Multi-channel Gas Analyser
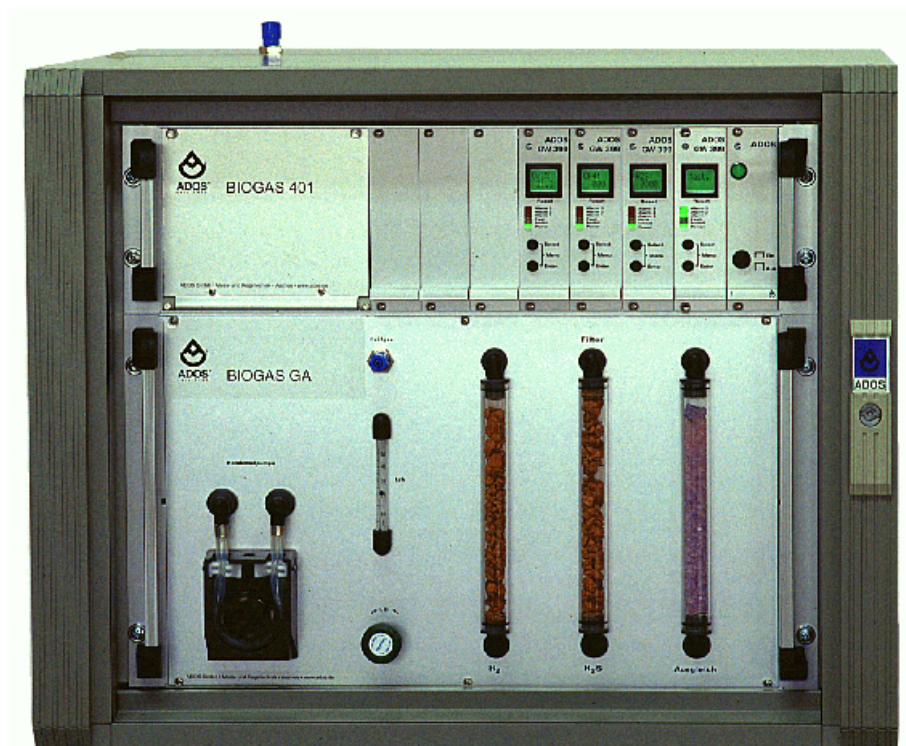
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0.   Introduction

The Biogas Analyser 401 monitors either continuously or at adjustable intervals, the biogas present in the gas components of the ambient air and provides early warning of the presence of noxious, explosive and non-combustible gases and vapours.

For monitoring the surrounding air, a microcontroller-aided gas warning system is used which incorporates warning and control functions. Various types of sensor can be connected via a 4-20mA current interface, using 2- or 3-wire techniques.

The Biogas Analyser 401 consists of individual channel-cards that are each connected to one sensor. A maximum of 6 channel-cards can be used in one 19" rack unit. One card is configured as the Master card that is used for setting the continuous or interval measurement cycles for the biogas analysis and at the same time, can be used for communication via the serial interface with evaluation units.

All information significant to operation, is displayed on the 2-line, 5-digit display on the channel-card. The information includes Actual value of gas, the measured gas component a the unit in use.

Three independent alarm thresholds can be set, the upper and lower limits of which are indicated by LED's. The background lighting of the display is colored to assist in immediate recognition of an alarm or fault condition.
LED's are also used to indicate the operational state of individual cards, viz. Fault condition, card inactive ((Inhibit function).

Two keys are used to operate the equipment.
These keys, together with menu-assistance, are used for setting minimum and maximum limit values, the number of measuring points, as well as other significant parameters, without any previous knowledge of programming. The siren is reset by a push-button on the unit. The alarm outputs can be tested without any application of gas, via a test function.

Digital switching outputs can be used for any ventilation and alarm control units.
The unit incorporates an RS232/ RS485 for data communication as well as a current output 4- 20 mA.

Depending on the version, the ADOS Biogas Analyser 401 can be connected to either
230 V or 115 V AC mains supply.

Two housing types are available, e.g. 19"-rack system or wall-mounting.

1.   Operating Summary

Display and operating controls are located on the front of the unit including the mains On/Off switch.
Two keys are used for the basic settings of the unit and for performing test routines. The alarm state is reset with the LCD-Reset key; for this the display should be momentarily pressed to activate the reset.

The basic setting of the unit is menu-assisted, via the LC-Display and the following keys:

"SELECT"   for selecting a measuring point in the Stop mode, selecting a menu item,
              and adjusting a value in a menu sub-item,
"ENTER"   for selecting a menu item, followed by confirmation

By simultaneously pressing "ENTER" and "SELECT" keys for 4 seconds, entry is made for the input of the code. After entering the number of the unit type"399" entry is allowed into the basic settings. Here, all settings can be checked and modified if required.
A return from the basic settings back to the measurement cycle, is made with the"SELECT"-Taste or automatically after 60 seconds, if no new settings key is pressed.

By pressing the"RESET" -key (LCD-key) during measurement the alarm can be cleared and the alarm outputs are reset.

After switch-on, the unit is automatically ready for measurement operation.

2.   Function

The Biogas Analyser 401 is a multi-channel gas warning unit, to which various types of sensor can be connected.
A 2-wire or 3-wire sensor can be connected to each channel card for the gas warning system.
The sensor current is connected via a 4-20 mA interface, to the microcontroller controlled channel card, which then processes and displays the measured value as an instantaneous value; the microcontroller also completes any control and warning functions that are necessary.

3.   Equipment Description

The Biogas Analyser 401 consists of the following system components:

S   Biogas suction with adjustable flow-through quantity and a flow-through display
S   Peltier element cooling with condensate pump
S   Gas components - filter system and conditioning
-       Optional, for monitoring the surrounding air, sensor inputs 4 -20 mA for connecting 2-wire sensors
        (e.g. ADOS 592 TOX) or 3-wire sensors (GTR 196)
-       Microcontroller-aided signal processing
-       LC-Display, 2-line, each with 5-digits
-       Ready, Fault and Alarm indications via LED's with colored background lighting for the
        LC-Display
-       2 keys for operating and 1 key for alarm reset
-       4 - 20 mA current outputs
-       RS232 or RS485 interface

4.   Basic Settings

The basic settings of the unit are menu-assisted, via the LC-Display and the keys:

"SELECT"   for selecting a menu item and setting a value
"ENTER"   for selecting a menu item, followed by confirmation

A return from the basic settings program back to the measurement cycle, is made automatically after 60 seconds, if no new settings key is pressed.
To modify a basic setting adjusted at-works, both keys must be held pressed simultaneously, for approximately 4 seconds. Then, the input of a code is necessary; this protects against unauthorised modification.
The code required corresponds to the equipment number on the front panel above the LC-Display, in this case, "399". To input the code number "399", the "SELECT" key must be pressed to increment the digit, to move once place, the "ENTER" key must be pressed.

At the end of input, the "ENTER" key must always be pressed for confirmation. In the basic settings program, the "SELECT" key is used to select any optional menu item.
The "SELECT" key can thus be used to scroll through the basic settings program to view the parameters, without actually making any modifications.

Only after pressing the "ENTER" key when a menu item has been selected, can a preset value be changed with the "SELECT" key.
A modified value is finalised (confirmed) and saved, by pressing the "ENTER" key.

An incomplete modification instruction is not saved and if no further key is pressed, after 60 seconds a return is made to the normal measurement cycle.
After correctly finalising a modification or aborting with the "SELECT" key, the next menu item is accessed.

The basic settings program contains the following menu items:
The text in brackets is the text shown on the display.

1. Deactivating the card (Set Inhib) for suppressing alarm signals at the outputs whilst test gas is being applied.
The number 1 indicates: Channel-card deactivated.
While the card is deactivated, the Inhibit LED is lit. The card is re-activated by entering a "0" in this menu item.

By pressing the "ENTER" key, the menu item is selected and a 1 is selected by pressing the "SELECT"-key as required, then confirmed with the "ENTER"-key. Then the next menu item can be selected with the "SELECT" key.

2. Automatic test routine (Start Test) for the alarm outputs
All alarms are initiated in sequence by pressing the "ENTER"-key.

3. Alarm parameters (Set Level)

Setting 3 independent limit values

3.1   Select an increasing or decreasing limit value, 1

3.2   Select an increasing or decreasing limit value, 2

3.3   Select an increasing or decreasing limit value, 3

For setting the limit value, refer to section 6.

4. Premature alarm reset (Set Horn)
This menu item is used to specify whether or not a premature reset of the alarm for each limit value, is allowed. A premature reset of the alarm for example, allows the siren to be switched off even though an alarm state still exists.
After selecting this menu item with the "ENTER"-key, the default value is shown. By pressing the "ENTER"-key again, a flashing cursor is shown in the second line. Now, with the "SELECT"-key the normal limit function (LV) or the premature resetting of the alarm (HORN), can be set. After selection, the cursor is switched off with the "ENTER"-key and by pressing the "SELECT"-key, the next menu item is selected.

5. Limit value latching (Set Reset)
Here, it is possible to specify whether an alarm switches off automatically after the level falls below the limit value or if the alarm must be manually reset with the "RESET"-key. After selection with the "ENTER"-key, the limit value is shown in the first line of the display (LV1:). Depending on the setting, the second line shows (auto) or (man.). The setting can be changed as in the section "Premature alarm reset".

6. Setting the relay operating mode (Set Rel.)
Here, the relay can be set to closed when in a de-activated state (N-ON) or when the relay is not energised (N-OFF). The conditions are shown on the display, in sequence: Alarm relay (LV1) - (LV3) followed by the fault relay (Flt.).

7. Setting the hysteresis (Set Hyst.)
In this menu item, a hysteresis value can be set, that is used to as a lower value that must be undermined before an initiated alarm is reset.

8. Setting the clock (Set Clock)
The clock is set by selecting the menu item with the "ENTER"-key.
The settings are made in the sequence: Year, Month, Date, Day of the week, Hour and Minutes. The menu item is selected with the "ENTER"-key so that the cursor flashes in the 2nd. line of the LC-Display. Then the "SELECT"-key is pressed until the value for setting appears on the display. After pressing the "ENTER"-key again, the cursor stops flashing and the next menu item can be selected with he "SELECT"-key.
After setting the clock, the time can be specified whether it is Summer or Winter time; this is displayed accordingly (Sum: 0). By changing the 0 to 1, a change can be made from Winter to Summer time.

A summary of the basic settings routine, is shown in the flowchart on the following page.

5.   Basic Settings Flowchart

Channel card

```
                    ┌──────────────────┐
                    │  Main  program   │◄──────────────┐
                    │  CO:  xxx  ppm   │               │
                    └──────────────────┘               │
                            │                          │
                     Both keys 4 sec.                  │
                            ▼                           │
                    ┌──────────────────┐  Return       │
                    │   Code-input     │  after 60 sec.│
                    │  Equip.No.  399  │──────────────►│
                    └──────────────────┘               │
                            │                          │
                       Enter-key                       │
                            ▼                           │
                    ┌──────────────────┐  Return       │
                    │ Inhibit function │  after 60 sec.│
                    │ (card disabled)  │──────────────►│
                    └──────────────────┘               │
                            │                          │
                       Select-key                      │
                            ▼                           │
                    ┌──────────────────┐  Return       │
                    │   Test  routine  │  after 60 sec.│
                    │                  │──────────────►│
                    └──────────────────┘               │
                            │                          │
                       Select-key                      │
                            ▼                           │
                    ┌──────────────────┐  Return       │
                    │   Limit  value   │  after 60 sec.│
                    │                  │──────────────►│
                    └──────────────────┘               │
                            │                          │
                       Select-key                      │
                            ▼                           │
                    ┌──────────────────┐  Return       │
                    │   Limit  value   │  after 60 sec.│
                    │      horn        │──────────────►│
                    └──────────────────┘               │
                            │                          │
                       Select-key                      │
                            ▼                           │
                    ┌──────────────────┐  Return       │
                    │   Limit  value   │  after 60 sec.│
                    │     locking      │──────────────►│
                    └──────────────────┘               │
                            │                          │
                       Select-key                      │
                            ▼                           │
                    ┌──────────────────┐  Return       │
                    │     Relay        │  after 60 sec.│
                    │ operating state  │──────────────►│
                    └──────────────────┘               │
                            │                          │
                       Select-key                      │
                            ▼                           │
                    ┌──────────────────┐  Return       │
                    │    Hysteresis    │  after 60 sec.│
                    │   adjustment     │──────────────►│
                    └──────────────────┘               │
                            │                          │
                       Select-key                      │
                            ▼                           │
                    ┌──────────────────┐  Return       │
                    │      Set         │  after 60 sec.│
                    │      time        │──────────────►│
                    └──────────────────┘               │
                            │                          │
                       Select-key                      │
                            └──────────────────────────┘
```
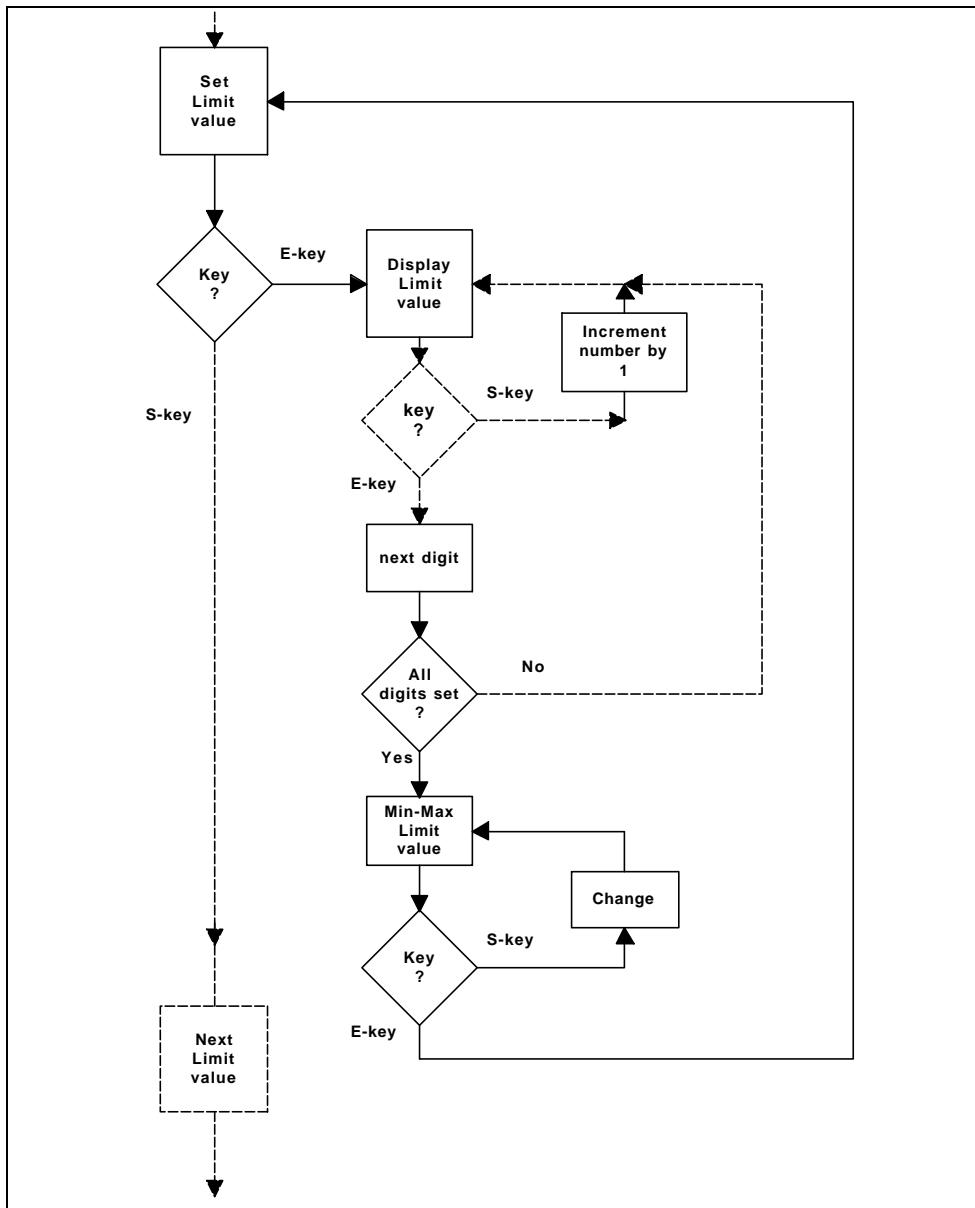
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6.   Menu Branching Flowchart

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Example of input:

If the limit value 1 is to be changed, select the sub-item with the "SELECT" key and then by pressing the "ENTER" key, the numerical value is accessed. Now, the flashing number can be incremented by pressing the "SELECT" key; the number to the right is selected by pressing the "ENTER" key, etc....

The value required is now confirmed with the "ENTER" key and then saved to memory.

Next, the limit value character is set. This is also altered with the "SELECT" key. If the limit value is to be activated when it is exceeded, a ">"-character should be selected; if the value is to be activated when the value falls short of the limit, a "<"-character should be set.

The first limit value is confirmed with the "ENTER" key. As a check, it is again displayed and can be changed by pressing the "ENTER" key.

The next menu item and limit value is accessed by pressing the "SELECT" key. Setting the second limit value follows the same procedure.

Programming is automatically cancelled if no other key is pressed within 60 seconds.

7.   Function description

The sensor signal is fed by way of a 4 - 20 mA current interface, to the microcontroller that converts the current signal to a concentration value. The current signal read in, is first checked for any interruption or faulty signal. If the measured value of the signal is less than a specified threshold, a fault message is output.

After calculating the concentration value, the limit values are tested and if they exceed or fall short of the set limit value an alarm is initiated. Depending on the settings previously specified, the alarm must be cancelled by pressing the "RESET" button or the alarm ceases automatically. After processing the limit value, the value of concentration is output to the LC-Display, the RS 232 interface and to the voltage output terminal.

During normal operation, the LC-Display is illuminated by a green background lighting. When an alarm is initiated, the background lighting changes to red. When a fault occurs on the card or the system shuts down, the background colour changes to yellow and the message "Fault" is shown on the display.

If the gas concentration being measured exceeds the end-value of the measurement range, i.e. the current from the sensor is greater than 20 mA, the display shows the message "o.flw" (overflow). When a limit value is exceeded, the display colour changes to red. If this is not the case, the display remains green.

8.   Master card

The Biogas Analyser 401 is fitted with an additional Master card, that can be used for external resetting of the alarms, for event logging and for communication with a process control systems.

The Master card scans the individual channel cards, in a cyclic sequence.

In addition to the channel cards, the Master card incorporates a serial interface (RS232 or RS485) for external data exchange.

Also, apart from the scan cycle for the biogas analysis, the biogas measurement time is set together with the delay time required for updating the measurement.

The number of measurements per day, can be set in scan cycle. For example, if 360 min. is entered here, this corresponds to 4 measurements each day.

In contrast to a continuous mode of measurement, this extends the life of the integrated chemical measurement cells. If there is no biogas measurement, air is sucked in from the surrounding area, whereby the last measured value remains on the display and is constantly released through the current output.

With the measurement time, a dead (or delay) time can be included that is given by the length of hose up to the suction point, as well as a response time for the individual measurement method to compensation up to a maximum value. Here, for example, a value of 300 sec. could be entered.

By pressing the 'Enter' key on a measurement card, the on-going measured value can be displayed.

Setting the Master card

The settings of the individual menu items on the Master card are the same as for the channel cards. Here therefore, only the additional menu items on the Master card will be explained.

Setting the biogas cyclic scan (Set Cycle)

The daily number of measurements can be set via the scan cycle. For example, if 360 min. is entered here, this corresponds to 4 measurements each day.

A value between 0 (continuous measurement) and 9999 min. is allowed.

Setting the biogas measurement time (Set MEAS.T = Measuring Time)
With the measurement time, a dead (or delay) time can be included that is given by the length of hose up to the suction point, as well as a response time for the individual measurement method to compensation up to a maximum value. .
Here, for example, a value of 300 sec. could be entered.
A value between 0 (continuous measurement) and 9999 min. is allowed.

When it is required to complete a continuous measurement, the cycle time should be set to 0 minutes; also, the measurement and delay times should both be set to 2 seconds.

This Programm step should only be selected when an H_2S measurement is NOT included, otherwise the H_2S measurement cell will be damaged. When completing H_2S measurements, the cycle time should be at least 60 minutes.

Setting the delay time of the display (Set ANZ.T = Display delay time)
To compensate for the T_{90} - times of the measured value aquisition, that are introduced by the length of hose, a delay time for the display (ANZ.T) can be adjusted between 0 and MEAS.T

Additional measurements can be requested at any time, by pressing the "ENTER"-key and holding it pressed for at least 3 seconds.

Example of activating a single measurement:

<u>**Normal measurement procedure:**</u>
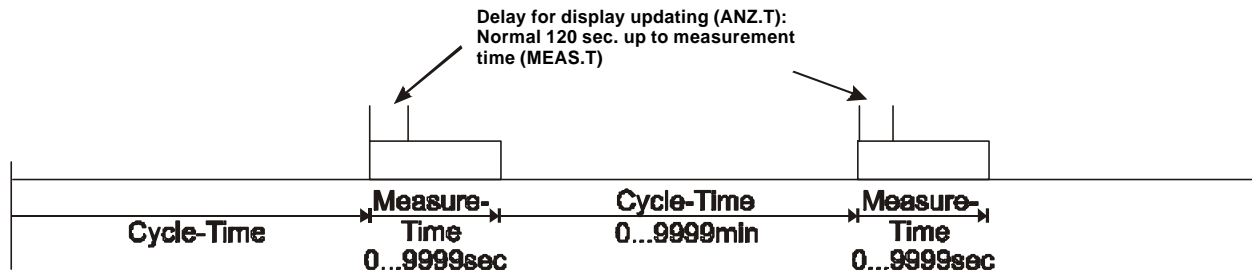
<u>**Request for single measurements should not occur during measurecycle is running !**</u>

Serial interface
After a measurement cycle, the measured values from all sensors are collectively output on the serial interface.
The baudrate is 9600 Baud, no parity, 8 data bits, 1 stopbit, hardware protocol: 9600,N,8,1

The printout has the following form:

First, the date and time is output, followed by the individual channels commencing with the channel number, then the measurement area, the individual alarm stages and finally the fault message.
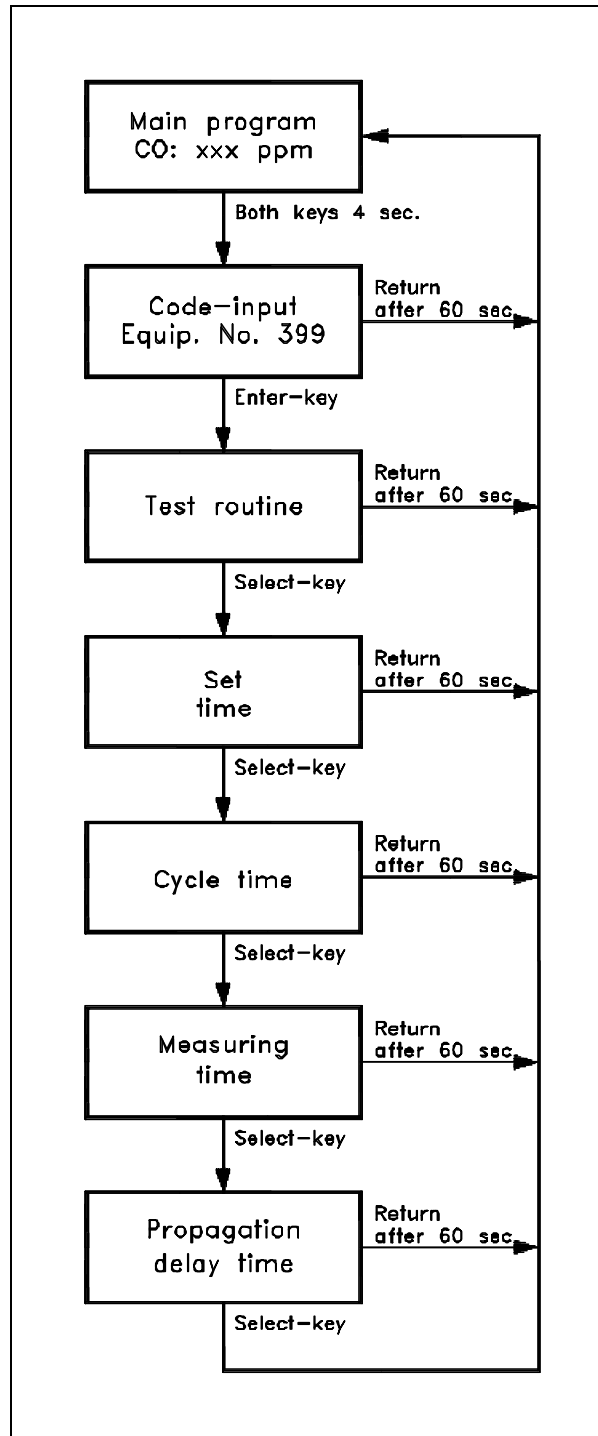If a card has been deactivated, the message 'Channel x Inhibit' is displayed.
In the case of a transfer error between the channel and Master cards, 'I2C-error' is displayed.

Example printout:

```
01.01.2000 08:15
Ch: 1  CO2: 0.03      Vol%   I1:1    Al2:0   Al3:0   Flt:0
Ch: 2  CH4: 00.1      Vol%   Al1:0   Al2:0   Al3:0   Flt:0
```

Master card, software setting flowchart

```
┌──────────────────────────────────────────────────────────┐
│                                                            │
│              ┌─────────────────────┐                       │
│              │   Main program      │◄──────────────┐       │
│              │   CO: xxx ppm       │               │       │
│              └─────────────────────┘               │       │
│                         │                           │       │
│                  Both keys 4 sec.                   │       │
│                         ▼                           │       │
│              ┌─────────────────────┐   Return       │       │
│              │   Code-input        │   after 60 sec.│       │
│              │   Equip. No. 399    │───────────────►│       │
│              └─────────────────────┘               │       │
│                         │                           │       │
│                     Enter-key                       │       │
│                         ▼                           │       │
│              ┌─────────────────────┐   Return       │       │
│              │   Test routine      │   after 60 sec.│       │
│              │                     │───────────────►│       │
│              └─────────────────────┘               │       │
│                         │                           │       │
│                     Select-key                      │       │
│                         ▼                           │       │
│              ┌─────────────────────┐   Return       │       │
│              │   Set               │   after 60 sec.│       │
│              │   time              │───────────────►│       │
│              └─────────────────────┘               │       │
│                         │                           │       │
│                     Select-key                      │       │
│                         ▼                           │       │
│              ┌─────────────────────┐   Return       │       │
│              │   Cycle time        │   after 60 sec.│       │
│              │                     │───────────────►│       │
│              └─────────────────────┘               │       │
│                         │                           │       │
│                     Select-key                      │       │
│                         ▼                           │       │
│              ┌─────────────────────┐   Return       │       │
│              │   Measuring         │   after 60 sec.│       │
│              │   time              │───────────────►│       │
│              └─────────────────────┘               │       │
│                         │                           │       │
│                     Select-key                      │       │
│                         ▼                           │       │
│              ┌─────────────────────┐   Return       │       │
│              │   Propagation       │   after 60 sec.│       │
│              │   delay time        │───────────────►│       │
│              └─────────────────────┘               │       │
│                         │                           │       │
│                     Select-key                      │       │
│                         └───────────────────────────┘       │
│                                                            │
└──────────────────────────────────────────────────────────┘
```

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9,   Equipment Configuration

The basic version of the biogas analyser 401 is designed for intermittent measurement. The measurement cycle required (including measurement time and display time), is set on the Master card. The measured values displayed (from the channel card), are updated after each measurement cycle; in the intervals, the card saves the latest measured value and the value is output to the display and the current output socket. If H_2S measurements are being made, the measurement time should not be less than 60 minutes to allow time for the electro-chemical sensor to regenerate.

Sub-assembly: Continuous Measurement
With this option, the components CH_4, CO_2 and/or O_2 are measured continuously, whilst the measurement of H_2S remains to be intermittent (controlled by the Master card). The channel cards for the continuous measurement incorporate their own program and are completely independent of the Master card. The concentration of the gases is continuously measured and output on the relevant channel card.
For calibrating a sensor card designed for continuous measurement, a switch is incorporated to allow a change-over from sampled gas to test gas. At the same time, a floating contact is switched into circuit that allows control via a local PLC system.

Sub-assembly: Measuring Point Selection
The biogas analyser can be fitted with a measuring point selection whereby for example, two fermentation plants can be monitored. The two sampled gas lines are laid up to the analyser and the switch-over between the two channels is made in the equipment. Three signals must be available from the local PLC system via floating contacts:
- Measuring point 1 enabled (continuous signal)
- Measuring point 2 enabled (continuous signal)
- Initiation of a special measurement (short pulse < 1s)
The sub-assembly "Measuring Point Selection" can be combined with the "Continuous Measurement" sub-assembly so that with the exception of H_2S, all other components can be continuously analysed.

Sub-assembly: Desulphurisation
With this configuration, biogas can be analysed before and after desulphurisation. The analyser incorporates two H_2S sensors each with different end-values of the measurement range. The sensor required is selected by enabling the relevant measuring point.

10.   Installation of the Biogas Analyser

Location

The room where the analyser is installed must have sufficient ventilation.
The equipment must be protected against direct sunlight.
The condensate and the gas outlet pipes must lead out to the open outside air.
Under no circumstances is the gas outlet pipe to be fed back into the Biogas line, since 70-80% of the time, air is being drawn in.
The appropriate VDE regulations that apply to the electrical connections, must be observed at all times.

Extraction pipe

The location of the gas extraction point must always be at the upper edge of the pipe, to prevent any condensate from reaching the analyser.
At the extraction point, a suitable stop valve of V4A must be fitted. Only teflon hose or V4A-pipe is suitable for use as an extraction pipe to the Biogas analyser. If the extraction pipe is less than 10m in length, a 6 mm LW hose can be used. For longer pipelines, a 4 mm LW hose should be used.
PVC or PE hoses are not suitable for the Biogas extraction.
Also, V2A-pipe is not suitable, as it reacts to H_2S.

11.   Maintenance

The following maintenance (or upkeep) work is based on checks twice yearly, which must be completed only by trained personnel.

The End-user can undertake a Maintenance contract with the manufacturer, ADOS GmbH, whereby efficient servicing is ensured by the company's own customer service.

Maintenance work can be split into testing the sensor and testing the gas suction of the Biogas Analyser 401.

On all sensors being used, the calibration checks outlined in the relevant operating instructions, with reference gas and calibration gas, must be completed since over a period of time, all sensors lose some of their sensitivity.
For this reason, once a loss of sensitivity has been established, the sensor must be re-calibrated or replaced.
Each sensor contains a small filter cartridge that must be replaced if found necessary.
The filter cartridge prevents error indications of the sensor due to cross-sensitivity, compared to other gasses.

Larger filter cartridges are on the front of the Biogas Analyser 401. In the course of time, these filters become saturated, i.e. with hydrogen sulphide and cannot be regenerated.
The filter must then be renewed, at the latest when the compensating filter changes in color to green.

When this situation arises, continued operation without changing the filter will cause damage to the test unit.

The accuracy of the interface signals and the function output signals, should be checked regularly, on the microcontroller-aided gas warning unit.

The automatic test routine in the basic settings menu, provides a straightforward method of checking the floating output contacts, in conjunction with ventilation control, acoustic and optical warnings.

12.   Calibration instructions

For the calibration of the sensor cards the following test gases are required:

Components	Zero-point adjustment	Range adjustment
H_2S	Ambient air (if H_2S-free), otherwise synthetic air	H_2S in synthetic air; concentration depending on the measuring range
CH_4	Ambient air; if necessary synthetic air	60% CH_4 + 40% CO_2 (respectively N_2)
CO_2	Ambient air; if necessary synthetic air	60% CH_4 (respectively air) + 40% CO_2
O_2	100% nitrogen; or test gas 60% CH_4 / 40% CO_2	Ambient air; if necessary synthetic air

The sensor cards are located behind the blind plates at the fore-part of the device.
Thereby the sensor card on position 1 corresponds with the channel card on position 10, the sensor card on position 2 with the channel card on position 9 and so on.

The electrochemical sensors (H_2S, O_2) dispose of a %-potentiometer ("span"), a
0-potentiometer ("zero") and two test sockets (top down).

On the IR-sensor-cards the 0-potentiometer ("zero") is located upmost and the
%-potentiometer ("span") one position underneath.

The test gas function is to be made via the test-gas input at the fore-part of the device.
By the use of test gas bottles you have to work with a pressure reducer. For all the
calibrations the gas flow amounts to 30 Liter per hour. The zero-point adjustment should always be made before the range adjustment.

Calibration of the CH_4 and CO_2-Sensors

Zero-point adjustment:
       Charge the appropriated gas via the test gas input. Keep press-formed the
       "Enter"-key of the corresponding channel card and read off the indicated
       concentration on the display. If necessary compensate with the 0-potentiometer ("zero") on the
       value 0,0%.

       ATTENTION! THE INDICATION REACTS A LITTLE LAGGED!

Range adjustment:
       Charge the appropriated gas via the test gas input. Keep press-formed the
       "Enter"-key of the corresponding channel card and read off the indicated
       concentration on the display. The indicated value has to comply with the
       concentration of the charged test gases. If necessary compensate with the
       %-potentiometer ("span").

       ATTENTION! THE INDICATION REACTS A LITTLE LAGGED!

Calibration of the H$_2$S-Sensor

Zero-point adjustment:

      Charge the appropriated gas via the test gas input and measure the voltage on
      the test sockets. After stabilisation of the sensor output signal, compensate
      with the 0-potentiometer ("zero") on the value 204 mV.

Range adjustment:

      Charge the appropriated gas via the test gas input and measure the voltage on the test sockets.
      After stabilisation of the sensor output signal, compensate
      with the %-potentiometer ("span") on the corresponding voltage-value V.
      This voltage results from following formula :

$$V = \frac{(1{,}02\ V - 0{,}204\ V) \times \text{test gas concentration}}{\text{Measuring range (final value)}} + 0{,}204V$$

Example : Measuring range (final value) = 2000 ppm, test gas concentration 1600 ppm

$$V = \frac{(1{,}02\ V - 0{,}204\ V) \times 1600\ \text{ppm}}{2000\ \text{ppm}} + 0{,}204V = 0{,}857\ V$$

(Zero-point and range adjustment are also possible via the display of the
corresponding channel card. See therefore "calibration of the CH$_4$ and CO$_2$-sensors")

Calibration of the O$_2$-Sensor

Zero-point adjustment:

      Charge the appropriated gas via the test gas input and measure the voltage on
      the test sockets. After stabilisation of the sensor output signal, compensate
      with the 0-potentiometer ("zero") on the value 204 mV.

Range adjustment:

      Charge the appropriated gas via the test gas input and measure the voltage on the test sockets.
      After stabilisation of the sensor output signal, compensate
      with the %-potentiometer ("span") on the value 1016 mV (with a measuring range of 0-21 Vol% O$_2$.

(Adjustment also possible via the display of the corresponding channel card.)

13.   Fault Clearance

Fault Description	Possible Causes	Fault Remedy
Channel card shows "Fault"; yellow display	Sensor zero point is below 4 mA	Calibrate the sensor
	Sensor is not connected correctly to the RMK module	Check the connection
	Sensor is defect	Notify ADOS
	Equipment has just been switched on	Normal response: Initiate special measurement
Channel card shows red display	Limit value exceeded	– (Sensor functions correctly)
Channel card shows "o.flw"	Concentration of sampled gas is greater than the end-value of the measurement range	– (Sensor functions correctly)
	Sensor is uncalibrated	Re-calibrate sensor
CH_4 or CO_2 card shows an obvious 'incorrect' measured value	SI-filter (balance filter) is exhausted.	Exchange SI filter
	Sensor is uncalibrated	Re-calibrate sensor
	Sensor is defect	Notify ADOS
H_2S or O_2 card shows an obvious 'incorrect' measured value	Electro-chemical measurement cell is exhausted; older than 2 years	Notify ADOS
	Sensor is uncalibrated	Re-calibrate sensor
	Sensor is defect	Notify ADOS
Different measured values on the display and the current output	Channel card or module defect	Notify ADOS
Incorrect or no, flow through	Needle valve mis-aligned	Re-adjust flow-through accurately with the needle valve
	Test gas pump defect	Notify ADOS
Master card does not switch the measurement cycle	Master card is incorrectly configured	Re-adjust the settings on the Master card
	3/2-way valve is defect	Notify ADOS
A special measurement cannot be initiated	Digital input on RMS module is defect	Notify ADOS

Fault Description	Possible Causes	Fault Remedy
During a measurement, gas is sucked-in via the test gas input	3/2-way valve is defect	Notify ADOS
During the calibration, sampled gas is sucked in	3/2-way valve is defect	Notify ADOS
Filter material changes its shape and form	Filter material is exhausted	Exchange filter element
SI filter material is light-blue	Filter material has absorbed moisture	– (normal response)
SI filter material is dark-blue	Filter material has absorbed moisture	Filter element due for exchange
SI filter material is green or black	Filter material is exhausted	Exchange filter element
Hose pump does not run during a measurement	Hose pump defect	Notify ADOS
Hose connecting the hose pump has stretched	Material fatigue	Exchange hose

14.   Technical Data

Details, per control unit

Sensors: Chemical measurement cells
                               Infrared sensors
                               Semiconductor sensors

Sensor input: 2-wire sensors (592 TOX) or
                               3-wire sensors (GTR 196)
                               for warning of explosive
                               gas mixtures

Sensor supply.   20V= / 200 mA

Measurement range: H_2S: 0 - 500 ppm or upto 0-5000 ppm
                               CH_4:   0 - 100 Vol.%
                               CH_4:   0 - 100 % LEL
                               O_2:   0 - 21 Vol.%
                               CO_2:   0 - 50 Vol.%
                               Other ranges by request

Accuracy: < 5% f.s.d.

Ambient temperature: + 5 ... + 45°C

Effects of temperature: < 2% for ± 20°C change

Installation: Wall-mounting

Output signals: Current output, 4-20 mA
                               RS 232 or RS 485 interface
                               Per channel:
                               3 Alarm relays
                               1 Fault relay

Relay rating: 230 V, 450 VA

Operating voltage: 230 V, 50 Hz
optional: 115 V, 60 Hz

Power consumption: 100 VA

Dimensions: 600 x 478 x 500 mm (WxHxD) 9 HU

Weight: approx. 61 kg

15.   Spare parts

No.	Discription
5042	Input/output modul GW 399 RMK
5155	Input/output modul GW 399 RMS DI
5012	19" plug-in for O_2-measuring
5013	19"-plug-in for CH_4-measuring
5014	19" plug-in for CO_2-measuring
5015	19" plug-in for H_2S-measuring
5294	Filter FF92 (dust filter)
5002	Filter RE
5003	Filter SI
5001	Channel card GW 399 E
5004	Solenoid valve Biogas
5000	Master card GW 399 E
5005	Gas suction pump Biogas
5017	Fine-metering valve V4A
5016	Voltage input module NMK
5006	Peltier element cooling
5350	Membrane Viton for gas suction pump
5007	Flow meter 0-50 l
5009	Hose for condensate pump
5008	Condensate pump
5010	Sensor H_2S (0-500 ppm)
5018	Sensor H_2S (0-5000 ppm)
5011	Sensor O_2
5295	Fuse
5351	Teflon-hose 4/6 mm p/m