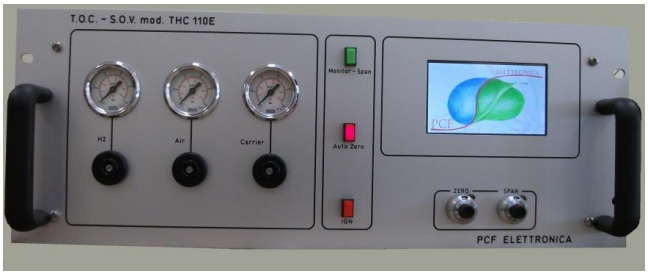
PCF Elettronica's HOT FID Mod. THC 110E

VOLATILE ORGANIC COMPOUNDS (V.O.C.) MONITOR

(Showing an exclusive injection system)



Operating Manual

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1.0 FOREWORDS

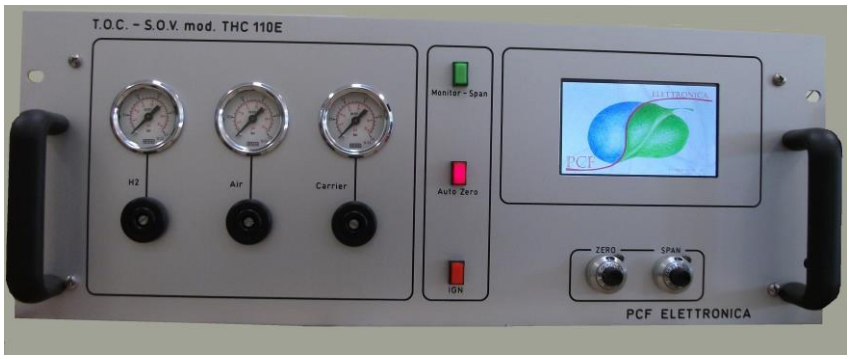
If you ask a technician which could be the ideal emissions V.O.C. monitor, he certainly would answer: an instrument with the following basic specifications:

1- fast response
2- linear response in a wide active range
3- low maintenance requirements
4- easy to install and easy to run
5- no possibilities of condensation in the analysis circuit.

PCF Elettronica's Mod. THC 110 Hot FID monitor intended for Volatile Organic Compounds (V.O.C.) monitoring meets all the above specifications and gives something more:

i) it can have a response down to 30 seconds;
ii) it is linear from fraction of ppm up to 100% concentration;
iii) for its exclusive sampling and injection system it reduces the sampled quantity to fraction of ml and the maintenance requirements accordingly;
iv) it combines digital electronics with traditional way of span and zero control and adjustment;
v) The sample is sucked from the stack and injected into to FID in slightly depression conditions. The dew point is accordingly lowered and the small quantity sampled and injected reduces the total quantity of corrosive sample circulated in the pneumatic circuit.

Besides these advantages the instrument is extremely price competitive and in special configuration (Mod. 527/H) it can measure the Total V.O.C. as well as specific compounds (e.g., benzene, toluene, butadiene, monomers etc.), in this case a gas chromatographic column will be introduced and the analytical cycle will seem more like to a process gas chromatograph than not a simple straight forward monitor.
The specific requirements of customer/application will be taken in consideration for each case and the matter solved with a specially programmed instrument.



2.0 WORKING PRINCIPLE

PCF's Mod. THC 110 Volatile Organic Compounds (V.O.C.) monitor, is intended to detect the total amount of volatile hydrocarbons at emissions or in processes showing high humidity content, without condensed water.
Please note that in the sample introduced in the instrument
must not be present condensed water.
The instrument is fully automated and thanks to its exclusive injection system it can operate in a wide range of temperatures and humidity with no influence in the reproducibility and stability of measurements in the applications.
An hydrogen micro flame may be employed as specific detector of organic compounds as the reaction of carbon oxidation, that takes place in it, generate a consistent quantity of ions.
The actual configuration of the detector foresees the mixing of hydrogen with the sample gas; the combustible mixture is then burnt at the extremity of a very small nozzle in oxygen excess (pure air in great stechiometric excess).
The electrical charges generated by the combustion of organic compounds within the sample are collected by a couple of metallic electrodes and successively converted electrical currents.
The ionisation currents fed to an electrometer generate at the output voltages proportional to the ion currents in the flame and in last instance proportional to carbon content within the sample.
Flame ionisation variations therefore correspond to voltage variations at the electrometer output that may be successively fed to data management and acquisition electronics.

Thanks to the high versatility and flexibility of the measuring system it's easily extended, with suitable extension of sampling and data management devices, to multi-point monitoring both at emission and industrial applications.

The FID detector is generally known as the most linear and stable sensor for detection of organic compounds. Particularly in emission monitoring, where a mix of hydrocarbons could be present in the sample, the measuring equipment requires a detector possibly equally sensitive to all types of compound. For this matter the FID is the detector that mostly meets the needs.
PCF Elettronica's FID detector is very well known for its stability as well as for its low maintenance in the time.

It's generally known that organic compounds in hydrogen flame ionise, generating a quantity of carbon - ions nearly proportional to their content in the compound itself. The quantity of carbon ions generated is proportional to the total quantity of carbon passing through the hydrogen flame, i.e. concentration of carbon compounds multiplied by their carbon atoms.

The carbon (methane) equivalent concept.

In the environment there is very high number of different organic compounds so the response of the instrument detector cannot be referred to a single compound. The measurements must be considered in terms of equivalent response, .i.e. the response of the detector is "normalised" (referred to) to a single compound. The characteristics of FID detector, i.e approximately proportional to organic carbon concentration in the sample, makes the purpose easy. At first approximation the same concentration in air of compounds with different carbon atom number responds proportionally to the number of atoms in the molecule, so:

Concentration ppm	Species	FID response
1	CH_4	1
1	C_2H_6	1.885
1	C_3H_8	2.770
1	C_6H_{14}	5.588
1	C_6H_6	5.508

In other words, once the instrument response is normalised to methane, 1 ppm of propane will approximately generate a signal as 3 ppm of methane equivalent or carbon equivalent. As for the equivalent methane concentration for 1 ppm of Benzene is 6 ppm.
As a simple rule to calculate the methane (carbon) equivalent in the sample:

concentration (ppm) x number of carbon in the molecule

e.g. a concentration of 20 ppm of propane gives: 20 ppm x 3 = 60 ppm equivalent of methane (carbon).

3.0 TECHNICAL SPECIFICATIONS

- Detector : Hot Flame Ionisation Detector
- Measuring ranges (3) : 0-100/1,000/10,000 ppm or mg/Nm^3 (other ranges optional, up to 100%)
- Background noise : 0,5% full scale
- Lower Detectable Limit (LDL) : 1% full scale
- Precision : ± 1% full scale
- Linearity : ±1% full scale
- Zero stability (24 hours) : < 0,1 ppm
- Span drift (24 hours) : < 0,2 ppm
- Measuring cycle : 30 seconds (up to 2000 sec.)
- Response time : 30 seconds
- Sample flow rate : 500 ml/min (does not affect measurements)
- Operating temperature range : 0 – 40 °C
- Zero drift : automatic compensation
- Zero/Span check : set from front panel and/or remote
- Display : two-line green LCD digital display
- Instruments controls : from front panel and or from remote control
- Analogue outputs : 0-10 Vdc or 4-20 mA (selectable)
- General alarm : for flame out, temperature and zero alarm
- Alarm on set value : one tension free SPDT for each channel
- Serial output : RS 232 (9 pin connector) control

- Services
  Hydrogen : 30 ml/min
  Pure Air : 300 ml/min
  Service Air : 4 - 5 Bar
- Suggested calibration gas cylinder : 20 ppm C_3H_8 (Propane, or any other equivalent molecule), air balance
- Sampling device : either membrane pump or air ejector (specify in order)
- Thermostated chamber : controlled up to 200°C with safety alarm for out of temperature condition
- Sampling valve : Mod. RSV 108-8 high temperature rotation valve
- Mounting : standard 19" rack or transportable bench top
- Dimensions: : 432x222x584 mm (117.15"x8.9"x23.17" WxHxD), 5U
- Weight : 15 Kg
- Standard power supply : 220/110 Vac 50/60 Hz (to be specified in order)
- Power consumption : up to 600 W, in the warm-up phase (heat traced line excluded)
- Heat traced line : 80 W/m
- Pneumatic connections : 1/4" or 4/6 mm and 1/2 mm

4.0 FRONT PANEL DESCRIPTION

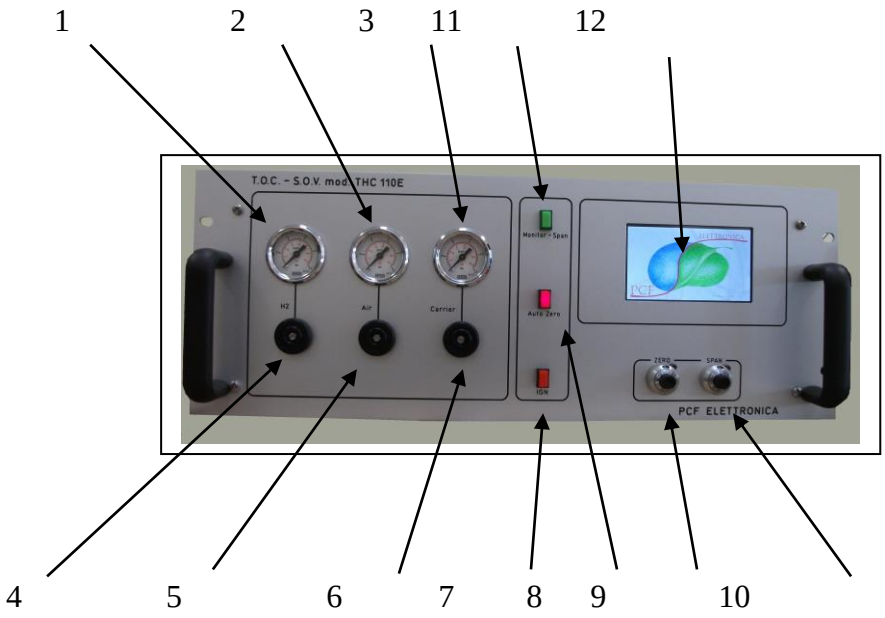


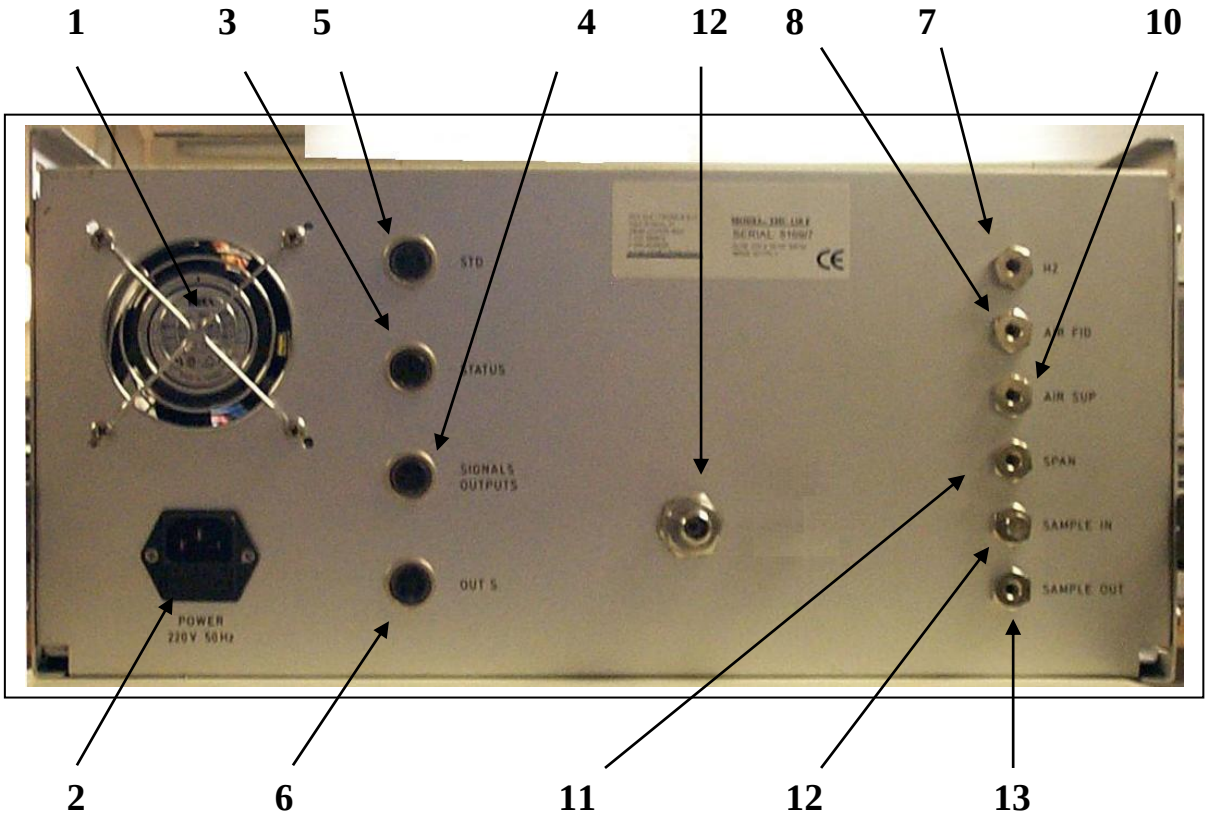
Figure captions

1- Hydrogen pressure gauge
2- Air pressure gauge
3- Carrier gas and zero air gauge
4- Hydrogen pressure regulator
5- FID air pressure regulator
6- Carrier pressure regulator
7- Power **ON/OFF** switch
8- Manual - auto zero switch
9- FID flame ignition switch
10- Auto - manual analytical working program switch
11- **SPAN** adjustment potentiometer
12- Digital signal display
13- **Base line** back off potentiometer
14- Measuring ranges attenuation switch

5.0 DESCRIPTION OF FRONT PANEL CONTROLS

1- Hydrogen pressure gauge (1) active when flame is ON, when flame is OFF the hydrogen interception valve will not allow pressure on the gauge.
2- Air pressure gauge (2), the air is the supporter of combustion in FID detector.
3- Carrier gas pressure gauge (3), the quality of air is the same as the FID air.
4- H_2 pressure regulator (4), it fixes the hydrogen quantity delivered to flame detector.
5- Air pressure regulator (5), it fixes the Air quantity delivered to detector as flame combustion supporter.
6- Carrier pressure regulator (6), if fixes the carrier gas quantity passed in the sampling loop then to the FID detector.
7- Power switch (7), for instrument general power ON/OFF
8- Switch (8) allows manual zeroing of the output signal base line.
9- Return switch (9), for automatic ignition of detector flame.
10- PROG switch (10) for the auto/manual insertion of the analytical cycle for the VOC measurement.
11- Potentiometer (11), for system full range sensitivity adjustment.
12- 40 character - two line LCD digital display (12), for digital display of VOC content in the analysed sample.

6.0 REAR PANEL DESCRIPTION



1- Instrument cooling fan.
2- Mains power supply socket.
3- Status contacts output connector.
4- Analogue signals output connector.
5- Standard solenoid valve control connector.
6- Electrometer output, external item Power Supply and optional remote controls connector.
7- Pneumatic connection for detector Hydrogen supply.
8- Pneumatic connection for detector FID Air supply.
9- Pneumatic connection for Carrier gas supply.
10- Pneumatic connection for rotation valve Service Air supply.
11- Pneumatic connection for SPAN gas.
12- Pneumatic connection for SAMPLE IN.
13- Pneumatic connection for SAMPLE OUT.
14- Pneumatic connection for the VENT.

7.0 DESCRIPTION OF REAR PANEL CONNECTIONS

1- Cooling fan (1) for keeping electronic circuits at environmental temperature.
2- Connection socket (2) to the mains power line (220/110 Vac, 50/60 Hz) for powering the instrument
3- Output socket of digital status signals (3) for flame OFF, temperature alarm and high concentration alarm.
4- On this socket (4) the 0-10 Vd and 4-20 mA analogue signals are available for peripheral data acquisition units connection.
5- Socket for powering the standard activation solenoid valve.
6- On socket (6) both a 12 Vdc 500 mA power supply for peripheral units as well as the output signal (0 - 10 Vdc) directly from electrometer are available.
7- To this pneumatic connector is plumbed the hydrogen supply either from gas cylinder or hydrogen generator.
8- To this pneumatic connector is plumbed the gas chromatographic air supply either from gas cylinder or UPP air generator.
9- Pneumatic connector to be plumbed to service air supply, at least 4 Bar pressure, to power the 10 port rotation pneumatic valve.

8.0 INSIDE VIEW

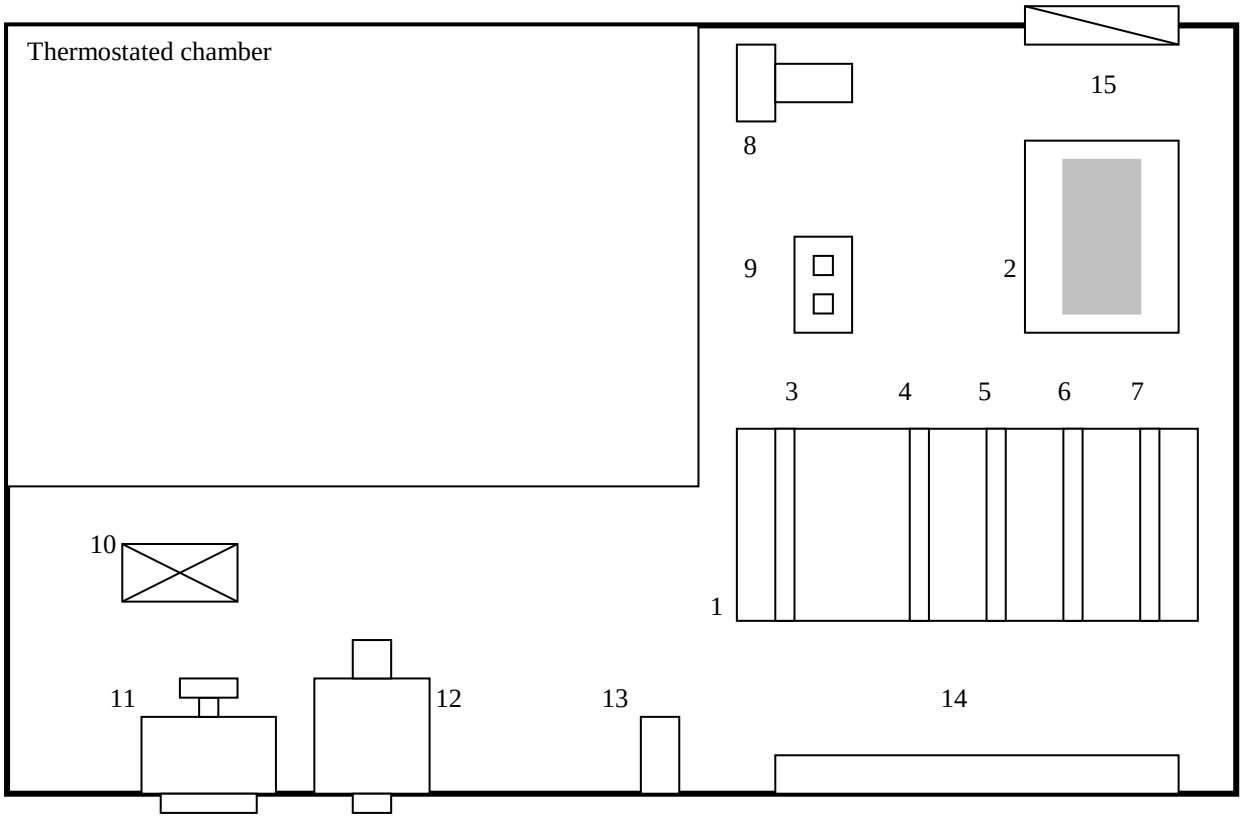


Figure captions:

1- Bus Board on which all PCBs are plugged (1).
2- General supply transformer (2).
3- Electrometer PCB (3)
4- Function programming and analytical peak memorisation PCB (4).
5- Auxiliary services PCB (5).
6- Thermostated chamber temperature regulator PCB (6).
7- Stabilised Power Supply PCB (7).
8- Sampling pump (8).
9- Connector array (9).
10- Hydrogen interception solenoid valve (10).
11- Front panel pressure gauge (11).
12- Front panel pressure regulator (12)
13- Front panel switch and potentiometers (13)
14- LCD digital display (14)
15- Cooling fan (159

PCB function description

The proportional thermo-regulator (4) is necessary to keep at constant temperature both analytical chamber and the FID detector.
The working temperature changes according analytical applications, the stability of the temperature control is within ±0.5 °C.
The temperature control is carried out by a PT 100 sensor.
The set point is fixed by a trimmer located on the same PCB.

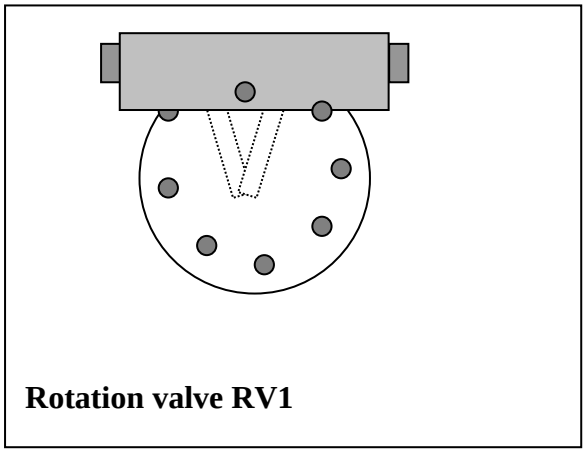
- The auxiliary services PCB includes electronic circuits for different functions. Automatic FID flame ignition function, flame ON/OFF digital signal, the hydrogen interception solenoid valve control circuit, the high voltage (300 Vdc) stabilised power supply, to excite the detector ionic field.

- The detector output signal is very low, a few pA of ionisation current (6), therefore this signal must be AMPLIFIED by a suitable sophisticated electronic circuit. On this PCB are located all elements for this purpose.

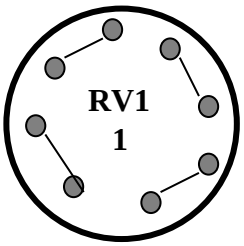
- The analytical peak memorising PCB (8) takes the signal from the electrometer amplifier output and memorises it up to the next analysis (sample and hold function), updating each time the concentration values at the output.

- The peak memorising output signal is 0-10 Vdc, the PCB (7) converts this voltage signal into a 4-20 mA signal, as to have at the output both analogue signal options.

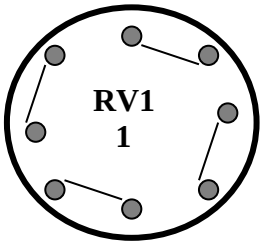
9.0 BIMATIC ROTATION VALVE



Rotation valve RV1

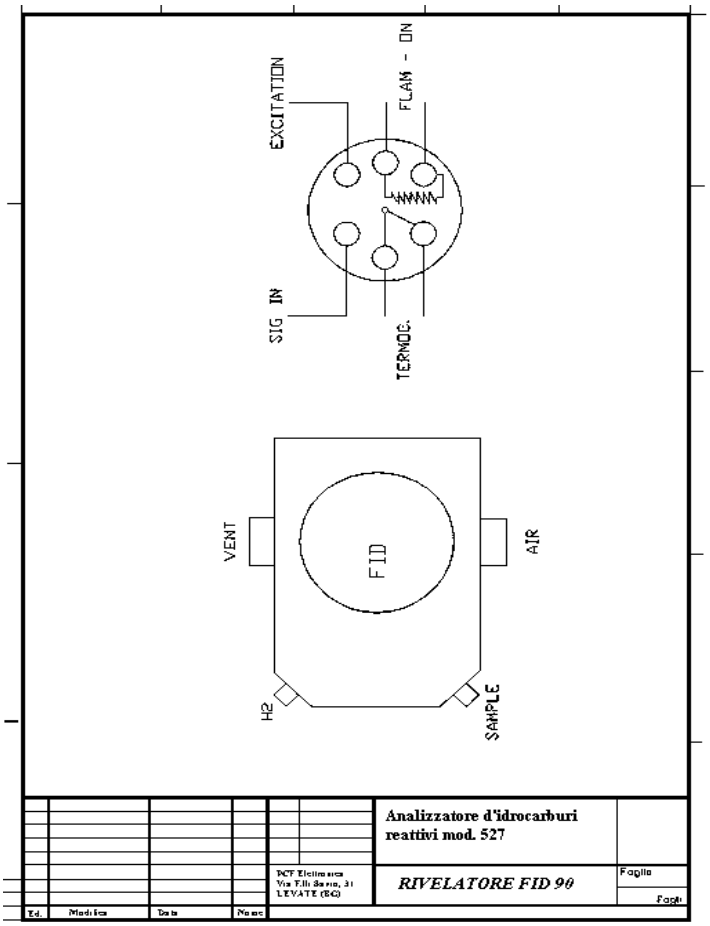


Sampling phase



Injection phase

The mod. RSV 108-8 high temperature valve is an 8 port rotation valve, specially designed, developed and manufactured by PCF Elettronica, intended to interconnect the pneumatic circuits at high temperature (up to 200°C).
The switching is performed by compressed air piloted by a 4 way solenoid valve and is dedicated to the automatic sampling of the sample.
In the description pneumatic circuits the two different positions, i.e. exited and not excited, the sampling and the injection phase respectively, of commutation valve in the different phases of analysis are shown.



10.0 FLAME IONISATION DETECTOR (FID)

The FID is the core of Model THC 110 Hot FID detector.
It shows a central nozzle that receives through a capillary hydrogen, about 25 ml/min, again through a capillary the nozzle is reached by the carrier gas carrying the sample compounds.
The nozzle is polarised, from an in built 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.
An air flow rate of about 250 ml/min, controlled by a third capillary, is supplied to the detector as combustion supporter gas. The quality of the combustion air must be very good (carbon content lower than 0.1 ppm) with the risk of jeopardising the measurements qualities.
Inside the detector are further located a Nickel spiral for the automatic switching of the flame as well as a thermocouple that detects when the flame is **ON** or **OFF** therefore command the automatic switching off the hydrogen flow when the flame is **OUT**.

11.0 WORKING MODE

Basically the sucking pump fills the sampling loop (0.6 ml) and cyclically the rotation of the eight-port valve inject the sampled quantity into the FID.
In order to avoid any condensation the sample is kept at high temperature (usually at 180 °C) from the sampling spot down to the THC 110 and through the FID detector. All the parts inside the instrument in contact with the sample are in resistant material (Teflon and SS) and kept at a constant high temperature (up to 200 °C).

Standard commissioning of the instrument
For a clearer explanation of the working set up see the next schematics.

Suggested installation of Mod. THC 110 for short distances from the gas sampling position.

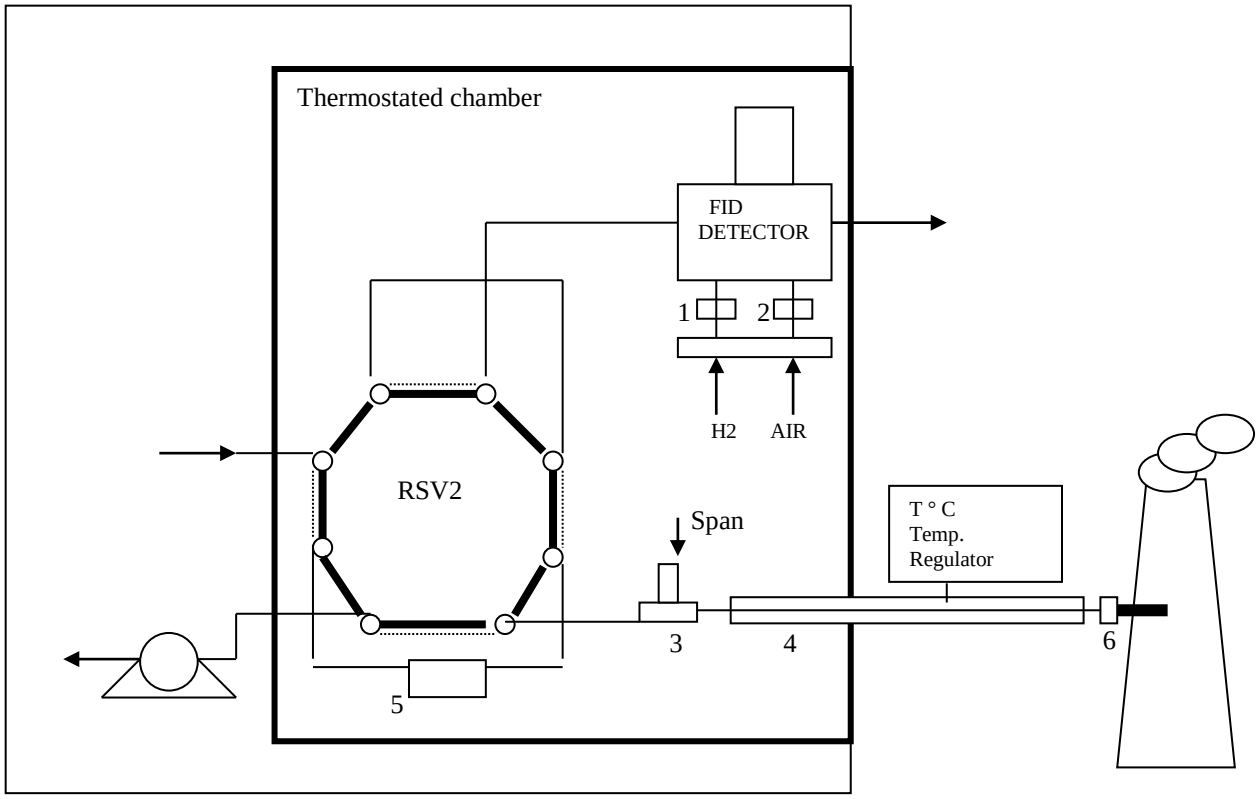


Figure captions:

FID Detector	Hot FID detector, within the thermostated chamber
1	Hydrogen capillary
2	Air capillary
3	Three way solenoid valve, span check/calibration
4	Heat traced line (0-200 °C)
5	Sampling loop, 0.6 ml
6	Sampling probe, can be heated
RSV2	High temperature eight port rotation valve
Pump	Can be either inside or outside the instrument, in the latter case a water trap may be introduced before the pump without modifying the measured sample content
Carrier	HC free air, the level of HC content depends from the used full range level. A thumb rule could be to have the HC content at least lower than 1% of full range value.
▬▬	Sampling phase
▬▬	Injection phase

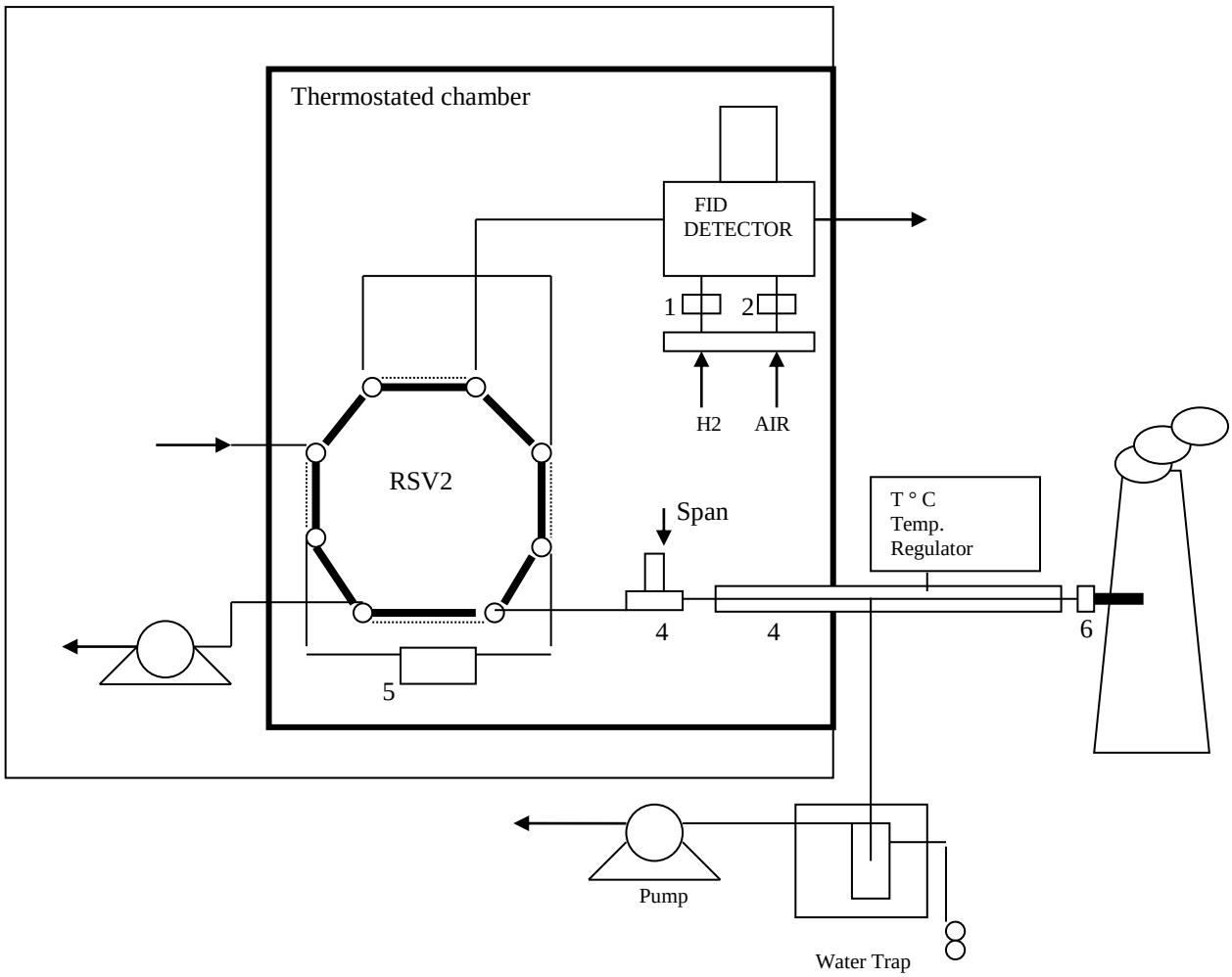
The sample, sucked by a pump or an air ejector, flows from the stack (duct) through:

- sampling probe;
- heat traced line, temperature controlled by a separate temperature regulator;
- the thermostated chamber of THC 110, showing:
  three-way calibration valve,
  eight port RSV2 rotation valve and cyclically
  FID detector then
  Out to vent.

The quantity of injected sample is extremely small with respect to the total flow into the instrument and then into the FID detector. The sample is circulated into the analytical circuit by clean and dry air (carrier). The total amount need for the measurement is practically reduced to a 1.2 ml/min (some 50 times less quantity that usual instruments that sample and pump the sample directly into the FID.

Suggested installation with a fast recycling loop of the gas under analysis.

The solution is strongly recommended when:
i) there is a long distance between the sampling and analysis locations,
ii) when the sample is particularly wet and dirty,
iii) when a very fast updating of the sample at the analyser is requested.

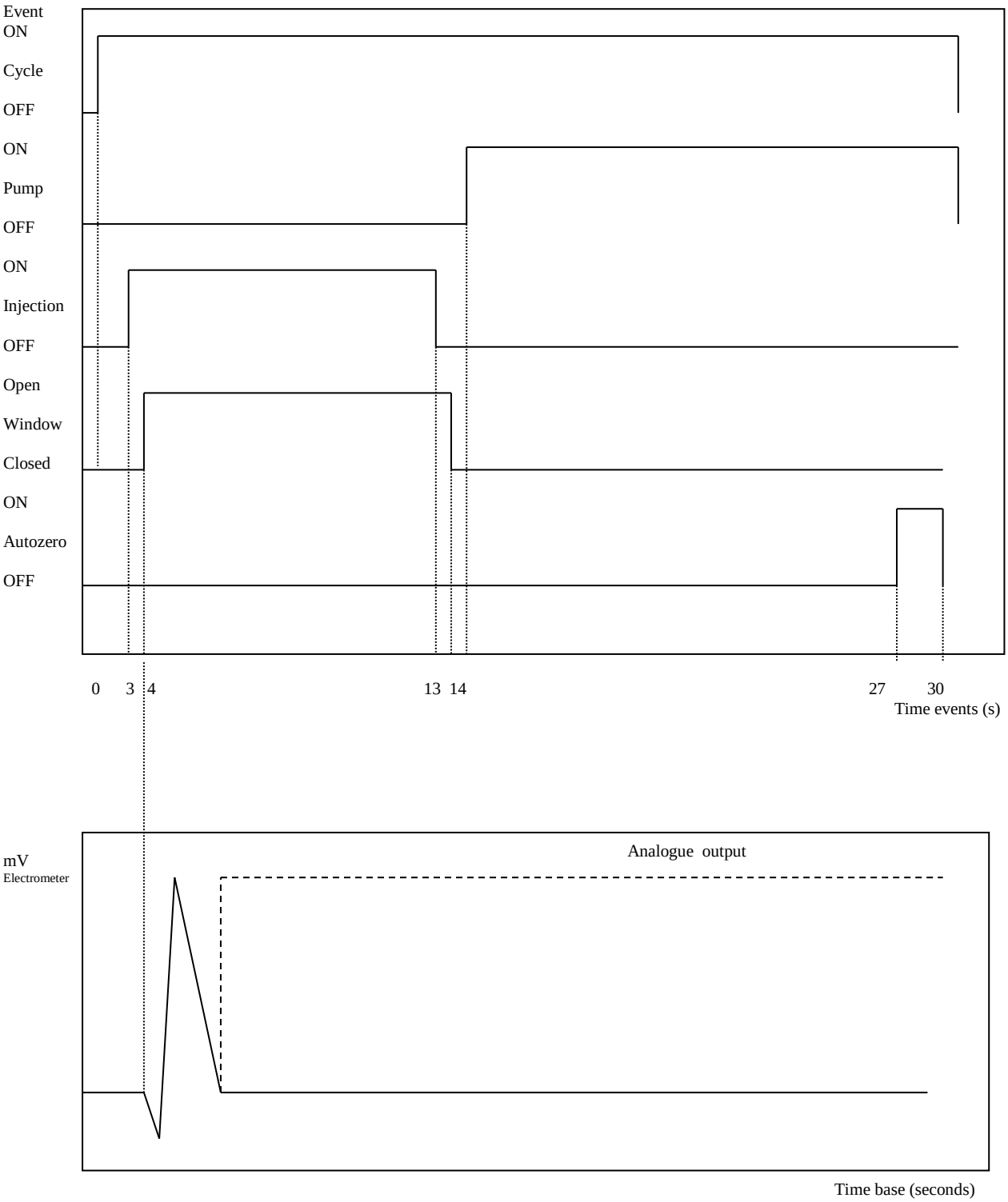


The operating phases

In the below table the fundamental operations of the instrument are shown:

Step	Elapsed time (s)	Event	RSV2 position	Gas flow	Electrometer output
	0	Cycle start			
Phase 1 Sampling phase	0 to 4 seconds		Base position 1-2 3-4 5-6 7-8 ports are connected	Sample gas flows through sample loop and then the pump or air ejector. Carrier gas flows into the FID detector	Nearly zero.
Phase 2 Injection and integration phase	4 to 14 seconds	Sample injection Back flush of sampling line	Active position 1-8 7-6 5-4 3-2 ports are connected	Sample gas flows directly to the pump or air ejector Carrier gas flows through sampling loop and then to FID detector	At the injection a small undershoot of electric signal then a peak, whose area is proportional to total quantity of carbon content in the 0.6 ml sample The electronics out put signal is continuous updated at every injection and peak integration
Phase 1 Sampling phase	14 to 27 seconds 27-30	Flushing of FID detector Auto-zero	Base position 1-2 3-4 5-6 7-8 ports are connected	Sample gas flows through sample loop and then the pump or air ejector. Carrier gas flows into the FID detector	Nearly zero.
	30	Cycle end			

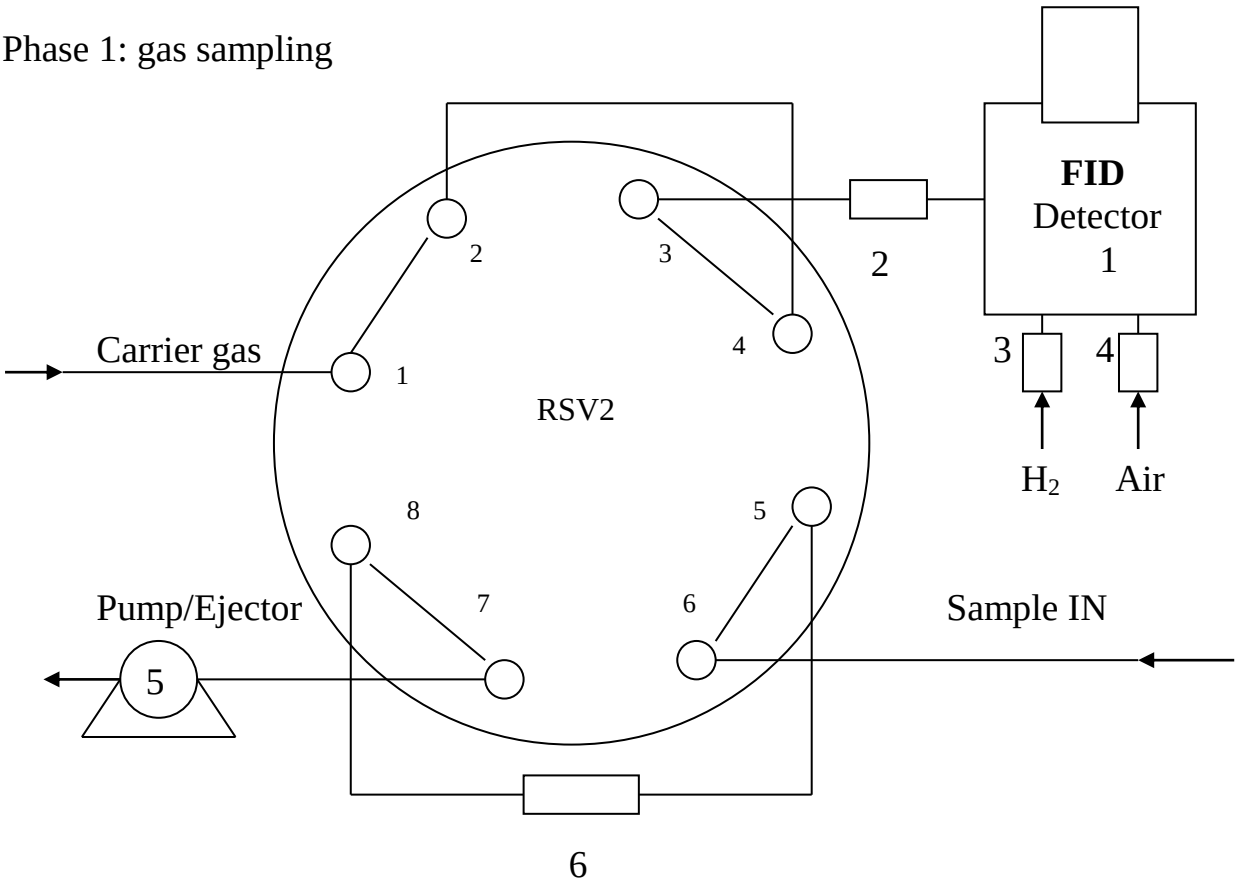
These steps in a time base diagram can be summarised as follows:



Flows of gases

The flows of gases are schematised in next two figures, the sampling and the injection phase respectively:

Phase 1: gas sampling



Phase 2: sample injection

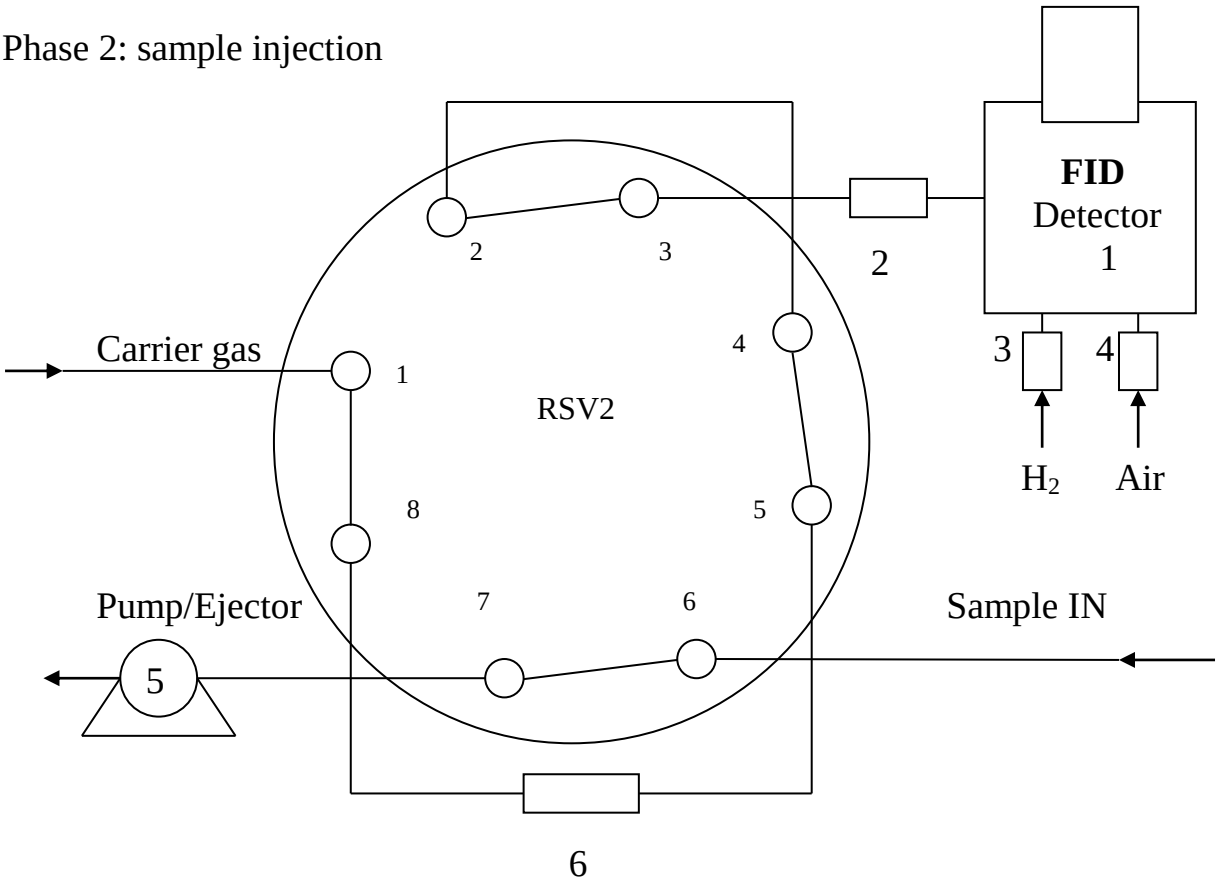


Figure captions:
1- Hot FID detector
2- Carrier gas capillary
3- Hydrogen gas capillary
4- Combustion air capillary
5- Sampling pump/ejector
6- Sampling loop

12.0 FIELD COMMISSIONING AND START UP

1- Connect the plumbing between the cylinder gas pressure reducers and the relevant gas connectors located on the analyser rear panel and indicated as Hydrogen, Air FID, Air Sup(ply, service air). Take care that the pneumatic connections are gas tight, specially for the hydrogen connection. A leakage connection can put the instrument in an unsafe condition as well as cause an abnormal gas consumption

2- Connect the power cord to the main power supply (220/110 Vac, 50/60 Hz, 300 VA).

3- Open the cylinder taps and regulate the relevant output pressures of Hydrogen, Air and Sample according to data in the final check record.

4- The relevant pressure on the manometers located on the instrument front panel, instead, must be set according to the values indicated in the instrument final check card, that goes with each instrument. Please note that the pressure of H_2 is visible just in the condition of **FLAME ON** or the **IGN** push button pressed.

5- Switch the Power switch in to position **ON**, now the instrument is on, green LED **ON**.

6- Check that PROG switch is in **OFF** position.

7- Connect output signal, see relevant schematics.

8- Wait till the green LED passes from continuously **ON** status into **BLINKING** status, this indicates that FID temperature set has been reached.

9- Press **IGN**(ition) key. Regulate hydrogen pressure on pressure gauge at the level indicated in the final check record supplied with the instrument.
Wait for 20-30 seconds.
If the FID flame is **ON** the hydrogen level indicated by relevant gauge on the front panel stays still and red Led above **IGN** key stays **OFF**.
If the Led switches **ON**, automatically Hydrogen pressure gradually drops to zero.

This means that detector flame is **OFF**. Repeat all operations described in the present section till flame stays continuously **ON**.
Note that at the first start up all the air trapped in the hydrogen line must be purged before FID detector lights on. It's a good rule to flow out all the air by having the hydrogen gas cylinder open and the pneumatic connection at the instrument slightly leaking. After a few seconds the connection can be tighted with no leaks.

10- With flame ON wait for 10-15 minutes then take Sample (Carrier) manometer gauge to pressure value as indicated in the final check record supplied with the instrument.
Now the instrument is in STAND - BY status.
If the value is not correct operate on the relevant by-pass regulator.
Wait for 5 minutes then press **AUTO ZERO** switch. By **ZERO** knob take Display value precisely to zero.

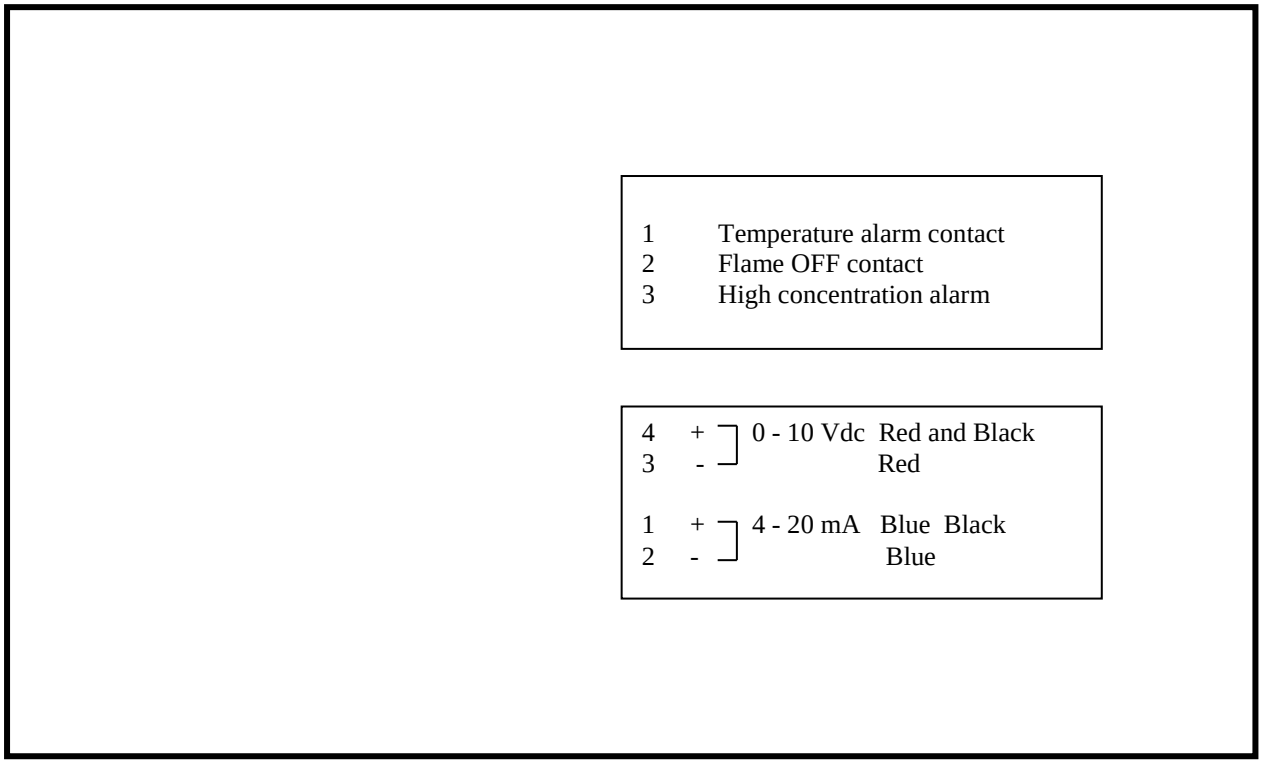
11- Set PROG switch into AUTO position, i.e. the instrument carries out analysis continuously.
The instrument switches from STAND - BY into ANALYSIS phase.

12- For calibration check/updating, set SPAN switch into CAL position. Wait for a couple of minutes (3 or 4 injections) and read the indicated value on display. If the value does not correspond to the expected one you may set the correct value by CAL Potentiometer.
Please note that the updating of the value is not immediate but it takes one measuring cycle
The value where to set the potentiometer may also be calculated with a proportion: e.g.
the range 0-100 ppm is in use,
the gas cylinder has an equivalent content of 60 ppm of methane,
the potentiometer is set to 50% and
the actual measured calibration value is 55 pp,
by a proportion we calculate that the potentiometer must be set to
50% : 55 ppm = x% : 60 ppm
that is *x% = 50% * 60 ppm / 55 ppm = 54.5%*
Once set the potentiometer to 54.5% check that the calibration value of the instrument corresponds to the 60 ppm equivalent value of the cylinder.

13- Switch the **SPAN** switch onto **OFF**.

14- The analyser is ready to measure **V.O.C.s.**

Rear panel electrical connections:

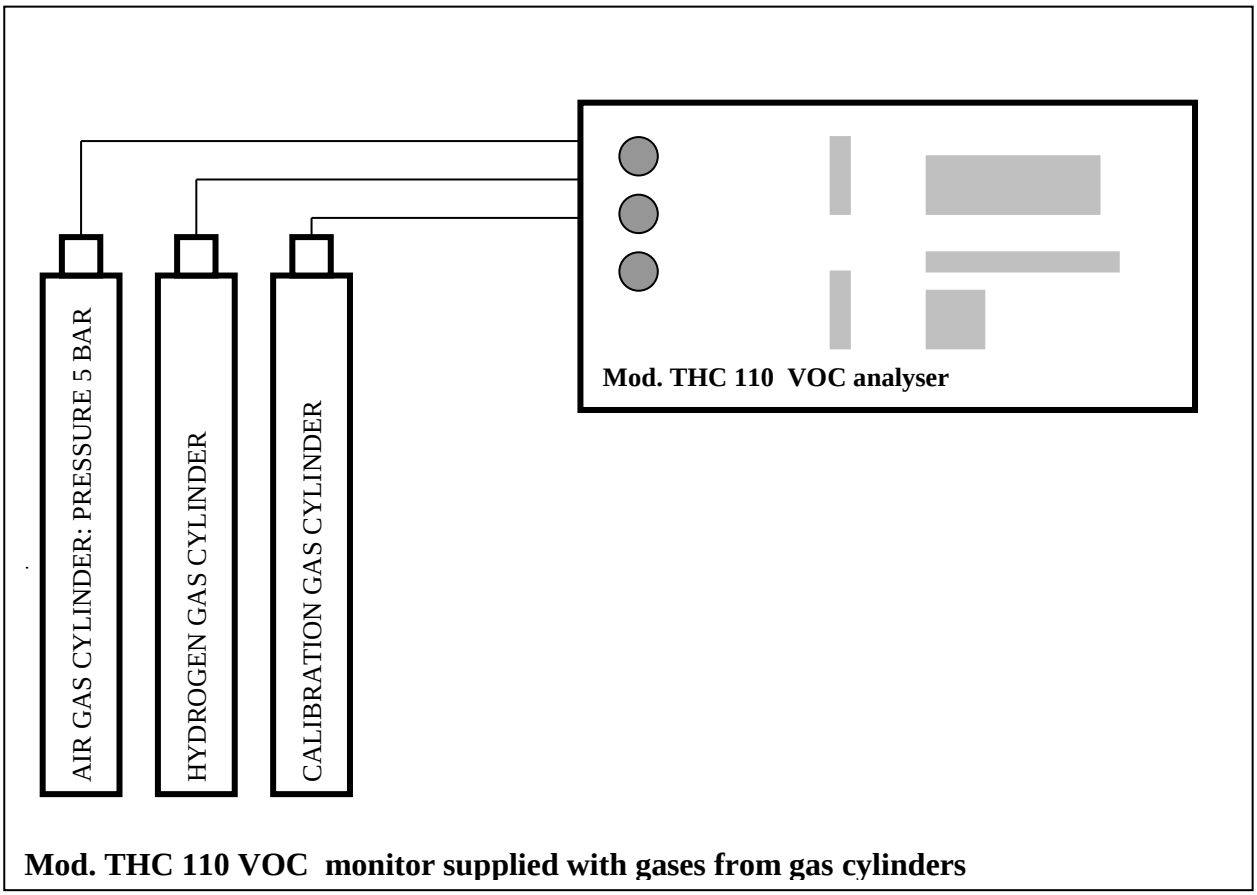


12.1 Suggested plumbing

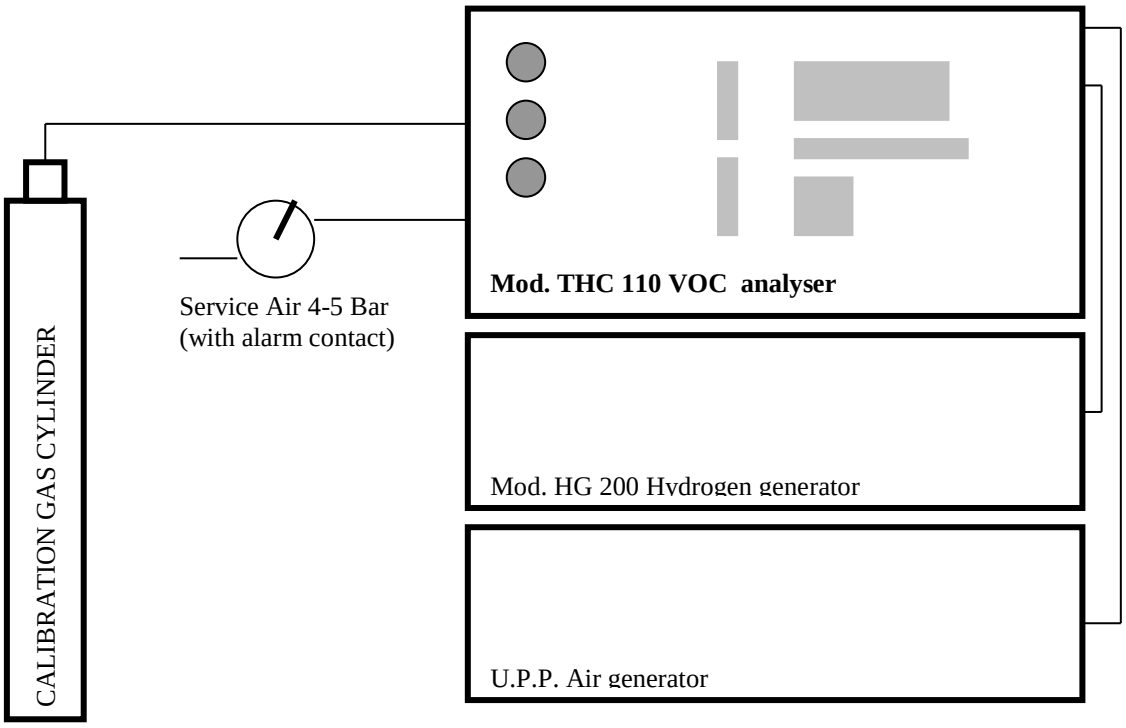
The instrument requires:
- hydrogen supply, 25-35 ml/min, as combustible gas of FID detector;
- pure air supply, 250 -300 ml/min, as supporter of combustion, and carrier gas, the hydrocarbon content must be lower than 0.1 ppm;
- service air, 4-5 bar, to activate the inner rotation valve, any service air will do the job.

The gases can either be supplied by compressed gas cylinders or by pure gas generators. The basic requirements are the purity as well as the supply pressure, high enough to guarantee the gauge set values.

Here below we show the two possible solutions of gas supply, intermediate solutions are also possible, according to the availability in the field or customer's specifications.



Mod. THC 110 VOC monitor supplied with gases from gas cylinders



Mod. THC 110 monitor supplied with gases from generators

13.0 MONITOR CALIBRATION

On PCF Elettronica's Mod THC 110 Hot FID monitor both a full calibration or a calibration check can be run as for zero just a check procedure can be performed. It must be kept in mind that the monitor is performing an autozero procedure before each measuring cycle.
Whenever a check of calibration/zero is required the instrument must be in the **AUTO/PROG mode**. Only with the instrument in analysis mode the "**SPAN**" function can be activated.
In order to start these procedures the relevant switches must be selected on the front panel.
If the "**SPAN**" command is selected the instrument performs the given command at the end of the current analysis cycle.

13.1 SPAN CHECK/CALIBRATION PROCEDURE

Connect to the rear panel IN SPAN gas connector a traceable gas cylinder, open both gas cylinder and pressure reducer valves and set a flow rate of 20-40 ml at the SAMPLE OUT (11) gas connector, better if the calibration gas is vented at the input.
Select the range suitable for the gas mixture in the gas cylinder.
Select the "SPAN" procedure by switching the relevant switch (14) on the front panel; once the current analysis is terminated, the instrument enters the calibration phase and starts an automatic analytical cycle.

Example:

Gas cylinder contains 20 ppm of C_3H_8, with air as balance. The methane equivalent corresponds to 20 ppm x 3 = 60 ppm equivalent of methane (carbon).
The suitable range is 100 ppm full scale.

If the gas cylinder contains more than one organic compounds it's suggested to express the total carbon concentration either in terms of carbon or methane equivalent, e.g.
Gas cylinder contains 20 ppm of CH_4 and 5 ppm of C_4H_{10} (buthane), with air as balance. The total carbon or methane equivalent is (20 + 5x4) ppm = 40 ppm
And so for any type of calibration mixture

The regulations of gain amplifier potentiometer (13) (allowed only within the calibration procedure) are carried out in order to set calibration values shown on the display that must correspond to the certified traceable gases.

At the end of calibration procedure **close** the calibration gas cylinder.

13.2 ZERO CHECK/REGULATE PROCEDURE

Connect a zero air supply on the sample IN, in vented condition (atmospheric pressure).
Wait a full analytical cycle, longer than 30 seconds, then by the front panel ZERO amplification potentiometer (13) take the signal of the display to zero value.
Lock the ZERO amplification potentiometer and disconnect zero air supply.

14.0 MONITOR MAINTENANCE PROCEDURE

All the operations described in the present section must be performed with main power supply to the instrument OFF (disconnect the mains plug) and with the H_2, Air, Span service gases intercepted by the main manometers and valves on the gas cylinders.

REPLACEMENT OF SAMPLING PUMP

- With a spanner disconnect the gas connection to the pump.
- Release the bolts that keep the pump in place.
- Disconnect power supply.
- Replace the pump.
- Fix the bolts and the gas connection.
- Perform a calibration check and eventually adjust the SPAN amplification potentiometer.

REPLACEMENT OF ROTATION VALVE

- Open the measuring chamber. If the instrument is just switched off wait for the cooling down to about room temperature.
- Tag the input to the valve ports. With an 8 mm spanner disconnect the gas connections, taking care not to ruin the screws of connections.
- Release the rotation valve bolts and replace the rotation valve with a new one.
- Connect to same ports the tubes, 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 SPAN amplification potentiometer.

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. ….

REPLACEMENT OF FID DETECTOR

- With an 8 mm spanner disconnect H2, Air and Sample gas connections. Take care not to spoil the screws and the tightness of connections.
- With a screw driver spanner release the FID block and remove the item.
- Replace the FID with a new one.
- With a spanner block the FID in position
- With an 8 mm spanner connect again H2, Air and Sampl pneumatic connections. Take care not to spoil the screws and the tightness of connections.
- Supply all the service gases and power the instrument.
- Perform a calibration check and control.

14.1 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.

FID AIR capillary check
By employing an 8 mm spanner disconnect the 2 mm steel tube connected to FID detector through the "AIR" 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 FID 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 FID detector.
In the operation of connecting the steel tube to the FID 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.

CARRIER flow rate check
By employing an 8 mm spanner disconnect the 2 mm steel tube connected to FID 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 FID detector.
In the operation of connecting the steel tube to the FID 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.

H_2 flow rate check

By employing an 8 mm spanner disconnect the 2 mm steel tube connected to FID detector through the "**H2**" tagged input. Then turn in the right direction (clock wise) Px trimmer located on the mother board till the **H_2** interception valve is active (take note of the turns required).

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 hydrogen pressure 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 FID detector, rotate Px trimmer located on the mother board (see service manual) to left direction (anti clock wise) of the same turn number till the safety solenoid valve opens again.

In the operation of connecting the steel tube to the FID 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.

15.0 **SUGGESTED MAINTENANCE SCHEDULE**

Basically PCF Elettronica's Mod. THC 110 Hot FID V.O.C. monitor is a very simple process FID instrument with tested parts to last years without maintenance. The eight port valve, the most sophisticated part 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 high measuring ranges (> 100 ppm) it is not necessary to have very pure combustion air, dry and compressed ambient air passed into carbon filters will do.

For good maintenance operations of the instrument we recommend:
- standard tool case
- digital multi-meter,
- strip chart recorder (0-10 Vdc)
- bubble flow meter with stop watch and/or digital flow meter.

Time	Operations	Actions (if necessary)
Commissioning	Check: Power Supply Gas Supplies (quality and pressure) Service Gas pressure Analogue output(s)	
Weekly	Sample flow	Replace or clean filters Front filter and/or Sintered filter
Monthly	Sample flow Sintered filter Zero check Calibration check	 If necessary adjust zero by ZERO potentiometer If necessary adjust span by SPAN potentiometer
Every 3 months	Sample flow Membrane pump	 Rebuild pump
Every 6 months	Calibration procedure	Change amplification
Every year	Check Cycle times H_2 capillary Air capillary Carrier capillary	Adjust retention times Replace
Every 3 years	Rotation valve	Maintain or replace

16.0 **TROUBLE SHOOTING**

POWER LED OFF

- Check the mains power supply	Connect power supply
- Check the fuse on the power supply	Eventually replace the fuse
- Thermostatic PCB not working	Replace thermostatic PCB
- Signalling LED broken	Replace signalling LED
- PT100 thermo-resistance open	Replace thermo-resistance

The flame does not ignite
Signalling LED always ON

- Auxiliary service PCB not working	Replace auxiliary service PCB
- Lack of Hydrogen or Air	Supply Hydrogen and Air
- Ignition spiral is broken	Replace FID
- Thermocouple is broken	Replace FID
- Clogged H2 or Air capillaries	Check flow rate and replace if necessary
- 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

Power LED ON, the others OFF

- Fuses on power supply PCB broken	Replace fuses
- Stabilised power supply PCB not working	Replace stabilised power supply PCB

Output signals dead

- FID detector not working	Replace FID detector
- Electrometer board not working	Replace electrometer board
- Auxiliary service PCB not working	Replace auxiliary service PCB

0-10 Vdc signal live
4-20 mA signal dead

Check external connection	Restore external connection
4-20 mA board not working	Replace 4-20 mA board

Lack of pneumatic Sample gas pressure

- Supply 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

Lack of FID Air pressure

- Supply air cylinder either empty or with closed interception valve	Open the gas cylinder or replace it
- Leakage in inner relevant circuit	Find and mend the leakage
- Pressure regulator not working	Replace it
- Manometer not working	Replace it

Lack of Hydrogen pressure

- Hydrogen gas cylinder either empty or closed	Either open the air gas cylinder or replace it
- Leakage in pneumatic circuit	Amend the leakage
- Pressure regulator not working	Replace pressure regulator
- Intercepting solenoid valve not working	Replace solenoid valve
- Auxiliary services PCB not working	Replace auxiliary services PCB
- Manometer not working	Replace manometer

No variations on output signals

- FID detector not working	Replace FID detector
- Electrometer board not working	Replace electrometer board
- Output signal board not working	Replace output signal board

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
- Lack of air on air ejector	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
- Auxiliary services PCB not	Replace A.S. PCB

working

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

SWITCHING OFF

- Take Power switch on OFF position
- Take AUTO OFF MAN switch on OFF position
- Wait for some ten minutes then close the valves on the supply gas cylinders or generators.

17.0 **SPARE PARTS**

Any time a spare part is purchased please supply the description of the part and, whenever possible the type and serial number of the instrument.

Code Number	Description
095020114	Sample capillary
095020115	Hydrogen capillary
095020116	Air capillary
095020120	Pressure regulator
095020121	Bar gauge
095020125	FID detector sub assembly
095020130	Red LED
095020131	Green LED
095020132	Return switch
095020133	Stable switch
095020134	SPAN potentiometer
095020135	Digital display
095020136	Power supply transformer
095020137	Power supply socket
095020138	Cooling fan
095020141	Electrometer PCB
	LCD and microprocessor PCB
095020143	Function programming PCB
095020144	Auxiliary services PCB
095020145	Temperature regulator PCB
095020146	Stabilised Power Supply PCB
095020150	PT 100 temperature sensor
095020152	FID detector heating resistance
09510116	Eight port Bimatic rotation valve
09510124	Rotation valve rebuild kit
09514822	Stainless steel tubing (1 m)
09514123	Seal set
09514124	Stainless steel pneumatic connections
	High temperature SPAN solenoid valve

Code Number	Description
09514125	Fuse set
09510351	Sampling pump (heated head as optional)
09514126	Sampling pump rebuild kit
09510201	Hydrogen interception solenoid valve
09514127	Sintered filter
09510202	Rotation valve pilot solenoid valve
09514128	Flame ON temperature sensor
09514129	Flame ignition resistance
09514130	Mains switch

Expendables kit

041-0213	N. 1 Carrier gas capillary
09510116	N. 1 Rotation valve rebuild kit
09514126	N. 1 Sampling pump rebuild kit

Spare parts kit

041-0213	N. 1 Carrier gas capillary
09510116	N. 1 Eight port rotation valve
041-0201	N. 1 H_2 interception solenoid valve
041-0221	N. 1 Pressure regulator

PCF ELETTRONICA MOD. THC 110
V.O.C HOT FID DETECTOR

FINAL CHECK RECORD

CARRIER	Bar ……	ml/min ……
H_2	Bar ……	ml/min ……
AIR	Bar ……	ml/min ……
SAMPLE CARRIER	Bar ……	ml/min ……
OVEN	°C ……	

ANALYTICAL PROGRAM SET

Injection	……..	4"
Back flush	……..……	14"
Acquisition time	……..…..	3-13"
Auto Zero	……..	27"
Cycle length	……..……	30"

CALIBRATION PROGRAM

Compounds employed for the calibration:
……..

Traceable cylinder concentration: …… ppm …… mg/m^3 V.O.C. …… mg/m^3

Concentration : …… ppm …… mg/m^3 V.O.C. …… mg/m^3

SPAN RANGE set point: ……. DIV

Service Engineer: …….. Date: ……