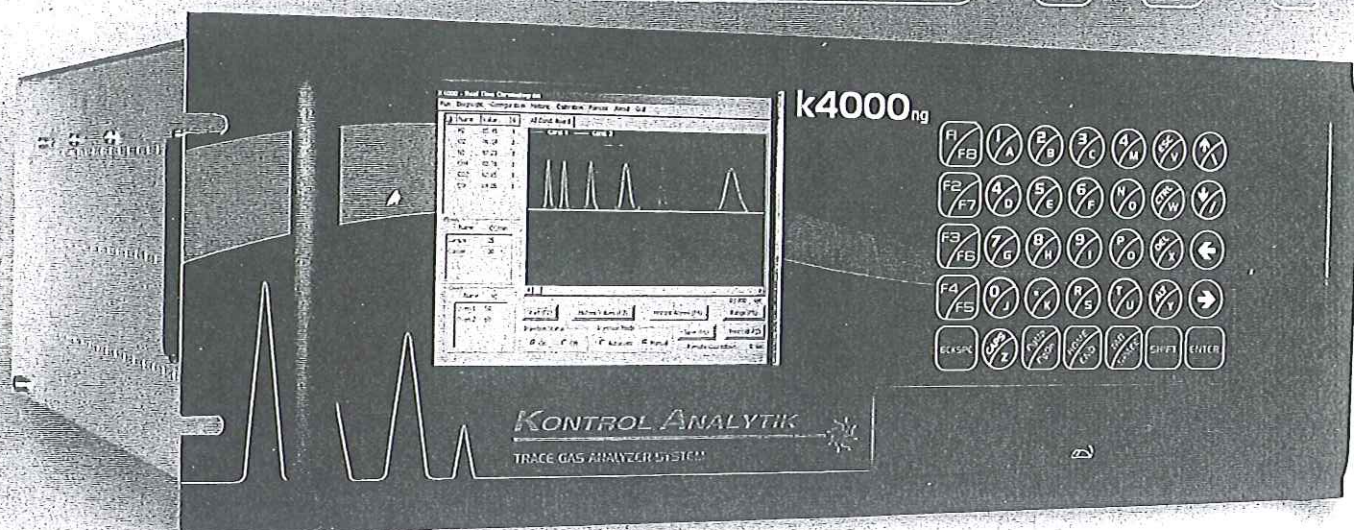


KONTROL ANALYTIK



KONTROL ANALYTIK K4000^{ng} SERIES TRACE GAS ANALYZER



k4000^{ng} User's Manual

ANALYTICAL SYSTEMS
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CONTRÔLE



ANALYTIQUE

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Košice

KONTROL ANALYTIK®

K4000^{NG} TRACE GAS ANALYZER

USER'S MANUAL
Version 3.1

Software Version 2.4
Revision "0"

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DECLARATION OF CONFORMITY

We, *Contrôle Analytique inc.*

Address: 1076 Johnson Street, Thetford Mines, Qc, Canada G6G 5W6;
Declares, under our sole responsibility, that the product:

Name: **K4000^{NG} series Trace Gas Analyzer**

Fulfills the requirements of the standard and regulations of the Directive,
in accordance with 72/23/EEC and 89/336/EEC:

DIN EN 61010: Low voltage directive

DIN EN 50081: Electromagnetic compatibility generic emission standard

DIN EN 50082: Electromagnetic compatibility generic immunity standard

as per following test specifications and methods:

Measuring conducted voltage emission

EN55022:5.1995 Class A Class B

Measuring radiated E-Field emission

EN55022:5.1995 Class B

Susceptibility against electrostatic discharge - air discharge

DIN EN 61000-4-2:3.1996, IEC1000-4-2

Susceptibility against radiated fields

IEC1000-4-3:9.97

Susceptibility against ns-pulses (burst)

EN61000-4-4:3.1996, IEC 1000-4-4

Susceptibility against spike injection (surge)

ENV50142:10.1995, IEC 1000-4-5

Susceptibility against conducted sinus wave

IEC1000-4-6:4.1997

Immunity against voltage dips, short interruptions and voltage variation

DIN EN 61000-4-11:4.1995

and the taken test reports and therefore corresponds to the regulation of the Directive.

This product is CE marked.

Thetford Mines, Quebec, Canada,
January 2003

FOREWORD

This User's Manual provides the necessary information to properly install and operate the analyzer. This manual also provides limited information for repair and part replacement. This manual is not intended to provide complete servicing procedures.

The analyzer should be operated only by personnel who are familiar with procedures required for safe operation.

Please contact us before attempting any repairs or procedures other than those described in this User's Manual.

1.0 CONCERNING THIS MANUAL

This analyzer is designed to be easy to use, according to the "Plug and Play" principle and so is this manual. For the benefit of clarity, all electronic, software and physical details not necessary for the operation of the unit are omitted. It was intentionally composed this way.

We understand that you bought this analyzer and you want to get it productive as soon as possible. To achieve this goal, take the time to read this manual in its entirety. Every section is based on the assumption that you have read and understood the preceding one, and every section has important comments for the user. This analyzer is very simple to install and to use; also, it is maintenance-free. No special technical knowledge is required to operate the unit.

We hope that you will enjoy working with the K4000^{NG} Trace Gas Analyzer. In the spirit of progress and continuous improvement, we would appreciate any comments you may have, negative or positive - as long as they are constructive.

Contrôle Analytique Inc. believes that the information in this manual is accurate. The document has been carefully reviewed for technical accuracy. If there should be any error, Contrôle Analytique Inc. reserves the right to make changes to subsequent editions of this document without prior notice to holders of this edition. The reader should contact Contrôle Analytique Inc. if errors are suspected. In no event shall Contrôle Analytique Inc. be liable for any damages arising out of or related to this document or the information contained in it.

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THANK YOU FOR BUYING KONTROL ANALYTIK ®

2.0 CAUTIONS AND WARNINGS

2.1 Caution

Improper installation, operation or servicing of this analyzer may cause damage to the analyzer and void the manufacturer's warranty.

2.2 Electrical shock hazard

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

For both safety and proper performance, this instrument must be connected to a properly grounded three-wire source of electrical power.

Both alarm switching relay contacts and digital output contacts wired to a separate power source must be disconnected before servicing.

Tampering or unauthorized substitution of components may adversely affect the safety of this product. Use only factory-approved components for repair.

2.3 Possible explosion hazard

Never introduce in this analyzer other gases than those specified in this User's Manual. This analyzer is not designed to be used in hazardous areas.

Oxygen/Hydrogen safety

If the analyzer is used with an oxygen sample, all parts in contact with the sample must be oxygen compatible. **Do not use any grease or hydrocarbons based sealant.** Furthermore, oxygen may cause fire or explosion. If the analyzer is used with a hydrogen sample, proper purging procedures are necessary to avoid the build-up of explosive atmosphere. In both cases (O₂ or H₂) proper purging or forced ventilation should be used to avoid the accumulation of explosive gas in case of leak. It may also be necessary to install an automatic sample shut off solenoid valve in case of power failure. Please refer to your local regulations.

Analytical system integrators, designers and users must consider total system design when O₂ and H₂ gases are involved. Integrators, designers and users are responsible for proper installation, operation and maintenance of the analyzer and related components. Please refer to CGA publications and local code regulations for more information regarding safety of such installations.

2.4 Gas hazard

Argon and helium are members of the rare gas family which consists of helium, argon, krypton, xenon or neon.

All of these gases are mono-atomic and are characterized by their extreme chemical inactivity. They are colorless, odorless, tasteless and NON TOXIC.

However, these gases can act as a simple asphyxiate by displacing the necessary amount of oxygen to support life. Proper ventilation must be done to provide a safe working area.

Nitrogen is a diatomic molecule and is colorless, odorless and non toxic. However, nitrogen can also act as a simple asphyxiate by displacing the necessary amount of oxygen to support life. Proper ventilation must be done to provide safe working area.

2.5 General safety instructions

To avoid the risk of electric shock, do not remove the casing or open the back of the unit. There are no user serviceable parts inside. Leave servicing to the experts!

To prevent fire or the risk of electric shock, keep this unit out of rain and away from moisture. The lightning symbol inside an equilateral triangle means that there are live, non-insulated parts inside this unit that may give you a dangerous electric shock if touched.

1. Instructions: Read all the safety instructions and all the operation instructions thoroughly before using the unit for the first time. Keep these safety instructions and operating instructions somewhere safe in case you need to refer to them again in the future.
2. Safety warnings: In your own interest, pay attention to all the safety warnings on the unit and in the operating instructions. Follow the instructions on operation and use of the unit in every respect.
3. Water and moisture: Never use the unit near water, for example near a bath, a wash basin, a sink a washing machine, in a damp cellar or near a swimming pool.
4. Ventilation: Wherever you put the unit, always ensure there is sufficient ventilation. Never put the unit on a bed, for example, or a sofa, a carpet or similar surface that might block the vents. Make sure there is proper ventilation to avoid overheating.
5. Effects of heat: Do not put the unit anywhere near sources of heat, such as radiators, hot-air shafts, ovens, etc.
6. Power source: Connect the unit only to the power source indicated on the operating instructions or on the unit.
7. Protecting the power cord: Run the power cord so that no one can step on it and nothing can rest on or against it. The power cord is particularly at risk in the area of the plug, the socket and where it comes out of the unit.
8. Cleaning: Follow the manufacturer's recommendations for cleaning the unit.

9. Unit not in use: If you are not going to use the unit for some time, remove the plug from the socket.
10. Foreign bodies: Take great care to ensure that no liquids or other foreign bodies can find their way inside the unit through the openings in the casing.
11. Repair in the event of damage: The unit should only be repaired by qualified personnel. Never try to do more in the way of maintenance to your unit than the operating instructions allow. Beyond that, always consult an expert for repair work.

2.6 General precautions for handling and storing high pressure cylinders

This analyzer is frequently applied to verify the contents of high-pressure cylinder gases. Mishandling of gas cylinders could result in death, serious injury or property damages. Handle gas cylinders with extreme care. Refer to general precautions for handling and storing high-pressure cylinders. Here are some precautions from the COMPRESSED GAS ASSOCIATION'S HANDBOOK.

1. Never drop cylinders or permit them to strike each other violently.
2. Cylinders may be stored in the open, but in such cases, should be protected against extreme weather. To prevent rusting, keep away from the dampness of the ground.
3. The valve protection cap should be left on each cylinder until it has been secured against a wall or a bench, or placed in a cylinder stand until it is ready to be used.
4. Avoid dragging, rolling, or sliding cylinders, even for a short distance; they should be moved by using a suitable hand-truck.
5. Never tamper with safety devices in valves or cylinders.
6. Do not store full and empty cylinders together. Serious suck-back can occur when an empty cylinder is attached to a pressurized system.
7. No part of a cylinder should be subjected to a temperature higher than 125° F (52° C). A flame should never be permitted to come in contact with any part of a compressed gas cylinder.
8. Do not place cylinders where they may become part of an electric circuit. When electric arc welding, precautions must be taken to prevent striking an arc against the cylinder.

EDITED FROM SELECTED PARAGRAPHS OF THE COMPRESSED GAS ASSOCIATION'S
"HANDBOOK OF COMPRESSED GASES" PUBLISHED IN 1981.
COMPRESSED GAS ASSOCIATION
1235 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VIRGINIA 22202

3.0 WARRANTY, SERVICE POLICY, REPAIR SERVICE

Goods and part(s) (excluding consumable) manufactured by Seller are warranted to be free from defects in workmanship and material under normal use and service for a period of twelve (12) months after installation and start up and not exceeding 18 months from shipment date. Consumable, chemical trap, O-rings, etc., are warranted to be free from defects in workmanship and material under normal use and service for a period of ninety (90) days from date of shipment by Seller. Goods, part(s) proven by Seller to be defective in workmanship and/or material shall be replaced or repaired, free of charge, F.O.B. Seller's factory provided that the goods, part(s) are returned to Seller's designated factory, transportation charges prepaid, within the twelve (12) months after installation and start up and not exceeding 18 months from shipment date. In the case of consumable, within the ninety (90) days period of warranty. A defect in goods, part(s) and consumable of the commercial unit shall not operate to condemn such commercial unit when such goods, part(s) and consumable are capable of being renewed, repaired or replaced.

The Seller shall not be liable to the Buyer, or to any other person, for the loss or damage directly or indirectly, arising from the use of the equipment of goods, from breach of any warranty, or from any other cause. All other warranties, expressed or implied are hereby excluded.

IN CONSIDERATION OF THE HEREIN STATED PURCHASE PRICE OF THE GOODS, SELLER GRANTS ONLY THE ABOVE STATED EXPRESS WARRANTY. NO OTHER WARRANTIES ARE GRANTED INCLUDING, BUT NOT LIMITED TO, EXPRESS AND IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

THIS WARRANTY IS THE ONLY WARRANTY MADE BY CONTRÔLE ANALYTIQUE INC. WITH RESPECT TO THE GOODS DELIVERED HEREUNDER, AND NO EMPLOYEE, REPRESENTATIVE OR OTHER PERSON OR ENTITY IS AUTHORIZED TO ASSUME FOR CONTRÔLE ANALYTIQUE INC ANY OBLIGATION OR LIABILITY BEYOND OR AT VARIANCE WITH THIS WARRANTY IN CONNECTION WITH THE SALE OF CONTRÔLE ANALYTIQUE PRODUCTS.

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Major force. Seller is not liable for failure to perform due to labor strikes or acts beyond Seller's direct control.

SERVICE POLICY

1. If a product should fail during the warranty period, it will be repaired free of charge. For out of warranty repairs, the customer will be invoiced for repair charges at current standard labor and materials rates.
2. Customers who return products for repairs, within the warranty period, and the product is found to be free of defect, may be liable for the minimum current repair charge.
3. For parts replacement, the original part must be returned with serial and model numbers of the analyzer. **NO PART WILL BE SHIPPED IF THE ORIGINAL IS NOT SENT BACK TO CONTRÔLE ANALYTIQUE INC.**

RETURNING A PRODUCT FOR REPAIR

Upon determining that repair services are required, the customer must :

1. Obtain an RMA (Return Material Authorization) number.
2. Supply a purchase order number or other acceptable information.
3. Include a list of problems encountered along with your name, address, and telephone and RMA number.
4. Ship the analyzer in its original crating or equivalent. Failure to properly package the analyzer will automatically void the warranty.
5. Every gas connections must be capped with appropriate metal caps. Failure to do so will automatically void the warranty.
6. Write RMA number on the outside of the box.
7. Use a Contrôle Analytique approved carrier. Also, the delivery must be sent to Contrôle Analytique facilities. Contrôle Analytique will not accept airport to airport delivery.
8. Contrôle Analytique will not cover transport fees.

Other conditions and limitations may apply to international shipments.

NOTE: Seller applies to KONTROL ANALYTIK® and/or authorized distributors.

Trade mark: *KONTROL ANALYTIK®* is a registered trade mark of Contrôle Analytique Inc.

PROPRIETARY RIGHTS

Buyer agrees that any Contrôle Analytique's software, firmware and hardware products ordered or included in the goods ordered are proprietary of Contrôle Analytique. No change, modification, defacement, alteration, reverse engineering, software decompilations nor reproduction of such software or hardware products, or disclosures of programming content to other parties is authorized without the express written consent of Contrôle Analytique.

To maintain Contrôle Analytique trade secret and other proprietary protection of such software and firmware, such items are not sold hereunder but are licensed to buyer.

Contrôle Analytique Inc. reserves the right to interrupt all business relationship and warranty or service if there is any tentative from any customers to reverse engineering any of Contrôle Analytique products or to tamper with any sealed module.

Trademarks and product identification as Kontrol Analytik are the property of Contrôle Analytique Inc. and shall be used only in connection with Contrôle Analytique's products. No third party could remove or deface any model number or marks.

4.0 GENERAL SPECIFICATIONS

REFER TO BACK COVER FOR SYSTEM CONFIGURATIONS AND OPERATING PARAMETERS.

Detector type:	Variable Electromagnetic induced plasma cell. Non ratiometric measurement. Material: Quartz, single element, vacuum tight to 10 PSIG (69 KPAG). TCD and FID. New to come...
Range:	2 ranges factor user's selectable between 2,5 or 10
Gas connections:	All connections 1/8" Swagelok® or 1/8" VCR.
Calibration gas:	Zero: 20 % of full scale normally in use or baseline calibration. Span: 80 % of full scale value normally in use or the target operating value in the process.
Weight:	From 20 to 32 kg (44-70 lbs.) based on hardware configuration Standard enclosure is rack mount 4U,
Dimensions:	Width: 19" (482 mm), Height: 7" (177 mm), Depth: 24" (600 mm)
Flow measurement accuracy:	0 to 200 cc \pm 1 % of full scale.
Carrier gas:	Argon, Helium or Neon gas (purifier recommended), see system configuration section in the back cover.
Sample gas:	Sample pressure range: 5 to 40 PSIG. Recommended pressure: 15 to 25 PSIG.
Supporting gas:	Depends on application, see system configuration in back cover.
Supply:	120 VAC, 50/60 Hz or 230 VAC, 50/60 Hz. (to be specified on order)
Power:	Maximum 150 watts, 2 fuses, 3A/250 V for a system equipped with 3 ovens, main chassis only
Operating temperature range:	10°C to 35°C (must be stable)
LDL	Lowest Detection Limit is full scale dependent. To be specified on order.
Repeatability:	A) 10 ppm or higher as full scale : \pm 1.5 % (or better) over 24 hours. B) Lower than 10 ppm as full scale: \pm 3 % (or better) over 24 hours
Standard features:	<ul style="list-style-type: none"> • Isolated 4-20 mA output, used as process value retransmission up to 8 outputs • High resolution isolated mA chromatogram output • Remote range identification contact output, one per peak, up to 8 • Two alarm dry contact outputs, user pre-settable limits • Two digital isolated inputs • System status dry contact output • Self-diagnostic system software • Electronic carrier flow monitoring • Electronic sample flow control system • Color graphic display • Ethernet connection
Options:	<ul style="list-style-type: none"> • Remote monitoring software

5.0 SYSTEM DESCRIPTION

5.1 Introduction

The K4000^{NG} trace gas analyzer system is a basic mainframe configured for the final application. Each system is shipped pre-configured and ready to run.

The most frequent application is the measurement of impurities in bulk gases, i.e. H₂, O₂, N₂, CH₄, CO, CO₂ and NMHC in H₂, O₂, N₂, Ar and He. Other applications are feasible like the sub ppb measurement of Argon (LDL=0.1 ppb).#

How the instrument is configured, i.e. detector, columns and valves are application dependent. The K4000^{NG} can be fitted with any type of detector as T.C.D. (Thermal Conductivity Detector), F.I.D. (Flame Emission Detector), Plasma Emission Detector, etc.

When an application asks for it, a K4000^{NG} system can have one or more slave chassis to hold various detectors and columns.

A slave chassis has its own electronic system to control detector and data acquisition. All system parameters are controlled by the K4000^{NG} analytical software package.

Once properly configured, the system is started and operated as a stand alone online process analyzer with minimum operator intervention. There is no need to define any chromatographic method to detect and integrate a peak. Simple key parameters are entered into some configuration tables and it's done. The system can be calibrated and used.

Each peak is reported on screen with its process value, i.e. percentage, ppm or ppb. The software has advanced diagnostic tools and trending features that ease the trouble shooting process and configuration parameter definition.

The system comes standard with one 4-20 mA isolated output (up to 8 for the main chassis). There is also up to 8 dry contact remote range identification outputs. There are 2 operating ranges per peak with a user selectable multiplication factor between ranges of 2,5 or 10. A high resolution isolate mA output is provided as standard feature to retransmit the real-time chromatogram signal. This output can be used with third party data acquisition on chromatographic software package. Two process alarm dry contact outputs are included. Two alarm set points per peak can be entered.

Contrôle Analytique was the first to include since the introduction of the first instrument a fail safe dry contact output used as a status alarm. This contact will be activated in the event where there is a risk(s) that may lead to believing that the reported value may begin to be or become unreliable.

It can be seen as a common alarm for the system. All digital I/O can be configured as normally closed or open. Finally, there are 2 isolated digital inputs. One input is used as a remote start function. The other one is reserved for custom request.

The K4000^{NG} is the most complete G.C. based gas analyzer presently available.

When properly installed and started-up, a plasma based system detector will run 2 years on a continuous basis without requiring maintenance.

Please, in order to appreciate and understand all the features of your K4000^{NG} system, take the time to read and understand all parts of the User's Manual.

If you have any doubt or questions as a customer of Contrôle Analytique Inc., you may contact us directly for technical support free of charge.

5.2 Plasma detector

The carrier gas flows at atmospheric pressure through a proprietary design pure quartz cell. This cell is submitted to a high frequency high intensity electromagnetic field.

The K4000^{NG} detector is based on a spectroscopic emission cell, which in itself is not a new technique. On the other hand the characteristics which make this system stable and selective are the frequency, the intensity, the regulation, as well as the coupling technique and focusing (stabilizing) electrodes used to keep the plasma stable.

Under these conditions, the plasma becomes the center of a luminous phenomenon (electroluminescence). In fact, the plasma is electromagnetically induced. Plasma is a collection of charged particles; in this case, the plasma consists of a stream of carrier gas (Ar, He or Ne). This process being an emission technique, it is very efficient for quantitative analysis. The recent advances in semiconductors as well as in optical coating and devices make the development of new instruments based on the plasma technology easier; this without the cost normally associated with this category of analytical instruments.

Once the carrier gas is ionized (charged), many spectral lines are emitted. Here, we think a few words regarding the technique used to create the plasma are necessary. There are many ways of producing light from a gas stream for analytical purposes. The electroluminescence phenomenon includes luminescence from all kinds of electrical discharges, such as sparks, arcs or tubes of different kinds, operating on direct or alternating current of low or high frequency. Some experiments were conducted in the microwave range by surface-wave induced plasma, also for the study of gas by optical emissions.

Excitation, in these cases, 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.

By any of the above mentioned methods, characteristic emission spectra can be obtained for carrier gas and each substance in it. The emission usually varies for a given substance, depending on the mode of excitation.

5.3 Electric and electronic hardware description

5.3.1 Signal conditioning

The signal conditioning module is based on the latest technology state of the art electronic devices. Only the highest resolution with the lowest noise is used. Operational amplifiers are the best grade ones. Electrical resistors have the lowest noise and zero thermal coefficient. This leads to an analogic signal conditioning that could have a very high gain with minimum drift and noise. A special design low noise high stability analogic power supply is on board.

The signal conditioning board can accept signals from up to 8 detectors. TCD, FID and plasma emission detectors could be used. The various signals can be monitored from the diagnostic menu. The signal conditioning module has its own microcontroller to communicate with the main PC.

5.3.2 Main PC and graphic display

The main PC board runs the K4000^{NG} chromatographic software. It manages all user interface I/O and sends the information to the I/O board and the Signal Conditioning board via RS-485. Keypad and color graphic display are directly connected to it.

5.3.3 Oven heater and control

Up to 8 ovens can be installed in the K4000^{NG} main chassis. The temperature electronic control hardware is mounted on the I/O board. There are 8 temperature control loops (PID) in the software. The temperature is measured with a RTD. The analog to digital resolution is 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 E.M.I.. Oven circuits are also protected by a fuse mounted on the I/O board.

5.3.4 I/O board

The I/O board holds all the I/O functions of the instrument. See following table.

Digital I/O	<ul style="list-style-type: none"> ❖ 2 isolated digital inputs ❖ 8 remote range dry contact outputs ❖ 2 alarm dry contact outputs ❖ 1 system status dry contact output ❖ 10 G.C. valve contact outputs ❖ 2 analog inputs ❖ 8 oven power relays
Analog I/O	<ul style="list-style-type: none"> ❖ 8 oven temperature RTD input ❖ 8 isolated process 4-20 mA output ❖ 1 high resolution isolated mA output for the chromatogram
Microcontroller:	
Plasma generator control interface:	

All digital inputs and outputs, analog 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 analyzer without the need to unscrew each wire individually

The I/O board holds the fuses for the I/O. Each fuse is socket mounted and easily replaced.

5.3.5 Remote starting

The system can be started by applying 120 volts AC on the first digital input of the analyzer. This will produce the same effect as pressing the **Start** button from the **RUN-REAL-TIME CHROMATOGRAM MENU** (see the menu description section for details about buttons). This can't be performed if a cycle is already in progress. A delay between the voltage applied and the beginning of a new cycle can be set with the **Remote starting time** edit box control from the **CONFIGURATION-SYSTEM MENU**. Note that this input is protected for transient and by a 0.5 ampere fuse.

When the end of the countdown is reached, the 120 Volt must not be applied anymore to start a cycle. If not, the countdown will restart.

NOTE: 120 VAC or DC can be applied to digital input. If you need to apply 240 VAC, you must add an external resistor ranging from 30 K Ω to 40 K Ω , 5 watts in series with the "+" terminal.

6.0 INSTALLATION AND START UP

Contrôle Analytique guarantees that the analyzer will perform accordingly to specifications if the analyzer is installed as indicated in the following:

IMPORTANT: Please refer to system configuration at the end of this manual before proceeding with installation and start-up. You must first know which hardware you have in your system for the application you ordered. There is some documentation not included in this manual which covers installation and operation of specific hardware. For example: gas purifier, various chemical traps, permeable separation device, etc...

6.1 Electrical

Connect the line cord to the proper line voltage according to the model you have (i.e. 120 V, 50/60 Hz or 230 V, 50/60 Hz).

This voltage must be stable, transient free and have a stable frequency, for optimum operation. Also, the analyzer must be properly grounded or improper operation will occur. If the instrument is fed by a UPS, the electrical waveform must be sinusoidal. Square waves have too much Harmonic.

6.2. Gas Circuit

CAUTION: It is of the highest importance to never pressurize the analyzer because the quartz cell would be irreversibly damaged. So, before supplying any gas to the instrument, first remove the caps on the vent connections. However, in such a way as to not contaminate the analyzer it is better to leave all caps on gas connections until the gas installation is done and properly purged.

6.2.1 Introduction

The sampling system is the most important part of your analytical system. The performance of your analyzer can be dramatically limited by your gas transporting system. What we mean, by gas transporting system, any pressure regulator, valve, line, fitting, filter, purifier, etc. which are in contact with the sample or carrier gas to be introduced into the analyzer.

Absolutely, no leaks can be tolerated. Here, by a leak, we mean introduction of outside contaminants originally not present in the system. In our case, such leaks are atmospheric inboard leakage.

For all gas line connections (including calibration and sample), we recommend the use of 1/8" stainless steel tubing in full length, no fittings. You must avoid pipe thread connections, because they are usually sealed with Teflon tape and some particles can be introduced into the lines. By using compression type tube fittings, the venturi aspiration of outside contaminants is virtually eliminated.

Tube quality is often overlooked. For 1/8" O.D. tube, use a minimum wall thickness of .028". The tube must be purchased to meet ASTM69 specifications. Inferior quality tubes may have irregularities on their circumference causing bad sealing with compression tube fittings.

Install a by-pass roto-meter on your sample line. It must be installed near the analyzer and close to the stream selection valve. This increases the gas velocity and allows a faster purging of the sample line, before selection. You will also get a faster response time this way. Also adjust your sample line pressure to a value, which will bring proper flow in the system: higher sample line pressure results in longer response time. The recommended pressure at the sample inlet is 5 PSIG. All lines must be cleaned and purged to remove any traces of moisture or particles. Particles can damage your stream selection valves. Also, particles in the inlet filter will trap moisture.

NOTE: The best sampling system available today is our MSS, i.e. Manual Sampling System or our ISS i.e. Integrated Sampling System. Both systems are patented. They will provide many years of trouble free service. They are easily remotely controlled, perfect for Auto Calibration Systems, etc. Please contact us or visit our Website for more information. See ANNEX C for MSS specification sheet.

6.3 Carrier Gas Hardware Selection

We strongly recommend the use of a gas purifier fed by UHP grade gas cylinder as a source of carrier gas. The purer the carrier gas, the better the performance of the analyzer. The cost associated with research grade cylinder of argon is high. The carrier grade argon cylinder quality is not enough.

The least costly solution over time, and better for the quality of carrier gas is to use a heated type getter based purifier. The cost of UHP grade argon cylinders is inexpensive compared to carrier or research grade. The purifier will last many years.

Gas Purifier

You can buy such purifier from Contrôle Analytique's representatives

The model number to order is: GP-200- 120 : 120 VAC
GP-200- 240 : 240 VAC

You must add the proper model definition digits for supply voltage and fittings type.
See purifier specification sheet.

Cylinder Pressure Regulator

The pressure regulator must be a double stage type and made of stainless steel. The outlet pressure range must be selected according to the carrier pressure setting indicated in the configuration in the back cover of this manual.

The pressure stability is a critical parameter affecting the accuracy of the analyzer. A good quality pressure regulator must be used. For calibration gas cylinder, an outlet pressure of 200 Kpag (30 psig) maximum is recommended.

Isolation and Samples Stream Selection Valves

The valves used for isolation or sample selection must be packless type i.e. diaphragm or bellows type. This is the only way to remove air diffusion.

See regulator specification sheets.

6.4 Analyzer cabinet installation

This unit is designed for a rack mounted cabinet. If you install it in a different type of cabinet without side support bracket, **you must install a metal bracket to support the rear side of the cabinet.**

Like every analytical equipment, it **must** be installed properly. The unit should not be installed in direct sunlight and exposed to any vibrations. The ideal room temperature is around 25 °C, and most important of all, the temperature must be stable; it is essential to avoid excessive excursion in temperature swings.

Never install the analyzer in an area where a strong electromagnetic field is present. Never use radio transmitters near the analyzer. Also, it is a good idea to eliminate fluorescent lights near sensitive electronic circuits. The analyzer must be installed in a vibration free environment.

6.5 Analyzer start-up

Before to accomplish this step, you must make sure that the following is done properly.

Proper pressure regulators are installed on calibration and carrier gas cylinder. Regulators must have been properly purged.

- A. The gas purifier used to supply carrier gas has been started as per manufacturer's user's manual [allow 3 hours purge flow (\approx 75 cc) out from purifier, after purifier reaches its operating temperature, before connecting it to the analyzer].
- B. All lines are purged and have a small amount of flow going out of them.

1. When the previous points (A, B, C) are done, remove the caps from detector vent, carrier vent, and purge vent. Install the U bypass tube between trap in and trap out bulkhead if a trap is part of the system. Next, remove the cap from the carrier gas inlet and connect the carrier gas line. Adjust the carrier pressure as specified on your configuration sheet. Wait one hour and proceed to step 2.

NOTE: If you have a permeable separation device in your system, please refer to included documentation for installation. You will need to have dry and hydrocarbon free air to purge this device. This device will be normally installed at "trap in" and "trap out" bulkhead. Please see system configuration at the end of this manual.

2. Remove the cap from sample vent. Install the moisture trap (if included with your system) directly at the sample inlet with a small length of 1/8" S.S. tubing. Connect the other end of the trap to your sample source. Set the sample inlet pressure between 10 (70 kPa) to 20 psig (140 kPa).

NOTE: The flow control valve is a miniature thermal valve. On power up the valve is cold. It may take up to two minutes before to have flow trough this valve. Once the valve is warm the flow will stabilize. If you put the flow set point to 0 cc for a while the valve will cool down again.

3. Switch power ON. Check with your configuration sheets and parameter listing (back pocket of your User's Manual) that the instrument has the proper configuration, valve timing and peak data entered correctly.

Adjust carrier pressure to have the right carrier flow after oven temperature is stabilized.

Enter your flow set point. A normal value is 75 cc/min. Please see section 8 to understand various menus.

The following step is done if your system is equipped with a chemical trap, please see system configuration at the end of this manual.

4. Remove the U shape trap bypass tube connected between trap in and trap out. Quickly connect one end of the trap to the TRAP IN bulkhead connection. Wait two or three minutes and connect the other end of the trap to TRAP OUT bulkhead connection.

NOTE: When you remove de U shape trap bypass tube, there is no more flow to the detector and the plasma will shut off. This is not harmful for the detector.

Let the flow stabilize and readjust the carrier pressure to read a flow value as indicated on your configuration sheet.

NOTE: The carrier pressure must be the same value as per section 4 of this manual. If the pressure is different, you will have to retune the timing parameter of the analyzer even if the carrier flow read OK. The timing is related to gas velocity. Sometimes the instrument is equipped with its own carrier pressure regulator.

From this point let the analyzer stabilize over night before attempting any calibration.

5. When sample, carrier flow, and oven temperature are stable and the analyzer have spent at least 12 hours purging after cold start up, you may calibrate the unit.

Please refer to the calibration section of this manual Make sure that you understand the calibration procedure.

After the calibration, the analyzer is ready to be used.

6.6 Regulator purging

Regulator purging is an operation that is not always given the attention it deserves in the use of both high-purity gases and calibration gases. It is easy to understand that special precaution is necessary when using these types of gases.

In order to maintain cylinder integrity and obtain the best results possible, the end user should purge all regulators. It should be remembered that what happens to the gas between the cylinder and its end use is controlled by the quality of the connecting lines and the efficiency of the purging procedure.

Regulator purging is often not done at all, or is done by simply allowing an arbitrary amount of gas to flow through the regulator. There is a shortcoming to this method, however. In virtually all regulators, there are internal "dead" pockets, which tend to hold contaminants.

The internal "dead" pockets in a regulator tend to be unaffected by the flow of a purge gas. Better results will be achieved by alternately pressurizing and depressurizing the regulator with the purge gas. This is called dilution purging, or static purging.

The most effective means of purging connecting lines and regulators is by using the dilution purging method. The following procedure refers to regulator purging diagram on next page. The first step in dilution purging is to attach the regulator to the specialty gas cylinder. A tee with a valve on the side branch should then be located in the line between the regulator and the instrument. This branch should be connected to a vent, while the main trunk runs to the instrument.

The second step is to turn the regulator adjustment knob to the fully closed position (fully clockwise). V1 and V2 must be closed. V1 will stay in the closed position to keep the moisture trap and the line filled with clean gas.

Thirdly, open and quickly close the cylinder valve: that will pressurize the inlet side of the regulator to the cylinder pressure. It is necessary to quickly close the cylinder valve after each cycle in order to keep downstream contaminants from entering the cylinder until the regulator is fully purged. Wait approximately one minute, and proceed to the next step.

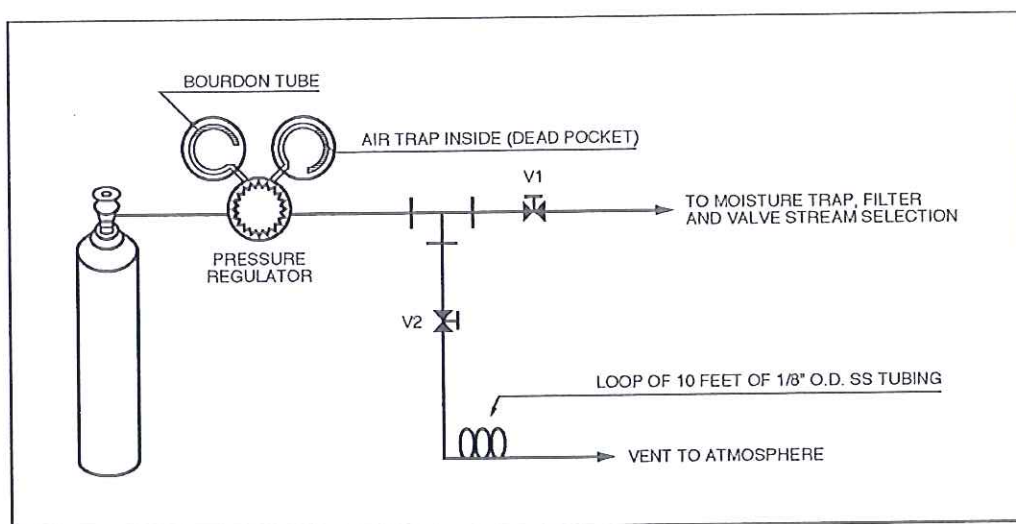
The fourth step is to open V2 to bleed regulator pressure. To avoid introduction of air do not depressurize completely. For example, if your pressure regulator has a maximum outlet pressure of 30 psig (206 kPa) or 100 psig (690 kPa), depressurize it to 5 psig (35 kPa). Then close V2.

Go back to the third step and repeat steps three and four. This cycle should be repeated 12 to 15 times to ensure that the regulator and the connecting line are both properly purged.

When this is done, readjust the outlet pressure of the regulator between 5 (35 kPa) and 10 psig (70 kPa), venting the excess of pressure through V2. Close V2, open V1 and allow flow through the line into the analyzer.

After this procedure, you should have clean gas in your system, and your calibration gas cylinder will not be polluted by air.

If you are not using your calibration gas cylinder for a long period of time, for any reason, close down the cylinder valve.



Regulator purging diagram

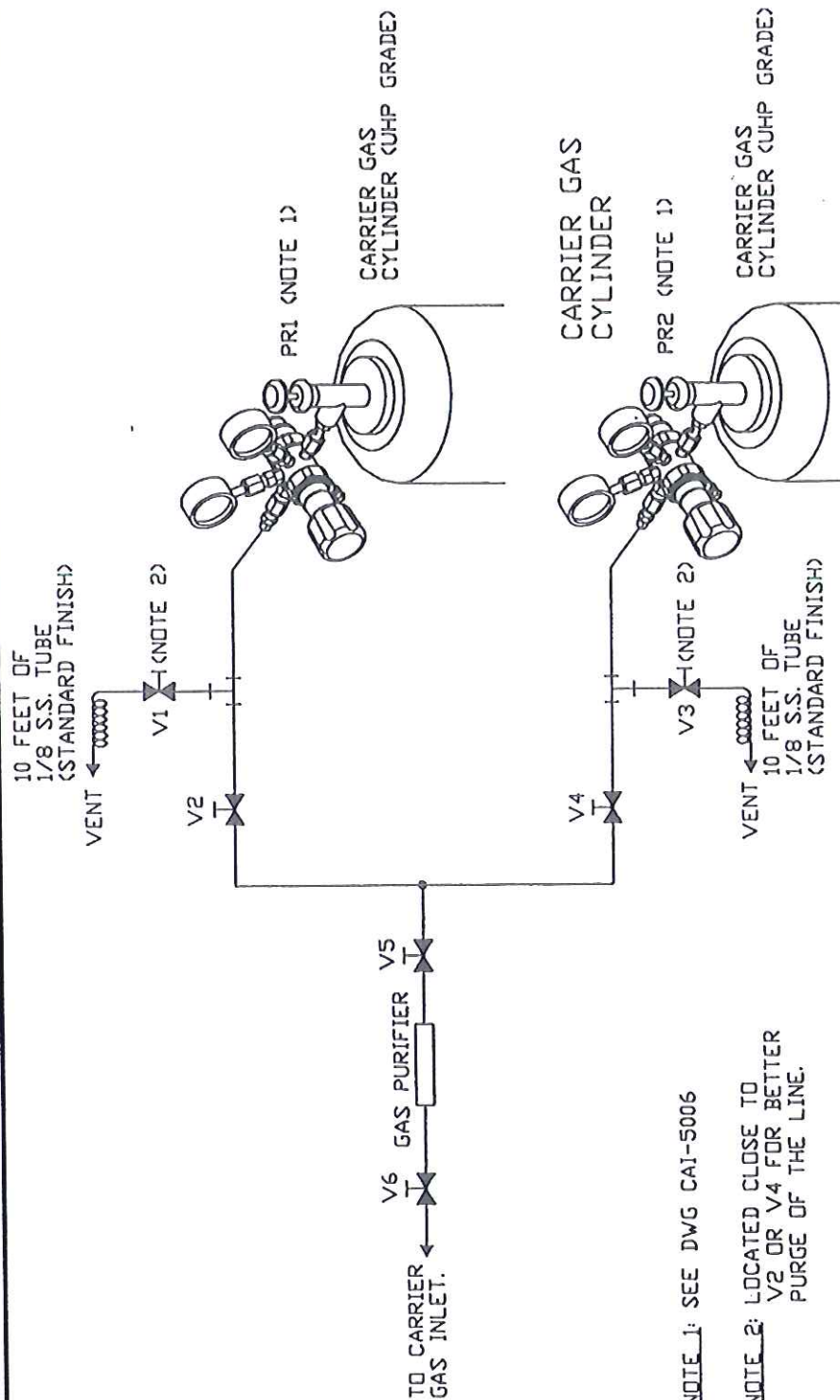
WARNING !!!

1. TO AVOID DAMAGE TO ANALYZER, ALWAYS LEAVE THE PROTECTION CAPS ON GAS CONNECTIONS UNTIL CLEAN GAS IS READY TO FLOW IN THE ANALYZER.
2. THE VENT CONNECTION OF THE ANALYZER MUST BE AT ATMOSPHERIC PRESSURE ALL THE TIMES. PRESSURIZING THE VENT SIDE OF ANALYZER COULD CAUSE THE QUARTZ CELL TO CRACK AND ALSO DAMAGE THE FLOW MODULE. FOR EXAMPLE, IF YOU HAVE TO CHECK YOUR SAMPLE LINES FOR LEAKS, DON'T DO IT WITH THE ANALYZER CONNECTED TO SAMPLE LINE WHILE THE VENT PROTECTION CAP IS STILL INSTALLED. SO PLEASE DO YOUR LEAK TEST AND CONNECT YOUR SAMPLE LINE TO SAMPLE INLET ONLY AFTER ALL LEAK TESTS ARE DONE. ANY FAILURE TO FOLLOW THESE RECOMMENDATIONS WILL VOID THE WARRANTY.
3. THE ANALYZER CABINET IS NOT DESIGNED TO BE SUPPORTED BY FRONT PANEL ONLY. A BRACKET SUPPORTING THE REAR OF THE ANALYZER CABINET MUST BE INSTALLED. SEE USER'S MANUAL FOR DRAWING OF SUCH INSTALLATION.

The carrier gas supporting system, **described on next page**, is a minimum requirement. This system will provide uninterrupted carrier gas to the analyzer and give the possibility to do a good purging procedure when replacing the cylinder. This is an absolute requirement to avoid column pollution and/or damage to the gas purifier.

However, this system requires operator intervention to execute cylinder changeover. Also, the pressure must be readjusted at the right value to keep carrier flow at the same value.

For system with automatic changeover and still having the right carrier pressure, please refer to annex D.



CONTROL ANALYTIQUE

SUPPORTING GAS

HARDWARE INSTALLATION

CAI-5006A

V1 TO V6: PACKLESS VALVES
NUPRO SERIE H VALVES
P/N: SS-2H, 1/8 SWAGelok
COMPRESSION FITTING
METAL BELLOW SEALED

GAS PURIFIER: MODEL PS2-CG50-R-XXX
XXX = SUPPLY VOLTAGE
1/8 TUBE FITTING
SWAGelok® TYPE

7.0 USER INTERFACE CONTROL DESCRIPTION

All analyzer's functions are controlled through different menus of the user interface in which controls are found. The user has to interact with these controls which are explained in this section. You must become familiar with these.

N.B.: The user toggles between controls by pressing the TAB key on the keyboard to go forwards, SHIFT-TAB to go backwards (if possible), by using the hot keys (F1 to F8) or with the mouse on the front of the analyser or with a mouse connected on the rear panel.

7.1 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.

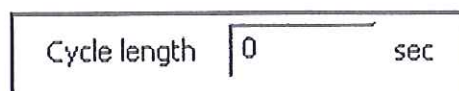


Figure 7.1: Edit Box control

When an Edit Box control that can accept user input is active, a cursor appears in this control.

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.

7.2 Radio control

The Radio control is used to select a mode of operation. The range mode is a good example.

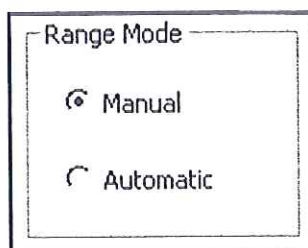


Figure 7.2: Radio control

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

7.3 Slide control

The slide control is used when the user may choose between items; for example, when the user has to choose between “selected peaks” or “all peaks” in the calibration menu.

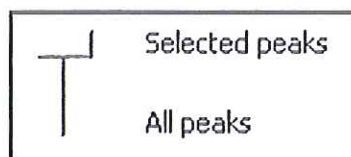


Figure 7.3: Slide control

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 position desired.

7.4 Push button control

The user clicks on a push button to trigger an action which is displayed on the button.

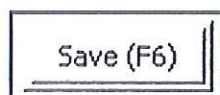


Figure 7.4: Button control

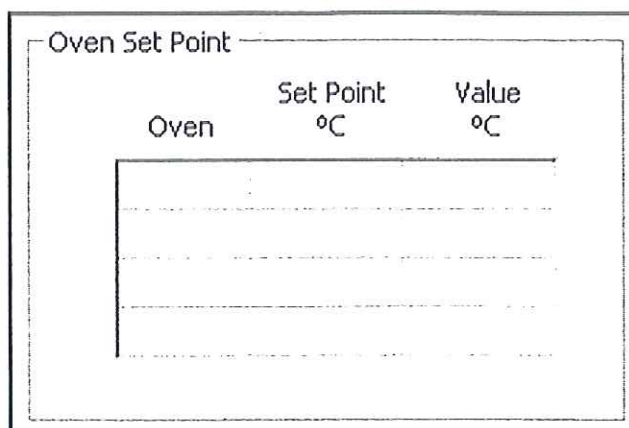
To operate a button from the keyboard:

- Press TAB until the button becomes active and press ENTER to activate the button.
- Or use the hot key corresponding to the button.

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

7.5 Grid control

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



Oven	Set Point °C	Value °C

Figure 7.5: Grid control

To operate a grid from the keyboard:

- Press TAB to move between cells in the grid to highlight it.
- To change a value, enter the new value and press ENTER or change cell.

To operate a grid with the mouse, just left-click on the desired cell to highlight it.

7.6 Combo control

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

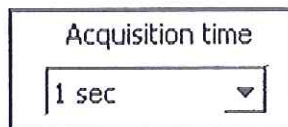


Figure 7.6: Combo Box control

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

To operate it with a mouse, left-click on the arrow and then left-click on the desired value.

7.7 Check Box control

The Check Box control is used to enable a feature.

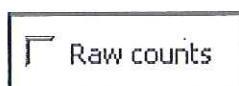


Figure 7.7: Check Box control

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

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

7.8 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.

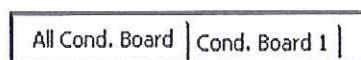


Figure 7.8: Check Box control

To operate it with the mouse, just click on the desired tab.

8.0 MENU DESCRIPTION

The analyzer's functions are regrouped in menus which are structured as in the following figure.

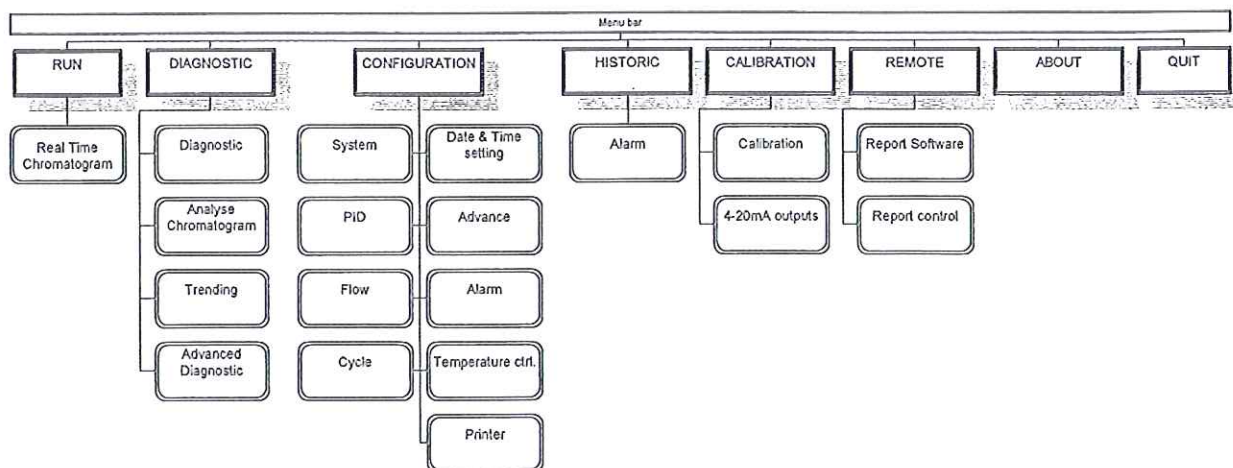


Figure 8.0

8.1 Run

8.1.1 Real Time Chromatogram

Pressing CTRL-R or clicking **Run** and then **Real Time Chromatogram** on the menu bar brings you to the **RUN-REAL TIME CHROMATOGRAM MENU** (fig. 8.1).

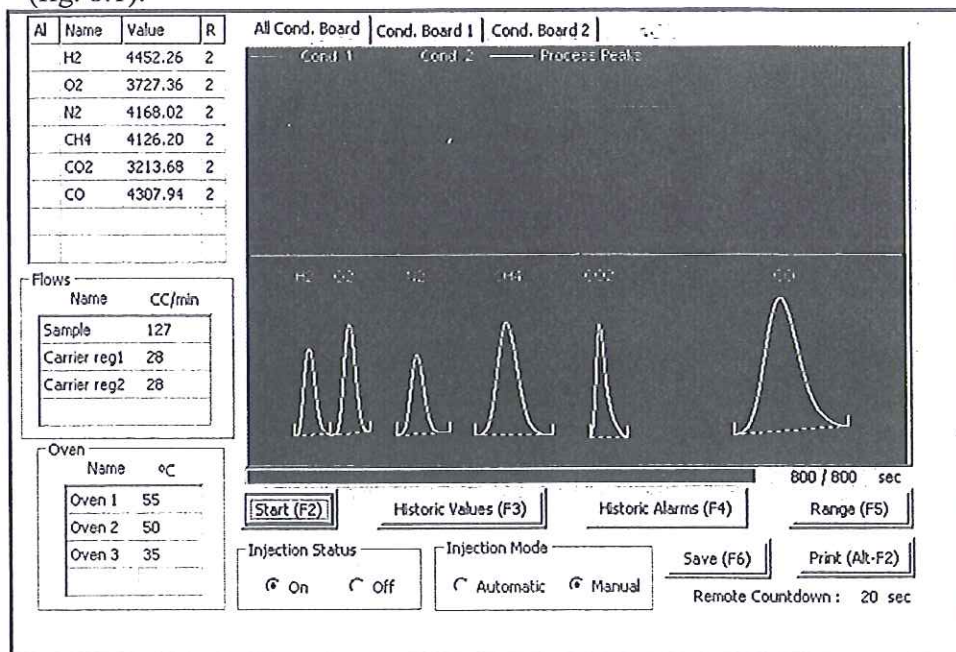


Figure 8.1.1

The real time chromatogram menu is the main menu of the K4000^{NG} Trace Gas Analyzer software. In this menu, you can start a cycle and visualize the resulting real time chromatogram. This chromatogram takes into account all the peak data that can be configured in the **CONFIGURATION-CYCLE MENU**.

A cycle may be executed by pressing the **Start** button and stopped by using the same button that would show **Stop**. 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 all the cycle, the progress bar increases with time. The bar starts at the left to end 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 (AI). When the peak detection process is done, the peak area is converted into the process value and displayed in the grid beside the peak name in the value field. Then, the analyzer waits for other peaks and applies the same procedure.

NOTE: The cycle continues even if you exit the **REAL-TIME CHROMATOGRAM MENU**.

You may also choose between two injection modes using the **Injection mode** radio button. If you select **Manual**, only one cycle is executed after the **Start** button is pressed. If you choose **Automatic**, the analyzer restarts new cycles until you press the **Stop** button or select **Manual**.

The **Injection Status** group box let you choose if the system must inject the sample or not. When the **ON** radio button is selected, the injection will be done. If **OFF**, it will be disabled.

A radio button in the **CONFIGURATION-SYSTEM MENU** let you choose between **Manual** or **Automatic** ranging. If **Manual** is selected, you may toggle between the 2 ranges by pressing the **Range** button. The range used to do 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, highlight the corresponding peak in the grid and press the **Range** button.

NOTE: When **Manual** ranging is selected, you can't change the **Range** during a peak. When **Automatic** ranging is selected, you can never change the **Range** by yourself; the range selection will be done 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.

Another important thing about peak values is the color displayed in the Alarm column (Al) of the peak grid. The color is used to display alarms for each peak. The following table represents the meaning of each color.

Color	Meaning
White	No alarm
Yellow	Alarm 1
Red	Alarm 2

From this menu, you can also access the alarm historic menu by pressing the **Historic Alarms** button. This button will turn red when an alarm occurs, turn yellow when the menu was opened but alarms are still active, and turn green if the problem is resolved. The **ALARM HISTORIC MENU** will be explained in section 8.1.1.2.

A trending can be saved by pressing the **Save** button. When the save button is pressed, a dialog box appears and asks you to enter a filename. You can load this file from the **ANALYSE CHROMATOGRAM MENU**. This menu will be explained in detail later. The button is enabled only when no cycle is in progress.

NOTE: Remember to delete trendings that are not used anymore with the **Delete** button of the **ANALYSE CHROMATOGRAM MENU** in order to avoid the analyzer hard disk to be filled up.

NOTE: When saving a real-time chromatogram, a pop-up will advise you if the analyzer hard-drive is full. If so, delete trendings from the **ANALYSE CHROMATOGRAM MENU** with the delete button.

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

You can view each conditioning board independently by clicking on the corresponding tab at the top of the chromatogram.

Moreover, you have access to a **Print** button, which enables you to print the chromatogram. The K4000^{NG} is configured for HP Laser Jet printers, but other printers might work.

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

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.

Push Button	Hot key	Function
Start/Stop	F2	Does an injection and begins a real-time chromatogram or stops a cycle and sets all gas chromatogram valves at their original position.
Range	F5	In Manual ranging only. Change the operating range.
Historic Values	F3	Accesses the HISTORIC VALUES MENU
Historic Alarm	F4	Accesses the ALARM HISTORIC MENU
Save	F6	Saves the real-time chromatogram in a file that can be opened from the ANALYSE CHROMATOGRAM MENU .
Print	Alt-F2	Send the screen to the printer.

8.1.1.1 Historic values menu

Displays the last 25 measures of concentration for the selected impurity. You first have to select a peak in the upper-left grid of the **REAL-TIME CHROMATOGRAM MENU** and then to press the Historic Values (F3) button to see these values.

8.1.1.2 Alarm historic menu

Displays the last 25 system alarms or peak value alarms.

System alarms :

➤ *Low sample flow:*

When the sample flow goes below 10 CC/min with a sample flow set point bigger than 10 CC/min;

➤ *Low carrier flow:*

When the carrier flow falls below 5 CC/min for the plasma and 2 CC/min for the TCD during 30 seconds, a "Plasma shut down" or "TCD shut down" alarm will be initiated after 30 seconds 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:*

When a "Plasma off" alarm is active, no "Low carrier flow" alarm is active, the starting mode is automatic (see section 8.3.1 about the **SYSTEM CONFIGURATION MENU** for the **Starting mode** definition) and no cycle is progressing (real-time chromatogram stopped or between cycles), the plasma is restarted.

➤ *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 1 degree Celsius.

➤ *Temperature deviation in the cabinet:*

When the cabinet temperature is different by more than Absolute Error plus 0.1 degree Celsius from the cabinet temperature set point (see the Temperature Control, section 8.3.8).

➤ *The flame on FID n is OFF:*

When the raw signal of the FID conditioning module is under the starting counts configured in the **ADVANCED CONFIGURATION MENU**. Do not change the starting counts; it is configured in factory based on the general configuration of the analyzer.

➤ *The flame on FID n is ON:*

When the raw signal of the FID conditioning module goes higher than the starting counts configured in the **ADVANCED CONFIGURATION MENU** after a flame OFF has been detected. Do not change the starting counts; it is configured in factory based on the general configuration of the analyzer.

NOTE: To ignite the FID, certain conditions must be respected. The FID needs at least a positive fuel flow, a positive air flow, a negative polarization and a high oven temperature. These parameters are set in factory by Contrôle Analytique. Fuel

flow must be around 30CC/min, air flow around 150CC/min, polarization around - 150 volts and oven temperature around 250 degrees Celsius.

➤ *Communication problem:*

When the user interface (PC) can not exchange any data with an electronic board.

➤ *Cabinet with temperature control is overheated:*

When the cabinet's temperature is too high for the electronic components and for a proper regulation.

Peak value alarms :

(no impact on 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.

When a problem arises, a new alarm is generated and the button of the **ALARM HISTORIC 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 if all alarms are resolved.

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

Some system functions such as a real-time chromatogram are disabled when alarms are active. Rectify the problems before proceeding with your analysis.

When the problem is resolved, the same alarm message is displayed, but with an "Ok" message (except for a "Plasma shut down" that is resolved with a "Starting" and for the "Plasma OFF" that is resolved with a "Plasma ON").

Example:

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

8.2 Diagnostic

8.2.1 Diagnostic

Pressing **Diagnostic (CTRL-P)** on the menu bar and then on **Diagnostic** brings you to the **DIAGNOSTIC-DIAGNOSTIC MENU** (fig. 8.2.1). The system diagnostic menu can be used for troubleshooting or only for information about the system.

This menu is divided in hardware component groups:

- Acquisition boards: read signals coming from detectors;
- IO boards: have several functionality related to the system as toggling relays, applying polarisation, reading mechanically regulated flows, regulating oven temperatures, etc;
- Electronic pressure regulators: regulate flows.

The screenshot displays the 'Diagnostic' menu with several tabs and data sections:

- Acq. Board Plasma #1 | Acq. Board Plasma #2 | Acq. Board FID #1**
 - Detector signal** table:

	Count	Volt
Cell	3787200	1.128674
Chromatogram	14432185	4.301126
 - Gain: 70, Scale Factor: 1x, Pre-Amp: 2, Polarity: Follower
 - Zero (F8)
- ID Board #1 | ID Board #2 | ID Board FID #3**
 - Flows** table:

Name	Count	CC/min
Carrier1	179508	24
Carrier2	173481	14
 - Ovens** table:

Name	°C
Oven1	50
Oven2	70
 - Pressure Regulator** table:

Flow Name	Count	CC/min	PSI
Sample1	3600	75.0	5.5
Al	15890	150.0	24.1
H2	544	0.3	0.8
Sample1	6621	50.0	10.0
Sample2	8404	50.0	12.8
 - Detector Generator Power**: #1: 85, #2: 85
 - Digital Inputs**: #1: 0, #2: 0

Figure 8.2.1

Depending on the configuration of the analyzer, 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, from 0 to 5V.

Chromatogram signal	The chromatogram signal represents the signal that will be displayed on the chromatogram and used to do the peak integrations. This data is displayed in counts, from 0 to 16777215 and also in volt, from 0 to 5 V.
Active Detector	Displays the current detector. These detectors are configured by Contrôle Analytique using the CONFIGURATION-ADVANCED MENU .
Gain	Displays the gain presently used. This gain amplifies the data to be displayed on the real-time chromatogram.
Pre-Amp	Displays the Pre-Amp Gain applies the signal. This gain will affect not only the Chromatogram Signal, but also the cell signal. There is 4 stages predetermined in factory that can be selected.
Offset	Displays the voltage applied at the input of the acquisition board in order to offset the signal. This is particularly used with a FID (flame ignition detector).
Scale Factor	Displays the factor presently used, which can be x1, x2, x5 or x10. This factor corresponds to the multiplier applied to the gain when range 1 is in use. The multiplier can be set in the <i>Range1 fact</i> 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.
Polarization	Displays the voltage used to polarize a FID (flame ignition detector).
Flame status	Indicates if the FID flame is ON (the gas is burning) or OFF (the gas is not burning). This status is based on the starting counts that are configured in the ADVANCED CONFIGURATION MENU .
Flows	Displays the carrier gas flows of the system.
Oven temperatures	Represents the ovens temperatures in Celsius degrees.
Detector Generator Power	Indicates the power applied to the different plasmas.
Digital Inputs	Shows the state of each digital input.

Pressure Regulator	Displays the Flow's Name, the Counts, the flow in CC/min and the pressure in PSI of the different electronic pressure regulators in the analyzer.
--------------------	---

The following table lists parameters that can be manually changed to diagnose a problem or simply to observe the effects of a change.

Parameter	Meaning
Active Detector	Let you choose which detector should be seen by the system. Only detectors for the conditioning board selected with the tab control can be selected.
Gain	Changes the system gain.
Pre-Amp	Toggles between Pre-Amp gain stage which can be 1, 2, 3 or 4.
Scale Factor	Toggles between factors which can be x1, x2, x5 or x10.
Polarity	Changes the system polarity.
Zero (F8)	Executes a zero, which means the baseline is reset to the current counts: when the zero is executed, the chromatogram cell counts are supposed to be near 83886076.
Ignite Flame (F2)	Turn on the glow plug in a FID in order to ignite the FID. The FID will turn on only if the proper conditions are respected (adequate fuel flow, air flow and FID temperature). When the FID is ON, water vapour is created at the exhaust of the FID on the analyzer back.
Detector Generator Power	These values can be change to apply a different power on the plasmas.

8.2.2 Analyse Chromatogram

Pressing **CTRL-L** or clicking on **Diagnostic** on the menu bar and then on **Analyse Chromatogram** brings you to the **DIAGNOSTIC-ANALYSE CHROMATOGRAM MENU** (fig. 8.2.2).

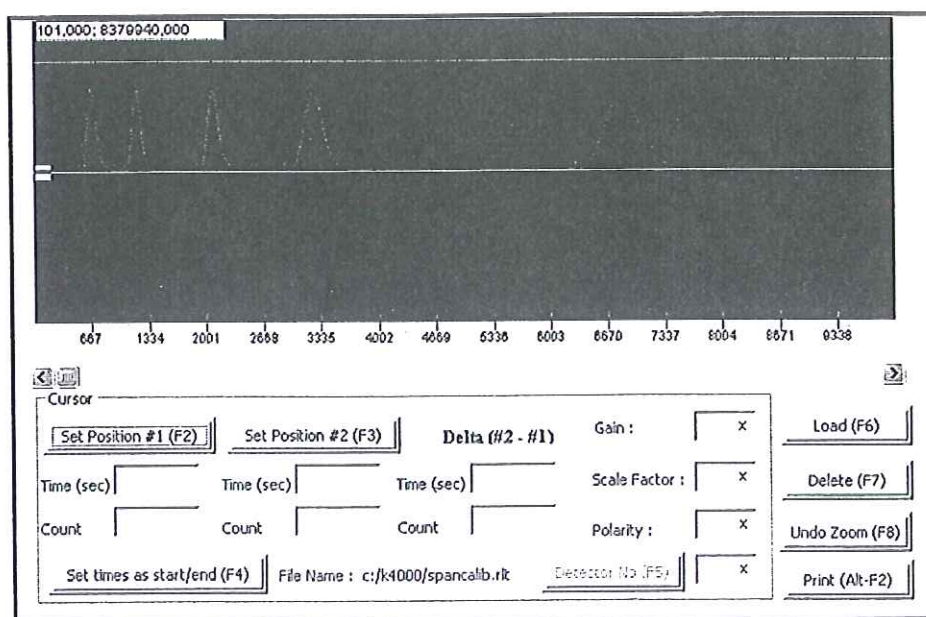


Figure 8.2.2

The analyse chromatogram menu is used when you need to analyse a chromatogram and define the right starting and ending times for the peaks. When you open this menu, the last real time chromatogram or the last trending (from the **DIAGNOSTIC-TRENDING MENU**) is automatically displayed. If there is no chromatogram in memory, the software will ask you for a file. If you wish to change the chromatogram, you only have to load it using the **Load (F6)** button.

All real time chromatograms are saved with the .rlt extension and .trd for the trending.

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

You can scroll the graph with the scroll bar on the bottom of the graph.

You can zoom in the chromatogram by using the mouse. By clicking on the left button of the mouse and holding it while moving, you can zoom in the region you want to observe. Pressing the **Undo Zoom (F8)** button will display the original chromatogram.

When you visualize a real time chromatogram, you cannot differentiate each conditioning board, you only get one line on the graph. But with a trending, each

detector read in the **DIAGNOSTIC-TRENDING MENU** can be seen with a different color. In this case, the **Gain**, the **Scale Factor**, the **Polarity** and the **Detector No** edit box will be enabled. In these boxes, you can see the data that was active at a precise time in relation with the cursor; by moving the cursor, the data changes.

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.

You can 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.

You may also delete a chromatogram using the **Delete (F7)** button.

NOTE: Since the analyzer has a limited hard disk space, it is a good habit to periodically delete unused trendings. Nevertheless, when saving a real-time chromatogram or a trending from the **DIAGNOSTIC MENU**, a pop-up will advise you if the analyzer hard-drive is full. If so, delete trendings from the **ANALYSE CHROMATOGRAM MENU** with the delete 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.
Detector No	F5	Move the cursor on the graph for the corresponding detector.

8.2.3 Trending

Pressing **CTRL-T** or clicking on the menu bar **Diagnostic** and then on **Trending** brings you to the **DIAGNOSTIC-TRENDING MENU** (fig. 8.2.3).

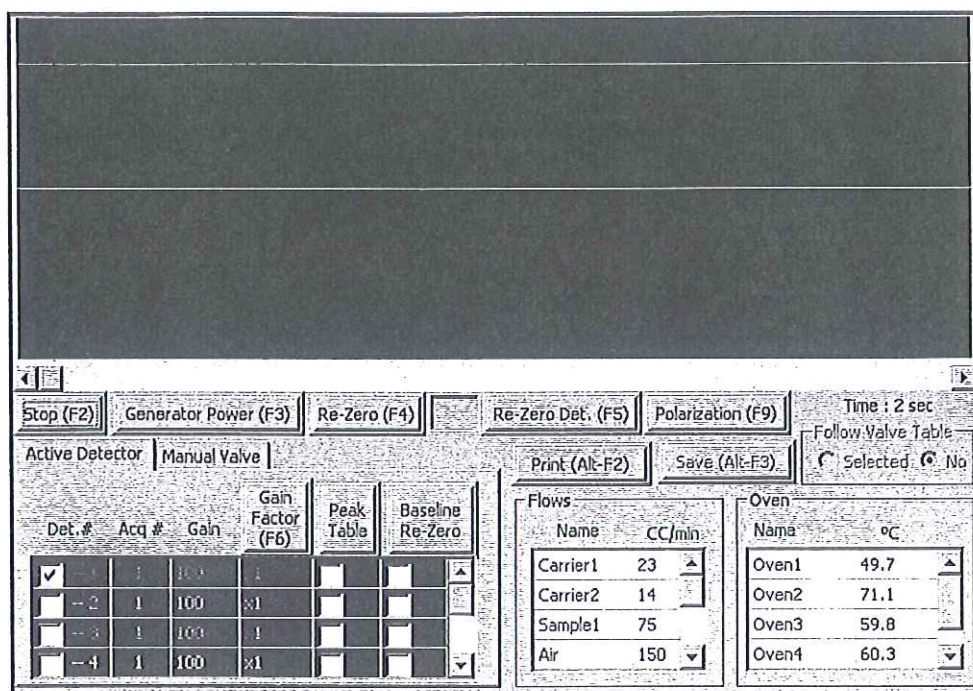


Figure 8.2.3

The trending menu is useful when you need to find peaks and set the proper settings for each of them, i.e. peak starting and ending times, gain, generator power and frequency, etc... These values must then be entered in the peak data table.

Before starting a trending, be sure that all parameters set in the **CONFIGURATION-SYSTEM MENU** such as sample flow, carrier flow, oven temperature, etc., have stabilized. Be sure that the gain, the detectors and the generator power are configured correctly. Nevertheless, these parameters can be changed during the trending process, except for the detectors.

To start a trending, you just have to press the **Start (F2)** button. When a trending is in progress you cannot change the detector to be trend on the graph. To stop a trending, just press the same button that will show Stop instead of Start.

You can change the generator power by pressing **Generator Power (F3)** button. A Pop-Up will ask you a value between 0 and 100% for each generator in the analyzer.

When the acquisition board is a FID, the **Polarization (F9)** button controls the detector polarization.

You can do a Re-Zero for the detector indicated in the edit box control beside the **Re-Zero (F4)** button. To change the detector number, just press the **Re-Zero Det. (F5)** button and it will change the detector number in the edit box. To make a Re-Zero, just click on **Re-Zero (F4)** button.

You can choose if you want to follow the valve table (timings for a valve to turn ON or OFF) or not in the **CONFIGURATION-FLOW MENU**. Click in the **Selected** or **No** radio box in the Follow Valve Table Group box. If you choose **selected** and then start a trending, a Pop-Up (Fig 8.2.3.1) asks you which valve table should be followed. In the Selection Column, a "1" means that the valve table will be followed and a "0", that the valve table won't be followed.

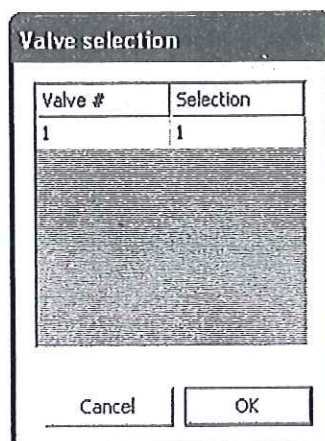


Figure 8.2.3.1

When the Active Detector tab of the left-bottom grid is selected, all configurations for each detector are shown. In the **Det. #** column, you can select the detector that you want to trend on the graph. A check box marked means that the detector will be trend. The **Cond** column indicates the conditioning board associated with the detector. The **Gain** column shows the actual gain for this conditioning board. If you want to change it, just change the value in the grid. The **Gain Factor** column indicates the Range Factor presently used. To change it, use the **Gain Factor (F6)** button. You have to select just one cell in the row for the desired conditioning board. You can select any detector row associated with that conditioning board. The **Peak Table** column let you choose if you want to follow the peak table and the **Baseline Re-Zero** column shows if the zero will be made between each peak. To make your choice, use the same procedure as for the Gain Factor with the **Peak Table** button and the **Baseline Re-Zero** button.

When you click on the Manual Valve tab, you see a grid that let you activate the valve that you want when a trending is in progress (Fig 8.2.3.2).

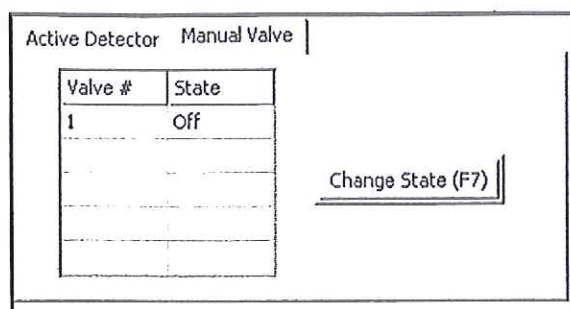


Figure 8.2.3.2

Select the valve that you want in the grid and use the Change State (F7) button to change its state. *Note that No must be checked in the Follow Valve Table group box in order to have this feature available.*

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

8.2.4 Advanced Diagnostic

Clicking **Diagnostic** on the menu bar and then **Advanced Diagnostic** brings you to the **DIAGNOSTIC-ADVANCED DIAGNOSTIC MENU** (fig. 8.2.4). This menu is used to trigger different components of the analyzer.

4-20 mA Diagnostic

IOBoard #1 ▼

4-20 #	mA
1	4.0
2	4.0
3	4.0
4	4.0
5	4.0
6	4.0
7	4.0
8	4.0

Relay Diagnostic

IOBoard #1 ▼

Relay #	State
1	On ▼
2	On ▼
3	On ▼
4	On ▼
5	On ▼
6	Off ▼
7	Off ▼
8	Off ▼

LEDs Diagnostic

FID #1 ▼

LED #	State
1	Off ▼
2	Off ▼
3	Off ▼
4	Off ▼

Status

☐ Active
☒ Not-Active

Alarm 1

☐ Active
☒ Not-Active

Alarm 2

☐ Active
☒ Not-Active

Data login

☐ Carrier1
☐ Carrier2
☐ Sample1
☐ Air
☐ H2
☐ Sample1

☐ Oven1
☐ Oven2
☐ Oven3
☐ Oven4
☐ FID

I/O Board #1 ▼

☐ Analog Input #1
☐ Analog Input #2
☐ Digital Input #1
☐ Digital Input #2

Acq. #1 (CB) ▼

☐ Raw counts
☐ Chrom counts

Time between acquisition

1 sec ▼

Start

View Data Trace

Figure 8.2.4

1) 4-20 mA Diagnostic:

This section is used to manually control the 4 to 20 mA analog 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 analog output will be set to this value and will stay at this value until it is changed from this menu or by normal operations from outside this menu.

2) Relay Diagnostic:

This section is used to verify if the Range relays on the I/O Boards are working properly. First select the board to diagnose by using the combo box just under the title "Relay Diagnostic". By using the combo box in the state column of the grid, you can switch the relay ON or OFF depending the configuration in **CONFIGURATION-ADVANCED CONFIGURATION MENU**. The value is applied after an **ENTER** on the keypad or when a mouse click is performed outside the combo box.

3) LEDs Diagnostic

This section is used to trigger the state of a LED display on components that do have LEDs.

4) Status, Alarm 1 and Alarm 2

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

5) Data Logging

This section is used to log data about certain components of the analyzer. By clicking in a particular component check box, it will make it active for data logging. You can set the Acquisition Time with the combo box ("Time between acquisition").

The **Start** button will start the acquisition. You can quit this menu and the acquisition will be still working, but **DON'T START A CYCLE AT THE SAME TIME!**

The **View Data** button will show you all data acquired for the selected components.

The **Trace** button will show you a graph of the data for each selected component.

8.3 Configuration

8.3.1 System

Pressing **CTRL-S** or by clicking **Configuration** on the menu bar and then **System** brings you to the **CONFIGURATION-SYSTEM MENU** (fig. 8.3.1). The system configuration menu is another very important menu. Many parameters are set there. These parameters are listed in the following paragraphs.

The screenshot displays the CONFIGURATION-SYSTEM MENU with several sections:

- Analog output:** Radio buttons for ☒ Track and ☐ Hold.
- mA Failure Mode:** Radio buttons for ☒ Off, ☐ Low, and ☐ High.
- Generator Starting Mode:** Radio buttons for ☒ Manual and ☐ Automatic.
- Range Mode:** Radio buttons for ☒ Manual and ☐ Automatic.
- Flow Set Point:** A table with columns Flow Name, Set Point (CC/min), and Value (CC/min).

Flow Name	Set Point CC/min	Value CC/min
Carrier1	25.0	23
Carrier2	15.0	14
Sample1	75.0	75
Air	150.0	150
- Oven Set Point:** A table with columns Oven, Set Point (°C), and Value (°C).

Oven	Set Point °C	Value °C
Oven1	50.0	49.1
Oven2	70.0	69.8
Oven3	60.0	58.9
Oven4	60.0	59.2
- Remote Starting Enable:** A checkbox and a text field showing '1' with a 'sec' unit.
- Screen Saver Enable:** A checkbox and a text field showing '900' with a 'sec' unit.
- Range Configuration:** A table with columns Peak #, Active State on Range #2, and Lock Range (F2).

Peak #	Active State on Range #2	Lock Range (F2)
H2	Opened	Set all opened Set all closed
O2	Opened	
N2	Opened	
CO	Opened	

At the bottom, there is a button labeled 'Reload Manufacturing Setting'.

Figure 8.3.1

1) Analog output:

You can choose between two modes. **Hold** mode maintains the 4-20 mA outputs even if a new cycle is started. In **Track** mode, analog outputs always track input gas values.

2) mA Failure mode :

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

3) Generator Starting mode:

- **Manual:** the automatic re-start feature is disabled and you may enter any plasma power value between 0 and 100%. 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.

NOTE: The system checks if the plasma is **OFF** between cycles. This feature is used only when the analyzer has a plasma as detector.

4) Range Mode:

Automatic: automatically 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 automatically on 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 presently used, the analyser switches to this lower range. **Manual:** you may change range manually.

NOTE: This process is independent for all peaks, which means that in **Automatic ranging**, the second peak range can stay the same even if the first peak changes range.

5) Flow Set Point:

Indicates the flows and the set point for each of them. There are two kinds of flow: Sample and Carrier.

Sample:

This value is used by the sample flow control loop. In the third column of the Flow Set Point grid, the real sample flow is displayed. There can be a delay between the time you specify a new set point and the time the real sample flow is displayed and stabilized to the specified set point. To change the set point, change the value in the second column for the corresponding flow.

Carrier:

This set point value is only used as a reference for carrier flow deviation alarm. The real carrier flow set point is determined by the pressure regulator on the back of the K4000^{NG}. If the actual carrier flow is 2 CC/min lower or 2 CC/min higher than the reference, the carrier flow deviation alarm is added in the **ALARM HISTORIC** and the contact status is opened (or closed, depending the configuration in the **CONFIGURATION-ALARM MENU**). This is, in fact, an alarm set point.

Minimum	0
Maximum	200
Resolution	1

6) Oven set point:

Defines the oven temperature in Celsius degrees. This 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 stabilized.

Minimum	0
Maximum	300
Resolution	1

7) Remote Starting Enable:

When this check box is checked, a cycle can be started by the digital input #1. The edit box specified the time that elapsed before the cycle starts after the digital input #1 is activated. When the 120 Volts is applied to the digital input #1, the remote starting countdown starts (it can be viewed in the **RUN-REAL TIME CHROMATOGRAM MENU**). To start a cycle, the 120 Volts must not be applied anymore when the countdown reaches 0. If not, the countdown restarts.

8) Screen Saver Enable:

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.

9) Reload manufacturer settings:

To reload the analyzer original configuration that was done in factory, click on this button.

10) Range Configuration:

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

By the **Lock Range** button, you can also Lock or Unlock the analyzer ranges. If you press the **lock button**, the range will be locked until you press the **unlock button**. (the lock button and the unlock button are the same. Only the text changes.). *The range can be lock if the analyzer is in autoranging mode, but it will be ignored.* By locking the ranges, you disable the range button in the **RUN-REAL TIME CHROMATOGRAM MENU** so that the ranges cannot be changed even if manual ranging is ON.

8.3.2 PID

Clicking on **Configuration** on the menu bar and then on **PID** brings you to the **CONFIGURATION-PID MENU** (fig. 8.3.2).

The screenshot displays two side-by-side configuration panels. The left panel is titled 'Flow' and features a dropdown menu at the top with 'Sample' selected. Below this are three input fields: 'Proportional' with a value of 0.02, 'Integrator' with a value of 0.03, and 'Differential' which is empty. A 'Save' button is located at the bottom right of this panel. The right panel is titled 'Oven' and has a dropdown menu at the top with '1' selected. It also contains three input fields: 'Proportional' with a value of 7.00, 'Integrator' with a value of 1.00, and 'Differential' with a value of 0.00. A 'Save' button is also present at the bottom right of this panel.

Figure 8.3.2

This menu lets you set the PID settings for flows and ovens. *Be sure to save your setting before changing Oven # and Flow #.*

8.3.3 Flow

Clicking on **Configuration** on the menu bar and then on **Flow** brings you to the **CONFIGURATION-FLOW MENU** (fig. 8.3.3.1).

This menu contains the flow sensor table. This data is set up by Contrôle Analytique inc. If you have to recalibrate some of these data, follow the following steps:

Carrier:

First of all, you need to choose the flow that you want to calibrate with the combo box on the top-left of the view. There are two kind of gas: carrier and sample. The carrier gas flow is changed using a gas regulator. For calibrating these sensors, you need a 0 CC/min point, a point higher than 200 CC/min and eight points between these values. Now, move the carrier valve and note the Flow meter counts in the **Flow Setting Tool**. Use a bubble flow meter to find the reading of the flow in CC and put these two values on paper. When you have 10 reading points, you must enter these in the flow table using the keyboard.

Flow	Counts
0.0	124609
6.4	134443
13.6	148618
28.2	168453
32.9	175482
38.2	182769
44.7	192787
50.3	198273
57.9	207309
72.6	221985

Flow Setting tools

Flow meter counts : 0

Flow Factor : 1.0

Validate (F3) Print (Alt-F3)

Figure 8.3.3

Sample:

For the sample, the same principle than the one of the carrier flow sensor calibration is used, but you can control the sample gas pressure with the control valve using the **Flow Setting Tool**. Wait for the PSI of the pressure valve to stabilize to the new set point. Now, use a bubble flow meter to find the reading of the flow in CC. When you have 16 reading points, you must enter these in the flow table using the keyboard. Note that the Flow Control Type depends on the tubing configuration of the system (bypass or direct). Therefore, keep the Flow Control Type as it is.

Flow	PSI
0.0	0.0
5.3	0.8
12.4	1.3
16.7	1.6
19.2	1.9
20.5	2.2
23.7	2.5
28.2	2.8
28.7	3.1
33.3	3.4
38.5	3.7
42.7	4.1
44.6	4.4
45.8	4.7
50.0	5.0
53.0	5.3

Flow Setting tools

0.0 PSI

PSI : 0.8

Flow Factor : 1.0

Flow Control Type
☐ Direct
☒ Bypass

Validate (F3) Print (Alt-F3)

Figure 8.3.3.1

In this menu, the control loops (flow set point values) are disabled. But as soon as this menu is closed, the control loops are re-enabled.

A flow association must be configured in the **CONFIGURATION-ADVANCED MENU** to know which flow is the carrier and which is the sample.

Flow Factor:

Many different types of sample gases may be handled by the K4000^{NG}. Flow transducers use the thermal conductivity principle to determine the volumetric flow (CC/min) of the gas. So various gases have different conductivities. For example, Helium and Hydrogen have a much higher thermal conductivity compared to Argon or Oxygen. The **Flow Factor** can be applied to the flow table in order to obtain the proper flow for various gases. Here are some factors for various gases:

Gas	Factor
Argon	1.0
Hydrogen	8.7
Helium	8.5
Oxygen	0.92
Nitrogen	1.04

NOTE: The minimum pressure required for proper operation could need to be re-adjust in order to avoid oscillation of the flow control loop when changing the sample gas type. This is application dependent.

TIP: The sample flow factor can be determined by using a bubble flow meter on the sample vent. To find a new flow factor for new sample gas, you may use a bubble flow meter connected on the sample vent bulkhead on the rear panel of the analyzer. Enter an arbitrary factor until the sample flow displayed on the LCD is close or equal to the flow measured with the bubble flow meter, that's all! For the sample flow, the absolute value is not critical, the stability is. This means that at the end of a cycle, the sample flow must be the same as the previous one. This is important for stability.

8.3.4 Cycle

Clicking on **Configuration** on the menu bar and then on **Cycle** brings you to the **CONFIGURATION-CYCLE MENU** (fig. 8.3.4).

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

1) General (Cycle Data and 4-20 mA Peak Association):

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**. Also, it is used to assign a peak to a particular 4-20 mA output.

NOTE: Don't change these values unless you know exactly what you are doing!

General
Peak
Configuration
Detection
Valve

Cycle Data

Cycle length: 800 sec
Second on chromatogram: 1000 sec

4-20 mA Peak Association

Peak #	I/O Board #	4-20 mA #
1	1	1
2	1	1
3	1	1
4	1	1
5	1	1
6	1	1

Save Peak Association Grid (F2) Print (F3)

Figure 8.3.4

2) Peak:

Peak Configuration:

The data that is found in the next menu is used during a running cycle. The system parameters change in real time according to each peak configuration.

The screenshot shows the 'Peak Configuration' menu. On the left is a sidebar with options: General, Peak, Configuration (selected), Detection, and Valve. The main area contains a table with the following data:

Name	Avr	Start	End	Det	Alarm 1	Alarm 2	Range 2	Range 1 fact.
H2	1	52.1	100.4	2	10000.0	10000.0	1000	1x
O2	1	105.6	155.0	2	10000.0	10000.0	1000	1x
N2	1	177.6	265.0	1	10000.0	10000.0	1000	1x
CO	1	273.0	405.0	4	10000.0	10000.0	1000	1x
CO2	1	545.0	605.0	8	10000.0	10000.0	1000	1x
THC	1	630.0	685.0	7	10000.0	10000.0	1000	1x

Below the table is the 'Peak #1 data' section with the following settings:

- Gain: 100
- Plasma power: 85 %
- Polarity: Inverter
- Pre-Amplification: 2

At the bottom are four buttons: Add peak (F2), Delete peak (F3), Save peak table (F4), and Print peak table (Alt-F2).

Figure 8.3.4.1

In the grid at the top of this menu, you found general information that does not depend upon the kind of detector. Here's a description.

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 Scale) This value indicates the full scale of the analyzer (Range 2).
Range 1 fact.	(Range 1 factor) The multiplier applied to the system, when the analyzer is on the first range.

Underneath the grid, you find extra information about the peak that is currently selected in the grid. This information depends on the type of detector.

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.
Polarisation	Polarisation applied to a FID detector.

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

N.B. For a TCD detector, the generator power is in relation with a temperature. The generator keeps the TCD at a constant temperature. Here is a graph representing this relation:

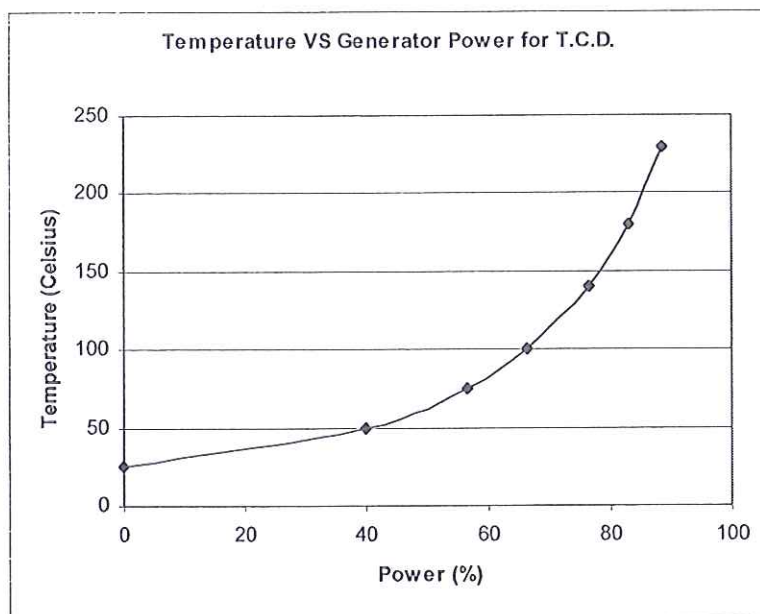


Figure 8.3.4.2

Peak Detection:

In this menu, you can modify constant that are used to detect if and when there is a peak.

Peak	H2	O2	N2	CO	CO2	THC
RMS Seg...	10	10	10	10	10	10
PD segne...	20	20	20	20	20	20
PD Nb Se...	4	4	4	4	4	4
Cut-Off f...	0.01	0.01	0.01	0.01	0.01	0.01
Filter Len...	100	100	100	100	100	100
THRESH F...	8	8	8	8	8	8
LDL	3.00	3.00	3.00	3.00	3.00	3.00
1 Derivative	1500	1500	1500	1500	1500	1500
2 Derivative	300	300	300	300	300	300

Save data

Figure 8.3.4.3

NOTE: AVOID CHANGING THESE SETTINGS: they are configured in factory by Contrôle Analytique Inc.

3) Valve data:

Valve timing configuration

1

On (sec)	Off (sec)
0	110
7199	7200
7199	7200
7199	7200
7199	7200
7199	7200
7199	7200
7199	7200
7199	7200

Save Valve #1 timing Print (F3)

Figure 8.3.4.4

This group box is used to control the valve state. By clicking in the combo box, you can change the time at which the valve go ON (open) or OFF (close). Each row in the grid indicates a sequence for the selected valve.

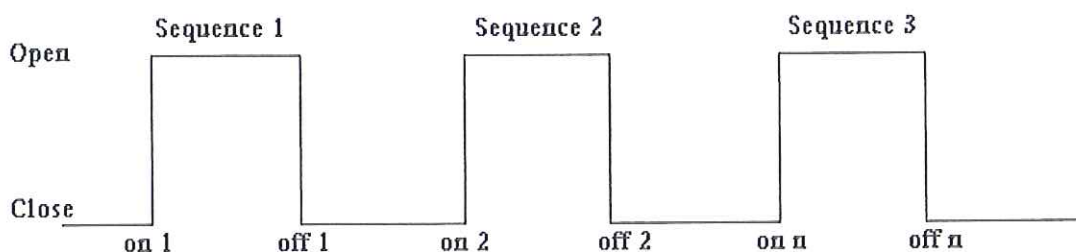


Figure 8.3.4.5: Typical sequence for timing closes and opens of a valve

Don't forget to save valve timing data with the **Save Valve** button each time you select a new valve in the combo or if you quit the menu.

NOTE: *A valve timing won't be apply if the timing are not saved first.*

8.3.5 Date and Time

Clicking on **Configuration** on the menu bar and then on **Date and Time** brings you to the **CONFIGURATION-DATE AND TIME MENU** (fig. 8.3.5).

The screenshot displays the 'CONFIGURATION-DATE AND TIME MENU'. It contains four input fields arranged in a 2x2 grid. The top-left field shows the time '8:10:57 PM' with a dropdown arrow. The top-right field shows the time '20:10:59'. The bottom-left field shows the date '26/09/2004' with a dropdown arrow. The bottom-right field shows the date '2004-9-26'. Below these fields is an 'Apply' button.

Figure 8.3.5

This menu lets you set the date and time of your analyzer. By using the combo box control, you can change the value of the date and of the time. Just click on Apply to set the desired value.

8.3.6 Advanced Configuration

Clicking on **Configuration** on the menu bar and then on **Advanced** brings you to the **CONFIGURATION-ADVANCED MENU** (fig. 8.3.6).

This menu is the analyzer core. It defines all the hardware components on which the K4000^{NG} is built.

NOTE: Therefore, you normally don't have to change these configurations; they are set in factory and reflect the hardware of the analyzer.

If for any reason you have to change any parameter of this menu, please contact Contrôle Analytique.

1) General:

General

Detector

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9

Flow

Valve

Oven

System Alarm

☐ On ☒ Off

Item	Quantity
Cond. Board	2
FID	1
I/O Board	2
Flow	9
Valve	3
Detector	9
Oven	5
Plasma	3
Press. Board	5
Temp. Ctrl.	0

RS-232 Communication

☒ On ☐ Off

Figure 8.3.6

In this menu, all K4000^{NG} alarm and error monitoring can be turned off when a user wants to work with the analyzer even if for example a flow is too low for a proper operation.

NOTE: Turning off System Alarm can be dangerous, for example if you are working with Hydrogen: the K4000^{NG} will stop advising you of any further problems!

Also, this is where the number of electronic boards, components and functionalities are entered.

Moreover, the RS232 communication can be turned ON and OFF if the system is purchased with this option.

NOTE: *AVOID CHANGING THESE SETTINGS: they are configured in factory by Contrôle Analytique Inc.*

2) Detector Association:

Detector #7

Detector Type: FID

FID #	Fuel Flow	Air Flow	Offset	Starting Count
FID #1	H2	Air	0.0031	41600

Save Cancel

Figure 8.3.6.1

The Detector association is used to configure the parameters relative to a precise detector or kind of detector. Depending on the type of detector that is selected, different parameters appear. For example, for a FID detector, you have to associate a Fuel flow and an Air flow. These flow associations are used to generate errors and alarms.

Don't forget to save the new configuration by clicking on the Save button.

NOTE: Flows must be configured before creating a new FID detector. Otherwise, it would be impossible to associate a flow with the FID detector.

NOTE: *AVOID CHANGING THESE SETTINGS: they are configured in factory by Contrôle Analytique Inc.*

Cond. Board #	Channel #	Location	Plasma #
1	1	I/O Board #1	1

Figure 8.3.6.2

In the case of a Plasma detector, a conditioning board must also be selected with the right channel. Moreover, a plasma must be associated to the detector by selecting its location on a IO board and its number on this IO board. The detector plasma association is used to process alarms such as Plasma Off , Plasma On and Plasma Starting.

Don't forget to save the new configuration by clicking on the Save button.

NOTE: *AVOID CHANGING THESE SETTINGS: they are configured in factory by Contrôle Analytique Inc.*

3) Flow:

Name	Location	Sensor #	Associated Plasma
Carrier1	I/O Board #1	Sensor #4	Plasma #1
Carrier2	I/O Board #1	Sensor #5	Plasma #2
Sample1	Press. Reg. #1		
Air	Press. Reg. #2		
H2	Press. Reg. #3		
Sample1	Press. Reg. #4		
Sample2	Press. Reg. #5		
Carrier3	I/O Board #2	Sensor #3	Plasma #1
Carrier4	I/O Board #2	Sensor #4	FID

Figure 8.3.6.3

The Flow menu associates a flow with a sensor on a certain I/O Board or Pressure Board. Name the flow, choose its location on the appropriate I/O Board, select Sensor number 3, 4 or 5 for a carrier, and associate a plasma (used to generate alarms and errors). If the location of the flow is Pressure Board, no sensor or plasma association is needed.

Don't forget to save the new configuration by clicking on the Save button.

NOTE: *AVOID CHANGING THESE SETTINGS: they are configured in factory by Contrôle Analytique Inc.*

4) Valve:

Valve #	Location	Channel #
Valve #1	I/O Board #1	Channel #1
Valve #2	I/O Board #2	Channel #1
Valve #3	I/O Board #2	Channel #2

Figure 8.3.6.4

The Valve menu associates a valve number to a valve channel on an I/O Board.

5) Oven:

Name	Location	Channel #	Max °C	Min °C
Oven1	I/O Board #1	Channel #1	300.00	0.00
Oven2	I/O Board #1	Channel #2	300.00	0.00
Oven3	I/O Board #2	Channel #1	300.00	0.00
Oven4	I/O Board #2	Channel #2	300.00	0.00
FID	FID #1	Channel #1	300.00	0.00

Figure 8.3.6.5

The Oven menu associates an oven with a certain I/O Board and a certain channel on this IO board. It is also possible to enter the maximum and minimum value for the temperature set point of this oven.

Don't forget to save the new configuration by clicking on the Save button.

NOTE: *AVOID CHANGING THESE SETTINGS: they are configured in factory by Contrôle Analytique Inc.*

8.3.7 Alarm

Clicking on **Configuration** on the menu bar and then on **Alarm** brings you to the **CONFIGURATION-ALARM MENU** (fig. 8.3.7).

Status Alarm

☐ Opened when active ☒ Closed when active

Alarm State

I/O Board #	Active State on alarm 1	Active State on alarm 2
1	Opened	Opened

Set All Opened. Set All Closed.

Figure 8.3.7

This menu lets you configure the alarms. The status alarm relay can be closed or opened when a status alarm is activated. Click on the desired 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.

8.3.8 Temperature Control

Clicking on **Configuration** on the menu bar and then on **Temperature Ctrl.** brings you to the **CONFIGURATION-TEMPERATURE CONTROL MENU** (fig. 8.3.8).

Location	Temp.(°C)
Zone 1	40.0
Zone 2	38.8
Exterior	25.1

Figure 8.3.8

This menu controls the temperature inside of the analyzer. **YOU SHOULD NOT CHANGE THOSE SETTINGS.** They were set in factory to make the analyzer temperature stable.

In the Cabinet Temperature group box, you can see 2 temperature zones. In the cabinet, it is separated by two imaginary zones. Zone #1 is the one regulated by the set point, Zone #2 is stable at a different temperature. You can also know the ambient temperature outside the analyzer with the exterior value.

If you have any problems to get the analyzer regulated in temperature, please contact factory.

8.3.9 Printers

Clicking on **Configuration** on the menu bar and then on **Printers** brings you to the **PRINTER CONFIGURATION MENU** (fig. 8.3.9).

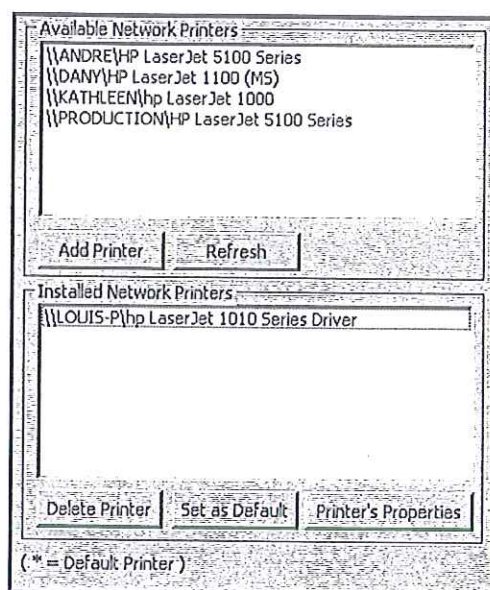


Figure 8.3.9

The available printers on your network will be display on the upper part of the menu. The **Refresh** button scans your network for newly installed printers. Otherwise, it is possible to configure a new printer by adding it with the **Add Printer** button. The **Set as default** button determines which printer is used for printing. The printer's properties can be modified with the **Printer's Properties** button.

8.4 Calibration

8.4.1 Calibration

By clicking **Calibration** on the menu bar and then **Calibration**, you access the **CALIBRATION-CALIBRATION MENU** (fig. 8.4.1).

Name	THRSH	Span Gas	Result	Rng	Select	TR5 Done	Span Done	Response Factor	Area Count
H2	0.0	1	< 0.00		YES ▼	NO	NO	0	0
O2	0.0	3	< 0.00		YES ▼	NO	NO	0	0

Time : 0 sec

Noise Threshold Calibration Enable (F2)

☐ Selected peaks
☐ All peaks

Start (F4)
Calculate Threshold (F5)

Span Calibration Enable (F3)

☐ Selected peaks ☐ Automatic Re-Span
☐ All peaks

Start (F6)
RE-SPAN (F7)

Figure 8.4.1

This menu is used to calibrate the system for the different gases you have to analyze.

Be sure to first configure all parameters of the system that you find in the **CONFIGURATION-SYSTEM MENU** and in the **CONFIGURATION-CYCLE MENU**. The analyzer must be properly started and purged before the execution of a calibration.

Specify the concentration of your span gas in the grid (span gas columns). This corresponds to the concentration of impurities found in the cylinders used for calibration. Click on the span calibration **Enable** button. This imposes ranges for integration based on the values specified in the **CONFIGURATION-CYCLE MENU** and those specified for span gas in the **CALIBRATION-CALIBRATION MENU**. These ranges are displayed in the **Range** column.

Example:

- If 100 is set in the **CONFIGURATION-CYCLE MENU** with a range factor of 5, then:

Range 2 \Rightarrow between 0 and 100

Range 1 \Rightarrow between 0 and 20

Then if 75 is set as the span gas, Range 2 is selected for calibration.

- If 25 is set in the **CONFIGURATION-CYCLE MENU** with a range factor of 10, then:

Range 2 \Rightarrow between 0 and 25

Range 1 \Rightarrow between 0 and 2.5

Then if 2.4 is set as the span gas, Range 1 is selected for calibration.

This determination of ranges applies only for the span calibration. The Noise Threshold Calibration is always done on range 1.

Calibration enabled will be displayed in the **RUN-REAL TIME CHROMATOGRAM MENU**. It is suggested and of common sense to do the calibration in **Automatic** injection mode. This allows a better gas equilibrium.

NOTE: When calibration is enabled, you can't change neither range configuration nor span gas values.

1) Noise Threshold (THRSH) Calibration:

This calibration step will find the noise level used for the peak detection process. In this step, **no injection** will be done. It is just a noise baseline on range #1, since the highest gain applied is always on this range. When starting the cycle, it will automatically switch to range #1. The RMS (Root Mean Square) value of this noise will be saved as noise and used for the peak pre-recognition.

First, you need to enable the Noise Threshold Calibration with the corresponding **Enable** button. After a few cycles in automatic injection, you can press **Calculate Threshold** button. The RMS value will be shown in the THRSH column of the grid. You can **Calculate Threshold** for **All peaks** or only the **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.

When the Noise Threshold Calibration is done, **YES** is displayed in the **TRS done** column of the grid.

2) Span calibration:

You must set the span calibration **Enable** with the corresponding button and start a calibration. After a cycle is over, it is possible to **ReSpan** the most recently calculated values of integration by pushing the corresponding button. You can **ReSpan All peaks** or only the **Selected peaks** by changing the corresponding slider state. When **Selected peaks** is selected, only peaks that have a **YES** in the Select column in the grid are considered. **ReSpan** takes the last peak integrations and sets it as the Span reference with the concentration values specified in the span gas column.

New peak values are displayed in the **Result** column and a **YES** is displayed in the **Span done** column of the grid.

The real-time chromatogram can still be seen in the **RUN-REAL-TIME CHROMATOGRAM MENU**. Clicking on this **Start** button automatically resets the injection **ON** to do the span calibration.

NOTE: Don't forget that prior to any calibration, the proper gas must be flowing through the analyzer, some runs must be done and the readings must be stabilized.

To perform a calibration, it is suggested to perform the following steps:

- Configure your system (peak data, valve timings, system configuration data, alarm data, range data, flow tables and PID settings) and your calibration data (zero and span gas).
- Enable Noise Threshold Calibration with the corresponding button in the **CALIBRATION-CALIBRATION MENU**.
- Start a calibration with the start button. Ranges #1 will be set automatically.
- After some cycles have been done (you are supposed to see a relatively straight line in the **RUN-REAL TIME CHROMATOGRAM MENU**), press **Calculate Threshold**.
- Disable Noise Threshold Calibration with the corresponding button.
- Enable Span calibration and press **Start**.
- After some cycles have been done (you are supposed to see peaks), press **ReSpan**.
- Disable span calibration with the corresponding button.
- Your system is calibrated.

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

The other values displayed on the grid are:

- Area counts: 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.

Moreover, there is an **Automatic Re-Span** option. When this option is checked, the analyzer automatically performs a re-span (same as pressing the **Re-Span** button) after a cycle of calibration reaches an end. In other words, after having press the **Start** button in the **Span** calibration, the cycle starts, then ends and the analyzer automatically calculates the value of this calibration with the last measured area counts and displays it in the **Result** column.

8.4.2 Calibration of the 4-20mA outputs

By clicking **Calibration** on the menu bar and then **4-20mA outputs**, you access the **4-20MA OUTPUT CALIBRATION MENU** (fig. 8.4.1).

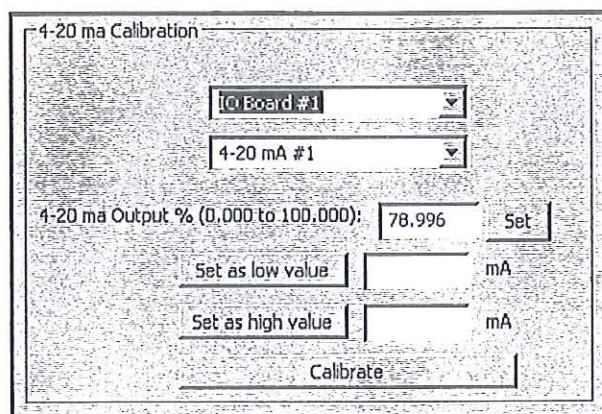


Figure 8.4.2

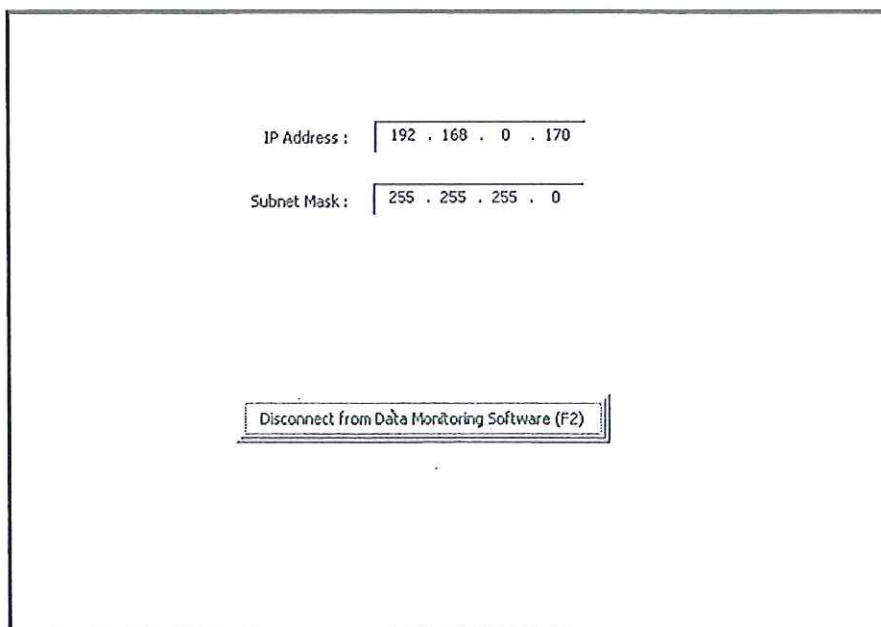
This menu is used to calibrate the 4-20mA outputs. This is originally performed in factory. Therefore, you normally don't have to do it again.

- ▶ **Step 1:** First choose the IO board on which you want to calibrate the 4-20mA outputs; normally, the 4-20mA outputs are on the first IO board;
- ▶ **Step 2:** Select the output you want to calibrate;
- ▶ **Step 3:** Connect an ampere-meter on the rear panel of the analyzer on the corresponding output;
- ▶ **Step 4:** Output a value between 0 and 100% (advise: 20%) by writing it in the edit box on the left of the "Set" button and click on "Set";
- ▶ **Step 5:** Write in the edit box on the right of "Set as low value" the reading on your ampere-meter and press "Set as low value";
- ▶ **Step 6:** Redo step 4 and 5 with a value higher than the first (advise: 80%) but enter it in the "Set as high value" edit box;
- ▶ **Step 7:** Press on the Calibrate button.

8.5 Remote

8.5.1 Report Software

Clicking on **Remote** on the menu bar and then on **Report Software** brings you to the **REMOTE-REPORT SOFTWARE MENU** (fig. 8.5.1).



The screenshot shows a menu with two input fields and one button. The first field is labeled 'IP Address :' and contains the value '192 . 168 . 0 . 170'. The second field is labeled 'Subnet Mask :' and contains the value '255 . 255 . 255 . 0'. Below these fields is a button labeled 'Disconnect from Data Monitoring Software (F2)'.

Figure 8.5.1

In this menu you can visualize the IP address of the K4000^{NG} that you'll need to use in the K4000^{NG} Report Software.

The **Disconnect** button is there if you want to close the communication between the K4000^{NG} and the PC Software. **If you close the K4000^{NG} Report Software in the PC, you must use this button to tell the K4000^{NG} that the connection is terminated.**

8.5.2 Remote Control

Clicking on **Remote** and then on **Remote Control** on the menu bar starts the configuration menu for the remote control.

The **Remote Control Configuration** menu is used to configure the analyzer for the remote control feature. This is only available when the analyzer is purchased with this option.

8.6 About

Clicking on **About** on the menu bar brings you to the **ABOUT MENU** (fig. 8.5.1).

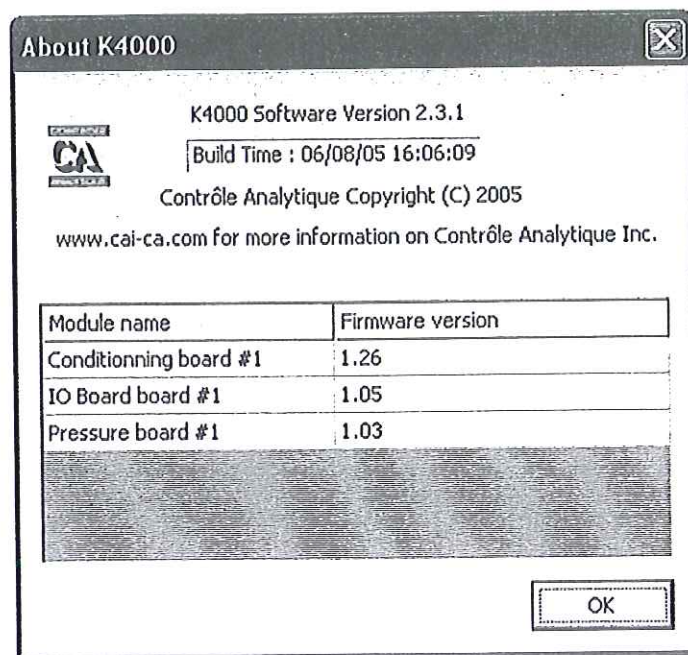


Figure 8.6

In this menu, you have the software version of the user interface (PC) and the firmware versions of the embedded electronic boards. This information can be very useful if you have to contact Contrôle Analytique's support.

8.7 Quit

It is important to always use the **Quit** button of the menu bar when the analyzer must be turned off. If you close the analyzer without quitting, some data could be corrupted. After a quit is done, wait for the black screen and then turn the analyzer power supply off with the switch on the back of the K4000^{NG}.

8.8 F.A.Q.

- "Problem when trying to open port #1 for serial communication"

If you see this message when starting up the analyzer, it is probably because the analyzer was not shutdown with the Quit button of the menu bar. By clicking Quit on the menu bar and restarting the analyzer, everything should be fine.

- "Communication problem with the I/O Board #?" or "Communication problem with the Cond. Board #?".

It means that the analyzer cannot communicate with the module number specified. If you see the message once, don't worry and the analyzer should be working OK. But if this message is continually appearing, shut down the analyzer and restart it. If the problem persists, contact Contrôle Analytique Support.

- "An error occurred when starting a new cycle. Please, try to start a new cycle."

When you see this message, it means that the analyzer has encountered a problem when trying to start a new cycle in automatic injection mode. The status relay will become active and you will now have to start a new cycle by pressing the Start/Stop button in the current menu. If the problem persists, contact Contrôle Analytique Support.

9.0 ANALYSER MAINTENANCE

The K4000^{NG} requires very little maintenance. If the analyzer is equipped with a trap (O₂ or H₂), this trap should be replaced ON in a periodic base. The frequency of replacement is a function of the sensitivity of the instrument i.e. if the instrument working range is 0-1 ppm or 0-200 ppm. Most of the time for high ppm range (>100 ppm) the trap is not required.

The sample inlet moisture trap can be regenerated by following the instructions included with this trap. If the analyzer is used for process monitoring (distillation column, etc.) you may replace it once a year. In truck loading station, where the moisture level is high due to the use of quick connectors, it is a preferable to regenerate or replace it every six months. These are only guide lines and frequency of replacement may be extended or shorten based on experience. Both traps (O₂ or H₂) and moisture are available from Contrôle Analytique.

The other parts of the system where maintenance is required are the diaphragm valves. Under normal condition, the valve's diaphragm should be replaced every two years.

9.1 Chemical trap replacement procedure:

- Set the analyzer in manual injection mode and wait the end of cycle.
- Record the carrier pressure and flow.
- Remove the expired trap.*
- Remove the caps (or plugs) from the new trap.
- Quickly install one end of the trap to the «trap in» labeled bulkhead. Wait two to three minutes and connect the other end of the trap to the trap out bulkhead.

NOTE: When you remove the expired trap from the gas circuit, the plasma will shut off. It will restart when the carrier flow will come back higher than 10 sccm.

- Let the system stabilize and readjust the carrier flow. If the carrier pressure is different from the previous one for the same carrier flow, you will have to enter new timing parameter for the beginning and ending of a peak. Furthermore, venting ending time may require slight readjustment. This is caused by different pressure drop from one trap to the other.

NOTE: After trap replacement, there will be some amount of nitrogen inside the trap. If your application is low ppm measurement of N₂ in O₂ you may have to wait 24 hours to get a stable reading. If you are measuring high level of nitrogen (> 80 ppm), one hour of purging will be enough.

9.2 Sample moisture trap replacement procedure:

- Set the sample flow setpoint to zero sccm.
- Remove the trap from sample inlet and install the new one.
- Set the sample flow set point to 150 sccm for a while to be sure to eliminate the air introduced in the trap during this process.
- Set the flow set point back to 75 sccm.

9.3 Valve diaphragm replacement procedure:

***NOTE:** Controle Analytique Inc is buys G.C. diaphragm valves from VALCO company. However, each of these valves, upon reception, is tested as "build" disassembled and reassembled with a unique procedure and retested. The Contrôle Analytique assembled valves have a better performance. For this reason Contrôle Analytique may trade in your weared valve for a minimum fee. This makes sure that you have maximum performance of your valves. Please contact us for more information.*

- Put the power off on the analyzer and shut off externally the sample flow.
WARNING: H₂ and O₂ are dangerous. Make sure you have no more sample flow into the analyzer.
- Remove the cover from the valves purged box.
- Unscrew the Allen screw in the middle of valve cap and lift up the cap just enough to pick up the old diaphragm.
- Install the new diaphragm in alignment pins with the «top» indication facing up, and replace the cap in the alignment pins. Take care to avoid to put your fingers on polished surface.
- Reinstall the Allen screw and retighten firmly.
- Reinstall the cover of the valve's purged box.
- Put back the sample flow pressure.
- Put the power on and wait for stabilization and recalibrate.

9.4 Timing procedure:

When you are replacing the O₂ or H₂ trap, or the chromatographic column, or if you change the analyzer's configurations it will be necessary to «resynchronize» the analyzer.

You must use a gas having about 80 % of the higher range full scale value. A gas with the same background as a typical sample gas composition should be used for this procedure.

To determine the new gain, polarity peak ending and starting time, cycle (run) length, etc., you will need to enter the sub diagnostic menu called trending. From that menu you may manually inject a sample, zero the baseline, and change gain and plasma power. Once you get an acceptable chromatogram you may save it for your records. You may also recall it for analyze. It's the perfect tool to watch the effects of oven temperature, carrier flow and other parameters on your peak shape and separation. When you are pleased with what you are watching, you directly transfer various times to the time table and voila!

9.5 Cell Cleaning (plasma emission detection only)

After many years of use and based on gas quality, there are sometimes some deposit build-up on the cell's internal walls. This deposit will reduce light transmission. It is possible to clean the cell with the Contrôle Analytique cell cleaning kit. This kit provides the needed hardware to circulate a chemical solution in the cell which will remove the deposit. Chemical solution is also included.

NOTE: The cell will need to be cleaned in very rare cases, this can happen in cases of high hydrocarbon content in the carrier gas or sample gases. It will take 2 to 3 years in such situations before the cell needs to be cleaned.

9.6 Routine check-up

The analyzer does not need a lot of supervision. But for accurate measurements you must be sure that:

1. Carrier flow is as per the value specified for your configuration. To check the carrier flow, put the injection mode in manual. Go back in «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 in the configuration section in the back cover.
3. The sample flow must be at the same value of the previous calibration procedure. This is to make sure you have the same sample volume injected. The default value of 75 sccm is OK.
4. Clean cabinet fan's filter periodically. This is very important, high internal temperature will eventually cause problems.

10.0 K4000RC SOFTWARE (REMOTE CONTROL)

This software is divided in two parts:

- K4000RC Viewer
- K4000RC Server

Note : The K4000RC Viewer and server are optional softwares. They need to be requested when buying the analyzer.

10.1 K4000RC Viewer:

The viewer can be used in any PC with Windows as operating system. It is designed to run stand-alone, without requiring any other packages to be installed first.

10.1.1 Connecting to a K4000^{NG}

Just execute the K4000RCViewer.exe application. The K4000RC Viewer will display the Connection Details dialog with the IP address of the analyzer (fig. 10.1.1)

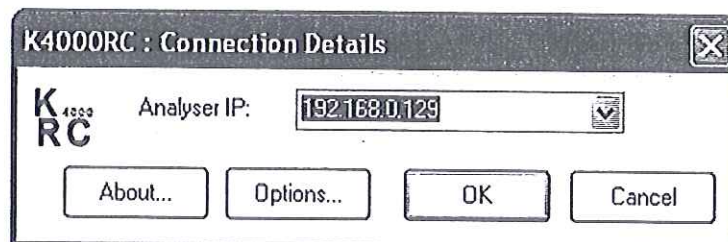


Fig 10.1.1

Once you have selected the analyzer IP to connect to, you can simply click Ok or press return to attempt to connect to it. If your connection attempt succeeds then the IP will be added to the Connection Details drop-down menu to avoid having to re-type it each time this menu is used. The IP Address is found in the REMOTE – REPORT SOFTWARE menu in the K4000^{NG}. This IP is assigned with DHCP, so no static IP can be used with the K4000^{NG}.

If a password is set in the K4000RC server, a dialog pops up asking for the password (fig. 10.1.2)

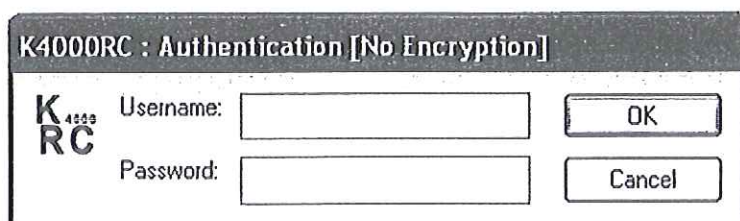


Fig. 10.1.2

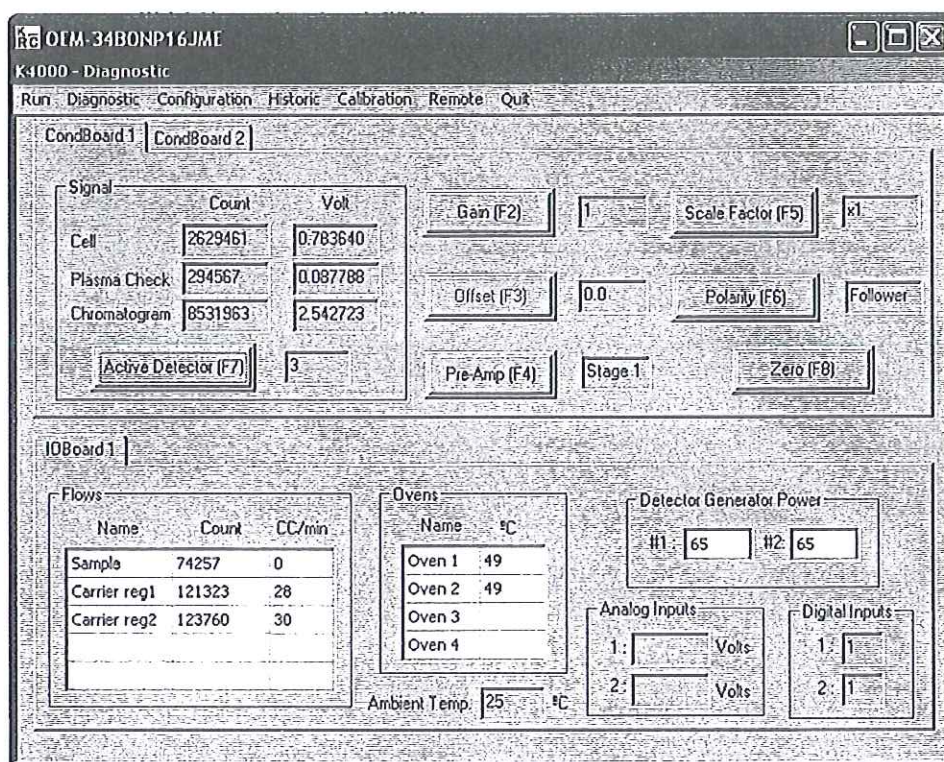
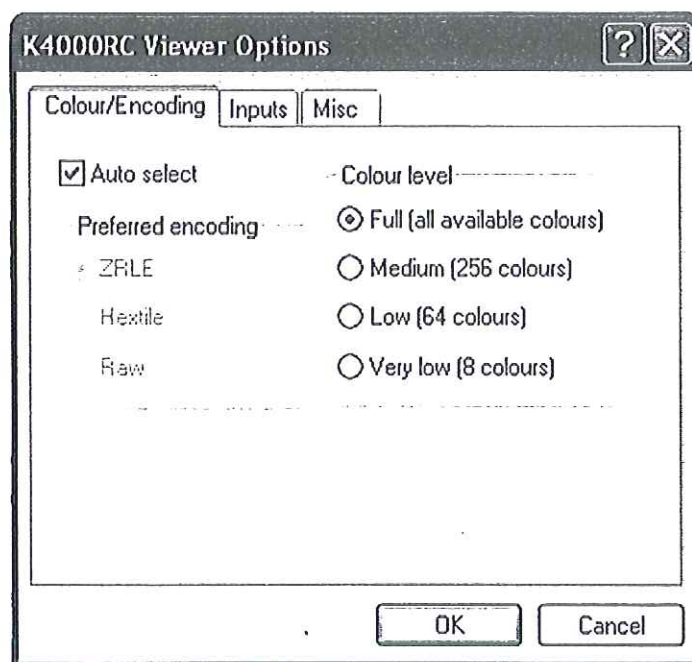


Fig. 10.1.3 (K4000RC Viewer when connected)

10.1.2 Options

Alternatively, you can select the Options... button to override the default connection configuration before connecting. There is another way to access the options dialog: first, by typing F9 or second, by double clicking the frame when a connection is active. The Options dialog consists of many pages with different options grouped according to their functionalities. The following documentation describes each option and the equivalent command-line parameters.

10.1.2.1 Color encoding



AutoSelect=true/false

Auto select

The Auto select check-box controls whether or not K4000RC Viewer should attempt to automatically gauge the speed of the network connection to the K4000RC Server and adjust its behavior accordingly. If selected, the viewer takes control of the graphical compression scheme used, and only requests full color updates if the network appears fast enough to support them. If not selected, then the user must select suitable encoding and format options manually.

PreferredEncoding=Raw/Hextile/ZRLE

ZRLE

Hextile

Raw

The ZRLE, Hextile and Raw radio buttons let the user choose between different graphical encoding for the K4000RC Viewer. The available encodings are arranged in order of increasing bandwidth requirements and decreasing processing requirements, so that ZRLE is most effective on slow networks such as dial-ups, while Raw is often most effective on fast LANs. The preferred encoding is determined automatically by K4000RC Viewer if the Auto select checkbox is ticked.

Color level

The Color level box controls whether K4000RC Viewer should request as many colors as the server can handle, or one of a predefined set of lower-color for minimizing the bandwidth.

FullColor=true/false

Full (all available colors)

If Full Color mode is selected then K4000RC Viewer will attempt to render colors as accurately as possible. Otherwise, a reduced number of colors will be used, to limit the required network bandwidth. The reduced color mode to use is determined by the LowColorLevel setting.

LowColorLevel=2

Medium (256 colors)

LowColorLevel=1

Low (64 colors)

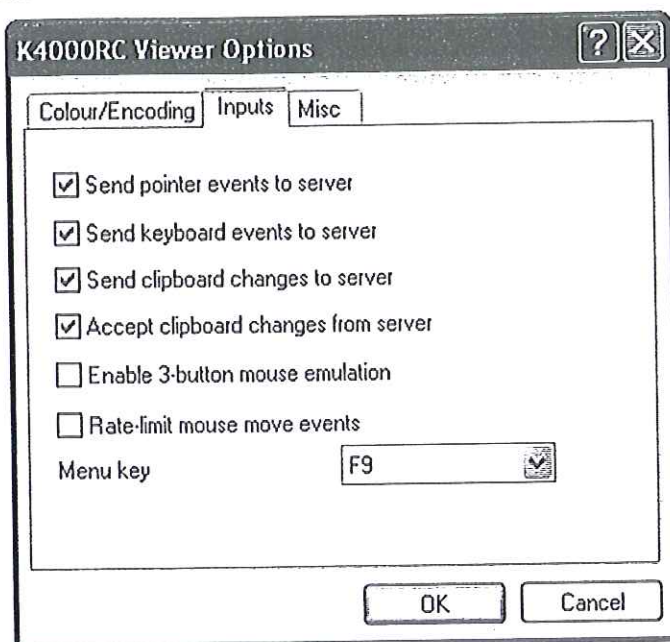
LowColorLevel=0

Very Low (8 colors)

If Full Color mode is not active, K4000RC Viewer requests one of the presets of lower color modes. These modes range from Medium color, which requests 8bpp palettized pixel data from the server, to Very Low color, which requests pixel data in 3bpp true-color format, causing the entire desktop to be rendered in lurid primary colors.

Note that if the Auto select check-box is ticked, then the automatic pixel format selection routines may override the user's selection and cause the connection to revert to Full Color mode.

10.1.2.2 Inputs



SendPointerEvents=true/false

Send pointer events to server

By default, any pointer actions within the K4000RC Viewer window is sent to the K4000RC server. If this checkbox is unchecked then pointer events will no longer be sent, allowing K4000RC Viewer to operate in a view-only mode.

SendKeyEvents=true/false

Send keyboard events to server

By default, any key pressed within the K4000RC Viewer window is sent to the K4000RC server. If this checkbox is unchecked then key events will no longer be sent, allowing K4000RC Viewer to operate in a view-only mode.

SendCutText=true/false

Send clipboard changes to server

By default, any text copied to the clipboard is sent to the K4000RC server, so that the remote and local clipboards are synchronized. If this checkbox is unchecked, then the clipboard data is no longer sent, ensuring that the clipboard actions made at the server are not affected by the viewer, and that sensitive data in the local clipboard cannot be leaked to the server.

AcceptCutText=true/false

Accept clipboard changes from server

By default, any text copied to the remote clipboard is sent by the K4000RC Server to the K4000RC Viewer. If this checkbox is unchecked, then the clipboard data sent by the

server is ignored, ensuring that the clipboard actions made at the server cannot affect the local clipboard.

Emulate3=true/false

Enable 3-button mouse emulation

When 3-button mouse emulation is enabled, pressing the left and right mouse buttons simultaneously will instead be treated as a middle-button press event. This is used when accessing a system requiring the use of all three buttons from a K4000RC Viewer machine that only has two physical buttons available.

PointerEventInterval=<milliseconds>

Rate-limit mouse move events

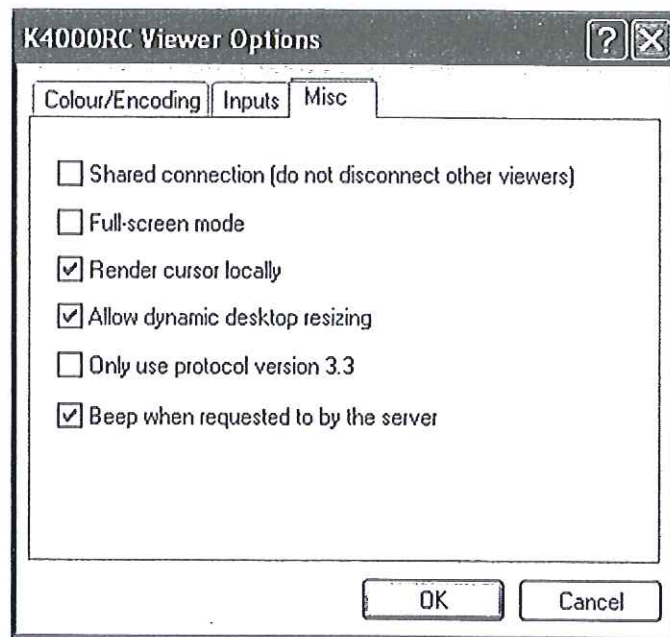
Over very slow networks such as dialup connections, mouse event data and mouse event acknowledgements can be a significant bandwidth drain. K4000RC Viewer can be configured to enforce a minimum interval between consecutive mouse movement events, to reduce traffic to and from the server. If PointerEventInterval is zero then mouse movement events are always sent to the server as soon as they occur. When checked, this option sets PointerEventInterval to 200ms.

MenuKey=<key-name>

Menu key

By default, pressing the F9 key within a K4000RC Viewer window will cause the F9 menu to be displayed. The MenuKey option allows a different key to be chosen, or the menu key feature to be disabled. MenuKey may be set to any one of the function keys F1 to F12 or left empty to disable the menu key feature.

10.1.2.3 Misc



Shared=true/false

Share connection (do not disconnect other viewers)

When connecting to a K4000RC Server, K4000RC Viewer can request that all other connected viewers are disconnected before the connection continues. If Share connection is checked, then K4000RC Viewer does not request other viewers to be disconnected. Note that the server may choose to ignore or refuse K4000RC Viewer's request. Note that this option is only available when configuring the Default Options or when configuring a new connection, not when the connection is already active.

FullScreen=true/false

Full-screen mode

If the Full-screen mode checkbox is checked, K4000RC Viewer attempts to take over the entire local display in order to show the remote desktop. The full-screen setting can be set as a default, used for new connections, and changed once a connection is active. The F9 Menu also provides a shortcut to toggle full-screen mode.

UseLocalCursor=true/false

Render cursor locally

K4000RC Viewer 4 supports rendering of the K4000RC Server's cursor locally, by the viewer. This means that the cursor responds more quickly to mouse movements and makes K4000RC connections over slow networks appear faster. Over faster networks, or for personal preference, this local rendering may be disabled by un-checking the Render cursor locally checkbox.

UseDesktopResize=true/false

Allow dynamic desktop resizing

K4000RC Viewer 4 supports dynamic resizing of the K4000RC Server desktop. If dynamic resizing is not supported by the viewer and by the server, then changes to the dimensions of the remote desktop may cause the K4000RC connection to be closed. Dynamic desktop resizing may be disabled if it causes problems on your system.

Protocol3.3=true/false

Only use protocol version 3.3

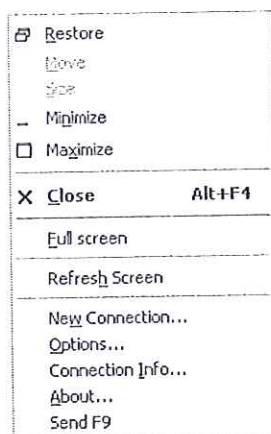
K4000RC Viewer 4 supports both the original K4000RC version 3.3 protocol, and the new K4000RC protocol versions 3.7 and 3.8. Some third-party K4000RC software use non-standard version numbers which may cause incompatibility issues. K4000RC Viewer 4 can therefore be configured to only use the original K4000RC protocol version 3.3, ensuring compatibility even with non-standard K4000RC Servers. Note that this option may be set as a Default Option, or when making a new connection, but cannot be changed once a connection is active.

AcceptBell=true/false

Beep when requested to by the server

By default, K4000RC Viewer 4 plays a default system beep when a bell event is sent by K4000RC Server. The beep can be disabled by setting AcceptBell to false.

10.1.2.4 F9 Menu



The so-called F9 Menu provides a quick way to access a set of frequently-used K4000RC Viewer functions. It is called the F9 Menu because it can be accessed by pressing the F9 key by default in a K4000RC Viewer window!

The F9 Menu can also be accessed by right-clicking on the titlebar of a K4000RC Viewer window, or by left-clicking on the System Menu button in the top left of the K4000RC Viewer window's titlebar.

Clicking anywhere outside the F9 Menu will cause it to go away again.

The F9 Menu provides the same set of available functions as the K4000RC Viewer window's normal System Menu, namely those allowing the window to be minimized, maximized, moved or closed.

Additionally, some K4000RC-specific actions are available:

Full screen

The Full screen menu item allows full-screen mode to be toggled on or off directly, without having to use the Options dialog. See the description of the Full screen setting in the Options page for more information.

Ctrl & Alt

Certain combinations of keys pressed with Ctrl and/or Alt are intercepted locally by Windows, preventing them from being passed to the server by K4000RC Viewer. The Ctrl and Alt menu options allow the Ctrl and Alt keys to be pressed or released at the server, regardless of the state of the K4000RC Viewer's local keyboard. If an item is ticked, then the key is down (pressed), otherwise it is up (released).

Send F9

Because by default the F9 key is used to access the F9 menu, it will not be sent to the K4000RC Server when it is pressed. To send an F9 keypress to the server, you can bring up the F9 Menu locally and select the Send F9 menu option. If a menu key other than F9 has been selected then this menu item will behave accordingly.

Refresh Screen

The Refresh Screen option causes K4000RC Viewer to request a fresh copy of the current state of the entire server desktop. This is useful with K4000RC Servers that use imperfect update hooking schemes.

New Connection...

The New Connection... option causes a new Connection Details dialog to be displayed, so that a connection can easily be made to another K4000RC Server.

Note that a K4000RC Viewer started in this way actually shares the same process as the K4000RC Viewer window from which it was started. The K4000RC Viewer process does not quit until *both* windows are closed. This may affect the behaviour of scripts which launch K4000RC Viewer.

Options...

This causes the Connection Options dialog to be displayed, allowing the settings for the *current* connection to be modified. See the description of K4000RC Viewer Options for more details.

Connection Info...

The Connection Info dialog displays information about the remote host, pixel format, line-speed estimate and protocol version. If you don't know what any of this means then

don't worry - it's all safe to ignore! The main use of the Connection Info dialog is to help in diagnosing any problems you might encounter while using K4000RC Viewer.

10.2 K4000RC Server:

The K4000RC Server is started automatically when starting up the K4000^{NG}. As soon as you get the IP Address from the REMOTE – REPORT SOFTWARE menu in the K4000^{NG} user interface, you can use the K4000RC Viewer to connect to your analyzer.

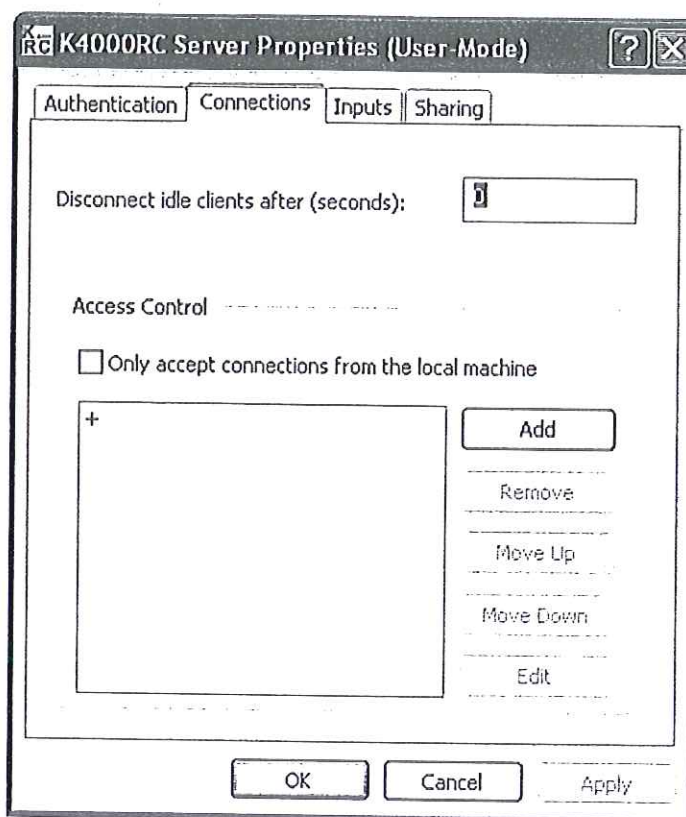
10.2.1 K4000RC Server Configuration:

K4000RC Server provides a number of options allowing its behavior to be tailored to your needs. These are configured via the K4000RC Config applet's Options dialog. To access to the configuration dialog, use the REMOTE-REMOTE CONTROL menu in the K4000^{NG} user interface.

The Options dialog consists many pages with options grouped according to their functionalities. The following documentation describes each option and the equivalent command-line parameters.

When the Ok or Apply buttons of the Options dialog are pressed, any changed settings are saved to the registry. Unless otherwise specified, changed settings take effect immediately.

10.2.1.1 Connection



IdleTimeout=(seconds)

Disconnect idle clients after

An idle client is one which has transmitted no keyboard or pointer events for more than a certain length of time. The K4000RC Server can be configured with a threshold, expressed in seconds, after which idle clients will be disconnected to conserve resources. If the threshold specified is zero second, then connections never times out. The default idle timeout is one hour.

Note that pointer and keyboard events received from clients prevent their connection to reach the timeout even if the K4000RC Server is configured to ignore those events (see below).

LocalHost=true/false

Only accept connections from the local host

If the server is configured to only accept connections from the local host then the Access control setting is ignored and K4000RC Server becomes completely inaccessible via all network interfaces, except via the local loopback interface. Normally, this setting is only useful when tunneling K4000RC sessions into the server, for instance via Secure Shell (SSH).

Hosts=(pattern)

Access Control

K4000RC Server can filter incoming connection attempts based upon the apparent IP addresses of their originators. The Hosts pattern determines which IP addresses are allowed to connect to and which are not. The pattern consists of a comma-separated list of IP address specifications. Each specification starts with an action, gives an IP address, and a subnet-style mask. The *first* specification to match the address of the new connection determines the action that is performed.

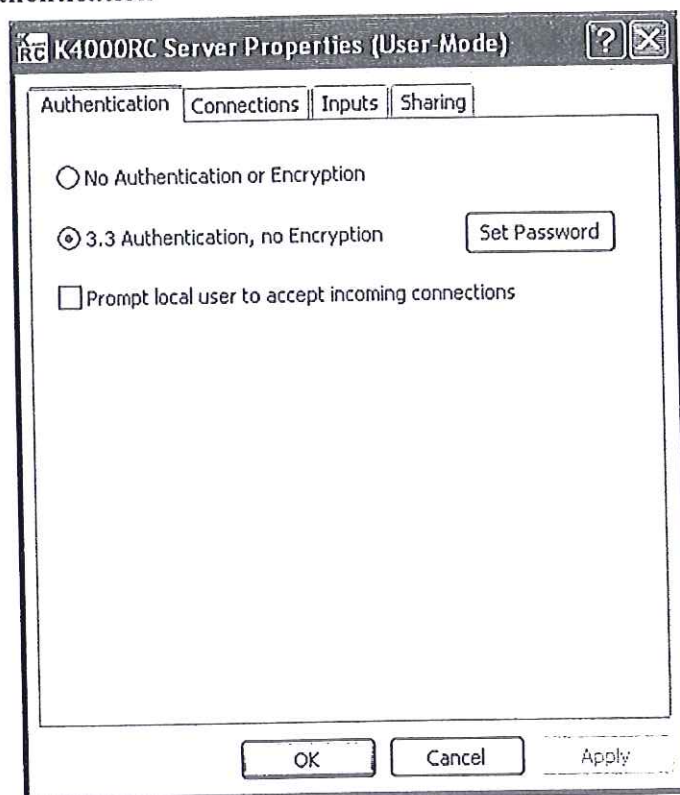
e.g. Hosts=+192.168.0.1/255.255.255.255,+192.168.1.0/255.255.255.0,-

The pattern given above allows the computer with address 192.168.0.1 to connect, as well as *any* computer in the 192.168.1 subnet. All other connections are rejected by the - term, which is actually redundant in this case - a connection will always be rejected if it doesn't match anything in the Hosts pattern.

Note that IP addresses and masks are specified in Type-A (xxx.yyyyyyyy), Type-B (xxx.yyy.zzzzzz) or Type-C (xxx.yyy.zzz.www) form. The specification 192.168 will therefore be interpreted as 192.0.0.168 rather than 192.168.0.0 as one might expect.

The Hosts pattern can be edited more easily through the Access Control interface, which allows IP address specifications to be edited individually and moved up (to match first) or down (to match last) the list.

10.2.1.2 Authentication



The Authentication page allows you to configure the required level of authentication of incoming K4000RC Viewer connections. At present, only two levels are provided - no authentication or classic K4000RC authentication. Some new authentication methods are in development, so expect this page to grow.

SecurityTypes=None

No Authentication or Encryption

If your K4000RC Server is operating in a protected environment, such as a secure LAN or firewall-protected network, then you may wish to configure K4000RC Server to accept connections without requiring a username or password to be specified. This might be useful when tunneling K4000RC over a secure protocol such as SSH, for example, to remove one redundant level of authentication.

We advise *extreme* caution when disabling authentication. Do not disable it unless you are *absolutely sure* that the host network is *completely* secure. By default, the server is configured with a password set to the analyzer serial number.

SecurityTypes=K4000RCAuth

3.3 Authentication, no Encryption

Most K4000RC Server configurations should at least be protected by a password required in order to authenticate the remote user to the server. This setting requires the user to provide the correct password when connecting but carries out the rest of the K4000RC session with no encryption.

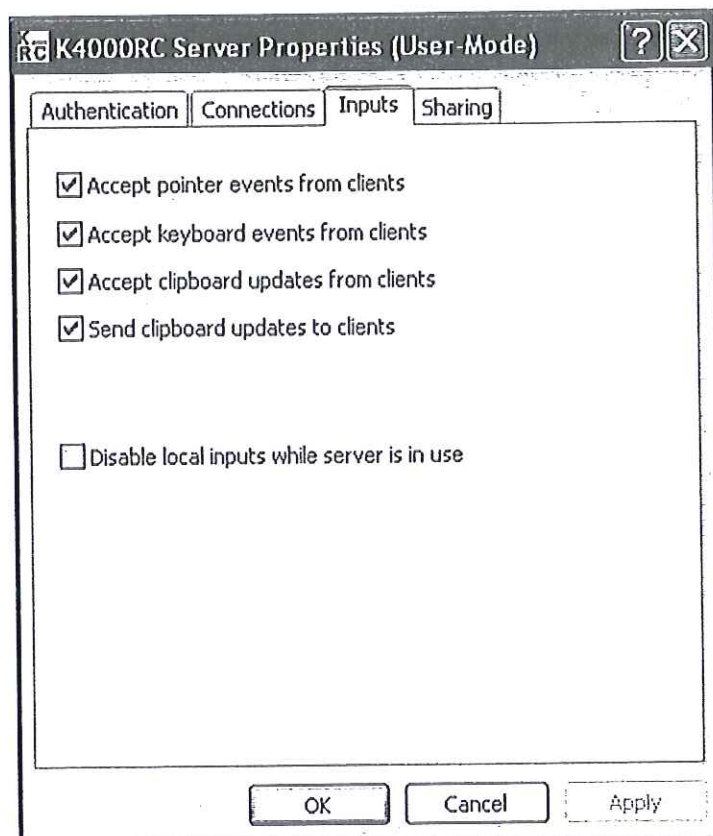
The password to use can be configured by selecting Set Password and by typing the new password twice. On platforms that support it, the passwords (and all other configuration options) are protected using native operating system security methods, so that the password cannot be read or tampered with by other users.

QueryConnect=true/false

Prompt local user to accept incoming connection

If this option is set then a dialog will be presented on the local desktop, prompting the user to accept or reject the connection. If no response is received while the dialog is displayed then the connection will be automatically rejected. If another connection is received while the dialog is displayed, then it will be rejected automatically.

10.2.1.3 Inputs



`AcceptPointerEvents=true/false`

Accept pointer events from clients

If this option is unchecked, then incoming pointer movements from all clients will be ignored, preventing any remote K4000RC Viewer from affecting the pointer of the K4000RC Server's desktop. This can be used to configure a server to become effectively view-only.

Note that a client will still be deemed active for the purposes of the IdleTimeout setting if it is sending pointer events to the server, whether or not they are accepted.

`AcceptKeyEvents=true/false`

Accept keyboard events from clients

If this option is unchecked, then incoming keystrokes from all clients will be ignored, preventing any remote K4000RC Viewer from typing into the K4000RC Server's desktop. This can be used to configure a server to become effectively view-only.

Note that a client will still be deemed active for the purposes of the IdleTimeout setting if it is sending keyboard events to the server, whether or not they are accepted.

AcceptCutText=true/false

Accept clipboard updates from clients

If this option is unchecked, then incoming clipboard updates will be ignored from all clients. This option should be used when making a K4000RC Server effectively view-only, but may also be proved useful to prevent clipboard changes made by clients from overriding the K4000RC Server's local clipboard when this would be undesirable or confusing.

SendCutText=true/false

Send clipboard updates to clients

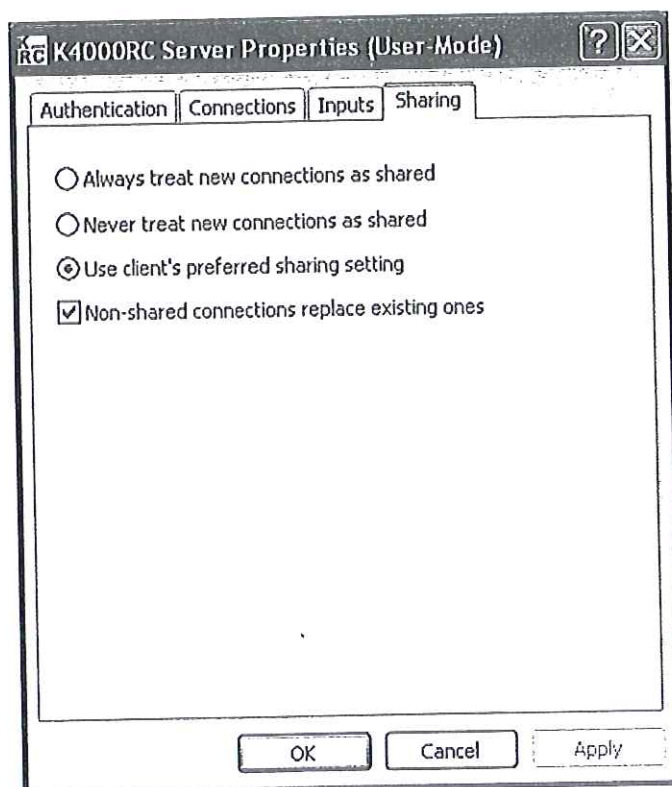
This option, if unchecked, prevents the K4000RC Server from informing clients of changes to its local clipboard contents. This can be useful when un-trusted clients are to be allowed to connect to the K4000RC Server, since it prevents any private data being accidentally leaked via the clipboard.

DisableLocalInputs=true/false

Disable local inputs while server is in use

If this option is checked, then the local console keyboard and mouse are ignored while there is one or more K4000RC session active. The desktop remains visible, but the local user is not able to interact with it in any way.

10.2.1.4 Sharing



`AlwaysShared=true`

Always treat new connections as shared

If this option is set, then all incoming connections are treated as shared ones, and thus no existing connections are terminated, regardless of whether the connected K4000RC Viewer requests the connection to be shared.

`NeverShared=true`

Never treat new connections as shared

If this option is set, then all incoming connections are to be treated as non-shared. K4000RC Server therefore either disconnects any existing connections, or refuses the incoming connection, depending on whether non-shared connections are configured to replace existing ones (see below).

`AlwaysShared=false,`

`NeverShared=false`

Use client's preferred sharing setting

When connecting, K4000RC Viewer specified whether the connection should be shared or non-shared. If this setting is configured then the K4000RC Viewer's preference will be respected.

`DisconnectClients=true/false`

Non-shared connections replace existing ones

If an incoming connection is to be shared (either by choice or because AlwaysShared is set) then existing connections remain active. If a connection is non-shared (either by choice or because NeverShared is set) then either the new connection must be rejected, or existing clients disconnected.

If this setting is configured then existing clients will be disconnected when a new non-shared connection is made. Otherwise, they will remain, and the new connection will fail.

ANNEX A: KDV VALVE DESCRIPTION

KDV-SERIES**KONTROL ANALYTIK
DIAPHRAGM VALVE***

Contrôle Analytique, is now offering its new diaphragm valve in all K4000^{NG} units. During the past few years, Contrôle Analytique has seen the performance of the K4000^{NG} trace gas analyzer limited by mechanical components available on the market. Concerned by the constant need to push application limits higher, Contrôle Analytique has designed its own diaphragm valve.

The base of the solution

The new valve concept is based on an elementary 3-way switching cell, the **KDV-3** (figure 2e). The 3-way switching cell contains 3 ports connected to the process and a purging/sealing groove to eliminate any risk of inboard/outboard leak and cross-port leak. One port is a common port, which is connected by internal grooves to port "a" and "b", which are commutable ports. Since commutable ports are independently actuated, the KDV-3 can take 4 different states. These states are shown in figures 2a to 2d. The KDV-3 valve body is illustrated in figure 2e.

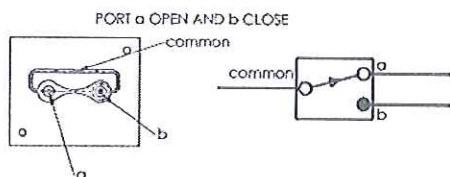


Figure 2a

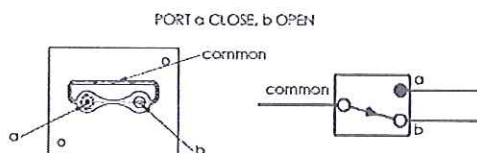


Figure 2b

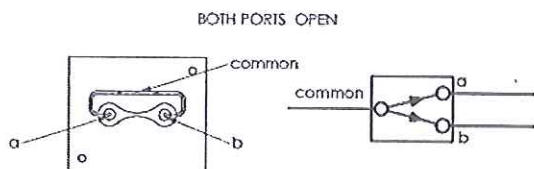


Figure 2c

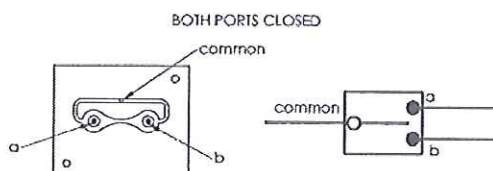


Figure 2d

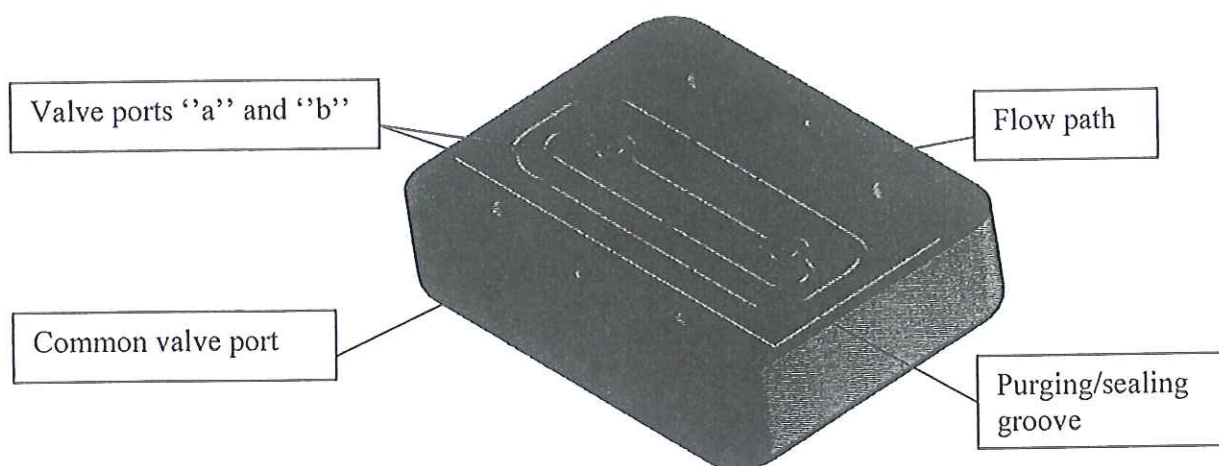


Figure 2e

Instead of closing or opening a flow path between some of the valve port, the valve's ports are directly closed as shown in figure 3a and 3b. In our valve, the plunger is pushing on a 316 series stainless and polymer sandwich diaphragm. The action of the plunger presses the diaphragm on the port's sealing surface to close it. This creates a positive tight shut-off valve.

The ports are drilled on a surface machined just a few mils below the top surface (figure 3a, port sealing surface). The sealing of the port has been tested with a ppb gas leak detector, and no leak could be detected even after the equivalent of 5 years of actuation at a process pressure of 500 psig. The small displacement needed to close or open the port gives the valve a very short actuation time. A circular groove is machined around all ports to give a constantly swept circuit even if the port is closed.

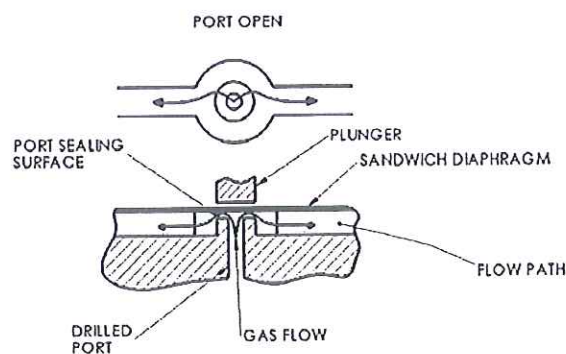


Figure 3a

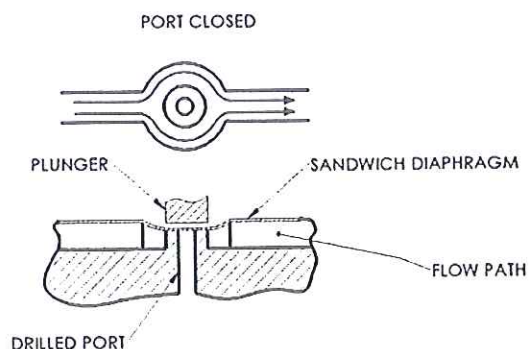


Figure 3b

This simple 3-way elementary switching cell could be used as a stand-alone 3-way valve, or multiple combination of it could be used to realize the function of a 6 port (or more) G.C. valve.

There is no dead volume effect in this valve because of the unique flow path scheme. All standard chromatographic configurations can be realized with the KDV-3.

The KDV-6 G.C. valve

Many 3-way cells could be embedded in the same substrate (see figure #4). When doing so, extra purging/sealing grooves are also added on the substrate. The purging/sealing grooves separate each switching cell. These purging/sealing grooves can be swept by a clean carrier to eliminate the possibility of any inboard or outboard contamination and cross-port leak. The purge outlet could also be monitored to report any leak or to give the status of the valve's wear. All those characteristics will give a long lifetime trouble free valve, and make system intelligent.

The valve body shown in figure #4 is a 6-port diaphragm valve and is the result of 3 KDV-3 embedded on the same substrate. Two independent concentric actuators (figure #5) actuate this valve. This actuator is designed to give a full control of the switching time. These actuators are compact and compressed air actuated.



Figure #4

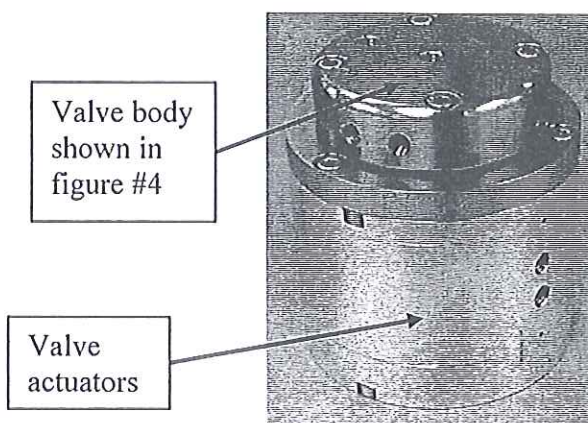


Figure #5

The new concept developed allows trouble free operations for many years. Tests have been conducted to simulate the equivalent of 5 years of use and this at 500 psig, without any apparent wearing. Furthermore, no leak was detectable, i.e. inboard/outboard or cross-port. Also, the unique internal flow path of the valve doesn't generate any dead volume effect.

This valve configuration is now used in the K4000^{NG} trace gas analyzer system. This is the first time that a chromatographic system allows to diagnose and warn the user in case of valve malfunction.

*International (PCT), patent pending

ANNEX B: DRAWINGS & I/O CONNECTIONS

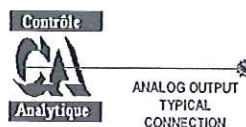
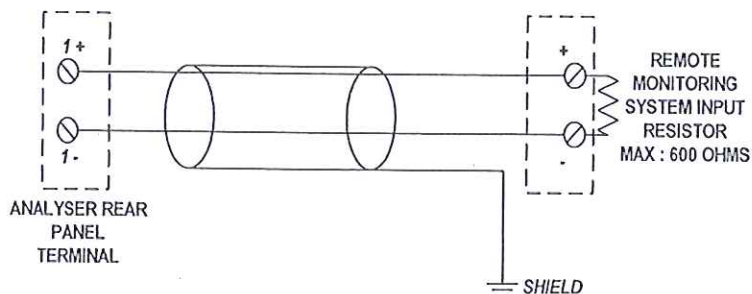
How to connect the 4-20 mA isolated output.

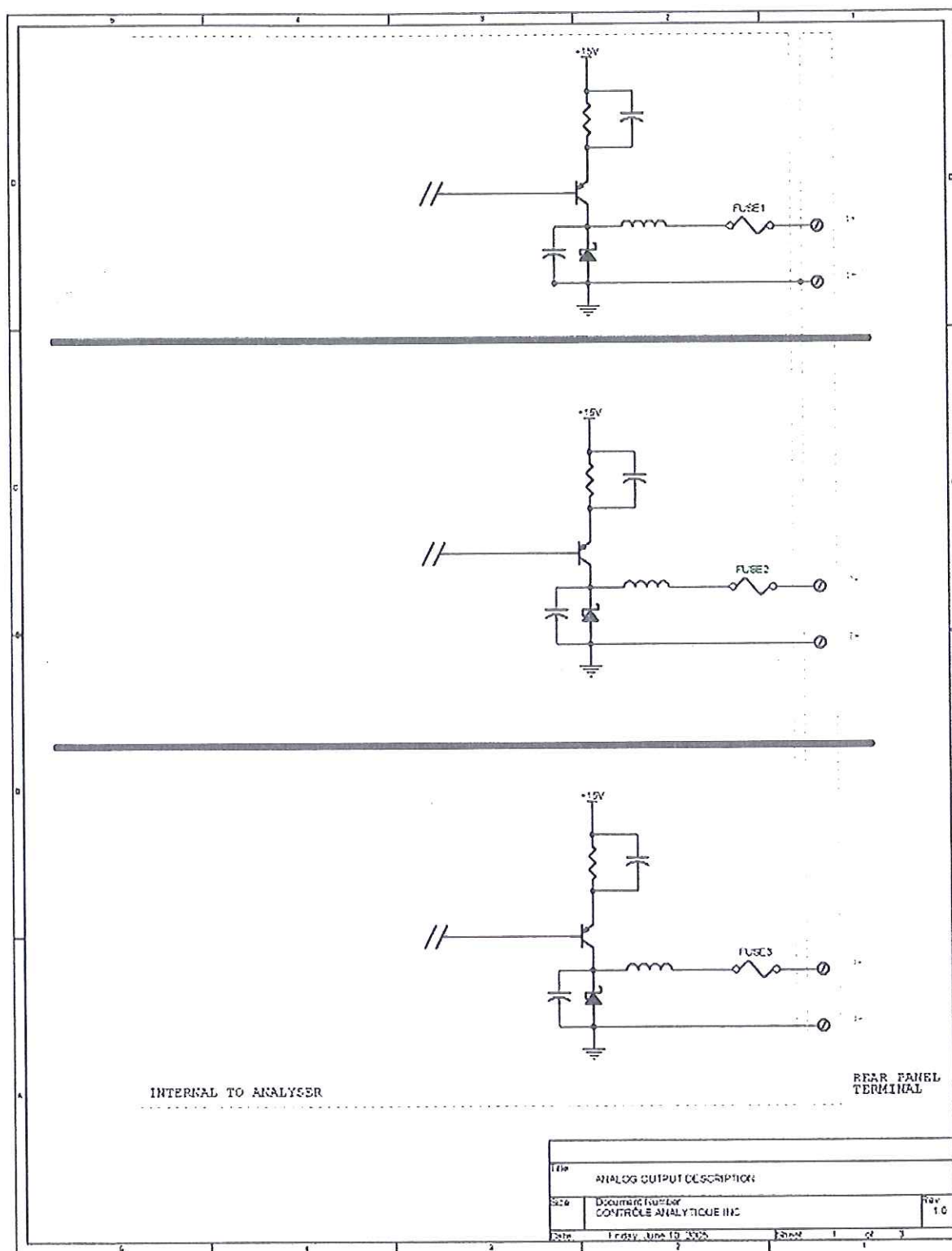
Use twisted pair shielded cable. Connect the shield at the remote instrument only. The shield must not be connected at the analyzer. It must be electrically isolated and floating.

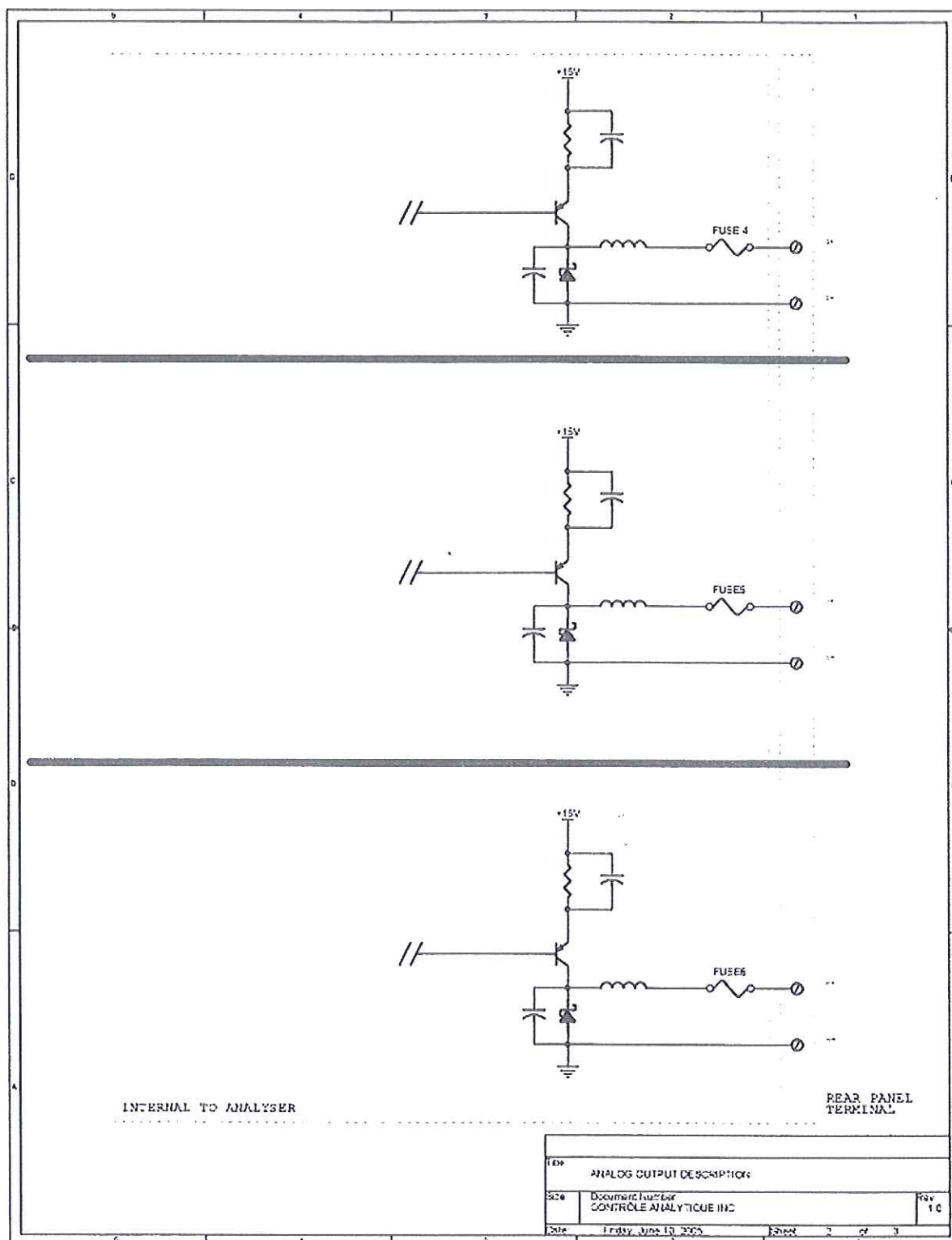
For each analog output, two wires must be used, i.e. one wire connected to "+" terminal, the other one connected to the "-" terminal. This is true for the 8 process analog outputs and the 3 chromatogram outputs.

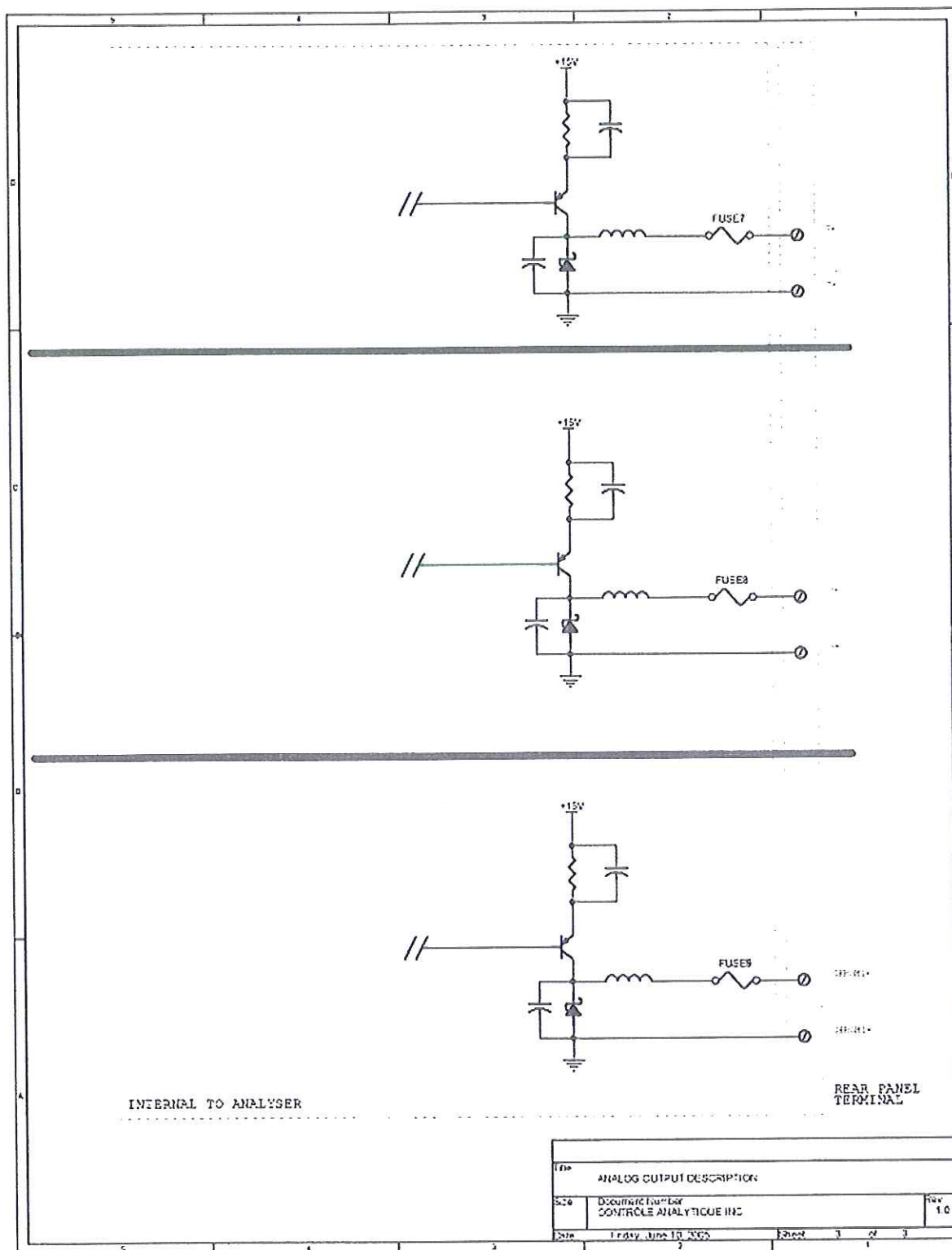
For those of you who will use the high resolution output with third party data acquisition and chromatographic package, you will need a terminating resistor to transform this output current to voltage. Maximum value is 600 ohms.

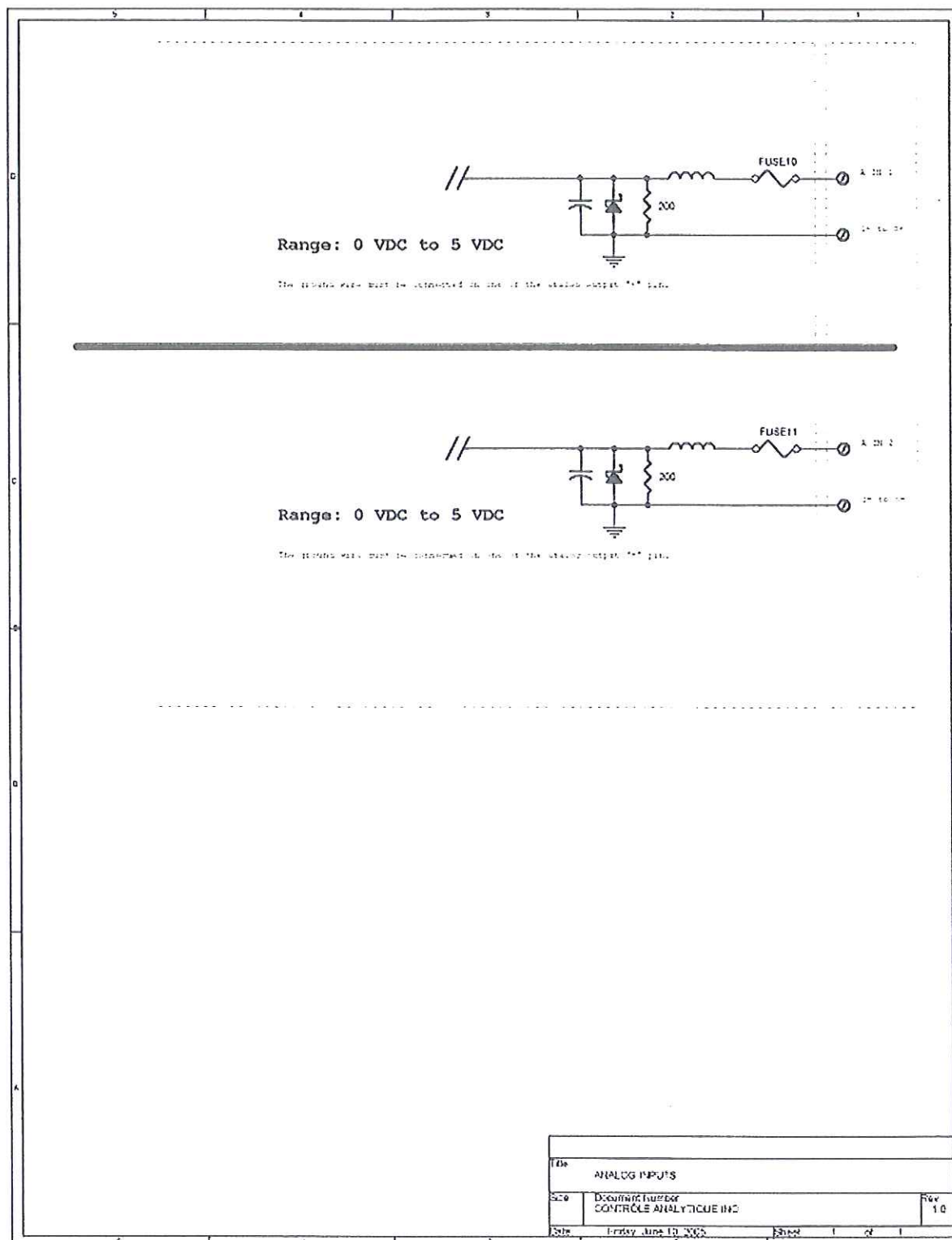
The 4-20mA output are common return (or ground). So single ended (instead of differential) analog input card of the remote monitoring software should be used.

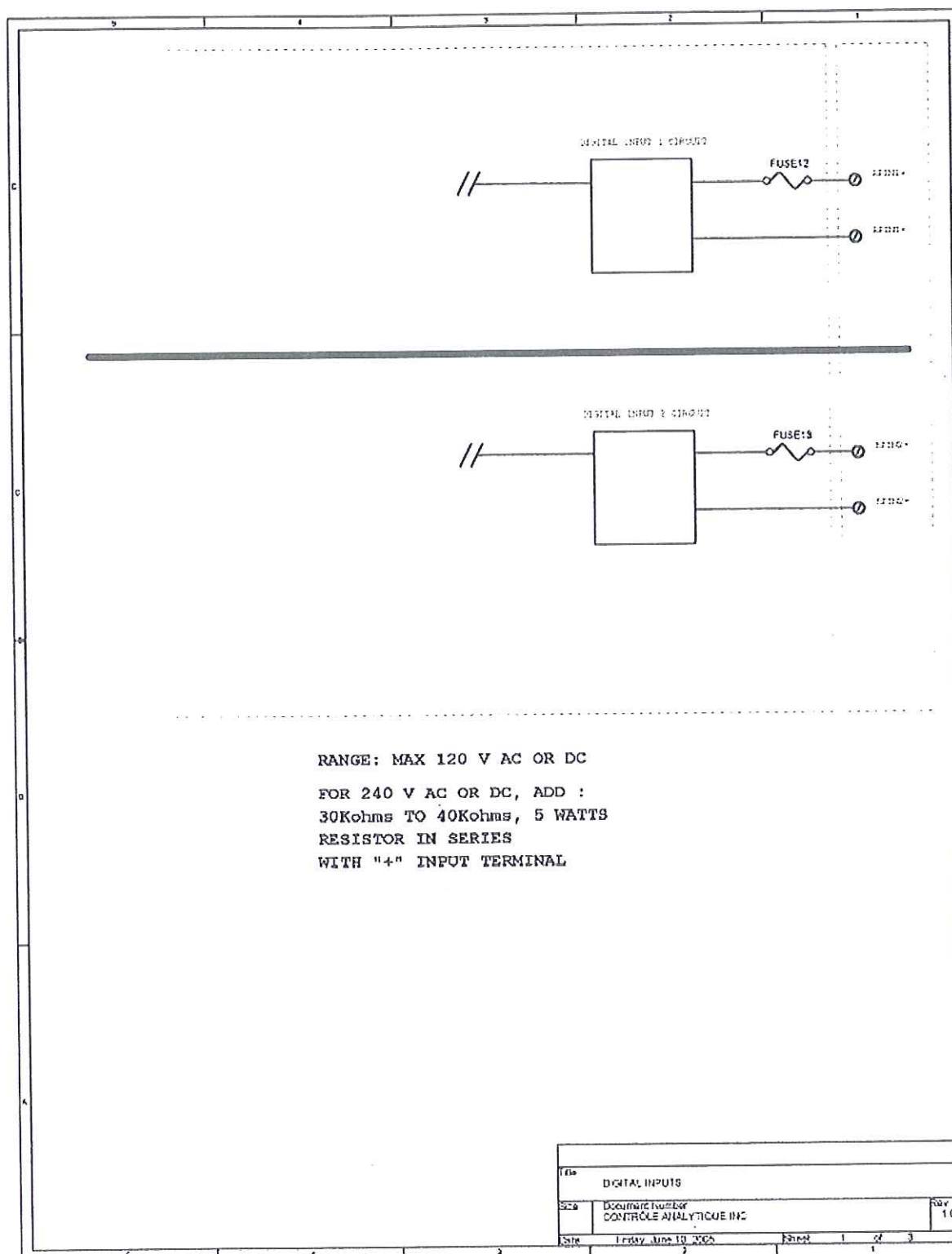












ANNEX C: CARRIER GAS INSTALLATION EXAMPLE

ANNEX C

In the following sheets there is a description different from the one in section 6 regarding carrier gas circuit support. The following system will transfer automatically from the «empty» cylinder to the new one without operator intervention.

The extra pressure regulator PR3 will make sure that there will be no major pressure variation during cylinder changeover. Also this system allows for proper purging when replacing a cylinder. This avoids damaging the gas purifier.

The cylinder's pressure regulators are not VCR type but each one has an isolation diaphragm on the low pressure side.

Other system designs are possible but the following key factors must be respected:

- System must be designed in such way as to avoid any inboard contamination (air diffusion)
- System must provide a way to execute proper purging on cylinder replacement.
- If unattended cylinder changeover is important, the system must provide a way to keep carrier pressure constant during cylinder changeover. Normally, this is achieved with an extra pressure regulator at the inlet of the analyzer.

CARRIER GAS PANEL OPERATING INSTRUCTION

Start-up

1. Install pressure regulator on each carrier gas cylinder.
2. Purge both legs with static purging procedure (see attached procedure).
3. Install gas purifier. Follow manufacturer start-up procedure. Allow 3 hours of activation time before connecting the carrier line to the K4000^{NG}. Adjust the gas pressure to have a small purge flow through the purifier (≈ 75 sccm).
4. After purifier activation, connect gas line from panel outlet bulkhead to PR3. PR3 should be mounted close to the carrier gas inlet.
5. Adjust PR1 at 20 psig higher than pressure required to have the specified carrier flow.
6. Adjust PR2 at 5 psig lower than PR1.
7. Adjust PR3 as required, to have proper carrier flow.

When PR1 pressure will become lower than PR2, CV1 will close and CV2 will open. At this time, the expired cylinder must be replaced according to the following procedure.

Cylinder # 1 replacement

1. Close cylinder valves V1 and V2, remove PR1, and install PR1 on the new cylinder.
2. Follow static purging procedure (see attached procedure).
3. Increase PR2 pressure by 5 psig and adjust PR1 pressure at 5 psig lower than PR2.
4. Open V2.

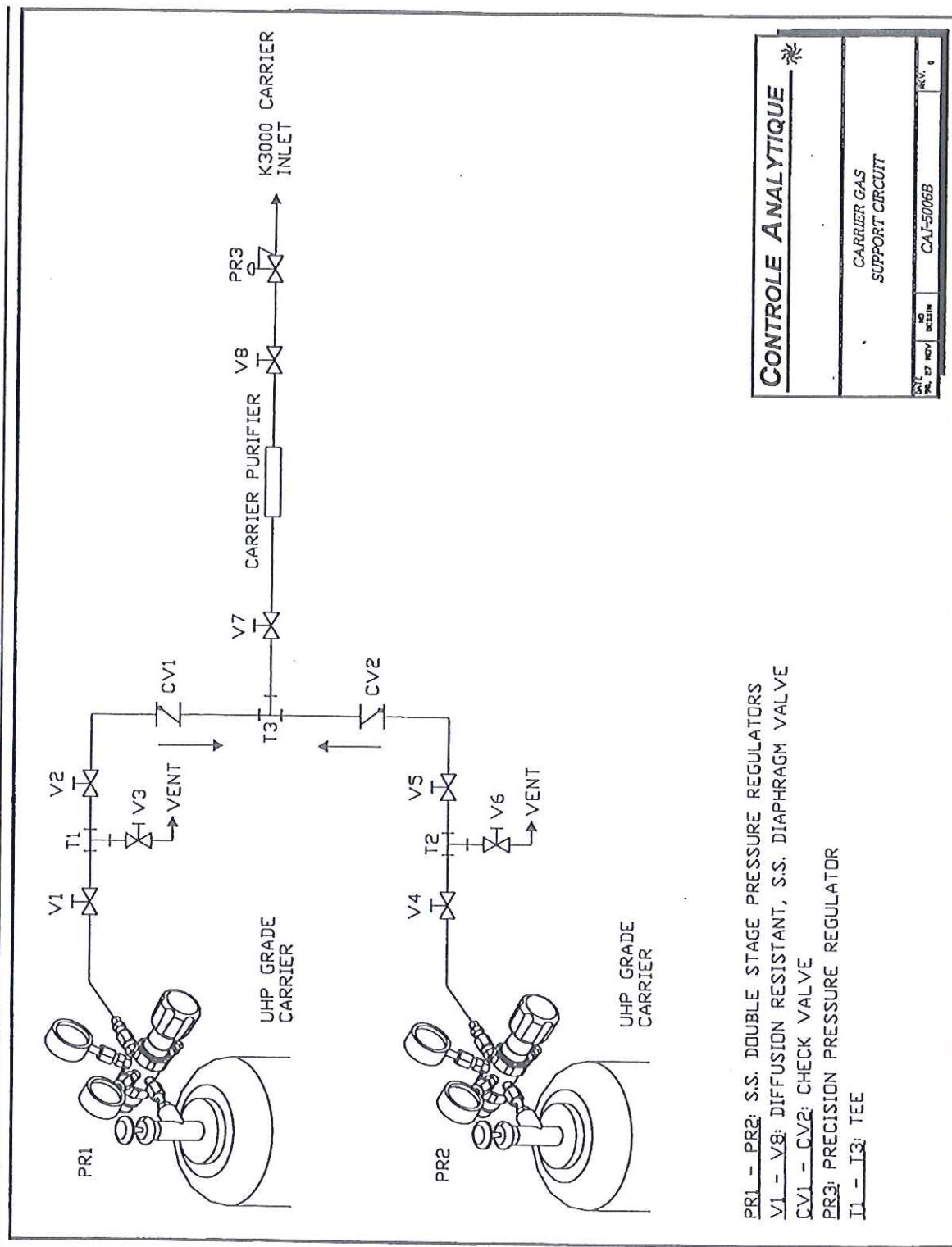
Same procedure should be done when replacing cylinder # 2.

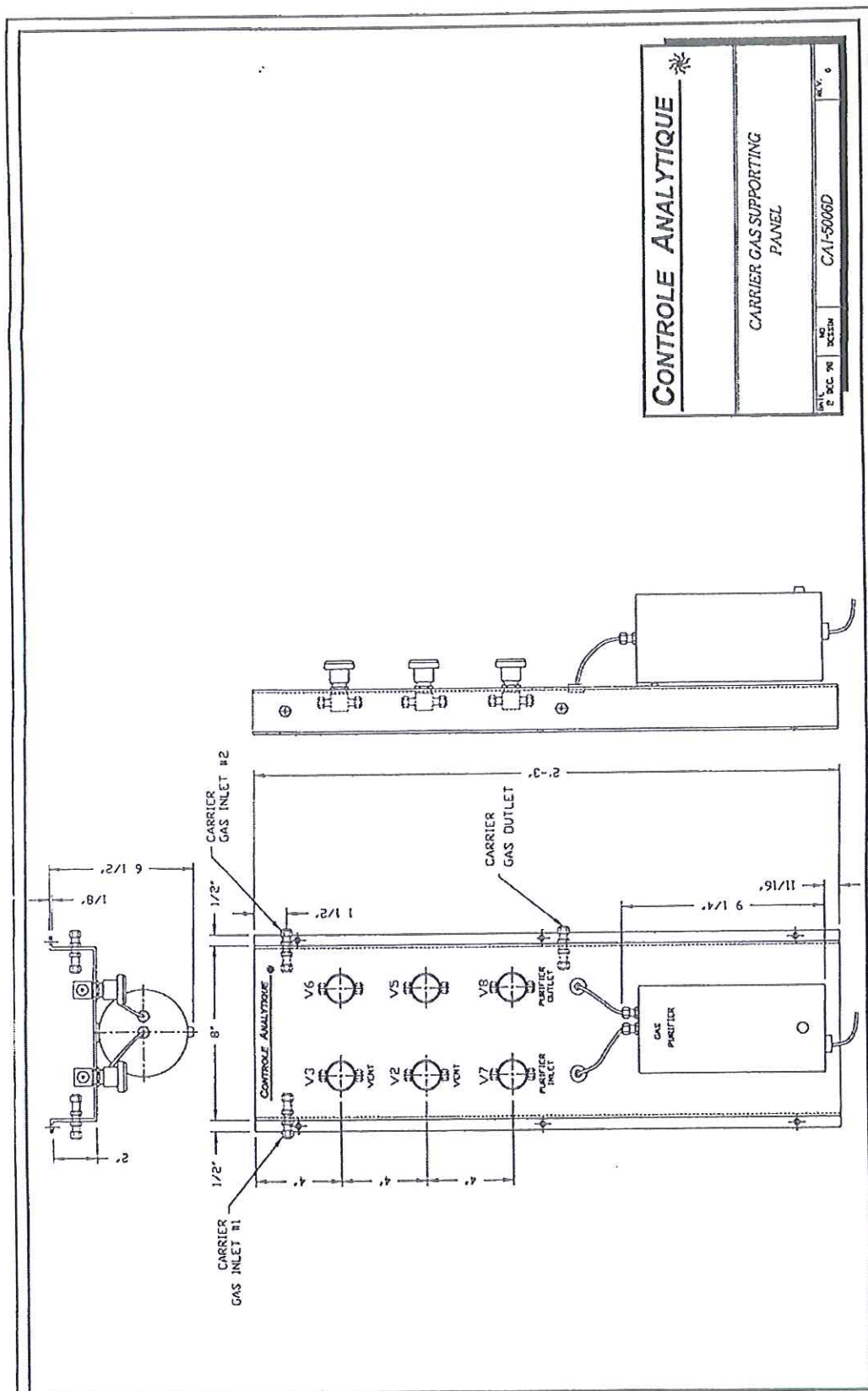
PR3 regulator will ensure stable pressure when cylinder change over occurs.

CARRIER GAS SUPPORTING CIRCUIT BILL OF MATERIALS

Reference drawing: # CAI-5006B
CAI-5006D

PR1, PR2	Double stage pressure regulator, metal to metal diaphragm seal with diffusion resistant isolation valve mounted on the regulator outlet 5-125 psig adjustable output pressure GGA580 Cylinder connection 1/8" Tube Swagelok® low pressure connection P/N: CAIT-500-125-580-DK2S (Contrôle Analytique tested)
CV1, CV2	Check valves, P/N: SS-2C-1, 1/8" tube fitting Swagelok®, cracking pressure 1 psi
V1, V4	Included with PR1, PR2
V2, V3, V5, V6, V7, V8	Packless isolation valve with 1/8" tube fitting Swagelok®, stainless steel made, cleaned, P/N: SS-2H, Nupro company
T1, T3	Tee, P/N: SS-200-3, 1/8" tube fitting S.S. Swagelok®
PR3	Precision pressure regulator, inlet pressure range: 0-250 psig outlet pressure range: 0-100 psig (Contrôle Analytique tested) P.N.: CA2816
CARRIER GAS PURIFIER	P/N: GP200-120: 120 VAC GP200- 240: 240 VAC From: Contrôle Analytique Phone: (418) 334-0990 Fax: (418) 334-0660
DWG-5006D Change over / purging panel assembly	Made by Contrôle Analytique. Provides a convenient way to replace carrier cylinder without carrier flow interruption. Valves arrangement allows easy static purging when replacing cylinder. Resulting in purifier longer life and avoiding cylinder pollution. Automatic cylinder back-up.





ANNEX D: APPLICATION NOTES



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Improving argon recovery in air separation plants with the use of proper process analytical tools. (AN-04)

Back to the basics

Argon is produced by air separation plants. Air constituents are nitrogen (78.09 %) oxygen (20.94 %) and argon (.934 %). These constituents are not chemically bonded together but are moving freely. A distillation process can separate the constituents of a mixture if their respective vapor pressures are different. This process is based on distillation columns where the most volatile components exit at the top and the less volatile ones exit from the bottom of the column. Argon is taken off from a low pressure column and introduced in a separate smaller distillation column called the crude argon column. Figure 1 shows a typical curve for vapor pressure of N₂, O₂ and Ar. Since the vapor pressure of the argon is close to the oxygen vapor pressure and is between nitrogen and oxygen, argon will be extracted between these two constituents in the low pressure column.

A typical concentration distribution of N₂ / O₂ / Ar in the low pressure column is shown in figure 2. According to the curve in figure 2, it is clear that argon should be extracted at the level where the concentration is maximum. However, at this point the nitrogen concentration is almost the same as

argon and there is also a lot of oxygen. The curves show 14 % of argon, 14 % of N₂, and 72 % for O₂. It is not possible in this column to find a point where argon is pure. In order to have a mixture which can be processed in a single distillation column, the low pressure column must be adjusted in such a way that the nitrogen concentration at the argon extraction point will be at a minimum. In this way, the extracted mixture will be almost binary (i.e. $\approx 10\% \text{ Ar} / 90\% \text{ O}_2 / \text{N}_2 < 2000 \text{ ppm}$).

This mixture is then fed to the crude argon column where it will be processed. In some plants, the process stops there, so the final product is crude argon. In other plants, there is an extra cycle to produce pure argon, called the warm argon cycle. In this cycle O₂ in argon will be reduced with H₂. Today there are also higher performance distillation columns without the need to have the warm argon cycle column. In such columns, packing is used instead of trays.

The problem

In order to have and maintain the optimum argon extraction efficiency, the argon draw-off mixture must be properly controlled. It is not an easy

task, and there are two possible problems. First, if the column profile is too low, i.e. the nitrogen contents in the mixture draw-off from the low pressure column is high ($> 2000 \text{ ppm}$), the crude argon column will stop working. At the limit, too much nitrogen will block the condenser of the crude argon column, eliminating the reflux. The liquid held in the trays (essentially argon) will fall in the low pressure column. There will be a fast drop in O₂ concentration in the low pressure column. The result is loss of O₂ and argon production. Many hours must be spent to restart the process.

Secondly, adjusting the low pressure profile too high i.e. O₂ level is high, results in a loss of argon in the waste nitrogen. Furthermore, doing so increases O₂ level in the crude argon column. The challenge is to monitor the level of nitrogen in the argon draw-off from the low pressure column. Until now, the analytical tools available for this application were relatively complex, custom built systems in process control interface. So most of the time the plants are operating with a poor argon recovery efficiency by maintaining a low level of nitrogen in the crude argon to avoid to crash the plant.

The Solution

The Contrôle Analytique's K4000^{NG} trace gas analyzer system can be configured to measure trace nitrogen in any mixture of oxygen and argon. The K4000^{NG} analyzer uses a separation column at the front end of the system to roughly isolate the oxygen from nitrogen. The detector is based on a plasma emission cell which is very selective to nitrogen. Refresh times less than 60 seconds are easily achieved. The K4000^{NG} comes with three operating ranges configured for the application. The most common ranges for low pressure distillation column control are 0-20 / 0-200 / 0-2000 ppm. The K4000^{NG} also comes with an isolated 4-20 mA output, three remote range identifications, dry contact outputs and two dry contact process alarm outputs. The K4000^{NG} is easily interfaced with any PLC, DCS, computer or other process control device. Automatic control of the

argon draw-off is feasible. The system may come with an isolated serial communication port or with automatic calibration subsystem. The K4000^{NG} is designed to be operated by a non-technical personnel. The system is user friendly, and is almost maintenance free.

When installed properly, it will operate many years without problems. When the analyzer is interfaced with the process control system, the plant may be operated at its optimum efficiency, resulting in a increased argon recovery of up to 5% in some situations. It is obvious that the payback is fast. Normally, the sample connection is made at the point where the argon mixture is extracted from the low pressure column. When the process is stable there is no problem to do so even if the level of N₂ is a little bit high. But in the same plants there are two big «desiccation bottles» to dry the

compressed incoming air and to remove the CO₂. One bottle is alternatively switched into the process when the other one is being regenerated. Before bringing back the newly regenerated bottle in the process, this one must be pressurized. Pressurizing this bottle involves sudden changes in pressure which can lead to an increased level of N₂ in the crude argon up to the limit where the crude argon column may dump.

This event may happen in a very short period of time. To help avoiding such situations, it is a good idea to monitor the low pressure column from a sample connection located physically higher than the argon draw-off point. This can be done just after the next tray section. Doing so will give time to react when a fast column upset occurs.

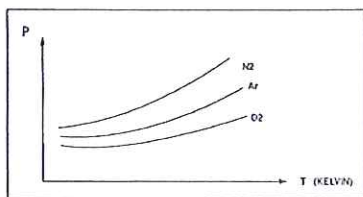


FIG. 1 - Vapor Pressure of Air Constituents

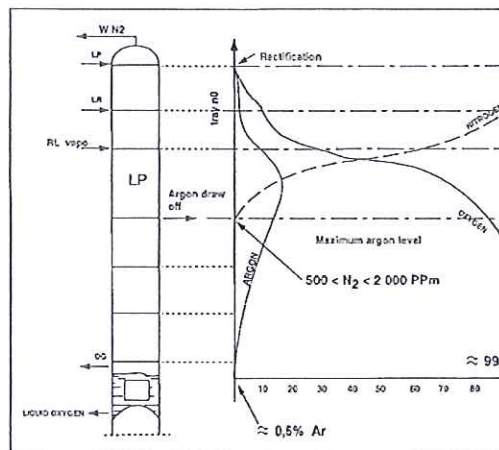


FIG. 2 - Typical low pressure Column Concentration Profile

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The Importance of Regular Purging

Here are some quick calculations to help you understand why it is so important to have some techniques to evacuate the air from pressure regulators when replacing calibration cylinders.

For example, let's take a pure argon cylinder of size 44 (i.e. 6m³ of gas). On this cylinder there is a double stage pressure regulator with two pressure gauges, CGA connector, and an outlet isolation valve. Lets assume that the internal volume of this pressure regulator is 100 CC (±10%). When installing this pressure regulator on the cylinder, the internal volume is occupied by the atmospheric air i.e. 78.2% N₂, 20.9% O₂, 0.9% Ar, moisture, CO₂, etc.

When the regulator is screwed in place on the pressure regulator, the air still is trapped inside the regulator. If you open the valve on the cylinder to pressurize the regulator, and there is no or little flow through the regulator, the air trap inside the regulator will diffuse inside the argon cylinder. The shock caused by the quick pressure build up inside the regulator helps to speed up the diffusion process.

So, assume no flow (worst case), we have the following situation:

100 CC of air and atmospheric impurities added to 6 m³ of pure argon (assuming perfect argon i.e. no impurities at all). This leads to the following calculation:

$$\frac{100 \times 10^{-6} \text{ m}^3 \text{ (i.e. 100 CC) of Air}}{6 \text{ m}^3 \text{ argon}} = 16.66 \times 10^{-6}$$

So the dilution ratio is 16.66×10^{-6} and $16.66 \times 10^{-6} \times 78.2\% \text{ N}_2 = 13 \text{ ppm of N}_2$

$$\text{and} \\ 16.66 \times 10^{-6} \times 20.8\% \text{ O}_2 = 3.5 \text{ ppm of O}_2$$

So starting from a pure argon cylinder and just by a bad pressure regulator purging procedure, we've got an argon cylinder with 13 ppm of N₂ and 3.5 ppm of O₂. These impurities will be added to any other impurity in the cylinder. This situation makes it difficult or even impossible to get accurate calibration. In some cases, we received phone calls from people claiming that the zero cylinder had higher readings than the span cylinder....**SO BE AWARE !!!!!**

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Sampling line size, (AN-01)

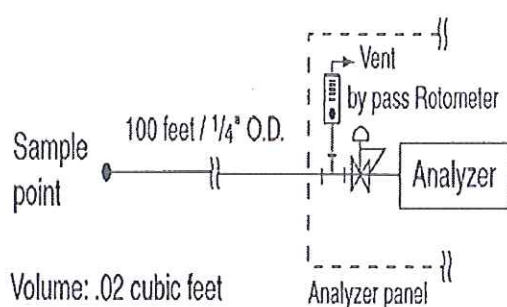
It is a common practice in air separation plants to use 1/4" O.D. line for sampling system. In older installation it is also common to have sample pressure regulator close to the analyzer sample inlet. This can lead to long lag time limiting the speed of response of an analytical system. For example, sample line of 100 feet of 1/4" O.D. with .190" I.D. (typical copper line) has an internal volume of .02 cubic feet. If the sample flow is 1 SCFH (475 sccm) and we assume the line to be at atmospheric pressure, it will take 1 minute and 12 sec. to travel down this line. If the same line is made of 1/8" O.D. with .085" I.D., the internal volume becomes equal to .004 cubic feet. This is 5 times less volume. It will take 24 seconds to travel down the line with 1 SCFH. We have assumed a line pressure equals to the atmospheric one. If the line is pressurized at 1 atmosphere there will be twice the volume of gas into the line so, twice the time will be required for a sample to go through this line.

One may thought to increase the sample flow through the 1/4" O.D. line to overcome this problem. If a bypass flow is set to 10 SCFH the time will be decrease by a factor of 10. But after one year of operation this result in 87600 cubic feet of gas thrown away. If this gas is pure argon, this gives around 97 cubic feet of liquid. This is also equivalent to 350 gas

cylinders (250 cubic feet size cylinder). The older type of analyzer system for trace nitrogen measurement uses 2 to 4 SCFH of sample flow (for silent electric discharge type) or 1.48 cubic feet (700 sccm) for ion mobility type. Contrôle Analytique analyzer works with a default sample flow of 75 sccm. The flow can be set as low as 25 sccm if required.

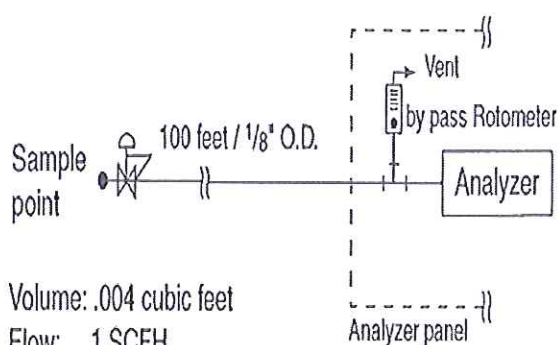
In conclusion, we are recommending the use of 1/8" O.D. stainless steel line for sampling lines. Furthermore, 1/8" O.D. line are available in coil of 500 or 1000 feet for long run. There is no need for fittings or welding. Also, installation cost is minimum since 1/8" O.D. line are easily installed. A sample line of 100 feet made of 1/8" O.D. and .085" I.D. connected to a nitrogen source at 1 PSIG and vented to the atmospheric pressure will have a flow of 475 sccm (1 SCFH). Well enough to supply sample gas to a K4000^{NG}. It will require 10 psig for 1000 feet long sample line.

The sample pressure regulator must be installed as close as possible from the sample connection point. The pressure will be adjusted to the minimum value required to have the proper flow into the analyzer. Such sampling system will have a faster response time, better leak integrity, less operation cost.



Volume: .02 cubic feet
 Flow: 1 SCFH
 Time: 1 min. 12 sec.

- High volume of sample gas to purge
- Low response time
- Many fittings (possible air contamination)
- Higher installation cost
- A lot of sample gas must be wasted for fast response time.



Volume: .004 cubic feet
 Flow: 1 SCFH
 Time: 24 sec.

- Low volume of sample gas to purge
- Fast response time (higher gas velocity)
- No fittings (no sample contamination)
- Low installation cost
- Minimum sample gas flow required