A² ADAHRS module
TURNS EKP V INTO AN EFIS
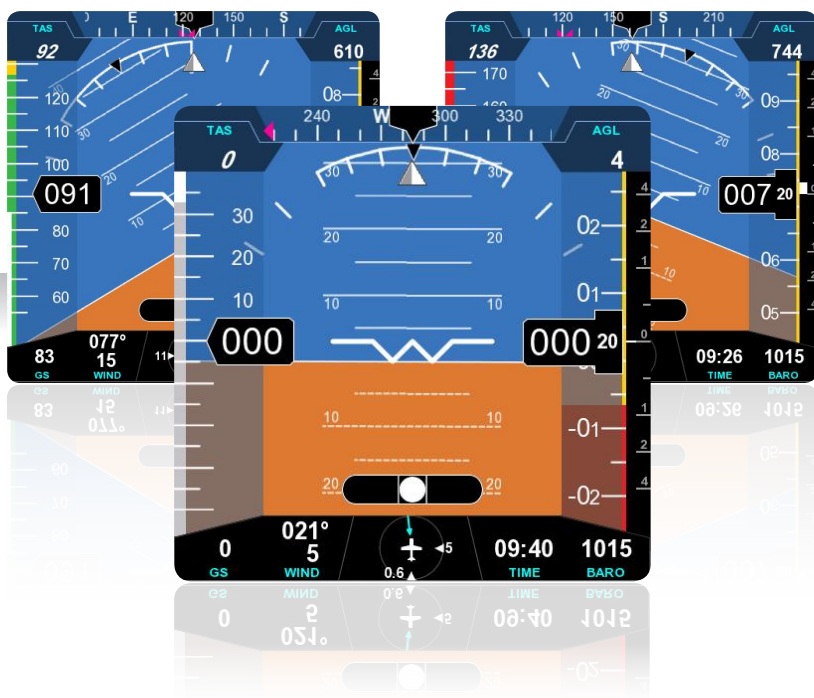
Bring attitude and airspeed
to your favourite moving map!

AvMap
SATELLITE NAVIGATION

Your journey, Our technology

DISCLAIMER & WARNINGS

This product is not TSO-certified and have received neither EASA nor FAA approval. This product is not intended for installation in type-certificated aircraft and is not a substitute for on-board instruments.

Avoid installing the product near heat sources or ensure adequate cooling is provided. Avoid routing of the wiring near sources of heat, RF or EMI interference.

The pilot in command assumes total responsibility and risk associated with the use of this device and remains solely responsible for flying in safe conditions.

AvMap disclaim any liability deriving from an improper use of the device, in a way that may violate the flight and navigation rules, regulations and safety.

1. System Overview

AvMap A2 ADAHRS extends the functionality of the EKP V Aeronautical Navigator and turns it into AvMap EFIS (Electronic Flight Information System), a centralized display for both navigation and primary flight information.

AvMap EFIS is composed by:

- **EKP V Aeronautical Navigator**, that acts as an integrated cockpit display and central processing unit
- **EKP V Cockpit Docking Station**, that allows the EKP V to be installed into the cockpit and provides connectivity to external modules
- **AvMap A2 ADAHRS**, a compact fixed-install unit providing attitude, heading, altitude and airspeed data to the system (Air Data, Attitude and Heading Reference System)

The core of the EFIS is AvMap A2 module. The module contains solid-state gyros, accelerometers, magnetic field sensors and air data sensors. The module is designed for fixed installation inside the aircraft and should be connected to the aircraft pitot-static system, in order to take full advantage of its functionality.

It is suggested to install the A2 aligned with the aircraft longitudinal axis, as it simplifies the attitude calibration process. The A2 can be installed in any orientation, whereafter a proper calibration needs to be performed (see Chapter 3. System Installation).

The A2 connects to the docking station via USB and provides the user with:
- Attitude (roll, pitch and heading angle)
- Airspeed
- Altitude
- Wind Estimation
- Side slip indication
- Vertical Speed

These information are collected and displayed to the pilot on the EKP V screen, when Primary Flight Display mode (PFD Mode) is selected. (See Chapter 2. System Operation for more details on the EFIS user interface).

Note: Although this user guide assumes the use of a Docking Station, it is also possible to connect the A2 module to the USB port of the EKP V cigarette-lighter cable.

2. System Operation

When the A2 module is connected to the EKP V a new MODE becomes available: Primary Flight Display Mode (PFD).
This mode is activated by pushing MODE button and then selecting Primary Flight Display.

Note: Push MODE repeatedly until the desired mode is selected, the unit will automatically switch to the new mode after a short time.

PFD screen
The PFD screen show the primary flight information using a digital presentation. A detailed explanation of each instrument is given in Figure 1.

Notes:
• TAS: because Outside Air Temperature is not available to the system, TAS value is approximated and based on current altitude only thus the TAS value is displayed in italic.
• Wind: wind data is approximated and displayed by the system when suitable GPS, compass and IAS data are available.
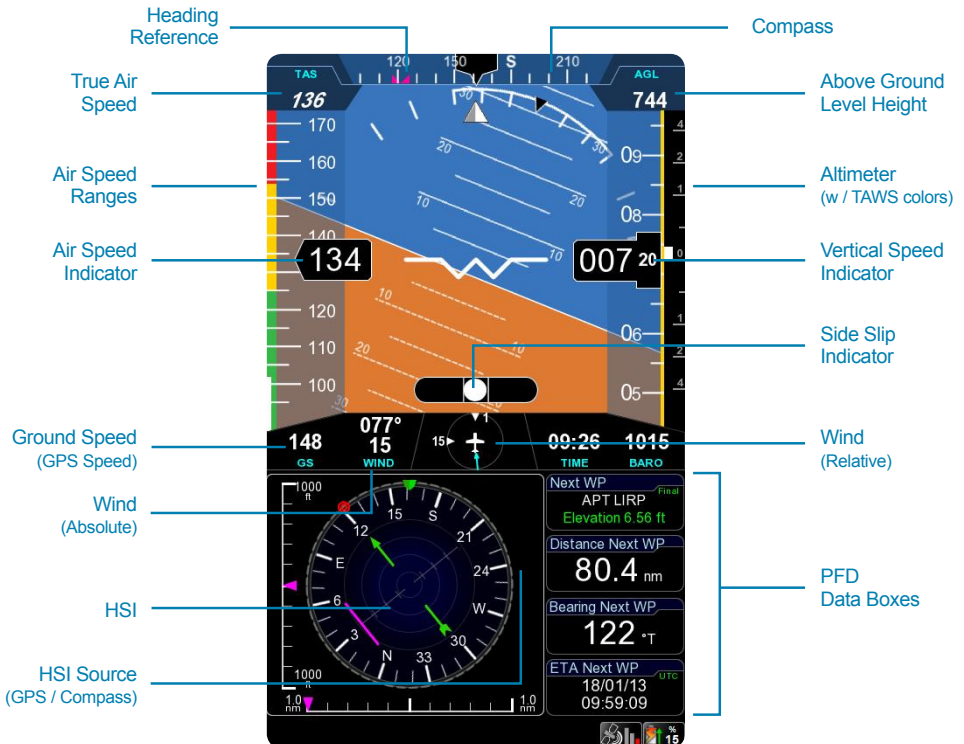

Figure 1

• Altimeter and terrain awareness: the altimeter tape includes a TAWS (Terrain Awareness Warning System) bar and terrain depiction (In red).
  Note: See AvMap EKP V User manual for more details on the TAWS feature.
• HSI Source: if no valid magnetic compass data is available (i.e. compass not yet calibrated), the HSI display is based on GPS "Course over Ground" and the HSI source flag shows "GPS". When correct compass data is available the source indicator changes to "AHRS" and proper magnetic heading is used to drive the instrument.

PFD settings

The PFD settings menu can be selected by pushing on the joystick when the unit is in Primary Flight Display mode. The menu includes the following items:
• BARO: set the current pressure reference for the altimeter
• Heading (HDG) Ref Mode: selects the heading reference to be used. Possible options:
  • Navigation: reference value is the course to the next waypoint (according to the active flightplan or GOTO)
  • Manual: show a heading value set by the pilot
  • Off: disable heading reference
• HDG Ref: set the manual heading reference
• Setup data fields: allow the user to customize the datafields shown on the PFD.

EFIS Menu

The EFIS menu is located in MENU > TOOLS > EFIS. The EFIS menu contains all options related to the EFIS system configuration and calibration.

Data Reception: (on/off) enable or disable the A2 module

Full Attitude Calibration, Compass Calibration, Horizon Alignment: see Chapter 4. System Calibration.

Reset Calibration Data: reset all A2 calibration data to factory defaults.

Aircraft Profile: allows to set aircraft-specific reference values. Refer to the aircraft operating manual to find the correct values.
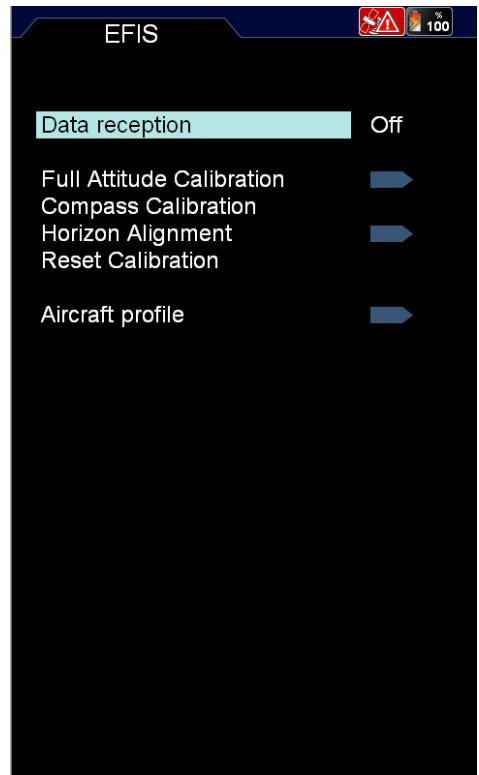

Figure 2

List of available reference values

Figure 3

V-speed values (control the white/green/yellow and red arcs in the airspeed indicator on Figure 1 on page 5)	
Vne	Never to Exceed speed
Vno	Maximum cruise speed
Vso	Stall speed with flaps & landing gear deployed
Vfe	Maximum flaps extended speed
Vs1	Stall speed with flaps & landing gear retracted

3. System Installation

The AvMap EFIS installation is divided in the following steps:

1. EKP V Cockpit Docking station installation (for Cockpit Installation)
2. A2 ADAHRS module installation
3. A2 initial attitude calibration (depending on selected installation orientation)
4. Aircraft Profile Setup
5. Compass calibration and test flight

Note: The installation of the EKP V Cockpit Docking Station is covered in the relevant documentation.

Installation requirements for the A2 ADAHRS module.

Location
The A2 can be installed in any location inside the aircraft. It is suggested to install the A2 aligned with the aircraft longitudinal axis, as it simplifies the attitude calibration process. To connect the pitot and static lines to the A2 ADAHRS module it is advisable to select a location where such lines are easily accessible (e.g. behind the instrument panel).

IMPORTANT: The A2 contains a magnetometer and other precision electrical sensors. The location selected for installation should be clear of strong magnetic or electromagnetic disturbances as much as possible. Avoid installing the A2 near electronic equipment (other digital EFIS, radios, transponders, etc), AC or variable DC cables, alternators, electrical motors, ferrous materials, etc. In such cases the proper behavior of the compass is not guaranteed (i.e. the compass may be crossed as "out of order" or may give erroneous indications).

Hint: use a hand-held compass to verify the magnetic disturbance in the area selected for installation. If the needle shows relevant changes or unstable indication, the location is not suitable for installation. Make sure to perform this test with all on-board electronic devices switched ON.

Orientation

It is suggested to install the A2 aligned with the aircraft longitudinal axis, as it simplifies the attitude calibration process. The A2 can be installed in any orientation, whereafter the proper attitude calibration procedure needs to be executed after first installation (see Chapter 4 AvMap EFIS Calibration, Full Attitude Calibration).

Three installation scenarios are possible:

Scenario A. A2 is installed flat (aligned with straight&level flight attitude) and is aligned with the aircraft longitudinal axis: no attitude calibration procedure is required in this case.

Scenario B. A2 is aligned with the aircraft longitudinal axis, is not aligned with straight&level flight attitude but pitch and roll offsets are present: simple Horizon Alignment Attitude Calibration procedure is required.

Scenario C. A2 is not aligned with aircraft longitudinal axis, nor with straight&level flight attitude: Full Attitude Calibration procedure is required.

Figure 4
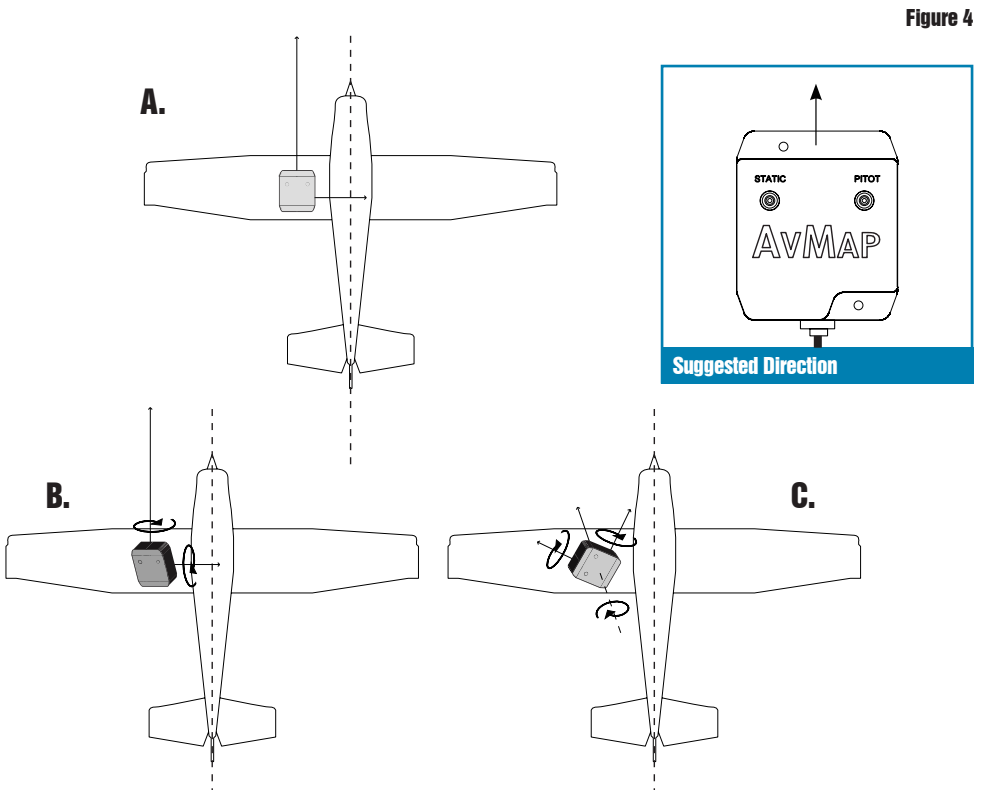
Connection to the pitot-static system

In order to display accurate speed and altitude data the A2 needs to be connected to the aircraft pitot-static system. First of all remove the two caps protecting the STATIC and PITOT ports. Installation along with other mechanical or digital altimeters and airspeed indicators is supported by mean of a T coupler (not included in the A2 box).

Connect the pitot line to the port labeled PITOT and the static line to the port labeled STATIC. Make sure the tubes fit tightly into the A2.

Note: Use flexible plastic tubes with an inside diameter of 5 mm (0,2 inches).

IMPORTANT: We recommend to test the pitot-static system for leakage after any alteration.

Static Port

Altimeter

Airspeed Indicator

Pitot Tube

STATIC   PITOT
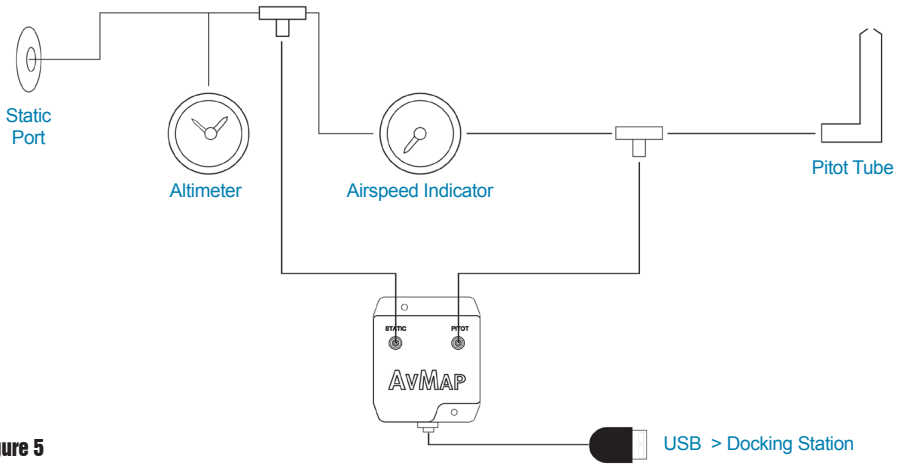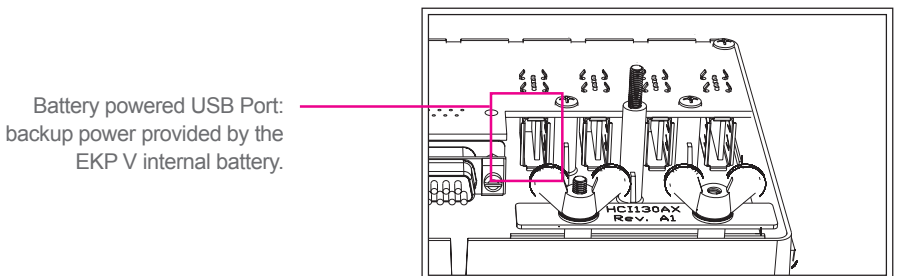
AvMap

USB > Docking Station

Figure 5

Connection to the Docking Station

The A2 includes a 1.5 m cable with a standard USB connector. Connect the USB cable to one of the USB ports of the EKP V Cockpit Docking Station.

One of the USB ports is powered by the EKP V internal battery (see Figure 6). If AvMap EFIS is the main source of primary flight information it is recommended to connect the A2 to this port, in order to maintain PFD indications in case of electrical power loss.

Figure 6

Battery powered USB Port: backup power provided by the EKP V internal battery.

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Rev. A1

4. System Calibration

Overview

The purpose of AvMap EFIS calibration procedure is to properly setup the system and to adapt it to the installation environment.

There are two different types of calibration procedures:

1. **Attitude calibration:** compensates for non-standard installation attitude (required for scenario B and C mentioned in Chapter 3).
2. **Compass calibration:** to compensate for any magnetic interference that could alter the reading of the internal magnetometer (required in all Scenarios, A, B and C, mentioned in Chapter 3).

The attitude calibration can be performed in three ways:

- **Scenario A.** No attitude calibration: if unit is aligned with aircraft axis
- **Scenario B.** Horizon Alignment: to compensate for pitch and roll offsets only
- **Scenario C.** Full Attitude Calibration: to compensate for pitch, roll and yaw offset between A2 and aircraft

Note: Compass calibration is required in any case.

Note: Make sure the A2 module is connected to the EKP V to be able to access the EFIS menu from the EKP V device. All EFIS calibration functions are available in MENU > TOOLS > EFIS (see Figure 2).

Full Attitude calibration

The procedure needs to be performed on the ground to determine the offset in pitch, roll and yaw between A2 installation attitude and the aircraft, and requires the user to set the aircraft in straight and level flight attitude (use blocks or jacks) whereafter a pitch up (or down) maneuver as wide as possible needs to be executed (see Figure 7).

Figure 7

Level & Straight Flight Attitude

Pitch Up

Pitch Down
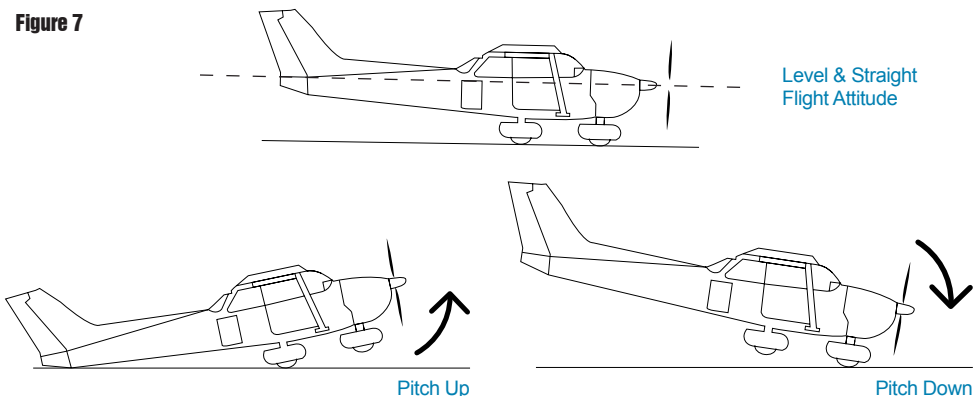
To access the step-by-step procedure select MENU > TOOLS > EFIS > Full Attitude Calibration.

1. Select if the maneuver will be pitch up or down. For tricycle aircraft the pitch up maneuver can be performed by pushing the tail (pitch up), while taildraggers will execute a pitch down maneuver by raising the tail.
2. Reset A2 ADAHRS calibration data; select Start. Wait until the reset phase is completed.
3. Set the aircraft in level and straight flight attitude by using jacks or blocks (or by asking a friend to push or lift the tail and hold). Press ENTER (joystick click) to record the sample in level & straight flight.
4. Set the aircraft in a pitch up (or down) attitude and press ENTER to record the pitch up/down sample.
   WARNING: be very careful not to change the aircraft heading while performing the pitch up /down maneuver.
5. Set values to A2 by pressing ENTER.

Wait a few minutes for the sensor to stabilize and realign. If pitch and roll after a few minutes are still not aligned fine-tune pitch and roll offset by executing a Horizon Alignment procedure.

Horizon Alignment
Execute this calibration procedure, either:
• to compensate only pitch/roll offset between the A2 and the aircraft axis.
• to perform a fine alignment of the pitch/roll values, after a full attitude calibration.

The procedure needs to be performed on the ground and can be started from MENU > TOOLS > EFIS > Horizon Alignment.

Procedure:
1. Make sure the aircraft is in straight and level flight attitude
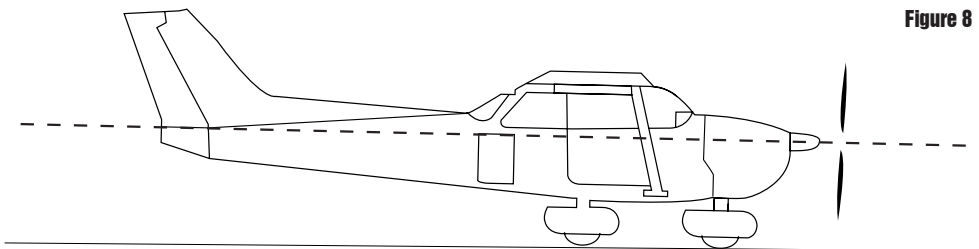2. Press the joystick to record a sample of pitch and roll angles

Figure 8

Compass Calibration and Test flight

The purpose of this procedure is to compensate magnetic disturbances the A2 is subject to, due to aircraft metal structures and electromagnetic components. These disturbances, if not compensated, could alter the heading value provided by the system.

For this reason the compass indicator is always marked as out of order (i.e. crossed) before the Compass Calibration procedure is executed.

Note: Compass Calibration is required in all scenarios after a proper Attitude Calibration is fulfilled.

WARNING: magnetometer calibration data is invalidated after every attitude calibration procedure (full attitude calibration and horizon alignment). Make sure to properly calibrate attitude before proceeding with Compass Calibration.

The Compass Calibration procedure must be executed in-flight and requires to steer the aircraft in 4 directions and execute some pitch up/down maneuvers. The total duration for this procedure is about 4 minutes.

Figure 9

↑ Pitch up + 20°
↓ Pitch down - 20°
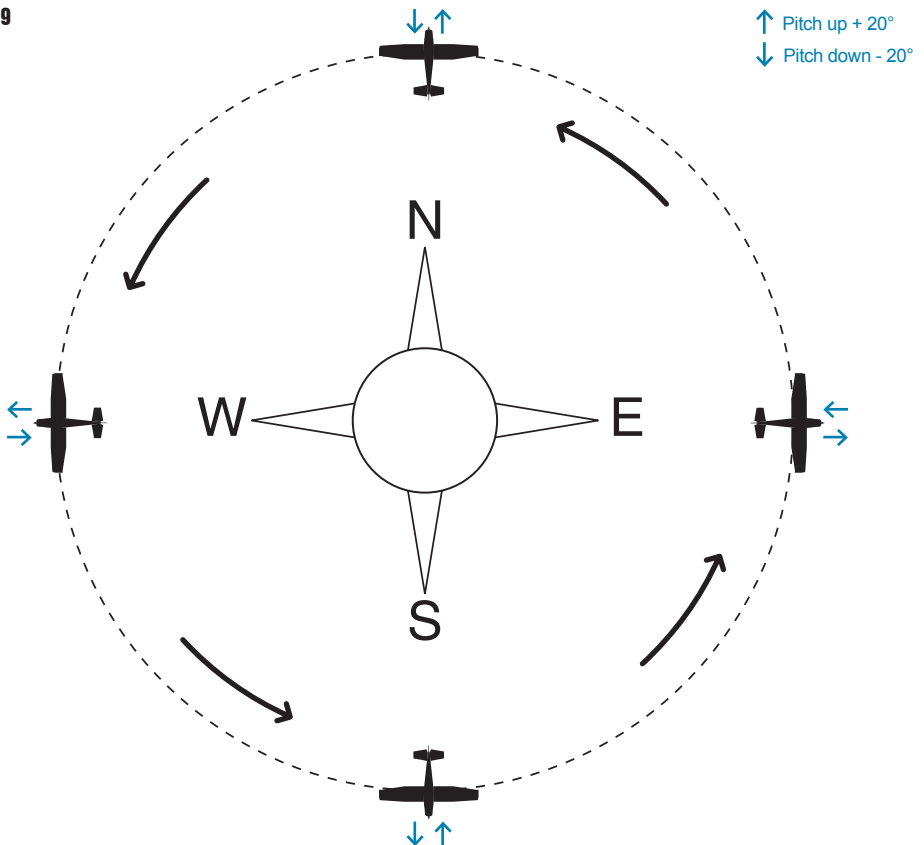
To start the guided procedure select MENU > TOOLS > EFIS > Compass Calibration.

After starting the procedure the screen switches to Primary Flight Display mode, where a flight director (i.e. magenta box) shows the maneuvers to perform. Follow the magenta box until the procedure is finished.

Assuming the calibration is started with the aircraft heading North, the steps required are:

1. Maintaining heading 000° execute: pitch up + 20°, back to straight flight and then pitch down -20°
2. Turn left to heading 270° by performing a standard rate turn (the proper bank will be shown by the flight director). The target heading for each step is shown as a magenta reference inside the heading tape.
3. Execute pitch up/down maneuvers as described in step #1
4. Repeat steps #2 and #3 for headings 180° and 090°, until reaching again the original heading.

At the end of a successful calibration procedures the compass instruments is enabled (i.e. red cross removed) and the HSI instrument correctly shows AHRS as data source, meaning that magnetic compass data are now available to the EFIS system.

Note: it's not required to start the procedure heading north. Any starting direction is acceptable.

Note: If the calibration fails or the compass indicator is not enabled, repeat the calibration procedure. If several calibration attempts fails review the installation location of the A2. Magnetic disturbance could be too high in the area selected.

Figure 10

5. Specifications

AvMap EFIS features
- Airspeed and Altitude from pitot-static system
- Attitude, side slip and heading information
- Integration of TAWS into the PFD with AGL Altitude indication
- Wind indicator with wind components
- Clear HSI display linked with EKP V flight planning function

A2 ADAHRS specifications
- Dimensions (mm) 70 x 60 x 35 / (in) 2.76" x2.36" x 1.38"
- Weight < 50 g / 1,8 Oz
- Operational Temperature -25°C to +85°C / -13°F to +185°F
- 3-axis gyros, accelerometers and magnetometers
- Acceleration range (3 axis) +/- 8 g
- Rotation Range +/- 1600 deg/s
- Air data sensors: range 10 to 250 kts, -1000 to 40000 ft
- Advanced data fusion capability
- USB Interface (1.5 m cable)
- Can be installed in any orientation
- Guided Calibration Procedure
- UAV Navigation® technology inside

A²ADAHRS module

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