Gasmess-Systeme GmbH

Instruction Manual
*Ex*T*ox* Biogas Analyser
Bio-Compact

Foreword

We thank you very much for your confidence in our products and us, the ExTox Gasmess-Systeme GmbH.

The biogas analyser Bio-Compact as well as all other ExTox-Products and services stand for our high quality targets. Our business is the health protection of mankind, protection of the environment and installations. We are glad to take this responsibility. Our Quality Management System therefore follows ISO 9001 and our Production Monitoring is to keep the European Directive 94/9/EC[1] ("ATEX"). You profit of the high reliability due to modern sensor techniques and consequent interpretation acc. to the requirements of the regulations and standards valid for industrial application.

The Bio-Compact combines all necessary components in one compact wall mounted housing – from sampling and preparation of measured gas, sensor technique and evaluation Reliable and permanent operation as well as easy maintenance has been important development targets.

Please do not hesitate to contact anytime in case of questions or if you require information:

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[1] respective 2014/34/EU from April 2016

Content

1 Introduction

This Instruction Manual generally describes operation, installation and maintenance of the following ExTox-Product:

Compact system for the analysis of Biogas (Bio-Compact)

Article-No	Type (L): up to 100 ppm H_2S	Type (H): up to 1000 ppm H_2S
Bio-Compact	430128	430129
Bio-Compact-A	430130	430131

Type specific data for each device should be taken from a corresponding separate and specific Data Sheet. This Data Sheet forms consequently part of this Instruction Manual. References on the Data Sheet within this text are marked with ☞*DB*.

The Bio-Compact uses a control unit of the Series ET-4D2. Configuration, operation and maintenance are described in the enclosed *Instruction Manual of the Series ET-8D and ET-4D2*.

Please read this Instruction Manual carefully before installation and initial operation. We kindly ask you to pay attention to all details and cross-references.

We kindly ask you not to repair the Bio-Compact or to perform any changes which go beyond the measures described herein. Otherwise you endanger your own safety and your warranty claims of merchantability. In such cases please contact ExTox or authorised ExTox Service Partner. Third parties take the responsibility for correct performance of work when maintenance and repairs are done by them.

On receipt of goods please take care that packing and consignment are not damaged and the goods supplied correspond to the articles described in the delivery note. Please do also compare with your order. In case of any damage please inform your forwarding agent and your supplier. Please keep the damaged packing.

Please keep in mind that our Bio-Compact is a sensitive measuring device and take special care when unpacking and installing it.

2 Features of the Bio-Compact

Compact system for the analysis of Biogas:

- Methane (CH_4), Oxygen (O_2) and Hydrogen Sulphide (H_2S)
  - Methane, 0 to 100 % (v/v) CH_4
  - Oxygen, 0 to 25 % (v/v) O_2
  - Hydrogen Sulphide:
    Type (H): 0 to 1000 ppm H_2S, e. g. raw gas, or
    Type (L): 0 to 100 ppm H_2S, e. g. behind active coal filter
- Sampling and conditioning of measured gas, transmitters and evaluation combined in one compact wall mounted arrangement. Process of measurement especially designed for biogas application.
  - Separate housing areas for electronics and gas part (transmitter module)
  - The parts of the housing can be opened separately in order to perform installation and maintenance works.
  - Connections between electronic and gas part are of plug-in type, therefore easily and separately changeable

- Transmitter-Module
  - all transmitter for CH_4, H_2S and O_2 integrated
  - Easily exchangeable (complete module)
  - Pre-adjusted ("Plug and Play")
- Discontinuous measurement, maximum 24 times per day
- Flame Arrestor Ⓔx IIG IIB3
- Indication of the latest measured value during flushing and air phases
- 4…20 mA-outputs for CH_4, O_2, and H_2S (only Bio-Compact-A)

The modular construction and the use of the approved ExTox-Transmitters technology and control units assure a cost effective acquirement and maintenance.

The control units in combination with ExTox-Transmitters comply with EN 60079-29-1 and EN 45544 series for Gas Detection Systems. Furthermore they are in conformity with the European Directives 94/9/EC (ATEX), 2004/108/EEC (EMC) and 2006/95/EEC (LVD)[2].

3 Indications and Facilities

The control unit ET-4D2 covering the indication of measured values, alarms and messages as well as keys forms the left-hand part of the wall mounted housing.

For description of the indications and facilities please see the Instruction Manual of the control unit.

4 Configuration

For description of configuration possibilities please see the Instruction Manual of the control unit.

The menu system parameter serves for factory sided activation of operating "BIO" instead of "ET-4".

Attention: Changing of these setting should in no way be done by the user. Changed measuring functions may otherwise lead to loss of safety and other functions.

[2] respective 2014/34/EU (ATEX), 2014/30/EU (EMC) and 2014/35/EU (LVD) from April 2016

5 Description

5.1 Functions

- *Course of Biogas-Measurement*

During operation mode "BIO" discontinuous measurement takes place. All channels for biogas measurement are selected in the menu *Channel Configuration* by setting the mode "TIMER". Three phases are run through cyclically:

1. *Air:* the gas flow is flushed with air that means the magnetic valve has switched to the inlet test gas / flushing air.
2. *Flushing:* the system switches to the measured gas inlet. The gas concentration is not measured during this time. This phase is needed to transport the sampled gas from the process to the Bio-Compact using the gas flow. The gas suction pump is switched off two minutes before end and the gas flow is closed. Measurement in batch mode is prepared.
3. *Measuring:* the system measures the actual values when changing over to phase measurement. During this phase the gas suction pump remains switched off.

You can manually interfere in this process. Measurement can be started by pressing the keys F6 and F3 simultaneously. The Bio-Compact first changes to the phase flushing and starts the measurement later on.

For channels in "TIMER" Mode all measured values, alarms and outputs remain frozen on the latest value of the previous measuring phase during the phases *Air* and *Flushing*. Latching alarms can only be reset during measuring phase. *Attention:* This means that reset will be possible in the next phase. If necessary, measurement can be started manually (see above) to reduce the waiting time on longer cycle times.

The times for the individual phases can be adjusted in the menu *Timer* which can be reached via the menu *System Parameter* and selection of the menu setting Mode "BIO".

- *Flow Monitoring*

A flow rate monitoring is integrated in the transmitter-module. Flow rate monitoring is based on measurement of pressure difference. The alarm is given in case of under-scale of a preset nominal value. This value is set factory sided. The under-scale message leads to system fault of the control unit.

5.1.1 Parameter Settings

- *System Parameter*

In the menu *System Parameter* the operation mode "BIO" instead of "ET-4" is factory-sided activated.

Attention: Changing of these setting should in no way be done by the user. Changed measuring functions may otherwise lead to loss of safety and other functions.

In the submenu *Bio* the following changes can be performed.

Access Level to perform changes within the Menu *Timer*: 3

Menu Text	Selection	Function
T1	4 to 1439	Duration of phase *Air* in minutes. (Default: 50 min)
T2	4 to 1439	Duration of phase *Flushing* in minutes. (Default: 5 min)
T3	3 to 1439	Duration of phase *Measuring* in minutes. (Default: 5 min)
Attention: The duration of a measurement cycle is the sum of T1+T2+T3. This means a cycle of 60 min including the default settings which correspond to 24 measurements per day. Please keep in mind that the design of Bio-Compact is based on 24 measurements per day in maximum. More frequent measurements can shorten the lifetime of sensors and components in the transmitter module. To configure longer measurement cycles it is recommended to increase T1 only.		
Flow	ON, OFF	For Bio-Compact the setting has to be OFF. *Attention:* Changing of these settings should in no way be done by the user. Changed measuring functions may otherwise lead to loss of safety and other functions.
Measured gas - right column -	Concentration	Concentrations of test gases for the measuring channels of the Biogas-Measurement have to be indicated. Only the TIMER controlled channels are processed. On the left side the measured gas and on the right side the corresponding concentration is indicated.

- *Channel Configuration*

In the menu the mode "TIMER" is factory-sided activated.

Attention: Changing of these setting should in no way be done by the user. Changed measuring functions may otherwise lead to loss of safety and other functions.

5.1.2 Pre-configured Relays and Digital Inputs

The relays K9 to K12 cannot be configured freely because they are used for internal control purposes.

Digital Inputs are not available.

5.1.3 Calibration and Adjustment

Calibration and adjustment is only done via automatic control.

- *Preparation*

You have to enter the concentrations of the used calibration gases in the menu "System Parameter/Mode/Bio/Timer". On the right side of the display you could enter the concentrations for CH_4, O_2 and H_2S. These values are necessary for automatic calibration. You will normally find this information on the test gas bottle. In case the test gases are filled in different pressure gas bottles, you have to follow the instructions following below for all used test gases. For calibration of the O_2-Measuring channel you have to apply a test gas which does not contain any oxygen.

- *Course*

You have to select the menu point "Calibration" 'in the menu "Setup". For that purpose you have to activate minimum Access Level 2 before. The calibration menu appears and the internal magnetic valve switches to flushing air. In case the system should not be calibrated you could leave the menu via "Esc". By means of "Start" the automatic calibration is started. The analogue outputs keep the measured values of the last measurement.

Calibration is done in five phases:

Phase	Indication on Display	Course
1	RINS AIR	The system is flushed with air for three minutes
2	READ ZERO	The gas suction pump is switched off. The system waits one minute until stabilisation of measured values. Then the measured values are stored (zero point values for CH_4, H_2S or 20.9 % (v/v) for O_2).
3	RINS GAS	The gas suction pump is switched on again and the system is flushed with connected test gas for four minutes. *Attention:* Only during this phase the test gas bottle has to be connected and the test gas has to be applied to the system. The test gas has to be applied pressure less. It has always to be ensured that an adequate test gas volume stream is provided, that means an application of test gas has to be set which corresponds to the one in measuring operation[3]. This is to avoid that air is additionally sucked in and dilution of the test gas resulting from this falsifies calibration / adjustment.
4	READ SENS	The measured gas pump is switched off and batch measurement is done within two minutes.
5	READY	Calibration is completed and a plausibility check of the new values for zero point and sensitivity takes place. Offset for the zero point may not exceed ± 2 mA. The gain factor for sensitivity has to be between 0.5 and 2 (see comments on adjustment of the control units). Calibration values outside these limits are rejected, in the calibration menu the message "ERROR" is issued after completed calibration and the previous settings are kept. *Attention:* The message "ERROR" for channels with measuring components which are <u>not</u> part of the test gas does not indicate a malfunction of the measuring channel. These measuring channels will be calibrated and adjusted later on or have already been calibrated and adjusted on application of other test gases.

When using several test gases please change now the bottle and start another calibration cycle by pressing *START.*

Calibration is definitely completed with ESC.

[3] Depending on type the necessary test gas volume stream may be considerably above the indicated volume stream.

5.2 Transmitter-Module

All gas sensing equipment is combined in one exchangeable transmitter-module which forms the right-hand part of the wall mounted housing. In case of maintenance this module can easily be taken off from the Bio-Compact and replaced by a new pre-adjusted module.

There are two types of transmitter modules available:

Transmitter module	Article (new/replacement)	In combination with:
CH_4, O_2, H_2S (H) Measuring ranges: 0-100 % (v/v) Methane 0-25 % (v/v) Oxygen 0-1000 ppm Hydrogen Sulphide	290010/ 295010	Bio-Compact Type (H)
CH_4, O_2, H_2S (L) Measuring ranges: 0-100 % (v/v) Methane 0-25 % (v/v) Oxygen 0-100 ppm Hydrogen Sulphide	290011/ 295011	Bio-Compact Type (L)

5.2.1 Replacement of a Transmitter Module

On delivery of the Bio-Compact a new transmitter module is installed (Art. 290xxx). In case you need a new one you will get a replacement transmitter module (Art. 295xxx), on which all wear parts have been replaced. The module has completely been checked and adjusted. It has the same warranty as a new module. In case you return the replaced module you will get a credit note for it.

Replacement is done in few steps:

1. Release access level 3 on the control unit (see *instruction manual of the control unit*).
2. Press the keys "F1+F5+F6". On the display "CHANGE MODULE" is indicated.
3. Select "Change". The latest actual measuring value is frozen and is constantly sent to the connected periphery for the duration of the module exchange.
4. Replace Module:
    a. Untighten glands at measured gas inlet and outlet and remove hoses.
    b. Open the housings of control unit and transmitter module.
    c. Disconnect both cable plugs placed at the control unit.
    d. Loosen the four fixing screws of the transmitter module.
    e. Remove transmitter module. Be careful not to damage the two ribbon-cables which connect the transmitter module to the control-unit.
    f. Install new transmitter module in reverse order.
5. Select "Ready". Measurement is started again.
6. Select "End". The Bio-Compact returns to the standard indication.

The Transmitter Module is pre-adjusted. After exchange it is necessary to let it run for approximately 1 to 3 hours till the final measuring accuracy is reached. During this time you should not perform any adjustment.

6 Operation of Bio-Compact

The operation of the control unit ET-4D2 is described in the *Instruction Manual of the Control Units Series ET-8D and ET-4D2*.
Furthermore the following remarks are valid for the additional functions and options.

6.1 Flow rate monitoring

A flow rate monitoring is integrated in the transmitter module. Flow rate monitoring is based on measurement of pressure difference. The alarm is given in case of under-scale of a preset nominal value. This value is set factory sided. The under-scale message leads to system fault of the control unit.

6.2 Flame Arrestor

A flame arrestor is integrated in the transmitter module. It has to be ensured that the flame arrestor is not clogged with dust or condensate. In other aspects it is maintenance free.
Please note that the measured gas should only contain flammable gases of ignition protection up to IIB3, such as for example methane. Typical biogas compositions are covered.

7 Application Hints

Here the application remarks in the *Instruction Manual of the Control Units Series ET-8D and ET-4D2* are valid.

8 Installation

8.1 Mechanical Installation

The wall mounted housing should be installed at an easily accessible place to enable the

reading out of messages at every time and to ensure an easy maintenance.

Please pay attention to the indicated operation temperature for the Bio-Compact. The bio-Compact should be installed protected against weather conditions and bigger climatic fluctuations.

In general we do not recommend an installation outside, as in principle measuring accuracy and lifetime are influenced in a negative way. In case it is however necessary, please contact ExTox to design a suitable protection.

The dimensions for assembly and further installation dimensions can be taken from the Technical Data Sheet (☞DB).

The Bio Compact itself may not be installed in hazardous areas.

8.2 Connection to the Process

The connections for the measured gas inlet, test gas / flushing air and gas outlet are marked at the bottom of the housing. The standard screw connections fit for usual 6/4 hoses (6 mm outer/4 mm inner diameter).

For usual laying of the line a distance of suction of up to 20 m length of hose can always be realised. Longer suction distances are generally possible, but it has to be checked before if the delivery rate of the pump is still sufficient.

At the measuring point the difference in pressure in comparison to the environment may not exceed -100 hPa and + 50 hPa.

Please ensure that the line from sampling till measured gas inlet of the Bio-Compact consists of suitable material and is protected against damage and leakages.

Condensation inside the line should be avoided. The measured gas line shall be placed with permanent incline to the sampling point to allow the condensate to get back into the process. Hose loops in which a higher quantity of condensate can be amassed shall be avoided. Otherwise the measuring readiness of the Bio-Compact might then impacted temporarily when sucking water. In the worst case pump and transmitters are damaged. In case bigger condensate

masses cannot be avoided an external condensate trap (KSF1, Art. 700304) can be installed before the line gets into the Bio-Compact. If necessary please contact your partner at ExTox.

Operation in most of biogas compositions is reliably possible due to the construction of the Bio-Compact. Only for some in practice rarely occurring gases incompatibilities with the used hose materials cannot completely be excluded. ExTox is on demand at your disposal for consultancy. The hose material is compatible to the biogas components.

On principle flammable or toxic measured gases should be lead off safely, for example out-of doors via the roof. For flammable gases there might be a classification as hazardous area of Zone 2 in the close-up range around the gas outlet (Radius < 30 cm). In this range there should not be any possible ignition source.

8.3 Electrical Installation

The electrical installation may only be done by electro specialists according to the installation regulations on the subject. Please ensure above all for an adequate protection against lightning and overvoltage. All connections are inside the housing of the control unit ET-4D2 accessible via the cable glands at the bottom of the housing.

Connection of transmitters and additional devices (gas suction pump, flow meter etc.) has already been done factory sided.

The Biogas-Compact automatically starts operation with connection to the power supply.

9 Maintenance of Gas Detection Systems

Maintenance is described in the *Instruction Manual of the Control Units Series ET-8D and ET-4D2.*

Additionally the gas flow and the therein additional devices have to be checked for correct function. The gas flow has to be tight. It has to be ensured that the hoses are not clogged with dust or condensate which would block the flow through.

Attention: In case of leakage the released biogas may form a flammable or toxic gas mixture after dilution in air.

10 Spares, Expendables, Options

Article-No.	Denomination
315011	Control Unit ET-4D2C
317011	Control Unit ET-4DA2C including 4…20 mA outputs
295010	Replacement Transmitter Module CH_4, O_2, H_2S (H)
295011	Replacement Transmitter Module CH_4, O_2, H_2S (L)
700304	KSF1 - External condensate trap with 840 ml/h pump

11 Technical Data, EC-Declaration of Conformity

The technical data should be taken from the Data Sheet (☞DB) which forms part of the delivery.

The EC-Declaration of Conformity is added separately to the documentation.