

# **MGL Avionics**

## **iEFIS**

### **Navigation**

**This document applies to G2 and G3 iEFIS and iEFIS “Lite”  
versions**

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# Introduction



The iEFIS systems provide a comprehensive navigation system. This documents describes the following related topics:

## ***Navigation sources***

This section describes the various internal and external navigation sources that can be used as horizontal (lateral) and vertical navigation sources.

## ***Navigation sources priority***

Some navigation sources exist both in an “internal navigation” as well as an “external navigation form”. This section describes how the relevant source is chosen.

## ***Navigation databases***

Navigation databases contain information on waypoints, navigation aids, airports and many other items. This section describes the databases available and how to use them.

## ***Navigation setup***

The EFIS allows you to customize the way you would like the navigation system to work to a very large degree. Customization may be done based on available navigation sources or on personal preferences.

## ***Using the navigation system***

This section describes how to use the various navigation modes and features.

## ***Diverts***

How to create multi-point diverts using the moving map.

## ***Intelliroutes***

How to use the Intelliroutes function to create automatic survey and search and rescue patterns.

## ***Flightplan tool***

This section describes the use of the flight planning tool. This tool is used to create and edit flight plans (Routes).

## ***Using the Moving Map***

The EFIS moving map allows a variety of interaction with the pilot. This section describes the available functionality.

## **IEFIS Lite**

The iEFIS Lite versions do not have support for ARINC or external analog navigation inputs. Please ignore any mention of these in this manual as they are not applicable for any model of iEFIS Lite.

The iEFIS Lite models do support external navigation receivers via RS232.

IEFIS Lite versions are not in any way artificially limited in functionality compared to the full function versions – they simply provide fewer interfaces to external systems. As long as a particular function does not rely on such an interface the function is available.

## **Navigation sources**

The EFIS provides the following available navigation sources. Some of these are based on internal sources, some require external sources.

### ***The internal GPS***

The internal GPS receiver is used as source for several navigation sources. These are:

#### ***Direct to GPS navigation***

This is the simplest form of GPS navigation. It directs you to a chosen geographic point, referred to as a “waypoint”. There are many different types of waypoints.

#### ***Route (Flight Plan) navigation***

This is somewhat related to the “direct to” GPS navigation but you follow a string of waypoints that are contained in a route file. Such routes can be followed in forward or reverse direction and you can select the next active waypoint in the route.

Routes can be created in applications such as “MGL Central”, several third party flight planning tools such as “PocketFMS” or “Easyplan” and you can also create routes directly on the EFIS itself using the “Interactive flight plan tool” (Please view manual “iEFIS flight plan tool” for details on this).

#### ***GVOR navigation***

Normal VOR stations are radio beacons that allow an aircraft to determine on which radial relative to the beacon it is currently (effectively an approach or departure bearing). Some VOR stations also have DME facilities and this can be used by suitable on-board equipment to measure the distance to that station.

GVOR is a GPS based simulation of a VOR/DME station. This is based on known locations and magnetic variations of VOR stations included in the navigation database(s).

The EFIS simulates all indicators such as the HSI (horizontal situation indicator) as if you would have tuned your navigation receiver to that station.

#### ***GLS Navigation***

This is a GPS based implementation of a simulated ILS and glideslope system. It can be used to guide an aircraft to the threshold of a runway at the correct approach angle.

This system is based on known runway threshold locations including elevation contained in the database(s). Visual highway in the sky (HITS) guidance can be provided in addition to traditional HSI and glideslope indicators. Unlike a normal ILS system, it is not required to select an OBS bearing as the system knows what that bearing should be,

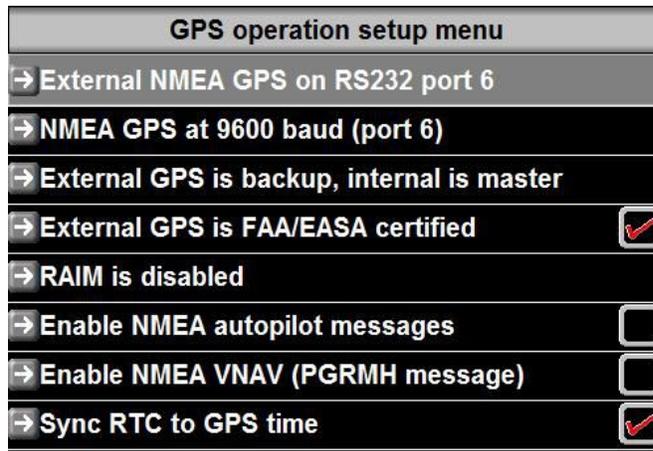
## The external GPS

The system can be configured to use an external GPS feed either via NMEA on RS232 port 6 (iBOX) or it can use GPS guidance from either one of the three available ARINC 429 receive ports.

Please note that typically, the internal GPS is a better performer to external GPS systems due to faster update rates and higher resolution. You may be forced to use an external, certified GPS for legal IFR procedures. In this case we recommend that you use the internal GPS as master. In this case the internal GPS will automatically be used for all internal operations that rely on high resolution (synthetic vision and autopilot) Even if you use the internal GPS as master and a certified external source is available, the external position will be forwarded to mode-s transponders for use with their extended squitters (1090ES).

All navigation sources available for the internal GPS are available for the external GPS.

Please use the GPS and NMEA port operation menu to select how to use an external GPS navigation source's GPS position:



Note: The internal GPS is a WAAS receiver that has RAIM capability. RAIM allows the GPS to detect and exclude satellites that are not contributing to an increase in position accuracy (for example this may happen if a Israelite's onboard time source is not accurate for some reason).

## Analog NAV inputs

The EFIS system provides several analog inputs. These are typically coupled to older navigation systems that provide a standard +/-150 mV signal.

The EFIS uses two of these, one as horizontal and the other for vertical guidance (plus validity flags).

These signals can be switched to the HSI and GSI for navigation. These signals are not dedicated to any form of navigation type but depend on the external equipment that is supplying these signals.

Typical sources are VOR/ILS radios and GPS systems.

**Please switch off the analog navigation inputs if you are not using them**

Floating inputs can result in external navigation activating itself. As any external navigation source has a higher priority in an iEFIS system this may override your internal navigation.



### ***ARINC inputs***

The EFIS provides three ARINC 429 receiver inputs, one high speed and two low speed. Each of these inputs can react to VOR, ILS and GPS navigation with or without vertical guidance.

Each of these inputs can be switched as source to the HSI and GSI for navigation.

A special mode is also provided where two inputs are combined into a GPS/VOR/ILS system using some non-standard methods employed by the Garmin 430W range of NAV/COM systems.

Please view manual “Stratmaster EFIS to Garmin 400/500W series ARINC Integration and Operation” for details.

### ***RS232 based navigation radios***

The EFIS system makes provision for navigation radios that use a serial RS232 communications line. This can be connected to RS232 port 1 or to any of the ports on a MGL COM extender module.

Currently the only such navigation radio supported is the Garmin SL30 NAV/COM radio and VAL Avionics NAV radio. These devices provide VOR and ILS/Glideslope information.

### ***Internal GPS and RAIM***

If you enable RAIM, you can select one of several “fixed” precisions that will be used as reference down to precision approach specifications. The system will never assume a higher precision than what you specify here but can lower the actual value depending on current GPS performance and warn you accordingly. RAIM precision estimates can be seen on the GPS status display at any time. The GPS status display will show yellow if current precision is worse than your set level.

You will find that most of the time, given a good satellite constellation, extremely good precision is available, well in excess of the minimum requirements for a precision approach. It is advisable to consult the current GPS performance before attempting any operations that require high accuracy.

During an automated procedure (such as a published arrival procedure), the system will select the required GPS/RAIM accuracy as dictated by the relevant leg.

EN-Route: 2NM. Position must be better than 2NM horizontal uncertainty.

Terminal: 1NM. Position must be better than 1NM horizontal uncertainty.

Non-precision: 0.3NM. Position must be better than 0.3NM horizontal uncertainty.

Precision: 40 meters horizontal, 50 meters vertical. GPS position estimate must be within 40 meters horizontal and 50 meters vertical.

Note: With RAIM set to “precision” it is possible for the GPS status display to turn yellow as conditions that could result in exceeding this precision can occur fairly easy. You will typically see the display turn yellow for example during initial acquisition of a position before all satellites in view have been evaluated.

Note: The method used to determine horizontal and vertical accuracy of the GPS position differs from that used in a certified GPS which is forced to use a method determined in the 1990's era. Modern GPS systems tend to use a better method that results in better accuracy of the accuracy estimates. For this reason the older methods are not implemented in modern GPS systems, including certified ones

The iEFIS system will use these modern methods but artificially worsen them by 50% so the likelihood of a “too good” estimate is very unlikely.

## **Navigation sources priority**

Many navigation sources have both internal and external sources.

An example of this is the VOR which may be simulated using the internal GPS or it may originate from an external NAV receiver. Most internal navigation sources have external equivalents.

The only navigation source that does not have an external source is the heading bug.

The iEFIS selects between the available, valid navigation sources using a simple priority scheme:

Highest priority:

A navigation source on an ARINC data feed has the highest priority

A navigation source on a RS232 data feed has the next highest priority

An internal navigation source has the lowest priority

Example:

You have a navigation receiver connected to an RS232 port. You also have a navigation receiver connected to an ARINC port.

Assume you have an internal GVOR source selected. You have also selected "VOR" as navigation source in the NAV menu (NAV button).

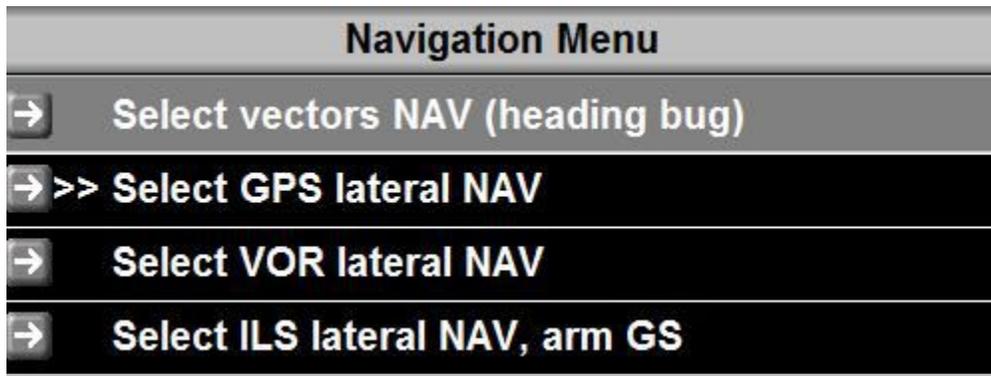
Assume further that both the RS232 and the ARINC navigation sources are both tuned to a VOR station and both are flagging the station as valid (i.e. a valid VOR signal is being received).

In this case the iEFIS will choose the ARINC source as it has the highest priority. If the ARINC source flags the station as not valid and the RS232 is still valid, the iEFIS will then switch to the RS232 based source. Finally, if even that source fails, the iEFIS will go back to its internal VOR source (assuming it is valid). If no source is valid the VOR navigation fails and the HSI will no longer show the relevant navigation information.

## **Switching between Navigation sources**

In principle, we have 4 different principal navigation sources in an iEFIS system (each of these can have more than one individual source, except for the heading bug).

The current navigation source is selected using the Navigation menu (press the NAV button).



### **Vectors NAV**

Vectors NAV means you want to fly a “vector” which will be interpreted as ground track corrected for local magnetic variation or, if GPS is not available, as magnetic heading as indicated by your compass connected to the iEFIS.

For example, you have been given a vector to fly by ATC. Assume ATC tells you to fly a heading of “270”. You dial 270 into your heading bug using the top right rotary control and then select “Vectors NAV” from the navigation menu (if not already selected).



The HSI will show a yellow arrow. As there is no course deviation when flying a heading the center segment of the arrow is solid.

### **GPS Lateral NAV**

GPS lateral navigation is perhaps the most common form of navigation. It is used for direct-to waypoint as well as route (flight plan) navigation. It is also used for divers and intelliroutes, both of which are special forms of routes.



This is also the only NAV source the system will automatically select in some cases. For example, regardless of currently selected NAV source, if you perform a “direct-to” waypoint selection the NAV source will be immediately selected to GPS Lateral NAV for you to reduce your workload.

GPS lateral navigation uses a magenta arrow that is segmented. The moving center segment shows you how far you are off-track in steps of 1 NM and which direction to fly to arrive at the waypoint (in the above image you can see you are very slightly to the left of the track and should fly slightly to the right to get to your waypoint).

## VOR NAV



VOR NAV is described in more detail further down in this document. The system provides for a primary and secondary VOR source showing “paddles” that give you an indication where these sources are located (from a direction point of view). The radials from these VOR stations are shown as lines.

Further VOR related information can be seen in the VOR status:

NAV	ID	Radial	DME
117.600	RIV	079	82.2
115.700	CTV	066	81.0

Note: DME is always shown if you are using GVOR since the distance is known. With external radio navigation receivers DME is not currently available.

## **ILS NAV**

ILS navigation combines both navigation radio based ILS and glideslope as well as the internal GPS based ILS (GLS) and glide slope.



ILS operations are detailed further down in this document.

## **Navigation databases**

Navigation databases and their installation are described in the manual “MGL EFIS Files” in detail.

This is an overview:

The EFIS has up to three navigation databases active at any one time. It is possible to install many more databases, each assigned a “region” code. While this is intended to allow installation of databases that each cover a different geographical region, this is not dictated in any fixed way – any database for any region code can contain any data. It is thus also possible to use different databases for the same region.

The active databases are organized into:

### ***Primary database***

This is a navidata file (Navidata.ewd), created by the MGL Central application or from a third party source. This database can be subscription product.

The database is identified by region by the last letter of the file name, example:

Navidata.ewd, Navidatb.ewd, Navidatc.ewd up to Navidatz.ewd.

The primary database can contain items such as:

- 1) All types of waypoints including nav aids
- 2) Airport information (frequencies, runways etc)
- 3) Airspaces
- 4) Obstacle database
- 5) Airways
- 6) Approaches
- 7) Standard arrivals
- 8) Standard departures

### ***Secondary database***

This is a navidata file (SNavia.ewd), created by the MGL Central application or from a third party source. This database cannot be an encrypted subscription product and must be in open format (such as produced by MGL Central).

The main purpose of this database is to allow you to use a subscription product but still allow you simultaneous use of your own database that you can maintain yourself if so desired.

The database is identified by region by the last letter of the file name, example:

SNavia.ewd, SNavib.ewd, SNavic.ewd up to SNaviz.ewd.

The secondary database can contain items such as:

- 1) All types of waypoints including nav aids
- 2) Airport information (frequencies, runways etc)

Other items may be included in this database but at time of writing are not utilized in the system.

### ***Supplementary waypoint database***

This database is created automatically in your system if it does not exist.

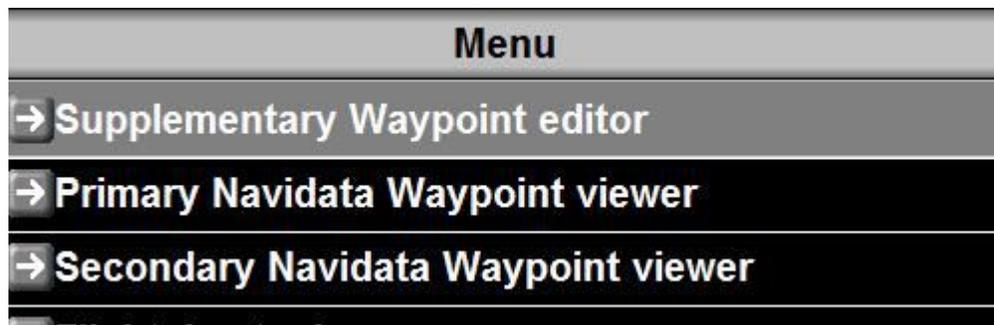
The filename is "Waypoint.ewd". This is a list of waypoints you can create and edit directly on the EFIS.

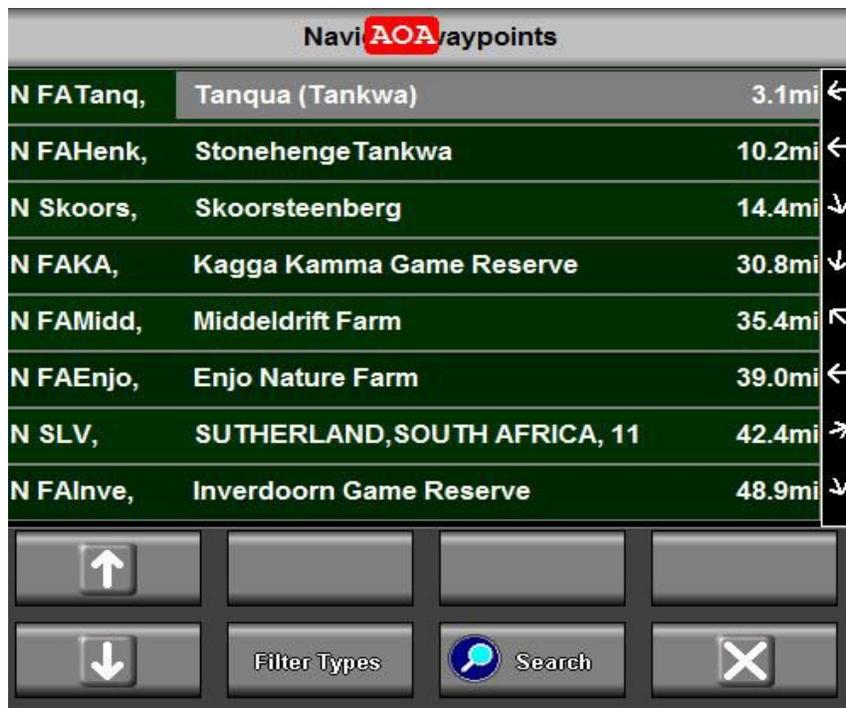
The primary and secondary databases are not editable so this database allows you to create new waypoints whenever you need them.

### ***Viewing or editing the databases***

The three databases have viewers and the supplementary database has a viewer/editor.

These are accessed from Menu level 2

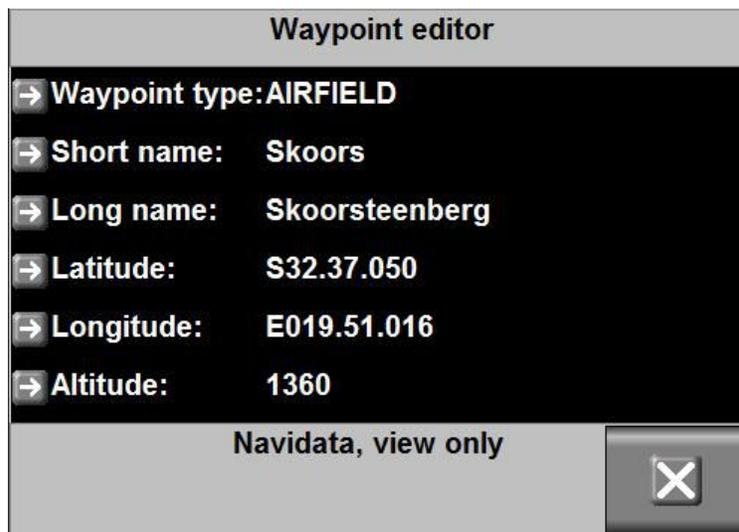




The primary and secondary databases can only be viewed, they cannot be changed on the system:

Basic information is shown in the viewer, distance to the waypoint from current location (or last known GPS location) as well as the relative direction of the waypoint from where the aircraft is pointing. In the above viewer, Stonehenge is to the left of us while Inverdoorn is behind us.

Tapping any of the waypoints brings up more information on the selected waypoint:



### ***Editing the supplementary waypoint database***

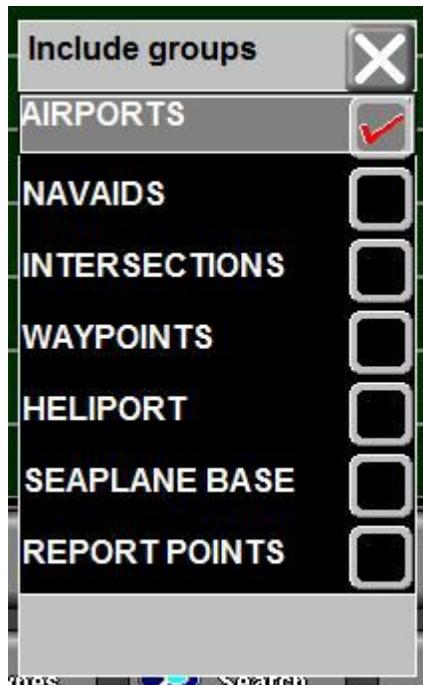
You can create new waypoints, edit (change) existing waypoints or delete waypoints.

New waypoints can be created from scratch or picked from an existing route.



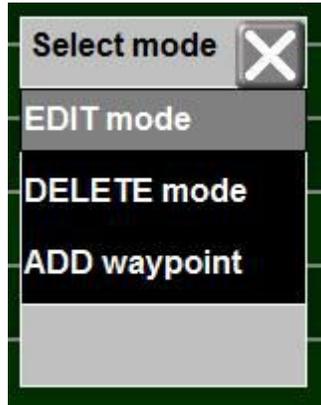
The above image shows an empty waypoint database. Note that it is also possible for the above image to show if the “Types” selected exclude any of the waypoint types you have in your database. Tap “Filter Types” to get the “Types” selection:

The above selection will allow any airport type and normal “untyped” waypoints to show but all other types will be suppressed from the viewer.

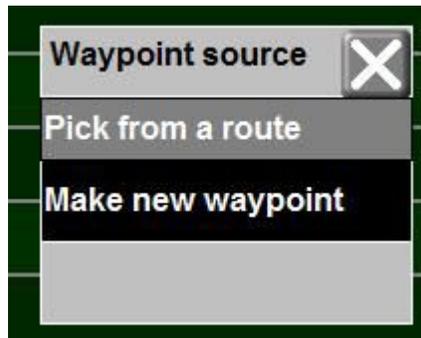


### ***Creating a new waypoint***

To create a new waypoint, Tap "MODE" (Select mode, add waypoints).



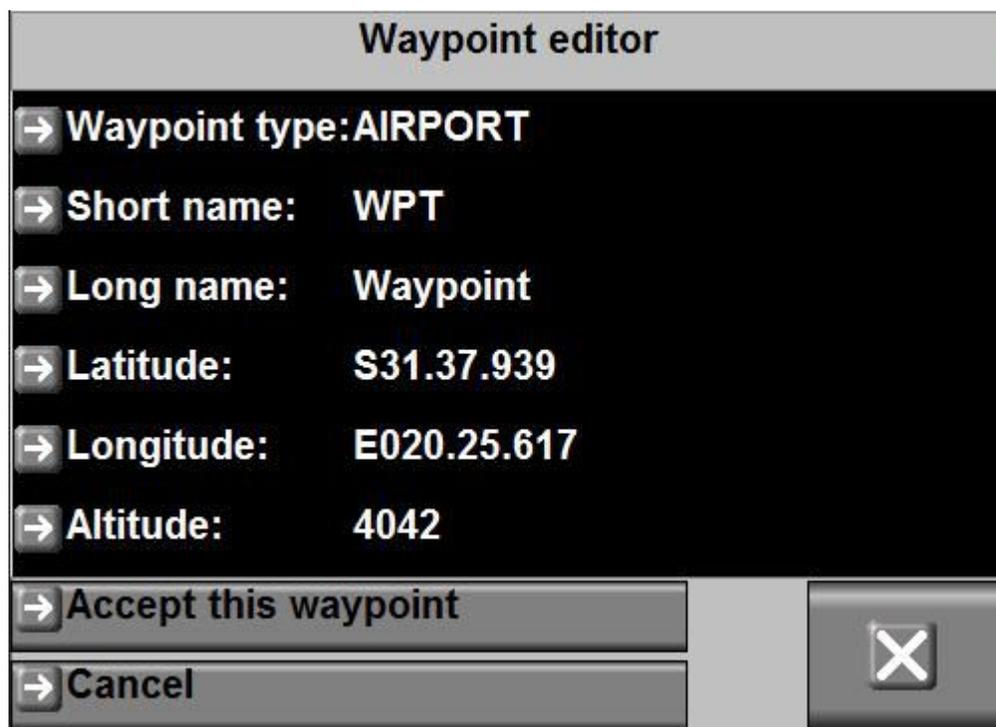
Tap "ADD waypoint" to ADD a waypoint.



You can pick a waypoint from any route (Flight Plan) in the system or you can make a new waypoint.

Please note that there is a special route file in the system called "MARKERS.ERT" this file is created when you use the "Markers Icon" to create an "ad hock" waypoint at your current location.

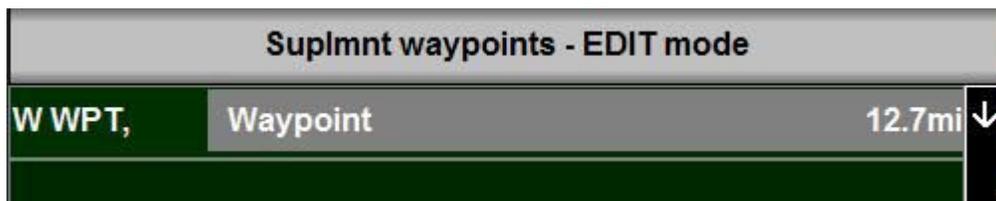
Let's create a new waypoint. Tap "Make new waypoint:."



A new waypoint is created at your current location (or last known GPS location).

You can edit all the parameters of the new waypoint and if you are happy, tap “Accept this waypoint” or tap “Cancel” to cancel.

If you tap “accept this waypoint” it will be added to your supplementary database (the Waypoints.ewd file in your Navdata folder).



The new waypoint has been created and is ready for use.

***Picking a new waypoint from a route***

If you are picking a new waypoint from a route, the EFIS will request that you select the route file name (The route file must be stored on your internal SSD drive in the Fplan folder – this is where all flight plans are kept).



Here we selected the route "A.ERT".



Here we selected FAFK, Fisantekraal:



At this point we can edit the details if required for our new waypoint. Perhaps we want to change the position slightly or change the name. Tap “Accept this waypoint” when you are done.



We are done, the waypoint has been added to the supplementary waypoint database and is ready to use.

### ***Edit and delete modes***

Using the “ADD/Mode” button you can change the editor mode between “EDIT” and “DELETE”. If in EDIT mode, selecting a waypoint will show the waypoint editor for this waypoint. If in “DELETE” mode, selecting a waypoint will delete it from the supplementary waypoint database.

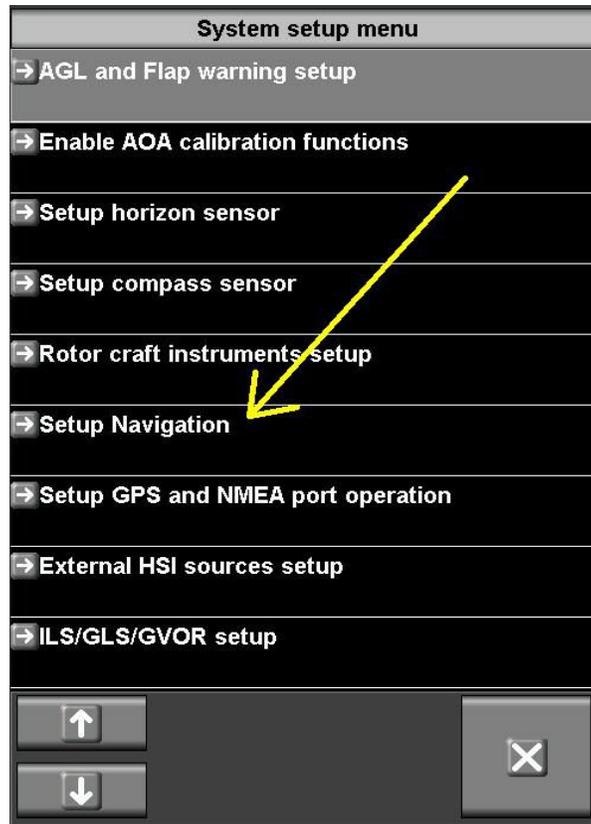
### ***Copy the supplementary database to and from the EFIS***

You can copy the supplementary database to and from the EFIS using the SD card and the file manager. The location of the supplementary database is the “Navdata” folder and you can use the file manager of the EFIS to perform the copy in both directions (log onto the source drive to copy onto another drive). The filename is “Waypoints.ewd”. You can edit this file in the MGL Central application.

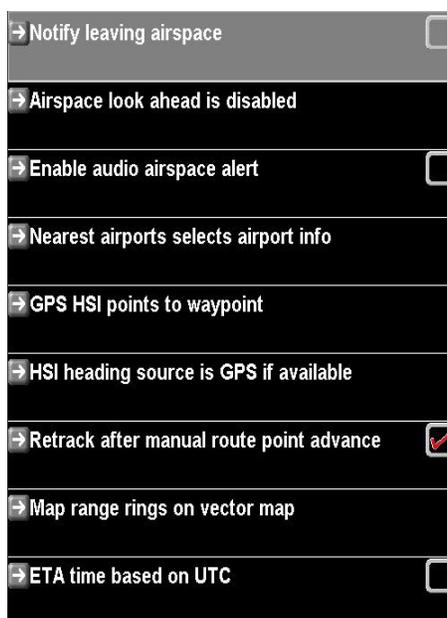
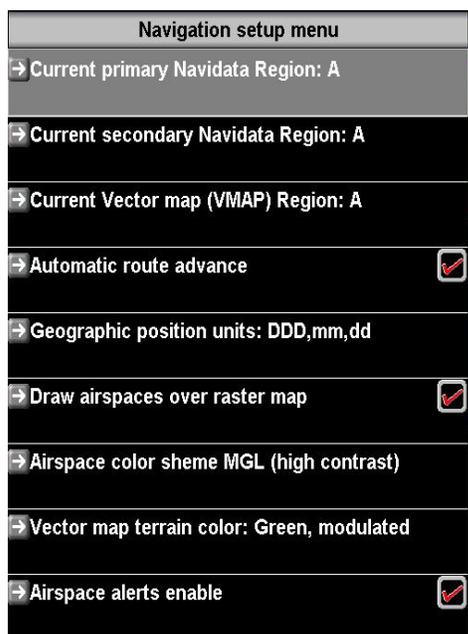
Tip: The file Waypoint.ewd is in the same format as any route file in \*.ERT format. This means that you can easily rename an existing route file to become a new supplementary waypoint file or you could turn an existing route file into a supplementary database. The renaming would need to be performed on an external computer, there is no file renaming facility on the EFIS.

## Navigation setup

Navigation setup is accessible via the System setup menu. Here you find setups that are usually done once for your system.



Functions in the navigation menu are:



### ***Current primary/secondary Navidata region / Current Vector map region***

Please refer to the document “MGL EFIS Files” for a detailed description of the region system. Basically, the region system allows you to install up to 26 files identified by region codes A to Z. Region codes can be used for Navidata files as well as vector map files.

Note: This setup is a duplication. You can change the region codes as part of the NAV Menu.

Note: The default vector map file installed at the factory for a G3 iEFIS has World-Wide coverage. However, you can install regional files if you so wish and switch between them using the Vector Map Region selection.

### ***Automatic route advance***

If you have a route active, this setting specifies if the EFIS should advance to the next waypoint in the route automatically if a waypoint has been reached.

You can advance to the next or previous route point either in the Route Menu (from the “Route” button) or by using the waypoint status menu. Depending on your screen design you may also have touch fields on your screen to perform this function.

Manual route point advance is available regardless of the Automatic route advance.

Note: Except for the last point in a route, the EFIS will apply GPS steering for the next waypoint in the route. The flight director (and thus autopilot control) will initiate a turn unto the next route leg slightly early so the next leg can be intercepted early. The point at which the turn is initiated depends on your autopilot rate of turn settings (even if you do not use an autopilot) and your current ground speed.

**It is recommended to enable the automatic route advance.**

## ***Nearest airports initial function.***

This function selects how you would like the system to respond to a nearest airports request (NAV Menu or Nearest airports icon).

If a route is active, selecting nearest airports brings up the “Live flightplan” (nearest airports can be selected from there).

If a route is not active, you can select the functionality of the Nearest airports function as follows:

The most likely use is to select it as “nearest airports”. If this is selected, selecting the nearest airports function brings up the nearest airports to your current location.

If the function is selected to show airport info (active goto) then the nearest airports function will select information on that airport (frequencies, runways and also GLS activation). If no goto is active or the active waypoint is not an airport then the nearest airport list is shown.

Note: You can select “nearest airports” from the airport information screen if the active waypoint is an airport so you do not lose this function.

## ***GPS HSI...***

This setting selects which way the HSI needle points if you are using GPS OBS. GPS OBS allows you to change the approach angle to an active waypoint.

Recommendation: Select “GPS HSI points to waypoint”. This way the HSI arrow will show you the direction to turn and by how much in order to reach the waypoint.

### ***GPS HSI points to waypoint***

This setting will cause the CDI to show deviation from the current selected OBS track and the HSI arrow will point towards the waypoint. This is the recommended setting.

### ***GPS HSI is locked to GPS OBS***

In this mode the CDI will show deviation from the current selected OBS track and the HSI arrow will point parallel to the selected GPS OBS track.

## ***Retrack after manual route advance***

This option, if selected, will activate a track to the next waypoint from your current location as you change the next waypoint in a route. If this option is not selected then the track to fly will be from the skipped waypoint to the next waypoint (I.e. the track will follow the defined route).

## ***HSI Heading source***

You may select the HSI heading source to be either the magnetic compass or the GPS ground track (if available). Recommendation: Select the GPS track.

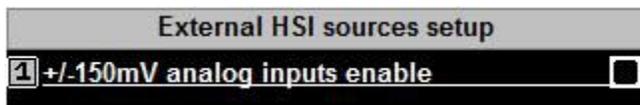
## Other navigation setup items

Other navigation setup menu items are self explanatory and not listed here.

## External HSI Sources setup



This setup menu currently contains a single item:



The EFIS systems provide analog navigation inputs intended for use with analog (needle based) instruments.

Four inputs are provided and they are used as:

- Input 1      Lateral CDI
- Input 2      Lateral CDI validity flag
- Input 3      Vertical GSI
- Input 4      Vertical GSI validity flag

If these inputs are not used it cannot be determined with certainty if they are not be used by the system. For this reason you can disable them.

**Please do not enable the analog inputs if you are not using them.**

Note: Analog inputs must be “zero'd” before they can be used (System initialization menu). Ensure connections to the balanced inputs are correct polarity to ensure correct left/right and up/down indication.

## Navigation source groups

Navigation sources are grouped into priority lists. Only one navigation source per group is considered based on priority:

GPS Lateral	VOR Lateral	ILS	Vectors
ARINC CDI	ARINC CDI/Radial	ARINC CDI/GS	
	RS232 CDI/Radial	RS232 CDI/GS	
Internal GPS	Internal GVOR	Internal GLS	Heading bug
	Analog CDI	Analog CDI/GS	

ARINC has the highest priority and will override lower priority navigation sources.

ARINC sources are devices such as the Garmin 400/500 series and compatible instruments.

RS232 sources currently refer only to the SL30 NAV receiver and compatible devices.

“Internal” refers to sources internal to the EFIS system.

The Analog navigation inputs have the lowest priority>

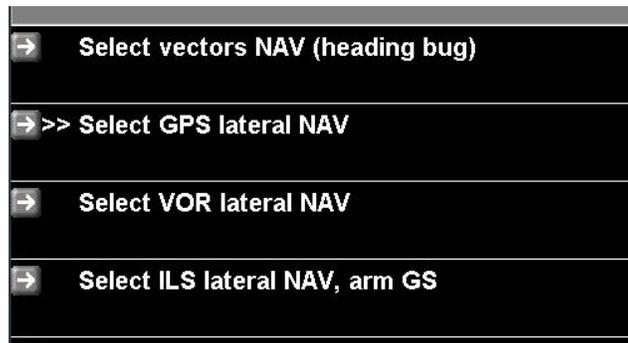
Note on Analog sources: The same CDI input is used for VOR and ILS. The ultimate use depends on the navigation source selected by the pilot in the EFIS: If VOR is selected then the CDI is assumed to be VOR. If ILS is selected then the CDI is assumed to be ILS.

## The navigation menu



### **Selecting navigation sources**

Selecting navigation sources is done partly automatically for internal sources such as GPS navigation as you select a destination. Regardless of this, you can select from one of the four navigation source groups at any time.



On the iEFIS you can also select the navigation source group by tapping on the HSI display.

Navigation source selection by tapping on the HSI display on iEFIS.



Selecting a GPS waypoint, activating a route (flightplan), selecting GVOR primary or activating a GLS selects the navigation source automatically.

Please note, this is still subject to higher priority navigation sources within the group. If, for example you have a VOR station selected on your NAV radio and that station has a valid radial (in range and receiving) – the EFIS will NOT use the GVOR solution but will be forced to use only the external VOR source. Should you wish to use the GVOR in this case, simply deselect the station on your NAV radio or switch it off.

**Special case: The ILS**

The system is designed in such a way that any active ILS source will be shown on the HSI and other available ILS indicators automatically regardless of any other selected navigation source. Existing navigation will not be affected, the ILS information is shown passively.

This allows you to, for example, use GPS RNAV to fly to the FAF (Final approach fix) – at that point the ILS and glide slope should be active and will be shown.

You may now proceed on the ILS without any further action required or if you prefer, you can select the ILS as navigation source which will suppress other lateral sources.

You will also do this if you are flying your approach on autopilot as the autopilot follows the selected navigation source. This means the autopilot will not follow the ILS unless the pilot demands this.



This display shows the ILS CDI with the OBS selected to the runway heading 030M. We are to the right of the runway centerline. ILS is shown in light blue.

We have the GPS lateral navigation active to the FAF which is dead ahead and we are on track. GPS lateral navigation is shown in maroon.

If the autopilot is engaged, it will follow the GPS lateral navigation until we switch navigation sources to “ILS lateral NAV”.

## Vertical navigation

Vertical navigation has one of two sources:

Altimeter bug	Glide slope
The altimeter bug can be set by the pilot to the desired altitude. It can also be set by a flight plan containing altitude change waypoints.	Glide slope can be dictated by an external NAV radio or it can originate from a GLS approach which uses runway geographic information contained in the database to calculate the glide slope.

Regardless of origin, the glide slope has a “validity flag” which tells the system when valid glide slope information is available.

Irrespective of any selected navigation source, when a glide slope is valid, any related display will be activated.

Typical glide slope display. This is the “modified” glide slope display usually used with MGL “default” screens. Other types of glide slope display may be available depending on your screen design.

The “modified” glide slope here shows that the aircraft is slightly below the glide



slope.

### ***Glide slopes and the autopilot***

If you have the autopilot engaged you will select the ILS lateral navigation source while still below the glide slope. You will be using the altitude bug to select the desired glide slope intercept altitude.

When you select (or reselect) the ILS lateral navigation source you will arm the autopilot to intercept the glide slope. The autopilot will not attempt to climb towards the glide slope but will remain on altitude bug.

As the glide slope indicator approaches ½ way to the intercept the autopilot will command a 1.5 degree decent, increasing to 2.2 degrees shortly before intercept. As the glide slope is intercepted the AP will then attempt to match the glide slope and track it to the touch down point.

Please take note that the pilot is still in control of engine power and possibly the rudder of the aircraft. The autopilot should be disengaged when minimums are reached and the touch down is to be performed by the pilot.

**Note: The EFIS does not have auto-land capability. The touch down has to be performed by the pilot.**

Note: Should the ILS be armed with autopilot engaged and you are already above the glide slope, the autopilot will attempt a three degree slope immediately, steepening it to up to 6 degrees in an attempt to intercept the glide slope. The pilot needs to decide whether to disengage the autopilot and perform a manual approach or to activate a “missed approach”.

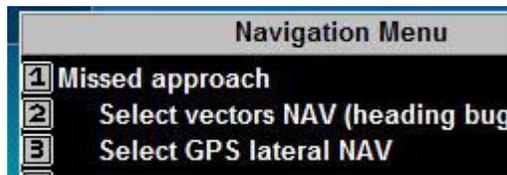
### **The missed approach**

Missed approaches may be initiated on the EFIS under autopilot or manual control.

In either case, the HSI will be set to vectors (Heading bug) – autopilot will be selected to VSI hold with the autopilot VSI selected to the maximum rate of climb selected as part of your autopilot pitch control setup.

If the missed approach is done from a GLS approach the heading bug is set to the runway heading. If the missed approach is done from an ILS approach the heading bug is selected from the current OBS setting (The assumption is that the OBS would have been set to the runway heading).

The missed approach procedure is available if the navigation source is selected to “ILS Lateral NAV” and the ILS is valid.



## Automatic approach guidance

The EFIS has automatic approach guidance for any runway included in the navigation database that has geographic information.

Guidance takes two forms: Approach guidance and approach information

### ***3D Approach guidance***

The EFIS will display approach guidance onto the closest runway provided you are within a +/-20 degree lateral cone of the centreline. This functionality is continuous and automatic.



This image shows approach guidance onto runway 03 at GROOTF. Approach guidance is shown with blue crosses on a white background. The glide slope angle is based on the angle selected in your GLS setup (typically 3.0 degrees).

You can view the approach guidance as GPS based ILS. Line up the crosses so you see a single cross on the screen – then you are exactly on the runway centreline and on the glide slope.

Note: Approach guidance has no effect on any current navigation solution or on the autopilot.

### ***Approach information***

Textual and graphical approach guidance is available. Shown here is an ILS approach.

### ***Take off guidance***

As the approach guidance latches onto the nearest runway it can be used during take off as a means to see if you are drifting off the center line. You will see a row of crosses extending into the sky ahead of you. Simply keep the crosses lined up for a perfect take off.



Textual information shows that we are 3.5 nm from GROOTF and need 3 minutes, 22 seconds to touch down at current speed. The HSI shows we are to the right of the runway. This is confirmed by the light blue ILS needles in the screen center which show the glide slope above us to our left.

## The GLS approach

The GLS approach is a GPS based implementation of an ILS system and relies on geographic runway information.

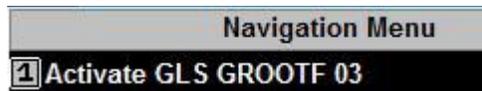
There are three ways of initiating a GLS approach:

From “nearest airports” direct	From “nearest airports” via intercept	Convert approach guidance into a GLS “direct” approach
Select the desired airport, then the runway and finally the direction to activate a “direct” approach.	Select the desired airport, then the runway and finally the direction “via intercept”.	If you see a suitable 3D approach guidance display on the screen you can convert it to a GLS approach via the NAV menu.

### ***Approach via intercept***

A temporary waypoint is created some distance along the runway centreline. A normal lateral GPS navigation is initiated to that point (also referred as FAF or Final Approach Fix). Once this point is reached, the GLS approach is activated. You setup the FAF distance in the GLS setup menu.

## Converting Approach guidance to a GLS approach



If you have the desired approach visible as guidance on the screen, you can select it as GLS approach using the NAV menu. The information shown gives you the short airport name and the runway.

### GLS approach features

GLS adds simulations of both outer and middle marker. If you have the EFIS sound output routed to your intercom system you will hear the standard marker tones if you overfly the virtual markers.

### GLS and the Autopilot

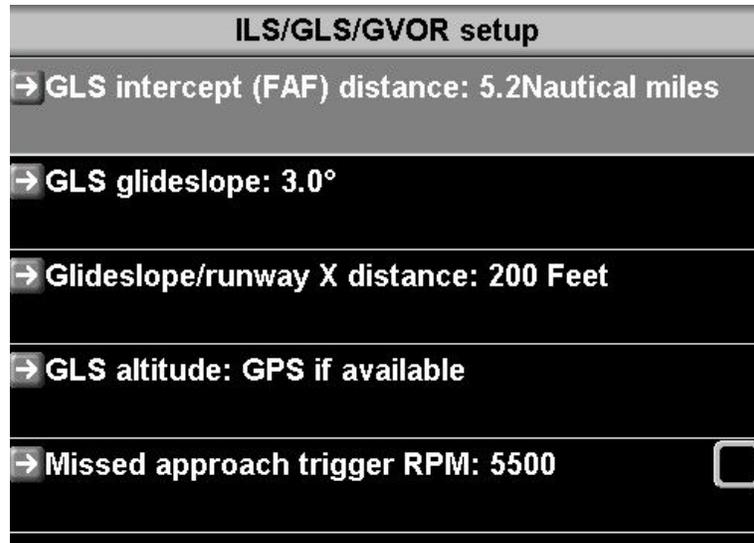
The autopilot can follow a GLS approach using the same methods described for a normal ILS approach.



The GLS approach uses white crosses on a green background to distinguish from the similar approach guidance. GLS, like ILS is a navigation source and can be used as source for the HSI and thus, the autopilot if engaged.

Like other internal GLS sources, it is selected as navigation source automatically. Note that it is subject to override of higher priority ILS sources if they are connected and valid. In particular, an external ILS source from a connected ARINC or RS232 NAV radio.

## GLS and GVOR setup menu



### ***GLS Intercept distance***

Distance from the touch down point to the final approach fix (FAF). The FAF is along the extended center line of the runway.

### ***GLS Glide slope***

Glide slope angle. Typically 3.0 degrees.

### ***Glideslope/runway X distance***

Runway coordinates in the database typically define points close to the runways outer boundaries (threshold). Here you can define the distance the touch down point should have from the threshold. Typical distances would be 300 feet for smaller aircraft.

### ***Altitude source for GLS***

You can choose to work GLS based on pressure altitude (subject to local pressure settings) or GPS altitude which requires a good GPS satellite constellation to be accurate.

Recommendation: Use pressure altitude if local barometric pressure correction is available.

### ***GLS outer and middle marker distances***

The iEFIS will simulate outer and middle markers both with typical sounds and display on screen. The Distances from the threshold are fixed to 3.9 and 0.3 Nautical miles.

## GVOR Range

Simulated range of a GVOR virtual transmitter is 100 statute miles.

## Direct-to GPS Navigation

Direct-to GPS navigation is one of the most common forms of navigation. Typically you select from a list of waypoints, airports or navigation beacons.

All waypoints - SELECT mode		
N FAFK,	Fisantekraal	7.7nm ↙
W FAFK,	FISANTEKRAAL	8.7nm ↙
N FADiem,	Diemerskraal	7.4nm ↑
N FAPU,	Paarl East Airport,SOUTH AF	8.4nm →
N FAGF,	Grootfontein SA	9.4nm ↙
N FAGoed,	Goedverwacht	9.8nm ↙
N FAWF,	Wintervogel Fly Inn	10.0nm ←
N FAAItto,	Altona	10.9nm ←
N ZA0091,	Altona Airport,SOUTH AFRICA	10.9nm ←
N FACrai,	Craigcor	12.7nm ↑
N HelDel,	Delaire Graff Estate	14.2nm ↘

↑	Pick from flightplan		
↓	Filter Types	Search	✕

You can filter the types of waypoints shown (Filter Types button). For example you may want to show only airports.

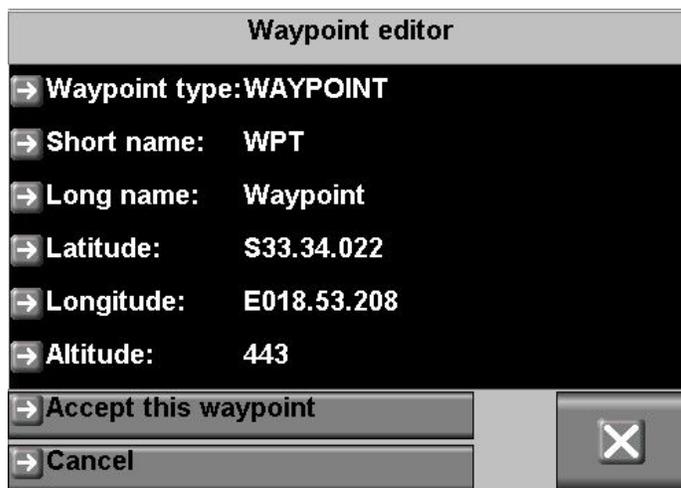
All waypoints are shown in order of distance from your current location (GPS position required). You may search for a waypoint if it is far away and you know the name. You can search either the short or the long names. On iEFIS systems you can also search for partial text contained anywhere in the name.

Distances to the waypoints are shown as well as direction to fly relative to the current ground track.

You may also pick a waypoint that may be contained in any of your route (Flightplans).

## Direct-to “Adhoc” navigation

A special form of direct-to navigation allows you to create an adhoc waypoint. Assume for example that you have been given coordinates for a destination and you do not want to go to the trouble of creating a new waypoint in your supplementary database.



You will see the standard waypoint editor with the current position and altitude set.

The altitude is not relevant in this case so you can ignore it (it is shown as the standard waypoint editor is used). You may change the default names – these will be shown as the active waypoint but you may choose to keep the defaults.

The Adhoc waypoint is not stored in any database and the information is lost when you select a new waypoint.

If you accept the waypoint a direct-to “Goto” is automatically set and you can fly to the waypoint using the normal HSI and autopilot functionality. The only difference to a normal Direct-to is that this waypoint does not exist in any of your databases and will be lost the moment to select any other waypoint.

## GVOR navigation



From the NAV menu, select “GPS: select GVOR station”.

Select the desired NAV source. The frequency associated to this source will be sent to the NAV radio if it can accept remote frequency control. In addition the GVOR will be activated and you will have an immediate, virtual radial if you are within the simulated GVOR range (100 statute miles) . Should the connected NAV radio receive a valid VOR signal it will override the simulated signal as the connected VOR source has a higher priority.

The EFIS supports selection of a primary and a secondary VOR station. Only the primary station can contribute a CDI for navigation.



HSI showing a single GVOR primary source. The green (A) paddle shows the direction of the location of the VOR station.



HSI showing both primary and secondary GVOR stations. The red (S) paddle shows the direction of the location of the secondary VOR station.

Note: Primary GVOR and VOR navigation can be used as a source for the autopilot: Enter the desired radial to fly using the OBS knob.

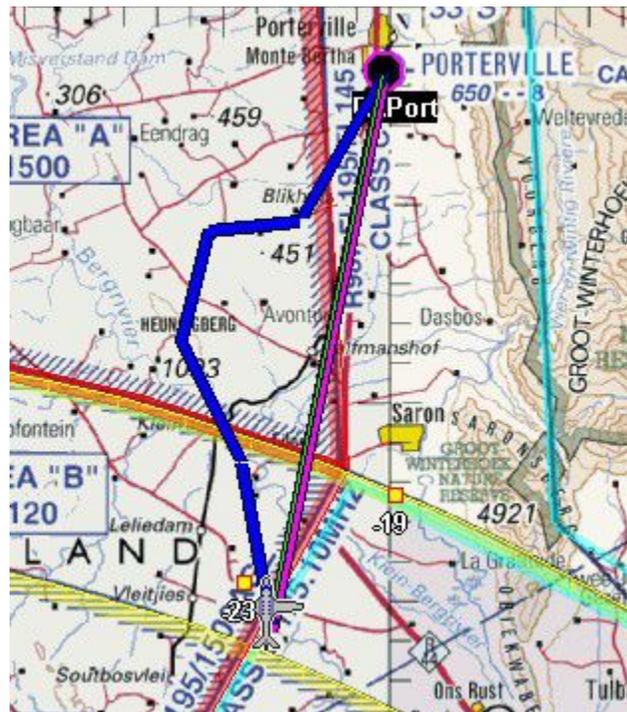
## Diverts

Diverts are applicable during any GPS navigation to a waypoint (Direct-to, route or intelliroute navigation).

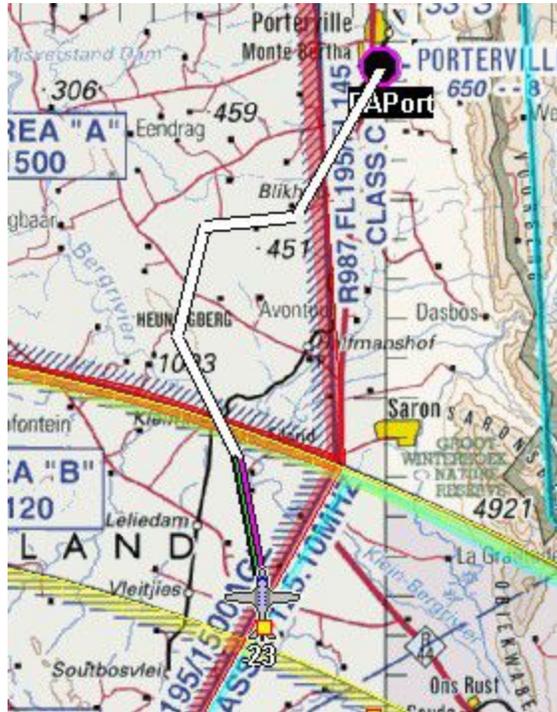
A divert is activated for example if you are flying towards a waypoint but need to avoid an airspace or obstacle or would like to fly anything other than a straight line to your waypoint.

As the iEFIS has a touch screen, diverts are very easy to use:

Change to a screen that is showing a map and tap on the map to activate the map functions and then press the “Divert” button.



Simply tap on the map to outline the divert you want to fly. Here we tapped on 4 locations to the left of our track. The divert is not yet active and is shown in blue. We can at this stage press “cancel” to return to normal mode (and forget the divert), we can remove the last point defined (if we made a mistake or want to change the location a bit) and if we are happy with our divert we can activate it:



Here the divert is activated and our track is now shown to the first divert point. Note that our divert track is shown in white.

By tapping on the map we can have the option of cancelling the divert at any stage and activate a track from our current position to the original waypoint.

Note that you can at any time use the GPS OBS to change the approach track angle in case you would like to approach your waypoint on a different track.

If you have an autopilot active, the autopilot will fly your divert.

If you intercept the last last leg of the divert the divert ends (same as cancelling it).

Diverts will be maintained in the EFIS memory through a power cycle.

## Intelliroutes

The Intelliroutes function is accessed from the Routes menu (Routes button).

The iEFIS system contains a facility to automate and create certain types of routes.

Currently two common types of survey and search and rescue patterns can be created.

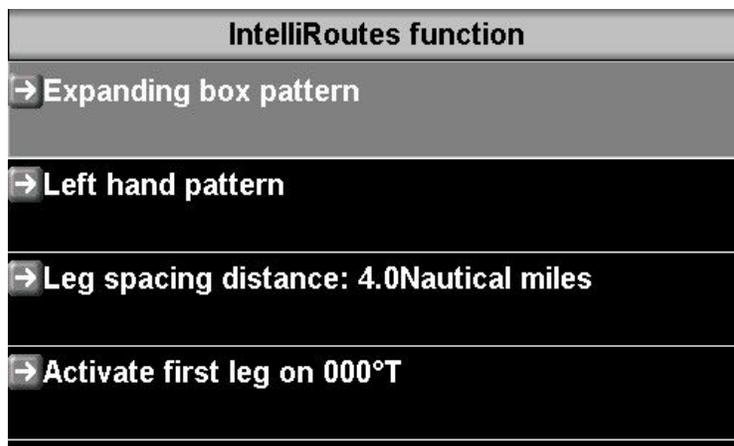
Creation and activation of an intelliroute is done at the current aircraft position and track. The current true track is shown in the intelliroute menu.

The current state of an intelliroute is maintained in EFIS memory through a power cycle. This makes it possible to interrupt an active intelliroute and continue it (perhaps after a refuel). This implies that no other waypoint is activated for navigation as this would automatically cancel the intelliroute.

Intelliroutes are shown with a gray track to distinguish them from other routes which are shown in white. As with any other navigation, the current active track is shown in magenta.

Intelliroutes may be “diverted”. See section on “Diverts” in this manual.

### ***Intelliroute “Expanding Box pattern”***

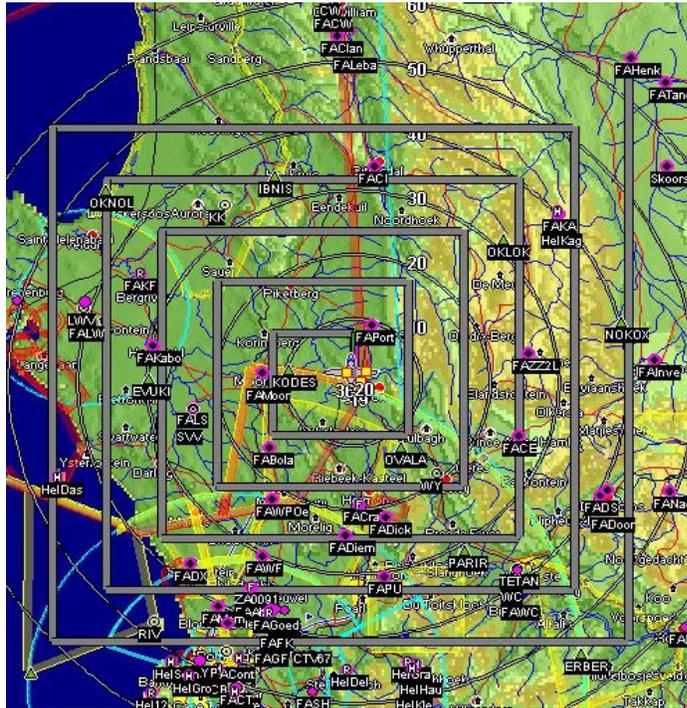


The Expanding box pattern is often used for search and rescue missions. The idea is that you start a search from a probable location and then fly a square, expanding box pattern.

You specify the distance between lanes and whether the turns are to the left or right.

Activate the box pattern by aligning the aircraft at the start location at the desired track. In the above selection we would activate the first leg in a true north direction and all turns would be to the left.

After activation our map would show:

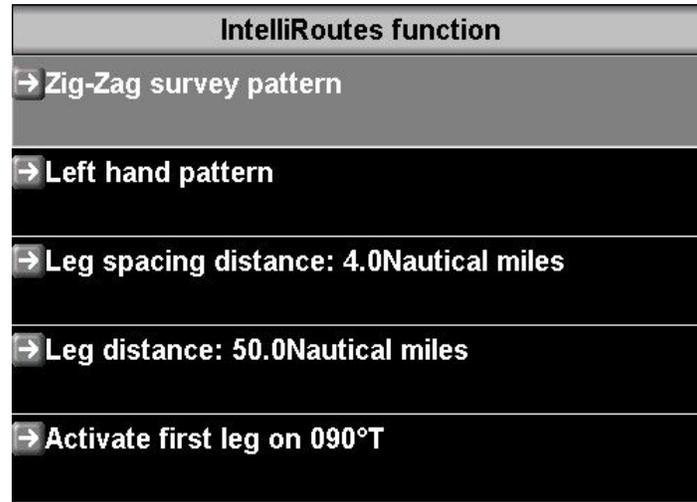


The box starts slightly offset to the right in this case to give even coverage. The lanes are 4NM apart giving us 2NM to each side minimum observability.

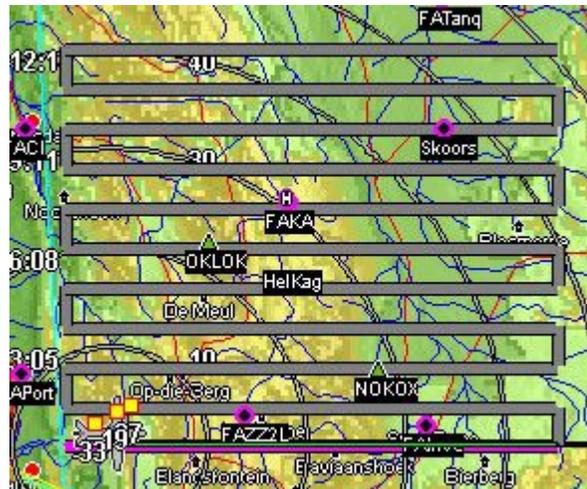
As long as the intelliroute is active, finishing one leg creates a new leg at the last point of the box.

The current pattern is saved through a power cycle so it is possible to interrupt a pattern and return to it later (for example to refuel). This implies that no other route or waypoint gets activated as this would cancel the intelliroute.

## IntelliRoute “Zig-Zag survey pattern”



The “Zig-Zag” survey pattern creates a “back and forth” pattern of a defined leg distance and lane spacing. The left or right hand pattern defines the direction of the first turn.

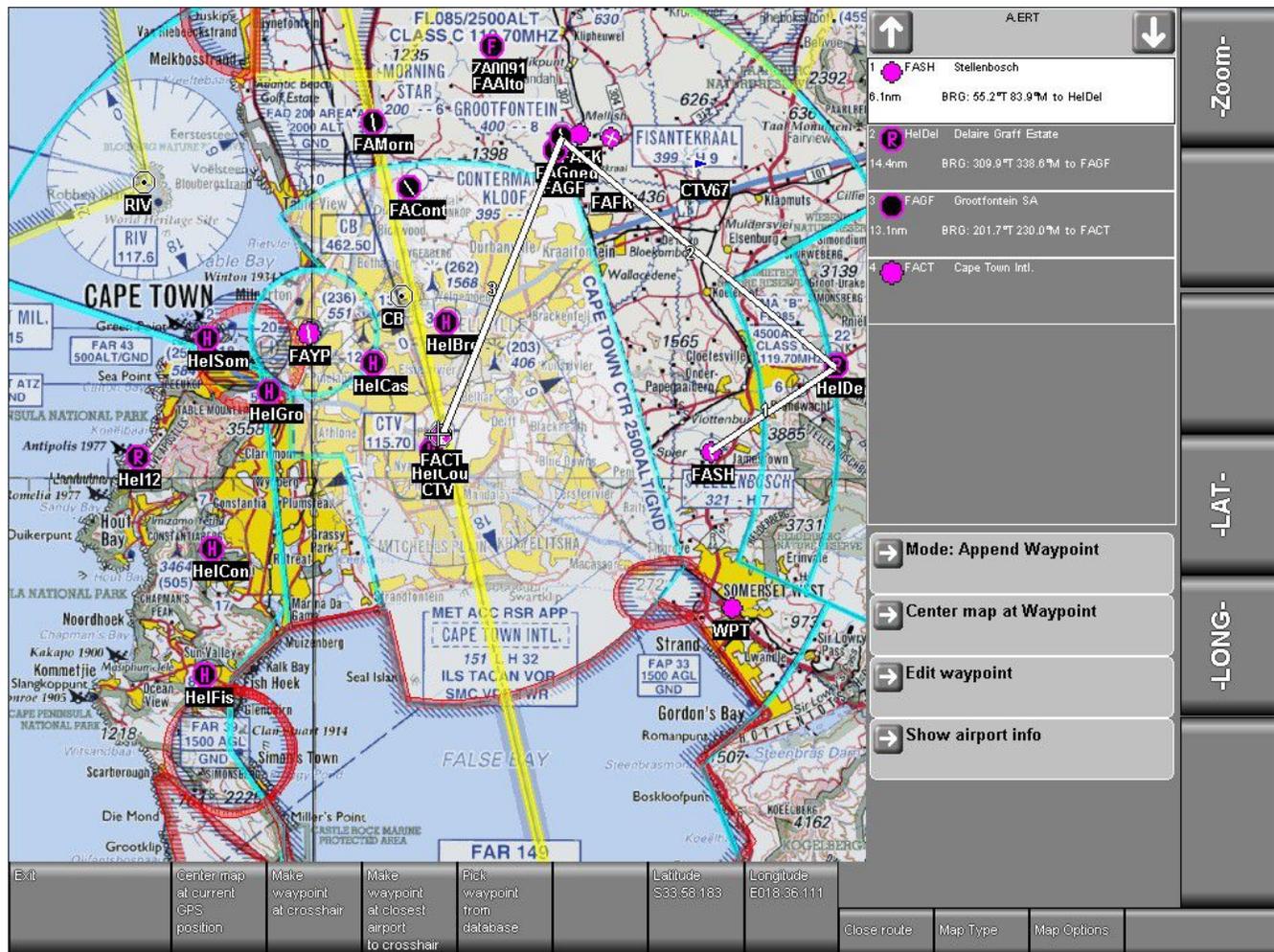


Zig-Zag patterns grow 90 degrees to the left or right from your initial track. As with all intelliroutes described here, you activate the route as you cross your intended starting position and have settled on the first outbound track.

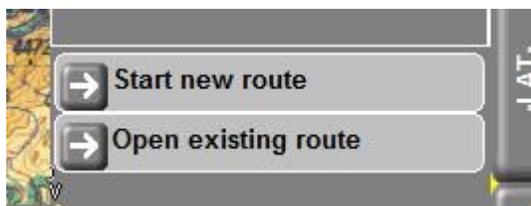
You can consider arriving at the starting position using direct-to navigation. As you reach your waypoint (starting point), activate the intelliroute – this action will automatically cancel your current active waypoint.

# The Flightplan Tool

The flight plan tool is the iEFIS based route editor. Here you can create new routes or edit existing ones.



The Flight plan tool starts with the option of creating a new route or editing an exiting route:



Routes are stored in your internal drive in the folder "Fplan". Route files can be copied using the file manager. You can also use the "route manager" and seldom will seldom need to access these files directly.

Once a route is open the right hand pane shows the route details. You can navigate the details using the touch screen.

Change the “mode” to append or insert new waypoints, change waypoint order or delete waypoints.

You can edit waypoint details such as the waypoint type.

For airports your can request airport details such as runways and frequencies from the current navidata database.



Using the softkeys you can pick waypoints from the map or from the database.

Picking waypoints from the map is simple:

Touch the map at any location – that location will become the center of the map. This is where the cross hair will be. By tapping the map the map can be rapidly moved. Utilizing the zoom levels the map can be moved by large distances with just a few taps.

The tapping method permits moving the map accurately even when flying in turbulence and is faster than dragging the map as you may do on a tablet.

Using the soft keys you can create a waypoint from the current map location or pick the waypoint that is closest to the cross hair so accurate positioning is not required.

Note that the rotary controls can also be used to move the map.

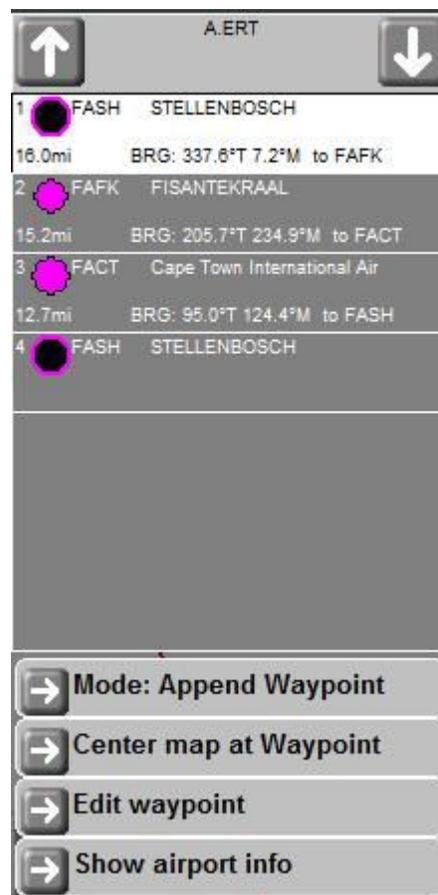
Any route changes are applied immediately even if the route being edited is currently active.

Selecting Map Options button shows the available map options. Most of these options relate to vector map display and declutter.

Select “Map Type” to select between raster and vector maps (assuming both types are installed).



When you are finished editing your route, you can “close” the route which allows you to create or edit another route or you can simply exit the flight plan tool. There is no need to save your work, it is saved as you close the route.





You can enter latitude and longitude values to quickly center the map at the required position. You can also center the map at any waypoint in an opened route file or set the map center to your current GPS position.

Tip: Your EFIS has a “demo mode” which you can enable in the operations setup menu (under system setup).

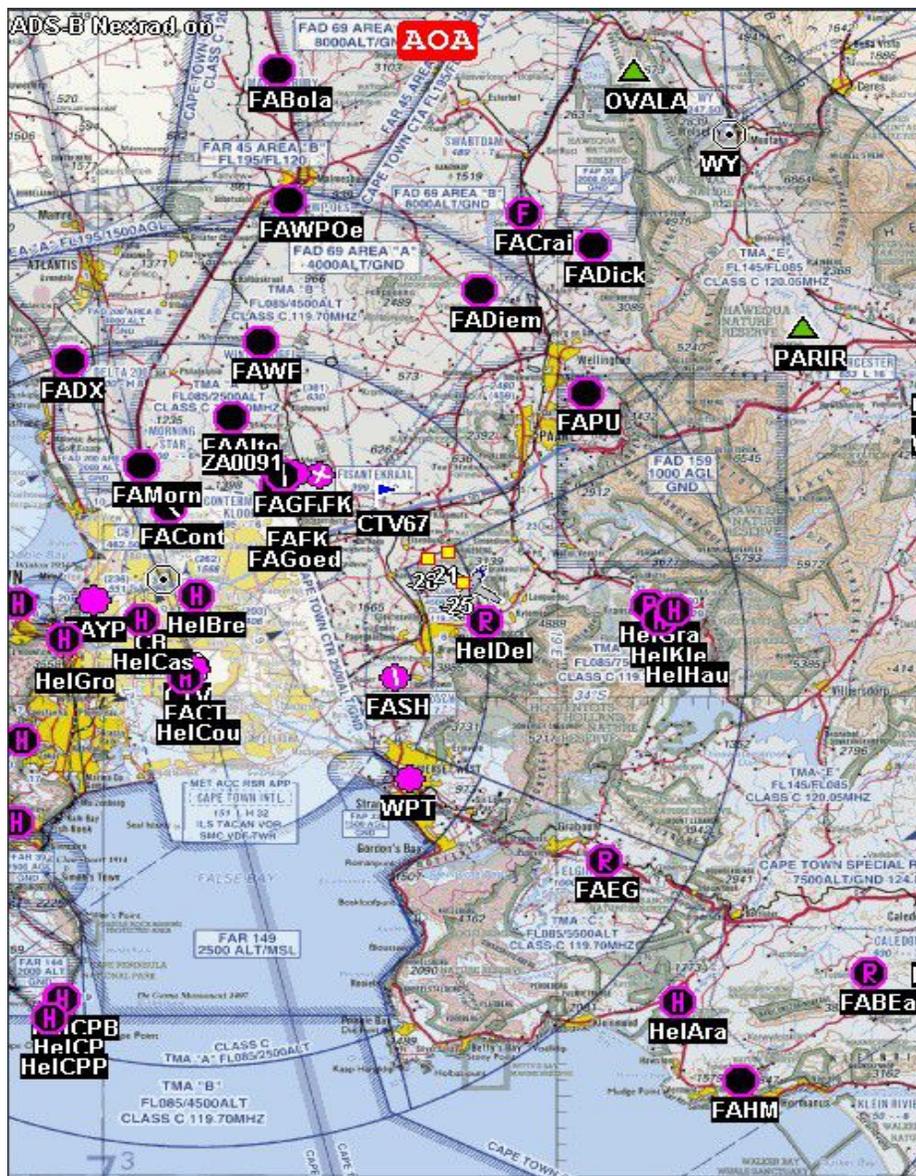
In demo mode you can select a fake GPS position using the position you enter here in the flight planning tool.



## Raster maps

Raster maps are based on digital images that have been converted into a format suitable for display on your EFIS. These maps would typically be based on official aeronautical chart publications.

With the MGL iEFIS system, you can create your own raster maps using digital map images (many are either in JPEG or TIFF format). You use the free MapMaker2 application that runs on a Windows PC to georeference the images and convert the images to the required format the EFIS can understand. MapMaker2 creates maps at high quality for each zoom level and can stitch together map tiles extracted from several sources to create a very large, seamless coverage.



Typical raster map shown in “North up” presentation.

Operating the map is simple. Tap on the map image at any location to bring up the primary map control bar:



The control bar will show for a few seconds. If you do not use it it will revert back to normal button functionality.

The control bar allows you to:

Zoom the map. Use “**Zoom +**” to zoom into the map (smaller map scale). Use “**Zoom -**” to zoom out (larger map scale). Vector and Raster maps have 5 zoom levels. You can add a further 4 zoom levels that will show a large scale map up to continent wide proportions.

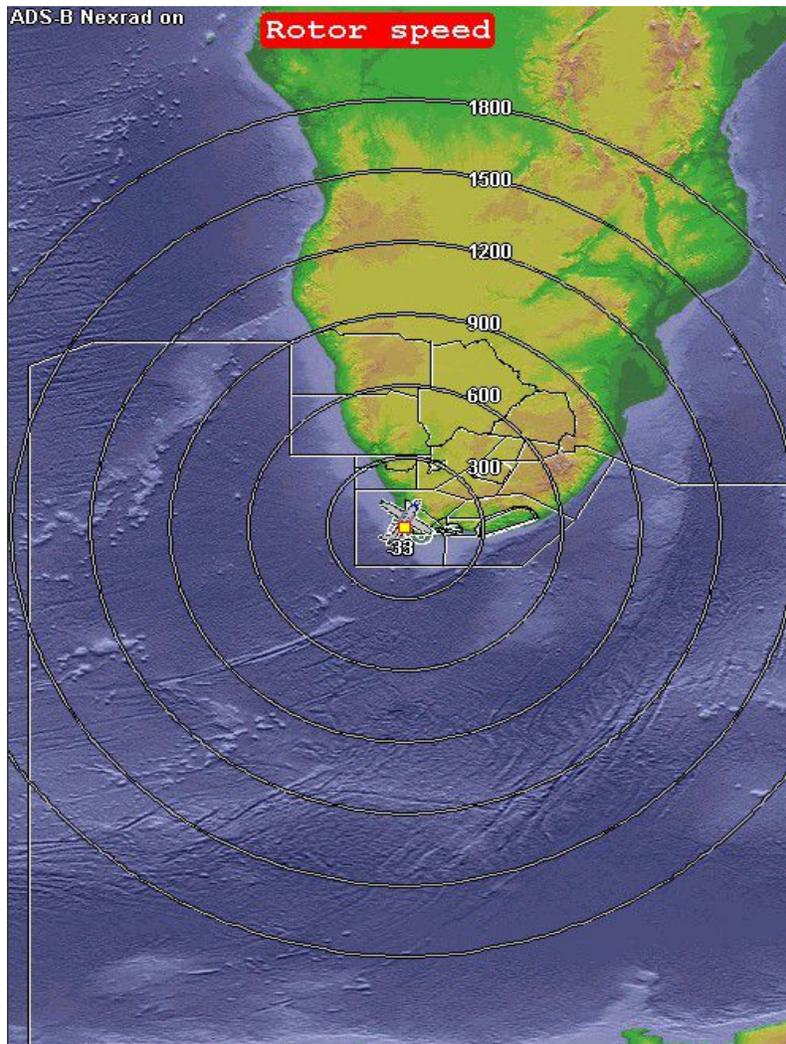
With the control bar active, you can select “**airport info**”. This will attempt to show you airport information closest to the point you have tapped on the map.

Use “**airspace info**” to obtain airspace information relevant for the location you tapped on the map.

Use “**PAN**” to place the map into “Panning mode”. In this mode you can move the map to view any part of it.

Use “**Mode**” to switch the map between vector and raster modes or select track up or north up. You can also select approach plates.

Choose “**Clear**” to return to the normal button menu (same as waiting a few seconds for the control bar to self cancel).



Typical display for the large scale zoom levels. This uses the file "World.bmp" contained in your "maps" folder as backdrop.

### ***Map double tap***

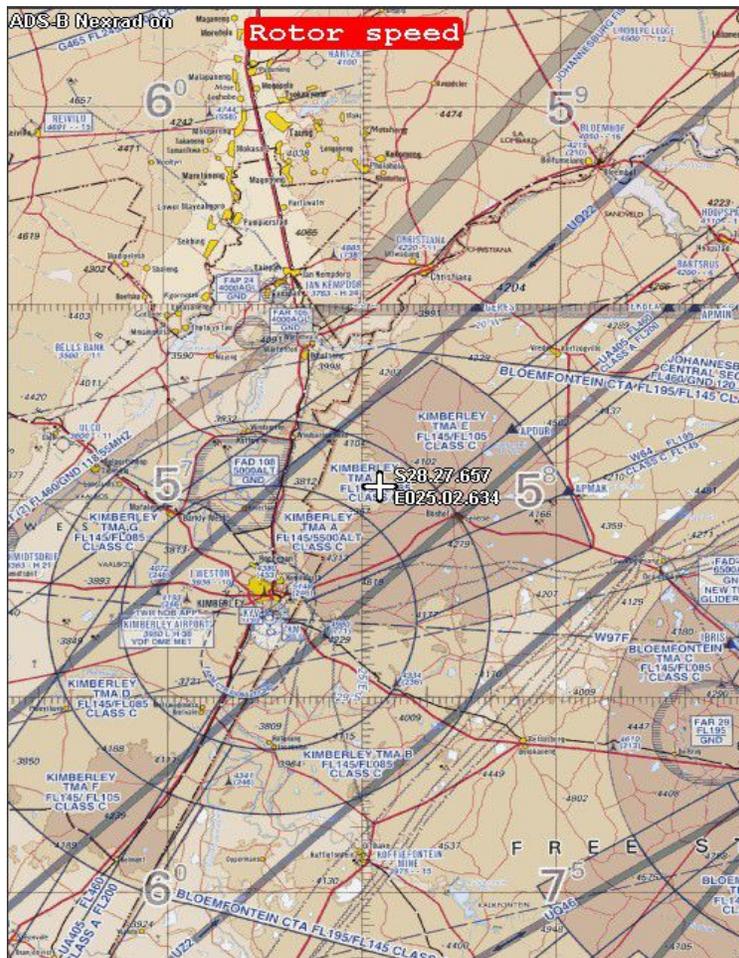
Tap the map twice at any location to show the distance to the location of your last tap and the time it will take to get there at your current ground speed.

While in this mode, any further tap will show the revised time and distance to the new tap location.

This function will time out after a few seconds or you can press "clear".

While in this mode you can press "Goto". This is a quick way to perform a direct-to navigation to any map location. The navigation mode will be automatically set to GPS. If your tap location is close to a waypoint in the database, it will be selected as navigation source. If there is no waypoint close by, the actual map location will be used.





Typical map panning display. The coordinates of the current panning location are shown in the map center.

### ***Holding the map pan***

Should you wish to find the time and distance to a location on the panned map or activate a “goto”, you must place the map in “PAN Hold”.

In “PAN Hold” you can double tap the map as before to obtain time and distance information or activate a “goto”.

When in “PAN-Hold”, press “PAN-Go” to continue panning the map or “PAN end” to cancel the panning and return to normal moving map operations.

## The route manager



### ***Live Flightplan***

If a flight plan (route) is active – the live flight plan provides information on distances, estimated flight times and fuel burn figures. You can also work with wind speed and direction to see how your various flight plan legs would be affected.

This menu entry is only visible if a flight plan (Route) is active.

### ***Step to Next/Previous waypoint in route***

This is a duplication of the tap functions provided by on-screen icons and the waypoint status dialog.

These functions allow you to step forwards or backwards through the route. You select the currently active waypoint in the route.

## ***Activate or restart route forward / reverse***

This allows you to select a route either stored on your local system or on an inserted SD card. If you select a route stored on a SD card it is automatically copied to your system for future use.

You may start a route from the first waypoint in the file or you may start it from the last waypoint in the file in which case the route is flown in reverse.

If you start a route in reverse, stepping forward in the route will step towards the first waypoint in the route (first waypoint in the actual route file when you created the route).

## ***Intelliroutes function***

Here you enter the Intelliroutes menu. Intelliroutes are special routes created by the system for example to create survey or search and rescue patterns.

## ***Deactivate route***

If a route is active you can deactivate it here.

You can also deactivate a route from the waypoint status menu.

## ***Create a new route / View or edit a route / Delete a route***

Routes are edited using the interactive flightplan tool.

## ***Import routes***

Various third part route formats may be imported. The list of supported formats may grow with future releases.

## **Route controls**

You may step backwards and forwards through a route using the provided screen and menu functions:



Note on the waypoint status dialog if a route is active:

Selecting “Cancel” with an active route will cancel the route but leave the current waypoint active. This waypoint would be the next waypoint in the route. Should you wish to cancel this waypoint as well, simply tap the “cancel” button again.

WP+ and WP- are the buttons to step forward or reverse in the route.

“Retrack” allows you to center the HSI, i.e. move the approach angle to the next waypoint so the track intersects your current position. This may be useful if you are stepping forwards in the route but do not want to follow the original track to the next waypoint but would rather like a track from your current position. This is similar to rotating the approach track using the “GPS OBS” knob.



Typical screen display with a route active. Note the Route+ and Route- buttons. Also note the highway in the sky presentation to the next waypoint shown with a green triangle. The green highway is your current track and you are within 180 degrees of ground track to this track. If you are more than 180 degrees deviant, the green highway turns to a red highway.

The blue highway is your next track, once you reach the next waypoint.

The VSI confirms that we are far to the right of the track and gives us a course correction to the right to intercept the waypoint.

The waypoint status shows bearing, distance and times.

## The Live Flightplan

Live Flightplan: edtw to edka aachen.ERT		
7.6nm to FASH / STELLENBOSCH BRG: 134°T, 163°M	ETE: 00:19 Fuel req: 0.63Lt, total: 0.63Lt	ETA: 17:10
13.9nm to FAFK / FISANTEKRAAL CRS: 337°T, 006°M	ETE: 00:34 Fuel req: 1.13Lt, total: 1.76Lt	ETA: 17:44
35.4nm to FAWC / Worcester CRS: 080°T, 109°M	ETE: 01:27 Fuel req: 2.90Lt, total: 4.66Lt	ETA: 19:11
44.4nm to FACT / Cape Town International Air CRS: 245°T, 274°M	ETE: 01:50 Fuel req: 3.66Lt, total: 8.32Lt	ETA: 21:01
11.0nm to FASH / STELLENBOSCH CRS: 095°T, 124°M	ETE: 00:27 Fuel req: 0.90Lt, total: 9.22Lt	ETA: 21:28
End of route		
Speed mode GPS GS	Fuel: 10.0Lt	

Whenever a route is active, the live flightplan shows you the currently active waypoint and all that are following. Using current performance as a base, you can view estimates of fuel required for each leg and well as en-route times and arrival times. Bearings are shown both

true as well as magnetic based on local magnetic variation.



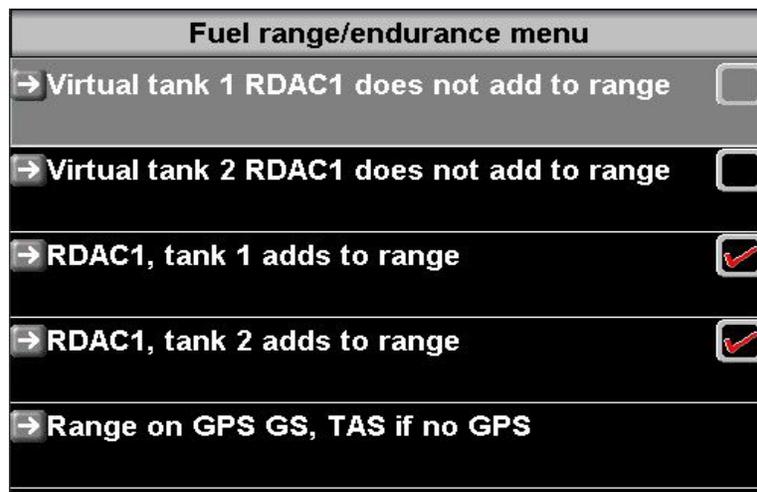
You can either use the current GPS ground speed as base for the calculations or you can enter your own scenarios.

The above example assumes a true aircraft speed of 120 knots, a wind angle of 30 degrees (west of north) and a wind speed of 25 knots.

The live flightplan is automatically updated as you change any of these factors so you can see the effect of speed and wind on your fuel burn and flight times.

Note that fuel burn would be based on your current performance.

The total available fuel is shown below the exit button. This value is based on your fuel range/endurance setup.



## Waypoint selection system

The iEFIS contains a common structure to view or select waypoints. Depending on the context, the function operates in slightly differing ways.

Here we start with the most common – using the “Direct goto” function to select a waypoint.

There are several ways to activate this function:



This icon is available after tapping the reveal icon on some EFIS screens (This is dependent on the individual screen design).



You can also reach this function via the NAV menu.:

→ **GPS: Goto waypoint and set HSI**

All waypoints - SELECT mode		
N STV,	STANDERTON,SOUTH AFRICA,	10.4nm →
N FAGroo,	Grootvlei (Lindes Airfield)	10.5nm ←
N FALeko,	Lekoa Lodge	13.7nm ↙
N ZA0030,	Dasville Airport,SOUTH AFRI	12.6nm ←
N FAGroo,	Grootdraai	18.8nm ↙
N FATonk,	Tonkins	19.5nm ↘
N ZA0023,	Villiers Airport,SOUTH AFRI	20.2nm ↙
N FAFinc,	Fincham	19.5nm ↑
N FAHG,	Heidelberg	19.8nm ↑
N HGV,	HEIDELBERG,SOUTH AFRICA,	121.0nm ↖
N FAArno,	HGV Arno	21.0nm ↖

↑	Pick from flightplan		
↓	Filter Types	Search	✕

Waypoints appear in order of distance from your current location.

The system maintains the nearest 20,000 waypoints from your database in memory and this is periodically refreshed as you change position. Waypoints that are very far away are not considered. Regardless if the memory list includes a waypoint or not, if it is contained in the database you can search for this.

To the right of the waypoint list are the distances and directions relative to your current ground track.



Using this example, the top waypoint is slightly to your left, the middle is behind you at 8 o'clock and the bottom one is slightly to your right.

Once you activate the waypoint list the sort order remains locked so waypoint positions cannot move. Distances and directions however will still update.



Note the “Types” button. Tap this to bring up a popup where you can select which types of waypoints to include in the list. Waypoint types are “Airports”, “Nav aids”, “intersections”, etc.

If you unselect all waypoint types, then airports will be automatically selected as it does not make sense to unselect everything. Some waypoint list modes are fixed – for example nearest airports or VOR stations.



You may select a waypoint that is included on any flight plans you have stored on your system. You will select the flight plan file name and then can pick the desired waypoint from that flight plan.



Tap the “Search” icon to activate the search function.



You can search short or long waypoint names. You can also select the search method. Either the waypoint name must start with the letters given in your search or you may choose “Contains”. In this case the name will match if any part of it contains your search criteria.

When you have finished your search you can tap the enter key on the keyboard. The search criteria will remain active until you either select a waypoint or tap the “Leave” button:



This allows you to select search criteria resulting in several pages of “hits” and use the up and down buttons to select your desired waypoint.



Note that most touch screen functions are also duplicated by means of the soft key buttons below the screen (except on iEFIS Lite systems).



Select “Nearest airports” from your NAV menu. This operates slightly different.

Nearest airports, Region A,A		
N FAPN,	Pilanesberg Intl.	9.8nm ←
N FAM	Mawa, Mawala	12.7nm →
N ZA0088,	Beestekraal Airport,SOUTH A	16.9nm ↓
N FABees,	Beestekraal	17.0nm ↓
N Karoob,	Karoobult	19.2nm →
N Kwikst,	Kwikstaart Musina	20.8nm →
N FALive,	Liverpool	21.6nm →
N FAKoko,	Kokoriba	23.0nm ↓
N FALief,	Liefeling	23.6nm ↓
N FARG,	Rustenburg	27.4nm ↙
N FASunR,	Sunset Ranch	30.2nm →

↑

↓

Search

✕

Note that there is no “Filter” button. Also note the region codes shown at the top. In this case we can see that both our primary as well as secondary navidata database is set to region code “A”. The region codes allow you to store several databases onto your system at the same time. You select the currently active code using the NAV menu.

Selecting any of the airports shows you the airport information display.

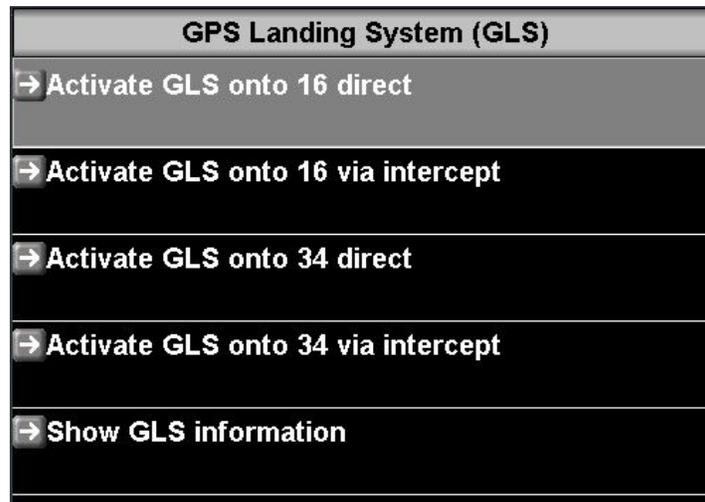


The airport information display shows you frequencies and runway information. Optionally, if available in the database, you can select airport information. If you have plates installed for this airport then you can choose to select from the available plates here.

If you have ADSB-IN then, if available, you can select METARs and TAFs related to the airport as they are broadcast from the ADSB network.

You can perform a “Direct-to” from the airport information display.

Tapping on the runway allows you to select a GLS approach.



You can activate a GLS approach either direct (the HSI will be set to ILS mode) or you can first navigate to an intercept point along the extended runway centerline (the distance from the touch down point is set in the GVOR/GLS setup menu, for example 5Nm).

GLS approaches can also be activated at any time from the NAV menu if you are approaching a runway and are seeing the blue approach guidance crosses – if you see the blue crosses you will find the NAV menu offers a function to activate this as a full GPS approach (the crosses turn green).

Tuning the approach guidance into a GLS approach is relevant if you are using the autopilot to fly your approach or if you would like to have the relevant HSI ILS display including glide slope.

GLS Information allows you to verify the GLS information in the database such as runway threshold position and elevations.