ETG 6903H

NH3 LASER ANALYZER

Portable version

ETG RISORSE E TECNOLOGIA
Via Baione, 2/K
10034 Chivasso
www.etgrisorse.com

Tel.: +39 011 19270890
Email: sales@etgrisorse.com

USER INSTRUCTION MANUAL

SUMMARY

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This alert identifies hazards that should be considered to prevent damage to property and people and the analyzer itself.

This symbol indicates information that is useful for the system

1 Overview

A new line of laser gas analyzers is available for monitoring the concentration of NH3 and H2O. The system is compact and ready to be used in the plant as it is a "hot" extraction system complete with probe and heated line. Based on laser technology, the system is free of interference and with a fast analysis response.

The analysis of the NH3 value at chimney is very important as a precursor of the particulate in ambient air and it is equally useful to measure the value of NH3 as regards the fallout of acid rains on the ground.

The analyzer software allows data logging, graphical trend, and other useful functions for the operator. The monitor is a touch screen.

1.1 ETG 6903P

1.1.1 Block diagram of the whole system

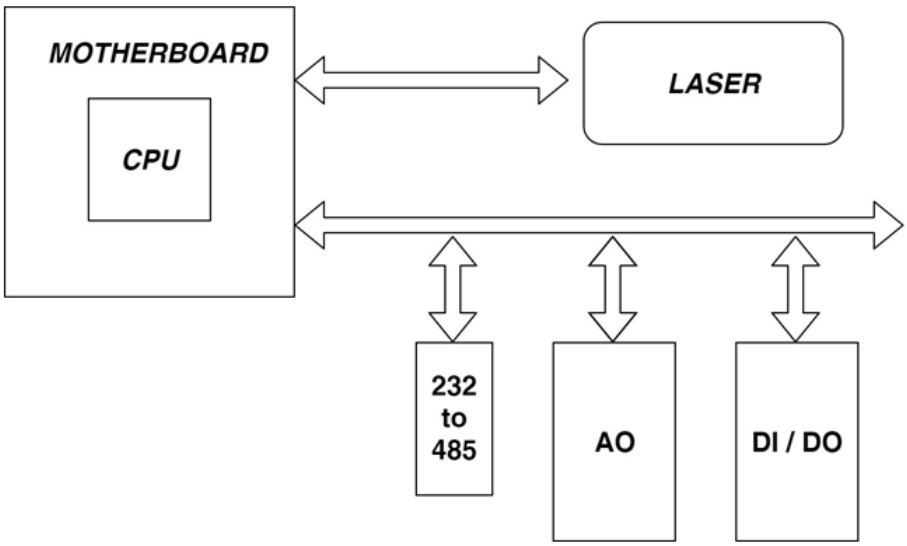
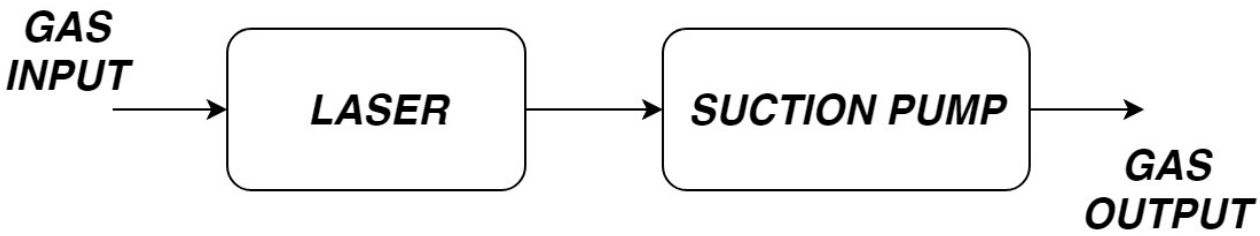


Fig. 1.1 Block diagram of Data transmission

1.1.2 Block diagram of the pneumatic scheme



1.1.3 Overview system

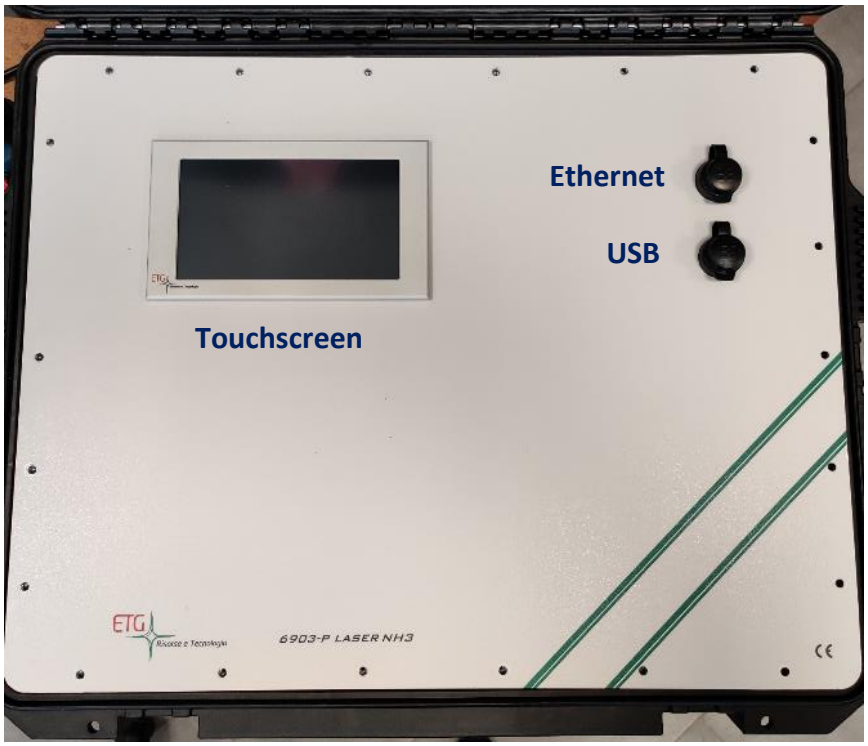


Fig. 1.2 Front Panel

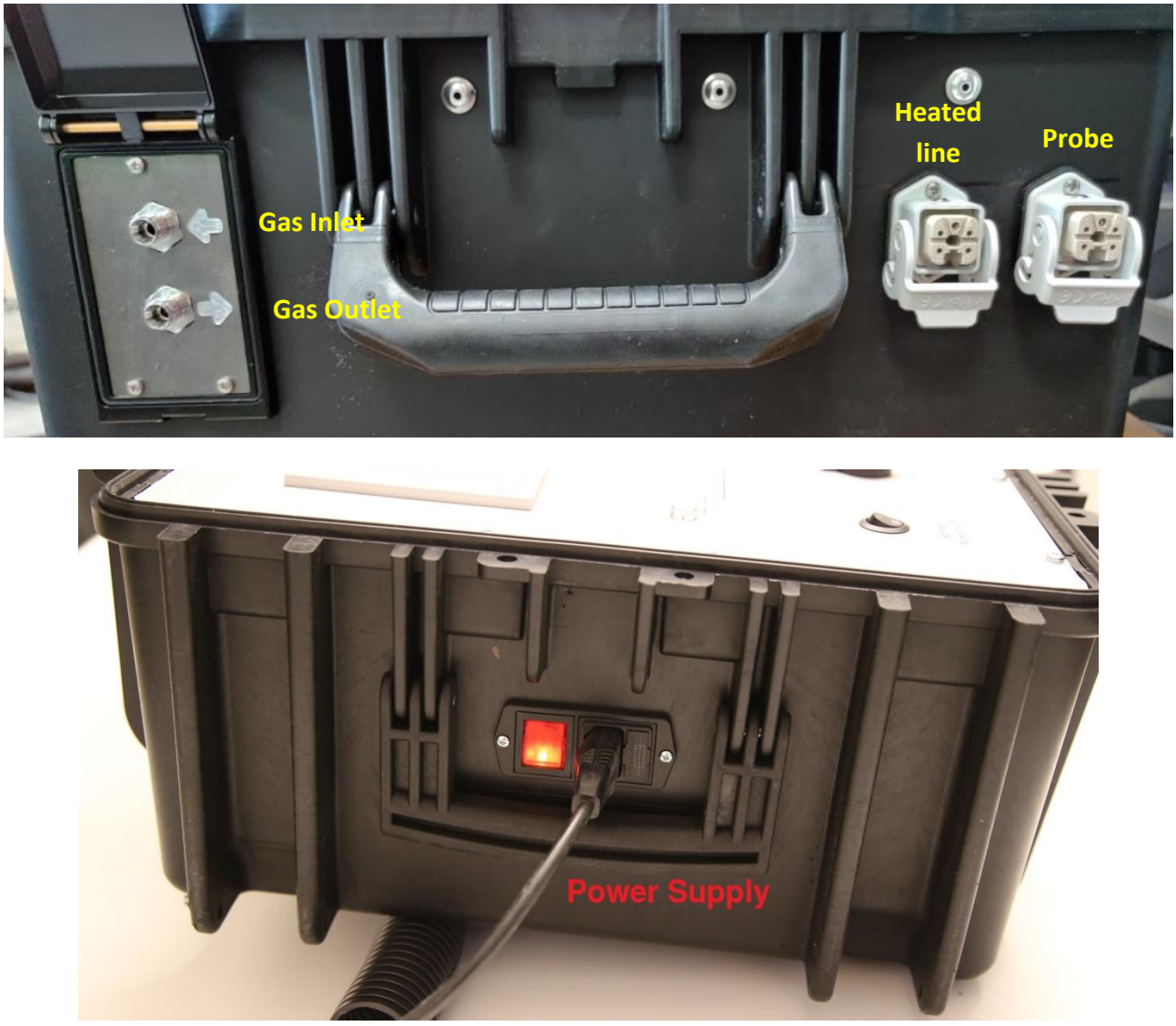


Fig. 1.3 Sides

2 Installation

The NH3 GAS ANALYSER is designed for the continuous measurement of NH3. This system has been designed with the intention to provide a system of high efficiency but at the same time intended for a user even low knowledge.

Thanks to the software developed by ETG, the user is able to carry out a high performance and versatile analysis in a few minutes.

The analyzer is ready to use.

Plug the charger and connect it to your power plug.

Please read this manual carefully.

2.1 Electrical and pneumatic connection

The procedure is simple.

For Pneumatic connection:

- Connect the Sample Line of the Heated Line to the GAS inlet
- Connect the Gas Outlet

For Electrical connection:

- Connect ch1+ and ch1- for 4-20mA signal of NH3 (range 0-500 exchangeable) in Fig. 2.1:

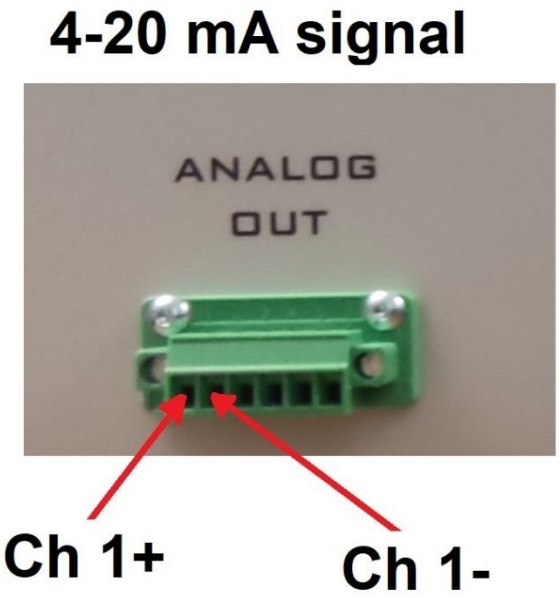


Fig. 2.1 Analog Output (optional)

- Connect the LAN cable, connect to the network with DHCP - Optional
- Connect all the Digital Inputs (Heated Probe, Heated Line)
- Connect the power supply by connecting a cable to the side socket of the ETG6903P

3 Main Screen

At start-up the Analyzer will show the screen with the numerical values of different variables measured in Real-Time as:

- Ammonia (NH3)
- Water Vapor (H2O)
- Laser Cell Temperature (Temp)
- Heated line Temperature (HLT) – Optional
- Heated probe Temperature (HPT) - Optional

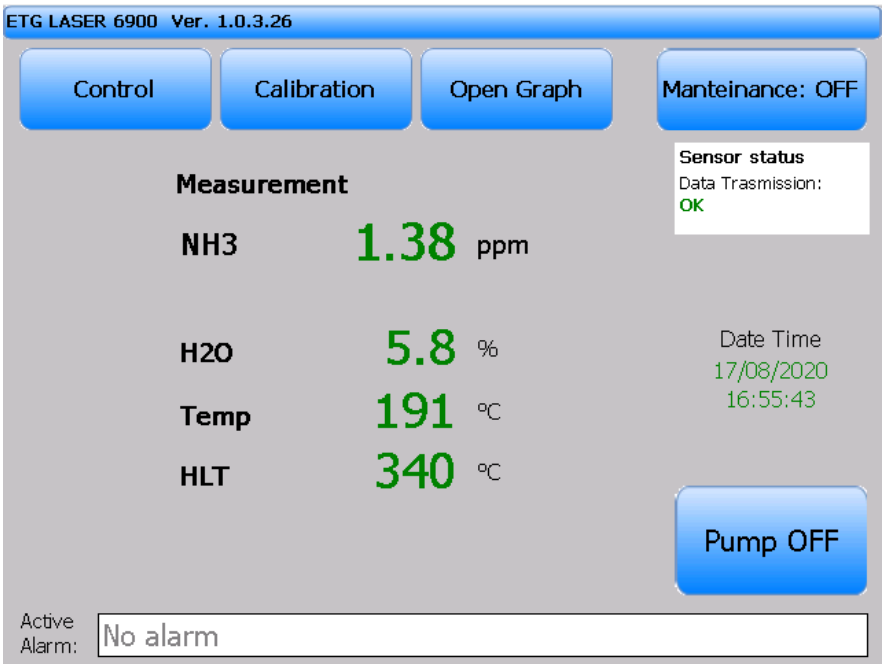


Fig. 3.1 Main Screen

Date Time and the Status of data transmission are also displayed.

In case of alarms, the bar at the bottom of the main screen start to show all the alarms with a reference code (that's need to be communicated to ETG for troubleshooting) as in Fig. 3.2.

Fig. 3.2 Alarm Bar

The buttons on the screen have different functions.

- "Control button" for the principal settings
- "Calibration button" to calibrate the laser
- "Open Graph button" to view the trend over time of the concentration
- "Maintenance button" to switch ON/OFF the maintenance status
- "Pump button" to switch ON/OFF the pump

3.1 Pump Command

The button for the pump at the bottom of the main screen shows the status of the pump:

- Click to “Pump OFF” to switch on the pump
- Click to “Pump ON” to switch off the pump

In presence of alarms, the pump will be turned off and disabled.

Fig. 3.3 Pump button: Pump Turned OFF (left); Pump Turned ON (center); Pump Disabled (right)

3.2 Maintenance Status - Optional

If the device is in maintenance, the variables from the laser are not valid so this information must be sent to Anybus.

In order to communicate this information, click to “Maintenance: OFF”.

Once clicked, digit the password (that will be communicated by ETG) with the keypad and then click to “Ok”.

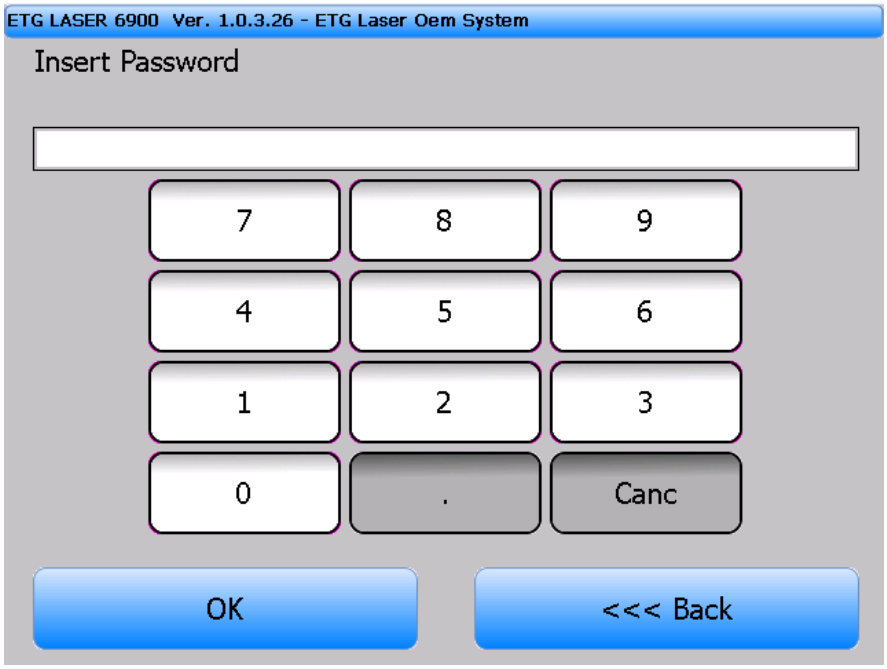


Fig. 3.4 Keypad Password

Instead of “Maintenance: OFF”, it will appear “Maintenance: ON” and the information will be sent to Anybus.

4 Measurement Graph

The program will display graph, in real-time measurement. The origin of the axis time is made to coincide with the beginning of the measurement session. You will see real time data in the upper side of the window ("Last Measure").

In the same screen of the software indicates the presence of any alarms with a reference code (that's need to be communicated to ETG for troubleshooting)

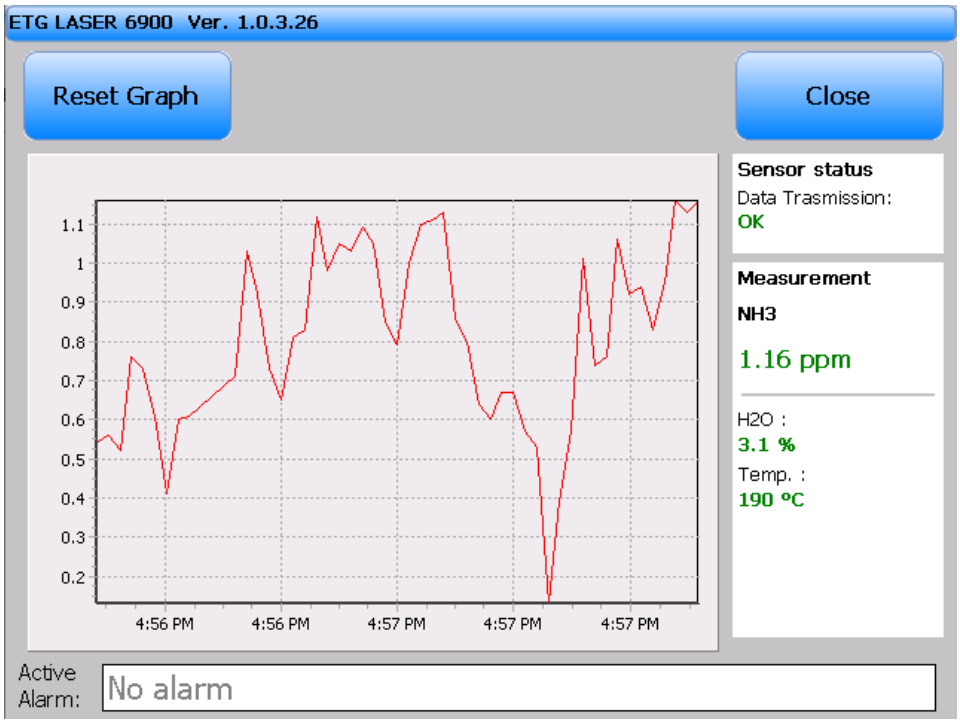


Fig. 4.1 Open Graph

If you click on "Reset Graph", the software, after asking for confirmation via a pop-up, start a new session of measurement to a new origin of the time axis.

NH3 (or HCl) gas need time to flow along the sampling line and to reach stability! Please wait at least 15-30 minutes according to the length of the sampling line!

If you are sampling ambient air, remember to activate the internal pump

If you are sampling gas from a pressure sampling point, be sure that this one it's not higher than 100mbars! (In that case do not activate the pump)

5 Control screen - Set up the analyzer

From the main screen (Fig. Main screen), tap on “Control” then, digit the password (that will be communicated by ETG) on the device to have the access to settings.

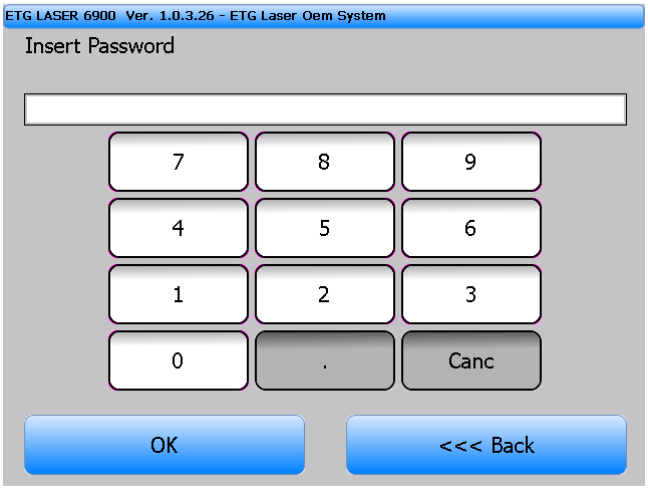


Fig. 5.1 Keypad Password

If the password is correct, the following screen will be open:

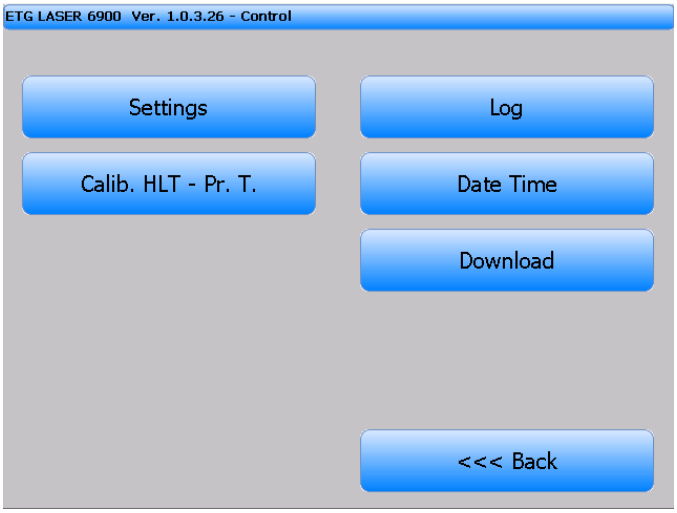


Fig. 5.2 Control

Now click on “Settings”.

5.1 Settings

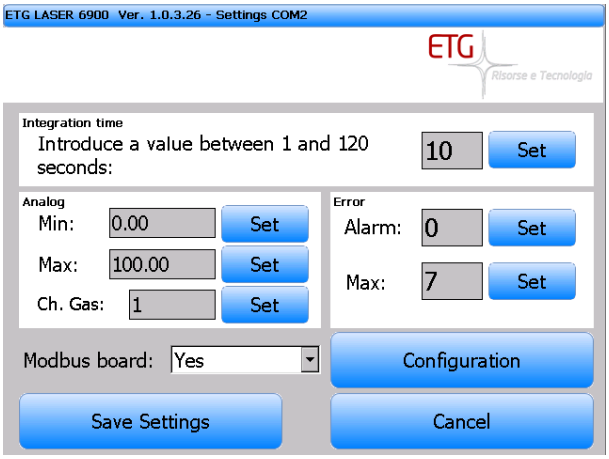


Fig. 5.3 Settings

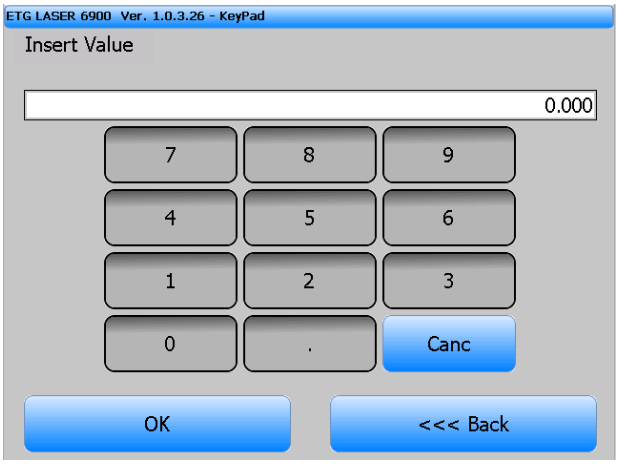


Fig. 5.4 Keypad

Here you can change the parameters of data acquisition from the laser sensor, clicking on “Set”

Tab. 5.1 Settings

Setting	*Description*	*Limits*
Integration Time	The sensor sends one value per second. If longer measurement periods can be accepted, the integration time can be increased. This reduces the noise of the measurement but increases the reaction time when changing the gas concentration. Note that this is just a parameter in the interface and does not affect the sensor.	1s < **Integration Time** < 120s
Analog Min (Analog)	Minimum concentration allowable. Below this limit, concentration will be coerced to this value	0<**Analog Min**< Analog Max
Analog Max (Analog)	Maximum concentration allowable. Above this limit, concentration will be coerced to this value.	0<Analog Min< **Analog Max**
Ch. Gas (Analog)	Analog output channel for NH3 concentration (optional)	1< **Ch. Gas** < 4
Modbus board	Enable Modbus communication (optional)	

If you want to save the new configuration, click on “Save Settings”, otherwise click on “Cancel”.

5.1.1 Modbus configuration - Optional

Click “Configuration” and set the correct Digital Input channel for Zero/Span, if they are present.

They are just configured correctly by ETG.

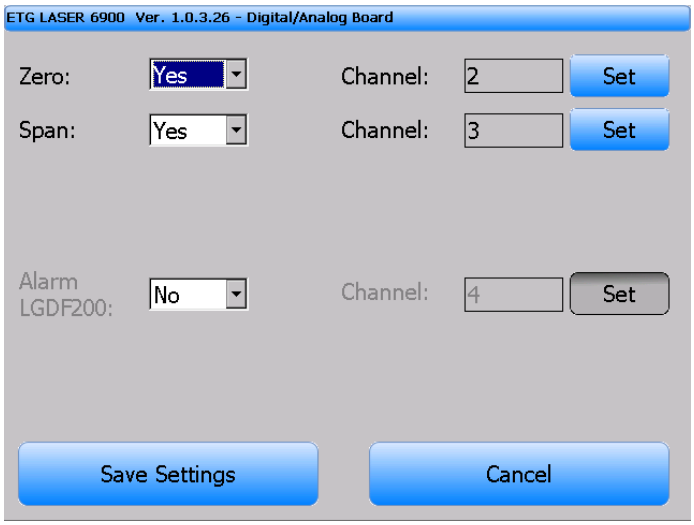


Fig. 5.5 Digital/Analog Board

5.2 HLT and Heated Probe Configuration - Optional

Click on “Calib. HLT – Pr. T.” from the “Control” Page.

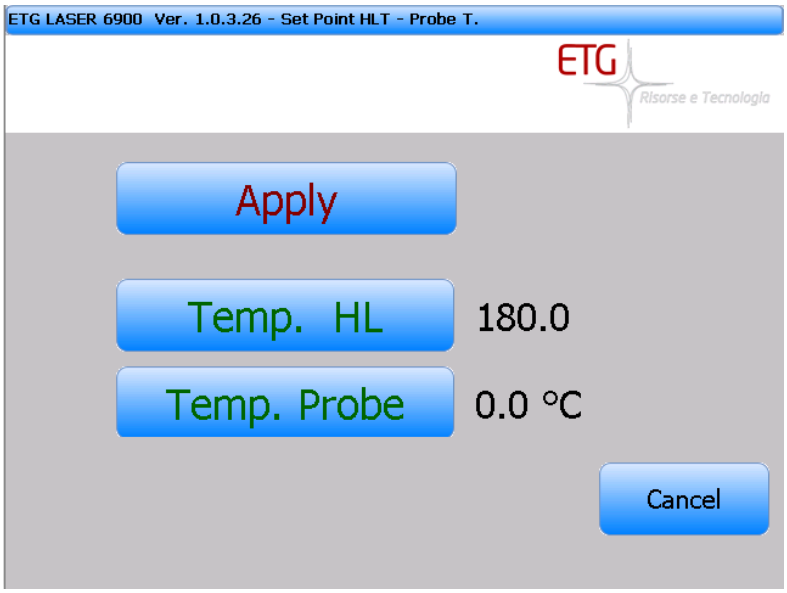


Fig. 5.6 Digital/Analog Board

Click on “Temp. HL” and digit on the keypad the working temperature for the Heated Line. The value must be between 170°C and 190°C.

Click on “Temp. Probe” and digit on the keypad the working temperature for the probe. The value must be between 170°C and 190°C.

Click on “Apply” to Set the working temperatures.

Probe Temperature cannot be set, because it is automatic. “Temp. Probe” button is disabled.

6 Data log and download

6.1 Data log

From “Settings” menu you can activate or deactivate the data log. From the main screen (Fig. Main screen), tap on “Control”, then digit the password (that will be communicated by ETG) on the device to have the access to settings. After, it will open the following screen:

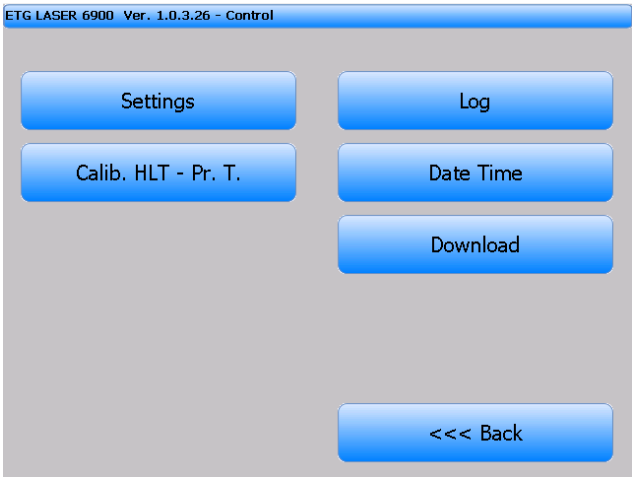


Fig. 6.1 Control

then click on “Log” and it will open the following screen:

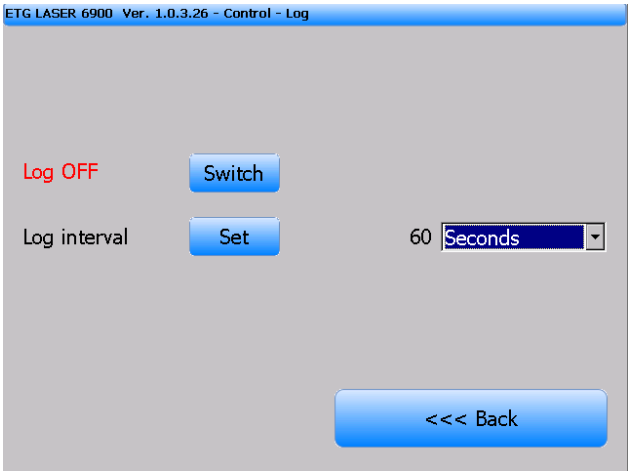


Fig. 6.2 Log

Tapping “Switch” you can activate or deactivate it.

You can set a different interval for data acquisition; default is 10 seconds (data is stored every 10 seconds).

6.2 Download

Recorded data can be downloaded using a USB stick. To do this

- go to the **Control** menu,
- digit the password (that will be communicated by ETG),
- then go to **Download**,
- select the desired day,
- insert the stick
- press “Copy To USB”.

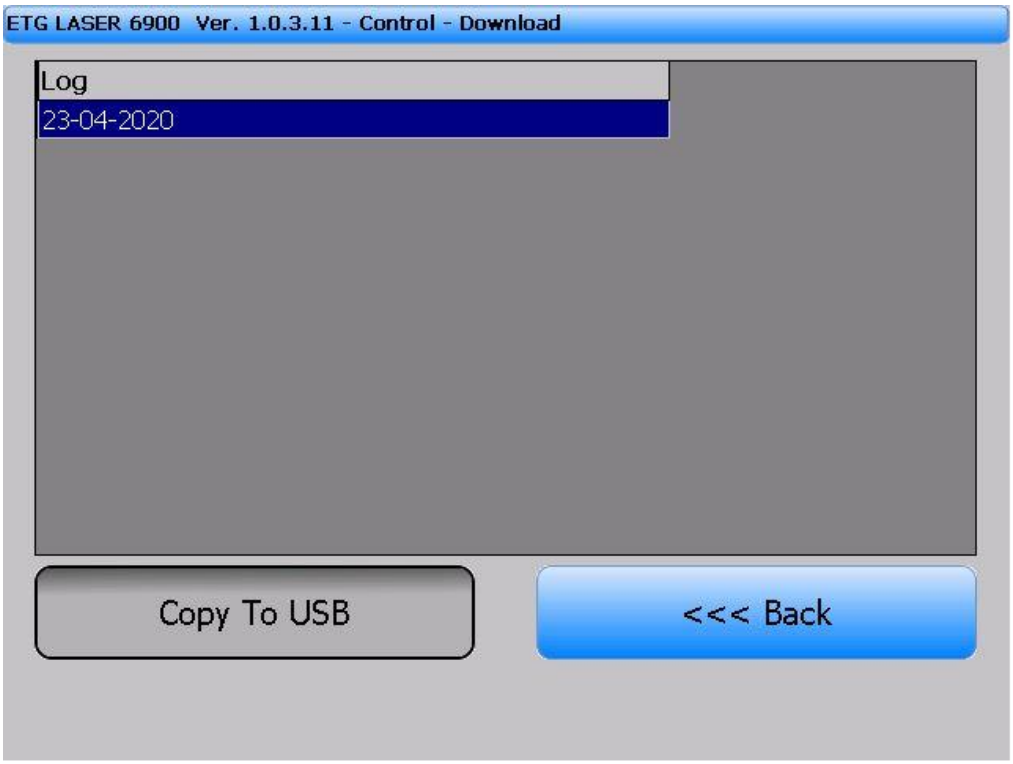


Fig. 6.3 Download Data by USB

If no USB is connected, the “Copy To USB” button remains disabled.

7 Calibration

From the main screen (Fig. Main screen), tap on ***"Calibration"*** then, digit the correct password (default 12345) on the following screen:

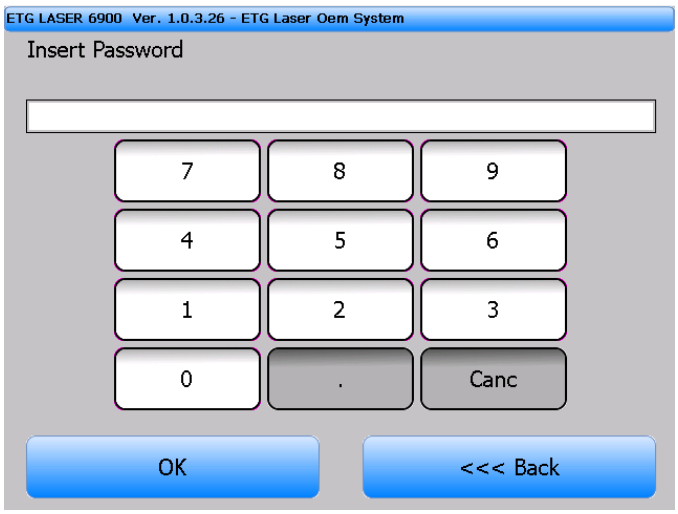


Fig. 7.1 Password keypad

If the password is correct, it will open the following screen:

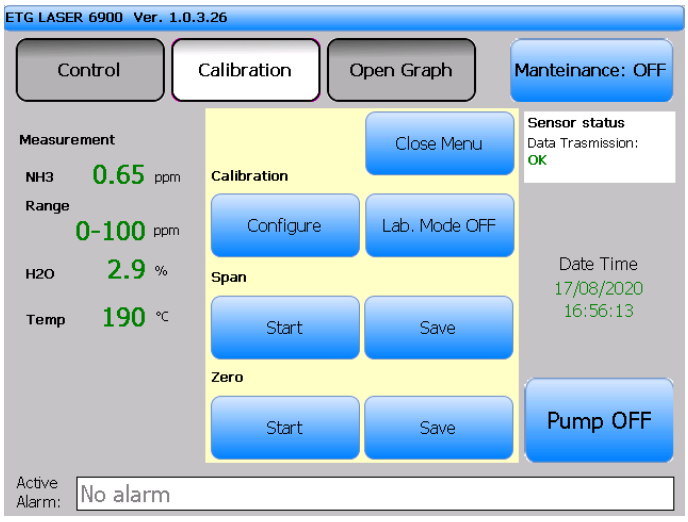


Fig. 7.2 Calibration Menu

The user can set the ***"offset"*** and the ***"span"*** of the instrument **(remember, the laser sensor is already was pre-calibrated and does not require frequent calibration)**.

Before starting the zero or span calibration, you will be prompted to insert the ***"span value"*** of the cylinder you have: click on ***"configure"*** in the ***calibration menu*** from the main screen.

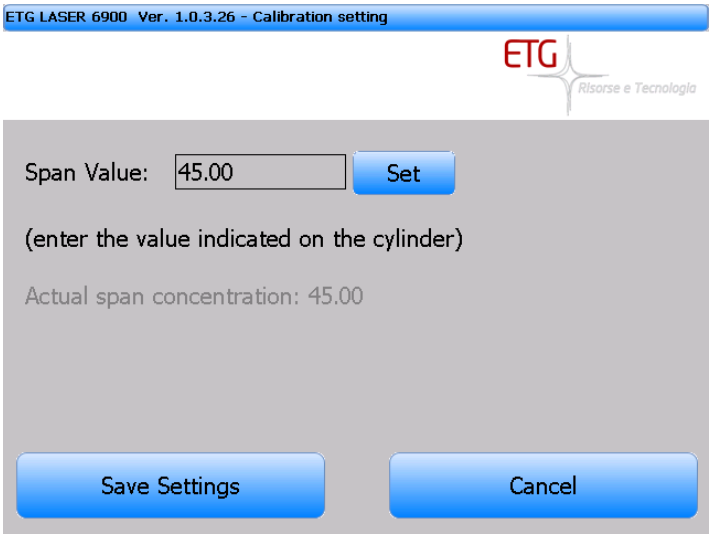


Fig. 7.3 Span Value

Insert the value of concentration reported on the cylinder. After entering and pressing ***"OK"*** the software will record this value and is ready to perform the calibration of the instrument.

Be sure to insert the correct value of "Span Value" or calibration make it unreliable the instrument!

7.1 Laboratory Mode

Laboratory Mode is needed to measure NH3 in a dry gas. Therefore, if you are sampling a sample from a cylinder, you must enable laboratory mode. In a wet gas, that mode must be disabled.

The Laboratory Mode Button shows “Lab. Mode On”, if the laboratory mode is enabled to measure dry gas.

The Laboratory Mode Button shows “Lab. Mode Off”, if the laboratory mode is disabled to measure wet gas.

In order to switch the laboratory mode, you must tap on the laboratory mode button.

During Span calibration, the laboratory mode is automatically enabled, so you don’t need to activate it!

7.2 Zero Calibration

N2 cylinder pressure must be reduced between **0.5 and 0.8 bar**!

The zero calibration is necessary to set the offset of the analyzer. Depend if you have the internal solenoid for calibration, after clicking on ***"Start"*** in Zero calibration, the analyzer will ask you to confirm or remember to open the pneumatic valve of the calibration in your system. After confirming the opening (manual or electronic) of the valve calibration, you will see that the graph is now showing not the sampling gas but the calibration gas. When the data has stabilized to a value that is acceptable, and after passing a sufficient time for stabilization of the measurement (not adjustable by user), if the user clicking on ***"Save Calibration"*** will set that value as the new value zero of the sensor. Click ***"Stop"*** to abort the procedure.

Wait at least **5 minutes** from the starting of the zero and its saving! N2 needs time to flow along the probe line.

Below are the summary screens to perform the zero calibration:

1. first of all, check if Nitrogen cylinder (N2) is properly connected to the Gas Input.

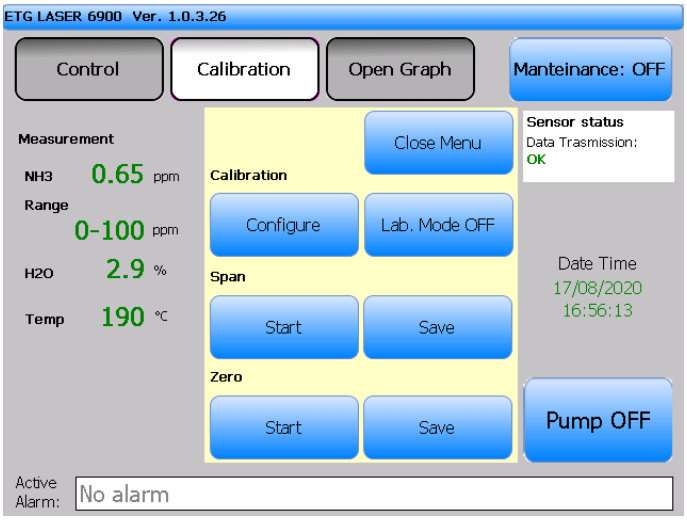


Fig. 7.4 Tap on Calibration → Zero Start

2. Then tap on Zero "Start". After, the following screen will open:

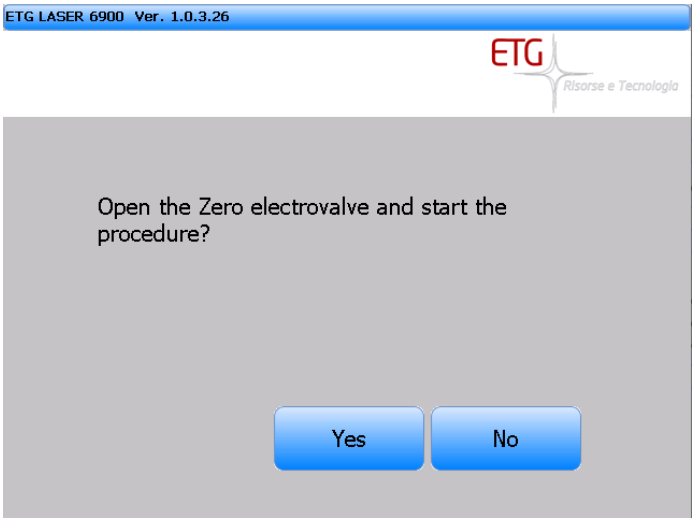


Fig. 7.5 Solenoid valve switching

3. After pressing “Yes”, the “Elapsed” timer will appear, you must wait at least 1 minute before proceeding. In fact, the gas inside the cell must first stabilize.

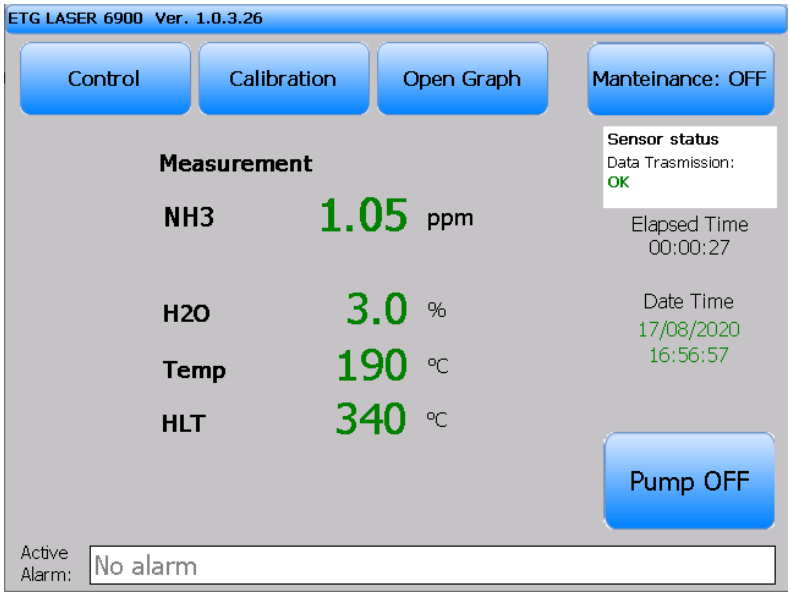


Fig. 7.6 Elapsed Time

4. After that, press on “Calibration” and digit the password. Then save the zero calibration, clicking on “Save”.

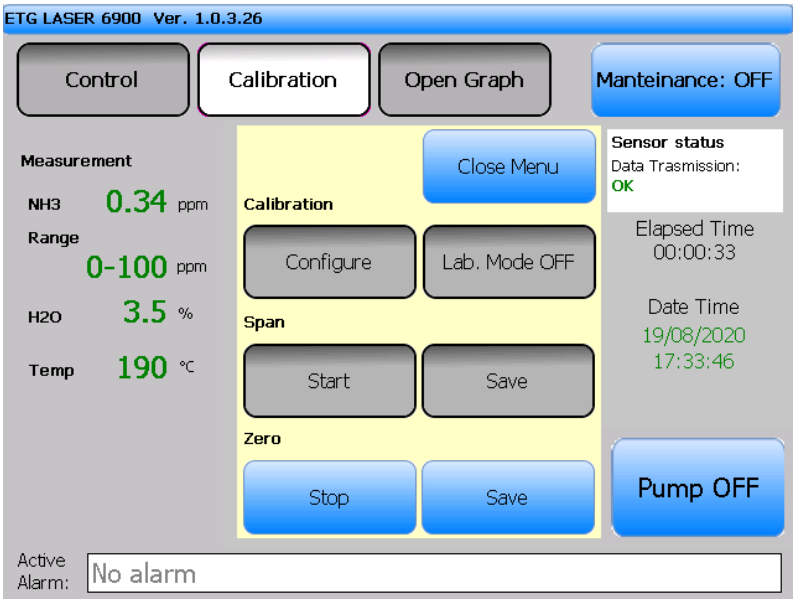


Fig. 7.7 After tap on Calibration → then Save Zero

5. A message will appear asking for confirmation, you must press “Yes” if you want to confirm. Otherwise press “No”, a new window will appear asking if you want to confirm the abortion of the procedure.

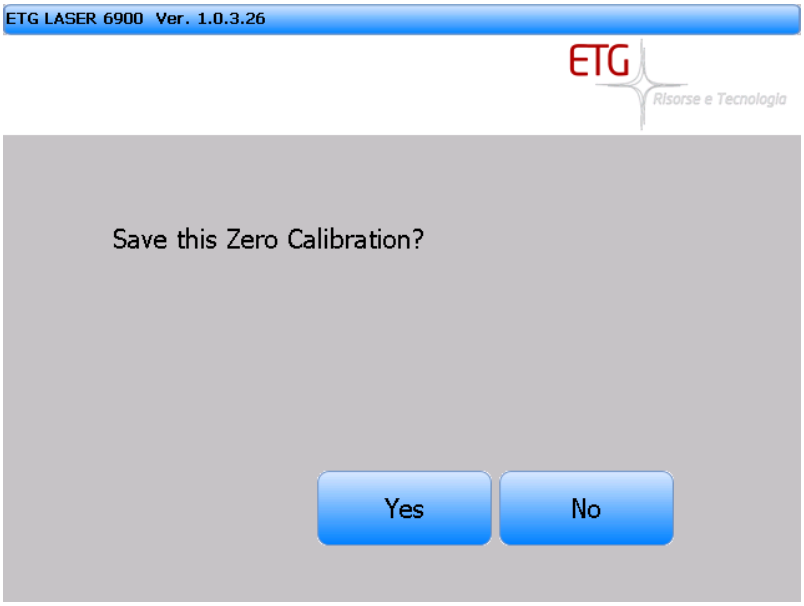


Fig. 7.8 Save Zero Calibration

6. After pressing “Yes", the timer will disappear, you will end up with a value tending to zero.

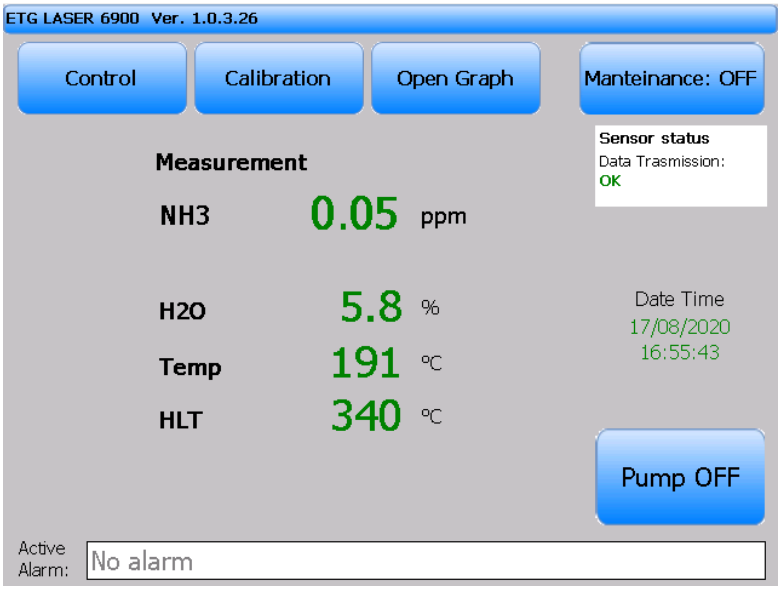


Fig. 7.9 After successfully calibration

7.3 Span Calibration

The procedure is the same as the ***calibration of zero***, save that the value recorded by the analyzer it will be used for Span compensation in the measurement.

Cylinder pressure of NH3 or HCl must be reduced between **0.5 and 0.8 bar**!

Span gas **needs time** to flow along the sampling line and **to reach stability**! Please wait:

- At least **15 minutes** from the starting of the span and its saving for **NH3**
- At least **30 minutes** from the starting of the span and its saving for **HCl**

Since both the calibrations (Zero and Span) are used for the compensation of the measured data, it is recommended to perform always both calibrations together, in order to update them both and to obtain a precise measurement.

8 Communication - Optional

The Anybus X-gateway allows you to seamlessly inter-connect/extend PLC control systems and their connected devices on a Modbus RTU network.

8.1 Main registers

The Anybus X-gateway is characterized by registers that hold information.

The Input buffer holds data forwarded from ETG network, and can be read by the Modbus Master.

Tab. 8.1 INPUT Buffer

# Register	Read/Write	Available register	Dimension	Unit Measure
0	R	disabled		
1	R	Valid(=0)/invalid(=1) measure	**Int 16 bit**	**n/a**
2-3	R	Conc. principal gas	**Float 32 bit**	**ppm**
4-5	R	H2O	**Float 32 bit**	**°C**
6-7	R	Cell Temperature	**Float 32 bit**	**°C**
8-9	R	HLT Temperature	**Float 32 bit**	**°C**
10-11	R	Probe Temperature	**Float 32 bit**	**°C**
12-13-14-15	R	Date Time Analyzer	**Double 64 bit**	**OLE format**
…		…		
74	R	Calibration Failed	**Int 16 bit**	
75	R	Counter Calibration from Anybus Correctly performed	**Int 16 bit**	
76	R	Watchdog communication	**Int 16 bit**	
77	R	Alarms	**Int 16 bit**	
78	R	System Status	**Int 16 bit**	
79-80	R	Span Value	**Float 32 bit**	**n/a**
81-82	R	Offset Value	**Float 32 bit**	**n/a**
83-84	R	Span Cylinder	**Float 32 bit**	**ppm**
85-86	R	Offset Cylinder (disabled)	**Float 32 bit**	**ppm**
87-88	R	Analog Min	**Float 32 bit**	**ppm**
89-90	R	Analog Max	**Float 32 bit**	**ppm**
91-92	R	Integration Time	**Float 32 bit**	**seconds**
93-94-95-96	R	Date Time last Configuration	**Double 64 bit**	**OLE format**

The Output buffer, instead, is forwarded to the ETG network, and can be both read and written by the Modbus Master.

Tab. 8.2 Output Buffer

# Register	Read/Write	Available register	Dimension	Unit Measure
1124	R/W	DI commands	**Int 16 bit**	
1125-1226	R/W	Span cylinder to Set	**Float 32 bit**	**ppm**
1127-1128	R/W	Warning Concentration Val to Set	**Float 32 bit**	**ppm**
1129-1130	R/W	Integration Time to Set	**Float 32 bit**	**s**
1131-1132-1133-1134	R/W	Date Time to Set	**Double bit**	**OLE format**

8.1.1 Variable Type

Each variable can be stored in one or more register and each register can store 2 bytes.

An **Integer** is held in one register (2 byte). For instance:

Register 75	
Byte 1	**Byte 2**
00	04

Corresponds to 0x0004 in hexadecimal representation and to 4 in integer representation.

A **Float** is held in two registers (4 byte). For instance:

Register 8		**Register 9**	
Byte 1	**Byte 2**	**Byte 1**	**Byte 2**
43	3B	00	00

Corresponds to 0x433B0000 in hexadecimal representation and to 187.0 in decimal representation.

A **Double** is held in four registers (8 byte). For instance:

Register 12		**Register 13**		**Register 14**		**Register 15**	
Byte 1	**Byte 2**	**Byte 1**	**Byte 2**	**Byte 1**	**Byte 2**	**Byte 1**	**Byte 2**
40	E5	83	95	56	6C	F4	1F

Corresponds to 0x40E58395566CF41F in hexadecimal representation and to 44060.6668 in decimal representation.

In a Double can be stored a date in OLE representation. For instance, 44060.6668 corresponds 17/08/2020 17:00:11 as Date Time

8.1.2 Valid/Invalid Measure (#Register 1)

This register give the validity of the float values hold from register 2 to register 11 and it can be equal to 0 or 1:

- **0** → valid measure
- **1**→ invalid measure (ongoing Calibration, ongoing maintenance, Values out of range, presence of alarms from laser or not communication with laser)

8.1.3 Values measured from the analyzer (from #Register 2 to #Register 11)

These registers hold all the values measured from the analyzer in float format.

8.1.4 Date Time Analyzer (from #Register 12)

These registers hold the Date Time of the instrument.

8.1.5 Automatic Calibration Failed (#Register 74)

If automatic Zero/Span is failed it will be equal to 1, instead it will be equal to 0;

8.1.6 Counter Calibration from Anybus Correctly performed (#Register 75)

Every time a new calibration (Span/Zero) is carried out successfully, the integer value in this register is incremented (wait 60 seconds after the Span/Zero command).

8.1.7 Watchdog communication (#Register 76)

If there is communication between computer and anybus, the integer value in this register switch between 0 and 1 every 5 seconds.

8.1.8 Alarms (#Register 77)

This register contains the information of the main alarms present in the analyzer.

Tab. 8.3 Alarms register

# Coil Register	*Bit position in register (from left to right)*	*Int value*	*Meaning*
1247	15	0x0001	Laser Driver Failure
1246	14	0x0002	Power on photodiode too high
1245	13	0x0004	Laser current compensation limit reached
1244	12	0x0008	Cell Temperature of out safe range
1243	11	0x0010	Low power on the photodiode
1242	10	0x0020	Warm-up (or Temperature out of range)
1241	9	0x0040	Laser temperature limit reached
1240	8	0x0080	Sensor Line-Locking not secured
1239	7	0x0100	Heated line Alarm
1238	6	0x0200	Heated Probe Alarm
1237	5	0x0400	DI Probe Alarm
1236	4	0x0800	Concentration Out of Range
1235	3	0x1000	Concentration above limit
1234	2	0x2000	Optical head's temp out of range
1233	1	0x4000	Communication error
1232	0	0x8000	disabled

8.1.9 System Status (#Register 78)

This register contains the information of the status of the analyzer.

Tab. 8.4 System Status register

# Coil Register	*Bit position in register (from left to right)*	*Int value*	*Meaning*
1263	15	0x0001	disabled
1262	14	0x0002	Ongoing Calibration (=1)
1261	13	0x0004	Ongoing Maintenance(=1)
1260	12	0x0008	Communication error(=1)
1259	11	0x0010	Presence of Laser alarms(=1)
1258	10	0x0020	disabled
1257	9	0x0040	disabled
1256	8	0x0080	disabled
1255	7	0x0100	disabled
1254	6	0x0200	disabled
1253	5	0x0400	disabled
1252	4	0x0800	disabled
1251	3	0x1000	disabled
1250	2	0x2000	disabled
1249	1	0x4000	disabled
1248	0	0x8000	disabled

8.1.10 Settings of the analyzer (from #Register 79 to #Register 82)

These registers hold all the main settings of the analyzer in float format.

8.1.11 Date Time last configuration (from #Register 12)

These registers hold the Date Time of the last configuration of the instrument.

8.1.12 DI commands (#Register 1124)

This register is needed to send commands to the analyser.

Tab. 8.5 DI commands register

# Coil Register	*Bit position in register (from right to left)*	*Int value*	*Meaning*
17.999	15	0x0001	Abort Zero/Span command
17.998	14	0x0002	Zero command
17.997	13	0x0004	Span Command
17.996	12	0x0008	Set Data Time
17.995	11	0x0010	Set Span cylinder Value
17.994	10	0x0020	Set Warning Concentration Val
17.993	9	0x0040	Set Integration Time

17.992	8	0x0080	disabled
17.991	7	0x0100	disabled
17.990	6	0x0200	disabled
17.989	5	0x0400	disabled
17.988	4	0x0800	disabled
17.987	3	0x1000	disabled
17.986	2	0x2000	disabled
17.985	1	0x4000	disabled
17.984	0	0x8000	Watchdog DI

8.1.13 Settings of the analyzer (from #Register 1125 to #Register 1134)

These registers hold all the main variables to be set before performing a command.

8.2 Modbus RTU Communication

The communication with anybus must be properly set to transmit and receive data.

- Communication: RTU 8 bit
- Baud Rate: 9600
- Parity: None
- Address: 7

In RTU protocol, each data transmitted and received is composed by

- The address of the device (1 byte)
- The function code of the command (1 byte)
- The data (>1 byte)
- The CRC – Cyclic Redundancy Check (2 byte)

8.2.1 Read Output Status (function 01)

Function 01 is used to read multiple coils in series.

For instance, if you want to read 15 coils (0x000F) from coil 1233 (0x04D1), you have to transmit the following bytes:

ID	**Function code**	**Coil Address**		**Number of Coils**		**CRC**	
		Hi	**Lo**	**Hi**	**Lo**	**Hi**	**Lo**
07	01	04	D1	00	0F		

If the command is correct, you will receive the following response:

ID	**Function code**	**Number of data byte**	**Data**		**CRC**	
			Bit 7,6,…,0	**Bit (empty),14,13,…,8**	**Hi**	**Lo**
07	01	02	50	02		

In this case, the anybus send 2 byte and the less significant bits are filled with zeros, if the number of bits to read is not a multiple of 8 as reported below. In fact, 0x50 and 0x02 stand for 0101 0000 and 0000 0010, respectively, so for the 15 coils there is the following configuration:

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	Bit 9	Bit 10	Bit 11	Bit 12	Bit 13	Bit 14	Bit 15
0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0

8.2.2 Read holding registers (function 03)

Function 03 is used to read multiple registers in series.

For instance, if you want to read 15 registers (0x000F) from register 1 (0x0001), you have to transmit the following bytes:

ID	Function code	Start Register		No Register		CRC	
		Hi	Lo	Hi	Lo	Hi	Lo
07	03	00	01	00	0F		

If the command is correct, you will receive the following response:

ID	Function code	Number of data byte	Register 1		…	Register 15		CRC	
			Byte HI	Byte Lo		Byte Hi	Byte Lo	Hi	Lo
07	03	1E	00	01		2E	C5		

In this case, the Anybus send 30 bytes (0x1E) of the 15 registers

8.2.3 Write Single coil (function 05)

Function 05 is used to modify a single coil to “0” or to “1”.

For instance, if you want to write “1” to coils 17984 (0x4640), you have to transmit the following bytes:

ID	Function code	Coil Address		Data		CRC	
		Hi	Lo	HI	Lo	Hi	Lo
07	05	46	40	FF	00		

If the command is correct, you will receive the same transmitted command as response:

ID	Function code	Coil Address		Data		CRC	
		Hi	Lo	HI	Lo	Hi	Lo
07	05	46	40	FF	00		

P.S.: In order to write “0” the transmitted Data Hi must be 0x00 instead of 0xFF.

8.2.4 Write Multiple coils (function 15)

Function 15 is used to modify more coils in series to “0” or to “1”.

For instance, if you want to write “1000 0000 0000 10” to 14 coils (0x000E) from coils 17984 (0x4640), you have to transmit the following bytes:

ID	Function code	Coil Address		Number of Coils		Number of data bytes	Data		CRC	
		Hi	Lo	Hi	Lo		Bit 8,7,…,1	Bit 16(empty),15(empty),14,…,9	Hi	Lo
07	0F	46	40	00	0E	02	01	10		

If the command is correct, you will receive the address of the starting coils (0x4640=17984) and the number of coils modified (0x000E=14).

ID	Function code	Coil Address		Number of Coils		CRC	
		Hi	Lo	Hi	Lo	Hi	Lo
07	0F	46	40	00	0E		

8.2.5 Write Multiple registers (function 16)

Function 16 is used to write more registers in series.

For instance, if you want to send 0x40E58395566CF41F to 4 registers (0x0004) from register 1131 (0x046B), you have to transmit the following bytes:

ID	Function code	Start Register		Number of Registers		Number of data bytes	Register 1131		…	Register 1134		CRC	
		Hi	Lo	Hi	Lo		Hi	Lo		Hi	Lo	Hi	Lo
07	10	04	6B	00	04	08	40	E5		F4	1F		

If the command is correct, you will receive the address of the starting register (0x046B=1131) and the number of registers modified (0x0004=4).

ID	Function code	Start Register		Number of Registers		CRC	
		Hi	Lo	Hi	Lo	Hi	Lo
07	10	04	6B	00	04		

8.3 Main Commands

It is possible to interact with the Analyzer with the Anybus in order to

- Set the integration time of the laser
- Set the Warning concentration value (if the concentration is above this value, the alarm “Gas above Warning Value” will be activated)
- Set the concentration value for the span (it must be below the analog min)
- Set a new Date Time
- Execute a Zero remotely
- Execute a Span remotely

P.S.: If checking after each interaction does not go well, repeat all the procedure or contact ETG.

8.3.1 Set integration time

The sensor sends one value per second. If longer measurement periods can be accepted, the integration time can be increased. This reduces the noise of the measurement but increases the reaction time when changing the gas concentration. Note that this is just a parameter in the interface and does not affect the sensor.

To change this value you have to:

1. Write 0x0000 (0) to register 0x0464 (1124)
2. Write integration time in float format (2 registers) from register 0x0469 (1129):
   10.0 s becomes 0x41200000
3. Write 0x8040 (32832) to register 0x0464 (1124)
4. Read a float (2 registers) from register 0x005B (91) and check if the value corresponds to the integration time
5. Write 0x0000 (0) to register 0x0464 (1124)

8.3.2 Set Warning Concentration Val

If this value is set and if measured concentration is above this value, the alarm “Gas above Warning Value” will be activated.

To set this value you have to:

1. Write 0x0000 (0) to register 0x0464 (1124)
2. Warning Concentration Val in float format (2 registers) from register 0x0467 (1127):
   60.0 ppm becomes 0x42700000
3. Write 0x8020 (32800) to register 0x0464 (1124)
4. Write 0x0000 (0) to register 0x0464 (1124)

8.3.3 Set Span Cylinder Value

To set the concentration of NH3 in the cylinder used for the span, you have to:

1. Write 0x0000 (0) to register 0x0464 (1124)
2. Write Span Cylinder Value in float format (2 registers) from register 0x0465 (1125):

45.0 ppm becomes 0x42340000

3. Write 0x8010 (32784) to register 0x0464 (1124)
4. Read a float from register 0x0053 (83) and check if the value corresponds to the Span Cylinder Value
5. Write 0x0000 (0) to register 0x0464 (1124)

8.3.4 Set Date Time

In order to change the Date Time of the analyzer, you have to:

1. Write 0x0000 (0) to register 0x0464 (1124)
2. Write Date Time in OLE format (double – 4 registers) from register 0x046B (1131): 17/08/2020 17:00:11 in Date Time representation becomes 0x40E58395566CF41F in OLE [pay attention to solar and legal time]
3. Write 0x8008 (32776) to register 0x0464 (1124)
4. Check Date Time from register 0x000C (12) to 0x000F (15)
5. Write 0x0000 (0) to register 0x0464 (1124)

8.3.5 Execute Zero

To execute a Zero remotely, you have to:

1. Write 0x0000 (0) to register 0x0464 (1124)
2. Write 0x8002 (32770) to register 0x0464 (1124)
3. Check if the device is on calibration from register 0x004E (78)
4. Wait until the device is no more on calibration from register 0x004E (78). The waiting time is **5 minutes**.
5. Check if the value in register 0x004B (75) is incremented and if calibration is not failed from register 0x004A (74)
6. Check the measured NH3 concentration in float format (2 registers) from register 0x0002 (2). It must be 0.0 approximately
7. Write 0x0000 (0) to register 0x0464 (1124)

8.3.6 Execute Span

To execute a Span remotely, you have to:

1. Check/Set the Span Cylinder Value
2. Write 0x0000 (0) to register 0x0464 (1124)
3. Write 0x8004 (32772) to register 0x0464 (1124)
4. Check if the device is on calibration from register 0x004E (78)
5. Wait until the device is no more on calibration from register 0x004E (78). The waiting time is **10 minutes** for **NH3** and **30 minutes** for **NH3**.
6. Check if the value in register 0x004B (75) is incremented and if calibration is not failed from register 0x004A (74)
7. Check the measured NH3 concentration in float format (2 registers) from register 0x0002 (2). It must be near the Span Cylinder Value

8. Write 0x0000 (0) to register 0x0464 (1124)

8.3.7 Abort Zero/Span

To abort an automatic calibration (Zero/Span), you have to:

1. Write 0x0000 (0) to register 0x0464 (1124)
2. Write 0x8001 (32769) to register 0x0464 (1124)
3. Check if the device is no more on calibration from register 0x004E (78)
4. Check if calibration is failed from register 0x004A (74)
5. Write 0x0000 (0) to register 0x0464 (1124)

9 Maintenance

9.1 ETG 6903P Maintenance

Tab 9.1 Maintenance

Check	Frequency	Methodology	Solution
Sampling Pump	6 months	Verify if there are aspiration on sample line ⚠ ***be sure that you're in sample mode and not in calibration!***	Contact ETG
Inline Filter	Every month	Verify if there are dirt inside the filter	Change the filter. Contact ETG for replacement.
Zero Calibration	Every month	Make it flow N2 inside the instrument (follow calibration's procedure) and verify the response of instrument around 0 ppm.	Zero- calibrate the analyzer.
Span Calibration	6 months	Make it flow Span Gas Cylinder inside the instrument (follow calibration's procedure) and verify the response of the instrument around the concentration of cylinder. Wait at least 15-30 minutes to reach stability of the measured value!	Span- calibrate the analyzer.

9.2 ETG GAS LASER MAINTENANCE AND TROUBLE SHOOTING

9.2.1 Warnings

The laser gas sensor modules will not require routine maintenance when the installation and operation instructions described in this document are carefully applied. The surface of the instrument can be cleaned with a soft tissue and the use of isopropyl alcohol. Any gas filtration and conditioning equipment must be checked and replaced periodically according to the manual specifications.

If the measurement cell gets contaminated or damaged, please contact ETG RISORSE E TECNOLOGIA for cell maintenance and replacements. As technical training is necessary for this procedure, we recommend setting up a system exchange program. Please contact ETG RISORSE E TECNOLOGIA for details.

In case of problems, recheck all the recommendations presented in this document and be sure they have been followed and fully applied. If the observed problems persist, contact your ETG Risorse e Tecnologia sales person.

It is important that this device is serviced only by adequately trained and qualified personnel.

This instrument contains electronic components that might be damaged by static electricity. The device cover should never be removed as it might damage the optics and/or electronics.

ETG gas sensor modules contain metal and elastomeric sealing parts. The customer is responsible for checking the compatibility of those materials with the gas applied to the device. Not observing these recommendations might lead to personal injury or death.

It is recommended that the user checks the device regularly to ensure that it is leak-free.
Joints may change their characteristics with age, exposure to process gas, temperature and pressure.

If it is necessary to remove the device from the system, unplug the electrical power before
any other manipulation.

Before removing the device from the system, purge thoroughly with a dry inert gas such as
Nitrogen before disconnecting the gas fittings. Ensure that the piping is de-pressurized. Failure to correctly purge and de-pressurize the device could result in fire, explosion, or severe injury.

9.2.2 Maintenance

After verifying the factors above, follow the troubleshooting procedures outlined here below:

Tab. 9.2 Failures

Problem	Possible Cause	Solution
No signal / No value output	No power supply or wrong polarity	Check wiring
Measurement cell temperature does not stabilize at desired temperature	Wrong polarity on heater power supply	Check wiring
The heating time is > 30 min (when started at 25°C / 77°F, ambient temperature)	The power supply used for the heater is not able to supply up to 8 A	Check max current of used power supply or change power supply
No reaction when target gas is flowed in	Condensation in system	Flow with dry and dust-free air in the Gas inlet and in the Purge inlet for at least 15 min
Every 10 or 11 acquisition points the time between points is longer	When the target gas concentration is below a certain limit, the sensor has an internal check which lasts longer (around 2s)	Flow with higher amount of target gas
The T90 is longer than expected	The flow is lower as 3 l/min	Increase the flow rate

9.2.3 ANNEX

Table 9.3 Laser alarms

N°	E/W	Message	Action/Solution	Detailed Explanation
19	E	Unexpected error /watchdog) Reboot (15 s)	Check Communication Contact Service	Check sensor connectivity
239	E	End Of Life	Soon Sensor will no longer work	The sensor will soon be out of service
240	E	Optical Head's temperature out of range	Check for additional errors (249) Bring the ambient system temperature within the specified range. Try to mount the system horizontally.	Check if ambient temperature is within specified range See also error code 248 & 252. OK (temperature within range), there is a system failure: service required.
241	E	Laser driver failure. Sensor not measuring.	Check for additional errors (250) Service required	Check if ambient temperature is within specified range See also error code 248 & 252. OK (temperature within range), there is a system failure: service required.
242	E	Laser driver failure. Sensor not measuring.	Check for other errors (251)	Service required Policy not yet defined. Reset the sensor.
243	E	Low power on the photodiode	Check for condensation OR Service required	Check that the conditions of use do not cause condensation. If this is not the case, service is required.
244	W	Low power on the photodiode.	Cleaning of optics required. OR see error 250 in Manual	Sensor is functioning but with compromised performance due to misaligned optics, dirt or condensation. Service required soon.
245	W	Power on photodiode too high.	Service required	Sensor functionality compromised Please call service
246	W	Laser temperature compensation executed (system restarting)		Aging of the laser is compensated until it reached EOL state.
247	E	Laser current compensation limit reached	Service required.	EOL is reached. Call service immediately.
248	E	Cell Temperature of out safe range. out of range --> switch off sensor AND gas flow Avoid condensation		SENSOR MIGHT BE HOT: DO NOT TOUCH WITH BARE HANDS The temperature limits are set between (H) Version: {-40°C.. 200°C}, Sensor not measuring. (A) Version: {50°C.. 100°C}. Check ambient temperature. Ensure proper venting Actively monitor ambient conditions
249	E	System Temperature out of range Sensor not measuring.	Bring the ambient system temperature within the specified range	Check ambient temperature. Ensure proper venting. Actively monitor ambient conditions out of range --> switch off sensor AND gas flow
250	E	Laser driver failure. Sensor not measuring	Service required	Check if ambient temperature is within specified range. See also error code 251 & 252 in the user manual. If OK (temperature in range), there is a system failure:

				service required.
251	E	Laser driver failure. Sensor not measuring	Service required	
252	W	Warm-up phase OR out of temp. range Warm-up phase OR out of t emp. range	(H) version: - Wait for termination of warm-up phase - Check heater power supply (H) & (A) version: - Check that the ambient temperature in the specified range - Turn off gas flow in case condensation could occur. (The sample pump is always blocked for cell and sampling heated line not reached temp)	Heated version (H): Wait for the cell temp. to stabilize. Warm-up time is about 1 hour (std. for room temp.). If the warm-up time exceeds 2 hours check the heater power supply. If the problem persists call ETG service. Ambient version (A): The sensor temperature is out of calibration range. System performance could be compromised. Compare external temperature with specifications. Turn off gas flow in case condensation could occur.
253	W	Laser temperature compensation executed system restarting)		If this occurs more than twice per year please call customer service.
238	W	Sensor Line-Locking not secured	Contact the service if the problem persists	Reference for line locking is below track-limit Baseline noise above defined track-limit

In any case, do not hesitate to contact us:

ETG Risorse e Tecnologia S.r.l.

Via Baione, 2/K

10034 Chivasso (TO), ITALY

Tel.: + 39 011 19270890

E-mail: service@etgrisorse.com

Website: www.etgrisorse.com