Installation / Operation Manual

SCU 9iS

System Control Unit

Version: 3.0

Contents

1. Preface

Thank you for purchasing a System Control Unit from RS Flight Systems. 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 System Control Unit (SCU) itself is based on the proven hardware of the second generation Engine Management Unit family (EMU 912iS evo and EMU 9xiS). The stand-alone main unit offers the following functionality:

- Automatic propeller speed control for Single Lever Power Control
  (in combination with optional MT Propeller governor)
- Automatic throttle valve control for helicopter or UAV applications
  (in combination with optional actuator system)
- Three optically isolated CANaerospace data bus interfaces for retained redundancy
- Engine Data transfer to CAN-based third party avionics systems (e.g. by Garmin or Dynon)
- Continuous monitoring and health checking of both ECU display buses
- 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)
- Remote installation possible
- Georeferenced data recording of all parameters at 10 Hz over up to 2000 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
- Several additional input and output channels for future system upgrades
- Suitable for 14 V and 28 V aircraft electrical systems
- Preassembled wiring harnesses available as accessories
- Highly customizable software (available on request)
- High level of manufacturing and quality control
- Engineering and production exclusively done in Germany

Figure 2-1: Top view of the SCU 9iS

Figure 2-2: SD Card Cover

In combination with either of the two optional extension units (Front Panel including switches or Display Panel without switches), the following additional functions are offered:

- Indication of the most important engine parameters, engine status and ECU faults
- Simple and self-explanatory operation via three push buttons
- All necessary indicator lights for Rotax iS engine operation
- All necessary switches for Rotax iS engine operation
  (Front Panel only, in combination with optional Start Power function)

Figure 2-3: SCU Display Panel

Figure 2-4: SCU Front Panel

3. Technical Specifications

	SCU 9iS Main Unit	SCU 9iS Main Unit BB
Mechanical Dimensions (width, height, depth)	120 x 149 x 34 mm 4.72 x 5.87 x 1.34 in	120 x 149 x 68 mm 4.72 x 5.87 x 2.68 in
Mounting Hole Pattern (width, height)	4 screws up to M4 92.4 x 137.6 mm 3.64 x 5.42 in	4 screws up to M4 92.4 x 137.6 mm 3.64 x 5.42 in
Total Mass	0.62 kg 1.37 lbs	0.72 kg 1.59 lbs
Housing	Aluminum, painted black and machined, IP30 (ISO 20653)	
Supply Voltage	9 to 32 Volts DC, according to EN2282	
Power Consumption	typ. 7.0 W (0.3 A at 14 V, 0.18 A at 28 V) without external load	
CANaerospace Interfaces	According to ISO 11898-2, optically isolated two input channels, one output channel	
Analog I/O	4 inputs (±10 V)	2 inputs (±10 V): Fuel Pressure Signal Governor Stop Signal
Digital I/O	5 low-side inputs, 5 high-side inputs 14 outputs (7 low-side, 7 high-side) driving up to 2.4 A each	1 output: Start Power Relay output
Positioning	Combined GPS/Galileo Sensor (Navilock NL-603P), 4 Hz update rate	
Electronics	Xilinx Spartan-3 FPGA with dual Microblaze processors	
Storage	Single side mounted SD/SDHC-Card, up to 256 GB	Black Box, 128 GB SDXC-Card
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 SCU 9iS and SCU9iS BB

	SCU Display Panel	SCU Front Panel
Mechanical Dimensions (width, height, depth)	90 x 66 x 23.5 mm 3.54 x 2.6 x 0.93 in	150 x 66 x 97.5 mm 5.91 x 2.6 x 3.84 in
Panel Cutout (width x height)	82 x 58 mm, 12 mm corner radii 3.23 x 2.28 in, 0.47 in corner radii	142 x 58 mm, 12 mm corner radii 5.59 x 2.28 in, 0.47 in corner radii
Mounting Hole Pattern (width, height)	4 M4 screws 80 x 57 mm 3.15 x 2.24 in	4 M4 screws 142 x 58 mm 3.59 x 2.28 in
Total Mass	0.12 kg 0.26 lbs	0.4 kg 0.88 lbs
Housing	Aluminum, visible surfaces anodized to aerospace standard	
Supply Voltage	12 V and 3.3 V, supplied by the SCU Main Unit Lane A/B LEDs supplied by ECU / HIC connector	
Power Consumption	typ. 0.5 W	
Display	2.1 inch monochrome OLED display, 170° viewing angle, 100 x 32 pixels, typ. 100 cd/m²	
Operating Temperature Range	-20 to +70 °C -4 to +158 °F	
Operating Altitude	< 7,620 m < 25,000 ft	
Humidity	< 95 %, non-condensing	

Table 3-2: Technical Specification SCU Extension Units

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.

The SCU is mounted on a horizontal or vertical surface using four screws (max. diameter 4.0 mm) not included in the package. The hole positions can be taken from Figure 4-1. If you are using fixed female threads in the mounting surface instead of nuts, provide a minimum thread length of 4 mm. Always secure your mounting joint. The Front and Display Panels require a rounded rectangular cutout (see Figure 4-9 and Figure 4-11) and are mounted on the aircraft instrument panel using four M4 Philips headed screws included in the package. Three-dimensional CAD-models of all units are available on the RS Flight Systems website: www.rs-flightsystems.com

As waste heat is dissipated via free convection, leave at least a 5 mm gap from the exterior surfaces (excluding the mounting face) 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 SCU 9iS Main Unit

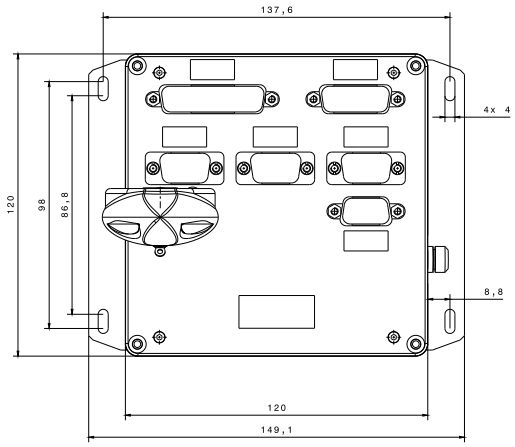

Figure 4-1: SCU 9iS Main Unit (front view)

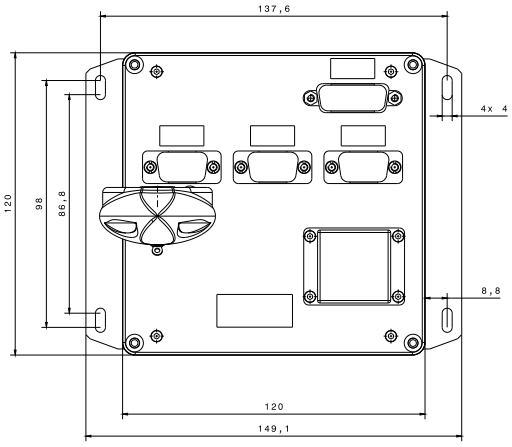

Figure 4-2: SCU 9iS Main Unit BB (front view)

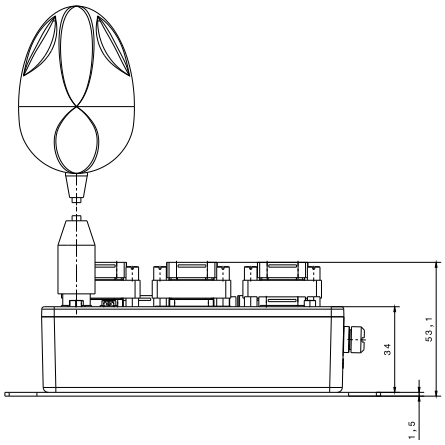

Figure 4-3: SCU 9iS Main Unit (side view)

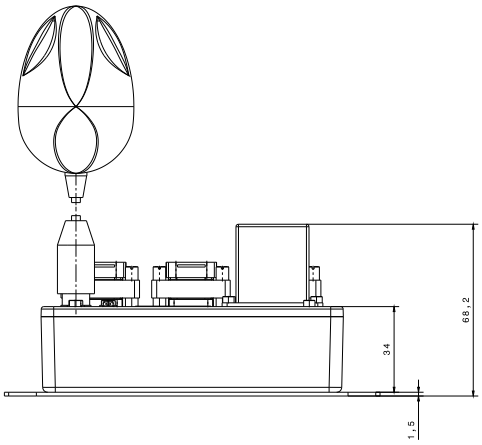

Figure 4-4: SCU 9iS Main Unit BB (side view)

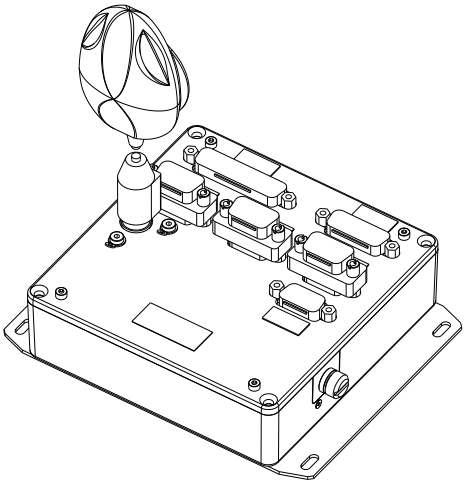

Figure 4-5: SCU 9iS Main Unit (iso view)

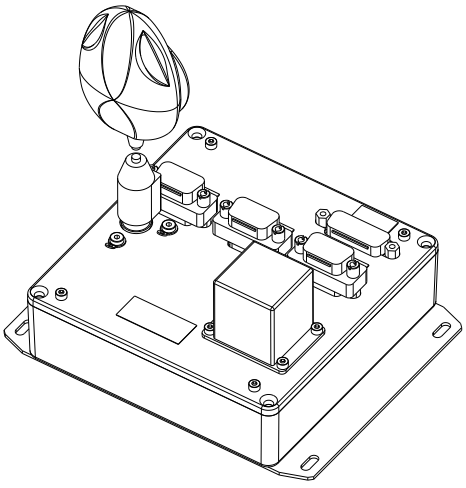

Figure 4-6: SCU 9iS Main Unit BB (iso view)

4.2 Drawings SCU Display Panel

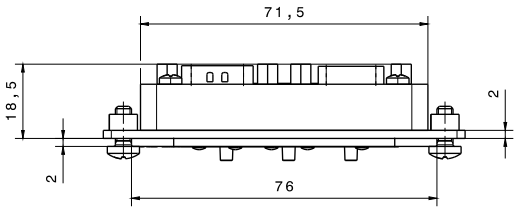

Figure 4-7: SCU Display Panel (top view)

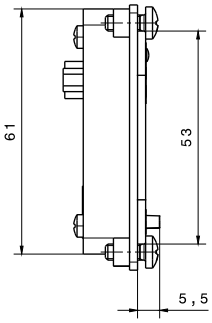

Figure 4-8: SCU Display Panel (side view)

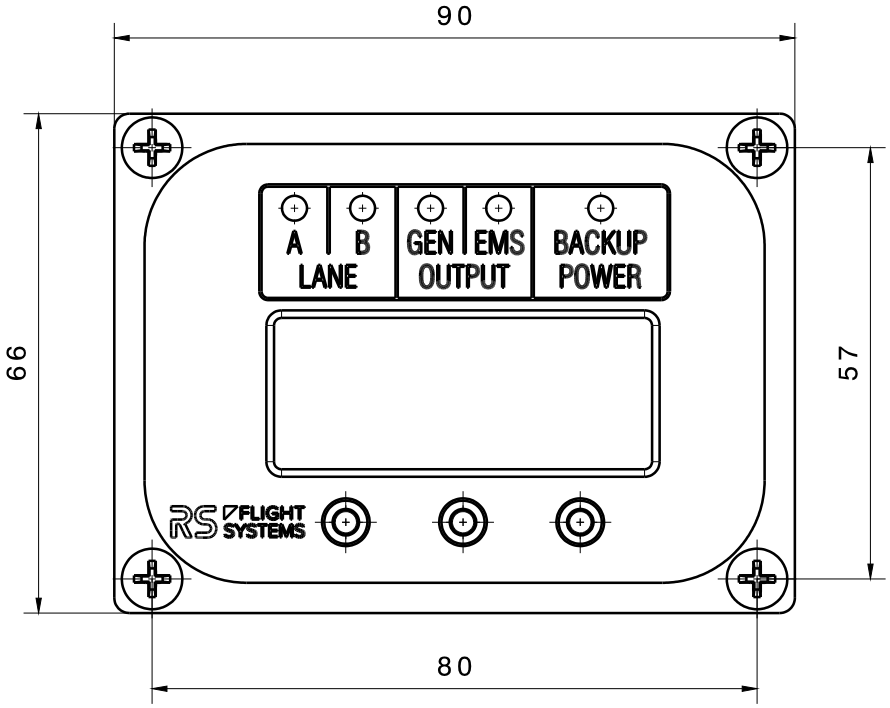

Figure 4-9: SCU Display Panel (front view)

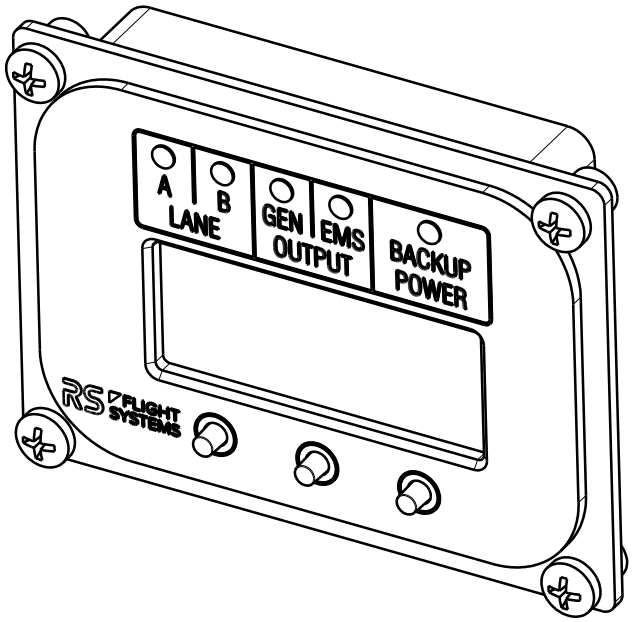

Figure 4-10: SCU Display Panel (isometric view)

4.3 Drawings SCU Front Panel

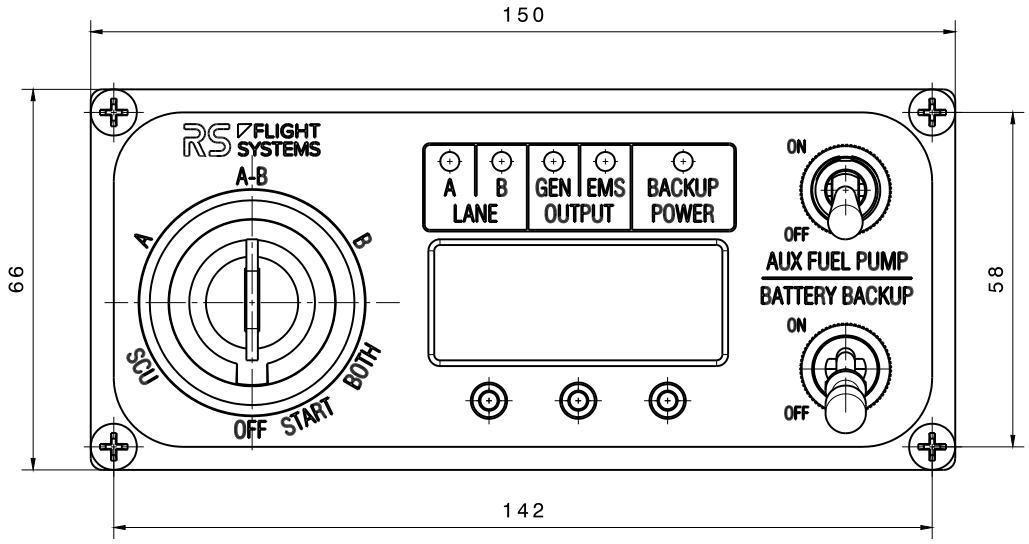

Figure 4-11: SCU Front Panel (front view)

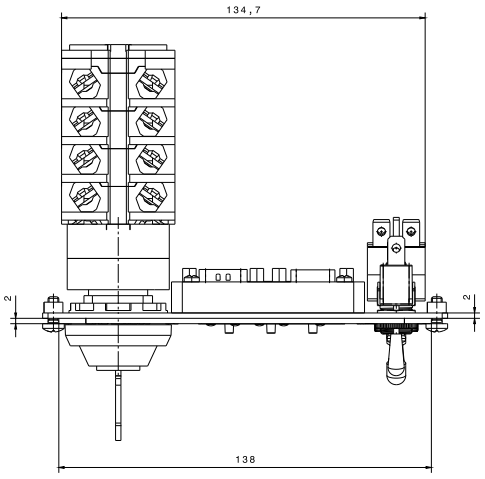

Figure 4-12: SCU Front Panel (top view)

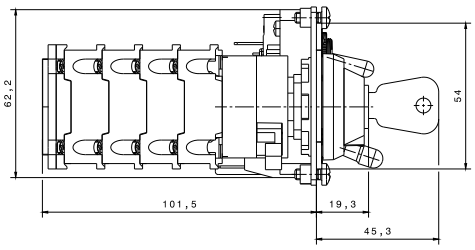

Figure 4-13: SCU Front Panel (side view)

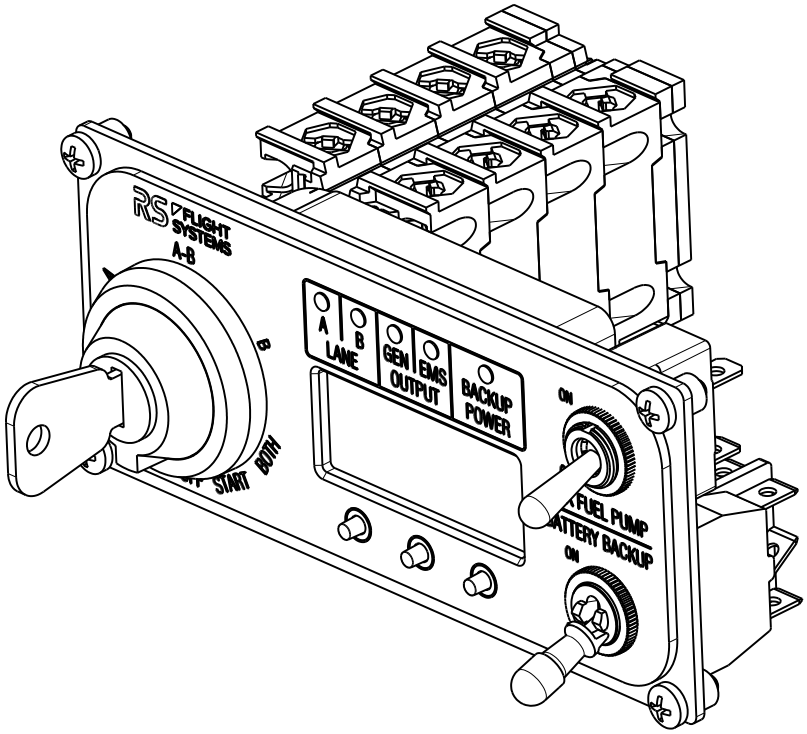

Figure 4-14: SCU Front Panel (isometric view)

4.4 Drawings SCU Front Panel

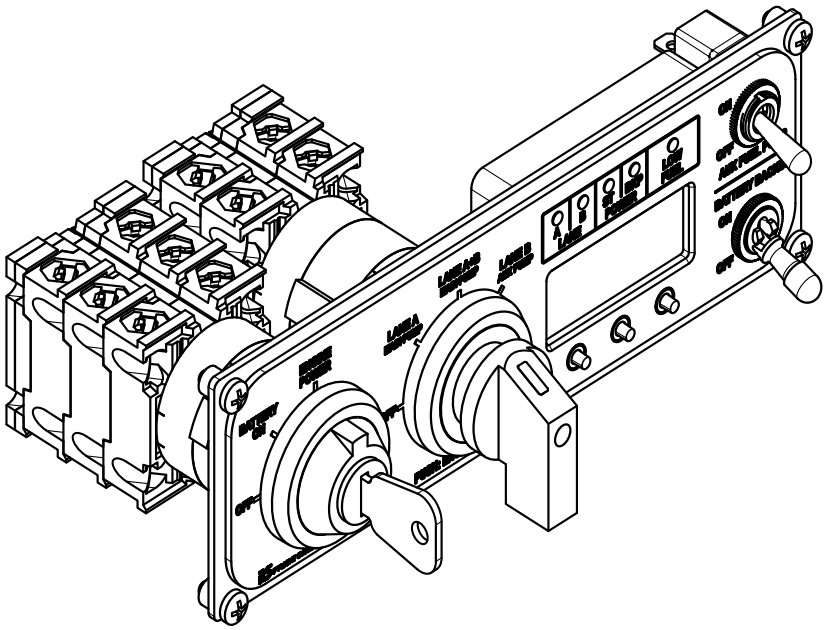

Figure 4-15: SCU Front Panel V2 drawing isometric view

For the SCU Front Panel V2, please refer to the Installation / Operation Manual SCU Front Panel V2.

5. Electrical Installation

The SCU Main Unit has seven connectors on the front side (five connectors on the SCU Main Unit BB). Six of them are standard density D-Sub connectors with 4-40 UNC threaded fastening. All three CAN Connectors ("Lane A", "Lane B" and "Lane C") 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	"AUX"	DA15S (female 15-pin D-Sub)	I/O
I/O	"EXT"	DB25S (female 25-pin D-Sub)	I/O
CANaero_A	"LANE A"	DE9P (male 9-pin D-Sub)	CAN Bus Input, Power Supply
CANaero_B	"LANE B"	DE9P (male 9-pin D-Sub)	CAN Bus Input
CANaero_C	"LANE C"	DE9P (male 9-pin D-Sub)	CAN Bus Output
FP	"FRONT PANEL OUT"	DE9S (female 9-pin D-Sub)	Connection to Extension Units
GNSS	"GPS INPUT"	Female Mini-DIN 6	GNSS Antenna

Table 5-1: SCU 9iS Main Unit connectors

Connector	Label	Connector Type	Usage
AUX	"AUX"	DA15S (female 15-pin D-Sub)	I/O
CANaero_A	"LANE A"	DE9P (male 9-pin D-Sub)	CAN Bus Input, Power Supply
CANaero_B	"LANE B"	DE9P (male 9-pin D-Sub)	CAN Bus Input
CANaero_C	"LANE C"	DE9P (male 9-pin D-Sub)	CAN Bus Output
GNSS	"GPS INPUT"	Female Mini-DIN 6	GNSS Antenna

Table 5-2: SCU 9iS Main Unit BB connectors

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.

Each of the extension units comes with two standard density D-Sub connectors with 4-40 UNC threaded fastening on the rear of the display part. In case of the Front Panel, the ignition, auxiliary fuel pump and battery backup power switches need to be connected using individual wires according to the Installation Manual of the BRP Rotax engine.

Connector	Label	Connector Type	Usage
LED	“LED”	DE9P (female 9-pin D-Sub)	Annunciator Lights
Display	“SCU”	DE9S (male 9-pin D-Sub)	Connection to Main Unit

Table 5-3: Extension Unit connectors

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 SCU. Preassembled wiring harnesses are available as accessories for simplifying the installation. For part numbers see Chapter 5.7 or contact RS Flight Systems directly.

Ensure that proper grounding connections are made and that the various ground potentials are not connected outside of the Main Unit. This is especially important for the analog reference ground.

Figure 5-1 shows an overview of all standard connections. Carefully check your wiring before powering up the unit for the first time.

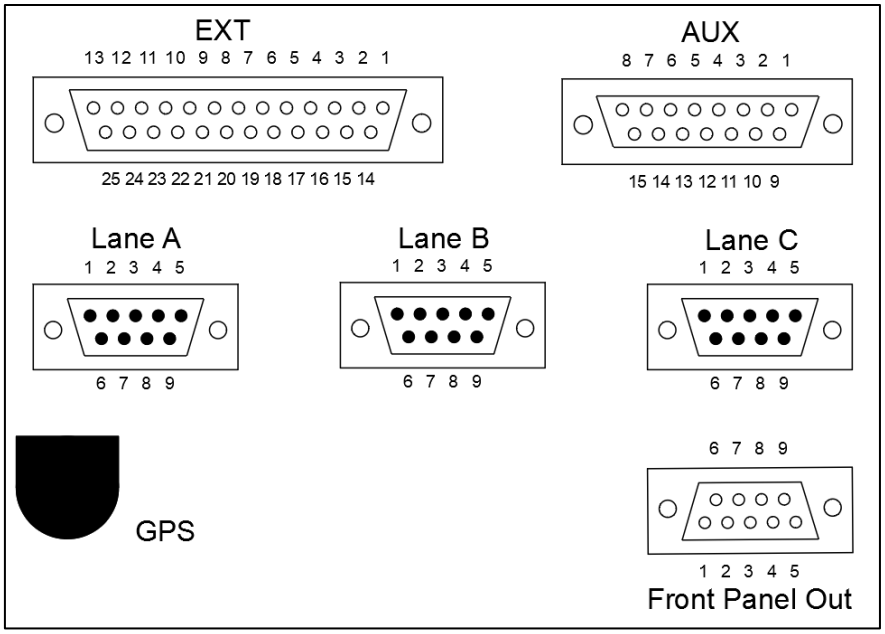

Figure 5-1: SCU Sub-D connector pin numbering

5.1 Lane A / Lane B / Lane C Connector

The Lane A Connector carries the power supply pins of the SCU (Pins 1 and 5) and Display CAN Lane A (Pins 2 and 7). Table 5-4 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 available on the two Harness Interface Connectors. Since termination resistors are built into the ECU as well as the SCU, no additional resistors are necessary.

Pin Number	Signal Name	Function
1	PWR_IN	positive SCU power supply
2	CANL_A	CAN Low, connect to HIC A, Pin 5
3	EXT_PWR_ACT	do not connect
4	EXT_DIN2	do not connect
5	AC_GND	negative SCU power supply, ground
6	EXT_DIN0	do not connect
7	CANH_A	CAN High, connect to HIC A, Pin 6
8	EXT_DIN1	do not connect
9	LS_OUT1	do not connect

Table 5-4: Lane A pinout

The 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 SCU. Table 5-5 specifies its pinout.

Pin Number	Signal Name	Function
1	PWR_IN	Optional: Backup Power
2	CANL_B	CAN Low, connect to HIC B, Pin 7
3	EXT_PWR_ACT	do not connect
4	EXT_LS_DIN8	do not connect
5	AC_GND	Optional: Backup Power GND
6	EXT_DIN3	do not connect
7	CANH_B	CAN High, connect to HIC B, Pin 8
8	EXT_DIN4	do not connect
9	SPARE	do not connect

Table 5-5: Lane B pinout

The Lane C Connector carries the third CAN Lane for the isolated output of the combined data from Lanes A and B to a third party display via the CANaerospace protocol.

Pin Number	Signal Name	Function
1	RS422RXA	do not connect
2	CANL_C	CAN Low, connect to external display
3	RS422RXB	do not connect
4	RS422TXA	do not connect
5	RS422TXB	do not connect
6	GND	do not connect
7	CANH_C	CAN High, connect to external display
8	DEBUG_TXD	do not connect
9	DEBUG_RXD	do not connect

Table 5-6: Lane C 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 5-7 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 5.7) 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 5.7):

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

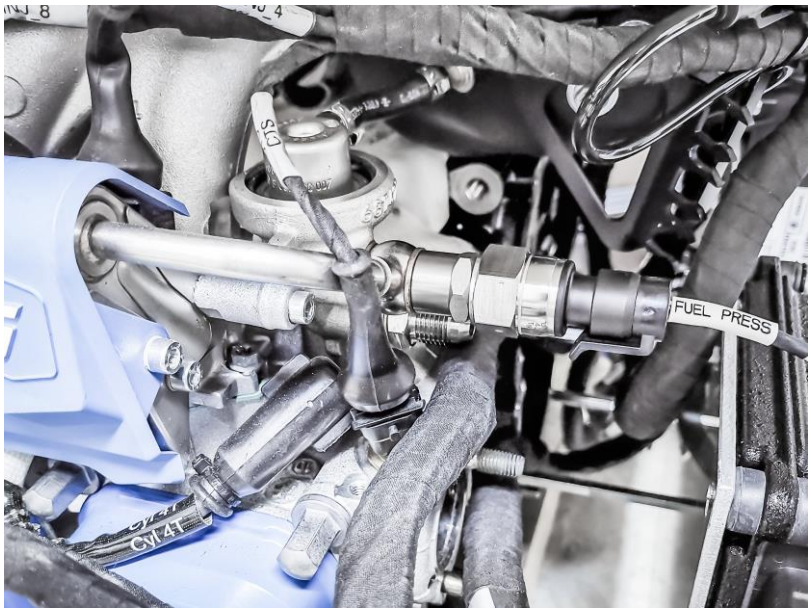

Figure 5-2: Fuel Pressure Sensor Installation

The standard hard- and software are designed to drive an electric MT-Propeller P-853-XX constant speed governor via the MOTOR+ and MOTOR- (Pins 7 and 8) outputs (function available on request). The exact variant of the governor depends on the specific aircraft configuration. Please contact RS Flight Systems for further details. A pre-wired harness is available as an accessory (see Chapter 5.7).

For SCU hardware revisions up to 2.0:

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

For SCU hardware revision 3.0 and higher:

The power supply of the P-853-XX governor is performed by an internal DCDC converter in the SCU and independent from the supply voltage of the SCU. Only 12 VDC governor versions must be used (e.g. P-853-12, P-853-95).

Pin Number	Pin Name	Function
1	AIN0	Analog Input 0 (Fuel Pressure)
2	DIN6	do not connect
3	DIN7	do not connect
4	AIN3	Analog Input 3 (Governor Limit)
5	GND	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	DIN5	do not connect
10	STARTER	do not connect
11	5V	5 V Analog Reference Voltage
12	GND	Analog Input Reference Ground
13	12V	12 V Analog Reference Voltage
14	A/C_GND	Aircraft Ground
15	GND	Internal Ground

Table 5-7: Auxiliary Connector pinout

The START_PWR and STARTER relay outputs drive up to 500 mA of inductive load and are referenced to the internal ground (Pin 15). The SCU uses these outputs to drive external start power and starter relays to simplify or even automate 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 startup of the SCU 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 (as found on the SCU Front Panel) remains necessary in order to fulfil all safety requirements (e.g. for engine restart in flight). An extinguishing diode across the relay coil is not needed and a suitable relay is available as an accessory (see Chapter 5.7). The Starter relay is intended for use on unmanned aircraft. Feel free to contact RS Flight Systems for different sensor and actuator configurations.

5.3 External Connector

The I/O connector offers filtered, but unregulated power output and further general I/O connections. The digital inputs are referenced to aircraft ground (Pin 3). The I/O connector is only available on the SCU 9IS Main Unit.

The low-side outputs are referenced to the internal ground and the high-side outputs are referenced to the power output.

Pin Number	Signal Name	Function
1	DIN9	do not connect
2	DIN10	do not connect
3	AC_GND	do not connect
4	LS_OUT2	do not connect
5	LS_OUT3	do not connect
6	LS_OUT4	do not connect
7	LS_OUT5	do not connect
8	LS_OUT6	do not connect
9	LS_OUT7	do not connect
10	GND	Internal Ground
11	GND	Internal Ground
12	GND	Internal Ground
13	GND	Internal Ground
14	GND	Internal Ground
15	LS_OUT0	do not connect
16	HS_OUT2	do not connect
17	HS_OUT3	do not connect
18	HS_OUT4	do not connect
19	HS_OUT5	do not connect
20	HS_OUT6	do not connect
21	HS_OUT7	do not connect
22	PWR	Power Output (9-32 V)
23	PWR	Power Output (9-32 V)
24	PWR	Power Output (9-32 V)
25	PWR	Power Output (9-32 V)

Table 5-8: External Connector pinout

Feel free to contact RS Flight Systems for your needs regarding I/O applications. Examples are automatically controlled LANE and fuel pump switches, temperature-controlled fan activation (Intercooler, Oil cooler), UAV applications and many more.

5.4 Front Panel out Connector

The Front Panel out connector is the interface to the optional extension units. A suitable connection harness between the main unit and the extension unit is available as an accessory (see Chapter 5.7). The pinout of the Front panel out connector is listed in Table 5-9. The Front Panel out connector is only available on the SCU 9IS Main Unit.

Pin Number	Signal Name	Function
1	PWR_IN 12V	positive Front Panel power supply
2	PWR_IN 3.3V	positive display power supply
3	OLED_SCK	Display control
4	OLED_MOSI	Display control
5	OLED_CS	Display control
6	TAST1	Button 1
7	TAST2	Button 2
8	TAST3	Button 3
9	GND	Internal Ground

Table 5-9: Front Panel Out Connector pinout

5.5 Electrical Installation Front / Display Panel

The pinout of the SCU connector is listed in Table 5-10. It is equal to the pinout of the Front Panel out connector of the SCU main unit.

Pin Number	Signal Name	Function
1	PWR_IN 12V	positive Front Panel power supply
2	PWR_IN 3.3V	positive display power supply
3	OLED_SCK	Display control
4	OLED_MOST	Display control
5	OLED_CS	Display control
6	TAST1	Button 1
7	TAST2	Button 2
8	TAST3	Button 3
9	GND	Internal Ground

Table 5-10: SCU Connector pinout

The pinout of the LED connector is listed in Table 5-11. For the connection of the warning lamps A and B please refer to the BRP Rotax Installation Manual 912iS / 915iS. The pre-resistors and the parallel resistors are integrated in the Front Panel and the Display Panel. Therefore, the pins 1-4 can be directly connected to the BRP Rotax HIC A and HIC B connectors.

The Start/Backup Power LED (pin 5) can be connected in parallel to the Start Power Relay in order to show the pilot the status of Start Power Relay function.

For the connection of the generator LEDs please refer to the manual of the generator.

Pin Number	Signal Name	Function
1	LANE_A	Warning Lamp Lane A
2	LANE_A_GND	Warning Lamp Lane A ground
3	LANE_B	Warning Lamp Lane B
4	LANE_B_GND	Warning Lamp Lane B ground
5	Backup_LED	Backup / Start Power LED
6	EMS_LED	EMS Power Controller LED
7	GEN_LED	Generator LED
8	GEN_LED_GND	Generator LED ground
9	Backup_EMS_GND	Backup / EMS Power LED ground

Table 5-11: LED Connector pinout

5.6 Wiring Diagrams SCU

This chapter describes the wiring of the SCU 9iS Main Unit. In Figure 5-3 the legend and nomenclature of the wiring is listed. In Figure 5-4 the general wiring for a connection to Garmin GEA 24, Dynon EMS-221, and Kanardia mini Daqu is shown. In Figure 5-5 the special wiring for the Garmin GEA 24B is represented.

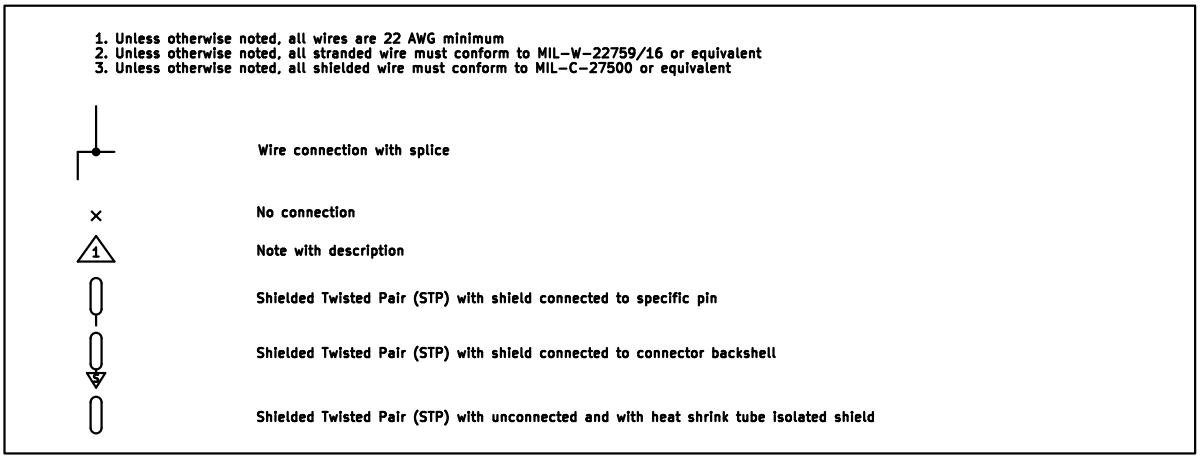

Figure 5-3: Legend of Wiring Diagram

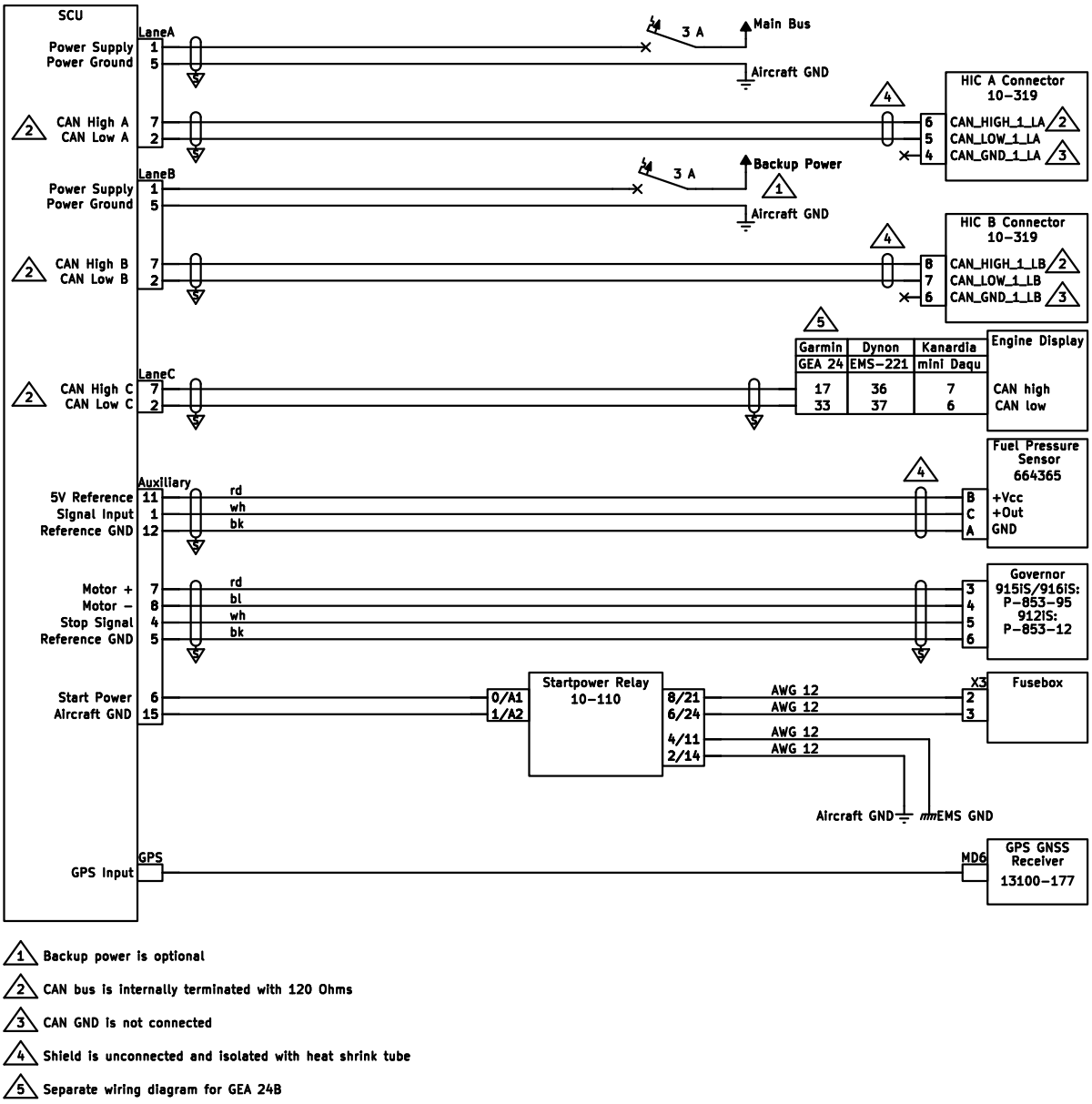

Figure 5-4: General Wiring Diagram

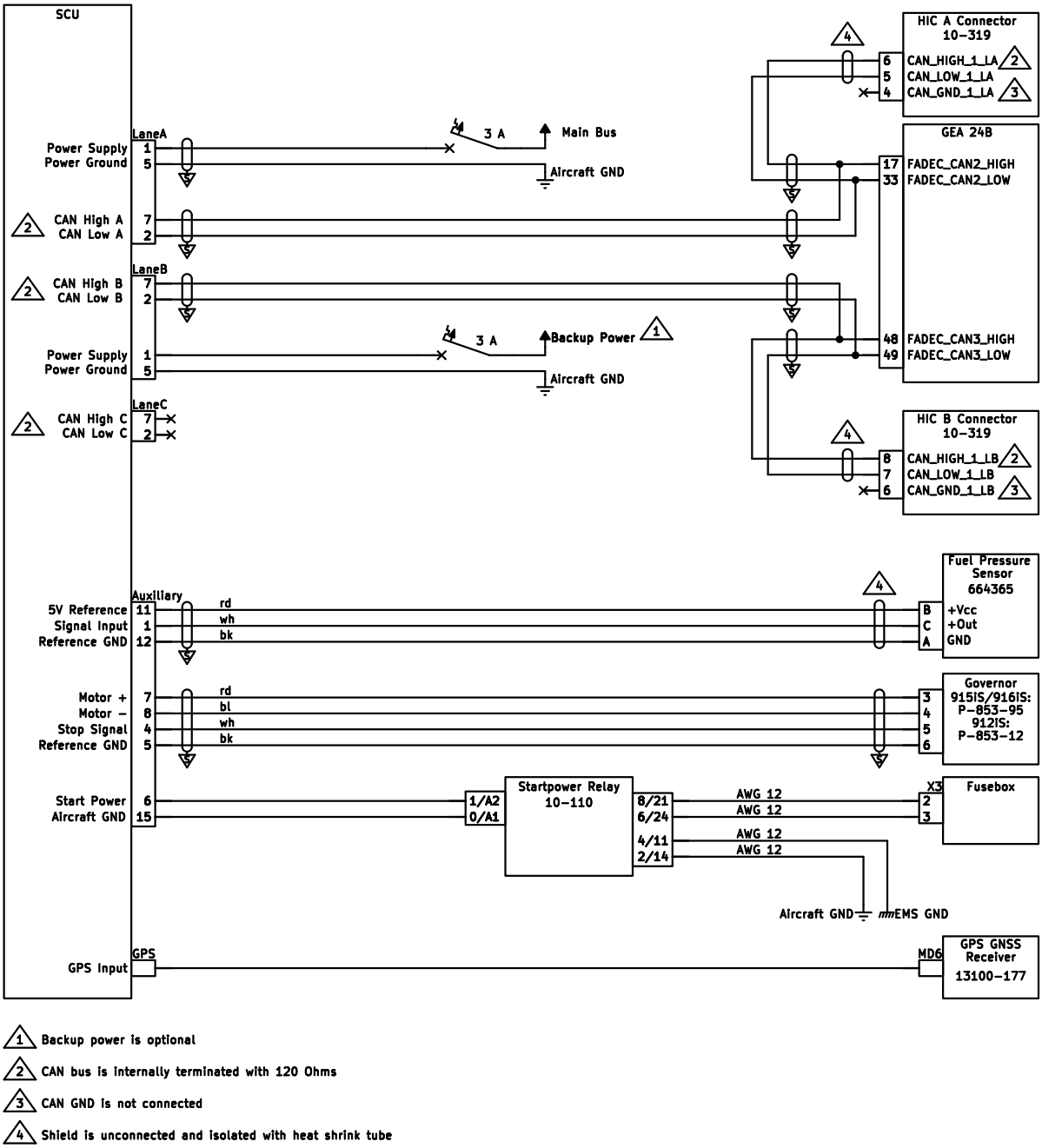

Figure 5-5: Wiring Diagram for Garmin GEA 24B

5.7 Available Accessories

Part No.	Name	Description
10-135	Wiring Harness Kit SCU	Shielded cables for the connection of the SCU Lane A, B and C to BRP Rotax 912/915 iS engines. Including power supply wires. Open wire ends at the side of the ECU. Length 2 m / 6.5 ft.
10-148	Wiring Harness SCU Display/Front Panel	Prewired shielded harness for the connection of the Front Panel or the Display Panel to the SCU. Length 1 m / 3.3 ft.
01001-132	SCU Front Panel	Please refer to chapter 4.3
01001-134	SCU Display Panel	Please refer to chapter 4.2
01002-075	SCU Front Panel V2	Advanced Switch Panel for Rotax iS engine with LCD Display
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
10-110	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: • 10-070 (Harness Fuel Pressure Sensor) • 10-806 (Hollow Screw) • 664365 (Fuel Pressure Sensor)
10-085	Connector Kit Auxiliary EMU/SCU	Manufacturing kit for Auxiliary connector Includes shell, connector housing and contacts Requires M22520 crimping tool
21008-716	SLPC Connection Harness	Prewired shielded harness for governor control Open end on SCU 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
10-316	Wire Harness SCU, 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	Power Supply Unit for the EMU and SCU, Input: 100 - 230 VAC, Output: 12 VDC, 5A. Connector for EMU/SCU
P-853-12	Propeller Governor 912iSC	MT Propeller governor for SLPC function. 12 V version.
P-853-95	Propeller Governor 915iS	MT Propeller governor for SLPC function. 12 V version.
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
46013-371	Backup Power Switch	2-pole Switch for the Rotax iS Backup Power function
46013-372	Toggle Switch	Switch for power supply of the EMU

Table 5-12: Harnesses and Accessories

6. Operation

6.1 Startup Power Relay Function

For the Rotax 912iS / 914iS / 915iS / 916iS engines, 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 6-1: Start Key Switch 9iS

Figure 6-2: Start Power Relay Kit

In order to improve the aircraft handling during the engine start process, the SCU 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 SCU 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 SCU 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”. An alternative to the Start Key Switch 9iS is the iS Engine Panel V3, which offers even more functions when switching the Rotax iS engine.

Figure 6-3: iS Engine Panel V3 Carbon

6.2 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 6.2. Feel free to contact RS Flight Systems for different SLPC configurations.

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 6-4. 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.

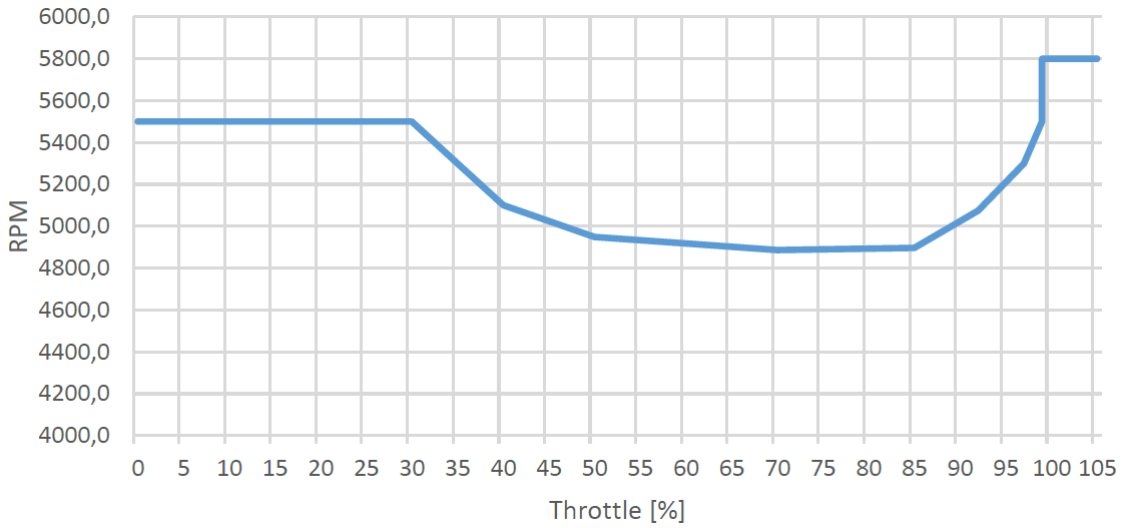

Figure 6-4: SLPC Control Curve

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 SCU 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 SCU due to a defect on the SCU side or a broken wire harness between SCU 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: RM02.01 for the 912iS and RM12.01 for the 915iS / 916iS. In both versions the requested RPM value can be selected with two push buttons on the SCU Display Panel or SCU Front Panel. If the manual version is used for 916iS engines, the range between 5450 rpm and 5750 rpm must be avoided.

For standard aircraft, six series versions are available:

Software Version	Engine	Description
RC0x:xx	912iS	Std. software for Rotax 912iS
RS0x:xx	912iS	STOL aircraft version
RG0x:xx	912iS	Gyrocopter version
RM0x:xx	912iS	Test software for manual propeller adjustment
RC1x:xx	915iS	Std. software for Rotax 915iS
RS1x:xx	915iS	STOL aircraft version
RG1x:xx	915iS	Gyrocopter version
RM1x:xx	915iS	Test software for manual propeller adjustment
RC2x:xx	916iS	Std. software for Rotax 916iS
RC4x:xx	914iS	Std. software for Rotax 914iS

Table 6-1: Standard Software Versions

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 air density. The resulting control curve is adapted to each type of aircraft. Standard versions are available for touring aircraft, STOL and seaplane. Feel free to contact RS Flight Systems for different SLPC configurations.

6.3 Display Function

If connected, the SCU shows engine and status information on the Display Panel. During SCU boot process the firmware version is displayed, after activating the CAN Lanes, the recommended throttle position is shown. After engine start, engine status information in sub menu 1 – 10 is available according to Figure 6-7. Engine power / eco mode is always displayed in the right lower corner.

Figure 6-5: Boot screen

Figure 6-6: Lanes activated, engine off

Figure 6-7: Menu 1

Menu	LH indicator	RH indicator
1	Manifold pressure MAP [mbar]	Engine RPM [rpm]
2	Throttle position sensor TPS [%]	Engine RPM [rpm]
3	Oil temperature OILt [°C]	Oil pressure OILp [bar]
4	Coolant temperature CHT [°C]	Ambient temperature AMBt [°C]
5	Fuel flow FF [l/h]	Fuel pressure FP [bar]
6	Exhaust gas temperature EGT1 [°C]	Exhaust gas temperature EGT2 [°C]
7	Exhaust gas temperature EGT3 [°C]	Exhaust gas temperature EGT4 [°C]
8	SLPC commanded RPM CMD [rpm]	GPS ground speed GS [kt]
9	Engine hours [h]	
10	UTC time [hh:mm:ss]	

Table 6-2: Display menu

6.4 Advanced Fuel Pressure Offset Configuration

By creating a “EMU912IS.CFG” file on the SD card with a common text editor 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 SCU.

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

6.5 Flight Data Recording

The SCU records all data transmitted by the ECU over both lanes and their respective CANaerospace interfaces. This function is only active as long as an SD card is inserted. For each restart of the SCU 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:

DAT000001.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 30 kilobytes per second. Using a 128 GB SDHX memory card, this results in a maximum recording time of more than 2000 hours (TBO of the engine). If a SDXC card with 64 GB or more is used it must be formatted with FAT32. The SCU 9iS Main Unit BB is equipped with a 128 GB SDXC card. An adapter to connect the Black Box to a card reader is available for OEMs at RS Flight Systems on request.

A powerful Engine Management Debriefing Station (EMDS) software for Microsoft Windows, SuSE Linux and Apple MacOS X operating systems is delivered with the SCU. This tool (see Figure 6-8 to Figure 6-12) 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/scu-9is

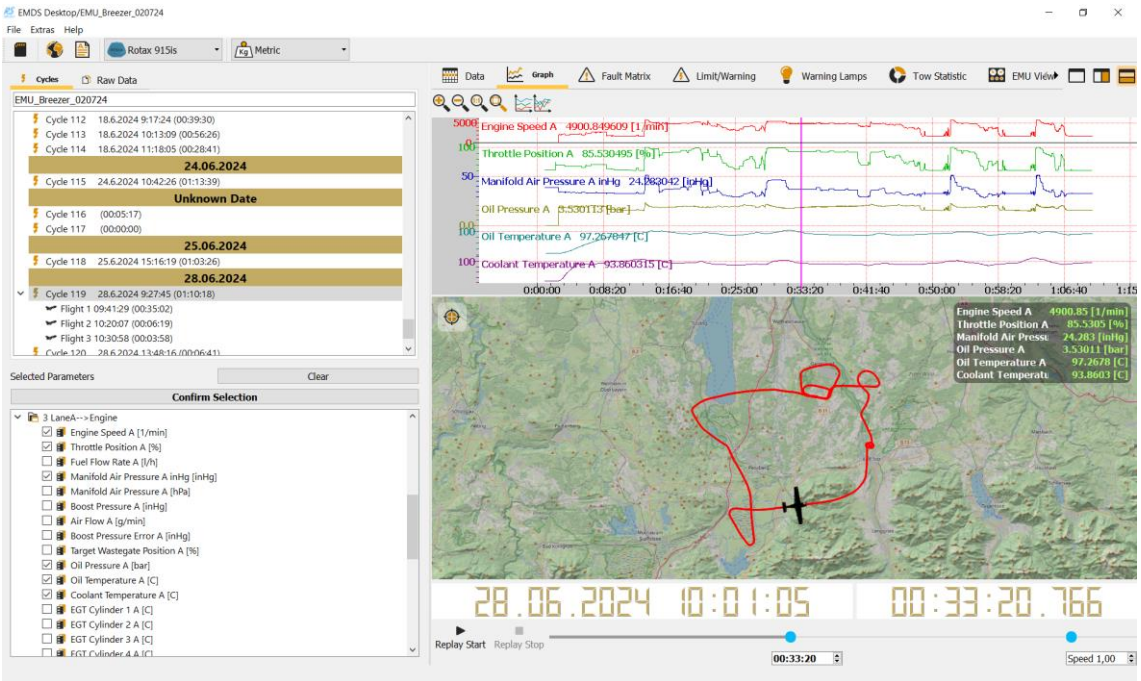

Figure 6-8: Engine Management Debriefing Station (EMDS) Software

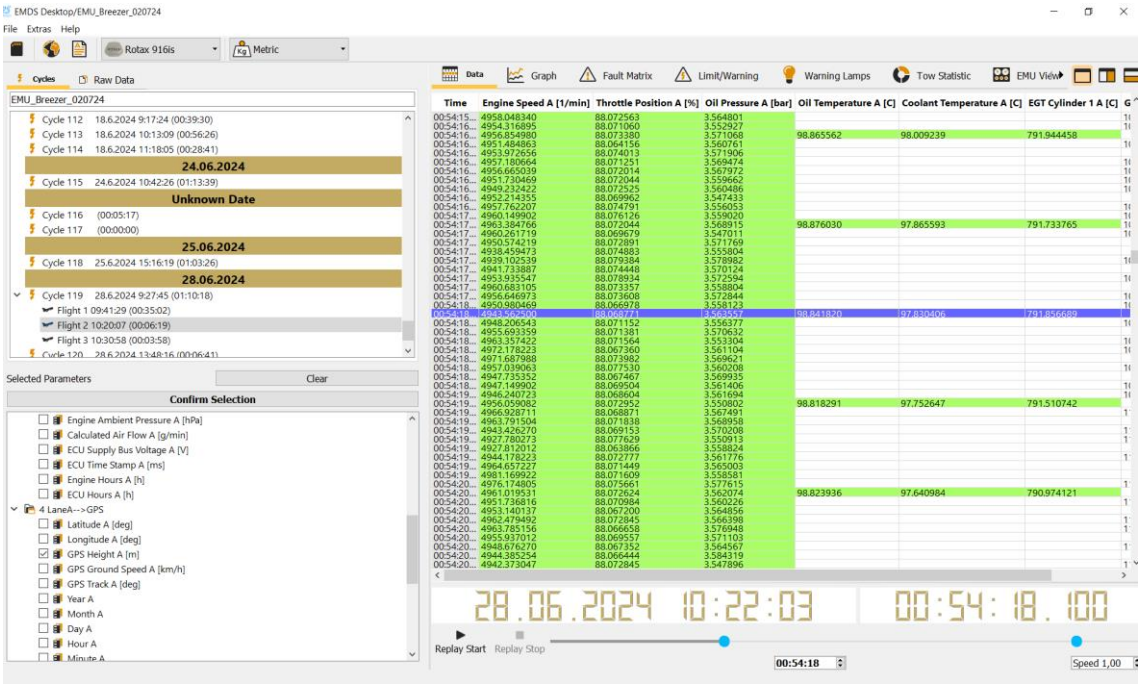

Figure 6-9: EMDS Data Screen

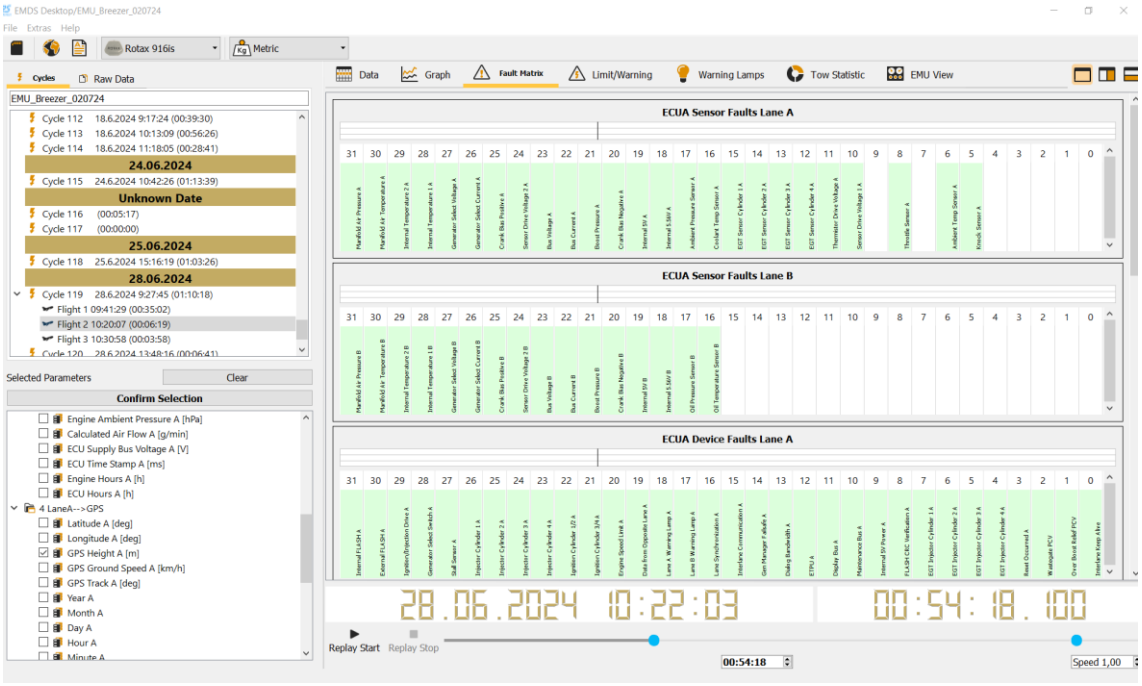

Figure 6-10: EMDS Fault Matrix Screen

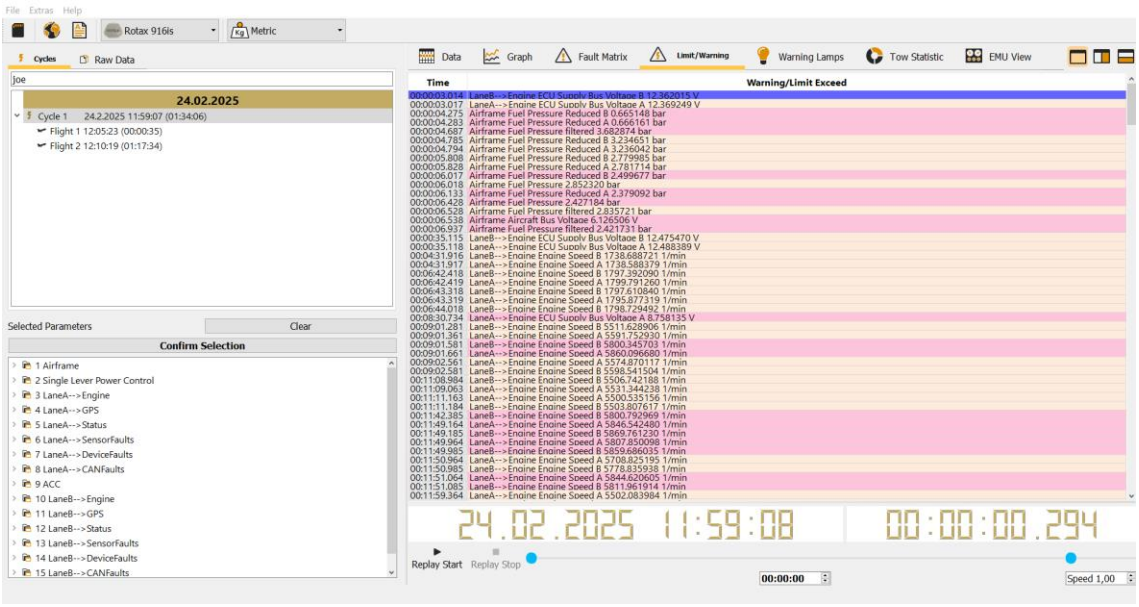

Figure 6-11: EMDS Limits Screen

Figure 6-12: EMDS generated Google Earth View

6.6 Software Update

The SCU 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:

SCU_915iS_SW_RS11.1C.zip -> SCU_915iS_SW_RS11.1C -> 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 down) in the slot in the main unit. The binary files are recognized by the SCU 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 6-1. Feel free to contact RS Flight Systems for customized software versions with individual SLPC algorithms.

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
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
SCU	System Control Unit
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
UAV	Unmanned Aerial Vehicle

UNC	Unified National Thread - Coarse
UTC	Coordinated Universal Time

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