

Installation / Operation Manual

EMU 912iS evo / EMU 9xiS
Engine Management Unit



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1. Preface

Thank you for purchasing an RS Flight Systems Engine Management Unit. We are pleased that you have chosen our product and are confident that it will meet all your expectations. In case of questions or problems with the unit, feel free to contact us:

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2. System Description

The second generation Rotax 912iS / 914iS / 915iS / 916iS Engine Management Unit family comprises two cockpit mounted engine monitoring, data logging and propeller control devices called EMU 912iS evo and EMU 9xiS. Both offer the same internals, software and functionality:

- Seamless integration into the Rotax 912iS / 914iS / 915iS / 916iS engine wiring harness
- Minimum installation effort (single device, 2 connectors and 6 wires for basic functionality)
- Indication of all available engine parameters, engine status and ECU faults
- Indication of additional sensor inputs (e.g. optional fuel pressure sensor)
- Automatic propeller speed control for single lever engine operation (in combination with MT Propeller governor, optional)
- Sunlight-readable backlit display with a wide viewing angle range
- Simple and self-explanatory operation (three push buttons, one rotary knob)
- Dual optically isolated CANaerospace data bus interfaces for retained redundancy
- Continuous monitoring and health checking of both ECU display buses
- Georeferenced data recording of all parameters at 10 Hz over up to 2,000 hours
- Simple data transfer and software update via an integrated memory card slot
- Sophisticated visualization and processing tool for recorded data (Windows, Linux, MacOS)
- Google Earth file export for recorded data including GNSS and engine data
- Additional input and output channels for future system upgrades
- Configurable for the use of different unit systems (metric/US customary)
- Suitable for 14 V and 28 V aircraft electrical systems
- Preassembled wiring harnesses available as accessory
- Highly customizable software (on request)
- High level of manufacturing and quality control
- Engineering and production exclusively done in Germany



Figure 2-1: EMU 912iS evo



Figure 2-2: EMU 9xiS

3. Technical Specifications

	EMU 912 iS evo	EMU 9xiS
Mechanical Dimensions (width, height, depth)	146 x 120 x 82 mm 5.75 x 4.72 x 3.23 in	139 x 104.5 x 78 mm 5.47 x 4.11 x 3.07 in
Panel Cutout Dimensions	128 x 116 mm 5.04 x 4.57 in max. corner radius 1.5 mm (0.06 in)	127 x 103 mm 5.0 x 4.055 in max. corner radius 0.5 mm (0.02 in)
Mounting Depth excl. connectors	74 mm 2.91 in	71 mm 2.8 in
Mounting	Four M4 screws 136.2 x 85.7 mm 5.36 x 3.37 in	Four M3 screws 133.5 x 79.5 mm 5.26 x 3.13 in
Total Mass	0.99 kg 2.18 lbs	0.81 kg 1.78 lbs
Housing	Machined Aluminum, surface anodized to aerospace standard	
Supply Voltage	9 to 32 Volts DC, according to EN2282	
Power Consumption	typ. 8.4 W (0.6 A at 14 V, 0.3 A at 28 V) without external load	
CANaerospace Interfaces	According to ISO 11898-2, optically isolated	
Analog I/O	4 inputs (± 10 V)	
Digital I/O	2 parallel outputs, driving up to 3.9/4.0 A	
Positioning	Combined GPS/Galileo Sensor (Navilock NL-603P), 4 Hz update rate	
Display	5 inch Active Color Matrix TFT, 640 x 480 pixels, dimmable LED backlight, maximum brightness 600 cd/m ²	
Electronics	Xilinx Spartan-3 FPGA with dual Microblaze processors, PicoMod1 Display Controller	
Storage	Single front mounted SD/SDHC-Card, up to 32 GB	
Operating Temperature Range	-20 to +70 °C -4 to +158 °F	
Operating Altitude	< 7,620 m < 25,000 ft	
Humidity	< 95 %, non-condensing	

Table 3-1: Technical Specification

4. Mechanical Installation

Upon delivery, undertake visual inspection of the package contents for signs of transport damage and verify the information on the type plate sticker against your order. Do not open the device housing.

For longer storage of the device, select a dry and clean environment. Make sure that the device is not stored near strong heat sources and that no metal chippings or other dirt can get into the device or its connectors.

Both EMU variants are mounted onto the instrument panel using a rectangular cutout (dimensions in Table 3-1) and four metric screws included in the package. The screw hole positions are symmetric to the cutout in both axes and can be taken from Figure 4-1 and Figure 4-3. If you are using fixed female threads in the panel instead of nuts, provide a minimum thread length of 4 mm. Always secure your mounting joint.

Three-dimensional CAD-models of the units and the cutouts are available at:

<https://www.rs-flightsystems.com/product-page/emu-912xis>

As waste heat is dissipated via free convection, leave at least a 5 mm gap from the aluminum surfaces to any other object. Forced cooling is not necessary.

The installation must be in accordance with the appropriate guidelines approved by the respective aviation authority. The person installing the device is responsible for compliance with all applicable legislation.

4.1 Drawings EMU 912iS evo

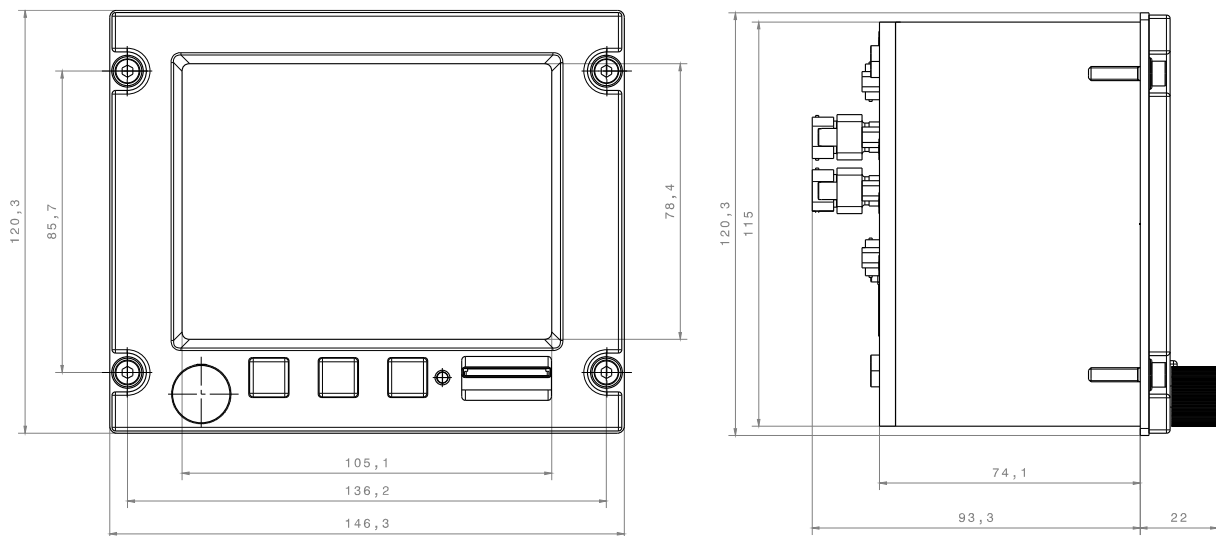


Figure 4-1: EMU 912iS evo (front/side view)

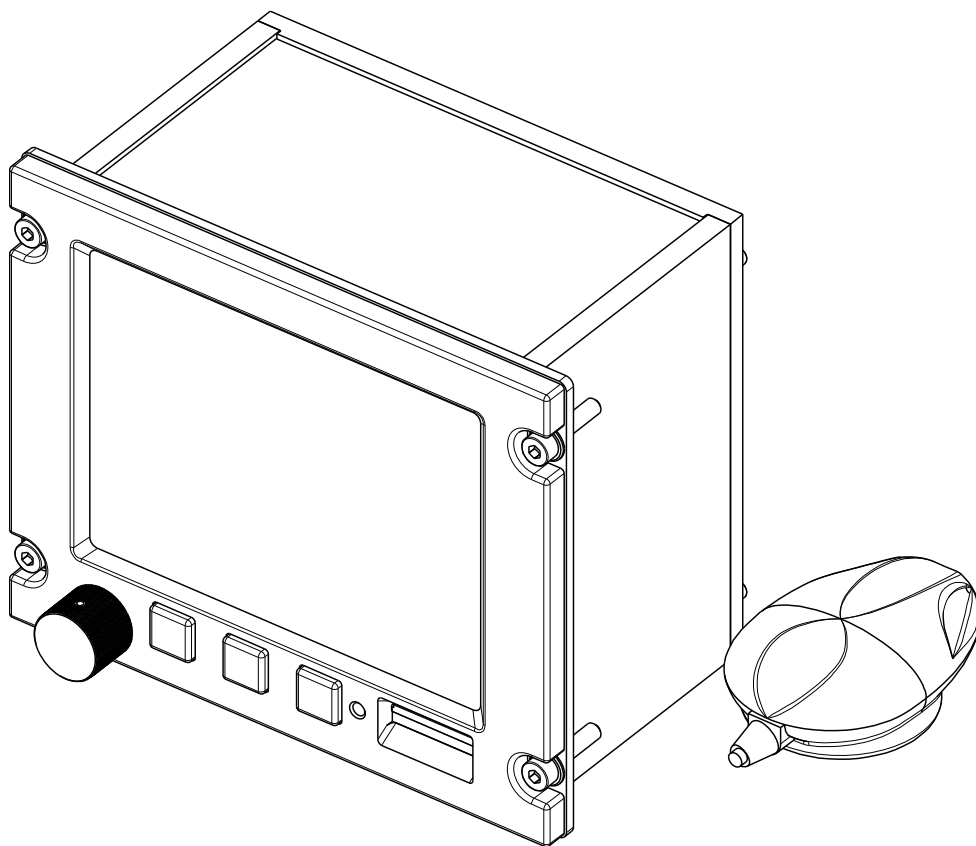


Figure 4-2: EMU 912iS evo (isometric view)

4.2 Drawings EMU 9xiS

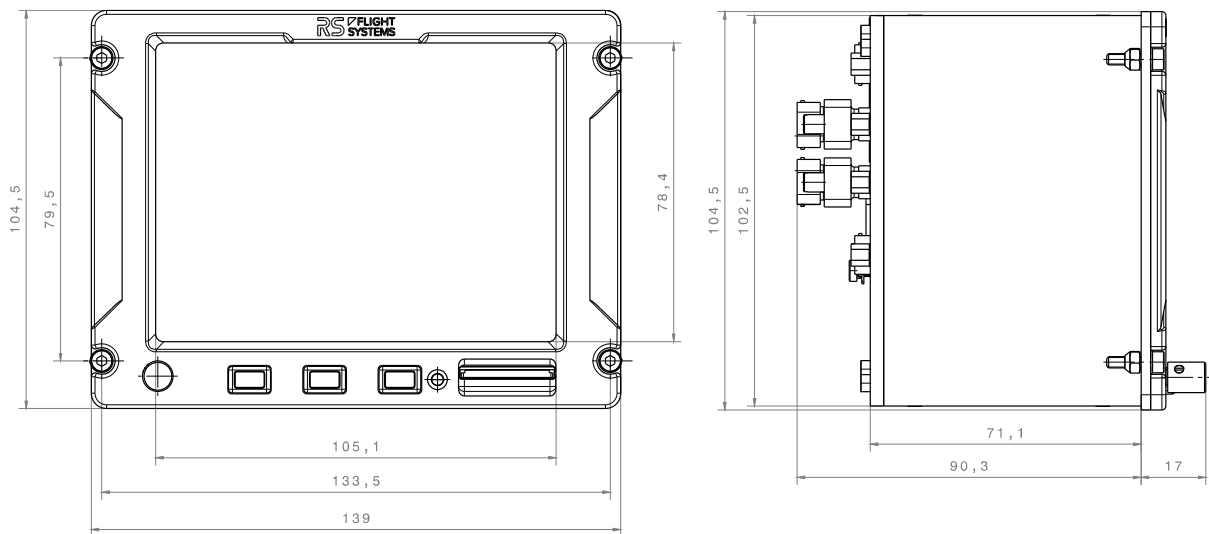


Figure 4-3: EMU 9xiS (front/side view)

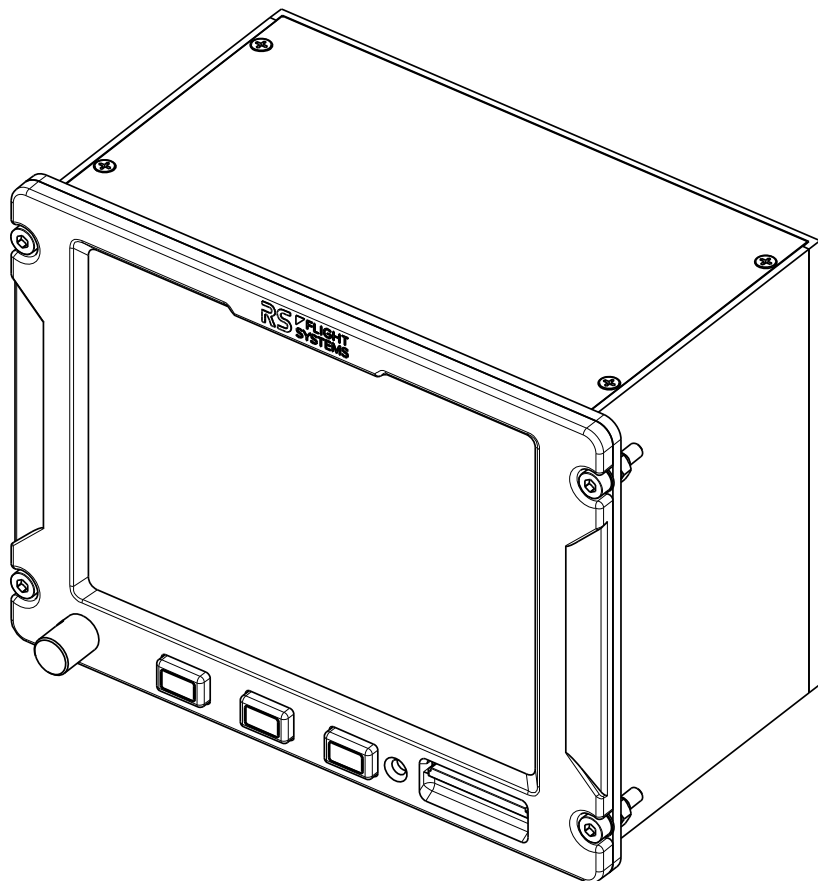


Figure 4-4: EMU 9xiS (isometric view)

5. Electrical Installation

The Engine Management Unit has five connectors on the rear side. Four of them are standard density D-Sub connectors with 4-40 UNC threaded fastening. Both CAN Connectors (“Lane A” and “Lane B”) are equipped with a filter adapter to enhance signal quality. Do not remove these filters. The DIN-style connector for the GNSS Antenna is secured with two safety wires.

Connector	Label	Connector Type	Usage
AUX	“Auxiliary”	DA15S (female 15-pin D-Sub)	I/O
CANaero_A	“Lane A”	DE9P (male 9-pin D-Sub)	CAN Bus, Power Supply
CANaero_B	“Lane B”	DE9P (male 9-pin D-Sub)	CAN Bus
SYSTEM	“RS-232”	DB9S (female 9-pin D-Sub)	Diagnosis
GNSS	none	Female Mini-DIN 6	GNSS Antenna

Table 5-1: Connector overview

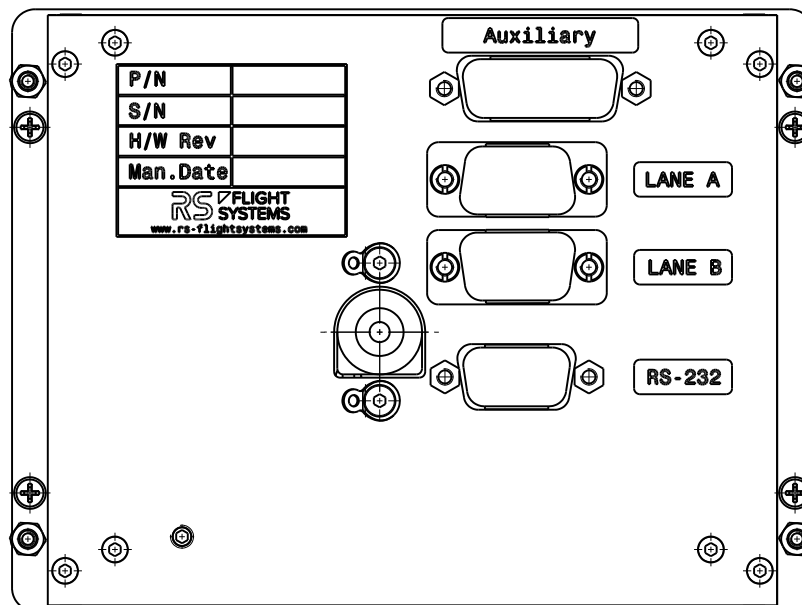


Figure 5-1: EMU 9xiS evo Rear View

Place the GNSS antenna in a spot where it has maximum optical visibility of the sky, e.g. the glare shield on top of the instrument panel. Poor GNSS reception has no adverse impact on the operation of the unit yet may impair recordings of position, ground speed and UTC data.

Only use self-extinguishing cables suitable for installation in aircraft; e.g. SAE-AS22759 or SAE-AS27500. AWG22 (0.34 mm²) is a sufficient cross section for power supply of the EMU. Preassembled wiring harnesses are available as an accessory for simplifying the installation. For part numbers see Chapter 5.5 or contact RS Flight Systems directly.

Figure 5-4 shows an overview of all standard connections. For a wiring of the EMU in parallel to a Garmin G3X MFD/PFD, please refer to Figure 5-5.

Carefully check your wiring before powering up the unit for the first time.

5.1 Lane A / Lane B Connector

Lane A Connector carries the power supply pins of the EMU (Pins 1 and 5) and Display CAN Lane A (Pins 2 and 7). Table 5-2 specifies its pinout. Reverse polarity and voltage surge protection are implemented on the Lane A connector, therefore power must be supplied there. Install a 3 A circuit breaker or quick fuse in the positive supply line. For CAN wiring, use shielded twisted pair cables with an impedance of 120 Ω . Do not connect either of the CAN Ground Pins on the two Harness Interface Connectors. Since termination resistors are built into the ECU as well as the EMU, no additional resistors are necessary. Pin 9 can be used for an external warning LED. The LED is switched on as soon as a warning message is shown on the EMU. Please note that pin 9 is a low side switch and must be connected to the ground side of the external warning LED.

Pin Number	Signal Name	Function
1	PWR_IN	positive EMU power supply
2	CANL_A	CAN Low, connect to HIC A, Pin 5
3	FB_CLOCK	do not connect
4	CANH_A	do not connect
5	GND	negative EMU power supply, ground
6	TERM	do not connect
7	CANH_A	CAN High, connect to HIC A, Pin 6
8	FB_DIN	do not connect
9	FB_SHIFT	External warning lamp, low side

Table 5-2: Lane A pinout

Lane B Connector carries the second Display CAN Lane of the ECU on Pins 2 and 7. This setup guarantees full redundancy of all data paths to the EMU. Table 5-3 specifies its pinout.

Pin Number	Signal Name	Function
1	PWR_IN	positive power supply (Backup)
2	CANL_B	CAN Low, connect to HIC B, Pin 7
3	FB_CLOCK	do not connect
4	CANH_B	do not connect
5	GND	negative power supply, ground (Backup)
6	TERM	do not connect
7	CANH_B	CAN High, connect to HIC B, Pin 8
8	FB_DIN	do not connect
9	FB_SHIFT	External warning lamp low side

Table 5-3: Lane B pinout

5.2 Auxiliary Connector

The Auxiliary Connector is used for general I/O purposes. It offers regulated 12 V (Pin 13) and 5 V (Pin 11) reference voltages for sensors and can supply a maximum of 100 mA each. Both supplies are referenced to a common ground (Pins 5 and 12) isolated from the aircraft supply potentials. The analog inputs also refer to the same potential. The maximum analog input voltage is ± 10 V. Note that higher voltages can permanently damage the unit as no protection is implemented on these inputs. It is recommended to use the analog inputs as shown in Table 5-4 and Figure 5-4.

It is recommended to place the optional fuel pressure sensor either as close as possible to the fuel pressure regulator on the fuel rail of the left cylinder bank (Cylinders 2 and 4) or on the outflow port of the fuel filter. The installation of the fuel pressure sensor on the fuel rail is marked in red in Figure 5-2. The available adapter (see Chapter 5.5) allows mounting it in both these places. A fuel pressure sensor with the following specifications is available as an accessory and supported by the standard software (see Chapter 5.5):

- Pressure range: 1 to 11 bar absolute pressure
- Supply voltage: 5 or 12 VDC
- Output voltage: 0.5 VDC to 4.5 VDC

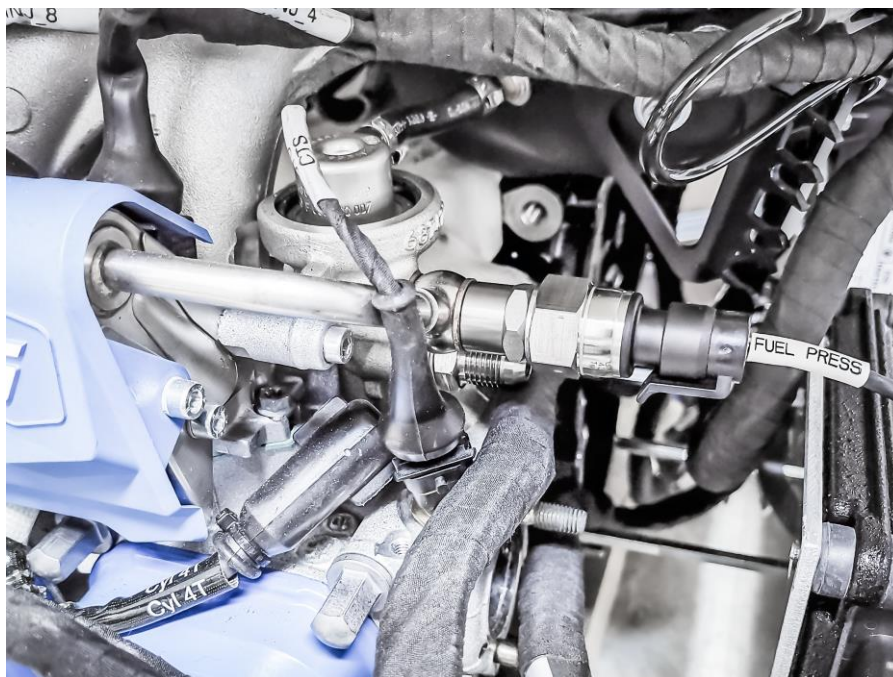


Figure 5-2: Fuel Pressure Sensor Installation

The MOTOR+/MOTOR- (Pins 7 and 8) and the DOUT+/DOUT- (Pins 9 and 10) outputs are driven by the same signals but have different drivers installed. Therefore, they cannot be used independently. The standard software is designed to drive an electric MT-Propeller P-853-XX constant speed governor via the MOTOR+ and MOTOR- pins (function available on request). This function is called Single Lever Power Control (SLPC). The exact variant of the governor depends on the specific aircraft configuration.

Please contact RS Flight Systems for further details. A prewired harness is available as an accessory (see Chapter 5.5).

For the SLPC function, a 390 Ohm resistor must be installed between Pin 4 and Pin 11 of the Auxiliary Connector (see Figure 5-4) on units with the following serial numbers:

EMU 912iS evo: SN 0100 – SN 0312

EMU 9xiS: SN 0001 – SN 0019

For higher serial numbers, this modification is integrated in the EMU and the 390 Ohm resistor must not be installed.

The power supply for the P-853-XX governor is related to the input voltage of the EMU. If the EMU is supplied with 12 VDC, a 12 VDC governor must be used (e.g. P-853-12, P-853-95). If the EMU is supplied with 24 VDC, 24 VDC governor must be used (e.g. P-853-77).

The START_PWR relay output drives up to 500 mA of inductive load and is referenced to the aircraft ground (Pin 15). The EMU uses this output to drive an external Start Power relay to simplify the engine start procedure. Using the Start Power relay, the ECU is automatically connected to the battery power during engine startup as opposed to the pilot activating a spring loaded “Start Power” switch. The function is activated only after the startup of the EMU until the engine reaches 1500 rpm for the first time. As soon as this condition is met, the ECU is supplied by one of the internal generators. A separate, mechanically locking “Battery Backup” toggle switch is still necessary in order to fulfil all safety requirements (e.g. for engine restart in flight). An extinguishing diode across the relay coil is typically not needed and a suitable relay is available as an accessory (see Chapter 5.5). Feel free to contact RS Flight Systems for different sensor configurations.

Pin Number	Pin Name	Function
1	AIN0	Analog Input 0 (Fuel Pressure)
2	AIN1	Analog Input 1
3	AIN2	do not connect
4	AIN3	Analog Input 3 (Governor Limit)
5	AGND	Analog Input Reference Ground
6	START_PWR	Start Power Relay Output
7	MOTOR+	Propeller Governor H-Bridge Driver Output (High Side)
8	MOTOR-	Propeller Governor H-Bridge Driver Output (Low Side)
9	DOUT0	Discrete Output, High Side (PWM capable)
10	DOUT1	Discrete Output, High Side (PWM capable)
11	5V	5 V Analog Reference Voltage
12	AGND	Analog Input Reference Ground
13	12V	12 V Analog Reference Voltage
14	ACSUP	Aircraft Power Supply (9-32 VDC)
15	ACGND	Aircraft Power Supply Ground

Table 5-4: Auxiliary Connector pinout

5.3 RS-232 Connector

The RS-232 Interface is reserved for future enhancements and diagnosis. Therefore, no connections must be made on this connector for routine operation. Currently, the only data transmitted via RS-232 is status information on startup. It is configured at 115.2 kBd, 8 Data bits per character, single stop bit and no parity. All reference power supply pins are restricted to the same limitations as on the auxiliary connector (Chapter 5.2).

Optional, the RS-232 can be used to drive an external warning panel. Feel free to contact RS Flight Systems for more details on this configuration.

Pin Number	Signal Name	Function
1	12V	12 VDC Power Supply
2	TXD	RS-232 Transmit Data
3	RXD	RS-232 Receive Data
4	3V3	3.3 VDC Power Supply
5	GND	Reference Ground
6	5V	5 VDC Power Supply
7	GPS_RX	GPS Receive Data
8	GPS_TX	GPS Transmit Data
9	GND	Reference Ground

Table 5-5: RS-232 Connector pinout

5.4 Wiring Diagrams SCU

This chapter describes the wiring of the EMU. In Figure 5-3 the legend and nomenclature of the wiring is listed. In Figure 5-4 the general wiring is shown. For a wiring of the EMU in parallel to a Garmin G3X MFD/PFD, please refer to Figure 5-5.

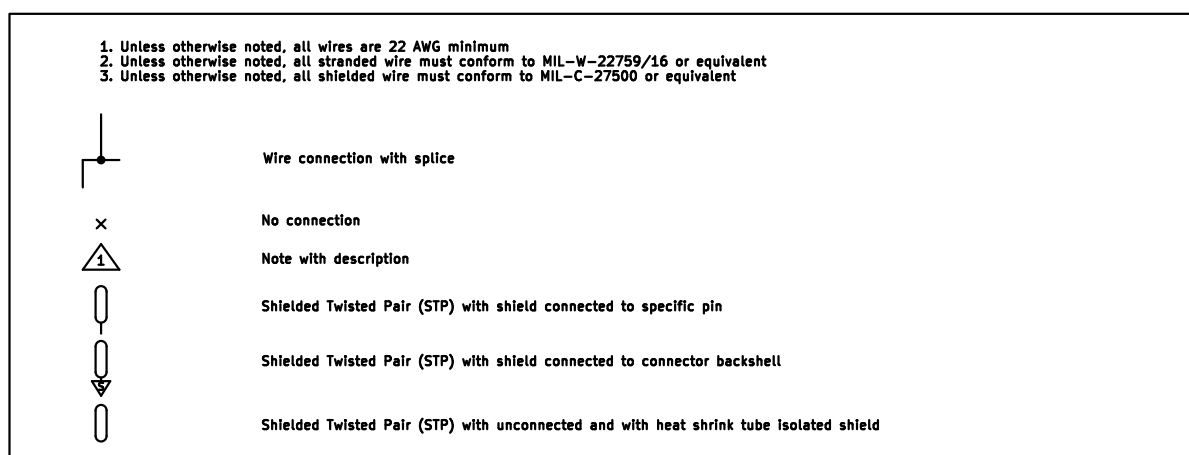


Figure 5-3: Legend of Wiring Diagram

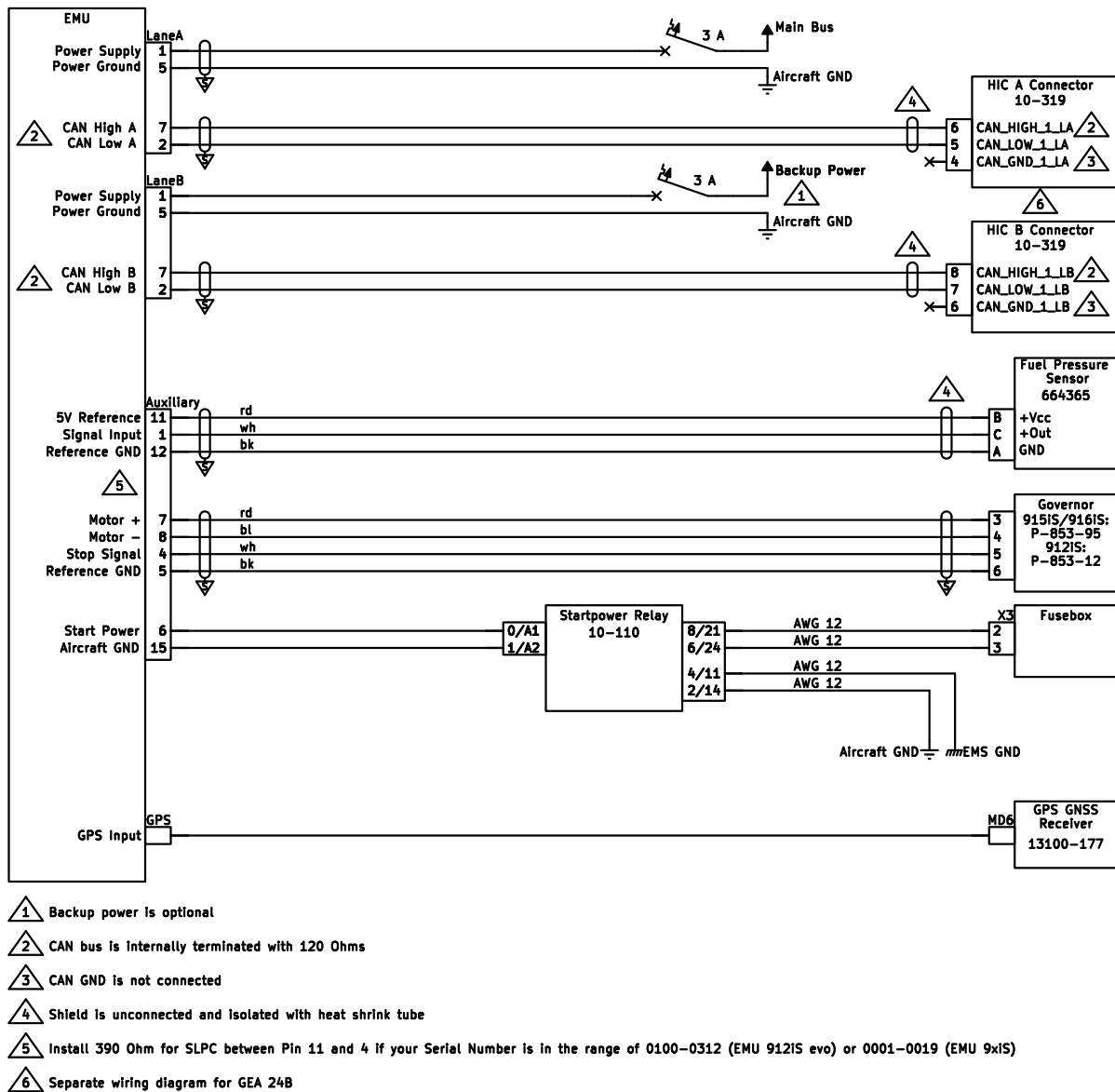


Figure 5-4: Standard Wiring Diagram

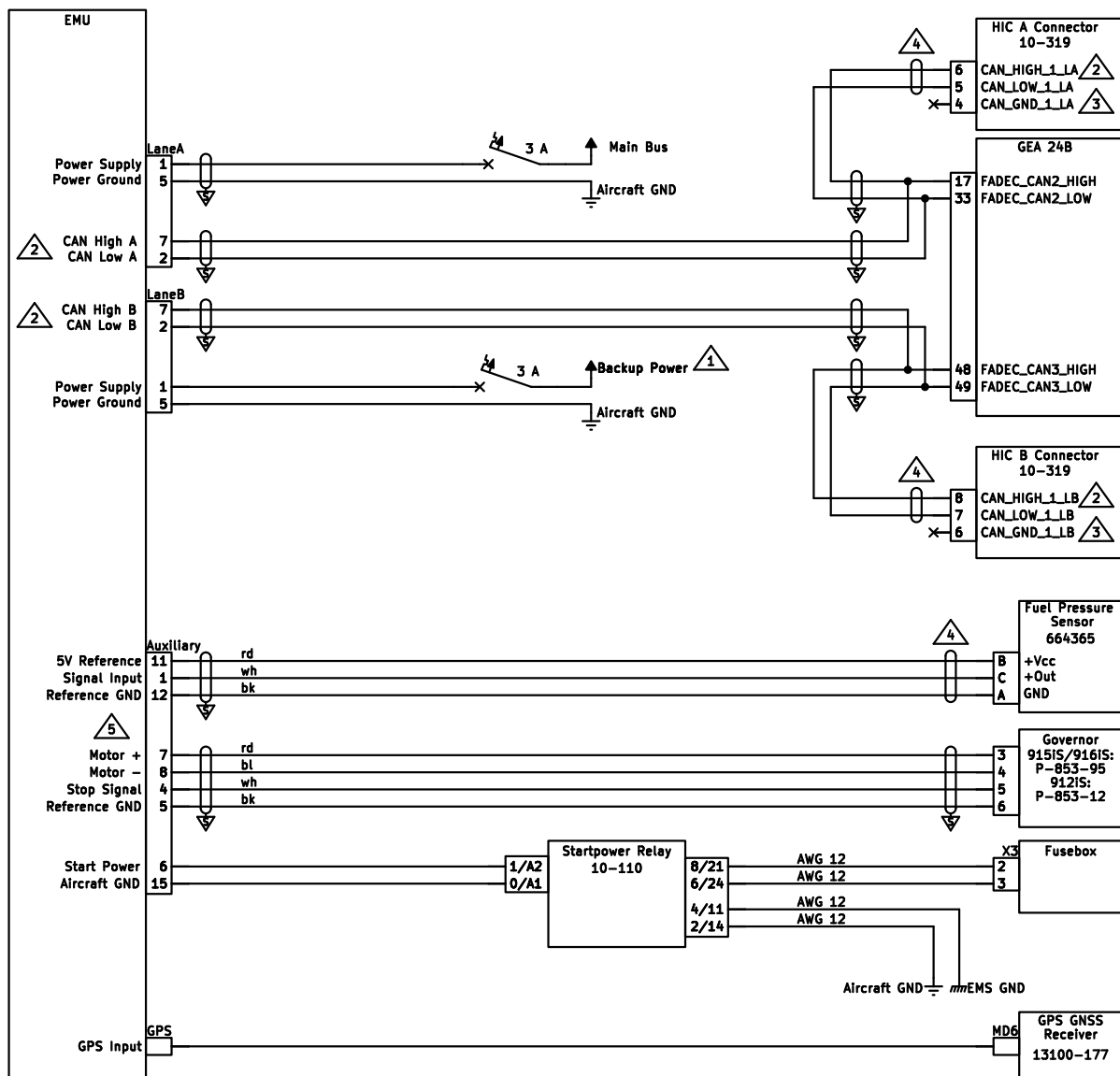


Figure 5-5: Wiring Diagram with Garmin GEA24B

5.5 Available Accessories

Part No.	Name	Description
21008-713	Wiring Harness Kit EMU	Prewired shielded harness for Lane A and B connectors Includes power supply wires Open ends on HIC side to allow for custom integration Length 2 m / 6.5 ft
10-110	Startpower Relay Kit	Kit for integration of the start power automatic function.
10-551	Startpower Relay Kit, LED Harness	Kit for integration of the start power automatic function with LED indication in the instrument panel.
10-072	Fuel Pressure Sensor Kit	Includes the following items: • 664365 BRP Rotax Fuel Pressure Sensor • 10-070 Harness Fuel Pressure Sensor • 10-806 Hollow Screw
10-085	Connector Kit Auxiliary EMU/SCU	Manufacturing kit for Auxiliary connector Includes shell, connector housing and contacts Requires M22520 crimping tool
21008-716	Wiring Harness SLPC	Prewired shielded harness for governor control Open end on EMU side to allow for custom integration. Length 3 m / 10 ft.
10-140	Start Key Switch 9iS	Starter Key Switch for Rotax iS engines. Switching of: LANE A / LANE B, Fuel Pumps MAIN and AUX, EMU/SCU, Ground Shortcut (OFF) and Starter
26002-485	iS Engine Panel V3	Advanced Switch Panel for Rotax iS engine.
12-363	iS Engin Panel V3 CARBON	Advanced Switch Panel for Rotax iS engine in CFRP
27007-456	iS Engine Panel V3u	Advanced Switch Panel for Rotax iS engine in vertical orientation
27007-387	iS Engine Panel V4	Advanced Switch Panel for Rotax iS engines with separate fuel pump switches and LED warning lamps
10-336	Plate for Instrument Panel SKS 9iS, EMU	Description plate for instrument panel for Start Key Switch 9iS, EMU Color: black. Markings: white, lasered
10-111	Wiring Harness EMU, prefabricated	Custom harness for the auxiliary connector Fully prewired on both ends Cable length and configuration information needed
10-193	Power Supply Unit EMU/SCU	Ground power supply unit with mating connector. Powers up the EMU without installation in the aircraft
P-853-12	Propeller Governor 912iS	MT Propeller governor for SLPC function. 12 V version.
P-853-95	Propeller Governor 915iS / 916iS	MT Propeller governor for SLPC function. 12 V version.
10-403	Cover Propeller Governor	GFRP cover for mt propeller governors series P-853-xx
10-225	Mounting Kit MT Propeller Governor	Mounting set with 4 screws for mounting the MT governor on Rotax iS engines
10-234	Mounting Tool MT Propeller Governor	Mounting tool for MT propeller governors
12-243	Mounting Tool Kit MT Propeller Governor	Mounting tool kit with 3 special wrenches for the installation of the propeller governor
10-273	Backup Power Switch Rotax iS	2-pole Switch for the Rotax iS Backup Power function
10-274	Toggle Switch	Switch for power supply of the EMU
10-388	LED Warning Lamp for EMU/Lanes, red	Red LED for panel-mount. Voltage: 5-28 VDC Indication lamp for ROTAX ECU Lane status. Ext. Warning Lamp EMU

Table 5-6: Connectors, Harnesses and Accessories

6. Operation

This chapter describes operational procedures only for the standard software version of the EMU.

6.1 Startup

The EMU starts up as soon as sufficient supply voltage is provided. The status LED on the front panel confirms startup by illuminating in red for 10 seconds while the device boots up. The subsequent startup screen is shown for 5 seconds and gives details about the current software version while internal testing routines are performed to ensure correct operation of all electronic components. Actuating the device buttons does not have any effect during startup.



Figure 6-1: EMU Startup Screen
(Software 912iS RS01.00)



Figure 6-2: EMU Startup Screen
(Software 915iS RS11.00)

6.2 Start Power Relay Functionality

For the Rotax 912iS / 914iS / 915iS / 916iS engine, the spring-loaded “Start Power Switch” (SPS), as specified in the BRP-Powertrain installation manual, has to be activated prior to engine start. As soon as START has been commanded and the engine is running, the SPS must be released. The function of the SPS is to temporarily feed aircraft battery power to the Engine Control Unit (ECU), so that engine start is possible. Remove this connection after the engine is running, so that during regular operation the ECU is exclusively supplied through its assigned alternator.



Figure 6-3: Start Key Switch 9iS



Figure 6-4: Start Power Relay Set

In order to improve the aircraft handling during the engine start process, the EMU provides a switch function which accomplishes automatic start power using an external relay wired in parallel to the SPS. This relay is activated as soon as the EMU is powered up (below 1 sec.) and remains activated until the engine reaches 1500 rpm for the first time. As soon as this happens, the relay is deactivated and is never activated again, until the EMU is turned off. Using this function, engine start can be commanded through a Start Key Switch, whose START position is spring-loaded. The aircraft installation of the relay with reference to the BRP-Powertrain documentation is shown in Figure 5-4.

The connection of the Start Key Switch 9iS, which is available as an accessory, is described in the “Installation / Operation Manual Start Key Switch 9iS”. Alternatively to the Start Key Switch 9iS a iS Engine Control Panel (iSEP) V3 or similar can be used.

6.3 Main Page

Upon completion of the startup process the display shows the MAIN page, which is an overview of the most important engine parameters, the active ECU and generator lanes, system status (e.g. power or economy mode) as well as caution and alarm messages. An exemplary view of the MAIN page is shown in Figure 6-5 and Figure 6-6. Other pages may be selected through the three bottom push buttons. Rotating the knob on the left-hand side (MCR) adjusts the TFT brightness between 2% and 100%. The initial brightness after power-on is 100%.



Figure 6-5: MAIN Screen
(Software 912iS RS01.00)



Figure 6-6: MAIN Screen
(Software 915iS RS11.00)

Data is displayed in two different ways on the MAIN page: dials and alphanumeric indicators. Dials are used for engine speed and manifold pressure, these two being the most important engine power indicators. Green (normal), amber (cautionary) and red (limit exceeded) arc sections allowing for a quick evaluation of parameters. Dial indicators for more precise readouts are combined with a white alphanumeric display at the bottom. Secondary parameters are only displayed alphanumerically close to the upper edge of the screen. They are grouped in pairs and their values change alert color for the same reasons as the dial indicators do. All color ranges are shown in Table 6-1a. In case of sensor failure, the display of the associated signal will revert to dashes ("---") thus immediately indicating the failure situation.

The rectangles labeled "A" and "B" indicate the error status of the ECU lanes by changing alert color from green (operational) to amber (non-fatal error) to red (inoperational). "ACT" marks the active lane controlling the engine, while "SBY" marks the inactive lane.

Parameter	Color Ranges 912 iS		Color Ranges 915 iS / 916iS	
Engine Speed	0 to 1400 rpm	Amber	0 to 1800 rpm	Amber
	1400 to 5500 rpm	Green	1800 to 5500 rpm	Green
	5500 to 5800 rpm	Amber	5500 to 5800 rpm	Amber
	> 5800 rpm	Red	> 5800 rpm	Red
Throttle Position	0 to 100 %	Green	0 to 100 %	Green
	> 100 %	Amber	> 100 %	Amber
Manifold Air Pressure	All	Green	< 60 hPa	Red
	-	-	60 to 1730 hPa 916 iS: 60 to 1800 hPa	Green
	-	-	> 1730 hPa 916 iS: > 1800 hPa	Red
Boost Pressure	-	-	< 410 hPa 916 iS: min ambient press	Red
	-	-	410 to 1730 hPa 916iS: ambient to 1800 hPa	Green
	-	-	> 1730 hPa 916iS: > 1800 hPa	Red
Oil Pressure	< 0.8 bar	Red	< 0.8 bar	Red
	0.8 to 2 bar	Amber	0.8 to 2 bar	Amber
	2 to 5 bar	Green	2 to 5 bar	Green
	5 to 7 bar	Amber	5 to 7 bar	Amber
	> 7 bar	Red	> 7 bar	Red
Oil Temperature	< 50 °C	Red	< -20 °C	Red
	-	-	-20 to 50 °C	Amber
	50 to 110 °C	Green	50 to 110 °C	Green
	110 to 130 °C	Amber	110 to 130 °C	Amber
	> 130 °C	Red	> 130 °C	Red
Fuel Pressure	< 2.5 bar	Red	< 2.5 bar	Red
	2.5 to 2.8 bar	Amber	2.5 to 2.9 bar	Amber
	2.8 to 3.2 bar	Green	2.9 to 3.2 bar	Green
	3.2 to 3.5 bar	Amber	3.2 to 3.5 bar	Amber
	> 3.5 bar	Red	> 3.5 bar	Red
Fuel Flow	All	Green	All	Green
Manifold Air Temperature	< 60 °C	Green	< 80 °C	Green
	> 60 °C	Red	> 80 °C	Red
Coolant Temperature	< -20 °C	Red	< -20 °C	Red
	-20 to 120 °C	Green	-20 to 120 °C	Green
	> 120 °C	Red	> 120 °C	Red
Exhaust Gas Temperature	< 950 °C	Green	< 950 °C	Green
	> 950 °C	Red	> 950 °C	Red
Ambient Air Pressure	All	Green	< 410 hPa	Red
	-	-	> 410 hPa	Green
Ambient Air Temperature	All	Green	< -40 °C	Red
	-	-	-40 to 50 °C	Green
	-	-	> 50 °C	Red
AC/ECU Voltage	< 9 V	Red	< 9 V	Red
	9 to 12.7 V	Amber	9 to 12.7 V	Amber
	12.7 to 14.8 V	Green	12.7 to 14.8 V	Green
	> 14.8 V	Red	> 14.8 V	Red
Engine Faults	Color corresponding to severity of fault condition			

Table 6-1: Standard Parameter Color Ranges

6.4 Central Warning Area

The central warning area in between the rectangles A and B displays informational messages when engine parameters are out of range. Messages displayed in the central warning area will disappear when confirmed by pressing the rotary knob. It is labeled "MCR" (Master Caution Reset) as soon as error messages show up.

All warnings with their respective priority stages are listed in Table 6-2.

Priority Stage	Warning text	Description
0 (highest)	NO ECU DATA	CANaerospace CBIT test failed
1	CHECK OIL PRESSURE	Oil pressure out of limits and RPM > 100
2	OVERBOOST – REDUCE POWER	Overboost detected (915 iS / 916 iS only)
3	CHECK OIL TEMPERATURE	Oil temperature out of limits and RPM > 100
4	GEN FAIL / CHECK BATTERY VOLTAGE	Generator 2 in use and RPM > 1500
5	COLDSTART: THROTTLE XX - YY %	Oil temperature dependent, if RPM < 100 and Coolant temperature > -30 °C and Coolant temperature < 20 °C
6	CHECK FUEL PRESSURE	Fuel pressure < 2.8 bar or Fuel pressure > 3.2 bar
7	CHECK COOLANT LEVEL	Coolant temperature > 150 °C
8	CHECK COOLANT TEMPERATURE	Coolant temperature > 120 °C and < 150 °C
9	CHECK EGT	Any EGT out of limits
10 (lowest)	CHECK AIRCRAFT VOLTAGE	Aircraft voltage out of limits and RPM > 10 and < 1500

Table 6-2: Warnings with priority stages

In Figure 6-7 the warning "NO ECU DATA" is shown. "NO ECU DATA" is displayed in red in the Central Warning Area. All sensor values are displayed with "---" in white. In Figure 6-8 the warning "CHECK FUEL PRESSURE" is shown. "CHECK FUEL PRESSURE" is displayed in red in the Central Warning Area. The sensor value (2.0 bar) is displayed in red in the value box.



Figure 6-7: Warning "NO ECU DATA"
(Software 915iS RS11.00)



Figure 6-8: Warning "Check FUEL PRSSURE"
(Software 915iS RS11.00)

In Figure 6-9 a high oil temperature is indicated. The sensor value (115 °C) is displayed in yellow in the value box. No warning is shown in the Central Warning Area. In Figure 6-10 the warning “CHECK OIL TEMPERATURE” is shown. “CHECK OIL TEMPERATURE” is displayed in red in the Central Warning Area. The sensor value (135 °C) is displayed in red in the value box.



Figure 6-9: High Oil Temperature
(Software 915iS RS11.00)



Figure 6-10: Warning “CHECK OIL TEMPERATURE”
(Software 915iS RS11.00)

6.5 Engine Data Information (INFO) Page

The Engine Data Information page is accessible from the main page by pressing the push button marked “INFO”. It displays selected engine data in parameter groups with colored bars indicating the current values and their associated operational warnings and limits. The desired parameter group may be selected by operating the two leftmost push buttons. The one selected is highlighted in green. Every single parameter value is shown with an arrow underneath the color bar and has a drag indicator (white horizontal lines above the color bar). These can be reset for the entire group via the push button marked “ZERO”. They do not self-reset. Pressing the return (RET) button brings up the MAIN page regardless of the currently selected parameter group.

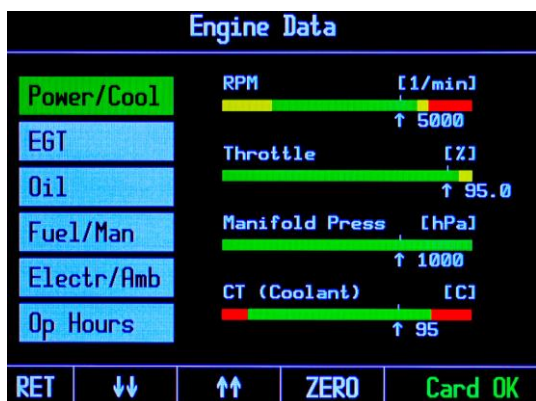


Figure 6-11: INFO-Power/Cool
(Software 912iS RS01.00)

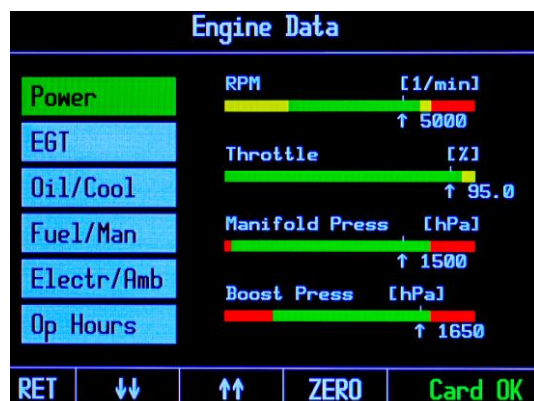


Figure 6-12: INFO-Power
(Software 915iS RS11.00)

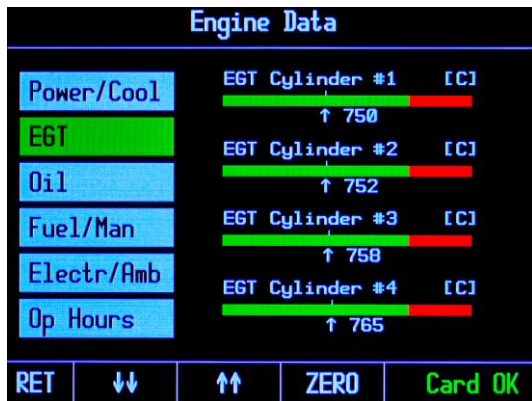


Figure 6-13: INFO-EGT
(Software 912iS RS01.00)

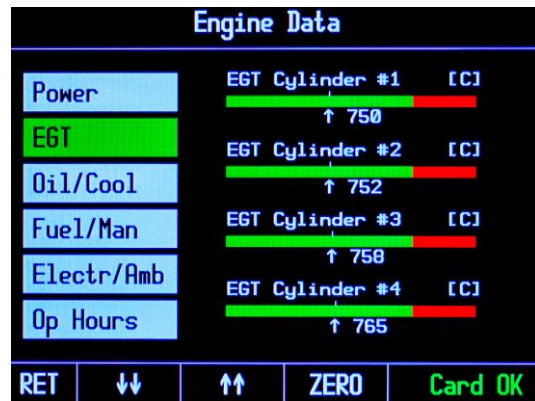


Figure 6-14: INFO-EGT
(Software 915iS RS11.00)

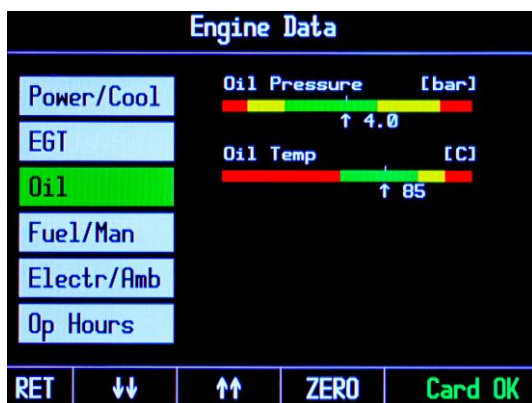


Figure 6-15: INFO-Oil
(Software 912iS RS01.00)

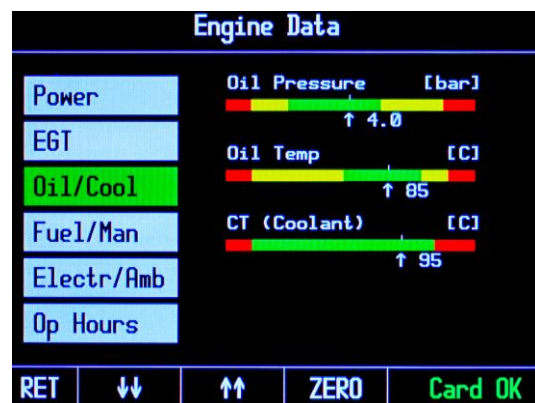


Figure 6-16: INFO-Oil/Cool
(Software 915iS RS11.00)

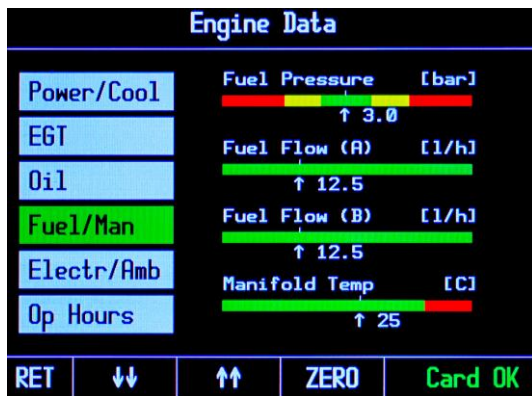


Figure 6-17: INFO-Fuel/Man
(Software 912iS RS01.00)

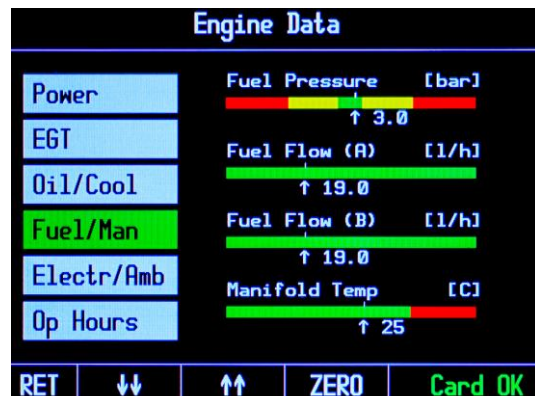


Figure 6-18: INFO-Fuel/Man
(Software 915iS RS11.00)

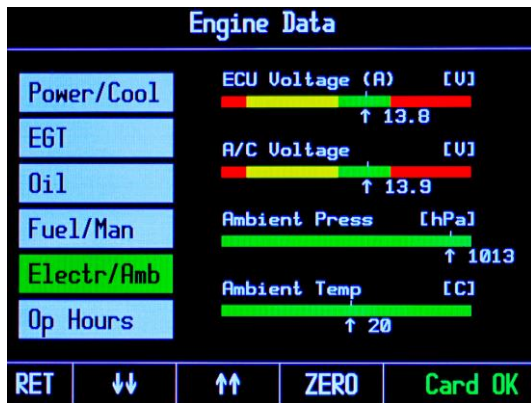


Figure 6-19: INFO-Electr/Amb
(Software 912iS RS01.00)

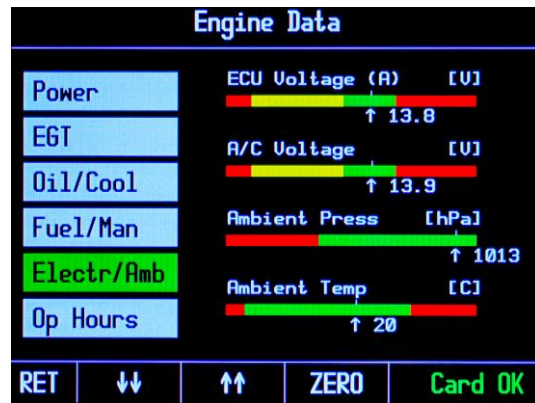


Figure 6-20: INFO-Electr/Amb
(Software 915iS RS11.00)

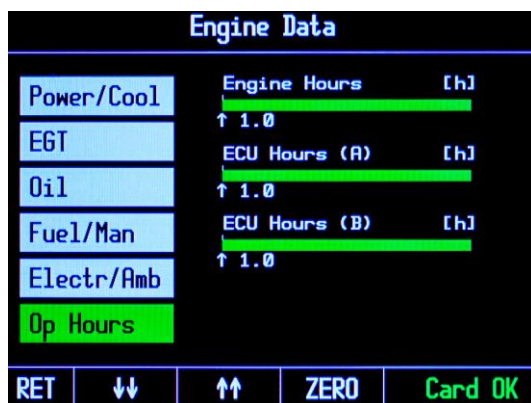


Figure 6-21: INFO-Op Hours
(Software 912iS RS01.00)

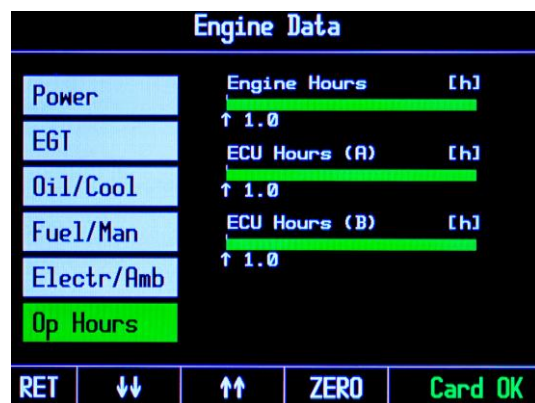


Figure 6-22: INFO-Op Hours
(Software 915iS RS11.00)

6.6 System Information (SYST) Page

The system information page is accessible from the MAIN page by pressing the push button marked “SYST”. It provides six subpages that can be selected using the two leftmost push buttons marked “↑↑” and “↓↓”. The one selected is highlighted in green or amber (for the “Warnings” and ECU Faults” subpages).

- The “Warnings” subpage shows warnings generated by the EMU color marked (green/amber/red) in accordance with their severity, e.g. for parameters exceeding limits from Table 6-1.
- The “ECU Faults” subpage shows system faults detected by one or both ECU Lanes. These are also color marked (green/amber/red) to indicate urgency and are displayed in reference to the respective ECU lane.
- The „ECU Status“ subpage lists operational status conditions of the ECU in clear text form.
- The “ECU Config” subpage lists information specific to the installation, such as serial numbers or software versions.
- The “Data Rec” subpage shows the current status of the data recording, such as the current file name and size as well as information about the GNSS receiver.

- The “CAN BusMon” subpage shows the output of the internal bus monitoring device. This may be used to troubleshoot installation and wiring problems. Clean installations should read zero errors for reception and transmission. The received and transmitted (Rx/Tx) number of messages on the two lanes is also shown for a timeframe of 100 ms.

Pressing the RET button brings up the MAIN page regardless of other selections. The layout of the SYST subpages is shown in the following figures:

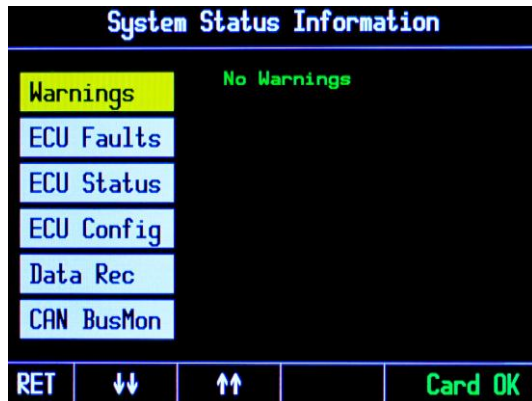


Figure 6-23: SYST-Warnings (normal)

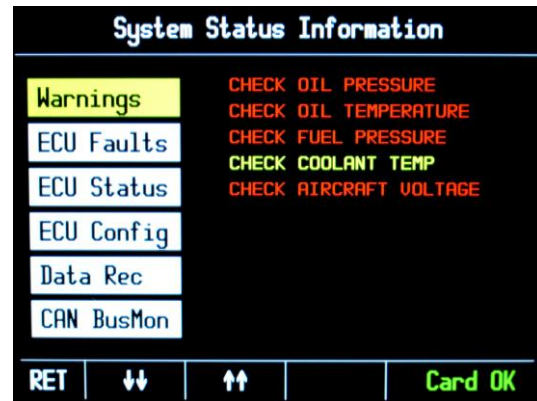


Figure 6-24: SYST-Warnings (Warning active)

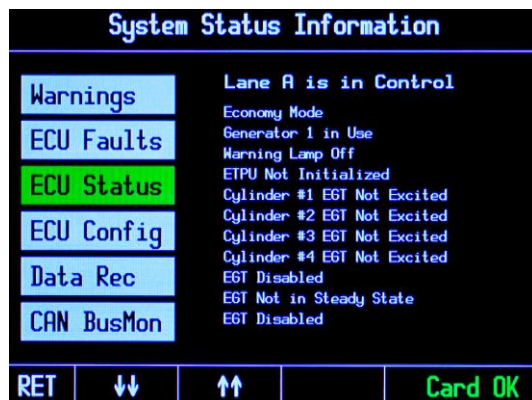


Figure 6-25: SYST-ECU Status

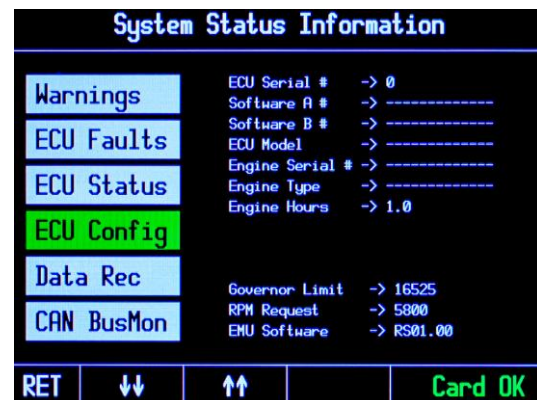


Figure 6-26: SYST-ECU Config

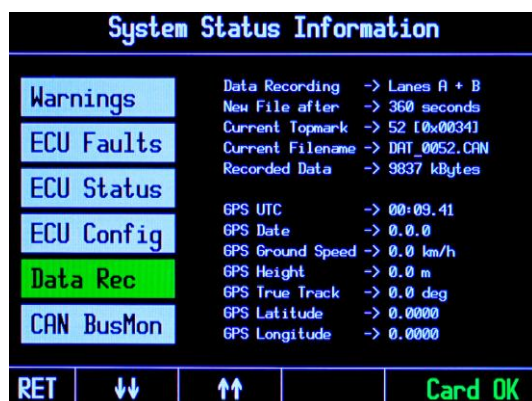


Figure 6-27: SYST-Data Rec

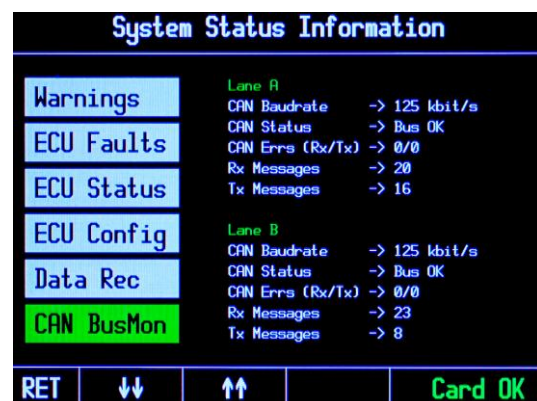


Figure 6-28: SYST-CAN BusMon

6.7 Configuration (CONF) Page

The configuration page is accessible from the MAIN page by pressing the push button marked “CONF” and allows the user to view, modify and store the EMU configuration settings on an SD card. The desired configuration item may be selected using the two leftmost push buttons marked “↑↑” and “↓↓” and is highlighted in green after selection.

Currently the EMU supports the following selections:

- Metric or US customary units for all alphanumerically displayed parameters (e.g. temperatures)
- Engine speed indication referenced to crankshaft or propeller.
- Manifold pressure values in hectopascals or inches of mercury.
- Offset addition to fuel pressure sensor value in order to compensate for sensing errors and position. This adjustment requires a calibrated pressure gauge.

Selected configuration settings become effective immediately and may be stored permanently on the SD card through the push button marked “SAVE” at any time. The file on the memory card containing the settings is named "EMU912IS.CFG". This file is in readable ASCII format and may also be edited on a desktop or laptop computer.

The layout of the SYST subpages is shown in the following figures:

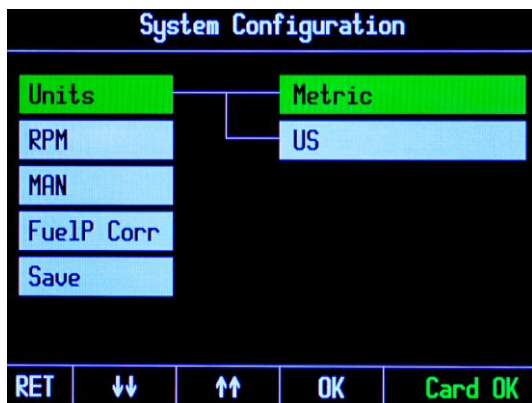


Figure 6-29: CONF-Units

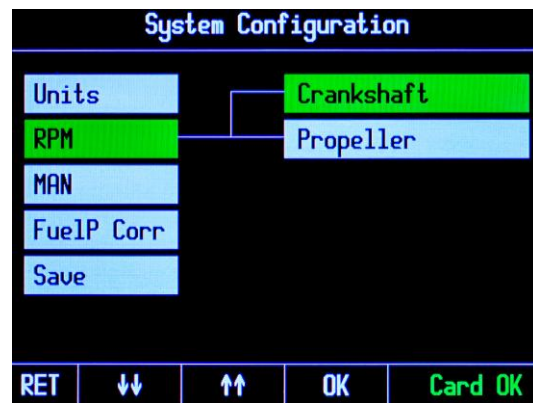


Figure 6-30: CONF-RPM

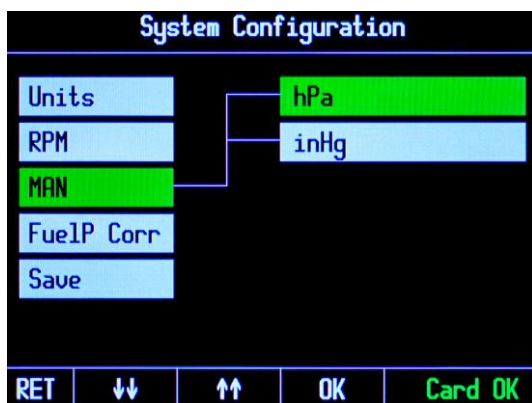


Figure 6-31: CONF-MAN

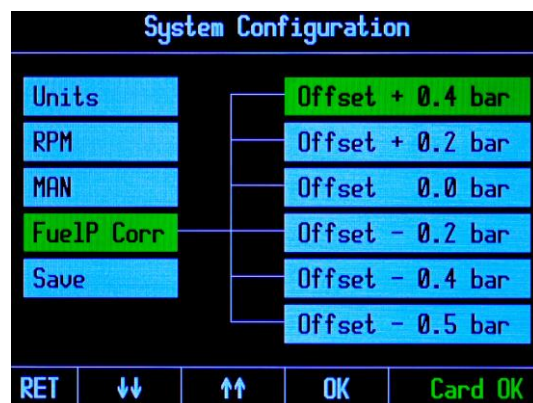


Figure 6-32: CONF-FuelP Corr

6.8 Fuel Totalizer

When opening the Configuration Page (CONF), the field “Fuel” is highlighted in light blue. By turning the knob, the total fuel quantity can be added. One click on the turn knob equals one liter. This is also valid in configuration “imperial”, where the total fuel is displayed in gallons instead of liters. By acknowledging the total fuel quantity, the value is stored on the SD card. The EMU computes the used fuel of a flight by summing up the injected fuel quantity of the ECU. The value is frequently stored on the SD card. After restarting the EMU, 1 l fuel is subtracted from the last stored value to compensate for uncertainty of engine start and engine shutdown. The fuel totalizer does not replace a fuel quantity gauge in the aircraft and the value of the fuel totalizer must not be used for remaining fuel quantity for flight planning.

6.9 Advanced Fuel Pressure Offset Configuration

In addition to the fuel pressure offset setting on the “CONF” page, see Figure 6-32: CONF-FuelP Corr, there are more possible options to choose. By opening the “EMU912IS.CFG” file on the SD card with a common text editor other offset options can be selected. The .CFG file is formatted as the following example:

```
UNITS=Metric
RPM=CRANKSHAFT
MAN=HPA
SEC=MAP
FPO=2
```

To change offset setting, exchange the Fuel Pressure Offset (FPO) definition “2” with a value according to Table 6-3 Fuel Pressure Offset, save file to SD card and reboot EMU.

Value	Fuel Pressure Offset [bar]
0	0.4
1	0.2
2	0.0
3	-0.2
4	-1.0
5	0.1
6	0.3
7	-0.1
8	-0.3
9	-0.4
A	0.5
B	-0.5
C	-0.6
D	-0.7
E	-0.8
F	-0.9

Table 6-3 Fuel Pressure Offset

6.10 Single Lever Power Control

Single Lever Power Control (SLPC) is an enhanced control function for automatic control of constant speed variable pitch propellers. With SLPC, the blue manual propeller lever is banned from the instrument panel and the function of setting a desired rpm value is conducted automatically. This function is also known as Full Authority Digital Engine Control (FADEC). Advantages for the pilot are increased safety in stress situations like missed approach, optimal setting in all states of flight, increased performance, and most fuel economic flight.

Single Lever Power Control option is only available in combination with a mt propeller governor type P-853-XX and a hydraulic constant speed propeller (e.g. mt propeller MTV-6, MTV-34). For installation of the SLPC please refer to chapter 5. Only in special EMU software versions the SLPC function is activated. Feel free to contact RS Flight Systems for different SLPC configurations.

Below the central warning area there are two more fields. The first field indicates whether the engine is operating in POWER (rich fuel mixture) or ECO (lean fuel mixture) mode. The second field shows the engine speed commanded by the SLPC function. This function is only available in software versions with SLPC. The status of the generators is shown in a third field near the bottom of the display, in between the two supplemental numeric displays for the power parameters.



Figure 6-33: MAIN Screen with SLPC
(Software 912iS RS01.0A)



Figure 6-34: MAIN Screen with SLPC
(Software 915iS RS11.0A)

In the customized SLPC software versions, the requested RPM value is automatically set. The requested RPM value is calculated from the throttle position, the manifold and the normalized air density. The resulting control curve is adapted to each combination of aircraft, type of engine, and type of propeller. Standard versions are available for touring aircraft, STOL and seaplane. Feel free to contact RS Flight Systems for different SLPC configurations.

An exemplary control curve of a SLPC version is shown in Figure 6-35. All curves for Rotax 916iS engines avoid the range between 5450 rpm and 5750 rpm. At a throttle lever position of 99,7 %, the rpm drops from 5800 rpm (full throttle, take-off position) to 5450 rpm (max cruise rpm). This setting is necessary due to the very high boost increase of the 916iS in the range between 5500 rpm to 5800 rpm.

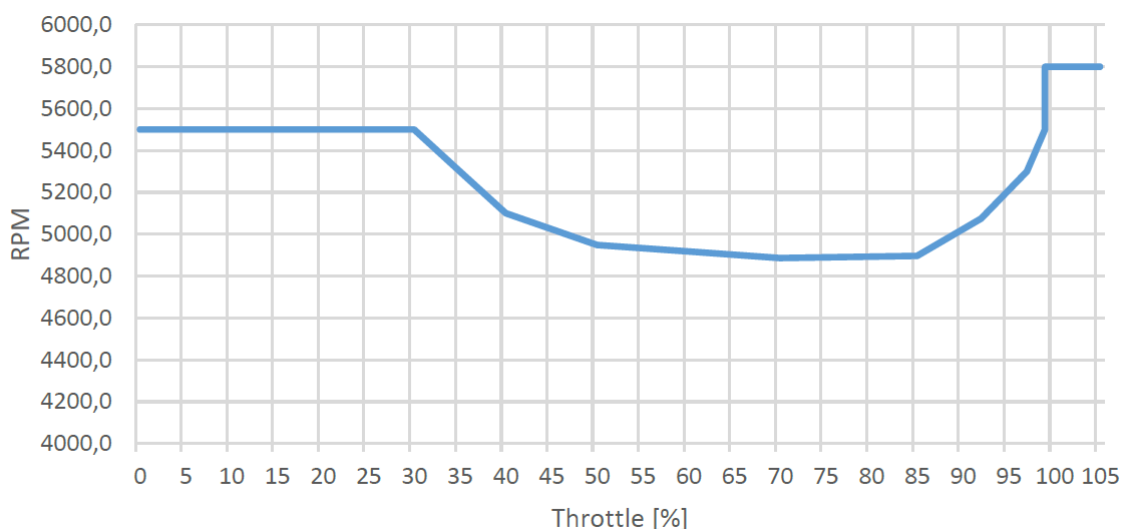


Figure 6-35: SLPC Control Curve

For safety reasons, the electro-hydraulic governor type P-853-XX is equipped with two internal safety stops. These stops are referenced to a set rpm. The upper limit for all governors is 5800 rpm. The lower limit is set for the most versions to 4600 rpm. The control curves of the SLPC function are using the range between 4800 rpm and 5800 rpm. This gives a safety margin of 200 rpm to the low rpm stop. The max rpm stop is a so-called soft stop (for governor revision K/H and higher). This soft stop function avoids unintended jamming of the governor in the max rpm position. The soft stop function is tested by the EMU during the booting process. Due to the spring-loaded mechanic of the stop, the tolerance of the rpm value is within ± 25 rpm (propeller rpm).

The governor is not self-inherent. In case of loss of control by the EMU due to a defect on the EMU side or a broken wire harness between EMU and governor, the governor will turn slowly to the min rpm stop. This process may take up to 10 min. For certification of new aircraft types for SLPC function, a safe operation and climb must be demonstrated in the min rpm position of the governor. Please note that the min rpm stop does not equal the coarse pitch position of the propeller blades. Even in min rpm position, the governor controls the propeller blades accordingly and the pitch angle will vary with the airspeed.

Two manual SLPC test versions are available at the RS Flight Systems website: RS01.0A for the 912iS and RS11.0A for the 915iS / 916iS. In both versions the requested RPM value can be selected with the rotary knob. The brightness function is deactivated, and the brightness is set to 100 %. If the manual version is used for 916iS engines, the range between 5450 rpm and 5750 rpm must be avoided.

6.11 Flight Data Recording

The EMU records all data transmitted by the ECU over both lanes and their respective CANaerospace interfaces and all internal values (e.g. GPS position, speed, time, fuel pressure). This function is only active as long as an SD card is inserted. For each restart of the EMU or every 6 minutes (0.1 recording hours) of runtime, a new file is created and the previous one is closed. The file naming convention is:

DAT00001.CAN

with 00001 being the decimal number, which is incremented by one for each new file and allows for 99999 different files to be created, named and stored. The number of the last file which has been closed and written to the SD card is stored as a 4-character ASCII string in the file "TOPDAT.CFG", which is also written to the card. Most of the data is transmitted 10 times per second and a typical data rate is 12 kilobytes per second. Using a 128 GB SDHC memory card, this results in a maximum recording more than 2000 h (TBO of the engine).

A powerful Engine Management Debriefing Station (EMDS) software for the Microsoft Windows, SuSE Linux and Apple MacOS X operating systems is delivered with the EMU. This tool (see Figure 6-36 to Figure 6-41) allows for visualization and post-processing of the recorded data as well as a three-dimensionally georeferenced data conversion to Google Earth compatible files.

The EMDS software is available on the following server:

<https://www.rs-flightsystems.com/product-page/emu-912xis>

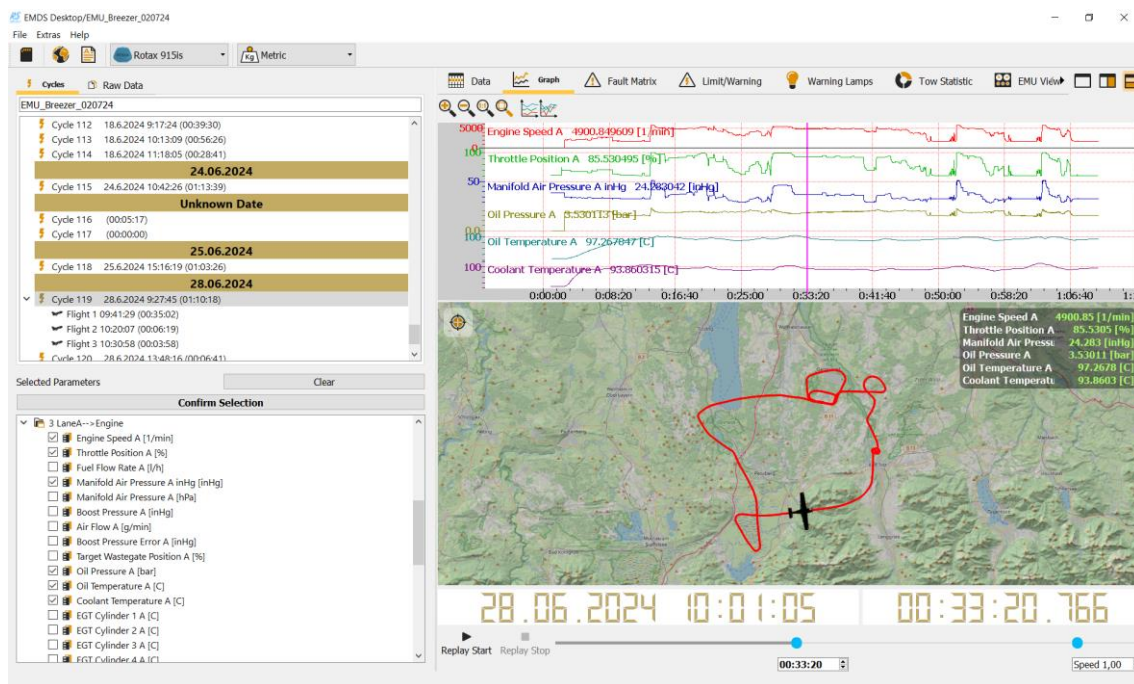


Figure 6-36: Engine Management Debriefing Station (EMDS) Software

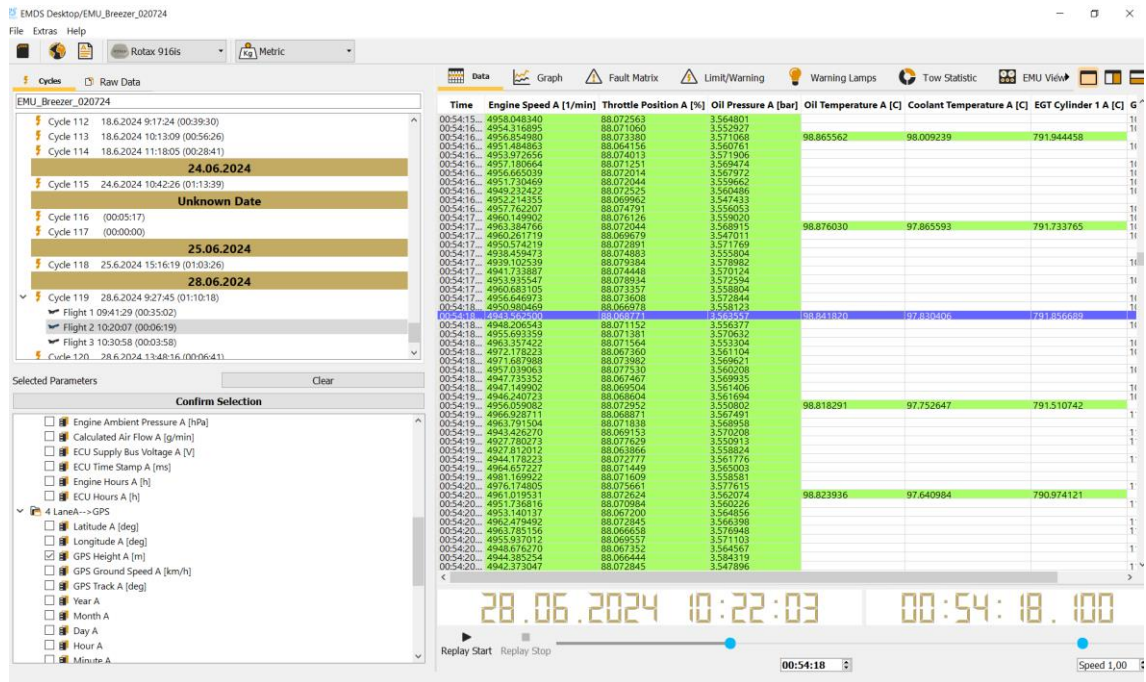


Figure 6-37: EMDS Data Screen

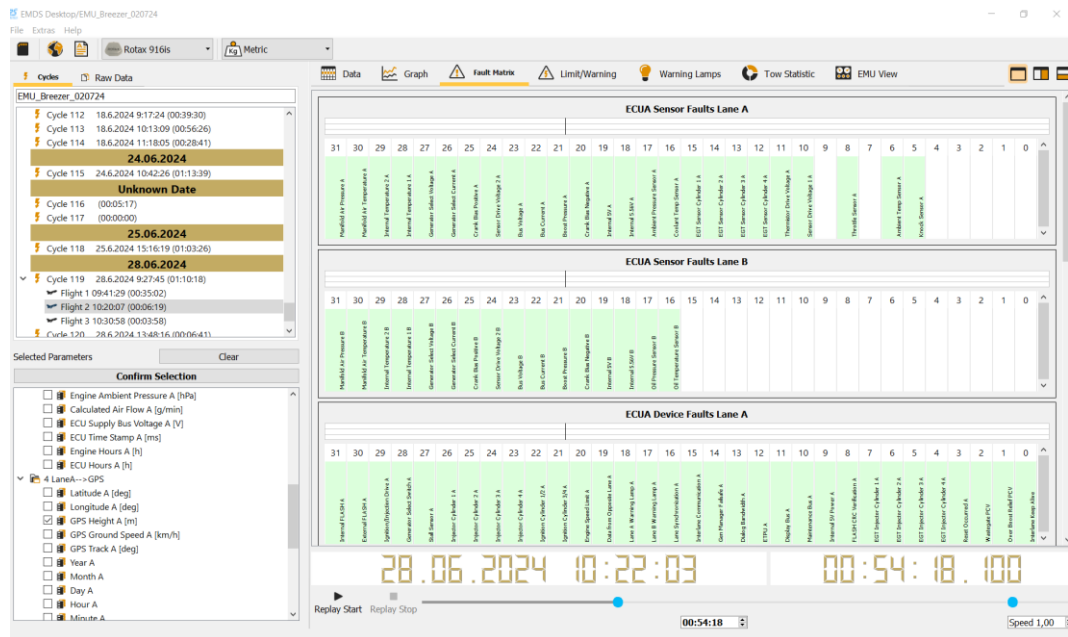


Figure 6-38: EMDS Fault Matrix Screen

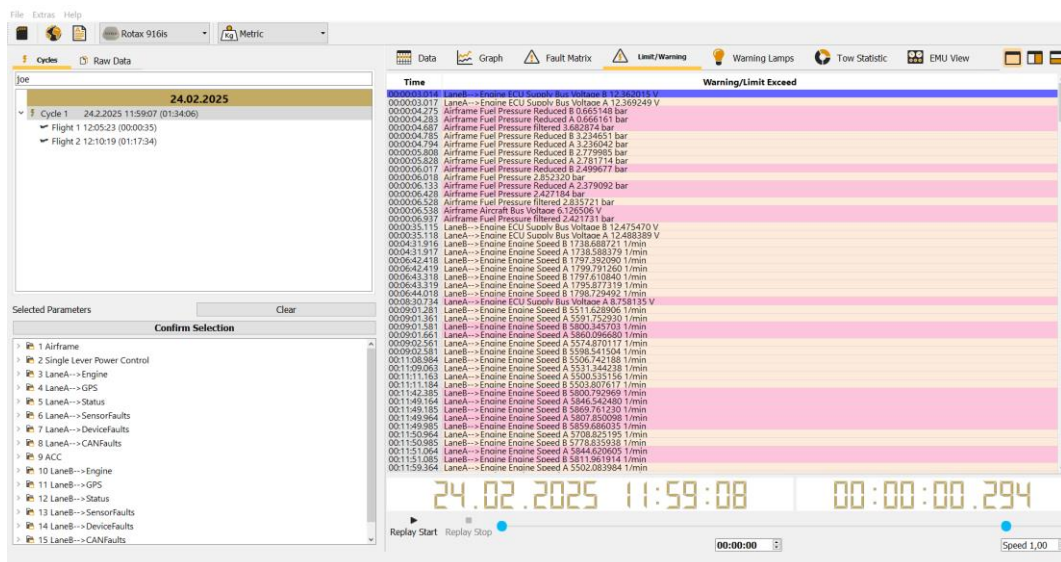


Figure 6-39: EMDS Limits Screen

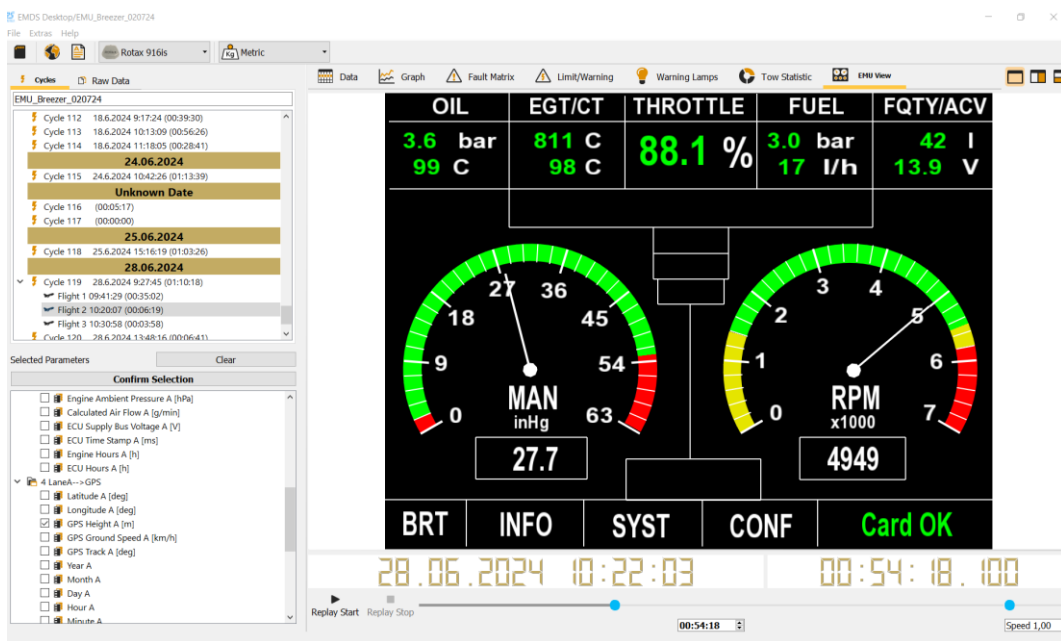


Figure 6-40: EMDS EMU Screen



Figure 6-41: EMDS generated Google Earth View

6.12 Software Update

The EMU allows for easy conduction of software updates through the SD memory card interface. The software is delivered in compressed .zip-files with the following exemplary structure:

EMU_915iS_SW_RS11.00.zip -> EMU_915iS_SW_RS11.00 -> mb0.srd, mb1.srd

The binary software upgrade files (mb0.srd, mb1.srd) must be stored on an SD memory card which is then inserted (contacts up) in the slot in the main unit. The binary files are recognized by the EMU each time power is applied and the device boots up. When update files are detected, the content is automatically programmed into flash memory and the device starts up using the new software. An installation logfile ("INSTALL.LOG") is created and stored on the memory card and the update files are deleted.

The standard software versions are listed in Table 6-4: Standard Software Versions. Feel free to contact RS Flight Systems for customized software versions with individual SLPC algorithms.

Software Version	Engine	Description
RS0x.xx	912iS	Std. software for Rotax 912iS without SLPC
RS0x.xA	912iS	SLPC test software for manual propeller adjustment
RS0x.xG	912iS	SLPC ground test software
RS1x.xx	915iS	Std. software for Rotax 915iS without SLPC
RS1x.xA	915iS	SLPC test software for manual propeller adjustment
RS1x.xG	915iS	SLPC ground test software
CH1x.xx	915iS	Helicopter version with RPM output and intercooler fan control
RS1x.xA	915iS / 916iS	SLPC test software for manual propeller adjustment
RS2x.xx	916iS	Std. software for Rotax 916iS without SLPC
RS3x.xx	EP917TSI	Std. software for Edge Performance 917 and 918 engines
RS4x.xx	914iS	Std. software for Rotax 914iS without SLPC

Table 6-4: Standard Software Versions

7. Abbreviations and Terms

Abbreviation	Description
ACT	Active
ACV	Aircraft Voltage
AUX	Auxiliary
AWG	American Wire Gauge
BRT	Brightness
CAD	Computer Aided Design
CAN	Controller Area Network
CHK	Check
CHT	Cylinder Head Temperature
CONF	Configuration
CT	Coolant Temperature
DC	Direct (non-alternating) Current
DNC	Do Not Connect
ECU	Engine Control Unit
ECV	ECU Voltage
EGT	Exhaust Gas Temperature
EMDS	Engine Management Debriefing Station
EMU	Engine Management Unit
EN	European Norm
FPGA	Field Programmable Gate Array
FPS	Fuel Pressure Sensor
GB	Gigabyte
GEN	Generator
GND	Ground
GNSS	Global Navigation Satellite System (e.g. GPS, Galileo, GLONASS)
HIC	Harness Interface Connector
ISO	International Organization for Standardization
I/O	Input/Output
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MAN	Manifold Pressure
MCR	Master Caution Reset
RET	Return
RPM	Revolutions per Minute (Engine Speed)
RS-232	Recommended Standard 232
RX	Reception
SAE	Society of Automotive Engineers
SBY	Standby
SD	Secure Digital (type of memory card)
SDHC	Secure Digital – High Capacity (type of SD card)
SLPC	Single Lever Power Control
SPR	Start Power Relay
STP	Shielded Twisted Pair
SYST	System
TFT	Thin Film Transistor (type of LCD)
TX	Transmission
UNC	Unified National Thread - Coarse
UTC	Coordinated Universal Time



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EMU | Version: 4.0

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