EMSAHRS
Installation and Operation Manual

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1. GENERAL DESCRIPTION

1.1 Introduction

This manual describes the physical, mechanical, and electrical characteristics, the installation requirements and the operation procedure of the Flymap EMSAHRS. The .Flymap EMSAHRS integrates the functions of the Flymap EMS as well as those of the Flymap AHRS. In addition it is designed to support the fuel injected Rotax 912 iS engine. It receives many engine parameters directly from the 912iS engine's ECUs via the CANaerospace data bus (CANaerospace is a higher layer protocol based on Controller Area Network, CANbus). The functionality includes continuous monitoring of the network health status, and the indication of all ECU generated warning and status messages.

1.2 Related Documents

Ref.	Title	Doc Number
1	FlymapL Installation Manual	500-310
3	AHRS Installation and Operation Manual	500-408
2	Flymap EMS Installation and Operation Manual	500-409
4	Flymap Autopilot Installation and Operation Manual	500-421

WARNING!

The Flymap EMSAHRS is not certified as an aviation sensor. Therefore, under no circumstances it should be used as attitude sensor in IMC conditions, not even as a backup device! Non-compliance with these instructions could result in personal injury or death!

Explanations:
- IMC: Instrument Meteorological Conditions; Weather conditions which requires flying by instruments and hence in accordance with IFR.
- IFR: Instrument Flight Rules; Rules to be followed while flying in IMC. Aircraft and crew must have appropriate approvals in order to fly according to IFR.
- VMC: Visual Meteorological Conditions; Weather conditions which are suitable to enable flying by visual references, and hence in accordance with VFR.
- VFR: Visual Flight Rules; Rules to be followed while flying in VMC. Aircraft and crew must not have special approvals in order to fly according to VFR.

Possible application fields include e.g. the training of IFR manoeuvres and procedures in VMC under supervision of a flight instructor.

1.3 Equipment Description

The EMSAHRS module is an extension to the FlymapL Multifunctional Display System. It consists of two parts, the Engine Monitoring System (EMS) and the Attitude and Heading Reference Systems (AHRS). With this single box, a Flymap System turns into a full blown EFIS (Electronic Flight Instrument System or Glass Cockpit).

The EMS part of the box is containing all necessary electronic circuits to interface temperature probes and other engine signals and convert them to digital signals which are communicated over a single serial communication connection to a Flymap equipment. It is designed to replace traditional engine instruments such as CHT, EGT, RPM, MP as well as fuel flow indicators and provide superior reliability and accuracy. The box must be connected to an empty serial communication interface of the Flymap Multifunctional Display System.

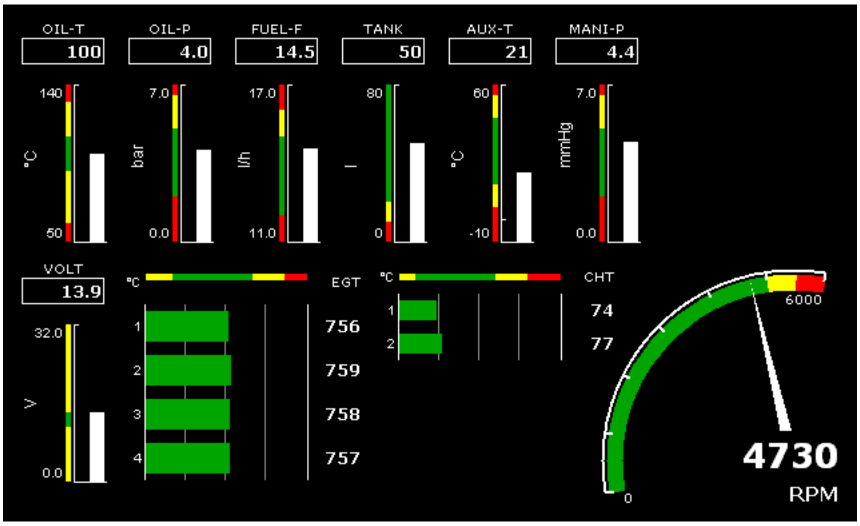


Figure 1-3-1, Engine Instruments

NOTE:
Touching on the screen to the FUEL-F or TANK indicator will open a 10-digit keypad to enter or modify the currently available fuel. From that value and from the measured fuel flow and ground speed, the system calculates the actual fuel available, the fuel remaining, the endurance and the remaining flight range.

The following parameters can be displayed from a ROTAX 912 aircraft engine as well as from a four- or six-cylinder Lycoming or Continental aircraft engine:

- Oil Temperature (OIL-T)
- Oil Pressure (OIL-P)
- Fuel Flow (FUEL-F)
- Fuel Tank Level (TANK)
- Outside Air Temperature (AUX-T)
- Manifold Pressure (MANI-P)
- System Voltage (VOLT)
- Exhaust Gas Temperature (EGT) for all cylinders
- Cylinder Head Temperature (CHT) for all cylinder
- Engine/Rotor/Propeller Rotation per Minute
- Outside Temperature (OAT)
- Trim/Flap Position

The AHRS part of the box contains an electronic 3-axis sensor that provides roll, pitch and yaw information of the aircraft. It is designed to replace traditional mechanical gyroscopic flight instruments and provide superior reliability and accuracy. In addition it contains three pressure sensors to be connected to the pitot and static system to measure altitude and airspeed of the aircraft. The third pressure input can be connected to an AOA (Angle Of Attack sensor). The information of the AHRS part will also be transmitted to the Flymap System using the same serial communication.

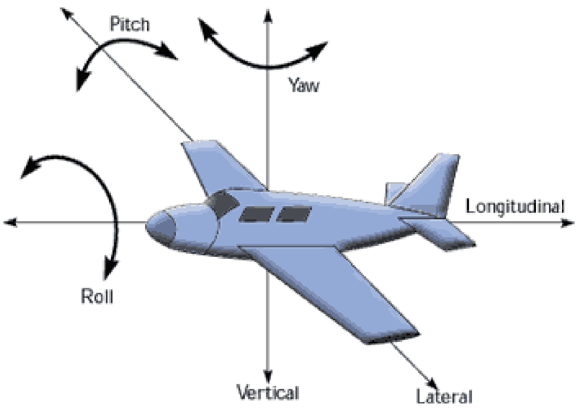


Figure 1-3-2, Aircraft Main Axis

Figure 1-3-3, Primary Flight Display with Map Window

Together with the Flymap the EMSAHRS module forms a PFD (Primary Flight Display) showing the following information:

- Pressure Altitude Indicator
- Airspeed Indicator
- True Airspeed and Ground Speed Display
- Vertical Speed Indicator (Climb/descent indication)
- Artificial Horizon with auto-calibration
- Horizontal Situation Indicator (HSI) with Course Deviation Indicator (CDI) and Selected Course Marker
- Additional Navigation Information (Bearing, Distance, Estimated Time Enroute)
- Ball Type Slip Indicator
- Acceleration Indicator (G-meter with continuous reading, maximum positive and negative loads and with automatically adjusting scale).
- Picture-in-picture display of map on the instrument page
- Picture-in-picture display of horizon on the map screen

In addition, two intelligent autopilot servos can be connected to the EMSAHRS box (see [4] for details of the autopilot functionality).

1.3.1 Housing Construction

The housing of the EMSAHRS is constructed from machined aluminium. This construction improves EMC and the resistance to the ingress of moisture.

Warning: Do not open the housing. There are no user serviceable parts or batteries inside and the warranty becomes void if the housing is opened.

1.3.2 Component retention

All major components and assemblies are secured to the chassis using metal screws. Components that may become loosened by vibration, such as plug in components and links are secured.

1.4 Interface Summary

The EMSAHRS module provides the following interface connections via the 19-pin connector:

- Aircraft power input (11 to 33 volts).
- One Serial communication interfaces (RS232) to be connected to the Flymap System
- Two Serial communication interfaces (RS232) to drive intelligent A/P servos
- CANaerospace bus interface

The EMSAHRS box provides the following interface connections via the 25-pin D-SUB connector:

- Six EGT probes (EGT1 - EGT6)
- Six CHT probes (CHT1 - CHT6)

The EMSAHRS box provides the following interface connections via the 37-pin D-SUB connector:

- Aircraft power input (11 to 33 volts).
- Four pulse counter inputs (RPM sender inputs, fuel flow transducers inputs)
- Sixteen resistive inputs (resistive temperature – and pressure probes, resistive fuel level sender)
- Two current loop inputs (current loop sensors)
- Bi-color warning indicator LED output
- Two ampere meter shunt connections
- One relay output
- 5V and 12V output

In addition the following pressure ports are available:

- Static pressure input port
- Pitot pressure input port
- AOA pressure input port
- Manifold pressure input port

1.5 Technical Specifications

The following table presents general mechanical and electrical specifications.

1.5.1 Mechanical Specifications

PHYSICAL DIMENSIONS:

Length (box only):	163 mm
Length (including flanges):	193 mm
Width	91 mm
Height	40 mm
Mounting wholes	4 mm

WEIGHT:

280 g (including connectors)

PRESSURE PORTs:

Diameter	∅ 6 mm

TEMPERATURE RANGE:

Operation	-20° C to +60° C
Storage	-55° C to +85° C

ALTITUDE:

7´315 m (24´000 ft)

1.5.2 Electrical Specifications

DC POWER REQUIRMENTS:

Supply Voltage	12 to 30 V ± 10%. Power Input must be protected using the same 5A circuit breaker as the Flymap System is connected to.
Power consumption	2 W

INTERFACES:

3 serial communication ports	RS232 to Flymap and servos. The serial communication interfaces conforms to the EIA Standard RS-232C with an output voltage swing of at least ±5 VDC when driving a standard RS-232 load
16 analogue General Purpose Resistive inputs	Rotax NTC probes, PT100 temperature probes, resistive fuel pressure probes, resistive oil pressure probes, resistive tank or pitch potentiometers etc.
2 pulse inputs for fuel flow transducers signals	for fuel flow transducer e.g. FloScan Model 201A-6
2 current loop inputs	for CL oil- and fuel pressure probes
2 pulse inputs	for RPM signals (0 .. 100 Hz)
2 analogue inputs	for 1 mΩ ampère meter shunt
12 thermocouple inputs	for type-K EGT probes and type-J CHT probes
Bi-color LED output	for warning LED
ROTAX ECU starter relay	supply power to the ROTAX ECU during engine startup (max 500 mA)

DESIGN:

All solid state in SMD technology. Printed circuit board, flat ribbon cable, printed circuit board connectors

1.6 Equipment Available

Item	Part number	Note
EMSAHRS Complete	500-084	Includes the EMSAHRS module, the Flymap connection cable including connectors as well as two pre-wired connectors (D-SUB 25 and D-SUB 37) with open end cables for the probes and other peripherals.

1.7 Additional Equipment Required

- Hardware Screws to mount the EMS
- Fittings T-type fitting for manifold pressure connection

- Tube Pressure instrument tube ∅ 6 mm
- Probes up to four ROTAX EGT probes and
  up to four ROTAX CHT probes
  one ROTAX Oil temperature probe

  ROTAX Sensor Kit (P/N 886977)

Rotax Oil Pressure Sensor (P/N 956357)
(resistive)

Rotax Oil Pressure Sensor (P/N 956413)
(current loop)

(Honywell P/N MLH010BSCDJ1231)

NOTE: The new current loop sensor has two terminals and the old one has only one terminal.

up to Type-J CHT Probes and
up to Type-K EGT probes

JUMO OAT probe

up to two Fuel Flow Transducer
e.g. FloScan Model 201A-6
Note: Each Transducer comes with its own data sheet showing the so called K-Factor. Conserve this sheet together with your aircraft records. The K-Factor must be entered into the configuration page in order to get precise fuel flow readout.

- Position — Resistive Trim- or Flap Position Sender (Ray Allen Co, Type POS-12, 1.2")

  or other variable resistor with values less 10 kΩ

- Relay — ROTAX ECU starter relay
  e.g. Finder P/N 66.82.9.012.0000 (12V, 140 mA)

- Shunt — One shunt with a resistance of 1 mΩ in order to display the current flow to and from the battery.

- LED — One Bi-Color warning LED

2. INSTALLATION OVERVIEW

2.1 Introduction

This section provides the necessary information for installing the EMSAHRS module. Installation of the EMSAHRS will differ according to equipment location and other factors. In addition to the provided connection cable other cabling will be fabricated by the installing agency to fit these various requirements.

2.2 Unpacking and Inspecting Equipment

Carefully unpack the equipment and make a visual inspection of the unit for evidence of damage incurred during shipment. If the unit is damaged, notify the carrier and file a claim. To justify a claim, save the original shipping container and all packing materials. Do not return the unit to Stauff Systec GmbH until the carrier has authorized the claim.

Retain the original shipping containers for storage. If the original containers are not available, a separate cardboard container should be prepared that is large enough to accommodate sufficient packing material to prevent movement.

2.3 Cabling and Wiring

Use MIL-W-22759/34 normal weight wire or equivalent for all connections unless otherwise specified by the aircraft manufacturer or by Stauff Systec GmbH. AWG #24 may be used for all signal and power connections to the EMSAHRS.

Use shielded cables for RS232 connections where shield is only connected on either side in order to avoid unexpected EMI effects.

Ensure that routing of the wiring does not come in contact with sources of heat, RF or EMI interference. Check that there is ample space for the cabling and connectors. Avoid sharp bends in cabling and routing near aircraft control cables or rods.

Temperature probes must be wired to the EMSAHRS using the cables delivered with the probes. Do never extend a probe connection cable using an ordinary copper wire. All cables must be routed away from high temperature areas. Secure probe leads to a convenient location on the engine approximately 20 to 30 cm from the probe, being sure there is sufficient slack to absorb engine torque. It is essential in routing the probe wire that this wire not be allowed to touch parts of the airframe or engine since abrasion will destroy this high temperature wire. Secure probe cables along the route to the EMS module box. Secure wire using original clamps, safety wire or tie wrap if possible.

Caution: EGT and CHT probes use wire made from special metals. As a result these probe cables are not able to withstand much flexing due to engine vibrations. Avoid making nice looking coils or similar constructions that will result in excessive vibration or flexing of the wire. Route the cables from the probe points tightly along suitable engine mounting points eliminating any chance of unnecessary wire flexing during engine operation.

2.4 Cooling Air

The EMSAHRS module does not need special cooling. Nevertheless, do not install the equipment near heat sources. It is recommended to provide beneficial air flow around to the unit.

3. INSTALLATION PROCEDURE

3.1 Mechanical Installation

3.1.1 Placement of the EMSAHRS module box

The EMSAHRS module must be installed behind the control panel as near as possible to the roll axis.

The module must be orientated with the Flymap logo on top and the arrow pointing in flight direction. The AHRS sensor must be firmly attached to the aircraft structure using four M4 screws. Make sure that no vibration occurs.

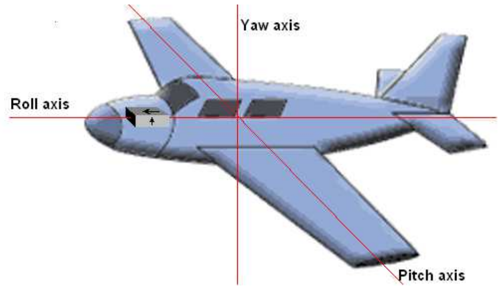


Figure 3-1-1: Acceptable installation position

In addition, the following requirements must be met:

- The box must not be exposed to direct engine vibrations. Never mount the EMSAHRS box on the engine itself. It is intended to be firmly attached to the aircraft structure or similar suitable structure using four M4 screws.
- The EMSAHRS module box must be installed so extreme heat from the engine cannot damage it.
- It must be mounted in a position where it is protected from any engine oils or other engine fluids including water.
- If required the EMSAHRS module box should be mounted inside a protected enclosure if it is otherwise not possible to protect it from environmental exposure such as rain.
- If the box is operated in conditions that may lead to corrosion of exposed electrical metal parts, suitable protection is a mandatory requirement.
- The EMSAHRS module includes very good protection against voltage transients on the power supply. However, in cases where severe transients containing a large amount of energy are expected, additional, external protection may be required.

3.1.2 Pressure Connections

3.1.2.1 Manifold Pressure Connections

The EMSAHRS module requires connections to the manifold pressure lines of the aircraft. 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 restriction of airflow through the engine, and hence of the unused power capacity in the engine. Connect the EMS module manifold pressure (MP) port to the MP line by inserting a T-type fitting in the existing MP line and use a 6 mm instrument tube between the fitting and the EMS box.

3.1.2.2 Pitot and Static Connections

The EMSAHRS module requires connections to the pitot and static lines of the aircraft. Pitot pressure is ram air pressure picked up by a Pitot-Tube that sticks directly into the air stream and produces a pressure proportional to the speed of the air movement. Static pressure is the pressure of the still air used to measure the altitude and serves as a reference in the measurement of airspeed.

The conventional design of a pitot-static system consists of a pitot tube connected to the airspeed indicator and a static pressure port connected to the altimeter, the vertical speed indicator and the airspeed indicator using small pipes or hoses. The two pressure ports on the AHRS housing are labelled with S (static pressure line) and P (pitot or dynamic pressure line).

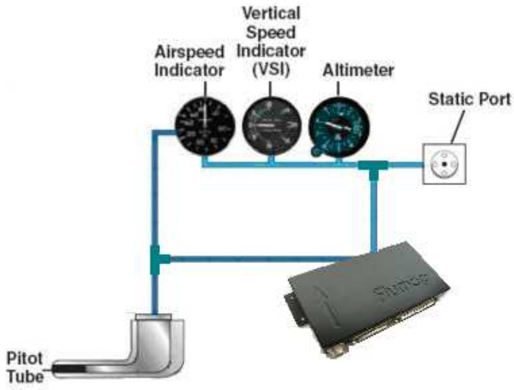


Figure 3-1-2-2: Pitot-Static installation

3.1.2.3 Static System Test

Connect the test equipment directly to the static ports, if practicable. Never blow air through the line toward the instrument panel. This may seriously damage the instruments. Apply a vacuum equivalent to 1’000 feet altitude above your current altitude and hold (differential pressure of approximately 36 hPa or 367 mm of water). After one minute, check to see that the leak has not exceeded the equivalent of 100 feet of altitude (decrease in differential pressure of approximately 355 Pa or 36 mm of water).

3.1.2.4 Pitot System Test

Connect the test equipment directly to the pitot tube and apply pressure to cause the airspeed indicator to indicate 100 knots (differential pressure of 25 hPa or 250 mm of water), hold at this point and clamp off the source of pressure. After 1 minute, the leakage should not exceed 10 knots (decrease in differential pressure of approximately 244 Pa or 25 mm of water).

Caution: To avoid rupturing the diaphragm of the airspeed indicator, apply pressure slowly and do not build up excessive pressure in the line. Release pressure slowly to avoid damaging the airspeed indicator.

3.1.3 CHT Probe Installation

Install the ROTAX CHT probes by following the ROTAX installation instruction at the locations prepared on the bottom of two cylinders. Install one probe on a front cylinder and the other one on a rear cylinder on the opposite side.

The Type-J CHT probes must be installed on Lycoming or Continental engines according to the installation instruction of the engine manufacturers.

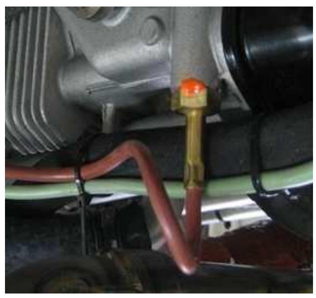


Figure 3-1-3 CHT Probe Installation

3.1.4 OAT Probe Installation

Install the JUMO PT100 OAT probe, P/N 60/00085313 in the airframe manufactures recommended location. If this is not possible, it is recommended that the OAT probe be placed in clean airflow such as in a cabin air scoop or below the underside of the wing away from engine heat or exhaust. In this case it is recommended that the installation be done like an antenna installation. An outside tube should be used to shield the probe from radiated heat.

3.1.5 Fuel Flow Transducer Installation

The fuel flow transducer measures the flows of gasoline. It generates repeatable signals across the flow range down to 1.1 L/h. The transducer bearing system is rated for continuous operation at the upper end of the flow range. Liquid enters the flow chamber tangentially, follows a helical flow path, and exits vertically, thereby venting any entrained vapour bubbles. The rotational velocity of the liquid is directly proportional to flow rate. A neutrally buoyant rotor spins with the liquid between V-jewel bearings. The vapour venting design requires that the transducer is positioned with the electrical connectors pointing up. Turbulence caused by valves or sharp elbows mounted close to the transducer inlet can affect transducer K-Factor and should be minimized.

Caution:	The sensor must be mounted with the arrow on its case pointing upwards, i.e. so that the cables are leaving the top of the transducer.

A normal fuel tank system for the ROTAX 912 engine installation is illustrated on the following picture. In such a situation, one fuel flow transducer can be installed at the shown position.

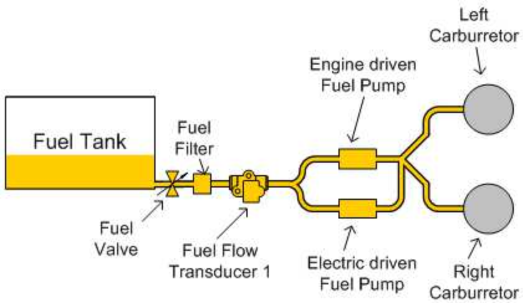


Figure 3-1-5-1, Tank Installations without Fuel Return Line

In some fuel tank system for the ROTAX 912 engine installation a fuel return line exists. In that case two fuel flow transducers must be installed. The fuel consumption will than be calculated by the Flymap System as the difference of the measured fuel flow on both transducers. The following picture illustrates this situation.

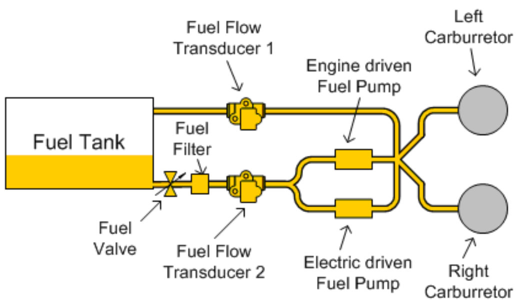


Figure 3-1-5-2, Tank Installations with Fuel Return Line

Find a convenient location within hose support or fittings and away from any hot exhaust pipes to suspend the fuel flow transducer. The hose support or fitting may be on the input and output line of the transducer. The sensors must be placed in a horizontal section of the fuel line at a low point in the fuel system. The fuel should go "up" when exiting the sensor. Its outlet should be at least 5 cm lower than the fuel pump inlet.

Install the two ¼ NPT hose fittings at the IN and OUT port of the transducer.

Caution:	**DO NOT OVER TIGHTEN FITTINGS**. Torque pipe thread fittings to the maximum of two full turns beyond hand tight (whichever comes first). We recommend that a fuel proof pipe thread sealant is used when installing fittings into the flow sensors such as (LockTite PST, Rector Seal, Leaklok, Permatex, Jomar, etc). **NEVER USE TEFLON TAPE.**

Cut the fuel hose at the selected position and mount the transducer using the fittings to both ends of the cutted fuel hose. The transducer must be wrapped with a fire sleeve. Place a small hole in the fire sleeve and pass the transducer wires through it. Seal with High temperature Silicone sealant.

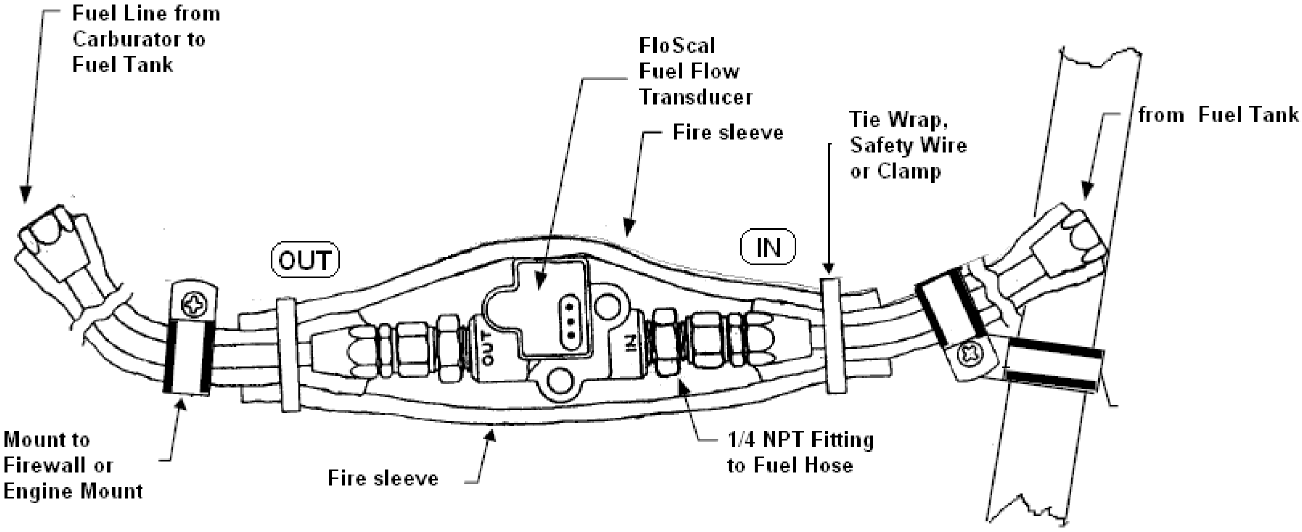


Figure 3-1-5-3, Mounting of the Fuel Flow Transducer

3.1.6 EGT Probe Installation

The ROTAX EGT Probe kit contains for each EGT probe a stainless threaded stud and a copper seal ring. The threaded stud must be welded to the exhaust elbow so that the EGT probe can be screwed in and sealed with the copper seal ring. Install the four ROTAX EGT probes by following the ROTAX installation instruction.

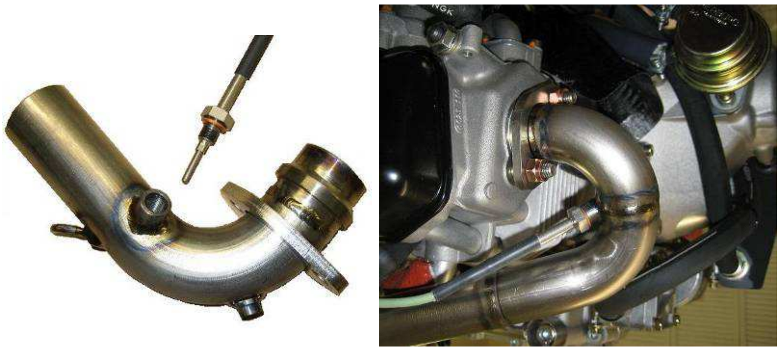


Figure 3-1-6, EGT Probe Installation

The Type-K EGT probes must be installed on Lycoming or Continental engines according to the installation instruction of the engine manufacturers.

Before drilling holes or welding studs to the exhaust system, mark the mounting position of each EGT probe. It is important that each probe be mounted a uniform distance from the exhaust stack flange. A nominal distance of 5 to 10 cm from the exhaust flange is recommended. If the recommended distance is impractical then position the probes a uniform distance from the flange as space permits. Do not mount probes in slip joints. Be certain to locate all positions of the studs before drilling or welding to ensure that nothing interferes with the probe, clamp, and clamp screw or wire. Careful matching of probe position will provide best temperature readings.

Than remove all exhaust elbows and weld the stainless threaded stud to the marked positions and drill the hole in order to screw in the probe.

3.1.7 Trim- or Flap-Position Sensor Installation

The position sensor provides a signal for the EMSAHRS by means of a sliding arm. The sliding arm is connected to a 0-5 KΩ variable resistor. Install the position sensor where the arm can travel just under its full length. Make sure that no extensive force will be applied to the arm in both end positions.

3.2 Electrical Connections

In the following chapters, wires identified by colors are connected to the D-SUB 37 connector (see chapter 4.1.2)

3.2.1 Rotax CANaerospace bus connection

The EMSAHRS module is designed to support the fuel injected Rotax 912 iS. It receives many engine parameters directly from the 912iS engine ECUs via the two CANaerospace busses. Engine parameters available from the 912iS engine ECUs include RPM, manifold pressure, oil pressure and temperature, coolant temperature, EGT for all four cylinders, ECU voltage as well as many system status and warning information.

The two busses must be connected together as shown in the schematics to the right.

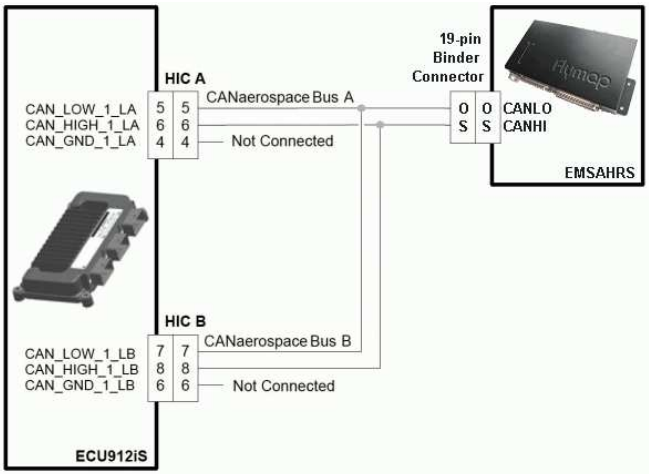


Figure 3-2-1, CANaerospace Bus Connection

3.2.2 Rotax ECU Startup Relay

The EMSAHRS 912iS Start Power function provides “912S style” engine start and handling. Whenever power is applied to the EMSAHRS module, the Can Relay Out (pin 17) signal becomes +12VDC and activates the ECU Startup Relay. That relay can feed the ROTAX ECUs with battery power in order to startup the engine. After the engine has reached an RPM of 1800/min, the EMSAHRS automatically deactivates the ECU Startup Relay. The battery backup switch allows engine startup in any case.

3.2.3 Bi-Color Warning LED Installation

The Bi-Color Warning LED must be installed in the instrument panel in best view of the pilot. It serves as a warning indicator whenever the engine instruments are not visible or during power up of the Flymap system. Connect to common terminal of the LED to one of the black wires (GND, pin 3, 5, 13, 16, 32 or 34), the red one to the brown-black wire (pin 30) and the green one to the brown wire (pin 29).

The warning LED will start flashing red, if the oil pressure is less than 2.5 bar or higher than 6.0 bar else it shows steady green.

3.2.4 Flymap and Power Connections

Electrical connections to the FlymapL and to the aircraft power system are made through a 19-pin connector. The connector of the FlymapL cable harness must be of type BINDER Series 682. The included cable assembly is equipped with the BINDER female straight connector P/N 99-2042-20-19. Table 4.1.1 lists the electrical connections of all input and output signals on this connector.

Connect the serial communication connector of the EMSAHRS module cable with a free serial communication interface at the FlymapL harness (default COM4). Note the port number used for that connection.

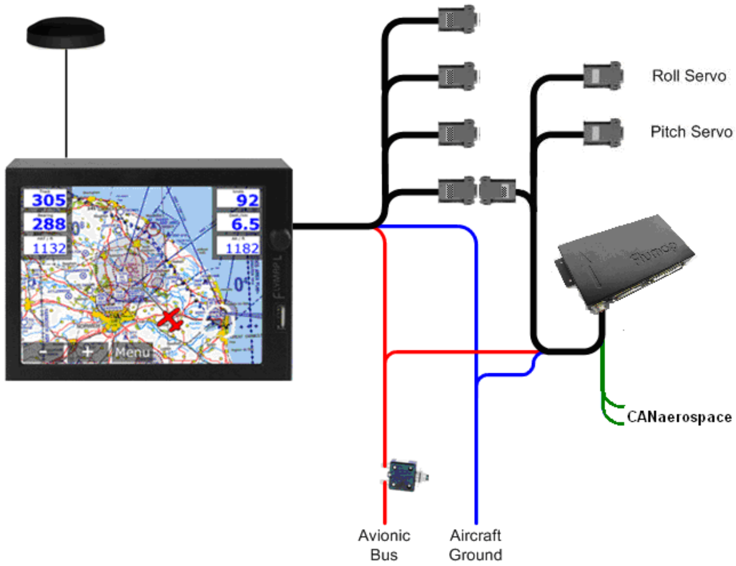


Figure 3-2-4: FlymapL and Power Connections

In addition, there are two wires with open ends of the EMSAHRS module cable. Connect them to the electrical system of the aircraft. The red cable must be connected to the same circuit breaker as the FlymapL is connected to and the black cable to the aircraft ground.

Caution:	Check all wiring connections for errors before connecting the EMSAHRS module. Incorrect wiring could cause internal component damage. The EMSAHRS module works with a voltage from 11 to 33 volts. A higher voltage or crossed connections will destroy the EMSAHRS module!

3.2.5 Probe Connections

3.2.5.1 CHT Probe Connection

The CHT probes must be connected to the open wires of the D-SUB 25 connector (see chapter 4.1.3).

3.2.5.2 Oil Temperature Probe Connection

The existing wire to the ROTAX Oil Temperature probe (see figure 3-2-5-2) must be intercepted and connected to the white-blue wire (pin 6).

Oil Temperature probes of 4/6-cylinder engines can be connected to the same wire.

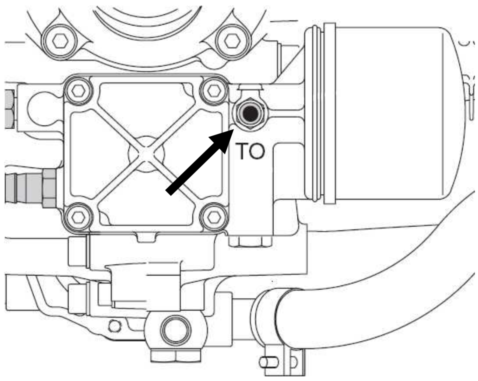


Figure 3-2-5-2, ROTAX Oil Temperature Probe

3.2.5.3 OAT Probe Connection

One wire of the OAT probe must be connected to the yellow wire (pin 9). The other wire of the OAT probe must be connected to one of the black wires (GND, pin 3, 5, 13, 16, 32 or 34). It plays no role which wire of the probe is connected to the black wire.

3.2.5.4 Fuel Flow Transducer Connection

Connect the red wire of the fuel flow transducer to the red wire (+12V, pin 15), the black one to one of the black wires (GND, pin 3, 5, 13, 16, 32 or 34) and the white one to the grey-green (pin 14). If two flow transducers are installed, the white wire of the second one must be connected to the grey-brown wire (pin 19) while the red and the black wires are connected as described above, else leave the grey-brown wire open.

3.2.5.5 RPM Sender Connection

Intercept the wire to the ROTAX RPM sender (see figure 3-2-5-5) and connect it to the green wire (pin 33). If the ROTAX RPM Indicator is not installed, connect the other wire to one of the black wires (GND, pin 3, 5, 13, 16, 32 or 34). If a ROTAX RPM indicator is installed, on of the wires is connected to ground. It plays no role which wire of the RPM sender is connected to GND.

Other RPM sender uses similar installation. A rotor RPM sender of a gyrocopter is connected to the green-black wire (pin 35).

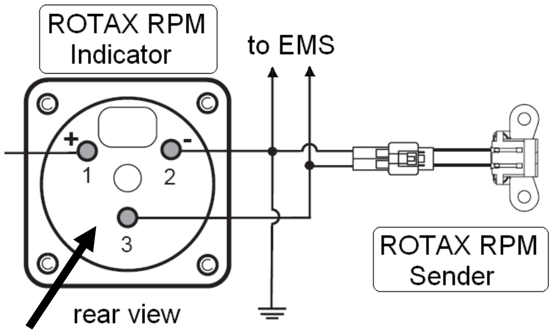


Figure 3-2-5-5, ROTAX RPM Sender

3.2.5.6 EGT Probe Connection

The EGT probes must be connected to the open wires of the D-SUB 25 connector (see chapter 4.1.3).

3.2.5.7 Oil Pressure Sender Connection

If the Oil Pressure Sender has only one terminal, it's a resistive probe. Intercept the wire to the ROTAX Oil Pressure Sender (see figure 3-2-5-7) and connect it to the white wire (pin 6). If it has two terminals, it is a current loop Oil Pressure sender. Connect the white wire to the white-green wire (pin 11) and the red wire of the probe to the red one (+12V, pin 15).

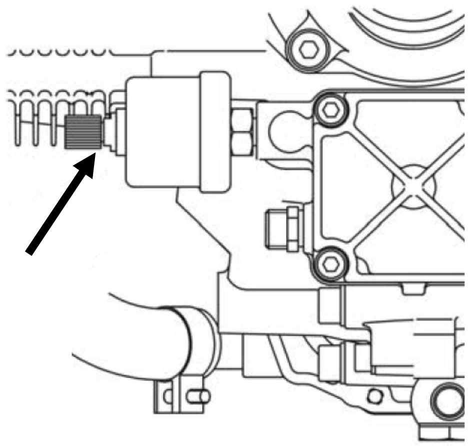


Figure 3-2-5-7, ROTAX Oil Pressure Sender

3.2.5.8 Trim- or Flap-Position Sensor Connection

The position sensor has three wires, an orange wire, a green and a blue wire. The green wire is the signal return, while the orange and the blue wires are the two ends of the potentiometer. Connect the green wire to the Trim- or Flap-Position input wire according to Table 4.1.2. Connect the blue wire to one of the black wires (GND, pin 3, 5, 13, 16, 32 or 34). Leave the orange wire open.

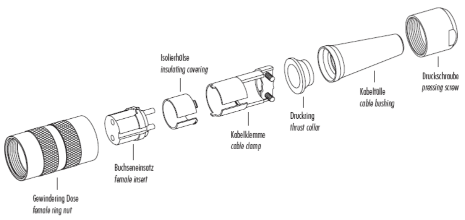
4. SYSTEM INTERCONNECTS

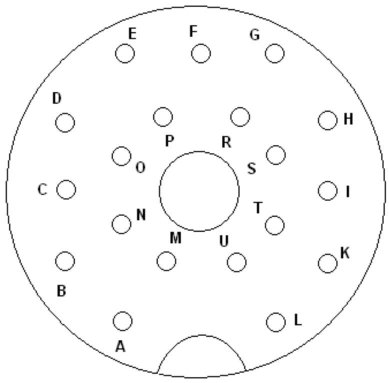
4.1 Connectors

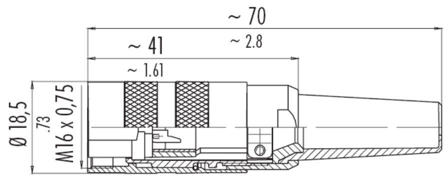
The EMSAHRS module is equipped with three connectors. The 19-pin connector is used to connect the EMSAHRS module to the Flymap Multifunctional Display System and connects the A/P servos as well as the ROTAX ECUs. The D-SUB 25 female connector connects the temperature probes while the D-SUB 37 male connector connects the other peripherals.

4.1.1 19-Pin Flymap and Power Connector

The connector used with the EMSAHRS module is a 19-pin Binder Series 682, P/N 99-2042-20-19







Note: Contact arrangements with view on the solder termination side of female insert.

Figure 4-1-1, 19-Pin Female Cable Connector

Pin	Description	Function	I/O	Pin	Description	Function	I/O
A	11 - 33 VDC	PWR	In	L	AC Ground	GND	-
B	NC *	-	-	M	11 - 33 VDC	PWR	In
C	NC *	-	-	N	NC *	-	-
D	NC *	-	-	O	CANaerospace	CANLO	Bus
E	Ground RS232	GND	-	P	RS232	TX	Out
F	NC *	-	-	R	NC *	-	-
G	RS232	RX	In	S	CANaerospace	CANHI	Bus
H	A/P Aileron Servo	RX	In	T	A/P Elevator Servo	RX	In
I	A/P Elevator Servo	TX	Out	U	AC Ground	GND	-
K	A/P Aileron Servo	TX	Out				

Table 4-1-1, EMSAHRS 19-Pin Connector Pinout

4.1.2 37-Pin Peripheral Connector

The open wires of the included D-SUB 37 cable assembly are used for the other peripherals. The wires are color coded. Depending on the engine use these wires according to the following list:

Pin	Color	Description	4-/6-Cylinder Engines	Rotax Engines
1	red-blue	Voltage 0-30 V		
2	red-brown	Voltage 0-30 V		
3	black	GND		
4	blue	Resistive		CHT 1
5	black	GND		
6	white	Resistive	Resistive Oil Pressure	Resistive Oil Pressure (Old)
7	white-blue	Resistive	Oil Temperature	Oil Temperature NTC
8	white-brown	Resistive	Resistive Fuel Pressure	Resistive Fuel Pressure
9	yellow	Resistive	OAT	OAT
10	yellow-black	Resistive		
11	white-green	Current Loop	CL Oil Pressure (new Sensor)	CL Oil Pressure (new Sensor)
12	white-red	Current Loop		CL Fuel Pressure
13	black	GND		
14	grey-green	Fuel Flow 1	Fuel Flow	Fuel Flow 1
15	red	12 Volt out		
16	black	GND		
17	green-blue	Can Relay Out		
18	red-black	5 Volt Out		
19	grey-brown	Fuel Flow 2	Fuel Flow 2	Fuel Flow 2
20	grey-blue	Resistive	Tank Fuel Level 1	Tank Fuel Level 1
21	grey	Resistive	Tank Fuel Level 2	Tank Fuel Level 2
22	blue-black	Resistive		CHT 2
23	yellow-blue	Resistive		
24	purple	Ampere meter Shunt +	Amperemeter Shunt +	Amperemeter Shunt +
25	purple-black	Ampere meter Shunt -	Amperemeter Shunt -	Amperemeter Shunt -
26	orange	Resistive	Gear Sw 1	Gear Sw 1
27	orange-blue	Resistive	Gear Sw 2	Gear Sw 2
28	orange-green	Resistive	Gear Sw 3	Gear Sw 3
29	brown	Led Out Green	Led Out Green	Led Out Green
30	brown-black	Led Out Red	Led Out Red	Led Out Red
31	yellow-brown	Resistive	Trim Pitch	Trim Pitch
32	black	GND		
33	green	RPM 1	RPM Engine	RPM Engine
34	black	GND		
35	green-black	RPM 2		RPM Rotor (Gyrocopter)
36	yellow-green	Resistive	Trim Roll	Trim Roll
37	yellow-red	Resistive	Flaps Position	Flaps Position

Table 4-1-2, 37-Pin Peripheral Connector Pinout

4.1.3 25-Pin Probe Connector

The open wires of the included D-SUB 25 cable assembly are used for the temperature probes. The wires are labelled ***Thermocouple 1-*** to ***12-*** and ***Thermocouple 1+*** to ***Thermocouple 12+***. Depending on the engine use these wires according to the following list:

Pin	Description	4-Cylinder Engines	6-Cylinder Engines	Rotax Engines	Pin	Description	4-Cylinder Engines	6-Cylinder Engines	Rotax Engines
1	NC				14	Thermocouple 12-		CHT 6-	
2	Thermocouple 12+		CHT 6+		15	Thermocouple 11-		EGT 6-	
3	Thermocouple 11+		EGT 6+		16	Thermocouple 10-		CHT 5-	
4	Thermocouple 10+		CHT 5+		17	Thermocouple 9-		EGT 5-	
5	Thermocouple 9+		EGT 5+		18	Thermocouple 8-	CHT 4-	CHT 4-	
6	Thermocouple 8+	CHT 4+	CHT 4+		19	Thermocouple 7-	EGT 4-	EGT 4-	EGT 4-
7	Thermocouple 7+	EGT 4+	EGT 4+	EGT 4+	20	Thermocouple 6-	CHT 3-	CHT 3-	
8	Thermocouple 6+	CHT 3+	CHT 3+		21	Thermocouple 5-	EGT 3-	EGT 3-	EGT 3-
9	Thermocouple 5+	EGT 3+	EGT 3+	EGT 3+	22	Thermocouple 4-	CHT 2-	CHT 2-	
10	Thermocouple 4+	CHT 2+	CHT 2+		23	Thermocouple 3-	EGT 2-	EGT 2-	EGT 2-
11	Thermocouple 3+	EGT 2+	EGT 2+	EGT 2+	24	Thermocouple 2-	CHT 1-	CHT 1-	
12	Thermocouple 2+	CHT 1+	CHT 1+		25	Thermocouple 1-	EGT 1-	EGT 1-	EGT 1-
13	Thermocouple 1+	EGT 1+	EGT 1+	EGT 1+					

Table 4-1-3, 25-Pin Probe Connector Pinout

5. FLYMAP CONFIGURATION and OPERATION

Since the EMSAHRS consists of two parts, the AHRS part and the EMS part, the configuration function is also divided into these parts.

5.1 Software Update

If you have received a software update together with your AHRS module, this software update must be installed before the Flymap can be configured for the AHRS.

5.2 AHRS Configuration

To select the configuration page, touch the **MENU** field and thereafter the ⟶ field until the tab “Artificial horizon” is visible. Then touch this tab and the following screen appears:

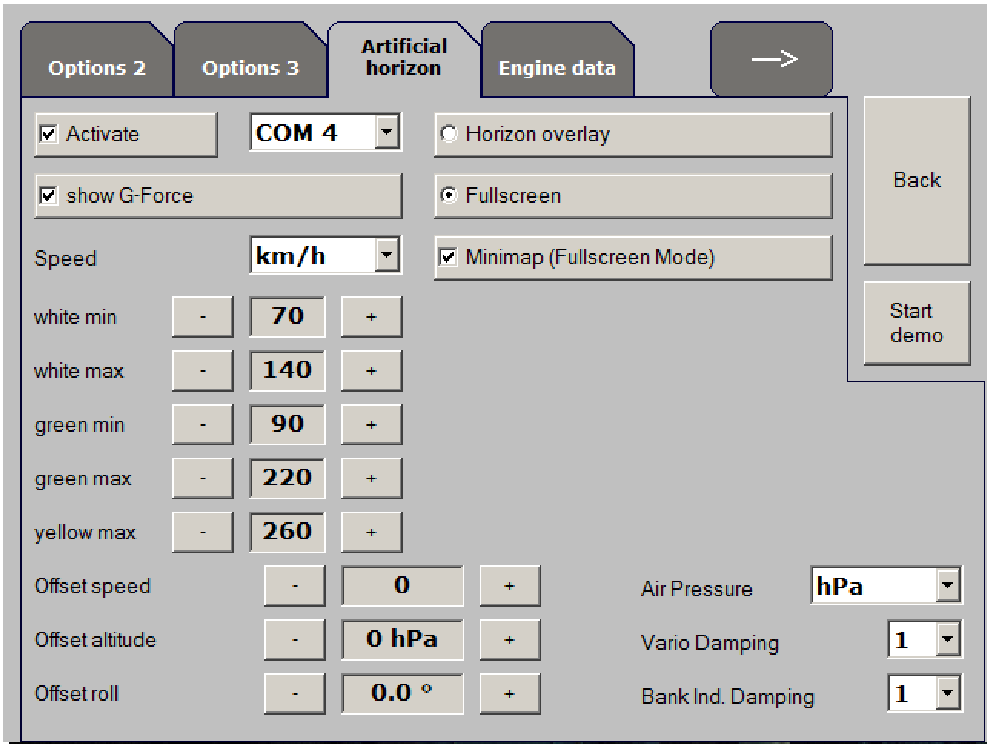


Figure 5-2, AHRS Configuration Page

Now select the serial port number you have noted under Flymap and Power Connections (chapter 3.2.4 on page 18) and check the **activate** box. This starts the communication protocol between the Flymap and the EMSAHRS module. Now touch the **Back** field and you see again the map screen.

Checking the **show GForce** box will show the GForce indicator on the PFD screen. In addition you may select **horizon overlay** to display the horizon on the map screen or **Fullscreen** to show the full PFD screen (Primary Flight Display). In case of selecting the full screen, checking the **Minimap (Fullscreen Mode)** will show a small map window on the PFD.

The following values can be adjusted by touching the + or the – field left or right to the appropriate field.

Adjust the speed range values according to the **Airspeed Indicator Markings** of your installed airspeed indicator:

White range: Flap range, in which the airplane can be flown with lowered flaps.
Green range: Normal manoeuvre range, in which the airplane is normally flown.
Yellow range: Caution range, operation in this speed range only in smooth weather condition.
Red line: Maximum permissible airspeed V_{NE}.

Note: The white and the green range may overlap and the red line is defined at the end of the yellow range.

Airspeed Indicator Calibration: To adjust the readout of the airspeed indicator to be identical as your conventional airspeed instrument you may adjust the offset value in the **Offset speed** field by touching the + or the – field left and right of the offset field.

Altimeter Indication Calibration: To adjust the altimeter a similar **Offset altimeter** may be applied.

Roll position calibration: If the airplane is positioned on a horizontal surface, the horizon must also show this horizontal position. If this is not the case, it is best to correct these using washers under the mounting screws of the AHRS module. If this is not possible, you can correct a small deviation by adjusting the value in the **Offset roll** field.

Air Pressure: Select your preferred measuring unit for air pressure, hPa or Inch.

Vario Damping: Select a suitable value to reach a smooth indication of the variometer indication.

Bank Ind. Damping: Select a suitable value to reach a smooth indication of the bank indication of the artificial horizon.

5.3 AHRS Operation

5.3.1 Initialization of the Sensor Module

After power up of the EMSAHRS sensor module an automatic calibration process will be initialized which takes about five seconds. The aircraft should not move during that time.

5.3.2 Display options

To display the artificial horizon, touch the **MENU** field and thereafter the **show artificial horizon** field. Depending on the selection on the configuration page, the horizon appears as overlay or as full screen PFD.

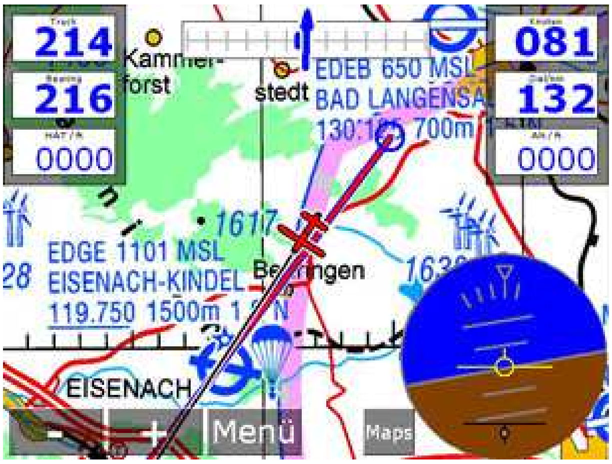


Figure 5-3-2-1 Map screen with horizon overlay

Figure 5-3-2-2, Full screen PFD without map window

Note: Activating the demo mode by touching **Start demo** will deactivate the **Horizon overlay.**

You can change from the overlay screen to the full screen PFD by touching and holding the artificial horizon. From the full screen PFD to the overlay screen you can change by touching and holding the overlay map window.

Note: The **Minimap (Fullscreen Mode)** box on the AHRS configuration page must be checked to to enable this function.

Figure 5-3-2-3 PFD with map window descending in left turn (slipping)

Figure 5-3-2-4, PFD with map window descending in right turn with overspeed.

5.3.3 Trim of Aircraft Symbol

During the normal flight the aircraft pitch depends on the aircrafts cruising speed. To trim the aircraft symbol of the artificial horizon touch above or below the horizontal line to move the symbol. The trim position is stored in permanent memory.

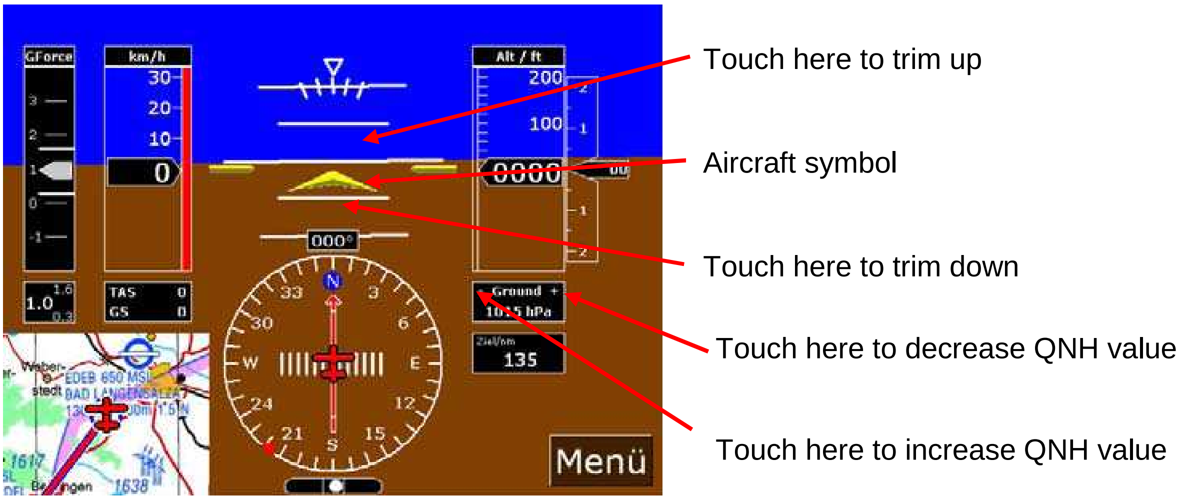


Figure 5-3-3, Trim of Aircraft Symbol

5.3.4 Airspeed indication

The airspeed indication shows the current speed of the aircraft based on the differential pressure measurement of static and dynamic air pressure. The accuracy of the indication will be sufficient at a speed of more than 40 knots. The airspeed is indicated in either knots, miles per hour or km/h depending on the selection made on the “Artificial horizon” configuration page (see chapter 5.2).

To the right of the airspeed field, coloured stripes are displayed according to the actual airspeed. These serve as a classic airspeed indicator, the display of the flap speed range, the normal manoeuvre and the caution speed range, etc. These ranges are specified in the configuration page of the AHRS module.

Below the airspeed display is the True Airspeed (TAS) and the Ground Speed (GS) field. The TAS is calculated from the actual airspeed plus 2 percent per 1000 feet barometric altitude. The GS displayed is as measured by the GPS system.

If the speed indicator (Airspeed) differs slightly from your existing airspeed instrument, an offset can be specified on the AHRS configuration page (see chapter 5.2).

5.3.5 Altitude indication

The altitude is calculated based on the static pressure. It is indicated in either feet or meters according to the selection made on the **display option** page. The vertical speed indication shows either feet per minute (ft/m) or meter per second (m/s).

In case your conventional altimeter shows a different altitude using the same QNH value, select an appropriate offset on the configuration page of the AHRS module (see chapter 5.2).

5.3.6 Acceleration Indication

The acceleration indicator shows the G-force in the direction of the Yaw-axis. The scale range is initially set to -2G to +4G. If forces are measured greater than this values the scale will automatically be adjust. The maximum positive and negative loads will be displayed as bold white lines. These values are stored in non volatile memory and can be reset by touching and holding on the G-force indicator.

5.3.7 Sensor Calibration

The sensor is calibrated automatically after power up. Should it be necessary to recalibrate the sensor, for example because the aircraft has moved during power up, you can force a recalibration by touching and holding the middle of the horizon in the full-screen PFD display until a context menu appears. From that menu select **Recalibrate horizon**.

During the calibration process the aircraft should not turn in either axis, thus it may be difficult to re-calibrate the sensor during flight.

After power up and after recalibration of the sensor the artificial horizon always shows a horizontal position. If the aircraft was in another position during power up or re-calibration, the artificial horizon will adjust slowly to the actual real position.

Note:	Should the horizon show an invalid position after an extreme flight manoeuvre (e.g. exceeding the maximum allowed turn rate), the horizon will automatically adjust to the actual position after a short time in horizontal flight. **Do not use the Recalibrate horizon function in this case!**

5.4 EMS Configuration

5.4.1 EMS Configuration Page

To select the EMS configuration page, touch the **MENU** field and thereafter the ⟶ field until the tab "Engine data" is visible. Then touch this tab and the following screen appears:

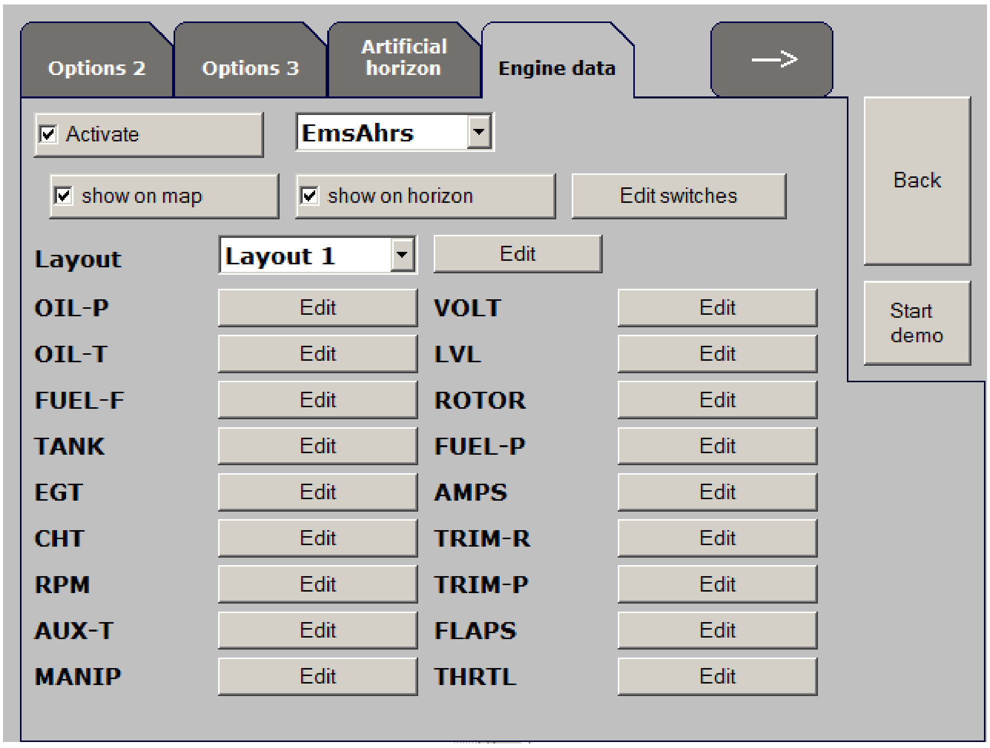


Figure 5-4-1-1, EMS Configuration Overview

Now select **EmsAhrs** from the serial port number list and check the **activate** box. This starts the communication protocol between the Flymap and the EMSAHRS module. Now touch the **Back** field and you see again the map screen.

Checking the **show on map** box will show the engine instruments on the map screen. Also check the **show on artificial horizon** field to display the engine instruments on the Primary Flight Display (PFD) screen.

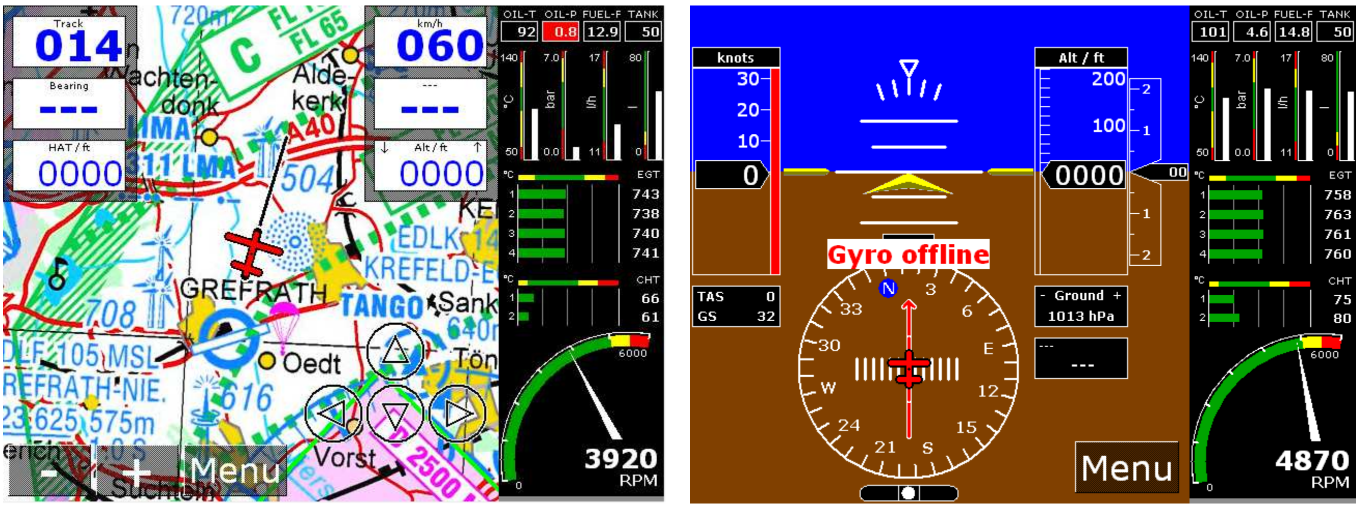


Figure 5-4-1-2, Engine Instruments on Flymap Screens

5.4.2 Instrument Configuration

To configure one of the engine instruments, touching the **Edit** field to the right of the instrument description will display the configuration page for that instrument. For example, if you want to configure the Oil Pressure Instrument, you press the **Edit** field to the right of **OIL-T** and the following configuration page appears:

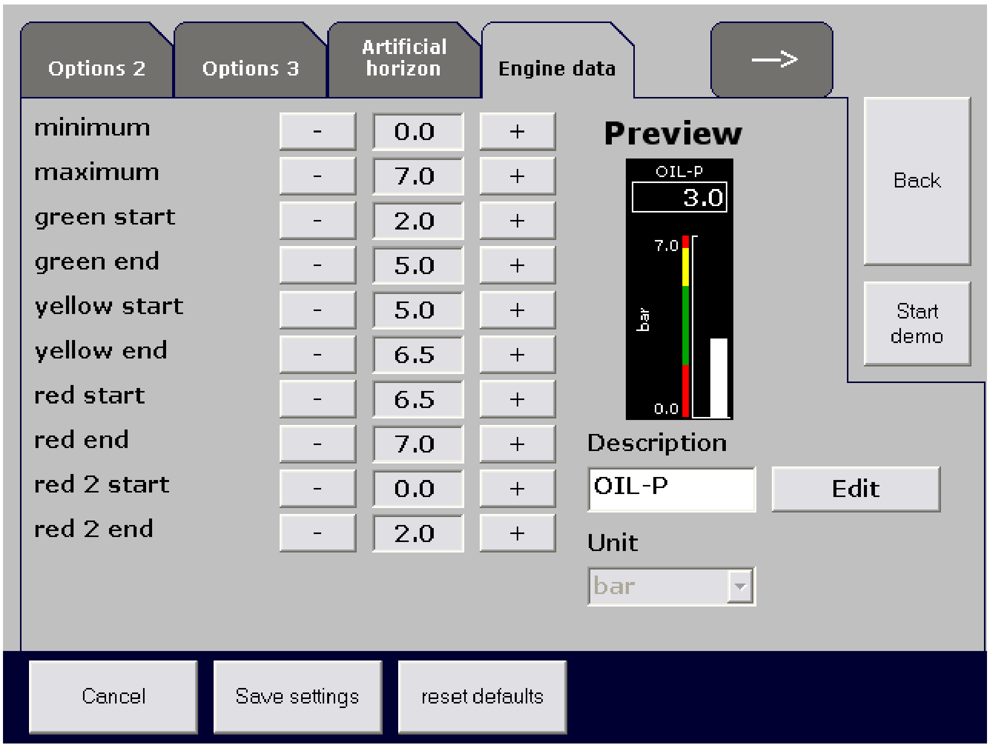


Figure 5-4-2, Instrument Configuration Page

The value field can be adjusted by touching the + or the – field left or right to the appropriate field.

For each instrument, you can specify **Caution Ranges** such as the green range, the yellow range and two red ranges as well as a minimum and a maximum value.

> **Note:** These ranges may not overlap and must be defined within the minimum and the maximum value.

The **Preview** shows the layout of the instrument you are configuring. On top, the description of the instrument is displayed. In the box below the current measured value is depicted as digital figures. In the centre of the preview field the color ranges are displayed and the measuring unit is showed to the left while the white bar to the right shows the current value measured.

Description: This field shows the instrument description. You may change it by touching the **Edit** field right of it.

Unit: for some instruments you may select your preferred measuring unit, e.g. fuel flow may be displayed in gal/h or L/h.

If all fields are adjusted according to your needs, touch the **Save settings** field to store the values permanently in the configuration memory or touch **Cancel** if you want to leave the configuration page without doing any changes. Touching the **reset defaults** field restores all values to the original factory defaults.

5.4.3 Tank Configuration

The configuration of the fuel tank system differs a little bit from the other instrument configuration pages. On this page you can specify if you have a second transducer installed into the fuel return line (see chapter 3.1.5 on page 15). Activate the **Flow2 – Flow1** check box if the transducer installed in the main fuel line is connected to the **Fuel2** terminal and that one in the fuel return line to the **Fuel1** terminal of the EMS module. Adjust the K-Factor in the field **Impulse/l** to the value specified for your transducer. Each transducer comes with its own data sheet showing the so called K-Factor. Conserve this sheet together with your aircraft records.

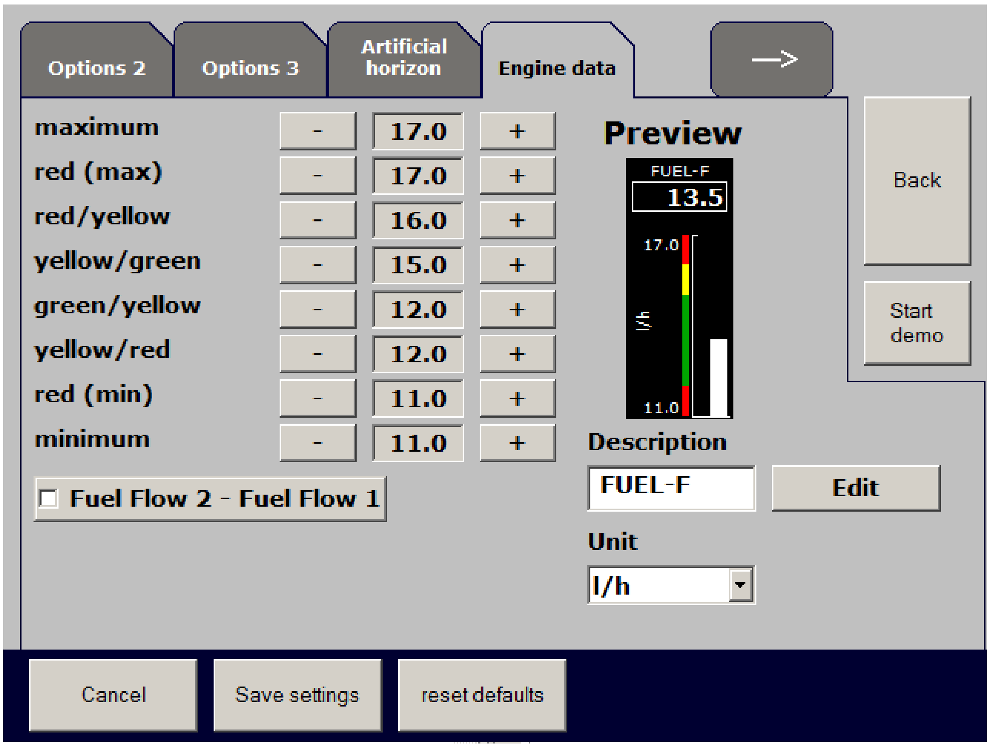


Figure 5-4-3, Tank Configuration Page

5.4.4 Trim- or Flap Position Configuration

On the position configuration page the **A/D Value** field displays the actual value emitted by the potentiometer. Now simply move the Trim or Flaps to the minimum and to the maximum position and note the respective **A/D Value**. Then enter these values into the **Min** and the **Max** field.

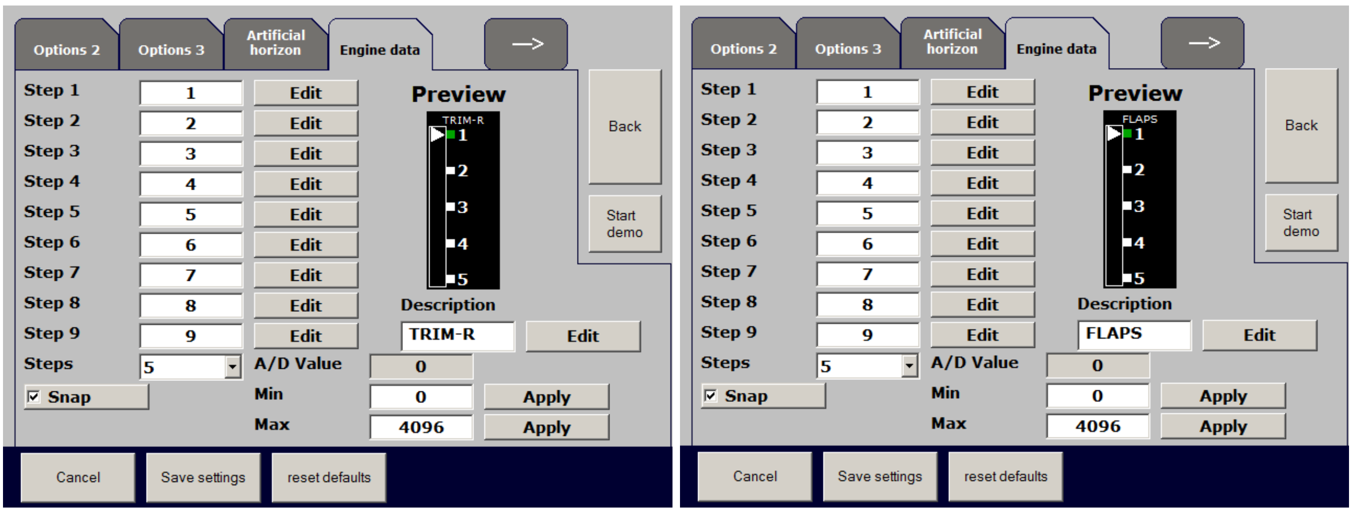
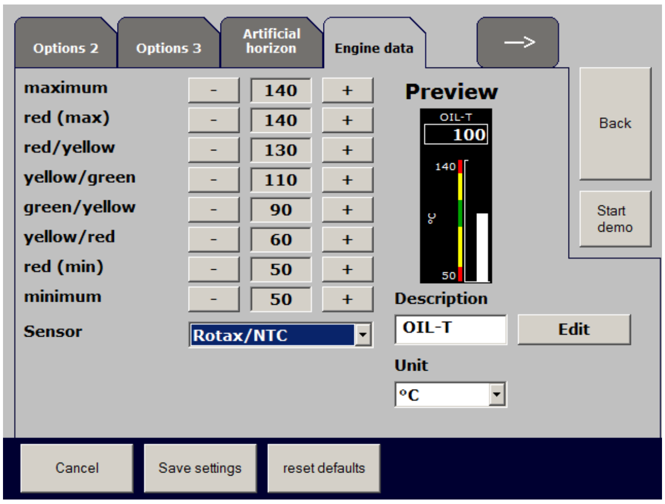


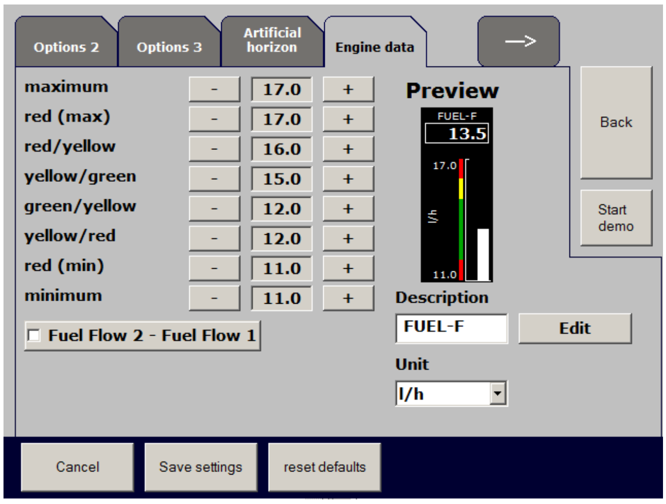
Figure 5-4-4 Trim- and Flap Position Indicator Configuration Page

The **Step** field specifies the number of steps. The software then calculates the values corresponding to equal steps. The Trim- or Flaps-Indicator will now show a continuous movement when they are in operation. If the **Snap** box is checked, the indicator will jump from position to position when moving.

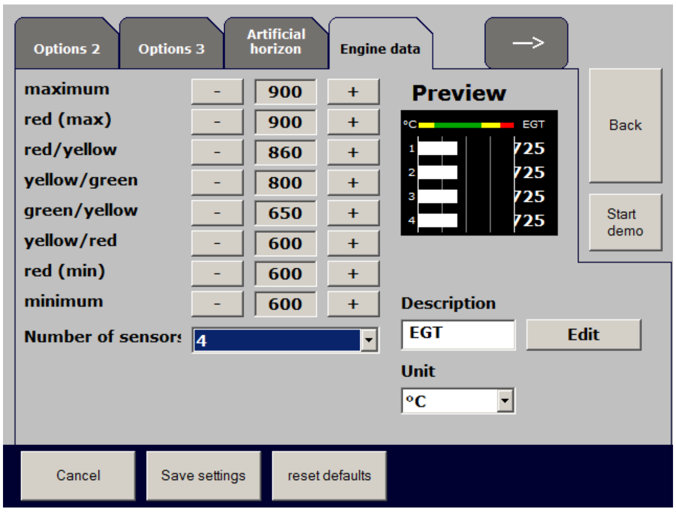
6. APPENDIX A, Instrument Configuration Pages



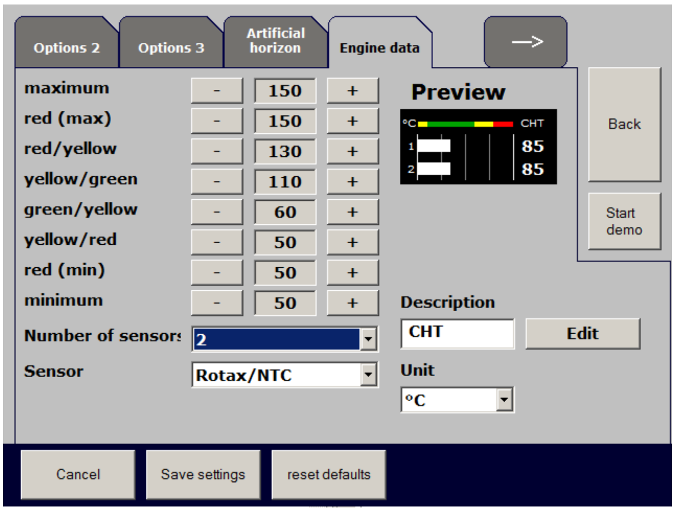
Oil Temperature Instrument Configuration Page



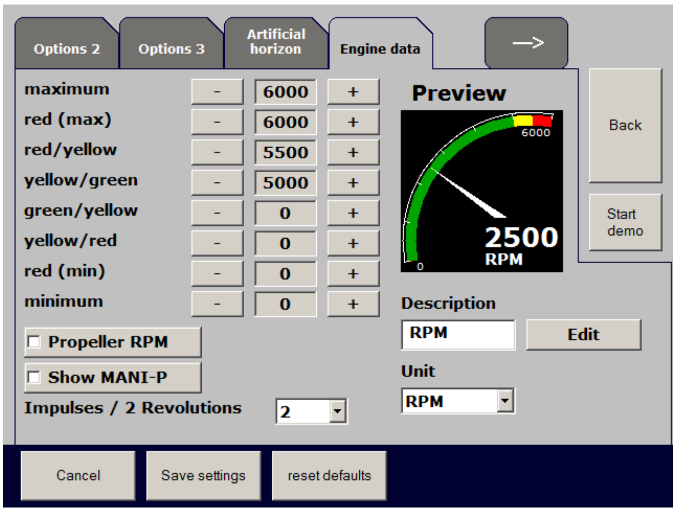
Fuel Flow Instrument Configuration Page



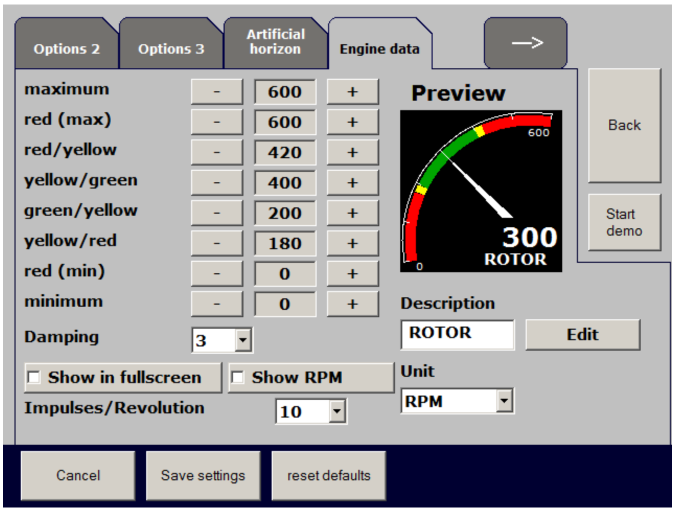
EGT Instrument Configuration Page



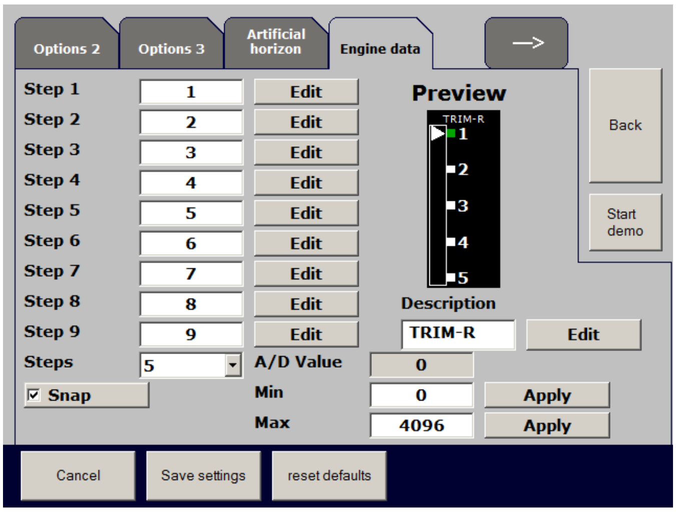
CHT Instrument Configuration Page



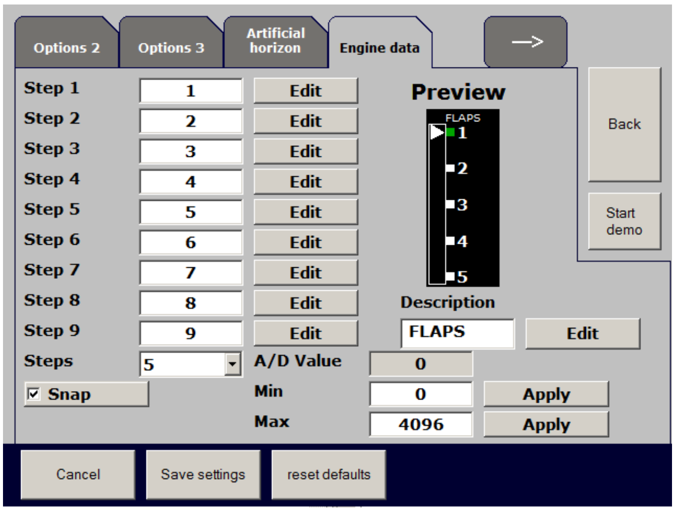
RPM Instrument Configuration Page



ROTOR Speed Instrument Configuration Page

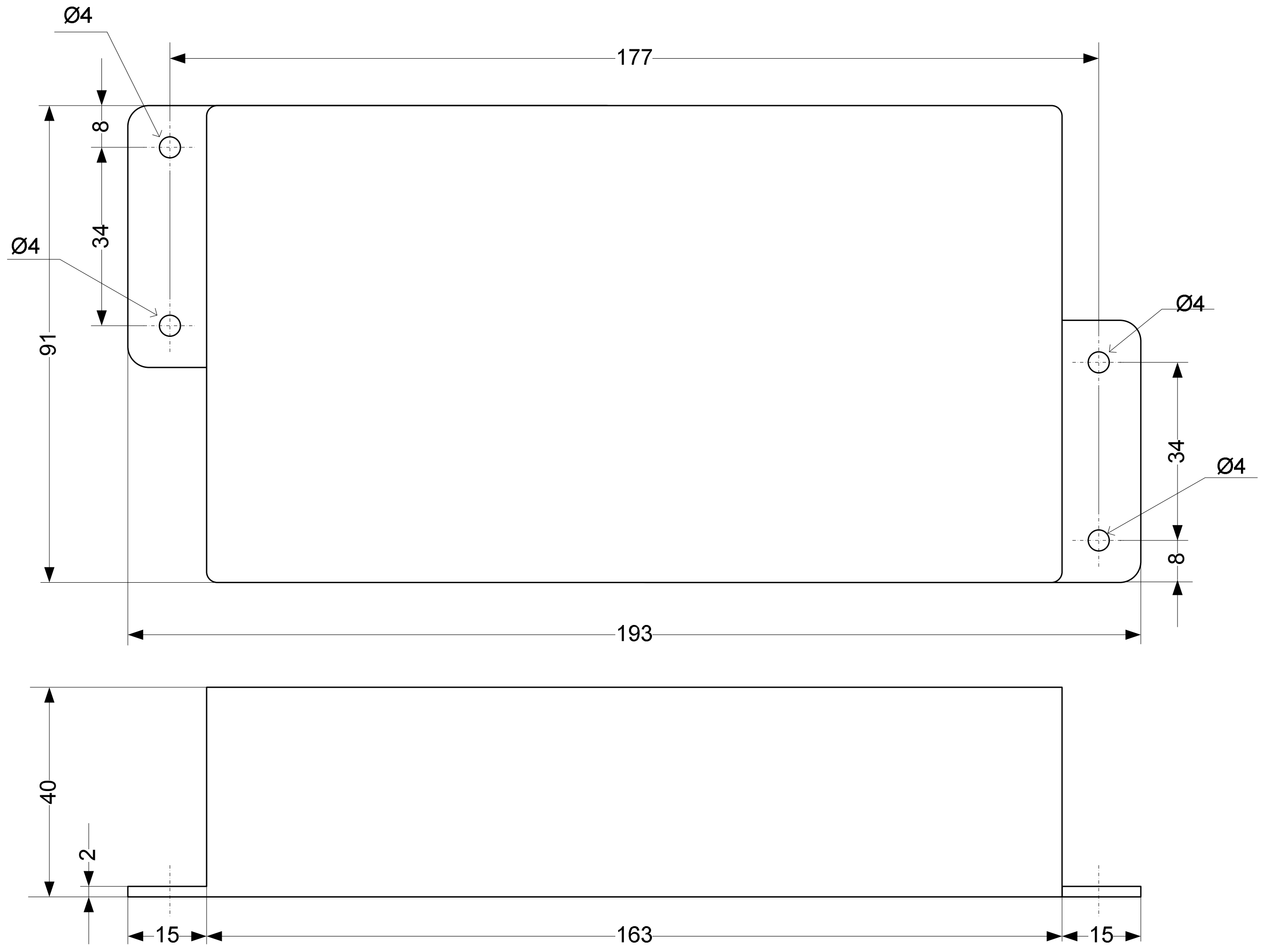


Trim Position Indicator Configuration Page



Flaps Position Indicator Configuration Page

7. APPENDIX B, Flymap EMSAHRS Dimensions



8. APPENDIX B, Flymap EMSAHRS Pictures