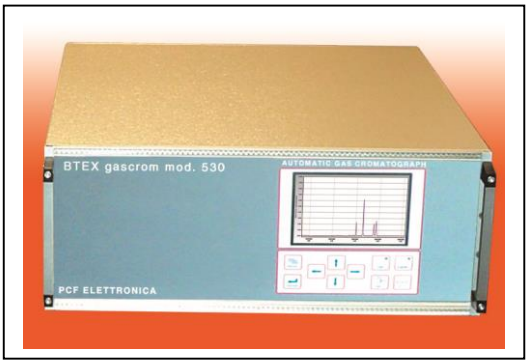
PCF Elettronica's MOD. 530 PID
BTEX Analyser

Benzene, Toluene, Ethyl-Benzene, Xylenes

SHOWING
EXCLUSIVE PURGE AND TRAP SYSTEM
GASCHROMATOGRAPHIC SEPARATION AND
RUNNING CROMATOGRAM DISPLAYED ON VIDEOGRAPHIC



Operating manual
[Release 28-06-2016]

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1.0 FOREWORDS.

PCF Mod. 530/PID BTEX analyser is an automatic gas chromatograph (GC) programmed to continuously and automatically measure aromatic compounds (BTEX, Benzene, Toluene, Ethyl-Benzene and m-p-o-Xylenes) in ambient air at trace levels.

Please note that working philosophy of an automatic GC is completely different from the standard ambient air analysers; the analysis is not continuous and the refreshing of measured values is at the end of analytical cycle (≈ 20 minutes)

1.1 INTRODUCTION

The present manual includes the following sections:

- general description of the analyser component parts
- description of commissioning start up procedure
- concise description of firmware
- concise analyser maintenance procedure
- most frequent trouble shootings.

The in built operative functions, the status, the temperatures and the data management are controlled by a powerful micro processor.

Thanks to a high capacity SD CARD, the analytical reference procedure (default configuration), each single measured value, the half hour-hour- eight hour and 24 hour mean values can easily be memorised.

The RS 232 serial connection can be employed either for printing reports on local printer or for remote and local connection to a data acquisition system.

Up to eight analogue 0-1Vdc or 4-20mA signals, relevant to the concentration of eight different components are always available on the analogue output PCB.

A LCD graphic digital display, a touch screen control facility is also available for most operations, shows statuses, measured values, recorded menus, that may be selected by the front panel key board, according the need and the variables of analytical program.

2.0 OPERATING PRINCIPLE

The PCF Elettronica Mod. 530/PID BTEX analyser detects and records basic aromatic hydrocarbons such as Benzene, Toluene, Ethyl-Benzene and m- p- o-Xylenes in a wide range of ambient conditions without any possibilities of water condensation or limitation in the ranges, measuring range from few tenths of ppbs up to a few ppms.

The instrument can be either employed in automatic monitoring systems or as a transportable version for air quality monitoring.

The basic analytical cycle is anticipated by a purge and trap step as to accumulate species and increase sensitivity of overall analysis.

The full analytical cycle is calibrated through calibration sources, such as traceable gas cylinders, permeation tubes or multipoint calibrators.

A pulling membrane pump fills a capillary (sampling loop), whose content, by switching of rotation valve (bimatic pneumatic valve), is passed on a GR Tenax trap by a carrier gas (that can be indifferently Nitrogen, Helium or Hydrogen; when changing the carrier gas the whole analytical recipe must be reprogrammed).

In order to increase sensitivity of the full system the latter operation can be repeated different times.

A capillary column will separate chemical species that are successively detected by PID detector.

The Photo Ionisation Detector (PID) is based on a UV (10.2 eVolt) continuous lamp that ionizes the organic compounds and a correspondent amount of ions are produced. The detector is therefore sensitive to the compounds structure, the unsatured compounds are easily broken and ionized, and the generated ions quantity is just proportional to the carbon amounts present in the sample.

The actual procedure for the detection of carbon atoms in the sample foresees the passing of the carrier gas in front of the UV (10.2 eVolt) lamp which brakes the carbon bonds and generates ions.

Such electrical charges, generated by the braking of the organic substances in gas sample are collected by two polarised metallic electrodes and converted in electrical current.

Successively these ionisation micro-currents are converted by an electrical circuit into voltage drops directly proportional to the currents generated in the flame.

The chromatogram of the analysis is continuously displayed on the touch screen graphic video display. The interval times of peak integration are displayed by different colour (red).

The values obtained by the above describe procedure are managed by the electronics then showed on digital display as well as made available at the outputs as analogue signals for local or remote recording and control.

3.0 TECHNICAL SPECIFICATIONS
(Benzene as reference)

- Measuring ranges : 0-100 µg/m^3 [≈ 30 ppb, as Benzene]
  : 0-1000 µg/m^3 [≈ 300 ppb, as Benzene]
- Measuring units : ppb or µg/m^3
- Sampled volume : 10 – 100 ml of air.
- Detector : PID (Photo Ionisation Detector).
- Measuring signal : direct or corrected for calibration values
- Background noise : ≤ 0.05 µg/m^3
- Lower Detectable Limit (LDL) : 0.1 µg/m^3
- Interference equivalent : <1 µg/m^3
- Zero stability (24 hours) : corrected automatically at every cycle
- Span drift (24 hours) : ≤ 1 µg/Nm^3
- Measuring cycle : 15-20 minutes (according to analytical cycle)
- Response time : 15-20 minutes (according to analytical cycle)
- Linearity : better than 1% full scale
- Precision : ± 0.5 µg/ m^3 Benzene equivalent
- Sample flow rate : 500 ml/min
- Instrument configuration : via key board on front panel
  or through SD card
- Operating temperature range : 0 – 40 °C
- Display : 640 x 200 pixel LCD graphic display
  (touch screen available)
- Analogue outputs : (8 x) 0-1 Vdc/4-20 mA
  Analogue outputs
- Digital I/O : 24 pin connector for 12 opto-isolated digital signal
- Serial outputs : RS 232 (9 pin connector) intended either for local/remote connection or for local printer connection

BTEX mod. 530/PID

- Services Carrier gas : 10 ml/min,
  either nitrogen or Hydrogen
- Calibration : via calibration loop from gas cylinder, multipoint calibrator or benzene permeation tube
- Sampling pump : WISA WIDO
- Mounting : standard 19" rack and/or transportable bench top
- Dimensions : 480x250x560 mm (19"x10"x22", WxHxD)
- Weight : 15 Kg
- Standard power supply : 220/110 Vac 50/60 Hz (to be specified in order)
- Power consumption : 650 W during heating up mode, 250 W in working mode
- Suggested calibration mixture : 20 ppb of Benzene, Toluene, Ethyl-Benzene and m-p-o-Xylene, air (Nitrogen) balance
- Pneumatic connections : 1/4" or 4/6 mm and 1/2 mm diameter tubes

4.0 FRONT PANEL DESCRIPTION

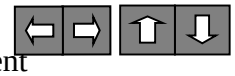
The front panel (see above figure) shows on the right hand side the touch screen colour video graphic display as well as a simplified control key board. In normal operation the operator can freely chose either to use the control key board or the touch screen facility. In the latter case we suggest to touch the screen either with a finger or with a stick (wood or plastic)

Access to the manometer set with relevant pressure reducers, to allow the setting of instrument service gas pressures, is allowed through a small door on the left hand side of the panel. Along with manometers and pressure reducers the gas chromatographic column by pass valve is also available (whenever needed).

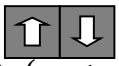
On the left hand side there is the CARRIER gauge (carrier gas) for the regulation of the carrier gas through the chromatographic column.

By opening the left hand side door access to SD memory card slot is also allowed, on this card analytical data, instrument set up and analytical method, that supervises the automatic procedure of desired analysis are recorded. This card can be extracted and easily read by a suitable standard reading support connected to a PC.

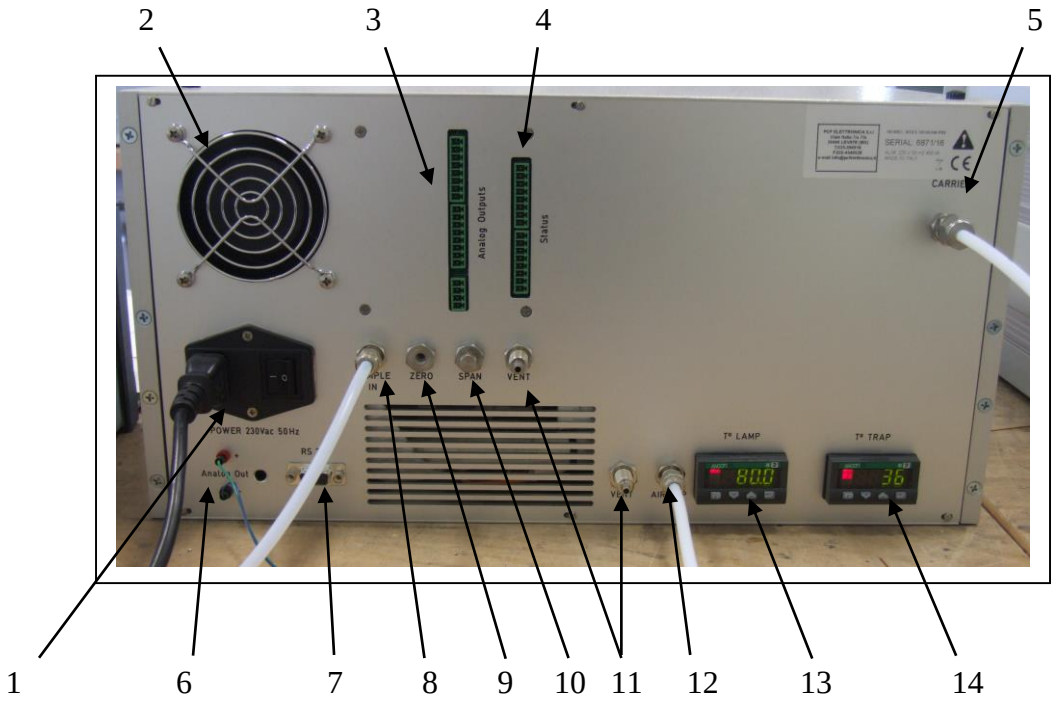
The key board is located on the lower part of the panel. As the implemented software is realised according to the menu driven procedure, the keys are reduced to a limited number:

- Four arrow keys  allow the cursor movement through the different

- menus as well as **increase or decrease** digital values.
- The **ENTER** button (or CONFIRM), to confirm the choice made by the operator.
- The **NO** button (or ABORT), to skip any wrong selections and/or return to previous menu step.
- The **PROG** button allows access to the PARAMETERS configuration menu.
- The **IGN** button allows the manual switching of the flame.
- The **A.ZERO** (AUTOZERO) allows the manual command of auto zeroing procedure of the chromatogram base line.

- **The ATT. (Attenuator)**  the (UP and DOWN) buttons allow the manual change of instrument measuring range (range selector). The range can be selected at any time of analytical cycle.

4.0 REAR PANEL VIEW



The rear panel (see figure above) includes the following items:

1. Input Power supply, 220/110 Vac, 50/60/Hz, 3 pin socket (1) including ON/OFF switch.
2. Cooling fan (2).
3. Analogue signal output, standard 16 pin female Cannon connector (3).
4. Instrument status and alarm output, standard 16 pin male Cannon connector (4).
5. Carrier gas (usually N_2) input connector (5).
6. PID OUTPUT, Photo Ionisation Detector analogue direct output from electrometer PCB , 0-10 Vdc (6).
7. RS-232 output, standard 9 pin female Cannon connector (7).
8. SAMPLE IN, gas connection for the sample gas input (8)
9. ZERO AIR, gas connection for Zero supply, same as PID AIR or N_2 (9).
10. SPAN, gas connection for the calibration gas input (10)
11. VENT, gas connection for venting gases out of analyser (11),
12. AIR SUP, gas connection for service air (5 Bar), intended for auxiliary services, pneumatic controls, automatic sampling valve etc. (12).
13. Temperature regulator of UV Lamp (13).
14. Temperature regulator of Tenax trap (14)

6.0 INSIDE VIEW

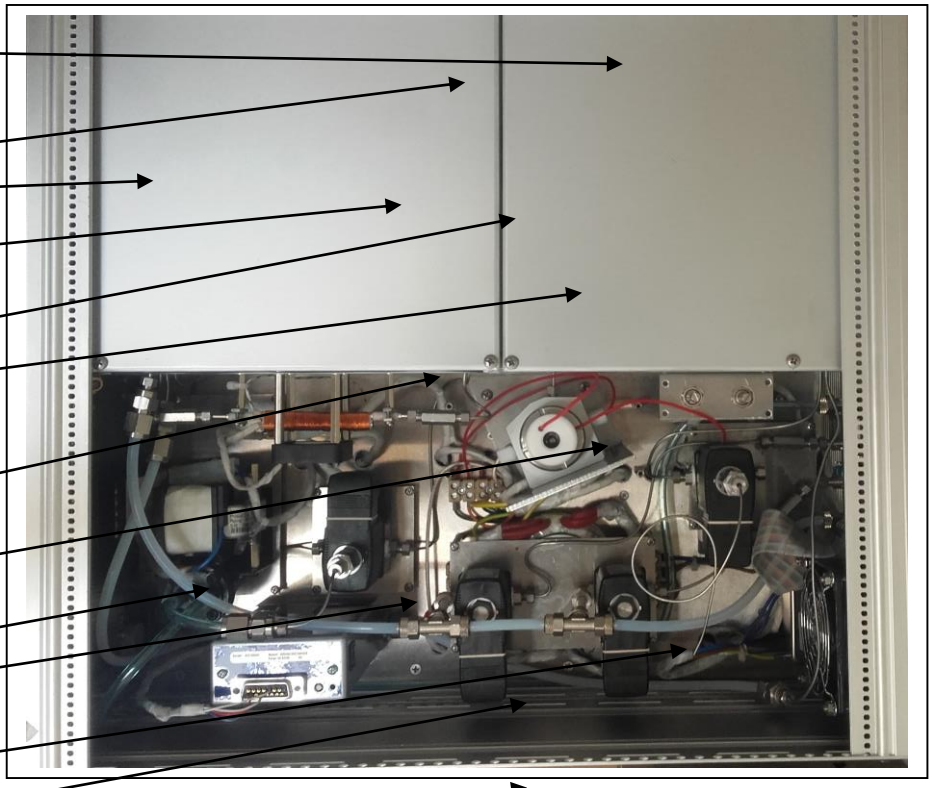
The great development in the field of integrate circuits, as well as the use of very high integrated chips, has greatly reduced the room occupied by electronics that manages all the instrument firmware. Inside the instrument we find the main Mother Board located on the right hand side, while the PCB carrying key board and LCD display is on the inner front panel,;on the rear, the PCB with all status and alarm signals, the analogue outputs and the connectors for remote connection is located.

The electrometer, the only electronic part that's separated from main electronics as it is a very high gain analogue amplifier, is located on the right hand side of equipment (as near as possible to PID detector).

The analysis chamber is the part that takes the largest room inside the instrument. It is located in the corner between the bottom and the right hand side and takes one third of the whole instrumental room. Inside the chamber the whole analytical circuit, the chromatographic column, the sampling and gas flow rate control capillaries, the ten port rotation valve as well as the PID detector are positioned.

In case of hydrogen as carrier gas is selected the thermally controlled analytical chamber will be continuously flushed with ambient air.

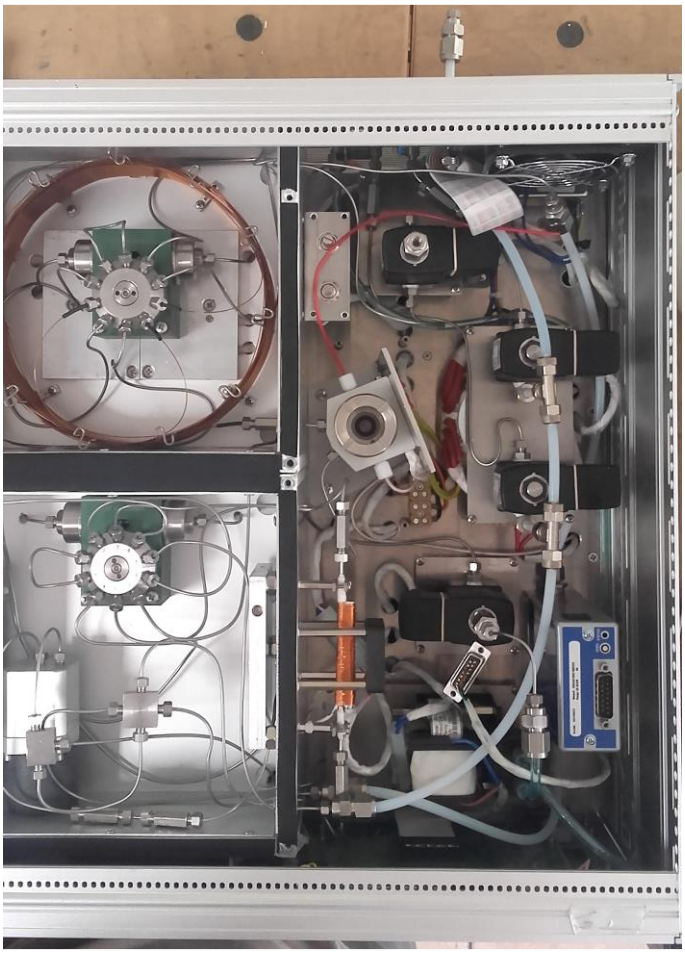
1) 230 Vac 50 Hz Power supply connector
2) Analogue & alarms output board
3) Analysis Chamber
4) Lamp reg. potentiometer
5) Pre-column wash electro valve
6) Zero electro valve
7) PID Detector
8) Span electro valve
9) Pneumatics chamber
10) Tenax trap
11) Mass Flow (carrier) Controller
12) Sampling pump
13) Electric trafo

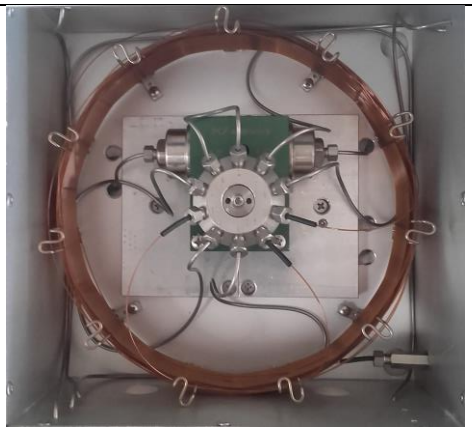


Further views from the top with removed the covers of shield:

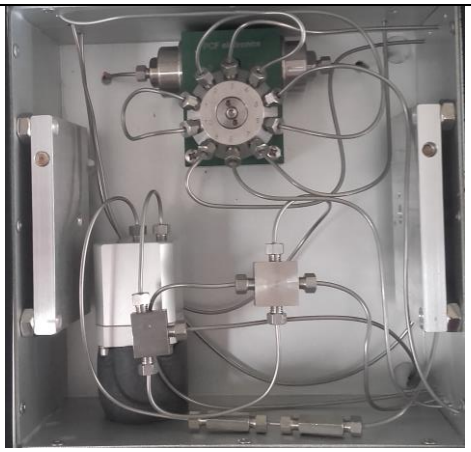
rear side

front side





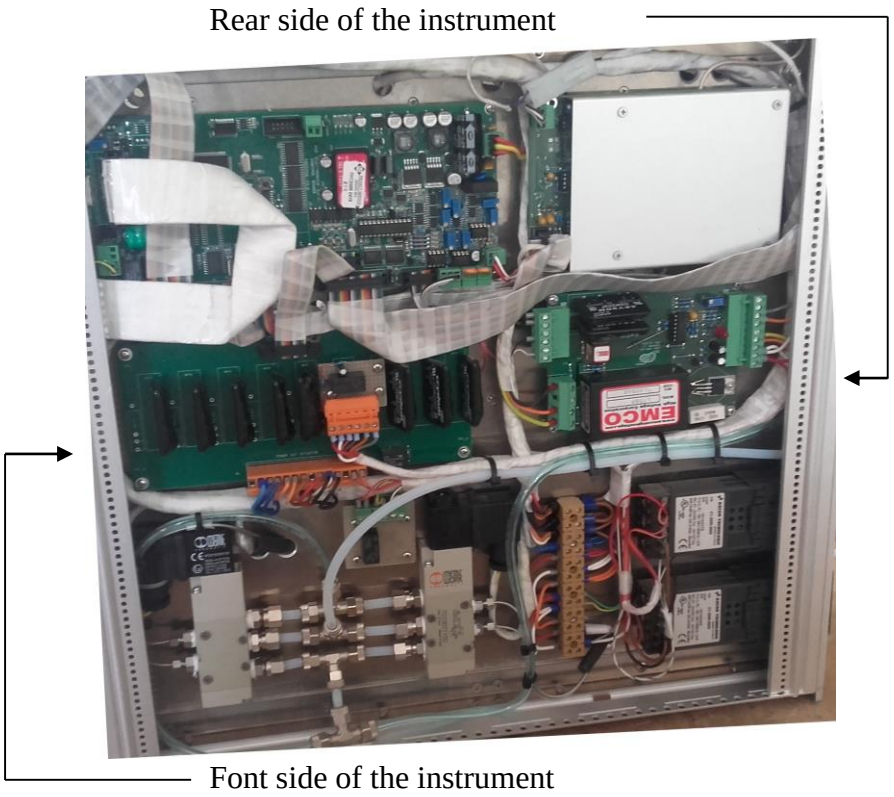
Top view of the analytic chamber:
Note:
The ten port pneumatic rotation valve.
The thermo stating plate under the valve.



Top view of the analytic chamber:
Note:
the ten port pneumatic rotation valve,

The column and pre column, to be replaced just as delivered. When replacing the columns please take note of connections and take care not to spoil the treads.	the thermo stated flow controller, set from the front panel, the thermo stating plates

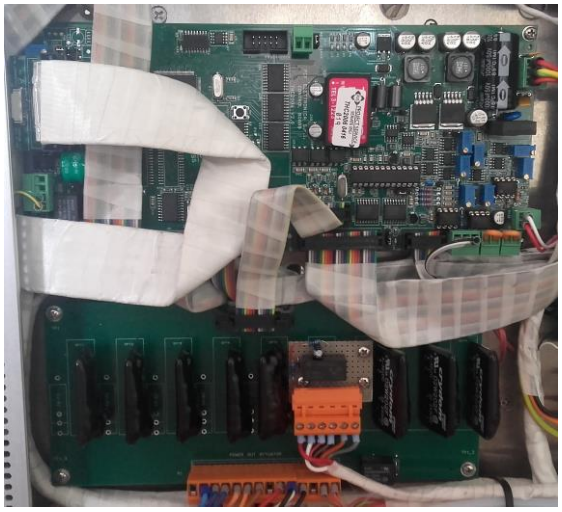
View of the bottom side of Mod. 530/PID when the cover shields is removed:



From top down:

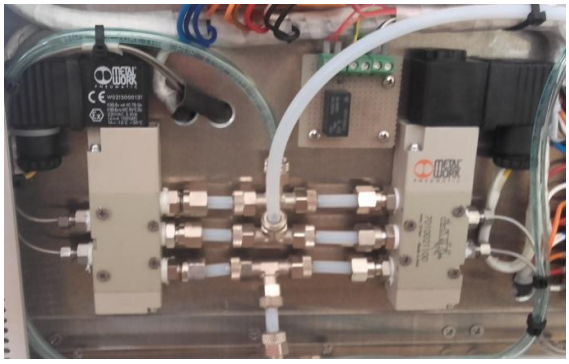
1- Left hand top side: main board PCB, with mounted the microcomputer chip.
2- Below the main board: Solid state relays PCB.
3- Right hand top side: Electrometer amplification board PCB, shielded against electrostatic interferences.
4- Below the electrometer board: UV lamp (10.2 e Volt) power supply board PCB.
5- Left hand bottom side: Pilot electro valves driving the pneumatic rotation valves.
6- Right hand bottom side: Tenax trap and PID detector temperature controllers.

The micro computer main board PCB and Solid State Relays (SSR) PCB



On the top the electrometer amplification PCB, shielded to avoid electrostatic interferences.

The two ten port pneumatic piloting electrovalves:
The right hand side one pilots the columns rotation valves
The left hand side one pilots tenax trap rotation valve



The temperature control units:
The top one controls the temperature of PID detector
The bottom one controls the temperature of Tenax trap
Both temperature controllers have the display on the rear panel of the instrument.

6.1 PHOTO IONIZATION DETECTOR (PID)

Separated in its component parts from bottom up: The base of the PID, The UV (10.2 e Volt) lamp. The mechanical support of the UV lamp. The UV lamp excitation ring. 	PID power supply board 

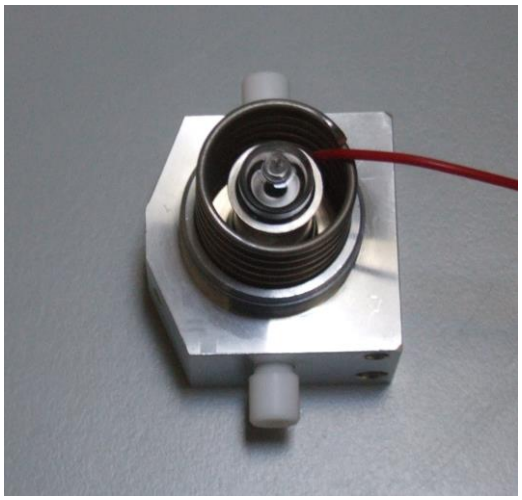
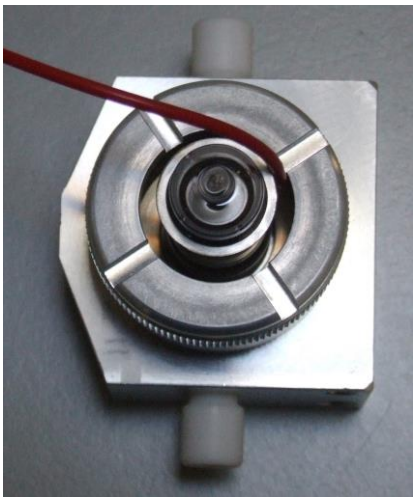
The PID is the core of the BTEX analyser.

It shows a central nozzle that receives through a capillary the carrier gas carrying the sample compounds.

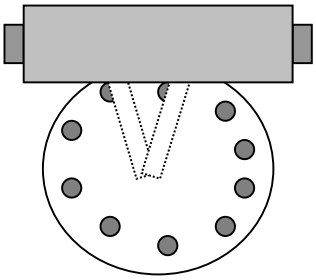
The nozzle is polarised, from an external power supply by a positive voltage of 300 Vdc with very low electrical currents. A metallic ring on the top of the nozzle collect the ionisation current and takes it to the input of electrometer circuit.

The PID detector is more sensitive to aromatic compound than the PID (Photo Ionization) detector, still it is not as stable.

Do not worry if you find that the PID detect is not always repeatable and if it decays in the time, particularly in the first period of life time of the UV lamp. Be ready to check calibration frequently and, eventually to increase the amplification of the signal.

The UV (10.2 e Volt) lamp. 	The UV (10.2 e Volt) lamp mounted on the PID socket. 
The UV (10.2 e Volt) lamp, mounted on the PID socket, with fixing spring and excitation ring 	The UV (10.2 e Volt) lamp, mounted on the PID socket, with the mechanical support 

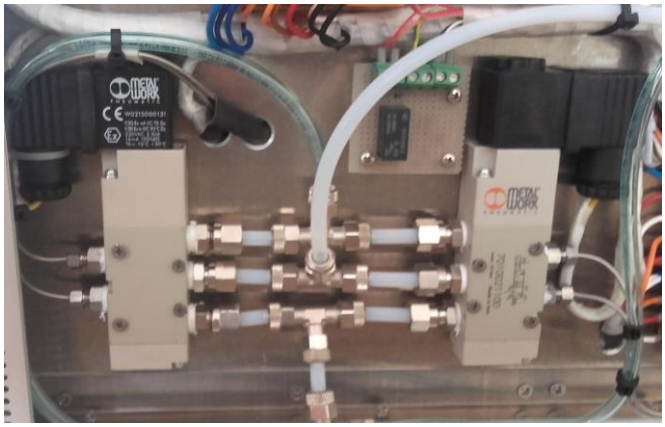
6.2 BIMATIC ROTATION VALVE



Rotation valve RV1

It is a ten port rotation valve that connects all the pneumatic circuits. The switching of the valve is controlled by compressed air supplied through a four way commanding solenoid valve.
Similar valve allows the interconnection of other pneumatic circuits.
In this instrument a single ten port valve is mounted and is intended for automatic sampling of air under analysis.
In the pneumatic schematics the position of the driving mechanism, in the exited and not excited position respectively is indicated during different analysis phases
The ten port rotation valve is conventionally indicated as **RSV1** (F9).

The two ten port pneumatic rotation valves piloting electro valves:

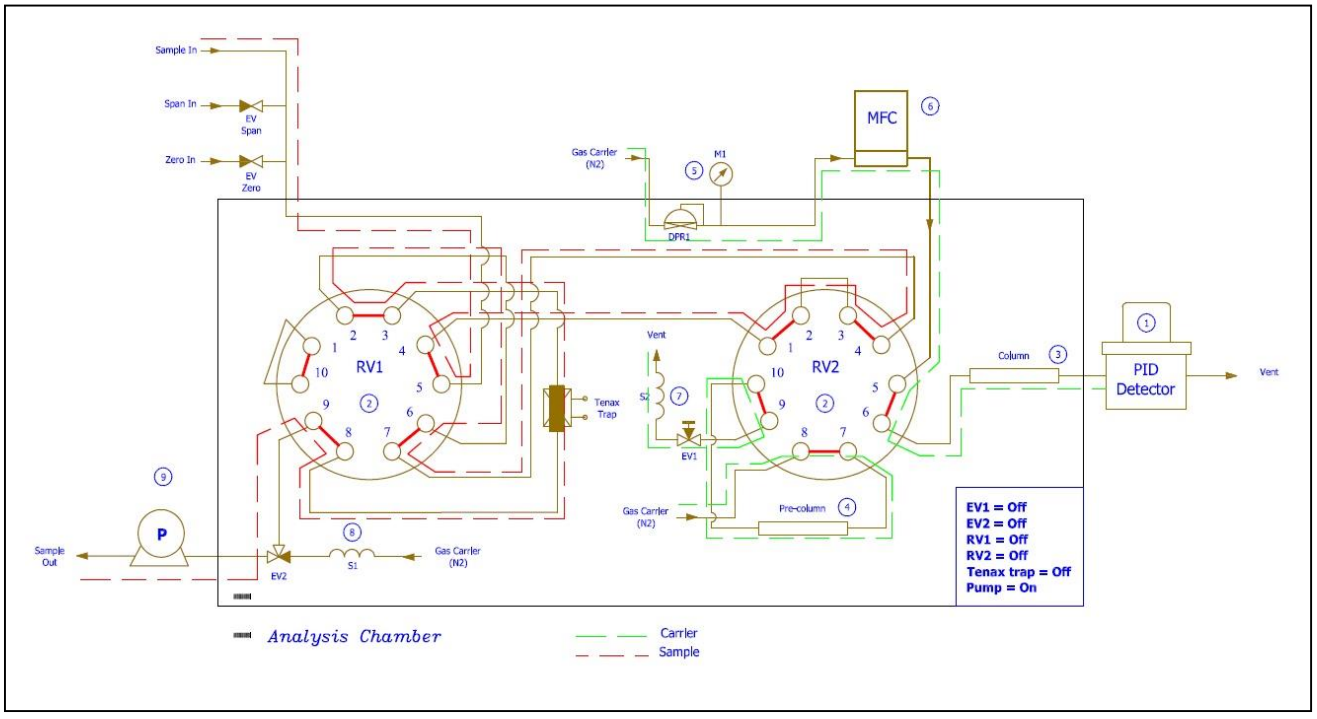


On the left hand side the piloting electro valves that drives tenax trap rotation valve:
On the right hand side hand side the one that drives per-column and column rotation valves

7.0 WORKING SEQUENCES.

Phase 1 (see BTX1 scheme)

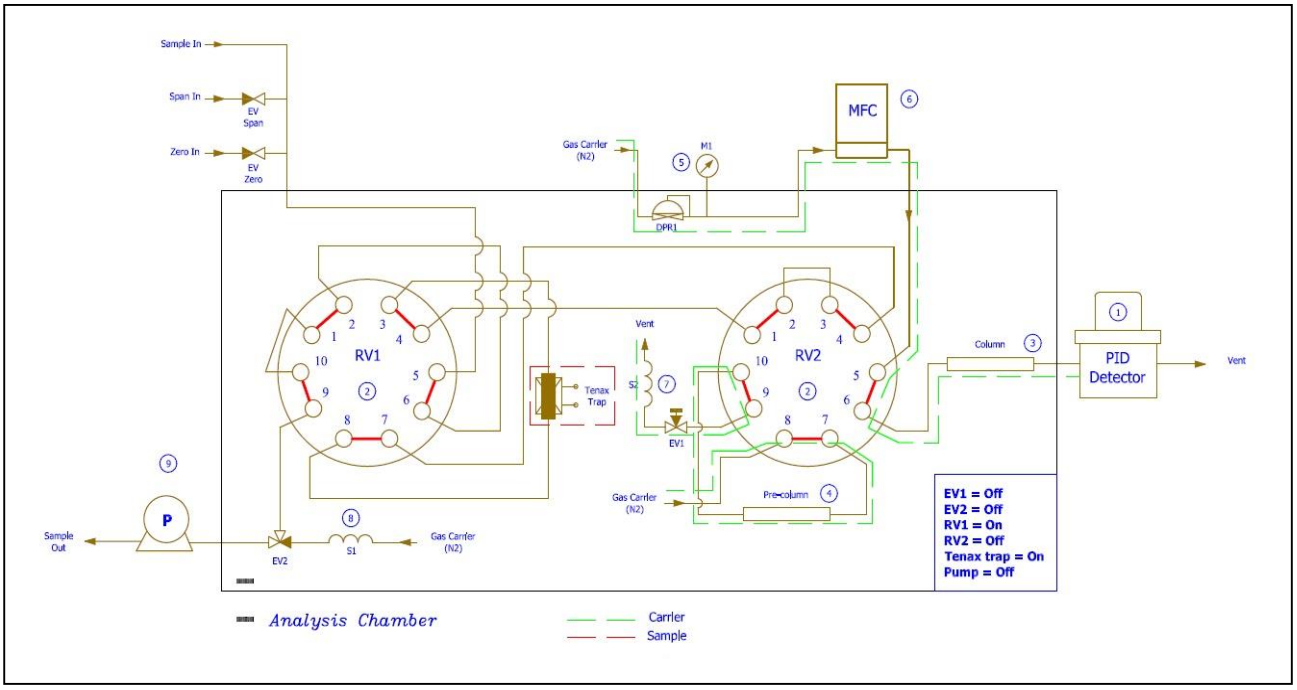
Sample is sucked in by the **PUMP** and passes through "Tenax Trap".
Meanwhile **CARRIER GAS**, controlled and shown by **Carrier** manometer, located on the front panel of instrument, flows through capillary **COLUMN** to **PID** detector.
The same CARRIER GAS during phase 1 flushes both the **PRE-COLUMN** and **COLUMN**.



BTX1 scheme, configuration in the sampling phase

Phase 2 (see BTX2 scheme)

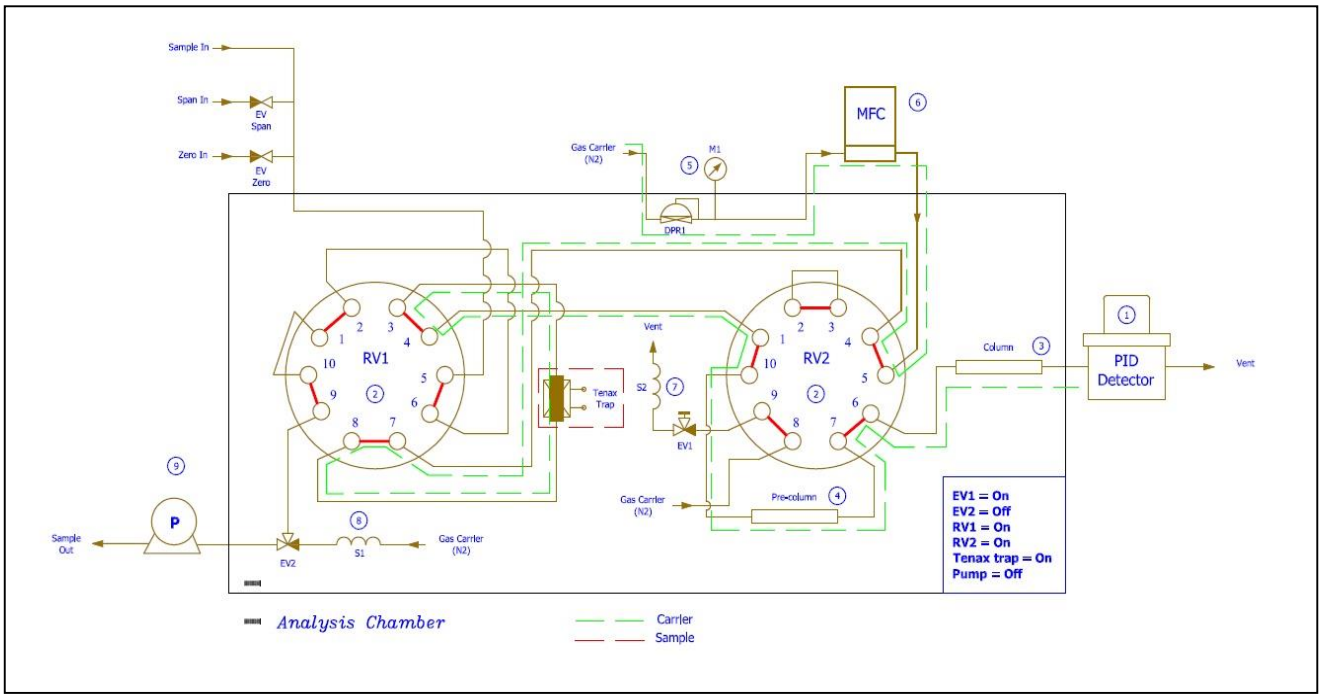
Sample sucking **PUMP** is switched off. "**TENAX TRAP**" is heating in flash at a very high temperature (about 170 °C), then **RV1** rotation Bimatic valve switches. During this second phase **CARRIER** gas flows continuously through the **COLUMN** and the **PRE-COLUMN**.



BTX2 scheme, configuration in the Tenax trap heating

Phase 3 (see BTX3 scheme)

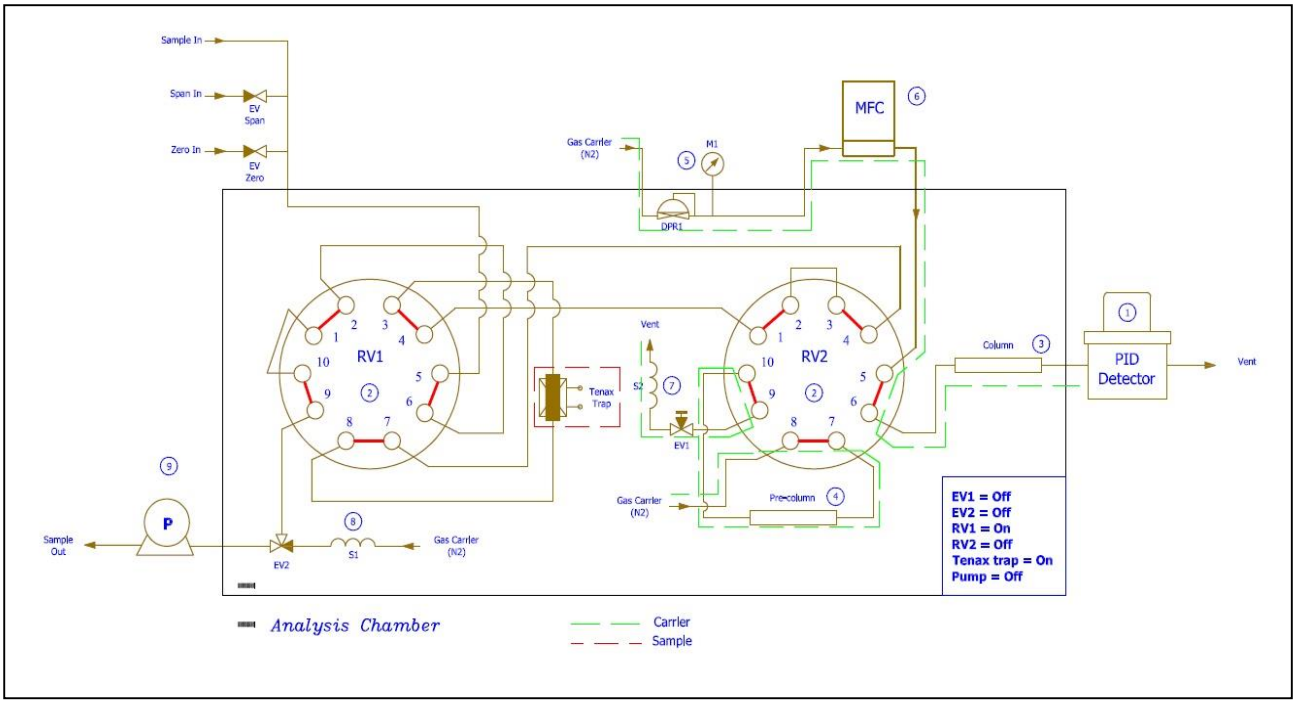
In phase three valves **EV1** and **RV2** switch on. **CARRIER** gas flows into the heated "**TENAX TRAP**" and injects the sample into pre-column. All other working conditions are as from phase 2. **PRE-COLUMN** separates aromatics from others hydrocarbons.



BTX3 scheme. Configuration inject phase. The sample is injected into the pre column.

Phase 4 (see BTX4 scheme)

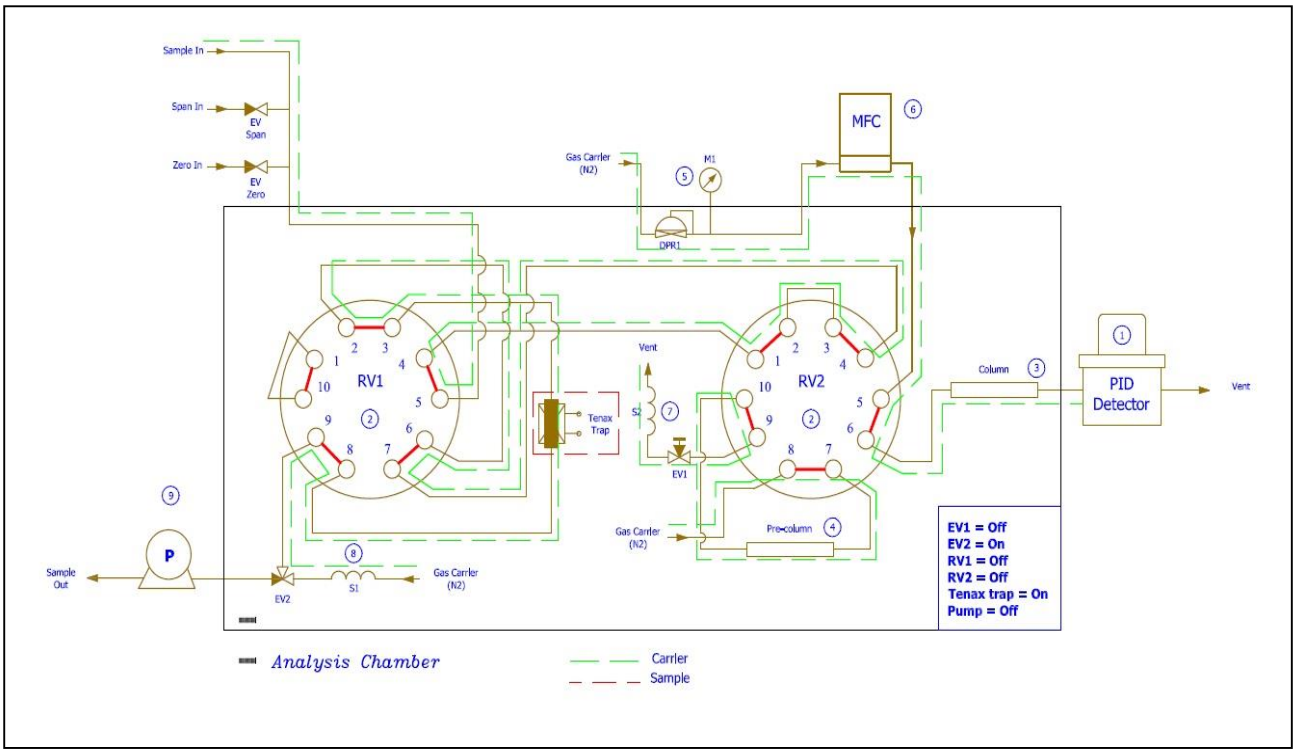
In phase four valves **EV1** and **RV2** switch off. **CARRIER** gas stops flowing into the heated "**TENAX TRAP**" and pre-column switches to back flush. All other working conditions are as from phase 3. **COLUMN** separates aromatic hydrocarbons.



BTX4 scheme, configuration during pre-column back flush. Column separates aromatic hydrocarbons

Phase 5(see BTX5 scheme)

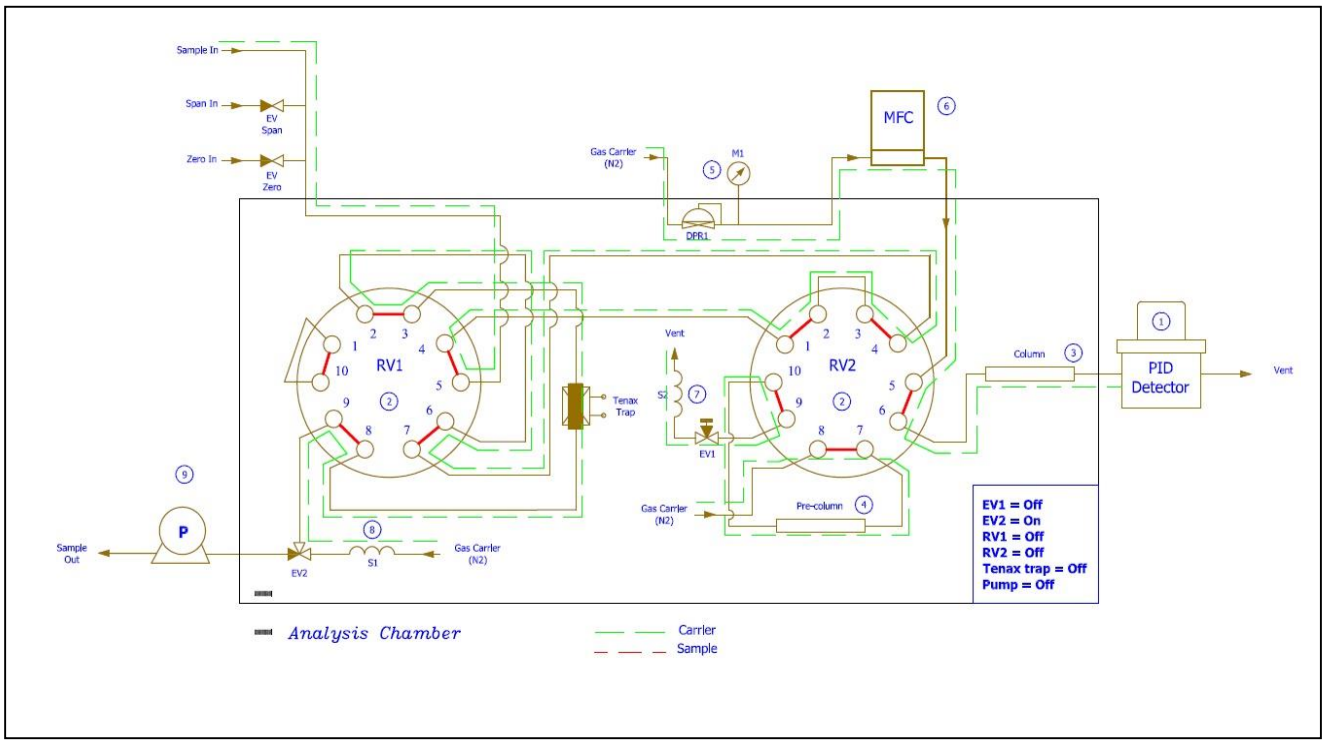
In phase five, valve **RV1** switches off, while **EV2** switches on. "**TENAX TRAP**" is kept heated up to high temperature as to desorb all species there trapped (purge phase). **PRE-COLUMN** is still washing in back flush. **COLUMN** is still separating aromatic hydrocarbons.



BTX5 scheme, configuration during Tenax trap washig

Phase 6 (see BTX6 scheme)

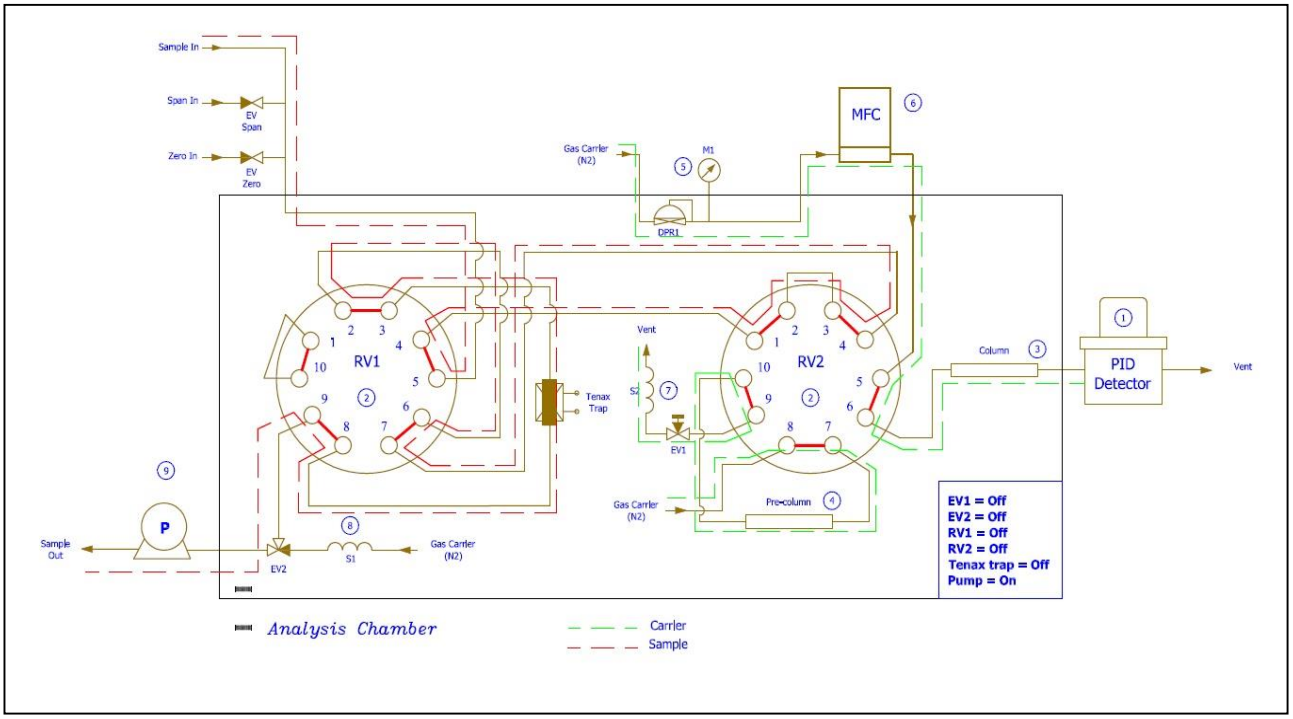
"**TENAX-TRAP**" heating system stops. Other conditions are the same of phase 5. **COLUMN** is still separating aromatic hydrocarbons, finally detected by **PID** detector.



BTX6 scheme, configuration during Tenax trap cooling down

Phase 7 (see BTX7 scheme)

In the last phase of the cycle **RV2** switches off and pump starts sampling for next cycle. The hydrocarbons eluted from capillary **COLUMN** are detected by PID and managed by micro computerised electronics.

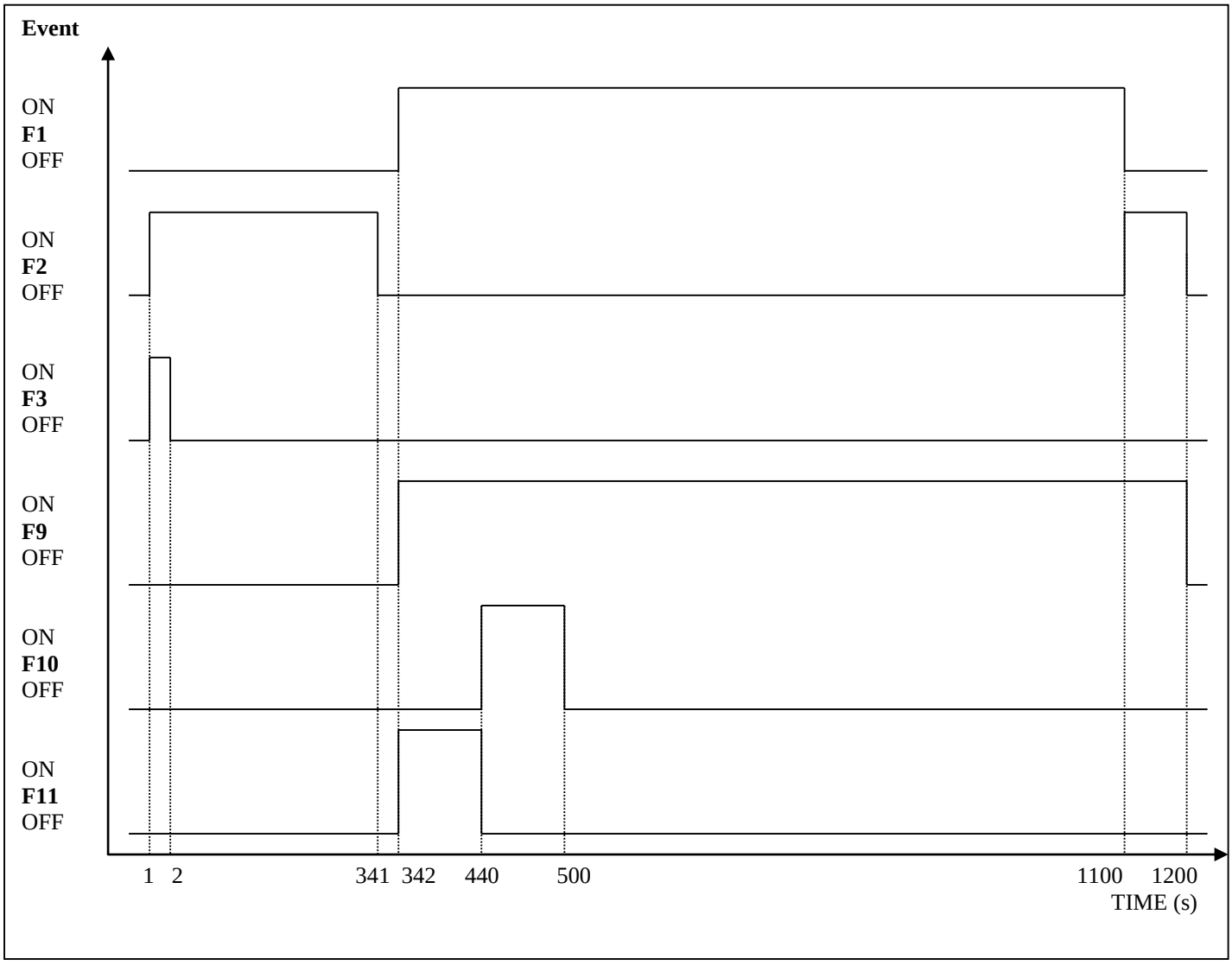


BTX7 scheme, configuration during sampling restart

Adjustable 0÷10 Vdc analogue signals from PID will be available on the output connectors (Rear Panel).
Instrument operating conditions as well as all set values are shown in the final check card.
Analytical cycle will be repeated every 10-20 minutes (according to the programmed chemical analysis); measured data will be updated every 10-20 minutes.

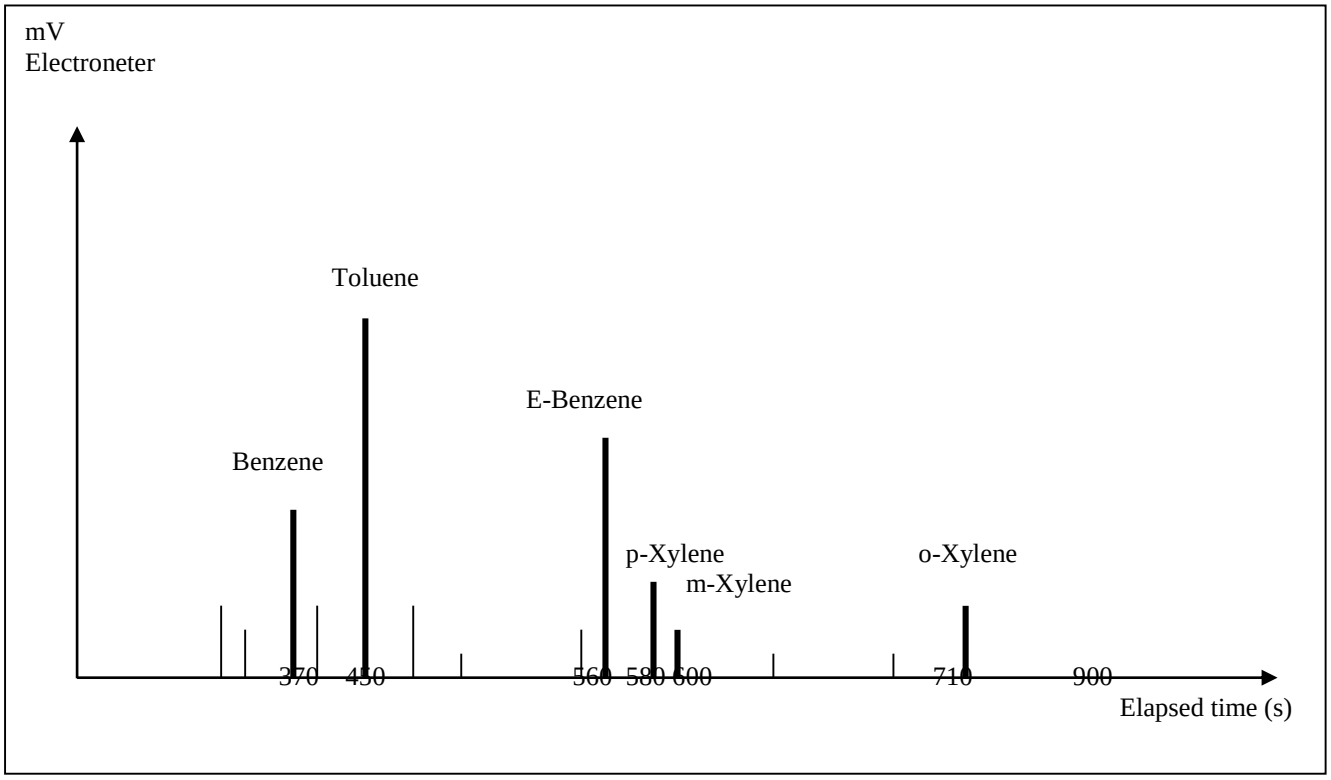
NOTE: According to required detection limits of the species under analysis phases 1, 2, 3 can be repeated many times.

The analytical cycle (in case of 20 minutes cycle, one of the longest) can be visually summarised:



FUNCTION	DESCRIPTION	EVENT #	ON1 Sec.	OFF1 Sec.	ON2 Sec.	OFF2 Sec.
F1	TRAP ENRICHMENT HEATING UP	1	181	780		
F2	SAMPLING PUMP	2	1	180	850	900
F3	AUTO ZERO	1	1	2		
F9	ENRICHMENT ROTATION VALVE	1	181	750		
F10	INJECTION VALVE	1	275	370		
F11	ENRICHMENT TRAP E/V	1	182	275		

The relevant Electrometer (0 -10 V range) output will be:



CHANNEL	CHANNEL STATUS	INTEGRATING WINDOW	
		TIME ON seconds	TIME OFF seconds
BENZENE	ON	360	390
TOLUENE	ON	440	490
ETHYL-BENZENE	ON	550	586
m-XYLENE	ON	588	598
p-XYLENE	ON	600	660
o-XYLENE	ON	700	750

The length of analytical cycle is programmable according to the needs connected to the application; the above described one lasts 900 seconds.

After 900 seconds the analyser is ready to repeat the same cycle, in a logic of either defined numbers of cycles or of continuous operation according to the operator choice.

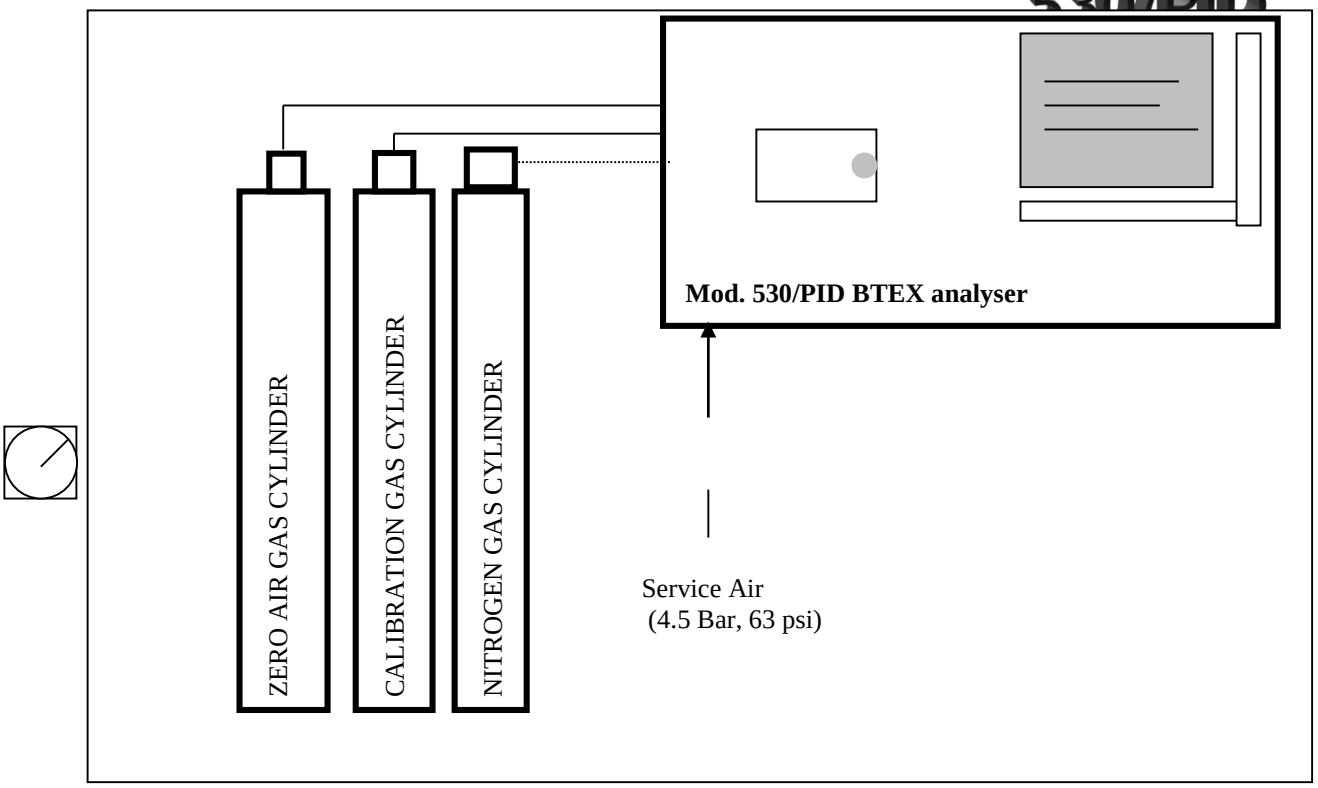
The versatility of user friendly firmware both from the analytical point of view and the program configuration, allows, by choosing the suitable chromatographic column and the relevant software program to detect specific compounds in air quality monitoring and at emissions. This is a great advantage with respect to the instrumentation actually available on the market.

8.0 FIELD COMMISSIONING AND INSTRUMENT START UP

- Connect the plumbing between the cylinder gas pressure reducers and the relevant gas connectors located on the analyser rear panel and indicated as Carrier.
- Connect the power cord to the main power supply (220/110 Vac, 50/60 Hz, 300 VA).
- Open the cylinder interception valve and regulate the relevant output pressures from cylinders as follows:

  Nitrogen 2 Bar,

  if for the servo commands a separated compress air is used, regulate it to 5 Bar.
- The relevant pressure on the manometers located on the instrument front panel (behind the front panel door), instead, must be set according to the values indicated in the instrument **final check card** at the end of this operating manual, that goes with each instrument.
- Switch the Power switch, on the rear panel of the instrument, in to position **ON** (indication I), now the instrument is **ON**, the display is **ON**, the start up procedure is running and the working display is on the screen.
- As the instrument reaches the set temperature, it starts the control of **LAMP ON**, if the lamp is off the **LAMP OFF** condition is displayed.
- In the status of **LAMP OFF** check that the lamp is correctly power supplied and it is still operating.
- When PID lampin **ON**, the instrument enters into the **STAND-BY** mode.
- If on the display any alarm messages are present, as long as all alarm conditions are not erased the indication "**STAND-BY**" will not be displayed.
- Wait further 5 minutes then press the push button **AUTOZERO**.
- Finally press "**ENTER**" push button. The instrument starts the analysis cycle(s).



The Zero Air Gas Cylinder may be used for Zero Check as well as in place of Service Air to actuate the rotation pneumatic valves.

9.0 IN BUILT FIRMWARE

At the switching on the PCF's logo is displayed then instrument enters into warming up and conditioning procedure.

As the instrument reaches the programmed temperature and the internal checks and controls did not detect any alarm conditions (the whole procedure takes some 20 minutes),
the PID lamp must be switched ON:

i) If the instrument is in MANUAL mode, the PID lamp must be ignited manually by pressing **IGN** (ignition) push button.

ii) Otherwise when the instrument is in AUTO-LIGHTING mode, PID lamp is ignited automatically.

As soon as the lamp is ON the instrument enters into the STAND-BY condition, by pressing **ENTER push button** the analytical cycles are performed.

Whenever modifications of the basic factory sets ups are needed, by pressing **PROG** push button on the key board, access to the "**MAIN**" menu is permitted. This level of the firmware allows setting of all basic process variables required for the automation of the analysis.

The firmware foresees a further level of the SW, the "CONFIGURATION" (**CONFIG**) menu. Where all working parameters of the instrument are available, e.g. analytical program, instructions to peak integration, measuring room temperature and base line linearity, modes and **I/O** controls.

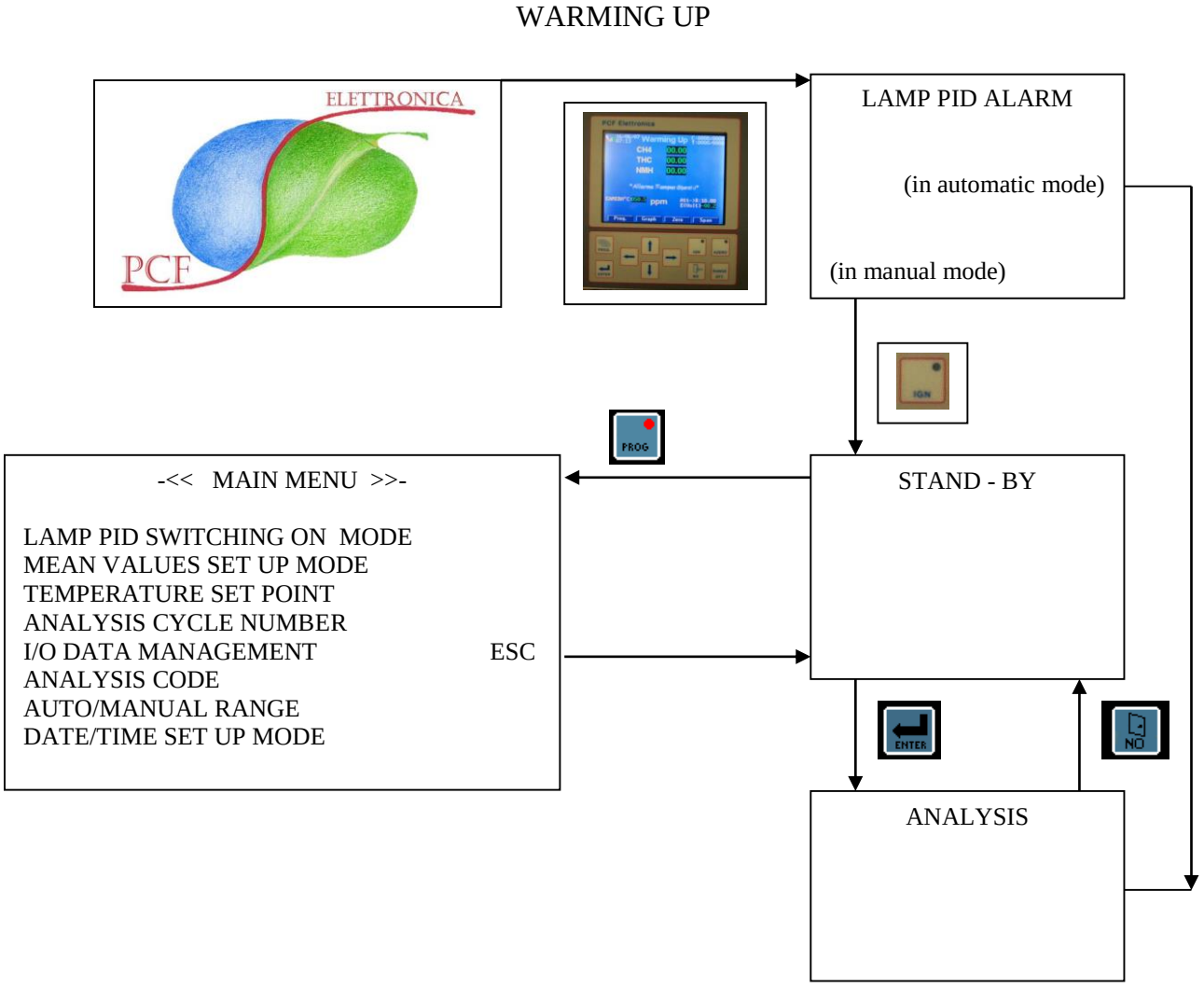
You do not need to enter this section of menu unless strictly necessary.

Attention! The modification of parameters included in the **CONFIG** menu may cause a variation in basic analytical mode, in retention times, in area integral calculation, in temperature linearity curves. We suggest to avoid any access or variations in "CONFIGURATION" menu without previously contacting PCF Electronica's technical service, reporting difficulties and/or necessities.

9.1 MENU GENERAL DESCRIPTION

At the switching on of the instrument the basic display (LOGO page) is shown on the screen including the PCF Elettronica's logo. After warming up and pre conditioning phase the instruments shows the basic display. At this level it is possible to

i) switch ON the lamp (if it is necessary);
ii) START analysis by pressing ENTER push button
iii) have access to "**MAIN**" menu or
*iv) "**CONFIGURATION**" menu, as indicated here below.*

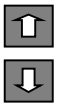


- Operator may have access to "**MAIN MENU** " by pressing "**PROG**" push button.
- To start the analysis procedure press "**ENTER**" push button.
- To step up in software menus "NO" push button must be pressed.

9.2 MAIN MENU

From STAND BY page by pressing "**PROG**" button the program enters into "MAIN MENU". As usual if the instrument is performing regular analytical cycle, it will conclude the cycle, then on the screen the FRONT page will be shown:

- ☐ LAMP LIGHTING MODE
- ☐ MEAN VALUES SET UP MODE
- ☐ TEMPERATURE SET POINT
- ☐ ANALYSIS CYCLE NUMBER
- ☐ I/O DATA MANAGEMENT
- ☐ ANALYSIS CODE
- ☐ AUTO/MANUAL RANGE
- ☐ DATE/TIME SET UP MODE

The "MAIN MENU" options are selected either by touching with a finger (wood or plastic stick the relevant option on the screen (touch screen) or by moving the cursor up and down on the display with arrow keys  confirming, as from figure, by **ENTER** button once selected the desired function

AUTOMATIC LAMP LIGHTING
(only if the instrument is programmed for) "optional"

This option allows to configure the instrument for the automatic mode of PID igniting.
If manual PID lamp lighting is selected, operator must follow the steps previously indicated in sect. 8.0 of the present manual. Otherwise if the automatic lamp lighting is selected, the instrument, following the automatic operations (as previously described in 8.0 section) the firmware will both ignite automatically the PID lamp and start the analysis procedure.

In case of mains POWER OFF, the instrument, in the "AUTOMATIC" configuration, at power on conditions will ignite the lamp and start the analysis cycles.
The "AUTOMATIC" lamp lighting procedure foresees 5 lamp lighting attempts. After five attempts if the lamp is still OFF the instrument stops any further attempt and will show a lamp OUT alarm. An intervention in the field of operator to start again the instrument will be required.

MEAN VALUES SET UP MODE (AVERAGING)

This MENU function allows to select an averaging time for the measured values.

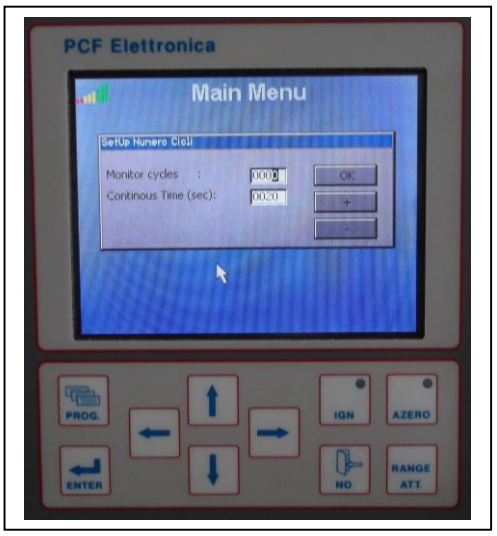
The operator will set the interval time (in minutes) in the relevant window as well as activate the function.

Whenever this function is activated, at the end of the set interval time, the software will compute the mean value of each measurements and it will memorize them in a special text file of SD card, easily down loaded into an electronic file.

TEMPERATURE SET POINT

As the analysis are performed in constant temperature condition, this configuration allows to set the chamber temperature of the gas chromatographic column.

ANALYSIS CYCLE NUMBER



This option allows the setting of finite number of analysis. The activation of this option makes visible on the display the analysis number performed by the format "**N. AN.: XXXX**"; as the instrument reaches the set value of analysis, the "**STAND-BY**" condition will be active.

By pressing "0000" the number of cycles performed by the instrument will be infinite, i.e. the instrument will run continuously.

By pressing, during the operation, the "**NO**" key the instrument, at the end of the current cycle, will enter the "**STAND-BY**" condition.

To start the continuous cycling press **ENTER** button, the instrument will start working continuously

I/O DATA MANAGEMENT

This option allows access to the I/O data management menu. It includes a second step menu with four choices:

- ☐ PRINTER MANAGEMENT
- ☐ DOWN LOAD CONFIG
- ☐ SAVE CONFIG
- ☐ ERASE ANALYSIS FILES

The first choice, PRINTER MANAGEMENT, allows the down loading of analysis data on the printer through the RS232 serial port.

The second choice, DOWN LOAD CONFIG, allows the down loading (whenever present on SD card) of a new analytical recipe. Analytical recipes can be memorized on SD card. In this way the same instrument can easily be reconfigured for different analysis (applications).

The third choice, SAVE CONFIG, allows the saving of the last configuration, whenever some modifications have been carried out (normally this choice is not used by operator).

Up to 50 recipes configurations can be memorised on the SD card by SAVE CONFIG function

Mod. 530/PID analyser saves automatically, in a text file memorised on the SD card, all analytical data as well as calculated mean values.

The forth choice allows the erasing of useless files.

AUTO/MANUAL RANGE

It's possible to select auto ranging mode for the analyser. By selecting this option the analyser will change automatically the measuring range, by reducing the amplification coefficient, whenever a single component reaches the full scale value. Vice-versa the analyser whenever all measured components are lower than 5% of actual measuring range will reduce automatically the range by increasing the amplification coefficient.

DATE AND TIME SET UP

The selection of this option makes possible the updating of date and time. This operation is very important for a correct data banking of data on flash memory; successively for a correct reading and interpretation when analytical data are downloaded on Personal Computer or any other Data Base.

10.0 ANALYTICAL START UP

As the instrument is switched ON it starts a series of initialisation processes followed by WARM UP procedure. Within this phase the analytical chamber is warmed up to set temperature and conditioned (the set up of chamber temperature was described in 9.3 chapter).

Within this warm up phase it's possible by pressing "PROG" push button, either on display (touch screen) or on key board to perform the desired set ups according to the described options of "MAIN MENU", see previous chapter.

As the instrument reaches the temperature set values, it performs a LAMP ON check, eventually signalling the case of LAMP OFF condition; CARRIER gas pressures is correct, according to the values reported in the **factory final check card**, operator may proceed to the lamp lighting by pressing IGN key located on the upper part of key board.

With the LAMP ON condition and with no alarm conditions whatsoever the instrument shows on the screen the page "**STAND-BY**". Press **ENTER** button to start analytical cycles.
Whenever any alarm conditions are present it is mandatory to trouble shoot the alarm causes in order to resume the monitoring procedure.

If the instrument has been programmed for continuous working mode (see section 9.2 for analytical cycles numbers), the analyser performs continuous analysis untill, by pressing **NO** button, the operator interrupts the measuring operations; at this point, completed the current analysis, the instrument returns in the "**STAND-BY**" condition.

If the automatic lighting mode was selected (the instrument must include this option), there is no need to perform any operations to bring the instrument in the full working conditions, as, once reached the temperature sets and performed no alarm condition checks, the instrument ignites the lampand starts the analytical cycle by passing the "**STAND-BY**" condition.

If a finite number of cycles were programmed, the instrument, once carried out the programmed number of analysis, returns in the "**STAND-BY**" condition, while whenever the **NO** button is pressed the instrument stops once terminated the current analysis; with a new **ENTER** command it starts counting the analysis cycles from the beginning. As the analysis are performed operator can check the analysis status on the display as well as the cycle counting on the top of display.

On the LCD video display the voltage level at the electrometer output, the selected range with relevant measuring unit, as well as the actual working and possible alarm conditions occurred during the operation are shown.

11.0 ANALYSER CALIBRATION

Whenever either a check of or a full calibration is required the instrument must be in the **analysis mode**. Only with the instrument in analysis mode the "**SPAN**" and "**ZERO**" function can be activated from touch screen.
In order to start these procedures the relevant icons must be selected on the lower part of the screen **by touch screen procedure**.
If the "**ZERO**" or "**SPAN**" command is selected the instrument performs the given command at the end of the current analysis cycle.
Whenever the **NO** button is pressed the instrument enters in "**STAND-BY**" condition only at the end of the current analysis cycle, aborting the selected procedure either of "**ZERO**" or "**SPAN**".
Always press **ENTER** button to resume the monitoring cycle.

11.1 "SPAN" CALIBRATION PROCEDURE

By this procedure the correcting factors of each measurement can be modified according to the last measured calibration values.

The instrument is on line; it is working regularly on sample gas.

1- Connect to “SPAN”, on the rear panel of the instrument, the calibration gas source, namely gas cylinder, permeation tube or multipoint calibrator.

2- Open the valve of calibration gas cylinder and check/regulate a flow of 20-40 ml/min that is getting out of “VENT” output on the rear panel of the instrument.

3- From front panel display select “SPAN” procedure, by touching the icon on the screen.
At the end of running analytical cycle the instrument enters the calibration procedure and start a new analytical cycle.

4- Select the correct measuring range to cover calibration concentration values by relevant push button.

5- Press “ENTER” push button and set the calibration concentration values (the certified values reported on the gas cylinder) confirming them by pressing “OK” icon on screen.

6- Operator must wait 3-5 full analysis cycles (60-100 minutes). Then as on the display “press PROG for calibrating” will be shown., by pressing “PROG” push button the instrument will compute automatically the correcting factors and the measurements will be shown according to the new values of calibration.

7- The new calibration has been concluded. Press “NO” and the instrument will exit the Span Procedure and re-enter into the analysis.

8- The calibration gas source can be closed.

11.2 "ZERO" CALIBRATION PROCEDURE

Select the "ZERO" check procedure. Once the instrument has carried out the current analysis cycle, it enters into "ZERO" mode.
The "ZERO" mode consist in a certain number of analysis in "Blank", i.e. a UPP air is introduced into the chromatographic column, that is exactly the same air used as carrier in order to evaluate the base line behaviour with no sample in the instrument.
The "ZERO" regulation on the present type of chromatograph does not make sense, as the built in Auto Zero function carries out an instrumental zero before any analysis.

12.0 ANALYSER MAINTENANCE PROCEDURE

(CONCISE INFORMATION, EXTENSIVE INFO IN THE SERVICE MANUAL)

All the operations described in the present section must be performed with main power supply to the instrument OFF (disconnect the mains plµg) and with the Carrier, Air, Span service gases intercepted by the main manometers on the gas cylinders.

GAS CHROMATOGRAPHIC COLUMN REPLACEMENT

- Open the measuring chamber. If the instrument is just switched off wait for the cooling down to about room temperature.

- With an 8 mm spanner disconnect the gas chromatographic column "C" connected to 4 and 6 port of RV1 rotation valve (commanded by F9 function), tagged with the relevant card that indicates the type.

- Connect to same ports the new column, making a special attention that connections are correct, avoiding to spoil the threads of rotation valve ports, as to guarantee a perfect tight connection of pneumatic circuit.

- Bring the analyser into measuring mode (again following the standard procedures previously described in this manual) and leave the instrument to work for about an hour without performing any setting.

- Perform a calibration check and eventually adjust the Standard values…

REPLACEMENT OF INPUT SINTERED FILTER

- Open the measuring chamber. If the instrument is just switched off wait for the cooling down to about room temperature.

- With an 8 mm spanner disconnect the steel filter holder "F" inserted between the "sample-in" connection and the "U2" SPAN solenoid valve.

- Open the filter older by employing two 17 mm spanner; either replace the steel sintered filter or wash it in a ultrasonic bath with a solvent at 80°C. Mount back everything with great care taking special care to the tightness of the pneumatic connections.

- Open the measuring chamber. If the instrument is just switched off wait for the cooling down to about room temperature.

- Bring the analyser into measuring mode (again following the standard procedures previously described in this manual) and leave the instrument to work for about an hour without performing any setting.

- Perform a calibration check and eventually adjust the Calibration values. ….

12.1 CAPILLARY FLOW RATE CHECK

The check of capillary flow rate is a very delicate operation, therefore it must be performed with the maximum care and attention.
The Capillary flow rate check is performed with the instrument ON and all the service gases connected and pressurised.

CARRIER flow rate check

By employing an 8 mm spanner disconnect the 2 mm steel tube connected to PID detector through the "IN" tagged input; then by a soap bubble flow meter and/or by a digital flow meter check that flow rate corresponds to the value indicated in the final check table.
In case for the same air pressure the flow rate differs from the reported one in the check table restore the correct flow rate by varying the pressure of Carrier air operating on the relevant pressure regulator located on instrument front panel. If the correct flow rate cannot easily restored replace the capillary.
When the check is completed connect back the steel tube to PID detector.
In the operation of connecting the steel tube to the PID detector a special care and attention must be given to the correct screwing of the connection in order to both avoid any damage to the thread as well as to have a tight connection.
The tightness of all connection are fundamental for a correct working condition of the instrument.

12.2 SUGGESTED MAINTENANCE SCHEDULE

Basically PCF Mod. 530/PID BTEX analyser is a relatively simple process gas chromatograph with tested parts to last years without maintenance.

The ten port valves, with purge and trap device, the most sophisticated parts in the instrument, should last more than three years without maintenance.

For a good performance in the field it is suggested to commission the instrument since the beginning with the correct gas qualities and pressure as well as to check regularly its working conditions.

For a good commissioning of the instrument we recommend:

- standard tool case
- digital multi-meter and oscilloscope
- strip chart recorder (0-10 Vdc).

Time	Operations	Actions (if necessary)
Commissioning	Check: Power Supply Gas Supplies (quality and pressure) Service Gas pressure Analogue outputs	
Monthly	Sample flow	Replace or clean filters Front filter and/or Sintered filter
Every 3 months	Sample flow Membrane pump	 Rebuild pump
Every 6 months	Calibration check	Change coefficients
Every year	Retention times Check Carrier capillary	Adjust retention times Replace
Every 3 years	Chromatographic Column Rotation valve	Replace column Maintain or replace

12.3 TROUBLE SHOOTING

Instrument completely dead:	
- Check the mains power supply	Connect power supply
- Check the fuse on the power supply socket	Eventually replace the fuse
- Mother Board is not working	Replace Mother Board
The lamp does not ignite	
- Mother Board is not working	Replace Mother Board
- Lack of Hydrogen or Air	Supply Hydrogen and Air
- Lighting spiral is broken	Replace PID
- Thermocouple is broken	Replace PID
- Transformer not working	Replace transformer
- Wrong hydrogen and air pressures	Set the correct hydrogen and air pressures
Auto zero does not perform	
- Electrometer board not working	Replace electrometer
- Mother Board not working	Replace Mother Board
- Key Board not working	Replace key board
Output signals dead	
- PID detector not working	Replace PID detector
- Electrometer board not working	Replace electrometer board
- Output signal board not working	Replace output signal board
- Mother board not working	Replace Mother board
4-20 mA signal not present	
Check external connection	Restore external connection
4-20 mA board not working	Replace 4-20 mA board
Lack of Carrier gas pressure	
- Supply air cylinder either empty or with closed interception valve	Open the gas cylinder or replace it
- Leakage in the relevant circuit	Find and mend the leakage
- Pressure regulator not working	Replace it
- Manometer not working	Replace it

Auto zero function not operative	
- Electrometer board not working	Replace electrometer board
- Mother Board not working	Replace Mother Board
- Key Board not working	Replace key Board
No variations on output signals	
- PID detector not working	Replace PID detector
- Electrometer board not working	Replace electrometer board
- Output signal board not working	Replace output signal board
- Mother Board not working	Replace Mother Board
Missing 4-20 mA signal	
- Check the external interconnection	Restore the interconnection
- 4-20 mA output signal board not working	Replace it
No pressure on carrier gas	
- Air gas cylinder either empty or closed	Open the air gas cylinder or replace it
- Leakage in the relevant circuit	Amend the leakage
- Pressure regulator not working	Replace pressure regulator
- Manometer not working	Replace manometer
No circulation of sample	
- Adduction sample line either intercepted or clogged	Restore correct sample flow
- Membrane pump not working	Either replace or repair membrane pump
- Mother Board not working	Replace Mother Board
- Rotation valves not working properly	Replace rotation valves
- Clogging in the analytical circuit	Find and amend the clogging cause and restore the correct flow
Low calibration values	
- New calibration procedure must be performed	Carry out a new calibration
- Sampling loops partially clogged	Replace sampling loops
- Defective rotation valves	Replace rotation valves
- Gas chromatographic column not active any more	Replace GC column

13.0 RS-232 SERIAL AND ELECTRICAL CONNECTIONS

The standard RS 232 serial communication system takes place in sequence at the end of each measuring cycle; the instrument, at the cycle end, gives a characters string carrying data of last performed analysis.
The serial communication takes place in ASCI code at 9600 baud rate, no parity bit, 8 start bit 1 stop bit.
RS 232 serial output port connection scheme (11)
5 = GND
3 = RX
2 = TX

ELECTRICAL CONNECTIONS

Analogue output connector M1 (1)

1 - Out signal chanel 1 (0–1 V or 4-20 mA).
2 - GND
3 - Out signal chanel 2 (0–1 V or 4-20 mA).
4 - GND
5 - Out signal chanel 3 (0–1 V or 4-20 mA).
6 - GND
7 - Out signal chanel 4 (0–1 V or 4-20 mA).
8 - GND

Analogue output connector M2 (2)

1 - Out signal chanel 5 (0–1 V or 4-20 mA).
2 - GND
3 - Out signal chanel 6 (0–1 V or 4-20 mA).
4 - GND
5 - Out signal chanel 7 (not in use).
6 - GND
7 - Out signal chanel 8 (not in use).
8 - GND

Digital input connector M3 (3)

1 - Input ZERO check.
2 - Input SPAN check/calibration.
3 - Input remote analysis START
4 - GND

Status alarm connector M4 (4)

1 - 2 Out of service
3 - 4 ZERO status
5 - 6 SPAN status
7 - 8 Range 1

Status alarm connector M5 (5)

1 - 2 Range 2
3 - 4 Range 3 (not in use).
5 - 6 Range 4 (not in use).
7 - 8 (not in use).

14.0 SPARE PARTS

Code Number	Description
09520114	Sample capillary
09520115	Hydrogen capillary
09520116	Air capillary
09520192	Nitrogen/Hydrogen mass flow controller
09520120	Pressure regulator
09520121	Bar gaµge
xxxxxxxx	PID detector sub assembly
09520130	Red LED
09520131	Green LED
09520132	Return switch
09520133	Stable switch
09520134	SPAN potentiometer
09520135	Digital display
09520136	Power supply transformer
09520137	Power supply socket
09520138	Cooling fan
09520141	Electrometer PCB
09520147	4-20 mA output PCB
09520143	Function programming PCB
09520144	Auxiliary services PCB
09520145	Temperature regulator PCB
09520146	Stabilised Power Supply PCB
09520150	PT 100 temperature probe
09520152	PID detector heating resistance
xxxxxxxx	Bi-matic ten port rotation valve
09510123	Rotation valve rebuild kit
09514822	Stainless steel tubing (10 m)
09514123	Seal set
09514124	Stainless steel pneumatic connections
09510112	SPAN solenoid valve
09510113	Purge & Trap device sub assembly
09510193	Purge & heating element
09510193	RSV rebuild kit
09514125	Fuse set
09510351	Sampling pump
09514126	Sampling pump rebuild kit
09510201	Hydrogen interception solenoid valve
09514127	Sintered filter
09510202	Rotation valve pilot solenoid valve
09514128	LampON temperature sensor
09514129	Lamplighting resistance
10010401	Mother Board PCB
10010402	Controller PCB
09510501	Analogue and status signals PCB

09510502	Key board PCK
10010403	Digital Display PCB
09514130	Mains switch
	Consumables set (including)
09510213	N.1 Carrier gas capillary
09520115	N.1 Hydrogen capillary
09510123	N.1 RSV rebuild kit
09514126	N.1 Sampling pump rebuild kit
	Spare parts set (including)
09510943	N.1 Chromatographic column
09510113	N.1 Purge and Trap device
09510221	N.1 Pressure regulator
09510115	N.1 Rotation valve

PCF ELETTRONICA S.r.l.
MOD. 530/PID (BTEX)
AROMATIC HYDROCARBON ANALYSER

FINAL CHECK CARD

CARRIER Bar …… ml/min ……

OVEN ……°C
COLUMN TYPE : ……..

CALIBRATION PARAMETERS

Range:	Component		Component	
		: ……. µg/m^3		: ……. µg/m^3
100 (X1)	BENZENE	: ……. ADJ	TOLUENE	: ……. ADJ
		: ……. µg/m^3		: ……. µg/m^3
100 (X1)	E- BENZENE	: ……. ADJ	p-XYLENE	: ……. ADJ
		: ……. µg/m^3		: ……. µg/m^3
100 (X1)	m-XYLENE	: ……. ADJ	o-XYLENE	: ……. ADJ
Range:	Component		Component	
		: ……. µg/m^3		: ……. µg/m^3
1000 (X10)	BENZENE	: ……. ADJ	TOLUENE	: ……. ADJ
		: ……. µg/m^3		: ……. µg/m^3
1000 (X10)	E- BENZENE	: ……. ADJ	p-XYLENE	: ……. ADJ
		: ……. µg/m^3		: ……. µg/m^3
1000 (X10)	m-XYLENE	: ……. ADJ	o-XYLENE	: ……. ADJ

Service Engineer: _____ Date: _____