





## Table of Contents

Introduction .....	3
1. General information .....	5
2. Handling in transport and storage .....	6
3. Installation.....	6
3.1. Environmental specifications.....	6
3.2. Dimensions .....	7
3.3. Mounting .....	7
3.4. Power and wiring.....	7
4. Operation and maintenance .....	10
4.1. Measured signals .....	10
4.2. Signal analysis .....	10
4.3. Additional functionalities.....	13
4.4. Readout of module records .....	13
5. Service, diagnostics and repairs .....	14
5.1. Service life.....	14
5.2. Checks .....	14
5.3. Cleaning and conservation.....	14
5.4. Troubleshooting.....	15
5.5. Repairs .....	15
5.6. Re-programming .....	16
5.7. Spare parts.....	16
6. Warranty .....	16

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## Introduction

This engine monitoring module EMS DAQ R02.01 is intended for ultralight, microlight, homebuilt and experimental aircraft. This module is not certified by the FAA and EASA. Fitting of this module to a certified aircraft is subject to the rules and conditions pertaining to such in your country. Please check with your local aviation authorities if in doubt.

This engine monitoring module EMS DAQ R02.01 is an element of the Integrated Avionics System that measures the following engine operation parameters:

- a) Engine speed;
- b) Rotor speed;
- c) Inlet air pressure;
- d) Inlet air temperature;
- e) Oil pressure;
- f) Oil temperature;
- g) Cylinder head temperature;
- h) Exhaust gases temperature;
- i) Fuel level;
- j) Pitch and roll trim position.

The purpose of EMS DAQ R02.01 type measuring module is to collect input, analyse it in terms of threshold levels, and record selected information. Measured values are communicated to the pilot by means of the following displays type EEM MOT 01 FE....

Functionalities of the module include:

- a) analysing and recording instances of crossing thresholds of operating parameters,
- b) providing records and statistics on how often, to what extent and for how long parameter values were outside the desired range;

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- c) recording flight time: from last engine start, and the total engine operation time (HOBS).

The module is designed to work with ROTAX 912 UL, 912 ULS and 914 engines. A list of signals processed by the module together with sensor types is presented in Table 1.

**Tab. 1** Sensors providing input for EMS DAQ R02.01 Module

No.	Parameter	Sensor
1	Engine speed	BRP TRIGGER COIL KIT 264087 <sup>1</sup>
2	Rotor speed	Autonics PR08-1.5DN
3	Inlet air pressure	Bosch 0 281 002 976
4	Oil pressure	BRP 456180 <sup>1</sup>
5	Oil temperature	BRP TEMPERATURE SENSOR 965531 <sup>1</sup>
6	Cylinder head temperature	BRP TEMPERATURE SENSOR 965531 <sup>1</sup> (2 sensors)
7	Exhaust gases temperature	BPR THERMO COUPLE NICR-NI K 966370 <sup>1</sup> (2 sensors)
8	Inlet air temperature	Bosch 0 281 002 976
9	Fuel level	Vdo 224-011-020-372g
10	Trim pitch and roll	Signal from actuator Linak La 12

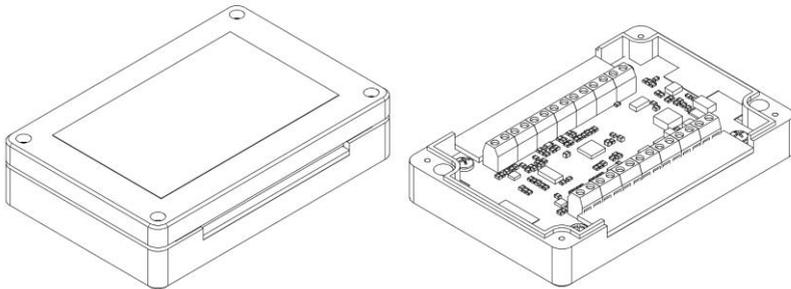
<sup>1</sup> Standard sensor for ROTAX engine

The module's casing made of black ABS is splash-proof. Cables connecting sensors with printed circuit board of the device enter the casing via screw connection terminal blocks. The opening is sealed by means of sealing foam tape pasted to both parts of the casing.

Hardware identification plates are located in the front of the casing (Fig. 1) and inside (on circuit board).

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**Fig. 1. EMS DAQ R02.01 module (complete casing and casing with lid removed)**

## 1. General information

This manual contains binding information, guidelines and warnings for safe handling and maintenance of this particular instrument before installation, during installation and in its operating phase. This document does not contain rules and guidelines on operation of aircraft instruments at large.

Read the manual thoroughly before turning on the instrument and precisely follow the instructions to install and configure it. This manual does not replace instructions on installation, maintenance and operation of this device in a particular airframe - these are to be prepared by the user. Instructing the pilots and maintenance personnel on operation of the instrument is also the responsibility of the user.

Operation of this device is the sole responsibility of the pilot in command (PIC) of the aircraft. This person must be proficient and carry a valid and relevant pilot's license. This person has to make themselves familiar with the operation of this module and the effect of any possible failure or malfunction. Under no circumstances does the manufacturer condone usage of this instrument for IFR flights.

This manual defines the scope of maintenance measures the user is authorised to conduct on their own. Any repairs or modifications outside this scope conducted by the user or contracted to a third party, as well as

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using non-original parts and subassemblies voids the warranty, relieves the supplier from any liability, making the device lose the status of the product of Auto & Aero Technologies Sp. z o.o. with all the resulting consequences.

## 2. Handling in transport and storage

1. The EMS DAQ R02.01 module is bubble-wrapped to protect it against vibration and other physical damage, and packed in a cardboard box together with the warranty card.
2. The display must be stored and transported assuring that:
  - the ambient temperature stays in the range of  $10 \div 40^{\circ}\text{C}$
  - the ambient relative humidity stays in the range of  $10 \div 90\%$ , safe from condensation.
3. The display should be protected from water.

## 3. Installation

### 3.1. Environmental specifications

The EMS DAQ R02.01 module has been designed to be installed in engine compartment of ultralight aircrafts of ceiling not exceeding 3 000 m (10 000 ft). Acceptable ranges of operating parameters are listed below:

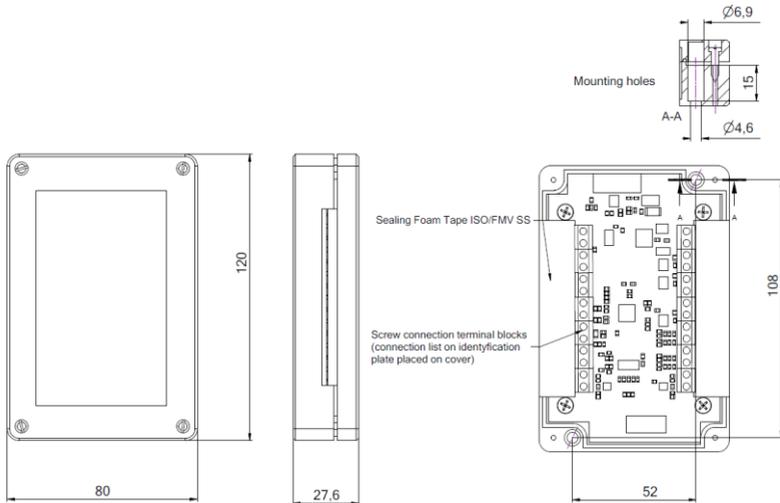
- Operating temperature:  $-20^{\circ}\text{C} \div 50^{\circ}\text{C}$
- Short-term operating temperature:  $-25^{\circ}\text{C} \div 60^{\circ}\text{C}$
- Humidity:  $0 \div 95\%$ , no condensation;
- Ambient air pressure:  $45 \div 105\text{ kPa}$ ;
- Vibrations:  $<5\text{ g}$  at frequencies below 150 Hz;

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**3.2. Dimensions**

Outline dimensions of the device are: 80 x 120 x 28 mm (*width x height x depth*), Weight: 160 g.



**Fig. 2. EMS DAQ R02.01 module outline drawing**

**3.3. Mounting**

The EMS DAQ R02.01 Module should be installed vertically using mounting holes (shown in Figure 2). The module should be located in a part of the engine compartment sheltered from splashes of water or other liquids, as close as possible to sensors and the battery.

**3.4. Power and wiring**

The EMS DAQ R02.01 module is powered from the aircraft power system. Power specifications: nominal supply voltage 12V, acceptable supply voltage range 8 ÷ 30V, current < 80mA.

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The module is connected to the system by means of screw connection terminal blocks attached to printed circuit plate inside the casing. A schematic diagram of the connection is shown in Figure 3.

The power supply requires 0.75 mm<sup>2</sup> wires.

Sensor connection requires 0.5 mm<sup>2</sup> wires.

Thermocouple wires should be attached directly to the module's connector.

Data bus (RS0, RS1, RS2) requires twisted pair wires (2 x 0.5mm<sup>2</sup>) according to DIN VDE 0814. Twisting should continue to the pins of the connector.

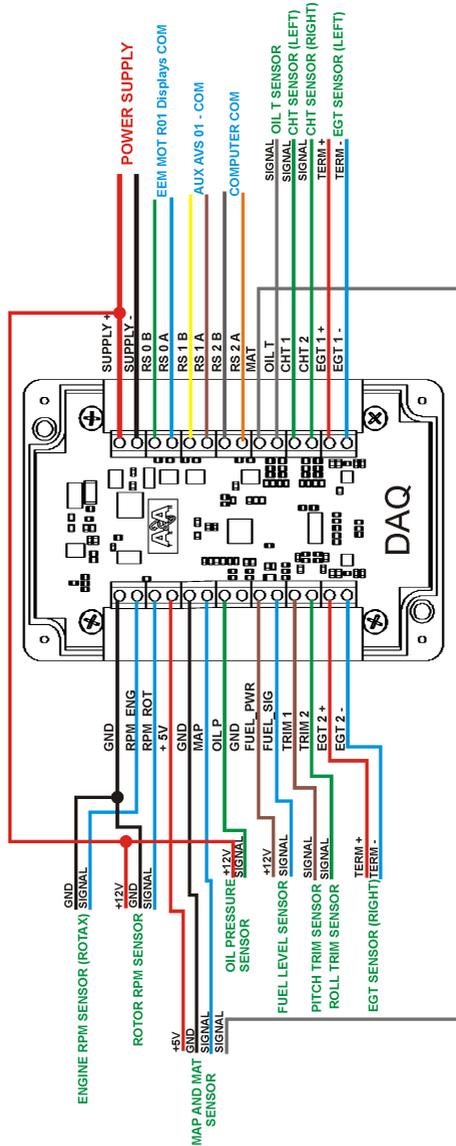
Power grounding to the battery clamp by means of a cable as short as possible (no longer than 0.5m).

Power, sensor and data bus wires are to be connected to the device with the lid removed, and placed with care so that the sealing tape of the lid and the case fit tightly.

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**Fig. 1** EMS DAQ R02.01 Module connections

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## 4. Operation and maintenance

*The module is to be connected to EEM MOT 01 FE... displays by RS485 (line RS0) and AUX AVS 01 module (line RS1) and diagnostic connector (line RS03).*

### 4.1. Measured signals

The type and value range of signals measures by the Module are listed in Table 2.

Tab. 2 Signals processed by EMS DAQ R02.01 Module

No.	Parameter	Measurement range	Accuracy
1	Engine speed	0 ÷ 6500 rpm	± 10 rpm
2	Rotor speed	0 ÷ 500 rpm	± 1 rpm
3	Inlet air temperature	0,3 ÷ 4 bar abs.	± 0,1 bar
4	Oil pressure	0 ÷ 10 bar	± 0,1 bar
5	Oil temperature	-20 ÷ 200°C	± 2°C
6	Cylinder head temperature	-20 ÷ 200°C	± 2°C
7	Exhaust gases temperature	-50 ÷ 950°C	± 5°C
8	Inlet air temperature	-20 ÷ 200°C	± 2°C
9	Fuel level	10 ÷ 120 l	± 1 l
10	Trim pitch and roll	0 ÷ 10 V	± 0,1V
11	Flight time		± 1 s
12	Total engine running time (HOOBS)		± 1 min

### 4.2. Signal analysis

The EMS DAQ R02.01 Module analyses and records instances and duration of the signals' exceeding threshold values for selected engine parameters

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listed in Table 3. The records of threshold crossing contain the following information:

- a) Type of occurrence;
- b) Number of occurrences of each type;
- c) Moment of occurrence defined by the number of system's starts from the fact of installing the system until the occurrence, total operation time of the system from its last start until the occurrence, and total engine operation time (HOOBS) until the occurrence.

**Tab. 3** Types of threshold crossings recorded by EMS DAQ R02.01 Module

No.	Signal	Threshold levels
1	Engine speed	> 5500 rpm, if present for more than 5 min
2	Engine speed	> 5800 rpm
3	Rotor speed	> 450 rpm
4	Inlet air pressure	> 46 inHg
5	Oil pressure	< 1 bar, if engine speed greater than 900 RPM
6	Oil pressure	> 7 bar, if engine speed greater than 900 RPM
7	Oil temperature	> 130°C
8	Oil temperature	> 130°C, if present for more than 15 min
9	Oil temperature	> 150°C
10	Oil temperature	< 50°C, if rotor speed greater than 200 RPM
11	Cylinder head temperature – sensor 1	> 110°C
12	Cylinder head temperature – sensor 1	> 110°C, if present for more than 30 min
13	Cylinder head temperature – sensor 1	> 120°C
14	Cylinder head temperature – sensor 2	> 110°C
15	Cylinder head temperature – sensor 2	> 110°C, if present for more than 30 min
16	Cylinder head temperature – sensor 2	> 120°C

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The occurrences of threshold crossing are recorded separately according to their type. The system remembers four last occurrences. Information on them is downloadable by means of a diagnostic connector, a converter, and a dedicated software. These logs (all or selected) can be cleared by the supplier of the aircraft and by the user.

The EMS DAQ R02.01 Module analyses and records statistics of selected parameters of engine and aircraft operation. These parameters are listed in Table 4. For each parameter, four value ranges are defined. The module records the following data:

- a) Number of instances of a parameter entering a specific range,
- b) Total duration of a parameter assuming values from a specific range.

The data are recorded separately for each parameter and for each of four value ranges. Information on the statistics is downloadable by means of a diagnostic connector, a converter, and a dedicated software (not supplied with the device). The statistical records (all or selected) can be cleared from the module only by the supplier of the aircraft.

**Tab. 4** Statistics of engine and aircraft operation parameters analysed and recorded by EMS DAQ R02.01 Module.

No.	Signal	Thresholds of value ranges			
		I	II	III	IV
1	Engine speed (rpm)	from 5500 to 5600	from 5600 to 5700	from 5700 to 5800	above 5800
2	Rotor speed (rpm)	from 400 to 425	from 425 to 450	from 450 to 475	above 475
3	Inlet air pressure (bar)	from 1,40 to 1,45	from 1,45 to 1,50	from 1,50 to 1,55	above 1,55
4	Inlet air temperature (°C)	from 50 to 55	from 55 to 60	from 60 to 65	above 65
5	Oil pressure (bar) – if engine speed >900 rpm	from 0,0 to 1,0	from 1,0 to 2,5	from 5,0 to 7,0	above 7,0
6	Oil temperature (°C)	poniżej 0	from 0	from 20	from 40

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			to 20	to 40	to 60
7	Oil temperature (°C) (if rotor speed > 200 rpm)	ponizej 0	from 0 to 20	from 20 to 40	from 40 to 60
8	Cylinder head temperature – sensor 1 (°C)	from 100 to 110	from 110 to 120	from 120 to 130	above 130
9	Cylinder head temperature – sensor 1 (°C)	from 100 to 110	from 110 to 120	from 120 to 130	above 130
10	Cylinder head temperature – sensor 2 (°C)	from 850 to 875	from 875 to 900	from 900 to 925	above 925
11	Cylinder head temperature – sensor 2 (°C)	from 850 to 875	from 875 to 900	from 900 to 925	above 925
12	Linear acceleration (g) <sup>1</sup>	from 2 to 4	from 4 to 8	from 8 to 12	above 12

<sup>1</sup> if connected to AUX AVS 01

### **4.3. Additional functionalities**

Connecting the module to AUX AVS 01 communication module enables the system to analyse linear acceleration and to adjust brightness of EEM MOT 01 FE... monitor displays (digital data about brightness level send form AUX AVS 01 to each monitors).

### **4.4. Readout of module records**

To access records of engine and aircraft operating parameters, the EMS DAQ R02.01 Module needs to be connected to data bus RS2 (Figure 3) by means of RS485->USB converter. A software enabling data transmission can be downloaded from [www.aatech.pl](http://www.aatech.pl).

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## 5. Service, diagnostics and repairs

### 5.1. Service life

- a) TBO of the module is not defined.
- b) In the case of failure or error, the module must not be used any more.

### 5.2. Checks

The following checks are recommended:

- 1) At pre-flight check:
  - a. Turn on the power to check if operational (the EEM MOT 01 FE... monitors should display data);
- 2) After 100 hours of flight:
  - a. Check the instrument's electric connections:
    - Remove the lid of the monitor casing;
    - Check if wires sit firmly in screw connection terminal blocks,
    - Check for wire damage as frayed insulation;
    - Place wires flatly and in parallel in the case to avoid overlapping at the exit from the casing,
    - Attach the lid.
  - b. Turn on the power on to check if operational (check if EEM MOT 01 FE... monitors display data);
  - c. Read/download EMS DAQ R02.01 records.

### 5.3. Cleaning and conservation

The casing is to be buffed with water-damped soft cloth. Optionally, if very dirty, can be cleaned with cloth sparingly damped with mild soap solution. Caution: avoid spilling liquids over the device.

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## 5.4. Troubleshooting

- a) If information is not displayed on some of the monitors (type FE...) when power is applied (Fig. 8), check connection inside measurement module. Check:
  - power connection; ensure that your power supply is capable of supplying at least 8 volts, and no more than 30 V.
  - data bus connection (RS0);



**Fig. 3. Indication of no connection to measurement module**

- a) If the system does not react to brightness adjustment, check connection with AUX AVS 01 (RS1);
- b) In the case of the module's failure or malfunction, turn power off and on again.
- c) If the above does not solve the problem, the module needs to be replaced.
- d) A defective module must not be used.

## 5.5. Repairs

Repairs and inspections of the module can be conducted only by its manufacturer.

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The module does not contain any user-serviceable parts. Unauthorized repairs or modifications may result in permanent damage to the equipment and void the warranty.

If the module fails, return the device to the Manufacturer with description of the failure circumstances and symptoms.

## 5.6. Re-programming

Modifications to the module's settings can be introduced by means of service software provided by the Manufacturer and the dedicated diagnostic interface.

The instrument's firmware updates are to be conducted on the basis of the bulletins published by the Manufacturer. The updates can be introduced by means of service software provided by the Manufacturer and the dedicated diagnostic interface.

## 5.7. Spare parts

The module does not contain any user-serviceable parts. The user is not allowed to disassemble it nor replace any subassemblies.

## 6. Warranty

1. Auto & Aero Technologies Sp. z o.o. warrants this product to be free from defects in materials and workmanship.
2. Auto & Aero Technologies Sp. z o.o. warrants proper operation of the product if it is used in accordance with its intended purpose and in accordance with the Operators and Maintenance Manual.
3. Auto & Aero Technologies Sp. z o.o. warrants this product for 12 months from date of purchase.
4. Auto & Aero Technologies Sp. z o.o. will, at its sole option, repair or replace any components that fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts or

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labour. The customer is, however, responsible for any transportation cost. The repair or replacement will be completed within 30 days from delivery of the product to Auto & Aero Technologies Sp. z o.o. However, if the failure is possible to be eliminated by means of updating the product's firmware, and if Auto & Aero Technologies Sp. z o.o. provides the customer with appropriate service tools, the Customer will conduct firmware update by themselves.

5. Any warranty repair will extend the warranty for the time of the repair.
6. If a valid warranty claim is lodged within months 7 to 12 after date of purchase, the warranty extends for a further 6 months after completion of the warranty repair.
7. This warranty does not cover failures due to:
  - a) mechanical damages and damages resulting from them,
  - b) unauthorised repairs,
  - c) damage caused by abuse or misuse,
  - d) unauthorised alterations to hardware or software.
8. The warranty does not cover claims that arise from the product parameters unless they are different from values declared by Auto & Aero Technologies Sp. z o.o.
9. The warranty does not cover activities that belong to normal operation such as cleaning and conservation, operation checks, and periodic inspections according to the Operators and Maintenance Manual.
10. The Customer loses all rights arising from the warranty if the product's protective seals are found to be tampered with.
11. The rejection of Auto & Aero Technologies Sp. z o.o. to conduct a warranty repair voids the warranty.

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