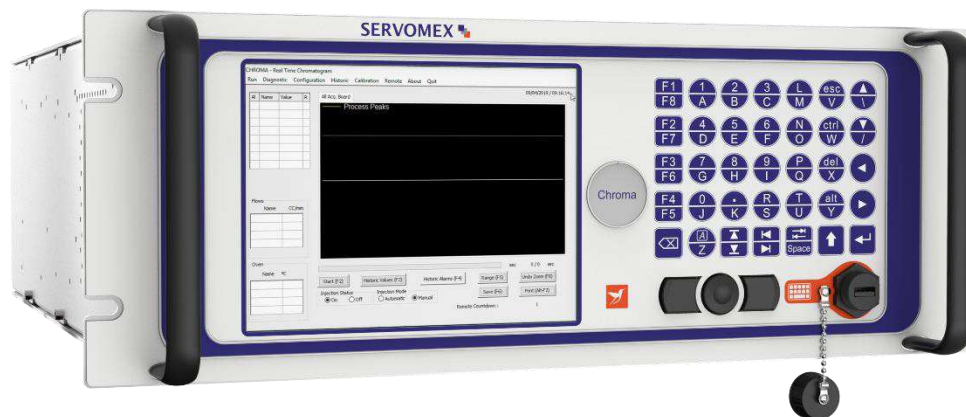




SERVOMEX  
**ANALYZERS**  
HIGH-PERFORMANCE GAS ANALYSIS



# SERVOPRO Chroma, NanoChrome & NanoChrome ULTRA QUICK START GUIDE

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Revision: **0**  
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## 1 DESCRIPTION AND DEFINITIONS

### 1.1 Scope of this manual

This manual provides basic overview of the SERVOPRO Chroma/NanoChrome/Ultra series Online Trace Gas analysers utilizing Plasma Emission Detectors. Further instruction and more detail information relating to other configurations (FID, TCD) is provided in the Relevant Operator Manual supplied with the instrument.



#### WARNING

This manual is only intended to instruct on the basic operation of the analyser once it has been installed. Installation must be carried out by following the instructions detailed in the Operator manual in order to ensure correct and safe use. Any maintenance of the analyser (including filter and fuse replacement) must only be carried out by following the instructions in the operator manual.



#### 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 Chroma must not be used as personal protective equipment.



#### WARNING

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



#### WARNING

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

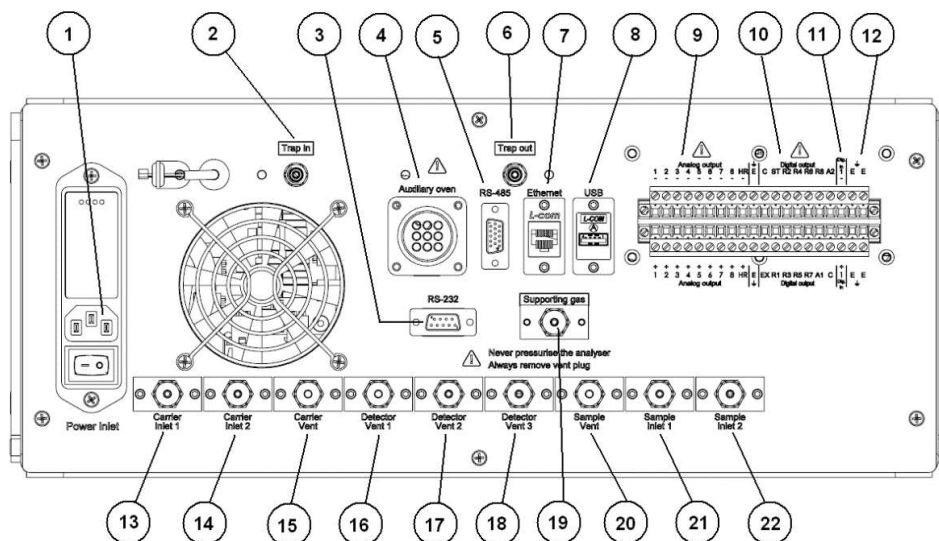


#### WARNING

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

## 1.2 Description of Analyser Rear Connections

### 1.2.1 SERVOPRO GC Complete Rear Connector



**Figure 1 : SERVOPRO GC 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 | 12. Earth terminals for cable screens |
| 2. Gas trap inlet                   | 13. Carrier gas inlet to detector 1   |
| 3. RS-232 /RS-485 socket            | 14. Carrier gas inlet to detector 2   |
| 4. Auxiliary oven                   | 15. Vent for carrier gases            |
| 5. RS-485 socket                    | 16. Detector 1 vent                   |
| 6. Gas trap outlet                  | 17. Detector 2 vent                   |
| 7. Ethernet port                    | 18. Detector 3 vent                   |
| 8. USB port                         | 19. Supporting gas inlet              |
| 9. Analogue 4-20 mA outputs         | 20. Sample gas vent                   |
| 10. Digital outputs                 | 21. Sample gas inlet 1 (process)      |
| 11. Digital input                   | 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, Swagelock (SWG) fittings are used on all gas outlets/vents.



## SERVOPRO GC Reduced Rear Connections

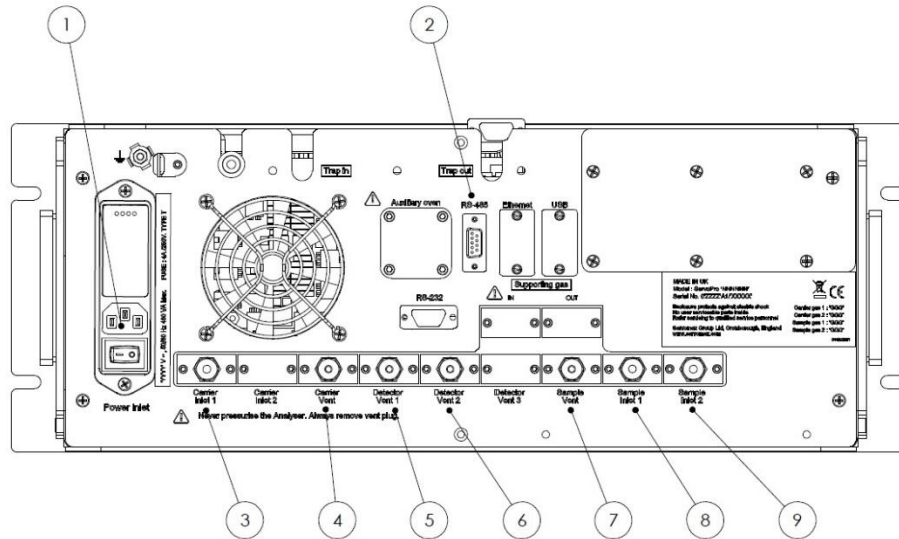


Figure 2 : SERVOPRO GC reduced rear connections

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)

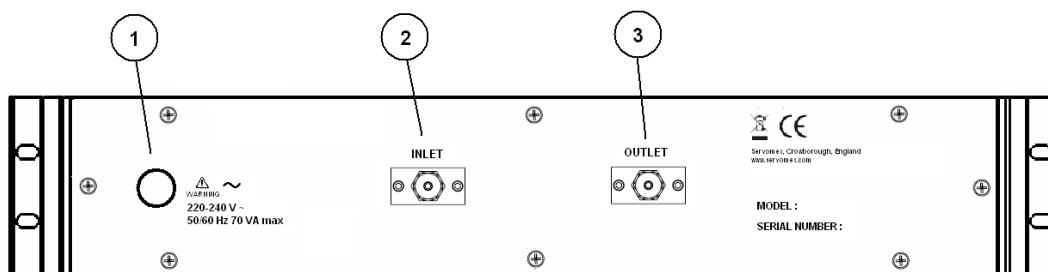
Note: the RS-232 port is replaced with a RS-485 port on Secondary Chassis 1 on an analyser with multiple secondary chassis.

## 1.3 Auxiliary Oven

### 1.3.1 Description of Auxiliary Oven

The Auxiliary Oven is an external module used when analysing N<sub>2</sub> impurity in either H<sub>2</sub> or O<sub>2</sub> background gas. It is connected to the specific channel making the N<sub>2</sub> determination, and removes the small volume of interfering background gas which has co-eluted with the N<sub>2</sub> prior to the passing to the detector.

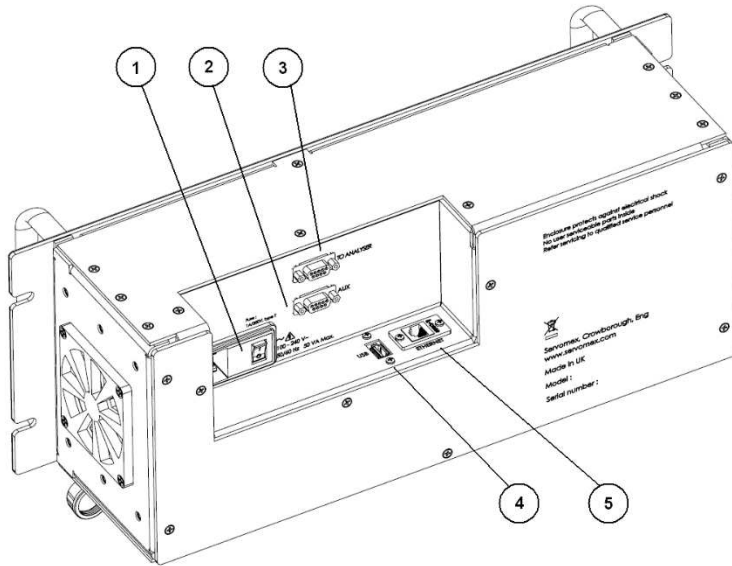
### 1.3.2 Auxiliary Oven Rear Connections



**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)

### 1.4 Standalone PC Rear Connections

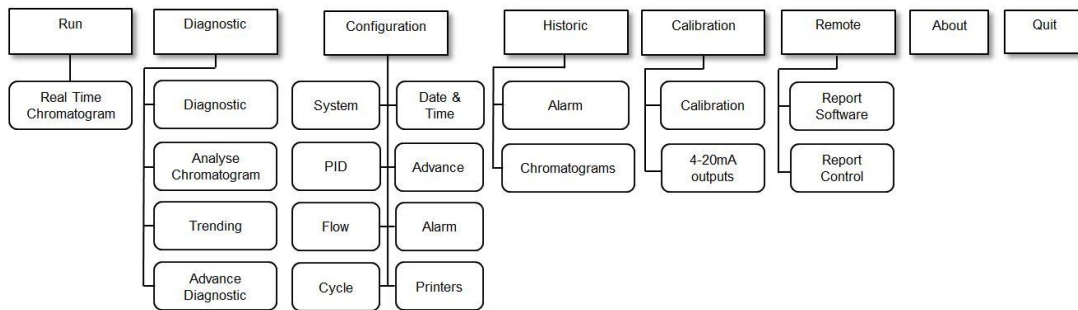


**Figure 4 : Standalone PC rear connections**

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

### 1.5 User Interface Menu structure

The analyser functions are grouped in menus which are structured as shown in Figure 5 : Menu Structure. The functions available from the menu are described in the following sections.



**Figure 5 : Menu Structure**

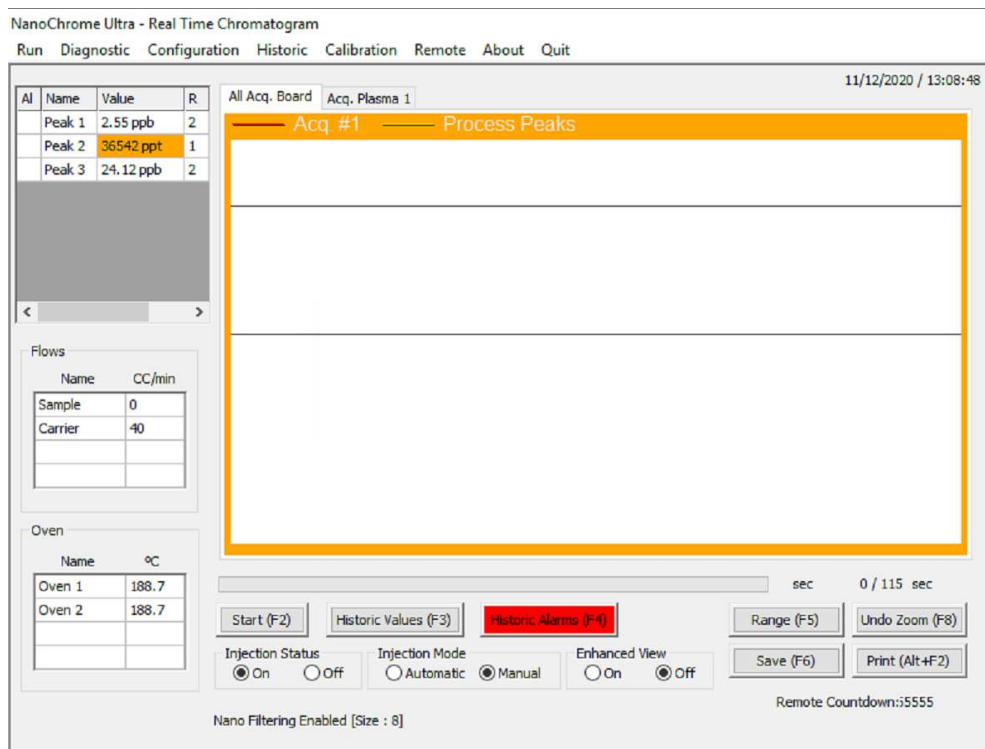
## 1.6 Run Menu

### 1.6.1 Real Time Chromatogram Menu

The **REAL TIME CHROMATOGRAM** menu 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 6), 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 and the cycle time.



**Figure 6 : Run - Real time menu**

### 1.6.2 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 (A1). 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.

### 1.6.3 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.

### 1.6.4 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.

### 1.6.5 Enhanced View (Ultra only)

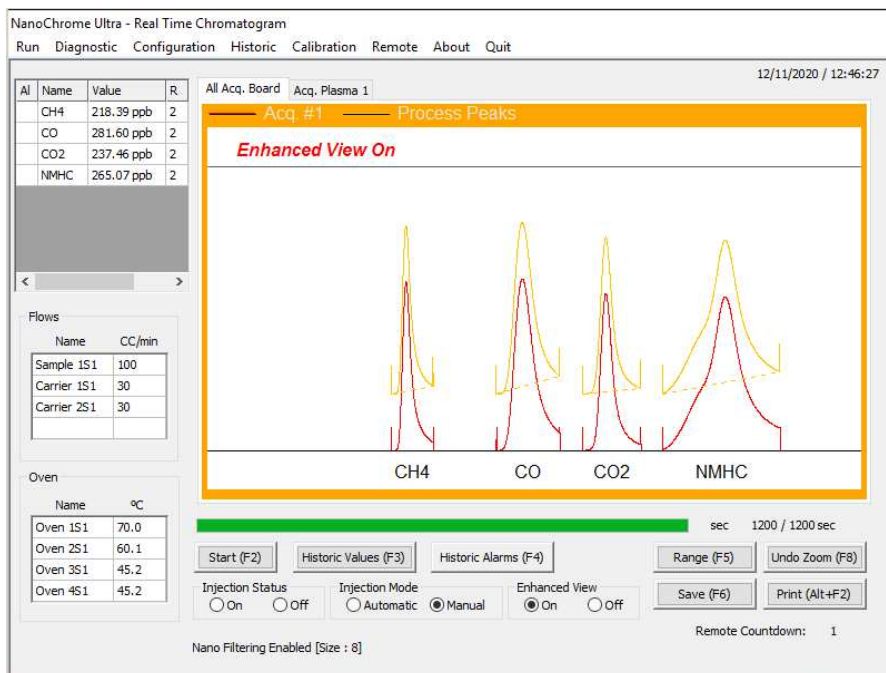
The **Enhanced View** radio control enables the chromatogram view to focus between the Baseline and the Saturation line (see Figure 15). This enables the user to clearly view the peaks on the chromatogram.

Figure 7 : Chromatogram in Enhanced View

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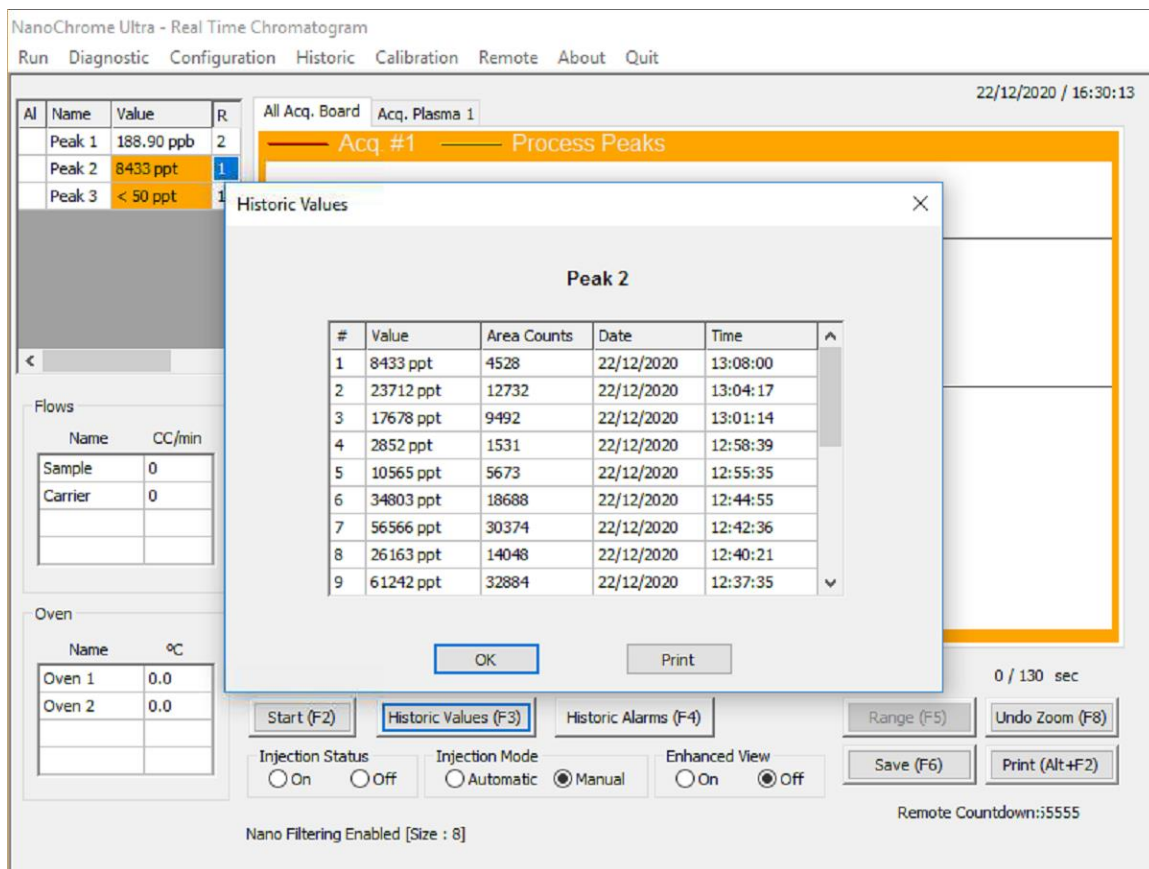
## SERVOPRO CHROMA/NANOCHROME/ULTRA Gas Analyser

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### 1.6.6 Historic values (F3)

Displays the last 20 measures of concentration and Area Counts 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 (see Figure 8).



**Figure 8 : Historic Values**

### 1.6.7 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 1.7.

### 1.6.8 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. ppt to ppb switching can be triggered with this action.



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.



If the peak selected is configured to ppb and the measurement switches into Range 1, ppt measurement will be seen in Peak table. If the measurement switches into Range 2, ppb measurement will be seen in Peak table.

Note that when Threshold calibration is enabled, “**Warning: Threshold Calibration enabled**” will be displayed in the chromatogram display with Enhanced View On.

Note that when Span calibration is enabled, “**Warning: Span Calibration enabled**” will be displayed in the chromatogram display with Enhanced View Off. During both Threshold and Span calibration the **Enhanced View** radio control will be disabled.

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 1 : Peak Grid - Alarm Status display colours**

### 1.6.9 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.

### **1.6.10 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.

### **1.6.11 Print (Alt F2)**

The **Print** button enables printing of the chromatogram. To add a printer, see the **CONFIGURATION-PRINTERS** menu.

### **1.6.12 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.

## ***1.7 Historic Menu***

### **1.7.1 Alarm Menu**

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

#### **1) System alarms:**

- ***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 (**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) Peak value alarms

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”).

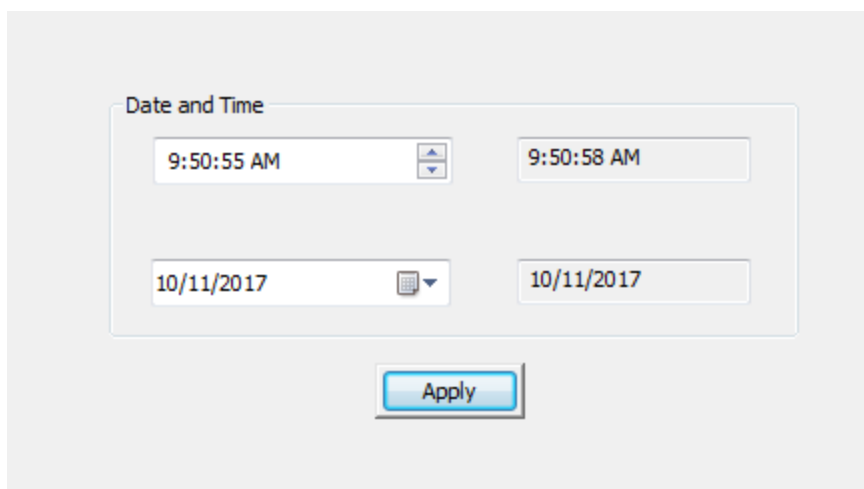
### **Example:**

- 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)

## **1.8 Date & Time**

Click on Configuration on the menu bar and then on Date & Time to access the CONFIGURATION-DATE & TIME menu (see Figure 9).

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



**Figure 9 : Date & Time menu**

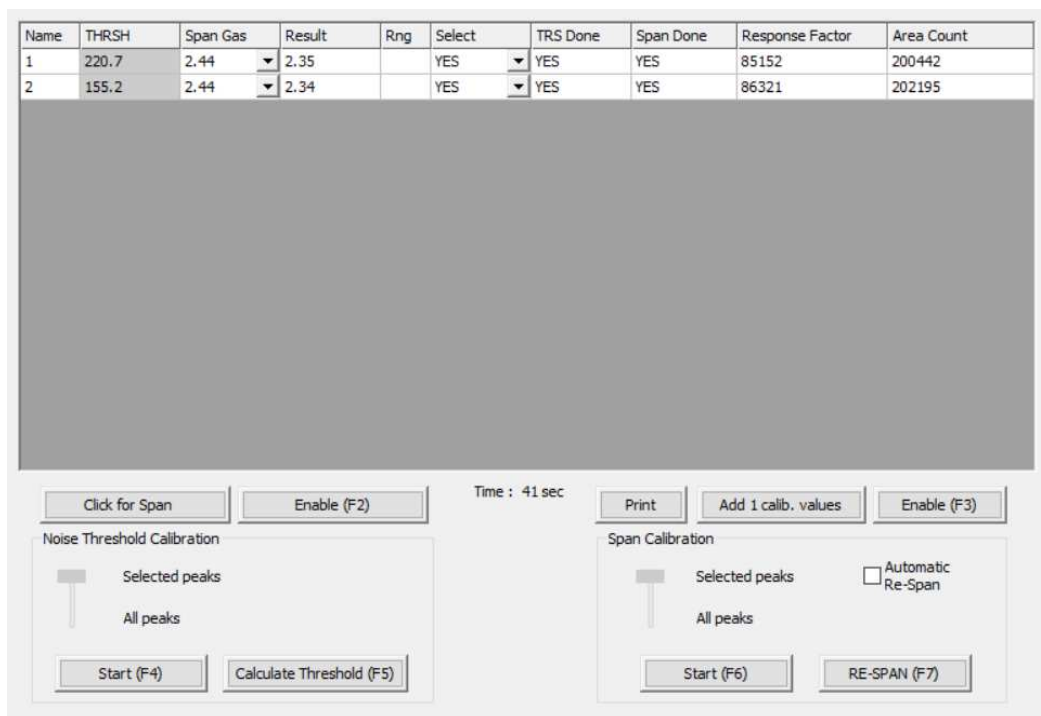
## **1.9 Analyser Calibration**

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

**Note:** Recommendation is to calibrate with between 80-110% of Full scale range

**Click on Calibration on the menu bar and then select Calibration to access the CALIBRATION-CALIBRATION menu (see Figure 10). 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.



**Figure 10 : Calibration-Calibration menu**

### 1.9.1 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.  
 Click on the Calibration-Calibration menu (see Figure 10).
2. Enable the **Noise Threshold Calibration** with the **Enable (F2)** button.
3. 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.
4. Click on **Start (F4)** button to start calibration

5. After one cycle in manual injection has completed, press the **Calculate Threshold** button. The RMS value will be shown in the **THRSH** column of the grid.
6. When the **Noise Threshold Calibration** is completed, **YES** is displayed in the **TRS done** column of the grid.
7. Disable the **Noise Threshold Calibration** with the **Disable (F2)** button (one button performs dual functions Enable or Disable, depending on the active mode).

### 1.9.2 Span Calibration

It is important to carry out the Span calibration procedure in Range 2 ONLY. 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 Figure 11).

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.



It is important to carry out the Span calibration procedure in Range 2 ONLY

The calibration procedure is described below.

1. Click on **Run-Real Time Chromatogram**, then select the **Automatic Injection** option.

Click on the Calibration-Calibration menu (see Figure 10).

Set the calibration gas values for each individual peak:

2. Select a peak **Name** with the mouse.
3. Click on the **Add “peak name” calib values** button and a pop-up menu will appear (see Figure 11).
4. 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.
5. 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.
6. Select **OK** and the pop-up menu will disappear.
7. For multiple peaks, repeat the above steps for each peak name
8. For each peak to be calibrated, left click on the arrow in the combo box in the **Span Gas** column to update the values

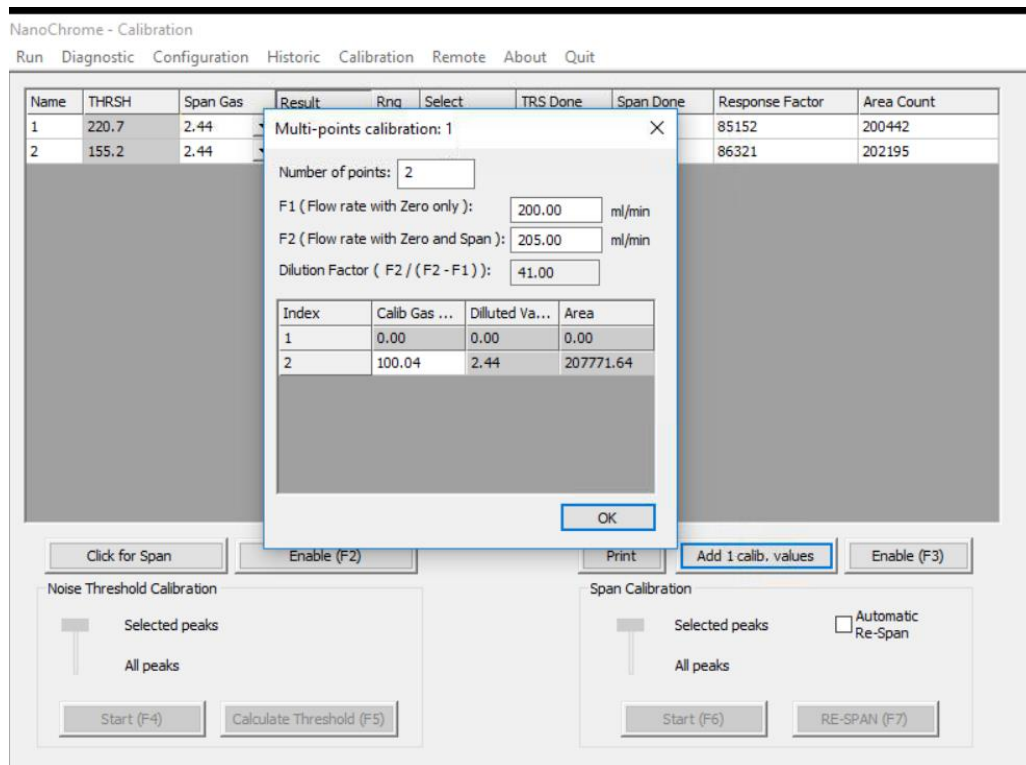
Start the calibration:

9. Enable the **Span Calibration** with the **Enable (F3)** button.
10. In the **Span** column select **Yes** for the peaks that require calibration
11. 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.
12. Click on **Start (F6)** button to start calibration
13. 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.
14. When the **Span Calibration** is completed, **YES** is displayed in the **Span Done** column of the grid.
15. Repeat the above if there are other peaks to be calibrated.
16. Disable **Span Calibration** with the **Disable (F3)** button (one button performs dual functions Enable or Disable, depending on the active mode).

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**Figure 11 : Calibration-Span menu**



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:

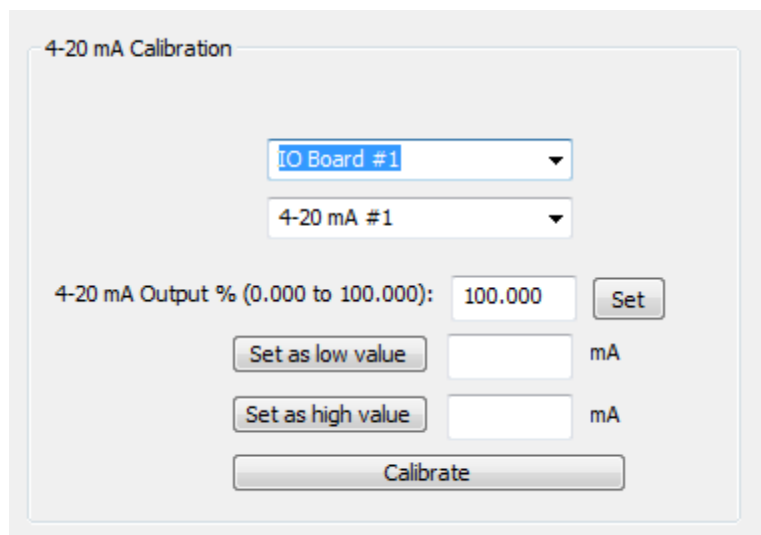
**Area Count:** this is the area that covers the peak in counts (digital converter units). This area is used to generate the concentration displayed in the Result column.

**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.

### **1.10 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 12).



**Figure 12 : Calibration-4-20 mA outputs menu**

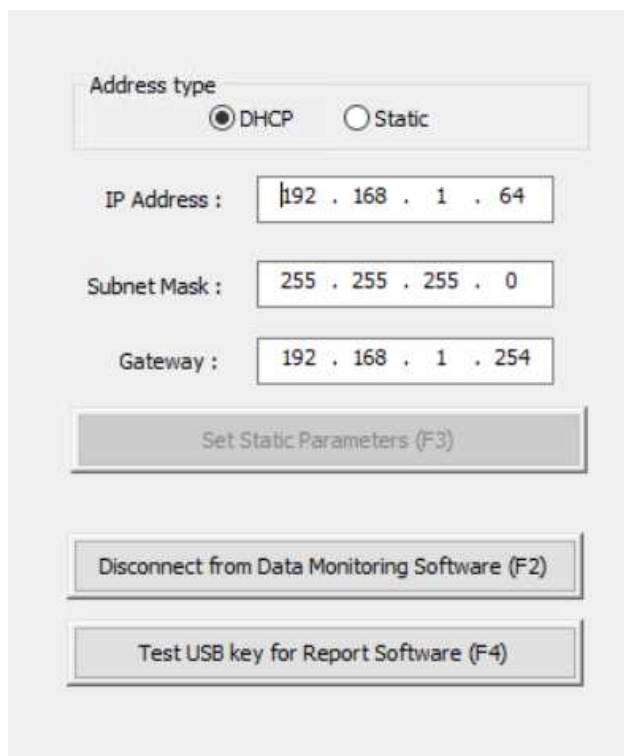
The 4-20mA outputs are factory configured. The setup procedure is shown below, but it is not normally required to be adjusted in the field.

- ▶ **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.

## **1.11 Remote**

### **1.11.1 Report Software**

Click on **Remote** on the menu bar and then on **Report Software** to access the **REMOTE-REPORT SOFTWARE** menu (see Figure 13).



The screenshot displays a configuration menu for network settings. At the top, there is a section labeled 'Address type' with two radio buttons: 'DHCP' (which is selected) and 'Static'. Below this, there are three input fields for IP configuration: 'IP Address' with the value '192 . 168 . 1 . 64', 'Subnet Mask' with the value '255 . 255 . 255 . 0', and 'Gateway' with the value '192 . 168 . 1 . 254'. Below these fields are three buttons: 'Set Static Parameters (F3)', 'Disconnect from Data Monitoring Software (F2)', and 'Test USB key for Report Software (F4)'.

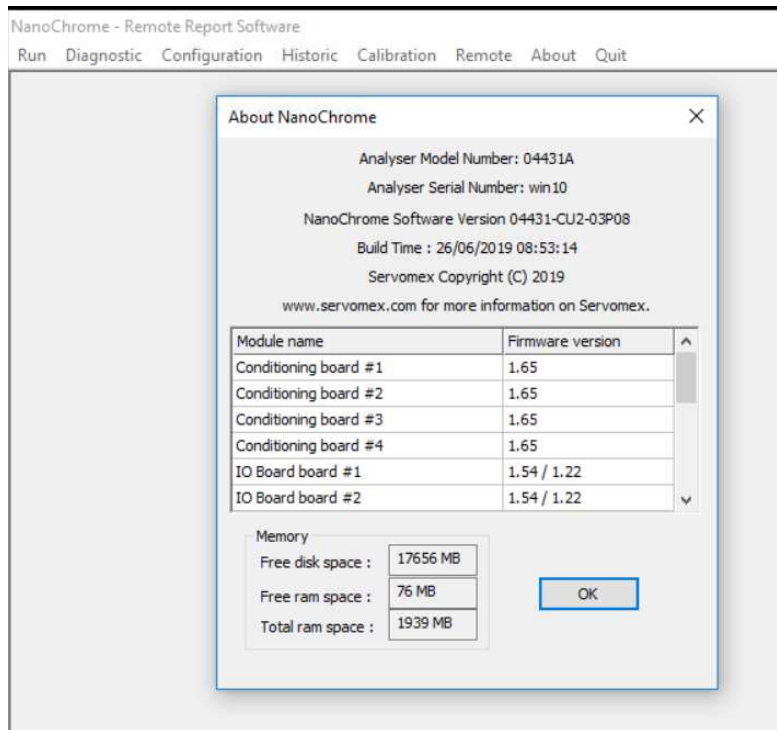
**Figure 13 : Remote Software menu**

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.

## 1.12 About

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

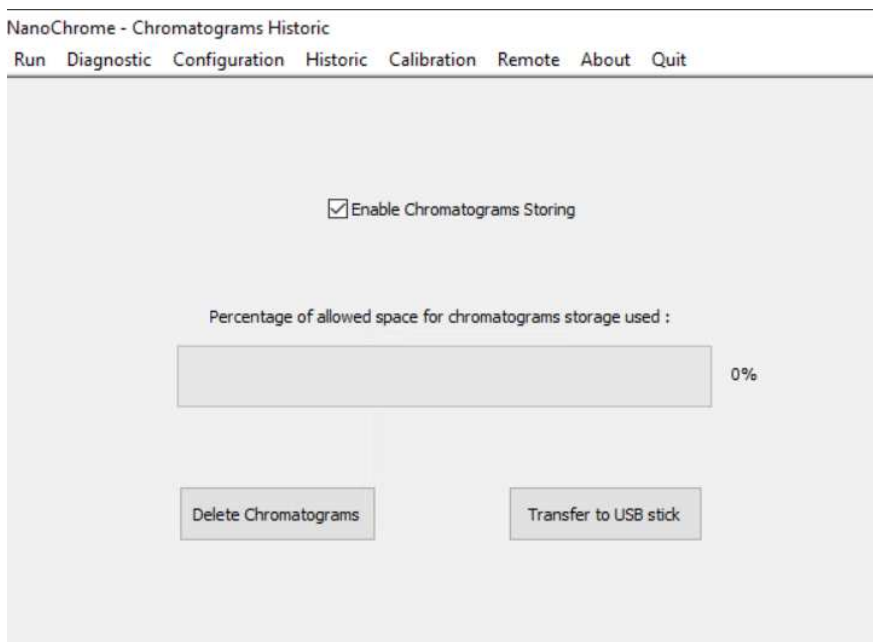


**Figure 14 : About menu**

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.

### 1.12.1 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 15) and the chromatograms will be saved at the end of each cycle. If not selected, the chromatogram will not be saved.



**Figure 15 : 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 overwrite 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\_XXXXX" where XXXXX 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.

### **1.12.2 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.

## 2 UNPACK THE ANALYSER

1. Remove the SERVOPRO NanoChrome Ultra 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 6.
5. Otherwise, read Section **Error! Reference source not found.** (User Interface), then continue to Section 3 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).

### 3 INSTALLATION AND SETUP

#### CAUTION

Only apply power to the analyser in accordance with the Start-up Procedure (Section 4.3). Incorrect start-up may cause damage to the analyser.

#### 3.1 Electrical installation

##### 3.1.1 Electrical safety

Refer to Operator manual for Electrical Safety

##### 3.1.2 Master chassis electrical connections

Figure 16 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 **Error! Reference source not found.**).

If an auxiliary oven is supplied, connect the cable coming out of the auxiliary oven to the chassis connector named “Auxiliary Oven” (see section 1.2.1). The cable carries the power supply and the temperature measurement.

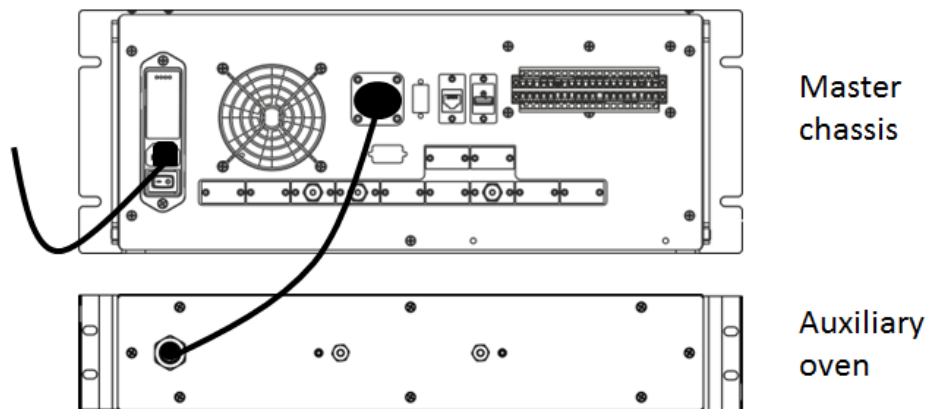


Figure 16 : Master chassis electrical connections



#### WARNING

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

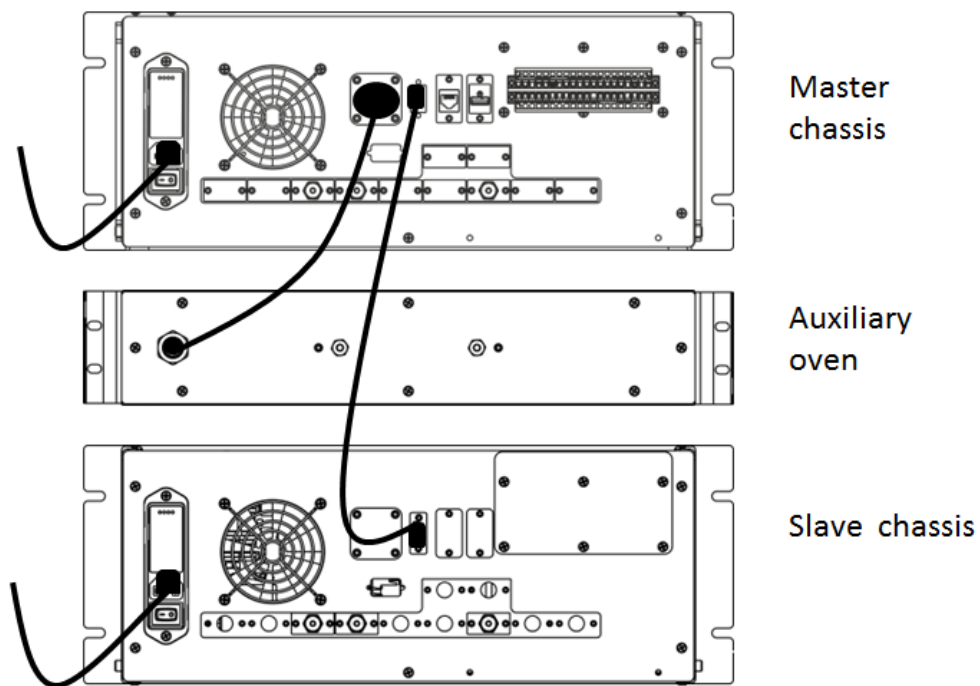


### 3.1.3 Master chassis with Secondary chassis electrical connections

Figure 17 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 operator manual)

If an auxiliary oven is supplied, connect the cable coming out of the auxiliary oven to the chassis connector named “Auxiliary Oven” (see section operator manual 1.2.1). 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.



**Figure 17 : Master with secondary chassis, electrical connections**

Figure 18 shows how to connect the SERVOPRO NanoChrome Ultra 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

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Secondary Chassis 2. Connect both RS-485 ports using the provided high density DB-9 cable.

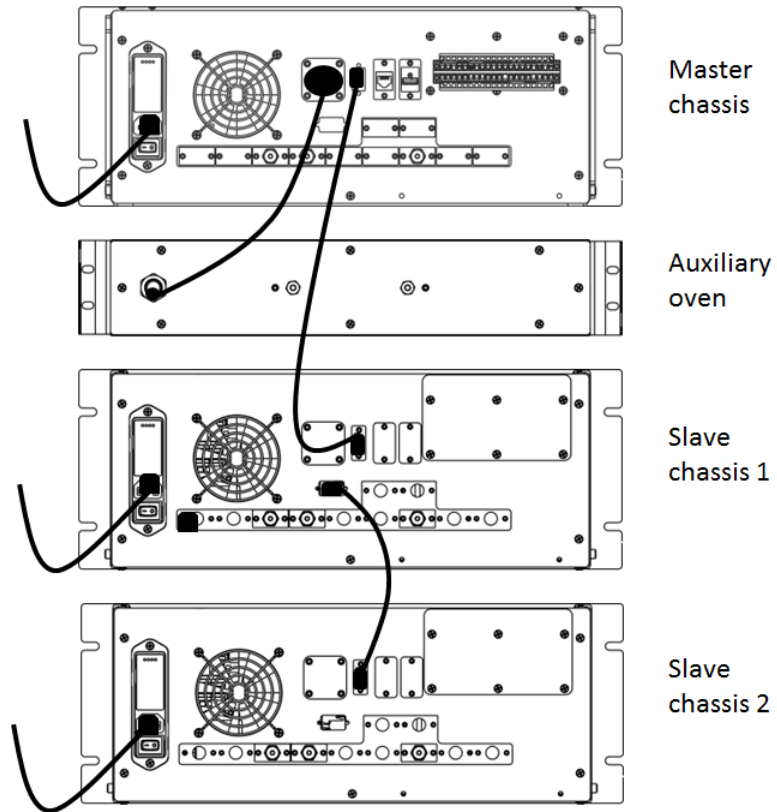


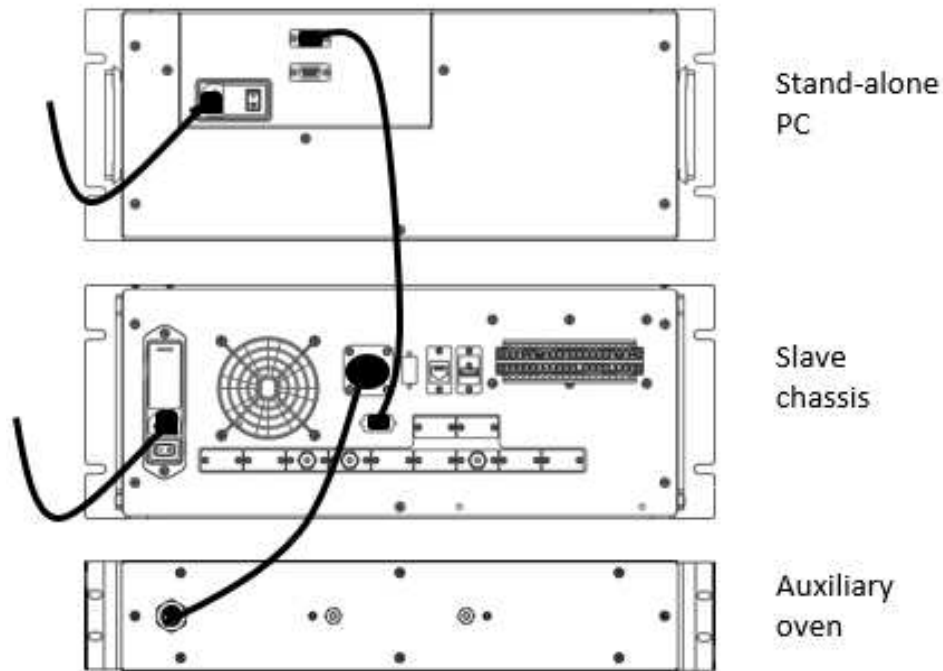
Figure 18 : Master with 2 Secondary Chassis, electrical connections

### 3.1.4 Stand-alone PC with Secondary chassis electrical connections

Figure 19 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. 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.



**Figure 19 : Stand-alone PC with secondary, electrical connections**

Figure 20 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

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to the RS-485 port on Secondary Chassis 2. Both connections should use the provided high-density DB-9 cable (see section **Error! Reference source not found.** and Figure 20

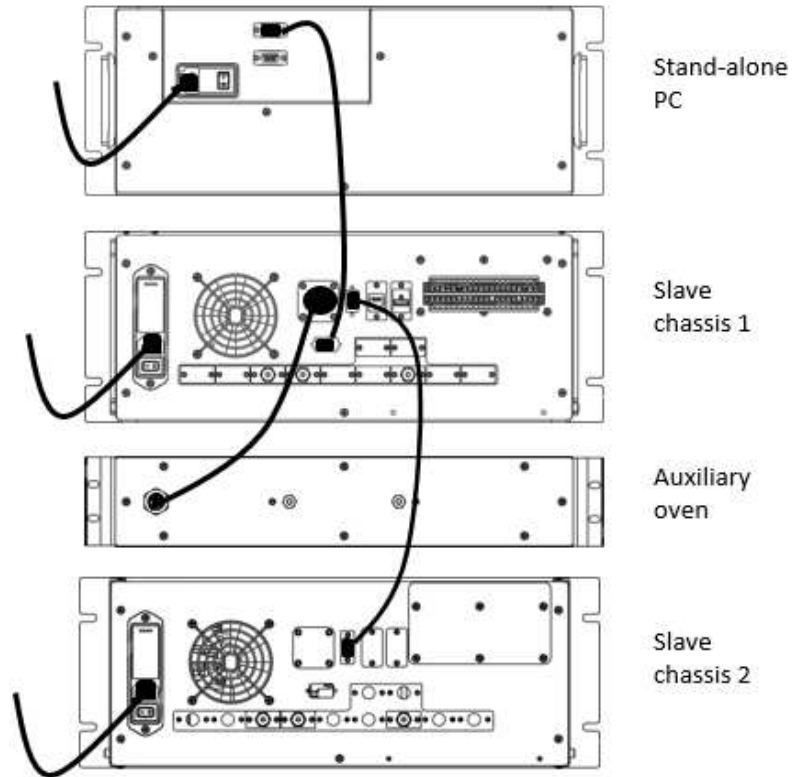


Figure 20 : Stand-alone PC with two Secondaries, electrical connections



#### WARNING

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

## 3.2 Master/Secondary Chassis rear panel electrical connections

### 3.2.1 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 operator manual.

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

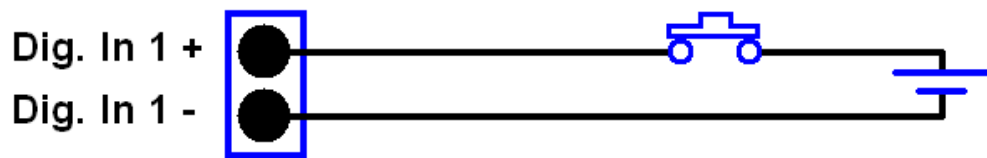


Figure 21 : Digital input connection



#### 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.

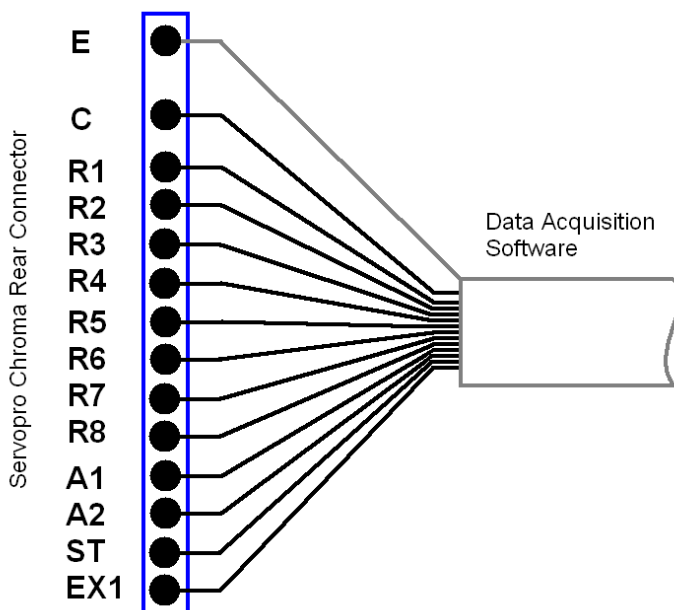
### 3.2.2 Digital output contacts

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 operator manual.

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 2 : 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 22 : Digital outputs connection**



**WARNING**

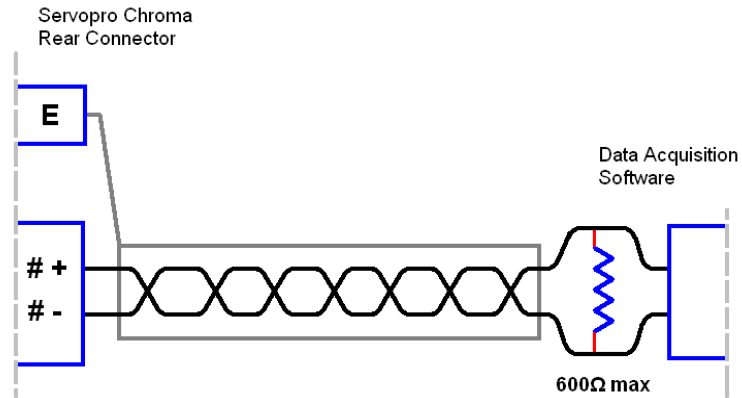
The digital output terminals are separated from the analyser mains circuits by reinforced insulation. The terminals must only be connected to circuits that are themselves separated from mains voltages by an isolation method that provides at least this level of protection.

### 3.2.3 4-20 mA outputs

The schematic of the 4-20 mA output circuit is shown in Figure 23. 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 operator manual.

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 23 : 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 3 : 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.

### 3.2.4 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 3.1.1 before making any electrical connections.

### **3.2.5 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.

### **3.2.6 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.



### 3.3 Gas Installation



#### WARNING

Do not pressurise the analyser sample or carrier gas 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 ready to connect to the pre-purged gas installation.



#### WARNING

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

#### CAUTION

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

#### 3.3.1 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 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.

Where fittings are required, compression tube fittings will eliminate the venturi aspiration of outside contaminants. 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 should be avoided as they are usually sealed with Teflon tape.

Install a by-pass rotameter on the sample line near the analyser and close to the stream selection valve. This 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.**

### **3.3.2 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. Carrier 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 the relevant pressure for your analyser (see Test Result Sheet).

### **3. Span 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 span/sample gas, the cylinder outlet pressure must be selected to provide the relevant pressure for your analyser (see Test Result Sheet).

### **4. 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.

## **3.3.3 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 3.3.34) 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 N<sub>2</sub> impurity in O<sub>2</sub> or H<sub>2</sub> background gas. The gas connections at the rear of the oven are shown in Figure 3.

### Trap In & Trap Out

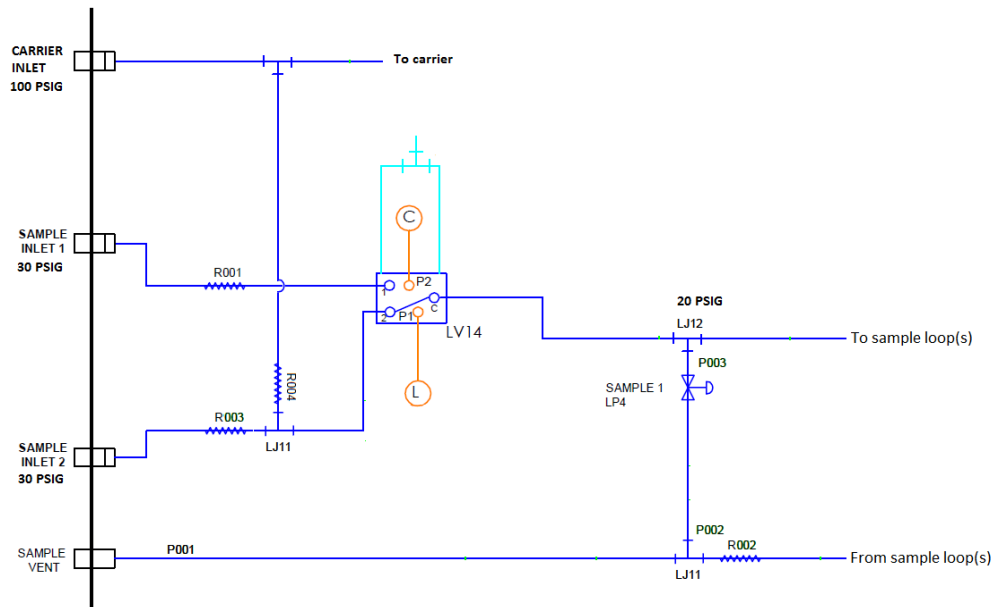
The oven **Inlet** gas connector is taken to the analyser chassis **Trap In** gas connector.

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

VCR tubing should be used in all cases.

### 3.3.4 Internal dilution system setup (NanoChrome and Ultra only)

The internal dilution system 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 24 : 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. Turn off valve on span gas cylinder and allow to flow rate to stabilise for approx. 5 minutes.
2. 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 1.9 and Figure 11).
3. 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.
4. Measure the flow F2 coming out of sample vent. Enter the value F2 in the calibration menu (see Figure 11). The analyser will calculate the Dilution Factor ( $F2/(F2-F1)$ ) and display it in the calibration menu.
5. Repeat step 1 to 6 for all chassis.

**CAUTION**

A SERVOPRO Chroma/NanoChrome/Ultra 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.

## **4 START-UP AND SHUTDOWN PROCEDURE**

### **4.1 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

### **4.2 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 systems parts (valves, fittings, pressure regulators) must be UHP rated

### **4.3 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 and follow installation instructions.
3. Purge the carrier gas line 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 required analyser pressure (see test result sheet or 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 required pressure (see Test result sheet or label on back of analyser).

**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 Ultra 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. 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. This must be done with all chromatographic valves in the off state. 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.
18. **Note:** If internal dilution system option is installed, verify the dilution system dilution ratio. Follow procedure described in section 3.3.4.
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 the operator manual .
20. After chromatography validation, calibrate the analyser (see Section 1.9). Then, run the analyser continuously on calibration gas for 12 injections. Verify that the last 4 results are within repeatability specification. Compare with results from the analyser Test Results Sheet (TRS).
21. Inject the process gas continuously and monitor the results. Make sure peak baselines are correct and that readings are stable.

#### **4.4 Shut-down procedure**

1. Press quit button in software and enter analyser password. Wait for screen to turn black and 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 column cool down with all gases connected.
3. Disconnect 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.



## **5 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. An Auxiliary oven will be used with some applications with O<sub>2</sub> and H<sub>2</sub> background gases. The trap in this oven will require replacing periodically, dependent on the application (typically every 2 years)
6. The SERVOPRO Puregas gas purifier will require replacement periodically, dependent on the application (typically every 2 years).
7. The permeation tube (fitted with each PED) will require replacement periodically, dependent on application (typically every 5 years). Please contact Servomex service department
8. Annual regeneration of the chromatographic columns (refer to operator manual).

## **6 STORAGE AND DISPOSAL**

### ***6.1 Storage***

Follow shutdown procedure. 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.

### ***6.2 Disposal***

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



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