TRELLEBORG

SafePilot
CAT ROT I-XT
User Guide

VERSION 4.0

Contents

Introduction

The **SafePilot CAT v4** series is a wireless connection between the AIS pilot plug and a portable piloting display, with the added benefit of a rate gyro and microprocessor to improve the standard data coming from the AIS pilot plug. This method facilitates the addition of decimal degrees to the heading information, as well as good quality ROT (Rate Of Turn) data. An advanced internal program handles the calculations, providing a reliable inertial platform needed for crucial positioning predictions; this being especially important in critical turns.
It is common knowledge that very often the position derived from the Pilot plug is not to be trusted. Either the offsets entered are wrong in the AIS transponder or the GPS receiver is of such poor quality that the position wanders around. Therefore we have developed the CAT I which is a standalone GNSS receiver delivering a position with 0.6m accuracy and 1cm/sec speed accuracy. It is a professional GNSS receiver that tracks GPS and GLONASS satellites and performs exceptionally well on positioning and speed accuracies. It also track SBAS satellites used for DGPS positioning.
Instead of using one CAT ROT and one CAT I we have made a Hybrid combining them both in one unit called SafePilot CAT XT. One XT acts as a CAT ROT and is used to forward the AIS data and another XT acts as a CAT 1 and is used to give the positioning. If the one used for positioning is going low on battery they can be swapped. This way you will always have on unit on charge and it is not necessary to charge the units in between jobs.

The TRELLEBORG MARINE SYSTEMS SafePilot systems are to be used as a secondary navigational aid and do not release the user (pilot, captain, navigator etc.) from any 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 to be noted that the SafePilot systems and software do not overrule/substitute the navigation system (charts, ECDIS) installed on board by law.

Unpacking

SafePilot CAT ROT includes:
1 pc. CAT Rot v4 with integrated rechargeable battery.
1 pc. Y-Cable (2metres) Charging and Pilot Plug.
1 pc. USB Charger
1 set of adapters (3 in total) to match EU, UK, USA, Japan, AUS standards.
1 pc. Short form user guide

SafePilot CAT I includes:
1 pc. CAT Rot v4 with integrated rechargeable battery.
1 pc. Charging cable
1 pc. USB Charger
1 set of adapters (3 in total) to match EU, UK, USA, Japan, AUS standards.
1 pc. Short form user guide

SafePilot CAT XT includes:
1 pc. CAT Rot v4 with integrated rechargeable battery.
1 pc. Y-Cable (2metres) Charging and Pilot Plug.
1 pc. USB Charger
1 set of adapters (3 in total) to match EU, UK, USA, Japan, AUS standards.
1 pc. Short form user guide

Additional value:

SafePilot Navigational software on iPad.

Operating the CAT ROT

Place the CAT ROT on a horizontal surface where it can be left and not moved during operation. It is important that the CAT ROT is horizontal and not moved during operation since this will interfere with the Rate Gyro computations. Connect the cable between the AIS pilot plug and the CAT ROT and turn on the CAT ROT by pressing the power button. When connected to an AIS plug the unit will flash blue until it receives AIS NMEA data and then it will emit steady blue. A steady blue light indicates that the CAT ROT is working properly. Now you can connect to the Wi-Fi network called "SafePilot CAT (xxxxxxxxx)" and you will start to receive data on the UDP port 17608. If a CAT I is used in conjunction with the CAT ROT it is recommended that these are turned on near one another and when the two are paired you will see a short flash green simultaneously on the two units which indicates that these two are paired.

*Once the unit is powered and being used, **do not move or replace the unit,** as this will affect the inertial calculation, giving faulty heading, ROT and position. Should this happen it can take up to 2 minutes before the data are stable again.*

In case the Pilot plug fails it is possible to use the CAT ROT in backup mode and use the built in GPS receiver. It then provides position, COG and SOG.
NOTE:
In this case nothing is connected to the ship's gyro (via the AIS plug), so we have no heading information and the Rate Of Turn cannot be calculated since the heading is used for calibration Of the internal Rate gyro.

LED guide:
The following instances of LED colours can occur on your CAT ROT

- Slow flashing Blue – Powered ON but no data from Pilot plug and no GPS position
- Steady Blue – Data from Pilot plug or GPS position computed
- Fast flashing Red – Battery critically low
- Slow flashing Red – Charging
- Steady Red – Fully charged
- Fast flashing Green – Firmware upgrade mode (Contact TMS DK for upgrade guide)
- Steady Green – General failure (Contact TMS DK if persistent)
- Flashing Green/Red – Internal Wi-Fi failure (Contact TMS DK if persistent)

Unit placed in bridge wing (GPS mode)

Typical location in wheel house

Wireless Interface

Wi-Fi

The CAT ROT has got an IEEE 802.11 b/g/n Wi-Fi interface that complies with the FCC, IC, ETSI, TELEC, Wi-Fi standards. The range of the Wi-Fi is >200m with a clear line of sight. On a ship with a lot of metal structures this range cannot be achieved but if the unit is placed on monkey island it will cover the entire bridge. One thing that can reduce the range of the Wi-Fi is if the windows have built in heat.

The CAT ROT / I / XT work by default on Wi-Fi channel 11. It is possible to change this channel in case there is a lot of traffic on this channel in the harbour. Contact us for support on this issue.

The CAT ROT works as an AP with a DHCP server. It can forward data to three different listeners (e.g. 3 I-pads with SafePilot). The Wi-Fi network is called "SafePilot CAT (xxxxxxxxxx)" and the password is "86912255"

The name of the Wi-Fi network is unique and the CAT I will automatically detect the CAT ROT and connect to it. The criteria is that the CAT I will connect to the CAT ROT with the strongest Wi-Fi signal. Once connected these two units will stay paired together until they are switched off.

All data from the CAT ROT are forwarded on the Wi-Fi network as UDP packages to the UDP port 17608.

Best Wi-Fi range

In order to obtain the maximum Wi-Fi range it is recommended to place the CAT ROT with the arrow on the housing pointing towards the bow of the vessel. If a CAT I is used, it should be placed likewise with the arrow pointing towards the bow. The reason is that the Wi-Fi antenna inside the CAT units is directional as illustrated below and this way the Wi-Fi will cover the entire bridge and also have maximum range towards the CAT I.

AIS Pilot Plug Mode

AIS Pilot Plug

The CAT ROT/XT connects to the AIS pilot plug with the supplied cable. The cable has got a standard plug used for pilot plugs and a SafePilot specific connector at the other end. The USB cable on this Y-cable is used for charging and it can be done while the unit is in operation on-board the vessel.

Sometimes the installation of the AIS transponder do not follow the wiring standard on the pilot plug, and this can mean opposite polarity on the data wires as well as using other pins in the plug. The SafePilot CAT ROT/XT units take care of this automatically once the unit is connected to the pilot plug.

Heading and ROT

The heading (gyro) data coming from the AIS pilot plug are **not** provided with decimal degree due to the format approved for the AIS. This means, that it is not possible to calculate and display usable ROT data based on the heading output from the pilot plug. The integrated rate gyro in the CAT ROT and the internal algorithms has the necessary accuracy and power to calculate the decimal degrees, thus providing good quality ROT data. Using this method ensure that predictions shown on the PPU are reliable.

In order to provide accurate Heading and Rate Of Turn it is important that the unit is placed horizontally !

AIS Data Format

The data format from the CAT ROT is standard NMEA AIS with added information provided by the CAT ROT.

More than 80% of all AIS transponders do not provide Rate Of Turn in the NMEA AIS message even though it is part of the message. Our CAT ROT/XT has a built in Rate gyro which computes a very accurate Rate Of Turn. This calculated value is implemented into the NMEA AIS message before it is forwarded onto the Wi-Fi network. Furthermore the CAT ROT/XT output NMEA HDT and ROT next to the NMEA AIS message. This is because there are no decimal degrees in the NMEA AIS message format but the CAT ROT/XT is capable of adding this value. Also the Rate Of Turn information in the NMEA AIS message is not very accurate at high Rate Of Turn, therefore the CAT ROT/XT add the NMEA ROT message.

Here you find an example of the data format.

UDP Port 17608:

$HEHDT,169.500,T*24
$HEROT,-0.014,A*03
!AIVDO,1,1,,,11mg=5@P2b0iLq2OsI@nJwwp0000,0*10

PMARS

This is a status message sent out giving various information to the navigation software. It is a TRELLEBORG MARINE SYSTEMS specified NMEA message with the following elements:

Message identifier: $PMARS

CAT code.

The type of CAT this is.

0 = CAT ROT v2

1 = CAT I

2 = CAT ROT XT (AIS)

3 = CAT ROT XT (GPS)

4 = CAT ROT v3

5 = CAT I v3

6 = CAT I v3 (BeiDou)

7 = CAT ROT v4

8 = CAT I v4

9 = CAT XT v4 (AIS)

10 = CAT XT v4 (GPS)

Scrambled Mac Address element A

Scrambled Mac Address element B

Charging battery

0 = Not charging

1 = Charging

Battery level code

0 = Critical, will turn off automatically. Most likely this value will never be seen.

1 = Low battery level

2 = Medium battery level

3 = High battery level

4 = Very High battery level

Firmware version

Formatted as a string like "CatXt v0.0.00"

* is a fixed separation before the checksum.

00 is the NMEA checksum. See NMEA 0183 standard for details.

). <CR><LF> End of the message.

CAT I/XT in GPS Mode

The GPS antenna is located below the cross on the lid of the unit. Do not cover this during operation, as this will affect the performance and accuracy of the GPS in backup mode. Avoid placing the unit nearby large objects when the unit is in GPS mode, as this may give unwanted shadows or reflections resulting in poor GPS stability. Avoid locations nearby ships' transmitting antennas and radar scanners.

GPS Data Format
The data format from the CAT I/XT(GPS) is standard NMEA messages. It provides NMEA GGA, VTG, GSA and GSV

Here you find an example of the data format.

UDP Port 17610:

$GPGGA,113715.000,5614.8746,N,01004.6049,E,2,8,1.07,63.8,M,43.2,M,3,0124*6C
$GPGSA,A,3,27,22,04,28,11,14,19,32,,,,,1.37,1.07,0.85*0B
$GPGSV,3,1,09,04,83,241,41,11,71,257,43,32,54,207,51,19,44,169,51*7D
$GPGSV,3,2,09,14,40,091,40,22,34,066,32,28,28,297,41,39,24,161,43*7E
$GPGSV,3,3,09,27,16,159,40*4B
$GPVTG,7.79,T,,M,0.02,N,0.04,K,D*37

Charging the Unit

IMPORTANT ! SafePilot CAT ROT/I/MAX charger compatibility

Use only chargers which are USB 2 and/or Quick Charge 1.0 compatible.

Quick Charge 2.0 and onwards may damage the internal charging circuitry in the SafePilot hardware. These quick charge devices uses higher voltage than the 5V which the SafePilot devices are designed for.

The charger provided is a USB charger capable of outputting 5V, 2.0A. It will charge the CAT ROT/I/XT from a flat battery in 5 hours. Using another charger is not recommended and we cannot guarantee the charge time. When the CAT ROT is connected to a charger and it is charging it will flash red. Once fully charged it will emit steady red.

If the CAT ROT/XT is out of power you can connect it to a PC that is capable of providing 5V 0.5A on the USB port. This is enough for the CAT ROT/XT to operate and it will also be charging.

The internal battery is a Lithium Ion battery capable of supplying the CAT ROT for 18 hours, CAT I for 14 Hours, XT in AIS mode for 18 Hours and finally the XT in GPS mode for 14 Hours. The charge status of the battery to the pilot display. If SafePilot is used you see the current charge.
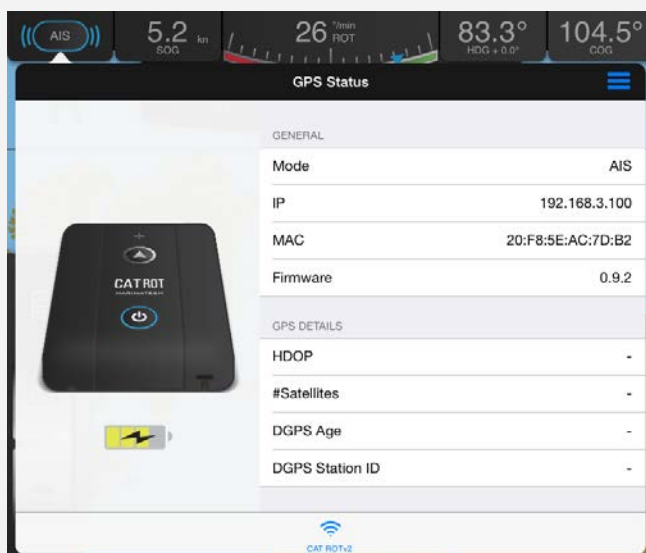
Technical Data

CAT ROT v4

Wireless transmission on Wi-Fi Channel 11, frequency: 2.462 GHz(Can be changed on request)
Data input: RS 422A, standard AIS format
Range: >200m line of sight, 50-100 meters on onboard vessel
Rate Of Turn accuracy (in AIS mode): < 0.5 deg. /min.* (2 min. initialization)
Rate Of Turn stability: < 1 deg./min.*
Settling time in AIS mode: 1-2 min.
GPS standalone accuracy: 5 m RMS
EGNOS/MSAS/WAAS/GAGAN is automatic. When available accuracy < 3m RMS
Speed accuracy +/- 0.1 kts (in GPS mode)

Temperature range operation: -20 to +50 deg. C
Temperature range storage   : -25 to +65 deg. C
Unit protection: IP 65
Compliance: CE
Battery capacity > 18 hours
Charging time from low bat. Approx. 6 hours
Battery life time: > 3-5 years
Battery type: Lithium Ion 3,7V 5200mAH
Size: H 25 x L 138 x W 100 mm
Weight: 330 g

Charger adaptor input 100-240 VAC – 50/60 Hz, 0.5 Amp.
Charger output: 5 VDC, 2.0 Amp
Net adapters: EU, UK, USA, Japan, AUS standards
Approvals: CE, UL, TUV, GS, CCC

If a USB charger of the type DCP or Non standard is used the CAT ROT will charge with 1500 mA.
If a USB charger of the type SDP or CDP is used the CAT ROT will charge with 500 mA.

It is entirely the user's responsibility that the chargers are capable of supplying the above current!

CAT I v4

Works only with E-Sea Fix CAT ROT v.4
Wireless transmission on Wi-Fi Channel 11, frequency: 2.462 GHz(Can be changed on request)
Range: >200m line of sight, 50-100 meters on onboard vessel
GPS standalone accuracy: 1.7 m RMS
GNSS constellations: GPS-GLONASS / GPS-BeiDou
EGNOS/MSAS/WAAS/GAGAN is automatic. When available accuracy < 0.6m RMS
Speed accuracy 1cm/sec RMS
Time to first fix, cold start: 65 sec.
Time to first fix, hot start: 35 sec.

Temperature range operation: -20 to +50 deg. C
Temperature range storage   : -25 to +65 deg. C
Unit protection: IP65(IP67 available)
Compliance: CE
Battery capacity > 14 hours
Charging time from low bat. Approx. 5 hours
Battery life time: > 3-5 years
Battery type: Lithium Ion 3,7V 5200mAH
Size: H 25 x L 138 x W 100 mm
Weight: 410 g

Charger adaptor input 100-240 VAC – 50/60 Hz, 0.5 Amp.
Charger output: 5 VDC, 2.0 Amp
Net adapters: EU, UK, USA, Japan, AUS standards
Approvals: CE, UL, TUV, GS, CCC

If a USB charger of the type DCP or Non standard is used the CAT I will charge with 1500 mA.
If a USB charger of the type SDP or CDP is used the CAT I will charge with 500 mA.

It is entirely the users responsibility that the chargers are capable of supplying the above current!

CAT XT v4

Wireless transmission on Wi-Fi Channel 11, frequency: 2.462 GHz(Can be changed on request)
Range: >200m line of sight, 50-100 meters on onboard vessel

GPS Mode
GPS standalone accuracy: 1.7 m RMS
GNSS constellations: GPS-GLONASS / GPS-BeiDou
EGNOS/MSAS/WAAS/GAGAN is automatic. When available accuracy < 0.6m RMS
Speed accuracy 1cm/sec RMS
Time to first fix, cold start: 65 sec.
Time to first fix, hot start: 35 sec.

AIS Mode
Rate Of Turn accuracy (in AIS mode): < 0.5 deg. /min.* (2 min. initialization)
Rate Of Turn stability: < 1 deg./min.*
Settling time in AIS mode: 1-2 min.

Temperature range operation: -20 to +50 deg. C
Temperature range storage   : -25 to +65 deg. C
Unit protection: IP65(IP67 available)
Compliance: CE
Battery capacity > AIS mode: 18 hours / GPS mode: 14 hours
Charging time from low bat. Approx. 5 hours
Battery life time: > 3-5 years
Battery type: Lithium Ion 3,7V 5200mAH
Size: H 25 x L 138 x W 100 mm
Weight: 410 g

Charger adaptor input 100-240 VAC – 50/60 Hz, 0.5 Amp.
Charger output: 5 VDC, 2.0 Amp
Net adapters: EU, UK, USA, Japan, AUS standards
Approvals: CE, UL, TUV, GS, CCC

If a USB charger of the type DCP or Non standard is used the CAT I will charge with 1500 mA.
If a USB charger of the type SDP or CDP is used the CAT I will charge with 500 mA.

It is entirely the users responsibility that the chargers are capable of supplying the above current!

Appendix

Firmware upgrade

In order to access the firmware upgrade mode you need to press the power button until the LED goes from Blue – Purple – Green. Then release the button and the LED will Slow flash Green. Now press the button again for 3 seconds until the LED goes to Quick flashing Green. Connect the USB cable to a PC and open the drive "SAFEPILOT".

Delete the firmware.bin and copy the new firmware to the drive.
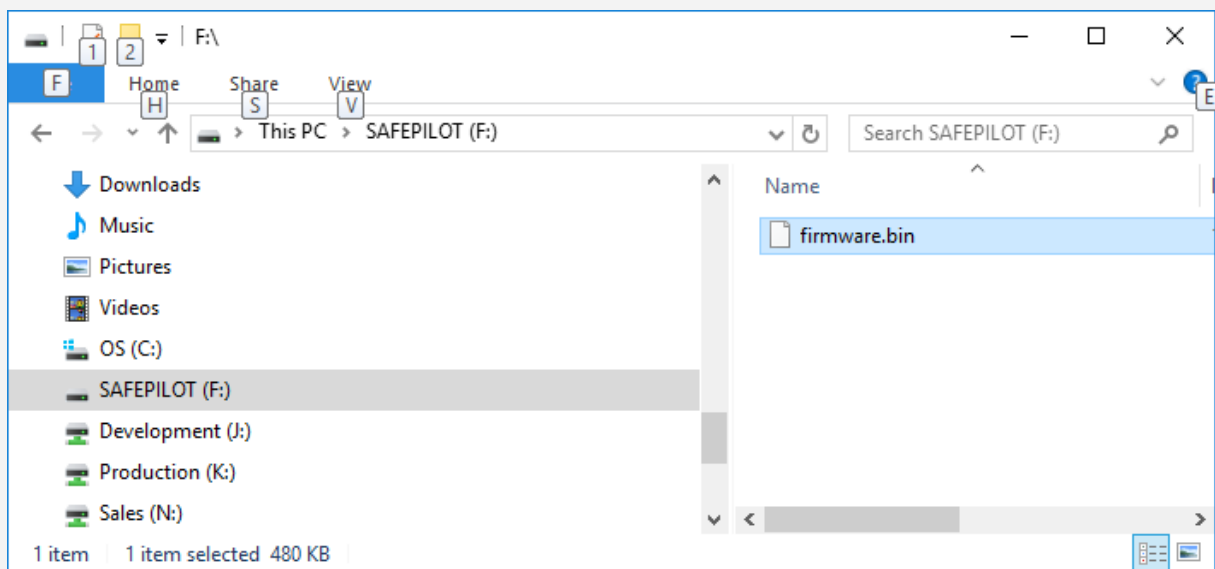
Automatic Power Off

In order to make sure that if a CAT ROT / CAT I / XT is powered ON by mistake in a bag or similar we have introduces an automatically power OFF feature.
It work as follows:
If the CAT ROT / XT AIS is powered ON by accident in the bag it will automatically power OFF as long as it does not get any data from the pilot plug or obtain a position after 10 minutes.
If the CAT I / XT GPS is powered ON by accident in the bag it will automatically power OFF as long as it does not obtain a position after 10 minutes.

The Automatic power OFF feature can be disabled on request. Contact Trelleborg Marine Systems for instructions.

Troubleshooting

CAT ROT connected to AIS pilot plug and no data received
- Make sure that the cable is properly connected
- Check that the status LED is emitting Blue
- Check that Wi-Fi is connected to "SafePilot CAT (xxxxxxxxx)"
- Disable firewall in Windows
- Release and renew the IP address on PC
- Make sure that no more than 3 portable pilot displays are connected to the CAT ROT/XT AIS

No data received from CAT I/XT GPS
- Check that the status LED is emitting Purple(meaning that it has got a position and is connected to the CAT ROT/XT AIS)
- Make sure that the CAT 1/XT GPS is placed at a location outside where it has unobstructed view to the sky
- Check that Wi-Fi is connected to "SafePilot CAT (xxxxxxxxx)"
- Relocate the CAT I/XT GPS to a location where it has got a better view towards the CAT ROT/XT AIS
- Turn the unit OFF and re-pair it with the CAT ROT/XT AIS

No position received from CAT I/XT GPS
- Check that the status LED is emitting Purple(meaning that it has got a position and is connected to the CAT ROT/XT AIS)
- Make sure that the CAT 1/XT GPS is placed at a location outside where it has unobstructed view to the sky
- Re-locate the CAT I/XT AIS to another location. Some antenna might be jamming the GPS receiver.

TRELLEBORG

Trelleborg is world leader in engineered polymer solutions that
seal, damp and protect critical applications in demanding
environments. Its innovative engineered solutions accelerate
performance for customers in a sustainable way. The
Trelleborg Group has annual sales of about SEK 21 billion
(EUR 2.3 bilion, USD 3.2 billion) in over 40 countries. The
Group comprises five business areas: Trelleborg Coated
Systems, Trelleborg Industrial Solutions, Trelleborg Offshore
& Constructions, Trelleborg Sealing Solutions and Trelleborg
Wheel Systems. In addition, Trelleborg owns 50 percent of
Trelleborg Vibracoustic, a global leader within antivibration
solutions for light and heavy vehicles, with annual sales of
approximately SEK 15 billion (EUR 1.7 billion, USD 2.3 billion)
in about 20 countries. The Trelleborg share has been listed on
the Stock Exchange since 1964 and is listed on NASDAQ
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