Nesis III User's Manual

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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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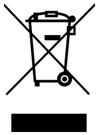

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Third Party Licensing

Nesis software is using the *Qt Library* published by *The Qt Company*. The LGPLv3 license version is used. Please refer to the License section on page 133 for more details.

Revision History

The following table shows the revision history of this document.

Date	Description
Sep 2018	Complete manual rework to match software version 3.3
Jan 2019	SW 3.4: GNSS Constellation window added, CTR is shown filled, UL Power, MWFly engine, Trig radio, Eagle Flarm, AIR Traffic support, GSA added to standard NMEA output, parameter editor enhancements, bug fixes.
Mar 2020	SW 3.6: New traffic message, various counters in info, removing unnamed waypoints, engine only logs, improved Rotax iS support, CAS support, WiFi GDL90 support, bug fixes.
Oct 2020	SW 3.7: New route planning page, wired GDL90 support, trim positions on all screens, METAR reports interpretation, bug fixes.
Apr 2022	SW 3.9: Approach chart capability, many minor fixes and improvements.
Oct 2022	SW 3.10: Screen editor, parameter storage and transfer, synchronization, new average fuel flow model, many minor fixes.

Contents

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 the manual before using Nesis. The introduction chapter contains some general information about the instrument and principles of the operation. Later chapters describe Nesis use and reveal the details. You may be also interested in reading:

- Nesis Installation Manual,
- DAQU or miniDaqu Installation Manual,
- MAGU Manual,
- Approacher User and Installation Manual,
- Autopilot Installation Manual
- our web page www.kanardia.eu.

1.1 Icons Used Trough the Manual

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

This icon denotes information that needs to be taken with special attention.

This icon denotes background information about the subject.

This icon denotes a tip.

This icon denotes a touchscreen action.

1.2 Warnings

The following warnings and limitations apply, when you use this instrument. Failing to do so, may result in significant injuries or even death.

- Before using the instrument, you shall carefully review and understand the Nesis system and Operating Handbook of the aircraft.

- Information from the Aircraft Operating Handbook always supersedes Nesis information.
- Use of any navigational data contained by Nesis is entirely at the pilot's risk.
- Carefully compare Nesis navigational information with other available navigational sources. In the case of any discrepancies, resolve them before proceeding with the navigation.
- The navigational data used in Nesis comes from various public domain and open data sources. Although the data was carefully crosschecked (where this was possible), the data may contain serious errors. The pilot is obliged to verify any navigational information provided by Nesis, with the relevant official sources, AIPs, Notams, etc.
- Databases in Nesis must be updated regularly in order to stay current. Such databases are freely available from our web site.
- Terrain elevation data shall not be used for terrain separation. Its use is informative only. The pilot must always fly in VFR conditions and he must maintain visual separation.
- Do not rely on the traffic information and traffic warnings shown by the device. It is solely the pilot responsibility to look out, to see and avoid other aircraft. The other aircraft position depicted on the screen may be wrong due to lack of proper equipment, poor reception and inaccurate or old information.
- Do not use weather information for maneuvering in, near, or around areas of hazardous weather. Weather information may not accurately depict current weather conditions.
- Never use Nesis to attempt to penetrate a thunderstorm. Always avoid any thunderstorm at least 30 km.
- The Global Positioning System is operated by the United States government, which solely responsible for its accuracy and maintenance. In a similar way, Russian government is responsible for the GLONASS system. The GNSS systems are subject to changes which could affect the accuracy and performance of all GNSS equipment. Therefore, the navigation information can be misused or misinterpreted and become unsafe.

1.3 Cautions

- The Nesis display uses special coating, which is sensitive to abrasive cleaners or cleaners which are using strong chemicals like ammonia or alike. Always use a lint-free soft cloth and mild cleaning solution or just pure water.
- Nesis does not have any serviceable parts. Repairs must be done only by authorized service centers. An unauthorized repair could void warranty.
- Due to high complexity of the system, the pilot must accept that providing self-test capability for all possible system failures is not practical. This means that an erroneous operation may occur without a fault indication or warning. This makes the pilot responsible to detect such an occurrence by means of cross-checking with all redundant or correlated information available.

1.4 USB Memory Stick

Many Nesis operations require a USB memory stick. One such stick is provided together with the instrument. You can also use any other USB memory stick as long as:

1. The stick capacity is 32 GB or less.
2. The stick is formatted to FAT32 format.
3. Hint: avoid using top notch high speed sticks. Nesis may have problems detecting them due to the age of underlying Linux operating system.

2 System Overview

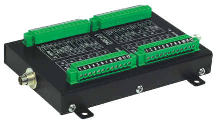
2.1 Components in the Nesis System

The Nesis System consists of several electronic components, which work closely together to bring flight, engine, traffic, fuel,... information onto graphical display. Some of these are required and some are optional.

2.1.1 Required CAN Bus Components

Majority of these components communicate trough CAN bus. This section lists components and explains their interaction. Please note that photos are not in scale.

Nesis master display is the major part of the system. It acts as a primary multi-functional display. Internally it hosts an embedded computer and an AD-AHRS-GNSS module called AIRU. The embedded computer reads information from the CAN bus and translates it into graphics you see on the screen. The AIRU module consists of multiple sensors: absolute pressure sensor for altitude and vertical speed, differential pressure sensor for airspeed, 3 axis angular rate and 3 axis accelerometer sensors for artificial horizon, GNSS sensor for position and OAT probe for true airspeed. Sensor readings are passed trough various mathematical models which in turn put the information on the CAN bus. AIRU is actually an independent device mounted inside Nesis for convenience.



Engine monitoring (called DAQU) is required to read the engine, fuel and aircraft related sensors and to put the obtained information on the CAN bus. It has three digital channels (Z1, Y1 and Y2), twenty analog channels (A, B, C, D) and a special manifold pressure connector (A13). DAQU also hosts +5/+12 V *power output* and ground (GND). Digital channels are typically used to read engine or rotor RPM and fuel flow sensors. Analog channels are typically used to measure CHTs, EGTs, coolant temperature, oil temperature, carburetor temperature, airbox/gearbox temperature, fuel levels, system voltage, electrical current, oil pressure, fuel pressure, hydraulics pressure, pitch trim, flap position and many others.
DAQU comes in three forms:

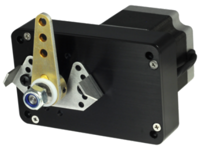
- Standard Daqu is typically used with carburetted engines like Rotax 912 UL, ULS, Rotax 914, Jabiru, Lycoming, Continental, etc.
- Mini DAQU is typically used with an engine that has its own ECU. Rotax iS, D-motor, Geiger Wankel, MW, various electrical motors, etc. Mini DAQU allows for a few additional sensors like Rotor RPM, fuel level, fuel pressure, etc.
- In some cases there is not enough channels on mini DAQU. In this case, standard DAQU modified for an ECU engine can be also used. This in fact works like miniDaqu, but with much more channels. Often used with ULPower engines, for example.

2.1.2 Optional CAN Bus Components or Accessories

Components listed below are all optional. This means they are not required for normal Nesis operation.

Electronic Compass (called MAGU) is a stand alone unit which measures magnetic field vector. It serves as a gyro stabilized compass and provides true and magnetic heading with high accuracy. It features an intelligent calibration algorithm, where only one known magnetic direction is needed to calibrate it. MAGU provides heading information on the CAN bus. With this information available, wind direction and wind speed is also derived by the AIRU unit.

Tail install and nose install versions of MAGU exist.



When two servo units (called SERU) are added to the CAN bus, the system also performs the autopilot function. Two different SERU units are available. Stronger and heavier has 6 Nm (53 in lb) torque, while the lighter and weaker has 3 Nm (27 in lb) torque.

Remote autopilot panel (called AMIGO) brings further enhancements to the autopilot functionality. It allows very simple and straightforward autopilot operation.

One or two remote control handles (called JOYU) can be added to the system. The handle allows almost complete control of the Nesis display with the buttons on the top. Buttons are fully configurable by Nesis. When BOXI unit is also present, it can also drive roll and pitch trim, radio transmission button (push-to-talk).

Trim and radio controller called (BOXI) must be used together with a JOYU handle. You can connect two trim motors to BOXI and then use JOYU handle to drive them. In addition, radio push-to-talk wiring can be made directly to BOXI.

Dimu is a dimming device. Its only job is to adjust LCD brightness of all devices connected to the CAN bus with a simple rotation of the knob. It also provides analogue output for third-party devices.

Small WiFi plug is used to connect Nesis to the WiFi network. This can be done with the help of a network access point created on a mobile phone. Nesis is connected to the Internet as long as the mobile phone is also connected. Alternatively, some public WiFi hot-spot can be also used, while aircraft is on the ground. Such connection can be used to make software updates, map and airspace updates and to access weather information.
Note: Not all WiFi devices are compatible. See the Nesis Installation Manual for more details.

An external carbon monoxide (CO) sensor can be connected directly to Nesis. In the case of elevated CO concentration buildup, a visual and acoustic alarm will appear.

2.1.3 Optional CAN Bus Displays

The system can be extended with several displays. All these displays are optional. They have no internal sensors. They get the information from the CAN bus.

Slave Nesis Display can be added to the system. It has the same functionality as the master Nesis. The only difference is that it does not host the AIRU unit and that some system tuning options are not accessible.

Slave AETOS display with diagonal size 7 inches is very similar to slave NESIS display. The AETOS display does not have touch screen and there are no maps available, however it includes 3D synthetic vision.

A small slave display (called EMSIS) comes in two forms. The first fits into 80 mm standard aviation opening, the second is larger with 3.5 inch diagonal and has more complex shape. They both can be viewed as small EFIS displays. EMSIS can show basic primary flight and engine monitor values.

A rectangular, very slim and very light LCD display (called DIGI) is typically used to show engine values. The values can be shown in the form of arcs, bars, boxes and values. Start of display is very fast. You can read oil pressure almost immediately, while Nesis primary display is still booting.

One or more slave round instruments can be added to the bus. They can show almost any value, which is available on the bus. The most typical are: airspeed indicator, altimeter, vertical speed indicator, engine RPM, rotor RPM, G-meter, etc. All indicators consists of a needle pointing to a scale and a LCD display. Pointer is driven by a stepper motor. Needle shows one value, but LCD display may show up to three different parameters.

HORIS slave primary flight display can complement the Nesis system, too. HORIS can show PDF screen, DI screen or G-meter screen.

3 Display Operation

This section will familiarize you with basic procedures referring to PFD, EMS and moving map operations.

3.1 Display Overview

The Nesis command panel is organized according to Figure 1. It uses three push buttons and one push knob for manipulation. It has an USB port for software, map and data updates. Most actions can be also activated using the touch screen.

Figure 1: Organization of the Nesis display.

Here is a brief description of individual items:

① The touch screen. It works just as touch on tablets and telephones do. It detects single touch, long single touch, multi touch, touch and drag, swipe, pinch.

② The Selector knob detects knob rotation, short push and long push. It is mostly used to select things, confirm selection, change values, change zoom levels, etc. Rotate the knob to select things and push the knob to confirm. Long push action opens the *options* screen.

(3) A short push on the button will perform Close/Back/Cancel commands. It is mostly used to close windows, to go back or to cancel some action. Long push action is user configurable.

(4) The User button. Both, short and long push are user configurable. By default it shows the list of nearest airports. However, when autopilot is detected, the default action opens the autopilot menu.

(5) A short push on the Screen switching button is used to switch to the next screen. Long push action is user configurable.

(6) The USB port is used for software, map and data updates, to copy the flights and logbook, etc.

In most cases you only use the selector knob and the close button.

Short push is defined as a momentarily press and release of the button. An associated action is activated on the release.

Long push is defined as a press-and-hold of the button. Button must be pressed and keep pressed for about two seconds. An associated action will be activated after two second period even if the button was not released yet. Nothing happens on release.

3.1.1 Touch Screen

The touch screen significantly simplifies handling and proves to be very helpful. It behaves in a similar way as most smart telephones and tablets do. Additionally it supports some swipes (gestures) listed below:

- On a map, place two fingers on the screen and pinch in or stretch out. This will zoom the map.
- A swipe across the screen to the left switches to the next screen.
- A swipe across the screen to the right switches to the previous screen.
- A swipe upwards opens the main menu.
- A touch on the navigation point on the main navigation screen activates this point in the direct-to mode. When more points are in the vicinity, a list of points is displayed.

- A touch on the bottom part of the round altimeter opens the baro correction window. A touch on the upper part opens altitude related details window.
- A touch on the classic screen map opens the navigation screen.

The list above is illustrative. More touch actions are revealed throughout the manual.

3.2 Turning ON/OFF

Nesis is connected to an avionics power bus which has a mechanical switch between the bus and the battery. Thus it is automatically turned ON and therefore it does not have an ON/OFF button.

Nesis has a pretty low power consumption. So, you may try to activate Nesis before cranking the engine. This works well in vast majority of cases assuming the battery is in good condition. If Nesis resets during engine start, this may indicate that the battery is becomming weak or some installation problem (long thin power cables or similar).

3.3 Start-up Sequence

When Nesis is powered ON and the program is ready, it opens the start-up window sequence also illustrated by Figure 2:

1. Use the Selector knob to confirm the warning (push the knob),
2. select the pilot,
3. select the instructor,
4. select the baro correction (rotate until correct value is shown and then push the knob),
5. Set the fuel level (for software tanks only – not shown on the figure).

You are asked for the pilot only if more than one pilots are entered into the pilot list and you are asked for the instructor only if at least one of the pilots is also marked as an instructor. Please see the section 8.4 on page 98 to see how to enter pilots and instructors.

Figure 2: Typical start-up sequence.

3.4 Status Bar

Most of the screens show status bar on the top. This bar holds some valuable information. It is illustrated on the Figure 3.

Figure 3: Illustration of the Status bar.

Status bar has the following elements:

1. Outside air temperature.
2. Flight time - time elapsed after takeoff was detected. In the case of traffic patterns, time since the last takeoff (touch-and-go) is shown.
3. Bearing and distance to the next navigation point. (Only when navigation is active.)
4. Estimated time of arrival to the next navigation point. Below is name of the navigation point.

⑤ Steering indicator in the top and current course on the bottom. A yellow line left of the center means that you should steer left and a yellow line right of the center means you should steer right. Steering indicator is pretty sensitive. A flashing yellow line indicates that course deviation is too large to fit onto scale.

⑥ Estimated time of arrival to the destination. Below is the name of the destination. (Only when route navigation is active.)

⑦ Ground speed derived from GNSS.

⑧ Time. A touch on the time element shows sunset time for next 10 seconds.

⑨ Various status symbols. More details are given next.

GNSS Symbols

These symbols show health of the GNSS receiver and reception of the GNSS satellites.

 A flashing red satellite symbol indicates an error. It means that communication with GNSS receiver was lost.

 A grey symbol indicates that GNSS is working, but position is not available.

 A cyan/gray color symbol indicates that only 2D fix is available – position is know, but its precision is limited.

 A cyan color symbol indicates that full 3D fix is available.

 This cyan color symbol indicates that precision of position is further enhanced with some augmentation system (WAAS, EGNOS, etc.)

Flarm Symbols

These symbols appear only when a Flarm device is connected to the Nesis. If none of the symbols is shown, it means that communication was not established successfully.

 A gray Flarm symbol indicates that communication with Flarm device was established, but Flarm is still not ready.

A gray symbol with cyan triangle indicates that Flarm received its own GNSS signal, but Flarm internal radio module is not active/not working.

A gray triangle with cyan arcs indicates that Flarm radio is working, but Flarm GNSS signal is not yet available or Flarm GNSS is not working.

A full cyan symbol indicates that Flarm is working properly.

A flashing red symbol indicates that Flarm has experienced an internal error and it may not be working properly or it does not work at all.

If connection between Nesis and a Flarm device was not established, no symbol apears. This means that either device is not present or it is not working or Nesis does not communicate properly with the device (wrong baud rate, parity, wrong connection, etc.)

3.4.1 GDL90 Devices

When an ADS-B device is connected with Nesis either over WiFi or directly with a cable and GDL90 communication protocol is used, the the following symbols appear.

A gray symbol indicates that communication with device was established, but the device is still not ready.

A cyan symbol indicates that communication with device was established and the device is ready to be used – it is working properly.

A red symbol indicates that device is in errorneous state and it should not be trusted.

If connection between Nesis and a GDL90 device was not established, no symbol apears. This means that either device is not present or it is not working or Nesis does not communicate properly with the device (wrong baud rate, parity, wrong connection, etc.)

Radio and WiFi Symbols

A communication with COM radio device was established.

A WiFi module was detected and communication was established. Note that this does not automatically mean that Nesis is also connected to the Internet. Nesis is connected to the Internet only when the host device (mobile phone) is connected to the Internet.

3.5 Screens

Nesis can show different screens. Typically five screens are shown, but this number is not fixed. Figure 4 shows examples of these screens.

A generic solution will be shown next. Your solution may be slightly or even significantly different. However, principles remain the same.

Figure 4: Typical four screens: 1 – Classic Screen, 2 – Navigation Screen, 3 – Engine Screen, 4 – Modern Screen (AHRS), 5 – Modern Screen (map), not shown in the Figure.

Use short press on the *Screen switch button* to switch between the screens. Or use left or right swipe touch action to switch between the screens.

More details about each screen are given in next sections.

3.6 Classic Screen

The classic flight information screen shows information, which is the pilot's primary concern. The default screen organization follows the recommended IFR T layout (classic six-pack). Figure 5 on page 26 shows an example of this screen. Please note that your screen can be significantly different.

Figure 5: Illustration of the classic flight information screen.

This screen has the following typical elements:

1. Status bar. This bar is shown on the top of most screens. Please refer to section 3.4 on page 22 for more details.

2. The airspeed indicator displays IAS (indicated airspeed) and TAS (true airspeed). The indicator background can display white, green, yellow arc, V_{NE} limit, recommended approach speed and other important speed limits. See also section 3.10.1 on page 41.

③ The artificial horizon indicator provides current attitude and side-slip information. Roll and pitch angle can be read from the top and middle scale respectively. The ball indicates the side-slip. Trim indicators (roll, pitch, yaw) are shown on the right bottom part of the horizon when trim position sensors are connected. Flap position is also possible. A touch on the horizon will toggle between 3D view and standard view. See also section 3.10.2 on page 42.

④ The altitude indicator shows current baro-corrected altitude. It is available in feet or meters. When scale is given in feet, the third needle can be shown as well. It also displays current QNH reference pressure (aka baro-correction). Pressure altitude and other details are accessible when touching the indicator. See also section 3.10.3 on page 44.

⑤ The RPM indicator is combined with the manifold pressure gauge. This combination allows optimal setting of power level. Gyroplanes and helicopters have rotors and in this case engine RPM is usually combined with rotor RPM. See also section 3.10.4 on page 45.

⑥ The moving map provides basic navigation information. It is located below the artificial horizon. The moving map can be configured to follow aircraft true heading, tracking or magnetic heading. This map can be also replaced with a direction indicator (see page 50). A touch on the moving map window will switch to navigation screen.

⑦ The vertical speed indicator. The indicator can be combined with g-meter (acceleration) located below the center.

⑧ The mini engine window organizes important engine parameters into simple colored bars. Each bar corresponds to one parameter and the color of the bar to its current status. See also section 3.10.7 on page 47.

⑨ The fuel computer window provides the fuel and economy information. Level of the fuel in tank, current and average fuel consumption, approximate range and endurance. This monitor can be also replaced with some other windows. See also section 3.10.8 on page 48.

Please note that most of the items in the classic screen are customizable. Please refer to the `Installation` manual for more details.

3.7 Navigation Screen

The navigation screen is a large moving map combined with some additional information. Large compass scale and vertical airspace situation are painted over the map.

3.7.1 Main Elements of the Navigation Screen

Figure 6 illustrates an example and defines the main elements of the screen.

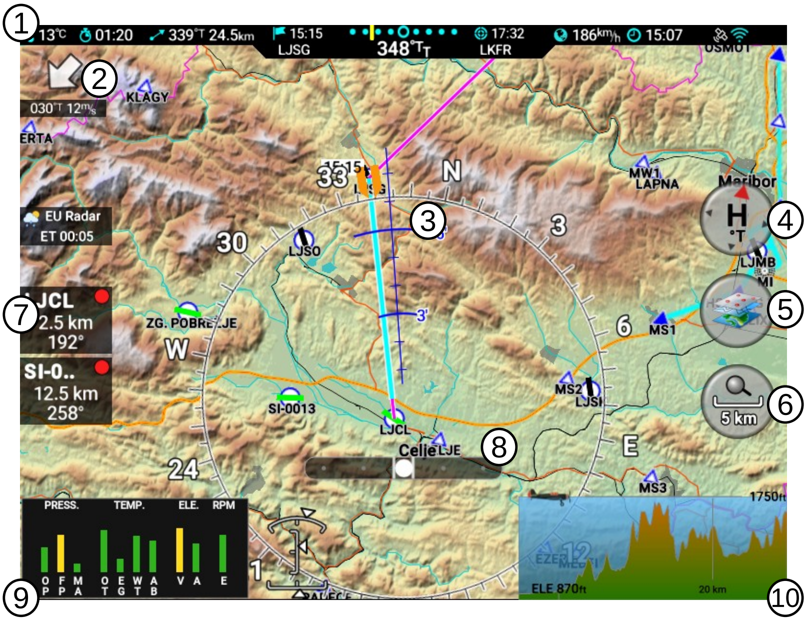


Figure 6: Illustration of the navigation screen.

① Status bar. This bar is shown on the top of most screens. Please refer to section 3.4 on page 22 for more details.

② Wind indication. This indication is available only when MAGU (electronic magnetic compass) is also present on the CAN bus. Depending on the settings, the wind indication may be hidden when calculated windspeed is below some threshold. See also section 8.3.4.

(3) A large compass rose over the map gives directional awareness. A tracking projection line with time arcs defines future position of the aircraft in minutes. This tells predicted position assuming that current ground speed and tracking remain the same.

A long touch on the compass rose will set the heading bug. If autopilot was engaged, this also sets new target heading for the autopilot.

(4) The map orientation button. It shows the orientation of the map – red arrow points to the North. A touch on the button changes orientation in sequence: Tracking up, Heading up (only when MAGU is present), North up.

(5) Map layers button. A touch on this button opens a window, where map layers and other map details are manipulated.

(6) Zoom scale button. The horizontal bar on the button defines a reference distance on the map. A touch on the button returns zoom to a default level.

(7) Two nearest airfields are shown: name of the airfield, distance and bearing. Green dot tells that airfield can be safely reached in the glide mode above minimum safe altitude, yellow dot tells it may be reached, but not above minimum altitude and red dot tells it can't be safely reached in the glide mode.

The glide calculation does not take terrain and wind into account. This means that you can see green dot, but the airfield is not reachable, due to high terrain or strong headwind.

A long touch on this area opens the nearest airfield window. Here you can see more then just two nearest airfields.

(8) Side slip indicator.

(9) The mini engine window organizes all most important engine parameters into one simple colored bar based map. Each bar corresponds to one parameter and the color of the bar to its current status. This window can be also hidden, see section 8.3.5.

(10) Terrain vertical profile window. The profile is always shown in the tracking direction – in the direction of the blue prediction line. The window also shows current baro-corrected altitude. A touch on the window makes it larger/smaller. This window can be also hidden, see section 8.3.5.

3.7.2 Moving the Map Around

A long-touch action on the map puts the map into pan mode. It also adds a home button symbol on the map and remove all unnecessary elements. Once the map is in the pan mode, it can be easily moved around. Figure 7 shows an example.

We recommend that you do not start the *long-touch* near the compass rose or near other windows as you may trigger some different action.

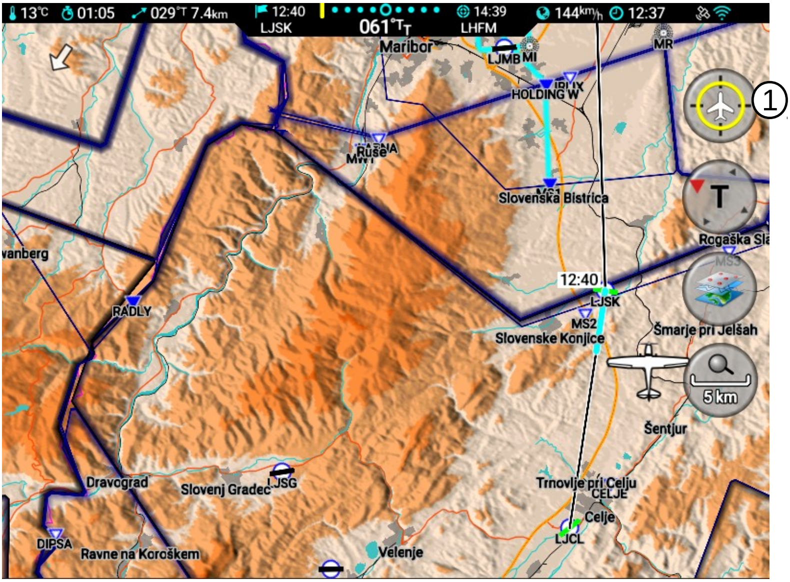


Figure 7: Illustration of the navigation screen in the pan mode.

A touch on the home button, marked as 1 on the Figure 7, brings back the standard navigation map.

3.7.3 Open Flightmap Association and Map Details

A large part of aeronautical information is obtained from the Open Flightmaps Association or OFM in short. Please visit `openflightmaps.org` home page for more details. The page also list the countries for which information is available.

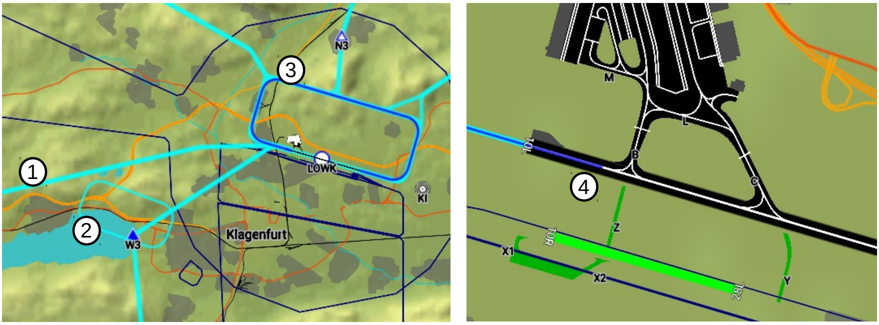


Figure 8: Example of OFM details.

OFM provides quality information for airspace structure (airspace zones), navigation points, airfield information, frequencies, transit, arrival and departure routes, holding zones, traffic circuits. Some of these countries have a very good coverage with a lot of details. Wherever such details are available, they are included in the Nesis. Figure 8 illustrates two examples.

1. Transit lines to holding and traffic circuit.
2. Holding.
3. Traffic circuit.
4. Runway and airfield details with taxiways and platforms.

3.7.4 Weather Overlay

When Nesis is equipped with a WiFi module and it has a live access to the Internet (EU only) or when it is equipped with an ADSB receiver supporting GDL90 protocol (US only) a weather overlay is shown over the base map. The transparency of the weather can be adjusted.

The weather overlay can be turned off by setting transparency to 0%.

3.7.5 Approach Maps

Nesis automatically shows approach maps as an overlay over the base map. A special desktop application called `Approacher` is used to prepare approach

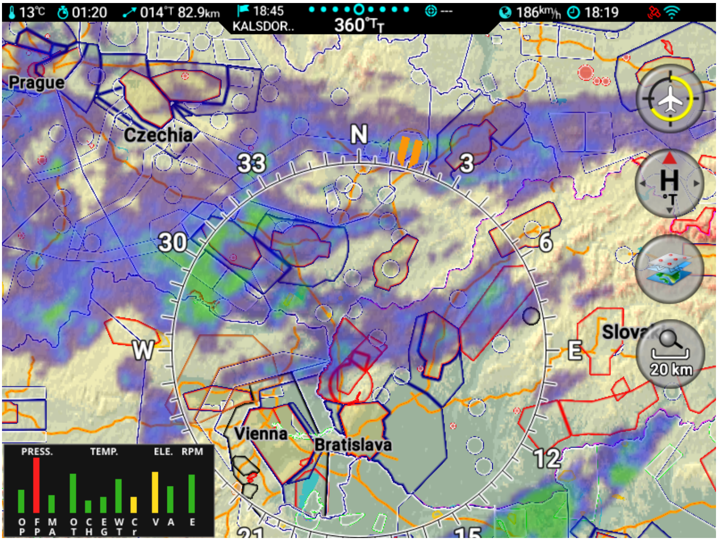


Figure 9: A weather overlay example.

Figure 10: Approach map overlay example for the LJPZ airfield.

maps from various sources. Anyone can prepare his own set of approach maps. Figure 10 shows one such example for the LJPZ airfield.

The application is accessible from our web site for Windows, Mac and Linux systems. Visit `www.kanardia.eu` and select `Support|Software`.

Furthermore, you may also try special online version of the app that runs in a web browser (Chrome, Firefox, etc.) Select the `APPS|Approacher` section on our home page and start working. It runs slightly slower than native apps, but it does not require any installation – just click and run.

There is a separate manual dedicated to the Approacher app, which provides step by step instructions of the map creation process. Select `SUPPORT|Documentation` section on our web.

See also sections 8.10, 13.4 for more details on how to copy maps, toggle their appearance or how to remove them.

Approach maps can be turned off by setting their transparency to 0%.

3.7.6 Map Layers And Details

The map shown on Nesis consists of several layers and details which are drawn on top of each other. Please refer to section 13.1 for more details.

Certain map layers can be enabled or disabled and some of them can be tuned. Touching the map layers button (Figure 6, option (5)) opens a window shown in Figure 11.

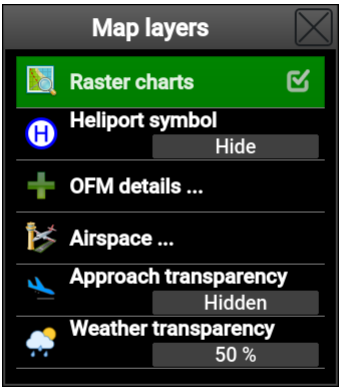


Figure 11: The Map layers window.

This window allows for quick access to various map options.

`Raster charts` This option toggles the visibility of the raster chart layer. When raster charts are not present, the command is ignored.

`Heliport symbol` allows to show, adjust or hide various heliport symbols that appear on the map.

`OFM details ...` opens a new window, where various OFM specific details are tuned. See section 3.7.7.

`Airspace ...` Opens a new window, where visibility of airspace zones can be defined. See section 3.7.8 for more details.

`Approach tranparency` is used to adjust the transparency of approach map overlay. A 0% means fully transparent (invisible) and 100% means opaque.

`Weather tranparency` is used to adjust the transparency of weather overlay. A 0% means fully transparent (invisible) and 100% means opaque.

3.7.7 OFM Details

This window mostly holds toggle options, which turn certain layer on or off. Colored lines left of the text show how these item appear on the map, Figure 12.

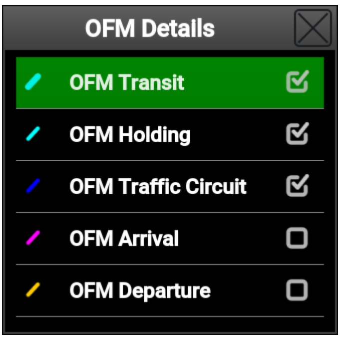


Figure 12: The Map layers window.

`OFM Transit` This option toggles transit routes defined in the OFM database. The transit routes are typically used to define a way trough TMA into CTR or into CTR holding.

`OFM Holding` This option toggles the holding patterns.

`OFM Traffic Circuit` This option toggles the traffic circuits.

`OFM Arrival` This option toggles the arrival route. They typically define a route into traffic pattern.

`OFM Departure` This option toggle the departure route.

3.7.8 Airspace Filter

Airspace zones appearance can also be tuned. Airspace structure can be quite complex and it can be difficult to understand in a top down view. In order to improve readability, some airspace zones can be filtered out. Figure 13 illustrates an example of airspace filter.

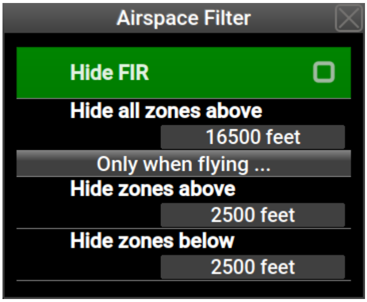


Figure 13: Dialog showing settings for the Airspace Filter window.

The following options are available:

`Hide FIR` When enabled, this option hides all airspace zones with the FIR attribute.

`Hide all zones above` unconditionally hides all zones, which bottom starts above specified value. Use this to hide some (typically A and B class) airspace zones, which are mostly used by the IFR only traffic. For example, if you never fly above 8000 feet, you can set this value at 10000 feet.

`Hide zones above` During flight, all zones whose bottom is more then specified distance above current flight altitude, will be hidden. This changes dynamically with the current aircraft altitude and with time. For example, when you fly at 4000 feet and this value is set to 2000 feet, all zones with the bottom above 6000 feet will be hidden. If you then descend to 1000 feet, all zones starting above 3000 feet will be hidden.

`Hide zones below` During flight, all zones whose top is more then specified distance below current flight altitude will be hidden. Again this changes dynamically with your current altitude.

3.8 Engine Screen

The engine monitoring screen displays classic round indicators of various engine and fuel related parameters. Round indicators are highly configurable and they may be adjusted to individual needs.

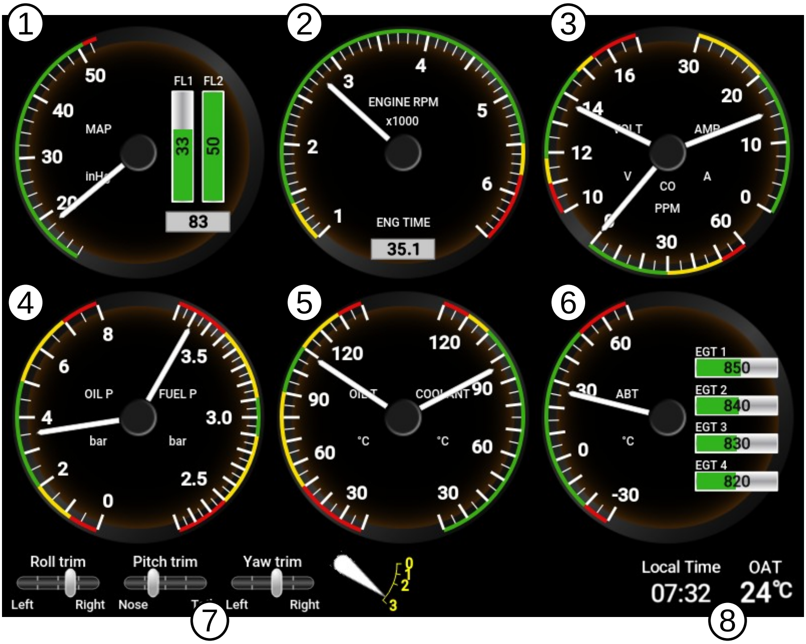


Figure 14: Example of the engine screen, your case may be different.

Figure 14 shows some of possibilities.

1. Combination of MAP arc, two fuel level bars and a frame for total fuel level.

2. One arc used for engine RPM and a frame used for engine total time.

3. Three arcs with single center used for ampere-meter, voltmeter and CO level.

4. Two arc used to show oil and fuel pressure.

5. Two arcs used to oil temperature and coolant temperature.

6. Single arc airbox temperature and four horizontal bars for EGT.

7. Roll, pitch and yaw trim indicators together with the flap indicator.

8. OAT – outside air temperature indication and local time.

Note that the engine screen does not show the status bar on the top on the Nesis III 8.4 model.

Please note that all six gauges on the engine screen are customizable. Please refer to the Nesis Installation Manual for more details.

3.9 Modern Screen

The modern screen combines big artificial horizon and other primary flight indications with engine monitor part.

The engine part of the screen is completely configurable. The illustration here shows a typical situation. Yours may be significantly different. Please refer to the Nesis Installation Manual for more details about how to configure the engine part.

1. Status bar. Please refer to section 3.4 on page 22 for more details.

2. Airspeed tape. Indicated airspeed is shown in a form of moving tape. Current IAS value is emphasised. ground speed and true air speed are available at the bottom os the tape. In addition, various V speeds are also shown in the form of small tags.

3. Vertical speed scale.

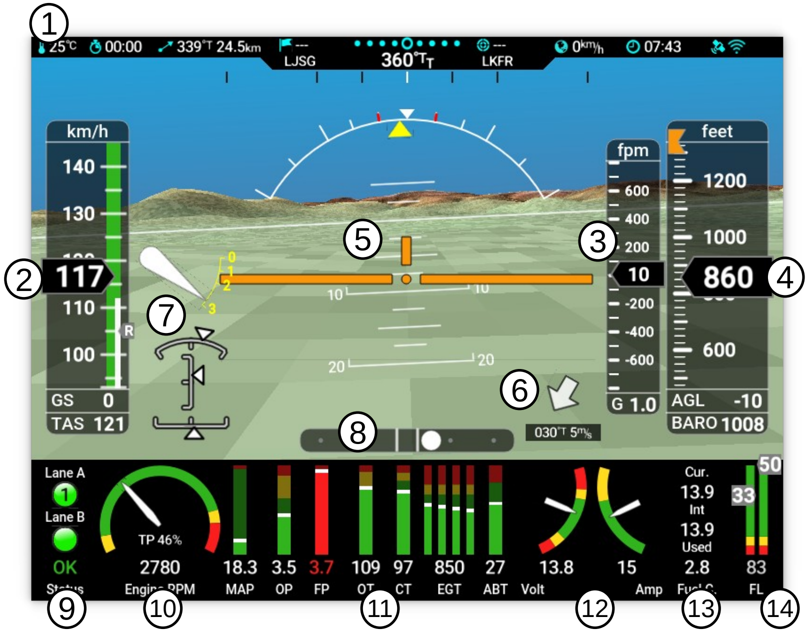


Figure 15: Illustration of the modern screen.

(4) Altitude tape. A height above ground level (AGL) and current baro correction value are shown at the bottom. Altitude bug is shown in orange.

A touch on the upper part of the altutude section opens the altitude details window, see Section 3.10.3. A touch on the buttom part opens baro correction the baro correction window. A long touch opens the altitude bug window. When autopilot is connected it also sets new AP target altitude.

(5) Attitude indication of pitch and roll. Roll scale has dash markings at 10, 20, 30 (long), 45, 60 (long) degrees. Long pitch scale line has number at side, medium line refers to a 5 degree step and short line is 2.5 degree step. Red dashes represent target roll at given speed in order to maintain the standard turn.

(6) Relative wind indication. Wind direction and speed are shown below[1].

[1] The wind indication is shown only when MAGU is connected to the CAN bus.

Windspeed indication may depend on the windspeed threshold, see also Section 8.3.4.

(7) Flap indication and trim indications.

(8) Slip indication.

(9) Engine status information for Rotax iS and ULPower engines. Number in the status light tells which generator is in use (Rotax iS). See also Section 6.

(10) Engine power section, RPM arc with totalizer and manifold pressure. During flight, the totalizer is not shown. A touch on the RPM arc will show totalizer for a couple of seconds. Throttle position is also shown when available.

(11) Various vertical bars for engine pressures and temperatures. When multiple sensors are used for the same parameter (EGT, for example) all bars are shown and the highest value is given below. If there is enough space, then the lowest value is also shown.

(12) Combination of two arc. Here it is used for voltage and current, but any other parameter can be also used instead.

(13) Fuel computer values. The indication changes every few seconds between two sets. The first set shows fuel consumption and fuel used, the second set shows range and endurance. A touch on this toggles between sets.

(14) Fuel tank combination. Left and right tank and sum of both below.

Please note that all items in the engine section (9 –14) are customizable. Please refer to the `Installation` manual for more details.

3.9.1 Modern Screen with Moving Map

There are two *modern* screens. The first one has an AHRS for the background like shown in Figure 15. The second one has a moving map for the background, an example is given in Figure 16.

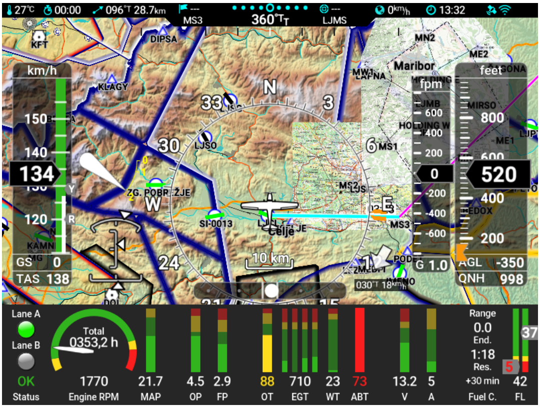


Figure 16: A moving map variant of modern screen.

3.9.2 Video

When Nesis is equipped with video source, then the modern screen with AHRS background also shows video image in the corner. This video image can be enlarged (over most of the screen, as shown in Figure 17) or shrinked to the corner with a simple touch on the video image. Video can be also disabled.

Figure 17: Video example over most of the screen.

3.10 Screen Elements

Nesis screens have several different elements that can be combined into one screen. Each of these elements have some specific features.

3.10.1 Airspeed Indicator

The airspeed indicator is used to display indicated and true airspeed. Indicated airspeed (IAS) is obtained from differential pressure sensor. The measured differential pressure (the difference between the total pressure and the static pressure) is converted into velocity assuming ISA conditions[2]. When outside temperature is known, true airspeed (TAS) is given as well. The scale has several markings as you can see in Figure 18.

Figure 18: An airspeed indicator example optimized for an aeroplane using two step landing flaps.

The markings on the figure have the following meanings:

1. IAS (indicated airspeed) is presented by a needle, which starts at centre and ends at scale markings.

2. TAS (true airspeed) is shown as a number inside the window.

3. The white range is the normal range of operating speeds for the aircraft with flaps extended as for landing or take off. Depending on the aircraft, the white range may have additional upper speed limits, which are

[2] ISA – International Standard Atmosphere

based on flap extension step. See also V_{FE1} and V_{FE2}. For a helicopter operation, the white range may be used for the autorotation optimal speed.

4. The green range is the normal range of operating speeds for the aircraft without extended flaps. The lower limit of the green range is also referred to as V_S – stall speed or minimum steady flight speed at which the aircraft is still controllable. The upper limit is also referred to as V_{NO} – maximum structural cruising speed.

5. The yellow range is the range in which the aircraft may be operated in smooth air, and then only with caution to avoid abrupt control movement.

6. V_{NE} (velocity never exceeded) – red-line mark indicates the maximum demonstrated safe airspeed that the aircraft must not exceed under any circumstances.

7. Units used for the indicated and true airspeed.

8. Optional V_{Ref} (yellow triangle) – landing reference speed, which is the recommended speed used on landings.

9. Optional V_Y speed (blue mark) – speed which results in the best rate of climb.

10. Optional V_{FE1} and V_{FE2}. When both are used, a white dot indicates a speed where first degree of flap can be used. The full flap extension speed limit is represented by V_{FE2} and it should in principle match end of white arc.

3.10.2 Small Attitude Indicator

The attitude indicator, also known as artificial horizon (AHRS), is used to inform the pilot on the orientation of the aircraft relative to earth. It indicates pitch and roll[3]. Figure 19 illustrates the attitude indicator combined with the inclinometer (ball).

The following markings are found on the indicator:

[3] Roll is also known as bank. The term bank is often found in literature but we prefer the term roll.

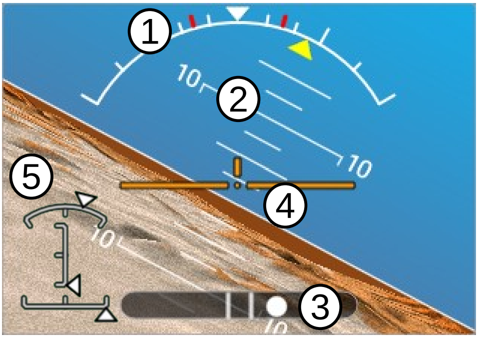


Figure 19: Attitude indicator combined with the slip – skid indicator.

(1) The roll scale is used to give a rough estimate about the roll value. The roll arrow in the form of yellow triangle is used to mark current roll value on the scale. The white triangle on the scale identifies zero roll. Two short dashes identify 10° and 20° roll. Larger dash is used for 30° roll, next short dash for 45° and final longer dash for 60°.

During flight, two orange markers identify the roll required to keep standard turn rate. Please note that turn rate marker position depend on the airspeed and they move as speed is changed.

(2) The pitch scale gives a rough estimate about current pitch angle. The scale should be read at the middle point of the yellow wing reference line.

(3) The slip-skid indicator, also known as the ball or inclinometer, indicates the coordination of aileron and rudder.

(4) The orange wing reference line is fixed and represents the horizontal reference line of the aircraft.

(5) Trim position indicators.

(6) Flight director guide lines (blue) are shown when autopilot is operating. Note: This is not shown in the Figure.

A touch on the background toggles between standard view and 3D view.

3.10.3 Altitude Indicator

The altitude indicator, also known as altimeter, is used to measure the atmospheric pressure from a static port outside the aircraft. This measurement is then converted into an altitude above sea level in accordance with a mathematical model defined by the ISA. The altitude is always calculated according to some reference pressure (baro-correction – QNH value). This pressure must be set by a pilot and can be changed during flight. The baro correction value is typically obtained from air traffic control.

Figure 20: The altitude indicator with the scale given in feet. Three needles are shown in this case.

The indicator shown in Figure 20 is used to display calculated altitude and reference baro-correction (QNH). The altitude is shown by two needles, where the short needle points to 1000 feet (or meters) and the long needle points to 100 feet (meters). When feet are in use, a 10.000 feet needle is also shown.

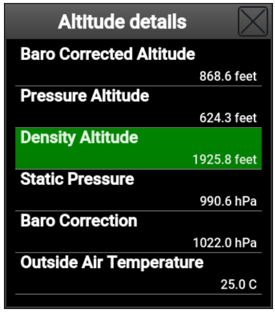
A touch on the bottom part of the indicator opens the baro correction window while a touch on the top part opens window with more altitude details, Figure 21.

The `Altitude details` window shows values for:

`Baro Corrected Altitude` this is the same altitude as shown on the altimeter. This altitude is corrected for the baro correction value (QNH value).

`Pressure Altitude` is altitude without baro correction – or baro correction set to 1013 hPa (29.92 inHg).

(a) Baro correction (QNH) entry window.



(b) Altitude details.

Figure 21: Touch operations on the altimeter.

`Density Altitude` is altitude corrected for variations from standard temperature. It is the air density expressed as an altitude. This altitude is a measure of aircraft's performance.

`Static Pressure` is uncorrected pressure reading from the static port. It serves as a base for all before mentioned altitudes.

`Baro Correction` is a setting given by air traffic control (QNH value) and defines current air pressure at MSL.

`Outside Air Temperature` is actual air temperature and is used in density altitude and TAS calculation.

3.10.4 Tachometer (RPM) and Manifold Pressure Indicator

A tachometer is an instrument that measures the rotation speed of a motor shaft. It displays engine revolutions per minute (RPM), hence its alternative name the *RPM indicator*. A manifold pressure is an effect of choked flow through a throttle in the intake manifold of an engine. It is a measure of the amount of airflow through the engine. Hence it is also a measure of the power capacity in the engine.

Both values are related to the power settings. Therefore we combined them into one single indicator, see Figure 22. This allows the pilot to optimally set the throttle and the propeller pitch. Note that some engines do not specify green and yellow range. Hence, such range is optional.

The optional green range defines the recommended range of RPM. The optional yellow range defines the range of RPM, which should not be used for longer period and should be generally avoided. The red mark limits the engine RPM.

Figure 22: The combination of RPM and manifold pressure indicator.

3.10.5 Gyroplane Engine RPM, Rotor RPM, Manifold and Prerotation Indicator

Gyroplanes require indication of rotor RPM. Figure 23 illustrates a special combination of parameters combined into one gauge.

Figure 23: Four in one: the combination of engine RPM, rotor RPM, manifold pressure and prerotation helper lamp.

① Engine RPM scale with color arcs.

② Rotor RPM scale with color arcs.

③ Manifold pressure scale with color arcs.

④ Prerotation lamp.

Prerotation lamp is used during rotor prerotation process as a part of takeoff procedure. The prerotation limiting values are set as rotor attributes. See the Nesis Installation Manual for more detais.

`Red` lamp is shown as long as rotor RPMs are has not reached the minimal safe value. This value is typically around 180 RPMs.

`Yellow` lamp is shown when minimal RPMs has been reached.

`Green` lamp is shown when recommended RPMs has been reached – typically around 200 RPMs.

The lamp symbol turns off once gyroplane is airborne.

3.10.6 Helicopter Rotor and Engine RPM Indicator

Piston engine powered helicopters have engines directly connected to the rotor (using some transmission, of course). So rotor RPM is directly related to engine RPM. The instrument in Figure 24 gives rotor and engine RPM expressed in percentages. The scales are set in such way that needles under normal operation have the same indication. Any misalignment of needles can be easily spotted giving a clear indication that something is wrong with the transmission.

Like in the gyroplane case, the bottom window can be configured to show the manifold pressure.

3.10.7 Mini Engine Monitor

The mini engine monitor window shows the most relevant engine information in one place in the form of color bars, see Figure 25. Each bar corresponds to one engine parameter. Green, yellow and red colors represent normal, caution and dangerous range, respectively.

The monitor bars are grouped into temperatures, pressures, electrics and RPMs. The temperature group includes CHT, EGT, oil and water (coolant)

Figure 24: The combination of rotor RPM and engine RPM. Both scales are in percentages.

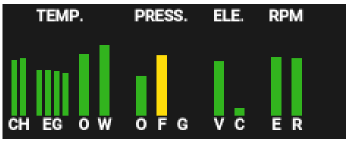


Figure 25: Illustration of the mini engine monitor.

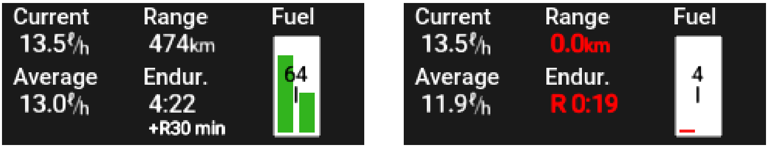
temperature. The pressure group contains oil and fuel pressures. Electrical section contains voltage and current. When monitor is shown on the navigation screen, engine RPM and rotor RPM bars are shown as well.

3.10.8 Fuel Computer Monitor

The fuel computer monitor provides the fuel related information like fuel quantity, economy, range and endurance. Figure 26 shows an example of such information.

The fuel computer monitor provides the following information:

- The current fuel consumption displays momentary fuel burning rate. It is given in l/h (liter per hour) or gal/h (gallons per hour) units.
- The average fuel consumption displays a value depending on the Fuel compute mode. See also section 8.3.3 on page 92.
  - In the *Fixed* mode the fixed prescribed value is used for the average fuel consumption.



(a) Normal situation with endurance of 4 hours and 22 minutes with a 30 min reserve.

(b) Endurance without any reserve and range of 0 km. Both are shown in red.

Figure 26: Fuel computer displays fuel economy, fuel level, endurance and range.

  - In the *Integral* mode, the fixed prescribed value is shown while not flying (on the ground). After take-off, the integral fuel consumption is calculated from the fuel flow. The complete flight after take-off is taken into account in this calculation.
  - In the *Moving average* mode, average is calculated for some given period of time.

- The *endurance* is a derived value based on the available fuel quantity, average fuel consumption (depends on the fuel computer mode) and endurance reserve. It represents the engine time left assuming average fuel consumption. At the bottom, specified endurance reserve is shown. Once the reserve is reached, the range and endurance text are shown in red and the reserved endurance remaining is shown.

- *Range* is a derived value, which is based on the available fuel quantity, average fuel consumption, current ground speed and the specified endurance reserve. Once endurance reserve is reached, range is zero and it is shown in red.

When no fuel level probes are connected to DAQU, Nesis provides a simulated fuel tank where Nesis calculates the available fuel based on the information entered before the flight or updated during the flight. The fuel level is reduced by subtracting the fuel flow integrated in time. Both, the initial information and the fuel flow integration, may be source of significant error, which can quickly lead to a completely wrong fuel level indication. An indication higher than actual represents a dangerous situation, where the fuel computer displays more fuel than it actually is. This gives wrong and unsafe information to the pilot. Therefore, the pilot must frequently compare the fuel level indicated by the fuel computer with the independent external fuel gauges and update the Nesis fuel level accordingly.

3.10.9 OAT, Flight Time, Fuel

The fuel computer window can be replaced by OAT, flight time, time and fuel quantity information. Illustration of this window is given in Figure 27.

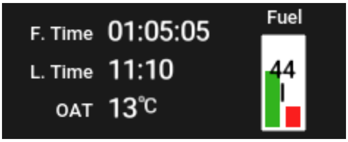


Figure 27: OAT, flight time, local time and fuel window.

3.10.10 Direction Indicator

A direction indicator may be shown instead the small moving map on the classic screen. The source of direction may either be a GNSS track or a magnetic compass. Figure 28 shows an example.

Figure 28: Illustration of the direction indicator.

The indicator also shows the heading bug. The bug is active only when a route or a direct to waypoint was activated.

A long touch on the compass rose will set the heading bug. If the autopilot is active it will also set the autopilot direction.

3.10.11 Special Markings on Engine Parameters

Special markings may appear on some engine parameters. These marking are as follows:

`Lo` stands for low sensor condition – the sensor has reached the low measuring point. Example: Real CHT temperature is 5 degrees, but sensor is able to measure only values above 25 degrees. In this case you will see the Lo mark.

`Hi` stands for high sensor condition. The maximum of the sensor has been exceeded.

`NC` stands for not connected. Such detection is possible only for certain channel - sensor combinations.

Figure 29: Round pressure indicator, with special markings shown on needles.

Figure 29 shows a pressure indicator, with oil pressure value as sensor not connected and fuel pressure value as below measuring limit.

Please note that availability of these special markings strongly depends on a sensor type, DAQU channel type in on channel function type. Usually only a sub-set of above mentioned conditions can be detected.

4 Flight Time Activities

This section describes procedures that are mainly used during flight. The major flight-time activities are accessible from the main menu.

4.1 Main Menu

A push on the knob brings up the main menu. This happens on all screens. Figure 30 shows the main menu for the Classic Screen. Some other screens may have less options.

A swipe in upward direction on the touch screen will also open the main menu.

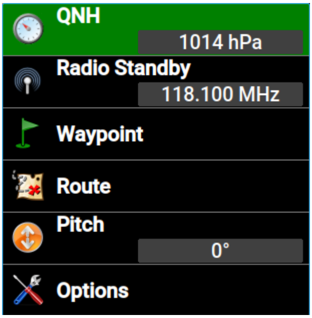


Figure 30: Main menu for the Modern Screen.

`BARO` Opens the baro correction window. See section 4.2 for more details.

`Radio Standby` Opens a window, which allows setting a new standby frequency on the radio. The option is only visible when Nesis and radio are properly connected. See section 4.3 for more details.

`Waypoint` Opens a window for a waypoint selection and manipulation. See section 4.4 for more details.

`Route` Opens a window for route selection and manipulation. See section 4.5 for more details.

`Pitch` Allows for pitch correction. This option is available only when AHRS is visible on the screen.

`Toggle View` This option is available on the Modern screen only. It allows changing view settings - toggle 3D mode and toggle video.

`Map Layers` This option is available on the Map screen only. It opens a window for the map layer manipulation.

`Options` Opens options screen used to tune the system settings. See section 8 starting on page 86 for more details.

4.2 Baro Correction – QNH

Rotate the knob to change the baro correction or press on the ⊕ or ⊖ buttons with the touch. Push the selector knob to close and confirm the selection or touch the check or ⓧ on the title bar. The window closes itself after some time-out period.

Figure 31: Setting the baro correction value.

4.2.1 QFE Setting

When aircraft is operated locally the QFE altitude rather than QNH may be set. In order to set the altimeter to the zero altitude (the QFE altitude), turn the knob until the altimeter is close to zero [4].

4.2.2 Initial Baro Correction Setting

When baro correction is not known but the airfield elevation is known, the baro correction can be approximated by setting the altimeter to the airfield elevation. This gives a pretty good approximation.

4.3 Radio Standby

This option is available only when Nesis is connected with a compatible radio. Please refer to the Installation Manual for more details.

The frequency is set in a window as shown in Figure 32.

The frequency is set in three steps. First, value left of decimal point is set, then first digit after the decimal and finally the last two digits. Once new frequency is confirmed it is sent to the radio as a standby frequency. Usually,

[4] Normally, exact zero can't be obtained as baro-correcting pressure change is made in discrete steps. One hPa at the sea level corresponds to approximately 8 meters of altitude.

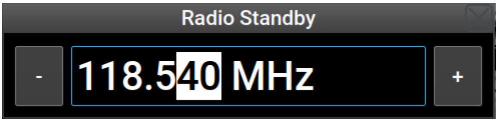


Figure 32: Setting the standby frequency value.

some button on radio panel must be pressed to make the standby frequency active.

4.4 Selecting a Waypoint

Nesis maintains separate lists of airfields, navigation aids[5], VFR reporting points[6] and user points. Thus selection of a waypoint is a two step process. In the first waypoint type is selected – Figure 33 left. In the second step actual waypoint is selected, Figure right.

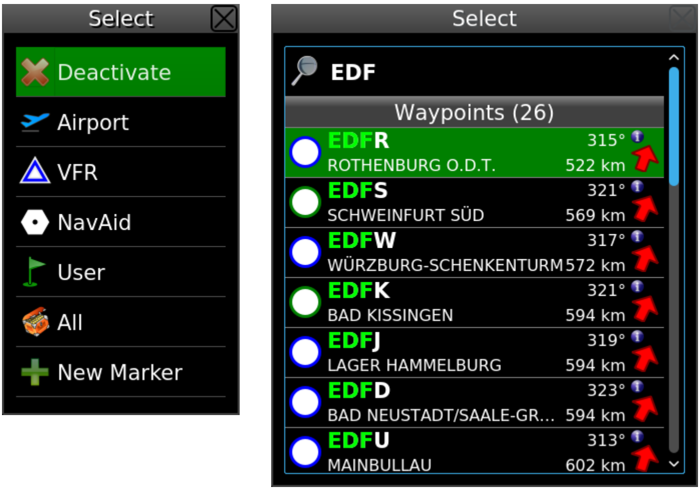


Figure 33: Waypoint options (left) and list of waypoints with active name filter (right).

[5] By the navigation aid we mean VORs, NDBs, ILSes, TACANs and other similar radio navigation aids, which locations are often used in VFR flight for the navigation.

[6] In Europe, VFR reporting points are more and more used in VFR flights to define the flying routes and entry/exit points in airspace zones.

First Step

The following options are available in the first step:

`Deactivate` This option is visible only if some waypoint was previously made active. It will deactivate navigation mode.

`Airport` Displays only airports and those user waypoints that were classified as airports.

`VFR` Displays only VFR reporting points from the database.

`NavAid` Displays only VORs, NDBs, TACANs, etc. from the database.

`User` Displays only user specified waypoints and markers.

`All` Displays all items from all databases together. This option useful when the type of the waypoint is not known. All types will be searched.

`New Marker` This is a special command, described in next subsection.

Second Step

In the second step the list of points is displayed. The list is sorted according to the distance from the aircraft position at the time when the list was created. Select one waypoint from the list and Nesis will navigate to that point in the direct-to mode.

When too many points are listed, they can always be filtered by name. Select the name option on the top and enter a few letters of the waypoint. Number of listed waypoints will rapidly decrease. Nesis searches both the name and the waypoint description. Matching part of the name is marked in green, see Figure 33 right.

4.4.1 Creating a Marker

The *New Marker* option from the first step is special. Use it to mark current location. When selected, Nesis creates a marker – a special user waypoint. The marker name is automatic (Mark 1, Mark 2, . . .).

Markers are intended to be used during flight. Issue the *Waypoint—New Marker* command in order to create a marker at some interesting place. After landing, the marker can be edited with a different name, description or coordinate.

4.4.2 Waypoint Details

Some waypoints, airfields for example, have more attributes than simply coordinates. Hence, before actual selection, Nesis offers the *Details* option.

The *Details* options opens the details window. An example is shown in Figure 34.

Figure 34: An example of the details window for LJMB airfield.

The window has several sections:

`General` The top part shows the coordinates and elevation.

`Frequencies` section lists frequencies associated with the waypoint. When radio is connected with Nesis, a selection of frequency will transfer it into the radio as a standby frequency.

`Runways` section lists runways available on this airfield.

`Weather` section is available when Nesis is connected to the Internet. METAR reports are shown. In addition, when the METAR report is selected, a new window is opened, where the METAR report is interpreted in a more friendly form. For an example, see Figure 35. Full METAR report is shown on the top and the interpreted part below. Note that we try to interpret as much as possible, but some parts may be too difficult to handle.

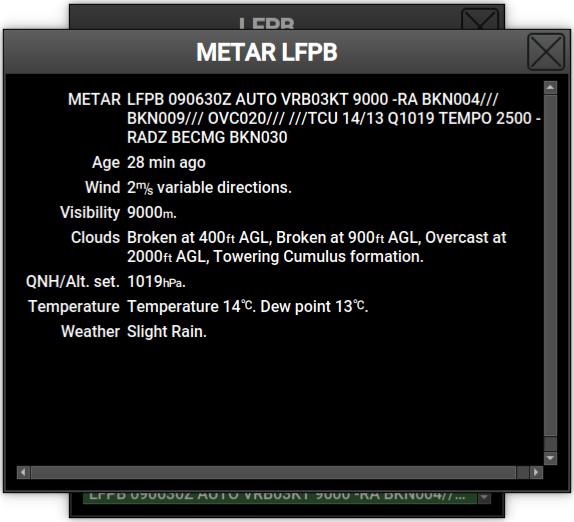


Figure 35: An example of interpreted METAR report.

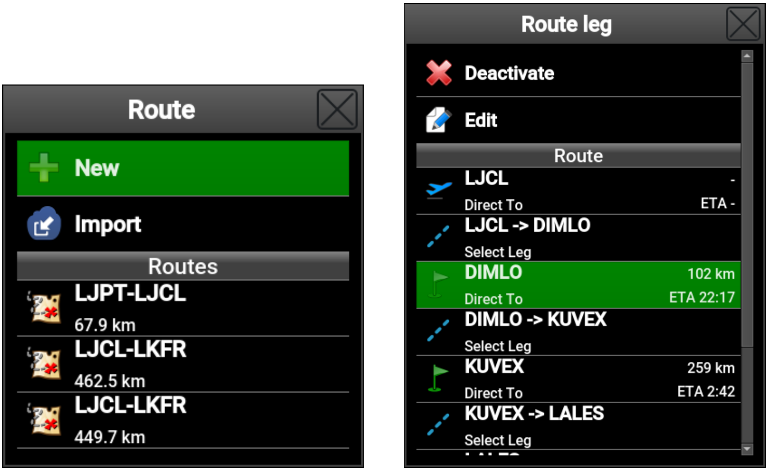
4.5 Route

This section describes how to activate and manipulate a route. The route functions are accessed via the *Route* command from the main menu. Depending on the current situation two different windows are opened:

- When there is no active route, Nesis opens the route selection/activation window. See Figure 36a. The window allows creation of a route, importing a route from USB stick or selection of one of existing routes from a list.
- However, if some route is already active, Nesis opens a route manipulation window. See Figure 36b.

4.5.1 Activating a Route

With no active route a window opens, like shown in Figure 36 left. Routes are sorted alphabetically. Route name is typically defined by a takeoff - landing airfield pair.



(a) Route selection. (b) Active route manupulation.

Figure 36: Route window depends on active route status.

To select a route, rotate the knob and push it or simply touch the route name. A window appears asking for further actions. Select *Activate* in order to make the route active. When window is closed, correct route leg will be selected automatically. This depends on current aircraft position regarding to the route.

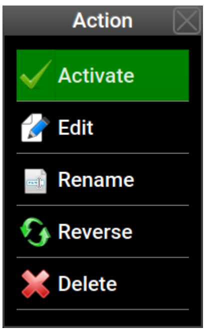


Figure 37: List of possible actions on the Route selection.

4.5.2 Actions on an Active Route

When the *Route* command is issued and some route is already active, a different window appears. See Figure 36 right.

The following options are possible here:

- The *Deactivate* item will make the route inactive.
- Select one of the remaining route waypoints in *direct to* mode. Nesis will navigate directly to this waypoint and once the waypoint is reached, it will resume with route navigation.
- Select one of the remaining route legs. Nesis will select this leg as a new active leg. This can be used to switch to the next leg early. Note that legs that were already completed can't be selected.

4.5.3 Importing a Route

Nesis can also import a route, which was previously prepared with some route planner. The route file must be saved in the Garmin `GPX` format. This means that any route planner, which can save/export route in the `GPX` format can be used.

- Prepare a route, save it in the `GPX` format and copy it to USB stick.
- Insert the stick into Nesis and select the `Import` command. See Figure 36 left.
- Select the route file from the USB stick. This will only copy the route into Nesis but it will not make it active.

4.5.4 Deleting a Route

Select a route from the list of routes and then select the `Delete` command. The selected route will be deleted from the list. The command can not be reverted.

4.5.5 Renaming a Route

In most cases routes have an automatic name, which consists of takeoff and landing airfield. In order to put a special name to a route, select the *Route* from the main menu and then select the *Rename* command. Use the on-screen keyboard or the knob to enter a new name.

4.5.6 Editing a Route

This command allows editing an existing route. New waypoints can be added or modified. In the case of touch screen a new page opens. See section 4.6.

4.5.7 Reversing a Route

This is a very convenient command. It reverses order of items in selected route. Route name is also automatically adjusted, unless route was previously renamed. Figure 38 shows a reversed route from the previous example.

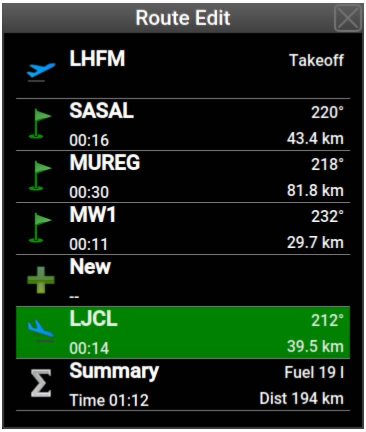


Figure 38: Result of a reversed route from previous example.

4.6 Creating a New Route

When the `New` option is selected, see Figure 36 left, Nesis switches to a special *Route Planning* screen. Touch screen is used extensively in planning.

The route creation process will be shown on an example on a route from LJSK (Slovenjske Konjice) to LOAV (Bad Vöslau). This route may have the following intermediate VFR reporting waypoints: GOLVA on border between Slovenia and FINKEHN to avoid crossing MATZ near Wiener Neustadt, just before the destination.

Figure 39 illustrates the final result. The route was created using the following steps:

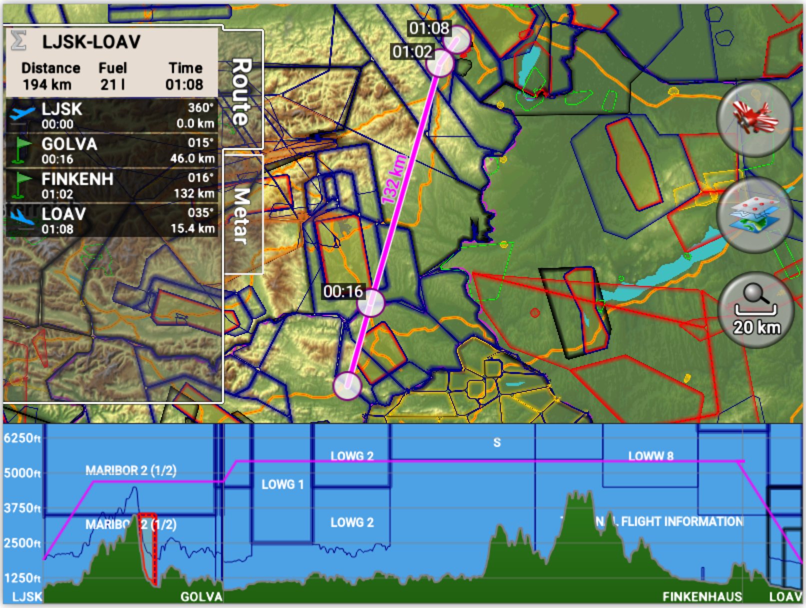


Figure 39: Example of route planning with touch screen.

- Use long-touch and drag to move the map so that you can see the departing airfield LJSK. Use some empty area on the screen to start the long-touch. Once you see the departing airfield, touch it and then choose `Select` if asked. This defines the departing airfield.
- Move the map so that you can see the destination airfield LOAV. Again, start the long-touch on an empty area. Once the destination is on screen, touch the airfield and confirm the selection. This defines the destination. Figure 40 illustrates the waypoint list you should see on the screen.
- Once departure and destination are known, touch the `Zoom` icon. Complete route will be shown. Check if route is crossing any CTRs or busy TMAs.
- Use the two finger touch (pinch) to zoom and to show Slovenian-Austrian border in more detail. Touch the purple route line near the border and drag it over the `GOLVA` border point. This will insert new waypoint and recalculate route automatically.

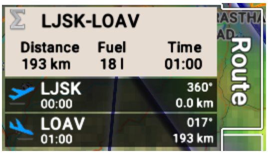


Figure 40: A list of waypoint after the departure and destination points were set.

Alternatively, touch the destination point on the list `LOAV`. This opens a window with the `Insert`, `Delete` and `Edit` options. Select `Insert`, then select `VFR` as this is a VFR border point and enter `GOLVA` into the search field. Select the resulting point.

- Observe the route path. Move the map if necessary. The path crosses Wiener Neustadt CTR area. Touch the path near by and drag it over the `FINKENHAUS` reporting point.

  Alternatively, you select the `LOAV` on the list and insert the `FINKENHAUS` VFR point.

- This seems fine now. Touch the `Zoom` icon again to see the complete route. At the bottom is the terrain profile with the airspace zones that route is crossing. Adjust the vertical flight line according to the terrain and airspace.

- Once you are happy with the route, select the `Airplane` icon. This saves the route and activates it at the same time.

  Alternative, touch the title of the route list. This opens a window and select the `Save & fly` option.

- If `Close` or `Pager` buttons are pressed, Nesis ask wheather to save the route you have prepared so far, Figure 41.

The route planning system is very flexible and it adds even more features. We recommend creating a few routes and checking them out.

- A touch on a circle representing a route waypoint allows you to remove the waypoint from the route.

- A list of route waypoints is displayed on the right. A touch on a waypoint name allows you to select a different waypoint, to remove the waypoint

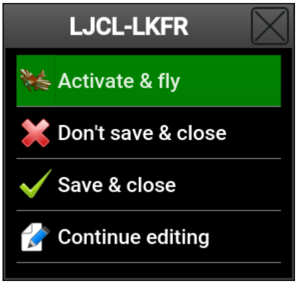


Figure 41: Closing the page or switching to a next page ask wheather to save, to ignore, to continue editing or to activate the route.

from the route or to insert a new waypoint infront, which will replace the existing one.

- A swipe over waypoint name to the left or to the right will remove the waypoint from the route.
- A touch on the route title opens the actions window. The following actions are displayed:
  - `Save & Fly` saves the route and activates it.
  - `Rename` opens a window where a different name can be assigned to the route. Default name consist from the departure and destination airfield designations. See also section 4.5.5.
  - `Reverse` will reverse all the waypoints in the route. See also section 4.5.7.
  - `Clear` removes all waypoints from the route.
- A touch on the `Metar` tab will collect current METAR information from airfields close to the route and display this in a list form. Either an Internet access or an active FIS-B link connection is required for this command. Figure 42 shows an example.

Estimated elapsed time (EET) is shown next to each waypoint on the route. EET is calculated based on the cruising speed, which is defined in section 8.3.3 on page 92. The route title also shows total route distance and estimated fuel consumption.

These values are just a rough estimate. No extra climb time, descend time and traffic pattern times are added in the calculations. The same is true for fuel consumption estimate – no extra fuel for climb or any reserves are taken into account.

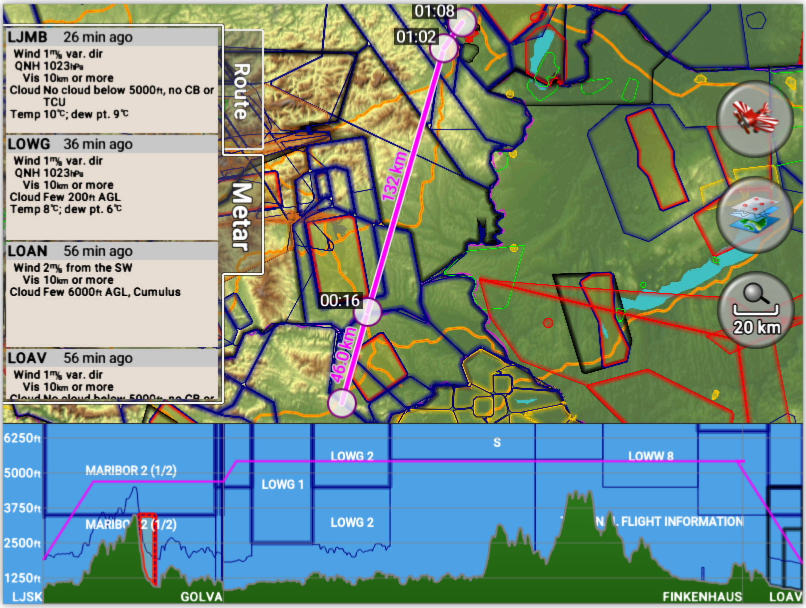


Figure 42: Example of METAR information along the route.

4.7 Adjusting Fuel Level

This option is available only when no fuel level sensors are connected to the EMS unit (DAQU) and Nesis calculates the fuel remaining from the fuel flow information.

Note that such way of fuel level indication is highly speculative and may lead to very inaccurate results. Never fully trust the fuel level indication.

Fuel level is first adjusted during the Nesis start-up procedure. Later, you can adjust it during the flight.

4.8 Setting Pitch Correction

A change in the cruising speed results in a different pitch angle. In order to correct the pitch, a correction value can be entered. Figure 43 shows a pitch correction window.

Figure 43: An example of the pitch correction window.

Note that this value is not permanently stored and Nesis always starts with the zero pitch correction.

If you want to adjust the pitch correction permanently, please refer to the `Installation manual`.

5 Flarm and ADS-B Receivers

Nesis can be connected with some Flarm or ADS-B receivers. In general, any device compatible with the Flarm or GDL90 protocol can be connected, however it was tested only with:

- Power Flarm Core – produced by Flarm Technology Ltd.,
- TRX 1500 – produced by Garrecht Avionik GmbH.
- AT-1 - AIR Traffic – produced by Air avionics.

In this section, we will use term *Flarm device* or simply *device* for any of above mentioned products.

This section does not explain any Flarm working principles. There are several documents and information sources available on Flarm official web site. We strongly recommend that you read them before you connect your Flarm device to our system:

- Please study the Nesis installation and any other manuals that you received with your device. The device manual information supersedes any conflicting information in this manual.

- Please, make sure that you understand the working principle of the device.
- Please visit `https://flarm.com/` and study documents found on this site. Specifically check the *SUPPORT* section, where you can find manuals and firmware updates.
- Please, also read the *FAQ* sub-section on the Flarm site. If can be found under *SUPPORT* section.
- For TRX and AT-1 devices, visit `https://www.air-avionics.com` and check the *SUPPORT* section for manuals and firmware updates.
- Update device with the latest firmware (software). Devices must be updated every year or they will stop working. Kanardia has nothing to do with this unusual demand.
- Devices are sometimes shipped with obsolete firmware. Update the device with the latest firmware version before installation.
- When a mode S transponder is installed in an aircraft, it does not necessary mean that it also transmits ADS-B out signal.
- Intruding traffic with C-mode or even S-mode transponder without ADS-B out signal are all non-directional targets. In addition, distance to the target is *estimated* from the signal strength. All this means that values shown in the traffic warning window are not very reliable for non-directional targets.

Please note that web pages are often reorganized and that manuals, firmware and FAQ can be moved to some other place.

5.1 Directional and Non-Directional Traffic

Power Flarm and other compatible devices consist of two independent subsystems merged into one device. The first is Flarm subsystem and the second one is ADS-B in subsystem.

5.1.1 Flarm Subsystem

The Flarm subsystem is only capable to *see* other aircraft that are also equipped with Flarm devices. The range of visibility varies significantly and depends on the antenna position, antenna shadowing, device strength, aircraft material . . . The range is about 10 km at best but may be significantly less in reality. It can be as low as a few hundred meters and blind spots are also possible. When the device detects a target – an airplane which has also a Flarm device on board, it will get a full set of target data: type, position, speed, etc. This is a directional traffic (or directional target). Flarms are mostly installed in gliders, but recently thay are also appearing in light aircraft as well.

5.1.2 ADS-B in Subsystem

The ADS-B in subsystem listens to transponder replies of other aircraft – targets. Here are two possibilities:

- The transponder reply comes from an aircraft, which is equipped with ADS-B out. In this case, the transponder reply also holds information about aircraft position, speed, direction, etc. Not many small airplanes are equipped with this. This kind of equipment is mostly found in airliners and in "more serious" aircraft. Most small GA aircraft and ULMs do not have such equipment.

- The transponder reply comes from an aircraft, which is NOT equipped with ADS-B out. These are majority of small aircraft. This reply does not include position, speed, direction. It has only altitude (C-mode) and squawk. The device tries to *estimate* distance of the target based on the transponder signal strength. A distance can be estimated (not very reliably) but the direction can not be estimated at all. Such targets are called "non-directional traffic" (or non-directional targets).

During flying device detects transponder responses from "non-directional" targets mostly. As direction is not known and distance is only a rough estimate, their position can not be drawn on the map, but their presence is announced to the pilot. This means that there may be frequent traffic advisories from the system, but the actual position of the target is not known.

Such behavior can be turned off, see Section 5.4.

5.2 Traffic on the Moving Map

Flarm device sends traffic information that it detects in regular intervals. A vertical or horizontal filter can be applied by the device to hide traffic that is out of specified limits.

Such traffic is shown on the main navigation map only. The following symbols are used.

 Approximate position of the intruding aircraft that poses as non-threat.

 A Proximity Advisory indicates that the intruding aircraft is within ±1200 feet and is within a 5 nm range, but is still not considered a threat.

 A Traffic Advisory is shown as a solid yellow circle. This indicates an aircraft in vicinity, which shall be considered as a threat.

 A serious threat is shown as a solid red circle. In most cases an additional warning window will appear on the screen in this case.

Figure 44 shows an example of such map. Three aircraft are shown, non of them as a threat.

On top of each symbol a relative vertical difference is shown and arrow on the right side shows a climbing or descending aircraft.

When Nesis is set to show altitude in feet, then the vertical difference will be shown in hundreds of feet. It is always shown as three digits. For example, *-008* means that aircraft is about 800 feet below. *000* means about the same height.

When Nesis is set to show altitude in meters, then the vertical difference will be shown in hundred of meters. It is always shown as two digits. For example, *+03* means that aircraft is 300 meters above. *00* means about the same height.

When intruding aircraft is climbing or descending faster than 500 feet/min (2.5 m/s) a vertical arrow is shown.

Once device stops sending traffic data for some aircraft for more than 5 seconds, the symbol for this aircraft will disappear.

Figure 44: Traffic symbols on a map. Vertical difference is in hundreds of feet, as three digits are used.

5.3 Warning

When device calculates that certain aircraft (or ground obstacle, or protected zone) poses a serious threat, it sends special warning message. Nesis intercepts this message and it shows a large warning window on any screen as long as such messages persist.

We would like to emphasize that relative position calculation and warning level logic are done by the device and not by Nesis.

Figure 45 illustrates an example.

1. Relative position of the threat regarding aircraft's track. The marking field will be yellow in the case of a warning and red in the case of an alert.

2. Horizontal distance to the threat.

3. Visual level of the threat. Circle is colored when threat is ±10°on horizon. Inner arrow is colored when threat is 10°- 30°above or below the

horizon and outer arrow is colored when threat is more than 30°above or below the horizon.

4 Vertical relative distance to the threat.

5 Threat symbol. Important: the symbol can be misleading. Always expect any kind of threat. The symbol depends on the value programmed into the intruding aircraft device.

Figure 45: Threat classified as warning comes from left, distance is 1.5 km, about at the same visual level, 450 feet below.

Figure 46 shows two more examples of traffic warning. Both these are classified as alerts. The right one is non-directional warning. A non-directional warning means that the device was not able to determine direction of the threat.

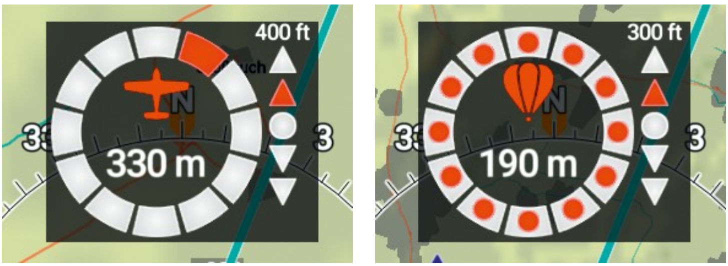


Figure 46: Left: Alert for an airplane, 330 meters away, slightly from right, 400 feet above and 10°- 30°above the horizon. Right: Alert for a balloon, 190 meters away, direction is not known, 300 feet above and 10°- 30°above the horizon.

5.4 Settings

Flarm device settings can be accessed via the *Options* screen. Selecting the *ADS-B/Flarm* icon opens a window shown in Figure 47. At the time of writing only devices produced by Flarm (PowerFlarm, PowerFlarm Fusion, PowerFlarm Portable) support options descried in this section.

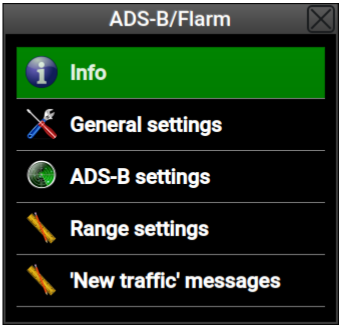


Figure 47: Flarm devices main menu window.

The following options are given:

`Info` Information about the device and its current settings. This is read only information.

`General settings` allows basic device configuration. Note, not all devices support this.

`ADS-B settings` allows configuration of some ADS-B specific settings. Note, not all devices support this.

`Range settings` allows configuration of some range based variables. Note, not all devices support this.

`Errors & Warnings` option appears only when the device detects an internal error or warning. It opens a window with the details.

`'New traffic' messages` allows tunning the on-screen messages, which appear when new traffic has been detected.

5.4.1 Info

The info section list device details. Please refer to the Flarm documentation for more explanation.

Although most of devices shall be able to provide this information, this may not be the case for all models.

`Model` is a short name/type of the connected Flarm device.

`Serial` is device's serial number.

`Software` is device's software version.

`Hardware` is device's hardware version.

`SW expires` date when device's software expires. Device will stop working after this date.

`Build` special build number of the device. This may be useful in troubleshooting.

`Baudrate` communication speed used to talk with the device.

`NMEA` defines which NMEA sentences is sent by the device. If can be Flarm specific only, pure NMEA only or both.

`Aircraft` defines what symbol will be used to represent this device.

`Id type` defines type of device specific ID. Each device has unique specific id.

`Id` defines the Id in use. This will be either Flarm id or ICAO id. Both ids shall be represented by a 6 hexadecimal characters.

`Region` defines the region for which was device configured.

`Flarm horizontal` tells horizontal limit to detect Flarm based signals. Please note that this is a theoretical limit. De facto limit can be significantly lower.

`Flarm vertical` tells vertical limit to detect Flarm based signals. Please note that this is a theoretical limit. De facto limit can be significantly lower.

`Capabilities` list features that were enabled in this device.

5.4.2 General Settings

The General settings option is used to some device parameters listed below. The values entered here are sent directly to the device. According to our experiences, only *Power Flarm* accepts these settings properly. You have to configure other devices in their specific way according with the instructions from producer.

`Aircraft type` specifies the symbol that represents the aircraft in Flarm transmission. It can be: glider, tow plane, rotorcraft, drop plane, airplane or jet.

`Baudrate` defines the communication speed between Nesis and Flarm device. We recommend using the highest speed that device supports, typically 57600 bauds. This ensures that device will be able to transmit all important messages.

`Config ID` opens a new window, where the ICAO 24-bit aircraft address in the form of six digit hexadecimal code is set. This address which uniquely identifies the device.

- When aircraft if equiped with transponder, the address is available in the aircraft registration documents or on the website of the local aircraft registration authority. Select the *Manual (ICAO) option* and enter the transponder address in the window below. The address consists of **six** hexadecimal characters.

  Setting the id is not enough to configure Flarm and transponder. You must also set the ***`Transponder type`*** *correctly. See section 5.4.3.*
- When unsure of the address and when a Mode-S transponder is not present in the aircraft, select the *Automatic* option. This will generate an address based on the serial number of the device.
- The *Random* option shall be avoided. It will generate a different address on every device restart.[7]

5.4.3 ADS-B Settings

These settings group is related with transponder and ADS-B settings. According to our experiences, only PowerFlarm family accepts these settings properly.

[7] Flarm devices have origin in gliders. On competitions, certain pilots want to hide identity, hence this option was introduced in Flarm.

`Transponder type` defines the type of the transponder built-in the aircraft. The options are: `Not installed`, which is default, `Mode S` and `Mode C`. If you set this option to mode S, please make sure that you also set `Config ID` correctly. See section 5.4.2.

`ADS-B warnings` can be enabled or disabled. The device listens to ADS-B squitter responses of other aircraft all the time and it processes this information. When warnings are disabled, no warnings like shown on Figure 45 for ADS-B based traffic will be given. However, the position of ADS-B traffic will still be transmitted, depending on their range.

`Use Mode-S altitude` When this is enabled, the device will try to use altitude detected by aircraft's own Mode-S transponder for calculation of vertical distances. When disabled, device will use altitude based on its own barometric pressure sensor. The own transponder detection is based on transponder 24 bit ICAO address. This address was entered in section 5.4.2.

`Process Mode-C targets` enables/disables processing of Mode-C transponder responses. Position of these targets is not known (so called non-directional targets) and the distance is only estimated from the signal strength. Most small general aviation aircraft are equipped with Mode-C transponders. With this option enabled, such a near-by aircraft can be detected, but not located.

`Own Mode-C suppression` selects a method for suppressing own Mode-C transponder. The *Aggressive* option may suppress other Mode-C targets on same altitude. The *Less aggressive* option may cause warnings from own Mode-C transponder in case of e.g. reflected signals.

`N/D target alarm` enables/disables traffic warnings for which direction is not known (non-directional traffic). Figure 46 right shows an example of such non-directional warning.

`N/D calibration` sets antenna calibration value. A higher value makes non-directional targets appear closer — it compensates for low antenna gain and/or a long cable.

`N/D target beep` enables/disables *beep* sound comming from the internal device beeper for non-directional targets. Note: not all Flarm devices have such beeper available and/or activated. This option does not apply to Nesis.

5.4.4 Range Settings

The range related settings define range filters of the device. According to our experiences, only *Power Flarm* accepts these settings properly.

Please note that actual detection capabilities of the device may be significantly lower then specified by these values. Especially, all metal and carbon aircraft are affected.

`Flarm horizontal range (m)` defines the horizontal distance cut-off limit for targets detected by Flarm to Flarm radio signal. Targets beyond this limit will not be shown.

`Flarm vertical range (m)` defines the vertical distance cuf-off limits for targets detected by Flarm to Flarm radio signal.

`ADS-B horizontal range (m)` defines the horizontal distance cut-off limit for targets detected by ADS-B squitter response.

`ADS-B vertical range (m)` defines the vertical distance cut-off limit for targets detected by ADS-B squitter response.

`N/D horizontal range (m)` defines the horizontal distance cut-off limit for non-directional targets. Please note, that distance is estimated on the signal strength.

`N/D vertical range (m)` defines the vertical distance cut-off limit for non-directional targets.

5.5 Errors

Flarm device may send error and warning messages, which indicate device's internal problems. When Nesis intercepts them, a red Flarm symbol is flashing in the status bar. In addition a Flarm status rectangle appears on the right side of the main map screen indicating number of errors. See Figure 48 left.

- In the main map window, touch the small Flarm status window. This opens the acknowledge window.
- Open the *Options* page with the icons, select the *ADSB/Flarm* icon and select the *Errors & Warnings* item. Note this item is shown only when an error or a warning is detected.

Please refer to the device documentation for the complete list of errors and warnings.

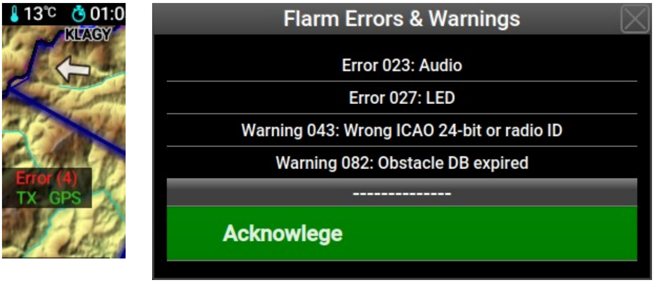


Figure 48: Left: a part of the main map screen, which shows the Flarm device status rectangle. Right: Flarm Error and Warning window. On top errors and warnings are displayed and the *Acknowledge* command at the bottom.

5.5.1 'New traffic' messages

When a new traffic is detected by the device and the traffic is close enough, Nesis may indicate it visualy or audibly. These specific settings are done in a window as shown in Figure 49.

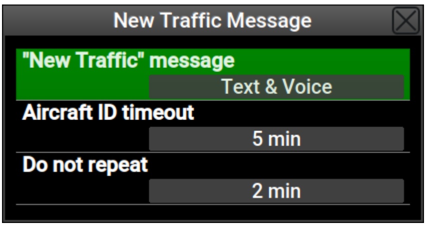


Figure 49: An example of setting for the new traffic message.

`"New Traffic" message` gives four options: `Disable`, `Text & Voice` gives a textual and audial indication of new traffic, `Text only` shows only text and `Voice only` plays only audial message.

`Aircraft ID timeout` defines how long does it take for an aircraft to be forgotten. When aircraft ID is not being received for this amount of time, it will be marked as forgotten and if later appears again later, a new warning will be given.

`Do not repeat` defines the time period, which starts when the last "New traffic" message is shown. Within this period this message will not be repeated for any new aircraft that may appear afterwards. This was introduced to reduce number of warnings. Please note that aircraft symbol will still appear on the map and that all collision warnings are still in effect regardless of this setting.

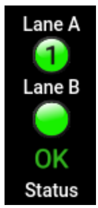
6 Engines with ECU

Some engines which have ECU connected to the Daqu are sending status and diagnostic messages. The status information item must be enabled/configured. It will not appear automaticaly. Please refer to the Installation Manual for the details.

6.1 Rotax iS

Figure 50 shows examples of the horizontal and vertical engine status information. It consists of two lanes named `A` and `B` and general status. Each lane can be green (active) or red (inactive). You should see the light change during the test procedure, when lanes are being checked by switching them off.

(a) Horizontal orientation.



(b) Vertical orientation.

Figure 50: Rotax iS engine status information.

6.1.1 Generator Control

A number `1` or `2` appear inside of one of the lane lights. This tells which lane is in control of the generator. The number tells which generator is in use.

1 means that the primary generator is in use and all is working normally.

② means that secondary generator is in use. This should only appear during the engine start until the engine RPM exceed 2800 RPM for about six seconds, when the ECU switches to the primary generator. If this appears during the flight is shall be considered as a warning. In this case the aircraft electric system runs only on the battery. Please refer to the official Rotax documentation for more details.

6.1.2 Status details

The status details are accessible from the alarms icon on the options screen. Select the `Alarms` icon and then the `Rotax iS status...` option. Figure 51 shows an example. Alternatively, a touch on the status area opens the same window.

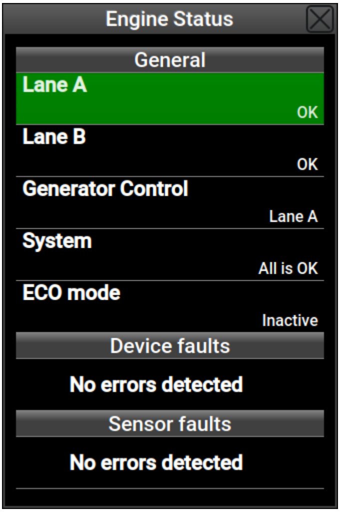


Figure 51: Detailed status information for Rotax iS engines.

The window has the following items:

`Lane A`, `Lane B` can have the following values: OK – normal operation, Inactive – lane is turned off, CAUTION and WARNING.

`Generator Control` tells which lane is in command for the generator control. It can be Lane A or Lane B.

`System` states general status of the ECU system. It can be one of the following messages:

- All is OK.
- No communication.
- Service is required.
- Land aircraft!

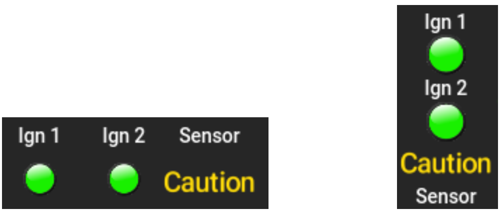
`ECO mode` has only two states: inactive and active. The active state means that the engine operates in the ECO mode.

`Device faults` Normaly `No errors detected` message is shown. In the case of ECU/engine failure, one or more messages can appear here.

`Sensor faults` Normaly `No errors detected` message is shown. In the case of sensor failure, one or more messages can appear here.

6.2 ULPower Engines

Figure 52 shows examples of the horizontal and vertical engine status information. It consists of two ignitions and general status.



(a) Horizontal orientation. (b) Vertical orientation.

Figure 52: ULPower engine status information.

A touch on the status part of the screen opens a window with more details. Figure 53 shows an example.

7 Logbook

Nesis automatically keeps a log of flights and stores them in a logbook. It keeps recording as long as Nesis is powered on. When logs are requested, it

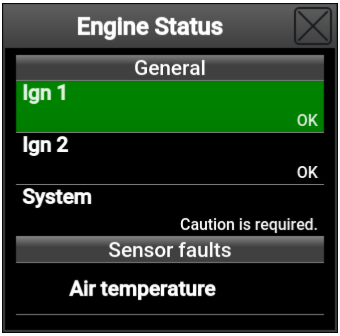


Figure 53: A more detailed status information for ULPower engines.

extracts takeoff and landing events and combines them in flights. An example is given in Figure 54.

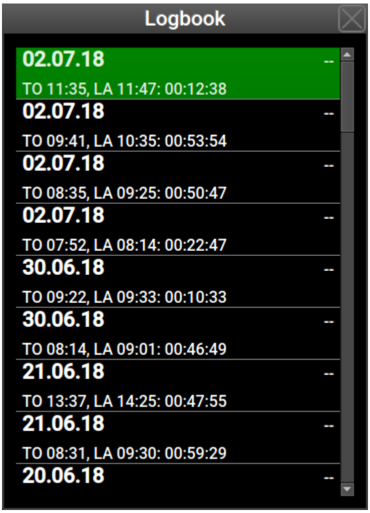


Figure 54: A logbook example. Pilot names are missing, two dash characters are shown instead.

Logbook can be accessed from the *Options* page by selecting the *Logbook* icon. See Figure 62 on page 88. Alternatively, a long-press on the pager button also opens the Logbook window by default.

The logbook shows only basic information about each flight, like date, name of the pilot, time of takeoff and time of landing.

Note that the logbook has a limited capacity of about 270 hours. When the limit is reached, the oldest log entries will be overwritten. Since Nesis is logging all the time and not only when flying, some invisible internal logs are created. This means that actual logged flying time will be about 25% less – you can expect to see about 200 flight hours.

When an item from the logbook is selected, more options are available. See Figure 55.

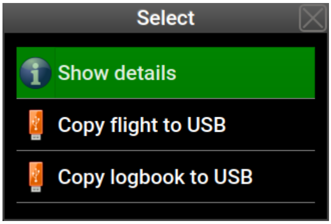


Figure 55: A logbook options example.

7.1 Show Details

The *Show Details* option, opens a window with more details about selected flight. Figure 56 gives an example.

These details have three groups: general, flight and engine. The general group shows:

`Date` of the flight.

`Pilot` name – as it was defined at the time of the takeoff.

`Instructor` name – as it was defined at the time of the takeoff.

Flight section gives details and some statistics about a flight.

`Takeoff` time when takeoff conditions were detected.

`Landing` time when landing conditions were detected.

`Duration` total flight duration.

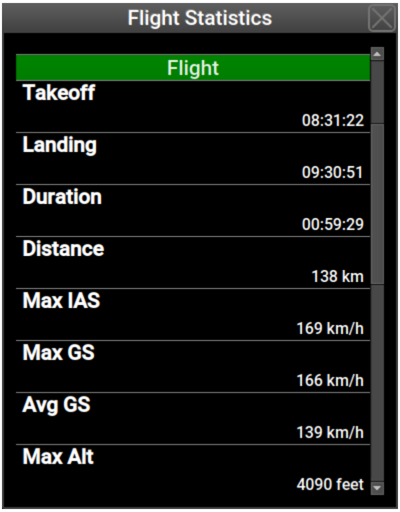


Figure 56: An example of flight details.

`Distance` distance traveled. This is not point-to-point distance. This is a distance of the path projected to the ground traveled during the flight.

`Max IAS` maximal indicated airspeed detected during flight.

`Max GS` maximal ground speed detected during flight.

`Max Alt` maximal baro-corrected altitude reached during flight.

`Min Alt` minimal baro-corrected altitude reached during flight.

`Max Acc` maximal normal acceleration reached during flight.

The engine group shows similar statistics for the engine.

`Start` time of engine start.

`Stop` time of engine stop.

`Duration` engine run time.

`Max CHT` maximal CHT reached during engine run.

`Max RPM` maximal RPM reached during engine run.

`Avg RPM` average RPM measured during engine run.

`Fuel used` during engine run.

`Avg fuel` average fuel consumption during engine run.

Please note that the fuel used and average fuel consumption strongly depend on the fuel flow measurement/estimation. If fuel flow is wrong, these two items will be wrong, too.

7.2 Copy Flight to USB

The *Copy flight to USB* option creates two files on the USB stick for the selected flight. One file has .kml extension and the other has .tab extension. The file name is a combination of pilot name, date and flight made on this date. For example a file name *ALES13-08-18-B* means: pilot name is ALES, flight was taken on 13-th of August 2018 and letter *B* means that this was the second flight of the day.

7.2.1 The Kml File

The kml file stores 3D points of the flight and can be viewed in any third party software, which accepts such format. One such software is Google Earth, but many others are supporting this format as well. Figures 57 and 58 show two examples. First is the top view of a flight and the second one is a detail with visible vertical profile.

7.2.2 The Tab File

The tab file stores a detailed information for every recorded second. The recording typically starts when engine start is detected and ends when engine is stopped.

The *Tab* file format is a plain text format, where each row represents one record and parameters in the record are separated by a tab character. Each record has several flight and engine parameters like: date, time, position, altitude, static pressure, velocities, wind speeds, engine temperatures, engine pressures, RPMs and many others. Typically, the file is opened with Microsoft Excel or with LibreOffice Calc.

Here are the steps needed to open the file in LibreOffice Calc. Steps in Microsoft Excel are similar.

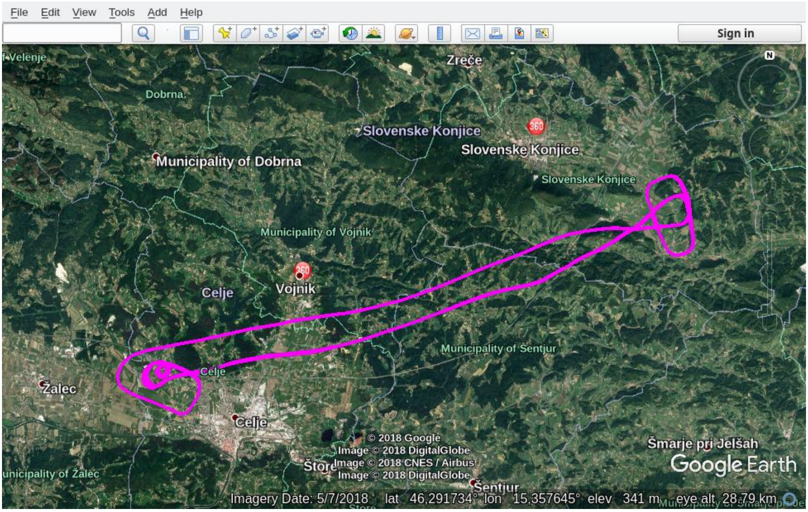


Figure 57: A flight file with kml extenstion opened in Google Earth.

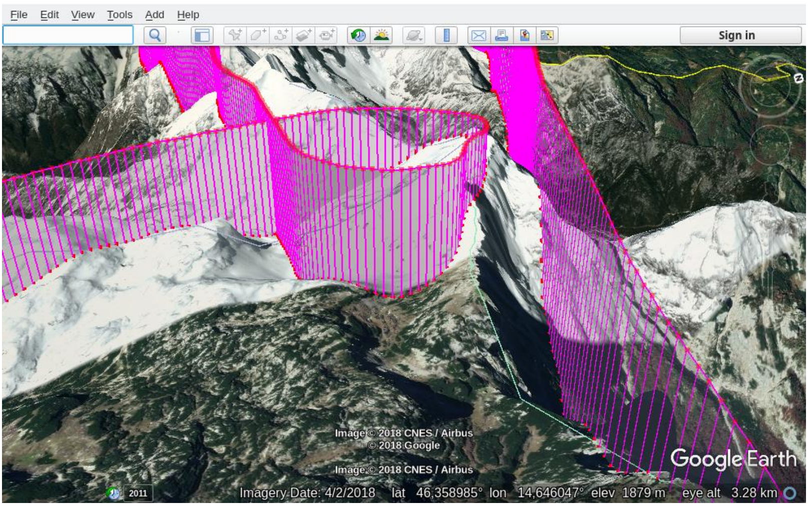


Figure 58: A detail of flight opened in Google Earth. Vertical profile is visible here.

1. Start the LibreOffice Calc.

2. Select the *File:Open* from the menu.

3. In the selection window, set *Filter* to *All Files*.

4. Search for file with the tab extension. An example is *ALES12-08-18-B.tab*

5. Calc detects that a text file is being imported and it opens a window as shown in Figure 59. Please make sure that the *Tab* option is selected as the separator and *English (USA)* as the language. This makes sure that decimal values are properly imported.

6. The result of the import is then shown in Figure 60. Some column widths were adjusted and some cells were hidden.

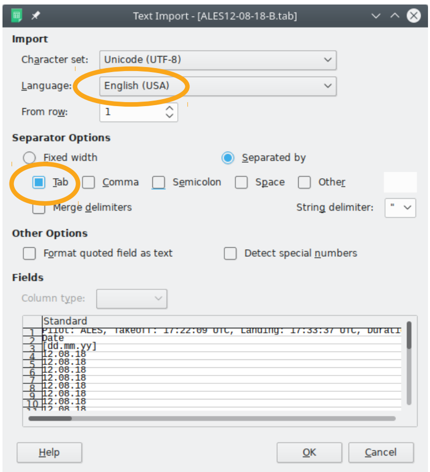
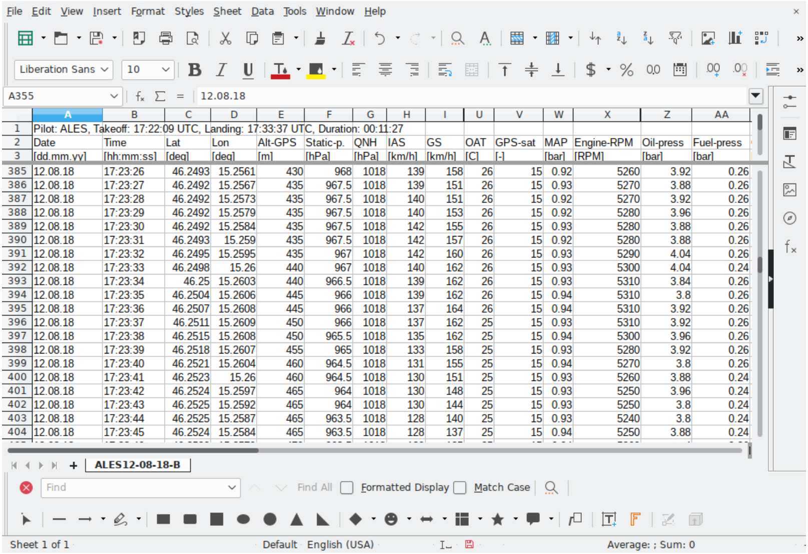


Figure 59: An example of Calc Text Import window.

7.3 Copy Logbook to USB

This command creates a logbook file in *html* format and copies it to USB stick. The logbook entries can be filtered for a pilot and for a period.



	A	B	C	D	E	F	G	H	I	U	V	W	X	Z	AA
1	Pilot: ALES, Takeoff: 17:22:09 UTC, Landing: 17:33:37 UTC, Duration: 00:11:27														
2	Date	Time	Lat	Lon	Alt-GPS	Static-p.	QNH	IAS	GS	OAT	GPS-sat	MAP	Engine-RPM	Oil-press	Fuel-press
3	[dd.mm.yy]	[hh:mm:ss]	[deg]	[deg]	[m]	[hPa]	[hPa]	[km/h]	[km/h]	[C]	[-]	[bar]	[RPM]	[bar]	[bar]
385	12.08.18	17:23:26	46.2493	15.2561	430	968	1018	139	158	26	15	0.92	5260	3.92	0.26
386	12.08.18	17:23:27	46.2492	15.2567	435	967.5	1018	139	151	26	15	0.93	5270	3.88	0.26
387	12.08.18	17:23:28	46.2492	15.2573	435	967.5	1018	140	151	26	15	0.92	5270	3.92	0.26
388	12.08.18	17:23:29	46.2492	15.2579	435	967.5	1018	140	153	26	15	0.92	5280	3.96	0.26
389	12.08.18	17:23:30	46.2492	15.2584	435	967.5	1018	142	155	26	15	0.93	5280	3.88	0.26
390	12.08.18	17:23:31	46.2493	15.259	435	967.5	1018	142	157	26	15	0.92	5280	3.88	0.26
391	12.08.18	17:23:32	46.2495	15.2595	435	967	1018	142	160	26	15	0.93	5290	4.04	0.26
392	12.08.18	17:23:33	46.2498	15.26	440	967	1018	140	162	26	15	0.93	5300	4.04	0.24
393	12.08.18	17:23:34	46.25	15.2603	440	966.5	1018	139	162	26	15	0.93	5310	3.84	0.26
394	12.08.18	17:23:35	46.2504	15.2606	445	966	1018	139	162	26	15	0.94	5310	3.8	0.26
395	12.08.18	17:23:36	46.2507	15.2608	445	966	1018	137	164	26	15	0.94	5310	3.92	0.26
396	12.08.18	17:23:37	46.2511	15.2609	450	966	1018	137	162	25	15	0.93	5310	3.92	0.26
397	12.08.18	17:23:38	46.2515	15.2608	450	965.5	1018	135	162	25	15	0.94	5300	3.96	0.26
398	12.08.18	17:23:39	46.2518	15.2607	455	965	1018	133	158	25	15	0.93	5280	3.92	0.26
399	12.08.18	17:23:40	46.2521	15.2604	460	964.5	1018	131	155	25	15	0.94	5270	3.8	0.26
400	12.08.18	17:23:41	46.2523	15.26	460	964.5	1018	130	151	25	15	0.93	5260	3.88	0.24
401	12.08.18	17:23:42	46.2524	15.2597	465	964	1018	130	148	25	15	0.93	5250	3.96	0.24
402	12.08.18	17:23:43	46.2525	15.2592	465	964	1018	130	144	25	15	0.93	5250	3.8	0.24
403	12.08.18	17:23:44	46.2525	15.2587	465	963.5	1018	128	140	25	15	0.93	5240	3.8	0.24
404	12.08.18	17:23:45	46.2524	15.2584	465	963.5	1018	128	137	25	15	0.94	5250	3.88	0.24

Figure 60: An example of flight details upon successful import.

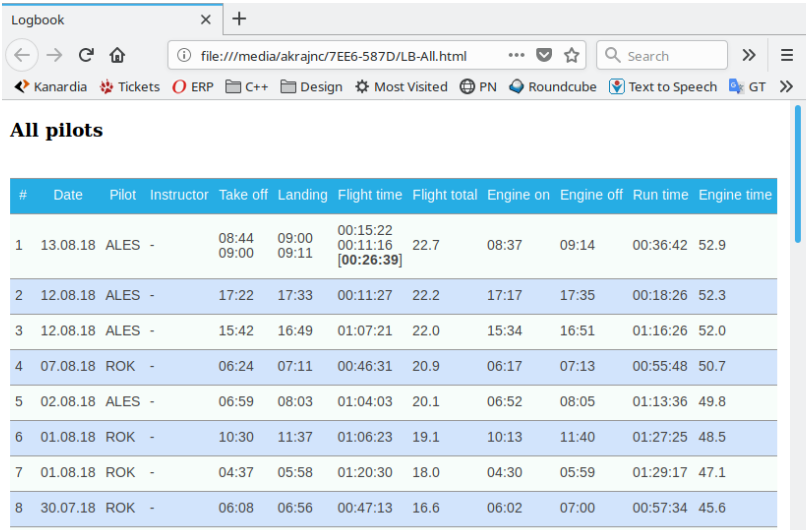
First, select a pilot or select *All pilots* in order to get a logbook for everyone. Second, select how far to look back. The options are: complete history, last year, last six months, 30 days, 7 days. After this selection, the logbook is generated on the USB stick. Any web browser can be used to view it or print it. The last flights come first. When touch-and-goes are detected, flight time for each such event is also shown. Figure 61 shows an example.

7.4 Landing and Takeoff Detection

The landing and takeoff detection strong depend of the logger options. This is also true for touch-and-go, hovering, etc. Please see Section 8.3.6 for more details.

8 User Options

Nesis options are split into two parts: user options and service options. User options are always accessible, while service options require special unique



All pilots

#	Date	Pilot	Instructor	Take off	Landing	Flight time	Flight total	Engine on	Engine off	Run time	Engine time
1	13.08.18	ALES	-	08:44 09:00	09:00 09:11	00:15:22 00:11:16 **[00:26:39]**	22.7	08:37	09:14	00:36:42	52.9
2	12.08.18	ALES	-	17:22	17:33	00:11:27	22.2	17:17	17:35	00:18:26	52.3
3	12.08.18	ALES	-	15:42	16:49	01:07:21	22.0	15:34	16:51	01:16:26	52.0
4	07.08.18	ROK	-	06:24	07:11	00:46:31	20.9	06:17	07:13	00:55:48	50.7
5	02.08.18	ALES	-	06:59	08:03	01:04:03	20.1	06:52	08:05	01:13:36	49.8
6	01.08.18	ROK	-	10:30	11:37	01:06:23	19.1	10:13	11:40	01:27:25	48.5
7	01.08.18	ROK	-	04:37	05:58	01:20:30	18.0	04:30	05:59	01:29:17	47.1
8	30.07.18	ROK	-	06:08	06:56	00:47:13	16.6	06:02	07:00	00:57:34	45.6

Figure 61: An example of logbook opened in Firefox browser. *All pilots* and *Complete History* were selected. A touch-and-go event is shown in row 1.

password. This section explains user options. See section 9 on page 110 for service options.

The user options screen can be accessed from the main menu. See Figure 30 on page 52 – the last item. Alternatively, a long-press on the knob also opens the user options screen by default.

8.0.1 Password

Some icons require password before proceeding and some options are available only when correct hardware is detected. Almost always the password is `314`, the first three most significant digits of number π. The password was introduced in order to prevent unwanted accidental alterations of important settings. The `314` password can be disabled, see section 8.3.1.

Access to the service options requires device specific password. See section 9.1 in page 110 for more details. This password can't be disabled.

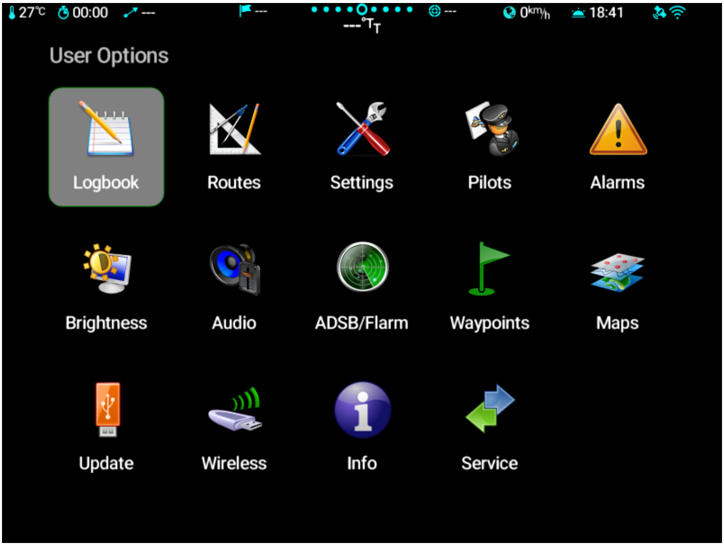


Figure 62: Illustration of the user options icon screen.

8.1 Logbook

Select the *Logbook* icon in order to access the logbook. Logbook activities are covered in section 7 starting on page 79.

8.2 Routes

Select *Routes* icon to work with routes. Route activities are covered in section 4.5 starting on page 57.

8.3 Settings

Figure 63 shows the window of main user settings items. Each of these items leads to another window with several options. They are explained in next subsections.

8.3.1 User

The user item leads to some user specific options and it is also used to assign actions to buttons and knobs, Figure 64.

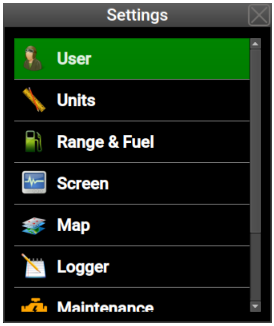


Figure 63: Main settings options.

Figure 64: User options.

`Language` Select between languages for which the translation was provided. Note that translations can be provided after the release of the software. In the case of partial translations, the missing translations will appear in the English language.

`Time zone` Specify the difference between local time and UTC time. Specify zero in order to show the UTC time everywhere. In majority of cases the difference is given in whole hours. However, some time zones also require the minute part. For example, Eucla in Australia is using UTC+8:45. In this case, set hours to 8 and minutes to 45.

`Use 314 password` Some people hate our 314 protection password. To turn the password off, set this option to *no*.

`Aircraft designation` Enter aircraft registration number.

Depending on the Nesis model, some short-cut actions can be assigned to individual buttons:

`User` default action opens list of nearest airfields.

`User long` default action issues the *Waypoint* command.

`Pager long` default action opens the *Logbook* window.

`External` is not used by default. In fact, the external button is usually not connected to Nesis. When it is connected, it is typically set to deactivate autopilot.

`External long` When connected, it is typically used to re-activate autopilot.

The following actions can be assigned to each of the buttons mentioned before. Note that some actions require additional equipment to be connected to the CAN bus to be operational.

- `Not used` means that this shortcut is not in use. `Autopilot menu` is a shortcut to the Nesis autopilot menu. See section 12.8 on page 121.
- `Autopilot level` is a shortcut to the autopilot level command.
- `Autopilot disable` is a shortcut to the autopilot disable command.
- `Logbook` is a shortcut to the logbook window.
- `Settings` is a shortcut to the user options page.
- `Near airfields` is a shortcut to the list of the nearest airfields.
- `Waypoints` is a shortcut to the waypoint selection window.
- `User Wayppoints` is a shortcut to user waypoint selection window.
- `Set marker` is a shortcut to the marker setting command.
- `Home screen` is a shortcut to the default (home) screen.
- `Alarms` is a shortcut to the alarms window.
- `Video resize` enlarges or shrinks the video subwindow.
- `Next page` switches to the next page – same as pager button.

8.3.2 Units

Nesis uses several units for different physical quantities like distance, velocity, mass, volume, etc. Table 9 shows available units. The quantities are grouped according to their function.

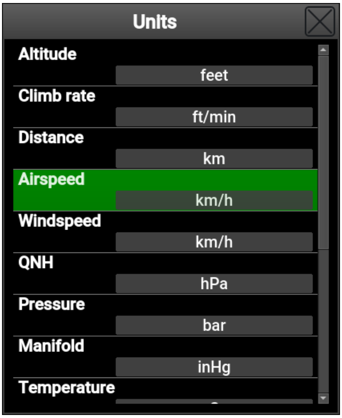


Figure 65: Unit selection window example.

Physical quantity	Available units
Altitude	feet, meters
Climb rate	ft/min, m/s
Distance	NM, km, mi(les)
Airspeed	kts, km/h, mph
Windspeed	kts, km/h, m/s
Baro correction (QNH)	hPa, inHg
Pressure	bar, psi
Temperature	°C, °F
Fuel	liters, US gallons, kWh (electric)
Flow	l/h, gal/h, kW (electric)
Engine RPM	RPM, %
Rotor RPM	RPM, %

Table 9: Available units for the individual physical quantity.

8.3.3 Range & Fuel

Parameters needed for range and fuel calculations are defined here. Figure 66 shows these parameters. Please refer also to Section 3.10.8 for more details on fuel computer monitor.

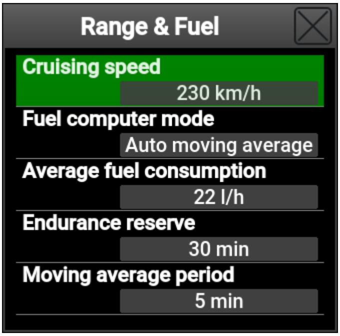


Figure 66: Parameters related to the range in fuel calculations.

`Cruising speed` This speed is used in *route* calculations. Fuel computer uses this value when aircraft is on the ground. Once aircraft is airborne, actual ground speed will be used by the fuel and range computer.

`Fuel computer mode` Fuel computer works in one of three modes, which define how average fuel consuption is calculated.

- The *Fixed* mode always uses the fuel consumption defined here in range and endurance calculations. It ignores actual values received from the fuel flow sensor.
- The *Integral* mode uses fixed estimated consumption while the aircraft is not flying – while on the ground or taxing. As soon as aircraft is airborne, it starts calculating integral consumption from the fuel flow and then it uses it for the range and endurance. The average is true integral average and takes all data after take-off into account -– it is not a moving average.
- The *Moving average* mode uses the fixed estimated consumption while the aircraft is not flying – while on the ground or taxing. As soon as aircraft is airborne, it starts calculating moving average consumption for the defined period of time. This value is then used for the range and endurance calculations.

`Average fuel consumption` represents fixed estimated average cruise fuel consumption of the aircraft. This value will be used by the fuel computer for the endurance and range calculation, depending on the selected mode.

`Endurance reserve` is the time reserve used in the endurance and range calculation.

`Moving average period` is the period of time used to monitor fuel consumption as required by moving average method. Shorter periods respond swifter to change in fuel consumption, while longer periods give slower response in range and endurance.

8.3.4 Screen

Figure 67 shows some options that affect how Nesis screens are shown.

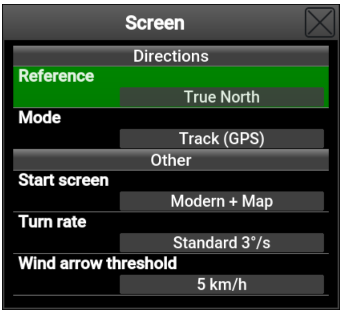


Figure 67: Parameters related to the Nesis screens.

`Reference` This options affects all directions shown in Nesis (bearings, tracking, flight planning etc.). These directions can be:

- true directions – as they are taken from standard paper map – they are related to true geographic North.
- magnetic directions – all directions are related to magnetic North.

`Mode` This option tells which value is shown on the top of each screen.

- Track received from the GNSS receiver or

- Heading received from the magnetic compass (Magu), when it is present on the CAN bus. If Magu is not present, GNSS track will be used instead even if this option is selected.

`Start screen` This option tells Nesis, which screen shall be active on the instrument start.

`Turn rate` defines visual aids for turn rate markers:

- Off – turn rate markers are not shown.
- Standard 3°/s – this is what most GA uses.
- Double 6°/s – double turn speed is slightly more dynamic.
- Glider option 12°/s – pretty fast rate.

`Wind arrow threshold` defines the windspeed above which the wind direction arrow is shown on the screen. `Magu` magnetic compass must be also present on the CAN bus in order to show the wind arrow.

8.3.5 Map

Maps (charts) can be also a bit customized. Figure 68 shows the options.

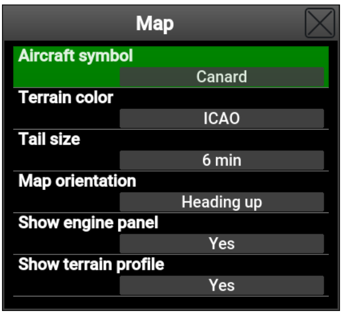


Figure 68: Map parameter that can be customized.

`Aircraft symbol` defines the aircraft symbol icon to be shown on the map.

`Terrain color` defines the terrain elevation color ramp used in terrain rendering.

`Tail size` is used to show your past flight path in real time on the map. The option defines how long this tail shall be in terms of time.

`Map orientation` defines the way the map is oriented on the screen.

- Heading up -– the map is oriented in the direction of the aircraft main axis.
- Tracking up – the map is oriented in the direction of the flight path – track (GNSS track).
- North up – the map is always oriented to the true North.

`Show engine panel` tells if the engine panel is shown on the main map screen.

`Show terrain profile` tells if the terrain profile is shown on the main map screen.

8.3.6 Logger

Logbook and logger use several parameters needed for correct takeoff and landing detection. Figure 69 shows these parameters.

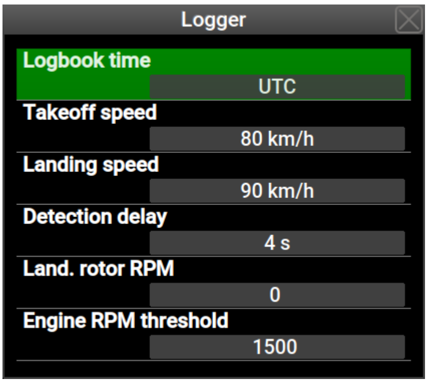


Figure 69: Logger and logbook specific parameters.

`Logbook time` defines the time used in logbook reports. It can be either local time or UTC.

`Takeoff speed` is the threshold speed, which must be exceeded. As soon it is exceeded (with a small delay) Nesis treats the aircraft as airborne. This speed shall be larger than wind gusts to prevent false logs.

`Landing speed` This is similar to takeoff speed, but it is used to detect landings. As soon as airspeed drops below this threshold, Nesis considers that the aircraft has landed and marks this in logger. It also stops counting flight time.

`Detection delay` is valid both for takeoff and landing. It defines the time for which takeoff or landing condition must be met. This is used to prevent false takeoff/landing detection.

`Takeoff rotor RPM` shall be used for helicopters only. All other aircraft shall set this to 0 (not used). This value is used to detect takeoff-and-hover condition. When rotor RPMs exceed this value for certain the detection delay amount of time, it considers helicopter as airborne. This works in conjunction with the takeoff speed.

`Landing rotor RPM` Set this to zero for all aeroplanes. Rotorcraft shall set this to a value, where they can't fly anymore (say 200 RPMs). When landing rotor RPM is set, Nesis does not relay completely on the landing speed alone, but it also demands that rotor RPMs are lower than given threshold. Only when both, speed and rotor RPMs are below their thresholds, it will detect landing.

`Engine RPM threshold` is the limiting engine RPMs used to detect that engine is running.

8.3.7 Maintenance

This option is used to set a maintenance warning. Figure 70 shows the maintenance options on the left and a warning window on the right.

`Next check at` specifies engine hours when maintenance check shall be performed.

`Warn before` is used to define how many hours before the check the warning starts to appear on the startup window.

8.3.8 Engine Shut Down

This is special option for the cases where the engine shall be cooled down by running on idle before shutting down. When aircraft is below some speed threshold and the engine RPMs are on idle a large countdown window starts

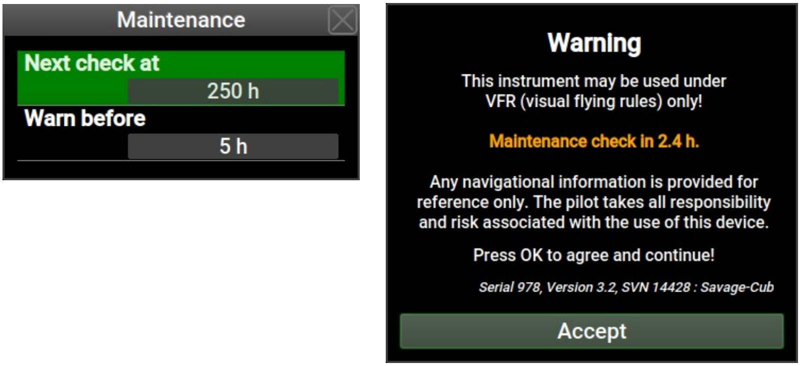
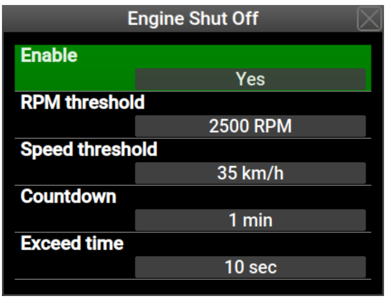


Figure 70: Left: Maintenance options. Right: Maintenance warning.

on the Nesis screen. Once the countdown disappears, it is safe to shut down the engine.

A long touch on the countdown window closes the window prematurely.

Figure 71a shows the parameters and Figure 71b shows the countdown.



(a) Parameters

(b) Countdown.

Figure 71: Engine shut down example.

`Enable` toggles this function on and off. It is off by default.

`RPM threshold` When engine RPMs are above this threshold for a certain amount of time (exceed time), it is considered that the engine is hot. When aircraft indicated airspeed is below the speed threshold and engine RPM is below this threshold, the countdown starts (only when engine is in hot mode).

`Speed threshold` This threshold shall be set below the flying airspeed and above high speed taxi. It is used together with the RPM threshold to determine when to start the countdown.

`Countdown` The countdown time - waiting time. When this time elapses, it is considered that engine is cool enough.

`Exceed time` It works together with the RPM threshold. When RPMs are higher than the threshold for more than *Exceed time*, it is considered that the engine is hot.

8.3.9 Glide

Glide is used to calculate the distance that can be reached by aircraft with engine not working – in a glide mode. The following parameters have to be defined:

`Glide ratio (finesse)` Define the glide ratio of the aircraft. Act conservatively. Smaller values yield to shorter glide distances.

`Reserve altitude` Define the reserve altitude. If some airfield can be reached in a glide mode above this altitude, then Nesis marks this in green. If an airfield can be reached, but below this altitude, it is marked yellow. All others are marked red.

This feature is impractical for some aircraft types: gyro-planes and helicopters. In this cases set the glide ratio to zero.

See also section 3.7.1 on page 28.

8.4 Pilots

When several people are flying an aircraft, pilots and instructors can specified. When more that one pilot is given, Nesis ask for its name on the startup and when at least one instructor is given, Nesis also asks for an instructor. Pilot and instructor names are automatically recorded, when takeoff conditions are detected and they will show in the logbook.

Figure 8.4 shown an example of one instructor and three pilots. A check over an icon means that this pilot/instructor is currently active.

Only one pilot can be active at the time. In addition, one instructor may be also active. An instructor appears in two roles as a pilot and as an instructor.

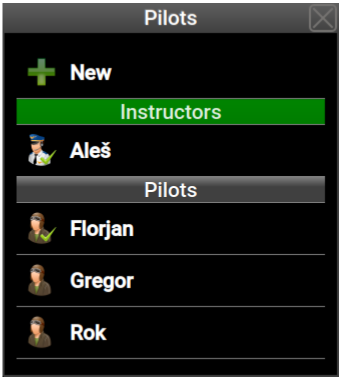


Figure 72: An example of window used to edit pilots.

Adding a Pilot

Select the *New* command in order to enter new pilot or instructor. A window appears and it ask to select between a pilot or an instructor. After this, enter a new pilot or instructor name.

Editing a Pilot

First select a pilot or an instructor name from a list. A command window appears. Select *Edit* from the list. Next, select class.

Note that a pilot name can't be edited. If a mistake was made, delete a name from the list and create a new one.

Deleting a Pilot

First select a pilot or an instructor name from a list. From a command window select *Delete* and name will be removed from the list.

Deleting a name from a list will also delete name from logbook. A flight, made by this pilot will be still in the logbook, but -- will appear instead of the name.

Activating a Pilot

On Nesis start, a chance is given to select a pilot or an instructor from the list. When a wrong name was selected, an active pilot or instructor can be activated from the options screen. Select the *Pilots* icon, select a name from the list and select *Activate* from the command window. An active instructor is selected in the same way.

8.5 Alarms

Nesis has several alarms, which are triggered, when certain parameter turns *red*. Selecting the *Alarm* icon from the *Options* screen opens a window where all possible alarms are listed. Figure 73 shows an example.

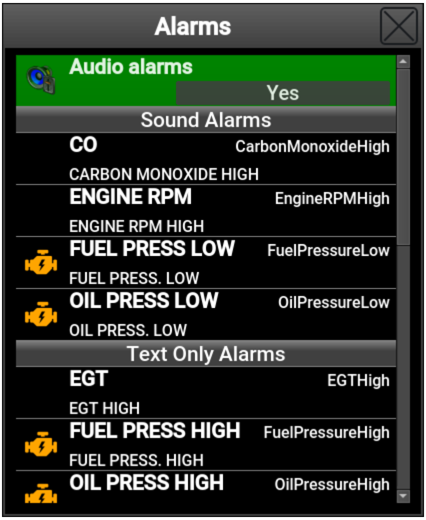


Figure 73: An example of alarms in Nesis.

The alarms shown in groups:

- `Sound Alarms` are alarms that produce either voice output or a warning beep. Any of this two is also accompanied with a text warning.
- `Text Only Alarms` are alarms that produce no audio output. They only display a text warning message.
- `Disabled` are alarms that will never show up.

A special (topmost) option in Figure 73 allows a quick mute of all alarms. When *No* is selected, no sound or voice will be played regardless of the actual state of individual alarms.

An engine symbol indicates that this alarm can only appear when engine is running. This prevents false alarms. The oil pressure alarms is such an example. The pressure is always low when engine is not running.

8.5.1 Editing an Alarm

Select an alarm from the list in order to open the alarm editor window shown in Figure 74.

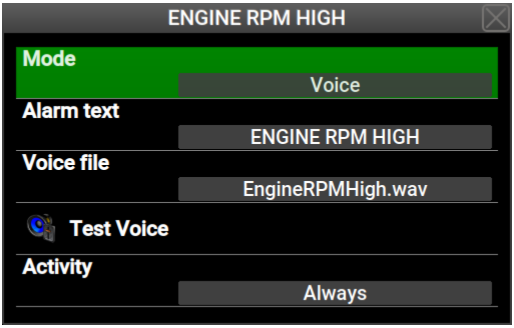


Figure 74: An example of alarm editor for the high engine RPM situation.

`Mode` For each alarm a behavior can be specified. There are four possibilities:

- `Disable` is used to disable alarm completely. This is useful in case of a sensor failure. A faulty sensor keeps signaling false alarms and with this options it will be disabled.
- `Text` is used to display an alarm without any sound.
- `Sound` is used to play a beep sound along with the text.
- `Voice` is used to play a voice describing the alarm along with the text. Alarm text output and voice depend on the language settings.

`Alarm text` Edit or enter a new text to be shown on the screen.

`Voice file` Select the voice file to be played when alarm is on. Voice will be played only if *Voice* option is selected for mode.

`Test voice` plays selected voice file. This is used to check if the selected file is the correct one.

`Activity` defines a condition when an alarm is active.

- *Always* means that the alarm is always active.
- *With engine* means that the alarm is active only when engine is running.

8.6 Brightness

The brightness icon is used to change the display brightness. Nesis always starts with 100% brightness. Brightness is selected in 10% steps.

When Nesis runs on a backup battery (when such option is installed) it is highly recommended to reduce brightness to 80% or less. This will significantly increase the run time available on the backup battery.

8.7 Audio

The *Audio* icon is used to change the audio level output for Nesis warnings. Figure 75 illustrates an example. The *Test* option is used to play a test file and the *Volume* sets the volume level in 10% steps.

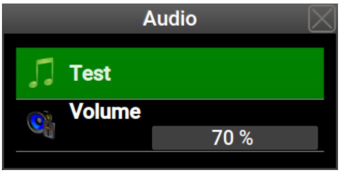


Figure 75: The audio level window.

8.8 ADSB/Flarm

The *ADSB/Flarm* icon is used to set various Flarm/ADSB settings. The details are covered in section 5.4 starting on page 71.

8.9 Waypoints

The *Waypoints* icon is used to add and edit user specific waypoints. Figure 76 shows a window that appears. The top part list commands and the bottom part list all user waypoints.

8.9.1 New Waypoint

The *New* command is used to create a new user waypoint. Nesis asks for a waypoint name first and once the name was given, it asks for the details. Figure 77 shows an example.

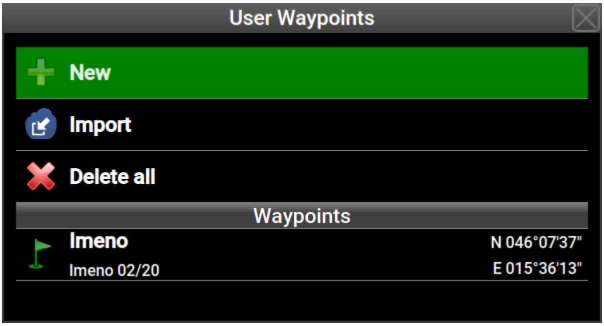


Figure 76: An example of user waypoint window.

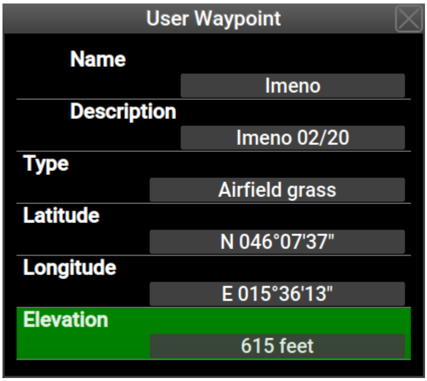


Figure 77: An example of user waypoint details window.

`Name` Name of the waypoint.

`Description` Longer description of the waypoint.

`Type` Type of the waypoint. When one of the airfield types is specified, this waypoint will also appear in the airfield list.

`Latitude` Waypoint latitude in degree, minutes, seconds format.

`Longitude` Waypoint longitude in degree, minutes, seconds format.

`Elevation` Waypoint mean sea level elevation.

8.9.2 Import

The *Import* command is used to import waypoints from a file on USB stick. Three different formats are recognised:

- Garmin GPX format,
- Google KML format,
- Glider CUP format.

During import, all importing waypoints that are closer than 0.5 NM to any existing waypoint are ignored.

Also, the total limit for user waypoint is set to 700. Any waypoint inserted after the limit has been reached, is ignored.

8.9.3 Transfer

This option is shown only, if the second Nesis is detected on the bus. This command will transfer all user waypoints from this Nesis to the other. Any existing user waypoint on the other Nesis will be overwritten.

8.9.4 Delete all

The *Delete all* command deletes all user waypoints in one step. A confirmation is required.

8.9.5 Delete unnamed

This command deletes all user waypoints that have no name assigned. These are typically markers, which name has not been changed to something meaningful.

8.9.6 Waypoint Edit/Delete

When a waypoint from the list is selected it can be either deleted or edited. No confirmation is required in the delete case. When *Edit* option is selected, a window shown in Figure 77 is opened. See section 8.9.1 for details.

8.10 Maps

The *Maps* icon is used to copy map files from the USB memory stick into the system. Such files are various maps, airspace database, license files, etc. Figure 78 shows available options.

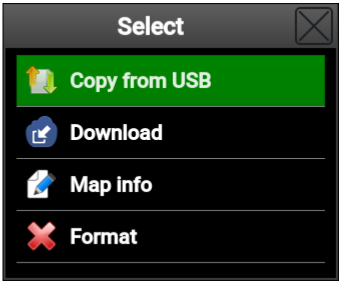


Figure 78: Map options window. Note that some options are available only when Nesis is connected to the Internet.

`Copy` copies a file with `kus`, `ras`, `nam` or `lic` extension from an USB memory stick. All these files are in Kanardia specific format. A new window appears asking for intended copy action, Figure 79. Vector maps have `kus` extension, raster maps use `ras` for the maps and `lic` for licenses and approach maps expect `nam` extension.

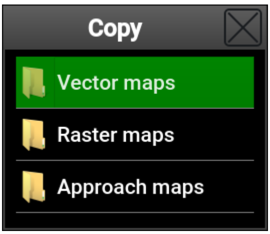


Figure 79: Type of file to search for.

Each copy is a two part process. First, Nesis checks the integrity of the file and if the check has passed, the file is copied next. Usually, a restart is required afterwards.

Please note that you can't use the copy command for the system update, although the update file has the correct extension. Use the *Update* icon instead.

`Download` is used to copy a file form the Internet and it is only shown when WiFi connection is available. In principle, this command is very similar to the `Copy`, just that it requires an active Internet connection.

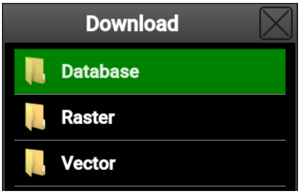


Figure 80: Type of file to search for.

Selecting `Database` allows downloading the latest airspace, airfield and other navigational data, while `Raster` and `Vector` work the same as in the `Copy` case.

The download is limited in file size, though. Some very large files like `USA.kus` can't be downloaded and a USB memory stick must be used instead. Please also note these files are quite large and transfer fees from your GSM provider may occur.

`Map info` lists *map files* loaded into Nesis, Figure 81. It does not list any system map files. The raster files list shows map name, date of map creation, map file name, map type and size.

`Vector` maps can't be deleted. Nesis only lists the country names that were loaded into the system.

`Raster` displays raster maps in the system. A selected raster map can be removed with the `Delete` command. After removal, Nesis will restart.

`Approach` displays approach maps in the system. A selected map can be deleted from the system using the `Delete` command or simply turned off/on using the `Disable/Enable` command.

`Format` is a very powerful command and normally it should never be used. It will reformat internal disk section. This section stores maps. This effectively deletes all maps – system maps and raster maps. The command can't be revoked. If there were license files installed, they will be lost too.

Figure 81: An example of raster file list. Red cross means that file is correctly copied but valid licence file is missing. Green check means that correct license file is also present.

8.10.1 When Copy Fails

Copying may fail. When it happens, an error message is displayed after the verification process has been completed. The most probable cause is a corrupted file on the USB memory stick. Download the file again and make sure to use the *Safe remove* command before removing USB memory stick from PC. Then try again.

8.11 Update

The *Update* icon starts system software update. It asks for a confirmation and when confirmed, Nesis restarts in a special update mode. More details are given in section 10 starting on page 112.

8.12 Wireless

The *Wireless* icon opens a window where parameters for wireless connection are given. Standard Nesis does not have wireless capabilities. You need a compatible wireless USB plug in adapter. It is typically connected to the USB port on the Nesis back side. Please refer to the Nesis Installation Manual for more details.

8.13 Info

The *Info* icon tells some technical information about the Nesis and connected CAN bus devices. Figure 82 shows an example.

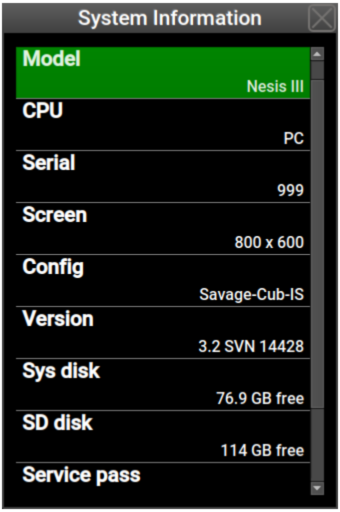


Figure 82: An example of info window with the system details.

`Qt Library` tells the Qt library version in use. When selected it opens further options. Please refer to section 14.1 on page 133 for more details.

`Model` tells Nesis model.

`CPU` tells the model of the main CPU used in Nesis.

`Serial` tells serial number of Nesis.

`Screen` defines the screen pixels resolution.

`Config` defines the configuration file used to define the number and look of Nesis screens.

`Version` is the version number of software in Nesis. First number is version in standard format and the second number is a build number. The later is useful in troubleshooting.

`Sys disk` tells free space on the Nesis system disk.

`SD disk` tells free space on the internal SD card, where map files are stored.

`Service pass` holds a numeric password, which is needed to access the *Service Options*.

`GNSS details` opens a window with GNSS satellite positions and status. The following status are shown:

- *Error* is shown if there is no GNSS reception or some internal error is detected.
- *2D fix* is shown when a position is known, but precision is limited.
- *3D fix* is shown when a position is known and enough satellites are visible for a good fix.
- *3D+SBAS* is shown when a position is also augmented with SBAS system – highest precision.

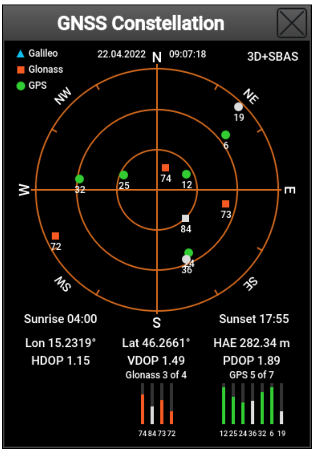


Figure 83: An example of GNSS details. The example shows bad satellite distribution and relatively weak signals.

`Counters` section lists three internal counters:

- Engine total time – total time of engine running.
- Flight total time – total time of aircraft being airborne.
- Power-on total time – total time of Nesis being powered on.

`CAN devices` section lists all devices detected on the CAN bus, together with their hardware and software versions, production data, etc.

8.14 Service

The *Service* icon is entry point to protected *Service Options* section. It requires a special password. This password is unique for each Nesis. It can be found under *Service pass* item on the info window. See section 8.13.

Additionally, this password is also written on the warranty card, that comes with each Nesis.

Service option icons are briefly explained in separate section 9, while the detailed explanation is given in the `Installation manual`.

9 Service Options

Most of *Service options* are covered in depth by other manuals, particularly in the *Nesis Installation Manual.* Here, only a brief information will be presented. Figure 84 shows the service options screen. Note that slave Nesis has only a subset of these icons.

9.1 Password

In order to access the service options page, a four digit device specific password is required. This password is written on the warranty statement, which should be delivered with the instrument. The same password can be also found by selecting the `Info` icon from user options (section 8.13). Search for the `Service pass` and number next to it is the service password.

9.2 Icons

The following icons are available on the service options page:

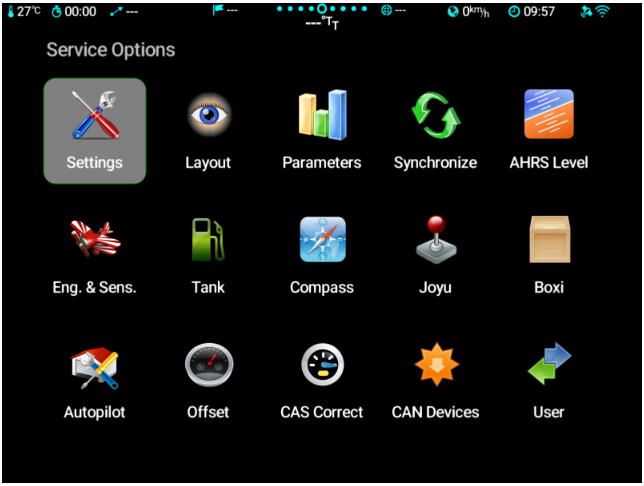


Figure 84: The service options window and corresponding icons.

`Settings` opens a window, where access to further settings like flap positions, trim sensitivity, properller pitch, special recorders, video input, serial ports, backup and restore, etc..

`Layout` is used to start screen editing (limited to engine part on Modern screens) and to define various screen options.

`Parameters` is used to define engine, flight and other parameter details like their names, green, yellow and red limits, responce times and other parameter specific attributes.

`AHRS Level` is used to set the level position of the AD-AHRS-GNSS module.

`Eng. & Sens.` opens window for the EMS device. Channels and sensors are configured here.

`Compass` opens a window for the calibration of optional electronic compass device called MAGU. The window is opened only when Magu was detected on the CAN bus. Due to complexity the details are explained in the *MAGU Manual*.

`Tank` is used for tank calibration.

`Offset` allows various sensor and counter adjustments.

`Autopilot` is access point to several autopilot configuration windows. A separate document was prepared for autopilot installation and settings. Please see the *Autopilot Installation Manual.*

`CAN devices` lists devices found on CAN bus and allows to perform some special operations on them.

`Joyu` is used to assign commands to the `Joyu` command stick.

`Boxi` is used to configure `Boxi` box used to drive trims, radio or some other external motor or relay. Boxi often works together with Joyu.

`Engine Log` is similar to the logbook, but it shows logs based on the engine time. It also detects shorter test engine runs on the ground, which are normally ignored by the logbook. This is useful for service and testing purposes. When an item is selected, it is copied to an USB memory stick in the *tab* format. See section 7.2.2 for more details.

`CAS Correct` is used to enter the calibration airspeed corrections. Please refer to the Installation manual for more details.

`User` brings back the *User Options* screen.

10 Software Update

This section describes actions required to update the software.

The Nesis software is under continuous development, where we are adding new features and sometimes we also remove some old ones. Updating to the latest version is not completely without risk, especially if you are updating from a very old version. If your system works fine, think about updating and its associated risk first. If you can wait with an update, try to update at the end of flying season. Please, avoid updating just before a long flying trip which you were long wating for.

10.1 Versioning

Kanardia is using semantic versioning MAJOR.MINOR.PATCH. A version labeled as 3.2.5 means major version 3, minor revision 2 and patch (fix) 5.

A MAJOR version increase means that it may break compatibility with existing version. Furthermore it may also mean that old hardware is not supported anymore or that some old features will be dropped. Think twice before updating to a higher version as significant side effects may occur.

A MINOR revision increase should keep compatibility with previous revision of the same version. Though sometimes side effects may kick in. If they do, they should be small enough.

A PATCH with higher number and same version and revision is usually issued to correct some corner cases which were not properly addressed. In most cases the changes are insignificant and side effects shall be minor or nil.

10.2 Downgrading

In general, downgrading to previous version or even to previous revision *IS NOT SAFE*. Significant negative side effects may occur.

10.3 Updating with USB Memory Stick

In most cases, Nesis is updated using USB memory stick. Here the following steps are required:

1. downloading an update file,
2. copying the update file to the USB stick,
3. updating Nesis with the USB stick.

In the case of two or more Nesis units, they must be updated one by one. Start with master first.

Once Nesis is updated to a new version, old version can not be put back without causing system instability.

10.3.1 Downloading Updates

The latest (actual) software can be found on the Kanardia web page `www.kanardia.eu`. Follow these steps:

(1) Open the home page and select *Nesis* icon on the top. This leads to Nesis specific page.

(2) Select *Software* next. This opens a page with Nesis specific software. An example is shown in Figure 85.

(3) Click on the link to start download process of selected software file.

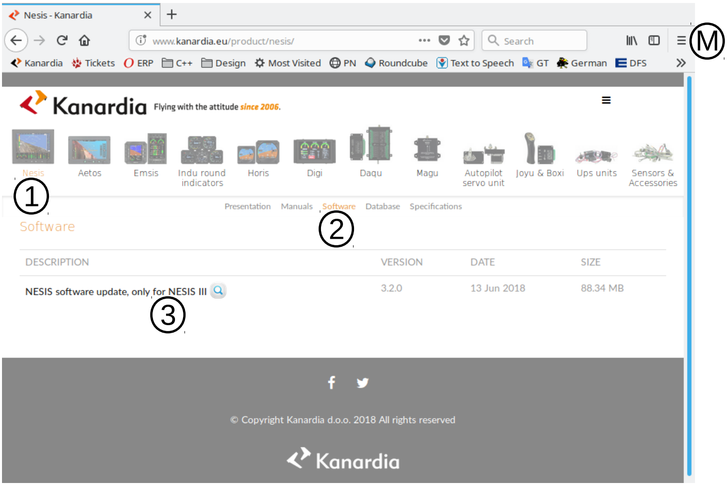


Figure 85: Illustration of the Nesis software download page. Usually only the latest update is available.

Problems with Download

Some people complain that after click on the link nothing happens. This is most probably because their browser blocks pop-up windows. Solution for this depends on the browser.

`Mozzila Firefox` solution is given in next steps:

1. Click on the ≡ menu symbol. See label M in Figure 85.
2. Select *Preferences* option. This opens a window in Firefox.
3. Select *Privacy & Security*.
4. Scroll down to the *Permissions* section.
5. Click on the *Exceptions* button next to the *Block pop-up windows*.
6. The *Allowed Websites – Pop-ups* window appears. Enter url address *www.kanardia.eu*.
7. Click on the *Allow* button.
8. Click on the *Save Changes* button.

`Chrome` solution:

1. Click on the ⋮ menu symbol.
2. Select the *Settings* option.
3. Scroll completely down and click on the *Advanced*. This opens *Privacy and security* options.
4. Click on the *Content settings* to open them in a new window.
5. Click on the *Pop-ups and redirects*.
6. Under *Allow* section, click on the *Add* button.
7. Enter *www.kanardia.eu* and press *Save*.

`Safari` solution:

1. Click on the *Safari* menu and select *Preferences*.
2. A window appears. Select the *Security* icon.
3. Uncheck the *Block pop-up windows* checkbox.

Note that Safari does not allow exceptions for individual web sites.

10.3.2 Copying Update File to the USB Memory Stick

The downloaded file must be copied to a USB memory stick. We recommend copying it to the root folder.

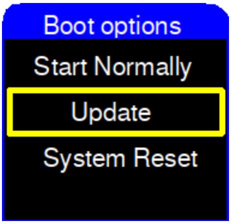
Important: Once file was copied, please make sure that the USB stick is safely removed from PC. This makes sure that all files are properly copied and closed before the stick is actually removed from PC.

10.3.3 Performing the Update

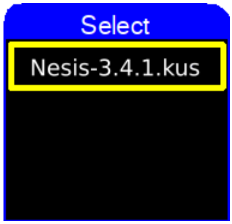
Once the update file is on the USB stick follow the steps below: Please note that touch screen is not working in the Nesis update mode.

1. Insert the USB stick with the update file into USB port.
2. Select *Options* from the main menu and then select the *Update* icon and confirm the decision. If option *User Password* is enabled the user must provide standard password **314**. Nesis will restart in special update mode.
3. Upon restart a window similar to Figure 86a opens. Select the *Update* option.

4. A window similar to Figure 86b opens with kus files listed. Normally, only one file is listed. Select the update file (kus file) and push the knob. The update process is now started.



(a) Nesis update mode options.



(b) Update file selection.

Figure 86: Special update mode example.

Once update process has been started, do not cancel or terminate it. Make sure that battery is sufficiently full. The update process may take a few minutes.

The update process will automatically perform the following steps:

- The update file integrity is verified. In the case of *Update file checksum ERROR* message, it usually means that the file was corrupted and it must be downloaded again. In most cases, forgetting to *safely remove* the USB stick from PC is to blame.
- Files stored inside the update file are copied into Nesis. Once this is completed, Nesis restarts.
- A few moments after the restart, firmware update begins. Nesis will update firmware in all devices found on the CAN bus automatically. The firmware update process may take a few minutes[8]. Secondary Nesis does not perform firmware update[9].

10.4 Direct Update Mode (Emergency Mode)

In the case of software failure, where Nesis does not start-up properly anymore and the *Update* icon from the *Options* screen can't be reached, the following

[8] In rare cases, the firmware update may fail. In this case, simply turn Nesis off and then on again. On the second try, it will update the remaining devices.

[9] Secondary Nesis with IGEP CPU is an exception, as it will only update its own MABU device.

approach may help:

1. Power Nesis off,
2. power it back on and
3. keep pressed the *Screen switching button*, see label (5) in Figure 1, page 19. Wait until the window similar to window shown in Figure 86a appears.

   This brings Nesis to the point where software can be updated.

11 Database Update

Nesis is using several aviation databases. These databases are regularly maintained and their latest versions are available on our web site.

The databases include: airfield information, frequency information, navigation points, airspace zones, recommended VFR routes, etc. All these databases are packed into one bundle and published on our web site. The name of the bundle is *AvioLatest.kus*.

11.1 Updating with USB Stick

In most cases the databases are updated using USB stick in three steps.

1. downloading the latest database file,
2. copying the file to the USB stick,
3. updating databases from the USB stick.

11.1.1 Downloading Updates

The latest (actual) database version can be found on the Kanardia web page `www.kanardia.eu`. Follow these steps:

1. Open the home page and select `Support` menu from the top and then select the `Database` option. A list of available files appears.
2. Select the `Avio-XXXX.kus` file. Check the publish date. The `XXXX` is just a placeholder for some number.

3. Click on the link to start the download process.

If you have problems with the download, please refer to the section 10 starting on page 112.

11.1.2 Copying Update File to the USB Stick

The downloaded file must be copied to the USB stick. We recommend copying it to the root folder.
Important: Once file was copied, please make sure that the USB stick is safely removed from PC. This makes sure that all files are properly copied and closed before the stick is actually removed from PC.

11.1.3 Performing the Update

Once the file is on the USB stick follow the steps below:

1. Insert the USB stick with the update file into Nesis USB port.
2. Select `Options` from the main menu and then select the `Map` icon
3. Select the `Copy from USB` option.
4. Select the `Vectors` option.
5. Search for the `Avio-XXXX.kus` file and select it. Nesis will copy the databases.
6. Wait for copy to finish and then close all windows.

Nesis will restart with new databases being active.

11.2 Update with WiFi

When Nesis is equipped with WiFi dongle and Internet access is available, the database can be updated online.

1. Select `Options` from the main menu and then select the `Map` icon
2. Select the `Download` option,
3. Select `Database`.

4. Search for the `Avio-XXXX.kus` file and select it. Nesis will copy the databases.
5. Wait for copy to finish and then close all windows.

12 Autopilot

When Nesis system is extended with one or two servo motors, than Nesis can be also used as an autopilot controlling device. In general, no other electronics, but servos is needed. This section describes basic operations with autopilot system.

12.1 Intended Use

The autopilot is designed to help a pilot in stable, controllable flight conditions during cruising. If such conditions are met, the autopilot can be engaged to take some relief from the pilot, who can perhaps focus a bit more on ATC communication or to do some navigation task. Nevertheless, it is still pilot's responsibility to monitor the autopilot and airplane behavior all the time.

12.2 Operation Limitations

Always respect the following limitations.

- The autopilot shall be only used in VFR (Visual Flying Rules) conditions.
- Information from the Aircraft Operating Handbook always supersedes information given in this manual.
- The autopilot is designed to be used only in cruising conditions. It will not work at low and high speeds. It can't fly approaches and departures and it can't do takeoffs and landings.
- The autopilot shall not be used in turbulence.
- Do not use the autopilot with flaps extended.
- In any case of abnormal activity, the autopilot must be deactivated and the pilot must take over the commands immediately. Never wait for autopilot to deactivate itself automatically.
- Autopilot does not use any information from Magu (magnetic compass).

12.3 System Description

Autopilot system shown in Figure 87 consists of Nesis, power supply switch and two or more servo motors units called *Seru*. All these units are connected via CAN data bus which enables the communication between them. The Nesis is used for autopilot control and configuration. The Seru units are servo-motors which are moving the aircraft control surfaces. Power switch is used to cut the power to the servo motors – this quickly disables servo motors and frees the aircraft commands. In addition, it is also possible to install a quick autopilot disable switch which can be placed on the command stick.

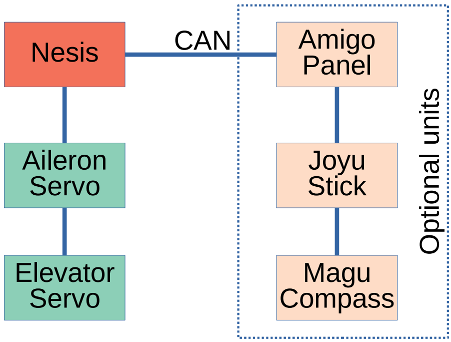


Figure 87: Main units of the autopilot system. Some units are optional.

Each Seru unit is controlling one aircraft control surface. In two axis autopilot system, one Seru unit is linked to the aircraft aileron which is controlling the roll angle and therefore controlling the heading of the aircraft. The second Seru unit is linked to the aircraft elevator and is controlling aircraft pitch and therefore altitude or vertical speed.

12.4 Autopilot Status Window

Autopilot status box as shown in Figure 88 can be found on each Nesis screen. The status box shows state of autopilot axes. A green text next to the axis indicates that it is active. A gray text means that an axis is disabled. In addition, selected autopilot parameters are also shown in the status box. When both autopilot axes are disabled the status box is hidden, automatically.

A short touch on the autopilot status opens the autopilot menu. A long touch on the autopilot status disables the autopilot.

Figure 88: An example of the autopilot status box.

12.5 Autopilot Setup

For autopilot installation and setup please check separate document: *Autopilot Installation Manual*. In this section only autopilot operations are described.

12.6 Setting User Button

User button shall be configured to provide a quick access to autopilot functions. It is advised to configure buttons as:

- *Short Press* set to the *Autopilot Menu* function,
- *Long press* set to the *Autopilot Disable* function.

Please check section 8.3.1 on page 88 for more details.

12.7 Safety

> Autopilot system is not terrain aware and it will not make any avoidance action or issue any terrain warning!

Please refer to the Autopilot Installation Manual for more details about the safety measures.

12.8 Operation

Short press on the *User* button shows the autopilot menu, Figure 89. All autopilot actions are accessed trough this menu.

The description of the actions is presented below. Some actions enable only pitch and some only roll autopilot servo. The level action is the only one, which enables both autopilot servos simultaneously.

Autopilot menu remembers the previous selection. When the menu is opened, previously accessed action is already selected. This saves time when you change one parameter often.

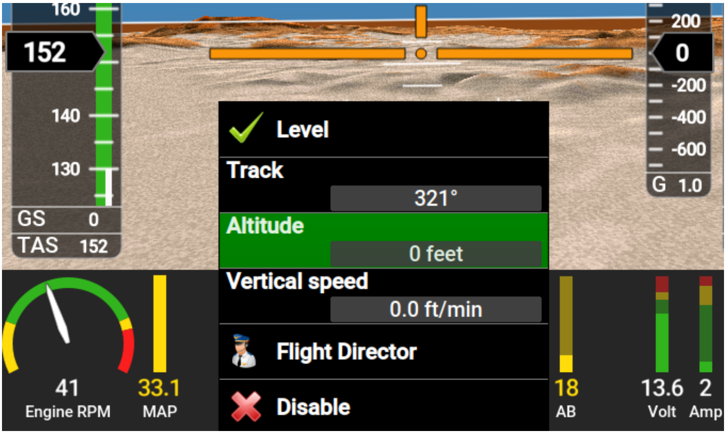


Figure 89: An example of the autopilot menu.

12.8.1 Track

In order to fly some desired track course the *Track* action is selected from the menu. A window with track direction input is shown in Figure 90. The default value of the input window is always current track. If active screen also shows the heading bug, the bug is adjusted as well.

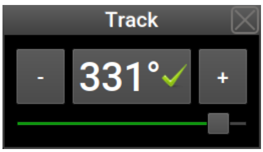


Figure 90: Illustration of the track input window.

If the autopilot was not active before selecting new track the roll servo motor will be automatically enabled after the track is confirmed. Otherwise, the autopilot will try to follow desired track while changing values on the input window.

The autopilot will always turn the airplane in the direction which is closer to the current track. When a change for more than 180°is made in one direction, the autopilot will turn the aircraft in opposite direction. The maximum roll angle of the turn is selected in autopilot setup menu. See *Autopilot Installation Manual* for reference.

A long touch on the compass rose sets the heading bug. When autopilot is active, it switches into track mode and it automatically follows new selected direction.

12.8.2 Altitude

In order to hold or change desired flying altitude the *Altitude* action is selected from the autopilot menu. A window with altitude input is shown in Figure 91. The default value of the input window is always current altitude.

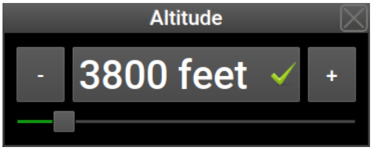


Figure 91: Illustration of the altitude input window.

12.8.3 Flight Director (HNAV)

In order to follow a pre-planned route or fly to some selected waypoint the *Flight director* action is selected from the autopilot menu. Nesis then becomes primary navigation source for the autopilot. The autopilot will follow any active navigation. Roll servo motor is automatically activated. Please refer to section 4.5 starting on page 57 for more information about route planing.

The flight director is controlling only direction of flight. To change altitude use *Altitude* command.

The navigation can be changed dynamically. When flight director is active the aircraft will start to turn immediately after selecting new waypoint or activating a different route leg.

When aircraft is significantly off-course, flight director approaches the active route leg at 45°angle. When close enough, it turns back to the leg direction minimizing the cross-track error.

Once aircraft reaches the last point of the route or a direct-to waypoint it starts to circle around that point. During turns, the aircraft is maintaining the roll angle configured in settings.

When autopilot is active a touch on a map navigation point will activate the touched point as a direct-to and put the autopilot into Flight Director mode (HNAV).

12.8.4 Disable

The *Disable* command disengages all servomotors connected to the system. This action is immediate and the user is not asked for any confirmation. The route or direct-to waypoint selection remains unchanged.

12.8.5 Level

The *Level* command is the only autopilot command that activates both servos. When the command is issued, autopilot keeps aircraft leveled. It does not follow any course and it does not maintain any particular altitude.

13 Maps

Nesis uses several different map principles that are combined into one system using layers technique:

- Vector map with elevation data. This map principle is using vector information to draw a map. Most entities like road, railroads, rivers, etc. are drawn as lines and filled areas at run time on top of a elevated terrain image.
- Raster map. This map comes already fully prepared - it is like a very big photo, with all possible details included in the photo.
- Approach maps. These are similar to raster map. They are usually refering to smaller areas around airfields. Please see the Approacher Manual for more details.

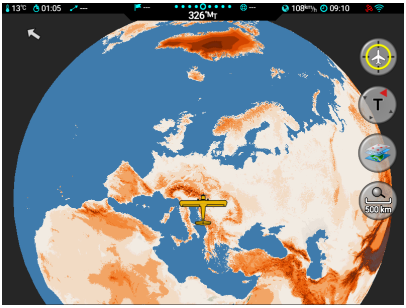
These map principles, which seems to be exclusive, are combined together using layers technique.

All map information is always drawn as a part of globe. No fixed projection is used. The projection is dynamic and automatically adapts according to the zoom level and current position. This was achieved by using the high performance graphics OpenGL system.

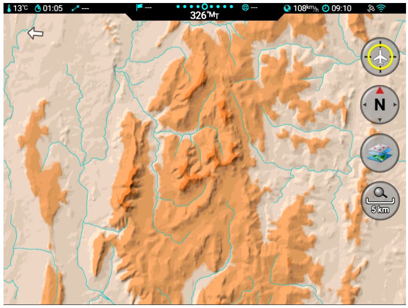
13.1 Layers

The map shown on Nesis consists of several layers, which are drawn on top of each other.

- Low resolution worldwide terrain presented as a globe is the most bottom layer. This layer is hidden most of the time by the high resolution terrain layers. Figure 92a shows example of this layer.
- High resolution terrain is drawn next. Some examples are shown as background in Figures 92b, 6 and 7.



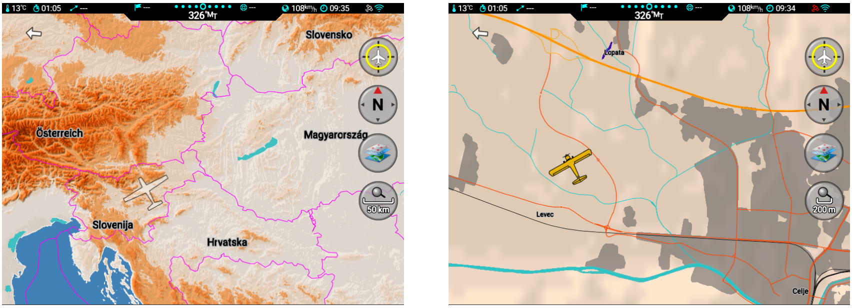
(a) Low resolution map – distant view seen as a globe.



(b) High resolution map – this one is made on globe as well.

Figure 92: All map operations are made on globe.

- Rivers, roads, railways, country borders, country names, cities are drawn next. The detail of this layer strongly depends on the zoom level. Figure 93 illustrates an example.
- On top of this layer come airspace zones. Their visibility also depends on the zoom level.
- Next, airfields, airfield details, navigation points are drawn. Some airfields have traffic patterns, holding zones, arrival and departure routes. They are drawn in a separate layer. See Figure 94a.
- When raster maps are used, they are drawn next. It is important to note, that they hide (overwrite) all layers below, in the part, where raster maps are visible. Figure 94b shows an example, where left part of the screen is covered with raster map and the rest is vector map. The



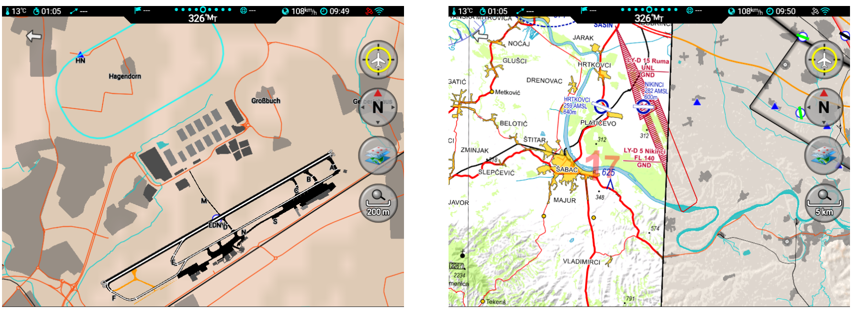
(a) Low vector detail.

(b) High vector detail.

Figure 93: The details of vector map depend on zoom level.

figure shows how raster map overwrites all previous layers. It also shows that both maps blend together pretty good.

- When weather information is available, it is drawn next in a semitransparent way.
- Approach maps are drawn next. They are also drawn in a semitransparent way where the transparency can be adjusted.
- Active navigation details, airplane symbol and other navigational and operational items are drawn the last.



(a) Airfield and traffic circuit detail.

(b) Raster and vector side by side.

Figure 94: More details of vector map and blending with raster map.

13.2 Vector Maps

Vector maps are based on several map sources.

- Elevation data is based on 3 arc-second DEM data, which is originaly provided by SRTM[10].
- Roads, rivers, lakes, railways, populated areas, state borders, etc. are obtained from the OSM[11] project. Only a tiny subset of this always growing project is used. We update this data once per year.
- The major source for aeronautical information, airfields, airspace zones, navigation aids, etc. represents the OFM[12] project. Partily, we also take data from Our airports[13] web page.

These maps are packed into several files, which can be downloaded from our server. These maps do not include any aviation information. They include terrain and basic topography.

13.2.1 Installing a Vector Map

The instrument is delivered with the vector maps partially installed. The low resolution maps are installed for complete world, but high resolution maps only for some specified area.

Low resolution world wide layer can be installed as follows:

1. Download the `WorldBase.kus` file.
2. Copy the file to a USB memory stick. Make sure to use *safe remove* option before removing the stick from your PC.
3. Insert the stick into Nesis, switch to `Options` page and select the `Map` icon.
4. Select the `Copy from USB|Vector` item and search for the `WorldBase.kus` on the stick. Select it to start the copy.

[10] Shuttle Radar Topography Mission, digital elevation data, produced by NASA.
[11] Open Street Map – `www.openstreetmap.org`.
[12] Open flight-maps – `www.openflightmaps.org`.
[13] Our Airports – `ourairports.com`.

The `WorldBase.kus` is already installed in Nesis by default, so the procedure mentioned above can be skipped in most cases.

High resolution layers are provided per country.

1. Visit our web page and use interactive map to select counties of your interest. Download them one by one.

2. Copy the downloaded files to the USB memory stick. Do not forget to use *safe remove* option before removing the stick form PC.

3. Start Nesis and insert the USB stick. Switch to the `Options` page and select the `Map` icon.

4. Select the `Copy from USB|Vector` item and then select a country with the `ras` extension from the stick. This start the copy process. Repeat this until all high resolution country files are copied.

5. Close all windows. Nesis will restart with new maps being active.

13.3 Raster Maps

Raster maps are complete maps in a form of an image usually prepared by professional organizations. The advantage of raster map is in the fact that final map optimization is done by human beings, which makes maps much more alike the paper map. In many cases, raster maps are nothing but electronic versions of paper maps.

Some of these maps may be obtained only under license and some of them are freely available.

Typically, these maps are provided as a file with `tiff`, `jpg`, `png`, `bmp` `pdf` or similar raster image extension. The most suitable format is tiff with integrated geo-referenced information – so called geotiff.

We use special software to convert one of these formats into a format optimized for Nesis and Emsis. Typical extension of our format is `ras`.

Some of our `ras` files are copy protected and they will be visible only when proper license file is also installed. This license file has `lic` extension.

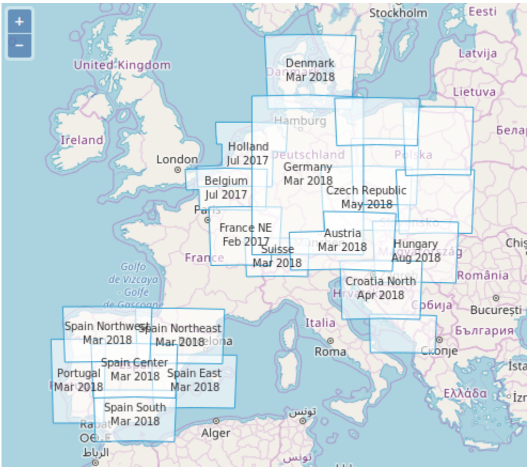


Figure 95: Availability of the DFS maps.

13.3.1 DFS

We obtain DFS – Deutsche Flugsicherung maps from R. Eisenschmidt GmbH – `www.eisenschmidt.aero`. We convert these maps into `ras` format that is optimized for Nesis and also Emsis. The maps can be downloaded from our web site. Figure 95 shows coverage of DFS maps.

All DFS are licensed maps. You can download the `ras` files from our web page and install them on Nesis, but they will not be displayed on Nesis screen unless proper license file is purchased from us and copied.

Installing License

The license file is bound to a Nesis serial number. In order to obtain the license file, please contact `support@kanardia.eu` and tell us your Nesis serial number. We will charge you a license fee and once this is paid, an email with the license file will be send back to you. If you have two screens, you have to tell us serial numbers of both screens. There are no additional license fees for the second screen.

The license file has the `lic` extension. It is copied to Nesis in the same way as the maps with `ras` extension are copied. Please see section 13.3.5. If you have two screens, you have to copy this to both.

You can copy any DFS ras file before you get the license file. The files will be installed, but ignored by Nesis until the proper license file is also present.

13.3.2 US Sectionals

FAA publishes and regularly updates several raster charts which are covering complete US territory. We take these charts and convert them into `ras` format suitable for Nesis.

All these charts are free – no license is needed. Figure 96 illustrates them for the main part of US.

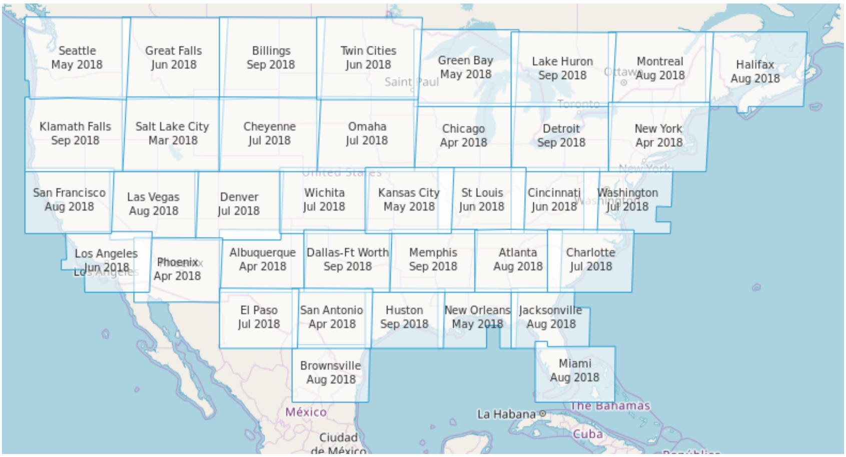


Figure 96: Availability of the US maps.

13.3.3 France – CartaBossy

CartaBossy is a popular choice for raster map of France. In order to respect the copyright of the author, please follow next steps:

1. Buy the paper map directly from CartaBossy web site `https://www.cartabossy.com/`.
2. For all buyers of the paper map, the author provides also access to the electronic version of the map. Download the electronic version to your PC. Use geo-referenced TIFF or TIF format.

3. Use "We transfer" web service (it is free) to send us the copy of the file you have downloaded. Use `support@kanardia.eu` address. Here is the link `https://wetransfer.com/`.

4. We will convert the file into a format, which is understood by Nesis. This will take a day or two. The file with `ras` extension will be send back to you using the same service.

5. Copy the file to Nesis with the help of the USB stick. See section 8.10 for more details.

13.3.4 User Charts

Any image file which is available in proper format can be converted into a `ras` format and then displayed on Nesis. It is also possible to scan a paper map and then convert the resulting file into `ras` format. Please contact `support@kanardia.eu` and we will discus options.

In order to display a copy of a paper map on the screen, the following steps need to be taken:

1. Try to get a map on a roll, which is printed on a non-glossy paper. This yields best results during scanning.

2. Scan the map on a large format scanner at 250 dpi resolution. Nowadays, such scanners are available in almost any town. Save the result in a tiff or png format.

3. This file requires some manual processing – usually one hour work. So, we will ask for a minor fee.

4. Send the resulting file to us for georeferencing. Use "We transfer" web service (it is free). Use `support@kanardia.eu` address. Here is the link `https://wetransfer.com/`.

5. We will convert the file into a format, which is understood by Nesis. This will take a day or two. The file with `ras` extension will be send back to you using the same service.

13.3.5 Installing a Raster Map

Raster maps have `ras` extension. In most cases they are downloaded from our server. Sometimes they are also obtained via *WeTransfer* or a similar service.

In order to copy a raster map to Nesis, follow next steps:

1. Download the raster map from our web page. In this case, the map will have the right extension. Alternatively, you may also receive a map via some file transfer service. Such file is usually ziped and the map is hidden inside the zip file. Extract the `ras` file from the zip file.
2. Copy the `ras` file to a USB memory stick. Make sure that you use the *safe remove* option before removing the USB stick from your PC.
3. Start Nesis, insert the USB stick and switch to the `Options` page and select the `Map` icon.
4. Select the `Copy from USB|Raster` items and search for the raster file to copy from the USB memory stick.
5. The copy process starts. Fist the file's signature (integrity) is checked and if all is well, the file is copied.
6. Close all windows. Nesis will reboot and system will use raster file automatically.

Some raster files are protected with a special license file, which binds the raster file with a serial number of the instrument. In this case, you have to install the license file as well. License files have `lic` extension. A license file is copied in the same way as the raster file.

If integrity check fails, the file is not copied. The cause of the failure is usually linked to coping from PC to USB-stick. The stick was removed from PC too quickly. Repeat the whole procedure once again starting with downloading from the server.

13.4 Installing Approach Maps

Nesis can also show approach maps as an transparent overlay. These maps are not downloadable from our web site due to copyright restrictions. However we prepared a desktop app, which allows users to create their own approach maps. The app and manual can be obtained from our web site. See also section 3.7.5.

The approach maps have the `nam` extension.

1. Once an approach map is prepared with the `Approacher` app, copy the `nam` file to an USB memory stick.
2. Insert the stick into Nesis, switch to the `Options` page and select the `Maps|Approach` items.
3. Select the file. This will copy the file into Nesis.
4. Close all windows. After restart maps will be used automatically.

14 Third Party Software

This section has nothing to do with the usage of the Nesis. You can skip it completely if you are not interested in software development and licensing issues.

14.1 The Qt Library

The Nesis software was developed with the help of the *Qt library*, which is a product of *The Qt Company*. The library offers several licenses. One of them is the LGPLv3 license, which we chose for the Nesis.

Choosing this license gives us some obligations. They are partly fulfilled by Nesis, partly by this manual and partly by our web server. The following subsections give insight into the details.

14.1.1 Modules and Linking

Nesis is using dynamic linking (.so) with the following libraries from the Qt library bundle: libQt5Core.so, libQt5Gui.so, libQt5Widgets.so, libQt5Xml.so, libQt5Concurrent.so, libQt5Network.so, libQt5DBus.so, libQt5OpenGL.so and libQt5EglDeviceIntegration.so.

14.1.2 Source Code and Toolchain

The source code of the Qt library used with Nesis and the toolchain used to build the binary image of library modules can be obtained following next steps:

1. Use your browser and open `https://www.kanardia.eu` web page.

2. Select `SUPPORT|Software` from the menu on the top right side. A list of various software bundles will appear.

3. Select `QtLibrarySource` to download the Qt library source code.

4. Select `Toolchain` to download the suite of programs that were used to build the library binaries.

14.1.3 Compiling The Library

Once both the library and the toolchain were downloaded, use the following steps to build the library binaries on your computer. We are using Kubuntu flavor of Linux operating system and instructions will be given for such system (or similar).

1. Extract `Toolchain.tar.bz2`.

2. Extract `QtLibrarySource.tar.bz2`.

3. Enter folder `qt5base-5.6.0/`.

4. Configure Qt5 with the following command and replace `{DIR}` with the folder, where the toolchain was extracted:

```
# ./configure -opensource -shared -no-static -no-sql-mysql -no-sql-psql \
   -widgets  -gui -opengl es2 -eglfs -no-openssl -no-gstreamer \
   -prefix {DIR}/QT -no-rpath -nomake tests -device buildroot -no-xcb \
   -no-cups -no-nis -no-gtkstyle -no-pulseaudio -no-xcb-xlib -no-harfbuzz \
   -no-libproxy -no-icu -no-xcb -device-option \
   CROSS_COMPILE={DIR}/host.a20/usr/bin/arm-buildroot-linux-gnueabihf- \
   -sysroot {DIR}/host.a20/usr/arm-buildroot-linux-gnueabihf/sysroot
```

5. Compile library with:

```
# make
```

6. Install library with:

```
# make install
```

   Library files are installed into folder:

   `{DIR}/host.a20/usr/arm-buildroot-linux-gnueabihf/sysroot/QT`

14.1.4 Installing Modified Qt Library

The LGPLv3 license allows you to freely adapt and change the source code according to your needs.

1. Use your favorite source code editor to edit and modify the Qt library source code.
2. Compile the changes using the toolchain (see section 14.1.3) and produce the binaries.
3. Copy the binaries to a USB memory stick. Put them into the USB stick root folder.
4. Insert the USB stick into Nesis.
5. Switch to the `Options` page and then select the `Info` icon.
6. Select the `Qt Library` from the list.
7. Select the `Install Qt Library` option.
8. Confirm the decision – select `Yes`.
9. Nesis will copy the libraries found on the USB stick to the internal flash drive by overwriting any existing libraries.
10. Close all windows and turn Nesis off.
11. Power Nesis on. Now, it should start with new version of Qt libraries.

If something goes wrong and Nesis does not start anymore, start it in emergency mode. See section 10.4 . Then perform software update with the official version of Nesis software. This should restore Nesis back to working state.

14.1.5 Copy of Qt License Document

A copy of the Qt license document is stored in Nesis. It can be viewed using the procedure below:

1. Switch to the `Options` page.
2. Select the `Info` icon.
3. A list of items appears. Choose the `Qt Library` option.

4. Another list appears. Choose the `View Qt license` item.
5. A window with original Qt license document appears. Scroll down to read the complete text.

15 Limited Conditions

Although a great care was taken during the design, production, storage and handling, it may happen that the Product will be defective in some way. Please read the following sections about the warranty and the limited operation to get more information about the subject.

15.1 Warranty

Kanardia d.o.o. warrants the Product manufactured by it against defects in material and workmanship for a period of twenty-four (24) months from retail purchase.

Warranty Coverage

Kanardia's warranty obligations are limited to the terms set forth below:

Kanardia d.o.o. warrants the Kanardia-branded hardware product will conform to the published specification when under normal use for a period of twenty-four months (24) from the date of retail purchase by the original end-user purchaser ("Warranty Period"). If a hardware defect arises and a valid claim is received within the Warranty Period, at its option and as the sole and exclusive remedy available to Purchaser, Kanardia will either (1) repair the hardware defect at no charge, using new or refurbished replacement parts, or (2) exchange the product with a product that is new or which has been manufactured from new or serviceable used parts and is at least functionally equivalent to the original product, or, at its option, if (1) or (2) is not possible (as determined by Kanardia in its sole discretion), (3) refund the purchase price of the product. When a refund is given, the product for which the refund is provided must be returned to Kanardia and becomes Kanardia's property.

Exclusions and Limitations

This Limited Warranty applies only to hardware products manufactured by or for Kanardia that have the "Kanardia" trademark, trade name, or logo affixed to them at the time of manufacture by Kanardia. The Limited Warranty does not apply to any non-Kanardia hardware products or any software, even if packaged or sold with Kanardia hardware. Manufacturers, suppliers, or publishers, other than Kanardia, may provide their own warranties to the Purchaser, but Kanardia and its distributors provide their products *AS IS*, without warranty of any kind.

Software distributed by Kanardia (with or without the Kanardia's brand name including, but not limited to system software) is not covered under this Limited Warranty. Refer to the licensing agreement accompanying such software for details of your rights with respect to its use.

This warranty does not apply: (a) to damage caused by use with non-Kanardia products; (b) to damage caused by accident, abuse, misuse, flood, fire, earthquake or other external causes; (c) to damage caused by operating the product outside the permitted or intended uses described by Kanardia; (d) to damage caused by service (including upgrades and expansions) performed by anyone who is not a representative of Kanardia or an Kanardia Authorized Reseller; (e) to a product or part that has been modified to significantly alter functionality or capability without the written permission of Kanardia; (f) to consumable parts, such as batteries, unless damage has occurred due to a defect in materials or workmanship; or (g) if any Kanardia serial number has been removed, altered or defaced.

To the extent permitted by applicable law, this warranty and remedies set forth above are exclusive and in lieu of all other warranties, remedies and conditions, whether oral or written, statutory, express or implied, including, without limitation, warranties of merchantability, fitness for a particular purpose, non-infringement, and any warranties against hidden or latent defects. If Kanardia cannot lawfully disclaim statutory or implied warranties then to the extent permitted by law, all such warranties shall be limited in duration to the duration of this express warranty and to repair or replacement service as determined by Kanardia in its sole discretion. Kanardia does not warrant that the operation of the product will be uninterrupted or error-free. Kanardia is not responsible for damage arising from failure to follow instructions relating to the product's use. No Kanardia reseller, agent, or employee is authorized to make any modification, extension, or addition to this warranty, and if any of the foregoing are made, they are void with respect to Kanardia.

Limitation of Liability

To the extent permitted by applicable law, Kanardia is not responsible for indirect, special, incidental or consequential damages resulting from any breach of warranty or condition, or under any other legal theory, including but not limited to loss of use; loss of revenue; loss of actual or anticipated profits (including loss of profits on contracts); loss of the use of money; loss of anticipated savings; loss of business; loss of opportunity; loss of goodwill; loss of reputation; loss of, damage to or corruption of data; or any other loss or damage howsoever caused including the replacement of equipment and property, any costs of recovering, programming, or reproducing any program or data stored or used with Kanardia products and any failure to maintain the confidentiality of data stored on the product. Under no circumstances will Kanardia be liable for the provision of substitute goods or services. Kanardia disclaims any representation that it will be able to repair any product under this warranty or make a product exchange without risk to or loss of the programs or data. Some jurisdictions do not allow for the limitation of liability for personal injury, or of incidental or consequential damages, so this limitation may not apply to you.

15.2 TSO Information — Limited Operation

This product is not TSO approved as a flight instrument. Therefore, the manufacturer will not be held responsible for any damage caused by its use. The Kanardia is not responsible for any possible damage or destruction of any part on the airplane caused by default operation of instrument.