Aetos Installation Manual

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Revision 1.4

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A lot of useful and recent information can be also found on the Internet. See `http://www.kanardia.eu` for more details.

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WEEE Statement

 Disposal of Waste Electrical and Electronic Equipment. This electrical item cannot be disposed of in normal waste. Check with your local authority for kerbside collection, or recycle them at a recycling centre.

Revision History

The following table shows the revision history of this document.

Rev.	Date	Description
1.0	Apr 2019	Complete manual rework.
1.1	Mar 2020	Changes accumulated from SW versions 3.4 – 3.6.
1.2	Oct 2020	Changes and clarifications for SW version 3.7.
1.3	Mar 2021	RS232 port clarification.
1.4	Mar 2022	Engine layout feature, SW version 3.9.

Contents

1 Introduction

First of all we would like to thank you for purchasing our product. Aetos is a complex instrument and we strongly recommend reading manuals before installation. You may be interested in reading:

- Aetos Installation Manual (this manual),
- Aetos User's Manual,
- DAQU Installation Manual,
- MAGU Manual,
- Autopilot Installation Manual,
- our web page www.kanardia.eu.

This manual assumes that you are familiar with the Aetos user interface system.

1.1 Icons Used Trough the Manual

A few icons appear on the side of the manual, which have special meanings:

This icon denotes information that needs to be taken with special attention. An injury or even death is possible if instructions are not obeyed.

Failing to follow the instructions may lead to the equipment damage.

This icon denotes background information about the subject.

This icon denotes a tip.

1.2 Warnings

The following warnings and limitations apply during installation.

- Software based fuel flow and software based fuel level can be very dangerous and misleading. They affect also range and endurance calculation. Never trust any of these values. Make sure that you have some reliable way to check the actual fuel level during the flight.

⚠ • Before installing the instrument, you shall carefully read and understand this manual and any other supplementing manual.

• The manual is not a substitute for an approved aircraft specific maintenance manual, installation or design drawing. Attempting to install Aetos and corresponding equipment by reference to this manual only (without planning or designing an installation specific to aircraft) may compromise the safety and is not recommended.

2 Display Installation

This section covers the installation of the Aetos display.

2.1 Placement Consideration

There are several consideration which affect the display position on the instrument panel.

• The display must be in direct view field of the pilot without any obstructions.

• The display supports landscape orientation only. Portrait orientation is not possible.

• The display has a modest power consumption. It is cooled trough top and bottom openings in the housing. Please make sure that cooling air will be able to circulate trough the housing openings.

• Avoid to place the display next to the heater vents or into any kind of direct stream of hot air.

⚠ • Monitor the internal display temperature. It must not exceed maximal internal rated temperature of the display. If this temperature comes close or even exceeds maximal rated temperature, a cooling system must be built into the instrument panel compartment, to keep the compartment temperatures low enough.

• The display housing extends behind instrument panel and some extra space must also allocated for the connectors, cables and tubes. See Figure 1 for more details.

- The display does not need special harness for the installation. It is mounted directly to the instrument panel.

- Fix/glue mounting nuts behind the instrument panel for simple instrument removal.

- The instrument panel must be flat. If instrument panel is not-flat, internal stresses will appear and they may damage the instrument bezel.

2.2   Main Display Dimensions

The display main dimensions are shown on Figures 1 – 3 and Figure 4 shows the cutout.
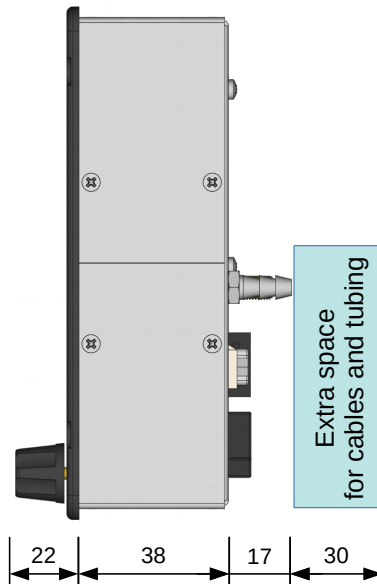
Figure 1: Aetos side view with dimensions.

The knob and part of the bezel protrude 23 mm in front of the instrument panel. On the back side, the housing requires 37 mm space. This space already includes thickness of the instrument panel. Pito-static connectors protrude extra 18 mm backwards. At least 30 mm is also required for the cables and pito-static tubing.
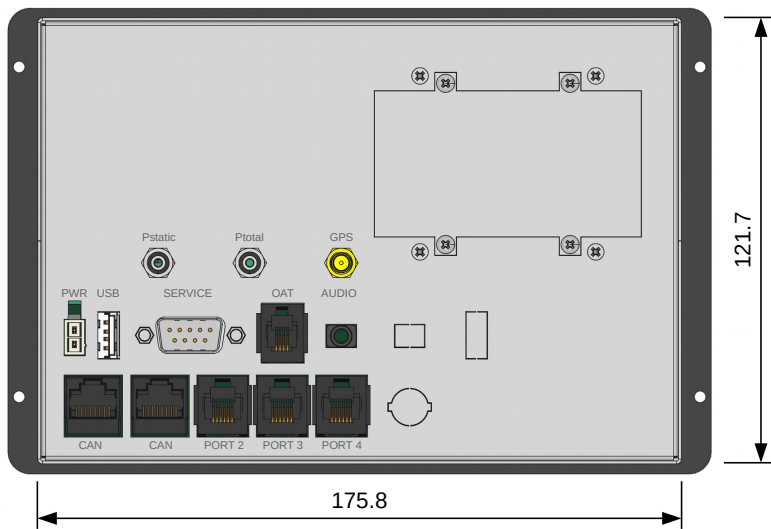
Figure 2: Back view with dimensions.

The bezel width is 192 mm and the height is 127 mm. Back side housing width is 176 mm, height 122 mm.

Figure 3 shows Aetos top view. Cooling openings are clearly visible. Same cooling openings are also on the bottom side. It is very importnat that bottom and top cooling openings are not obstructed – cooling air must freely circulate.
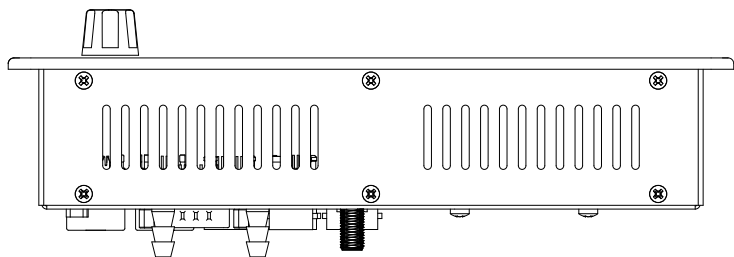
Figure 3: Aetos top view.

2.3   The Cutout

Cut your instrument panel according to your Aetos display size using cut-out dimensions and cut-out templates. The cut-out drawing can be downloaded from our web page: `www.kanardia.eu/support/manuals/`, search for the `Aetos Cutout.pdf` or `Aetos Cutout.dxf`. Please note that the cutout tolerance was already added to the green cutout line. Figure 4 illustrates the cutout dimension.

The cutout tolerance was already added.
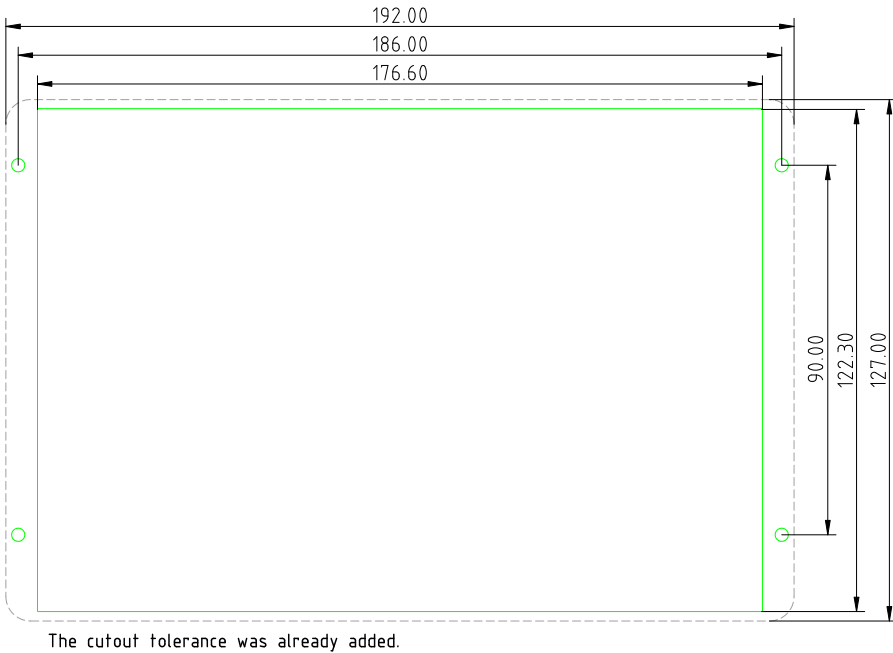
Figure 4: Aetos cutout dimensions. The figure is not actual size!

Some mounting notes:

- The display is mounted from front.

- The display is shipped with a set of mounting hardware (four screws and nuts). You can replace screws and nuts with more appropriate ones, Do not use screws with head larger than 5.5 mm in diameter.

- Do not re-drill holes in the bezel.

Print the template on a hard paper. After printing, take a precise ruler or measuring tape and make sure that printed sizes are correct. This procedure is necessary, because some printers or PDF rendering software may slightly adjust the document size, producing wrong cut-out dimensions.

If possible, make a cutout with a CNC equipment. You can use the *dxf* file to program the CNC. This will make excellent results.

2.4   Mounting Procedure

Once the appropriate opening is made in the instrument panel, test mount the display. Adjust the opening if necessary.

There are several ways to fix the Aetos into the panel:

- using supplied M3 nut and lock washer,

- using self-clinching nut insert,

- using threaded rivet nut insert,

- using spacer stud and epoxy.

Details are shown in next subsection.

2.4.1   Fixation with Supplied M3 nut and Lock Washer

This is the most straightforward method of fixation. Figure 5 shows an example.

① Aetos aluminium bezel.

② Instrument panel plate.

③ M3 bolt with head colored black.

④ External teeth lock washer.

⑤ Standard M3 nut.

Please do not use excessive force on M3 bolt/nut to avoid damage of plastic bezel.

This fixation principle has one disadvantage – it makes Aetos service removal a bit difficult as nut on the back side may be difficult to access.
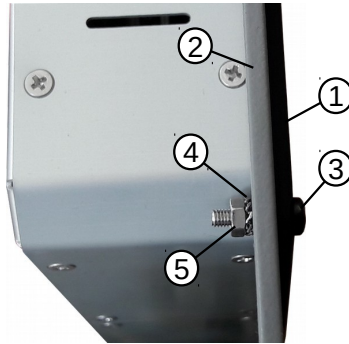
Figure 5: An example of fixation using supplied M3 nut and lock washer.

2.4.2 Fixation with Self-Clinching Nut

Instead of using standard nut and lock washer, a self clinching nut may be used. They come in various forms, which depend on the instrument panel material. Some special tools like arbor press may be required.

For instrument panels made of aluminum, a nut like shown on Figure 6 can be used. The nut must be pressed into the panel before installing the instrument. Once pressed, the nut shall not turn when Aetos is removed and this makes servicing easier.

The hole size needs to be as accurate as possible. It is recommended to do a few tests on a scrap part first.
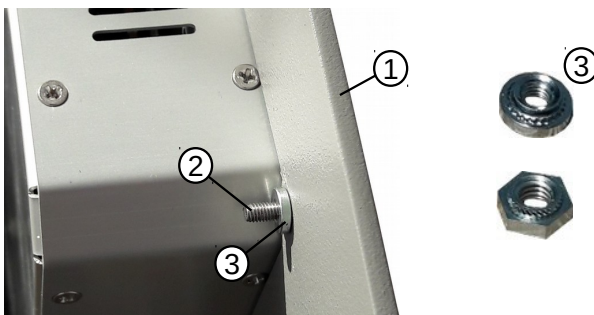
Figure 6: Self-clinching nut suitable for instrument panels made of aluminum.

① Instrument panel plate.

② M3 bolt.

③ Self-clinching M3 nut.

2.4.3   Fixation with Threaded Rivet Nut Insert

Threaded rivet nut inserts (a.k.a. *rivnuts*) may be also used, especially on the composite and thin panels. Again, they come in various forms. Some special riveting tool is needed to fix the threaded rivet.

Get some aluminium M3 rivnuts. Drill a hole into the panel, as it is required by the rivnut used. Then use the rivnut tool to fix the inserts. Be gentle, as there is only minimal panel material between hole and the cutout chamfer. Figure 7 shows an example.

There is a small disadvantage using rivnuts. As the rivnut head has some minimal thickness, the Aetos bezel will probably not mount flush with the panel – there will be a small gap.
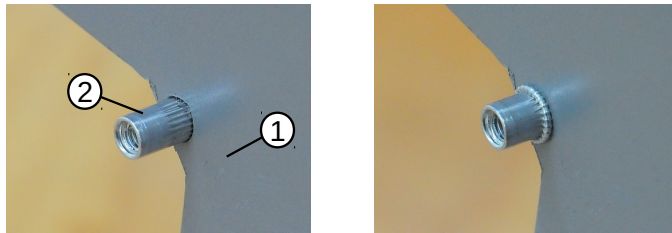
Figure 7: Example of rivnuts inserts. Left: a rivnut before compressing. Right: a compressed rivnut. ① – instrument panel, ② – rivnut.

2.4.4   Fixation with Spacer Stud and Epoxy

As another alternative, a M3 nut can be epoxied to the back of the instrument panel. Standard M3 nut is a bit too small to be epoxied successfully. Thus a M3 spacer stud at least 6 mm in length may be used instead.

1. The spacer surface shall be made rough using coarse sandpaper. If spacer is coated, the coat shall be removed. A dremel tool comes handy.

2. Sand the back side of the panel where epoxy will be applied. Surface must be dull.

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3. Mix a small batch of epoxy together with some cotton flox or with milled glass fibers. These add strength and also increase viscosity, which makes epoxy application easier.

4. Apply a small amount of oil or grease on bolt thread. This will prevent strong bond between epoxy and thread if epoxy is applied over the bolt thread by accident.

5. Fix spacers in place using M3 bolts and apply the epoxy mix around the spacers.

6. Wait for epoxy to cure.
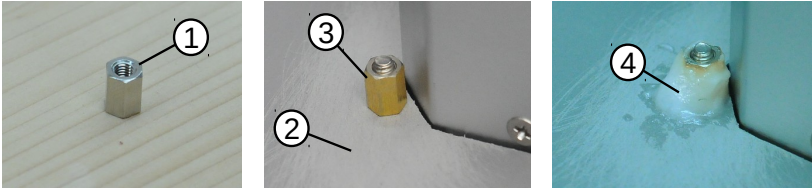
Figure 8: Example of spacer stud fixed with epoxy: (1) – spacer stud, (2) – panel surface sanded with 60 grid sandpaper, (3) – spacer stud sanded with dremel tool, coat removed, (4) – spacer stud fixed with epoxy mixed with cotton flox.

This fixation principle is a bit messy, but works very well in practice.

3 Power Installation

Aetos power input requirements are compatible with 12 and 24 V aircraft power systems. Aetos accepts 10 – 30 V range.

The supplied power cable have two unterminated wires. The red wire must be connected to the power (+12V or +24V) terminal. The blue wire connects to the ground terminal. The other side of the power cable has a plastic connector. This connector has a hook next to the red cable. Insert the connector into Aetos at the back. The notch and the hook must match – they prevent wrong cable orientation, see Figure 9.

When a slave Aetos is also connected to the system, it is powered with its own power cable.

The cable side of power connector (1) consists of the following parts:
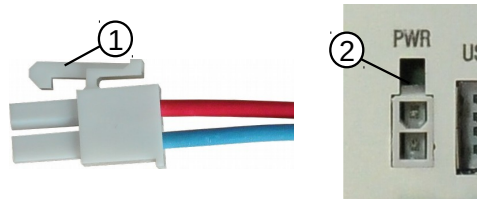
Figure 9: Left: The power conector on cable. Right: Power connector on Aetos back. (1) – hook on the power cable connector, (2) – notch on Aetos back.

- plastic part with a hook ...Würth Elektronik, PN 649 002 113 322,

- two female crimp terminals ...Würth Elektronik, PN 649 006 137 22,

- 0.75 mm^2 (about AWG 18) red and blue leads.

The terminals have finitive number of mating cycles. They belong to the 25 mating cycles quality class.

3.1 Circuit Breaker

The power input must be routed trough a circuit breaker. Aetos consumes about 800 mA at 12V on full brightness. Various peripheral devices (Daqu, Magu, Indu, etc.) are powered via Aetos and they add to total consumption. A rough estimate is 250 mA per device.

So a circuit breaker rated at 1.5 to 2.5 A is needed for the systems with one Aetos. In the case of two Aetos connected to the same circuit breaker, use 2.5 to 3.5 A rated circuit breaker instead.

It is recommended that each Aetos gets its own circuit breaker.

3.2 Aircraft Master Relay

Please make sure that aircraft master relay (in fact all relays) have a protection diode (a flyback diode)[1], which protects against voltage spikes. A coil in relays without this diode may cause spikes that exceed 100 V and they propagate on the system bus. Such spikes may cause permanent damage on Kanardia equipment and other avionics.

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[1] Wikipedia: `https://en.wikipedia.org/wiki/Flyback_diode`

3.3   Backup Battery

This backup battery solution works only on 12V systems.

Aetos may be powered via an optional external backup battery system called UPSU. The backup system consists of electronic circuit UPSU, a simple lead VRLA AGM battery (1.2 Ah is typically used) and a DPDT (or DPST) switch. Figure 10 shows the schematics.

The Aetos system is switched on/off by a double pole switch. This switch turns on/off two circuits at the same time. The first one brings system power into UPSU and the second one brings backup battery power into UPSU. When there is enough voltage present on the system bus, system power is used and if there is no voltage on the system bus, backup power is used. UPSU will switch between both sources automatically. UPSU also charges the backup battery when system voltage is high enough (13V or more).
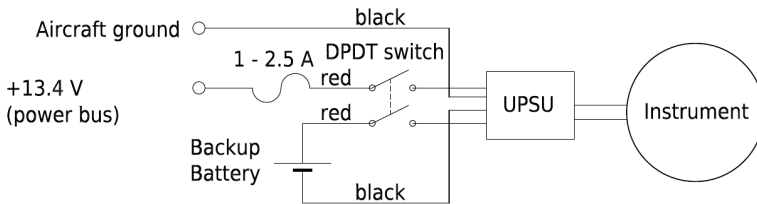
Figure 10: Schematics of the UPSU backup system. Blue leads may be supplied instead of black ones.

The electronics part of the UPSU is shown on the Figure 11.
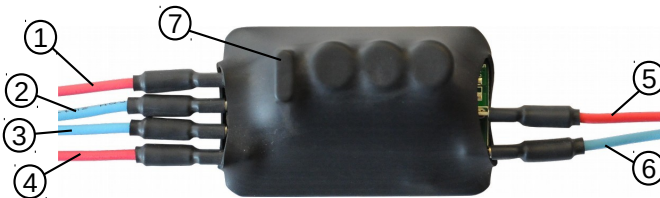
Figure 11: UPSU electronics. Input power leads from system bus and backup battery are on the left and the output power leads are on the right.

① Input power lead from the system 12V bus.

② Ground from the system bus.

③ Ground from the backup battery.

④ Input power lead from backup battery.

⑤ Output power lead towards Aetos.

⑥ Ground lead towards Aetos.

⑦ Internal 10A fuse electronics fuse.

The following table shows approximate elapsed backup times[2] that were obtained from 1.2 Ah 12 V battery for some typical configurations. Longer elapsed time can be achieved by using a battery with larger capacity (2 Ah, 2.7 Ah, 3.4 Ah, ...) at the expense of weight increase.

Configuration	Time
Aetos and DAQU	37 min
Aetos, DAQU, Digi	TBD

Table 1: Backup times achieved on a full 1.2 Ah battery at 22°C. All instruments running at 100% brightness.

Reducing the LCD brightness level significantly increases backup times.

4   GNSS Antenna Installation

The GNSS system in Aetos consists of two parts: the GNSS module and GNSS antenna. The module is an integral part of the AD-AHRS-GNSS device, which is built in the Aetos and the antenna cable connects to the back side of the Aetos.

Standard SMA male connector is used on the antenna coaxial 50 Ω cable to connected to the Aetos, Figure 12.

For the most reliable performance, the antenna requires a clear view of the sky. The supplied antenna shall be mounted inside the cockpit on a place, which will give the best 360°view of the sky. Top of the instrument panel, below the windscreen is a typical place. Try to meet the following recommendations:

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[2] Elapsed time when equipment is running solely on the power from backup battery.
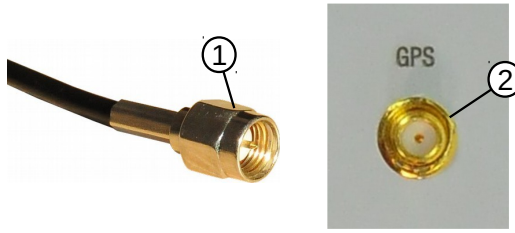
Figure 12: GNSS antenna connection: (1) – SMA male connector of GNSS antenna cable, (2) – SMA female connector on the Aetos back side.

- The mouning location shall be level, clean and flat.

- Try to avoid other transmitting antennas – the location shall be at least 1 m away.

- Avoid placing it next to other active GNSS antennas as they may cause interference.

- Take care for correct orientation, see Figure 13.

You may use double sided self adhesive tape to fix the antenna. The actual fixation principle depends on the surface material.

Although the general rule is that the antenna shall be unobstructed, good results were also obtained for antennas placed under the instrument panel covers made of *thin* fiberglass. This does not work with metal of carbon fiber covers.

Aetos comes equipped with one of the two possible antennas as shown on Figure 13.

The GNSS receiver is capable of SBAS enhancement from EGNOS, WASS, etc. system. When SBAS signal is being received, this gives additional precision to the calculated GNSS position.

The GNSS module usually starts cold. This means that it will take about 30 s to obtain first fix, but no more than 60 s in the worst case.

4.1   GNSS Signal Check

Aetos can show the GNSS satellite constellation and quality of the reception. This is accessible under the *Info* icon.

Figure 13: GNSS antenna orientation: ① – small, pure GPS antenna – the *GPS* text must be facing upwards, towards the sky. ② – larger combined GPS/Glonass antenna – the triangle must point upwards, towards the sky.

1. Select *Options* on the main menu.

2. Select the *Info* icon.

3. Search for the *GNSS details* item and select it. A window like shown on the Figure 14 will appear.

The window shows positions of the satellites on the sky. GPS constellation is represented with disks and Glonass is represented with squares. All detected positions are shown. Satellites used in the position calculation are colored green. Grey color means that a satellite is being tracked, but it is not being used in the solution. Under unobstructed sky satellites should be evenly distributed.

HDOP, VDOP and PDOP[3] values indicate quality of the solution. The meaning of the DOP values is given in Table 2. In general, HDOP shall be always be less than 5.

Vertical bars at the bottom of the screen indicate quality of the signal reception. Below each bar is satellite PNR number. Green color indicate satellites used in positional measurements.

Solution fix is shown in the top right corner. It can be one of the following values:

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[3] DOP – Dilution of precision, HDOP – horizontal DOP, VDOP – vertical DOP and PDOV – combined DOP.
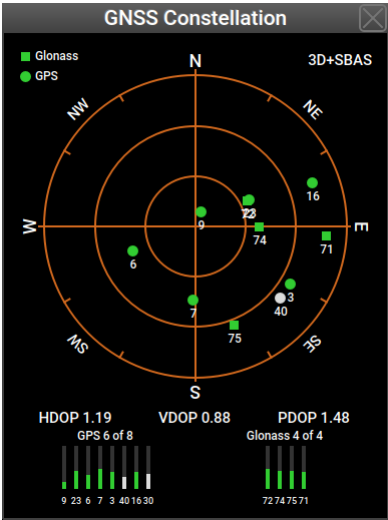
Figure 14: An example of GPS and Glonass constellations. The satellite distribution on the example shows poor reception as most satellites appear in the SE quadrant.

Error – there is no communication or data is not available yet.

None – there is no fix. Position is not known.

2D fix – only 2D fix is obtained. The position measurements are poor.

3D fix – 4 or more satellites are used in the solution. The position quality should be good. See also DOP table.

3D+SBAS — 3D position is further enhanced with the SBAS system.

5 Outside Air Temperature Sensor

5.1 Installation

Outside air temperature (OAT) probe is shipped with the Aetos primary display. This is a digital temperature sensor inserted into a threaded aluminium housing. Default OAT cable length is 1.5 meters, but other lengths are available on request.

DOP	Rating	Description
< 1	Ideal	Highest possible confidence level.
$1 - 2$	Excellent	Positional measurements are considered accurate.
$2 - 5$	Good	Still acceptable for route navigation.
$5 - 10$	Moderate	Position can be used, but it should be improved.
$10 - 20$	Fair	Position indicates a very rough location.
> 20	Poor	Inaccurate measurements.

Table 2: Meaning of the DOP values.

OAT information is required to calculate the true airspeed from the indicated airspeed and altitude.

In order to provide accurate measurements, the OAT probe must be installed on a proper place, where the probe is not exposed to the disturbing sources of heat:

- engine heat and exhaust heat,

- direct sunlight,

- heated air exited from cabin.

It is not recommend installing the probe in the heated cabin area, since the elevated temperature in the cabin may influence the back side of the probe (aluminium housing conduction).

Please follow these steps to install the OAT probe:

1. Locate a spot in the aircraft taking into account the considerations from above and drill a ϕ 8 mm hole.

2. Remove the external nut from the probe, but keep the washer, internal nut and plastic insulation sleeve on the probe.

3. Install the probe into the hole *from the interior*. Guide the cable trough the aircraft to the Aetos display back side.

4. Apply some thread-lock liquid and thread the external nut to the probe. The liquid is necessary to avoid losing the cap due to vibrations.

5. Tighten the internal nut so that the probe sits firmly and apply thread-lock liquid on the nut. Do not over-tight it.

6. Slide the plastic sleeve over the exposed threads of the probe and cover as much threads as possible. Shrink the sleeve using hot air blower. Do not use open flame. Plastic (shrink) sleeve mainly serves as thermal insulation from cabin heat.

Figure 15: Inserting the OAT probe (left), cap is in place, tighten the internal nut, slide the insulation shrink sleeve (right).

5.2   Connection

The digital thermometer in the tip of the probe is type DS18B20. OAT connector is standard RJ12 type, as shown on Figure 16. Description of individual pins is given in Table 3.
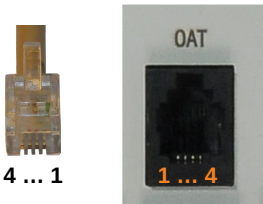
Figure 16: Designation of the pins.

Pin	Description
1	+3.3V
2	Data
3	GND
4	Not connected

Table 3: Description of the OAT pins.

The cable can be extended or shortened as needed.

You can also build your own probe. Use DS18B20 sensor and connect it according to Figure 16, Table 3 and DS18B20 datasheet.

6   Audio and Video

Aetos can be connected to the audio system (audio out) and video (video in). These two have nothing in common – audio and video are not associated. Audio connection is used to allow Aetos to send out some audio messages, mostly warnings, which can be then heard in the headset. Video is used to show some video image from an on-board camera on the Aetos screen.

6.1   Audio Connection

Aetos is equipped with an audio output. Audio output is used to play audible messages and warnings to the pilot.

Basic Aetos kit is shipped with an audio connector cable. One end of the cable has a male 3.5 mm mono audio jack which fits into Aetos master unit. The other end is open ended and it should be connected to audio panel or external input of a radio station.

Audio output from the Aetos is 1.5 V@600 Ω peak-to-peak. Output is isolated with an audio transformer, so both signal and ground must be connected. Use of a shielded cable is preferred.

We provide short manual and schematic for most widely used radio stations. Please refer to the radio manual first. The radio manual supersedes any information given here.

6.1.1   Trig TY91/TY92

Audio output of the Aetos must be connected to the auxilary input on Trig TY91/TY92 radio station. Please connect Aetos audio output as on Figure 17.

The Trig TY91/92 radio station must be configured to accept audio from Aetos. Please follow next steps to configure auxilary audio input on Trig radio:

- press the `MON` button for at least 2 seconds to enter setup,

- press the `MON` button twice to reach the `Auxilary input volume` menu,

Trig TY91/TY92 - 25 pin D-SUB
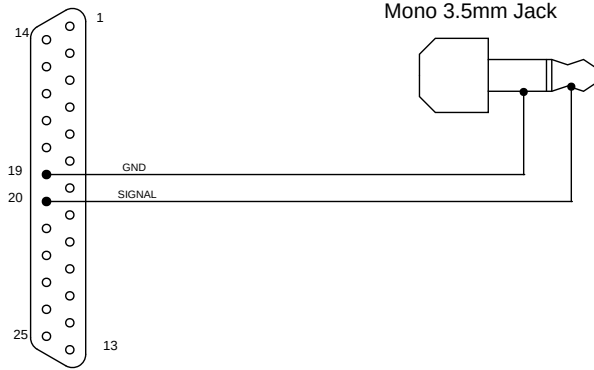
Figure 17: Schematic for connecting Aetos audio to Trig TY91/TY92 radio station.

- use small turning knob to select relative audio volume,

- press the `MON` button to reach the `Auxilary input muting` menu,

- use small turning knob to select bewteen `off` and `on`.

If `Auxilary input muting` is set to `on` the auxiliary audio input will be muted when the radio station is receiving or transmitting.

6.1.2   Funke ATR833

Audio output of the Aetos must be connected to the external audio input on Funke ATR833 radio station. Please connect Aetos audio output as on Figure 18.

The Funke ATR833 radio station must be configured to accept audio from Aetos. Please follow next steps to configure external audio input on Funke ATR833 radio:

- press the `SET` button for at least 5 seconds to enter setup,

- press the `SET` button four times (4x) to reach the `External Audio` menu,

- with the `VOL/SEL` button select entry `auto off`,

ATR833S - 25 pin D-SUB
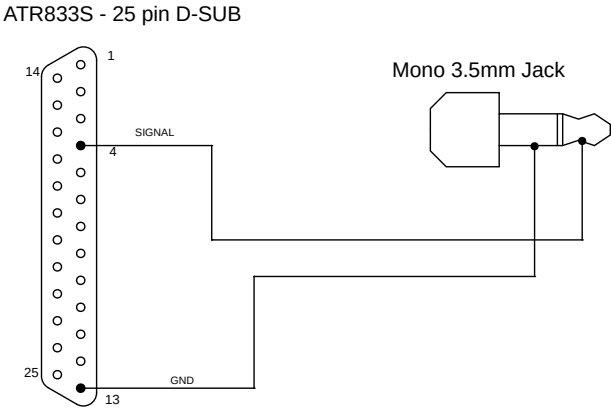
Figure 18: Schematic for connecting Aetos audio output to Funke ATR833 radio station.

- press the `DW` button or wait for 10 seconds to exit setup menu.

If some messages are cut you should select the `no RXTX` mode. However this makes audio input permanently active, which may lead to some small noise always present in a headset.

6.1.3   Dittel KRT2

Audio output of the Aetos must be connected to the External-NF input on KRT2 radio station. Please connect Aetos audio output as on Figure 19.

KRT2 - 15 pin D-SUB
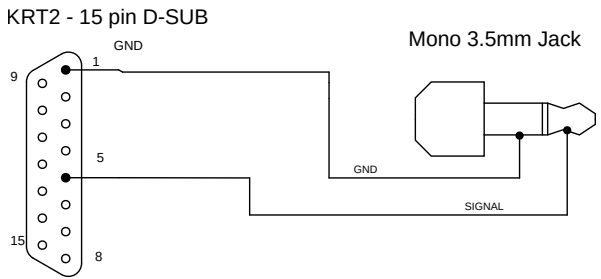
Figure 19: Schematic for connecting Aetos audio to KRT2 radio station.

KRT2 must be configured to accept audio signal from Aetos. Please follow next steps to enable external audio on KRT2:

- Press the `AUX` button six times (6x) to reach the `EXT` menu.

- Use rotation knob to select different audio levels.

The correct selection is usually `EXT01` or `EXT02`. Different selections in the `EXT` menu means:

- `EXT00` - external input always off,

- `EXT01` - external input always on,

- `EXT02` - use threshold for enabling external audio - minimum volume,

- ...

- `EXT09` - use threshold for enabling external audio - maximum volume.

6.2   Video Connection

Optionally, Aetos comes equipped with a BNC video connector. In general, any video camera with analog composite video signal in PAL or NTSC format can be connected. The SECAM format is not supported.

The input on Aetos has impedance $75\,\Omega$ and is expecting video signal with amplitude 1.5 V peak to peak. The video signal source must be connected to Aetos with $75\,\Omega$ coaxial cable.

Aetos does not recognize video format automatically. In order to configure the format used by video camera, follow next steps:

1. Select *Options* on the main menu.

2. Select the *Service* icon and enter the product specific password to access the service options.

3. Select the *Settings* icon from service page.

4. Search for the *Video input* and change it to the proper format.

The last step is illustrated on Figure 20.
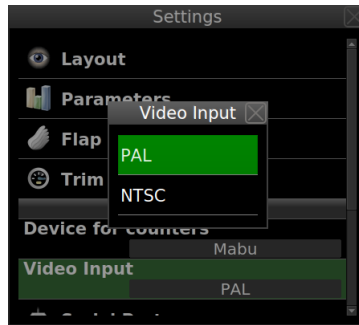
Figure 20: An example of video input format selection.

7 USB

Aetos has two USB ports. One at the back and one at the front. The front one is typically used with USB memory stick for data transfers and software updates. The back USB port is typically used for WiFi module, as a charger or as a cable tethering.

7.1 USB Memory Stick

On order to transfer data between the memory stick and Aetos, the memory stick must meet the following requirements:

- Max supported capacity is 32 GB.

- The stick must be formatted as FAT32 (Windows).

One memory stick is supplied in the kit.

In some occasions Aetos does not detect the USB memory stick properly. Removing the stick and inserting it back again usually solves the problem.

If the problem persist, try with a memory stick made by a different producer or try to insert it into the back port.

7.2 WiFi Module

When a suitable WiFi module is connected to Aetos and the module is properly configured and connected to some WiFi network with the Internet access,

then Aetos also gets access to the Internet. One such example is the WiPi module shown on Figure 21.

Please note that not all modules are compatible. For time being, we are supporting modules with the RT5370 chipset only.

Figure 21: En example of small WiFi module, called WiPi.

1. Plug the module into Aetos USB port. Back port shall be used, but it should work well also with the front port.

2. From the `Options` page select `Wireless` icon. Figure 22a shows an example screen.

3. Select the `Add` item. A list of detected networks appear. An example is shown on Figure 22b. You will see a different list.

4. Select a network where you want to connect to. In the example, `SkyEcho_B7D1` will be selected. This is an ADS-B receiver/transeiver[4] produced by uAvionics.

5. Enter the network password. Keep it empty when password is not required by the network.

6. After a few seconds, Aetos will connect to the network. See figure 22c.

7.3   USB Cable As Charger

Standard USB cable can be used to charge some (not all) devices. The maximal charge current is 500 mA. This may not be adequate power source for some devices.

Never connect power banks - the reverse current from power banks may permanently damage Aetos.

---

[4] This device is specially suited for the UK market.

(a) Initial window   (b) Network list   (c) Success
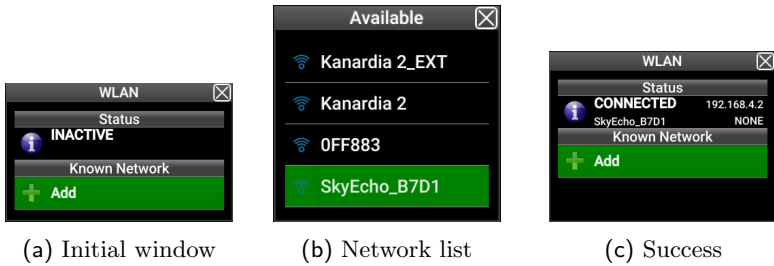
Figure 22: WiFi connection sequence example.

7.4   USB Cable As Tethering

Standard USB cable can be also used to connect a smart phone and Aetos. When *tethering* is enabled on the phone and the phone has Internet connection, then Aetos is connected to the Internet as well.

Please check your mobile phone documentation on how to enable the tethering mode. Usually, the procedure is as follows:

1. Connect Aetos and smart phone with a USB cable.

2. On the smart phone, select the settings icon.

3. Then select the connections item.

4. Search for the mobile hotspot and tethering option.

5. Enable the USB tethering option.

No actions are required on the Aetos side.

8   The CAN Bus

Aetos has two CAN bus ports. The CAN bus is the main communication bus between Kanardia devices. The CAN bus is a very robust vehicle bus. The communication is message based and connected devices communicate without the host computer. See https://en.wikipedia.org/wiki/CAN_bus for more details about the bus.

8.1 Connector and Plug

We are using standard Ethernet computer cable with RJ45 connector on each side. Communication leads are central twisted pair leads – pins 4 and 5, while other pins are used as a power supply for connected devices.

The cable can be bought in almost any computer shop. Although the connector seems a bit *cheap*, it is very reliable. We do not remember any plug/connector contact problem or failure in last 10 years.
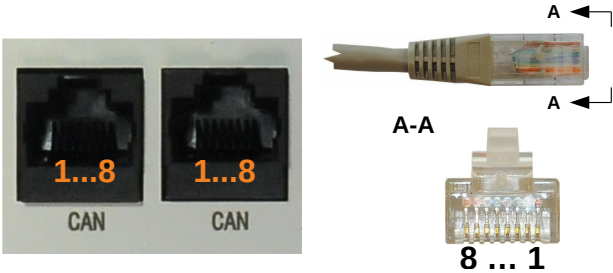
Figure 23: Designation of the CAN bus pins.

Pin	Description
1,2,3	+12V
4	CAN low
5	CAN high
6,7,8	GND – Ground

Table 4: Description of the CAN bus pins.

Our CAN bus system is running at 500 kBit/s.

8.2 The CAN Topology

CAN system can be used in different topologies. We are using line/bus type topology. Figure 24 shows schematic of this topology. It consists of one main CAN bus line and several devices (also referred to as nodes) are connected to the main bus via short connections. The connecting lines shall be short – up to 30 (50) cm, while the main line can be up to 40 meters long. Each side of the main bus line must have a terminator, which is a 120 Ω resistor.
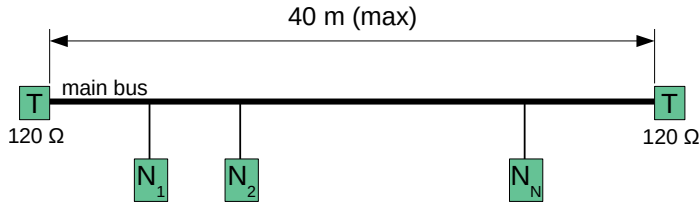
Figure 24: CAN line/bus topology principle used by Kanardia

Most of the Kanardia devices have two CAN bus ports that allow devices to be daisy-chained to each other. Main bus enter in one port and exits in the other. Port order is not important – both are equal. Inside device housing there may be more internal modules. In the case of Aetos, there is AIRU module (AD-AHRS-GPS module) and Aetos electronic board module. Both are internally connected to the main CAN bus.
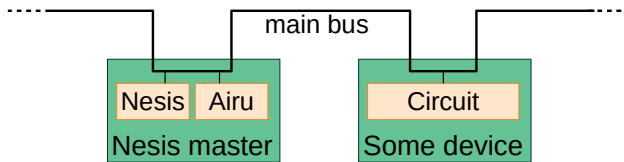
Figure 25: Device daisy-chaining, where devices has two CAN ports.

Daqu and Magu devices are a bit special. They usually appear on each end of the main bus. They have a built-in 120 Ω resistor, which is used as a CAN bus terminator. This means no extra terminator is required.

In most cases the main CAN bus is pretty short. It is typically less than 4 m long. For such short lengths one terminator suffices – there is no signal deterioration. Figure 26 illustrates the Aetos basic kit topology.

⚠ If Daqu is omitted from the bus, then CAN communication between Aetos and Airu module does not work as there is no terminator present. In this case, one terminator plug must be inserted instead.

8.2.1 T-Junction

Certain devices (SERU – autopilot servomotor, for example) have only one CAN connector and they can't be daisy-chained. In this case, a T-junction is needed. T-junction is a simple element with three RJ45 connectors.
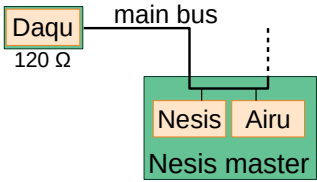
Figure 26: Topology of Aetos basic kit – Daqu also serves as a bus terminator. Because the main bus is very short, second terminator is not really needed.
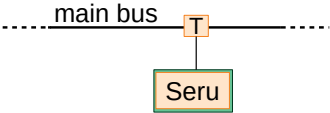
Figure 27: Devices with only one CAN connector require T-junction.

8.2.2 Terminator Plug

Aetos usually works together with Daqu and special terminator plugs are not required. But there are some occasions (to run Aetos as a standalone device, for example), when the terminator plug is needed.

The terminator is nothing but a simple 120 Ω resistor between CAN high and CAN low leads – pins 4 and 5 on Figure 23 and Table 4. A standard 1/4 Watt resistor will do.

9   Service Port

The service port consists of a D-SUB 9 pin connector and it is a multipurpose port. The port supports several roles: terminal communication with the built-in computer, auxiliary RS-232 port for general use, external push button command and alarm output signal. All functions can be used in parallel, although this is seldom needed.

Figure 28 and Table 5 define role of individual pins.

9.1   Terminal Communication

Terminal connection is used for communication with the main Aetos computer. This is a classic RS-232 connection at 115200 bit/s, 8 bits data, no
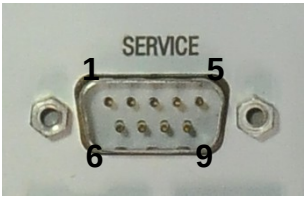
Figure 28: Service port D-SUB male with designated pins.

Pin	Description
1	External push button input.
2	Terminal RX (RS-232)
3	Terminal TX (RS-232)
4	12 V output, max 200 mA
5	GND – ground
6	Port 1 auxiliary RX (RS-232)
7	Port 1 auxiliary TX (RS-232)
8	Alarm switch – reserved for future use.
9	GND – ground

Table 5: Description of the service port pins.

parity bit, one stop bit. Figure 29 illustrates the connection.

⚠ A communication with a terminal shall be used only during production and factory maintenance or repair.
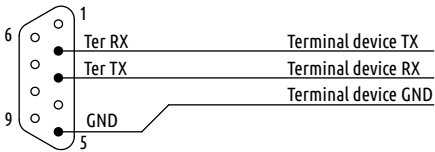
Figure 29: Connection schematics for service terminal.

9.2   Port 1 – Auxiliary RS-232

Aetos has three RS-232 communication ports used to connect to third party devices, see page 40. We recommend to use them first. However, if needed, an additional RS-232 communication can be established trough the service

port. Figure 30 shows the connection schematic. If Aetos and device are both connected to the same power source, the GND connection may be omitted.
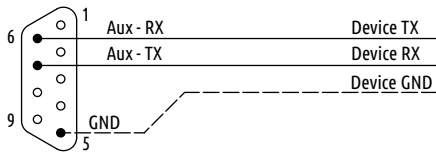
Figure 30: Connection schematics for auxiliary port 1.

9.3   External Push Button

Aetos allows connection of one external push button. The external button has two events: a normal push event(or short press) and a long push event (long press). In most cases an external button is used together with the autopilot system and events are associated with one of the AP commands.

Figure 31 shows the connection schematic.
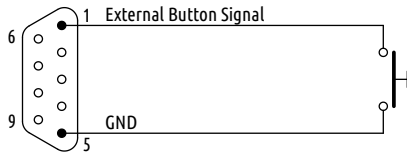
Figure 31: External push button schematics

In normal operation the circuit is open. When the button is pressed, it closes the circuit and connects pin 1 with the ground. This is detected by Aetos either as a short press or a long press event. Aetos will execute associated command.

Short press event is executed on button release (if the release cames soon enought). A long press is executed when button is kept pressed long enough.

9.3.1   Configuration

Once the external button is connected, it must be also configured in Nesis before it becomes operational. Some function must be assigned to a short press and a long press event.

1. Select the `Settings` icon from the User Options page and enter `314` password, if necessary.

2. Select the `User` option from the list.

3. Scroll down the window and search for the `External` and `External long` items. Assigne them functions of your choice. A typical example is shown on Figure 32. `External` represents the short press event on the external button and the `External long` represents the long press event.
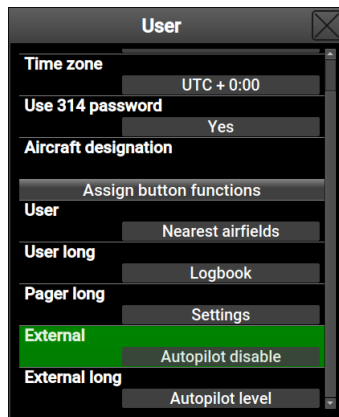
Figure 32: External push button configuration. The example shows autopilot settings, but any other functions can be used instead.

9.4   Alarm Switch

The software does not support this function yet.

When some device (any CAN bus device) reports an error condition, like some engine parameter outside limits or a sensor failure, an output signal will be raised. This alarm line can be used to trigger some other device, an alarm light on the instrument panel, for example.

Figure 33 illustrates schematics for small load connected to pin 8. When alarm is on, optocoupler internaly connects the line to ground (GND) and closes the circuit – the current starts flowing through the load. The load must be externally powered with the system bus voltage.
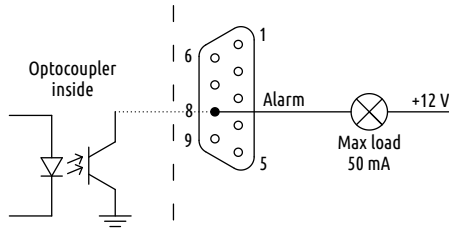
Figure 33: Alarm switch schematics with the load on the line.

Figure 34 illustract solution for a larger load. This load must be connected via relay and the circuit must be protected with a flyback diode. (Some relays have this diode already built-in.) When alarm is on, the circut is closed by optocoupler and coil in the relay gets energized. This, in turn, activates the relay switch and closes the load circuit.
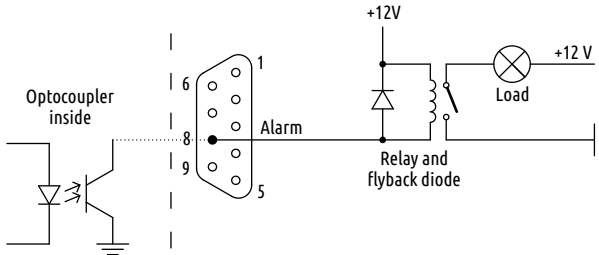
Figure 34: Alarm switch schematics with the relay solution for larger loads.

10   RS-232 Ports

Aetos has three RJ12 connectors at the back, which are intended for three independent RS-232 communications. And additional auxiliary RS-232 can be established trough the service port. Figure 35 shows these ports. They are labeled as:

- ADSB-Flarm – Port 2,

- Radio – Port 3,

- Transponder – Port 4.

Port 1 – is auxiliary port on the service connector. All these ports are independent. The names used next to port number are merely suggestions.

Figure 35: RS-232 ports at the back side of the Aetos.

10.1   Pinout

This section describes ports 2, 3 and 4 only. See section 9.2 on page 37 for the port 1 description.

A standard RJ12 (6P6C) plug is needed to connect to the port. The table 6 defines the pinout and figure 36 illustrates pin ordering on connector and plug. In most cases, only pins 5 and 6 are connected. Pin 1 is used only when you use Aetos as a power source for connected device.

Please note that output power on pin 1 is limited. The maximal current of all ports together must not exceed 500 mA.

Never connect external power source to pin 1. This will damage the internal circuit.

When connected device is only receiving data from Aetos, only pins 5 and 6 shall be used.

Figure 36: RS-232 ports with RJ12 connectors and their pin numbers.

Pin	Description
1	+12V out – used to power some device.
2	Not used.
3	Not used.
4	RX – receive data. Connect with TX on device.
5	TX – send data. Connect with RX on device.
6	GND – ground.

Table 6: Description of RJ12 pins for the serial RS-232 communication.

10.2   Configuration

Once some external device is connected, port must be also properly configured.

1. Select *Options* on the main menu.

2. Select the *Service* icon and enter product specific password to access the service options.

3. Select the *Settings* icon from service page.

4. Select the *Serial ports* item. Figure 37 illustrates the window.

5. Select the port where device was connected and choose one of the options described next.

6. Close all windows. Aetos will reboot and the communication with the device should be established.
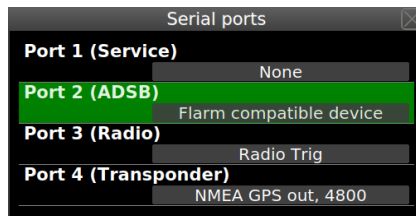
Figure 37: Serial port configuration window.

The options for each port are as follows:

None the port is not in use.

Radio KRT2 the port is connected with a KRT2 radio. Aetos will send KRT2 specific commands to the radio.

Radio ATR833 the port is connected with an ATR 833 radio. ATR 833 specific commands will be sent to radio.

Radio Trig the port is connected with a Trig TY91/TY92 radios. Trig's slightly modified SL40 protocol adapted for 8.33 kHz channel spacing will be used for communication.

Transponder KTX2 Use this to connect to the KTX2 transponder. This option will transmit NMEA RMC message only. Some early KTX2 transponders were not working of other messages (like GGA) were also present.

Flarm compatible device the port is connected with a Power Flarm, TRX 1500, or some other Flarm compatible device. Automatic baud rate detection is used for Flarm devices. Aetos expects one of the following baud rates: 4800, 9600, 19200, 28800, 38400, 57600. We recommend using higher boud rates like 38400 or 57600, when possible.

NMEA GPS out, 4800 the port will send out GPS data in NMEA format at 4800 baud, N-8-1[5]. RMC, GGA and GSA sentences are sent every second.

NMEA GPS out, 9600 same as above, but at 9600 baud.

NMEA GPS out, 19200 same as above, but at 19200 baud.

CO Level sensor Use this for Kanardia external CO sensor. Please make sure to set the *Internal CO Sensor* option to **Not present**, see section 11.7 for more details.

CO GD40 FDS Use this options when connectng GD 40 module produced by Flight Data Systems. See section 10.3.12 for connection details.

GDL90 compatible, 115200 connects to a device which outputs the ADS-B information in GDL90 format. Configure the device to output at 115200 baud, N-8-1. See Figure 54 for an example.

---

[5] N-8-1 – no parity, 8 bit data, one stop bit.

10.3   Connection Details

Next sub-sections illustrate connection details for specific devices. These are merely our recommendations.

Some devices can be connected in different ways. Any device manual always supersedes instructions given here.

10.3.1   TQ KRT2 Radio

Please read the *KRT2 Manual* before any connection is made to Aetos. The manual can be obtained from `https://www.tq-general-aviation.com`.

Connection to a KRT2 radio is made using a trick. Aetos pretends to be a KRT2RC remote control unit. This means that connection is only possible when the remote unit is not connected to KRT2.

KRT2 utilizes 15 pin D-SUB connector, where the housing is used as 16-th pin for GND. Figure 38 illustrates the connection of KRT2 and Aetos. Illustration shows only leads required by Aetos. Much more leads are connected to the 15 D-SUB connector. Use an adapter board, if possible. Please refer to the KRT2 documentation for more details on connections and adapter board.

If KRT2 and Aetos are both connected to the same airplane ground, then GND line can be omitted (dashed line).
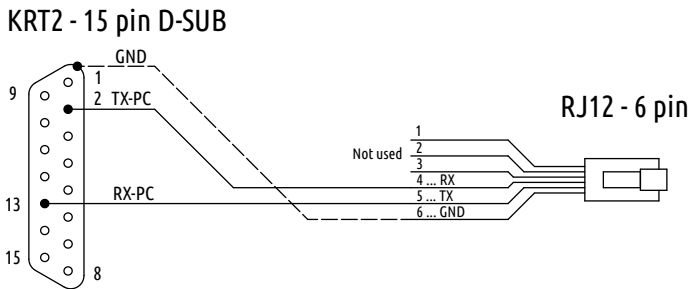
Figure 38: Schematic connection for KRT2 and Aetos RS-232 port.

10.3.2   Funke ATR 833 Radio

Please read the *ATR 833 Installation Manual* before any connection is made to Aetos. The manual can be obtained from `https://www.funkeavionics.de/`. Open the *Service* menu and search for the manual.

Connection to a ATR 833 radio is made using a trick. Aetos pretends to be a remote control unit. This means that connection is only possible when the remote unit is not connected to ATR 833.

ATR 833 utilizes 25 pin D-SUB connector. Figure 39 illustrates the connection of ATR 833 and Aetos. Illustration shows only leads required by Aetos. Much more leads are connected to the 25 D-SUB connector. Use an adapter board, if possible. Please refer to the ATR 833 documentation for more details on connections.

If ATR 833 and Aetos are both connected to the same airplane ground, then GND line may be omitted (dashed line).

Figure 39: Schematic connection for ATR-833 and Aetos RS-232 port.

10.3.3 Trig TY91/TY92 Radio

⚠ Please read the *TY91/TY92 Installation Manual* before any connection is made to Aetos. The manual can be obtained from `https://trig-avionics.com/`. Open the *Support* menu and search for the manual.

Trig TY91/TY92 radios consist of main unit and of a controller unit (TC90). The connection must be made to the controller unit. Figure 40 illustrates the connection between Aetos and the TC90 controller unit.

If TC90 and Aetos are both connected to the same airplane ground, then GND line may be omitted (dashed line).

TC90 Controller - 15 pin D-SUB
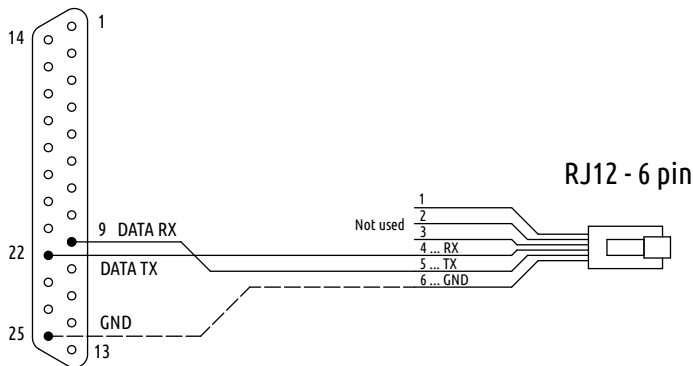
RJ12 - 6 pin
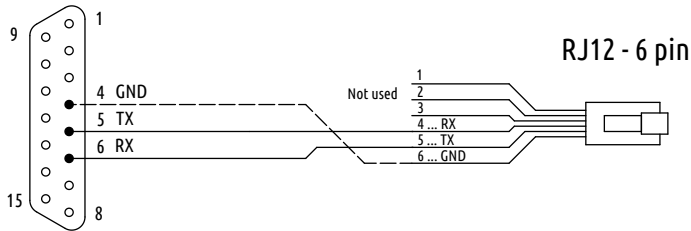
Figure 40: Schematic connection for Trig.

10.3.4   Funke TRT800H Transponder

Please read the *TRT800H Installation Manual* before any connection is made to Aetos. The manual can be obtained from `https://www.funkeavionics.de/`. Open the *Service* menu and search for the manual.

Funke transponder TRT800H may optionally connect to some GPS data source, which then enables ADS-B out function. This connection is made to the open cable ends, which are part of the external memory address adapter (TRT800EMxx). Do not attempt to open the connector/adapter!

Configure the transponder RS-232 part to *NMEA* and set data rate to *4800*. Also, set Aetos port to *NMEA GPS out, 4800*, see Figure 37.

Connect according to Figure 41, brown lead (RXD) from pin 12 on transponder with TX lead from RJ12 connector. Connect also GND from RJ12 with one of the grounds on transponder (shield of the cable or blue lead from pin 9). The communication is unidirectional only – Aetos transmits GPS data on TX and transponder receives the data on RX.

10.3.5   Trig TT21/TT22 Transponder

Please read the *TT21/TT22 Installation Manual* before any connection is made to Aetos. The manual can be obtained from `https://trig-avionics.com/`. Open the *Support* menu and search for the manual.

When a GPS data source is connected to the transponder, it will enable ADS-B out function automatically. Select *NMEA* protocol on transponder and Aetos and also match the data rate on both.

Figure 42 shows connection schematics. The D-SUB 25 connector on the transponder side is multipurpose connector. Only connection related to the

TRT800EMxx Cable Plan
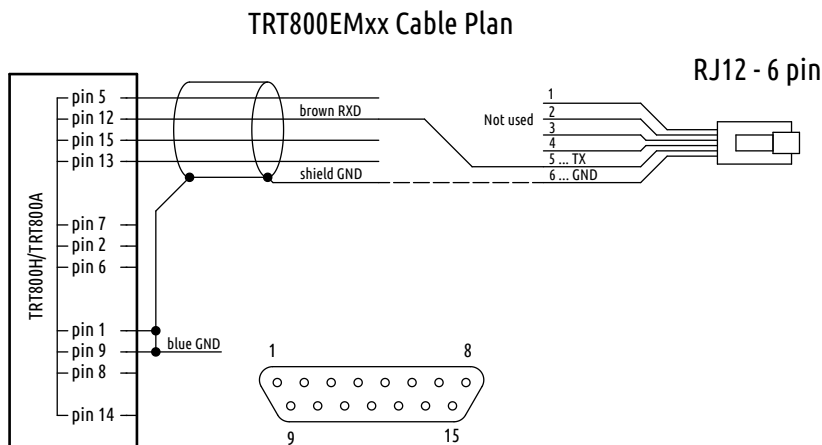
Figure 41: Schematic connection for the TRT800H transponder.

Aetos are shown. The communication is unidirectional only – Aetos transmits GPS data on TX and transponder receives the data on RX.

TT21/TT22 - 25 pin D-SUB
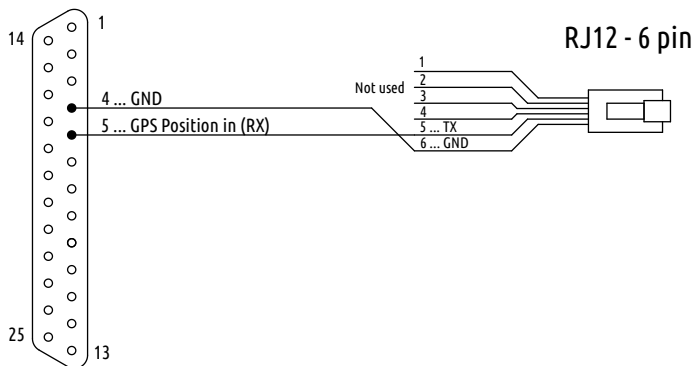
Figure 42: Schematic connection for the Trig TT21/TT22 transponder.

10.3.6   TQ KTX2 Transponder

Please read the *KRT2 Manual* before any connection is made to Aetos. The manual can be obtained from `https://www.tq-general-aviation.com`. Please note that KTX2 requires software version 101 or higher for the ADS-B out to operate.

Figure 43 shows connection schematics. The D-SUB 15 connector on the transponder side is multipurpose connector. Only connection related to the Aetos are shown. Although, the communication is unidirectional only – Aetos transmits GPS data on TX and transponder receives the data on RX, KTX2 manual requires to connect the RX line as well. It does not say anything about GND lines however.
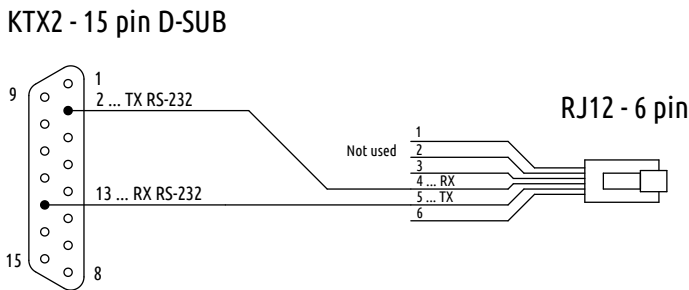
Figure 43: Schematic connection for the TQ KTX2 transponder.

10.3.7   Power Flarm

Please read the *PowerFLARM Core Installation Manual* before any connection is made to Aetos. The manual can be obtained from the Flarm Technology Ltd web site. Aetos User Manual has one complete section devoted to Flarm based products. Please read this section as well. Aetos allows you to do almost complete configuration of Flarm.

Flarm SW Update

When you purchace your Flarm device, it is very likely that SW in the device has already expired. Please update the SW first. This procedure involves downloading the latest SW from Flarm web site, copying the file to USB stick and restating Flarm with the stick inserted. The details are on the Flarm web site.

Flarm Configuration

In order to use Port 1 on the Flarm device, you have to activate it and set it properly. We suggest you to use the *Flarm configuration tool*, which is avialble from the `Support|Tools & Software` section of the Flarm web site.

From connection point of view, it is important to set:

- Data sentence on the RJ 45 connector – `GPS and Flarm`.

- Protocol version for the RJ45 connector – `Version 7`.

- Baud rate of the RJ45 connector – `57600` (or at least 38400).

Connection

PowerFLARM core has two communication ports at the back side. Port 1 has RJ45 connector and port 2 has D-SUB 9 pin connector. This section describes connection to port 1.

The port 1 on Flarm has 8 pin RJ45 connector, while Aetos is using 6 pin RJ12 connector. The schematics on Figue 44 shows meaning of individual pins and proper connection. 6 or 8 pin flat cable can be used. Pins 1 and 8 on the Flarm side can be left open, as well as pins 3 and 4.

Power Flarm gets power from Aetos, hence pin 2 on Flarm side and pin 1 on Aetos side must be connected as well. For the same reason GND pins must be connected too.

RJ45 - 8 pin   **RJ12 - 6 pin**

```
8 ... GND
7 ... GND                          1 ... +12 V
6 ... RX                           2
5 ... TX                           3
4 ... GND                          4 ... RX
3 ... +3V out                      5 ... TX
2 ... +12V in                      6 ... GND
1 ... +12V in
```
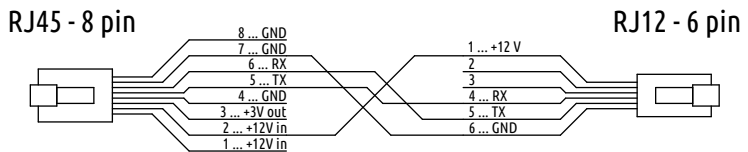
Figure 44: Schematic connection for Power Flarm devices.

10.3.8   TRX 1500

Please read the *TRX-1500A User and Installation Manual* before any con-
nection is made to Aetos. The manual can be obtained from the `https://www.air-avionics.com/` web site. Open the *Support* menu and then se-
lect *Old & Discontinued Products*.

Connection

TRX 1500 has a 15 pin three row main connector at the back side. The
connector provides power supply to the unit and several I/O ports.

As TRX 1500 uses only one connector for several ports, the schematics on
Figure 45 shows two cables comming out of the main connector. The bottom
one connects to Aetos serial port, while to top cable is optional and can be
connected to one of optional Flarm displays.
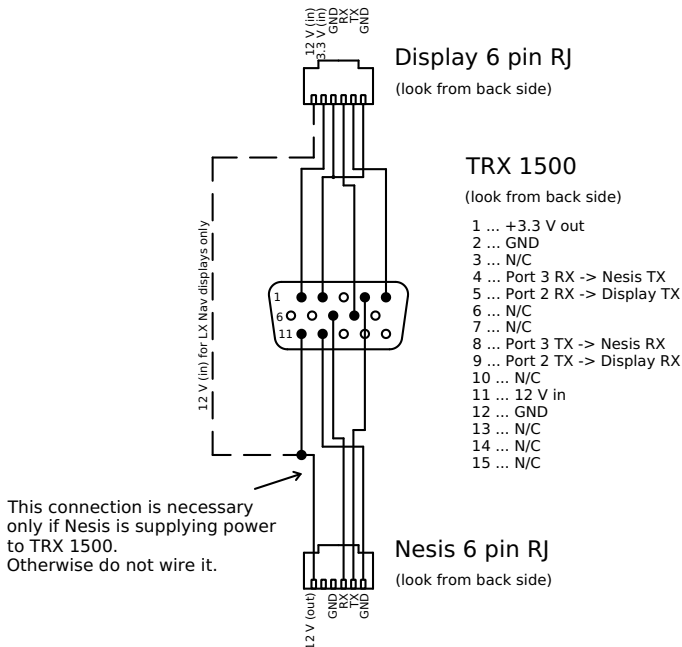
Figure 45: Schematic connection for TRX 1500.

The schematic assumes that Aetos will be connected on port 3 and optional
display on port 2.

Some displays require 12 V for their operation. In this case Pin 11 shall be also connected with the display connector.

Configuration

TRX 1500 can't be configured with the Aetos. A PC computer with TRX-Tool software and USB connection must be used instead. See TRX 1500 documentation for details.

We recommend the configuration as shown on next figures. Figure 46 shows the *general* page. If you have a transponder on your aircraft, enter the transponder ICAO address into the *ICAO Mode-S address (hex)* field.
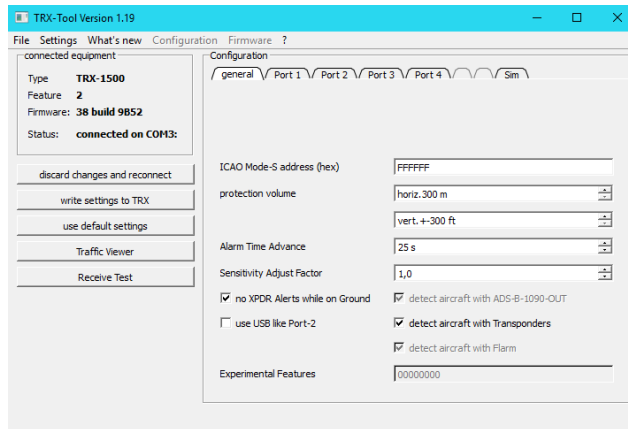
Figure 46: TRX 1500 general settings page. Enter correct transponder ICAO address here.

Figure 47 shows typical settings for Port 2, where optional LCD display may be connected.

Figure 48 shows settings used to connect Aetos on the port 3.

Different settings may suit your needs better. Feel free to experiment. If something goes wrong, you may return to the settings shown on the Figures 46 to 48.

10.3.9   AIR Traffic AT1

Please read the *AIR Traffic Installation Manual* before any connection is made to Aetos. The manual can be obtained from the `https://www.air-avionics.`
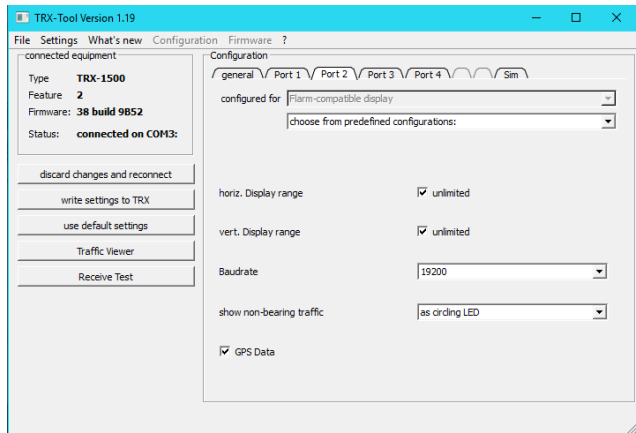
Figure 47: TRX 1500 port 2 settings page. Port is connected to display.
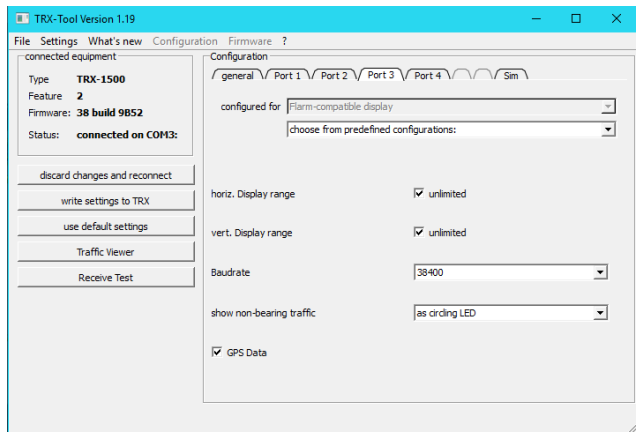
Figure 48: TRX 1500 port 3 settings page. Port is connected to Aetos.

com/ web site. Open the *Support* menu and search for the manual.

Connection

AT1 has a D-SUB26 HD connector on its back side. This is a multi purpose connector and several devices may use it. Schematics shown on Figure 49 shows only connections required to connect data port 3 on AT1 with Aetos.

It is also assumed that Aetos will provide power for AT1.

In order to turn AT1 on, a switch between pins 22 and 23 is required. When switch is closed, AT1 is turned on and vice versa. Alternatively, pins 22 and 23 can be permanently connected. In this case, AT1 is powered on as soon Aetos is powered on.

A separate power line can be provided for AT1. In this case, do not connect pin 1 on AT1 with pin 1 on RJ12. However, pin 6 on RJ12 and one of GND pins on AT1 shall be connected.
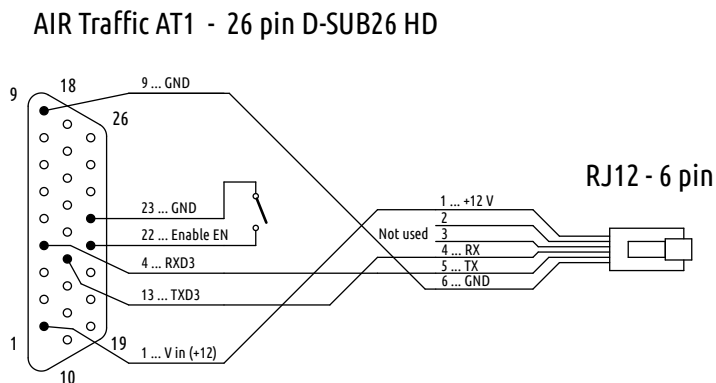
Figure 49: Schematic connection for AIR Traffic AT1 device.

Configuration

The AT1 devices can't be configured with Aetos and one of the procedures from device's manual shall be used. The WiFi solution is shown next.

Turn the AT1 on. AT1 will act as an WiFi access point. Connect a computer, a telephone or a tablet to the *AIR-Traffic* SSID and establish connection per device's manual. Once connection is established, open the browser with correct URL address. Figure 50 shows the situation after the connection was made and device data was synchronised.

Set the HEX code – *Own ICAO Address* of your transponder.

Aetos will connect to data port 3. Default protocol for port 3 is Garmin TIS protocol. This must be changed. At the same time we also recommend using higher baud rate. In order to change this, select the *Advance Configuration* button and scroll down until the RS-232 data port section. Figure 51 shows settings we used.

AIR Traffic

Configuration

Simple Configuration	Advanced Configuration

Own ICAO Address (HEX):
To identify signals from the own transponder, AT-1 uses the aircraft's unique ICAO 24 bit address, also called 'HEX Code'. Entering this code is mandatory for AT-1 to function properly. If your aircraft does not have an ICAO address, for example, because you do not have a Mode-S Transponder or 406MHz ELT installed and, therefore, no ID has been assigned to your aircraft yet, please enter 'FFFFFF' instead.

`FFFFFF`

Own Aircraft Category:
Configure the category of aircraft the AT-1 is installed in. This parameter adjusts warning thresholds to suit the operational requirements of the aircraft category.

`MOTORPLANE`

WiFi Interface Activation:
Gives options to activate the integrated WiFi interface. If not using an in-flight WiFi data connection, we recommend setting this option to 'First 15 Minutes On'. This allows WiFi functions like the AT-1 configuration webpage to be accessed within the first 15 minutes after power-on. After 15 minutes, the WiFi interface is switched off for saving power. Be careful! Setting this option to 'Always Off' will render the AT-1 configuration webpage via WiFi inaccessible.

`ALWAYS ON`

WiFi Interface Output:
Selects the data output for the WiFi Interface.

`FLARM PROTOCOL`

RS-232 data port 1 Output:
Selects the data output for the RS-232 data port 1.

`NMEA GPS ONLY`

RS-232 data port 2 Output:
Selects the data output for the RS-232 data port 2.

`FLARM PROTOCOL`

RS-232 data port 3 Output:
Selects the data output for the RS-232 data port 3.

`GARMIN TIS PROTOCOL`

Save	Cancel

Show Device Info

Show Simulator Control

Print This Page

Figure 50: Home page of the AT1 device. RS-232 data port 3 was not set yet.

1. Change the *RS-232 data port 3 Output* to FLARM PROTOCOL and

2. change the *RS-232 data port 3 RS-232 Data Rate* to 57600.

3. You can also experiment with *Range* and *Vertical Range* settings, but default values are OK.

4. Press the *Save* button to activate the changes.

Aetos requires a few seconds to detect new data rate and detect the format. This procedure is automatic.

Unfortunately, AT1 does not fully implement the Flarm protocol. So Aetos can't obtain device information. An attempt to access any of the ADS-B/Flarm options on Aetos will result in *Flarm info is not available* message. This does not mean that AT1 device is not working properly.

10.3.10   Flarm Eagle

Please read the *Flarm Eagle Manual* before any connection is made to Aetos. The manual can be obtained from the `http://www.lxnavigation.com/` web

Figure 51: Data port 3 settings required for the communication with Aetos.
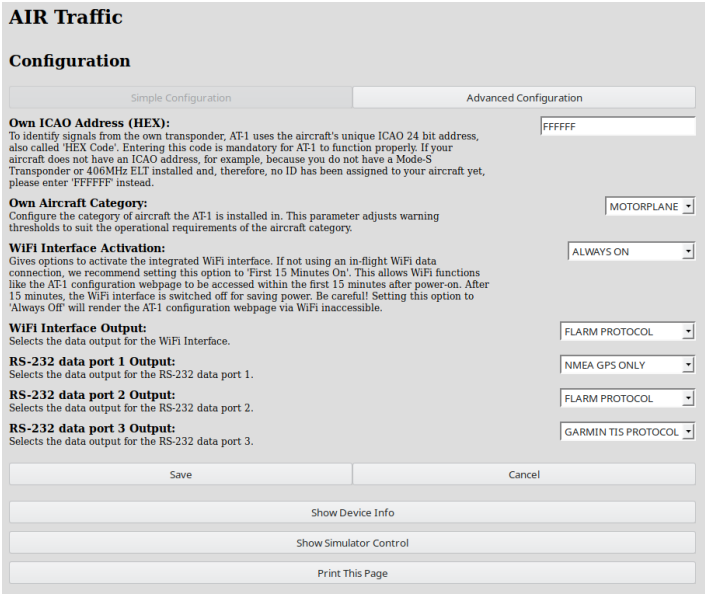
site.

Flarm Eagle is the smallest and lightest of all Flarm devices that we were testing. Please note that ADS-B in is offered by Flarm Eagle as an option and it is not provided by default.

Connection

Flarm Eagle has typical Flarm RJ12 six pin connector on front. Pins numbering is the same as on the Aetos, so connection can be made with a flat cable. The same cable can also provide power for the Flarm Eagle.

Configuration

Flarm Eagle fully supports the Flarm protocol and it can be configured with Aetos. Alternatively, it can be configured via USB port or via micro SD card (depending on the Flarm Eagle model).
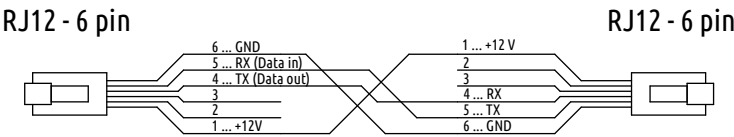
Figure 52: Schematic connection for Flarm Eagle device.

10.3.11   uAvionix echoUAT

Please read the *echoUAT Manual* before any connection is made to Aetos. The manual can be obtained from the `https://uavionix.com/` web site.

echoUAT can be connected via Wifi or via RS-232 cable. We recommend using cable connection whenever possible. This section gives details for the cable connection.

Figure 53 gives the connection details. When both devices are connected to the same power source, which is usually the case, then there is no need to connect GND (dotted line).
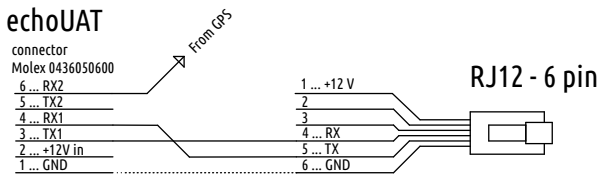
Figure 53: Schematic connection for echoUAT device.

Configuration

echoUAT supports GDL90 protocol. Please configure the device to transmit data on COM 1, as it is shown on Figure 54. From the Aetos point of view only settings in the orange rectangle are important. Rectangle on the left makes sure that both TIS-B (traffic on 1090 MHz) and FIS-B (uplink on 978 MHz) are received. The rectangle on the right configures COM 1 port as it is expected by Aetos.
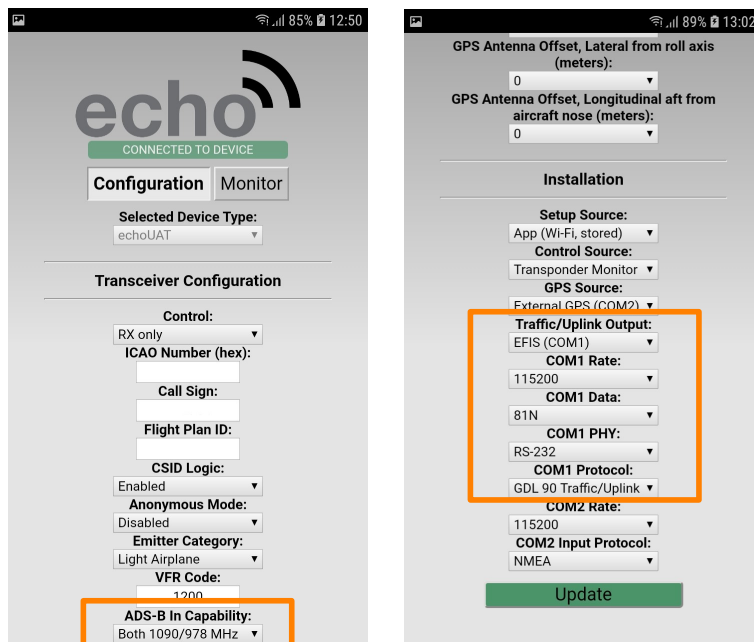
Figure 54: Configuration of the echoUAT device.

10.3.12   Carbon Monoxside – Flight Data Systems – GD 40

This device is produced by Flight Data Systems `http://www.fdatasystems.com/gd-40-co-detector/`. It connets to Aetos via RS-232 port. A typical connection is shown on Figure 55.

GD 40 consumes about 40 mA at 12V . This is low enough to be powered from Aetos port. Be careful however, as total power capacity of devices powered by Aetos is limited. If you are in doubt, some external power source shall be used instead.

GD 40 comes equipped with red/green warning led. This can be optionally connected according to schematics. Optional push button can be connected to GD 40. When pushed GD-40 comenses a test procedure. GD 40 also drives a relay switch and outputs audio stream. Please refer to the GD 40 manual for more details `http://www.fdatasystems.com/s/GD_40_Manual.pdf`.
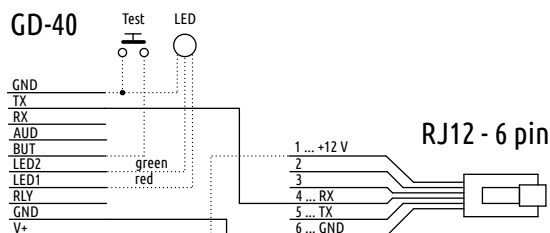
Figure 55: Typical connection to GD-40 CO device.

11 Service Settings

The *Settings* icon in the service page opens access to several configurations options, which significantly affect Aetos behaviour and outlook.

11.1 Parameters

Parameters have a section of its own. Please see section 15, starting on page 77.

11.2 Flap Settings

Before you can proceed with the flap settings, plaese make sure that flap sensor was correctly connected to Daqu (see Daqu manual), Daqu channel was correctly configured (see section 13.3) and `Min-Max` position was determined (see section 13.3.2).

Flaps may have several fixed positions between fully retracted and fully extended. This window is used to define visual flap stops markings, which are relative to the full flap travel. Typically, flap stop 0 corresponds to 0% of travel and full flaps to 100%. Aetos allows setting up to five different position. Figure 56 shows an example.

`Time of travel` defines approximate time of flap from 0 to 100%. This value is used with combination of flap position sensor to detect the flap movement and also to prevent sporadic flap movement messages.

    If flap movement window appears on the screen, but flaps are not moving, increase this value.

    If flap movement window does not appear on the screen, or appears too late and the flaps are moving, reduce this value.
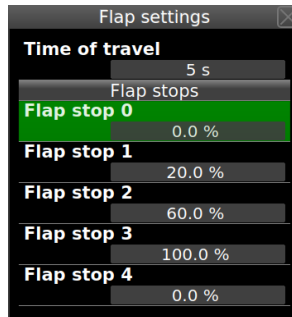
Figure 56: Example of flap stops window for an airplane with three flap positions.

`Flap stop` define flap position in percentage of full travel range.

Flap stops that are not used, must be set to zero.

11.3   Recorder

In normal operation the options shall be set to *Disabled*. This means that no special recording takes place.

Sometime, moststly due to software development purposes, a recorder may be turned on. The record option appear on the top left area of the Modern screen. Only one recorder can be active at the same time. The following recorders are possible.

`GDL90` can be used to record all information received from some GDL90 defice to a USB memory stick. Such records come handy for development and debuging TIS-B and FIS-B services of ADS-B systems.

`CanData` records complete internal CAN bus traffic to USB memory stick.

`Kalman` records sensors information from AD-AHRS-GPS module. It is used for post processing, debugging and simulating AHRS behaviour.

Normally, recordings are not necessary.

11.4 Trim Sensitivity

When trim position sensors are connected and properly configured with Daqu, Aetos can also show their position.

In order to properly detect a trim position change, an approximate travel time from one trim stop to the opposite trim stop is required. This time will be used together with the trim sensor values to detect the trim movement and to distinguish it from sensor fluctuations (false trim position changes).
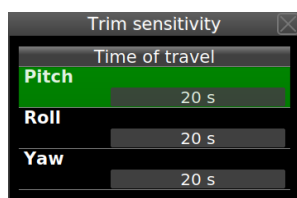
Figure 57: Example of trim sensitivity settings.

If trim movement window appears on the screen, but the trim is not moving, increase corresponding value.

If trim movement window does not appear on the screen or appears too late and the trim is moving, reduce this value.

11.5 Video Input

Certain Aetos models have a composite video input connection. Aetos must know the format of this analogue video input. It can be either PAL or NTSC. Only these two formats are supported. Please check which format is used in your camera and set it accordingly.

11.6 Serial Ports

Aetos has several serial (RS-232) multi purpose ports at the back. Please refer to the section 10 starting on page 40 for details.

11.7 Internal CO Sensor

Aetos may have a build-in internal CO (carbon monoxide) sensor. It can be chosen from:

`Not present` sensor is either not present or it is disabled.

`Internal CO v1.0` sensor is enabled.

`Internal CO v1.1` sensor is enabled.

i Since 2019 we do not equip Aetos with internal sensors anymore. We use external CO sensors instead. An external sensor is connected to one of RS-232 ports at the back of the Aetos. Please see 10 starting on page 40 for details.

11.8 Backup

This command creates several backup files and stores them on a USB memory stick. It effectively stores all major settings. The saved files can be used to transfer the same settings to a different instrument or to restore settings on an existing one.

A valid USB memory stick must be inserted in USB port before the command is issued. On success, *Nesis-Backup* folder is created on USB stick with the following files:

- `Settings.bak` stores most user options and settings.

- `Pilots.bak` stores pilots and instructors.

- `UserWpts.bak` stores user defined waypoints.

- `Routes.bak` stores routes.

- `Parameters.bak` stores all parameter settings.

- `Daqu.bak` stores a copy of Daqu settings, when Daqu is connected to the CAN bus.

- `Ini.bak` stores a copy of some initialization parameters.

- `airplane` folder stores all layout `*.conf` files found on Aetos.

11.9   Restore

This command restores backup files from a USB memory stick. The files are expected to be located in *Nesis-Backup* folder. If only one such folder exists on the USB memory stick, then restore process is automatic. If several *Nesis-Backup* folders exists (each in its own parent folder), then a window is shown to select the parent folder to copy from.

On success, all above mentioned files are restored and Aetos is restarted.

Important note: The Aetos software version is important. The restore will fail if the backup was created with newer version. For example: Backup was created with Aetos running SW version 3.4 and a restore attempt is made on Aetos with SW version 3.3. This restore will fail without a warning and it will leave Aetos in an undetermined state. The restore will be successful only on versions 3.4 and above.

12   AHRS-Leveling

During the assembly of the AD-AHRS-GNSS unit (AIRU) into the primary Aetos and during the installation of the Aetos display into the instrument panel, a small misalignment may appear. This means that internal axes of the AIRU are not parallel to the airplane axes – the unit is slightly rotated. Such misalignment can be adjusted without loss of precision using the procedure described in this section.

Please note that the attitude can't be adjusted when the airplane is flying or engine is running.

Please make sure that aircraft is level for both, roll and pitch. Make also sure that Aetos is turned on for at least ten minutes – this warms up the internal electronics and stabilizes numerical filters.

Before the automatic alignment is made, the yaw misalignment shall be determined.

Follow next steps to open the AHRS Level window:

1. Select *Options* on the main menu.

2. Select the *Service* icon and enter product specific password to access the service options.

3. Select the *AHRS Level* icon from service page.

A window similar to one shown on Figure 58 appears on the screen.

Figure 58: AHRS Leveling window.

12.1   Yaw Misalignment

When the instrument panel is perfectly flat and perpendicular to the airplane x-axis (longitudinal axis) than there is no yaw misalignment and the correction angle is zero. This perfect situation is illustrated on figure 59 left.

Some instrument panels or Aetos installations are rotated regarding the airplane x-axis (longitudinal axis). In this case the misalignment angle Ψ must be measured and its value entered into Aetos. Figure 59 defines positive and negative Ψ angle.

When Ψ is known, enter its value into *Yaw* item as shown on Figure 58. Then you can proceed with the pitch and roll adjustment, which are automatic.
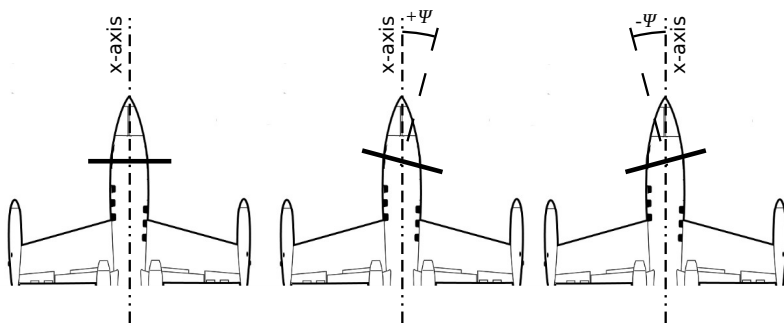

Figure 59: Top-down view illustration of possible yaw misalignment: perfect position (left), positive yaw misalignment angle (middle), negative yaw misalignment angle (right).

Yaw correction affects the roll and pitch correction as well. Hence it is important to set yaw before roll and pitch adjustments are made.

12.2   Roll and Pitch Adjustment

Once yaw correction is known (in most cases it is zero), roll and pitch can be adjusted automatically. Press the *Auto adjust* item on the window from Figure 58 and wait for the progress bar to finish. Observe roll and pitch values. At the end, they should be close to zero.

If necessary, minor manual adjustments can be made by pressing on $\ominus$ or $\oplus$ symbols of the pitch and roll item. AIRU needs some time to react, so make these adjustments slowly.

12.3   Initial Pitch

Small pitch adjustment can be also made during a flight. It is typically needed when cruising speed has changed. Once the Aetos shuts down, this in-flight adjustment is forgotten.

The *Initial Pitch* option from Figure 58 allows entering the initial pitch correction, which will be used when the Aetos starts.

13   Engine & Sensors

This section refers mostly to the engine sensors and other aircraft sensors (trim, flap position, fuel level, rotors,. . . which are connected to Daqu.

It is highly recommended to read and understand the Daqu manual before doing changes. Almost any change described in this section will directly affect the Daqu device. Any change will be transmitted to Daqu, which needs some time to respond. Therefore, we recommend not to work too quickly – give the system some time to adjust to changes.

In order to show a sensor parameter on screen, three different activities must be completed:

1. Sensor/transducer/probe must be connected either to Daqu or to some ECU. This depends on the engine model. This topic is extensive and quite complex. It has a manual on its own. Please refer to the `miniDaqu` or `Daqu` manual for more details.

2. Correct engine model must be selected. In addition, for each sensor that connects to `Daqu` a corresponding channel must be configured. This is covered in sections 13.1 and 13.3.

3. Each sensor-probe is associated with certain function, which in turn is associated with a parameter. Parameters can be enabled/disabled, have green, yellow, red ranges and some other specific values. These ranges and values must be set properly in order that Aetos can display it on the screen. Please refer to section 15 for more details.

Figure 60 shows an example of engine sensors window. The window consists from the top bar, where the engine model and some flags can be set and the larger bottom part, where Daqu channels are configured.

The window will show up only when Daqu is properly connected to the CAN bus.
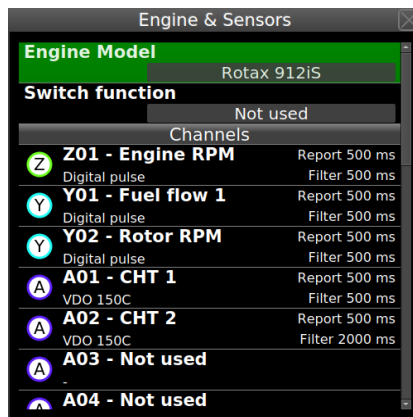
Figure 60: An example window for engine and sensors.

13.1   Engine Model

Engine model shall be selected first. This tells Daqu if this is a classical engine or it has some kind of ECU (Rotax iS, UL-Power, D-Motor, ...). Aetos uses this info to load default parameter settings for the engine, section 15. For some engines it also tells which software fuel flow calculation models shall be used (It is used only when fuel flow sensor is not present.)

Engine	ECU	FF-Model
Generic engine (any engine)		
Rotax 582 65 HP		○
Rotax 912 80 HP		○
Rotax 912 100 HP		○
Rotax 914		○
Rotax 912 iS	●	●
Rotax 915 iS	●	●
Jabiru 2200		○
Jabiru 3300		○
Geiger Wankel A 2-74	●	
MW fly with CC-m	●	●
UL Power RS-232	●	●
UL Power CAN 125 kb/s	●	●
UL Power CAN 500 kb/s	●	●

Table 7: Engine models, ECU connectivity and fuel flow availability (● from ECU, ○ from software model).

The *Generic engine* option can be used for any engine any is normally used with Lycomming, Continental . . .

Some ECU base engines provide fuel flow information. For all others, a fuel flow sensor is recommended even for engines where a software fuel flow model exists.

13.2   Switch Function

This option is available only when miniDaqu is connected to the CAN bus. Standard Daqu does not have this possibility.

The miniDaqu EMS box has one auxiliary digital port, which is acting as a switch. This switch function can be set to:

`Not used` the switch is not in use.

`ECU start` can be used in conjunction with Rotax iS engine only. It is used to automatically engage/disengage the start button switch. This can be useful in engine start sequence.

`Alarm light` turns on the switch (alarm line), when an alarm condition is met. Note: SW 3.4 does not support this yet.

When the *ECU start* is active, an additional option appears. It is labeled as *iS start switch RPM threshold*. This defines the RPM limits that must be reached to automatically disengage the start button switch.

13.3   Channels

Aetos lists all channels available on Daqu. Channels types are designated with letters, which define the hardware capabilities of each channel. Channels labelled with Z and Y are digital channels, while channels labeled with A, B, C, D, E and F are analogue channels. Please refer to the Daqu manual for more details.

Selecting a channel opens a small action window, Figure 61. Some of the actions depend on the channel function or sensor type.
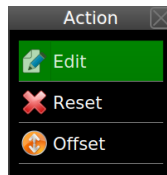
Figure 61: An action window example.

`Edit` Opens the channel editor window, which allows tuning the channel details: function, sensor type, filter, etc.

`Reset` clears all the channel data and set the channel as not used.

`Min/Max` is used to define the sensor limits, required for some functions like trim and flap.

`Offset` is used to slightly adjust the sensor's zero settings. This option is not available for some sensors.

`Tank` is used to give additional details for the fuel level sensor.

In order to access the last three options, channel must be first properly set with the *Edit* command.

13.3.1   Channel Editing

The channel editor window depends on the channel type and also on the selected function and sensor. Bottom part of the window changes dynamically, but the first four items are the same for all channels. Figure 62 shows an example of channel editing window.
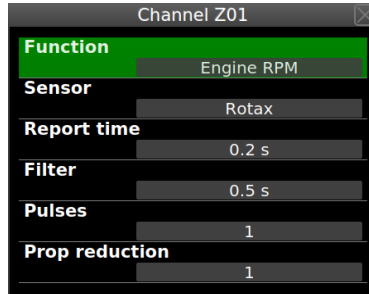

Figure 62: An example of channel Z editing. Z is typically used for the engine RPM.

Function A list of available functions for this type of channel is shown. The function tells what the channel is measuring.

Sensor A list of sensors available for the selected channel and selected function is provided. Select one from the list. This tells Daqu what kind of signal is to be expected on this channel.

Report time defines how frequently Daqu sends measurements to the CAN bus. This is defined as a time interval between two measurements being sent. Small value means that measurements are send frequently.
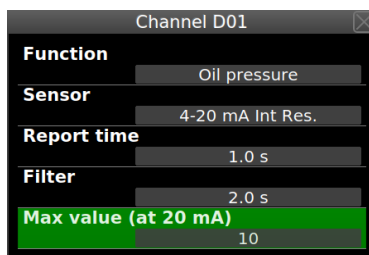
Filter defines a low level filtering. This is a low pass filter time constant. A larger value means that more time is needed for a measurement to react on a sensor change. The optimal value depends on the sensor and function type.

Pulses value is specific for digital channels (Z,Y). It defines how many digital pulses are required for one event. For example, some rotor sensor may issue 12 pulses per one rotor revolution.

Prop reduction is specific to Engine RPM function. Some engines have reduction gear boxes (Rotax for example). If the reduction ratio is

entered, then the propeller RPM will be shown instead of the engine RPM. This value is typically set to 1.0, which results in engine RPM.

Figure 63 shows another example. In this case an oil pressure sensor is connected to channel D1. As a generic family of sensors is selected in the *Sensor* i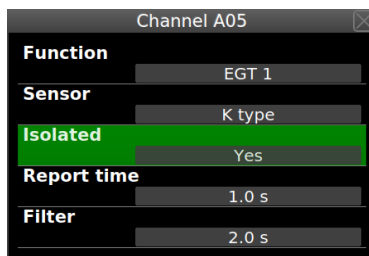tem, an additional items appears at the bottom – *Max value (at 20 mA)..* This value is used to define the sensor range. In the example the value is set to 10 bar, which is typically used with Rotax engines.

Figure 63: An example of channel D editing. Certain sensors require additional value, which defines the sensor range.

Another, slightly different example is shown on Figure 64. In this case sensor is a thermocouple and this type requires a selection between isolated or non-isolated type.

Figure 64: An example of channel A editing. An EGT sensor is connected to the channel.

Note: The functions can't repeat themselves. When one specific function was assigned to one channel and then the same function is assigned to the other channel, the first assigned function will be reset and the last assigned function will be kept.

13.3.2   Min/Max

Functions like trim position, flap position and throttle positions require two additional parameters. After defining basic channel parameters, these two parameters are available trough the *Min/Max* window. These two parameters are sensor values at both extremes.
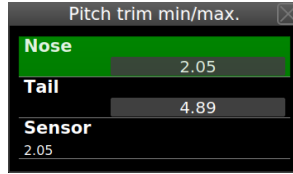

Figure 65: An example of extreme positions for the pitch trim sensor.

`Nose` holds the value of the pitch trim sensor when trim is at the full forward – nose down position. The value can be entered manually.

`Tail` holds the value of the pitch trim sensor when trim is at the full backward position – tail down position. The value can be entered manually.

`Sensor` is the raw pitch sensor value currently detected. If sensor is measuring the voltage, then voltage is shown, if sensor is measuring resistance, resistance is shown. Selecting the sensor item allows copying current sensor value either into *Nose* or *Tail* fields.

In typical scenario, aircraft is trimmed full forward and once sensor value is stable, sensor value is copied to *Nose*. Then it is trimmed fully backward and once sensor value is stable it is copied to *Tail*.

13.3.3   Offset

For certain sensors, offset can be adjusted. This is used in cases, when the correct sensor value is known, but the actual value shown by the sensor is slightly incorrect.

Example on Figure 66 shows a MAP sensor. The known (reference) pressure value is 0.96 bar and the *Offset* value was adjusted to 0.04 bar until the MAP sensor also shows 0.96 bar.
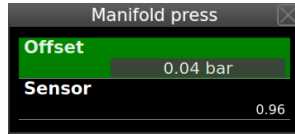
Figure 66: An example of manifold pressure offset.

13.3.4   Tank

The tank action is shown only for fuel level sensors. Details are given in next section.

14   Tank

Aetos supports two modes for the fuel level indication. The first mode is based on fuel level sensors and the second one is a software simulated tank.

Please note that you shall complete this section (14) before adjusting tank color ranges – red, yellow, green.

14.1   Fuel Level Sensors

After the fuel level sensor channel has been set for certain fuel tank, the tank must be calibrated. In principle, this is similar to the *Min/Max* procedure for trim sensors. However, the tanks can have pretty complex shape, which very often results in non-linear behaviour.

Three different approaches are supported to match the tank shape:

1. Linear – linear curve is assumed and only min and max value are needed.

2. User – up to 20 tank points can be given to define the shape.

3. Predefined shapes – nominal curves are predefined and the selected curve will be scaled between min and max value.

14.1.1   Linear Shape

This is the simplest tank calibration solution. It only requires three additional values. Figure 67 illustrates the main tank window and figure 68 illustrates situation with the empty and full tank.

`Shape` must be set to linear.

`Tank capacity` defines the total tank capacity.

`Empty/full` define fuel level sensor values at empty and full tank.
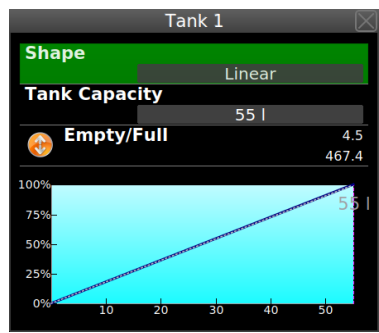
Figure 67: An example of linear fuel tank.
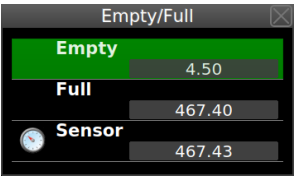
Figure 68: An example of linear fuel tank.

Typically, the tank is completely drained and a value shown by the fuel level sensor is copied to the *Empty*. Then, the tank is filled with fuel and the sensor value is copied to the *Full*.

We recommend taking notes. If something goes wrong, the empty and full values can be entered directly (from notes) - without messing with a fuel again.

14.1.2   User Shape

This is the most complex solution, but also the most precise one. It allows up to 20 calibration points per tank. 20 points are an overkill, 5-8 points are usually more than enough. Fuel level sensors precision and resolution

are quite limited and sometimes also fuel type dependent. Having too much points in calibration is not beneficial.

In order to define a user shape for tank, set the *Shape* parameter to `User`. The window will change slightly. Then select the *Edit* item. This opens a window, where tank measurements are manipulated.

💡 A typical procedure is described next. Taking notes on paper about every measurement point is highly recommended.

1. Make sure that aircraft is in level position for a cruise flight.

2. Make the tank empty – drain all fuel out. Select proper fuel sensor (or tank) and set `User` shape. Select the *Edit* item and issue the *Clear* command to remove any existing points. Figure 69a shows the situation. There are no points in the *Measurements* list. *Sensor* value is informative and shows the readings from the sensor. This value is either voltage or resistance detected by Daqu – this depends on the sensor type.

3. Slowly pour some fuel into the tank and observe when the *Sensor* value starts changing. Usually sensors will not react immediately, as they can't reach the true low fuel point. Select the *Add point* item and set the *Fuel Quantity* value to zero[6].

4. Pour more fuel in known steps. 5-20 liter steps are usually fine. Use larger steps for very large tanks. Wait for sensor value to stabilize. Then select the *Add point* and set the cumulative fuel quantity for this step.

5. Repeat the previous step until the sensor value stops changing. When this happens the upper sensor limit point has been reached. Putting more fuel into tank will have no effect on the sensor. Sensors in many aircraft reach this point way before true fuel tank capacity is reached.

6. Close the editing window. The fuel tank has been calibrated and the tank specific shape will be shown on the window.

---

[6] Here, in fact are two possible approaches. You can set the value to zero and then starting counting fuel from this point on. Any amount of fuel poured into tank before this point is a kind of reserve. During flight, if you reach the zero, you still have some *reserve* in tank. But do not count on this.

The other alternative is not to enter zero, but correct amount of fuel. In this case, tank indication will never reach zero during flight, but only the value at the low sensor position even though the true fuel quantity will be smaller. This can be misleading, so we advocate NOT to use this approach.

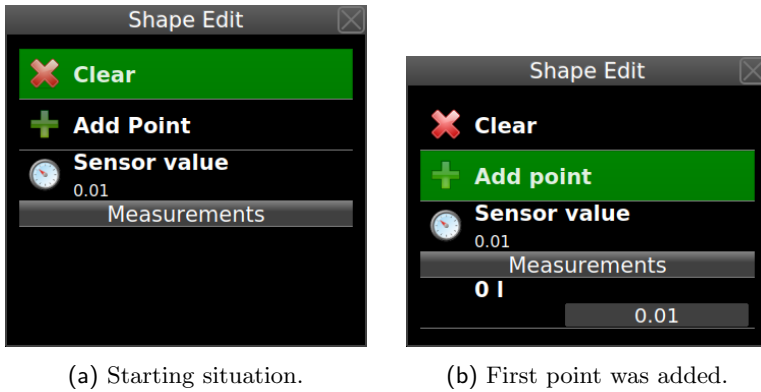(a) Starting situation.   (b) First point was added.

Figure 69: Editing tank measurement points.

During measurement, calibration point can be edited – quantity and sensor values can be adjusted. Also, points can be deleted. Simply click on a measurement point and select appropriate action.

Figure 70a shows an example of complete tank list. Steps were 10 liters and the sensor stopped at 2.58 and 42 liters. Initially, during first step, 4 liters were needed for a sensor to react. So, the real tank capacity is 46 liters, but Aetos will show values between 0 and 42.

Figure 70b shows the final situation. The dark blue color line on the chart shows tank non-linearity.

14.1.3   Predefined Shapes

Solution with predefined shapes is suitable for the cases, where the shape of tank is known in advance. In this case, correct shape is slected and only *Empty/Full* procedure is applied. This is similar to the *Linear* case.

This works well, when fuel sensor mounting position do not vary from case to case. Typically, tanks of larger depths has less problems and give better results. For wing based tanks, we recommend user shape approach even if the *shape* is known.

1. Make sure that aircraft is in level position for a cruise flight.

2. Select one of the predefined shapes from the list.

3. Make the tank empty – drain all fuel out.

(a) Final list of points.

(b) User defined tank shape.
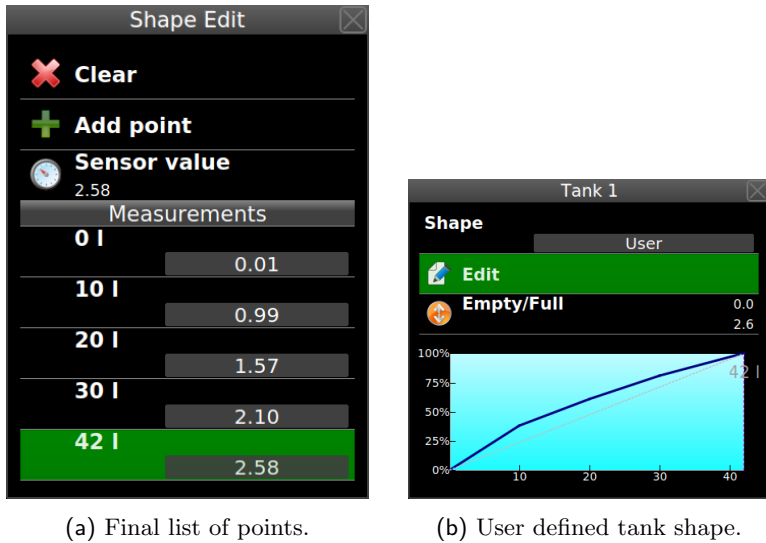
Figure 70: An example of tank measurement points.

4. Select the *Empty/Full* option and set the sensor value for the empty tank.

5. Fill up the tank and then sent the full case.

6. Close the window.

There is also an alternative way for this. It can be used when sensor values for empty and full are known and you are sure that they do not vary from sensor to sensor. In this case:

1. Select a predefined shape,

2. Select the *Empty/Fuel* option.

3. Select the *Empty* and enter the min (empty) sensor value.

4. Repeat this for the *Full* and enter the sensor value.

5. Close the window.

The tank shape has now been defined and scaled to empty and full sensor position.

Predefined shapes also support the *Edit* option, where individual points can be adjusted. Since this alters the shape, the shape name will change to *User* automatically.
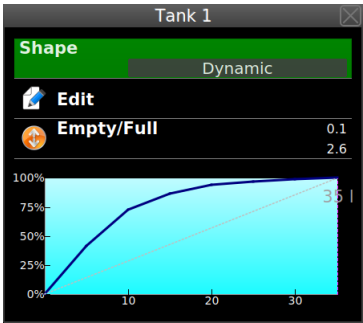

Figure 71: An example of a predefined tank shape after the *Empty/Full* were set. Non-linearity in this case is pretty severe.

14.2   Simulated Fuel Tank

Software fuel tank simulation is used when no fuel level sensors were configured. Selection of the *Tank* icon opens a simple window, which accepts the fuel tank capacity. Figure 72 shows situation for the 80 liters fuel tank.

Figure 72: Software tank capacity set to 80 liters.

Using simulated fuel tank can be dangerous. The fuel remaining is calculated from initial estimated fuel quantity and fuel consumption. Both, initial estimate and fuel consumption can be wrong, which may lead to indicate more fuel remaining that it really is.

When the simulated fuel tank is used, a high quality fuel flow meter is recommended. Do not use the simulated fuel tank with software based fuel flow.

15   Parameters

It is recommended that engine sensors and corresponding Daqu channels are set before parameter specific values are defiend. See section 13 and `Daqu` or miniDaqu manual. Also, make sure that tanks are defined and configured before editing their parameters here. See section 14.

The *Parameters* window is used to set and tune name, range and color limits for different parameters used by Aetos. Figure 73 shows the options.
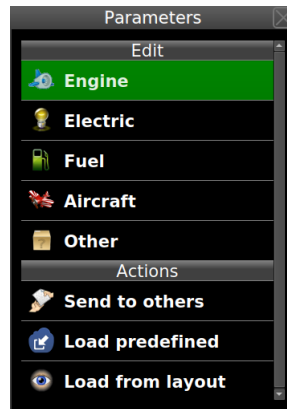

Figure 73: Various options for parameter settings.

These options have the following meanings:

Edit (Engine, Electric, ..., Other) opens a selection list where one parameter is selected and then edited. This allows tuning of individual parameter. See section 15.1 for details.

Send to others is used to send parameter values from this Aetos to other units/devices connected to the CAN bus. At the time of writing only Nesis and Aetos devices benefit from this feature. This may eliminate the need to tune the parameters on other devices.

Load predefined loads engine parameters for the currently selected engine model. Engine model shall be defined before this command is used. Please, see section 13.1 for more details. Nevertheless, some minor parameter editing may still be required (like number of cylinders, etc).

`Load from layout` is a legacy option. Older layouts have layout and parameter information in the same file. A list of internal layout appears. Select a layout and Aetos will erase/reset all existing parameters and load parameters from the layout instead.

If selected layout does not have any parameters defined, the command is ignored.

15.1   Parameter Editing

Selection of an item from the *Edit* section starts parameter editing. First a group is selected and then a parameter from the group. Parameter editor window is shown on Figure 74.
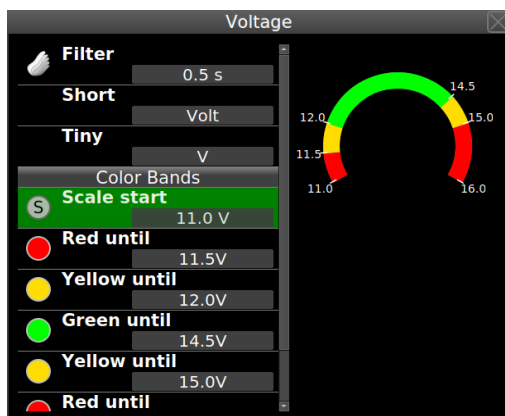
Figure 74: Example of parameter editor.

`Enable` option must be checked for the parameter to appear on the screen.

`Filter` option defines reaction of on parameter change. The value if given is seconds. A small value means that parameter reacts quickly while a large value does the opposite.

Please note that this filter is a second stage filter. The first stage filtering is typically done by Daqu and this filtering works on a top of the first one.

The filter time defines the time needed for filter to reach about 63% of the input change. For example, assume the filter is set to τ seconds an

the parameter signal goes from 0 to 100 in one step. The parameter response will reach 63 after τ seconds.

`Short` defines a short name for parameter. Change it as needed, but keep it short.

`Tiny` defines a tiny version of the parameter name. It must remain tiny, one or two letter max. It is used where short name does not fit.

`Count` Some parameters have more values. EGT and CHT are two such examples. `Count` defines how many values shall be shown.

Color bands define the parameter scale color marking limits. Illustration of the parameter limits is given in the right part of the window.

`Scale start` defines the starting value (low limit) of the scale.

`Color until` defines the color (red, green, yellow) used from previous limit until the given value. Note that limiting value must be always larger than the previous one.

`Add` adds a new color band at the end.

The *Color until* items are added until full scale range is defined. A *Color until* item can be also removed or inserted.

A valid parameter requires at least two *Color until* items. If only one is given, Aetos will not draw the scale properly or will not draw it at all.

Observe the arc on the left side of the window. It displays current color bands. The arc must be valid. If you see `Invalid` on the right, then the color bands are not properly defined and parameter may not show on the screen even if it is enabled.

16 Offset

Some sensors and counters may require occasional adjustment. The offset window allows adjustment for static and dynamic pressure sensors, CO sensor, fuel flow correction and time counters adjustments.

Please make sure that Aetos is running for at least 10 min before any sensor adjustments are made. This is not necessary for counter adjustments.

Static (altitude) allows for static pressure offset. A precise reference static pressure must be known. Adjust the correction, so that indicated static pressure will shown the same value as reference static pressure. The pressure is adjusted in 0.1 hPa steps. One steps corresponds to about 0.83 m (2.7 feet) at sea level.

Alternatively, if when reference pressure is not known, a reference altimeter can be also used. Set the reference altimeter baro-correction (QNH) to 1013 hPa. If Aetos altimeter is too high regarding to the reference altimeter, increase the correction. If Aetos altimeter is too low, decrease the correction.

For example, Aetos shows 15 feet too high regarding to reference altimeter. Increase correction for about $15 : 2.7 \approx 6$ steps = 0.6 hPa.

Dynamic (airspeed) allows for dynamic pressure offset. Make sure that pito-static system is not covered/blocked and that no wind is present. We recommend doing this in a closed hangar.

Adjust the correction, so that dynamic pressure will show zero. We recommend doing this at least once per year – say at the start of every season.

Engine total time changes the engine total time counter to a new value. This comes handy when there is a difference between engine total time in aircraft books and Aetos logs. The engine total time change is visible from the logs. The change will not correct the existing logs. It will only affect new ones. It takes about 10 seconds for the change to become permanent. Do not close/reboot Aetos for 10 seconds after the change.

Flight total time changes the flight total time counter to a new value. The change will not correct the existing logs. It will only affect new ones. It takes about 10 seconds for the change to become permanent. Do not close/reboot Aetos for 10 seconds after the change.

Fuel flow factor affects software based fuel factor only. It does not affect sensor fuel flow factor. It is used to correct fuel flow indication for the cases where fuel flow is computed from engine RPM and manifold pressure for a known engine. Increasing the factor will also increase the calculated fuel consumption.

Use software based fuel flow with great care. The indications may be incorrect and this indication will also impact the software based fuel tank, range and endurance, when used. Never trust the software based

fuel flow and software based fuel level. Make sure that you have some reliable way to check the actual fuel level during the flight.

`Carbon monoxide` allows for the CO sensor offset. Note that some Aetos models do not have CO sensor installed. With the engine turned off and in a good ventilated area with a cabin opened, adjust the CO indication so that it will show about 0 ppm. Note that some populated and polluted surroundings may have significant amount of CO in the air. Normal values in clean environment are up to 2 ppm.

17   Autopilot

Autopilot installation and tuning are described in a special manual. The manual can be found on our web site.

18   Special

In very rare cases, some special system commands may be issued. These commands are needed neither during installation nor during operation. They may come handy in the case of instrument malfunction or during low level factory setup.

Each of these commands is protected by unique password. Selecting the *Special* icon opens window shown on Figure 75. If correct password was entered, the appropriate command is executed.
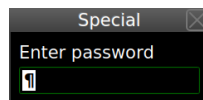
Figure 75: Each special command is protected by password.

The *special* commands are not listed. They are given only on request directly to the OEM or to the user.

19   CAN Devices

Selection of the *CAN Devices* icon opens a list of devices connected to the CAN bus. The list is mostly informative. However, some configuration actions

are also possible for certain device types.

19.1   Indu/Digi Layout Change

Aetos can upload a new LCD layout file to all devices from the *Indu* group (round instruments with a needle and LCD display and Digi). The LCD layout is stored in a binary file with the *isb* extension.

1. The new LCD layout file for some specific devices is typically obtained from Kanardia customer support as an email attachment.

2. The file is copied to an USB memory stick.

3. From the list of devices on the CAN bus, the target Indu/Digi device is selected. Special care must be taken if more than one Indu devices are connected.

4. Aetos lists the files with the *isb* file extension found on the USB memory stick. Select the file from the list (it will be probably only one). The file will be transferred to the flash memory on the selected Indu device, device will reset and new LCD layout will become active.

19.2   Enable/Disable Magnetic Heading

When Magu (electronic magnetic compass) is present on the CAN bus it transmits the magnetic heading information by default.

If Magu for some reason does not work properly due to sensor malfunction or due to bad calibration, the magnetic heading will be bad (off for many degrees). Bad magnetic heading will affect AHRS stabilization and AHRS may start causing problems – undefined behaviour.

Selecting Magu from the list of CAN devices, will show two options:

`Enable magnetic heading` turns magnetic heading on (default).

`Disable magnetic heading` turns magnetic heading off. Use this if Magu calibration was not successful or if Magu does not work properly.

Alternatively, Magu can be disconnected from the CAN bus.

20 Joyu

Joyu has a pretty complex system of push buttons, rotation/push wheel and direction stick. To each of these some special function can be assigned.

Furthermore, one Joyu can be used to command several devices connected to the same CAN bus. For example, Aetos, Emsis, Boxi and Joyu are connected to the CAN bus. Some of Joyu buttons can be configured to command Aetos and some to command Emsis and some to command Boxi. The same is true also for the case, where second Joyu is on the same CAN bus.

20.1 Device/Action Pairs

Joyu supports devices listed in this section. Each device supports specific actions. A device and action form a device/action pair. A device/action pair can be assigned to one of Joyu buttons or Joyu wheel. Devices are identified by their serial numbers. This makes it possible to distinguish between devices of the same type connected to one CAN bus.

The following device/actions are available:

- Nesis & Aetos

  `Wheel` . . . same as rotating the knob.

  `OK`   . . . same as pushing the knob, which equals to the OK button.

  `Cancel` . . . same as pushing the *Cancel/Back* button.

  `User` . . . same as pushing the *User* button.

  `Pager` . . . same as pushing the page switching button.

  `AP Menu` . . . opens the autopilot main menu.

  `AP Level` . . . issues a autopilot *Level* command.

- Boxi

  `PTT`   . . . radio transmission command – connects the PTT pin to GND.

  `AUX`   . . . AUX command – connects the AUX pin to GND.

  `Motor 1+` . . . moves the motor 1 in the positive direction.

  `Motor 1-` . . . moves the motor 1 in the reverse direction.

  `Motor 2+` . . . moves the motor 2 in the positive direction.

  `Motor 2-` . . . moves the motor 2 in the reverse direction.

- Emsis

  `Wheel` ... same as pushing up/down arrow.

  `OK`   ... same as the OK button.

  `Cancel` ... same as pushing the *Cancel/Back* button.

  `Pager` ... same as pushing the page switching button.

- All devices

  `AP Disable` ... disables the autopilot function. The command is sent to all devices on CAN bus.

20.2   Configuration

Selection of the *Joyu* icon allows simple configuration of Joyu commands for all connected CAN bus devices. Aetos detects which devices are present on the bus and includes actions for these devices, too.

Figure 76 shows an example of Joyu without any functions assigned. Illustration on the right enumerates the buttons. Wheel can be pressed, so it also functions as a button.

Figure 76: Initial, empty Joyu configuration window.

1. Press a button or turn the wheel on Joyu. A window appears and asks which device/action pair shall be assigned to this button.

2. Assign a device from the list and its action to the button pressed in the previous step. Figure 77 shows an example for button 1.
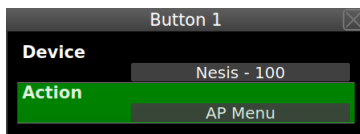
Figure 77: Joyu button 1 was assigned to Aetos with serial number 100 with the autopilot menu action.

3. The process is repeated for all buttons. Some of the buttons can remain unused.

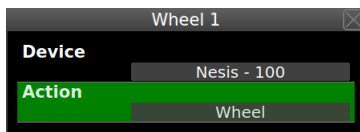4. Rotate a wheel. Same window appears, but with less options. Figure 78 illustrates an example.

Figure 78: Joyu wheel movement was assigned to Aetos with serial number 100. Action in this case is knob rotate action, which equals to wheel.

An example of final situation is shown on Figure 79. When the window is closed the configuration is sent to all devices on the CAN bus. They all receive a complete command/action list.

Same principles apply when two Joyus are connected to the CAN bus.

⚠ Joyu is a very powerful command device. It efficently combines different devices and their actions. The same principles as with all powerful tools apply here as well. It is very easy to create a complete mess, especially when two Joyus are in use. Please make a paper plan first and then start assigning device/action pairs to the individual buttons.

21   Calibrated Airspeed

When corrections for the calibrated airspeed are known, they can be entered into the system. Up to seven correction points can be entered. Let's illustrate this with an example. Table 8 shows calibrated airspeed values.
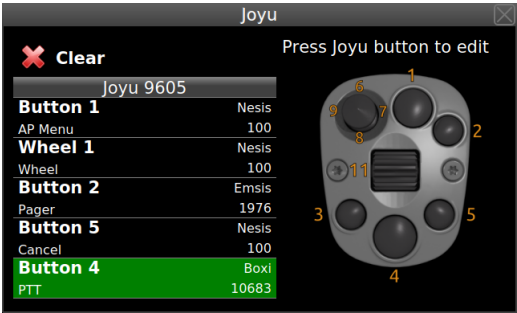
Figure 79: Final situation – three different devices are controlled with one Joyu.

IAS	km/h	90	110	150	200
CAS	km/h	94	115	152	195
Δ	km/h	+4	+5	+2	-5

Table 8: Example: Table with IAS and CAS. Differences are entered into Aetos.

1. Select the `CAS Correct` icon from the `Service Options` page.

2. Enter points as shown in the Figure 80.

3. Close the window. At that moment the calibration table was sent to Airu (AD-AHRS-GPS) and from this point on CAS, TAS and wind calculations will take this correction into account.

Please note that the first item is always set to 0. This can't be changed. Corrections are interpolated, where smaller and larger correction exists. When IAS value exceedes the last value in the table, the last given correction is used without any extrapolation.

22   Layout Edit

Since software version 3.9, the editing of engine box on *modern* screens is possible. The editor enables the users of Aetos to simply adapt part of the screen to their preference. The editing can be done with touchscreen or with mechanical knob and buttons. Figure 81 shows the editable part of the screen.
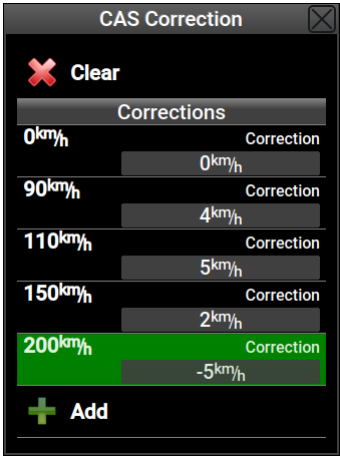
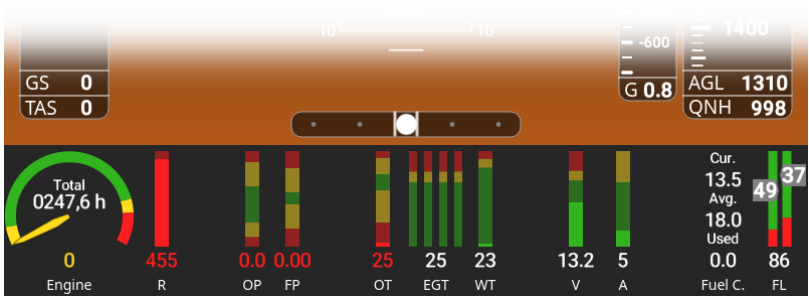Figure 80: An example of the CAS correction table.

Figure 81: Part of the screen which is editable.

In order to edit the screen, you have to:

- Enable editing.

- Do the editing on the screen.

22.1 Enable Editing

The screen editing is not enabled by default. The main reason for this is to prevent unintentional editing when least needed – during the flight. Select:

1. The `Options|Service (+password)|Layout`.

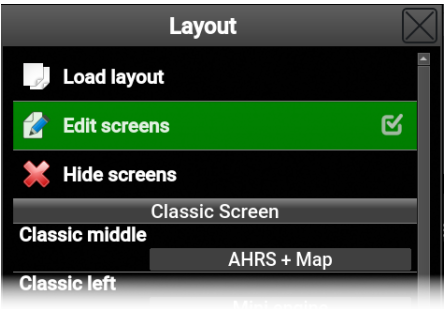2. Check the `Edit screens` options, see Figure 82.

Figure 82: Option that must be enabled before screen editing.

Please note that this option must be enabled each time Aetos restarts. This can be a bit annoying, but it prevents accidental editing.

22.2 Start Editing

In order to start editing, first switch to the screen and then open the main menu. The main menu will show additional item: `Edit screen` as seen on figure 83. When you enable it, it will switch to editing mode.
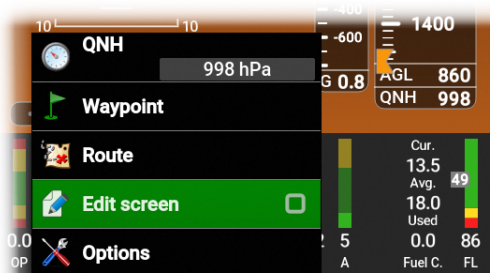

Figure 83: Main menu with `Edit screen` option which must be enabled to start editing.

After the `Edit screen` option is selected from the main menu the appearance of the page changes as shown in figure 84. Some items are marked:

1. selection rectangle of a sub-group,

2. selected item rectangle,

3. sub-group handle,

4. stretch (elastic space),
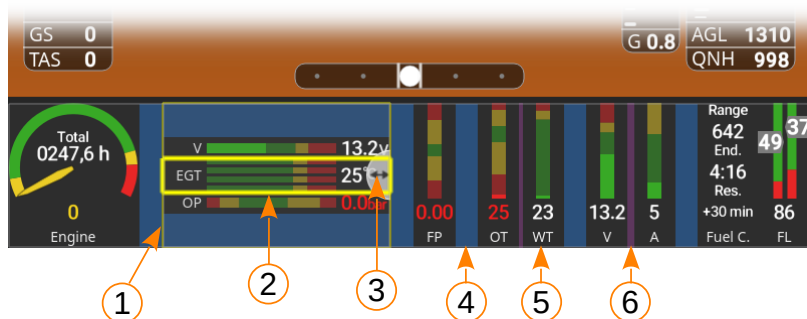
5. vertical bar,

6. spacer.

Figure 84: Part of the panel which is editable.

Every item in the layout is placed inside layout group. Layout group can be horizontal or vertical. Each group can contain multiple sub-groups and ordinary items like bars and arcs.

22.3   Navigation

Navigation between items in a page can be done with touchscreen or with rotating and pushing the knob. Selected item on screen is marked with yellow box around item.

22.4   Edit Item

To edit an item in layout it must be selected by clicking on the touchscreen or navigating to it with rotating knob. After click the dialog with following actions will be shown as in figure 85a.

The actions listed in dialog will be slightly different depending on the type of the item selected.
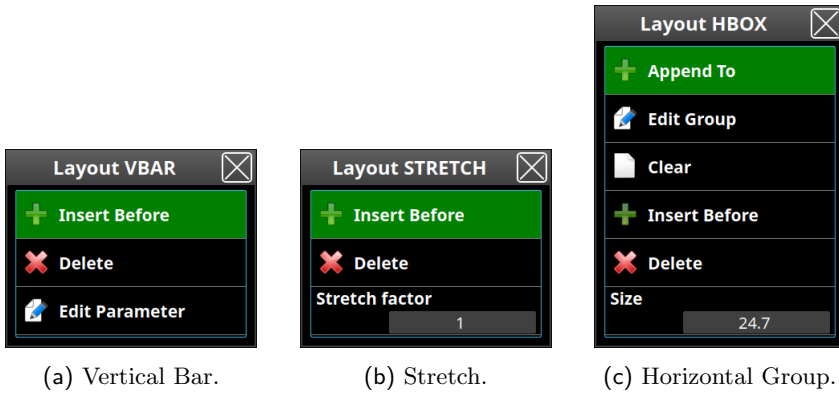
(a) Vertical Bar.   (b) Stretch.   (c) Horizontal Group.

Figure 85: Different edit dialogs for most common items.

`Append To` will insert new item to selected sub-group. It is shown only if selected item is vertical or horizontal group.

`Edit Group` will enable editing of sub-group. It is shown only if selected item is vertical or horizontal group.

`Insert Before` will insert new item before selected one.

`Delete` is used to delete selected item from the layout.

`Edit Parameters` is shown only if item is representing one or more parameters. This enables user to quickly edit the color bands or bar count.

`Size` is shown only if item can be resized. In case of vertical group, horizontal group and space this is defined as percentage of full width or height. In the case of stretch this represents the stretch factor.

22.5   New Item

When adding new item to the selected group the user is presented with dialog as shown in figure 86. The selection dialog differs slightly if you are inserting items into vertical or horizontal group.

`Parameter Arc` is parameter presentation as colored arc with needle.

`Vertical Bar` is parameter presentation as colored vertical bar with number.
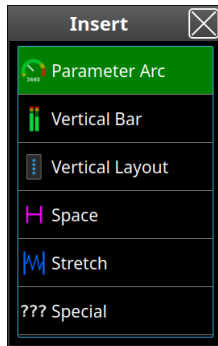
(a) List of basic items.
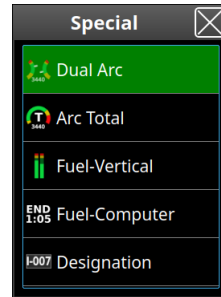
(b) List of special items.

Figure 86: Inserting new items.

Horizontal Bar is parameter presentation as colored horizontal bar with number.

Vertical Layout is layout which organises items in vertical direction.

Horizontal Layout is layout which organises items in horizontal direction.

Spacer is fixed size item used to separate other items.

Stretch is variable sized space which fills all available space. If there are multiple stretches in layout their size is split between them.

Special opens new dialog with more items to choose from.

Dual Arc is used mostly for helicopter rotor/engine RPM display. However it can be used as general display for two different parameters.

Arc Total is similar to Prameter Arc but displays second parameter like engine total time.

Fuel Vertical is vertical bar representation of fuel tank level.

Fuel Computer is special vertical item for representing endurance, range and fuel flow.

Designation is text as set up in user settings. See Options| Settings (+314)| User| Aircraft designation.

22.6   Edit Menu

When no items are selected or if you touch the upper-right corner of the screen the main menu is shown. This menu allows to make basic layout actions.
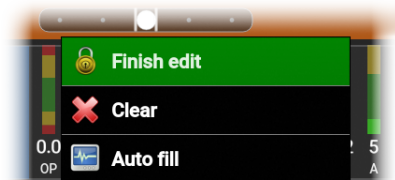

Figure 87: Main menu shown when no items are selected.

`Finish edit` will finish editing of the page and save the current layout to internal Aetos storage.

`Clear` will completly clear editable space.

`Auto Fill` will clear and automatically fill editable space with default items.

23   Maintenance

Aetos does not require special maintenance. However, it is advisable that some checks are made during annual aircraft inspection. In particular, you may want to check various pressure sensors.

All offsets mentioned below are accessible from the `Service` options. Select the `Offset` icon and then correspoinding item. See also section 16.

23.1   Pitostatic Test

Static and dynamic pressure test shall be performed with standard pitostatic testing equipment. Aetos has integrated solid state sensors, which are known to develop slight offset in time. This offset shall be adjusted.

23.1.1   Static Pressure

Select the `Static(altitude)` and adjust the correction so that indicated static pressure will show the same value as the reference static pressure. If pitostatic test fails, then sensor is defective and it must be replaced in factory.

23.1.2 Dynamic Pressure

Select the `Dynamic (airspeed)` item from the offset list. Adjust the correction, so that dynamic pressure will show zero. We recommend doing this test in a closed hangar. If pitostatic test fails, then sensor is defective and it must be replaced in factory.

23.2 Engine Pressures

We recommend checking/adjusting engine pressure sensors once per year. Make sure that there is no pressure in the fuel or oil system. Remove the sensor from the engine, if unsure. All engine sensors are checked with the engine turned off!

23.2.1 Oil Pressure

Select the `Oil Pressure` item from the offset list. Adjust the correction, so that pressure will show zero.

23.2.2 Fuel Pressure

Select the `Fuel Pressure` item from the offset list. Adjust the correction, so that pressure will show zero.

Some engines may be equipped with absolute sensors (Rotax iS family for example). If this is the case, the unloaded sensor must show the static pressure. Adjust the correction, so that the indicated pressure matches the static pressure.

23.2.3 Manifold Pressure

Select the `Manifold Pressure` item from the offset list. Adjust the correction, so that manifold pressure will match the static pressure. Both values are indicated on the screen.

24 Service

Aetos and corresponding equipment does not have any serviceble parts. In the case of a device failure, the device shall be sent to the factory for a repair. Please refer to the Warranty conditions (published as a part of User's Manual), for more details.

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