

Nesis III — User's Manual

Kanardia d.o.o.

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Revision History

The following table shows the revision history of this document.

Rev.	Date	Description
1.0	Sep 2018	Complete manual rework to match software version 3.3

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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 Installation Manual,
- MAGU 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. 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. The GPS system is subject to changes which could affect the accuracy and performance of all GPS 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.

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 and fuel information onto graphical display. The system consists of various components, some of these are required and some are optional.

2.1.1 Required CAN Bus Components

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



Nesis master 8 inch 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-GPS 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, GPS sensor for position and OAT probe for true airspeed. Sensor readings are passed through 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, etc.
- In some cases there is not enough channels on mini DAQU. In this case, standard DAQU modified for ECU engine can be also used.

2.1.2 Optional CAN Bus Components

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 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.



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 and 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.

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 only difference is that the AETOS display does not have touch screen and there are no maps.



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 of the actions can be also done 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.
- 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 opened 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 and when autopilot is detected, it starts the autopilot actions.
- 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:

- 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 round altimeter opens the QNH window;
- A touch on the classic screen map opens the navigation screen;

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 after main switch and once Nesis is running, you start cranking the engine. This works well in vast majority of cases.



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 QNH (rotate until correct QNH 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 7.4 on page 82 to see how to enter pilots and instructors.

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.

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.



Figure 2: Typical start-up sequence.



Figure 3: Illustration of the Status bar.

- 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 left. 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 GPS.
- ⑧ Time.

- ⑨ Various status symbols. More details are given next.

Various symbols can appear on the symbol section of the status bar.

GPS Symbols

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



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



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



A cyan/gray color symbol indicates that only 2D fix is available – position is known, 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 some of Flarm devices 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 a cyan triangle indicates that Flarm received its own GPS 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 GPS signal is not yet available or Flarm GPS 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.

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.

3.5 Screens

Nesis can show different screens. Typically four screens are shown, but this number is not fixed. We work closely together with a customer and we prepare special screen layout for each customer/aircraft. Figure 4 shows examples of these four screens.

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

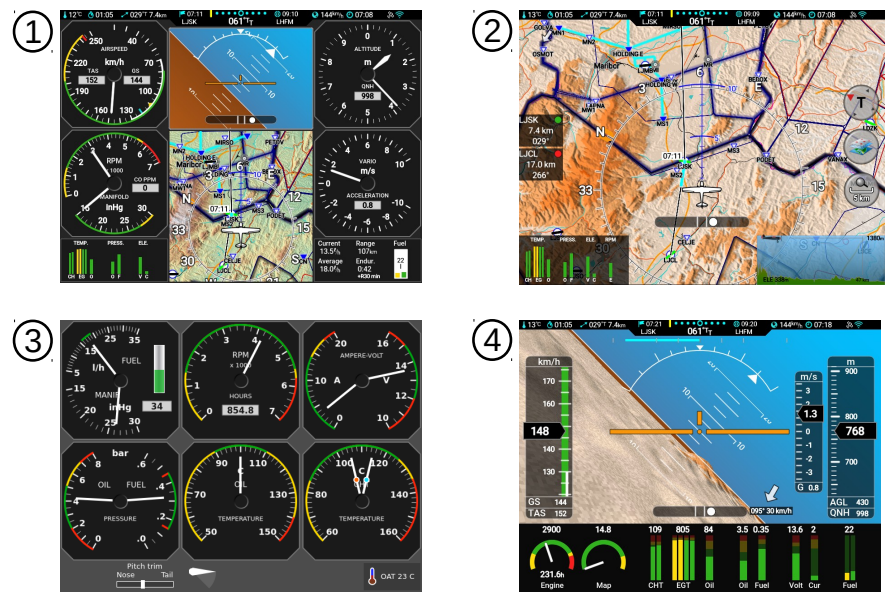


Figure 4: Typical four screens: 1 – Classic Screen, 2 – Navigation Screen, 3 – Engine Screen, 4 – Modern Screen.

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 most important instruments have classical look and follow the recommended IFR T layout (classic six-pack). Figure 5 on page 24 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 20 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 34.
 - 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. A touch on the horizon will toggle between 3D view and standard view. See also section 3.10.2 on page 36.
- 
- 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). A touch on the QNH label opens the QNH setting window. See also section 3.10.3 on page 37.
 - 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 38.
- 
- 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 42). 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 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. See also section 3.10.7 on page 40. Alternatively, an airplane designation can be shown instead.
 - 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 41.

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 this screen.

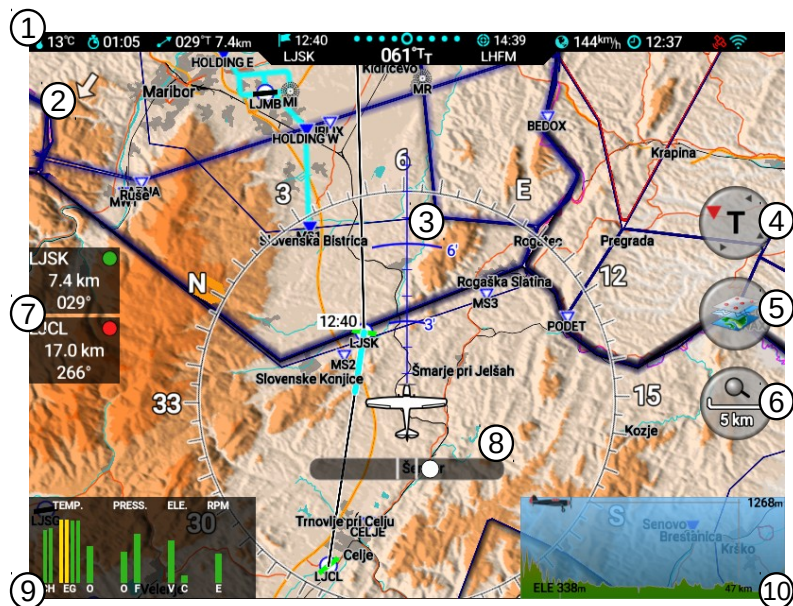


Figure 6: Illustration of the navigation screen.

- ① Status bar. This bar is shown on the top of most screens. Please refer to section 3.4 on page 20 for more details.
- ② Wind indication. This indication is available only when MAGU (electronic magnetic compass) is also present on the CAN bus.
- 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.

- 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 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 information is shown: name of the airfield, distance and bearing. Green dot tells that airfield can be safely reached in a glide mode above minimum safe altitude, yellow dot tells it may be reached, but not above minimum altitude and orange dot tells it can't be safely reached in a 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 than 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.
- 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.



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.

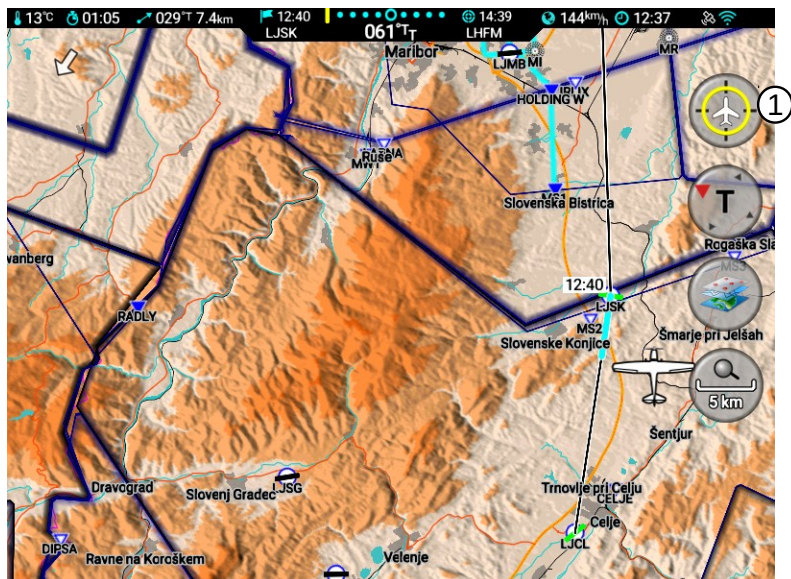


Figure 7: Illustration of the navigation screen in the pan mode.

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

Once a map is in the *pan-mode*, a long touch creates a marker – a special user waypoint.

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.

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. Where-ever such details are available, they are included in the Nesis. Figure 8 illustrates two examples.

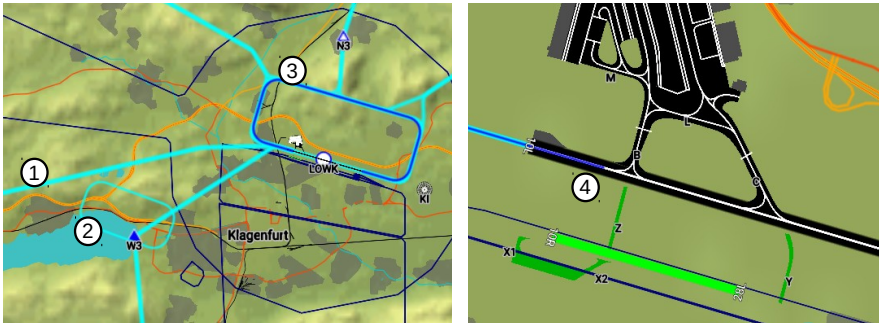


Figure 8: Example of OFM details.

- 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 Map Layers

The map shown on Nesis consists of several layers, which are drawn on top of each other. Please refer to section 11.1 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 9.

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.

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

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.

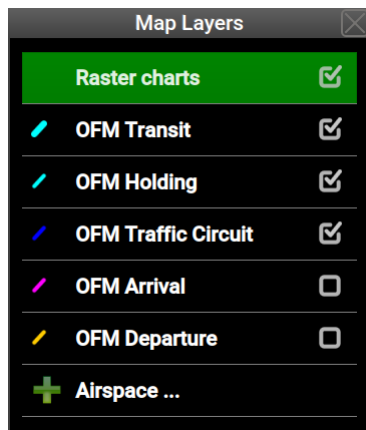


Figure 9: The Map Layers window.

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

OFM Departure This option toggle the departure route.

Airspace ... Opens a new window, where visibility of airspace zones can be defined. See section 3.7.5 for more details.

3.7.5 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 10 illustrates an example if airspace filter.

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 IFR only traffic. For example, if you never fly above 8000 feet, you can set this value at 10000 feet.

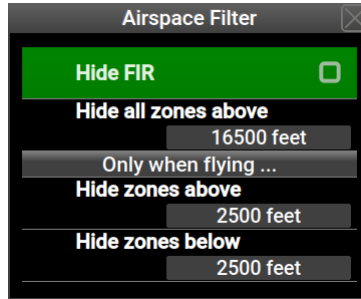


Figure 10: Dialog showing settings for the Airspace Filter window.

Hide zones above During flight, all zones, which 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. After that, you descend to 1000 feet. Now, all zones starting above 3000 feet will be hidden.

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

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 11 shows some of possibilities.

- ① Combination of two arcs used for fuel flow and MAP, two bars for fuel levels in two tanks and and a small 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.



Figure 11: Illustration of the engine screen.

- ⑤ Single arc used to oil temperature.
- ⑥ Single arc with two needles for CHT and four horizontal bars for EGT.
- ⑦ Roll and pitch trim indicators together with flap indicator.
- ⑧ OAT – outside air temperature indication.

Note that the engine screen does not show the status bar on the top.

3.9 Modern Screen

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

- ① Status bar. Please refer to section 3.4 on page 20 for more details.



Figure 12: Illustration of the modern screen.

- 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 of the tape. In addition, various V speeds are also shown in the form of small tags.

- ③ Vertical speed scale.

- ④ Altitude tape. A height above ground level (AGL) and current QNH value are shown at the bottom.



A touch on the QNH area of the altitude tape will open QNH window.

- ⑤ Attitude indication of pitch and roll. Roll scale has dash markings at 10, 20, 30 (long), 45, 60 (long) degrees. Figure 12 shows situation at 45 degree roll. Long pitch scale line has number at side, medium line refers to a 5 degree step and short line is 2.5 degree step.

- ⑥ Relative wind indication. Wind direction and speed are shown below¹.

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

- ⑦ Flap indication.
- ⑧ Slip indication.
- ⑨ Engine parameter in the shape of round arc.
- ⑩ Single value engine parameter in the shape of vertical bar and a value below.
- ⑪ Multi value engine parameter in the shape of vertical bar. The highest value is shown below.
- ⑫ Trim position.
- ⑬ Fuel tank combination. Left and right tank and sum of both below.

3.9.1 Video

If Nesis is equipped with video option, then modern view also shows video image in the corner. This video image can be enlarged (over most of the screen) or shrinked to the corner with a simple touch on the image.

Video can be also removed.



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 conditions². When outside temperature is known, true airspeed (TAS) is given as well. The scale has several markings as you can see on Figure 13.

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 ISA – International Standard Atmosphere



Figure 13: An airspeed indicator example optimized for an aeroplane using two step landing flaps.

- 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 based on flap extension step. See also V_{FE1} and V_{FE2} . The white range in a helicopter 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 V_{Ref} (yellow triangle) – landing reference speed, which is the recommended speed used on landings.

- ⑨ V_Y speed (blue mark) – speed which results in the best rate of climb.
- ⑩ V_{FE1} and V_{FE2} (orange dots; one dot for V_{FE1} and two for V_{FE2}), are used to mark the upper limits for extended flaps. The full flap extension limit is represented by V_{FE2} .

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 roll³. Figure 14 illustrates the attitude indicator combined with the inclinometer (ball).

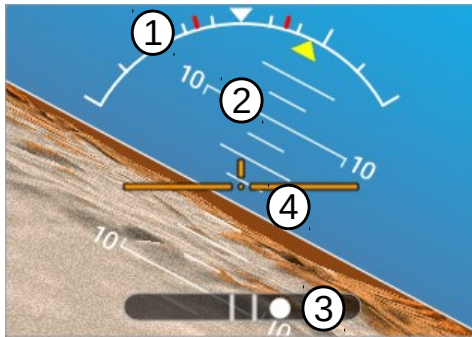


Figure 14: Attitude indicator combined with the slip – skid indicator.

The following markings are found on the 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 selected turn rate. Please note that turn rate marker position depend on the airspeed and they move as speed is changed.

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

- 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.



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 (QNH value – baro-correction). This pressure must be set by a pilot and can be changed during flight. The QNH value is typically obtained from air traffic control.



Figure 15: The altitude indicator with the scale given in feet.

The indicator shown on Figure 15 is used to display calculated altitude and reference QNH pressure (baro-correction). 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).



A touch on the QNH window opens the QNH editing window.

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 16. 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.

The manifold pressure scale is always given in inHg (inches of mercury) units.



Figure 16: The combination of RPM and manifold pressure indicator.

3.10.5 Gyroplane Engine RPM, Rotor RPM, Manifold and Pre-rotation Indicator

Gyroplanes require indication of rotor RPM. Figure 17 illustrates a special combination of parameters combined into one gauge.

- ① Engine RPM scale with color arcs.



Figure 17: Four in one: the combination of engine RPM, rotor RPM, manifold pressure and prerotation helper lamp.

- 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.

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.

Once gyroplane is airborne, the lamp does not show anymore.

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 on Figure 18 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.



Figure 18: The combination of rotor RPM and engine RPM. Both scales are in percentages.

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 19. Each bar corresponds to one engine parameter. Green, yellow and red colors represent normal, caution and dangerous range, respectively.



Figure 19: Illustration of the mini engine monitor.

The monitor bars are grouped into temperatures, pressures, electrics and RPMs. The temperature group includes CHT, EGT, oil and water (coolant) 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 20 shows an example of such information.



- (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 20: Fuel computer displays fuel economy, fuel level, endurance and range.

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 7.3.3 on page 76.
 - In the *Manual* mode the setting specified value is always shown for the average fuel consumption.
 - In the *Automatic* mode, the average value from the settings is shown while not flying (on the ground). After take-off, the average fuel consumption is calculated from the fuel flow. The complete flight after take-off is taken into account in this calculation.
- 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 en-

duration 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 indicators and update the Nesis fuel level.



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 on Figure 21.

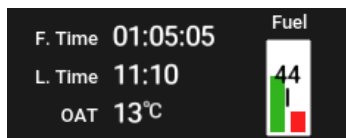


Figure 21: OAT, flight time, local time and fuel window.

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 GPS track or a magnetic compass. Figure 22 shows an example.

The indicator also shows heading bug. The bus 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.





Figure 22: Illustration of the direction indicator.

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. DAQU has detected an active channel, but it feels no sensor.
- SC stands for a short-cut. DAQU thinks that sensor is in a short-cut (very low resistance is detected).

Figure 23 shows 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.



Figure 23: Round pressure indicator, with special markings shown on needles.

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 24 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.

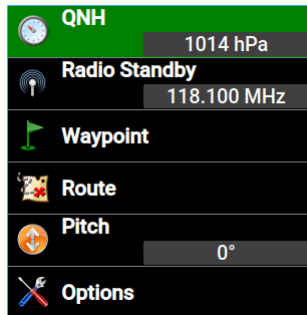


Figure 24: Main menu for the Modern Screen.

QNH Opens a QNH editor 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 7 starting on page 73 for more details.

4.2 QNH

Rotate the knob to change the QNH or press on the \oplus or \ominus buttons with the touch. Push the selector knob to close and confirm the selection or touch the check or \otimes on the title bar. The window closes itself after some time-out period.

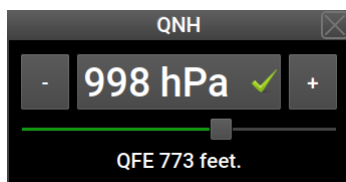


Figure 25: Setting the QNH value.

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 QNH Setting

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

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.

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 on Figure 26.

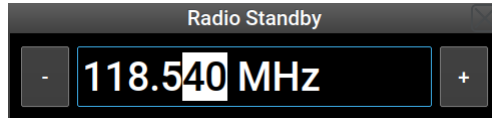


Figure 26: Setting the standby frequency value.

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. In order to make it active, some minimal action has to be made on the radio.

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 27 left. In the second step actual waypoint is selected, Figure right.

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.

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.

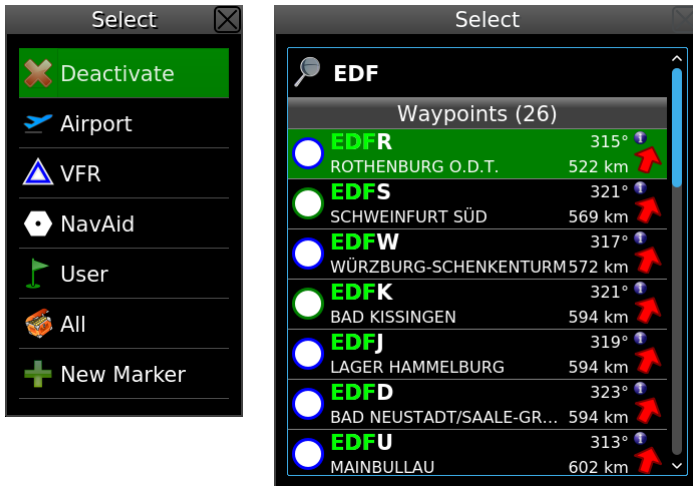


Figure 27: Waypoint options (left) and list of waypoints with active name filter (right).

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

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.

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.



When map screen is in the pan mode, see section 3.7.2, a long touch on the map also creates a marker.

4.4.2 Waypoint Details

Some waypoints, airfields for example, have more features but geographic coordinates and before actual selection, Nesis also offers the *Details* option.

The *Details* options opens the details window. An example is shown on Figure 28.

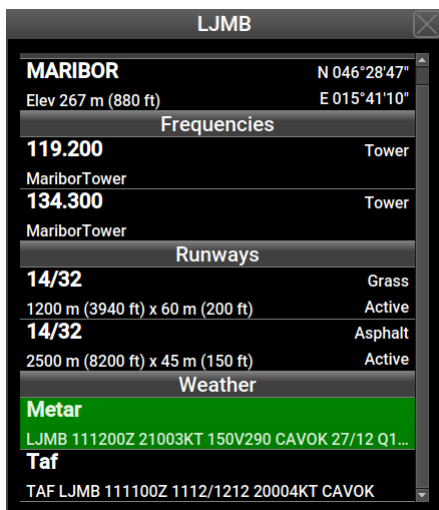


Figure 28: An example of the details window for LJMB airfield.

The window has several sections:

General The top part shows the coordinates and elevation.

Frequencies section lists frequencies associated with the waypoint, when available. When radio is connected with Nesis, a selection of frequency will transfer it into the radio. The selected frequency will be set as a standby frequency.

Runways section lists runways available on this airfield.

Weather section is available when Nesis is connected to the Internet. METAR and TAF 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. See Figure 29. In a similar way, TAF details are also shown, but the content is not interpreted.

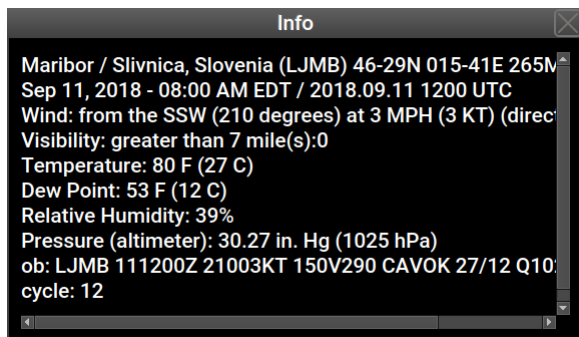


Figure 29: An example of interpreted METAR report.

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 30 left. 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 30 right.

4.5.1 Activating a Route

With no active route a window opens, like shown on Figure 30 left. Routes are sorted alphabetically. Route name is typically defined by a takeoff - landing airfield pair.

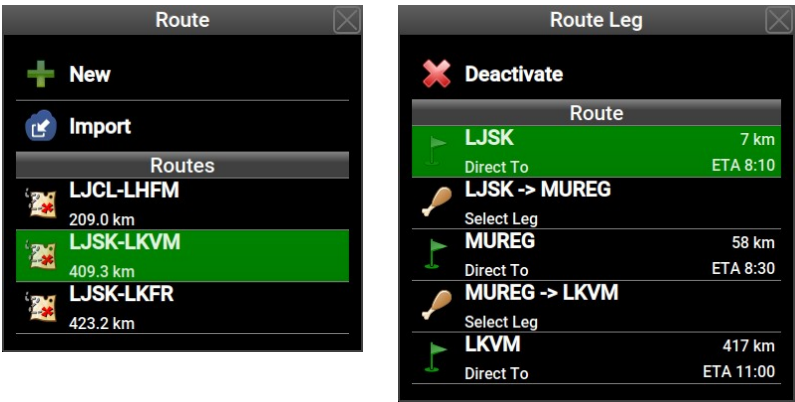


Figure 30: Route selection and activation window (left) and route manipulation window (right).

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.

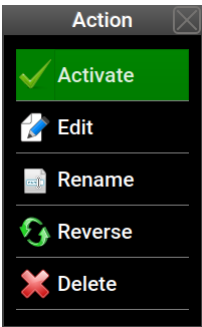


Figure 31: List of possible actions on the Route selection.

4.5.2 Creating a New Route

A route consists of a takeoff and landing airfield. Between these two, there may be several intermediate waypoints.

The route creation process will be shown on an example of a route from LJCL (Celje) to LHFH (Fertőszentmiklós). This route may have the following intermediate VFR reporting waypoints: MW1, to avoid Maribor CTR, MUREG on border between Slovenia and Austria, SASAL on border between Austria and Hungary.

In order to create above mentioned route, follow the steps:

- Select the *New* option from Figure 30 left.
- Nesis asks you for the departing (takeoff) airfield. Search for LJCL and select it.
- Next, Nesis asks for arrival (landing) airfield. Search for LHFH and select it.
- A window shown on Figure 32 left appears. The window shows both airfields and an item labeled as *New in-between*.
- Select the *New* item to add MW1, MUREG and SASAL waypoints in sequence. All these are VFR waypoints, so select *VFR* or *All* when asked for a waypoint type.
- The final situation is shown on Figure 32 right. The item labeled as *New* will be removed from the final route automatically.
- Close windows. Note that a new route is not activated automatically. It must be activated manually.

Notice the *Summary* item. The total distance, estimated time needed for the route and estimated fuel consumption are shown. The time estimate is based on the typical aircraft cruising speed. See section 7.3.3 on page 76. Note, this is a rough estimate. No extra climb time, descend time and traffic pattern times are added.

The same is true for fuel consumption estimate – no extra fuel for climb or any reserves are taken into account. It is based on the typical consumption. See section 7.3.3 in page 76 for more details.

Each item in the route can be changed. Any intermediate waypoints can be changed or removed. A new waypoint can be inserted before the selected item. Please feel free to experiment.



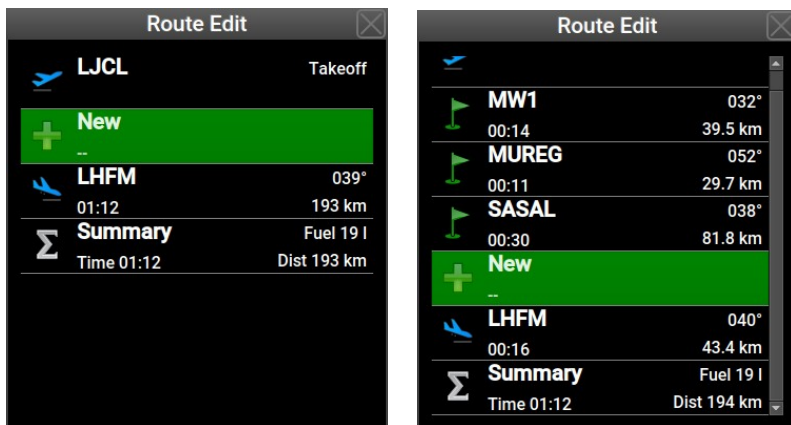


Figure 32: Route at the beginning, when only takeoff and landing airfields are known (left) and route at the end, when all intermediate points are entered (right).

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 Garmin *GPX* format. This means that any route planner, which can save/export route in *GPX* format can be used.

- Prepare a route, save it in *GPX* format and copy it to USB stick.
- Insert the stick into Nesis and select the *Import* command. See Figure 30 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

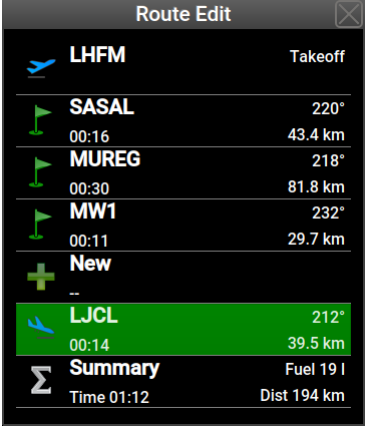
Select a route from the list of routes and then select the *Delete* command. The selected route will be deleted from the list. The command can be reverted.

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 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 33 shows a reversed route from the previous example.










Route Edit		
	LHFM	Takeoff
	SASAL	220°
	00:16	43.4 km
	MUREG	218°
	00:30	81.8 km
	MW1	232°
	00:11	29.7 km
	New	
	--	
	LJCL	212°
	00:14	39.5 km
	Summary	Fuel 19 l
	Time 01:12	Dist 194 km

Figure 33: Result of a reversed route from previous example.

4.5.7 Actions on an Active Route

When the *Route* command is issued and some route is already active, a different window appears. See Figure 30 right on page 51.

The following options are possible here:

- The *Deactivate* item will make the route inactive.
- Select one of 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.

4.6 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 this indication.

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

4.7 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 34 shows a pitch correction window.

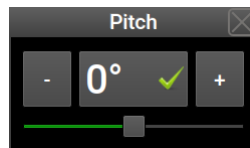


Figure 34: An example of the pitch correction window.

4.8 Pitch and Roll Trim

Please refer to DAQU Installation Manual for connections and settings.

Once the pitch or roll trim is configured any change of trim opens a window shown on Figure 35. The window shows relative position of the trim. When trim position stops changing the window will disappear.



Figure 35: An example of the pitch trim and roll trim position window.

5 Flarm and ADS-B Receivers

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

- Power Flarm Core – produced by Flarm Technology Ltd.,
- TRX 1500 – produced by Garrecht Avionik GmbH.

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 installation and any other manual 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.
- For TRX 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.
- Please, also read the *FAQ* sub-section on the Flarm site. It can be found under *SUPPORT* section.
- When a mode S transponder is installed in an aircraft, it does not necessarily 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 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 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 36 shows an example of such map. Three aircraft are shown, none 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

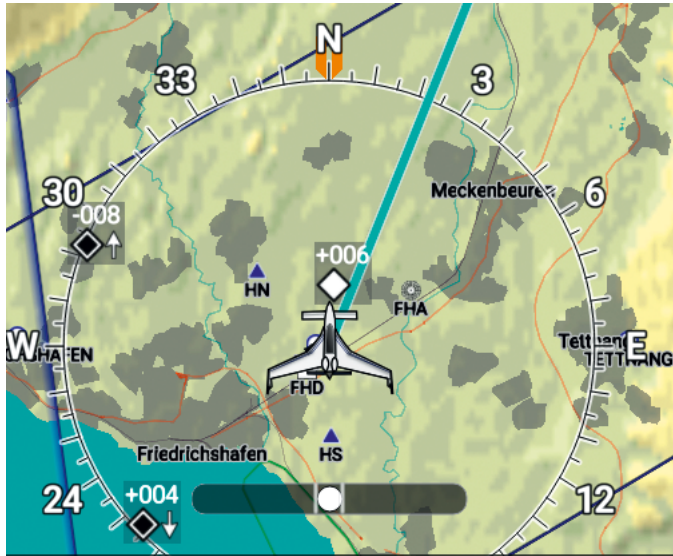


Figure 36: Traffic symbols on a map. Vertical difference is in hundreds of feet, as three digits are used.

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.

5.2 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 all decision making is done by the device.

Figure 37 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 $\pm 10^\circ$ on horizon. Inner arrow is colored when threat is $10^\circ - 30^\circ$ 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 37: Threat classified as warning comes from left, distance is 1.5 km, about at the same visual level, 450 feet below.

Figure 38 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.

5.3 Settings

Flarm device settings can be accessed via the *Options* screen. Selecting the *ADS-B/Flarm* icon opens a window shown on Figure 39.

The following options are given:

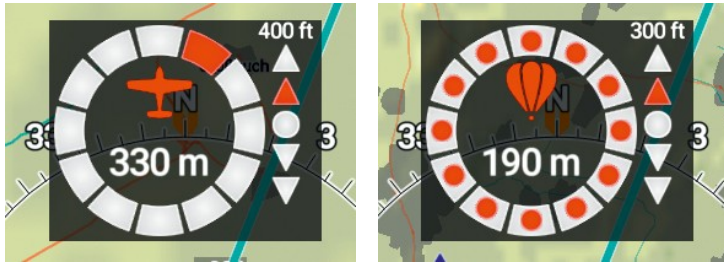


Figure 38: Left: Alert for an airplane, 330 meters away, slightly from right, 400 feet above and 10° - 30° above the horizon. Right: Alert for a balloon, 190 meters away, direction is not known, 300 feet above and 10° - 30° above the horizon.

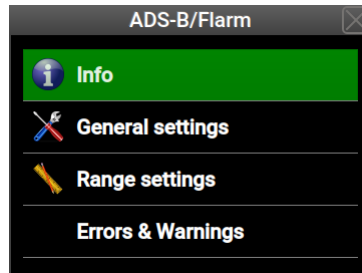


Figure 39: Flarm devices main menu window.

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.

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

5.3.1 Info

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

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. It 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.

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.

5.3.2 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.

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 is set. This address which uniquely identifies the device.

- Typically, 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 address in the window below.
- 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

5.3.3 ADS-B Settings

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

Transponder type defines the type of the transponder built-in the aircraft.

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 37 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 5.3.2.

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

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 38 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 on the device for non-directional targets. Note: not all Flarm devices have such beeper available and/or activated. This does not affect Nesis.

5.3.4 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 cut-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.

5.4 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 40 left.

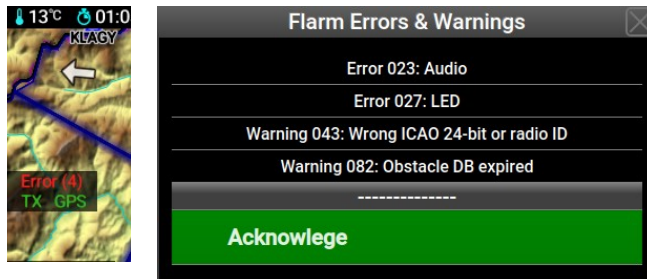


Figure 40: Left: a part of the main map screen, which shows the Flarm device status rectangle. Right: Flarm Error and Warning window. On top errors and warnings are displayed and the *Acknowledge* command at the bottom.



- 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.

6 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 extracts takeoff and landing events and combines them in flights. An example is given on Figure 41.

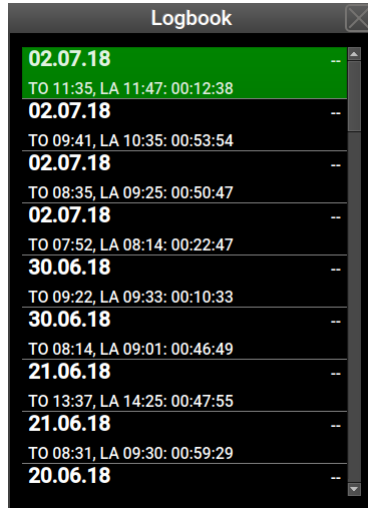


Figure 41: A logbook example. Pilot names are missing, two dash characters are shown instead.

Logbook can be accessed from the *Options* page by selecting the *Logbook* icon. See Figure 49 on page 73. 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 42.

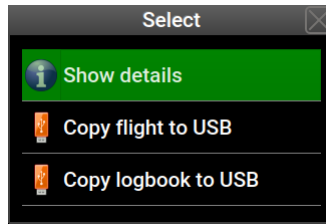


Figure 42: A logbook options example.

6.1 Show Details

The *Show Details* option, opens a window with more details about selected flight. Figure 43 gives an example.

Flight Statistics	
Flight	
Takeoff	08:31:22
Landing	09:30:51
Duration	00:59:29
Distance	138 km
Max IAS	169 km/h
Max GS	166 km/h
Avg GS	139 km/h
Max Alt	4090 feet

Figure 43: An example of flight details.

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.

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.



6.2 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.

6.2.1 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 44 and 45 show two examples. First is the top view of a flight and the second one is a detail with visible vertical profile.

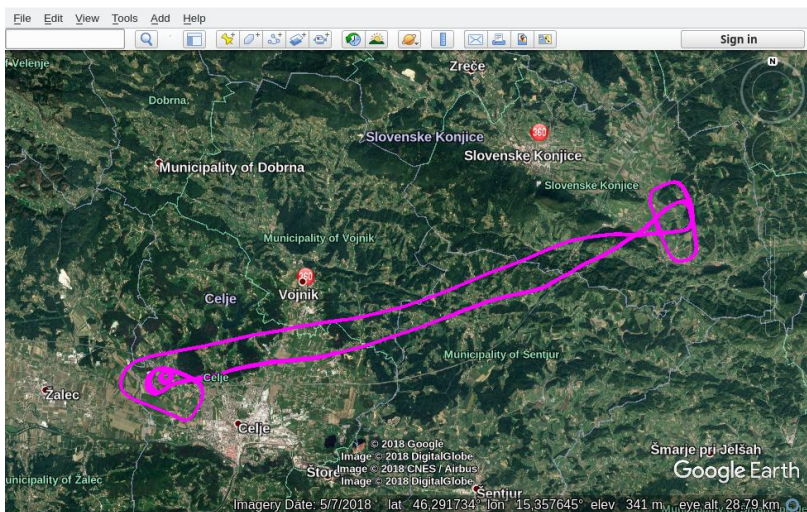


Figure 44: A flight file with kml extension opened in Google Earth.

6.2.2 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

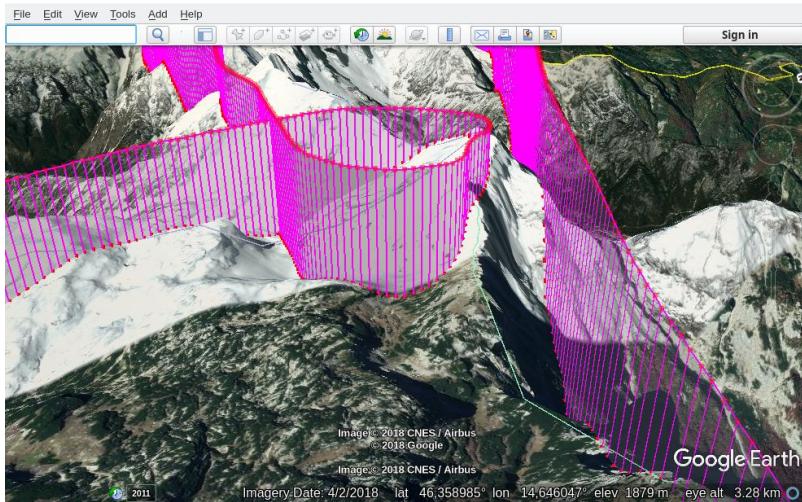


Figure 45: A detail of flight opened in Google Earth. Vertical profile is visible here.

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.

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 on Figure 46. 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.

- The result of the import is then shown on Figure 47. Some column widths were adjusted and some cells were hidden.

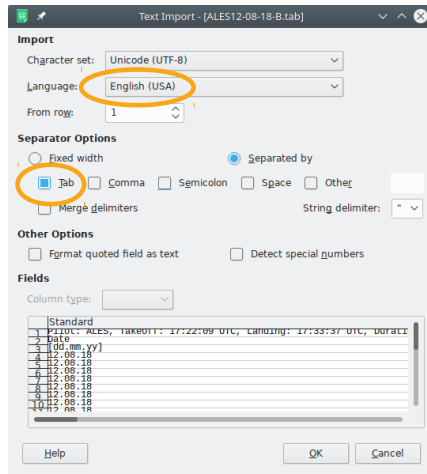


Figure 46: An example of Calc Text Import window.

6.3 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.

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 48 shows an example.

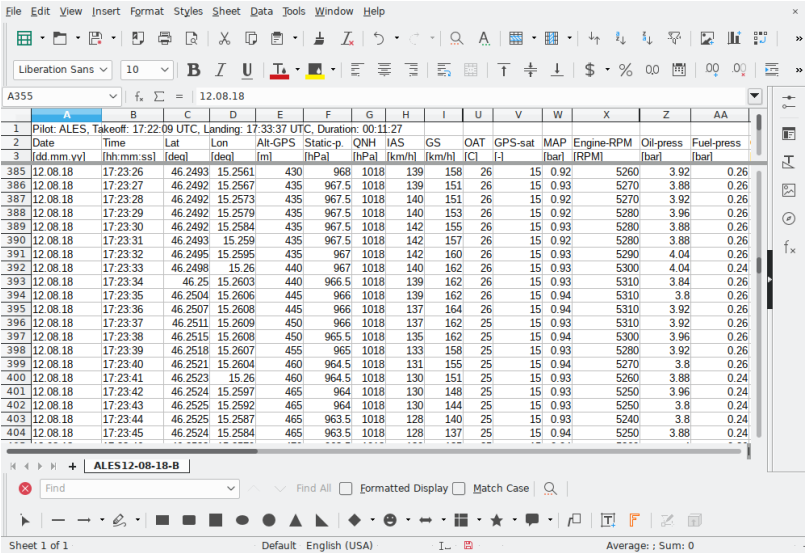


Figure 47: An example of flight details upon successful import.

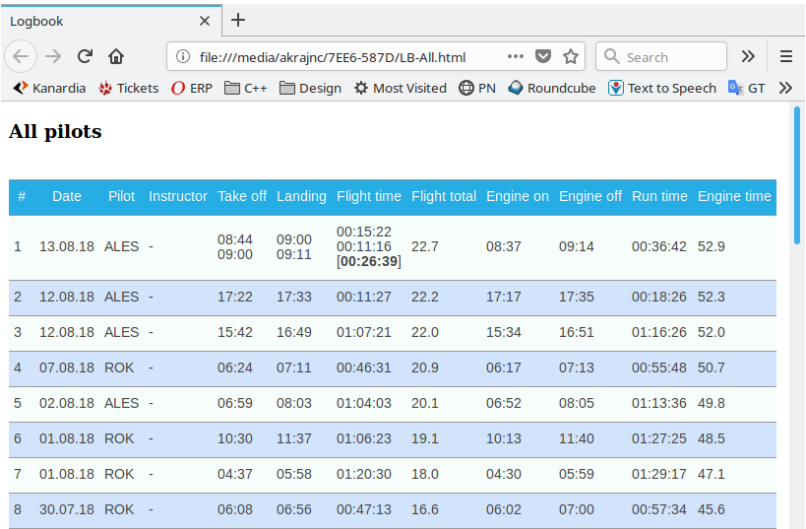


Figure 48: An example of logbook opened in Firefox browser. *All pilots* and *Complete History* were selected. A touch-and-go event is shown in row 1.

7 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 password. This section explains user options. See section 8 on page 92 for service options.

The user options screen can be accessed from the main menu. See Figure 24 on page 45 – the last item. Alternatively, a long-press on the knob also opens the user options screen by default.

Some icons require password before proceeding and some options are available only when correct hardware is detected. The factory default password is **314**, first three most significant digits of number π . The password was introduced in order to prevent unwanted accidental alterations of important settings. The password can be disabled, see section 7.3.1.

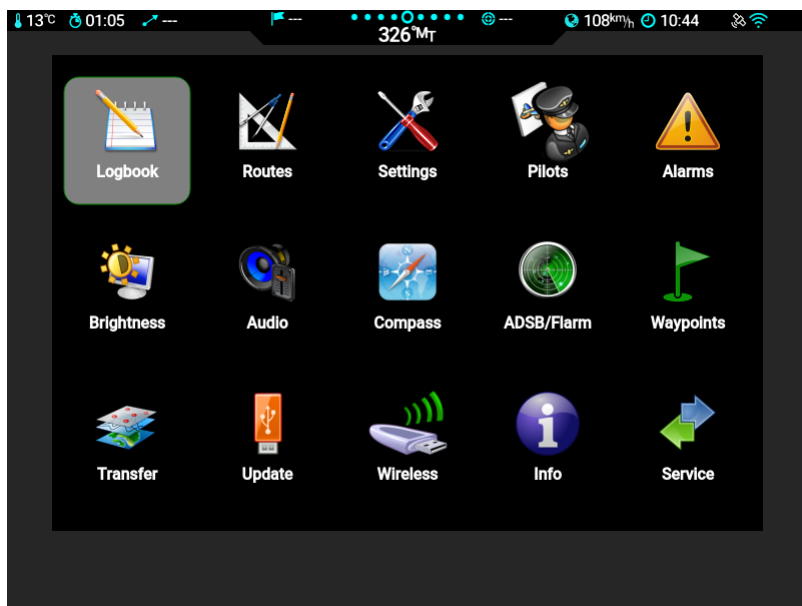


Figure 49: Illustration of the user options screen.

7.1 Logbook

Select the *Logbook* icon in order to access the logbook. Logbook activities are covered in section 6 starting on page 66.

7.2 Routes

Select *Routes* icon to work with routes. Route activities are covered in section 4.5 starting on page 50.

7.3 Settings

Figure 50 shows the settings options.

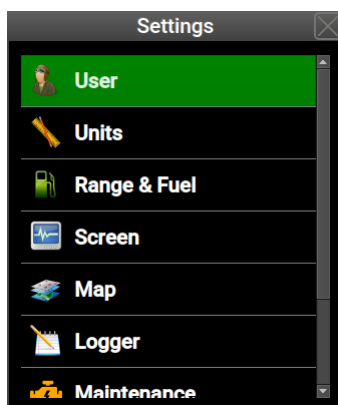


Figure 50: Some of the user settings options.

7.3.1 User

This icon is used to specify some user specific options and to assign actions to buttons and knobs.

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 English language.

Time zone Specify the difference between local time and UTC time. Specify zero in order to show the UTC time everywhere.

Use 314 password Some people hate our 314 protection password. Set this option to no, to turn the password off.

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 issued the *Logbook* command.

External is not used by default. In fact 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.

Autopilot menu is a shortcut to the Nesis autopilot menu. See section 10.5 on page 102.

Autopilot disable is a shortcut to the autopilot disable command.

Autopilot level is a shortcut to the autopilot level command.

Logbook is a shortcut to logbook actions.

Settings is a shortcut to the user options page.

Near airfields is a shortcut to the list of 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 is a shortcut to the default (home) screen.

Alarms is a shortcut to the alarms window.

7.3.2 Units

Nesis uses several units for different physical quantities like distance, velocity, mass, volume, etc. Table 8 shows available units. The quantities are grouped according to their function.

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
QNH	hPa, inHg
Pressure	bar, psi
Temperature	°C, °F
Fuel	liters, US gallons
Flow	l/h, gal/h
Engine RPM	RPM, %
Rotor RPM	RPM, %

Table 8: Available units for the individual physical quantity.

7.3.3 Range & Fuel

Parameters needed for range and fuel calculations are defined here. Figure 51 shows these parameters.

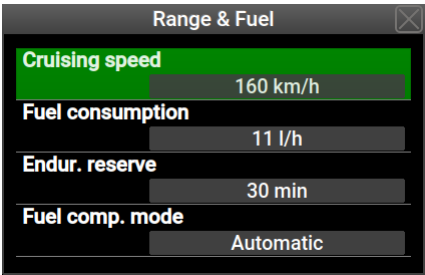


Figure 51: Parameters related to the range in fuel calculations.

Cruising speed This speed is used in *route* calculations, when aircraft is on the ground. Once aircraft is airborne, actual ground speed will be used.

Fuel consumption represents average cruise fuel consumption of aircraft. This value will be then used in the fuel computer for the endurance and range calculation. See also the Fuel computer mode section.

Endur. reserve is the reserve used in the endurance and range calculation. The reserve is given in time. Please refer to the page 41 for more details on fuel computer monitor.

Fuel computer mode Fuel computer works in one of two modes: fixed or automatic.

- The *fixed* mode always uses the fuel consumption given here in range and endurance calculations. It ignores the values given from fuel flow sensor/calculator.
- The *automatic* mode uses the fuel consumption given here only while the aircraft is not flying – while on the ground or taxing. As soon as aircraft is airborne, it starts calculating average consumption from the fuel flow and then it uses its average for the range and endurance. The average is true average and takes all data after take-off into account – it is not a moving average.

7.3.4 Screen

Figure 52 shows some options that affect how Nesis screens are shown.

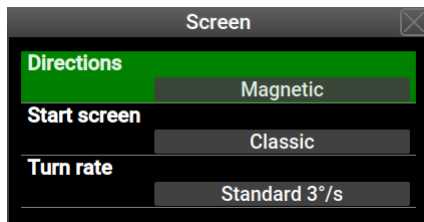


Figure 52: Parameters related to the Nesis screens.

Directions 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.

Start screen This option tells Nesis, which of the four major screens shall be activate on the start.

Turn rate defines visual aids for turn rate markers:

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

7.3.5 Map

Maps (charts) can be also a bit customized. Figure 53 shows the options.

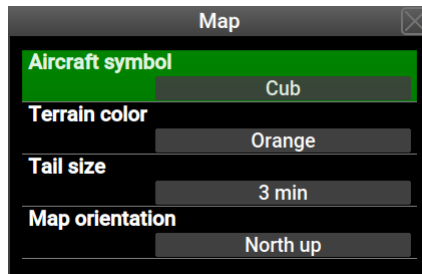


Figure 53: Parameters related to the Nesis maps.

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 (GPS track).
- North up – the map is always oriented to the true North.

7.3.6 Logger

Logbook and logger use several parameters needed for correct takeoff and landing detection. Figure 54 shows these parameters.

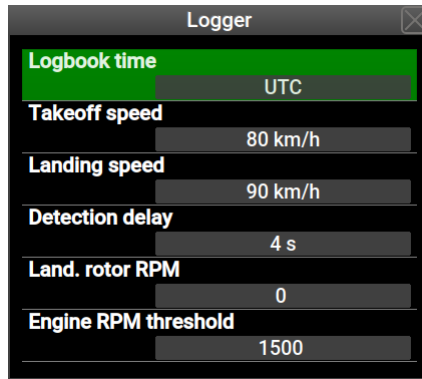


Figure 54: Logger and logbook specific parameters.

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 speed. It defines the time for which takeoff or landing condition must be met. This is used to prevent false takeoff/landing detection.

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.

7.3.7 Maintenance

This option is used to set a maintenance warning. Figure 55 shows the maintenance options on the left and a warning window on the right.

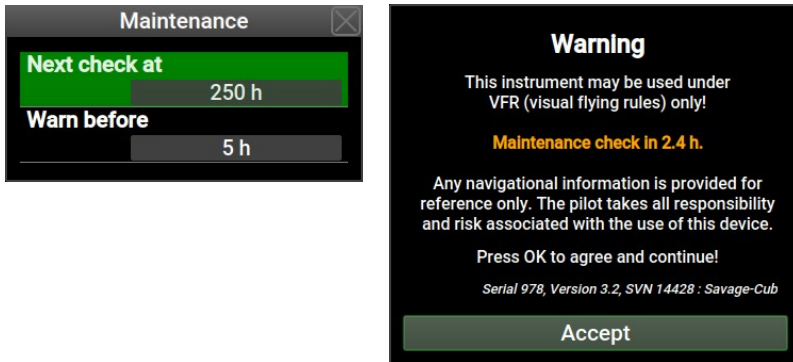


Figure 55: Left: Maintenance options. Right: Maintenance warning.

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.

7.3.8 Engine shut off

This is special option for the cases, where the engine must be cooled down by running on idle before switching off. When aircraft is below some speed

threshold and the engine RPMs are on idle a large countdown starts on the Nesis screen. Once the countdown disappears, it is safe to switch the engine off. Figure 56a shows the parameters and Figure 56b shows the countdown.

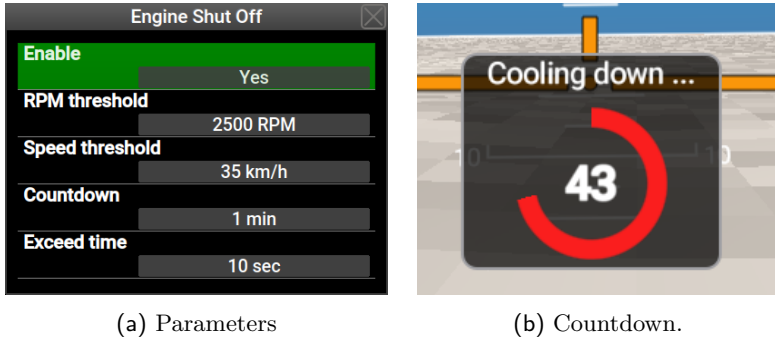


Figure 56: Engine shut off example.

This options is disabled by default.

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 speed is below some speed threshold and RPMs are below this threshold, the countdown starts (only if engine is in hot mode).

Speed threshold This limit shall be set below flying speed. 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 was cooled 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.

7.3.9 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 smaller glide distance calculated.

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, specify 0 for the glide ratio.

See also section 3.7.1 on page 26.

7.4 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 7.4 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 can be also active. An instructor can appear in two roles as a pilot or as an instructor.

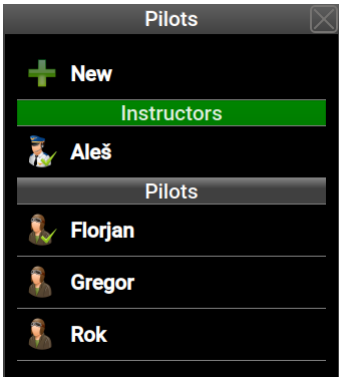


Figure 57: An example of window used to edit pilots.

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, a new active pilot or instructor can be activated from the options screen. Select the *Pilots* icon, select a name from the list and finally select *Activate* from the command window. An active instructor is selected in the same way.

7.5 Alarms

Nesis has several alarms, which are triggered, when certain parameter goes *red*. Selecting the *Alarm* icon from the *Options* screen opens a window with alarms. Figure 58 shows an example.

For each alarm a behaviour 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.

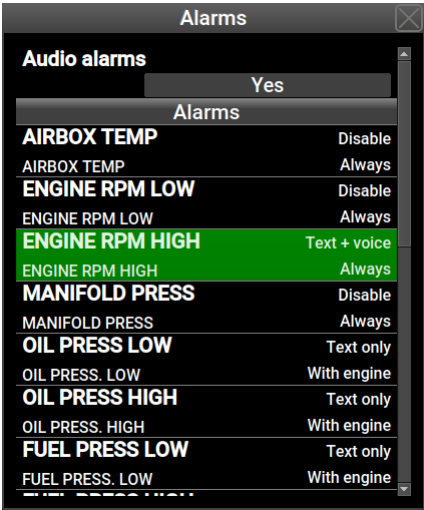


Figure 58: An example of alarms in Nesis.

A special (topmost) option on Figure 58 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.

7.5.1 Editing an Alarm

Select an alarm from the list in order to open the alarm editor window shown on Figure 59.

- Mode** Select one of behaviour modes. See previous description.
- 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 condition when an alarm is active.
 - *Always* means that the alarm is always active.

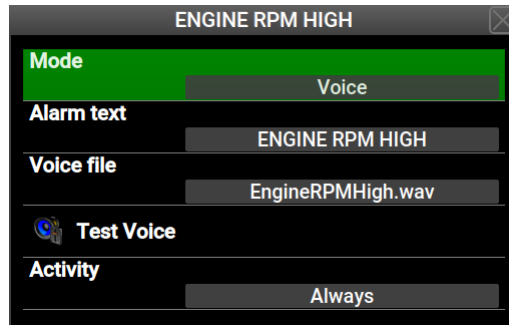


Figure 59: An example of alarm editor for the high engine RPM situation.

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

7.6 Brightness

The brightness icon is used to change the display brightness in range Nesis always starts with maximal 100% brightness. When Nesis detects that it runs on a backup battery (when such option is installed) it will automatically reduce brightness to 80% unless lower brightness was already selected. Brightness is selected in 10% steps.

7.7 Audio

The *Audio* icon is used to change the audio level output for Nesis warnings. Figure 60 illustrates an example. The *Test* option is used to play a test file and the *Volume* sets the volume level in 10% steps.

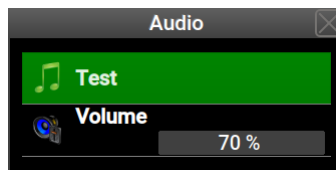


Figure 60: The audio level window.

7.8 Compass

The *Compass* icon 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 of *MAGU* installation and calibration the details are explained in the *MAGU Manual*. Please refer to our web site and download the manual.

7.9 ADSB/Flarm

The *ADSB/Flarm* icon is used to set various Flarm/ADSB settings. The details are covered in section 5.3 starting on page 60.

7.10 Waypoints

The *Waypoints* icon is used to add and edit user specific waypoints. Figure 61 shows a window that appears. The top part list commands and the bottom part list all user waypoints.

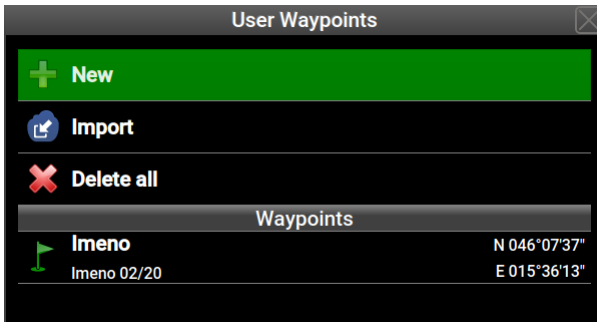


Figure 61: An example of user waypoint window.

7.10.1 New Waypoint

The *New* command is used to create a new user waypoint. First Nesis asks for a waypoint name and once the name is given, it asks for the details. Figure 62 shows an example.

Figure 62: 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.

7.10.2 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.

7.10.3 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.

7.10.4 Delete All

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

7.10.5 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 on Figure 62 is opened. See section 7.10.1 for details.

7.10.6 Transfer

The *Transfer* icon is used to copy certain helper files from the USB stick into the system. Such files are maps, airspace, configuration, translation, etc. Figure 63 shows all transfer options.

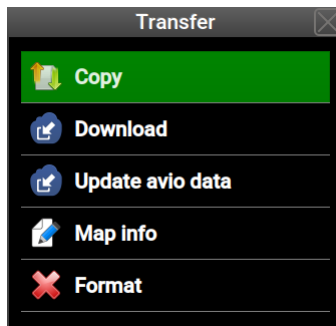


Figure 63: Transfer options window. Note that *Download* and *Update avio data* options are available only when Nesis is connected to the Internet.

Copy copies a file with *kus* or with *lic* extension from an USB stick. All these files are in Kanardia specific format and they have special header, which tells Nesis what this file is for and where to store it. Each copy is a two part process. First, Nesis checks the integrity of the file and if the check passes, the file is copied. Usually, a restart is required after the file copy has been completed. 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 download detailed map for some country. This command appears only if Nesis is connected to the Internet. A list of continents appear. Select a continent and then a country. Repeat this for all countries where a detailed map is needed.

Update avio data This command appears only if Nesis is connected to the Internet. The command will download latest airspace, airfield, way-points database from Kanardia server.

Map info lists all *raster map files* loaded into Nesis, Figure 64. 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. A raster map can be also deleted. Select a raster map file and then confirm the Remove option. After removal, Nesis must restart.

Format is a very powerful command and normally it should never be used. It will reformat internal disk section, which holds the maps and effectively delete all maps – system maps and raster maps. The command can't be revoked.

7.11 Update

The *Update* icon starts system software update. It asks for a confirmation and when confirmed, restarts Nesis in special update mode. More details are given in section 9 starting on page 94.

7.12 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.



Raster Maps		
	Bossy F,B,L,CH 2018 2018 [1]	01.01.18
	CB-FR-18.ra	366 MB
	Austria 2017 [1]	30.03.17
	D-AT17.ra	141 MB
	Belgium 2017 [1]	20.07.17
	D-BE17.ra	58.8 MB
	Suisse 2017 [1]	17.08.17
	D-CH17.ra	74.0 MB
	Czech Republic 2017 [1]	30.03.17
	D-CZ17.ra	155 MB
	Germany 2017 [1]	30.03.17
	D-DE17.ra	285 MB
	Denmark 2017 [1]	13.04.17
	D-DK17.ra	60.0 MB
	Croatia North 2017 [1]	13.10.16
	D-HR17N.ra	127 MB
	Croatia South 2017 [1]	13.10.16

Figure 64: 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.

7.13 Info

The *Info* icon tells some technical information about the Nesis and connected CAN bus devices. Figure 65 shows an example.

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.

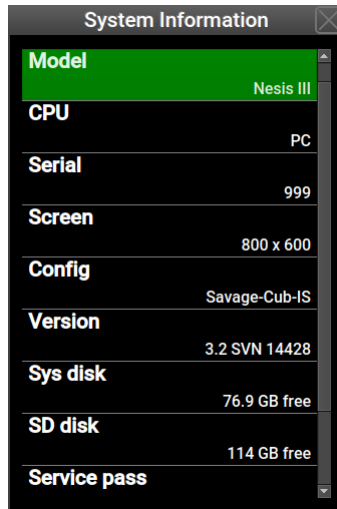


Figure 65: An example of info window with the system details.

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* section.

CAN devices section lists all devices detected on the CAN bus.

7.14 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 7.13.

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

Service option icons are explained in separate section 8 starting on page 92.

8 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 66 shows the service options screen. Note that slave Nesis has only a subset of these icons.

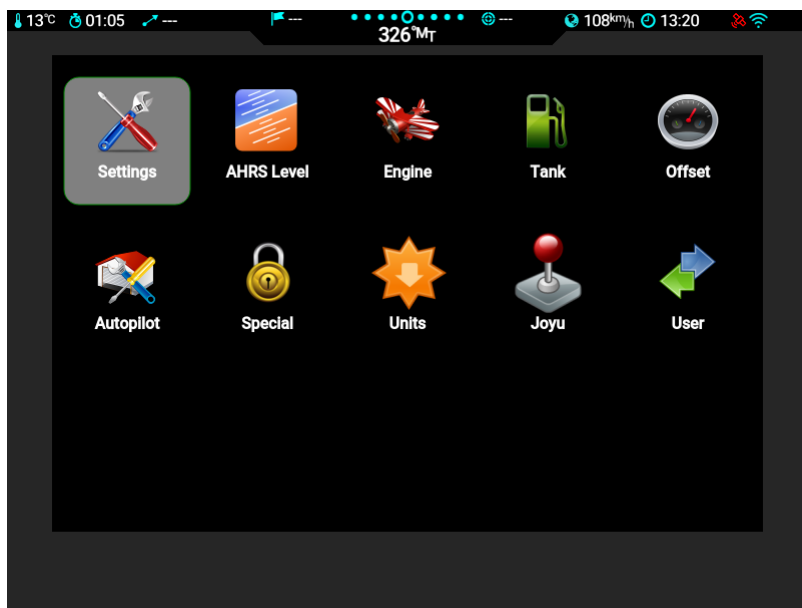


Figure 66: The service options window and corresponding icons.

Settings opens a window, where access to further options is provided. It is used to select layout - screen organization, defines parameter limits and color codes, flap positions, trim limits and video signal type.

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

Engine opens window for the EMS device. Channels and sensors are configured here.

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*.

Special Special functions allows you to enter various passwords which affect Nesis behaviour. To prevent unwanted changes, do not use this function unless we instructed you to do so. Most passwords are given to the customers on a need-to-know basis.

Units 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.

User brings back the *User Options* screen.

9 Software Update

The Nesis software is under constant development and we recommend updating it regularly. This section describes actions required to update the software.

9.1 Updating with USB Stick

In most cases, Nesis is updated using USB 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.

Once Nesis is updated to a new version, old version can not be put back without causing system instability. If you really want to put the old version back, you have to send Nesis and all CAN bus devices connected to Nesis back to Kanardia.



9.1.1 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 on Figure 67.
- ③ Click on the link to start download process of selected software file. Before downloading the software, a window appears asking for your email address. This is optional. Download will be completed also if address is not given.

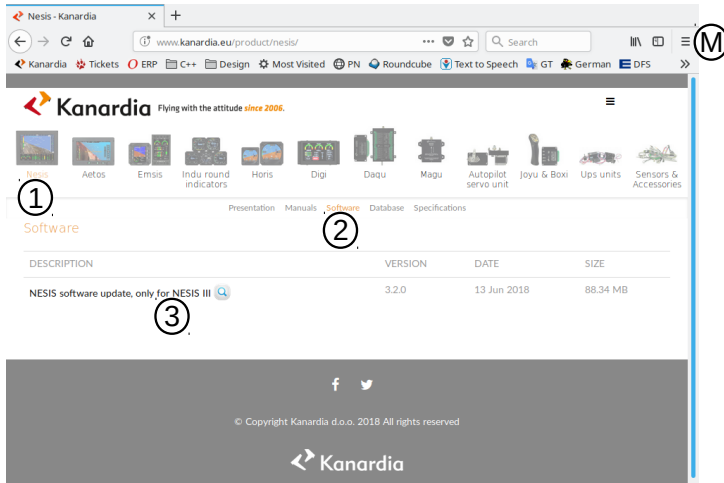


Figure 67: Illustration of the Nesis software download page. Usually only latest update is available.


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.

Mozilla Firefox solution is given in next steps:

1. Click on the \equiv menu symbol. See label (M) on Figure 67.
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.

9.1.2 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.

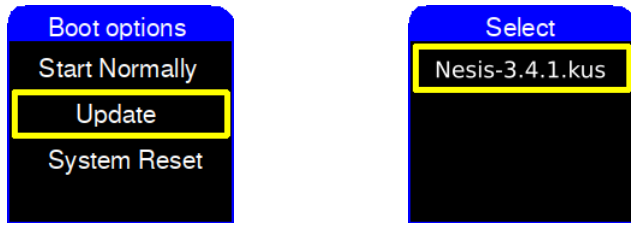
Important: Once file was copied, please make sure that the USB stick is safely removed from PC. This makes sure that all files are properly copied and closed before the stick is actually removed from PC.



9.1.3 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. Nesis will restart in special update mode.
3. Upon restart a window similar to Figure 68a opens. Select the *Update* option.



(a) Nesis update mode options.

(b) Update file selection.

Figure 68: Special update mode example.

4. A window similar to Figure 68b 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.



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 minutes⁸. Secondary Nesis does not perform firmware update⁹.

9.2 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 on Figure 1, page 18. Wait until the window similar to window shown on Figure 68a appears.

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

10 Autopilot

When Nesis system is extended with one or two servo motors, than Nesis can be also used as a main autopilot controlling device. In general, no other electronics, but servos is needed.

This section describes basic operations with autopilot system.

10.1 System Description

Autopilot system shown on Figure 69 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. It is also possible to install a quick autopilot disable switch which can be placed on the command stick of the airplane.

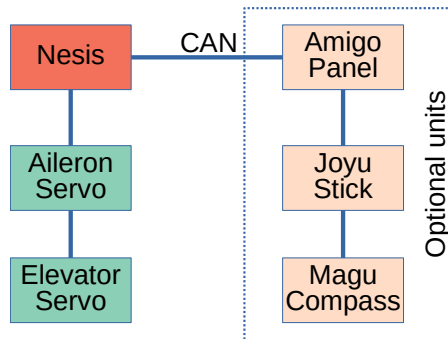


Figure 69: Main units of the autopilot system. Some units are optional.

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.

10.1.1 Autopilot Status

Autopilot status box as shown in Figure 70 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.



Figure 70: An example of the autopilot status box on the Classic screen.

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



10.2 Autopilot Setup

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

10.3 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 7.3.1 on page 74 for more details.

10.4 Safety

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





The autopilot is directly linked with aircraft commands thus it presents high risk if something fails or goes wrong. Kanardia autopilot is using following safety features:

- Automatic disable when aircraft is outside safe operating limits.
- Motor override - the servo motor can be safely overridden, but the commands are jerky.
- Servo power switch immediately cuts the power of servo motors.
- Safety pin will break if the motor is mechanically blocked.
- Mechanical limiter limits the movement of the motor lever preventing mechanical lock-up.

10.4.1 Electrical Disconnect



The autopilot motors are disconnected as soon as power supply is removed. Therefore it is essential that the power to the servo motors can be cut with removable fuse or with a separate switch. The power supply for the motors should be routed separately from the rest of Nesis and aircraft system.

10.4.2 Automatic (Safety) Disable

The Autopilot will also disengage automatically and immediately if any of the following values will be out of range:

- minimum autopilot IAS,
- maximum autopilot IAS,
- maximum autopilot vertical speed,
- maximum autopilot roll angle,
- maximum autopilot pitch angle.

This values must be configured correctly and they depends on the type and performance of the aircraft. The values can be changed in the *Service Options*. Please refer to Autopilot Installation Manual for more information.

10.4.3 Disabling the Autopilot

The following ways may be used to disable autopilot system:

1. Select the *Disable* option from the autopilot menu.
2. Press the *User* button when the autopilot menu is active (double click on user button).
3. Make a long press on the *User* button – the long press function must be properly defined.
4. When installed – press the autopilot disable switch placed on the command stick.
5. When *Joyu* is connected to the CAN bus and its buttons properly configured – press (or long press) the corresponding button on Joyu.
6. Cut the power to the servos – electrical disconnect.
7. Make a long touch on the status window.

The servomotors are designed to be over-driven with external force from command stick with no damage.



10.5 Operation

Short press on the *User* button shows the autopilot menu, Figure 71. All autopilot actions are accessed through 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 last selection. When the menu is opened, last action is already selected. This saves time when you change one parameter often.

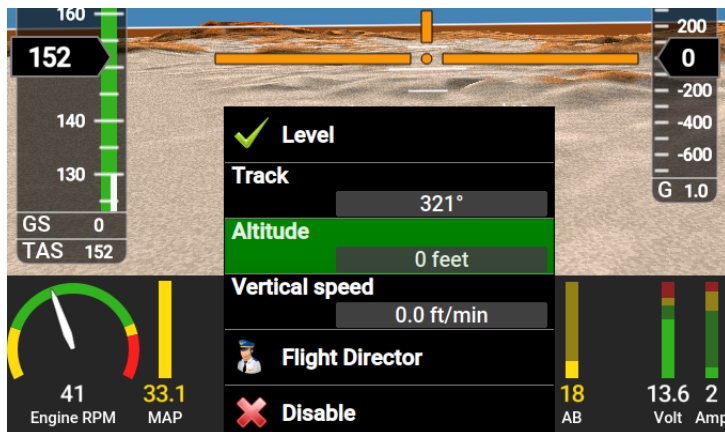


Figure 71: An example of the autopilot menu.

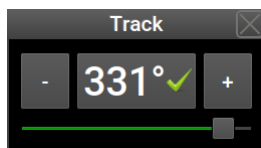


Figure 72: Illustration of the track input window.

10.5.1 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 on Figure 72. 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.

If the autopilot was not active before selecting new track the 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.



10.5.2 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 on Figure 73. The default value of the input window is always current altitude.

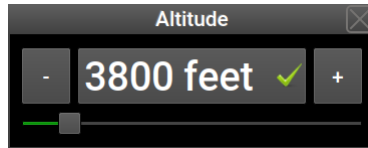


Figure 73: Illustration of the altitude input window.

10.5.3 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 50 for more information about route planing. The flight director is controlling only direction of flight. To change altitude use *Altitude* or *Vertical Speed* commands.



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).



10.5.4 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.

10.5.5 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.

11 Maps

Nesis uses two 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.

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

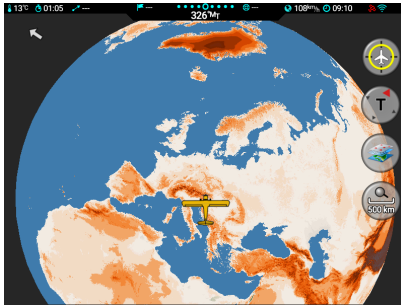
All map information is always drawn as a part of globe. No fixed projection is used. The projection is dynamic and automatically adapts according to the zoom level and current position. This was achieved by using the high performance graphics OpenGL system.



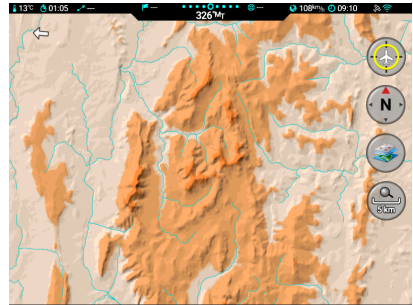
11.1 Layers

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 74a shows example of this layer.
- High resolution terrain is drawn next. Some examples are shown as background on Figures 74b, 6 and 7.
- Rivers, roads, railways, country borders, country names, cities are drawn next. The detail of this layer strongly depends on the zoom level. Figure 75 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 76a.

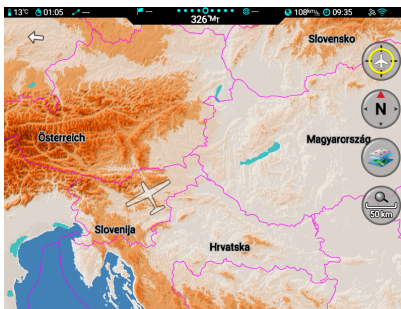


(a) Low resolution map – distant view seen as a globe.



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

Figure 74: All map operations are made on globe.



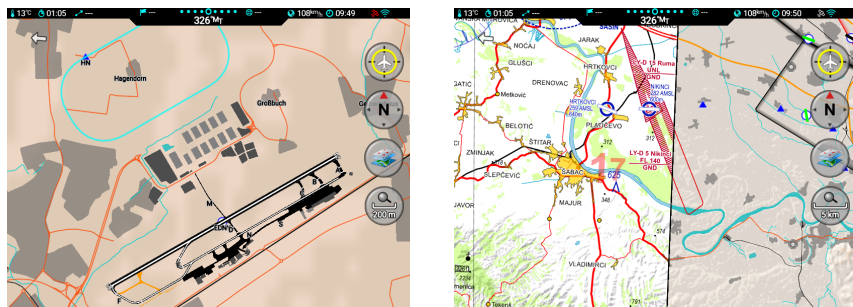
(a) Low vector detail.



(b) High vector detail.

Figure 75: The details of vector map depend on zoom level.

- 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 76b shows an example, where left part of the screen is covered with raster map and the rest is vector map. The figure shows how raster map overwrites all previous layers. It also shows that both maps blend together pretty good.
- 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 76: More details of vector map and blending with raster map.

11.2 Vector Maps

Vector maps are based on several map sources.

- Elevation data is based on 3 arc-second DEM data, which is originally provided by SRTM¹⁰.
- Roads, rivers, lakes, railways, populated areas, state borders, etc. are obtained from the OSM¹¹ project. Only a tiny subset of this always growing project is used. We update this data once per year, usually in summertime.
- The major source for aeronautical information, airfields, airspace zones, navigation aids, etc. represents the OFM¹² project. Partly, we also take data from Our airports¹³ web page.

11.3 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.

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.

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.

11.3.1 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 Emsis. The maps can be downloaded from our web site. Figure 77 shows coverage of DFS maps.

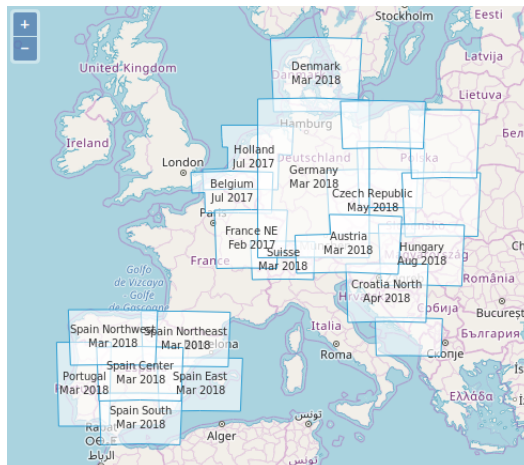


Figure 77: Availability of the DFS maps.

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 also obtained.

The license file is bound to a Nesis serial number. In order to obtain the license file, please contact us 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.

11.3.2 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 78 illustrates them for the main part of US.

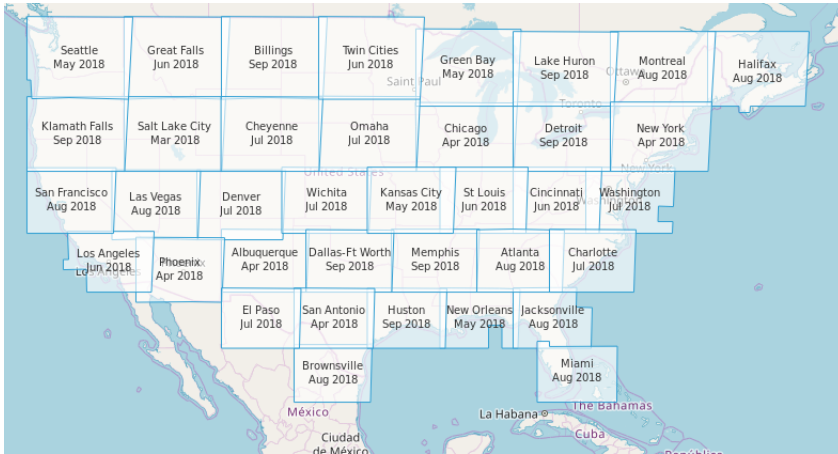


Figure 78: Availability of the US maps.

11.3.3 User Charts

Any image file which is available in proper format can be converted into a *ras* format. It is also possible to scan a paper map and then convert the resulting file into *ras* format. Please contact us and we will discuss options.

12 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.

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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.

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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.

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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.

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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

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12.2 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.