Cambridge Avionics

Rotax 912iS / 915iS Status Monitor

Part No: CAV13

Installation and Operation Manual

(Please retain for reference)

Version 3.0

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(For firmware 4.0 and subsequent)

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CONTENTS

1. INTRODUCTION

The Rotax i-Series fuel-injected engines bring modern technology to the field of light aviation. They features twin, fully redundant fuel injection and electronically controlled ignition systems managed by twin Engine Control Units (ECUs).

The ECUs communicate with Engine Management Systems (EMS) and cockpit instrumentation systems by means of two pilot display CANbuses. As well as transmitting conventional engine operating parameters, the CANbuses also provide additional useful information, including over fifty specific device and sensor status messages.

Much of this additional useful information is not used or displayed by many popular EMS units. This is because, being based on conventional technology, they simply read the engine parameter data from the CANbuses and translate this to simulate conventional analogue engine instruments.

The 912iS/915iS Status Monitor is designed to complement existing EMS units by providing access to the additional and useful ECU information. It also functions as a useful backup instrument for many parameters and may be used as the sole instrument for initial engine start and tests.

This manual includes important information regarding the installation and operation of the equipment and should be read before use.

2. SUMMARY OF FUNCTIONS

The Status Monitor provides the following functions within the confines of a traditional 57mm (2 1/4 inch) diameter instrument:

- RPM meter
- MAP meter
- Oil pressure meter
- Coolant temperature meter
- Engine hour meter
- Throttle position indicator
- ECU voltmeter
- Full engine and generator status display (including economy and power modes)
- Verbose descriptions of any sensor or device errors and faults

3. INSTALLATION

3.1 Mechanical Installation

The Status Monitor is mounted in a standard 57mm avionics instrument hole.

The diagram in Section 7 shows the required layout of main panel and mounting screw holes. The figure also shows (dotted line) the amount of space required behind the panel to accommodate the instrument.

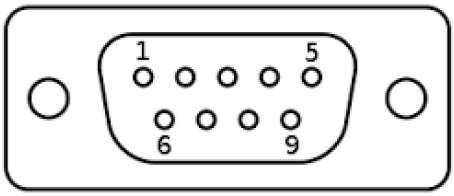
The mounting screws (provided) are M4 size and should be passed through the aircraft instrument panel and screwed into the tapped holes provided. Take care not to cross-thread or over-tighten the screws. In the unlikely event of the tapped threads becoming stripped, please see Section 6.2.

Remove the protective film from the display window before use.

3.2 Electrical Installation

All connections are made via a 9-pin male D connector on the rear of the instrument.

3.2.1 Connector Pin-Out



Pin	*Function*
1	CAN H
2	CAN L
3	(Unused)
4	(Unused)
5	Ground (0V)
6	(Unused)
7	(Unused)
8	(Unused)
9	Power supply +

NB: Do not connect anything to any of the unused pins as these are provided for test purposes in the factory. Applying a voltage to any of the unused pins could damage the instrument.

3.2.2 Power Supply

The Status Monitor requires a DC supply of between 8 and 16 volts.

It is acceptable to use the same supply as used for any existing EMS or RDAC units providing that the overall circuit is protected by a fuse or breaker of 1A or 2A rating. If a separate supply is used, this should ideally be protected using a 1A fuse or breaker.

As with conventional EMS displays, the Status Monitor has no on/off switch and it is acceptable to leave it connected during engine cranking. Should the voltage drop below 8V, an automatic brown-out detection circuit within the instrument is activated and this will protect and reset it when normal supply voltage levels are restored.

The aluminium case and front panel are not internally grounded, but no problems will result if they are grounded externally.

3.2.3 CANbus Connections

Both ECU Lane A and Lane B CANbuses are connected to pins 1 (CAN-H) and 2 (CAN-L) of the rear panel D-Sub connector.

Generally in 912iS installations, the Lane A and Lane B CANbuses will already be connected together and to the main EMS or RDAC unit. In these cases, the Status Monitor should be connected in parallel with the existing EMS unit.

In the case of installations where the Lane A and Lane B CANbuses are kept separate then it is still allowable to connect these together and to the Status Monitor. For more information regarding the pros and cons of keeping the ECU CANbuses separated, please see the note in Section 6.1.

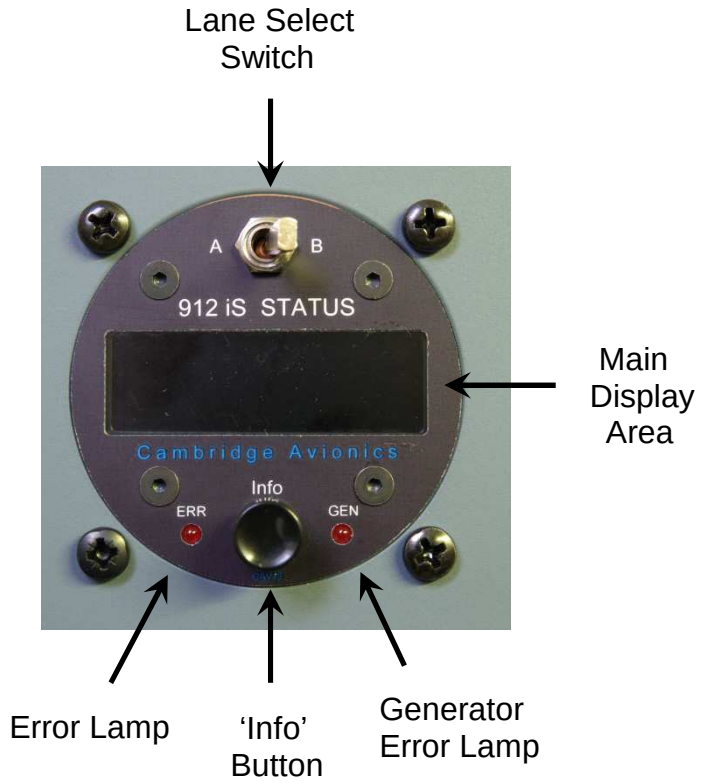
As with all CANbus wiring, twisted pair cabling should be used. Wire stub lengths should ideally be kept to lengths of 30cm or less.

Because it is intended to be connected in parallel with an existing bus, the Status Monitor has no bus terminating resistor.

4. OPERATION

4.1 Controls and Indicators

The figure below shows the main controls and indicators of the Status Monitor.



Control / Indicator	***Function***
Lane Select Switch	Selects ECU CANbus to read, Lane A or Lane B
'Info' Button	Selects display modes and user set-ups
Error Lamp	Illuminates on receipt of any ECU status error message
Generator Error lamp	Illuminates on receipt of a generator error message from ECU
Main Display	12 x 2 character OLED display

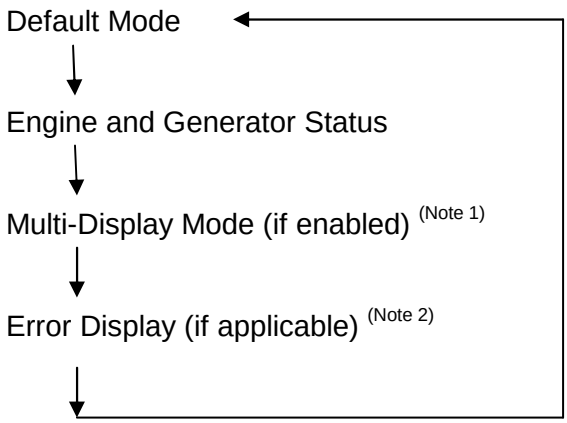
4.2 Power-Up

On first applying power, the Status Monitor switches on and performs an internal reset and test. A reset is indicated by the two indicator lamps flashing 3 times in quick succession. The internal firmware version is displayed for approximately 2 seconds after which the instrument reverts to the default display mode.

4.3 Display Modes

The Status Monitor has four display modes.

Pressing the 'Info' button cycles between these modes in the following sequence:



Note 1: Multi-Display Mode is user configured as described in Section 4.6.

Note 2: Error Display Mode will only be entered if there is an error to display. When an error occurs, the instrument automatically enters this mode.

Each display mode is described in more detail in the following sections.

4.4 Default Display Mode

The default display mode is always entered after switch-on.

When reading the ECU Lane A CANbus, the default display indicates RPM, engine hours (to 2DP) and throttle percentage. An example is shown below (left).

When reading the ECU Lane B CANbus, the default display indicates RPM, engine hours (to 1DP) and the actual voltage as seen by the ECUs. An example is shown below (right).

4.4.1 Note Regarding Engine Hours Display

Engine hours information is only sent down the pilot display CANbuses once per minute. Thus, when the Status Monitor is first used, it will take at least one minute, from the time at which the ECU Lanes are switched on, before the correct engine hours are displayed.

When engine hours information has been received from either ECU Lane, it is stored by the Status Monitor in non-volatile memory and will be shown immediately on subsequent power cycles.

4.5 Engine and Generator Status Display

In this mode, the display shows the current engine and generator status as reported by the selected ECU Lane.

The message descriptions have the following meanings:

MODE	(Shows engine PLA mode)
P	Engine is operating in 'Power' mode
E	Engine is operating in 'Economy' mode

GEN	(Shows generator control status)
N	This Lane is not controlling a generator
A	This Lane is controlling Generator A
B	This Lane is controlling Generator B

SYNC	(Shows engine speed and sync status)
Stall	Engine stalled, no crankshaft teeth detected
Wait	Engine running but waiting for valid synchronisation
Lane	Lane is synchronised to crankshaft position (Note 1)
Both	Lane is synchronised to crankshaft position and other Lane (Note 2)

Note 1: Rotax sometimes refer to this as 'half sync.'
Note 2: Rotax sometimes refer to this as 'full sync.' There is some evidence that not all ECUs correctly report full sync. on the pilot display CANbuses.

(Example displays shown on next page)

For example, this is typically what is seen prior to engine start when monitoring the Lane A CANbus.

Lane A is commanding Generator B. The engine is shown in power (default) mode and is stalled.

This is a typical display following a successful engine start.

Lane A is commanding Generator B (which is now running and supplying power to the engine systems), the engine has entered economy mode and the Lane is synchronised to the crankshaft position.

This is a typical display following a successful ‘Generator Swap’.

Generator A should take over the powering of the engine systems when the engine is first run to ~2400RPM for a few seconds.

As shown here, Lane A is now commanding Generator A (which is independently supplying all the engine systems). Generator B is supplying the aircraft electrical equipment and is charging the battery.

4.6 Multi-Display Mode

Multi-Display Mode is user selectable and configurable. It is disabled by default in a new Status Monitor.

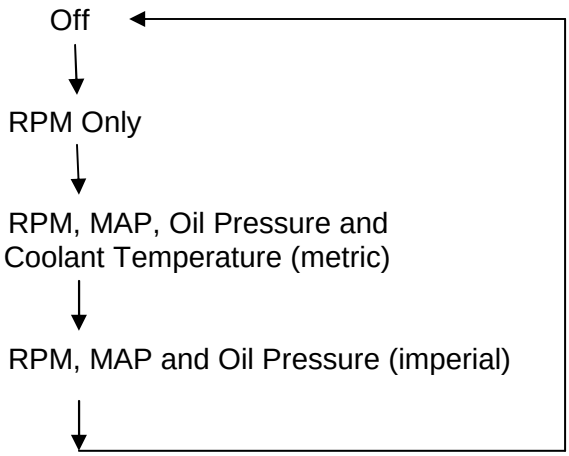
The Multi-Display modes enable the display of combinations of additional parameters which may be found useful for EMS backup purposes, or if the Status Monitor is the only instrument being used during initial engine start and tests.

To select Multi-Display Mode or change its settings, press and hold the ‘Info’ button for at least three seconds.

The display will indicate ‘RPM + Mode’ and show the current mode setting.

Pressing the ‘Info’ button repeatedly will then cycle through the four multi-display mode settings as follows:

Multi-Display Mode Settings



These mode settings have the following displayed names and functions:

Mode Setting	***Function***
Off	Multi-Display Mode is disabled
RPM Only	The display will show RPM with Lane A or Lane B selected
+MAP/O/C met	The display will show RPM and: Lane A: MAP in hectopascals Lane B: Oil Pressure in bar and Coolant Temperature in Celsius (alternating)
+MAP/Oil imp	The display will show RPM and: Lane A: MAP in inches of mercury Lane B: Oil pressure in PSI

When the required mode setting is shown on the display, press and hold the ‘Info’ button again, for at least 3 seconds. The display will show “Option Set” and store the mode setting. The mode setting is saved when the power is switched off.

A typical display when Multi-Display is enabled with the ’RPM Only’ option.

A typical display when Multi-Display is enabled with the '+MAP/Oil imp' option and Lane A selected.

Typical displays when Multi-Display is enabled with the '+MAP/O/C met' option and Lane B selected.

(These displays alternate every few seconds).

4.7 Error Display Mode

The error display mode is automatically entered in the event of any error status message being received from the selected ECU Lane. Typically, if an ECU Lane warning lamp illuminates or flashes, the Status Monitor will provide a description of the reason.

In the unlikely event of multiple errors or failures being reported, the Status Monitor will scroll through these in turn.

When an error condition is detected, the 'ERR' lamp on the Status Monitor will illuminate and will not extinguish until the error as reported has been cleared. In the event of a Generator error, the 'GEN' lamp will also illuminate.

In this example, a device fault is being indicated by Lane B.

This is a fuel injector error or fault on cylinder #1.

In this case, a generator-related error is being indicated.

While in an error condition, the other display modes remain available and can be cycled by pressing the 'Info' button.

Sections 6.3 and 6.4 give further details of all the error status messages.

4.8 'No Data' Display

If no data for a particular parameter is being received from the ECU, then its value on the display will be indicated by a dash ("-"). This might also be seen briefly when switching lanes and before any updated information is received.

5. SPECIFICATIONS

Parameter	***Value***	***Comments***
Fascia panel size	57mm dia. x 2mm thick	
Size behind panel	82mm x 63mm x 31mm	Width x Height x Depth
Power supply range	8 – 16 V DC	
Current consumption	90mA typ, 120mA max.	
Operating temp. range	-10C to +40C	
Weight	125g	
Connector	9-pin D-Sub	
Fuse/breaker	1A or 2A	

6. ADDITIONAL NOTES AND INFORMATION

6.1 Note Regarding Connection of ECU Lane CANbuses

CANbus systems are designed to be connected together, from both physical and electrical (protocol) standpoints. Early 912iS installation manuals from Rotax showed that the pilot display CANbuses from ECU Lanes A and B can be connected in parallel and then fed to an EMS/RDAC with no problems. In this configuration the system works perfectly well. However, if a wiring or cable error should arise in a shared connection or connector (such as an open, short or poor soldered connection) then there is a possibility that both CANbus signals could be compromised.

Because such shared connections are made by the user/installer, rather than by Rotax themselves (and are thus not under their direct control), Rotax changed their guidance in later installation manuals to show the CANbuses being kept separate and with individual connections to RDAC/EMS units.

While it is true that a wiring error in a parallel connection *could* compromise both buses, this is very unlikely if care is taken in making the connections. It should be noted that, even if data from the pilot display CANbuses is lost, the engine does not stop and the actual engine performance is not compromised.

6.2 Stripped Mounting Holes

The instrument mounting holes are tapped into polycarbonate and whilst working perfectly satisfactorily under normal circumstances, if the instrument is removed or installed multiple times the threads will tend to wear more rapidly than metal equivalents. In the unlikely event of the threads becoming stripped during installation, all is not lost! It is possible to use a set of longer (M4 x 35mm) screws, washers and nuts (not provided) to mount the instrument. Remove the 4 small round labels from the rear of the instrument and carefully pass the screws all the way through the instrument case before securing them with M4 washers and nyloc nuts against the rear face.

6.3 Sensor Error Messages

This section provides more information on the specific sensor error messages as displayed by the Status Monitor.

Note that messages marked ******* are applicable to the 915iS turbo engine only.

Error Message	***Further Information***
Knock sensor *******	Knock sensor error or failure
Ambient temp	Engine ambient temperature sensor error or failure
Throttle pos	Throttle position sensor error or failure
Drive volt 1	Sensor drive voltage #1 out of limits
Therm. Drive	Thermistor drive voltage out of limits
EGT cyl 4	Exhaust Gas Temperature sensor error or failure (cylinder 4)
EGT cyl 3	Exhaust Gas Temperature sensor error or failure (cylinder 3)
EGT cyl 2	Exhaust Gas Temperature sensor error or failure (cylinder 2)
EGT cyl 1	Exhaust Gas Temperature sensor error or failure (cylinder 1)
Coolant temp	Coolant temperature sensor error or failure
Amb. Press	Engine ambient pressure sensor error or failure
Oil temp.	Oil temperature sensor error or failure
Oil pressure	Oil pressure sensor error or failure
Crankfault 2	Crankshaft position sensor #2 error or failure
Boost pres. *******	Turbo boost pressure sensor error or failure
ECU current	ECU current too high or current sensor error or failure
Bus voltage	Bus voltage out of limits
Drive volt 2	Sensor drive voltage #2 out of limits
Crankfault 1	Crankshaft position sensor #1 error or failure
Gen sel curr	Generator select current error
Gen sel volt	Generator select voltage error
Int. temp. 2	Internal temperature out of limits or temperature sensor #2 error or failure
Int. temp. 1	Internal temperature out of limits or temperature sensor #1 error or failure
Man. temp.	Manifold air temperature sensor error or failure
MAP	Manifold Air Pressure sensor error or failure

6.4 Device Error Messages

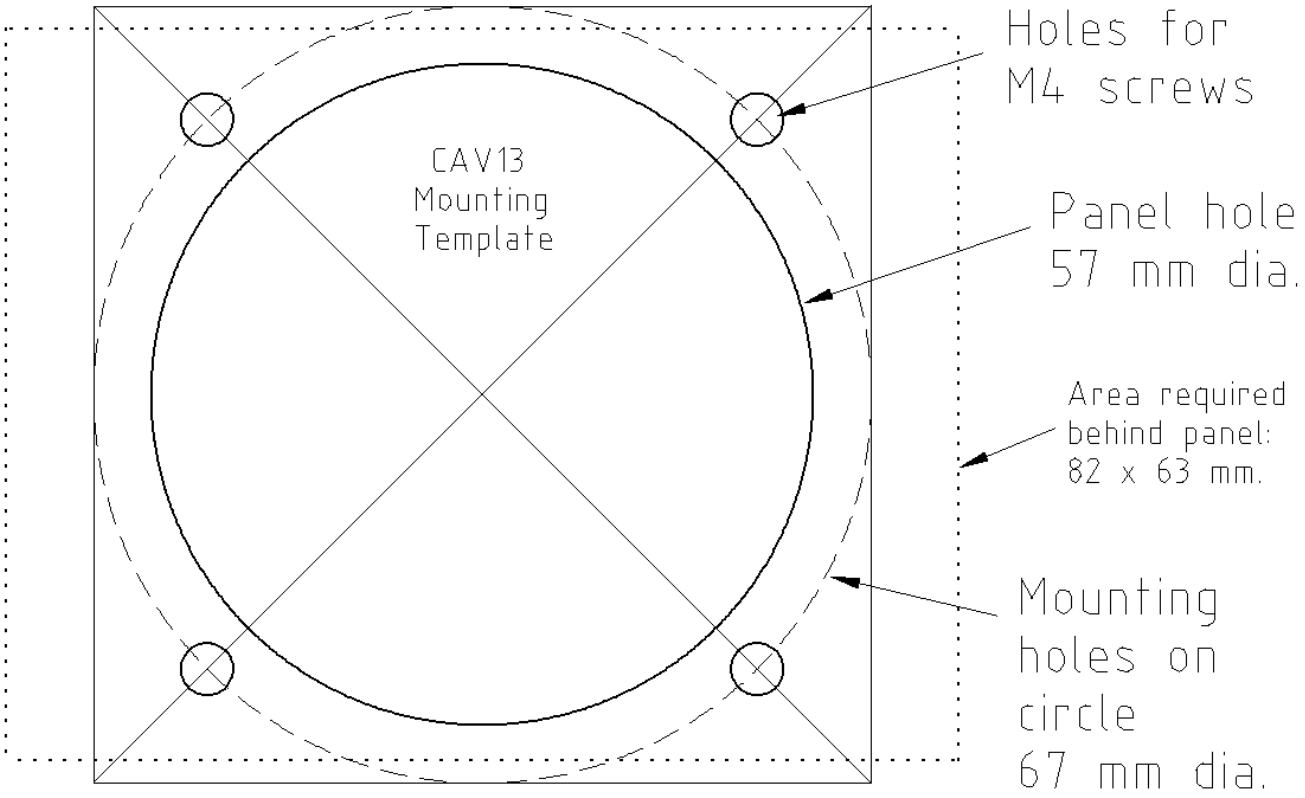
This section provides more information on the specific device error messages as displayed by the Status Monitor.

Note that messages marked ******* are applicable to the 915iS turbo engine only.

Error Message	***Further Information***
Interlane KA *******	Inter-lane keep-alive discrete signal failure
Overboost CV *******	Overboost relief pressure control valve error or failure
Wastegate CV *******	Wastegate pressure control valve error or failure
Reset	Uncommanded ECU reset occurred
EGT Inj 4	EGT Injector cylinder #4 error or failure
EGT Inj 3	EGT Injector cylinder #3 error or failure
EGT Inj 2	EGT Injector cylinder #2 error or failure
EGT Inj 1	EGT Injector cylinder #1 error or failure
Flash CRC	Internal FLASH memory CRC verification failure
Maint CAN	Maintenance CANbus error
EMS CAN	Pilot display CANbus error
Int. Timer	Internal timer error
Int. Logger	Internal logging system error
Generator	Generator or generator circuit error or failure
Lane comms	Inter-Lane ECU communication failure
Lane sync	Lane synchronisation error
Lamp B	Warning lamp (Lane B) error or fault
Lamp A	Warning lamp (Lane A) error or fault
Lane B data	No data received from Lane B (as reported by other Lane)
Lane A data	No data received from Lane A (as reported by other Lane)
Limiter	Engine speed limiter activated
Ign cyl 3 / 4	Ignition error or fault, cylinders 3 and 4
Ign cyl 1 / 2	Ignition error or fault, cylinders 1 and 2
Inj cyl 4	Fuel injector error or fault, cylinder #4
Inj cyl 3	Fuel injector error or fault, cylinder #3
Inj cyl 2	Fuel injector error or fault, cylinder #2
Inj cyl 1	Fuel injector error or fault, cylinder #1
Stalled	Engine reporting unexpected stall
Gen selector	Generator select switching error or fault
Ign/Inj driv	Ignition / Injector driver error or fault
Ext Flash	External FLASH memory error or fault
Int Flash	Internal FLASH memory error or fault

7. PANEL MOUNTING DETAILS

(Not to scale)



8. CERTIFICATIONS AND DISCLAIMER

The equipment is manufactured in the UK according to EN ISO 9000 / EN ISO 9001 and is CE marked according to 2006/95/EC, EN55022 and EN55011 Class B.

The equipment ***is not*** approved by FAA, EASA or CAA.

Important Note:

This equipment is not approved for installation in type certified aircraft.

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The manufacturer reserves the right to alter any aspect of the product specification without notice.

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