SERVOPRO Chroma
OPERATOR MANUAL

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SERVOMEX
a spectris company

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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 Chroma Online Trace Gas analyser, abbreviated to "SERVOPRO Chroma" or "analysers" where applicable in the reminder of this manual.

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 Chroma. 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 addressed, may result in personal injury or death.

CAUTION
Cautions highlight hazards which, if not addressed, can result in damage to the SERVOPRO Chroma 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 Chroma Gas Analyser

1.3.1 Introduction

The SERVOPRO Chroma is a 19" rack mounted online trace gas analyser, shipped pre-configured and requires little operator intervention. The analyser measures impurities in bulk gases, such as H_2, O_2, N_2, Ar, CH_4, CO, CO_2 and NMHC impurities in H_2, O_2, N_2, Ar or He background gas.

The analyser configuration - form factor, detector(s), column(s), and valves - is application dependent. The analyser can be fitted with a number of detector types – Plasma Emission Detector (PED), TCD (Thermal Conductivity Detector), or FID (Flame Ionisation Detector). The SERVOPRO Chroma 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/PC 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 Chroma 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 with a user selectable multiplication factor between ranges of 2, 5 or 10. 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 an isolated digital input for a remote start function.

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 (stabilizing) 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 **Flame Ionisation Detector (FID)**

The low noise flame ionization detector (FID) is designed to measure hydrocarbons from the sub ppm to percentage level. The sample gas is introduced into a hydrogen flame. Any hydrocarbons in the sample will produce ions when they are burnt. The ions are detected using a collector, which generates a very small current that is proportional to the rate of ionisation, and which in turn depends on the concentration of hydrocarbons.

The SERVOPRO Chroma uses the logarithm feature of transistors to produce an electrometer that is not only extremely stable with variations in temperature but also offers low noise performance. The use of transistors has eliminated the need for high value resistances, and hence the noise and drift that they cause. The SERVOPRO Chroma can measure a broad range of currents, from femtoamperes (10^{-15}) to milliamperes (10^{-3}).

Information on how to set up and operate the FID is given in Section 12.

1.3.4 Thermal Conductivity Detector (TCD)

The Thermal Conductivity Detector (TCD) is a universal technique suitable to determine mixture of gases at percentage levels. The TCD compares the thermal conductivity of two gas flows – the pure carrier (reference) gas and the impurity eluting from the GC column. Changes in the temperature of the electrically-heated wires in the detector are affected by the thermal conductivity of the gas which flows around this. The changes in this thermal conductivity are sensed as a change in electrical resistance and are measured. The sensitivity is close related to the nature of the impurity and the selection of the carrier gas.

1.3.5 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.

1.3.6 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.

1.3.7 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 a 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.

1.3.8 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 Chroma Complete Rear Connections
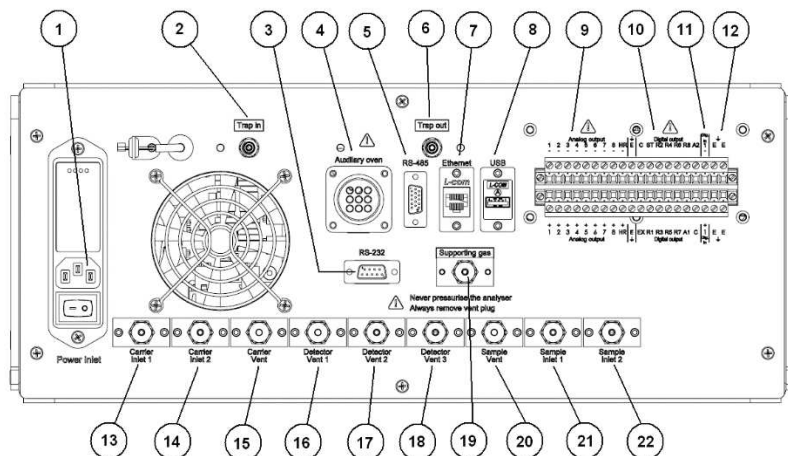
Figure 1 : SERVOPRO Chroma complete rear connections

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. Carrier gas vent
16. Detector 1 vent
17. Detector 2 vent
18. Detector 3 vent
19. Supporting gas inlet
20. Sample gas vent
21. Sample gas inlet to detector 1
22. Sample gas inlet to detector 2

Several of the ports shown above are optional, and may be fitted depending on the analyser configuration and intended use.

	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.

1.4.2 SERVOPRO Chroma Reduced Rear Connections
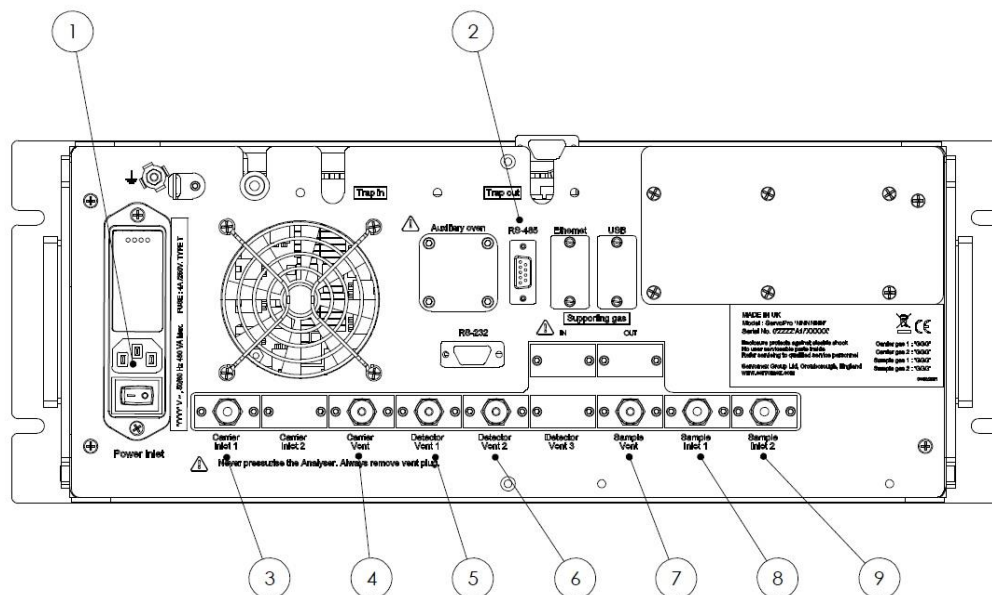
Figure 2 : SERVOPRO Chroma reduced rear connections

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
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.

Gas connections when FID Detector is fitted
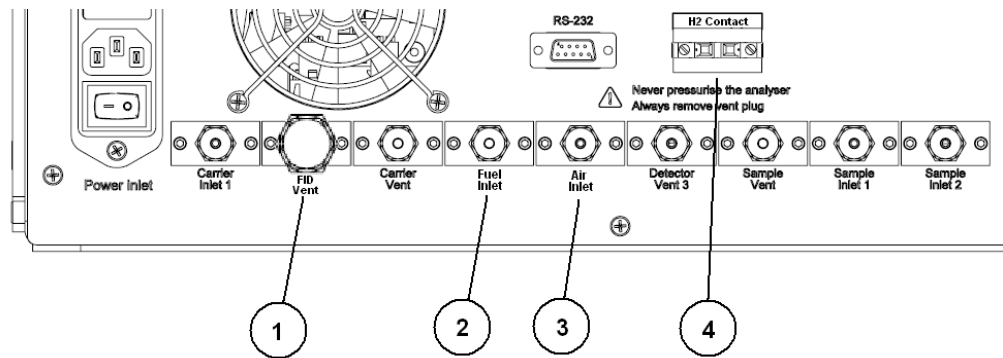
Figure 3 : Gas connections when FID Detector fitted

When a FID detector is installed in the SERVOPRO Chroma, the function of some of the rear gas connections are changed, as shown in Figure 3.

1. FID Detector vent
2. Fuel inlet
3. Air inlet
4. H2 contacts to control the fuel shut-off valve (see section 6.2.7)

See Section 12 for more information on the FID detector.

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
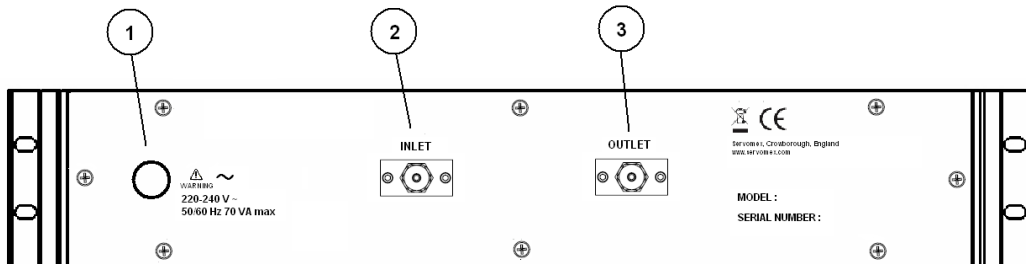
Figure 4 : Auxiliary Oven rear connections

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
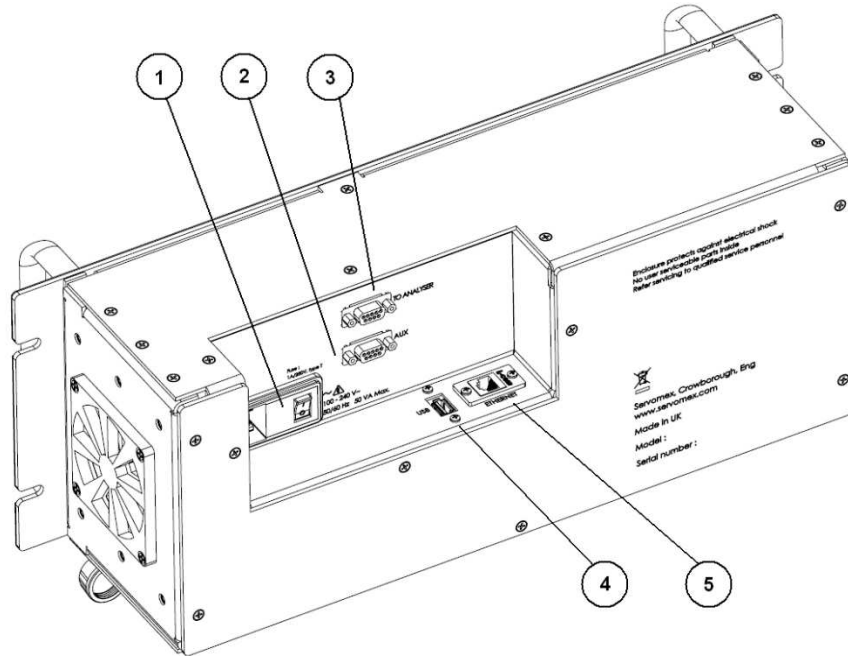
Figure 5 : Standalone PC rear connections

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 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 Chroma 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 SOFTWARE LICENSE

2.1 MICROSOFT SOFTWARE LICENSE TERM

WINDOWS OPERATING SYSTEM   **Last updated [July 2015]**

IF YOU LIVE IN (OR IF YOUR PRINCIPAL PLACE OF BUSINESS IS IN) THE UNITED STATES, PLEASE READ THE BINDING ARBITRATION CLAUSE AND CLASS ACTION WAIVER IN SECTION 9. IT AFFECTS HOW DISPUTES ARE RESOLVED.

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1. Overview.

   a. **Applicability.** This agreement applies to the Windows software that is preinstalled on your device, or acquired from a retailer and installed by you, the media on which you received the software (if any), any fonts, icons, images or sound files included with the software, and also any Microsoft updates, upgrades, supplements or services for the software, unless other terms come with them. It also applies to Windows apps developed by Microsoft that provide functionality such as mail, calendar, contacts, and news that are included with and are a part of Windows. If this agreement contains terms regarding a feature or service not available on your device, then those terms do not apply.

   b. **Additional terms.** Depending on your device's capabilities, how it is configured, and how you use it, additional Microsoft and third party terms may apply to your use of certain features, services and apps.

      (i)   Some Windows apps provide an access point to, or rely on, online services,

and the use of those services is sometimes governed by separate terms and privacy policies, such as the Microsoft Services Agreement at (aka.ms/msa). You can view these terms and policies by looking at the service terms of use or the app's settings, as applicable; please read them. The services may not be available in all regions.

(ii) The manufacturer or installer may also preinstall apps, which will be subject to separate license terms.

(iii) The software may include third party software such as Adobe Flash Player that is licensed under its own terms. You agree that your use of Adobe Flash Player is governed by the license terms for Adobe Systems Incorporated at (aka.ms/adobeflash). Adobe and Flash are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States and/or other countries.

(iv) The software may include third party programs that Microsoft, not the third party, licenses to you under this agreement. Notices, if any, for the third party program are included for your information only.

2. Installation and Use Rights.

a. **License.** The software is licensed, not sold. Under this agreement, we grant you the right to install and run one instance on your device (the licensed device), for use by one person at a time, so long as you comply with all the terms of this agreement. Updating or upgrading from non-genuine software with software from Microsoft or authorized sources does not make your original version or the updated/upgraded version genuine, and in that situation, you do not have a license to use the software.

b. **Device.** In this agreement, "device" means a physical hardware system) with an internal storage device capable of running the software. A hardware partition or blade is considered to be a device.

c.   **Restrictions.** The manufacturer or installer and Microsoft reserve all rights (such as rights under intellectual property laws) not expressly granted in this agreement. For example, this license does not give you any right to, and you may not:

(i)   use or virtualize features of the software separately;

(ii)   publish, copy (other than the permitted backup copy), rent, lease, or lend the software;

(iii)   transfer the software (except as permitted by this agreement);

(iv)   work around any technical restrictions or limitations in the software;

(v)   use the software as server software, for commercial hosting, make the software available for simultaneous use

by multiple users over a network, install the software on a server and allow users to access it remotely, or install the software on a device for use only by remote users;

(vi) reverse engineer, decompile, or disassemble the software, or attempt to do so, except if the laws where you live (or if a business where your principal place of business is located) permit this even when this agreement does not. In that case, you may do only what your law allows; and

(vii) when using Internet-based features you may not use those features in any way that could interfere with anyone else's use of them, or to try to gain access to or use any service, data, account, or network, in an unauthorized manner.

d. Multi use scenarios.

(i) **Multiple versions.** If when acquiring the software you were provided with multiple versions (such as 32-bit and 64-bit versions), you may install and activate only one of those versions at a time.

(ii) **Multiple or pooled connections.** Hardware or software you use to multiplex or pool connections, or reduce the number of devices or users that access or use the software, does not reduce the number of licenses you need. You may only use such hardware or software if you have a license for each instance of the software you are using.

(iii) **Device connections**. You may allow up to 20 other devices to access the software installed on the licensed device for the purpose of using the following software features: file services, print services, Internet information services, and Internet connection sharing and telephony services on the licensed device. The 20 connection limit applies to devices that access the software indirectly through "multiplexing" or other software or hardware that pools connections. You may allow any number of devices to access the software on the licensed device to synchronize data between devices. This section does not mean, however, that you have the right to install the software, or use the primary function of the software (other than the features listed in this section), on any of these other devices.

(iv) **Remote access.** Users may access the licensed device from another device using remote access

technologies, but only on devices separately licensed to run the same or higher edition of this software.

(v)   **Remote assistance.** You may use remote assistance technologies to share an active session without obtaining any additional licenses for the software. Remote assistance allows one user to connect directly to another user's computer, usually to correct problems.

(vi)   **POS application.** If the software is installed on a retail point of service device, you may use the software with a point of service application ("POS Application"). A POS Application is a software application which provides only the following functions: (i) process sales and service transactions, scan and track inventory, record and/or transmit customer information, and perform related management functions, and/or (ii) provide information directly and indirectly to customers about available products and services. You may not use the software on a device with automated teller machine ("ATM") as the primary functionality.

(vii)   **Cloud Computing Devices.** If your device uses Internet browsing functionality to connect to and access cloud hosted applications: (i) no desktop functions may run locally on the device, and (ii) any files that result from the use of the desktop functions may not be permanently stored on the industry system. "Desktop functions," as used in this agreement, means a consumer or business task or process performed by a computer or computing device. This includes word processing, spreadsheets, database, scheduling, and personal finance.

(viii) **Desktop Functions**. If your system performs desktop functions, then you must ensure that they: (i) are only used to support the industry application, and (ii) operate only when used with the industry application.

(ix)   **Specific Use.** The manufacturer designed the licensed device for a specific use. You may only use the software for that use.

e.   **Backup copy.** You may make a single copy of the software for backup purposes, and may also use that backup copy to transfer the software if it was acquired as stand-alone software, as described below.

3. **Privacy; Consent to Use of Data.** Your privacy is important to us. Some of the software features send or receive information when using those features. Many of these features can be switched off in the user interface, or you can choose not to use them. By accepting this agreement and using the software you agree that Microsoft may collect, use, and disclose the information as described in the Microsoft Privacy Statement available at (aka.ms/privacy), and as may be described in the user interface associated with the software features.

4. **Transfer to a Third Party.**

   c. **Software preinstalled on device.** If you acquired the software preinstalled on a device, you may transfer the license to use the software directly to another user, only with the licensed device. The transfer must include the software and, if provided with the device, an authentic Windows label including the product key. Before any permitted transfer, the other party must agree that this agreement applies to the transfer and use of the software.

   d. **Software preinstalled on device.** If you acquired the software preinstalled on a device, you may transfer the license to use the software directly to another user, only with the licensed device. The transfer must include the software and, if provided with the device, an authentic Windows label including the product key. Before any permitted transfer, the other party must agree that this agreement applies to the transfer and use of the software.

5. **Authorized Software and Activation.** You are authorized to use this software only if you are properly licensed and the software has been properly enabled and activated with a genuine product key or by other authorized method. When you connect to the Internet while using the software, the software will automatically contact Microsoft or its affiliate to confirm the software is genuine and the license is associated with the licensed device. You can also activate the software manually by Internet or telephone. In either case, transmission of certain information will occur, and Internet, telephone and SMS service charges may apply. During activation (or reactivation that may be triggered by changes to your device's components), the software may determine that the installed instance of the software is counterfeit, improperly licensed or includes unauthorized changes. If activation fails the software will attempt to repair itself by replacing any tampered Microsoft software with genuine Microsoft software. You may also receive reminders to obtain a proper license for the software. You may not bypass or circumvent activation. To help determine if your software is genuine and whether you are properly licensed, see (aka.ms/genuine). Certain updates, support, and other services might only be offered to users of genuine Microsoft software.

6. **Updates.** You may obtain updates only from Microsoft or authorized sources, and Microsoft may need to update your system to provide you with those updates. The software periodically checks for system and app updates, and may download and install them for you. To the extent automatic updates are enabled on your device, by accepting this agreement, you agree to receive these types of automatic updates without any additional notice.

7. **Geographic and Export Restrictions.** If your software is restricted for use in a particular geographic region, then you may activate the software only in that region. You must also comply with all domestic and international export laws and regulations that apply to the software, which include restrictions on destinations, end users, and end use. For further

information on geographic and export restrictions, visit (aka.ms/georestrict) and (aka.ms/exporting).

8. **Support and Refund Procedures.** For the software generally, contact the device manufacturer or installer for support options. Refer to the support number provided with the software. For updates and supplements obtained directly from Microsoft, Microsoft may provide limited support services for properly licensed software as described at (aka.ms/mssupport). If you are seeking a refund, contact the manufacturer or installer to determine its refund policies. You must comply with those policies, which might require you to return the software with the entire device on which the software is installed for a refund.

9. **Binding Arbitration and Class Action Waiver if You Live in (or if a Business Your Principal Place of Business is in) the United States.**

    We hope we never have a dispute, but if we do, you and we agree to try for 60 days to resolve it informally. If we can't, you and we agree to **binding individual arbitration before the American Arbitration Association ("AAA") under the Federal Arbitration Act ("FAA"), and not to sue in court in front of a judge or jury**. Instead, a neutral arbitrator will decide and the arbitrator's decision will be final except for a limited right of appeal under the FAA. **Class action lawsuits, class-wide arbitrations, private attorney-general actions, and any other proceeding where someone acts in a representative capacity aren't allowed. Nor is combining individual proceedings without the consent of all parties.** "We," "our," and "us" includes Microsoft, the device manufacturer, and software installer.

    c. **Disputes covered—everything except IP.** The term "dispute" is as broad as it can be. It includes any claim or controversy between you and the manufacturer or installer, or you and Microsoft, concerning the software, its price, or this agreement, under any legal theory including contract, warranty, tort, statute, or regulation, **except disputes relating to the enforcement or validity of your, your licensors', our, or our licensors' intellectual property rights.**

    d. **Mail a Notice of Dispute first.** If you have a dispute and our customer service representatives can't resolve it, send a Notice of Dispute by U.S. Mail to the manufacturer or installer, ATTN: LEGAL DEPARTMENT. If your dispute is with Microsoft, mail it to Microsoft Corporation, ATTN: LCA ARBITRATION, One Microsoft Way, Redmond, WA 98052-6399. Tell us your name, address, how to contact you, what the problem is, and what you want. A form is available at (aka.ms/disputeform). We'll do the same if we have a dispute with you. After 60 days, you or we may start an arbitration if the dispute is unresolved.

    e. **Small claims court option.** Instead of mailing a Notice of Dispute, and if you meet the court's requirements, you may sue us in small claims court in your county of residence (or if a business your principal place of business) or our principal place of business– King County, Washington USA if your dispute is with Microsoft. We hope you'll mail a Notice of Dispute and give us 60 days to try to work it out, but you don't have to before going to small claims court**.**

    f. **Arbitration procedure.** The AAA will conduct any arbitration under its   Commercial Arbitration Rules (or if you are an individual and use the software for personal or

household use, or if the value of the dispute is
$75,000 USD or less whether or not you are an individual or how you use the software,
its Consumer Arbitration Rules). For more information, see www.adr.org or call 1-800-
778-7879. To start an arbitration, submit the form available at (aka.ms/arbitration) to
the AAA; mail a copy to the manufacturer or installer (or to Microsoft if your dispute is
with Microsoft). In a dispute involving $25,000 USD or less, any hearing will be
telephonic unless the arbitrator finds good cause to hold an in-person hearing instead.
Any in-person hearing will take place in your county of residence (of if a business your
principal place of business) or our principal place of business—King County,
Washington if your dispute is with Microsoft. You choose. The arbitrator may award
the same damages to you individually as a court could. The arbitrator may award
declaratory or injunctive relief only to you individually to satisfy your individual claim.

g. **Arbitration fees and payments.**

  (i)   **Disputes involving $75,000 USD or less**. The manufacturer
or installer (or Microsoft if your dispute is with Microsoft)
will promptly reimburse your filing fees and pay the AAA's
and arbitrator's fees and expenses. If you reject our last
written settlement offer made before the arbitrator was
appointed, your dispute goes all the way to an arbitrator's
decision (called an "award"), and the arbitrator awards you
more than this last written offer, the manufacturer or
installer (or Microsoft if your dispute is with Microsoft) will:
(1) pay the greater of the award or $1,000 USD; (2) pay your
reasonable attorney's fees, if any; and (3) reimburse any
expenses (including expert witness fees and costs) that your
attorney reasonably accrues for investigating, preparing,
and pursuing your claim in arbitration. The arbitrator will
determine the amounts unless you and we agree on them.

  (ii)   **Disputes involving more than $75,000 USD.** The AAA
rules will govern payment of filing fees and the AAA's and
arbitrator's fees and expenses.

  (iii)   **Disputes involving any amount.** If you start an arbitration
we won't seek our AAA or arbitrator's fees and expenses, or
your filing fees we reimbursed, unless the arbitrator finds
the arbitration frivolous or brought for an improper
purpose. If we start an arbitration we will pay all filing, AAA,
and arbitrator's fees and expenses. We won't seek our
attorney's fees or expenses from you in any arbitration.
Fees and expenses are not counted in determining how
much a dispute involves.

h.   **Must file within one year.** You and we must file in small claims court or arbitration any
claim or dispute (except intellectual property disputes — see Section 9.a.) within one
year from when it first could be filed. Otherwise, it's permanently barred

i.   **Severability**. If the class action waiver is found to be illegal or unenforceable as to all or
some parts of a dispute, those parts won't be arbitrated but will proceed in court, with

the rest proceeding in arbitration. If any other provision of Section 9 is found to be illegal or unenforceable, that provision will be severed but the rest of Section 9 still applies.

j.   **Conflict with AAA rules.** This agreement governs if it conflicts with the AAA's Commercial Arbitration Rules or Consumer Arbitration Rules.

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****

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3 SPECIFICATIONS

> ### WARNING
>
> You must install and use the SERVOPRO Chroma in accordance with the requirements of this section and subsequent sections of the manual. If you do not, 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 Standalone 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, Secondary, 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:
FID: up to 5% full scale
Plasma: up to 3% full scale
TCD: up to 5% full scale

3.1 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 5.125 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 or Secondary chassis:	400 VA
Auxiliary oven:	400 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
Carrier gas pressure rating	
Minimum (plasma, TCD):	630.6 kPa (90 psig)
Minimum (FID):	828.6 kPa (120 psig)
Maximum:	828.6 kPa (120 psig)
Sample gas pressure rating	
Minimum:	69.0 kPa (10 psig)
Maximum:	137.9 kPa (20 psig)
Detector type:	Plasma, TCD and FID

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

3.2 Gas

Carrier gas:

Type	Argon, Helium or Nitrogen*
Pressure range	630.6 to 690.5 kPa (90 to 100 psig)
Flow	30 cc/min to 1000 cc/min

Sample gas:

Type	Hydrogen, Oxygen, Nitrogen, Argon, Neon, Helium, Carbon Dioxide, Nitrous Oxide (for other sample gases contact Servomex)
Pressure range	69.0 to 137.9 kPa (10 to 20 psig)
Flow	25 cc/min to 150 cc/min

For analyser fitted with FID:

Gas used for combustion	Air and Hydrogen[3]
Pressure range for Air and Fuel	103.4 to 206.9 kPa (15 to 30 psig)
Air flow	300 to 500 cc/min
Fuel flow	30 to 100 cc/min

Table 3 : Gas Specification

---

[3] Hydrocarbon traps must be used to remove hydrocarbons
*Nitrogen option available when FID or TCD detector fitted

3.3 Ovens Specification

Chromatographic oven:

Maximum temperature	300 ˚C	Minimum temperature	Ambient

Auxiliary oven:

Maximum temperature	300 ˚C	Minimum temperature	Ambient

FID Oven:

Maximum temperature	100 ˚C	Minimum temperature	Ambient

TCD oven:

Maximum temperature	300 ˚C	Minimum temperature	Ambient

Table 4 : Ovens specification

3.4 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

Table 5 : Environmental limits

3.5 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 6 : Digital relay outputs

3.6 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	More than 20 mA (24 mA maximum)
Cable requirements:	
Type	Multi-strand twisted pair with overall screen
Size	$0.2 – 3.3 \text{ mm}^2$ (24-12AWG)
Maximum length	30 m

Table 7 : 4-20 mA outputs

3.7 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	$0.2 – 3.3 \text{ mm}^2$ (24-12AWG)
Maximum length	30 m

Table 8 : Digital inputs

3.8 Hydrogen Relay Output

This relay is only available when a FID detector is

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

Table 9 : Hydrogen relay output

3.9 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

3.10 RS-232 Port

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

Table 11 : RS-232 port

3.11 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

3.12 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

3.13 Mains input cables (Master/Secondary/Standalone 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

4 THE USER INTERFACE

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

4.1 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.

4.1.1 Edit Box control

The Edit Box control is used to input or view a numerical value. A typical use of this control might be the input of the cycle length.
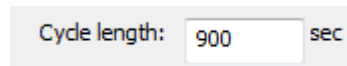
Figure 6: Edit Box control

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.

4.1.2 Radio control

The Radio control is used to select a mode of operation, for example, the range mode.
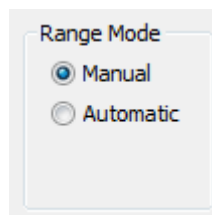
Figure 7 : Radio control

To 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.

4.1.3 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.
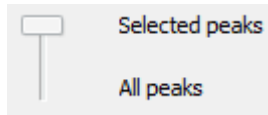
Figure 8 : Slide control

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 from the mouse, move the slider to the required position.

4.1.4 Push button control

Click on a push button to initiate the action that is displayed on the button.
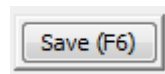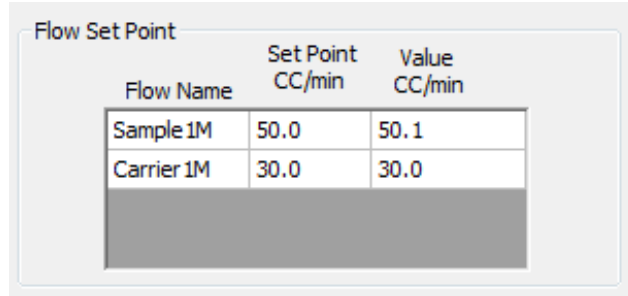
Figure 9 : Button control

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

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

4.1.5 Grid control

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

Figure 10 : 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.

4.1.6 Combo control

The Combo Box control is used to choose a value between sets of predetermined values.
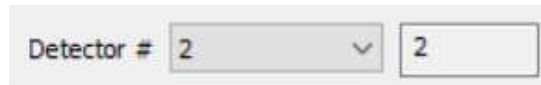
Figure 11 : Combo Box control

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.

4.1.7   Check Box control

The Check Box control is used to enable a feature.

Figure 12 : 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).

4.1.8   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.
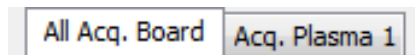
Figure 13 : Tab Box control

4.2 User Interface Menu Description

The analyser functions are grouped in menus which are structured as shown in Figure 14 : Menu Structure. The functions available from the menu are described in the following sections.
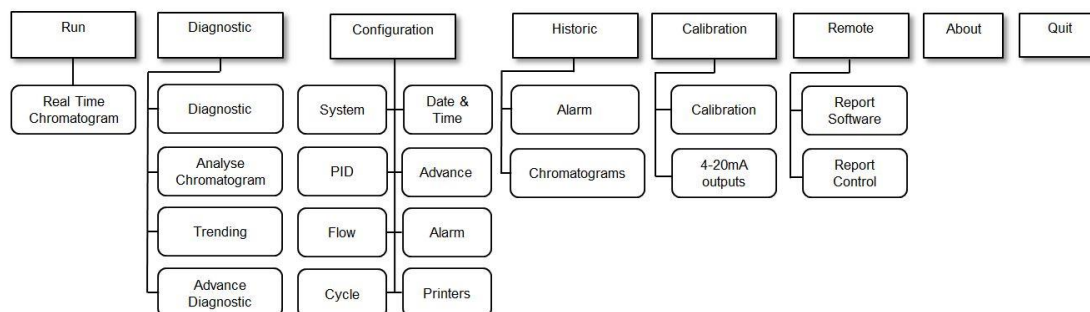
Figure 14 : Menu Structure

4.3 Run Menu

4.3.1 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 15), 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 ovens temperature and the cycle time.
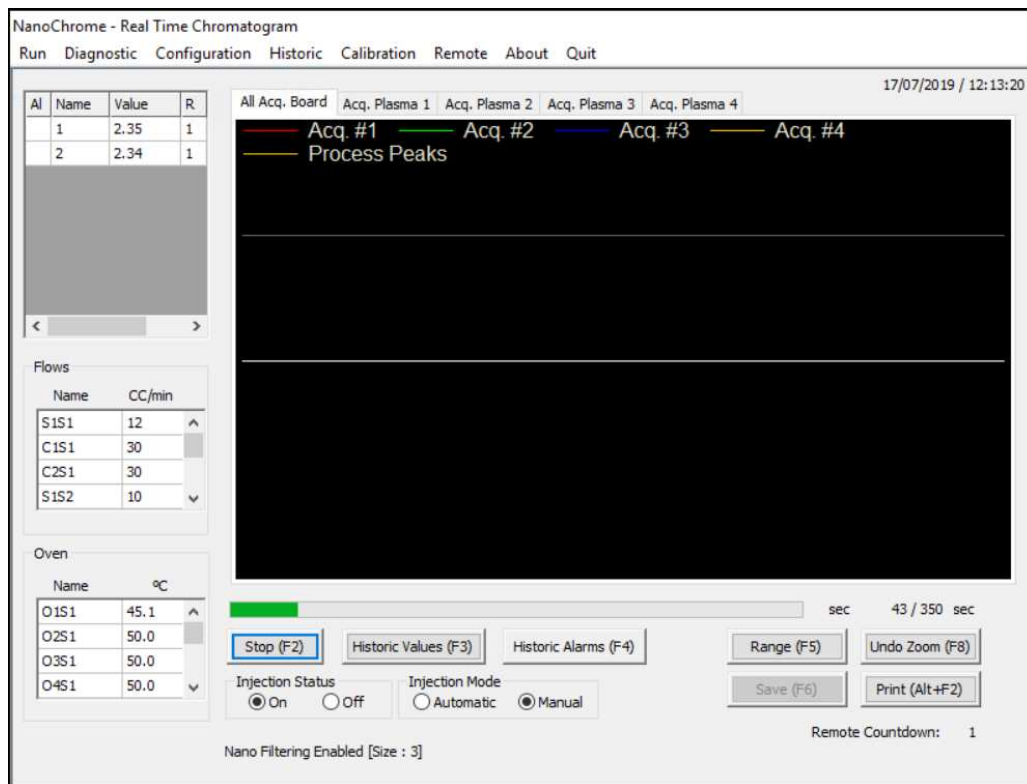
Figure 15 : Run - Real time menu

4.3.2 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 shown 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.

4.3.3   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.

4.3.4   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.

4.3.5   Historic Values (F3)

Displays the last 20 measures of concentration 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.

4.3.6   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 4.4.1.

4.3.7   Range (F5)

Use the **CONFIGURATION-SYTEM MENU** to select either **Manual** or **Automatic** ranging. If **Manual r**anging 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. 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

Figure 16 : Peak Grid – Alarm Status display colours

4.3.8   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 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 by using 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 you see the integration windows.

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

4.3.9   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.

4.3.10 Print (Alt F2)

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

4.3.11 Remote Countdown

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

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

4.4 Historic Menu

4.4.1   Alarm Menu

Displays the last 200 system alarms, peak value alarms and event logs, and all the current 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 and 2 cc/min for the TCD for 30 seconds, a "Plasma #X on I/O Board #X shut down" or "TCD #X on I/O Board #X shut down" alarm will be initiated to protect the system by turning off the plasma or TCD.

- *Plasma shut down or TCD shut down*
  When a "Low carrier flow" alarm remains active for 30 seconds, turns the plasma or TCD off.

- *Plasma OFF*
  When the cell signal counts are lower than the starting count, it indicates that the plasma 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 4.6.1, **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, 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 degree 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) <u>Peripheral alarms:</u>

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 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" message and for the "Plasma OFF" that is resolved with a "Plasma ON" message).

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)

4.5 Diagnostic Menu

4.5.1 Diagnostic

Pressing **Diagnostic (CTRL-P)** on the menu bar and then on **Diagnostic** brings you to the **DIAGNOSTIC-DIAGNOSTIC MENU** (**Figure 17**). The system diagnostic menu provides information about 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 17 : 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, from 0 to 16777215 and also in volts, between 0 - 5V.
Chromatogram signal	Displays 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. This is used with a FID (flame ionisation detector).
Scale Factor	Displays the scale factor in use (x1, x2, x5 or x10), applied to the gain when range 1 is in use. The multiplier 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 the chassis and outside the chassis for the main I/O Board. If there's more than one IO Board into the analyser, only the inside temperature is shown for the others. The outside temperature sensor may not be fitted on all analysers in this event the reading will display a reading of "0.00"
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 15 : Diagnostic menu

Table 16 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 for the plasma detector, 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 plasmas (in %).

Table 16 : Diagnostic menu – manual checks

4.5.2 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 18**).
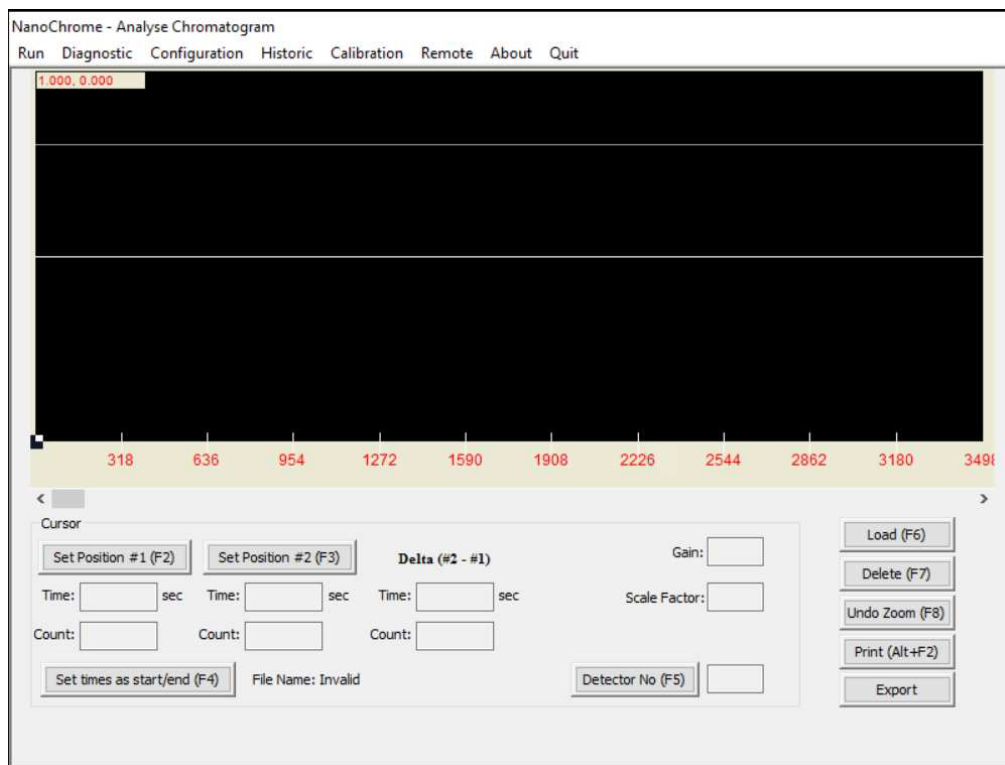
Figure 18 : Diagnostic – Analyse Chromatogram

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 first opened, the software requests the name of the file that has previously been saved. This can be a real-time chromatogram or a trending one. You can change the chromatogram by using the **Load (F6)** button.

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.

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.

1) <u>**Set times as start/end (F4)**</u>

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) <u>**Detector No (F5)**</u>

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) <u>**Load (F6)**</u>

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

4) <u>**Delete (F7)**</u>

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

5) <u>**Export**</u>

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 the Chromatogram to the USB memory stick
Detector No	F5	Move the cursor on the graph for the corresponding detector.

Table 17 : Diagnostic-Analyse Chromatogram menu

4.5.3 Trending

Press CTRL-T **or click on** Diagnostic **on the menu bar and then on** Trending **to reach the** DIAGNOSTIC-TRENDING **menu (Table Figure 19).**
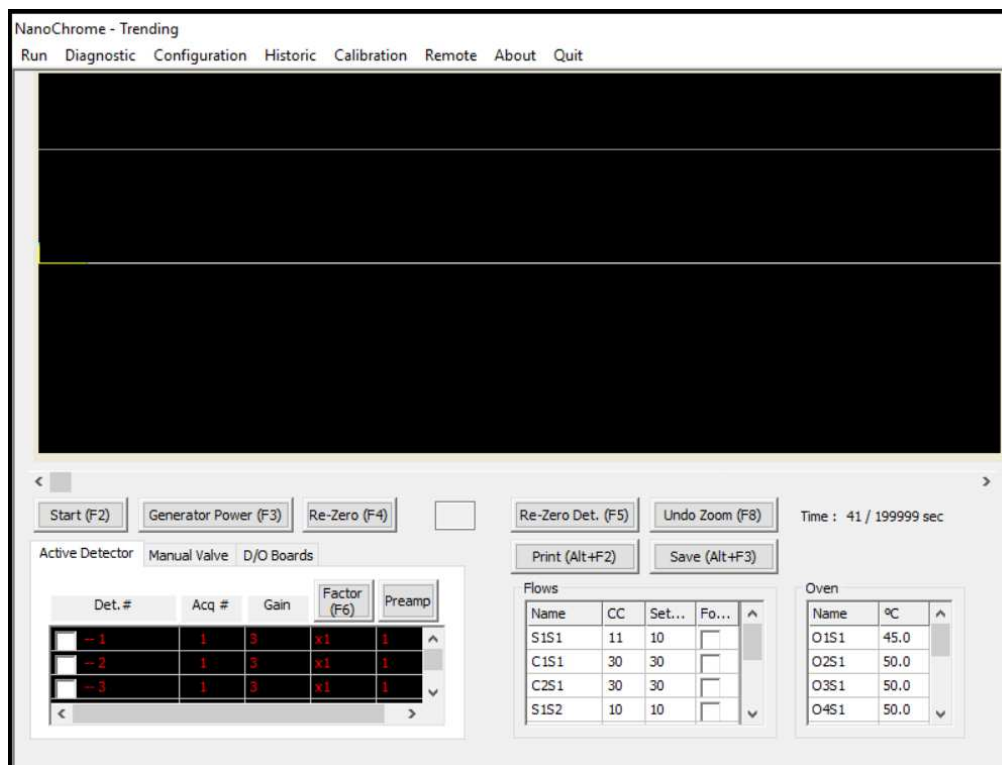
Figure 19 : Diagnostic - Trending menu

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 analyzer.

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 Figure 20).**
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 19).

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.

7) D/O Boards

The **D/O Boards** tab is used to control the digital outputs of the D/O Boards (if any) into the analyser.
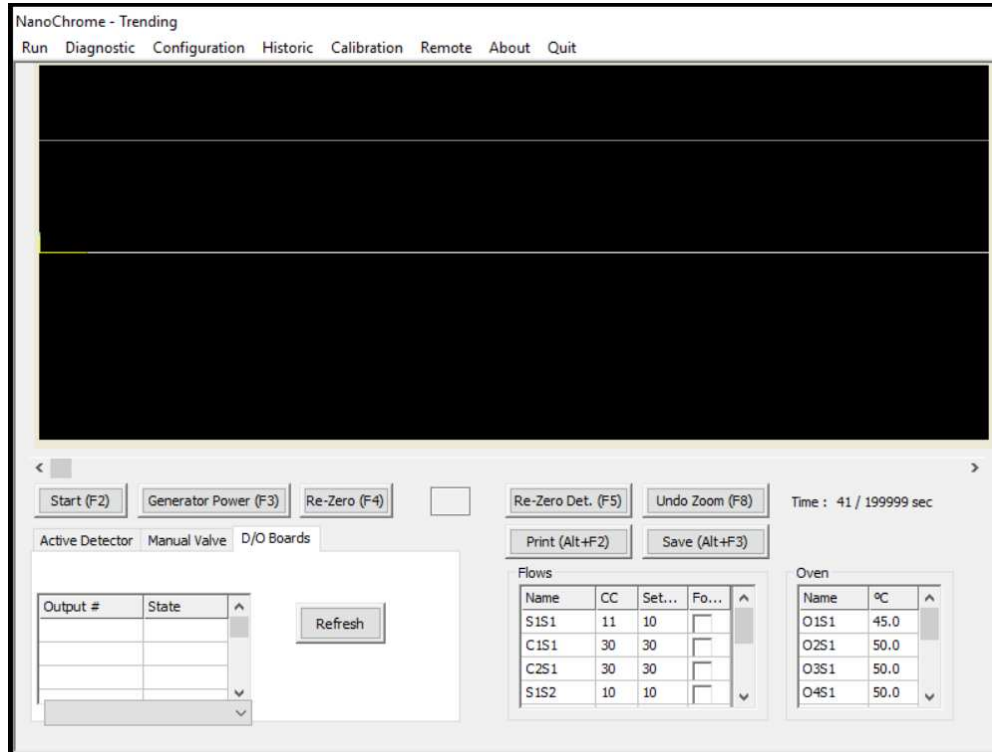
Figure 20 : Trending menu valve state

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 18 : Trending menu – summary of functions

4.5.4 Advanced Diagnostic

Click Diagnostic **on the menu bar and then** Advanced Diagnostic **to access the** DIAGNOSTIC-
ADVANCED DIAGNOSTIC **menu (Figure 21).**
This menu is used to trigger different components of the analyser.
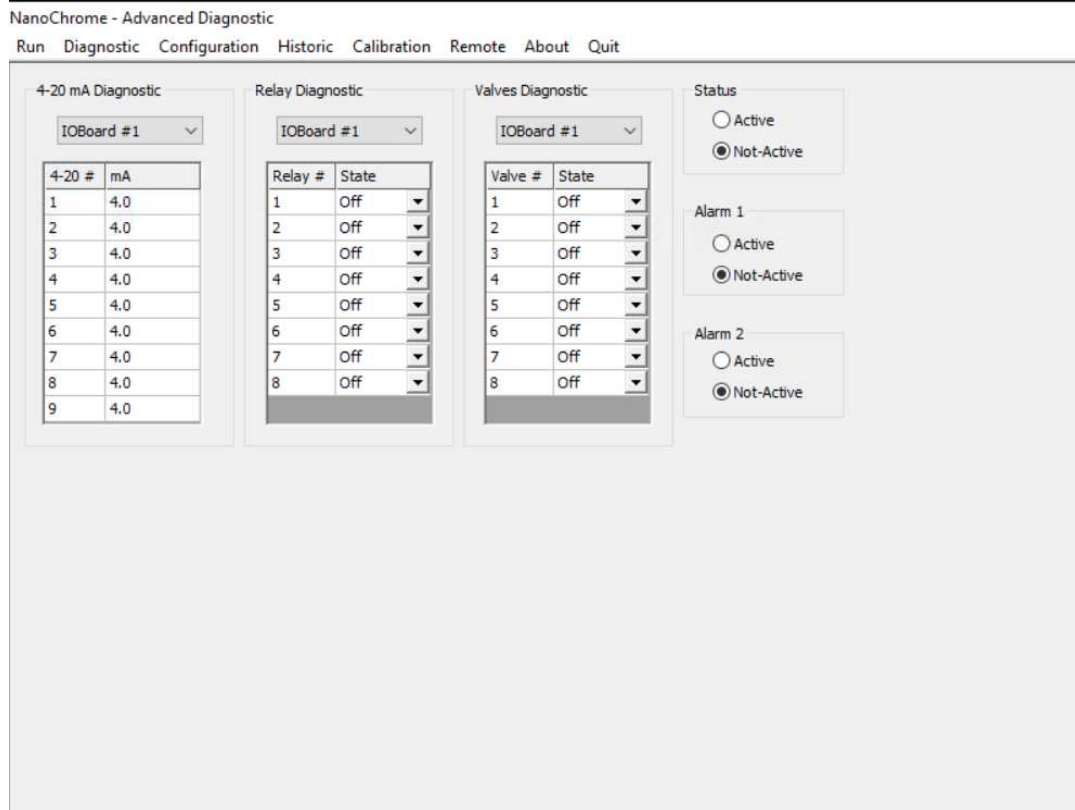
Figure 21 : Diagnostic - Advanced Diagnostic menu

1) <u>4-20 mA Diagnostic:</u>

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) <u>Relay Diagnostic:</u>

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) <u>Valves Diagnostic:</u>

This combo box is used to confirm the valves on the I/O Boards are working properly. 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) <u>Status, Alarm 1 and Alarm 2</u>

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

4.6 Configuration Menu

4.6.1 System

Press **CTRL-S** or click **Configuration** on the menu bar and then **System** to access the **CONFIGURATION-SYSTEM** menu (**Figure 22**). The **System** configuration menu allows adjustment of several key parameters.

Figure 22 : Configuration - System menu

1) <u>Analogue 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 the 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) <u>Generator Starting mode</u>

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

<u>NOTE</u>: The system checks if the plasma is OFF between cycles. This feature is used only when the analyser has a plasma cell.

4) <u>Range Mode</u>

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 all peaks, in Automatic ranging the second peak range can stay the same even if the first peak changes range.

5) <u>Auto-Start on Boot-Up</u>

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) <u>Flow Set Point</u>

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

The Flow Set Point 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).

DO NOT CHANGE THESE SETTINGS: they are factory configured.

7) <u>Oven set point</u>

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	200

Table 19 : Oven set point

DO NOT CHANGE THESE SETTINGS: they are fact configured.

8) <u>Remote Starting Enable</u>

When this check 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) <u>Screen Saver Enable</u>

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

10) Reload manufacturer settings

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 Chroma. 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) 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.

4.6.2 Proportional Integral Derivative (PID)

Click on Configuration **on the menu bar and then on** PID **to access the** CONFIGURATION-PID **menu (see Figure 23).**

DO NOT CHANGE THESE SETTINGS: they are factory configured.

Figure 23 : Configuration-PID menu

4.6.3 Flow

Click on **Configuration** on the menu bar and then on **Flow** to access the **CONFIGURATION-FLOW MENU** (see Figure 24).

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

Figure 24 : Configuration-Flow menu

4.6.4 Cycle

Clicking on **Configuration** on the menu bar and then on **Cycle** to access the **CONFIGURATION-CYCLE** menu (Figure 25).

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 25 : Configuration-Cycle menu

2) <u>Peak Configuration</u>

The data found in this menu is used during an analysis (Figure 26). 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 20 : Peak Configuration Columns).

Additional information about the peak currently highlighted in the grid is shown in the area below the grid. This information depends on the type of detector (see Table 21 : Peak Data).

The available Functions for the Peak Configuration menu are shown in Table 22 : Peak Configuration Menu.

DO NOT CHANGE THESE SETTINGS: they are factory configured.

Figure 26 : Cycle-Peak Configuration menu

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 20 : 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 21 : 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 22 : Peak Configuration Menu

SERVOPRO CHROMA Gas Analyser

3) <u>Peak Detection</u>

This menu allows modification of constants that are used in the peak detection (see Figure 27). The key parameters in this menu are described below, for information only.

Figure 27 : Peak detection configuration menu

> DO NOT CHANGE THESE SETTINGS: they are factory configured.

4) Valve data

The group box shown in Figure 28 is used to control the valve state. Each row in the grid indicates a sequence for the selected valve, see the example shown in Figure 29. The timings for valve ON (open) or OFF (close) are set during factory configuration.
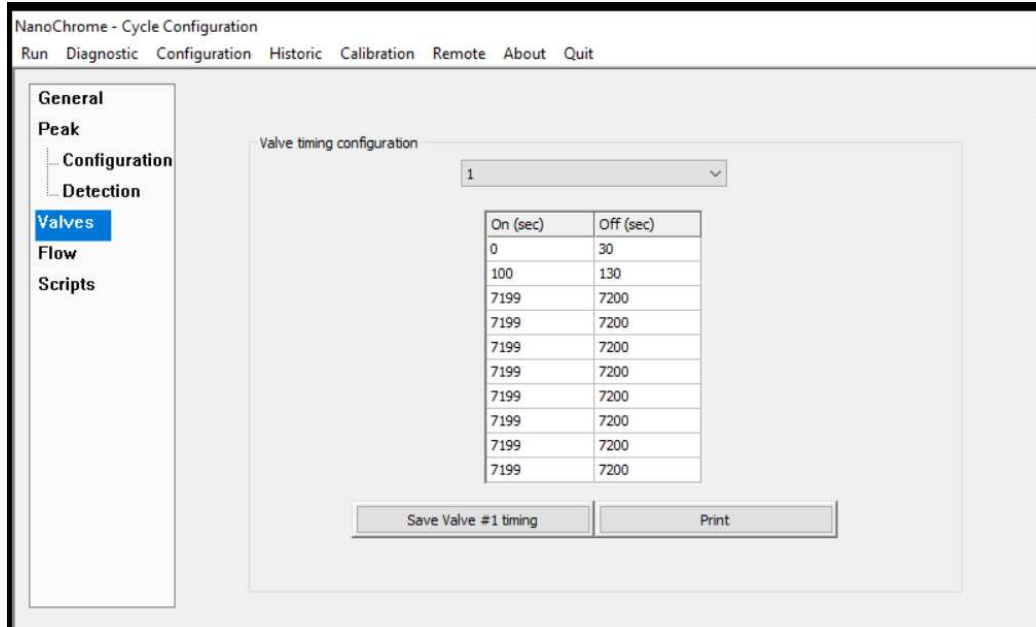
Figure 28 : Valve configuration menu
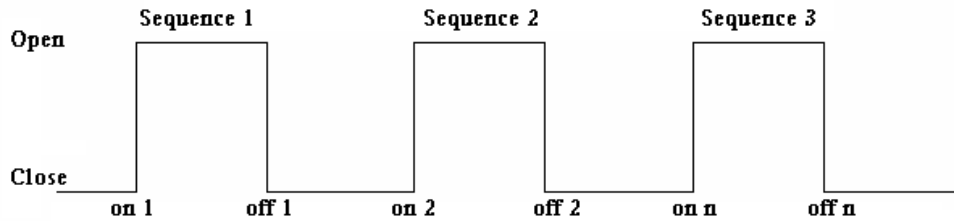
Figure 29 : Typical sequence for valve timing

DO NOT CHANGE THESE SETTINGS: they are factory configured.

5) <u>Flow</u>
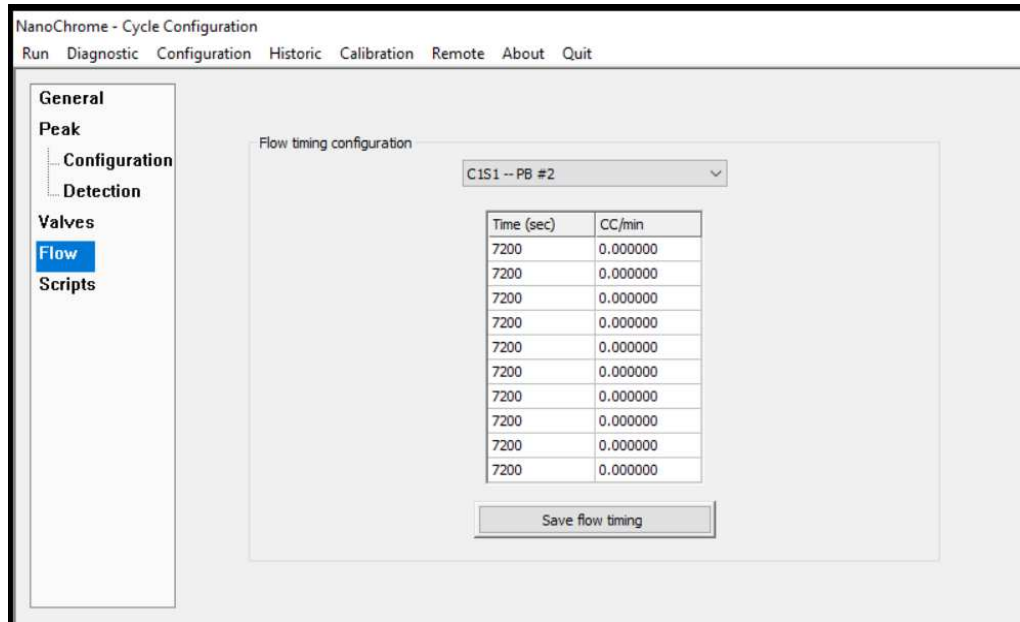
Figure 30 is used to configure the Flow timing table, which is used to change a flow set point during a cycle.

A time of 7200 secs means that this point is not in use. In the example shown in Figure 30, 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.
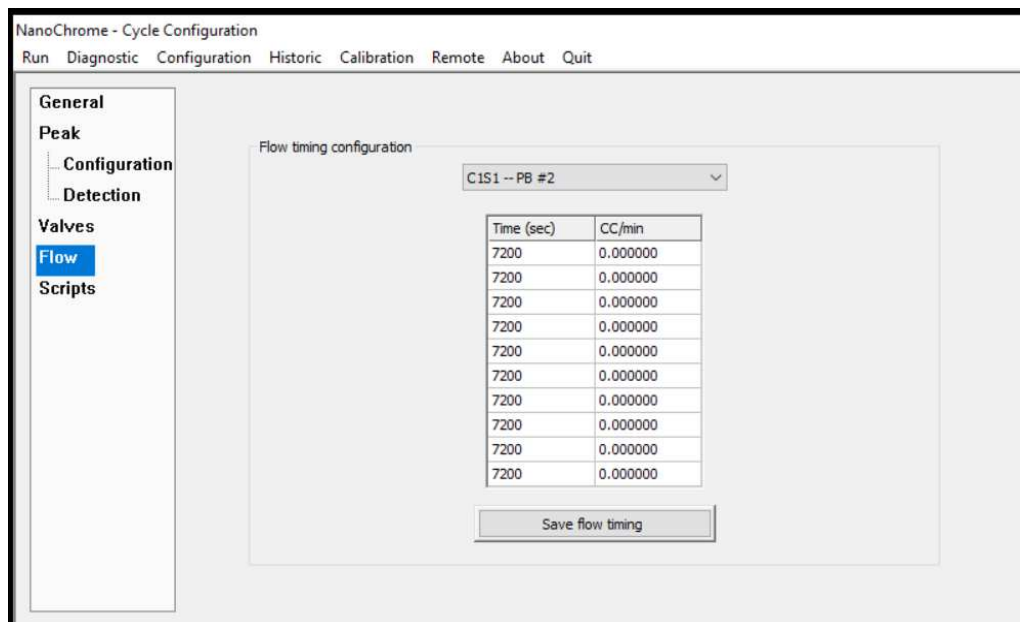
Figure 30 : Flow timing configuration menu

DO NOT CHANGE THESE SETTINGS: they are factory configured.

4.6.5 Date & Time

Click on **Configuration** on the menu bar and then on **Date & Time** to access the **CONFIGURATION-DATE & TIME** menu (see **Figure 31**).

Use the combo box control to change the value of the date and the time. Click on **Apply** to set the desired value.
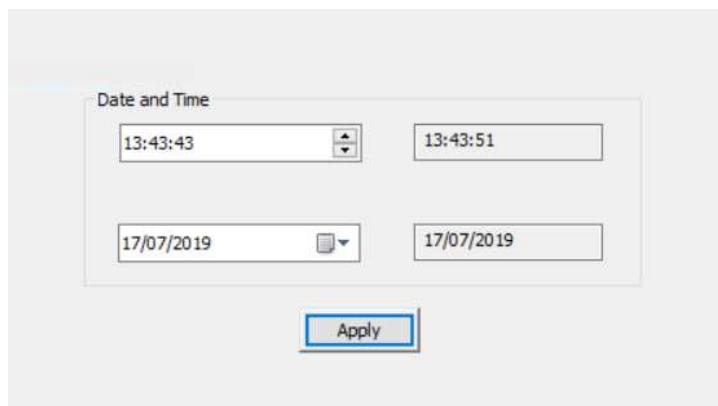
Figure 31 : Date and Time menu

4.6.6 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
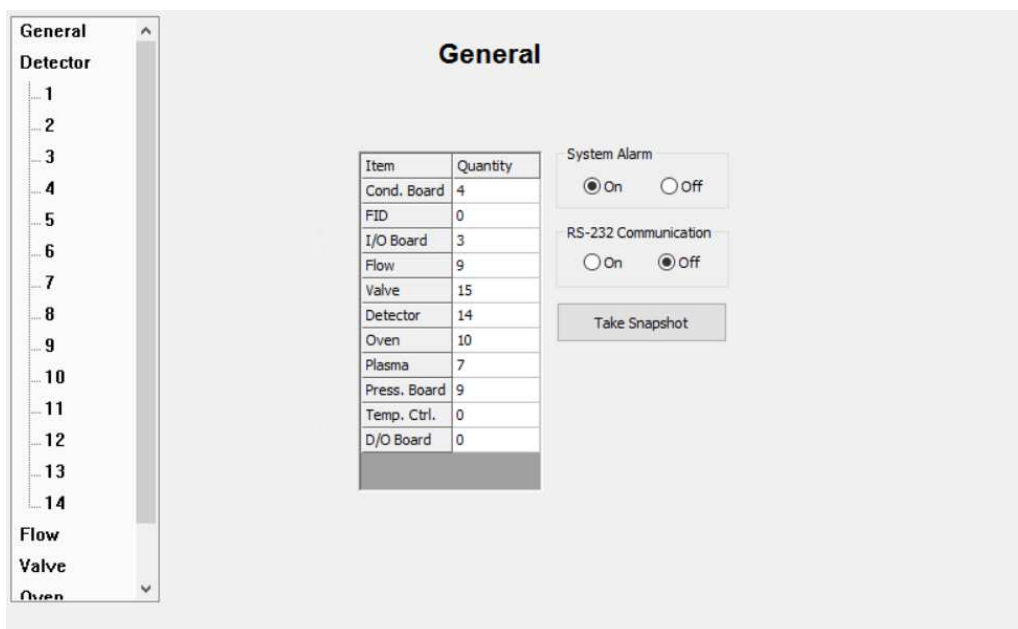
Figure 32 : Advanced configuration-General menu

The General **menu shows the entries for electronic boards, components and functionalities (see Figure 32).**

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 send to Servomex to help diagnose a problem in the analyser. Use this button only under supervision from Servomex.

2) <u>Detector Association</u>
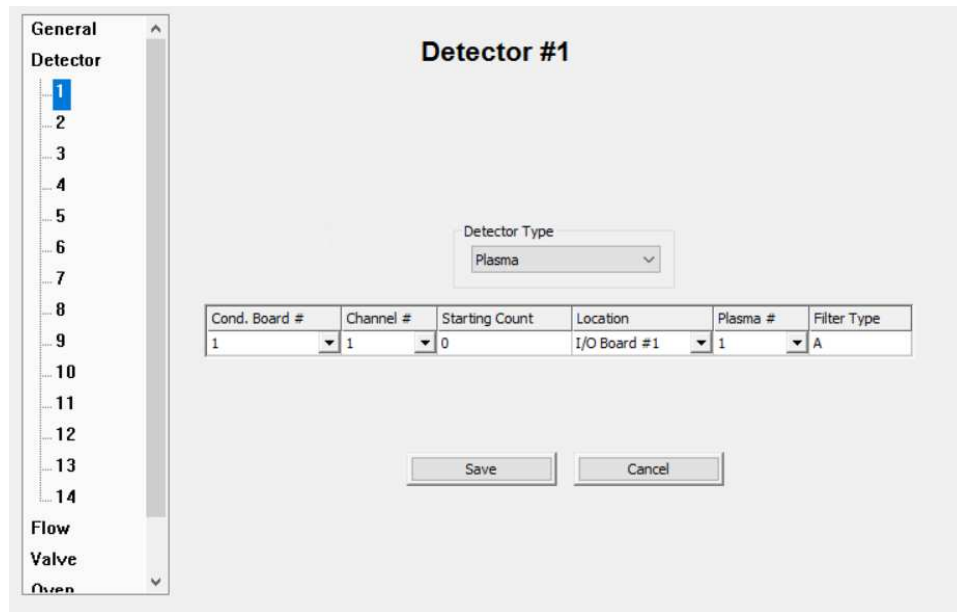
Figure 33 : Advanced configuration-Detector menu

The Detector menu shows each plasma cell, which is configured with a conditioning board selected for the correct channel (see Figure 33). 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 34 : Advanced configuration-Flow menu

The **Flow** menu associates a flow with a regulator on an I/O Board and a plasma detector (See Figure 34 : Advanced configuration-Flow menu). 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 35).**

DO NOT CHANGE THESE SETTINGS: they are factory configured.

Valve #	Location	Channel #
Valve #1	I/O Board #1	Channel #1
Valve #2	I/O Board #1	Channel #2
Valve #3	I/O Board #1	Channel #3
Valve #4	I/O Board #1	Channel #4
Valve #5	I/O Board #1	Channel #5
Valve #6	I/O Board #2	Channel #1
Valve #7	I/O Board #2	Channel #2
Valve #8	I/O Board #2	Channel #3
Valve #9	I/O Board #2	Channel #4
Valve #10	I/O Board #2	Channel #5
Valve #11	I/O Board #3	Channel #1
Valve #12	I/O Board #3	Channel #2
Valve #13	I/O Board #3	Channel #3
Valve #14	I/O Board #3	Channel #4
Valve #15	I/O Board #3	Channel #5

Figure 35 : 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 36).**

DO NOT CHANGE THESE SETTINGS: they are factory configured.

Name	Location		Channel #	
O1S1	I/O Board #1	▼	Channel #1	▼
O2S1	I/O Board #1	▼	Channel #2	▼
O3S1	I/O Board #1	▼	Channel #3	▼
O4S1	I/O Board #1	▼	Channel #4	▼
O1S2	I/O Board #2	▼	Channel #1	▼
O2S2	I/O Board #2	▼	Channel #2	▼
O3S2	I/O Board #2	▼	Channel #3	▼
O4S2	I/O Board #2	▼	Channel #4	▼
O5S2	I/O Board #2	▼	Channel #5	▼
O1S3	I/O Board #3	▼	Channel #1	▼

Figure 36 : Advanced configuration-Oven menu

4.6.7 Alarm

Click on **Configuration** on the menu bar and then on **Alarm** to access the **CONFIGURATION-ALARM MENU** (see Figure 37).

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 37 : Configuration Alarm menu

4.6.8 Printers

Click on **Configuration** on the menu bar and then on **Printers** to access the **CONFIGURATION-PRINTERS** menu (see Figure 38).
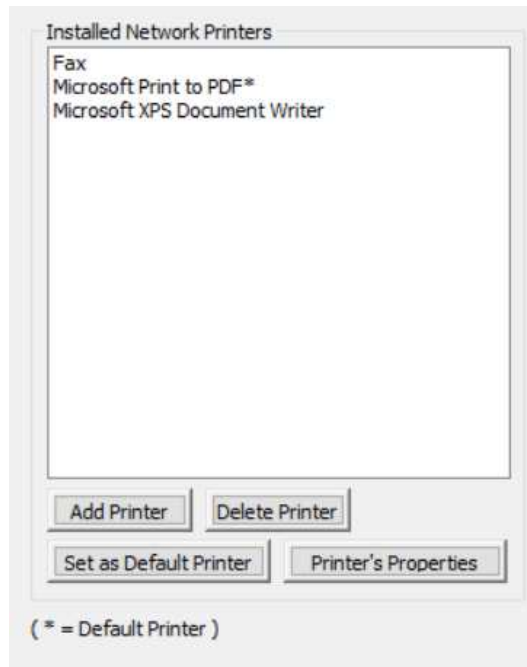
Figure 38 : Printers configuration menu

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 then insert into the USB port on the front of the analyser. Click on the **Add Printer** button and enter the password, either "c.a.i." or 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.

4.6.9 Export the Analyser Configuration

The analyser configuration may be backed up to a USB stick.

Click on **Configuration** on the menu bar and then on **System** to access the **CONFIGURATION-SYSTEM** menu.

Insert a USB stick in the USB port on the front of the analyser.

Click on the **Export Configuration** button to export the data to the USB stick. A message will appear confirming the export operation has started. After 5 minutes the stick can be removed from the USB port.

Note: refer to the Service Manual for instructions on how to import the configuration files back to the analyser.

4.7 Analyser Calibration

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

Click on **Calibration** on the menu bar and then **Calibration** to access the **CALIBRATION-CALIBRATION** menu (see Figure 39). 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.

Name	THRSH	Span Gas	Result	Rng	Select	TRS Done	Span Done	Response Factor	Area Count
1	220.7	2.44 ▾	2.35		YES ▾	YES	YES	85152	200442
2	155.2	2.44 ▾	2.34		YES ▾	YES	YES	86321	202195

Time : 41 sec

Click for Span | Enable (F2) | Print | Add 1 calib. values | Enable (F3)

Noise Threshold Calibration

Selected peaks

All peaks

Start (F4) | Calculate Threshold (F5)

Span Calibration

Selected peaks

☐ Automatic Re-Span

All peaks

Start (F6) | RE-SPAN (F7)

Figure 39 : Calibration menu

4.7.1 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 no cycle is currently running. Click on **Run-Real Time Chromatogram**, then select the **Manual Injection** option.

2. Click on the **Calibration-Calibration** menu (see Figure 39).

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, 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).

4.7.2 Span calibration

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 39).

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 40**).

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. 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).
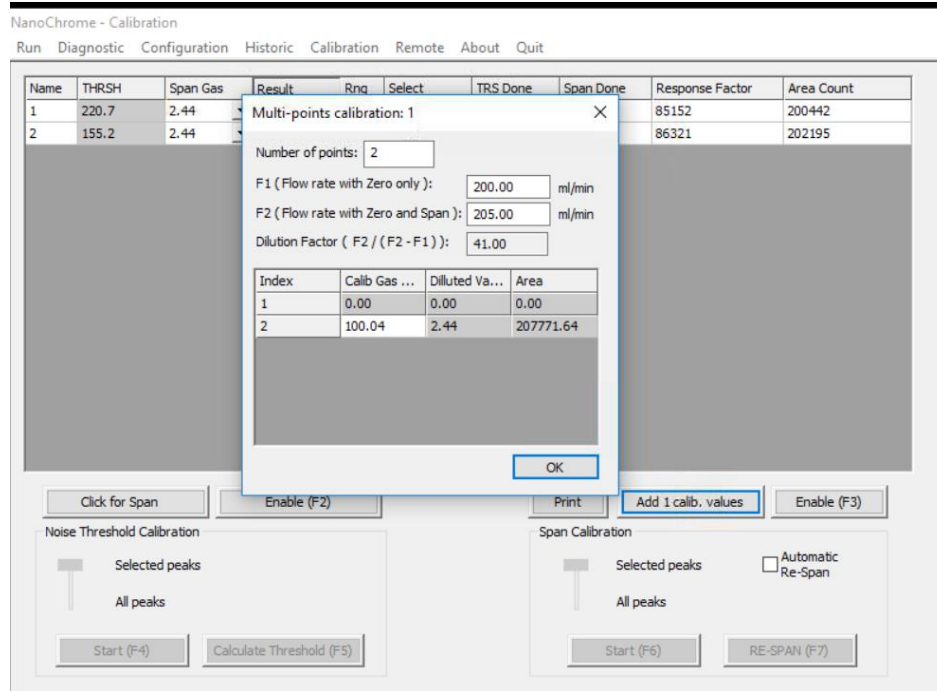
Figure 40 : Calibration-Span menu

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, RE-SPAN 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.

4.8 Calibration of the 4-20mA outputs

Click **Calibration** on the menu bar and then **4-20mA outputs** to access the **CALIBRATION-4-20MA OUTPUT CALIBRATION** menu (see Figure 41).

Figure 41 : Calibration- 4-20 mA outputs calibration menu
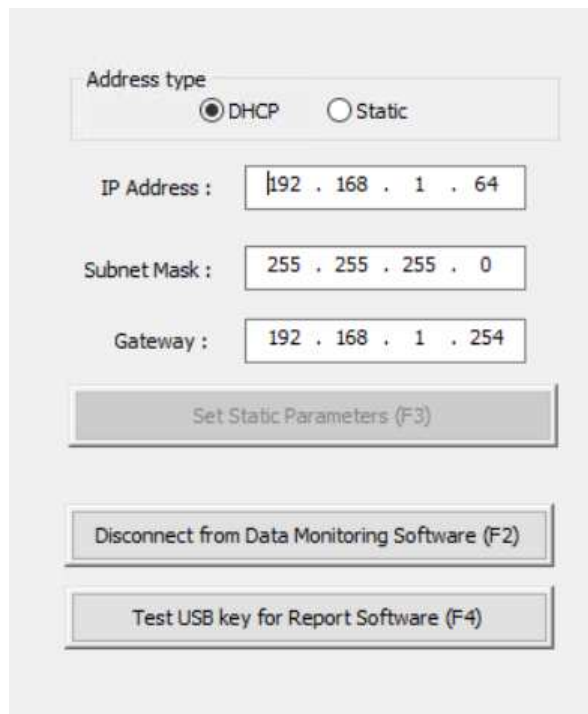
The 4-20mA outputs are factory configured. The setup procedure is shown below, but it is not normally required to be adjusted in the field.

► **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 rear panel of the analyser on the corresponding output
► **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.

4.9 Remote

4.9.1 Report Software

Clicking on **Remote** on the menu bar and then on **Report Software** brings you to the **REMOTE-REPORT SOFTWARE MENU** (see Figure 42).

Figure 42 : Remote-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.

4.9.2 Remote Control

Click on **Remote** on the menu bar and then on **Remote Control** to access the **REMOTE-REMOTE CONTROL** menu (see Figure 43).
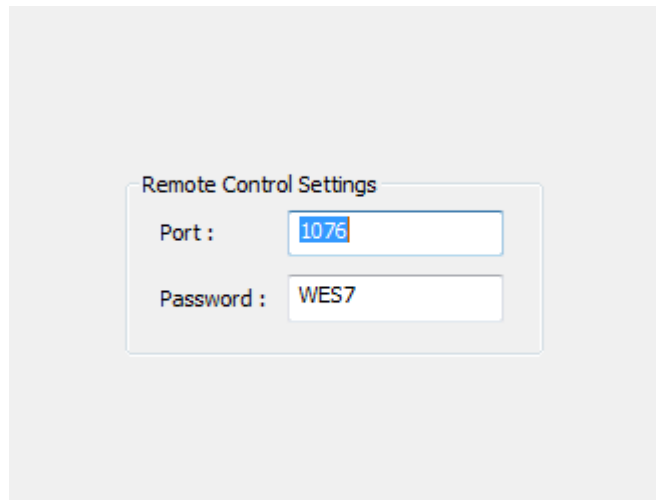
Figure 43 : Remote-Remote control menu

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.

4.10 About

Click on **About** on the menu bar to access the **ABOUT MENU.**
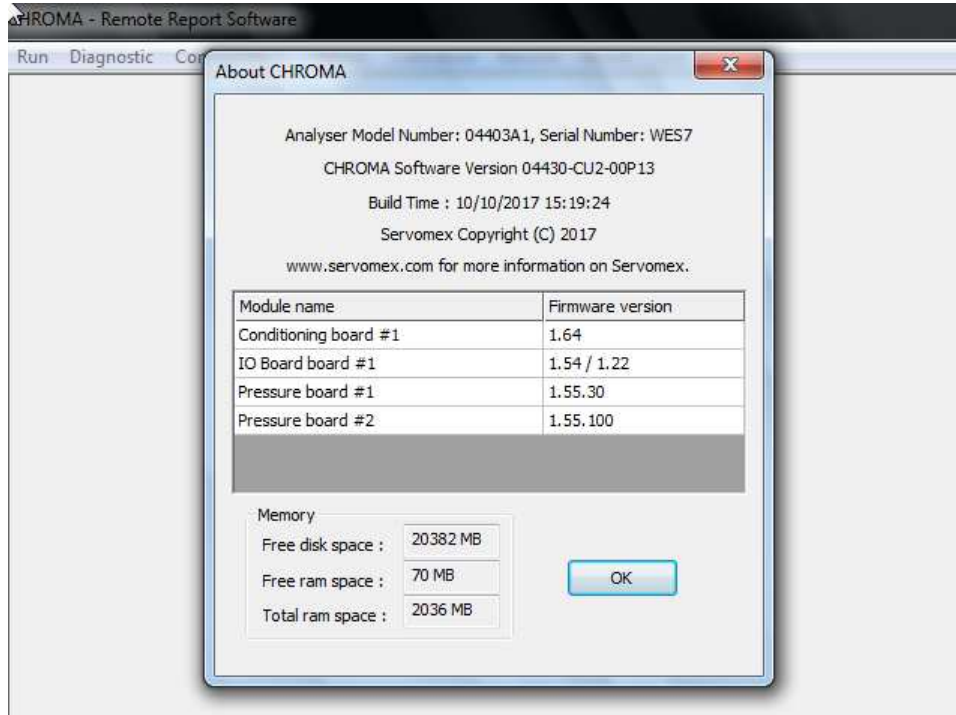
Figure 44 : About menu

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.

4.10.1 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 45). When selected, chromatogram will be saved at the end of each cycle. If not selected, chromatogram will not be saved.
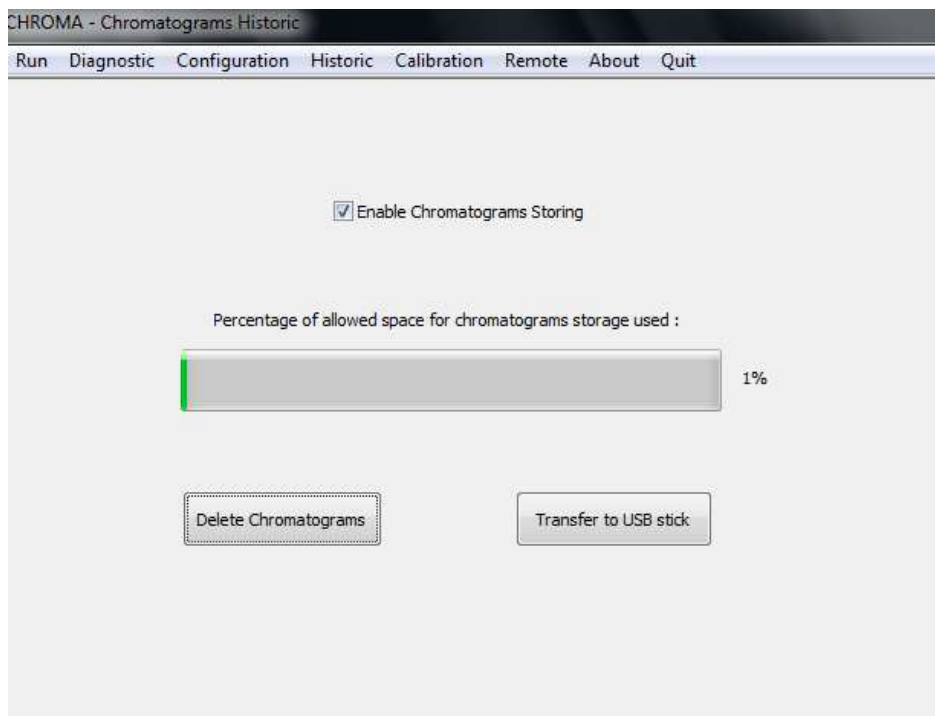
Figure 45 : Historic-Chromatogram saving menu

A space of 500 Mb is configured on the hard drive. This will allow storage of around two months 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_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.

4.10.2 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.

5 UNPACK THE ANALYSER

1. Remove the SERVOPRO Chroma 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:
   o Place the analyser and any other equipment supplied back in its protective packing.
   o Store the analyser as described in Section 9.1.
5. Otherwise, read Section 4 (User Interface), then continue to Section 6 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).

6 INSTALLATION AND SETUP

<div style="border:1px solid black; text-align:center">

CAUTION
Only apply power to the analyser in accordance with the Start-up Procedure (Section 7.3). Incorrect start-up may cause damage to the analyser.

</div>

6.1 Electrical installation

<div style="border:1px solid black; text-align:center">

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

</div>

<div style="border:1px solid black; text-align:center">

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.

</div>

6.1.1 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 3.1.
- 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.

6.1.2 Master chassis electrical connections

Figure 46 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 3.13).

If an auxiliary oven is supplied, connect the cable coming out of the auxiliary oven to the chassis connector named "Auxiliary Oven" (see section 1.5.2). The cable carries the power supply and the temperature measurement.
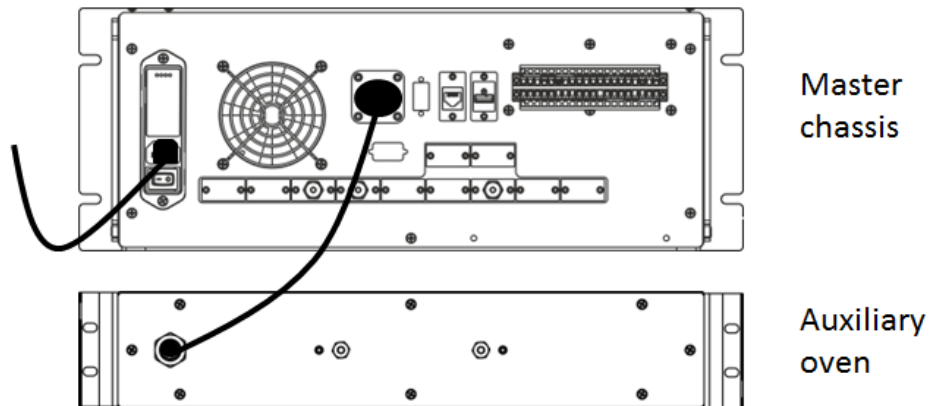
Figure 46 : Master chassis electrical connections

| ⚠ | WARNING

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

6.1.3 Master chassis with Secondary chassis electrical connections

Figure 47 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 3.13).

If an auxiliary oven is supplied, connect the cable coming out of the auxiliary oven to the chassis connector named "Auxiliary Oven" (see section 1.5.2). 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 3.11 and Figure 47).
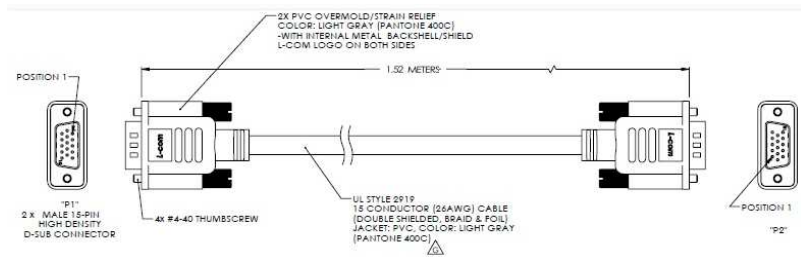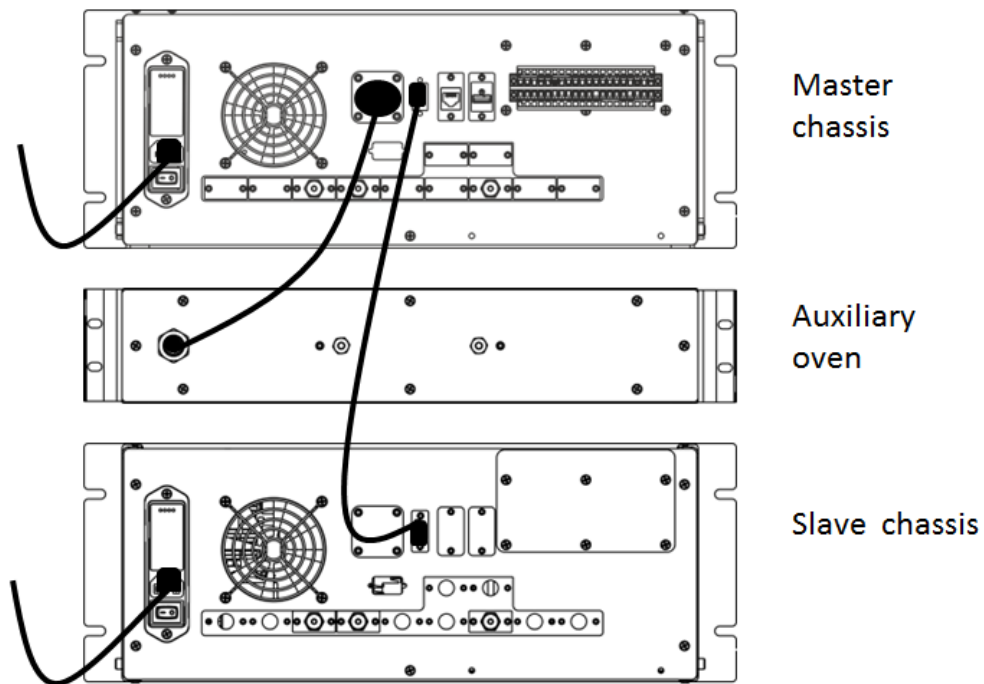
Figure 47 : Master with secondary chassis, electrical connections

Figure 48 shows how to connect the analyser 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 the RS-485 ports using the provided high density DB-9 cable (see section 3.11 and Figure 48).
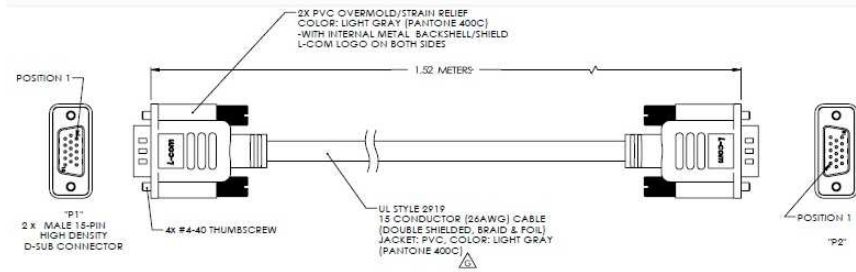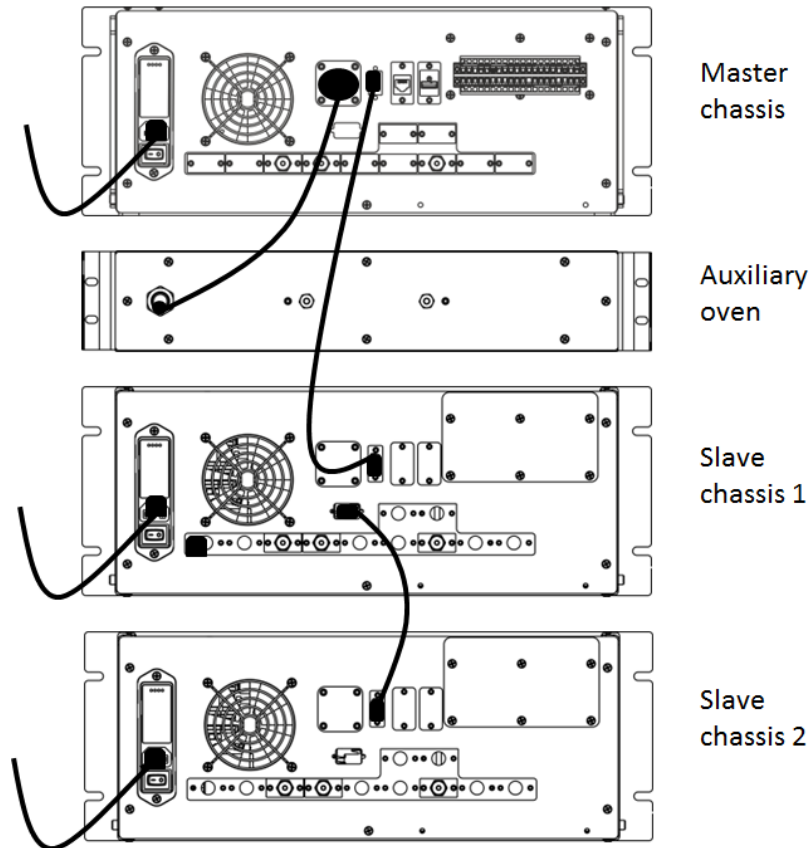
Figure 48 : Master with 2 Secondary Chassis, electrical connections

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

6.1.4 Stand-alone PC with Secondary chassis electrical connections
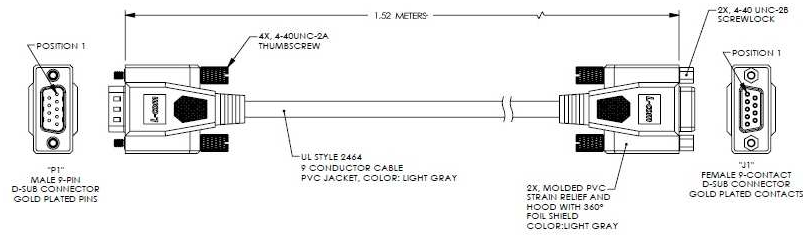
Figure 49 shows how to connect an analyser supplied as a stand-alone PC with a secondary chassis. Connections must be connected to a power source using properly rated cables (see section 3.13). The stand-alone PC must always be connected to the same protective earth as the secondary chassis of the system.

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 49).
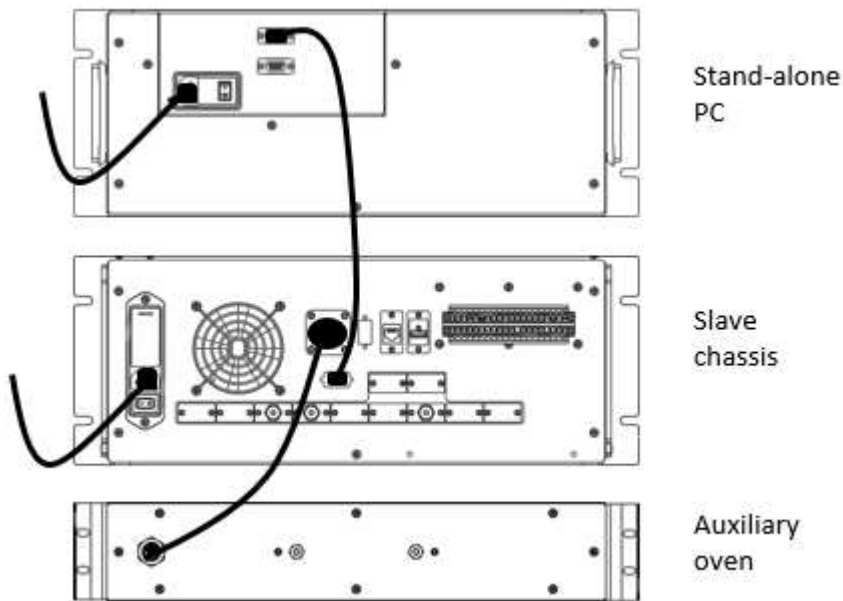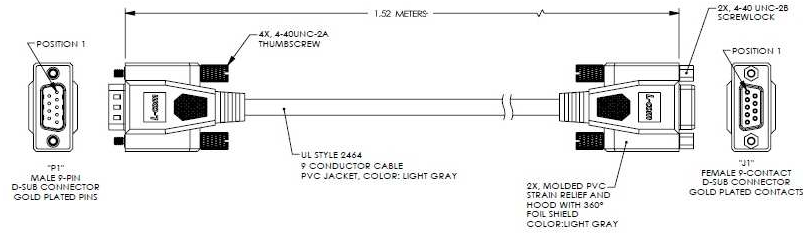
Figure 49 : Stand-alone PC with secondary, electrical connections

Figure 50 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 3.11 and Figure 50).
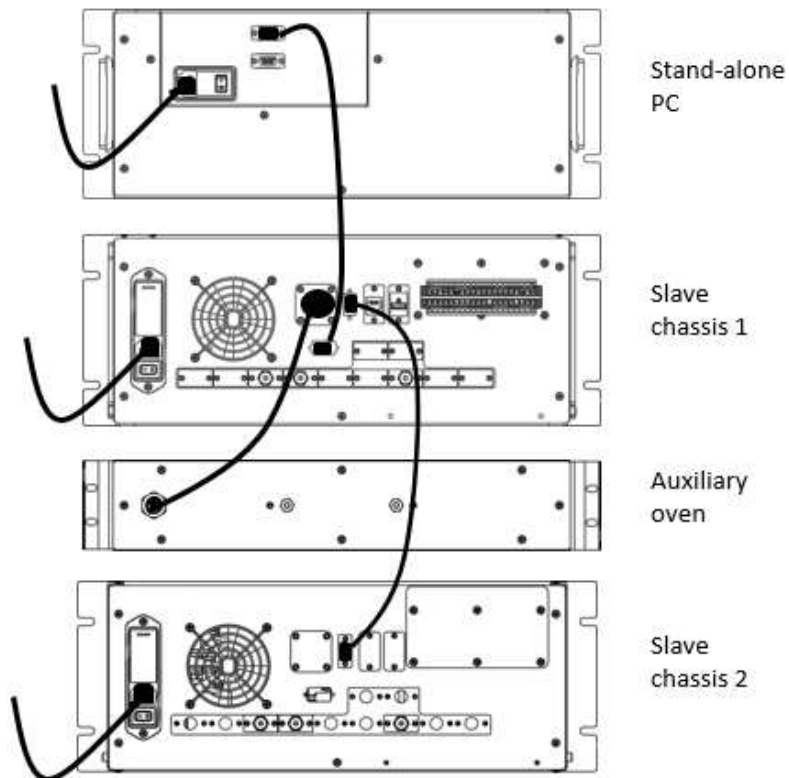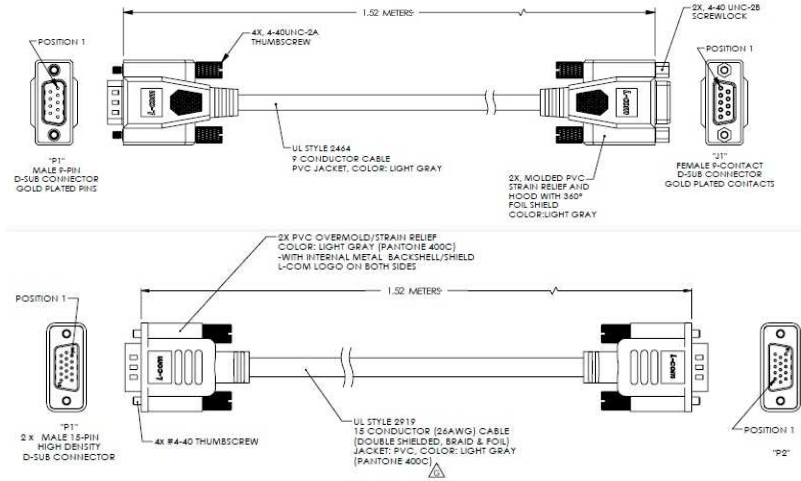
Figure 50 : Stand-alone PC with two Secondarys, electrical connections

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

6.2 Master/Secondary Chassis rear panel electrical connections

6.2.1 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 6.1.1.

The shield of the digital input contacts cable must be terminated to the analyser on one the "E" ports of the rear connector.
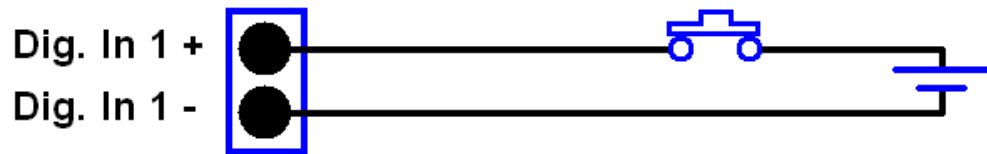
Figure 51 : Digital input connection

	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.

6.2.2 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 6.1.1

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 23 : 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.
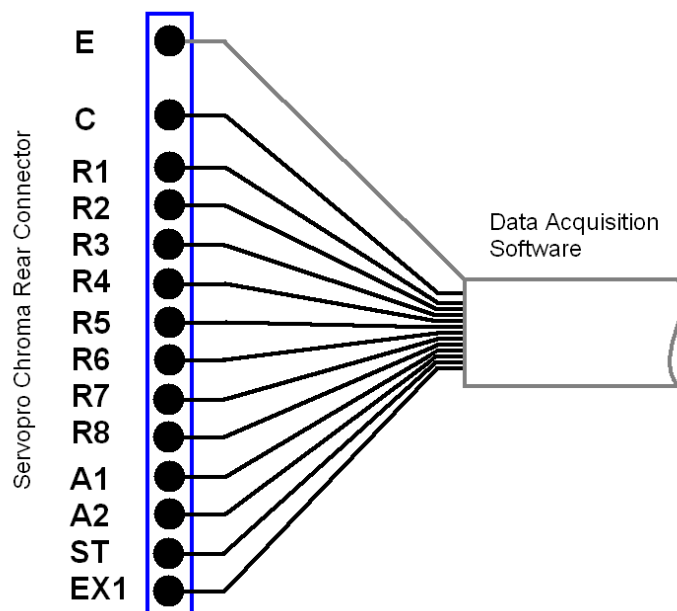
Figure 52 : Digital outputs connection

	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.

6.2.3 4-20 mA outputs

The schematic of the 4-20 mA output circuit is shown in Figure 53. 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 6.1.1.

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.
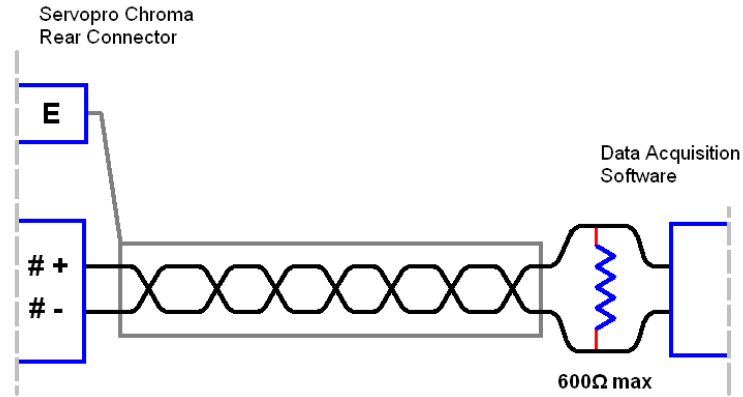
Figure 53 : 4-20 mA schematic and external connections

#	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	NOT USED			

Table 24 : 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.

6.2.4 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 6.1.1 before making any electrical connections.

6.2.5 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.

6.2.6 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.

6.2.7 FID fuel shut-off relay/Hydrogen relay output

> **WARNING**
>
> A fuel shut-off valve must be connected to the analyser when a
> FID detector is installed to prevent the accumulation of fuel.

A fuel shut-off valve must be connected to the rear connector of the analyser
when a FID detector is fitted to the analyser. This valve is normally closed and is
controlled by the analyser software. In the event of a problem, the valve will shut
automatically to prevent the accumulation of fuel inside the analyser.

See the FID Addendum (Section 12) for more information when using a FID
detector.
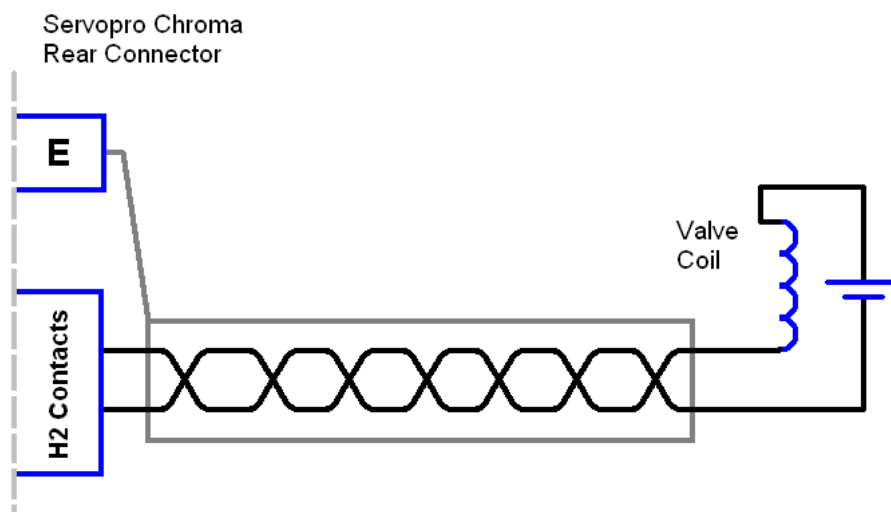
Figure 54 – Connecting a fuel shut-off valve

> **WARNING**
>
> The FID relay 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.

6.3 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 <u>remove</u> the caps on the <u>vent</u> 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.

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

6.3.1 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 for ppb analysis. 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 seals each time you connect VCR tubing.

6.3.2 Carrier Gas Hardware Selection

The use of high grade carrier gas will improve the analyser performance. It is recommended to feed UHP 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 100psig at the analyser for PED and TCD detectors,

and 120 psig for a FID detector. For the calibration gas, the recommended maximum cylinder outlet pressure is 200 kPa (30 psig).

3. <u>**Isolation and Sample Stream Selection Valves**</u>

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

6.3.3 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 or Ar, 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.

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 4.

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.

7 START-UP AND SHUTDOWN PROCEDURE

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

7.2 Installation requirements
1. Face seal fittings
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

7.3 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 100 psig for PED or TCD detectors or 120 psig for a FID detector. 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 10 psig.
8. Optional: If the analyser has a second sample inlet, connect the calibration gas to sample inlet 2 and adjust pressure to 10psig.

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 is coming out of the carrier and detector vents and adjust carrier gas supply pressure to have a total flow close to the one specified in the analyser 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.

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13. Set oven set point to 200 degC and purge the analyser for 12 hours minimum.
14. After the purge, return the oven set point to the original value, recorded in the analyser TRS.
15. **For PED**: 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 0.15 V for argon carrier with 65% plasma power indicates a leak in the system.
16. **For FID**: Start up the detector as described in Section 12.9.
17. **For TCD**, continue to next step.
18. 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 4.6.4.
19. After chromatography validation, calibrate the analyser (see Section 4.7). 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).
20. Inject the process gas continuously and monitor the results. Make sure peak baselines are correct and that readings are stable.

7.4 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.

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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.

8 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 O2 and H2 background gases. The trap in this oven will require replacing periodically, dependent on the application.

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.

9 STORAGE AND DISPOSAL

9.1 Storage

Follow shutdown procedure described in Section 7.4. Refit any protective cover and place the analyser and 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.

9.2 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 is not suitable for disposal in municipal waste streams (such as landfill sites, domestic recycling centres and so on). Refer to section 14 for disposal requirements in accordance with the WEEE Directive within the EC.

10 COMPLIANCE

- The analyser complies with the European Community "Electromagnetic Compatibility Directive":

    o 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.

    o 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.

11 RS-232 ADDENDUM

The communication parameters of the analyser are:
- Baud rate: 38400
- Parity bits: none
- Data bits: 8
- Stop bits: 1

The following tables describe the command set:

11.1 Start analysis

Request / Command			K4000 Response			
Character No	Character	ASCII Code No (hex)	Character No	Character	ASCII Code No (hex)	Meaning
			1	>	3Eh	command ID Analysis started
			2	A	41h	
1	>	3Eh	3	1	31h	
2	A	41h	4 (checksum)	q	72h	
3 (checksum)	A	41h	5	<	3Ch	
4	<	3Ch	1	>	3Eh	command ID Failure
			2	A	41h	
			3	0	30h	
			4 (checksum)	r	71h	
			5	<	3Ch	

Table 25 : RS-232 Start Analysis

11.2 Analyser status

Request / Command			K4000 Response			
Character No	Character	ASCII Code No (hex)	Character No	Character	ASCII Code No (hex)	Meaning
			1	>	3Eh	
			2	B	42h	command ID
			3	1	31h	1 = success
			4	1 or 0	31h or 30h	**Analyser ready: 1=ready; 0=not ready (still running)**
			5	1 or 0	31h or 30h	Run Modus: 1=measurement; 0=not measurement
1	>	3Eh	6	1 or 0	31h or 30h	Run Modus: 1=calibration; 0=not calibration
2	B	42h	7	1 or 0	31h or 30h	General Alarm: 1=OK; 0=Alarme active
3 (checksum)	B	42h	8	1 or 0	31h or 30h	Flow Alarm Sample: 1=OK; 0=Alarm active
4	<	3Ch	9	1 or 0	31h or 30h	Flow Alarm Carrier: 1=OK; 0=Alarm active
			10	1 or 0	31h or 30h	Detector Alarm (Plasma off?): 1=OK; 0=Alarm active
			11	1 or 0	31h or 30h	Calibration Alarm: 1=last cal. OK; 0=last cal. invalid
			12	1 or 0	31h or 30h	Measurement Alarm 1=last measurement OK 0=invalid
			13 (chksm)	X		
			14	<	3Ch	
			1	>	3Eh	
			2	B	42h	command ID
			3	0	30h	0 = failure
			4 (chksm)	r	72h	
			5	<	3Ch	

Table 26 : RS-232 Analyser Status

11.3 Send results

Request / Command

Character No	Character	ASCII Code No (hex)
1	>	3Ch
2	C	43h
3 (chksm)	C	43h
4	<	3Eh

K4000 Response

Character No	Character	ASCII Code No (hex)	Meaning	Peak Data
1	>	3Eh		
2	C	2	Command ID	
3	0 or 1	30h or 31h	0 = Failure, 1 = Success (If failure, jump to Char no 154 (checksum))*	(if failure)
4	Space or any Character between 0 and 9	20h or 30h to 39h		Peak Data for Peak No.1
5	Space or any Character between 0 and 9	20h or 30h to 39h		
6	Space or any Character between 0 and 9	20h or 30h to 39h		
7	Space or any Character between 0 and 9	20h or 30h to 39h	Examples of format of Concentration Result from Peak No. 1:	
8	Space or any Character between 0 and 9	20h or 30h to 39h		
9	Space or any Character between 0 and 9	20h or 30h to 39h	15.00 (could be 15.00 %, 15.00 ppm or 15.00 ppb)	
10	Space or any Character between 0 and 9	20h or 30h to 39h	1000000.00 (could be 1 Mio. ppm or 1 Mio.ppb)	
11	.	2Eh		
12	any Character between 0 and 9	20h or 30h to 39h		
13	any Character between 0 and 9	20h or 30h to 39h		
14	;	3Bh	Semicolon for Data Separation	
15	1 or 2 or 4	31h or 32h or 34h	Dimension of concentration of Peak No. 1: 1=%; 2=ppm; 4=ppb	
16	;	3Bh	Semicolon for Data Separation	
17	1 or 0	31h or 30h	measurement valid for Peak No. 1; 1=valid; 0=invalid	
18	;	3Bh	Semicolon for Data Separation	
19	Space or any Character between 0 and 9	20h or 30h to 39h		Peak Data for Peak No. 2
20	Space or any Character between 0 and 9	20h or 30h to 39h		
21	Space or any Character between 0 and 9	20h or 30h to 39h		
22	Space or any Character between 0 and 9	20h or 30h to 39h		
23	Space or any Character between 0 and 9	20h or 30h to 39h	Concentration Result Peak No. 2:	
24	Space or any Character between 0 and 9	20h or 30h to 39h		
25	Space or any Character between 0 and 9	20h or 30h to 39h		
26	.	2Eh		
27	any Character between 0 and 9	20h or 30h to 39h		
28	any Character between 0 and 9	20h or 30h to 39h		
29	;	3Bh	Semicolon for Data Separation	
30	1 or 2 or 4	31h or 32h or 34h	Dimension of concentration of Peak No. 2: 1=%; 2=ppm; 4=ppb	
31	;	3Bh	Semicolon for Data Separation	
32	1 or 0	31h or 30h	measurement valid for Peak No. 2; 1=valid; 0=invalid	
33	;	3Bh	Semicolon for Data Separation	
34	Space or any Character between 0 and 9	20h or 30h to 39h		Peak Data for Peak No. 3
35	Space or any Character between 0 and 9	20h or 30h to 39h		
36	Space or any Character between 0 and 9	20h or 30h to 39h		
37	Space or any Character between 0 and 9	20h or 30h to 39h		
38	Space or any Character between 0 and 9	20h or 30h to 39h	Concentration Result Peak No. 3:	
39	Space or any Character between 0 and 9	20h or 30h to 39h		
40	Space or any Character between 0 and 9	20h or 30h to 39h		
41	.	2Eh		
42	any Character between 0 and 9	20h or 30h to 39h		
43	any Character between 0 and 9	20h or 30h to 39h		
44	;	3Bh	Semicolon for Data Separation	
45	1 or 2 or 4	31h or 32h or 34h	Dimension of concentration of Peak No. 3: 1=%; 2=ppm; 4=ppb	
46	;	3Bh	Semicolon for Data Separation	
47	1 or 0	31h or 30h	measurement valid for Peak No. 3; 1=valid; 0=invalid	
48	;	3Bh	Semicolon for Data Separation	
49	Space or any Character between 0 and 9	20h or 30h to 39h		Peak Data for Peak No. 4
50	Space or any Character between 0 and 9	20h or 30h to 39h		
51	Space or any Character between 0 and 9	20h or 30h to 39h		
52	Space or any Character between 0 and 9	20h or 30h to 39h		
53	Space or any Character between 0 and 9	20h or 30h to 39h	Concentration Result Peak No. 4:	
54	Space or any Character between 0 and 9	20h or 30h to 39h		
55	Space or any Character between 0 and 9	20h or 30h to 39h		
56	.	2Eh		
57	any Character between 0 and 9	20h or 30h to 39h		
58	any Character between 0 and 9	20h or 30h to 39h		
59	;	3Bh	Semicolon for Data Separation	
60	1 or 2 or 4	31h or 32h or 34h	Dimension of concentration of Peak No. 4: 1=%; 2=ppm; 4=ppb	
61	;	3Bh	Semicolon for Data Separation	
62	1 or 0	31h or 30h	measurement valid for Peak No. 4; 1=valid; 0=invalid	
63	;	3Bh	Semicolon for Data Separation	
64	Space or any Character between 0 and 9	20h or 30h to 39h		Peak Data for Peak No. 5
65	Space or any Character between 0 and 9	20h or 30h to 39h		
66	Space or any Character between 0 and 9	20h or 30h to 39h		
67	Space or any Character between 0 and 9	20h or 30h to 39h		
68	Space or any Character between 0 and 9	20h or 30h to 39h	Concentration Result Peak No. 5:	
69	Space or any Character between 0 and 9	20h or 30h to 39h		
70	Space or any Character between 0 and 9	20h or 30h to 39h		
71	.	2Eh		
72	any Character between 0 and 9	20h or 30h to 39h		
73	any Character between 0 and 9	20h or 30h to 39h		
74	;	3Bh	Semicolon for Data Separation	
75	1 or 2 or 4	31h or 32h or 34h	Dimension of concentration of Peak No. 5: 1=%; 2=ppm; 4=ppb	
76	;	3Bh	Semicolon for Data Separation	
77	1 or 0	31h or 30h	measurement valid for Peak No. 5; 1=valid; 0=invalid	
78	;	3Bh	Semicolon for Data Separation	
79	Space or any Character between 0 and 9	20h or 30h to 39h		Peak Data for Peak No. 6
80	Space or any Character between 0 and 9	20h or 30h to 39h		
81	Space or any Character between 0 and 9	20h or 30h to 39h		
82	Space or any Character between 0 and 9	20h or 30h to 39h		
83	Space or any Character between 0 and 9	20h or 30h to 39h	Concentration Result Peak No. 6:	
84	Space or any Character between 0 and 9	20h or 30h to 39h		
85	Space or any Character between 0 and 9	20h or 30h to 39h		
86	.	2Eh		
87	any Character between 0 and 9	20h or 30h to 39h		
88	any Character between 0 and 9	20h or 30h to 39h		
89	;	3Bh	Semicolon for Data Separation	
90	1 or 2 or 4	31h or 32h or 34h	Dimension of concentration of Peak No. 6: 1=%; 2=ppm; 4=ppb	
91	;	3Bh	Semicolon for Data Separation	
92	1 or 0	31h or 30h	measurement valid for Peak No. 6; 1=valid; 0=invalid	
93	;	3Bh	Semicolon for Data Separation	
94	Space or any Character between 0 and 9	20h or 30h to 39h		Peak Data for Peak No. 7
95	Space or any Character between 0 and 9	20h or 30h to 39h		
96	Space or any Character between 0 and 9	20h or 30h to 39h		
97	Space or any Character between 0 and 9	20h or 30h to 39h		
98	Space or any Character between 0 and 9	20h or 30h to 39h	Concentration Result Peak No. 7:	
99	Space or any Character between 0 and 9	20h or 30h to 39h		
100	Space or any Character between 0 and 9	20h or 30h to 39h		
101	.	2Eh		
102	any Character between 0 and 9	20h or 30h to 39h		
103	any Character between 0 and 9	20h or 30h to 39h		
104	;	3Bh	Semicolon for Data Separation	
105	1 or 2 or 4	31h or 32h or 34h	Dimension of concentration of Peak No. 7: 1=%; 2=ppm; 4=ppb	
106	;	3Bh	Semicolon for Data Separation	
107	1 or 0	31h or 30h	measurement valid for Peak No. 7; 1=valid; 0=invalid	
108	;	3Bh	Semicolon for Data Separation	
109	Space or any Character between 0 and 9	20h or 30h to 39h		Peak Data for Peak No. 8
110	Space or any Character between 0 and 9	20h or 30h to 39h		
111	Space or any Character between 0 and 9	20h or 30h to 39h		
112	Space or any Character between 0 and 9	20h or 30h to 39h		
113	Space or any Character between 0 and 9	20h or 30h to 39h	Concentration Result Peak No. 8:	
114	Space or any Character between 0 and 9	20h or 30h to 39h		
115	Space or any Character between 0 and 9	20h or 30h to 39h		
116	.	2Eh		
117	any Character between 0 and 9	20h or 30h to 39h		
118	any Character between 0 and 9	20h or 30h to 39h		
119	;	3Bh	Semicolon for Data Separation	
120	1 or 2 or 4	31h or 32h or 34h	Dimension of concentration of Peak No. 8: 1=%; 2=ppm; 4=ppb	
121	;	3Bh	Semicolon for Data Separation	
122	1 or 0	31h or 30h	measurement valid for Peak No. 8; 1=valid; 0=invalid	
123	;	3Bh	Semicolon for Data Separation	
124	Space or any Character between 0 and 9	20h or 30h to 39h		Peak Data for Peak No. 9
125	Space or any Character between 0 and 9	20h or 30h to 39h		
126	Space or any Character between 0 and 9	20h or 30h to 39h		
127	Space or any Character between 0 and 9	20h or 30h to 39h	Concentration Result Peak No. 9:	
128	Space or any Character between 0 and 9	20h or 30h to 39h		
129	Space or any Character between 0 and 9	20h or 30h to 39h		
130	Space or any Character between 0 and 9	20h or 30h to 39h		
131	.	2Eh		
132	0	20h or 30h to 39h		
133	0	20h or 30h to 39h		
134	;	3Bh	Semicolon for Data Separation	
135	1 or 2 or 4	31h or 32h or 34h	Dimension of concentration of Peak No. 9: 1=%; 2=ppm; 4=ppb	
136	;	3Bh	Semicolon for Data Separation	
137	1 or 0	31h or 30h	measurement valid for Peak No. 9; 1=valid; 0=invalid	
138	;	3Bh	Semicolon for Data Separation	
139	Space or any Character between 0 and 9	20h or 30h to 39h		Peak Data for Peak No. 10
140	Space or any Character between 0 and 9	20h or 30h to 39h		
141	Space or any Character between 0 and 9	20h or 30h to 39h		
142	Space or any Character between 0 and 9	20h or 30h to 39h		
143	Space or any Character between 0 and 9	20h or 30h to 39h	Concentration Result Peak No. 10:	
144	Space or any Character between 0 and 9	20h or 30h to 39h		
145	Space or any Character between 0 and 9	20h or 30h to 39h		
146	.	2Eh		
147	0	20h or 30h to 39h		
148	0	20h or 30h to 39h		
149	;	3Bh	Semicolon for Data Separation	
150	1 or 2 or 4	31h or 32h or 34h	Dimension of concentration of Peak No. 10: 1=%; 2=ppm; 4=ppb	
151	;	3Bh	Semicolon for Data Separation	
152	1 or 0	31h or 30h	measurement valid for Peak No. 10; 1=valid; 0=invalid	
153	;	3Bh	Semicolon for Data Separation	
154	X		Checksum	
155	<	3Ch		

Table 27 : RS-232 Send Results

11.4 Enable-Disable Calibration

Request / Command			K4000 Response			
Character No	Character	ASCII Code No (hex)	Character No	Character	ASCII Code No (hex)	Meaning
1	>	3Eh	1	>	3Eh	
2	D	44h	2	D	44h	Command ID
3	0 or 1 (0 = disable / 1 = enable)	30h or 31h	3	1	31h	Success
4 (chksm)	t or u	74h or 75h	4 (chksm)	u	75h	
5	<	3Ch	5	<	3Ch	
			1	>	3Eh	
			2	D	44h	
			3	0	30h	Failure
			4 (chksm)	t	74h	
			5	<	3Ch	

Table 28 : RS-232 Enable-Disable Calibration

11.5 Respan

Request / Command			K4000 Response			
Character No	Character (meaning)	ASCII Code No (hex)	Character No	Character	ASCII Code No (hex)	Meaning
1	>	3Eh	1	>	3Eh	
2	E	45h	2	E	45h	command ID
3	Any number from 1 to 9 (number of the calibration point if multi-point)	31h to 39h	3	0 or 1	30h or 31h	0 = Failure, 1 = Success
4 (Peak 1)	0 or 1 (0 = don't respan, 1 = respan)	30h or 31h	4	u or v	75h or 76h	Checksum
5 (Peak 2)	0 or 1	30h or 31h	5	<	3Ch	
6 (Peak 3)	0 or 1	30h or 31h				
7 (Peak 4)	0 or 1	30h or 31h				
8 (Peak 5)	0 or 1	30h or 31h				
9 (Peak 6)	0 or 1	30h or 31h				
10 (Peak 7)	0 or 1	30h or 31h				
11 (Peak 8)	0 or 1	30h or 31h				
12 (Peak 9)	0 or 1	30h or 31h				
13 (Peak 10)	0 or 1	30h or 31h				
14 (Chksm)	X					
15	<	3Ch				

Table 29 : RS-232 Respan

11.6 Change Configuration

Request / Command			K4000 Response			
Character No	Character	ASCII Code No (hex)	Character No	Character	ASCII Code No (hex)	Meaning
1	>	3Eh	1	>	3Eh	
2	F	46h	2	F	46h	Command ID
3	1 or 9 (Configuration Number)	30h to 39h	3	1	31h	Success
4 (chksm)	Checksum	70h to 7Fh	4 (chksm)	w	77h	(It will take approximately 30 to 45 seconds for the analyser PC to re-boot after the success response)
5	<	3Ch	5	<	3Ch	
			1	>	3Eh	
			2	F	46h	
			3	0	30h	Failure
			4 (chksm)	v	76h	
			5	<	3Ch	

Table 30 : RS-232 Change Configuration

When the analyser is configured for use with different background gases, the configuration may be switched using a remote command via the RS-232.

12 FID ADDENDUM

This section describes how to set up and operate a Flame Ionisation Detector (FID) in the SERVOPRO Chroma analyser.

12.1 FID Advanced Configuration – General Menu

The analyser configuration is set in factory. **It will not normally require adjustment.**

The **Advanced Configuration** menu is used to add or remove FIDs by amending the quantity (see Figure 55).
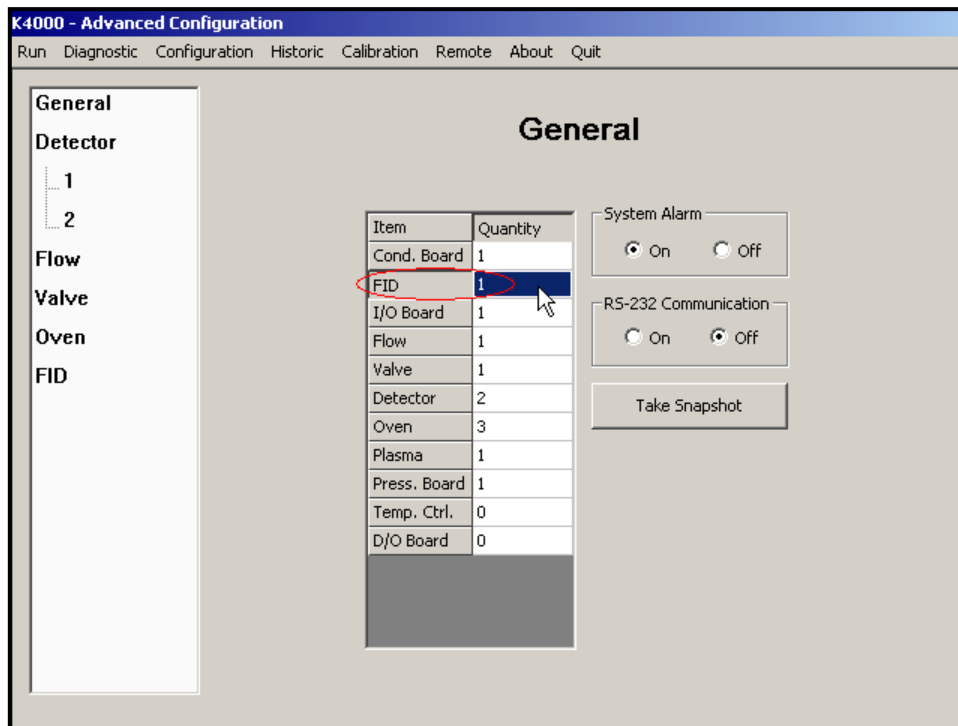

Figure 55: Advanced menu

12.2 FID Advanced Configuration - FID Menu

The FID Menu is used to modify the FID settings. The modifications must be saved for the modifications to take effect, by clicking on the **Save** button.
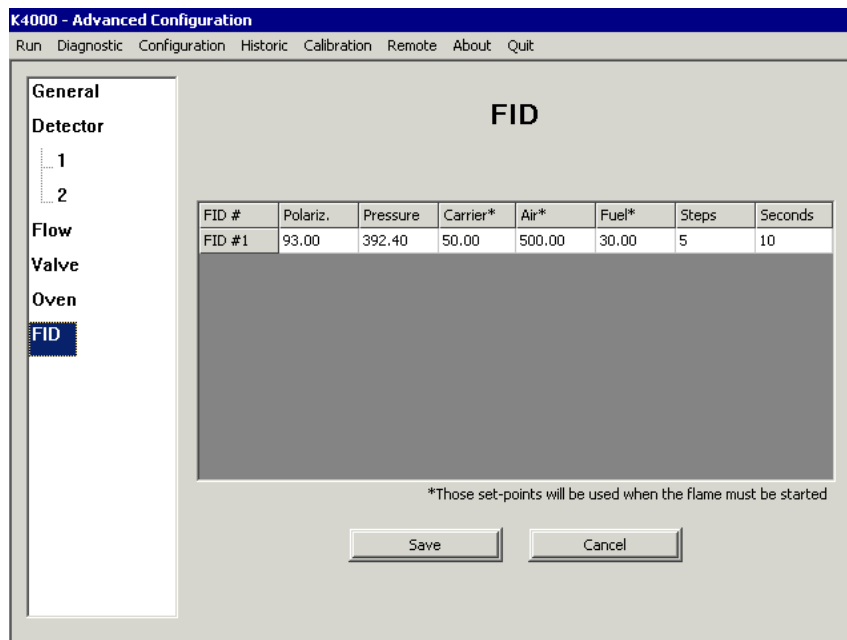

Figure 56: Advanced Configuration FID menu

Parameter	Range	Unit	Description
Polariz.	0-200	Volt	Voltage that is applied to the FID polarizer.
Pressure	300-500	In of H_2O	This value is used to calibrate the pressure sensor used by the FID. When **Save** is clicked, the pressure sensor is calibrated with the value entered in the box.
Carrier*	0-100	cc/min	This carrier set point is only used to ignite the FID. This set point is not used during normal operation.
Air*	0-1000	cc/min	This air set point is only used to ignite the FID. This set point is not used during normal operation.
Fuel*	0-200	cc/min	This fuel set point is only used to ignite the FID. This set point is not used during normal operation.
Steps	0-10	Steps	Number of steps for ramping flow to normal value
Seconds	0-60	Seconds	Time between each step.

Table 31 : Advanced FID menu parameters

Air, Fuel and carrier set points are for the ignition. When **ignite flame** is pressed in the Diagnostic menu, the analyser will change these set points to ignite the flame and then it will return to the normal value when the flame is lit.

DO NOT CHANGE THESE SETTINGS: they are factory configured.
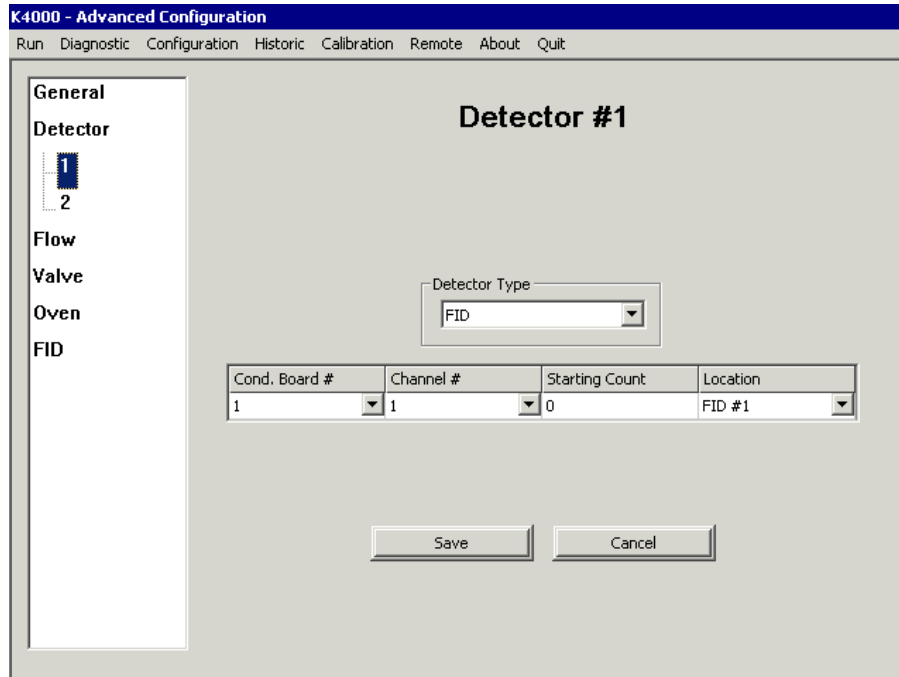
12.3 FID Advanced Configuration – Detector Menu

Figure 57: Advanced Detector menu

Use the **Detector** menu to modify the FID detector settings. The modifications must be saved before the modifications take effect by clicking on the **Save** button.

- Cond. Board: Select the acquisition board the FID is connected to.

- Channel #: Select the channel the FID is connected on the acquisition board.

- Starting Count: Threshold value read by the detector inside the FID to determine if the flame is lit.

- Location: The position of the detector.

DO NOT CHANGE THESE SETTINGS: they are factory configured.

12.4 FID Advanced Configuration – Flow Menu

Use the **FLOW** menu to name each flow/pressure regulator associated with the FID. A FID requires Air, Fuel and Carrier gases to operate. Enter the required name in the location field, with the correct Parent and Type. For example, in Figure 58, the name "Air" has been entered, associated with Parent "FID #1", and Type "FID". The same is repeated for Fuel and Carrier.

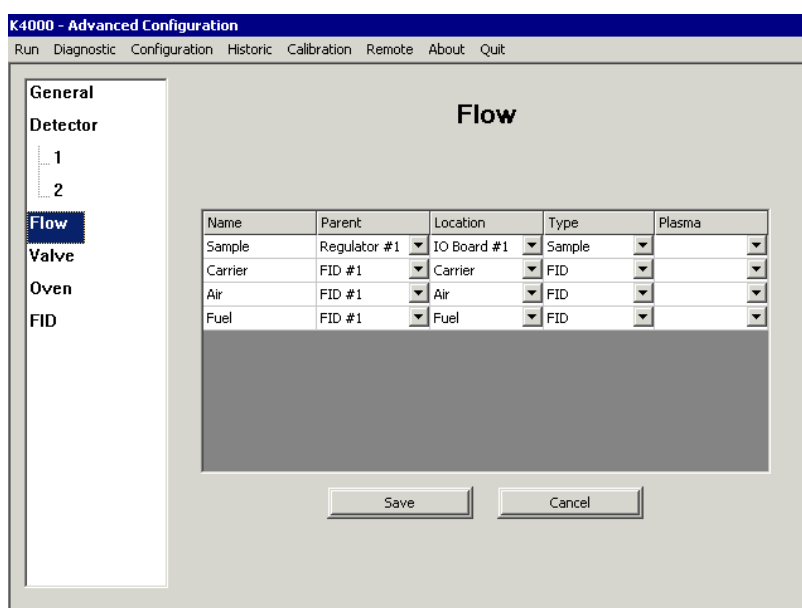The modifications must be saved for the modifications to take effect, by clicking on the **Save** button.

Figure 58: Advanced Configuration Flow menu

DO NOT CHANGE THESE SETTINGS: they are factory configured.

12.5 FID Advanced Configuration – Oven Menu

Use the **OVEN** menu to name the oven associated with the FID. Select the FID as the **Location**, the **Channel #** will default to Channel #1 as the FID allows configuration of its first oven only.

The modifications must be saved for the modifications to take effect, by clicking on the **Save** button.
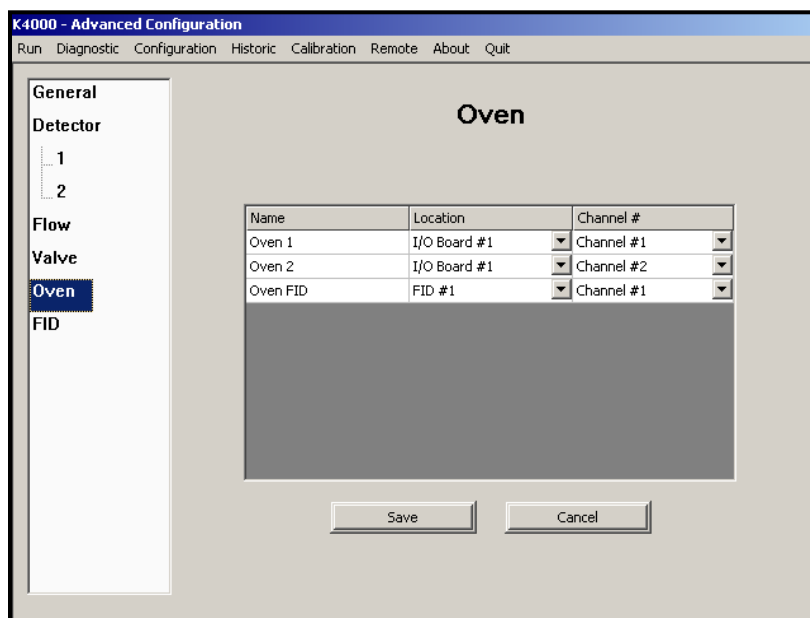

Figure 59: Advanced oven menu

> **DO NOT CHANGE THESE SETTINGS: they are factory configured.**

12.6 FID Monitoring and Configuration Menus

The flows and ovens associated with the FID will be displayed with the other flows and ovens in the analyser in the various analyser menus, as shown in the following examples.
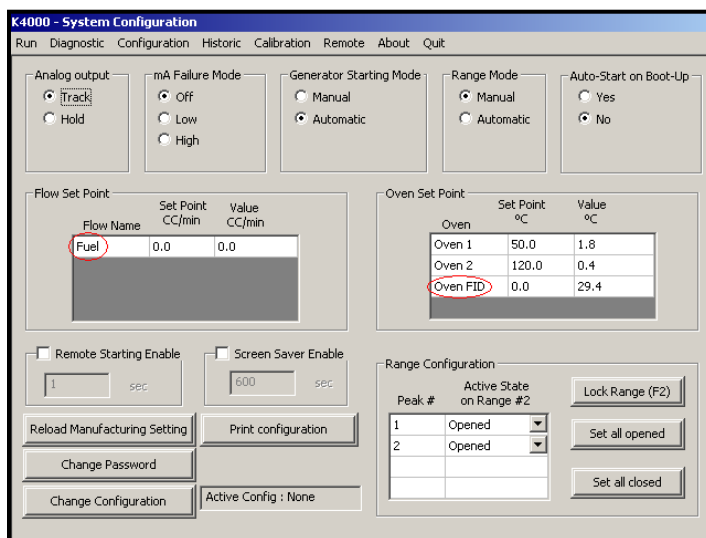
System Configuration menu:

Figure 60: Monitoring System Configuration menu
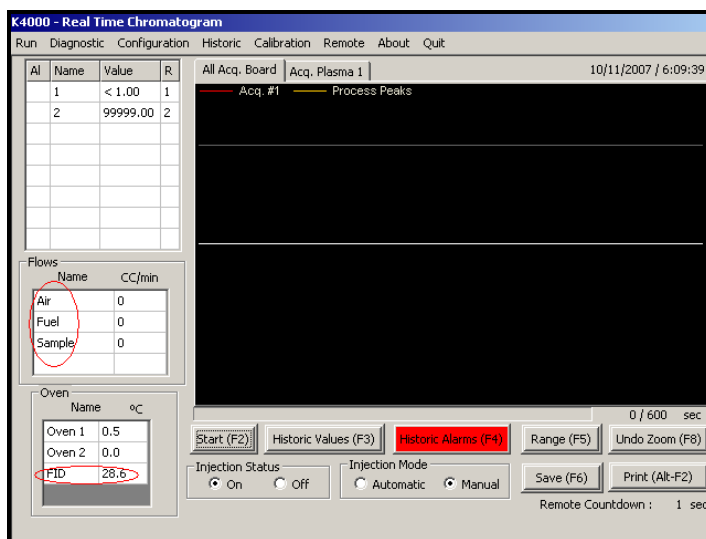
Real Time Chromatogram menu:

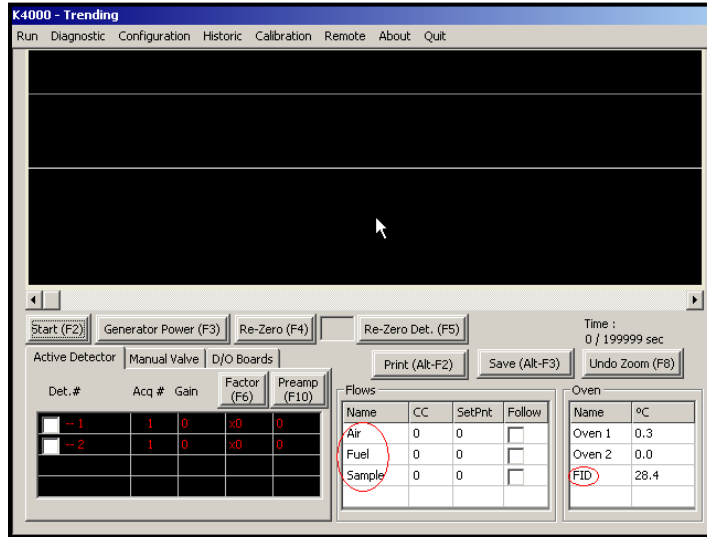**Figure 61: Monitoring Real Time Chromatogram menu**

Trending menu:

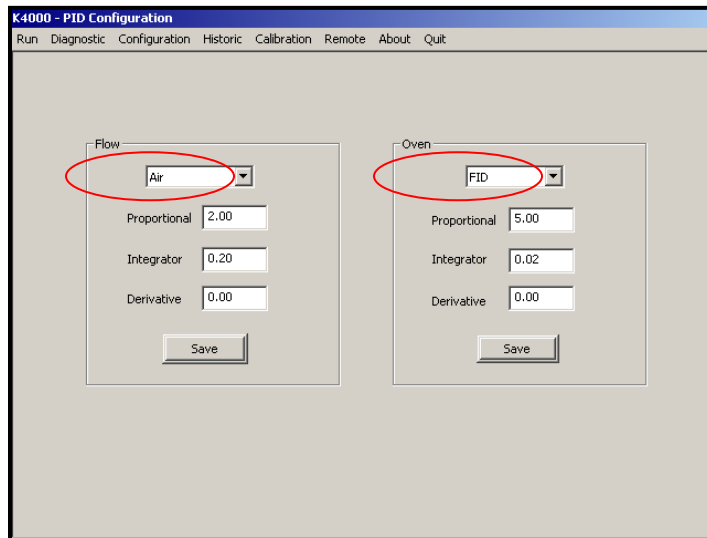**Figure 62: Monitoring Trending menu**

PID Configuration menu:

Figure 63: Monitoring PID Configuration menu

Flow Configuration menu:

Figure 64: Monitoring Flow Configuration menu

12.7 FID Diagnostic-Diagnostic Menu

Use the **Diagnostic** menu to change the FID parameters.

Select the **FID Board #** tab to access the boxes for entering the FID Gain, Offset and Pre-Amp. **These values are used in the Trending menu.** These values are used to configure the default values in the **Cycle Configuration** menu (see Section 12.8).

The FID internal temperature and Flame status are displayed.

The flame may be manually ignited by clicking on the **Ignite flame** button.

Figure 65 : Diagnostic menu

12.8 FID Cycle Configuration Menu

Use the **Cycle Configuration** menu to change the Log Amplifier parameters that are associated with each FID peak (see Figure 66).

When the parameters have been selected on the **Diagnostic** menu, these values have to be set in the **Cycle Configuration** menu. Enter the **Peak/Configuration** menu and select a FID peak. The **Peak # data** panel will allow entry of the **FID Board** parameters gain, offset and Pre-Amplification.
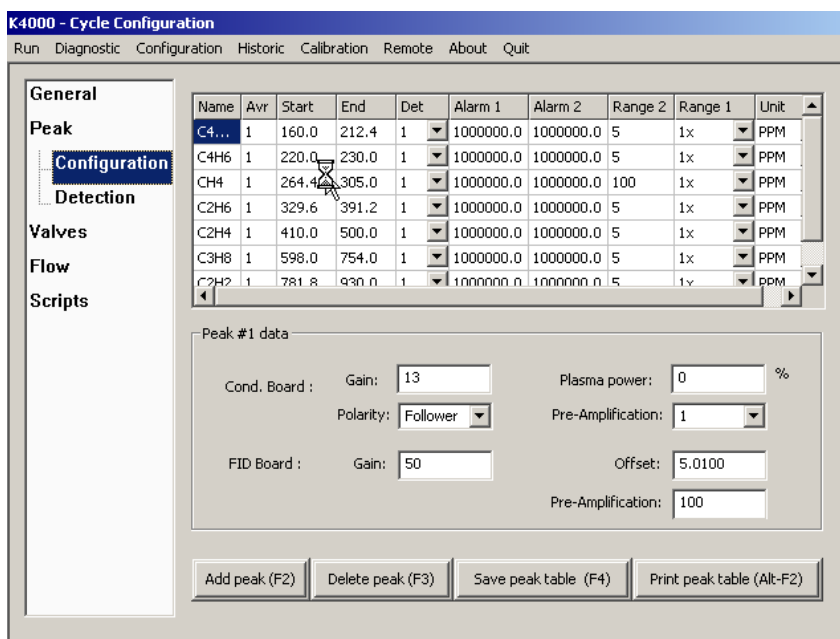

Figure 66: Cycle Configuration menu

12.9 FID Startup

1. Connect all gases to the analyser and make sure that the system is fully purged.
2. Power up the analyser
3. Set the flow set points to the following values for purging:

Gas	Flow set point (cc/min)
Fuel	0
Air	300
Carrier	50

Table 32 : Gas flow set point

4. Wait for FID temperature stabilisation. Once temperature is stable, set flow set points to the following values:

Gas	Flow set point (cc/min)
Fuel	40
Air	300
Carrier	50

Table 33 : Gas flow set point 2

Note: The above data may vary for each analyser, the details are provided in the documents shipped with the analyser.

5. Once flows are stable, press the ignite button to start the detector. The flow set point will automatically change to ignition set point and the detector will ignite.

Gas	Flow set point (cc/min)
Fuel	70
Air	500
Carrier	50

Table 34 : Gas ignition Point

Note: The above data may vary for each analyser, the details are provided in the documents shipped with the analyser.

6. When the flame is lit, the flow set points will come back to their normal values, shown in Step 4 above.

7. The analyser is ready to use.

12.10 FID System Errors

This section describes the reported system errors.

Air flow deviation: This error occurs when the difference between air flow and air flow set point is higher than 5 cc/min. When this error is active, the flame cannot be ignited.

Low air flow: This error occurs when the air flow is below 10 cc/min. When this error is active, the flame cannot be ignited.

Fuel flow deviation: This error occurs when the difference between fuel flow and fuel flow set point is higher than 5 cc/min. When this error is active, the flame cannot be ignited.

Low fuel flow: This error occurs when the fuel flow is below 10 cc/min. When this error is active, the flame cannot be ignited.

Sample flow deviation: This error occurs when the difference between sample flow and sample flow set point is higher than 5 cc/min. When this error is active, the flame cannot be ignited.

Ambient temperature deviation: This error occurs when ambient temperature is out of range. Ambient temperature must be between 5°C and 50°C.

F.I.D. temperature deviation: This error occurs when the difference between actual FID temperature and FID temperature set point is higher than 10°C. When this error is active, the flame cannot be ignited.

Glow plug damaged: A glow plug is used to ignite the detector. If the glow plug is damaged, this error message is displayed. When this error is active, the flame cannot be ignited. The glow plug must be changed.

Flame off: This error occurs when the FID's flame is off.

Sample flow reg. problem: A fault with the sample pressure regulator. To clear the error, reboot the system. If the error remains after rebooting, contact Servomex for support.

Air flow reg. problem: A fault with the air pressure regulator. To clear the error, reboot the system. If the error remains after rebooting, contact Servomex for support.

Fuel flow reg. problem: A fault with the fuel pressure regulator. To clear the error, reboot the system. If the error remains after rebooting, contact Servomex for support.

Each time an error occurs the status contact relay will close. If the "mA failure mode" has been set to low or high, the 4-20 mA analogue output will respond according to this setting.

As the FID requires a fuel gas, the software has built-in functions to reduce the risk of explosion. If the flame is off for more than 5 minutes and the set point of the fuel gas is not already at 0 cc/min, the set point for the fuel gas will automatically be set to 0 cc/min and the fuel gas shut off valve will be closed.

When one of the gases is not flowing in the analyser, it is normal that the flame goes off. It is also normal that the flame goes off when there is no sample gas into the analyser.

12.11 FID Troubleshooting

Symptom	Problem cause	Possible remedy
Burner doesn't ignite	Fuel gas emerging from burner jet diluted with other gases because fuel system is insufficiently purged.	Purge fuel gas regulator.
	Air and fuel flow not properly set.	Adjust air and flow set points to match the values on the Test Results Sheet.
	Glow plug damaged.	Contact Servomex.
	Analyser not able to reach starting flow set points	Verify all inlet pressures.
Analyser's reading is noisy	Air or fuel is contaminated.	Replace air or fuel cylinder. Add hydrocarbon traps. Purge tubing.
	There is a leak on sample line.	Leak test your sampling system.
	Flows are not stable	Verify that all gas pressures are stable. Verify that flow readings are stable. Re-validate PIDs for ovens and flows
	Tubing used to connect gases to the SERVOPRO FID was not properly purged.	Purge tubing
	There is a dead volume on one of the gas stream.	Verify plumbing diagram and remove any dead volume.
	Exhaust is blocked by water	Make sure the exhaust tubing has a slope.
Loss of sensitivity or no signal	Electrical elements of burner partially short circuited by combustion products.	Contact Servomex.
	Polarisation spring is not in contact with FID jet.	
False flame indication	Flame sensor may be damaged.	

Table 35 : FID Troubleshooting

13 ANALYSER TROUBLE SHOOTING

This section addresses some of the typical issues that may be experienced whilst operating the SERVOPRO Chroma. 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
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 36 : 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	Flow variation due to valve actuation.	26
28	Carrier gas supply pressure too high	27

Table 37 : 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.

Table 38 : Troubleshooting Typical Issues – Potential Solutions

14 PRODUCT DISPOSAL – WEEE DIRECTIVE

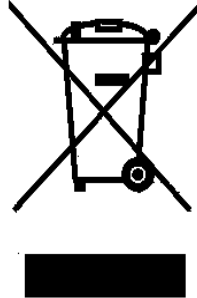The label shown in Figure & is fitted to the analyser.

Figure 67 :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.

15 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