TECHNICAL MANUAL

$O_3$42 *Module*

UV PHOTOMETRIC

OZONE ANALYZER

- JUNE 2010 -

Environnement S.A
L'instrumentation de l'environnement

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WARNING

SUMMARY

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EPA Equivalency Designation.

Environnement S.A. Model O342M UV Ozone Analyzer *Automated Equivalent Method:* **EQOA-0206-148**

"Environnement S.A Model O342M UV Photometric Ozone Analyzer," operated with a full scale range of 0 - 500 ppb, at any temperature in the range of 10 °C to 35 °C, with a 5-micron PTFE sample particulate filter, with response time setting of 11 (Automatic response time), and with or without any of the following options:2 c) Internal ozone generator, d) Span external control (zero/span solenoid valve).

[*Federal Register*: Vol. 67, page 42557, 06/24/02]

CHAPTER 1

GENERAL INFORMATION - CHARACTERISTICS

1 GENERAL INFORMATION - CHARACTERISTICS

Figure 1–1 - $O_3$42M Presentation

1.1 GENERAL INFORMATION

1.1.1 PRESENTATION

The $O_3$42M is a continuous ozone analyzer (specific for low concentrations).

It uses the principle of ozone detection by absorption in ultraviolet light.

The analyzer provides many advantages through the use of recent advanced electronic and optical technologies and requires very limited maintenance.

The sample is taken with a Teflon tube (outside diameter 6 mm) connected to the back of the unit. The sample is taken by an internal pump.

The measurement is indicated by a graphic display on the front panel.

1.1.2 DESCRIPTION

1.1.2.1 Front panel

The front panel includes:

a general switch

a backlit liquid crystal display

– 16 lines 40 columns (240 x 128 pixels)

– the display provides the measurement values according to the selected unit, the information required for programming and testing the unit.

a keyboard with 6 touch-sensitive keys

The control and check functions of the unit are controlled through the keyboard.

– the function of each key varies with the different screens or menus.

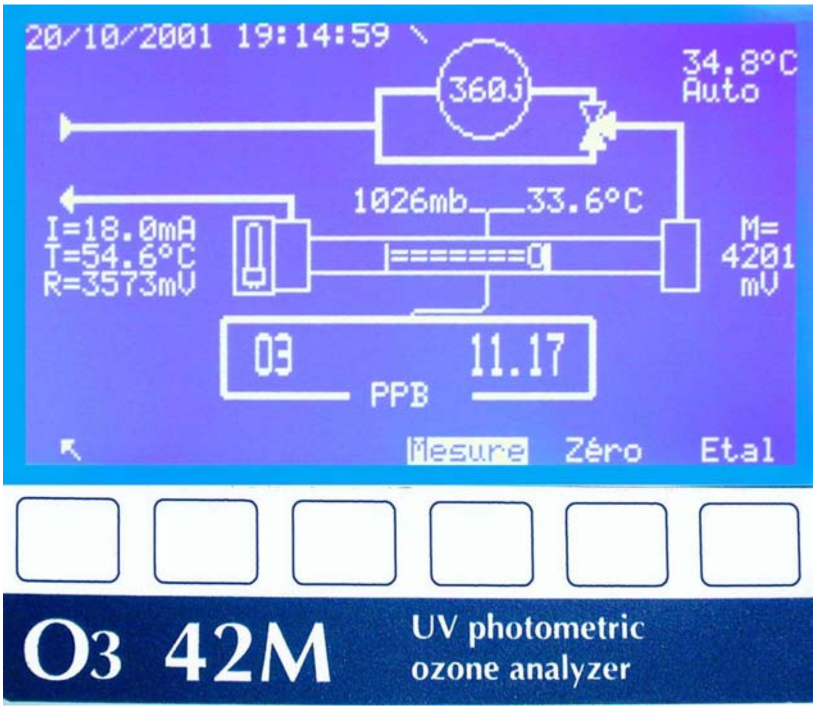


Figure 1–2 - Keyboard and display

(3) and (4) : SV block option (Zero / span inlets are not available for standard model)

Figure 1–3 – Rear panel of rack version

(1) dust filter, (2) pump outlet, (3) and (4) zero-span inlet, (5) electric connection plug, (6) fuse.

Figure 1–4 - Rear panel of box version

1.1.2.2 Rear panel

The rear panel of the $O_3$42M contains the electrical connectors and fluids inlet/outlet connector.

Electrical Equipment Connections (left hand side)

- The main power supply assembly consists of a 3-contact socket (5) for standard power cable connection, and general fuse: 0,6 A / 220 V or 1,2 A / 115 V (6).

Gas inlets/outlets

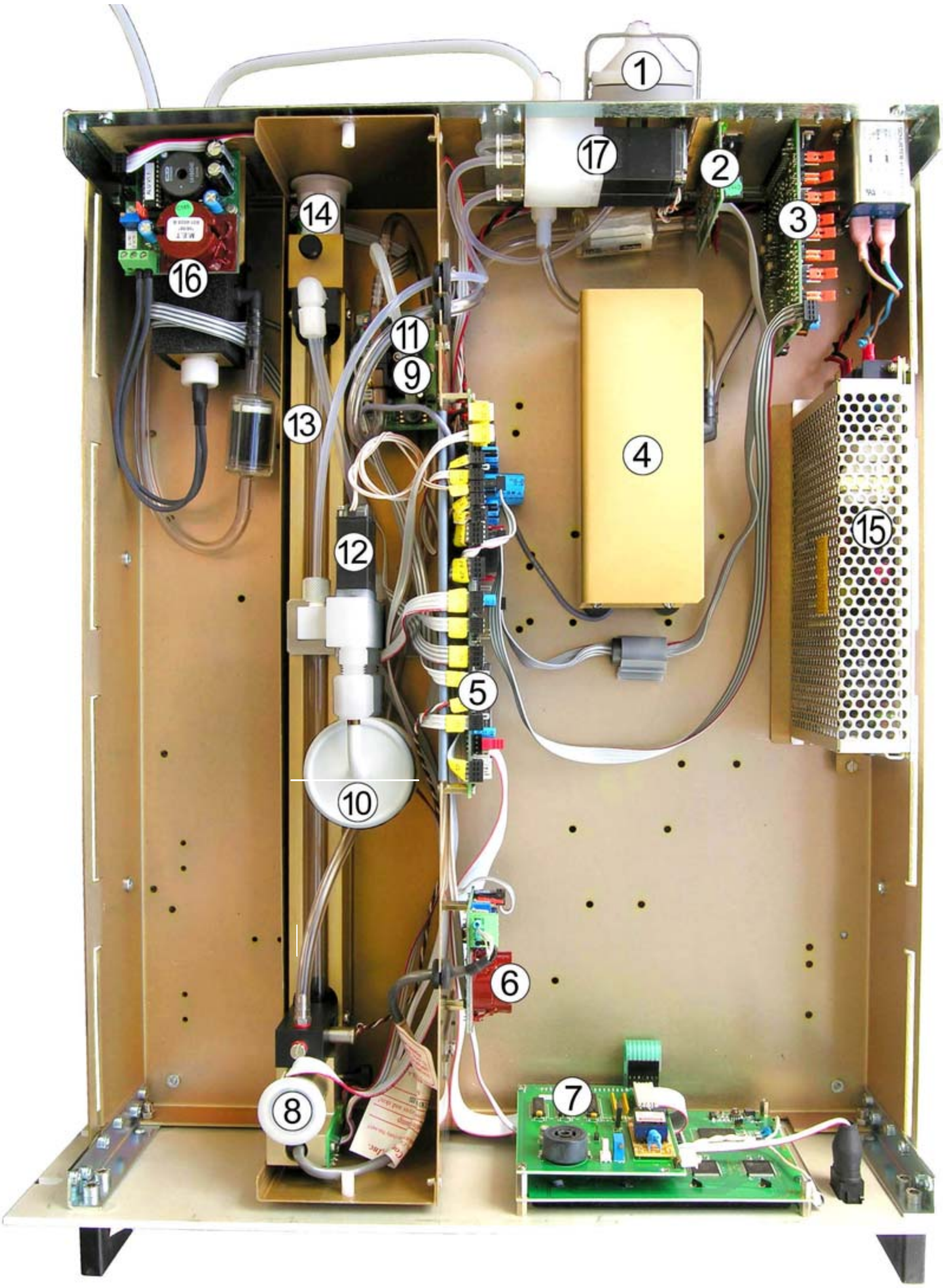
- Inlet of sample to be analyzed is composed of connection piece for 4/6 mm tube associated with a dust filter holder equipped with Teflon filtering membrane (1).
- The "pump" outlet (2) for exhaust of the analyzed sample, consisting of a 4/6 mm Teflon connection piece.

The rear panel could also contain the following internal options:

With ZERO/SPAN solenoid valve option :

- The zero (4) and span (3) inlets, consisting of a pneumatic fitting for a 4/6 mm tube, are used either for connecting an outside supply of ozone trace free "ZERO AIR", or for connecting an ozone generator device (with both gases always at atmospheric pressure).

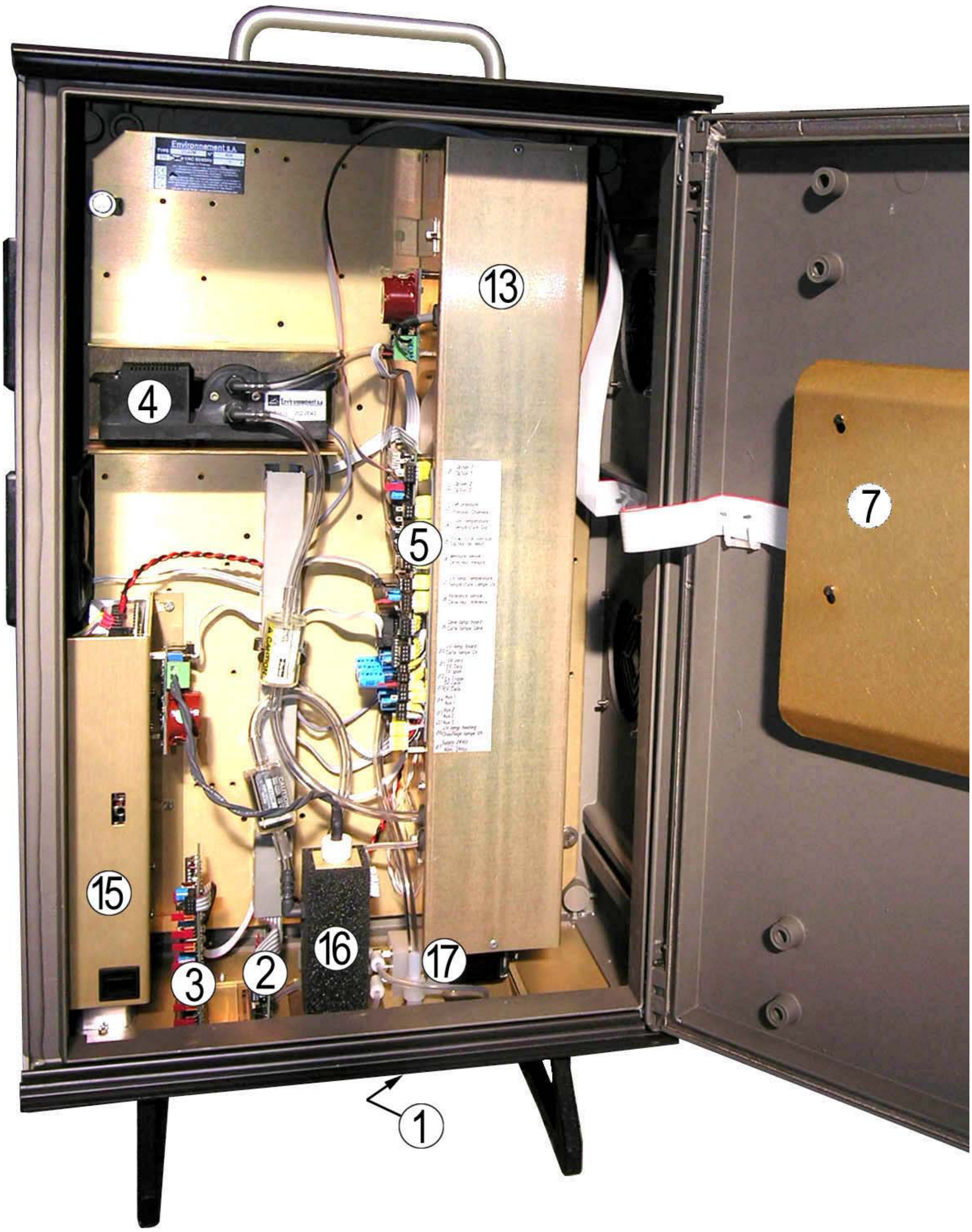
NOTE : The inlet (4) must be kept sealed when the built-in ozone generator option is available.



(1) dust filter, (2) RS232 series interface board, (3) inlet/outlet ESTEL board, (4) pump, (5) module board, (6) UV lamp supply, (7) interface board, (8) Reference detector, (9) barometre, (10) ozone purifyer, (11) board of fluid checking, (12) 3-way solenoid valves, (13) measurement chamber, (14) Measurement detector, (15) 24V D.C. supply, (16) ozone generator, (17) Zero-Span SV block.

Figure 1–5 – Internal components of O342M rack version

The switch from 230V to 115V is located inside the 24V DC power supply box (15).



1) dust filter, (2) RS232 series interface board, (3) inlet/outlet ESTEL board, (4) pump, (5) module board, (7) interface board, (13) measurement chamber, (15) 24V D.C. supply, (16) ozone generator, (17) Zero-Span SV block.

Figure 1–6 – Internal components of O342M box version

The switch from 230V to 115V is located inside the 24V DC power supply box (15).

1.1.2.3 Components location

The components inside the unit are accessed by simply unscrewing the screws at rear and lateral sides of the unit and removing the upper cover

CAUTION : risk of electric shocks, only skilled technician should intervene inside the analyzer.

Mechanical components (fig. 1-4)

This includes the following equipment:

– inlet dust filter (option) (1),

– filter-solenoid valve assembly (option) (17),

– measurement cell (13),

– pump (4).

After passage through the inlet dust filter (1), the sample to be analyzed is routed to a block consisting of a 3-way solenoid valve (12) and a selective ozone scrubber (10).

The sample then goes into the measurement cell (13), where the ozone molecules selectively absorb the UV rays encountered on the 253.7-nanometer wavelength. The measurement cell holds the measurement detector. At the outlet of the cell, the gas is suctioned in by the pump (4), located at the end of the flow system.

Option

The analyzer could be equipped with a built in ozone generator.

Electronic components

The signals provided by the "measurement" (14) and "reference" (8) detectors as well as the signals delivered by the barometer (9) and the temperature and flow sensors (10) are sent to the analog-to-digital converter, located on the module board (5), via a multiplexer. They are converted into digital signals.

The Modul board (5) holds the main + 15 V, – 15 V, + 5 V and – 5 V power supplies and the circuits of temperatures control, acquisition and numeric processing.

The microprocessor carries out processing of acquisitions, calculations, automatic controls and interface control.

The RS-232 serial interface board (2) dialogs with a microcomputer either directly or through a modem link.

The interface board (7) required for interconnections between the microprocessor board, the keyboard, and the display is installed on the front panel.

The UV lamp power block (6) is mounted on the frame.

The 24V DC power supply block is located at (15), it also includes the commutation switch from 230V to 115V.

Option : The analyzer could be equipped with :

– an input/output Estel board (3),

– an ozone generator (16),

– a SV Zero-Span block (17).

1.1.3 MAIN FEATURES

1.1.3.1 Standard

- Programmable measurement range of 0.1 to 10 ppm, with a minimum detectable limit of 1 ppb for 50 seconds response time.
- Automatic check-up of parameters influent the metrology (UV energy, flow rate, temperature, pressure) and correct running.
- Measurement values indicated in ppm or mg/m^3.
- Memory storage of average measurements with a programmable period (maximum capacity: 5120 averages).

1.1.3.2 Optionally

The monitor can be equipped with the following options:

- an internal O_3 generator,
- 1 to 4 Estel board(s) :
  - Analog outputs of various parameters as O3 concentration and/or MUX channels.
  - Remote signaling of various functions as "measurement" and "alarm".
- Ram extension for an extended memory storage capacity (24576 averages max.)

1.1.4 ASSOCIATED EQUIPMENT

- Analog recorders or data loggers.
- Numerical data acquisition systems.
- Serial printer for continuous printout of displayed measurements (programmable period), and configuration.

1.2 CHARACTERISTICS

1.2.1 TECHNICAL CHARACTERISTICS

Measurement range	:	programmable (10.00 ppm maximum)
Units	:	ppm or mg/m^3 (programmable)
Noise (σ)	:	0.0005 ppm. (response time 50 sec.)
Minimum detectable limit (2 σ)	:	0.001 ppm. (response time 50 sec.)
Response time (0-90 %)	:	10-90 s (programmable)
Zero drift	:	< 1 ppb /7 days
Span drift	:	< 1 % /7 days
Linearity	:	± 1 %
Sample flow rate	:	≈ 1 liter/min.
Temperature and pressure influence	:	automatic compensation of pressure / temperature
Display	:	LCD 240 x 128 text and graphic modes
Control keyboard	:	6 keys
Output signals (option)	:	3 analog outputs: 0-1 V, 0-10 V, 0-20 mA, 4-20 mA
Power supply	:	230V - 50Hz (115V - 60Hz) + ground
Consumption	:	– 70 V.A – 90 V.A with optional generator O_3 "on".
Working temperature	:	+ 10 °C to 35 °C
Memorization of measurement values	:	Capacity: 5120 averages max (24976 with RAM extension).
Measurement values or configuration		
printout	:	On serial printer connected on COM2
Alarm checks	:	Permanent detection and indication of malfunctions: temperature, flow rates, electrical parameters, overshooting of programmable O_3 measurement threshold...
Tests and diagnostics for maintenance	:	Selection on keyboard and display of all parameters.
Backup saving time for data stored in RAM and of real-time clock	:	>6 months by incorporated battery.

OPTIONS

O_3 internal generator	:	Concentration range generated 150 to 500 ppb adjusted, accuracy ± 5 %.

1.2.2 OPERATING CHARACTERISTICS

Not applicable.

1.2.3 STORAGE CHARACTERISTICS

Temperature: – 10 °C to 60 °C.

1.2.4 INSTALLATION CHARACTERISTICS

1.2.4.1 Links between units

The O_342M monitor requires the following power supplies and external links:

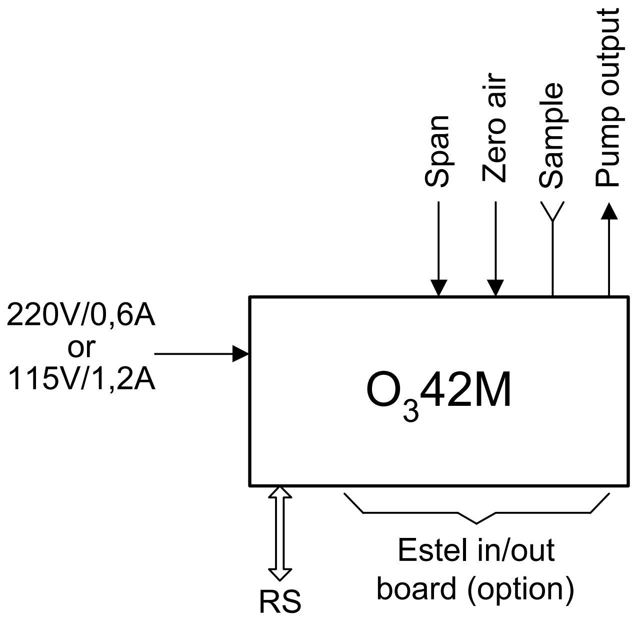


Figure 1–7 - Links between units

1.2.4.2 Dimensions and weight

The analyzer comes in the form of a standard 19-inch, 3-unit rack and under the form of a box.

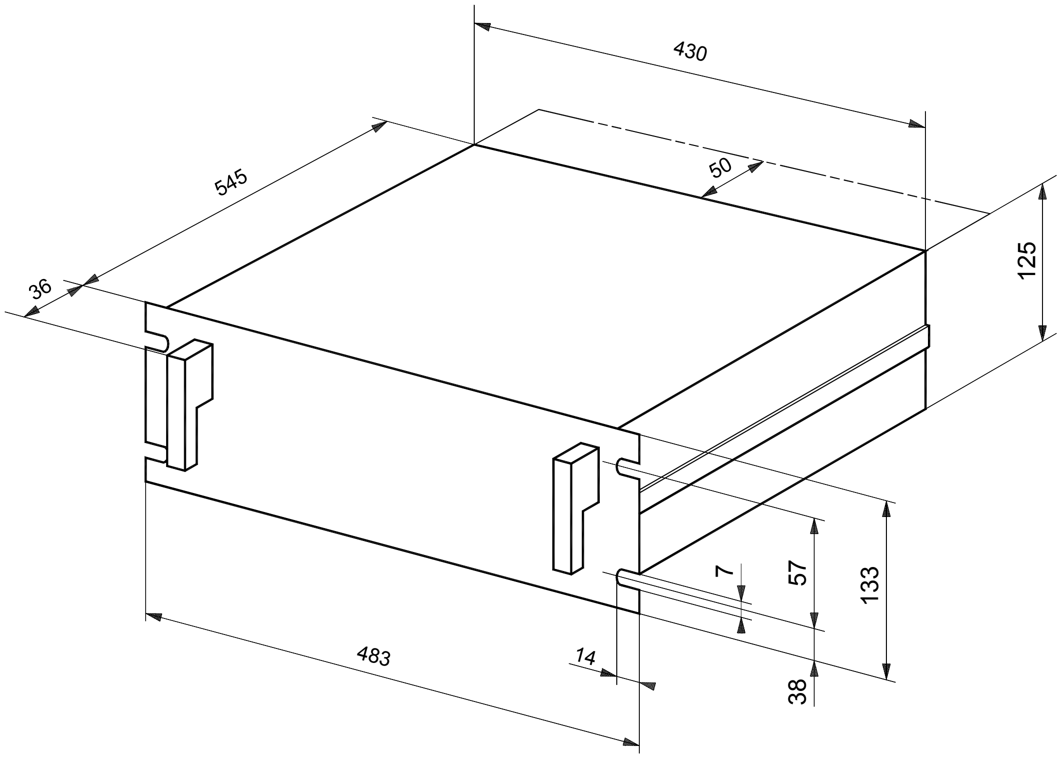
Length	:	581 mm	430 mm (box version)
Width	:	483 mm	225 mm (box version)
Height	:	133 mm	740 mm (box version)
Weight	:	9 Kg	12 kg (box version)

1.2.4.3 Handling and storage

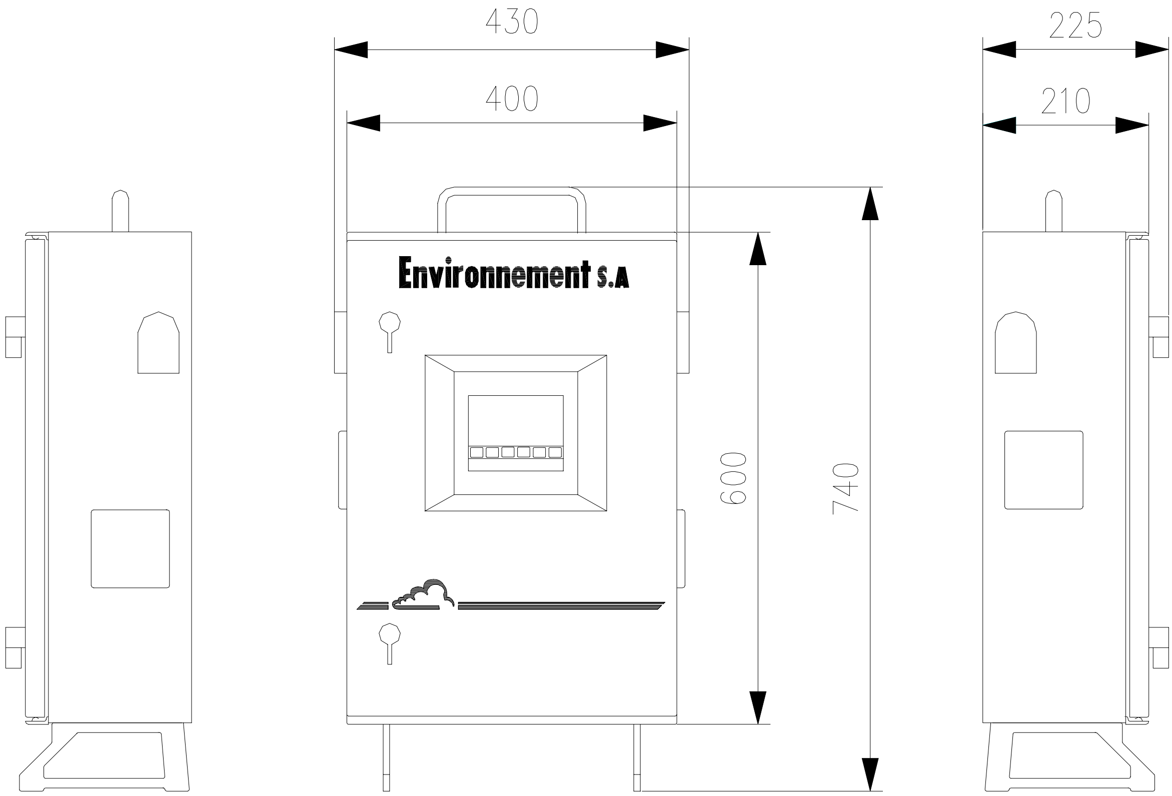
The O_342M monitor must be handled with care to avoid damage to the various connectors and fittings on the rear panel.

Ensure the gas inlets and outlets on the unit are protected with caps whenever storing the monitor.

The unit is stored in a case provided for this purpose.



Rack version



Box version

Figure 1–8 - Outline dimensions

CHAPTER 2

OPERATION

2 OPERATION

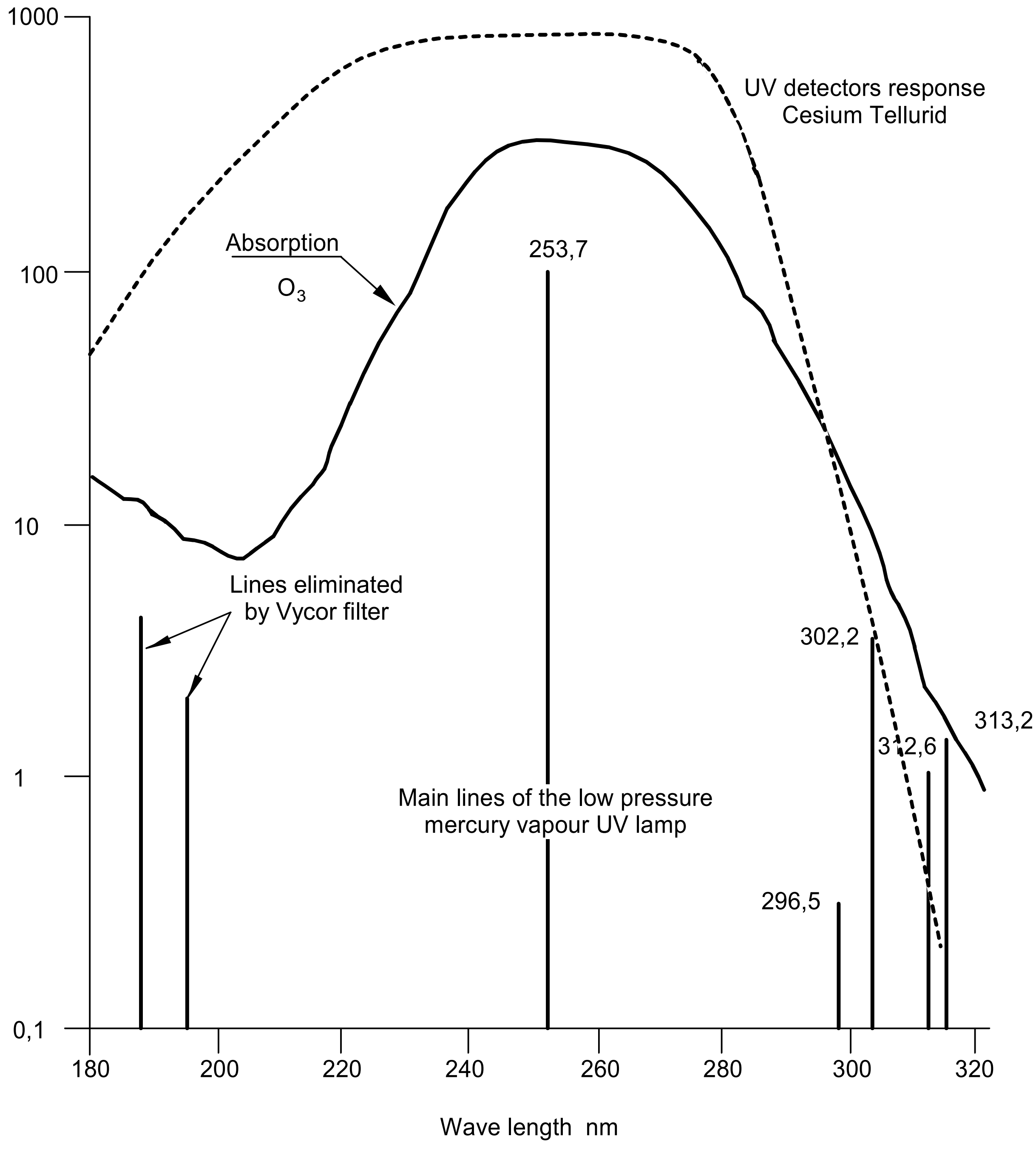


Figure 2-1 - Ozone absorption spectrum

2.1 PRINCIPLE OF MEASUREMENT

The ozone absorption spectrum is extended to a wavelength of 253.7 nanometers, which corresponds to the main emission line of mercury, as shown on Figure 2-1.

The ozone absorption coefficient was experimentally defined at 253.7 nm:

absorption coefficient = 308 $atm^{-1}.cm^{-1}$
at P_0= 101.3 k Pa and t_0 = 273 °K (0 °C)

Calculation of this concentration after application of the Beer Lambert law is:

$$[O_3]\ ppm = \frac{10^6}{\alpha \ell} . Ln \left[\frac{io}{i}\right] \text{at } p_0 \text{ and } t_0$$

Calculation under measurement conditions becomes:

$$Cppm\ [O_3] = \frac{10^6}{\alpha \ell} . Ln \left[\frac{io}{i}\right] \frac{Po}{P} . \frac{t}{to}$$

$\alpha\, l = K$

K calibration coefficient.

l optical path length in cm.

i_0 being UV energy measured through measurement cell when sample does not contain ozone molecules (passage through selective filter).

i being UV energy measured on sample containing ozone to be measured (direct passage).

The $O_3$42M calibration coefficient (according to the formula $\alpha\, l$ = k) is set at a value of 12554 for :

α = 308

l = 40.76 cm

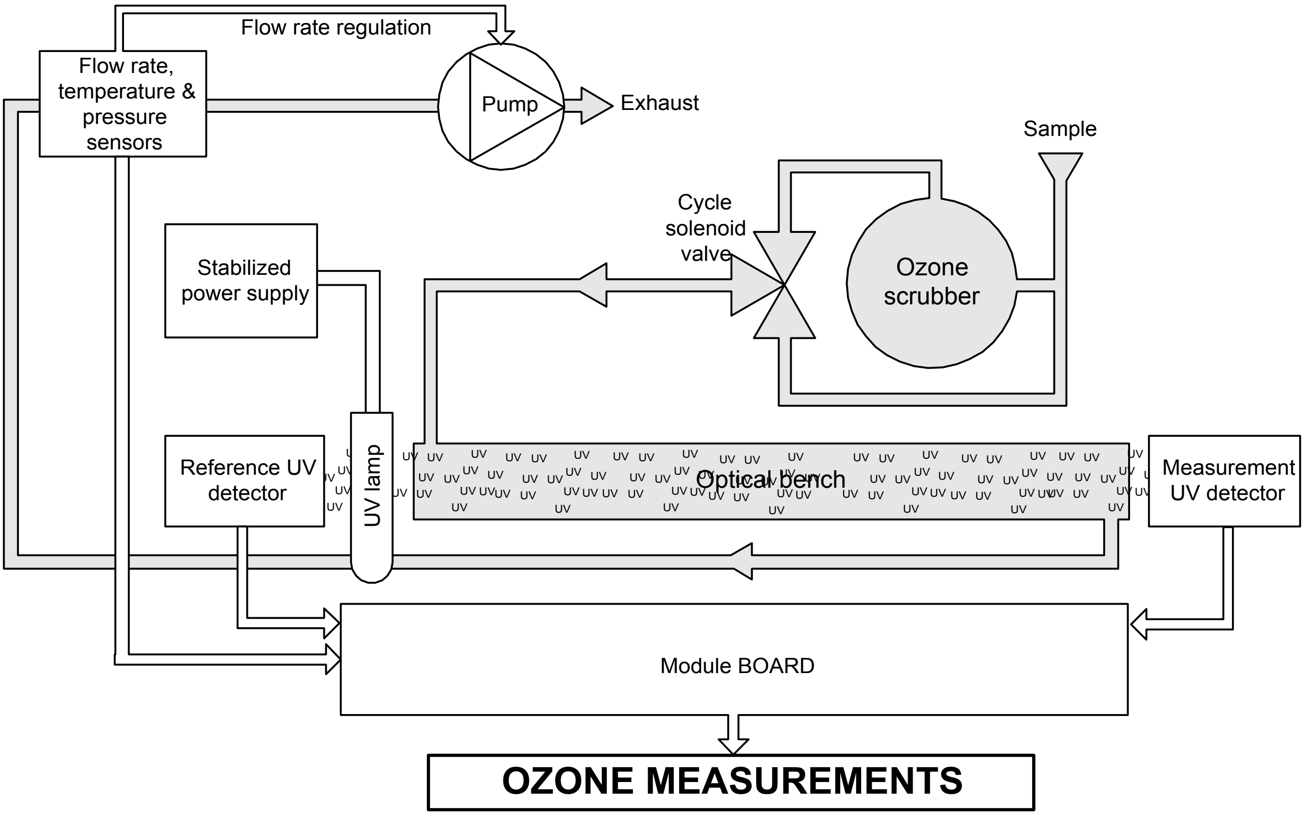


Figure 2-2 - General schematic diagram

2.2 ANALYSIS

In order to compensate for the drifts in the UV lamp and to make the two measurements i_0 and i under the same conditions, a "UV reference" detector integrates the energy emitted by the UV lamp. The durations of the measurements i_0 and i will be checked using "UV reference" detector signal so that these two measurements can be made under the same conditions.

A measurement corresponds to the following cycle:

– passage of gas through the O_3 selective filter; ventilation of measurement chamber (3 seconds),

– measurement of i_0 made through "UV measurement" detector (corrected by "UV reference"),

– switch of solenoid valve,

– passage of gas directly into measurement chamber, ventilation (3 seconds),

– measurement of i made through UV measurement (corrected by "reference UV").

i.e. one complete cycle in approximately 10 seconds.

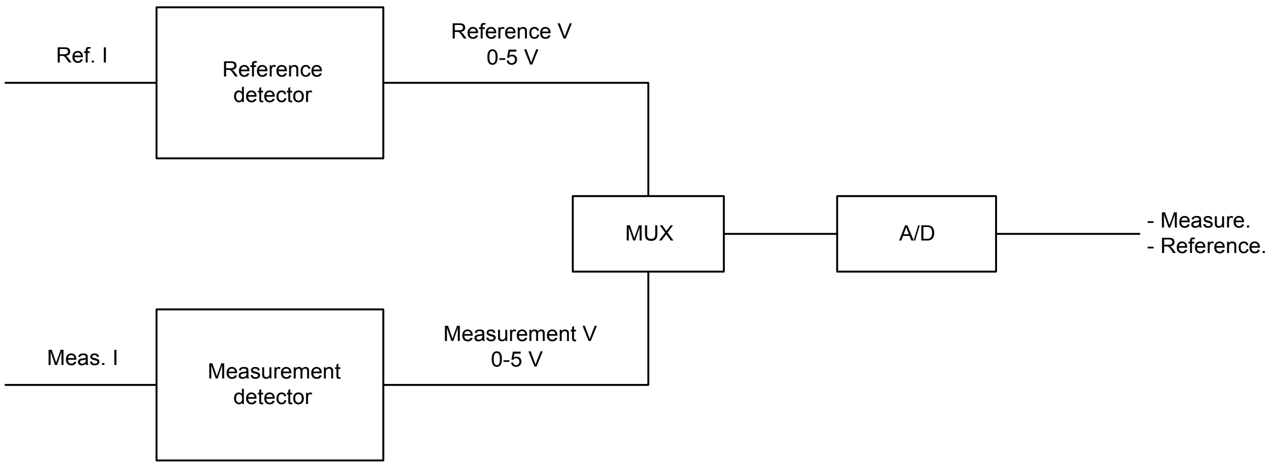
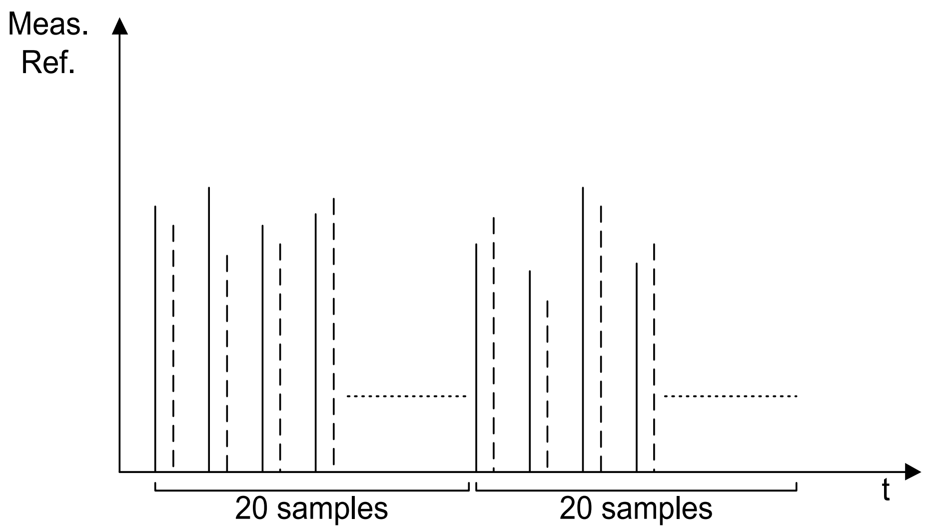


Figure 2-3 - Acquisition of UV energies I_0 and I



Meas. ——— One measurement each 50 µs

Ref. – – – – One measurement each 50 µs

Each 20 acquisitions (1 ms) calculation of the UV energy compensation.

Acquisition of energies i_0 and i (see Figure 2-3):

- The linear analog to digital converters convert the reference and measurement signals (V Ref. and V Measurement) coming from the UV detectors into a frequency pulse train.

  12 values of V measurements are averaged and compensated by the average of 12 reference measurements: it is the calculation way to do the I or I_0 metrology compensated in real time by the measurement of UV lamp energy. The calculator performs 100 averages during each half-cycle measurement.

  The half cycle in which the sample passes through the ozone selective filter (solenoid valve off) gives the value i_0.

- The next half cycle in which the sample passes directly into the measurement chamber (solenoid valve on) gives the value i :

  The raw concentration is calculated using:

$$C_B = \frac{10^6}{K} \ Ln\left(\frac{i_0}{i}\right)$$

  A barometric sensor measuring the pressure P in the measurement chamber is used to make the pressure compensation.

  A sensor measuring the temperature T of the gas is used to make the temperature compensation.

  The corrected compensation is calculated using:

$$C_C = C_B \ x \ \frac{273+T}{273} \ x \ \frac{1013}{P}$$

2.3 AUTOMATIC RESPONSE TIME

In order to optimize its metrology, the O342M monitor is equipped with a software function called "automatic response time" (TR11) which enables filtration of measurements depending on evolution of concentrations.

2.3.1 SIMPLIFIED PRINCIPLE OF OPERATION

An average of instantaneous readings is carried out corresponding to a minimum response time.

$$[\text{MEAS}]_{\text{AVERAGE}} = \frac{1}{n}\sum_{1}^{n}[\text{MEAS}]_{\text{INSTANTANEOUS}}$$

n = number of instantaneous measurements which is determined by the programmed response time.

Then, a weighted average between the filtered values ($[\text{MEAS}]_{\text{FILTERED}}$) and the average measurements ($[\text{MEAS}]_{\text{AVERAGE}}$) is recursively calculated according to the formula:

$$[\text{MEAS}]_{\text{DISPLAYED}} = [\text{MEAS}]_{\text{FILTERED (NEW)}} = X\,[\text{MEAS}]_{\text{FILTERED (OLD)}} + Y\,[\text{MEAS}]_{\text{AVERAGE}}$$

$X + Y = 1$

When the difference ($[\text{MEAS}]_{\text{FILTERED (OLD)}} - [\text{MEAS}]_{\text{AVERAGE}}$) exceeds a determined threshold, the value of Y is increased, up to a maximum value of 0.99 which corresponds to a fixed response time of TR_{MIN}.

When $[\text{MEAS}]_{\text{FILTERED (OLD)}} - [\text{MEAS}]_{\text{AVERAGE}}$ is below the threshold, Y is progressively decreased.

2.3.2 PROGRAMMING THE RESPONSE TIME

The function of automatic response time may be activated or de-activated in the *CONFIGURATION ⇨ Measurement mode* menu.

The minimum response time may also be modified in that menu.

See chapter 3 section 3.3.4.2 to obtain more information about programming of those functions.

2.4 SIMPLIFIED FLOWCHART OF MAIN PROGRAM

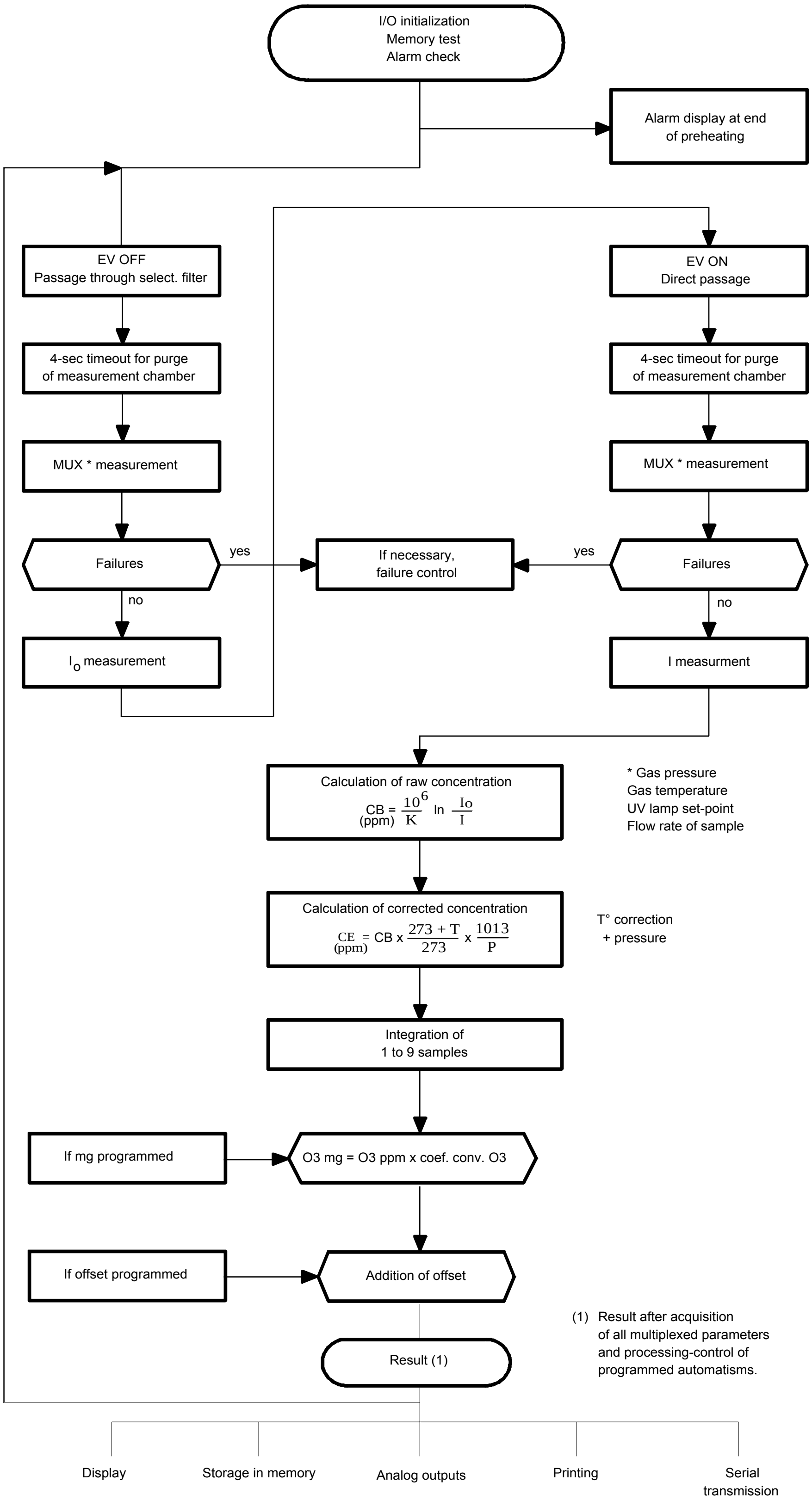


Figure 2-4 - Simplified flow chart of main program

NOTES: Precautions to be taken in measuring methods for ozone and phenomena generating incorrect operation:

Ozone is highly reactive; there may therefore be drops in concentration on contact with surfaces.

The Teflon inlet dust filter is an area likely to catch a few ppb of ozone through the deposit of dust. When there is a minor deposit of dust, it is possible to not install the filter membrane. When there is a major deposit of dust, for low content measurements (less than 20 ppb), it will be necessary to saturate the areas having a tendency to absorb by passing a high concentration of ozone (400 to 800 ppb) through them for 1 or 2 hours. This also holds true for long external connection pieces (to be avoided). Regularly check the amount of dust covering the inlet filter and change the membrane frequently.

The ozone measurement is made over a 10-second cycle. Differences in pressure or even variations in air turbulence in the chamber can create noise on the measurement. In order to avoid this problem, it is imperative that the sample gas be delivered at the atmospheric pressure at the inlet of the device.

By its principle, the analyzer has no long-time calibration or zero drift; on abrupt pressure variations or abrupt, abnormal variations in the concentration of other gases absorbing in this region of the spectrum and intervening punctually in a cycle can cause noise in the measurement.

The gas flow system was designed to be as symmetrical as possible.

Air tightness of the 3-way solenoid valve and selective filter should be checked regularly. A regular check should also be made on the balance of the load loss in measurement mode i and i_0.

Finally, the replacement dates for the selective filter should be kept up to date. It is advisable to replace them once a year (see Chap. 4).

IN SUMMARY:

- Ozone is reactive and is easily trapped.
- The gas system, solenoid valve and measurement chamber should be kept clean at all times.
- Measurement is cyclic; the pressure should be balanced between the two channels.
- The selective filter should be changed regularly.

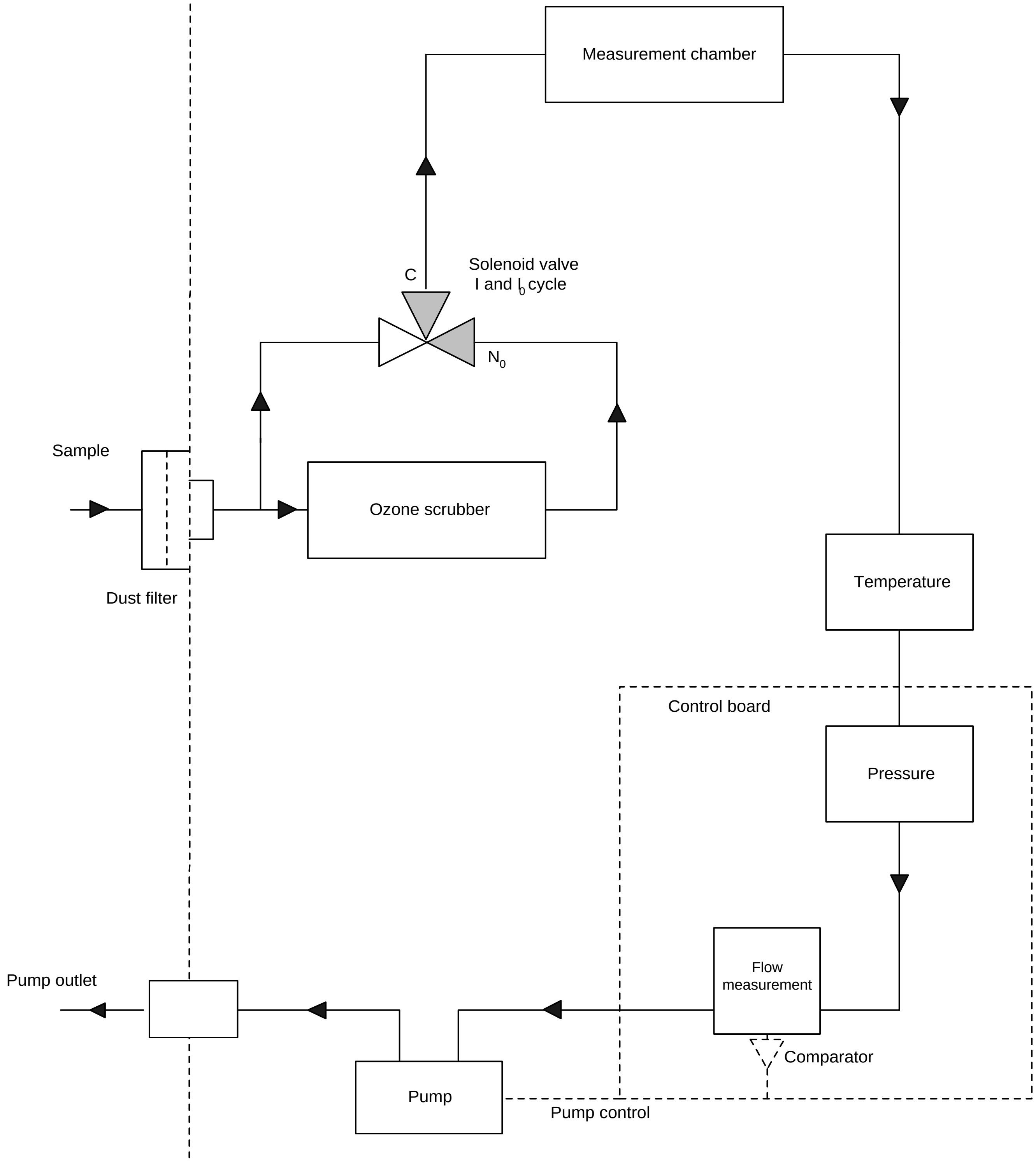


Figure 2-5 - Schematic diagram of basic gas flow system

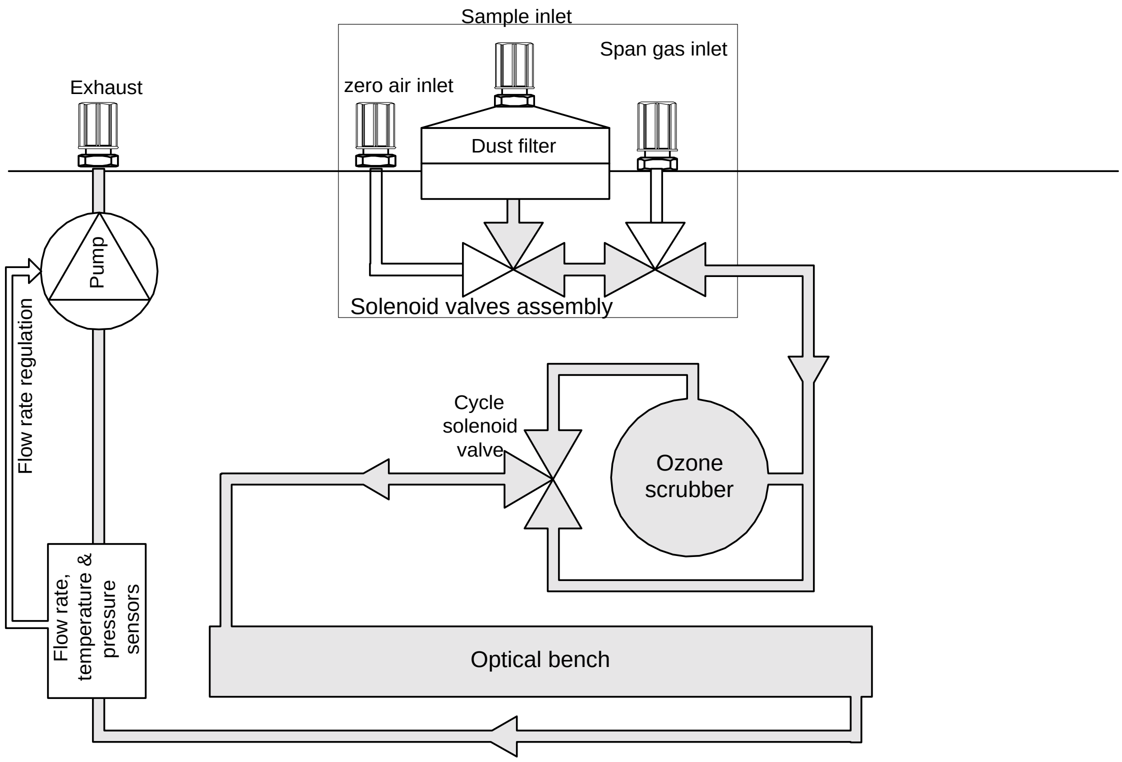
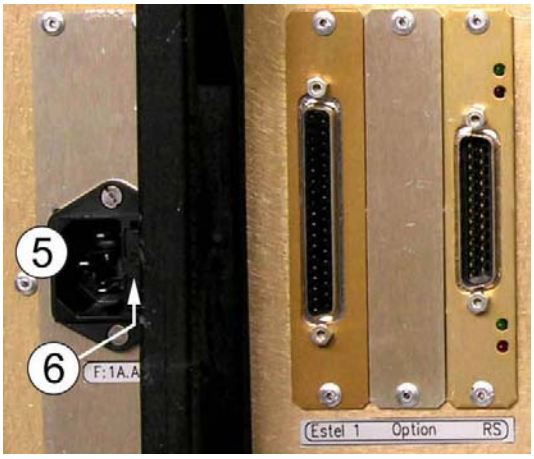


Figure 2-6 - Schematic diagram of gas flow system with solenoid valves option

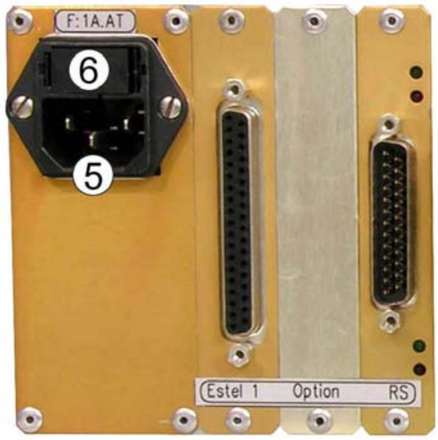
CHAPTER 3

OPERATING INSTRUCTIONS

3. OPERATING INSTRUCTIONS



box



rack

Figure 3–1 - Electrical connections

Table 3-1 - DB37 and DB25 connectors links

RS232 / 422 serial links

COM1	COM2
2-TX	14-TX
3-RX	16-RX
4-RTS	7-GND
7-GND	
20-DTR	
21-TX	
11-RX	

ESTEL BOARDS

PIN N°	CONNECTIONS	PIN N°	CONNECTION
1	ANA OUTPUT 1	17	REMOTE CONTROL 3
2	ANA OUTPUT 2	18	REMOTE CONTROL 4
3	ANA OUTPUT 3	19	+5VCC
4	ANA OUTPUT 4	20	ANA OUTPUT GROUND
5	ANA INPUT 1	21	ANA OUTPUT GROUND
6	ANA INPUT 2	22	ANA OUTPUT GROUND
7	ANA INPUT 3	23	ANA OUTPUT GROUND
8	ANA INPUT 4	24	ANA INPUT GROUND
9-28	RELAY 6 CONTACT	25	ANA INPUT GROUND
10-29	RELAY 5 CONTACT	26	ANA INPUT GROUND
11-30	RELAY 4 CONTACT	27	ANA INPUT GROUND
12-31	RELAY 3 CONTACT	34	REMOTE CONTROL GROUND
13-32	RELAY 2 CONTACT	35	REMOTE CONTROL GROUND
14-33	RELAY 1 CONTACT	36	REMOTE CONTROL GROUND
15	REMOTE CONTROL 1	37	REMOTE CONTROL GROUND
16	REMOTE CONTROL 2		

NOTE : Output relays contacts are normally open and potential free.

Remote controls are done by closing a potential free dry contact

Analog inputs accept maximum 2.5 VCC.

3.1 INITIAL STARTUP

The monitor is checked and calibrated in the factory before delivery.

3.1.1 PRELIMINARY OPERATIONS

Start-up first consists in carrying out the following preliminary operations:

– Visually examine the interior of the instrument in order to ensure that no element has been damaged during transport.

– **Remove the caps from the "gas" inlets and outlets on the unit** (keep these aside for future storage, see chapter 1.2.3).

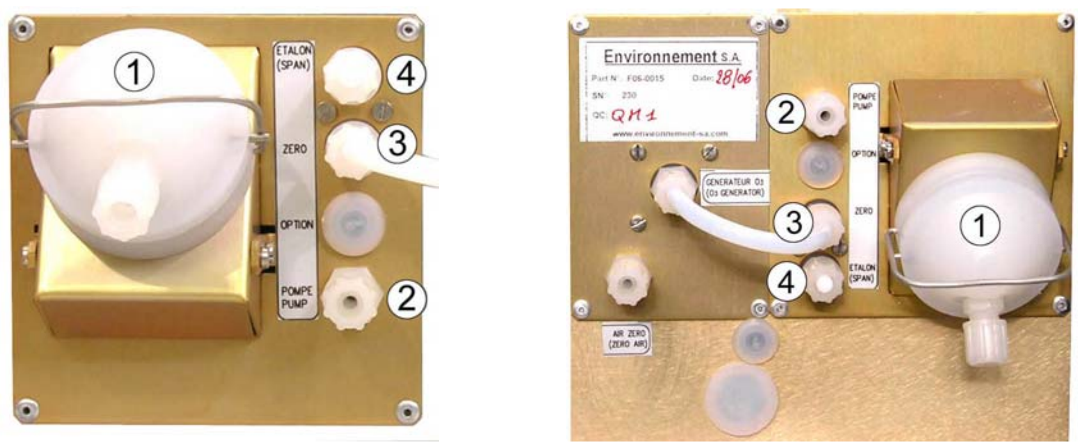
If the ozone generator option is available, keep in place the stopper of span inlet.

– Connect the 4/6 Teflon air sampling tube to the "sample inlet" after having checked for the presence of a Teflon filtering membrane in the inlet dust filter (fig.3-2)

– Connect the digital outputs to the DB25 connector (see Table. 3-1).

– Connect the analog inputs / outputs to the DB37 connector(s) (see Table 3-1).

– Connect the « mains » power supply cord to a socket 230 V, 50 Hz + ground or 110 V, 60 Hz + ground according to the supply voltage specified on the order.



rack coffret

Figure 3–2 - Fluid connections

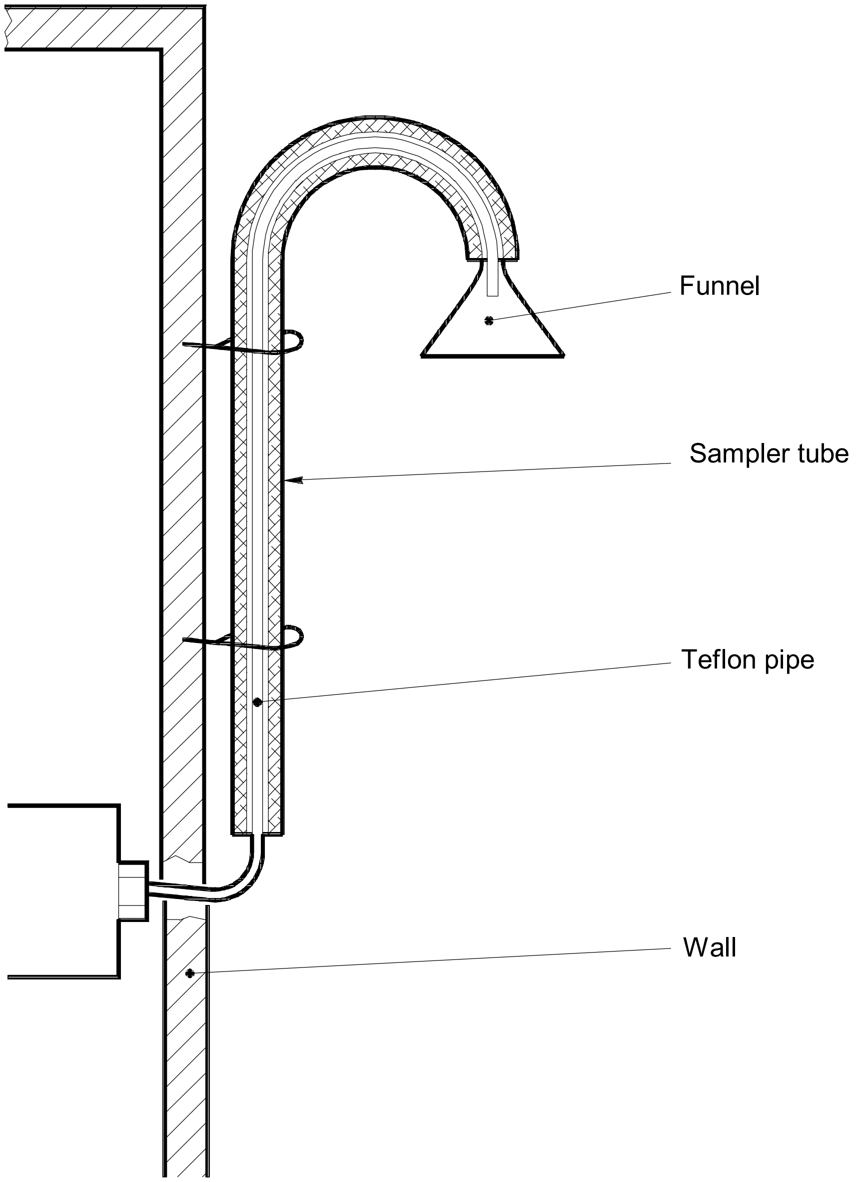


Figure 3-3 - Installation of the "sample gas" inlet

NOTE : Recommended height for sampling tap: 2.50 m
Maximum recommended length of gas Teflon sampling pipe: 6 m.

3.1.2 STARTING UP THE UNIT

Press the ON/OFF switch located on the front panel. The analyzer goes into the «warm-up» cycle (the duration of this cycle is a function of the time passed since the last switch off.)

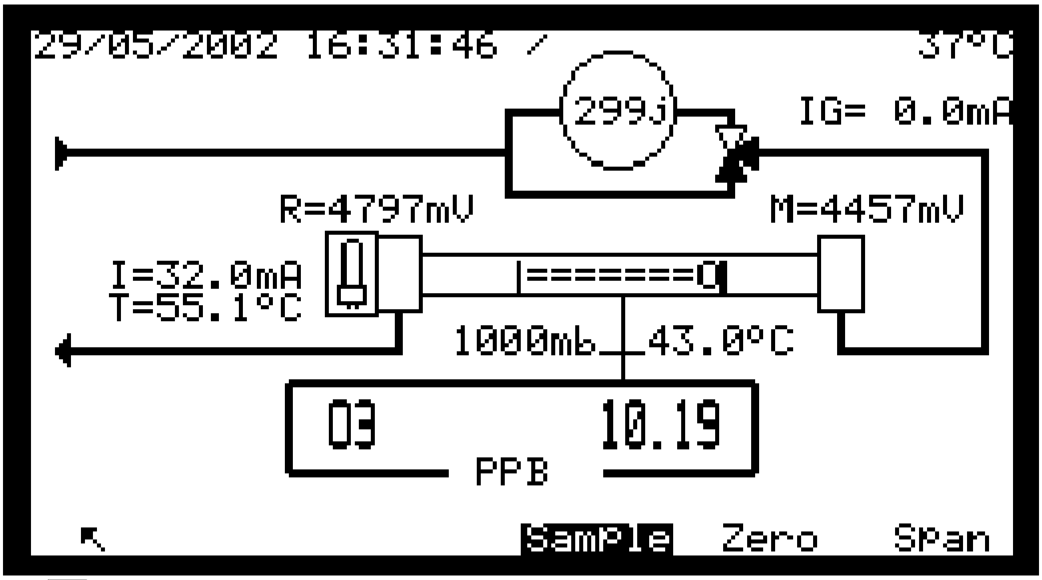
The warm-up cycle is terminated when the following two conditions are satisfied:

- all metrological parameters are within operational limits,
- the analyzer has made 10 consistent measurements within ± 4 ppb.

Display at start-up:

The WARM UP message appears in the top left corner.

- Display after warm-up: the measurement display after warm-up can be chosen in *Configuration ⇨ Measurement mode* screen. Example given here below : screen *Synoptic*



STOP

After some time (programmable in CONFIGURATION ⇨ Measurement mode) without action on any key, the screen passes in stand-by mode.
Pressing down any key makes it going back to display mode.

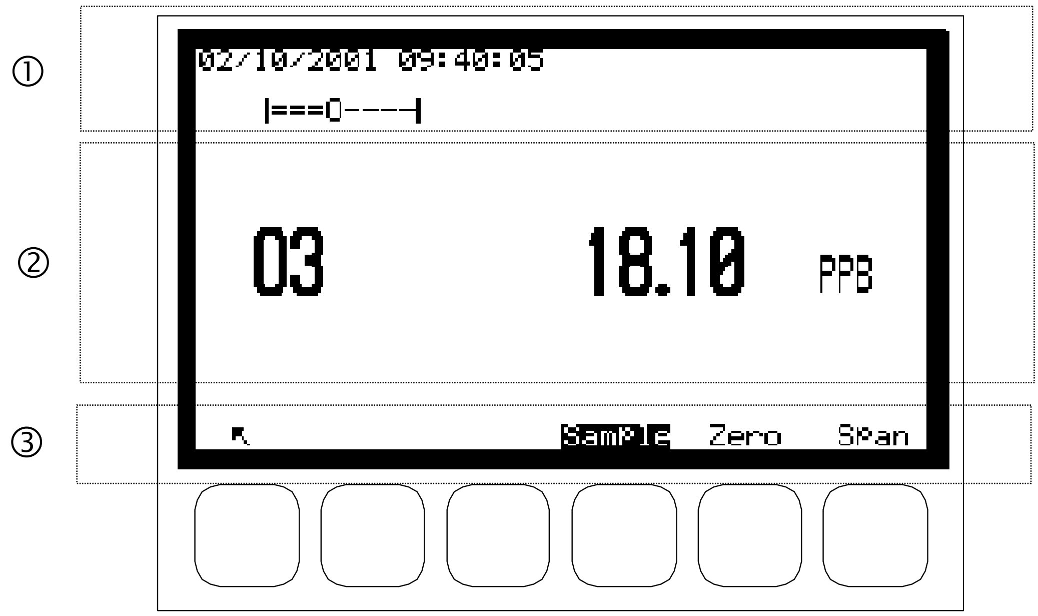
3.2 PROGRAMMING THE O3 42 MODULE

3.2.1 SELECTION AND MODIFICATION OF THE PROGRAMMABLE PARAMETERS.

The keyboard is located under the LCD screen. The bottom line gives the function of each key for the current screen.

The title of the menus and the selected fields are displayed in reverse video. By default the first line of the menus is selected. In the next paragraphs, the selected fields are symbolized in white on black background.

3.2.1.1 Screen areas definition



① Information area: displays the date and time in the top left corner. In the top right corner, the WARM UP or SPAN message blinks. The ALARM message appears if an operating fault is detected within the instrument operating parameters.

② Measurement or configuration area: displays the measurement parameters (gas, value, units...) or the programmable parameters according to the selected menu.

③ Status area and keys functions: displays the keys functions, the analyzer operating mode and the O_3 inlet ("sample" in the example above).

NOTE : In the next paragraphs, the keys are symbolized by the icon or function displayed inside a rectangle.

3.2.1.2 Definition of the main functions of the 6 keys

(the availability of these functions is context dependent)

↖ Used to display the previous menu or to abort the current operation (parameter programming, etc.)

↑ Used to select the required sub-menu or the parameter to be modified. Also used to increase the digit whose modification is in progress.

↓ Used to select the required sub-menu and the parameter to be modified. Also used to decrease the digit whose modification is in progress.

← Moves the cursor to the left (only available during numerical parameters modifications).

→ Moves the cursor to the right (only available during numerical parameters modifications).

✳ Authorizes the selected parameter modification.

↵ Used to valid the selection or the value of the parameter whose modification is in progress.

Print Used to print out the current screen.

>> Used to select the displayed parameters.

3.2.2 PROGRAMMING THE OPERATING PARAMETERS

3.2.2.1 Programming the digital parameters

Select the parameter with the ↓ or ↑ keys in the appropriate menu, press down the ✳ key to access to the modification of the parameter, the 1st digit blinks. Select the digit to be modified with the ← or → keys then increase it with the ↑ key or decrease it with the ↓ key. The ↵ key validates the modifications of the selected field; the ↖ key cancels the modifications of the selected field.

3.2.2.2 Programming the configurable parameters with toggle list

Select the parameter with the ↓ or ↑ keys in the appropriate menu, press down the ✳ key to access to the modification of the parameter, the field blinks. Select with the ↑ or ↓ keys the wanted value in the toggle list. The ↵ key validates the modifications of the selected field; the ↖ key cancels the modifications of the selected field.

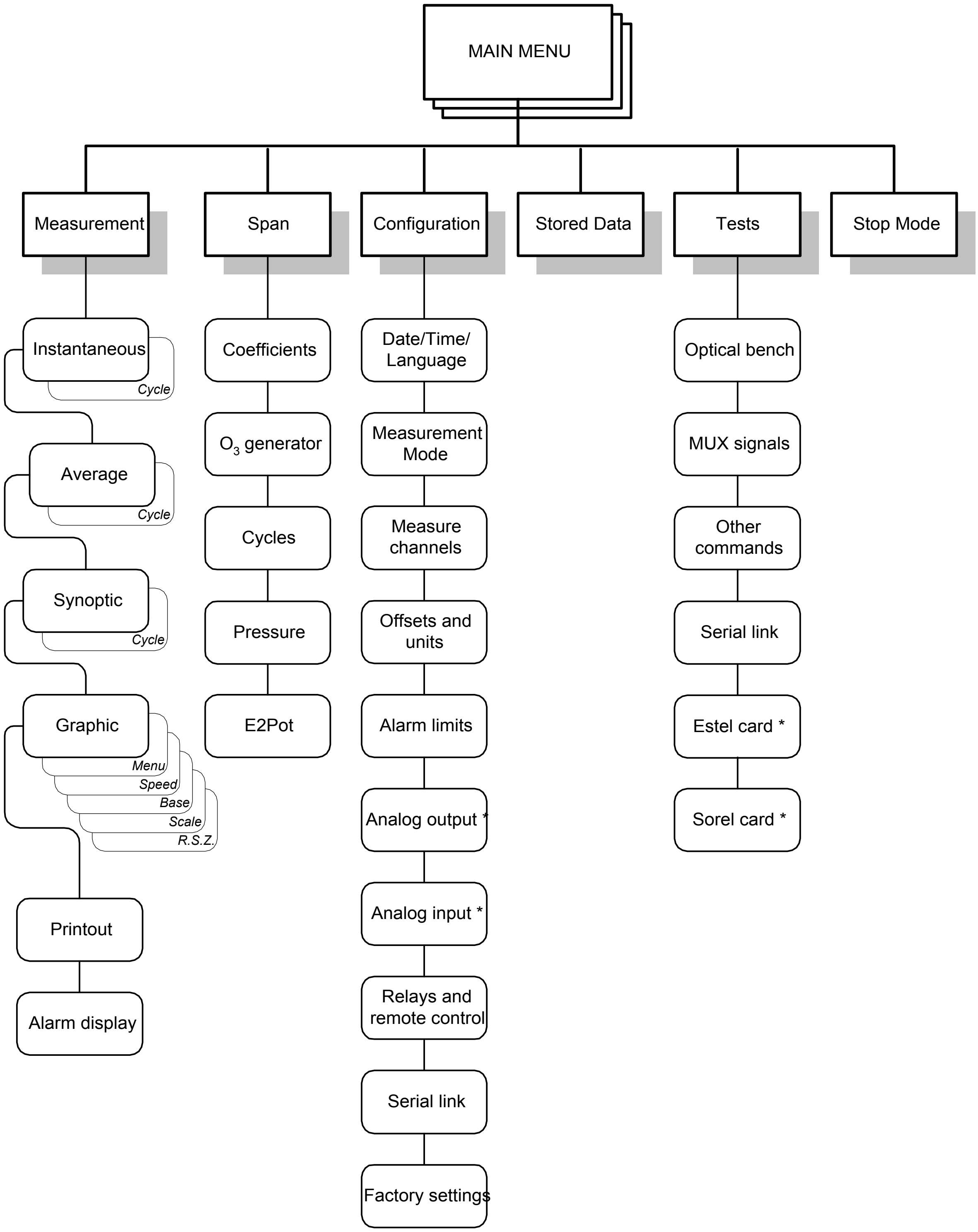


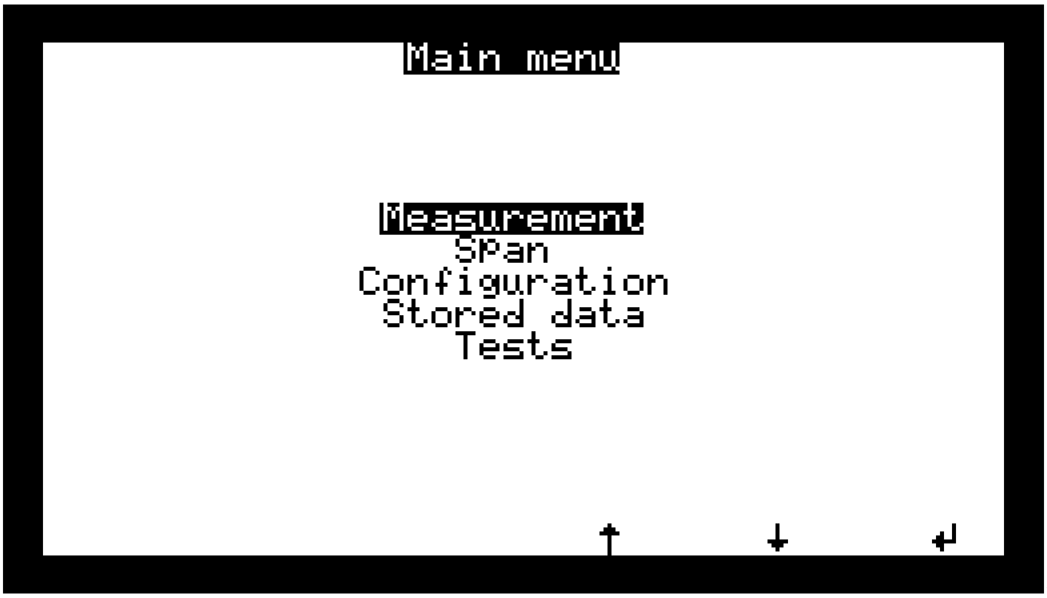
Figure 3–4 - Software overview

* note: appears in the menu only when option present

3.3 DESCRIPTION OF THE DIFFERENT SCREENS

3.3.1 MAIN MENU

This screen is used to choose the menus giving access to the analyzer operating parameters.



Select the menu with the ↑ or ↓ keys, validates the selection with the ↵ key.

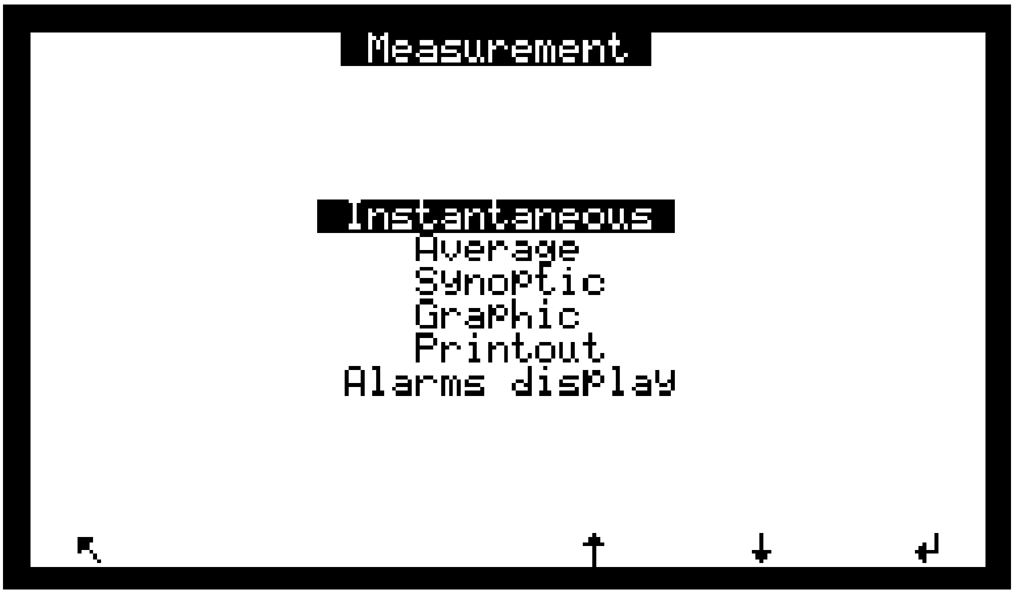
Example:

ACTION	DISPLAY	REMARKS
	Measurement Span Configuration Stored data Tests Stop mode	– Display of the main menu, the 1[ST] item is selected by default.
↓	Measurement Span Configuration Stored data Tests Stop mode	– Selection of the next item.
↓	Measurement Span Configuration Stored data Tests Stop mode	– Selection of the next item.
↵	Date/Time/Language Measurement mode Measure channels Offsets and units Alarms limits Analog outputs Analog inputs Relays and remote control Serial link Factory settings	– Validates the selection (configuration menu) and displays the sub-menu.
↖	Measurement Span Configuration Stored data Tests Stop mode	– Goes back to the previous menu.

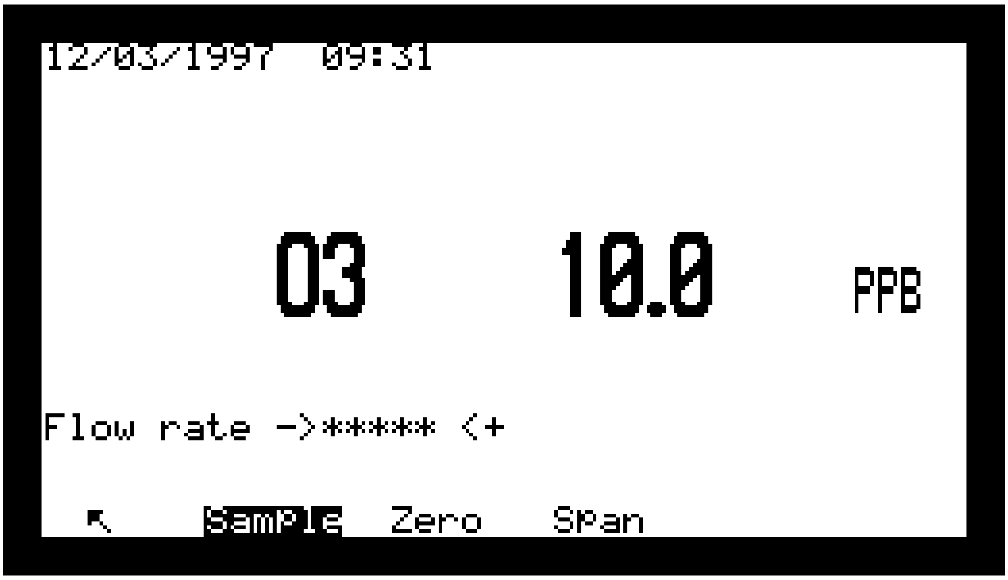
NOTE : To make the reading easier, when a sub menu is quoted in the text, the corresponding menu is reminded before (i.e. *Configuration* ⇨ *Date / time / language*).

3.3.2 MEASUREMENT

This screen is used to choose the measurement display mode: instantaneous, average, synoptic or graphic, to activate the continuous printout and to display the alarms.



3.3.2.1 MEASUREMENT ⇨ Instantaneous



Definition of the specific keys of this screen

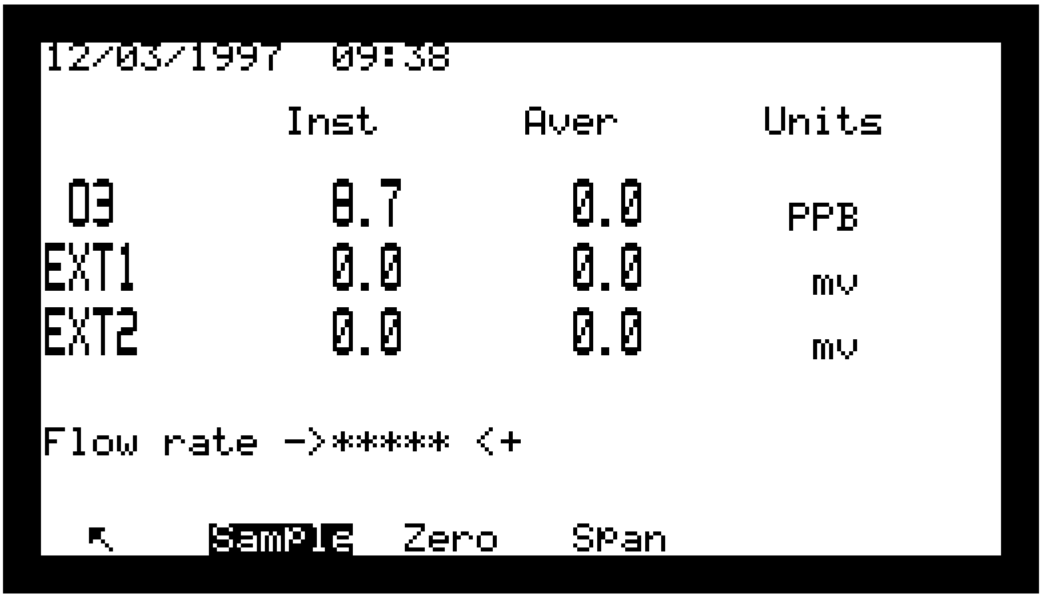
Sample Selects the sample gas inlet. The gas is continuously sampled through the inlet dust filter. The measurement mode, the unit and the range are those chosen in the *Configuration* menu and in the corresponding sub-menus. This mode can be interrupted at any time by starting an automatic cycle or by manual selection of another gas inlet (zero or span).

Zero Selects the zero/span gas inlet for zero check. The function of this key depends on the equipment of the analyzer.

- **Zero/span solenoid valve option :**

The zero/span solenoid valve is energized; the zero/span gas inlet is selected. The following can be connected to this inlet: either a filter containing activated charcoal, connected to a dust filter with an overall load loss of less than 20 mbar, or an ozone-free zero air available at atmospheric pressure.

3.3.2.2 MEASUREMENT ⇨ Average

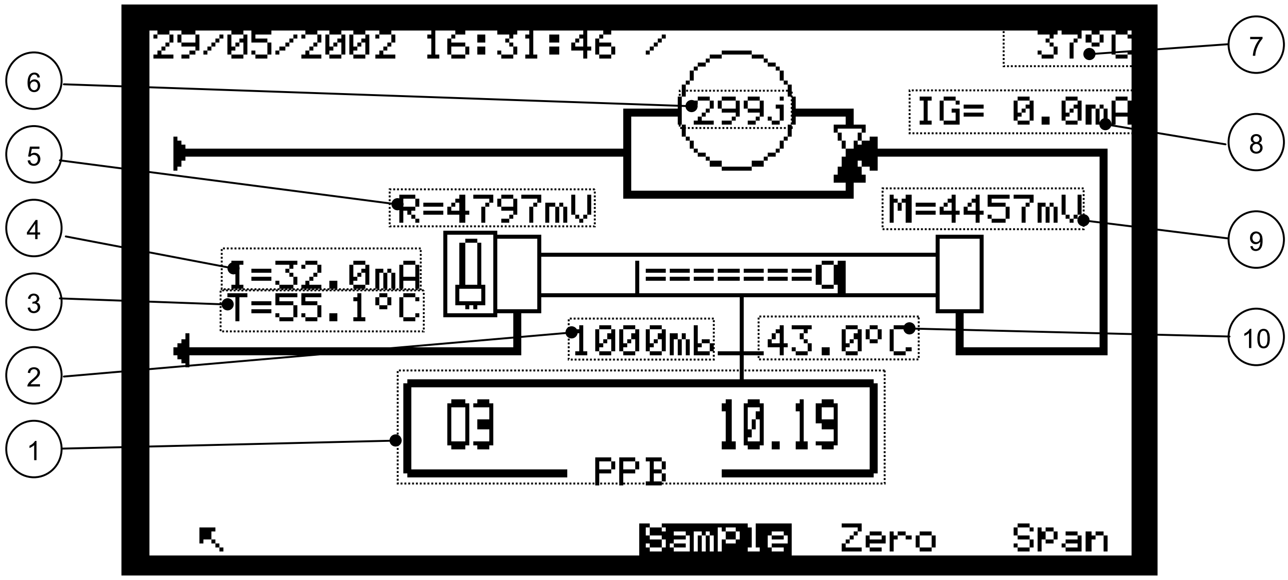


Definition of the specific keys of this screen

Sample Zero Span have the same function than the screen *Measurement ⇨ instantaneous*.

3.3.2.3 MEASUREMENT ⇨ Synoptic

This screen represents the entire flow circuit and displays significant operating parameter values: gas, concentration and units (1), measurement UV detector signal (9), UV lamp current (4), reference UV detector signal (5), MNO_2 zero filter autonomy in days (6), internal temperature (7), optical bench temperature (10). Pressure in the measurement cell (2). Lamp temperature (3) and current (4). Ozone generator lamp current (8) if option available.

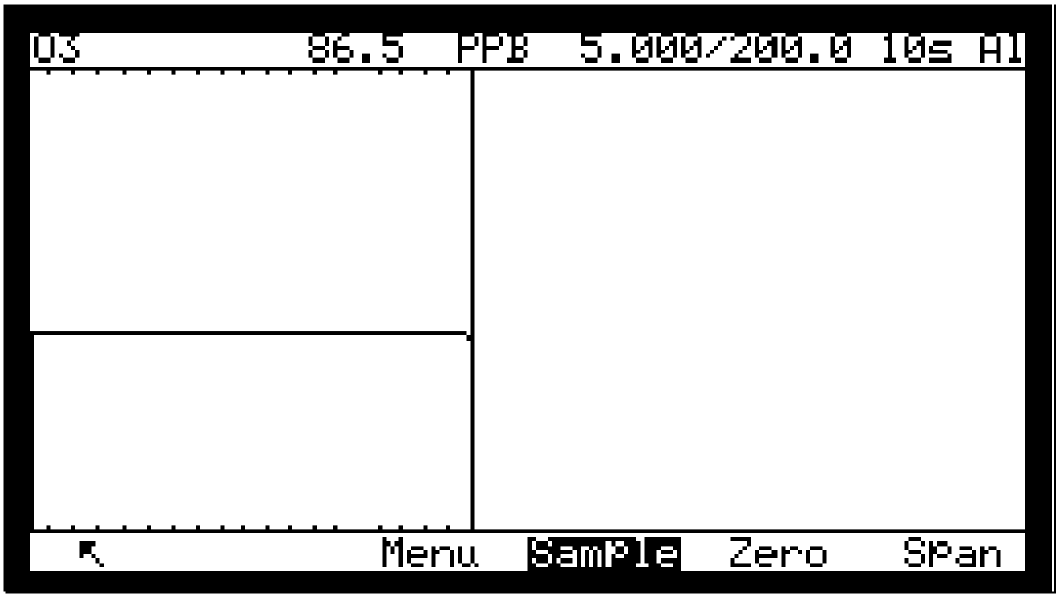


Definition of the specific keys of this screen

Sample Zero Span have the same function than the screen *Measurement ⇨ instantaneous*.

3.3.2.4 MEASUREMENT ⇨ Graphic

This screen is used for graphic plotting of the measurement values on sample or zero / span gas inlet. Horizontal and vertical full scales are programmable. The vertical line shows the current position : the measurements are given on the left side of this line and the screen is automatically refreshed when plotting arrives at the end of the screen right side.



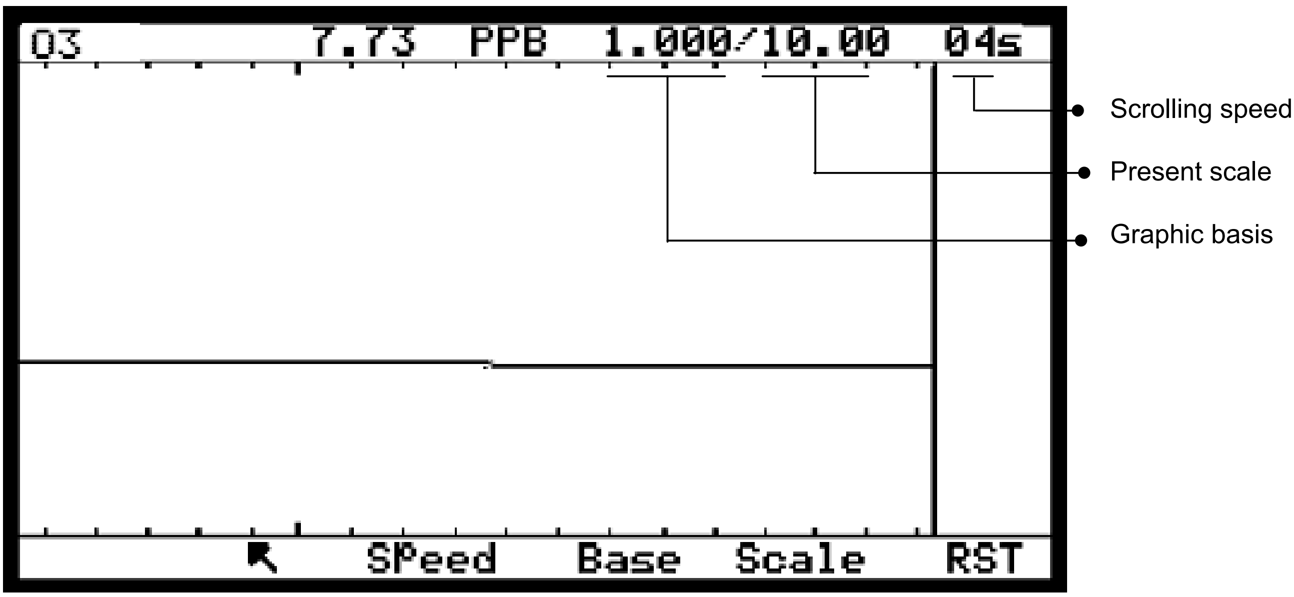
Definition of this screen specific keys

Sample Zero Span have the same function than the screen *Measurement ⇨ instantaneous*.

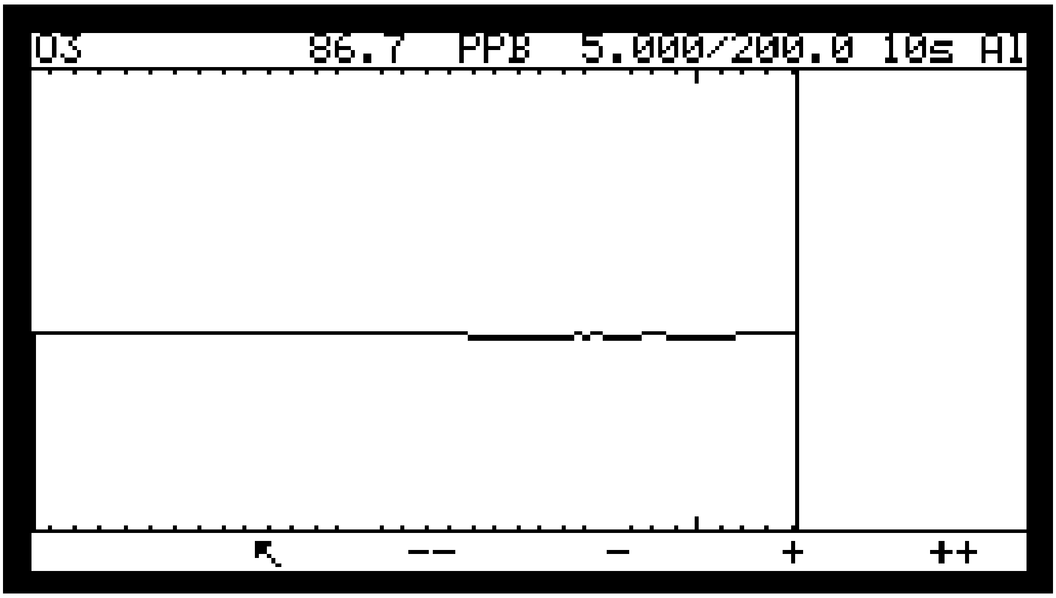
3.3.2.4.1 Graphic ⇨ "Menu" screen

Pressing down the Menu key gives access to the following graphic adjustments: scrolling speed on the screen, basis line, full scale.

The R.S.T key is used to put again the graphic to zero.



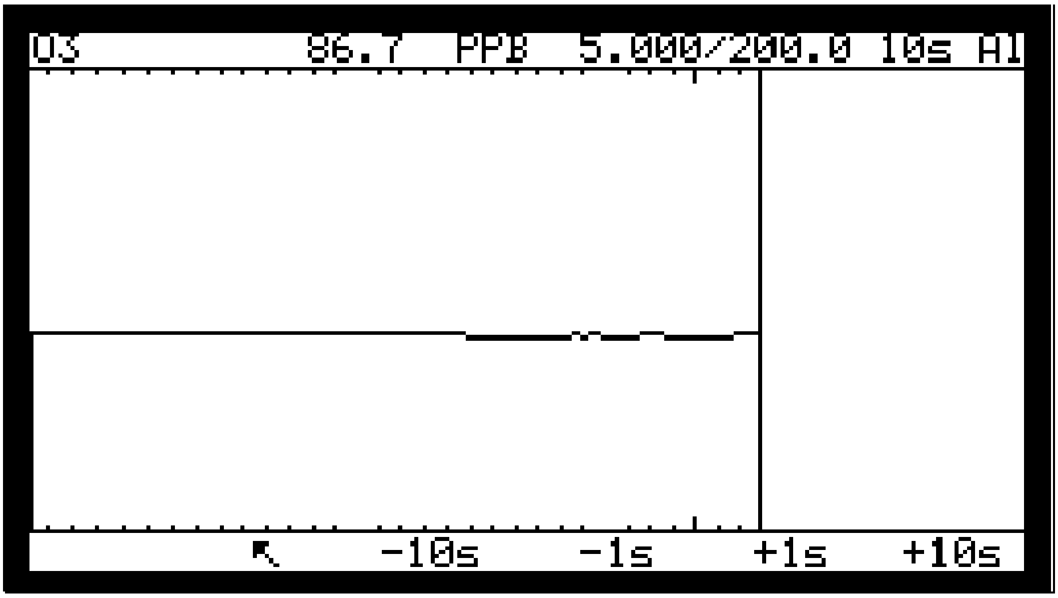
3.3.2.4.2 *Graphic ⇨ Base*



Pressing down the Base key allows to adjust the value of the basis line (within a range from zero to a value, which is just lower than the full scale).

- **--** Divides the present basis line by 10 (when the value basis line is 5, it puts it back to the zero position)
- **-** Selects the inferior basis line among 5000, 2000, 1000, 500, 200, 100, 50, 20, 10, 5, 2, 1, 0.
- **+** Selects the superior basis line among 0, 1, 2, 5, 10, 20, 100, 200, 500, 1000, 2000, 5000.
- **++** Multiplies the basis line value by 10.

3.3.2.4.3 *Graphic ⇨ Speed*



Pressing down the Speed key allows to adjust the scrolling speed of the measurement displayed on the screen (from 1s. mini, to 60s maxi).

- 10s Decrease the current speed of 10 seconds.

- 1s Decrease the current speed of 1 second.

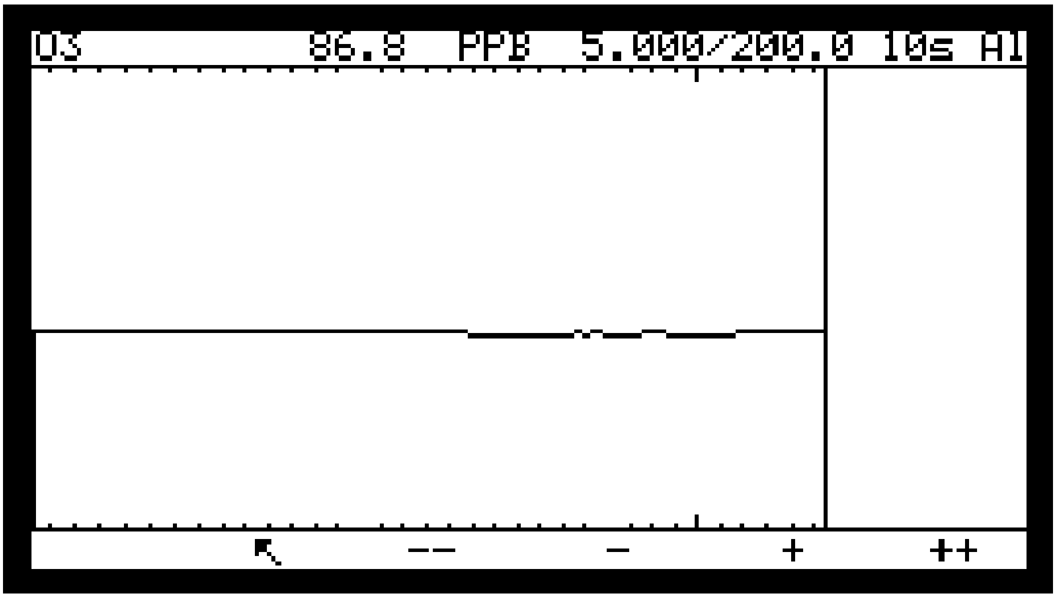
+1s Increase the current speed of 1 second.

+10s Increase the current speed of 10 seconds.

The programmed duration is equivalent to the interval between the recording of each point
Example: when a scrolling speed is adjusted on 10 seconds, then the graphic screen duration is 240x10 = 2400s.

3.3.2.4.4 Graphic ⇨ Scale

Pressing down the Scale key allows to adjust the full scale of the graphic (minimum value is just higher than the basis line, maximum is 10000)



-- Divides the current scale by 10 (when the scale is 5, it puts it back to the zero position)

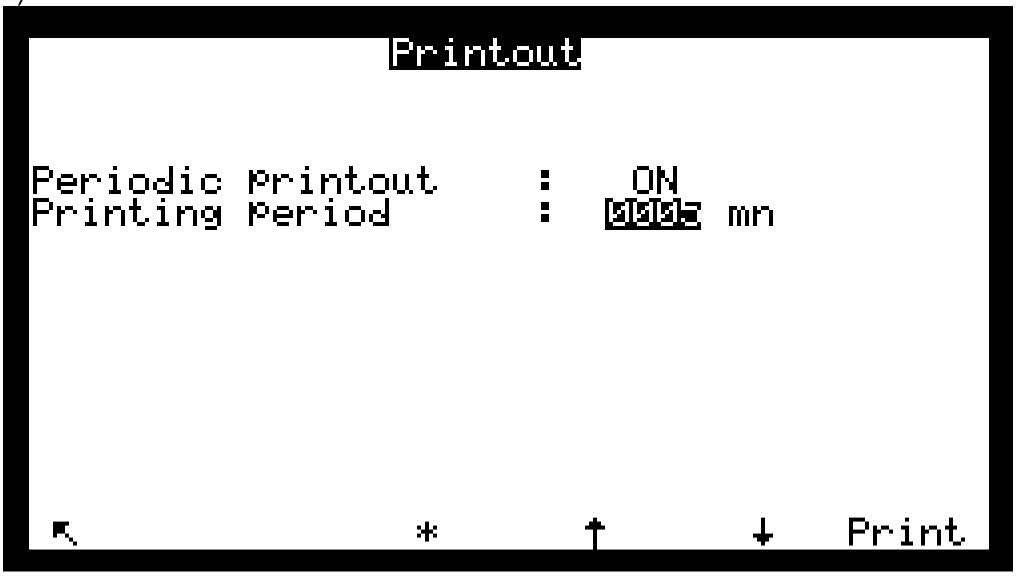
- Selects the current scale among 5000, 2000, 1000, 500, 200, 100, 50, 20, 10, 5, 2, 1, 0.

\+ Selects the current scale among 0, 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000.

++ Multiplies the current scale by 10.

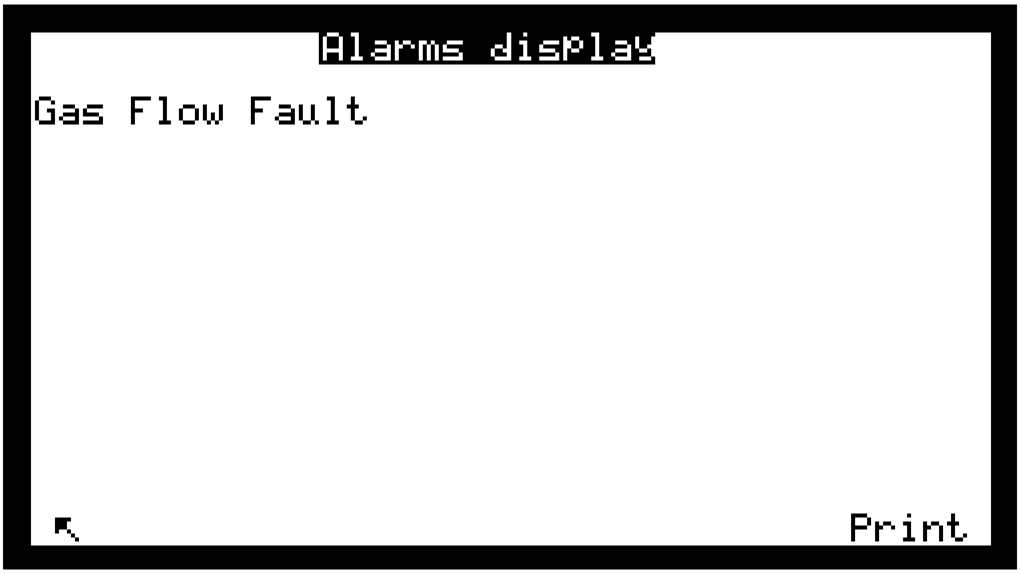
3.3.2.5 MEASUREMENT ⇨ Printout

This menu is used to start real time printout on a serial printer connected to one of the serial ports. It is also used to define calculation period and printing rate of the average measurements (0001 to 9999 mn).



3.3.2.6 MEASUREMENT ⇨ Alarms display

This screen displays the operating faults in case of alarm. Possible corrections for these faults are given in chapter 5.



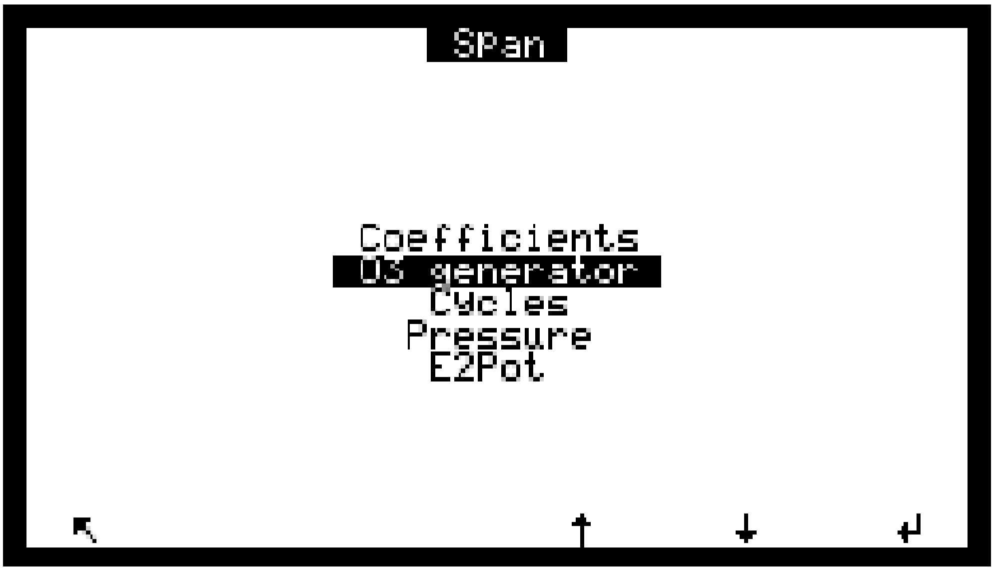
3.3.3 SPAN

This menu gives access to the followings functions:

- Programming the span coefficients.
- Monitoring of the O3 generator operation parameters, when analyzer is equipped with (optional).
- Programming the span gas values.
- Programming the period and duration of the automatic cycles.
- Pressure sensors calibration.

Programmable digital potentiometer (E2Pot) allows to:

- adjust UV lamp current and consequently measurements and reference signal amplitude;
- adjust flow rate control point.

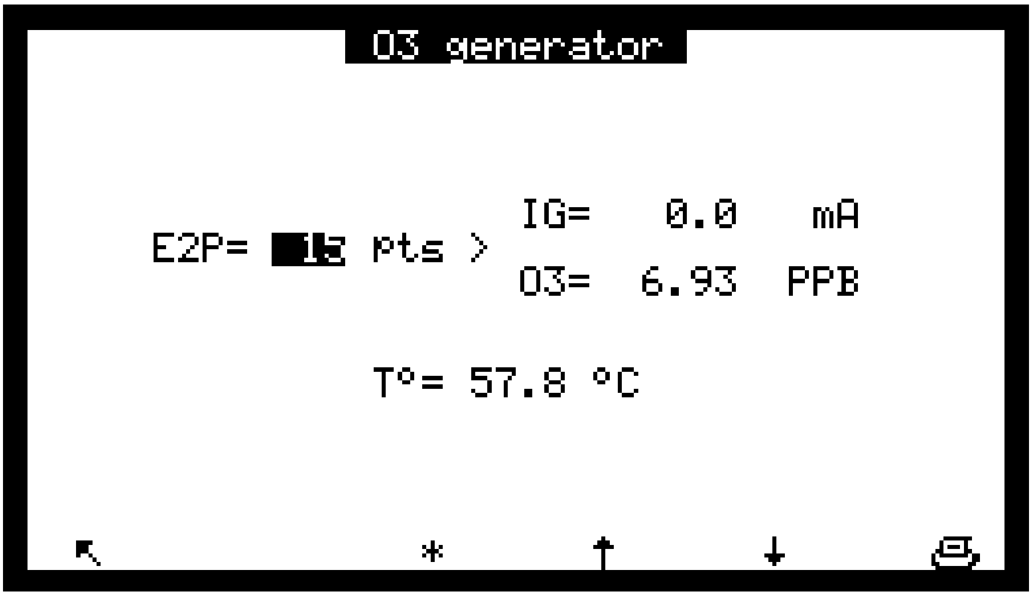


3.3.3.1 SPAN ⇨ Coefficients

The "Factors" are the span factors, the one of the O_3 should never be set outside the interval 12554 ±5 %. This screen permits to manually modify these factors. The field Delta is not used.
The zero adjust field allows to program a zero correction value within the range of ± 2 ppb by steps of 0.1 ppb.

3.3.3.2 SPAN ⇨ O_3 generator (optional)

The command line "O3 generator" appears in *SPAN* menu when the "O_3 + Gen" Mode has been programmed in *CONFIGURATION ⇨ Measurement mode* screen.



This screen allows to display and to program ozone generation parameters:

- IG gives the current value (mA) in ozone generator UV lamp,
- O_3 is the concentration value red on internal generator in span position,
- T°C is O_3 generator block temperature, normally regulated at 60°C,
- E2P is the current adjustment of the UV lamp, given in number of points from 0 to 99.

3.3.3.3 SPAN ⇨ Cycles

This screen is used to program the period and the duration (time) of the automatic cycles.

The possible automatic cycles are:

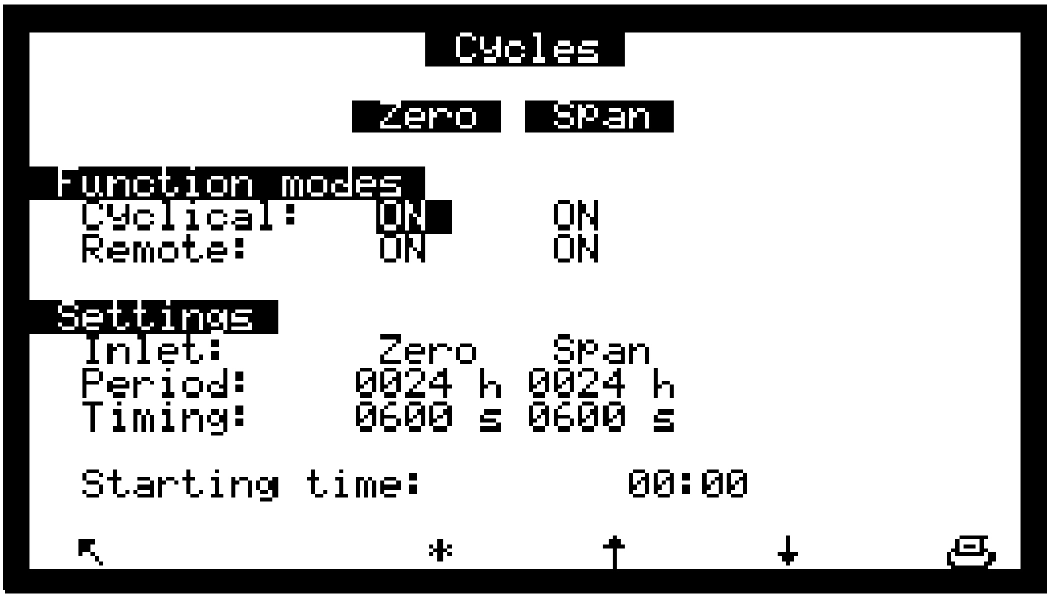
- ZERO : zero air check
- SPAN : span gas check.

The “Remote” fields are used to configure the cycles remote controls (ESTEL board option), ZERO, and SPAN. The status programmed in the “Cyclical” fields (ON = active, OFF = inactive) governs the analyzer reaction when a dry contact is closed on the remote controls inputs (see Table 3.1).

The “Inlet” fields allow to select gas inlets used during the automatic sequences. The reference concentrations for automatic calibration are those programmed in the previous menu.

The “Starting time” field is used to program the time when the 24 hours or 24 hours multiple cycle are launched. If a 24h ZERO cycle, or a 24h SPAN cycle are programmed, at start time the following sequence is launched: ZERO then SPAN.

To inhibit an automatic cycle, program 0000h in the “Period” field.



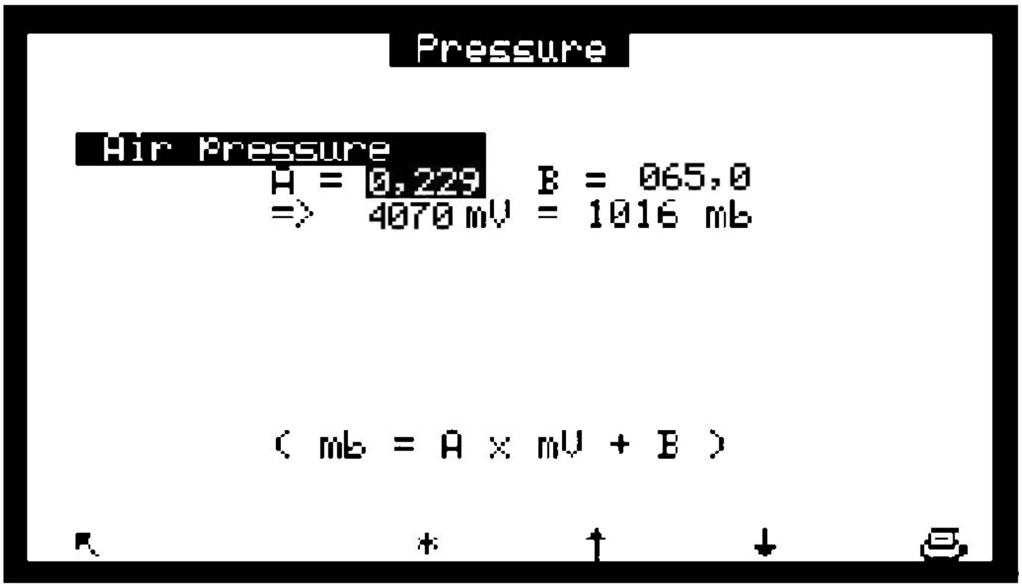
3.3.3.4 SPAN ⇨ Pressure

This screen is used to program the calibration curve of the pressure sensors

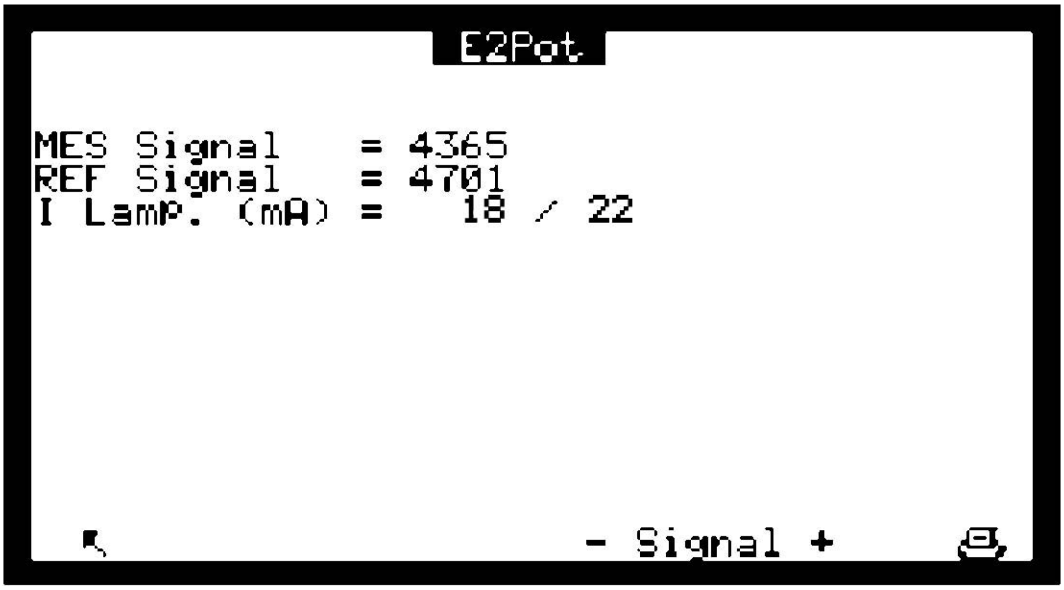
Pressure sensors calibration:

- Connect a reference pressure sensor in parallel to the pressure sensor to be calibrated.

Enter the slope (A) and intercept (B) values in the pressure calibration window fields.



3.3.3.5 SPAN ⇨ E2Pot

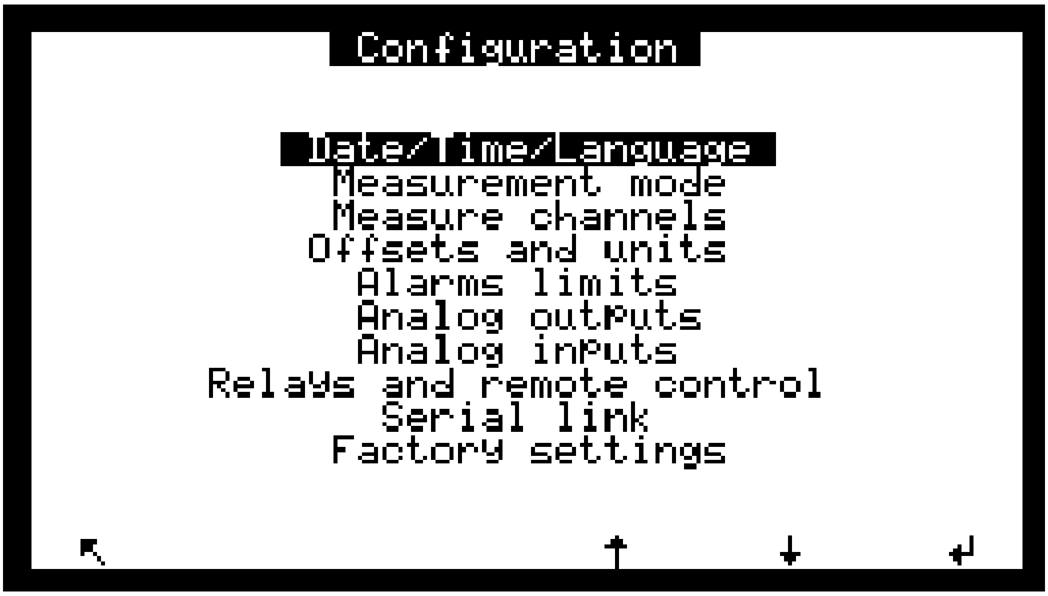


Sign+ and Sign- keys allow to adjust UV lamp current.

3.3.4 CONFIGURATION

This menu gives access to the following functions:

- Response time programming.
- Dilution function programming.
- Analog outputs configuration.
- Unit and offset programming
- Alarm thresholds, activation and assignment of the alarm relays.
- Serial link programming.
- Reset of the main programmable parameters.
- Software serial number.



3.3.4.1 CONFIGURATION ⇨ Date/time/language

This screen is used to set the internal clock of the analyzer, as well as to choose the displayed language among French, English, German, Italian and Spanish. It also shows the software version number to remind in case of software dysfunction.

3.3.4.2 CONFIGURATION ⇨ Measurement mode

This screen allows to program the standard mode or using O_3 generator mode (optional), and the electronic response time from about 20 sec. to 100 sec. The table bellow gives the fixed response times corresponding to the programmed values.

Programmed Value	Fixed response time (seconds)
01	100
02	50
03	40
04	30
05	20

Programming 11 activates the automatic response time (see chapter 2, “Principle of the automatic response time”), the electronic response time is then 30 seconds.

The advised value is: Response time = 11.

This screen gives also access to the Dilution function: to measure very high concentrations (ex. found in industrial environment), it is necessary to bring them to values corresponding to the range of analyzer by inserting a dilution system in the sampling line to get: $C_{ANALYZER\ INLET} = C_{SAMPLE}$ / K dilution
The real concentration display is obtained by application of a K Dilution multiplying factor to the measured concentration.

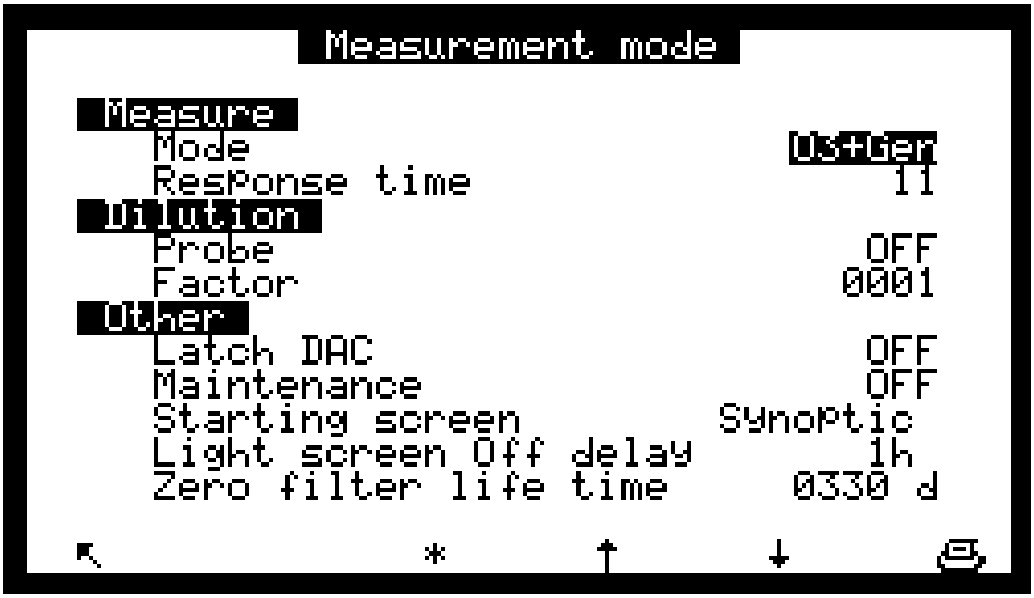
“Latch DAC" field: when this field is ON, the analog outputs are latched during the Zero and Span cycles, in order to not perturb data loggers.

“Maintenance” field: is used to trigger one of the alarm relays (see § 3.3.4.5 and table 3.1). The maintenance mode is reminded on the *Measurement* screens.

"Starting screen" field allows to program the default measurement screen after start up.

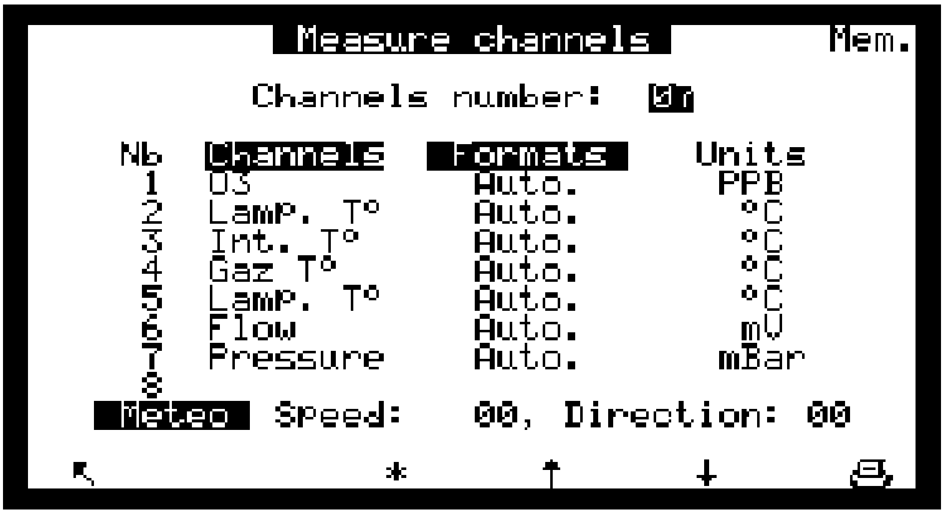
"Light screen of delay" field allows to program the duration

"Zero filter life time" allows to program a day down-counter, which triggers, when zero, filter alarms message. The setting value depends on the analyzer using conditions. The factory setting value, 365 days, corresponds to the advised maintenance frequency (see section 4.3.3).



3.3.4.3 CONFIGURATION ⇨ Measure channels

This screen is used to select the parameter, the display format and the unit for each measure channel. The programming of measure channels allows to display (screen *MEASUREMENT ⇨ Instantaneous* or screen *MEASUREMENT ⇨ Average*) and to store (menu *STORED DATA*) other parameters than the one displayed by default (O_3). It allows to store MUX channels and analog inputs (ESTEL option). The channel number field is used to select the number of parameters.



- The 8 "Channels" fields are used to choose the parameter among MUX or analog inputs.
- The "Formats" fields are used to choose the display format among 4 possibilities (X.XXX, XX.XX, XXX.X, XXXX). "Auto" manages the comma in order to display the same resolution at any time.

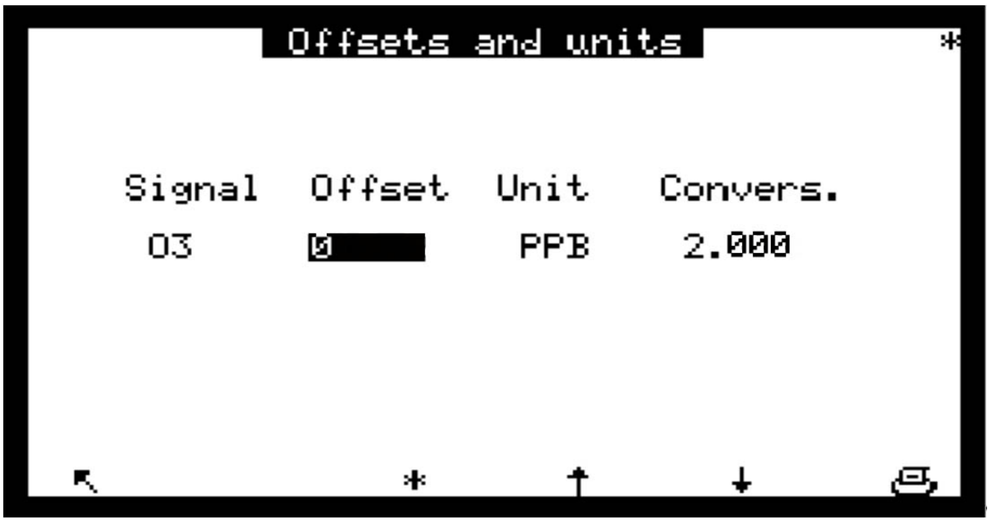
The "Units" fields refer to the units programmed in screen *CONFIGURATION ⇨ Offsets and units*, or *CONFIGURATION ⇨ Analog inputs.*

Meteo fields allow to assign the channel where meteorological parameters are connected in order to apply a trigonometric treatment to those data.

3.3.4.4 CONFIGURATION ⇨ Offset and units

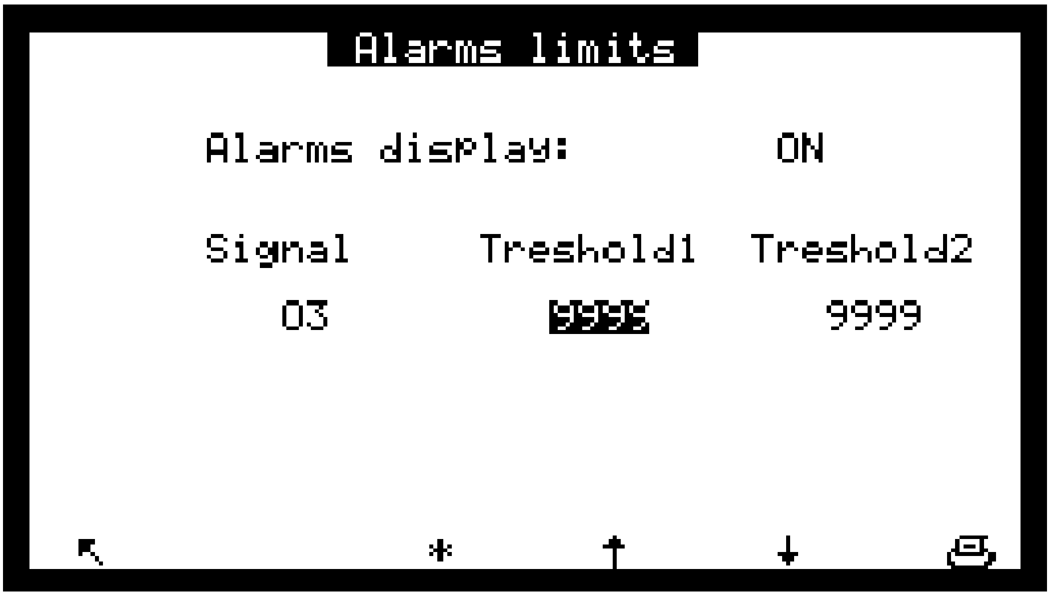
This screen is used to program the offset. This value is added to the measurements. It is also used to program the conversion factor from ppm to mg/m^3, when the mg/m^3 unit is selected.

The conversion factor is depending on standard conditions used in the country. In Europe, the conditions are : 20°C and 101,3 hPa. In consequence, the conversion factor to use is 2,000.



3.3.4.5 CONFIGURATION ⇨ Alarm limits

2 limits are programmable for the programmed parameter: Threshold 1 and Tersely 2, which are used to activate the relays and the alarm messages. When the "Alarms display" field is “OFF”, the displays and the alarm relays are inhibited.



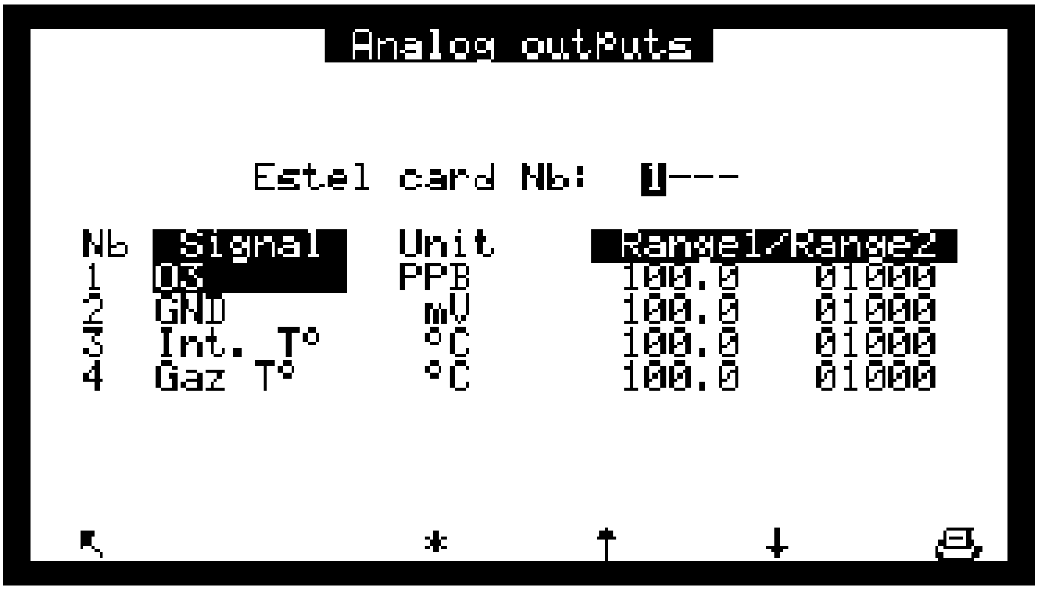
3.3.4.6 CONFIGURATION ⇨ Analog outputs

This screen is used to choose the analog outputs parameters (only when ESTEL board option is available) for the O_3 concentration and 3 other measurement channels.

This screen is used to program the ranges for each displayed parameter. The ranges correspond to the analog output full scale.

Range 1 corresponds to the analyzer standard range. The analyzer switches to Range2 when Range1 is exceeded, and switches from Range 2 to range 1 when 85 % of Range 1 is reached.

This screen is also used to choose the parameters unit among ppb mg/m^3, mV, °C or hPa.



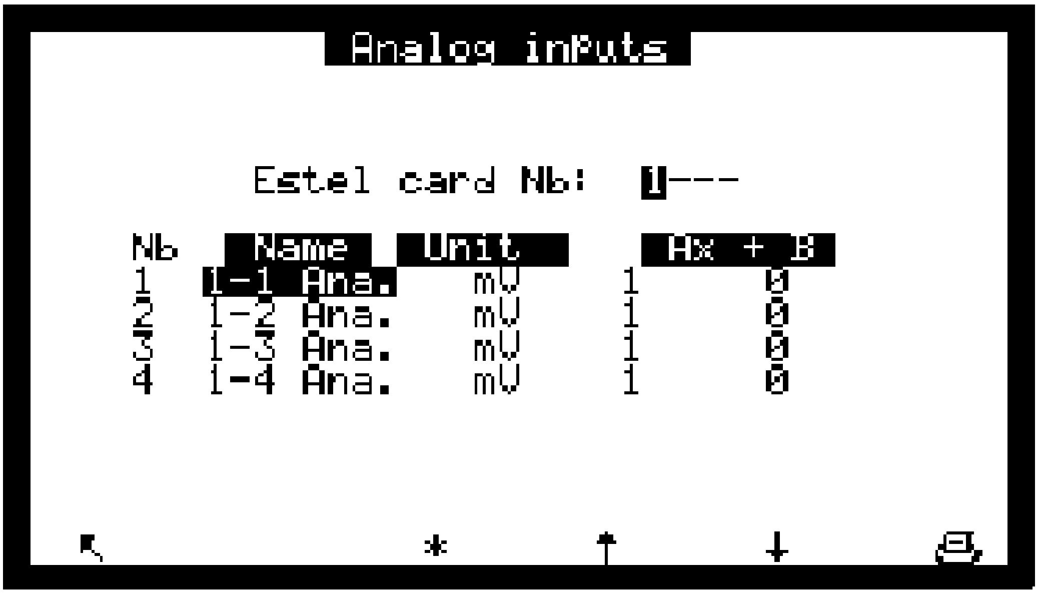
3.3.4.7 CONFIGURATION ⇨ Analog inputs

This screen is used to program the analog inputs characteristics.

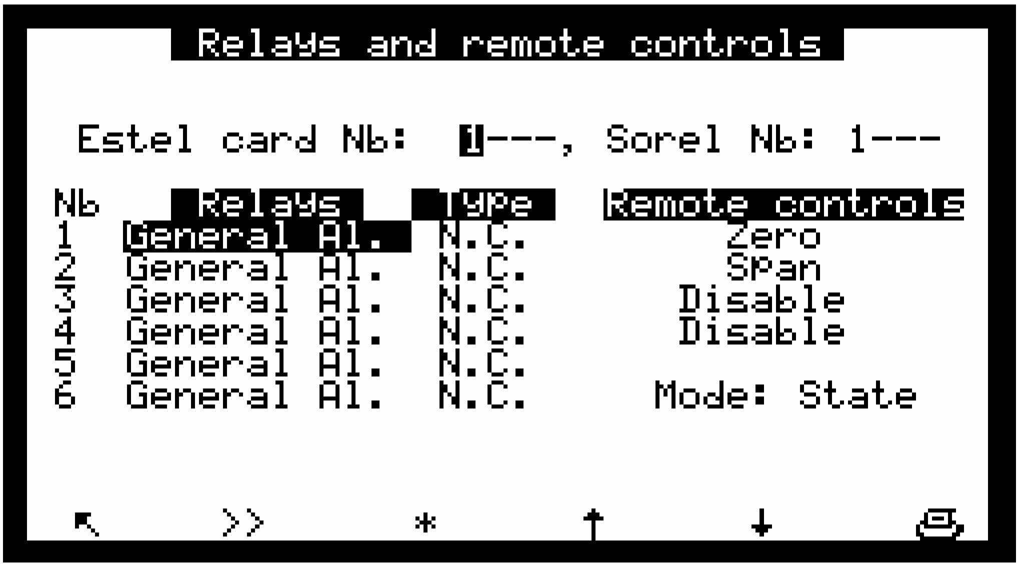
The fields Name allows to enter an 8 alphanumeric characters name.

The fields units allows to choose a unit among: none, ppt, ppb, ppm, µg/m^3, mg/m^3, gr/m^3, µg/Nm^3, mg/Nm^3, gr/Nm^3, µg/Sm^3, mg/Sm^3, gr/Sm^3, %, µgr, mgr, gr, mV, U, °C, °K, hPa, mb, b, l, Nl, Sl, m^3, l/min, Nl/min, Sl/min, m^3/h, Nm^3/h, Sm^3/h, m/s or km/h, in a scrolling menu.

The fields aX + b allow to enter the linearity curve of the sensor connected on the input.



3.3.4.8 CONFIGURATION ⇨ Relays and remote control



This screen allows to configure the function of each input / output of the ESTEL and SOREL board(s).

- **The "Estel card Nb" and “Sorel Nb” field is used to choose what board to configure.**
- **The "Relays" fields are used to control the relays according to the following situations :**

Disable	⇨ Relay not assigned
General alarm	⇨ Any operating fault triggers the relay
Ch.1 > Thrs.1	⇨ Limit 1 channel 1 exeedence triggers the relay
Ch.1 > Thrs.2	⇨ Limit 2 channel 1 exeedence triggers the relay
Ch.2 > Thrs.1	⇨ Limit 1 channel 2 exeedence triggers the relay
Ch.2 > Thrs.2	⇨ Limit 2 channel 2 exeedence triggers the relay
Ch.1 > Thrs.3	⇨ Limit 1 channel 3 exeedence triggers the relay
Ch.2 > Thrs.3	⇨ Limit 2 channel 3 exeedence triggers the relay
Overrange	⇨ Range 2 exeedence triggers the relay
Flow rate	⇨ Abnormal flow rate triggers the relay
Temperature	⇨ Abnormal temperature in the analyzer triggers the relay
Pressure	⇨ Barometric pressure in chamber
Null gas	⇨ On zero, relay is triggered
Span	⇨ On span, relay is triggered
Ref-Zero	⇨ On Ref-Zero, relay is triggered
Auto Span	⇨ On Auto Span, relay is triggered
Warm-up	⇨ On Warm-up, relay is triggered
Stand-by	⇨ On Stand-by, relay is triggered
Maintenance	⇨ Relay triggered when the analyzer is in maintenance mode

- "Type" fields are used to control (NC) or not (NO) the relays when alarm OFF.

3.3.4.9 CONFIGURATION ⇨ Serial link

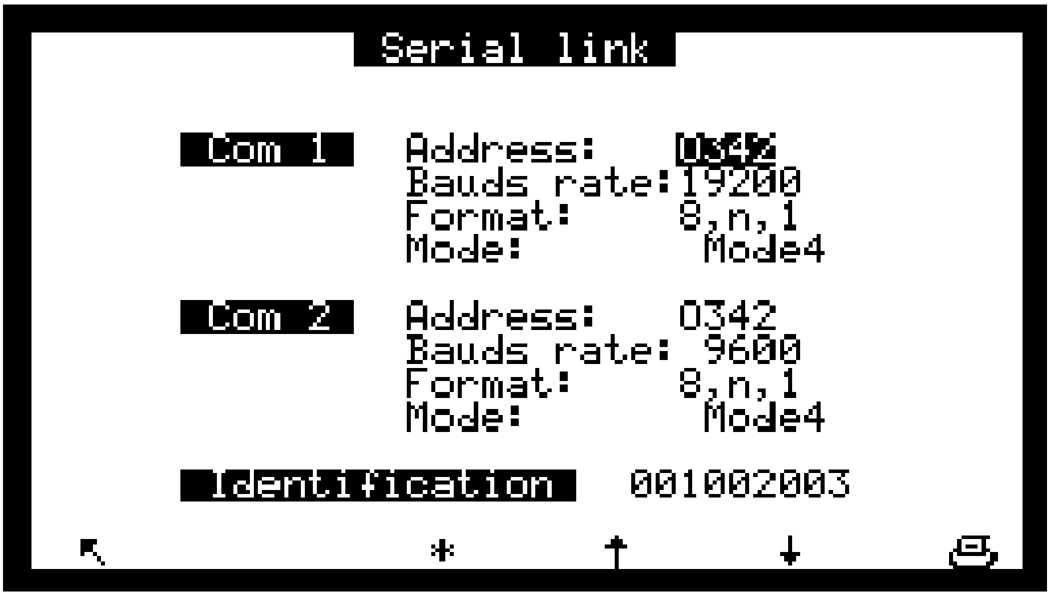
This screen is used to configure the Serial links (COM 1 and 2).

The 9 alphanumeric digits identification is used to define the analyzer code for remote transmission or when the instrument is integrated into a network.

The baud rate, format and communication modes of the 2 channels are programmable among:

- Baud rate: 1200, 2400, 4800, 9600, 19200, 38400 (limited to 19200 bds at present time)
- Format : 7n1, 7o1, 7e1, 7n2, 7o2, 7e2, 8n1, 8o1, 8e1, 8n2, 8o2, 8e2
- Communication mode: Mode 4, impress. to send measurements to printer in real time, Jbus, Special1, and Special2.

The field identification allows to program the analyzer identification when Jbus mode is used.

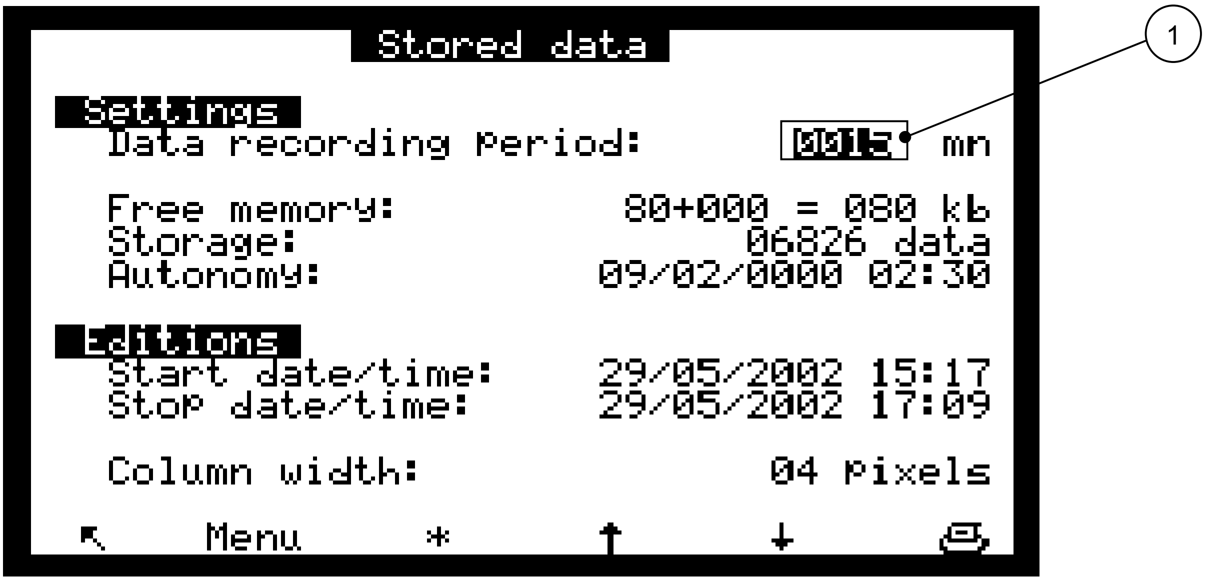


3.3.4.10 CONFIGURATION ⇨ Factory settings.

When this item is selected, pressing down the ↵ key displays the screen shown here below:

3.3.5 STORED DATA

The access to stored data management is directly done from Main Menu. The stored data consists in the average of analyzer measurements within a defined time interval.



This screen allows to parameter data recording period from 1 to 1440 min (i.e. 24 hours) and informs about memory status:

NOTE : Free memory: from 80 Ko in standard operation, it can be increased to 464 Ko in adding a 384 Ko memory board (optional). This board is automatically detected when switching on the analyzer and it is indicated on the screen (1).

NOTE : Storage : it is the possible records number, it depends on free memory

NOTE : Autonomy: it is the duration (days number, months number, years number, hours, minutes) while memory can store data, considering free space and data recording period. In the here-above example: 9 days, 2 month, 0 year, 2 hours, 30 minutes.

Data can be edited in the form as table or histogram: this screen allows to program date and hour of edition beginning, date and hour of edition end, histogram column width.

Menu key gives access to data display, printing functions, and memory reset-to-zero.

Stored data edition in tabular form

This screen presents stored data list according to parameters defined in the screen before. The running mode (measurement, zero, calibration…), during a memorization period, is coded in the status column. The status codes meaning are:

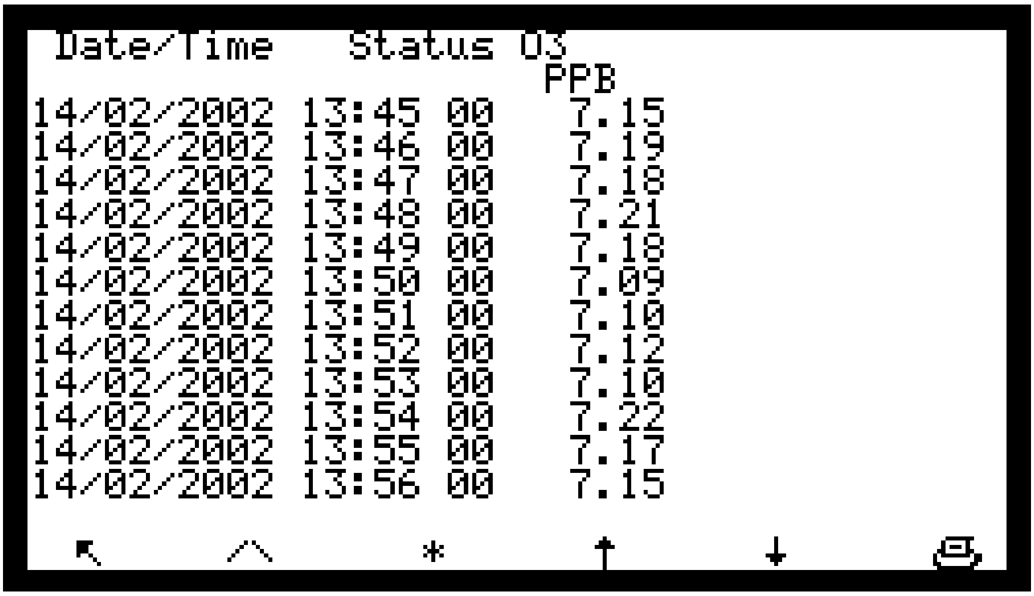
00	Measurement valid
01	Range 2 over shooting
02	General alarm
04	Calibration fault
08	Zero measurement
10	Span measurement
20	Maintenance
40	Less than 2/3 of valid measurements during the average period
80	Power supply failure
FF	Configuration modification

The displayed status code corresponds to the summation of the status codes (hexadecimal numbers) that occurs during the memorization period.

Example: with an average period of 20 min:

5 min zero and 15 min measurement give the 00 status code and the displayed average is the 15 min. measurement average.

11 min. zero and 9 min. measurement give the 08 status code and the displayed average is the 11 min. zero average.

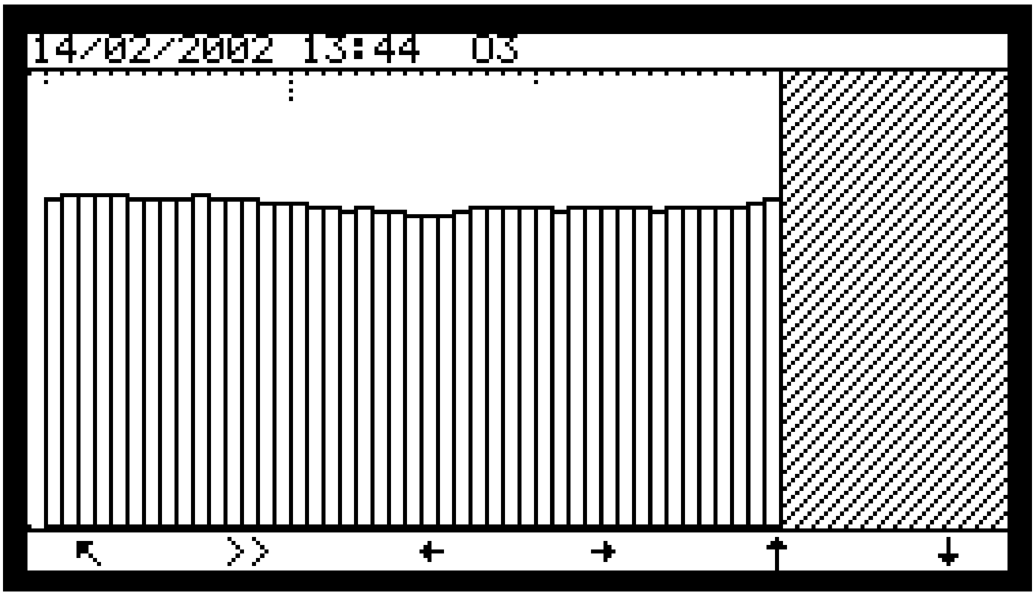


Definition of the specific keys to this screen:

↑ ↓	Select the previous or the next page.
^	Select stored data beginning or end.
*	Display the other measurement channels if more than 3 channels are programmed in *CONFIGURATION* ⇨ *Measure channels* screen

Stored data edition in the form as histogram

This screen displays records in the form as columns; each column corresponds to the measurements average within the data-recording period as defined in *STORED DATA* screen*.* Only one channel is displayed at once. The information line gives first record date and hour, the channel name, and, alternatively blinking, full scale with unit, and data recording period.



Definition of the specific keys to this screen

↖ Return to previous menu.

← Display previous stored data plotting.

→ Display next stored data plotting.

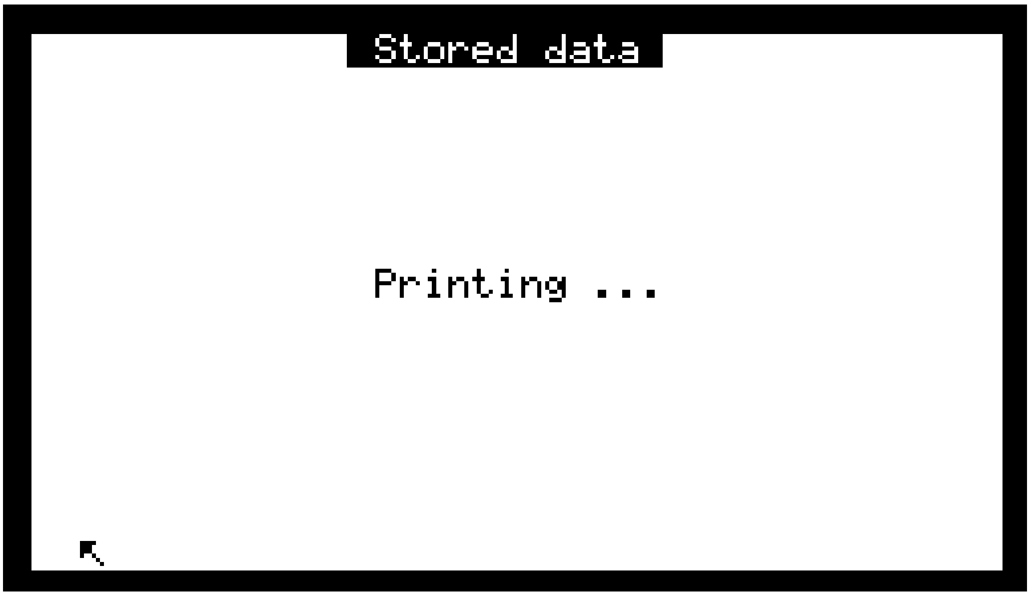
↑ X 2 zoom in.

↓ X 2 zoom out.

>> Select the next measure channel, when more than one measure channel is programmed.

Stored data printing

To print data, press down the Print key found in "Menu" function of "Memorized data" screen. The blinking message "Printing …" indicates printed data output. Data printing can be suspend at any time, pressing down F1 key. When printing is finished, the screen displays the message "Printing finished". When none communication port is programmed on printer output (serial port), the error message "Printing not set" is displayed.



```
O342M[1.19]
25-08-2001
                  O3      MX06     MX13
HH:MN status  PPB     hPa      °C
10:15   000   14.7    1001.7   39.4
10:30   000   21.7    1001.4   39.5
10:45   000   21.4    1002.1   39.4
11:00   000   17.9    1002.6   39.4
11:15   000   16.0    1002.4   39.4
11:30   000   14.7    1000.7   39.4
11:45   000   13.9    1001.4   39.4
12:00   000   13.5    1002.1   39.5
12:15   000   12.0    1001.8   39.4
12:30   000   12.9    1001.6   39.3
12:45   000   12.7    1001.1   39.2
13:00   000   12.3    1000.8   39.1
13:15   000   11.8    1001.0   39.0
13:30   000   10.6    1001.3   38.9
13:45   000   9.2     1001.5   38.7
14:00   000   8.5     1001.8   38.7
14:15   000   8.0     1002.1   38.5
14:30   000   7.7     1002.3   38.3
14:45   000   6.8     1002.5   38.2
15:00   000   7.6     1002.6   38.1
15:15   000   7.5     1002.4   38.0
-----------------------------------------
15:45   000   8.1     1002.4   37.9
16:00   000   8.5     1002.3   37.5
16:15   000   8.5     1002.6   37.5
16:30   000   8.7     1002.6   37.7
16:45   000   9.1     1002.5   37.8
17:00   000   9.2     1001.8   37.9
17:15   000   9.2     1002.4   38.0
17:30   000   9.0     1002.2   37.9
17:45   000   9.1     1002.0   37.9
```

Figure 3-5 - Printout example

Memory reset to zero

Pressing down the Reset key allows to empty storage memory. **This action is irreversible**: before to do it, the software asks you to confirm. If your answer is "YES", the software resets end edition dates and hours to the current dates and hours.

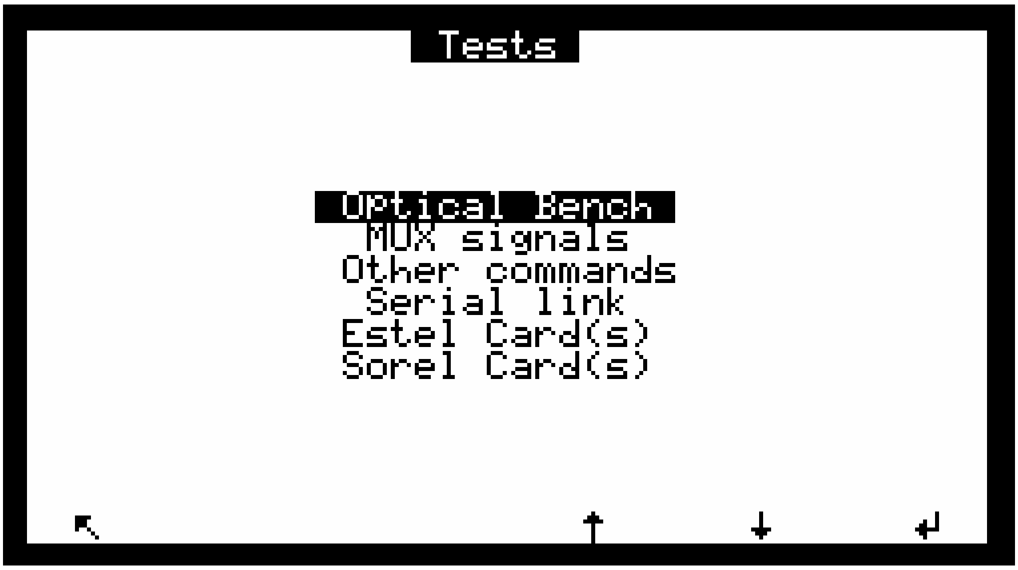
3.3.6 TEST

This screen gives access to the following functions:

Optical and flow parameters checking when maintenance operations occur.

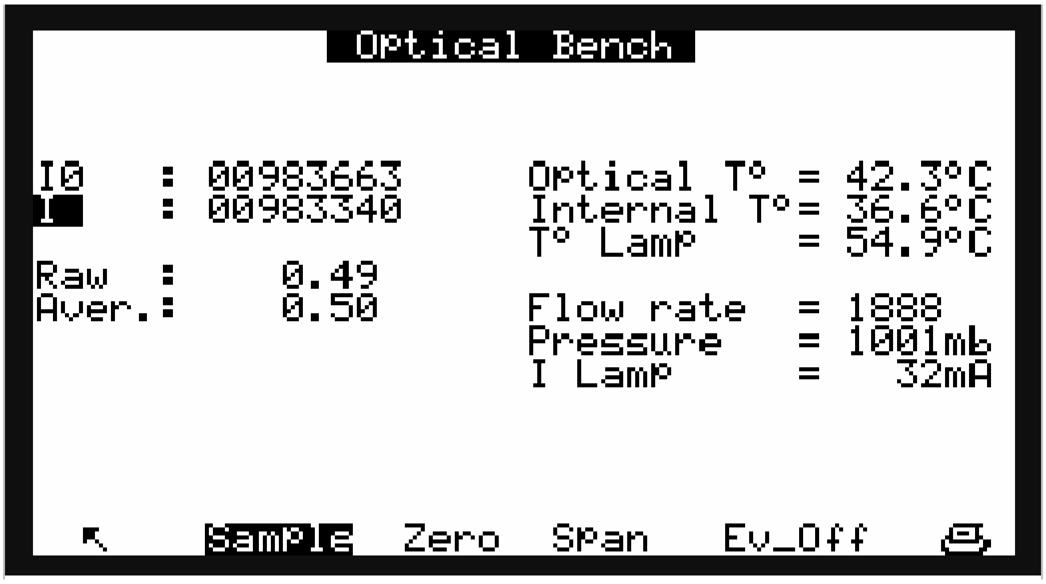
Serial link checking.

Checking of the ESTEL board working (when option available)



3.3.6.1 TEST ⇨ Optical bench

This screen is used to follow-up the measurement parameters periodically or occasionally.



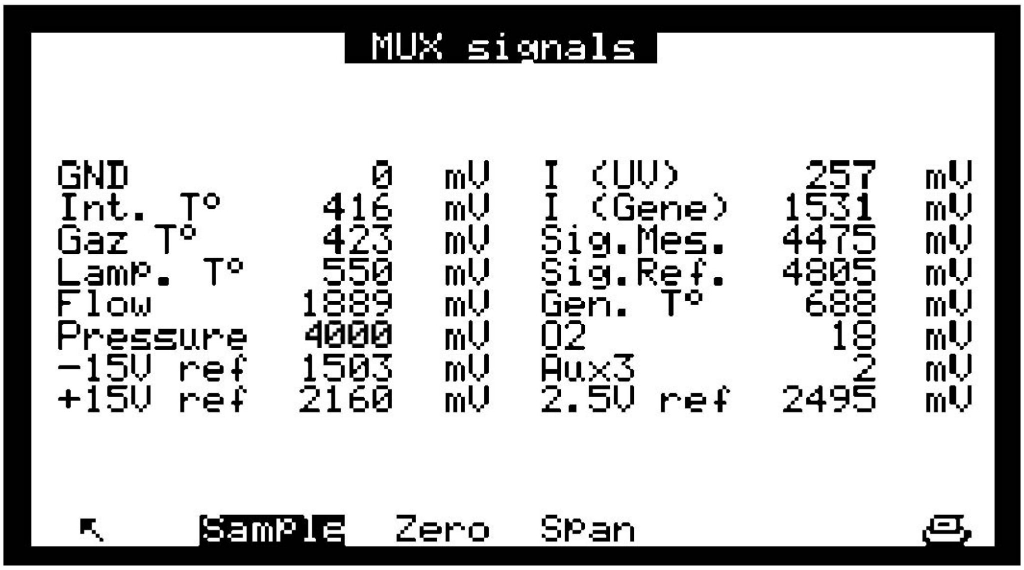
Definition of the specific keys of this screen

Sample Zero Span have the same function as the screen *Measurement ⇨ Instantaneous*.

EV-OFF Allows to control solenoid valve manually.

3.3.6.2 TEST ⇨ MUX Signals

This screen is used to check the multiplexer signals.



Definition of the specific keys of this screen

For this screen the Sample Zero Span keys have the same function as the screen *Tests ⇨ Optical bench*.

NOTE : The "XXXX mV" displayed values will be checked according to the acceptable limits in next table.

Table 3-2 - MUX signals (Acceptable limits on the multiplexer 1 to 16 channels)

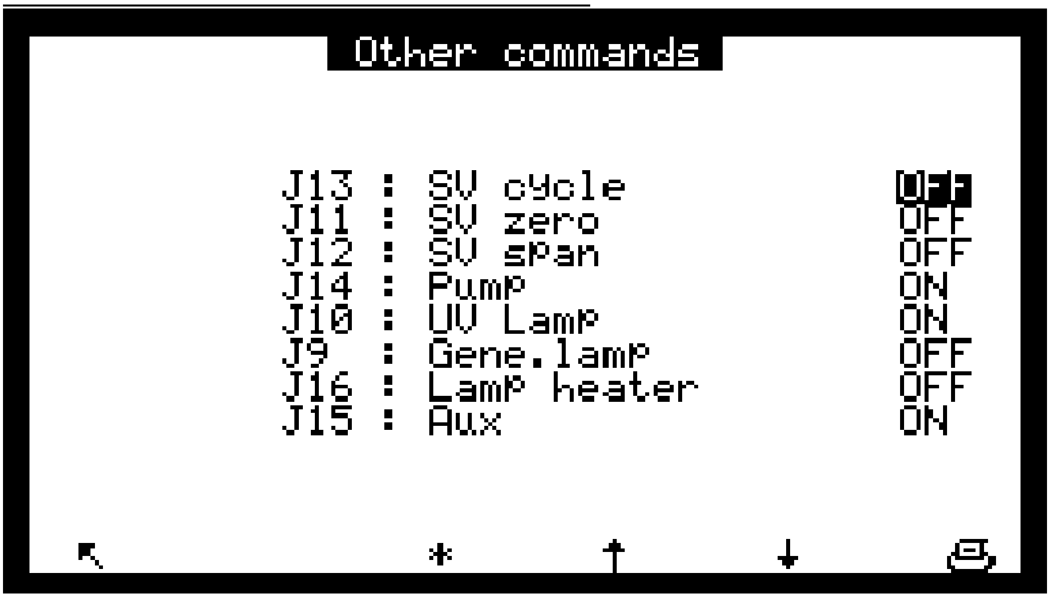
Channel	Display	Parameters	Lower Limit	Typical	Upper limit
1	GND	Analog ground	0 mV	0 mV	+ 10 mV
2	Int. T°	Internal temperature of the analyzer	100 mV	_	600 mV
3	Lamp. T°	Measurement UV lamp temperature regulation	500 mV	550 mV	600 mV
4	Gas T°	Gas temperature at measurement chamber output.	100m V	_	500 mV
5	Flow	Voltage provided by flow rate sensor placed at measurement chamber output.	1500 mV	2000 mV	2500 mV
6	Pressure	Vacuum pressure inside the measurement chamber	3000 mV	4000 mV	5000 mV
7	-15 V ref	-15 V power supply	-1600 mV	1500 mV	- 1200 mV
8	+15 V ref	+15 V power supply	1200 mV	1500 mV	1600 mV
9	I (UV)	Average current in UV lamp	0100 mV	0185 mV	0250 mV
10	I (Gene)	Optional ozone generator UV lamp current	–	_	–
11	Sig. Mes.	UV measurement detector signal	500 mV	4000 mV	4800 mV
12	Sig. Ref.	UV reference detector signal	500 mV	4500 mV	4800 mV
13	Gen. T°C	Generator temperature (option)	550 mV	595 mV	650 mV
14	O2	Option	_	_	_
15	Aux3	Aux3	_	_	_
16	2.5 V ref.	Check of the analog / digital converter	2400 mV	2500 mV	2600 mV

3.3.6.3 TEST ⇨ Other commands

STOP

The selection of this menu makes ineffective some controls. When the instrument is again in measurement mode, some alarms could occur.

This screen is used to check that the MODUL board is working correctly.



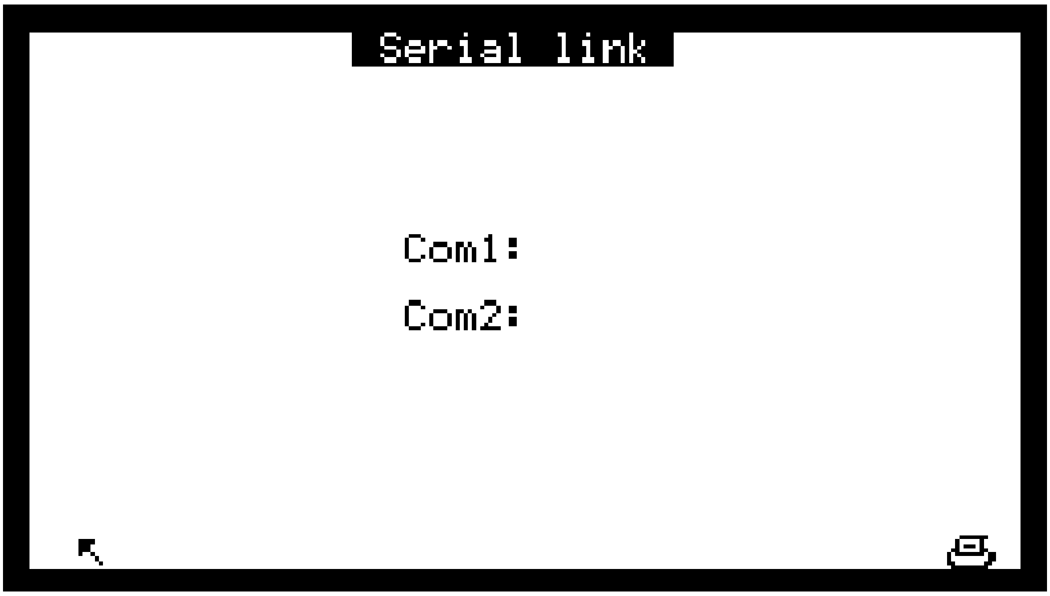
Jxx refers to the module board connector numbers.

↑ ↓ ✳ are used to change status.

3.3.6.4 TEST ⇨ Serial link

This screen permits to check the serial link and shows the inputs / outputs which have to be strapped when the serial link is not connected and you still want to check it

2-3: Emission/Reception, 4-6 and 7-8: modem signals.



3.3.6.5 TEST ⇨ ESTEL Card(s)

This screen is only displayed when the option is available.

It is used to set the analog outputs and to monitor the working state of the remote controls and analog inputs.

The “Estel card Nb:” field is used to select the board to be tested.

The “DA.C” fields are used to program the number of points generated at analog output.

The “Ax + B” fields are used to program the span factors of each output. These factors are calculated according to the value measured at the output.

Example: for a 0-1000mV output, the point value is $\frac{1000}{4000}$=0.25mV .

3000 points give 3000x0,25=750mV as theoretical value.

760 mV measured at the output imply a k factor = $\frac{750}{760}$ = 0,987

The “Out” fields are used to control the relays manually.

The "AD.C" & "Rem" fields are used to read the status of these inputs.

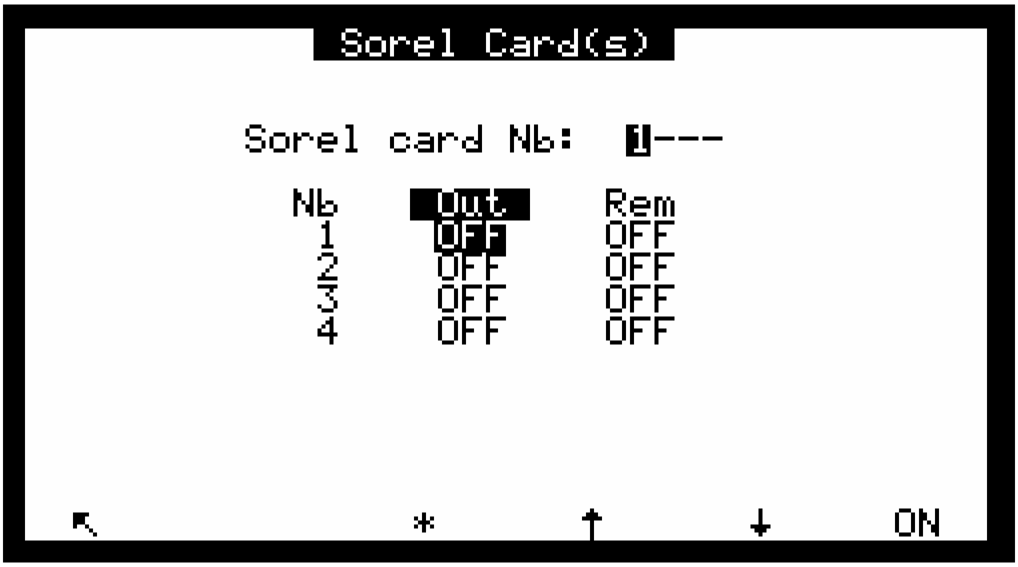
Definition of the specific keys to this screen

0/OFF Gives 0 pt on all the analog outputs and opens all relays contacts.

4000/ON Gives the full scale (4000 pts) on all analog outputs and closes all relays contacts.

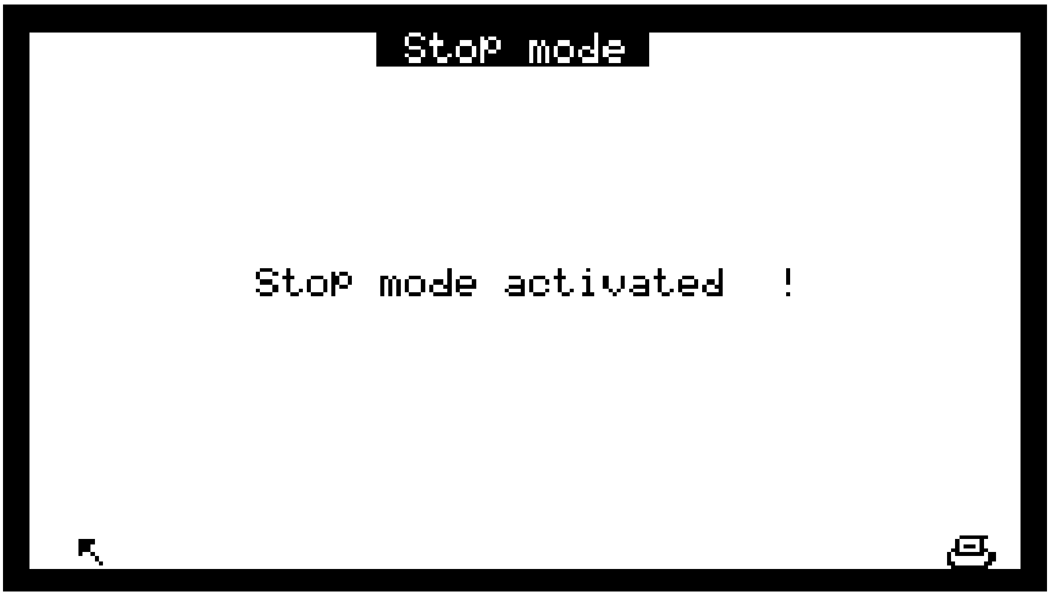
3.3.6.6 TESTS ⇨ SOREL board

This screen is only displayed when the option SOREL board is available. It enables to check manually the relays and remote controls of this board.



The "Sorel card Nb:" field enables to select what Sorel board to check (when several boards of this type are available in the device).

3.3.7 STOP MODE



Stop mode is used to put pumping unit off, all the other regulations keep on operation. To activate again measurement mode, you need to go back to menu measurement, select and input Measurement mode.

3.4 CALIBRATION

IMPORTANT NOTICE:

Use of the analyzer, as an equivalent method for EPA reporting, requires periodic multipoint calibration and subsequent zero / span checks as described below. All gases for calibration must be traceable to a reference photometer.

3.4.1 OVERVIEW OF CALIBRATION AND CONCEPTS

To ensure the accuracy of the measurements performed using the O342M monitor, the unit must be regularly checked, calibrated and adjusted, following the quality assurance plan of the user.

– Zero and span check :

This operation consists of comparing the monitor response, for zero air and a span point of the range used, to the gas standards used. This check is used to measure the monitor drift in time without modifying the span coefficient (K span). This check can be performed using the internal zero air and span gas from the optional ozone generator.

Periodicity: generally 24 hours in automatic cycle mode.

– Span adjustment or two point calibration :

This procedure is used to check and correct the monitor response to the zero and a span point located at about 80 % of the full scale of the measurement range used.

Periodicity: weekly or less frequently if the installation allows it or depending on the quality assurance plan of the user.

– Multipoint calibration :

This involves a more complete check up of the monitor performance characteristics including linearity.

Periodicity: quarterly or depending on quality assurance plan of the user, or following out-of-tolerance calibration check results requiring an intervention on the monitor or following installation or re-installation of the monitor.

3.4.1.1 Zero air generation

Purified air, dried and free of any traces of ozone (< 2 ppb), connected to zero air inlet of analyzer (with optional zero solenoid valve, option "Span External Control"), or directly to the sample gas inlet, at atmospheric pressure. Zero air should also be free of any substances potentially absorbing at 254 nm (such as Benzene or other aromatics) and of any substances reacting with Ozone (such as NO and C_2H_4).

This can be obtained using one of the following methods:

- A zero air generator with ozonizer, activated charcoal and molecular sieve (type JPAG / INSAT).
- A cylinder of reconstituted pure air.
- A set of filtering columns (see Figure 3-6) made of inert material and whose efficiency is periodically checked by comparison to a zero air generator, at the time of a multipoint calibration (for zero and span checks and 2 points calibration only).

These filtering columns contain: 450 cc silicagel and 450 cc activated vegetable charcoal (grain 22-631-362)

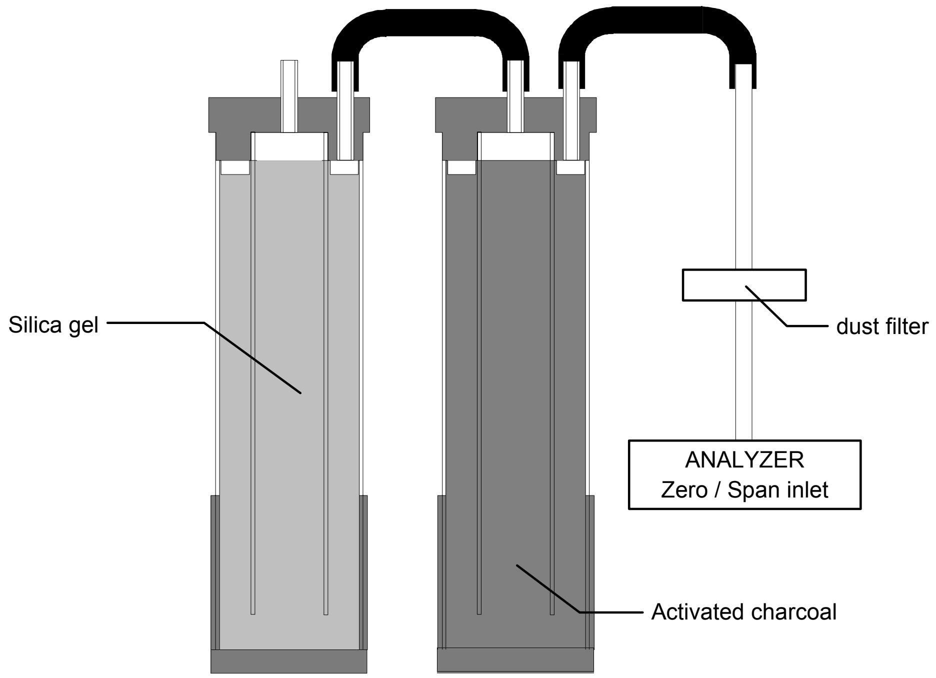


Figure 3-6 - Filtering columns

3.4.1.2 Ozone standard generation

Use one of the three methods below, depending on the application:

- A complete calibration system containing a photometer :

This apparatus is described in § 3.4.1.3.

It is possible to use a modified version of the $O_3$42M ($O_3$42M/C) and a source of pressurized dry clean air to comply with the requirements for an ozone calibration system. Note however that such a photometer must never be used to sample ambient air and must always be used with dry clean air.

- A certified ozone transfer standard :

A transfer standard is certified by relating the output of the transfer standard to one or more ozone standards. The exact procedure varies depending on the nature and design of the transfer standard. Consult Reference 8 of appendix 6.1 for guidance.

- An internal ozone generator of the analyzer (for span checks only).

3.4.1.3 Description of a complete calibration apparatus

A complete UV calibration system consists of an ozone generator, an output port or manifold, a photometer, an appropriate source of zero air, and other components as necessary. The configuration must provide a stable ozone concentration at the system output and allow the photometer to accurately assay the output concentration to the precision specified for the photometer (see 3.4.1.3.1). Figure 3-7 shows a commonly used configuration and serves to illustrate the calibration procedure which follows. Other configurations may require appropriate variations in the procedural steps. All connections between components in the calibration system downstream of the O_3 generator should be of glass, Teflon, or other relatively inert materials. Additional information regarding the assembly of a UV photometric calibration apparatus is given in Reference 9 of appendix 7.13. For certification of transfer standards which provide their own source of O_3, the transfer standard may replace the O_3 generator and possibly other components shown in Figure 3-7. See Reference 8 of appendix 6.1 for guidance.

3.4.1.3.1 UV photometer

The photometer consists of a low-pressure mercury discharge lamp, (optional) collimation optics, an absorption cell, a detector, and signal-processing electronics, as illustrated in Figure 3-7. It must be capable of measuring the transmittance, I/I_0, at a wavelength of 254 nm with sufficient precision such that the standard deviation of the concentration measurements does not exceed the greater of 0.005 ppm or 3% of the concentration. Because the low-pressure mercury lamp radiates at several wavelengths, the photometer must incorporate suitable means to assure that no O_3 is generated in the cell by the lamp, and that at least 99.5% of the radiation sensed by the detector is 254 nm radiation. (This can be readily achieved by prudent selection of optical filter and detector response characteristics). The length of the light path through the absorption cell must be known with an accuracy of at least 99.5%. In addition, the cell and associated plumbing must be designed to minimize loss of O_3 from contact with cell walls and gas handling components. See Reference 9 of appendix 6.1 for additional information

3.4.1.3.2 Air flow controllers

Devices capable of regulating air flows as necessary to meet the output stability and photometer precision requirements.

3.4.1.3.3 Ozone generator

Device capable of generating stable levels of O_3 over the required concentration range.

3.4.1.3.4 Output manifold

The output manifold should be constructed of glass, Teflon, or other relatively inert material, and should be of sufficient diameter to insure a negligible pressure drop at the photometer connection and other output ports. The system must have a vent designed to insure atmospheric pressure in the manifold and to prevent ambient air from entering the manifold.

3.4.1.3.5 Two-way valve

Manual or automatic valve, or other means to switch the photometer flow between zero air and the O_3 concentration.

3.4.1.3.6 Temperature indicator

Accurate to ±1 °C.

3.4.1.3.7 Barometer or pressure indicator

Accurate to ±2 torr.

3.4.1.3.8 Option 1

The various O_3 concentrations required in steps 11 of § 3.4.1.5 and 3.a of § 3.4.4.3 may be obtained by dilution of the O_3 concentration generated in steps 6 of § 3.4.1.5 and 2.b of § 3.4.4.3. With this option, accurate flow measurements are required. The dynamic calibration system may be modified as shown in Figure 3-8 to allow for dilution air to be metered in downstream of the O_3 generator. A mixing chamber between the O_3 generator and the output manifold is also required. The flow rate through the O_3 generator (F_0) and the dilution airflow rate (F_D) are measured with a reliable flow or volume standard traceable to NBS. Each O_3 concentration generated by dilution is calculated from:

$$[O_3]'_{OUT} = [O_3]_{OUT} \left(\frac{F_0}{F_0 + F_D} \right)$$

where:

$[O_3]'_{OUT}$ = diluted O_3 concentration, ppm

F_0 = flow rate through the O_3 generator, liter/min

F_D = diluent air flow rate, liter/min

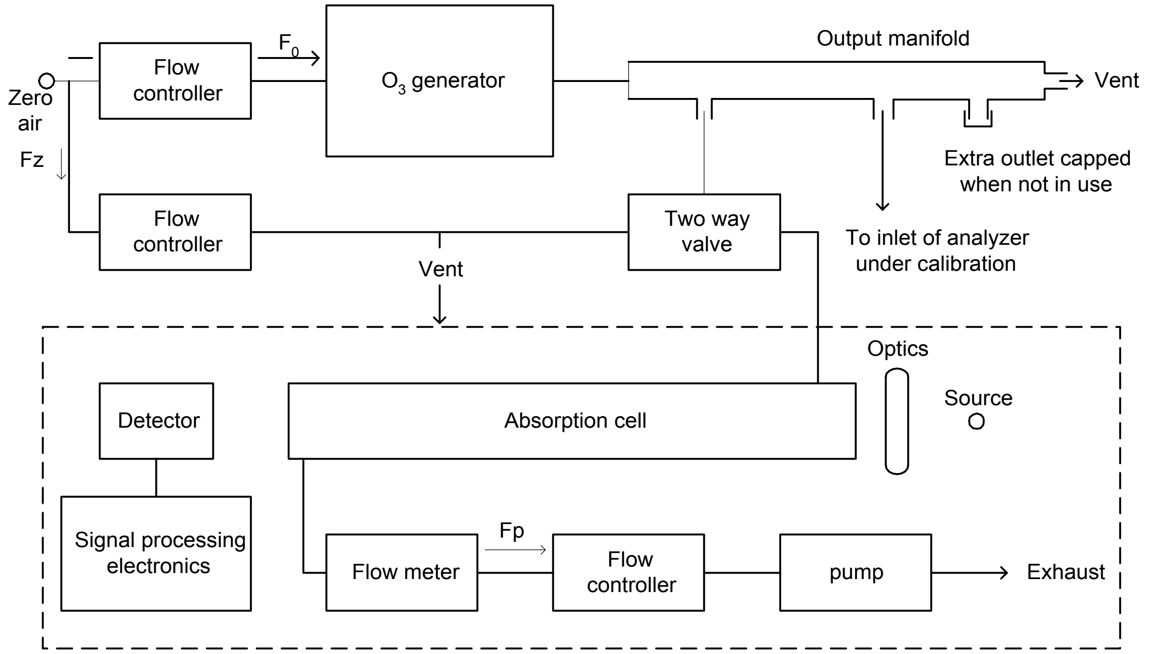


Figure 3-7 - Schematic diagram of a typical UV photometric calibration system (1)

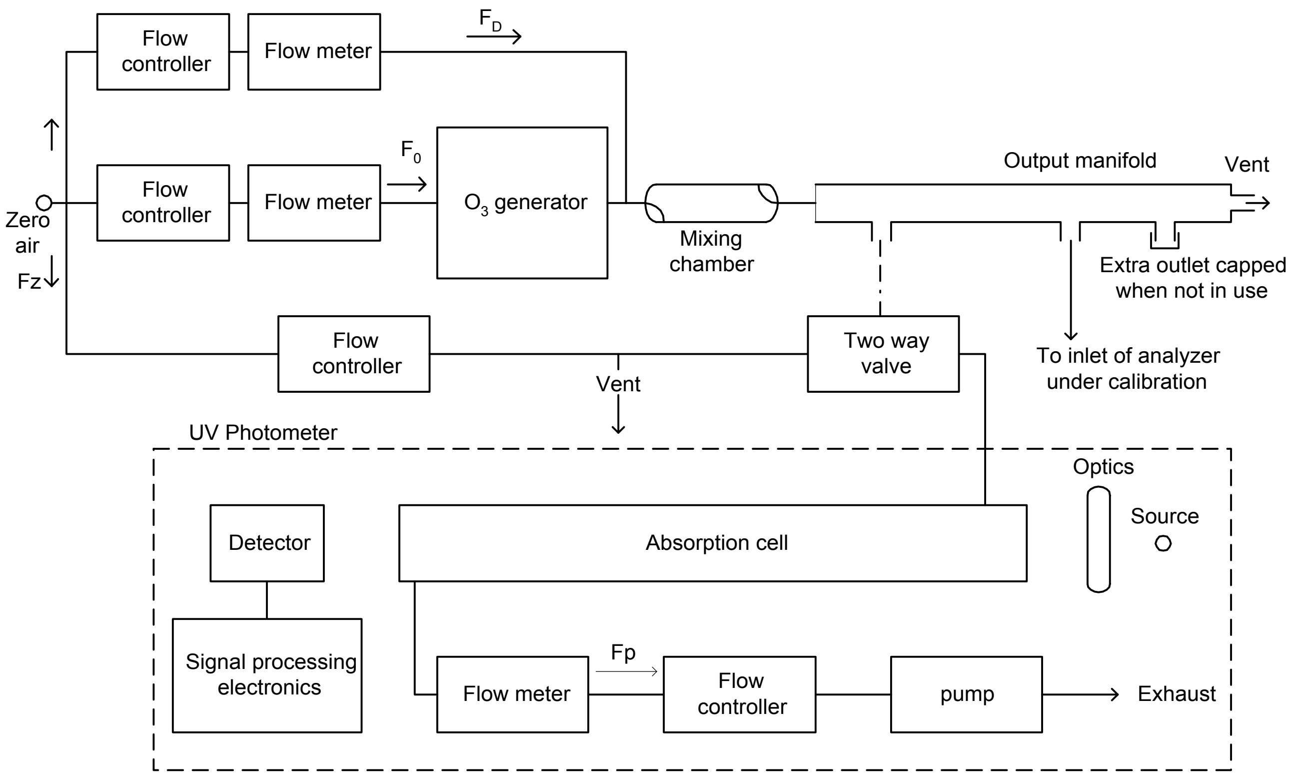


Figure 3-8 - Schematic diagram of a typical UV photometric calibration system (2)

3.4.1.4 Preparation and verification of calibration apparatus

3.4.1.4.1 General operation :

The calibration photometer must be dedicated exclusively to use as a calibration standard. It should always be used with clean; filtered calibration gases, and never used for ambient air sampling. Consideration should be given to locating the calibration photometer in a clean laboratory where it can be stationary, protected from physical shock, operated by a responsible analyst, and used as a common standard for all field calibrations via transfer standards.

3.4.1.4.2 Preparation :

Proper operation of the photometer is of critical importance to the accuracy of this procedure. The following steps will help to verify proper operation. The steps are not necessarily required prior to each use of the photometer. Upon initial operation of the photometer, these steps should be carried out frequently, with all quantitative results or indications recorded in a chronological record either in tabular form or plotted on a graphical chart. As the performance and stability record of the photometer is established, the frequency of these steps may be reduced consistent with the documented stability of the photometer.

b.1) Instruction manual:

Carry out all set up and adjustment procedures or checks as described in the operation or instruction manual associated with the photometer.

b.2) System check:

Check the photometer system for integrity, leaks, cleanliness, proper flow rates, etc. Service or replace filters and zero air scrubbers or other consumable materials, as necessary.

b.3) Linearity:

Verify that the photometer manufacturer has adequately established that the linearity error of the photometer is less than 3%, or test the linearity by dilution as follows: Generate and assay an O_3 concentration near the upper range limit of the system (0.5 or 1.0 ppm), then accurately dilute that concentration with zero air and assay it again. Repeat at several different dilution ratios. Compare the assay of the original concentration with the assay of the diluted concentration divided by the dilution ratio, as follows:

$$E = \frac{A_1 - A_2 / R}{A_1} \times 100\%$$

where:
E = linearity error, percent
A_1 = assay of the original concentration
A_2 = assay of the diluted concentration
R = dilution ratio = flow of original concentration divided by the total flow

The linearity error must be less than 5%. Since the accuracy of the measured flowrates will affect the linearity error as measured this way, the test is not necessarily conclusive. Additional information on verifying linearity is contained in Reference 9 of appendix 7.13.

b.4) Intercomparison :

When possible, the photometer should be occasionally intercompared, either directly or via transfer standards, with calibration photometers used by other agencies or laboratories.

b.5) Ozone losses:

Some portion of the O_3 may be lost upon contact with the photometer cell walls and gas handling components. The magnitude of this loss must be determined and used to correct the calculated O_3 concentration. This loss must not exceed 5%. Some guidelines for quantitatively determining this loss are discussed in Reference 9 of appendix 7.13.

3.4.1.5 Assay of O_3 concentrations using a photometer

To generate and assay the ozone concentrations using a photometer or a complete calibration apparatus, follow the procedure below.

- (1) Allow the photometer system to warm up and stabilize.
- (2) Verify that the flowrate through the photometer absorption cell, F allows the cell to be flushed in a reasonably short period of time (2 liter/min is a typical flow). The precision of the measurements is inversely related to the time required for flushing, since the photometer drift error increases with time.
- (3) Insure that the flowrate into the output manifold is at least 1 liter/min greater than the total flowrate required by the photometer and any other flow demand connected to the manifold.
- (4) Insure that the flowrate of zero air, F_Z, is at least 1 liter/min greater than the flowrate required by the photometer.
- (5) With zero air flowing in the output manifold, actuate the two-way valve to allow the photometer to sample first the manifold zero air, then F_Z. The two photometer readings must be equal ($I = I_0$).

NOTE : In some commercially available photometers, the operation of the two-way valve and various other operations of this section (3.4.1.4) may be carried out automatically by the photometer.

- (6) Adjust the O_3 generator to produce an O_3 concentration as needed.
- (7) Actuate the two-way valve to allow the photometer to sample zero air until the absorption cell is thoroughly flushed and record the stable measured value of I_0.
- (8) Actuate the two-way valve to allow the photometer to sample the ozone concentration until the absorption cell is thoroughly flushed and record the stable measured value of I.
- (9) Record the temperature and pressure of the sample in the photometer absorption cell. (See Reference 9 of appendix 6.1 for guidance).
- (10) Calculate the O_3 concentration from the equation below. An average of several determinations will provide better precision.

$$[O_3]_{OUT} = \left(\frac{-1}{\alpha l} \ln \frac{I}{I_0}\right)\left(\frac{T}{273}\right)\left(\frac{760}{P}\right) x \frac{10^6}{L}$$

where:

$[O_3]_{OUT}$ = O_3 concentration, ppm

α = absorption coefficient of O_3 at 254 nm = 308 atm^{-1} cm^{-1} at 0 °C and 760 torr

l = optical path length, cm

T = sample temperature, K

P = sample pressure, torr

L = correction factor for O_3 losses from § 3.4.1.4.b 5 = (1-fraction O_3 lost).

NOTE : Some commercial photometers may automatically evaluate all or part of the equation above. It is the operator's responsibility to verify that all of the information required for this equation is obtained, either automatically by the photometer or manually. For "automatic" photometers which evaluate the first term of the equation above based on a linear approximation, a manual correction may be required, particularly at higher O_3 levels. See the photometer instruction manual and Reference 9 of appendix 6.1 for guidance.

NOTE : Model $O_3$42M/C uses the exact formula (no linear approximation to replace the logarithm) for calculating $[O_3]_{OUT}$.

- (11) Obtain additional O_3 concentration standards as necessary by readjusting the ozone generator and following all the steps (6) to (10) described above or by dilution (see Option 1 in § 3.4.1.3.h)

3.4.1.6 Internal valve for zero and span switching (see Erreur! Source du renvoi introuvable.)

This feature is provided with the option "span external control".

When performing a multipoint calibration the user should connect the zero and span gas sources to the sample gas inlet. After this calibration the zero and span sources should be connected to the corresponding inlets of the analyzer. The $O_3$42M should give identical responses whether the sources are connected to the sample or the zero and span inlets of the analyzer. If not then internal valves should be serviced. Subsequently internal valves can be used for zero and span checks and two point calibrations.

3.4.2 ZERO AND SPAN CHECK

3.4.2.1 Equipment required

– zero air :

Use any of the methods described in paragraph 3.4.1.1.

– Span point :

Use any of the methods described in paragraph 3.4.1.2.

3.4.2.2 Procedure

– Zero check

- With standard $O_3$42M, apply zero gas to sample gas inlet at atmospheric pressure.
- For $O_3$42M with zero / span solenoid valve option or internal Ozone generator option, apply zero gas to zero inlet and use zero key to select the zero air inlet on analyzer.

Wait for measurement to stabilize. The measurement should be within ± 5 ppb of zero.

– Check of span point

Use one of the methods described in paragraph 3.4.1.2 to generate ozone.

Apply ozone to the inlet of the analyzer at atmospheric pressure.

Wait for the reading to stabilize.

The reading under span minus reading under zero air should be within 10% of generated concentration. Otherwise check quality of zero and span gases, leaks in generation system and pressure at analyzer inlet. If everything is correct then perform a two point calibration.

3.4.2.3 Use of automatic cycles

This procedure cannot be used to adjust the zero or calibration coefficients.

To program the cycles, see menu *Span ⇨ Cycles* paragraph 3.3.3.3.

– Zero cycle (zero/span solenoid valve option) :

The zero air generator is permanently connected to the monitor zero/span gas inlet. The recommended duration of the zero check is 600 seconds.

– Span check cycle :

The span point generator is permanently connected to the monitor zero/span gas inlet. The generated concentration must be below the full scale of the range used for the measurement. The recommended duration of the check is 600 seconds.

NOTE : The zero gas and calibration gas must both be supplied to the zero/span inlet one after the other at atmospheric pressure. This can be automatized since the analyzer features two, zero and span, control contacts accessible on the rear panel (see table 3.1).

3.4.3 TWO POINT CALIBRATION

3.4.3.1 Equipment required

– Zero air

Use one of the methods described under paragraph 3.4.1.1

– Span point

Use one of the first two methods described under paragraph 3.4.1.2

CAUTION : Materials in contact with zero or span gases must be made of Teflon, glass or other inert material.

3.4.3.2 Procedure

- (1) Allow sufficient time for the O_342M analyzer and the photometer or the transfer standard to warm-up and stabilize.
- (2) Allow the analyzer to sample zero air until a stable reading is obtained and adjust the analyzer zero control using procedure described in paragraph 3.3.4 It can be useful to offset the analyzer reading using procedure described in paragraph 3.3.4.3 to facilitate observing negative values. Note the obtained reading as [Z].
- (3) Generate an ozone concentration standard, $[O_3]_{OUT}$, of approximately 80% of the full scale of the range used. Allow the O_342M to sample this ozone concentration standard until a stable reading is obtained. Note the obtained reading as $[O_3]_{READ}$.
- (4) Adjust the analyzer's span as described in § 3.2.3.1 following the formula :

$$K(SPAN)_{NEW} = K(SPAN)_{OLD} \bullet \left(\frac{[O3]_{READ} - Z}{[O3]_{OUT}} \right)$$

NOTE : The factory setting for K span is usually 12554. Should the results of the calibration lead to a deviation from this value of more than ±5%, then extreme care has to be exercised in re-checking the whole process since such a result is likely to be inconsistent.

- Check the quality of zero air.
- Check certification of Ozone transfer (if applicable) and construction and set up of calibration apparatus.
- Check for leaks.
- Check for appropriate pressure at the used inlet of the analyzer.
- If everything is correct and proper maintenance has been performed on the analyzer, then perform a complete multipoint calibration to ascertain the linearity.

3.4.4 MULTIPOINT CALIBRATION

3.4.4.1 Equipment required

– Zero air

use any of the following methods :

- A zero air generator with ozonizer, activated charcoal and molecular sieve (type JPAG / INSAT).
- A cylinder of reconstitued pure air.

– Span gas

Use one of the two methods below :

- A complete calibration system containing a photometer :

This apparatus is described in § 3.4.1.3.

It is possible to use a modified version of the O_342M (O_342M/C) and a source of pressurized dry clean air to comply with the requirements for an ozone calibration system. Note however that such a photometer must never be used to sample ambient air and must always be used with dry clean air.

- A certified ozone transfer standard :

  A transfer standard is certified by relating the output of the transfer standard to one or more ozone standards. The exact procedure varies depending on the nature and design of the transfer standard. Consult Reference 8 of appendix 6.1 for guidance.

3.4.4.2 Overview

Gases will be applied at atmospheric pressure to the sample gas inlet of the analyzer.

Materials in contact with zero or span gases must be made of Teflon, glass or other inert material.

Calibration of the monitor requires precision gas generation of 7 points including zero (example : 0, 15, 30 ,45, 60, 75 and 90% of the full scale of the range used), the dilution carrier gas must be the same as the one used for the zero measurement.

The multipoint calibration consists of 3 steps.

- (1) Install and check ozone generation apparatus.
- (2) Perform a two point calibration procedure (§ 3.4.3.2).
- (3) Generate several ozone concentrations and plot a calibration curve to check linearity.

It is recommended to connect a strip chart recorder to the analog outputs of the analyzer for data gathering and processing. If "RS232-422" option is available, data can be collected by a computer.

3.4.4.3 Procedure

- (1-a) Install and check ozone generation apparatus according to the instruction manual of the ozone standard use for calibration.
- (1-b) Allow sufficient time for the $O_3$42M analyzer and the photometer or the transfer standard to warm-up and stabilize.
- (2-a) Allow the analyzer to sample zero air until a stable reading is obtained and adjust the analyzer zero control using procedure described in paragraph 3.3.4 It can be useful to offset the analyzer reading using procedure described in paragraph 3.3.4.3 to facilitate observing negative values. Note the obtained reading as [Z].
- (2-b) Generate an ozone concentration standard, $[O_3]_{OUT}$, of approximately 80% of the full scale of the range used. Allow the $O_3$42M to sample this ozone concentration standard until a stable reading is obtained. Note the obtained reading as $[O_3]_{READ}$.
- (2-c) Adjust the analyzer's span as described in § 3.3.4 following the formula :

$$K(SPAN)_{NEW} = K(SPAN)_{OLD} \bullet \left(\frac{[O3]_{READ} - Z}{[O3]_{OUT}} \right)$$

- (3-a) Generate several ozone concentrations following the instruction manual of the ozone standard used for the calibration. For each ozone concentration record the corresponding analyzer response.
- (3-b) Plot the $O_3$42M responses versus the corresponding generated O_3 concentrations and draw the analyzer's calibration curve or calculate the appropriate response factor using least squares regression.
- (3-c) Fine adjust the K span factor if necessary according to the result of (3-b).

NOTE : The factory setting for K span is usually 12554. Should the results of the calibration lead to a deviation from this value of more than ±5%, then extreme care has to be exercised in re-checking the whole process since such a result is likely to be inconsistent.

- Check the quality of zero air.
- Check certification of Ozone transfer (if applicable) and construction and set up of calibration apparatus.
- Check for leaks.
- Check for appropriate pressure at the used inlet of the analyzer.
- If everything is correct then the analyzer needs servicing (see chapter 4)

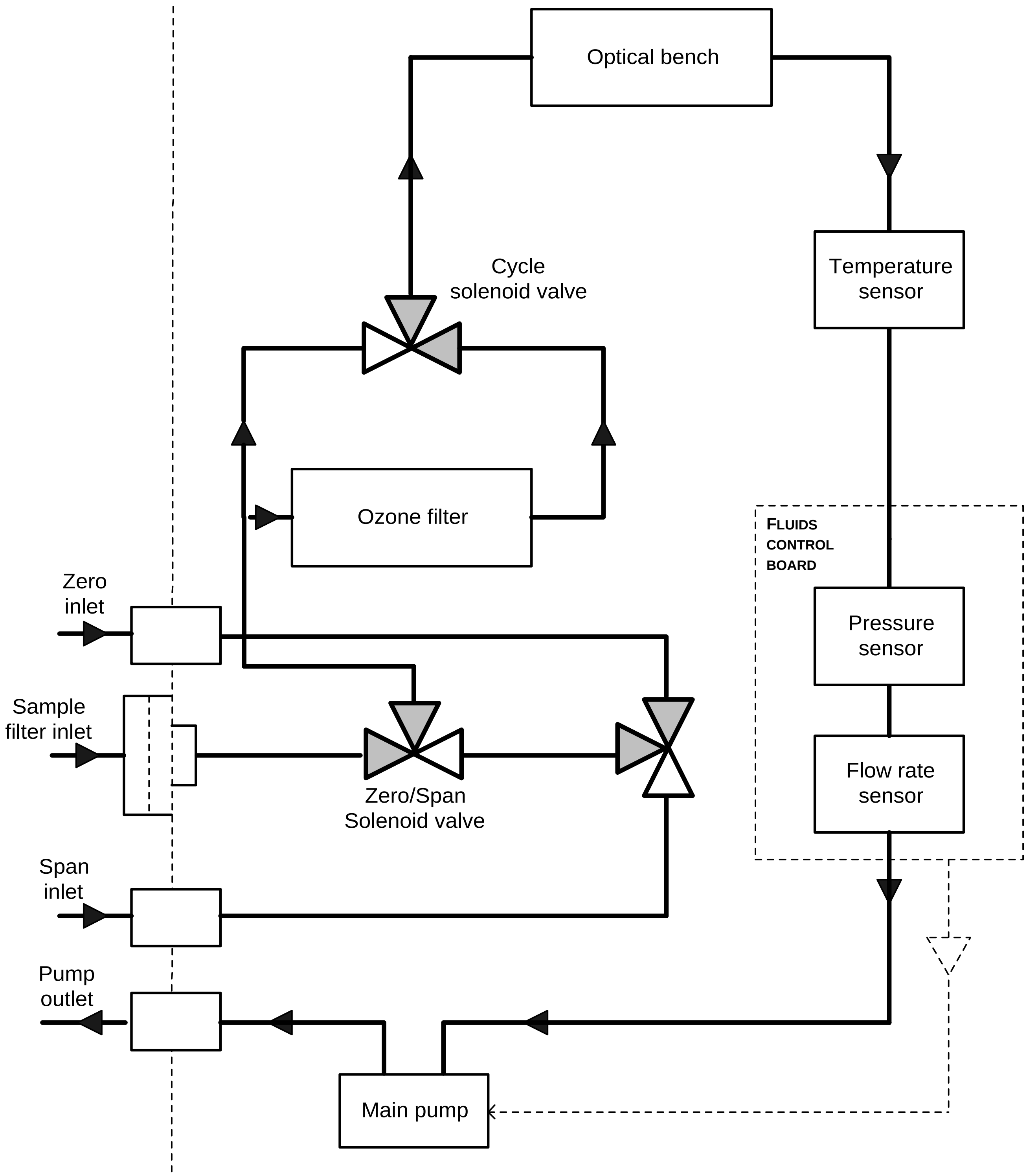


Figure 3–9 - Gas flow system with zero span solenoid valve

3.4.6 INTERNAL OZONE GENERATOR

CAUTION : This feature must not be used for span adjustment in case of reference method analyzer (compliance) monitoring. The span point check can be performed using the internal Ozone generator.

3.4.6.1 General operating principle

The zero air, obtained by filtering the ambient air, is drawned through a chamber containing a low pressure mercury vapor lamp.

This lamp is operated by a current regulated power supply. The temperature of the unit is kept constant.

The 184.9 nm wavelength UV rays emitted by the lamp convert part of the oxygen contained in the zero air into Ozone, through the following reactions :

$$O_2 \xrightarrow{hv} O+O \text{ and } O_2+O \longrightarrow O_3+W$$

A fixed Ozone concentration is therefore distributed between the analyzer optical bench by means of the zero/span solenoid valve and the ozone outlet available on the rear part of the analyzer.

3.4.6.2 Description of the operating mode

See § 3.3.3.2 *SPAN ⇨ O_3 Generator*

3.4.6.3 Remarks on use of Ozone generator as calibration standard

This option should not be used when using analyzer for EPA gathering data.

In principle, the analyzer cannot calibrate itself. It can nevertheless serve as a system for making performance checks.

In any case, some restrictions must be indicated in order to guarantee the highest efficiency of the system :

– high system repeatability, differences not exceeding the highest of the values between ±5% and ±5 ppb, requires operation of lamp under rated conditions, i.e. at a temperature of about 60°C and a regulated supply current of approximately 4 or 10 mA (depending on the UV lamp model). To do this, the required concentrations will preferably be selected within the range of 150 to 250 ppb.

– buildup of a current in the lamp or of large variations in its values lead to a stabilization period not exceeding a few minutes, but can go as high as 2 hours to generate a high concentration (> 500 ppb) the required period to stabilize the temperature of the lamp. This is why it is recommended, when using 10 minutes auto span check, to generate a concentration of about 200 ppb.

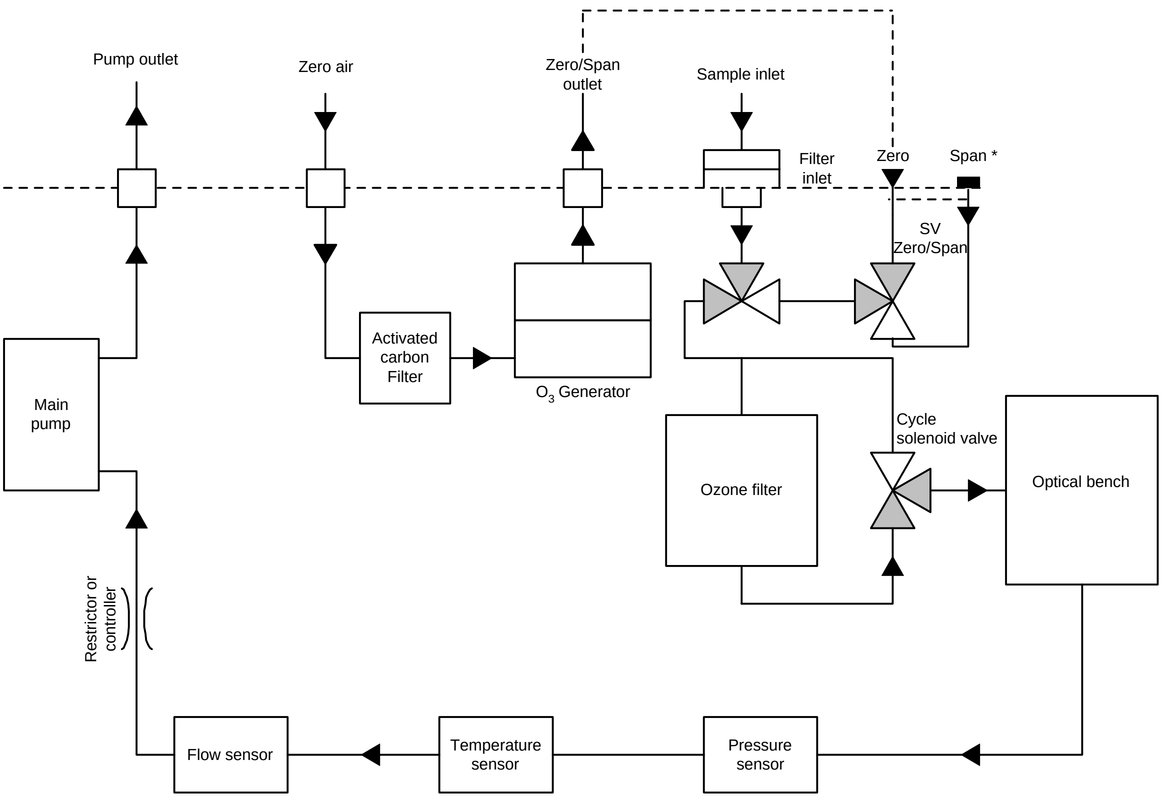


Figure 3–10 – Gas flow system with Ozone generator

CHAPTER 4

PREVENTIVE MAINTENANCE

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4 PREVENTIVE MAINTENANCE

4.1 SAFETY INSTRUCTIONS

Operators must observe the safety instructions at all times.

Cut off the power supply when performing any work inside the unit.

Only qualified personnel should intervene on the unit.

The manufacturer shall not be responsible for any consequences resulting from:

– use of the monitor by non-qualified people,
– use of the monitor in other conditions than those specified in this document,
– modification of the monitor by the user,
– non-maintenance of the monitor.

A systematic periodic inspection is required.

4.2 MAINTENANCE CALENDAR

By its design, the $O_3$42M requires very limited maintenance. However, to ensure the monitor's performance characteristics over time, the unit must be serviced regularly. The frequencies indicated below are given as an example and can vary according to operating conditions.

Operation	Frequency	Sheet No.
Replacement of inlet filter	15 to 30 days	4.3.1
Check on gas flow, optical and electrical parameters	30 days	4.3.2
Check of pump valves and diaphragm	6 months	4.3.3
Maintenance on measurement cell (*)	Yearly	4.3.4
Replacement of O3 scrubber	6 months to 1 year	4.3.5
Cleaning of flow restrictor	1 year	4.3.6
Cleaning of solenoid valve (*)	Yearly	4.3.7
Check and realignment of measurement and reference signals	Yearly	4.3.8
Replacement of UV lamp when ref. voltage value near limits	Yearly	4.3.9
Ozone generator maintenance	Yearly	4.3.10
(*) If analyzer is used without inlet filter membrane: monthly frequency.		

Yearly check

The monitor must be returned to laboratory for complete cleaning (measurement chambers, restrictors, gas flow rate, etc.) and check of all metrological parameters.

Carefully check seals around pneumatic fittings.

4.3 MAINTENANCE OPERATION SHEETS

MAINTENANCE SHEET

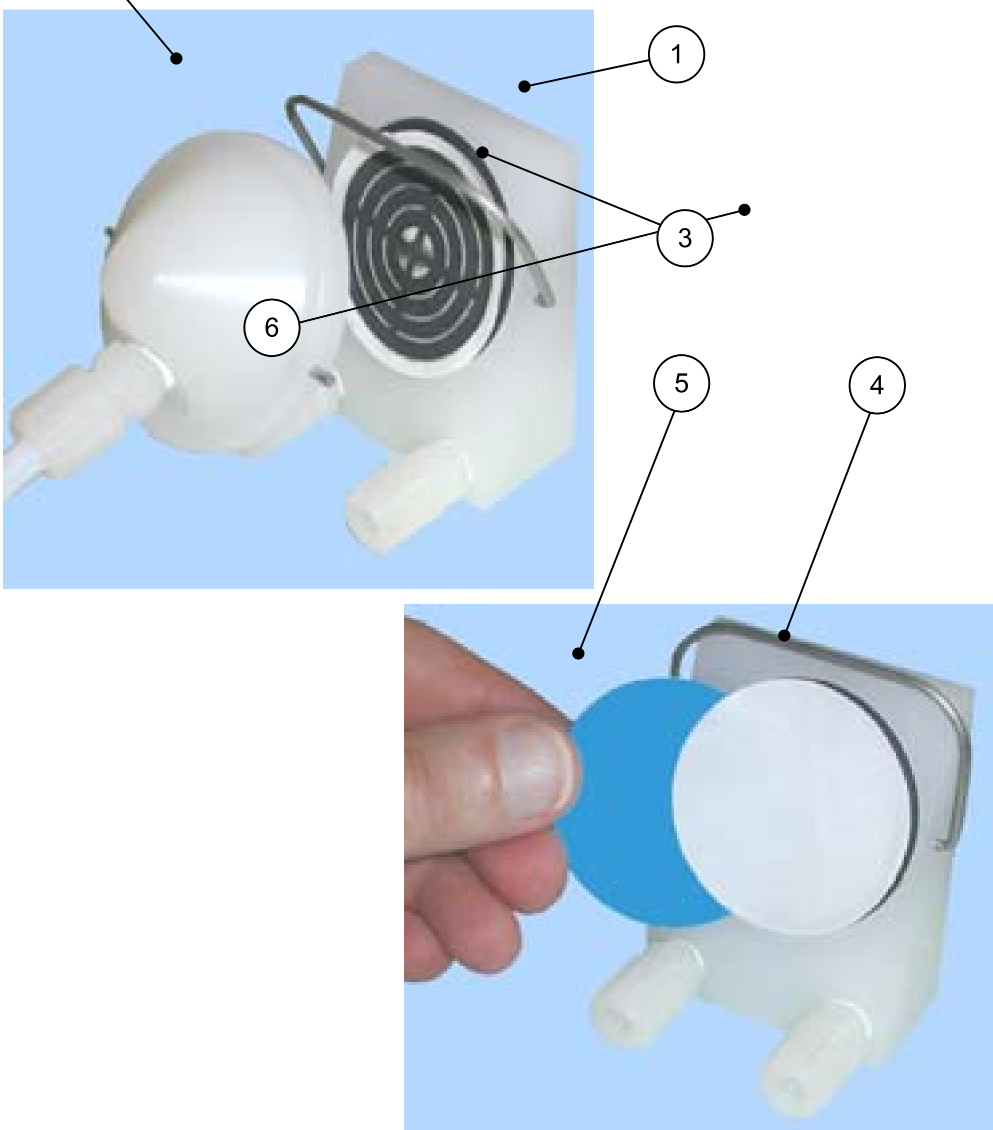
<table>
<tr><td>MONITOR serial No.:</td><td colspan="2">OPERATION SHEET: 4.3.1</td></tr>
<tr><td>Scope: Replacement of inlet filter</td><td>PAGE: 1/1</td><td>Frequency: 15 days</td></tr>
<tr><td colspan="2">Sample inlet PTFE filter: "MITEX" Teflon filter - 5 µm porosity - 47 mm dia. Ref.: F05-11-842
a) Unlock the filter cover (2) by rotating the locking spring (1)
b) Remove the dirty filter (3)
c) Place the new filter (4) by slipping it slightly from its paper protection(5) onto the filter holder (6).


Figure 4-1 – Inlet dust filter</td><td>Date</td></tr>
<tr><td colspan="2">Tools required
• none</td><td></td></tr>
</table>

MAINTENANCE SHEET

MONITOR serial No.:	**OPERATION SHEET: 4.3.2**	
Scope: Check on gas flow and optical parameters	**PAGE: 1/2**	**Frequency: 15 days**

Regular checks on gas flow and optical parameters using *Measure* ⇨ *Synoptic* display mode and *Maintenance* ⇨ *MUX signal* (see sections 3.3.2.3 and 3.3.6.3) help to prevent foreseeable alarms (UV energy too low, measurement signal too weak, abnormal accumulation of dirt in measurement chamber, inlet filter or ventilation tube clogged, flow restrictor clogged, etc.).
The maximum ratings listed in Table 3.2 on page 3-29 and retrieval of the results on the inspection sheets in section 4.5 and the results of the test will be used to decide whether it is necessary to carry out the following procedures:

- Cleaning of tubes see sheet 4.3.4.
- Cleaning of optical bench windows and mirrors see sheet 4.3.4.
- Cleaning of Teflon solenoid valve see sheet 4.3.7.
- Cleaning of flow limiting valve (or "restrictor") see sheet 4.3.6.
- Readjustment of UV signals see sheet 4.3.8.
- Replacement of UV lamp see sheet 4.3.9.

Checking Gas flow Parameters

- Use a calibrated flowmeter to check that the flow rate at the sample inlet is about 1 liter/minute.
- Check pressure in <TEST> mode (see section 3.2.2.5.).

Tools required:

- 1 calibrated flowmeter.

PARAMETERS REPORT

MONITOR SERIAL NO.:									OPERATION SHEET : 4.3.2			
Scope : Check of gas flow and optical parameters									PAGE : 2/2		Frequency : 15 days	
	Measurement ⇒ Synoptic				*Test ⇒ MUX signals*				*Clean or exchange*			
			Pressure		Flowrate		Channel 3	Channel 9	O3 scrubber	cell tube	Windows	Solenoid valve
DATE	M	R			EV off	EV on	Lamp T°	I <UV>				

MAINTENANCE SHEET

<table>
<tr><td colspan="2">MONITOR serial No.:</td><td colspan="2">OPERATION SHEET: 4.3.3</td></tr>
<tr><td>Scope: Check of pump valves and diaphragm</td><td>PAGE: 1/1</td><td colspan="2">Frequency: Yearly</td></tr>
<tr><td colspan="2" rowspan="2">Check condition of diaphragm and pump valves. Replace them if necessary.

<u>Replacement of diaphragm and valves</u>
The diaphragms and valves are parts that wear out; these parts are replaced very easily.

<u>Replacement of diaphragm and pump valves</u>
Power instrument off, unplug the power cord
a) Disconnect supply connector.
b) Disconnect gas flow connections.
c) Loose the 3 screws (1) fastening pump assembly to frame in order to release the 3 pump holder slots.
d) Unscrew the 2 screws (3) fastening pump on its holder.
e) Draw a permanent mark (13) on the pump boddy (8) for reassembling purpose.
f) Remove the nut (5) fastening pump boddy (8) on the vibrating blade (6).
g) Unscrew the 2 screws (7) fastening pump boddy to pump housing (9).
h) Remove pump boddy.
i) Separate the various parts..
j) Clean diaphragm (10), the two valves (11) and the gasket (12).
k) Dust off or clean the different parts with alcohol (dismount valves if only necessary)
l) Check diaphragm, change it if necessary.
m) Reassemble, repeating steps above in reverse order.</td><td>Type of operation</td><td>Date</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td colspan="2">Tools required
• Dia. 4 mm cross-tip screwdriver,
• Dia. 5 mm flat screwdriver,
• Combination pliers
• Alcohol solution</td></tr>
<tr><td colspan="4"><u>Type of operation:</u> D: Replacement of diaphragm V: Replacement of valves</td></tr>
</table>

MAINTENANCE SHEET

MONITOR serial No.:	OPERATION SHEET: 4.3.3	
Scope: Check of pump valves and diaphragm	PAGE: 2/2	Frequency: Yearly

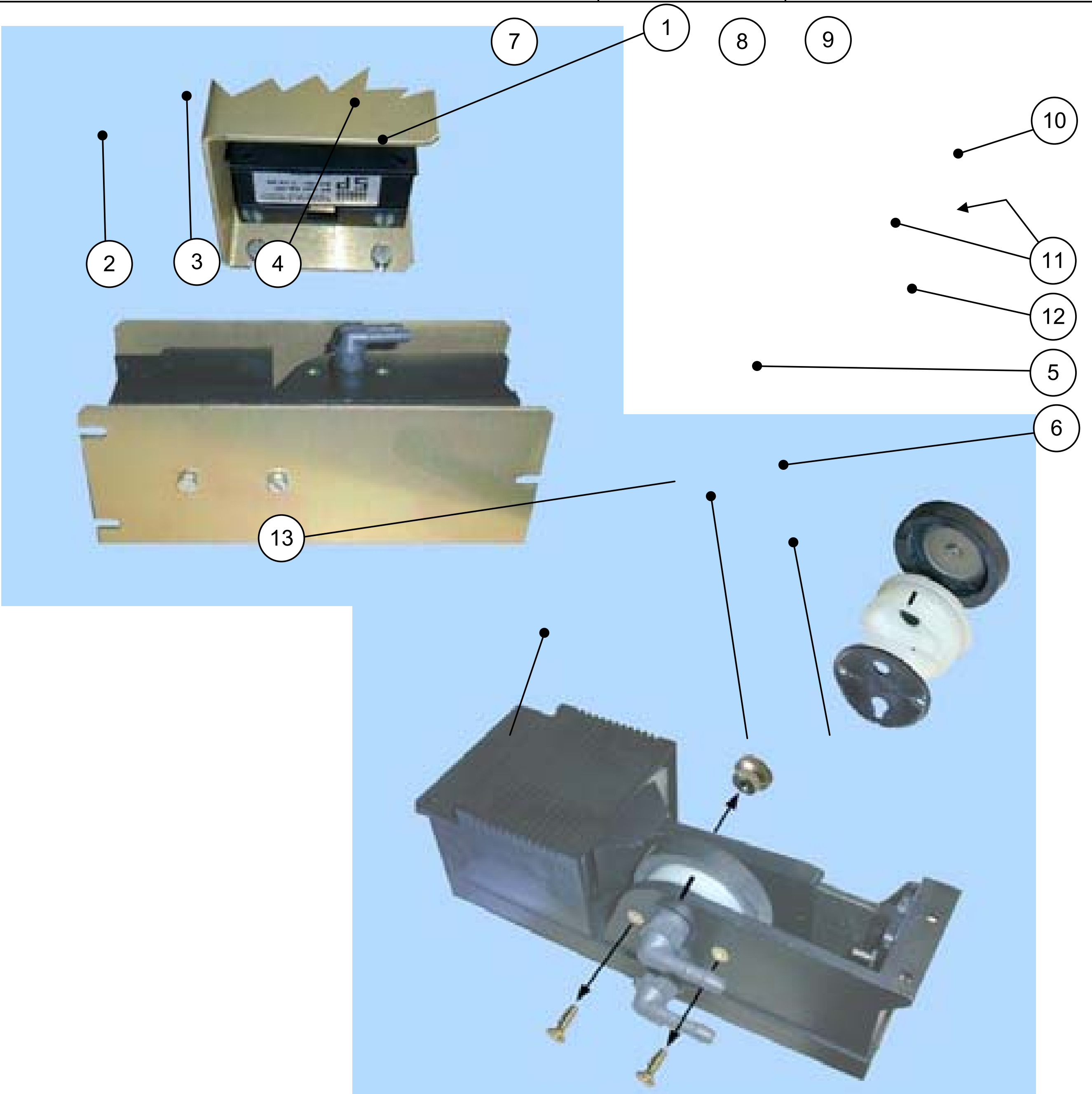


Figure 4-2 – Exploded view of the pump.

MAINTENANCE SHEET

MONITOR serial No.:	OPERATION SHEET: 4.3.4	
Scope: Maintenance on measurement cell	PAGE: 1/2	Frequency: Yearly

Date

Cleaning Tube : see Figure 4-3 - Maintenance on measurement cell

Switch off analyzer. Unplug mains power supply cord.

Pulling it up, remove cover of optical bench.

Disconnect sample input tube out off detector assembly (4).

Dismount cell measurement assembly by loosening the 2 screws.(1)

Tilt bench assembly.(2)

Loosen screws (3) by about 1 mm.

Pull out the measurement bloc. (5)

Free up optical bench glass tube (6) being careful to not tilt it too much inside the support.(2)

Clean glass windows (7) using tips slightly dampened with alcohol.

Clean optical bench glass tube (6) by pushing optical paper slightly dampened with alcohol through it with a Teflon tube (this paper is used to avoid scratching the internal surfaces).

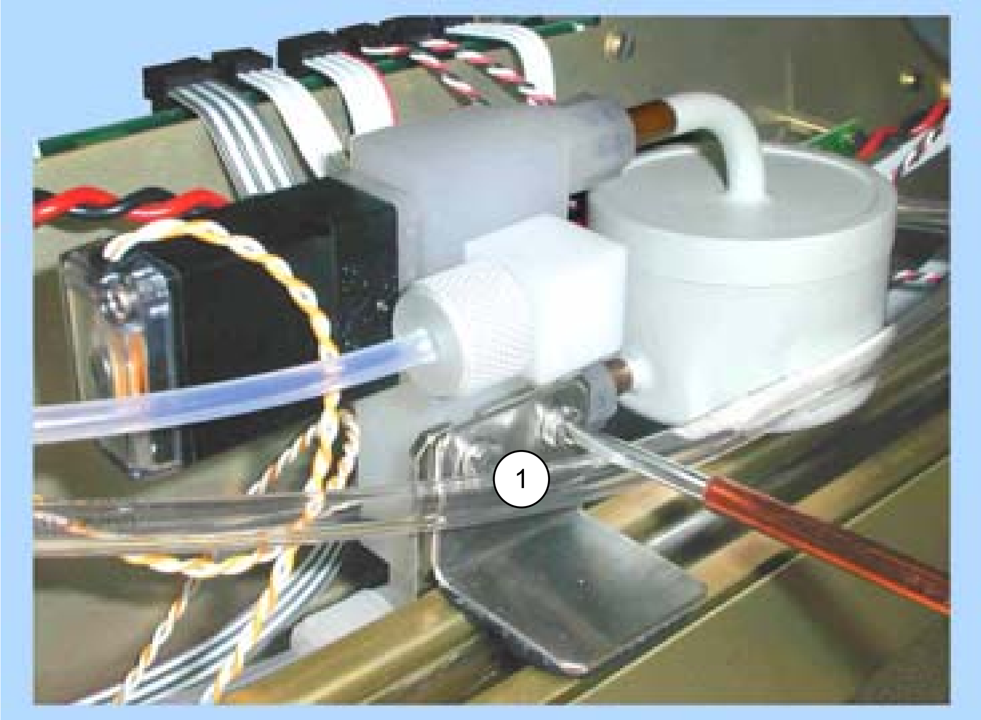
Mount again the whole following the reverse order.

Tools Required

- Optical paper.
- Alcohol solution.
- Teflon tube (300 mm).
- 5 mm diam screwdriver.

MAINTENANCE SHEET

MONITOR serial No.:	OPERATION SHEET: 4.3.4	
Scope: Maintenance on measurement cell	PAGE: 2/2	Frequency: Annual



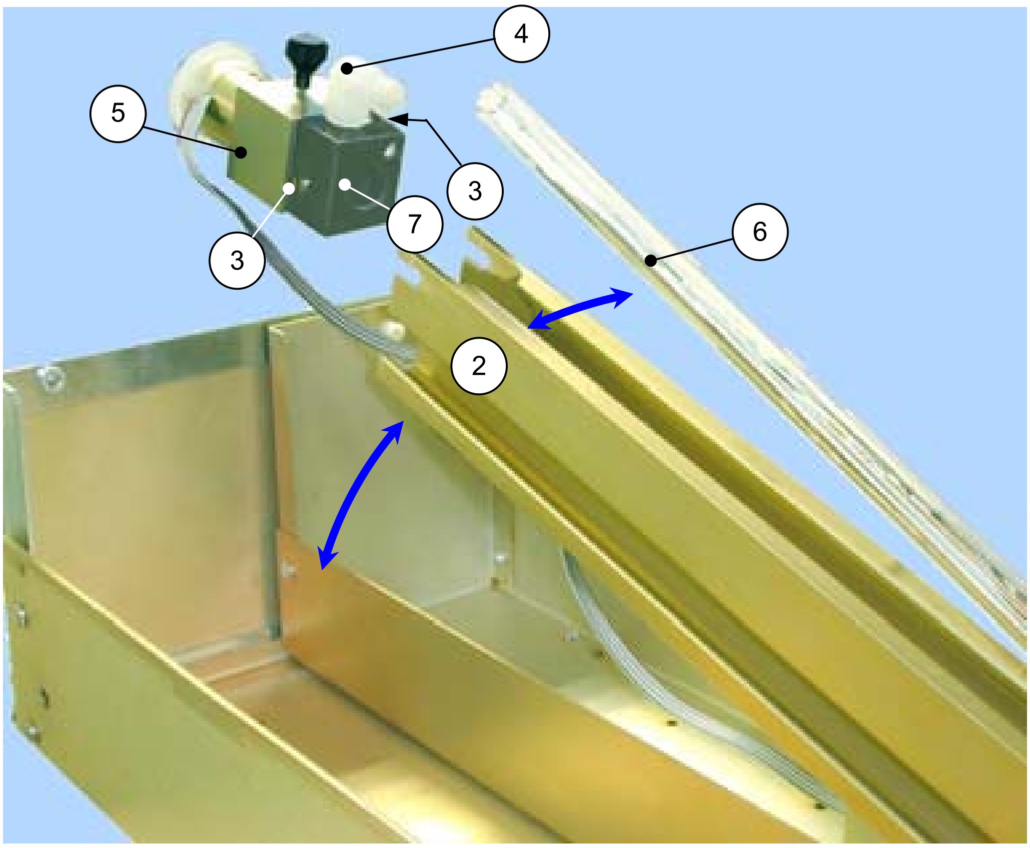


Figure 4-3 - Maintenance on measurement cell

MAINTENANCE SHEET

MONITOR serial No.:	**OPERATION SHEET: 4.3.5**	
Scope: Replacement O_3 scrubber	**PAGE: 1/1**	**Frequency: Annual**

Replacing O_3 Scrubber (see Figure 4-4):

Date

– MNO_2 scrubber (1) is a complete cartridge.

– Loose the 2 screws (2) on SV block and pull it out.

– Interchange scrubber taking care of tightness

– Mount again the whole as shown in Figure 4-4.

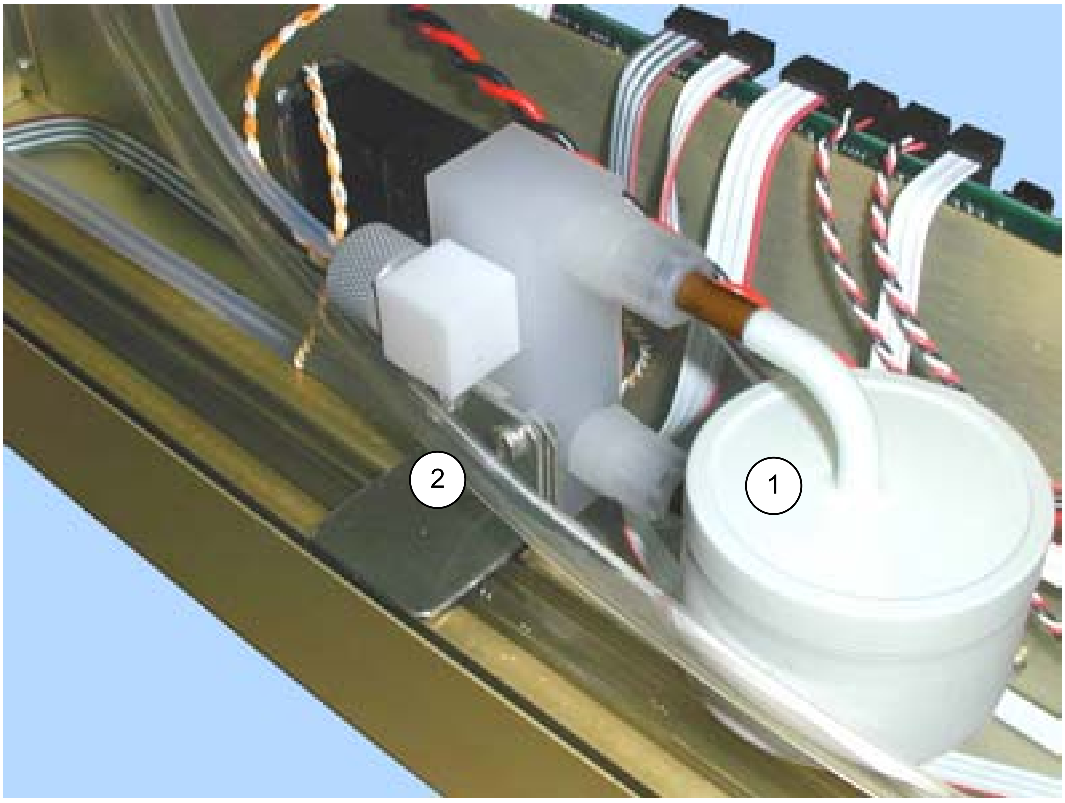


Figure 4-4 - Replacement of Ozone scrubber

Tools Required

- Kit, P/N P06-K-0010-A.

MAINTENANCE SHEET

MONITOR serial N°:	OPERATION SHEET : 4.3.6	
Scope : Cleaning of flow resrtictor	PAGE : 1/1	Frequency : Annual

Dates

Cleaning of flow resrtictor *:

Remove the flow restrictor from the fluid circuit (see (2) in figure 4-3).

Immerse it into alcohol, and then dry it blowing compressed air.

Tools required

- Alcohol solution.
- Compressed air.

* no more present when pump is controlled.

MAINTENANCE SHEET

MONITOR serial No.:	OPERATION SHEET: 4.3.7	
Scope: Cleaning of solenoid valve	PAGE: 1/1	Frequency: Annual

Date

Cleaning solenoid valve :

Switch off analyzer. Unplug power cord.

Disconnect supply cable of solenoid valve.

Unscrew the two screws (1) holding the solenoid valve onto the mount.

Remove the white back part of the valve (2) only.

Clean PTFE body (2) and valve (3) with a cloth dampened with alcohol.

If membrane is worn, replace the solenoid valve.

Assemble again. Run a leak test on the analyzer.

Pay attention to mounting sense (shift of holes on footing)

Replacing solenoid valve:

If a leak is detected, replace solenoid valve.

NOTE : Similar procedure for optional solenoid valves

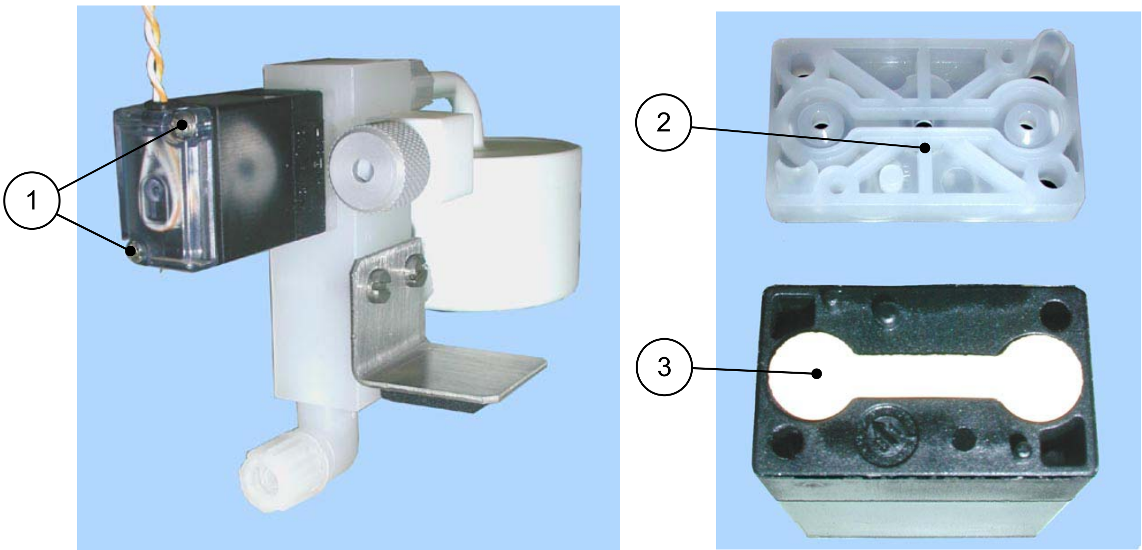


Figure 4-5 – Solenoid valve

Tools Required

- Kit, P/N P01-E033-00A.
- 4 mm cross type screwdriver
- 5 x 100 mm screwdriver.
- Soft clothe.
- Alcohol solution.

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MAINTENANCE SHEET

MONITOR serial No.:	OPERATION SHEET: 4.3.8	
Scope: Check and realignment of reference and measurement signals	PAGE: 1/2	Frequency: Annual

Date

Checking Measurement Signals:

Check MES and REF parameters in either *Span ⇒ E2Pot* or *Test ⇒ Signal Mux* screen ("Sig. MES." channel 11 and "Sig. REF." channel 12).

Normal value ≈ 4500 mV.

If these values are near the limits (500 and 4800 mV), readjust signals.

If it is impossible to set the two voltages to more than 3000 mV, in this case increase the power of the UV lamp (see *Span ⇒ E2Pot* sub menu. If it is too short, change the UV lamp (see sheet 4.3.8).

Realigning Measurement Signals:
The MES and REF signals are adjusted using the Gain (G) potentiometers on the respective detectors (Figure 4-6).
Set the zero potentiometer (Z) to get 10 mV signal. This adjustment must be done with detector put out of bench and its window being protected from any UV beam (1).

If it is possible to set "UV REF" to at least 4000 mV, but impossible for "UV MES", there are two possibilities:

- clean measurement cell (windows, mirrors; see sheet 4.3.4.),
- measurement UV detector faulty (to check for this possibility: invert detectors; in this case, the problem should be the opposite).

If it is possible to adjust "UV MES" to at least 4000 mV, but impossible to adjust "UV REF", it means that "UV REF" detector is out of work.

Tools Required

- 2 mm screwdriver.

MAINTENANCE SHEET

MONITOR serial No.:	OPERATION SHEET: 4.3.8	
Scope: Check and realignment of reference and measurement signals	PAGE: 2/2	Frequency: Annual

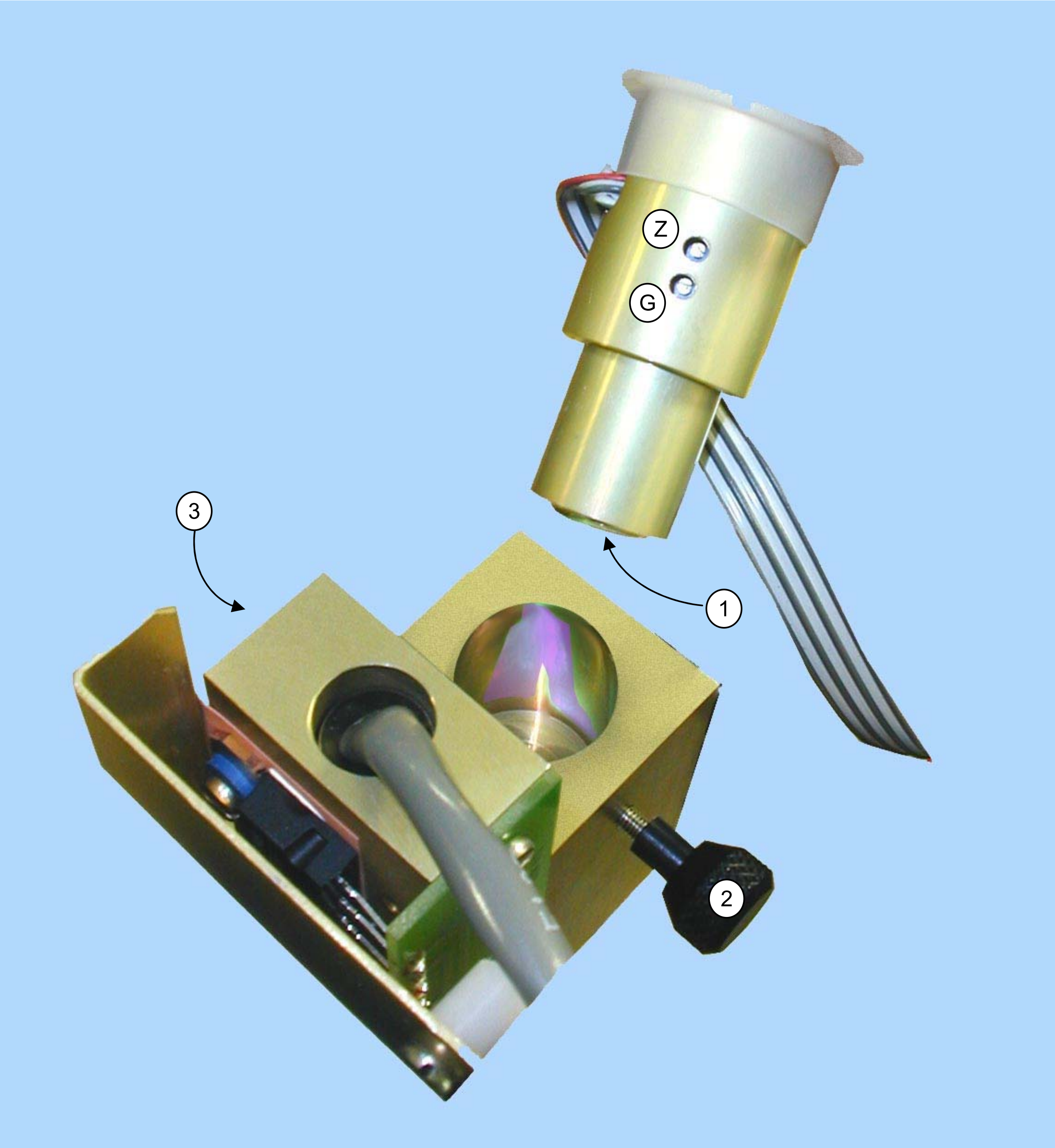


Figure 4-6 - Unlock and set detectors

MAINTENANCE SHEET

MONITOR serial No.:	OPERATION SHEET: 4.3.9	
Scope: Replacement of measurement UV lamp	PAGE: 1/2	Frequency: Annual

Date

Checking UV Lamp:

If the MES and REF values are near the low limits, check these parameters in *Test ⇒ Mux signals* menu (see "Corrective Maintenance").

See operation sheet 4.3.7 - Check and realignment of reference and measurement signals.

If signals remain too low, it is necessary to replace UV lamp.

Replacing measurement UV Lamp: (see Figure 4-7)

Switch off device. Disconnect power cord, unscrew the screw (1). Disconnect the two supply wires (2) (3) and the ground wire (4) from the UV power supply board connector. Remove used lamp. Carefully pick up new lamp by its socket (3), place it in its slot (2) and screw again (1). Connect supply and ground wires to UV power supply board. Check the correct wiring. Switch on device.

Go into *Span ⇒ E2pot* screen and check I Lamp (am).

- Adjustment using – signal + for UV lamp power supply with I Lamp reading from 18 to 22 mV.
- Adjust rotational and crosswise position of lamp so as to have maximum voltage values: measure signal, measure reference. Once this value is obtained, tighten the knurled thumb screw.
  If the MES or REF signals are saturated (4999 mV), decrease G (gain) in respective detectors.

Before realigning measurement signals, it is advisable to let the lamp's UV energy and temperature stabilize.

Lampe HRef. : D01-0096-B

Date

Replacing optional O3 generator UV lamp: (see Figure 4-8)
Switch off device. Disconnect power cord, Disconnect the lamp connector (1), unscrew the knurled nut (2).
Place the O-ring at 2mm from the beginning of the cylindrical par of the lamp bulb (3), place the knurled nut on the lamp, screw the assembly on the generator, reconnect the supply connector (1).
Replace the charcoal filter cartridge (5).

Tools Required

- 2 x 7.5 mm screwdriver.

MAINTENANCE SHEET

MONITOR serial No.:	OPERATION SHEET: 4.3.9	
Scope: Replacement of measurement UV lamp	PAGE: 2/2	Frequency: Annual

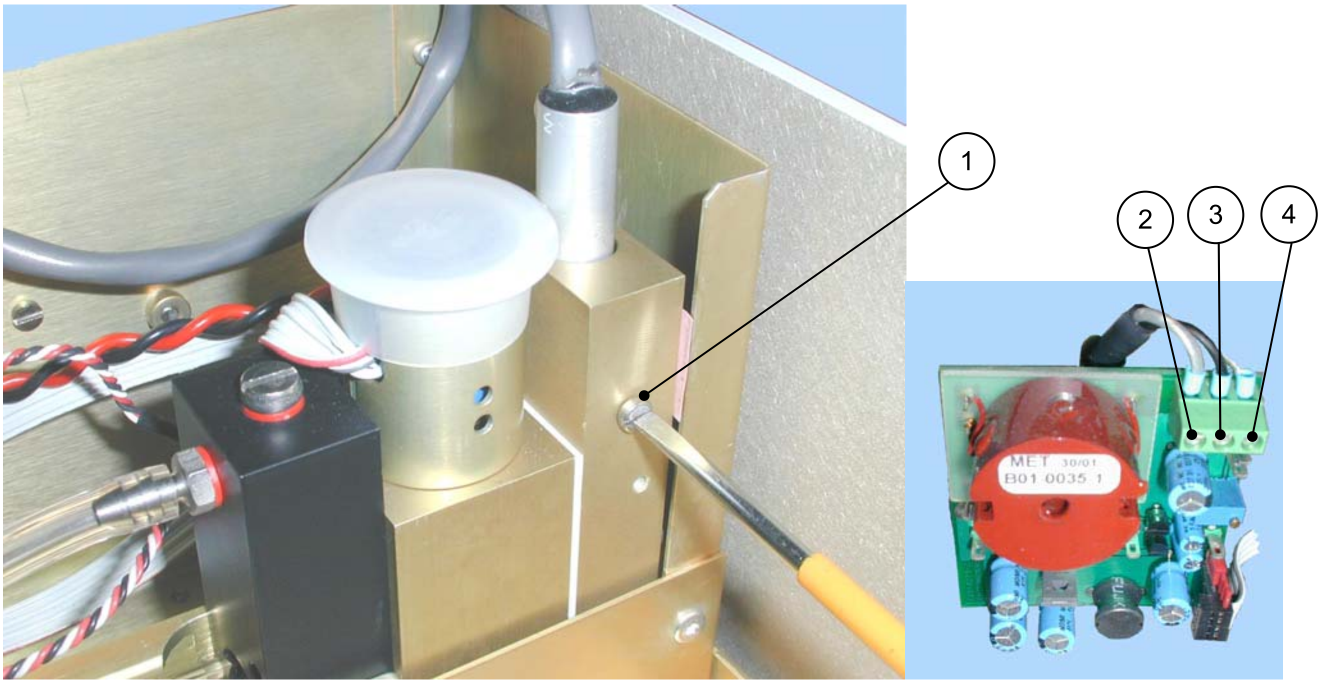


Figure 4-7 – Replacement of measurement UV lamp

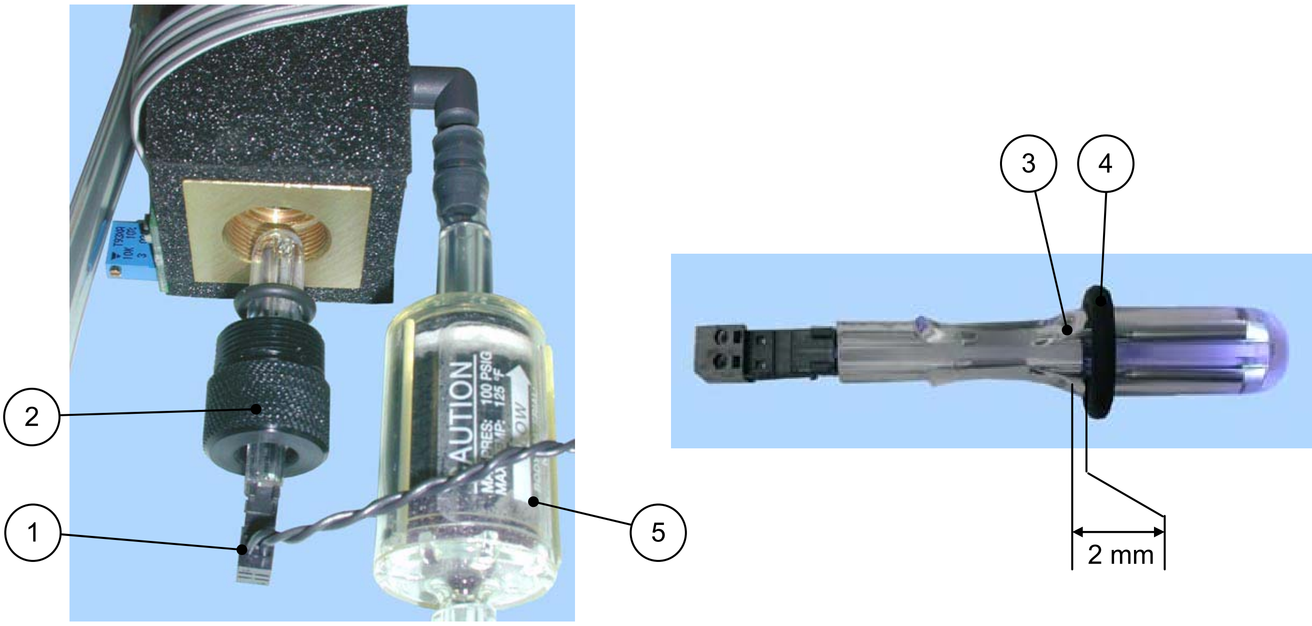


Figure 4-8 – Replacement of optional O3 generator UV lamp

FICHE MAINTENANCE SHEET

MONITOR serial N° :	**OPERATION SHEET : 4.3.10**		
Scope : Ozone generator maintenance	**PAGE : 1/2**	**Frequency : Annual**	

Change the active carbon filter and clean or replace the UV lamp.

See Figure 4–9

<u>Replacement of active carbon filter</u>

Remove both fluid connections of inlet and outlet (2) and (3), put in place a new filtering cartridge (1) by respecting the sense indicated on the part.

<u>Cleaning or replacement of UV lamp</u>

- Unscrew both screws (4) retaining both electric connectors of the power supply board of ozone generator. Remove the connectors.
- Carefully unscrew the nut (5) keeping in place the UV lamp inside ozone generator, and remove the lamp.
- Remove the nut and the seal (7). Clean the lamp with a soft rag. If necessary, replace the lamp.
- Replace the nut (5) and the seal (7) on the lamp (8), and screw again the lamp inside the ozone generator.

Tools required :

- Cross-tip screwdriver
- Flat wrench 7 mm,
- Socket wrench 7 mm.
- Combination pliers.

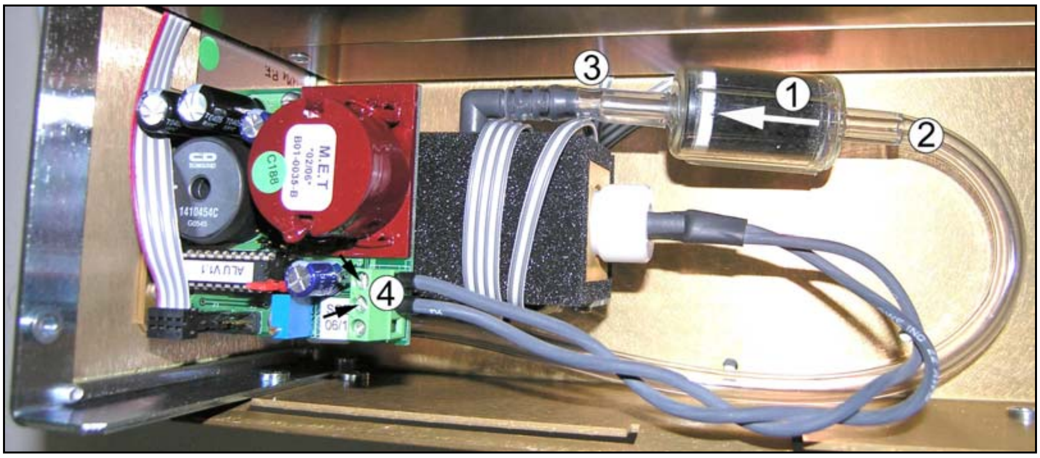
Operation types	**Dates**

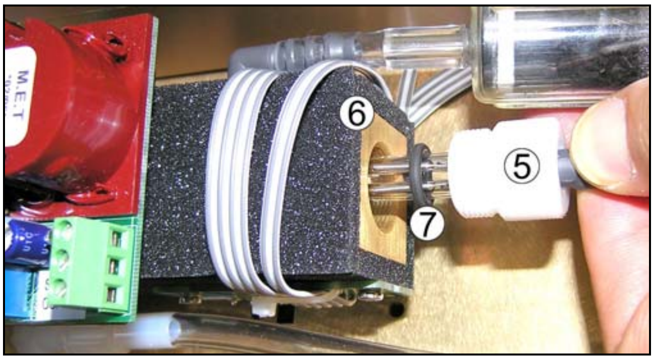
<u>Types of operations</u> :   **R : Replacement**   **C : Cleaning**

MAINTENANCE SHEET

MONITOR serial N°:	OPERATION SHEET : 4.3.10	
Scope : Ozone generator maintenance	PAGE : 2/2	Periodicity : Annual

Replace carbon active filter and clean or replace the UV lamp.





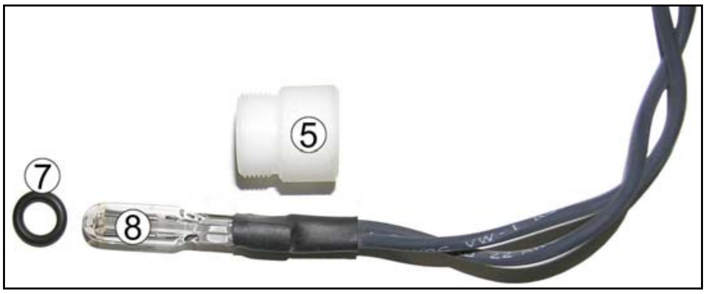


Figure 4–9 – Ozone generator maintenance

4.4 O342M MAINTENANCE KIT

Maintenance kit for 1 year (O342M standard)	**O342-K**
This kit includes :	
1 maintenance kit for pump	V02-K-0041-A
1 ozone scrubber (selective filter)	F05-0096-A
1 box of 25 diaphragms (Teflon filter)	SAV-K-000042-A
2 dust-protective on-line filters	F05-IDN-10G

Maintenance kit for 1 year (O342M with ozone generator)	**O342-K2**
This kit includes :	
1 maintenance kit for pump	V02-K-0041-A
1 ozone scrubber (selective filter)	F05-0096-A
1 box of 25 diaphragms (Teflon filter)	SAV-K-000042-A
2 dust-protective on-line filters	F05-IDN-10G
1 active carbon on-line filter	F05-SDN-A

Recommended spare parts kit (O342M standard)	**O342M-RSP**
This kit includes :	
1 mercury wired lamp	D01-0096-B
1 SV wiring (3-way wired solenoid valves)	D01-0749-C
1 optical block tube	P08-0077-A
1 wired pump 24/50Hz	V02-0043-A

Recommended spare parts kit (O342M with ozone generator)	**O342M-RSP2**
This kit includes :	
1 mercury wired lamp (measurement UV lamp)	D01-0096-B
1 SV wiring (3-way wired solenoid valves)	D01-0749-C
1 optical block tube	P08-0077-A
1 wired pump 24/50Hz	V02-0043-A
1 mercury wired lamp (lamp of the ozone generator option)	D01-0784-A

CHAPTER 5
CORRECTIVE MAINTENANCE

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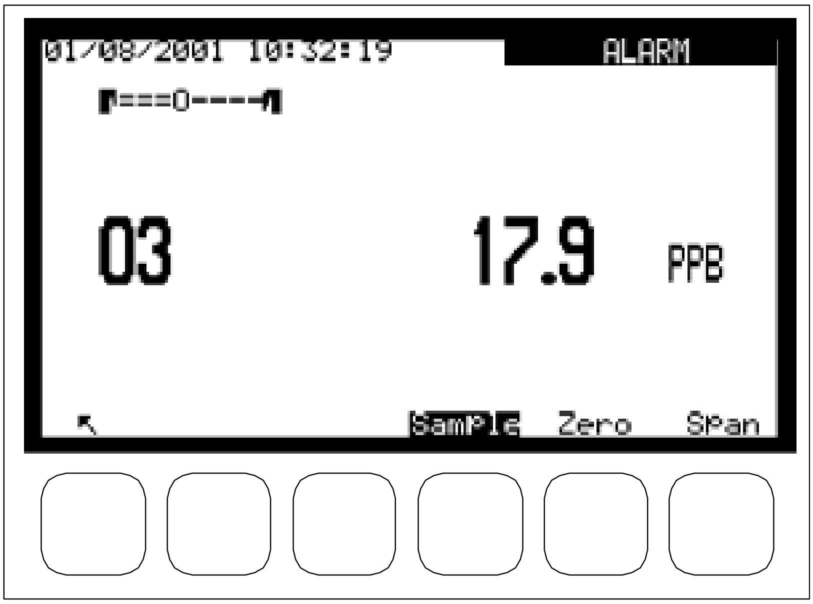
5 CORRECTIVE MAINTENANCE

Corrective maintenance of the monitor should only be performed by qualified personnel using the information provided in this document.

The monitor automatically and continuously self-tests its main components. Any malfunction detected is indicated by a plain-language message on the display and a buzzer.

Table 5.1 summarizes the main faults indicated by the unit with corresponding corrective possible actions.

In case of operating fault, the ALARM message blinks in the top right corner.



To check which operating fault is present select the menu *Measurement ⇨ Alarms display.*

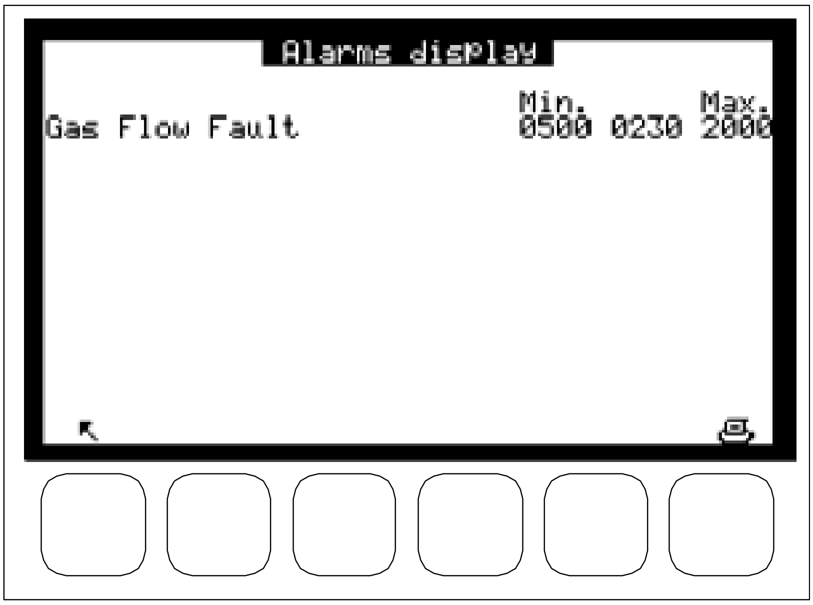


Table 5-1– List of faults and corrective actions

ALARM MESSAGE	CAUSE	POSSIBLE ACTION
Analog to digital converter	– The reference voltage 2,5 V (multiplexer input 16) is outside the de-signed limits.	– Test electrical signals (TEST ⇨ MUX Signals menu). If voltage displayed is greater than 2520 mV or less than 2480 mV. – Check 2,5 V test, + 5 V, + 15 V and - 15 V supply voltages on Modul board.
UV SOURCE FAULT	– The UV lamp is not lit. – There is a failure in the UV power supply.	– Turn off, then turn back on. – Check voltage on connector.
REF SIGNAL FAULT	– The UV lamp energy is not high enough.	– Test electrical signals (*TESTS ⇨ MUX Sig-nals* menu). – Adjust position of UV lamp (see section 4.3.8) to obtain a maximum of energy (REF signal). – Increase gain on REF (reference) detector to obtain 2000 < REF (reference) < 4800 (see section 4.3.7). If still impossible: – Increase UV lamp supply current using *Span ⇨ E2pot* function (read MUX signal, ADJ lamp, max. 250 mV) so as to read more than 3000 mV in *TESTS ⇨ Optical bench* mode. – Replace lamp if it is impossible to adjust it (see section 4.3.8). – The UV REF detector is out of service (see section 4.3.7).
MEASURE SIGNAL FAULT	– If the REF signal is nor-mal, it means that the optical bench is dirty or the UV MES detector is out of service. – There is not enough energy from the UV lamp.	– Clean optical bench tube (see section 4.3.4) and windows. – Increase gain on measurement detector to obtain 3000 < MES < 4800 (see section 4.3.7). – Replace lamp if necessary (see section 4.3.8). – Measurement detector is out of work (see section 4.3.7).

ALARM MESSAGE	CAUSE	POSSIBLE ACTION
FLOW RATE FAULT	– Flow rate not correct in measurement chamber: the pump is not running correctly.	– Carry out pump complete overhauling.
	– Leak in gas flow system.	– Check all connections. – Measure flow rate. Compare to test sheet for device. – Put a flowmeter at the outlet of the device. Plug sample inlet. The ball of the flowmeter should drop to zero. If it does not, there is a leak.
	– Flow rate OK, no leak.	– Adjust flow value to about 2200 by using the SPAN ⇨ E2Pot screen.
PRESSURE FAULT	– The pressure in the measurement chamber is abnormally high > 1,050 mbar or low < 500 mbar.	– Check that sample is really at atmospheric pressure. – Check that there is no clogging. – Disconnect tube on pressure sensor. – Check that MUX signal, pressure, corresponds to the ambient barometric pressure. If necessary, use *Span ⇨ Pressure* screen to adjust its value.
GAS TEMP. FAULT	– The temperature of the sample in the measurement chamber is < 10° C or > 55° C.	– The device is not under the normal operating conditions (see section 1.2.1 for operating temperature).
OVERRANGE	– The measurement value exceeds the range selected.	– Change range (see section 3.3.4.3).
OPTIC. TEMP. FAULT	– The temperature of the UV lamp unit is abnormal.	– Check heating connection and if the LED control reacts (ON/OFF). – Heating element is faulty (TIP 3055).

Table 5-1– List of faults and corrective actions (following)

SYMPTOM	POSSIBLE CAUSES	ACTIONS
Monitor does not react when switched on (no by-default display).	– Power failure. – Cord faulty. – Connector not plugged in correctly. – Main fuse out of service.	– Check that power is available. – Test continuity of cord. – Check fuse inserted in connector block. – Check connection between power supply block and Module board 24 V.
Monitor remains in warm-up mode (no by-default display).	– Microprocessor board faulty. – Reset circuit blocked. – Microprocessor 5 V failure.	– Check display flashing. – If no flashing, check that modul board is correctly set. Replace it if necessary. – If it flashes, wait 15 minutes to see if the failure is displayed.
Failure display following replacement of UV lamp.	Lamp gives off too much energy. Lamp does not light up.	– Change lamp position (rotate). – Check wiring of lamp. Decrease gain at level of REF or MEAS detector, depending on failure.

STOP **Switching power supply is protected from short circuits.**
When it happens, it is necessary to disconnect/ reconnect the power cord in order to reset the power supply protection.

Table 5–2 – Board RS4i Configuration

Jumpers references	Symbols	Nature of operation
SW1, SW2	● ■	Channel 1 on RS422 standard
SW3	■ ●	Channel 1 on RS232 standard
ST1	■	Load RX bus RS422 active
	● ●	Load RX bus RS422 inactive
ST2	■	Load TX bus RS422 active
	● ●	Load TX bus RS422 inactive
ST3	● ●	Not used

NOTE : Channel 2 is on the RS232 standard.

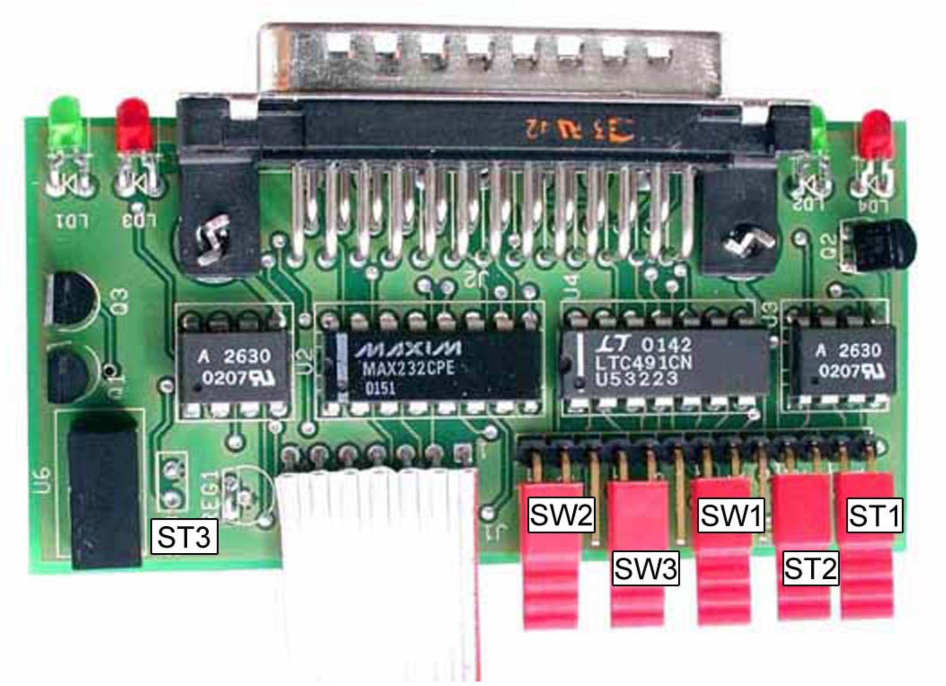


Figure 5–1 – Card RS4i Configuration

Table 5–3 – Keyboard Interface configuration

Jumpers references	Symbols	Nature of operation
ST1	▮	Keyboard inhibited
	⁚	Keyboard active
P1	LCD contrast adjustment potentiometer	

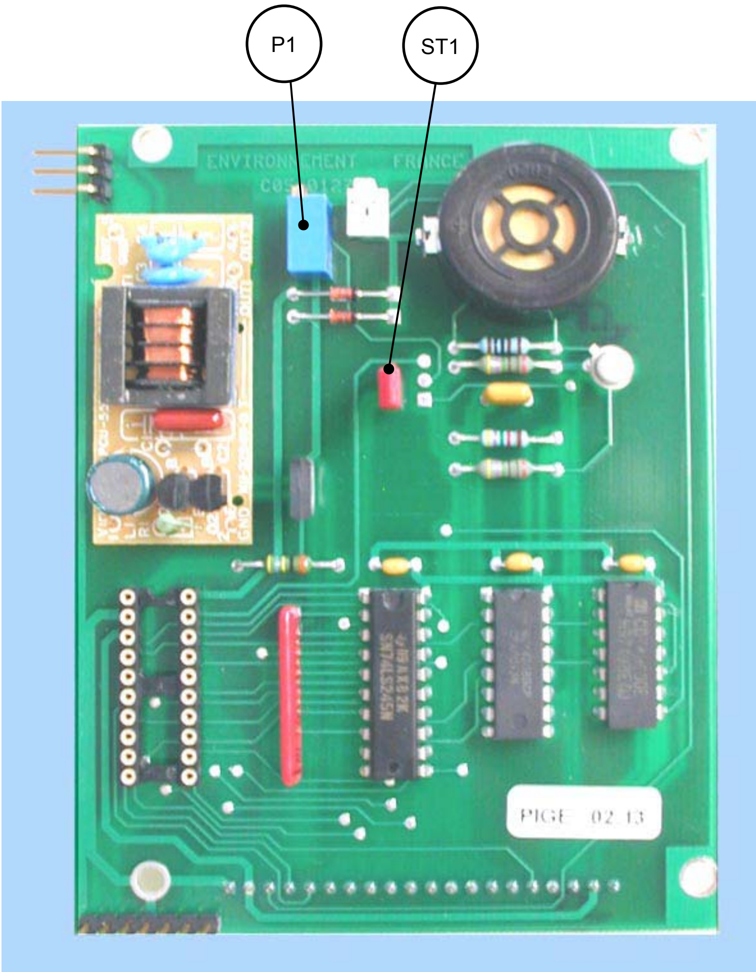


Figure 5–2 – Keyboard Interface board

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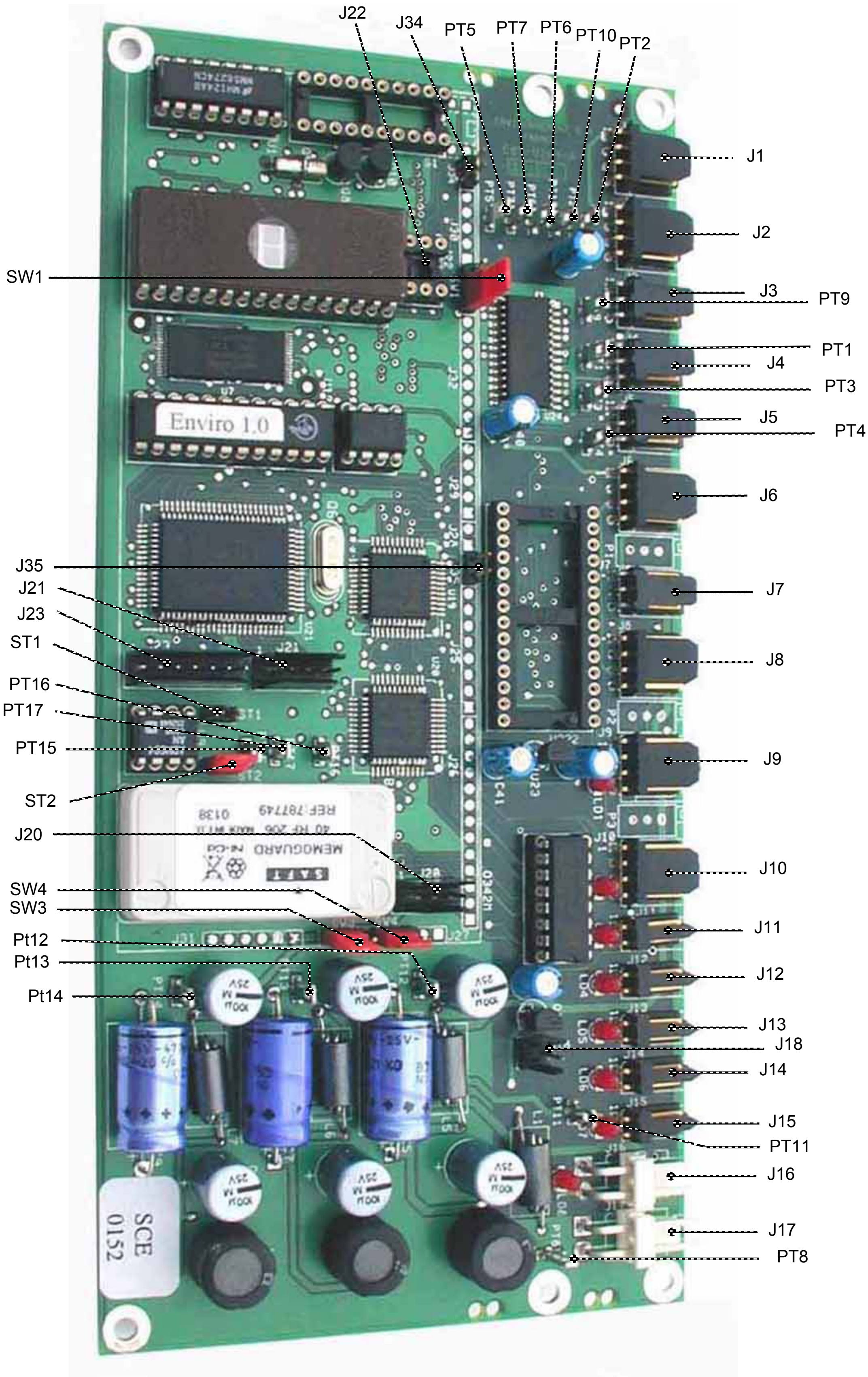

Figure 5–3 – MODULE board

Table 5–4 – MODULE board configuration

Test points.	Type of signal
PT1	Flow ratel
PT2	Cell pressure
PT3	UV lamp temperature
PT4	Gaz temperature
PT5	A/D RUN
PT6	A/D STATUS
PT7	A/D CS
PT8	0 V (GND)
PT9	0 V (GND)
PT10	MUX output
PT11	+24VCC
PT12	+5VCC
PT13	+15 VCC
PT14	-15VCC
PT15	I off+
PT16	I off -
PT17	RAM reset

Jumpers		Nature of operation
SW1 EPROM Configuration	1 2 3	Selects 27C20 (2 Mbits)
	1 2 3	Selects 27C40 (4 Mbits)
SW3 Power supply	1 2 3	5V I2C Bus
	1 2 3	24V I2C Bus
SW4 Internal clock	1 2 3	=CLK/2
	1 2 3	= CLK (default position)
ST1		(default position)
		Resets microprocessor
ST2 Watch dog		Inactive
		Active (default position)

Connector	Connection
J1	Option 1
J2	Option 2
J3	Cell pressure
J4	Gaz temperature
J5	Flow rate sensor
J6	Measurement detector
J7	UV lamp temperature
J8	Reference detector
J9	O3 generator UV lamp
J10	Measurement UV lamp
J11	SV Zero
J12	SV span
J13	SV cycle
J14	Auxiliary 1
J15	Auxiliary 2
J16	UV lamp heating
J17	+24VCC supply
J18	+4VCC on/off switch
J19	Not used
J20	Estel board I2C bus
J21	Synchro bus
J22	RS4i board I2C bus
J23	RAM extention option
J24	Not used
J25	Not used
J26	Not used
J27	Not used
J28	Not used
J29	Not used
J30	Not used
J31	Not used
J32	Not used
J33	Not used
J34	Stand by LED option
J35	Maintenance switch option

Table 5–5 – Configuration of UV lamp supply board (measurement)

Jumper marks			Nature of operations
SW2		3 2 1	O342M Measurement lamp (1-2 linked)
ST1			OFF
ST2			ON

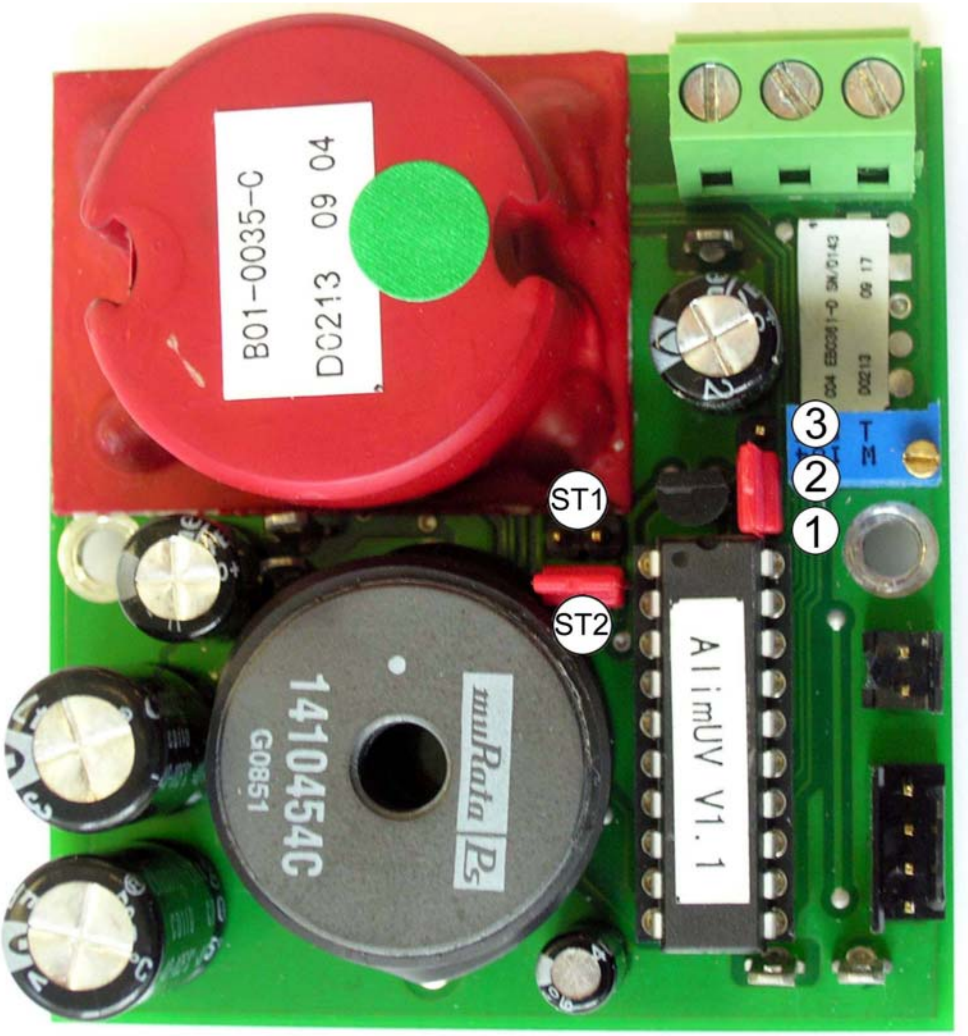

Figure 5–4 – Board of measurement UV lamp supply

Table 5–6 – Configuration of UV lamp – ozone generator option

Jumper marks		Nature of operations
SW2		O342M
ST1		O3 generator
ST2		O3 generator

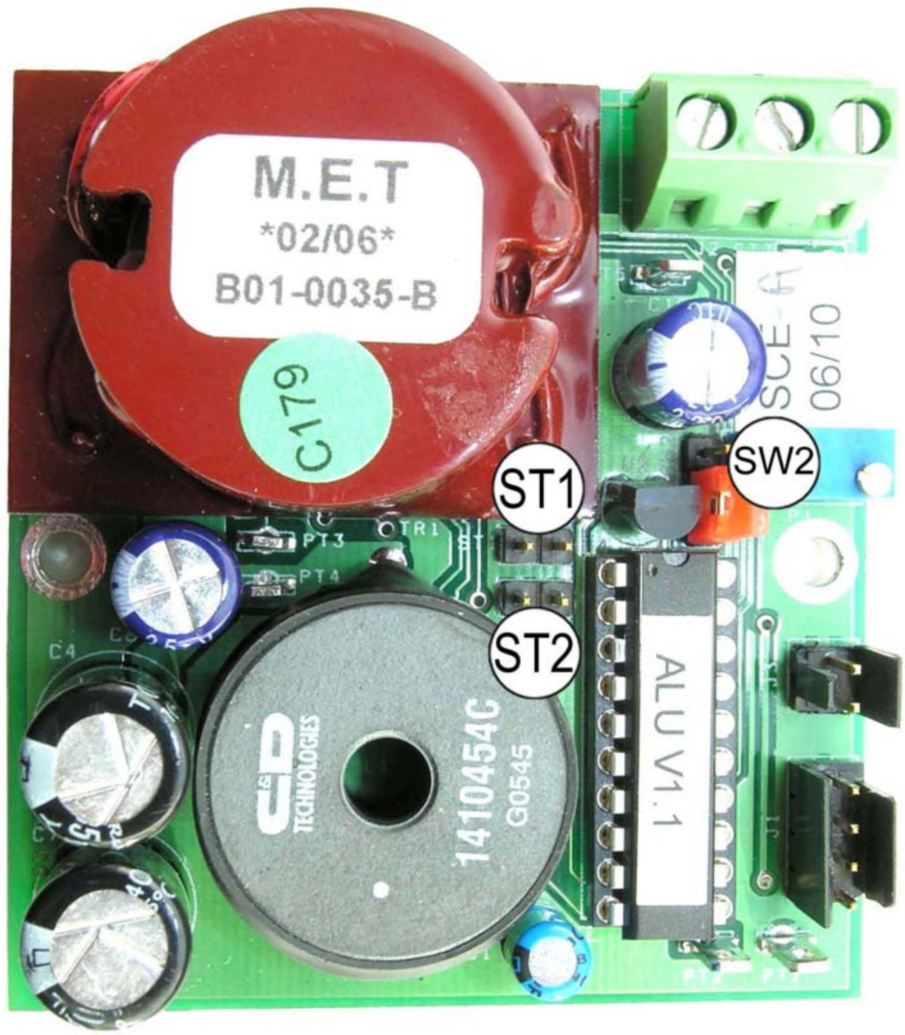

Figure 5–5 – Board of UV lamp, ozone generator option

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CHAPTER 6
APPENDIX

6.1 CALIBRATION PROCEDURE

1. Principle

The calibration procedure is based on the photometric assay of ozone (O_3) concentrations in a dynamic flow system. The concentration of O_3 in an absorption cell is determined from a measurement of the amount of 254 nm light absorbed by the sample. This determination requires knowledge of (1) the absorption coefficient (α) of O_3 at 254 nm, (2) the optical path length (l) through the sample, (3) the transmittance of the sample at a wave-length of 254 nm, and (4) the temperature (T) and pressure (P) of the transmittance is defined as the ratio I/I_0 , where I is the intensity of light which passes through the cell and is sensed by the detector when the cell contains an O_3 sample, and I_0 is the intensity of light which passes through the cell and is sensed by the detector when the cell contains zero air. It is assumed that all conditions of the system, except for the contents of the absorption cell, are identical during measurement of I and I_0. The quantities defined above are related by the Beer-Lambert absorption law,

$$\text{Transmittance} = \frac{I}{I_0} = e^{-acl} \qquad (1)$$

where:

α = absorption coefficient of O_3 at 254 nm = 308±4 atm^{-1} cm^{-1} at 0 °C and 760 torr. [1, 2, 3, 4, 5, 6, 7]

c = O_3 concentration in atmospheres

l = optical path length in cm

In practice, a stable O_3 generator is used to produce O_3 concentrations over the required range. Each O_3 concentration is determined from the measurement of the transmittance (I/I_0) of the sample at 254 nm with a photometer of path length l and calculated from the equation,

$$c(\text{atm}) = -\frac{1}{\alpha l}(1\text{n } I / I_0) \qquad (2a)$$

or,

$$c(\text{ppm}) = -\frac{10^6}{\alpha l}(1\text{n } I / I_0) \qquad (2b)$$

The calculated O_3 concentrations must be corrected for O_3 losses which may occur in the photometer and for the temperature and pressure of the sample.

2. Applicability.

This procedure is applicable to the calibration of ambient air O_3 analyzers, either directly or by means of a transfer standard certified by this procedure. Transfer standards must meet the requirements and specifications set forth in Reference 8.

3. Apparatus

A complete UV calibration system consists of an ozone generator, an output port or manifold, a photometer, an appropriate source of zero air, and other components as necessary. The configuration must provide a stable ozone concentration at the system output and allow the photometer to accurately assay the output concentration to the precision specified for the photometer (3.1). Figure 1 shows a commonly used configuration and serves to illustrate the calibration procedure which follows. Other configurations may require appropriate variations in the procedural steps. All connections between components in the calibration system downstream of the O_3 generator should be of glass, Teflon, or other relatively inert materials. Additional information regarding the assembly of a UV photometric calibration apparatus is given in Reference 9. For certification of transfer standards which provide their own source of O_3, the transfer standard may replace the O_3 generator and possibly other components shown in Figure 1; see Reference 8 for guidance.

3.1 *UV photometer*. The photometer consists of a low-pressure mercury discharge lamp, (optional) collimation optics, an absorption cell, a detector, and signal-processing electronics, as illustrated in Figure 1. It must be capable of measuring the transmittance, I/I_0, at a wavelength of 254 nm with sufficient precision such that the standard deviation of the concentration measurements does not exceed the greater of 0.005 ppm or 3% of the concentration. Because the low-pressure mercury lamp radiates at several wavelengths, the photometer must incorporate suitable means to assure that no O_3 is generated in the cell by the lamp, and that at least 99.5% of the radiation sensed by the detector is 254 nm radiation. (This can be readily achieved by prudent selection of optical filter and detector response characteristics). The length of the light path through the absorption cell must be known with an accuracy of at least 99.5%. In addition, the cell and associated plumbing must be designed to minimize loss of O_3 from contact with cell walls and gas handling components. See Reference 9 for additional information.

3.2 *Air flow controllers*. Devices capable of regulating air flows as necessary to meet the output stability and photometer precision requirements.

3.3 *Ozone generator*. Device capable of generating stable levels of O_3 over the required concentration range.

3.4 *Output manifold*. The output manifold should be constructed of glass, Teflon, or other relatively inert material, and should be of sufficient diameter to insure a negligible pressure drop at the photometer connection and other output ports. The system must have a vent designed to insure atmospheric pressure in the manifold and to prevent ambient air from entering the manifold.

3.5 *Two-way valve*. Manual or automatic valve, or other means to switch the photometer flow between zero air and the O_3 concentration.

3.6 *Temperature indicator*. Accurate to ±1 °C.

3.7 *Barometer or pressure indicator*. Accurate to ±2 torr.

4. Reagents

4.1 *Zero air*. The zero air must be free of contaminants which would cause a detectable response from the 0_3 analyzer, and it should be free of NO, C_2H_4 and other species which react with O_3. A procedure for generating suitable zero air is given in Reference 9. As shown in Figure 1, the zero air supplied to the photometer cell for the I_0 reference measurement must be derived from the same source as the zero air used for generation of the ozone concentration to be assayed (I measurement). When using the photometer to certify a transfer standard having its own source of ozone, see Reference 8 for guidance on meeting this requirement.

5. Procedure

5.1 *General operation*. The calibration photometer must be dedicated exclusively to use as a calibration standard. It should always be used with clean, filtered calibration gases, and never used for ambient air sampling. Consideration should be given to locating the calibration photometer in a clean laboratory where it can be stationary, protected from physical shock, operated by a responsible analyst, and used as a common standard for all field calibrations via transfer standards.

5.2 *Preparation*. Proper operation of the photometer is of critical importance to the accuracy of this procedure. The following steps will help to verify proper operation. The steps are not necessarily required prior to each use of the photometer. Upon initial operation of the photometer, these steps should be carried out frequently, with all quantitative results or indications recorded in a chronological record either in tabular form or plotted on a graphical chart. As the performance and stability record of the photometer is established, the frequency of these steps may be reduced consistent with the documented stability of the photometer.

5.2.1 *Instruction manual*: Carry out all set up and adjustment procedures or checks as described in the operation or instruction manual associated with the photometer.

5.2.2 *System check*: Check the photometer system for integrity, leaks, cleanliness, proper flowrates, etc. Service or replace filters and zero air scrubbers or other consumable materials, as necessary.

5.2.3 *Linearity*: Verify that the photometer manufacturer has adequately established that the linearity error of the photometer is less than 3%, or test the linearity by dilution as follows: Generate and assay an O_3 concentration near the upper range limit of the system (0.5 or 1.0 ppm), then accurately dilute that concentration with zero air and reassay it. Repeat at several different dilution ratios. Compare the assay of the original concentration with the assay of the diluted concentration divided by the dilution ratio, as follows:

$$E = \frac{A_1 - A_2 / R}{A_1} \times 100\% \qquad (3)$$

where:

E = linearity error, percent
A_1 = assay of the original concentration
A_2 = assay of the diluted concentration
R = dilution ratio = flow of original concentration divided by the total flow

The linearity error must be less than 5%. Since the accuracy of the measured flowrates will affect the linearity error as measured this way, the test is not necessarily conclusive. Additional information on verifying linearity is contained in Reference 9.

5.2.4 *Intercomparison*. When possible, the photometer should be occasionally intercompared, either directly or via transfer standards, with calibration photometers used by other agencies or laboratories.

5.2.5 *Ozone losses*: Some portion of the O_3 may be lost upon contact with the photometer cell walls and gas handling components. The magnitude of this loss must be determined and used to correct the calculated O_3 concentration. This loss must not exceed 5%. Some guidelines for quantitatively determining this loss are discussed in Reference 9.

5.3 *Assay of O_3 concentrations*.

5.3.1 Allow the photometer system to warm up and stabilize.

5.3.2 Verify that the flowrate through the photometer absorption cell, F allows the cell to be flushed in a reasonably short period of time (2 liter/min is a typical flow). The precision of the measurements is inversely related to the time required for flushing, since the photometer drift error increases with time.

5.3.3 Insure that the flowrate into the output manifold is at least 1 liter/min greater than the total flowrate required by the photometer and any other flow demand connected to the manifold.

5.3.4 Insure that the flowrate of zero air, F_Z, is at least 1 liter/min greater than the flowrate required by the photometer.

5.3.5 With zero air flowing in the output manifold, actuate the two-way valve to allow the photometer to sample first the manifold zero air, then F_Z. The two photometer readings must be equal ($I = I_0$).

NOTE: In some commercially available photometers, the operation of the two-way valve and various other operations in section 5.3 may be carried out automatically by the photometer.

5.3.6 Adjust the O_3 generator to produce an O_3 concentration as needed.

5.3.7 Actuate the two-way valve to allow the photometer to sample zero air until the absorption cell is thoroughly flushed and record the stable measured value of I_0.

5.3.8 Actuate the two-way valve to allow the photometer to sample the ozone concentration until the absorption cell is thoroughly flushed and record the stable measured value of I.

5.3.9 Record the temperature and pressure of the sample in the photometer absorption cell. (See Reference 9 for guidance).

5.3.10 Calculate the O_3 concentration from equation 4. An average of several determinations will provide better precision.

$$\left[O_3\right]_{OUT} = \left(\frac{-1}{\alpha l}\ln\frac{I}{I_0}\right)\left(\frac{T}{273}\right)\left(\frac{760}{P}\right) \times \frac{10^6}{L} \qquad (4)$$

where:

$[O_3]_{OUT}$ = O_3 concentration, ppm
α = absorption coefficient of O_3 at 254 nm = 308 atm^{-1} cm^{-1} at 0 °C and 760 torr
l = optical path length, cm
T = sample temperature, K
P = sample pressure, torr
L = correction factor for O_3 losses from 5.2.5 = (1-fraction O_3 lost).

NOTE: Some commercial photometers may automatically evaluate all or part of equation 4. It is the operator's responsibility to verify that all of the information required for equation 4 is obtained, either automatically by the photometer or manually. For "automatic" photometers which evaluate the first term of equation 4 based on a linear approximation, a manual correction may be required, particularly at higher O_3 levels. See the photometer instruction manual and Reference 9 for guidance.

5.3.11 Obtain additional O_3 concentration standards as necessary by repeating steps 5.3.6 to 5.3.10 or by Option 1.

5.4 *Certification of transfer standards*. A transfer standard is certified by relating the output of the transfer standard to one or more ozone standards as determined according to section 5.3. The exact procedure varies depending on the nature and design of the transfer standard. Consult Reference 8 for guidance.

5.5 *Calibration of ozone analyzers*. Ozone analyzers are calibrated as follows, using ozone standards obtained directly according to section 5.3 or by means of certified transfer standard.

5.5.1 Allow sufficient time for the O_3 analyzer and the photometer or transfer standard to warmup and stabilize.

5.5.2 Allow the O_3 analyzer to sample zero air until a stable response is obtained and adjust the O_3 analyzer's zero control. Offsetting the analyzer's zero adjustment to +5% of scale is recommended to facilitate observing negative zero drift. Record the stable zero air response as "Z".

5.5.3 Generate an O_3 concentration standard of approximately 80% of the desired upper range limit (URL) of the O_3 analyzer. Allow the O_3 analyzer to sample this O_3 concentration standard until a stable response is obtained.

5.5.4 Adjust the O_3 analyzer's span control to obtain a convenient recorder response as indicated below:

recorder response (% scale) =

$$\left(\frac{\left[O_3\right]_{OUT}}{URL} \times 100\right) + Z \qquad (5)$$

where:

URL = upper range limit of the O_3 analyzer, ppm
Z = recorder response with zero air, % scale

Record the O_3 concentration and the corresponding analyzer response. If substantial adjustment of the span control is necessary, recheck the zero and span adjustments by repeating steps 5.5.2 to 5.5.4.

5.5.5 Generate several other O_3 concentration standards (at least 5 others are recommended) over the scale range of the

O_3 analyzer by adjusting the O_3 source or by Option 1. For each O_3 concentration standard, record the O_3 and the corresponding analyzer response.

5.5.6 Plot the O_3 analyzer responses versus the corresponding O_3 concentrations and draw the O_3 analyzer's calibration curve or calculate the appropriate response factor.

5.5.7 Option 1: The various O_3 concentrations required in steps 5.3.11 and 5.5.5 may be obtained by dilution of the O_3 concentration generated in steps 5.3.6 and 5.5.3. With this option, accurate flow measurements are required. The dynamic calibration system may be modified as shown in Figure 2 to allow for dilution air to be metered in downstream of the O_3 generator. A mixing chamber between the O_3 generator and the output manifold is also required. The flowrate through the O_3 generator (F_0) and the dilution air flowrate (F_D) are measured with a reliable flow or volume standard traceable to NBS. Each O_3 concentration generated by dilution is calculated from:

$$[O_3]'_{OUT} = [O_3]_{OUT} \left(\frac{F_0}{F_0 + F_D} \right) \qquad (6)$$

where:

$[O_3]'_{OUT}$ = diluted O_3 concentration, ppm
F_0 = flowrate through the O_3 generator, liter/min
F_D = diluent air flowrate, liter/min

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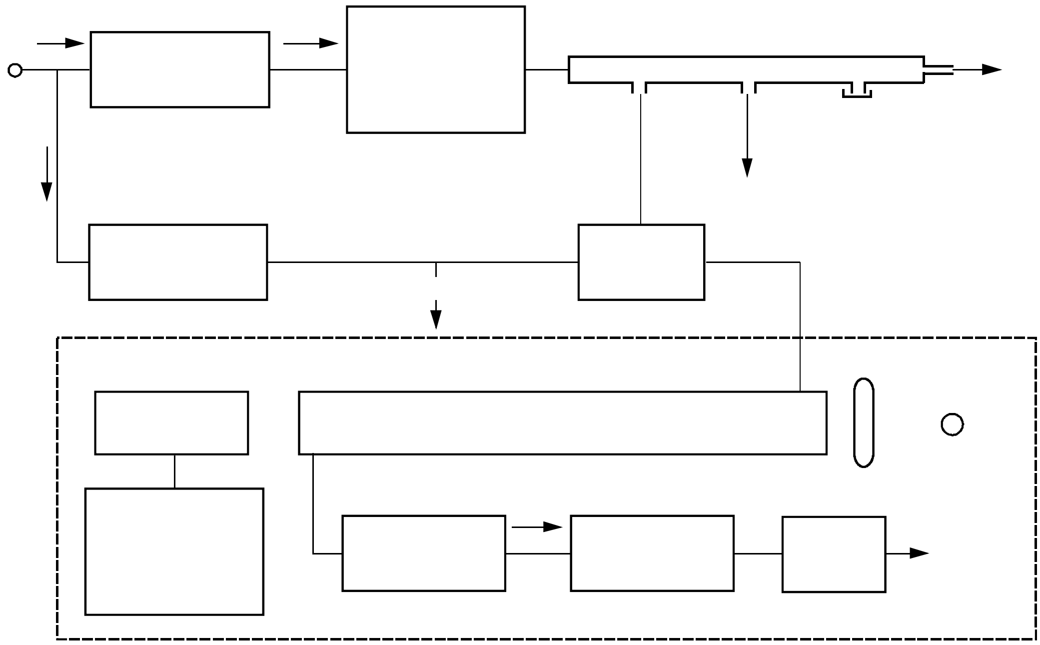

Figure 1 - Schematic diagram of a typical UV photometric calibration system

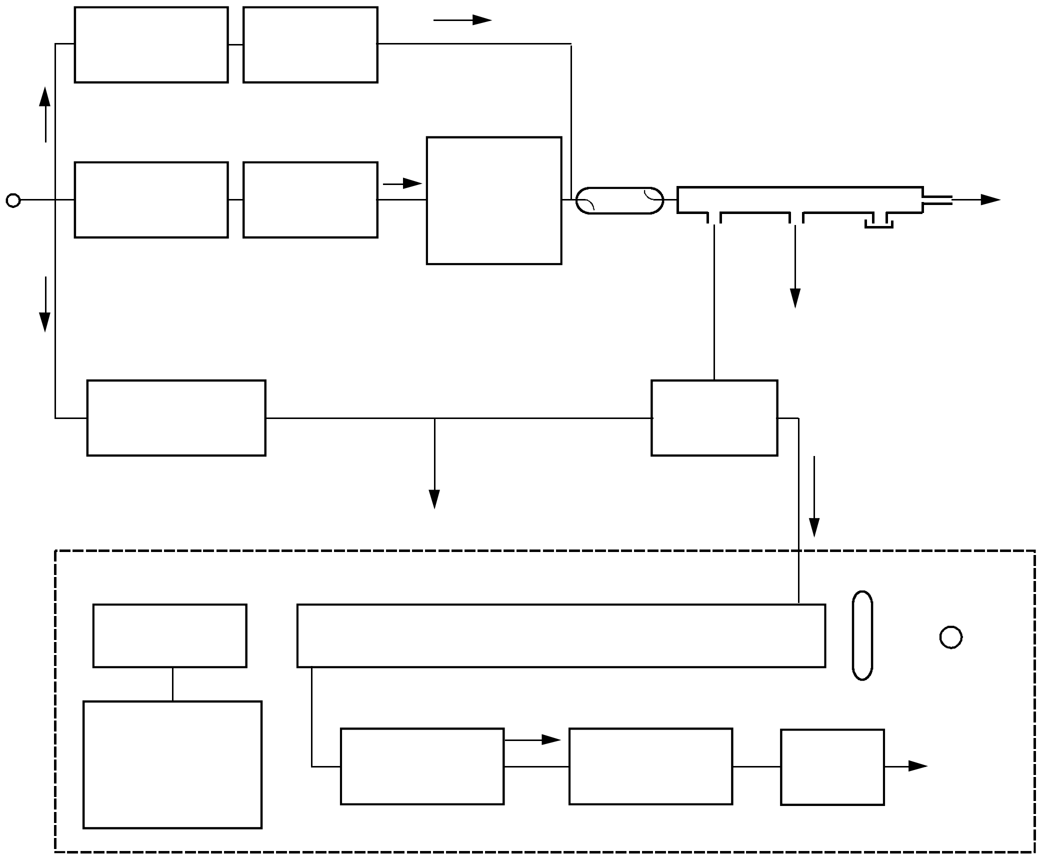

Figure 2 - Schematic diagram of a typical UV photometric calibration system

ESTEL Board

INPUTS / OUTPUTS BOARD

OPTION OF 2M ANALYZERS

- June 2009 -

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ESTEL BOARD

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3	05-2004	11	06-2009		
4	05-2004	12	06-2009		
5	05-2004	13	06-2009		
6	05-2004	14	06-2009		
7	05-2004	15	06-2009		
8	06-2009	16	06-2009		

1. ESTEL BOARD

ESTEL board is a universal board of logic and analog inputs/outputs for the 2M series analyzers. It is optional: it is possible to install up to 2 ESTEL boards in an analyzer.

1.1 FUNCTION AND USE

The ESTEL board has 4 functions:

- 4 Analog inputs,
- 4 Analog outputs,
- 6 Relays,
- 4 Remote controls.

The ESTEL board enables dialog with the measurement module and relieves it of the Inputs/Outputs functions. It enables remote control and/or remote signalling of certain functions as: "measurement", "zero", "calibration", "alarm".

The analog inputs are used to connect independent monitors in order to follow-up, for example, weather parameters.

The analog outputs enable to send numeric parameters (gas concentration to be analyzed, MUX channels) to analog independent peripherals in order, for example, to store and process several data of several months.

Equipped with an ESTEL board, the analyzer can work as an autonomous unit of analysis.

1.2 TECHNICAL CHARACTERISTICS

Management by specialized micro controller:

- 4 analog inputs of 12 bits, 0-2,5 volts full scale,
- 4 not-insulated analog outputs, configurable into: 0-1 volts, 0-10 volts, 0-20 mA, 4-20 mA (maximum load of 1000 Ohm).
- 4 insulated by optocoupler logic inputs,
- 6 potential-free contacts for remote signalling,
- only one power supply of 8 to 24 volts,
- i2C communication visualization using a LED.

Electric connection:

- 4-point connector for link with Module boards of 2M series,
- Inputs / Outputs centralized on only one female connector SUB D 37 points. This connector is screwed on the rear panel of the analyzer.
- Option of external connection, see paragraph 1.6

Voltage and current on relays:

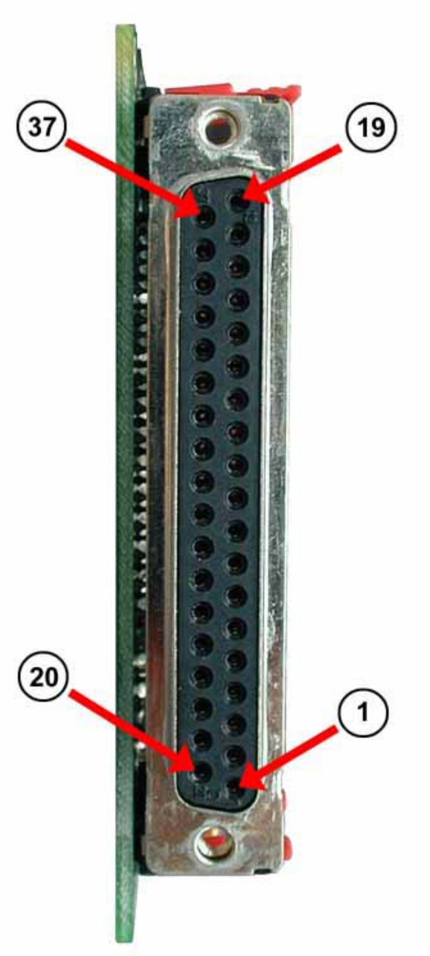
- Maximum voltage by relay contact : 50 volts
- Maximum current by relay contact : 1 Ampere at 24 V D.C. (resistive load)

Remote controls:

- By dry contact between (1-4) Remote control and ground Remote control.

1.3 CONFIGURATION

PIN N°	CONNECTION
1 + 20 GND	Analog output 1
2 + 21 GND	Analog output 2
3 + 22 GND	Analog output 3
4 + 23 GND	Analog output 4
5 + 24 GND	Analog input 1
6 + 25 GND	Analog input 2
7 + 26 GND	Analog input 3
8 + 27 GND	Analog input 4



PIN N°	CONNECTION
14-33	Relay contact 1
13-32	Relay contact 2
12-31	Relay contact 3
11-30	Relay contact 4
10-29	Relay contact 5
9-28	Relay contact 6
15 + 34 GNDI	Remote control 1
16 + 35 GNDI	Remote control 2
17 + 36 GNDI	Remote control 3
18 + 37 GNDI	Remote control 4
19	5 VCC or + 24 VCC

(*) according to SW5 jumper position

GND: ground

GNDI: insulated ground

Table 1 - Configuration of ESTEL board_index A

Jumpers mark	Symbols	Nature of operations
ST1, ST2, ST8		ESTEL selection, board N° 1
		ESTEL selection, board N° 2
		ESTEL selection, board N° 3
		ESTEL selection, board N° 4
ST3		0 V to ground (default)
		Floating 0 V
DAC1 DAC2 DAC3 DAC4		0-1 V, idem for the 4 DAC.
		0-10 V, idem for the 4 DAC.
		0-20 mA, idem for the 4 DAC.
		4-20 mA, idem for the 4 DAC.
P1, P2, P3, P4	4 mA adjustment in 4-20 mA mode	

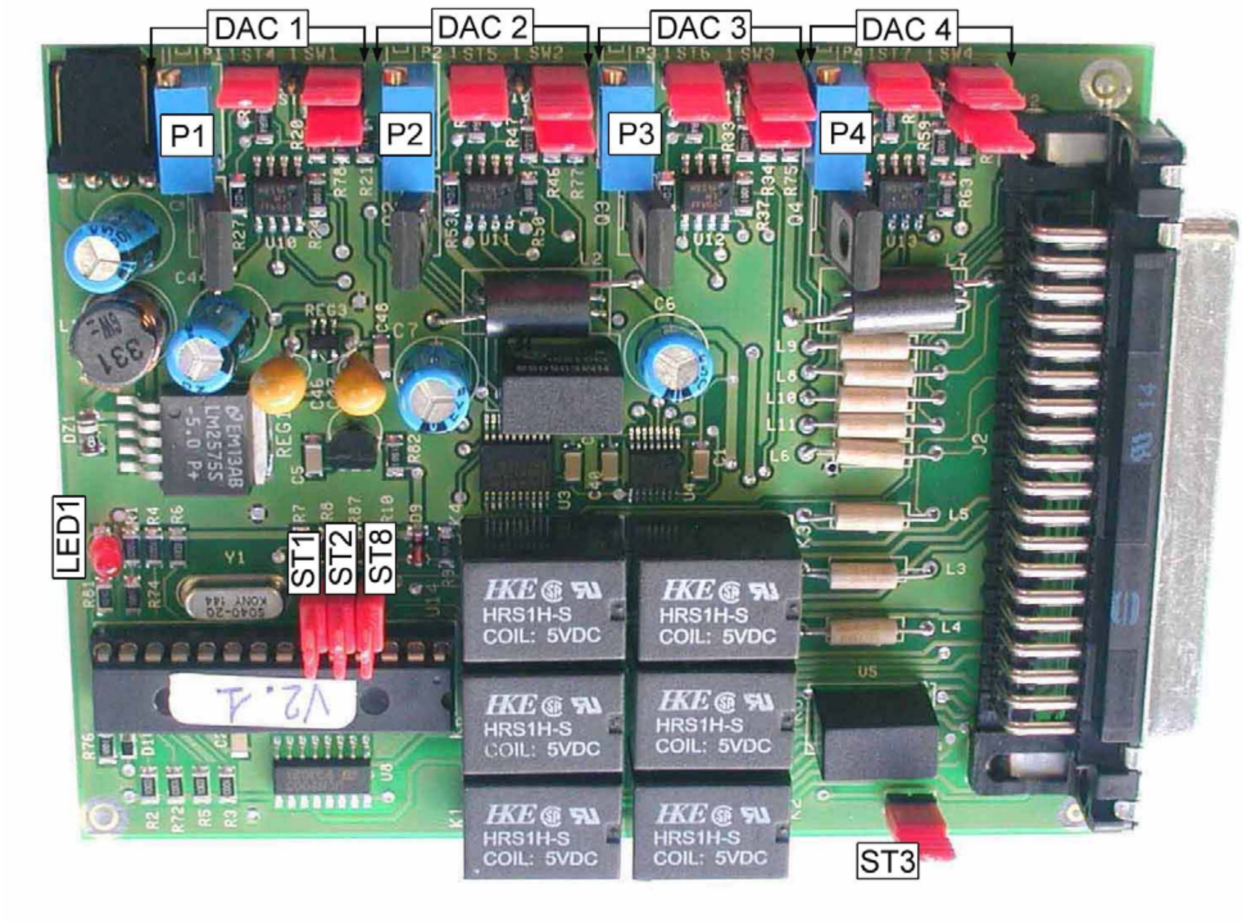


Figure 1 - ESTEL board_index A

Table 2 - Configuration of ESTEL board_index B

Jumpers mark	Symbols	Nature of operations
ST7, ST6, ST5		ESTEL selection, if 1 board
		ESTEL selection, if 2 boards
		ESTEL selection , if 3 boards
		ESTEL selection, if 4 boards
ST8		0 V to ground (default)
		Floating 0V
DAC 1		0-1 V (or optional 2,5 V and 10 V) idem for the 4 DAC
DAC 2		0-10 V, idem for the 4 DAC
DAC 3		0-20 mA, idem for the 4 DAC
DAC 4		4-20 mA, idem for the 4 DAC
SW5		Output 5 V Output 24 V } on pin 19

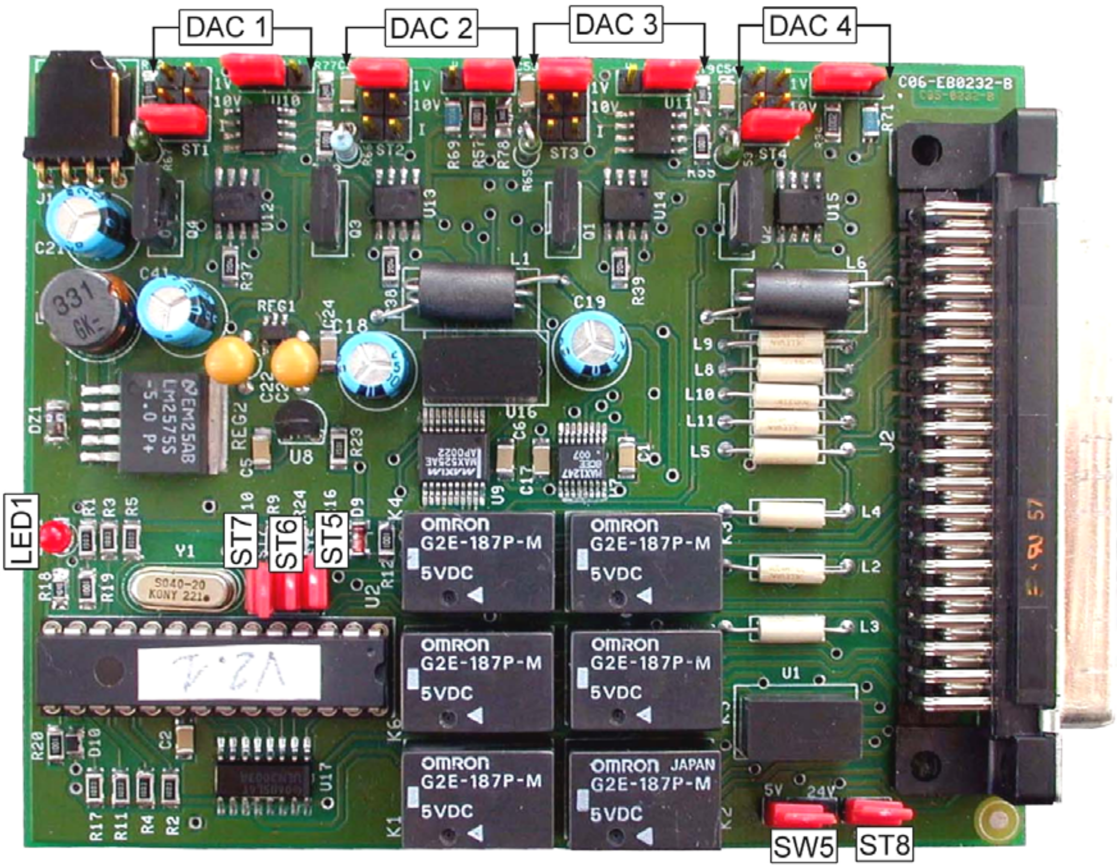


Figure 2 – ESTEL board-index B

Specific configuration of output 0-5 volts instead of 0-10 volts

There are 4 possible configurations for 0-5 volts output:

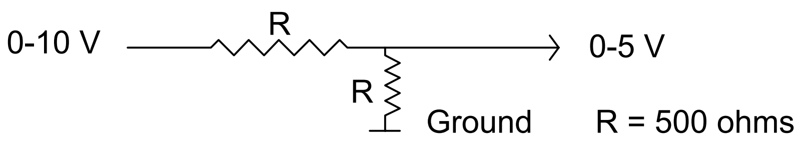
- Board configured into 0-10 volts with addition of a by-2 divider bridge :

The user (customer) carries out himself the operation at input of his acquisition system.

Operating mode:

Connect each analog output, previously configured into 0-10 volts, to ground through 2 resistances of equal value within 500 and 1000 ohms.

Take off the divided-by-2 signal at terminals of the resistance that is connected to the ground.



- Board configured into 0-10 Volts with adjustment of half gain :

In menu *Tests ⇨ ESTEL boards*, adjust the A and B coefficients of each channel in order to obtain 0-5V at analog output for 0-4000 pts resolution of analog-to-digital converter.

- Board configured into 0-20 MA

The user (customer) carries out himself the operation at output of his acquisition system.

Operating mode:

Connect each analog output, previously configured into 0-20 mA, to ground using a 250 0hms resistance, tolerance 1 %.

Voltage, thus generated, is equal to $U_{mV} = 250 \times I_{mA}$, that is to say 5 V for $I = 20$ mA.

Note: place resistance the nearest possible of receiver equipment.

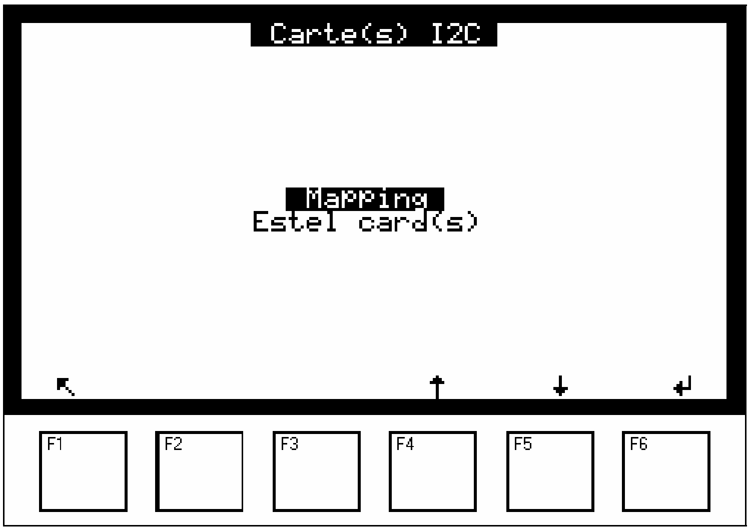
- Modification of gain resistance on ESTEL board

We carry it out if the user (customer) does not accept the other solutions.

1.4 PROGRAMMATION

The ESTEL board programmation is carried out from the « ESTEL board » menu of the « Carte(s) I2C » screen.

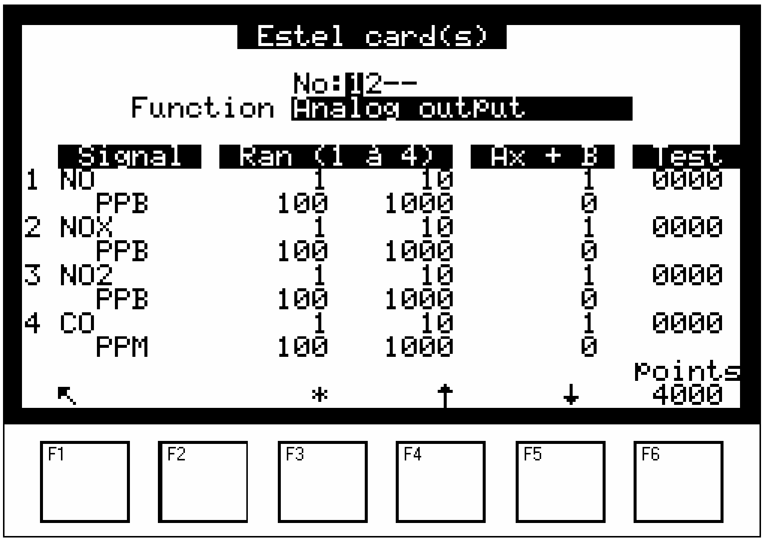
This menu enables to visualize the effective communications of the various modules and to configure the various ESTEL boards.



The analyzer automatically detects the presence of one or several ESTEL boards and offers menus enabling the user to adjust and configure each board.

1.4.1 ESTEL CARD(S) ⇨ Analog output

To access the various screens of the ESTEL board, select the current function and choose the wanted function using the **[↑], [↓]** keys.



<u>« Analog output » Function</u>

This screen enables to assign the parameters to the analog outputs for the ESTEL board whose n° indicated in the field « No » is highlighted. These parameters are:

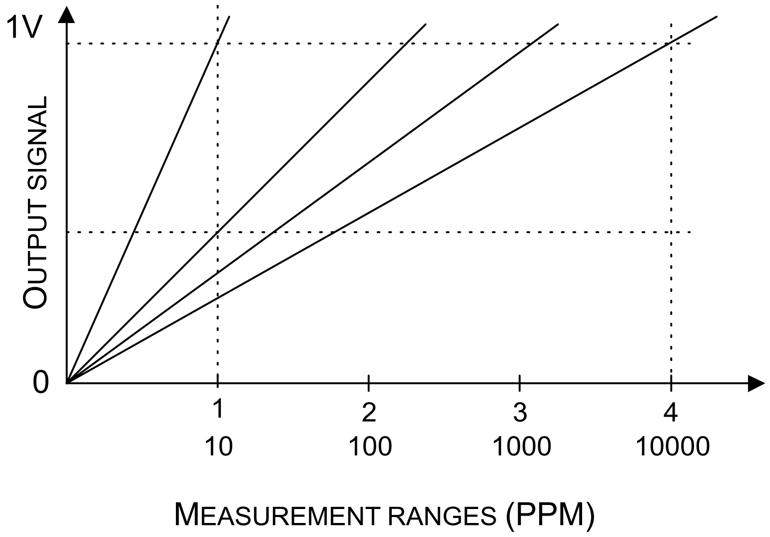
- Concentration of the analyzed gases,
- Auxiliary channels (multiplexer),
- Analog inlets.

REMINDER : On an ESTEL board, analog outputs can be configured into: 0–1 Volt, 0–10 Volt, 0-20 mA, 4–20 mA.

Four ranges are available and correspond to the full scale of the analog output, units are those of the parameters displayed in the « Signal » column.

When signal value is higher than the full scale of the current range, the analyzer switches to the next higher range. It switches again to the lower range when measurement again passes under 85%.

When the user assigns several measurement ranges to only one analog output, he can change the metrological resolution as the here-below curve shows it.



To avoid the ranges switching, the user must assign the same value to the 4 ranges of the parameter he will send to an analog output.

The Ax+B calibration curve is used to adjust the mV signal of the taken-into-account analog output.

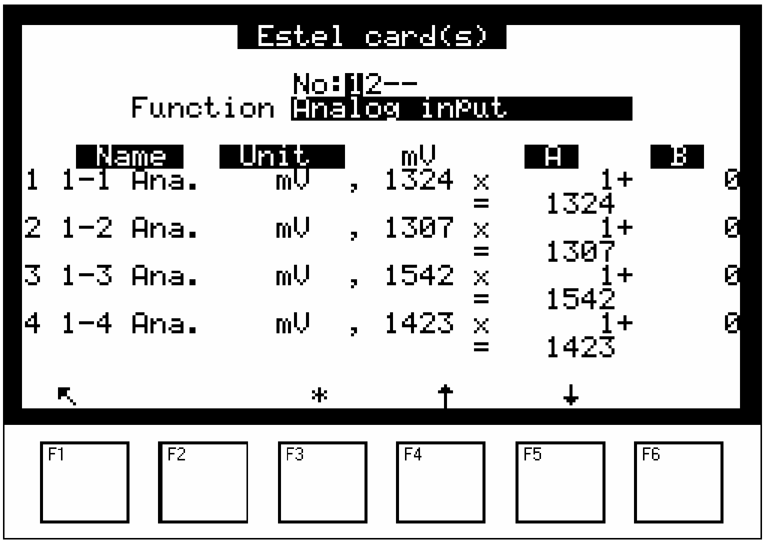
The « Test » column is used to test the 5 analog outputs and to adjust the points number.

For a range 1 :

– 0 point (lower scale of output) ⇨ 0 volt obtained at output,
– 4000 points (higher scale of output) ⇨ 1 volt obtained at output.

F6 key [Points 4000] enables to force the full scale on the whole analog outputs.

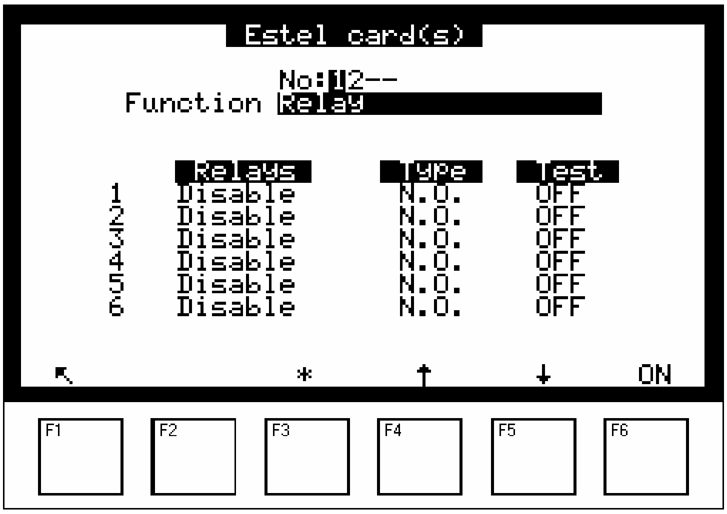
1.4.2 ESTEL CARD(S) ⇨ Analog input



Each ESTEL board has 4 analog inputs : this screen is used to program characteritics of these analog inputs.

- "Name" fields are used to enter a name of 8 alphanumeric digits.
- "Unit" fields are used to select the unit by : none, ppt, ppb, ppm, µg/m^3, mg/m^3, gr/m^3, µg/Nm^3, mg/Nm^3, gr/Nm^3, µg/Sm^3, mg/Sm^3, gr/Sm^3, %, µgr, mgr, gr, mV, U, °C, °K, hPa, mb, b,l, Nl, Sl, m^3, l/min, Nl/min, Sl/min, m^3/h, Nm^3/h, Sm^3/h, m/s ou km/h, in the toggle menu.
- The "Ax + B" fields enable to adjust the calibration curve of each parameter.

1.4.3 ESTEL CARD(S) ⇨ Relay

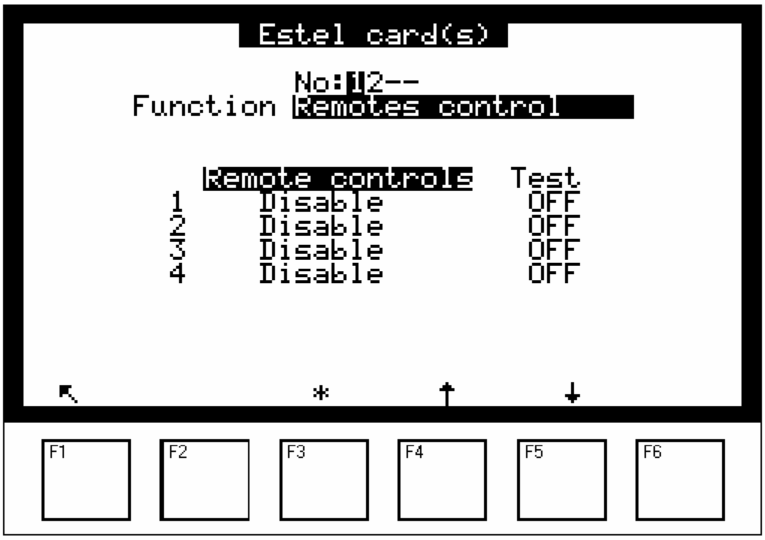


"Relays" fields are used to control relays according to the following conditions:

Disable	⇨ Relay not assigned
General alarm	⇨ Any operating fault triggers the relay
Range over-range	⇨ Scale 2 over range triggers the relay
Flow rate	⇨ Abnormal flow rate triggers the relays
Temperature	⇨ Abnormal temperature in the analyzer triggers the relay
Pressure	⇨ Barometric pressure in chamber
Zero Air	⇨ On Zero, relay is triggered
Span	⇨ On Span, relay is triggered
Zero-Ref	⇨ On Zero-Ref, relay is triggered
Auto Span	⇨ On Auto-Span, relay is triggered
Warm-Up	⇨ On Warm-up, relay is triggered
Stop mode	⇨ In Stop mode, relay is triggered
Alarm control	⇨ Control detection during threshold over range, relay is triggered.
Alarm or Control	⇨ Relay triggered
Module alarm	⇨ Alarm detected on module, relay triggered
Measure	⇨ Relay triggered
Maintenance	⇨ In Maintenance mode, relay is triggered

- The "Type" fields are used to control (NC) or not (NO) the relays when alarms are OFF.
- "Test" fields are used to manually control these relays.

1.4.4 ESTEL CARD(S) ⇨ Remote controls



This screen displays the assignment of remote control inlets.

The available assignment choice are : « Inactive», « Stop mode », « Zero Ref. », « Zero », « Span », « Auto span».

«Test» column is used to display the value read at remote control inlet, for the selected assignment.

1.5 INSTALLATION AND REPLACEMENT OF ESTEL BOARD

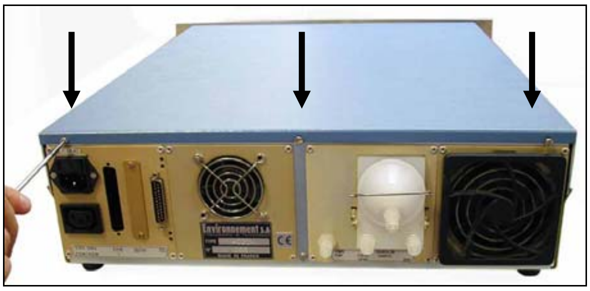
- Switch off the analyzer and unplug the mains cable before any maintenance work of the analyzer,
- Respect connection of ESTEL board / MODULE board at J20 when reassembling.

1.5.1 Switch off the analyzer

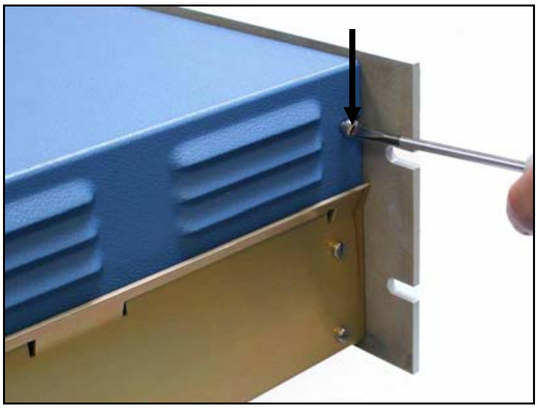
1.5.2 Unplug the mains cable

1.5.3 Put off the cover

(1) Unscrew the screws located on the rear panel of the analyzer

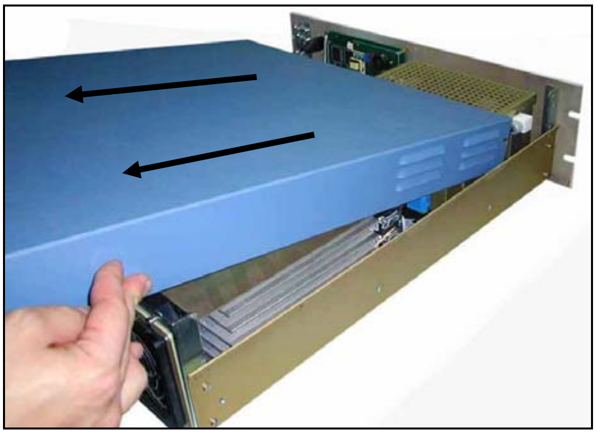


(2) Unscrew the screws located on lateral sides



(3) Lift up the cover

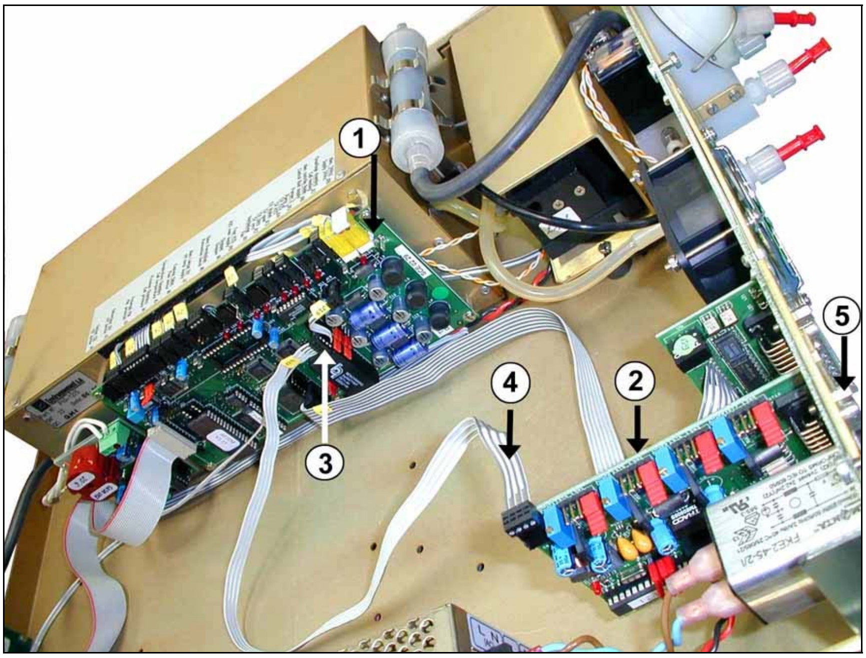
(4) Remove the cover by pulling it backward



If the analyzer is already equipped with an ESTEL board, follow step 1.5.4.

If the analyzer is not equipped with ESTEL board, follow step 1.5.5.

1.5.4 Dismount ESTEL board



(1) Module board

(2) ESTEL board

(3) J20 connector on Module board

(4) Connecting cable between Estel board / Module board

(5) Fixing screw of Estel board on rear panel of the analyzer

Disconnect the connecting cable between ESTEL board (4) / Module board (3).

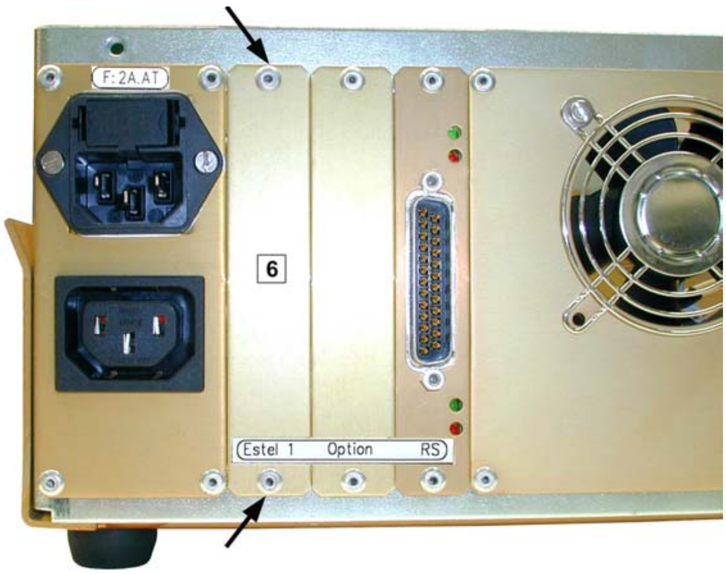
Unscrew the fixing screws (5) of ESTEL board on rear panel of the analyzer.

Remove ESTEL board.

Configure jumpers of the new board making functionality correspondences according to Table 1 or Table 2.

Re-assemble the board.

1.5.5 Unrivet the back plate (6) of rear panel of analyzer



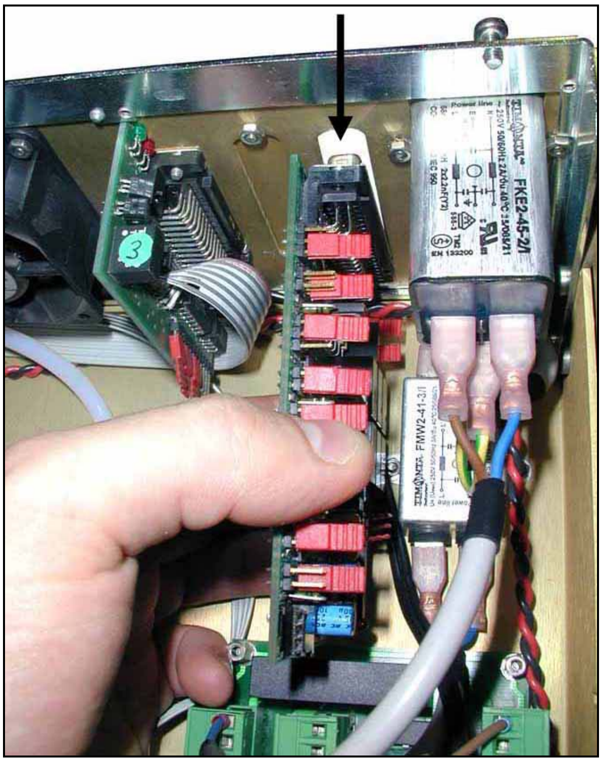
(7)

Then, install at the same place, the new plate (7) delivered with the board

1.5.6 Installation of board inside the analyzer

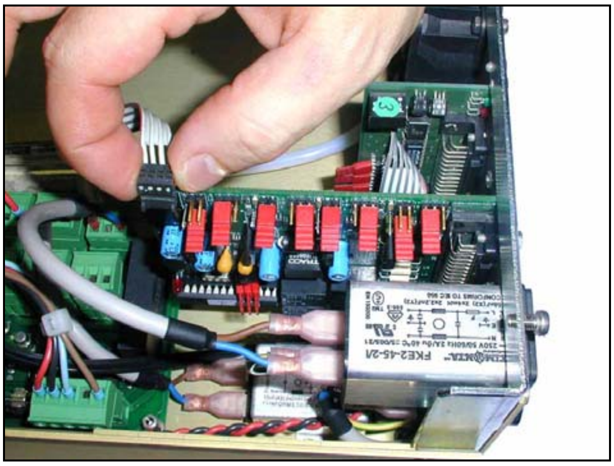
ANALYZER SWITCHED OFF

(1) Vertically insert the board inside its slot.

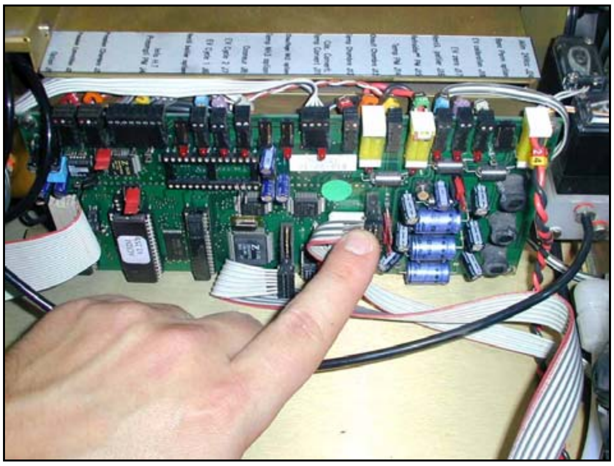


(2) Re-screw the board on the slot

(3) Fit again connector on ESTEL board



(4) Then, re-connect on Module board at **J20**



(5) Replace cover on the analyzer. See 1.5.3 .

(6) Connect mains cable and switch on the analyzer. See 1.5.2 and 1.5.1.

1.6 OPTION OF EXTERNAL CONNECTION

Five different options of ESTEL external connection are available:

DESIGNATION	REFERENCE	MARK
Option of external Estel connection	**P10-1337-A**	Figure 3
• Cable	• D02-INF-37-37M-M-A	(1)
• Tie-point block interface board	• C10-0012-A	(2)
• DIN track	• G13-IB-18066	(3)

DESIGNATION	REFERENCE	MARK
Option of external Estel connection + 4 insulated outputs.	**P10-1338-A**	Figure 4
• Cable	• D02-INF-37-37M-M-A	(1)
• Tie-point block interface board	• C10-0012-A	(2)
• Symmetrical DIN track Limit stop	• G13-IB-18066 D03-103-002-26	(3)
• 2-way galvanic insulator	• I11-Jk2000-2	(4)

DESIGNATION	REFERENCE	MARK
Option of external Estel connection + 1 insulated output	**P10-1350-A**	Figure 4
• Cable	• D02-INF-37-37M-M-A	(1)
• Tie-point block interface board	• C10-0012-A	(2)
• Symmetrical DIN track Limit stop	• G13-IB-18066 D03-103-002-26	(3)
• 1-way galvanic insulator	• I11-Jk2000-1	(4)

DESIGNATION	REFERENCE	MARK
Option of external Estel connection + 2 insulated outputs	**P10-1351-A**	Figure 4
• Cable	• D02-INF-37-37M-M-A	(1)
• Tie-point block interface board	• 10-0012-A	(2)
• Symmetrical DIN track Limit stop	• G13-IB-18066 D03-103-002-26	(3)
• 2-way galvanic insulator	• I11-Jk2000-2	(4)

DESIGNATION	REFERENCE	MARK
Option of external Estel connection + 3 insulated outputs	**P10-1352-A**	Figure 4
• Cable	• D02-INF-37-37M-M-A	(1)
• Tie-point block interface board	• C10-0012-A	(2)
• Symmetrical DIN track Limit stop	• G13-IB-18066 D03-103-002-26	(3)
• 2-way galvanic insulator 1-way galvanic insulator	• I11-Jk2000-2 I11-JK2000-1	(4)

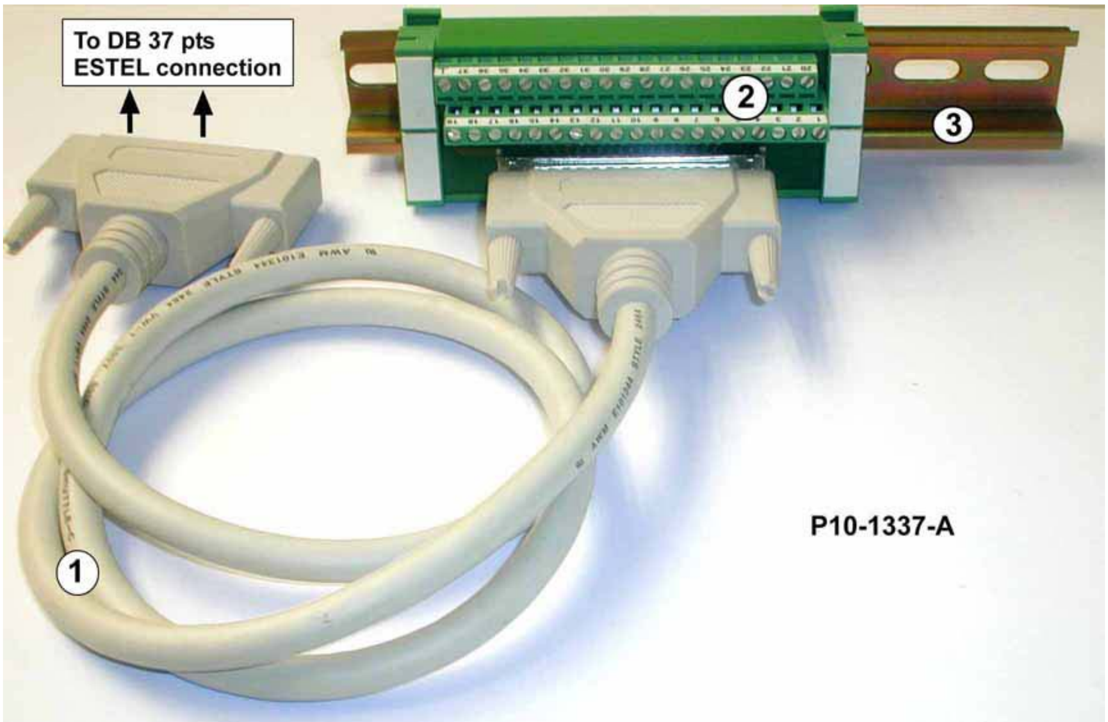


Figure 3 – Option of external connection P10-1337-A

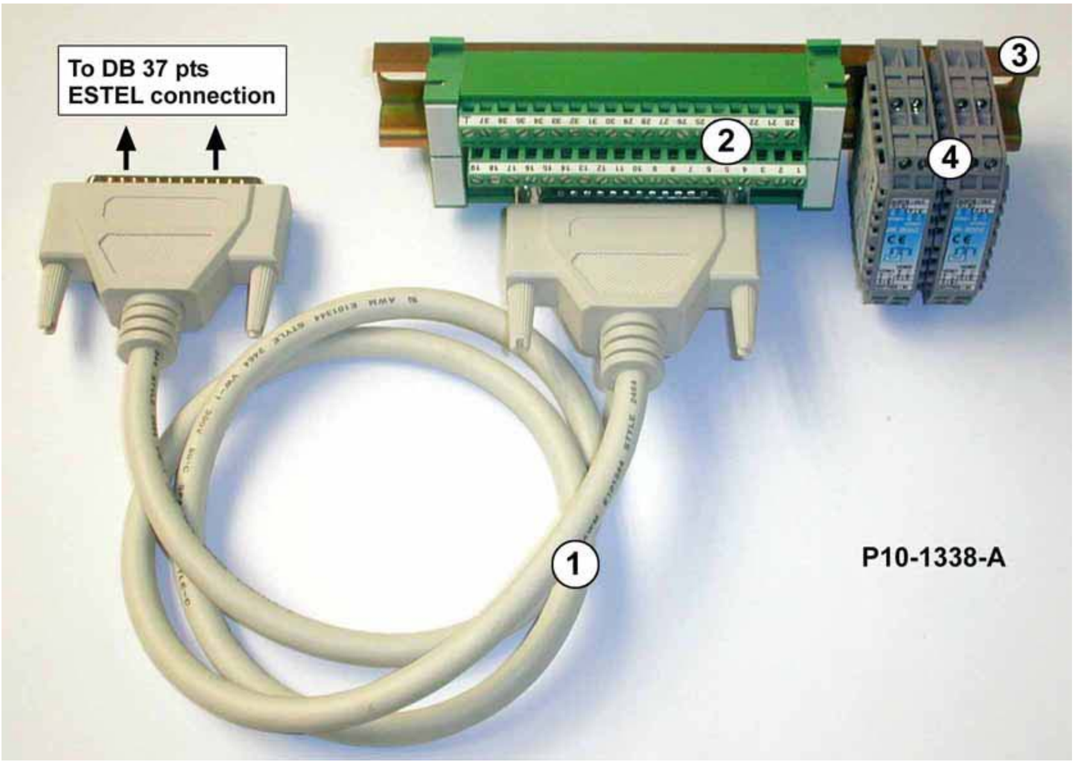


Figure 4 – Option of external connection + 4 insulated outputs P10-1338-A

SOREL Board

BOARD OF LOGIC INPUTS / OUTPUTS

OPTION OF 2M ANALYZERS

- April 2010 -

Environnement S.A
L'instrumentation de l'environnement
111 bd Robespierre, 78300 POISSY - -TEL. 33(0)-1.39.22.38.00 – FAX 33(0)-1.39 65.38.08
http://www.environnement-sa.com

SOREL BOARD

Up-to-date:

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9	05-04
10	05-04

1. SOREL BOARD

SOREL board is a universal board of logic inputs/outputs for the 2M analyzers. It is optional. It is possible to install up to 2 SOREL boards in an analyzer.

1.1 FUNCTION AND USE

SOREL board has 2 functions:

- Relays control (4 in all)
- Remote controls (4 inputs)

SOREL board communicates with measurement module through Bus i2C and relieves it of the Inputs/Outputs functions. It enables the remote control and/or the remote signaling of certain functions as: "measurement", "zero", "calibration" and "alarm".

1.2 TECHNICAL CHARACTERISTICS

Management by specialized micro controller:

- only one power supply of 24 volts,
- 4 logic inputs,
- 4 contacts for remote signaling, potential configurable by the user,
- Visualization of i2C communication using a LED.

Electric connection:

- 4-point connector for link with module boards of 2M series,
- Inputs / Outputs centralized on plug-in connector. This connector in screwed on the rear panel of the analyzer using a back-plate.

Voltage and current on relays:

- Maximum voltage by relay contact: 50 volts D.C.
- Maximum current by relay contact : 1 Ampere at 24 V D.C. (resistive load)

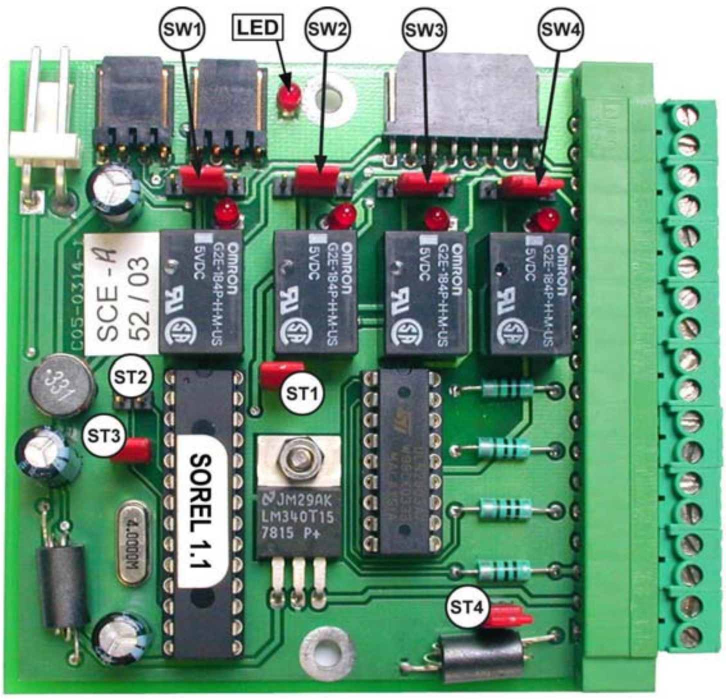
Voltage at logic inputs:

- Maximum voltage 24 V D.C.

1.3 CONFIGURATION

Table 1 - Configuration of SOREL board

JUMPERS MARK	SYMBOLS	NATURE OF OPERATIONS
ST1, ST2, ST3	▬ ▬ ▬	SOREL selection, board N° 1
	▬ ●● ▬	SOREL selection, board N° 2
	▬ ▬ ●●	SOREL selection, board N° 3
	▬ ●● ●●	SOREL selection, board N° 4
	●● ▬ ▬	SOREL selection, board N° 5
	●● ●● ▬	SOREL selection, board N° 6
	●● ▬ ●●	SOREL selection, board N° 7
	●● ●● ●●	SOREL selection, board N° 8
ST4	▬	0 V to ground (default)
	●●	Floating 0 V
SW1 Relay nb 1 SW2 Relay nb 2 SW3 Relay nb 3 SW4 Relay nb 4	●▬●	Potential free contact
	▬▬	Referenced contact to 0 V and 24V



18	Relay contact #4 (-)
17	Relay contact #4 (+)
16	Relay contact #3 (-)
15	Relay contact #3 (+)
14	Relay contact #2 (-)
13	Relay contact #2 (+)
12	Relay contact #1 (-)
11	Relay contact #1 (+)
10	GND
9	Remote control #4
8	GND
7	Remote control #3
6	GND
5	Remote control #2
4	GND
3	Remote control #1
2	+15V
1	+24V

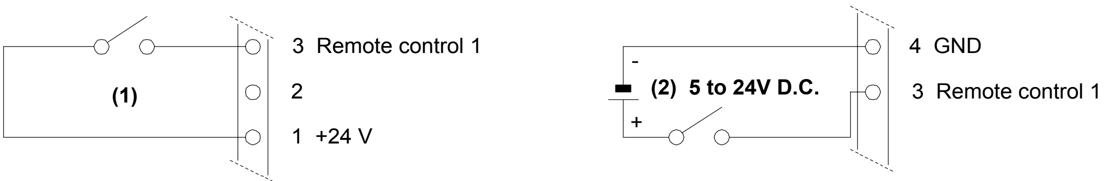


Figure 1 – SOREL board

NOTE: Output relay contacts are normally open when analyzer is switched off.

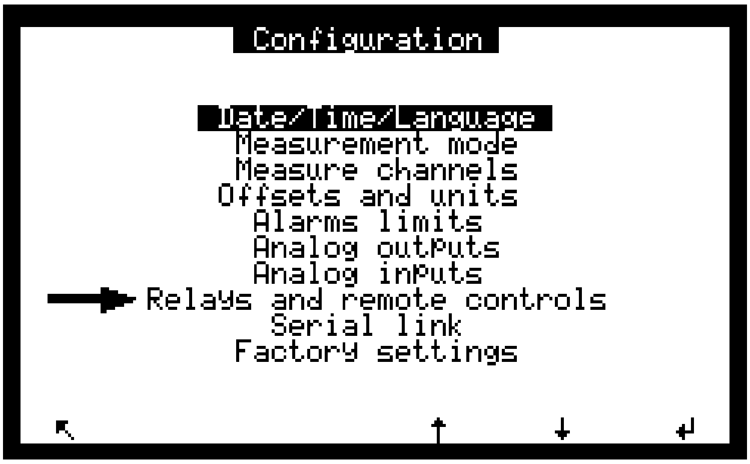
1.3.1 Programmation

The hereafter screens (§ 1.3.1 à § 1.3.3) are given as example.

Refer to technical manual of the analyzer in which SOREL board is installed.

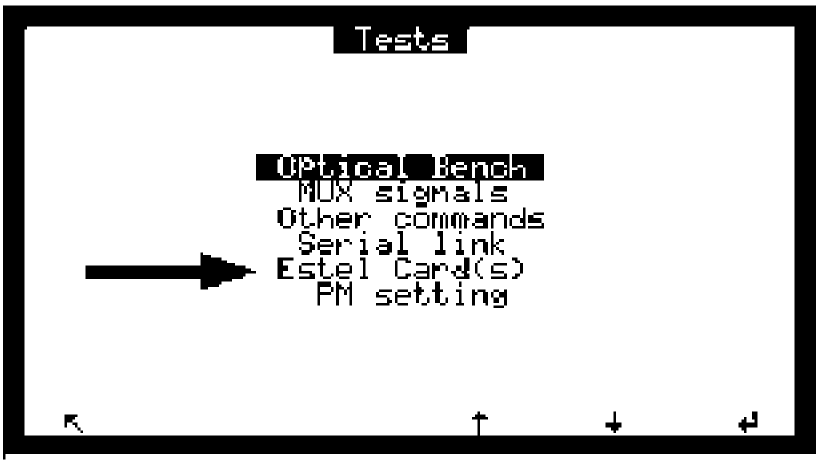
The analyzer automatically detects the presence of one or several SOREL and/or ESTEL boards and offers menus enabling the user to adjust and configure each board.

- In CONFIGURATION menu of main software program, the "Analog outputs", "Analog inputs", "Relays and remote controls" items are only displayed if the SOREL and/or ESTEL board option is available. **Only, the sub-menu "Relay and remote controls is necessary to program the SOREL board.**



- In the TESTS menu of the main program, **the item "ESTEL card" is displayed if one SOREL board at least is detected.**

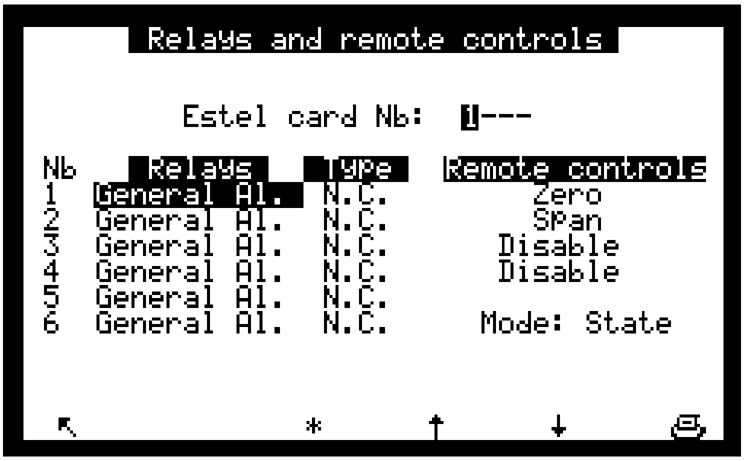
  The same screen as for ESTEL board must be used, but it is necessary not to take into account of data about analog inputs and outputs.



1.3.2 CONFIGURATION ⇨ Relays and remote controls

This screen enables to configure function of each input / output of SOREL and/or ESTEL board(s).

- **SOREL board is displayed as an ESTEL board,**
- The "ESTEL card Nb: " is used to select what board to configure.
- "Relays" fields are used to control the relays according to each analyzer: refer to *CONFIGURATION ⇨ Relays and remote controls* paragraph of the technical manual of your analyzer.



- The "Type" fields are used to program relays into "normally closed" (NC) or "normally open" (NO) when alarms are OFF.
- The "Mode" field is used to configure the working mode of remote controls.

Two different modes are possible:

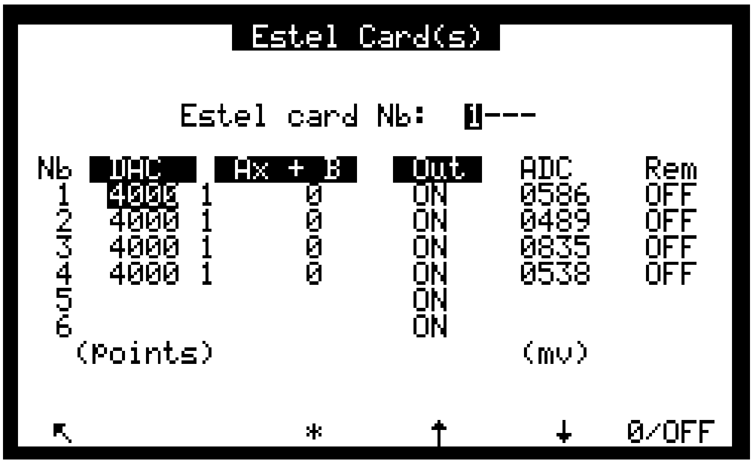
<u>"State" mode</u>: control is activated as long as remote control is active (closed contact).

<u>"Rise</u>" mode: control is activated when state modification of remote control is detected. When it is down, control remains active. A new modification of state de-activates control.

1.3.3 TESTS ⇨ ESTEL card

This screen is used to check operation of remote controls and relays.

Analog functionalities are not active for SOREL board.



The “Estel card Nb:” field is used to select the board to be tested.

The “Out” fields are used to control the relays manually.

The "Rem." fields are used to know state of these logic inputs.

Definition of the specific keys of this screen:

0/OFF Opens all the relay contacts.

4000/ON Closes all the relay contacts.

1.4 INSTALLATION OR REPLACEMENT OF SOREL BOARD

- Switch off the analyzer and unplug the mains cable before any maintenance work in the analyzer,
- Respect connection of SOREL board / MODULE board at J20 when reassembling.

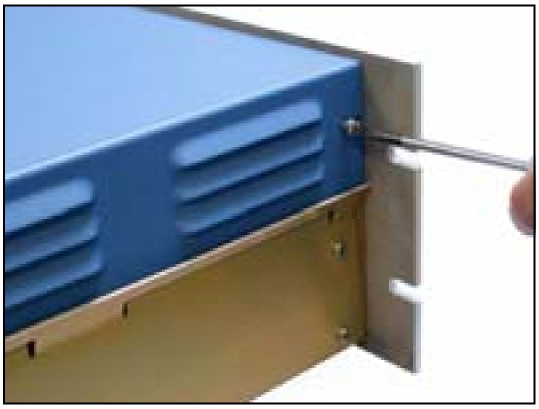
1.4.1 Switch off the analyzer

1.4.2 Unplug the mains cable

1.4.3 Put off the cover

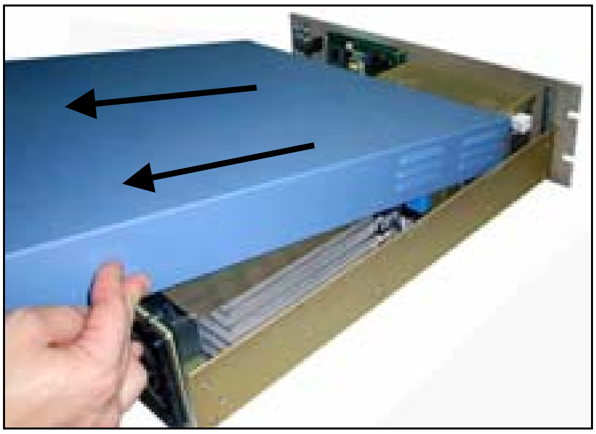
(1) Unscrew the screws located on the rear panel of the analyzer

(2) Unscrew the screws located on lateral sides



(3) Lift up the cover

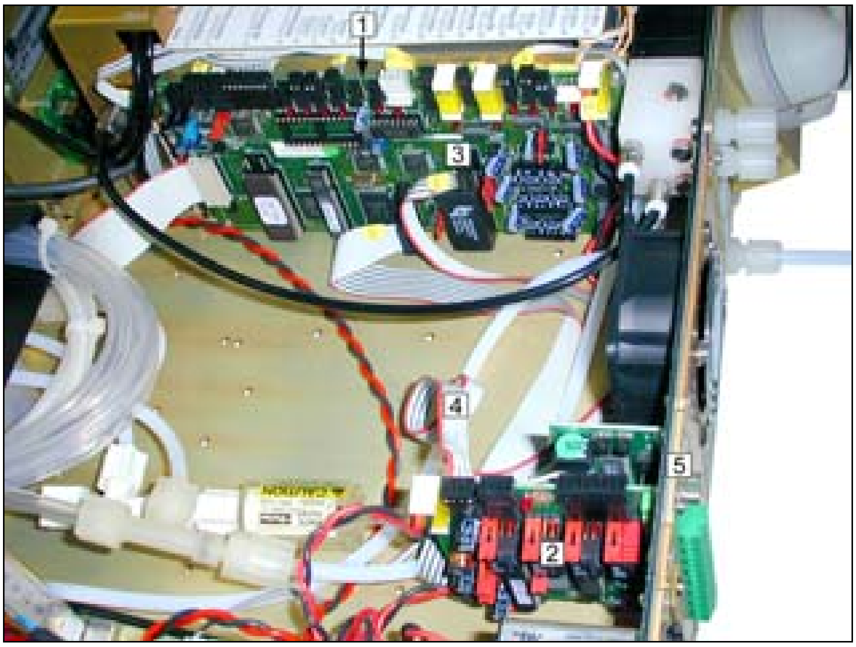
(4) Remove the cover by pulling it backward



If the analyzer is already equipped with a SOREL board, follow step 1.4.4

If the analyzer is not equipped with ESTEL board, follow step 1.4.5

1.4.4 Dismount SOREL board



(1) Module board

(2) SOREL board

(3) Connector J20 on Module board

(4) Connecting cable between Sorel board / Module board

(5) Fixing screw of Sorel board on rear panel of the analyzer

Disconnect the connecting cable between SOREL board (4) / Module (3) board.

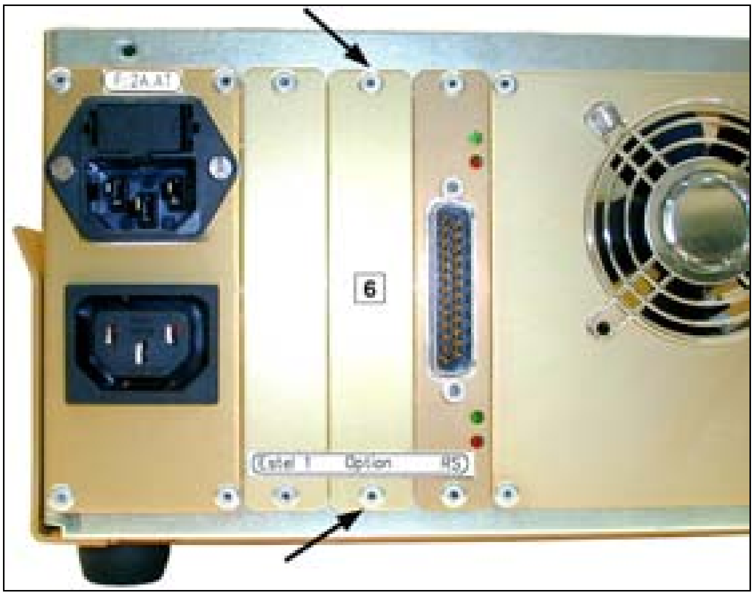
Unscrew the fixing screws (5) of SOREL board on rear panel of the analyzer.

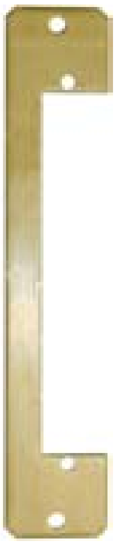
Remove SOREL board.

Configure jumpers of the new board carrying out correspondence of functionalities according to Table 1.

Re-assemble the board.

1.4.5 Unrivet the back plate (6) of rear panel of analyzer





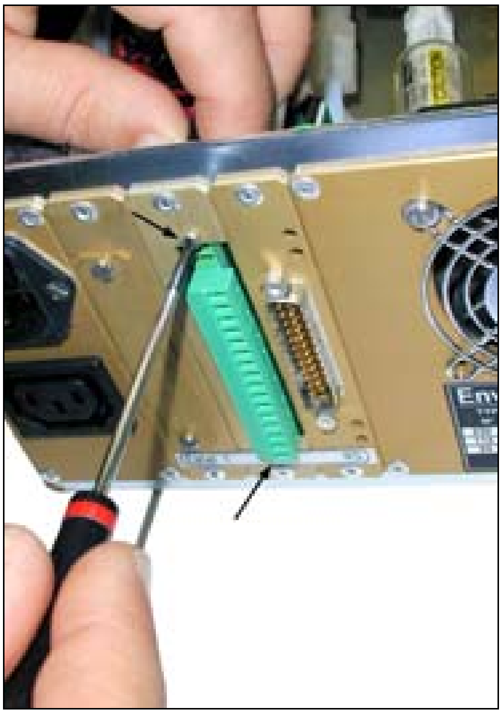
(7)

Then, install at the same place the new plate (7) delivered with the board

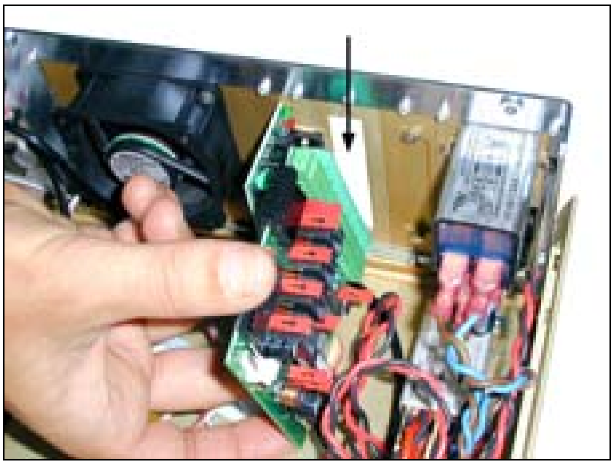
1.4.6 Installation of board inside the analyzer

ANALYZER SWITCHED OFF

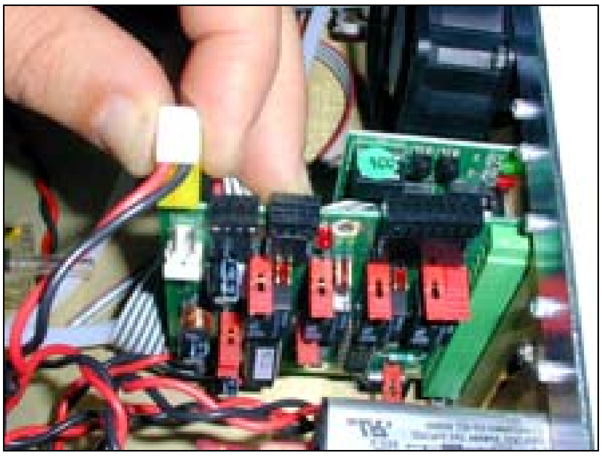
(2) Re-screw the board on back plate



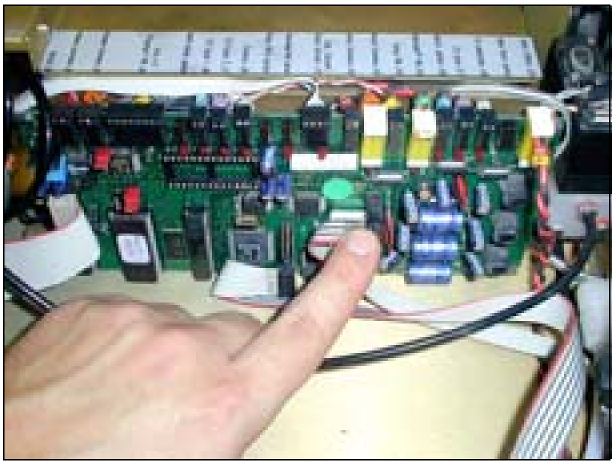
(1) Vertically insert the board inside its slot.



(3) Fit again connector on SOREL board



(4) Then, re-connect on Module board at **J20**



(5) Replace cover on the analyzer. See 1.4.3.

(6) Connect mains cable and switch on the analyzer. See 1.4.2 and 1.4.1.