

# Instruction Manual

## Biogas Analyzer InCa Bio 04



**- IMPORTANT -**

**Refer to the safety instructions  
before installation begins**

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## 1. Safety instructions

Before the instrument is placed into operation this manual should be reviewed with special attention to all the instructions, cautions and warnings

### Installation

The electrical connection for the instrument must be carried out by qualified personnel in accordance with all applicable national codes, local regulations and the power supply voltage listed on the rating plate.

### Maintenance

All applicable safety regulations must be observed when working with toxic or flammable gases.

### Gas connections

Gas connections must be carried out by qualified personnel in accordance with all applicable national codes and local regulations.

### Application

The analyzer is designed to measure BIO gas from a variety of sources including Land fill and Sewage treatment gases that contain CO<sub>2</sub>, CH<sub>4</sub>, O<sub>2</sub> and H<sub>2</sub>S. All wetted parts are corrosion resistant and single or multi stream measurement is available for these applications. The unit is rated for indoor installation in a general purpose area but the stream switching valves (supplied with the 2 ~ 8 process stream option) are air operated and can be remote mounted in either general purpose or areas classified as hazardous by the NEC.

### Instrument

The analyzer has been carefully leak tested at the factory and the enclosure has two independent fans (outside air and power supply) which provide 1~2 m<sup>3</sup> of air circulation per hour. No gas is released inside the enclosure and the flow rate of the gas pump is mechanically restricted to 30 l /hr max.

#### CAUTION:

This instrument has been designed as a process gas analyzer and is not applicable for personnel protection, area monitoring or detection of MAC or UEL limits.

## 2. Instrument Overview

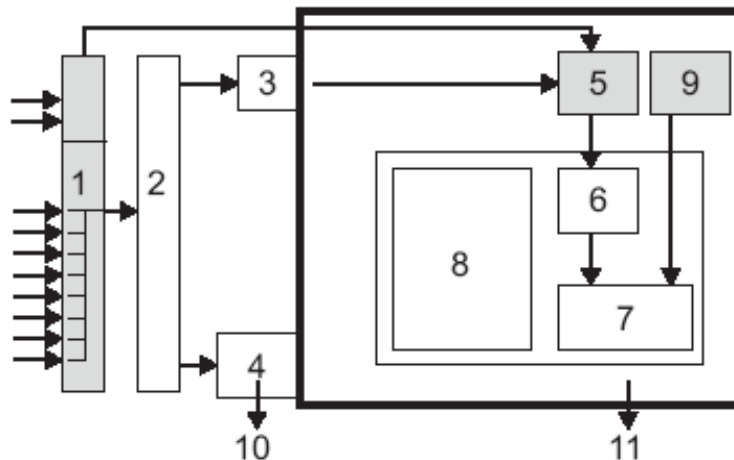


Figure 1: InCa Bio 04 Block diagram

1	Gas flow measurement	2	Peltier cooler
3	Flame arrestor	4	Condensate pump
5	Process gas pump	6	Optical Sensors
7	Electrochemical sensors	8	Microprocessor
9	Air pump	10	Condensate drain

Process gas enters through the connections (1). A diaphragm pump (5) draws the process gas through a Peltier cooler (2) and flame arrestor (3) and pumps it first into the optical sensors (6) and then through the electrochemical sensor system (7). Any condensate is drained through a pump (4). Four sensors for CO<sub>2</sub>, CH<sub>4</sub> (optical) and O<sub>2</sub> and H<sub>2</sub>S (electrochemical) analyze the process gas concentrations. Process gas is conditioned by a pulsed phase measuring process in the electromechanical sensor system and process gas and air are alternately pumped in through a diaphragm pump (9) into the sensor system (this process reduces the H<sub>2</sub>S load and greatly increases the the sensor life). The micro processor (8) calculates and displays the component concentrations and outputs them as 4 – 20 mA DC and RS 232 signals. A drain port (10) allows the liquid condensate to be collected and (11) is the sample gas exhaust port.

The measurement channels are selected in a user defined cycle and the unit purges with air after each measurement.

### 3. Technical Data

#### Dimensions

Height: 620mm (24.4")  
Width: 70mm (2.75")  
Depth: 215mm (8.46")  
Weight: 28 - 48 kg (62 – 106lb)

#### NDIR dual-beam sensors

CO<sub>2</sub> 0 - 100 vol %  
CH<sub>4</sub> 0 - 100 vol %  
Pressure and temperature compensated  
Accuracy ± 1% of measured value

#### Electrochemical sensors

O<sub>2</sub> 0 - 25 vol %  
H<sub>2</sub>S 0 - 5000 ppm  
Accuracy ± 5% of measured value  
H<sub>2</sub>S 5000 - 10000 ppm  
Accuracy ± 10% of measured value

#### Response time (T90 time)

20 seconds plus sample transport time

#### Temperature control

50°C ± 5°C

#### Gas flow

25 - 35 l/h (0.8 – 1.2 Scfh)

#### Measuring points

1 x process gas channels (8 max.)

#### Option

2 x calibration gas inputs

#### Condensed water removal

Peristaltic (hose) pump

#### Gas sample system

- Gas cooler
- Flame arrestor (ATEX) rated
- Long-life pump module

**Tube connections**

6 mm OD

4 mm ID

**Power supply**

90 ~ 240 VAC, 50/60 Hz

**Interfaces**

- 1 x RS 232
- 4 x 4 - 20 mA
- 3 x Status relay

**Operating temperature**

5 - 45°C

**Warm up time**

15 minutes at 20°C

### 3.1. Enclosure Details

The aluminium case has a very durable paint finish and a silver cover on the left side that protects the peltier cooler, pneumatic valve system and the condensate pump. Twelve red function diodes show the control valve status, two of the upper diodes are for the zero and calibration gas valves and the other 8 are for the process gas valves. Any unused channel status diodes remain blanked out and unlit.

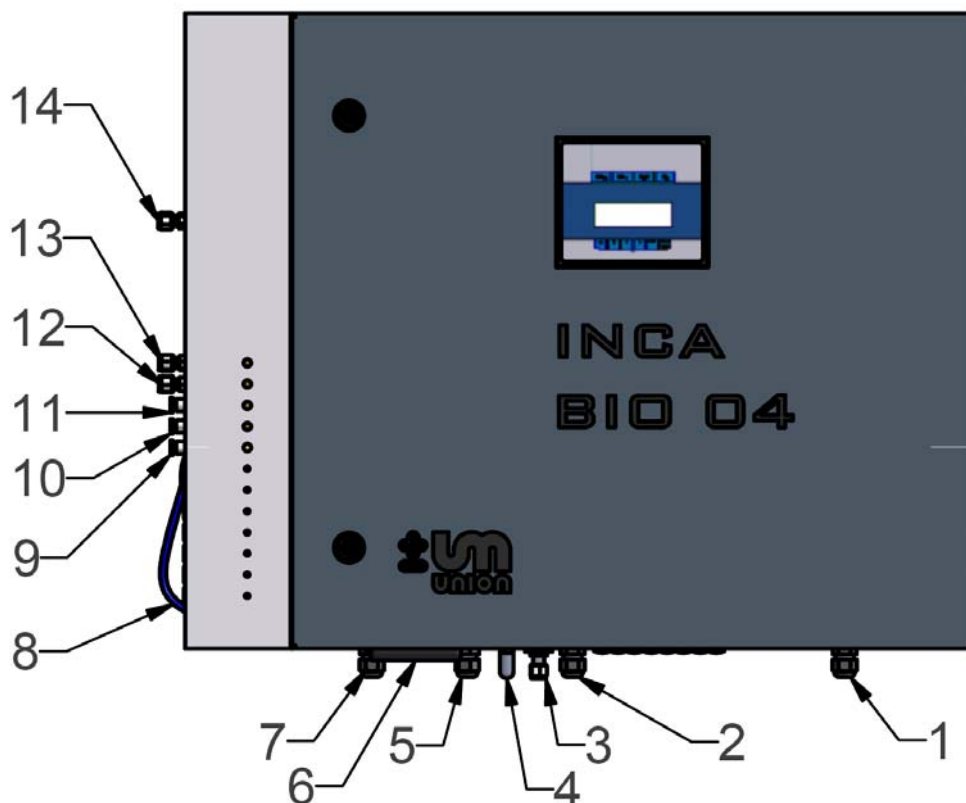


Figure 2: Enclosure with door closed

1	Power supply connection	2	Spare connection
3	Output process gas	4	Air Filter
5	4-20 mA output connection	6	Fan
7	Relay connection	8	Air valve tubing
9	Air operated inlet valve (x3)	10	Air operated inlet valve (x2)
11	Air operated inlet valve (x1)	12	Zero gas inlet
13	Calibration gas inlet	14	Process gas inlet



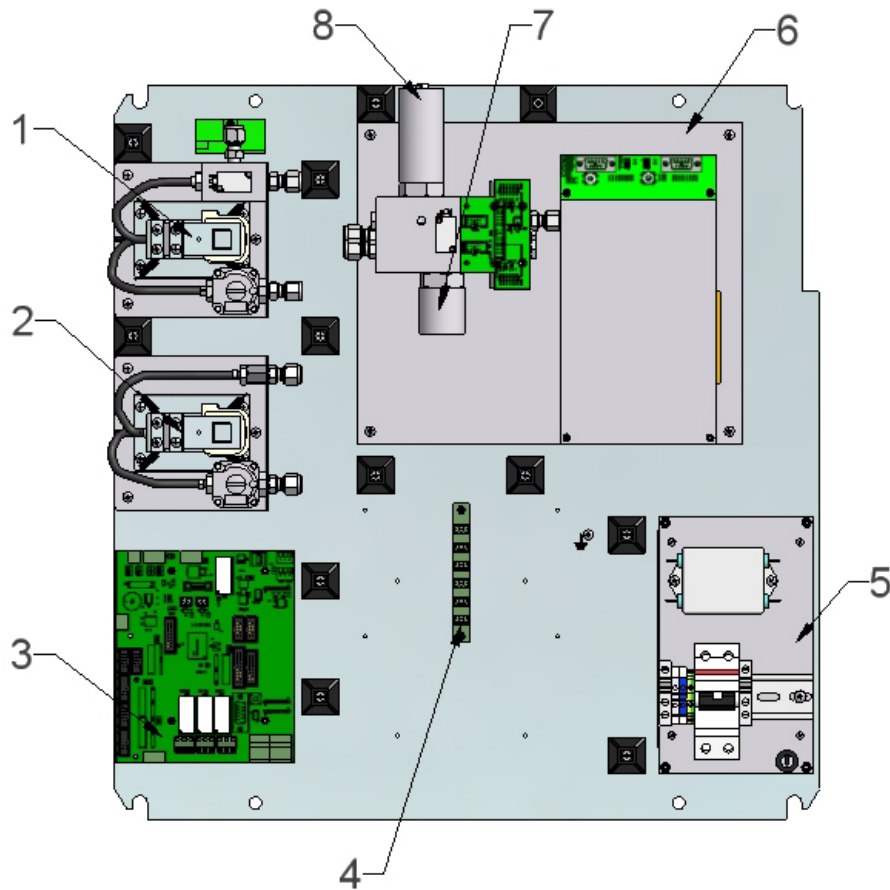


Figure 2: Internal mounting plate

- |   |                            |   |                       |
|---|----------------------------|---|-----------------------|
| 1 | Diaphragm process gas pump | 2 | Diaphragm air pump    |
| 3 | Valve control 4-20 mA      | 4 | External bus          |
| 5 | Power supply               | 6 | IR sensor module      |
| 7 | H <sub>2</sub> S sensor    | 8 | O <sub>2</sub> sensor |

All functional components are mounted on a plate (the tubing connections are not shown for clarity).

Several bus systems are available as an option for module 4 and more information on available formats (Profibus dp etc) is available on request.

### 3.2. Installation requirements

The analyzer must be installed in a clean dry indoor general purpose area. The air controlled stream switching valves (supplied with the 2~8 process stream option) can be remote mounted in either general purpose or areas classified as hazardous by the NEC. The left side of the enclosure should be accessible for sample gas connections and the right-hand side only needs enough space to allow the door to open.

The ambient temperature has to be within the operating specification and the gas supply lines should also be above 0°C to avoid freezing conditions as the process gas is usually loaded with moisture.

### 3.3. Mounting the instrument

The InCa Bio 04 is wall mounted and the bracket (1) has 2 elongated holes for mounting and horizontal alignment and 2 tabs (3-4) to mount the instrument as shown in figure 3.

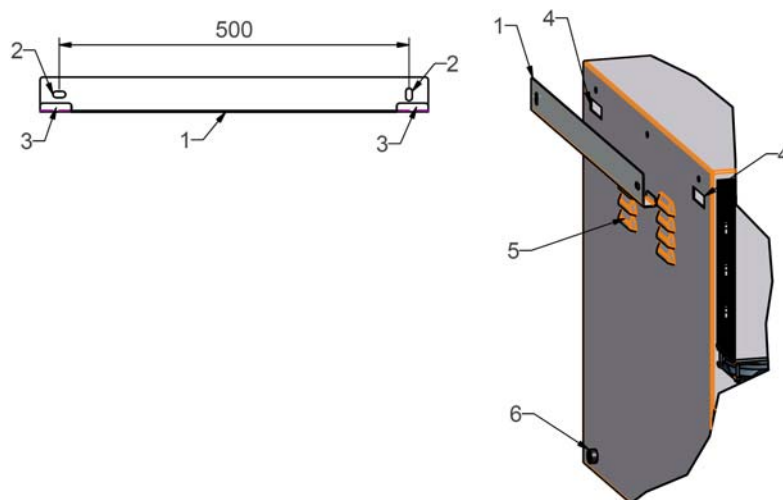


Figure 3: Enclosure rear view

1	Wall bracket	2	Mounting holes
3	Mounting tabs	4	Holes for tabs
5	Air fan inlet	6	Mounting spacer

### 3.4. Gas connections

6x4mm (1/4") PTFE tube is recommended and only suitable tubing should be used.

Run the tubing to the appropriate connections and carefully leak test each line as any leak in the tube system will pull in ambient air and create measurement errors.

The instrument can be supplied for different sized connections and this needs to be specified at the time of order.

#### 3.4.1. Condensate pump

The standard instrument has one gas inlet (1) and one condensate exit (2). Separate piping needs to be provided for the discharge of condensate and sample gas.

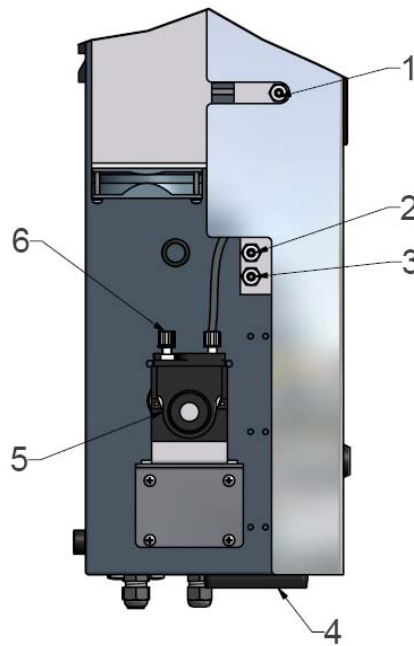


Figure 4: Analyzer connections

1	Process gas inlet	2	Calibration gas inlet
3	Zero gas inlet	4	Air Fan enclosure
5	Condensate pump	6	Condensate outlet

Instruments with the calibration gas option will have two additional connections (2-3) and is calibrated with zero gas (air) only if supplied without these connections.

For more information about calibration gas refer to section 4

**Important:**

The calibration gas input pressure must not exceed **70 mbar** (28"H<sub>2</sub>O or 1 PSIG).

### 3.4.2. Air operated valve and jet pump connections

Air operated valves (1-3) are controlled using hoses (4-5-6) and the number of valves can range from 2 to 8 units, the number of the process gas streams will determine the number of valves required. Air operated valves can be remote mounted and are only supplied for measurement applications with more than one process gas stream.

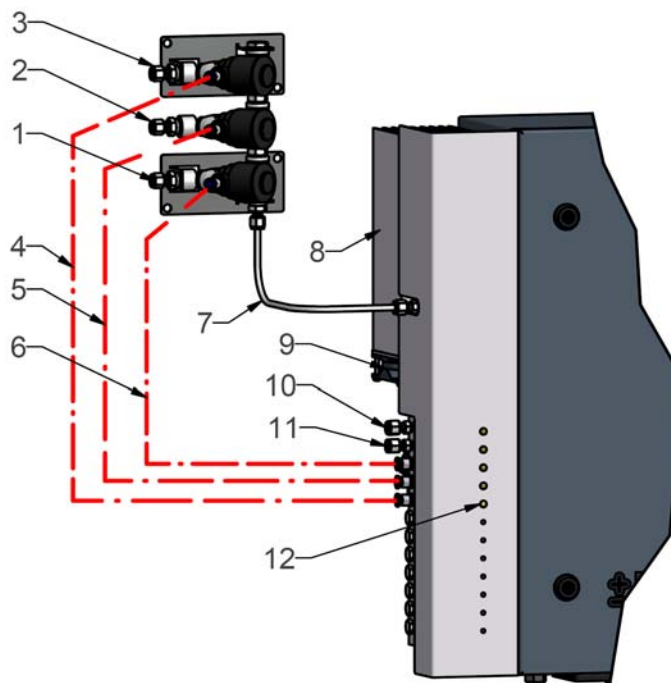


Figure 5: Analyzer with 3 air valve connections

1	Process gas 1 inlet	2	Process gas 2 inlet
3	Process gas 3 inlet	4	Hose for air valve
5	Hose for air valve	6	Hose for air valve
7	Process gas connection	8	Peltier cooler
9	Peltier cooler fan	10	Calibration gas inlet
11	Zero gas inlet	12	Control valve status LED's

Compressed air controls the air valves (4-5-6) and the process (Biogas) enters the valves at (1-2-3). PTFE tubing 6x4mm (1/4") is recommended for the connection between process gas inlet (7) and the valves.

**Caution:** The compressed air must be clean and dry to avoid valve damage.

Calibration gas connections (2-3) are for both manual and automatic calibration. The **Zero** inlet is for calibration gas 1 and the **Cal** inlet is for cal gas 2. The three air hoses (4-5-6) (maximum of 8) are used for the air operated valves (1-2-3) shown in fig 5.

The process gas and jet pump air need two separate vent discharge connections.

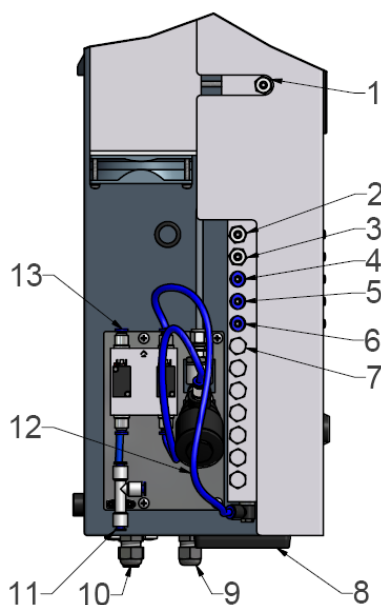


Figure 6: Analyzer with connections for three air operated valves

1	Process gas inlet	2	Calibration gas inlet
3	Zero gas inlet	4	Air valve connection (1)
5	Air valve connection (2)	6	Air valve connection (3)
7	Blanking plug	8	Air fan
9	Output 4-20 mA	10	Output relays
11	Air aspirator (Jet pump)	12	Pneumatic tube
13	Compressed air inlet		

### 3.5. Power supply

The instrument power supply is rated for 90~250V 50/60Hz as shown in fig. 7. An electronic noise suppression filter is installed (4) and the power supply rail (5) with terminal strip and on/off switch (circuit breaker) is located below the filter.

**Warning:** The main power supply can carry a voltage of up to 250 VAC and any wiring must meet the requirements of VDE 0100 or equivalent national or local codes.

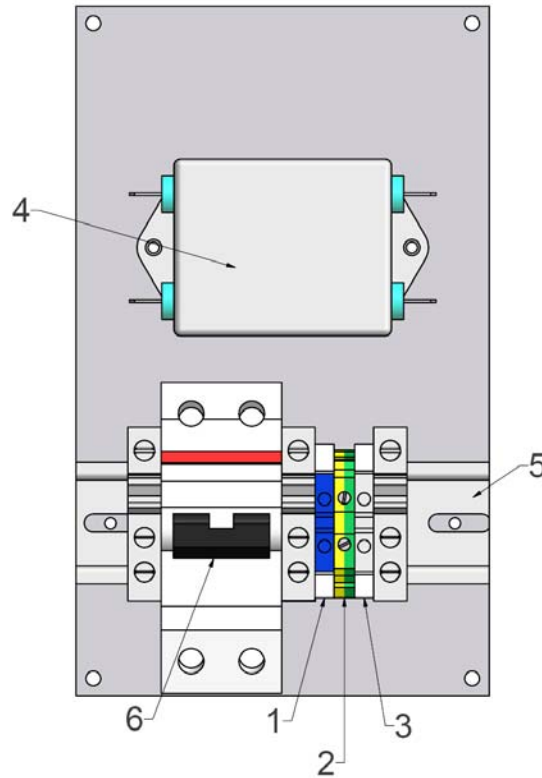


Figure 7: Power connection panel inside the enclosure

1	Neutral (N)	2	Ground (G)
3	Hot or Phase (L)	4	Noise filter
5	DIN mounting rail	6	ON/OFF switch

Switch (6) can be accessed by opening the door.

### 3.5.1. Electronic interface

The electronic interface:

Digital bus	(1)
Status information	(2-4)
Current output 4-20 mA	(5-8)

The above are located on the “valve control 4-20 mA” board (see figure 2 and 8)

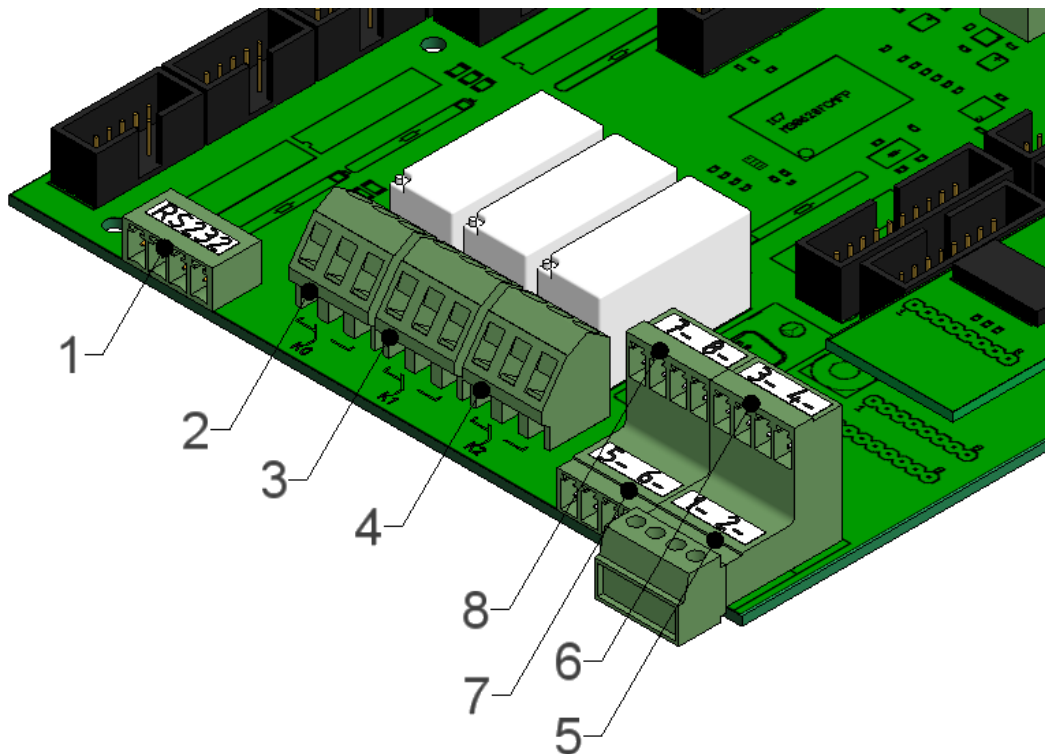


Figure 8: Valve control board 4-20 mA

1	RS 232	2	Not in use
3	In operation	4	Fault
5	1 CO <sub>2</sub> ~ 2 CH <sub>4</sub>	6	3 H <sub>2</sub> S ~ 4 O <sub>2</sub>
7	5 CO <sub>2</sub> ~ 6 CH <sub>4</sub>	8	7 H <sub>2</sub> S ~ 8 O <sub>2</sub>

Terminal ID note: 4-20mA output terminals 5, 6, 7, 8 are + and the - sign is ground.

The standard digital bus (1) is RS232 with a transmission rate of 2400 Baud. Data edit as a standard will be released in a later software version.

Alarm status information (terminals 2-3-4) is generated using volt-free relay contacts.

Relay contacts:

Terminal block K0 = Service request (Future function)

Terminal block K1 = Fault

Terminal block K2 = Operation

Terminal wiring:

1 - 2 Contacts normally closed

2 - 3 Contacts normally open

A maximum of 8 galvanically isolated 4-20 mA outputs are available and dual outputs are provided per removable terminal block (terminals 5-6-7-8) fig.8.

The output signals are configured to provide additional status information:

0.0 mA = Broken cable or instrument powered off

3.2 mA = Fault

4-20 mA = No fault (normal measuring range)

> 20 mA = Over-range condition



## 4. Calibration

Calibration is required depending on the required measurement accuracy shorter calibration intervals will eliminate any drift and generally provide higher accuracies. Ambient air (gas 1) is used and calibration gas (gas 2) with a certified concentration.

### 4.1. Methane and Oxygen

For methane and oxygen the ambient air (gas 1) is used as a zero/span and the measurement is very stable between calibrations with very little drift.

### 4.2. CO<sub>2</sub> and H<sub>2</sub>S

For CO<sub>2</sub> calibration a certified calibration gas is required with a similar composition to the user's process gas stream.

Gas composition examples:

#### Gas 1 (Ambient air)

CO <sub>2</sub>	0.0	vol%
CH <sub>4</sub>	0.0	vol%
H <sub>2</sub> S	0.0	ppm
O <sub>2</sub>	20.9	vol%

#### Gas 2 (Gas mixture)

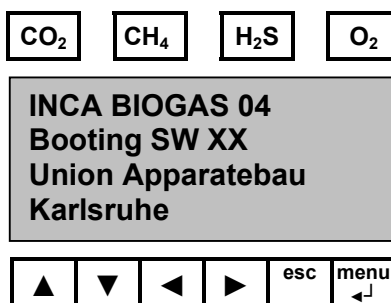
CO <sub>2</sub>	40.0	vol%	(20 - 60 vol%)
CH <sub>4</sub>	60.0	vol%	(35 - 65 vol%)
H <sub>2</sub> S	25	ppm	(10 - 35 ppm)
O <sub>2</sub>	0.0	vol%	(0.0 vol%)

The amount of H<sub>2</sub>S in the process gas can be considerably higher than 25ppm, up to 3000 ppm but a special routine configures the concentration to suit the sensor.

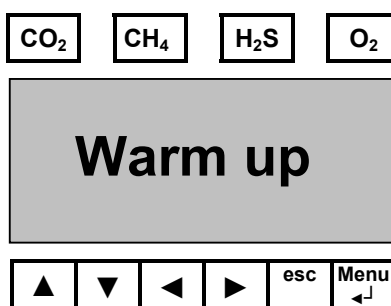
## 5. Start Up

Check all connections and switch the power on.

The instrument automatically starts an on-screen self-test routine:



Initial warm-up takes approximately 15 - 20 minutes and during this time the sensor block is heated and the gas cooler chilled down. For an instrument that has been recently switched off it only takes 3 - 4 minutes to regain operational temperature.



After the warm-up period the operation cycle starts and comprises of both purge and measuring phases for the measuring channels, after one cycle is finished the cycle repeats its self again on the next channel.

## 6. Menu Overview

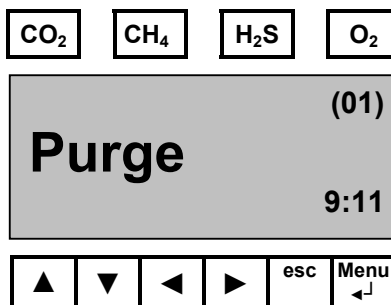
Four menu keys above the screen show each gas component in either % or ppm.

Six function keys are located under the lower part of the screen: keys *up*, *down*, *left*, *right* select cursor position. *Menu* key selects the next lower menu level and the *escape* key returns the user to the previous menu level.

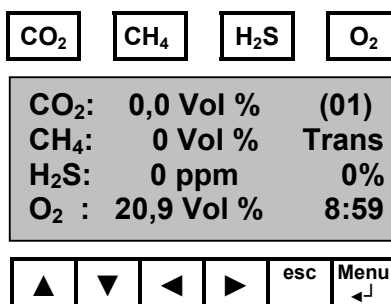
The 4 x 20 character display can be switched to an individual component mode that is suitable for viewing at a greater distance.



During normal operation the instrument cycles between the measurement channel and its purge cycle, the number of the active channel is displayed in upper right corner of the screen and a countdown for remaining time is displayed at the lower right and is preset to 10 minutes. The total measuring time for each channel is user selectable and is password protected.



After purging the components of the gas are measured and the instrument displays the individual gas components (channel 01 shown).

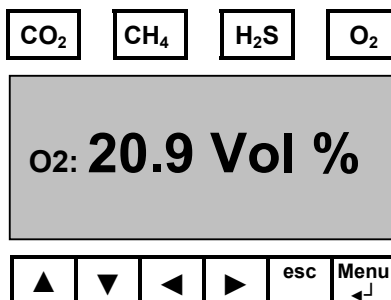


After 5 minutes the unit switches to channel 11. This is the dedicated purge channel that is also used for checking the oxygen sensor with an ambient air source.

All measured values are stored until overwritten by the next measurement cycle.

The instrument switches to the next channel if the multi-stream option is configured.

Four upper keys display the component concentration regardless of the menu, the screen is held until the key is pushed again and the main program continues running in the background.

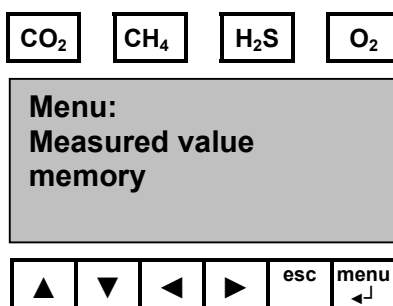


## 6.1. Sub menus

Sub menus can be accessed by using the *menu* key, the *up*▲ and *down*▼ keys highlight the “measuring value memory”, “measuring point now” and “service password” sub menus.

### 6.1.1. Measuring value memory

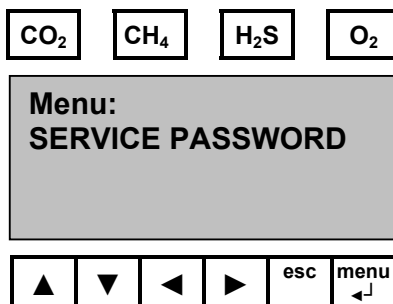
The “measuring value memory” contains the most recent measurement data for all channels together with the time intervals.



Push *Menu* for the first measurement point data press *up*▲ and *down*▼ for the other measurement points and the screen shows “- - -” for any unconfigured channels.

### 6.1.2. Service password

Service passwords are provided after instruction and/or training and purge times or other parameters can be configured in these menus.



Push *Menu* to set the three-digit password using the *up*▲ and *down*▼ buttons and press the *Menu* key to enter the password.

Both “Service” and “Calibration” sub menus can be individually password protected.

**Caution:** Care should be used when working in the service menu as any system data that is changed in error can cause a system malfunction.

The “Service” menu contains the following functions:

(PASSWORD I)

“MEASUREMENT NOW”

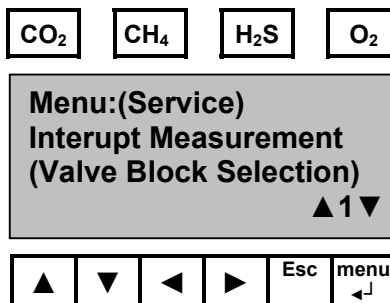
“NUMBER OF MEASUREMENT POINTS”

“MEASURING TIME PER MEASUREMENT POINT”

“HOLD TIME PER MEASUREMENT POINT”

### 6.1.2.1. Measurement now

With this command any current measuring or purging process can be interrupted, it is principally for testing valve function.

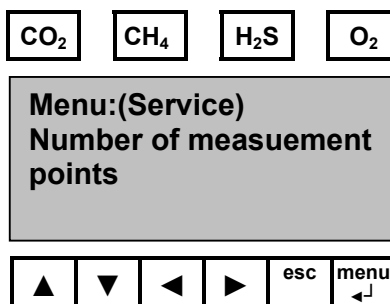


Use *up* ▲ and *down* ▼ to select measurement point “1” or “11” for purging. Press *Menu* to enter the selection.

**Caution:** Do not try to enter data into any unused channels as this may cause a malfunction in measurement mode.

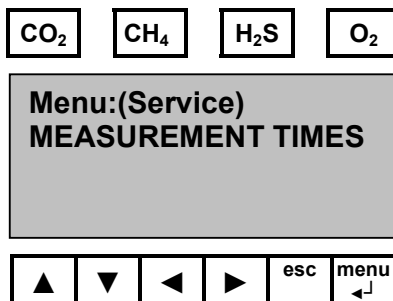
### 6.1.2.2. Number of measurement points

This function is not supported with the current software and no attempt should be made to change it, otherwise a system error will occur.

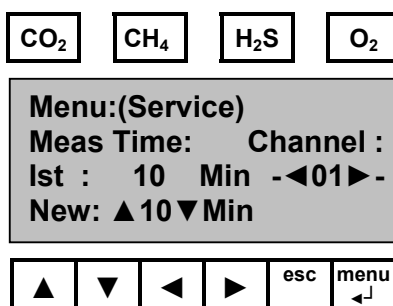


### 6.1.2.3. Measuring time per measuring point

Times for each measurement point “MEASUREMENT TIMES” can be individually programmed and some field adjustment may be necessary to suit the application.



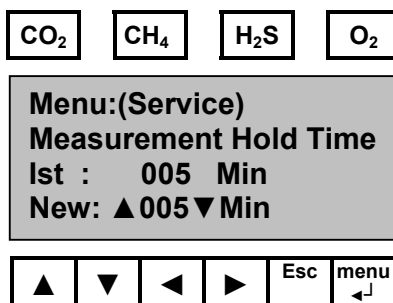
Press the *Menu* button to enter any new settings.



Change time using buttons *up* ▲ and *down* ▼ and select the measurement channels with *right* ► or *left* ◀.

### 6.1.2.4. Pause time per measurement point

A measurement pause time is available for each point.



Push *Menu* button to set the time in the menu “Measurement Hold Time”.

### 6.1.2.5. Calibration

The “Calibration” menu contains the following functions:

(PASSWORD II)

“AUTOCAL”

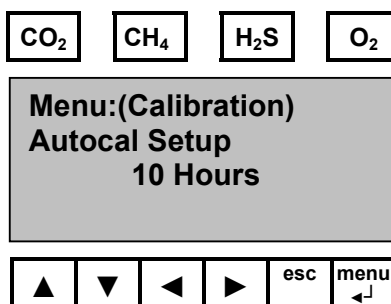
“CALGAS 1”

“CALGAS 2”

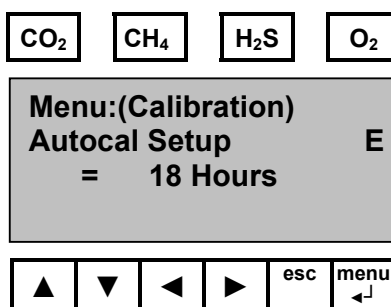
### 6.1.2.6. Auto calibration

The unit can be set to automatically calibrate itself using a known calibration gas at user selectable time intervals.

**Caution:** This function is only possible if the unit is equipped with calibration gas valve option.



Use buttons *up* ▲ and *down* ▼ to program the auto calibration time settings.



The example above shows a time change of 18 hours, which is entered using the *Menu* button and the large “E” for EDIT in the screen will disappear. Auto calibration is switched off at the factory, so the display will initially show “OFF”.

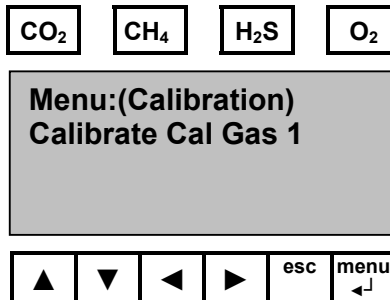


### 6.1.2.7. Calibration

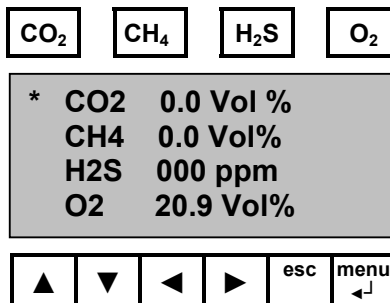
“Calibrate” compares the measured values against the known values of a specially mixed calibration gas that has been specially blended to meet this requirement.

A two point calibration is used and two gas mixtures are required.

Enter calibration gas 1 with the *Menu* button in menu “Calibration”.

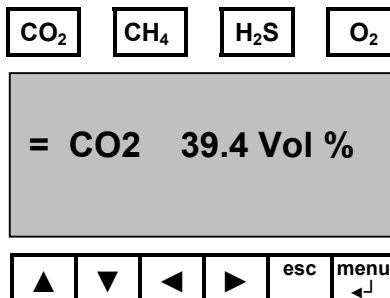


The new calibration gas concentrations can be entered by the user.



Use the *up* ▲ and *down* ▼ keys to select the gas that needs to be changed.

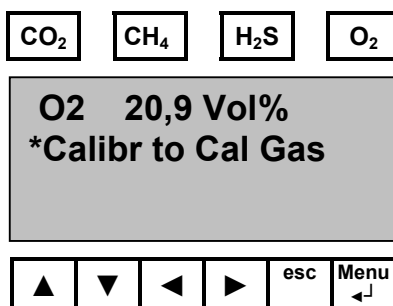
Press the *Menu* button to display the selected gas in a larger screen format.



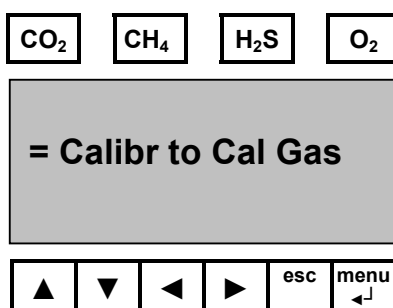
Use buttons *right* ► and *left* ◀ for a large change in data and buttons *up* ▲ and *down* ▼ for small increments. To enter the concentration press *Menu* and the display will switch back to the previous window.

Once the calibration gas concentration is set correctly and the calibration gas supply is connected, the calibration routine with the first gas mixture can be initiated.

Select “Calibr to Cal Gas” with the *down* ▼ button.



Press *Menu* to enter choice and a “sure?” question appears on screen.



Press the *Menu* button and “Calibration Done” is now displayed.

The steps described for gas 1 are all applicable to program gas 2.

**Important:** When changing the calibration gas cylinders for gas 1 or gas 2 they should be switched on to purge the air from the lines for at least five minutes before any calibration is performed otherwise an error may occur.

## 7. Status Codes

The status codes indicate a malfunction has occurred during operation. Some of the codes can be rectified by the user - other codes are more serious and have to be reported for factory advice.

Status 40:	AD error on Peltier element
	Temperature sensor on Peltier element defective
Status 90:	General bus error
Status 91:	Bus error
	Relay card not recognized
Status 92:	Bus error
	Infrared measurement not recognized
Status N.C.:	Not connected or defective
	- applies to both optical and chemical sensors
Status 60:	Temperature sensor broken
Status 53:	Lamp 1 defective
Status 54:	Lamp 2 defective
Status 21:	Zero gas error CO <sub>2</sub>
Status 22:	Zero gas error CH <sub>4</sub>
Status 24:	Span gas error CO <sub>2</sub>
Status 25:	Span gas error CH <sub>4</sub>
Status 30:	Operating temperature not reached
Status P+/P+:	Pump status

## **8. Maintenance and Service**

The instrument is modular in construction and any maintenance or service can be performed by the user with simple tools.

### **8.1. Pump life**

In normal operation the life of both diaphragm pumps is approximately 16K hours (2 years). Note: The gas pump module is equipped with a solenoid valve to prevent any backflow of air into the system.

The air pump does not have a valve and both units can be obtained as a spare part and are easily replaced by the user and new tube connections are also supplied with the pumps.

### **8.2. Electro chemical sensor life**

The life time of the chemical sensors ( $H_2S$  and  $O_2$ ) depend on gas concentration and the average life of the  $H_2S$  sensor is approximately 18 months when operating on normal process gas concentrations. Average  $O_2$  sensor life is more than a year at 20.9% oxygen.

A pre-calibrated electrochemical sensor can be supplied as a spare part, allowing the instrument to be quickly returned to service by the user.

### **8.3. Optical sensor life**

The  $CH_4$  and  $CO_2$ , optical sensors have an almost an unlimited life but are sensitive to dirt and humidity. In most cases the complete sensor block with heater and IR detectors will need replacement and the complete replacement module can be installed by the user.

### **8.4. Condensate pump**

The peristaltic (hose) pump is a consumable part and should be replaced every 24 month by the user. The hose, which can be damaged by abrasives, is available as a spare part.

## 8.5. Maintenance intervals

**Caution:** Ignoring routine maintenance at the recommended service intervals may lead to a fault or series of faults that result in a total instrument shutdown.

## 8.6. Software update

The operating software is updated on a regular basis and the user has the option to update the instrument software should the need arise.

Any software update will require a RS232 'null' modem cable as well as a PC with a RS232 interface and Windows 98 operating system or higher.

**Caution:** Windows NT drivers should not be used as they may cause compatibility problems that cannot be solved by the manufacturer of the transfer software.

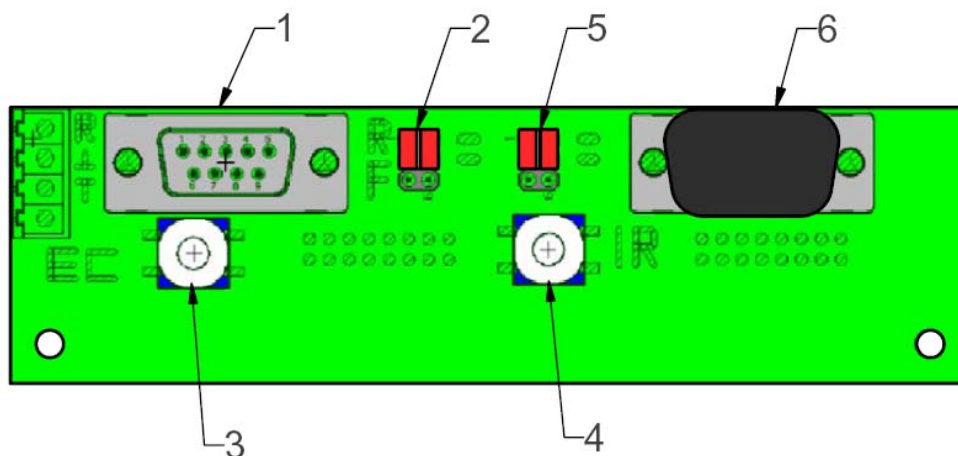


Figure 9: Interface board

1	RS 232 (EC sensor)	2	Jumper (EC sensor)
3	Reset (EC sensor)	4	Reset (IR sensor)
5	Jumper (IR sensor)	6	RS 232 (IR sensor)

RS232 IR (6) is used by the factory for the internal calibration of the IR measurement together with (4-5) and these items are not user accessible.

RS232 EC (1) is used to update the InCa Bio 04 software. The PC software is commercially available Flasher Software (software update program) used by the microprocessor manufacturer.

Open the enclosure, switch off line power and connect the RS232 interface to the PC using the COM1 interface and a 'null' modem cable.

Set jumper (2) to the lower position (figure 9). Switch on line power and push the reset button (3).

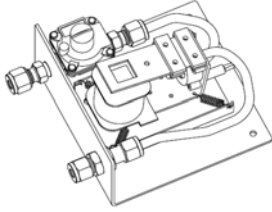
Start the program by double clicking the file name **FLASHM16.EXE** and the following on-screen dialog will appear.

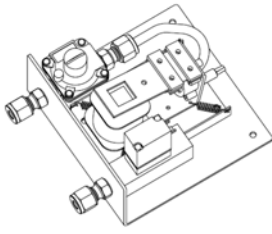
The data should be the same as the screen below.





New software can now be loaded to the flash memory – just press start. Upon completion reset the two jumpers (figure 9) to the upper position. Cycle the instrument power off then on to display the current software and version number.


## 9. Spare Parts List

	<p>Assembly group diaphragm pump air Accessories hoses</p> <p>Weight: 550 grams</p>
<p>Description: Assembly group diaphragm pump air</p>	

	<p>Assembly group diaphragm pump gas MVG accessories hoses</p> <p>Weight: 675 grams</p>
<p>Description: Assembly group diaphragm pump bio gas</p>	

	<p>Electrochemical Sensor O<sub>2</sub> - complete with brackets and electronics</p> <p>Weight: 40 grams</p>
<p>Description: Electrochemical Sensor O<sub>2</sub></p>	

	<p>Electrochemical Sensor H<sub>2</sub>S - complete with brackets and electronics</p> <p>Weight: 40 grams</p>
<p>Description: Electrochemical Sensor H<sub>2</sub>S</p>	

	<p>Flame arrester Weight: 200 grams</p>
<p>Description: Flame arrester SS</p>	