SERVOMEX
ANALYZERS
HIGH-PERFORMANCE GAS ANALYSIS

SERVOPRO NanoChrome

OPERATOR MANUAL

Part Number:	**04416001A**
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1 DESCRIPTION AND DEFINITIONS

1.1 Scope of this manual

This manual provides installation, operation and routine maintenance instructions for the SERVOPRO NanoChrome Online Trace Gas analyser.

1.2 Safety information

Read this manual and ensure that you fully understand its content before you attempt to install, use or maintain the SERVOPRO NanoChrome. Important safety information is highlighted in this manual as WARNINGs and CAUTIONs, which are used as follows.

WARNING

Warnings highlight specific hazards which, if not taken into account, may result in personal injury or death.

CAUTION

Cautions highlight hazards which, if not addressed, can result in damage to the SERVOPRO NanoChrome or other equipment or property.

This manual also incorporates “Be aware of” information, which is used as follows:

This highlights information which it is useful for you to be aware of (for example, specific operating conditions, and so on).

1.3 Description of NanoChrome Gas Analyser

1.3.1 Introduction

The SERVOPRO NanoChrome is a 19" rack mounted online trace gas analyser, shipped pre-configured and requires little operator intervention. The application is the measurement of impurities (H_2, N_2, Ar, CH_4, CO, CO_2 and NMHC) in bulk gases (H_2, O_2, N_2, Ar or He).

The analyser configuration - form factor, plasma detector(s), column(s), and valves - is application dependent. The analyser consists of a master chassis, which may be fitted with one or more secondary chassis, or a PC with one or more secondary chassis, and may also have an auxiliary oven. The master chassis provides the User Interface and communications. Each master chassis and secondary chassis is fitted with an electronic system to control its detector(s) and data acquisition.

All instrument parameters are controlled by the SERVOPRO NanoChrome analytical software package. Each impurity peak is reported on screen with its process value. The software offers advanced diagnostic tools and trending features, to ease the configuration parameter definition and support the trouble shooting process.

The analyser is provided with a 4-20 mA isolated output for each impurity peak as standard (up to eight 4-20 mA outputs for the main chassis).

There are two operating ranges per peak (range 1/range 2) with a user selectable multiplication factor for range 2 of 1, 2, 5 or 10 X range 1. There is a dry contact remote range identification output for each impurity peak.

Two process alarm dry contact outputs are included, and two alarm set points per peak can be entered. A fail-safe dry contact output is provided for the system status alarm; this contact will be activated when there is a risk that the reported value may prove unreliable.

There is one isolated digital input for a remote start function.

All digital I/O can be configured as normally closed or open.

1.3.2 Plasma Emission Detector (PED)

The plasma emission detector (PED) is based on a spectroscopic emission cell, which is an established technique to measure impurities from the ppb to ppm level. The characteristics which make the plasma system stable and selective are the frequency, intensity, regulation, the coupling technique and the focusing (stabilising) electrodes.

The carrier gas flows at atmospheric pressure through a proprietary pure quartz cell. The cell is submitted to a high frequency high intensity electromagnetic field. This ionizes the carrier gas which becomes the centre of a luminous phenomenon (electroluminescence), a collection of charged particles called the plasma.

Once the carrier gas is ionized many spectral lines are emitted. Excitation results mostly from electron or ion collision; that is, the kinetic energy of electrons or ions accelerated in an electric field in which the atoms or molecules of a gas are subjected to, which cause the emission of light.

The presence of the impurities in the sample gas to be analysed will alter the spectrum of emitted lines. Characteristic emission spectra can be obtained for carrier gas and each substance in it.

1.3.3 Signal conditioning

The signal conditioning module offers very high gain with minimum drift and noise. A special design low noise high stability analogue power supply is used.

The signal conditioning board can accept signals from up to 7 detectors. The various signals can be monitored from the diagnostic menu. The signal conditioning module has its own microcontroller to communicate with the main PC.

1.3.4 Main PC and graphic display

The main PC board manages all User Interface I/O and sends the information to the I/O board and the Signal Conditioning board via RS-485. The keypad and colour graphic display are directly connected to it.

1.3.5 Oven heater and control

Up to 6 ovens can be fitted into the main chassis. The temperature electronic control hardware is mounted on the I/O board. There are 6 temperature control loops (PID) in the software. The temperature is measured with an RTD. The analogue to digital resolution uses 24 bit A/D converters. The heater is controlled in a Pulse with Modulation (PWM) scheme.

There are 8 electronic relays mounted on the I/O board. These relays turn ON at zero crossing voltage and turn OFF at zero crossing current thus eliminating EMI. Oven circuits are also protected by a fuse mounted on the I/O board.

1.3.6 I/O board

The I/O board holds all the I/O functions of the instrument, shown in the table below.

Digital I/O	❖ 1 isolated digital input ❖ 8 remote range dry contact outputs ❖ 2 alarm dry contact outputs ❖ 1 system status dry contact output ❖ 1 extra relay ❖ 10 G.C. valve contact outputs ❖ 6 oven power relays
Analogue I/O	❖ 6 oven temperature RTD input ❖ 8 isolated process 4-20 mA output

Table 1 : I/O board

All digital inputs and outputs, analogue inputs and outputs are transient and fuse protected. The I/O board is connected to an external 40 pin I/O connector through a flat cable connector.

The 40 pin I/O connector mounted on the rear panel of the instrument may be disconnected from the analyser without the need to unscrew each wire individually.

The I/O board holds the fuses for the I/O. Each fuse is socket mounted to make replacement easy.

1.4 Description of Analyser Rear Connections

1.4.1 SERVOPRO NanoChrome Complete Rear Connector

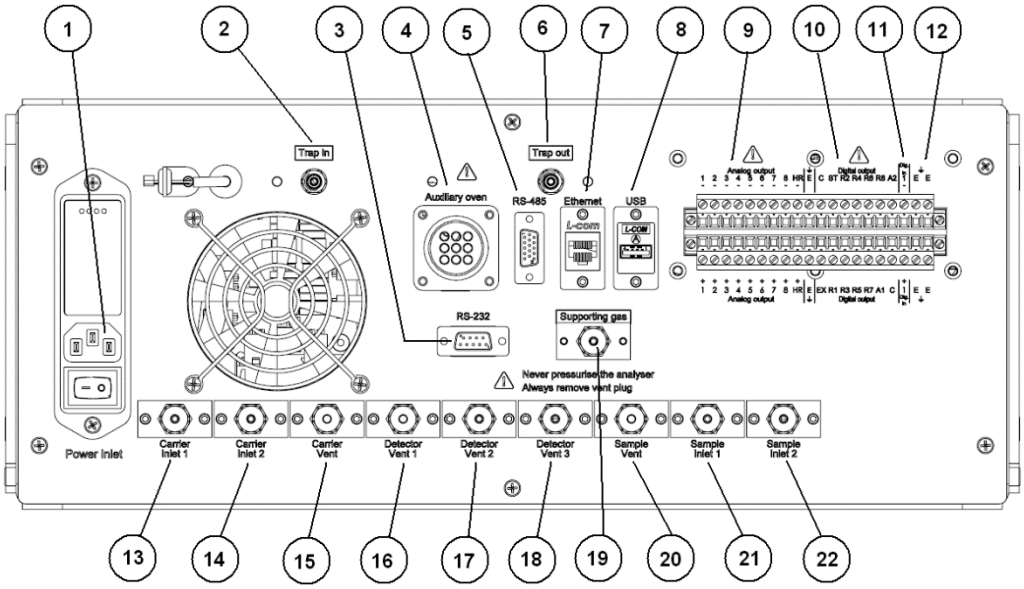


Figure 1 : SERVOPRO NanoChrome complete rear connections

This rear panel is fitted to the master chassis, and to the secondary chassis in a system with a stand-alone PC.

1. Power inlet with switch and fuse
2. Gas trap inlet
3. RS-232 /RS-485 socket
4. Auxiliary oven
5. RS-485 socket
6. Gas trap outlet
7. Ethernet port
8. USB port
9. Analogue 4-20 mA outputs
10. Digital outputs
11. Digital input
12. Earth terminals for cable screens
13. Carrier gas inlet to detector 1
14. Carrier gas inlet to detector 2
15. Vent for carrier gases
16. Detector 1 vent
17. Detector 2 vent
18. Detector 3 vent
19. Supporting gas inlet
20. Sample gas vent
21. Sample gas inlet 1 (process)
22. Sample gas inlet 2 (span)

Several of the ports shown above are optional and may be fitted depending on the analyser configuration and intended use. VCR fittings are used on all gas inlets, Swagelok (SWG) fittings are used on all gas outlets/vents.

1.4.2 SERVOPRO NanoChrome Reduced Rear Connections

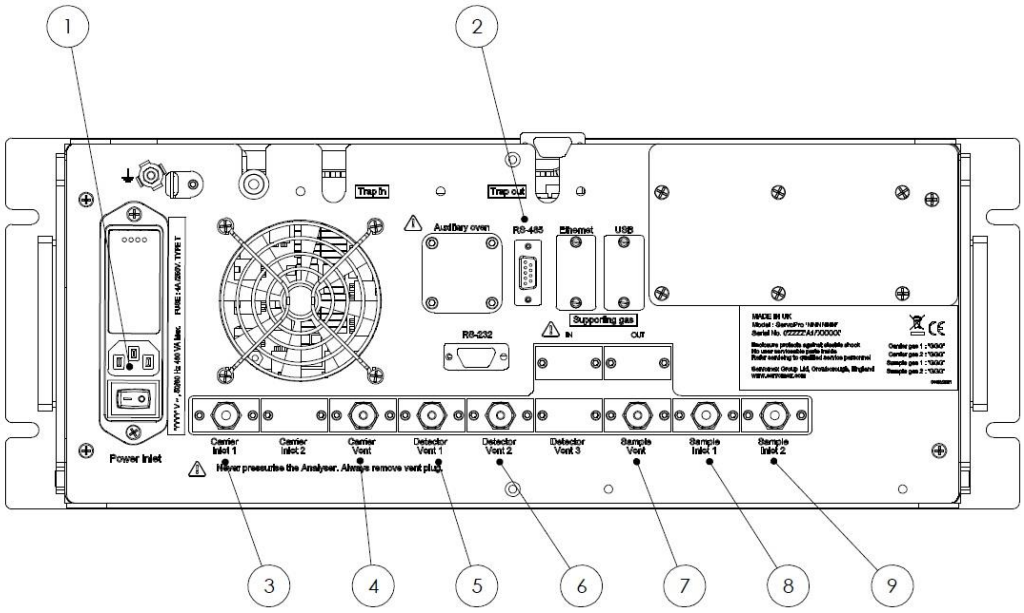


Figure 2 : SERVOPRO NanoChrome reduced rear connections

This rear panel is fitted to the secondary chassis in a system with a master chassis.

1. Power inlet with switch and fuse
2. RS-485 port
3. Carrier gas inlet
4. Carrier gas vent
5. Detector 1 vent
6. Detector 2 vent
7. Sample gas vent
8. Sample gas inlet 1 (process)
9. Sample gas inlet 2 (span)

Note: the RS-232 port is replaced with a RS-485 port on Secondary Chassis 1 on an analyser with multiple secondary chassis.

WARNING

Any Connections on the Rear Panel to the Analogue 4-20mA Outputs, Digital Outputs (Relay Outputs) and Digital Input shall be connected to voltage sources derived from suitably approved double isolated power supply or system with voltages not exceeding 30Vac or 60Vdc and shall be from a limited energy circuit as defined in EN61010 -1. UNDER NO CIRCUMSTANCES SHALL THESE CONNECTIONS BE CONNECTED DIRECTLY TO MAINS VOLTAGES.

1.5 Auxiliary Oven

1.5.1 Description of Auxiliary Oven

The Auxiliary Oven is an external module used when analysing N2 impurity in either H2 or O2 background gas. It is connected to the specific channel making the N2 determination and removes the small volume of interfering background gas which has co-eluted with the N2 prior to the passing to the detector.

1.5.2 Auxiliary Oven Rear Connections

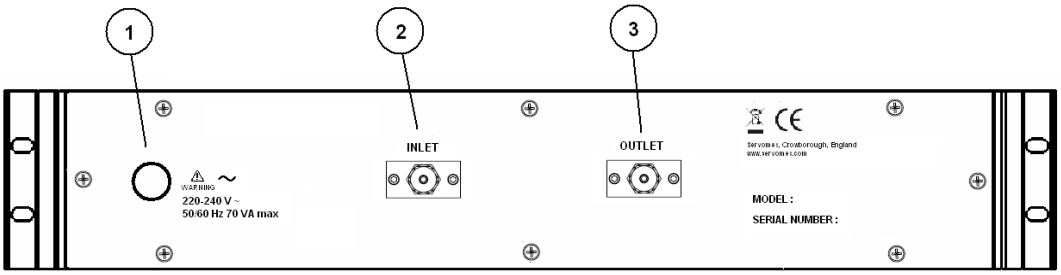


Figure 3 : Auxiliary Oven rear connections

1. Power inlet
2. Oven inlet (connect to Trap In gas connector on Master or Secondary Chassis)
3. Oven outlet (connect to Trap Out gas connector on Master or Secondary Chassis)

1.6 Standalone PC Rear Connections

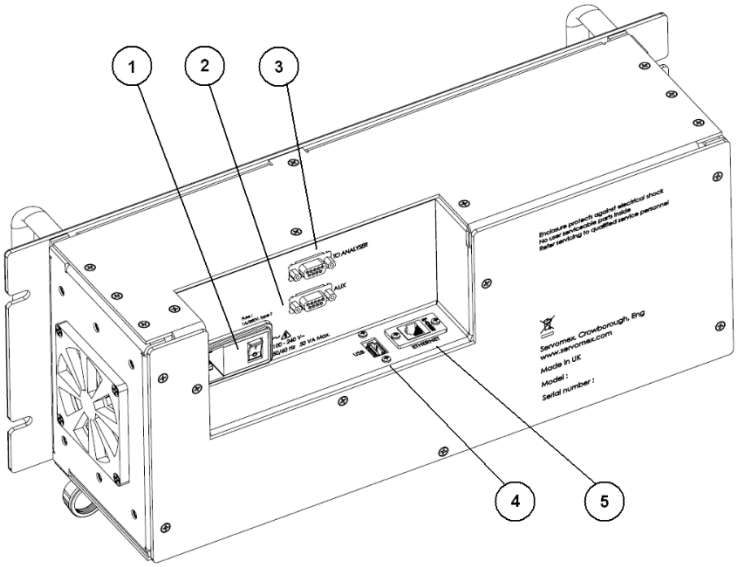


Figure 4 : Standalone PC rear connections

1. Power inlet with switch and fuse
2. RS-232 port for remote terminal (marked “AUX”)
3. RS-232 port for secondary unit (marked “TO ANALYSER”)
4. USB port
5. Ethernet port

CAUTION

To comply with the requirements of the EU EMC Directive, data cables used with the standalone PC (USB, Ethernet) must be fitted with ferrite beads (Würth 74271131 or 74271221, depending on cable size), which should be clamped around 2 turns of cable.

CAUTION

To comply with the requirements of the EU EMC Directive, the front USB port should be use with a USB memory stick only. Rear USB port to be used with Keyboard mouse or USB memory stick only. Only a keyboard supplied by Servomex shall be used.

CAUTION

To comply with the requirements of the EU EMC Directive, a single turn ferrite (Wurth type 742-711-31) shall be fitted to the RS232 output cable.

WARNING

This analyser is not a medical device as defined in the medical devices directive 93/42/EEC and is not intended to be used on human beings for the diagnosis, prevention, monitoring, treatment or alleviation of disease, injury or replacement or modification of the anatomy.

WARNING

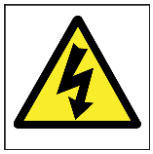
The SERVOPRO NanoChrome must not be used as personal protective equipment.

WARNING

Improper installation, operation or service of this analyser may cause damage to the analyser and void the manufacturer's warranty

WARNING

All connections must be properly connected and leak free. Improper gas connection could result in explosion or death.



WARNING

Do not operate unless the cabinet is securely closed. Servicing this instrument implies possible exposure to shock hazard level voltages which cause death or serious injury.

WARNING

Any equipment connected to standalone PC shall be separated from any mains voltage by at least double insulation.

2 SPECIFICATIONS

WARNING

Install and use the SERVOPRO NanoChrome in accordance with the requirements of this section and subsequent sections of the manual. If not followed, the protection facilities incorporated into the design of the analyser may not operate as intended, sample gas measurements may not be accurate, or the analyser may be damaged.

CAUTION

To comply with the applicable requirements of EU EMC Directive: The case of the Auxiliary Oven shall be bonded to the case of the Master/Secondary unit using braid less than 20 cm long.

CAUTION

To comply with the applicable requirements of EU EMC Directive: The case of the Stand-alone PC shall be bonded to the case of the Master/Secondary unit using braid less than 20 cm long.

CAUTION

To comply with the applicable requirements of EU EMC Directive: The assembly shall be bonded to a local EMC earth. The bond shall be less than 1 m in length.

CAUTION

The Master Chassis, Secondary Chassis, Standalone PC and Auxiliary oven enclosures do not contain any user replaceable parts inside.

CAUTION

If the analyser is subjected to external RF signals; additional errors can occur for Plasma detector, up to 3% full scale

2.1 General

Dimensions H x W x D

Master chassis:	178 x 483 x 610 mm (7 x 19 x 24 ins)
Secondary chassis:	178 x 483 x 610 mm (7 x 19 x 24 ins)
Auxiliary oven:	83 x 483 x 457 mm (3.3 x 19 x 18 ins)
Stand-alone PC:	178 x 483 x 130 mm (7 x 19 x 5.1 ins)

Weight

Master chassis:	11 - 27 kg (24.2 – 59.4 lbs)
Secondary chassis:	11 - 27 kg (24.2 – 59.4 lbs)
Auxiliary oven:	7.5 kg (16.5 lbs)
Stand-alone PC:	5 kg (11 lbs)
Electrical supply requirements:	
Voltage:	100 to 120 Vac or 220 to 240 Vac[1],[2]
Frequency:	50 to 60 Hz
Power (maximum)	
Master chassis:	400 VA
Secondary chassis:	400 VA
Auxiliary oven:	100 VA
Stand-alone PC:	60 VA
Fuse rating/type:	
Master/Secondary chassis	Two fuses 4 amp / 250 V, Time delay, Type “T” or equivalent miniature fuses 5 x 20 mm
Stand-alone PC	Two fuses 1 amp / 250 V, Time delay miniature fuses 5 x 20 mm
Detector type:	Plasma

Table 2 : General Specification

[1] The analyser is supplied configured for operation with one of these voltage ranges. You must specify the voltage range when you order the analyser

[2] This analyser is rated in accordance to IEC 60664-3 Over Voltage Category II, Pollution Degree

2.2 Performance

Limit of Detection (LOD) †		Background Gas				
		He	H_2	N_2	Ar	O_2
Impurities	H_2	0.5ppb	-	0.5ppb		0.8ppb
	CO	0.5ppb				
	CH_4	0.5ppb				
	CO_2	0.5ppb				
	NMHC	0.5ppb				
	Ar	0.5ppb			-	0.5ppb
	N_2	0.3ppb		-	0.3ppb	
Range		0-250ppb				
Accuracy (intrinsic error) FS		The greater of ±2% of reading or LOD				
Repeatability		The greater of ±2% of reading or LOD				

Table 3 Performance Specification

2.3 Gas

Carrier gas:	
Type	Purified helium or argon with < 1 ppb total impurity (application dependent)
Carrier pressure range	
He,H_2, N_2, Ar sample	553 +/- 7 kPa (80 +/- 1 psig)
O_2 sample	587 +/- 7 kPa (85 +/- 1 psig)
Flow	90 cc/min to 810 cc/min[3]
Sample gas:	
Type	Hydrogen, Oxygen, Nitrogen, Argon, Helium
Pressure range	207.0 kPa (30 psig)
Flow	50 cc/min to 350 cc/min

Table 4 : Gas Specification

[3] Up to 300 cc/min extra carrier gas is consumed when internal dilution system valve is activated.

2.4 Oven

Chromatographic oven:	
Maximum temperature	300 ˚C
Minimum temperature	Ambient
Auxiliary oven:	
Maximum temperature	300 ˚C
Minimum temperature	Ambient

Table 5 : Oven specification

2.5 Environmental Limits

Ambient temperature range*	+5°C to +40°C
Operating ambient humidity range	0 to 95% RH non-condensing
Maximum Operating altitude	2000 m (max)
Ingress protection	IP20

*for best performance control within +/- 1°C

Table 6 : Environmental limits

2.6 Digital Relay Outputs

Maximum voltage	24 VDC
Maximum current	1 Amp
Cable requirements:	
Type	Multi-core cable with overall screen
Maximum size	0.82 mm^2 (18 AWG)
Maximum length	30 m
Isolation from other circuits	30Vac or 60Vdc (all relays share a common reference)

Table 7 : Digital relay outputs

2.7 4-20 mA Outputs

Maximum load	400 Ω
Isolation from earth	30Vac or 60Vdc
Isolation from other circuits	30Vac or 60Vdc (channels 1 to 8 share a common reference)
Output range:	
Normal sample measurement	4 to 20 mA
Under range	Less than 4 mA
Over range	Over than 20 mA (24 mA maximum)
Cable requirements:	
Type	Multi-strand twisted pair with overall screen
Size	0.2 – 3.3 mm^2 (24-12 AWG)
Maximum length	30 m

Table 8 : 4-20 mA outputs

2.8 Digital Inputs

Maximum voltage	24 VDC
Maximum current	1 Amp
Isolation from earth	30Vac or 60Vdc
Isolation from other circuits	30Vac or 60Vdc
Cable requirements:	
Type	Multi-core cable with overall screen
Size	0.2 – 3.3 mm^2 (24-12 AWG)
Maximum length	30 m

Table 9 : Digital inputs

2.9 *Ethernet Port*

Cable requirements	
Standard	10/100 BaseT
Connector type	RJ45 (CAT5 UTP)
Maximum length	30 m

CAUTION
This cable shall not be routed outside the building in which the analyser is installed without the application of screening or similar protection.

Table 10 : Ethernet cable

2.10 *RS-232 Port*

Type	Male 9 way D connector
Cable requirements	NULL modem Shielded cable
Maximum length	10 m

Table 11 : RS-232 port

2.11 *RS-485 Port*

Type	D-sub HD15 Male/Male shielded
Cable requirements	Wired straight Shielded cable
Maximum length	0.75 m

Table 12 : RS-485 port

2.12 *USB Connector*

Type	USB Type A
Cable requirements	Shielded standard USB cable with male Type A connector
Maximum length	1 m

Table 13 : USB port

2.13 Mains input cables (Master/Secondary/Stand-alone PC)

Type	IEC 60320-1-C13
Cable requirements	-Screened -Specified for 10 A / 250 Vac -Fit with a main plug that meets the requirement of the country where analyser us used.
Maximum length	2 m

Table 14 : Mains cable

3 THE USER INTERFACE

3.1 User Interface Controls

All analyser functions are accessed through the menus of the user interface. The controls provided in the menus are explained in this section.

3.1.1 Edit Box control

The Edit Box control is used to input or view a numerical value, for example, to input the cycle length.

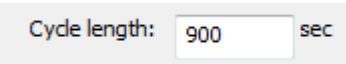


Figure 5: Edit Box control

When an Edit Box control is available to accept an input a cursor appears.

To operate an Edit Box control from the keyboard:

- Press LEFT or RIGHT to move the cursor.
- Press HOME to move the cursor to the beginning of text.
- Press END to move the cursor to the end of the text.

3.1.2 Radio control

The Radio control is used to select a mode of operation, for example, the range mode.

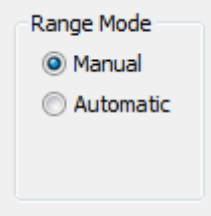


Figure 6 : Radio control

The mouse or the keyboard can be used to operate an Edit Box control. The left and right or the up and down arrows will switch between values.

3.1.3 Slide control

The slide control is used to choose between items; for example, the user may choose either “Selected peaks” or “All peaks” in the calibration menu.

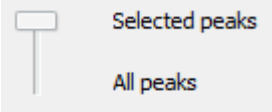


Figure 7 : Slide control

To operate a slide from the keyboard:

- Press UP to move the slider up one position.
- Press DOWN to move the slider down one position.
- Press HOME to move the slider to the top of the slide.
- Press END to move the slider to the bottom of the slide.

To operate using the mouse, move the slider to the position desired.

3.1.4 Push button control

Click on a push button to initiate the action that is displayed on the button.

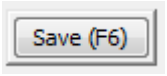


Figure 8 : Button control

To operate a button from the keyboard, use the hot key corresponding to the button.

To operate using the mouse, left click on the button.

3.1.5 Grid control

The grid is used to show, change or highlight data.

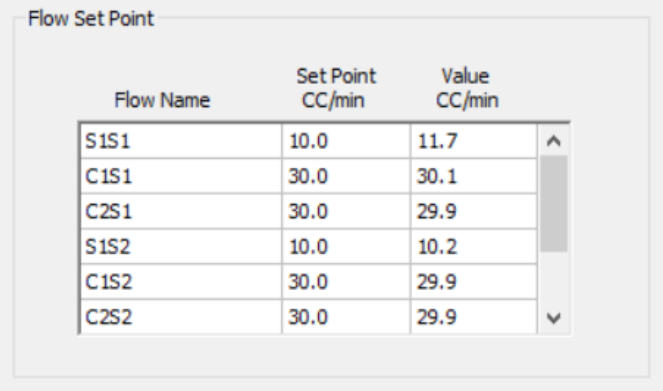


Figure 9 : Grid control

To change a value on the grid, select the cell by left clicking with the mouse to highlight the cell, then enter the new value.

3.1.6 Combo control

The Combo Box control is used to choose a value between sets of predetermined values.

Figure 10 : Combo Box control

To operate a Combo Box with the keyboard, press UP and Down to change between the different values.

To operate using the mouse, left-click on the arrow and then left-click on the desired value.

3.1.7 Check Box control

The Check Box control is used to enable a feature.

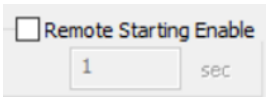


Figure 11 : Check Box control

To operate the Check Box with the keyboard, press the space key to make it checked (enabled) or unchecked (disabled).

To operate using the mouse, left-click in the check box to make it checked (enabled) or unchecked (disabled).

3.1.8 Tab control

The Tab control is used to switch between different pages of data. For example, a tab in the **RUN-REAL TIME CHROMATOGRAM MENU** can be selected to toggle between each conditioning boards.

To operate using the mouse, left-click on the desired tab.

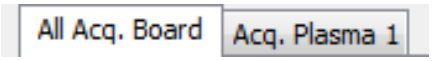


Figure 12 : Check Tab control

3.2 User Interface Menu structure

The analyser functions are grouped in menus which are structured as shown in Figure 13 : Menu Structure. The functions available from the menu are described in the following sections.

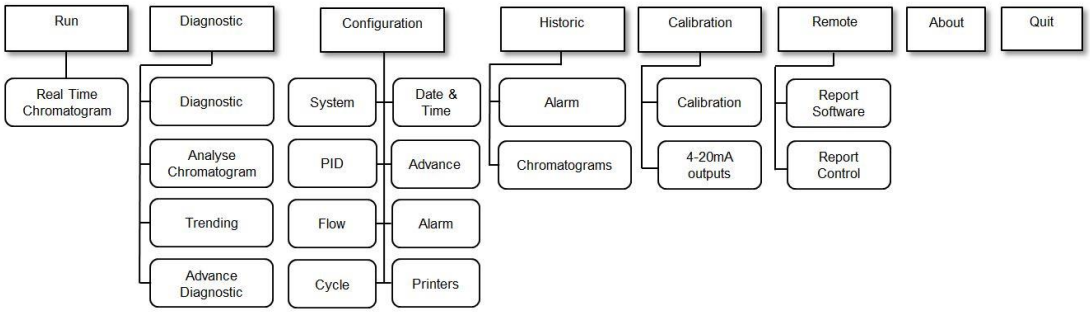


Figure 13 : Menu Structure

3.3 Run Menu

3.3.1 Real Time Chromatogram Menu

The **REAL TIME CHROMATOGRAM** menu is used to run analysis and you can initiate a cycle and visualise the resulting real time chromatogram. The chromatogram presents all the peak data that can be configured in the **CONFIGURATION-CYCLE** menu.

To access the **RUN-REAL TIME CHROMATOGRAM** menu (see Figure 14 overleaf), press CTRL-R or click on **Run** and then **Real Time Chromatogram.**

The following information is also displayed in the **RUN-REAL TIME CHROMATOGRAM** menu: the carrier flow, the sample flow, the oven temperature, date & time, and the cycle time.

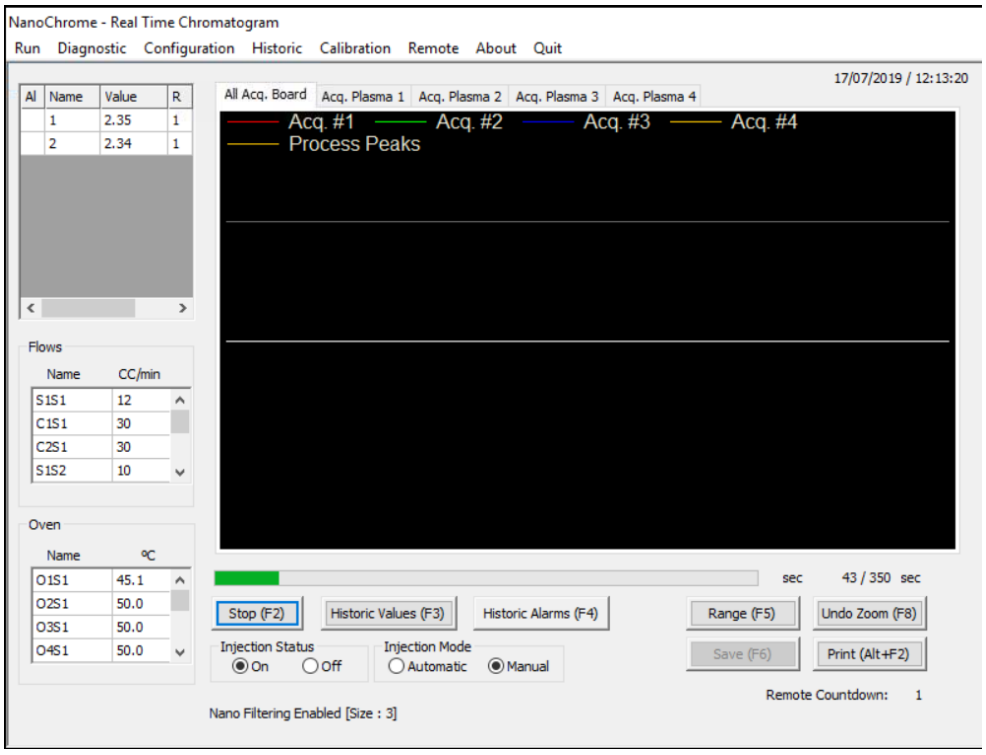


Figure 14 : Run - Real time menu

3.3.2 Start button (F2)

A cycle may be executed by pressing the button labelled **Start,** which is then re-labelled **Stop**. The cycle can then be stopped by pressing the same button, which is then re-labelled **Start**. **Start** and **Stop** may also be actioned by toggling F2.

When a cycle is started, the analyser waits for the ending time of the first peak and begins its peak detection between the starting time and the ending time. If a peak is found, the peak that is detected and used for integration is presented in yellow below the raw signal coming from the detectors.

During the cycle, the progress bar rises with time. The bar starts at the left and ends at the right. The cycle length can be set in the **CONFIGURATION-CYCLE** menu. During a peak, a green circle appears at the corresponding peak of the upper grid alarm column (Al). When the peak detection process is completed, the peak area is converted into the process value and displayed in the grid beside the peak name in the value field. Then the analyser waits for other peaks and applies the same procedure.

The cycle continues even if you exit the **REAL-TIME CHROMATOGRAM MENU**.
It is not recommended to **Stop** a real time chromatogram during a cycle as chromatography is still continuing (additional purge time required).

3.3.3 Injection Mode

Use the **Injection Mode** radio control to select one of two injection modes. The **Manual** mode executes one cycle after the **Start** button is pressed. The **Automatic** mode restarts new cycles until the **Stop** button is pressed or the **Manual** mode is selected.

3.3.4 Injection Status

The **Injection Status** radio control enables sample injection when the **ON** radio control is selected and disables sample injection when the **OFF** radio control is selected.

3.3.5 Historic values (F3)

Displays the last 20 measures of concentration and Area for the selected impurity. Select a peak in the upper-left grid of the **REAL-TIME CHROMATOGRAM MENU** and then press the **Historic Values (F3)** button to see these values.

3.3.6 Historic Alarm (F4)

Press the **Historic Alarm** button to access the **Historic Alarm** menu. This button will turn red when an alarm occurs, turn yellow when the menu is opened and alarms are still active, and turn green if the problem is resolved. The **Historic Alarm Menu** is described in more detail in section 3.4.

3.3.7 Range (F5)

Use the **CONFIGURATION-SYSTEM MENU** to select either **Manual** or **Automatic** ranging. If **Manual** ranging is selected, press the **Range** button to toggle between the 2 ranges. The range used for the last integration of a peak or the range selected is displayed in the *R* column, next to the peak value in the grid at the left of the chromatogram.

To change a peak range set the **Manual** ranging by highlighting the corresponding peak in the grid and then press the **Range** button.

The **Range** cannot be changed during a peak integration. When **Automatic** ranging is selected, range selection will be automatically based on the result of the last peak calculations.

Note that when calibration is enabled, "***Warning: Calibration enabled"*** will be displayed in the chromatogram display.

The colour displayed in the **Alarm column (Al)** of the peak grid indicates the alarm status for each peak. The following table shows the meaning of each colour.

Colour	Alarm Status
White	No alarm
Yellow	Alarm 1
Red	Alarm 2

Table 15 : Peak Grid - Alarm Status display colours

3.3.8 Save (F6)

Trending data can be saved by pressing the **Save** button at the end of a cycle. When the **Save** button is pressed, a dialog box appears and asks for a filename to be entered. Load this file from the **ANALYSE CHROMATOGRAM MENU**. The button is enabled only when no cycle is in progress.

Delete trending data that is no longer required with the **Delete** button of the **ANALYSE CHROMATOGRAM** menu.

When the hard drive is 99% full, saved data will be over-written with the new data. The oldest data will be over-written first.

Note that a tick mark (little vertical line) is displayed on the real-time chromatogram at every starting and ending peak to help identify the integration windows.

View each conditioning board's trending independently by clicking on the corresponding tab at the top of the chromatogram.

3.3.9 Undo Zoom (F8)

Use the mouse to zoom into the trending. Press and hold the left mouse button while moving the mouse. A rectangle will appear on the screen to identify the zone to zoom. Releasing the left mouse button will apply the zoom. Press the **Undo Zoom** button to show the original trending without any zoom.

3.3.10 Historic Calibration Values (F9)

Displays the last 20 Span Calibration measures of concentration, Area Counts and Response Factor for the selected impurity. Select a peak in the upper-left grid of the **REAL-TIME CHROMATOGRAM MENU** and then press the **Historic Calibration Values (F9)** button to see these values.

3.3.11 Print (Alt F2)

The **Print** button enables printing of the chromatogram. To add a printer, see the **CONFIGURATION-PRINTERS** menu**.** See section 3.6.8 for guidance on setting up a printer

3.3.12 Remote Countdown

A remote countdown field shows the time left when remote starting is activated. The remote time can be set in the **CONFIGURATION-SYSTEM** menu.

Note: If the analyser has multiple configurations, the name of the current configuration will appear in the bottom right corner of this menu.

3.4 Historic Menu

3.4.1 Alarm Menu

Displays the last 200 system alarms, peak value alarms and event logs, and all the active alarms.

1) <u>System alarms:</u>

- ***Low sample flow***
  When the sample flow goes below 10 cc/min with a sample flow set point greater than 10 cc/min.

- ***Low carrier flow***
  When the carrier flow falls below 5 cc/min for the plasma detector for 30 seconds, a “Plasma #X on I/O Board #X shut down” alarm will be initiated to protect the system by turning off the #X plasma detector.

- ***Plasma shut down***
  When a “Low carrier flow” alarm remains active for 30 seconds, turns the plasma detector off.

- ***Plasma OFF***
  When the cell signal counts are lower than the starting count, it indicates that the plasma detector is physically off.

- ***Starting***
  The plasma is restarted when the following is true
  - "Plasma off" alarm is active
  - "Low carrier flow" alarm is inactive
  - Starting mode is automatic (see section 3.6.1, **SYSTEM CONFIGURATION MENU** for the **Starting mode** definition)
  - No cycle is progressing (real-time chromatogram stopped or between cycles)

- ***Plasma ON***
  When the cell signal counts go above the starting counts after a "Plasma OFF", it indicates that the plasma is physically on.

- ***RTD problem*:**
  When an oven temperature falls below 10 degrees Celsius.

- ***Carrier flow deviation***
  When the carrier flow is higher or lower than the carrier flow set point by 2 cc/min or more; the injection is still possible and the system continues to report process values.

- ***Oven temperature deviation***
  When an oven temperature is higher or lower than the oven temperature set point by 2 degrees Celsius or more.

- ***Communication problem***
  When the user interface (PC) cannot exchange any data with an electronic board inside the analyser.

2) <u>Peak value alarms</u>

Peak value alarms do not impact the system status alarm dry contact output.

- ***Alarm 1 peak #***
  When the concentration of impurity is greater than the Alarm 1 for the peak.

- ***Alarm 2 peak #***
  When the concentration of impurity is greater than the Alarm 2 for the peak.

- ***Overscale peak #***
  When the concentration of impurity is greater than the actual scale of the peak.

3) Peripheral alarms:

Some peripherals connected with the analyser may show their alarms/errors status in the **Historic Alarm** menu. Refer to their User Manuals for more information.

When a problem arises, a new alarm is generated and the button of the **HISTORIC ALARM** menu turns red. If the menu is opened and an alarm is still active, it turns yellow. If another alarm occurs, it turns red again. The button will turn green when all alarms are resolved.

Every system alarm will activate or deactivate the system status alarm dry contact output, depending on the settings in the **CONFIGURATION ALARM** menu. Peak value alarm 1 and 2 each have a separate dry contact output that is activated or deactivated, depending on the **CONFIGURATION ALARM** menu, when the alarm thresholds are reached.

Some system functions, such as a real-time chromatogram, are disabled when alarms are active. Rectify the problems before proceeding with your analysis. When the problem is resolved, the same alarm message is displayed, but with an "Ok" message (except for a "Plasma shut down" that is resolved with a "Starting" and for the "Plasma OFF" that is resolved with a "Plasma ON").

Example:

• If a "Low carrier flow" occurs, the following message is displayed:
(date) Low carrier flow: (hour)
• When the flow problem is rectified, the following message is displayed:
(date) Low carrier flow: Ok (hour)

3.5 Diagnostic Menu

3.5.1 Diagnostic

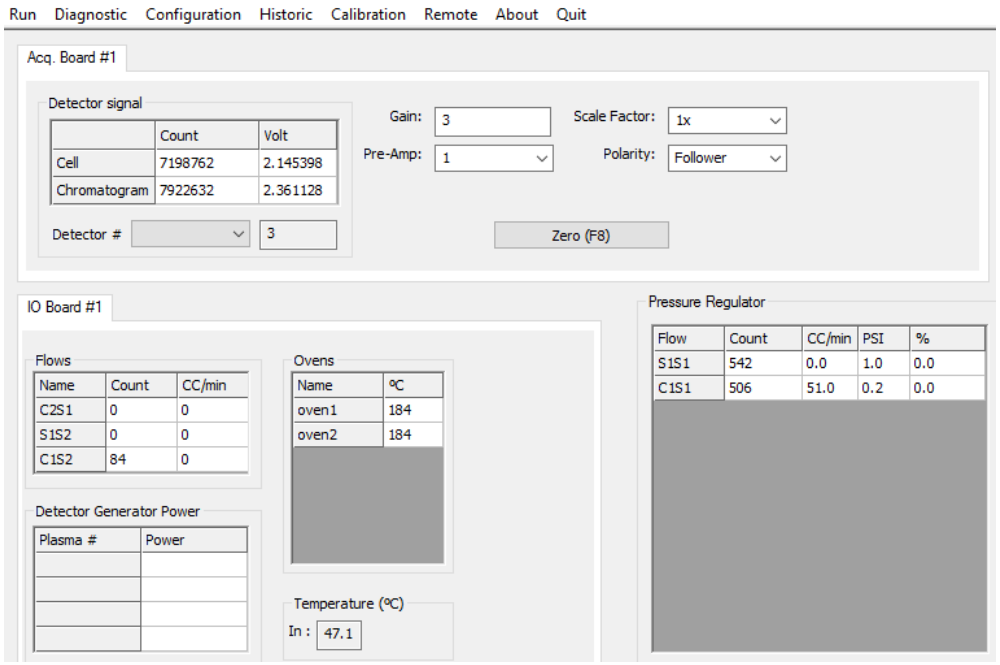
Press **Diagnostic (CTRL-P)** on the menu bar and then on **Diagnostic** to reach the **DIAGNOSTIC-DIAGNOSTIC** menu (Figure 15). The system diagnostic menu provides information on the system and aids trouble shooting.

This menu is divided in hardware component groups:

- Acquisition boards: read signals coming from detectors, applying polarisation
- IO boards: viewing oven temperatures, changing plasma power
- Pressure regulators: viewing regulated flows with corresponding counts and PSI values

Figure 15 : Diagnostic menu

Depending on the configuration of the analyser, different parameters are displayed under the corresponding tab of a hardware component. The following table lists the data that can be found in the **DIAGNOSTIC-DIAGNOSTIC** menu,



Data	Meaning
Cell	The cell counts are the detector raw signal. This data is displayed in counts, between 0 – 16777215, and also in volts, between 0 - 5V.
Chromatogram signal	Displayed on the chromatogram and used to perform the peak integrations. This data is displayed in counts, between 0 - 16777215 and also in volts, between 0 - 5 V.
Active Detector	Displays the current detector. These detectors are factory configured using the **CONFIGURATION-ADVANCED** menu.
Gain	Displays the gain currently applied. This gain amplifies the data to be displayed on the real-time chromatogram.
Pre-Amp	The Pre-Amp Gain affects the Chromatogram Signal and the cell signal. This is factory set to one of 4 levels.
Offset	Displays the voltage applied at the input of the acquisition board to provide an offset to the signal.
Scale Factor	Displays scale factor in use (x1, x2, x5 or x10), applied to the gain when range 1 is in use. Can be set in the *Range1 factor* column in the Peak data grid of the **CONFIGURATION-CYCLE** menu. This factor also corresponds to the gain factor of the **DIAGNOSTIC-TRENDING** menu.
Polarity	Displays the current polarity of the gain. If a gain of 100 and the “inverter” (negative) value is entered, the gain is –100. If the polarity is changed to follower (positive), the gain is +100. This allows negative peak to be trend positively and properly integrated.
Flows	Displays the flow rates of mechanically regulated flows (if any fitted) measured on this I/O Board.
Oven temperatures	Displays the oven temperatures in degrees Celsius.
Detector Generator Power	Indicates the power applied to the different plasma detectors.

Temperature	Shows the temperature in degrees Celsius inside and outside of the chassis for the main I/O Board.
Pressure Regulator	Displays the Flow Name, the Counts, the flow in cc/min and the pressure in PSI of the different electronic pressure regulators in the analyser.

Table 16 : Diagnostic menu

Table 17 : Diagnostic menu – lists parameters that can be manually changed to help diagnose a problem.

Parameter	Meaning
Active Detector	Selects the detector seen by the system. Only detectors for the conditioning board selected with the tab control can be selected.
Gain	Changes the system gain.
Pre-Amp	Toggles between Pre-Amp gain stage which can be 1, 2, 3 or 4.
Scale Factor	Toggles between factors which can be x1, x2, x5 or x10.
Polarity	Changes the system polarity.
Zero (F8)	Executes a zero, which means the baseline is reset to the current counts. When the zero is executed, the chromatogram cell counts will be near 83886076.
Detector Generator Power	These values can be changed to apply a different power on the plasma sensors (in %).

Table 17 : Diagnostic menu – manual checks

3.5.2 Analyse Chromatogram

Press **CTRL-L** or click on **Diagnostic** on the menu bar and then on **Analyse Chromatogram** to display the **DIAGNOSTIC-ANALYSE CHROMATOGRAM** menu (see Figure 16).
Figure 16 : Diagnostic - Analyse Chromatogram

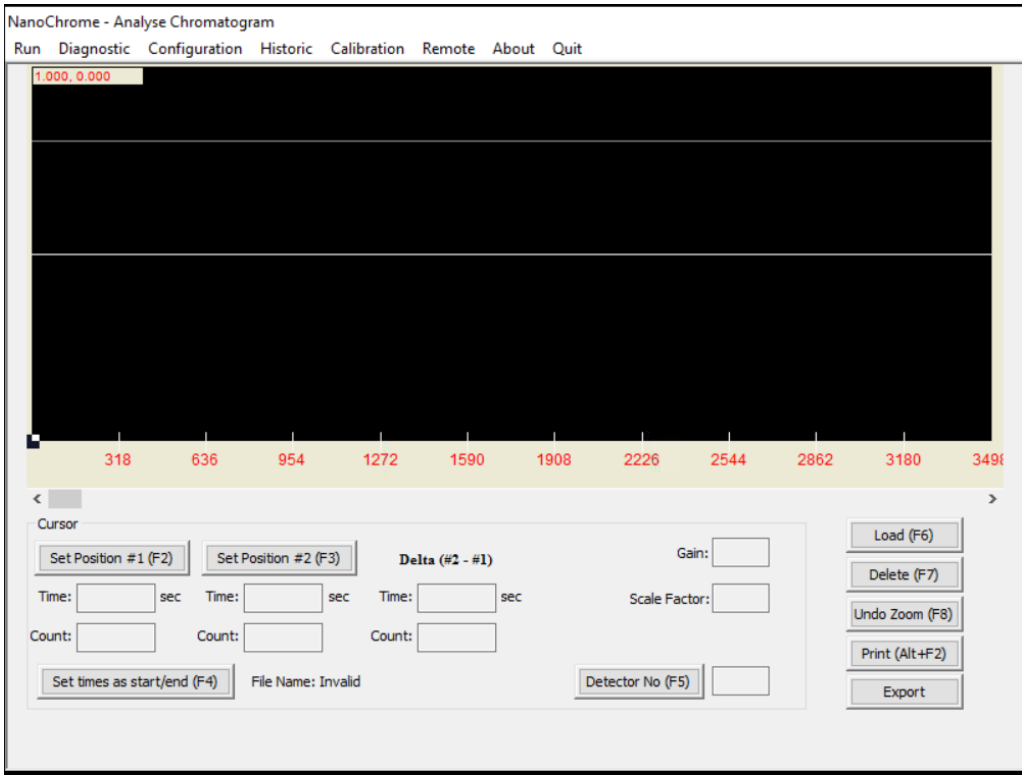


Figure 16 : Diagnostic - Analyse Chromatogram

The **Analyse Chromatogram** menu is used to analyse a chromatogram and define the right starting and ending times for the peaks. When the menu is opened, the software requests the name of a file that has been previously saved. This can be a real-time chromatogram or a trending one.

Real time chromatograms are saved with the **.rlt** extension and trending chromatograms with the **.trd** extension.

A square cursor can be used to move through each line of the graph. The position of the cursor is shown on the top-left of the screen. The X axis shows time in 1/10 sec and the Y axis indicates values in counts.

The graph can be scrolled using the scroll bar at the bottom of the graph.

Use the mouse to zoom in the chromatogram. Left click and hold the mouse button while moving the mouse to zoom in the region you want to observe. Press the **Undo Zoom (F8)** button to display the original chromatogram.

The **Detector No** edit box will be enabled if there is more than one conditioning board fitted. A real time chromatogram does not identify the conditioning board, it shows one line on the graph. A trending chromatogram will display each conditioning board in the **DIAGNOSTIC-TRENDING** menu in a different colour. In this case, the **Gain**, the **Scale Factor**, and the **Polarity** edit boxes will be displayed. These boxes display the data that was active at a precise time in relation with the cursor; by moving the cursor, the data changes.

1) **Set times as start/end (F4)**

   Use the **Set times as start/end (F4)** button to directly modify the peak data. The times specified in the edit control for each position will be automatically reported in the **Start** and **End** cells of the Peak data grid in the **CONFIGURATION-CYCLE** menu for the peak selected after having pushed the **Set times as start/end (F4)** button. To change the time for each position, move the cursor to the desire position on the graph and click on the corresponding button, either **Set Position #1 (F2)** or **Set Position #2 (F3).** The difference between both positions (delta) is automatically calculated.

2) **Detector No (F5)**

   The **Detector No (F5)** button is enabled only when a trending is loaded. It will move the cursor on the graph for the corresponding detector.

3) **Load (F6)**

   To change the chromatogram, use the **Load (F6)** button.

4) **Delete (F7)**

   Delete a chromatogram using the **Delete (F7)** button.

5) **Export**

   Export a chromatogram to the USB stick using the **Export** button.

Push Button	Hot key	Functions
Set Position #1	F2	Set time and counts for the position #1
Set Position #2	F3	Set time and counts for the position #2
Undo Zoom	F8	Resizes the trending to the normal size.
Delete	F7	Removes a trending from the memory.
Load	F6	Opens and displays a trending file saved in memory.
Set times as start/end	F4	Changes the starting and the ending of the peak you select with the values of time specified by the cursors positions.
Print	Alt-F2	Prints the screen.
Export		Exports chromatogram to the USB stick
Detector No	F5	Move the cursor on the graph for the corresponding detector.

Table 18 : Diagnostic Analyse Chromatogram menu

3.5.3 Trending

Press CTRL-T or click on Diagnostic on the menu bar and then on Trending to reach the DIAGNOSTIC-TRENDING menu (**Figure 17**).

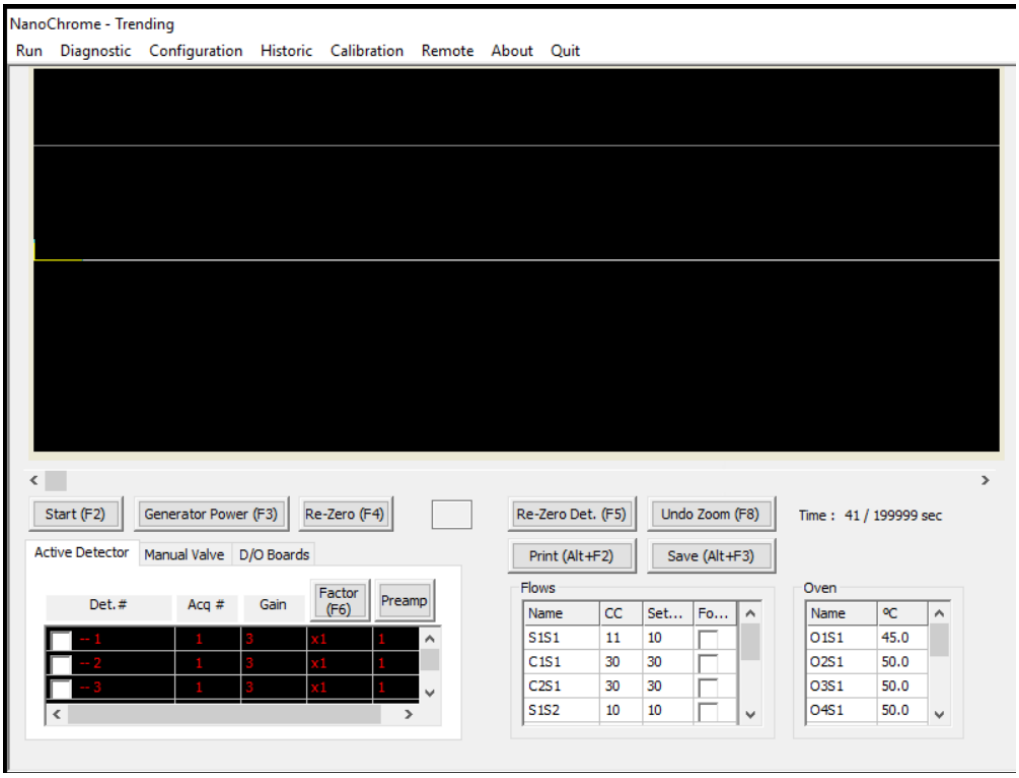


Figure 17 : Diagnostic - Trending menu

Push Button	Hot key	Functions
Start/Stop	F2	Start and Stop a trending
Generator Power	F3	Set the generator power for the detector.
Re-Zero	F4	Executes a Zero.
Re-Zero Det.	F5	Change the detector to make the zero.
Print	Alt-F2	Print the graph
Save	Alt-F3	Save the trending
Undo Zoom	F8	Restore the zoom to the original trending

Table 19 : Trending menu – summary of functions

The trending menu is used to find peaks and select the proper settings for each peak, such as peak starting and ending times, gain, generator power and frequency. These values must then be entered in the peak data table.

Before starting a trending, ensure all parameters set in the **CONFIGURATION-SYSTEM** menu, such as sample flow, carrier flow, oven temperature have stabilised. It is important that the gain, the detectors and the generator power are configured correctly. These parameters can be changed during the trending process.

1) **Start (F2)**
   Press the **Start (F2)** button to start a trending. To stop a trending, press the same button which is now showing **Stop** instead of **Start**.

2) **Generator Power (F3)**
   Change the generator power by pressing **Generator Power (F3)** button. A Pop-Up will ask for a value between 0 and 100% for each generator in the analyser.

3) **Re-Zero**

   The edit box control beside the **Re-Zero (F4)** button shows the selected detector. To change the detector, press the **Re-Zero Det. (F5)** button. To make a Re-Zero, click on **Re-Zero (F4)** button.

4) **Undo Zoom (F8)**

   The trending can be zoomed using the mouse. Press the mouse left button and hold while moving the mouse. A rectangle appears on the screen to identify the zone to zoom. Release the left button to apply the zoom. Press the **Undo Zoom (F8)** button to show the original trending without any zoom.

5) **Manual valve tab**

If a box in the Follow? **column is checked, the configured valve timing will be activated for that valve (see).**

If the box in the **Follow?** column is unchecked, the valve can be manually turned on and off using the combo box located in the **State** column. The valve table showing the timings for a valve to turn ON or OFF can be accessed using the **CONFIGURATION-CYCLE-VALVES** menu.

6) Active Detector tab

When the Active Detector tab of the left-bottom grid is selected, all configurations for each detector are shown (see Figure 17).

In the **Det. #** column, select the detector to trend on the graph. A check box marked means that the detector will be trended.

The **Acq #** column indicates the conditioning board associated with the detector.

The **Gain** column shows the actual gain for this conditioning board. Adjust the gain by changing the value in the grid.

The **Gain Factor** column indicates the Range Factor presently used. Change it using the **Gain Factor (F6)** button. Select just one cell in the row for the desired conditioning board and select any detector row associated with that conditioning board.

Preamplification of detector signal will alter the detector voltage. The **Preamp** column indicates the pre-amplification used on the detector gain. Change it using the **Preamp** button.

7) D/O Boards tab

The **D/O Boards** tab is not used.

3.5.4 Advanced Diagnostic

Clicking Diagnostic **on the menu bar and then** Advanced Diagnostic **to access the** DIAGNOSTIC-ADVANCED DIAGNOSTIC **menu** see (**Figure 18**)
This menu is used to trigger different components of the analyser.

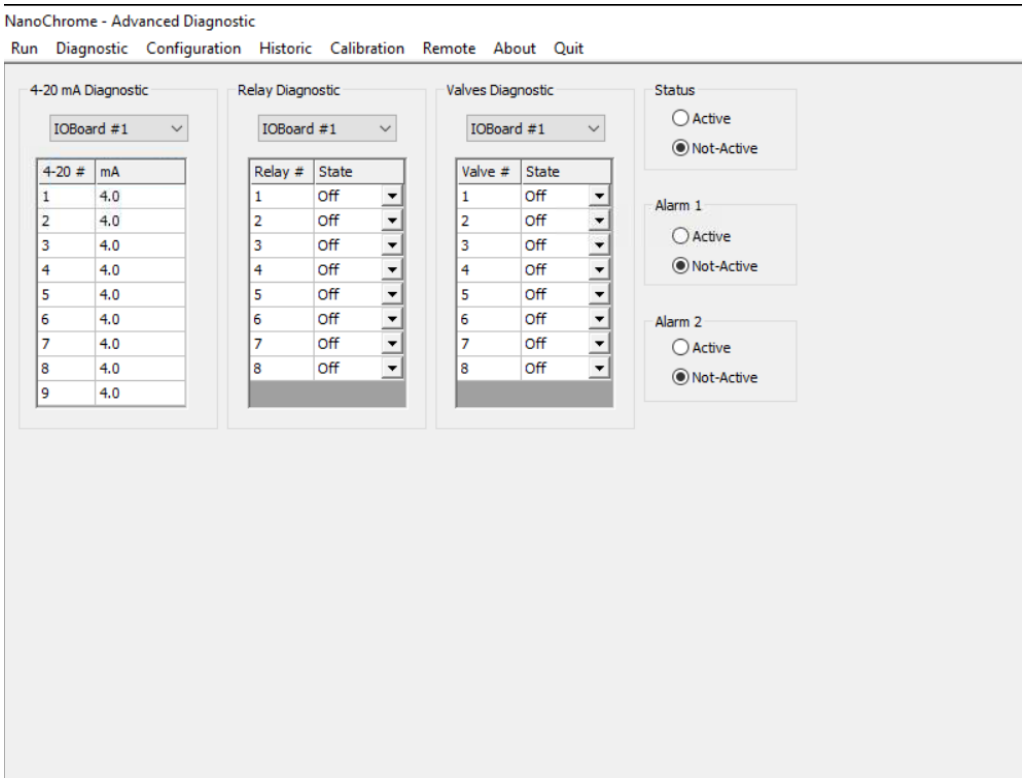


Figure 18 : Diagnostic - Advanced Diagnostic menu

1) 4-20 mA Diagnostic

This combo box is used to manually control the 4-20 mA analogue outputs.

First select the board to diagnose by using the combo box just under the title "4-20mA Diagnostic". Enter a value in the grid from 4 to 20 for the corresponding 4-20 mA # and press **ENTER**. The analogue output will be set to this value and will stay at this value until it is changed from this menu or by normal operations from outside this menu.

2) Relay Diagnostic

This combo box is used to confirm the Range relays on the I/O Boards are working properly. Select the I/O Board to diagnose by using the combo box just under the title "Relay Diagnostic". Use the combo box in the state column of the grid to switch the relay ON or OFF depending on the configuration in **CONFIGURATION-ADVANCED CONFIGURATION** menu. To apply a change, press **ENTER** on the keypad or perform a mouse click outside the combo box.

3) Valves Diagnostic

This combo box is used to confirm the valves on the I/O Boards are working properly. First select the I/O Board to diagnose by using the combo box just under the title "Valves Diagnostic". Use the combo box in the state column of the grid to switch the valve ON or OFF. The value is applied after an **ENTER** on the keypad or when a mouse click is performed outside the combo box.

4) Status, Alarm 1 and Alarm 2

These group boxes let you change the state of the corresponding relays of Alarm and Status for a short period of time. If the analyser processes a new alarm or error, these relays will return to their normal state after a short moment even if you have triggered a different state. By default, these relays are on the first I/O board.

3.6 Configuration Menu

3.6.1 System

Press **CTRL-S** or click **Configuration** on the menu bar and then **System** to access the **CONFIGURATION-SYSTEM** menu (**Figure 19**). The **System** menu allows adjustment of several key parameters.

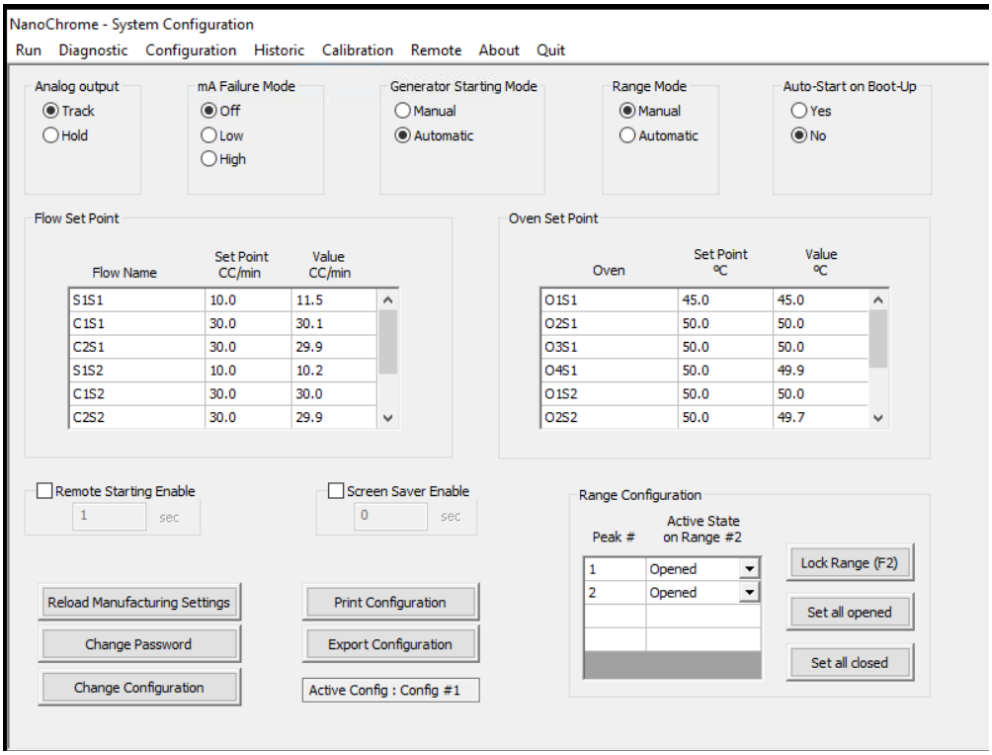


Figure 19 : Configuration - System menu

1) <u>Analog output</u>

Two modes are available. The **Hold** mode maintains the 4-20 mA outputs even if a new cycle is started. The **Track** mode ensures analogue outputs always track input gas values.

2) <u>mA Failure Mode</u>

In the case of a system status alarm, this control sets <u>all</u> the 4-20 mA outputs below 4mA if **LOW** is selected and higher than 20 mA if **HIGH** is selected. Selecting **OFF** will disable this function and the 4-20 mA outputs reflect signal values as in normal operation.

3) Generator Starting Mode

• **Manual:** the automatic re-start feature is disabled and any plasma power value between 0 and 100% may be entered. It is useful for troubleshooting or when re-configuring the system.

• **Automatic:** when the cell raw counts are lower than the cell **Plasma starting count** value, a higher power will be applied to the cell to restart the plasma.

NOTE: The system checks if the plasma is OFF between cycles.

4) Range Mode

Manual: you may change range manually.

Automatic: changes the range according to the result of the previous peak integration. If the result of peak integration gives a value higher than 99% of the range presently used, the analyser switches to the next higher range. The next integration gives the proper result. If the result of a peak is lower than 90% of the lower range currently set, the analyser switches to this lower range.

As this process is independent for each peak, in Automatic ranging the second peak range can stay the same even if the first peak changes range.

5) Auto-Start on Boot-Up

When set to **Yes**, will try to start a cycle (or several cycles if the **Injection mode** has been set to **Automatic**) on the analyser boot-up after all the alarms are resolved.

6) Flow Set Point

Indicates the flows and the set point for each flow. The flow is controlled by an autonomous electronic Pressure Regulator Board.

DO NOT CHANGE THESE SETTINGS: they are factory configured.

This value is used by the flow control loop. In the third column of the Flow Set Point grid, the real flow is displayed. There may be a delay after a new set point is entered before the real flow is displayed and stabilized to the specified set point. Change the set point by adjusting the value in the second column for the

corresponding flow. The range of the values that can be set corresponds to the range of the associated flow sensor table (see **CONFIGURATION-FLOW** menu).

7) Oven set point

Defines the oven temperature in degrees Celsius and is used by the oven temperature control loop. The real temperature of the oven is displayed in the third column of the Oven Set Point grid. To change the set point, change the value in the second column for the corresponding oven. Be aware that the desired set point can take several minutes to be reached and stabilised.

Minimum	0
Maximum	300
Resolution	1
Regen temp	200

Table 20 : Oven set point

DO NOT CHANGE THESE SETTINGS: they are factory configured.

8) Remote Starting Enable

When the box is checked, a cycle can be started by the digital input #1. The edit box specifies the time that elapsed before the cycle starts after the digital input #1 is activated. When the 24 Volts is applied to the digital input #1, the remote starting countdown starts (it can be viewed in the **RUN-REAL TIME CHROMATOGRAM** menu). Remove the voltage when the countdown reaches 0 to start a cycle, or else the countdown will restart.

9) Screen Saver Enable

When this check box is checked, the screen saver is enabled. The edit box specifies the time that will elapse before the screen is powered off. By moving the mouse or pressing a key, the screen will power on.

10) Reload Manufacturer setting:

To return settings to the analyser factory configuration, click on this button. Before using this function, please call Servomex for more information.

11) Range Configuration

This is used to configure the relays on the I/O Board for the Peak Ranges. Change the value of the combo box for the corresponding peak to change its state when range 2 is active.

Use the **Lock Range** button to Lock or Unlock the analyser ranges. Press the **Lock Range** button to lock the range until the same button is pressed again (the name label on the button will change). *The Lock Range function will be ignored if the analyser is in auto-ranging mode.* Locking the ranges will disable the range button in the **RUN-REAL TIME CHROMATOGRAM** menu so that the ranges cannot be changed even if manual ranging is ON.

12) Print configuration

This button is used to print the system configuration. For analysers with multiple configurations, this function will only print the current system configuration.

13) Change Password

This button is used to set a new password for the SERVOPRO NanoChrome. This password is used to quit the software or to access the **CONFIGURATION-ADVANCED MENU**.

The default the general password for the analyser is its serial number. Click on this button to change the password. A dialog window will request the current password and will require the new password to be entered twice.

14) Export Configuration

This button is used to export the configuration for the analyser onto a USB memory stick that is inserted in the USB drive on the analyser. This generates a backup of the configuration file.

15) Change Configuration

If the analyser is supplied with multiple configurations to operate in different background gases, the active configuration can be changed by clicking the "**Change configuration**" button. Changing the active configuration will upload all the parameters according to the new selected configuration.

16) Oven Regen

This Feature is used by to test the ovens at different temperatures during production testing.

3.6.2 PID – Proportional Integral Derivative

Click on CONFIGURATION on the menu bar and then on PID to access the CONFIGURATION-PID menu (see Figure 20).

This menu allows changes to the PID settings for flows and ovens. ***Be sure to save the current settings before changing Oven # and Flow #.***

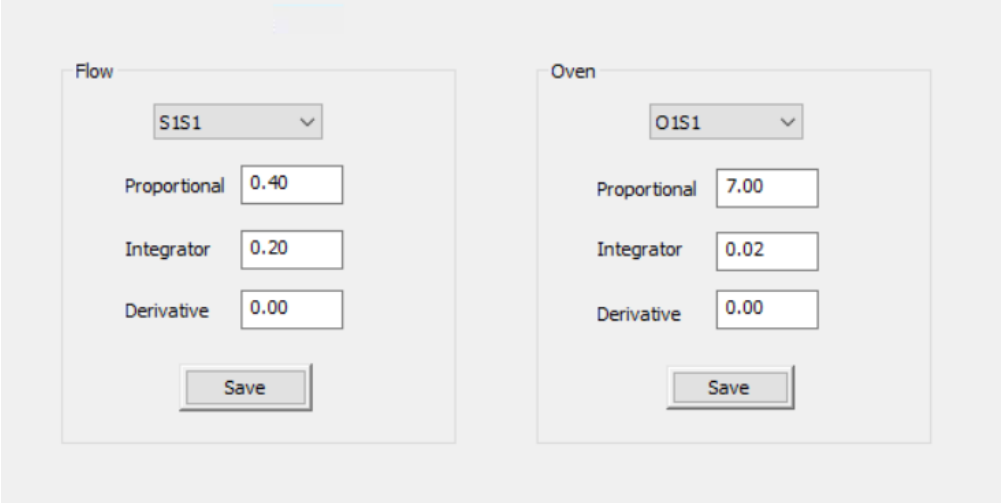


Figure 20 : Configuration-PID menu

DO NOT CHANGE THESE SETTINGS: they are factory configured.

3.6.3 Flow

Click on **CONFIGURATION** on the menu bar and then on **Flow** to access the **CONFIGURATION-FLOW** menu (see Figure 21).

This menu contains the flow sensor table set up during the factory configuration. The information on this table may be useful when servicing the analyser.

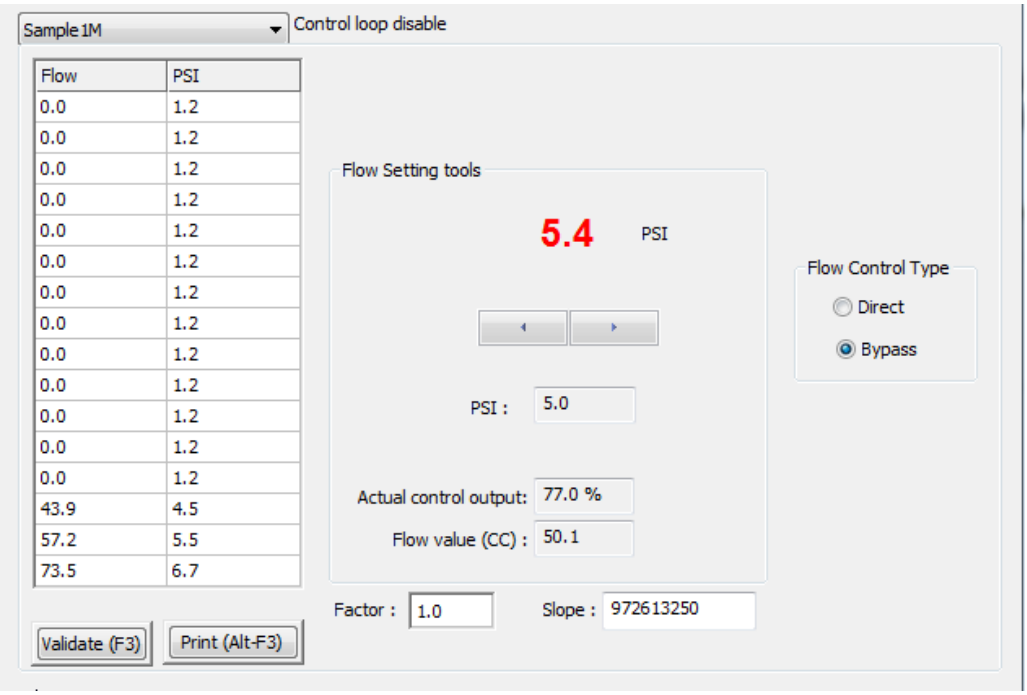


Figure 21 :Configuration-Flow menu

DO NOT CHANGE THESE SETTINGS: they are factory configured.

3.6.4 Cycle

Click on **Configuration** on the menu bar and then on **Cycle** to access the **CONFIGURATION-CYCLE** menu (see Figure 22).

This menu contains the essential system information when a cycle (Real time chromatogram) is in progress.

1) <u>General (Cycle Data and 4-20 mA Peak Association):</u>

This menu is used to set the duration of the cycle (length of one chromatogram) and the duration displayed in the **REAL-TIME CHROMATOGRAM** menu. It is also used to assign a peak to a specific 4-20 mA output.

DO NOT CHANGE THESE SETTINGS: they are factory configured.

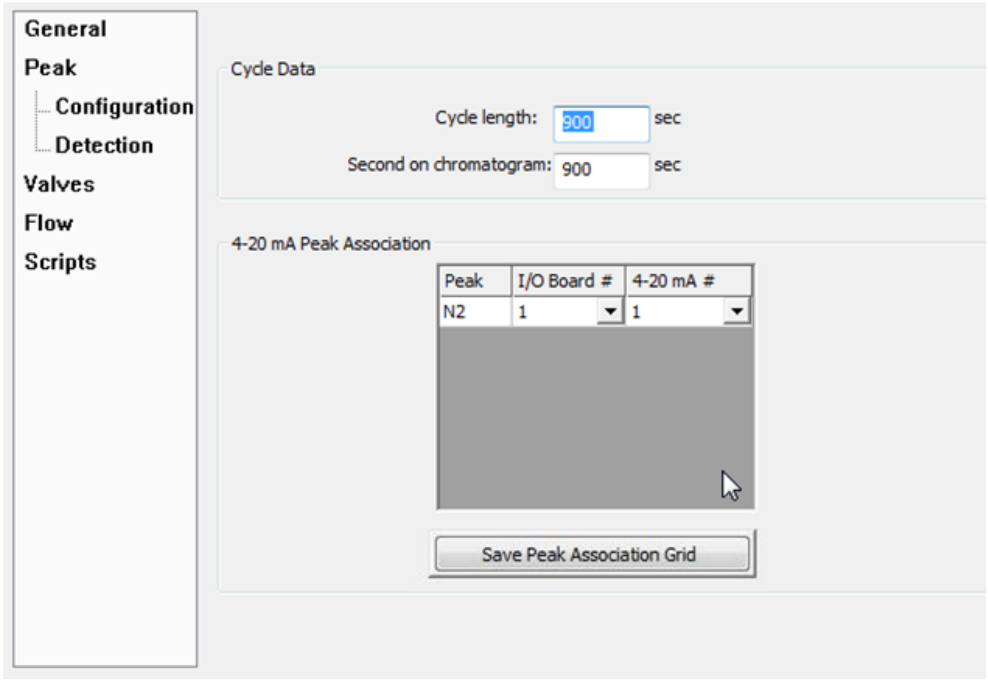


Figure 22 : Configuration-Cycle menu

2) Peak - Configuration:

The data found in this menu is used during an analysis (see Figure 23. The system parameters change in real time according to each peak configuration.

The grid at the top of this menu shows general information (see Table 21 : Peak Configuration Columns).

Additional information about the peak currently highlighted in the grid is shown in the area below the grid (see Table 22 : Peak Data).

The available Functions for the Peak Configuration menu are shown in Table 23 : Peak Configuration Menu.

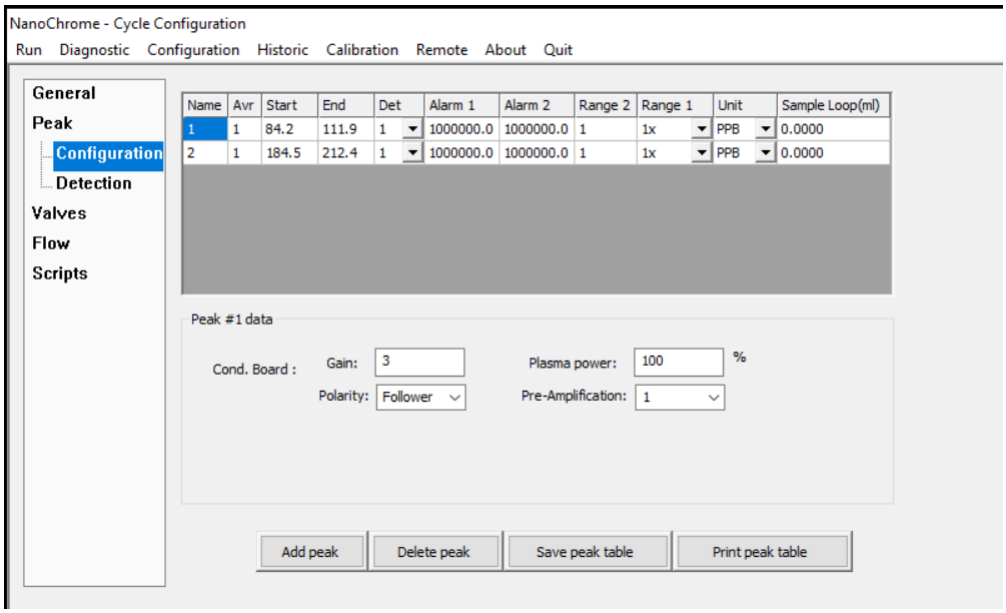


Figure 23 : Cycle-Peak Configuration menu

DO NOT CHANGE THESE SETTINGS: they are factory configured.

Column	Explanation
Name	Name of the peak
Avr	Average that can be used to calculate the impurity value of the peak. An average of 1 disables the feature.
Start	The Starting time of a peak.
End	The Ending time of a peak.
Det.	The detector number used to trend the peak. Refer to the **CONFIGURATION-ADVANCED** menu for the detector number association.
Alarm 1	When the peak exceeds this value, the Alarm 1 will be activated.
Alarm 2	When the peak exceeds this value, the Alarm 2 will be activated.
Range 2	Range 2 value is the maximum full scale of the analyser.
Range 1	Shows the factor selected to re-scale Range 2 to the (lower) Range 1.
Unit	Unit of the peak (PPM, PPB or %)
Sample loop	Volume of sample introduced in ccs (ml)

Table 21 : Peak Configuration Columns

Polarity	The polarity: Follower or Inverter.
Gain	The peak gain.
Plasma/generator Pwr	Detector Generator Power used for the corresponding peak.
Pre-Amp	Shows the stage of the Pre-Amp for the corresponding peak.

Table 22 : Peak Data

Push Button	Hot key	Functions
Add Peak	F2	Add a peak to the grid
Delete selected peak	F3	Delete the peak selected in the grid.
Save peak table	F4	Save the peak grid
Print Peak Table	Alt-F2	Print the peak grid
Peak Detection Cfg.	None	Brings the Peak Detection Configuration Menu

Table 23 : Peak Configuration Menu

3) Peak - Detection

This menu is used for factory configuration of constants that are used in the peak detection (see Figure 24). The key parameters in this menu are described below, for information only.

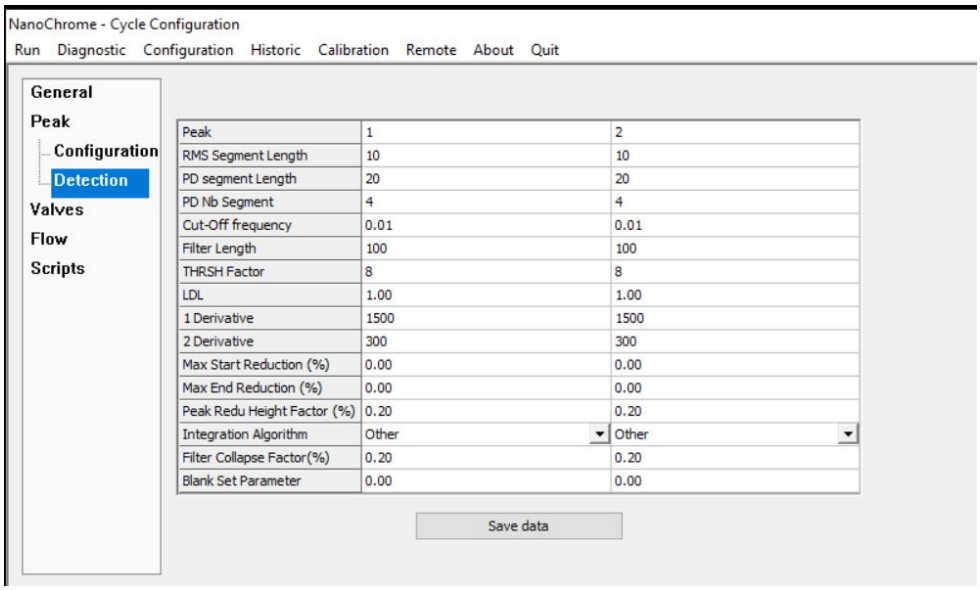


Figure 24 : Peak Detection configuration menu

DO NOT CHANGE THESE SETTINGS: they are factory configured.

Integration algorithm:
The peak detection method applies one of these integration types - Gaussian, Bi-Gaussian or Other, this is factory determined do not change.

Peak window reduction:
The system repeatability may be improved by reducing the integration window as a function of height, which in turn reduces the integrated baseline noise. Figure 25 shows the principle used for the peak window reduction; the three parameters that are configured are:

(1) peak reduction (height) factor
(2) max start reduction
(3) max end reduction.

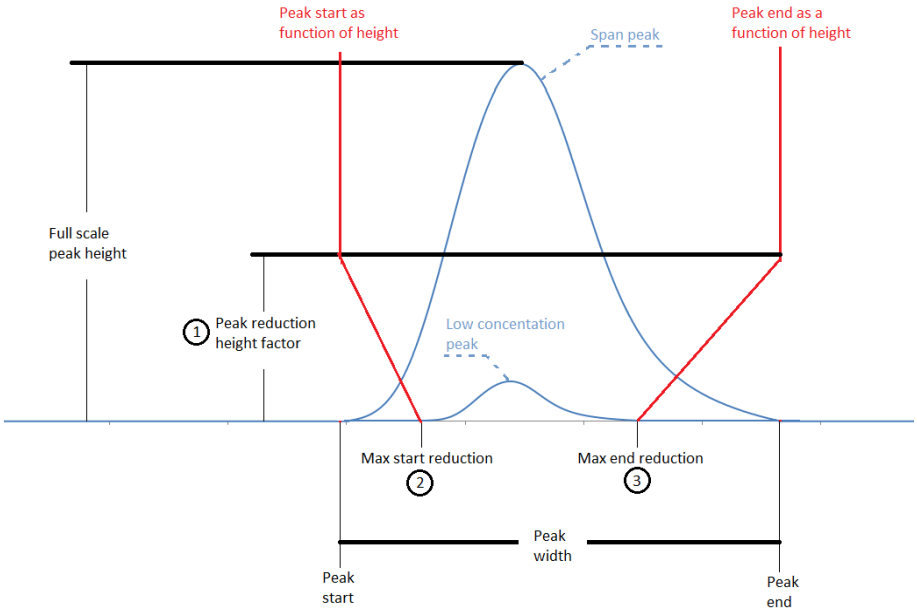


Figure 25 : Peak window reduction

The **peak reduction (height) factor** is the height at which the software starts to reduce the window. Above this factor, the software uses the full-scale peak width. For example, for a 1000 ppb full-scale range, a factor of 10% reduces the window only when the peak is below 100 ppb. Above 100 ppb, the full-scale peak width is used for integration.

The **maximum (peak) start reduction factor** and **maximum (peak) end reduction factor** are expressed as a percentage of the peak full-scale width. For example, if a peak has a full-scale width of 150 seconds, a reduction of 10% means 15 seconds maximum reduction. These parameters are determined by injecting a low concentration which is near the limit of quantification, typically 5% of the range or 3 times above the limit of detection (LOD).

The peak start and peak end of the low concentration peak in Figure 25 are determined and used to configure the **max start reduction factor** and **max end reduction factor**. If the **max start reduction factor** has been set to 15% and the **max end reduction factor** has been set to 30%., then at the maximum, the total window is reduced by 45%.

Yellow integrated peak: If a peak is detected, the filtered peak it appears as in yellow peak in the real-time menu. The raw signal is shown as a red peak.

Report software: Only the raw chromatogram is sent to the Report Software.

Filter Collapse:
The **filter collapse** threshold is used to reset the filter and improve response time. The parameter is a percentage of the analyser range. For example, if the parameter is set to 1% for a range of 1000 ppb, the filter will reset if two consecutive unfiltered peaks have a difference of more than 10 ppb.

Blank Set Parameters:
The **Blank Set Parameter** is used to correct for baseline integration on blank (zero gas) in order to provide a more accurate measurement at low concentration.

4) Valve data

Figure 26 Shows the group box that is used to control the valve state. Each row in the grid indicates a sequence for the selected valve. The timings for valve ON (open) or OFF (close) are set during factory configuration.

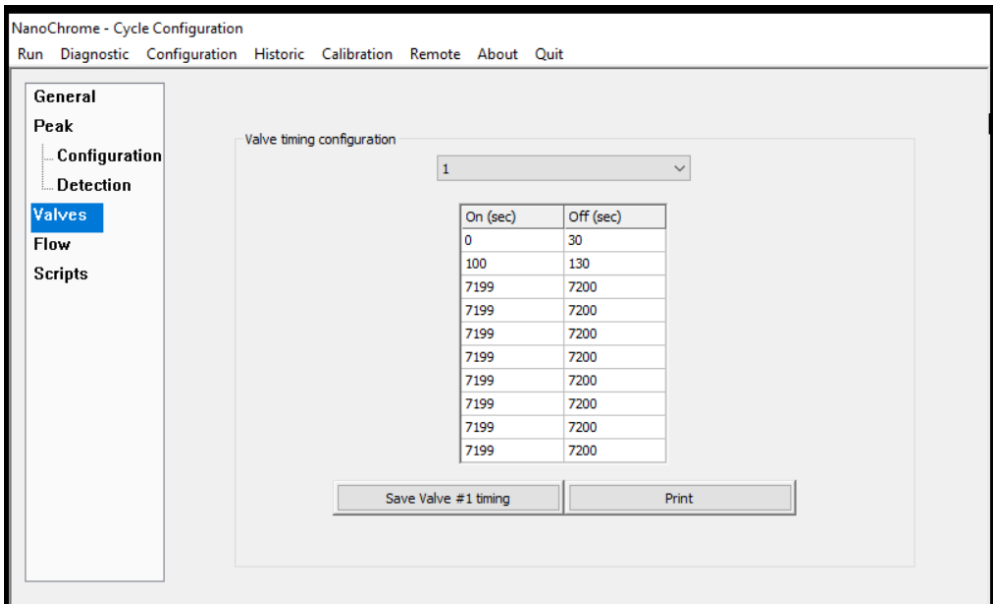


Figure 26 : Valve configuration menu

DO NOT CHANGE THESE SETTINGS: they are factory configured.

5) Flow

The group box in

Figure 27 is used to configure the Flow timing table, which is used to change a flow set point during a cycle.

A time of 7200 secs means that this point is not in use. In the example shown in
Figure 27 the set point is 30 cc/min at the beginning of the cycle and will not change during the cycle because the other timings are set to 7200 secs.

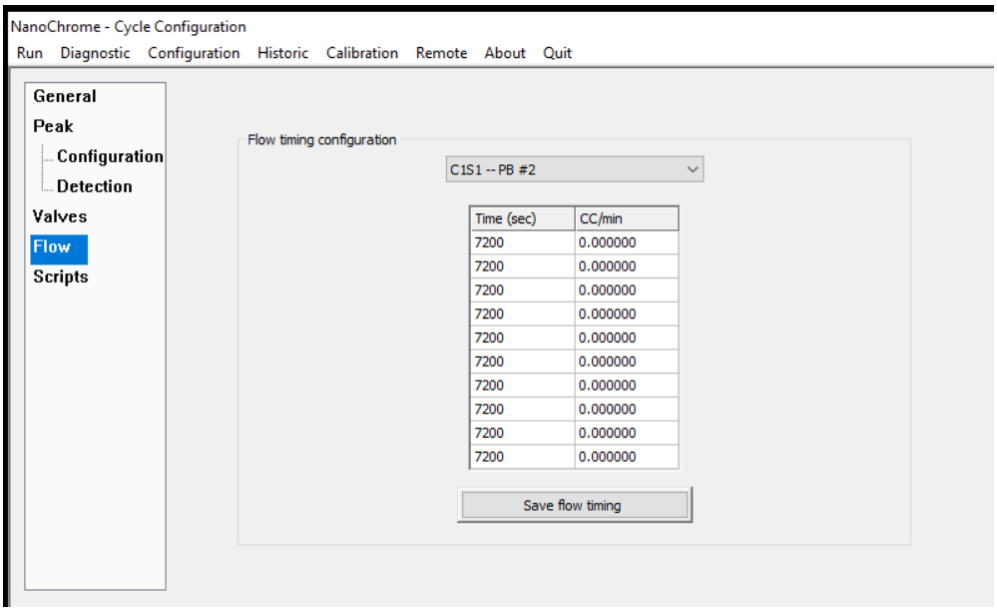


Figure 27 : Flow timing configuration menu

3.6.5 Date & Time

Click on **Configuration** on the menu bar and then on **Date & Time** to access the **CONFIGURATION-DATE & TIME** menu (see Figure 28).

Use the combo box control to change the value of the date and the time. Click on **Apply** to set the desired value.

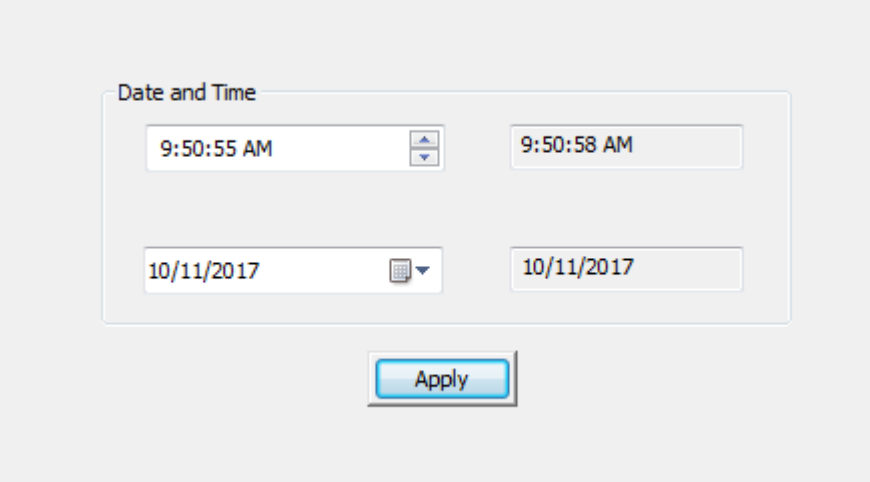


Figure 28 : Date & Time menu

3.6.6 Advanced Configuration

The Advanced Configuration is a key resource for service technicians, and the menu defines the configuration of the hardware components built into the analyser.

DO NOT CHANGE THESE SETTINGS: they are factory configured.

Access to the **Advanced Configuration** menu requires entry of a password. The default password is the serial number of the analyser, and can be changed in the **CONFIGURATION-SYSTEM CONFIGURATION** menu.

Contact Servomex before changing any parameter shown in this menu.

1) General

The General menu shows the entries for electronic boards, components and functionalities (see Figure 29).

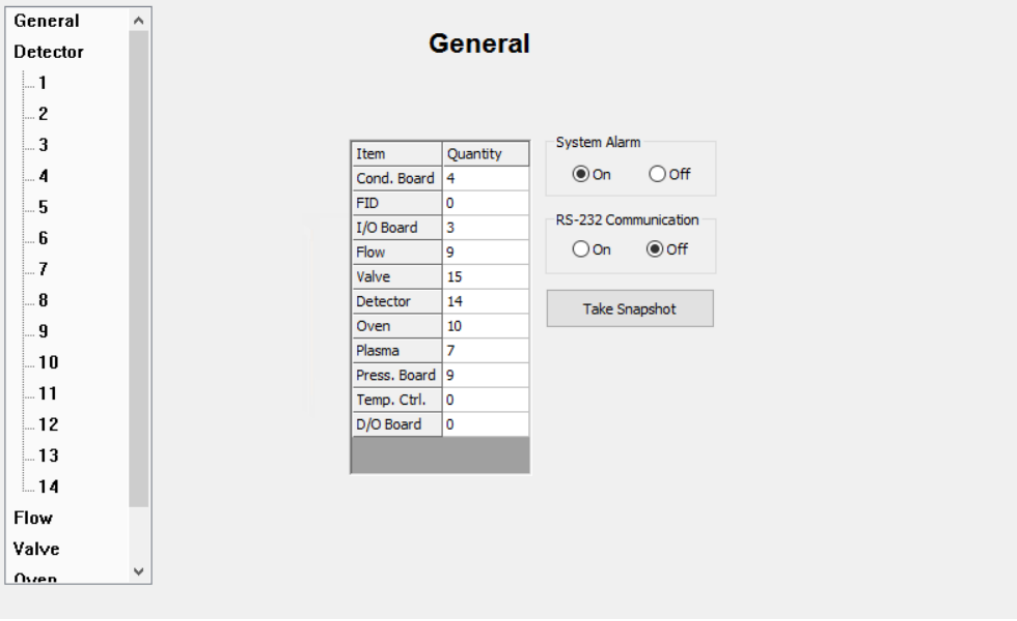


Figure 29 : Advanced configuration – General menu

The menu allows alarm and error monitoring to be turned off. This may be useful when a service technician needs to work with the analyser even if, for example, a flow is too low for correct operation.

NOTE: Turning off System Alarm can be dangerous. For example, when working with Hydrogen, the analyser will stop advising of problems.

The menu allows the RS232 communication can be turned ON and OFF if this option has been supplied.

DO NOT CHANGE THESE SETTINGS: they are factory configured.

Use the **Take Snapshot** button to capture images to help Servomex diagnose a problem in the analyser. Use this button only under supervision from Servomex.

2) Detector Association

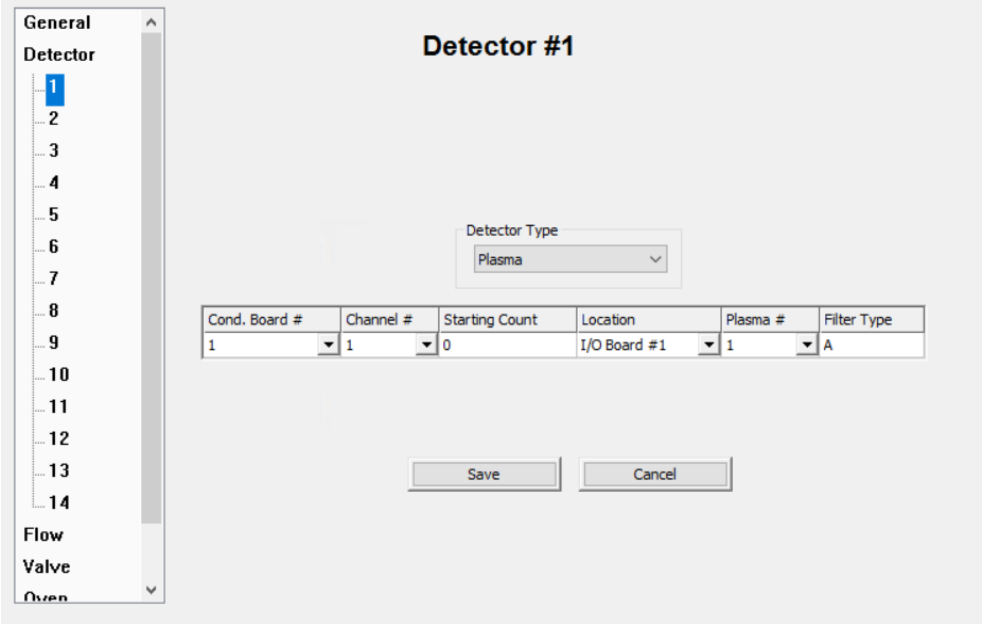


Figure 30 : Advanced configuration-Detector menu

The Detector menu shows each plasma cell, which is configured with a conditioning board selected for the correct channel (see Figure 30).
Each plasma detector is associated to the plasma cell by selecting its location on an I/O board and its number on this I/O board. The plasma detector association is used to process alarms such as Plasma Off, Plasma On and Plasma Starting.

This list includes all detectors, including those contained within any secondary units connected to the master unit or stand-alone PC. An individual conditioning board can process up to 7 detectors.

DO NOT CHANGE THESE SETTINGS: they are factory configured.

3) Flow

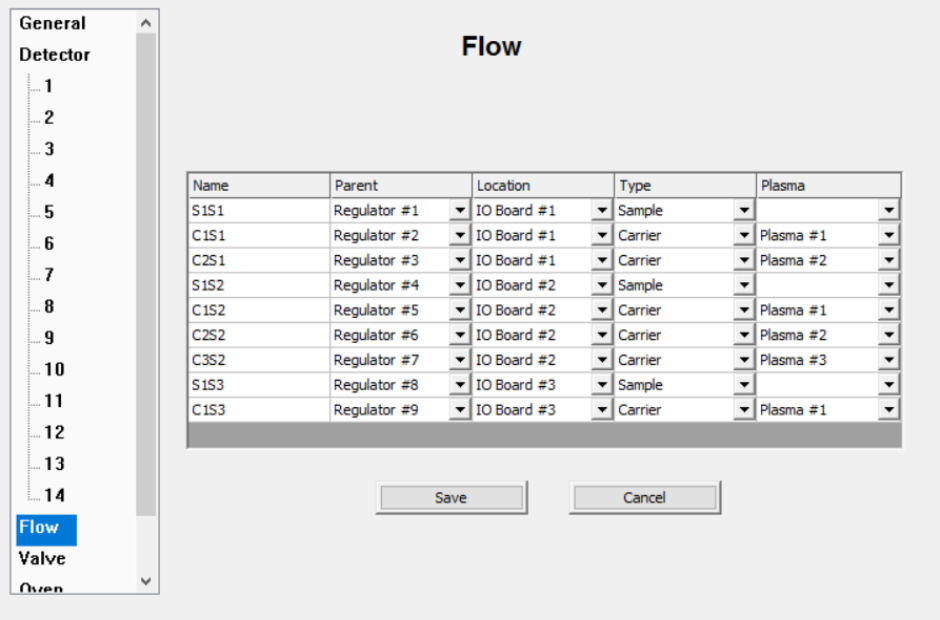


Figure 31 : Advanced configuration-Flow menu

The Flow menu associates a flow with a regulator on an I/O Board and a plasma detector (see Figure 31).
The menu shows the name given to each flow and its location on the appropriate I/O Board, and for a carrier regulator, its association with a plasma detector (used to generate alarms and errors). For sample regulators there is no association with a plasma detector.

DO NOT CHANGE THESE SETTINGS: they are factory configured.

4) Valve

The **Valve** menu associates a valve number to a valve channel on an I/O Board (see **Figure** 32**).**

DO NOT CHANGE THESE SETTINGS: they are factory configured.

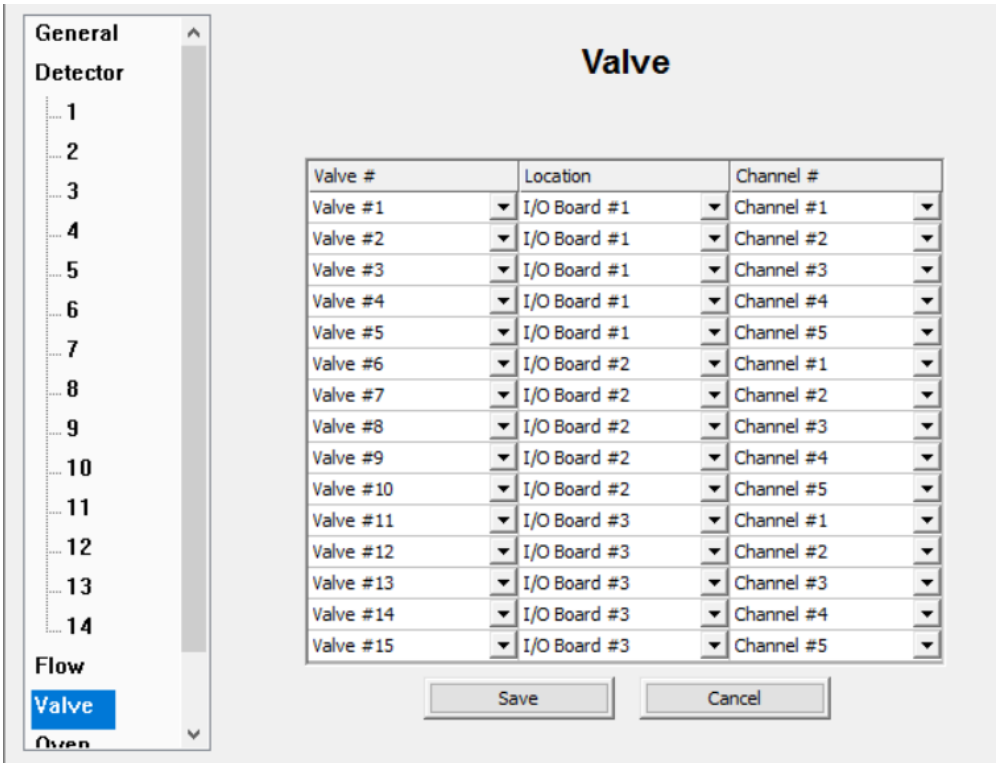


Figure 32 : Advanced configuration-Valve menu

5) Oven

The Oven menu associates an oven with an I/O Board and a channel on the I/O board (see Figure 33).

DO NOT CHANGE THESE SETTINGS: they are factory configured.

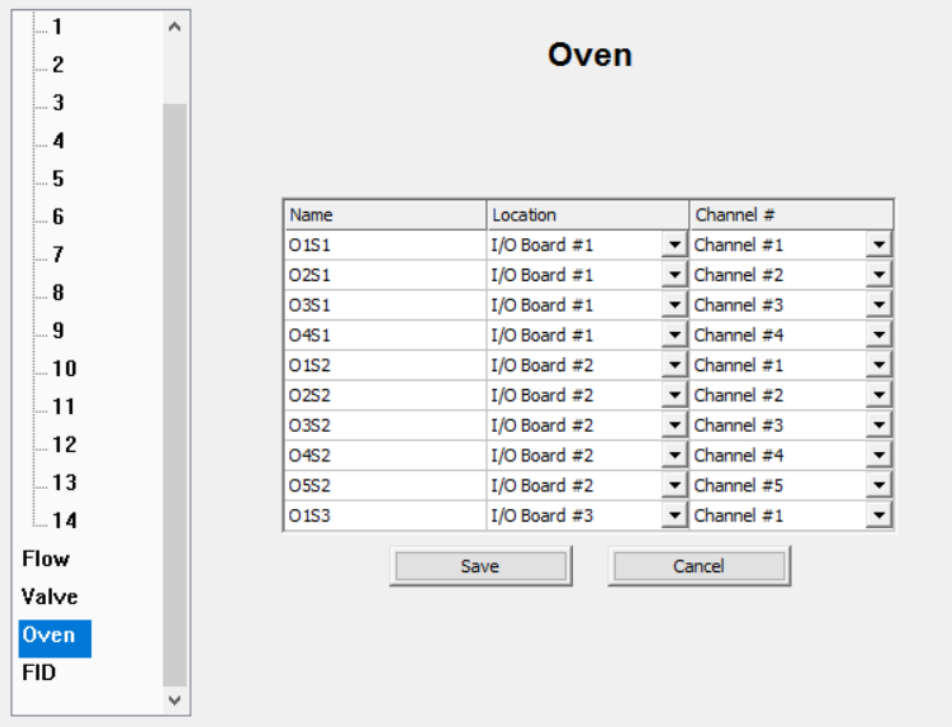


Figure 33 : Advanced configuration - Oven menu

3.6.7 Alarm

Click on **Configuration** on the menu bar and then on **Alarm** to access the **CONFIGURATION-ALARM** menu (Figure 34).

This menu allows configuration of the alarms. The status alarm relay can be closed or opened when a status alarm is activated, by clicking on the relevant radio box button.

To set the active state for the Alarm 1 and Alarm 2 relay on the I/O Board, use the corresponding combo box in the Alarm State grid.

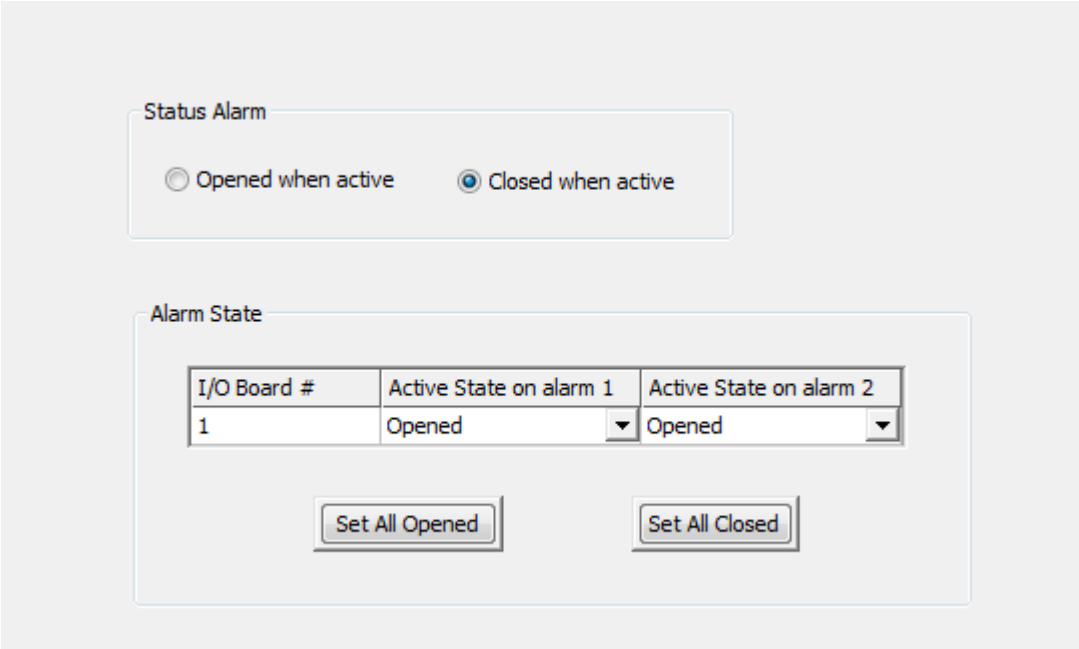


Figure 34 : Configuration-Alarm menu

3.6.8 Printers

Click on **Configuration** on the menu bar and then on Printers to access the **CONFIGURATION-PRINTER** menu (see Figure 35).

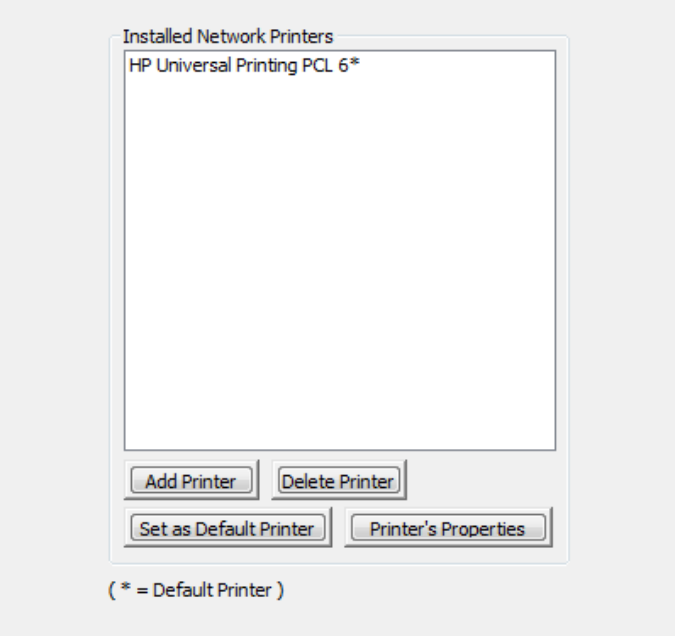


Figure 35 : Configuration-Printer menu

Printers already installed on the analyser will be listed in this menu.

The **Set as default** button determines which printer is used as default for printing.

The **Add Printer** button is used to configure a new printer. Prior to adding a printer, copy the printer driver to a USB stick and insert into the USB port on the front of the analyser. Click on the **Add Printer** button and enter the password, factory configured as the serial number of the analyser. A new dialog wizard window will appear showing a list of available printers. For added security it is recommended to use only network printers. Select the network printer to add, and follow the on-screen instructions to install the printer driver from the USB stick.

To remove a printer, use the **Delete Printer** button.

The printer's properties can be modified with the **Printer's Properties** button.

DO NOT SHARE THE PRINTER: to avoid a security risk.

3.7 Analyser Calibration

Note: It is recommended to calibrate the analyser once a month.

Click on **Calibration** on the menu bar and then select Calibration to access the **CALIBRATION-CALIBRATION** menu (see Figure 36). This menu is used to calibrate the system for the different gases being analysed.

The analyser must be properly started and purged before the execution of a calibration. The calibration procedure consists of the Noise Threshold Calibration followed by the Span Calibration. The 'Analyser Calibration' menu is not designed for real time running. For real time running, run the analyser in 'Realtime' menu and ensure calibration mode is disabled.

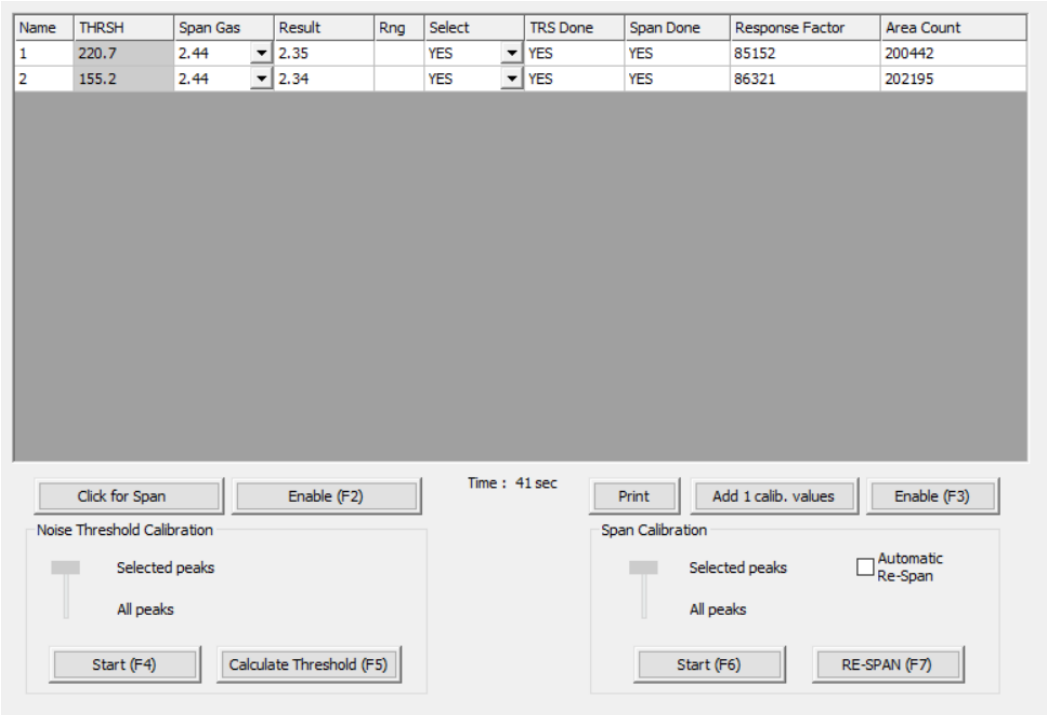


Figure 36 : Calibration-Calibration menu

3.7.1 Noise Threshold (THRSH) Calibration

This calibration step determines the noise level used for the peak detection process. **No injection** will be made as this is a noise baseline on range #1. The highest gain applied is always on this range. When starting the cycle, it will automatically switch to range #1.

The calibration procedure is described below.

1. Check that there is no cycle currently running. Click on **Run-Real Time Chromatogram**, then select the **Manual Injection** option.
2. Click on the **Calibration-Calibration** menu (see Figure 36).
3. Enable the **Noise Threshold Calibration** with the **Enable (F2)** button.
4. Select **Calculate Threshold for All peaks** or **Selected peaks** by changing the corresponding slider state. When **Selected peaks** is selected, only peaks that have a **YES** in the **Select** column of the grid will be considered.
5. Click on **Start (F4)** button to start calibration
6. After one cycle in manual injection has completed, ensuring no peaks present and no baseline drift, press the **Calculate Threshold** button. The RMS value will be shown in the **THRSH** column of the grid.
7. When the **Noise Threshold Calibration** is completed, **YES** is displayed in the **TRS done** column of the grid.
8. Disable the **Noise Threshold Calibration** with the **Disable (F2)** button (one button performs dual functions Enable or Disable, depending on the active mode).

3.7.2 Span Calibration

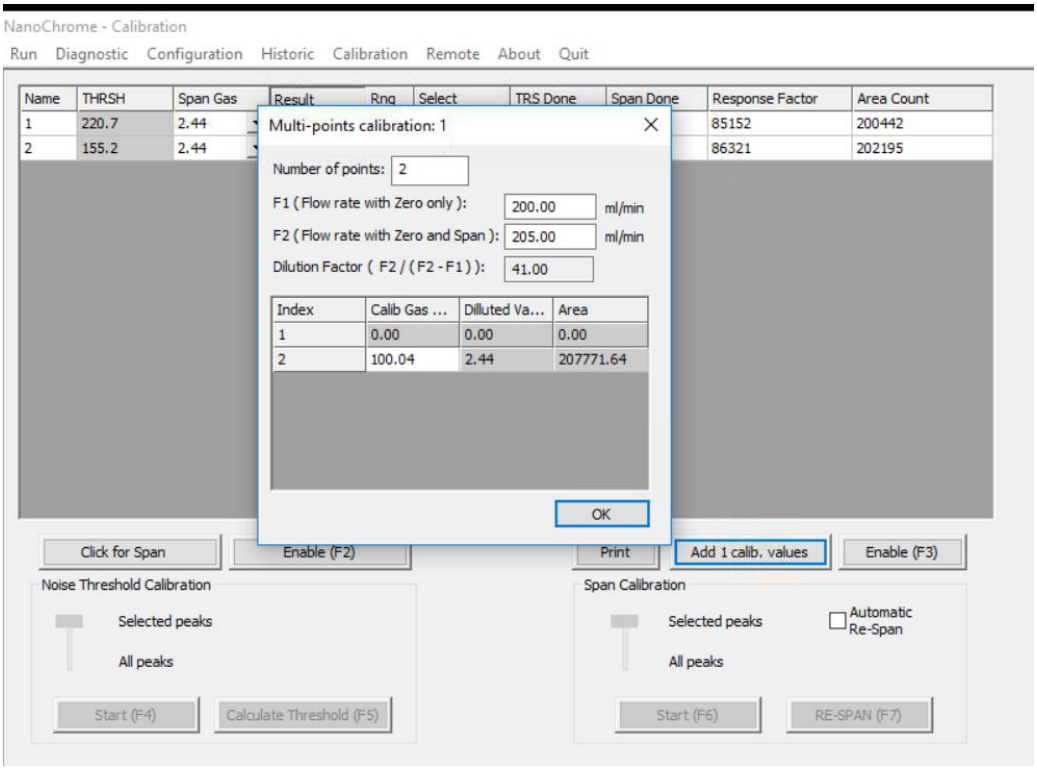


Figure 37 : Calibration-Span menu

The **dilution factor** represents the internal dilution ratio and is set to 1 unless the analyser is fitted with an internal dilution system.

If the analyser is fitted with an internal dilution system:

Sample inlet 1 is used for the process gas, and sample inlet 2 is used for the span gas.

Pressing the **Click for Span** button will select analyser sample inlet 2.

Diluted Value: equals the **Calib Gas Value** column divided by the **dilution factor** (see).

Each chassis in a multiple chassis analyser may be fitted with an internal dilution system and the associated dilution factor can differ depending on the impurity to be analysed. This information is provided with each analyser in the Test Results Sheet (TRS).

Refer to section “Internal dilution system setup” for more information.

The **dilution factor** has to be checked after installation and each time the inlet carrier pressure or span gas pressure is changed.

The calibration procedure is described below.

1. Click on **Run-Real Time Chromatogram**, then select the **Automatic Injection** option.
2. Click on the **Calibration-Calibration** menu (see Figure 36).

Set the calibration gas values for each individual peak:

3. Select a peak **Name** with the mouse.
4. Click on the **Add “*peak name*” calib values** button and a pop-up menu will appear (see Figure 37).
5. Enter **the number of points** that will be used to calibrate the system. A minimum of two points is required: point 0.00 by default and the span value. The **Area** value will be calculated by the analyser.
6. For a chassis fitted with an Internal Dilution System, the values of **F1** (**Flow rate with Zero only**) and **F2** (**Flow rate with Zero and Span**) are set during factory configuration.
7. Select **OK** and the pop-up menu will disappear.
8. For multiple peaks, repeat the above steps for each peak name
9. For each peak to be calibrated, left click on the arrow in the combo box in the **Span Gas** column to update the values

Start the calibration:

10. Enable the **Span Calibration** with the **Enable (F3)** button.
11. In the **Span** column select **Yes** for the peaks that require calibration.
12. Select **All peaks** or **Selected peaks** by changing the slider state. When **Selected peaks** is selected, only peaks that have a **YES** in the **Select** column of the grid will be calibrated.
13. Click on **Start (F6)** button to start calibration.
14. After three cycles with consistent peak values (within 3% FS) press the **RE-SPAN** button to accept the calibration. A pop-up box question will appear **Are you sure you want to re-span?** Select **YES** to accept the calibration. The **Result** column will be updated with the value set in the **Span Gas** column, and the **Response Factor** column will be re-calculated.

15. When the **Span Calibration** is completed, **YES** is displayed in the **Span Done** column of the grid.
16. Repeat the above if there are other peaks to be calibrated.
17. Disable **Span Calibration** with the **Disable (F3)** button (one button performs dual functions Enable or Disable, depending on the active mode).

The value set in the **Calib Gas Value** column must be the impurity value of the calibration gas before the dilution. The software automatically calculates the dilution values based on the dilution factor.

Calibration enabled will be displayed in the **RUN-REAL TIME CHROMATOGRAM** menu. It is recommended to perform the calibration in **Automatic** injection mode. This will ensure better gas equilibrium.

The range configuration cannot be changed when calibration is enabled.

Prior to accepting a calibration, ensure the correct gas is flowing through the analyser and there have been multiple runs to ensure the readings have stabilised.

Calculate Threshold, ReSpan and **Start** buttons are only accessible when calibration is enabled.

Other parameters displayed on the grid are:

Area Count: this is the area that covers the peak in counts (digital converter units). This area is used to generate the concentration displayed in the Result column.

Response factor: this is the area counts divided by the value in the Result column.

Automatic Re-Span: when the box is checked, the analyser automatically performs a re-span after a cycle of calibration reaches an end (the same action as pressing the **Re-Span** button). This means that after pressing the **Start**

button in **Span** calibration, the cycle will start and then end, and the analyser will automatically calculate the value of this calibration using the last measured area counts and displays it in the **Result** column.

3.8 Calibration of the 4-20mA outputs

Click **Calibration** on the menu bar and then **4-20mA outputs** to access the **CALIBRATION-4-20MA OUTPUTS** menu (see Figure 38).

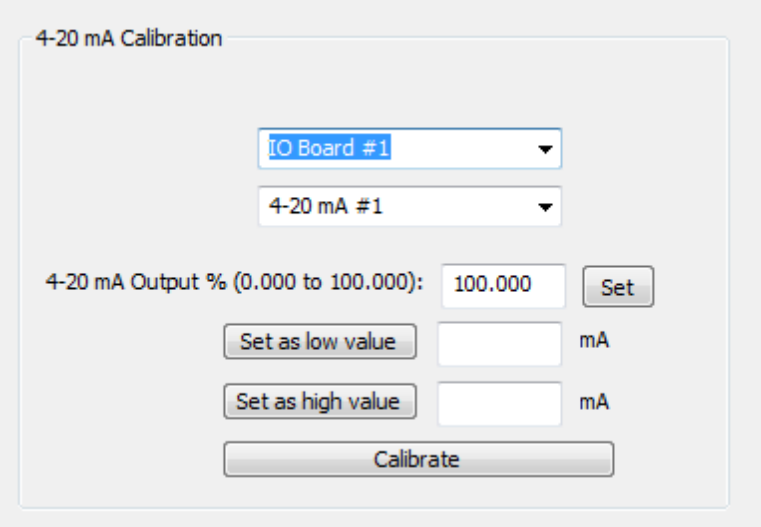


Figure 38 : Calibration-4-20 mA outputs menu

The 4-20mA outputs are factory configured. The setup procedure is shown below, but it is not normally required to be adjusted in the field.

- ► **Step 1**: Select the I/O board. The 4-20mA outputs are normally on the first I/O board for a multiple chassis analyser.
- ► **Step 2**: Select the output to be calibrated
- ► **Step 3**: Connect an ammeter to the corresponding output on the rear panel of the analyser
- ► **Step 4**: Output a value between 0 and 100% (eg 20%) by entering the value in the edit box to the left of the **Set** button, and then click on this button
- ► **Step 5**: Enter the ammeter reading in the edit box to the right of **Set as low value** and press the **Set as low value** button
- ► **Step 6**: Repeat step 4 and step 5 with a value higher than the first (eg 80%) only this time enter the values into the **Set as high value** edit box
- ► **Step 7**: Press on the **Calibrate** button.

3.9 Remote

3.9.1 Report Software

Click on **Remote** on the menu bar and then on **Report Software** to access the **REMOTE-REPORT SOFTWARE** menu (see Figure 39).

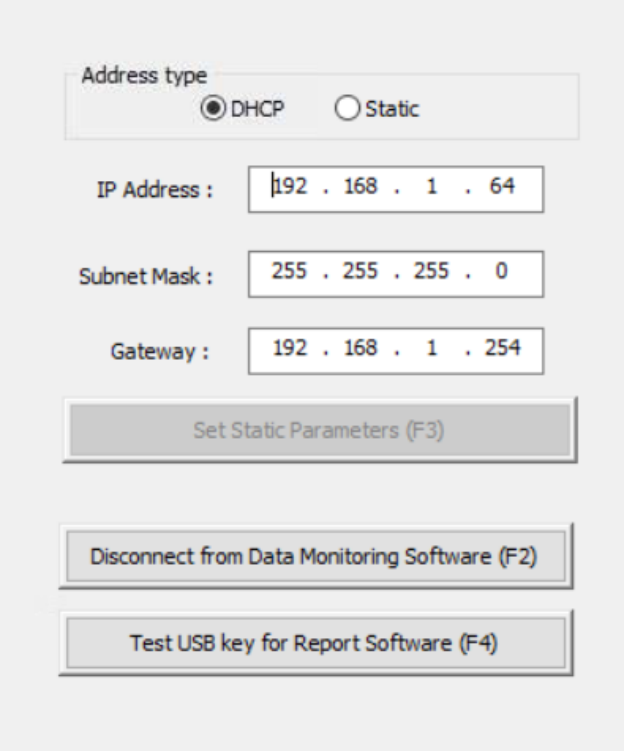


Figure 39 : Remote Software menu

This menu is used to configure the IP address of the analyser required to use the Report Software.

Two types of IP address can be configured: Static or DHCP. A static address is an address that is manually set once, and a DHCP address is an address that is automatically set by a router on the network.

To set a Static IP address, select the Static type, enter the three configuration parameters, then press the **Set Static Parameter (F3)** button.

The **Disconnect from Data Monitoring Software** button is used to close the communication between the analyser and the PC Software.

Note: If the Report Software in the PC is closed, the **Disconnect from Data Monitoring Software** button must be pressed to inform the analyser that the connection is terminated.

The **Test USB key for Report Software** button is used to test the analyser detection of a USB key that can then be used to acquire data for the Report Software.

3.9.2 Remote Control

Click on **Remote** on the menu bar and then on **Remote Control** to access the **REMOTE-REMOTE CONTROL** menu (see Figure 40).

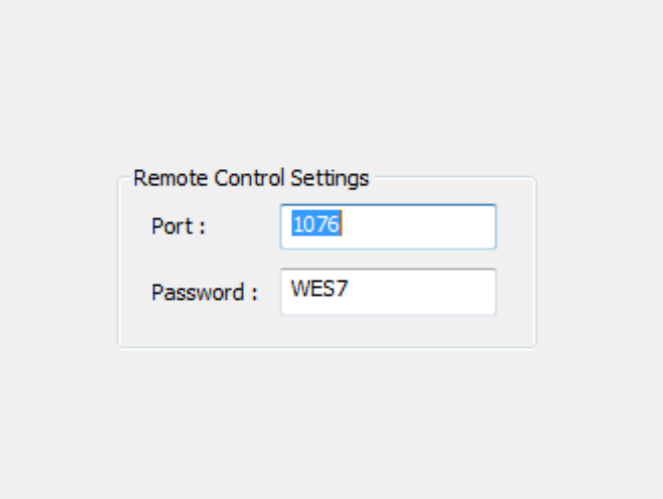


Figure 40 : Remote-Remote control menu

This menu sets the network port number on which the remote control software will communicate with the analyser and the password used for the login connection.

3.10 About

Click on **About** on the menu bar to access the **ABOUT MENU.**

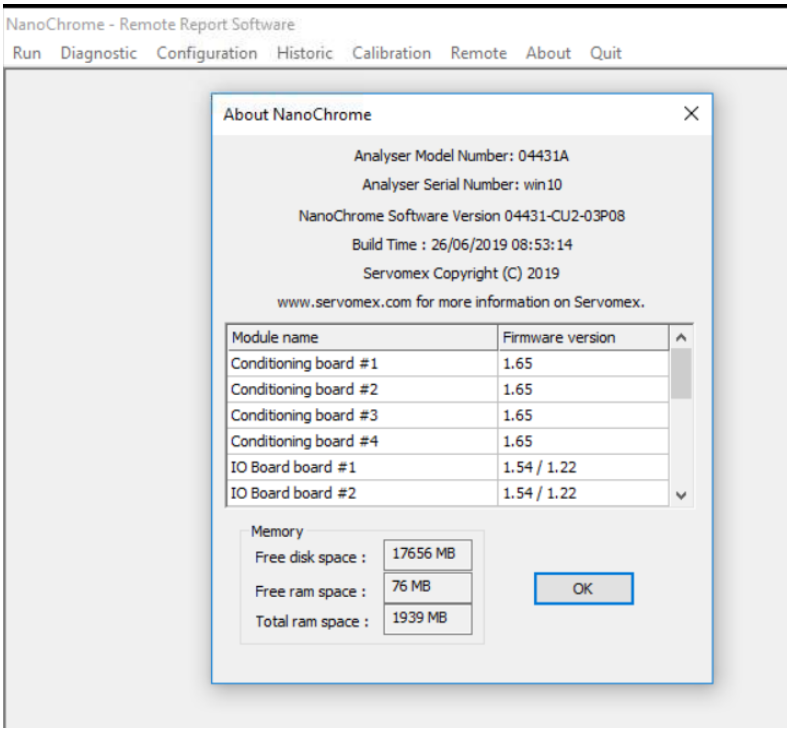


Figure 41 : About menu

This menu shows the software version of the user interface (PC), the firmware versions of the embedded electronic boards and information about the memory usage. This information will be useful when contacting Servomex support.

3.10.1 Chromatogram saving

Storage of chromatograms on the internal hard drive is configured from the **HISTORIC-CHROMATOGRAM** menu. To enable this feature, the check box must be selected. (See Figure 42) and the chromatograms will be saved at the end of each cycle. If not selected, the chromatogram will not be saved.

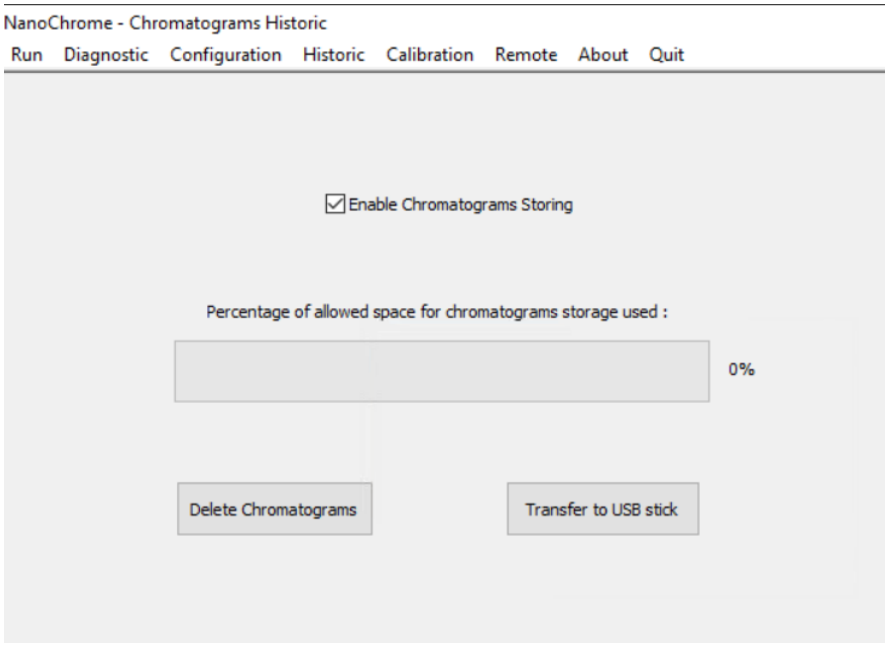


Figure 42 : Historic-Chromatogram saving menu

A space of 500 Mb is configured on the hard drive. This will allow storage of around one month of continuous data, depending on the complexity of the analysis. When the stored data reaches 99% capacity, the new data will over-write the files, starting with the oldest.

To transfer the data, insert a USB key into the port at the front of the analyser and press the **Transfer to USB stick** button. All the stored data will be transferred to the USB key. If the USB key is not detected, an error message will be displayed.

Chromatograms are transferred to a folder on the USB named "chrom_XXXXXX" where XXXXXX is the serial number of the analyser. Copy the folders onto a PC computer and use the import feature of Report Software to import them.

Chromatograms on the hard drive can be deleted by pressing the **Delete** button. This will delete all chromatograms on the hard drive. The progress bar indicates the actual used space on the hard drive.

3.10.2 Cycle Data Logging

Storage of cycle data Logging on the internal hard drive is configured from the **HISTORIC-CYCLE DATA LOGGING** menu. To enable this feature, the check box must be selected (see Figure 46). When selected, cycle data will be saved to a file at the end of each Real Time cycle. If not selected, Real Time cycle data will not be saved to the file. Span Calibration data will always be saved to the file regardless on if Enable Cycle Data Storing in Real Time is selected or not.

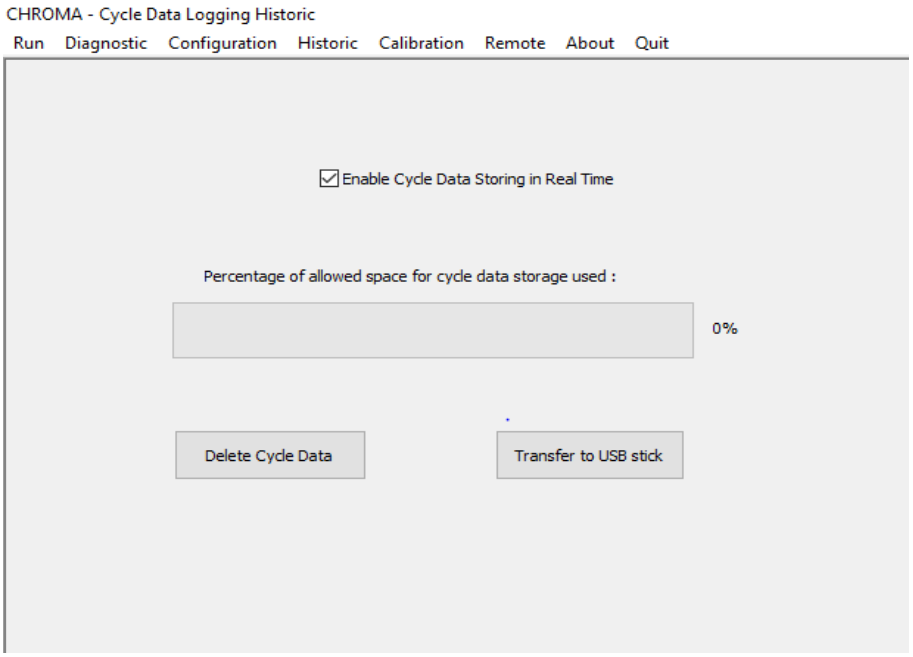


Figure 43 : Cycle Data Logging

The cycle data symbols are as followed:

Symbol	Meaning
*	Calibration Cycle
[c]	Impurity Concentration
AC	Area Counts
RF	Response Factor

All content is split up by a semi colon ;

Calibration Cycle data is represented in the following order as:

1. * “Calibration symbol”
2. Peak Name
3. [c] “concentration
4. AC “Area Counts”
5. RF “Response Factor”
6. Date Stamp
7. Time Stamp

Real Time Cycle data is represented in the following order as:

1. Peak Name
2. [c] “concentration
3. AC “Area Counts”
4. Date Stamp
5. Time Stamp

Data is stored into a file called `CycleDataCurrent.txt`, when the file gets to 500kb or over file is renamed and archived with a stamp date i.e., `CycleData2022.01.06.16:17.txt`. when this happens a new file CycleDataCurrent.txt is created for storing future cycle data. A space of 200Mb is configured on the hard drive for Cycle Data file storage. This will probably never get reached, When `CycleDataCurrent.txt` reaches the 500KB limit and the

total amount of stored Cycle Data files reaches 99% of the 200MB capacity, the oldest time stamped data file will get deleted.

All the Cycle Data files can be transferred to a USB stick by selecting **Transfer to USB stick** button. If the USB key is not detected, an error message will be displayed.

Cycle Data files on the hard drive can be deleted by pressing the **Delete** button. This will delete all chromatograms on the hard drive.

3.10.3 Quit

It is important to use the Quit button on the menu bar before the analyser is powered off.

If you close the analyser without using Quit, there is the risk that data will be corrupted. After the **Quit** button has been pressed, wait for the black screen and then turn the power supply off using the power switch on the back of the analyser.

When clicking on the **Quit** button, the analyser will request a password.

4 UNPACK THE ANALYSER

1. Remove the SERVOPRO NanoChrome and any other equipment from its packing.

2. Remove the wrapping plastic.

3. Inspect the instrument and other items supplied and check for damage. If any item is damaged, immediately contact Servomex or local Servomex agent.

4. If the analyser is not going to be used immediately:
   - Place the analyser and any other equipment supplied back in its protective packing.
   - Store the analyser as described in Section 7.

5. Otherwise, read Section 3 (User Interface), then continue to Section 5 onwards to install, set up, and operate the analyser.

Retain the shipping documentation and packaging for future use (for example, return of the analyser to Servomex for servicing).

5 INSTALLATION AND SETUP

CAUTION
Only apply power to the analyser in accordance with the Start-up Procedure (Section 6.3). Incorrect start-up may cause damage to the analyser.

5.1 Electrical installation

CAUTION
The analyser is heavy and should be carried and installed by at least two people.

CAUTION
The analyser and auxiliary oven should be installed using guide rails or equivalent to ensure that the equipment is supported both by the front and the back.

5.1.1 Electrical safety

WARNING

Ensure that the electrical installation of the analyser conforms to all applicable local and national electrical safety requirements.

WARNING

Failure to follow the safety instructions given below when you install the analyser may invalidate the analyser warranty, or may cause the analyser not operate correctly or cause it damage.

WARNING

All signal terminals are separated from the analyser mains circuits by reinforced insulation. The terminals must only be connected to circuits that are themselves separated from mains voltages by an isolation method that provides at least this level of protection.

The following safety instructions must be considered:

- The electrical supply coupler or plug must be easily accessible for disconnection from the electrical supply.
- The electrical supply circuit must incorporate a suitable fuse or over-current protection device, set to or rated at no more than 10 A for each individual chassis of the system.
- The electrical supply must be able to provide the required maximum power consumption: refer to section 2.1.
- Provide the analyser with a sound earth connection via the electrical supply plug.
- All signal and electrical supply cables must be rated of temperature of 70 ˚C or higher.
- Route cables that you connect to the analyser so that they do not present a trip hazard.
- When carrying out insulation testing, disconnect all cables from the analyser.

5.1.2 Master chassis electrical connections

Figure 44 shows how to connect an analyser supplied with only a master chassis. The master chassis must be connected to a power source using a properly rated cable (see section 2.13).

If an auxiliary oven is supplied, connect the cable coming out of the auxiliary oven to the chassis connector named “Auxiliary Oven” (see section 1.4.1). The cable carries the power supply and the temperature measurement.

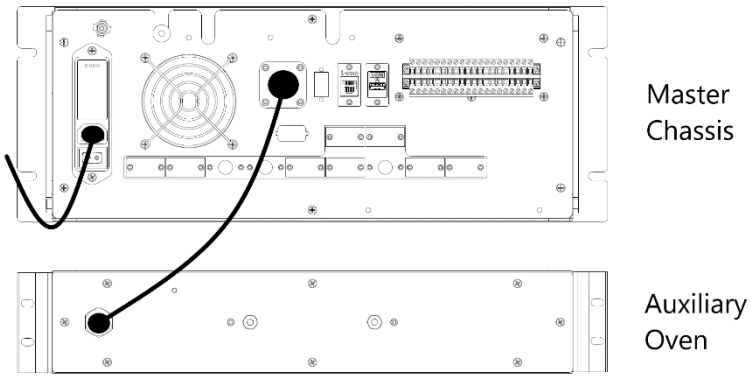


Figure 44 : Master chassis electrical connections

WARNING
The units shall only be connected using the cables supplied by Servomex.

5.1.3 Master chassis with Secondary chassis electrical connections

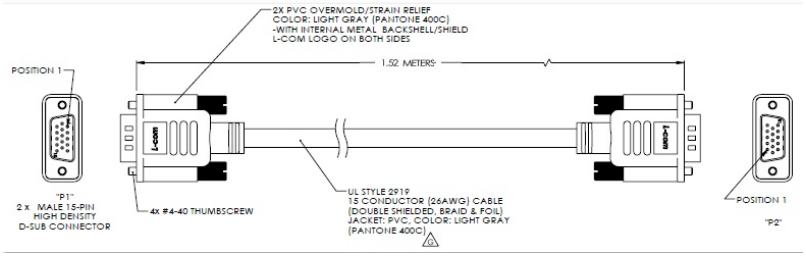
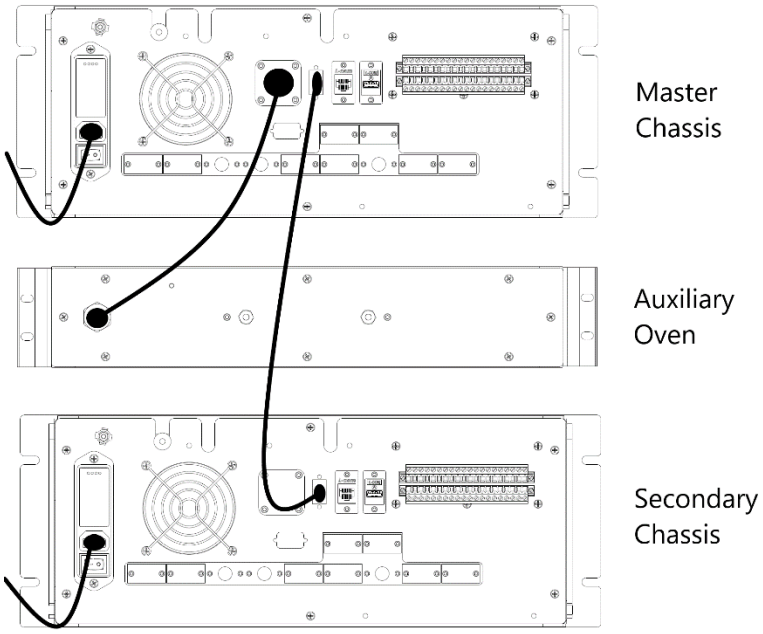


Figure 45 shows how to connect an analyser that is supplied with a master chassis and a secondary chassis. Connections to a power source must use properly rated cables (see section 2.13).

If an auxiliary oven is supplied, connect the cable coming out of the auxiliary oven to the chassis connector named “Auxiliary Oven” (see section 1.4.1). The cable carries the power supply and the temperature measurement.

The master chassis communicates with the secondary chassis using RS-485 ports. Connect both RS-485 ports using the provided high density DB-9 cable (see section 2.11 and Figure 45).



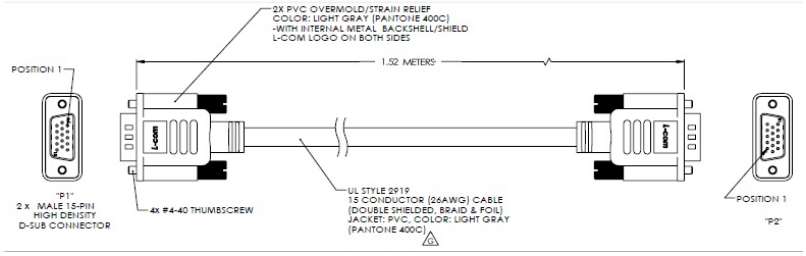


Figure 45 : Master with secondary chassis, electrical connections

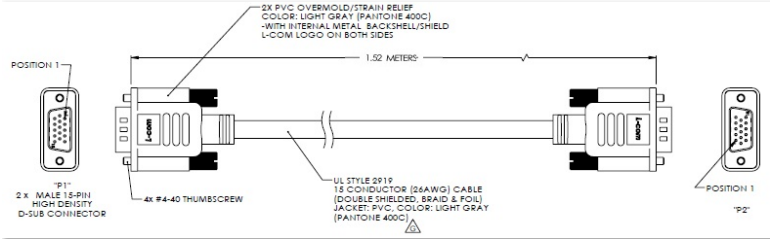
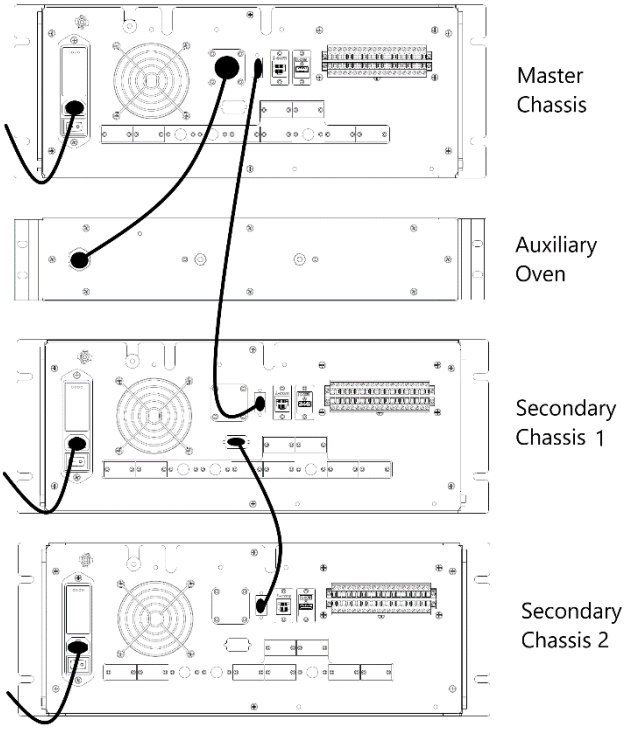


Figure 46 shows how to connect the SERVOPRO NanoChrome that is supplied with a master chassis and two secondary chassis. The RS-485 port of the Master Chassis connects to the first RS-485 port of Secondary Chassis 1. The second RS-485 port of Secondary Chassis 1 connects to the RS-485 port of Secondary Chassis 2. Connect both RS-485 ports using the provided high density DB-9 cable (see section 2.11)



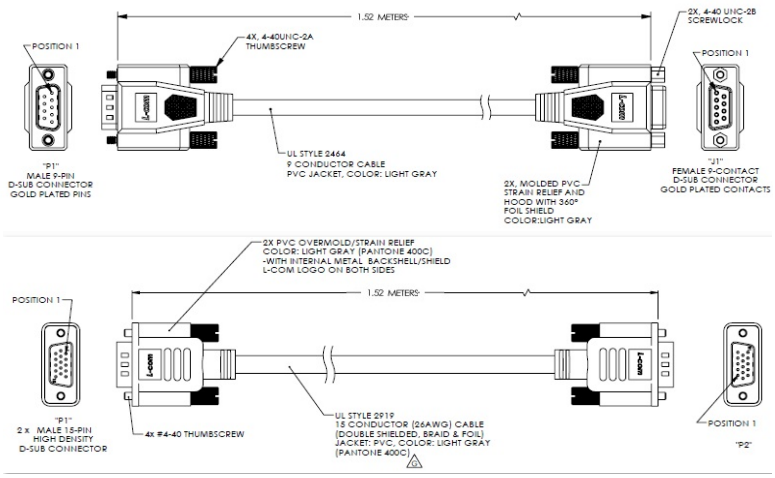


Figure 46 : Master with 2 Secondary Chassis, electrical connections

WARNING

The units shall only be connected using the cables supplied by Servomex.

5.1.4 Stand-alone PC with Secondary chassis electrical connections

Figure 47 shows how to connect an analyser supplied as a stand-alone PC with a secondary chassis. Connections must be connected to a power source using properly rated cables (see section 2.13). The stand-alone PC must always be connected to the same protective earth as the secondary chassis of the system.

If an auxiliary oven is supplied, connect the cable coming out of the auxiliary oven to the connector named “Auxiliary Oven” on the stand-alone PC. The cable carries the power supply and the temperature measurement.

The stand-alone PC communicates with the secondary chassis using a RS-232 port. Connect the port “To analyser” on the PC to the RS-232 port on the secondary chassis (see Figure 47).

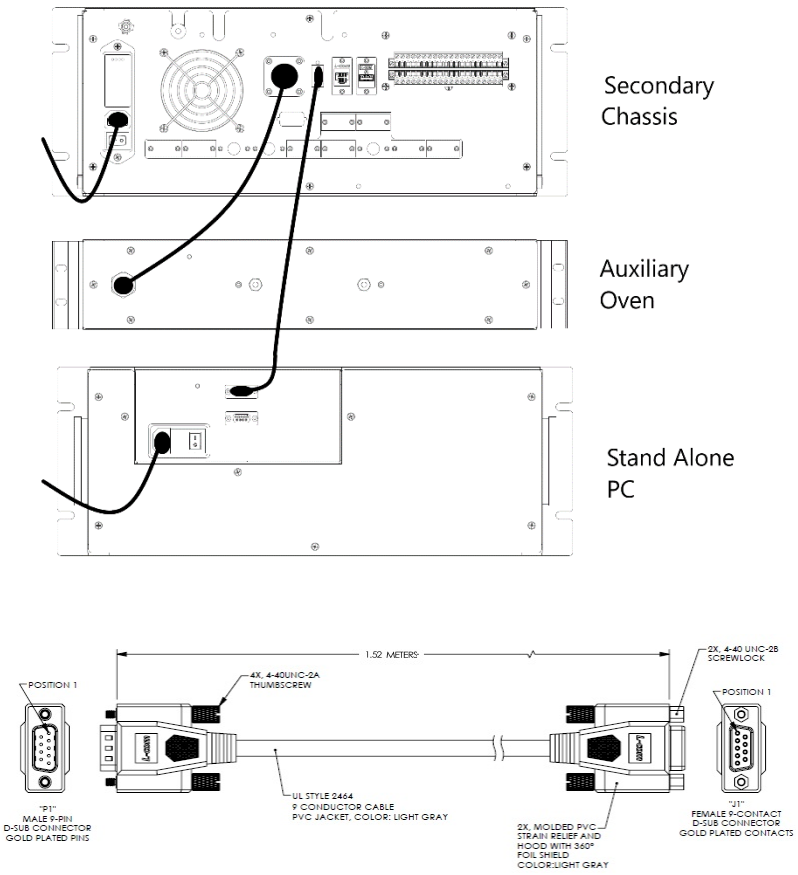


Figure 47 : Stand-alone PC with secondary, electrical connections

Figure 48 shows how to connect an analyser supplied as a stand-alone PC with two secondary chassis. The stand-alone PC RS-232 port “To Analyser” connects to the RS-232 port on the Secondary Chassis 1. The RS-485 port on Secondary Chassis 1 connects to the RS-485 port on Secondary Chassis 2. Both connections should use the provided high-density DB-9 cable (see section 2.11 and Figure 48.

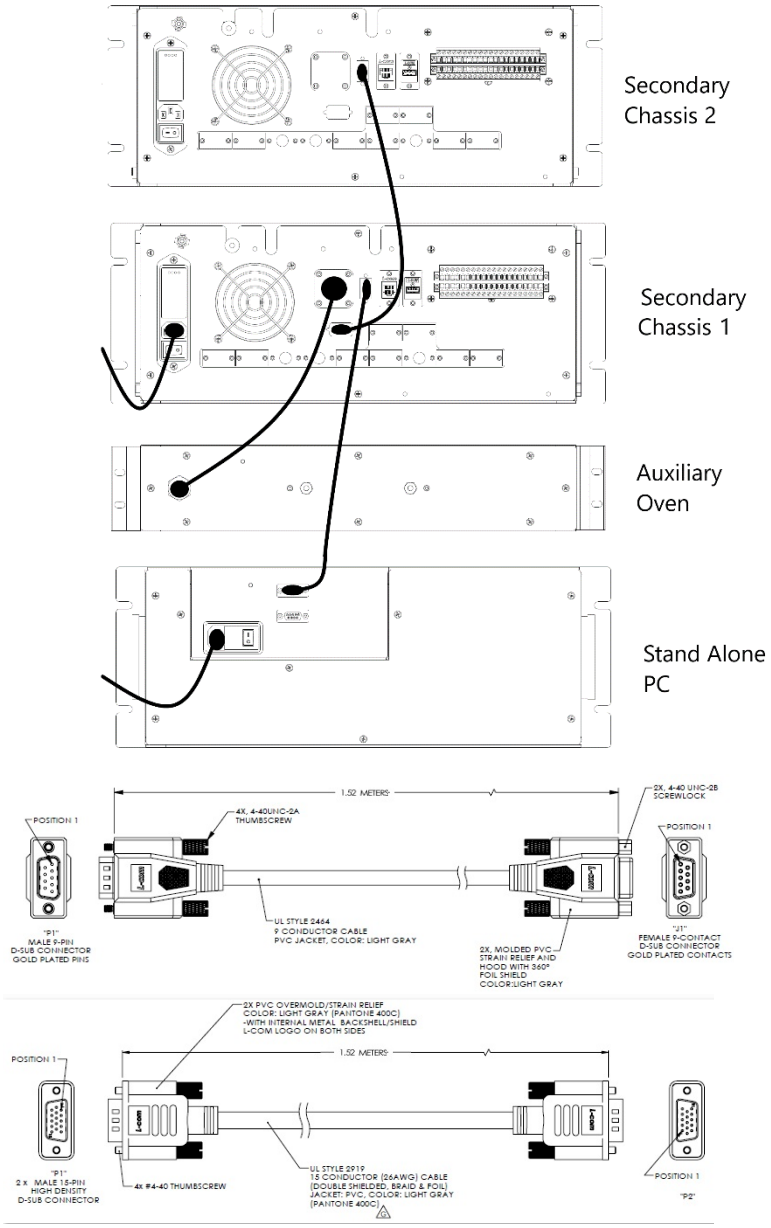


Figure 48 : Stand-alone PC with two Secondarys, electrical connections

WARNING

The units shall only be connected using the cables supplied by Servomex.

5.2 Master/Secondary Chassis rear panel electrical connections

5.2.1 Digital input

There is one digital input used to start an analysis remotely. Connection between the analyser and the remote system is made with a shielded twisted cable. In case of fuse failure, change fuse F12, referring to section 5.1.1.

The shield of the digital input contacts cable must be terminated to the analyser on one the "E" ports of the rear connector.

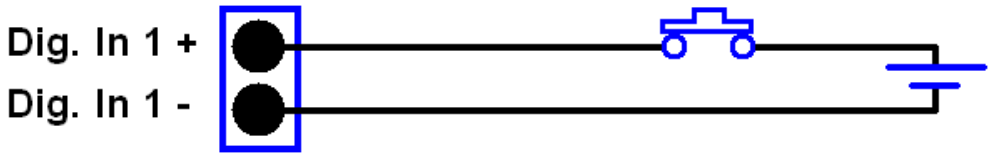


Figure 49 : Digital input connection

WARNING

The digital input terminals are separated from the analyser mains circuits by reinforced insulation. The terminals must only be connected to circuits that are themselves separated from mains voltages by an isolation method that provides at least this level of protection.

5.2.2 Digital output contacts

There are up to 12 dry contact, unpowered digital outputs. They are connected to a common port and fused. In the case of fuse failure, change fuse F14, referring to section 5.1.1.

Port Name	Purpose
E	Earth point for cable screening
R1 – R8	Range ID contacts
A1 – A2	Alarm indicators
ST	Status indicator
EX1	Calibration indicator **or** Cycle indicator

Table 24 : Digital Output Contacts

The shield of the digital output contacts cable must be terminated to the analyser on one the "E" ports of the rear connector.

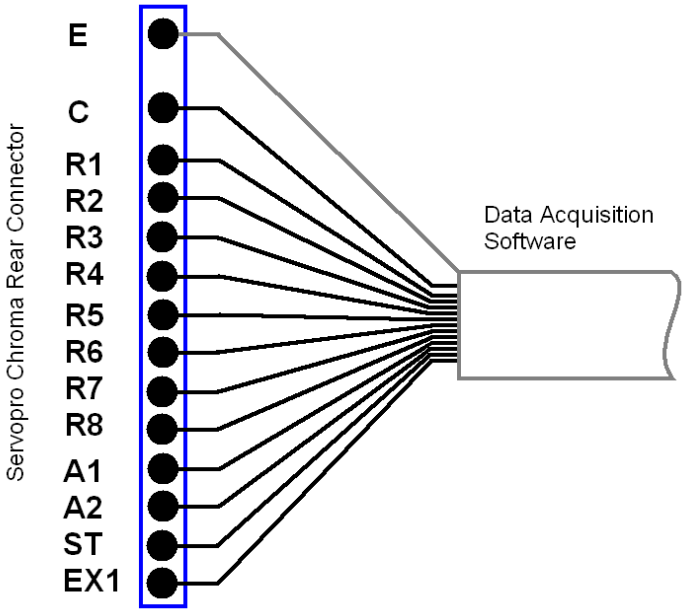


Figure 50 : Digital outputs connection

WARNING

The digital output terminals are separated from the analyser mains circuits by reinforced insulation. The terminals must only be connected to circuits that are themselves separated from mains voltages by an isolation method that provides at least this level of protection.

5.2.3 4-20 mA outputs

The schematic of the 4-20 mA output circuit is shown in . Use a shielded twisted cable to connect between the analyser and the monitoring system, with a load resistor connected at the monitoring system. A differential input must be used on the data acquisition system to properly monitor the data. In case of fuse failure, refer to Table 2 and section 5.1.1.

The twisted pair must be terminated at a matched pair (+ -) of numbered output ports and the shield must be terminated to the analyser on one of the “E” ports of the rear connector.

Each numbered output is set to a specific impurity represented on the chromatogram and can be changed via the configuration menu.

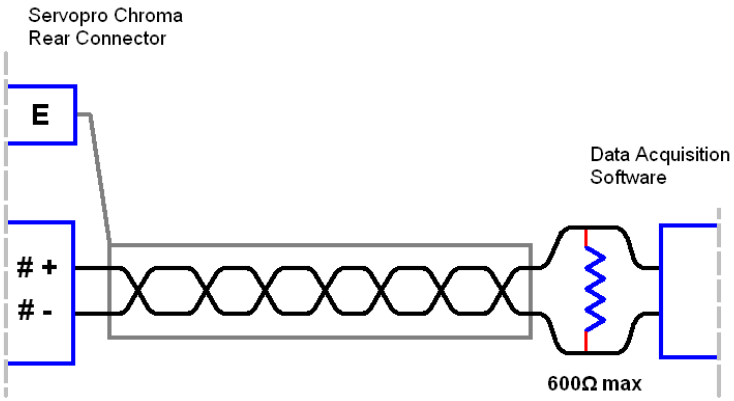


Figure 51 : 4-20 mA schematic and external connections

#	Name	Positive pin	Negative pin	Associated fuse
1	4-20 mA #1	1+	1-	F1
2	4-20 mA #2	2+	2-	F2
3	4-20 mA #3	3+	3-	F3
4	4-20 mA #4	4+	4-	F4
5	4-20 mA #5	5+	5-	F5
6	4-20 mA #6	6+	6-	F6
7	4-20 mA #7	7+	7-	F7
8	4-20 mA #8	8+	8-	F8
9	HR	HR+	HR-	F9

Table 25 : 4-20 mA connections and associated fuses

WARNING

The analogue output terminals are separated from the analyser mains circuits by reinforced insulation. The terminals must only be connected to circuits that are themselves separated from mains voltages by an equivalent isolation method.

5.2.4 RS-485 port

The RS-485 port is only to be used to communicate with other analyser chassis. It is not designed to interface with third party systems. Multiple chassis need to be connected using shielded D-sub HD15 Male/Male cable.

WARNING

The RS-485 output terminals are separated from the analyser mains circuits by reinforced insulation. The terminals must only be connected to circuits that are themselves separated from mains voltages by an equivalent isolation method.

CAUTION

To comply with EMC requirements, the RS-485 shall only be connected using the supplied cable. Refer to section 5.1.1 before making any electrical connections.

5.2.5 RS-232 port

The analyser can be remotely controlled by a computer using the optional RS-232 port. The computer is connected to the analyser by the mean of a DB-9 RS-232C (Null-modem) cable. The computer must have appropriate software to read the data transmitted by the analyser. See the RS-232 addendum for information about the analyser communication protocol.

WARNING

The RS-232 output terminals are separated from the analyser mains circuits by reinforced insulation. The terminals must only be connected to circuits that are themselves separated from mains voltages by an isolation method that provides at least this level of protection.

5.2.6 Auxiliary oven port

The auxiliary oven must be connected to the auxiliary oven port on the rear panel of the master or secondary chassis. This port is not suitable for third party ovens.

5.3 Gas Installation

WARNING

Do not pressurise the analyser carrier or sample inlet as this may cause irreversible damage to the quartz cell in the plasma detector. Before supplying gas to the analyser remove the caps on the vent connections. To prevent contamination of the analyser gas line it is recommended to leave the caps on gas connections until the gas installation is completed and ready to purge.

WARNING

This analyser is not to be used with any sample gases that form a flammable mixture.

WARNING

Ensure fan is not blocked or covered.

WARNING

Installation leak testing must be conducted before potentially flammable, toxic gasses are introduced.

WARNING

For analysers using potentially flammable or toxic sample gasses

Ensure that the Installation location is vented to ensure adequate dilution and/or extraction can be achieved, and installation complies with all applicable site safety requirements including requirements for area monitoring.

WARNING

For analysers using FID detectors. Fuel gas will be flammable when mixed in the FID chamber. Sample gas may be flammable. Ensure that the external connections are leak free at full operating pressure.

WARNING
For analysers using FID detectors. Hydrogen fuel gas will be flammable when mixed in the FID chamber. Ensure that the analyser is installed in a forced ventilated cabinet and installation complies with all applicable site safety requirements.

WARNING
For analysers measuring CO_2
Carbon dioxide is an asphyxiant. Ensure that the Installation location is vented to ensure a CO_2 can be diluted to levels below 5000 ppm and installation complies with all applicable site safety requirements including requirements for area monitoring.

CAUTION

For units fitted with FID. When the detector is in operation, water vapour comes out of the exhaust. The tube must have a slope of at least 10 degrees down to avoid water accumulation.

CAUTION

To comply with EMC requirements the pipe work shall be bonded to local EMC earth

5.3.1 Choosing the right materials for the sampling system

The gas sampling system is crucial to achieving optimum analyser performance. The gas sampling system includes any pressure regulator, valve, line, fitting, filter, purifier, etc. which is in contact with the sample or carrier gas to be introduced into the analyser. Even small leaks or dead volumes can introduce external contaminants originally not present in the system. In most applications, leaks are atmospheric inboard leakage.

For all gas line connections (including calibration and sample), the use of 1/8" stainless steel tubing (minimum wall thickness 0.028”) in full length and with no fittings is recommended. The material should meet ASTM69 specifications as lower quality tubes may have irregularities on their circumference that will cause poor seals with compression tube fittings and potentially organic contamination.

Where fittings are required, VCR fittings are recommended. VCR face seal fittings use a metal-to-metal seal to ensure the best quality leak tight connection. The seal on a VCR fitting is made when the gasket is compressed by two beads during the connector engagement. Pipe thread connections (NPT/BST) should be avoided as they are usually sealed with Teflon tape.

Installation of a high quality leak free by-pass rotameter on the sample line near the analyser and close to the stream selection valve will increases the gas velocity to allow a faster purge of the sample line and improve response time. Adjust the sample line pressure to a value that brings the correct flow into the system. All lines must be cleaned and purged to remove any traces of moisture or particles. Particles can damage the stream selection valves and will trap moisture in the inlet filter.

CAUTION

Use new VCR gaskets each time the tubing is connected.

5.3.2 Carrier Gas Hardware Selection

The use of high grade carrier gas will improve the analyser performance. It is recommended to feed at least 5N grade cylinder gas through a gas purifier to generate the carrier gas.

1. Gas Purifier

The SERVOPRO PureGas purifier is available with either compression or VCR fittings, and for use with 110V or 220VAC power supplies.

The model number to order is:

02005A1_01	SERVOPRO PUREGAS, 1/8" COMP, 110V
02005A1_02	SERVOPRO PUREGAS, 1/8" COMP, 220V EU
02005A1_03	SERVOPRO PUREGAS, 1/8" COMP, 220V UK
02005A1_04	SERVOPRO PUREGAS, 1/8" VCR, 110V
02005A1_05	SERVOPRO PUREGAS, 1/8" VCR, 220V EU
02005A1_06	SERVOPRO PUREGAS, 1/8" VCR, 220V UK

Note: gas purifiers will not remove Ar impurity from He carrier gas. For determination of Ar impurity ensure the UHP grade carrier gas is certified to have less than 1ppb Ar present.

2. Cylinder Pressure Regulator

A stable pressure is critical to the analyser performance, which means high quality cylinder pressure regulators must be used. The pressure regulator should be a stainless steel, double stage type. For the carrier gas, the cylinder outlet pressure must be selected to provide 85psig at the analyser for O2 background gas and 80psig for all other background gases. For the calibration gas, the recommended maximum cylinder outlet pressure is 200 kPa (30 psig).

3. Isolation and Sample Stream Selection Valves

The valves used for isolation or sample selection must be packless type i.e. diaphragm or bellows type, to eliminate air diffusion.

5.3.3 Gas Connections - Rear Panel

The analyser configuration is application specific, consisting of a master chassis, a master chassis with one or more secondary chassis, or a PC with one or more secondary chassis. If required, each chassis may be fitted with an external oven.

1. Master and Secondary Chassis

At the back of each chassis there are gas inlet connections for the process and carrier gases, which are described below. See Figure 1 for the position and description of the gas connections.

Carrier Inlet 1
The carrier gas is normally He, which will be taken to Carrier Inlet 1. For multiple chassis configurations, the carrier gas should be split to feed each chassis.

Carrier Inlet 2
Carrier Inlet 2 will be used when two different carrier gases are required in a chassis.

Sample Inlet 1
The process gas or span gas is taken to Sample Inlet 1. For multiple chassis configurations, the process gas or span gas should be split to feed each chassis.

Sample Inlet 2
This is an option, and allows the span gas to be permanently connected to the analyser. For multiple chassis, the span gas should be split to feed each chassis.

The optional Internal Dilution System (see 5.3.3) is fitted to Sample 2 Inlet. The internal Dilution System dilutes the span gas with the carrier gas with a fixed dilution ratio, suitable for the calibration process.

2. Auxiliary Oven

An external auxiliary oven is required to support the determination of N2 impurity in O2 or H2 background gas. The gas connections at the rear of the oven are shown in Figure 3.

Trap In & Trap Out
The oven **Inlet** gas connector is taken to the analyser chassis **Trap In** gas connector.

The oven **Outlet** gas connector is taken to the analyser chassis **Trap Out g**as connector.

VCR tubing should be used in all cases.

5.3.4 Recommended Carrier gas supply

Figure 52 shows a typical carrier gas system to feed the SERVOPRO NanoChrome, in Servomex recommended order.

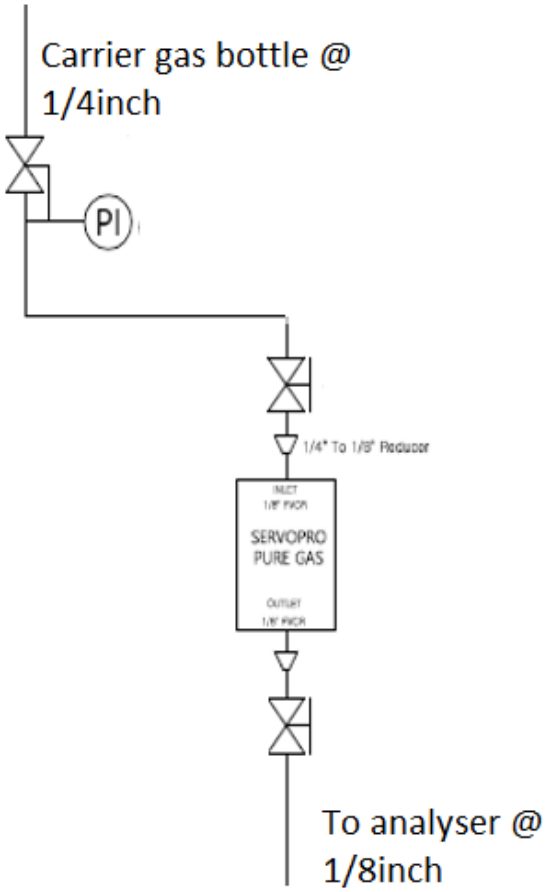


Figure 52 : Carrier gas supply system

5.3.5 Internal dilution system (IDS) setup

The internal dilution system (IDS) uses carrier gas to dilute a calibration gas to a fixed ratio, nominally a factor of 20 to generate a suitable span gas concentration. That means a suitable span gas concentration of 5ppm will be diluted to 250ppb.

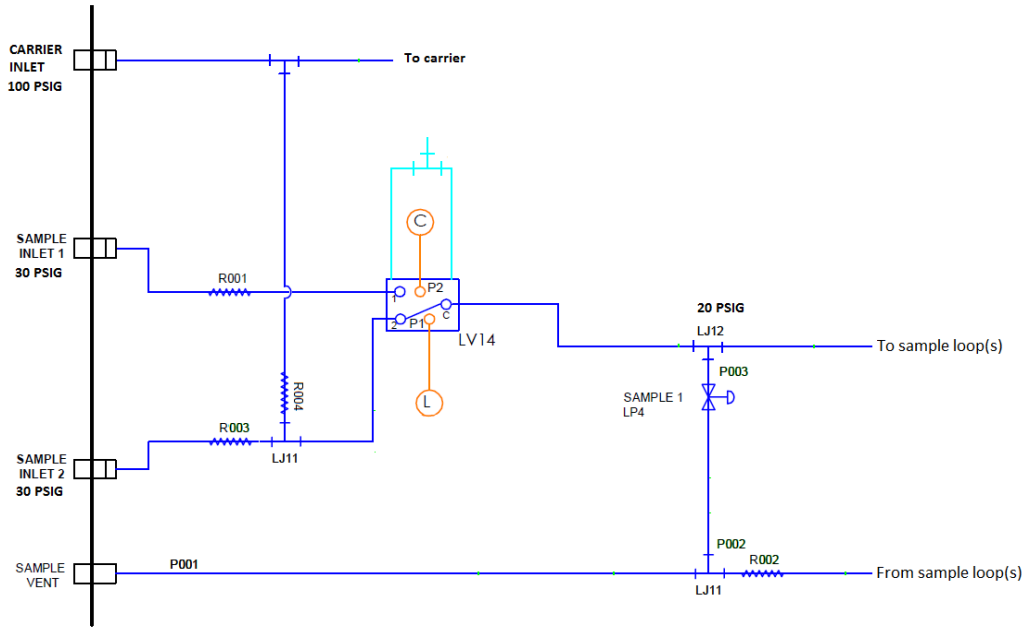


Figure 53 : Internal dilution system schematic

The dilution ratio is a function of the carrier gas inlet pressure and span gas inlet pressure connected to sample inlet 2. The internal restrictors are set during production but it is important to re-calculate the dilution ratio during installation or every time the supply pressures are changed.

The dilution ratio is determined for each impurity, as follows:

1. Navigate to calibration menu and enable internal dilution (click for span)
2. Turn off valve on span gas cylinder and allow to flow rate to stabilise for approx. 5 minutes.
3. Measure the flow F1 coming out of sample vent while analyser is controlling the sample flow at the set point. Enter the value F1 in the calibration menu (see section 3.7 and). This flow rate is determined by the inlet pressure of the carrier gas.
4. Turn on valve on span gas cylinder to the correct pressure (30 psig) and allow flow rate to stabilise for approx. 5 minutes. Make sure that analyser controls sample pressure to the set point.

5. Measure the flow F2+F1 coming out of sample vent. Enter the value F2 in the calibration menu (see). The analyser will calculate the Dilution Factor (F2/(F2-F1)) and display it in the calibration menu.
6. Repeat step 1 to 6 for all chassis.

CAUTION

A SERVOPRO NanoChrome may consist of multiple chassis. Each chassis has its own internal dilution system which will require verification of the dilution ratios for each relevant impurity.

To reduce the analyser purge time during start-up, it is recommended to activate the dilution system valve for a few minutes to purge dead volumes. This is important if the external carrier gas line is contaminated.

The sample inlet can be changed from process to span using the calibration menu. If the analyser has multiple chassis, the internal dilution system for each chassis will change state at the same time. Refer to calibration section.

CAUTION

The internal dilution system dilutes the calibration gas using carrier gas. Carrier gas is only consumed for dilution when the internal dilution system is in use (valve activated). If sample inlet 2 is not connected to a calibration bottle, it is important to install a cap on sample inlet 2. Otherwise, carrier gas will be vented from sample inlet 2.

6 START-UP AND SHUTDOWN PROCEDURE

6.1 Equipment/Tools

1. Flow meter 0-500 cc/min range with 1 cc/min resolution (Restek ProFlow 6000 Cat#: 22656)
2. 7/16'' spanner
3. 1/8 VCR gaskets
4. Helium leak detector (eg Restek Electronic Leak Detector Cat# 22655)
5. 0-100 PSIG Pressure gauge with 1.5% accuracy

6.2 Installation requirements

1. Face seal fittings (VCR type)
2. Carrier gas: purified 5N argon or helium
3. Semiconductor grade 316L stainless steel pipes
4. All system parts (valves, fittings, pressure regulators) must be UHP rated

6.3 Start-up procedure

WARNING

Do not connect gas to analyser unless all caps are removed.
Do not pressurise detector vent(s)
The carrier gas must be connected to the analyser before power is applied

1. Verify main voltage rating.
2. Connect carrier gas purifier(s) and follow installation instructions.
3. Purge the carrier gas line(s) before connecting to the analyser. Static purges are recommended to fully purge dead volumes. A static purge consists of lowering the delivery pressure close to atmospheric pressure and re-pressurising to operating pressure. This process must be repeated at least 5 times.
4. Remove all caps from the analyser backplate.
5. Adjust carrier gas supply pressure to 80 psig if sample background gas is He, H2, N2, Ar or 85 psig if sample background gas is O2. See label on back of analyser.
6. Connect carrier gas to the analyser.
7. Connect the process gas to sample inlet 1 and adjust supply pressure to 30 (+/- 1.0 psig) psig.

CAUTION

It is important that carrier gas pressure is stable and fixed. Changing the carrier gas delivery pressure will affect dilution ratio from internal dilution system.

8. **Note:** If the analyser has the internal dilution system option, connect the calibration gas to sample inlet 2 and adjust supply pressure to 30 psig.
9. Power on the analyser.
10. Verify that analyser parameters are as reported in the Test Results Sheet (TRS) shipped with each analyser.
11. Verify flow coming out of carrier and detector vents and adjust carrier gas supply pressure to have a total flow close to the one specified in the TRS.
12. Verify leak integrity of the external system using a gas leak detector.

CAUTION

Do not use SNOOP to find leaks as it can contaminate the gas lines. Use a gas sniffer.

13. **Note:** It is necessary to purge the optional internal dilution system. To purge the internal dilution system go into **Calibration/Calibration** menu and click the button "**Click for Span**". This activates the internal dilution system. Leave the analyser in that state for 5 minutes then click on the button "**Click for process**". While the sampling system is purging, fine tune the sample pressure. Adjust the sample pressure to have a sample vent flow equal to F2 ± 1 cc/min as specified in the analyser TRS.
14. Verify leak integrity of external gas supply system using a helium leak detector.

CAUTION

The SERVOPRO NanoChrome is designed to measure ultra-trace level impurities. It is important to fully purge all gas lines and allow the analyser to stabilise for a minimum of 12 hours after gas connections. Many days may be required to reach optimum performance.

15. Regenerate the columns (Set oven set point to 200 ˚C) and purge the analyser for 12 hours minimum.
16. After purge, return oven set point to the original values, recorded in the analyser TRS.

17. Verify analyser "Detector A" raw signal for purity and compare to data recorded on analyser TRS. All "Detectors A" are specific to nitrogen. A reading above 0.10 V for helium carrier and 0.2 V for argon carrier with 100% plasma power indicates a leak in the system, incorrectly purged system, or dead volume.
18. **Note:** If internal dilution system option is installed, verify the dilution system dilution ratio. Follow procedure described in section 5.3.4.
19. To validate the chromatography inject the calibration gas. Make sure that all peaks are centred in their peak window. If not, adjust the peak windows. Refer to section 3.6.4 .
20. After chromatography validation, calibrate the analyser (see Section 3.7). Then, run the analyser continuously on calibration gas for up to 12 injections from the run realtime menu. Verify that the last 4 results are within repeatability specification.
21. Inject the process gas continuously and monitor the results. Make sure peak baselines are correct and that readings are stable.

6.4 Shut-down procedure

1. Press quit button in software and enter analyser password. Wait for screen to turn black plus a further minute to allow system to shut down fully and then turn-off power.

CAUTION

It is important to allow the analyser to power itself down. Turning off the power to the analyser after the screen turns black but before it completes the shutdown procedure may result in loss of data.

2. Wait for one hour to let columns cool down with all gases connected and flowing.
3. Disconnect and turn off all gases.

WARNING
Do not install caps on vent if carrier or sample gas inlets are still connected. This will damage the detector.

4. Install caps on all inlets and outlets.

7 ROUTINE MAINTENANCE

Ensure the following for optimum performance:

1. Carrier flow is the value specified for your configuration. To check the carrier flow, put the injection mode in manual. Return to **RUN** menu and watch the value. It is normal to have carrier flow deviation during a cycle. Between and before an injection the carrier flow must be correct.

2. From time to time, verify the oven temperature in the diagnostic menu. It must be constant and at the value specified for the analyser configuration.

3. The sample flow must be the same value as for the previous calibration procedure. This will ensure the same sample volume is injected. The default value is 50 cc/min per channel.

4. Clean the cabinet fan filter periodically. This will support effective cooling and avoids problems caused by high internal temperature.

5. The SERVOPRO Puregas gas purifier will require replacement periodically, dependent on the application (typically every 2 years).

6. The permeation tube An Auxiliary oven will be used with some applications with O2 and H2 background gases. The trap in this oven will require replacing periodically, dependent on the application (typically every 2 years)

7. (fitted with each PED) will require replacement periodically, dependent on application (typically every 5 years). Please contact Servomex service department.

8 STORAGE AND DISPOSAL

8.1 Storage

Follow shutdown procedure described in Section 6.4. Refit any protective cover and place the analyser with any associated equipment in its original packing before storage.

Store the analyser and any associated equipment in a clean, dry area. Do not subject it to excessively hot, cold, or humid conditions.

8.2 Disposal

Dispose of the analyser and any associated equipment safely, and in accordance with the local and national safety and environmental requirements.

The SERVOPRO NanoChrome is not suitable for disposal in municipal waste streams (such as landfill sites, domestic recycling centres and so on). Refer to section 10 for disposal requirements in accordance with the WEEE Directive within the EC.

9 COMPLIANCE

- The analyser complies with the European Community "Electromagnetic Compatibility Directive":
    - Emissions: Class B - Equipment suitable for use in domestic establishments and in establishments directly connected to a low voltage supply which supplies buildings for domestic purposes.

    - Immunity: “Basic” – Considered appropriate to equipment intended for use in domestic, commercial and light industrial environments.

- The analyser complies with the European Community "Low Voltage Directive", by the application of EN 61010-1 and rated for Over Voltage Category II, Pollution Degree 2.

- The analyser complies with the Class B digital apparatus requirements of ICES-001 of Canada through the application of EN 55011:2009+A1:2010

- L'analyseur est conforme aux Conditions B numériques d'appareillage de classe de NMB-001 du Canada par l’application du EN 55011 :2009+A1 :2010.

- The analyser complies with Part 15 of the US FCC Rules for Class B equipment. It is suitable for operation when connected to a public utility power supply that also supplies residential environments.

- The analyser has been assessed to IEC 61010-1 for electrical safety including any additional requirements for US and Canadian national differences.

- Windows 10 License held in Manual Addendum 0440010A_0

10 ANALYSER TROUBLESHOOTING

This section addresses some of the typical issues that may be experienced whilst operating the SERVOPRO NanoChrome. The section describes the observed symptoms, the likely causes, and the potential solutions.

If these steps do not resolve the issue, then contact Servomex for technical support.

Symptom #	Symptom description	Cause
1	Baseline noise	1,2,3,4,5,21,24
2	Unstable baseline	1,2,3,4,5,21,24
3	No peak	6,7,8,9,19,22,23,24,26
4	Saturated detector signal	1,2,3,4,19,21,24
5	Negative peaks	1,2,3,4,24
6	NMHC baseline drift	10
7	Poor repeatability on span calibration	1,2,3,4,5,11,12,13,20,21,23,24,25
8	Poor repeatability on process gas	1,2,3,4,5,12,21,23,24,25
9	Results drift on span calibration gas	14,15,23,24
10	Peak elution time moving	11,22,23,24
11	Sensitivity change on span calibration gas	1,2,3,4,16,17,21,23,24,29
12	Span calibration peak not inside window	9,23,24,25,26
13	Unexpected peak on zero gas (blank)	27
14	High carrier flow consumption	28

Table 26 : Troubleshooting Typical Issues – Symptoms

Cause #	Cause Description	Solution
1	Carrier purifier not working	1
2	Carrier gas grade not suitable	2
3	No carrier purifier	3
4	Polluted carrier gas	4
5	Too short vent pipe	5
6	Plasma off	6
7	Span calibration gas connected to smp 1 inlet	7
8	Wrong span calibration gas pressure	8
9	Carrier flow not reaching set point	9
10	Moisture in span or process	10
11	Unstable carrier flow	9,11,12
12	Unstable sample flow	13,14
13	Peak slightly outside integration window	15
14	Span bottle almost empty (<10% content)	16
15	Unstable ambient conditions (pressure/temperature)	17
16	Span gas mixture	18
17	Wrong span gas background mixture	19
19	Damaged detector	20
20	Verify for presence of dead volume.	21
21	Leak on carrier gas line	4
22	Incorrect column temperature	22
23	Incorrect valve timing or valve not actuating.	23
24	Column require regeneration	24
25	Packed column properties slighly changed during shipping or over time.	25
26	Calibrated restrictor slighly changed during shipping.	25
27	Process gas contamination	26
28	Carrier gas supply pressure too high	27
29	Dilution ratio changed	28

Table 27 : Troubleshooting Typical Issues – Likely Causes

Solution #	Solution description
1	Verify if purifier is powered. It will normally be hot. In doubt, change purifier. Power down analyser following shut down procedure. A typical carrier gas purifier must be changed every two years. Refer to purifier specifications.
2	Helium or Argon carrier gas must be 5N grade or better. If not, purifiers may not be able to remove all impurities. Change carrier gas bottles for proper grade.
3	Install an argon or helium purifier.
4	Verify leaks on external fittings using a helium leak detector. Verify the carrier gas grade. Verify if carrier gas purifier is working or if needs to be changed. A typical carrier gas purifier must be changed every two years. Verify for any dead volumes.
5	Air could flow back to the detector by back diffusion. It is recommended to have a vent pipe of at least 2 meters on all detector vents to prevent this problem. Connect a vent pipe.
6	Verify that plasma are on in the diagnostic menu. Plasma power must be 100% for all plasma.
7	Span calibration gas must be connected to sample inlet 2. Process must be connecter to sample inlet 1.
8	Make sure the span pressure is precisely set to 30 PSIG at the back of the analyser.
9	Make sure the carrier pressure is set to appropriate pressure and that the appropriate carrier gas is used.
10	Install a moisture trap. It is important to understand that a moisture trap will delay system response time.
11	Make sure the carrier gas pressure is not above the maximum carrier pressure of 100 PSIG.
12	Make sure carrier gas delivery pressure is stable.
13	Make sure the sample gas pressure is not above the maximum sample pressure of 30 PSIG.
14	Make sure sample gas delivery pressure is stable.
15	Verify that carrier gas set points are as per analyser TRS. Verify that carrier gas flow is stable. Verify that oven temperature are as analyser TRS and stable. Revalidate PIDs and re-save flow table
16	If the span bottle is below 10% of its original content, the bottle must be changed.
17	As any analytical instruments, this product is affected by ambient pressure and temperature variations. It is suggested to install the instrument in a temperature regulated room (+/- 1 °C).
18	Span bottles containing low impurity concentration can be polluted when pressure regulator is installed. Low impurity span bottles also more prone to error. Confirm analyser detector response with a new calibration span bottle coming from a different batch.
19	The NanoChrome is configured to be calibrated with a span gas containing impurities in helium background. Any other background will affect the internal dilution system ratio and false the dilution factor
20	Make sure that detectors were not pressurize. A pressurization will permanently damage the plasma quartz cell. If the detector has been pressurised, a new detector must be installed.
21	If dead volumes are present, they must be eliminated if possible. Dead volumes can be eliminated by purging the volume using calibrated orifice. If not possible to remove dead volumes, do static purges.
22	Verify that column temperature is stable and as per analyser TRS. Revalidate PID values
23	Verify that valve timing is as per analyser TRS. Also, verify that valve is actuating. Valve can be manually tested using trending menu, manual valve menu. An actuation sound will be heard when valve state changes.

24	Chromatographic columns can be polluted with ambient air and impurities during installation of if carrier gas runs out. The impurities slowly release from columns and generate noise. Column can be heated at a higher temperature to clean them. A temperature of 150 °C for 24 hours is suggested.
25	Contact Servomex.
26	Check process gas introduced to analyser is free of contamination, such as particulates or moisture.
27	Connect a flow meter to the carrier vent. Reduce carrier supply pressure to have a vent flow close to the one specified in the analyser TRS.
28	Verify dilution system pressures and flows, then re-do the internal dilution system table

Table 28 : Troubleshooting Typical Issues – Potential Solutions

11 PRODUCT DISPOSAL - WEEE DIRECTIVE

The label shown in Figure & is fitted to the analyser.

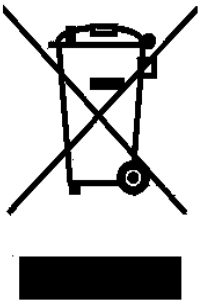


Figure 54 : The WEEE label

This label identifies that –

- The analyser is considered to be within the scope of the Waste Electrical and Electronic Equipment (WEEE) Directive.
- The analyser is not intended for disposal in a municipal waste stream, but shall be submitted for material recovery and recycling in accordance with the local regulations which implement the WEEE Directive.
- For additional information and advice on the disposal of the analyser in accordance with the requirements of the WEEE Directive, contact Servomex at info@servomex.com or your local Servomex agent.
- If you send the analyser to Servomex or your local Servomex agent for disposal, the analyser must be accompanied by a correctly completed decontamination certificate.

12 REACH REGULATION

In pursuance of the requirements included in Article 33 of the European REACH Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals, information on Substances of Very High Concern (SVHC) contained in Servomex products is provided on www.servomex.com