Nesis III Installation Manual

Revision 2.2

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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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Credits

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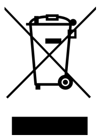
Some open source code is used in the Nesis software:

- https://angusj.com/clipper2/
- https://flatbuffers.dev/

- https://www.oberhumer.com/opensource/lzo/
- https://rapidxml.sourceforge.net/
- https://www.sqlite.org/index.html
- https://www.nayuki.io/page/free-small-fft-in-multiple-languages
- https://rapidjson.org/
- https://design.ubuntu.com/font

Some icons used in this manual and in Horis are contributed to `https://www.flaticon.com`, in particular, by Freepik, Flat icons, Maxim Basinski, Prosymbols, Juicy Fish, Vectors Market, Maswan, Muhammad Usman.

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
2.2	Jan 2024	Metal particle support.
2.1	Feb 2023	OAT pin correction, UPSU additional fuse on battery, alarm lamp support on the service port, updated to SW 3.11.
2.0	Oct 2022	Manual rework, chapters introduced, screen customization, SW 3.10.
1.4	Mar 2022	Engine layout feature, SW version 3.9.
1.3	Mar 2021	RS232 port clarification.
1.2	Oct 2020	Changes and clarifications for SW version 3.7.
1.1	Mar 2020	Changes accumulated from SW versions 3.4 - 3.6.
1.0	Apr 2019	Complete manual rework.

Contents

Chapter 1

Introduction

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

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

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

1.1 Icons Used Through 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 Nesis 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.

1.3 Minimal System

Nesis minimal system consists of two components: Nesis III display and DAQU (engine management box). They are sold together as a kit.

This manual starts with the installation instructions for the minimal system and then adds separate sections for optional components.

Some components have their own installation manuals.

Chapter 2

Installation

2.1 Display

This section covers the installation of the Nesis display.

2.1.1 Placement Consideration

There are several considerations 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 through top and bottom openings in the housing. Please make sure that cooling air will be able to circulate through 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 2.1 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 plastic bezel.

2.1.2 Main Display Dimensions

The display main dimensions are shown on Figures 2.1 – 2.3 and Figure 2.4 shows the cutout.

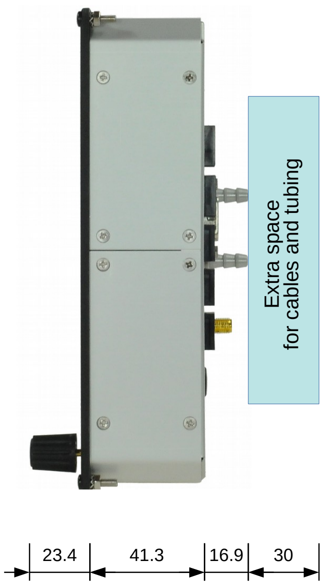


Figure 2.1: Nesis side view with dimensions.

The knob and part of the bezel protrude 23.4 mm in front of the instrument panel. On the back side, the housing requires 41.3 mm space. This space already includes thickness of the instrument panel. Pito-static connectors protrude extra 16.9 mm backwards. At least 30 mm is also required for the cables and pito-static tubing.

Figure 2.2: Back view with dimensions.

The bezel width is 214.3 mm and the height is 174.9 mm. Back side housing width is 210.3 mm, height 168.9 mm.

Figure 2.3 shows Nesis 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.

2.1.3 Cutout

Cut your instrument panel according to your Nesis 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 `Nesis III Cutout.pdf` or for `Nesis III Cutout.dxf`. Please note that the cutout

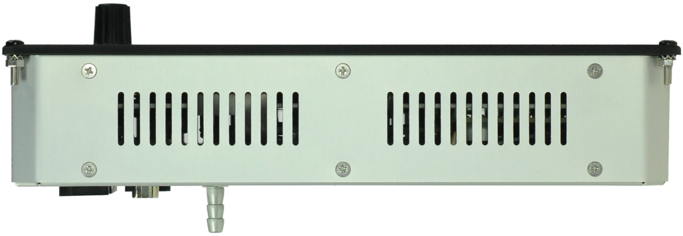


Figure 2.3: Nesis top view.

tolerance was already added to the green cutout line. Figure 2.4 illustrates the cutout dimension.

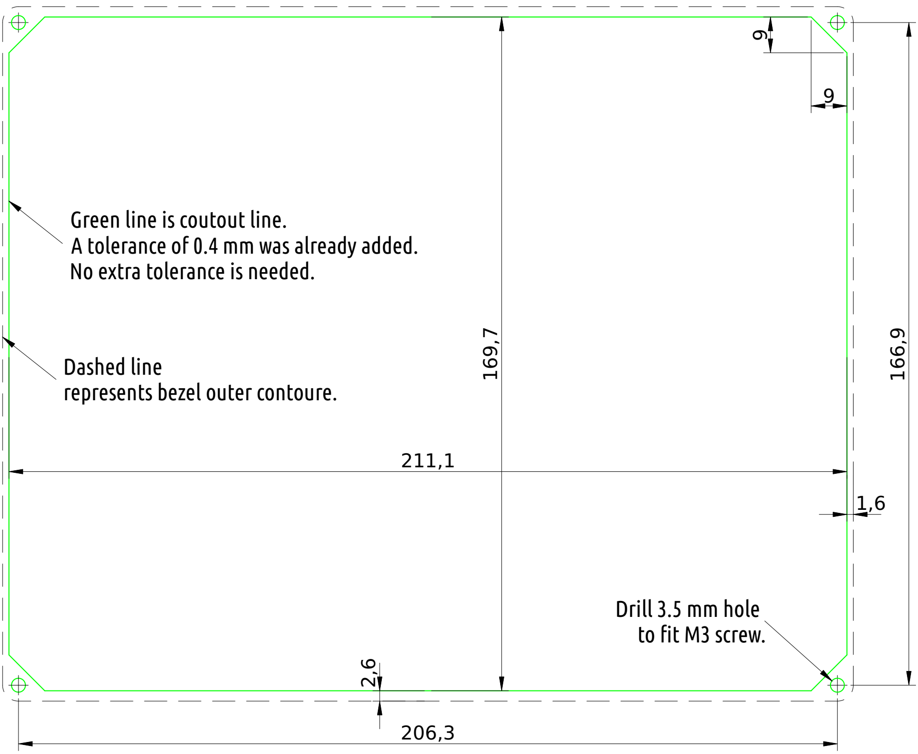


Figure 2.4: Nesis cutout dimensions. The figure is not actual size!

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.
- Due to highly sensitive multi point touch screen, the bezel had to be made of non-conductive material – it is made of ABS plastic. Please be careful. Do not bend the bezel and do not over-tighten the screws. Bezel corners are especially sensitive.

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.

2.1.4 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 Nesis 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.

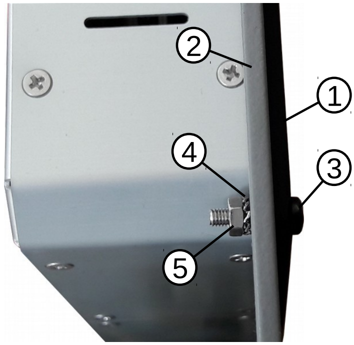


Figure 2.5: An example of fixation using supplied M3 nut and lock washer.

2.1.4.1 Fixation with Supplied M3 nut and Lock Washer

This is the most straightforward method of fixation. Figure 2.5 shows an example.

① Nesis plastic bezel – made of ABS plastic.

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 Nesis service removal a bit difficult as nut on the back side may be difficult to access.

2.1.4.2 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 2.6 can be used. The nut must be pressed into the panel before installing the instrument.

Once pressed, the nut shall not turn when Nesis 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.

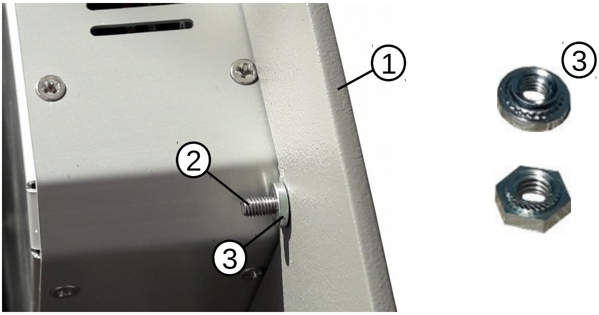


Figure 2.6: Self-clinching nut suitable for instrument panels made of aluminum.

(1) Instrument panel plate.

(2) M3 bolt.

(3) Self-clinching M3 nut. (Two nut examples are shown on the figure.)

2.1.4.3 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 2.7 shows an example.

There is a small disadvantage using rivnuts. As the rivnut head has some minimal thickness, the Nesis bezel will probably not mount flush with the panel – there will be a small gap.

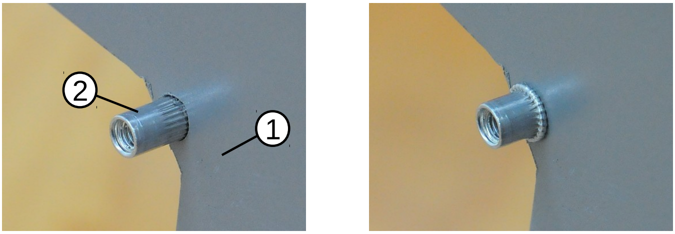


Figure 2.7: Example of rivnuts inserts. Left: a rivnut before compressing. Right: a compressed rivnut. (1) – instrument panel, (2) – rivnut.

2.1.4.4 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 shall 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.

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 tiny 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. But be careful not to put any grease on the surfaces where epoxy must be applied.

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

6. Wait for epoxy to cure.

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

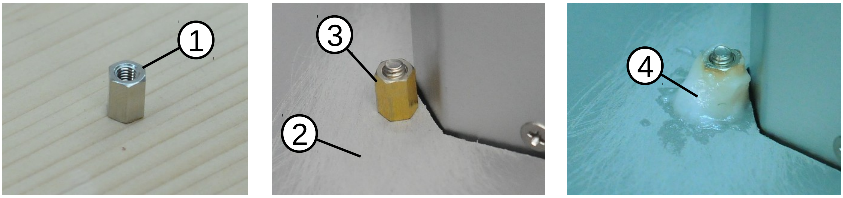


Figure 2.8: Example of spacer stud fixed with epoxy: (1) – spacer stud, (2) – panel surface sanded with 60 grid sandpaper, (3) – spacer stud sanded with dremel tool, coat removed, (4) – spacer stud fixed with epoxy mixed with cotton flox.

2.2 Power

Nesis power input requirements are compatible with 12 and 24 V aircraft power systems. Nesis 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 Nesis at the back. The notch and the hook must match – they prevent wrong cable orientation, see Figure 2.9.

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

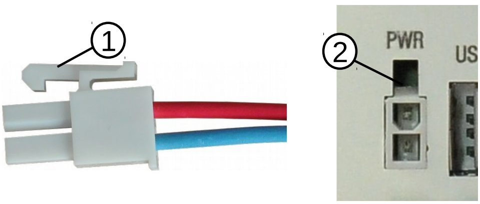


Figure 2.9: Left: The power conector on cable. Right: Power connector on Nesis back. (1) – hook on the power cable connector, (2) – notch on Nesis back.

The cable side of power connector (1) consists of the following parts:

- 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.

2.2.1 Circuit Breaker

The power input must be routed through a circuit breaker. Nesis consumes about 800 mA at 12V on full brightness. Various peripheral devices (Daqu, Magu, Indu, etc.) are powered via Nesis 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 Nesis. In the case of two Nesis connected to the same circuit breaker, use 2.5 to 3.5 A rated circuit breaker instead.

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

2.2.2 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.

2.2.3 Backup Battery

This backup battery solution works only on 12V systems.

Nesis 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 2.10 shows the schematics.

The Nesis 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

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

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).

Both positive terminals (the system bus and the backup battery) must be protected each with its own fuse. Use a fuse in 1 – 3 A range.

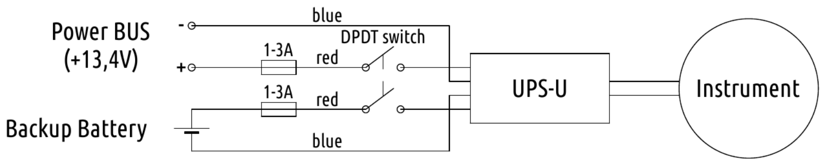


Figure 2.10: Schematics of the UPSU backup system.

The electronics part of the UPSU is shown on the Figure 2.11.

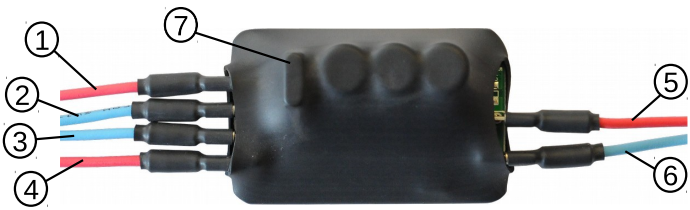


Figure 2.11: UPSU electronics. Input power leads from system bus and backup battery are on the left and the output power leads are on the right.

(1) Input power lead from the system 12V bus. Make sure to install a fuse on the system bus side.

(2) Ground from the system bus.

(3) Ground from the backup battery.

(4) Input power lead from backup battery. Make sure to install a fuse on the battery side as well.

(5) Output power lead towards Nesis.

(6) Ground lead towards Nesis.

(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
Nesis and DAQU	37 min
Nesis, DAQU, Digi	TBD

Table 2.1: 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.

2.3 GNSS Antenna

The GNSS system in Nesis 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 Nesis and the antenna cable connects to the back side of the Nesis.

Standard SMA male connector is used on the antenna coaxial 50 Ω cable to connected to the Nesis, Figure 2.12.

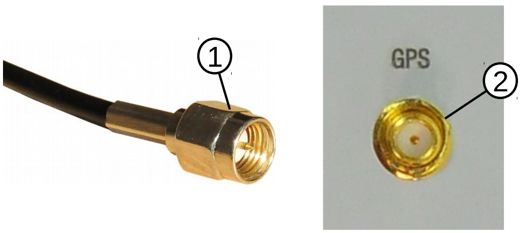


Figure 2.12: GNSS antenna connection: (1) – SMA male connector of GNSS antenna cable, (2) – SMA female connector on the Nesis back side.

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:

[2] Elapsed time when equipment is running solely on the power from backup battery.

- 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 2.13.

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.

Nesis comes equipped with one of the two possible antennas as shown on Figure 2.13.

Figure 2.13: 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.

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.

2.3.1 GNSS Signal Check

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

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 2.14 will appear.

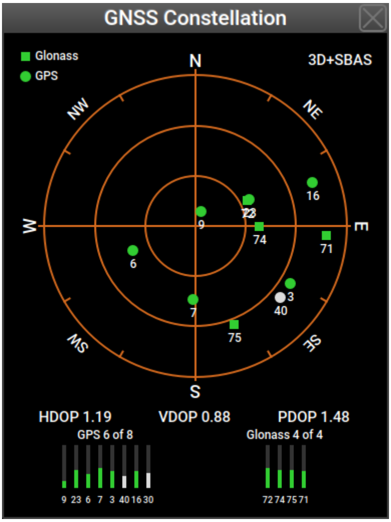


Figure 2.14: An example of GPS and Glonass constellations. The satellite distribution on the example shows poor reception as most satellites appear in the SE quadrant.

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 2.2. 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:

`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.

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 2.2: Meaning of the DOP values.

2.4 OAT – Outside Air Temperature

2.4.1 Installation

Outside air temperature (OAT) probe is shipped with the Nesis primary display. This is a digital temperature sensor inserted into a threaded aluminium housing.

[3] DOP – Dilution of precision, HDOP – horizontal DOP, VDOP – vertical DOP and PDOV – combined DOP.

Default OAT cable length is 1.5 meters, but other lengths are available on request.

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 through the aircraft to the Nesis 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 2.15: Inserting the OAT probe (left), cap is in place, tighten the internal nut, slide the insulation shrink sleeve (right).

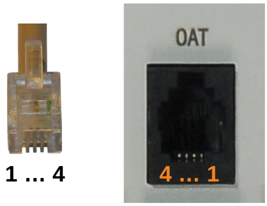


Figure 2.16: Designation of the pins.

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

Table 2.3: Description of the OAT pins.

2.4.2 Connection

The digital thermometer in the tip of the probe is type DS18S20+. OAT connector is standard 4P4C type (four pins), as shown on Figure 2.16. Description of individual pins is given in Table 2.3.

The cable can be extended or shortened as needed.

You can also build your own probe. Use DS18S20+ sensor and connect it according to Figure 2.16, Table 2.3 and the sensor datasheet.

2.5 Audio

Nesis 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 Nesis 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 Nesis screen.

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

Basic Nesis 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 Nesis 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 Nesis 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.

2.5.1 Trig TY91/TY92

Audio output of the Nesis must be connected to the auxilary input on Trig TY91/TY92 radio station. Please connect Nesis audio output as on Figure 2.17.

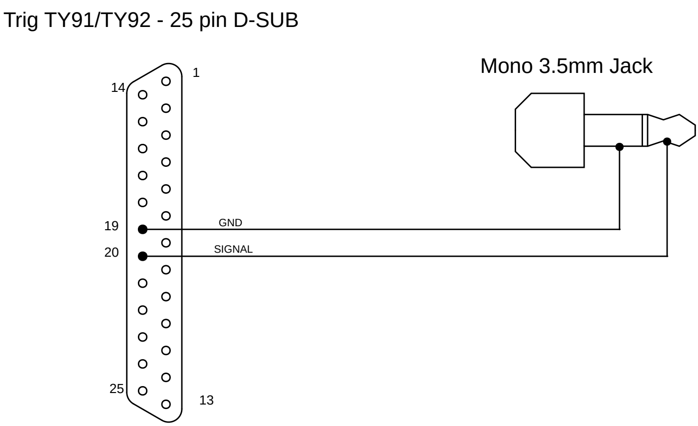


Figure 2.17: Schematic for connecting Nesis audio to Trig TY91/TY92 radio station.

The Trig TY91/92 radio station must be configured to accept audio from Nesis. 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,
- 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.

2.5.2 Funke ATR833

Audio output of the Nesis must be connected to the external audio input on Funke ATR833 radio station. Please connect Nesis audio output as on Figure 2.18.

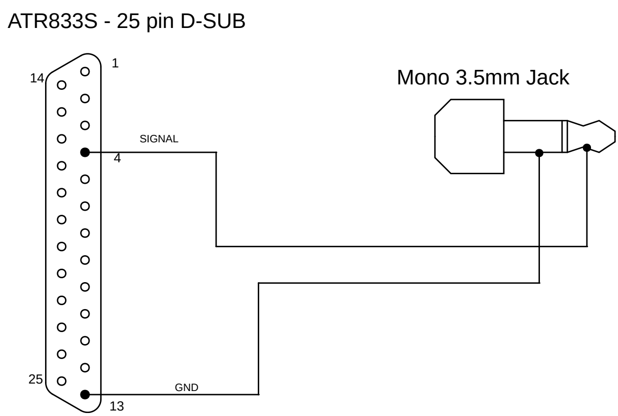


Figure 2.18: Schematic for connecting Nesis audio output to Funke ATR833 radio station.

The Funke ATR833 radio station must be configured to accept audio from Nesis. 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`,
- 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.

2.5.3 Dittel KRT2

Audio output of the Nesis must be connected to the External-NF input on KRT2 radio station. Please connect Nesis audio output as on Figure 2.19.

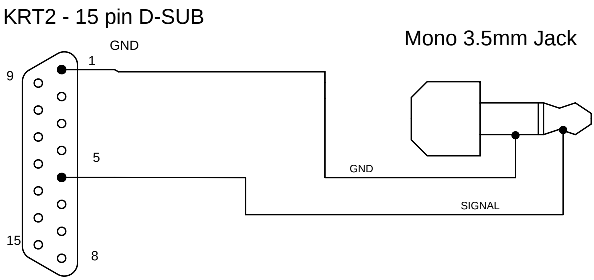


Figure 2.19: Schematic for connecting Nesis audio to KRT2 radio station.

KRT2 must be configured to accept audio signal from Nesis. 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.

2.6 Video

Please note that audio and video are not associated. Video is used to show some video image from an on-board camera on the Nesis screen.

Nesis 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 Nesis has impedance $75\,\Omega$ and is expecting video signal with amplitude $1.5\,\mathrm{V}$ peak to peak. The video signal source must be connected to Nesis with $75\,\Omega$ coaxial cable.

Nesis 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 2.20.

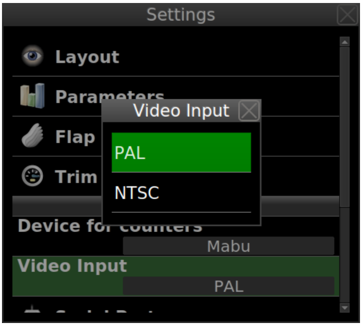


Figure 2.20: An example of video input format selection.

Chapter 3

Ports

3.1 USB

Nesis 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.

3.1.1 USB Memory Stick

On order to transfer data between the memory stick and Nesis, 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 Nesis 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.

3.1.2 WiFi Module

When a suitable WiFi module is connected to Nesis and the module is properly configured and connected to some WiFi network with the Internet access, then Nesis also gets access to the Internet. One such example is the WiPi module shown on Figure 3.1.

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

Figure 3.1: En example of small WiFi module, called WiPi.

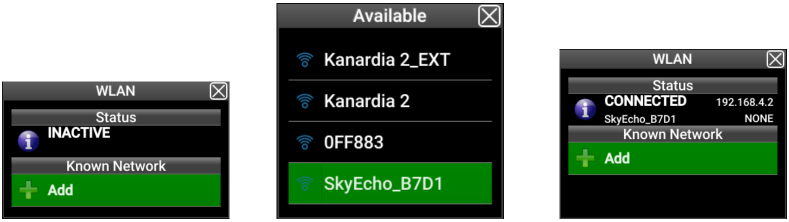
1. Plug the module into Nesis USB port. Back port shall be used, but it should work well also with the front port.
2. From the `Options` page select `Wireless` icon. Figure 3.2a shows an example screen.
3. Select the `Add` item. A list of detected networks appear. An example is shown on Figure 3.2b. 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[1] produced by uAvionics.
5. Enter the network password. Keep it empty when password is not required by the network.
6. After a few seconds, Nesis will connect to the network. See figure 3.2c.

3.1.3 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 Nesis.

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



(a) Initial window (b) Network list (c) Success

Figure 3.2: WiFi connection sequence example.

3.1.4 USB Cable As Tethering

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

3.2 The CAN Bus

Nesis 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.

3.2.1 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.

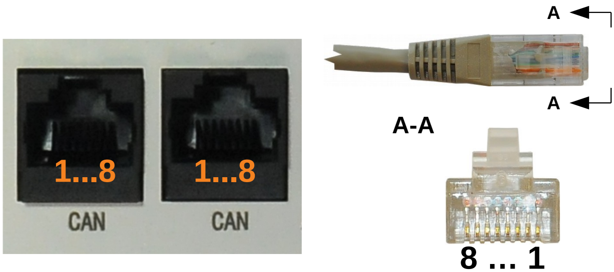


Figure 3.3: Designation of the CAN bus pins.

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

Table 3.1: Description of the CAN bus pins.

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

For the time being, only Kanardia CAN devices are compatible with our CAN system. Never connect a third party CAN device to our CAN bus. A serious damage may occur in the hardware. Some third companies also use RJ45 plugs and you may be tempted to connect them with our CAN system. However, they are using different pinout and different/conflicting message protocol.

3.2.2 The CAN Topology

CAN system can be used in different topologies. We are using line/bus type topology. Figure 3.4 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.

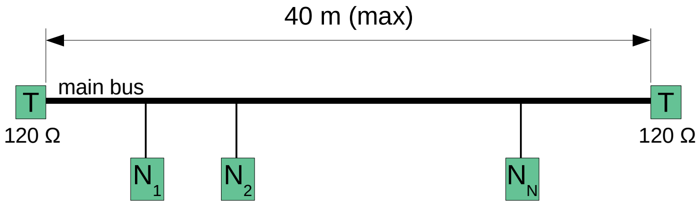


Figure 3.4: CAN line/bus topology principle used by Kanardia

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 Nesis, there is AIRU module (AD-AHRS-GPS module) and Nesis electronic board module. Both are internally connected to the main CAN bus.

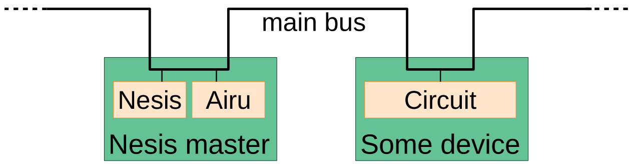


Figure 3.5: Device daisy-chaining, where devices has two CAN ports.

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 3.6 illustrates the Nesis basic kit topology.

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

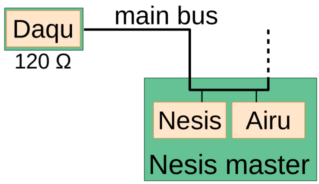


Figure 3.6: Topology of Nesis basic kit – Daqu also serves as a bus terminator. Because the main bus is very short, second terminator is not really needed.

3.2.2.1 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.

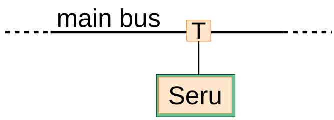


Figure 3.7: Devices with only one CAN connector require T-junction.

3.2.2.2 Terminator Plug

Nesis usually works together with Daqu and special terminator plugs are not required. But there are some occasions (to run Nesis 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 3.3 and Table 3.1. A standard 1/4 Watt resistor will do.

3.3 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

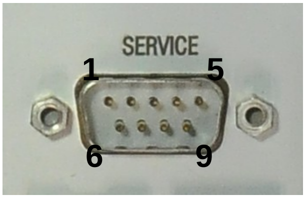


Figure 3.8: Service port D-SUB male with designated pins.

and alarm output signal. All functions can be used in parallel, although this is seldom needed.

Figure 3.8 and Table 3.2 define role of individual 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 3.2: Description of the service port pins.

3.3.1 Terminal Communication

Terminal connection is used for communication with the main Nesis computer. This is a classic RS-232 connection at 115200 bit/s, 8 bits data, no parity bit, one stop bit. Figure 3.9 illustrates the connection.

A communication with a terminal shall be used only during production and factory maintenance or repair.

3.3.2 Port 1 – Auxiliary RS-232

Nesis has three RS-232 communication ports used to connect to third party devices, see page 44. We recommend to use them first. However, if needed,

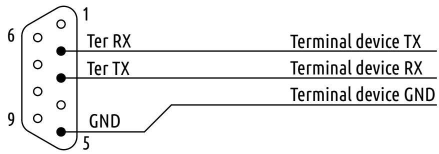


Figure 3.9: Connection schematics for service terminal.

an additional RS-232 communication can be established through the service port. Figure 3.10 shows the connection schematic. If Nesis and device are both connected to the same power source, the GND connection may be omitted.

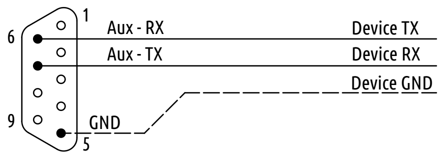


Figure 3.10: Connection schematics for auxiliary port 1.

3.3.3 External Push Button

Nesis 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 3.11 shows the connection schematic.

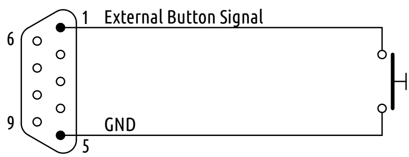


Figure 3.11: External push button schematics

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 Nesis either as a short press or a long press event. Nesis will execute associated command.

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

3.3.3.1 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. Assign them functions of your choice. A typical example is shown on Figure 3.12. `External` represents the short press event on the external button and the `External long` represents the long press event.

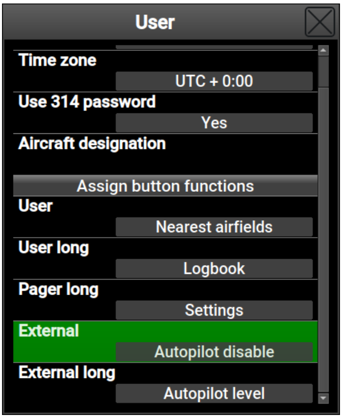


Figure 3.12: External push button configuration. The example shows autopilot settings, but any other functions can be used instead.

3.3.4 Alarm Switch

When Nesis detects some parameter outside operational limits, an output signal may be raised. This depends on the parameter alarm settings. The alarm line can be used to trigger some other device, an alarm lamp on the instrument panel, for example. Please refer also to the Nesis User Manual alarms section.

Figure 3.13 illustrates schematics for small load connected to pin 8. When alarm is on, optocoupler internally 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.

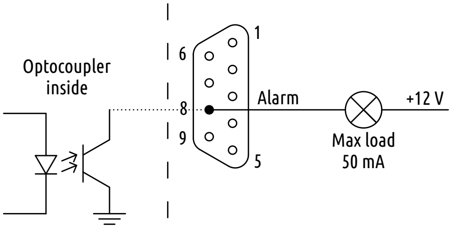


Figure 3.13: Alarm switch schematics with the load on the line.

Figure 3.14 illustrates 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 circuit is closed by optocoupler and coil in the relay gets energized. This, in turn, activates the relay switch and closes the load circuit.

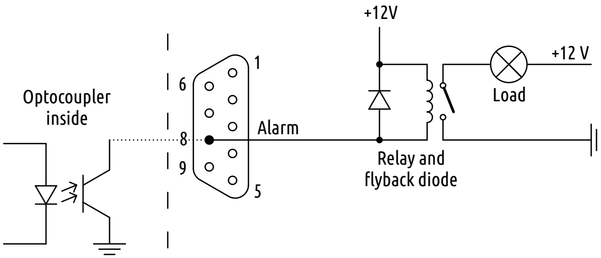


Figure 3.14: Alarm switch schematics with the relay solution for larger loads.

3.4 RS-232 Ports

Nesis has three RJ12 connectors at the back, which are intended for three independent RS-232 communications. And additional auxiliary RS-232 can be established through the service port. Figure 3.15 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 3.15: RS-232 ports at the back side of the Nesis.

3.4.1 Pinout

This section describes ports 2, 3 and 4 only. See section 3.3.2 on page 41 for the port 1 description.

A standard RJ12 (6P6C) plug is needed to connect to the port. The table 3.3 defines the pinout and figure 3.16 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 Nesis 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 Nesis, only pins 5 and 6 shall be used.

3.4.2 Configuration

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

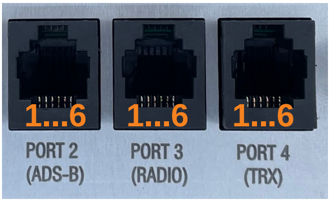


Figure 3.16: RS-232 ports with RJ12 connectors and their pin numbers.

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

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 3.17 illustrates the window.
5. Select the port where device was connected and choose one of the options described next.
6. Close all windows. Nesis will reboot and the communication with the device should be established.

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. Nesis will send KRT2 specific commands to the radio.

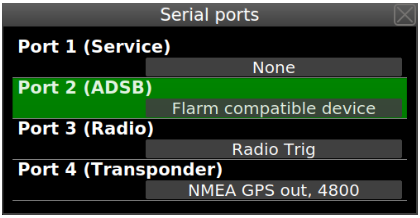


Figure 3.17: Serial port configuration window.

`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. Nesis 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[2]. 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 4.1.9 for more details.

`CO GD40 FDS` Use this options when connectng GD 40 module produced by Flight Data Systems. See section 3.4.3.12 for connection details.

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

`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 3.34 for an example.

3.4.3 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.

3.4.3.1 TQ KRT2 Radio

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

Connection to a KRT2 radio is made using a trick. Nesis 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 3.18 illustrates the connection of KRT2 and Nesis. Illustration shows only leads required by Nesis. 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 Nesis are both connected to the same airplane ground, then GND line can be omitted (dashed line).

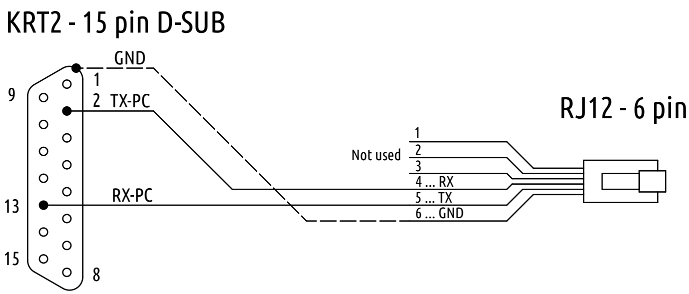


Figure 3.18: Schematic connection for KRT2 and Nesis RS-232 port.

3.4.3.2 Funke ATR 833 Radio

Please read the *ATR 833 Installation Manual* before any connection is made to Nesis. 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. Nesis 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 3.19 illustrates the connection of ATR 833 and Nesis. Illustration shows only leads required by Nesis. 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 Nesis are both connected to the same airplane ground, then GND line may be omitted (dashed line).

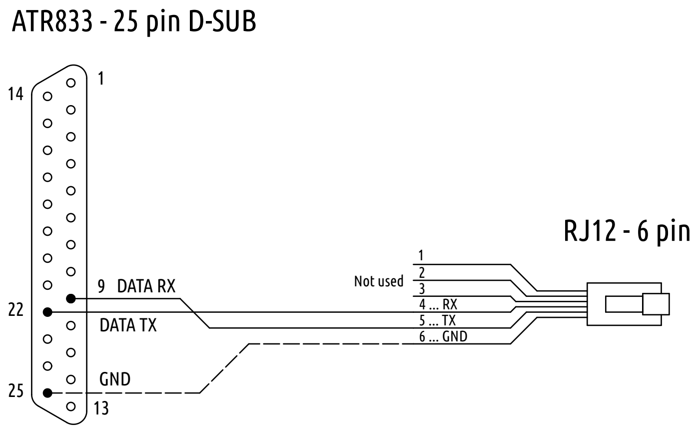


Figure 3.19: Schematic connection for ATR-833 and Nesis RS-232 port.

3.4.3.3 Trig TY91/TY92 Radio

Please read the *TY91/TY92 Installation Manual* before any connection is made to Nesis. 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 3.20 illustrates the connection between Nesis and the TC90 controller unit.

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

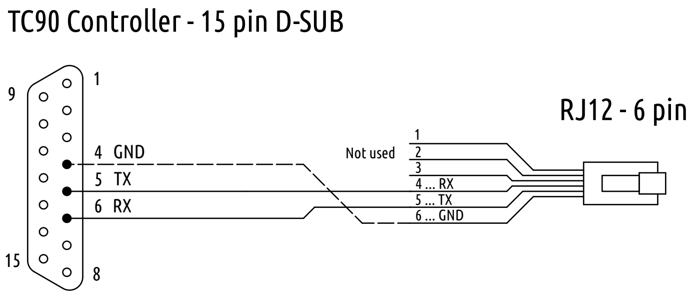


Figure 3.20: Schematic connection for Trig.

3.4.3.4 Funke TRT800H Transponder

Please read the *TRT800H Installation Manual* before any connection is made to Nesis. 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 Nesis port to *NMEA GPS out, 4800*, see Figure 3.17.

Connect according to Figure 3.21, 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 – Nesis transmits GPS data on TX and transponder receives the data on RX.

3.4.3.5 Trig TT21/TT22 Transponder

Please read the *TT21/TT22 Installation Manual* before any connection is made to Nesis. The manual can be obtained from `https://trig-avionics.com/`.

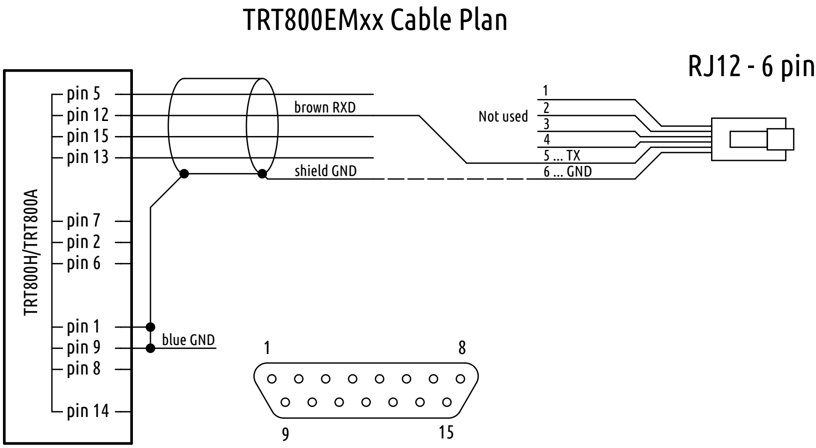


Figure 3.21: Schematic connection for the TRT800H transponder.

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 Nesis and also match the data rate on both.

Figure 3.22 shows connection schematics. The D-SUB 25 connector on the transponder side is multipurpose connector. Only connection related to the Nesis are shown. The communication is unidirectional only – Nesis transmits GPS data on TX and transponder receives the data on RX.

3.4.3.6 TQ KTX2 Transponder

Please read the *KRT2 Manual* before any connection is made to Nesis. 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 3.23 shows connection schematics. The D-SUB 15 connector on the transponder side is multipurpose connector. Only connection related to the Nesis are shown. Although, the communication is unidirectional only – Nesis 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.

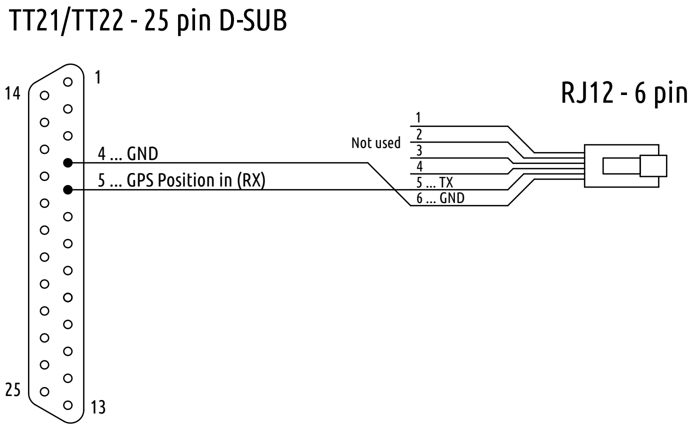


Figure 3.22: Schematic connection for the Trig TT21/TT22 transponder.

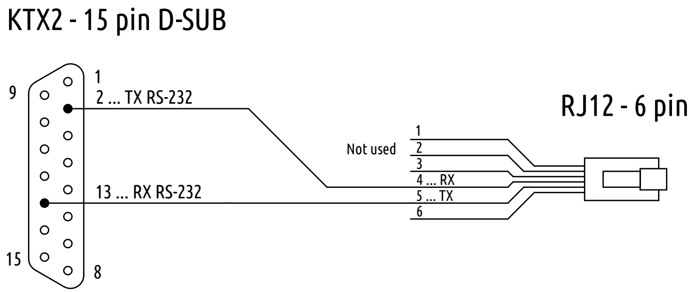


Figure 3.23: Schematic connection for the TQ KTX2 transponder.

3.4.3.7 Power Flarm

Please read the *PowerFLARM Core Installation Manual* before any connection is made to Nesis. The manual can be obtained from the Flarm Technology Ltd web site. Nesis User Manual has one complete section devoted to Flarm based products. Please read this section as well. Nesis 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 Nesis is using 6 pin RJ12 connector. The schematics on Figue 3.24 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 Nesis, hence pin 2 on Flarm side and pin 1 on Nesis side must be connected as well. For the same reason GND pins must be connected too.

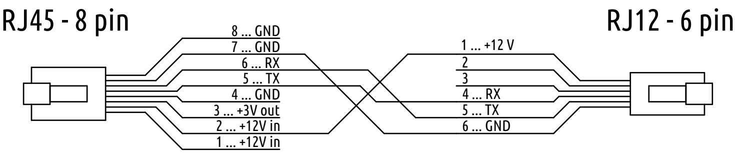


Figure 3.24: Schematic connection for Power Flarm devices.

3.4.3.8 TRX 1500

Please read the *TRX-1500A User and Installation Manual* before any connection is made to Nesis. The manual can be obtained from the `https://www.air-avionics.com/` web site. Open the *Support* menu and then select *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 3.25 shows two cables comming out of the main connector. The bottom one connects to Nesis serial port, while to top cable is optional and can be connected to one of optional Flarm displays.

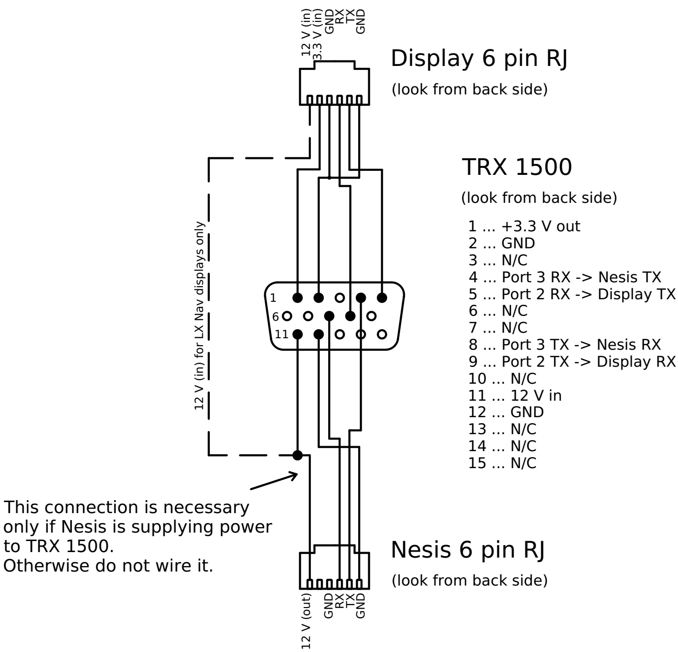


Figure 3.25: Schematic connection for TRX 1500.

The schematic assumes that Nesis 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 Nesis. 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 3.26 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.

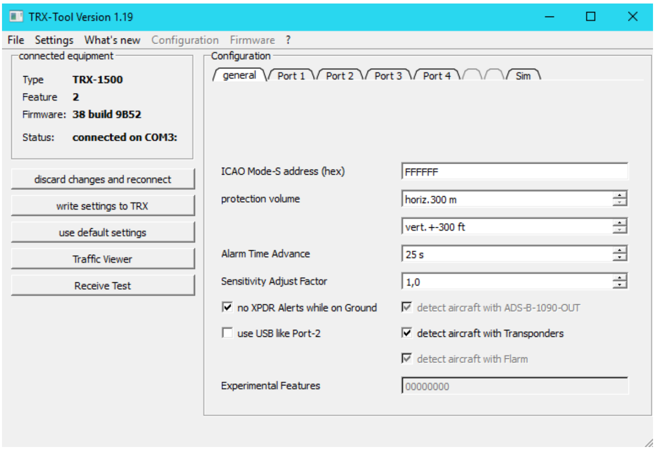


Figure 3.26: TRX 1500 general settings page. Enter correct transponder ICAO address here.

Figure 3.27 shows typical settings for Port 2, where optional LCD display may be connected.

Figure 3.28 shows settings used to connect Nesis 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 3.26 to 3.28.

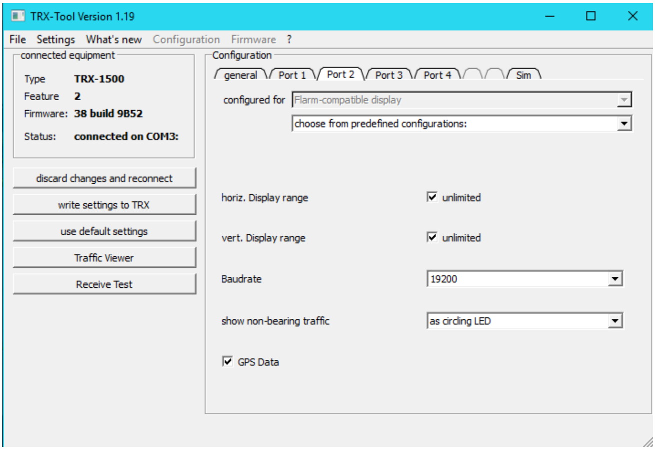


Figure 3.27: TRX 1500 port 2 settings page. Port is connected to display.

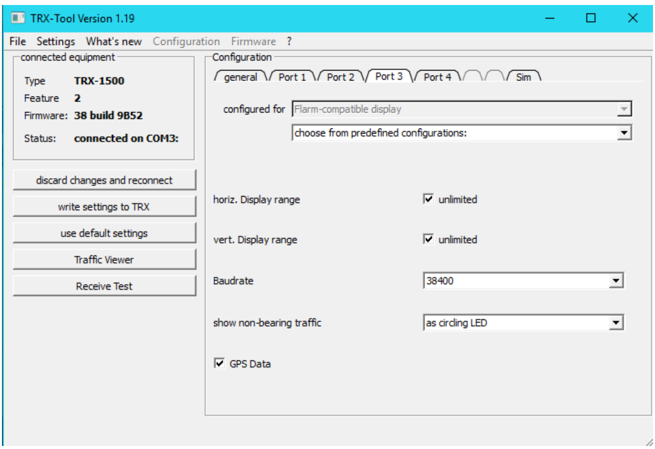


Figure 3.28: TRX 1500 port 3 settings page. Port is connected to Nesis.

3.4.3.9 AIR Traffic AT1

Please read the *AIR Traffic Installation Manual* before any connection is made to Nesis. The manual can be obtained from the `https://www.air-avionics.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 3.29 shows only connections required to connect data port 3 on AT1 with Nesis. It is also assumed that Nesis 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 Nesis 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.

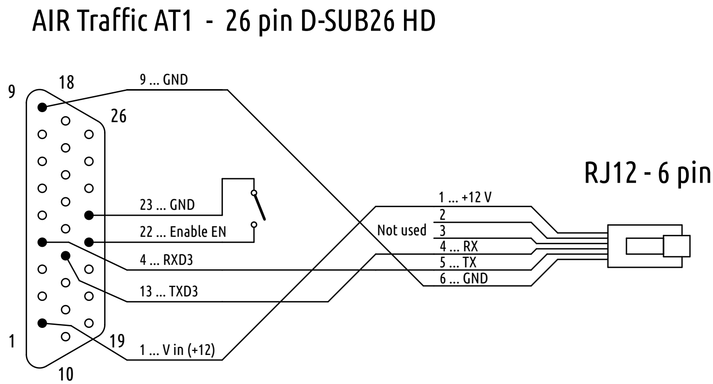


Figure 3.29: Schematic connection for AIR Traffic AT1 device.

Configuration

The AT1 devices can't be configured with Nesis 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 3.30 shows the situation after the connection was made and device data was synchronised.

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

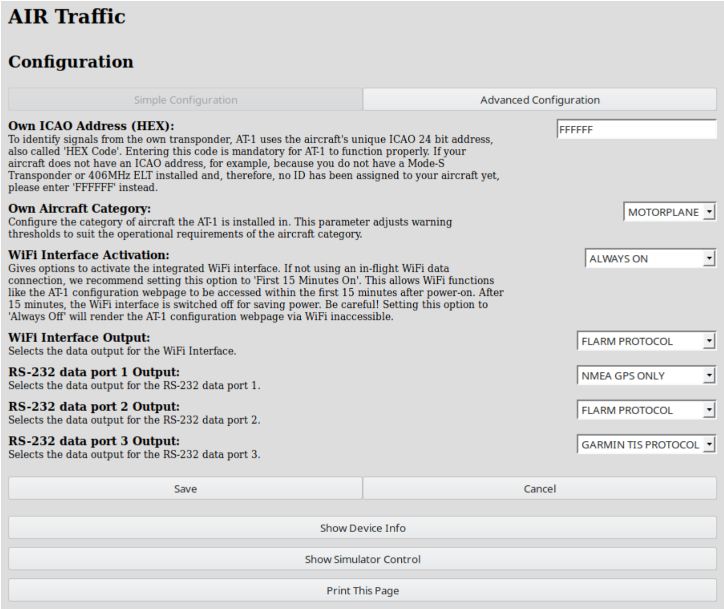


Figure 3.30: Home page of the AT1 device. RS-232 data port 3 was not set yet.

Nesis 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 3.31 shows settings we used.

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.

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

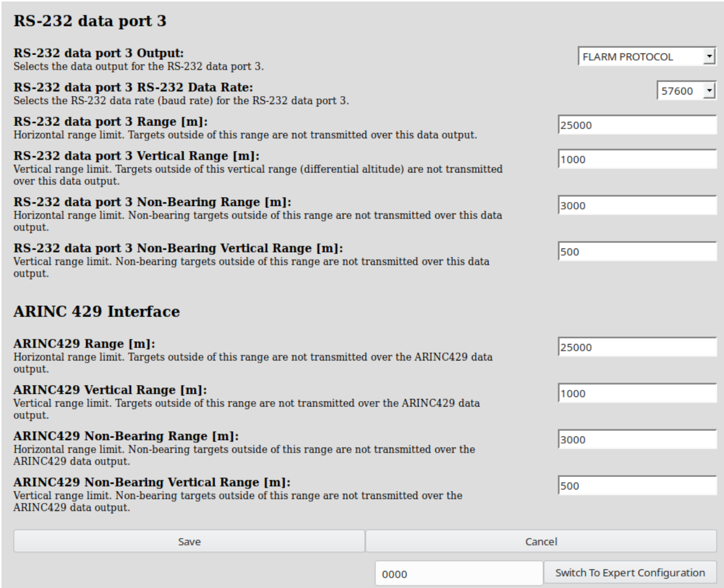


Figure 3.31: Data port 3 settings required for the communication with Nesis.

3.4.3.10 Flarm Eagle

Please read the *Flarm Eagle Manual* before any connection is made to Nesis. The manual can be obtained from the `http://www.lxnavigation.com/` web 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 Nesis, so connection can be made with a flat cable. The same cable can also provide power for the Flarm Eagle.

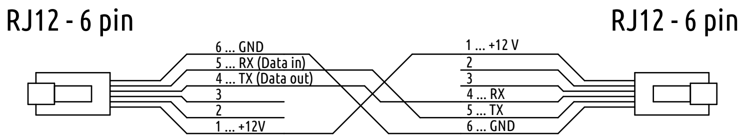


Figure 3.32: Schematic connection for Flarm Eagle device.

Configuration

Flarm Eagle fully supports the Flarm protocol and it can be configured with Nesis. Alternatively, it can be configured via USB port or via micro SD card (depending on the Flarm Eagle model).

3.4.3.11 uAvionix echoUAT

Please read the *echoUAT Manual* before any connection is made to Nesis. 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 3.33 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).

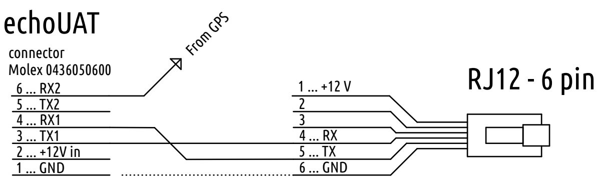


Figure 3.33: Schematic connection for echoUAT device.

Configuration

echoUAT supports GDL90 protocol. Please configure the device to transmit data on COM 1, as it is shown on Figure 3.34. From the Nesis 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 Nesis.

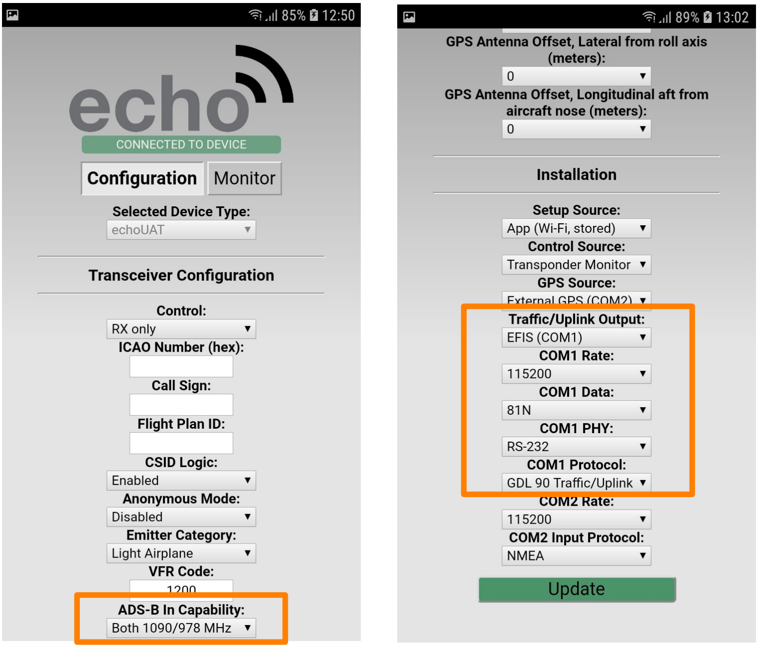


Figure 3.34: Configuration of the echoUAT device.

3.4.3.12 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 Nesis via RS-232 port. A typical connection is shown on Figure 3.35.

GD 40 consumes about 40 mA at 12V . This is low enough to be powered from Nesis port. Be careful however, as total power capacity of devices powered by

Nesis is limited. If you are in doubt, some external power source shall be used instead.

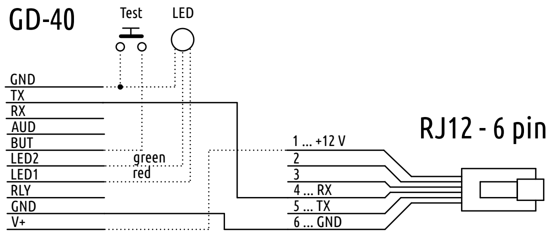


Figure 3.35: Typical connection to GD-40 CO device.

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`.

Chapter 4

Service Options

Service options are special password protected options, which shall not be accessed in normal flight operations. The protection password is unique and it is bound to Nesis serial number. In order to access the service options, issue the following commands:

1. Activate the main menu by pushing the knob.
2. Select the `Options` item. This will open the user opetions page.
3. Select the `Service` icon and enter the access password. If you do not know the password, select the `Info` icon first and search for the `Service pass` number. This is the password you have to enter.

Figure 4.1 appears. Each of the icons shown is explained in next subsections.

4.1 Settings

The `Settings` icon is a gateway for some further options, Figure 4.2.

4.1.1 Flaps Settings

Before you can proceed with the flap settings, please make sure that flap sensor was correctly connected to Daqu (see Daqu manual), Daqu channel was correctly

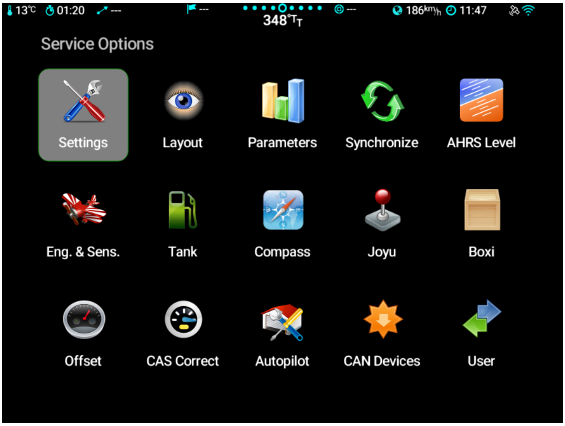


Figure 4.1: Service options icons screen.

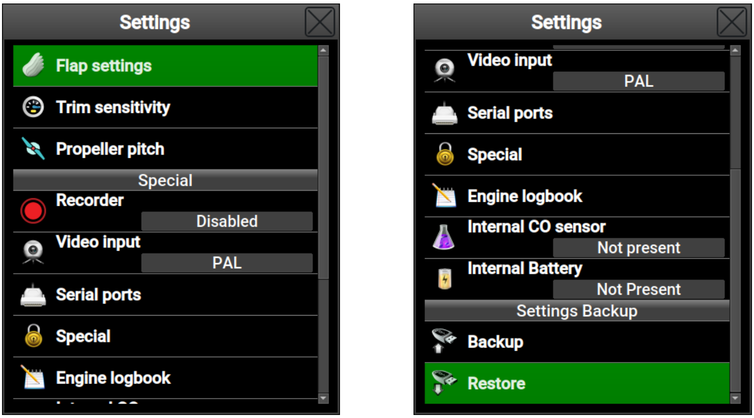


Figure 4.2: Entry point for the parameter editing.

configured (see section 4.6.3) and `Min-Max` position was determined (see section 4.6.3.2).

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%. Nesis allows setting up to five different position. Figure 4.3 shows an example.

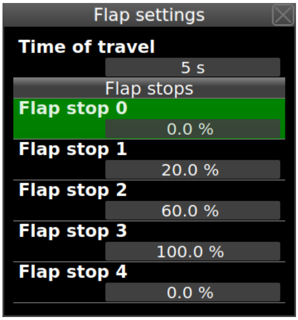


Figure 4.3: Example of flap stops window for an airplane with three extended flap positions. The fourth position is set to 0 and it is ignored.

`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.

`Flap stop 0..4` define flap position in percentage of full travel range.

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

4.1.2 Trim sensistivity

When trim position sensors are connected and properly configured with Daqu, Nesis 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).

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.

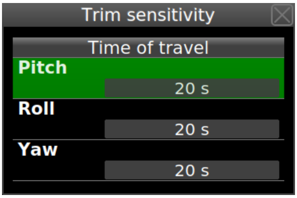


Figure 4.4: Example of trim sensitivity settings.

4.1.3 Propeller pitch

This feature is seldom used. If your propeller is equipped with a position sensor, which in turn is compatible with one of Daqu channels, then you shall configure Daqu first for this sensor. Once this is done, use this command to tell the minimal and maximal propeller position limits in degrees. Figure 4.5 shows an example.

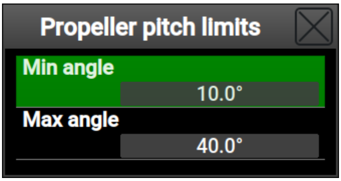


Figure 4.5: Properller pitch limits example.

4.1.4 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.

4.1.5 Video Input

Certain Nesis models have a composite video input connection. Nesis 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.

4.1.6 Serial Ports

Nesis has several serial (RS-232) multi purpose ports at the back. Please refer to the section 3.4 starting on page 44 for details.

4.1.7 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. The command opens a window shown on Figure 4.6. If correct password was entered, the appropriate command is executed.

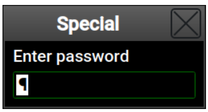


Figure 4.6: Each special command is protected by password.

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

4.1.8 Engine logbook

This option comes handy when some ground engine run was performed one would like to extract engine parameters from the logbook for this particular run.

The options works similar to the standard logbook. Standard logbook filters out entries, which do not have any flight time or if the total flight time is too short. Here, all entries are shown even very short ones. It takes about 10 seconds for an engine run to be detected. Figure 4.7.

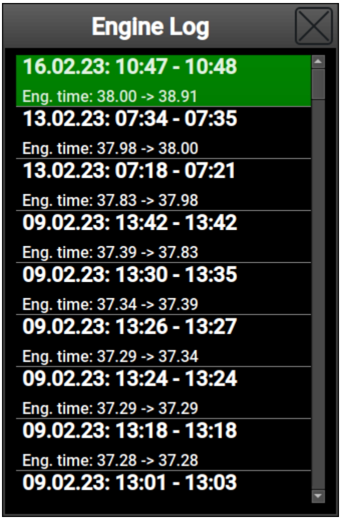


Figure 4.7: Engine logbook example.

1. Insert an USB memory stick into Nesis.
2. Select the engine run you would like to copy.
3. A file with `tab` extension will be made on the USB memory stick.
4. View the content with on a spread-sheet. Check the Logbook section of the Nesis User Manual for more details.

4.1.9 Internal CO Sensor

This option is for backward compatibility only. It will be removed in future version.

Since 2019 we do not equip Nesis 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 Nesis. Please see 3.4 starting on page 44 for details.

Nesis 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.

4.1.10 Internal Battery

This option is obsolete. It is used for backward compatibility and it will be removed in future versions.

4.1.11 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.SN-XXX.tgz* file is created on the USB stick. Here SN stands for serial number of your Nesis, XXX is a number which is incremented for the each save (001, 002, ...) and depends on the previous backups found on your memory stick.

It includes 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 Nesis.

4.1.12 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 Nesis is restarted.

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

Please also note that restore across major versions are in principle not supported. For example, you can't use a backup made with version 3.5 and restore it in version 4.1.

4.2 Layout

The *Layout* command opens a window where Nesis screens layout is organized. Figure 4.8 illustrates the window.

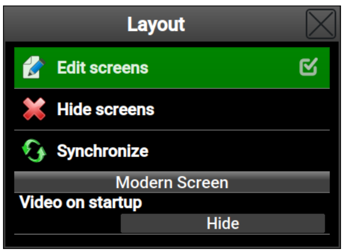


Figure 4.8: Nesis screen layout configuration window example.

Several options are given:

`Edit screens` enables the screen editing. On panels which allow editing new menu option `Edit screen` is enabled. Details are provided in a section 6.1.

`Hide screens` allows you to hide some unwanted screens.

`Syncronize` is used for layout syncronization between two screens. Only layout will be syncronized. Other settings will remain untouched. See also section 4.4 for full syncronization.

`Video on startup` is used to show or hide the video window used on the modern screen.

4.3 Parameters

Parameters have a section of its own. Please see section 5, starting on page 94.

4.4 Syncronize

This option is useful when two Nesis screens are used. Once the first screen is setup properly, this command synchronizes the second screen accordingly. Devices of other types are not affected (e.g. Emsis, Horis, Digi ...).

We recommend that the master screen is completely configured/setup first and once you are happy with the setup, use this command to transfer the setup to the slave screen.

The command works in both ways. This means that you can also transfer slave screen setup (configuration, layout, parameters, etc.) to the master as well.

It may happen that you will still have to make some minor adjustment on the screen after the synchronization. As master and slave screen have some feature differences, a small subset of the setup can't be synchronized.

The command may have undesired effects. Never use it in-flight. It shall be used as a part of the configuration/setup process only.

If screens do not run the same software version, the results are not predictable. Make sure to use the same software in both screens.

For partial synchronization see sections 4.2 and 5.2.2.

4.5 AHRS-Leveling

During the assembly of the AD-AHRS-GNSS unit (AIRU) into the primary Nesis and during the installation of the Nesis 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 Nesis 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 4.9 appears on the screen.

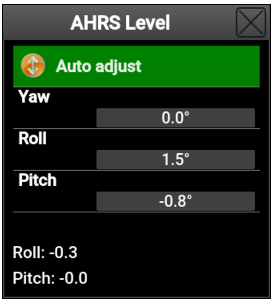


Figure 4.9: AHRS Leveling window.

4.5.1 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 4.10 left.

Some instrument panels or Nesis 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 Nesis. Figure 4.10 defines positive and negative Ψ angle.

When Ψ is known, enter its value into *Yaw* item as shown on Figure 4.9. Then you can proceed with the pitch and roll adjustment, which are automatic.

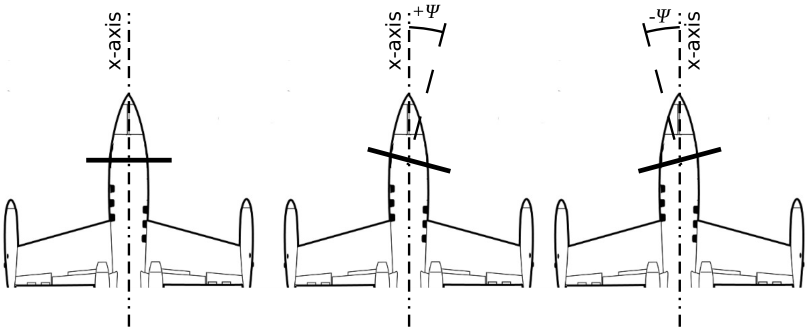


Figure 4.10: Top-down view illustration of possible yaw misalignment: perfect position (left), positive yaw misalignment angle (middle), negative yaw misalignment angle (right).

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

4.5.2 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 4.9 and wait for the progress bar to finish. Observe roll and pitch values. At the end, they should be close to zero.

In some cases aircraft ground position differs from the cruising position significantly. In such cases a manual pitch adjustment shall be used.

If necessary additional manual adjustments can be made by selecting `Roll` or `Pitch` item and changing the correction angle manually. The correction is applied once the window is closed. Usually, some experimenting is needed to get the proper value.

4.6 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 4.6.1 and 4.6.3.

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 Nesis can display it on the screen. Please refer to section 5 for more details.

Figure 4.11 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.

4.6.1 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, . . .). Nesis uses this info to load default parameter settings for the engine, section 5. 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.)

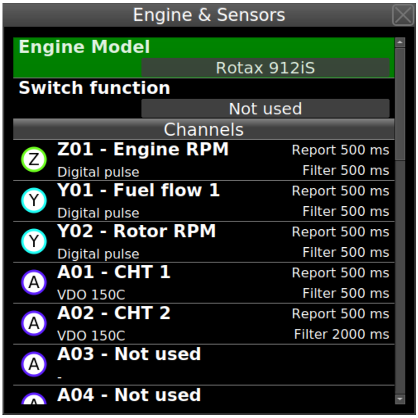


Figure 4.11: An example window for engine and sensors.

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 4.1: 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.

4.6.2 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.

4.6.3 Channels

Nesis 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 4.12. Some of the actions depend on the channel function or sensor type.

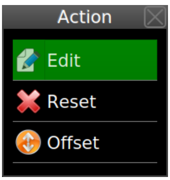


Figure 4.12: An action window example.

`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.

4.6.3.1 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 4.13 shows an example of channel editing window.

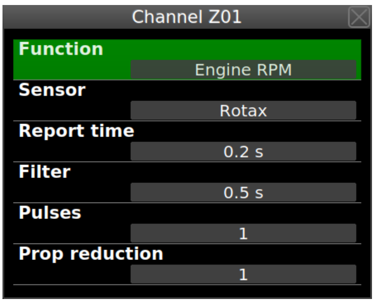


Figure 4.13: An example of channel Z editing. Z is typically used for the engine RPM.

`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 4.14 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* item, 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.

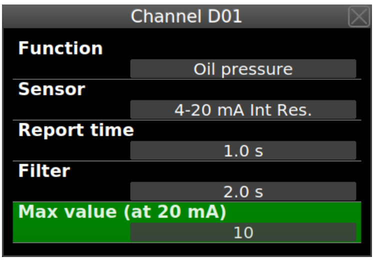


Figure 4.14: An example of channel D editing. Certain sensors require additional value, which defines the sensor range.

Another, slightly different example is shown on Figure 4.15. In this case sensor is a thermocouple and this type requires a selection between isolated or non-isolated type.

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

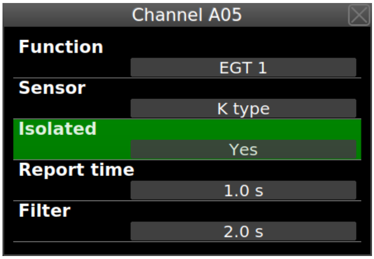


Figure 4.15: An example of channel A editing. An EGT sensor is connected to the channel.

channel, the first assigned function will be reset and the last assigned function will be kept.

4.6.3.2 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 through the *Min/Max* window. These two parameters are sensor values at both extremes.

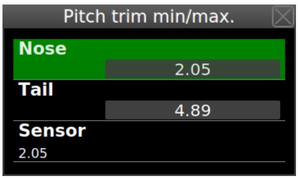


Figure 4.16: An example of extreme positions for the pitch trim sensor.

`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*.

4.6.3.3 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 4.17 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.

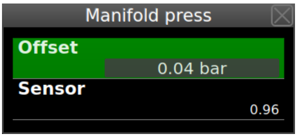


Figure 4.17: An example of manifold pressure offset.

4.6.3.4 Tank

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

4.7 Tank

Nesis 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 (4.7) before adjusting tank color ranges – red, yellow, green.

4.7.1 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.

4.7.1.1 Linear Shape

This is the simplest tank calibration solution. It only requires three additional values. Figure 4.18 illustrates the main tank window and figure 4.19 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.

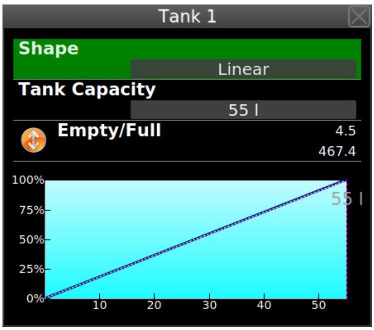


Figure 4.18: An example of linear fuel tank.

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.

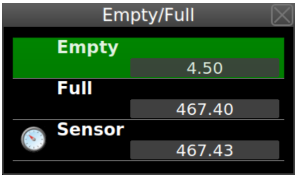


Figure 4.19: An example of linear fuel tank.

4.7.1.2 User Shape

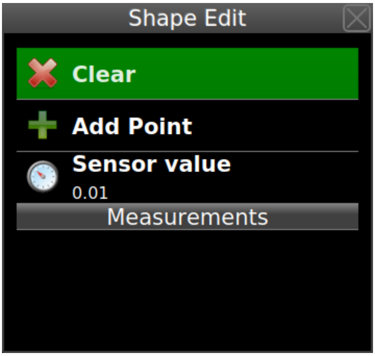
This is the most complex solution, but also the most precise one. It allows up to 20 calibration points per tank. 20 points are an overkill, 5-8 points are usually more than enough. Fuel level sensors precision and resolution are quite limited and sometimes also fuel type dependent. Having too much points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

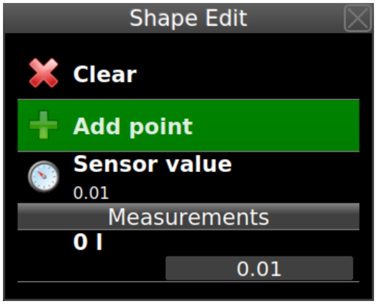
A typical procedure is described next. Taking notes on paper about every measurement point is highly recommended.

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 4.20a 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[1].

[1] 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 4.20: Editing tank measurement points.

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.

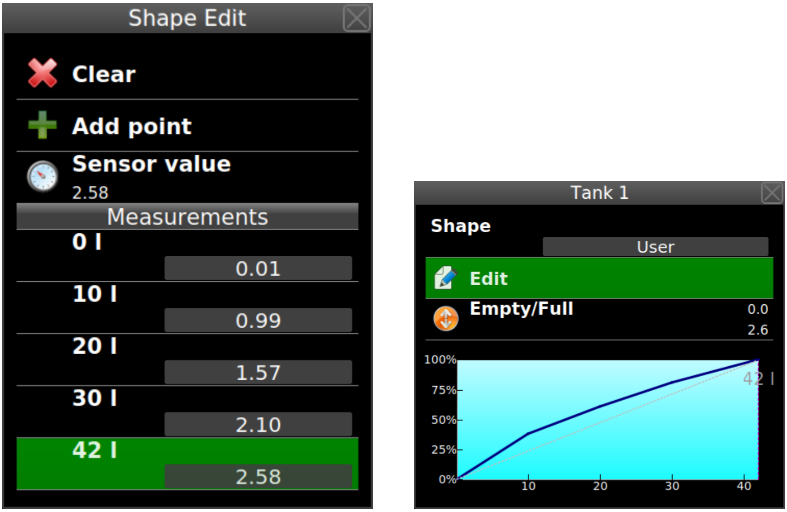
5. Repeat the previous step until the sensor value stops changing. When this happens the upper sensor limit point has been reached. Putting more fuel into tank will have no effect on the sensor. Sensors in many aircraft reach this point way before true fuel tank capacity is reached.

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

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 4.21a 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 Nesis will show values between 0 and 42.

Figure 4.21b shows the final situation. The dark blue color line on the chart shows tank non-linearity.



(a) Final list of points. (b) User defined tank shape.

Figure 4.21: An example of tank measurement points.

4.7.1.3 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.
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.

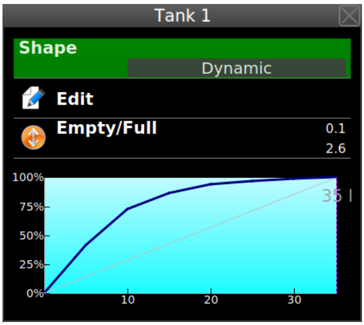


Figure 4.22: An example of a predefined tank shape after the *Empty/Full* were set. Non-linearity in this case is pretty severe.

4.7.2 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 4.23 shows situation for the 80 liters fuel tank.
Using simulated fuel tank can be dangerous. The fuel remaining is calculated from initial estimated fuel quantity and fuel consumption. Both, initial estimate

Figure 4.23: Software tank capacity set to 80 liters.

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.

4.8 Compass – Magu

Compass installation and calibration is a complex process which is described in a separate manual. Please refer to the Magu manual (Magu i.e. electronic magenetic compass) for more details.

The manual is accessible from our web site.

4.9 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, Nesis, Emsis, Boxi and Joyu are connected to the CAN bus. Some of Joyu buttons can be configured to command Nesis 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.

4.9.1 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 transmition 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.

4.9.2 Configuration

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

Figure 4.24 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 4.24: 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 4.25 shows an example for button 1.

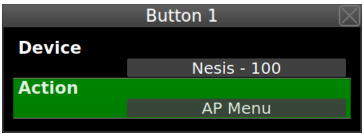


Figure 4.25: Joyu button 1 was assigned to Nesis with serial number 100 with the autopilot menu action.

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 4.26 illustrates an example.

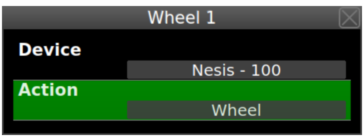


Figure 4.26: Joyu wheel movement was assigned to Nesis with serial number 100. Action in this case is knob rotate action, which equals to wheel.

An example of final situation is shown on Figure 4.27. When the window is closed the configuration is sent to all devices on the CAN bus. They all receive a complete command/action list.

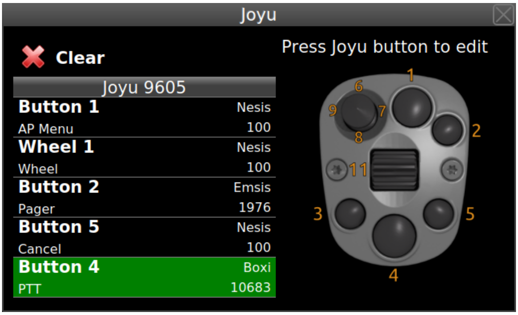


Figure 4.27: Final situation – three different devices are controlled with one Joyu.

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.

4.10 Boxi

Boxi details are covered in a separate manual. Please take a look at:

- Boxi II User and Installation Manual or
- Boxi User and Installation Manual (older models).

Both manuals are accessible from our web site.

4.11 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 Nesis 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 Nesis altimeter is too high regarding to the reference altimeter, increase the correction. If Nesis altimeter is too low, decrease the correction.

For example, Nesis 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 Nesis 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 Nesis 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 Nesis 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 Nesis 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.

4.12 Calibrated Airspeed – CAS Correct

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 4.2 shows calibrated airspeed values.

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

Table 4.2: Example: Table with IAS and CAS. Differences are entered into Nesis.

1. Select the `CAS Correct` icon from the `Service Options` page.
2. Enter points as shown in the Figure 4.28.
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.

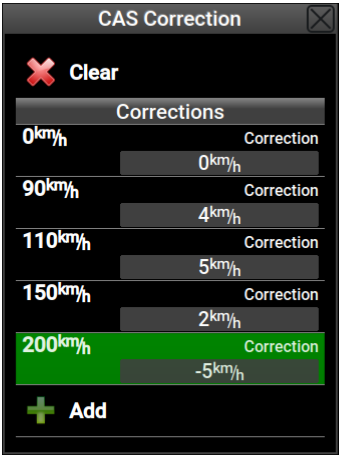


Figure 4.28: An example of the CAS correction table.

4.13 Autopilot

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

4.14 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.

4.14.1 Indu/Digi Layout Change

Nesis 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. Nesis 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.

4.14.2 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.

chapter

Chapter 5

Parameters

We used a term *parameter* to define some on screen flight, engine, electric value that may appear in a form of a gauge, bar, arc, value box, status light, . . . A typical parameter consists of:

1. Several names of different length: normal, short and tiny. They are used to describe a parameter.
2. Filter value is used to smoothen response on a change.
3. Several color bands may be used to define warning, caution and normal use limits.
4. Attributes are used to define special points for specific parameters like indicated airspeed (Vx, Vy, Vref, . . .) or RPMs.

It is recommended that engine sensors and corresponding Daqu channels are set before parameters are being edited. See section 4.6 and `Daqu` or miniDaqu manual. The same is true for the tanks. Their corresponding Daqu channels shall be set and tank shall be configured before editing their parameters here. See section 4.7.

Some parameters are related to *functions* in Daqu channel settings. This relation is weak. If a Daqu channel is configured for some engine function, it does not automatically mean that it is also enabled and used by Nesis parameter. You may have to enable and configure it manually. For example, if you configure some Daqu channel for a *carburetor temperature*, you will also have to enable and configure corresponding Nesis parameter and then perhaps also perform some screen customization.

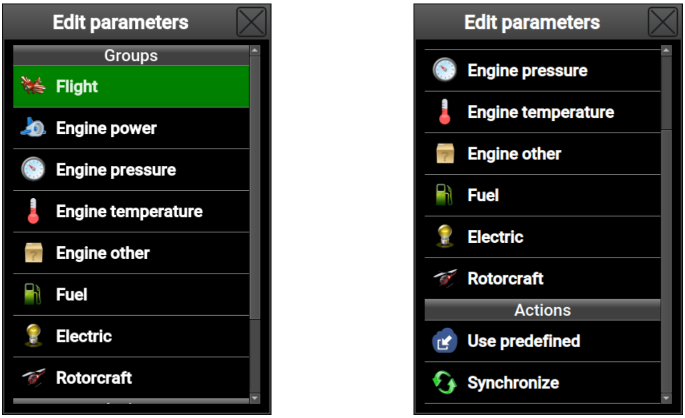
5.1 Parameter Editing

There are two ways to edit a parameter:

- Service options have a dedicated icon with general access to individual parameters.
- Various screen customization items have a direct shortcut to an individual parameter.

This chapter describes the first option, while the Chapter 6 deals with the second option. Nevertheless, both are similar.

In order to access the main parameter editing window, issue the `Options | Service + (password) | Parameters` command. This opens a window similar to Figure 5.1. It is divided into two parts. The top part shows parameter groups and the bottom part gives access to special actions.



(a) Parameter groups (b) Actions

Figure 5.1: Entry point for the parameter editing.

5.2 Actions

The following actions are available at the bottom of the window. You may need to scroll down to access them.

5.2.1 Use predefined

This command will load predefined parameter values (color arcs) for most engines parameters. It will ask for the engine model and after the engine selection, it will redefine engine parameters. Please note that these are not official parameter values. Always consult your pilot's operating handbook or your engine manual for correct values and adjust parameters as needed.

5.2.2 Syncronize

This command transfers all parameter values to other devices found on the CAN bus. This comes handy, when you set all parameters on Nesis and then you want that all other devices use the same parameter color bands, names, etc. It is up to the receiving device to accept this command. At the time of writing Nesis and Aetos are fully supported, while Digi and some other Indu devices are partially supported. Emsis is also partitaly supported since version 3.11. Horis is not supported.

5.3 Groups

There are more than fifty various parameters that are supported by the system. This number is too large for a one large list to appear on the screen. For this reason parameters are organized in groups. Some parameters appear in more than one group, for convenience. Figure 5.1a illustrates group names. After a group was selected, a list of group parameters appears. Some examples are given in Figure 5.2.

A selection of parameter name gives access to individual parameter details.

5.4 Parameter Details

Parameter details are defined in a window similar to Figure 5.3. The window shows a situation for the oil pressure parameter. Most of other parameters follow the same logic.

`Show (default only)` check is used in combination with the automatic screen customization. This check only works if default configuration is used. It tells the system that this parameter shall be shown on the screen. You can override this with manual screen tuning.

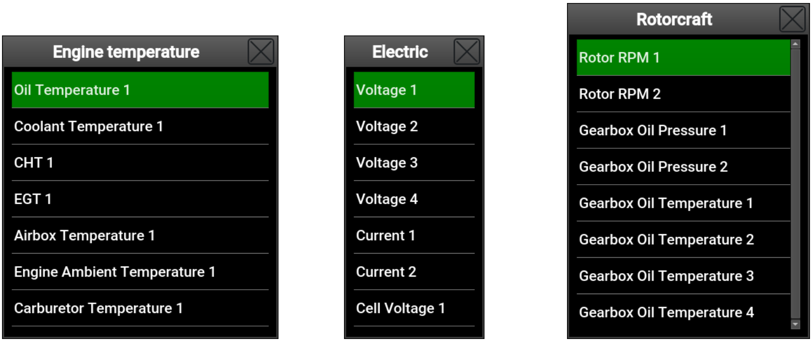


Figure 5.2: Parameter lists examples.

Figure 5.3: Parameter details in oil pressure example.

`Filter` defines a time filtering constant – low pass filter constant. It is used to smoothen the screen response of a parameter change. The value is given in seconds. It can be described as a time needed for a parameter to adapt to about 63% of the change. Small values (0.5 seconds or less) lead to a vivid response and larger values (2 seconds or more) to a lazy response.

Each parameter is different here and some experimenting is needed to find correct value. For example, engine RPM requires swift response and lower value while the fuel level (or fuel tank) parameter will perform better with a slow response – higher value.

Please also note that `Daqu` already applies a similar filter. If you want a quick response and you set your filter low but you still get a slow response, please also check the Daqu channel setting for this parameter. This means that in the case of Daqu related parameters, the filter is applied twice. First in Daqu and then also in Nesis.

`Names` allows definition of three different names for each parameter. In fact, there are four different names:

- System name can't be changed. It is shown in the window title.
- Long name is used where there is enough space available to display it.
- Short name is used in scale and gauge titles where space is limited.
- Tiny name is used where space is very limited and only two, maybe three characters are available.

Please note that these names may still be overridden with names specified by gauges and other visual elements.

`Color bands` are used to identify parameter range limits represented by green, yellow, red and also transparent color. The later is also called *no color*.

`Attributes` are limited to some specific parameters like indicated airspeed and RPMs.

5.4.1 Color Bands

A parameter may have some associated color bands which together form a scale. These bands are typically used to define green, yellow and red operation areas. They can also define a transparent area, where no colors are used.

Figure 5.4 illustrates an example for an indicated airspeed parameter. First the start point `Scale start` is defined. It was set to `70 km/h`. Then a green band spans until `170 km/h`, followed by a yellow band until `220 km/h`. This is also a VNE limit. However, some extra red band is given above VNE and it is set to `240 km/h`. VNE is not explicitly given. It is derived from the yellow/red border value `220 km/h`, automatically.

On the right side of the window scale is automatically updated. Bands are shown in the arc form together with their limiting values. Some parameters may take additional attributes. They appear below the arc.

Another example is given in Figure 5.3 where oil pressure is defined. The scale starts at `0 bar` and then various band spans are added until the end of the red band is defined. The values shown in the example are typical for Rotax engines.

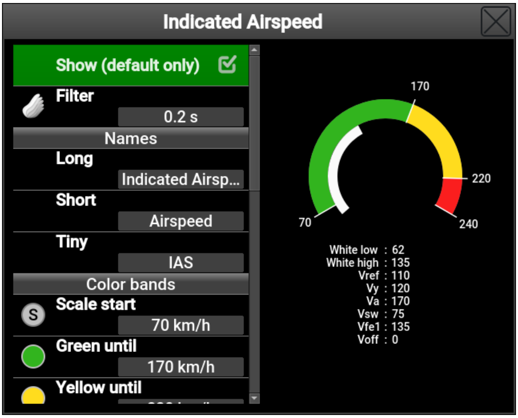


Figure 5.4: Color bands example for indicated airspeed. Many airspeed related attributes were also defined.

Add

The `Add` item appends a new band to the last one. The end of previous band is taken for the start of the new one. End ot the new band must be specified as well as the band colour, Figure 5.5.

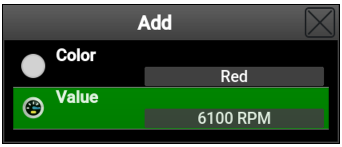


Figure 5.5: The last, red area band for the engine RPM example. End of the band is given. The band start is taken from the end of previous band, automatically.

Delete, Insert And Edit

Selecting an existing band opens a window with the following options:

`Edit` opens editing window for the existing band. Band color and its end value can be changed.

`Insert` allows to insert a new band in-front of the selected band.

`Remove` removes the selected band.

5.4.2 Attributes

Attributes are special values that are combined with some parameters. An attribute takes only a single value and has a special meaning. Any attribute is optional. When an attribute is zero, it is considered not to be used.

Indicated Airspeed

Indicated airspeed uses the following special attributes:

`White low` defines the lower point of the white arc, which is used for allowed flap extension airspeed range.

`White high` defines the upper point of the white arc.

`Vref` defines landing reference speed or threshold crossing speed.

`Vy` defines speed where the best rate of climb is achieved.

`Vx` defines speed that allows for the best angle of climb.

`Va` defines design maneuvering speed.

`Vsw` defines the speed where stall warning alarm will be shown. Please note this is typically significantly higher than actual stall warning speed.

`Vfe1` defines marking for first degree flap position.

`Vfe2` defines marking for max flap position (smaller than Vfe1).

Engine RPM

Sometimes engine RPMs are shown as percentages rather than as actual RPMs. This is usually case in helicopter applications. In order to convert actual RPMs into percents two values shall be defined. Linear interpolation (and extrapolation) is then used for the conversion.

`RPM at 100%` is 100% RPM threshold.

`RPM at 0%` is optional and is set to zero by default. Non zero values are seldom used.

Rotor RPM

Rotor RPMs behave similar to the engine RPMs, see the previous subsection. Gyrocopters may use two extra attributes which are related to a prerotation phase:

`Prerot. red/yellow` defines the rotor RPM threshold where pre-rotation status indication light changes from red into yellow (amber). A typical value is around 180 RPM.

`Prerot. yellow/green` define the rotor RPM threshold where pre-rotation status indication light changes from yellow (amber) into green. A typical value is around 200 RPM.

Pre-rotation status light indication is optional. For the time being the indication light only appears on gauges which are in the `Reset to default` mode.

5.5 EGT And CHT

These parameters are a bit special in their index nature. Namely they behave like a normal parameter but more of them appear at the same time – each for its own cylinder. The `Count` defines how many sensors are in use. This must be set for each parameter individually as not all cylinders may be equipped with sensors.

This number must match number of actual connected sensors. These sensors must also be configured properly – their corresponding channels must be set in the most cases[1]. At the time of writing, Nesis does not cross check this requirement.

For example, when `Count` is set to 4 for EGTs, then the system expects that 4 sensors will be installed and their corresponding channels configured.

Another special example is Rotax 912 CHT case. Rotax 912 has four cylinders, but it installs only two sensors; one in cylinder 1 and the second one in cylinder 3. So, `Count` is set to two. You can't use indices 1 and 3, but you have to use indices 1 and 2. Namely, an index number can't be higher than the count value. chapter

[1] This is not the case for the Rotax iS, ULPower engines and other engines equipped with ECUs.

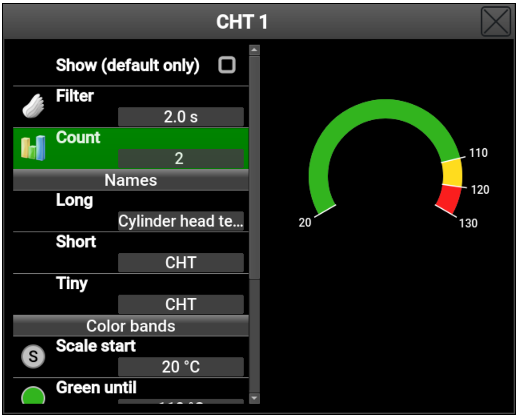


Figure 5.6: `Count` appears for certain parameter. An example is given for Rotax engine, where there are four cylinders, but only two sensors are used for CHT/CT.

Chapter 6

Screen Customization

Since software version 3.9 customization of engine part on *modern* screens is possible. In addition, since version 3.10 *classic* and *engine* screens can be customized too. The customization is done with a help of an on-screen editor. Editing can be done with touchscreen or with mechanical knob and buttons.

In order to edit a screen, you have to:

1. Enable editing fist,
2. enable the edit mode on the selected screen.

Note that some screens (map screen, for example) or screen parts are not editable.

6.1 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. In order to enable screen editing, select:

1. The `Options|Service (+password)|Layout`.
2. Check the `Edit screens` options, see Figure 6.1.

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

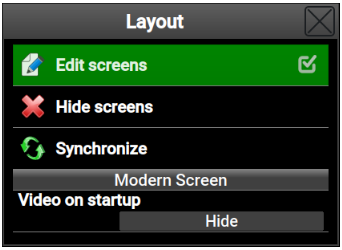


Figure 6.1: Option that must be enabled before screen editing.

3. Once editing is enabled use the `Pager` button to switch to the screen you want to edit. Then push the knob and select `Edit screen` from the menu, Figure 6.2. Alternatively, long touch on the screen.

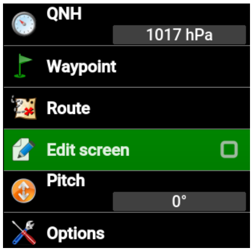


Figure 6.2: Main menu with `Edit screen` option which must be enabled to start editing this screen.

6.1.1 Edit Menu

Once screen is in the `edit mode` a push on the button or a touch in the top right corner of the screen opens a menu as it is illustrated in Figure 6.3.

`Finish edit` stops editing this screen and also saves any potential changes. Basic edit mode is still active and you may start editing again or switch to another screen and start editing there.

Alternatively, editing mode can be closed by pressing the `Close` button a few times.

`Clear` is used on modern screens only. It completely empties engine part of the screen and allows for the fresh start.

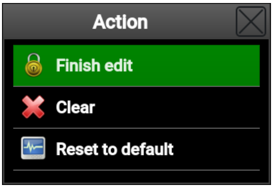


Figure 6.3: Edit menu actions. Some screens do not have the `Clear` option.

`Reset to default` looks at active parameters, resets current screen and assign gauges, bars, . . . automatically. This is a very powerful command and in most cases it generates correct layout. It is essential that parameters are defined properly before this command is used.

6.2 Classic Screen

A classic screen consist of the following items that can be edited, Figure 6.4:

- Central section. Here you can select one of several forms of the central section.
- Two mini panels, the first on bottom left and the second on bottom right. Several different mini sections are available to choose from. One of them can be also edited in detail. Please note that the mini sections are available on 8.4“ models only.
- Four round gauges, two by two on each side. Each gauge can be edited to a great detail.

6.2.1 Central Section

Enable editing mode first, see Section 6.1. Touch or select the central section. A window as shown in Figure 6.5 appears. Select the layout you want.

Figure 6.6 illustrates the options.

Figure 6.4: A typical example for automatically generated classic screen on 8.4” display.

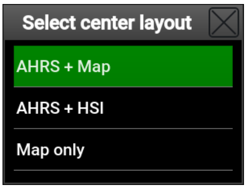


Figure 6.5: Classic center options to choose from.

6.2.2 Left And Right Mini Panels

This selection is only available on `8.4"` version of Nesis.

Enable editing mode first, see Section 6.1. Touch or select one of the mini panels. A window as shown in Figure 6.7 appears. Select the layout you want.

Figure 6.6 illustrates the mini panel options:

`Mini engine` is the default option for the left panel. It shows mini vertical bars for some engine parameters. Bars are typically shown in green/yellow/red colors for quick indication of any potential engine problem. This panel can be further edited. See Section 6.2.2.1 for the details.

`Aircraft designation` will display some text on the panel. This text is typically aircraft registration number.

(a) AHRS + Map. (b) AHRS + HSI. (c) Map only.

Figure 6.6: Illustration of options for the central section of the Classic screen.

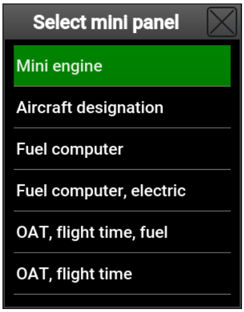


Figure 6.7: Classic mini panel options to choose from.

`Fuel computer` is the default option for the right panel. Is shows a small compact fuel computer.

`Fuel computer, electric` combines major fuel computer parameters with some major electric values.

`OAT, flight time, fuel` shows OAT, flight time and fuel level only.

`OAT, flight time` shows OAT and flight time only.

6.2.2.1 Mini Engine Panel

A mini engine panel is organized into up to four groups. You can use less groups than four, but not more. Each group consists of a title and one or more parameters, which are shown as vertical bars and short two letter name under the group title. By default, the name is defined by the `tiny` parameter name, but a user name can be also given. An example of mini engine panel is shown in Figure 6.8.

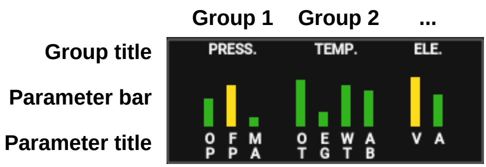


Figure 6.8: Layout organization of a mini engine panel.

The mini engine groups, individual parameters and parameter names can be configured in more details by selecting the mini engine panel and then choosing the `Edit mini panel` option. This brings up a situation similar to Figure 6.9. The window lists a summary of all groups on the top and also allows `Reset to default` at the bottom. Groups names are shown on the top right, while group parameters are listed on the bottom right of each item.

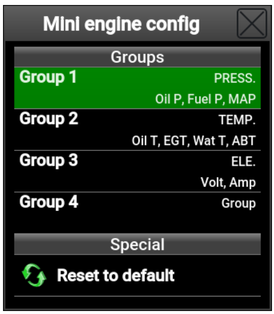


Figure 6.9: Configuration window of the mini engine panel.

`Group 1, ...` will open another window, where group details can edited. More details are given below.

`Reset to default` will try to figure out groups based on the current list of active parameters. It is important to properly set individual parameters before you issue this command. Enable parameters you use and disable unused ones. See section 5 for more details.

Mini Panel Group Editing

Figure 6.10 shows an example of group editing window.

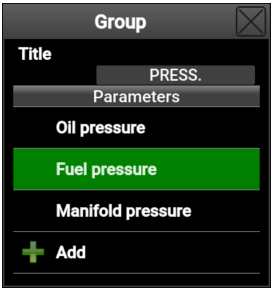


Figure 6.10: Group editing window example.

`Title` defines a title of the group. Do not make this name too long. Figure 6.8 shows an example and it may give you a feeling how much letters you can enter.

`Parameters` lists parameters that are included in the group. Selecting a parameter opens yet another window, which allows further changes explained next.

`Add` will ask you to append a new parameter into the group.

Mini Panel Parameter Editing

When a parameter was selected a window appears, which allows for some parameter changes. Figure 6.11 shows an example.

The following options are available:

`Select parameter` shows current parameter in use. Selecting this option will ask you for a new parameter that will be shown instead.

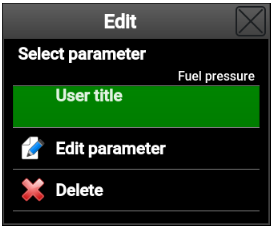


Figure 6.11: Parameter editing window example.

`User title` allows user to define a special name for the parameter. Although parameter defines three names (normal, short and tiny), these may not be always appropriate. Here you can give a name explicitly. Remember that only first two letters will be used as the space is very limited. See Figure 6.8. When `User title` is left empty (default) the first two letters from the parameter's tiny name will be used automatically.

`Edit parameter` opens parameter editor window, where parameters color ranges can be edited as well as parameter names. See Figure 5.1 for an example.

`Delete` removes parameter from the group.

6.2.3 Round Gauges

Classic screen has four round gauges, two on left and two on right. Each gauge can be edited in detail.

Enable editing mode first, see Section 6.1. Touch or select one of gauges. This opens a window similar to example in Figure 6.12. Gauges like this also appear on the *engine* screen. They work on the same principle. Thus gauge editing was put into separate section 6.5 starting on page 122.

6.3 Engine Screen

The engine screen consist of six gauges that can be edited. There is also a part of the screen at the bottom (8.4" version) or on the right side (7" version), which can't be edited at the time being.

Enable editing mode first, see Section 6.1. Touch or select one of gauges. Gauge editing is explained in Section 6.5 in detail.

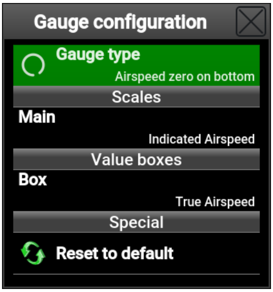


Figure 6.12: Gauge editing window example.

Figure 6.13: A typical example for automatically generated engine screen for Rotax engine on 8.4" display.

In addition to the gauges, the bottom part can be also configured. The bottom shows trim and flaps positions, engine status an some other information. Click on the bottom part to open a window as shown in Figure 6.14.

6.4 Modern Screens

Only a part of the modern screen can be edited. Figure 6.15 shows the editable part. Sometimes two modern screens are used: one with AHRS and one with a moving map. They both share the same editable part.

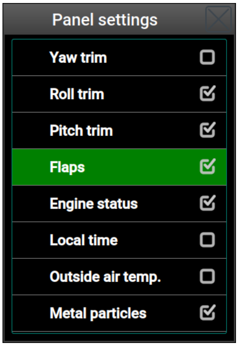


Figure 6.14: Check the indicators to show at the bottom or at the side of the engine screen.

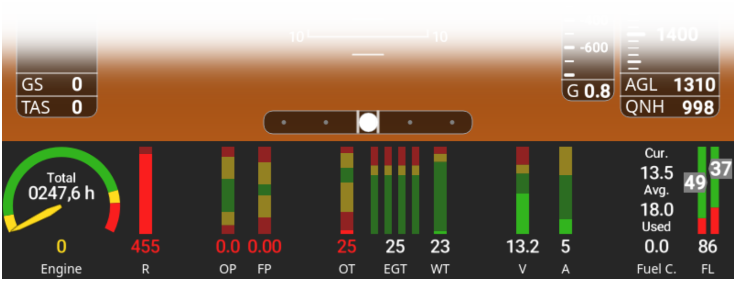


Figure 6.15: Part of the screen which is editable.

Enable editing mode first, see Section 6.1. Touch or select one of items in the editable section.

After the `Edit screen` option is selected from the main menu the appearance of the page changes as shown in figure 6.16. Note that your case may be significantly different. Items that are marked have the following meaning:

(1) An arc shapped item.

(2) A sub-group of items marked with a thing yellow line.

(3) Currently selected item. In this case, it appears in the sub-group.

(4) A vertical bar.

(5) A combination of several vectical bars belonging to the same parameter, EGTs or CHTs, for example.

(6) A stretch space. Its width varies automatically.

(7) A combination of two arches into one visual item.

(8) A fuel computer item.

(9) A fixed space between two items.

(10) A fuel level item.

Figure 6.16: Illustration of main items used for editing the bottom part of the screen. Not all possibilities are shown.

Every item is placed inside a group. A group can be horizontal or vertical. Each group typically contains ordinary items like bars and arcs and sometimes also sub-groups.

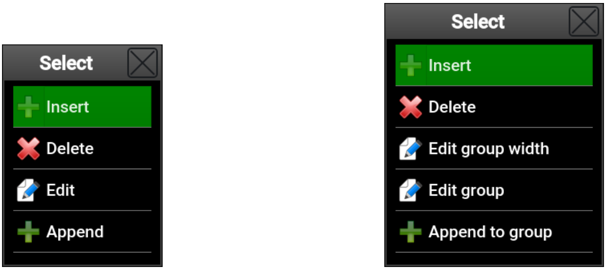
6.4.1 Navigation and Editing

Navigation between items in a group can be done with the touchscreen or with the knob. Selected item is marked with a yellow box. See Figure 6.16 where EGTs are marked with a yellow box.

A touch or a push of the knob opens a selection window as shown on Figure 6.17. Actual options depend on a situation.

`Insert` inserts a new item like a bar, an arc, a space, a stretch or something similar into the currently active group.

`Delete` removes currently selected item or an empty sub-group.



(a) An item is selected. (b) A sub-group is selected.

Figure 6.17: Selection window and its options. Some options may be hidden, depending on a situation.

`Edit` opens an edit window for currently selected item.

`Append` appears only when the last item in a group is selected. It works in the same way as insert but the new item is appended at the back.

`Edit group width` appears only when a sub-group is selected. It asks for a subgroup size[1]. The size is given in percentage of the parent group.

`Edit group` selects the first item in the subgroup – it *enters* into the subgroup.

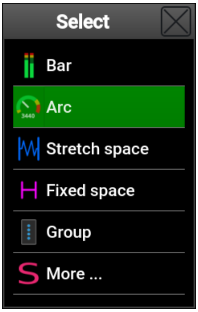
`Append to group` is similar to `Insert` but the new element will be put at the back.

6.4.2 Insert And Append

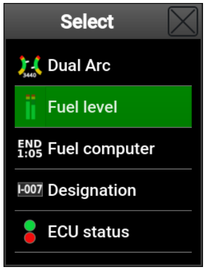
The `Insert` and `Append` commands work in a similar way. They ask you which item to create and then this item is either inserted or appended to the active group. Figure 6.18 illustrates selection options.

`Bar` inserts either a vertical or horizontal bar. Orientation is automatic and depends on the active group. Nesis also asks for the parameter to shown in the bar. If parameter is not selected, a placeholder is used instead. A placeholder means that it is not associated to any parameter yet. More in Section 6.4.2.1.

[1] This can be either width or height, depending on the parent group and the display size



(a) Basic items.



(b) More special items.

Figure 6.18: `Insert` and `Append` item options. In some cases, not all options are shown.

`Arc` inserts an arc element. This is similar to bar, just the shape is different. A placeholder arc is created. More in Section 6.4.2.2.

`Stretch space` inserts a special *elastic* element, which visually separates individual items. Nesis will automatically calculate the size in a way to populate underlying group evenly. More in Section 6.4.2.8.

`Fixed space` defines a fixed amount of space between two elements. The space is defined in pixels. More in Section 6.4.2.9.

`Group` inserts a subgroup into current group. This allows group nesting. Such nesting is only allowed to a certain level. More in Section 6.4.2.10.

`More` gives access to more special items, Figure 6.18b. Some of them may not appear in certain group orientation and may be omitted from the list.

`Dual arc` inserts special two arc combination. It is usually used in rotorcraft for rotor and engine RPM combination, but you can also use it elsewhere. More in Section 6.4.2.3. Here Nesis does not ask for parameters and uses two placholders instead. After the item was created, select it and use the `Edit` command to change parameters to something meaningful.

`Fuel level` is special item, which displays fuel level bars in a bit specific way. It also shows total fuel level. More in Section 6.4.2.4.

`Fuel computer` combines numeric fuel computer items into one element. More in Section 6.4.2.5.

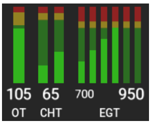
`Designation` shows user specific designation text, usually aircraft registration. More in Section 6.4.2.6.

`ECU status` shows engine ECU status indication. At the time being, it is limited to Rotax iS and ULPower engines only. More in Section 6.4.2.7.

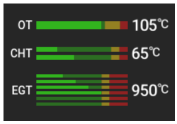
6.4.2.1 Bar

Most parameters are shown in the form of bars. Some parameters (EGT, CHT) allow multiple bars on the same parameter. Example in Figure 6.19 illustrates the case where CHT has `Count` set to 2 and EGT to 6. Maximal numerical value is always shown, while the minimal value is shown only in smaller font if there is enough space (vertical bars only).

Bar orientation depends on the underlying group. When the group lists its items horizontally, bars are vertical and vice versa.



(a) Vertical bars.



(b) Horizontal bars.

Figure 6.19: Example of bars. Orientation depends on the group they belong to.

6.4.2.2 Arc

Any parameter can be also shown as an arc. An arc consumes significantly more space and must be used wisely not to overcrowd the group, Figure 6.20.

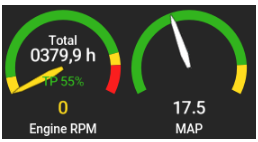


Figure 6.20: Arc examples. Left arc is associated with engine RPM and thus it is a bit special. The right arc shows MAP and is a standard one.

When an arc is associated with the engine RPM parameter, it becomes a bit special as it shows total time and throttle position value over the same arc.

The total engine time value is shown while engine is not running. It can be also shown on demand for about 10 seconds by touching the arc. When throttle position information is available, it is shown slightly below the needle center.

In the case of Rotax iS engines, the throttle position also changes color for easier engine start. The color depends on oil/coolant temperature. See Rotax manual for more details.

6.4.2.3 Dual Arc

This item combines two parameters into one visual element. Usually it is used in rotorcraft to combine engine RPM with rotor RPM. Figure 6.21 shows two examples. On the left, engine and rotor RPMs are combined. On the right, system voltage and DC current (Amps) are combined. Dual arcs come handy where bars would be boring and arcs would use too much space.

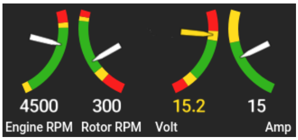


Figure 6.21: Dual arc examples.

6.4.2.4 Fuel Level

Fuel level shows one or two vertical bars, depending on how many fuel tanks parameters were configured. There is a small confusion here as fuel tank parameters are not directly connected to fuel tank sensors and fuel tank calibration shapes. Fuel level item here only takes a look at fuel tank parameters and ignores others.

For the time being, up to two fuel tanks are supported. Also, fuel level item can only appear in horizontal groups.

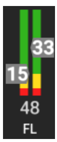
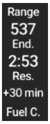


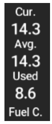
Figure 6.22: Fuel level bars example.

6.4.2.5 Fuel Computer

Fuel computer combines five different parameters into one item. Figure 6.23 illustrates the case. As the space is limited, it is organized into two sets. The first set contains range and endurance with reserve, while the second set contains current fuel flow, average fuel flow and used fuel.



(a) First set.



(b) Second set.

Figure 6.23: Fuel computer example.

Fuel computer shows one set for about 10 seconds and then it switches to another set. A touch on the fuel computer will change the set immediately.

6.4.2.6 Designation

Designation is usually a registration number. An example is shown in Figure 6.24. A designation is entered by the `User options | Settings | User | Aircraft designation` command.

Figure 6.24: Designation marking example.

6.4.2.7 ECU status

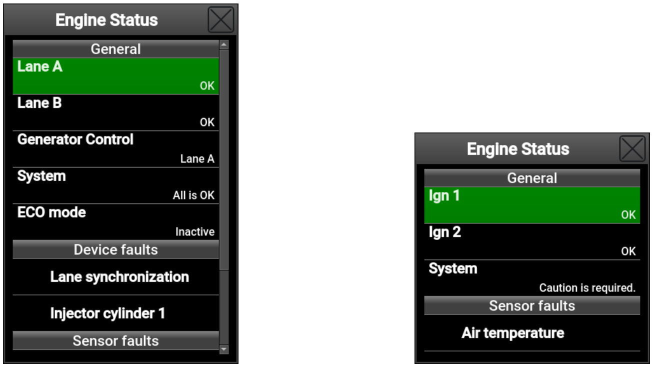
Rotax iS and ULPower engines are equipped with ECUs, which are sending their general status all the time. This status can be shown on screen in a form of two check lights and a short status string.

The official engine documentation on ECU/engine status is very sparse. We tried our best to decode the information. In the case of any caution or warning, do not relay on our information or our interpretation. Always consult official engine service facility and official engine documentation.

A touch on the status area opens a window with more detailed information.

(a) Rotax iS (b) ULPower

Figure 6.25: Engine ECU status examples.



(a) Rotax iS (b) ULPower

Figure 6.26: Engine ECU detailed status examples.

6.4.2.8 Stretch space

`Stretch` space is a special, dynamic item which adapts its size automatically. It is used to visually separate items like bars, arches.

Each stretch is associated with a `stretch factor`. The default factor value is 1 and in most cases you do not need to change it. However, a larger value can be assigned. A larger value means a more greedy stretch. For example, if there are two stretch spaces used, one with factor 1 and the other with factor 2 and they both have to accommodate for 90 pixels, the stretch with factor one will get $\frac{1}{1+2} \times 90 = 30$ pixels, while the greedy one (factor 2) will get $\frac{2}{1+2} \times 90 = 60$ pixels. Don't let the math to confuse you, experiment instead.

Let's take a look at few examples, Figure 6.27.

Figure 6.27a shows effect when a stretch is placed at the top. It takes all available space and pushes other items to the bottom.

Figure 6.27b does the opposite. The stretch is placed at the bottom. It will

(a) Top only. (b) Bottom only. (c) Top, bottom. (d) Variable.

Figure 6.27: Some examples of stretch placements.

take all the space at the bottom and two remaining items are pushed to the top.

Figure 6.27c has two stretches: one at the top and one at the bottom. They both have the same default value. They share the available space equally, which places other items to the center.

Figure 6.27d is using three stretches.The top and bottom stretches have their value set to 2 and the middle stretch is set to value 1. Thus, the top and bottom stretch take more space than the middle stretch.

These illustrations were done on a vertical group. Similar effects are obtained in horizontal group, where items are pushed left or right instead.

6.4.2.9 Fixed space

This items inserts a fixed amount of pixels between two elements. It is useful, when you want to precisely control some space between two items.

6.4.2.10 Group

`Group` is a special item, which creates a new group within the parent group. It is often called a sub-group. When a parent group is horizontal, then a sub-group is vertical and vice versa. Figure 6.16 on page 113 illustrates a sub-group used in a horizontal group where items in the sub-group are distributed vertically.

A touch on a sub-group item will start editing the selected item directly. Press the `Close` button once or twice in order to select a sub-group instead.

For the time being a sub-group can't have additional sub-groups.

6.4.3 Delete

Selecting the `Delete` command from the menu removes currently selected item. See Figure 6.17 on page 114 for the illustration.

6.4.4 Edit

Selecting the `Edit` command opens a new window where selected item can be edited. The window depends on the item type. Note that some items do not support this option.

6.4.4.1 Bar and Arc

Bars and arcs are associated with one parameter only. The `Edit` command opens window as shown in Figure 6.28. It has two options:

`Select parameter` allows for parameter selection. This is a two step selection. First a group is selected, then a parameter within the group.

`Edit parameter` is used to change some parameter settings. Usually parameter color ranges are changed or parameter names.

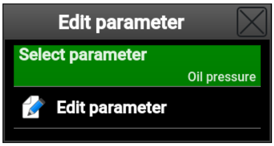


Figure 6.28: Parameter editing window.

6.4.4.2 Dual Arc

Dual arc is nothing but a combination of two arcs. Hence two parameters are associated with it. In principle editing is similar to arc and bar, where a left or right parameter (arc) must be selected first, Figure 6.29. Once the parameter is selected, it follows the logic of Section 6.4.4.1.

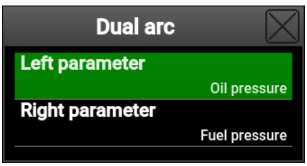


Figure 6.29: Left or right parameter/arc must be selected first.

6.4.4.3 Stretch

Stretch factor can be adjusted. Default factor is 1 and it usually gives good results. If you feel that certain stretch requires more space, you can increase its factor, Figure 6.30.

Figure 6.30: Stretch factor editing.

6.4.4.4 Space

Fixed space is defined in screen pixels and the exact amount can be prescribed. Figure 6.31 illustrates an example.

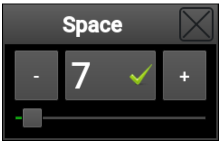


Figure 6.31: Fixed space editing.

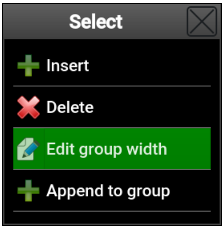
6.4.4.5 Group

When a sub-group is selected without any of its internal item being highlighted, the `Edit` command allows for the group resize. The group size is defined as percentage of parent width or height. This depends on the parent orientation.

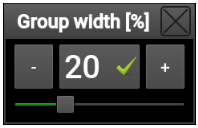
6.5 Gauge Editing

Classic and engine screens contain several gauges. These gauges can be edited quite in detail to meet different needs.

Gauge editing starts in a windows similar to examples shown in Figure 6.33. For the illustration, actual gauges that belong to these windows are shown on the top.



(a) Edit on group.

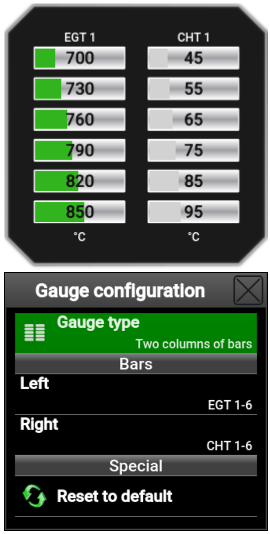


(b) Group size is specified in percentage of its parent.

Figure 6.32: Editing a group width.

(a) Airspeed.

(b) Electric, CO as scales.



(c) Temperature as bars.

Figure 6.33: A few examples of gauge editing windows on the bottom and their correspond gauges on the top.

A gauge configuration window has three major elements:

- `Gauge type` defines basic shape of a gauge. More than a dozen shapes are available and more are expected to be added in the future. Please note a symbol on the left. It mimics the basic underlying shape of the gauge.

- A list of `Scales`, `Value boxes`, `Bars`, `Fuel` allows for parameter selection and customization. These lists and their elements vary on a gauge type.

- `Reset to default` is a command, which resets the gauge type and associates list values to default settings for this particular gauge. The default settings depend on the screen, current parameter values and gauge position on the screen. It ignores parameters currently used by the gauge and takes all *enabled* parameters into consideration.

6.5.1 Gauge Type

A gauge type defines a combination of scale arcs, value boxes, bars and fuel elements. They are listed in the following table. The first few options are a bit special, as they only allow for a limited customization.

`Altimeter` is a gauge which corresponds to a classic altimeter. It combines the main scale and the baro-correction value box. It only allows limited customization – the `user title` for the main scale and the baro box.

`Airspeed zero on top` corresponds to a classic indicated airspeed indicator whose zero speed scale starts on the top. In addition it also has a value box for true airspeed. It allows for limited customization of user defined titles for the scale and the value box.

`Airspeed zero on bottom` corresponds to a classic indicated airspeed indicator whose zero speed scale starts on the bottom. In addition it also has a value box for true airspeed. It allows for limited customization of user defined titles for the scale and the value box.

`Vertical speed` corresponds to a classic vertical speed indicator. It is combined with the acceleration value box. It allows for limited customization of user defined titles for the scale and the value box.

`Scale` defines a gauge with only one scale arc spanning over complete gauge. The scale can show any active parameter.

`Scale, box` defines a gauge with one scale arc spanning over complete gauge combined with a value box on the bottom. The scale or box can show any active parameter.

`Scale, two boxes` defines a gauge with one scale arc spanning over complete gauge combined with two value box on the bottom. The scale or boxes can show any active parameter.

`Scale top, bottom` defines a gauge with one scale longer arc spanning on top and one shorter arc on the bottom. Scales can show any active parameter.

`Scale left, right` defines a gauge with two symmetric scales, one on the left and other on the right side. Scales can show any active parameter.

`Scale left, right, box` defines a gauge with two symmetric scales and additional value box on bottom. Scales and box can show any active parameter.

`Three scales` defines a gauge with two symmetric scales combined with a scale on the bottom. Scales can show any active parameter.

`Scale left, bars` defines a gauge with a scale on the left side and a set of horizontal bars on the right side. Scale and bars can show any active parameter.

`Bars, scale right` defines a gauge with a set of horizontal bars on the left and a scale on the right. Scale and bars can show any active parameter.

`One column of bars` defines a gauge with a centered set of horizontal bars. Bars can show any active parameter.

`Two columns of bars` defines a gauge with two sets of horizontal bars. Bars can show any active parameter.

`Scale, fuel` defines a gauge with a scale on the left and a fuel group on the right. The scale can show any active parameter, but the fuel group is bound to fuel level. The shape of the fuel group depends on the number of tanks in use. If only one tank is in use, some other gauge type may give better results, `Scale left, right` for example.

`Two scales, fuel` defines a gauge with a two scales on the left (top, bottom) and a fuel group on the right. Scale can show any active parameter, but the fuel group is bound to fuel level. The shape of the fuel group depends on the number of tanks in use. If only one tank is in use, some other gauge type may give better results, `Three scales` for example

`Rotor scales, boxes` defines a special gauge usually used by rotorcraft mostly. The left scale and left value box are usually set to the same parameter. The same is true for the right scale and the right value box. Boxes 1, 2, 3 correspond to the left, central and right boxes, respectively. Left and right boxes do not have a title as they are usually related to the corresponding scale.

6.5.2 Scales, Value Boxes, Bars

Each `Gauge type` has its own set of scales, value boxes and bars. Each of these is then associated with a parameter and an user name. These can be further edited in more detail. Bars are slightly special and are covered in Section 6.5.2.1.

Selecting a scale, value box or bar item opens a window similar to an example shown in Figure 6.34.

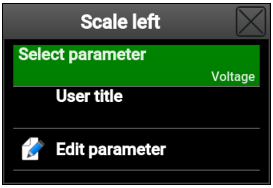


Figure 6.34: Editing a scale. Value box works in the same way.

`Window title` tells which element of the scale is being edited. For example, Figure 6.34 shows that the *left scale* is being configured.

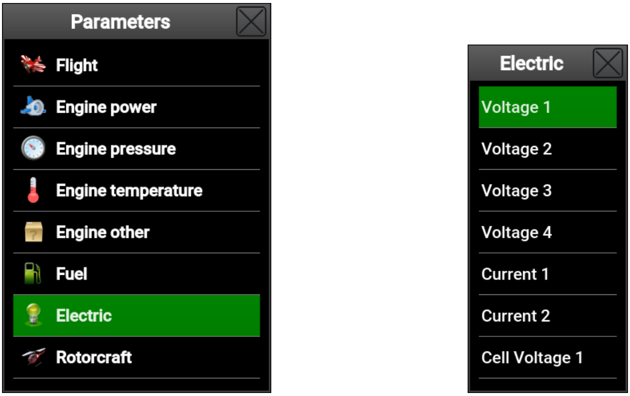
`Select parameter` allows selection of the parameter to be shown for a scale, a value box or a bar. In some special cases such selection is not possible (airspeed, altimeter, vertical speed gauges). As there is a lot of parameters to chose from, the parameter selection is made in two steps – first a logical group is selected and then a final parameter. Figure 6.35 illustrates an example. Please note, that a parameter can appear in more than one group.

`User title` allows user defined parameter name. When this is left empty, the short name of selected parameter will be shown.

`Edit parameter` opens editor window for the selected parameter. This can be used to change parameter color bands, parameter names and some attributes. Please note that these parameter changes are global. They will affect any other visual element in Nesis that depend on this parameter.

6.5.2.1 Bars

Bars behave in a very similar way as `scales` and `value boxes` with one exception – they are handled as a group itself. In most cases there is not a single bar, but a set of bars. Each bar may belong to a different parameter, while certain



(a) Select group first. (b) Parameters within a group.

Figure 6.35: A parameter selection example. A group is selected first and a parameter afterwards.

bars belong to the same parameter but with different index (EGTs, CHTs, for example).

As bars act as a group, there is an intermediate window, which handles such group – a parameter can be added, removed to a group or being edited.

Figure 6.33c shows an example of a bar group, which consists of six EGT values. These EGTs belongs to the same parameter, but each has a different index 1,2 . . . 6.

A selection of a bar group opens a window. An example is given in Figure 6.36.

In order to add a parameter, select the `Add` button. This opens a window for parameter selection. The selected parameter will be then added to the list.

Nesis does not allow you to use more than eight items in a bar group. When more than eight items are used, bars become very small and visual result becomes sluggish.

A selection on any of existing parameters opens a window where parameter details can be edited. In principle this is identical to section 6.5.2 from page 126 with two extra options:

`Index` appears only for CHT and EGT parameter types. Namely there may be several EGTs and CHTs in use for one engine. They all belong to the same parameter (EGT/CHT), but with different index.

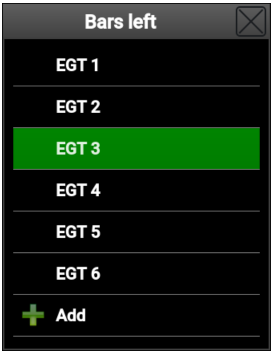


Figure 6.36: Parameter in one bar group. In this case they all belong to the same EGT parameter, but each with a different index.

`Delete` is used to remove this parameter-index pair from the bar group.

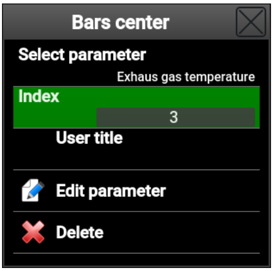


Figure 6.37: EGTs and CHTs get extra options – index selection and delete.

Let's observe a change that appears when different parameter types are mixed in a bar group. Example in Figure 6.33c shows six EGTs in a group. Let's add a `Placeholder` and then edit the placeholder into `Manifold pressure`. After this change the gauge appearance changes as it is illustrated in Figure 6.38. As long as all bar items belong to the same parameter (pure EGT or pure CHT case), they are combined together and individual titles are omited. But after they are mixed each one gets its own title.

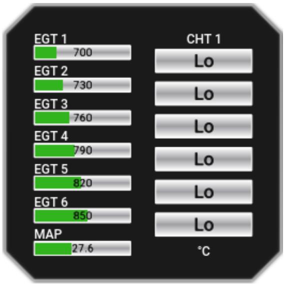


Figure 6.38: A change of appearence after `MAP` was added to the group.

6.5.2.2 EGT And CHT Scales

The scales were already covered in Section 6.5.2. However, there is an exception for parameters that support indices (EGT, CHT). In this case one scale can show several needles where each needle corresponds to different index.

All handling is very similar to bars with a limitation to one parameter only, but with several needles. When scale parameter is selected and when parameter type is EGT or CHT a window appears allowing to add additional needle using the `Add index` command, Figure 6.39.

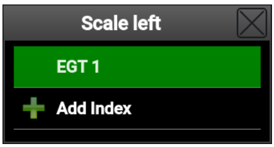


Figure 6.39: Adding a second needle for the same parameter. EGT and CHT only.

An example with two scales both having two needles per scale is shown in Figure 6.40.

Please note that you can't define arbitrary index. Index is bound to number of max indices that can be used with EGT or CHT. This value is defined as `Count` in the parameter editor, see Section 5.5. Let's take Rotax 912 ULS engine for example. It has two CHTs (or CTs) one is located on cylinder 1 and the other on cylinder 3. In this case, you set `Count` to 2 and then you can only use indices 1 and 2. You can not use indices 1 and 3. The same is true for EGTs.

Please do not use a trick where one would set `Count` to 3 and then add indices 1 and 3 only on the scale and connect CHT 1 and CHT 3 sensors only. Such

Figure 6.40: Two scales, both with two needles.

trick will leave index 2 (CHT 2) undefined. The Nesis alarm system will expect all three temperatures properly defined but CHT 2 is missing and you may get false alarms or no alarms at all. In addition, three bars will be shown on the modern page, which is not what you probably want.

Chapter 7

Maintenance

Nesis 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 4.11.

7.1 Pitostatic Test

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

7.1.1 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.

7.1.2 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.

7.2 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!

7.2.1 Oil Pressure

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

7.2.2 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.

7.2.3 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.

7.3 Service

Nesis 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.