JRC

ALPHATRON Marine

AlphaRiverTrackPilot

for inland vessels

User Manual

www.jrc-world.com

Contents

I Preface

I.1 Revision History

Revision	Description	Author	Date
V1.0	First release		1 - October - 2018
V1.1	Added drawing		27 - March - 2019
V2.0	Update to new version		26 - January - 2021

I.2 Abbreviations

Abbreviation	Explanation
CPU	Central Processor Unit
ECDIS	Electronic Chart Display Information System
GPS	Global Positioning System
IP rating	International Protection rating
LED	Light-Emitting Diode
LTE	Long Term Evolution
PLC	Program Logic Controller
Vdc	Volt direct current
NMEA	National Marine Electronics Association
GGA	NMEA sentence: Global Positioning System Fix Data
HDT	NMEA sentence: Heading Degrees, True
ROT	NMEA sentence: Rate Of Turn
VTG	NMEA sentence: Track Made Good and Ground Speed

Table 1: List of Abbreviations

II Safety Instructions

This manual applies only to the track control system AlphaRiverTrackPilot. It does not apply to the autopilot system (ROT control), the rate of turn(ROT) sensor and indicator, the GPS receiver nor the rudder control system. For a safe operation of the track control system the following safety instructions must be respected:

- Read the complete manual before activating the track control system.
- Keep this manual at hand for all users of the track control system.
- Maintenance and installation must only be carried out by qualified persons.
- **Risk of electric shock or physical damage!** Always disconnect power to the track control system before performing any maintenance. Make sure the track control system can not be switched on accidentally.
- Follow the local rules concerning accident prevention and environmental protection.
- Follow the general safety instructions of the country where the track control system is used.
- Make sure the track control system is only used when in perfect technical condition.
- The skipper must monitor the operation of the track control system at any time and switch back to manual control in case of an error.
- The track control system has only one sensor for determining the position and orientation of the ship (GPS compass). If there is an undetected failure of the sensor there may be large deviations from the selected track. Especially beneath bridges and close to large buildings, reception of GPS signals is deteriorated, and thus the track control system must be monitored carefully.
- There is no warranty that the tracks delivered with the track control system are free of errors.
- The track control system is not an autonomous system that reacts to the surrounding traffic. The skipper is fully responsible to comply with the laws and regulations of inland navigation.
- At the beginning of each trip, the skipper must make sure that switching between track control, autopilot and emergency steering works correctly.
- If an alarm is signaled by the track control system, switch over to manual or emergency steering. Once the alarm is resolved, the track control system can be activated again.

1 Description

AlphaRiverTrackPilot is a track control system for inland vessels. It is designed to assist in navigation by steering the ship along pre-defined guiding lines. The track control system computes the steering commands such that the center of gravity of the ship follows the guiding line with a small cross track error. The steering commands are sent to the autopilot system as values for desired rate of turn (ROT). The autopilot system controls the rudder angle so that the ship turns as required by the track control system. The position, orientation and motion of the ship are measured using a GPS compass together with a ROT sensor (gyro).

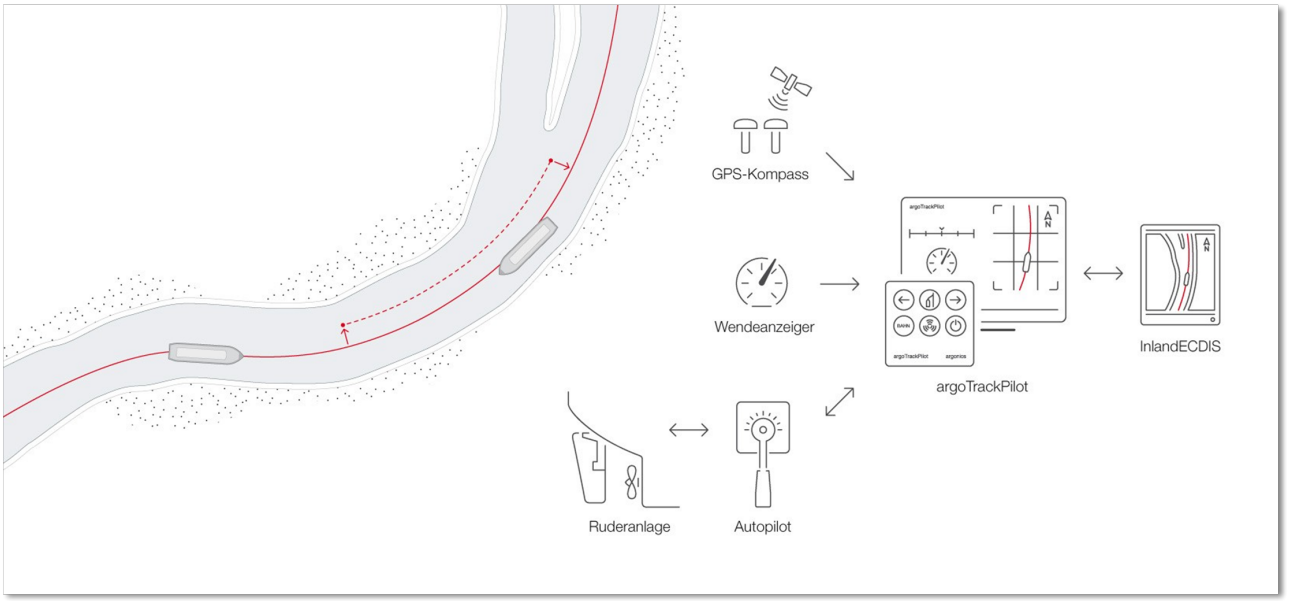


Figure 1: Overview navigation

The track control system features a network interface for inland ECDIS chart displays. At first, the chart display shows the selected guiding line. Later, using the chart system, it is possible to select other guiding lines or create new guiding lines according to personal experience and send them to the track control system.

For passing and encounter of other vessels there is an adjustable offset to the guiding line. The offset is changed using the joystick on the control panel, a button on the touchscreen serves to reset the offset to zero. When an offset has been set, a new parallel guiding line is computed by the track control system and displayed, in red, in the chart system.

The track control system is delivered together with a touchscreen that displays the most important data of the control system. It is possible to select different configurations and control parameters i.e. for different loading conditions. The touchscreen also displays alarms and warnings.

The track control system can be delivered with an optional LTE modem for remote monitoring and maintenance.

1.1 Limitations

The track control system performs an extensive analysis of the sensor data to be able to detect errors of the GPS receiver and the ROT sensor. The detection of errors is subject to the technical possibilities. Detected errors are displayed on the touchscreen. Severe errors will trigger an additional acoustic alarm. In case of such a severe error, it is required to switch to manual steering.

Since there is only one single sensor for the measurement of the position and attitude of the ship, there is no guarantee that every possible error of the sensor is detected. If there is an undetected failure of the sensor there may be large deviations from the selected track. Especially beneath bridges and close to large buildings, reception of GPS signals is deteriorated and thus the track control system must be monitored carefully. Someone must monitor the operation of the track control system at any time and switch back to manual control in case of an error. The track control system is not an autonomous system that reacts to the surrounding traffic.

The skipper is fully responsible to comply with the laws and regulations of inland navigation.

2 System Overview

The following diagram shows a functional overview of the AlphaRiverTrackPilot system for inland vessels.

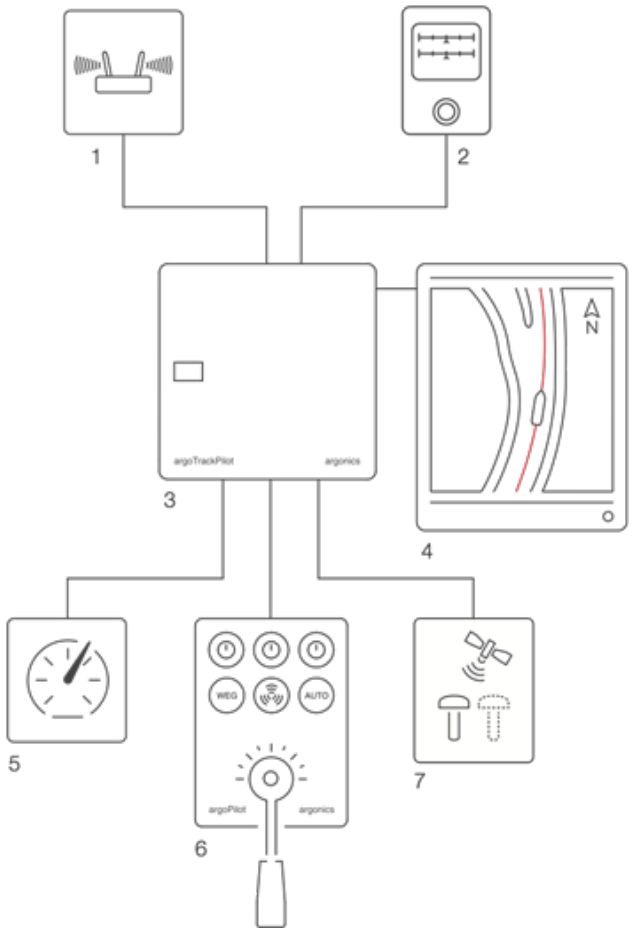


Figure 2: Functional drawing of the AlphaRiverTrackPilot

The individual parts are:

1. LTE modem
2. Control panel Alphatron
3. Control cabinet argoTrackPilot
4. ECDIS
5. Rate of turn indicator
6. Autopilot
7. GPS compass

2.1 Scope of Delivery

The delivery of the AlphaRiverTrackPilot comprises of:

- Control cabinet with AlphaRiverTrackPilot
- Control panel with joystick and touchscreen 7" for table top mounting
- Optional: LTE modem

2.2 Technical Data

Control cabinet	
Supply voltage	18 Vdc ... 32 Vdc
Supply current	1.5 A
Ambient temperature	-25 °C ... 60 °C
Storage temperature	-40 °C ... 85 °C
Relative humidity	5% .. 95%
Dimensions	Width: 380mm, Height: 380mm, Depth: 210mm
Weight	11 kg

Control panel	
IP rating	Front IP56 / Back IP22
Dimensions	Width: 160mm, Height: 180mm, Depth: 72mm
Dimensions for mounting hole	Width: 138mm, Height 172mm
Weight	1.2 kg

For the dimensions of the AlphaRiverTrackPilot see *Figure 6: Dimensions of the AlphaRiverTrackPilot* on page 23.

3 Operation

The touchscreen of the control panel shows the most important data of the control system. Via the touchscreen it is possible to adjust and reset the offset to the guiding line, and select different configurations and control parameters for different loading conditions. The touchscreen also displays detailed alarm and warning information.

3.1 Touchscreen Interface

The following figure shows the structure of the touchscreen interface. The default page is the "Track Pilot" page (left). Using the "PROFILES" button the configuration selection page for different loading conditions is reached (top left). By pressing "MENU", the central selection page is shown. From the "MENU" page, the "GuidingLines" (top left), the "Firewall" (top middle), the "Joystick test" (top right), the "ABOUT" (lower left), "LANGUAGE" (bottom middle) and the "NEWS" (bottom right) can be reached. The "ABOUT" page displays information about the version of the user interface and the track control software. The following chapters give more detailed information about each of the pages of the touchscreen interface control.

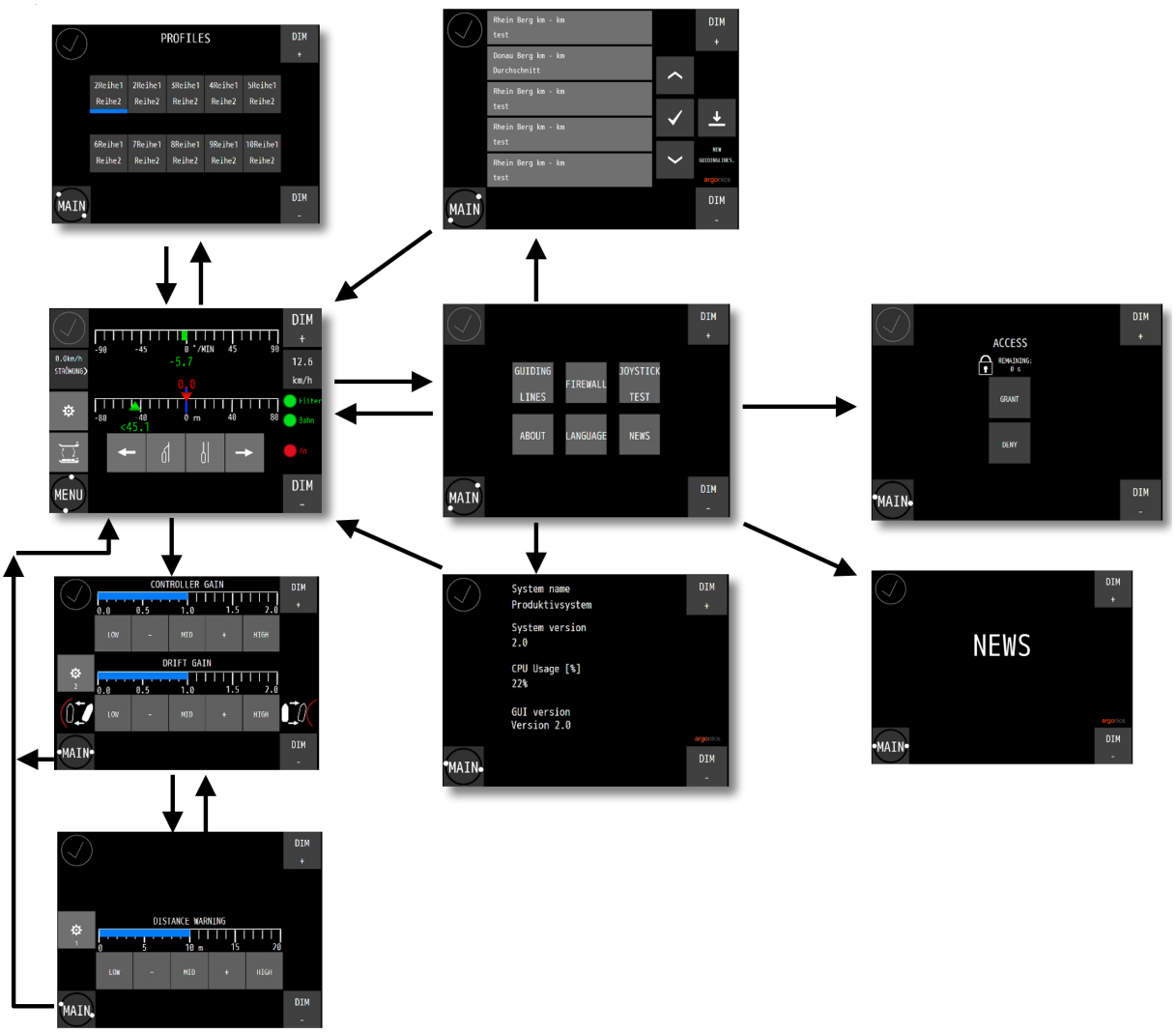
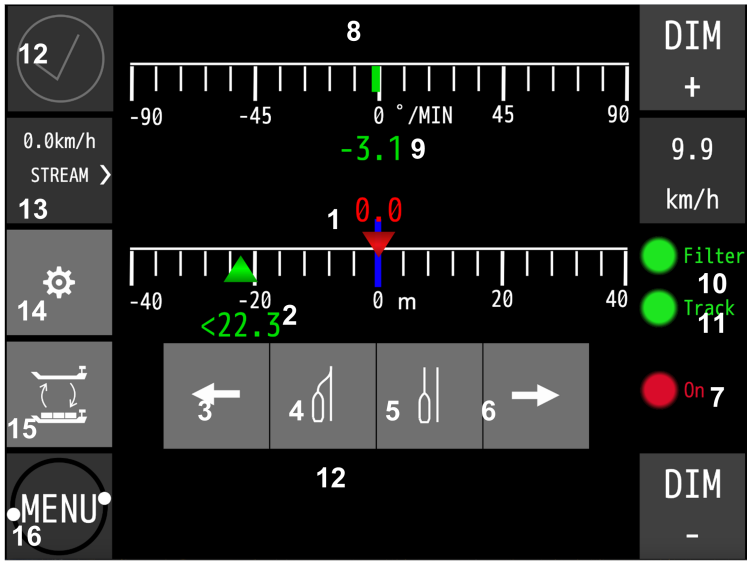


Figure 3: Pages on touchscreen interface

3.1.1 Track Pilot

The Page "**Track Pilot**" shows the most important information concerning the TrackPilot:

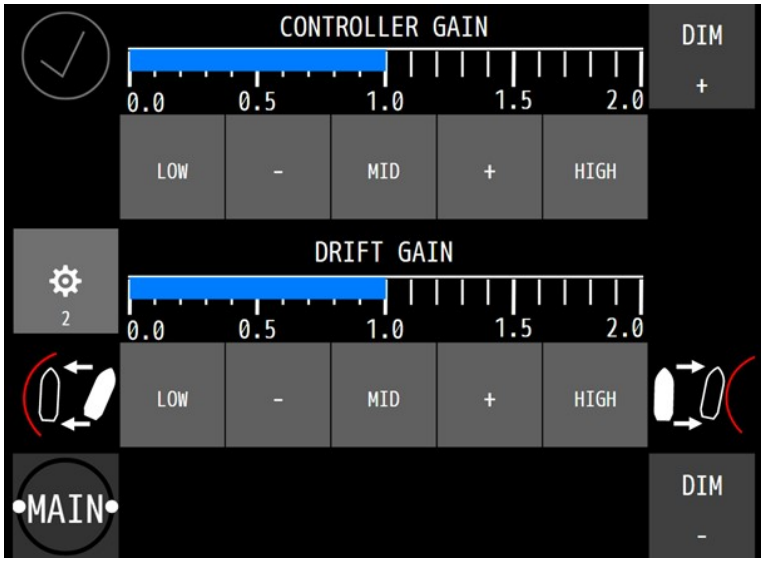


1. **Current** offset (Distance between original guiding line and parallel line): The blue line at 0.0m offset corresponds to the original guiding line. The red label displays the current offset. If the red label is to the left of the blue line, the ship will move at the desired offset to the port side of the original line, and vice versa.
2. **Current cross track error** in relation to the desired offset. The figure shows a cross track error of 22.3m to the port side of the parallel line.
3. **Adjust port:** Move parallel line to the port side.
4. **Reset offset:** Move parallel line to the original line.
5. **Adjust to current offset:** Move parallel line to the current position.
6. **Adjust starboard:** Move parallel line to starboard side.
7. **Run:** A green light shows the state (ON) of the track control system.
8. **ROT command** to autopilot system in °/min displayed in red.
9. **ROT** of the ship in °/min. To achieve good performance of the TrackPilot it is important that the autopilot system is able to follow the ROT command without much delay and without overshoot.
10. **Filter:** State of the position estimation system. Track control can not be switched on if state is not OK (red light). If the track control system is already switched on, and an error occurs, the "Filter" light turns red. This can happen when passing bridges and the GPS signal is lost. Short losses of GPS signal are compensated by dead reckoning and are not a problem. If the signal is lost for a longer time, an alarm will be activated.
11. **Track:** State of the current guiding line. Track control can not be switched on if state is not Ok (red light). If the track control system is already switched on and an error is detected, the "Track" light turns red and an alarm is activated. The system checks if the guiding line in front of the ship is long enough and if there are very sharp turns.
12. **Alarm area:** Alarms and warnings are signaled in this area (see *Alarms* on page 18).To show the alarm description, press the alarm symbol. Alarms are shown in red color, warnings are shown in yellow color. Alarms can only be acknowledged and reset by switching off track control. To acknowledge a warning, press and hold the warning symbol. The warning symbol changes to an exclamation mark when the warning has been acknowledged.
13. **Stream config:** Opens a menu to set up the stream velocity in km/h and the direction of travel, upstream or downstream. With this setting the control system is able to compensate for effects of the rivers current. This setting is especially important for a good performance of the control system in turns because it determines the desired drift angle. The skipper needs to estimate the speed of the current and select the corresponding setting.
14. **Configuration:** Opens the configuration menu. see *Configuration* on page 10.
15. **PROFILES:** Opens the profiles menu. See *Profiles* on page 11.
16. **Menu:** Opens the menu for further pages.

3.1.2 Configuration

3.1.2.1 Configuration page 1

The page "CONFIGURATION" contains important settings for the track control system that does have a direct impact on the performance of the track control system. It is important to adjust the correct settings for a good control performance.



- **CONTROLLER GAIN:** The controller gain can be adjusted from "LOW" to "HIGH". A higher controller gain allows for more rudder activity and leads to a smaller cross track error. Increased rudder activity can lead to less smooth steering of the ship. This gain is similar to the rudder setting of an autopilot. The button "+" and "-" can be used for fine tuning of the controller gain.
- **DRIFTGAIN:** This gain adjusts the drift that the TrackPilot tries to achieve in turns. If the skipper sees that the ship is always on the outside of the line in turns he can raise the drift gain to get closer to the line. Same works for the other way round. The symbols indicate the behavior. The red lines symbolize the guiding line.
- **Button with "2":** Pressing this button (left middle), leads to the second configuration page.
- **MAIN**: By pressing the button "MAIN", the page "Track Pilot" will be displayed again.

3.1.2.2 Configuration page 2

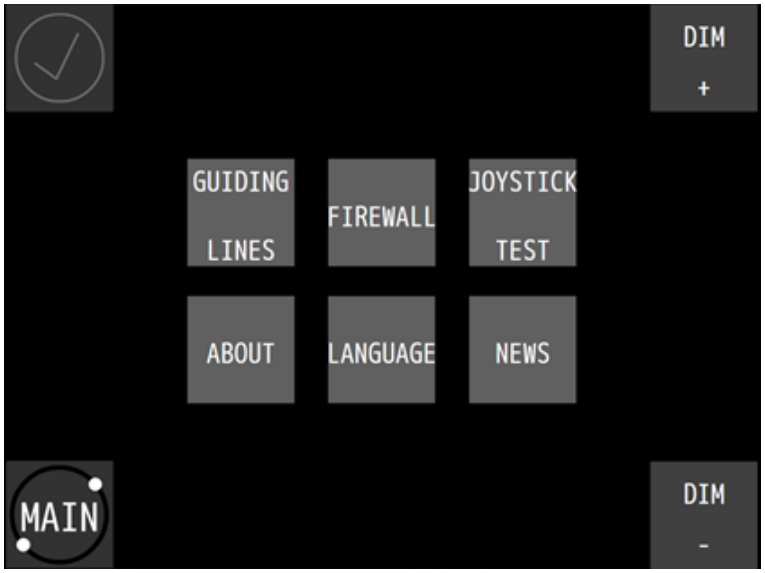
- **DISTANCE WARNING:** It is possible to adjust the warning of distance to the track to your needs. On narrow stretches the threshold can set lower to be warned earlier when leaving the track. On wider stretches the threshold can be increased.
- Button with "1": Pressing this button (left middle), leads back to the first configuration page.
- **MAIN:** Pressing the button „MAIN“ leads back to the page "Track Pilot".

3.1.3 Profiles

On the page "Profiles" different sets of controller parameters can be selected for different loading conditions. These parameter sets have to be activated and adjusted by a qualified technician during a sea-trial. The active parameters set is highlighted by a blue bar.

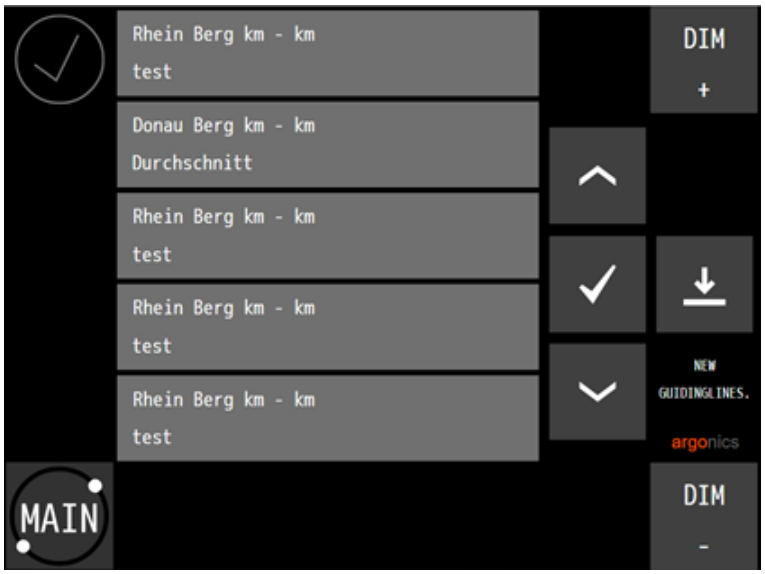
3.1.4 Menu

Pressing the MENU-Button, in the bottom left corner of the TrackPilot page, will change the page to the "Menu" page. On the "Menu" page there is a selection menu for the different pages of the control panel.



3.1.4.1 Guiding lines

Pressing the "GUIDINGLINES"-Button in the menu leads to a page to load and choose guiding lines.



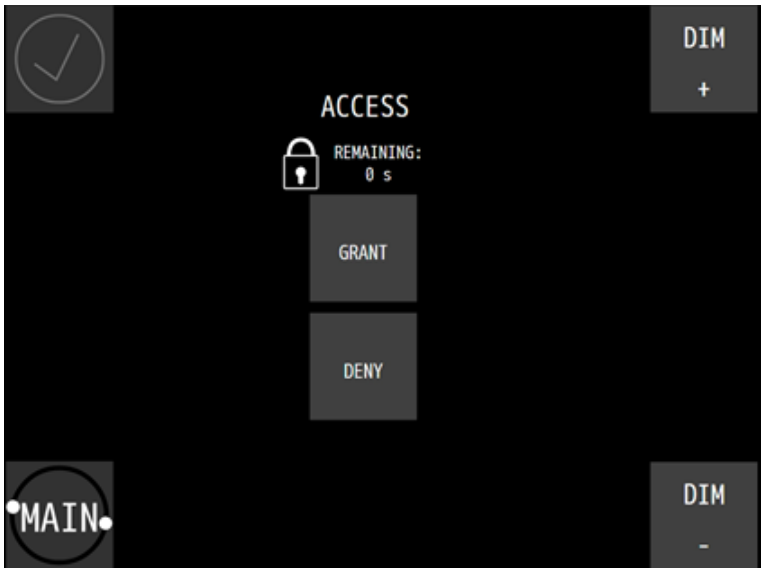
From Version 2.0 and higher argonics provides a guidingline service.

Clicking on the button with the download symbol (down arrow) starts the process of looking for new guidinglines. The TrackPilot connects to the server and looks for new files. The result of this process will be displayed beneath the download button. If it says "New Guidinglines" it will reload automatically the list with the new downloaded guiding lines already in it. Marking one of the lines with a click or touch won't activate them directly. But clicking on the button with the check mark, loads and activates the marked guiding line.

Attention If the TrackPilot is active a new guiding line can not be chosen. The button with the check mark has a white overlay to indicate that its not clickable.

3.1.4.2 Firewall

Pressing the "FIREWALL"-Button in the menu leads to a page to open or close the firewall.



GRANT: Pressing this button opens the access for external connections. This is important for remote maintenance and updates done by support.

DENY: To deny the access for external connections press this button for a few seconds. There will be a loading bar on top of the button which when fully loaded indicates that the firewall is closed.

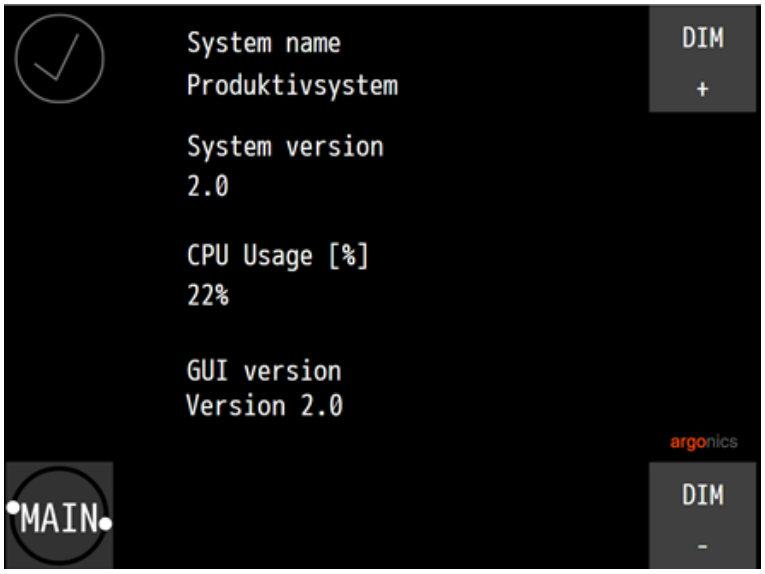
If the firewall is open the lock symbol will be displayed as open and there will be remaining time greater than zero. When the remaining time went down to zero the firewall will be closed automatically.

3.1.4.3 News page

Clicking the button "NEWS" in the menu will open the latest news. News will be updated every night. The last downloaded news file will be displayed on this page. If there is any news, this is shown by a blinking arrow beside the menu button and the news button in the menu.

3.1.4.4 About

The "ABOUT" page displays information about the version of the user interface and the TrackPilot software. Also the current CPU usage of the TrackPilot is displayed.



3.2 Switching Track Control On

There are two possibilities how the track control system is switched on:

- **Alphatron autopilot:** Select "Compass" on the autopilot control panel.
- **Veth brand autopilot:** Press "Track" on the touchscreen of the AlphaTrackPilot control panel.

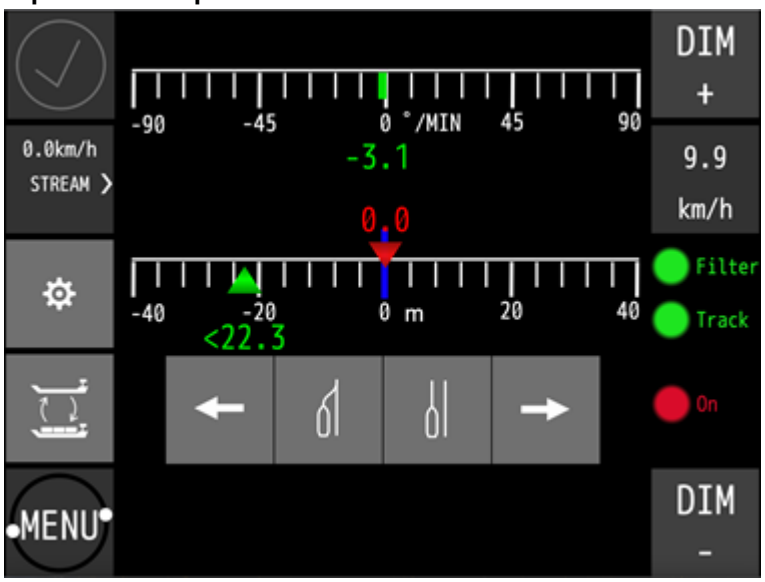
The following conditions must be satisfied before the track control system can be switched on:

- Filter is OK (led is green)
- Track is OK (led is green)
- Autopilot system is ready to enter track pilot mode

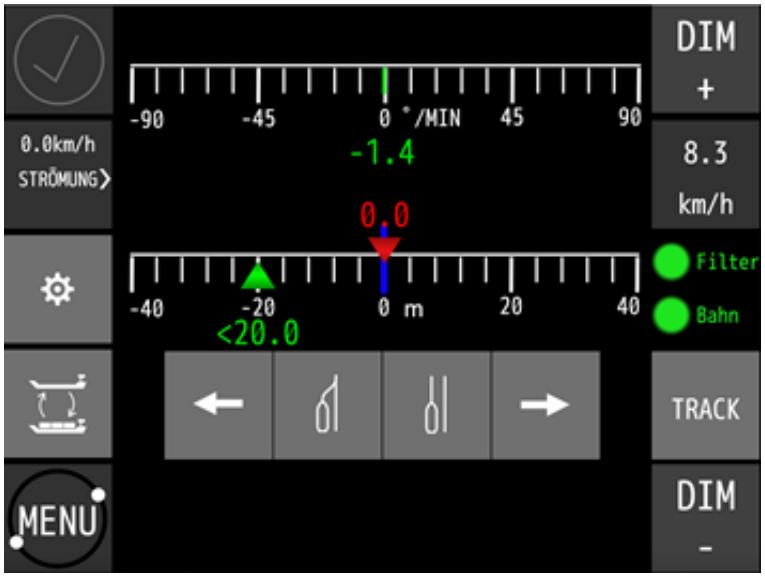
When the track control system is active, the light "Run" on the touchscreen is green. On other autopilots the button "Track" on the touchscreen is highlighted with a blue bar.

Some examples of the Track pilot:

Alphatron autopilot:



Veth autopilot:



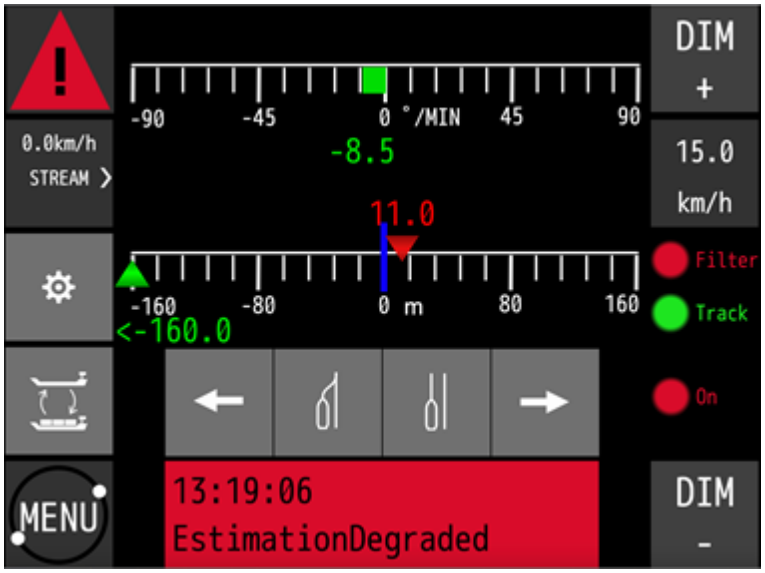
The user must check if the track control system is active and working correctly, otherwise the user needs to continue to steer manually. Before switching on the track control system, the user must check in the chart display if the displayed ship position and orientation match the real position and orientation. Additionally, the user must check if the selected guiding line is on the fairway, and free of collisions.

The track control system checks the following conditions before set the light "Filter" and "Track" to green:

- The GPS system transmits position and heading information
- The position and heading information received from the GPS system are consistent
- The selected guiding line is free from kinks and loops
- The selected guiding line is long enough
- The distance to the selected guiding line is not too large

The track control system can not be switched on if the filter and the track are not OK. If one of the above conditions is not met during active track control, the state of the light for "Filter" or "Track" will change into red color. An acoustic and

optical alarm will be activated that can only be reset by switching the track control off. For more information about alarms see *Alarms* on page 18.



3.3 Switching Track Control Off

There are two methods to switch the track control system off, each depening on which autopilot is connected:

- Select "AUTO" or "WEG" on the autopilot control panel when an AlphaRiverPilot is connected.
- Press "Track" on the touchscreen of the AlphaTrackPilot control panel when a Veth autopilot is connected.

If the track control system has been switched off successfully the green light "Run" on the touchscreen turns red. For other autopilots, the blue bar on the "Track" button on the touchscreen disappears. It is needed to check if the track control system is really switched off and the manual steering is functioning as expected.

3.4 Adjusting the Offset

For passing and meeting of other vessels there is an adjustable offset to the guiding line. To adjust the offset move the joystick on the control panel left or right. The speed of the adjustment is proportional to the angle of the joystick. The offset can also be adjusted by pressing the corresponding buttons on the touchscreen of the control panel (see *Touchscreen Interface* on page 8). To reset the offset to the original line use the button on the touchscreen.

The position of the new parallel line must be checked in the chart display to make sure that the new line is inside the fairway and does not lead to collisions. The picture *Figure 4: Offset to Starboard* on page 17 shows the original guiding line (blue) and the new parallel line (red) with an offset to starboard.

Figure 4: Offset to Starboard

The picture *Figure 5: After offset to zero* on page 17 shows, the original guiding line (blue) and the new parallel line (red), after a reset of the offset to zero.

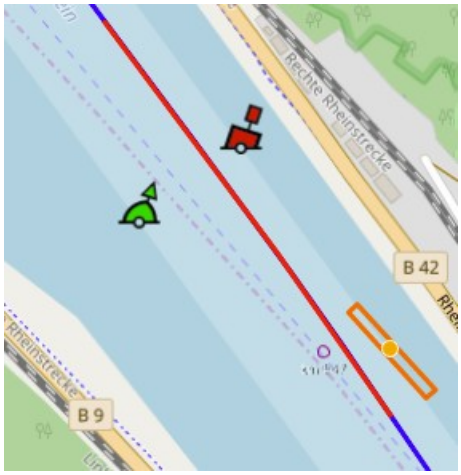
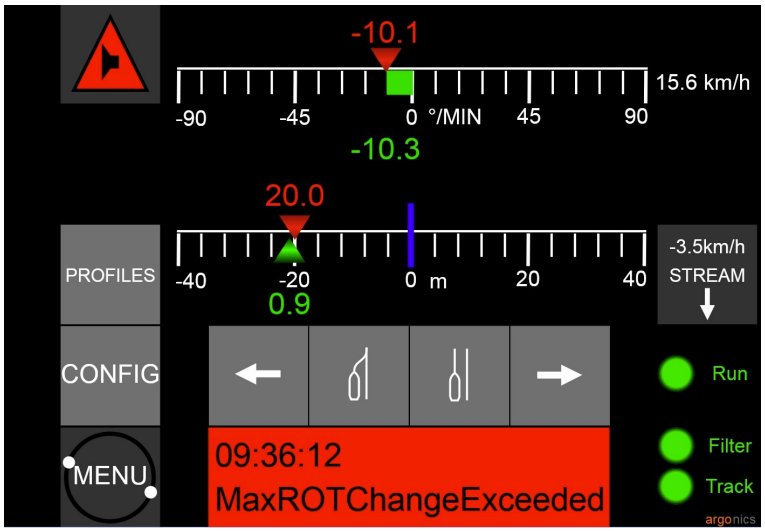


Figure 5: After offset to zero

4 System Warnings and Errors

4.1 Alarms

Alarms are raised in critical situations and require an immediate reaction of the skipper. Alarms are signaled using an acoustic and optical signal. The optical signal is a blinking red symbol in the top left alarm area of the touchscreen. More information will be displayed in the bottom area of the screen. If there are more than one active alarm or warning, the alarm text in the bottom area will switch between the different alarms and warnings.



Important Alarms can only be reset, by deactivating the TrackPilot.

The following table lists all possible alarms and give some advice on how to react on a certain alarm.

Name	Description	Action
EstimationDegraded	Error detection of GPS sensor found a problem like a big change in position or heading angle, probably caused by crossing beneath a bridge.	• Acknowledge alarm by switching to manual steering. There is no other way to acknowledge the alarm. Track control system can not be switched on until problem is fixed. • Wait until state of „Filter“ led light returns to green color. • Check in chart display if ship position in map and reality match. • Switch on track controlsystem • Increasedattention • If the problem returns, switch to manual steering

Name	Description	Action
MaxROTChangeExceeded	Fast change in rate of turn command to autopilot. The command has not been sent to the autopilot to prevent a dangerous maneuver. Could be caused by an undetected error of the GPS sensor.	• Acknowledge alarm by switching to manual steering. **Note** There is no other way to acknowledge the alarm. **Note** Track control system can not be switched on until problem is fixed. • Wait until state of "Filter" led light returns to green color. • Check in chart display if the ship's position on the map and reality match. • Switch on track control system. • Increased attention. • If the problem returns, switch to manual steering.
VeryCloseToEndOfGuidingline	The ship is very close to the end of the guiding line. After reaching the end the track control system cannot compute meaningful command values.	• Immediately switch to manual steering. • Choose new guiding line.
CurvatureError	Guiding line check returned a curvature value that would lead to a high turning rate. Caused by an error in the guiding line, either way points are too close together, not aligned correctly, or the track contains a very sharp bend.	• Acknowledge alarm by switching to manual steering. **Note** There is no other way to acknowledge the alarm. **Note** Track control system can not be switched on until problem is fixed. • Check the guiding line displayed in the chart display. Look for kinks or loops. • Correct bad way points. • Activate other guiding line. • Wait until state of "Track" led light returns to green color. • Switch on track control system. • Increased attention.

Name	Description	Action
CurvatureDerivativeError	Guiding line check returned a curvature derivative value that would lead to a high turning rate change. Caused by an error in the guiding line, either way points are too close together, not aligned correctly, or the track contains a very sharp bend.	• Acknowledge alarm by switching to manual steering. **Note** There is no other way to acknowledge the alarm. **Note** Track control system can not be switched on until problem is fixed. • Check the guiding line displayed in the chart display. Look for kinks or loops. • Correct bad way points. • Activate other guiding line. • Wait until state of "Track" led light returns to green color. • Switch on track control system. • Increased attention.
DistanceAlarm	The distance to the selected guiding line is too large. This error can occur if the wrong guiding line (wrong river for example) is selected in the chart system. Also after reboot of the track control system, a default guiding line is selected that is not close enough to the current position. Or the desired offset from the guiding line is too large.	• Track control system can not be switched on. • If track control system is active, acknowledge alarm by switching to manual steering. **Note** There is no other way to acknowledge the alarm. **Note** Track control system can not be switched on until problem is fixed. • Select a closer guiding line. • Navigate the ship closer to the selected guiding line by manual steering. • Wait until state of "Track" led light returns to green color. • Switch on track control system.
DeadmanAlarm	Deadman detection has not detected any input for a too long time.	Acknowledge alarm by switching to manual steering. There is no other way to acknowledge the alarm. Switch TrackPilot back on.

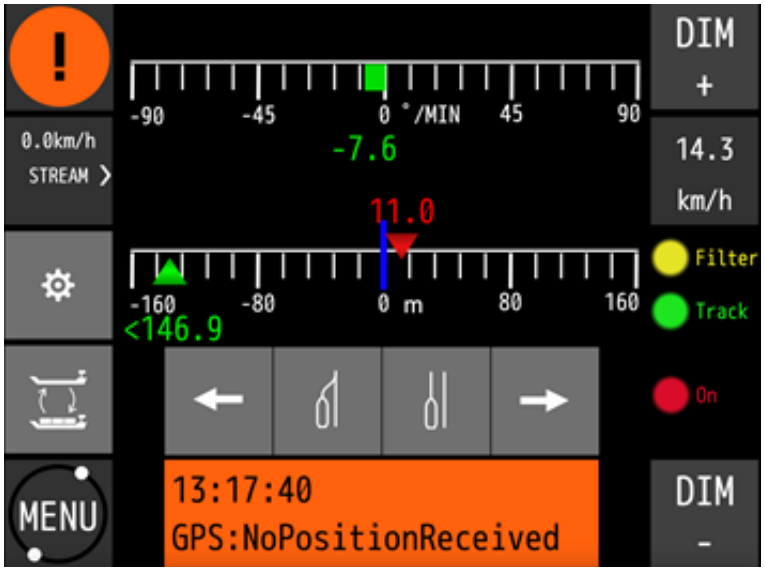
Table 2: Alarms

4.2 Warnings

Warnings alert about states of the track control system that do not require an immediate action. However, check the cause for the warning and switch to manual steering if required. Warnings are signaled by a blinking yellow symbol in the

top left corner of the touchscreen interface. More information will be displayed in the bottom area of the screen. If there is more than one active warning, the warning text in the bottom area will switch between the different warnings.

To acknowledge a warning, press and hold the warning symbol , or the text area of the warning on the touchscreen. After the warning has been acknowledged, the warning symbol stops blinking and changes into the following symbol.



The following table lists all possible warnings and gives advice on how to react to a given warning.

Name	Description	Action
CloseToEndOfGuidingline	The ship is close to the end of the guiding line. After reaching the end the track control system cannot compute meaningful command values.	• Choose a new guiding line • Switch to manual steering
FilterDegraded	Error detection of GPS sensor found a problem.	• Closely monitor track control system for correct operation • Wait for the warning to disappear. If EstimationDegraded alarm comes up switch to manual steering
DistanceWarning	The cross track error to the parallel line is too large.	• Check if the autopilot system processes the commands by the track control system (compare ROT to desired value) • Reset warning
VelocityLow	The velocity of the ship is below a certain threshold. At slow speeds there is not enough rudder force to achieve a good control performance.	• Increase velocity • Switch to manual steering
Deadman Warning	Deadman detection is on and will activate an alarm in 30 seconds	Make any input on the TackPilot: Move guiding line Press any button on the touch display Switch off

Name	Description	Action
MainPowerSupplyFailure	Main power supply voltage is beneath a certain threshold.	• Check fuse of main power supply (F1) • Check connection to power supply **Note** If the main power supply fails, track control will issue undefined commands
GPS:NoPositionReceived	GPS receiver does not send GGA sentences	• Acknowledge warning • Closely monitor track control system for correct operation • Increase attention • Wait if data comes back • Otherwise switch to manual steering
GPS:NoVelocityReceived	GPS receiver does not send VTG sentences	• Acknowledge warning • Closely monitor track control system for correct operation • Increase attention • Wait if data comes back • Otherwise switch to manual steering
GPS:NoHeadingReceived	GPS receiver does not send HDT sentences	• Acknowledge warning • Closely monitor track control system for correct operation • Increase attention • Wait if data comes back • Otherwise switch to manual steering
GPS:NoROTReceived	GPS receiver does not send ROT sentences	• Acknowledge warning • Closely monitor track control system for correct operation • Increase attention • Wait if data comes back • Otherwise switch to manual steering

Table 3: Warnings

5 Appendix

5.1 Dimensions

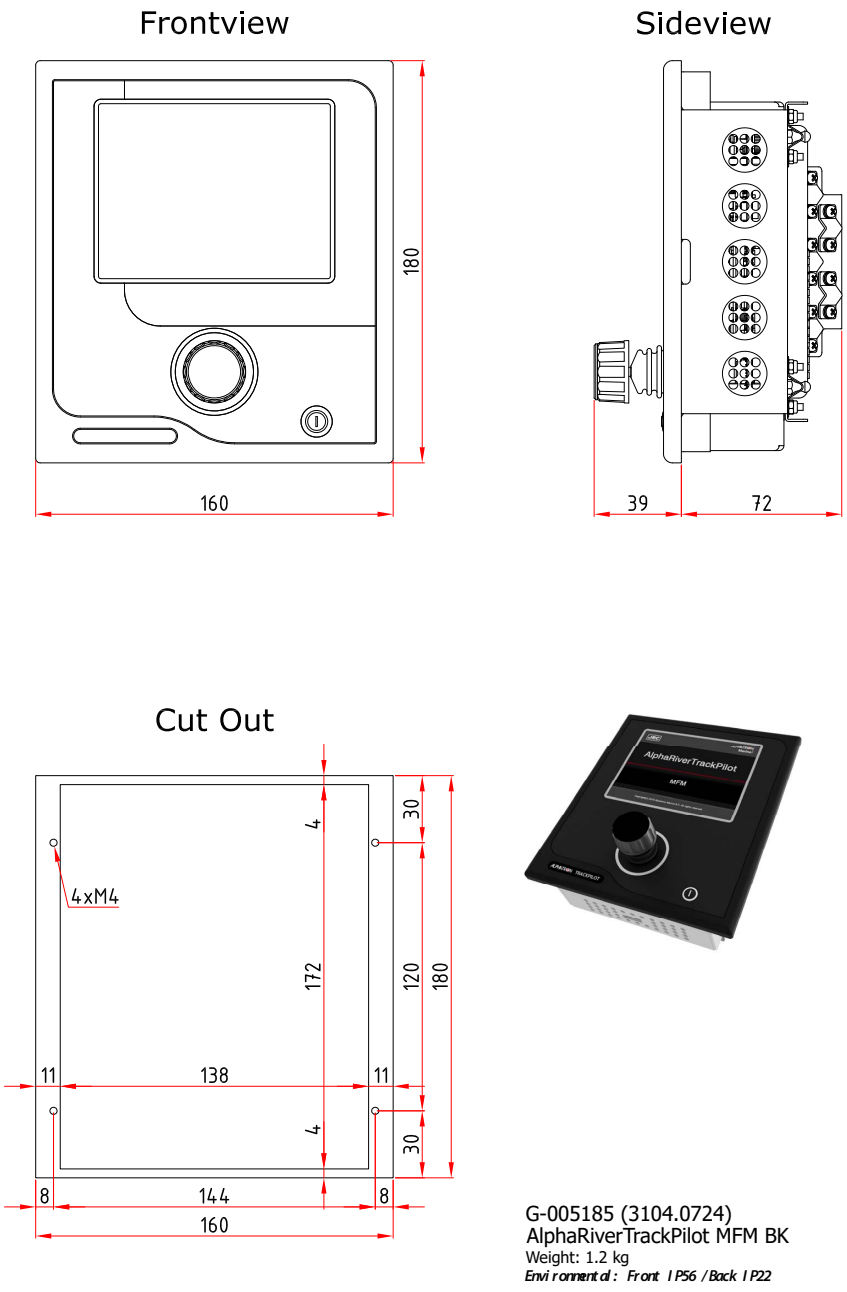


Figure 6: Dimensions of the AlphaRiverTrackPilot

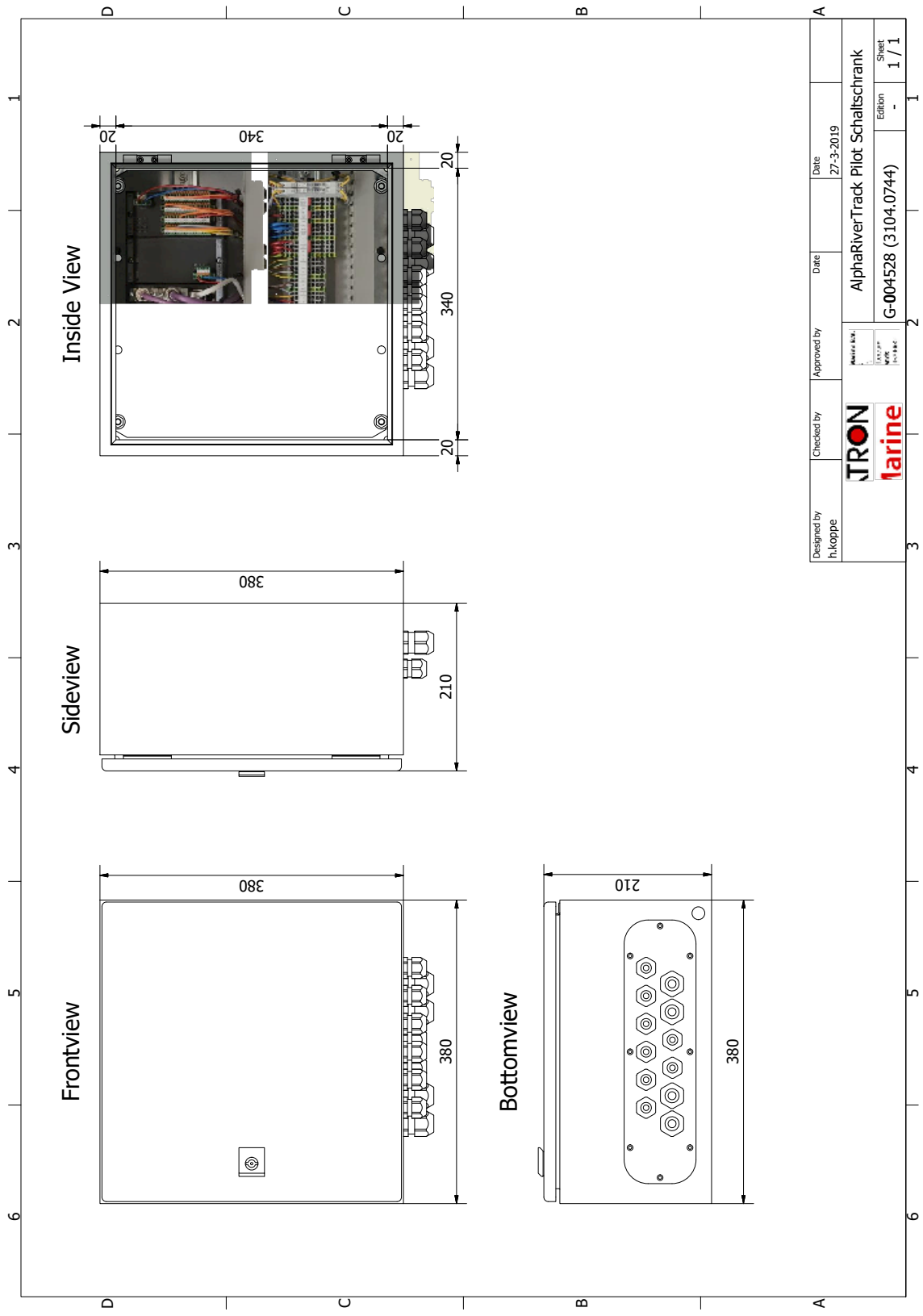


Figure 7: Dimensions of the control cabinet

5.2 Connection diagram

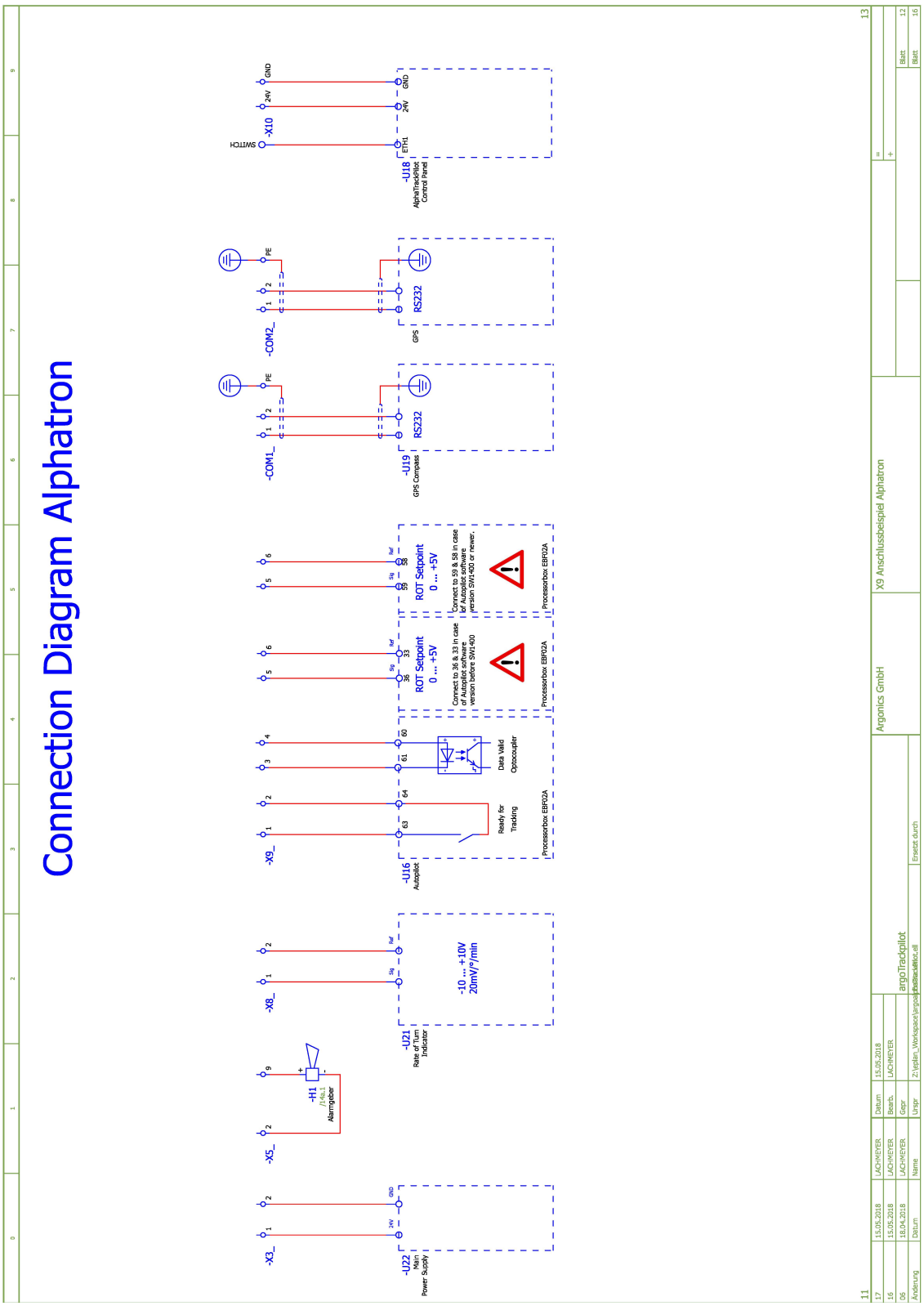


Figure 8: Connection diagram Alphatron

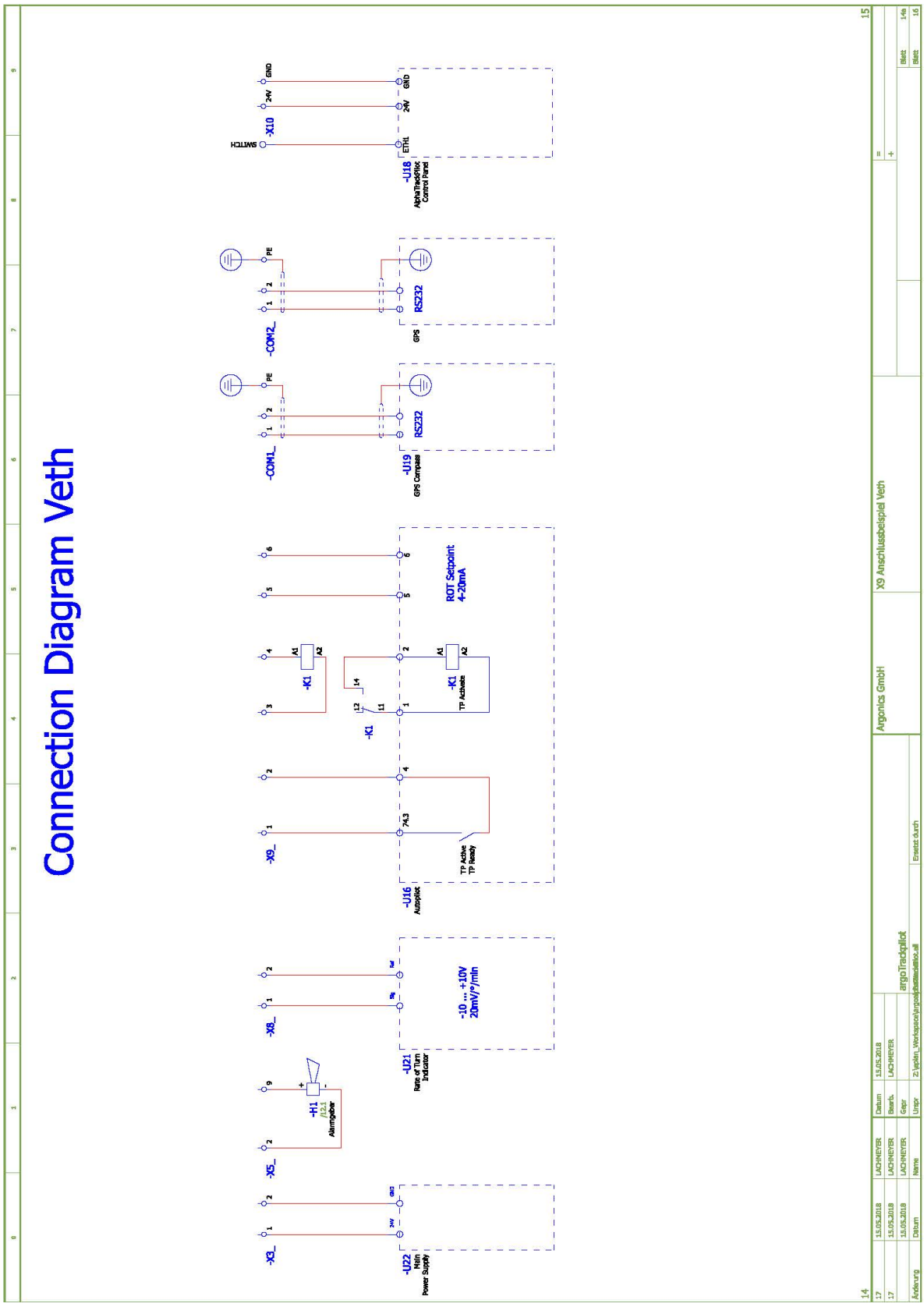


Figure 9: Connection diagram Veth

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