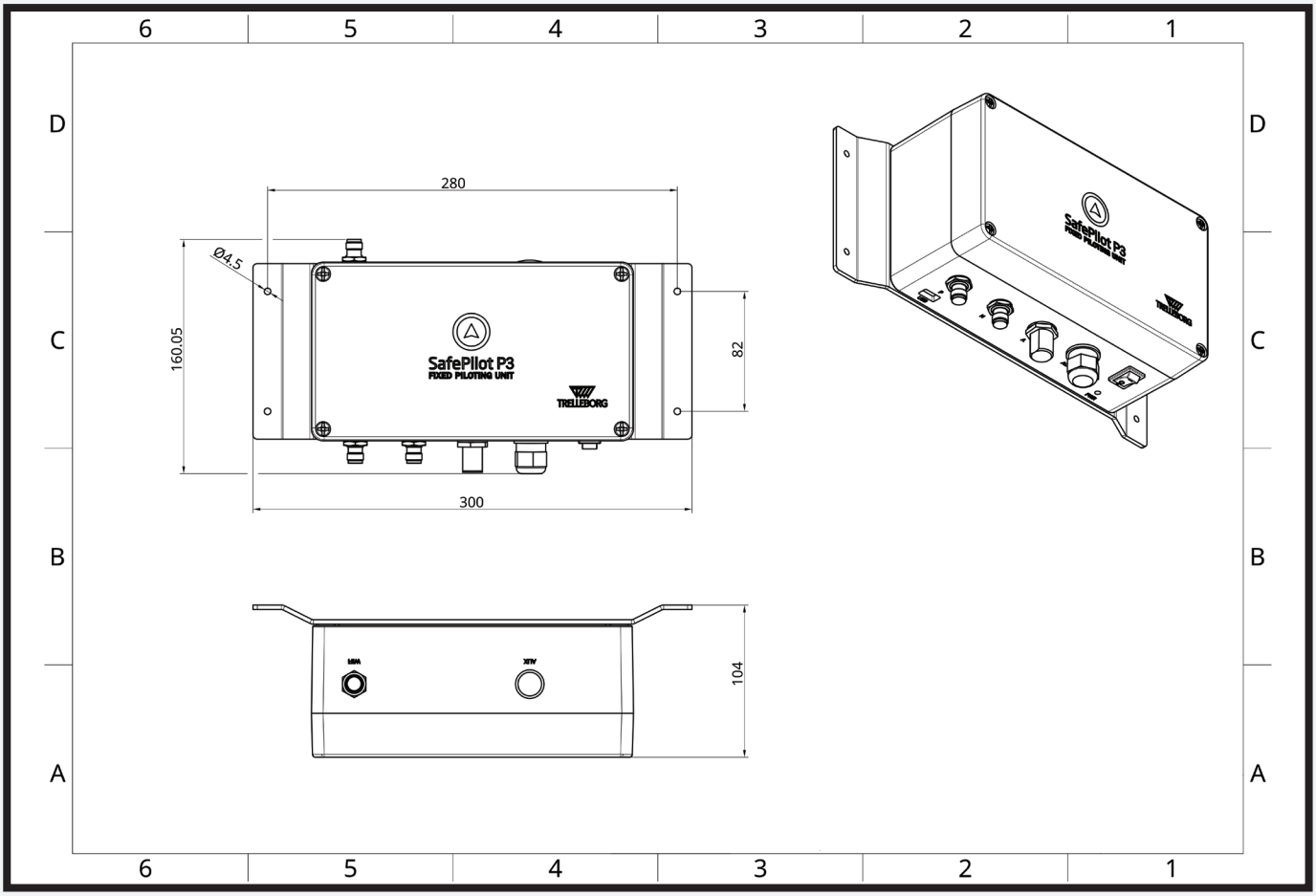
**b.** Picture of the location and mount of Wi-Fi antenna inside the wheelhouse

**c.** Picture of each of the three antennas on top of the wheelhouse.

**d.** Picture of the cable through the ceiling.

**31.** Check functionality according to Appendix 4.

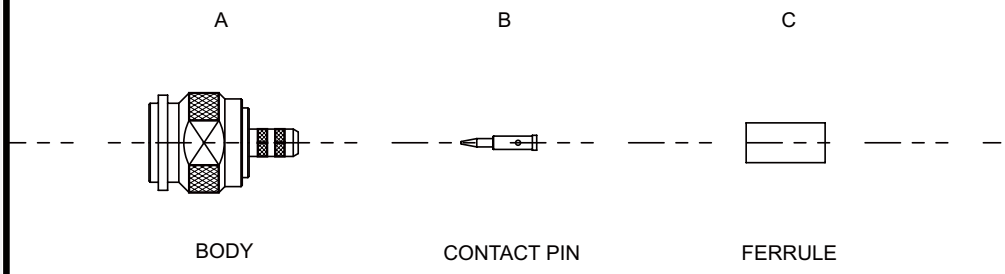
## APPENDIX 1 – MECHANICAL LAYOUT OF P3 UNIT

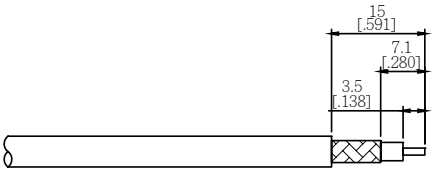
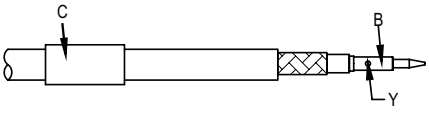
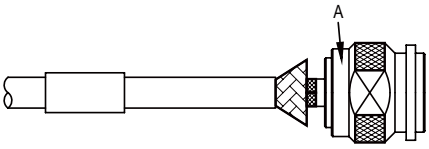
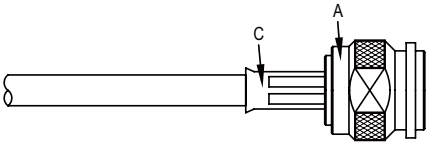


## APPENDIX 2 – INSTRUCTION HOW TO MOUNT TNC CONNECTOR

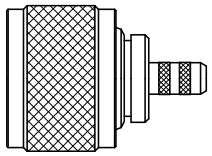
# *CABLE ASSEMBLY INSTRUCTION*

TNC



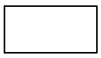

| DIAGRAM | ASSEMBLY INSTRUCTION |
|---|---|
|  | Step 1: STRIP AS SHOWN. |
|  | Step 2: SLIDE FERRULE " C " OVER CABLE.<br>Step 3: PUT PIN " B " ON CENTER CONDUCTOR AND SOLDER OR CRIMP IN " Y ".<br>(USE SQUARE 1.6mm/0.063inch SECTION OF INSERT-B IF CRIMPED) |
|  | Step 4: LOOSEN BRAIDING AND SLIDE CONNECTOR " A " IN PLACE. |
|  | Step 5: SLIDE FERRULE " C " TOWARDS THE CONNECTOR " A " AND CRIMP.<br>(USE 5.5mm/0.217inch HEX SECTION OF INSERT-B) |

## APPENDIX 3 – INSTRUCTION HOW TO MOUNT N CONNECTOR

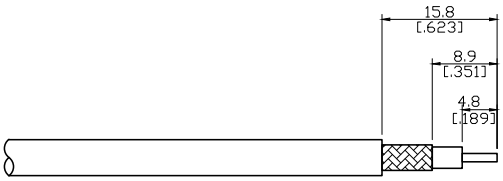
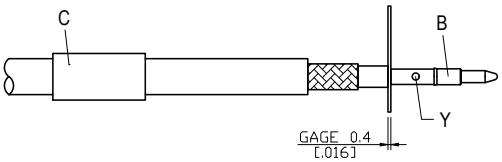
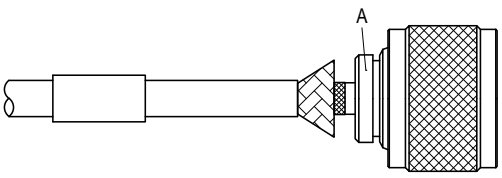
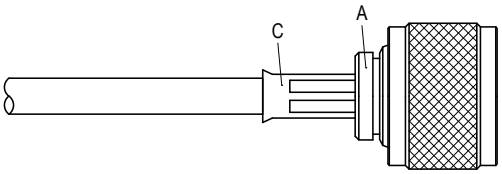


BODY

CONTACT PIN

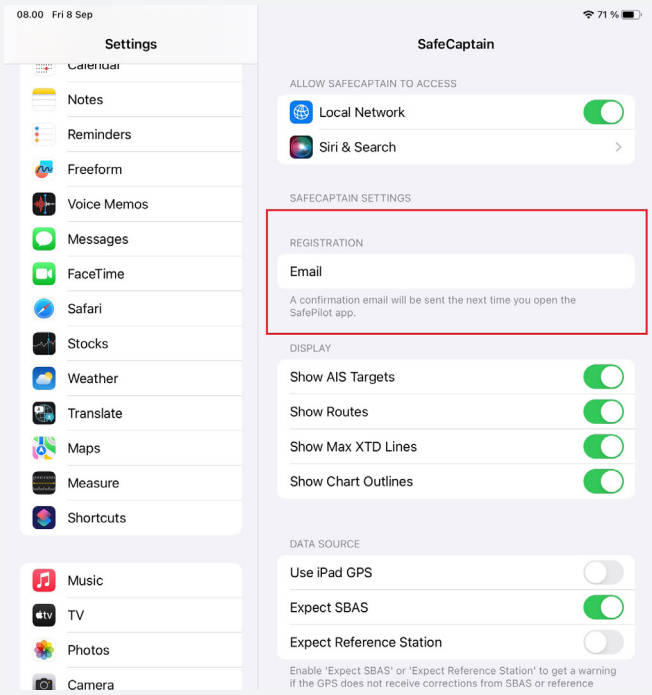


FERRULE

| DIAGRAM | ASSEMBLY INSTRUCTION |
|---|---|
|  | Step 1: STRIP AS SHOWN. |
|  | Step 2: SLIDE FERRULE " C " OVER CABLE.<br>Step 3: PUT 0.4 MM GAGE IN PLACE, INSERT CABLE'S CENTER CONDUCTOR INTO CENTER PIN " B " AND SOLDER OR CRIMP IN " Y ".<br>(USE SQUARE 1.6mm/0.063inch SECTION OF INSERT-B IF CRIMPED) |
|  | Step 4: LOOSEN BRAIDING AND SLIDE CONNECTOR " A " IN PLACE. |
|  | Step 5: SLIDE FERRULE " C " TOWARDS THE CONNECTOR " A " AND CRIMP.<br>(USE 5.5mm/0.217inch HEX SECTION OF INSERT-B) |

## APPENDIX 4 – TEST

1. Register SafeCaptain by entering your email in SafeCaptain Settings.




2. Connect the iPad to a WiFi with internet access and open SafeCaptain.

3. Connect to the SafePilot P3 network.

4. Start the SafeCaptain app.

5. Check that you see GPS/SBAS (Arrow 1) in the quality indicator and that there is a heading (Arrow 2) derived.

6. Check that AIS targets are received (Arrow 3)

7. Bring the iPad to both bridgewings and make sure that data is received. You see that by observing that information is present in the top bar indicated by arrow 1 and 2.

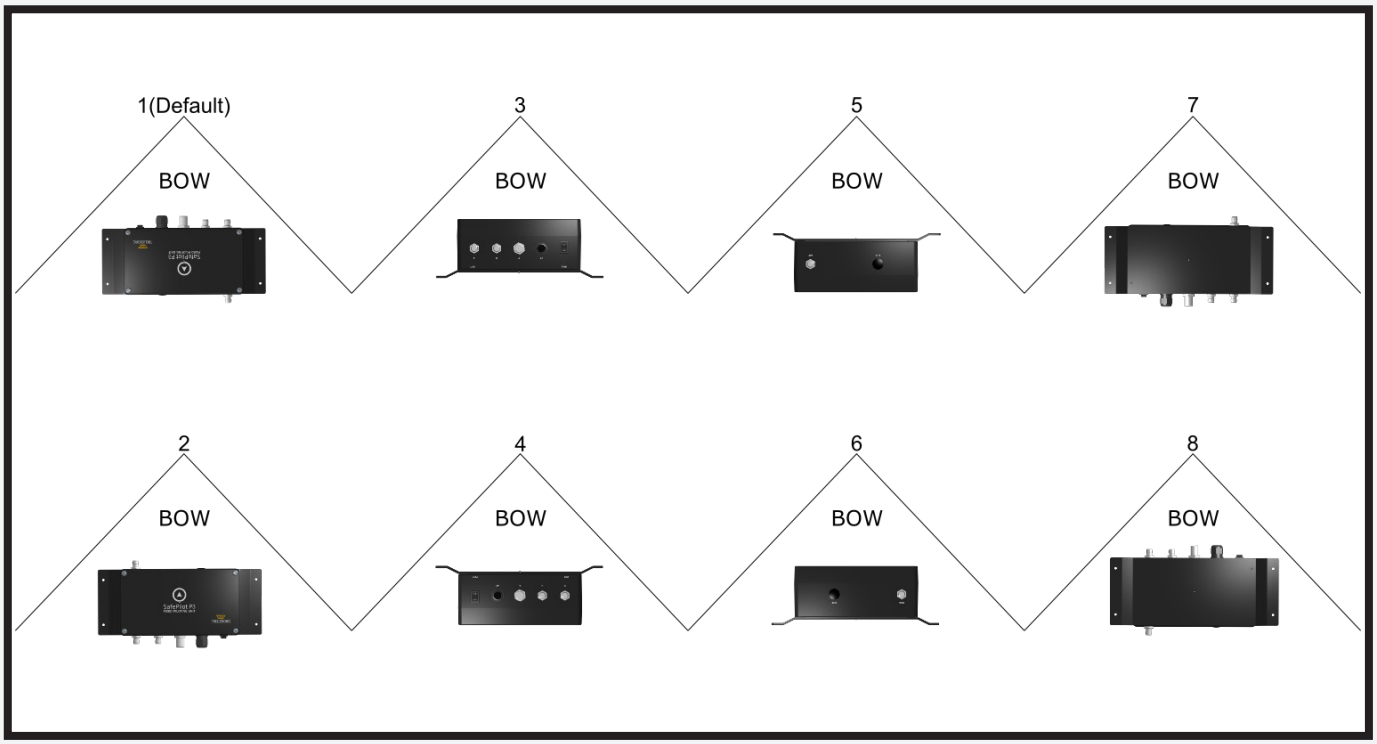
## APPENDIX 5 – MAINTENANCE

| | |
|---|---|
| **EVERY THREE MONTHS** | A visual inspection of the antennas and cables should be performed |
| | Ensure that there is a proper seal on the connector with vulcanizing tape |
| **EVERY FIVE YEARS** | Internal battery within the SafePilot P3 positioning unit must be replaced to remain compliant with ACP requirements |
| | To replace the internal battery email safepilotp3@trelleborg.com before this date |

## APPENDIX 6 – ORIENTATION OF SAFEPILOT P3 UNIT INSIDE THE WHEELHOUSE

The SafePilot Control Unit can be installed in eight different orientations. Below pictures are seen from above, upper left shows the default orientation.

Each orientation has got a number which corresponds to the orientation in the calibration app.



## COMMON ERRORS & TROUBLESHOOTING

For step by step guidance and instructuctions on:

- Registering SafeCaptain
- Updating SafeCaptain
- License Pending (error message)
- Data Validation
- Updating P3 Firmware
- Importing S-57 and S-63 Charts
- Using SafeCaptain
- Panama Canal NPU Certificate

Please see our comprehensive guide by visiting **https://bit.ly/3Q3N78w**.

## FURTHER INFORMATION & GUIDANCE

For generic questions in relation to installation and SafePilot P3 please see our FAQs by visiting **www.safepilotp3.com/support**.

**GET IN TOUCH**
**Technical support | support@safepilotp3.com**
**Logistic: logistics@safepilotp3.com**
**Sales: safepilotP3@trelleborg.com**

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