INSTRUMENTS

A+T Pilot user guide and Pilot Controller installation

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Contents

Health and Safety information
Under the terms of European and UK Health and Safety Legislation, A+T Limited is required to classify any hazardous materials in the products it supplies and to provide relevant safety information to users.
Any hazardous materials in A+T products are clearly marked with appropriate symbols. Product Safety Data Sheets relating to these materials are available on request.

Conformity.
The A+T Pilot Control, interface cards and displays comply with the CE EMC directive 2004/108/EC and Level 2 of the Radio communications (Electromagnetic Compatibility) standard 2008

CE

1. Introduction

This user guide assumes familiarity with marine electronic navigation systems and basic PC software tools.

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This guide covers:

- The A+T Pilot system and aspects of the Web-server interface which is needed to set up, commission, calibrate and carry out diagnostics.
- Installation of the A+T Pilot Controller and connection to pilot drive systems.

For installation of the Pilot Processor unit, see the **A+T ATP2_Pilot Processor user guide**. The ATP2 and Pilot Processor are common hardware platforms.

For installation of the Pilot Head Display, see the **A+T MFD_PHD user guide**

GNSS (Global Navigation Satellite System) is used to refer to GPS, Galileo, GLONASS and the other such positioning systems.

This document provides the background and explanation of how the Pilot works. Detailed ‘how to’ is not provided as this is generally intuitive from the web-server. Updates are continually produced reflecting feedback and system development.

Please visit: - www.AandTinstruments.com/downloads for the latest version of the manual and the Pilot software.

2. A+T Pilot features

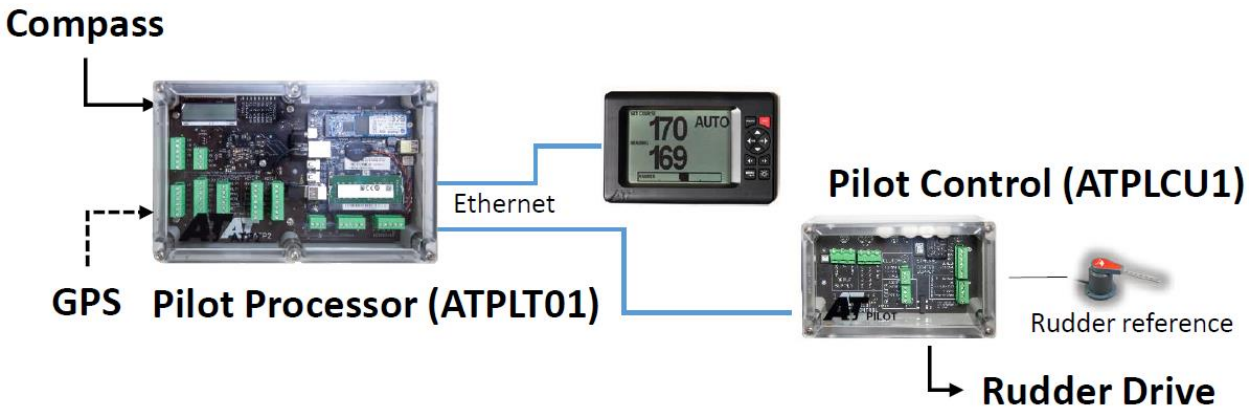
The A+T Pilot is engineered to the highest standards and designed for racing yachts, superyachts and large cruising and classic yachts (motor and sail). There are three key components to the A+T Pilot:

1. **Pilot Processor**
   The Pilot Processor is the 'brains' of the A+T Pilot and communicates via ethernet with the Pilot Control unit. The Pilot Processor utilises a web-server to setup and commission sensors and drives, and to manage advanced settings ensuring superior pilot performance

2. **Pilot Control unit**
   The Pilot Control unit, on command from the Pilot Processor, delivers drive power of up to 50A to reversible DC motor drive units, as well as drive signals for proportional valve and clutched/braked systems.

3. **Pilot Head Display (PHD)**
   At least one A+T Pilot Head Display is required to Start and Stop the pilot, and to send steering commands to the Pilot Processor

Typical system structure



3. Connectivity

The A+T Pilot system may be installed to operate as a stand alone system, however it is compatible with most common systems and data buses including:

- A+T ethernet
- Fastnet for compatibility with B&G H2000, H3000 and WTP2/3 instrument systems
- CANbus – N2k compatible for use with N2k Pilot displays and chart plotters
- NMEA0183

4. Pilot commands

The A+T Pilot Processor will receive commands from:

- A+T PHD
- B&G H2000 & H3000 pilot displays
- N2k compatible systems with Pilot controls (displays and Chart plotter units)
- Web-server
- Tiller control NFU and FU

5. Pilot drives

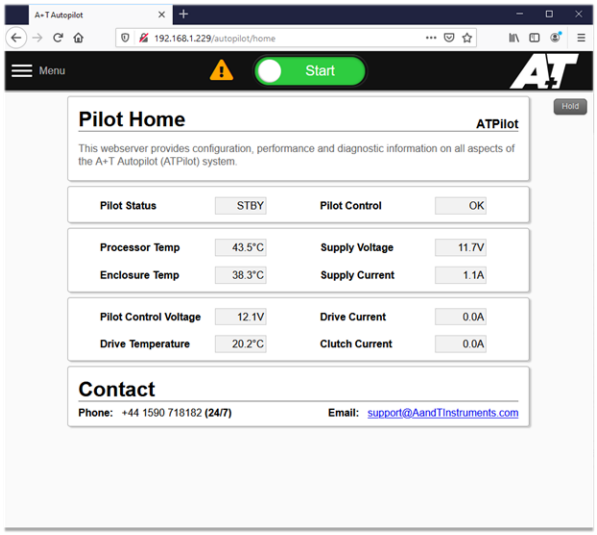
The A+T Pilot Controller unit will drive:

- 9-32V DC electric motors (peak 50A)
- Hydraulic Proportional Valve (+/-10V or 4-20mA)
- Constant running Hydraulic Valve
- Reversible DC motor i.e. Rotary or Hydraulic Linear
- Clutch and Brake controlled systems

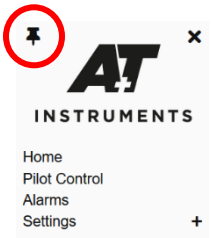
6. Web-server

Setup and commissioning of the A+T Pilot is via the web-server. The Pilot may also be controlled from the web-server. See the A+T ATP2 and Pilot Processor Manual for web-server connection instructions.

Connect to the Pilot web-server by entering the relevant IP address as described in the **A+T ATP2_Pilot Processor user guide** in any web browser.



The Pilot banner is always at the top of the web-server page.



The Menu may be pinned open for ease of access

The Alarm Icon will be Amber if there are active Warnings and Red for active Alarms

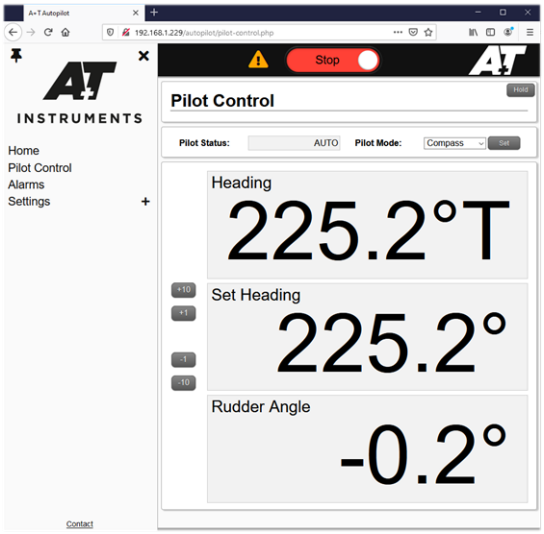
Clicking on the A+T logo will return you to the Pilot web-server Home Page.

7. Pilot Operation

The A+T Pilot may be Started or Stopped from any PHD, the web-server, H2000/H3000 pilot displays or N2k pilot displays and pilot compatible plotters.

Web-server

- Select Menu > Pilot Control
- Select Pilot mode and send course and rudder commands



PHD

- Press Menu and scroll to Pilot Mode to change Pilot Mode
- In Power Steer mode ◀1 and 1▶ will command 10 degrees

Tiller Control

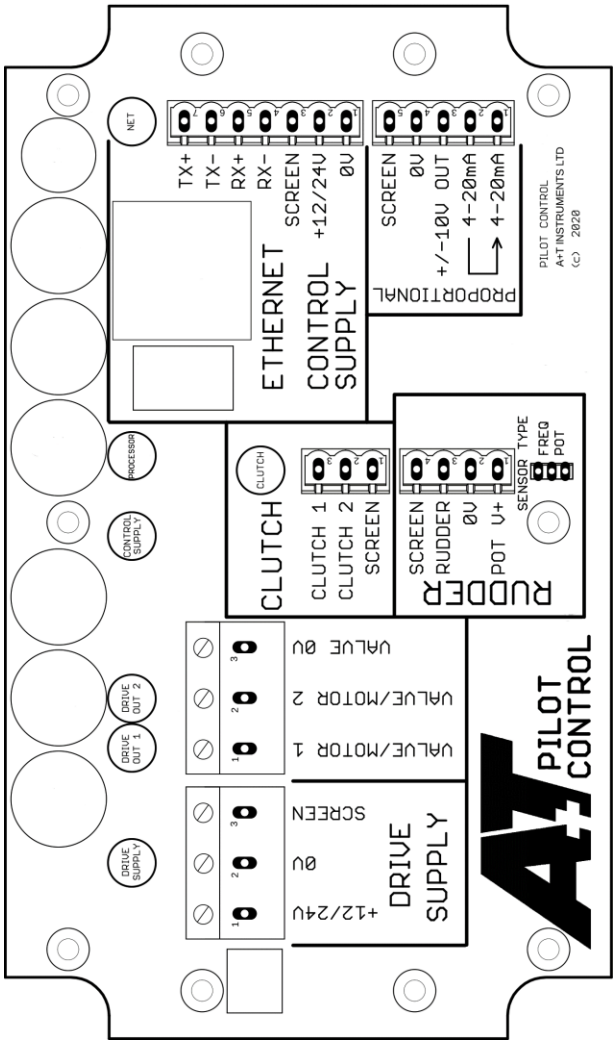
- Follow up and non-Follow up type levers in Power Steer mode

APPENDIX A - Pilot Control unit Installation

1. Mounting

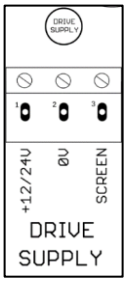
The Pilot Control unit may be mounted in any location convenient to the Pilot drive power supply cable run, clutch/valve and Rudder sensors as required.
It is recommended to orient the cable glands either vertically down or horizontally to reduce the risk of water ingress.

2. Pilot Control connections



3. Power supply

The Pilot Controller requires one independent DC power input

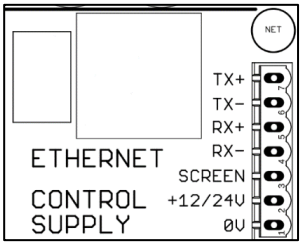


- **DRIVE SUPPLY** – 12 or 24v power with a fuse or circuit breaker per your drive specification, but not larger than 50A
  - ↳ When power is supplied to **DRIVE SUPPLY** the DRIVE SUPPLY LED will illuminate

- **PILOT CONTROL SUPPLY** - The Pilot Control unit must receive power from the ethernet connection to the Pilot Processor. See 4. below. When power is supplied to the Pilot Control, the CONTROL SUPPLY LED will illuminate

4. Ethernet network connection

There is one on-board ethernet connection. This must be connected to the Pilot Processor either via the A+T Instrument ethernet network, or preferably to Net1 or Net2 on the Pilot Processor.



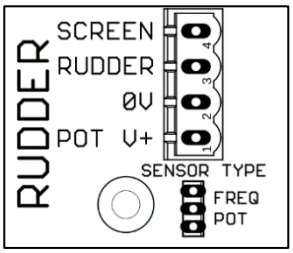
When the ethernet network is connected and active the NET LED will illuminate.

Terminal	A+T Colour	Cat5e screened cable
TX+	Brown	White/Orange
TX-	Blue	Orange
RX+	White	White/Green
RX-	Green	Green
SCRN	Bare	Screen
+V	Red	White/Brown & Brown
0V	Black	White/Blue & Blue

Note: The +V and 0v connections use spare wires within cat5e cable. Twist together the White/Brown and Brown pair, and the White/Blue and Blue pair for connection to the +V and 0V terminals.

5. Rudder angle sensor

The Rudder angle input may be from either Potentiometer or Frequency type sensors.



Select your sensor output type by moving the header to the **FREQ** or **POT** position.

For A+T Rudder Reference Unit (ATRRU01)

- Wiring:
- Move the header to the **POT** position

SCREEN	Screen
RUDDER	Green
0V	Blue
POT V+	Red

Other sensors such as linear displacement and string pot potentiometer/voltage dividers may be used.

6. Pilot Drive Connections

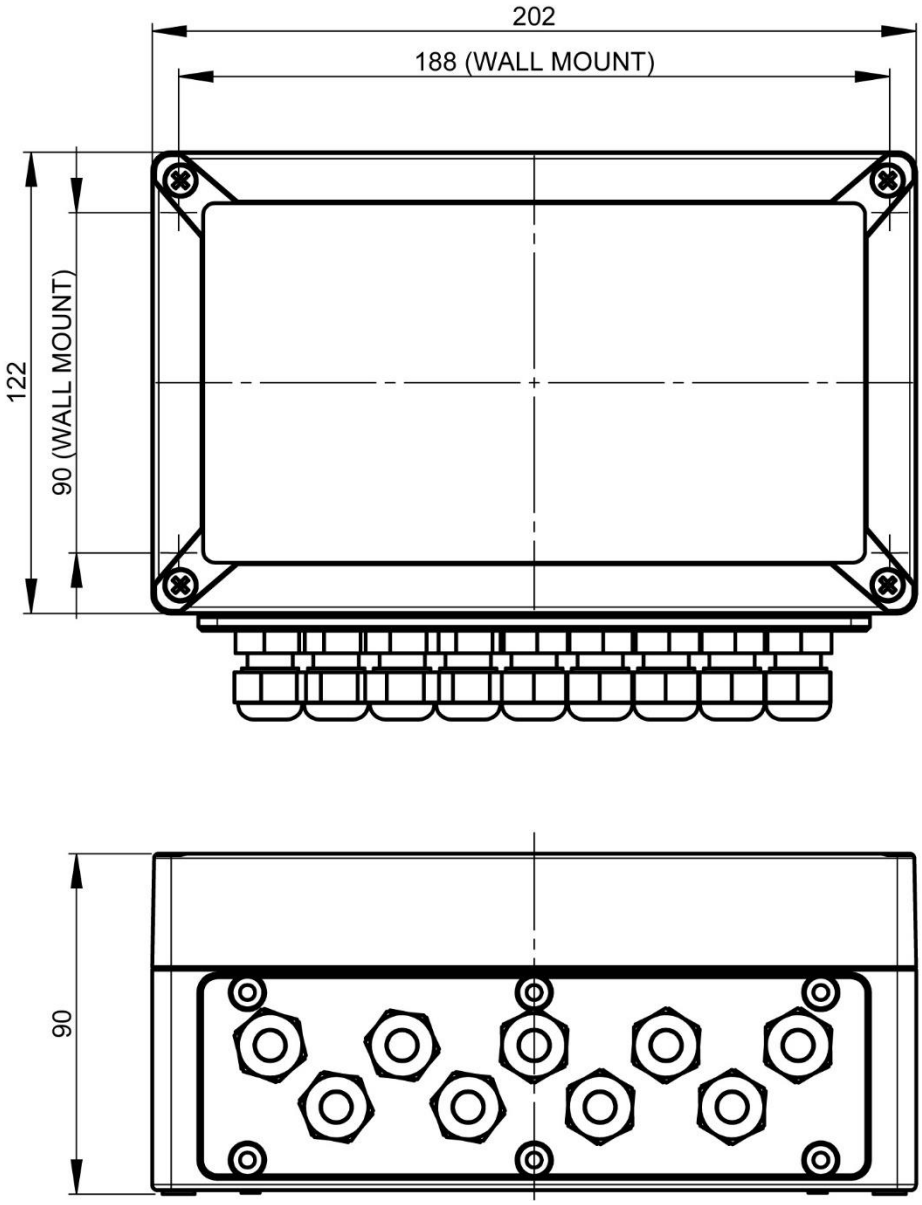
The A+T Pilot can drive most common drive types. See the relevant appendix for your drive type

APPENDIX B - Reversible DC motor i.e. Rotary drive or Hydraulic Linear
APPENDIX C - Hydraulic Proportional Valve (+/-10v and 4-20mA types), and constant running or on demand hydraulic pumps

7. Specifications

Power consumption	Watts
Weight	0.81kg
Operating temperature	-10 to +70 deg C

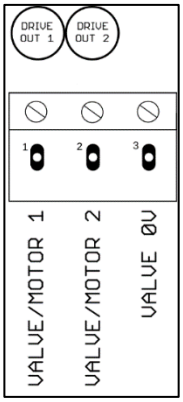
8. Mounting Template



APPENDIX B - Reversible DC motor drives

Refer in the first instance to your Pilot Drive specifications.

VALVE/MOTOR 1	Drive A
VALVE/MOTOR 2	Drive B
VALVE 0V	Not used



Hydraulic Valve drives:

VALVE/MOTOR 1	Valve A
VALVE/MOTOR 2	Valve B
VALVE 0V	Valve A & B 0V

Note: The Pilot will discover the direction the rudder moves when power is supplied to VALVE/MOTOR 1 or 2 in dockside commissioning.

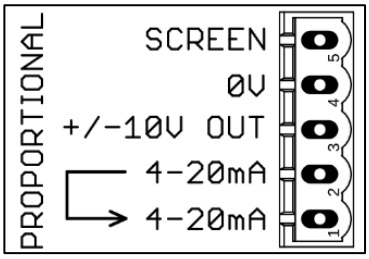
When VALVE/MOTOR 1 or 2 is activated the associated LED will illuminate.

APPENDIX C - Proportional Valve Drive Outputs

Refer in the first instance to your Pilot Drive specifications.

These outputs are isolated low current signals designed to drive proportional valve controllers with either

- +/- 10V (Bosch/Rexroth)
- 2.5 to 7.5V (Danfoss)
- 4-20mA which provides the current loop power.

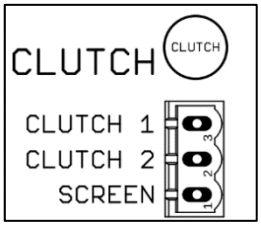


- Depending on settings, the proportional valve outputs will output:

	100% direction 1	Stopped	100% direction 2
Bosch	-10V	0V	+10V
Danfoss	2.5V	5V	7.5V
4-20mA	4mA	12mA	20mA

The Clutch output can be used to control either a constant running pump or ‘on demand’ pump up with 10A continuous to 20A peak.

CLUTCH 1	+ V
CLUTCH 2	0 V



APPENDIX D – Set-up, Commissioning and Diagnostics

Settings

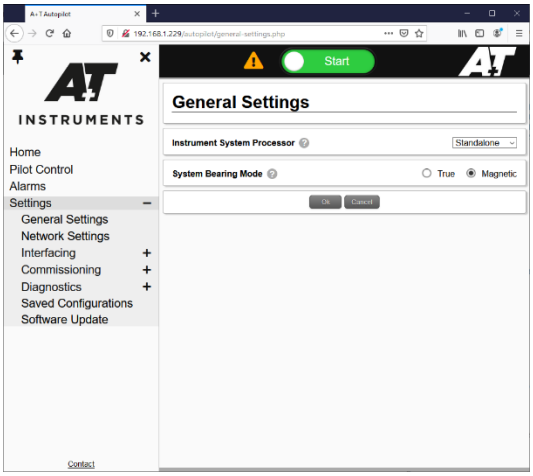
Prior to commissioning, the A+T requires Setup of sensors, inputs and outputs on the web-server

1. General Settings

Set your Instrument System Processor

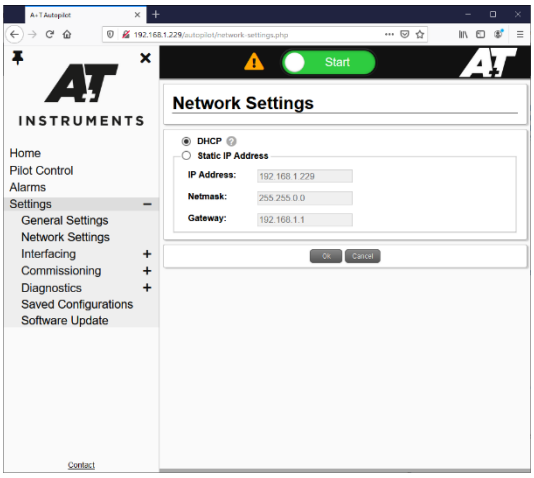
- Standalone: No processor
- A+T: ATP1 and ATP2
- Legacy: B&G H2000/H3000, WTP2/3

Set System Bearing Mode to True or Magnetic



2. Network Settings

Obtain an IP address from a DHCP server or set a fixed IP



3. Interfacing

3.1 GNSS

- Select Input Type and Source

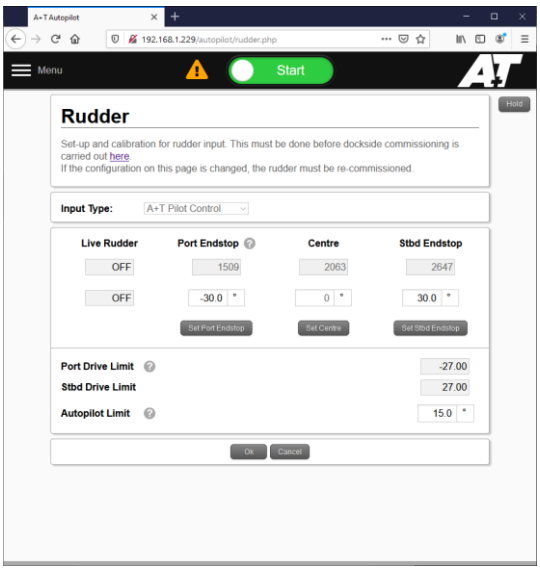
3.2 Heading

- Select Input Type and Source
- An Offset may be input if required

3.3 Rudder

Calibrate Rudder sensor input parameters and Drive Limits

NOTE: Establish the actual degrees of rudder angle at the maximum physical limits that the rudder can be moved to and the position of 0 deg rudder angle before starting this calibration process.



1. Enter the rudder angle in degrees to the Port Endstop, move the rudder to the maximum physical position to Port then press **Set Port Endstop**
2. Centre the rudder and press **Set Centre**
3. Enter the rudder angle in degrees to the Stbd Endstop, move the rudder to the maximum physical position to Port then press **Set Stbd Endstop**
4. The Pilot Processor will calculate and display the Port and Starboard Drive Limits that the Pilot will never exceed. This is to prevent driving against physical stops and vessel structure.
5. You may set the Autopilot Limit which is the maximum angle the Pilot will drive the Rudder while under way. This is to prevent violent vessel motion when large course change instructions are sent to the Pilot Processor.

3.4 Tiller Control

- **Follow-up** – non-spring loaded. Moving the lever commands a desired rudder angle that the Pilot will drive the rudder to, and stop when the desired angle is achieved
- **Non follow-up** – spring loaded. Moving the lever commands the direction to move the rudder. When released and centred the Pilot will stop driving the rudder

4. Commissioning

4.1 Dockside Commissioning

This process measures the maximum rate at which the Pilot drives the rudder with no resistance due to vessel speed. The rate of change of rudder angle is continually monitored by the Pilot Processor and if, when the Pilot is running, the rate of change of Rudder angle is less than 25% of the calculated maximum a Warning is triggered.

Rudder Drive Type and **Clutch Control Modes** must be set before commissioning.

- Rudder Drive Type – 5 options:
  1. **Not Set** – Factory default only
  2. **Bang Bang** – Pilot Drive power is ON or OFF only
  3. **Variable** – Pilot Drive power is variable and tuneable
  4. **Proportional (+/-10V, 4-20mA)**
  5. **Proportional (2.5 – 7.5V)**

- Clutch Control Modes:
  1. **Disabled**
  2. **Enabled** – drive system dependent
  3. **Demand** – drive system dependent

4.1.1 Variable Drive Settings

Traditional **Bang Bang** systems instantly apply 100% power when commanded to move the rudder and instantly stop when commanded.

Variable and **Proportional** drive settings manage the drive system in order to reduce shock on the steering hardware and improve pilot performance. The **Variable** settings may also be set to limit high powered drive systems to improve performance, comfort and economy.

- For reversible DC motor type drives, the amount of power the Pilot applies to the drive system is adjusted
- For proportional valve drive systems, the Pilot will manage the valve position

Three parameters must be set to tune the pilot **Variable Drive Settings.**

- **Max Drive %** - The proportion of the maximum possible drive rate to be used
- **Min Drive %** - The proportion of the maximum possible drive rate to be instantly used when the drive system is commanded to move the rudder
- **Run-Up Time** – the time taken for the pilot to get from **Min Drive Rate** to **Max Drive Rate** and from **Max Drive %** to **Min Drive %**

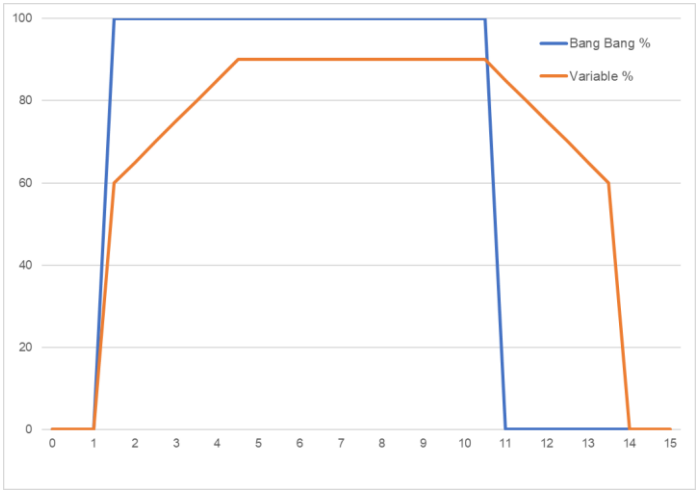


Figure 1

Figure 1 demonstrates the power supplied to a pilot drive for 10 seconds with a **Bang Bang** drive type and a **Variable** drive type with the **Max Drive %** = 90%, **Min Drive %** = 60% and a **Run-Up Time** = 4 seconds.

Commissioning notes

- **Variable** settings may be tested in the Dockside Commissioning process to observe behaviour of the drive system with different settings.

- It is important to note when setting Max, Min and Run-Up that a fully loaded rudder with Pilot engaged will behave differently to an unloaded rudder under Dockside Commissioning settings.

- It is recommended to **NOT** set the **Min Drive %** below 60% for this reason.

4.1.2 Running Dockside Commissioning

WARNING: RISK OF SERIOUS INJURY OR DAMAGE

Dockside Commissioning will drive your steering system through its full range to establish drive direction and drive rates. Ensure the steering system is clear of all obstructions. This procedure must be undertaken at the dock or with the vessel stopped in open water.

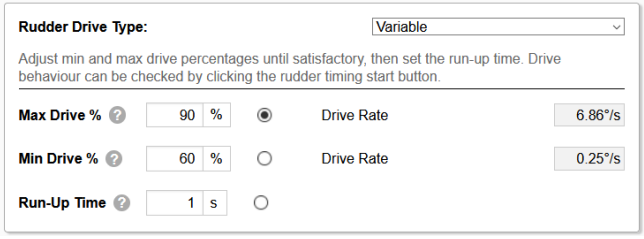
Pressing **Start** will initiate the Commissioning procedure. A progress bar will indicate the status of the rudder timing procedure, and will indicate a pass if completed successfully.

If the procedure fails a Warning will be displayed with a description of the failure. Correct the cause of the error and repeat the procedure.

You may observe the rudder angle and rates in the time series graphs at the bottom of the page.

- **Bang Bang** – centre the rudder and press **Start.** When completed successfully, press **OK**

- **Variable** and **Proportional**
  1. Enter values for **Max Drive %** and **Min Drive %**, and for **Run-Up Time**
  2. The **Rudder Timing Procedure** must be completed for all three **Variable** drive parameters.
     2.1. Select the first radio button and press Start.
     2.2. Repeat for the second and third radio button, then press **OK.**



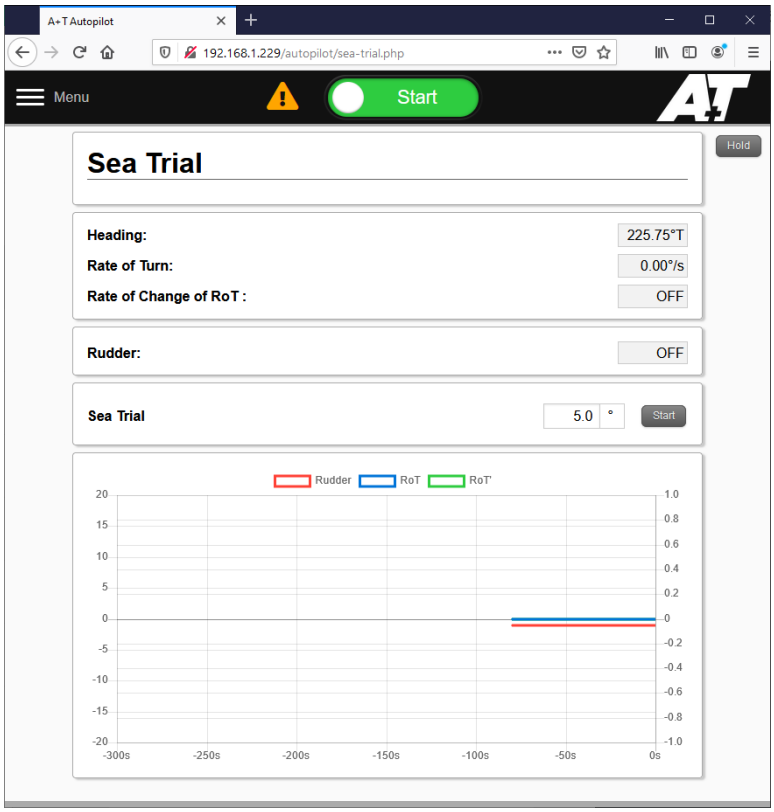
4.3 Sea Trial

The sea trial process will analyse the vessels response to changes of rudder angle while under way to establish the **Proportional, Differential** and **Integral** factors. These determine how the pilot applies rudder to steer the vessel.

- **Proportional factor**
  The amount of rudder to be applied for a given course change command (sometimes called Gain)

- **Differential factor**
  The amount of rudder required to reduce the rate of turn of the vessel (sometimes called counter rudder)

- **Integral factor**
  The amount of rudder required to maintain a steady course in an unbalanced system, for example on a single propellor motor yacht or weather helm of a sailing yacht.



4.3.1 Running the Sea Trial

You must set the number of degrees that the sea trial process will use.

WARNING: RISK OF SERIOUS INJURY OR DAMAGE

This process drives the steering system to predetermined rudder angles initiating turns. Ensure you have adequate safe navigable sea room, that the steering system is free of any obstacles, and all personnel are clear of all moving parts including wheels and tillers before proceeding.

1. At your chosen sea trial speed, steer a steady course and press **Start.**
2. You may observe the variables during the sea trial both in the text boxes and on the time series graph.
3. Once complete, your Pilot is ready for use.

4.4 Advanced

You may adjust the **Proportional, Differential** and **Integral** factors from the sea trial based values.

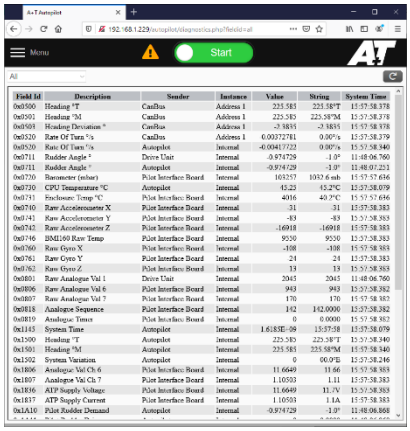
These three variables are interrelated and caution must be used in adjusting these as some combinations may result in undesirable or unpredictable behaviour.

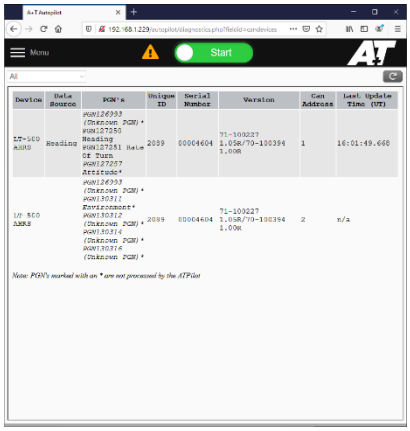
Any changes should be fully tested in open water before being relied upon for general use.

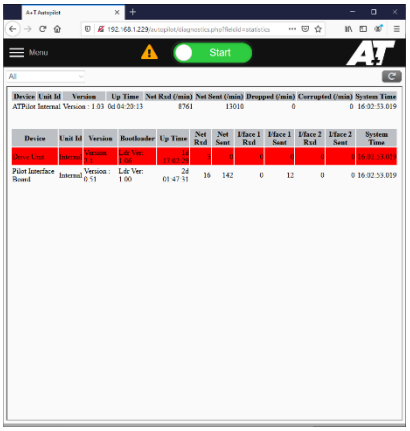
5. Diagnostics

5.1 All, CANbus, Statistics

View live raw data as used by the pilot for diagnostic purposes.







5.2 Data Logs

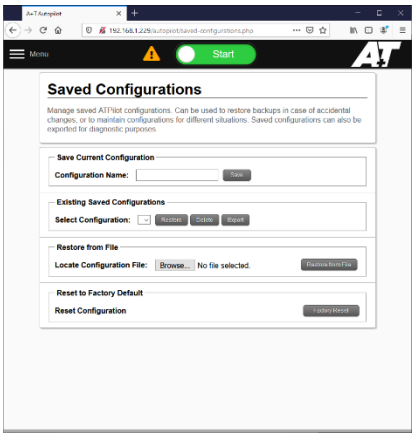
The Pilot Processor may internally log data for diagnostic purposes, not for general use.

- The **Log Frequency** may be adjusted
- Press **Start** to begin logging.
- You may delete or export logs to your PC

5.3 Event Logs

You may view and download system event logs within the Pilot Processor for diagnostic purposes.

6. Saved Configurations



The Pilot settings and Sea Trial results may be saved as backups in case of a system reset, and may be exported for diagnostic purposes.

7. Software Update

To update Pilot Software, select the update file and press **Update.**

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