MOD. 8807/NR H (New Release)
Portable GC

Showing an exclusive injection system,
Gas chromatographic separation of species
As well as a proprietary and exclusive

FID
Flame Ionisation Detector

OPERTING MANUAL

Basic configuration for NMH (Non-Methane HC) analyser

(Release July 20th

2018)

Contents:

1. FOREWORDS

The FID detector is generally known as the most linear and stable sensor for detection of organic compounds. Particularly in environmental monitoring, where a mix of hydrocarbons are present in the sample, the measuring equipment requires a detector possibly equally sensitive to all types of compound.

The basic version of Mod. 8807/NR, NMH portable GC analyser, has been studied, developed and manufactured to monitor Total Hydro-Carbon (THC) Fraction, the Methane Fraction (CH_4) and the difference between the two, namely the Non Methane Hydrocarbon Fraction, in stacks.

Please note that NMH (Non-Methane Hydrocarbon) acronym is very much similar to commonly used TNMHC (Total Non -Methane Hydrocarbon).

PCF Electronica'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. The quantity of carbon ions generated are proportional to the total quantity of carbon passing through the hydrogen flame.

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	CH4	1
1	C2H6	≈ 2
1	C3H8	≈ 3
1	C6H6	≈ 6

In other words, once the instrument response is *normalised* to *methane* (or carbon) *equivalent*, 1 ppm of propane will approximately generate a signal as 3 ppm of methane (actually the signal is not exactly three times but more likely 2.75 times).

Please check on the enclosed APPENDIX a more extensive discussion of the matter as well as the full list of response of the most common hydrocarbon compounds to FID detector.

1.1 Introduction

The present manual includes the following sections:

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

The inbuilt firmware that controls the analytical cycle is fully described, the **CONFIGURATION MENU should not be entered** but left to service purposes.
The operative functions, the status, the temperatures as well as the analytical data are managed by an industrial micro processor, while the analytical programs is permanently recorded on EEPROM.
Thanks to a "*USB pen flash drive"* on the front panel of the instrument, showing a minimum capacity of 2Bites, both measures as well as the configuration of the instrument may be stored; access to the cards it's possible from the front panel:

USB pen flash drive

Such instrument firmware allows data banking for all analytical data, these can be successively downloaded through either the RS232 or the USB serial connections.
Up to six measured species may be displayed on the front panel of Mod. 8807/NR portable GC monitor, in the NMH configuration just three measured values are shown: CH_4, NMH, THC.

The touch screen shows the analysis progress, the instrument operating status, the measured values, the recorded menus, that may be selected by the front panel key board, according the need and the variables of analytical program as well as the actual output of FID signal.

2.0 OPERATING PRINCIPLE

The PCF Elettronica's Mod. 8807/NR, NMH portable GC analyser, in its basic configuration, detects and records methane and non methane fractions of hydrocarbon in a wide range of ambient as well as stack conditions without any possibilities of water condensation or limitation in the ranges, from few tens of ppb ($\mu g/m^3$) up to thousands of ppm ($mg/m^{3)}$.

The instrument can be either employed in automatic monitoring systems or in a transportable version for air quality monitoring.
The basic analytical cycle is capable to measure continuously THC (Total Hydro Carbons, i.e. any type of hydrocarbon compound present in the environment), CH_4 (Methane fraction) and NMH (Non Methane Hydrocarbons fraction), which actually is the difference (THC - CH_4).
The full analytical cycle is calibrated through traceable gas cylinders.
The Flame Ionisation Detector (FID) is based on an hydrogen micro flame, where the organic compounds are oxidised and a correspondent amount of ions are produced. The detector is therefore insensitive to the compounds structure 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 mixing of the combustion hydrogen with the sample flow; this mixture is successively burnt in a micro flame with oxygen excess (hydrocarbon free air in large stoichiometric excess).
The electrical charges, generated by the combustion 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 in an electrical circuit into voltage drops directly proportional to the currents generated in the flame.
The values obtained by the above describe procedure are managed by the electronics then showed on a digital display as well as made available at the outputs as analogue signals for local or remote recording and control.
The same concentration values are available through the USB serial port and, memorised on a Pen Flash Drive in built in the instrument, may be downloaded via USB to a remote data collection device. The full capacity of the in -built Memory card is higher than 2 Gbytes.

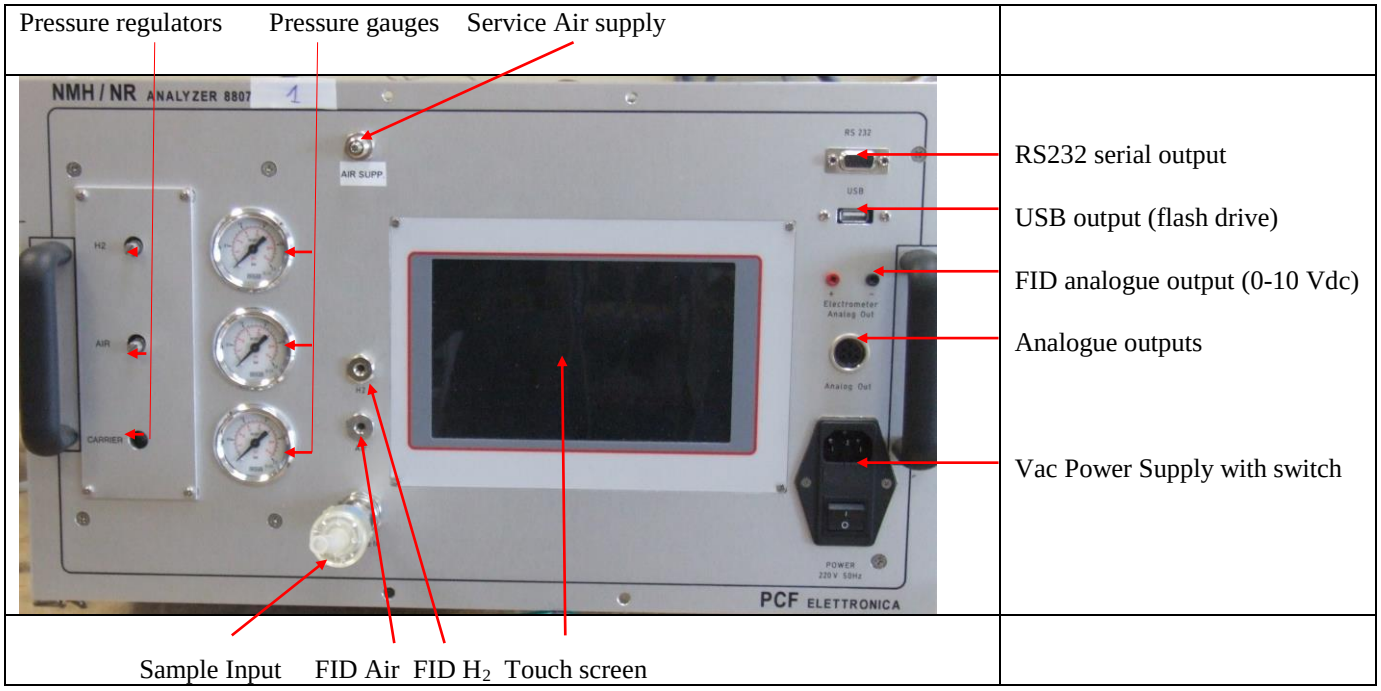
3.0 TECHNICAL SPECIFICATIONS

- Active range : 0-10,000 ppm (mg/m^3)
- Measuring ranges CH_4, THC/TVOC, NMH : (four basic ranges 0-5/10/20/50/100 ppm) (others available on request, within the active range)
- Units : Mod. 8807/NR may be calibrated in ppm or mg/m^3
- Background noise : 0,01 ppm
- Lower Detectable Limit (LDL) : < 0.02 ppm
- Zero stability (24 hours) : < 0.01 ppm
- Span drift (24 hours) : < 0.02 ppm
- Measuring cycle : 180 seconds for NMH
- Response time : 180 seconds for NMH
- Linearity : better than 1% full scale
- Precision : ± 0.5 %
- Sample flow rate : 500 ml/min
- Operating temperature range : 0 - 40°C
- Display : 640 x 200-pixel colour LCD graphic display touch control.
- Information on display :
  : Zero level
  : Controlled Temperature Chamber temperature
  : Date and Time Chromatogram
  : Performed analysis number
- Instrument configuration : from front panel
- Three front panel outputs
  - CH_4 : on display or RS232/USB serial output
  - NMH : on display or RS232/USB serial output
  - THC (TVOC) : on display or RS232/USB serial output

- Serial output : RS232 and USB port
- Zero drift : automatic compensation
- Zero/Span : set from a calibration mixture through the sampling port under vented conditions
- Services
  - Hydrogen : 25- 30 ml/min
  - Pure Air : 250-300 ml/min
  - Service Air : 4.5 Bar (63 psi) clean and dry without HC
- Calibration gas cylinder (sugg_ed for range 0-10) : 4 ppm CH_4 + 1 ppm C_3H_8 (propane), **air balance** (proportionally higher for ranges higher than 10 ppm).
  Note: the THC must not exceed the selected range.
- Sampling pump : electrically heated pump
- Mounting : in a heavy duty aluminium case
- Dimensions : 400x500x600 mm (16 » x12"x 6",WxDxH)
- Weight : 20 Kg
- Standard power supply : 230/110 Vac 50/60 Hz (to be specified in order)
- Power consumption : 300 VA
- Pneumatic connections : 1/4" or 4/6 mm and 1/2 mm

4.0 TOP PANEL DESCRIPTION

All the controls of the instrument are accessible from the top panel.



The top panel (see above figure) shows on the centre the touch screen colour video graphic display as well as control key board. 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).

The manometers with relevant pressure reducers to allow the setting of instrument service gas pressures are positioned 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).

The **H_2** (hydrogen) manometer gauge, as combustible gas for the FID flame, is located on the top, the **Air** gauge (air to FID), as the combustion gas for the flame, stays in the middle and, finally, the **Carrier** gas gauge, for the regulation of the carrier gas through the chromatographic column (whenever present) can be found on the bottom.

On the left-hand side of each gauge a trimmer allows the regulation and setting of the gas pressures.

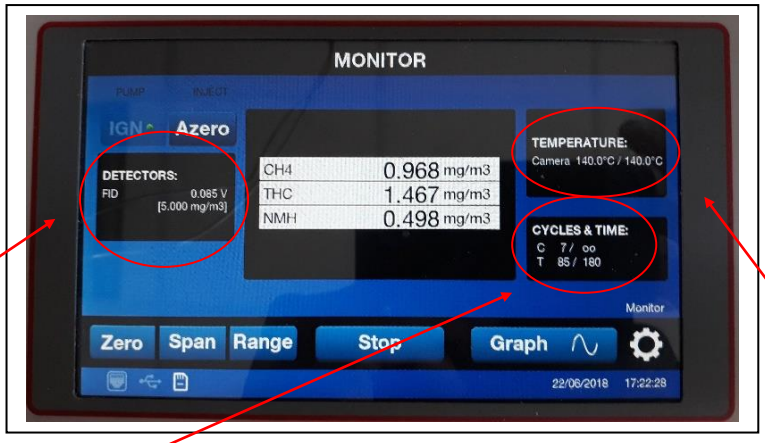
Please remember that **pressures/flow rates are connected to FID response and therefore to calibration.**

Keep the setting of the pressures/flow rates as much constant as possible, better if at the same value indicated in the FINAL CHECK RECORDS supplied with each instrument.

On the right end side corner you may find the USB port suitable for a digital pen flash drive, on the latter unit analytical data, instrument set up and analytical method, that supervises the automatic procedure of desired analysis, may be recorded. The digital pen flash drive can be extracted and easily read by any reading support connected to a PC.

The basic operating menu (HOME MENU) is displayed on the lower part of the video display. As said it is user friendly and allows easy correction, by back return, if some selection proved wrong.

BASIC MENU IN MONITORING CONDITIONS



Info about detector output [selected measuring range]

Temperature of analytical camera

Programmed cycle:
C 7/00 = seventh cycle of continuous measurements
T 85/180 elapsed time : 85 s of a 180 s cycle

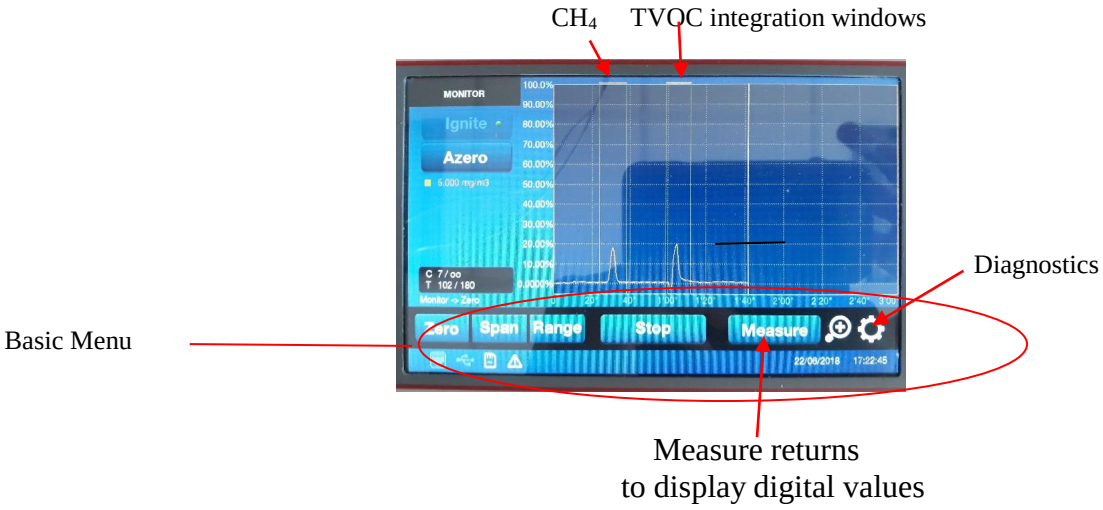
Further figure captions:

IGNITE:	for the ignition of FID flame.
AZERO:	electronical zeroing of the FID signal.
DIAGNOSTICS:	information on working set and conditions.
ZERO:	ZERO command (the instrument enters ZERO at the end of running cycle).
SPAN:	SPAN command (the instrument enters SPAN at the end of running cycle).
RANGE:	select range of the instrument (usually 4 or 6 ranges freely selectable)
MONITOR:	measuring condition.
STOP:	the instrument stops working and enters into (STAND BY) READY condition.
GRAPH:	the running chromatogram is displayed.
SETTINGS:	the working sets and condition of the instrument may be modified while in operation (MONITOR), front-end/back-end feature.

As in all the modern equipment the basic software commands/settings are self explaining.
No possibility to make mistakes:

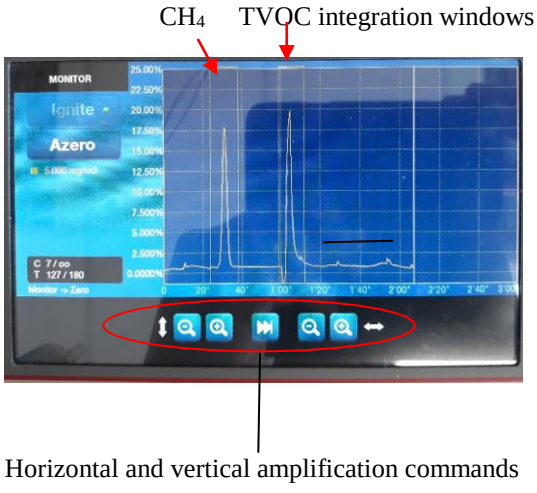
- The new setting must be confirmed
- If operator does not intend to confirm he must push **Back**

THE DISPLAY WHEN GRAPH IS SELECTED



Same display as above with amplified the signals

THE DISPLAY WHEN "GRAPH" IS SELECTED



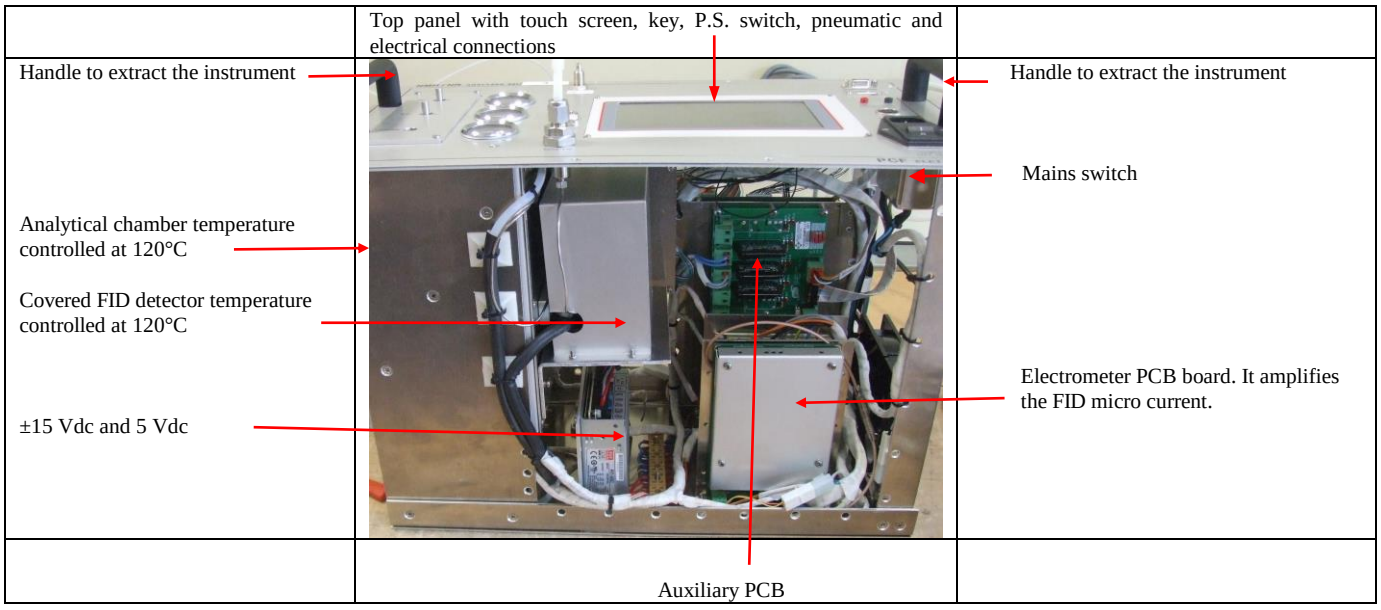
5.0 EXTRACTED ANALYZER VIEWS

The great development in the field of integrate circuits, thanks to the use of very high integrated chips, has dramatically reduced the room occupied by electronics that manages all the instrument firmware. Inside the instrument we find the main Mother Board located on the rear side, while the touch screen PCB carrying LCD display is on the top panel.

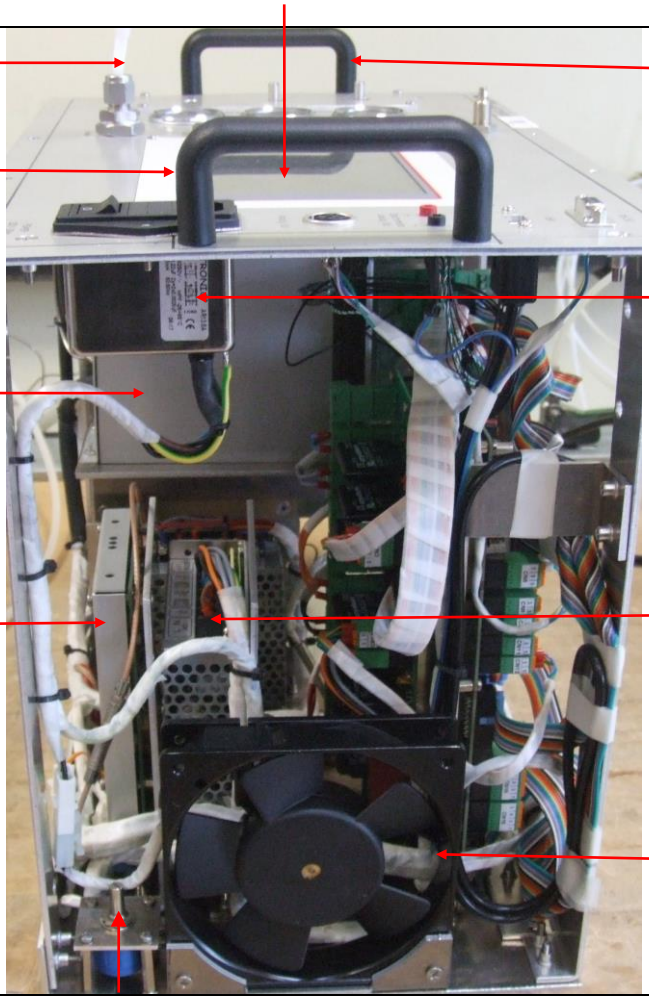
The electrometer, the only electronic part that differs from the core electronics as it is a very high gain analogue amplifier, is located on the right-hand side of equipment (as near as possible to FID detector).

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

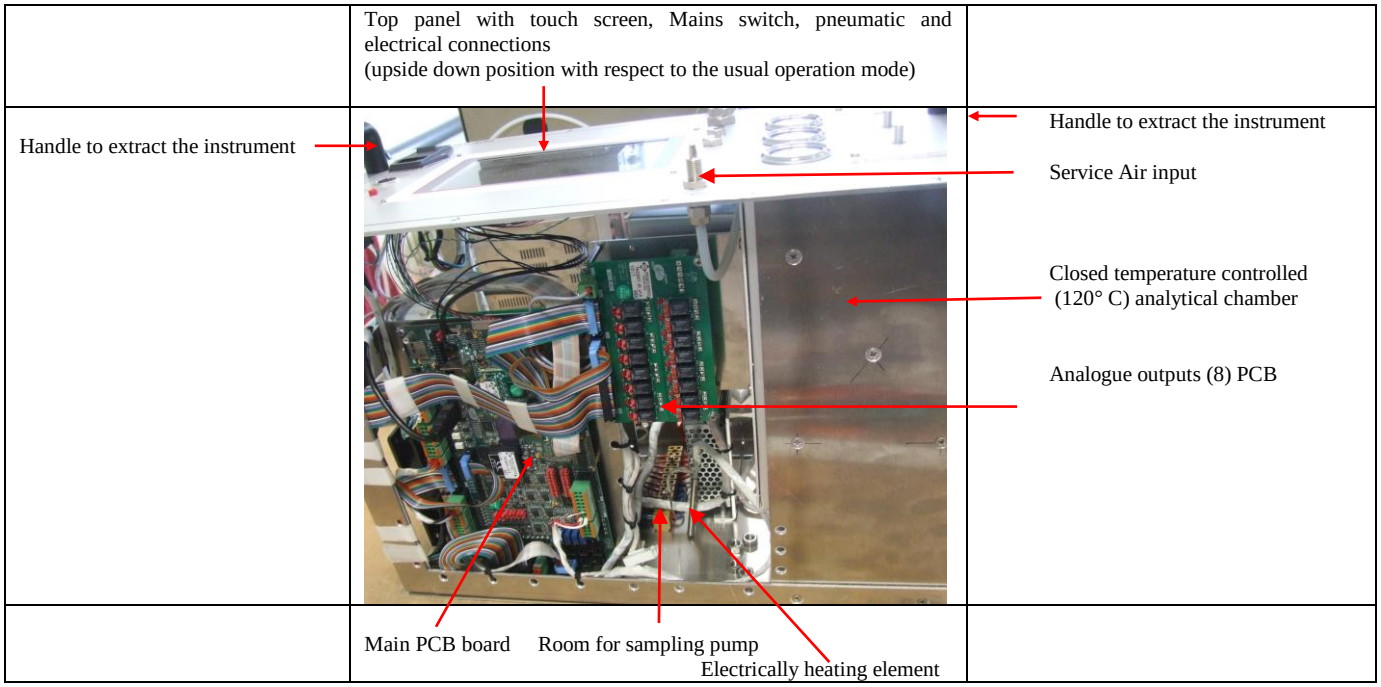
5.1 Extracted analyser (front view)



5.2 Extracted analyser (right hand view)

	Top panel with touch screen, key board, P.S, pneumatic and electrical connections	
Dust filter used when sampling from environment Handle to extract the instrument Covered FID detector temperature controlled at 120°C Electrometer PCB board. It amplifies the FID micro current		Handle to extract the instrument Power supply connector and switch . ± 15 Vdc Power Supply Air ventilation fan
	Electrometer PCB trimmer. Do not touch it without contacting PCF Service Dept	

5.3 Extracted analyser (rear view)



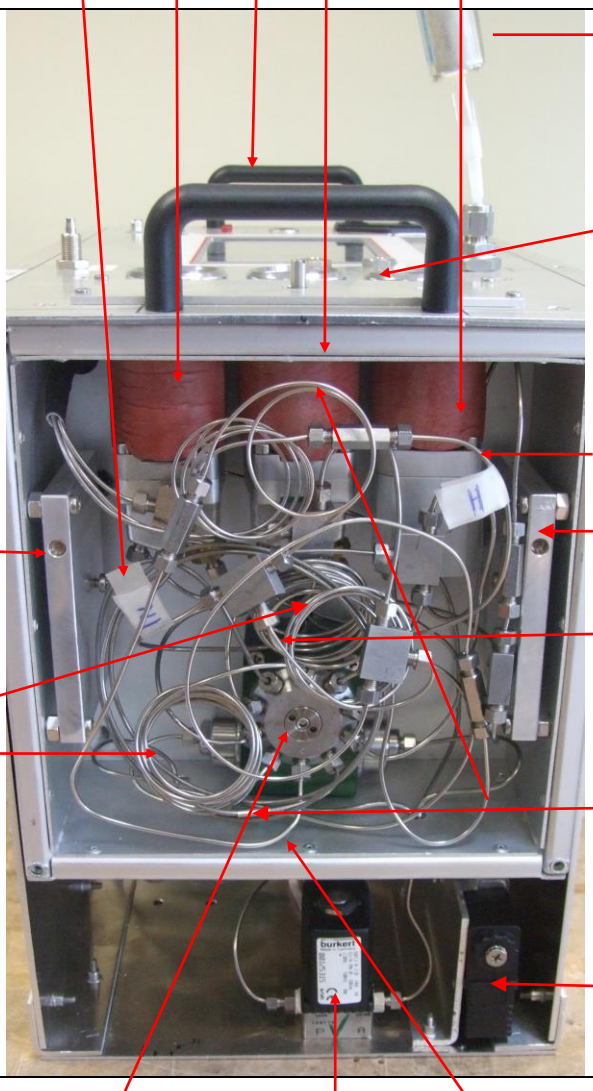
Note: To detect the single components in the temperature controlled analytical room we suggest to keep in mind the pneumatic circuit of the instrument.
The identifications of the component are very important whenever it could be useful to replace parts for maintenance as well check the important flow rates of

- Hydrogen (remember that the interception electro valve must be opened by commanding the ignition of the FID)
- Zero Air to FID.
- Carrier Zero Air.

Please see next picture with the open analytical chamber

5.3 Extracted analyser (left hand view)

(with open the analytical chamber, the heart of the analytical process)

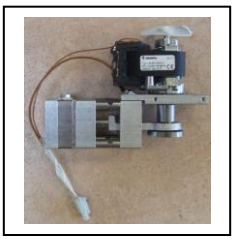


6.0 SUB SYSTEMS

6.1 Electrically (not) heated pump

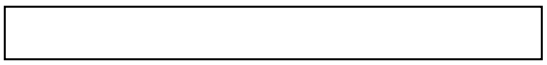
Sampling pump revision kit

Electrically heated pump



Not heated sampling pump

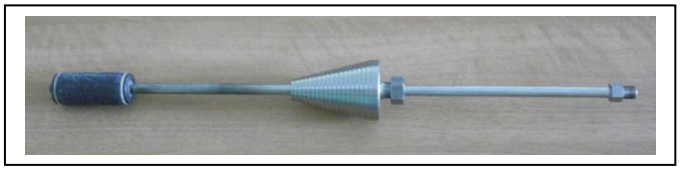
Input/Output + Power cord



6.2 Electrically heated sampling line and probes

3 m electrically heated sampling tube with spare parts for installation

S.S. sampling probe with dust filter on top

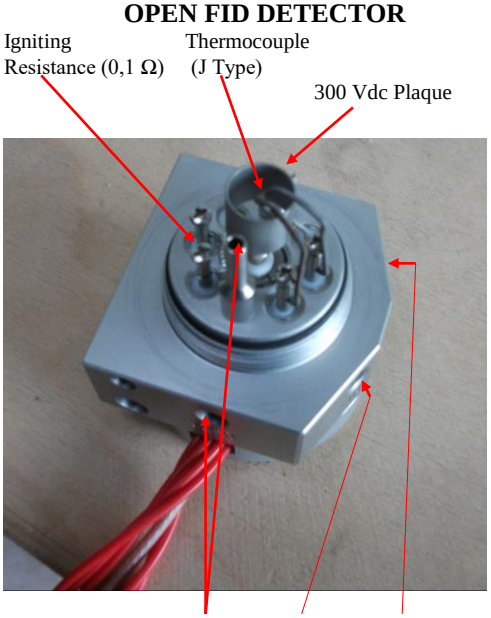


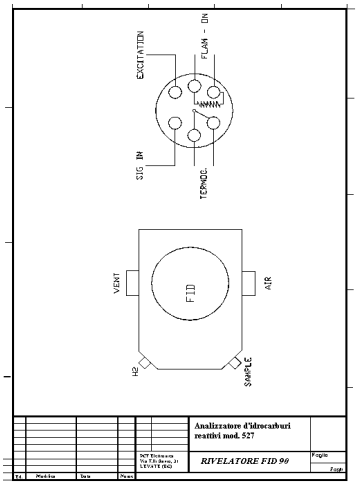
Electrically heated dust filter probe

6.3 FID (Fame Ionisation Detector)

FID DETECTOR

OPEN FID DETECTOR





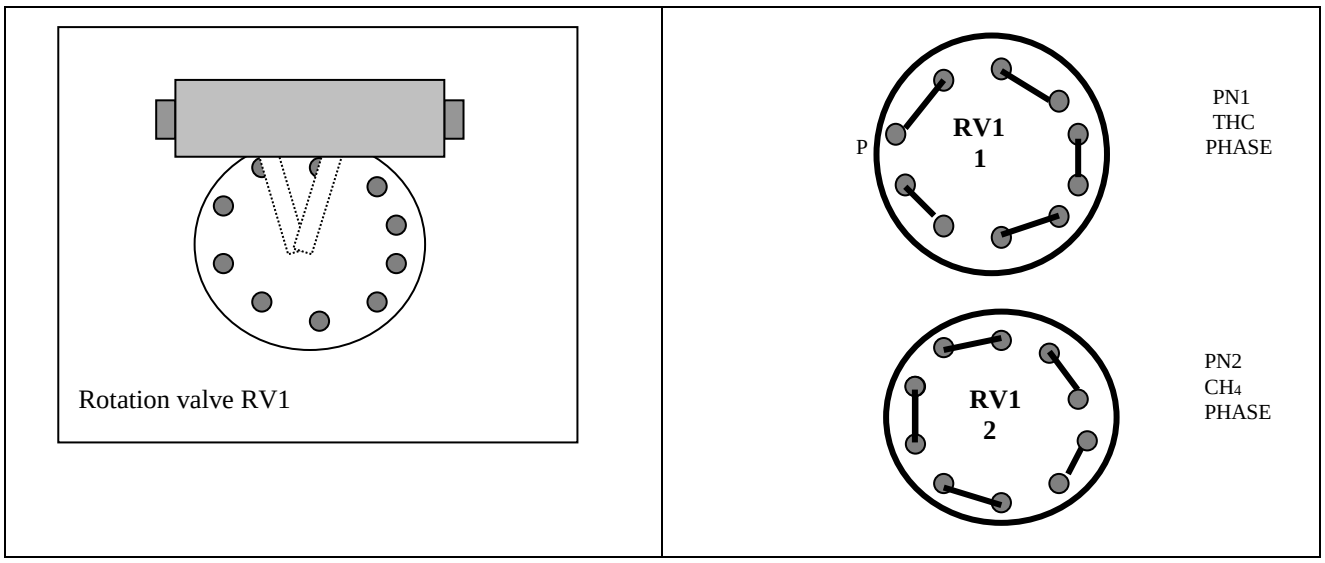
Proprietary FID schematics (the black magic!)

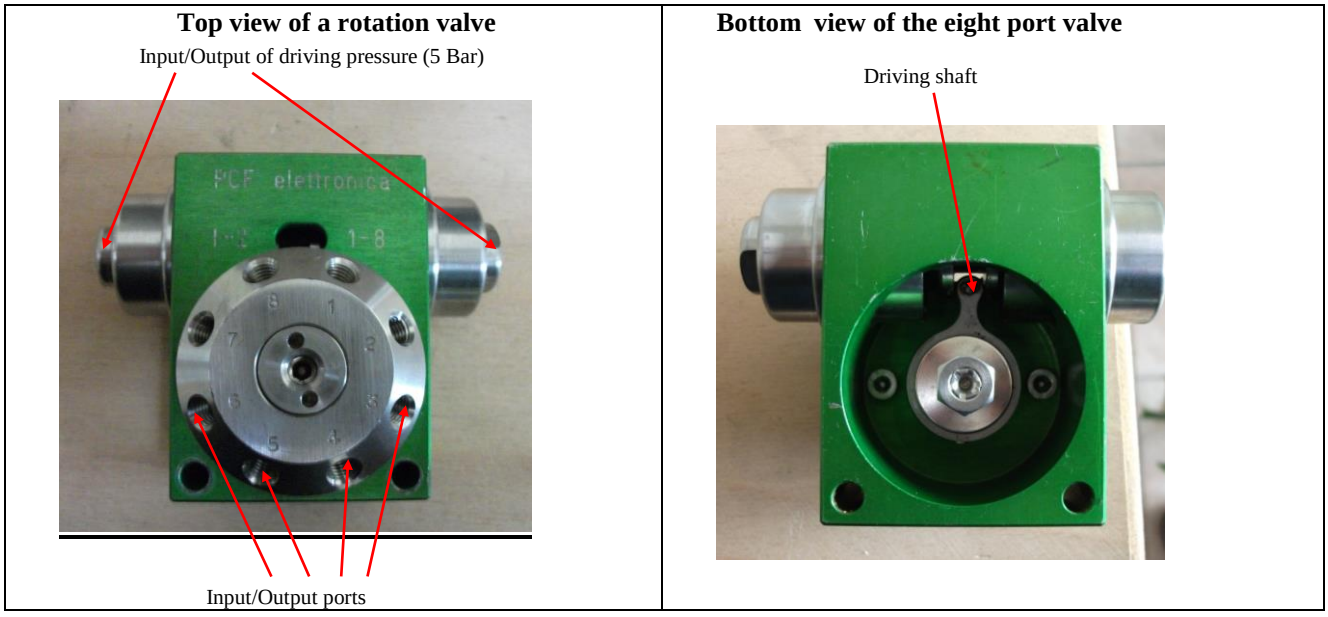
The FID is the core of the Mod. 8807/NR NMH portable GC analyser.

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 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. An air flow rate of about 230 ml/min, controlled by a third capillary, is supplied to the detector as combustion gas. The quality of the combustion air must be very good (carbon content lower than 0.1 ppm) and stable in the time, 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.

The amplified FID electrical signal may be measured and/or recorded on strip chart recorder from 30-27 pins (normalised 0-1 Vdc signal).

6.4 Bimatic rotation valve and cycles of the analyser

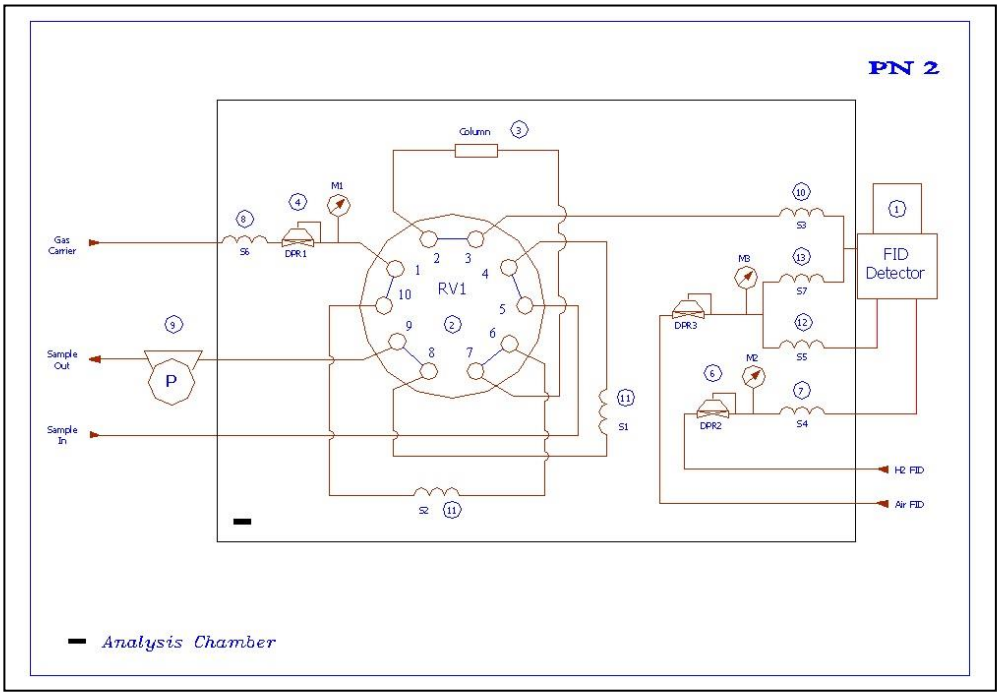




It is a ten-port rotation valve that connects all the pneumatic circuits. The switching of the valve is controlled by compressed air supplied through a four way command solenoid valve. This valve allows the interconnection of other pneumatic circuits. In the Mod. 8807/NR portable GC analyser a single rotation valve provides sampling of gas as well as THC and CH_4 phase analysis. In the pneumatic schematics the two different switching modes of the valve, i.e. with the solenoid valve **PN1** and **PN2** for the relevant THC and CH4 analysis phases, are shown.
The ten port rotation valve is conventionally indicated by **RV1**.

6.5 Analysis cycles

Phase 1 "Analysis CH_4 and Sampling TVOC/THC"



Phase 2 "Analysis TVOC/THC and Back Flush column"

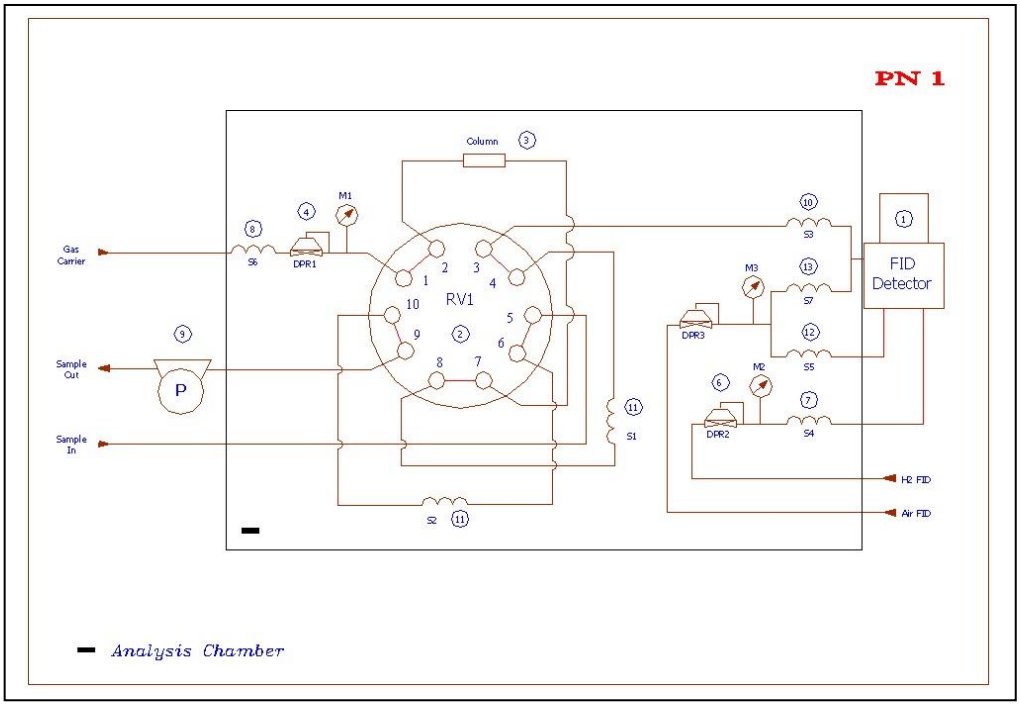


Figure Captions:

1- FID detector

2- RV1 rotation valve

3- Gas chromatographic column

4- DPR1 AIR CARRIER pressure regulator, M1 relevant manometer

5- DPR3 AIR (UPP) pressure regulator, M3 relevant manometer

6- DPR2 H2 pressure regulator, M2 relevant manometer

7- S4 hydrogen capillary

8- S6 carrier gas capillary

9- Membrane sampling pump, may either be heated for stack sampling or not heated for environment sampling.

10- S3 sample gas capillary

11- S2 (CH_4) and S1 (THC) sampling loop capillary

12- S5 air capillary

13- S7 O_2 plus gas capillary, a devise introduced to increase stability and smaller under shooting.

7.0 WORKING MODE (NMH version)

In working conditions, position PN2, gas sample is pulled by membrane pump P (9) or an air ejector, it passes through the sintered filter F1 (8) and then through the sampling loop S1 (11) with a capacity of 0.6 ml. Meanwhile the carrier gas controlled and displayed by the AIR CARRIER manometer on the instrument front panel goes through loop S2 (11) and the column then to the FID detector.

At the start of the cycle, the sampling pump is OFF to allow that the amount of sample in loop S1 is equilibrated against the atmospheric pressure, then the Bi-matic type rotation valve RV1 (F9) switches into position 1 (PH1) and the carrier gas flows into loop S1 taking the sample into the column and then into the detector.

While the compounds in the sample of loop S1 separate in the chromatographic column, the pump switches ON again and pulls the sample through loop S2.

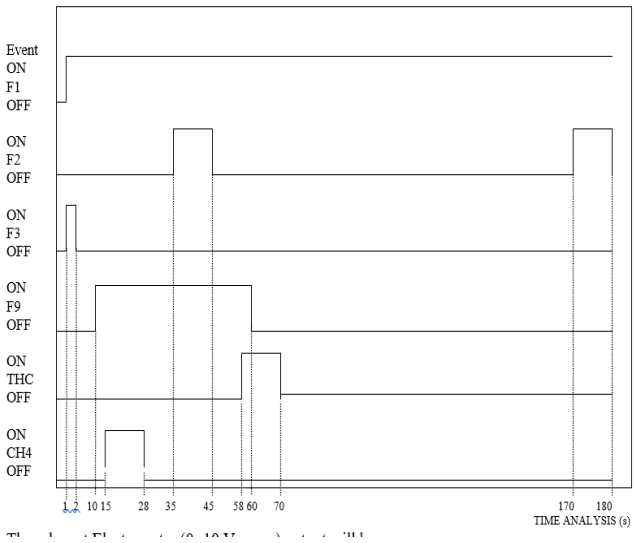
The fasted compound through the column and the first to be detected by FID is the methane, the relevant signal is processed by the microcomputer and memorised in CH_4 electronic channel.

The pump switches OFF again, the RV1 valve commutes to position 2 (PH2), carrier gas enters into S2 and takes the sample directly into the detector generating a signal proportional to the total quantity of hydrocarbons present in the sample. The whole amount of hydrocarbon s dissolved in the sample are determined with no possibility of queuing effect of water interference, as it may occur in other analysers.

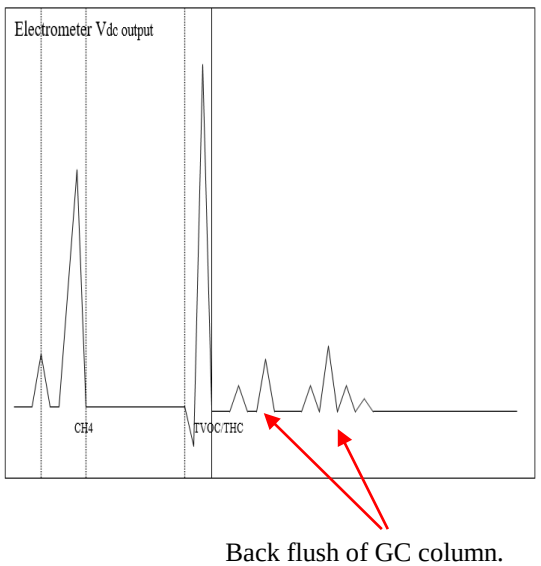
The relevant signal is processed by the microcomputer and memorised in the THC channel as the Total Hydro-Carbon value.

For the whole time RV1 is in position PH2 the chromatographic column is under a back flush current that brings out all the heavy compounds injected with CH_4 fraction.

The analytical cycle can be summarised as:



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



Back flush of GC column.
In calibration phase there will be a single broad peak

The direct FID analogue signal is available (0-10 Vdc) from the front panel.
The table of operative conditions as well of the values is enclosed in the manual as final check.
The length of analytical cycle is programmable according to the needs connected to the application; the above described one lasts 180 seconds.
After 180 seconds the analyser is ready to repeat the same cycle, more cycles or continuous operation according to the operator choice.

- "**ZERO**" check is performed by introducing a sample totally free of carbon compounds (carbon content lower than 0.1 ppm).
  As a carrier gas is employed ultra pure AIR (an air with the content of carbon compound lower than 0.1 ppm), it is not required to introduce further air to check the ZERO, it's enough to keep the pump OFF, this operation introduces just U.P.P. carrier air filling the loops S1 and S2 respectively, free from any interference from external sample.

- "**SPAN**" Calibration/Check is performed by introducing in the circuit, by the activation of a special solenoid valve, the content of a gas cylinder of known concentration and repeating the described cycle operations. By operating on the key board, on the electronic regulators controlled by micro computer the sensitivity of the instrument can be adjusted (ADJ); the set sensitivity values are then memorised.

  Please remember *that whenever the combustion and carrier gas air is not HC free (CH_4 is the species most difficult to scrub) the response for CH_4 content decreases.*
  Please take into account that CH_4 content is always around ~2 ppm, slightly higher in agricultural and polluted environment. Whenever you do not find these values you must check efficiency of you HC high temperature scrubber.

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 both in air quality monitoring and at emissions. This is a great advantage with respect to the instrumentation actually available on the market.

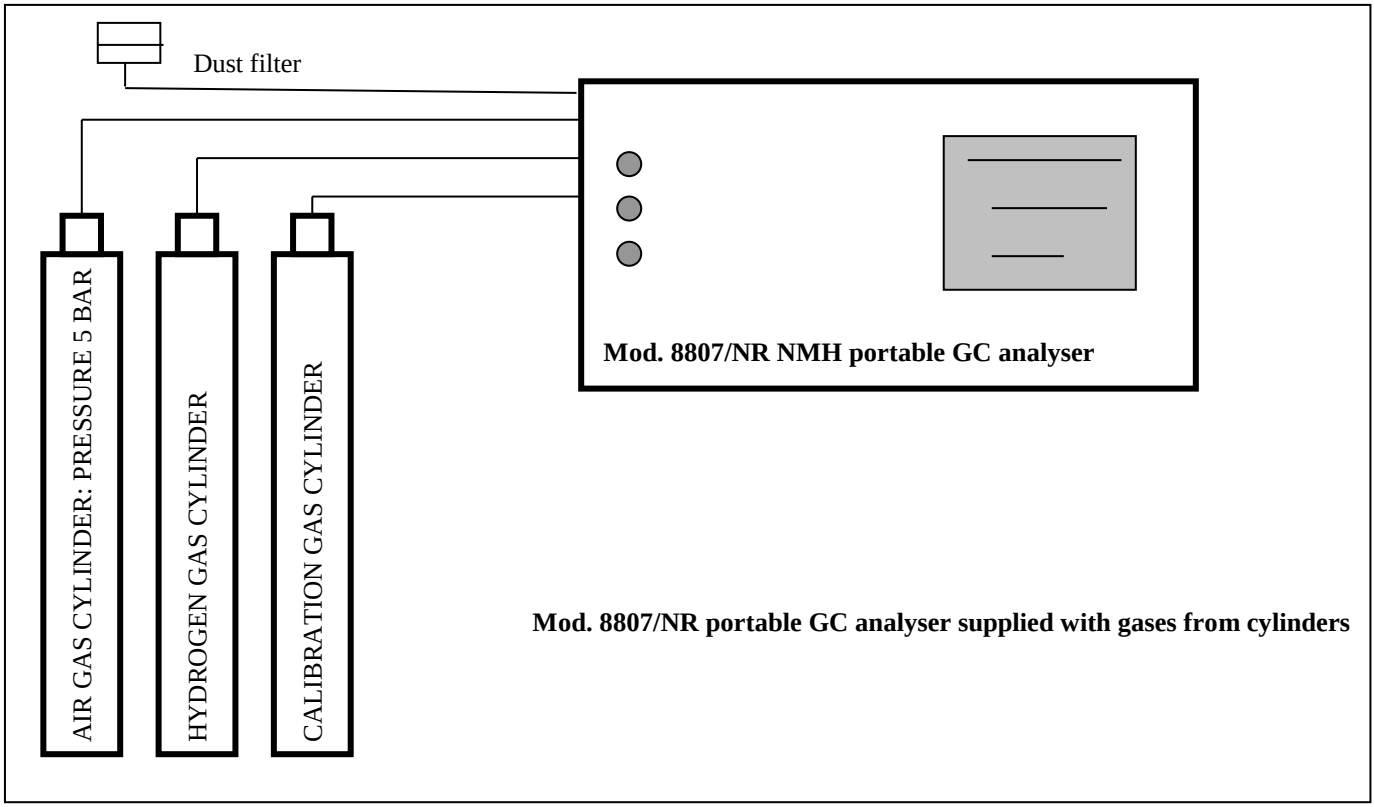
8.0 FIELD COMMISSIONING AND INSTRUMENT START UP

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

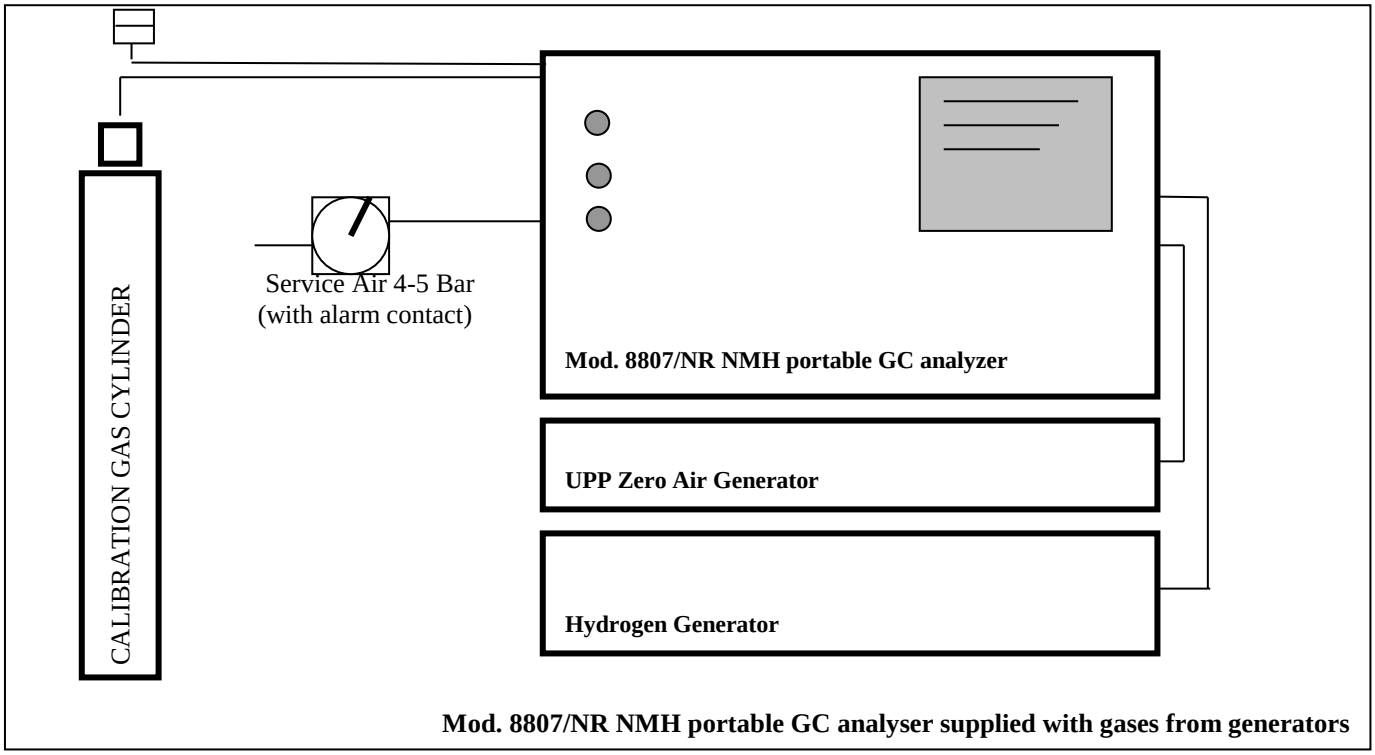
  FID pure Air ≈ 3 Bar (43.5 psi),

  Hydrogen ≈ 3 Bar (43.5 psi),

  if for the servo commands a separated compress air is used, regulate it to > 4.5 Bar (65.25 psi).
- 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 only visible in the condition of FLAME ON or the IGNITE icon pressed.
- 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 home display is on the screen.
- As the instrument reaches the temperature set it starts the control of FLAME ON, if the flame is off the FLAME OFF condition is displayed.
- In the status of FLAME OFF press IGNITE icon button, set the hydrogen pressure to the value indicated in the final check record. Wait about 20-30 seconds.
- When FID flame in ON, the instrument enters into the STAND-BY mode and no flame alarm I displayed on the screen.
- In case the flame of FID does not ignite, the instrument automatically shows on the display an alarm of FLAME OFF accompanied by a chime sound. In these conditions the flame is off. Repeat the operation described above to reach the FLAME ON condition ("STAND-BY" will be on the screen).
- If on the display any alarm messages are shown, as long as all alarm conditions are not erased the indication "STAND-BY" will not be displayed.
  NOTE: in occasional conditions, it is necessary to reduce drastically the carrier gas pressure to switch on the flame.
- Once the flame is ON wait for 10-15 minutes then take the Sample (Carrier) manometer to pressure set written in the enclosed final check record.
- Wait further 5 minutes then press the icon button AZERO (Autozero).



Mod. 8807/NR portable GC analyser supplied with gases from cylinders



Mod. 8807/NR NMH portable GC analyser supplied with gases from generators

9.0 IN BUILT FIRMWARE

(Do not enter the SERVICE MENU unless strictly necessary)
The Mod. 8807/NR H SW is very much similar to the one of Mod. 529/NR.

At the switching ON, after a few seconds the front page (HOME PAGE) is displayed.

RANGE:	select range of the instrument (usually 4 or 6 ranges freely selectable)
IGNITE:	for the ignition of FID flame.
DIAGNOSTICS:	information on working set and conditions.
AZERO:	electronical zeroing of the FID signal.
ZERO:	ZERO command (the instrument enters ZERO at the end of running cycle).
SPAN:	SPAN command (the instrument enters SPAN at the end of running cycle).
MONITOR:	measuring condition.
STOP:	the instrument stops working and enters into STAND BY condition.
GRAPHS:	the running chromatogram is displayed.
SETTINGS:	the working sets and conditions of the instrument may be modified while in operation (MONITOR), *front end/back end feature*.

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

As previously said, the basic instrument menu is self-explaining, user friendly menu.
With simple information the operator may carry out the fundamental operation on the instrument:

i) Start the instrument operation (MONITOR icon).

ii) Check/Calibrate ZERO

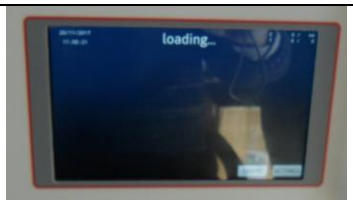
iii) Check/Calibrate SPAN.

iv) Modify the instrument basic configurations, excluded the modifications done only in the service menu.

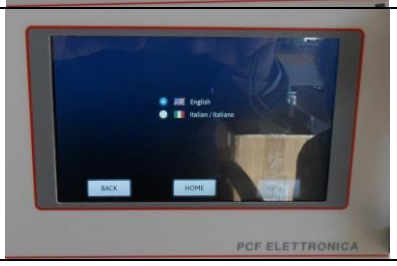
v) Some important information to note:
   1- Whenever you open a window from the HOME menu you always may return BACK without recording the possible modifications.
   2- When the instrument is switched ON and starts warming up, he reads automatically the default configuration from the USB port (see picture …) provided that the digital pen with the default configuration is inserted in the USB slot.
   3- The New Software is of the type. It means that the operator may dialogue with the electronics while the cycle is carried on.

9.2 HOME Menu

Let' see step by step what happens when you switch ON the instrument.

STEP	DESCRIPTION	PICTURE
1	At switching ON the instrument shows the PCF's LOGO.	
2	The Model Number of the unit in operation is displayed. Remember that the same electronics may be configured for Mod. 529/NR NMH, 530NR BTEX and for Specific Compounds (e.g. AROMATICS)	
3	The instrument reads the default configuration from the USB port.	
4	The instrument warms up. No monitoring in this phase. Please note that on the bottom lines of the display the basic icons are displayed.	
5	The instrument concluded the warm up phase, note that the temperature of the analytical temperature reached the set value (left-hand, middle of the screen) The SW informs the operator that the FID flame is OFF. If the switching ON of the flame is programmed as automatic the instrument will switch on the same otherwise the operator must switch it on by touching IGNITE icon.	
6	The instrument is telling that it tries to switch ON the flame. Please note that it will do three trials. If they are unsuccessful an alarm will be shown. The first time the ignition of the flame could be difficult because there is air in the H2 tubes. We suggest to purge the H2 tube before starting the igniting of the instrument.	

7	The SW tells that it is ready to: - Start the cycle (MONITOR icon) - Check/Calibrate ZERO - Check/Calibrate SPAN (the range)	
8	The operator has chosen MONITOR. The instrument enters in monitoring (measuring) phase. Do not bother about the absolute values. As the instrument was opened and set different times the first analysis will not be reliable.	
9	This is the video display when the operator chooses SETTING icon. All the simple settings of the instrument are displayed. The more advanced settings are reachable from the Service Menu. Note that whenever you open an icon you have three choices: - To return back to the previous step. - To return to HOME display. - To save the introduced modifications. -	
10	Once the IGNITE icon was touched the operator may choose to ignite the flame - Automatically: auto-ignition tipped off - Manually, auto-ignition **not** tipped off - Switch OFF the flame. (CYCLES), to set the number of measuring cycles. When setting 00, the instrument measures continuously for infinite cycles. Till STOP Is selected.	
11	Whenever the operator did not save the set modification.	
12	RANGE, to choose the measuring range as default one. The instrument may be programmed for up to 6 ranges: from 0-5 mg/m^3 up to 0-10,000 mg/m^3	

13	TEMPERATURE, the setting of the temperature controlled chamber temperature.	
14	CALIBRATION, for setting the calibration reference values.	
15	DATE AND TIME, to set the correct date and time.	
16	IP ADDRESS, setting of the instrument identification code.	
17	DIAGNOSTIC, it shows the working conditions of the instrument. No setting possible.	
18	LANGUAGE selection.	

19	OPTIONS, further setting of the instrument operating mode.	
20	SERVICE, the way to enter into the service menu Is protected by a password. **Do not enter unless strictly necessary**.	

10.0 ANALYSER CALIBRATION

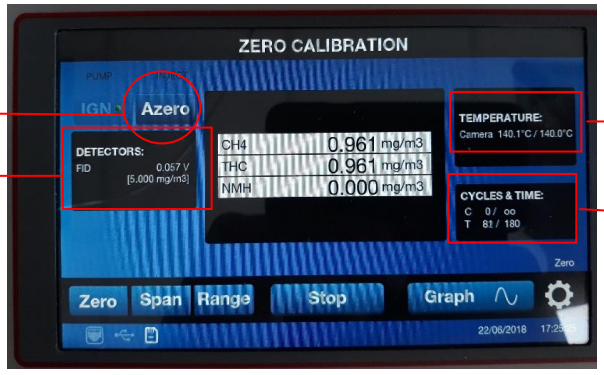
Whenever either a *check of or a full calibration* is required the instrument must be in the analysis mode. Only with the instrument in analysis mode the "SPAN" and "ZERO" function can be activated.
In order to start these procedures, the relevant icons must be selected on the lower part of the screen by moving around with arrow push buttons.

If the "ZERO" or "SPAN" icon is selected *the instrument performs the given command at the end of the current analysis cycle.*
Please note that, as the instrument measures with the second injection the TVOC, the latter in the calibration cylinder should not be higher than the selected range.

In ZERO CALIBRATION MODE
Please read carefully the display where you will find the fundamental working conditions of the instrument

Azero is electronic zero of the base line

Electrometer output Vdc
Selected measuring range



Temperature of analytical chamber
Actual/set values

Cycle number/00 (continuous)
Elapsed time
After ZERO it returns to MONITOR

	In SPAN CALIBRATION MODE Please read carefully the display where you will find the fundamental working conditions of the instrument	
Azero is electronic zero of the base line Electrometer output Vdc Selected measuring range Command to authorise the calibration. The values will be taken as reference		Temperature of analytical chamber Actual/set values Cycle number/00 (continuous) Elapsed time After SPAN it returns to MONITOR

When the instrument is in “READY” condition it is like in a stand by conditions, waiting for next command.

Always press MONITOR button to resume the monitoring cycle.

Always keep in mind that the instrument is working per cycles, therefore after any command you must wait till the instrument concluded the previous operation.

10.1 "SPAN" CALIBRATION PROCEDURE

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- Follow the indications and requests from the in-built SW. All the steps are self-explaining.

6- Operator must wait 3-5 full analysis cycles. Then the instrument will ask if the operator intends to carry out a full calibration.

7- Once the calibration was performed press MONITO icon and the instrument returns to monitoring conditions after the end of running cycle. The calibration gas source can be closed.

Example:
Gas cylinders contains 4 ppm of CH_4 and 1 ppm of C_3H_8, air balance.
The THC equivalent, normalised against methane is (4+3) = 7 ppm.
By the above calculation we normalised all measurements taking methane as reference molecule.
The suitable range can either be 10 or 20 ppm full scale

NOTE: do not go with the amplification value lower than 01.00 as it would mean a gain factor lower than 1.
At the end of calibration procedure shut the calibration gas cylinder.

10.2 “ZERO" CALIBRATION PROCEDURE

Select the "ZERO" check procedure; once the instrument carries out the current analysis cycle, with the new analytical cycle the instrument 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 exactly the same air used as carrier in order to evaluate the base line behaviour with no sample in the instrument.

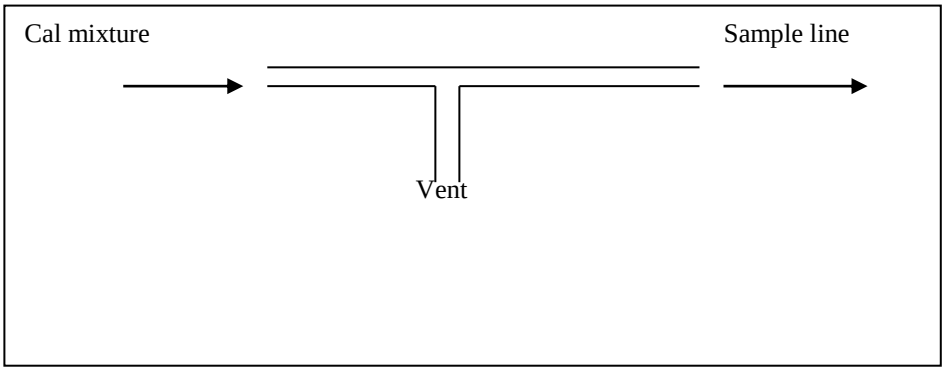
The "ZERO" regulation on the present type of chromatograph does not make sense, as the auto zero function carries out an instrumental zero before any analysis.

10.3 ZERO/SPAN CHECK

FID detector is a very stable detector in the time.
Provided you keep the gas supply pressures and flows constant you will get a constant response of the instrument.
Instead of performing a full calibration of the instrument, with adjustment of response factors, you may just check the status of calibration of the same.
For this matter please carry our just a calibration check:

1- supply on the sample line either a zero or calibration mixture under vented conditions.

2- Check the response of the instrument, if it's within 5% of full scale do not modify the response factors.



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11.0 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 plug) and with the H_2, Air, Span, Service gases intercepted by the main manometers on the gas cylinders.

Please remember that whenever you take a step in the maintenance of the instrument be sure you will be able to return back in the original conditions.

REPLACEMENT OF INPUT SILICA WOOL 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 silica wool 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.

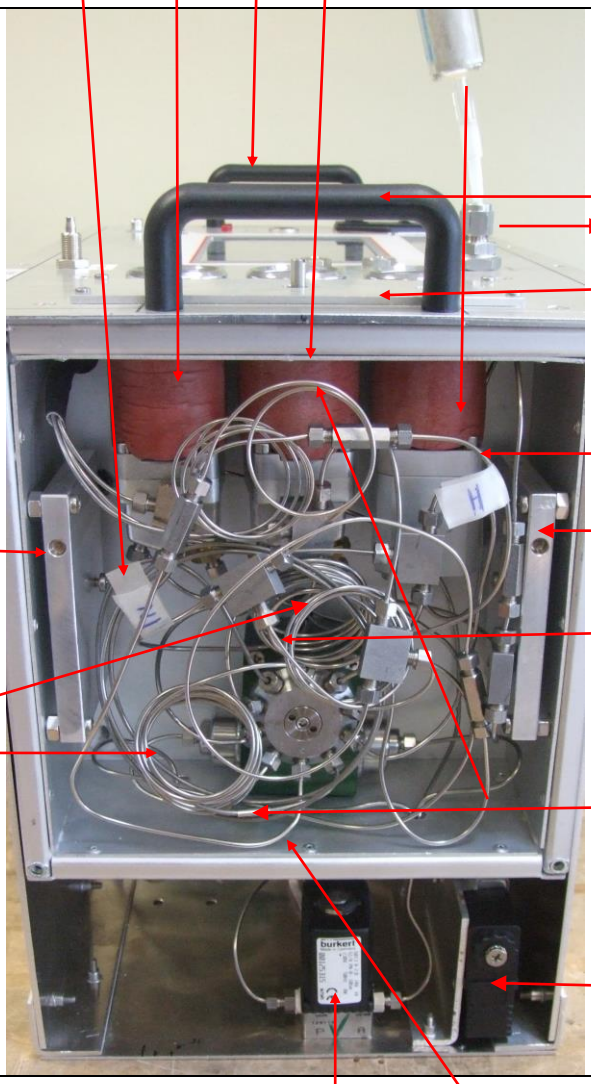
- Perform a calibration check and eventually adjust the Calibration values. ….

11.1 Capillary/restrictor 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.

Please refer to the following picture to locate the right places where to check the flows rates.
In order to identify correctly each component part in the temperature controlled chamber refer to the pneumatic circuit of the analyser.



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 "**H_2**" 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.

11.2 Suggested maintenance schedule

Basically PCF's Mod. 8807/NR portable GC (Non Methane Hydrocarbon) analyser is a very simple process gas chromatograph with tested parts to last years without maintenance.
The ten 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 a good commissioning and maintenance of the instrument we recommend:
- standard tool case
- digital multi meter
- digital flow meter and
- strip chart recorder (0-10 Vdc).

Time	Operations	Actions (if necessary)
Commissioning	Check: Quality of ZERO AIR Power Supply Gas Supplies (quality and pressure) Service Gas pressure Analogue outputs	
Monthly	Sample flow Calibration check	Replace or clean filters Front filter Do a full calibration cycle
Every 3 months	Sample flow Membrane pump	 Rebuild pump
Every year	Retention times Check: H_2 capillary Air capillary Carrier capillary Sampling pump	Adjust retention times Replace
Every 3 years	Rotation valve	Maintain or replace

11.3 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 flame does not ignite	
- Mother Board is not working	Replace Mother Board
- Lack of Hydrogen or Air	Supply Hydrogen and Air
- Ignition spiral is broken	Replace FID
- Thermocouple is broken	Replace FID
- Clogged H_2 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
- Mother Board not working	Replace Mother Board
- Key Board not working	Replace key board
Output signals dead	
- FID detector not working	Replace FID 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
Lack of FID Air 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

- FID detector not working	Replace FID 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 pressure on FID Air

- Air gas cylinder either empty or closed	Either open the air gas cylinder or replace it
- Leakage in the inner pneumatic circuit	Amend the leakage
- Pressure regulator not working	Replace pressure regulator
- Manometer not working	Replace manometer

No 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
- Mother Board not working	Replace Mother Board
- Manometer not working	Replace manometer

No circulation of sample

- Adduction sample line either intercepted or clogged	Restore correct sample flow
- Ejector not working	Check the ejector and the compressed air supply
- 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 Methane peak on display (< 1.8 ppm)	
Poor zero air quality, the high temperature scrubber does not scrub the whole methane content	Maintain the scrubber, if necessary change the zero air generator
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
No reproducible values	
Check quality of ZERO AIR	
Feed FID AIR and CARRIER with the air from a certified gas cylinder and measure the quality of air generated by a zero air generator as sample	Maintain scrubber of zero air generator or if not enough reduce the quantity of air passed through zero air generator

12.0 RS232 and USB SERIAL COMMUNICATIONS AND ELECTRICAL CONNECTIONS

12.1 **Description of Ethernet (ETH) protocol** for the new hydrocarbons analysers (THC 2017 board = Mod. 529/NR H = Mod. 8807/NR)

The IP address of the THC 2017 board is set from the configuration menu, in the section **"IP Address"**
The communication UPD port in the receiving mode is the **6500**.
The THC 2017 board answers the following commands:

$MWA#: request command of the operating parameters, containing DATE,HOUR,WORKING MODE,NUMBER OF CONCLUDED CYCLES, ALARMS ON, CHANNEL, MEASURING UNIT,END OF COMMUNICATION.

$MWC0/1#: disconnection (0) or connection (1) commands with the system, after which the values of the channel and the various operations carried out related to the test in progress are returned.

$MWS0/1#: command to activate the SPAN command.

$MWZ0/1#: command to activate the ZERO command.

$MWM0/1#: commands to activate the Measure function to start the test and to put it in stop.

The MW characters represent a Magic Word that identifies in the message, the type of machine destined to receive it in order to make the used protocol more robust and univocal.

For the THC2017 the MW to be used is '1 ~' which in hexadecimal corresponds to the value 0x317E

The THC 2017 board returns a unique status string that contains the following information in order and separated by a ';':

<DATE>;<TIME>;<CYCLE EXECUTED>;<TOTAL CYCLE>;

<ALARMS CODE>;<GENERAL_STATUS>;<MONITOR_STATUS>;

<REMOTE_ZERO_STATUS>;<REMOTE_SPAN_STATUS>;

<CHANNEL_1_LABEL:>;<CHANNEL_1_VALUE>;<CHANNEL_1_UNIT>;
<CHANNEL_2_LABEL: >;<CHANNEL_2_VALUE>;<CHANNEL_2_UNIT>;
<CHANNEL_3_LABEL: >;<CHANNEL_3_VALUE>;<CHANNEL_3_UNIT>;
<CHANNEL_4_LABEL: >;<CHANNEL_4_VALUE>;<CHANNEL_4_UNIT>;
<CHANNEL_5_LABEL: >;<CHANNEL_5_VALUE>;<CHANNEL_5_UNIT>;
<CHANNEL_6_LABEL: >;<CHANNEL_6_VALUE>;<CHANNEL_6_UNIT>;
<CHANNEL_7_LABEL: >;<CHANNEL_7_VALUE>;<CHANNEL_7_UNIT>;
<CHANNEL_8_LABEL: >;<CHANNEL_8_VALUE>;<CHANNEL_8_UNIT>;

'#' end of string character.

The string of status, whatever is the active configuration, always shows the same formatting to allow a uniformity of interpretation, given by the separator characters that allow an easier interpretation.

<ALARMS CODE> Alarm codes are returned in hexadecimal value and the individual bits have the following meaning:

Bit 0	→	ALARMS_TEMPERATURE_1	0x00000001
Bit 1	→	ALARMS_TEMPERATURE_2	0x00000002
Bit 2	→	ALARMS_TEMPERATURE_3	0x00000004
Bit 3	→	ALARMS_TEMPERATURE_4	0x00000008
Bit 4	→	ALARMS_IGNITION_1	0x00000010
Bit 5	→	ALARMS_IGNITION_2	0x00000020
Bit 6	→	ALARMS_IGNITION_3	0x00000040
Bit 7	→	ALARMS_IGNITION_4	0x00000080
Bit 8	→	ALARMS_GASES_1	0x00000100
Bit 9	→	ALARMS_GASES_2	0x00000200
Bit 10	→	ALARMS_GASES_3	0x00000400
Bit 11	→	ALARMS_ELECTROM_1	0x00000800
Bit 12	→	ALARMS_ELECTROM_2	0x00001000
Bit 13	→	ALARMS_ELECTROM_3	0x00002000
Bit 14	→	ALARMS_ELECTROM_4	0x00004000

<GENERAL_STATUS> General status codes of the operation:

S0 →CONFIGURATION LOAD
S1 →WARMUP
S2 →STANDBY
S3 →READY
S4 →MONITOR ON RUN (for further details see specific monitor status)
S5 →ZERO RUN
S6 →SPAN RUN

<MONITOR_STATUS> Code of the specific status of the Monitor phase:

M0 →MONITOR IDLE
M1 →MONITOR RUNNING
M2 →MONITOR STOPPING (the monitor has been stopped by the user but the stop will occur only at the end of the cycle)
M3 →MONITOR STOPPED
M4 →MONITOR HALTED (monitor interrupted due to a problem)
M5 →MONITOR COMPLETED
M6 →MONITOR WAIT USER (the monitor cycles were completed, waiting for user action)

REMOTE_SPAN_STATUS> and <REMOTE ZERO STATUS> These two codes identify the status of the two auxiliary inputs of the THC 2017 for operating the SPAN or ZERO. If not present, the '-' character is displayed. If they are present, the characters 'Z' or 'S' are returned respectively.

12.2 **RS232 Communication Protocol** (Mod. 529/NR H)

Note: The protocol developed for ethernet communication is the same as the one used for the serial communication. It was also installed for the management of the last version of THC 1.7.0

The parameters for a remote connection are the followings:

Baudrate: 115200

Data bit: 8

Stop bit: 1

Parity: none

Flow control: none

In case of connection stability with the THC2017 board (Mod. 528/NR H) by means of the command $MWC1# the board returns the status information at 2 seconds interval continuously until the disconnection command is sent or until the machine is turned off.

12.3 Analog Outputs

This analyser it's configurated to have 4-20 mA currents outputs. The pin outs are as follow:

1 +CH_4	(black/green)
2 – CH_4	(green)
3 + TOC	(black/white)
4 – TOC	(white)
5 + NMH	(red/black)
6 – NMH	(red)

13.0 SPARE PART LIST

Code Number	Description
09520114	Sample capillary
09520115	Hydrogen capillary
09520116	Air capillary
09520120	Pressure regulator
09520121	Bar gauge
09520125	FID detector sub assembly
09520130	Red LED
09520131	Green LED
09520132	Return switch
09520133	Stable switch
09520134	SPAN potentiometer
09520135	Digital display
09520137	Power supply socket
09520138	Cooling fan
09520141	Electrometer PCB
09520147	4-20 mA outputs PCB
090-0011	Function programming, main PCB
090-0012	Auxiliary services PCB
09520145	Temperature regulator PCB
090-0025	+5 Vdc, +24 Vdc Stabilised Power Supply PCB
090-0026	+5 Vdc, ±15 Vdc Stabilised Power Supply PCB
09520150	PT 100 temperature gauge
09520152	FID detector heating resistance
09510116	Eight port Bimatic 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
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	Flame ON temperature sensor
09514129	Flame ignition resistance
09514130	Mains switch
090-0012	IN/OUT Status PCB
09510336	Electrometer amplifier PCB
090-0014	Touch screen colour digital display
041-0943	GC column for NMH analysis

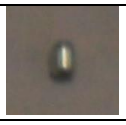
Suggested consumables set (including)

09520114	N.1 Sample/Carrier gas capillary
09510123	N.1 RSV rebuild kit
09514126	N.1 Sampling pump rebuild kit

Suggested spare parts set (including)

09520115	Hydrogen capillary
09520116	Air Capillary
09510943	N.1 Chromatographic column
09520120	N.1 Pressure regulator
09510115	N.1 Rotation valve

The most frequently used pneumatic connections

POS.	P/N	DESCRIPTION	PIC
1	062-6119	M12 Bolt with tightness	
2	100-0993	Ferrules for tube 2/1 (10 pcs x set)	
3	100-0992	6MB adapter for tube 2/1 (10 pcs set	
4	100-6125	Linear conjunction for tubes 2/1	
5	100-6126	T-junction/adapter for tubes 2/1	
6	100-6127	2/1 tube to 6/4 tube adapter	
7	062-6302	Pieces of 2/1 tubes	

NOTE: We, PCF Elettronica Srl, are OEM manufacturer. We keep all spare parts in our stock. Replacements can be supplied in a matter of few days.

PCF ELETTRONICA

mod. 8807/NR portable GC stack analyzer
AUTOMATIC GAS CHROMATOGRAPH

Before shipment each instrument is thoroughly checked in our laboratories.
Final reports are produced that accompany in copy the equipment.
Please keep the documents with the original operating manual enclosed with the instrument.

14.0 FACTORY FINAL CHECK RECORDS (in the NMH configuration)

CARRIER	Bar ……	ml/min ……
H_2	Bar ……	ml/min ……
AIR	Bar ……	ml/min ……

OVEN ……°C

CALIBRATION PARAMETERS

Range:	Component	
5	CH_4	: …… mg**C**/m^3
		: …… ADJ
	TVOC/THC	: …… mg**C**/m^3
		: …… ADJ
	NMH	: …… mg**C**/m^3
		: …… ADJ

10	CH_4	: …… mg**C**/m^3 : …… ADJ
	TVOC/THC	: …… mg**C**/m^3 : …… ADJ
	NMH	: …… mg**C**/m^3 : …… ADJ
20	CH_4	: …… mg**C**/m^3 : …… ADJ
	TVOC/THC	: …… mg**C**/m^3 : …… ADJ
	NMH	: …… mg**C**/m^3 : …… ADJ J
50	CH_4	: …… mg**C**/m^3 : …… ADJ
	TVOC/THC	: …… mg**C**/m^3 : …… ADJ
	NMH	: …… mg**C**/m^3 : …… ADJ
100	CH_4	: …… mg**C**/m^3 : …… ADJ
	TVOC/THC	: …… mg**C**/m^3 : …… ADJ
	NMH	: …… mg**C**/m^3 : …… ADJ

Service Engineer: _____ Date: _____

APPENDIX 1

FID Response Factors

Here below please find some of the experimentally obtained **FID responses**, wider evidence you may find in Internet:
http://che.psu.edu/faculty/rioux/group/group_info/references/response_factors_for_gas_chromatographic_analyses.pdf

Organic Compound	*Molecular Weight*	*Relative Sensitivity*	*Response Factor [1]*	*Response against Methane*	*Response against Propane*	*ppm to mg/m³ conversion factor*	*ppm to mgC//m³ conversion factor*
Methane	16.04303	0.99	15.8826	**1.0000**	0.3675	0.7158	0.5359
Ethane	30.07012	0.98	29.4687	1.8554	0.6819	1.3416	1.0718
Propane	44.09721	0.98	43.2153	2.7209	**1.0000**	1.9674	1.6076
Butane	58.12430	1.09	63.3555	3.9890	1.4660	2.5932	2.1435
Pentane	72.15139	1.04	75.0374	4.7245	1.7364	3.2190	2.6794
Hexane	86.17848	1.03	88.7638	5.5887	2.0540	3.8449	3.2153
Heptane	100.2056	1.00	100.2056	6.3091	2.3188	4.4707	3.7511
Octane	114.2327	0.97	110.8057	6.9765	2.5640	5.0965	4.2870
Nonane	128.2598	0.98	125.6946	7.9140	2.9086	5.7223	4.8229
Isopentane	72.15139	1.05	75.7590	4.7699	1.7531	3.2190	2.6794
2,2-dimethyl Butane	86.17848	1.04	89.6256	5.6430	2.0739	3.8449	3.2153
2,3-dimethyl Butane	86.17848	1.03	88.7638	5.5887	2.0540	3.8449	3.2153
2-methyl Pentane	86.17848	1.05	90.4874	5.6973	2.0939	3.8449	3.2153
3-methyil Pentane	86.17848	1.04	89.6256	5.6430	2.0739	3.8449	3.2153
2,2-dimethyl Pentane	100.2056	1.02	102.2097	6.4353	2.3651	4.4707	3.7511
2,3-dimethyl Pentane	100.2056	0.99	99.2035	6.2461	2.2956	4.4707	3.7511
1,1,2-trimethyl cycle hexane	126.2438	0.98	123.7189	7.7896	2.8629	5.6324	4.8229
Cycle heptane	98.18963	1.01	99.1715	6.2440	2.2948	4.3807	3.7511
Benzene	78.11472	1.12	87.4885	5.5084	2.0245	3.4851	3.2153
Toluene	92.14181	1.10	101.3560	6.3816	2.3454	4.1109	3.7511
Ethyl Benzene	106.1689	1.03	109.3540	6.8851	2.5304	4.7367	4.2870
Para Xylene	106.1689	1.00	106.1689	6.6846	2.4567	4.7367	4.2870
Meta Xylene	106.1689	1.04	110.4157	6.9520	2.5550	4.7367	4.2870
Ortho Xylene	106.1689	1.02	108.2923	6.8183	2.5059	4.7367	4.2870
1,2,3-trimethyl Benzene	120.1960	0.98	117.7921	7.4164	2.7257	5.3625	4.8229
N propyl Benzene	120.1960	1.01	121.3980	7.6435	2.8091	5.3625	4.8229
n- butyl Benzene	134.2231	0.98	131.5386	8.2819	3.0438	5.9884	5.3588
Acetylene	26.03824	1.07	27.8609	1.7542	0.6447	1.1617	1.0718
Ethylene	28.05418	1.02	28.6153	1.8017	0.6622	1.2516	1.0718
Methanol	32.04243	0.23	7.3698	0.4640	0.1705	1.4296	0.5359
Ethanol	46.06952	0.46	21.1920	1.3343	0.4904	2.0554	1.0718
n- Propanol	60.09661	0.60	36.0580	2.2703	0.8344	2.6812	1.6076
Iso propanol	60.09661	0.53	31.8512	2.0054	0.7370	2.6812	1.6076
n-Butanol	74.12370	0.66	48.9216	3.0802	1.1320	3.3070	2.1435
Iso butanolo	74.12370	0.68	50.4041	3.1735	1.1663	3.3070	2.1435
sec-Butano	74.12370	0.63	46.6979	2.9402	1.0806	3.3070	2.1435
ter-Butanol	74.12370	0.74	54.8515	3.4536	1.2693	3.3070	2.1435
Methyl-iso-buthyl-carbinol	88.15079	0.74	65.2316	4.1071	1.5095	3.9328	2.6794
1-Hexanol	102.17790	0.74	75.6116	4.7607	1.7496	4.5587	3.2153
1-Octanol	128.21610	0.85	108.9837	6.8618	2.5219	5.7204	4.2870
1-Decanol	154.25440	0.84	129.5737	8.1582	2.9983	6.8821	5.3588
Butyrraldehyde	72.10776	0.62	44.7068	2.8148	1.0345	3.2171	2.1435

1-Eptaldehyde	114.18900	0.77	87.9255	5.5360	2.0346	5.0945	3.7511
1-Octaldehyde	128.21610	0.80	102.5729	6.4582	2.3735	5.7204	4.2870
Decanal	156.27030	0.80	125.0162	7.8713	2.8929	6.9720	5.3588
Formic acid	46.02589	0.01	0.4603	0.0290	0.0107	2.0534	0.5359
Acetic acid	60.08807	0.23	13.8122	0.8696	0.3196	2.6793	1.0718
Propionic acid	74.08007	0.40	29.6320	1.8657	0.6857	3.3051	1.6076
Butyric acid	88.10716	0.48	42.2914	2.6628	0.9786	3.9309	2.1435
Hexanoic acid	116.16130	0.63	73.1816	4.6077	1.6934	5.1825	3.2153
Eptanoic acid	130.18840	0.61	79.4149	5.0001	1.8377	5.8084	3.7511
Octanoic acid	144.21550	0.65	93.7401	5.9021	2.1691	6.4342	4.2870
Methyl acetate	74.08007	0.20	14.8160	0.9328	0.3428	3.3051	1.6076
Ethyl acetate	88.10716	0.38	33.4807	2.1080	0.7747	3.9309	2.1435
Isopropyl acetate	102.13430	0.49	50.0458	3.1510	1.1581	4.5567	2.6794
sec-Buthyl-acetate	116.16130	0.52	60.4039	3.8031	1.3977	5.1825	3.2153
Iso-buthyl acetate	116.16130	0.54	62.7271	3.9494	1.4515	5.1825	3.2153
Acetonitrile	41.08807/NR NMH portable GC1	0.39	16.0106	1.0081	0.3705	1.8316	1.0718
Dimethyl formamide	73.09534	0.41	29.9691	1.8869	0.6935	3.2611	1.6076
Trimethyl amine	59.11188	0.46	27.1915	1.7120	0.6292	2.6373	1.6076
Ter-Buthyl amine	73.13897	0.54	39.4950	2.4867	0.9139	3.2631	2.1435
Diethyl amine	73.13897	0.61	44.6148	2.8090	1.0324	3.2631	1.0718
Aniline	93.12939	0.75	69.8470	4.3977	1.6163	4.1550	3.2153
Acetone	58.08067	0.59	34.2676	2.1576	0.7930	2.5913	1.6076
Tetrahydrofuran	72.10776	0.76	54.8019	3.4504	1.2681	3.2171	2.1435
Isopropyl ether	102.17790	0.70	71.5245	4.5033	1.6551	4.5587	3.2153
2-Butoxyethanolo	118.17730	0.60	70.9064	4.4644	1.6408	5.2725	3.2153

[1] – response factor = relative sensitivity x molecular weight.

APPENDIX 2

Hydrogen Safety (very important!)

The combustible gas (H_2) supplied to the instrument must show a 99,999% (in volume) purity.

Do not use H_2 mixed with Helium.

The highest allowed concentration (impurity) of VOC in it **must not be higher than 0.1 mg/m^3**.
Our Company suggests and supplies, when requested to, 5.5 "Transistor" type Hydrogen,

- purity 99,9995%
- H_2O content < 3 ppmV
- O_2 content < 1 ppm

PLEASE DO NOT SUPPLY H_2 AT A PRESSURE HIGHER THAN THE SUGGESTED ONE :
H_2= 3,0 Bar max.

The care that all the requirements foreseen for the safe use of combustible gases, ly upon customer's responsibility..
Cautions when using hydrogen

The Customer must take care that all the hydrogen gas cylinders be according the actual safety norms and requirements, as well as take care of the lodging rooms, of the installation of safety valves that interrupt the hydrogen flow automatically in case of alarm condition, etc.

APPENDIX 3

Entering the SERVICE MENU (very delicate matter!)

Usually the field operator deals with the Main Set up Menu.
If it is necessary to enter (very delicate matter!!) the Service Menu please remember that the

PASS WORD is **2017**

When You are in the Service Menu be very careful because the configuration of the same should not be modified. Be always in the conditions to return to original setting.

APPENDIX 4
Converting MOD. 8807/NR from NMH into "AROMATICS" configuration and vice versa

General
The Mod. 8807/NR basically is a portable gas chromatograph (GC) with FID/PID detector.
As such it may be configured to measure a large variety of chemical species.
For instance:
i) the basic configuration may be set to measure NMH (Non-Methane HC), either in the environment or in stacks with gas temperatures up to 120°C.
ii) the second one: "AROMATICS", to separate and measure (Butadiene), Benzene, Toluene and Xylenes and/or other Aromatics.

The Mod. 8807/NR should be configured/programmed by technicians with knowledges in gas chromatography.

By a responsible technician, using the adequate GC column (packed ones), the Mod. 8807/NR may be configured to measured other sets of compounds, namely solvents, halogenated compounds, aliphatic compounds etc.

Please note that Mod. 8807/NR portable GC analyser is a **portable** instrument, intended to operate under the supervision of the operator.
The measuring sessions, in heavy-duty environment should be short and after each session is advisable to refresh the sampling line and measuring circuit by recirculation of ambient air for a few measuring cycles. Do not leave the instrument to operate in heavy duty environment unattended for long periods; the heavy-duty conditions could damage the same.
When measuring in clean environment the instrument may be left unattended to measure for longer periods, days or weeks.

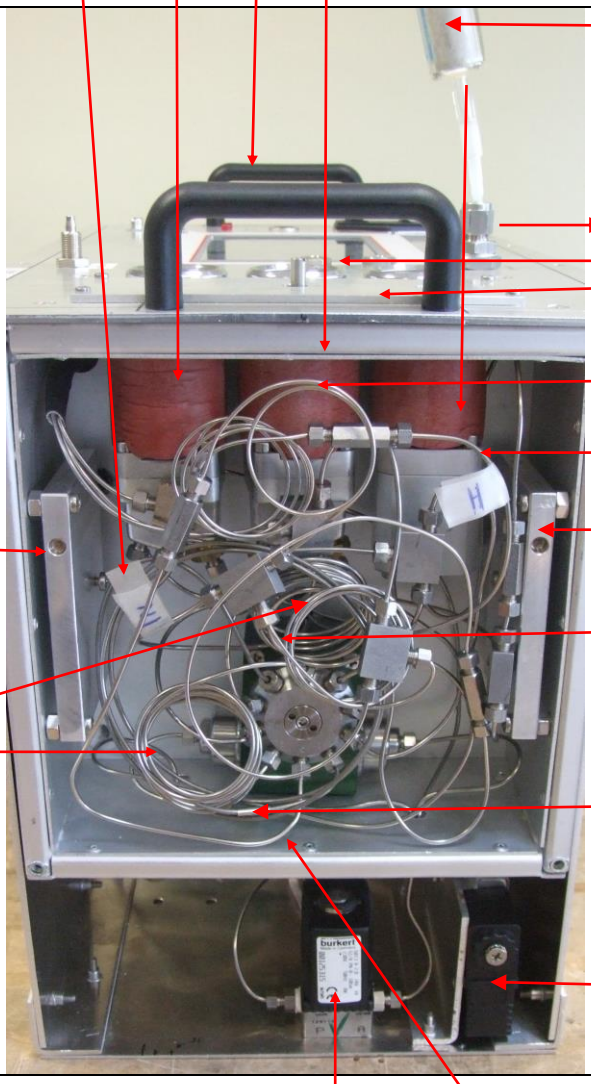
You may switch from NMH configuration in Aromatics configuration by changing
i) the hardware of the instrument, basically the GC column
and
ii) the SW of the instrument, basically to separate and integrate the peaks.

You are strongly advised against continuous changing the configuration!!!

If not performed properly, reconfiguring the instrument could easily cause damages to the fine mechanics, especially the threads of the rotation valve.
Be very careful.
Operate with great attention!!
Do not force the threads!!

A.4.1 The hardware difference

For measuring Benzene, Toluene, Xylenes and/or other aromatics the employed GC column is different from the one used for the separation of NMH (Non Methane HC).
Both columns are mounted in the thermo stated (120°C) analytical chamber, see below figure:



The Gas chromatographic columns

The GC column to separate NMH (Non-Methane HC) is a POROPAQ QS type of 1 m length, is a packed column and operates at 120°C.

Packed GC column to separate NMH (Non-Methane HC)

The GC column to separate Benzene, Toluene and Xylene (o-Xylene), 50 cm long, 0 S – 550 - 20% CW 60 – 80 type, is a packed column and operates at 140°C.

Packed GC column to separate AROMATICS

When you replace the GC column **be very careful** in unscrewing and screwing the bolts that fix the column to the rotation valve. The treads are very delicate; if you spoil them the whole rotation valve must be replaced (it's quite expensive!!).

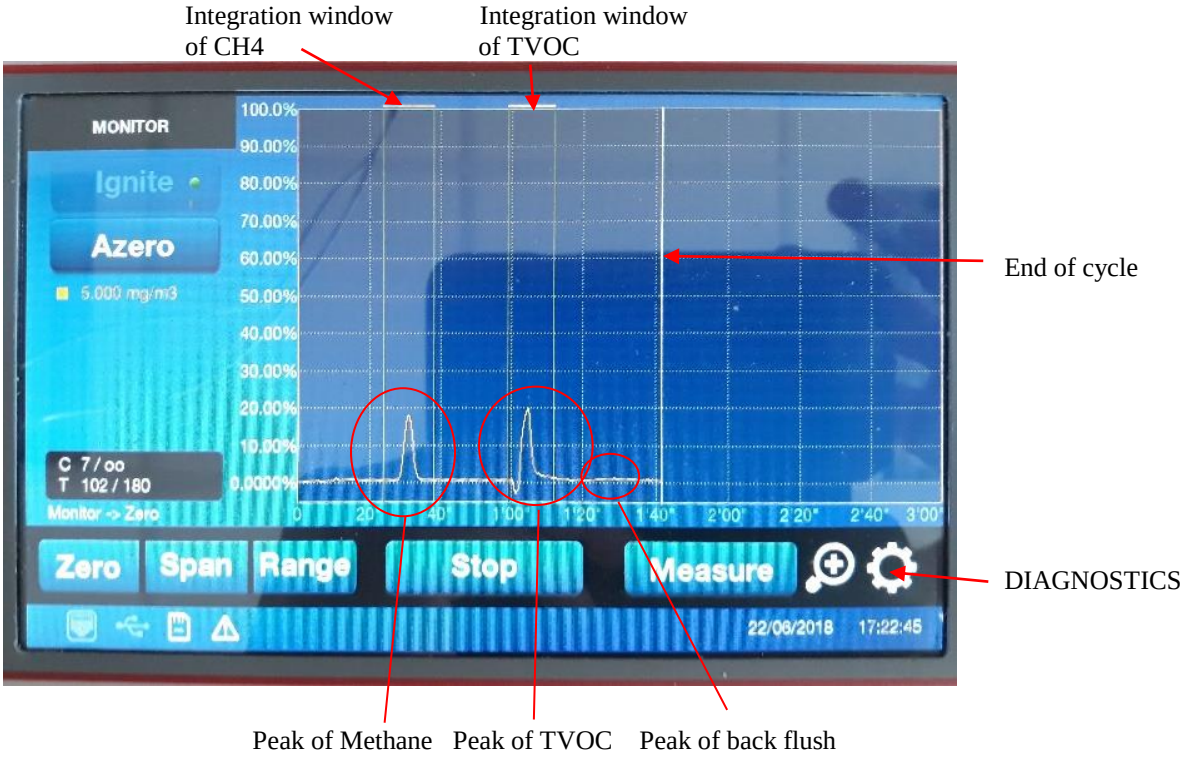
A.4.2 The SW difference

We remind that Mod. 8807/NR, portable GC analyser, basically, performs a cycle in which it separates species either CH_4 (when operating as NMH) or Benzene + Toluene + Xylenes (when operating as "AROMATICS") plus a second injection direct into FID in which it measures the THC (Total HC).
In both version Mod. 8807 produce three displayed measures:
CH_4
NMH
THC (Total HC = Total VOC)
In the **NMH configuration**.
And
Benzene (C_6H_6)
Toluene (C_7H_8)
Xylenes (C_8H_{10}) and/or other Aromatics, e.g. Ethyl-Benzene, Cumene, etc.
In the **"AROMATICS" configuration**.

As said in the NMH configuration we integrate just the CH_4 signal and the THC (Total HC) signal generated by the second injection. The NMH value is the result of the difference (TVOC/THC – CH_4)

The characteristic chromatogram for the NMH analysis is the following:

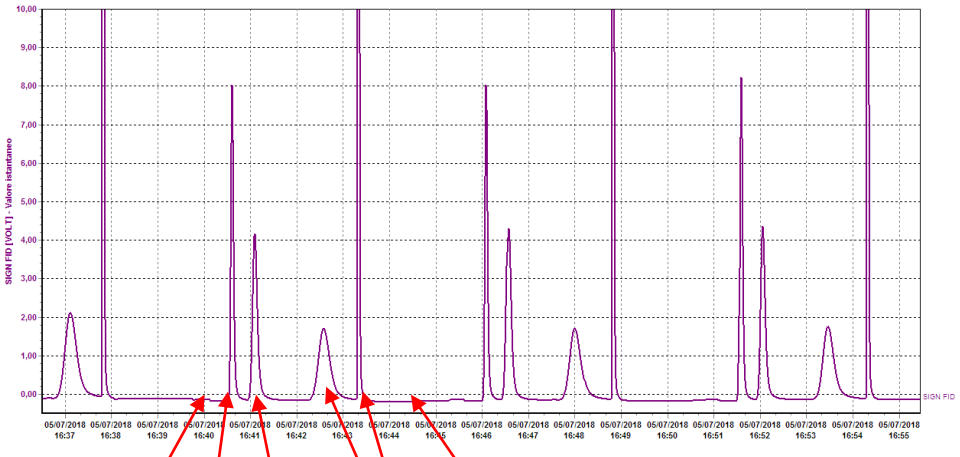
The NMH separation chromatogram



While in the Aromatics configuration the instrument separates and integrates the Benzene, the Toluene the Xylenes and/or other species you may have in your calibration cylinder.

The Aromatics separation chromatogram

Cycle start Rotation valve reverses Back flush End of the Cycle

	THE REPETITION TESTS OF YOUR SPECIFIC GC COLUMN	
	FIRST CYCLE SECOND CYCLE TRHIRD CYCLE	
		
	Cycle start Reverse rotation valve Back flush Benzene Toluene o-Xylene	

The simplest way to switch from a configuration into the other and vice versa is to:

i) change the GC column
ii) down load the relevant configuration memorized as “DEFAULT CONFIG” in our laboratories in the testing and calibration phase.
iii) Introduce new species contained in your calibration gas cylinder with relevant integration windows.

Still it could be useful for Customer to know the procedure followed to convert a configuration into the other one and vice versa.

The Mod. 8807/NR portable gas chromatograph shows a self-explaining software package. The fundamental operations could be synthetized in:

i) **Download and upload the configurations.** When the instrument is delivered is supplied by the basic (default) configurations. The Customer should copy the file in a separate storage and keep it to be used when necessary.
Whenever the Customer has developed a special configuration he may save it and keep to be used when necessary.

ii) **Increase/decrease the detected species** (up to 8 ones).

iii) **Set the correct integration times of the integration windows**

iv) Set the length of the cycle.

v) Calibrate the instrument.

Whenever you need to enter into the SERVICE MENU take note of the steps performed as to be able to return to the original point. Do not memorize the changing if you are not 100% sure about your variations.

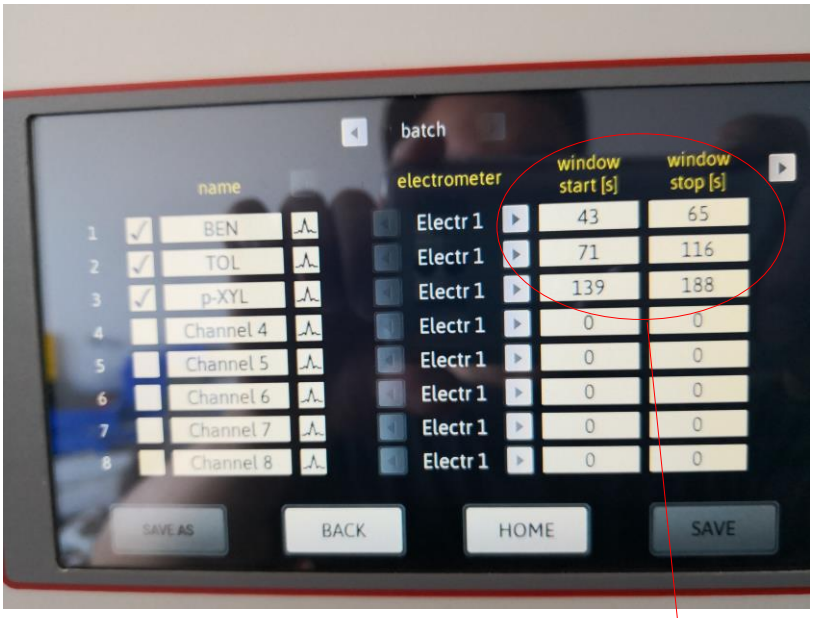
We remind the necessity to limit the number of accesses to service menu as well as to a limited number of service people
In case of difficulties please return to default configuration.

The basic steps for reconfigure the analyser to integrate specific peaks are the following:

1- **Download and upload the configurations.**
The configuration files may be memorised in SD cards and/or in USB flash drive units.
Operate as it follows:

a. Switch OFF the analyser.
b. Insert the USB flash drive unit in the relevant port inside the small front panel port.
c. Switch ON the analyser and wait for a few minutes till the new Firmware is loaded.
d. Open the SERVICE MENU
Select “Options”
Select “Manager Configurations”
Press “load from USB”
Select file of the type e.cfg, e.g. BTX.CFG and load it into the analyser memory.
e. Extract the USB flash drive unit.

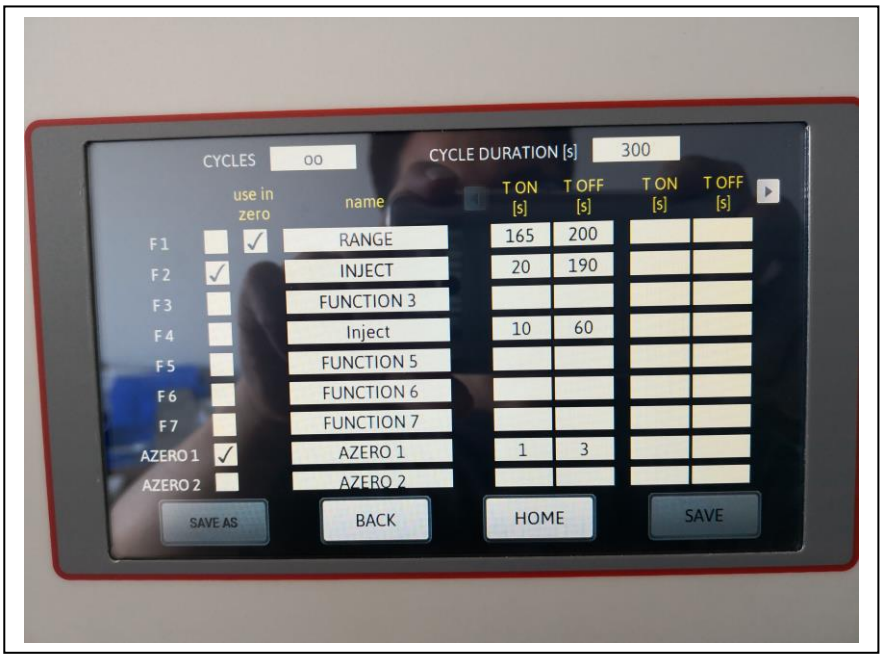
2- **Configure a new peak (**increase/decrease the detected species (maximum number of peaks: 8).



- Enter SERVICE MENU.
- Select CHANNELS.
- Digit the New Component (tick it).
- Insert Start/Stop of the integration window.
  - Either select SAVE: you overwrite the actual COFIGURATION or
  - SAVE AS you create a new CONFIGURATION.
- Return to HOME

3- **Set the correct integration times of the integration windows**
(See the figure above)

4- Set the length of the cycle.



5- Recalibrate.

After a new Configuration, with change in species under analysis, you should run a new Calibration. For the latter purpose please follow the indications given in the specific section.
Remember to enter into the sample line at **vented conditions**, atmospheric pressure.