G36

Oxygen Analyzer Manual

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Green
Instruments

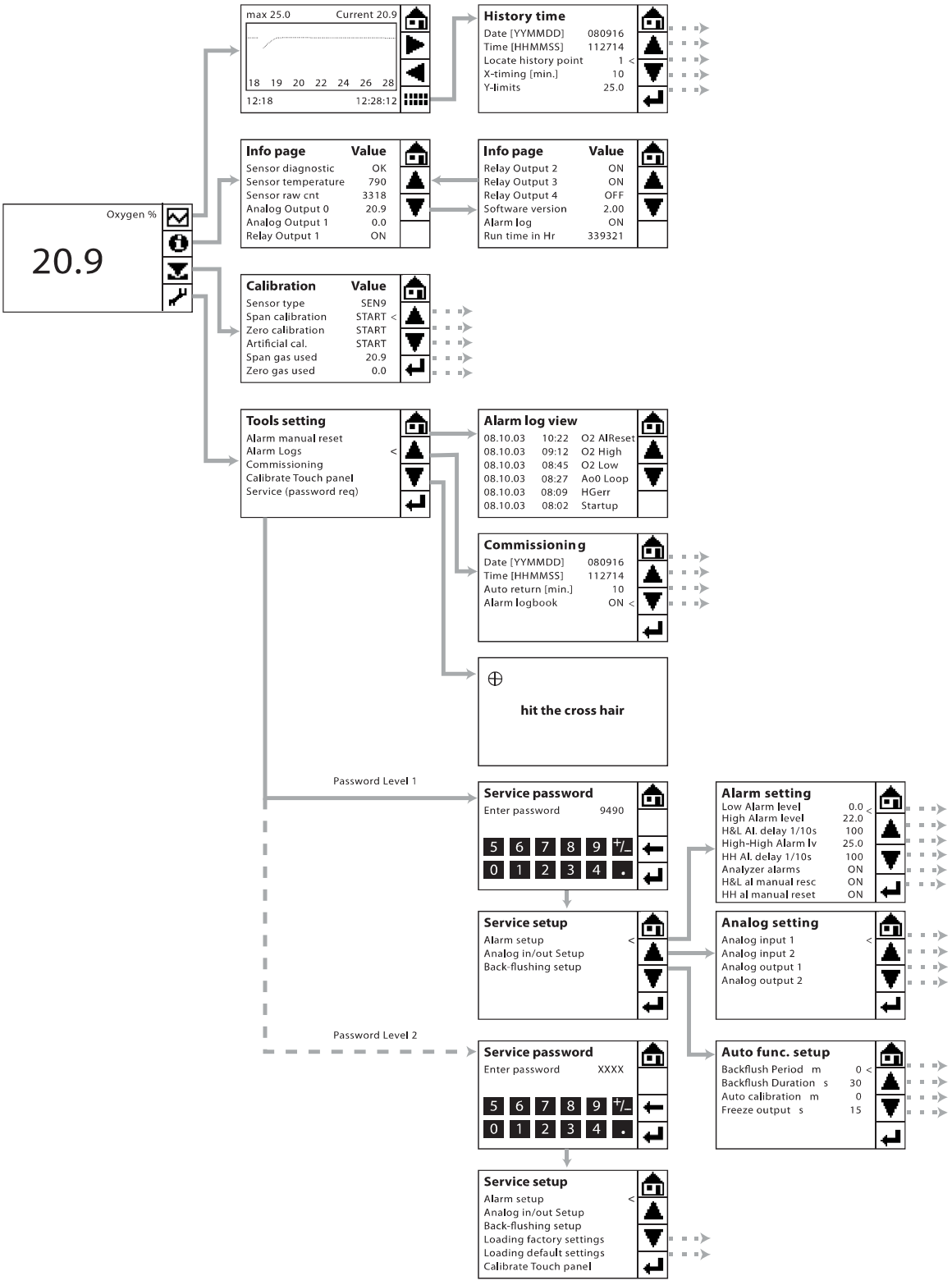

Figure 1-1: Program Menu Structure of the G36 Oxygen Analyzer

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1 Introduction

1.1 About this Manual

This manual contains data and instructions for the installation, operation, and maintenance of the G36 Oxygen Analyzer.

The instructions have been made in general terms and do not take into consideration a specific installation. The instructions & figures have been made in general terms and do not take into consideration specific installations. The figures used in the manual are only for general illustration purposes. As such, the instruction manual is designed only for the G36 Oxygen Analyzer.

The instructions for the installation, operation, and maintenance of the complete analyzing system including sampling board designed for the G36 Oxygen Analyzer by Green Instruments A/S are provided in a separate manual.

The manual does not describe all possible situations but only the most common and known situations and cannot replace the necessary education of the personnel. Should situations not described in the manual occur, which cannot be solved in accordance with normal known practice and good workmanship, the operator should contact Green Instruments A/S for instructions.

Attention

Before operation, read all instructions and warnings within this manual and associated documentation. Improper use may cause personal injury and/or damage of equipment and may void the warranty. Green Instruments A/S disclaims any responsibility for damage and/or injury caused by improper installation, use or maintenance of the equipment

Green Instruments A/S reserves the right to minor alterations and improvements owing to developments without being obliged to enter the corresponding changes in this manual.

1.2 Inquiries and Feedback

All claims and inquiries for spare parts shall be addressed to Green Instruments A/S or our distributors. In all correspondence, or when ordering spare parts, please carefully state the equipment type and serial number, which can be found on the label on the equipment.

Green Instruments A/S appreciates all feedback and suggestions for improvement. If any questions appear or any discrepancies are found in this manual, kindly contact Green Instruments:

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1.3 About the Analyzer

The G36 Oxygen Analyzer continuously measures the content of oxygen with concentrations up to 21.0%. The G_{36} Oxygen Analyzer can be used to measure the content of oxygen in N_2 or CO_2 based inert gas, in stack gas, or in connection with exhaust gas recirculation (EGR).

The G36 Oxygen Analyzer uses a zirconia sensor. The zirconium dioxide sensors have long been established as industry standards. The G36 uses a new type of zirconia sensor, which can be used in a wide range of applications.

The most important element of the sensor is the zirconia cell. At high temperatures, the oxygen ions can diffuse through the zirconium dioxide membrane. When the membrane is exposed to an environment that contains different amounts of oxygen (e.g. the sensor internal reference gas on one side and sample gas on the other), nature seeks to balance itself, and the transportation of ions through the membrane will generate an electrical charge.

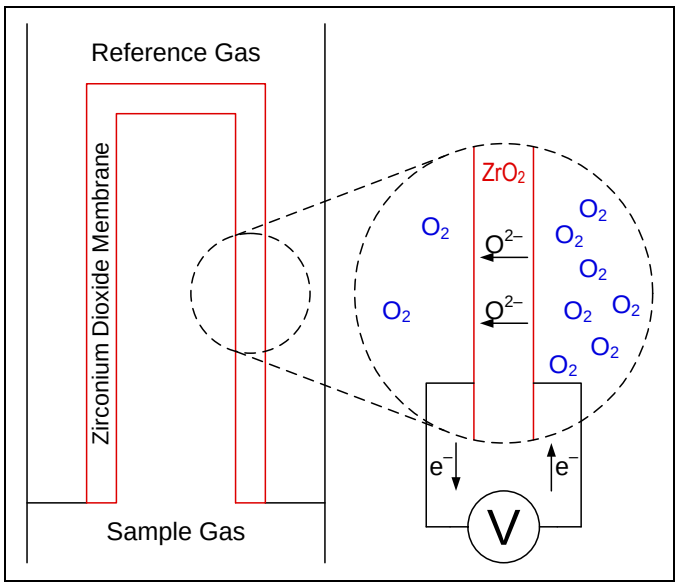


Figure 1-1: Simplified schematic of the zirconia cell

This charge depends on the amount of the passing oxygen ions i.e. the difference between the oxygen levels in the sample gas and the reference gas. This voltage will be detected and converted into a signal that is proportional to the oxygen concentration in the sample gas. The signal will be processed in the analyzer and the oxygen concentration of the sample gas will be shown in the display.

The G_{36} Oxygen Analyzer has CE and MED markings as well as DNV, Bureau Veritas, and Lloyds Register Type Approvals.

Download all product certificates at https://greeninstruments.com/

2 Specifications

G36 Analyzer

Analyzer Types	
• Inert Gas O_2 Analyzer • Stack Gas O_2 Analyzer • EGR-O_2 Analyzer	Monitors O_2 content in inert gas (N_2 or CO_2 based) Monitors O_2 content in stack gas Monitors O_2 content in exhaust gas recirculation
Sensor types	Zirconia sensor type SEN1 or SEN9
Measurement range	0.0%…21.0% O_2
Ambient temperature	–15°C … 55°C
Ambient humidity	Up to 100% at all relevant temperatures
Power supply	100…230 VAC – 50/60Hz
Power consumption	Max. 40 VA per analyzer – recommended fuse: 4 AT
Sample flow	0.2…8.0 l/m
Sample temperature	SEN1: ≤ 250°C; SEN9: ≤ 650°C
Sample pressure	SEN1: max.1 bar; SEN9: max. 4 bar
Digital display	Touch screen 71 x 39 mm
Output signals	Active 4…20 mA – range selectable – default 0.0…25.0%
Load output (max.)	600 ohm/24 VDC
Relays	4 relays, volt free, 24 V AC/DC, 5 A
Alarm functions	Low or High O_2 level – set points freely configurable High-High O_2 level – set point freely configurable System failure alarm
Response time*	90% of measuring scale in less than 45 sec. with sample flow rate of 0.8 l/m, sample line of 1 m
Repeatability	+/– 0.1% of the measuring range
Linearity/Accuracy	+/– 0.5% of the measuring range
Drift (one month)	+/– 0.1% of the measuring range
Dimensions	17 × 20 × 9 cm (H×W×D)
Weight (analyzer only)	2.5 kg without packaging
Analyzer casing	Aluminum casing IP67
Optional: O2 analyzer with pressure compensation module, BV’s product certificate.	

Specifications are subject to changes without notice.

* Response time depends on the sample flow rate and the length of the sample line.

3 Safety Aspects

Attention

- Follow the operating instructions!
- Make sure that all power and signal cables are connected correctly before operating the analyzer.
- The sensor and sensor housing are hot and can cause severe burning of personnel if not handled with care.
- The G36 Oxygen Analyzer is only suitable for installation in a safe, non-hazardous area and not suitable for use with flammable sample gases.
- It should be pointed out that installation and operation of the G36 Oxygen Analyzer and associated equipment must be carried out by skilled, trained, and certified personnel, and that Green Instruments A/S does not take any responsibility for the operation of the analyzer and associated equipment whatsoever.
- The analyzer must only be applied as described in this instruction manual. If the analyzer is used in a manner not specified by Green Instruments, the protection provided by the analyzer may be impaired.
- Successful and safe operation of this equipment depends on proper handling, installation, operation, and maintenance.

Hazardous voltage!

Always disconnect power before installing or servicing the analyzer. Ignoring this warning can result in severe personal injury or material damage. Read the instruction carefully to ensure correct connection of all power and signal leads. Make sure that the correct voltage is connected to the analyzer (see rating marked on the analyzer name plate).

Circuit breaker!

The installation must include a way to switch off the electrical power by a clearly marked switch or circuit breaker external to the analyzer. The external switch or circuit breaker shall be placed in close proximity to the analyzer and within easy reach of the operator.

Overload protection!

For compliance with the IEC 61010-1 (2003) safety requirements, the installation must include a means of overcurrent protection to provide protection against excessive energy being drawn from the power supply system in case of a fault in the analyzer.

Protective earth!
The analyzer must be connected to protective earth.

Installation and fault finding!
Electrical installation and fault finding on the analyzer should only be undertaken by a suitably trained and qualified engineer.

EMC!
For compliance with the EMC product standard IEC 60533 (1999), the connection cables for the main supply, relays, interface, and analog output signals should be shielded or provided with equivalent protection.
Special precautions have to be taken in connection to "long" signals or control lines of more than 30 meter.

Sensor!
The sensor must not be exposed to strong mechanical shocks. Otherwise the sensor element may crack without visible damage.
The sensor must be connected to the analyzer before the analyzer is powered up (risk of damage). As soon as the analyzer is under voltage, the connection to the sensor must not be interrupted. Therefore, please disconnect the power when you need to connect or disconnect the sensor.

Connections!
All electrical connections and power supplies are placed inside the analyzer. To gain access, unbolt the top cover of the analyzer using a standard 4-6 mm screwdriver.

Poisonous gases!
Both sensor types, SEN1 and SEN9, used for the G_{36} Oxygen Analyzer are not suitable for installation in areas with a high concentration of methane (CH_4).
Besides, a reduced life time can occur if the sensor is subjected to lead, phosphor, silicon, halogens or high concentration of sulfur.

Recycling!
Please do not dispose the G_{36} Oxygen Analyzer with regular refuse. Disposal should be in accordance with the requirements of the current statutory regulations.

Symbol identification


Caution, risk of danger


Caution, hot surface


Caution, risk of electrical shock


Protective earth

CE The CE mark proves the compliance of the instrument with the requirements of the relevant EU directives

4 Control at Delivery

When you receive the G36a Oxygen Analyzer, please inspect, and confirm that the received scope of supply is in accordance with the packing list and that nothing is damaged. Any discrepancy should be reported to the supplier immediately.

If any of the received parts are damaged, the shipping company should be informed, and new parts should be made available before completing the installation.

5 Installation & Connections

Read this chapter in its entirety before installing the analyzer.

5.1 Where to Install the Analyzer

Satisfactory operation, faultless functions, and minimal maintenance of the G36 are achieved by paying attention to the following notes:

- The equipment should be installed in a clean area away from dust, oil mist, and moisture. The analyzer should be installed at viewing level in an area with good access for operating and servicing. The location and installation of the analyzer must be chosen, so that the ambient temperature is below 55°C at any time.
- The gasses supplied to the sensor must have a constant flow and pressure. This flow and pressure control is achieved with the sampling system that is typically delivered with the analyzer. Please consult the respective manual or contact Green Instruments A/S.
- The sensor house for both SEN1 and SEN9 have 1/8'' BPS connection. Sampling tube and vent line should be arranged in the way which ensures the flow and pressure at sensor house constant and within the required range.
- The sensor can be installed up to 6 m from the analyzer. The sensor and the sensor house shall be mounted horizontally (sensor pointing sideways) or downwards (sensor pointing down) to prevent the water condensation collecting at the sensor house.

5.2 Electrical Connection

Note

Each analyzer will be configured at the factory to be either:

- An Inert Gas Oxygen Analyzer for monitoring O2 in inert gas
- A Stack Gas Oxygen Analyzer for monitoring O2 in stack gas
- An EGR Oxygen Analyzer for monitoring O2 in the EGR system

For the default configuration and connection of each analyzer, please see the Testing & Configuration Sheet attached to each analyzer.

The electrical connections are dependent on the actual system configuration. The terminals are all located on the PC-Board. Only the functions to be used shall be connected.

Please choose the cables that fulfill the following requirements:
Wire size for power supply: 1 x 1.5 mm2 w/screen
Wire size for analog in/output connections: 1 x 1.5 mm2 w/screen
Wire size for digital in/output connections: 1 x 1.5 mm2 w/screen

5.2.1 Power Supply

The power supply terminal is located at the bottom right corner of the electrical board and is marked power supply rating (100…230 VAC).

Before connecting the power supply, please make sure that the power supply rating for the analyzer corresponds with the power supply available.

5.2.2 Sensor Connections - SEN

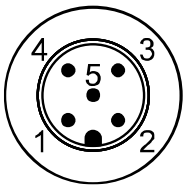
The analyzer is equipped with either a SEN1 or a SEN9 sensor (see the Testing & Configuration Sheet). The sensor is connected to the terminal SEN in the analyzer.

Attention

Each analyzer is delivered with cable connections that are fit for use for either SEN1 or SEN9. See chapter 11 for the spare parts list.

The sensors are connected to the terminal SEN as follows:

Terminal SEN	Pins at SEN1	Pins at SEN9's connection
Terminal 1 (Sensor electrode)	3	1(black)
Terminal 2 (Sensor electrode)	2	2 (yellow)
Terminal 3 (Sensor electrode)	1	3 (red)
Terminal 4 (No connection)		
Terminal 5 (Sensor heating)	4	4 (grey)
Terminal 6 (Ground)	5	5 (white)



The cable between sensor and the analyzer can be delivered up to 6 m in length.

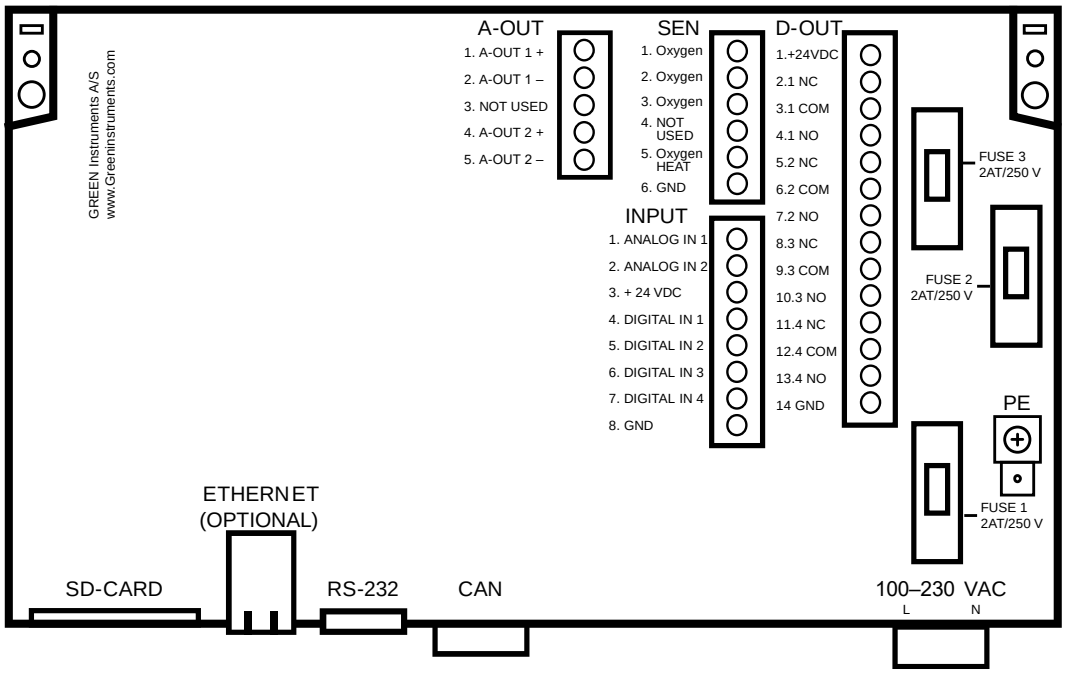


Figure 5-1: Terminals PC-Board - 100 - 230 VAC

5.2.3 Relay Outputs – D-OUT

The analyzer is arranged with four relay outputs connected to D-OUT with 14 terminals.

It is important to note that the configuration of the analyzer might deviate from the configurations listed below. Please see the Testing & Configuration Sheet that is attached to each analyzer.

The default relay functions, and connections of the Inert Gas Oxygen Analyzer are as follows:

Relay No.	Relay function	Terminal Connections	
	Internal power supply + 24 VDC	Terminal 1	
Relay 1	Alarm High/Low O_2 level	Terminals 2.1-3.1-4.1 (NC-COM-NO)	Inverted Normally energized
Relay 2	Alarm High High O_2 level	Terminals 5.2-6.2-7.2 (NC-COM-NO)	Inverted Normally energized
Relay 3	System failure alarm	Terminals 8.3-9.3-10.3 (NC-COM-NO)	Inverted Normally energized
Relay 4	Calibration Span Gas	Terminals 11.4-12.4-13.4 (NC-COM-NO)	Normally de-energized
	Internal power supply – ground	Terminal 14	

For the Stack Gas Oxygen Analyzer and the EGR Oxygen Analyzer relay functions and connections are as follows:

Relay No.	Relay function	Terminal Connections	
	Internal power supply + 24 VDC	Terminal 1	
Relay 1	Alarm High/Low/ High-High O_2 level	Terminals 2.1-3.1-4.1 (NC-COM-NO)	Inverted Normally energized
Relay 2	System failure alarm	Terminals 5.2-6.2-7.2 (NC-COM-NO)	Inverted Normally energized
Relay 3	Auto Back-flushing	Terminals 8.3-9.3-10.3 (NC-COM-NO)	Normally de-energized
Relay 4	Auto-Calibration	Terminals 11.4-12.4-13.4 (NC-COM-NO)	Normally de-energized
	Internal power supply – ground	Terminal 14	

Alarms

The values for three O2 level alarms (Low, High, and High-High) can be set following instruction in section 7.2.

The system failure alarm includes a sensor alarm and alarm for open loop of the analog outputs. If the G36 Oxygen Analyzer is configured with a digital flow switch, the system failure alarm will also include the flow alarm.

Normally energized

Normally energized means that the relay is energized in the alarm free condition during operation. The relay will be de-energized when there is an alarm or when the supply voltage disappears from the analyzer. Thus, the normally energized relays will give a fault signal in the event of failure of power to the analyzer.

Normally de-energized

Normally de-energized means that the relay is de-energized in the normal operating condition. For the Inert Gas Oxygen Analyzer, relay 4 (normally de-energized) will be energized in span calibration condition. For the Stack Gas Oxygen Analyzer or the EGR Oxygen Analyzer, relay 3 or 4 respectively will be energized when the analyzer is back-flushing or auto calibrating.

5.2.4 Input Connections – INPUT

The input connections (INPUT) are placed right below the sensor connections SEN. The terminal is arranged with 8 poles for 2 analog inputs and 4 digital inputs. The configuration is as follows:

Terminals 1 & 3:	Ai01 – Analog Input 1 for connection of a passive 4-20 mA signal*
Terminals 1 & 8:	Ai01 – Analog Input 1 for connection of an active 4-20 mA signal**
Terminals 2 & 3:	Ai02 – Analog Input 2 for connection of a passive 4-20 mA signal*
Terminals 2 & 8:	Ai02 – Analog Input 2 for connection of an active 4-20 mA signal**
Terminals 4 & 8:	Di00 – Digital Input 1 for connection of an NPN input
Terminals 5 & 8:	Di01 – Digital Input 2 for connection of an NPN input
Terminals 6 & 8:	Di02 – Digital Input 3 for connection of an NPN input
Terminals 7 & 8:	Di03 – Digital Input 4 for connection of an NPN input

* Passive input signal means signal voltage from the G36 analyzer.

** Active input signal means signal voltage from external source.

As an option, digital input 1 can be set up for artificial calibration, and/or digital input 2 can be set up for back-flushing.

For setting the analog inputs please see appendix 12.1.

5.2.5 Analog Output Connections – A-OUT

There are two active 4…20 mA output signals*** for load up to 600 ohm. The configuration is as follows:

Terminals 1 & 2	=	Analog Output 1 for the remote indication of oxygen level
Terminal 3	=	No connection
Terminals 4 & 5	=	Analog Output 2 (optional)

*** Active output signal means signal voltage from the G36 analyzer.

For setting of analog outputs please see section 0.

5.2.6 SD Card

The SD card is used for storage of the historical trend of O_2 and the logbook. The SD card can also be used to load a new software version to the analyzer.

Data log

The internal memory of the analyzer measures and saves six values every minute. However, the internal memory can only store one hour of logging, which is equal to 360 log values. If there is no SD card installed the new log values will supersede the old log values. This means there will be no historical trend curve and alarm logs as well.

However, if you install an SD card in the analyzer, the internal memory will be saved on the SD card every minute. If the analyzer alarm and logbook functions are on, the alarms will also be logged on the SD card.

There are two log files in the SD card, a log file for O_2 values – ***g1x.log*** and a log file for alarms – ***g1x.alm***.

If you want to read the log files directly from the SD card using a Windows-operated computer, you have to use Notepad. Do not open the log files in WordPad. WordPad will damage the format of the log files, and the analyzer will be unable to log any more data on the SD card.

The best way to read the log files is to copy them to the local disk of your computer and then open them from your computer. This way, you can use any program that can open a txt-file including Notepad, WordPad, MS Word and MS Excel.

The data in the log file – ***g1x.log*** includes five columns, i.e.:

YYYY-MM-DD	HH:MM:SS	Datalog of A-OUT 1 (O_2 *100)	Datalog of A-OUT 2	Unix time
2009-11-12	13:01:54	2089	0000	1258027314

The SD card shall be replaced after two years due to the limited capacity.

Software and default configuration uploading

The folder ***bin*** at the SD card includes two files: ***G1.bin*** and ***g1parm.bin***. ***G1.bin*** is the software file and ***g1parm.bin*** is the default configuration file.

If Green Instruments delivers a new software version with two files named ***G1.bin*** and ***g1parm.bin*** the following steps will guide you through the installation:

- Replace the old files at the SD card with the new files ***G1.bin*** and ***g1parm.bin*** that you have received.
- Set the SD card back in the analyzer. Then, restart the analyzer. Now the analyzer will automatically check the SD card to see if there is a new software version. If yes, the new software will automatically be loaded to the internal memory of the analyzer.
- After uploading the new software version, reload our default settings by choosing Load default settings in *Tools setting\Service (password level 2)\Load default settings.*
- After uploading the new software version, you have to reset the analyzer following the instructions in chapter 7.

5.2.7 Other Connections

The Ethernet, RS-232, and CAN connections are not in use by default.

6 Menu structure

Please see Figure 1-1 for the Program Menu Structure

6.1 Main Menu

The analyzer is designed with a touch screen. The Main Menu displays the current oxygen value in percent, and to the right four function keys are displayed. The function keys are connected to four different functional menus: Graph, Information, Calibration and Tools.

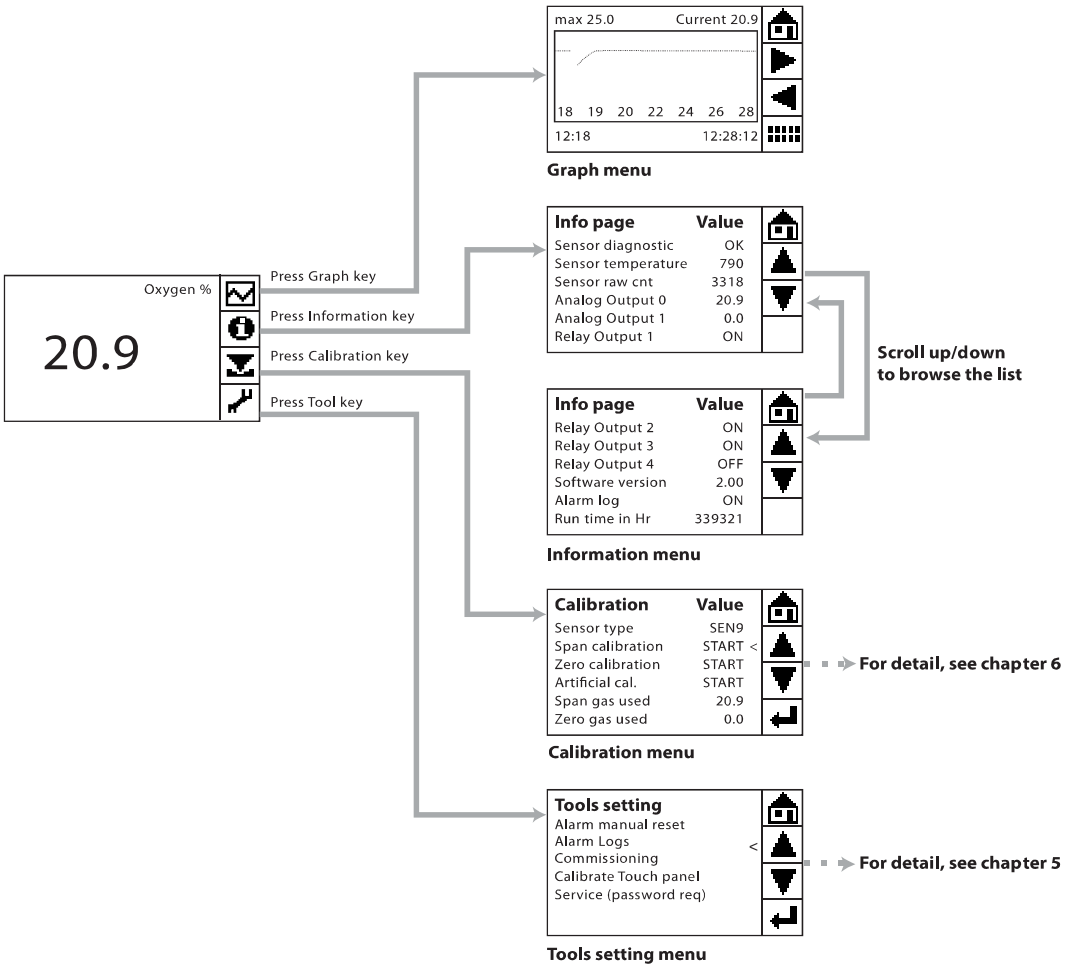


Figure 6-1: The G36 main menu and four functional menus

If the alarm function is on and an alarm is triggered, the alarm message will be displayed at the bottom left corner of the screen.

6.2 Graph Menu

Pressing  changes the display into a graphical mode in which a trend curve of the log values (Y-axis) is shown on a time scale (X-axis).

The actual oxygen value in percent is displayed in the upper right corner of the graph screen as Current.

The trend curve displays the log values from the SD card. The trend screen has 108 dots in the timeline. Therefore, the trend curve will show 1 log value per dot if the X timing is set to 18 minutes (6 log values/minute x 18 minutes = 108 values). If the X timing is less than 18 minutes, the trend curve will be shown as a dotted line.

If the X timing is 36 minutes, two values will be printed at the same X-position. Similarly, if the X-timing is 180 minutes, 10 values will be printed at the same X-position with all different Y values.

Pressing  gives access to the History time menu, where you can choose to see the trend curve in a specific historical period and change the setting for the trend curve.

Note for Stack gas oxygen analyzer

During back-flushing, the Current status is changed to bFrozen with the oxygen value measured before the backflushing.

During auto calibration, the Current status is changed to cFrozen with the oxygen value measured before the calibration.

History time & Graph settings

To see the trend curve in a specific historical period, it is possible to change the values in Date & Time. If for example it is now 12:28 and you want to see the trend curve at 11:00 you have to go through the following steps:

- First, select Time and enter the historical point of time.
- Then, select Locate history point, and the screen will show to the trend curve at that specific time.

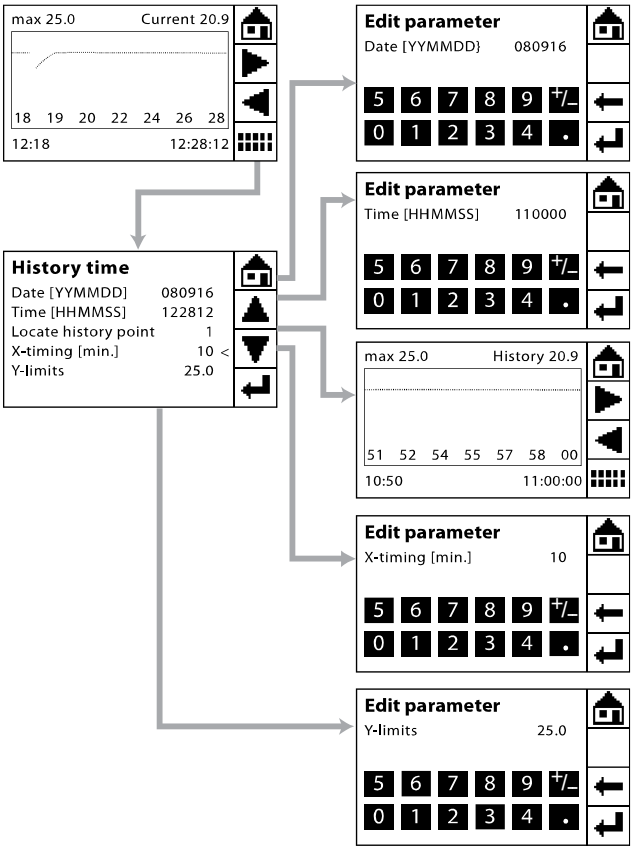


Figure 6-2: History & Settings

It will take time for the analyzer to browse an old history point. The longer time you want to go back, the longer time the analyzer will require to recall the history. When the analyzer is recalling history, the touch screen will freeze and will not immediately react to touching.

If you want to browse a history point which dates back more than a week, it will be best to read the history data directly from the log file at the SD card. For details of how to read the log file, please go to section 5.2.6.

X-timing shows the time range of the trending graph, which can be set as required. However, the time range should not exceed 1440 minutes (24 hours). The time range is displayed on the lower part of the graph screen with the starting point in the bottom left corner and the ending point in the bottom right corner.

Y-limits shows the maximum of measurement range displayed in the trend curve. Default setting is 25 percent. The Y-limits is displayed in the top left corner of the graph screen as Max.

6.3 Information Menu

If you press ⓘ the following information will appear:

Sensor diagnostic	Shows the status of the sensor: OK indicates the sensor is working. HGerr, VMerr, UNerr, IAerr, IPerr, or HDerr indicate sensor failure or connection failure of a sensor cable.
Sensor temperature	Shows the current temperature of the sensor. After starting the analyzer, it will take about five minutes for the sensor to reach its normal operating temperature. The operating temperature of SEN9 is approx. 785ºC. The operating temperature of SEN1 is approx. 750ºC. If the sensor temperature is much lower than the normal operating temperature, the display of oxygen will be incorrect. This can be caused a bad connection between the sensor and the sensor connection terminal SEN, a defect sensor, or too high sample/gas flow through the sensor.
Raw sensor cnt	Shows the raw adc count signal from the sensor.
Analog output 0	Shows the current O_2 in percent from analog output 1 (Ao00).
Analog output 1	Not in use as per default (Ao00).
Relay outputs 1-4	Shows the status of relay outputs 1-4: ON or OFF.
Software version	Shows the software version of the analyzer. For installation of new software version, see section 5.2.6.
Alarm log	Shows the status of the alarm logbook: ON or OFF. When the status is OFF, no alarm will be logged, and the alarm logbook view in the service menu is also OFF.
Run time in Hr	Shows the analyzer's running time in hours - power ON only.

To browse the list in the information menu, please go up and down the list by using the scrolling keys ▲▼.

6.4 Calibration Menu

Pressing ⏳ gives access to the calibration function. In the calibration menu, you can:

- See the sensor type selected for the analyzer (SEN1 or SEN9).
- Access zero, span, and artificial calibration START functions for the analyzer.

- Set values for the test gases: Zero and Span.

Use the scrolling keys ▲▼ to browse the list and press ↵ to select the action to be taken, e.g. selecting Span cal. will start the span calibration.

For further information, please see chapter 8.

6.5 Tools Menu

Pressing 🔧 gives access to the Alarm manual reset function, Alarm logs and the operating system of the analyzer including Commissioning, Calibrate touch panel, and Service.

Use the scrolling keys ▲▼ to browse the list and press ↵ to select the action to be taken.

Alarm manual reset: When the Analyzer alarms is set ON and either H&L alarm manual reset or HH alarm manual reset is set ON, it is required to reset the relevant alarm manually.

To reset an alarm, enter the *Tools menu* and choose Alarm manual reset. Please note that an alarm will remain in operation while the alarm condition is still present. Thus it is only possible to reset an alarm when the alarm condition no longer exists.

Alarm logs show all log alarms if the Alarm Logbook in *Tools settings\Commissioning\Alarm Logbook* and the Analyzer Alarm in *Tools setting\Service (password level 1)\Alarm setting\Analyzer Alarm* are ON.

An O_2 level alarm is logged only after the alarm delay runs out (default at 10 seconds for all three alarm levels). The alarm delay for O_2 limit can be changed in the Alarm setup menu. For more details, see section 7.2.

Failure alarms (sensor or analog output loop alarms) have no alarm delay and are logged immediately. Data log is saved on the SD card every minute.

The alarm logbook might have the following displays:

O2 Low	O_2 low level alarm
O2 High	O_2 high level alarm
Al manual reset	Alarm manual reset
O2 High High	O_2 high high level alarm
HGerr/VMerr/UNerr/IAerr/IPerr/HDerr	Sensor failure
Ao0 Loop	Open loop of analog output 1 (Ao00)
Ao1 Loop	Open loop of analog output 2 (Ao01)
Startup	The analyzer is restarted

Commissioning

Commissioning gives access to the settings of the basic display including Date and Time, Auto returns, and Alarm logbook. For details of these parameter settings, please see section 7.1.

Calibrate Touch Panel

The touch panel requires calibration every time the user reloads the factory settings.

To calibrate select the "Calibrate touch panel" and follow the instructions on the screen, i.e. hitting the cross hairs when they appear on the screen.

- If the touch panel is calibrated correctly, i.e. you have hit the cross hairs on the screen; the message "Saved – hit the touch panel" will appear. Complete the calibration by touching the panel one more time.

- If the touch panel is calibrated incorrectly, i.e. you have not hit all the cross hairs, the display will show the message Error try again – hit the touch panel. In this case, you must calibrate the touch panel again.

- Note that it can be useful to calibrate the touch panel using a small pointed object such as a pencil. However, the pointed object cannot be too sharp, and you must be careful not to push it too hard to avoid damaging the touch screen.

Service (requires an access password)

- Password level 1 is 9490. This gives you access to the analyzer configuration including Alarm setup, Analog input/out setup, and Back-flushing setup. For details of these settings, please see sections 7.2, 7.3, 7.4, and 7.5.

- Password level 2 gives you access to two other functions: Load factory settings and Load default settings. For password level 2, see the Testing & Configuration Sheet delivered with each analyzer.

Please see Figure 1-1 for the overview of the program menu structure.

Attention

The Testing & Configuration Sheet is an important document. It includes the factory settings as well as the password for level 2 functions. Please keep this Testing & Configuration Sheet in your files.

6.6 Navigating the Menu Structure

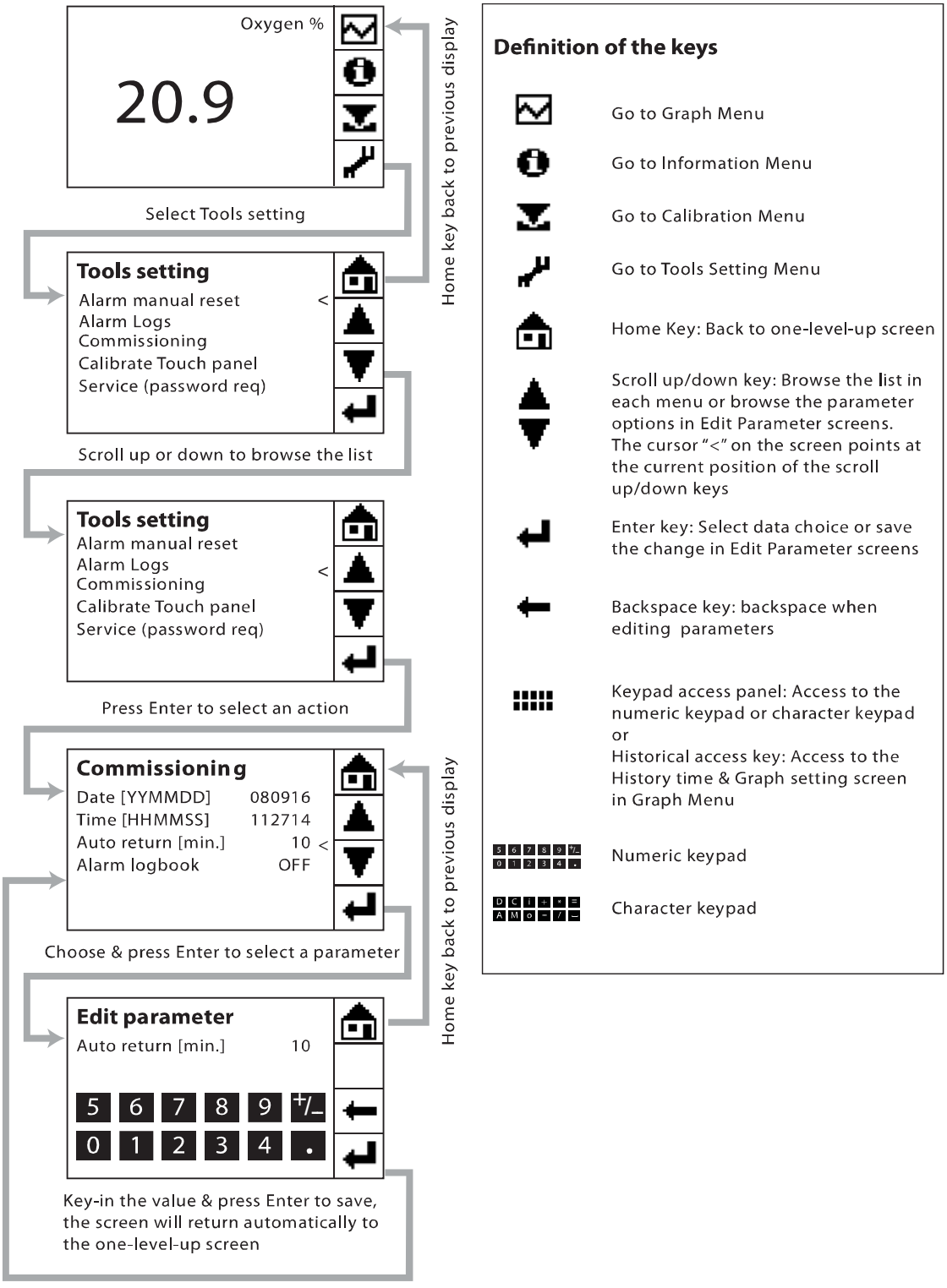


Figure 6-3: Navigating the menu structure

7 Configuration & Commissioning

Before starting the analyzer for the first time after completing the installation, please check and confirm that all electrical connections are installed according to the instruction.

After switching the power on, the analyzer readings shall be stable before starting calibration. It normally takes about five minutes to warm up. During the heating up of the sensor, the Main Menu will display the oxygen content of 0.0. After several minutes, when the sensor has reached its operation temperature, the Main Menu starts displaying the actual oxygen content.

7.1 Setting of Basic Display Parameters

The route for setting the basic display parameters is *Tools menu\Commissioning*.

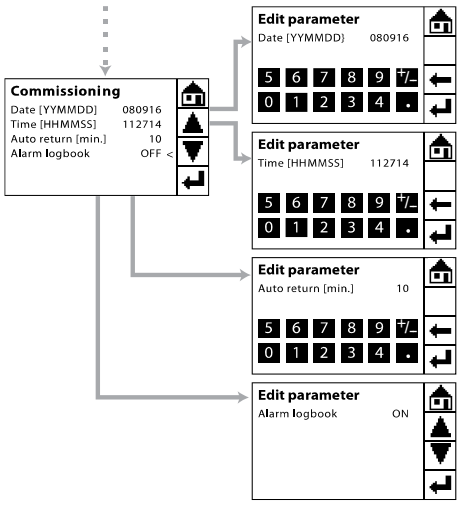


Figure 7-1: Basic display settings

Date and **Time**: The logbook and trend graph use the calendar and clock as reference. Date and time are per default set to follow the Coordinated Universal Time (UTC). The current time is displayed in the Graph Menu. Date and Time can be set upon your requirement. However, it is recommended not to change date and time too often as it will be difficult to keep track of the historical data.

Auto return [min.]: Sets the timeout period. If there is no action taken during that period, the system automatically reverts to the Main Menu from anywhere in the functional menus (except for the Graph Menu). Default setting for auto return is 10 minutes. Minimum setting is 1 minute.

Alarm logbook: ON/OFF mode is set here. If the Alarm logbook is ON, the alarm logbook starts to record all of the alarms. The last 12 alarms are shown in *Tools menu\Alarm Logs*. If the Alarm logbook is OFF, no alarms are saved.

7.2 Setting of Alarms

The route for setting the alarm limits is *Tools menu\Service (Password level 1: 9490)\Alarm setup*.

The G_{36} has three alarms for oxygen level:

Low Alarm level sets the low O_2 level alarm – default set to 0.0%

High Alarm level sets the high O_2 level alarm – default set to 22.0%

High-High Alarm lv sets the high O_2 level alarm – default set to 25.0%

Besides, there are other settings for alarms as follows:

H&L Al. delay 1/10s sets the alarm delay for both Low and High O_2 level alarms. Default set to 100 (equal to 10 seconds).

HH Al. delay 1/10s sets the delay for High-High O_2 alarm. Default set to 100 (equal to 10 seconds).

Analyzer alarms is used to turn ON/OFF the alarm function of the analyzer including analyzer failure alarm and oxygen level alarms.

When the Analyzer alarms are ON and one of the alarm conditions are present, the Main Menu will display the alarm message (e.g. Alarm: Low O_2) in the bottom left corner of the screen. Then, the alarm relay will be triggered after the delay period is over. For alarm relay output function and connection, please follow the instruction in section 5.2.3.

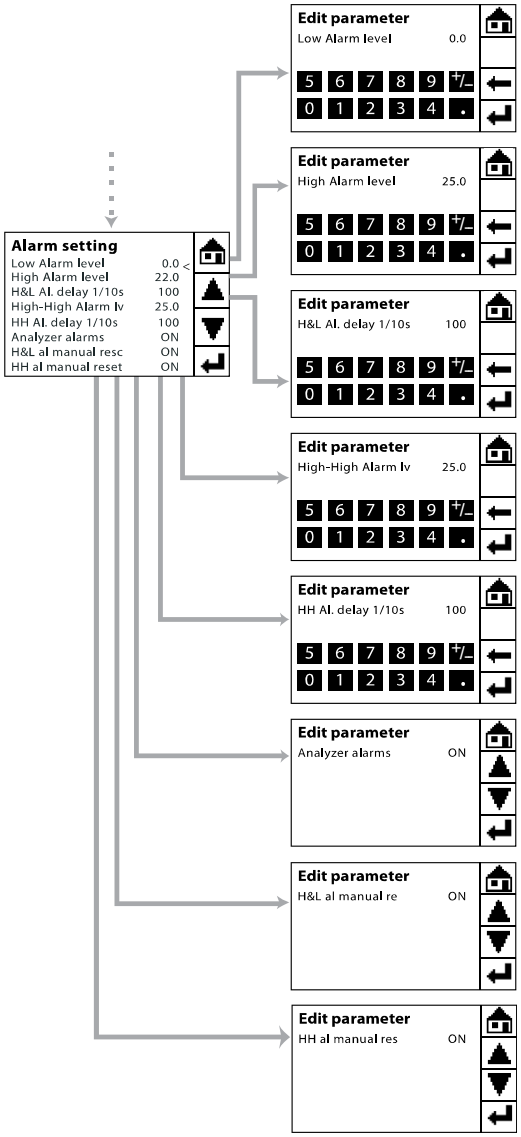


Figure 7-2: Settings of Alarm limits

H&L alarm manual res is used to switch the manual reset function of the High or Low alarm ON/OFF.

When the “H&L alarm manual res” is OFF, the High or Low alarm will disappear automatically when the reading of the O_2 value is no longer in the alarm zone (O_2 level alarms).

When the “H&L alarm manual res” is ON, it is required a deliberate manual action to reset either High or Low alarm.

To reset an alarm, enter *Tools menu* and choose *Alarm manual reset*.

HH alarm manual res is used to switch the manual reset function of the High High alarm ON/OFF.

When the “HH alarm manual res” is OFF, the High High alarm will disappear automatically when the reading of the O_2 value is no longer in the alarm zone (O_2 level alarms).

When the “HH alarm manual res” is ON, it is required a deliberate manual action to reset the High High alarm.

To reset an alarm, enter *Tools menu* and choose *Alarm manual reset*.

Note

If the analyzer is intended to detect a potentially hazardous gas concentration and the Analyzer alarms is set ON, the manual reset functions of the intended alarm should also be set ON in order to compliance with the common safety requirement.

7.3 Setting of Analog Inputs

Both analog inputs are not used by default. Therefore, the parameters in both analog input settings must not be edited.

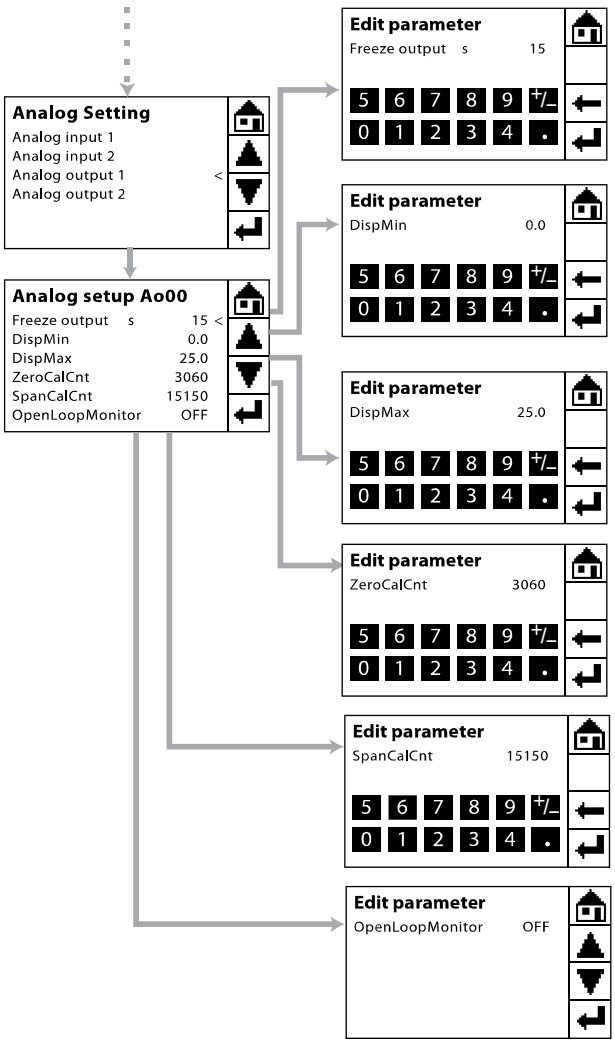
However, if the analyzer has been specifically ordered with preset analog inputs, please see Appendix 12.1 for more information.

7.4 Setting of Analog Outputs

7.4.1 Analog Output 1

The route for setting Analog output 1 is *Tools menu\Service (Password level 1: 9490)\Analog in/out settings\Analog output 1*.

Analog output 1 (Ao00) is connected to terminal A-OUT connection 1 & 2 with default setup to indicate the actual oxygen value in percent.



Freeze output: The freezing of the output signal after back-flushing or calibration is set to 20 seconds by default.

Analog Output Scale: The analog output signal can be scaled by editing the minimum and maximum values (DispMin/DispMax).

The scale is freely configurable, but usually only the maximum setting is changed. The range of the output signal must correspond to the requirements and settings of the external instrumentation or system.

The default setting is 0.0–25.0% oxygen and 25.0% ≙ 20 mA). This is appropriate ternal instrumentation is operating with of 4–20 mA and display of 0.0–25.0% ox

If however, the external instrumentation is working with an input in a different range – for example 0.0–10.0% oxygen, i.e. 0.0% ≙ 4 mA and 10.0% ≙ 20 mA – then the maximum value in DispMax has to be changed – in this example to 10.0.

Figure 7-3: Settings of Analog Output 1

Calibration of Analog Output Signal

Calibration of the analog output signal is usually only relevant after reloading new factory/default settings. The calibration of the analog signal is carried out in one of the following ways:

Option 1: Input of tested values

- Select **ZeroCalCnt** and key in the value according to the **ZeroCalCnt** value in the Testing & Configuration Sheet attached to each specific analyzer. Press ↵ to save. The screen will automatically return to the Analog setup Ao00 screen.
- Select **SpanCalCnt** and key in the value according to the value in the **SpanCalCnt** value in the Testing & Configuration Sheet attached to each specific analyzer. Press ↵ to save.

Option 2: Manual calibration

Only if the analog signal does not function properly with the input of the tested values – Calibration Option 1, the analog signal shall be calibrated manually. For manual calibration of analog signal 1 (Ao00), zero test gas and instrument air shall be used.

Connect a current meter with a range 4-20 mA between terminal A-OUT connection 1 & 2.

For zero calibration:

- Select DispMin. Enter the oxygen value of the zero test gas and save.
- Introduce zero test gas to the sensor.
- Select ZeroCalCnt. Then adjust and save the value to correspond with 4 mA output.
- Select DispMin. Change the value back to the minimum value of the scale required by the external instrumentation (usually 0% O2 – in rare cases other values).

For span calibration:

- Select DispMax. Enter 20.9 (oxygen % in the instrument air) and save.
- Introduce the instrument air to the sensor.
- Select SpanCalCnt. Then adjust and save the value to correspondent with 20 mA output.
- Select DispMax. Change the value back to the maximum value of the scale required by the external instrumentation (usually 25% O2 – in some cases 10% O2 - in rare cases other values).

Open Loop Monitor

The function can be switched ON/OFF. The default setting is OFF. If the function is ON, there will be an alarm displayed Alarm: Loop in the Main Menu if the loop between A-OUT connection 1 & 2 is open.

7.4.2 Analog Output 2

The route for setting Analog output 2 is *Tools menu\Service (Password level 1: 9490)\Analog in/out settings\Analog output 2*.

Analog output 2 (Ao01) is connected to terminal A-OUT connection 4 & 5. Analog output 2 is per default arranged to display the oxygen value just as Analog output 1. The adjustment of settings and calibration is done as described in chapters 7 & 8.

If ordered, Analog output 2 can be set to display Analog input 1 (Ai01). Most settings are done equivalently to the description in chapter 7 with the exception of the manual calibration of the output signal. If Analog output 2 is connected to Analog input 1 then follow these instructions for a manual calibration of the output signal.

- Connect a current meter to terminal A-OUT connection 4 & 5 for measuring the analog output 2.

For zero calibration:

- Simulate a 4 mA current to Analog input 1.
- Select ZeroCalCnt. Then adjust and save the value that corresponds to 4 mA showed on the current meter connected to the analog output 2

For span calibration:

- Simulate a 20 mA current to Analog input 1.
- Select SpanCalCnt. Then adjust and save the value that corresponds to 20 mA showed on the current meter connected to the analog output 2.

7.5 Back-flushing & Auto Calibration

Attention

Not relevant for the Inert Gas Oxygen Analyzer!

The backflushing and auto calibration functions are not used by default for the Inert Gas Oxygen Analyzer. The parameters in this menu, therefore, must not be edited.

This section is only valid for the Stack Gas Oxygen Analyzer and the EGR

Oxygen Analyzer

The route for setting of back-flushing and auto calibration is *Tools setting\Services (password level 1: 9490)\Back-flushing setup*.

Back-flush period is used to set the interval between two back-flashings. The default setting for auto back-flushing interval is 6 hours (360 minutes). There will be no back-flushing if the Back-flush period is set to 0.

Back-flush duration is per default set to 30 seconds.

Auto calibration is used to set the interval between two auto calibrations. By default, the analyzer is set for auto calibration every 24 hours (1440 minutes). There will be no auto calibration if the Auto Calibration is set to 0.

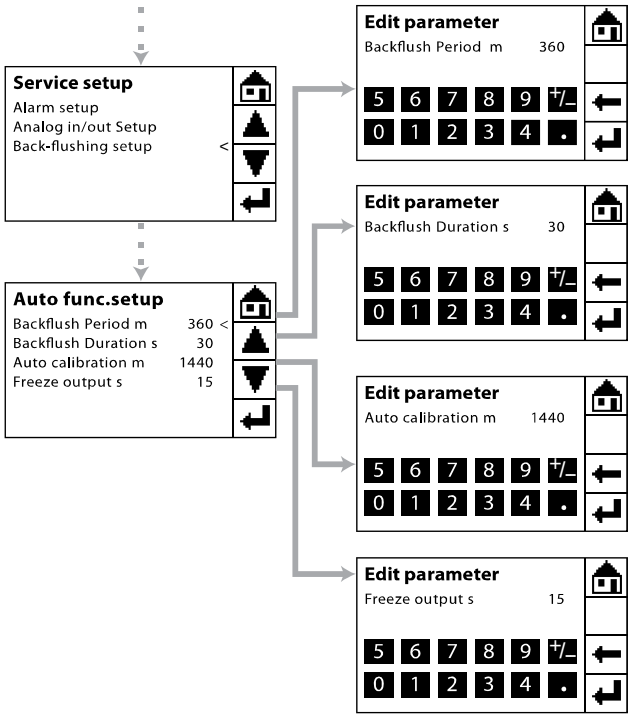


Figure 7-4: Setting of back-flushing

Freeze output is the freezing time of output signals after calibration or back-flushing. Default setup is 15 seconds. This parameter can be set either here or in the setting of the Freeze output under Analog in/out setup. See chapter 7.

7.6 Loading Default Settings & Factory Settings

The route for these two functions is *Tools setting\Services (password level 2 – see Testing & Configuration Sheet for password).*

Load Default Settings

This function makes it possible to return to the standard settings. After loading the default settings, the analyzer will restart automatically loading the default settings from the SD card to the analyzer. After reloading the default settings, please calibrate the touch panel and reset the analyzer using the Testing & Configuration Sheet attached to each analyzer or following the instruction in chapter 8.

In case the g1parm.bin at the SD card has been deleted accidentally, please contact Green Instruments for resending the standard setting file.

Load Factory settings

Loading factory settings should only be used under the instructions from Green Instruments. After loading factory settings, please calibrate the touch panel, and then reset the analyzer.

7.7 Commissioning of the Analyzer

After completing the configuration, please verify the installation and setup of the analyzer with the following steps:

- Check that the span calibration gas is connected before span calibration; and zero calibration gas is connected before zero calibration. Calibration gases shall be connected to the sensor without any leaking and in accordance with a good installation practice. A leaking connection will result in loss of calibration gas and may result in poor calibration. In order to have the accurate result, the pressure and flow rate of the sample gas should be the same as the pressure and flow rate of the calibration gasses.
- Check that the setup of the analog output signals is correct.
- Check that the setup of the alarm levels is correct.
- Check that the setup of the calibration values for zero and span calibration gas is correct.

Calibration can be performed when the indication of oxygen content on the Main Menu has stabilized, normally about five minutes after starting the analyzer. Calibration is carried out as described in the following chapter.

8 Calibration

After completing the installation and before putting the analyzer into operation, the analyzer must be calibrated.

After switching the power on, the analyzer readings shall be stable before starting calibration, which will normally take about five minutes of warm-up time.

The analyzer is arranged for calibration by using certified calibration gases or instrument air. In addition, the analyzer can be artificially calibrated. However, artificial calibration should only be used for intermediate purposes and cannot replace manual calibration with a known and certified calibration gas.

Attention

For the purpose of calibration, the signal from the sensor shall be stable for at least 10 seconds. Therefore, during calibration there must not be variations in pressure or flow in the calibration gas supplied to the sensor.

In order to have an accurate result, the pressure and flow rate of the sample gas should be the same as the pressure and flow rate of the calibration gases.

During the calibration with known oxygen gases, press  to restart the analyzer without changing any change of settings and calibration values.

8.1 Calibration with Known Oxygen Gases

The zero-calibration gas to be used shall be a mixture of pure nitrogen with a known amount of oxygen. The best practice of zero calibration is to use a calibration gas just below the target range of the application.

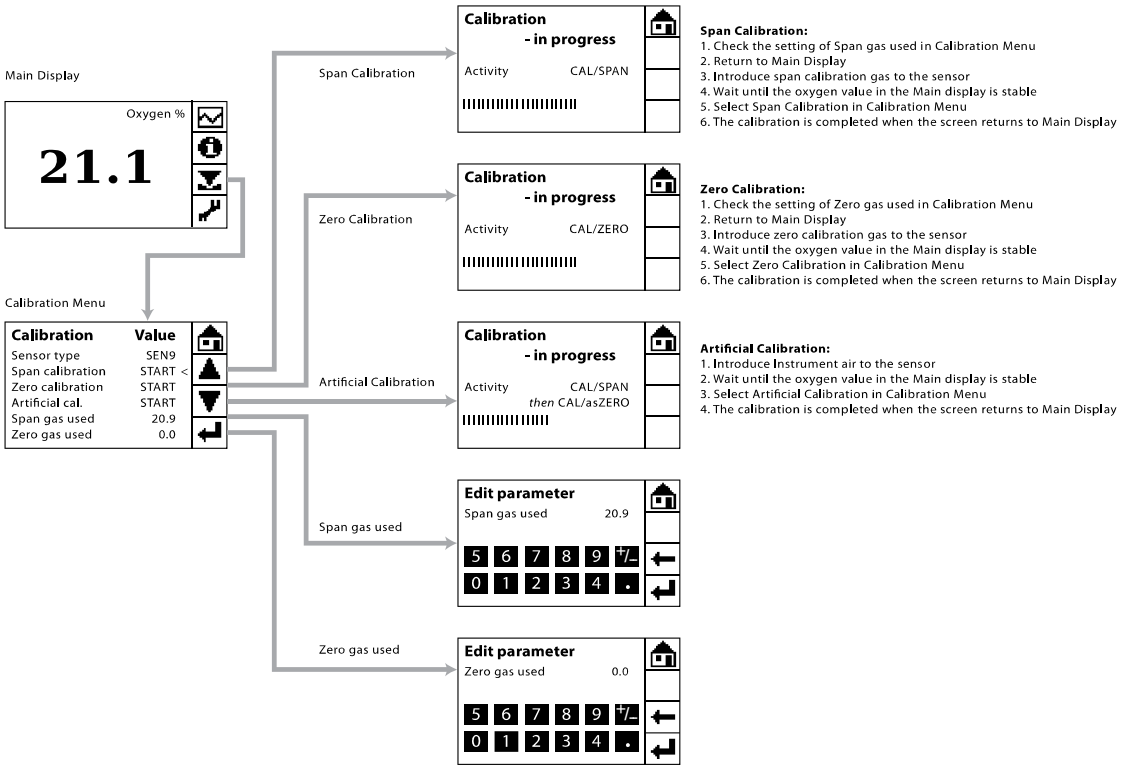


Figure 8-1: Calibration Menu Structure & Quick guide

For the span calibration gas, clean dry instrument air with oxygen content of 20.9% is recommended.

Before starting to calibrate the analyzer, check the settings of zero and span gas used in the Calibration Menu.

- If the value of zero gas used is not correct, select Zero gas used and enter the value of the zero gas used
- If the value of span gas used is not correct, select Span gas used, and enter the value of the span gas used.
- Press  to go back to the Main Menu.

To calibrate the oxygen signal, do the following steps:

- Introduce zero calibration gas to the sensor, and wait for the zero value reading to stabilize, e.g. 1.8%. Then enter Calibration Menu and select Zero calibration. The zero calibration is completed when the analyzer returns to the Main Menu. The new calibration value will be displayed after 15 seconds (as per default setting of freeze output).

- Introduce the span calibration gas to the sensor, and wait for the span value reading to stabilize, e.g. 21.1%. Enter Calibration Menu and select Span calibration. The span calibration is completed when the display returns to the Main Menu. The new calibration value will be displayed after 15 seconds (as per default setting of freeze output).

The calibration should be checked according to the requirements of each application.

8.2 Artificial Calibration of Oxygen Signal

The analyzer is arranged with the possibility to carry out an artificial calibration using only instrument air. Artificial calibration is carried out as follows:

- Apply instrument air with 20.9% oxygen to the sensor.
- Enter Calibration Menu and select Artificial Calibration. The artificial calibration will now start calibrating first Span using the instrument air as the reference; then Zero using the reference Zero point generated by the analyzer.
- The calibration is completed when the analyzer returns to normal reading (i.e. 20.9 displayed on the main menu).

Attention

For the Stack Gas Oxygen Analyzer and the EGR Oxygen Analyzer

With the default configuration, the analyzer is automatically calibrated every 6 hours using the artificial calibration. The interval between two calibrations can be changed as described in section 7.5.

9 Routine Maintenance

9.1 Analyzer

The analyzer is tested from the factory. The analyzer does not require any special maintenance. The LCD shall be kept clean in order to give a clear view and allow proper operation of the touch screen. The touch screen shall be cleaned using a soft damp cloth or soft tissue. Dirt and oil on the surface of the analyzer need to be removed carefully using neutral detergent and a clean rag.

9.2 Calibration

The most important routine maintenance task is to calibrate the analyzer regularly. The analyzer has to be calibrated after each startup of the G36 Oxygen Analyzer. If in operation continuously, experience has shown that one calibration per week is sufficient. See chapter 8.

9.3 Sensor

Attention

- The sensor/sensor house is hot and can cause severe burning of personnel if not handle with care.
- Turnoff the analyzer before working with the sensor.
- Before removing the sensor from the sensor house, make sure that there is no over-pressure or hot sampling gas inside the sensor house.

The sensor is a consumable part and needed to be changed when its lifetime is over. To change the sensor, following the below steps:

- Turn off the analyzer first; then unplug the sensor connection.
- Loose the sensor from the sensor house and replace it by a new sensor.
- Plug the new sensor back to the sensor house. Then turn on the analyzer.

9.4 Gas connection

The calibration and sample gas connections to the sensor should always be checked and ensured no leaking. A leaking connection might result in inaccurate measuring results.

Besides in order to have accurate measuring results, the gasses supplied to the sensor must have a constant flow and pressure. The pressure and flow rate of the sample gas should be the same as the pressure and flow rate of the calibration gasses.

10 Troubleshooting

Troubleshooting should always be carried out by trained personnel. The G_{36} Oxygen Analyzer is connected to hazardous electric voltages, which can cause personal injury or mechanical damage if not handled correctly and in accordance with normal safety regulations.

Trouble	Possible Cause →Action
No display at all	→Check the circuit breaker →Check power supply – the power supply needs to be at correct voltage →Check fuse inside the analyzer
No display despite power supply and fuse are found OK	The analyzer is defect →Reboot, repair, or exchange the analyzer
Display only indication 0.0	No signal from sensor → Check connection both at the analyzer and sensor; Then wait for several minutes, re-plug the sensor, or restart the analyzer Check sensor temperature in ⓘ Information Menu, see section 0. If the sensor temperature could not reach its operating temperature before it starts working, the sensor's diagnostic status will show OK, but the display only indicates 0.0 → Check if the sample flow is too high. Try to take the sensor out of the sensor house and let it hang in the ambient air to see if the sensor temperature can reach its operating condition.
Incorrect indication of oxygen level	→Try to recalibrate the analyzer →Try artificial calibration if normal calibration is not working, see section 8.2 →Check the sensor's diagnostic status and temperature in Information Menu, see section 0. Check sensor connection, or replace the sensor if it is defect
Incorrect remote display and recording	There might be a mismatch in the output range of the analyzer and the input range of the remote system →Check and correct output signal settings, see section 0.
No trend curve Graph Menu may be frozen	Y-limits is set too low → reset Y-limits, see section 6.2 X-timing is set too high → restart the analyzer, reset X-timing, see section 6.2
Touch panel errors	→Calibrate the touch panel, see section 6.5
No data log No historical trend curve	→Check if the SD card is in position. →If yes, check the SD card's lock mode. The lock button should always be in the unlock position.

Trouble	Possible Cause →Action
	→Replace the SD card if it is defect.
Unable to reload default settings	→ If the screen shows “Error!! No SD card”, please check the SD card inside the analyzer. Replace the SD card if it is defect. Contact Green Instruments for a new SD card with the default setting file → If the screen shows “Error!! No parm file”, please Contact Green Instruments to resend the default setting file. Copy the g1parm.bin to the SD card (SD-card:\bin), then try to reload default settings one more time.

11 Spare Parts

Spare parts are not included in the standard delivery. Spare parts can be ordered when necessary. When ordering spare parts, please mention the serial number of the analyzer, which you can find on the label on the right side of the blue analyzer box.

Part No.	Part Description	the specific appearance of the spare parts is subject change without notice; the function however will not change
00328	O-ring for IG sensor	
00390	SEN1 Oxygen sensor plug-in type – complete with O ring	
01258	SEN9 Oxygen sensor screw-in type – with male connector	
00477	Sensor cable for SEN1 – 0.8 m	
01121	Sensor cable for SEN1 – 1.5 m	
00922	Sensor cable for SEN1 – 3.0 m	
00457	Sensor cable for SEN9 – 3.0 m	
01047	Cable glands – M20 (11-14 mm)	
01251	Fuse 2 AT (pkg of 10)	

Part No.	Part Description	the specific appearance of the spare parts is subject change without notice; the function however will not change
01052	Sensor Housing for SEN1 with stay with 1/8" BSP connection	
01450	Sensor Housing for SEN9 with stay with 1/8" BSP connection	
01241	G_{36a} Oxygen Analyzer 100-230 VAC	
01245	This Manual	
01471	SD card with Green Instruments' software & standard settings files Please inform the serial number of the analyzer when ordering a new SD card.	
	Optional equipment – including pressure transmitter (part #01390), remote digital display (part # 33590), signal amplifier for logarithmic output (part # 33593), flow alarm (part # 01527) can be supplied.	

Attention

All spare parts must be stored in the original packaging at a dry place. The maximum storage time of the sensor is 2 years.

Storage temperature: -15 °C…55 °C

12 Appendix

12.1 Setting of Analog Inputs

The analog inputs are not in use by default. If however, the analyzer has been specifically ordered with preset analog inputs they are set accordingly. See the specific arrangement in the Testing & Configuration Sheet.

The two analog input signals of the G36 can be configured for most input requirements such as pressure, temperature, flow and opacity. The analyzer can be optional arranged with one or both analog inputs. For the analyzer with pressure compensation module, Analog Input 1 is per default setup for pressure transmitter.

Both input signals can also be configured to be displayed on the Main Menu. See Figure 12-1 for details of the Main Menu when both analog inputs are in use.

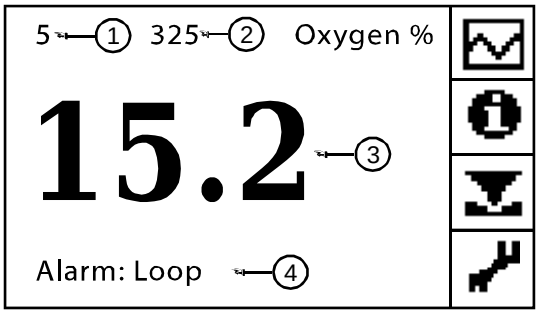


Figure 12-1: Main Menu if both analog inputs are agreed to be used

- Position 1: Display of Analog input 1 (e.g. pressure in kPa).
- Position 2: Display of Analog input 2 (e.g. gas temperature in ^{o}C).
- Position 3: Current oxygen value in percent.
- Position 4: Display of the current alarm (e.g. Alarm of open analog output loop) – if there is no alarm, there will be no display here.

Freeze output
No setting is required for this parameter. The default setting is 15 seconds.

Analog Input Scale
The analog input signals should be 4-20 mA.

The display range of the input signals is from 0.0 to 999.9. Both input signals can be scaled freely within this range by editing the minimum and maximum displays (DispMin/DispMax).

- The minimum display is correspondent to a signal of 4 mA.
- The maximum display is correspondent to a signal of 20 mA.

Calibration of Analog Input Signals

The route for calibration of Analog Input 1 is *Tools menu\Service (Password level 1: 9490) \Analog in/out settings\Analog input 1*.

This procedure should usually only be relevant after reloading the factory settings. The calibration of analog input signal is carried out in one of the following ways:

Option 1: Input of tested values

- Select ZeroCalCnt and key in the value according to the ZeroCalCnt value in the Testing & Configuration Sheet attached to each specific monitor. Press ↵ to save. The screen will automatically come back to the Analog setup Ai01 screen.
- Select SpanCalCnt, and key in the value according to the value in the SpanCalCnt value in the Testing & Configuration Sheet attached to each specific monitor. Press ↵ to save.

Option 2: Manual calibration

Do the manual calibration of analog signal only if the analog signal does not function properly with the input of the tested values (Option 1).

The manual calibration of analog input signal requires you to go back and forth between the Analog setup Ai01 screen and the Main Menu.

For zero calibration:

- Simulate a current of 4 mA to Analog Input 1. For passive input signal, connect to terminal INPUT connection 1 & 3. For active input signal, connect to terminal INPUT connection 1 & 8.
- Select ZeroCalCnt and adjust the value in ZeroCalCnt until value of analog input Ai01 in the Main display equal to the MinDisp value. Then save the new value of ZeroCalCnt.

For span calibration:

- Simulate a current of 20 mA to Analog Input 1. For passive input signal, connect to terminal INPUT connection 1&3. For active input signal, connect to terminal INPUT connection 1 & 8.

- Select SpanCalCnt and adjust the value in SpanCalCnt until value of analog input Ai01 in the Main display equal to the MaxDisp value. Save the new value of Span-CalCnt.

For the calibration of Analog Input 2 (Ai02), select Analog Input 2 in the Analog settings menu and connect the simulator to Analog Input 2, terminal INPUT connection 2 & 3 (passive input signal) or connection 2 & 8 (active input signal). Then, follow the same procedure for setting of Analog Input 1.

Open Loop Monitor
No setting is required for this parameter. The default setting is OFF and shall not be changed.

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