490-GC PRO Micro-GC

User Manual

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NOTICE: This document contains references to Varian. Please note that Varian, Inc. is now part of Agilent Technologies. For more information, go to **www.agilent.com/chem.**

Agilent Technologies

2 Varian Analytical Instrument Warranty

Hardware Products

All analytical instruments sold by Varian are warranted to be free from defects in material and workmanship for the periods specified and in accordance with the terms on the face of Varian's quotation or as otherwise agreed upon in writing between Varian and the Customer. The warranty period begins on the date of **shipment** from Varian to the original Customer. However, where installation is paid for by the Customer or included in the purchase price, the warranty period begins upon completion of installation. If the Customer schedules installation to start later than 30 days after delivery or if such delay is caused through the Customer's inability to provide adequate facilities or utilities or through failure to comply with Varian's reasonable pre-installation instructions or through other omissions by Customer, then the warranty period starts on the 31st day from date of shipment. Moreover Varian will charge the Customer for labor and other expenses involved in making multiple or follow-up installation service calls.

Software Products

Where software is provided within the frame of a license agreement concluded between the Customer and Varian, any warranty shall be strictly in accordance with the terms of such agreement.
In the absence of a license agreement and unless an alternate warranty period is agreed upon in writing between Varian and the Customer, the warranty period is as specified on the face of Varian's quotation. Varian warrants such software products, if used with and properly installed on Varian hardware or other hardware as specified by Varian to perform as described in the accompanying Operator's Manual and to be substantially free of those defects which cause failure to execute respective programming instructions; however, Varian does not warrant uninterrupted or error-free operation.

Remedies

The sole and exclusive remedy under hardware warranty shall be **repair** of instrument malfunctions which in Varian's opinion are due or traceable to defects in original materials or workmanship or, at Varian's option, **replacement** of the respective defective parts, provided that Varian may as an alternative elect to **refund** an equitable portion of the purchase price of the instrument or accessory.
Repair or replacement under warranty does not extend the original warranty period.
Repair or replacement under warranty claims shall be made in Varian's sole discretion either by sending a Customer Support Representative to the site or by authorizing the Customer to return the defective accessory or instrument to Varian or to send it to a designated service facility. The Customer shall be responsible for loss or damage in transit and shall prepay shipping cost. Varian will return the accessory or instrument to the Customer prepaid and insured. Claims for loss or damage in transit shall be filed by the Customer. To correct software operation anomalies, Varian will issue software revisions where such revisions exist and where, in Varian's opinion, this is the most efficient remedy.

Limitation of Warranty

This **warranty does not cover** software supplied by the Customer, equipment and software warranted by another manufacturer or replacement of expendable items and those of limited life, such as but not limited to: Filters, glassware, instrument status lamps, source lamps, septa, columns, fuses, chart paper and ink, nebulizers, flow cells, pistons, seals, fittings, valves, burners, sample tubes, probe inserts, print heads, glass lined tubing, pipe and tube fittings, variable temperature dewars, transfer lines, flexible discs, magnetic tape cassettes, electron multipliers, filaments, vacuum gaskets, seats and all parts exposed to samples and mobile phases.
This **warranty shall be void** in the event of accident, abuse, alteration, misuse, neglect, breakage, improper operation or maintenance, unauthorized or improper modifications or tampering, use in an unsuitable physical environment, use with a marginal power supply or use with other inadequate facilities or utilities. Reasonable care must be used to avoid hazards.
This warranty is expressly in lieu of and excludes all other express or implied warranties, including but not limited to warranties of merchantability and of fitness for particular purpose, use or application, and all other obligations or liabilities on the part of Varian, unless such other warranties, obligations or liabilities are expressly agreed to in writing by Varian.

Limitation of Remedies and Liability

The remedies provided herein are the sole and exclusive remedies of the Customer. In no case will Varian be liable for incidental or consequential damages, loss of use, loss of production or any other loss incurred.

Declaration of Conformity

We hereby Declare that the equipment listed below complies with the requirements of:

The Low Voltage Directive 73/23/EEC (93/68/EEC)

The EMC Directive 89/336/EEC (92/31/EEC and 93/68/EEC)

Applicable Standards

LVD	EN 61010-1 CSA 22.2 No. 1010.1-92	UL 3101-1
EMC	EN 61326-A1 47CFR part 15	ANSI C63.4-1992

Type of Equipment: Micro Gas Chromatograph **Model:** 490-GC

Manufacturer - EU

Print Name: G. A. Wassink

Signed: ________________

Position: Quality Manager

Date: November 28, 2001

Company Name: Varian B.V.

Address: Herculesweg 8
P.O. Box 8033
4330 EA Middelburg
The Netherlands

Telephone: +31(0) 118 671 000

Authorized Representative – USA

Print Name: Martin O'Donoghue

Signed: ________________

Position: General Manager

Date: November 28, 2001

Company Name: Varian, Inc.

Address: 2700 Mitchell Drive
Walnut Creek, California 94598
USA

Telephone: 925-939-2400

3 Safety Information

Information

In accordance with Varian's commitment to customer service and safety, this instrument and its accompanying documentation (NEN 5509) complies with the CE specifications and the safety requirements for electrical equipment for measurement, control, and laboratory use
(CEI/IEC 1010-1), $_{c}CSA_{us}$ and FCC-b.

This device has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
Operation of this equipment in a residential area is likely to case harmful interference in witch case the user will be required to correct the interference at his own expense.

To prevent any injury to the user or any damage to the instrument it is essential that you read the information in this chapter.

If this manual is not in your native language and if you have problems understanding the text, we advise you to contact your Varian office for assistance. Varian cannot accept responsibility for any damage or injury caused by misunderstanding of the information in this manual.

Operating Instructions

This instruction manual is provided to help you establish operating conditions, which will permit safe and efficient use of your equipment.

Special considerations and precautions are also described in the manual, which appear in the form of **NOTES**, **CAUTIONS**, and **WARNINGS** as described below (next page).

It is important that you operate your equipment in accordance with this instruction manual and any additional information, which may be provided by Varian. Address any questions regarding the safe and proper use of your equipment to your local Varian office.

Information to aid you in obtaining optimal performance from your instrument.

Alerts you to situations that may cause moderate injury and/or equipment damage, and how to avoid these situations.

Alerts you to potentially hazardous situations that could result in serious injury, and how to avoid these situations.

Warning Symbol		***Warning Description***
	**WARNING: Shock hazard**	Indicates dangerous voltage: (terminals fed from the interior by voltage exceeding 1000V must be so marked).
	**WARNING: Burn hazard**	Indicates parts that may cause burns when touched.
	**Instruction Manual**	Indicates that the user should refer to the manual before operating the equipment.
	**Protective Conductor terminal**	For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal, which must be connected to ground before operating equipment.
	**Radioactive hazard**	Indicates that the instrument contains radioactive components, which may cause personal injury when handled incorrectly.
	**Skin puncture**	Indicates sharp or suddenly moving parts such as injection needles that may cause injury.
	**Static discharge Warning**	Indicates instrument contains parts that can be damaged by electrostatic discharge. Take care for proper grounding before handling.
	**Do not touch**	Touching this item may result in damage to the instrument or personal injury.

3.1 General Safety Precautions

Follow these safety practices to ensure safe equipment operation.

- Perform periodic leak checks on all supply lines and pneumatic plumbing.
- Do not allow gas lines to become kinked or punctured. Place lines away from foot traffic and extreme heat or cold.
- Store organic solvents in fireproof, vented and clearly labeled cabinets so they are easily identified as toxic and/or flammable materials.
- Do not accumulate waste solvents. Dispose of such materials through a regulated disposal program and not through municipal sewage lines.

NOTICE: This instrument has been tested per applicable requirements of EMC Directive as required to carry the European Union CE Mark. As such, this equipment may be susceptible to radiation/interference levels or frequencies, which are not within the tested limits.

This instrument is designed for chromatographic analysis of appropriately prepared samples. It must be operated using appropriate gases and/or solvents and within specified maximum ranges for pressure, flows, and temperatures as described in this manual. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

It is the responsibility of the Customer to inform Varian Customer Support Representatives if the instrument has been used for the analysis of hazardous biological, radioactive, or toxic samples, prior to any instrument service being performed or when an instrument is being returned to the Service Center for repair.

Cautions

1. Disconnect the instrument from all power sources before removing protective panels to avoid exposure to potentially dangerous voltages.
2. When it is necessary to use a non-original power cord plug, make sure the replacement cord adheres to the color-coding and polarity described in the manual and all local building safety codes.
3. Replace faulty or frayed power cords immediately with the same type and rating.
4. This instrument should be placed in a suitable location with sufficient ventilation to remove gases and vapors. Space around the instrument must be sufficient to enable cooling of the instrument.
5. Before plugging the instrument in or turning the power on, always make sure that the voltage and fuses are set appropriately for your local power source.
6. Do not turn on the instrument if there is a possibility of any kind of electrical damage. Instead, disconnect the power cord and contact your Varian office.
7. The supplied power cord must be inserted into a power outlet with a protective earth ground connection. When using an extension cord, make sure that the cord is also properly grounded.
8. Do not change the external or internal grounding connections as this could endanger you and/or damage the instrument.
9. The instrument is properly grounded when shipped. You do not need to make any changes to the electrical connections or to the instrument chassis to ensure safe operation.
10. When working with this instrument, follow the regulations for GLP (Good Laboratory Practice). Take care to wear safety glasses and appropriate clothing.
11. Do not place containers with flammable liquids on this instrument. Spillage of the liquid over hot parts may cause fire.

12. This instrument may use flammable or explosive gases e.g. hydrogen under pressure. Be sure to be familiar with and to follow accurately the operation procedures prescribed for those gases before operating the instrument.
13. Never try to repair or replace any component that is not described in this manual without the assistance of a Varian service engineer. Unauthorized repairs or modifications will result in rejection of warranty claims.
14. Always disconnect the AC power cord before attempting any type of maintenance.
15. Use proper tools when working on the instrument to prevent danger for you and/or damage to the instrument.
16. The customer should not attempt to replace battery(s) or fuse(s) in this instrument other then specified in the manual.
17. Damage can result if the instrument is stored under unfavorable conditions for prolonged periods (e.g., subject to heat, water, etc.).
18. Do not shut off column flow when the oven temperature is high this may damage the column.
19. This unit has been designed and tested in accordance with recognized safety standards and designed for use indoors.
20. If the instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired.
21. Substituting parts or performing any unauthorized modification to the instrument may result in a safety hazard.
22. Changes or modifications not expressly approved by the responsible party for compliance could void the user’s authority to operate the equipment.

Spare Parts Availability

It is the policy of Varian to provide operational spare parts for any instrument and major accessory for a period of seven (7) years after shipment of the final production run of that instrument. Spare parts will be available after this seven (7) year period but on an *as available* basis. Operational spare parts are defined as those individual electrical or mechanical parts that are susceptible to failure during their normal operation. Examples include relays, lamps, temperature probes, detector elements, motors, etc. Sheet metal parts, structural members or assemblies and castings, printed circuit boards, and functional modules are normally capable of being rebuilt to like-new condition throughout their useful life and therefore will be supplied only on an *as available* basis after the final production run of the instrument.

Service Availability

Varian provides a variety of services to support its customers after warranty expiration. Repair service can be provided by attractively priced service contracts or on a time and material basis. Technical support and training can be provided by qualified personnel on both a contractual or as-needed basis.

Varian Analytical Instruments Sales Offices

For Sales or Service assistance and to order Parts and Supplies, contact your local Varian office.

Argentina
Buenos Aires
Tel. +54.11.4.783.5306

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Tel. +61. 3.9560.7133

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Tel. +43.2626.20090

Benelux
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Middelburg, The Netherlands
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Korea
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Mexico and Latin America (N)
Mexico City
Tel. +52.5.55.5239465/026

Russian Federation
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Oxford
Tel. +44.1865.291500

Venezuela
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Tel. +58.212.285.0320/2494

United States

Walnut Creek, California, USA
Tel. +1.800.926.3000
(GC and GC/MS)

Tel. +1.800.367.4752 (LC)

VARIAN

http://www.varianinc.com/

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5 Introduction

Congratulations and thank you for purchasing the Varian, Inc. 490-GC PRO.

The 490-GC PRO is a powerful single or dual or quad channel high speed Micro GC suited for analyses of gaseous samples.
This instrument is tailored to meet your needs.
The columns are installed and the instrument as a whole has been thoroughly tested at our factory.
The 490-GC PRO incorporates technical advancements in **Micro electronic gas control** (EGC). The unique advantages of the 490-GC allow column head pressure settings to become part of the GC method and these can be programmed electronically.

The Varian, Inc. 490-GC PRO with Micro EGC allows you to optimize your analysis. Apart from the constant pressure mode, the Micro EGC in the 490-GC allows you also to program the pressure over your column.

Pressure programming not only improves the speed of the analysis, but it will give you the opportunity to run new and more extended applications.

The 490-GC PRO analytical channels can optionally be equipped with backflush and Micro-Gasifier capabilities thus optimizing the analysis even further.

The PRO edition is equipped with an integrated Data Handling System in order to operate in automated process environment. It operates stand alone continuously analyzing online samples. It supports analog output (4-20mA), analog input, digital inputs, relay control, stream selector control, Modbus communication, LCD control.

The integrated Data Handling System consists of peak integration, peak identification and peak calibration, An advanced sequence manager is capable of servicing most automated processes, which can consist of multi stream analysis, auto calibration and calibration validations, all on selectable time basis.

The system can operate in a network environment storing analysis results on any FTP server connected to the network.

Any internet browser can be used to monitor the status and last analysis results of the instrument.

Analysis results can be collected and opened in Microsoft Excel.

This instrument is designed to operate 24 hours a day, day after day without any interruption or failure. The stability is no longer dependent on instable personal computer systems vulnerable to viruses, etc.

Additional PRO Tooling (PROstation) is available to configure a 490-GC PRO, development of the application and to monitor the ongoing process. Any other Data Handling System should not be used in combination with a 490-GC PRO.

Analysis results can be provided either analog (4-20mA) as digital (Modbus TCP/IP and serial communication to a DCS, PLC or SCADA system.

For problems or questions about your 490-GC PRO, please contact your nearest Varian, Inc. subsidiary or Varian, Inc. representative.

6 Pre-installation requirements

Refer to the Pre-Installation Instructions (CP501265) for site preparation and unpacking information.

7 490-GC PRO Installation

This chapter describes the installation of the instrument, in particular hardware.

7.1 Inspection

The 490-GC PRO will arrive packed in one large box and one or more smaller cartons. Inspect the cartons carefully for damage or signs of rough handling. Report damage to the carrier and to your local Varian office.

7.2 Unpacking

Unpack the 490-GC PRO and accessories carefully and transfer to the work area, using proper handling techniques. Inspect the 490-GC PRO and accessories carefully for damage or signs of rough handling. Report damage to the carrier and to your local Varian office.

WARNING

Avoid back strain or injury by following all safety precautions when lifting (heavy) objects.

CAUTION

The instrument has been protected during shipment by protection caps. Prior to operating, remove

- At the back of the system all (plastic) caps.

7.3 Packing list

7.3.1 490-GC PRO

Check the packing list to see if you have received all that you require.

Item	Part number
External sample filter kit	CP736729
Filters 5x for external filter assy.	CP736467
CD-ROM user manual 490-GC PRO Micro-GC	CP505532490
Cable Dsub9 Male-Female 3 meter	CP177138
Locking nut 	CP420200 x 4
Male Luer 	CP420100 x 4
Front and back ferrule 1/16” SS x 2	CP4417
Capillary tubing SS 1/16” x 1.0 mm, 10 cm	CP4008
Loopback plug	CP741684
Power supply 110V or	CP49PWR110
Power supply 220V or	CP49PWR220
Power supply 240V	CP49PWR240

7.3.2 Accessories

Item	Qty	Part number
Spare filters (5 pieces) for external filter	5	CP736467
Manual 490-GC PRO (hard copy)	1	CP501387490
Manual Micro-GC power supply (hard copy)	1	CP501267
Heated sample inlet elbow with frit	5	CP740434
Ethernet crossover cable 10 meter	1	CP740293
Ethernet crossover cable, 2 meter	1	CP740292
Combo card (Ethernet and Com ports), including 3 meter crossover cable (not for HUB)	1	CP740292
Aux power car cigarette lighter DC adapter	1	CP740291
Charger for MICRO-GC battery pack	1	CP740427
Battery pack NiMH (rechargeable)	1	CP740328
Micro Gasifier 110 Volt	1	CP740431
Micro Gasifier 220 Volt	1	CP740432
Micro Gasifier 240 Volt	1	CP740433
Genie 170 BTU filter complete	1	CP739535
Genie 101 BTU filter complete	1	CP739534
Genie 170 standard filter complete	1	CP739536
Genie 170 BTU membrane	1	CP739531
Genie 170 standard membranes	5	392590004
Genie 101 BTU standard membranes	5	392590005

7.4 Installation

7.4.1 Install Gas Regulators and Set pressures

Carrier gas supplied from cylinders should have a two-stage pressure assembly to adjust the carrier gas pressure to 550kPa ± 10 % (80psi ± 10%). Set cylinder regulator pressure to match the 490-GC PRO gas inlet pressure. See on page 11.

7.4.2 Carrier gas

The most commonly used carrier gas for the 490-GC PRO is either He or N_2. The recommended purity for carrier gas is 99.995% minimum. See on page 11.

7.4.3 Connect to Power

Connect the power connector to the 490-GC PRO, and then plug the power cord into an appropriate power source.

7.4.4 Connect data handling peripherals

The 490-GC PRO must be connected to a PROstation for setting up the method.
PROstation is connected to the cable connectors inside the 490-GC PRO (see on page 10).

- Hardware connection between the PROstation (computer) and 490-GC PRO should be made via Ethernet only. For additional information, follow the links: Communication_setup on page 85 and Cable_connectors on page 10.

7.4.5 Sample

Connect the sample to the 490-GC using the sample-in connector situated at the front of the instrument (see front view on page 8).
Read chapter Sample Gas on page 13 for more important information!

7.4.6 Heated Sample line

To connect heated sample lines refer to Heated Sample line chapter on page 14.

7.4.7 Turn power ON

Turn on the 490-GC PRO using the power switch on the lower front of the instrument. The “READY” LED should light (after two minutes) when ready. (see Front_view on page 8).

7.4.8 Factory default states and settings

Your 490-GC PRO is shipped from the factory with default settings. The following is relevant information on the factory default states and settings:

- When the 490-GC PRO is turned on, the power LED will light up and the system will begin the Flush cycle procedure. The Flush cycle is a 2-minute cycle in which the various valves are activated and deactivated in order to flush the entrapped air from the manifold, valves, and tubing.
- After the flush cycle is finished, the method (the default method in this case), which was last active before the instrument was shutdown, is activated:
- All heated zones will be set at 30°C.
- The Detector filaments will be set to OFF.
- Pressure will be set at 50kPa(7.3psi)

7.4.9 Ambient Pressure

The 490-GC PRO will automatically shut down if the ambient pressure
> 120 kPa (standard) or > 110 kPa (Energy meter).

7.4.10 Ambient Temperature

The 490-GC PRO will automatically shut down if the ambient temperature exceeds 65°C.

8 Instrument Overview

This chapter describes the different part of the instrument.

8.1 Front view

READY led

Led OFF: System NOT ready
Led ON: System ready

RUN led

Led OFF: No run
Led blinking: Chromatographic in progress

ERROR led

Led OFF: No error
Led blinking: Error present
See here for the complete list on page 353

POWER led

Led OFF: No power
Led ON: Power OK
Led blinking: Voltage < 10 Volt

SAMPLE 1 and SAMPLE 2

Sample gas inlet connector
See here for more details on page 13

POWER ON/OFF SWITCH

Switch the 490-GC PRO Micro-GC ON or OFF

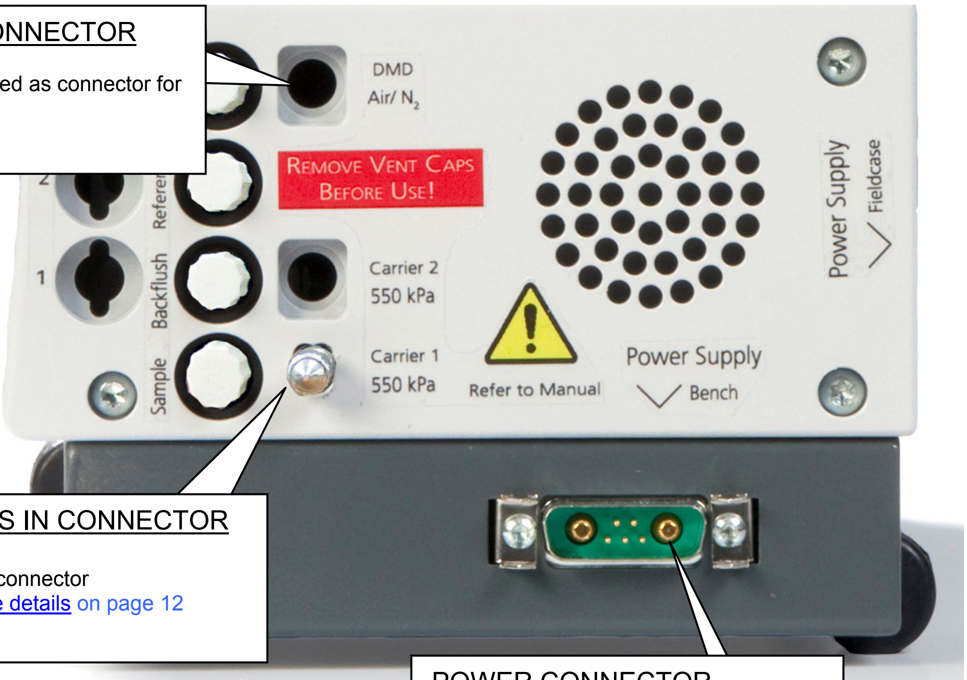
8.2 Back view

VENTS

NOTE:
It is possible to connect long vent lines to these fittings in order to safely guide hazardous fumes to a fume hood or other appropriate vent.

AUXILIARY CONNECTOR

In DMD channel used as connector for transport gas.



CARRIER GAS IN CONNECTOR

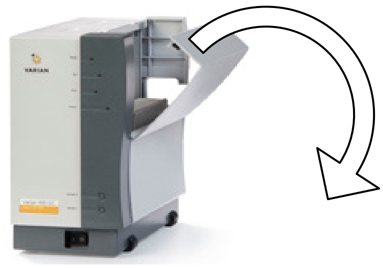
Carrier gas input connector
See here for more details on page 12

POWER CONNECTOR

Power IN connector (male).
See here for more details on page 15

8.3 *Inside View*

Open the cover and the cable connectors will be visible.



ASSIGN IP-ADDRESS BUTTON

Holding down this button duing power-up will set the “assign IP-address mode”
See Assign_new_IP_address on page 87

Red led: Transmit data
Green led: Receive data

ETHERNET

Ethernet RJ45 connector for Ethernet installations.
See here for more details on page 58

COM 2 & COM 3

RS232RS485- communication interface.
(Com2 supports RS232 and Com3 RS485)

See here for more details on page 32

COM 1

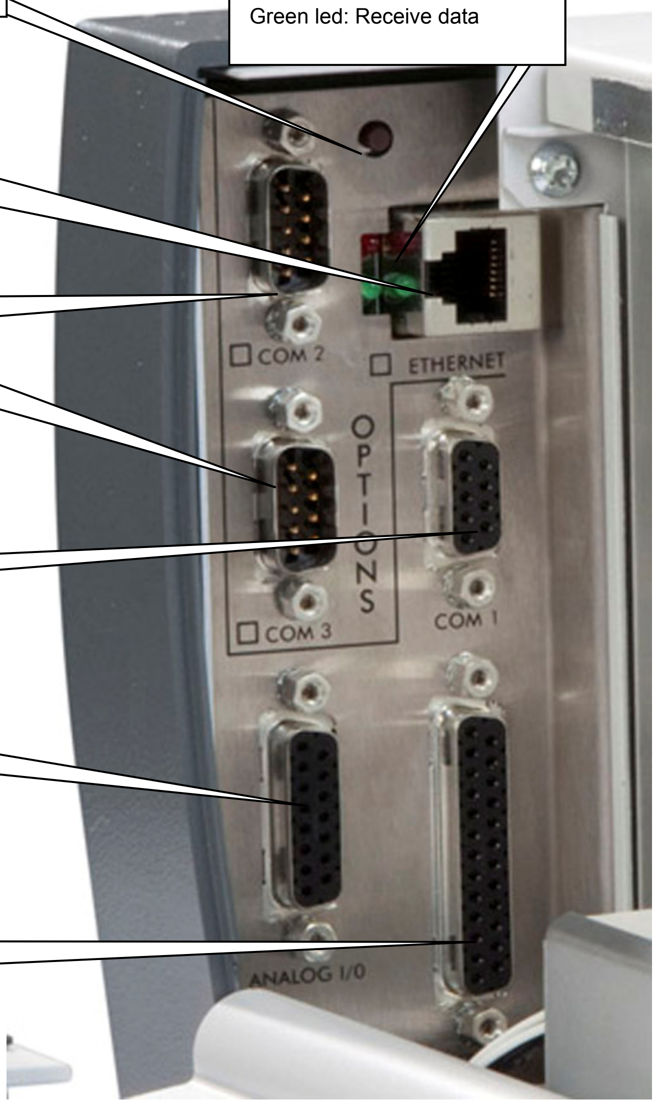
RS232-communication interface.
See here for more details on page 32

ANALOG I/O

External Analog I/O signals.
See here for more details on page 33

DIGITAL I/O

Digital in and output signals, like start_stop, ready_out, start_in and much more.
See here for more details on page 30

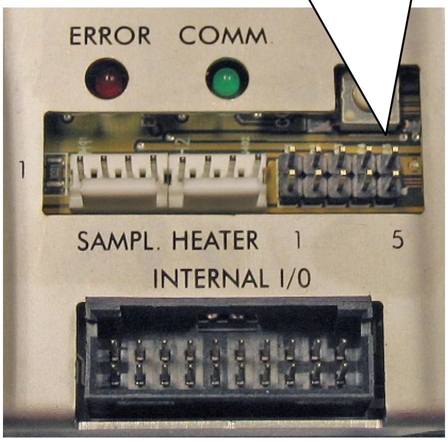


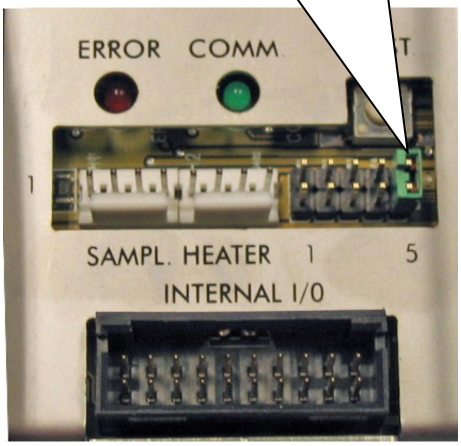
8.3.1 Method Lock

After removing the Right Side Cover, additional connectors will be visible.
Jumper 5 is important for the 490-GC PRO.
If the jumper is ***NOT*** present, the method can be changed from PROstation or a Modbus master system (**default**).

NO jumper 5 present
490-GC PRO method change allowed.
DEFAULT

Jumper 5 present
490-GC PRO method change **NOT** allowed.





8.4 Carrier gas connection

The carrier gas line is connected from a carrier gas connection to the 490-GC PRO at the rear panel **CARRIER GAS 1 or 2** port.

CAUTION

Do not use any kind of plastic tubing since air will diffuse through the tubing, which may cause noisy baselines and decreased sensitivity. The metal tubing should be clean for GC use. Buy either flamed or chromatographically clean tubing.

Specifications for the carrier gas used on 490-GC PRO:

Pressure: 550kPa ± 10 % (80Psi ±10%)
Purity: 99.995% minimum
Dry and free of particles: CP-Gas Clean filters are recommended

CP-Gas Clean filters are recommended to remove any traces of moisture and oxygen. For low-level analysis a better grade of carrier gas should be considered. The type of analysis you want to perform determines the type of carrier gas used. The difference between the relative thermal conductivity of the carrier gas and the sample components should be as high as possible. Refer to the table for several relative thermal conductivities.

Hydrogen	47.1	Ethane	5.8
Helium	37.6	Propane	4.8
Methane	8.9	Argon	4.6
Oxygen	6.8	Carbondioxide	4.4
Nitrogen	6.6	Butane	4.3
Carbon monoxide	6.4		

WARNING

Your 490-GC PRO is configured either for carrier gas He (or H_2) or it is configured for N_2 (or Ar). Make certain that the carrier gas selection in the PROstation corresponds to the carrier gas connected to your 490-GC. Use carrier gas corresponding this configuration. Changing type of carrier gas must only be carried out using the mandatory procedure in the PROstation Software on page 91.

WARNING

If you are using hydrogen as carrier gas, pay particular attention to possible leaks at connections inside and outside the 490-GC PRO (use an electronic Leak Tester).

NOTE

CP-Gas Clean filters are filled with nitrogen. If you are not using nitrogen as the carrier gas, flush filters and gas lines after installation of a new filter.

8.5 1HSample gas

The 490-GC PRO is an analyzer built for the analysis of gases and vapors only. You are advised to prepare a non-condensing gaseous samples standard sample for routine check up of the instrument. Sample pressure should be between 0-100 kPa (0-15 psi), the temperature between 0 and 110°C ± 5°C of the analyzer ambient temperature and it must be filtered, preferably through a 5 μm filter. Varian, Inc. ALWAYS recommends the use of the external filter kit part number CP736729.
Click here for more details about the heated sample line on page 14.

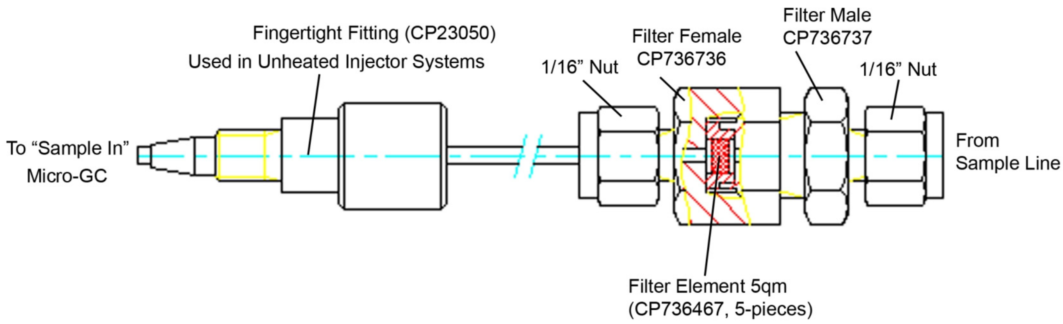
WARNING

Liquids will seriously damage the instrument and should be avoided!

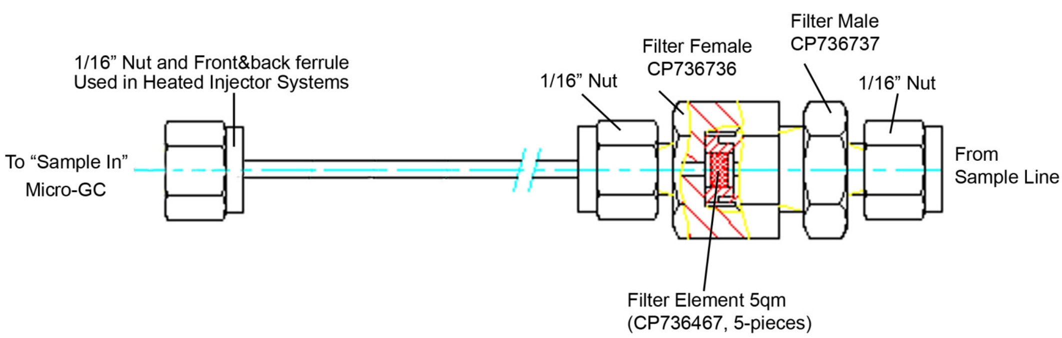
8.5.1 Handling a sample

If possible, filter and dry the sample before introducing it to the Micro-GC. It is advised to use an External Sample Filter Unit between the injector and the sampling device.
The Filter, male must be hand tightened into the Filter Female, followed by a 1/8th turn with a 7/16" wrench. The arrow on the Filter Female should be directed towards the Fingertight Fitting. Replace the External Filter Unit on page 5 at regular intervals.

8.5.2 Unheated Injector Systems



8.5.3 Heated Injector Systems



NOTE

Whenever possible remove moisture from samples introduced to the 490-GC PRO.

8.6 Heated sample line

A heated sample line is always combined with a heated injector.
A heated injector and sample line is an option for a channel unit and is chosen in case condensable samples need to be analyzed and condensation in the sample lines needs to be prevented.
The heated sample and injector can be controlled between 30°C and 110°C (see PROstation information on page 113)

8.6.1 Connect a heated sample line

WARNING

Before connecting a heated sample line, allow the sample line heater to cool down to ambient temperature. The metal surfaces of the sample line heater are very hot and could burn your skin.

- Open the side panel, the heater will be visible.
- Remove the insulation.

- The sample line connector will be visible.

- Connect the sample line.

WARNING

Insulate the sample line coming into the 490-GC PRO, this to prevent damage to the in/out coming cables.

8.7 2HPower

The 490-GC PRO requires 12.0 VDC, 130W maximum.
Refer to the User manual power supply for more information part number CP501267.

Only use the power supply that has been supplied with the instrument.

8.8 Shut down Procedure

When the instrument is shut down for more than a few days please, carry out the procedure mentioned below

Create a method for all channels with the following settings:

- Filaments switched OFF.
- Column temperature set at 30°C.
- Injector temperature set at 30°C.
- Pressure set at 50 KpA.
- Wait until the temperature of the column and injector is < 40°C (to protect the column), before switching off the Micro-GC.
- Remove the carrier gas tubing and plug all the vents/carrier gas connections with 1/8” brass nut or plastic cap.
- When the instrument is going to be used again then follow the procedure below.

8.9 Long storage Recovery procedure

Follow the recovery procedure below if your 490-GC PRO Micro-GC has been stored for a long period of time

- Remove the 1/8” brass nuts & plastic caps from all the vents/carrier gas connections.
- Connect carrier gas tubing and apply pressure on the 490-GC PRO Micro-GC, according to the pre-installation requirements.
- Wait at least 10 minutes before switching ON the Micro-GC.
- Immediately check if the detector filaments are switched OFF, switch OFF if necessary (see Method_setup on page 113 for more details).

- Set the column(s) temperature to the maximum allowed temperature (160 °C or 180 ° depending on the column module).
  Condition the column module, preferably overnight. This will ensure that all the water has been removed from the column module and no damage will occur to the TCD filaments.

8.10 *Initial operation*

A test method has been provided. This method has been designed to determine if the instrument is functioning properly and comes together with test chromatograms on which the test conditions are stated.

NOTE

If you ordered a Molsieve column, make sure it is conditioned before use.
See conditioning_Molsieve_columns on page 24 **for parameters.**

9 Columns and applications

There are different type of columns available. The type of column depends on the application.

9.1 Setting up the test method

To enter the method parameters, refer to the method set-up portion on page 113.
Send the instrument parameters from the data-handling package software to the PRO. You can watch the 490-GC PRO status in the instrument status tab on page 273.

9.2 Injecting the sample

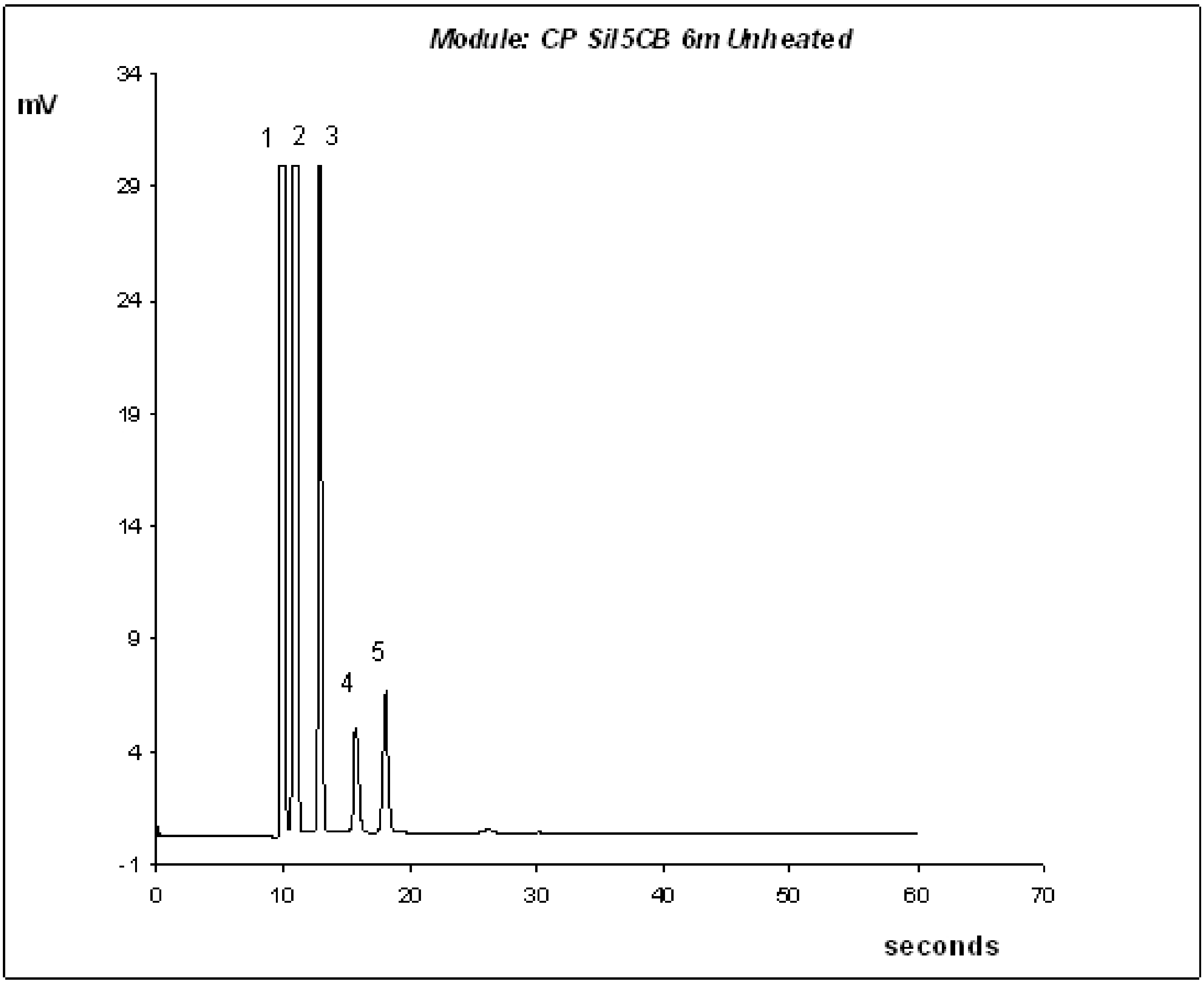
Connect the sample by means of a 1/16" line to the 490-GC PRO Micro-GC. You are advised to put an external 5 µm filter between the sample and the 490-GC PRO Micro-GC for additional filtering (see Sample_Gas on page 13 for more details).

Activate a single run.

Following are a few results on commonly used columns. CP-Sil 5 CB and CP-Sil 19 CB, HayeSep A and Molsieve. The sample is natural gas, which provides a convenient standard for testing the instrument in any configuration of these columns.

N_2	0.77 %	Nitrogen
CH_4	89 %	Methane
C_2H_6	8 %	Ethane
C_3H_8	1 %	Propane
IC_4H_{10}	0.14 %	Isobutane
NC_4H_{10}	0.2 %	N-butane
IC_5H_{12}	0.007 %	Isopentane
NC_5H_{12}	0.001 %	N-pentane

9.3 Column CP-Sil 5 CB 6 meter Unheated



Instrument Parameters

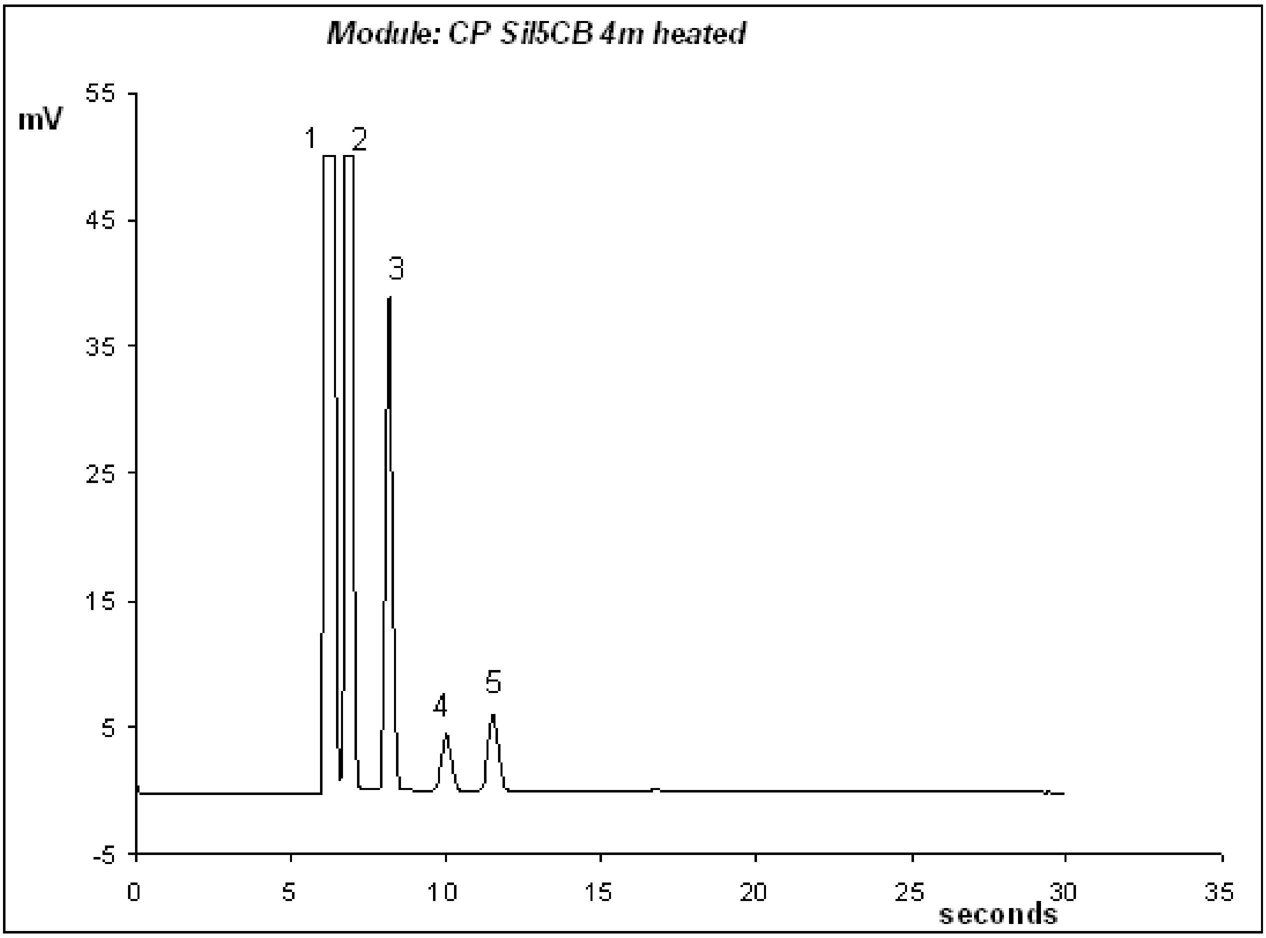
Column temperature	50°C
Injector temperature	NA
Column pressure	150 kPa (21PSI)
Sample time	30 s
Injection time	40 ms
Run time	60 s
Detector sensitivity	Auto

Peak identification

ID	*Component*	*Concentration*
1	Composite	Balance
2	Ethane	8.1%
3	Propane	1.0%
4	i-Butane	0.14%
5	n-Butane	0.20%

The natural gas components, mostly hydrocarbons, separate in the same order on the non-polar and medium-polar CP-Sil CB columns. Nitrogen, methane, carbon dioxide, and ethane are not separated on these columns. They produce a composite peak. For separation of these components a HayeSep A column is advised.

9.4 Column CP-Sil 5 CB 4 meter heated



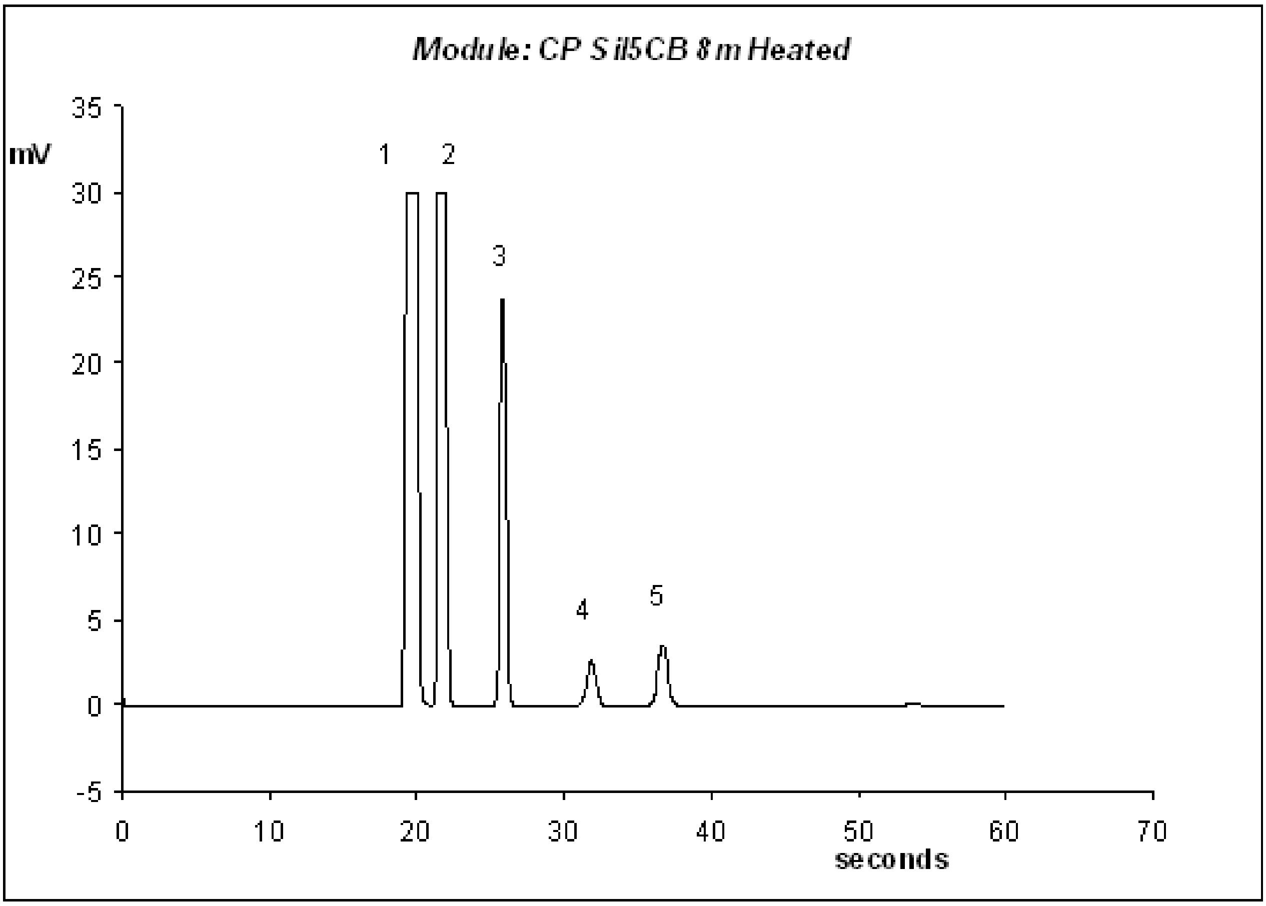
Instrument Parameters

Column temperature	50°C
Injector temperature	110°C
Column pressure	150 kPa (21PSI)
Sample time	30 s
Injection time	40 ms
Run time	30 s
Detector sensitivity	Auto

Peak identification

ID	*Component*	*Concentration*
1	Composite	Balance
2	Ethane	8.1%
3	Propane	1.0%
4	i-Butane	0.14%
5	n-Butane	0.20%

9.5 Column CP-Sil 5 CB 8 meter heated



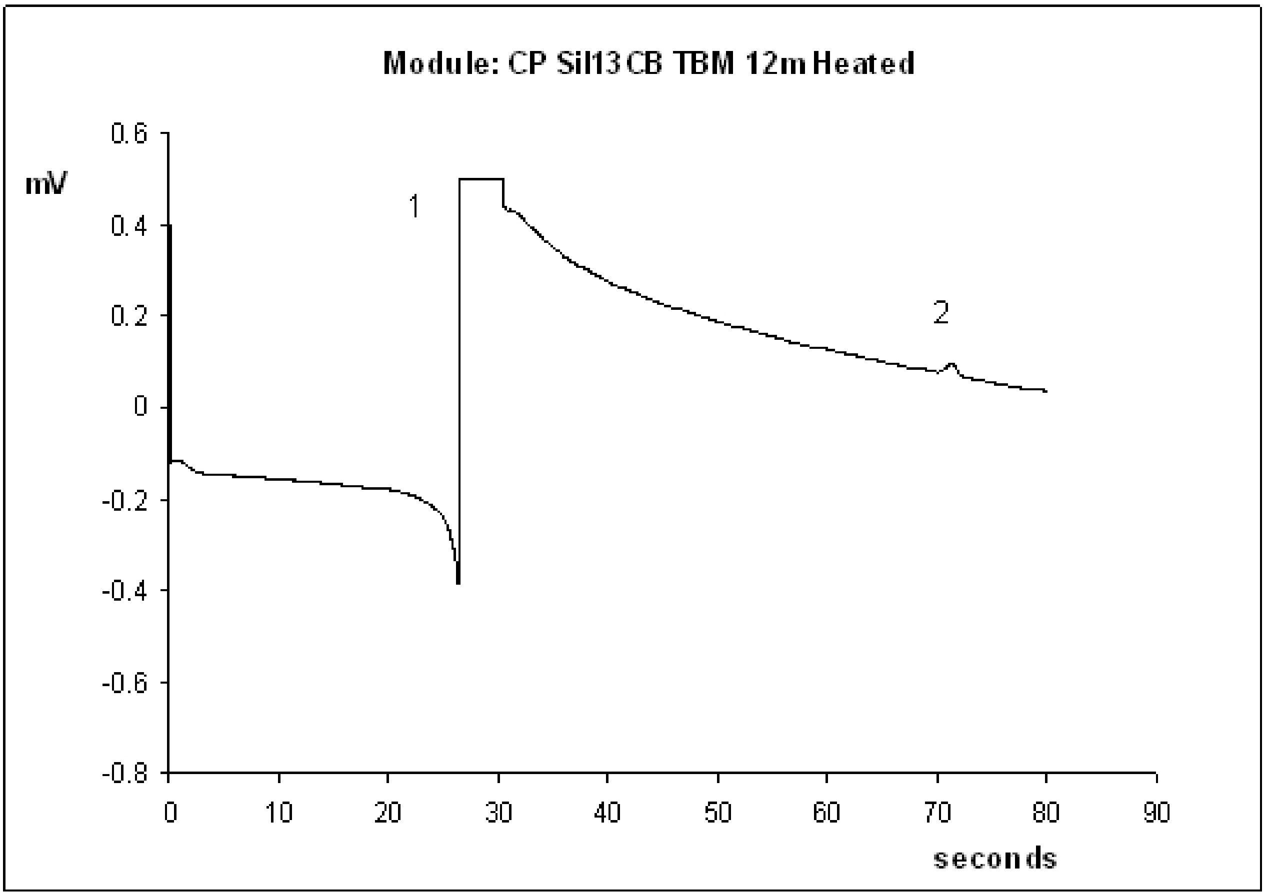
Instrument Parameters

Column temperature	50°C
Injector temperature	110°C
Column pressure	150 kPa (21PSI)
Sample time	30 s
Injection time	40 ms
Run time	60 s
Detector sensitivity	Auto

Peak identification

ID	*Component*	*Concentration*
1	Composite	Balance
2	Ethane	8.1%
3	Propane	1.0%
4	i-Butane	0.14%
5	n-Butane	0.20%

9.6 Column CP-Sil 13CB 12 meter heated



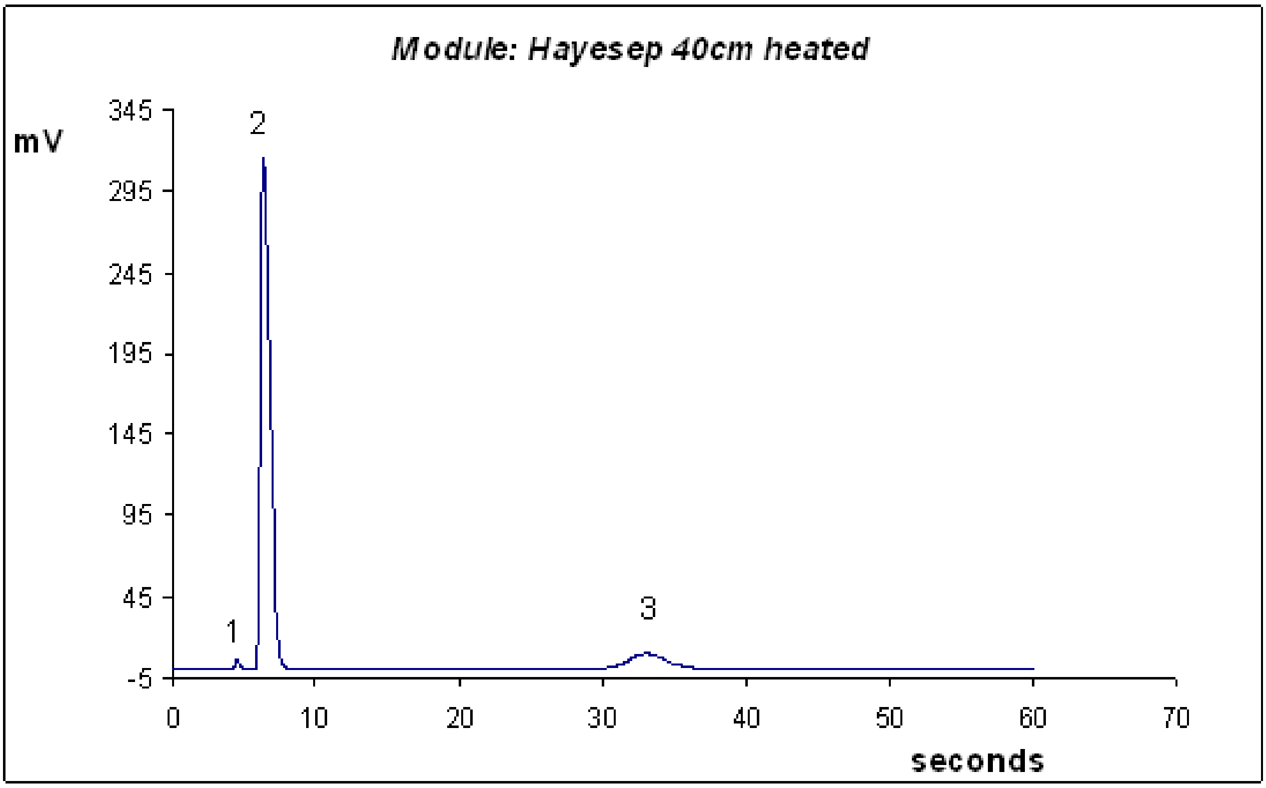
Instrument Parameters

Column temperature	40°C
Injector temperature	50°C
Column pressure	250 kPa (38 PSI)
Sample time	30 s
Injection time	255 ms
Run time	80 s
Detector sensitivity	Auto

Peak identification

ID	*Component*	*Concentration*
1	Methane	Balance
2	TBM	6.5ppm

9.7 Column HayeSep 40 cm Heated



The HayeSep A column separates oxygen, methane, carbon dioxide, ethane, acetylene, ethylene, and selected sulfur gases. Nitrogen coelutes with oxygen. Components with a higher molecular weight than propane have long retention times on this column.

Instrument Parameters

Column temperature	50°C
Injector temperature	110°C
Column pressure	150 kPa (21PSI)
Sample time	30 s
Injection time	40 ms
Run time	60 s
Detector sensitivity	Auto

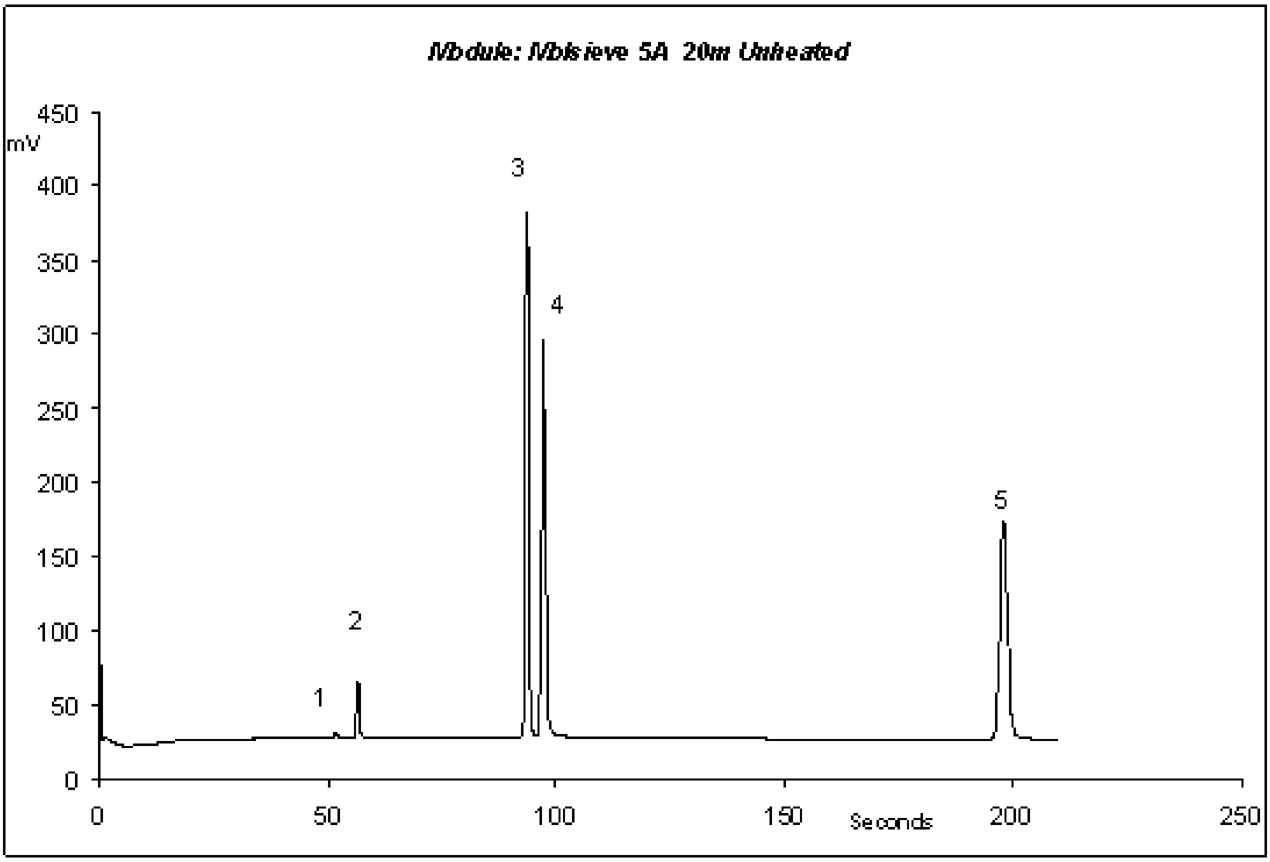
Peak identification

ID	*Component*	*Concentration*
1	Nitrogen	0.77%
2	Methane	Balance
3	Ethane	8.1%

WARNING

Maximum allowable column temperature: 160 °C

9.8 Column Molsieve 5Å 20 meter Unheated



Instrument Parameters

Column temperature	40°C
Injector temperature	NA
Column pressure	200 kPa (28 PSI)
Sample time	30 s
Injection time	40 ms
Run time	210 s
Detector sensitivity	Auto

Peak identification

ID	*Component*	*Concentration*
1	Neon	18ppm
2	Hydrogen	1.0%e
3	Argon	0.2%
4	Oxygen	0.2%
5	Nitrogen	0.2%

The Molsieve 5Å column is designed to separate: hydrogen, carbon monoxide, methane, nitrogen, oxygen, and some noble gases. Higher molecular weight components have much higher retention times on this column.

9.8.1 Conditioning of Molsieve columns

On a properly activated column nitrogen and oxygen will be very well separated. However, in time you will find that these two peaks will start to merge together. This is caused by water, present in the sample or carrier gas, adsorbing to the stationary phase. To restore the columns efficiency it will suffice to raise the oven temperature to 180 °C (max. column oven temperature) and, with the normal operating pressure on the column head, leave it to condition for about an hour. You are advised to switch the detector filaments off during this period. After reconditioning you can test the column performance by injecting plain air. If you have a proper separation between nitrogen and oxygen again the column separation power has been restored. If the 490-GC PRO's frequency of use is very high, you might adopt a standard reconditioning procedure of leaving the instrument with the oven temperature at 180°C overnight. The longer the reconditioning period the better the column performance without damage.

REFERENCE

10 GC Channels

The Instrument consists maximal 2 or 4 GC channel dependent of the instrument chassis.
A GC channel is equipped with an injector, a column and a TCD detector.

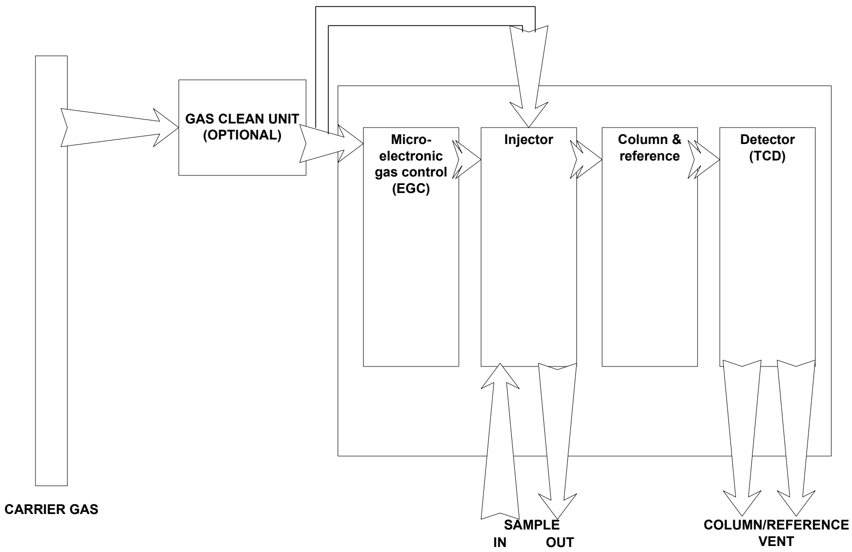
10.1 Carrier gas

The Varian, Inc. 490-GC PRO is configured for the use with either He (or H_2) or N_2 (or Ar).

Having chosen one option definitely rules out the use of the other without the instrument undergoing internal changes prior to any switching of carrier gas type.

It is recommended to use gases with a minimum purity of 99.995%. Since the injection valve is operated pneumatically, there is a limit of 550kPa ± 10 % (80psi ± 10%) to the main gas supply.

Your 490-GC PRO is configured either for carrier gas He (or H_2) or it is configured for N_2 (or Ar). Use the carrier gas type, for which your instrument is configured, otherwise the detector filaments can be damaged.



10.2 Micro electronic gas control (EGC)

The 490-GC PRO has built-in Micro EGC regulators that can be adjusted to get a constant or programmed pressure control, which result in a constant or programmed flow through the injector, column and detector. The pressure range of the Micro EGC is between 50-350 kPa (7 - 49 Psi). This pressure sets a continuous flow of carrier gas of about 0.2-4.0 mL/min.
A typical pressure rise is 200 kPa/min, which will give a significant pressure increase during the run, without excessive baseline disturbance. In most cases baseline subtraction may improve the quality of chromatograms that suffer from baseline drift.

10.3 Injector

The injector has a built-in 10μl sample loop that is filled with the gaseous sample. The pressure of the sample should be between 0-100 kPa (0-15 psi) and the sample temperature within 5-110 °C ±5 °C of the analyzer. By activating a START from the communication package, a vacuum pump will draw the gas sample through the loop and then the injector will inject the gas sample from the sample loop into the gas stream. The minimum pressure required by the injector is 550 ± 10 kPa (80 ± 2 psi). A typical injection time is 40 milliseconds (ms). This equals an average injection volume of 200 nL. Injection time will be rounded to a multiple of 5 ms. A practical minimum value is 40 ms.

NOTE

In most cases a value of 0 - 20 milliseconds will result in no injection.

10.4 Column

A variety of column configurations are possible on the 490-GC. The columns you require for your specific analysis have been installed at our factory. Other configurations are, of course, possible, but changing the column modules is a delicate matter that can only be handled by one of our service engineers. Table I show several standard columns as supplied in the 490-GC PRO and selected applications. Other columns are available by contacting Varian, Inc.

Column/Phase type	Target components
Molsieve 5Å	Permanent gases, methane, CO, NO ,etc.(H.R. for O2-Ar baseline separation). Optional Retention Time Stability (RTS) configuration
Hayesep A	Hydrocarbons C1-C3, N2, CO2, air, volatile solvents.
CP-Sil 5 & 8 CB	Hydrocarbons C3-C10, aromatics, organic solvents.
CP-Sil 19 CB	Hydrocarbons C4-C10, high boiling solvents, BTX.
CP-WAX 52 CB	Polar higher boiling solvents.
PLOT Al2O3/KCl	Light hydrocarbons C1-C5 saturated and un-saturated. Optional Retention Time Stability (RTS) configuration.
Pora Plot U	Hydrocarbons C1-C6, Freons, Anesthetics, H2S, CO2, SO2, volatile solvents.
Pora Plot Q	Hydrocarbons C1-C6, Freons, Anesthetics, H2S, CO2, SO2, volatile solvents.
CP-CO_X	CO, CO2, H2, Air, CH4.
THT column	THT and C3-C6 $^+$ in Natural Gas Matrix.
TBM column	TBM and C3-C6$^+$ in Natural Gas Matrix.
CP-Poraplot	Specially tested for H_2S in natural gas (10 to 50 ppm)
MES column	Unique column specially tested for MES in natural gas (1 ppm)

Table I **Some Varian, Inc. columns and applications**

WARNING

All columns except the HayeSep A and MES (110 °C) (TCEP) column can be used up to 180 °C, the maximum temperature of the column oven. The HayeSep A will deteriorate above 160 °C. Exceeding this temperature will cause the column to lose efficiency instantly and the column module will need replacement.

10.5 Detector

10.5.1 TCD

The 490-GC PRO is equipped with a thermal conductivity detector (TCD). This detector responds to the difference in thermal conductivity between the carrier gas and the sample components. The construction of a TCD is such that the changing thermal conductivity of the carrier gas stream, due to components present, is compared to the thermal conductivity of a constant reference gas stream.

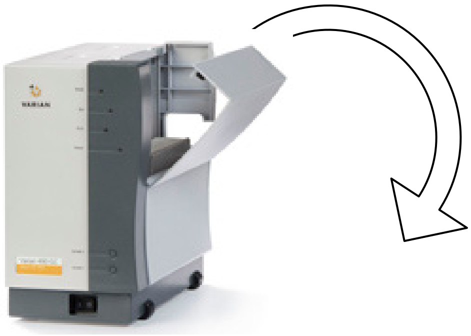
10.5.2 DMD

The Differential Mobility Detector, DMD, is fully integrated into a 490-GC Analytical channel.
Differential Mobility Detection is an advanced form of Ion Mobility Spectroscopy (IMS). It uses a drift tube under atmospheric and thermally constant conditions. See for more details chapter The difference mobility detector on page 44 .

11 Inputs / Outputs

The 490-GC PRO has several in/output ports accessible inside the instrument for interfacing with external devices.

Open the cover.



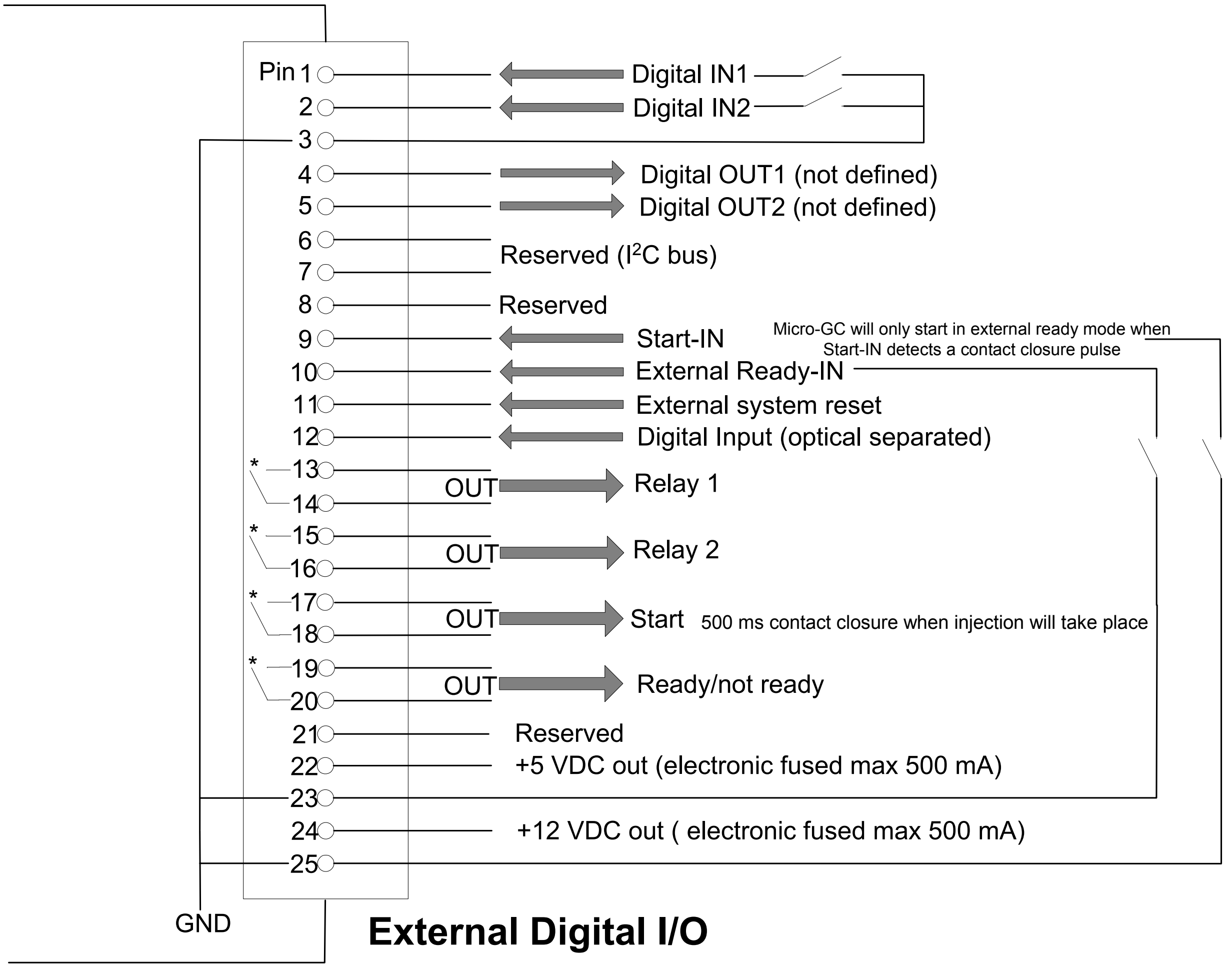
At the front of the 490-GC PRO, the external device connectors will be visible.

NOTE

Close the cover after connecting the cables!

11.1 External digital I/O

Connection between 490-GC PRO and external devices is made with the appropriate cable to the External Digital I/O port.



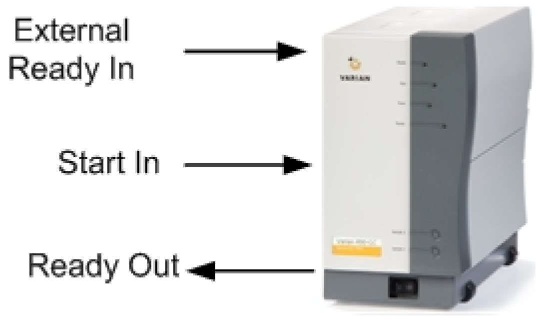
* Relay contacts maximum 24 Volt 1 Ampere

11.1.1 Ready/Not Ready signal

The Instrument Ready/Not Ready output will follow instrument status (Ready LED in the front of the instrument).
The External Digital I/O connections are also available from the optional Extension Boards.

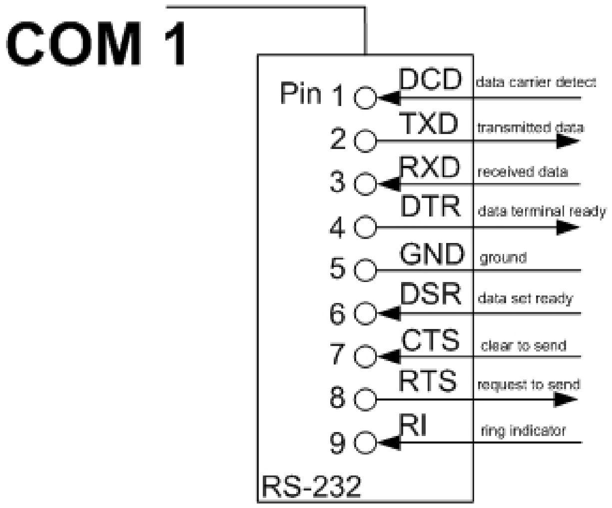
11.1.2 Synchronization with other devices

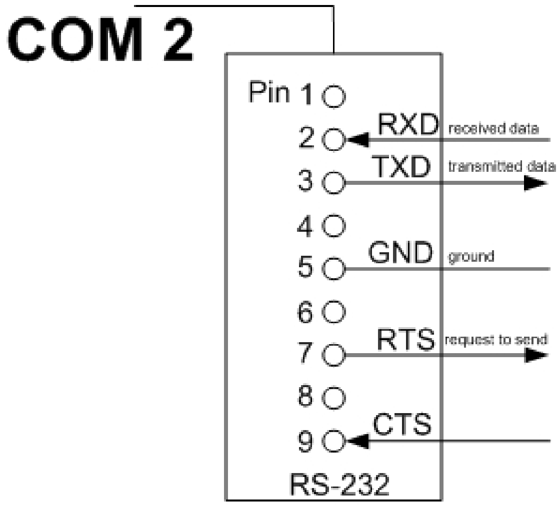
- External Ready In signal determines 490-GC PRO's instrument state. When external devices is not ready, the 490-GC PRO will be not ready to start run.
- Start In signal starts one single run.
- Ready Out will be ready when the system is not in a chromatographic run phase and all temperatures, pressures (selectable external ready In) are ready.

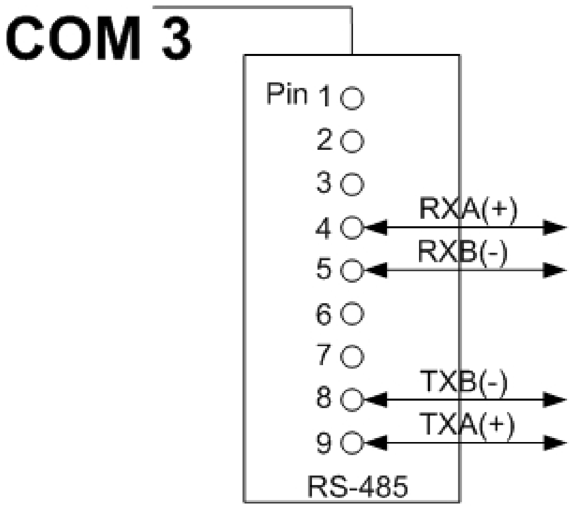


11.2 Communication ports (COM)

In the table below an overview is given of the communication possibilities.



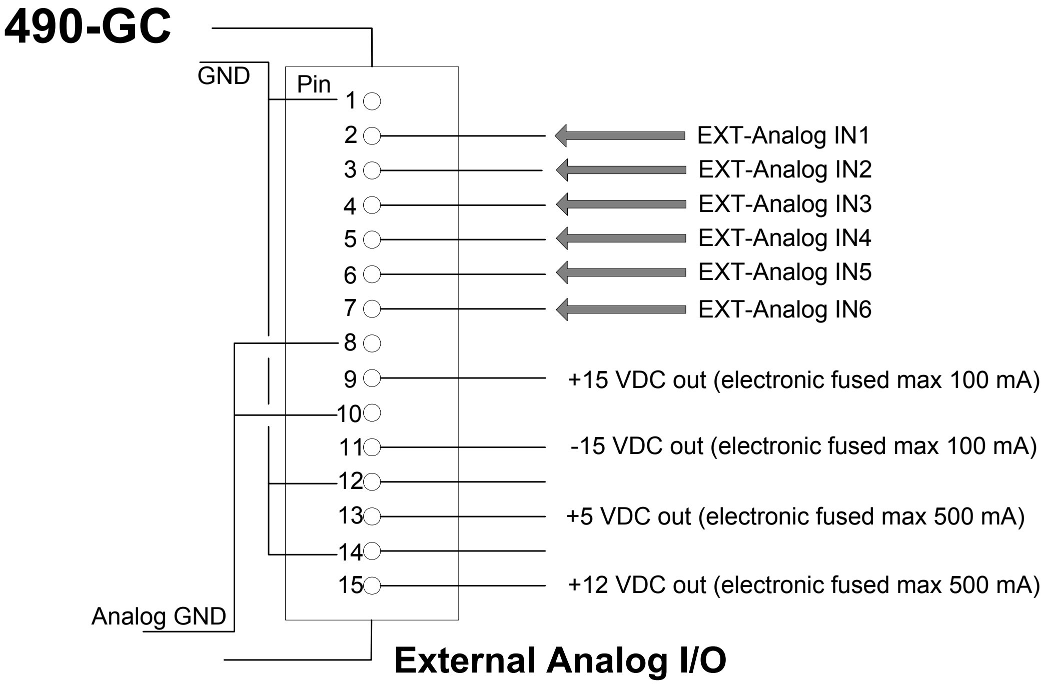




Port	Type
COM1	RS-232-interface
COM2	RS-232-interface
COM3	RS-485-interface
Ethernet	10Mbit

11.3 External Analog I/O

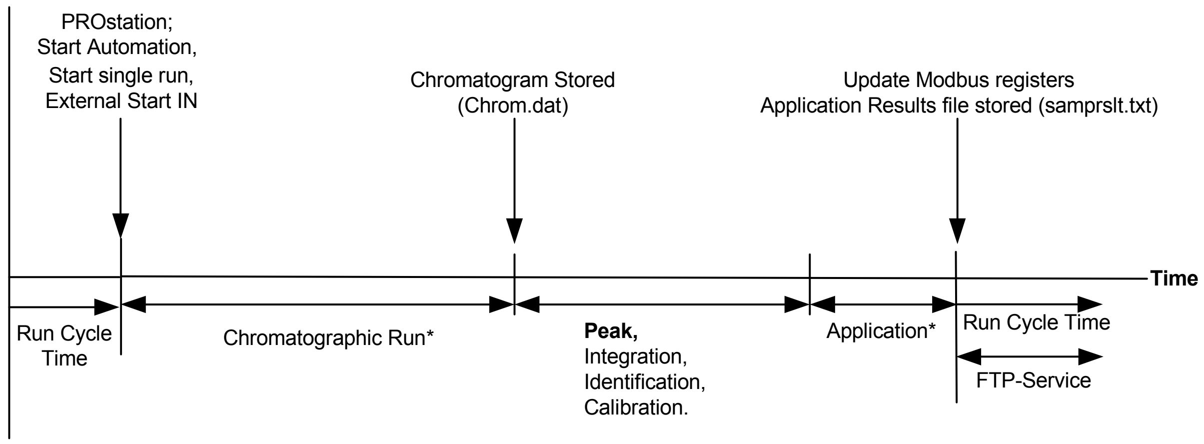
This external analog I/O port can handle six (6) analog inputs (input 0-10 Volt)
The User Interface receives this analog information, and translates this information into actions to be taken by the local user interface and/or events/data to be shown/stored in the remote user interface.
The External Digital I/O connections are also available from the optional Extension Boards.



12 490-GC PRO Cycle Scheme

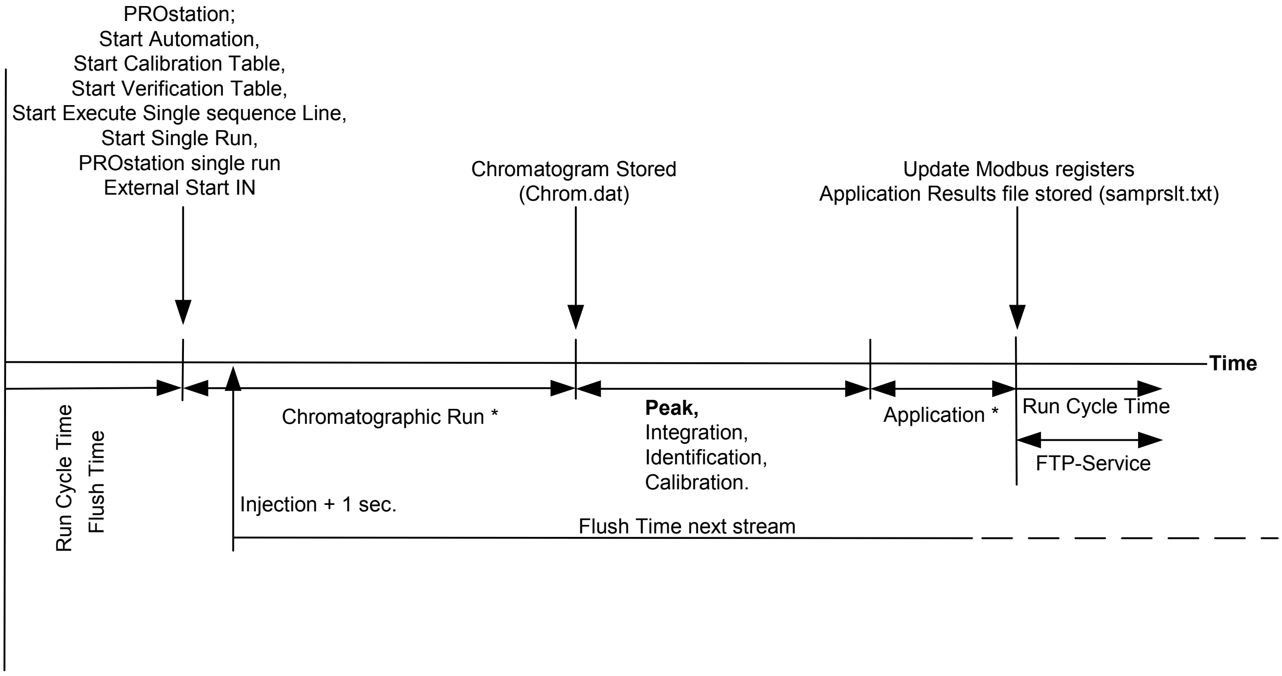
This chapter describes the order of tasks a 490-GC PRO performs in the different modes.

12.1 490-GC PRO Cycle without Stream Selector



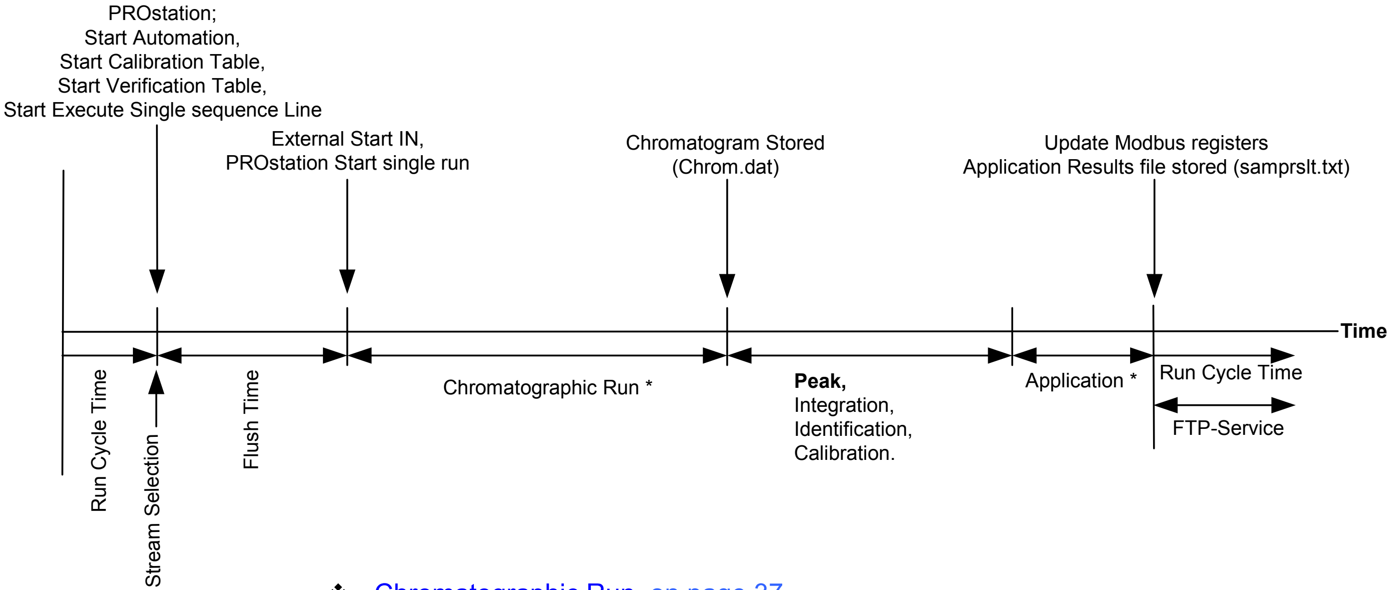
- ❖ Chromatographic Run on page 37.
- ❖ Application

12.2 490-GC PRO Cycle with Stream Select with Stream ahead



- Chromatographic Run on page 37.
- Application

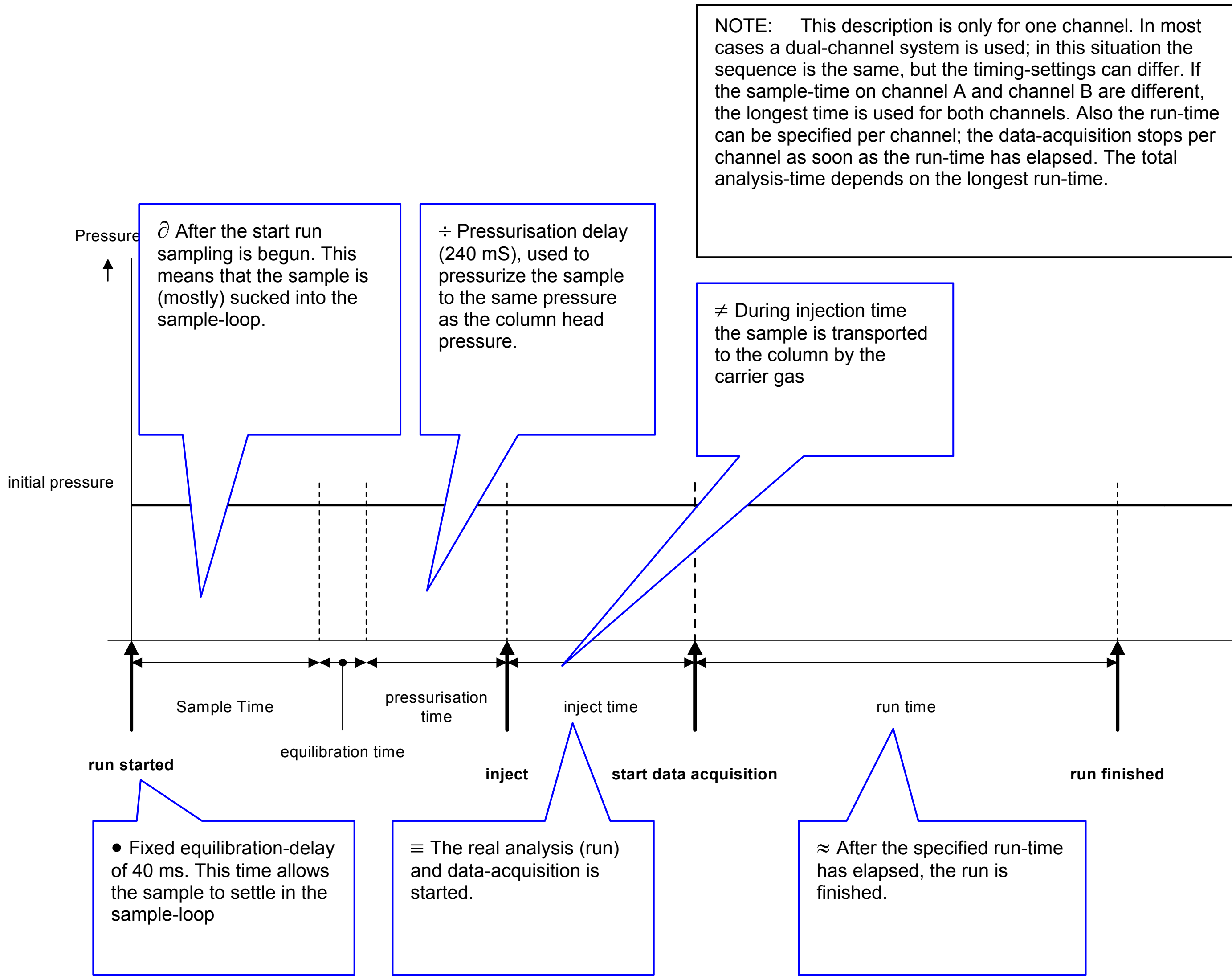
12.3 490-GC PRO Cycle With Stream Select without Stream ahead



- Chromatographic Run on page 37.
- Application

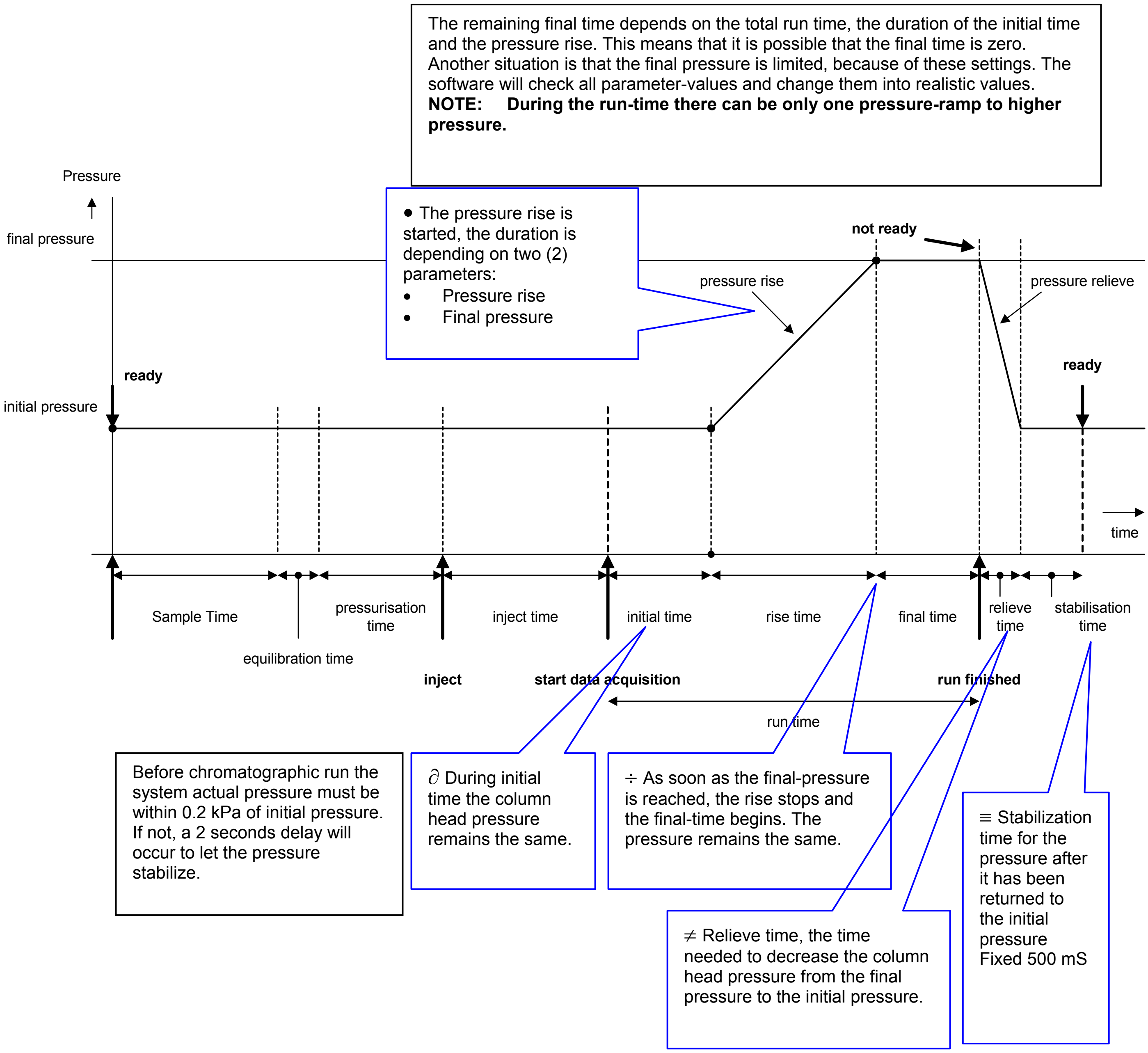
12.4 490-GC PRO Chromatographic Run with static (electronic) pressure

This time diagram will help you to understand the Static (electronic) pressure chromatographic run of the 490-GC.



490-GC PRO Chromatographic run with electronic pressure control

This timing diagram will help you to understand the electronic pressure control (EGC) chromatographic run of the 490-GC.
The diagram shows the situation in the 490-GC, using electronic (programmed) pressure control. The timing before the injection is identical to the static pressure cycle.



13 Column Module Conditioning

NOTE

Follow this procedure to make sure that any water that might be present inside the analytical column is removed before the TCD is switched on.
Also follow this procedure if the 490-GC PRO Micro-GC or 490-GC PRO Micro-GC module has been stored for a long period.

WARNING

The detector filaments may be damaged if this procedure is not followed!

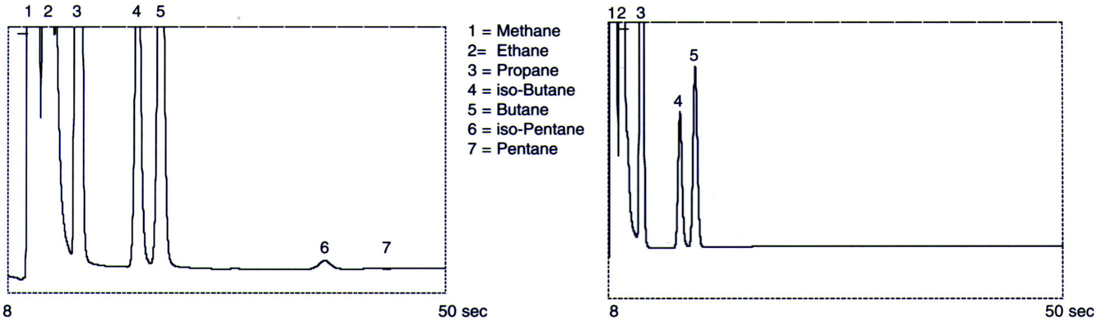
1. Switch off the TCD filaments in the method.
2. Set the column temperature of the module to the maximum temperature (160° C or 180°C depending on the column module). ***Leave the filaments off!!***
3. Download this method to the 490-GC PRO Micro-GC.
4. Condition the column module, preferably overnight.

This will insure you that all the water has been removed from the column module and no damage will occur to the TCD filaments.

In case column conditioning is required, this may also be initiated from the "Start" menu in PROstation on page 269 (column Reconditioning).

14 Backflush option

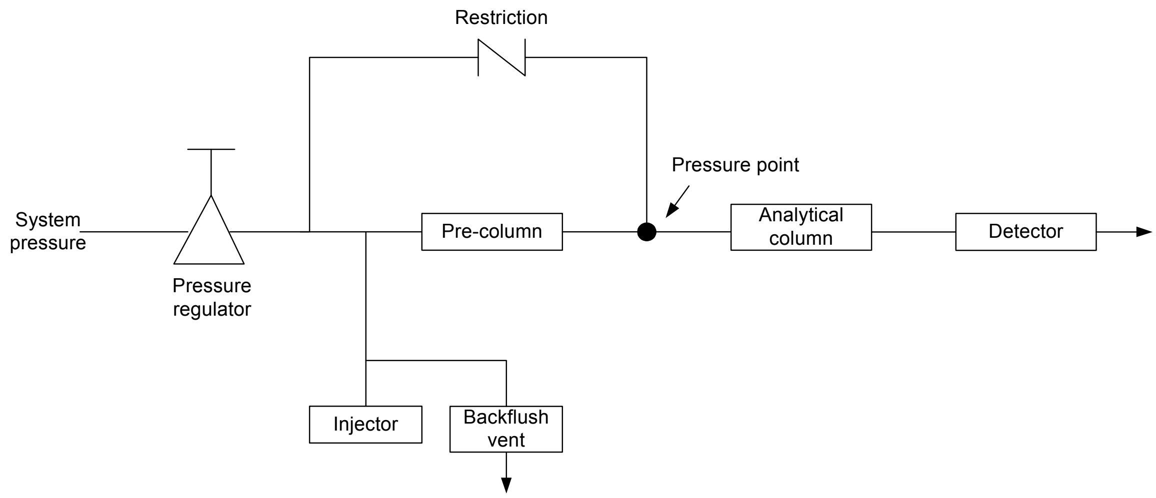
Backflush to vent is an advanced technique, which is used to prevent later eluting compounds to reach the analytical column and detector. The main reason for applying this technique is to keep the analytical column clean and reduce analysis time.
The Varian 490-GC PRO Micro-GC is optionally available with GC modules that incorporate backflush capabilities.



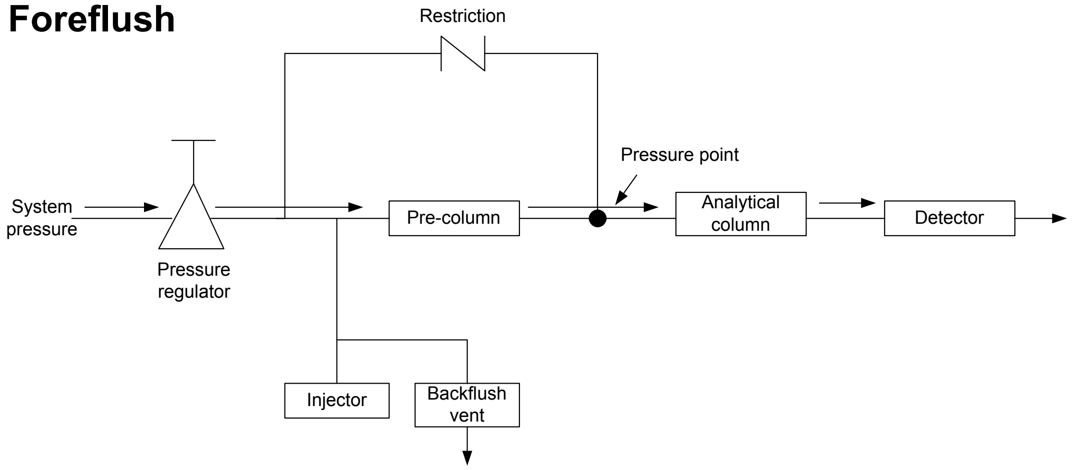
Natural gas analysis, straight.

Natural gas analysis, with backflush at 8 seconds.

A backflush system always consists of a pre-column and an analytical column. The two columns are coupled with a so-called pressure point, which makes it possible to invert the carrier gas flow direction through the pre-column at a preset time, the "backflush time".

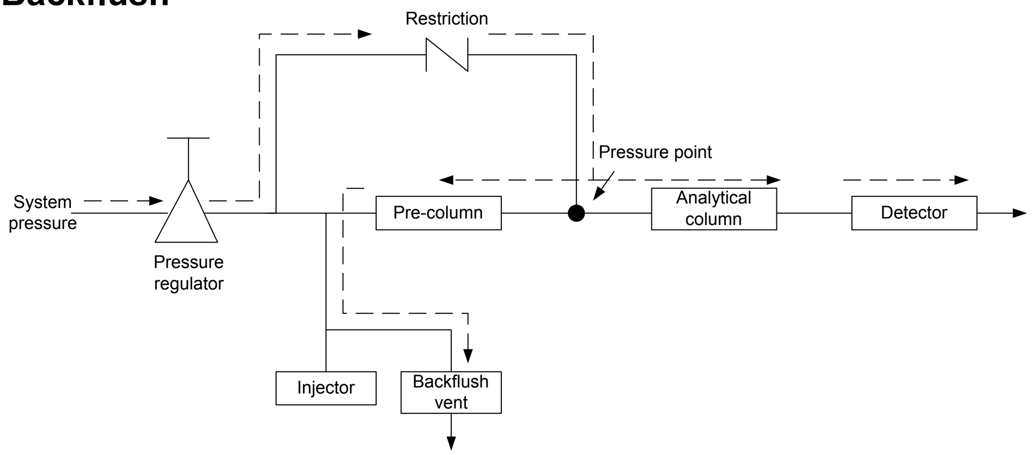


Foreflush



The injector, two columns, and detector are set in line.
The sample is injected onto the pre-column where a pre-separation takes place; injection takes place in "foreflush" mode (see foreflush diagram).

Backflush



When compounds which are to be quantified are transferred to the analytical column, the backflush valve switches (at the backflush Time). On the pre-column the flow is inverted and all compounds left on the pre-column are now (back) flushed to the vent (see backflush diagram). On the analytical column the separation continues, because here the flow is not inverted!

The standby mode for the 490-GC is to be in the backflush configuration (if the instrument is equipped with the optional backflush valve).
Back flushing will ensure that the pre-column will be in optimal condition for the next run.

14.1.1 Tuning

Tuning of the backflush time is done by trial and error. Reducing the backflush time will transfer fewer compounds to the analytical column.

How to Tune

Obtain a chromatogram in foreflush. Check out the retention times of the compounds you have to quantify.
Start at a backflush time of 10 seconds. Obtain a second chromatogram. Adjust the Backflush time (increments of 0.1 seconds are possible) until all components of interest are transferred to the analytical column and all unwanted peaks are backflushed.
Be aware that a small pre-column is used. It is not always possible to cut between 2 peaks!
Backflush Time range 0.5 seconds until maximum run time.

Special value

BACKFLUSH TIME = 0 this puts the system in FOREFLUSH mode during run the entire run.

15 Shipping Instructions

If your 490-GC PRO for any reason must be sent back to the factory, it is very important to follow these additional shipping preparation instructions:

1. Add all the vent caps at the back of the 490-GC PRO.
2. Always include the power supply.
3. Include, if used, the inlet filter(s).

16 Cleaning Instructions

To keep the 490-GC PRO surface clean, refer to the remarks given below:

- Switch the 490-GC PRO off.
- Remove the power cable.
- Put protection plugs on the sample and carrier gas inlets.
- Put protection plugs on the Column vents.
- Use a soft (no hard or abrasive) brush to carefully brush away all dust and dirt.
- If the outer case is dirty (never clean the inside!) clean it with a soft, clean cloth dampened with mild detergent.
- Never use alcohol or thinners to clean the 490-GC PRO, these chemicals can damage the case.
- Be careful not to get water on the electronic components.
- Do not use compressed air to clean.

17 Disposal Instructions

When the lifetime of the 490-GC PRO has (or parts of it have) reached the end of its useful life, disposal must be carried out in accordance with all (environmental) regulations applicable in your country.

18 The Differential Mobility Detector

WARNING:
RADIATION SOURCE
This detector contains a Ni^{63} beta-emitting radioactive isotope plated onto a metallic foil for ionization of the carrier gas.

For details about procedures governing the handling, leak testing, repair, storage, shipping and maintenance of records for the Ni^{63} DMD detector as a radioactive sealed source please refer to the Ni^{63} Radiation Safety Manual (Safety manual not yet available April 2004).

18.1 General functionality

Varian has extended its 490-GC Micro Gas Chromatography product line with a new detector. The Differential Mobility Detector, DMD, integrated into the 490-GC chassis is a joint development of Sionex Corporation and Varian Instruments.

Differential Mobility Detection is an advanced form of Ion Mobility Spectroscopy (IMS). It uses a drift tube under atmospheric and thermally constant conditions. The advantage over IMS is that DMD uses additional sets of RF modulation voltages, which results in selective performance, which is tuneable depending on the compounds of interest and the matrix.

Ions generated by a Ni63 radioactive ionization source are transported through a drift tube by means of a high velocity transport gas, usually Zero-Air or Nitrogen. The drift tube basically consists of two parallel plates, approximately 500 microns apart. Over these plates a RF modulated electric field is applied by setting a fixed Voltage of 2-500 Volts/cm and a Scanning Voltage (or Compensation Voltage). The RF modulation frequency is 1.3 Megahertz.

Isolation results from the interaction between the ion and the net applied field that alternates between high and low electric field strength. Trajectory of the target ions will be tuned so that the ions of interest straight through the filter without colliding with the electrode plates, when they would be neutralized and not detected. The Compensation Voltage is used for 'tuning' the trajectories of ions in order to get the 'desired' ions towards the detector.

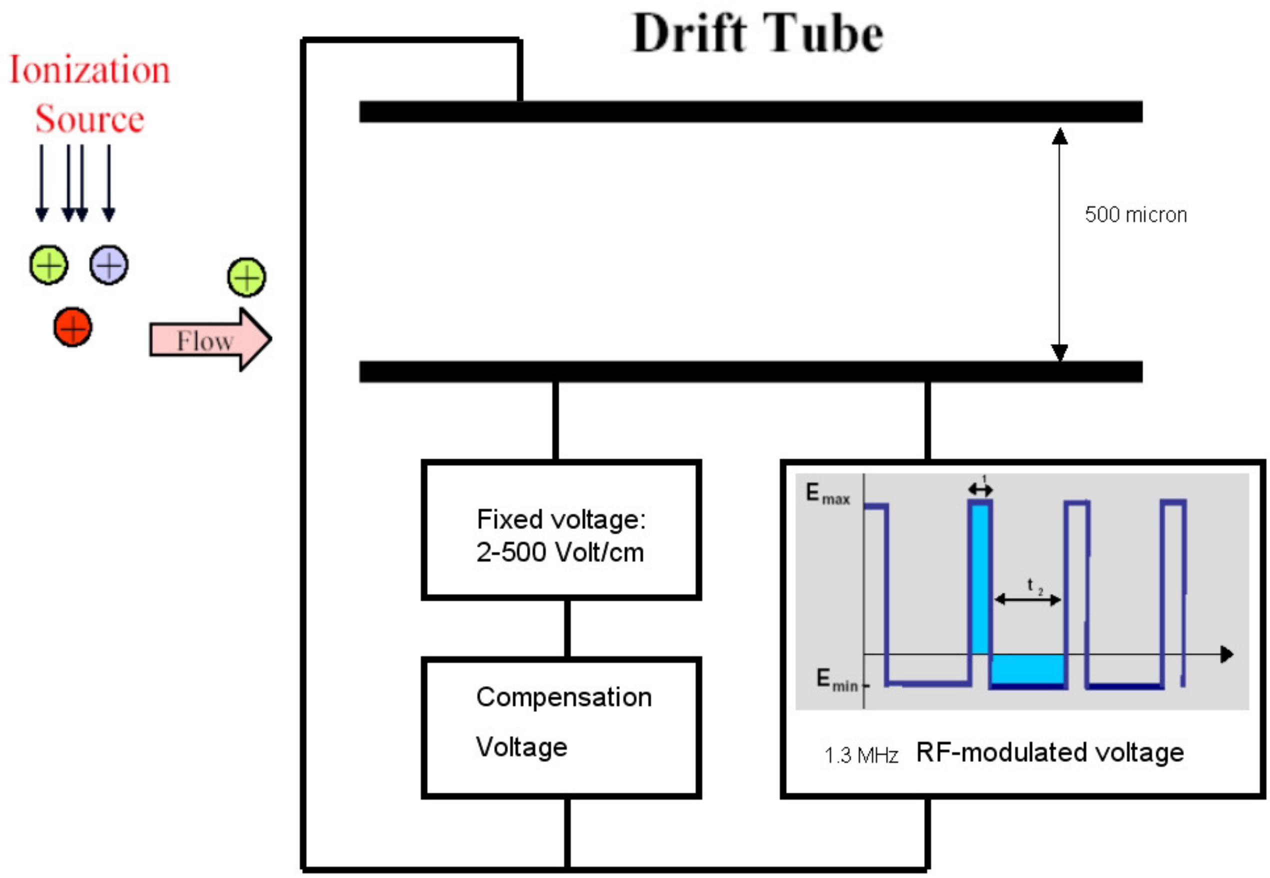


Figure 1: DMD set-up showing different voltages applied

As illustrated in 1, the net voltage applied results from three independent settings:

- A fixed voltage, or RF-Voltage,
- A scanning voltage, also referred to as Compensation Voltage,
- A RF modulated voltage.

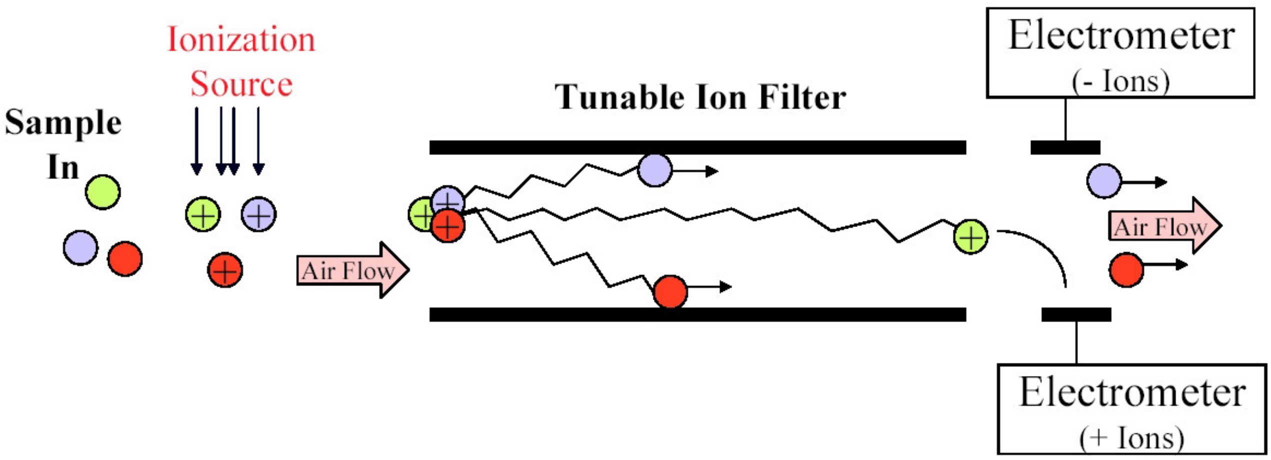
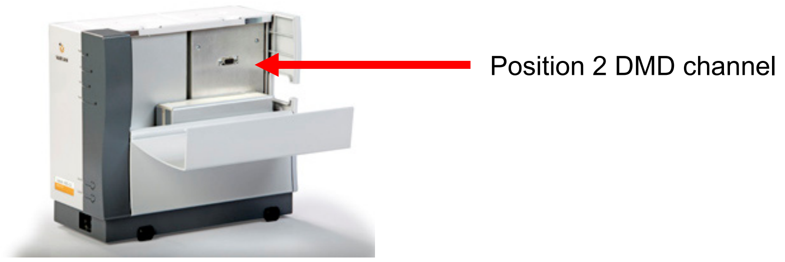


Figure 2: Separation principle of DMD

As illustrated in Figure 2, the DMD is equipped with two detectors, one for positive ions and one for negative ions. Yet, the data produced by the DMD show a 'normal' two-dimensional representation as the system will be 'tuned in time' to detect certain species by setting compensation voltages to accommodate transmission of the compound of interest in that particular part of the chromatogram. This 'time-segmented' detection thus leads to maximum selectivity for the application of interest as the matrix is eliminated. The application specific method is saved inside the DMD hardware.

18.2 490-GC PRO DMD Channel

The DMD channel is always located in the last position (against the backpanel)



The 490-GC firmware recognises the DMD channel as a detector only, and automatically sets the controls accordingly.

Being a complete instrument, the 490-GC DMD consists of a basic cabinet, a column module with its pneumatic system, its standard µ-TCD and an additional DMD. The standard channel's µ-TCD output is in series with the DMD inlet via a heated transfer line. The temperature of this heated transfer line is controlled from the DMD electronics.

From a control point of view, the DMD has no control of a column temperature or column head pressure or the optional injector temperature as needed for the GC channel. No carrier gas type needs to be selected in the configuration.
Furthermore, the DMD method is factory tuned and ready to perform the appropriate application. This requires the Micro-GC method to be identical throughout its use with respect to chromatographic column and settings.

18.3 General operation

Within the PROstation, the DMD will be handled as a separate channel. With respect to the operation of the DMD note the following:

- In instrument configuration, selection of carrier gas type and heated injector has been removed.
- In method development for the DMD channel, GC-channel specific information has been left out. Instead, the Transfer line temperature and the detector tuning capabilities are added.
- In instrument status for the DMD channel, GC-channel specific information has been left out. Instead, the Transfer line temperature and the detector tuning capabilities are added.

18.4 Tuning the DMD

The complete DMD method for the instrument specific application has been tested and is loaded inside the DMD. Generally no modification or changes are required in case the factory-supplied method is used throughout.

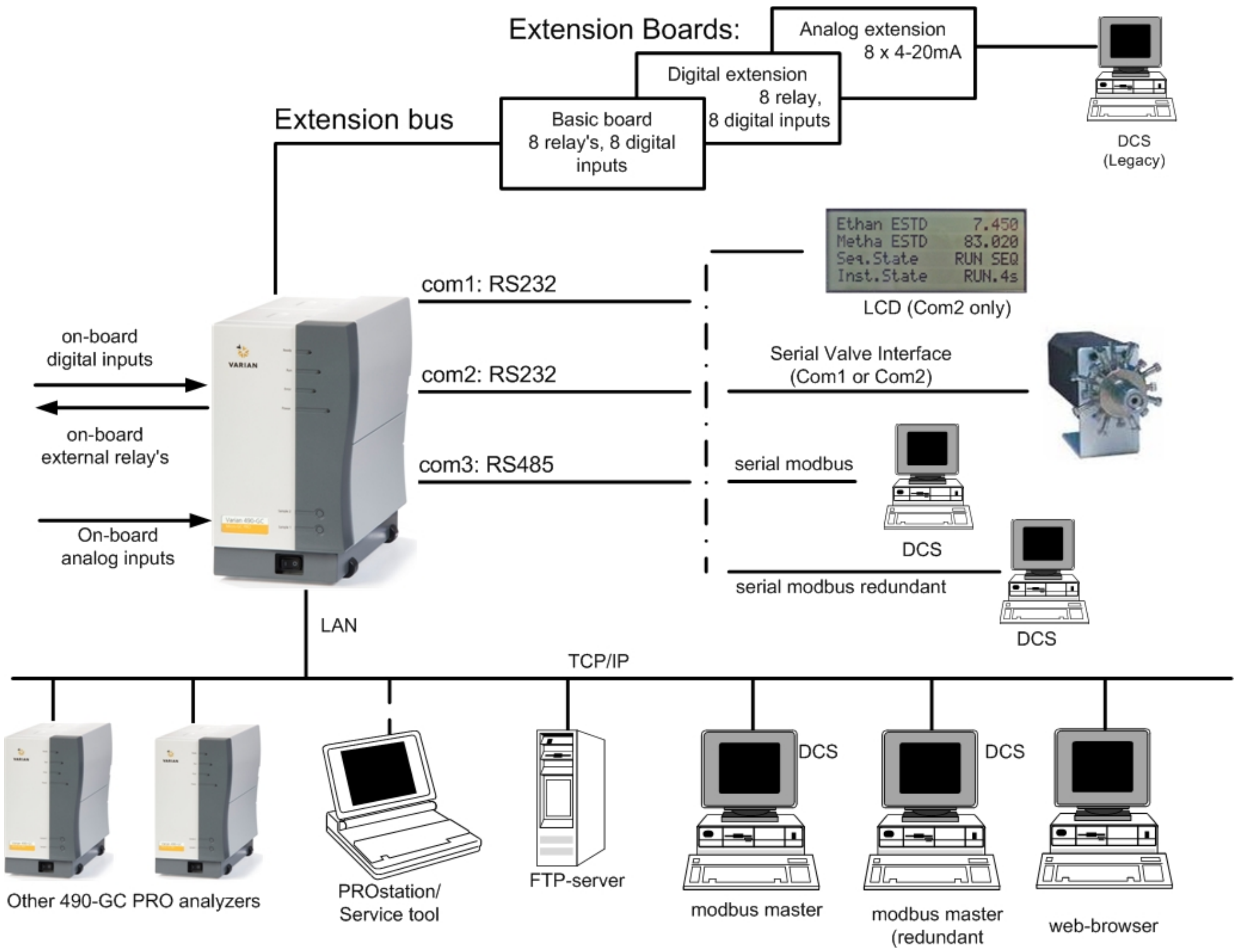
In case of a suspected misalignment of the method, where retention time or compensation voltage may be out of tune, a tuning run may be required.
To enter into Tuning mode, select [**Tuning**] for the appropriate channel in the 490-GC method. Connect a calibration sample containing the components of interest and start the run. The tuning run will automatically align the optimum compensation voltage.
Under tuning conditions there will be no chromatogram sent to workstation. Visible on the screen will be a straight line.

After the tuning-run is completed, revert back to setting [**Analysis**] for the appropriate channel in the 490-GC method again and continue normal operations.

19 Networking Capabilities

This chapter describes the interfaces of the 490-GC PRO to other systems.

19.1 The 490-GC PRO network environment



19.1.1 TCP / IP Connected

- **PROstation**
  A Microsoft Windows package used for uploading, downloading and editing of methods, sequences, integration tables Modbus communication settings, and diagnostics etc. and to visualize the ongoing process.
  Within the TCP/IP network one PROstation can monitor only one single instruments, even though multiple 490-GC PRO instruments may be part of the network.
  <u>After setup disconnect PROstation.</u>

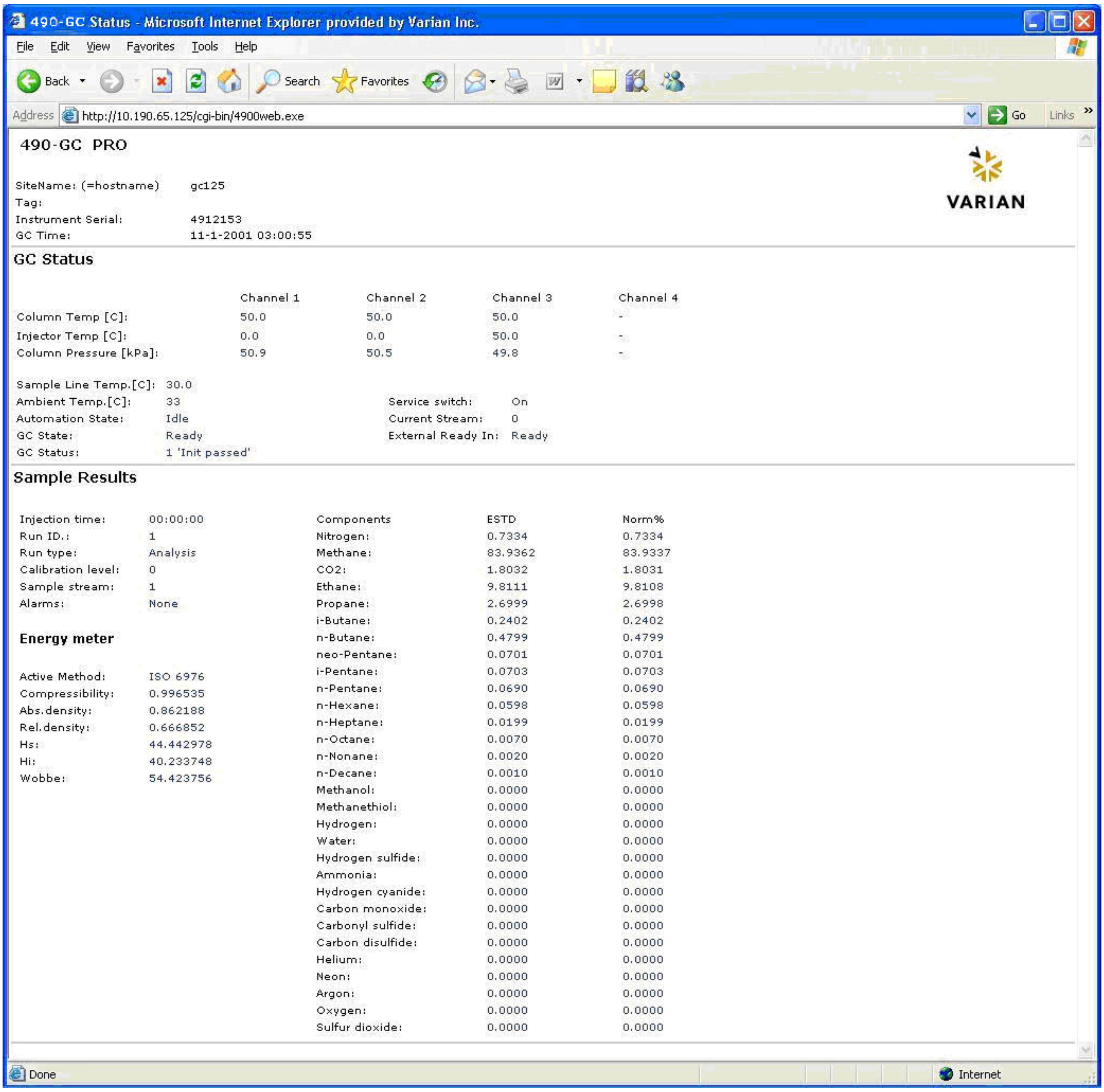
- **FTP server**
  External storage capacity for run-data, reports and diagnostics. Note that the 490-GC PRO has no capabilities for storing data, except for the last run. By obtaining a “35-day logging” license, the 490-GC PRO is capable of storing data.

- **Modbus TCP/IP communication protocol**
  The main connection to the control computer (DCS, Flowcomputer, SCADA, etc). Via Modbus analysis results, GC-status, external device status, etc. are provided to the DCS and certain operations can be requested by the DCS. A total of 25 Modbus TCP/IP Masters can connect to the same 490-GC PRO simultaneously.

  Additional Modbus Protocol/Specifications documents can be found on the Installation CD.
  - Modbus TCP/IP Protocol and Message implementation.
  - Modbus Daniel protocol (serial mode) includes defined Modbus registers.
  - Modbus MODICON protocol (serial).

- **Web server**
  From anywhere on the network the status of the 490-GC PRO instrument can be monitored using an ordinary-internet browser. Apart from the status, the last set of analysis results is provided and regularly updated. The screen refresh rate is 10 seconds.

  <u>To have a quick overview of the status of the 490-GC PRO it is highly recommended to use an ordinary internet browser.</u>



- **Other 490-GC PRO analyzers**
  Multiple 490-GC PRO instruments may be connected to the network.
  Multiple internet browsers from different computers can display the instrument status of the same 490-GC PRO simultaneously.
  Multiple 490-GC PRO can transfer the analysis results to the same FTP server simultaneously.

19.1.2 Serial connected

- **Serial valve interface (Valco)**
  Sample stream selection can be performed in a number of ways. One way is the use of Valco (VICI) stream selectors (electrically activated).

- **Modbus serial communication protocol**
  The main connection to the control computer (DCS, SCADA, etc). Via Modbus analysis results, GC-status, external device status, etc. are provided to the DCS and certain operations can be requested by the DCS.
  A total of 2 Modbus Serial Masters Can connect to the same 490-GC PRO simultaneously.

- **LCD screen (optional)**
  Refer to the 490-GC PRO Micro-GC LCD module user manual (CP501373)

On the screen you can display:

- Actual operating conditions
- Instrument status as well as run status
- Calculated values
- Instrument errors
- Etc, etc

The user can select output fixed or scrollable

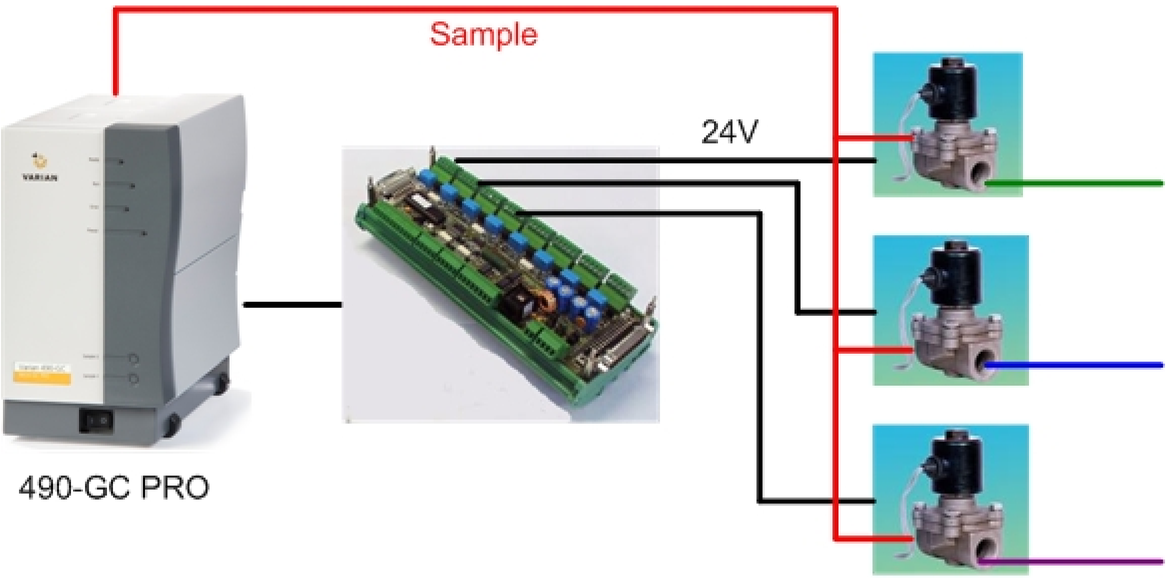
19.1.3 Connected via Extension bus

- **Extension boards:**
  Refer to the Micro-GC PRO Extension Boards usermanual (CP501370).

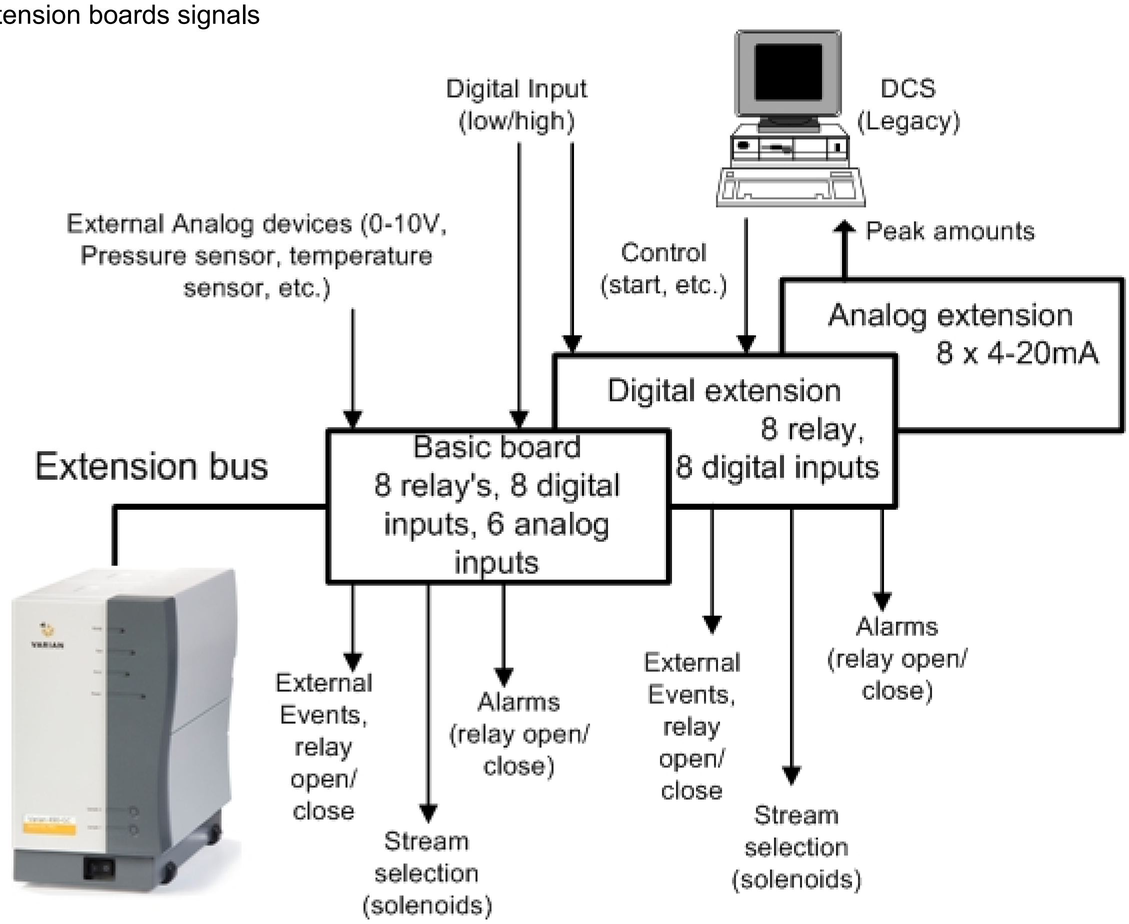
The 490-GC PRO has limited on-board capabilities for digital inputs and external relays (see external digital I/O on page 30).
By using a series of extension boards the instruments capabilities to control solenoids, handle I/O's is greatly expanded. A maximum of 8 boards is stackable, leading to a maximum of 64 external relays, 64 digital inputs, a maximum of 25 configurable analog outputs.

The use of these extension boards is endless:
- Solenoid driven stream selection
- Alarming to DCS or external device by use of relay,
- Collecting analog signals from external devices (flow meter, etc)
- Collecting digital input from external devices (flow meter, etc)
- Handling external digital inputs representing: start automation, stop automation, start calibration table, start verification table, selecting a stream, executing a single line.
- Providing sample results via analog output (4-20mA, configurable) to a DCS.

Example of multi stream selection by use of extension board(s) and solenoid valves

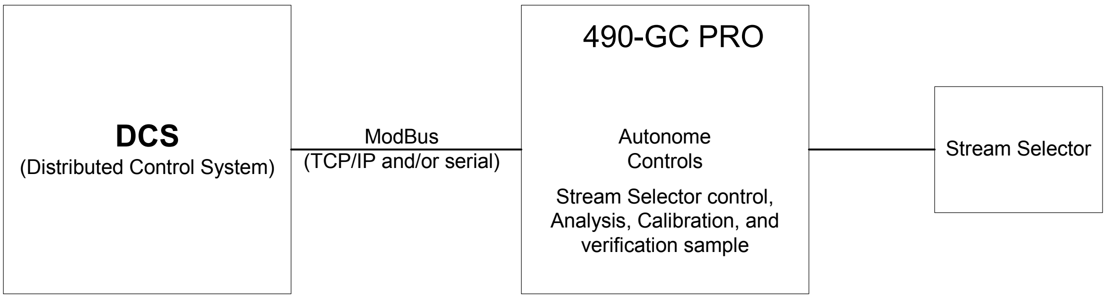


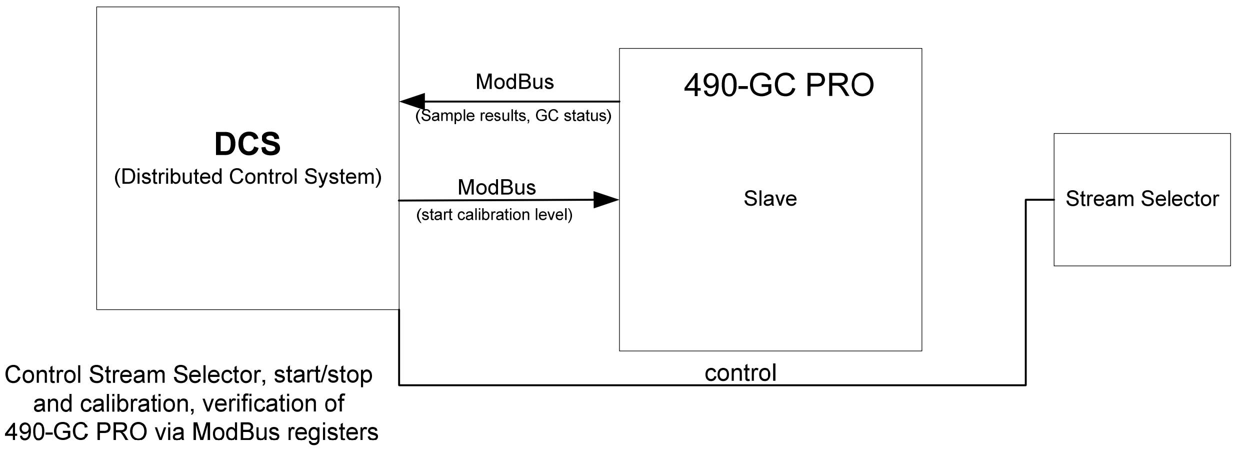
Extension boards signals



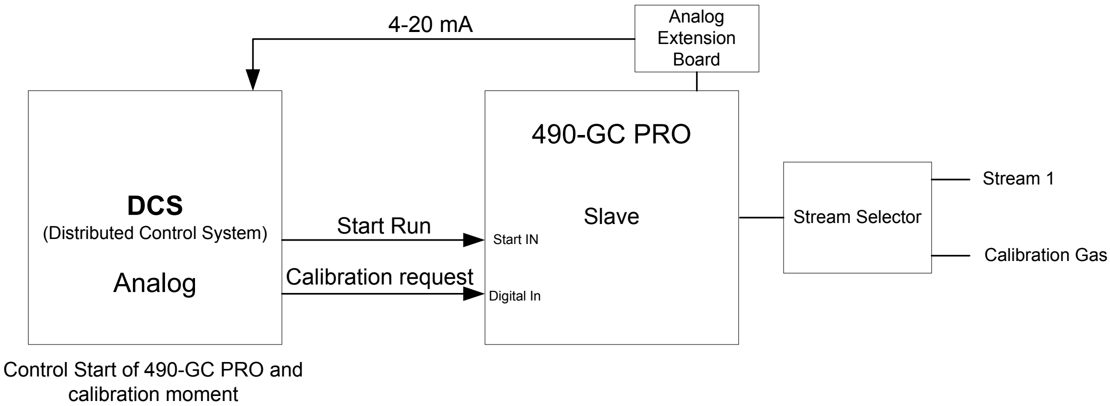
20 How to use the 490-GC PRO

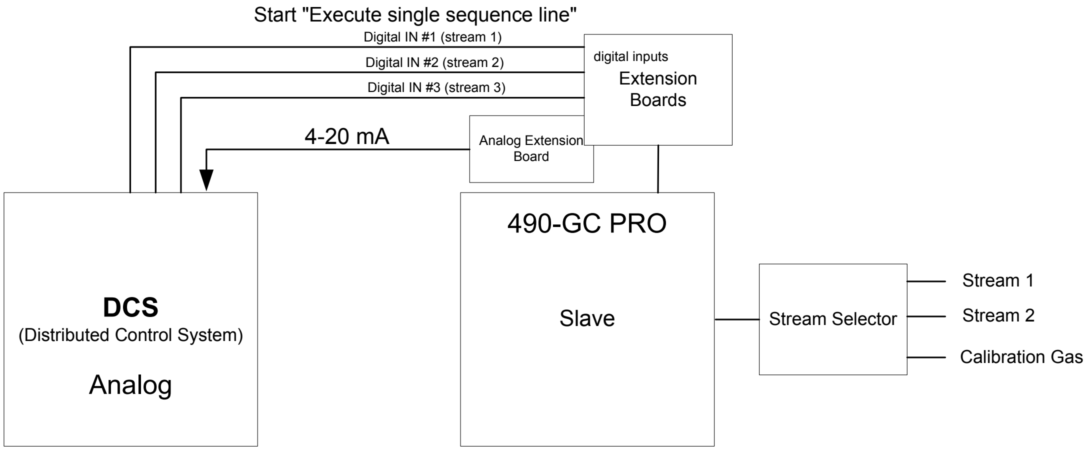
In the examples you will find a few of the possibilities how to use/connect the 490-GC PRO in combination with other devices.
If you have questions about your 490-GC PRO, please contact your nearest Varian, Inc. subsidiary or Varian, Inc. representative.

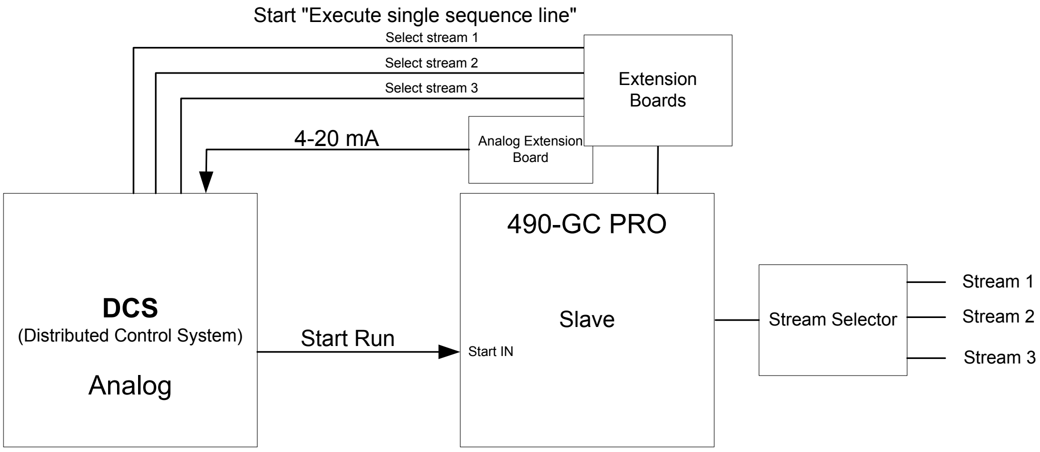


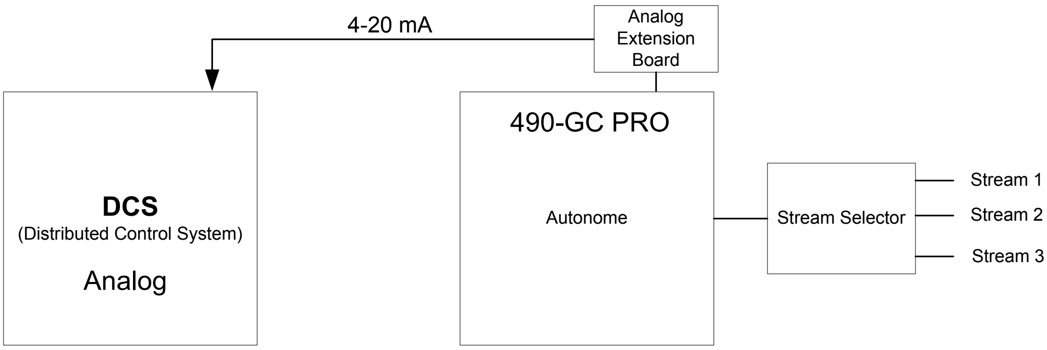


20.1 Analog Cases

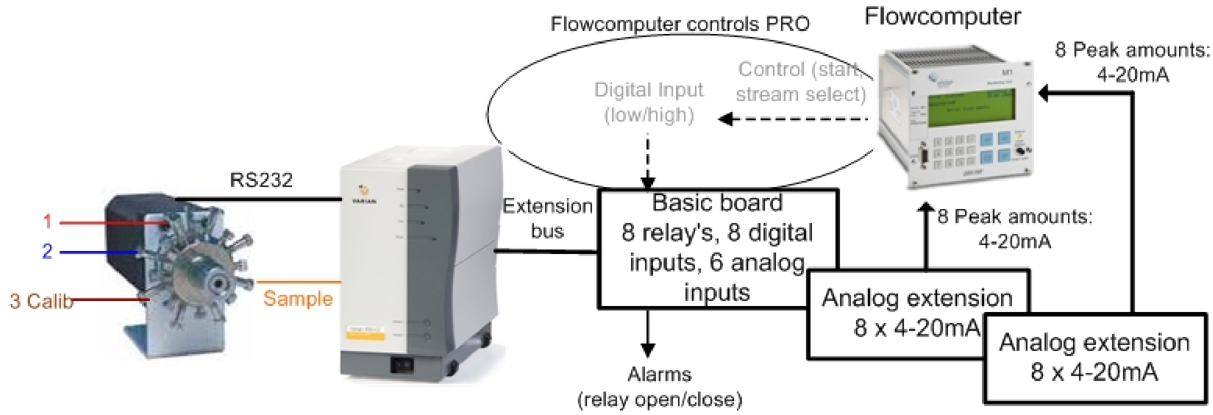






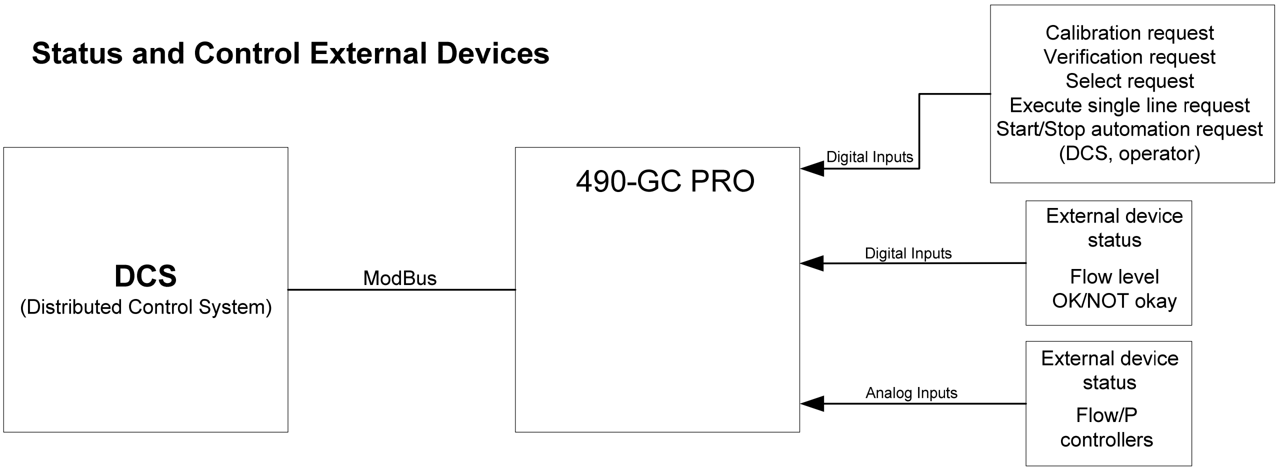


Flow computer controls 490-GC PRO via analog signals and received results via 4-20 mA signals

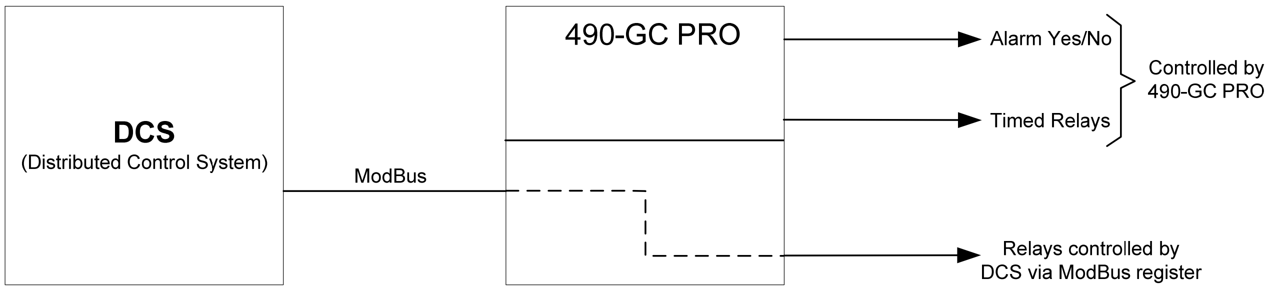


20.2 Status and Control External Devices

Status and Control External Devices



Digital Output External Devices



21 PROstation Tool

Because all workstation functionality like integration, identification, quantification, application as well as verification and calibration capabilities are incorporated inside the 490-GC PRO MPU, external control is not required. Basically PROstation software package allows the user to perform uploads and downloads of configuration and method settings and to collect and display Analysis results.

NB. The 490-GC PRO is only capable of storing 1 functional method. Yet, using serial valve interface or sample line control via the extension boards, multiple streams may be analyzed using that one method.

PROstation is required to do the method development, initial calibration and setup of 490-GC PRO communication required in most automated processes.

Once the method has been developed an acceptance test can be performed. During this phase PROstation is connected while a sequence of runs is performed. The analysis results collected by PROstation should indicate whether the method settings are correct in order to generate excellent analysis results.

Once the instrument is ready to monitor the real process, PRostation should be disconnected from the instrument while the 490-GC PRO operates autonomously. If tracing of data afterwards is required setup an FTP server.

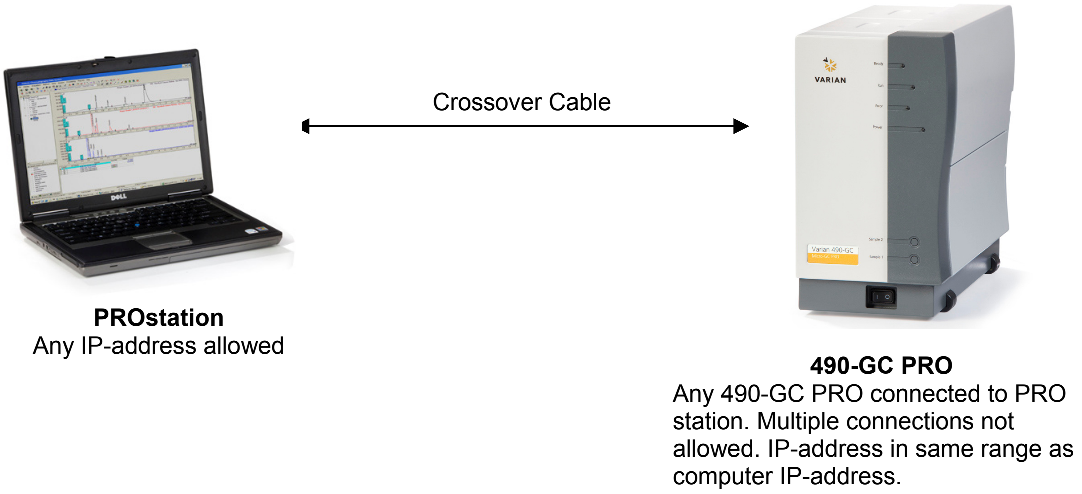
Multiple 490-GC instruments can be configured, only one single instrument can be actively monitored from PROstation at a time.
This allows flexible switching between instruments if more 490-GC analyzers are connected to the same network.

Connection with the 490-GC PRO is always via TCP/IP.

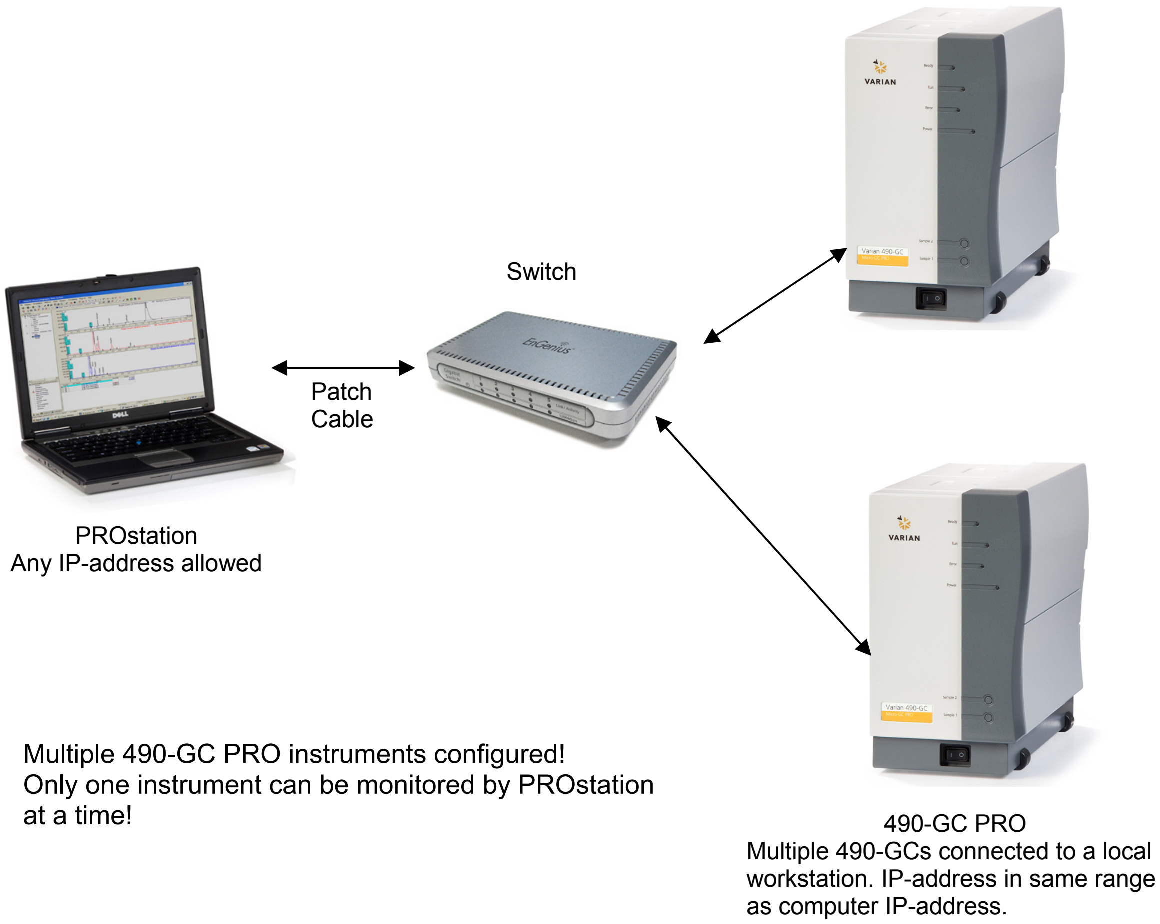
21.1 Ethernet Communication

An Ethernet crossover cable (RJ-45 connector) is included with the Ethernet option.
The crossover cable must be used to control the 490-GC PRO in a peer-to-peer communication (see Inside View on page 10).
This requires IP addresses in the same range for computer and Micro-GC. Only the most right IP segment must be different.
In case both the computer as well as the 490-GC are connected to a (local) network this cable cannot be used for control of the Micro-GC.
However this crossover cable must be used if a new IP address has to be assigned to the Micro-GC. Once the IP address is assigned you can disconnect the crossover cable and connect computer and Micro-GC both to a (local) network.

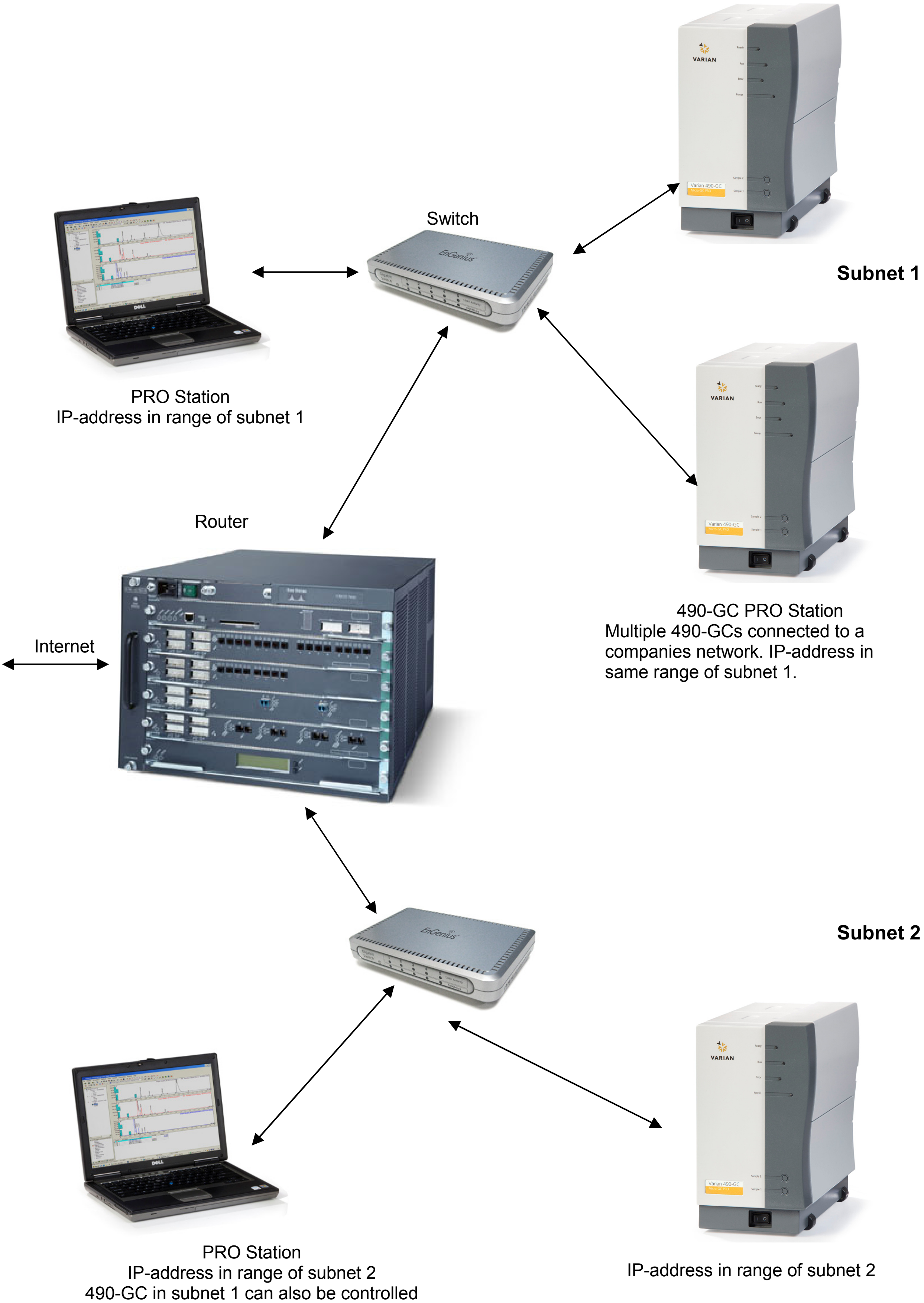
21.1.1 Peer-to-peer: single instrument



21.1.2 Multiple instrument (local network)

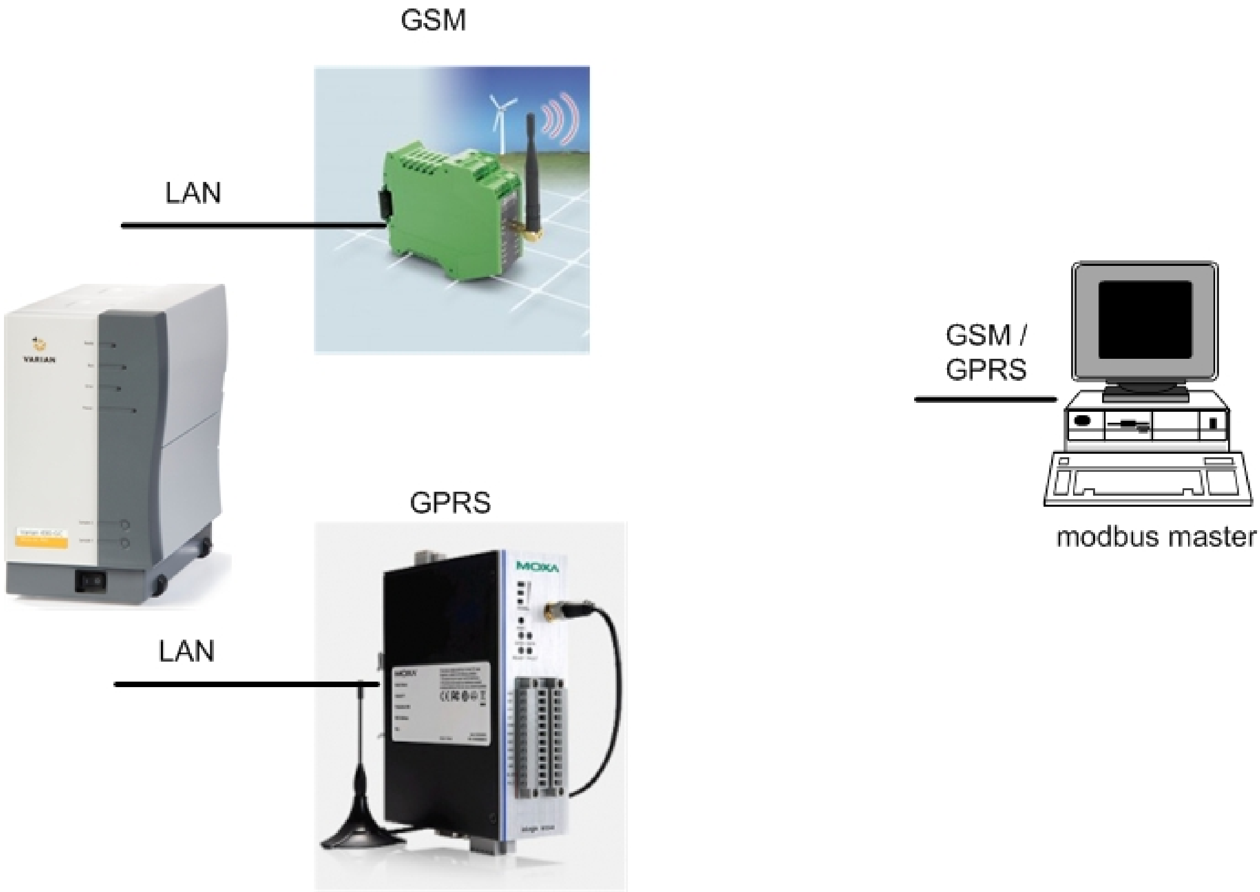


21.1.3 Global network: Multiple instruments

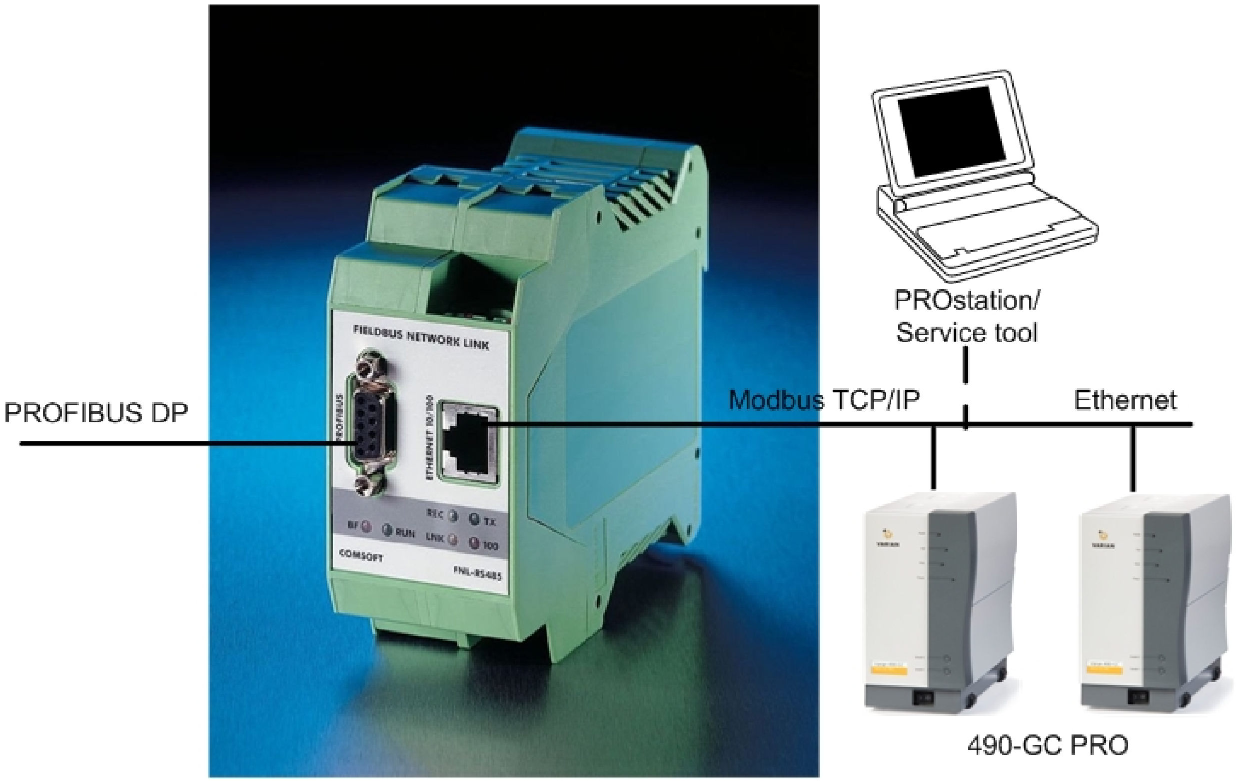


21.1.4 Wireless: Modbus TCP over WIFI

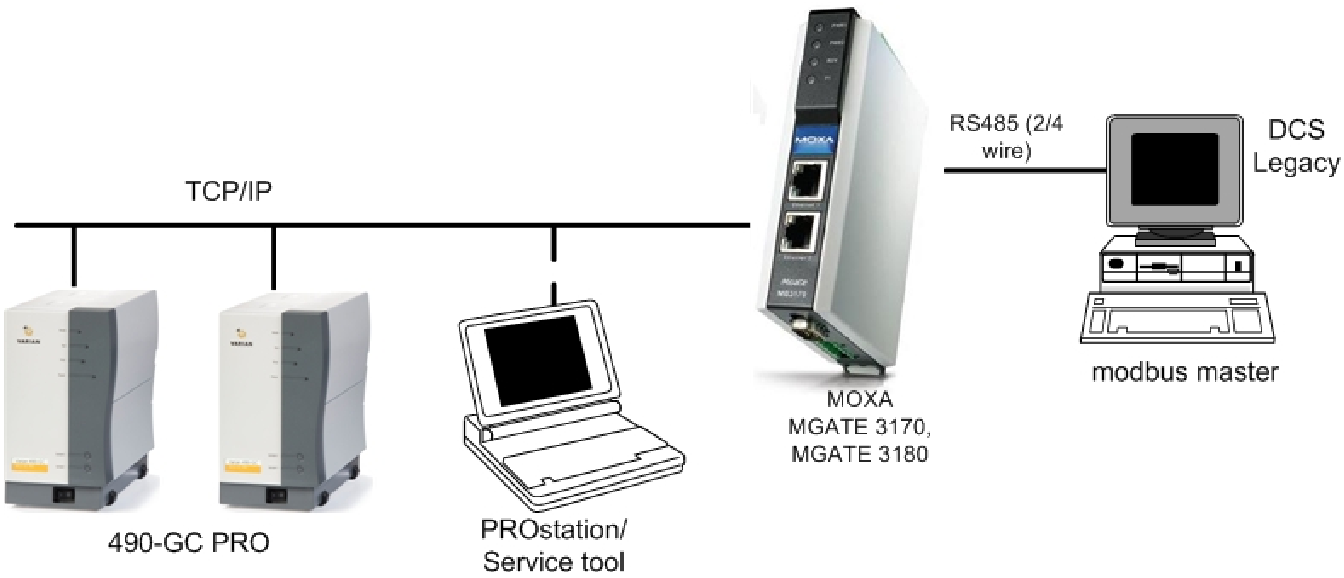
21.1.5 Wireless: Modbus TCP/IP over GSM / GPRS



21.1.6 Modbus TCP/IP to PROFIBUS conversion



21.1.7 Modbus serial to Modbus TCP/IP conversion

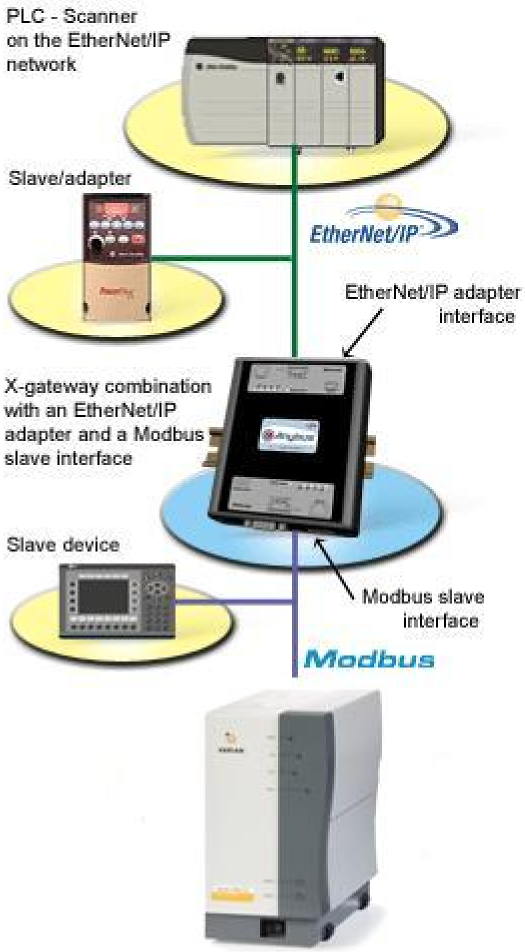


When to use Modbus serial to Modbus TCP/IP conversion

- DCS with only 2 wired RS485
- DCS with only RS485 and 490-GC PRO on other location
- DCS with only RS485 and multiple 490-GC PRO's

21.1.8 Modbus TCP to other industrial networks

Modbus TCP/IP to Ethernet/IP
with the AnyBus Gateway

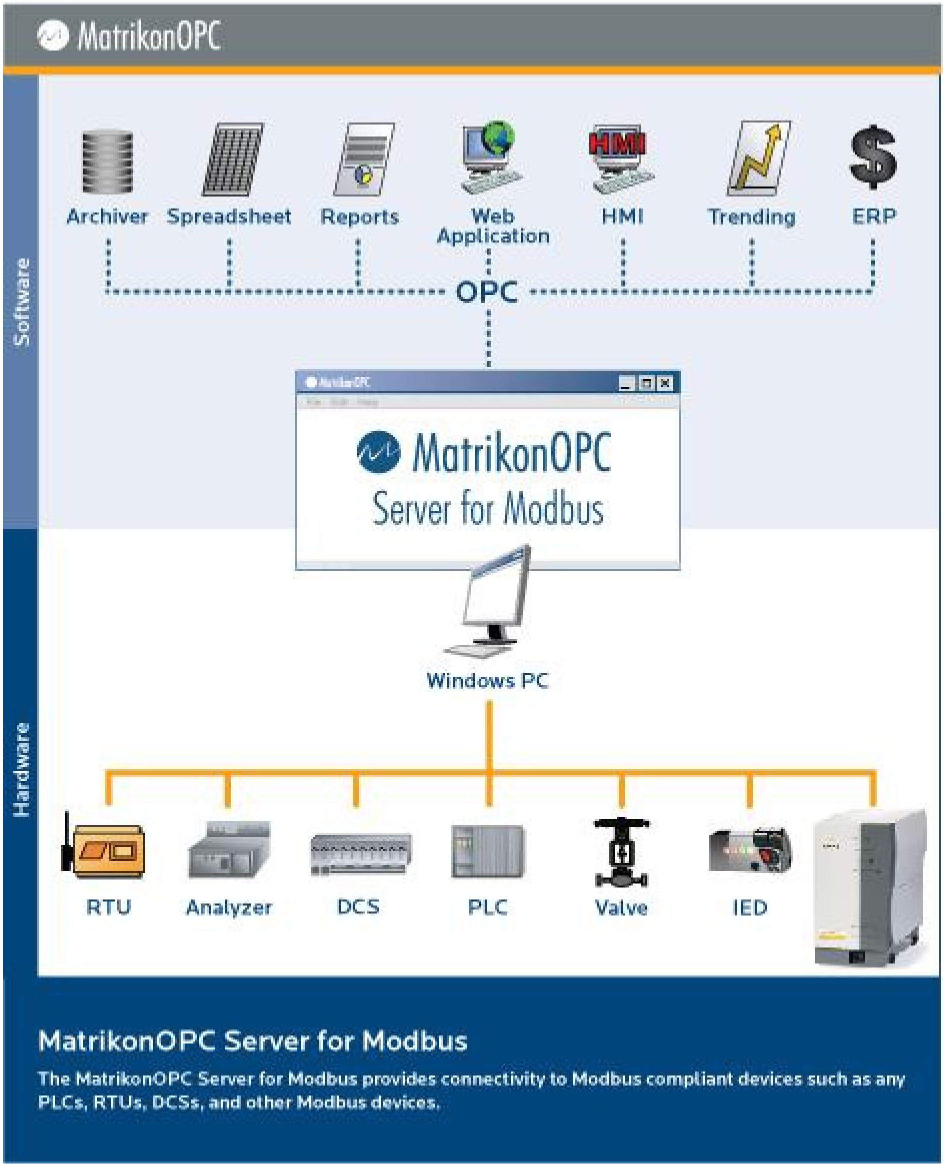


AnyBus Gateway supports:
Profibus, DeviceNet, CANopen, Modbus, Interbus, CC-Link, ControlNet, AS-Interface and the industrial Ethernet protocols Profinet, EtherNet/IP, Modbus-TCP and EtherCAT

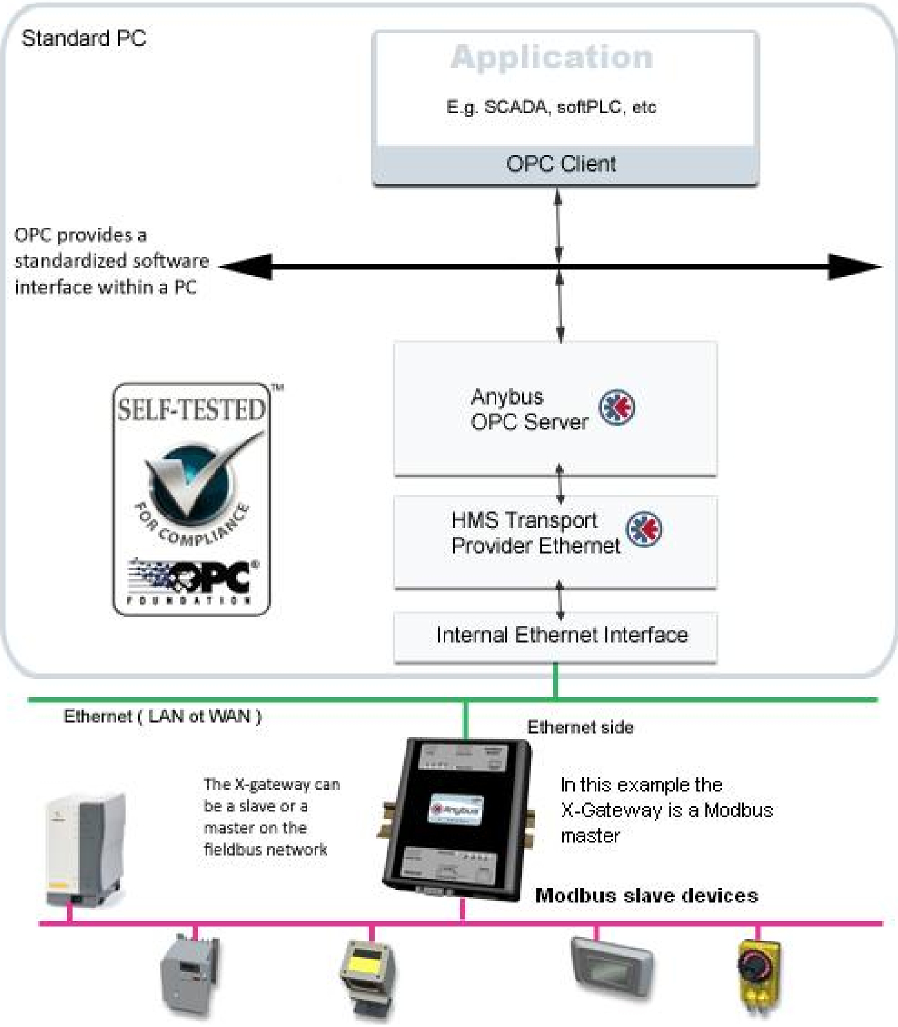
21.1.9 Modbus TCP to OPC

OLE for Process Control (OPC)
(OLE = Object Linking and Embedding developed by Microsoft)

- Requires Modbus TCP OPC server (driver)
- OPC is a standard on all SCADA applications
- Once data is in OPC format any SCADA application can read it.

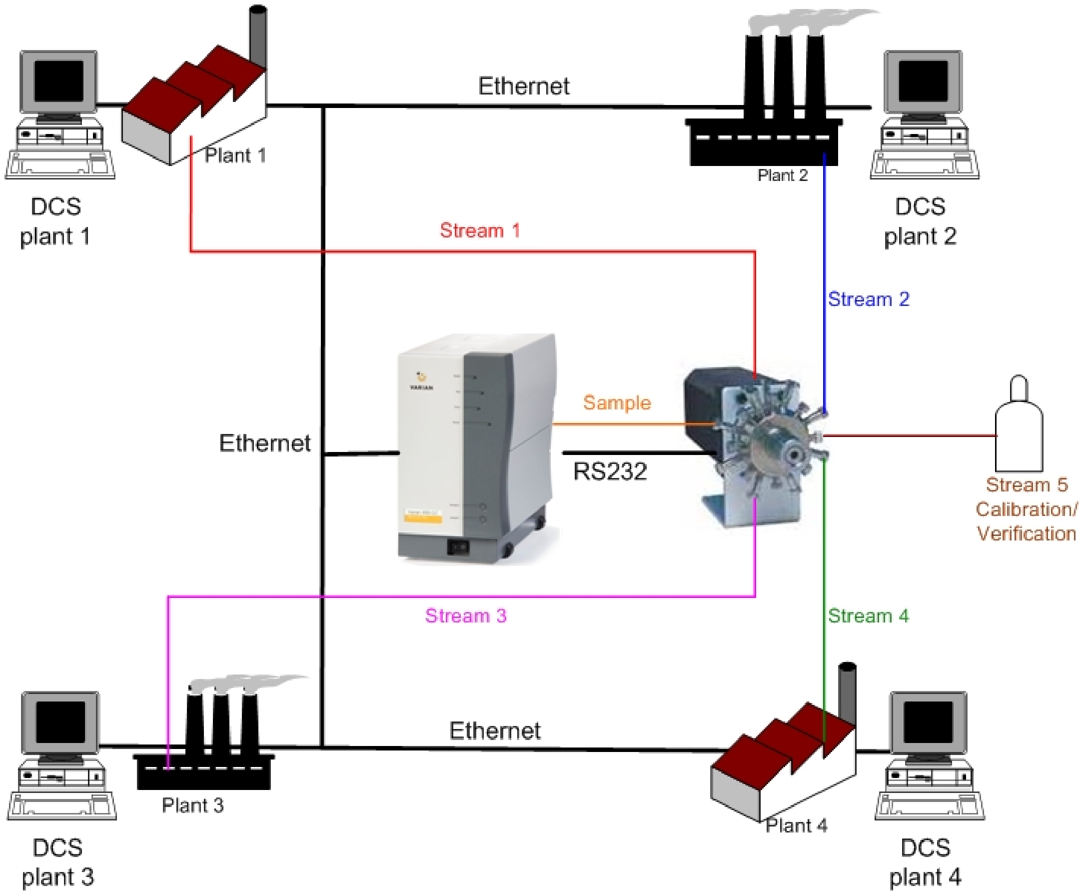


Modbus TCP to OPC by using the AnyBus X-Gateway



21.1.10 Modbus TCP and multiple Modbus masters

In the example below, every DCS reads it's a specific range of Modbus registers containing only the results of a specific sample stream.



21.1.11 Firewall configuration

The 490-GC PRO (and PROstation) communicates over a TCP-IP network. On the TCP/IP network 490-GC PRO and PROstation uses some standardized protocols and some custom protocols.
All protocols used, make use of UDP (User Datagram Protocol), TCP (Transmission Control Protocol) or ICMP **(**Internet Control Message Protocol).
Any of these protocols can be blocked by a firewall, preventing the 490-GC PRO and PROstation communicate with each other. Therefor the firewall should be configured as showed below.

490-GC PRO custom data protocols using TCP protocol

TCP-Port	User	Description	Direction
4900	InstDataExchange (PROstation)	Inst protocol Instrument status and up- download	From PC (PROstation) to 490-GC PRO
4901	InstDataExchange (PROstation)	Datastream protocol Chromatogram data	From PC (PROstation) to 490-GC PRO
4902	InstDataExchange (PROstation)	PDef protocol Stream selection	From PC (PROstation) to 490-GC PRO
4903	InstDataExchange (PROstation)	RFile protocol Alternative file and data transfer	From PC (PROstation) to 490-GC PRO

Standardized data protocols using TCP protocol

TCP-Port	User	Description	Direction
502	490-GC PRO	Modbus TCP/IP Protocol Data transfer to Modbus masters.	From Any Modbus master (PC - winDCS, scada / DCS / Flowcomputer) to 490-GC PRO
21* (By Default)	InstDataExchange (PROstation). 490-GC PRO	FTP protocol -Test for FTP communication to -FTP server (PROstation Getting chromatogram and diagnostic data (PROstation) -Storing chromatogram and analysis reports on server (490-GC PRO)	Bidirectional.
80	Internet Explorer	Onboard Web server for Instrument status	From PC to 490-GC PRO

* The FTP port used by PROstation and 490-GC PRO is definable via the FTP configuration on page 265.

Standardized data protocols using UDP protocol

UDP-Port	User	Description	Direction
39	InstDataExchange (PROstation)	RLP protocol. Detection of all 490-GC PRO instruments on the subnet	From PC (PROstation) to 490-GC PRO
67	InstDataExchange PROstation	BooptP protopcol Assinging an IP-address to a 490-GC PRO	From PC (PROstation) to 490-GC PRO

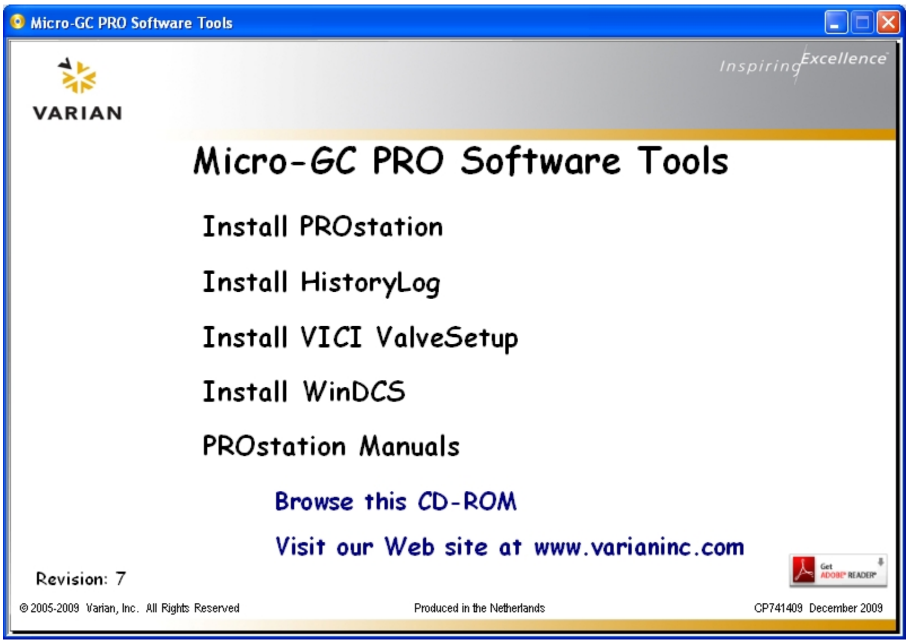
Standardized data protocols using ICMP protocol

ICMP protocol	User	Description	Direction
No port used	InstDataExchange (PROstation)	Ping protocol To check if a 490-GC PRO is reachable via the network	From PC (PROstation) to 490-GC PRO

Often it is company policy to block Ping and or at least RLP in such a way that the protocols will not leave the subnet. In that case, 490-GC PRO instruments connected on a different subnet can not be detected or checked. However, as long as all other protocols are let through, communication is still possible, when the IP address is suplied directly in the configuration manager on page 85.

22 Software Installation

This chapter describes how to install PROstation and other optional and convenient tools.
All programs can be found on the included Varian PROstation CD-Rom.
The CD-Rom is auto-starting, if the CD is not starting double-click on the file “autorun.exe” located in the CD main directory.



Depending on the chosen menu item it will install:

- PROstation on page 70: the tool for configuration, method development, collecting analysis results of the 490-GC PRO
- History Log on page 75: A tool for viewing logged data files according API chapter 21 (license required).
- VICI Valve Setup on page 74: a tool for configuring the optional available VICI Valco electric (on page 101) actuated valve.
- WinDCS on page 74: tool for testing and simulating a DCS monitoring the 490-GC PRO via Modbus serial or TCP/IP protocol.

After choosing a menu item a setup will be started to guide you through the Installation procedure.
See the next chapters for installation details.

NOTE

For some programs inside the 490-GC PRO specific licenses will be required.
The available licenses can be reviewed in the configuration screen from PROstation.

22.1 System Requirements

- Hardware

- Processor speed:	Processor with 2 GHz CPU or higher
- Internal RAM:	Recommended 1 GB RAM or more using Windows XP.
- Peripherals:	CD-Rom player
	Free Ethernet port
	Free USB slot holding the USB key license.

- Software

- Microsoft Windows:	Windows versions: Windows XP professional edition (ServicePack 2 or higher).

Other BootP services part of Galaxie must be disabled.

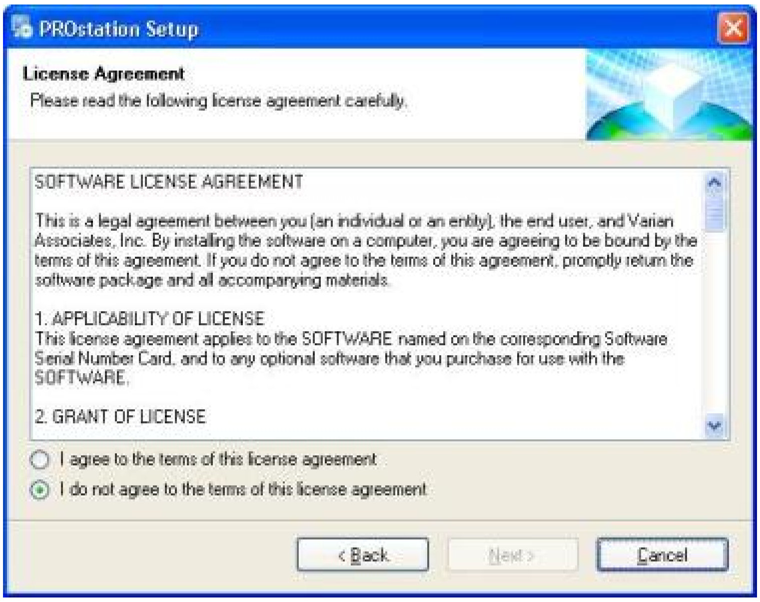
22.2 Install PROstation

Insert the CD-ROM “490-GC PRO Software Tools”, the CD will autostart.
Select “Install PROstation” to start the installation.
Users must log in as a “Windows administrator”.
Make sure no other Windows applications are running during the PROstation installation.

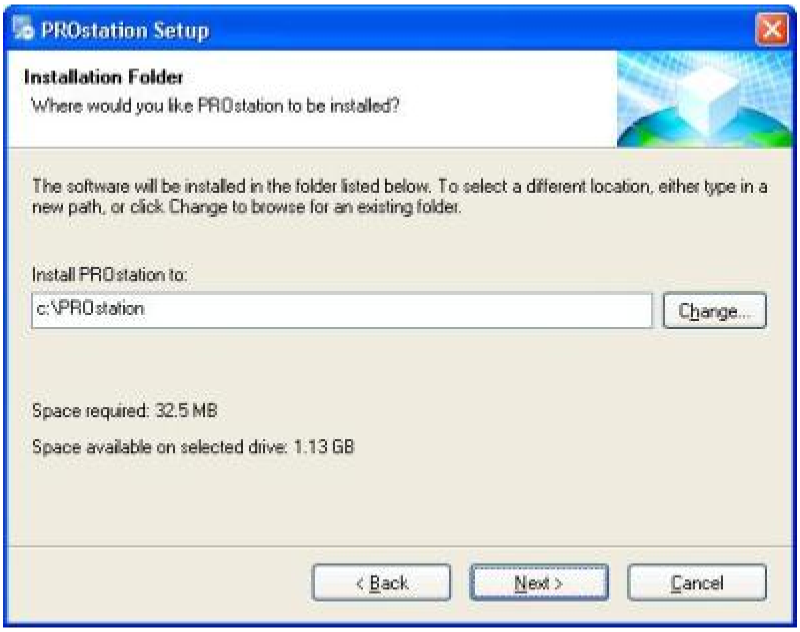
After choosing the PROstation item from the setup menu a welcome screen will be visible.
The welcome screen will show the version of PROstation and point at some important notes. Note that the version you will install from the CDROM probably will be newer than the one displayed in this picture.

- Click on “Next”, you will get to the license Agreement.

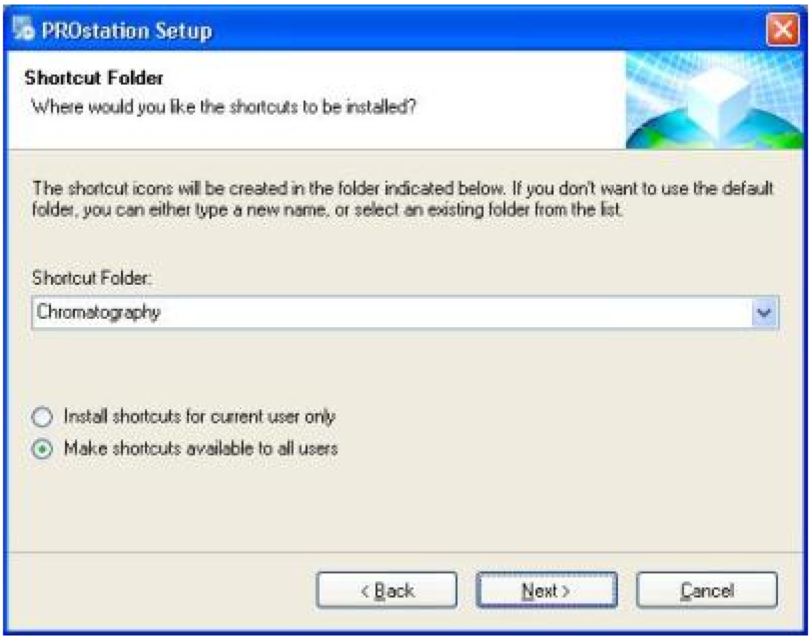
- Read the license Agreement ***carefully***.



- After reading the license agreement select button "I agree to the terms of this license agreement" and click on "Next".

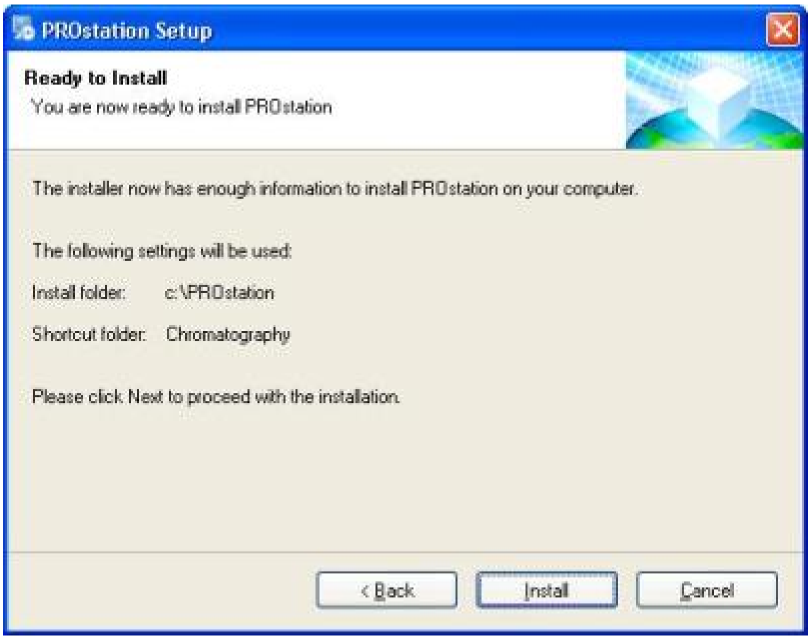


- Select the folder where PROstation should be installed. Click on “Next”.



- Fill in the name of the Shortcut folder and select whether or not shortcuts may be available to all users and click on “Next”.

Note: installing shortcuts for ‘current user only’ is not a hard protection mechanism. Selecting “Install shortcuts for current user only” means that only the current user will have a PROstation shortcut in the Windows Start menu. If some other user finds PROstation on the hard disk, he can still run it.



Setup is ready to transfer files to the computer, click on “Install”.

After the installation the computer ***<u>must be restarted</u>*** to complete the installation.

If during the installation an error message is shown concerning a Crypto-Box, files for the PROstation USB Key already exist and they are in use by a previous version of PROstation or by another application.
You can now either follow instructions to complete the setup or cancel the installation; in both cases you should close all Windows applications and restart the installer to fulfill the Crypto-Box installation successfully.

22.3 Installing ValveSetup and/or WinDCS

Insert the CD-ROM “490-GC PRO Software Tools”, the CD will autostart.
Select “Install VICI Valve Setup or “Install WinDCS” to start the installation.

Users must log in as a “Windows administrator”.
Make sure no other Windows applications are running during the VICI Valve Setup or WinDCS installation.

After choosing the VICI Valve Setup or WinDCS installation item from the setup menu a welcome screen will be visible.
The welcome screen will show the version of VICI Valve Setup or WinDCS installation and point at some important notes. Note that the version you will install from the CDROM probably will be newer than the one displayed in these pictures.
Complete the installation. Basically this comes down to pressing the ‘Next’ button a couple of times.

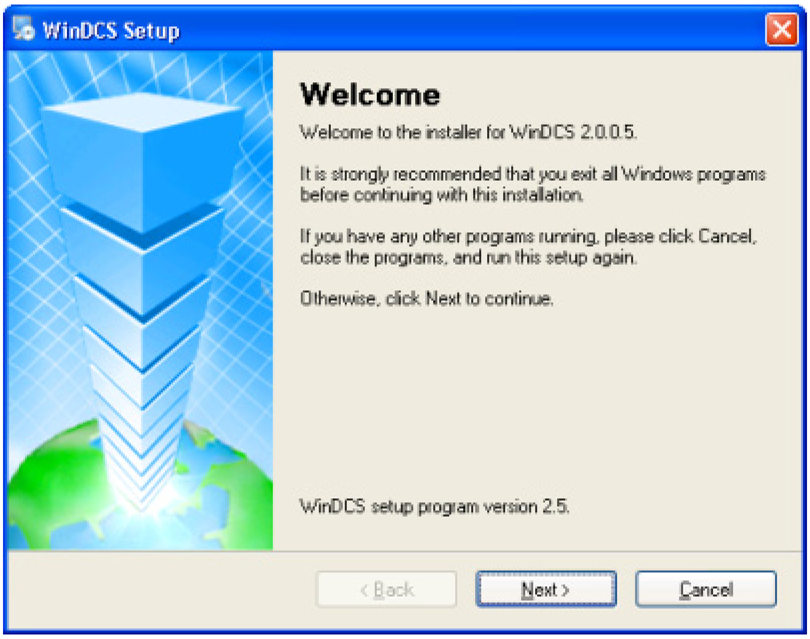


Figure 3: Install WinDCS Welcome screen

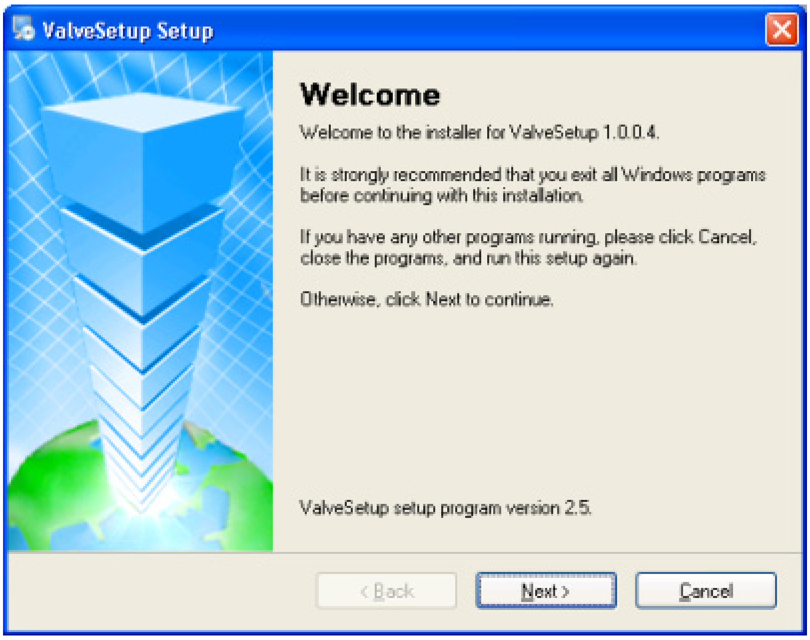


Figure 4: Install ValveSetup Welcome screen

Note: installing shortcuts for the current user only is not a hard protection mechanism. Selecting "Install shortcuts for current user only" means that only the current user will have a VICI Valve Setup or WinDCS shortcut in the Windows Start menu. If some other user finds the VICI Valve Setup or WinDCS on the hard disk, he/she can still run VICI Valve Setup or WinDCS.

22.4 History Log

22.4.1 Installation

To install the History Log run SetupHistoryLog.exe on the CD-ROM.
Complete the installation. Basically this comes down to pressing the 'Next' button a couple of times.

For detailed information about History Log, click here on page 363.

23 Instrument Configuration

The instrument requires to be configured (software settings) before first operation.

23.1 Main Menu

PROstation can be started from the Windows desktop or via the Windows menu. After a login procedure you will get in the main menu manager where you can configure 490-GC PRO instruments.

23.1.1 Login Procedure

After starting PROstation a login screen is displayed. In this screen you can type the username and password.
Depending on the username and password you will log in as one of the three default security levels. The default username and password are:

Security level	Username	Password
Administrator level	admin	demo
Service level	service	demo
Read only level	readonly	demo

By entering administrator username and password, the usernames and passwords can be changed for all levels by clicking on the change button.

If the “No Password” checkbox is checked, passwords are not required to login and will be ignored. The Security levels and the usernames, belonging to the security levels, still exist.

Depending on the security level you have different privileges.
The table below shows the differences in privileges for different security levels.

Privilege	**Administrator level**	**Service level**	**Read only level**
Reading all available status parameters	X	X	X
Open, Edit and save Method-, application-, sequence-, datafiles ,Modbus- and FTP settings,	X		
Up-/download and Edit calibration amounts	X	X	
Up-/download Method	X	X	
Up-/download Application	X		
Up-/download Sequence (Automation)	X	X	
Up-/download and Edit site information	X	X	
Up-/download Modbus settings	X		
Up-/download FTP service	X		
Up-/download chromatogram data	X		
Up-/download Real time clock	X	X	
Uploading sample results	X	X	
Uploading diagnostics	X	X	
Up-/download Usersettings from the Configuration	X	X*	X*
Starting and stopping the instrument	X		
Full control over the instrument	X		

* upload only

NOTE

This table is only valid when the 490-GC PRO's "Service Switch" on page 11 is enabled. All privileges for all security levels are set back to read-only when the "Service Switch" on the 490-GC PRO is disabled.

NOTE

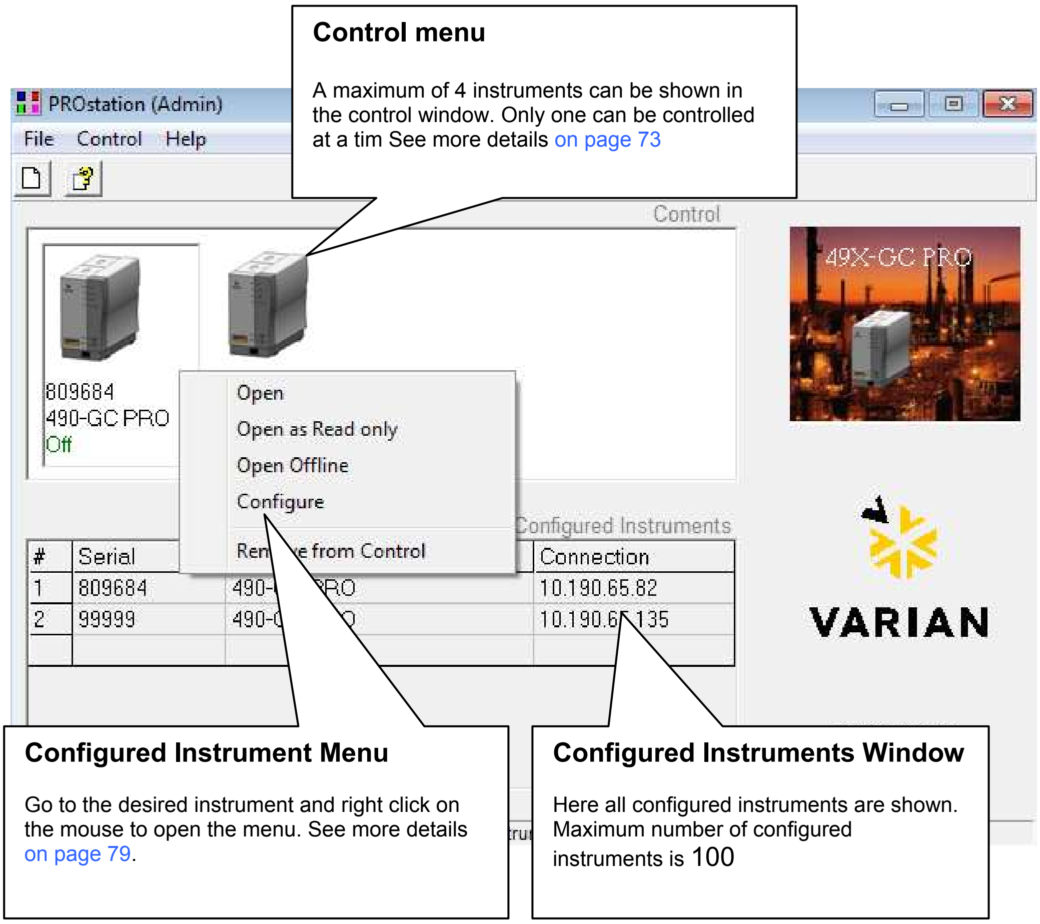
During this login procedure, the Varian USB protection dongle is checked. If no Varian security key is found, PROstation will be started in ‘demo mode’. The table below shows what the privileges are when PROstation is started in ‘demo mode’. ‘Demo mode’ actually has the same privileges as an Offline instrument, except for the limitation that only 1 instrument can be created.

Option	**Normal** **Varian security key found**	**Demo** **No Varian security key found, Offline instrument**
Create Virtual instrument	X	X
Create online instrument	X	
Number of active instruments at the same time	4	1
Number of instruments created	**100**	1
Open Method-, application-, sequence-, datafiles ,Modbus- and FTP settings	X*	X
Saving Method-, application-, sequence-, datafiles ,Modbus- and FTP settings	X*	X
Download Method-, application-, sequence-, datafiles ,Modbus- and FTP settings	X*	
Getting status information of an connected instrument	X	
Start or stop an instrument	X*	

* logged in as administrator only

23.2 Main Menu Functions

After login the main menu will be started.
The main menu exists mainly out of 2 frames.
The upper frame shows all controllable instruments.
The lower frame shows all configured instruments.



23.2.1 Configured Instrument Menu

The Configured Instrument menu can be popped up by a click with the right mouse button on one of the configured instruments.
In the Configured Instrument menu the following menu items can be selected:

23.2.1.1 Copy instrument X to control window

Copies the selected instrument to the Control window, it is then available for controlling.
An error message will be displayed when:

- Instrument already exists in the Control frame.
- Number of instruments exceeds the maximum of 4.

23.2.1.2 Configure Instrument X

Configures the selected instrument.

23.2.1.3 Create new Instrument

When a new instrument is created it will appear in the Configured Instruments frame and in the Control frame (maximum number of controllable instruments in the control window is 4).

NOTE

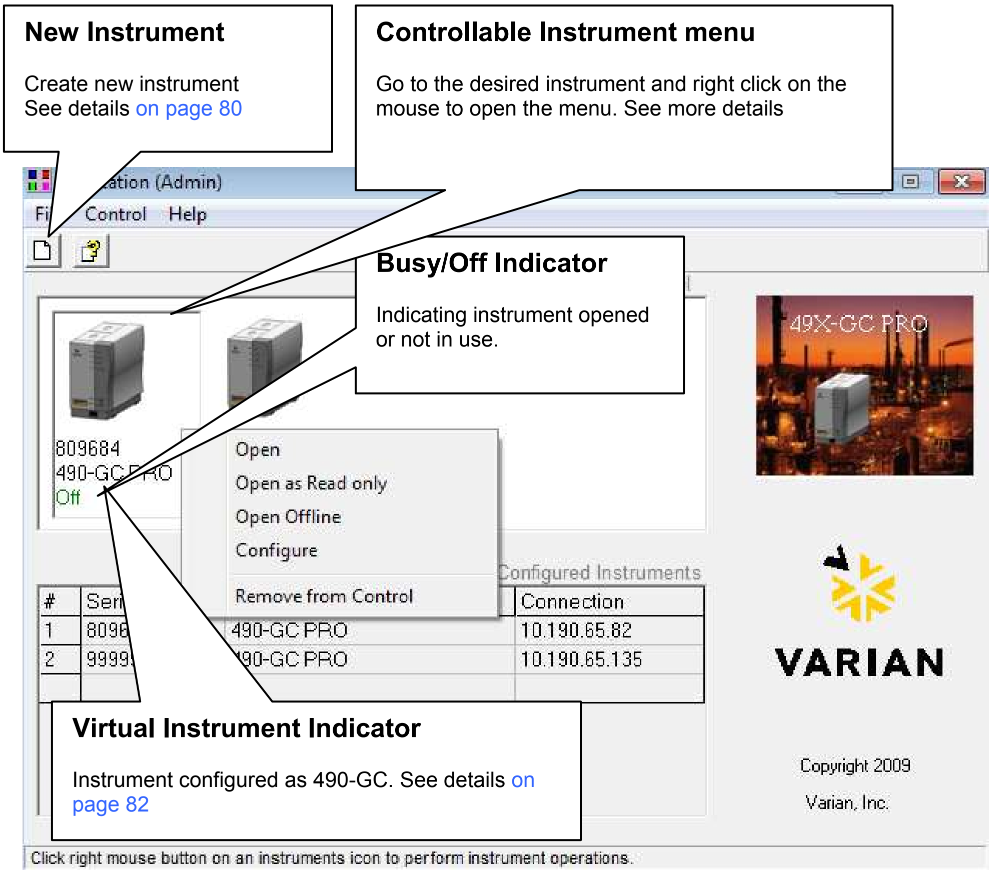
You must be logged in as Administrator or Service to create a new instrument

23.2.1.4 Delete Instrument X

Removes the selected instrument permanently from the list with configured instruments and from PROstation.

23.2.2 Control Menu

The Control window is the frame where all controllable instruments are visible.
The maximum number of controllable instruments is 4.



- **Controllable Instrument Menu**
  The control menu, for an existing and configured instrument, can be accessed in several ways: via the Control pulldown menu and via right clicking on a controllable instrument.
  In the Controllable Instrument menu the following menu items can be selected:

- **Open**
  Open the selected Instrument. The privileges depend on the Login level, see Login Procedure on page 76.

- **Open as read only**
  Open the selected Instrument as read only.
  The instrument has the same capabilities as when you are logged in as Read only user, see Login Procedure on page 76.

- **Open as Offline**
  Open the selected instrument as Offline.
  The instrument allows method editing for that particular configured instrument.

- **Configure**
  Configures the selected instrument See Config_Instr_config on page 83.

- **Remove from control**
  Removes the selected instrument from the control window. The removed Instrument will still be available in the Configured instruments window.

23.2.3 Virtual instrument

After creating a new instrument you can choose whether you want the instrument to be a real instrument or a Virtual instrument.
In PROstation Created instruments can be either new, configured or Virtual.

- "New instrument" is the state where the instrument is in directly after creation.
- "Configured instrument" is a new instrument, which had contact with a 490-GC PRO instrument and uploaded its configuration. If a configured instrument is used, the status will be either Busy or Off.
- "Virtual instrument" is used for creating a method without the need to be connected to an instrument. In the instrument configuration menu, hardware tab you can set the "Virtual instrument" mode.

Option	**New instrument** **	**Configured instrument opened normally**	**Configured instrument Opened Offline**	**Virtual instrument**
Hardware Configuration editable	X			X
Selecting to create an Virtual instrument	X***			
Configure network-settings	X	X		
Upload Configuration	X	X		
Download Usersettings		X*		
Download PROstation settings		X*		
Open/Edit Method-, application-, sequence-, datafiles ,Modbus- and FTP settings		X*	X*	X*
Saving/Edit Method-, application-, sequence-, datafiles ,Modbus- and FTP settings		X*	X*	X*
Upload a method		X		
Download Method-, application-, sequence-, datafiles ,Modbus- and FTP settings		X*		
Getting status information of a connected instrument		X		
Start or stop an instrument		X		

* Logged in as administrator only
** After configuring network settings and uploading configuration, the new instrument becomes configured.
*** When selecting this option an upload is not possible

NOTE

It is not possible to make a configured instrument Virtual, although a configured instrument can be opened as Offline.
An instrument opened as Offline will not make contact with the 490-GC PRO instrument.
An instrument Opened as Offline has a fixed hardware configuration, whereas in a virtual instrument the hardware configuration is freely editable.

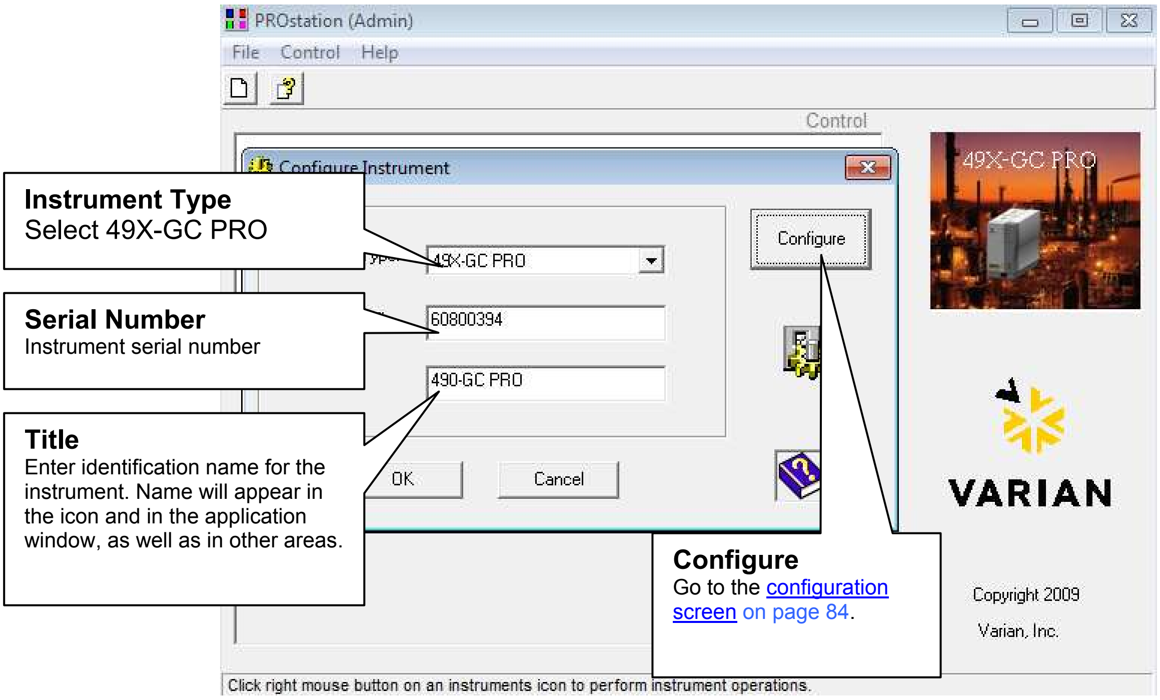
23.3 Instrument Configuration

Configuration of instruments and detectors is done from the Main Menu of PROstation. To access instrument configuration, either create a new instrument, or select an instrument by clicking it to highlight it, then select the **Control/Configure…**command. Or, click the instrument with the right-hand mouse button and select **Configure…** from the popup menu.

NOTE

You must have PROstation administrator privileges in order to configure instruments.

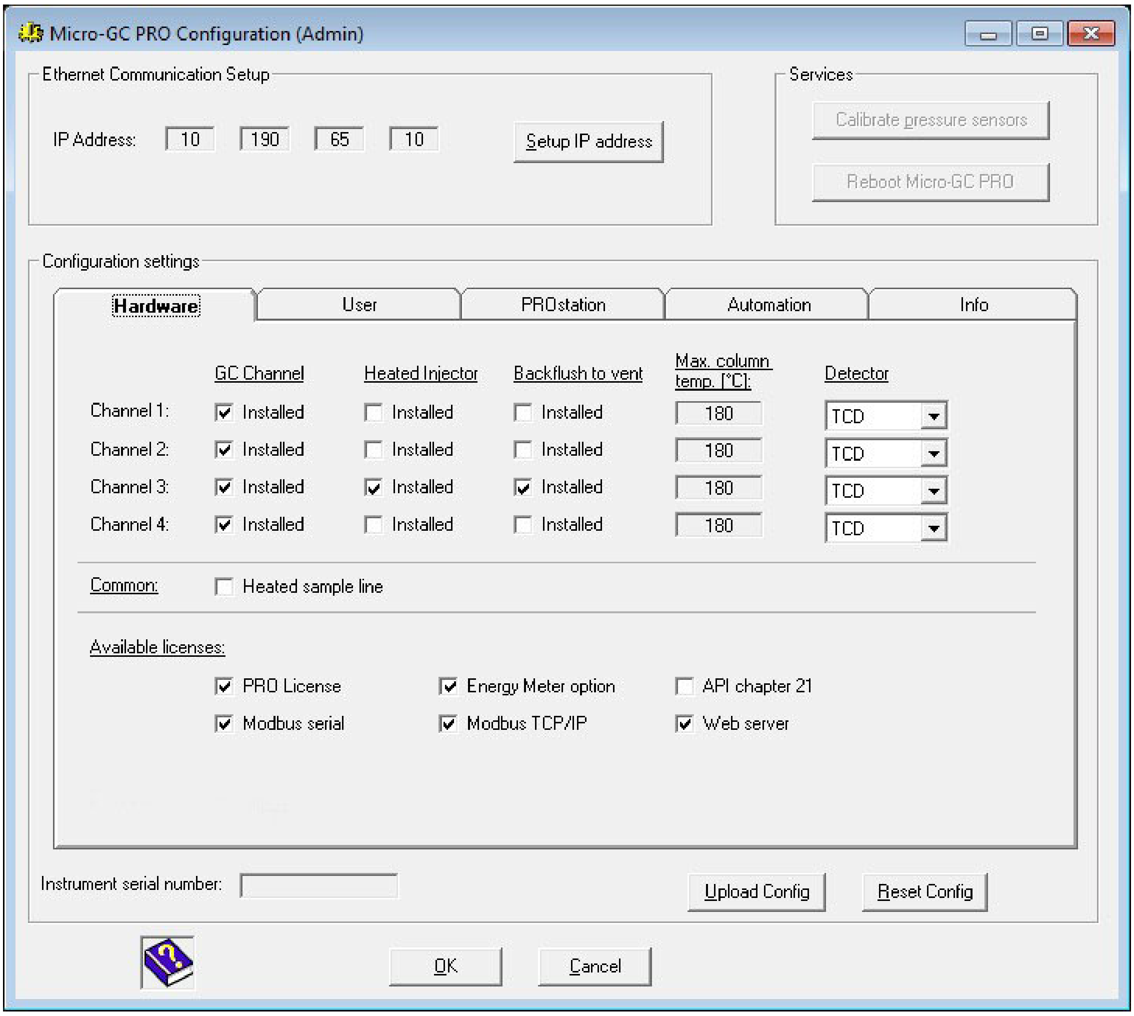
To configure a new instrument press CTRL-N or press **F**ile in the control box of the main menu and select "New Instrument" in the pull-down menu.
When you select the **Configure** command for a Varian 490-GC, a configuration dialog box will appear.



23.4 490-GC PRO Configuration

In this configuration screen the 490-GC PRO Micro-GC can be configured.
The screen is split up in three frames:

1. Communication Frame on page 85
2. Services Frame on page 102
3. Configuration Frame on page 88



1. Setup the communication first on page 85.

2. Press the “Upload” button to upload the 490-GC PRO Micro-GC hardware configuration to the computer. The uploaded configuration consists of user settings and all kind of information about software versions, etc. Once the configuration is uploaded to the computer all the settings in the “Hardware” tab will be locked.

Do not press the “Upload” button If no 490-GC PRO Micro-GC is connected. Manually select the hardware settings, which match a virtual connected 490-GC PRO. This can be useful for method development on a computer without having a 490-GC PRO connected.

3. Fill in the user settings parameters (carrier gas, number of flush cycles, etc) and download to the 490-GC PRO Micro-GC.

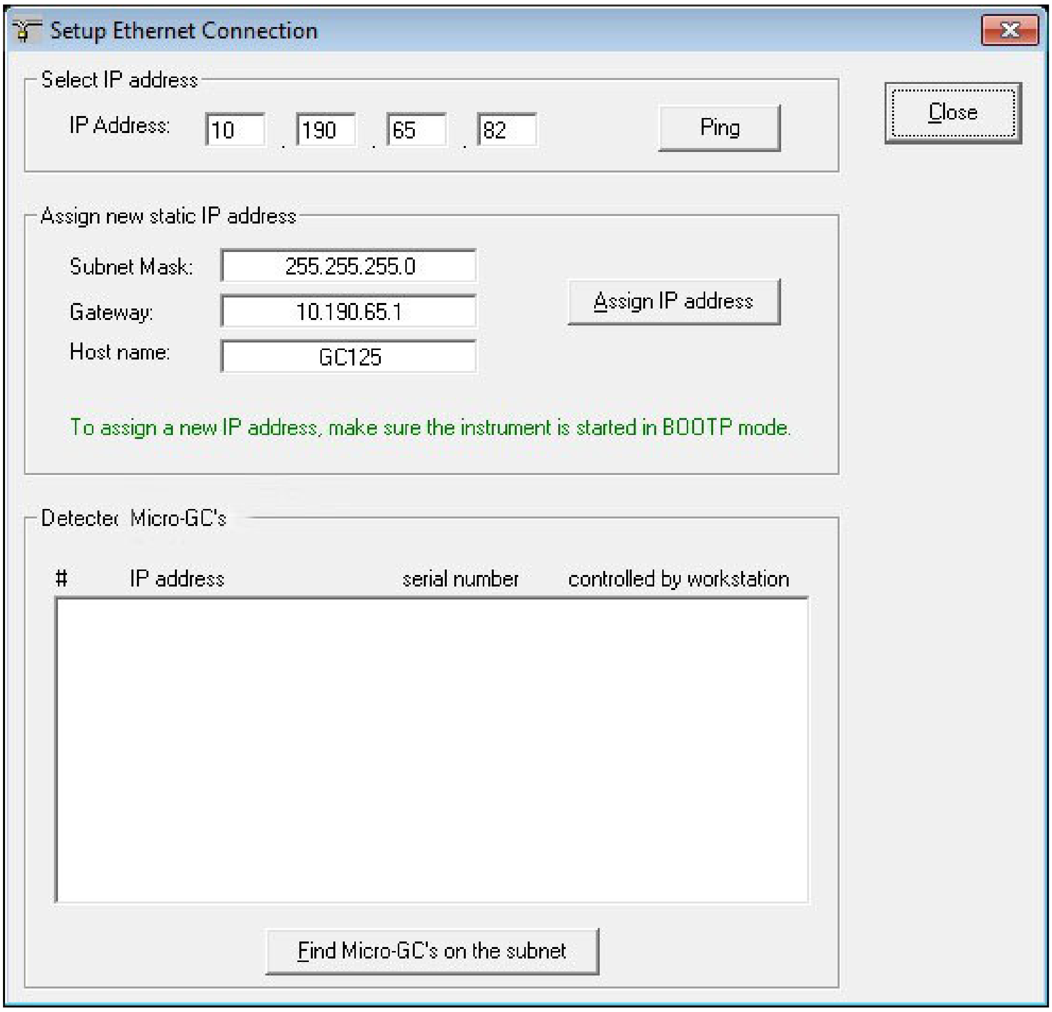
23.5 Communication Frame

23.5.1 Ethernet communication

Select the “Setup IP address” button in order to setup the IP address for the instrument. If the IP address is already known (and in the correct subnet range) only the IP address has to be typed in, see Setup Ethernet Connection below.
It’s also possible to change the IP address and to view all the 490-GC PRO Micro-GCs connected to the subnet.
Find more information in Find Instruments on the network on page 86 and Assign new IP address on page 87.

23.5.2 Ethernet connection setup

If the computer and the 490-GC PRO are both connected to the same subnet, click on the “Find 490-GC’s on the net” button. This will show all the Micro GC’s connected to the subnet, see topic Find Instruments on the net on page 86. Select the 490-GC PRO you want to control or type in the IP address manually. If the 490-GC PRO is not connected to the same subnet, only type in the IP address and exit the “Setup Ethernet Connection” window. It is assumed that the 490-GC PRO Micro-GC has the correct IP address if it is not part of this subnet, otherwise first assign a new IP address, see topic Assign new IP address on page 87.

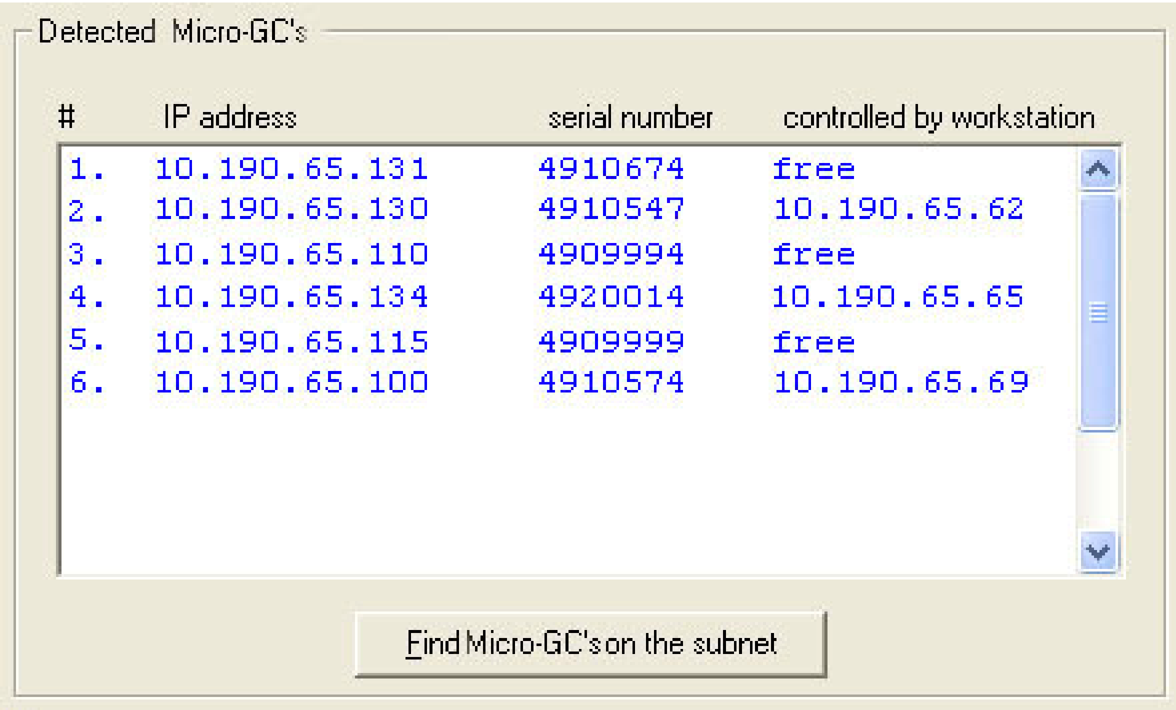


23.5.3 Find Instruments on the network

The “Find Instruments on the net” is used to view all the 490-GC PRO on the local subnet.
For each 490-GC PRO detected the IP address, instrument serial number and status is displayed.
If the instrument is already controlled from another computer, the IP address of that computer will be displayed. If not, the status “free” is displayed.

This can be helpful if the IP address of an instrument is forgotten or unknown.

Instruments connected to the network with an invalid IP address for that subnet are also detected, but without instrument serial number. This is because The “Find Instruments on the network” feature is using a connection-less protocol (UDP); however the serial number is loaded via a TCP/IP connection.



23.5.4 Assign new IP address via Ethernet Connection

If for the network the 490-GC PRO Micro-GCs IP address is unknown or invalid, a new IP address must be assigned.
To assign a new IP address the following steps are required:

1. Make sure this computer and the 490-GC PRO Micro-GC are connected to the same subnet or use the supplied Ethernet crossover-link cable to connect computer and 490-GC PRO Micro-GC (peer to peer connection).

2. Setup the IP address for the computer in case the computer wasn't connected to a network before. For a global network, the system administrator must be contacted.

3. Enter the IP address that must be assigned to the 490-GC PRO Micro-GC. This IP address must be in the range determined by the subnet mask.

4. Enter the Subnet Mask. This will be in most cases 255.255.255.0.

5. Enter the Gateway IP address if this is required. In most small local network this is not required.

6. Enter a Host name for the 490-GC PRO Micro-GC.

7. Do now reboot the 490-GC in the assign IP-address mode. Hold down the push button located just above the Ethernet RJ-45 connector in the Micro-GC on page 10 (BOOTP button) and power up the Micro-GC. Hold down this button till Ready and Power leds start blinking. This will approximately take 1 minute. The 490-GC is now in assign IP-address mode and starts broadcasting on the net "Waiting for IP address assignment". There is a BOOTP/DHCP client running in the Micro GC when it is started in service mode.

8. Now press the "Assign IP address" button.The 490-GC driver assigns the defined IP address to the first received BOOTP/DHCP request. This will maximally take 2 minutes.

9. The 490-GC PRO Micro-GC starts up with the assigned IP address.

NOTE

Never startup two 490-GC PRO Micro-GCs in the assign IP-address service mode at the same time. Otherwise an IP address could be assigned to the wrong 490-GC PRO Micro-GC.

23.6 Configuration Frame

In this frame different tabs are available:

- Hardware Tab on page 89
- User Tab on page 91
- PROstation Tab on page 91
- Automation Tab on page 94
- Info Tab on page 99

NOTE

Always click on the “Upload” button before editing the various tabs
(Except if you want to create a virtual instrument).

The instrument hardware settings, user settings, instrument serial number, available licenses and general information (like software version numbers, etc.) will be uploaded from the 490-GC PRO and displayed in the Configuration tabs, see **Figure 5.**

23.6.1 Hardware Tab

The Hardware Tab contains the hardware settings of the 490-GC PRO.
These can be uploaded from the instrument by pressing the "Upload" button.

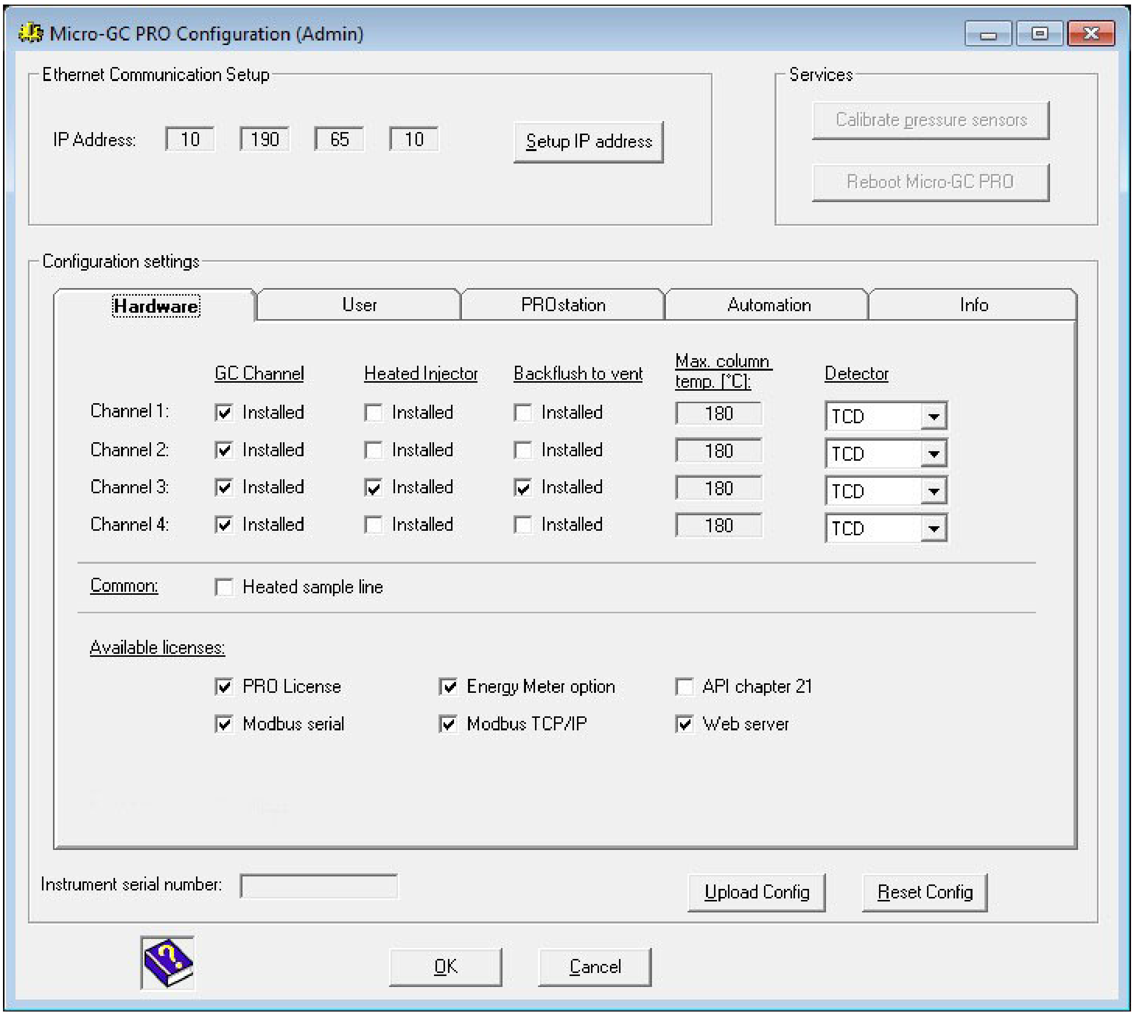


Figure 5: Hardware Tab

The configuration screen of new created instruments will have all options available.
After an upload has been performed from a connected 490-GC PRO, all settings in the configuration screen will be overwritten with the settings of the connected 490-GC PRO. All options will no longer be editable anymore.
To overcome this, a checkbox option is available to create a virtual instrument on page 82, which cannot connect to an instrument and can always be used for method creation/demo purposes.

If not checked, the virtual instrument checkbox disappears as soon as an upload has been performed.
If the configuration is not uploaded from the instrument but manually selected, control of the instrument is impossible! Manual configuration can be useful for method development on a computer without having a 490-GC PRO connected.

If in the "Detector" field "DMD" is visible, the checkbox for heated injector on Channel 2 or Channel 4 disappears.

23.6.1.1 Available Licenses and Options

After performing an upload the available licenses in de 490-GC PRO will be visible, seeFigure 5.

Available licenses:

- **490-GC PRO Licenses**
  License to identify itself as a 490-GC PRO and operate as such.

- **Energy Meter option**
  License to get enhanced calculation options.
  Energy meter option must be activated on the User Tab. (Only in combination with 490-GC PRO license.)

- **API 21 Logging**
  Storing analysis results of 35 days maximum according API chapter 21.
  API 21 must be activated on the User Tab. (Only in combination with 490-GC PRO license.)

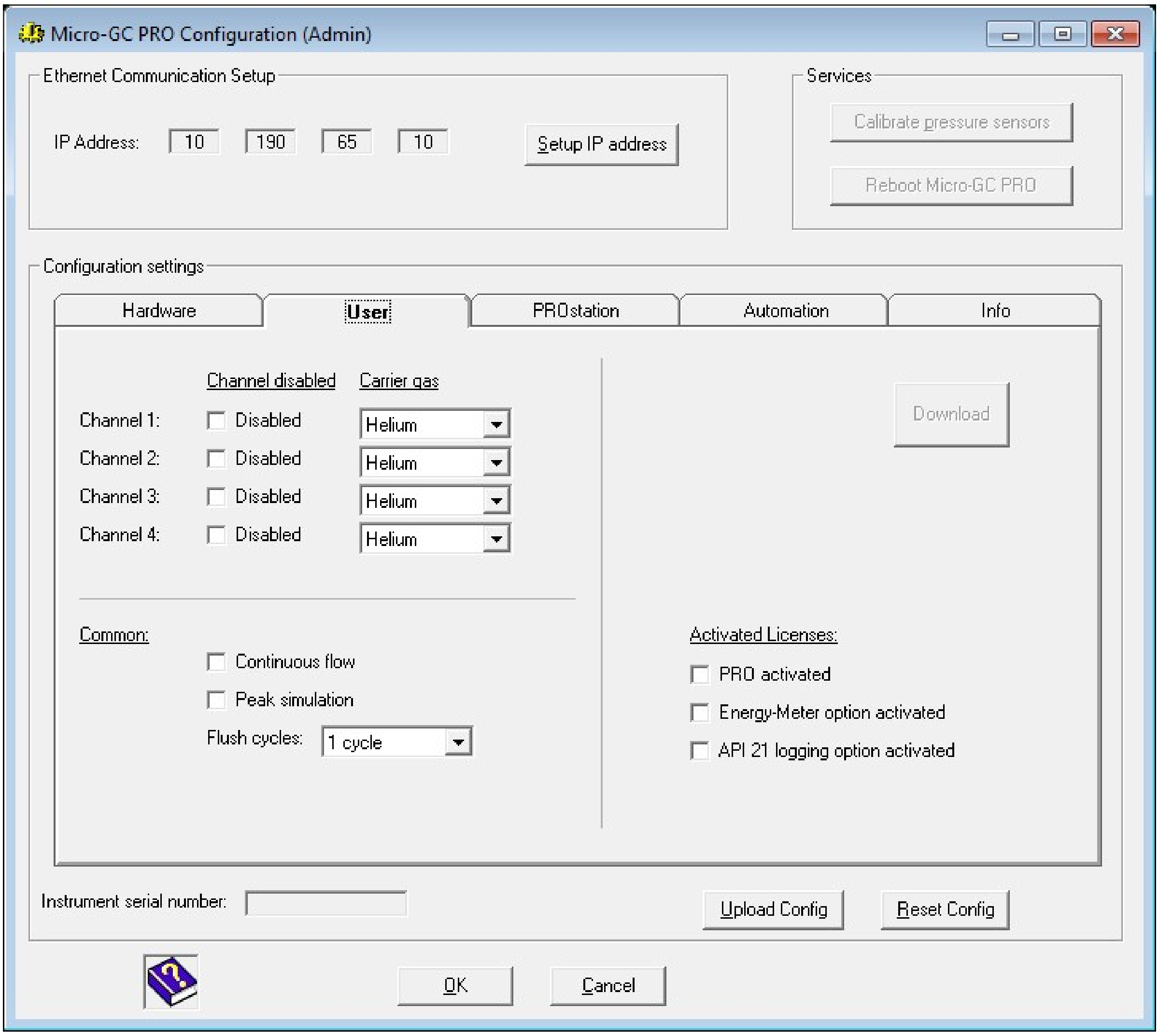
- **Modbus serial**
  Option to configure and use Serial Modbus communication. (Only in combination with 490-GC PRO license.)

- **Modbus TCP/IP**
  Option to configure and use Modbus communication via TCP/IP. (Only in combination with 490-GC PRO license.)

- **Web Server**
  Option to have access to the 490-GC PRO instrument web site, showing the instrument status and last analysis results.

23.6.2 User Settings tab

The User settings tab contains user selectable parameters.
Press the 'Download' button in order to download all changes to the 490-GC PRO.



- Carrier gas
  Select the carrier gas which is required for the application. Changing carrier gas requires a special procedure, which must be followed. The 490-GC driver will guide you through the special procedure.

- Download User Settings
  Press the "Download User settings" button in order to download the settings "Channel disabled", "Carrier gas", "Continuous flow","Peak simulation" and the "Number of flushcycles" to the 490-GC PRO Micro-GC.
  NOTE: Only the parameters from the
  "user Settings" tab are downloaded.

- Channel disabled
  Disable an installed channel. Once an installed channel is disabled, the 490-GC PRO Micro-GC will ignore this channel.

- Continuous Flow
  Select continuous flow in case this is required.

- Peak simulation
  Peak simulation can be used for demonstration and communication testing. If it is selected all the GC channels will generate a default chromatogram.

- Flush cycles
  The number of flush cycles is configurable. Select between "None", 1, 2 and 3 flush cycles. The Flush cycle is invoked at startup of the instrument or when pressure is restored after a low-pressure error.

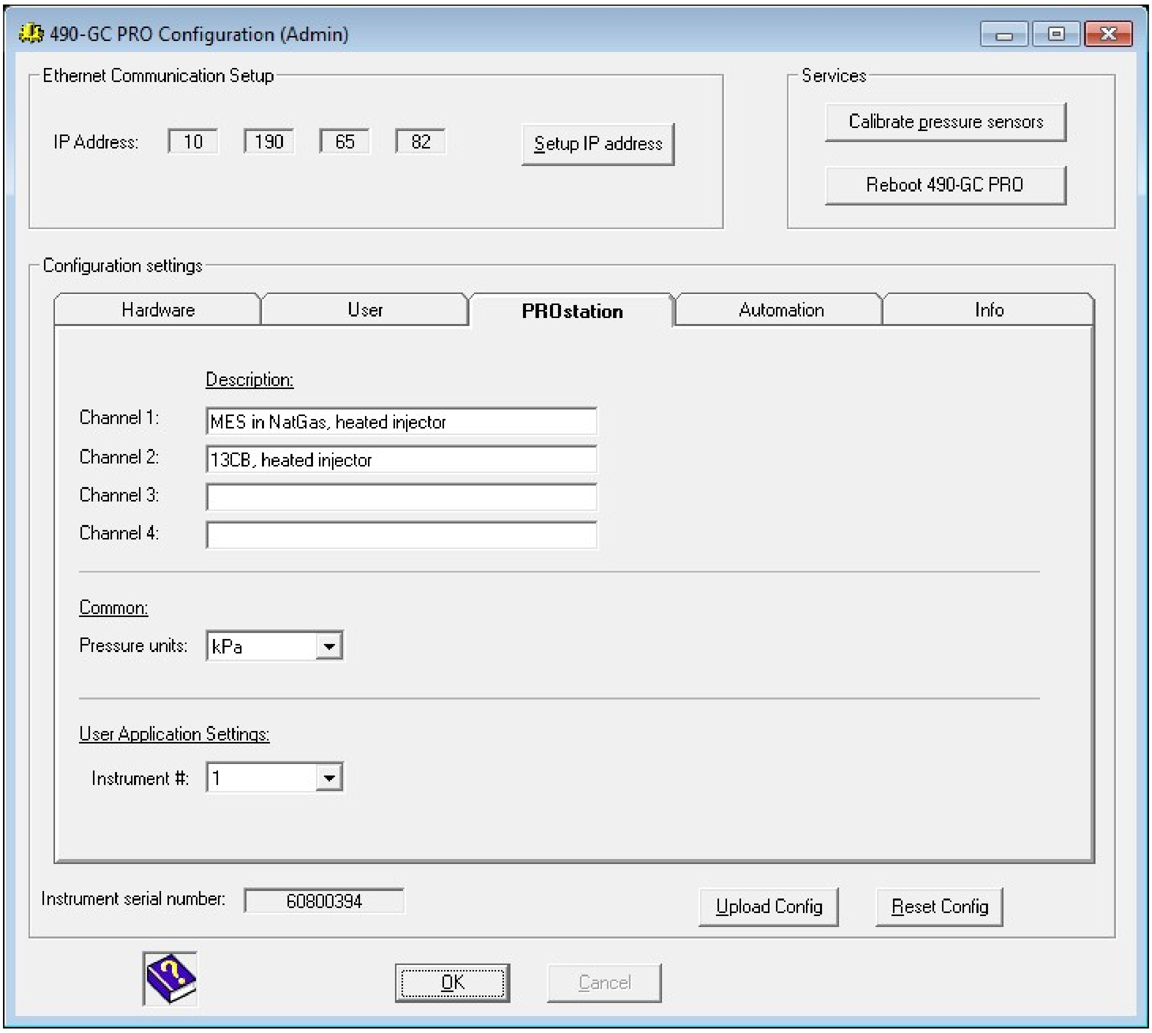
- 490-GC PRO activation
  Activate 490-GC PRO behavior*. The connected instrument must have a 490-GC PRO License before activation is possible. See available licenses on page 90.
- Energy meter activation
  Activate Energy meter behavior. The connected instrument must have a 490-GC PRO and Energy meter license before activation is possible. See available licenses on page 90.

- API 21 Logging activation
  Activate API 21logging behavior. The connected instrument must have a license before activation is possible. See available licenses on page 90.

- If not checked, the instrument will act as a standard 490-GC PRO Micro-GC and requires a Workstation connected (Galaxie).

23.6.3 PROstation tab

The PROstation settings tab contains only PROstation related settings.

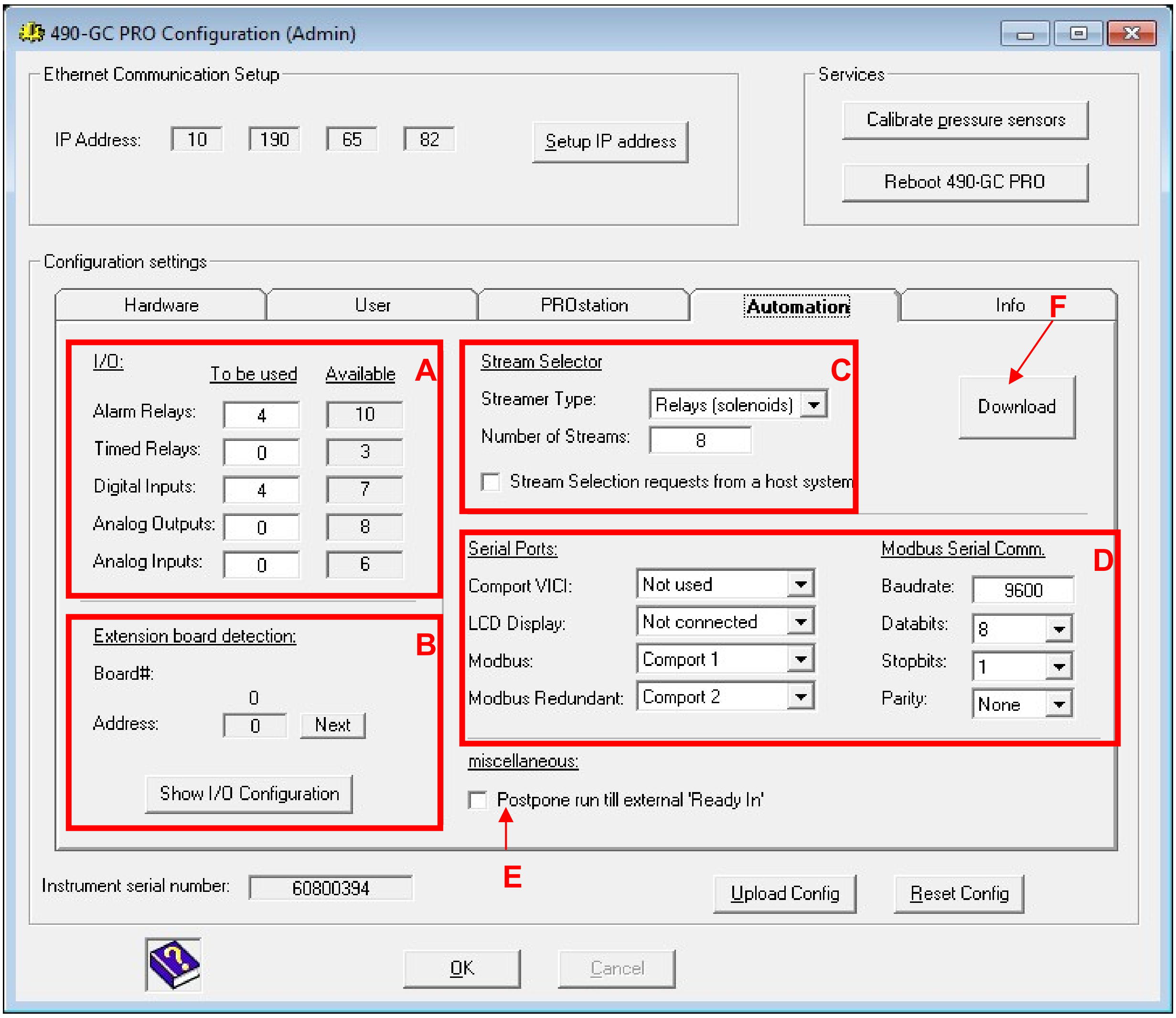


- Channel description
  The channel descriptions are uploaded from the Electronic Data Sheets (EDS) of the GC channels each time the “Upload Config“ button is pressed. This will be the description of the column installed. The descriptions will appear on top of each chromatogram window in Instrument control. The channel description can be replaced by any other text if this is desired, for instance the application name (hydro carbons, permanent gasses, etc)

- Pressure units
  Select between kPa and PSI. The column and ambient pressures status will be displayed in the selected pressure units in the Method Setup on page 113 and Instrument Control on page 273 window of instrument control.

23.6.4 Automation Tab

The Automation tab contains mainly settings for control of external devices.



A I/O settings
[Set the I/O settings](#)
The available I/O's are shown on the left-hand site (on page 95).

B Extension board detection
Gives information of which boards are connected.

C Stream Selection
The 490-GC supports a number of Auto sampling devices see Stream selection on page 97

D Serial ports settings
Setting of the serial ports on page 98 for different types of equipment.

E Postpone run
This setting on page 98 can be used to synchronize another device with the 490-GC PRO.

F Download
Download Automation tab settings to the PRO

23.6.4.1 IO settings

The IO settings show the availability and usage of the different types of IO.

- **Alarm Relays**
  Can be used for alarming, for instance when a specific component's concentration exceeds the predefined limits. Many more parameters can be checked for exceeding their limits. Enter the number of Alarm Relays to use.

- **Timed relays**
  Can be used for a time program based upon the states of the run. For example a relay can be switch X seconds after injection. Enter the number of Timed Relays to use.

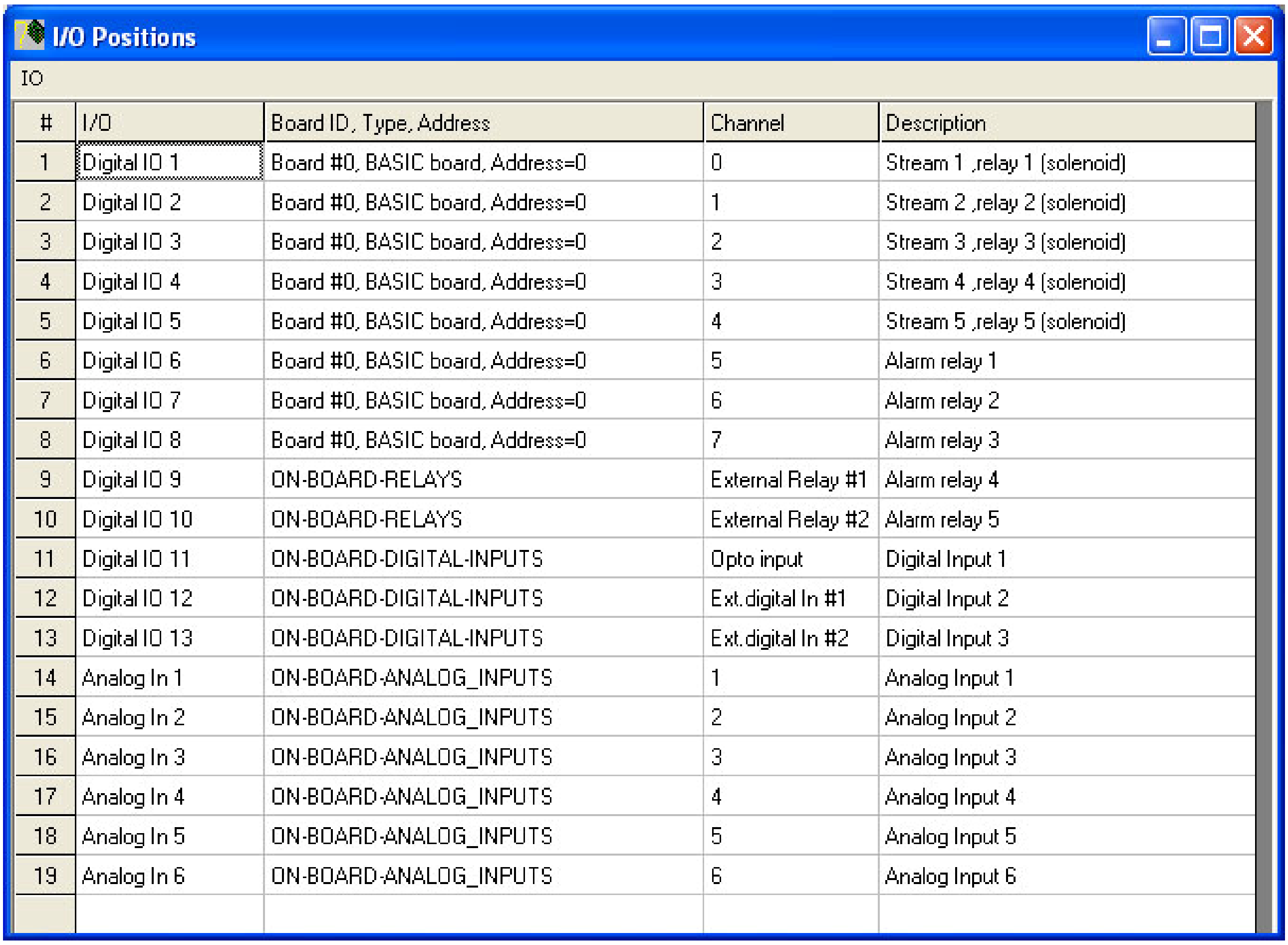
- **Digital inputs**
  Can read information from devices connected to the 490-GC PRO, for example to request a calibration run or just to pass through over Modbus. Enter the number of Digital Input to use.

- **Analog outputs**
  To convert sample results to an analog output signal (4-20 mA).
  Many parameter values can be scaled to a 4-20 mA, 0-1 V or 0-10V signal. Enter the number of Analog output channel to use.

- **Analog inputs**
  For collecting analog inputs (0 - 10V) from for instance a flow or pressure meter. The acquired voltages can be converted to pre defined units using a linear equation (y=a.x+b). The calculated units can be used in alarming, reporting or become available for a modbus master. Enter the number of Analog Input channels to use.

23.6.4.2 *Show IO locations*

IO's are available on both the 490-GC PRO and Extension boards.
The possible IO's can be divided over several Extension boards. The connections on the Basic Extension Basic board serve the IO's that are located on the 490-GC mainboard.
Pressing the button "Show IO locations" shows a table with the physical location of every I/O on the Extension boards.


I/O Positions

IO

#	I/O	Board ID, Type, Address	Channel	Description
1	Digital IO 1	Board #0, BASIC board, Address=0	0	Stream 1 ,relay 1 (solenoid)
2	Digital IO 2	Board #0, BASIC board, Address=0	1	Stream 2 ,relay 2 (solenoid)
3	Digital IO 3	Board #0, BASIC board, Address=0	2	Stream 3 ,relay 3 (solenoid)
4	Digital IO 4	Board #0, BASIC board, Address=0	3	Stream 4 ,relay 4 (solenoid)
5	Digital IO 5	Board #0, BASIC board, Address=0	4	Stream 5 ,relay 5 (solenoid)
6	Digital IO 6	Board #0, BASIC board, Address=0	5	Alarm relay 1
7	Digital IO 7	Board #0, BASIC board, Address=0	6	Alarm relay 2
8	Digital IO 8	Board #0, BASIC board, Address=0	7	Alarm relay 3
9	Digital IO 9	ON-BOARD-RELAYS	External Relay #1	Alarm relay 4
10	Digital IO 10	ON-BOARD-RELAYS	External Relay #2	Alarm relay 5
11	Digital IO 11	ON-BOARD-DIGITAL-INPUTS	Opto input	Digital Input 1
12	Digital IO 12	ON-BOARD-DIGITAL-INPUTS	Ext.digital In #1	Digital Input 2
13	Digital IO 13	ON-BOARD-DIGITAL-INPUTS	Ext.digital In #2	Digital Input 3
14	Analog In 1	ON-BOARD-ANALOG_INPUTS	1	Analog Input 1
15	Analog In 2	ON-BOARD-ANALOG_INPUTS	2	Analog Input 2
16	Analog In 3	ON-BOARD-ANALOG_INPUTS	3	Analog Input 3
17	Analog In 4	ON-BOARD-ANALOG_INPUTS	4	Analog Input 4
18	Analog In 5	ON-BOARD-ANALOG_INPUTS	5	Analog Input 5
19	Analog In 6	ON-BOARD-ANALOG_INPUTS	6	Analog Input 6

- IO type
  Gives the type and number of the specific IO's.
- BoardID, Type, Address
  Shows the location address, the type of the board and the address of the board on which a specific IO is located.
- Channel
  Channel is the location of the specific IO on the selected Extension board or 490-GC PRO mainboard.
- Description
  Describes where the specific IO is used for.

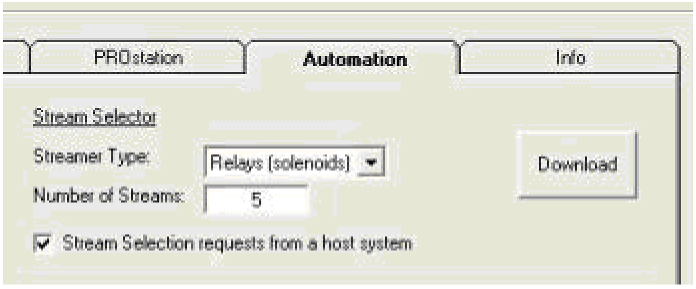
23.6.4.3 Stream selection type

The 490-GC PRO supports a number of Auto sampling devices.
Choose between the following auto sampler types:

- VICI Com-2 or Com-1 via the use of Null modem adapter or Vici Null cable (pn VLI22697NULL).
  Use a VICI electric actuated stream selection valve controlled from the seriel port (RS232) of the 490-GC PRO. This also requires selection of a serial port 'Comport VICI'
- Relays (solenoids)
  For every stream being used, one relay is required. Relays are used to control solenoid valves. When selecting a stream, the corresponding relay will close while all other relays are opened

23.6.4.4 Number of Streams

Here you can select the maximum number of streams for the configured stream selector.
In case the "Relays (solenoids)" stream selector is configured, select the number of streams you want to use. Without Extension boards, the two "on board relays" of the 490-GC PRO are available.
With Extension boards connected, 2 to 64 relays are available, depending on the number of boards connected and the number of relays used for other tasks.



- **Number of streams**
  5 relays used for Stream selection.

- **Available Relays**
  The Available relays are decreased from 18 to 13 to serve the stream selection

Note that the more relays are used for Stream selector control, the less are available for other tasks. The number of available relays for other tasks will be shown in the "available bar". If no more relays are available, the numbers will color red.

In case a VICI sampler is configured, select the number of streams required. Make sure the VICI valve has enough streams available and that it is configured correctly.

- Available Relays
  Not enough Relays are available to support the stream selection.

- Maximum Positions
  20 relays used for Stream selection, only 18 available.

23.6.4.5 Stream Selection requests from host

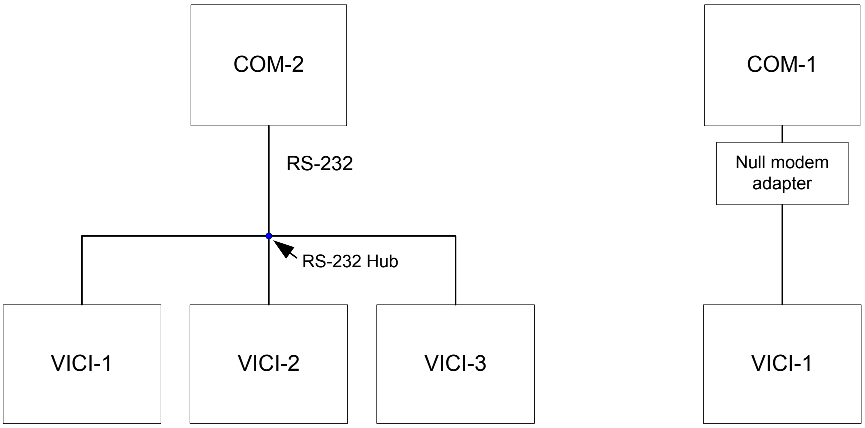
Select this when Stream selection must be done from the host system. Otherwise the sequence in the 490-GC PRO will select the valves see Stream selection on page 97

23.6.4.6 Configuration of the serial ports

The 490-GC PRO is equipped with serial ports for connecting up to 4 different types of external devices.

- VICI Valco Valves, electric actuated .
- A 490-GC PRO LCD display that displays process data like analysis results, instrument status, etc.
- Besides numerous DCS'es connected simultaneously via Modbus TCP/IP, also DCS's and a redundant DCS can be connected via Modbus over the serial ports. Since only 3 serial ports are available, not all 4 external devices can be connected at the same time.

Connection scheme of VICI valve connected to a serial port

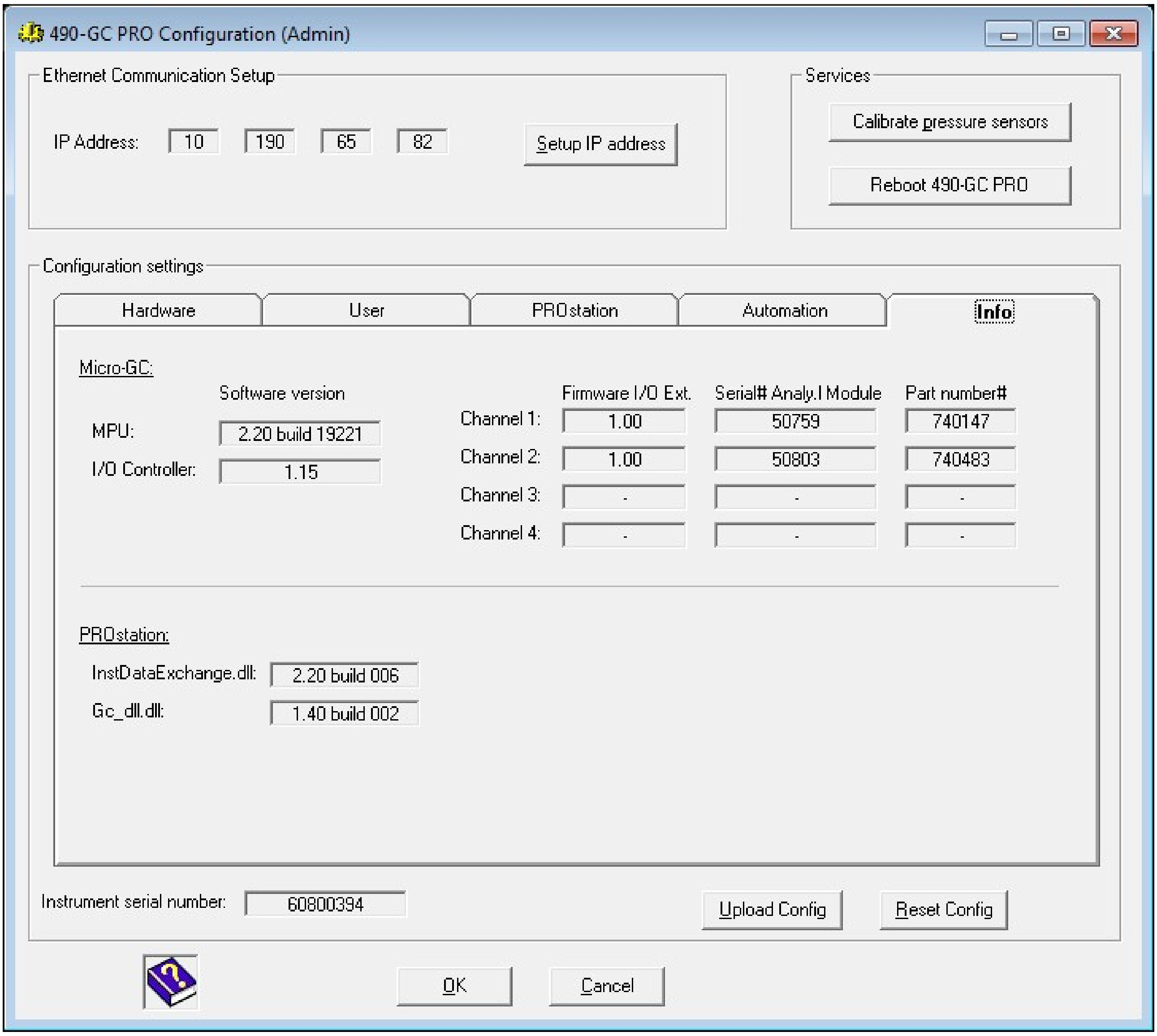


23.6.4.7 Postpone run till external ready in

This setting is used to synchronize another device with the 490-GC PRO.
If selected, the 490-GC PRO will postpone the start of its run till the 'Ready-In' signal is true. 'External Ready In' is included in determination of overall Instrument Readiness.

23.6.5 Info Tab

The Info tab contains information about software versions, serial numbers and part numbers uploaded from the 490-GC when the “Upload Config” button is pressed.



- **MPU**
  Software version of the GC application in the MPU of the 490-GC PRO.
- **Firmware I/O Ext.**
  Software version of the I/O Extenders, a micro controller in the 490-GC PRO on every GC channel.
- **Serial# Analytical Module**
  Serial numbers of the analytical module part of the GC channel.
- **Part number#**
  Part number of each GC channel.
- **GC_DLL**
  Software version of the GC_DLL.dll library used by the PROstationer. This library contains the communication and protocol layer.

- **InstDataExchange**
  Software version of the InsDataExchange.dll used by PROStation. This library creates a connection between the different parts of PROstation.

- **I/O Controller**
  Software version of the I/O Controller, a micro controller in the 490-GC PRO

23.7 VICI Valve

In order to control a VICI electric actuated multi positional valve, the valve identity for this valve must be known.
By default the VICI valve as shipped by Varian, does not have an identity. In case only one VICI valve is controlled by the 490-GC PRO, a valve identity is not required and you can skip this chapter.

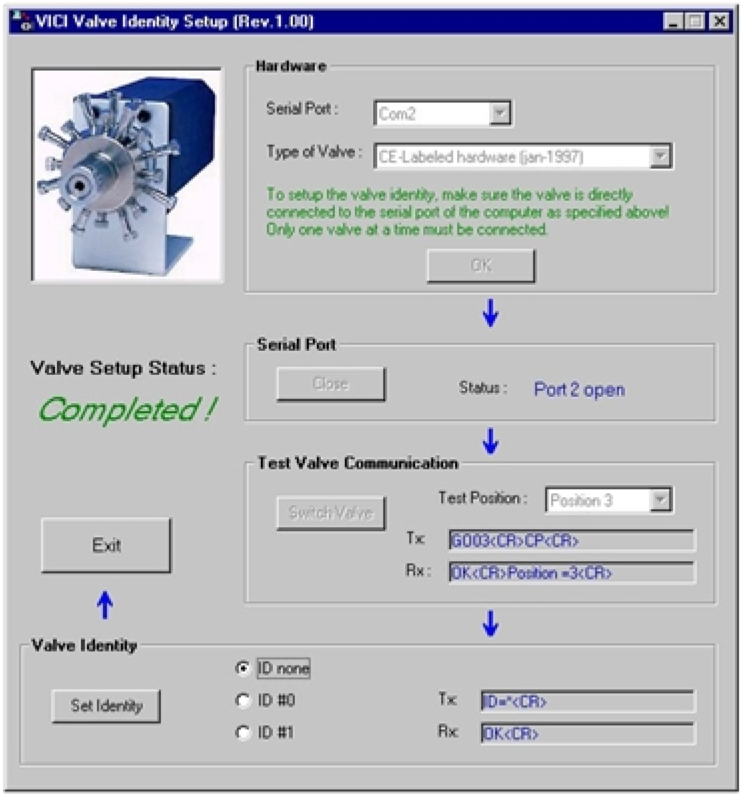
23.7.1 Setup Valve Identity

In case multiple valves should be controlled, every single valve must have its own unique identity.

To setup the identity for a single VICI valve, only connect the specified VICI valve to a free serial port of your computer (do not connect to the external serial port of the 490-GC). Run the ValveSetup.exe program (Windows Start bar – Programs – Chromatography – ValveSetup).

From the ValveSetup program the following steps must be performed:

1. Select the serial port to which the VICI valve is connected.
2. Press OK button.
3. In the “Serial port” frame, select “Open port”.
4. Select a valve position in the “Test position” box.
5. Press the “Switch Valve” button. The valve should now switch to the required position. If it doesn’t, check if the right port was selected.
6. In the “Valve Identity” frame, select the required valve identity.
7. Press “Set Identity” button. The required identity will now be set.
8. Press “Exit” to exit the program.



NOTE Use the valve setup program available on the PROstation CDROM

23.8 Services Frame

23.8.1 Calibrate Pressure Sensors

Select this service if the pressure sensors have to be calibrated.

Calibration must only be carried out if there is any reason to distrust the actual column pressure as shown in the Instrument Status window.

It's important to exactly follow the instructions given by PROstation.
Prior to the calibration, disconnect the carrier gas tubing.

1. Disconnect the carrier gas tubing.
2. Allow the 490-GC PRO to stabilize (2 minutes).
3. The TCD filaments will automatically switch off when low carrier gas pressure has been detected.
4. Press the OK button.
5. Reboot the 490-GC PRO.

23.8.2 Reboot MPU 490-GC

The “Reset 490-GC” service allows you to restart the 490-GC MPU remotely. This can be useful in case of Ethernet communication and long distance between computer and 490-GC PRO.

23.8.3 End Configuration

After all necessary information has been entered and downloaded to the 490-GC PRO instrument, the configuration must be exited and accepted by pressing the “OK” button on the 490-GC PRO configuration window and “OK” from the configuration instrument window.

Now the instrument is completely configured and the configuration information is stored.
From the PROstation main menu, one can select and open an instrument by double-left clicking on the appropriate instrument icon to continue method development.

23.9 PROstation Operation

Once programmed the 490-GC PRO gas chromatograph is capable of running samples and report results to external computers without any workstation connected. Programming the 490-GC PRO is done using the PROstation package.

PROstation is the communication interface between your PC and the 490-GC PRO.
PROstation allows up- and downloading of various method parts. Inside PROstation the methods can be edited only. PROstation is not a standard data handling system! It can not do any integration or result calculation. That is handled inside the 490-GC PRO.
PROstation is capable of collecting and showing results only.

After the instrument(s) have been configured, a method should be developed.
Method development takes a number of separate steps: The first part is the development of the chromatographic method:

- Set Clock (it is advised to use the PC clock)
- Run a (test or calibration) sample with correct analytical instrument settings
- Develop and set integration parameters
- Run the method wizard
- Complete the identification table
- Setup calibration parameters
- Run the application wizard
- Complete all application features
- Run a sample and show integration and application results
- Setup automation (sequence, FTP service, etc)
- Start full automation

Method development tables should be completed for each individual channel separately. Once this is done, the application should be set. The application contains all information regarding the way results are reported, either after normalisation or via the embedded Energy Meter application (license protected).
As a third item, the Automation should be built. Automation determines how the 490-GC PRO will operate. Automation selects the sample stream, determines if a run is a normal run, a calibration, verification or a blank run. Automation also controls the external communication via ModBus as well as file and/or result transfer to an external storage facility (FTP)

Method -, Application - and Automation information is all stored in separate files to allow the use of a specific part in another 490-GC PRO instrument that must handle a sample identically (automation) or communicates to the same external computer (Modbus).

Note that for changes to take effect, different types of downloads to the instrument are required.

Find a brief instruction on chapter Quickstart on page 285 how to complete instrument setup for operation.
All details about peak calibration can be found in chapter Calibration on page 321.
Find a number of Input Output signal cases on chapter Input Output signals on page 344.

24 PROstation Instrument Control

This chapter describes the Instrument Control program. Its function is method development and monitoring anaysis.

24.1 Log in

When PROstation is started, User Name and Password are requested.
Press the ‘Change’ button in order to setup passwords for different end users.
The default password is ‘demo’ for all users.

24.2 Users

There are three user levels for logging into the instrument.
Each level requires a unique login.
Setup a unique password for each user, see Figure 6.

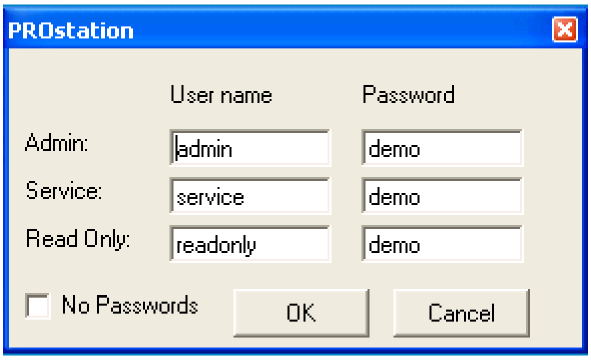


Figure 6: Three levels of login each with password

24.2.1 Method developer (admin)

Developers have full control of the instrument and are authorized to modify any parameter, unless the ‘method protection jumper’ is placed, see Method Lock on page 11.
Continue on chapter Toolbar Instrument Control on page 107.

24.2.2 Service Engineer (service)

Engineers are authorized to only change a few parameters. These include:

- Changing the concentrations of calibration mixtures (after placing a new calibration bottle).
- Changing the sequence
- Starting and Stopping sequence
- Testing Input/Output signals
- Setting date and time of internal clock.

- Changing parameters in Site Information window

Instrument control and method editing menus are limited, see Figure 7 and Figure 8

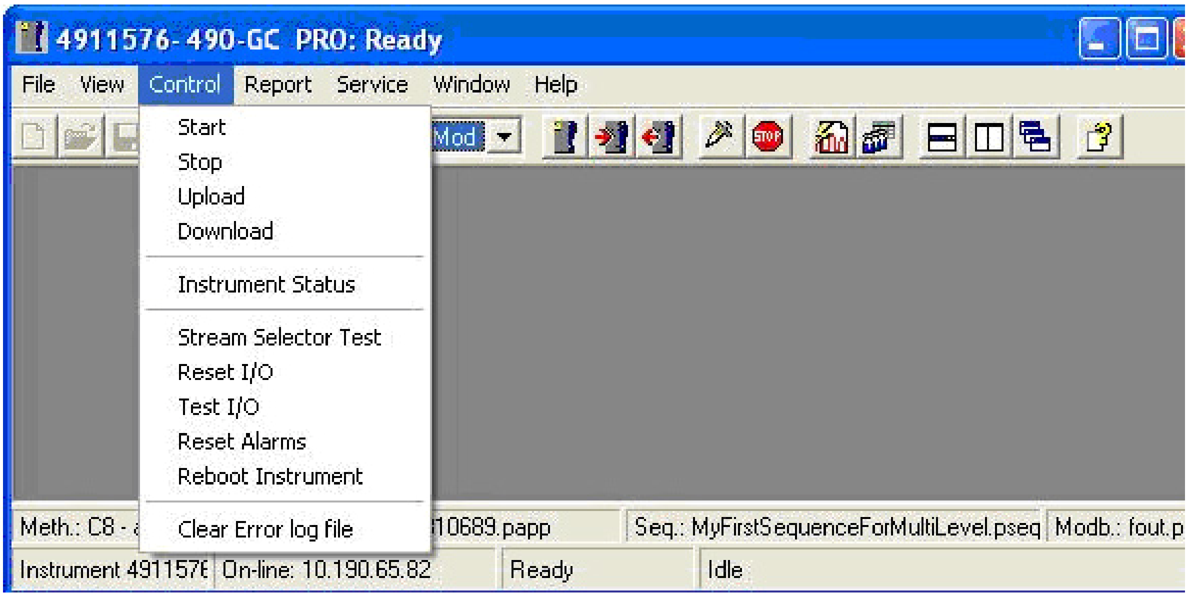


Figure 7: Instrument control menu for service engineers

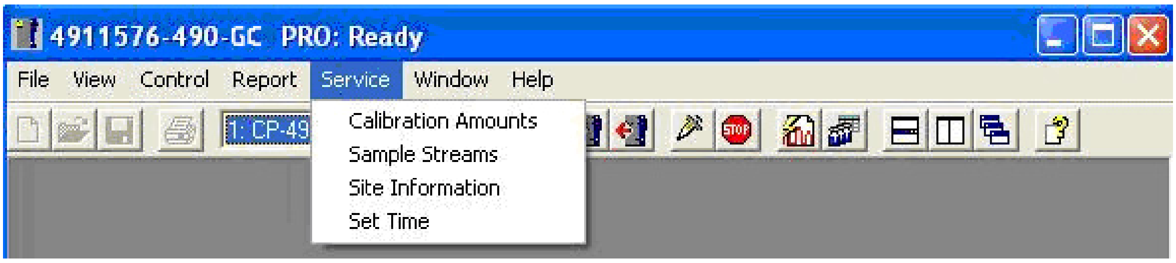


Figure 8: Service menu for changing methods for service engineers

24.2.3 Operator (readonly mode)

The authorization only includes viewing reports, chromatograms, method, instrument status, etc., see Figure 9. The Instrument Control menu only consists of uploading methods to PROstation and viewing instrument status.

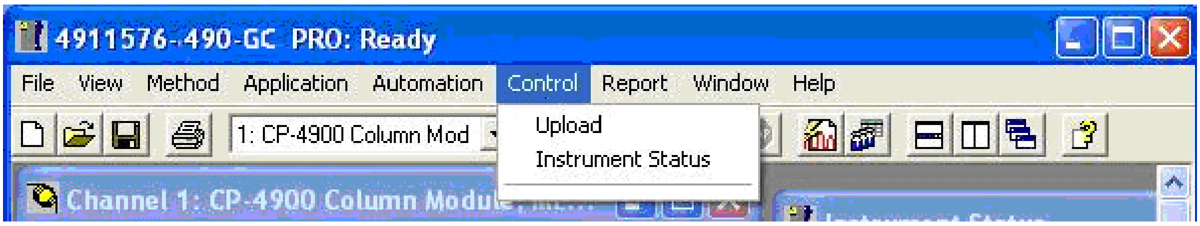
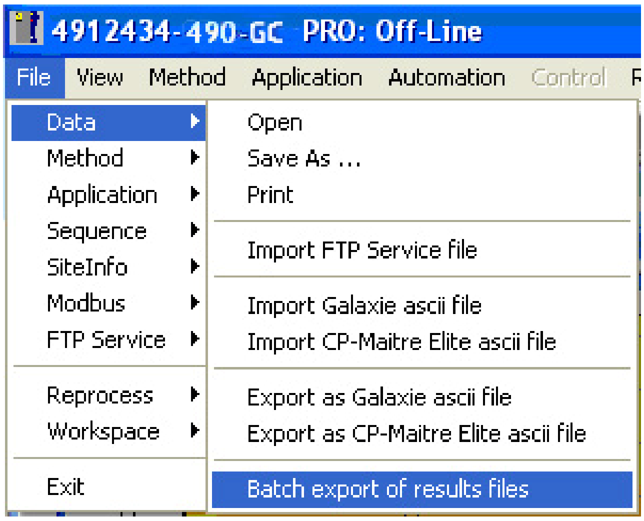


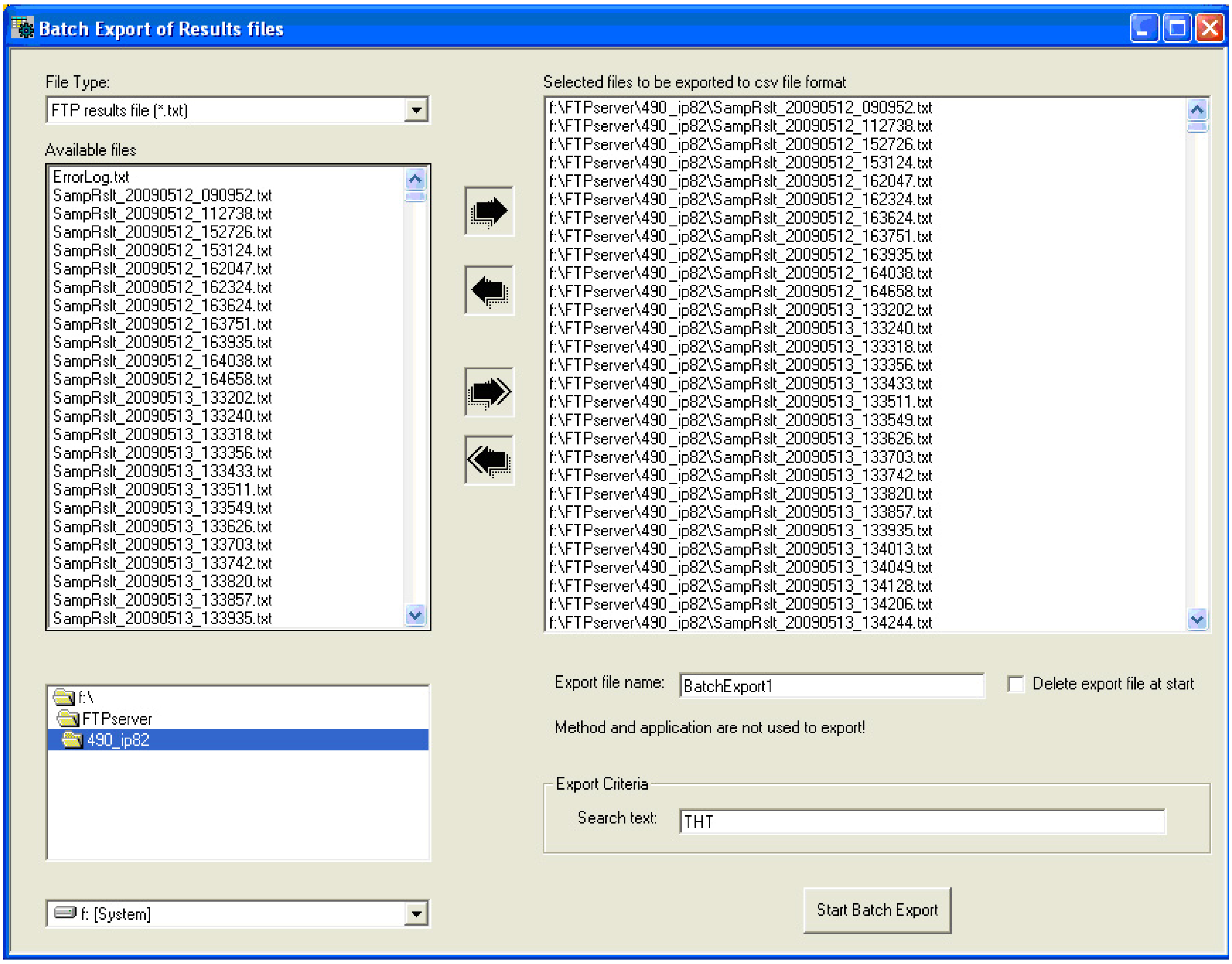
Figure 9: Control menu for operators (read only mode)

24.2.4 Off Line control

Off line control allows to setup methods without an instrument connected.

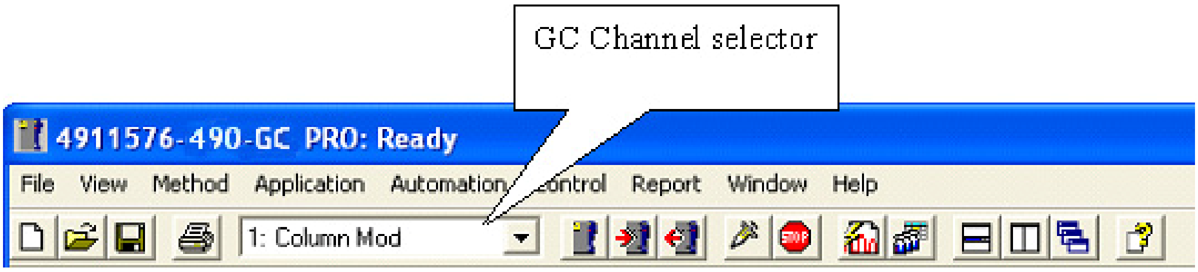
Another feature is exporting component results from a selected peak (searched by peak name) in a selected group of FTP sample results files. The exported file can be opened in Excel for further analysis.
Also sample result files (file name *.prslt) generated by PROstation can be (re-)exported to a csv (comma seperared text file). The export file is identical to the export file as defined in menu ‘Method - Advanced’.





24.3 Toolbar Instrument Control

Once logged in as an administrator (method development), the toolbar below is shown.



The PROstation menus and toolbars should be used to instruct PROstation what to do.
The more frequently used commands have images on the lower toolbar.
Use the ‘GC Channel selector’ to browse through all installed GC channels for every opened window under the Method menu.

To find out more of the menus and toolbars just click on the links below:

File: on page 108

View: on page 112

Method: on page 113
- Instrument Setup… on page 113
- Integration Events… on page 119
- Peak Identification on page 134
- Peak Quantification/Calibration on page 144
- Advanced on page 162
- Properties on page 163

Application: on page 164

Automation: on page 184
- Sequence on page 185
- Site Information on page 193
- Modbus on page 194
- FTP service on page 265
- Set Instrument clock on page 266
- Reprocess Analysis on page 267

Control on page 268

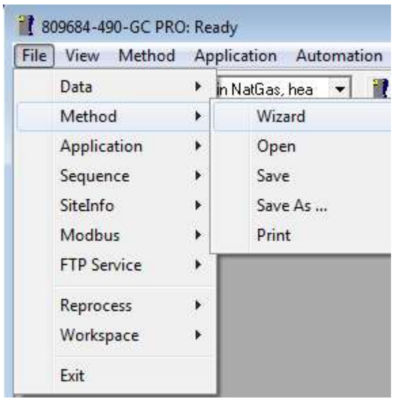
- Start on page 269
- Stop on page 271
- Upload on page 272
- Download on page 272
- Instrument status on page 273
- Stream Selector Test on page 274
- Reset I/O on page 274
- Test I/O on page 275
- Reset Alarms on page 276
- Reboot Instrument on page 275
- Clear Error log file on page 276

Report on page 277

- Integration Report on page 278
- Application Report on page 280
- Stream Application Report on page 282
- Diagnostics on page 283
- Print Integration Report on page 284
- Print Application Report en page 284
- Auto Print Application Report on Calibration on page 284
- Auto Print Application Report on Alarm on page 284

24.4 File

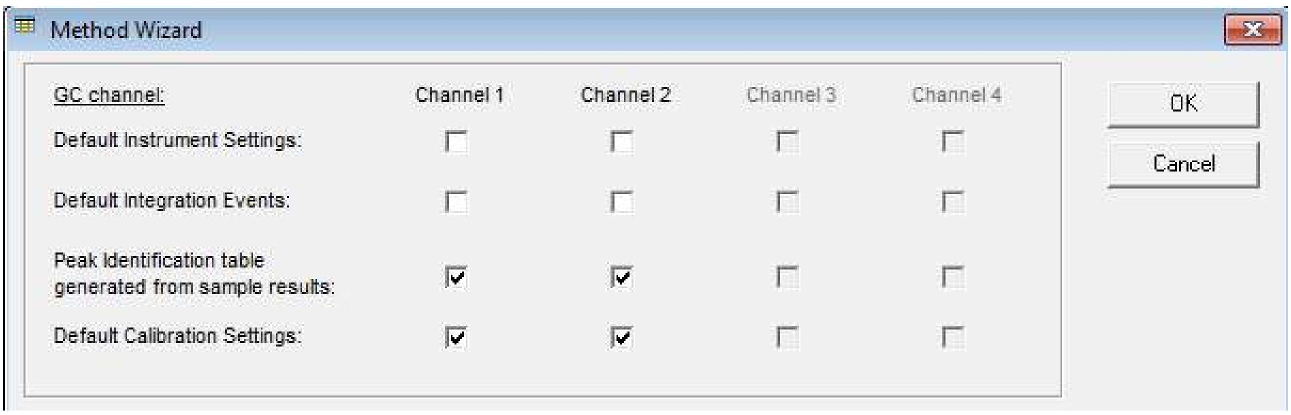
From the PROstation toolbar, select File:



From here a new menu item can be selected or the open, save or save as function can be activated. Also a wizard function for some of the individual menu items can be selected. How and when the wizard should be used, will be discussed in separate sections.

24.4.1 Method Wizard

The method wizard can be used to easily generate a Method containing Peak identification/Calibration settings extracted from an analysis run. Find an example of when to use this wizard in chapter Quickstart on page 302.

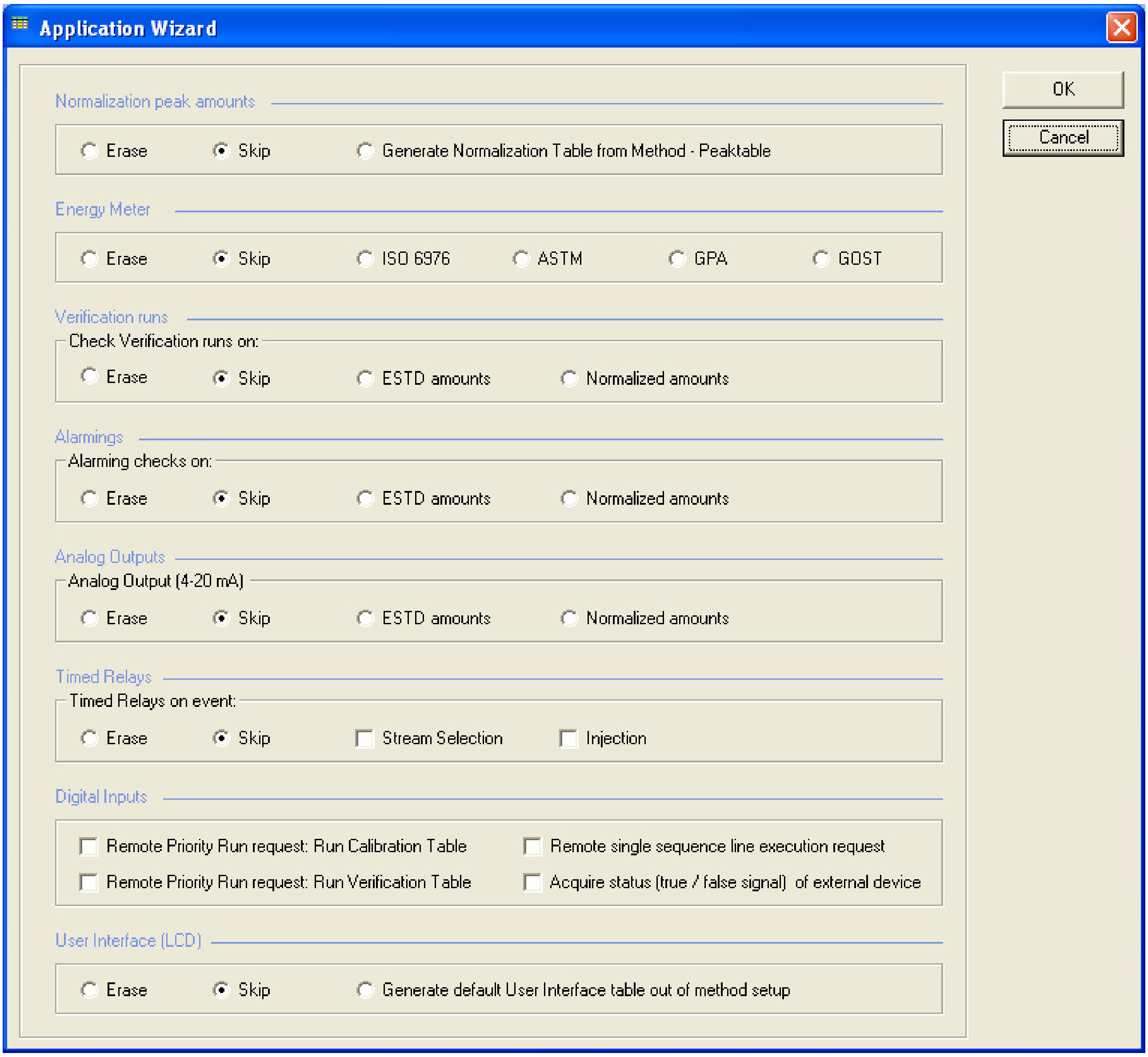


To activate the method wizard, from the PROstation toolbar select file\method\wizard:

The method wizard fills the different method tables with necessary default data.
Check the appropriate boxes for the tables you want the wizard to fill. Note that filling the peak Identification/Calibration table is only valuable after the integration parameters have been optimized.
This implies that you can use the wizard multiple times for different tables.

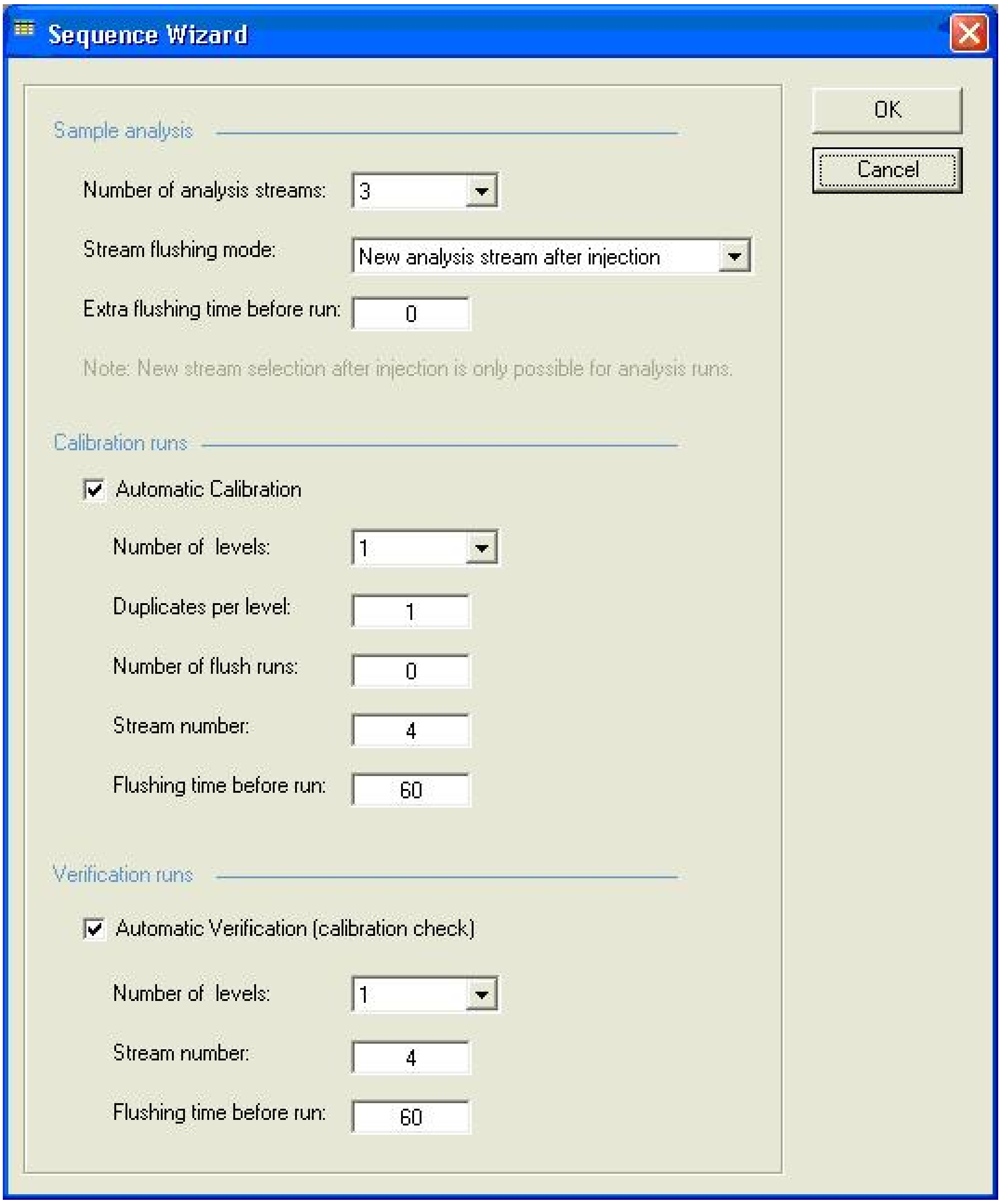
24.4.2 Application Wizard

Select the application wizard in order to quickly setup an application from a fine tuned method.
To activate the application wizard, from the PROstation toolbar select file\application\wizard.
The Normalization table will be filled from the Method – Peak Identification/Calibration table if this option is selected.
Find an example of when to use this wizard on chapter Quickstart on page 310.



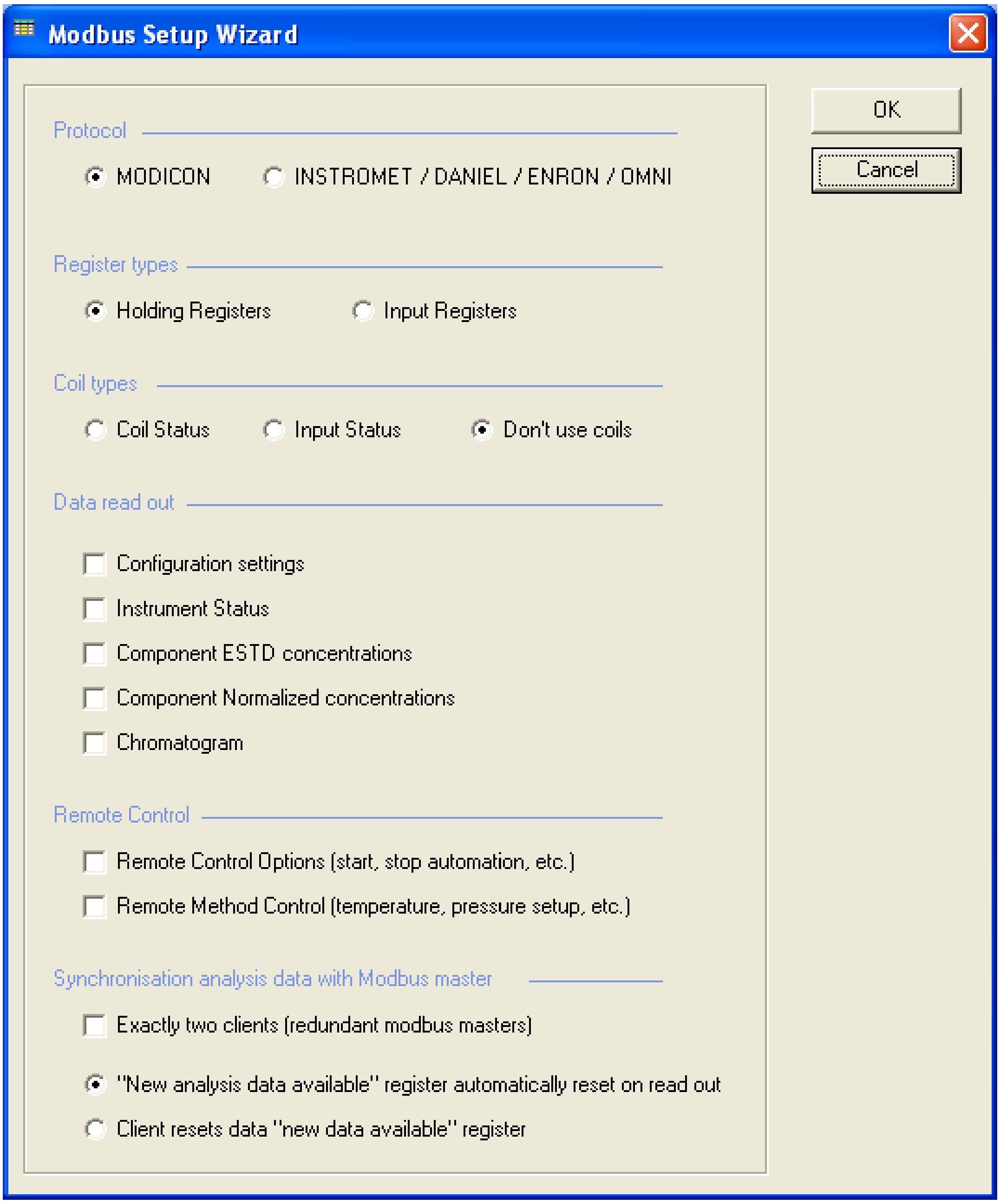
24.4.3 Sequence Wizard

Select the sequence wizard in order to quickly setup a sequence from scratch.
To activate the sequence wizard, from the PROstation toolbar select File\Sequence\Wizard.
Find an example of when to use this wizard In chapter Quickstart on page 316.
Find more information about what tables are generated on chapter Sequence on page 185.



24.4.4 Modbus wizard

Select the Modbus Setup Wizard in order to generate a modbus table from scratch containing a list of modbus registers holding the sample results, instrument status, instrument control, etc.
To activate the Modbus wizard, from the PROstation toolbar select file\Modbus\wizard. More information can be find here on page 194.



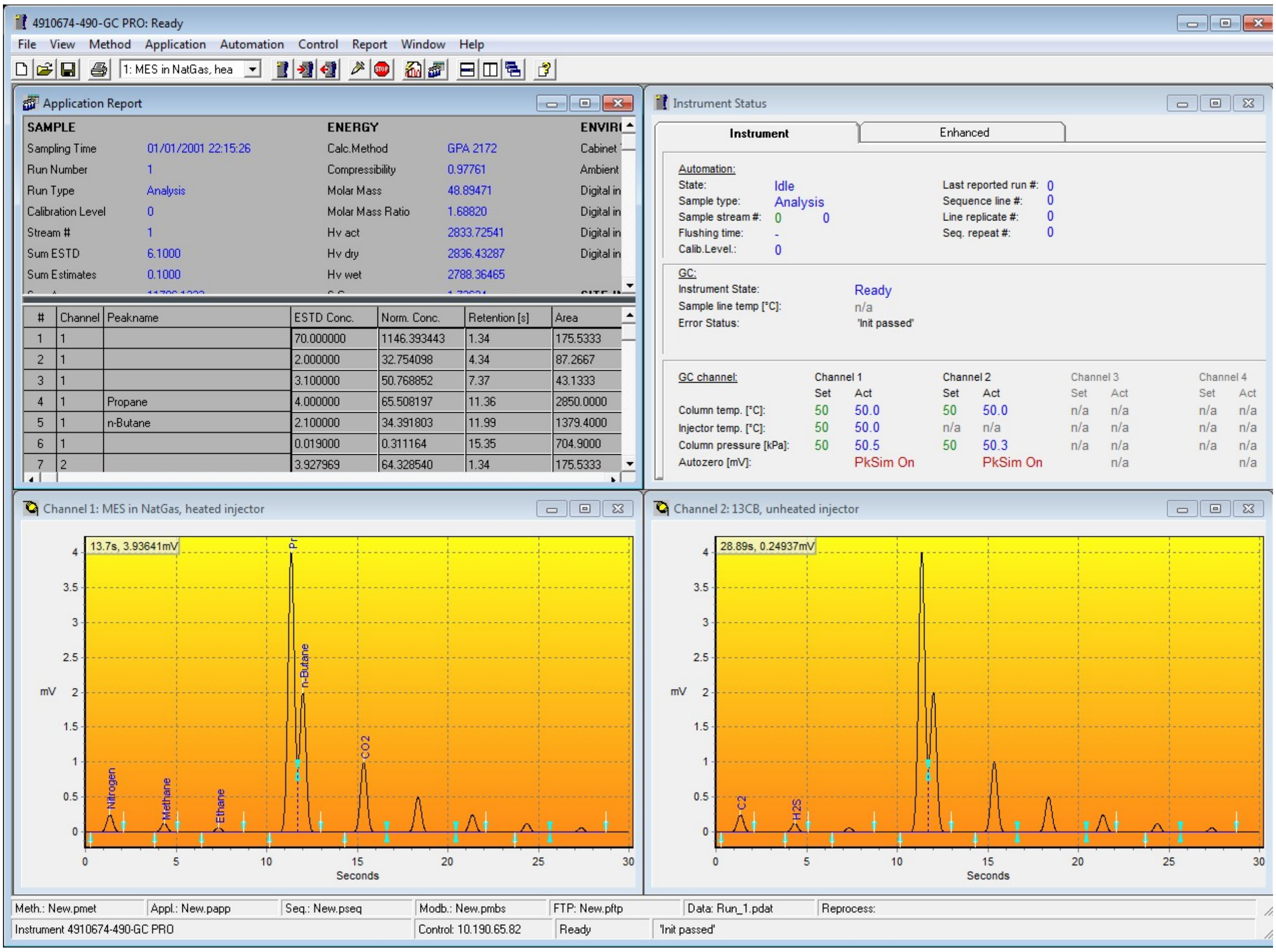
24.5 View

From the PROstation toolbar, select view:

There is a choice between two different workspaces:

24.5.1 Application workspace

Detailed instrument status, application report and the actual channel data.
The chromatogram window has all kinds of scaling functionality. This is identical to the scaling functions in the Calibration chart, see chapter Calibration Chart on page 155.



24.5.2 User workspace

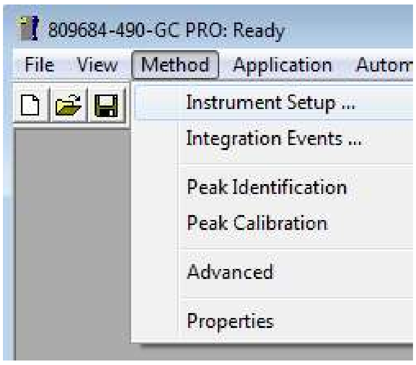
The user workspace displays a fixed number of windows on the screen which cannot be changed.

24.6 Method

The method consists of all windows found under the Method menu.

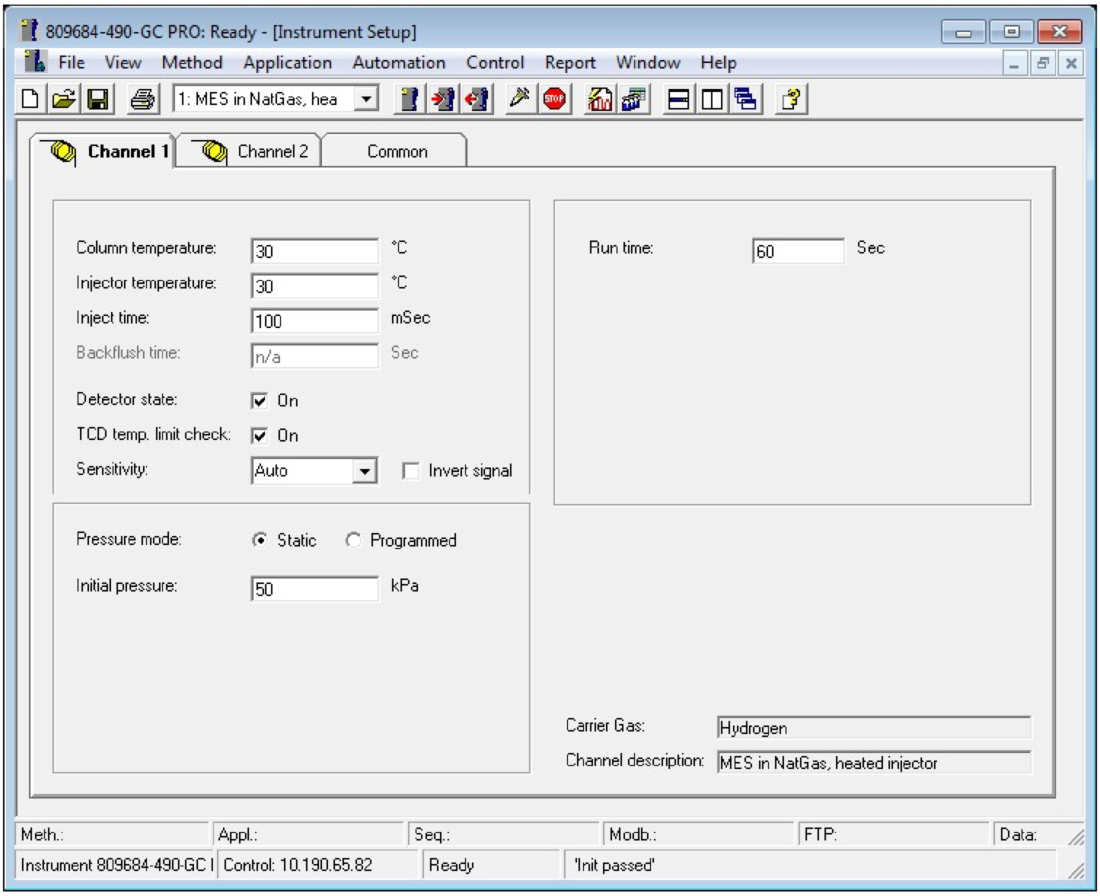
24.6.1 Instrument Setup

Before you can make a run with your 490-GC PRO, you must set up the instrument and data acquisition parameters for one or both channels of the instrument. To access the Instrument Setup dialog, click the Instrument Setup icon on the toolbar, or select the Method/Instrument Setup command from the menu.



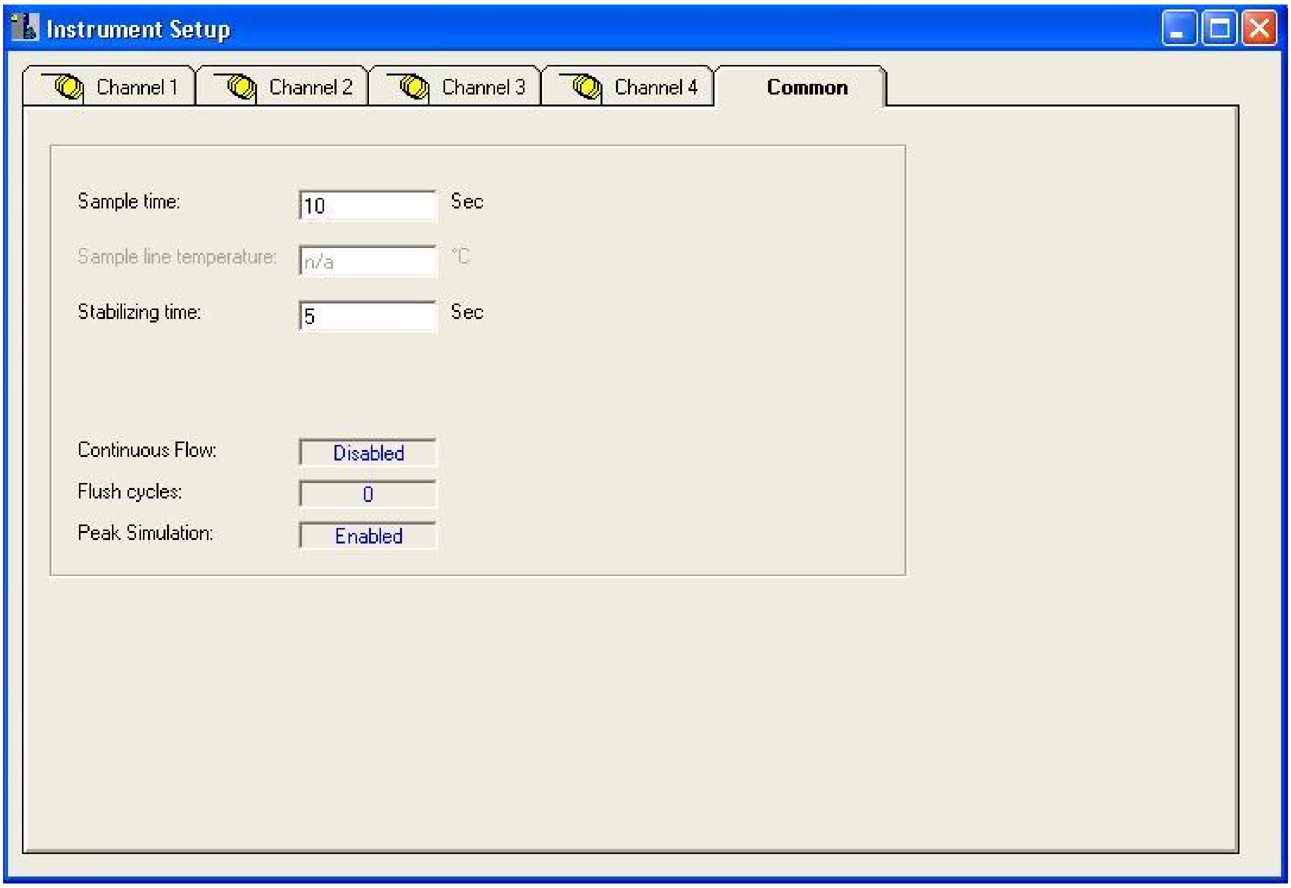
24.6.2 490-GC Tab

The 490-GC Tab consists of the sub tabs: “Channel” and “Common”.
For each single channel installed in the 490-GC a separate channel tab will appear. Installed channels, which are disabled in the configuration, will not be displayed.



24.6.3 Instrument Common Tab

This tab contains parameters you can set which are common for all installed channels.



- **Sample time**
  Sample Time determines the amount of time the pump operates to draw the sample into the sample loop. The sample time you enter here applies to all channels.

- **Sample line temperature**
  This setting will control the instrument heated sample line (only when sample line is physically connected).

- **Stabilizing Time**
  If for Stabilizing Time on page 115 a value larger than zero is entered, an extra instrument state will be created, the Stabilizing state.

- **Continuous flow**
  This is the current continuous flow setting in the 490-GC. At startup of Instrument control this setting is uploaded from the 490-GC.

- **Flush cycles**
  This is the current number of flush cycles in the 490-GC PRO. At startup of Instrument control this setting is uploaded from the 490-GC PRO.

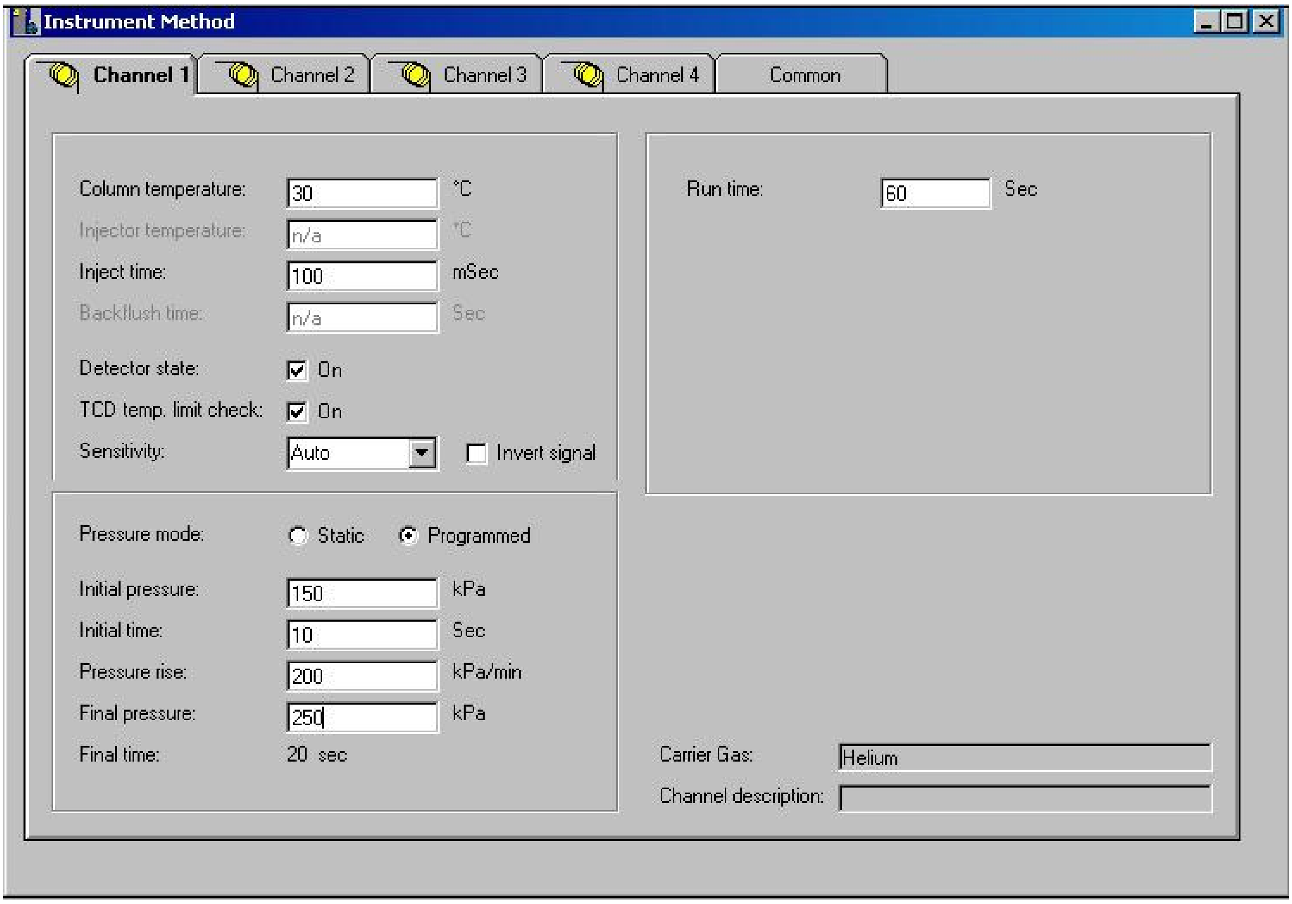
- **Peak simulation**
  This is the current peak simulation setting in the 490-GC PRO. At startup of Instrument control this setting is uploaded from the 490-GC PRO.

24.6.4 Stabilization Time

The stabilization state becomes active as soon as all individual temperature and pressure states of all channels are in the Ready state. In the Stabilizing state, all individual temperature and pressure states are checked.
If they all remain ready during the stabilizing period the overall instrument state will become Ready.
If during the stabilizing period one of the channel temperatures or pressures becomes 'Not Ready', the overall instrument state will jump to 'Not Ready' and the whole process will start again. Enter zero for Stabilizing time if the stabilizing period is not required.

24.6.5 Instrument Method Channel Tab

For each channel installed in the Hardware tab of the 490-GC PRO configuration (and not disabled in the User Settings tab of the 490-GC PRO configuration) a Channel tab appears (Click here if a DMD channel is installed).



- **Column temperature**
  Enter the desired column temperature, in degrees C. The 490-GC driver checks on the maximum allowed temperature, which can be found in the Hardware tab of the instrument configuration.

- **Injector temperature**
  Enter the desired injector temperature, in degrees C. This is only possible if the GC channel is equipped with heated injector hardware, see Hardware tab of the instrument configuration.

- **Inject time**
  Enter the Inject Time. The Inject Time determines the amount of time the injection valve will be open. A practical minimum value is 20ms.

- **Backflusk time**
  Enter the backflush time in seconds. This is only possible if the GC channel is equipped with backflush to vent hardware, see Hardware tab of the instrument configuration. A backflush time of zero means no backflush.

- **Detector state**
  Select this box to turn the detector filaments on.

- **Invert signal**
  Select this box to invert (change polarity) of the acquired detector data.

- **Sensitivity**
  Select the desired detector sensitivity – Auto (auto ranging), Low Medium, High or Extra high. Auto is highly advised as it gives the widest linear dynamic range, with the lowest noise level.

- **TCD temp.limit check**
  Select this box to turn the TCD temperature limit check on. If activated the TCD will be protected against high amount of Air and protect the filaments.

- **Pressure Mode**
  Select the pressure-programming mode to be used.
  Choose **Static** for non-ramped mode. Choose **Programmed** if you want to enter a programming ramp rate. If you select **Programmed,** the following parameters will become available.

- **Run Time**
  Run Time determines the length of time, data will be sampled.

- **Initial Pressure**
  Enter the initial pressure setting, in kPa or PSI (depending on configuration).

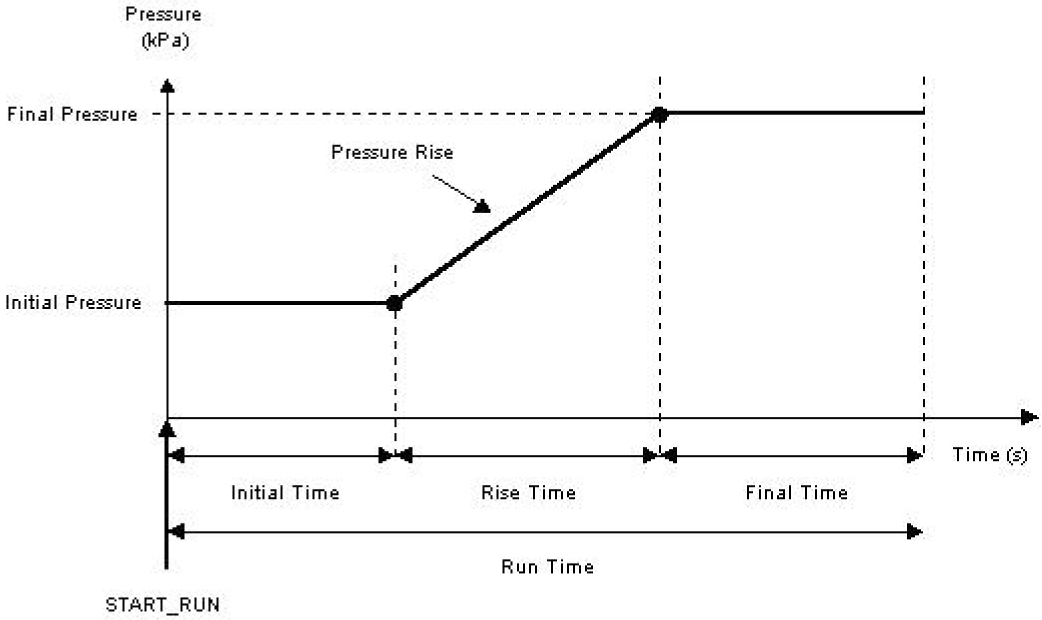
- **Initial Time**
  Enter the time to hold the initial pressure, in seconds.

- **Pressure Rise**
  Enter the rate of pressure change for the ramp, in kPa/min or PSI/min (depending on configuration).
  Note: Positive rise only.

- **Final Pressure**
  Enter the final pressure setting, in kPa or PSI (depending on configuration).

- **Final Time**
  The final time will be calculated and displayed, based on the **Run time** you have set in the Acquisition Parameters.
  If the final time displayed is 0, meaning your Run time is equal to or less than the sum of your initial time and the time to ramp the pressure to the final pressure setting. You should change your run time accordingly.
  If you have entered an incorrect parameter for any of the above items, an error message will be displayed in this field to aid you in correcting the setting.

Pressure program scheme

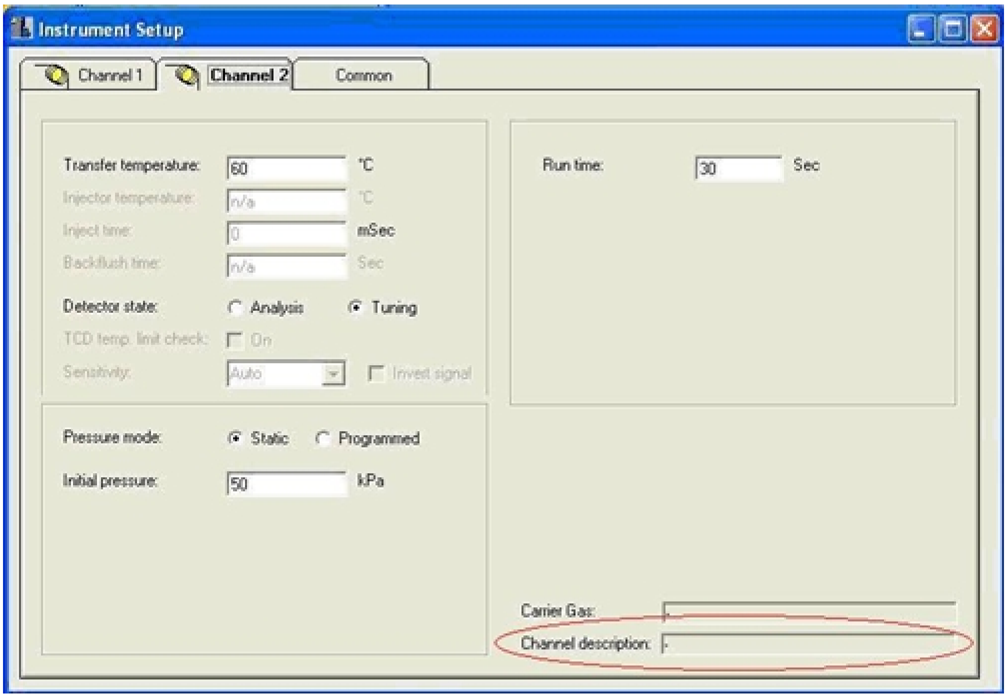


24.6.6 Channel Tab DMD

When setting up the instrument for a 490-GC PRO with DMD detector, in Channel 2 respectively Channel 4 for a Quad 490-GC PRO system the following is changed:
The Transferline Temperature can be set for the transferline from μ-TCD to DMD. These temperatures are preset with final testing the DMD but may be changed according to sample requirements. Be aware that sample line and transferline are in fact different parts of the instruments and take care not to mix these parameters….
Detector state should be set to analyse always.

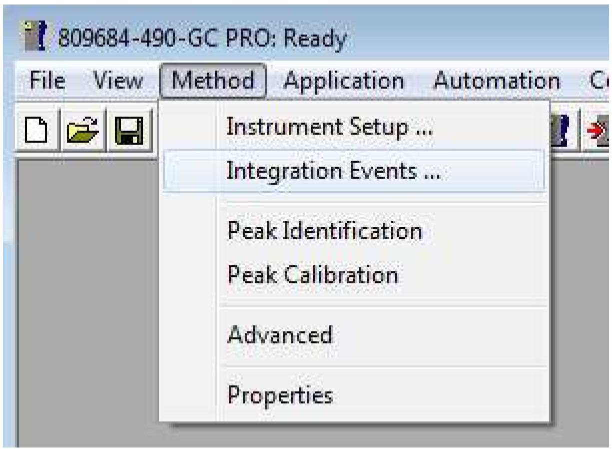
Tuning of the DMD channel should be performed by trained service engineers.

The Channel Description in the lower right hand corner indicates the presence of a Sionex DMD Channel (unless the channel description is overwritten in the configuration).



24.6.7 Integration Events

To access integration events, click on “Method” and select “Integration Events…”.



There will be 51 Integration Event choices. Click on the “on page…” text; this will guide directly to the correct page:

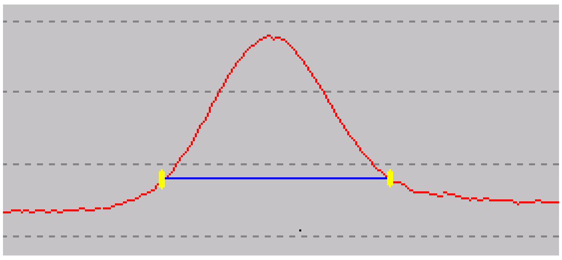
1. Set peak width, on page 120.
2. Set Threshold [10nV], on page 121
3. Double Peak Width Now, on page 120
4. Halve Peak Width Now, on page 120
5. Estimate Threshold, on page 121
6. Compute Noise On, not available
7. Compute Noise Off, not available
8. Add to Threshold, on page 124
9. Set Minimal Height, on page 122
10. Set Minimal Area, on page 122
11. Turn Integration On, on page 122
12. Turn Integration Off, on page 122
13. Start Peak Now, on page 123
14. End Peak Now, on page 123
15. Split Peak Now, on page 124
16. Add Peaks/Grouping On, on page 124
17. Add Peaks/Grouping Off, on page 124
22. Baseline Valley to Valley On, on page 125
23. Baseline Valley to Valley Off, on page 125
24. Horizontal Baseline On, on page 125
25. Horizontal Baseline Off, on page 125
26. Horizontal Baseline By Peak On, on page 126
27. Horizontal Baseline By Peak Off, on page 126
28. Backward Horizontal Baseline On, on page 126
29. Backward Horizontal Baseline Off, on page 126
30. Horizontal Backward Baseline On, on page 126
31. Horizontal Backward Baseline Off, on page 126
32. Force Baseline On, on page 127
33. Force Baseline Off, on page 127
34. Force Baseline By Peak On, on page 127
35. Force Baseline By Peak Off, on page 129
36. Baseline Now, on page 129
37. Baseline Next Valley, on page 130
38. Set Skim Ratio, on page 130
39. Tangent Skim Next Peaks On, on page 131
40. Tangent Skim Next Peaks Off, on page 131
41. Tangent Skim Rear On, on page 131

24.6.7.1 Set Peak Width

This event defines the width of the peak to be found in the chromatogram. This value is used to smooth the chromatogram by grouping several acquisition points during peak detection. The number of grouped points depends on the chosen width. A point whose height is the mean of all the points in the group represents each group.

Enter a value corresponding approximately to the width of the narrowest peak to be detected in the chromatogram.

If the peak width varies greatly in the same chromatogram, it is possible to change peak widths throughout the chromatogram as necessary. Set new values in Set Peak Width, half it using Half Peak Width, or double it using Double Peak Width.
If the defined peak width value is too small, the peaks will be detected, but too late.



If the defined peak width value is too large, the peaks will not be detected at all.
A peak width must be defined before integrating the chromatogram.
The default peak width is 0.2 seconds.

24.6.7.2 Set Threshold

This parameter is used to define the start and the end of peaks and eliminates the lowest signal variations due to noise or to detector signal drift.

The chromatogram is first normalized to 100,000 (Highest peak of the chromatogram) in order to obtain a similar detection from one analysis to another (for example, if the injected quantity varies). Next, the points are grouped depending on the peak width defined above. The mean height of a group of points is compared to the mean height of the following group. If the difference is higher than the threshold, the integrator marks the beginning of a peak. The position of the marker is adjusted by only considering the points. The peak will only be kept if its area and height are larger than minimum values defined by user.

The peak ends are detected in the same way using the threshold.

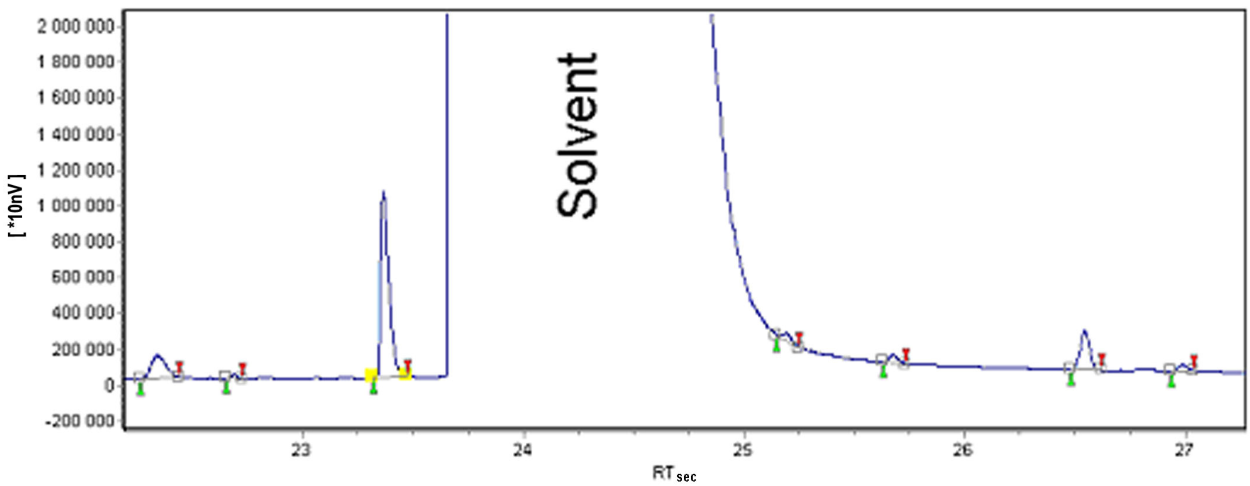
The value of the threshold is important. If a too high threshold value is defined, the peak starts will be detected too late and the peak ends too early. Moreover, small peaks could not be detected at all. If a too small threshold value is defined, the peak starts will be detected too early, and the peak ends too late, and signal noise can be detected as peaks.

The user can define the threshold value, or the 490-GC PRO can estimate it using **Estimate threshold** according to the peaks that should be detected.
It is also possible to add a value to the threshold using **Add to threshold**. For example, if the threshold is estimated at the beginning of the analysis, and the signal noise increases at the end of the analysis, the threshold should be increased only at the end. Note that it is possible to add a negative value in order to decrease the threshold value.
The default threshold value is 10.

24.6.7.3 Set Solvent Threshold

This event performs the elimination of solvent peak(s) if they are not peaks of interest.
The parameter associated with this event works without previous normalization of the chromatogram. The points are grouped depending on the peak width defined above. The mean height of a group is compared to the mean height of the following group. If the difference is higher than the solvent threshold, the 490-GC PRO considers that the peak is a matrix peak, and does not integrate it.

The defined value must be high enough to prevent the deletion of peaks of interest.



24.6.7.4 Estimate Threshold

If the event "Estimate threshold" is not defined, solvent peaks are integrated. The user can define several events ‘Estimate threshold’. For each time the event is defined, the 490-GC PRO calculates threshold.

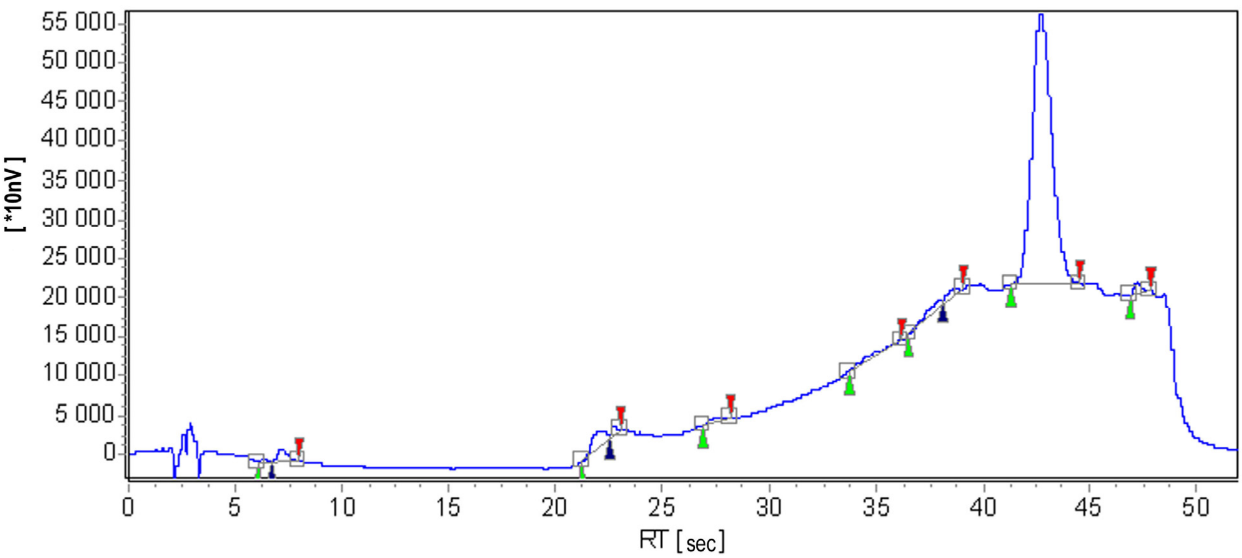
24.6.7.5 Set Minimum Height/Area

These parameters are used to prevent the integration of noise as peaks or to eliminate small peaks which are not of interest in the analysis.

All peaks whose height or area is less than the minimal height and/or area parameters set, are deleted from the peak report. Therefore, choose parameters that are less than the areas and heights of all the peaks to be integrated.
By default, minimum area and height settings are equal to zero.

24.6.7.6 Turn integration On/Off

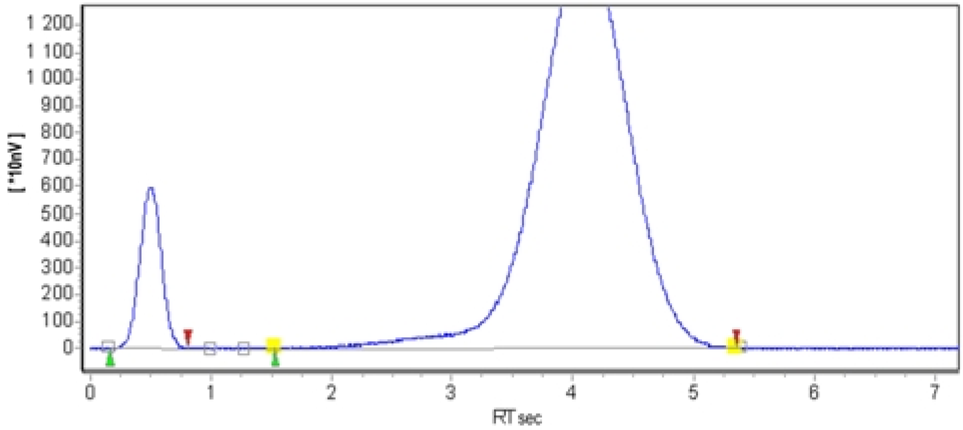
These events activate or deactivate integration within sections of the chromatogram (e.g., during baseline fluctuations (injection shock)):



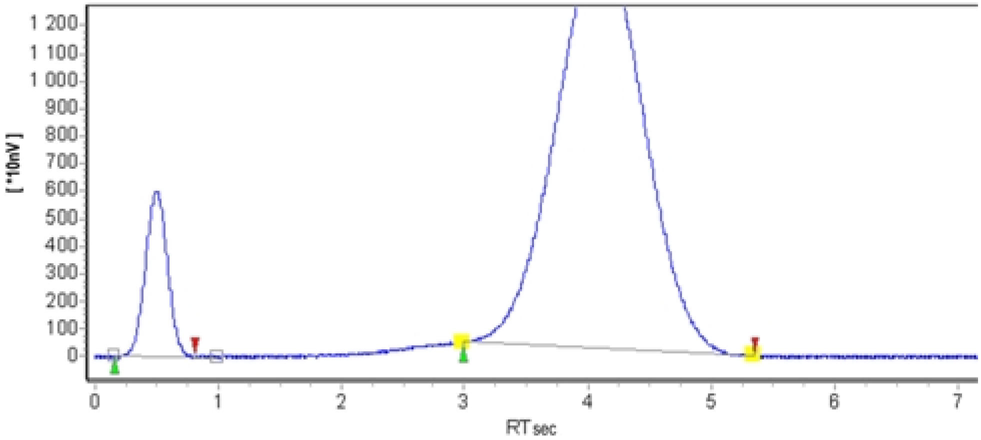
In the above example, integration has been deactivated during the first 5 seconds.

24.6.7.7 *Start/Stop Peak Now*

These events allow the start or the end of a peak to be defined, earlier or later, without having to modify the integration parameters. The marker is re-positioned at a new retention time when this event is specified. For example, before:



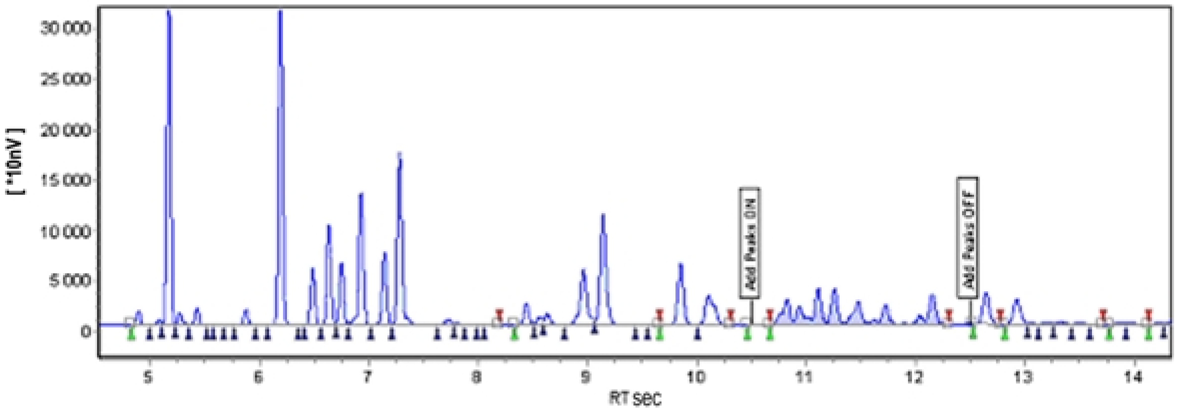
After:



Be cautious if using these events in automatic mode: check that retention times have not shifted from one analysis to another.

24.6.7.8 Add Peaks/Grouping

This event enables addition of several peaks. All the peaks defined between the activation and the deactivation of this event are grouped into one peak.
For example, isomers whose names are not known peak by peak, but contain nearly the same response factors can be considered as one group. The peak grouping is considered as one peak. Note that the peak start or stop position is automatically adjusted around the defined time to avoid the baseline cut by the signal.

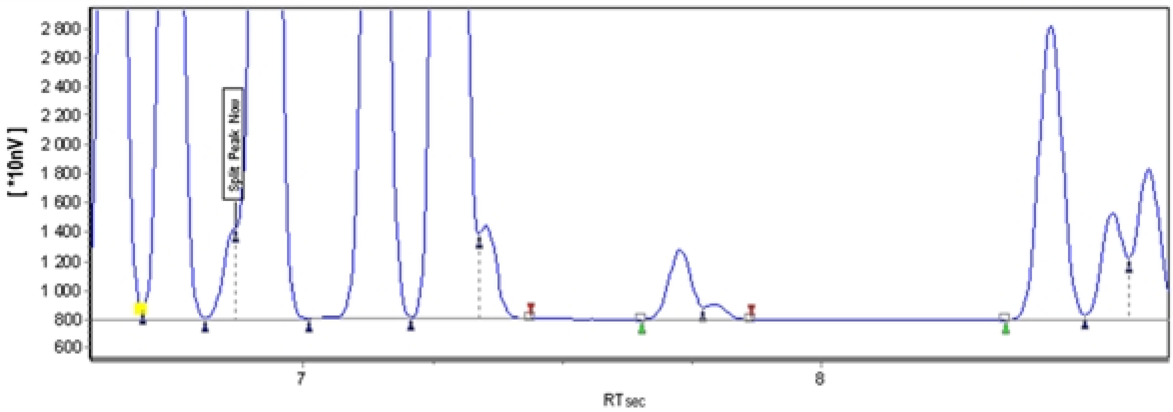


In the above example, the peaks between 10.5 and 12.5 seconds are added.

NOTE: if the baseline cuts the signal in the section corresponding to the 'Add peaks' events (ON + OFF), the expected added peak can be not defined. In this case, change the baseline position thanks to the corresponding integration event(s).

24.6.7.9 Split Peak

This event will split a peak into two parts, and can be used either to separate peaks poorly resolved or to obtain specific results on parts of some peaks in certain applications.

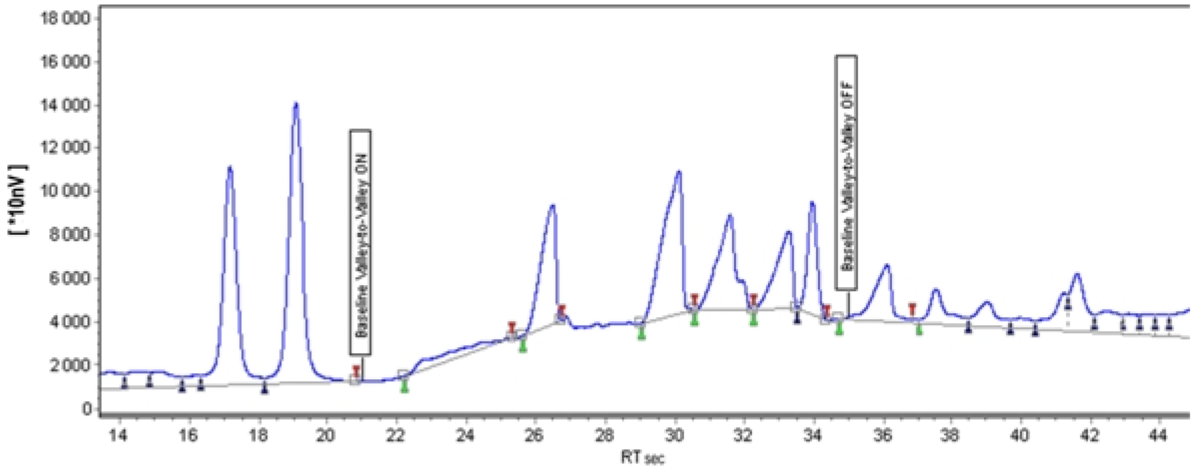


Be cautious when using this event in automatic integration mode. If retention times vary from one analysis to another, the results may not be as expected.

Baseline Processing

24.6.7.10 Baseline valley to valley On/Off

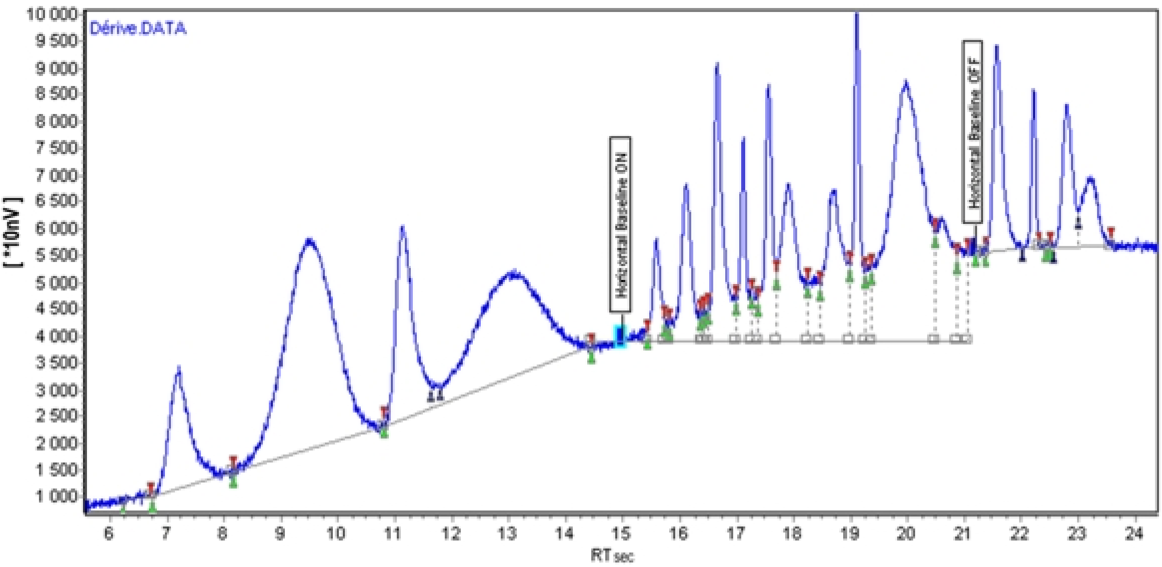
When this event is activated, the baseline passes through all the valleys.



Each peak has its own baseline drawn from the peak start marker to the peak end marker.

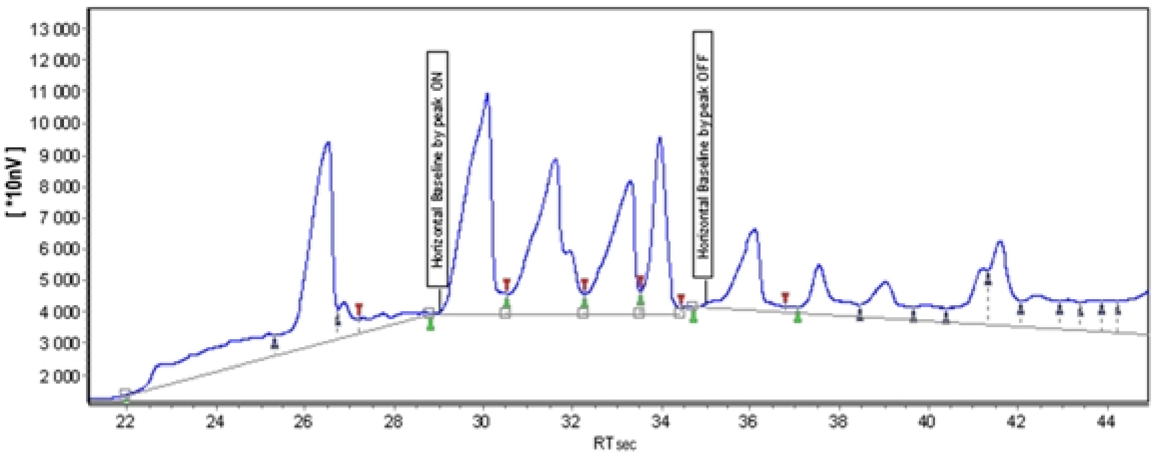
24.6.7.11 Horizontal baseline

This event enables the definition of a horizontal baseline.
A horizontal baseline is drawn from the activation of this event until its deactivation. It is imperative to define the event couple (ON and OFF) to apply this event.



The height of the baseline is the height of the signal when the event is activated.
It is better to use the "Horizontal baseline by peak" event, because the height of the baseline will be related to the start or the end of a peak, and not to the event activation time.

24.6.7.12 Horizontal Baseline by Peak

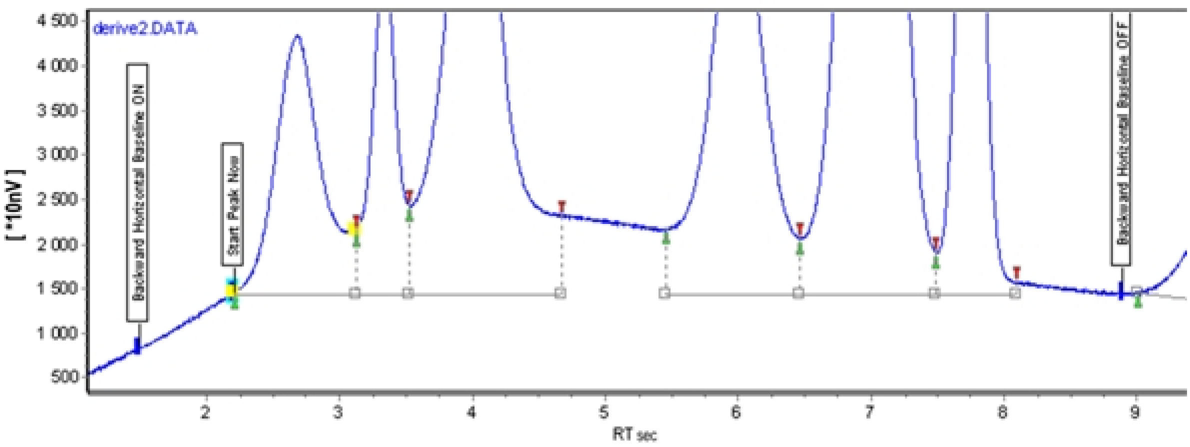


This event enables definition of a horizontal baseline. The horizontal baseline start or stop are not applied to the defined times, but to the nearest start or stop peak time

If an event is activated at the beginning of a peak (between the start marker and the peak apex), it becomes operative at the peak start time. If the event is activated at the end of the peak (between the top of the peak and the stop marker), it becomes operative at the peak stop marker time.

24.6.7.13 Backward Horizontal baseline

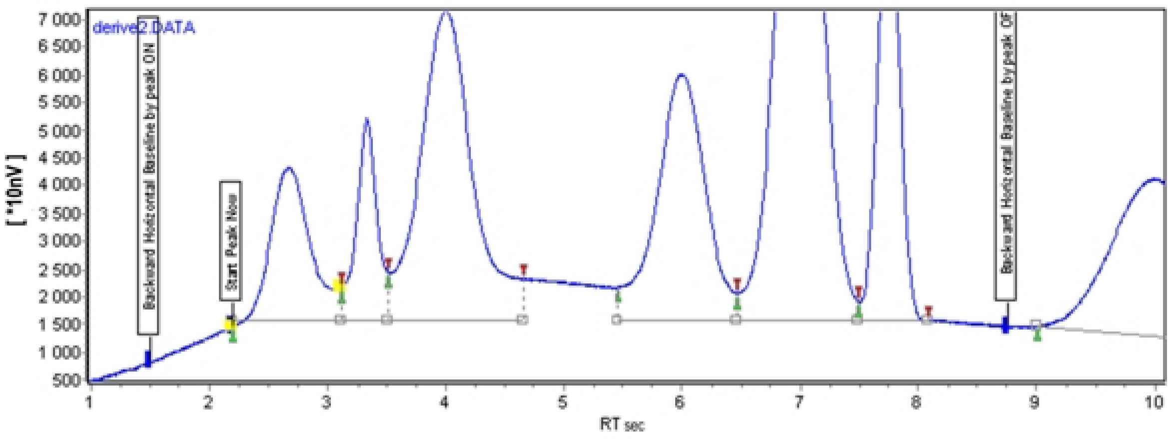
This event enables definition of a horizontal baseline at the level of the signal when this event is deactivated.



The horizontal baseline is drawn from the activation of the event until its deactivation. The baseline is drawn at the level of the signal when the event is deactivated. As a consequence, the two events “Horizontal baseline Backward On” and “Horizontal baseline Backward Off” must be defined.

24.6.7.14 Backward Horizontal Baseline by Peak

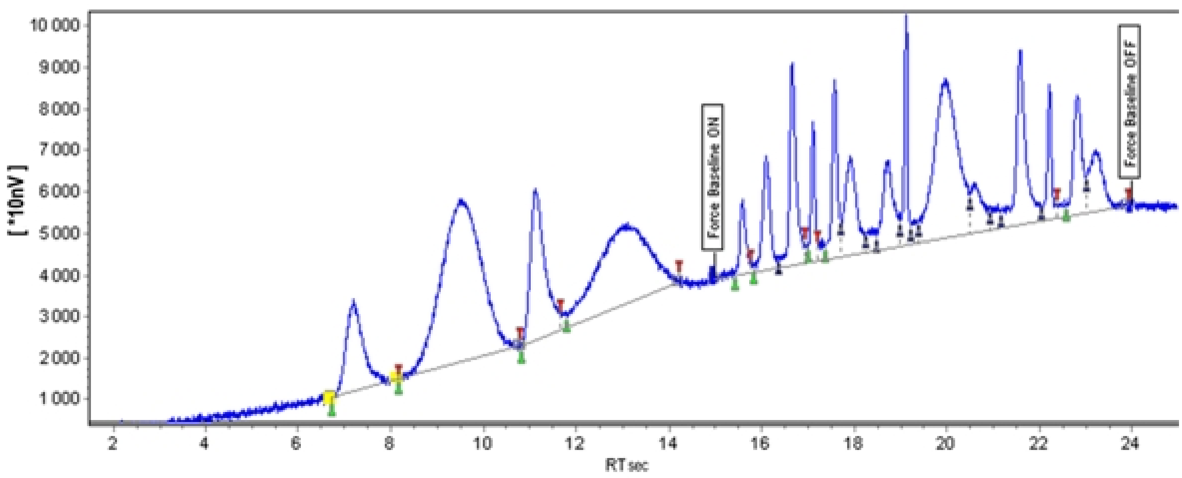
This event enables definition of a backward horizontal baseline. The horizontal baseline is drawn from the activation of the event until its deactivation. The baseline is drawn at the level of the signal at the stop marker of the peak preceding the event deactivation.



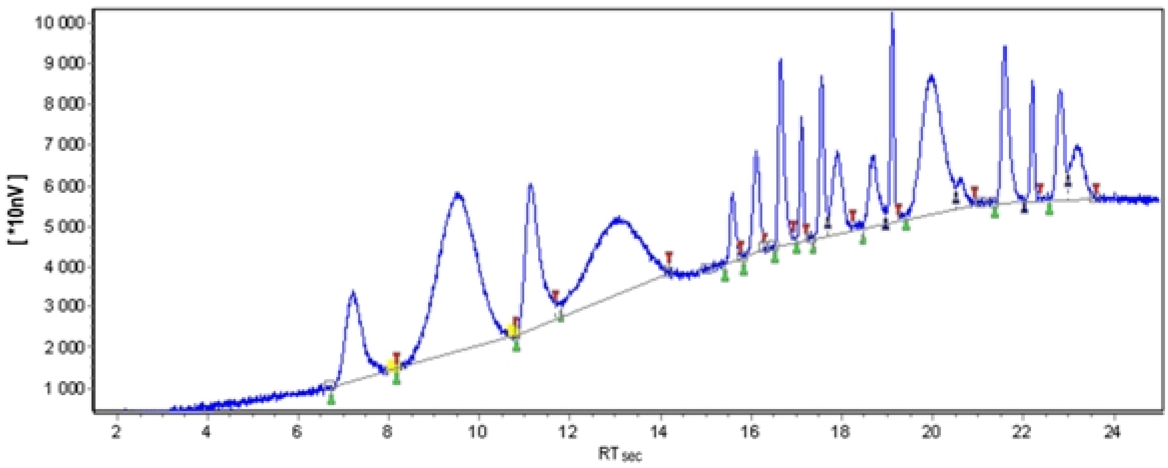
As a consequence, the two events “Backward Horizontal Baseline by peak On” and “Backward Horizontal Baseline by peak Off” must be defined.

24.6.7.15 Force Baseline

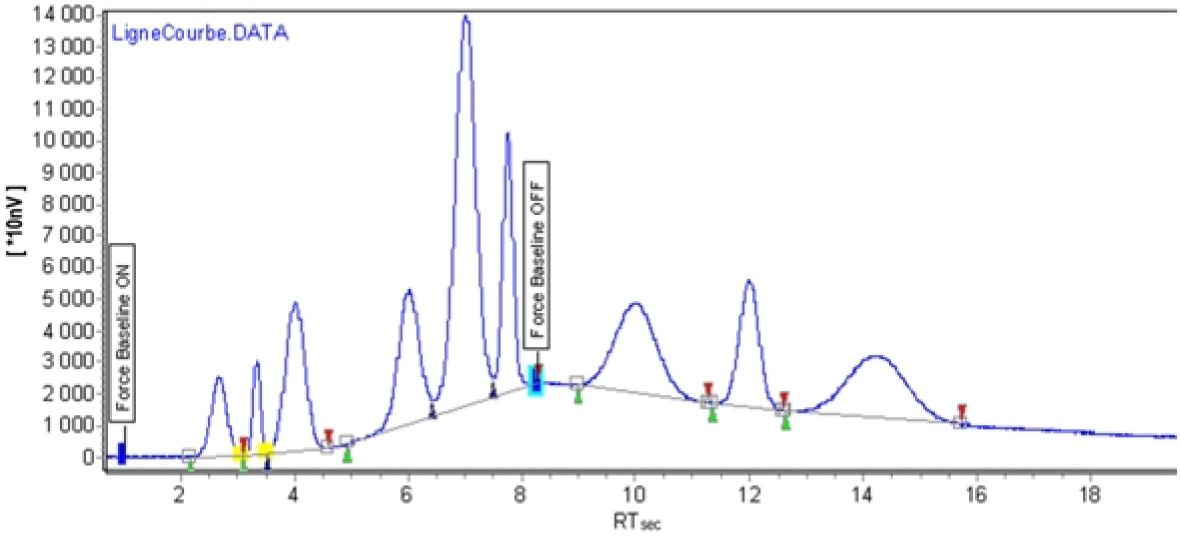
This event forces all the peaks between the events “Force baseline On” and “Force baseline Off” to have a common baseline. The peak markers of the first and last peaks are therefore modified by this event. To prevent modification of the first and last peak markers, the recommended event to use is “Force baseline by peak”.
As a consequence, the two associated events “Force baseline On” and “Force baseline Off” must be defined.



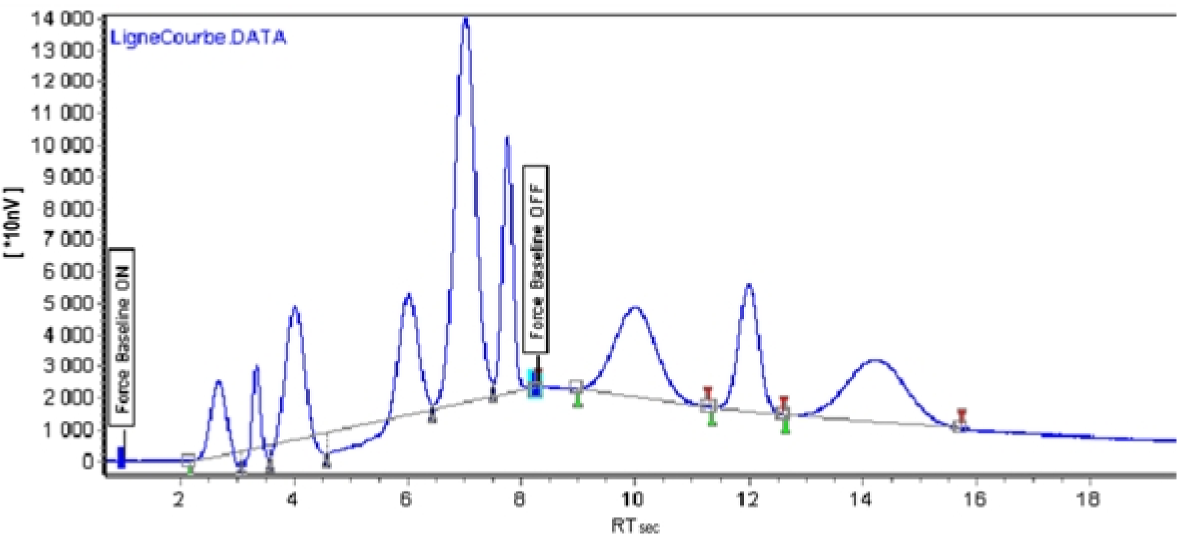
instead of



If the forced baseline penetrates the signal, the baseline will automatically adjust so that it always remains under the signal.



instead of

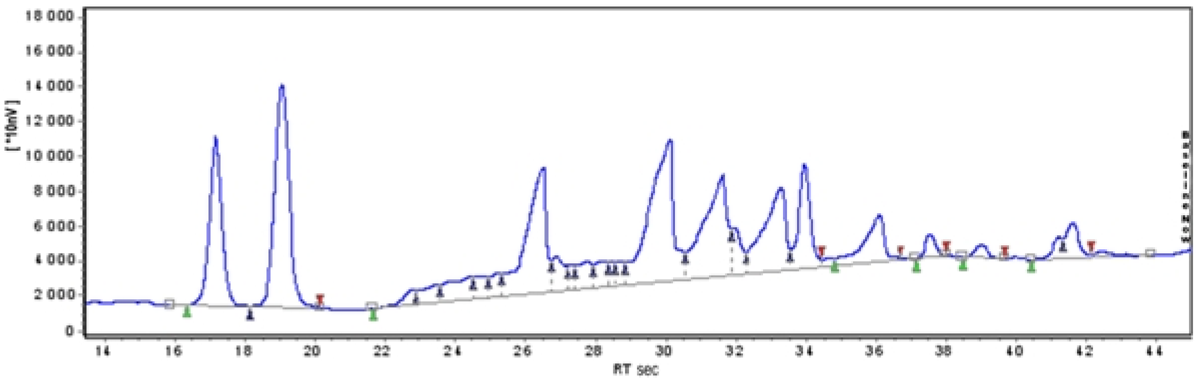


24.6.7.16 Force Baseline by Peak

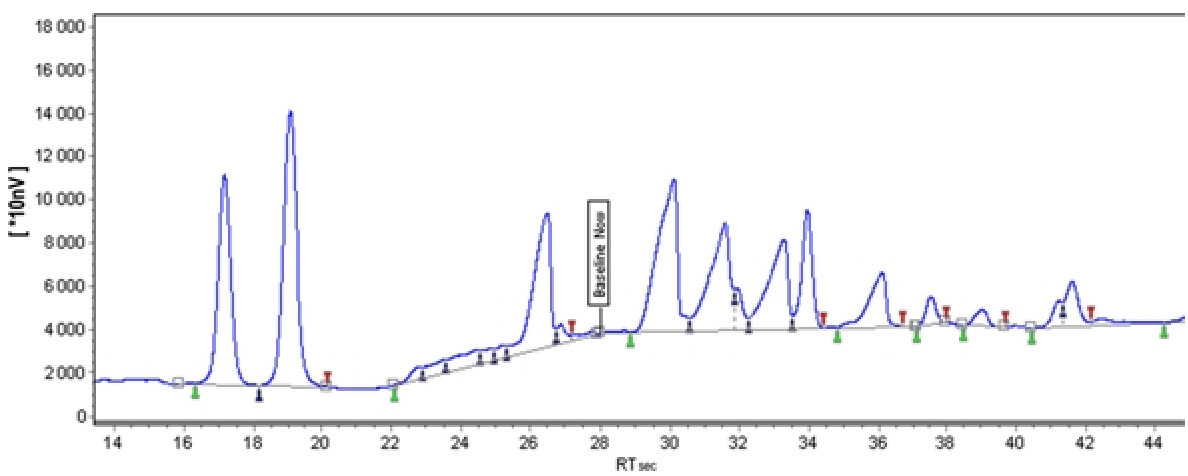
This event forces all the peaks between the events ”Force baseline by peak On” and “Force baseline by peak Off” to have a common baseline.
The difference with force baseline is that in this case, the markers of the first and the last peak are not modified.

24.6.7.17 Baseline Now

This event forces the baseline to pass through the signal at the event time.



Becomes



This event is used to bring the baseline back to the signal.
Separate peaks, which have a common baseline, end a tailing peak earlier.
The position of this event is relative to retention time drift, but as for most of the events, a similar peak-dependent event exists: “Baseline next valley”.

24.6.7.18 Baseline Next Valley

This event is similar to the previous one (Baseline now). The only difference is that the 490-GC PRO waits for the valley following the event to bring back the baseline to the signal.
As a consequence, this event is best suited for separation of peaks having a common baseline, since "Baseline next valley" is less dependent on retention time variations from one analysis to another.

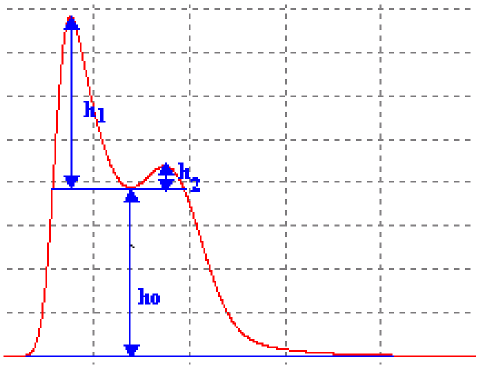
Shoulder Peaks

To integrate a peak as the skimming of another, **both peaks need first to be integrated**. Thus it is important to define correct detection parameters (Set peak width and Set threshold) before defining the skimming parameters.

24.6.7.19 Set Skim Ratio

This event sets the shoulder integration threshold above a mother peak. This threshold must be associated to the events "Tangent skim front/rear" and "Exponential skim front/rear".
A peak will be integrated as a shoulder peak on another peak, if its height satisfies the shoulder peak criterion.
In the following example, the second peak will be considered as a shoulder on the first peak if:

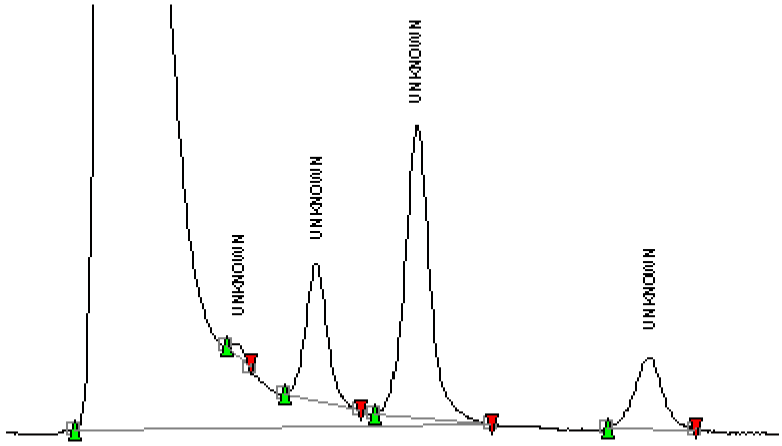
$$\frac{h_1}{h_2} \geq \text{parameter} \quad (ho \neq 0)$$



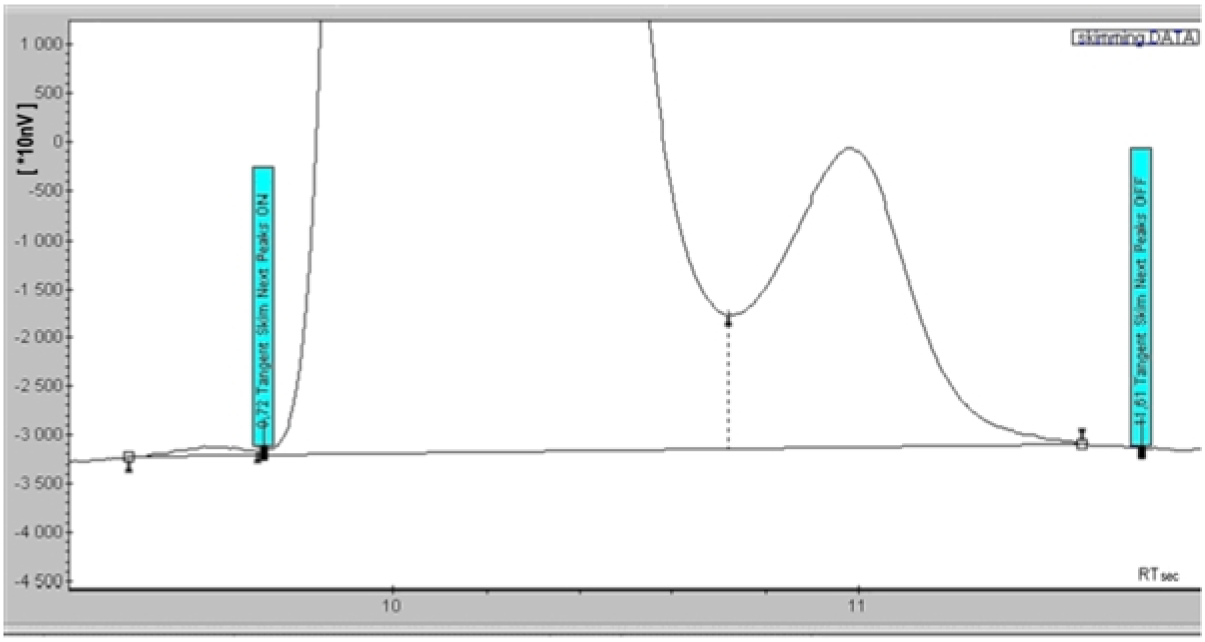
By default, this threshold is equal to 4.

24.6.7.20 Tangent Skim Next Peaks On/Off

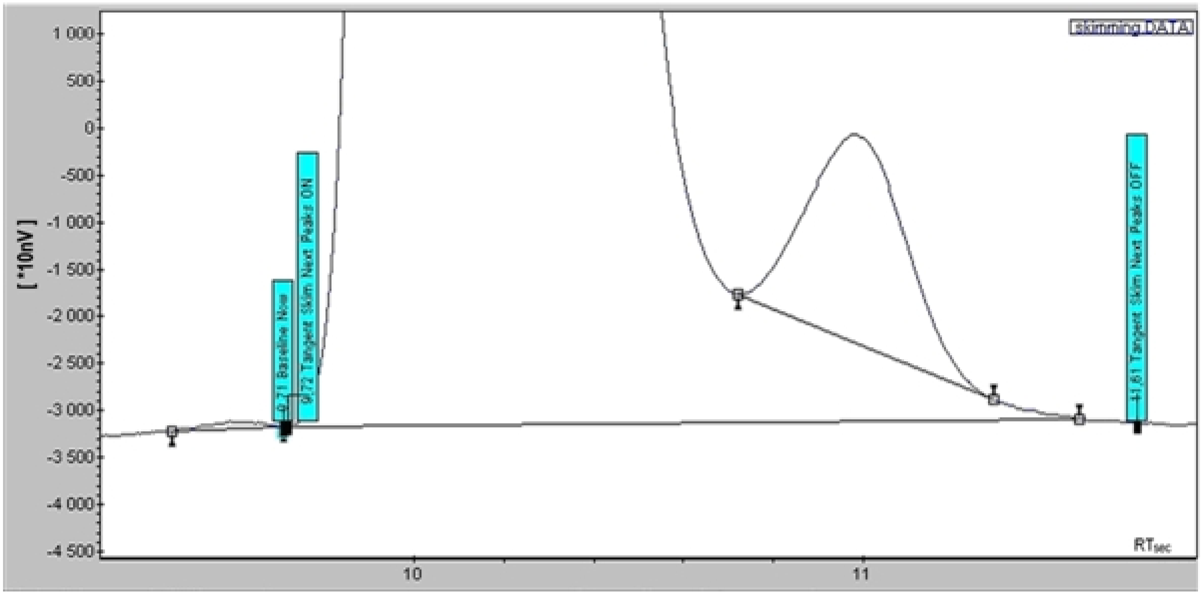
If this event is activated (On), all the peaks having a common baseline are integrated as shoulder peaks on the first peak, with a tangent baseline.



The **tangent skim Next Peaks** event does not work when the mother peak is not fully resolved (e.g. has a valley with the previous peak). The use of a **Baseline Now** event has the effect of removing the valley, and thus allows the skimming event to work properly. See figures below.



*Without the **baseline now** event, there is a group of three peaks sharing a common baseline*

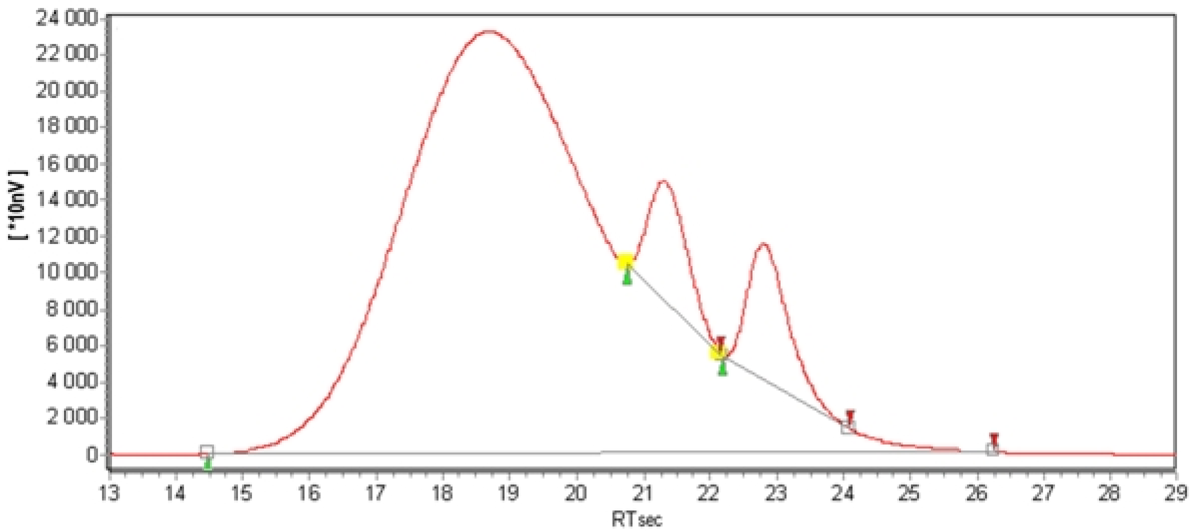


The **baseline now** event just breaks the group of peaks

Note that there is another event, more powerful, called **Tangent Skim Rear**, which handles such situations.

24.6.7.21 Tangent Skim Rear/Front

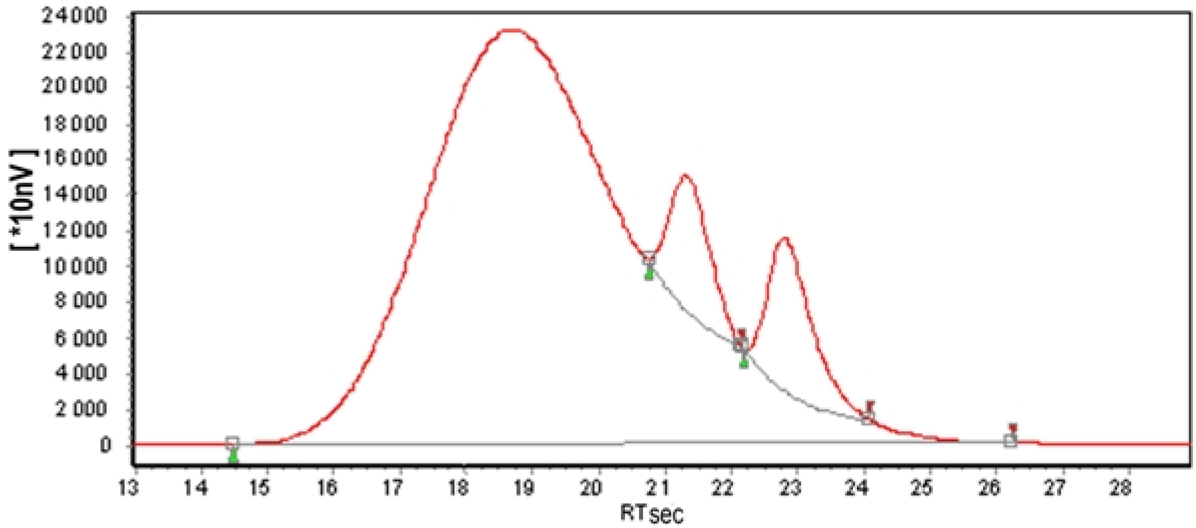
Select this event to integrate one or several peaks as shoulders on a mother peak with a tangent baseline. 490-GC PRO detects poorly resolved peaks whose heights satisfy the above height criterion (see page 130), a tangent baseline is drawn underneath the shoulder peaks.



If the event is "Tangent skim front", the shoulders are integrated before the mother peak. If the event is "Tangent skim rear", the shoulders are integrated after the mother peak.

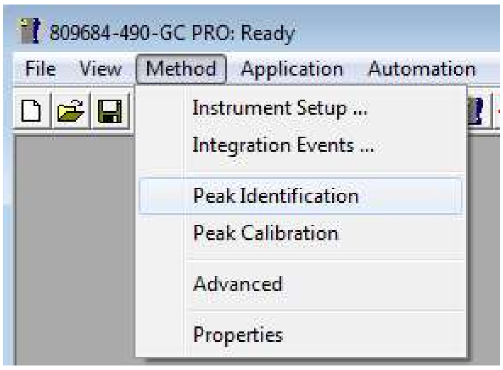
24.6.7.22 Exponential Skim Rear/Front

Select this event to integrate one or several shoulder peaks with an exponential baseline.
If the 490-GC PRO detects two poorly resolved peaks whose heights satisfy the above height criterion (see page 130), an exponential baseline is drawn underneath the shoulder peaks.

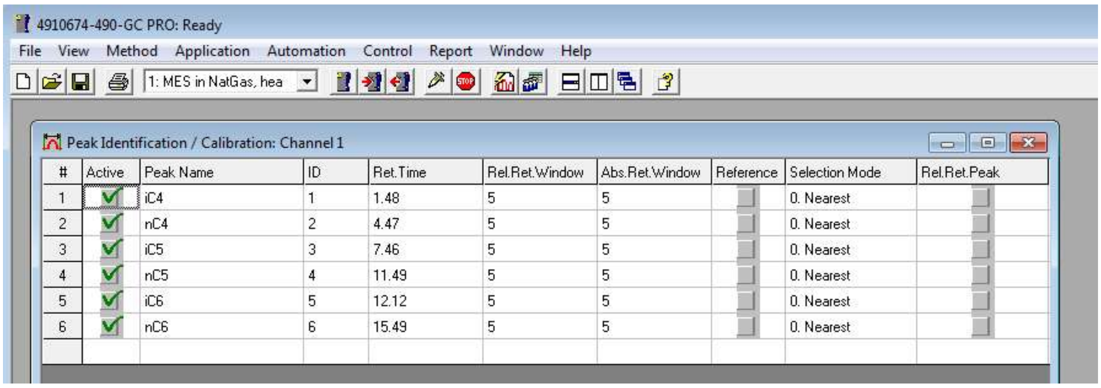


24.6.8 Peak Identification

The Peak Identification/Calibration contains settings to identify a peak on its retention time.
To access the Peak Identification/Calibration table, click on "Method" then select "Peak Identification".
If no method is developed before, it is easier to start with running the Method Wizard. Read information in chapter Method Wizard on page 108.



24.6.8.1 The Peak Identification Table



The first step is to fill out the identification table.

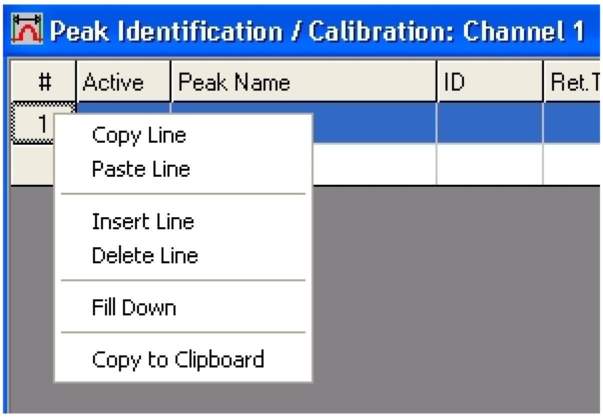
The identification table associates a peak, identified by its retention time, to a name.
It is possible to define reference peaks by checking the *Reference peaks* box.
These are then used for the peak identification when differences in the retention times due to analytical conditions occur.

24.6.8.2 How to Build an Identification Table

To fill a table, press the right mouse button when in the table.
Insert as many lines as needed, fill in the names and retention times.

Each line of the table represents one peak. In each line, enter the name of the compound corresponding to the peak, identified by its retention time and then choose the identification window width in the columns "Abs. Ret Windows" and "Ret Ret Window selection" and the identification mode.

To delete an identification table line, highlight it by left clicking at the beginning of the line that is to be removed, then right click and choose ***DELETE Line*** in the popup menu.



The popup menu of the peak identification table contains a Copy line option that enables its content to be copied and pasted into another application.

24.6.8.3 Identification Table Columns

The parameters in the Identification table used for peak identification.

24.6.8.3.1 Peak Name

The name of the compound corresponding to the peak. Two different peaks cannot have the same name.

24.6.8.3.2 Retention Time

The theoretical retention time of the peak. Two different peaks cannot have the same retention time.

24.6.8.3.3 Abs. Ret. Window

The absolute part of the identification window.

24.6.8.3.4 Ret. Ret. Window

The relative part of the identification window.
These windows define the maximum interval around the retention time in which the peak will be assigned a specific compound name.

The absolute identification window is defined in seconds. The relative identification window is defined as a percentage of retention time. If the relative identification window percentage (Rel. Ret. Window) is used, the larger the retention time is, the wider the relative retention time window will be.

If retention time is RT, absolute window is Abs, and relative window is %W, a peak will be identified as the peak if its retention time is between

$$\mathrm{RT} - \mathrm{Abs} - \left(\frac{\%\mathrm{W} \times \mathrm{RT}}{100}\right) \text{ and } \mathrm{RT} + \mathrm{Abs} + \left(\frac{\%\mathrm{W} \times \mathrm{RT}}{100}\right).$$

The identification window can thus be defined in seconds using absolute or relative windows, or defined using a combination of both.
The reference peak identification windows are treated separately.
The reference peaks are identified first followed by all other peaks.
If the reference peaks are correctly identified in these windows, it is then possible to define larger windows for reference peaks.
This will ensure that they will be found, even if a retention time offset occurs.

24.6.8.3.5 Reference

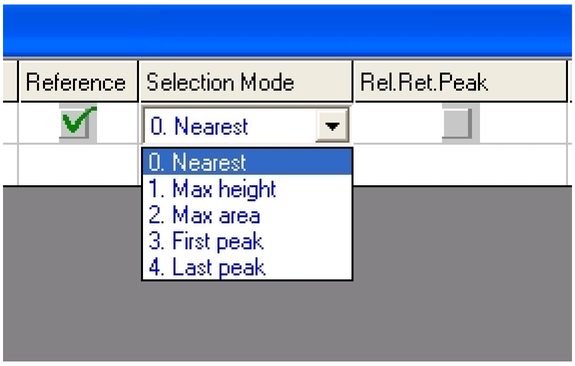
To select reference peaks, check the *Ref* box in the appropriate line(s) to indicate that the selected peak is now considered a reference peak.
The theoretical retention times of the peaks will be corrected according to the difference between theoretical and experimental retention time of these peaks (see Non-reference peaks expected retention time).

The reference peaks must be chosen carefully. Reference peaks must be common constituents that will always appear in the chromatogram.
If a reference peak is not present, another peak could be incorrectly assigned as the reference peak, and thus, the identification of the other peaks will be severely affected.

Reference peaks should be easily recognizable. It is better to choose very high or large peaks, or the last peak of the run (with the certainty that no other peak will occur afterward).

24.6.8.3.6 Selection Mode

This column defines which peak will be chosen if several peaks are included in the identification window.



- Nearest:
  The peak will be the one whose retention time is the closest to the defined time.

- Max height:
  The peak will be the highest one.

- Max area:
  The peak will be the largest one.

:

- First:
  The peak will be the first peak found in the reference window.

- Last:
  The peak will be the last peak found in the reference window.

Peaks are always listed in the retention time order.

24.6.8.4 Identification Process

Peaks are identified by their retention times, according to the identification window defined by the user.

In simple cases, peak retention times are reproducible from one analysis to the other. In the case of non-reproducible retention times from one chromatogram to the other (due to analysis conditions, samples etc.), identification is more complicated and the definition of easily identifiable reference peaks is advisable.

In a first step the 490-GC PRO will identify the reference peaks and will estimate the time offset (according to the retention time) that will be applied during the identification of the other peaks of the chromatogram (non-reference).

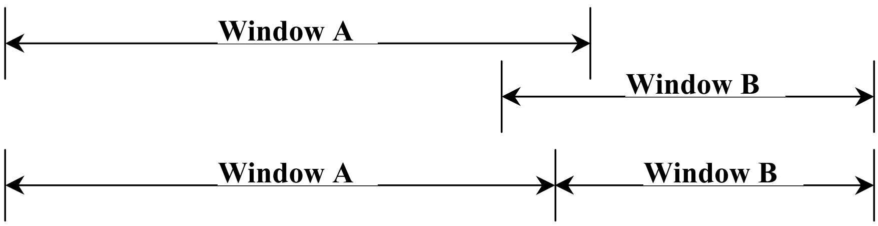
First, the 490-GC PRO checks that the identification windows of the reference peaks do not overlap each other. If window overlap occurs, the 490-GC PRO resolves the overlaps and the reference peak identification is processed.

Using the experimental reference retention times, The 490-GC PRO calculates the other expected retention times, resolves the non-reference peak window overlaps, and the non-reference peaks are identified with these retention times and windows.

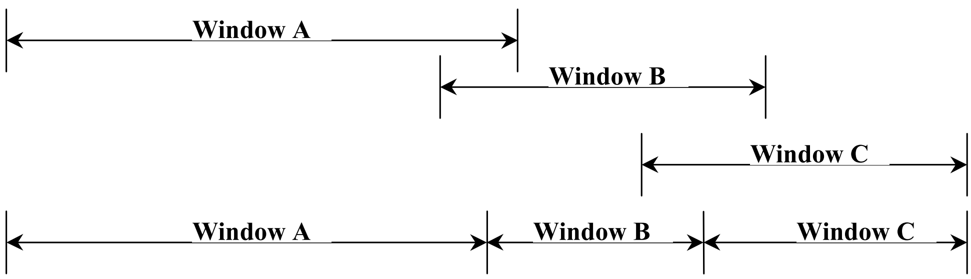
Since the reference and non-reference peaks are processed separately, it is possible to define larger reference windows because it does not matter if they overlap with the non-reference identification windows.

24.6.8.4.1 Resolving Window Overlap

If peaks are very close together, windows can overlap. This means that the end of an identification window can occur after the beginning of the next one. To cope with this problem, the 490-GC PRO considers the common part of the windows, splits it in two, and assigns half to each window.
For example:



If several successive windows overlap, the system resolves the first overlap (two first identification windows), then the next two ones.
For example:



When using the relative identification windows (Ret. Ret. Window), window overlaps can occur easily. If problems are encountered in peak identification, investigate what occurs during the window overlapping resolution.

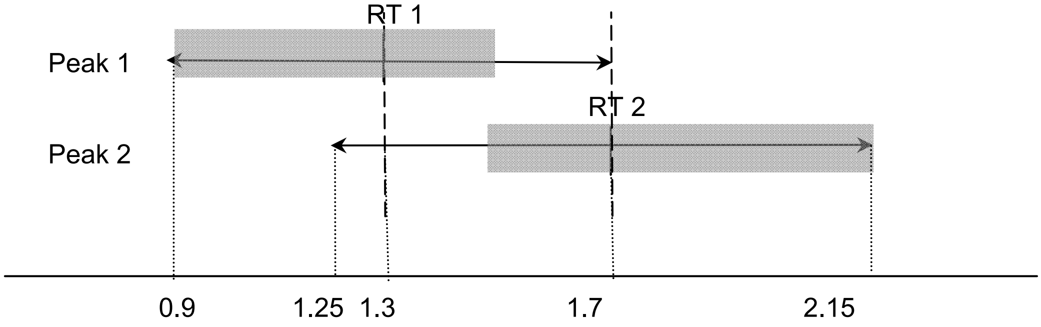
General Rule:

The window limit can not go beyond the retention time of the previous or of the next peak. In this case the retention time of the
previous/next peak is taken into account as the limit of the window, and the overlap is divided in two.

Example1: a peak retention time belongs to the identification window of another peak

Peak 1: RT1= 1.3   ID window: 0.4 min: [0.9 -1.7]

Peak 2: RT2= 1.7   ID window: 0.45 min [1.25 -2.15]



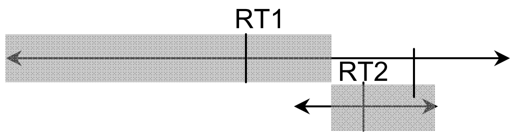
The identification window of Peak 1 becomes: [0.9-1.5] where 1.5 = RT1 + (RT2-RT1)/2

The identification window of Peak 2 becomes: [1.5-2.15] where 1.5 = RT2 - (RT2-RT1)/2

Example 2: a peak window belongs entirely to another.

Peak 1: RT1= 1.7 ID window: 0.45: [1.25 -2.15]

Peak 2: RT2= 1.99   ID window: 0.04(W2) [1.95 -2.03]



The identification window of Peak 1 becomes: [1.25-1.97]

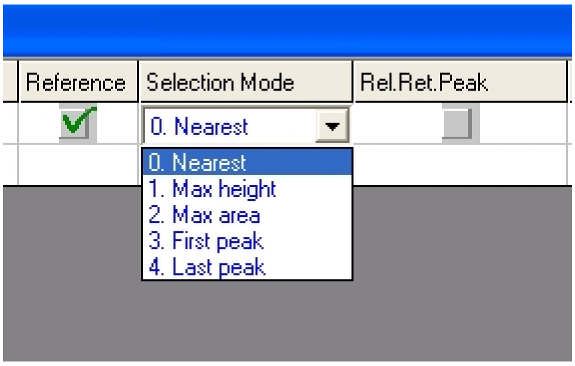
where $1.97 = RT1 + \left(RT2 - RT1 - \frac{W2}{2} \right)$

The identification window of Peak 2 becomes: [1.97-2.03] where

$$1.97 = RT2 - \left(\frac{W2}{2} \right)$$

24.6.8.4.2 Finding Reference Peaks

An identification window is defined for each peak.
A peak is identified as the reference peak if its retention time is found to be within the reference identification window. If there are no such peaks, the reference is not found.



If a reference identification window contains several peaks, the reference peak is chosen according to the selected reference window mode:

- **Nearest**
  The peak will be the one whose retention time is the closest to the defined time.

- **Max height**
  The peak will be the highest one.

- **Max area**
  The peak will be the largest one.

- **First**
  The peak will be the first peak found in the reference window.

- **Last**
  The peak will be the last peak found in the reference window.

Once the reference peaks are identified, the 490-GC PRO will identify the other peaks.

24.6.8.4.3 Identification of the Non Reference Peaks

Generally, the retention times are recalculated according to the two adjacent reference peaks. The formula for calculating the expected retention times for the non-reference peaks is:

$$RT = RT_1 + (RT_{ID} - RT_{ID1}) \times \frac{RT_2 - RT_1}{RT_{ID2} - RT_{ID1}}$$

Where

RT is the expected retention time for a non reference peak.

RT_1 is the real retention time of the reference peak preceding the peak.

RT_2 is the real retention time of the reference peak following the peak.

RT_{ID} is the theoretical retention time of the peak defined in the identification table.

RT_{ID1} is the theoretical retention time of the reference peak preceding the peak, defined in the identification table.

RT_{ID2} is the theoretical retention time of the reference peak following the peak, defined in the identification table.

If peaks are eluted before the first reference peak: $RT_1 = RT_{ID1} = 0$. The index 2 is attributed to the next reference peak:

$$RT = RT_2 \frac{RT_{ID}}{RT_{ID2}}$$

If a peak appears after the last reference peak:

$$RT = RT_1 + (RT_{ID} - RT_{ID1}) \times \frac{RT_1 - RT_0}{RT_{ID1} - RT_{ID0}}$$

where RT_0 and RT_1 represent respectively the real retention times of the two reference peak eluted before the peak of interest.

Note that this correction step works best when reference peaks are distributed throughout the entire chromatogram. In particular, be careful when using references that elute only at the beginning of a long run. They have a too strong impact on retention times at the end of the run. To minimize this effect, define a reference peak at the end of the run.

Once the system has calculated expected retention times for the remaining peaks, it centers the calculated identification windows on these times. If any windows overlap, the system will resolve the conflicts.
If several peaks fall within a window, the correct peak is chosen according to the selected identification mode:

- **Nearest**
  The peak will be the one whose retention time is the closest to the defined time.

- **Max height**
  The peak will be the highest one.

- **Max area**
  The peak will be the largest one.

- **First**
  The peak will be the first peak found in the reference window.

- **Last**
  The peak will be the last peak found in the reference window.

Note that if a reference peak is not found, its retention time will be the retention time set in the identification table, as if it had not shifted at all, therefore the identification of the peaks placed between the previous and the next reference peak may be affected.
If no reference peak is defined or found, peaks are identified by the retention times set in the identification table. Each peak retention time is compared to the identification window defined in the identification table.

Example:

For example, assume that three peaks exist in a chromatogram with theoretical retention times (saved in the identification table) of 5, 6, and 10 seconds.

When the sample is analyzed, the retention times have shifted to 6, 7.2, and 12 seconds. If the identification windows are 0.5 minutes wide, and reference peaks are not used, the peaks will not be identified.

However, if the last peak at 12 seconds is defined as the reference peak, and it elutes 1.2 times later than the defined theoretical retention time of 10 seconds, the expected retention times for the two other peaks (non-reference peaks) can be calculated.

First peak: 5 x 1.2 = 6 seconds.

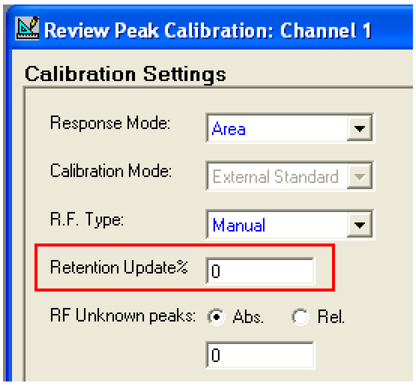
Second peak: 6 x 1.2 = 7.2 seconds.

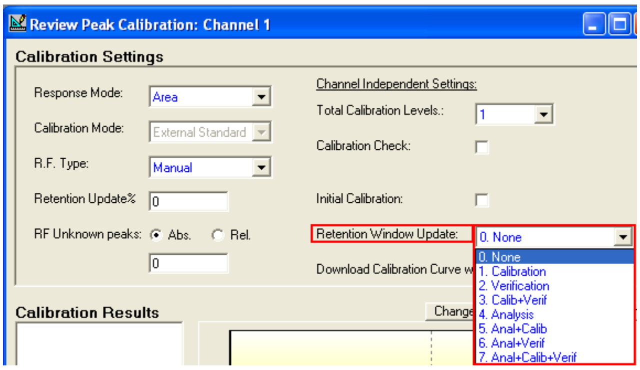
The first two peaks can now be identified correctly with these new corrected retention times.

24.6.8.5 Moving Retention Window

The main peak identification is performed on retention window as defined in the Peak Identification/Calibration table on page 134. However the retention of a peak can drift in time. Although the drift is small, on a longer time the peak can drift outside its retention window. The retention window of a peak can be setup to follow the actual retention in order to compensate for retention drift.
Open the ‘Calibration’ window and set the parameters “Retention Update%” and “Retention Window Update” to activate retention compensation.

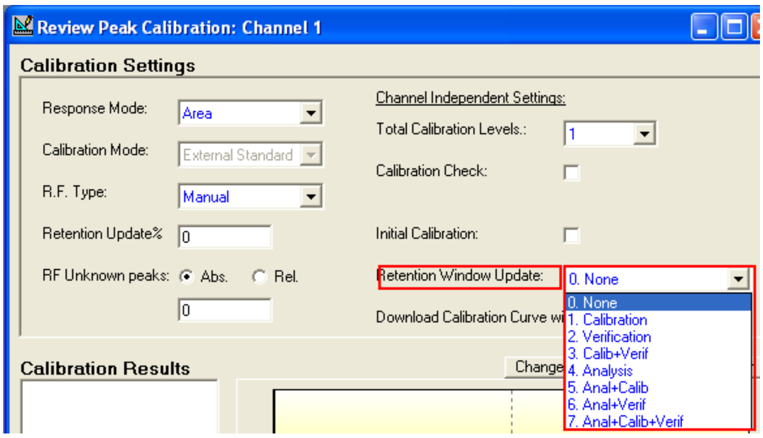
- **Retention Update%**





With the ‘Retention Update%’ parameter one can set the percentage of shifting the Retention Window as defined in the Peak Identification/Calibration table. Use this parameter in order to use the optimum retention window for peak identification. A peaks retention can shift over a longer period. By setting a positive value in the ‘Retention Update%’ the retention window will shift with the percentage the retention from a peak differs from the retention in the Peak Identification/Calibration table. One can determine to ony update the retention window on a specific sample type, for instance a calibration run.
New_Ret = Current_Ret + ((New_Ret - Current_Ret) * RetentionUpdate / 100)

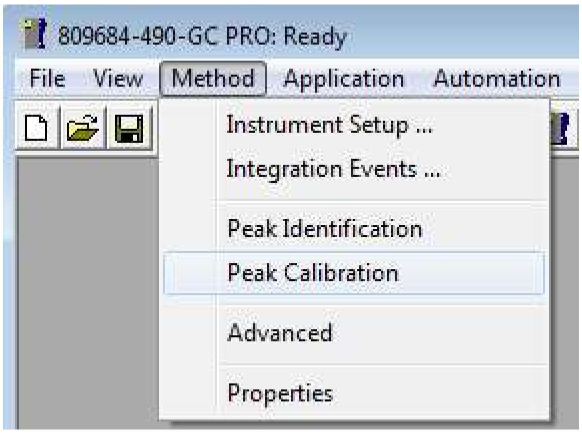
- **Retention Window update**



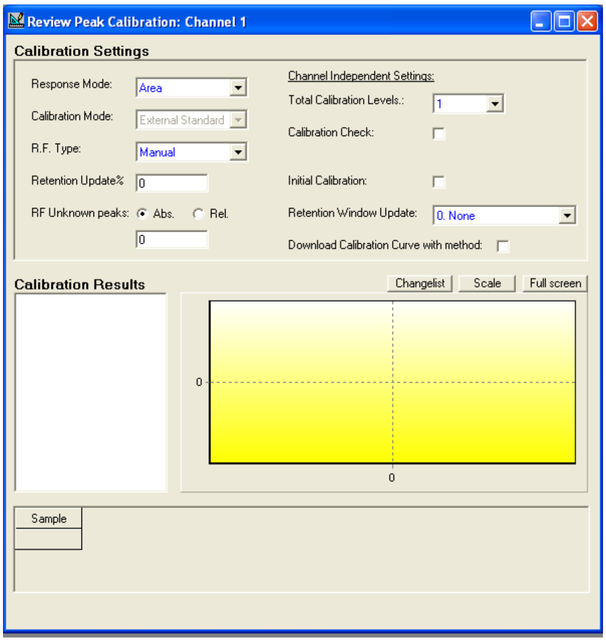
Select the type of runs on which the retention window must be updated for a GC channel.

24.6.9 Quantification/Calibration

The aim of this step is to define the calibration parameters.
To define the calibration parameters select the Method/Peak Calibration menu.



A default calibration window will appear with several calibration options see figure below. The following chapter describes the functionality of the different Calibration Settings.

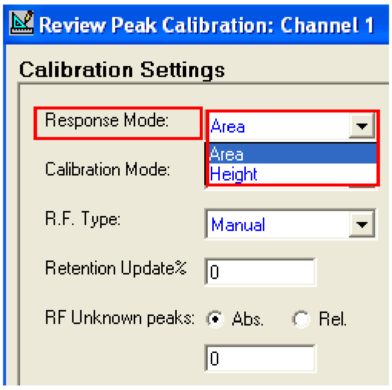


24.6.9.1 Calibration parameters (channel dependent)

Channel unique calibration parameters.

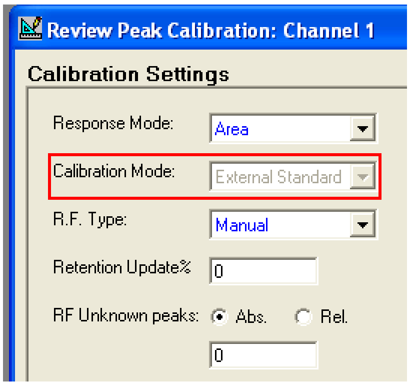
24.6.9.1.1 Response Mode

Define the Response Mode. Select Area or Height from the list.
This defines the processing of the peak concentration. For most applications on a 490-GC PRO Micro-GC, area must be selected.

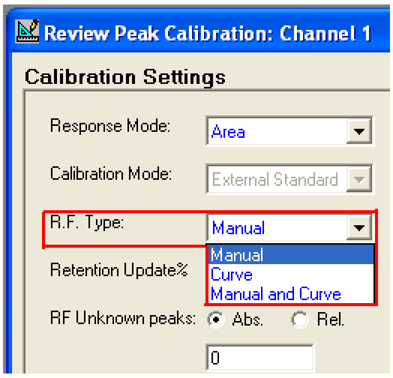


24.6.9.1.2 Calibration Mode

External Standard mode is the fixed mode for the calibration run.



24.6.9.1.3 R.F. type



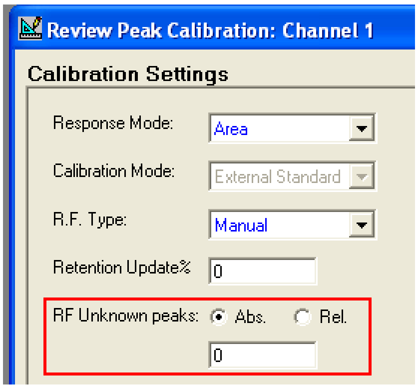
Define how the Response factor should be determined. There are three options.

- Manual.
  If the components Response Factor cannot be determined from a calibration mixture, it must be set manually in the Peak Identification/Calibration table.
  The concentration of a peak (Q) is determined by using the equation:
  Q= RF x R
  in which RF is the Manual R.F. of the component in the Peak Identification/Calibration table. R is the response (area and height) of the peak.

- Curve.
  If a component exists in the calibration mixture, the Response Factor can be determined by the instrument by running a calibration run. This option requires that every component in the Peak Identification/Calibration table for that particular GC channel exists in the calibration mixture. Manually R.F. for other peaks are ignored and resulting in a peak concentration zero.
  The cordinates of a calibration point in the curve are the response area/height of the compound and the associated quantity (amount).
  The concentration of a peak (Q) is determine by using the equation:
  $Q = a * x^3 + b * x^2 + c * x + d$
  in which a is the Cubic Coeff., b the Quadratic Coeff., c the Linear Coeff. and the Intercept Coeff. From the Peak Identification/Calibration table. x is the response (area or height) of the peak.

- Manual and Curve
  If both manual R.F. and determined R.F. by the instrument are performed in one GC channel, select this option. See description for R.F. type ‘Manual’ and ‘Curve’.

24.6.9.1.4 RF Unknown peaks



It is possible to process the Response Factor of unknown components in two different ways. These are:

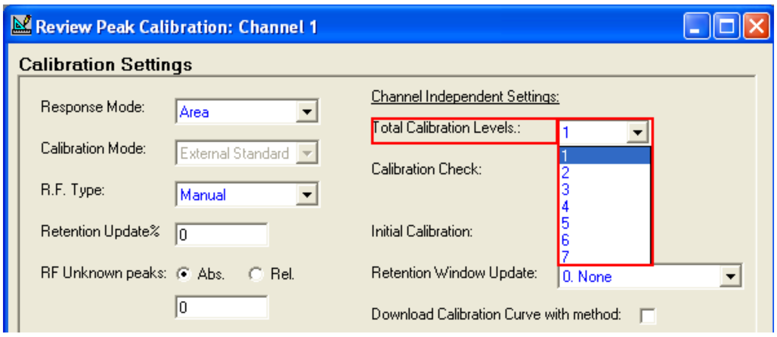
- Absolute (Abs.)
  Enter the Response Factor for all unidentified peaks of this GC channel. This R.F. is determined outside the instrument or described in literature.
  The concentration of an unidentified peak (Q) is determined by using the equation:
  Q= RF x R
  in which RF is the value from 'RF Unknown peaks' and R is the response (area and height) of the peak.

- Relative (Rel.)
  In order to determine the concentration of an unidentified peak, the Response Factor will be used from the first identified peak following the unidentified peak.
  The concentration of an unidentified peak (Q) is determined by using the equation:
  $Q = a * x^3 + b * x^2 + c * x + d$
  in which a is the Cubic Coeff., b the Quadratic Coeff., c the Linear Coeff. and the Intercept Coeff. From the Peak Identification/Calibration table of the identified peak following (higher retention) the unidentified peak. x is the response (area or height) of the unidentified peak.

24.6.9.2 Calibration parameters (channel independent)

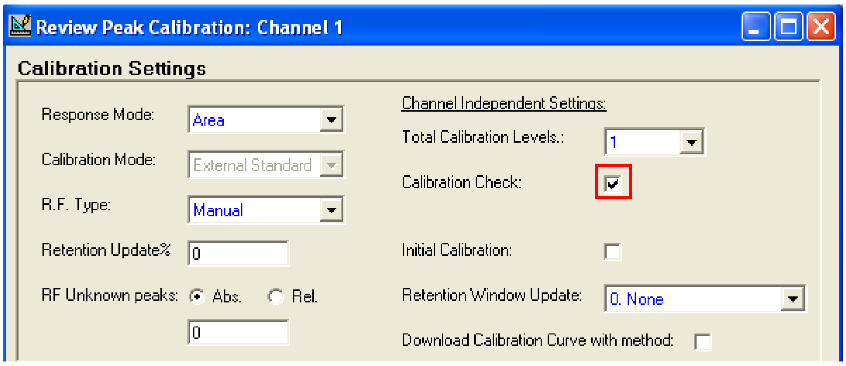
Calibration parameters common for all GC channels.

24.6.9.2.1 Total calibration level



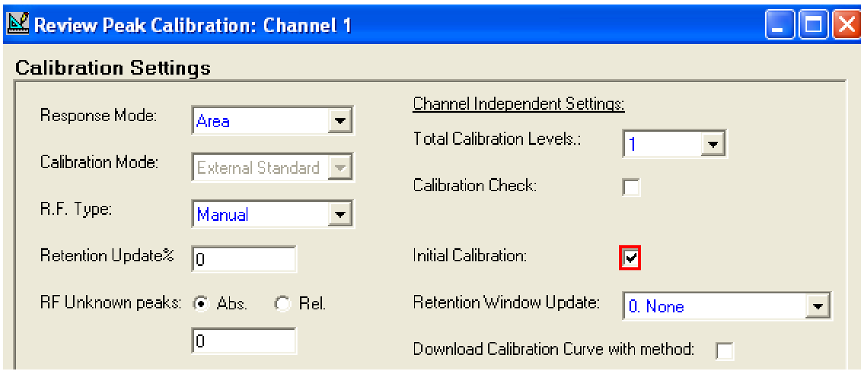
Determines the Total Calibration Levels that are required. If only a single level calibration is performed select ‘1’. For Multi Level Calibration define the total levels to be used (maximal 7 levels). Detailed description of Multi Level Calibration is described in Calibration on page 321

24.6.9.2.2 Calibration Check



A calibration check is used to check whether the response factor (curve) drifts away in time after every new calibration. When a new calibration is performed the detector response will be compared with the initial calibration. In a single calibration level system enter the percentages of drifiting allowed in the Peak Identification/Calibration table on page 134 (Initial RF% and Current RF% attributes).
For a multilevel calibration level with a field correction calibration (Rw), the allowed drifting is entered in the Rw Limit% field.

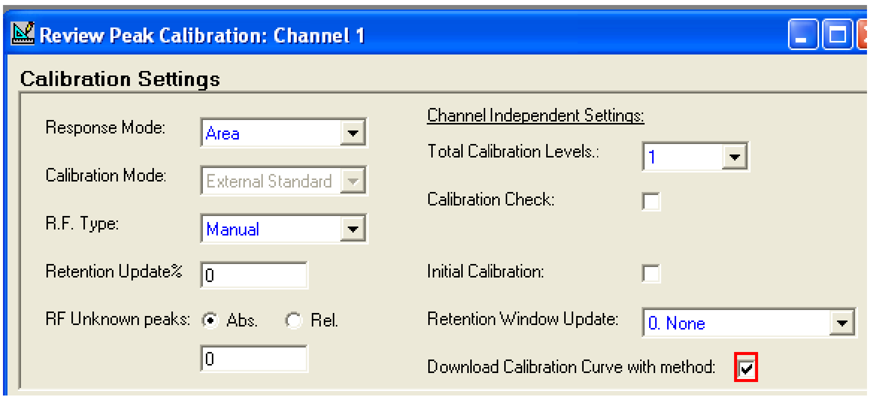
24.6.9.2.3 Initial Calibration



If it is required to check the Response factor of a new calibration run against current Response factor (determined in last calibration run) and initial Response factor (determined in an Initial Calibration run) select this option.
To setup a check for Response factors do the following:

- Select both 'Initial Calibration' and 'Calibration Check' and download method to the instrument and perform a calibration run(s). All new Response factors will not be checked and stored in the instrument as "Initial RF" values.
- Deselect 'Initial Calibration'. Download the method to the instrument.
- In the Peak Identification/Calibration table on page 134 enter percentages for InitialRF% and CurrentRF% attributes.
- Now perform analysis and daily calibration run(s) with 'Calibration Check' (still) on. When a calibration run is performed and one of the peaks new R.F. exceeds its limits for InitialRF and CurrentRF, the entire calibration will be rejected and the instrument continuous with R.F. from the last good calibration.

24.6.9.2.4 Download Calibration Curve with method

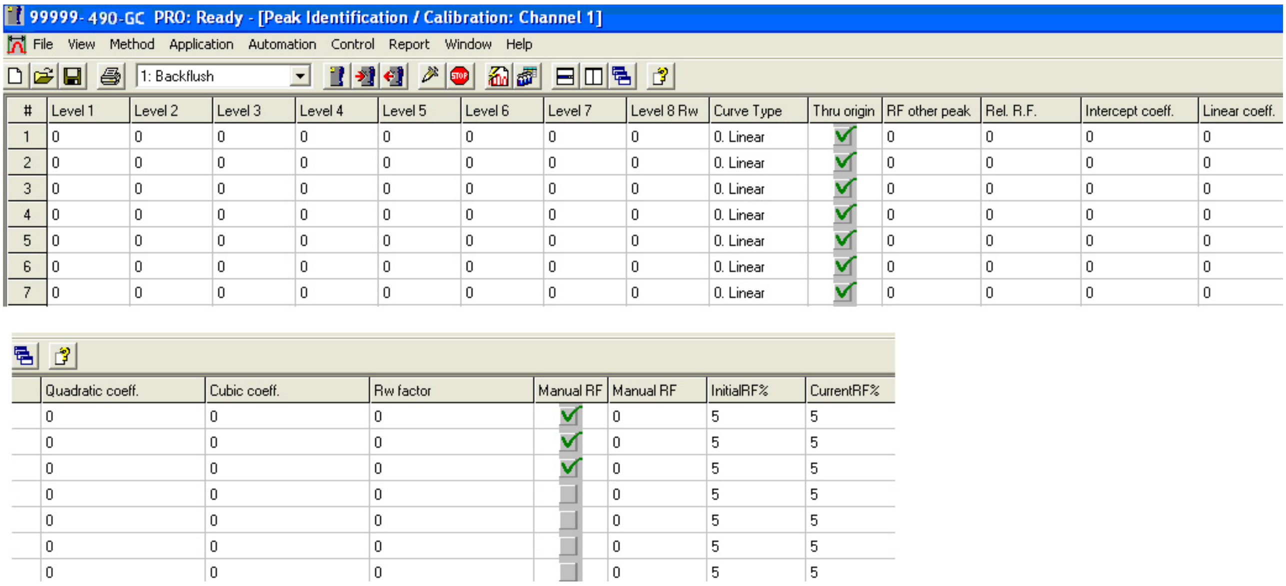


If a calibration curve (or R.F.) is determined outside the instrument select "Download Calibration Curve with method" option. Enter the curve coefficients in the Peak Identification/Calibration table on page 134.
Find more information in chapter Offline Calibration on page 323.
Note: After downloading the new Calibration Curve (download Method) disable this option.

24.6.9.3 Prepare a Calibration Method

Setting up all parameters for a calibration.

24.6.9.3.1 Peak Identification/Calibration table



This part defines how to prepare the calibration. Open the Peak Identification/Calibration table. Here peaks are listed in order of their retention time and appropriate component name. Complete the Peak ID table.

- **<u>Level 1-7</u>**
  Fill in the “Levels” in the corresponding fields (level 1 to 7). These are the concentrations of components labeled on the gas bottle containing the calibration mixture. Level 1 contains the lowest sample concentration and level 7 the highest, see chapter On Line Calibration on page 325.

- **<u>Level 8 Rw</u>**
  Fill in the Level 8 Rw value if performing a multi level calibration with a field calibration correction. These are the concentrations of components labeled on the gas bottle containing the field calibration mixture, see chapter Rw Calibration on page 326.

- **<u>Curve Type</u>**
  Three types of mathematical regression models are available, see chapter Calibration on page 321.

- **<u>Thru origin</u>**
  The curve will be forced to go through the origin (0.0). Find more information on chapter Calibration on page 321.

- **<u>RF other peak</u>**
  Select the peak number to use the calibration curve from. For instance if peak 4 in the peak Identification table is n-Butane and peak 8 is n-Hexane and requires the Response factor from n-Butane, enter ‘4’ in ‘RF other peak’ for n-Hexane peak.

- **<u>Rel. RF</u>**
  Must be used in combination with ‘RF other peak’. This is an extra factor multiplied with the Response factor from the peak referring to.
  The concentration of an identified peak (Q) is determined by using the equation:
  Qpeak = R * R.F.other_peak * Rel.RF.
  in which R.F.other_peak is response factor from the peak referring and R is the response (area and height) of the peak.

- **Intercept Coeff.**
  The calculated intercept coefficient of the calibration curve. Can also be set manually if the calibration is determined off-line. Find more information in chapter Calibration on page 321 and chapter Download Calibration Curve with method on page 149.

- **Linear Coeff.**
  The calculated linear coefficient of the calibration curve. Can also be set manually if the calibration is determined off-line. Find more information in chapter Calibration on page 321 and chapter Download Calibration Curve with method on page 149.

- **Quadratic Coeff.**
  The calculated Quadratic coefficient of the calibration curve. Only required if calibration curve is set to Quadratic of Cubic. Can also be set manually if the calibration is determined off-line. Find more information in chapter Calibration on page 321 and chapter Download Calibration Curve with method on page 149.

- **Cubic Coeff.**
  The calculated Cubic coefficient of the calibration curve. Only required if calibration curve is set to Cubic.Can also be set manually if the calibration is determined off-line. Find more information in chapter Calibration on page 321 and chapter Download Calibration Curve with method on page 149.

- **Rw factor**
  The calculated Rw coefficient of the calibration curve. Only required if a multi level calibration is performed with a field correction calibration. Find more information in chapter Rw calibration on page 326.

- **Manual RF selection**
  Select this option if the Response factor can/should not be determined by the instrument and will be set manually by the operator. This option can only be used in single level calibration for a component. If selected enter a Response Factor in the next column 'Manual RF'.
  Find more information in chapter R.F. type on page 146.

- **Manual RF value**
  Enter a manual Response factor if 'Manual RF' was selected in the previous column. Find more information in chapter R.F. type on page 146.

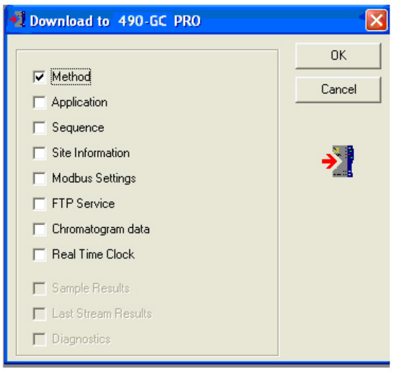
- **Initial RF%**
  This is the limit percentage the calculated Response Factor from a new calibration run can differ from the Initial Response Factor for that component. The entire calibration for all components will be rejected if exceeding this limt. Use this setting only for a single level calibration.
  Find more information in chapter Calibration Check on page 148 and chapter Calibration validation on page 339

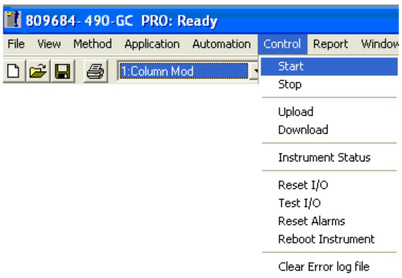
- **Current RF%**
  This is the limit percentage the calculated Response Factor from a new calibration run can differ from the Current Response Factor for that component. The entire calibration for all components will be rejected if exceeding this limt. Use this setting only for a single level calibration.
  Find more information in chapter Calibration Check on page 148 and chapter Calibration validation on page 339

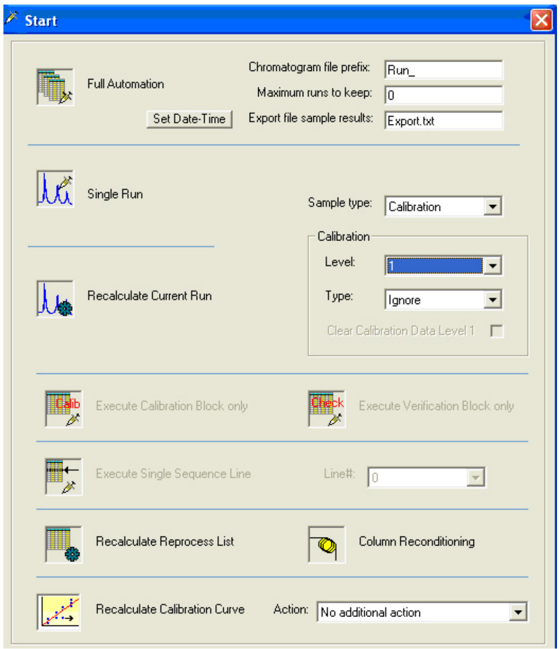
24.6.9.3.2 Running a new Calibration

If the calibration curve is not determined outside the instrument, but must be determined inside the instrument, perform all calibration levels in order to let the instrument determine the calibration curve for every peak.
Make sure the Calibration method is saved and downloaded to the instrument. Start a Calibration run via Control\Start. Define correct parameters and Press “Single Run” or run the Calibration block if it is prepared.

Note: If a calibration analysis is already performed reprocess the existing “Calibration run” manually for the selected level.







After completion of the run, the 490-GC PRO processes the chromatogram.
The chromatogram, analysis results and the updated method containing the calibration curve will be automatically uploaded to PROstation.
The Analysis results can be found in the Integration Report, see Figure 12.
The updated calibration curve can be found in the Preview Calibration window, see Figure 10.
The calibration curve coefficients can be found in the Peak Identification/Calibration window, see Figure 11.

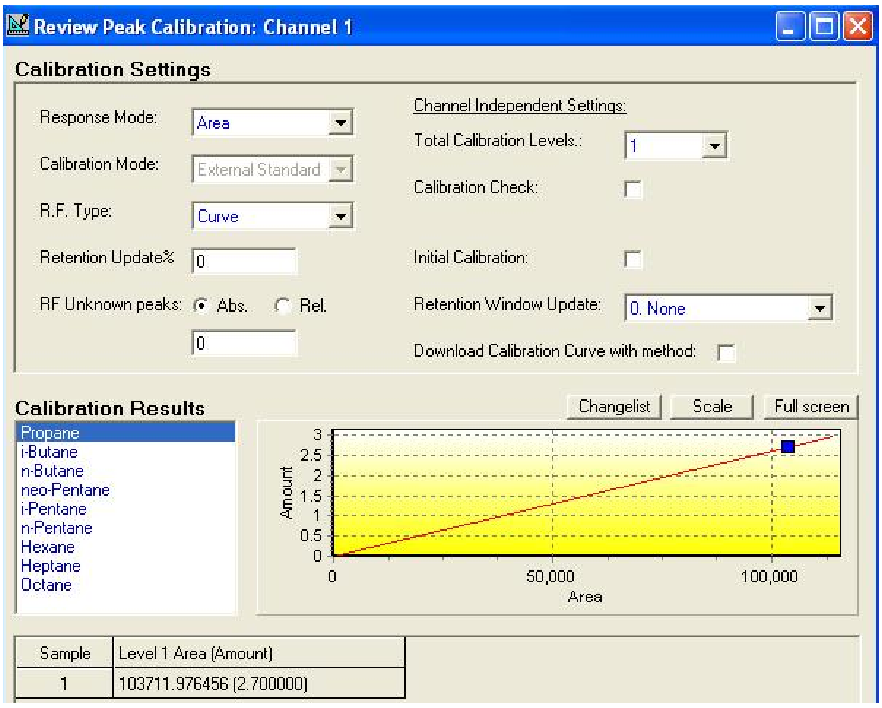


Figure 10: Example of a Calibration Curve (single calibration level).

Peak Identification / Calibration: Channel 1

#	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Curve Type	Thru origin	RF other peak	Intercept coeff.	Linear coeff.	Quadratic co
1	8.2	0	0	0	0	0	0. Linear	✓	0	0	30328.0095141151	0
2	1.01	0	0	0	0	0	0. Linear	✓	0	0	44087.287923873	0
3	0.139	0	0	0	0	0	0. Linear	✓	0	0	52558.1201747489	0
4	0.199	0	0	0	0	0	0. Linear	✓	0	0	51790.3908422235	0
5	0.0011	0	0	0	0	0	0. Linear	✓	0	0	47256.2706191814	0
6	0.007	0	0	0	0	0	0. Linear	✓	0	0	60601.7721216526	0
7	0.00098	0	0	0	0	0	0. Linear	✓	0	0	70098.413805452	0

Figure 11: Peak ID/Calibration table after calibration

Integration Report

#	Channel	Peak #	Peakname	Width	Separ.Code	Validation	Pk Start [s]	Pk End [s]	Assymetry 5%	New RF	InitRF Alarm
1	1	1	Peak1_11.49	0.4039	BB	0	11.12	12.19	1.4377	3.29728E-5	
2	1	2	Peak2_13.76	0.4258	BV	0	13.08	16.05	1.1155	2.26823E-5	
3	1	3	Peak3_16.95	0.5511	VV	0	16.05	18.43	1.0163	1.90266E-5	
4	1	4	Peak4_19.52	0.5729	VV	0	18.43	20.48	1.0291	1.93086E-5	
5	1	5	Peak5_20.8	0.7406	VB	0	20.48	21.94	2.1322	2.11612E-5	
6	1	6	Peak6_28.5	0.9060	BB	0	25.57	30.05	1.0119	1.65012E-5	
7	1	7	Peak7_33.05	0.9069	BB	0	31.62	35.09	1.6320	1.42657E-5	

Figure 12: Example of an Integration report.

24.6.9.3.3 Recalibrating an existing ‘Calibration’ run

If a “Calibration” run (chromatogram) is already collected, reprocessing this data is sufficient to let the instrument determine the calibration curve. In all cases make sure the method is saved and method and chromatogram are downloaded to the instrument, see Figure 13.

Identical to the description in chapter Running a new Calibration, chromatogram, method and analysis results will be uploaded to PROstation after the processing.

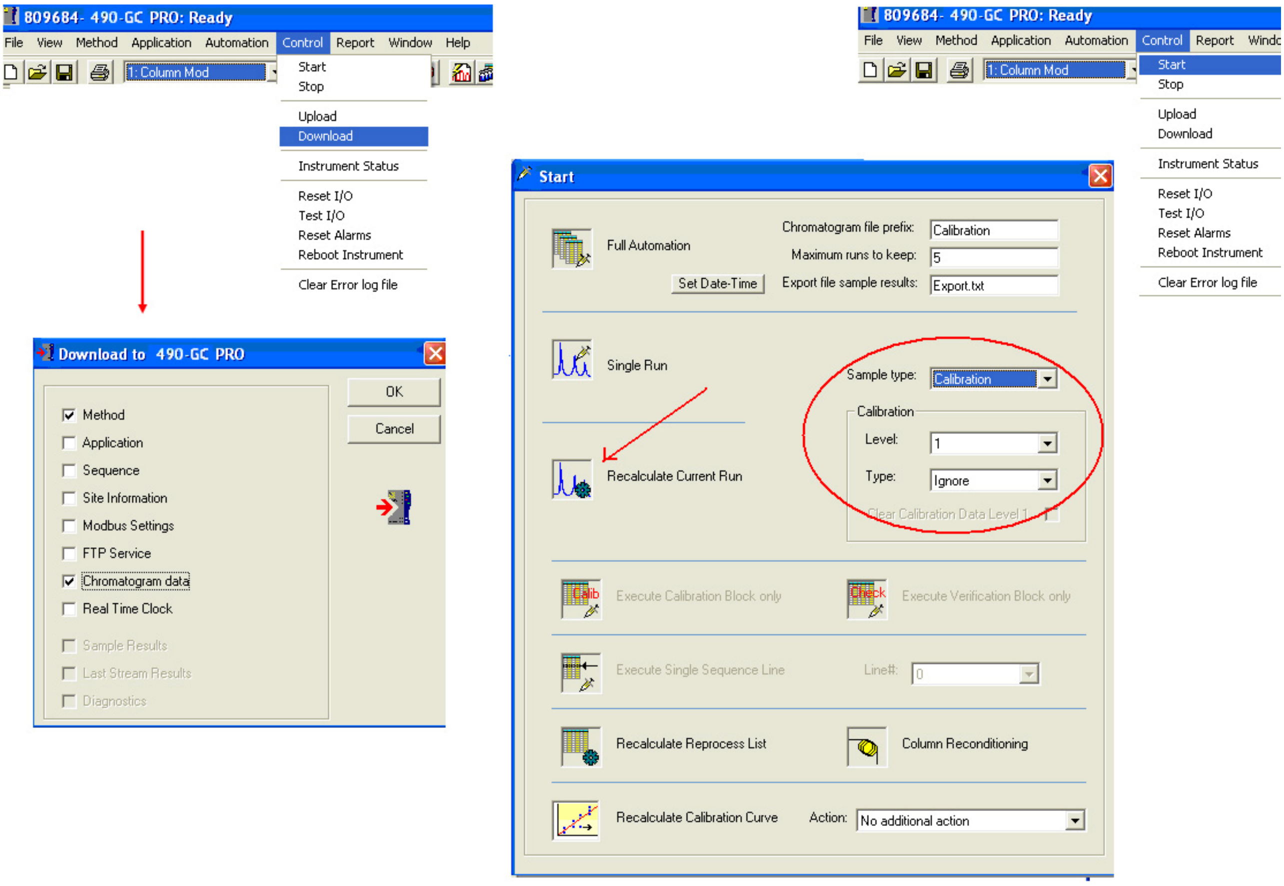
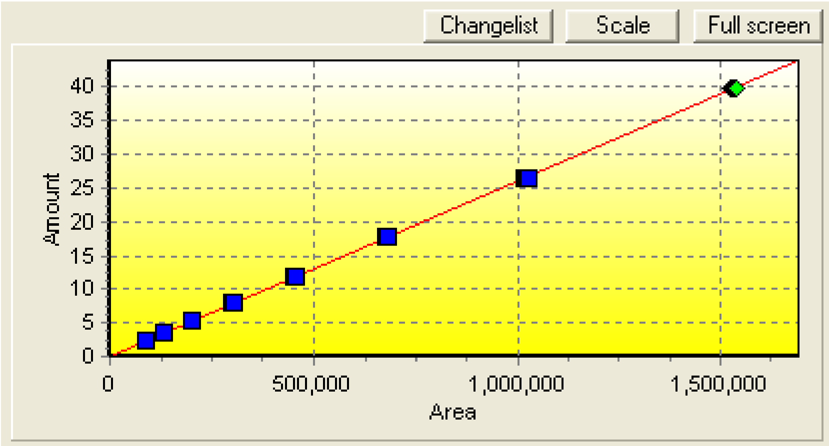


Figure 13: Reprocessing a calibration run.

24.6.9.4 Calibration Chart

The Calibration graph has certain functionality that makes it easier to work with and inspect the Calibration curve.



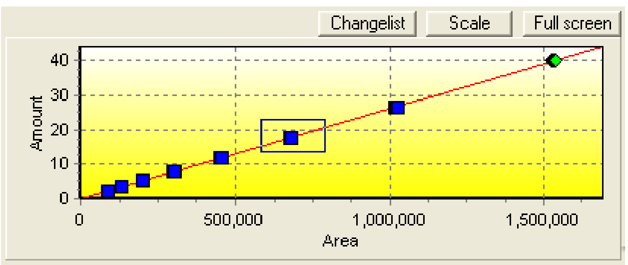
Buttons:
- Show changelist See 24.6.9.4.1
- Change scale of curve. See 24.6.9.4.4 Scale setting
- Show curve in full screen. See 24.6.9.4.4 Scale setting

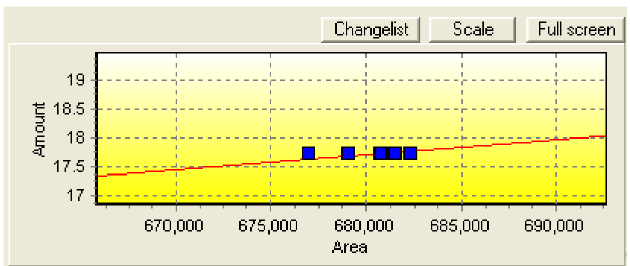
24.6.9.4.1 Change list

Click on the button 'Changelist' to load the change list. The function of the change list is explained in paragraph 24.6.9.4.7 Remove and revert calibration outliers.

24.6.9.4.2 Zoom functionality

By selecting a location (rectangle) in the calibration chart with the left mouse button and by then dragging from the left upper position to right bottom (keeping the left mouse button pressed), will show a zoom rectangle. If the left mouse button is released, the chart will zoom in on the rectangle shown.





To zoom out, select any location in the calibration chart with the left mouse button and then drag from lower right to upper left corner of chart (keeping the left mouse button pressed). Again a rectangle is shown. When the left mouse button is released, the chart will fully zoom out.

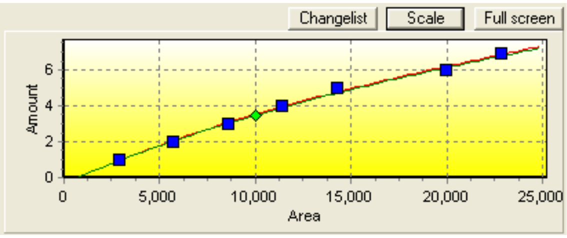
24.6.9.4.3 Drag functionality

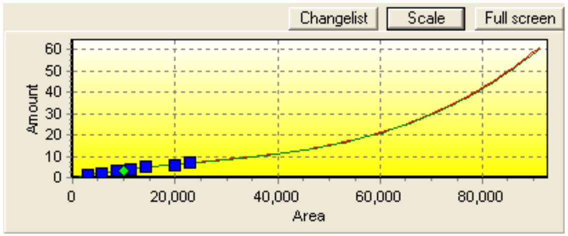
Select any location in the calibration chart with the right mouse button and drag the mouse, keeping the right mouse button pressed. Now the calibration lines and points are dragged along in the chart window.
When the mouse button is released the calibration chart will remain as shown at that moment.

24.6.9.4.4 Scale setting

The scale button can be used to quickly inspect what shape/behaviour the calibration curve has for higher concentrations. Typically this function can be useful for non linear calibration curves.

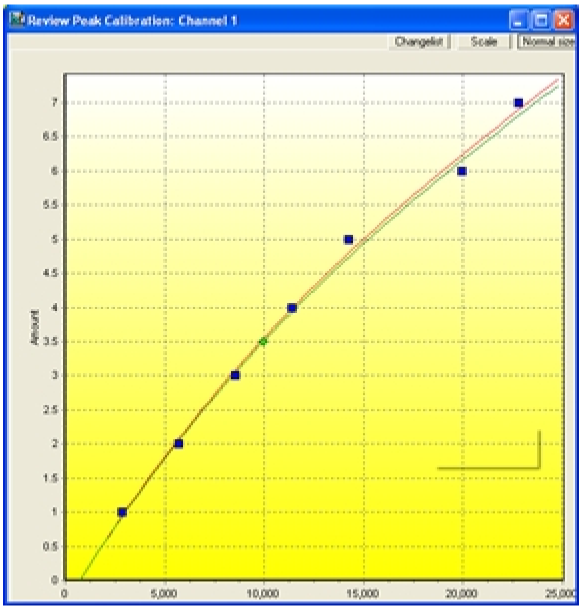
The scale button switches between 3 steps. The default step is the same as the fully zoomed out view. The two other scale modes show the calibration curve for an amount respectively 4 times bigger and 20 times bigger than the biggest amount currently in the calibration graph.





24.6.9.4.5 Full Screen

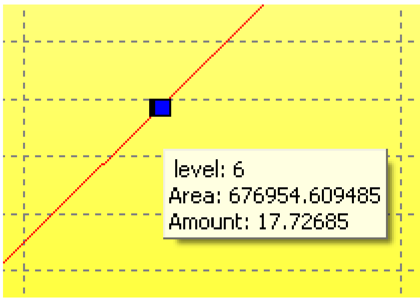
Use the button ‘Full screen’ to show the calibration chart maximized within the ‘Review Peak Calibration’ window. All calibration chart functionality, like drag and zoom functionality, are available in this view.



To return to the normal view, use the ‘Normal Size’ Button.

24.6.9.4.6 Calibration graph tooltip text

When pointing with the mouse pointer at a calibration point or a calibration line, a so called tooltip text will appear supplying information about the item the mouse pointer is pointing at.
When the mouse pointer is hovering over a calibration point, it presents the Calibration level number, Area and amount of that calibration point. In case the mouse pointer is pointing at a calibration line, the tooltip text appears, presenting the Area and Amount of the location on the calibration line.
In case the mouse pointer is pointing at an Rw Calibration point or corrected Rw calibration line, the tooltip text will inform about this as well.
Find more information about an Rw calibration on chapter Rw calibration on page 326.

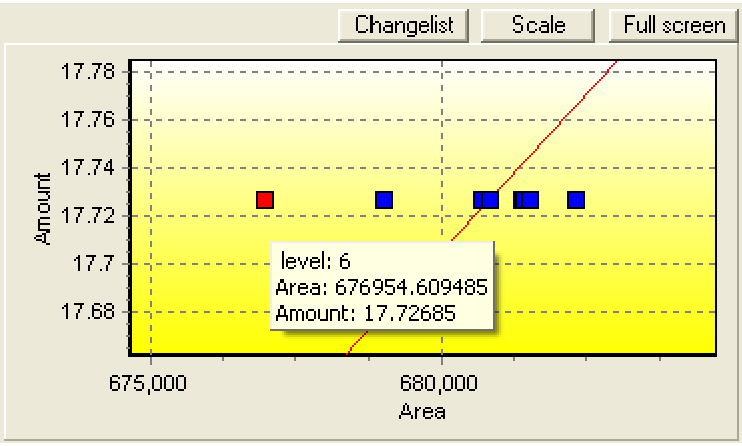


24.6.9.4.7 Remove and revert calibration outliers

24.6.9.4.7.1 Marking calibration Outliers for delete

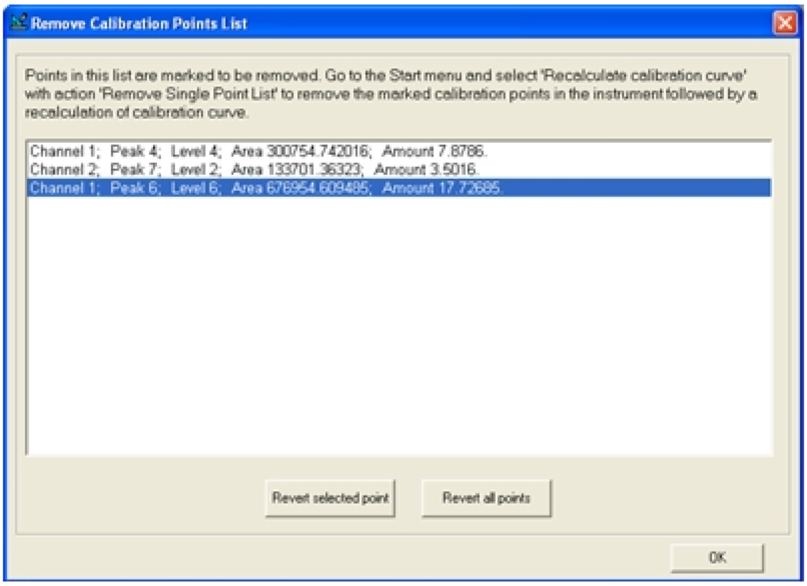
Removing outliers from the calibration curve can be performed by means of the remove single calibration points mechanism. This chapter describes how this mechanism works and how to use it.

When clicking on a calibration point with the left mouse button, this point will be marked for deletion. Marking for deletion means that the calibration point is stored in a change list and the point will be colored red in the calibration graph.



Note that if calibration points are very close to each other, the red colored calibration point might not be visible.

To view the calibration point change list, open the change list viewer by clicking on the 'ChangeList' button. The change list viewer shows the GC channel, component, calibration level, Area and Amount of the calibration points that are marked for deletion. The change list can contain numerous points of different channels, components and levels.

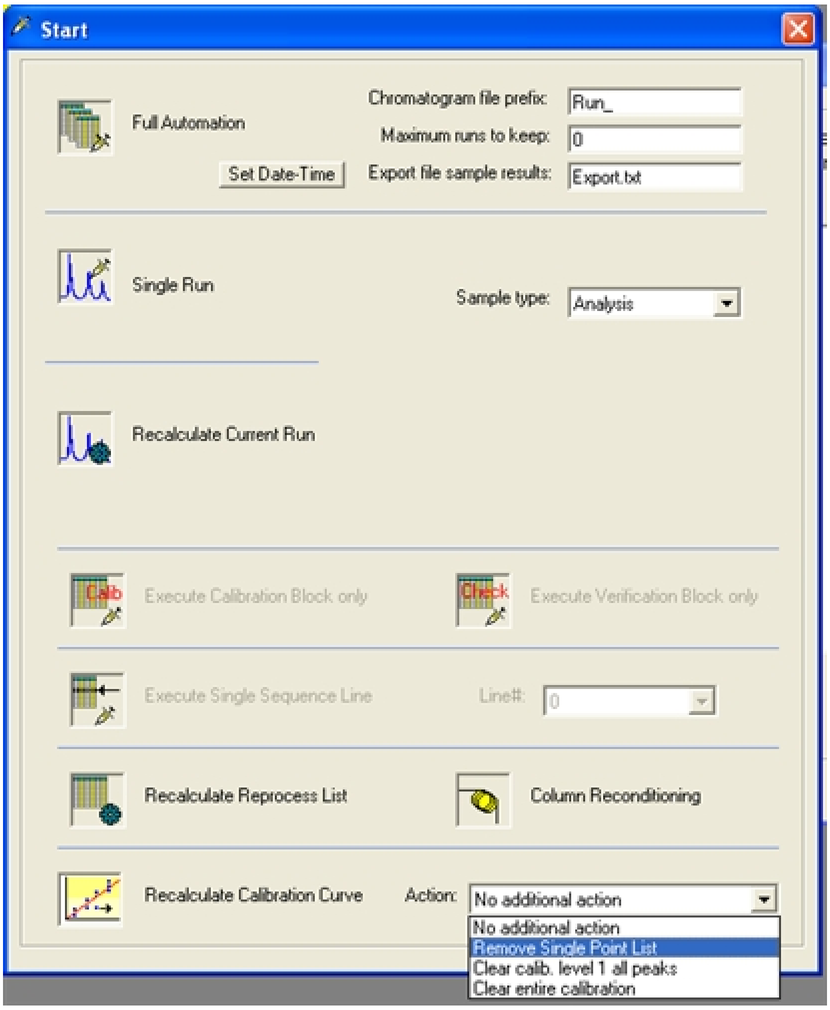


Note that the change list is cleared when a method is uploaded from the instrument or when a new method is opened or when PROstation is closed

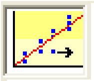
24.6.9.4.7.2 *Removing calibration outliers*

The points are only marked visually, but they still are present in the calibration chart. Note that at this stage the ‘Changelist’ only exists in PROstation and not in the instrument. To remove the marked calibration points from the calibration graph, proceed as follows:

- Select the ‘Start automation’ button from the tool bar (or select ‘Start’ from the ‘Control’ menu).



- Go to the ‘Recalculate Calibration Curve’ section and select the item ‘Remove Single Point List’ from the ‘Action‘ list.
- Click on the ‘Recalculate Calibration Curve’ button



- Now all marked calibration points are removed from corresponding calibration graphs (graphs from the different channels and components) and all calibration curves are recalculated. Afterwards the method is automatically uploaded including the updated calibration curves with the previous marked points removed. Note that the curve equation exists in the method peaktable.
- The change list is cleared, since all points previously in the change list are now removed.

Note that points marked for delete can only be deleted by means of above guideline and not by downloading the method. The change list is not downloaded to the instrument.

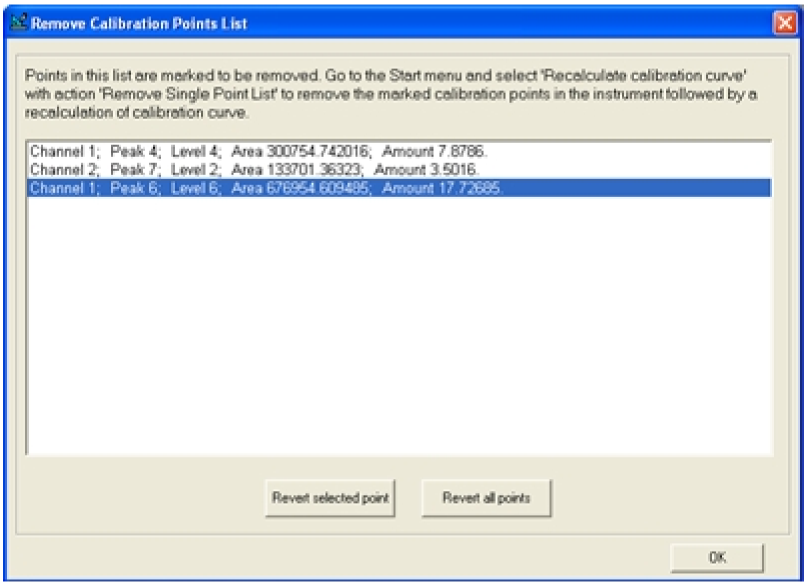
Note that the item ‘Remove Single Point List’ in the ‘Recalculate Calibration Curve’ list only exists when there are points in the Change list.

24.6.9.4.7.3 Reverting calibration points marked for deletion

When accidently an incorrect calibration point is marked for delete, this can be reverted. To revert a calibration point in the change list, that calibration point is removed from the change list and is colored black again in the corresponding calibration graph. When actually removing the marked points as described in paragraph 24.6.9.4.7.2, the reverted points will not be removed.

One can choose to revert a single point from the list or to revert the complete list at once.

- Go to the Calibration method
- To view the calibration point change list, start the change list viewer by clicking on the button ‘ChangeList’
- Select a calibration point to revert by clicking on it
- Click on the button ‘Revert Selected Point’
- To remove several point, redo this procedure



- To revert all points at once, click on the button 'Revert All Points' in stead

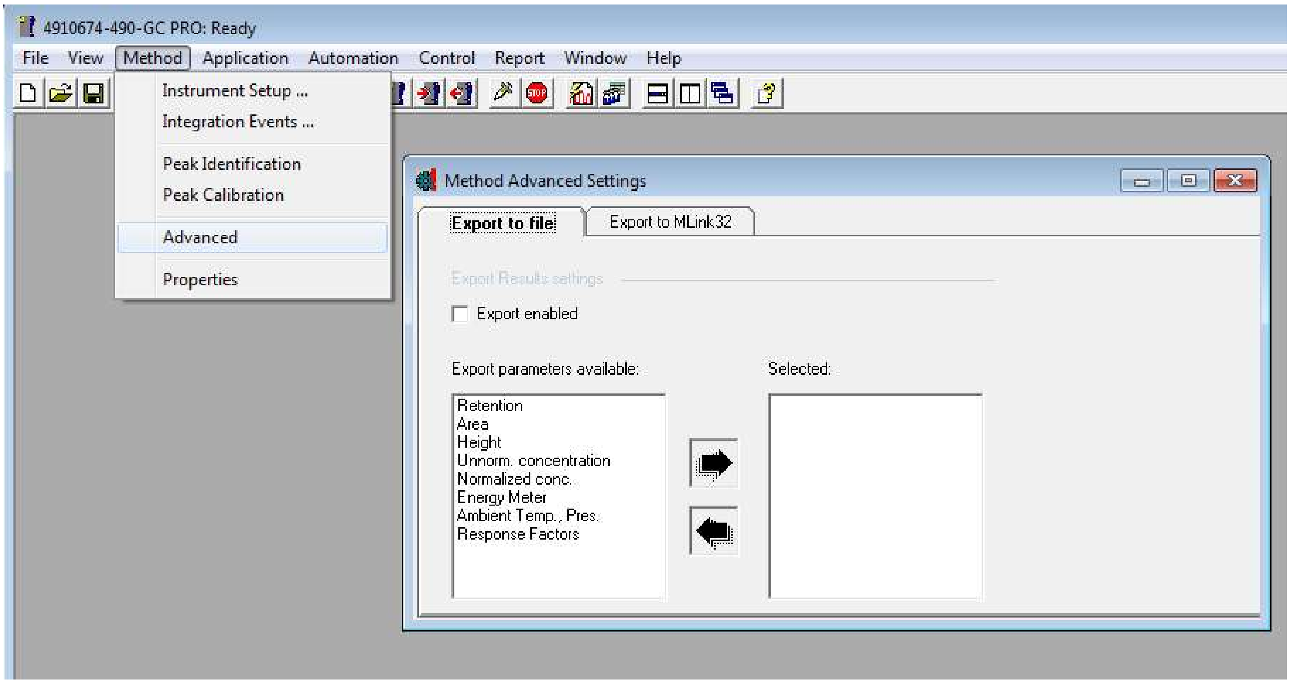
NOTE

Note that points can only be reverted before the procedure as described in paragraph 24.6.9.4.7.2 is executed.

24.6.10 Method Advanced

From the PROstation toolbar, select method/advanced:

By moving the highlighted items from left to right, the user identifies which properties should be exported to a file. Both peak properties as well as global properties can be exported. Each run, one line is added to the export file. The export file name should be entered at the start of the automation (Control/start).



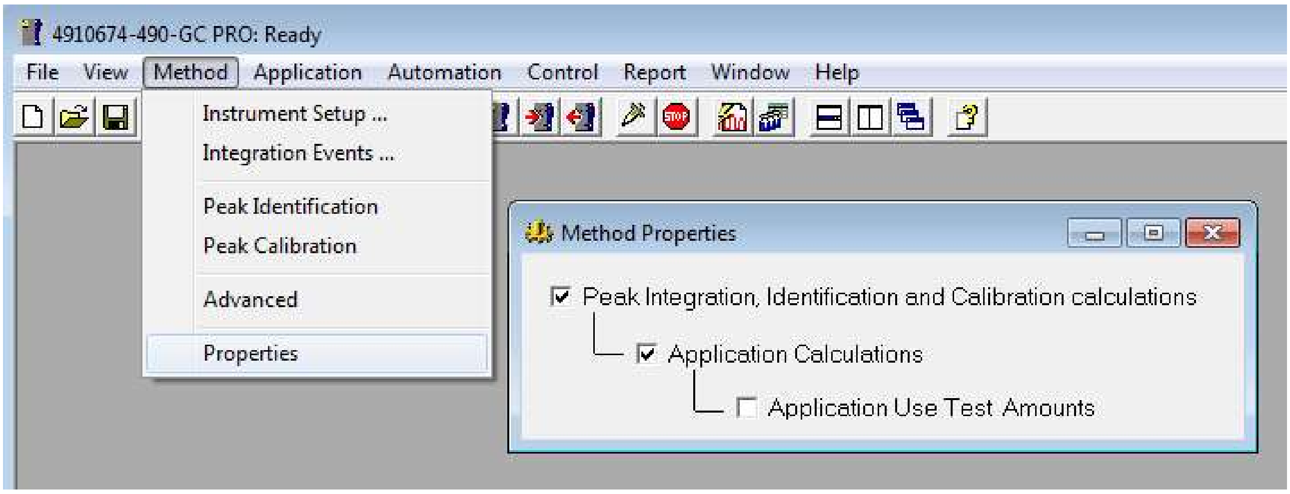
24.6.11 Method Properties

The method properties define what the 490-GC PRO executes after the chromatographic run has ended. If 'Peak integratration, Identification and Calibration calculations' is disabled, all runs will be performed without calculations.

If only the upper box is checked, the run data will be integrated; peak identification and concentration calculations will be performed and presented in the Integration Report. If the upper box is unchecked the underlying lines are not accessible.

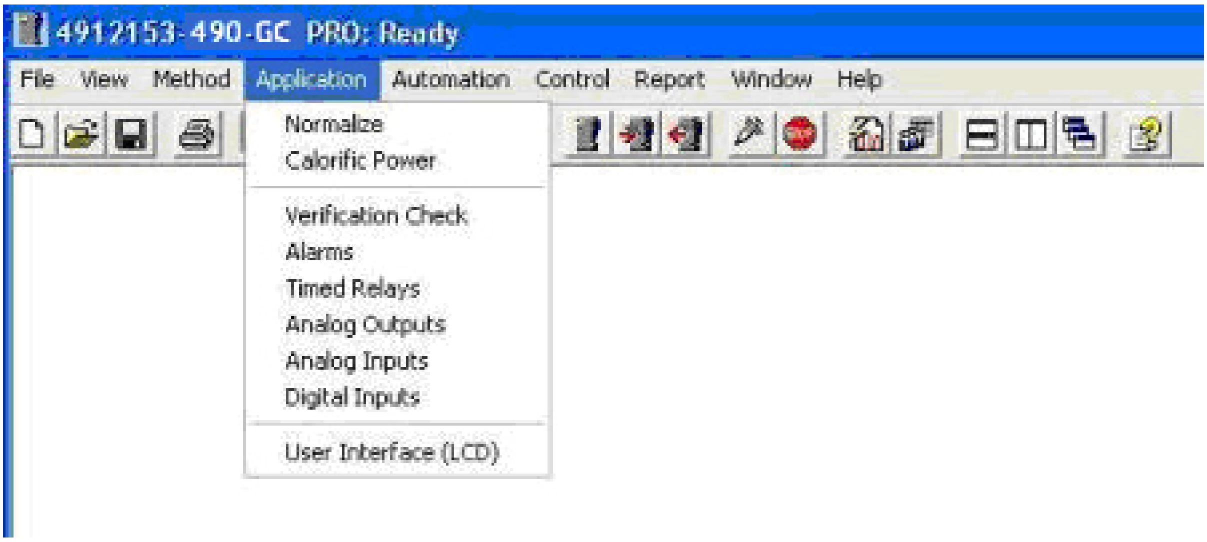
If the middle box is checked, only possible in combination with a checked upper box, application calculations will be performed and Input output signals are controlled.. The sample results are presented in the Application Report.

If the bottom box is checked, only possible in combination with a checked middle box, application calculations will be performed using test amounts instead of actual calculated amounts.



24.7 Application Menu

The application allows additional calculations on the results as reported in the Integration Report. Also analog and digital interfacing can be defined. The external interfacing is provided by the (on-board) standard GC I/O and/or by the Extension Boards, see chapter Connected via Extension bus on page 52.



Normalize on page 165
Standard calculation available in 490-GC PROstation.

Calorific Power on page 167
Calorific Power calculation.

Verification Check on page 170
Conditions that must be valid for verification runs are listed in the Verification Check.

Application - Alarms on page 172
The alarms are used to signal external devices that a parameter value is in or out of its limits.

Application - Analog Outputs en page 174
The analog outputs are used to indicate a parameter value to an external device.

Timed relays on page 177
The timing relays are used to trigger or control external devices. The timing is coupled to run time or stream selector events.

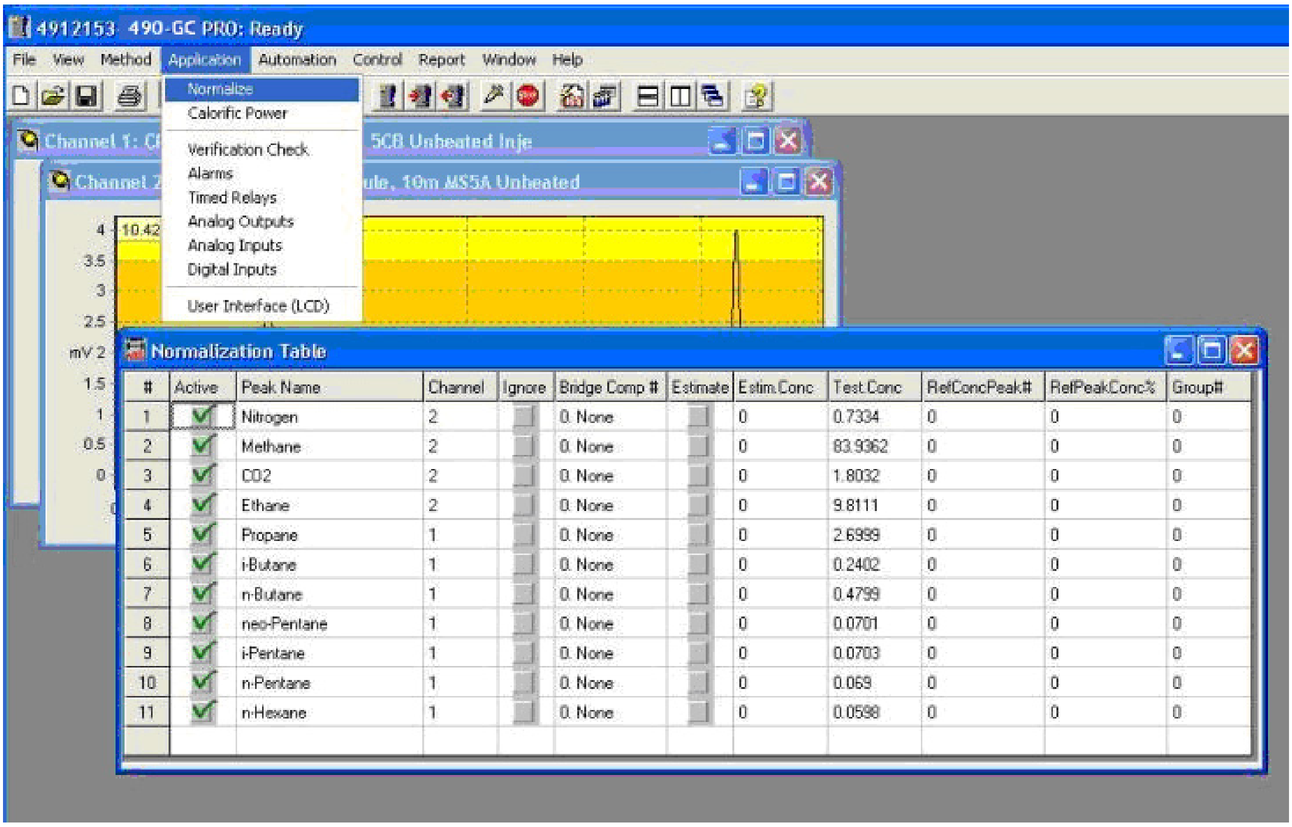
Analog Inputs on page 179
The analog inputs are used to measure external parameters. They can be coupled to alarms or analog outputs.

Digital Inputs on page 180
The digital inputs can be used to interrupt the automation run sequence or trigger a sequence run in idle mode. They can also be used to signal an alarm status.

Local User Interface on page 181
The Lui is an optional, four line dispay

24.7.1 Application - Normalize

Normalization is a standard calculation available in the 490-GC PROstation in addition to calculated external standard concentrations.
The Normalization table is activated under the Application menu.
If the Normalization table is empty, run the Application Wizard on page 109. This automatically generates all peaknames in the Normalization table for all configured peaknames in the Peak Identification/Calibration table.



Components in the Normalization table are identified only on their name as they exist in the Peak Identification/Calibration table.
The normalization table consists of:

- **#**
  Index number.

- **Active**
  If unchecked, the information of this peak will not be downloaded to the 490-GC PRO during a method download action.

- **Peak Name**
  The name must be identical to the peakname in Peak Identification/Calibration table.
  It can also be filled in automatically using the Application Wizard.

- **Channel**
  The GC channel on which the peak is detected.

- **Ignore**
  If checked, the external standard concentration for this peak is excluded from the normalization calculation.

- **Bridge Component**
  A bridge component is used to bridge two GC channels and compensate for an injection difference between the two channels, a so called bridge component. This requires a component to be detected on two GC channels.
  Select '0.none' if not using a bridge component.
  Select '1.comp.1' for a component which is detected on two GC channels. Mark the same component on the other channel also with '1.comp.1'.
  If the instrument is equipped with 3 or 4 channels, two other channels can be bridged by marking the two components '2.comp.2'.
  Once a bridge component is defined, the instrument calculates a bridge factor of the component marked as '1.comp.1'. This factor is the division of the two external standard concentrations. Note that this factor should be close to value 1.0. All peak concentrations of one channel will be multiplied with this bridge factor. Make sure to select 'Ignore' for only one appearance of the bridge component. This will exclude one instance of the components concentration from the normalization concentration.

- **Estimate**
  Select to add a component to the Application Normalization that is not identified in the chromatographic run. Give a name in the name-field. The added component can either have an absolute value to be provided in the 'Estmate Conc' field. Alternatively the concentration can be set relative to an identified peak (add indexnumber to RefConcPeak# field) and a fixed percentage peak (add %number to RefPeakConc% field) of that peak.

- **Test Conc**
  Value to check the normalization calculation method. Any value given here will overrule the actual calculated normalized concentration. Note, that you have to select the appropriate box "Application Use test Amount" under Method\properties on page 163.

- **RefConcPeak#**
  Must be used in combination with "Estimate", see parameter "Estimate".

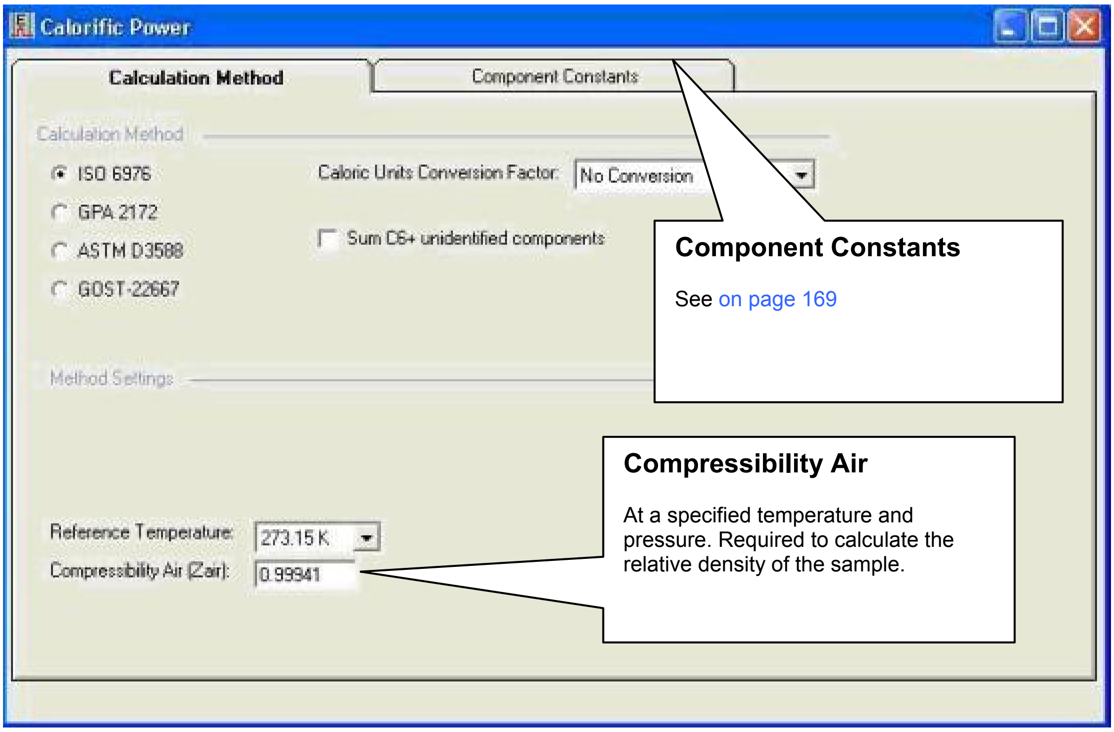
- **RefPeakConc%**
  Must be used in combination with "Estimate", see parameter "Estimate".

- **Group#**
  Multiple components can be grouped together. Groups will be separately reported in the Application Report.
  Add a component to a group by giving the group number, range: 1-9.
  If for instance components Methane, Ethane and Propane must be to be grouped, enter a '1' in the Group# column for all three components.

24.7.2 Application - Calorific Power

NOTE

The calculation of the calorific value is license protected.



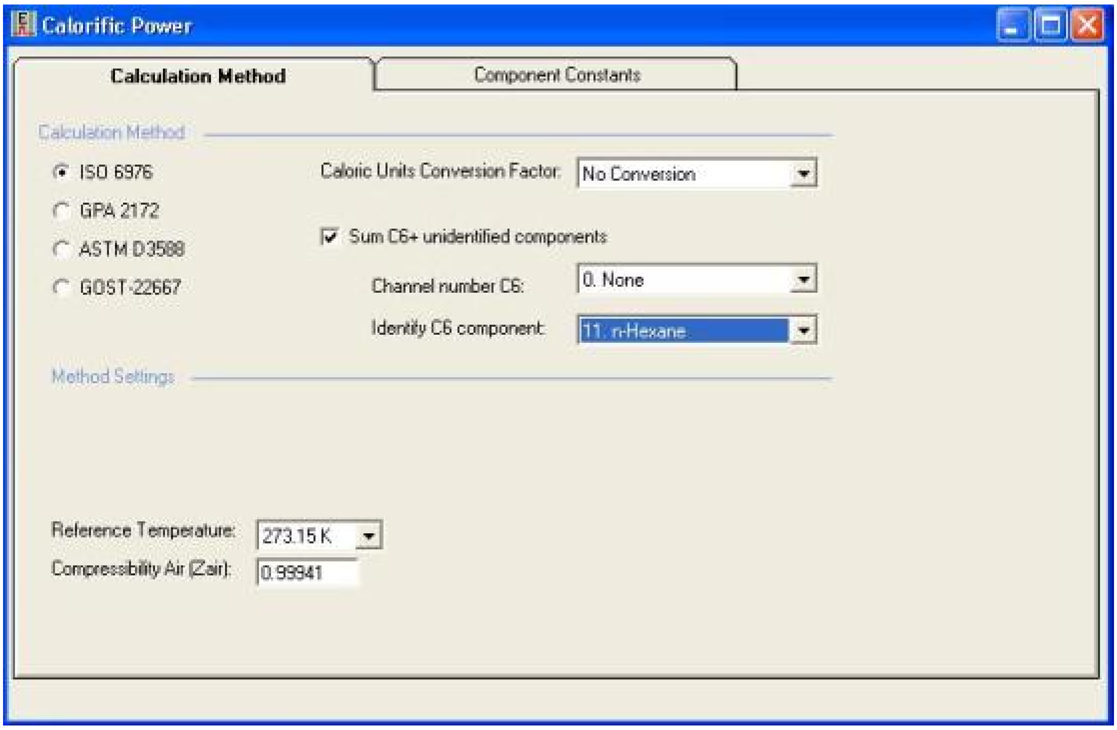
In addition to this software package, you must possess and use the following:

24.7.2.1 Calculation Method

- International Standard ISO6976 document; Natural Gas-Calculation of calorific values, density and relative density and Wobbe index from composition" second edition 1995-12-01, Ref.no. ISO 6976-1995(E).
- GPA Standard 2172-86 document "Calculation of Cross Heating Values, Relative Density and Compressibility Factor for Natural Gas Mixtures from Compositional Analysis.
- ASTM D3588-91 document "Standard Practice for Calculation Heat Value, compressibility Factor and Relative Density of Gaseous Fuels
- GOST 22667, a Russian standard.

These documents describe in detail the calculation procedures used.

24.7.2.2 *Sum C6+ unidentified components*



This option is used to sum up all C6+ component concentrations or to sum all isomers of C6, C7, C8, C9 etc depending on the number of components in the application normalization-window.

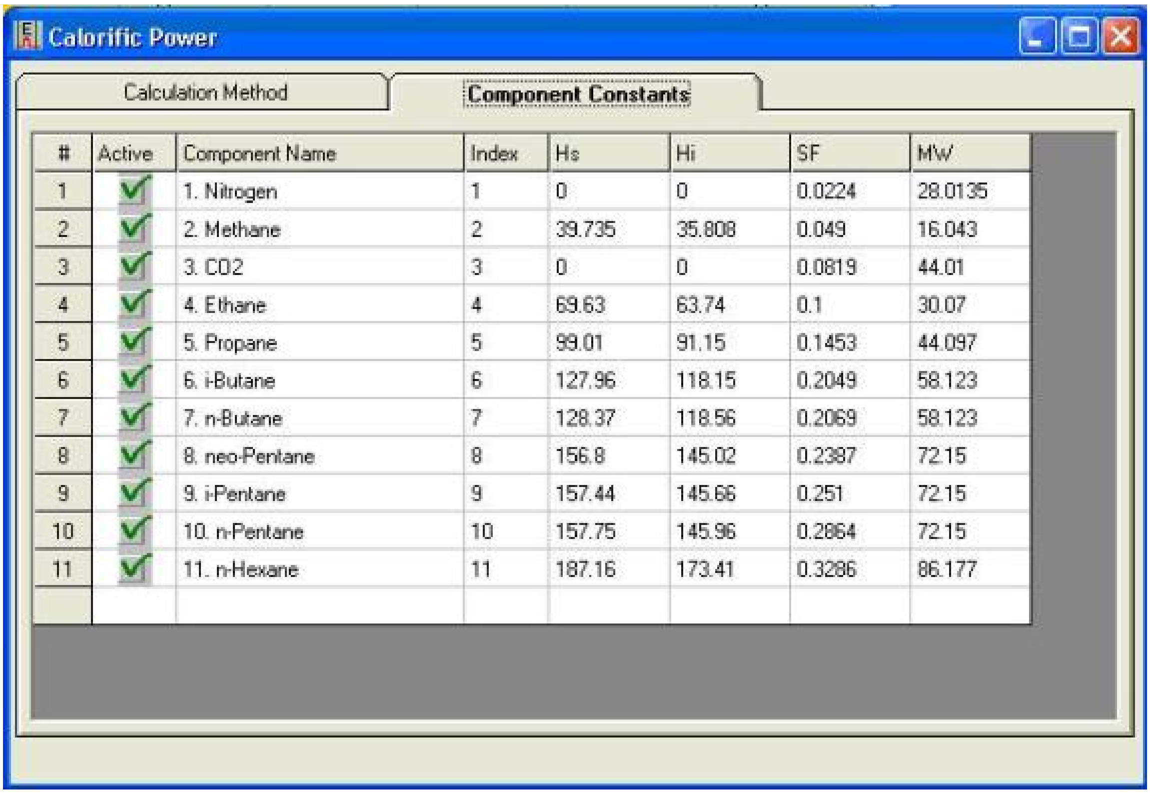
Summing C6+ unidentified components must be used in combination with setting the RF unknown peaks to Relative in the Method-Calibration window.

By setting the “Sum C6+ unidentified components” all unidentified peak concentrations are added to the first identified application peak concentration following the unidentified peak. If there is no identified application peak following the unidentified peak, the concentration is added to the first identified application peak before the identified peak.

NOTE

The “Summing” option can only be used for one GC-channel.
Basically this is the GC channel on which the heavier hydro carbons are analysed

24.7.2.3 Component Constants



#	Active	Component Name	Index	Hs	Hi	SF	MW
1	✓	1. Nitrogen	1	0	0	0.0224	28.0135
2	✓	2. Methane	2	39.735	35.808	0.049	16.043
3	✓	3. CO2	3	0	0	0.0819	44.01
4	✓	4. Ethane	4	69.63	63.74	0.1	30.07
5	✓	5. Propane	5	99.01	91.15	0.1453	44.097
6	✓	6. i-Butane	6	127.96	118.15	0.2049	58.123
7	✓	7. n-Butane	7	128.37	118.56	0.2069	58.123
8	✓	8. neo-Pentane	8	156.8	145.02	0.2387	72.15
9	✓	9. i-Pentane	9	157.44	145.66	0.251	72.15
10	✓	10. n-Pentane	10	157.75	145.96	0.2864	72.15
11	✓	11. n-Hexane	11	187.16	173.41	0.3286	86.177

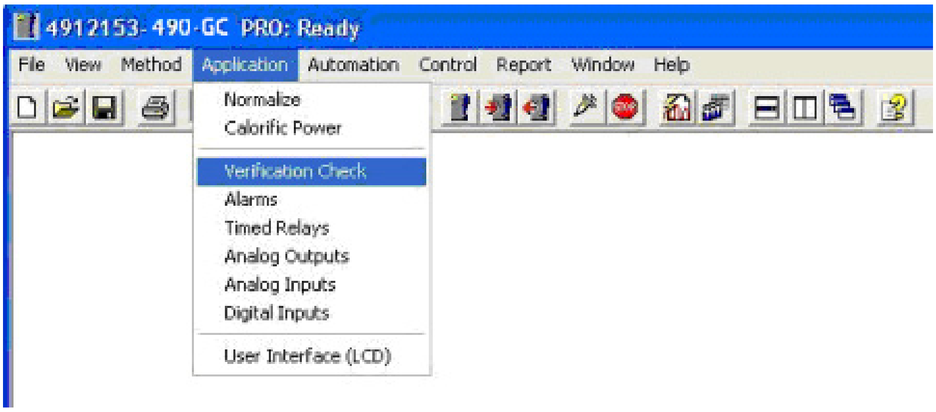
Components Constants tab:

- Active: Will take part in the calculation procedure.
- Component Name: The name of component/peak from the Application - Normalization window.
- Index: Line number the component name exist in the Normalization window.
- Hs: The ideal Superior Calorific Value for that component at a specifed temperature and pressure.
- Hi: The ideal inferior Calorific Value for that component at a specified temperature and pressure.
- SF: The summation factor for that component at a specified temperature and pressure.
- MW: The Molar mass for that component.

Specific values are pre-programmed and may depend on the calculation method used.
It is up to application specialist to change the values of constants in order to meet the latest method.

24.7.3 Application - Verification Check

As part of the automation, on the basis of time or number of runs passed, a verification block can be programmed.



The results of this verification will either be reported as a normal sample, identifying the run being a verification run or the results will be reported as normal but also compared to a set of pre-programmed limits. As part of the application, the user must define limits, against which the verification should be checked. The user can choose from raw results, sample results or calculated results.
The user must program the appropriate minimum and maximum values. If outside the programmed range, the verification is set negative, initiating a calibration block!

Note that the verification table must be set very carefully. Too many variables will likely result in unwanted and unnecessary calibrations. Too little variables might result in unwanted errors.

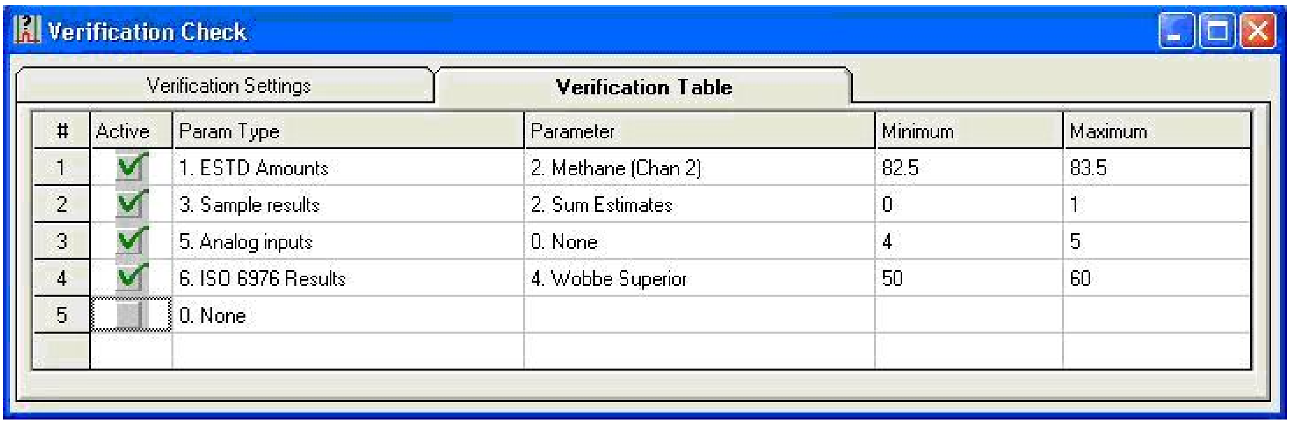
During a verification run it is possible to check whether parameters are within limits. Such as:

– External standard or normalized concentrations of components listed in the Application Report.

– Sample results like sum or group total and bridge component as defined in the Normalization window (Application menu).

– Analog Inputs using the (sampling) converted values as defined in the Analog Input window.

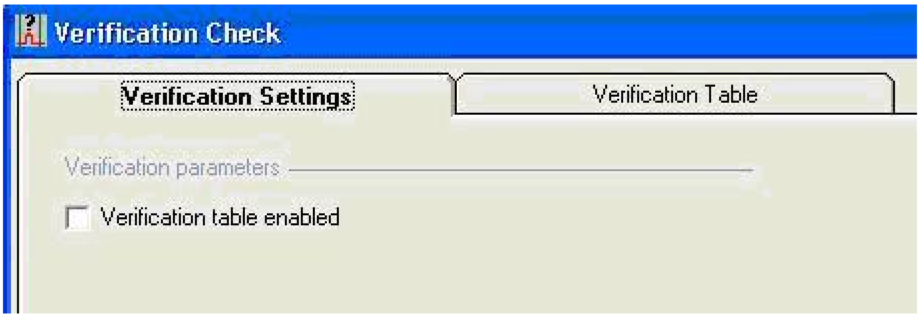
– Calorific Power results as defined in the Energy Calculation window (Application menu).



#	Active	Param Type	Parameter	Minimum	Maximum
1	✓	1. ESTD Amounts	2. Methane (Chan 2)	82.5	83.5
2	✓	3. Sample results	2. Sum Estimates	0	1
3	✓	5. Analog inputs	0. None	4	5
4	✓	6. ISO 6976 Results	4. Wobbe Superior	50	60
5		0. None			

A verification check is only performed after the sample calculation of a verification run, either from the Sequence- or Verification Table or Single run.

Do not forget to enable the Verification Table in the Settings tab:

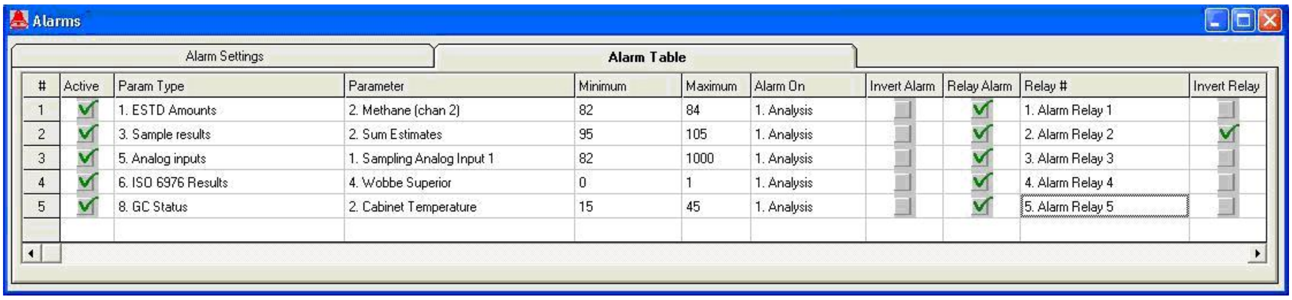


Use Download Application from the Control menu to store the Verification settings to the 490-GC PRO. Only the Activated lines in the Verification Table will be downloaded to the 490-GC PRO.

Find more information in chapter Verification run on page 339.

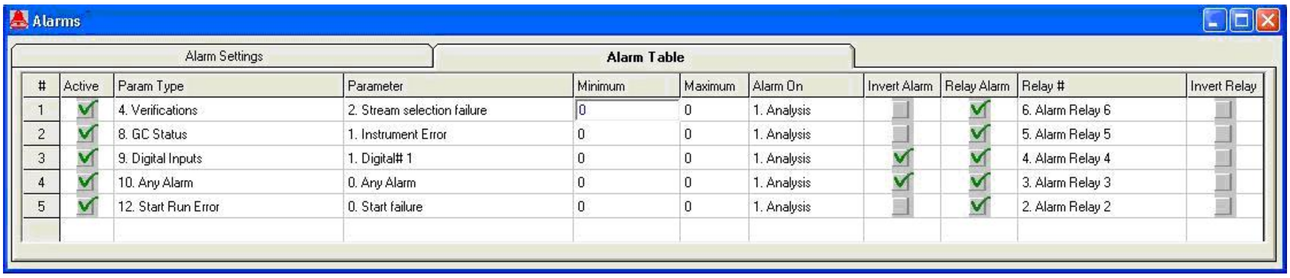
24.7.4 Application - Alarms

Alarm relays can be used to indicate whether parameters are out of limits. Such as:
- External standard or normalized concentrations of components listed in the Application Report.
- Sample results like sum or group total and bridge component as defined in the Normalization window (Application menu).
- Analog Inputs using the (sampling) converted values as defined in the Analog Input window.
- Calorific Power results as defined in the Energy Calculation window (Application menu).
- GC Status such as ambient temperature & pressure.
- External Digital inputs from other devices such as flowmeter.



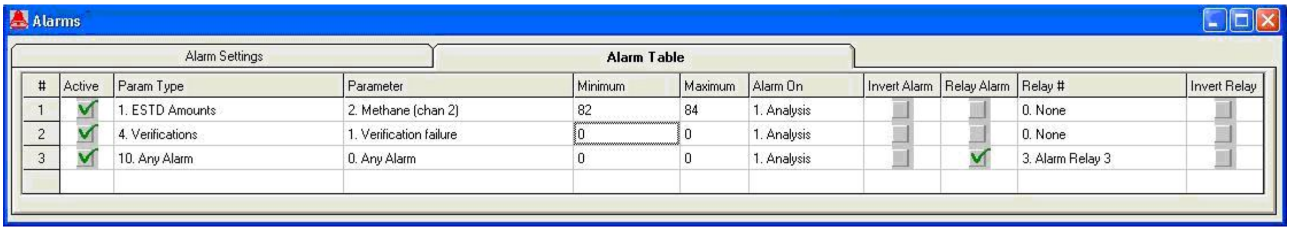
#	Active	Param Type	Parameter	Minimum	Maximum	Alarm On	Invert Alarm	Relay Alarm	Relay #	Invert Relay
1	✓	1. ESTD Amounts	2. Methane (chan 2)	82	84	1. Analysis		✓	1. Alarm Relay 1	
2	✓	3. Sample results	2. Sum Estimates	95	105	1. Analysis		✓	2. Alarm Relay 2	✓
3	✓	5. Analog inputs	1. Sampling Analog Input 1	82	1000	1. Analysis		✓	3. Alarm Relay 3	
4	✓	6. ISO 6976 Results	4. Wobbe Superior	0	1	1. Analysis		✓	4. Alarm Relay 4	
5	✓	8. GC Status	2. Cabinet Temperature	15	45	1. Analysis		✓	5. Alarm Relay 5	

The Minimum and Maximum column entries can be omitted (here left zero).
Some parameters do not need maximum and minimum such as digital inputs.



#	Active	Param Type	Parameter	Minimum	Maximum	Alarm On	Invert Alarm	Relay Alarm	Relay #	Invert Relay
1	✓	4. Verifications	2. Stream selection failure	0	0	1. Analysis		✓	6. Alarm Relay 6	
2	✓	8. GC Status	1. Instrument Error	0	0	1. Analysis		✓	5. Alarm Relay 5	
3	✓	9. Digital Inputs	1. Digital# 1	0	0	1. Analysis	✓	✓	4. Alarm Relay 4	
4	✓	10. Any Alarm	0. Any Alarm	0	0	1. Analysis	✓	✓	3. Alarm Relay 3	
5	✓	12. Start Run Error	0. Start failure	0	0	1. Analysis		✓	2. Alarm Relay 2	

Using one relay output for multiple alarm conditions can be handled by using the ‘Any Alarm’ parameter. For example, to set an alarm if either the ESTD Amount of Propane is out of limits or a Verification Failure occurs, use the following Alarm Table:

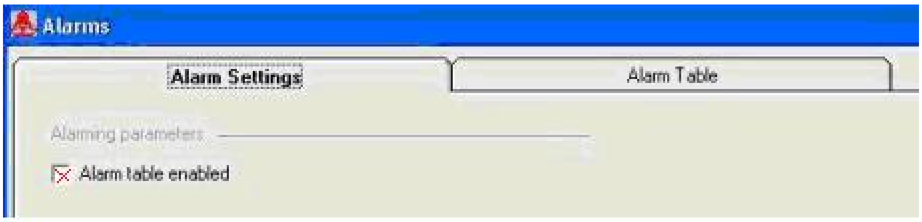


#	Active	Param Type	Parameter	Minimum	Maximum	Alarm On	Invert Alarm	Relay Alarm	Relay #	Invert Relay
1	✓	1. ESTD Amounts	2. Methane (chan 2)	82	84	1. Analysis			0. None	
2	✓	4. Verifications	1. Verification failure	0	0	1. Analysis			0. None	
3	✓	10. Any Alarm	0. Any Alarm	0	0	1. Analysis		✓	3. Alarm Relay 3	

Although the first two Alarms have no physical relay their status can be read using ModBus.
For failsafe purposes or inverting a digital input, the alarm output can be inverted in the Invert Alarm column.

The analog outputs are set after processing a certain run type (or when using “Recalculate Current Run”).
The run type is defined in the “Alarm On” column. Either:
- Analysis, Blank, Calibration or Verification

Do not forget to enable the Alarm Table in the Settings tab:

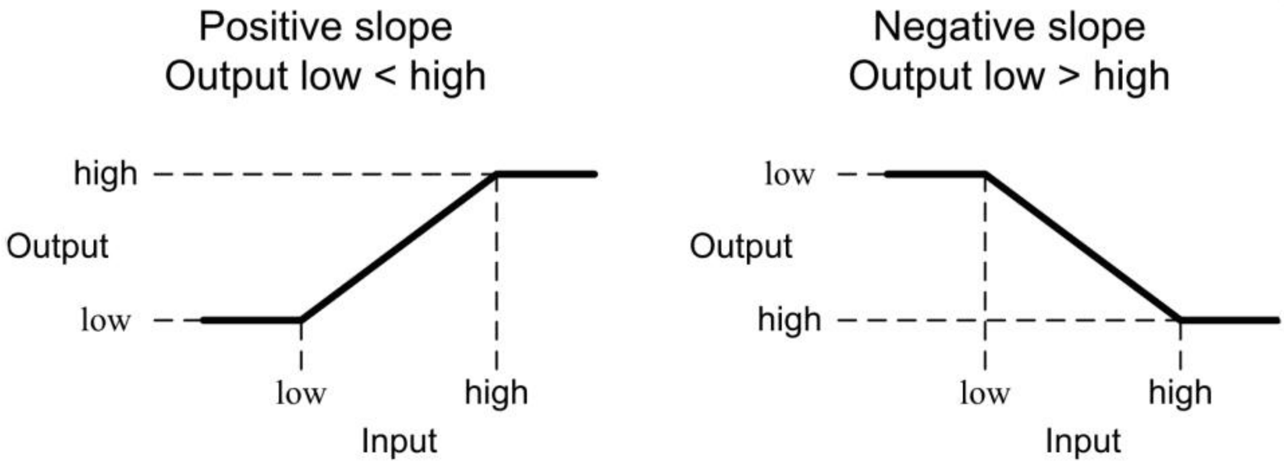


Use Download Application from the Control menu to store the Alarm settings to the 490-GC PRO. Only the Activated lines in the Alarm Table will be downloaded to the 490-GC PRO.

Find more information in chapter Case 2: Alarms on page 350.

24.7.5 Application - Analog Outputs

Analog outputs can be used to indicate a parameter value or status. The conversion from the input value is illustrated in the following curves:

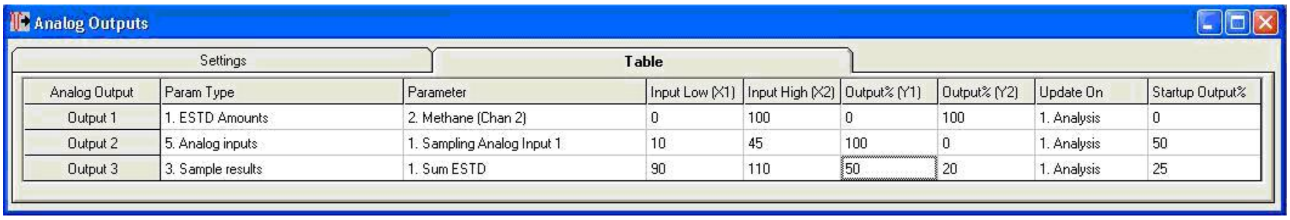


- The conversion follows a straight line (linear interpolation) between the points [Input Low X1, Output Y1] and [Input High X2, Output Y2].
- Outside the <Input Low X1, Input High X2> input range the output is limited to the respective Output Y1 or Output Y2 value.
- A negative slope is defined by making Output Y2 smaller than Output Y1.
- A zero slope (equal Output Y1 and Y2) gives one output (Output Y1/Y2) for all input values.
- Note that Input Low must at all times be smaller than Input High.

The analog outputs can be coupled to parameters as:

- Integration results for components defined in the Method menu.
- Sample results like sum or group total and bridge component as defined in the Normalization window (Application menu).
- Analog Inputs using the (sampling) converted values as defined in the Analog Input window.
- Calorific Power results as defined in the Energy Calculation window (Application menu).

Examples of these parameters and possible conversions are given below:

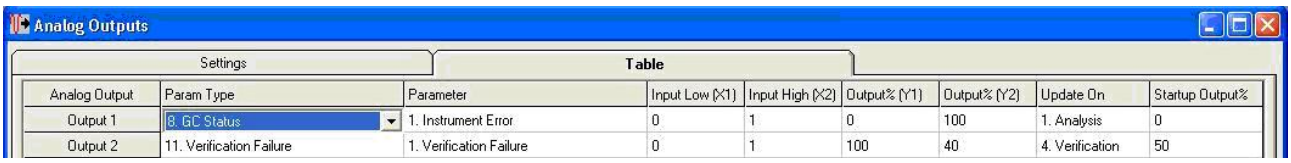


Analog Output	Param Type	Parameter	Input Low (X1)	Input High (X2)	Output% (Y1)	Output% (Y2)	Update On	Startup Output%
Output 1	1. ESTD Amounts	2. Methane (Chan 2)	0	100	0	100	1. Analysis	0
Output 2	5. Analog inputs	1. Sampling Analog Input 1	10	45	100	0	1. Analysis	50
Output 3	3. Sample results	1. Sum ESTD	90	110	50	20	1. Analysis	25

Analog Outputs can also be coupled to digital signals. Such as:

- GC Status and
- Verification Failure

Use for digital inputs 0 and 1 as Input Low X1 and High X2 values. Naturally the output will be the respective Output Y1 or Y2 value.

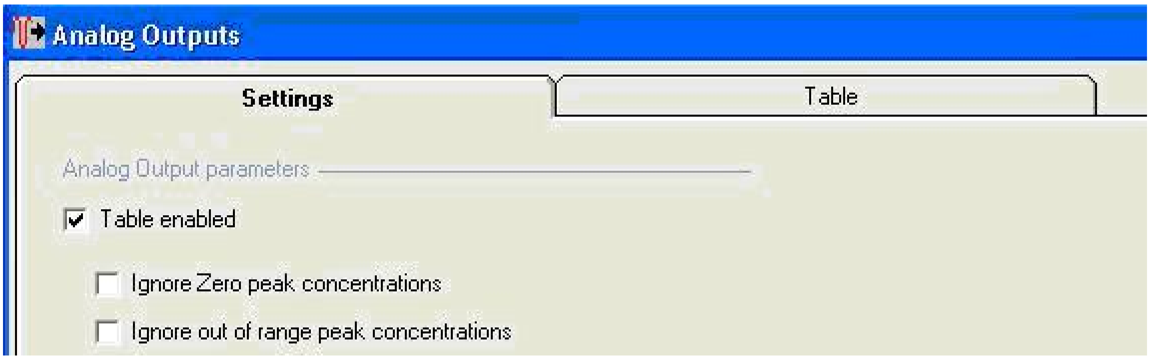


Analog Output	Param Type	Parameter	Input Low (X1)	Input High (X2)	Output% (Y1)	Output% (Y2)	Update On	Startup Output%
Output 1	8. GC Status	1. Instrument Error	0	1	0	100	1. Analysis	0
Output 2	11. Verification Failure	1. Verification Failure	0	1	100	40	4. Verification	50

The analog outputs are set after processing a certain run type (or when using Recalculate Current Run). The run type is defined in the Update On column. Choices are:

– Analysis, Blank, Calibration and Verification

Do not forget to enable the Analog Output Table in the Settings tab:



Use Download Application from the Control menu to store the Analog Output settings to the 490-GC PRO.

Find more information on chapter Case 1: Analog Output on page 347.

24.7.6 Parameters

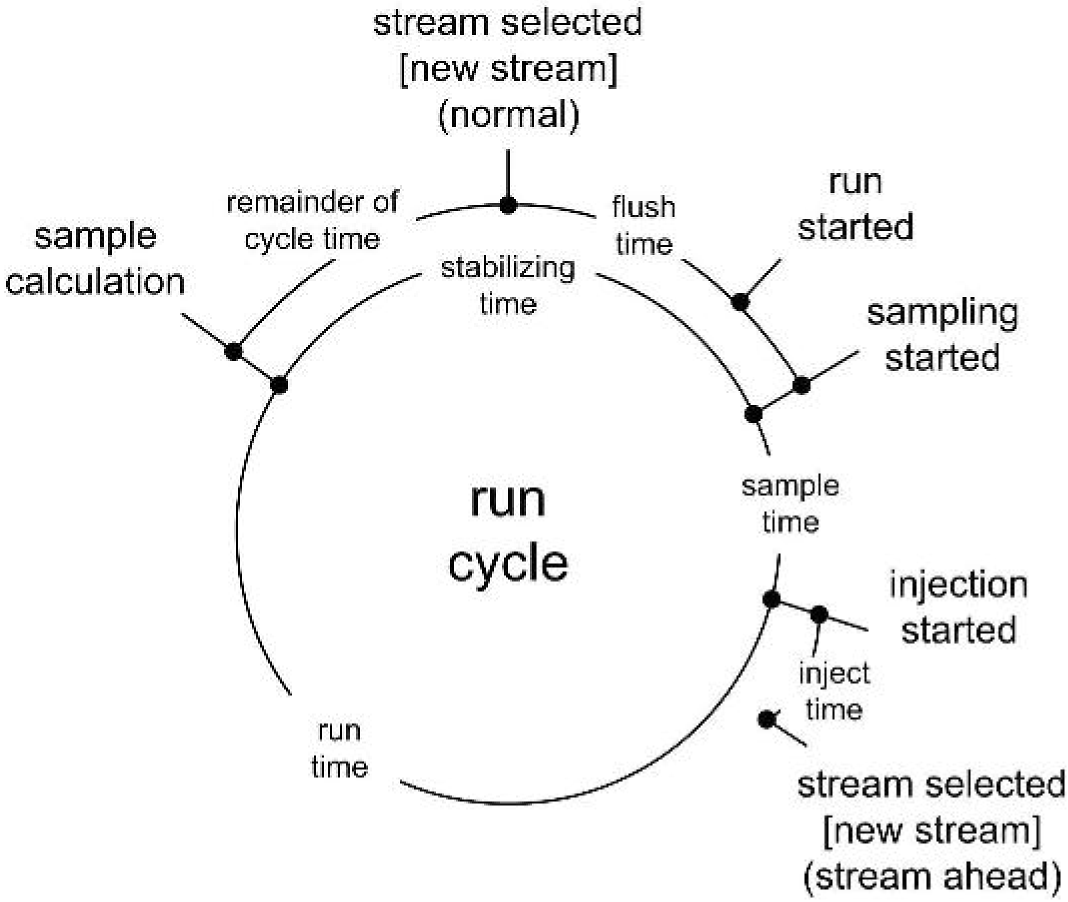
The parameters for Verifications, Alarms and Analog Output are listed in the following table:

	Parameter Type	Parameter	Display
Integration results	(1) ESTD Amounts	<Component 1>	Application report (lower table)
		<Component 2>	
		…	
	(2) Normalized Amounts	<Component 1>	
		<Component 2>	
		…	
(3) Sample results		ESTD total Group 1	
		…	
		ESTD total Group 10	
		Normalized total group 1	
		…	
		Normalized total group 10	
		Sum ESTD	Application report (Sample column)
		Sum Estimates	
		Bridge comp. factor	
Inputs	(5) Analog inputs	Sampling Analog Input 1	Application report (Environment column)
		Sampling Analog Input 2	
		…	
	(9*) Digital Inputs	[Digital# 1]	
		[Digital# 2]	
		…	
Calorific Power	(6) ISO6976 Results	Compressibility	Application report (Energy column)
		Molar Mass	
		Molar Mass Ratio	
		Wobbe Superior	
		Hs	
		Hi	
		Abs. Density	
		Rel. Density	
	(7) ASTM / GPA Results	Compressibility	
		Molar Mass	
		Molar Mass Ratio	
		Wobbe	
		Hv_actual	
		Hv_dry	
		Hv_wet	
		S.G.	
		S.G. Pnds/Ft3	
		Specific Volume	
		Hv_Act MJ/m3	
		Zair	
GC Status	(10*) Any Alarm		from Alarm table
	(11**) Verification Failure		Application report (Verification Check)
	(4*) Verifications	Verification failure	
		Unknown peaks detected	
		Calibration Alarm	
		Stream selection failure	Instrument Status (Common tab)
	(12*) Start Run Error	Start failure	
	(8***) GC Status	Instrument Error	
		Cabinet Temperature	Application report (Environment column)
		Ambient Pressure	

* only for Alarms, ** only for Analog Outputs, *** not for Verifications
<…> example, […] option depends on the configuration

24.7.7 Application - Timed Relays

Timed relays are used to signal run sequence events or control external actuators.



The following events are available:

Run Started	- the start of a new run
Sampling Started	- the sample gas is directed through the injector
Injection Started	- the sample gas is injected into the chromatography system
Sample Calculation	- the results from the chromatogram are calculated
Steam Selected	- a stream is selected
New Stream	- a new stream is selected

The time periods between events are:

Stabilizing time	- defined in the Common tab of Instrument Method
Sample time	- defined in the Common tab of Instrument Method
Inject time	- defined in the Channel tabs of Instrument Method
Run time	- defined in the Channel tabs of Instrument Method
Cycle time	- defined in the Sequence Properties of Automation Sequence
Flush time	- defined in the Tables of Automation Sequence

The timing of the events Stream Selected and New Stream depends on the Stream Ahead Scheduling option (Sequence Properties tab of Automation Sequence). Without Stream Ahead the stream selector position is updated at the end of the run followed by the Flush Time. In case of Stream Ahead the stream selector position is updated just after the injection. Flushing is started and the remaining Flush time shorted.

If we want to indicate that the chromatography system is in action we make the following definition in the Timed Relays tables:


Timed Relays

#	Event	Delay [s]	Timed Relay	Relay State
1	4. Injection Started	0	1. Timed Relay 1	1. Energize
2	5. Sample Calculation	0	1. Timed Relay 1	0. De-energize

The first line defines the Energize event (Injection Started) for the Timed Relay 1. The second line defines the De-energize event (Sample Calculation).

If we want to pulse a relay if a new stream is selected, we make the following definition:


Timed Relays

#	Event	Delay [s]	Timed Relay	Relay State
1	6. New Stream	0	2. Timed Relay 2	1. Energize
2	6. New Stream	2	2. Timed Relay 2	0. De-energize

Here each time a new stream is selected, Timed Relay 2 is energized for 2 seconds.

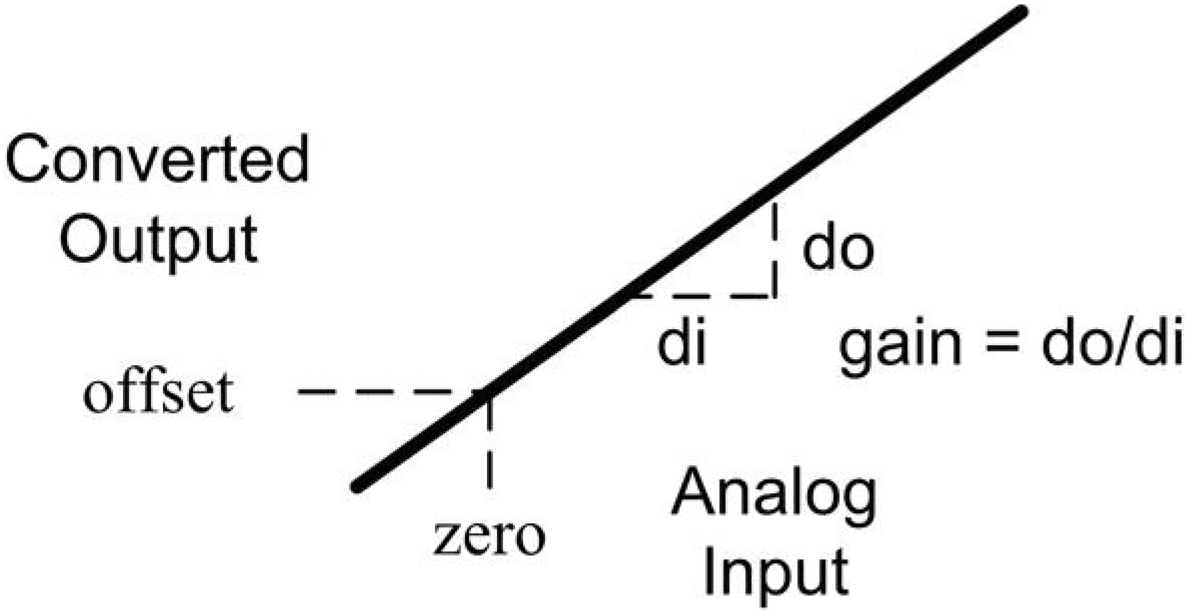
Note that a timed relay basically requires two definition lines in the table. The number of lines is limited to 6, thus 3 timed relays can be defined.

Use Download Application from the Control menu to store the Timed Relay settings to the 490-GC PRO

Find more information on chapter Case 3: Timed Relays on page 351.

24.7.8 Application - Analog Inputs

The analog inputs are used to measure external parameters. They can be coupled to alarms or analog outputs. The conversion is defined in the Analog Inputs table columns:



- The gain defines the change in output for a change in input. The offset is the output for zero input.
- The gain and offset can also be of negative value. Also decimal values are possible.
- For alarms and analog outputs the converted output values are used.

Suppose we use an external PT-100 temperature sensor. A current source of 5mA is used for excitation. The analog input measures the voltage across the sensor. The conversion from input voltage to centigrade temperature is defined as follows:

Analog Inputs

Channel	Gain	Offset
1	519.5	-259.7

The analog inputs are displayed in the Application Report. Note that the inputs are measured at the start of the sampling period. The Application report is updated after the sample calculation is finished.

The Analog inputs are continuously updated in the enhanced tab of the Instrument Status (control menu).

Use Download Application from the Control menu to store the Analog Input settings to the 490-GC PRO.

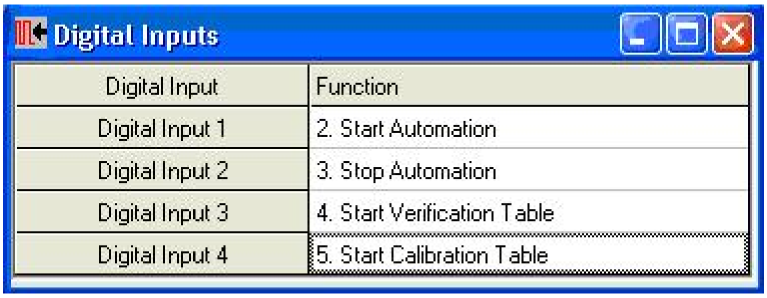
24.7.9 Application - Digital Inputs

Digital inputs are basically used to trigger automation events like:

- Start / Stop Automation
- Start Calibration or Verification table
- Run sequence line

In addition they can also be used to signal an external device status or alarm.

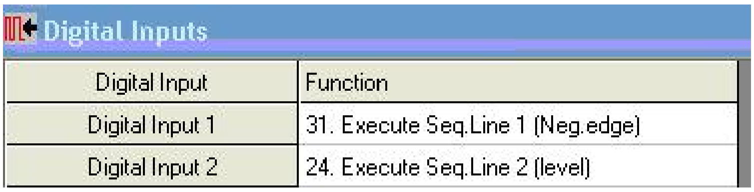
Using two digital inputs the Automation mode can be started and stopped.


Digital Inputs

Digital Input	Function
Digital Input 1	2. Start Automation
Digital Input 2	3. Stop Automation
Digital Input 3	4. Start Verification Table
Digital Input 4	5. Start Calibration Table

Here also the Verification or Calibration table can be started in idle or automation mode (priority run).

The triggering of a sequence line is done in idle mode only. For a single execution, use the edge sensitive input. Shortly closing the digital input switch is sufficient to start the sequence line. For continuous execution, use the level sensitive input. The inputs are scanned every 5 seconds. To perform handshaking, use a timed relay to indicate that the run is started. This way one can also keep track of the number of runs started.


Digital Inputs

Digital Input	Function
Digital Input 1	31. Execute Seq.Line 1 (Neg.edge)
Digital Input 2	24. Execute Seq.Line 2 (level)

Notes:

- During automation or a run the digital inputs are scanned at the end of the run (event Sample Calculation).

- All digital inputs are edge sensitive, except for the (non-latching) on-board digital inputs and level sensitive defined (execute) sequence lines.

Find more information on chapter Case 4: Digital Inputs on page 352.

24.7.10 Application - Local User Interface (LCD)

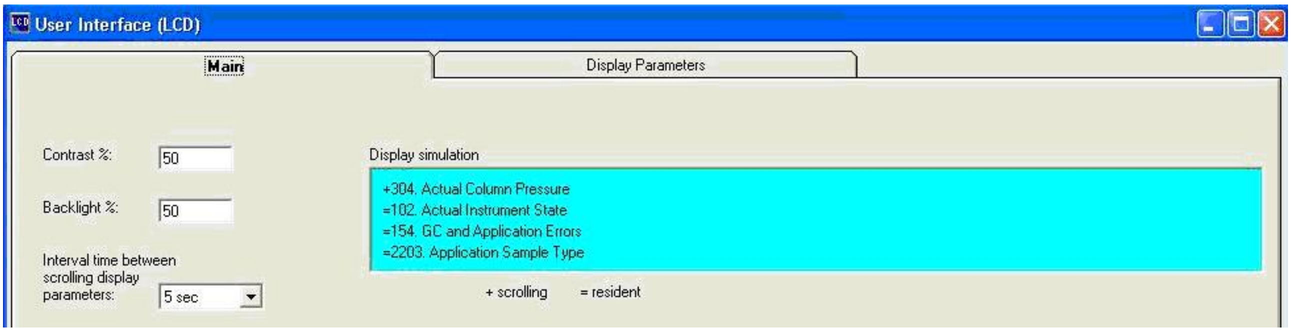
The LUI is an optional, four line digital display.
The hardware handling has been described in a separate manual: CP501373

On the screen you can make available:

- Actual operating conditions
- Instrument status as well as run status
- Calculated values
- Instrument errors
- Etc., etc.

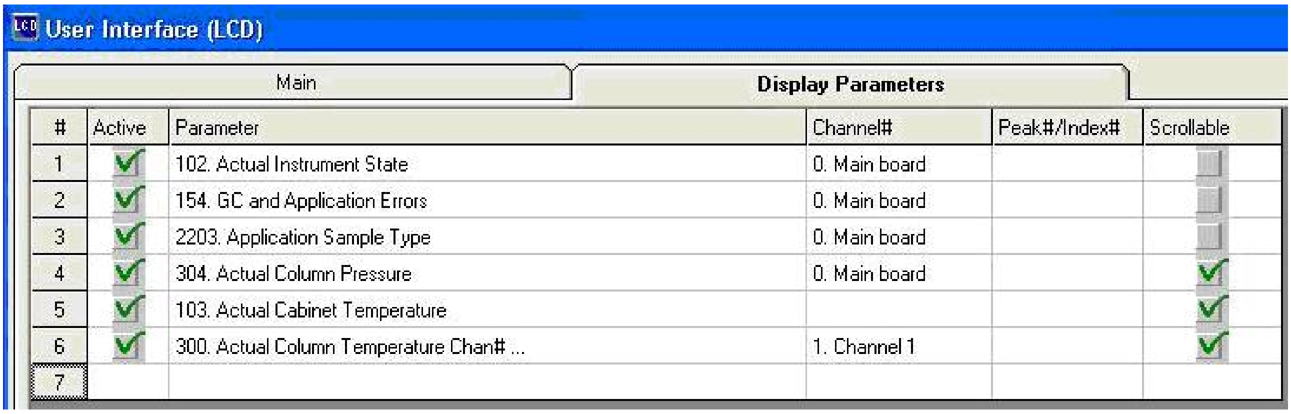
The user can select a fixed or scrollable output.

In order to program the LUI output, select application\user interface (LCD) from the PROstation toolbar.



On the main tab of the user interface you can set the contrast and brightness of the LCD as a percentage of the maximum output, as well as the scrolling time interval. The right hand side provides a simulation of the selected parameters.

The parameters to display are selected under the display parameters tab:



Apart from the parameter, one can select the channel, peak or index (whatever is appropriate for that particular parameter). Also it is identified if the parameter should be visible in a fixed or scrollable format.

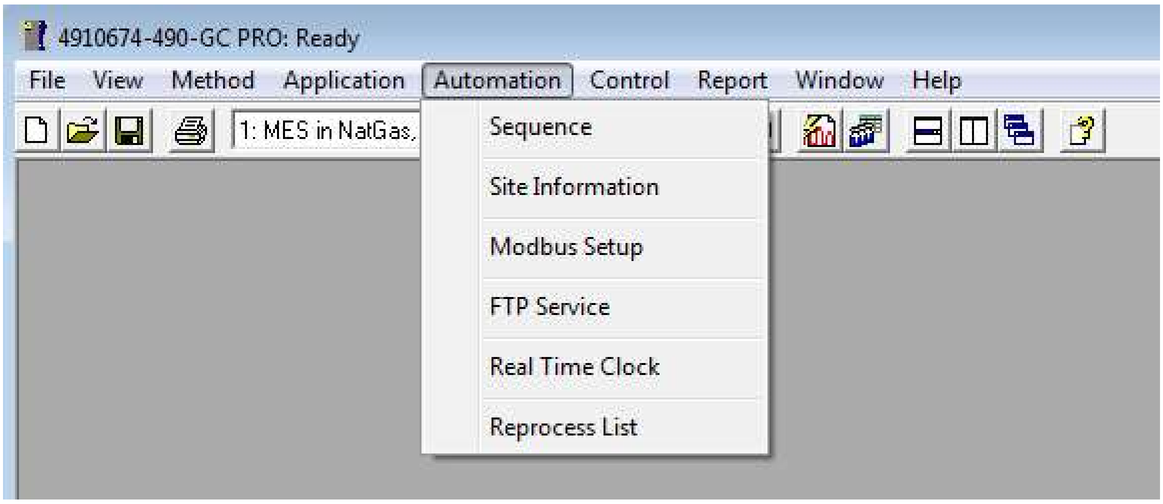
The following parameters are available for display on the optional LCD:

"0. None"
"9. Continuous Flow mode [1=Yes, 0=No]"
"58. Actual Stream Number"
"100. Actual SampleLine Temp"
"102. Actual Instrument State"
"103. Actual Cabinet Temperature"
"104. Actual Ambient Pressure"
"105. External Power Supply Voltage"
"106. External Started status"
"129. Digital Input #2"
"131. External Device Ready Status [1=Yes, 0=No]"
"132. Error Code status"
"134. Actual Flush time [s]"
"138. Actual Sequence State"
"139. Actual Calibration Level Setting"
"141. Actual Sample Type"
"152. GC Errors only"
"153. Application Errors only"
"154. GC and Application Errors"
"300. Actual Column Temperature Chan# ..."
"302. Actual Injector Temperature"
"304. Actual Column Pressure"
"308. Board Temperature Chan# ..."
"500. MPU firmware version number"
"515. Current Time"
"601. Instrument Serial Number"
"611. Operating Runs logging"
"612. Operating Time logging"
"613. Operating Max Temperature logging"
"811. Operating Max Temperature logging Chan..."
"1202. Integration Report: Total Peaks Integrated chan# ..."
"1214. Integration Report: Identified peaks chan# ..."
"1375. Integration Report: Area meth-peak#.. chan#.."
"1376. Integration Report: Height meth-peak#.. chan#.."
"1377. Integration Report: Amount meth-peak#.. chan#.."
"1378. Integration Report: Retention meth-peak#.. chan#.."
"1331. Integration Report: Calibration Alarm"
"2200. New Data Available (synchronization flag)"
"2202. Application Run number ID."
"2203. Application Sample Type"
"2204. Application Calibration Level"
"2205. Application Stream number"
"2207. Application Digital Input I/O-chan# ..."
"2208. Application Analog Input I/O-chan# ... at sampling time [V]"
"2209. Application Computed Analog Input I/O-chan# ... at sampling time"
"2210. Application Current Analog Input I/O-chan# ..."
"2211. Application Alarm Status"
"2212. Application Alarm on Index# ..." ' Step
"2213. Application Verification Status"
"2216. Application Total Peaks"
"2217. Application Sum ESTD"
"2218. Application Sum Estimates"
"2221. Application Sum Areas"
"2225. Application Day of Injection"

"2226. Application Hour of Injection"
"2227. Application Minute of Injection"
"2228. Application Second of Injection"
"2229. Application Total Unknown Peaks"
"2230. Application $$$$ Retention"
"2231. Application $$$$ Height"
"2232. Application $$$$ ESTD"
"2233. Application $$$$ Normalized ESTD"
"2235. Application Group @ Total ESTD"
"2236. Application Group @ Total Norm"
"2237. Application $$$$ Area"
"2260. Application Calorific Value Calculation Method"
"2262. Application Compressibility."
"2263. Application Molar Mass"
"2264. Application Molar Mass Ratio"
"2265. Application Wobbe Superior"
"2266. Application ISO Hs"
"2267. Application ISO Hi"
"2268. Application ISO abs. Density"
"2269. Application ISO rel. Density"
"2271. Application ISO Wobbe Inferior"
"2274. Application GPA/ASTM Hv(act)"
"2275. Application GPA/ASTM Hv(dry)"
"2276. Application GPA/ASTM Hv(wet)"
"2277. Application GPA/ASTM S.G."
"2278. Application GPA/ASTM SG(Pnds/FT3)"
"2279. Application GPA/ASTM Specific Volume"
"2280. Application GPA/ASTM Hv(MJ/M3)"

24.8 Automation

To automate your 490-GC PRO Micro-GC, configure your instrument as described in Instrument Configuration, Automation Tab.
In this Configuration Setup the user sets his I/O settings, Stream Selection hardware, Extension Boards and various other automation related parameters.



Sequence en page 185

Site Information en page 193

Modbus Setup on page 194

FTP Service on page 265

Automation – Real Time Clock on page 266

Automation – Reprocess List on page 267

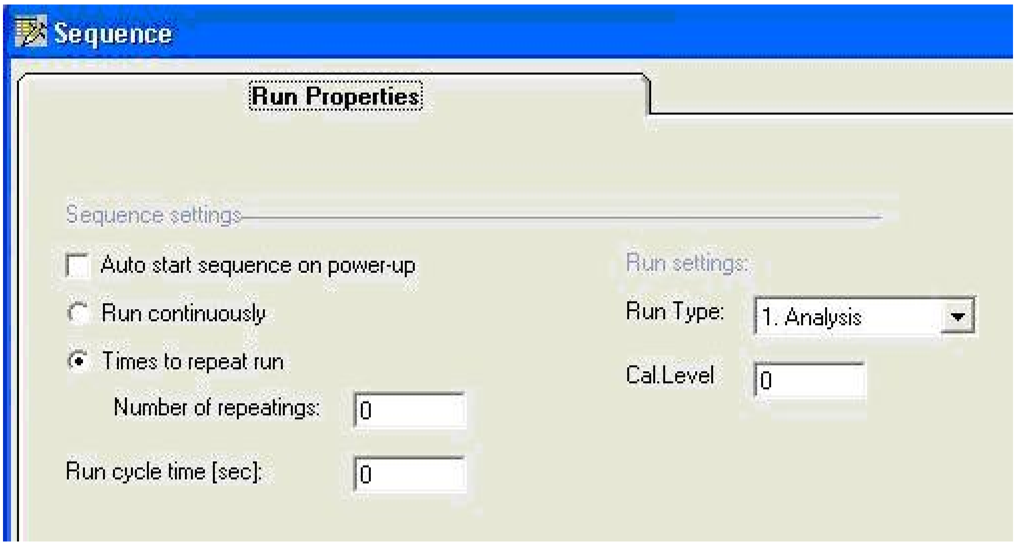
24.8.1 Automation - Sequence

If no Sequence available, execute the Sequence Wizard. This will generate a sequence upon the selections in the wizard, see chapter Sequence Wizard on page 110.

To access Sequence click on the ‘Automation’ pull down menu from the PROstation Toolbar and select ‘Sequence’.

The Sequence menu has two different layouts, depending on stream selection hardware present.
A hardware setup with no stream selection device is unable to switch to different sample streams, or select calibration- or verification gas streams while being automated.
A hardware setup with a VICI sample selection device or a Relay type sample selector has the ability to switch sample streams, run blank samples, run and perform timed calibrations and/or verifications.

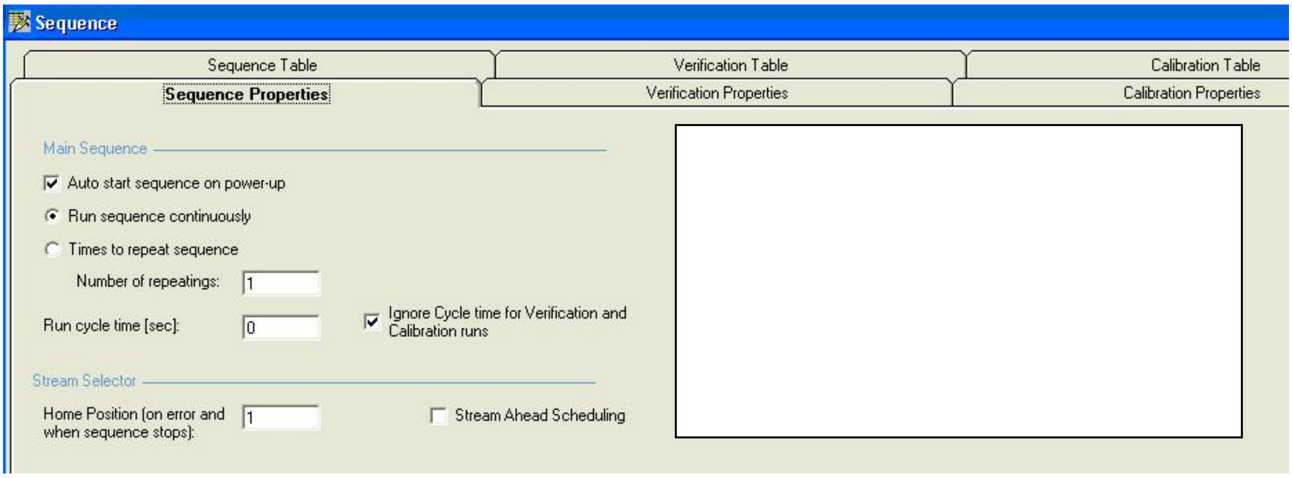
A hardware setup with no stream selection device is unable to switch to different sample streams, or select calibration- or verification gas streams while being automated.



The sequence Run Properties will look like:
As only one single sample is connected, one run type can be performed. In case of a necessary calibration or verification, the sequence must be stopped, the appropriate sample connected and the Run Properties must be changed or another sequence opened and downloaded to the instrument. To resume normal operation again the Run type must be reset to ‘Analysis’ again.

Above screen (single stream sequence properties) is also active, if in the configuration on page 94 a sampler has been selected in combination with “Host System Control”.
A hardware setup with a VICI sample selection device or a Relay type sample selector has the ability to switch sample streams, run blank samples, run and perform timed calibrations and/or verifications.

Consequently the sequence menu will look like the picture below.



Auto Start sequence on power-up

Used to start automation automatically after booting the 490-GC Instrument. When the checkbox is checked automation will start the Sequence Table, and any present Calibration/Verification Tables in the active automation method.
The instrument will resume its routine after a power cut or failure automatically without human intervention.

Enable this option when 490-GC is running in “stand-alone” mode, in case of a power failure the 490-GC PRO will start the automation again. Also the sequence will start from the beginning.

Run Sequence Continuously

When this option is selected the system will cycle the Sequence continuously. After completing the last line of automation in the Sequence Table, the system will continue with the first line in the Table. The system will stop only with human intervention or when it is indicated it should do so when Calibration or Verification fails.
A continuous sequence can be interrupted by:

- Programmed and activated calibration block.
- Programmed and activated verification block.
- External intervention via ModBus.

Times to repeat Sequence

When this option is selected the system will do a defined number of cycles of the Sequence Table. After completing its last cycle, the system will stop and go to ready state.

Number of Repeatings

Represents the number of times a sequence should be repeated.

Run Cycle Time

The run cycle time on page 34 represents the time that should expire before a new run can be started. Normally a run cycle consists of sample flush time, chromatogram runtime and calculation time (in this order).

When the cycle time is set greater than the total time needed to complete this chromatographic cycle, the system will hold and wait until the indicated amount of time has elapsed before proceeding to the next run (cycle).

Home Position

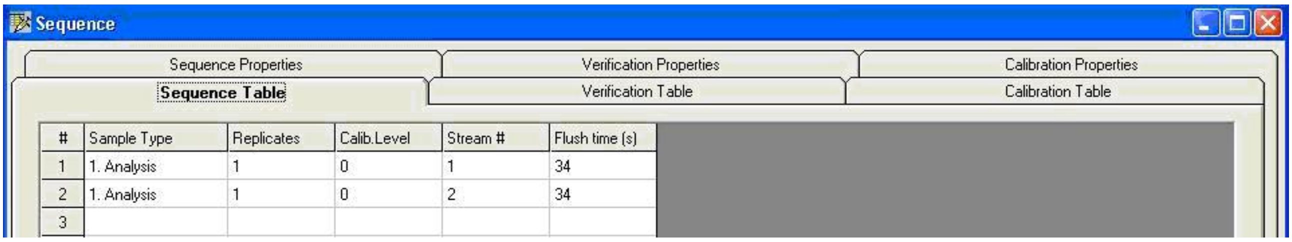
Determines the position of the stream selection device at power startup and after completion of the sequence (including aborting the automation) or when the system has encountered an error. This option ensures that a 'known' sample stream flows through the sample lines in case there is no analysis being performed by the system.

Stream Ahead Scheduling

When this option is selected, it enables the 490-GC PRO to start pre-flushing the sample for the next sample stream, just 1 second after injection. This feature will cut down cycle times when switching streams, as switching to different sample streams often requires a longer time for a sample to reach equilibrium.
Note that this option only works for analysis-to-analysis run types. A calibration or verification run cannot schedule the stream ahead.

24.8.2 Sequence Table

If a sequence is required with automatic calibration by means of a stream selector, it is recommended to put only analysis runs (Sample Type = Analysis) in the Sequence Table. In addition fill the 'Calibration Table' only with the required calibration runs and finally set the triggering for a calibration in the 'Calibration Properties'.



- **Sample Type**
  The sample type for this line (run). Can be set to 'None', 'Analysis', 'Blank', 'Calibration', 'Verification'. Sample type = None represents a blank run without sample being injected (injectime=0 msec).

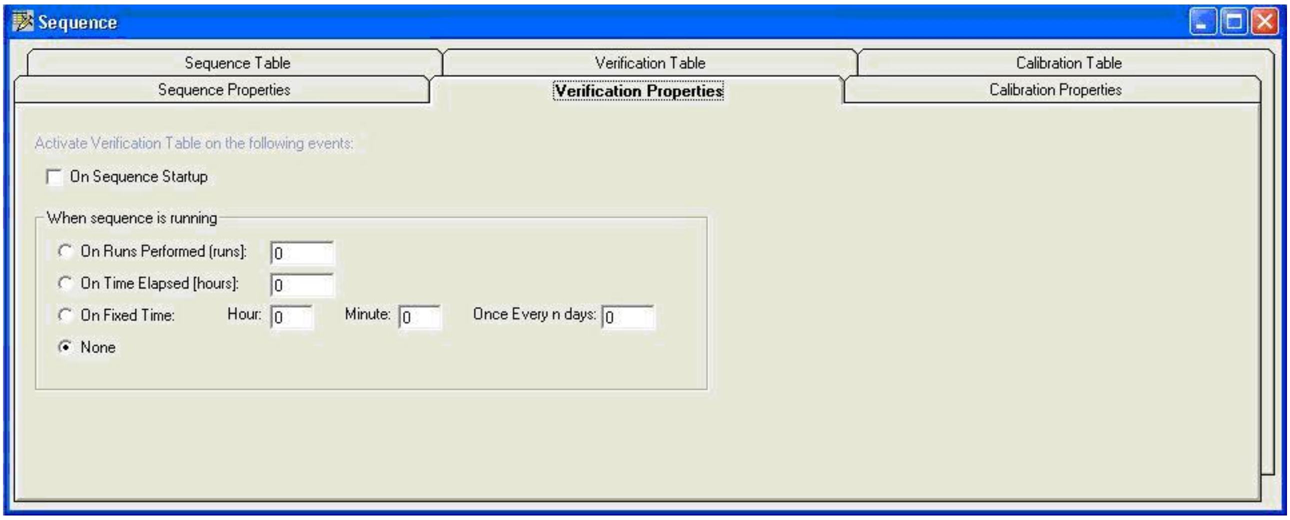
- **Replicates**
  The number of runs for this line in the Sequence Table.

- **Calib. Level**
  Sets the calibration level for the line. The number of Calibration levels available is determined by the calibration method. Note that this field is only relevant when sample type is set to Calibration of Verification.
  For an Analysis run type, just enter a 0.

- **Stream#**
  The sample stream number for this line.

- **Flush Time**
  Sets the time in seconds the sample selected in Stream# is flushed through the tubes before the actual injection is made. Note that when 'Stream Ahead Scheduling' is enabled, the flushing process of the next sample stream will be invoked 5 seconds after injection.

24.8.3 Verification Properties



- **On Sequence Start up**
  Checking 'On Sequence Startup' forces the system to run the verification table on starting automation. Once the verification table is completed, the system will revert back to the sequence table contents.

- **On runs performed (runs)**
  Selecting this option forces the sequence table to be interrupted after a selectable number of runs, and then switch to the Verification Table. Once the verification table is completed, the system will revert back to the sequence table.

- **On Time elapsed (hours)**
  Selecting this option forces the sequence table to be interrupted every number of hours of runtime as indicated, and switch to the Verification Table. Once the verification table is completed, the system will revert back to the sequence table.

- **On Fixed Time / Once every 'n' days**
  Selecting this option forces the sequence table to be interrupted at a fixed time every 'n' days, and switch to the Verification Table. Once the verification table is complete, the system will revert back to the sequence table.

  Note that the system will always complete the run in progress before switching to verification Table contents. For instance, if we set the system to switch to Verification Table at 14:02 hrs each day and a 3-minute run is started at 14:01 hrs, this run will be completed and the actual switch to Verification Table will take place at 14:04 hrs.
  A Verification Table should be finished before reverting, unless it fails the verification criteria. In that case it may switch automatically to the calibration Table.

24.8.4 Verification Table

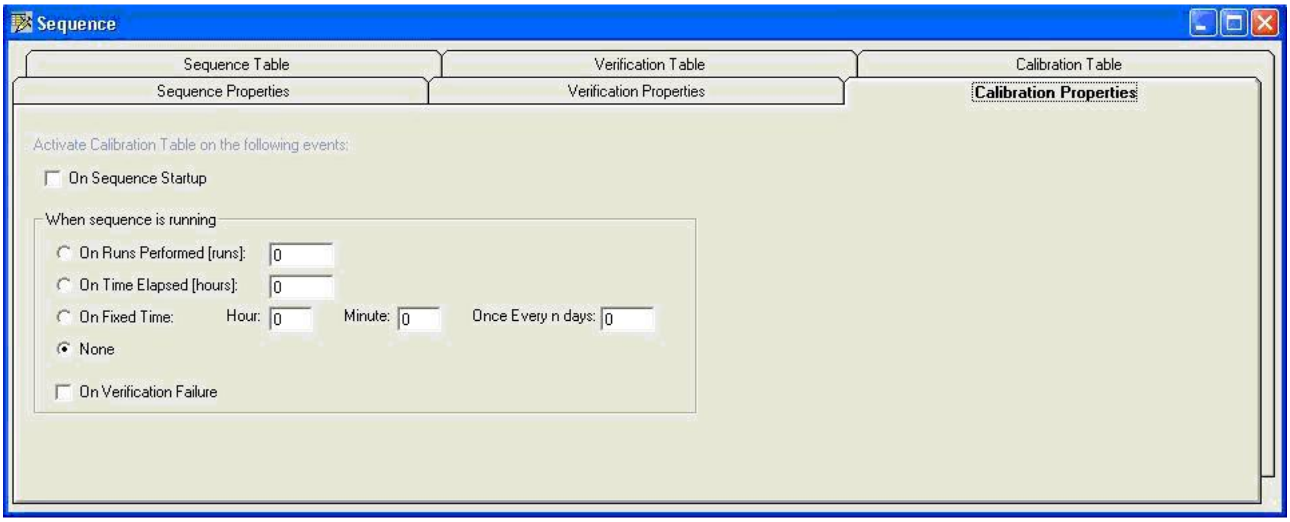
- **Replicates**
  Determines the amount of cycles for this particular line in the Verification Table.

- **Calib. Level**
  Set the calibration level for the line. The number of Calibration levels that are available is determined by the calibration method. Verification calculation is done against the set level of calibration

- **Stream#**
  Sets the sample stream for this particular sequence table line

- **Flush Time**
  Sets the time in seconds the sample selected in Stream# is flushed through the lines before the actual injection is performed. Note that when 'Stream Ahead Scheduling' is enabled, this flushing process may be started during the previous run!

24.8.5 Calibration Properties



- **On Sequence Start up**
  Checking 'On Sequence Startup' forces the system to run the calibration table on starting automation. Once the calibration table is completed, the system will revert back to the sequence table contents.

- **On runs performed (runs)**
  Selecting this option forces the sequence table to be interrupted after a selectable number of runs, and then switch to the Calibration Table. Once the Calibration table is completed, the system will revert back to the sequence table.

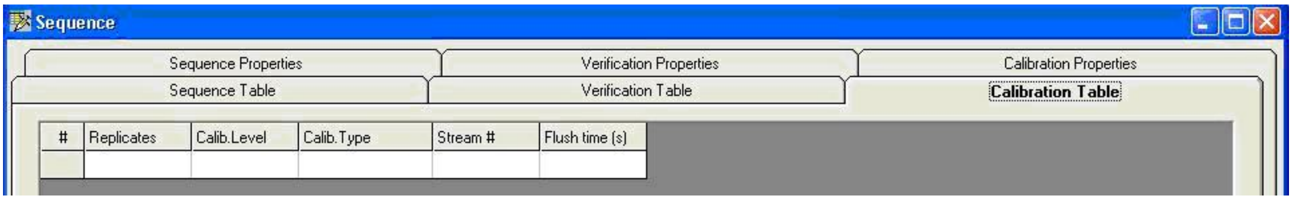
- **On Time elapsed (hours)**
  Selecting this option forces the sequence table to be interrupted every number of hours of runtime as indicated, and switch to the Calibration Table. Once the Calibration table is completed, the system will revert back to the sequence table.

- **On Fixed Time / Once every 'n' days**
  Selecting this option forces the sequence table to be interrupted at a fixed time every 'n' days, and switch to the CalibrationTable. Once the Calibration table is complete, the system will revert back to the sequence table.

- **On Verification Failure**
  When this option is selected, the system will run the calibration block after verification has failed to meet its criteria for that particular calibration level. System will complete calibration table and revert back to verification Table, complete that and revert back to Sequence Table.

  Note that the system will always complete the run in progress before switching to Calibration Table contents. In case a Calibration Table is running it will be completed at all times, before switching to verification block or reverting back to Sequence Table.

24.8.6 Calibration Table



- **Replicates**
  Determines the amount of cycles for this particular line in the Calibration Table.

- **Calib. Level**
  Set the calibration level for the line. The number of Calibration levels is determined by the calibration method. Calibrating will add data points to the calibration curve according to Cal level set.

- **Calib. Type**
  This field sets the way the calibration result is handled. Available options are Ignore, Replace or Append. Selecting 'Ignore' causes the calibration to be rejected and they will not be added to the calibration curve. This can be used for "flushing" runs. This cleaning the system without performing an update of the calibration curve.
  Selecting 'Replace' will delete all available older calibration points for the particular level in the calibration curve and the new calibration result for the level is added instead.
  Selecting 'Append' simply adds the result to the existing calibration curve.

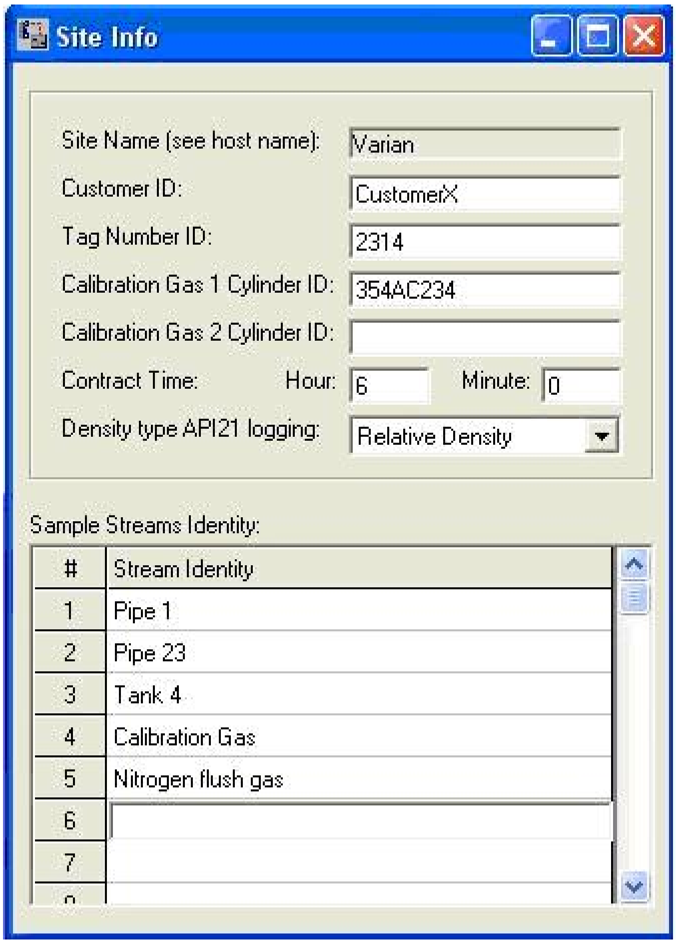
- **Stream#**
  Sets the sample stream for this calibration line

- **Flush Time**
  Sets the time in seconds the sample selected in Stream# is flushed through the tubes before the actual injection is performed. Note that when 'Stream Ahead Scheduling' is enabled, this flushing process may be started during the previous run!

  The necessary information for the calibration calculations is taken from, and stored as a part of the method (peak calibration on page 155).

24.8.7 Automation - Site Information

Site information parameters are only used by “API 21 Logging 35 days analysis license”. The settings as listed below will be stored together with analysis results in a database stored in the instruments flash memory.

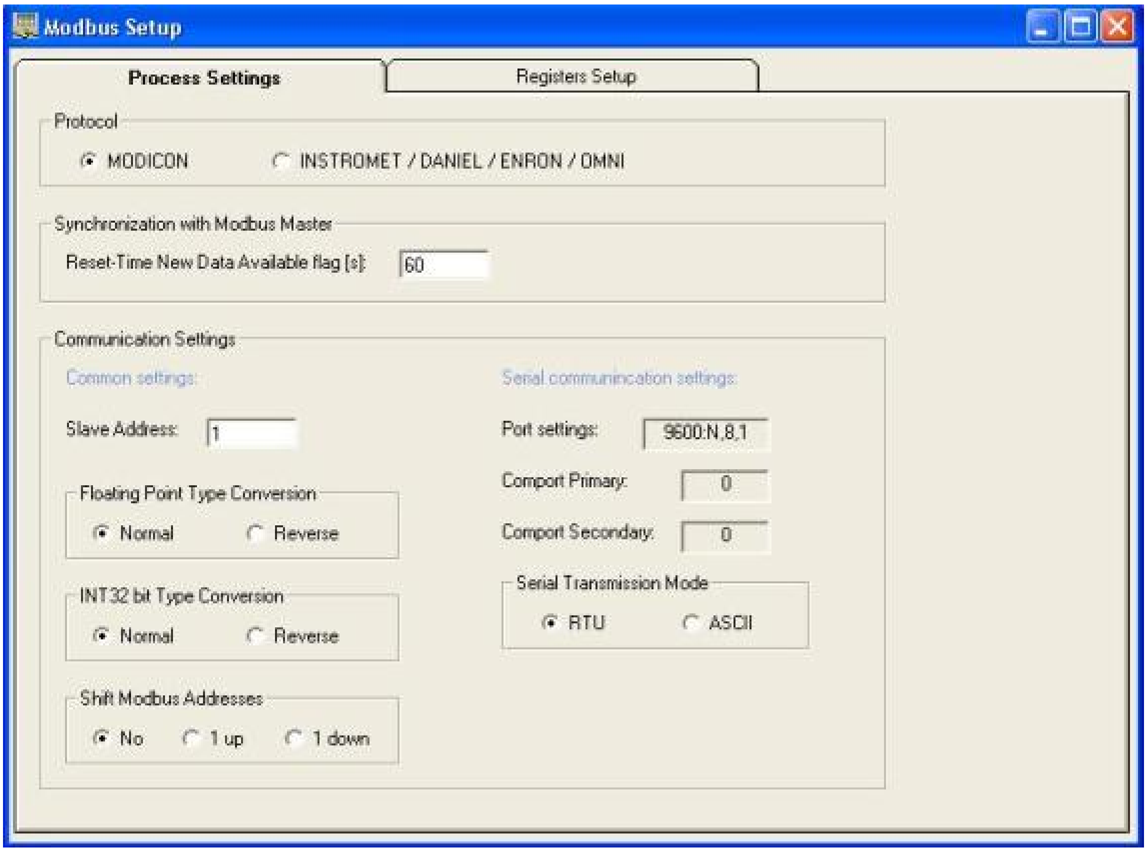


24.8.8 Automation - Modbus Setup

In order to interact with the 490-GC PRO via Modbus registers needs to be coupled to parameters ID's. The Modbus table is the list where parameter ID's can be linked to Modbus registers. Follow up the steps as described below for a proper Modbus table setup.

24.8.8.1 Process Settings Tab

The Modbus Setup will be visible throughout "Automation" and "Modbus setup".



24.8.8.2 Protocol

Change the Modbus protocol from standard MODICON to other derived Modbus protocols. Modbus MODICON is a standard protocol for SCADA systems.
Differences between Modbus MODICON and other Modbus protocols can mainly be found in the holding and input registers above the address 4999 range and above the 6999 range. Above address 4999 the non-MODICON protocol will return 4 byte integers, above 6999 the protocol will give 4 byte floating point values.

24.8.8.3 Synchronization with Modbus Master

For certain parameters synchronization is required while otherwise the values read are not reliable.
Among others the 'Reset Time New Data Available Flag and data flag itself avoids mixing up sample results of two up following runs. The 'Reset Time New Data available flag' is the time in seconds the "data available flag" remains set. It is recommended to set the "data available flag" time lower than the 490-GC run time.
The reset time avoids missing data when more then 1 Modbus masters reads data from the same 490-GC-PRO or when the Modbus Master connects while a 490-GC PRO is running, For more information see 24.8.8.16.1 on page 204.

24.8.8.4 *Modbus communication Settings*

How to setup Modbus TCP/IP and serial communication to a modbus master?

24.8.8.4.1 Slave address

The Modbus serial slave address of the 490-GC PRO. Every serial Modbus device must have a unique slave address. This way the Modbus Master (DCS, flow computer) knows how to contact a specific 490-GC PRO. In a Modbus TCP/IP network the slave address is ignored in the 490-GC PRO. If there is a conversion from Modbus TCP/IP to serial Modbus by a so called Modbus bridge, although ignored by Modbus TCP/IP devices, the slave address is vital when the Modbus request is passed from Modbus TCP/IP to Modbus serial by a so called Modbus bridge. For more information see Modbus bridge on page 208.

24.8.8.5 *Serial Communication settings*

How to setup serial communication to a modbus master?

24.8.8.5.1 Baud rate

Baud rate of the serial connection. The speed in characters per second in which data is transmitted over the serial connection between the 490-GC PRO (Modbus client) and the DCS or flow computer (Modbus Master).

24.8.8.5.2 Port settings

The port settings on which the primary and secondary comport are configured. This configuration is set in the PROstation configuration window on page 98.

24.8.8.5.3 Comport Primary

The Comport to which the first Modbus master is connected as set in the PROstation configuration window on page 98.

24.8.8.5.4 Comport Secondary

The Comport to which the second or redundant Modbus master is connected as set in the PROstation configuration window on page 98.

24.8.8.5.5 Serial Transmission Mode

RTU
RTU (Remote Terminal Unit). RTU can only be used with 8 data bits serial communication. Note that with 8 data bits, 2 stop bits are not possible.

ASCII
ASCII is a standard for sending over information (American Standard Code for Information Interchange). ASCII is standardized to 7 data bits serial communication, but if necessary can also be used on 8 data bits serial communication.

24.8.8.6 Floating Point Type Conversion

The Modbus MODICON protocol has no definition of 32 bit floating point values. Lacking this definition, two kinds of floating point value definitions have emerged.

This option switches between both of the options, where 'Normal' is the definition as used in the 490-GC PRO and 'Reverse' is the definition where the first 2 bytes are swapped with the last 2 bytes.

24.8.8.7 Int32 bit type conversion

The Modbus MODICON protocol has no definition of 32 bit integer values. Lacking this definition, two kinds of 32 bit integer value definitions have emerged.

This option switches between both of the options, where Normal is the definition as used in the 490-GC PRO and 'Reverse' is the definition where the first 2 bytes are swapped with the last 2 bytes.

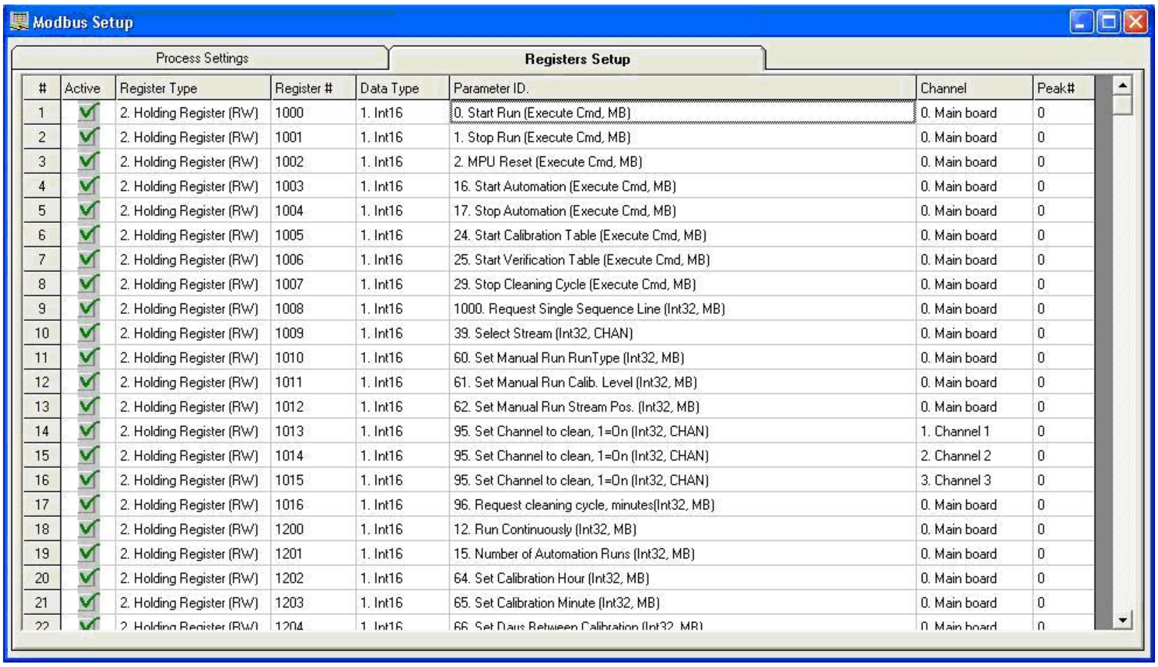
24.8.8.8 Shift Modbus addresses

When using Modbus, several kinds of Modbus register addressing can be used. The 490-GC PRO has three different options.

- **No:** where for register 500 a request for register 500 is sent out (as the 490-GC PRO has always done)
- **1 down:** where for register 500 a request for register 499 is sent out (which can mostly be found in the field)
- **1 up:** Where for register 500 a request for register 501 is sent out (rarely used)

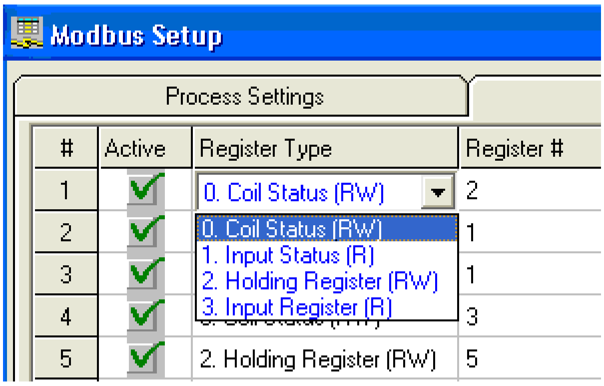
For more information see advanced address shift information on page 206

24.8.8.9 Registers Setup Tab



#	Active	Register Type	Register #	Data Type	Parameter ID	Channel	Peak#
1	✓	2. Holding Register (RW)	1000	1. Int16	0. Start Run (Execute Cmd, MB)	0. Main board	0
2	✓	2. Holding Register (RW)	1001	1. Int16	1. Stop Run (Execute Cmd, MB)	0. Main board	0
3	✓	2. Holding Register (RW)	1002	1. Int16	2. MPU Reset (Execute Cmd, MB)	0. Main board	0
4	✓	2. Holding Register (RW)	1003	1. Int16	16. Start Automation (Execute Cmd, MB)	0. Main board	0
5	✓	2. Holding Register (RW)	1004	1. Int16	17. Stop Automation (Execute Cmd, MB)	0. Main board	0
6	✓	2. Holding Register (RW)	1005	1. Int16	24. Start Calibration Table (Execute Cmd, MB)	0. Main board	0
7	✓	2. Holding Register (RW)	1006	1. Int16	25. Start Verification Table (Execute Cmd, MB)	0. Main board	0
8	✓	2. Holding Register (RW)	1007	1. Int16	29. Stop Cleaning Cycle (Execute Cmd, MB)	0. Main board	0
9	✓	2. Holding Register (RW)	1008	1. Int16	1000. Request Single Sequence Line (Int32, MB)	0. Main board	0
10	✓	2. Holding Register (RW)	1009	1. Int16	39. Select Stream (Int32, CHAN)	0. Main board	0
11	✓	2. Holding Register (RW)	1010	1. Int16	60. Set Manual Run RunType (Int32, MB)	0. Main board	0
12	✓	2. Holding Register (RW)	1011	1. Int16	61. Set Manual Run Calib. Level (Int32, MB)	0. Main board	0
13	✓	2. Holding Register (RW)	1012	1. Int16	62. Set Manual Run Stream Pos. (Int32, MB)	0. Main board	0
14	✓	2. Holding Register (RW)	1013	1. Int16	95. Set Channel to clean, 1=On (Int32, CHAN)	1. Channel 1	0
15	✓	2. Holding Register (RW)	1014	1. Int16	95. Set Channel to clean, 1=On (Int32, CHAN)	2. Channel 2	0
16	✓	2. Holding Register (RW)	1015	1. Int16	95. Set Channel to clean, 1=On (Int32, CHAN)	3. Channel 3	0
17	✓	2. Holding Register (RW)	1016	1. Int16	96. Request cleaning cycle, minutes(Int32, MB)	0. Main board	0
18	✓	2. Holding Register (RW)	1200	1. Int16	12. Run Continuously (Int32, MB)	0. Main board	0
19	✓	2. Holding Register (RW)	1201	1. Int16	15. Number of Automation Runs (Int32, MB)	0. Main board	0
20	✓	2. Holding Register (RW)	1202	1. Int16	64. Set Calibration Hour (Int32, MB)	0. Main board	0
21	✓	2. Holding Register (RW)	1203	1. Int16	65. Set Calibration Minute (Int32, MB)	0. Main board	0
22	✓	2. Holding Register (RW)	1204	1. Int16	66. Set Days Between Calibration (Int32, MB)	0. Main board	0

24.8.8.9.1 Register Type



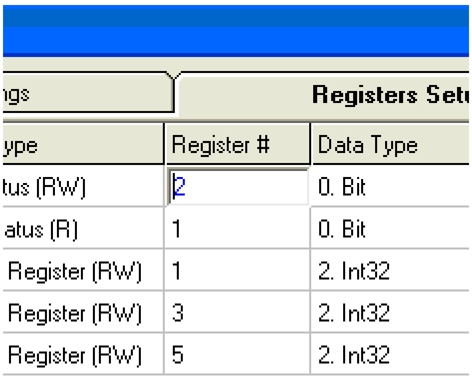
Coil status: This register is a single bit register.
Modbus master is capable of reading and writing this register.

Input Status: This register is a read only single bit register.
This register can only be read from a Modbus master.

Holding register: This is a 16 bit integer register.
Modbus master is capable of reading and writing.
Two registers grouped together can hold a 4 byte integer or 4 byte floating point value.

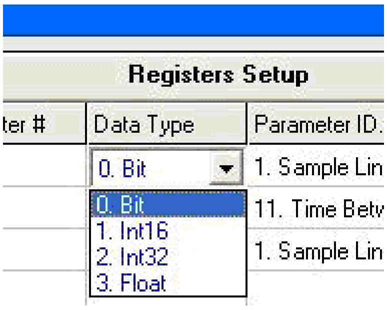
Input register: This is a 16 bit integer register.
This register can only be read.
Two registers grouped together can hold a 4 byte integer or 4 byte floating point value.

24.8.8.9.2 Register



The Register # column contains the Modbus register address.
Note that 'Holding' and 'Input' registers require two registers to store a floating point or 32 bit integer value in MODICON mode.
In the Modbus mode, used by Daniel, Elster-Instromet (and others), 32 bit integers and 32 bit floating point values are handled differently from Modbus MODICON. In contrast with Modbus MODICON, only 1 register is required. In Modbus Daniel mode, certain register ranges are built up of 32 bit registers, which means that 1 register can contain a complete floating point or 32 bit integer value. The 32 bit integers can only be stored in the register range between and including register 5000 and 6999. Floating points can only be stored in the register range after and including register 7000.

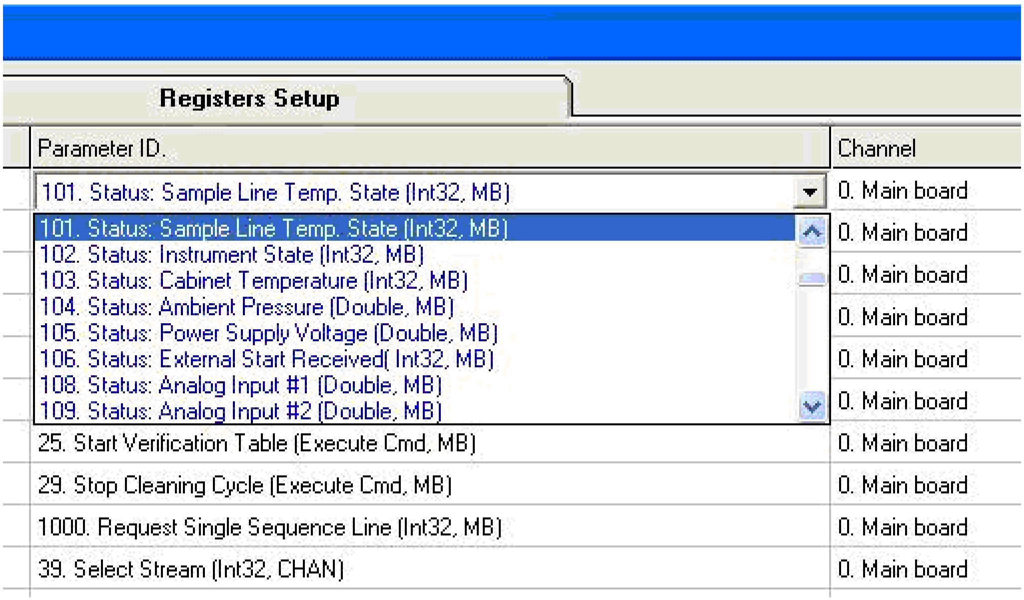
24.8.8.9.3 Data Type



In the Data type column one can choose what kind of data type the register output is.

Bit: a single bit, value 0 or 1.
Int16: 16 bit integer value.
Int32: 32 bit integer value.
Float: 4 byte floating point value.

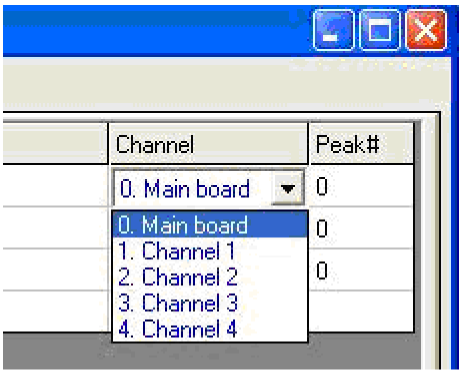
24.8.8.9.4 Parameter ID



Parameter ID number is the output number in the 490-GC PRO that corresponds with the parameter or function that needs to be called to retrieve a value from 490-GC PRO or start an action in it.
The Modbus parameters that can be selected in the Modbus table in PROstation, are ordered by subject. This means that for example all Modbus parameters concerning integration results, are grouped together, whatever the numbers of those parameters are.

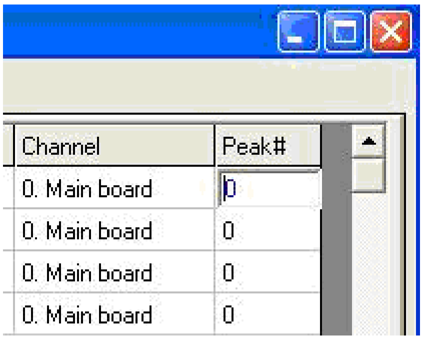
Note that the remarks between brackets reveal the data type for that particular parameter, (Bit, Int16, Int32, Float), the channel value (location of the 490-GC PRO part to address) and optionally the Peak values that should be used.
Which data type, channel and peak value are required for each parameter, is defined in the Modbus parameter reference on page 211.

24.8.8.9.5 Channel



If a Parameter ID concerns the mainboard or the instrument itself, the choice should be "0 Main board". Otherwise one of the four channels, required I/O number, stream number, etc must be chosen.
Which channel setting is required for each parameter, is defined in the Modbus parameter reference on page 211.

24.8.8.9.6 Peak#



Peak numbers should be set for those Parameter ID's concerning peak related parameters or certain indexes. For some parameters the values in the 'Peak#' column are used for other purposes.
Which peak setting is required for each parameter, is defined in the Modbus parameter reference on page 211.

24.8.8.9.7 Which Parameter ID's to use

The 490-GC PRO Micro-GC uses parameter ID's to allow getting or setting data remotely.

1. Determine whether the Modbus master (DCS, etc.) must be capable to only read data from the 490-GC PRO Micro-GC or should also write data.

2. Setup and complete the method, application and automation. Make sure all method peaks exist in the application normalization table. If the application is still empty, run the application wizard in order to create a component list from the method peak table.

3. Now open a predefined Modbus table from hard disk (developed for a 490-GC PRO Micro-GC) or select the Modbus wizard when developing a new Modbus table. In the Modbus wizard, select the options that are required. It is advisable not to select options which are not requested by the Modbus master. Select "OK" to generate a dynamic Modbus table from the selected options. If Elster-Instromet / Daniel mode was selected, a component identity is created on holding register 3001 and up, for every component in the application normalization table. This is required in order to be Daniel protocol compatible.

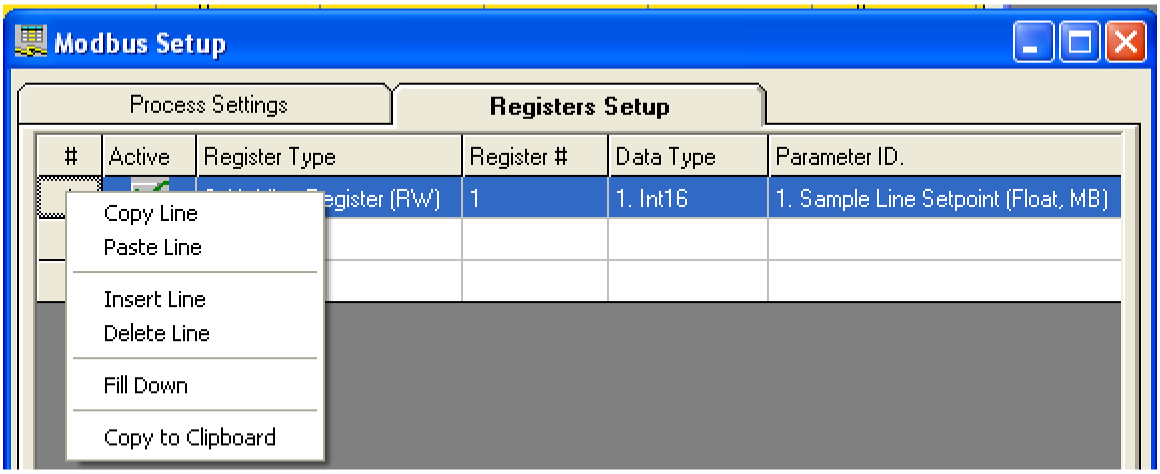
4. Modify, delete or add lines to the generated Modbus table to fulfill the requirements.

5. Download, Save and Print the Modbus table. A printout is required for setting up the Modbus master's (DCS) Modbus registers.

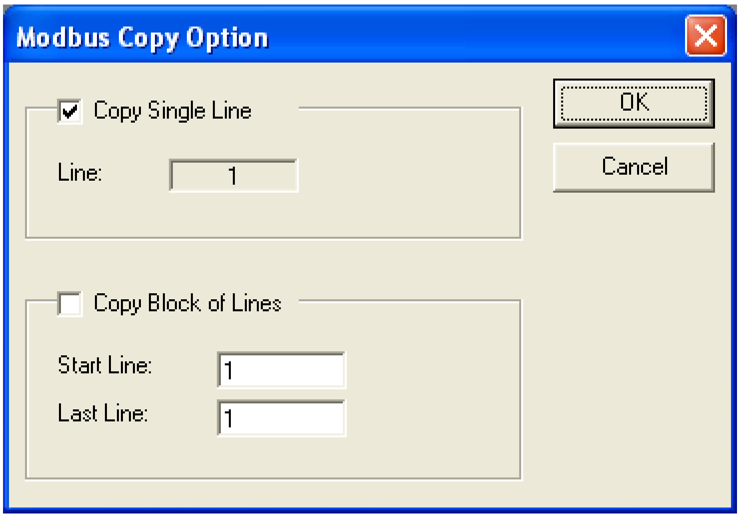
6. The WinDCS application can be used to test the Modbus registers.

24.8.8.9.8 Table Copy Functions

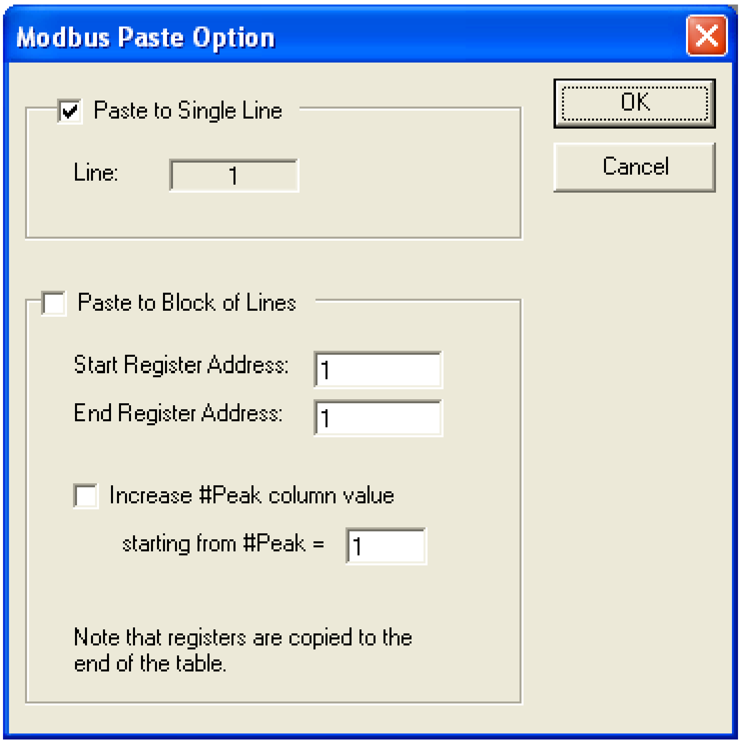
By right mouse clicking on a row containing valid data, a menu dialog appears.
This allows the operator to use copy and paste functions to setup the modbus table more efficient.



The Copy window



The Paste window



24.8.8.10 Remote system Synchronization

Create Modbus holding registers containing the parameter ID's 515 on page 228 to 520 on page 229 in the Modbus table.
Make sure the Modbus master sets parameter 518 on page 229 "second" as the last clock parameter.
On downloading parameter 518 on page 229 "second", the real-time clock is updated in the BIOS of the 490-GC PRO Micro-GC. The BIOS is responsible for setting the application clock correctly at reboot.

24.8.8.11 Reading Sample Results

Use parameter ID's 2203 to 2237 on page 237 for reading all relevant sample results after detecting that new sample results are available (see synchronization). Unnormalized (ESTD) component concentrations can be read by reading the Modbus register containing parameter 2232.
For normalized values use parameter 2233.
The peak column must contain the component number from the application normalization window; channel must be set to "0-mainboard"
For an Energy meter parameter ID's 2260-2280 on page 247 must be read in addition. All sample results parameters must wait for a New Data Available flag on page 236 (synchronization bit) to be set.

24.8.8.12 Reading Stream Specific Results

Parameter ID's 2400-2418 on page 251 are used for reading the last stream specific sample results. The 490-GC PRO holds the last sample results of every stream in RAM memory.

24.8.8.13 Fixed Values

By using parameter 9000 on page 264 "fixed values", Modbus registers can be setup to return a fixed definable value.
Enter the required value (INT16 value) in the "peak" column of the Modbus table. This parameter can for example be used for additional identification.

24.8.8.14 Execute Commands

The execute command parameters on page 257 (0-36) can be used to remotely perform an action. Although these parameters trigger some action in the 490-GC PRO, they still require regular Modbus parameters to be written to Modbus.

If for example the 490-GC PRO Micro-GC must be rebooted on request, create the following line in the Modbus table:

Register type:	"0 Coil Status"
Register:	100 (any other coil address is allowed)
Data type:	"0 Bit"
Parameter ID:	"2 MPU reset (execute Cmd, MB)"
Channel:	"0 MB"
Peak:	"0"

In order to request the 490-GC PRO Micro-GC to reboot, set coil status 100 to value 1.

24.8.8.15 Full Remote Control 490-GC PRO Micro-GC

Although the 490-GC PRO Micro-GC can run autonomic, it also can be configured to act as a slave. The Modbus master system is then responsible for selecting the stream, setting Run type, Calibration level, Starting runs, etc.

For remote control, setup a Modbus table containing at least the Parameter ID's as listed below. It is assumed that the method parameters should not be changed during operation.

1. 0 Start Run (execute CMD, MB)
   24 Start Calibration Table (execute CMD, MB) *
   25 Start Verification Table (execute CMD, MB) *
   60 Set Manual Run Type (INT16, MB)
   61 Set Manual Run Calibration level (INT16, MB)
   62 Set Manual Run Stream position (INT16, MB)

2. To prepare a new run, the Modbus master must set Run type, Calibration level and stream position (parameter ID's 60, 61, 62 on page 216) and then start a single run (parameter ID 0). Pre-defined calibration and/or verification tables can simply be started by sending out an execute command (Execute command ID's 24 or 25 on page 257).

* These are priority runs. They will be executed after the current run is completed. In instrument idle mode priority runs will be executed at once.

24.8.8.16 Advanced Modbus information

How to synchronize a 490-GC PRO with a modbus master?

24.8.8.16.1 Synchronize 490-GC PRO with new data available flag(s)

To synchronize a DCS with 490-GC PRO new analysis data, setup a Modbus table containing a 'New data available' flag (synchronization parameters 2200, 2201 or 2238 on page 236) on an input status register or, if required, an input register.

All sample result related parameter id's, which are linked to Modbus registers, should only be read when the 'New data available' flag is set to 1. This means the run has finished, all calculation is done and Modbus registers containing result data have been updated with information of the finished run.

Now all sample results parameter id's can be read any time.

The 490-GC PRO has 3 different 'New Data Available' flags (that cannot be used in combination), with their own behavior when it comes to resetting the flag.

Parameter 2200
Is set to 1 when all sample result data of the last finished run is available. This value is automatically reset after the 'Reset-Time data available' flag expires. The 'Reset-Time data available' flag can be set in the "Process Setting" TAB "Modbus Setup" on page 194. These parameters should not be used when more than one Modbus master reads data from the same 490-GC PRO.

Parameter 2201 and 2238
Becomes 1 at the moment all sample result data of the last finished run is available. This value is reset back to 0 directly after register is read by a flow computer. However if the parameter is not read, the value will be reset automatically after the "Reset-Time data available flag" expires. The "Reset-Time data available flag" can be set in the "Process Setting" TAB "Modbus Setup" on page 194. These parameters must be used when more then one Modbus master reads data from the same 490-GC PRO, otherwise one of the Modbus Masters misses new data.

Make sure to check chapter Modbus pitfalls, attention points and recommendation below for additional information.

24.8.8.16.2 Modbus pitfalls, attention points and recommendations

Modbus synchronization (and Modbus in general) has some pitfalls and points of attention. Some are unique to the 490-GC PRO, some are general to Modbus. Below the most common are listed.

1. **Use identical Modbus settings and Modbus table on both master and slave side**
   Modbus settings on the 490-GC PRO (slave) should be the same as on the Flow Computer side (master).

2. **Reset time new data available flag**
   Make sure the 'Reset-Time data available' flag is smaller than the run time, but long enough to be detected by the Modbus master(s).
   Please find chapter Synchronize 490-GC PRO with new data available flag(s) on page 204 for additional information.

3. **'New Data available flag' only accounts for result data**
   The new data available parameters 2200, 2201 or 2238 on page 236 is only applicable to sample result data. E.g. status data is valid at any time and reading status does not require waiting for the synchronization parameter to be set to 1.
   Please find chapter Synchronize 490-GC PRO with new data available flag(s) on page 204 for additional information.

4. **Do not combine 'new data available' flags**
   Do not use any combination of new data available parameters 2200, 2201 or 2238 on page 236 in the same Modbus table. You should use either parameters 2200 or 2201 or 2238 on page 236.

   If you use them combined, unexpected behavior will occur, meaning that if e.g. parameter 2201 is read, parameter 2201 will be reset to 0, but parameter 2200 and 2238 will be reset as well. Same issues could occur when using a combination of two or more times the same synchronisation parameter (2200, 2201, 2238) on page 236.
   Please find chapter Synchronize 490-GC PRO with new data available flag(s) on page 204 for additional information.

5. **Int32 and Float data types in Modbus MODICON.**
   If working in Modbus MODICON mode, always use 2 register spaces for 32 bit values, because Modbus MODICON by design only accomodates 16 bit register spaces. The 32 bit values that can be used are Float and Int32 (32 bit integer).

   Modbus MODICON)

Register	Register type	Data type	Parameter ID
502	Holding register	Float	2232. Application: Comp. ESTD Conc.
504	Holding register	Float	2237. Application: Comp. Area

6. **Int32 and Float data types in Modbus Daniel**
   If working in a Modbus addition as used by e.g. Elster-Instromet, Daniel, Enron and Omni, you have 32 bit address spaces to your availability, but only for certain address ranges. From address 5000 to 6999 only 32 bit integers can be used. From 7000 and up only floating points can be used. These address ranges have 32 bit address spaces, so for one 32 bit integer or 1 floating point value (which is 32 bit as well), only one address space has to be used.

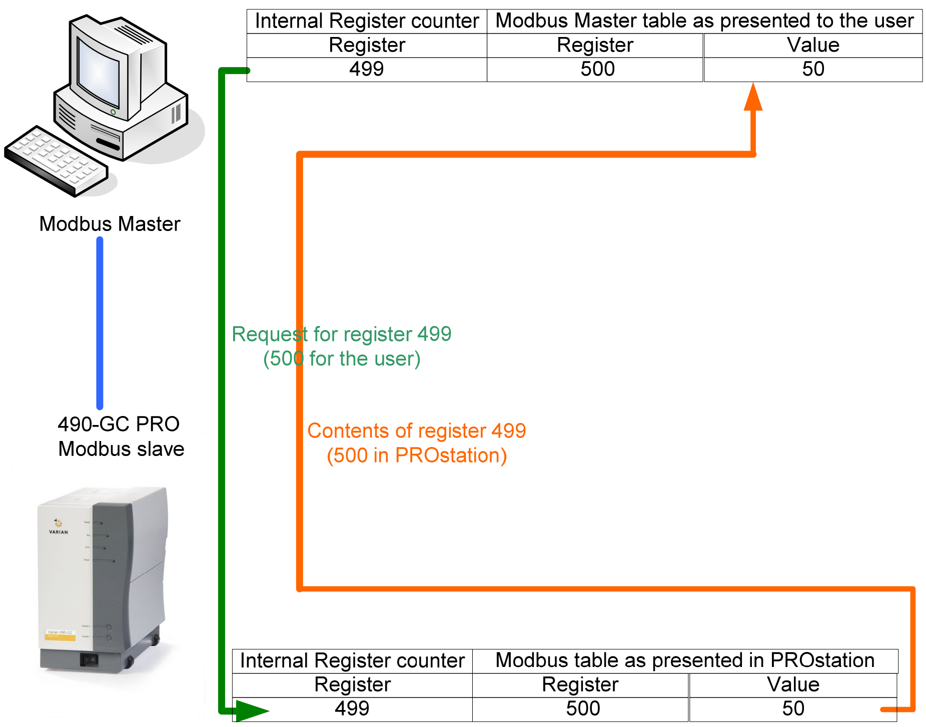
   Modbus Elster-Instromet/Daniel/ Enron / Omni Int32

Register	Register type	Data type	Parameter ID
7002	Holding register	Float	2232. Application: Comp. ESTD Conc.
7003	Holding register	Float	2237. Application: Comp. Area

7. Modbus register address shift

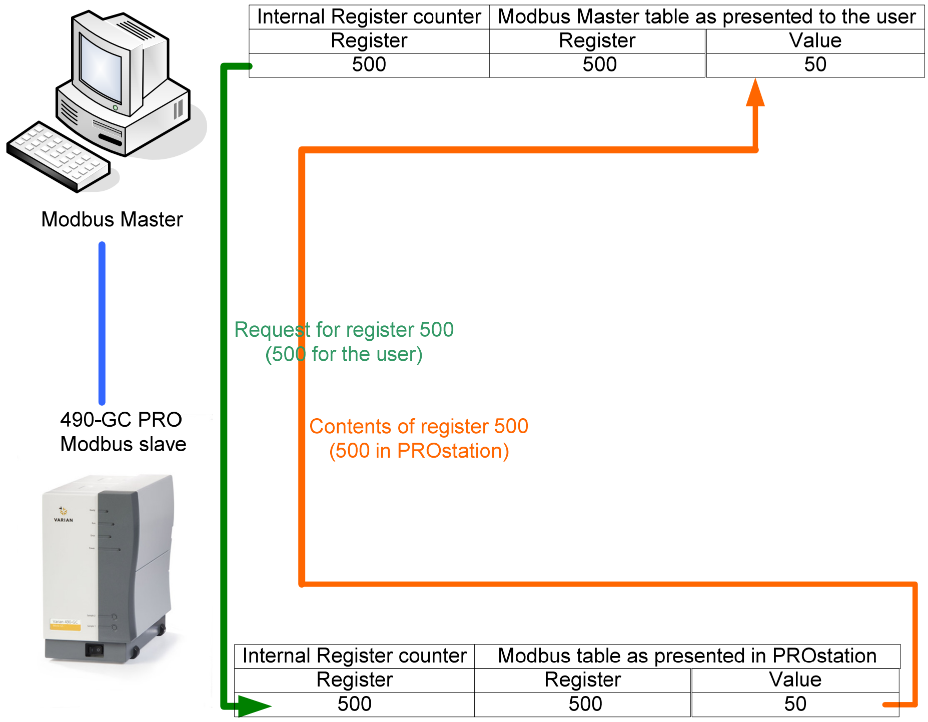
Manufacturers of Modbus equipment can start counting a Modbus table at various starting points, different from what is shown to the user. Below the various ways of counting are explained. Those different ways of counting are better known as address shift (manual and PROstation).

If the Modbus master (flow computer) internally starts counting the Modbus table at 0, the master requests register 499 if register 500 is defined in the Modbus table presented to the user of the Modbus Master. The 490-GC PRO (Modbus slave) – if address shift configured correctly – returns the content of register 500. If the 490-GC PRO is configured in another way, the Modbus master will end up with the content of register 499 or 501 or with an error. This is most common in the field and according to the official Modbus MODICON standard.
To handle this type of address shift properly, set the Modbus address shift on page 196 to '1 down'.

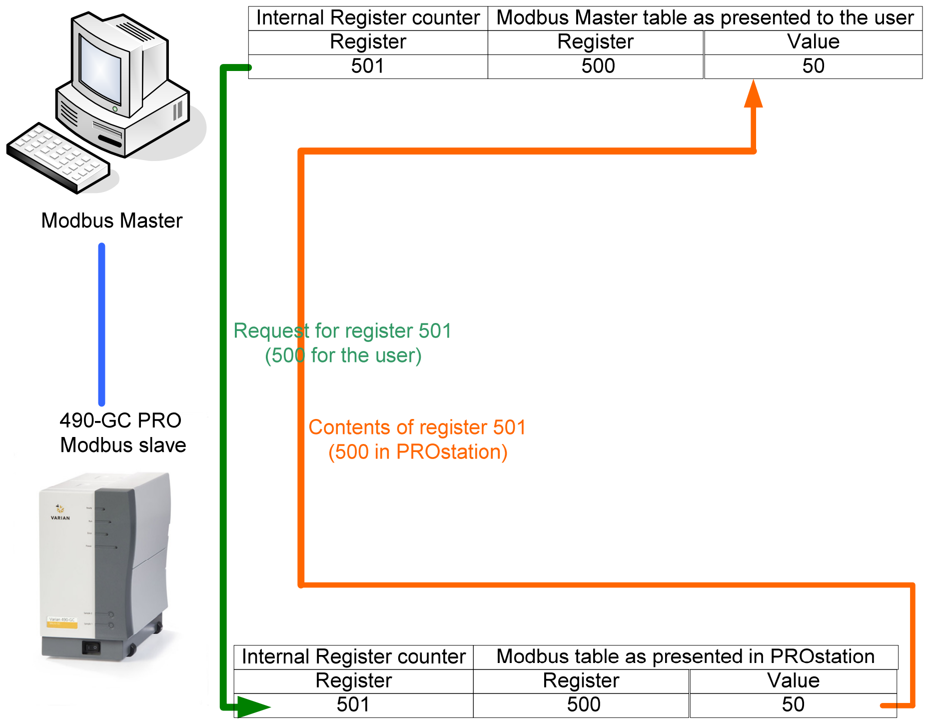


If the Modbus master (flow computer) internally starts counting the Modbus table at 1, the master requests register 500 if register 500 is defined in the Modbus table presented to the user of the Modbus Master. The 490-GC PRO (Modbus slave) – if address shift configured correctly – returns the content of register 500. If the 490-GC PRO is configured in another way, the Modbus master will end up with the content of register 499 or 501 or with an error. This is the way the 490-GC PRO has operated in the past.

To handle this type of address shift properly, set the Modbus address shift on page 196 to ‘No’.



If the Modbus master (flow computer) internally starts counting the Modbus table at 2, the master requests register 501 if register 500 is defined in the Modbus table presented to the user of the Modbus Master. In this case the Modbus table presented to the user often starts at 0.
The 490-GC PRO (Modbus slave) – if address shift configured correctly – returns the content of register 500. If the 490-GC PRO is configured in another way, the Modbus master will end up with the content of register 499 or 501 or with an error. To handle this type of address shift properly, set Modbus address shift on page 196 to ‘1 up’.



8. Register requests outside the 490-GC PRO Modbus table

If an address is requested outside the table defined in the 490-GC PRO, the 490-GC PRO will ignore the request and return an error

For example, assume this is the complete table defined in the 490-GC PRO
490-GC PRO table (Daniel mode)

Register	Register type	Data type	Parameter ID
7002	Holding register	Float	2232. Application: Comp. ESTD Conc.
7003	Holding register	Float	2237. Application: Comp. Area

Now assume a block of registers ranging from 7001 up to and including 7004 is requested by the flow computer. The 490-GC PRO responds with an error, because registers 7001 and 7004 are not configured in the 490-GC PRO's Modbus table.

9. Communication start test

Some Modbus Master applications (for example Cimplicity) test all their configured Modbus registers in large blocks at start of communication. These blocks often exceed the limits as defined in the Modbus table of the Modbus master or used during normal communication. The register blocks to which the 490-GC PRO responds with an error, will be removed from the communication schedule. In other words all registers and register blocks that fail during this test, will never be requested again until the communication is stopped and restarted (again the configured registers are tested).

Configured Modbus master table

Register	Data type
500	Int16
520	Int16

During normal communication, register 500 and 520 will be requested independently. While testing, it could be that a block of registers is requested from 500 to 520 at once. Due to the 490-GC PRO’s behavior described in point 8 above, this test will fail, although nothing is wrong with the 490-GC PRO’s configuration. The test algorithm and how or when several independent registers are grouped during the test, is unknown to us.

To have a workaround for this problem, make sure to leave no gaps between registers of the same type. Moreover communicate the behavior described in this point (point 9) and point 8 above with the local Modbus specialist / application specialist.

24.8.8.16.3 Modbus Bridge

Because of the variety of Modbus variants and connection possibilities, one can come across a Modbus network configuration that the 490-GC PRO does not or can not support. The same problem can occur when a Modbus serial network is required and all 490-GC PRO’s serial ports are occupied for additional equipment. In such cases a Modbus bridge can be the solution.

Cases where a Modbus bridge can help:

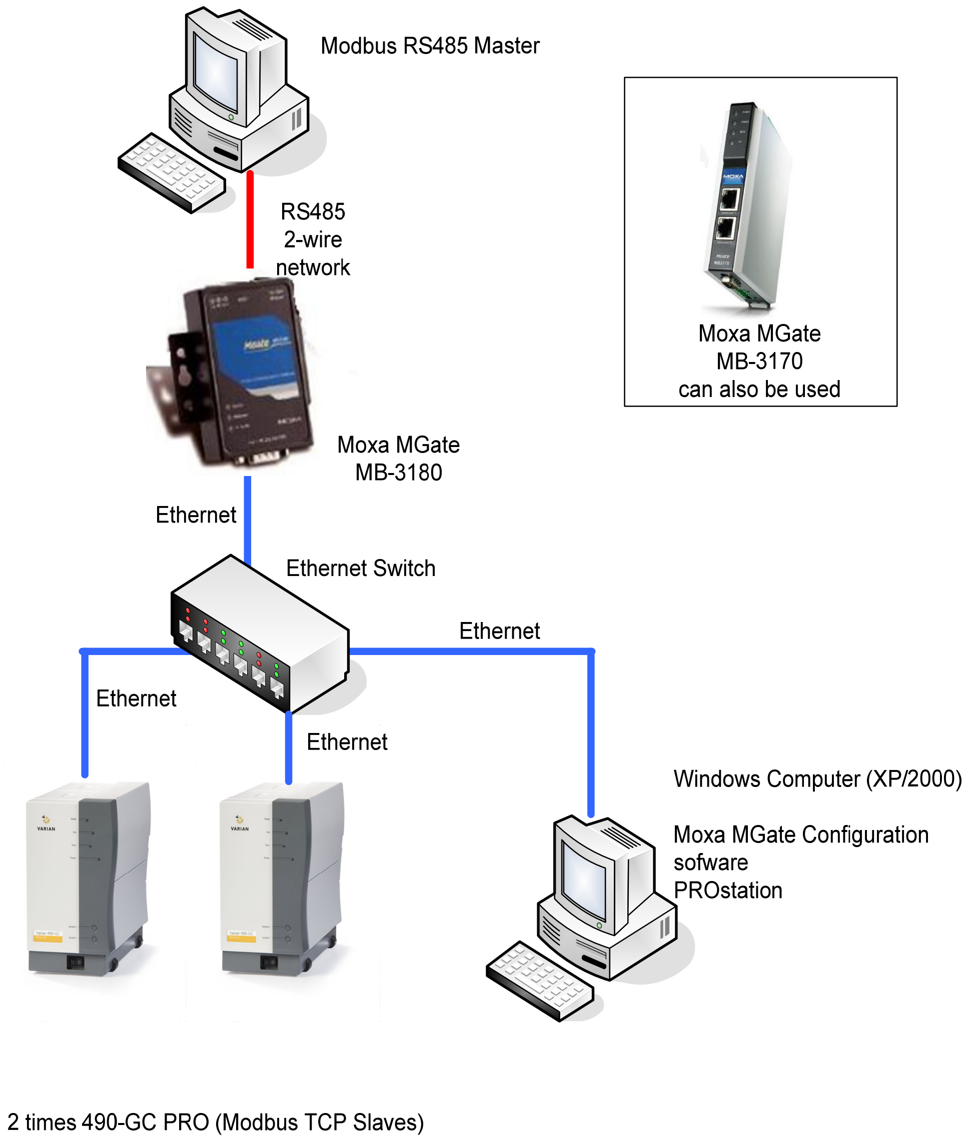
- Modbus RS485 2 wire serial network
- Any Modbus serial network where all serial ports of the 490-GC PRO in use
- Modbus RS422 serial network
- Modbus TCP/IP Master for some reason does not communicate with Modbus TCP/IP in the 490-GC PRO

To help with these issues, Varian, Inc. has tested a couple of Modbus bridges of Moxa Inc. operating in 'serial to Modbus TCP' mode and 'Modbus TCP to serial' mode. The advice is to use one of these Modbus bridges in case one is needed. Moxa comes in two Modbus bridge series: a standard series (MB3x80, where x is the number of ports) and an industrial series (MB3x70 where x is the number of ports)

Often the standard series (MB3x80) is more suitable in case the 490-GC PRO is used in a clean laboratory environment.

The industrial series is more suitable for use in industrial environments. It has some specific industrial options, like redundant power supply, power supply alarm, din rail mounting, Ethernet cascading, priority control for urgent commands etc.

Here is an example diagram of a situation where 2 490-GC PRO devices are connected to a Modbus RS485 2 wire serial network, which is normally not supported by the 490-GC PRO.



In case there is also one or more Modbus Master(s) on the Modbus TCP/IP network that needs to communicate with the network, note that a 2-port Modbus gateway is required (or two individual Modbus gateways).

NOTE

Contact your local Moxa dealer for prices and ordering of Moxa products!
http://www.moxa.com/where_to_buy/where_to_buy.aspx
(make sure to select 'Modbus gateways' in the search criteria)

Information standard series:
http://www.moxa.com/product/MGate_MB3180_3280_3480.htm

Information industrial series:
http://www.moxa.com/Product/MGate_MB3170_3270.htm
Note that the MB3X80 series does not have a power supply included. In most cases when using this device, the power supply is extracted from the industrial plant.

24.8.8.17 Modbus Parameter ID Reference

This chapter lists and explains all available Modbus parameters. The Modbus parameters are listed in the same order and same way as they are listed in the Modbus configuration of PROstation. This means that the Modbus parameters are ordered by subject.
Each subject that contains a Modbus parameter, is put into a separate paragraph, which makes it easier to find the correct Modbus parameters.

Each Modbus parameter description consists of several fields. Some fields are only for use in the Modbus table of PROstation (Modbus slave), others are required to use in PROstation and the DCS or flow computer (Modbus masters). Below a description of all possible fields. Only the fields of interest for PROstation Modbus table are marked:

- **Description:** Describes the general task
- **Allowed values:** One of the defined values is selected for each Modbus parameter, depending on whether the particular value is read only, write only or read / write.
    - **Return value:** Specification of the kind or range of return value for a read-only parameter. (Corresponds with return value field in the Modbus Master). If an error occurs, a Modbus error will be returned instead.
    - **Set value:** Specification of the kind or allowed range of set value for a write only parameter (Corresponds with return and set value field in the Modbus Master). If successful, 0 will be returned, otherwise a Modbus error is returned.
    - **Return / set value:** Specification of the kind or allowed range of return or set value for a read / write parameter (Corresponds with return and set value field in the Modbus Master). If successful, 0 will be returned, otherwise a Modbus error is returned.
- **Unit:** Specification of the used unit (if any)
- **Accuracy:** Specification of the returned or required accuracy (if specifiable)
- **Modbus data type:** The advised Modbus register type that should be used to work with a particular Modbus parameter.
- **Modbus Data Type:** The advised data type that should be used to work with a particular Modbus parameter.
- **Channel (PROstation):** The location of the 490-GC PRO where the Modbus request should be addressed to. This field contains a select list with possible locations for the selected parameter ID. This select list changes according to the Modbus parameter specified (corresponds with the Channel column in the Modbus table in PROstation)
- **PEAK (PROstation):** An additional field that is required for some Modbus parameters to do additional selections. Most of the times it is used to select a particular peak, but more often it is used to select a particular relay or IO port. (Corresponds with the Peak column in the Modbus table in PROstation)
- **Remarks:** This field specifies additional behavior, characteristics, warnings and / or attention points.
- **See also:** This field gives links to related Modbus parameters or related chapters elsewhere in the manual.

24.8.8.17.1 System method and configuration settings

1. Sample Line Setpoint (Float, MB)

- **Description:** Returns / sets the sample line Setpoint
- **Return / Set value:** 30 to 110
- **Unit:** degrees Centigrade (˚C)
- **Accuracy:** 1 °C
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bits floating point)
- **Channel (PROstation): Main board** (value = 0)
- **Remarks:**
    - Before use, check if a heated sample line is installed in the configuration screen on page 89.
- **See also:**
    - Sample line setpoint method screen on page 114
    - Heated Sample line chapter information on page 14

2. Flush Cycle Active (bit, MB)

- **Description:** Returns / sets whether or not the 490-GC PRO will perform a flush cycle when needed. For example after restart (changing gas bottle)
- **Return / Set value:**
    - 0 = No flush cycle will be performed
    - 1 = Flush cycle will be performed
- **Register type:** Bit (1 Bit)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** when recovering from a 'too low pressure error', a flush cycle is always performed. A 'too low pressure error' occurs when changing a gas bottle or certain gas errors.
- **See also:**
    - Flush cycle setting on page 91
    - The chapter about the factory default settings on page 6 briefly mentions the flush cycle. For detailed information about the flush cycle, refer to the 490-GC micro gc manual
    - 490-GC PRO cycle schema on page 34

3. Number of flush cycles (Int16, MB)

- **Description:** Returns / sets the number of flush cycles set in the 490-GC PRO configuration
- **Return / Set value:** 1, 2 or 3
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type**: Int16 (16 bit integer)
- **Channel (PROstation): Main board** (value = 0)

NOTE

This parameter can return a value bigger than 0, even when parameter number 2. Flush Cycle Active (bit, MB) is set to 0

- **See also:**
    - Flush cycle setting on page 91
    - The chapter about the factory default settings on page 6 briefly mentions the flush cycle. For detailed information about the flush cycle, refer to the 490-GC micro gc manual
    - 490-GC PRO cycle schema on page 34

4. Sampling Time [ms] (Int16, MB)

- **Description:** Returns / sets sampling time set in the 490-GC PRO method
- **Return / Set value:** 0 to 999
- **Unit:** milliseconds (ms)
- **Accuracy:** 1 ms
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation): Main board** (value = 0)
- **See also:**
    - Sampling time method setting on page 114
    - Explanation chromatografic run in chapter 490-GC PRO cycle schema on page 34

9. Continuous Flow Mode (bit, MB)

- **Description:** Returns / Sets whether or not continuous flow mode is switched on as set in the 490-GC PRO method
- **Return / Set value:**
    - 0 = Continuous flow mode is switched off
    - 1 = Continuous flow mode is switched on
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (value = 0)
- **See also:** Continuous flow configuration setting on page 91

10. Stabilization Time [s] (Int16, MB)

- **Description:** Returns / sets the stabilizing time as set in the 490-GC PRO method
- **Return / Set value:** 0 to 99
- **Unit:** Seconds (s)
- **Accuracy:** 1 s
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** int16 (16 bit integer)
- **Channel (PROstation): Main board** (value = 0)
- **Remarks:** 0 = stabilizing time off
- **See also:**
    - Stabilizing Time on page 115
    - Stabilizing Time method setting on page 114
    - Explanation chromatografic run in chapter 490-GC PRO cycle schema on page 34

24.8.8.17.2 Automation 1 - Modbus parameters

11. Cycle time [min] (Float, MB)

- **Description**: Returns / set the total cycle time of a 490-GC PRO cycle (run)
- **Return / Set value:** 0 to 1440
- **Unit:** minutes (min)
- **Accuracy:** 0.01
- **Modbus Register Type:** Holding Register (Input register in case of reading)
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation): Main board** (value = 0)
- **Remark:**
    - Note that the this value in PROstation is defined in seconds
- **See also:**
    - Chapter 490-GC PRO cycle schema on page 34
    - Corresponding value in the sequence properties of PROstation on page 185 (Note that this value is in seconds)

12. Run Continuously (bit, MB)

- **Description:** Returns / sets whether or not the 490-GC PRO is set to run the Sequence continuous
- **Return / Set value:**
    - 0 = Run Continuously option is not activated
    - 1 = Run Continuously option is activated
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (value = 0)
- **See also**:
    - Corresponding value in the sequence properties of PROstation on page 185

15. Number of Automation Runs (Int32, MB)

- **Description:** Returns / sets the number of runs to perform as set in the sequence
- **Return / Set value:** 0 to 2147483647
- **Unit:** -
- **Accuracy:** 1
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int32 (32 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **See also:**
    - Corresponding value in the sequence properties of PROstation on page 185

16. Calibration at Startup (bit, MB)

- **Description:** Returns / sets whether or not the calibration table will be executed at startup of the sequence
- **Return / Set value:**

  - 0 = At startup of the sequence the calibration table will be started (before the sequence starts)
  - 1 = At startup of the sequence no calibration will be performed
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (value = 0)

19. Verification at Startup (bit, MB)

- **Description:** Returns / sets whether or not the verification table will be executed at startup of the sequence
- **Return / Set value:**
  - 0 = At startup of the sequence the verification table will be started (before the sequence starts)
  - 1 = At startup of the sequence no verification will be performed
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (value = 0)

35. Verification After Calibration Failure (bit, MB)

- **Description:** Returns / sets whether or not a new calibration will be performed in case the verification fails
- **Return / Set value:**
  - 0 = No calibration will be performed on verification failure
  - 1 = The calibration table will be executed when the verification fails
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (value = 0)
- **See also:** chapter 24.8.3 Verification Properties on page 189

24.8.8.17.3 Hardware

39. Select Stream (Int16, CHAN)

- **Description:** Switches the stream selector to the stream supplied
- **Set Value:** 1 to the number of streams set in the configuration
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Unit:** -
- **Accuracy:** 1
- **Channel (PROstation):** The CHAN argument holds the desired stream number
- **See also:**
  - This parameter does the same as Stream selection test on page 274

41. Set Digital Channel (bit, CHAN)

- **Description:** Sets the value of a digital output
- **Set value:**

  0 = Deactivate digital output
  1 = Activate digital output
- **Modbus Register Type:** Coil status
- **Modbus data type:** Bit (1 bit)
- **Remarks:**
  - In case of using extension boards on page 52, this parameter only resembles the value sent to the extension boards. On the extension boards a choice can be made between normally open and normally closed relays.
- **Channel (PROstation):** The CHAN argument selects the digital output

51. Read Analog Output (Float, CHAN)

- **Description:** Returns the actual value from an analog output

- **Return value:** Analog out value depending on settings in the Analog output table
- **Unit:** Set output signal in percent.
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):**The CHAN argument selects the analog Output. The number of analog outputs depends on the configuration
- **Remarks:**
  - This parameter only returns valid information if extension boards on page 52 are installed and Analog outpus are configured

52. Read Digital Output (bit, CHAN)

- **Description:** Returns the current value from a digital output
- **Return value:**
  0 = Deactivated
  1 = Activated
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):**The CHAN argument selects the digital output
- **Remarks:**
  - This parameter only resembles the value read from the extension boards on page 52, on the extension boards a choice can be made between normally open and normally closed relays.
- **See also:** Chapter extension boards on page 52

53. Read Digital Input (bit, CHAN)

- **Description:** Returns the current value from a digital output
- **Return value:**
  0 = Deactivated
  1 = Activated
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** The CHAN argument selects the digital input
- **See also:** Chapter **24.7.9 Application - Digital Inputs**

54. Read Digital Input Pos edge (bit, CHAN)

- **Description:** Returns the latched positive edge of the signal on a digital input
- **Return value:**
  0 = No Positive edge detected
  1 = Positive edge has been detected
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** The CHAN argument selects the digital input
- **Remarks:** The parameter is reset after reading
- **See also:** Chapter **24.7.9 Application - Digital Inputs**

55. Read Digital Input Neg edge (bit, CHAN)

- **Description:** Returns the latched positive edge of the signal on a digital input
- **Return value:**
  0 = No negative edge detected
  1 = Negative edge has been detected
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** The CHAN argument selects the digital input
- **Remarks:** The parameter is reset after reading
- **See also:** Chapter **24.7.9 Application - Digital Inputs**

57. Read Requested Stream Position (Int16, MB)

- **Description:** Returns the last requested stream position

- **Return value:** integer value bigger than 0, representing the stream position
- **Unit:** -
- **Accuracy:** 1
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** In case the stream selector is controlled by the 490-GC PRO, the maximum number of stream positions depends on the number of streams selected in the configuration.

58. Read Current Stream Position (Int16, MB)

- **Description:** Returns the current selected stream position
- **Return value:** integer value bigger than 0, representing the stream position
- **Unit:** -
- **Accuracy:** 1
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** In case the stream selector is controlled by the 490-GC PRO, the maximum number of stream positions depends on the number of streams selected in the configuration.

24.8.8.17.4 Automation 2 – Modbus parameters

60. Set Manual Run RunType (Int16, MB)

- **Description:** Sets the run type in the single run settings
- **Set value:**
  0 = Analysis / unknown
  1 = Calibration
  2 = Blank (Baseline)
  3 = Verification
- **Modbus Register Type:** Holding Register
- **Modbus data type:** int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** This option only applies to the manual or single run

61. Set Manual Run Calib. Level (Int16, MB)

- **Description:** Sets the Calibration level in the single run settings
- **Set value:** integer value from 1 to 7 depending on the number of calibration levels. Set value can also be 8 in case number of calibration level is bigger than 3 (Multi level calibration)
- **Modbus Register Type:** Holding Register
- **Modbus data type:** int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** This option does only apply to the manual run (single run). Note that level 8 is the Rw calibration.

62. Set Manual Run Stream Pos. (Int16, MB)

- **Description:** Sets the stream position in the single run settings
- **Set value:** 1 to the number of streams configured in the 490-GC PRO (Maximum 64 streams)
- **Modbus Register Type:** Holding Register
- **Modbus data type:** int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** This option does only apply to the manual or single run.

63. Set Stream Ahead Scheduling (Bit, MB)

- **Description:** Return / Sets the stream ahead scheduling
- **Return / Set value:**
  - 0 = Stream ahead scheduling off
  - 1 = Stream ahead scheduling on

- **Modbus Register Type:** Coil status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** This option only applies to full automation analysis runs

64. Set Calibration Hour (Int16, MB)

- **Description:** Sets the hour value of the calibration 'start on fixed time' option
- **Return / Set value:** integer value from 0 to 23
- **Unit:** Hours
- **Accuracy:** 1 hour
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** This option only applies to full automation calibration runs

65. Set Calibration Minute (Int16, MB)

- **Description:** Sets the minute value of the calibration 'start on fixed time' option
- **Return / Set value:** integer value from 0 to 59
- **Unit:** Minutes
- **Accuracy:** 1 minute
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** This option only applies to full automation calibration runs

66. Set Days Between Calibration (Int16, MB)

- **Description:** Sets the days value of the calibration 'start on elapsed days' option
- **Return / Set value:** integer value from 1 to 365
- **Unit:** Days
- **Accuracy:** 1 day
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** This option only applies to full automation calibration runs

67. Set Verification Hour (Int16, MB)

- **Description:** Sets the hour value of the verification 'start on fixed time' option
- **Return / Set value:** integer value from 0 to 23
- **Unit:** Hours
- **Accuracy:** 1 hour
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** This option only applies to full automation verification runs

68. Set Verification Minute (Int16, MB)

- **Description:** Sets the minute value of the verification 'start on fixed time' option
- **Return / Set value:** integer value from 0 to 59
- **Unit:** Minutes
- **Accuracy:** 1 minute
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** This option only applies to full automation verification runs

69. Set Days Between Verification (Int16, MB)

- **Description:** Returns / Sets the days value of the verification 'start on elapsed days' option
- **Return / Set value:** integer value from 1 to 365

- **Unit:** Days
- **Accuracy:** 1 day
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** This option only applies to full automation verification runs

24.8.8.17.5 Method Protection – Modbus parameters

70. Read Method protection (Bit, MB)

- **Description:** Returns the lock status of the method protection
- **Return value:**
  0 = Method protection disabled (unlocked)
  1 = Method protection enabled (locked)
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (value = 0)

91. Set Unlock Method Protection (Bit, MB)

- **Description:** Unlocks / relocks the method protection when the hardware method locking is placed
- **Set value:**
  0 = Relock method protection
  1 = Unlock method protection
- **Modbus Register Type:** Coil status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** This option only applies when the Method protection switch is placed. If Method locking is unlocked and the 490-GC PRO is rebooted, the method is relocked automatically again

95. Set Channel to clean, 1=On (Bit, CHAN)

- **Description:** Selects a channel to be cleaned
- **Set value:**
  0 = Deselect channel for cleaning
  1 = Select Channel for cleaning
- **Modbus Register Type:** Coil status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Remarks:**
  - The channels selected for cleaning will only be cleaned after parameter
  - 96. Request cleaning cycle, **minutes** is sent and handled by the 490-GC PRO
- **See also:**
  - Execute command 29. Stop Cleaning Cycle
  - Parameter
  - 96. Request cleaning cycle, **minutes**

96. Request cleaning cycle, minutes(Int32, MB)

- **Description:** Set the cleaning time in minutes and requests a cleaning cycle
- **Set value:** Cleaning time in minutes
- **Unit:** Minutes
- **Accuracy:** 1 minute
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Int32 (32 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - When the 490-GC PRO receives a request for cleaning it will schedule the cleaning cycle. The cleaning cycle will be started after finishing the current run
- **See also:**

  - Execute command 29. Stop Cleaning Cycle
  - Parameter 95. Set Channel to clean

99. Set Extension Bus Relay (Int16, CHAN, PEAK)

- **Description:** Switches one of the relays positioned on one of the additional extension boards.
- **Set value:** 1 to the number of configured relays
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Use the CHAN argument to select the relay. This should be the relay number as assigned in the Automation TAB of the configuration window of PROstation
- **Peak (PROstation):** Use the PEAK argument to select the state of the relay
  - 0 = De-energized
  - 1 = Energized
- **Remarks:** The channel cleaning for the channels clean finish run first
- **See also:**
  - Execute command 9. Energize Relay 1
  - Execute command 10. De-energize Relay 1
  - Execute command 10. De-energize Relay 1
  - Execute command 12. De-energize Relay 2
  - Execute Command 31. Reset Timed Relays
  - Execute Command 32. Reset Alarm Relays
  - Execute Command 33. Reset Analog **Outputs**
  - Execute Command 35. Reset All Alarms

1000. Request Single Sequence Line (Int16, MB)

- **Description:** Requests to run a single line from the sequence
- **Set value:** 1 to maximum number of lines in the sequence
- **Unit:** -
- **Accuracy:** 1
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** When the 490-GC PRO receives a request to run a single sequence line, it will schedule this single run. It will be started after finishing the current run.

24.8.8.17.6 GC status – Modbus parameters

100. Status: Sample Line Temp. (Float, MB)

- **Description:** Returns the current temperature of the sample line
- **Return value:** 30 to 110
- **Unit:** Degrees Centigrade (°C)
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)

101. Status: Sample Line Temp. State (Bit, MB)

- **Description:** Returns whether or not the heated sample line is ready
- **Return value:**
  0 = Not ready (Temperature not yet reached)
  1 = Not ready (Temperature reached)
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (value = 0)

102. Status: Instrument State (Int16, MB)

- **Description:** Returns the overall instrument state of the 490-GC PRO
- **Return value:**
  0 = Initializing
  1 = Flushing
  2 = Running
  3 = Stabilizing
  4 = Ready
  5 = Critical or Fatal Error
  6 = Advisory Fault
  7 = Broken
  8 = Not ready
  9 = Waiting for external ready in
  10 = Cleaning
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)

103. Status: Cabinet Temperature (Int16, MB)

- **Description:** Returns the cabinet temperature
- **Return value:** -
- **Unit:** Degrees Centigrade (°C)
- **Accuracy:** 1 °C
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** -40 to 50 are the specified operating temperature

104. Status: Ambient Pressure (Float, MB)

- **Description:** Returns the ambient pressure at the location of the 490-GC PRO
- **Return value:** -
- **Unit:** Pascal (Pa)
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)

105. Status: Power Supply Voltage (Float, MB)

- **Description:** Returns the actual power supply Voltage of the 490-GC PRO
- **Return value:** Around 12 to 14 V
- **Unit:** Volt (V)
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)

106. Status: External Start Received(Bit, MB)

- **Description:** Returns whether or not an external start is received
- **Return value:**
  0 = No External start received
  1 = External start received
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** After reading this parameter the value will be reset to 0
-

108. Status: Analog Input #1 (Float, MB)

- **Description:** Returns the current voltage of analog input 1 as provided by an external device.
- **Return value:** Voltage (1-10V)
- **Unit:** Volt
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **See also:** Chapter 24.7.8 Application - Analog Inputs

109. Status: Analog Input #2 (Float, MB)

- **Description:** Returns the current voltage of analog input 2 as provided by an external device.
- **Return value:** Voltage (1-10V)
- **Unit:** Volt
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **See also:** Chapter 24.7.8 Application - Analog Inputs

110. Status: Analog Input #3 (Float, MB)

- **Description:** Returns the current voltage of analog input 3 as provided by an external device.
- **Return value:** Voltage (1-10V)
- **Unit:** Volt
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **See also:** Chapter 24.7.8 Application - Analog Inputs

111. Status: Analog Input #4 (Float, MB)

- **Description:** Returns the current voltage of analog input 4 as provided by an external device.
- **Return value:** Voltage (1-10V)
- **Unit:** Volt
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **See also:** Chapter 24.7.8 Application - Analog Inputs

112. Status: Analog Input #5 (Float, MB)

- **Description:** Returns the current voltage of analog input 5 as provided by an external device.
- **Return value:** Voltage (1-10V)
- **Unit:** Volt
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **See also:** Chapter 24.7.8 Application - Analog Inputs

113. Status: Analog Input #6 (Float, MB)

- **Description:** Returns the current voltage of analog input 6 as provided by an external device.
- **Return value:** Voltage (1-10V)
- **Unit:** Volt
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)

- **Channel (PROstation):** Main board (value = 0)
- **See also:** Chapter **24.7.8 Application - Analog Inputs**

24.8.8.17.7 GC / Run Mode status – Modbus parameters

131. Status: External Device Ready Status [Bit, MB]

- **Description:** Returns the ready status of possible external connected device
- **Return value:**
  0 = External is device not ready
  1 = External is device ready
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (value = 0)

132. Status: Error Number (Int32, MB)

- **Description:** Returns the error number as shown in Error status in the GC section of the status screen.
- **Return value:** Error number generated when the 490-GC PRO is in error.
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int32 (32 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - Use parameter
  - 152. Status: Instrument Error **Status** to get only a notification whether or not the 490-GC PRO is in error
  - This parameter returns an error number when the 490-GC PRO has an error in the severity classes: 'Advisory Fault', 'Critical Error' or 'Fatal Error'
  - As soon as the 490-GC PRO is no longer in error, This parameter returns 0 again

134. Status: Actual Flush time [min] (Float, MB)

- **Description:** Returns the remaining to finish the flush cycle
- **Return value:** Actual flush time
- **Unit:** Minutes
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)

138. Status: Current Sequence State (Int16, MB)

- **Description:** Returns the current automation (or sequence) state
- **Return value:**
  0 = Idle
  1 = Running Manual (single run)
  2 = Running sequence (full automation)
  3 = Running calibration block
  4 = Running verification block
  5 = Equilibrating stream (selecting and flushing stream)
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)

139. Status: Current Calibration Level Setting (Int16, MB)

- **Description:** Returns the current calibration level.
- **Return value:** Integer value from 0 to 8 depending on the number of calibration levels. Level 8 is the Rw Calibration that can be used in Multi level calibration. Level 0 is an Analysis (Unknown) run
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)

- **Remarks:** Current calibration level 1 to 8 can also be returned in case of blank or verification runs

141. Status: Current Sample Type (Int16, MB)

- **Description:** Returns the sample type of the current run
- **Return value:**
  0 = Analysis / unknown
  1 = Calibration
  2 = Blank (Baseline)
  3 = Verification
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)

152. Status: Instrument Error Status(Bit, MB)

- **Description:** Returns whether or not the 490-GC PRO is in error
- **Return value:**
  0 = 490-GC PRO is not in error
  1 = 490-GC PRO is in error
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - To obtain the error number use parameter 132. Status: Error Number
  - This parameter only sets a notification (return value = 1) when the 490-GC PRO has an error in one of the the severity classes 'Advisory Fault', 'Critical Error' or 'Fatal Error'
  - As soon as the 490-GC PRO is no longer in error, this parameter is reset and will return value 0
- **See also:**
  - Parameter 2212. Application: Alarm status On Index
  - Parameter 2211. Application: Overall Alarm status
  - Parameter 2402. Appl.: Stream Alarm on Index
  - Parameter 2403. Appl.: Stream Overall Alarm Status

153. Status: Application Error Status (Bit, MB)

- **Description:** Returns whether or not there is an alarm in the calibration or an error in the stream selection or an alarm on one of the conditions specified in the alarm table at the moment of requesting this Modbus parameter.
- **Return value:**
  0 = No error or alarm at this moment
  1 = an error or alarm raised in Calibration, Stream selection or in any condition specified in the alarm table
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (value = 0)
- **See also:**
  - Parameter 2212. Application: Alarm status On Index
  - Parameter 2211. Application: Overall Alarm status
  - Parameter 2402. Appl.: Stream Alarm on Index
  - Parameter 2403. Appl.: Stream Overall Alarm Status

161. Status: Current running time (Int16, MB)

- **Description:** Returns the runtime of the current run starting as shown, during the run, in Instrument status in the GC section of the status screen. Return value is 0 at begin of the run and increases while the run proceeds.
- **Return value:** 0 to the runtime as specified in the method (maximum run time is 600)
- **Unit:** seconds (s)
- **Accuracy:** 1 s
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)

- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** This parameter resets to 0 at the end of the run

163. Status: Current Stream Analyzing (Int16, MB)

- **Description:** Returns the stream number, which the current run uses to analyze gas from.
- **Return value:** 0 to the runtime as specified in the method (maximum run time is 600)
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:** This value is set at the beginning of a run and will not be reset until the next run is being analysed from a different stream. In case there is no following run, the last returned value will remain until the 490-GC PRO is switched off

24.8.8.17.8 Channel Method setting – Modbus parameters

202. Set Column Temperature (Float, CHAN)

- **Description:** Sets the column temperature of the selected channel in the method of the 490-GC PRO.
- **Return / Set value:** 30 to the maximum allowed channel temperature most used maximum temperatures are 160 or 180
- **Unit:** Degrees Centigrade (°C)
- **Accuracy:** 1 °C
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Remarks:** The maximum allowed column temperature is shown in the **Hardware Tab** of the configuration screen.
- **See also:** Chapter **23.6.1** **Hardware Tab**

203. Set Injector Temperature (Float, CHAN)

- **Description:** Sets the injector temperature of the selected channel in the method of the 490-GC PRO
- **Return / Set value:** 30 to 110
- **Unit:** Degrees Centigrade (°C)
- **Accuracy:** 1 °C
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)

204. Set Run Time [s] (Int16, CHAN)

- **Description:** Sets the run time of the selected channel in the method of the 490-GC PRO
- **Return / Set value:** 1 to 600
- **Unit:** seconds (s)
- **Accuracy:** 0.1 s
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Channel (value = 1 to 4)

205. Set Injection Time [ms] (Int16, CHAN)

- **Description:** Sets the injection time of the selected channel in the method of the 490-GC PRO
- **Return / Set value:** 1 to 600
- **Unit:** milliseconds (ms)
- **Accuracy:** 1 ms
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Channel (value = 1 to 4)

207. Set Back flush Time [s] (Float, CHAN)

- **Description:** Sets the back flush time of the selected channel in the method of the 490-GC PRO
- **Return / Set value:** 1 to 600
- **Unit:** seconds (s)
- **Accuracy:** 1 s
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Remark:**
    - The value of this parameter is only taken into account in case of a back flush channel

209. Set Initial Pressure [Pa] (Float, CHAN)

- **Description:** Sets the initial pressure of the selected channel in the method of the 490-GC PRO.
- **Return / Set value:** 50 to 350
- **Unit:** Pascal (Pa)
- **Accuracy:** 1 pa
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Remarks:** Note that the initial pressure anywhere in PROstation is shown in kPa

215. Set TCD Power [1=On/0=Off] (Bit, CHAN)

- **Description:** Sets the Detector state or TCD power on or off for the selected channel in the method of the 490-GC PRO. In case of a DMD detector, this parameter switches between Tuning and Analyzing.
- **Return / Set value:**
    - 0 = Detector state / TCD power Off (in case of DMD Analysis)
    - 1 = Detector state / TCD power On (in case of DMD Tuning)
- **Unit:** Pascal (Pa)
- **Accuracy:** 1 pa
- **Modbus Register Type:** Coil status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Channel (value = 1 to 4)

218. Set TCD Range [0,16,256,1024] (Int16, CHAN)

- **Description:** Sets the TCD sensitivity range of the TCD Detector for the selected channel in the method of the 490-GC PRO.
- **Return / Set value:**
    - 0 = Low
    - 16 = Medium
    - 256 = High
    - 1024 = Extra High
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Remarks:** If parameter auto ranging (**220. Set TCD Auto Ranging**) is switched on, the values are ignored

220. Set TCD Auto Ranging [1=On/0=Off] (Bit, CHAN)

- **Description:** Sets the TCD sensitivity of the TCD detector to Auto ranging for the selected channel in the method of the 490-GC PRO.
- **Return / Set value:**
    - 0 = Switch Auto ranging off
    - 1 = Switch Auto ranging On
- **Modbus Register Type:** Coil status
- **Modbus data type:** Bit (1 bit)

- **Channel (PROstation):** Channel (value = 1 to 4)
- **Remarks:** If parameter auto ranging is switched off, a manual TCD sensitivity range needs to be set by means of parameter **218. Set TCD Range**

221. Set TCD Invert Signal [1=On/0=Off] (Bit, CHAN)

- **Description:** Sets the Invert signal option on or off for TCD detector of the selected channel in the method of the 490-GC PRO.
- **Return / Set value:**
    - 0 = TCD Invert signal switched Off
    - 1 = TCD Invert signal switched On
- **Modbus Register Type:** Coil status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Channel (value = 1 to 4)

24.8.8.17.9 Channel Status – Modbus parameters

300. Column Temperature (Float, CHAN)

- **Description:** Returns the actual column temperature for the selected channel, as displayed in the GC-Channel status part of the Instrument status screen.
- **Return value:** The actual column temperature can be 30 to 160 or 30 to 180, depending on the maximum allowed
- **Unit:** Degrees Centigrade (°C)
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- The maximum allowed column temperature is shown in the **Hardware Tab** of the configuration screen.
- **See also:** Chapter **23.6.1** **Hardware Tab**

301. Column Temp.State (Bit, CHAN)

- **Description:** Returns whether or not the actual column temperature has reached the channel's set point for the selected channel. The return value is equal to the ready status of the channel temperature as shown in the GC-Channel status part of the Instrument status screen (Column temp value is blue = ready / Column temp value is red = not ready.
- **Return value:**
    - 0 = The actual column temperature has not reached the channel's set point (Not Ready)
    - 1 = The actual column temperature has reached the channel's set point (Ready)
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Channel (value = 1 to 4)

302. Injector Temperature(Float, CHAN)

- **Description:** Returns the actual injector temperature for the selected channel, as displayed in the GC-Channel status part of the Instrument status screen.
- **Return value:** The actual injector temperature vary between 30 to 110
- **Unit:** Degrees Centigrade (°C)
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)

303. Injector Temp.State (Bit, CHAN)

- **Description:** Returns whether or not the actual injector temperature has reached the channel's set point for the selected channel. The return value is equal to the ready status of the injector temperature as shown in the GC-Channel status part of the Instrument status screen (injector temp value is blue = ready / injector temp value is red = not ready.

- **Return value:**
  - 0 = The actual injector temperature has not reached the channel's set point (Not Ready)
  - 1 = The actual injector temperature has reached the channel's set point (Ready)
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Channel (value = 1 to 4)

304. Column Pressure (Float, CHAN)

- **Description:** Returns the actual column pressure for the selected channel, as displayed in the GC-Channel status part of the Instrument status screen.
- **Return value:** The actual column temperature varies between 50 and 350
- **Unit:** Pascal (Pa)
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Remarks:** Note that the column pressure anywhere in PROstation is shown in kPa

305. Column Pressure State (Bit, CHAN)

- **Description:** Returns whether or not the actual column pressure has reached the channel's set point for the selected channel. The return value is equal to the ready status of the column pressure ready status as shown in the GC-Channel status part of the Instrument status screen (column pressure value is blue = ready. Column pressure value is red = not ready).
- **Return value:**
  - 0 = The actual column has not reached the channel's set point (Not Ready)
  - 1 = The actual injector temperature has reached the channel's set point (Ready)
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Channel (value = 1 to 4)

308. Channel Board Temp (Int16, CHAN)

- **Description:** Returns the actual channel board temperature for the selected channel.
- **Return value:** The actual board temperature should vary between approx. ambient temperature and maximum allowed board temperature
- **Unit:** Degrees centigrade (°C)
- **Accuracy:** 1 °C
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Channel (value = 1 to 4)

24.8.8.17.10 Main board – Modbus parameters

500. MPU firmware (Float, MB)

- **Description:** Returns the MPU firmware version and subversion and build number (build number only from version 2.0 and up), combined in one number
- **Return value:**
  - The value returned is build up in the following way: <Version>.<subversion(2 digits)><Build number(remaining digits)>
  - Example 2.1117579 – Version 2, subversion 11, build number 17579
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Remarks:** Build number is only returned from firmware version 2.00 and up

501. IOC firmware (Float, CHAN)

- **Description:** Returns the IOC firmware version and build, combined in one number

- **Return value:**
    - The value returned is built up in the following way: <version>.<subversion>
      Example 1.15 – version 1, subversion 15
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)

502. Channel 1 installed (1 bit)
- **Description:** Returns whether or not channel 1 is installed
- **Return value:**
    - 0 = Channel 1 is not installed
    - 1 = Channel 1 is installed
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):**-

503. Channel 2 installed (1 bit)
- **Description:** Returns whether or not channel 2 is installed
- **Return value:**
    - 0 = Channel 2 is not installed
    - 1 = Channel 2 is installed
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):**-

504. Channel 3 installed (1 bit)
- **Description:** Returns whether or not channel 3 is installed
- **Return value:**
    - 0 = Channel 3 is not installed
    - 1 = Channel 3 is installed
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):**-

505. Channel 4 installed (1 bit)
- **Description:** Returns whether or not channel 4 is installed
- **Return value:**
    - 0 = Channel 4 is not installed
    - 1 = Channel 4 is installed
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** -

515. Clock: Day of Month (Int16, MB)
- **Description:** Returns the current day of month of the system date set in the 490-GC PRO
- **Return / Set value:** integer value from 1 to 31
- **Unit:** Days
- **Accuracy:** 1 day
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)

516. Clock: Month (Int16, MB)
- **Description:** Returns the current month of the system date set in the 490-GC PRO

- **Return / Set value:** integer value from 1 to 12
- **Unit:** Months
- **Accuracy:** 1 month
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)

517. Clock: Year (Int16, MB)

- **Description:** Returns the current year of the system date set in the 490-GC PRO
- **Return / Set value:** integer value from 1 to 99
- **Unit:** Years
- **Accuracy:** 1 year
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)

518. Clock: Second (Int16, MB)

- **Description:** Returns the current second of the system time set in the 490-GC PRO
- **Return / Set value:** integer value from 0 to 59
- **Unit:** Seconds (s)
- **Accuracy:** 1 s
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)

519. Clock: Minute (Int16, MB)

- **Description:** Returns the current minute of the system time set in the 490-GC PRO
- **Return / Set value:** integer value from 0 to 59
- **Unit:** Minutes (min)
- **Accuracy:** 1 min
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)

520. Clock: Hour (Int16, MB)

- **Description:** Returns the current hour of the system time set in the 490-GC PRO
- **Return / Set value:** integer value from 1 to 23
- **Unit:** Hours (h)
- **Accuracy:** 1 h
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)

24.8.8.17.11 Main board EDS – Modbus parameters

601. Instrument serial number (Int32, MB)

- **Description:** Returns the 490-GC PRO's serial number
- **Return value:** Serial number
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int32 (32 bit integer)
- **Channel (PROstation):** Main board (value = 0)

611. Log: Number of runs (Int32, MB)

- **Description:** Returns the total number of runs performed since production, stored on mainboard of the instrument.
- **Return value:** Serial number

- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int32 (32 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This value is not viewable from PROstation

612. Log: Operating Period (Int32, MB)

- **Description:** Returns the total operating period stored on mainboard of the instrument
- **Return value:** Operating period
- **Unit:** Quarter of hours
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int32 (32 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This value is not viewable from PROstation

613. Log: Max Ambient Instrument Temperature (Int16, MB)

- **Description:** Returns the maximum ambient temperature stored on mainboard of the instrument
  Return value: Maximum ambient temperature
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int32 (32 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This value is not viewable from PROstation

24.8.8.17.12 Integration method – Modbus parameters

1230. Integ.Meth.: Level 1 amount (Float, CHAN, MetPEAK)

- **Description:** Returns / sets the amount for calibration level 1 of the selected peak on the selected channel. This value is filled in, in the 'Level 1' column for the selected peak in the method peak table of the selected channel.
- **Return / Set value:** Any 32 bit floating point value
- **Unit:** -
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **MetPeak (PROstation):** Peak number index as used in the method peak table. The Method peak numbers starts with 1 for the first peak in the list, increasing with 1 for each following peak in the method peak table.
- **Remarks:**
  - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

24.8.8.17.13 General Integration Results – Modbus parameters

1202. Int.Rep.: Number of Peaks, Named + Unnamed(Int16, CHAN)

- **Description:** Returns the total number of peaks (named and unnamed) for the selected channel.
- **Return value:** Total number of peaks for the selected channel, detected during integration. Total number of peaks is the sum of all named peaks (peaks defined in the method peak table) as well as all unnamed peaks (not defined peaks or not detected within the defined window of a peak)
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit Integer)

- **Channel (PROstation):** Channel (value = 1 to 4)
- **Remarks:**
    - Named peaks are peaks that are detected during integration, within the retention time peak window of a peak or group defined in the method peak table
    - Unnamed peaks are peaks that are detected during integration but fall outside any peak or group window defined in the method peak table
    - This parameter only supplies valid data of the last run when a synchronization parameter is set to ‘1’. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.
- **See also:**
    - Parameter 1214. Int.Rep.: Number of Named Peaks
    - Parameter 1215. Int.Rep.: Number of Unnamed Peaks
    - Parameter 2216. Application: Total Peaks
    - Parameter 2229. Application: Total Unknown peaks

1214. Int.Rep.: Number of Named Peaks(Int16, CHAN)

- **Description:** Returns the total number of named peaks for the selected channel.
- **Return value:** Total number of named peaks for the selected channel, detected during integration.
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit Integer)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Remarks:**
    - Named peaks are peaks that are detected during integration, within the retention time peak window of a peak or group defined in the method peak table
    - This parameter only supplies valid data of the last run when a synchronization parameter is set to ‘1’. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.
- **See also:**
    - Parameter 1202. Int.Rep.: Number of Peaks, Named + Unnamed
    - Parameter 1215. Int.Rep.: Number of Unnamed Peaks
    - Parameter 2216. Application: Total Peaks
    - Parameter 2229. Application: Total Unknown peaks

1215. Int.Rep.: Number of Unnamed Peaks(Int16, CHAN)

- **Description:** Returns the total number of unnamed peaks for the selected channel. **Return value:** Sum of total number of unnamed peaks and total number of named peaks. Named peaks are peaks detected during integration within a peak window of a component defined in the method peak table. Unnamed peaks are peaks detected outside any peak window.
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit Integer)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Remarks:**
    - Unnamed peaks are peaks that are detected during integration but fall outside any retention time peak or group window defined in the method peak table
    - This parameter only supplies valid data of the last run when a synchronization parameter is set to ‘1’. For synchronization parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.
- **See also:**
    - Parameter 1202. Int.Rep.: Number of Peaks, Named + Unnamed
    - Parameter 1214. Int.Rep.: Number of Named Peaks
    - Parameter 2216. Application: Total Peaks
    - Parameter 2229. Application: Total Unknown peaks

1331. Int.Rep.: Calibration Alarm (Bit, MB)

- **Description:** Returns if a response factor of one or more peaks detected in the current calibration run does not meet the allowed variation. The allowed variation for response factor alarms is defined in the Method peak table **Return value:**
    - 0 = Current run has no calibration alarm

    - 1 = Current run does have a Calibration alarm
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
    - This parameter will only be set at the end of the calibration run**.** If in the following run the error or alarm doesn't occur anymore, the return value is reset to 0.
    - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

24.8.8.17.14 Integration results of all peaks Named and unnamed

1219. Int.Rep.All: Retention Time (Float, CHAN, Peak)

- **Description:** Returns the retention time of the peak selected from the list of all detected peaks (named and unnamed)
- **Unit:** Minutes
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Peak (PROstation):**
    - Peak number index as used in integration result table or the integration report. The integration peak numbers start with 1 for the first peak in the list, increasing with 1 for each following peak in the integration result table.
- **Remarks:**
    - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization,parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

1203. Int.Rep.All: Peak Area (Float, CHAN, Peak)

- **Description:** Returns the peak area of the peak selected from the list of all detected peaks (named and unnamed)
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Peak (PROstation):**
    - Peak number index as used in integration result table or the integration report. The integration peak numbers starts with 1 for the first peak in the list, increasing with 1 for each up following peak in the integration result table.
- **Remarks:**
    - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

1204. Int.Rep.All: Peak Height (Float, CHAN, Peak)

- **Description:** Returns the peak height of the peak selected from the list of all detected peaks (named and unnamed)
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Peak (PROstation):**

  - Peak number index as used in integration result table or the integration report. The integration peak numbers starts with 1 for the first peak in the list, increasing with 1 for each up following peak in the integration result table.
- **Remarks:**
  - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

1205. Int.Rep.All: Amount (Float, CHAN, Peak)

- **Description:** Returns the amount of the peak selected from the list of all detected peaks (named and unnamed)
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Peak (PROstation):**
  - Peak number index as used in integration result table or the integration report. The integration peak numbers starts with 1 for the first peak in the list, increasing with 1 for each following peak in the integration result table.
- **Remarks:**
  - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

1207. Int.Rep.All: Peak Width (Float, CHAN, Peak)

- **Description:** Returns the width of the peak selected from the list of all detected peaks (named and unnamed)
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **Peak (PROstation):**
  - Peak number index as used in integration result table or the integration report. The integration peak numbers starts with 1 for the first peak in the list, increasing with 1 for each up following peak in the integration result table.
- **Remarks:**
  - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization, the parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

1209. Int.Rep.All: Peak Named Yes/No (Bit, CHAN, Peak)

- **Description:** Returns whether or not the selected peak is a named or unnamed peak.
- **Return value:**
  - 0 = Current selected peak is a unnamed peak
  - 1 = Current selected peak is a named peak
- **Modbus data type:** Bit (1 bit)
- **Modbus Register Type:** Coil status / Input Status
- **Channel (PROstation):**Channel (value = 1 to 4)
- **Peak (PROstation):**
  - Peak number index as used in integration result table or the integration report. The integration peak numbers starts with 1 for the first peak in the list, increasing with 1 for each up following peak in the integration result table.
- **Remarks:**
  - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For a synchronization parameter, the parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

24.8.8.17.15 Integration results named peaks only

1375. Int.Rep.Named: Area Named Peak (Float, CHAN, MetPEAK)

- **Description:** Returns the peak area of the selected named peak
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **MetPeak (PROstation):**
  - Peak number index as used in method peak table. The method peak table index number starts with 1 for the first peak in the list, increasing with 1 for each up following peak in the integration result table.
- **Remarks:**
  - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For a synchronization parameter, the parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be

1376. Int.Rep.Named: Height Named Peak (Float, CHAN, MetPEAK)

- **Description:** Returns the peak height of the selected named peak
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **MetPeak (PROstation):**
  - Peak number index as used in method peak table. The method peak table index number starts with 1 for the first peak in the list, increasing with 1 for each up following peak in the integration result table.
- **Remarks:**
  - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

1377. Int.Rep.Named: Amount Named Peak (Float, CHAN, MetPEAK)

- **Description:** Returns the amount of the selected named peak
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **MetPeak (PROstation):**
  - Peak number index as used in method peak table. The method peak table index number starts with 1 for the first peak in the list, increasing with 1 for each up following peak in the integration result table.
- **Remarks:**
  - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

1378. Int.Rep.Named: Retention Named Peak (Float, CHAN, MetPEAK)

- **Description:** Returns the retention time of the selected named peak
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **MetPeak (PROstation):**
  - Peak number index as used in method peak table. The method peak table index number starts with 1 for the first peak in the list, increasing with 1 for each up following peak in the integration result table.
- **Remarks:**

- This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

1380. Int.Rep.Named: Width Named Peak (Float, CHAN, MetPEAK)

- **Description:** Returns the width at half height of the selected named peak.
- **Accuracy:** Floating point single precision
- **Unit:** Minutes
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **MetPeak (PROstation):**
    - Peak number index as used in method peak table. The method peak table index number starts with 1 for the first peak in the list, increasing with 1 for each up following peak in the integration result table.
- **Remarks:**
    - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

1381. Int.Rep.Named: StartTime Named Peak (Float, CHAN, MetPEAK)

- **Description:** Returns the start time of the selected named peak
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **MetPeak (PROstation):**
    - Peak number index as used in method peak table. The method peak table index number starts with 1 for the first peak in the list, increasing with 1 for each up following peak in the integration result table.
- **Remarks:**
    - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

1382. Int.Rep.Named: EndTime Named Peak (Float, CHAN, MetPEAK)

- **Description:** Returns the end time of the selected named peak
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **MetPeak (PROstation):**
    - Peak number index as used in method peak table. The method peak table index number starts with 1 for the first peak in the list, increasing with 1 for each up following peak in the integration result table.
- **Remarks:**
    - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

1383. Int.Rep.Named: Asym Named Peak (Float, CHAN, MetPEAK)

- **Description:** Returns the end time of the selected named peak
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Channel (value = 1 to 4)
- **MetPeak (PROstation):**

    - Peak number index as used in method peak table. The method peak table index number starts with 1 for the first peak in the list, increasing with 1 for each up following peak in the integration result table.
- **Remarks:**
    - This parameter only supplies valid data of the last run when a synchronization parameter is set to '1'. For synchronization, parameters 2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset can be used.

24.8.8.17.16 New data avalibale flag

2200. Sync: Data available (Bit, MB)

- **Description:** Returns '1' at the moment all sample result data of the last finished run is available and resets automatically to '0' after the "Reset-Time data available flag" expires. This parameter can also be reset by the Master.
- **Return / Set value:**
    - **0: No new data available / reset new data available**
    - **1: (Still) new valid data available**
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
    - The "Reset-Time data available flag" can be set in the "Process Setting" TAB "Modbus Setup" (Synchronization with Modbus Master)
    - For obvious reasons it is advised not to set '1' in the Modbus register.

2201. Sync: Data available with reset(Bit, MB)

- **Description:** Returns '1' at the moment all sample result data of the last finished run is available and resets automatically to '0' after a Modbus Master has read the new data.
- **Return value:**
    - **0: No new data available**
    - **1: New (not yet read) valid data available**
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (value = 0)
- **Remarks:**
    - If the no Modbus master is reading the new data the value is automatically reset to '0' after the "Reset-Time data available flag" expires.
    - The "Reset-Time data available flag" can be set in the "Process Setting" TAB "Modbus Setup" (Synchronization with Modbus Master)
    - Parameter 2238 is a copy of this parameter

2238. Sync: Data available2 with reset(Bit, MB)

- **Description:** Returns '1' at the moment all sample result data of the last finished run is available and resets automatically to '0' after a Modbus Master has read the new data.
- **Return value:**
    - **0: No new data available**
    - **1: New (not yet read) valid data available**
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (value = 0)
- **Remarks:**
    - If the no Modbus master is reading the new data the value is automatically reset to '0' after the "Reset-Time data available flag" expires.
    - The "Reset-Time data available flag" can be set in the "Process Setting" TAB "Modbus Setup" (Synchronization with Modbus Master)
    - Parameter is a copy of parameter 2201

2202. Sync: Run Number (Int32, MB)

- **Description:** Returns a number, which is increased at the end of every run. This number is increased for each run, whether the current run is an Analysis(unknown), Calibration, verification or blank(check) runs doesn't matter.
- **Return value:** Positive integer value
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int32 (32 bit integer)
- **Channel (PROstation): Main board** (value = 0)
- **Remarks:**
    - After a restart of the 490-GC PRO this parameter is reset back to 0
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

24.8.8.17.17 Application data – Modbus parameters

2203. Application: Sample Type (Int32, MB)

- **Description:** Returns the sample type of the last run.
- **Return value:**
    - 0 = Analysis / unknown
    - 1 = Calibration
    - 2 = Blank (Baseline)
    - 3 = Verification
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int32 (32 bit integer)
- **Channel (PROstation): Main board** (value = 0)
- **Remarks:**
    - After a restart of the 490-GC PRO this parameter is reset back to 0
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2399. Application: Is Analysis Run (Bit, MB)

- **Description:** Returns whether or not the last run was an analysis
- **Return value:**
    - 0 = Last run is not an Analysis run, but calibration, blank or verification
    - 1 = Last run is an Analysis run
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2204. Application: Calibration Level (Int16, MB)

- **Description:** Returns whether the calibration level of the last run.
- **Return value:**
    - 0 = No calibration level, thus no calibration or verification run
    - 1 to 8 = calibration level depending on the number of calibration levels. The return value can be 8 in case number of calibration levels is bigger then 3 (Multi level calibration)
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation): Main board** (value = 0)
- **Remarks:**

  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2239. Application: Calibration ignore (Bit, MB)

- **Description:** Returns whether the last run is an ignored calibration. An ignored calibration is a calibration run that will not be accepted as such. In other words flush run with calibration gas.
- **Return value:**
  - 0 = A normal calibration run
  - 1 = A calibration run that will be ignored
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (value = 0)
- **Remarks:**
  - This parameter also returns 0 in case the last run was an Analysis, verification or blank run. So make sure the run type is known before using this parameter
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2205. Application: Stream Position (Int16, MB)

- **Description:** Returns the stream that was requested for the last run. This is the stream position request at the start of the sequence or single run.
- **Return value:**
  - an integer value bigger then 0
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation): Main board** (value = 0)
- **Remarks:**
  - In case the stream selector is controlled by the 490-GC PRO, the maximum number of stream positions depends on the number of streams selected in the configuration.
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2206. Application: Stream Position OK (Bit, MB)

- **Description:** Returns whether or not the requested stream of the last run is correctly switched.
- **Return value:**
  - 0 = Requested stream is not switched due to communication failure with the stream selector or stream selector failure. In other words. Last run is sample from a wrong stream position.
  - 1 = Requested stream is successfully switched
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2207. Application: Digital Input (Bit, CHAN)

- **Description:** Returns the value of the Digital input at the end of the last run.
- **Return value:**

  0 = Deactivated

  1 = Activated
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):**The CHAN argument selects the digital input
- **Remarks:**

- This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2208. Application: Raw Analog In (Float, CHAN)

- **Description:** Returns the Raw analog value of the analog input at the end of the last run. This is the value as it was sampled directly of the analog inputs
- **Return value:** 0 – 10
- **Unit:** Volt
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):**The CHAN argument selects the analog input
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2209. Application: Computed Analog In (Float, CHAN)

- **Description:** Returns the calculated analog value of the analog input at the end of the last run. This is the value after the calculation factor and offset (as defined in the analog input table) are supplied.
- **Return value:** The calculated analog value
- **Unit:** The unit as calculated in the analog input table
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):**The CHAN argument selects the analog input
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2210. Application: Sampling comp.Analog In (Float, CHAN)

- **Description:** Returns the calculated analog value of the analog input at the moment of sampling. This is the value after the calculation factor and offset (as defined in the analog input table) are supplied.
- **Return value:** The calculated analog value
- **Unit:** The unit as calculated in the analog input table
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):**The CHAN argument selects the analog input
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2211. Application: Overall Alarm status (Bit, MB)

- **Description:** Returns if any of the configured alarms from the alarm table was raised at the end of the last run
- **Return value:**
  - 0 = No alarm raised
  - 1 = An alarm from the alarm table was raised at the end of the last run
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 0)
- **Remarks:**

- This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

- **See also:**
  - Parameter 2212. Application: Alarm status On Index
  - Parameter
  - 152. Status: Instrument Error **Status**
  - Parameter 2402. Appl.: Stream Alarm on Index
  - Parameter 2403. Appl.: Stream Overall Alarm Status

2212. Application: Alarm status On Index (Bit, MB, PEAK=Index)

- **Description:** Returns whether or not the selected alarm from the alarm table was raised at the end of the last run.
- **Return value:**
  - 0 = No alarm raised
  - 1 = An alarm from the alarm table was raised at the end of the last run
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 0)
- **PEAK (PROSTATION): Use** the PEAK argument to select an alarm (by line number / index) from the alarm table.
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
  - Parameter 2211. Application: Overall Alarm status
  - Parameter
  - 152. Status: Instrument Error **Status**
  - Parameter 2402. Appl.: Stream Alarm on Index
  - Parameter 2403. Appl.: Stream Overall Alarm Status

2213. Application: Overall Verification status (Bit, MB)

- **Description:** Returns whether or not all verification criteria are passed. The verification criteria can be defined in the verification table.
- **Return value:**
  - 0 = All verification criteria passed
  - 1 = One of the verification criteria did not pass
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (Value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
  - Parameter 2211. Application: Overall Alarm status
  - Parameter
  - 152. Status: Instrument Error **Status**
  - Parameter 2402. Appl.: Stream Alarm on Index
  - Parameter 2403. Appl.: Stream Overall Alarm Status

2216. Application: Total Peaks (Int16, MB)

- **Description:** Returns the total number of peaks of the application report. These are peaks that are defined in the normalization table (maximum 100 peaks) and which are also detected in the integration report.
- **Return value:** 0 maximum number of peaks in the application report (maximum 100 peaks)
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)

- **Channel (PROstation):** Main board (Value = 0)
- **Remarks:**
    - The application report is a system wide report, so one can't select peaks per channel from the application report.
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
    - Parameter 2229. Application: Total Unknown peaks
    - Parameter 1202. Int.Rep.: Number of Peaks, Named + Unnamed
    - Parameter 1214. Int.Rep.: Number of Named Peaks
    - Parameter 1215. Int.Rep.: Number of Unnamed Peaks

2217. Application: Sum ESTD (Float, MB)

- **Description:** Returns the sum of ESTD values of all peaks in the application report of the last run. These are peaks that are defined in the normalization table (maximum 100 peaks) and which are also detected in the integration report.
- **Return value:** Positive value
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (Value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
    - Parameter 2418. Appl.: Stream Sum ESTD

2218. Application: Sum Estimates (Float, MB)

- **Description:** Returns the sum of estimates of all peaks that are identified as estimate peak in the normalization table and also detected in the integration report.
- **Return value:** 0 - 100
- **Unit:** Percent (%)
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (Value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2221. Application: Sum Areas. (Float, MB)

- **Description:** Returns the sum of areas of all peaks that are defined in the normalization table (maximum 100 peaks) and also are detected in the integration report.
- **Return value:** Positive value
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (Value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2222. Application: Is Startup Run. (Bit, MB)

- **Description:** Returns the whether or not the last run was the first run after startup of the 490-GC PRO.
- **Return value:**

- 0 = Last run was not a startup run
- 1 = Last run was a the first run after startup of the 490-GC PRO

- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Main board (Value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2223. Application: Year of Injection (Int16, MB)

- **Description:** Returns the year of injection of the last run.
- **Return value:** integer value from 1 to 99
- **Unit:** Years
- **Accuracy:** 1 year
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2224. Application: Month of Injection (Int16, MB)

- **Description:** Returns the month of injection of the last run.
- **Return value:** integer value from 1 to 12
- **Unit:** Months
- **Accuracy:** 1 month
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2225. Application: Day of Injection (Int16, MB)

- **Description:** Returns the day of injection of the last run.
- **Return value:** integer value from 1 to 31
- **Unit:** Days
- **Accuracy:** 1 day
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2226. Application: Hour of Injection (Int16, MB)

- **Description:** Returns the hour of injection of the last run.
- **Return value:** integer value from 1
- **Unit:** Hours (h)
- **Accuracy:** 1 h
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**

- This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2227. Application: Minute of Injection (Int16, MB)

- **Description:** Returns the minute of injection of the last run.
- **Return value:** integer value from 1 to 60
- **Unit:** Minutes (min)
- **Accuracy:** 1 min
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2228. Application: Second (time) of Injection (Int16, MB)

- **Description:** Returns the second of injection of the last run.
- **Return value:** integer value from 1
- **Unit:** Seconds (s)
- **Accuracy:** 1 s
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2229. Application: Total Unknown peaks. (Int16, MB)

- **Description:** Returns the total number of unknown peaks of the application report. These are peaks that are NOT defined in the normalization table but still detected in the integration report.
- **Return value:** 0 maximum number of peaks in the application report (maximum 100 peaks)
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (Value = 0)
- **Remarks:**
  - The application report is a system wide report, so one can't select peaks per channel from the application report.
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
  - Parameter 2216. Application: Total Peaks
  - Parameter 1202. Int.Rep.: Number of Peaks, Named + Unnamed
  - Parameter 1214. Int.Rep.: Number of Named Peaks
  - Parameter 1215. Int.Rep.: Number of Unnamed Peaks

2230. Application: Comp. Retention. (Float, MB, PEAK)

- **Description:** Returns the Retention time of the selected peak from the application report of the last run.
- **Return value:** 0 to maximum runtime of this run.
- **Unit:** Minutes
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)

- **Peak (PROstation):** Use the PEAK argument to select a Peak (component) in the last application report. To do so fill in the peak index of the corresponding peak in the normalization table.
- **Remarks:**
    - The application report is a system wide report, so one can't select peaks per channel from the application report.
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2231. Application: Comp. Height. (Float, MB, PEAK)

- **Description:** Returns the height of the selected peak from the application report of the last run.
- **Return value:** Any floating point value
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Peak (PROstation):** Use the PEAK argument to select a Peak (component) in the last application report. To do so fill in the peak index of the corresponding peak in the normalization table.
- **Remarks:**
    - The application report is a system wide report, so one can't select peaks per channel from the application report.
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2232. Application: Comp. ESTD Conc. (Float, MB, PEAK)

- **Description:** Returns the ESTD concentration of the selected peak from the application report of the last run.
- **Return value:** A positive floating point value
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Peak (PROstation):** Use the PEAK argument to select a Peak (component) in the last application report. To do so fill in the peak index of the corresponding peak in the normalization table.
- **Remarks:**
    - The application report is a system wide report, so one can't select peaks per channel from the application report.
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2233. Application: Comp. Normalized Conc. (Float, MB, PEAK)

- **Description:** Returns the Normalized concentration of the selected peak from the application report of the last run.
- **Return value:** 0-100
- **Unit:** Percent (%)
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Peak (PROstation):** Use the PEAK argument to select a Peak (component) in the last application report. To do so fill in the peak index of the corresponding peak in the normalization table.
- **Remarks:**
    - The application report is a system wide report, so one can't select peaks per channel from the application report.
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2237. Application: Comp. Area (Float, MB, PEAK)

- **Description:** Returns the area of the selected peak from the application report of the last run.
- **Return value:** A positive floating point value
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Peak (PROstation):** Use the PEAK argument to select a Peak (component) in the last application report. To do so fill in the peak index of the corresponding peak in the normalization table.
- **Remarks:**
    - The application report is a system wide report, so one can't select peaks per channel from the application report.
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2235. Application: Group total ESTD. (Float, MB, PEAK)

- **Description:** Returns the sum of the ESTD concentrations of all peaks in the selected group from the application report of the last run.
- **Return value:** A positive floating point value
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Peak (PROstation):** Supply the peak index for a group in the normalization table in the PEAK argument, to find the corresponding group in the application report.
- **Remarks:**
    - The application report is a system wide report, so one can't select peaks per channel from the application report.
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2236. Application: Group total Normalized (Float, PEAK)

- **Description:** Returns the sum of the normalized concentrations of all peaks in the selected group from the application report of the last run.
- **Return value:** 0-100
- **Unit:** Percent (%)
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Peak (PROstation):** Supply the peak index from a group in the normalization table in the PEAK argument, to find the corresponding group in the application report.
- **Remarks:**
    - The application report is a system wide report, so one can't select peaks per channel from the application report.
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

24.8.8.17.18 Energy Meter Method

2255. Application: Comp New RF (Float, MB, PEAK)

- **Description:** Returns the new Response Factor of the selected peak from the application report of the last run.
- **Return value:** Any floating point value
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Peak (PROstation):** Use the PEAK argument to select a Peak (component) in the last application report. To do so fill in the peak index of the corresponding peak in the normalization table.
- **Remarks:**
  - The application report is a system wide report, so one can't select peaks per channel from the application report.
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2256. Application: Comp. Current RF (Float, PEAK)

- **Description:** Returns the Current Response Factor of the selected peak from the application report of the last run.
- **Return value:** Any floating point value
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Peak (PROstation):** Use the PEAK argument to select a Peak (component) in the last application report. To do so fill in the peak index of the corresponding peak in the normalization table.
- **Remarks:**
  - The application report is a system wide report, so one can't select peaks per channel from the application report.
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2258. Application: Comp. Initial RF (Float, PEAK)

- **Description:** Returns the Initial Response Factor of the selected peak from the application report of the last run.
- **Return value:** Any floating point value
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Peak (PROstation):** Use the PEAK argument to select a Peak (component) in the last application report. To do so fill in the peak index of the corresponding peak in the normalization table.
- **Remarks:**
  - The application report is a system wide report, so one can't select peaks per channel from the application report.
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2289. Application: Comp. Rw (Float, MB, PEAK)

- **Description:** Returns the field calibration correction Factor (Rw factor) of the selected peak from the application report of the last run.

- **Return value:** Any floating point value
- **Accuracy:** Floating point single precision
- **Modbus Register Type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Peak (PROstation):** Use the PEAK argument to select a Peak (component) in the last application report. To do so fill in the peak index of the corresponding peak in the normalization table.
- **Remarks:**
    - The application report is a system wide report, so one can't select peaks per channel from the application report.
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

24.8.8.17.19 Energy Meter Results

2260. Application: Active Energy Method (Int16, MB)

- **Description:** Returns the active energy meter calculation method as used in the application report of the last run.
- **Return value:**
    - 1 = ISO 6976
    - 2 = GPA 2172
    - 3 = ASTM 3588
    - 4 = GOST 22667
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2262. Application: ISO/ASTM/GPA Compressibility (Float, MB)

- **Description:** Returns the compressibility of the sample reported in the application report of the last run. This value is only valid in case ISO 6976, ASTM 3588, GPA 2172 or energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
    - Parameter 2404. Appl.: Stream ISO/ASTM/GPA **Compressibility**

2263. Application: ISO/ASTM/GPA Molar Mass (Float, MB)

- **Description:** Returns the molar mass of the sample reported in the application report of the last run. This value is only valid in case ISO 6976, ASTM 3588, GPA 2172 or energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**

  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2264. Application: ISO/ASTM/GPA Molar Mass Ratio (Float, MB)

- **Description:** Returns the molar mass ration of the sample reported in the application report of the last run. This value is only valid in case ISO 6976, ASTM 3588, GPA 2172 or energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).

2265. Application: ISO Wobbe Superior (Float, MB)

- **Description:** Returns the Wobbe superior index of the sample reported in the application report of the last run. This value is only valid in case ISO 6976 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
  - Parameter 2405. Appl.: Stream ISO Wobbe **Superior**

2266. Application: ISO/GOST Hs (Float, MB)

- **Description:** Returns the Wobbe superior of the sample reported in the application report of the last run. This value is only valid in case ISO 6976 or GOST 22667 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
  - Parameter 2406. Appl.: Stream ISO/GOST Hs

2267. Application: ISO/GOST Hi (Float, MB)

- **Description:** Returns the Hi value of the sample reported in the application report of the last run. This value is only valid in case ISO 6976 or GOST 22667 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
  - Parameter 2407. Appl.: Stream ISO/GOST Hi

2268. Application: ISO Abs.Density (Float, MB)

- **Description:** Returns the Absolute density value of the sample reported in the application report of the last run. This value is only valid in case ISO 6976 energy calculation method is used.
- **Modbus register type:** Holding Register / Input Register
- **Return value:** A positive floating point value
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
    - Parameter 2408. Appl.: Stream ISO Abs.Density

2269. Application: ISO Rel.Density (Float, MB)

- **Description:** Returns the relative density value of the sample reported in the application report of the last run. This value is only valid in case ISO 6976 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
    - Parameter 2409. Appl.: Stream ISO Rel.Density

2271. Application: ISO Wobbe Inferior (Float, MB)

- **Description:** Returns the Wobbe inferior value of the sample reported in the application report of the last run. This value is only valid in case ISO 6976 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
    - Parameter 2410. Appl.: Stream ISO Wobbe Inferior

2274. Application: ASTM/GPA Hv Actual (Float, MB)

- **Description:** Returns the Hv actual value of the sample reported in the application report of the last run. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
    - Parameter 2411. Appl.: Stream ASTM/GPA Hv Actual

2275. Application: ASTM/GPA Hv Dry (Float, MB)

- **Description:** Returns the Hv dry value of the sample reported in the application report of the last run. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.

- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
    - Parameter 2412. Appl.: Stream ASTM/GPA Hv Dry

2276. Application: ASTM/GPA Hv Wet (Float, MB)

- **Description:** Returns the Hv wet value of the sample reported in the application report of the last run. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
    - Parameter 2413. Appl.: Stream ASTM/GPA Hv Wet

2277. Application: ASTM/GPA SG (Float, MB)

- **Description:** Returns the SG value of the sample reported in the application report of the last run. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
    - Parameter 2414. Appl.: Stream ASTM/GPA SG

2278. Application: ASTM/GPA Density lb/ft3 (Float, MB)

- **Description:** Returns the Density value of the sample reported in the application report of the last run. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.
- **Return value:** A positive floating point value
- **Unit: lb/ft3**
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
    - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
    - Parameter 2415. Appl.: Stream ASTM/GPA Density

2279. Application: ASTM/GPA Spec.Vol.ft3/lb (Float, MB)

- **Description:** Returns the Specific volume of the sample reported in the application report of the last run. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.
  Return value: A positive floating point value
- **Unit: ft3/lb**

- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
  - Parameter 2416. Appl.: Stream ASTM/GPA Spec.Vol.ft3/lb

2280. Application: ASTM/GPA Hv act. MJM3 (Float, MB)

- **Description:** Returns the Hv Actual of the sample reported in the application report of the last run. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.
- **Return value:** A positive floating point value
- **Unit: MJ/m3**
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (value = 0)
- **Remarks:**
  - This parameter only supplies valid data of the last run, at the end of the run. Use one of the synchronization parameters to detect the end of the run (2200. Sync: Data available , 2201. Sync: Data available with reset or 2238. Sync: Data available2 with reset).
- **See also:**
  - Parameter 2417. Appl.: Stream ASTM/GPA Hv act. MJM3

24.8.8.17.20 Stream specific Application data

2400. Appl.: Stream Component ESTD(Float, CHAN=stream, PEAK)

- **Description:** Returns the ESTD concentration of the selected peak from the application report of the last run, which was sampled and analyzed on the selected stream.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Use the CHAN argument to select the stream to retrieve the last ESTD value from.
- **Peak (PROstation):** Use the PEAK argument to select a Peak (component) in the last application report generated on the selected stream. To do so fill in the peak index of the corresponding peak in the normalization table.

2401. Appl.: Stream Component Norm%(Float, CHAN=stream, PEAK)

- **Description:** Returns the Normalized concentration of the selected peak from the application report of the last run, which was sampled and analyzed on the selected stream.
- **Return value:** A positive floating point value
- **Unit:** Percent (%)
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Use the CHAN argument to select the stream to retrieve the last Normalized concentration value from.
- **Peak (PROstation):** Use the PEAK argument to select a Peak (component) in the last application report generated on the selected stream. To do so fill in the peak index of the corresponding peak in the normalization table.

2402. Appl.: Stream Alarm on Index(Bit, CHAN=stream, PEAK=index)

- **Description:** Returns whether or not the selected alarm from the alarm table was raised at the end of the last run, which was sampled and analyzed from the selected stream.
- **Return value:**

  - 0 = No alarm raised
  - 1 = An alarm from the alarm table was raised at the end of the last run for the selected stream.
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Use** the CHAN argument to select the stream to retrieve the last Alarm results from.
- **PEAK (PROSTATION):** Use the PEAK argument to select an alarm (by line number / index) from the alarm table.
- **See also:**
  - Parameter 2403. Appl.: Stream Overall Alarm Status
  - Parameter 2212. Application: Alarm status On Index
  - Parameter 2211. Application: Overall Alarm status
  - Parameter

  152. Status: Instrument Error Status

2403. Appl.: Stream Overall Alarm Status (Bit, CHAN=stream)

- **Description:** Returns if any of the configured alarms from the alarm table was raised at the end of the last run, which was sampled and analyzed from the selected stream.
- **Return value:**
  - 0 = No alarm raised
  - 1 = An alarm from the alarm table was raised at the end of the last run for the selected stream.
- **Modbus Register Type:** Coil status / Input Status
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):** Use the CHAN argument to select the stream to retrieve the last Alarm results from.
- **See also:**
  - Parameter 2402. Appl.: Stream Alarm on Index
  - Parameter 2211. Application: Overall Alarm status
  - Parameter 2212. Application: Alarm status On Index
  - Parameter
  - 152. Status: Instrument Error **Status**

2404. Appl.: Stream ISO/ASTM/GPA Compressibility (Float, CHAN=stream)

- **Description:** Returns the compressibility of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ISO 6976, ASTM 3588, GPA 2172 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Use the CHAN argument to select the stream to retrieve the Compressibility from.
- **See also:**
  - Parameter 2262. Application: ISO/ASTM/GPA Compressibility

2405. Appl.: Stream ISO Wobbe Superior (Float, CHAN=stream)

- **Description:** Returns the Wobbe superior index of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ISO 6976 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation): Use** the CHAN argument to select the stream to retrieve the Wobbe Superior from.
- **See also:**
  - Parameter 2265. Application: ISO Wobbe Superior

2406. Appl.: Stream ISO/GOST Hs (Float, CHAN=stream)

- **Description:** Returns the Wobbe superior of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ISO 6976 or GOST 22667 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Use the CHAN argument to select the stream to retrieve the Hs from.
- **See also:**
  - Parameter 2266. Application: ISO/GOST Hs

2407. Appl.: Stream ISO/GOST Hi (Float, CHAN=stream)

- **Description:** Returns the Hi value of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ISO 6976 or GOST 22667 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Use the CHAN argument to select the stream to retrieve the Hi from.
- **See also:**
  - Parameter 2267. Application: ISO/GOST Hi

2408. Appl.: Stream ISO Abs.Density (Float, CHAN=stream)

- **Description:** Returns the Absolute density value of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ISO 6976 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Use the CHAN argument to select the stream to retrieve the Absolute Density from.
- **See also:**
  - Parameter 2268. Application: ISO Abs.Density

2409. Appl.: Stream ISO Rel.Density (Float, CHAN=stream)

- **Description:** Returns the relative density value of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ISO 6976 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Use the CHAN argument to select the stream to retrieve the Relative Density from.
- **See also:**
  - Parameter 2268. Application: ISO Abs.Density

2410. Appl.: Stream ISO Wobbe Inferior (Float, CHAN=stream)

- **Description:** Returns the Wobbe inferior value of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ISO 6976 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation): Use** the CHAN argument to select the stream to retrieve the Wobbe Inferior from.
- **See also:**
  - Parameter 2268. Application: ISO Abs.Density

2411. Appl.: Stream ASTM/GPA Hv Actual (Float, CHAN=stream)

- **Description:** Returns the Hv actual value of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Use the CHAN argument to select the stream to retrieve the Hv Actual from.
- **See also:**
    - Parameter 2274. Application: ASTM/GPA Hv Actual

2412. Appl.: Stream ASTM/GPA Hv Dry (Float, CHAN=stream)

- **Description:** Returns the Hv dry value of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Use the CHAN argument to select the stream to retrieve the Hv Dry from.
- **See also:**
    - Parameter 2275. Application: ASTM/GPA Hv Dry

2413. Appl.: Stream ASTM/GPA Hv Wet (Float, CHAN=stream)

- **Description:** Returns the Hv wet value of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation): Use** the CHAN argument to select the stream to retrieve the Hv Wet from.
- **See also:**
    - Parameter 2275. Application: ASTM/GPA Hv Dry

2414. Appl.: Stream ASTM/GPA SG (Float, CHAN=stream)

- **Description:** Returns the SG value of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Use the CHAN argument to select the stream to retrieve the SG value from.
- **See also:**
    - Parameter 2275. Application: ASTM/GPA Hv Dry

2415. Appl.: Stream ASTM/GPA Density lb/ft3 (Float, CHAN=stream)

- **Description:** Returns the Density value of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation): Use** the CHAN argument to select the stream to retrieve the Density value from.
- **See also:**
    - Parameter 2275. Application: ASTM/GPA Hv Dry

2416. Appl.: Stream ASTM/GPA Spec.Vol.ft3/lb (Float, CHAN=stream)

- **Description:** Returns the Specific volume of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Use the CHAN argument to select the stream to retrieve the Specific Volume from.
- **See also:**
  - Parameter 2279. Application: ASTM/GPA Spec.Vol.
  - Parameter 2275. Application: ASTM/GPA Hv Dry

2417. Appl.: Stream ASTM/GPA Hv act. MJM3 (Float, CHAN=stream)

- **Description:** Returns the Hv Actual of the sample reported in the application report of the last run, which was sampled and analyzed from the selected stream. This value is only valid in case ASTM 3588 or GPA 2172 energy calculation method is used.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation): Use** the CHAN argument to select the stream to retrieve the Hv Actual value from.
- **See also:**
  - Parameter 2280. Application: ASTM/GPA Hv act. MJM3
  - Parameter 2275. Application: ASTM/GPA Hv Dry

2418. Appl.: Stream Sum ESTD (Float, CHAN=stream)

- **Description:** Returns the sum of ESTD values of all peaks in the application report of the last run, which was sampled and analyzed from the selected stream. These peaks are defined in the normalization table (maximum 100 peaks) and which are also detected in the integration report.
- **Return value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation): Use** the CHAN argument to select the stream to retrieve the Sum ESTD value from.
- **See also:**
  - Parameter 2280. Application: ASTM/GPA Hv act. MJM3
  - Parameter 2217. Application: Sum ESTD
  - Parameter 2275. Application: ASTM/GPA Hv Dry

24.8.8.17.21 Site Info parameters

965. SiteInfo: Calorific Value (Float, MB)

- **Description:** Returns / sets the Calorific value, which is inserted in the Site Info area. The Calorific value is taken from the specification on the calibration gas bottle.
- **Return / Set value:** A positive floating point value
- **Unit:** Depends on the unit specified on the calibration gas bottle
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (Value = 0)
- **Remarks:**
- **See also:**

966. SiteInfo: Density (Float, MB)

- **Description:** Returns / sets the Density value, which is inserted in the Site Info area. The Density value is taken from the specification on the Calibration gas bottle.
- **Return / Set value:** A positive floating point value
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Float (32 bit floating point)
- **Channel (PROstation):** Main board (Value = 0)

24.8.8.17.22 Read Chromatogram

With this set of parameters it is possible to read chromatogram data via Modbus.

8013. Set Channel Nr. remote chrom. data (Int16, MB)

- **Description:** Sets the channel number from which the chromatogram data needs to be read from.
- **Set value:** A positive integer value
- **Modbus register type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (Value = 0)
- **Remarks:**
  - Chromatogram data can only be retrieving from one channel at a time.

8014. Set Data rate remote chrom. data (Int16, MB)

- **Description:** Sets the data rate of the chromatogram data to retrieve.
- **Set value:** 1-100
- **Modbus register type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (Value = 0)
- **Remarks:**
  - When using 8016. Remote read single chrom. point on page 257 :
    - Each chromatogram point recorded will be returned, if set value is 1 (100 Hz)
    - Each second chromatogram point recorded will be returned, if set value is 1 (50Hz)
    - Each hundredth chromatogram point recorded will be returned, if Set value is 100 (1 Hz)

8015. Set Offset Time remote chrom. data (Int16, MB)

- **Description:** Sets from which time (offset), the chromatogram data must be read. The offset time is measured from the start of the chromatogram. If for example one is
- **Set value:** 0-length of the chromatogram
- **Unit:** Seconds (s)
- **Modbus register type:** Holding Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (Value = 0)
- **Remarks:**
  - The time set must not be bigger then the run time of the chromatogram to retrieve

8016. Remote read single chrom. point (Int32, MB)

- **Description:** Reads a single chromatogram point from the channel.
- **Return value:** any 32 bit integer value
- **Unit:** 10 nano Volt (10 nV)
  - The unit is 10 nV. If for example a value 20 is returned, it means that the value is 20 10 nV = 200 nV
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation):** Main board (Value = 0)
- **Remarks:**
  - The time set must not be bigger then the run time of the chromatogram to retrieve
  - When setting the data rate (8014. Set Data rate remote chrom. data on page 256) at:
    - A value of 1, each chromatogram point recorded will be returned (100 Hz)
    - A value of 1, each second chromatogram point recorded will be returned (50Hz)
    - A value of 100, each hundredth chromatogram point recorded will be returned (1 Hz)

24.8.8.17.23 Execute Commands

In contradistinction with all other Modbus parameters, these Modbus parameters are used to perform an action rather then returning or setting a value. However these parameters trigger some action in the 490-GC PRO, it are still regular Modbus parameters to Modbus that needs to be written. Most of these so called execute commands can also be requested from PROstation.

0. Start Run (Execute Cmd, MB)

- **Description:** Starts a single run (manual run) using the method, application, and all other concerned parameters that are currently in the 490-GC PRO. After ending this run, the 490-GC PRO will return to idle mode.
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 0)
- **Remarks:**
- **See also:**
  - Parameter 16. Start Automation
  - Parameter 24. Start Calibration Table
  - Parameter 25. Start Verification Table **17. Stop Automation**

1. Stop Run (Execute Cmd, MB)

- **Description:** Stops the current running single run (manual run). After the current run has stopped the 490-GC PRO will return to idle mode.
- **Set Value:**
  - 0 = No effect in anyway

  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 0)
- **Remarks:**
- **See also:**
  - Parameter 17. Stop Automation

2. MPU Reset (Execute Cmd, MB)

- **Description:** This command the MPU, a so called software reboot. This will also reset some automation parameters (p.e. Parameter **15. Number of Automation Runs**), but leaving parameters that can be downloaded from PROstation, untouched.
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 0)
- **Remarks:**
  - The onboard IO (Standard or general IO) of the 490-GC PRO will be reset during a software reboot.
  - All IO of the optional extension boards will remain untouched during a software reboot, Except for the onboard IO, which are put through on the Basic Extension Board as well.

7. Calibrate TCD (Execute Cmd, CHAN)

- **Description:** This command can be used to calibrate the TCD of a channel of the 490-GC PRO. Only use this command if suspicion is raised that the TCD's are not performing correctly.
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation):**Channel (value = 1 to 4)
- **Remarks:**
  - The TCD's are calibrated at startup
  - Before calibrating the TCD's, make sure to the 490-GC PRO is in idle mode and that no run or sequence is about or scheduled to start. If the TCD is calibrated during a run, the calibration is not reliable.

9. Energize Relay 1 (Execute Cmd, MB)

- **Description:** This command energizes (switches on) onboard relay 1
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 1)
- **Remarks:**
  - When an optional extension board is used, the onboard relays are put through on the Basic Extension Board.
- **See also:**
  - Parameter 99. Set Extension Bus Relay
  - Execute command 10. De-energize Relay 1
  - Execute command 11. Energize Relay 2
  - Execute Command 12. De-energize Relay 2
  - Execute Command 31. Reset Timed Relays
  - Execute Command 32. Reset Alarm Relays
  - Execute Command 33. Reset Analog **Outputs**

10. De-energize Relay 1 (Execute Cmd, MB)

- **Description:** This command de-energizes (switches off) the onboard relay 1
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 1)
- **Remarks:**
  - When an optional extension board is used, the onboard relays are put through on the Basic Extension Board.
- **See also:**
  - Parameter 99. Set Extension Bus Relay
  - Execute command 9. Energize Relay 1
  - Execute command 11. Energize Relay 2
  - Execute Command 12. De-energize Relay 2
  - Execute Command 31. Reset Timed Relays
  - Execute Command 32. Reset Alarm Relays
  - Execute Command 33. Reset Analog **Outputs**
  - Execute Command 35. Reset All Alarms

11. Energize Relay 2 (Execute Cmd, MB)

- **Description:** This command energizes (switches on) the onboard relay 2
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 1)
- **Remarks:**
  - When an optional extension board is used, the onboard relays are put through on the Basic Extension Board.
- **See also:**
  - Parameter 99. Set Extension Bus Relay
  - Execute command 9. Energize Relay 1
  - Execute command 10. De-energize Relay 1
  - Execute Command 12. De-energize Relay 2
  - Execute Command 31. Reset Timed Relays
  - Execute Command 32. Reset Alarm Relays
  - Execute Command 33. Reset Analog **Outputs**
  - Execute Command 35. Reset All Alarms

12. De-energize Relay 2 (Execute Cmd, MB)

- **Description:** This command de-energizes (switches off) the onboard relay 2
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 1)
- **Remarks:**
  - When an optional extension board is used, the onboard relays are put through on the Basic Extension Board.
- **See also:**
  - Parameter 99. Set Extension Bus Relay
  - Execute command 9. Energize Relay 1

- Execute command 10. De-energize Relay 1
- Execute command 11. Energize Relay 2
- Execute Command 31. Reset Timed Relays
- Execute Command 32. Reset Alarm Relays
- Execute Command 33. Reset Analog Outputs
- Execute Command 35. Reset All Alarms

13. Store Config on Flash (Execute Cmd, MB)

- **Description:** This command stores the 490-GC PRO configuration on the onboard flash disk. All configuration settings that have been changed since last save action or since last startup, will now be stored in the configuration. This command only concerns configuration parameters that have been changed by means of Modbus. Configuration parameters downloaded from PROstation, are automatically stored on flash. The configuration of the 490-GC PRO is considered as all parameters that can be changed in the configuration screen of PROstation
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 1)
- **Remarks:**
  - Configuration parameters download from PROstation are automatically stored on flash.
  - Be aware that downloading configuration parameters from PROstation will overwrite configuration changes done via Modbus and vice versa. When configuration changes are done via Modbus, make sure in PROstation to first upload the current (changed) configuration from the 490-GC PRO.
  - Changed parameters, even if not saved, will be uploaded when in the configuration screen of PROstation an upload is performed.

15. Store Method on Flash (Execute Cmd, MB)

- **Description:** This command stores the 490-GC PRO method on the onboard flash disk. All method settings that have been changed since last save action or since last startup, will now be stored in the configuration. This command only concerns method parameters that have been changed by means of Modbus. Configuration parameters downloaded from PROstation, are automatically stored on flash. The method of the 490-GC PRO is considered as all parameters that can be changed in the method screens of PROstation
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 1)
- **Remarks:**
  - Modbus parameters download from PROstation are automatically stored on flash.
  - Be aware that downloading method parameters from PROstation will overwrite configuration changes done via Modbus and vice versa. When Modbus changes are done via Modbus, make sure in PROstation to first upload the current (changed) method from the 490-GC PRO.
  - Changed parameters, even if not saved, will be uploaded when in the PROstation an upload of the method is performed.

16. Start Automation (Execute Cmd, MB)

- **Description:** This command starts the automation using the method, application, and all other concerned parameters that are currently in the 490-GC PRO. After automation has ended (when the automation is not set to endless running), the 490-GC PRO will return to idle mode.
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 0)
- **Remarks:**
  - Start automation does not necessarily start the sequence. If the sequence settings instruct to first start the verification or calibration table, the 490-GC PRO will perform as instructed.
- **See also:**
  - Parameter 16. Start Automation
  - Parameter 24. Start Calibration Table
  - Parameter 25. Start Verification Table **17. Stop Automation**

17. Stop Automation (Execute Cmd, MB)

- **Description:** This command stops the automation of the 490-GC PRO. After automation is ending (when the automation is not set to endless running), the 490-GC PRO will return to idle mode. The Automation will only stop after the current run has finished.
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 0)
- **Remarks:**
- **See also:**
  - Parameter 16. Start Automation
  - Parameter 24. Start Calibration Table
  - Parameter 25. Start Verification Table **17. Stop Automation**

24. Start Calibration Table (Execute Cmd, MB)

- **Description:** This command starts the calibration table using the method, application, and all other concerned parameters that are currently in the 490-GC PRO. In case the 490-GC PRO is in idle mode, executing the calibration table starts immediately. In case the 490-GC PRO is in running automation mode, executing the calibration tables starts after the current run has finished. After the calibration table has ended, the 490-GC PRO will return to idle mode or to running automation, depending upon the 490-GC PRO was in idle mode or in running automation mode at the moment of starting the calibration table
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 0)
- **Remarks:**
  - Running the calibration table will stop after 17. Stop Automation is executed. If the 490-GC PRO. If automation was running before the calibration table was started, then the automation will be stopped as well.
- **See also:**
  - Parameter 16. Start Automation
  - Parameter 16. Start Automation
  - Parameter 25. Start Verification Table **17. Stop Automation**

25. Start Verification Table (Execute Cmd, MB)

- **Description:** This command starts the verification table using the method, application, and all other concerned parameters that are currently in the 490-GC PRO. In case the 490-GC PRO is in idle mode, executing the verification table starts immediately. In case the 490-GC PRO is in running automation mode, executing the verification tables starts after the current run has finished. After the verification table has ended, the 490-GC PRO will return to idle mode or to running automation, depending upon the 490-GC PRO was in idle mode or in running automation mode at the moment of starting the verification table
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 0)
- **Remarks:**
  - Running the verification table will stop after 17. Stop Automation is executed. If the 490-GC PRO. If automation was running before the verification table was started, then the automation will be stopped as well.
- **See also:**
  - Parameter 16. Start Automation
  - Parameter 17. Stop Automation
  - Parameter 24. Start Calibration Table

29. Stop Cleaning Cycle (Execute Cmd, MB)

- **Description:** This command stops the cleaning cycle if that is currently running. If the automation was running before the cleaning cycle was started, the 490-GC PRO will return to running automation. Otherwise it will return to idle mode.
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 0)
- **Remarks:**
- **See also:**
  - Parameter 95. Set Channel to clean
  - Parameter
  - 96. Request cleaning cycle, **minutes**

31. Reset Timed Relays (Execute Cmd, MB)

- **Description:** This command resets all timed relays to their original setting.
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 1)
- **Remarks:**
- **See also:**
  - Parameter 99. Set Extension Bus Relay
  - Execute command 9. Energize Relay 1
  - Execute command 10. De-energize Relay 1
  - Execute command 11. Energize Relay 2
  - Execute Command 12. De-energize Relay 2
  - Execute Command 32. Reset Alarm Relays
  - Execute Command 33. Reset Analog Outputs
  - Execute Command 35. Reset All Alarms

32. Reset Alarm Relays (Execute Cmd, MB)

- **Description:** This command resets all alarm relays to their original setting.
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 1)
- **Remarks:**
  - The extra relays that become available when using one or more optional extension board, can be connected as normally open or normally closed. For relays that are connected as normally open, will be reset to open and the once that are connected as normally closed will be reset to closed.
  - The standard onboard relays are normally open only
- **See also:**
  - Parameter 99. Set Extension Bus Relay
  - Execute command 9. Energize Relay 1
  - Execute command 10. De-energize Relay 1
  - Execute command 11. Energize Relay 2
  - Execute Command 12. De-energize Relay 2
  - Execute Command 31. Reset Timed Relays
  - Execute Command 33. Reset Analog **Outputs**
  - Execute Command 35. Reset All Alarms

33. Reset Analog Outputs (Execute Cmd, MB)

- **Description:** This command resets the analog outputs to their 'low signal'. For a 4-20 mA and a 0-10 V output it means that the analog signal is reset to respectively 4 mA and 0 V
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 1)
- **Remarks:**
  - Analog outputs are only available when using an analog extension board (In combination with a basic extension board)
- **See also:**
  - Parameter 99. Set Extension Bus Relay
  - Execute command 9. Energize Relay 1
  - Execute command 10. De-energize Relay 1
  - Execute command 11. Energize Relay 2
  - Execute Command 12. De-energize Relay 2
  - Execute Command 31. Reset Timed Relays
  - Execute Command 32. Reset Alarm Relays
  - Execute Command 35. Reset All Alarms

35. Reset All Alarms (Execute Cmd, MB)

- **Description:** This command resets all alarms to their original setting. This command resets, the alarm relays, the calibration alarms, overall alarm status and the verification alarms.
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 1)
- **Remarks:**
- **See also:**
  - Parameter 99. Set Extension Bus Relay
  - Execute command 9. Energize Relay 1
  - Execute command 10. De-energize Relay 1
  - Execute command 11. Energize Relay 2
  - Execute Command 12. De-energize Relay 2
  - Execute Command 31. Reset Timed Relays
  - Execute Command 32. Reset Alarm Relays
  - Execute Command 33. Reset Analog **Outputs**

36. Empty ErrorLog file (Execute Cmd, MB)

- **Description:** This command empties the 490-GC PRO's error log file. This is the log file, which is uploaded when an upload diagnostic is performed.
- **Set Value:**
  - 0 = No effect in anyway
  - 1 = Execute the command specified
- **Modbus register type:** Coil
- **Modbus data type:** Bit (1 bit)
- **Channel (PROstation): Main board** (Value = 1)
- **Remarks:**

24.8.8.17.24 Fixed value repeater

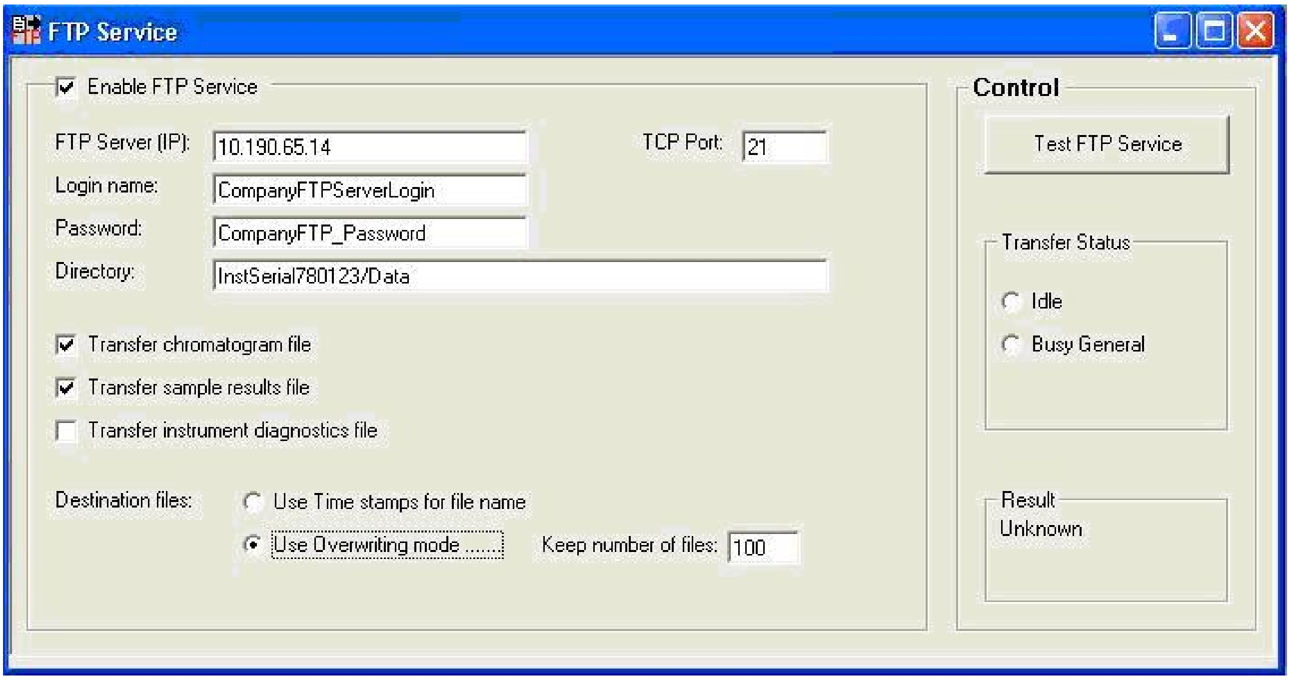
9000. Fixed Value (Int16, MB, PEAK=fixed value)

- **Description:** Returns the value that needs to be defined in the peak argument for this parameter. This parameter can for example be used to let the 490-GC PRO return an additional identification.
- **Return value:** Fixed value defined in the peak column of the Modbus table
- **Modbus register type:** Holding Register / Input Register
- **Modbus data type:** Int16 (16 bit integer)
- **Channel (PROstation): Main board** (Value = 1)
- **PEAK (PROSTATION): Use** the Peak argument to define the fixed value to return

24.8.9 Automation – FTP Service

490-GC PRO FTP Service is responsible for transferring analysis results, RAW data (chromatogram) and diagnostic data to a Pre-defined FTP Server.

The 490-GC PRO firmware has an onboard FTP Client, capable of sending files to an FTP server.



The FTP-server name must be setup by entering its IP address.
If it is required to store the instrument data in a subdirectory on the FTP server, be sure to use “/” (slash) instead of “\” in order to set a sub directory. If only one sub directory deep from the root directory, a slash is not required. In the example above, the files are stored in ‘InstSerial780123Data’ folder, which is a subdirectory of the default directory after logging in with an FTP client using the login name and password as defined above. If this sub directory has a sub directory ‘test1’ and data should be stored in this folder, enter ‘InstSerial780123Data/test1’.

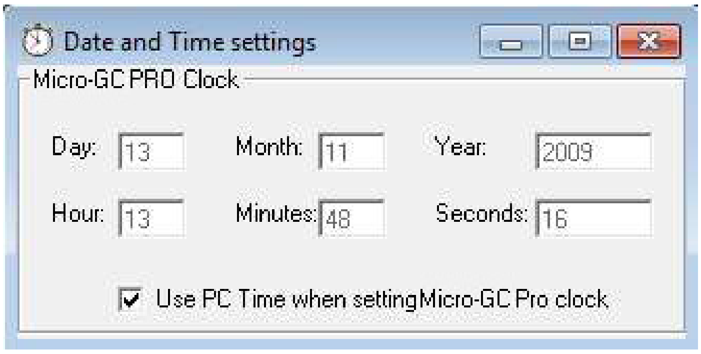
In the example above, the chromatogram file and sample results file are sent to the FTP server at the end of every run. Under ‘Destination Files’ can be set under which name to store the selected files. If Time stamps is selected, the chromatogram is stored as Chrom_[time].dat, the sample results as Chrom_[time].txt and the diagnostic data as ErrorLog.txt.
The Chromatogram file as stored on the FTP server can be opened in PROstation in a later stage for diagnostics purposes. The sample results and ErrorLog file are simple text files and can be opened in any ordinary text editor.

Set TCP Port to a value other than default 21 if this required by the FTP server.

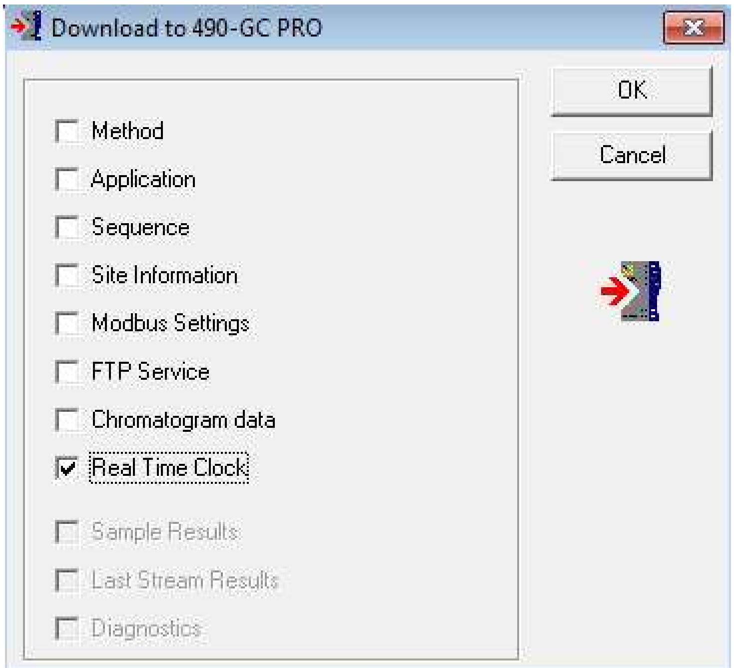
The “Test FTP Service” button can be used to check whether the correct FTP server settings are used. By pressing the button, the selected files are immediately sent to the FTP server. Check on the FTP server if they were received.

24.8.10 Automation – Real Time Clock

To set the correct time in the 490-GC PRO, select Automation\Real Time Clock from the PROstation toolbar.



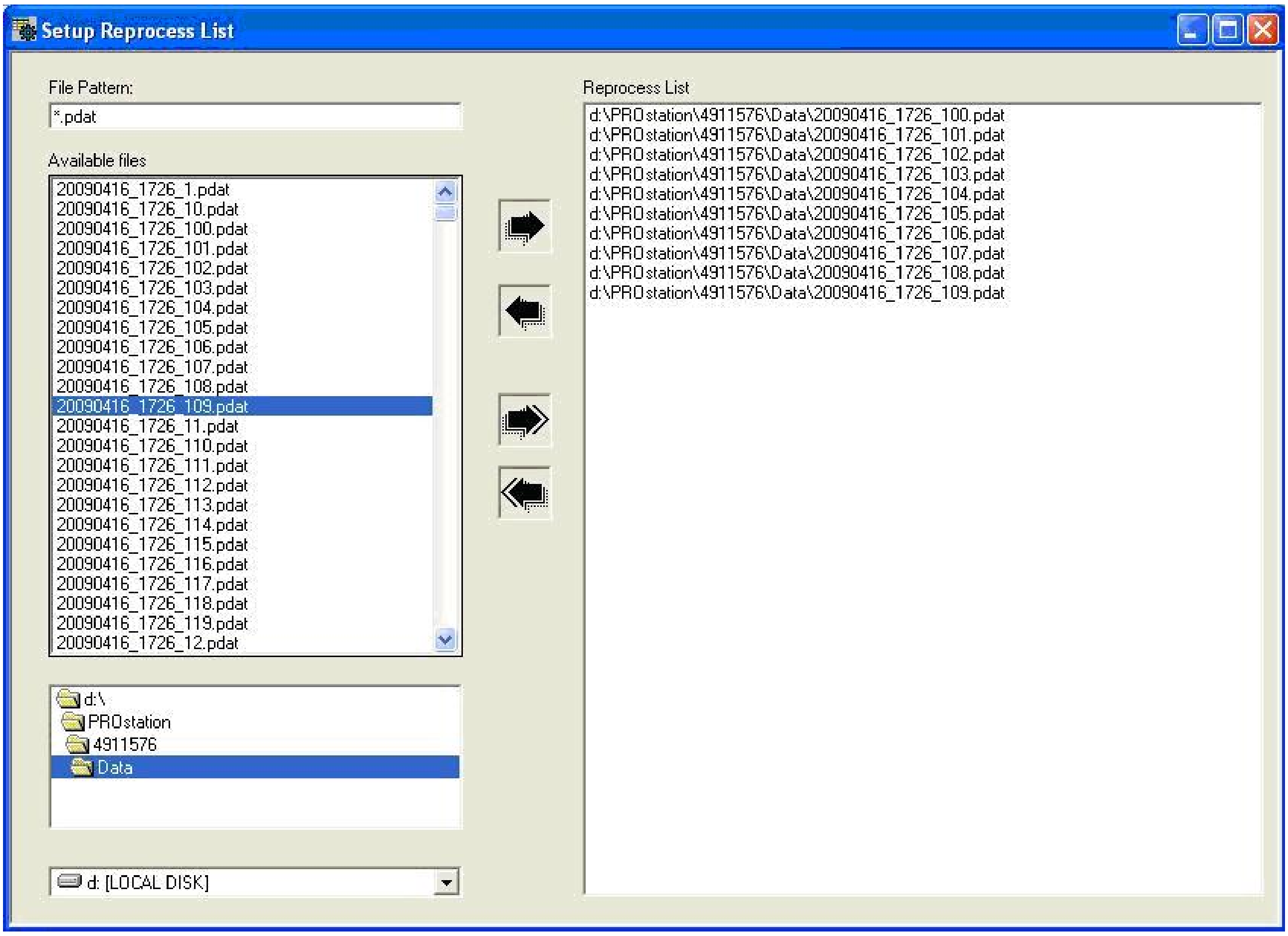
You may either enter the time as is or select 'Use PC Time'.
Leave this window open and select 'Download' from the 'Control' menu, check 'Real Time Clock' and press the "OK" button in order to set the time in the instrument.



An alternative way to set the time is via Modbus communication protocol in an automated process where clock synchronization is required.

24.8.11 Automation – Reprocess List

Chromatogram files as stored on the local hardisk on PROstations computer can be reprocessed as a batch of files.
Transfer the files of a directory of the 'Available List' to the "Reprocess List" shown on the right side of the screen.



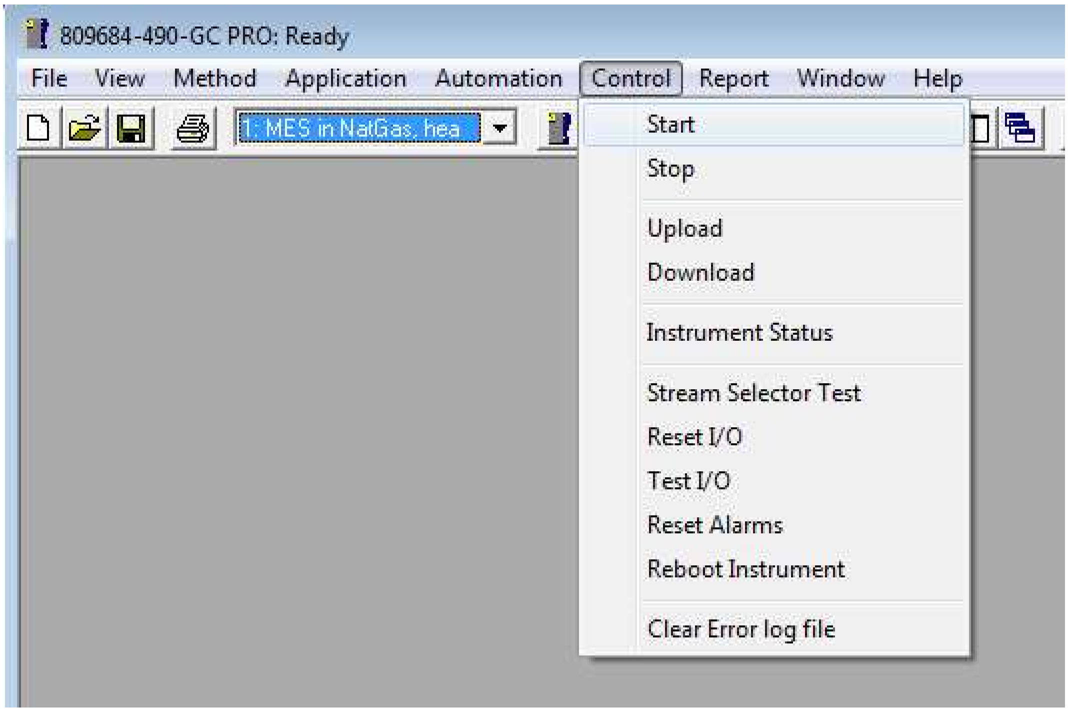
Close this window and you will be asked to enter a name. The list will be stored under this name.
This list can always be reopened via the menu 'File' – 'Reprocess' – 'Open'.

From the 'Control' menu, select 'Start', 'Recalculate Reprocess List'. PROstation will download the first chromatogram from the list to the 490-GC PRO and request the instrument to process this chromatogram. When the 490-GC PRO completes the calculations, the result and chrotogram are shown in PROstation. Now the second chromatogram will be downloaded to the instrument. This will continue till the results of the last processed chromatogram are uploaded to PROstation.

Note that you can only reprocess chromatograms on a non-running instrument. PROstation itself has no process capabilities.

24.9 Control

Under Control you will find all items related to instrument communication: start/stop, up- and down loading controls, status, etc.



Start on page 269

Stop on page 271

Upload on page 272

Download on page 272

Instrument Status on page 273

Stream Selector Test on page 274

Reset I/O on page 274

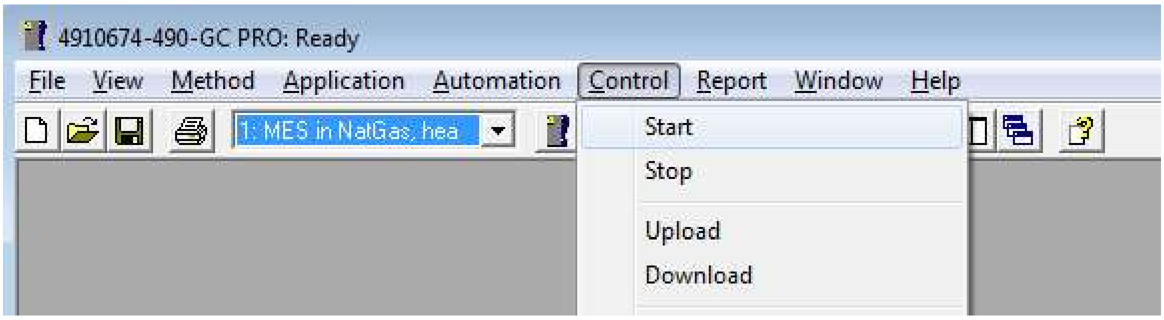
Test I/O on page 275

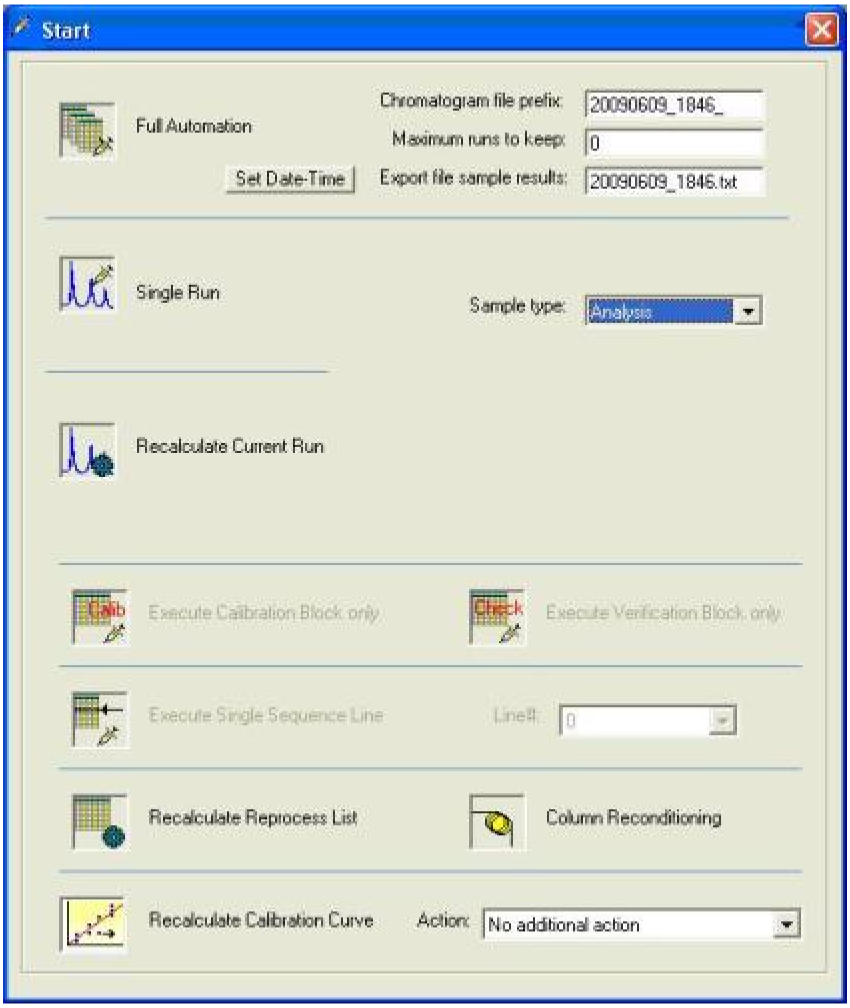
Reboot Instrument on page 275

Clear Error log file on page 276

24.9.1 Control - Start

To start the 490-GC PRO from the PROstation toolbar select **control/start** or click directly on the start icon.





Because the 490-GC PRO is capable of executing several different tasks, it is necessary to identify what to start. Apart from Full Automation, most of the possibilities listed are used during method development or instrument service.

Note: execution of the various items is only possible after the appropriate methods have been downloaded to the instrument.

- **Full Automation**
  This will start the execution of the full automation sequences as developed under automation and downloaded to the instrument. The automation consists of a main sequence and optionally a calibration and verification sequence. Those sequences run in the instrument and continue, even if PROstation is exited.
  Full Automation requires the parameters ‘Chromatogram file prefix’, ‘Maximum runs to keep’ and ‘Export file sample results’ to be filled in.
  Once the automation is started the collected chromatogram and sample results are stored on the local hardisk of PROstation PC under the file name as defined ‘Chromatogram file prefix’. In addition all sample results are stored in a “tab separated file” as defined by ‘Export file sample results’ parameter. This text file can be opened in Excel for statistical analysis.
  Attention: When automation is running, do not open the export file; instead open a copy of this file.

- **Single Run**
  This will start a single run. This consists of sample injection, chromatographic separation, integration and calculation. Depending on the availability of an application method, this will be performed as well.
  This option requires the parameters “Stream Position’ and ‘Sample type’.
  If a run is a calibration run, additionally ‘Level’ and ‘Type’ has to be filled in.

- **Recalculate current run**
  This option allows the user to reintegrate and recalculate the run currently in memory of the 490-GC PRO. This feature is especially useful when developing methods. Integration, calibration or application methods can be edited and downloaded to the instrument. Changes can be effectuated by recalculating the same run as before.
  Note that you can only reprocess the current on a non-running instrument. PROstation itself has no process capabilities.

- **Execute Calibration block**
  This option allows the user to directly start a calibration block. Practically this will be used only to perform a calibration without running the main sequence.

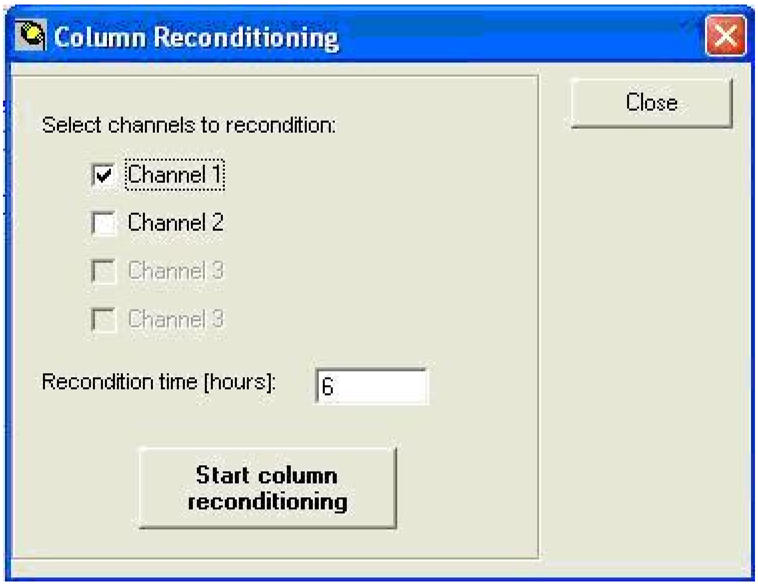
- **Execute Verification block**
  This option allows the user to directly start a verification block only. Practically this will be used to check a calibration without running the main sequence.

- **Execute single sequence line**
  This option allows the user to start a single line from a complete sequence.
  This option requires the parameters “Stream Position’, ‘Sample type’, ‘Level’ and ‘Type’ to be filled in.

- **Recalculate reprocess list**

  This option will start the reprocessing (integration/calculation) following the list as defined under Automation/reprocess list.

- **Column Reconditioning**
  To bake out the column(s) on the maximum allowed temperature for that column for a period of time, select the Column Reconditioning option.



In this example only the column in channel 1 will be baked out for 6 hours on its maximum allowed temperature, which is stored in channel persistent memory. Press the ‘Start column reconditioning’ button to start this process. When reconditioning time expires, the column temperature will return to its operating temperature.

- **Recalculate calibration curve**
  Use this option to let the 490-GC PRO recalculates its calibration curve out of the available calibration data (amount and area for all calibration levels).
  In addition a pre-recalculation action can be performed, before recalculating the curve fit. These are:
  - Remove Single Point List: If single calibration points are marked in the Method – Calibration window in order to be removed from the calibration curve, this option will appear. The selected points will be removed from the calibration fit and the curve will be recalculated.
  - Clear calib. level 1 all peaks: Clears all calibration data performed with calibration level 1. If more calibration levels exist, these can be cleared as well.
  - Clear Rw values: Resets all Rw values to 1.0. This option is only required in a multi level calibration in combination with a field calibration, used to make a correction on the curve.
  - Clear entire calibration: This clears the entire calibration curve of all peaks and requires performing a new calibration from scratch.

24.9.2 Control – Stop Column Reconditioning

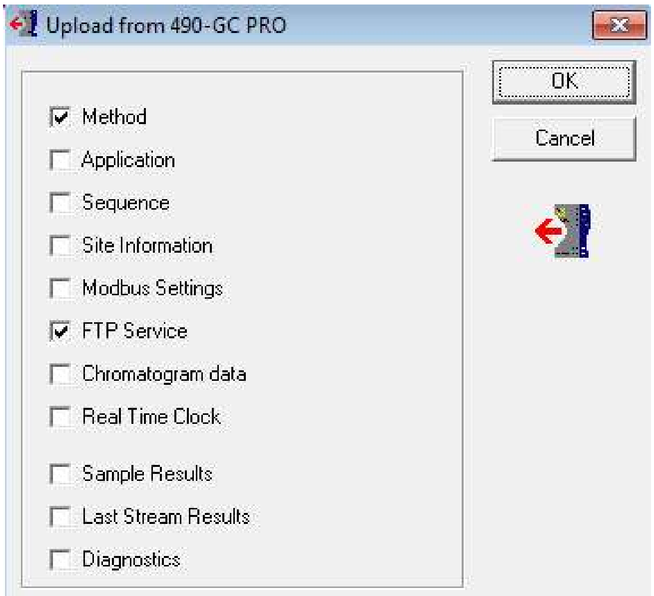
Once the Column Reconditioning is started, this option will become visible in the ‘Control’ menu. Select ‘Stop Column Recondioning’ to abort this process immediately and return to operating column temperature.

24.9.3 Control – Stop

To stop 490-GC PRO Micro-GC activity, select Control/Stop or click directly on the Stop-icon.
On a “Stop Automation” the current run will first be completed, before Automation is stopped.
When an execute block is performed, the current run will be aborted immediately and the Automation will be stopped.
When Automation is stopped, all Timed Relays will be reset to their default state.

24.9.4 Control - Upload

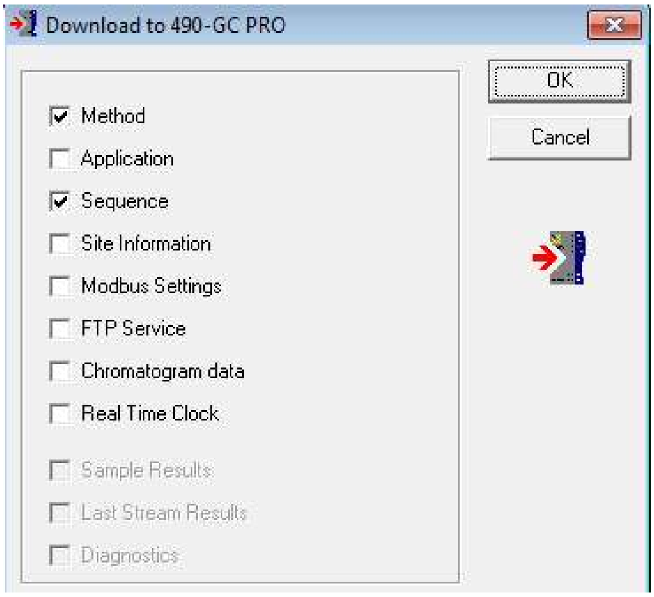
Uploading from the instrument to PROstation
From the PROstation toolbar, select **control/upload**



As different parts of the complete 490-GC PRO method are stored in different sections, one must identify which part needs to be uploaded from or downloaded to the instrument. This minimises traffic and at the same time it allows the user to focus on specific parts.

24.9.5 Control – Download

Downloading from PROstation to the instrument.
From the PROstation toolbar, select **control/download**
Select which items to download:

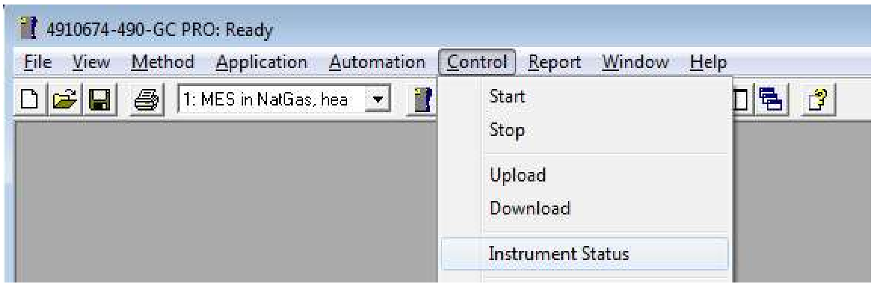


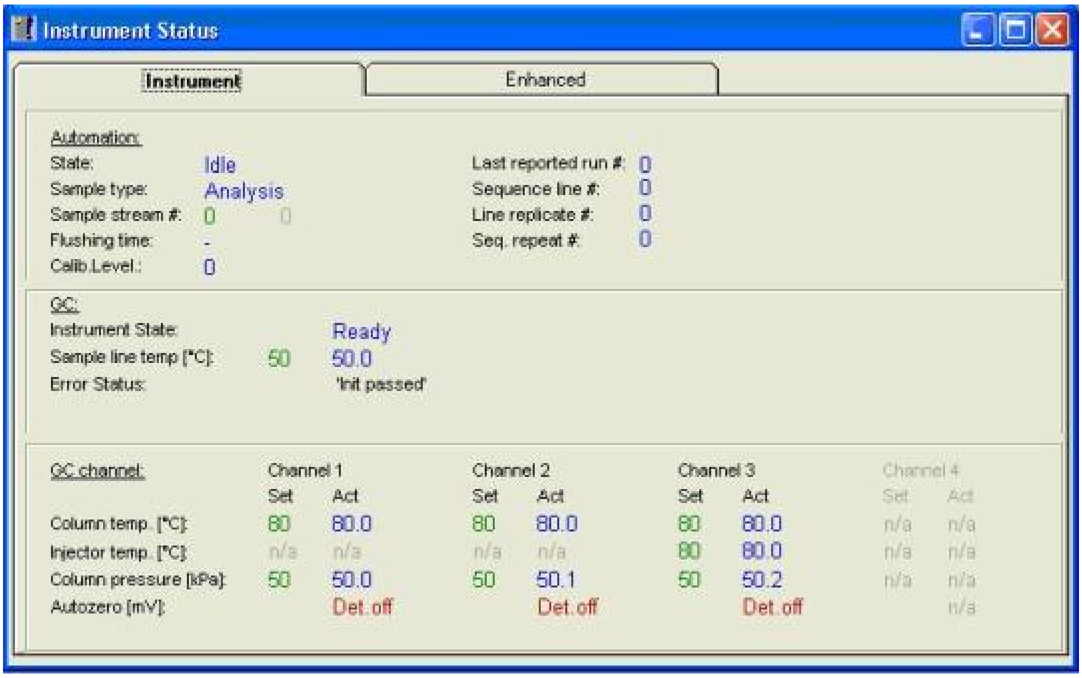
Note: Method change is related to Jumper 5 on page 11

Obviously, sample results and diagnostics should not be downloaded to the instrument and hence they are greyed out.

24.9.6 Control - Instrument Status

The **Control/Instrument Status** command is used to bring up a real-time status screen for your Varian 490-GC PRO. The instrument method settings ("Set" column) will only appear if a method is up or downloaded from/to the 490-GC PRO.





24.9.6.1 Automation

Current Automation state, Sample type, Sample stream, Flushing time, Calib. Level and more is displayed.

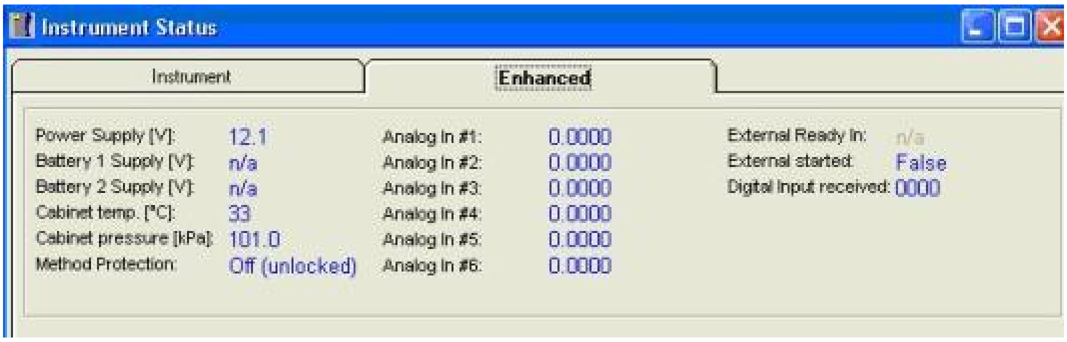
24.9.6.2 GC

Instrument State, Sample line temperature and Error status will be visible.

24.9.6.3 GC channel

The channel status consists of settings and actual. Status data is colored blue if the actuals are within the settings window and colored red if they are outside the settings windows. In Channel 2 and 4 for a dual and quad configuration with DMD detector respectively, the column transfer shown is the actual transferline temperature between GC and DMD Channel. Injector Temperature, Column Pressure and Autozero value are not displayed for a DMD channel position.

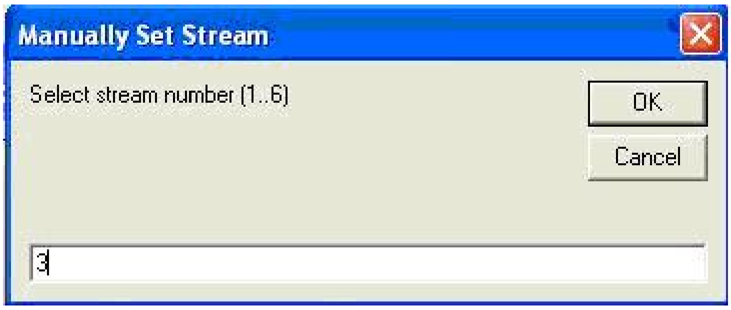
24.9.6.4 Enhanced status



Status of Power supply, battery supplies, cabinet pressure and temperature of the instrument, external analog input (corrected by scaling factor and offset value set in the application), external Ready In, External Start and digital input received for configured digital inputs (represented in binary format).

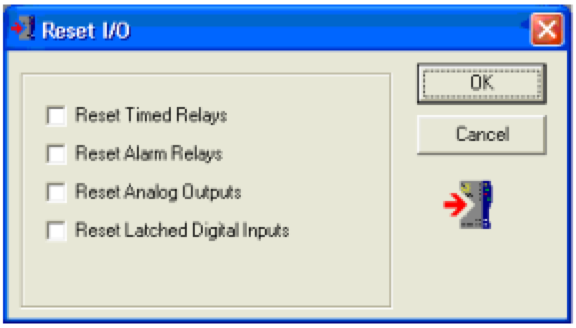
24.9.7 Control – Stream Selector Test

From the PROstation toolbar, select **Stream Selector Test.**
Select a stream number within the configured range and press the 'OK' button. The stream selector (whether a VICI valve or a relay configured device) should now switch the requested stream number.



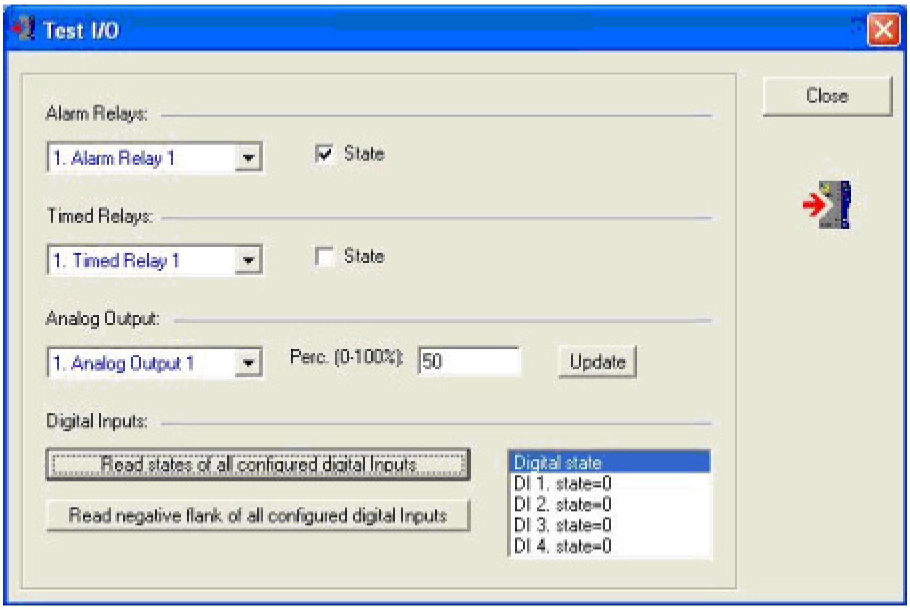
24.9.8 Control - Reset I/O

From the PROstation toolbar, select **control/reset I/O.**
Select the type of I/O which should be reset and press the 'OK' button to request the 490-GC PRO to execute the selected options.



24.9.9 Control - Test I/O

From the PROstation toolbar, select **control/test I/O**.



The hardware and software configuration of your predefined I/O's can be checked.

Select an Alarm from the list and toggle the State check. The relay should switch.

Select a Timed Relay from the list and toggle the State check. The relay should switch.

Select an Analog Output from the list and enter a percentage of the full scale the hardware can provide. Measure the generated output with a digital multimeter.

Generate a digital input (shortcut of digital input to ground) and press button 'Read states of all configured digital Inputs'. The correct digital input state must have value 1. Release the shortcut and again press this button. The state of the digital input should show 0.

With the 'Read negative flank of all configured digital Inputs' option, only the change from 'no shortcut' to 'shortcut', results in state=1. The state is cleared after reading its status. Check this by again pressing this button after you have generated a negative flank and check that the state becomes 0.

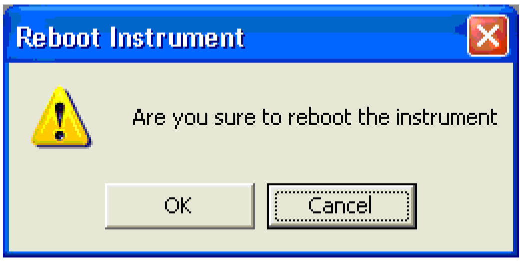
24.9.10 Control - Reset Alarms

From the PROstation toolbar, select ‘control/test I/O’.

Pressing ‘OK’ resets all application alarms in the 490-GC PRO. Application alarms are set if parameters exceed their range as defined in the Alarm table of the Application.

24.9.11 Control - Reboot Instrument

From the PROstation toolbar, select **control/reboot**
If it is required to reboot the system, select OK.



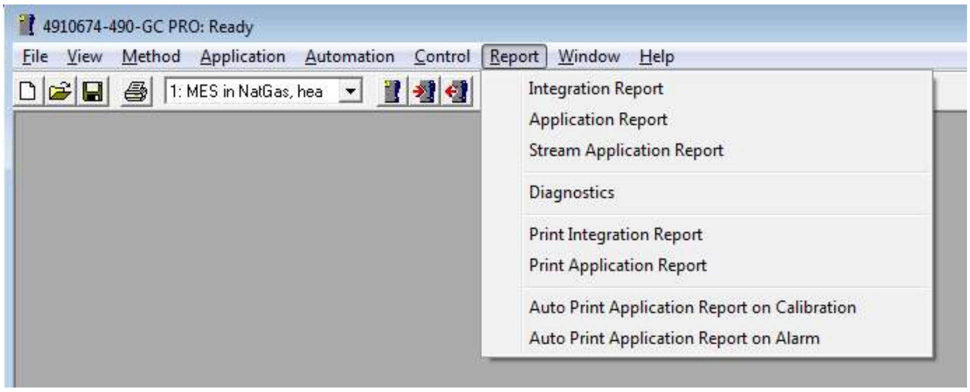
24.9.12 Control - Clear Error Log

From the PROstation toolbar, select **control/clear error log**
Select OK to clear (empty) the error log.

After clearing ErrorLog, upload ‘Diagnostics’ followed by displaying Diagnostic. The Error Report will be empty.

24.10 Report

To access the reporting capabilities, from the PROstation toolbar select Report.



The pull down menu is divided into different sections:

- Integration, application and/or stream application report (displayed on screen),
- Diagnostics
- Print request for integration or application report
- Automated print request on calibration or alarm.

Integration Report on page 278

Application Report on page 280

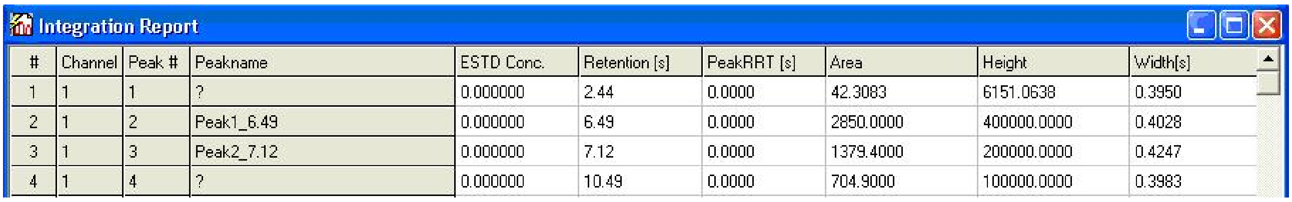
Stream Application Report on page 282

Diagnostics on page 283

Print integration/application report on page 284

Auto Print application report after Calibration or Alarm on page 284

24.10.1 Integration Report



#	Channel	Peak #	Peakname	ESTD Conc.	Retention [s]	PeakRRT [s]	Area	Height	Width[s]
1	1	1	?	0.000000	2.44	0.0000	42.3083	6151.0638	0.3950
2	1	2	Peak1_6.49	0.000000	6.49	0.0000	2850.0000	400000.0000	0.4028
3	1	3	Peak2_7.12	0.000000	7.12	0.0000	1379.4000	200000.0000	0.4247
4	1	4	?	0.000000	10.49	0.0000	704.9000	100000.0000	0.3983

The integration report parameters are determined in the 490-GC PRO at the end of a chromatographic run and uploaded to PROstation.

The following properties are part of the integration report:

- **Index number**
  Line number.

- **Channel number**
  GC channel.

- **Peak number**
  Peak number in GC channel.

- **Peak name**
  Name of the peak as given in the Peak Identification/Calibration table.

- **ESTD Conc.**
  Calculated external standard concentration

- **Retention [s]**
  Retention time in seconds.

- **PeakRRT**
  Relative retention time calculated if reference peak has been identified in the peak table.
  RRTi = PEAKi_retention / PEAKref_retention

- **Area**
  Peak area in [x 10nV.s] units

- **Height**
  Peak height in [x10nV] units

- **Width [s]**
  Peak width at half height in seconds.

- **Sep.Code**
  Peak separation code identifying the baseline relative to the peak.
  This can be BB, BV, VB, VV in which B = baseline and V = value

- **Validation**
  Not used.

- **Pk Start [s]**
  Start time for the peak

- **Pk End [s]**
  End time for the peak

- **Asym 5%**

Peak asymmetry factor at a height of 5%

- **Used RF**
  Response factor used to calculate the external standard concentration.
  This parameter is only reported in a single level calibration

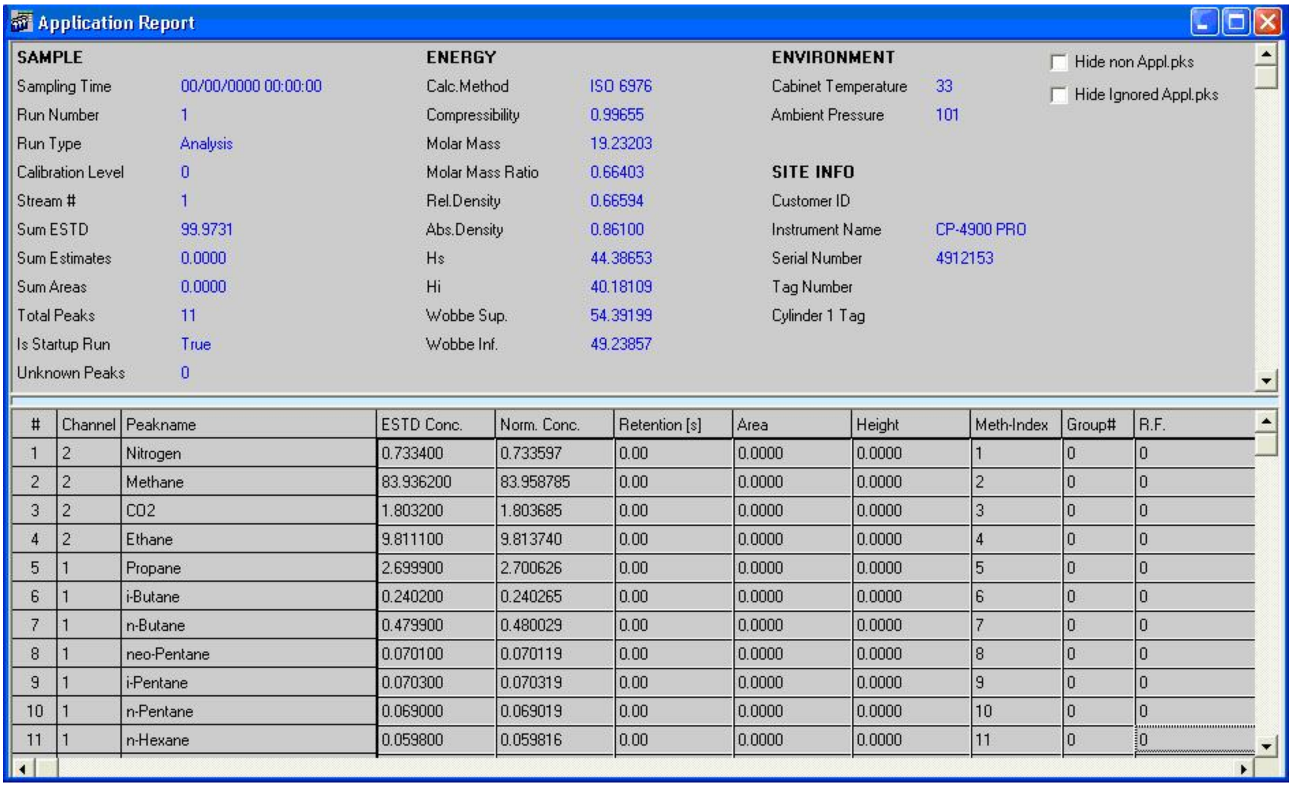
- **Rw**
  Factor calculated from measured concentration of calibration sample devided by given calibration of level 8 value from the Peak Identifciation/Calibration table.
  Response factor used to calculate the external standard concentration.
  This parameter is only reported in a multi level calibration performing a calibration of level 8.

- **Init RF Alarm**
  A calibration failure based on a too large difference of the new response factor compared to the initial response factor. This parameter is only reported for a calibration run in a single level calibration.

- **Current RF Alarm**
  A calibration failure based on a too large difference of the new response factor compared to the current response factor. This parameter is only reported for a calibration run in a single level calibration.

- **Rw Alarm**
  Response factor used to calculate the external standard concentration.
  This parameter is only reported in a multi level calibration performing a level 8 calibration.

24.10.2 Application Report



#	Channel	Peakname	ESTD Conc.	Norm. Conc.	Retention [s]	Area	Height	Meth-Index	Group#	R.F.
1	2	Nitrogen	0.733400	0.733597	0.00	0.0000	0.0000	1	0	0
2	2	Methane	83.936200	83.958785	0.00	0.0000	0.0000	2	0	0
3	2	CO2	1.803200	1.803685	0.00	0.0000	0.0000	3	0	0
4	2	Ethane	9.811100	9.813740	0.00	0.0000	0.0000	4	0	0
5	1	Propane	2.699900	2.700626	0.00	0.0000	0.0000	5	0	0
6	1	i-Butane	0.240200	0.240265	0.00	0.0000	0.0000	6	0	0
7	1	n-Butane	0.479900	0.480029	0.00	0.0000	0.0000	7	0	0
8	1	neo-Pentane	0.070100	0.070119	0.00	0.0000	0.0000	8	0	0
9	1	i-Pentane	0.070300	0.070319	0.00	0.0000	0.0000	9	0	0
10	1	n-Pentane	0.069000	0.069019	0.00	0.0000	0.0000	10	0	0
11	1	n-Hexane	0.059800	0.059816	0.00	0.0000	0.0000	11	0	0

The application report parameters are determined in the 490-GC PRO at the end of a chromatographic run and uploaded to PROstation.
The application report contains the results from all, instrument wide, application-related calculations, e.g. normalization, possibly in combination with calorific power calculation. The above example shows the report after instrument wide normalization.
Components are identified on their name as they were reported in the Integration Report. Find more information in chapter Normalization on page 165.

SAMPLE

- **Sampling time**
  The time the sample was injected according the 490-GC PRO internal clock

- **Analysis #**
  Run ID number, increases every analysis with 1. This number resets at reboot of the instrument.

- **Run type**
  Indication of the run type: analysis, calibration, verification or blank run.

- **Calibration level**
  identifies the calibration level (range 1-8) of a calibration run. For a non calibration 0 is reported.

- **Sum ESTD**
  Sum of external standard concentrations for all components listed in the normalization table excluding components marked as 'Estimate'.

- **Sum Estimates**
  Sum of all component concentrations defined in the normalization table as 'Estimate'.
  These should be the components not identified in the chromatographic analysis.

- **Sum Area**
  Sum of area of all peaks in all channels detected.

- **Total Peaks**
  Total identified peaks in all GC channels.

- **Is Startup Run**
  Identifies if the current run is the first run after an instrument reboot (power up).

- **Unknown peaks**
  Number of unidentified peaks in all GC channels.

- **Current stream #**
  The current stream number at the moment the reported is generated in the 490-GC PRO.

- **Alarms**
  All alarmings as defined in the Alarming window under the Application menu are reported here on alarm index if an alarm occurs.

<u>ENERGY</u>

All parameters related to calculating calorific value of a gas mixture are reported in this section. Depending o the energy method selection (ISO, GPA, ASTM, GPA) the report will be slightly different.

<u>ENVIRONMENT</u>

- **Sampling Analog #**
  These are the converted analog input values as defined in the Analog Input window under the Application menu. During the sampling state part of a chromatographic run, analog input signals are measured, converted to real units and stored in the 490-GC PRO.

- **Cabinet temperature**
  Internal analyzer temperature, measured by a temperature sensor on the mainboard.

- **Ambient Pressure**
  Internal analyzer ambient pressure, measured by a pressure sensor on the mainboard.

<u>SITE INFO</u>

This data was defined in the Site Info window found under the Automation menu.

<u>COMPONENTS LIST</u>

The component list contains the peaks as defined in the Normalization window found under the Application menu. It contains the following parameters:

- **#**
  Index number

- **Channel**
  The GC channel peak was identified.

- **Peak name**
  The name of the peak as defined in the Normalization table found under the Application menu.

- **ESTD Conc**
  The external standard concentration of the peak found in the integration report.

- **Norm Conc**
  Calculated concentration after normalization following the normalization table. Normalization is performed to (100% – SumEstimate) percentage.

- **Retention[s]**
  The retention of the peak found in the integration report.

- **Area**
  The area of the peak found in the integration report.

- **Height**
  The height of the peak found in the integration report.

- **Meth Index**
  Peak index number as the peak is defined in the Normalization table.

- **Group #**
  This peak is part of a group as defined in the Normalization table.

- **RF**
  Response factor used to calculate external standard concentration. This parameter is only reported in a single level calibration.

- **Rw**
  The Rw factor used to calculate external standard concentration from the corrected curve.
  This parameter is only reported for a multilevel calibration with field calibration correction.

Depending on the extent of the application as well as the configured stream selection, specific information becomes available.

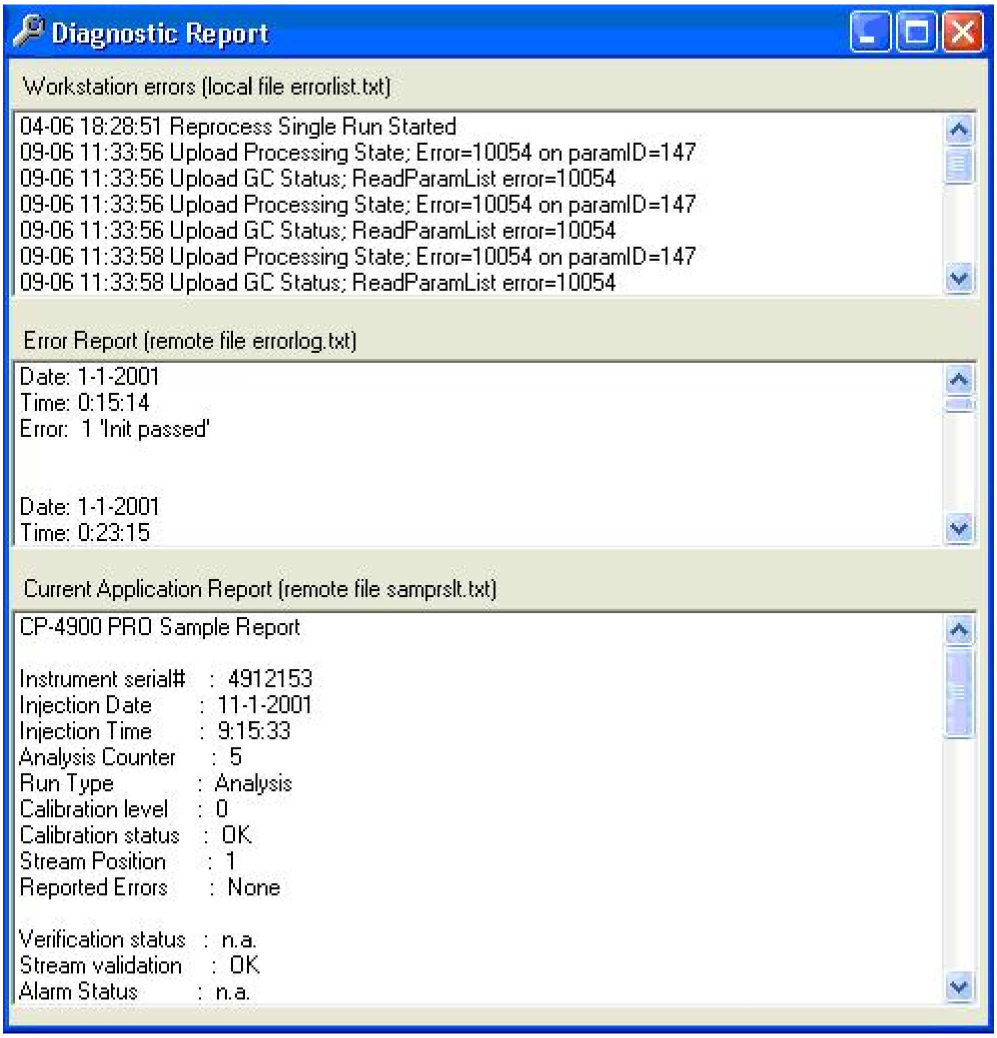
The application report is updated after every run.

24.10.3 Stream Application Report

The stream application report is an equivalent of the application report. It basically contains concentration results and, if selected, energy meter results and limited sample information. The stream application report however, is updated after that particular stream has been run again. The specific stream information is available while other streams are being analyzed.

24.10.4 Diagnostics

The diagnostic report becomes available after uploading via Control\Upload diagnostics. The information is brought on screen after Report\Diagnostics is selected from the PROstation toolbar:



Three different diagnostic reports are available:

- **Workstation errors**
  (errorlist.txt on PROstation computer)
  Information about uploads from the instrument and downloads to the instrument; any communication that has taken place. The file is cleared after a start (run, sequence, recalculation) has been sent to the 490-GC PRO.

- **Internal instrument errors**
  (errorlog.txt on instrument flash memory)
  This file contains all class 1 and higher errors that have occurred. Also the firmware updates are recorded.
  More extended error information is provided in the Error handling section on page 344.
  The file can be cleared after a remote request: from the PROstation toolbar select Control/Clear Error Log File.

- **Current application report**
  (samprslt.txt on instrument flash)

The bottom field shows the last report as stored on flash. This is made available for diagnostics after a system crash.

24.10.5 Print integration/application report

After an upload of sample results, the integration report will be printed after selecting Report/Print Integration Report from the PROstation toolbar

After an upload of sample results, the application report will be printed after selecting Report/Print Application Report from the PROstation toolbar

24.10.6 Auto print application report after Calibration or Alarm

Obviously, this only works properly if PROstation is continuously connected.

Select Report/Auto Print Application Report after Calibration from the PROstation toolbar if the application report needs to be printed after every calibration.

Select Report/Auto Print Application Report after Alarm from the PROstation toolbar if the application report needs to be printed after every calibration.

25 PROstation Quick Start

The 490-GC PRO system comes pre installed with PRO licenses. To prepare the instrument for online analysis, it first needs to be configured by PROstation tool.

25.1 "Log in" Procedure PROstation.

Open PROstation and follow the "Log in" procedure, see Figure 14.
- Log on with User Name: "admin" and Password: "demo".
- When Password is entered, the user is now able to change the Password by using the "Change" button.

Figure 14: PROstation tool login screen

25.2 Change Password.

Click on the "Change button" the following screen will appear as shown in Figure 15.

There are two options:
- "No Password" option: enabling this option gives the user the ability to log in to PROstation without password.
- Edit a new password in the Password field (admin/<u>new password</u>?)
- Click on the "OK" button. Now PROstation will return to the main login window, see Figure 14.
- Password should be changed successfully.
- Press "OK" button in this window; now the user is logged in to PROstation.

- To verify that Password is changed successfully, close and reopen PROstation.

- Now the user must log in with new Password or press "OK" button when "No Password" option is enabled. PROstation opens with the main screen as shown in Figure 16.

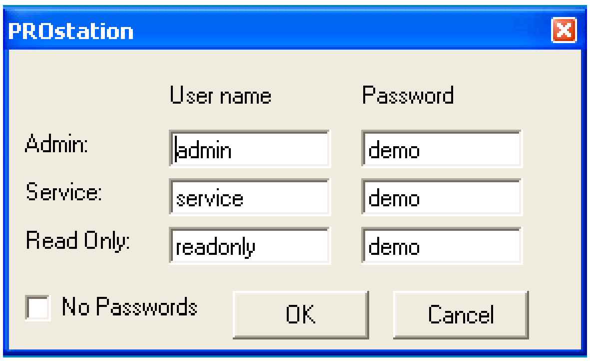


Figure 15: Change Password window

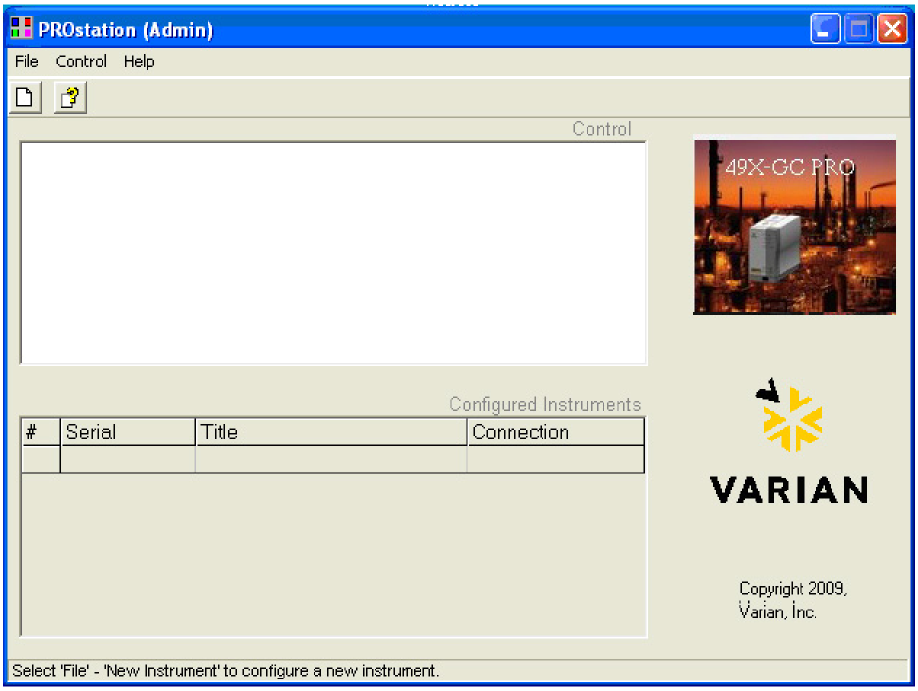


Figure 16: Main window PROstation

25.3 System configuration

To configure the instrument create a new instrument in PROstation.

- Select: File\New Instrument Ctrl+N", see Figure 17.
- Now a "Configure Instrument" window will appear, see Figure 18.
- Instrument Serial number is not identified yet.

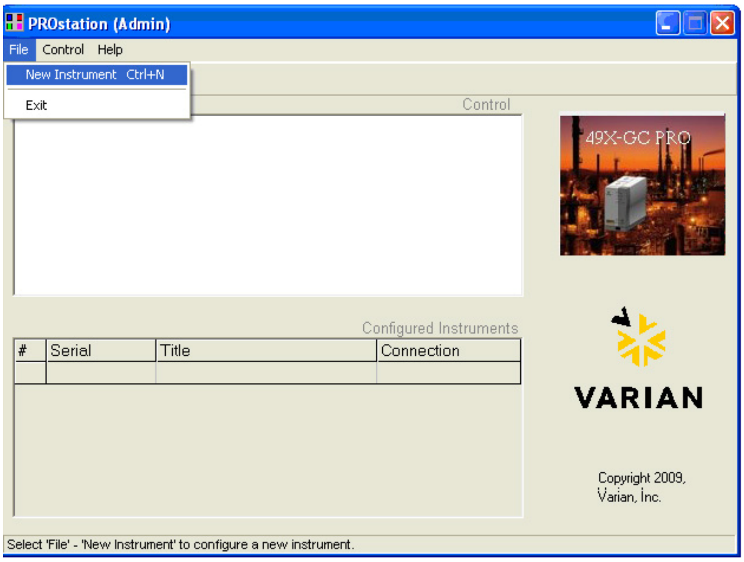


Figure 17: Create 'New instrument' screen

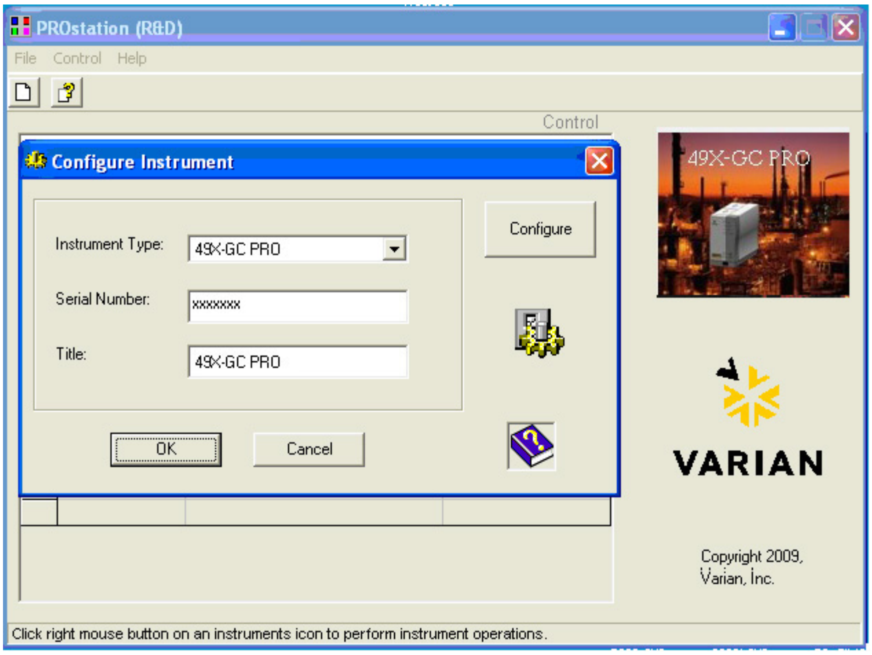


Figure 18: Configuration Instrument window

- Click on the “Configure” button. Now the 490-GC PRO configuration window appears displaying the configuration settings of the instrument.

At this point the default settings of PROstation are displayed. Those are not the settings of the instrument yet.

The following configuration parameters are set when the instrument has not been configured yet:

- Figure 19
- User tab, see Figure 20
- PROstation tab, see Figure 21
- Automation tab, see Figure 22
- Info tab, see Figure 23.

For detailed information, see chapter Instrument Configuration on page 76

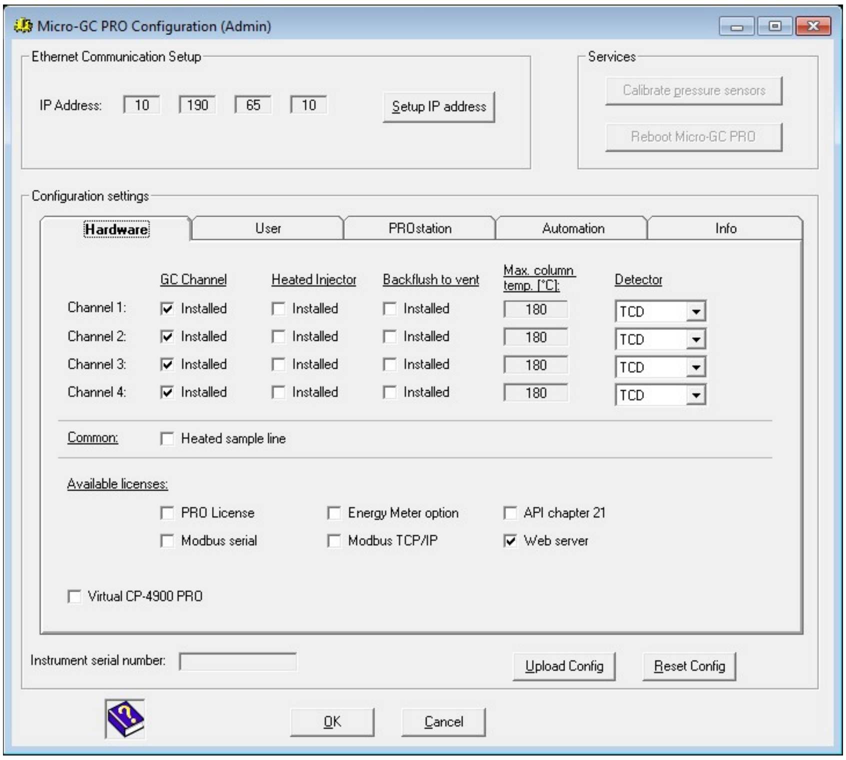


Figure 19: Hardware tab with default settings.

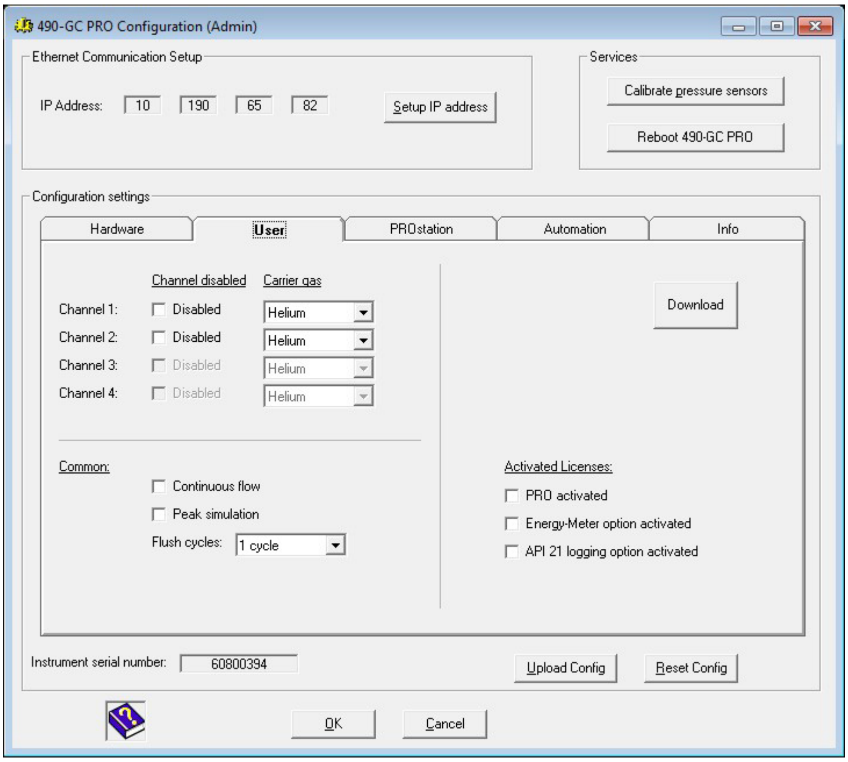


Figure 20: User tab with default settings

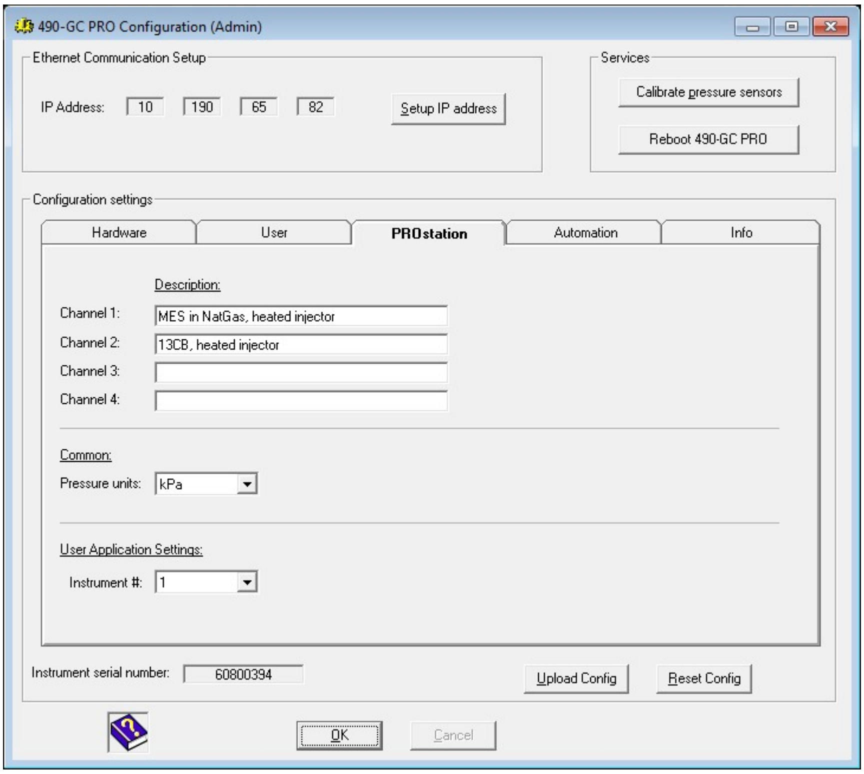


Figure 21: PROstation tab with default settings

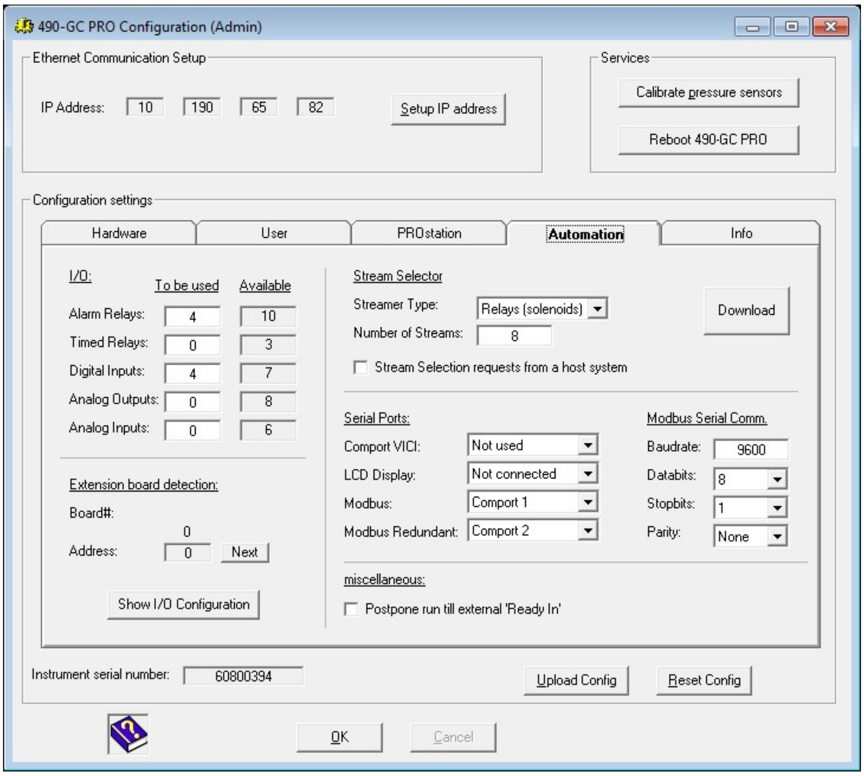


Figure 22: Automation tab with default settings

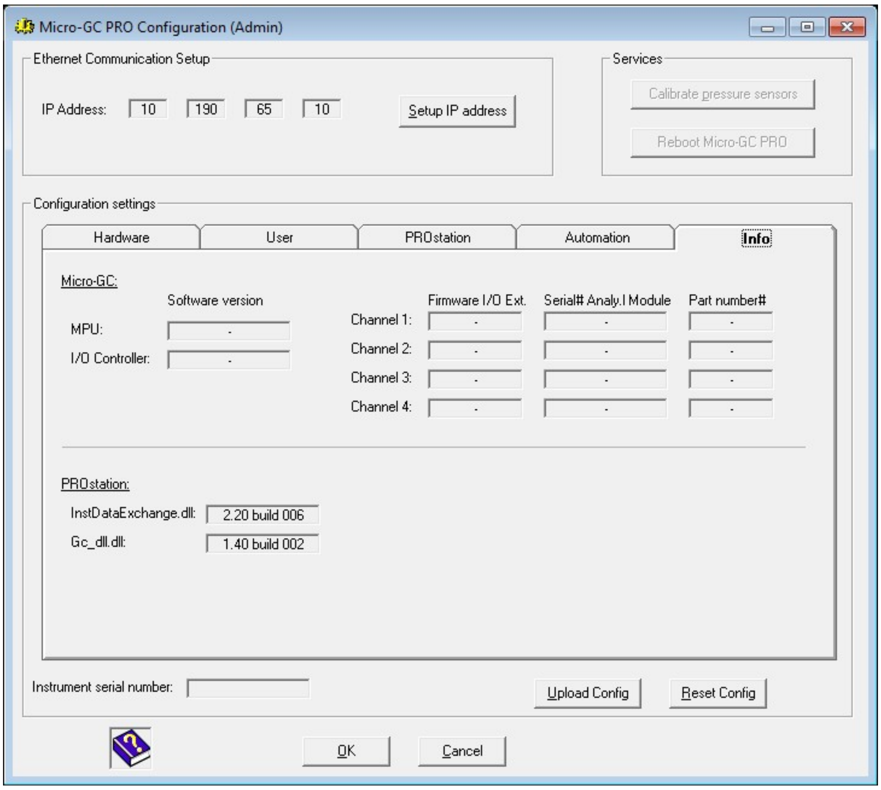


Figure 23: Info tab with default settings

25.3.1 Assigning IP address to the instrument

For assigning an IP address to the instrument, follow the procedure as described in chapter Assign new IP address via Ethernet Connection on page 87.

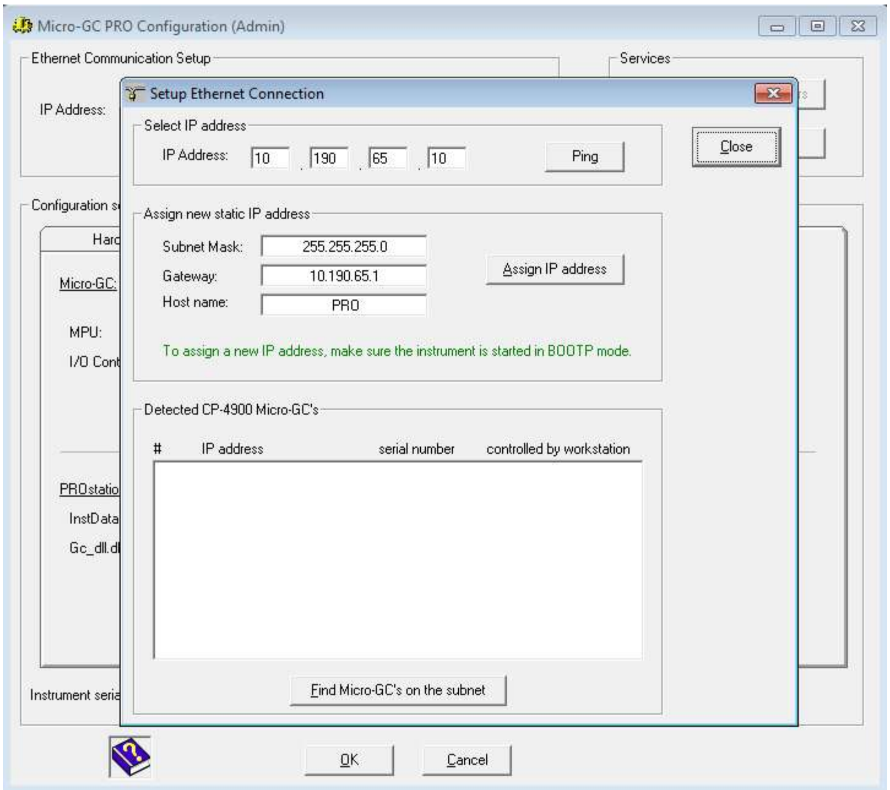


Figure 24: Set up Ethernet connection screen

25.3.2 Upload Instrument configuration

- After assigning an IP address to the instrument successfully, check/change the instrument configuration.
- Upload the instrument configuration. Click on “Upload Config” button.
- Instrument configuration is uploaded and is properly displayed in PROstation.
- The following tab should be displayed with instrument information:

25.3.3 Hardware tab

In the hardware configuration tab the hardware installed and available licenses are listed.

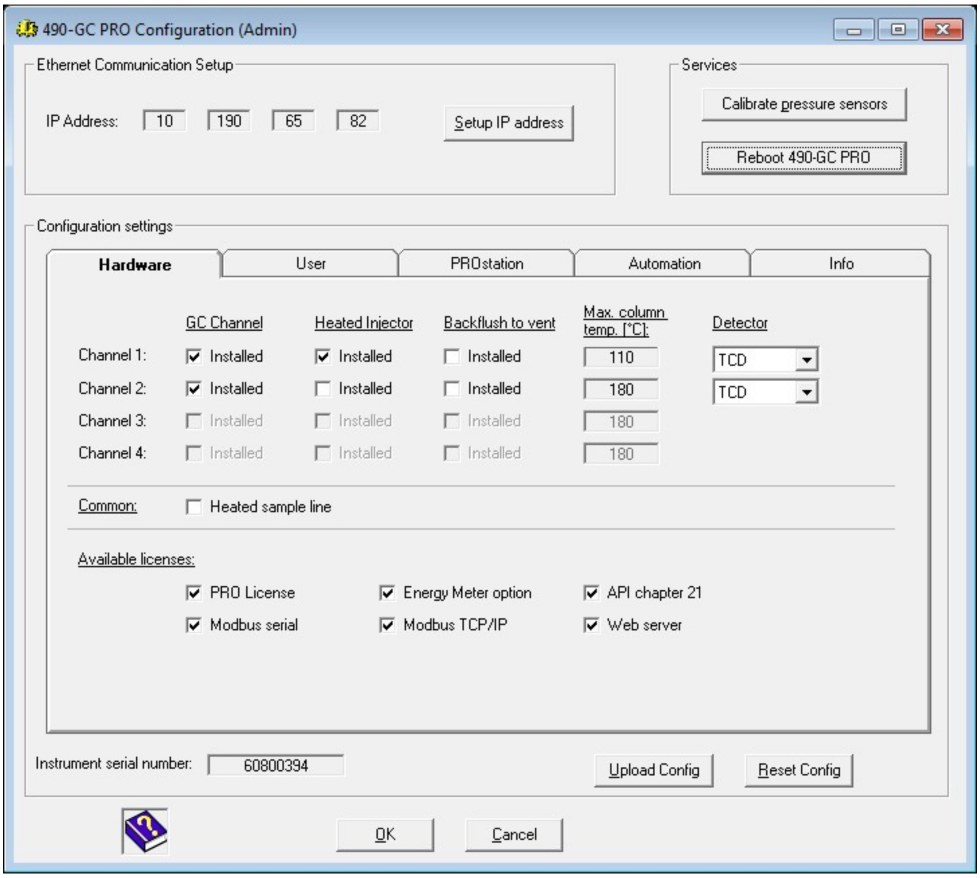


Figure 25: Hardware tab.

Find detailed information about licenses on page 89.

25.3.4 User tab

In the user tab, configuration parameters can be changed such as: carrier gas, flush cycle, channel enable/disable, license activation, etc.

Change any parameters if required. If one or more parameters are changed, press the “Download” button.

When a reboot is required, a pop-up window will appear requesting the user to reboot the instrument. Press the “Reboot 490-GC PRO” button to adapt configuration changes.

Find detailed information about User tab on chapter User Settings tab on page 91

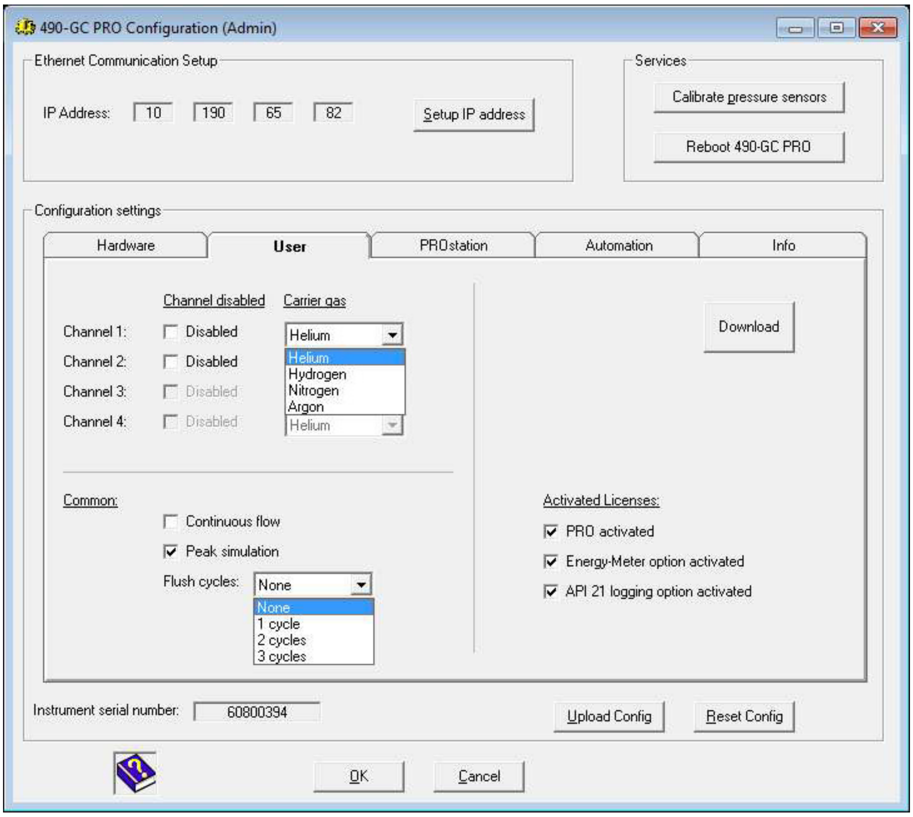


Figure 26: User tab

Pop up window: Reboot your instrument. In this example system carrier gas type is changed from He to N2, see. chapter User Settings tab on page 91

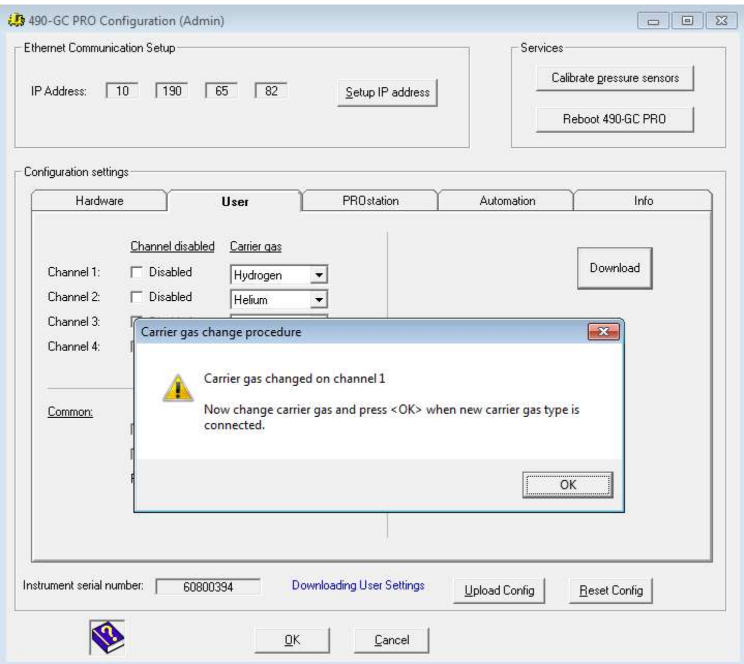


Figure 27: Pop up window changing carrier gas.

25.3.5 PROstation tab

PROstation tab contains information about the installed columns, see also chapter PROstation tab on page 93.

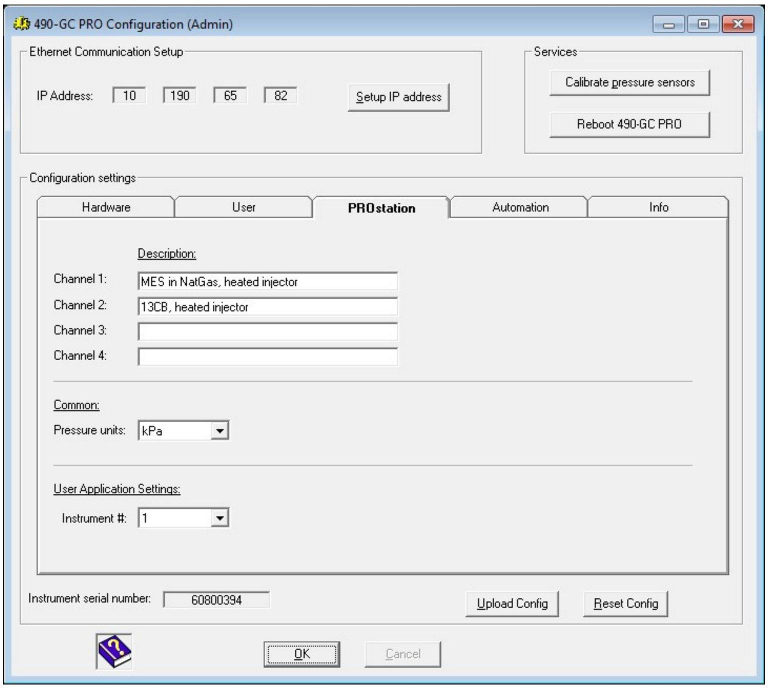


Figure 28: PROstation setting Instrument

25.3.6 Automation tab

The automation tab contains configuration settings about Input/output signals, stream selector, extension board detections and serial ports.
When a parameter is changed by the operator, activate this by pressing the 'Download' button. Find detailed information about the Automation tab on chapter Automation Tab on page 94

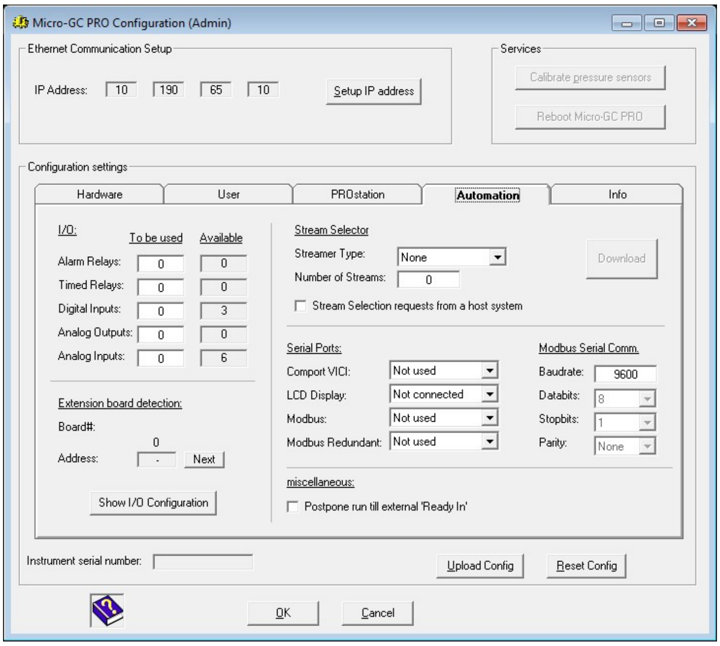


Figure 29: Automation tab

25.3.7 Info tab

The Info tab contains information about serial numbers and part numbers of installed channels, MPU version, I/O version and several software version numbers of PROstation components.
Find detailed information about the Info tab on chapter Info Tab on page 99.

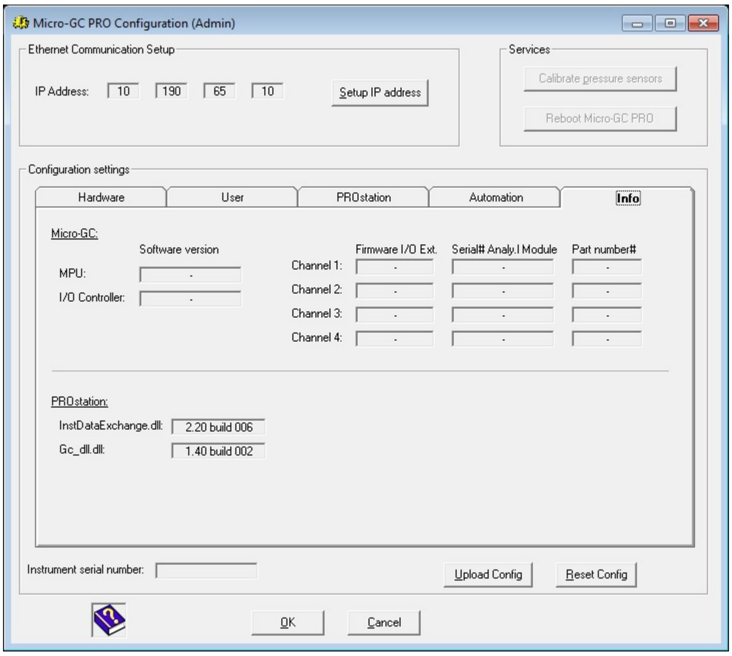


Figure 30: Info tab

25.3.8 Exit configuration

Exit configuration screen by clicking on the “OK” button. The instruments serial number is displayed in the ‘Configure Instrument’ screen.

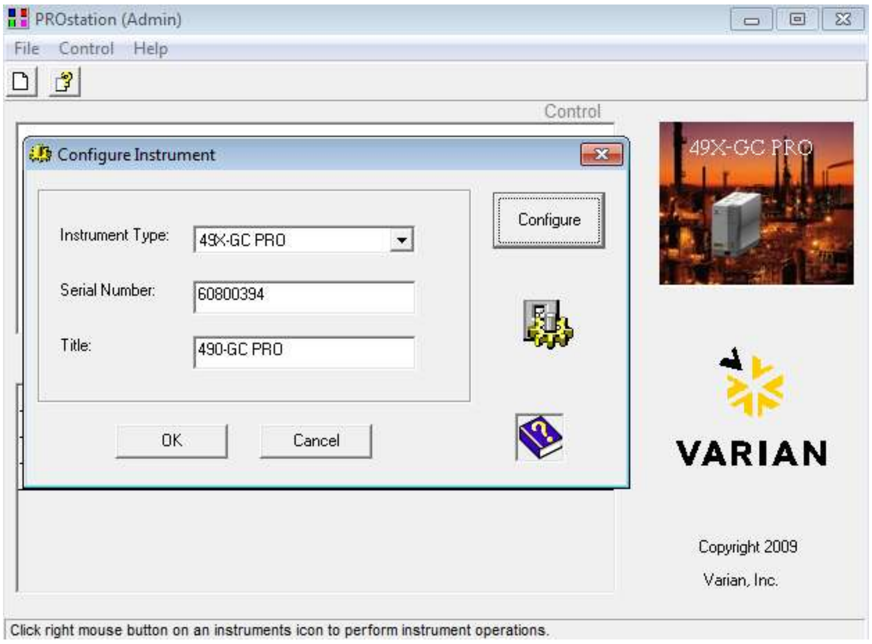


Figure 31: Exit system configuration

- Exit configuration page by pressing on the “OK” button see Figure 31.
- The created instrument now appears in the PROstation database and its serial number is shown, as well as IP address and busy status, see Figure 32.
- When instrument connection status is “Off”, this indicates that the instrument is not in use.
- When instrument is in use (the instrument is opened in PROstation) “Busy” is displayed, see Figure 32.

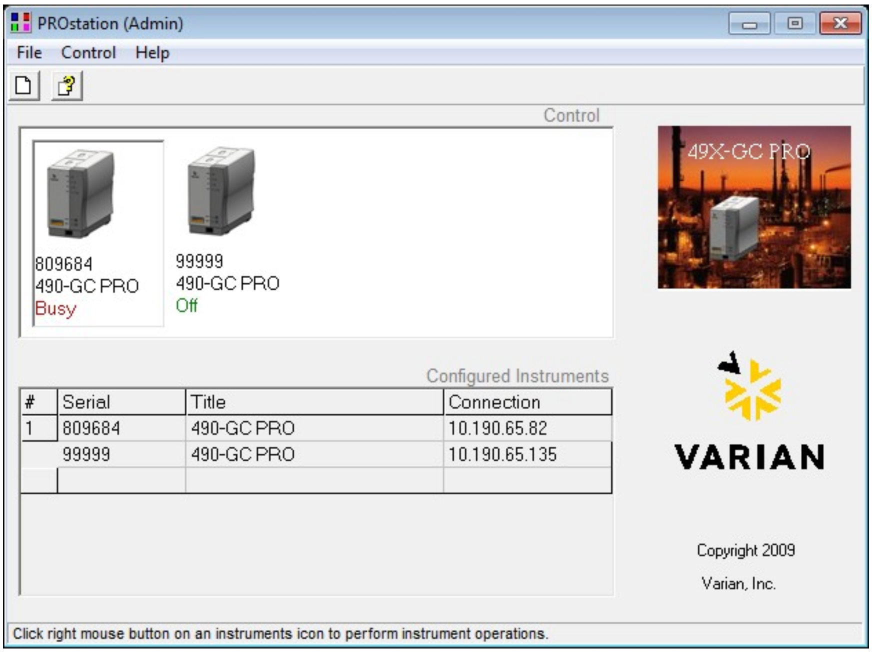


Figure 32: Instrument connected status

25.4 Instrument Method Setup

- Right click on the instruments to open the instruments dialog menu.
- Select the "Open" option for full Instrument control. This is required for method development and acceptance, see Figure 33. The 'Open' option can also be achieved by double left mouse clicking on the instruments icon.
- The operator is also able to remove the instrument from the PROstation database, 'Open as read only' in order to only view the ongoing analysis or to 'Open Off line' for off line method development or analysis results display.

Find detailed information about Instrument Setup on page 113

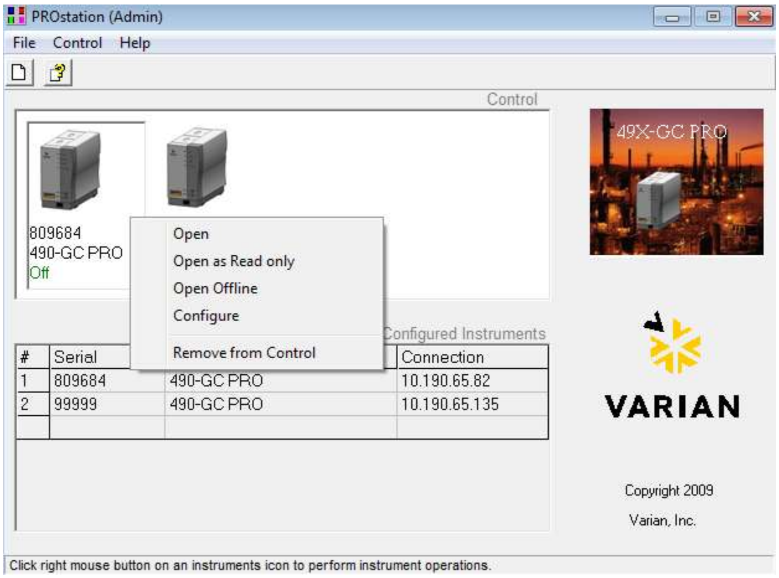


Figure 33: Open Instrument menu

25.4.1 Real Time Clock

Before creating a new method, set date and time of the 490-GC PRO's internal clock.
Find detailed information about setting the clock on chapter Automation – Real Time Clock on page 266.

25.4.2 Method Development

- For creating a new method, select: Method\Instrument Setup, see Figure 34.
- An Instrument setup screen will appear, displaying the installed channel(s) and a common tab, see Figure 35.

- Edit method parameters such as temperatures, injection time, pressure etc. for all installed GC channels, There are also several 'system-wide' parameters in the common tab.

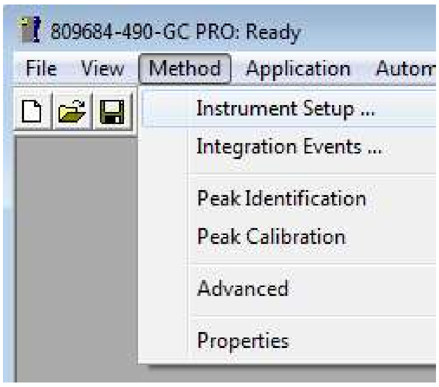


Figure 34: Method Instrument Setup.

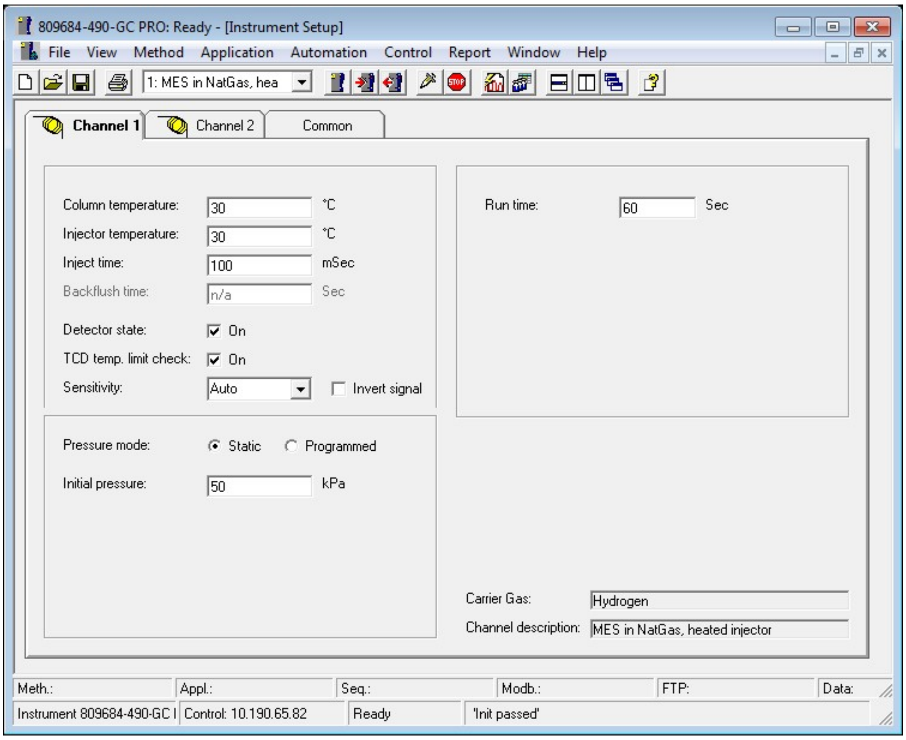


Figure 35: Instrument Setup window

Find detailed information about Instrument Setup on page 113

- Save method. Select: File\Method\Save as" edit method name, see Figure 36.
- Download the method to the instrument. Select: Control\Download, see Figure 37. Now a download window will appear with several download options, see Figure 38.
- Select 'Method' in the "Download to 490-GC PRO" screen. Press "OK", see Figure 38

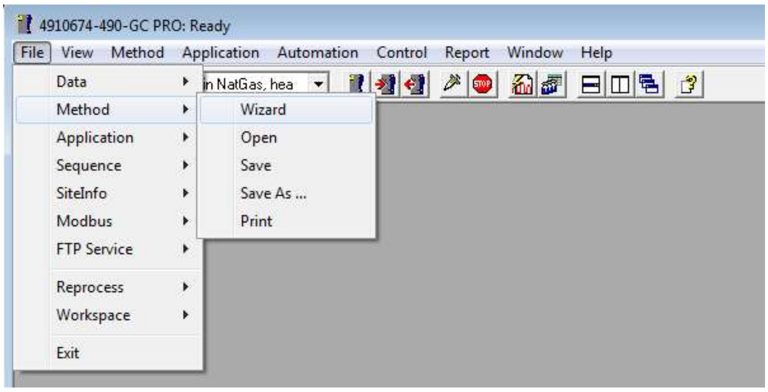


Figure 36: Save method

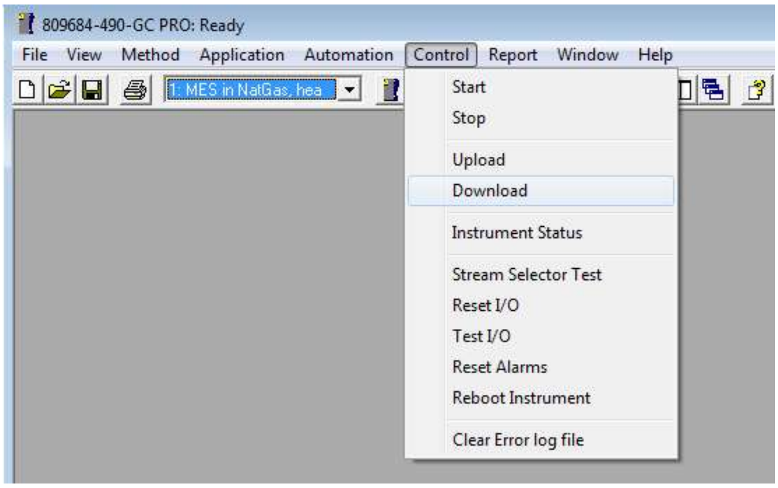


Figure 37: Download method menu

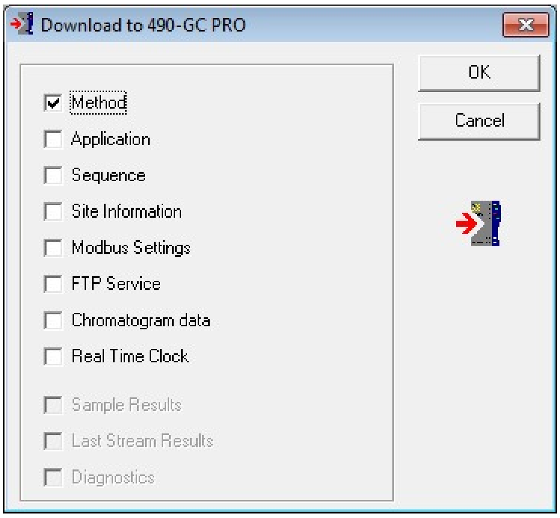


Figure 38: Download to 490-GC PRO window

25.4.2.1 Peak Integration

For method optimization a calibration standard (sample) is required with known concentrations (calibration levels). Concentrations of the components from the calibration gas can be found on the label of the mixture. Make sure a calibration sample is connected to the instrument in order to perform an analysis.

Make an analysis of the calibration sample level 1 (bottle 1).
- Start a single run. Select: Control\start, see Figure 39. A “Start” dialog screen will appear on the screen, see Figure 40.
- Select “Analysis” for Sample Type, see Figure 40.
- Select ‘Stream’ number if a stream selector is configured.
- Press the “Single Run” icon. The run will start and a chromatogram will be displayed during the chromatographic run. It is recommended to have all components of the calibration sample baseline separated in order to have optimum results. In practice this often can’t be achieved.
- Fine tune instrument parameters such as column temperature, injector temperature or pressure followed by a new single run □ntil satisfied peak separation is achieved.
- After a single run is finished an integration report is automatically uploaded by PROstation.
- Check whether the peak integration is also usable for the sample to measure. This requires connecting to sample gas and performing a single run.

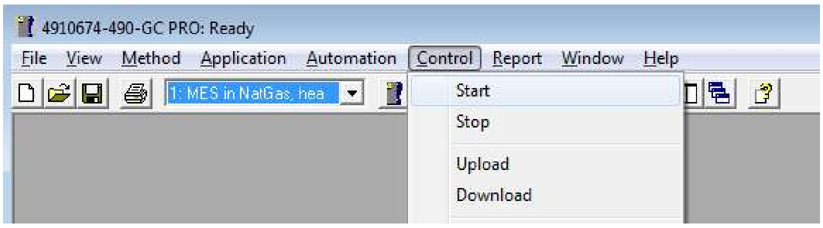


Figure 39: Control menu with Start option

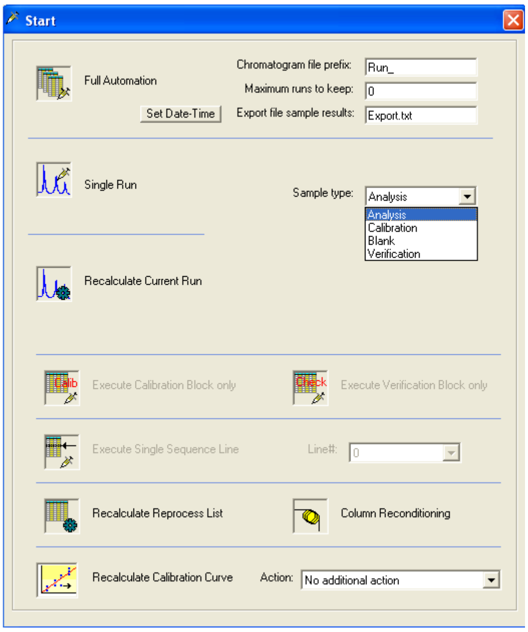


Figure 40: Start screen

25.4.2.1.1 Integration Events

Fine tune peak integration. Select Method\Integration, Figure 41. Define the integration parameters for each individual GC channel in order to integrate every peak correctly, see Figure 42.

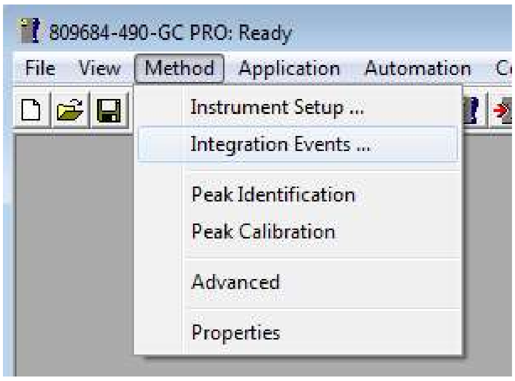


Figure 41: Access to Integration events

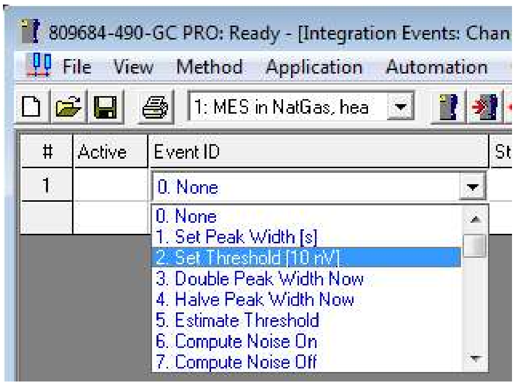


Figure 42: Integration events

- Repeat saving and downloading method (see Figure 36, Figure 37, Figure 38) containing the integration events and reprocess current analysis (select Reprocess icon in Start window, see Figure 40) until peak integration is acceptable.
- Repeat this procedure for all other channels.

Find detailed information about Integration Events on page 119

25.4.2.2 Identification of Peaks

To identify peaks from the chromatogram, select the ‘Method Wizard’ from the ‘File’ menu.

- Select: File\Method\Wizard, see Figure 43.
- The method wizard table is filled with necessary default settings for available GC channels. Select the “OK” button without any parameters changed. See Figure 44.

Note: Make sure peak separation is completed before starting the Method Wizard!

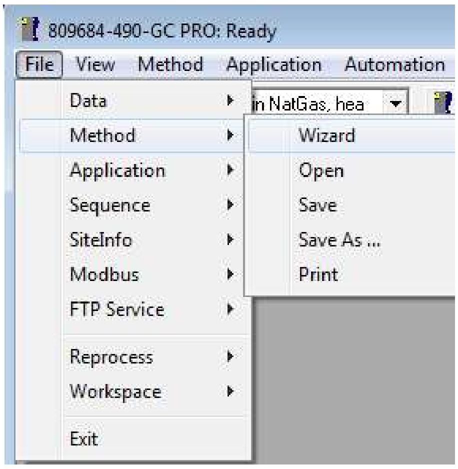


Figure 43: Open Method Wizard menu

Figure 44: Method Wizard containing default settings.

- Open the Peak Identification/Calibration table. Select: Method\Peak Identification, see Figure 45.
- Replace retention time based peaknames with the component names from the calibration mixture for all installed channels, see Figure 46.
- Adjust all other parameters from the Peak Identification/Calibration table e.g. Rel. Ret window, abs. Ret window, levels etc. see Figure 46.
- Save and download the method, see Figure 36, Figure 37, Figure 38.
- Reprocess chromatogram. Select: Control\start\Recalculate current data, see Figure 40.
- View the Integration Report which was automatically uploaded to PROstation at the end of a reprocess action, select Report/Integration report.
- Verify the content of the Integration Report. Repeat from step “Adjust all other parameters …” if parameters of the Peak Identification/Calibration table require some modification.

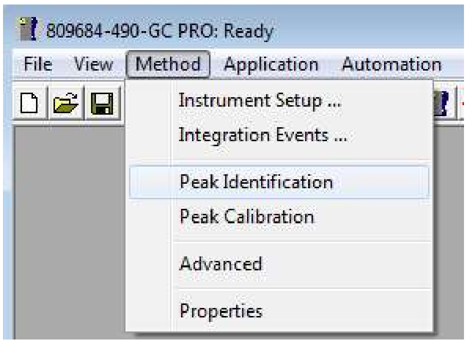


Figure 45: Open Peak Identification table.

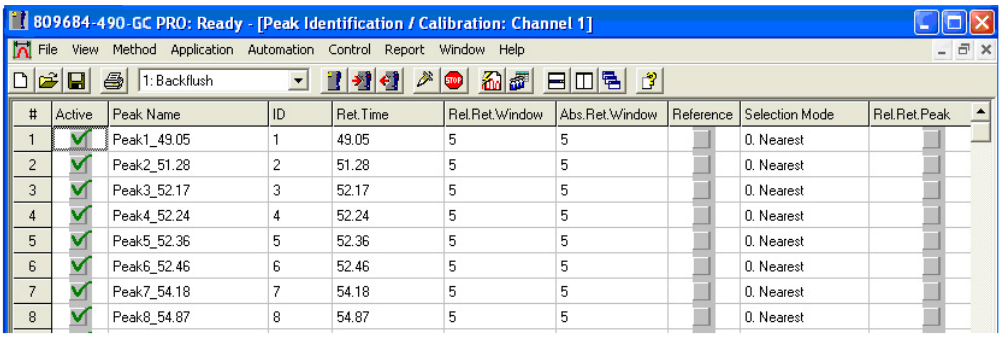


Figure 46: Peak Identification table containing retention time based peak names.

Find detailed information about Peak Identification on page 134

25.4.2.3 Calibration

How to setup a calibration?

25.4.2.3.1 General Calibration Settings

Make sure calibration gas is connected!

To setup a calibration, select: Method\Peak calibration, see Figure 47.
A calibration screen appears displaying several calibration parameters, see Figure 48.
Define the parameters for calibration such as: Response Mode, Calibration Mode, RF type, Total Calibration Levels, etc., see Figure 49.

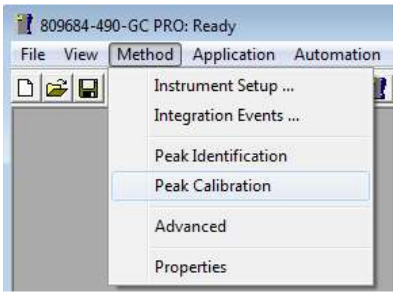


Figure 47: Open Peak Calibration

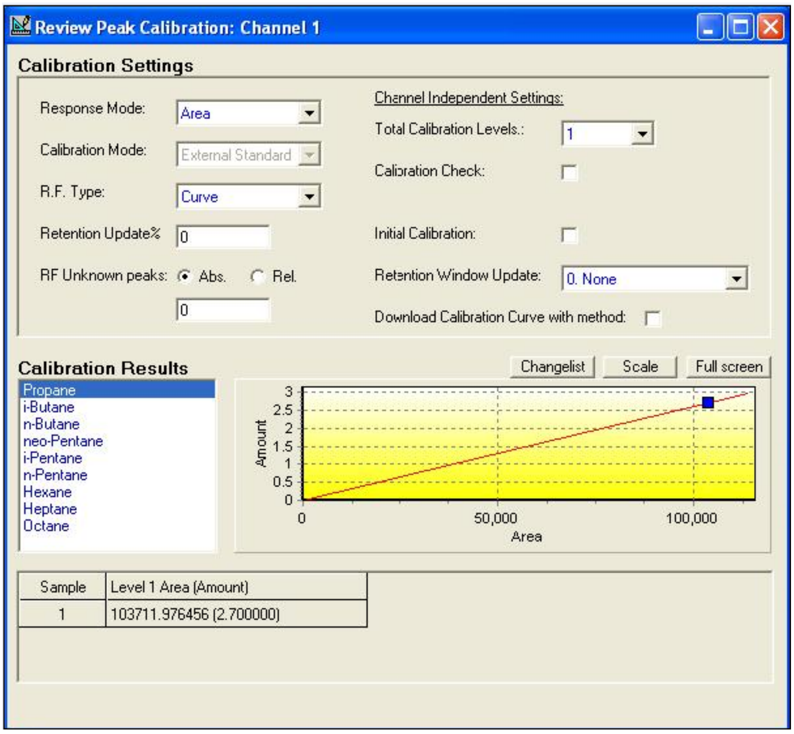


Figure 48: Review Peak Calibration window.

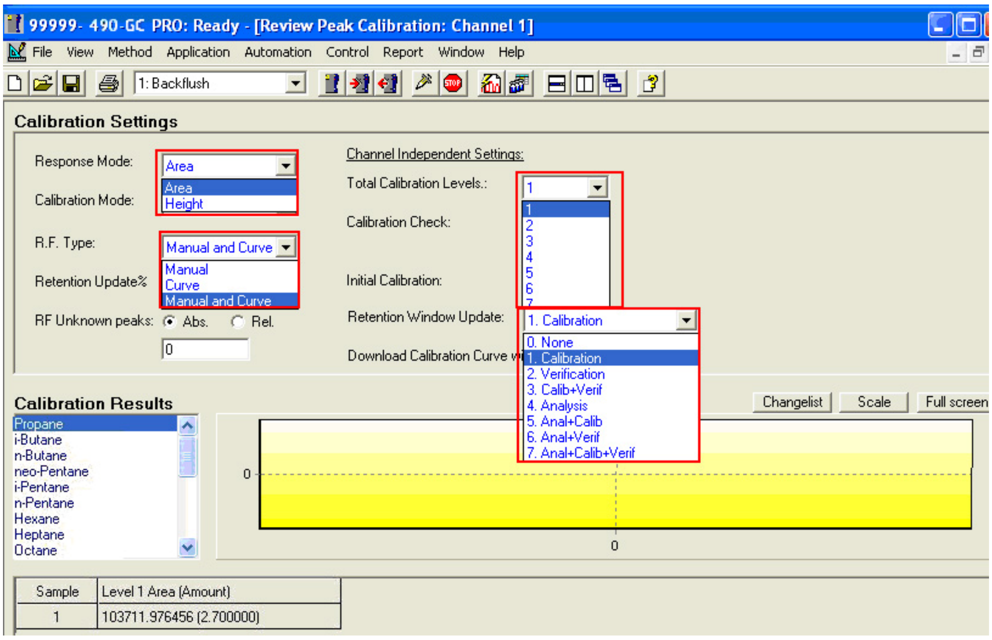


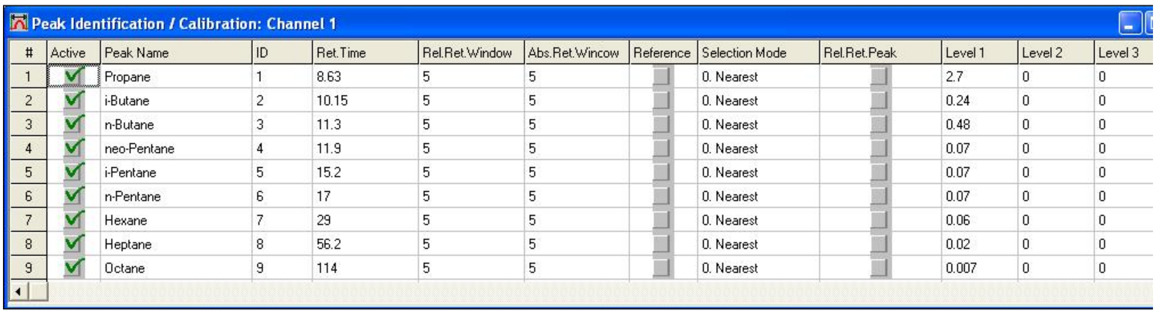
Figure 49: Calibration parameters.

Find detailed information about Quantification/Calibration on page 144 and Calibration on page 321.

25.4.2.3.2 Calibration Settings per Peak

Select the Peak Identification/Calibration window in order to set the levels (amounts) of the calibration mixture.

- Open peak Identification/Calibration table, select method\Peak ID table, Figure 45.
- Enter levels 1 to 7, see Figure 50.
- Levels (concentration of a component) can be found on the label of the gas bottle. Level 1 means calibration bottle number 1. Level 1 should the calibration mixture containing the lowest component concentrations.
- Select curve type: Linear, Quadratic or Cubic.
- Select “Thru origin” if applicable e.g. level 1.


Peak Identification / Calibration: Channel 1

#	Active	Peak Name	ID	Ret.Time	Rel.Ret.Window	Abs.Ret.Wincow	Reference	Selection Mode	Rel.Ret.Peak	Level 1	Level 2	Level 3
1	✓	Propane	1	8.63	5	5		0. Nearest		2.7	0	0
2	✓	i-Butane	2	10.15	5	5		0. Nearest		0.24	0	0
3	✓	n-Butane	3	11.3	5	5		0. Nearest		0.48	0	0
4	✓	neo-Pentane	4	11.9	5	5		0. Nearest		0.07	0	0
5	✓	i-Pentane	5	15.2	5	5		0. Nearest		0.07	0	0
6	✓	n-Pentane	6	17	5	5		0. Nearest		0.07	0	0
7	✓	Hexane	7	29	5	5		0. Nearest		0.06	0	0
8	✓	Heptane	8	56.2	5	5		0. Nearest		0.02	0	0
9	✓	Octane	9	114	5	5		0. Nearest		0.007	0	0

Figure 50: Peak Identification table containing levels, curve type selection

- Save and download the method, see Figure 36, Figure 37, Figure 38.
- Perform a calibration run. Select Control\start, see Figure 39.
- In the “start' dialog screen select Sample type “Calibration”, 'Level' is set to '1', Type' is set to 'Replace', see Figure 51.
- Select 'Single run'.

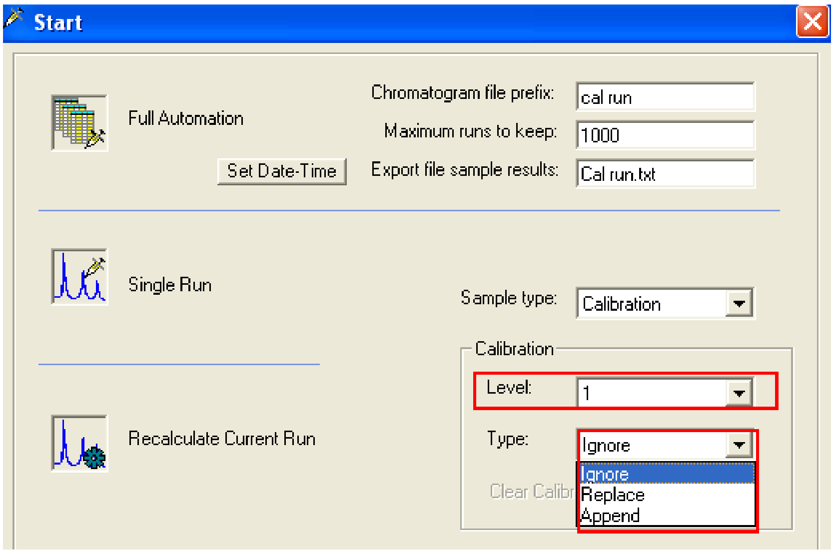


Figure 51: “Start dialog screen (Sample Type, calibration Level and Type)

- After the run is completed, the method containing the updated calibration curve (Calibration window) and calibration curve coefficients (Peak Identification/Calibration table) will be uploaded automatically, see Figure 52 and Figure 53.

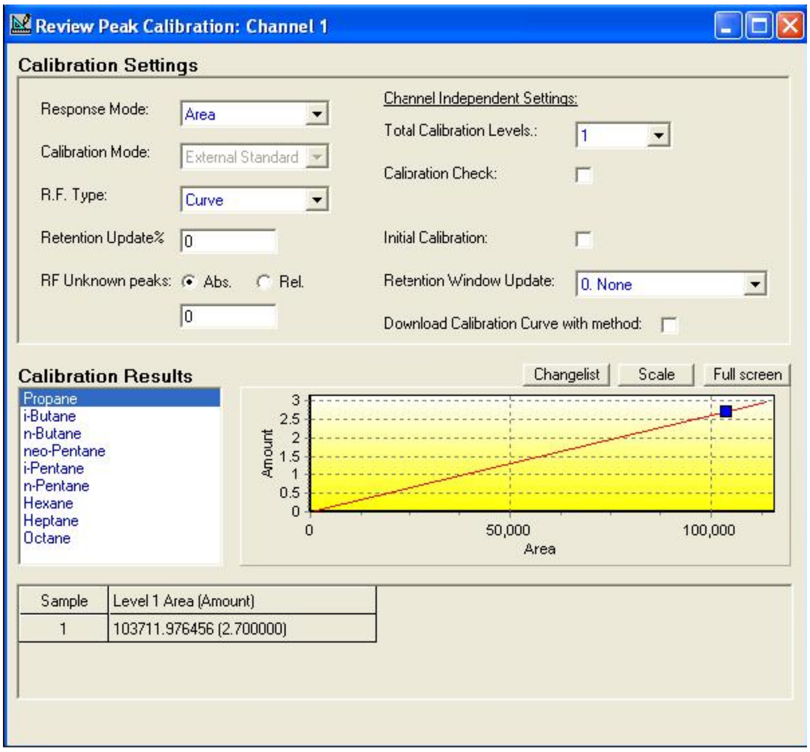


Figure 52: Peak Calibration window containing the calibration curve for the selected peak.

Peak Identification / Calibration: Channel 1

#	Curve Type	Thru origin	RF other peak	Rel. R.F.	Intercept coeff.	Linear coeff.	Quadratic coeff.	Cubic coeff.
1	0. Linear	✓	0	0	0	2.60336375052103E-05	0	0
2	0. Linear	✓	0	0	0	2.16789573657729E-05	0	0
3	0. Linear	✓	0	0	0	1.95912042028336E-05	0	0
4	0. Linear	✓	0	0	0	0	0	0
5	0. Linear	✓	0	0	0	1.94752888461485E-05	0	0
6	0. Linear	✓	0	0	0	1.91011729955003E-05	0	0
7	0. Linear	✓	0	0	0	1.62411695273832E-05	0	0
8	0. Linear	✓	0	0	0	1.37844728034724E-05	0	0
9	0. Linear	✓	0	0	0	1.15885714677186E-05	0	0

Figure 53: Peak Identification/Calibration table containing "Linear coefficient" Values.

- Connect calibration gas and perform an Analysis treating the calibration gas as normal sample. Select: Control start\single run (Run type = Analysis).
- When the run is completed the integration report is uploaded containing the analysis results of the calibration gas, see Figure 54.
- Check the ESTD concentrations for every peak in the Integration Report. These should be very close to the concentrations as typed under level 1 in the Peak identification/Calibration table. This must be approved to accept the method for instrument operation.

Integration Report

#	Channel	Peak #	Peakname	ESTD Conc.	Retention [s]	PeakRRT [s]	Area	Height	Width[s]
1	1	1	Propane	2.700000	8.49	0.0000	103711.9765	16887573.0580	0.3595
2	1	2	i-Butane	0.240000	10.03	0.0000	11070.6431	1581615.4945	0.4008
3	1	3	n-Butane	0.480000	11.18	0.0000	24500.7910	2960519.9932	0.4155
4	1	4	i-Pentane	0.070000	15.08	0.0000	3594.2984	357932.0341	0.5671
5	1	5	n-Pentane	0.070000	16.92	0.0000	3664.6964	366238.0485	0.5655
6	1	6	Hexane	0.060000	29.36	0.0000	3694.3152	240718.5036	0.8634
7	1	7	Heptane	0.020000	56.26	0.0000	1450.9079	58389.8226	1.3984
8	1	8	Octane	0.007000	114.12	0.0000	604.0434	14171.6596	2.3929
9	2	9	Nitrogen	19097.168268	7.13	0.0000	19097.1683	1596690.6080	0.6854
10	2	10	Methane	1432627.779449	8.87	0.0000	1432627.7794	67466412.6502	1.1869
11	2	11	CO2	44019.212737	21.91	0.0000	44019.2127	1073306.1149	2.3103
12	2	12	Ethane	259256.250695	35.10	0.0000	259256.2507	4089823.0960	3.5550

Figure 54: Example of integration report.

25.4.2.4 Method Advanced

In Method Advanced define the analysis parameters which should be exported to a tab separated text file (export file), for processing and diagnostics in MS Excel at a later stage.

- Select: Method\Advance, see Figure 55.
- Select "Export enabled" option. Define which parameters to export, Figure 56.
- Save method. A method download is not required since the export parameters exist only in PROstation.

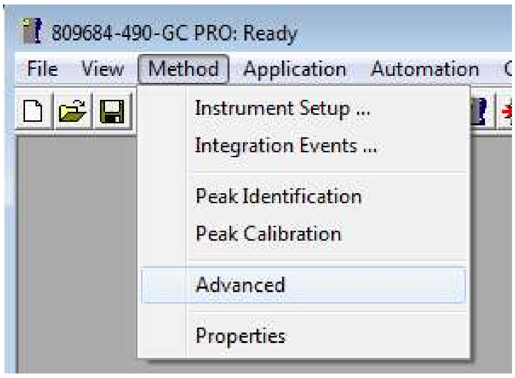


Figure 55: Open Method Advanced

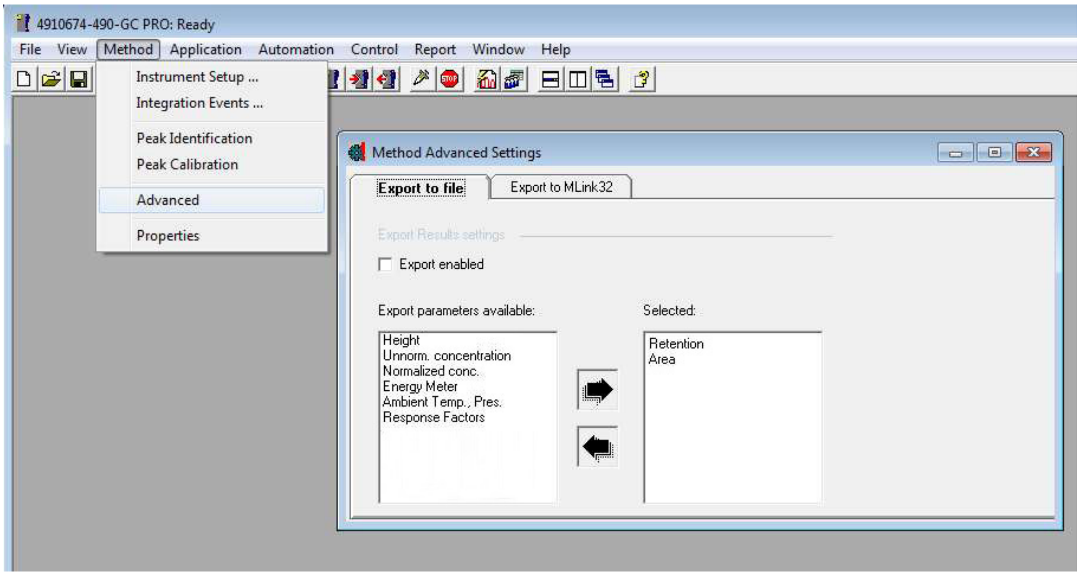


Figure 56: Method Advanced Export Results settings

25.4.2.5 *Method properties*

Activate method properties. Select: Method\Properties, see Figure 57. Select the type of calculations to perform at the end of a chromatographic run. If nothing is selected, no integration will be performed.

Note: “Application Calculation” should only benefit if Calorific value, IO’s or an LCD are defined.

Find detailed information about Method Properties on page 163.

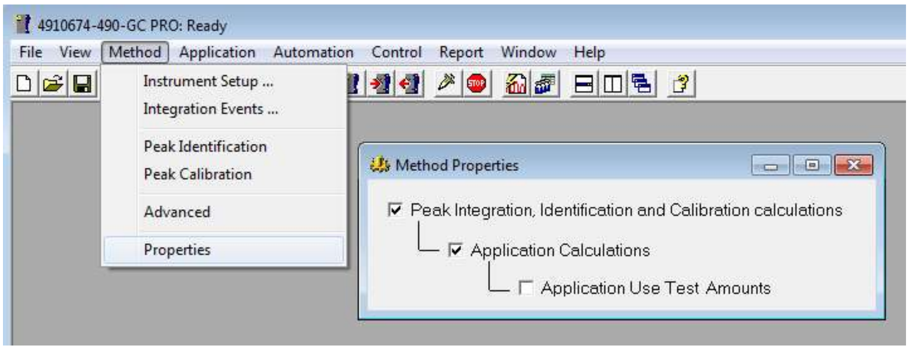


Figure 57: Method properties

25.4.3 Application Development

From the Application menu Normalization, Calorific Power, Analog and Digital Control can be defined. Note: an Application or Verification check is only required when Calorific values, IO's or an LCD screen are defined.

- Activate Application Wizard. Select: File\Application\Wizard, see Figure 58.
- Select from the Application window, select option "Generate Normalization table from Method-Peak table", see Figure 59.
- Select the options required for later instrument operation and press "OK" button.
- Save Application, see Figure 58 (Save as option). Edit a proper application file name.

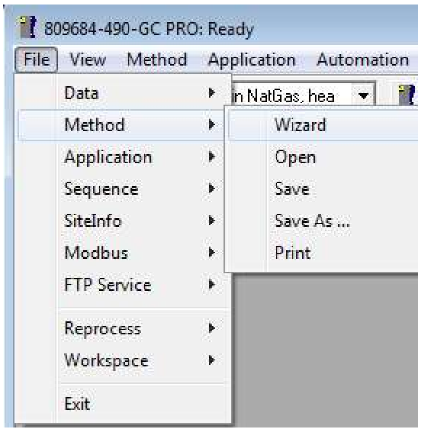


Figure 58: Activate Application wizard.

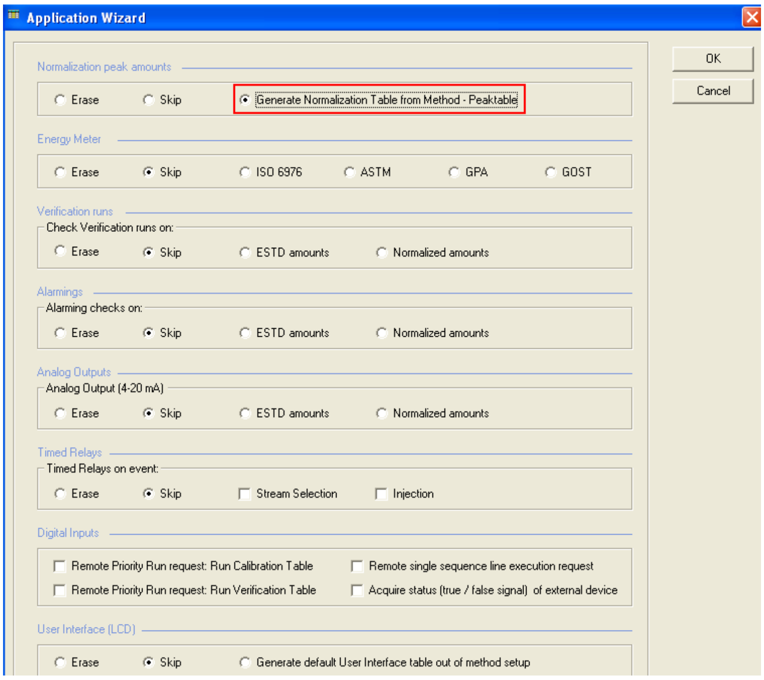


Figure 59: Application Wizard

Find detailed information about Application Wizard on page 109.

25.4.3.1 Application-Normalize

- Open Normalize window. Select: Application\Normalize, see Figure 60. This table should be filled with the identified peaks from the Peak Integration/Calibration table, see Figure 61.

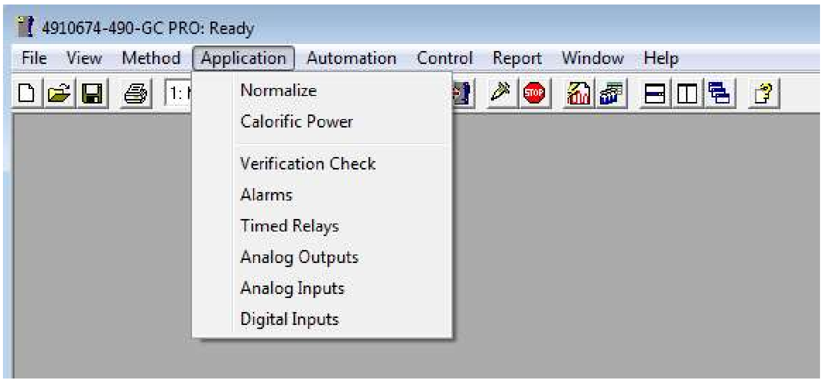


Figure 60: Open Normalize window.

Normalization Table

#	Peak Name	Channel	Ignore	Bridge Comp #	Estimate	Estim.Conc	Test.Conc	RefConcPeak#	RefPeakConc%	Group#
1	Methane	2		0. None		0	83.02	0	0	0
2	Ethane	2		0. None		0	7.45	0	0	0
3	Propane	1		0. None		0	4.39	0	0	0
4	Butane	1		0. None		0	1.08	0	0	0
5	2-Methylpropane	1		0. None		0	0.83	0	0	0
6	Pentane	1		0. None		0	0.25	0	0	0
7	2-Methylbutane	1		0. None		0	0.31	0	0	0
8	Hexane	1		0. None		0	0.3	0	0	0
9	Helium	1		0. None		0	0.03	0	0	0
10	Nitrogen	2		0. None		0	0.32	0	0	0
11	CO2	2		0. None		0	2.02	0	0	0

Figure 61: Normalization Table.

Find detailed information about Application – Normalize on page 165

25.4.3.2 Calorific power

- Select: Application\Calorific Power\Sample settings tab, see Figure 62 and Figure 63.
- Set parameters for the required energy calculation method.
- In 'Calculation Method' tab select Calculation Method, Calorific Units, Conversion factor and a number of method settings used for Calorific power, see Figure 64.
- In the 'Component Constants' tab set the values for every component as described in the literature of the selected method (ISO, GPA, ASTM, GOST), see Figure 65. There a number of predefined applications installed during PROstation installation. These contain calorific constants.

Find detailed information about Application – Calorific Power on page 167

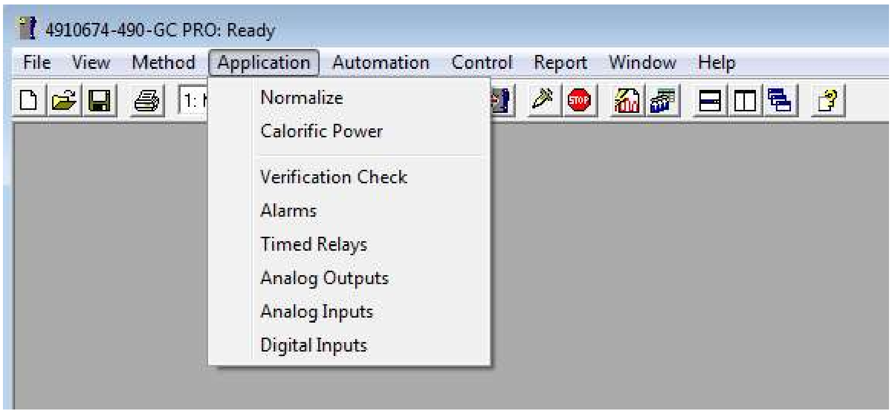


Figure 62: Open Calorific Power window

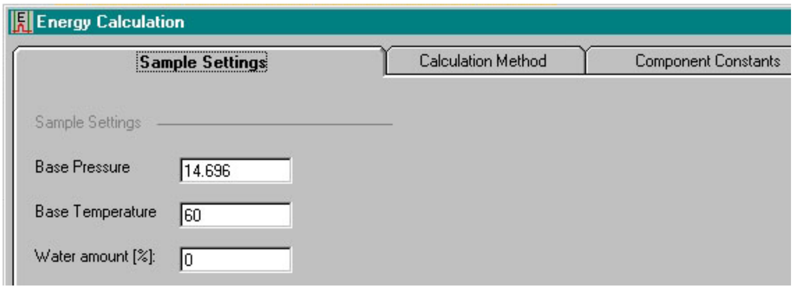


Figure 63: Calorific Power - Sample Settings tab

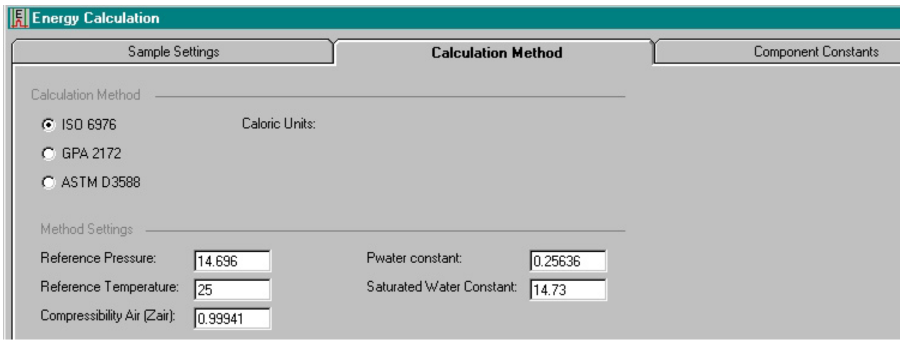
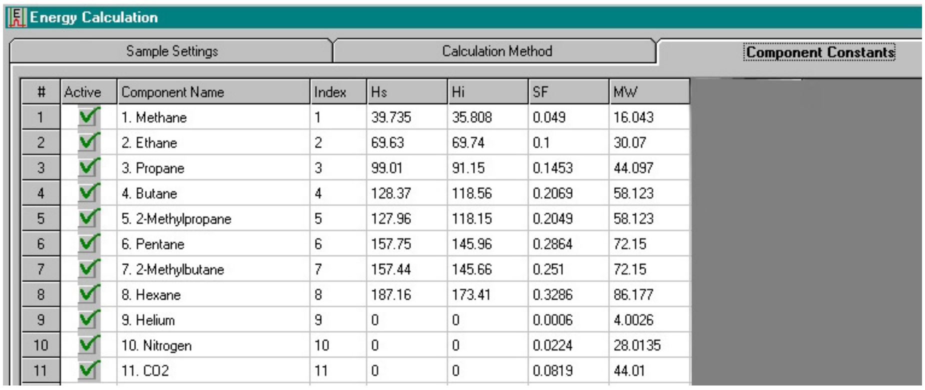


Figure 64: Calorific Power - Calculation Method tab



#	Active	Component Name	Index	Hs	Hi	SF	MW
1	✓	1. Methane	1	39.735	35.808	0.049	16.043
2	✓	2. Ethane	2	69.63	69.74	0.1	30.07
3	✓	3. Propane	3	99.01	91.15	0.1453	44.097
4	✓	4. Butane	4	128.37	118.56	0.2069	58.123
5	✓	5. 2-Methylpropane	5	127.96	118.15	0.2049	58.123
6	✓	6. Pentane	6	157.75	145.96	0.2864	72.15
7	✓	7. 2-Methylbutane	7	157.44	145.66	0.251	72.15
8	✓	8. Hexane	8	187.16	173.41	0.3286	86.177
9	✓	9. Helium	9	0	0	0.0006	4.0026
10	✓	10. Nitrogen	10	0	0	0.0224	28.0135
11	✓	11. CO2	11	0	0	0.0819	44.01

Figure 65: Calorific Power – Component Constants tab

25.4.3.3 *Verification Check*

Verification checks can be performed to validate the calibration curve at any moment.
If it is decided not to perform verification runs, this chapter can be skipped.
A verification check can be programmed in time. After the verification run, predefined parameters are checked on their limits.

- Select: Application\Verification Check.
- Activate "Verification table enabled", see Figure 66.
- In the 'Verification Table' tab define parameters, see Figure 67.

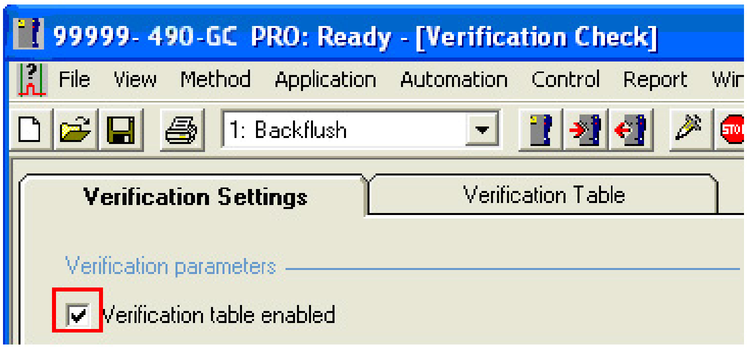


Figure 66: Verification Settings tab

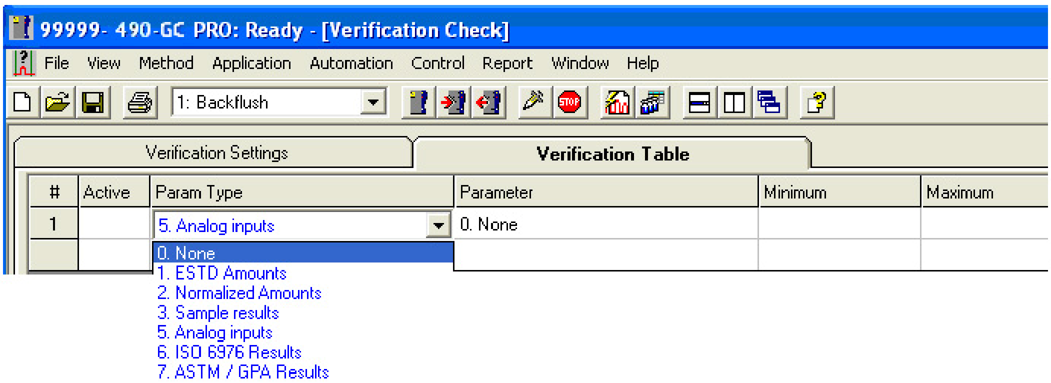


Figure 67: Verification Table

Find detailed information about Application – Verification Check on page 170 and Calibration validation on page 339.

25.4.3.4 Alarmings

Select type of alarmings and when an Alarm should be generated on exceeding a predefined range. Select the type of alarm from an available list. Select: Application\Alarm, see Figure 68

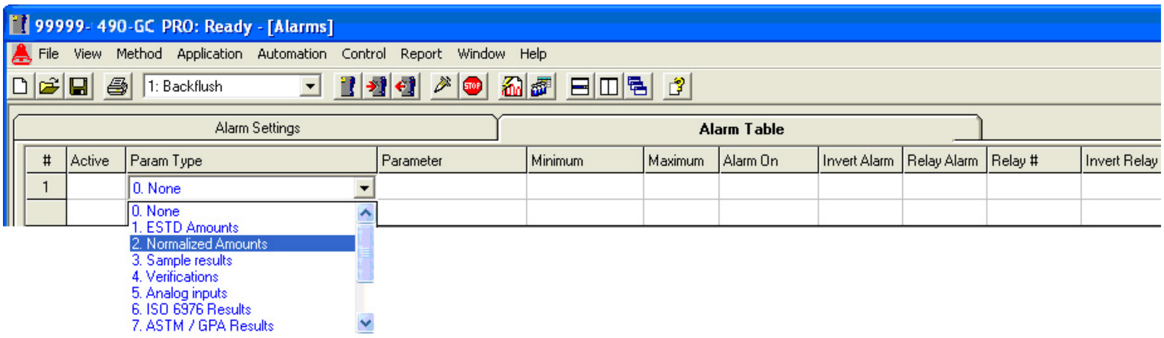


Figure 68: Alarm table

Find detailed information about Application – Alarms on page 172 and I/O CASES on page 344.

If Analog Output, Timed Relays, Analog Input, Digitial Input and an LCD screen are required, find this informations on chapters Application – Analog Outputs on page 174, Application – Timed Relays on page 177, Application – Analog Inputs on page 179, Aplication – Digital Inputs on page 180, Application – Local User Interface (LCD) on page 181.

25.4.3.5 Activate Application

- Save Application and download Application to instrument, see Figure 69.
- Perform a single run (Run type analysis).
- After the run is completed, an Application Report will be uploaded containing the analysis results, see Figure 70
- Check the application report in order to approve your application for instrument operation.

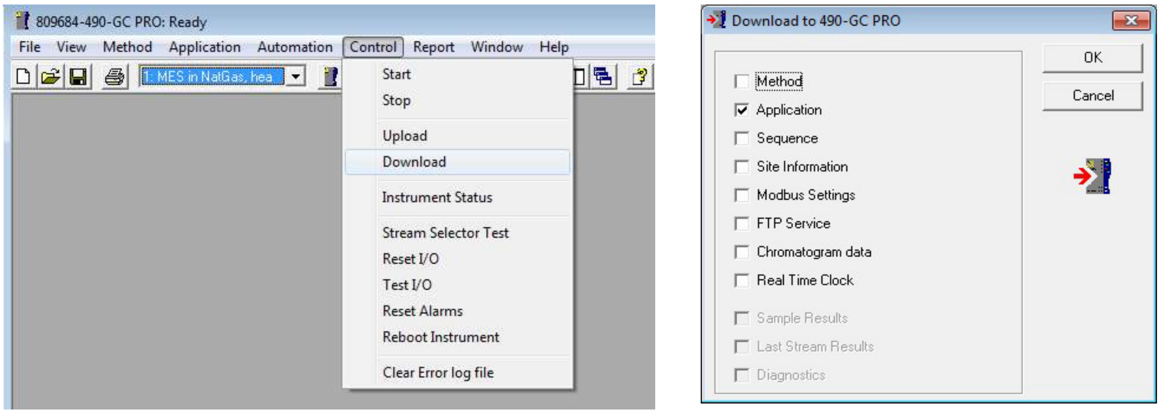
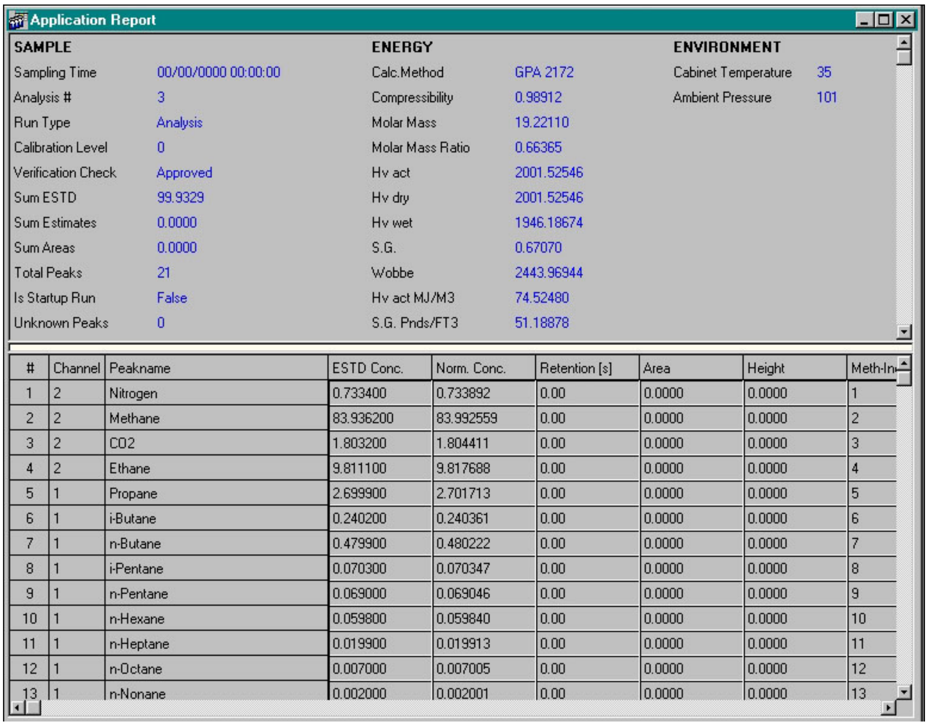


Figure 69: Download application



Application Report

SAMPLE		ENERGY		ENVIRONMENT	
Sampling Time	00/00/0000 00:00:00	Calc.Method	GPA 2172	Cabinet Temperature	35
Analysis #	3	Compressibility	0.98912	Ambient Pressure	101
Run Type	Analysis	Molar Mass	19.22110		
Calibration Level	0	Molar Mass Ratio	0.66365		
Verification Check	Approved	Hv act	2001.52546		
Sum ESTD	99.9329	Hv dry	2001.52546		
Sum Estimates	0.0000	Hv wet	1946.18674		
Sum Areas	0.0000	S.G.	0.67070		
Total Peaks	21	Wobbe	2443.96944		
Is Startup Run	False	Hv act MJ/M3	74.52480		
Unknown Peaks	0	S.G. Pnds/FT3	51.18878		

#	Channel	Peakname	ESTD Conc.	Norm. Conc.	Retention [s]	Area	Height	Meth-In
1	2	Nitrogen	0.733400	0.733892	0.00	0.0000	0.0000	1
2	2	Methane	83.936200	83.992559	0.00	0.0000	0.0000	2
3	2	CO2	1.803200	1.804411	0.00	0.0000	0.0000	3
4	2	Ethane	9.811100	9.817688	0.00	0.0000	0.0000	4
5	1	Propane	2.699900	2.701713	0.00	0.0000	0.0000	5
6	1	i-Butane	0.240200	0.240361	0.00	0.0000	0.0000	6
7	1	n-Butane	0.479900	0.480222	0.00	0.0000	0.0000	7
8	1	i-Pentane	0.070300	0.070347	0.00	0.0000	0.0000	8
9	1	n-Pentane	0.069000	0.069046	0.00	0.0000	0.0000	9
10	1	n-Hexane	0.059800	0.059840	0.00	0.0000	0.0000	10
11	1	n-Heptane	0.019900	0.019913	0.00	0.0000	0.0000	11
12	1	n-Octane	0.007000	0.007005	0.00	0.0000	0.0000	12
13	1	n-Nonane	0.002000	0.002001	0.00	0.0000	0.0000	13

Figure 70: Application Report

Note: Perform a Verification Analysis. Only to check whether the Calibration Limits are within range.

25.4.4 PROstation Automation

To setup a sequence from scratch, start the Sequence Wizard, see Figure 71.
Set the parameters and press 'OK' button. This will generate a sequence which is almost ready to use.

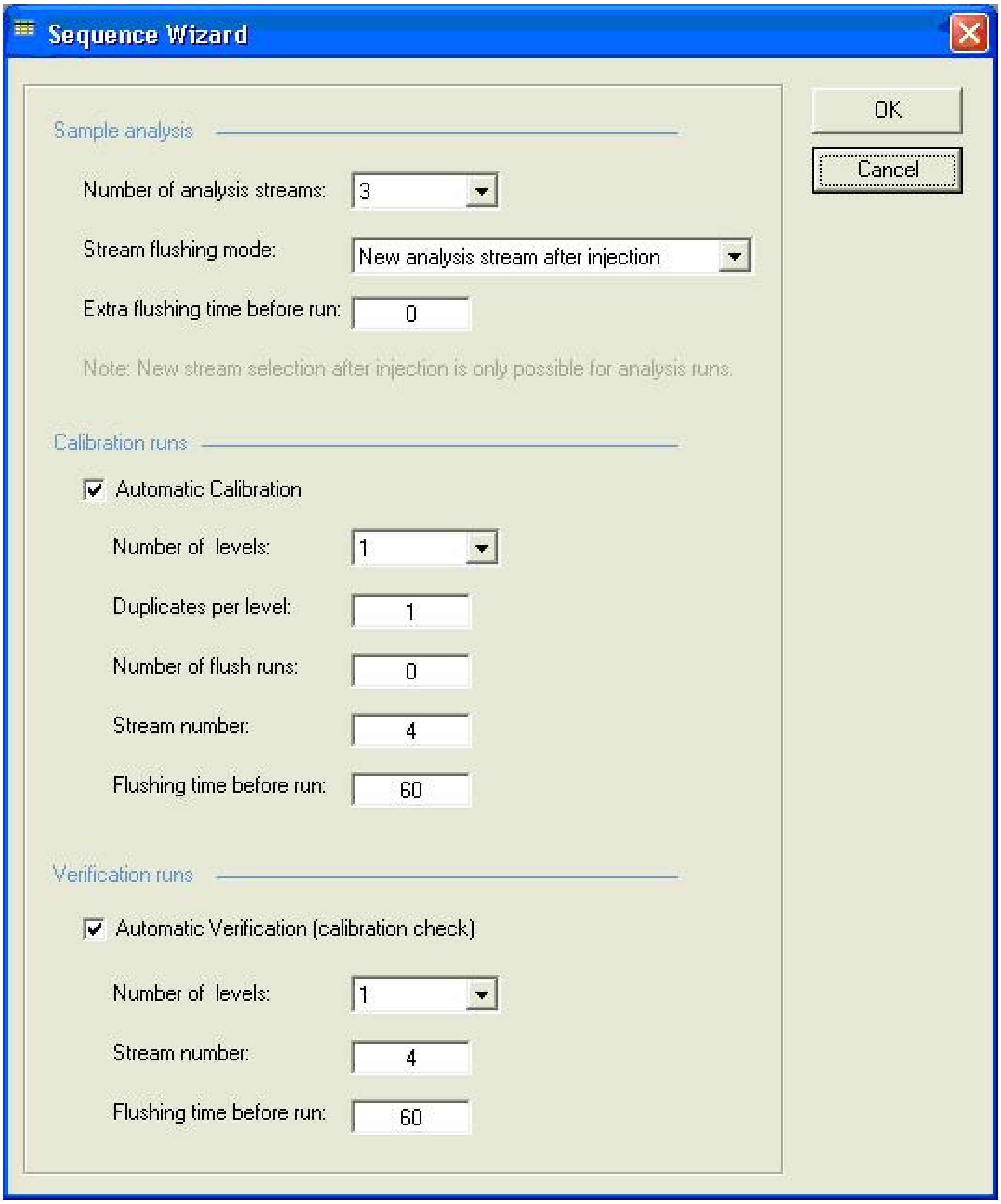


Figure 71: Sequence Wizard

To access the sequence, select: Automation\Sequence, see Figure 72.

Fine tune the sequence after the sequence wizard has created most of the parameters.
Find information about Sequence setup in chapter Automation on page 184.
Save sequence and download sequence to the instrument, see Figure 73.

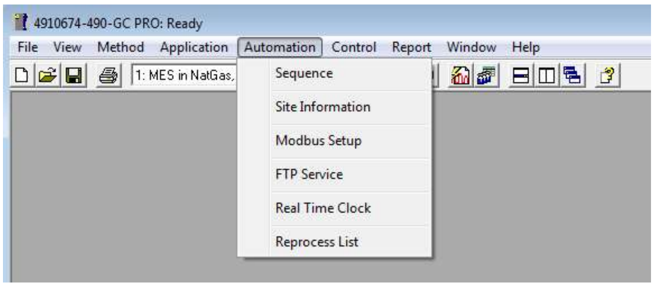


Figure 72: Automation – Sequence

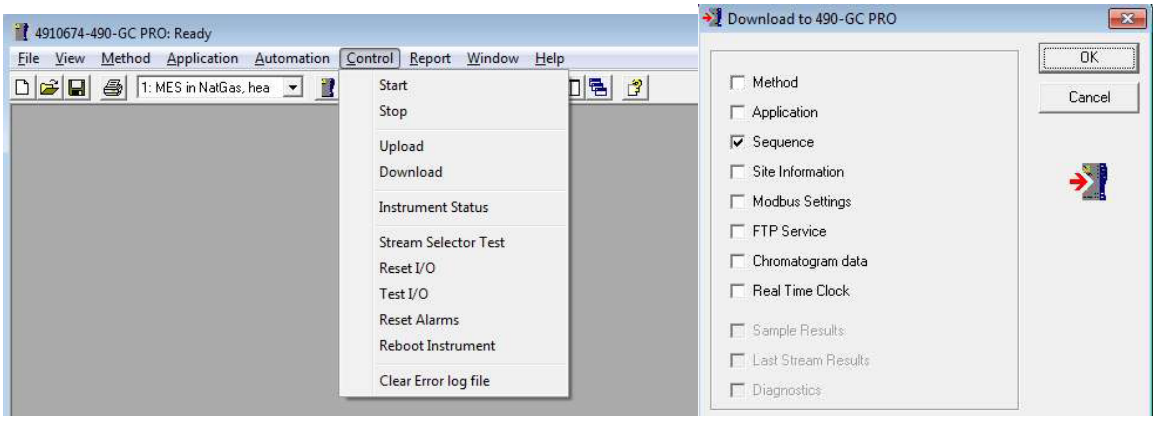


Figure 73: Download Sequence.

25.5 Start the Analyzer

Start full Automation to test Instrument performance.

- Select: Control\Start
- Set chromatogram file name in the correct field, see Figure 74.
- Set Maximum runs e.g. 100 runs, see Figure 74.
- Set ‘Export file sample results’ file name. Results will be exported in a tab separated file. This can be opened in Excel at a later stage.
- Make sure all sample streams and calibration mixture(s) are connected to the stream selector. In case only one sample stream is selected, stream selection parameters can be ignored.
- Now start full automation by pressing on “Full Automation”.

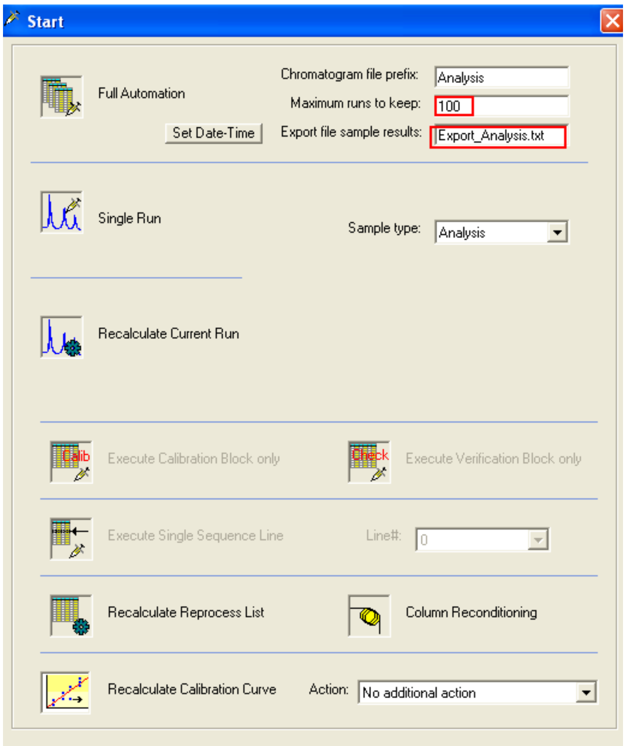


Figure 74: Start Full Automation

Find detailed information about the Automation – Sequence on page 185 and Sequence on page 334.

25.5.1 PROstation View

When the instrument is running a single run or sequence, one can monitor the instrument by making PROstation display the live chromatogram, Integration or Application report and instrument status.
The layout of PROstation can be defined by positioning the required windows on the screen and followed by a save of the workspace. In the View window, one can select the workspace to activate.
Below an example of the Application Workspace.

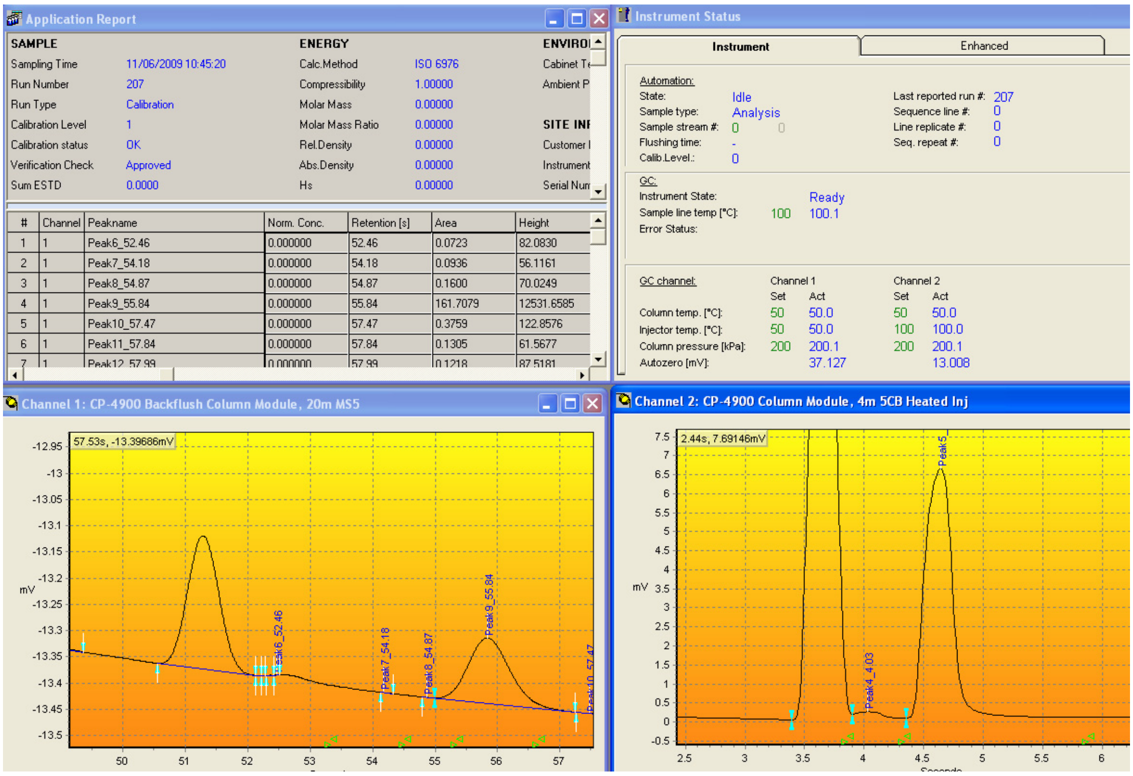


Figure 75: Example of application workspace of PROstation View.

In PROstation the following reports are available:
- Integration Report
- Application Report
- Stream Application Report, the last application report for every sample stream.
- Diagnostic Report containing operation errors and other events (upload report first Control\diagnostic\OK).
- Select: Report\ Report type, see Figure 76.

- Printing options are also avaible in this menu.

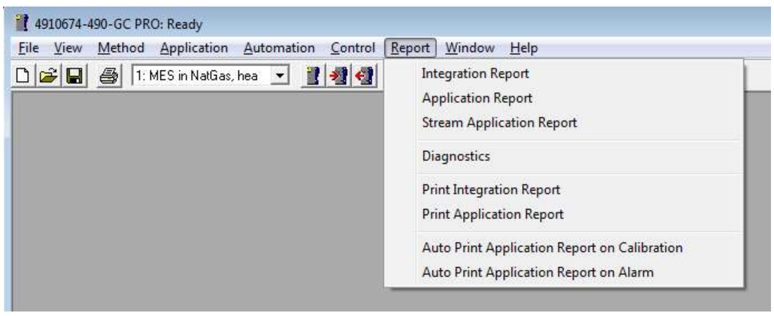


Figure 76: PROstation Reports

25.5.2 490-GC PRO web server.

Open any ordinary internet browser and enter the IP address of the instrument in the URL box., see chapter TCP / IP Connected on page 48.
This will show instrument status and results of the last analysis.
The internet browser is a quick way to monitor the state of the operating instrument and have a quick view on current sample results.
Exit the internet browser if it is not used as a continuous monitor for operators.

25.5.3 Continuous analysis

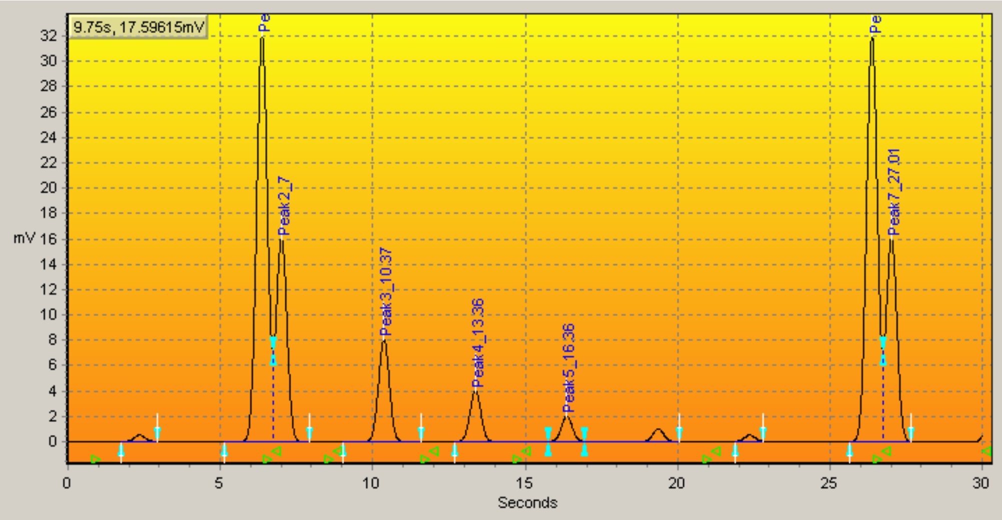
The instrument is now ready to use. Disconnect PROstation and connect Analog Output or Modbus Master to retrieve data from the instrument. The instrument will run continuously. An internal watchdog will monitor the ongoing process. If for some reason the ongoing process is disturbed, the instruments internal PC will be rebooted. Make sure to always have the “Restart on reboot” option enabled in the Automation – sequence page in order to let the instrument continue a sequence which was interrupted by reboot.

26 Calibration

This chapter describes the calibration mechanism available in the 490-GC PRO. The multi level calibration is compliant with ISO-10723 “Natural gas – Performance evalutation for on-line analytical systems.”

26.1 Chromatogram

The primary data from a GC is a chromatogram, see figure below.



Using an integration module the chromatogram can be analysed. The output of the integration is the combination of the retention time of a peak and its area. The retention time in combination with the Peak Identification table identifies the component. The area under the component peak, is proportional to the concentration of that particular component.
The integration of a single chromatogram results in multiple areas, one area for each component.

26.2 Calibration options

The relation between the area and the concentration of a component can be determined using a calibration mixture containing known concentrations for all components. A unique calibration mixture with known concentrations is called a level.
Calibrating with only one level is called a single level calibration this is described in chapter 26.2.1.
Calibrating with more than one level is called a multi level calibration this is described in chapter 26.2.2.

26.2.1 Single level calibration

When calibrating with only one level, the relation between area and concentration can only be described with a linear curve through the origin (0,0).

Y = a * x

“x” represents the Area
“y” represents the Concentration

Coefficient a is calculated using the following formula:

a = Concentration / Area

Coefficient a is also known as Response Factor (RF).
Example:

Data set:

Level	Area	Concentration
1	2850	3.5

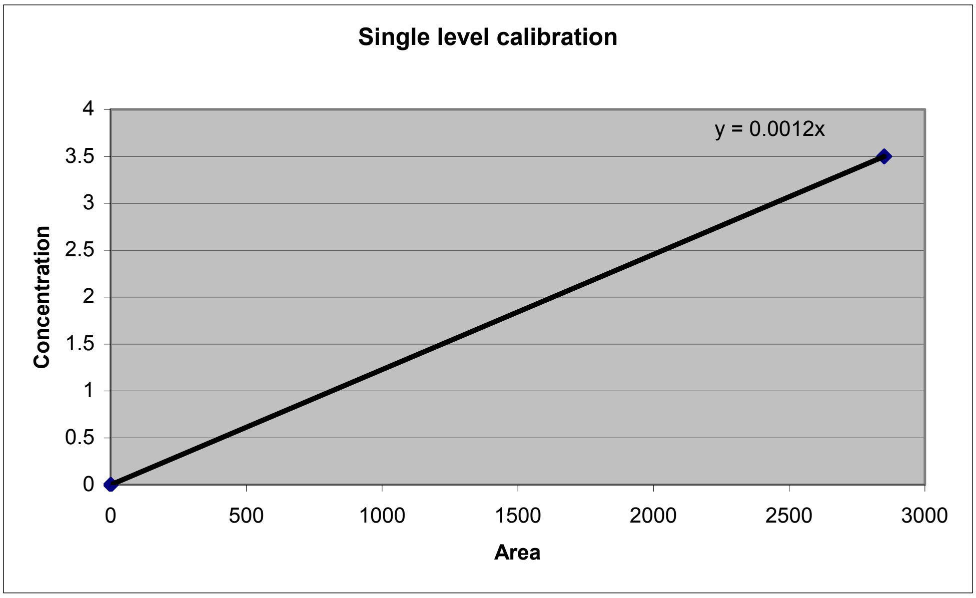


Figure: Single level calibration curve

a = 3.5 / 2850 = 0.0012

26.2.2 Multi level calibration

By using multiple calibration mixtures, a multi level calibration can be performed.
Each calibration level results in a point on the calibration curve. The calibration curve gets more accurate by calibrating with more than one calibration level.

The relation between the area and concentration is described via a polynomial curve, up to cubic is supported. Linear and quadratic curves can be achieved by setting the coefficients “a” and “b” to zero.

$Y = a * x^3 + b * x^2 + c * x + d$

“x” represents the Area
“y” represents the Concentration

Example:

Data set:

Level	Area	Concentration
1	2850	1.0
2	5700	2.0
3	8550	3.0
4	11400	4.0
5	14250	5.0
6	19950	6.0
7	22800	7.0

The data above has been used to fit a cubic curve:

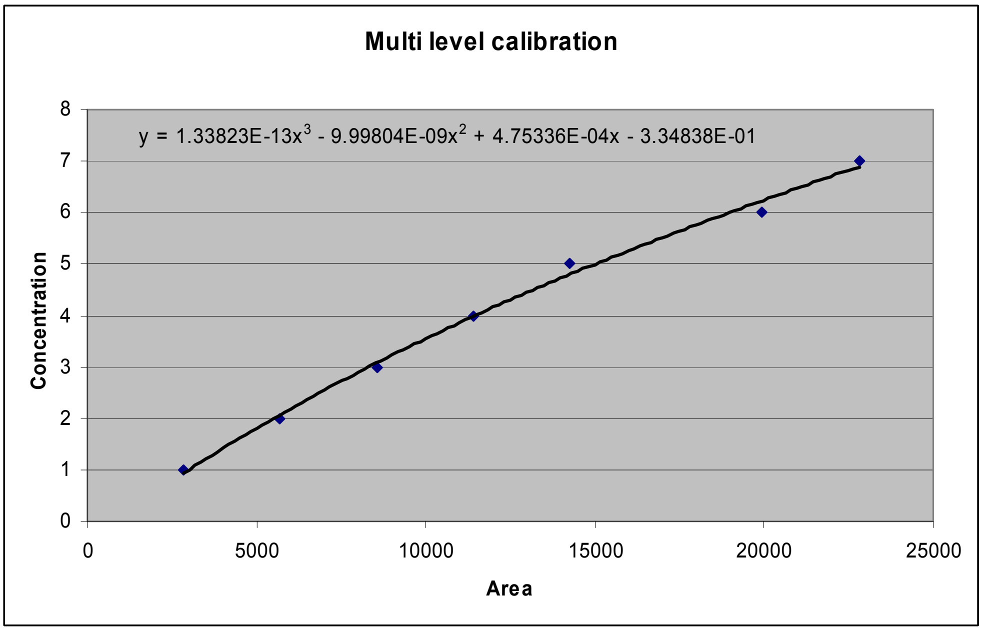


Figure: Multi level calibration using cubic fit

26.2.3 Offline Calibration

The coefficients of the polynomial equation can be determined in third party mathematical tools. This is called ‘Offline Calibration’.

The coefficients for the polynomial equation can only be set if the option “Allow overriding Curve Coefficients” is enabled in the Peak Calibration screen, see screen dumps below.
The Peak Calibration screen can be opened using the menu option shown below.

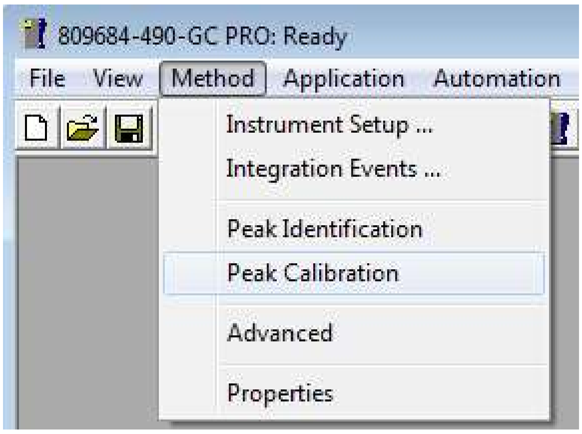


Figure: Screenshot menu item “Peak Calibration”

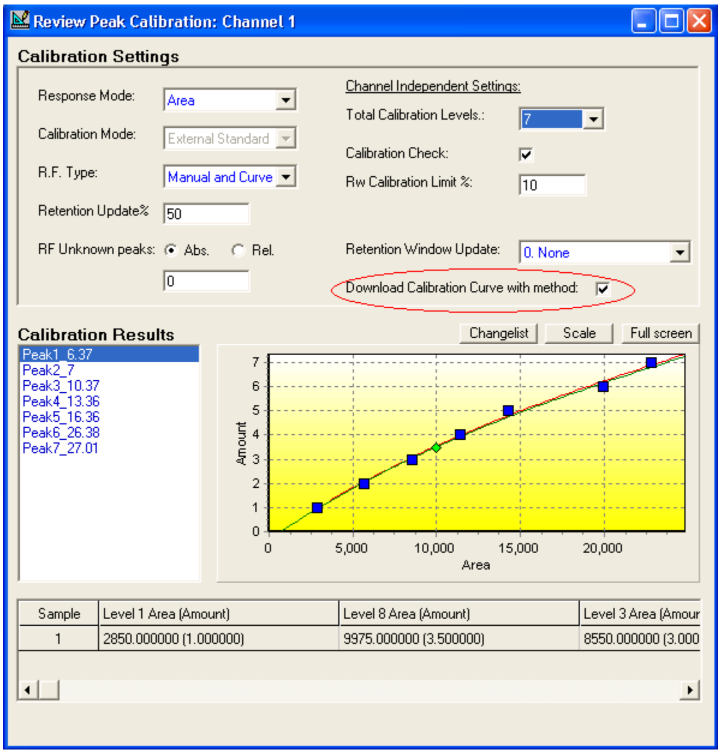


Figure: Calibration settings

The coefficients of the polynomial curve can be downloaded to the instrument via the method.

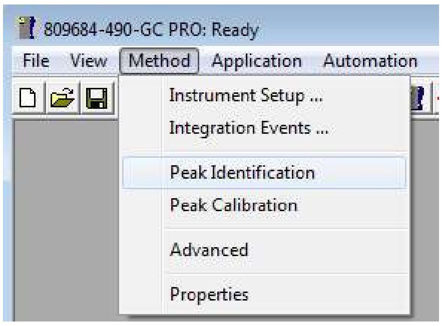
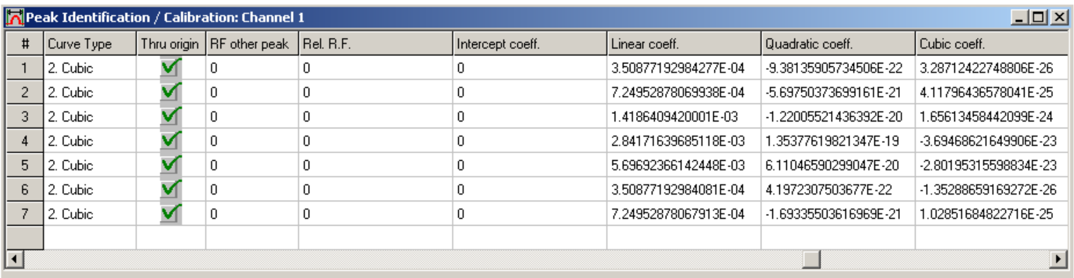


Figure: Screenshot menu item “Peak Identification”

The coefficients of the curve can be entered in the Peak Identification table. The Peak Identification can be selected via the menu structure, see figure above.


Peak Identification / Calibration: Channel 1

#	Curve Type	Thru origin	RF other peak	Rel. R.F.	Intercept coeff.	Linear coeff.	Quadratic coeff.	Cubic coeff.
1	2. Cubic	✓	0	0	0	3.50877192984277E-04	-9.38135905734506E-22	3.28712422748806E-26
2	2. Cubic	✓	0	0	0	7.24952878069938E-04	-5.69750373699161E-21	4.11796436578041E-25
3	2. Cubic	✓	0	0	0	1.4186409420001E-03	-1.22005521436392E-20	1.65613458442099E-24
4	2. Cubic	✓	0	0	0	2.84171639685118E-03	1.35377619821347E-19	-3.69468621649906E-23
5	2. Cubic	✓	0	0	0	5.69692366142448E-03	6.11046590299047E-20	-2.80195315598834E-23
6	2. Cubic	✓	0	0	0	3.50877192984081E-04	4.1972307503677E-22	-1.35288659169272E-26
7	2. Cubic	✓	0	0	0	7.24952878067913E-04	-1.69335503616969E-21	1.02851684822716E-25

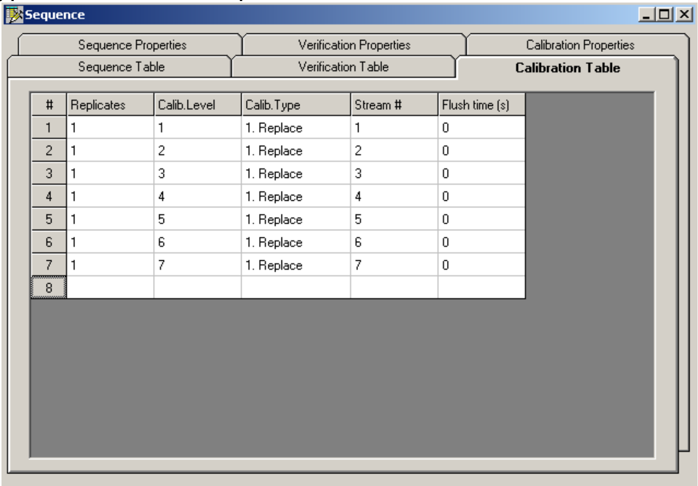
Figure: Coefficients Polynomial

The coefficients of the polynomial curve $y = a * x^3 + b * x^2 + c * x + d$ are defined as follows:
a = Cubic coeff.
B = Quadratic coeff.
C = Linear coeff.
D = Intercept coeff.

26.2.4 Online Calibration

The 490-GC PRO is capable of performing the calibration by itself. The sequence containing the calibration table can be downloaded to the 490-GC PRO.

A typical calibration sequence for seven calibration levels is shown in the table below:

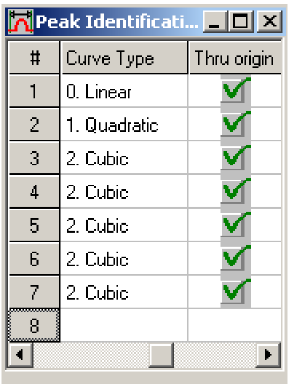


#	Replicates	Calib.Level	Calib.Type	Stream #	Flush time (s)
1	1	1	1. Replace	1	0
2	1	2	1. Replace	2	0
3	1	3	1. Replace	3	0
4	1	4	1. Replace	4	0
5	1	5	1. Replace	5	0
6	1	6	1. Replace	6	0
7	1	7	1. Replace	7	0
8					

Figure: Calibration Table

The 490-GC PRO is capable of calibrating up to seven levels. After each calibration run, the 490-GC PRO will perform a curve fit using the available calibration data.
When more than one replicate is chosen, the 490-GC PRO will average the measured areas.

The level of the polynomial fit, either linear, quadratic or cubic, can be selected. The curve can also be forced through the origin (Point (0,0)). The options for the fit can be entered in the Peak Identification table.



#	Curve Type	Thru origin
1	0. Linear	✓
2	1. Quadratic	✓
3	2. Cubic	✓
4	2. Cubic	✓
5	2. Cubic	✓
6	2. Cubic	✓
7	2. Cubic	✓
8		

Figure: Peak Identifcation Table, Curve Type and Thru origin

The user is responsible for verification of the calibration output. PROstation is capable of showing the calibration curve and points for each component. The graphical output of the calibration can be examined in the “Peak Calibration”, see figure below.

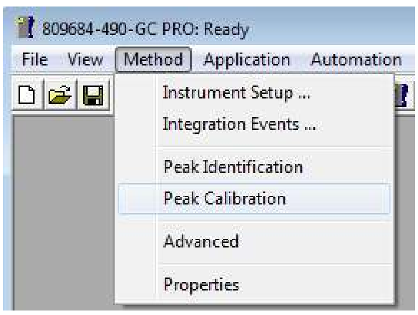


Figure: Peak Calibration

After selecting the "Peak Calibration" the screen below is shown.

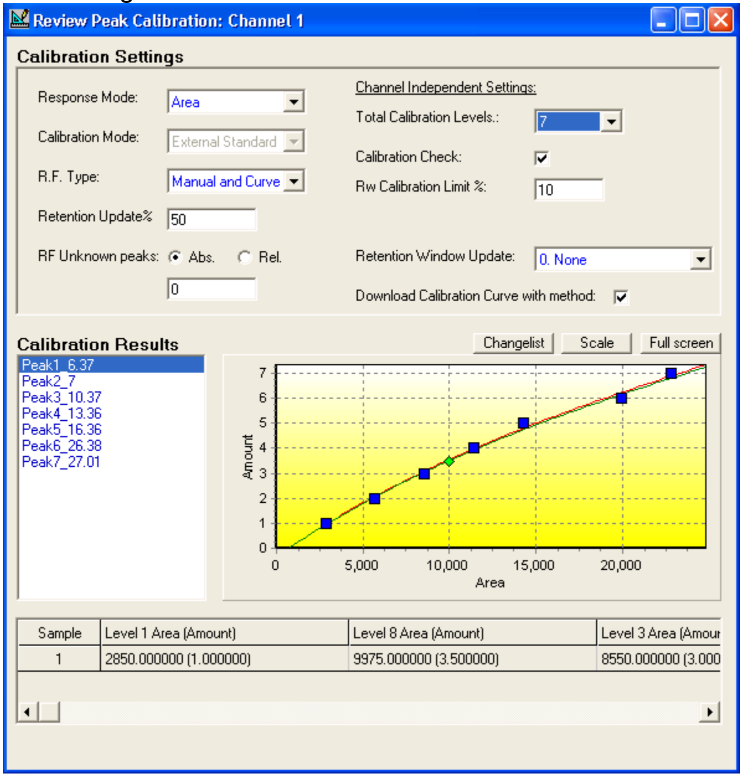
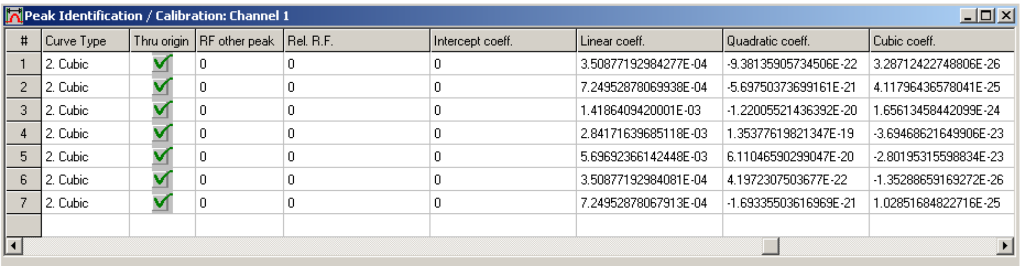


Figure: Calibration screen

The coefficients can be examined in the Peak Identification Table after uploading the method:


Peak Identification / Calibration: Channel 1

#	Curve Type	Thru origin	RF other peak	Rel. R.F.	Intercept coeff.	Linear coeff.	Quadratic coeff.	Cubic coeff.
1	2. Cubic	✓	0	0	0	3.50877192984277E-04	-9.38135905734506E-22	3.28712422748806E-26
2	2. Cubic	✓	0	0	0	7.24952878069938E-04	-5.69750373699161E-21	4.11796436578041E-25
3	2. Cubic	✓	0	0	0	1.4186409420001E-03	-1.22005521436392E-20	1.65613458442099E-24
4	2. Cubic	✓	0	0	0	2.84171639685118E-03	1.35377619821347E-19	-3.69468621649906E-23
5	2. Cubic	✓	0	0	0	5.69692366142448E-03	6.11046590299047E-20	-2.80195315598834E-23
6	2. Cubic	✓	0	0	0	3.50877192984081E-04	4.1972307503677E-22	-1.35288659169272E-26
7	2. Cubic	✓	0	0	0	7.24952878067913E-04	-1.69335503616969E-21	1.02851684822716E-25

Figure: Coefficients Polynomial

26.3 Rw calibration

After determining the relation between the area and concentration via the fit, the validity of the curve should be checked periodically. Typically a daily interval is chosen.
The ambient pressure and the decline of the detector are factors for which a correction should be made.

The picture below shows the fitted curve in the middle and two possible field calibrations: one above the fitted curve and one below the fitted curve.

The concentration of the Rw calibration gas must be filled in, this is called "Level 8 Rw". During the calibration, the 490-GC PRO calculates the factor between the concentration found via the fitted curve and the concentration entered (see figure below). This factor is called the Rw factor.

Peak Identification / Calibration: Channel 1

#	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8 Rw
1	1	2	3	4	5	6	7	3.45
2	1	2	3	4	5	6	7	3.6
3	1	2	3	4	5	6	7	3.51
4	1	2	3	4	5	6	7	3.49
5	1	2	3	4	5	6	7	3.48
6	1	2	3	4	5	6	7	3.502
7	1	2	3	4	5	6	7	3.499
8								

Figure: Peak Identification Table, the levels

Peak Identification / Calibration: Channel 1

#	Curve Type	Thru origin	RF other peak	Rel. R.F.	Intercept coeff.	Linear coeff.	Quadratic coeff.	Cubic coeff.	Rw factor
1	0. Linear	✓	0	0	0	3.50877192984277E-04	-9.38135905734506E-22	3.28712422748806E-26	0
2	1. Quadratic	✓	0	0	0	7.24952878069938E-04	-5.69750373699161E-21	4.11796436578041E-25	0
3	2. Cubic	✓	0	0	0	1.4186409420001E-03	-1.22005521436392E-20	1.65613458442099E-24	0
4	2. Cubic	✓	0	0	0	2.84171639685118E-03	1.35377619821347E-19	-3.69468621649906E-23	0
5	2. Cubic	✓	0	0	0	5.69692366142448E-03	6.11046590299047E-20	-2.80195315598834E-23	0
6	2. Cubic	✓	0	0	0	3.50877192984081E-04	4.1972307503677E-22	-1.35288659169272E-26	0
7	2. Cubic	✓	0	0	0	7.24952878067913E-04	-1.69335503616969E-21	1.02851684822716E-25	0
8									

Figure: Peak Identification Table, the Rw factor

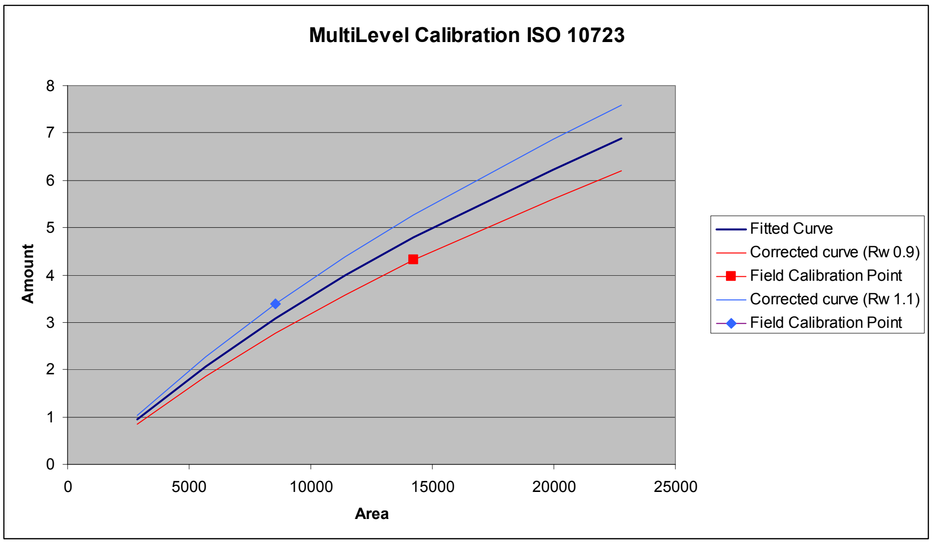


Figure: Graphical representation of the Rw correction.

Typically the Rw factor will vary around 1.

An Rw calibration can be scheduled in the sequence identical to other calibration levels.
The Rw limit can be specified using a percentage, for instance an Rw limit of 10% means that the Rw must be within 0.9 and 1.1.

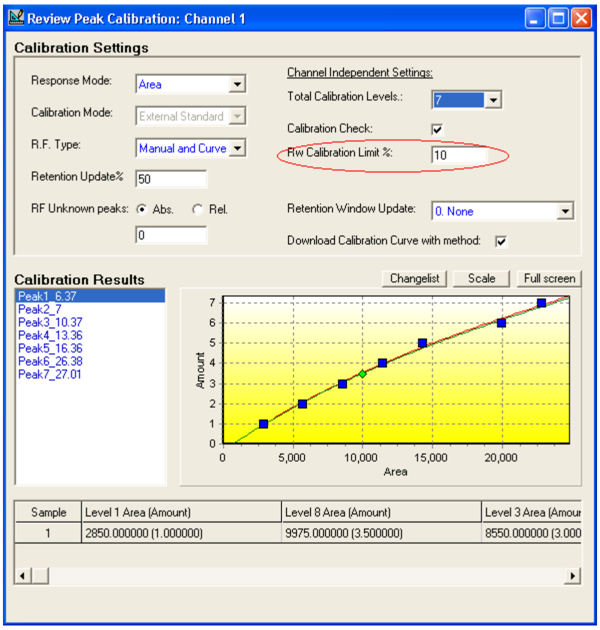


Figure: Rw Limit.

The Rw factor will be used in the following way:

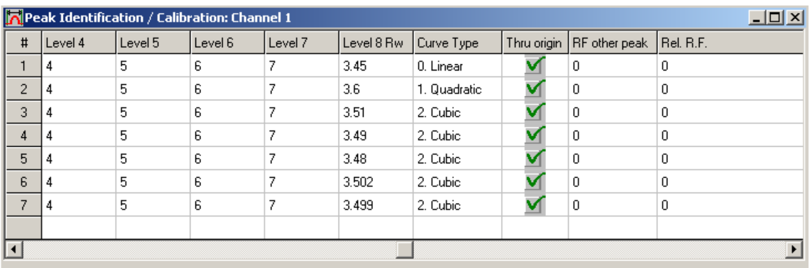
$$y = Rw * (a * x^3 + b * x^2 + c * x + d)$$

"x" represents the Area
"y" represents the Concentration

26.4 Relative RF

When it is not possible to determine a calibration curve for a component, it is possible to refer to a component that has a curve.
During an analysis, the 490-GC PRO will use the curve of the referred component in combination with the Relative RF factor.

Typical use: C6+ components refer to the C3 curve with a Relative RF factor.
The Relative RF factor can be determined using a Lab GC.


Peak Identification / Calibration: Channel 1

#	Level 4	Level 5	Level 6	Level 7	Level 8 Rw	Curve Type	Thru origin	RF other peak	Rel. R.F.
1	4	5	6	7	3.45	0. Linear	✓	0	0
2	4	5	6	7	3.6	1. Quadratic	✓	0	0
3	4	5	6	7	3.51	2. Cubic	✓	0	0
4	4	5	6	7	3.49	2. Cubic	✓	0	0
5	4	5	6	7	3.48	2. Cubic	✓	0	0
6	4	5	6	7	3.502	2. Cubic	✓	0	0
7	4	5	6	7	3.499	2. Cubic	✓	0	0

Figure: Peak Identification Table, Rel.R.F.

Peak © referring to peak c:

$$y = \text{Rel. R.F.}_i * Rw_c * (a_c * x^3 + b_c * x^2 + c_c * x + d_c)$$

"x" represents the Area
"y" represents the Concentration

26.5 Setting up a typical single level calibration

This chapter describes typical usage of the 490-GC PRO in combination with a single level calibration.

26.5.1 Environment

The description of this chapter is based on the environment described in this paragraph.

- Three streams to analyse continuously.
- One calibration stream.

26.5.2 Sequence

The sequence is setup using the “Sequence Table” and the “Sequence Properties”. The “Sequence Properties” determine how the “Sequence Table” will be used.

26.5.2.1 Sequence Table

The sequence table defines which analysis should be run and in what order. The figure below shows that three streams are to be analysed, starting with stream 1, followed by stream 2 and then stream 3. Each stream starts with flushing for 60 seconds to prevent mixing of the different streams.

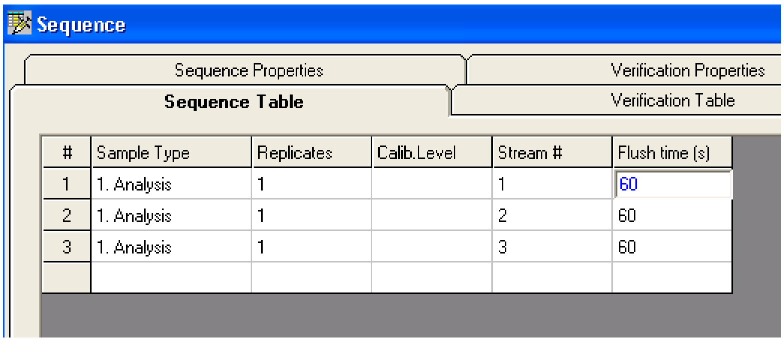


Figure: Sequence table

26.5.2.2 Sequence properties

The sequence properties define how the Sequence Table is being used. The figure below defines that the sequence should start at startup of the 490-GC PRO and that it should run continuously. The option “Home Position (on error and when sequence stops)” defines the position of the stream when the sequence has been interrupted. This option can be used to prevent waste of (expensive) calibration mixture in case of an error.

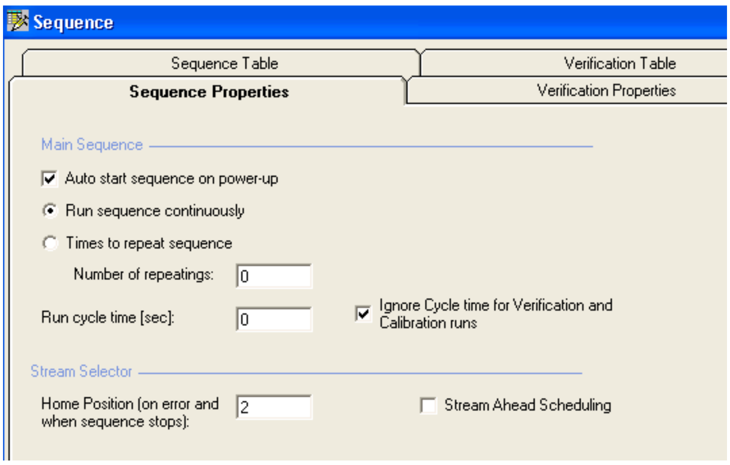


Figure: Sequence Properties

26.5.2.3 *Calibration table*

The calibration table defines how a calibration should be performed. In this example the calibration mixture is connected to stream 4.

The concentration of the calibration level and curve type must be entered in the Peak Identification table, see figures below.

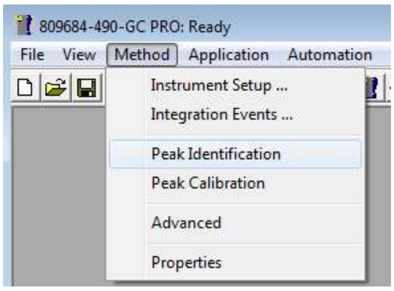
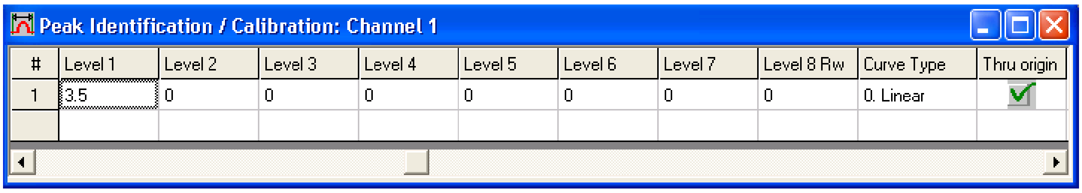


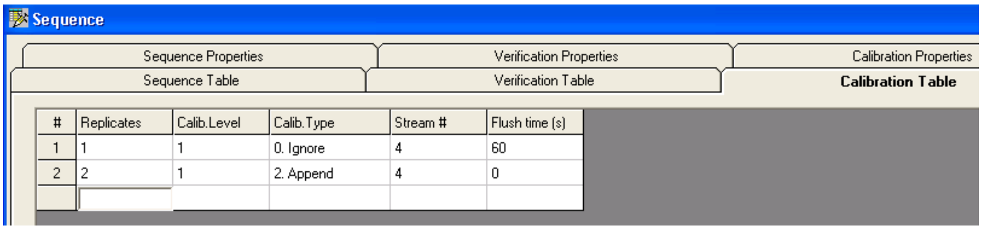
Figure: Screenshot menu item “Peak Identification”



#	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8 Rw	Curve Type	Thru origin
1	3.5	0	0	0	0	0	0	0	0. Linear	✓

Figure: Peak Identification table

The calibration consists of two steps: the “Ignore” step and the “Append” step. The “Ignore” step is responsible for flushing the 490-GC PRO to ensure a reliable calibration. The “Append” step with the number of replicates set to two, forces the 490-GC PRO to clear the previous calibration points and add two new calibration points. Based on these points, the coefficient of the linear curve is determined.



#	Replicates	Calib.Level	Calib.Type	Stream #	Flush time (s)
1	1	1	0. Ignore	4	60
2	2	1	2. Append	4	0

Figure: Calibration table

26.5.2.4 Calibration properties

The calibration properties define how the Calibration Table will be used. The figure below defines that the calibration should start at 07:00 ‘o clock every day.

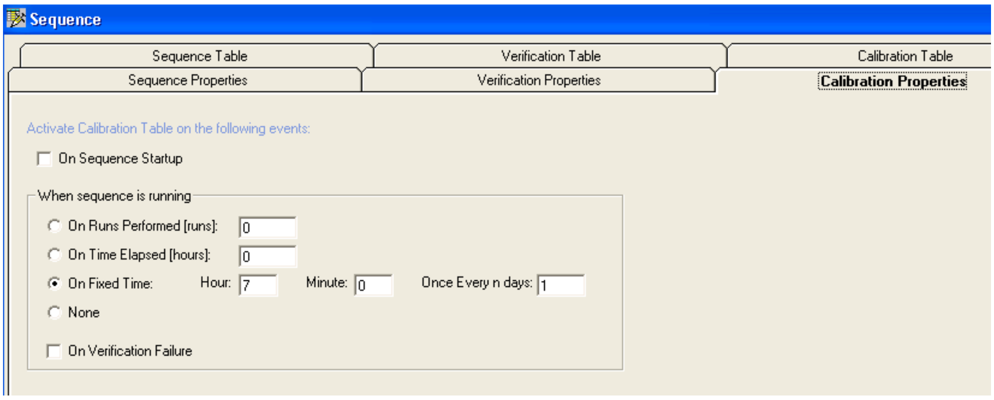


Figure: Calibration Properties

26.6 Setting up a typical multi level calibration

This chapter describes typical usage of the 490-GC PRO in combination with multi level calibration.

26.6.1 Environment

The description of this chapter is based on the environment described in this paragraph.

The 490-GC PRO will be used in two different contexts, the Calibration of the multi level curve and the daily usage

Calibration of the multi level curve.

- Seven calibration streams.
- One Rw calibration stream.

Daily usage.

- Three streams to analyse continuously.
- The Rw calibration stream.

26.6.2 Calibration of the multi level curve

Before the 490-GC PRO can be used in combination with a multi level curve, it is required to perform the calibration of the multi level curve. Typically the multi level curve is determined on a laboratory with all calibration mixtures available.

For each calibration level the concentration and curve type must be filled in the Peak Identification table, see figures below.

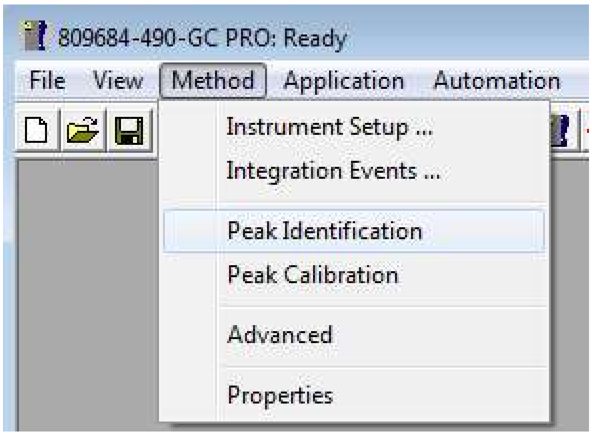


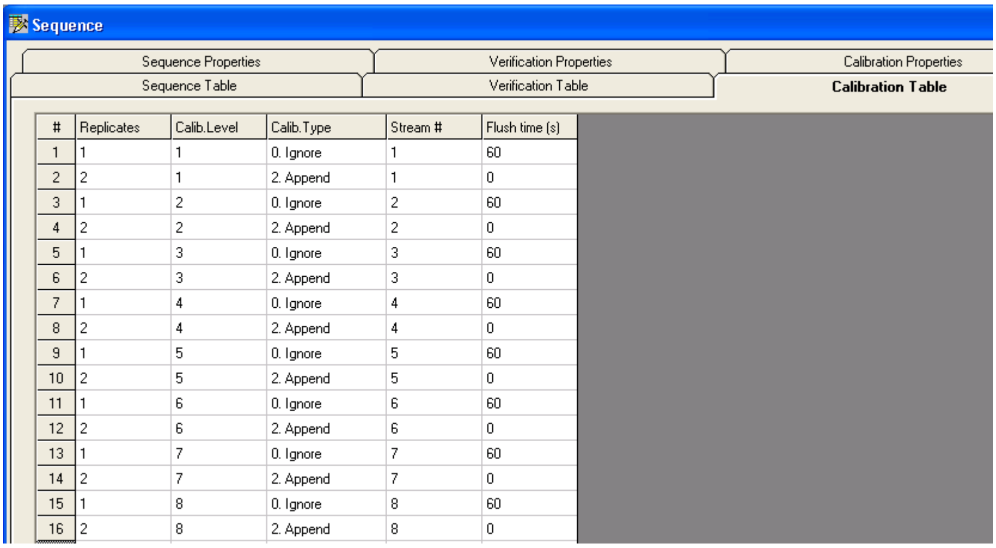
Figure: Screenshot menu item “Peak Identification”

Peak Identification / Calibration: Channel 1

#	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8 Rw	Curve Type	Thru origin
1	1	2	3	4	5	6	7	3.5	2. Cubic	
2	1	2	3	4	5	6	7	3.5	2. Cubic	
3	1	2	3	4	5	6	7	3.5	2. Cubic	
4	1	2	3	4	5	6	7	3.5	2. Cubic	
5	1	2	3	4	5	6	7	3.5	2. Cubic	
6	1	2	3	4	5	6	7	3.5	2. Cubic	
7	1	2	3	4	5	6	7	3.5	2. Cubic	

Figure: Peak Identification table Containing the component concentration of the mixture.

Figure below shows the calibration table for performing the calibration of level 1 to 7 and level 8 (Rw).



#	Replicates	Calib.Level	Calib.Type	Stream #	Flush time (s)
1	1	1	0. Ignore	1	60
2	2	1	2. Append	1	0
3	1	2	0. Ignore	2	60
4	2	2	2. Append	2	0
5	1	3	0. Ignore	3	60
6	2	3	2. Append	3	0
7	1	4	0. Ignore	4	60
8	2	4	2. Append	4	0
9	1	5	0. Ignore	5	60
10	2	5	2. Append	5	0
11	1	6	0. Ignore	6	60
12	2	6	2. Append	6	0
13	1	7	0. Ignore	7	60
14	2	7	2. Append	7	0
15	1	8	0. Ignore	8	60
16	2	8	2. Append	8	0

Figure: Calibration table

The calibration can be started using the Start screen, see figure below.

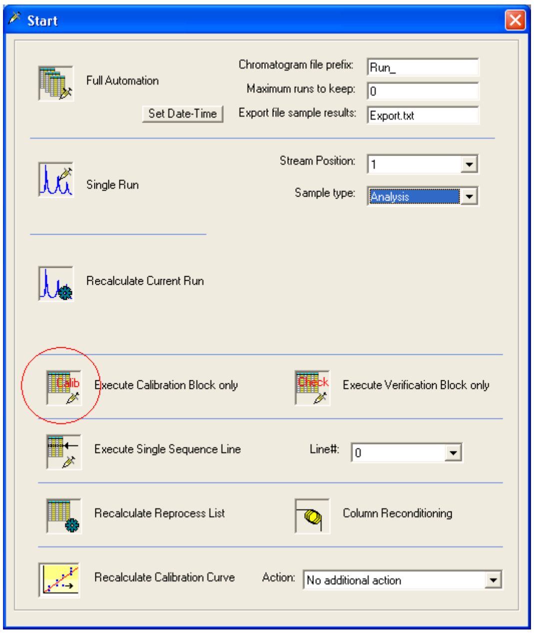


Figure: Starting calibration table

When the calibration sequence has finished, the derived curves and their coefficients can be examined in the Peak Calibration screen and the Peak Identification table, see figures below.

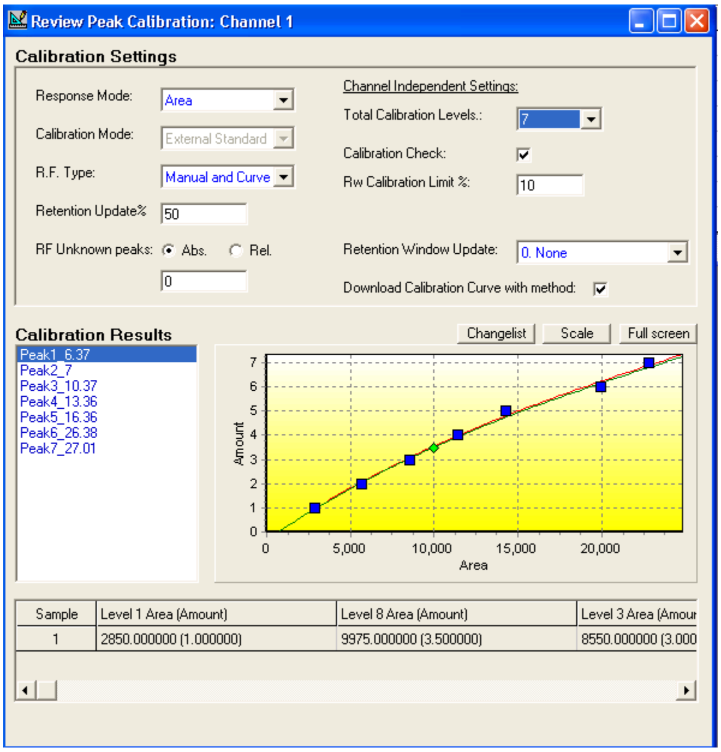


Figure: Peak Calibration screen

Peak Identification / Calibration: Channel 1

#	Intercept coeff.	Linear coeff.	Quadratic coeff.	Cubic coeff.	Rw factor
1	-0.334838024429273	4.75336420359404E-04	-9.99803798731265E-09	1.33823348939439E-13	0.987402459579224
2	-0.334838024429309	9.82100042068294E-04	-4.26799654539517E-08	1.18030924546192E-12	0.98740245957924
3	-0.334838024428803	1.92184536535423E-03	-1.63436661110184E-07	8.84471701426598E-12	0.987402459579345
4	-0.334838024429421	3.84969820417061E-03	-6.55791780235471E-07	7.10900260674187E-11	0.987402459579105
5	-0.334838024428985	7.71767260557988E-03	-2.63563522024319E-06	5.72779774065094E-10	0.987402459579301
6	-0.334838024429227	4.75336420359201E-04	-9.99803798729665E-09	1.33823348938992E-13	0.987402459579281
7	-0.33483802442894	9.82100042067315E-04	-4.26799654538165E-08	1.18030924545489E-12	0.987402459579291

Figure: Peak Identification table, the coefficients.

26.6.3 Sequence

The sequence is setup using the “Sequence Table” and the “Sequence Properties”. The “Sequence Properties” determine how the “Sequence Table” will be used.

26.6.3.1 Sequence Table

The sequence table defines which analysis should be run and in what order. The figure below shows that three streams are to be analysed.

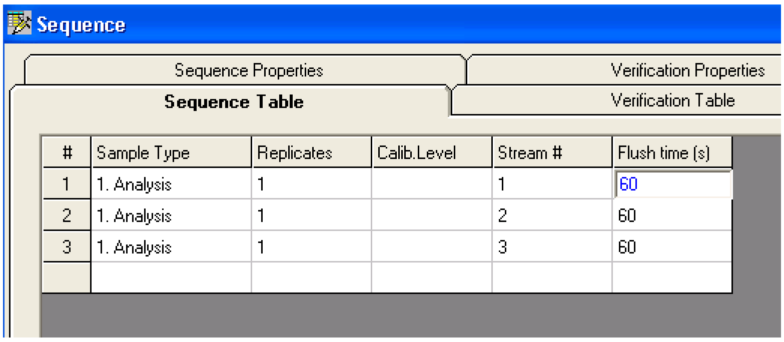


Figure: Sequence table

Three streams are to be analysed, starting with stream 1, followed by stream 2 and then stream 3. Each stream starts with flushing for 60 seconds to prevent mixing of the different streams.

26.6.3.2 Sequence properties

The sequence properties define how the Sequence Table is being used. The figure below defines that the sequence should start at startup of the 490-GC PRO and it should run continuously. The option “Home Position (on error and when sequence stops)” defines the position of the stream when the sequence has been interrupted. This option can be used to prevent waste of (expensive) calibration mixture in case of an error.

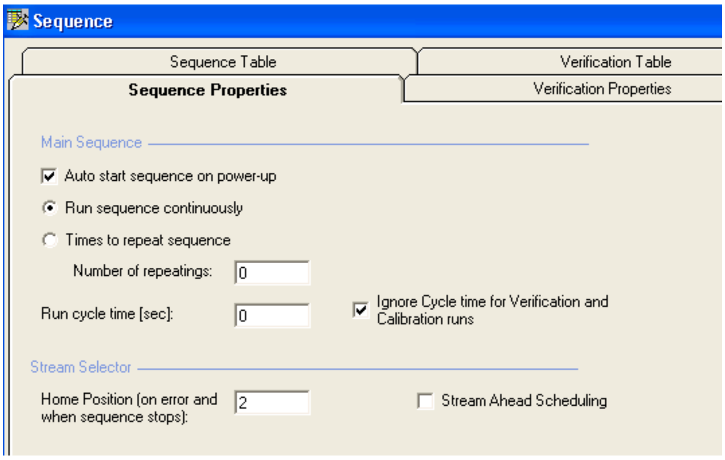


Figure: Sequence Properties

26.6.3.3 Calibration table

The calibration table defines how a calibration should be performed. In this example the Rw calibration mixture is connected to stream 4.
The calibration is build up with two steps: the “Ignore” step and the “Replace” step. The “Ignore” step is responsible for flushing the 490-GC PRO to ensure a reliable calibration. The “Replace” step forces the 490-GC PRO to clear the previous calibration points and add one new calibration point. Based on this point the Rw factor is detemined.

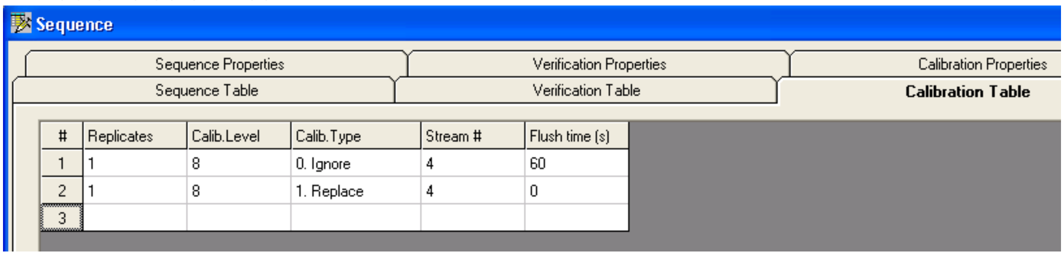


Figure: Calibration table

26.6.3.4 Calibration properties

The calibration properties define how the Calibration Table is being used. The figure below defines that the calibration should start at 07:00 ‘o clock every day.

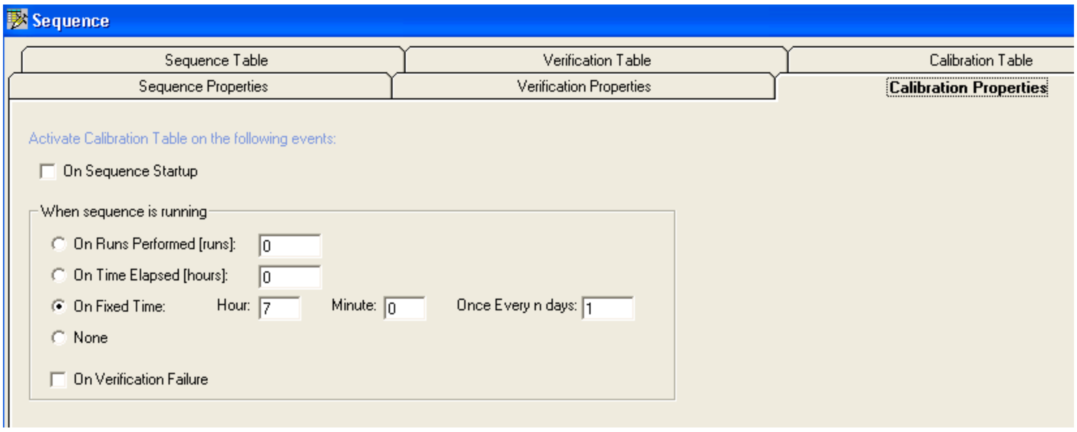


Figure: Calibration Properties

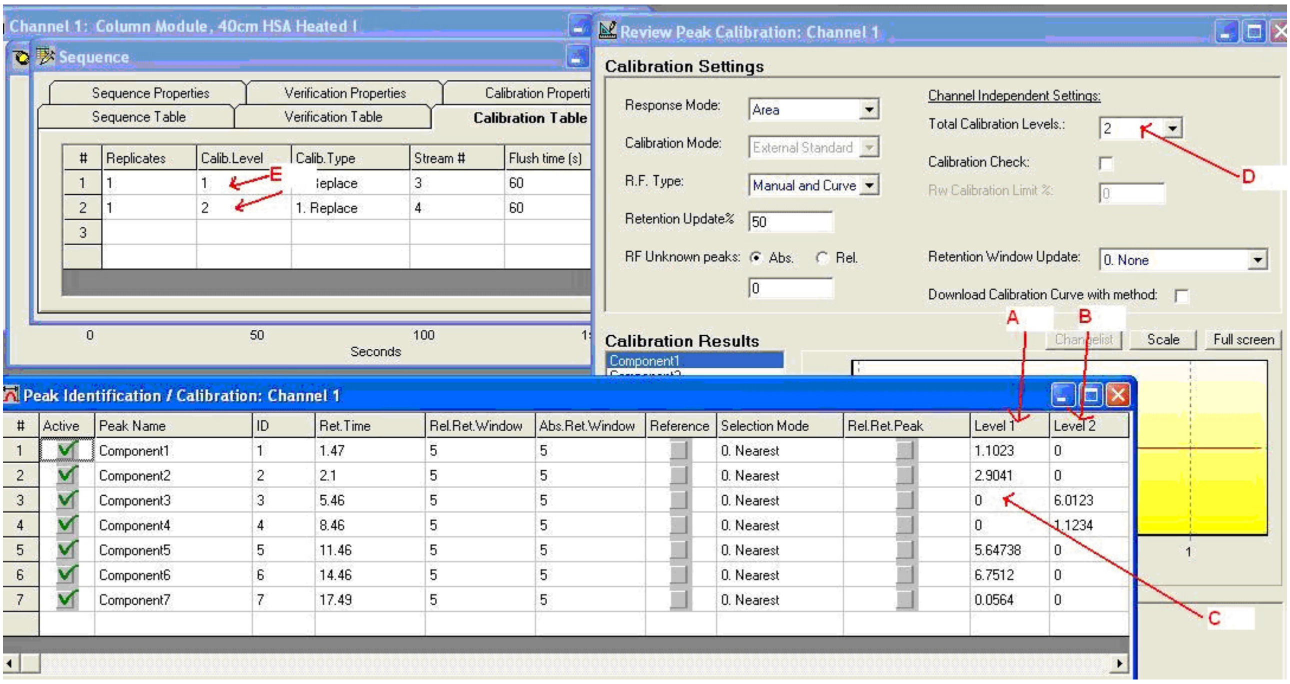
26.7 Single point calibration with multiple calibration mixtures

If multiple calibration mixtures are required because not all components are available in one calibration mixture, use multiple calibration levels. Every level represents a calibration mixture

26.7.1 Two calibration mixtures

To setup a method and sequence with two calibration mixtures do the following:

- In the Peak identification table set the level amounts for calibration mixture 1 (A). Put a zero for not existing components in mixture 1 (C)
- In the Peak identification table set the level amounts for calibration mixture 2 (B). Put a zero for not existing components in mixture 2.
- In the Peak Calibration window set the “Total Calibration Levels” to 2. (D)
- Save and download the method.
- Setup a sequence and use the ”Cal.Level” parameter to distinguish between the two calibration mixtures



26.7.2 More than two calibration mixtures

This is identical to two calibration mixtures. Set the “Total Calibration levels” equal to the number of calibration mixtures. Fill in the level amounts in the Peak identification table and extend the calibration table of the sequence with more levels.

26.8 Multiple point calibration with multiple calibration mixtures

A combination of multiple calibration points per peak and multiple calibration mixtures containing only a subset of components as identified in the peak identification table can be handled, see picture below.
The 490-GC PRO will handle the amounts in level 3 and 4 as the second calibration point of a component, because zero values are ignored. The calibration curve will end up with two calibration points for every component.
A combination of single and multiple calibration points per peak is also possible. The 490-GC PRO will count the number of positive values in all level columns for a component.

Peak Identification / Calibration: Channel 1

#	Active	Peak Name	ID	Level 1	Level 2	Level 3	Level 4
1	✓	Component1	1	1.1	0	3.0	0
2	✓	Component2	2	2.9	0	5.2	0
3	✓	Component3	3	0	6.7	0	20.3
4	✓	Component4	4	0	1.8	0	12.5
5	✓	Component5	5	5.3	0	11.4	0
6	✓	Component6	6	6.9	0	15.7	0
7	✓	Component7	7	7.1	0	16.3	0

26.9 Calibration validation

There are two distinct methods available for validating the calibration in the 490-GC PRO: the verification run and response factor (R.F.) limit checking during a new calibration run.

26.9.1 Verification run

The Verification run can be used to verify whether the calibration curve for every component is still valid. Typically the calibration gas mixture is used for this verification, although it might be another gas sample.

The validation criteria (defined lower and upper limits) for the Verification run are configured in the 'Verification Check' window found in the 'Application' menu, see figure below.

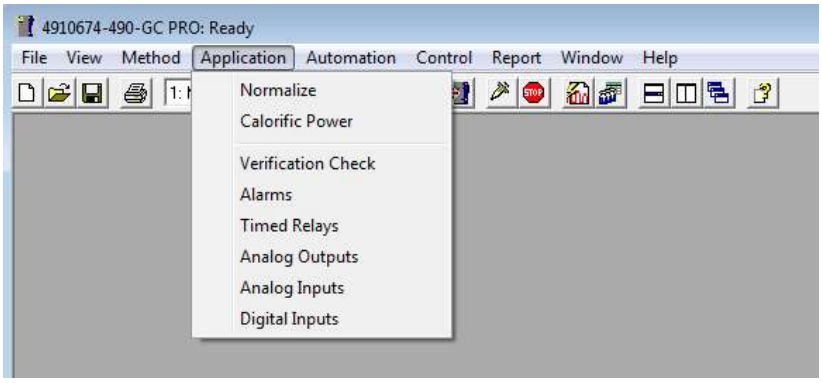


Figure: Menu option "Verification Check"

The window below contains two criteria: the Normalized Amount of Methane must be within 82.0 and 82.5, the Normalized Amount of Ethane must be within 5.1 and 5.3.
Note that the components used in this table must be defined in the 'Normalize' window part of the Application. Also 'ESTD concentrations' refer to the 'Normalize' window. Also calorific values can be checked in energy meter configurations.

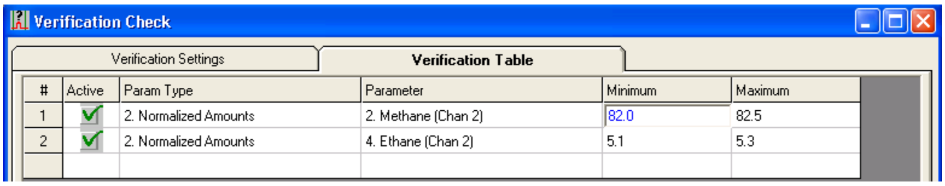


Figure: Verification table

The verification criteria must be enabled in the Verification Settings tab, see figure below.

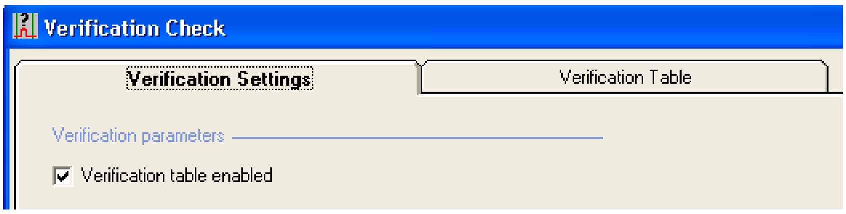


Figure: Verification Settings

After defining the verification criteria the Verfication sequence must be entered. Select the menu option Sequence, see figure below.

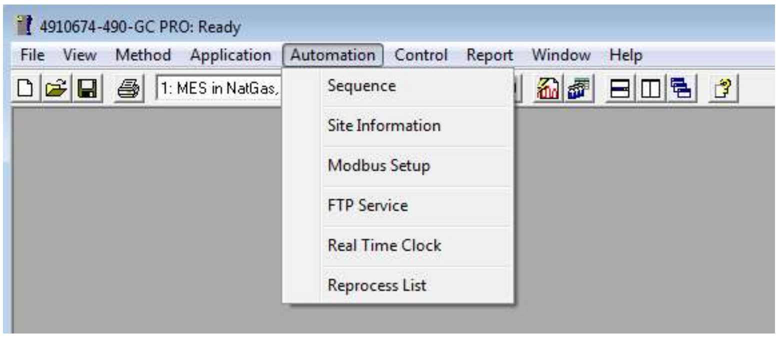


Figure: Menu option Sequence.

The Verification table contains the run (sequence of runs) parameters for a verification run. In this example the calibration mixture is sampled from stream 4. First an extra flushing of 60 seconds is performed in order to flush away sample from a previous run.

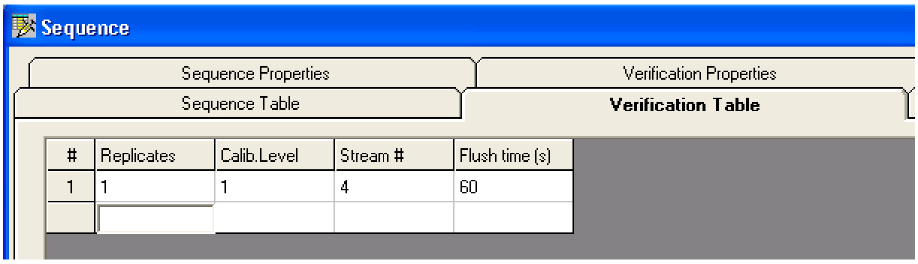


Figure: Verification Table

In the 'Verification Properties' tab, define when to perform the verification while running full automation. The figure below shows that the verification should start at 07:00 'o clock every day.

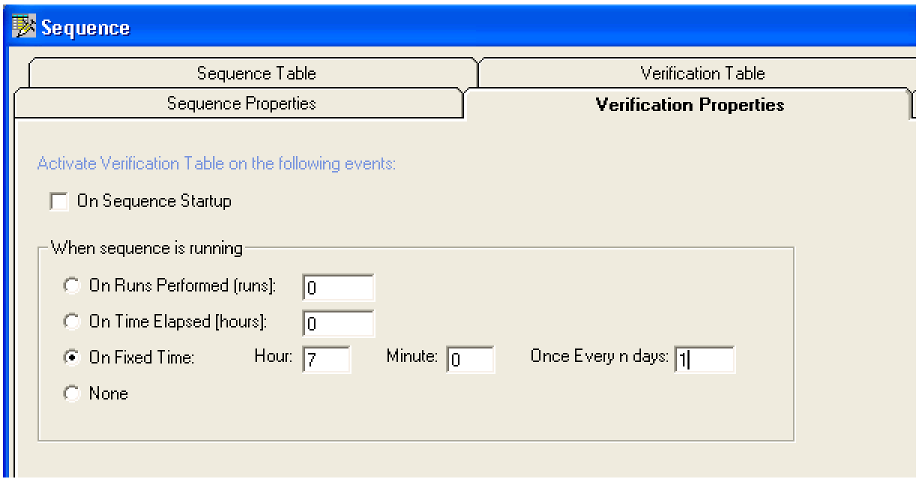


Figure: Verification properties

The result of a verification run is either pass or fail. This is reported in the Application Report. The result can be read by Modbus protocol. It is possible to use a verification failure after a verification run as a trigger to start the Calibration Table automatically, see figure below.

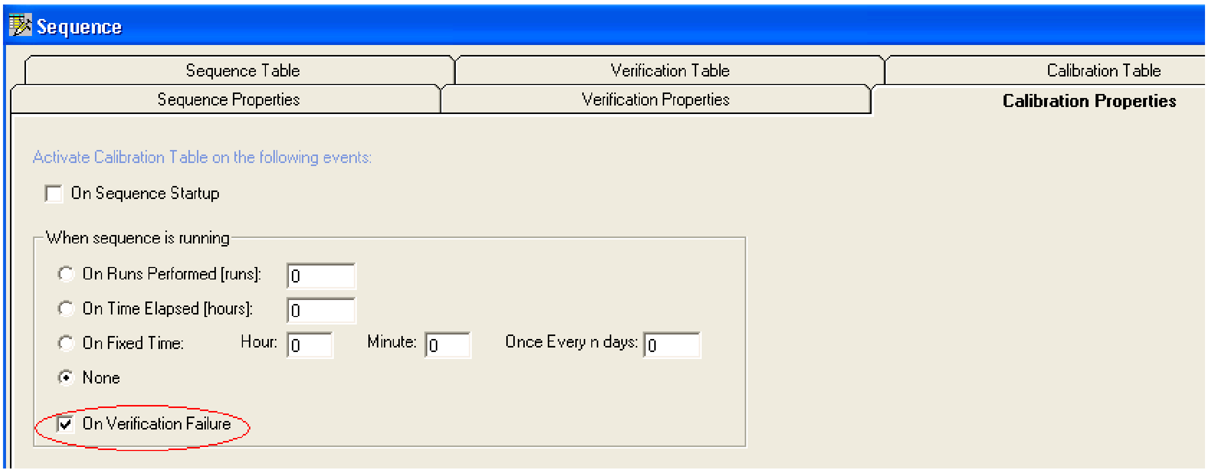


Figure: Option to start calibrating on verification failure

26.9.2 Calibration limits

The 490-GC PRO has multiple options for checking the calibration values, before accepting them. Checking of the Response Factor (RF) against the initial RF and current RF is called 'RF checking' see chapter 26.9.2.1. This is used in single level calibration.
Multi level calibration is used in combination with the so called Rw factor. The Rw factor is determined using an Rw calibration (Level 8) and tested against the Rw limit, see chapter 26.9.2.2.

26.9.2.1 RF checking

RF checking against the initial RF requires the determination of the initial RF. The initial RF can be determined like a normal calibration, only with the option 'Calibration Check' and 'Initial Calibration' enabled followed by a download of the Application, see figure below.

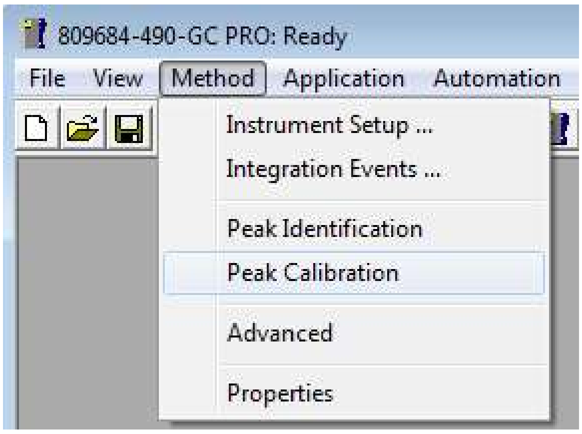


Figure: Peak Calibration

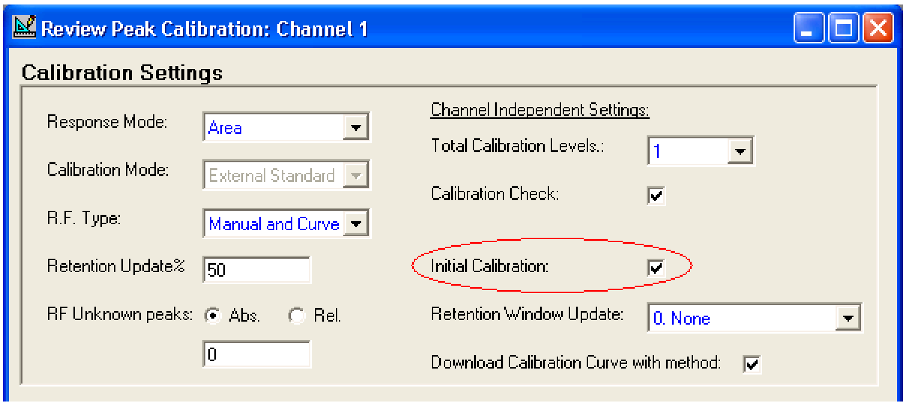


Figure: Initial Calibration

After running an Initial Calibration, the 490-GC PRO will store the value of the Initial RF for every component. In the Peak Identification table, limits can be entered for a calibration.
The settings from the screen below allow 5% deviation from the Initial RF and 5% deviation from the Current RF. These limits are only active when the option ‘Calibration Check’ is enabled.
Each component can have its own InitialRF% and CurrentRF%.
If any peak fails for Initial–- or Current R.F. validation, the entire calibration will be rejected for all peaks and the 490-GC PRO will continue using the current Response Factors determined in the last successful calibration run.

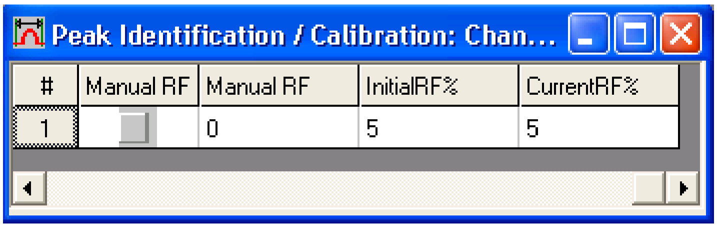


Figure: Peak Identification, limits RF

26.9.2.2 Rw Limit

An Rw calibration can be performed when a multi level calibration curve has been determined. Typically this is used in non linear calibration curves. When the multi level calibration curve is accurate, the value of the Rw factor should be around 1.0. The 490-GC PRO can be configured to test the Rw factor before accepting it. The settings of the screens below enable the testing of the Rw Limit (Calibration Check) and allow a value of 1.0 +/- 10% (0.9 till 1.1), see figures below.

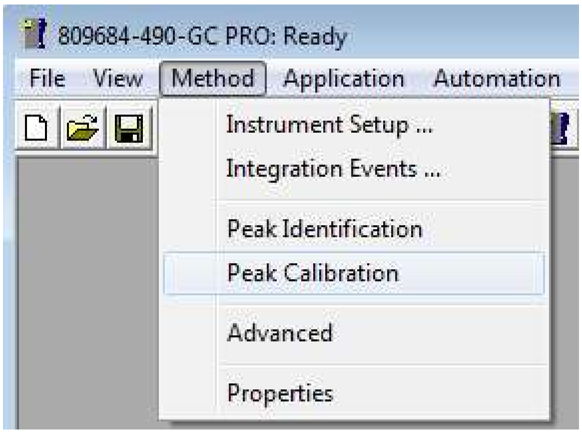


Figure: Peak Calibration

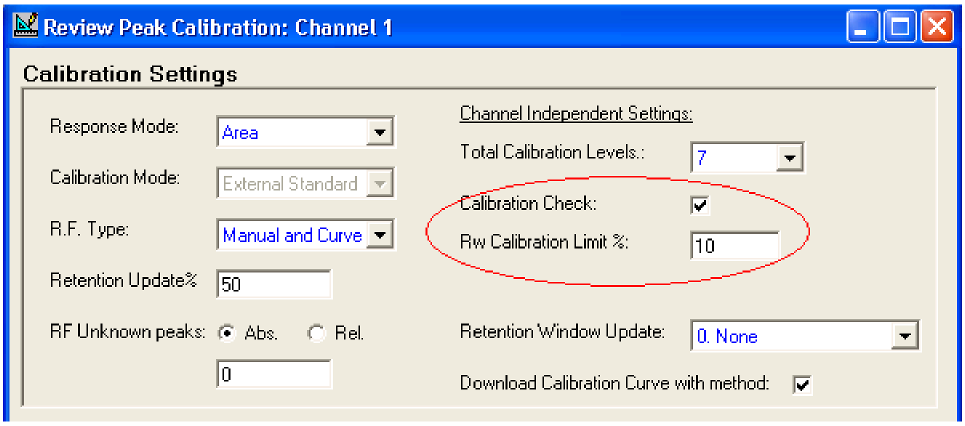


Figure: Rw Calibration Limit %

If any peak Rw exceeds its limit, the entire calibration for all peaks will be rejected and the 490-GC PRO will continue using the current Response Factors as determined in the last successful calibration run.

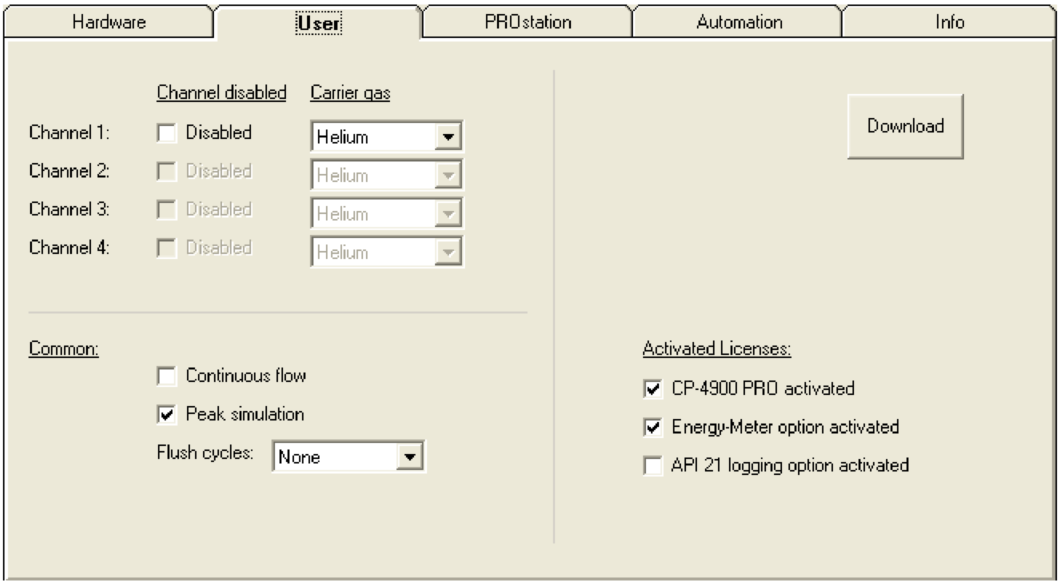
27 I/O CASES

The cases below describe how all I/O's can be configured and used in a 490-GC PRO Micro-GC. The following hardware has been used for these cases:

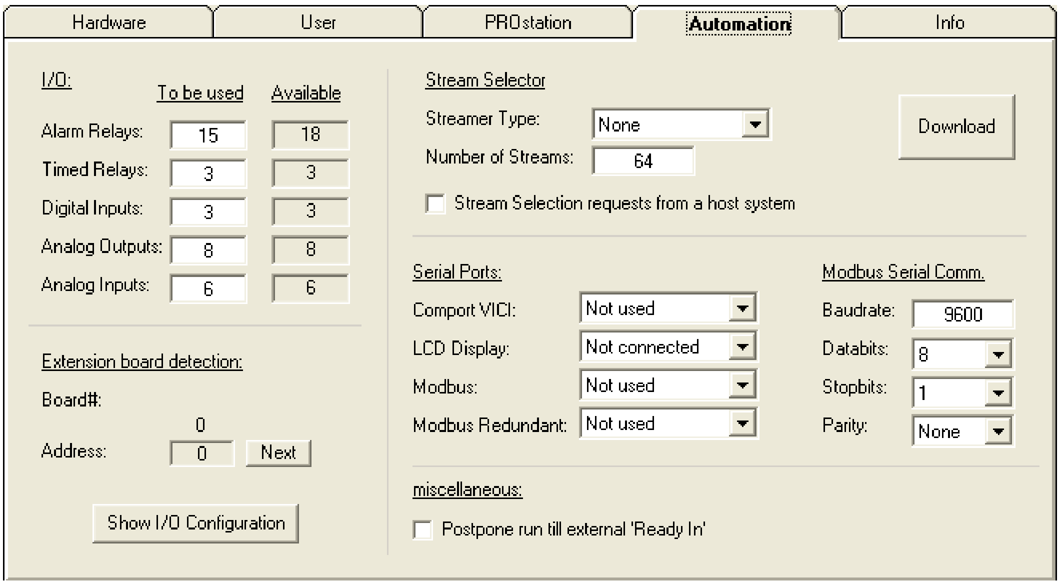
- Extension boards: basic extension board (CP741116), analog output board (CP741117), digital extension board (CP741118).
- 25-pin digital I/O interface cable & 15-pin analog I/O interface cable (CP741120)

General setup

The following licenses have been activated:

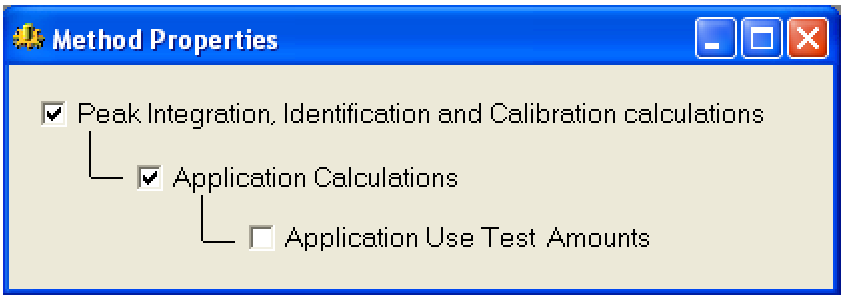


The following 490-GC setup has been configured:

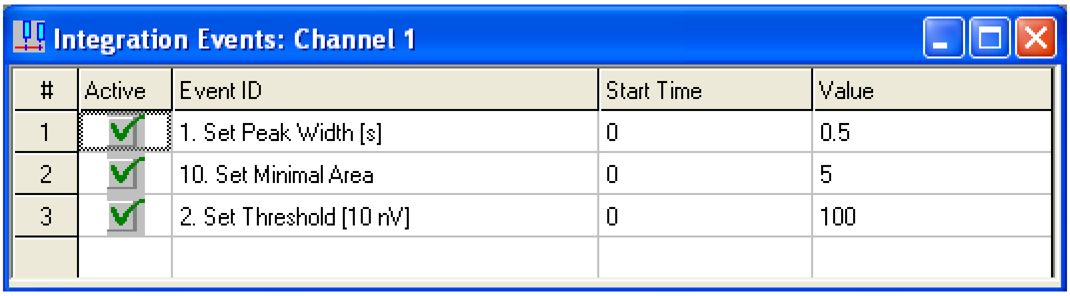


Cases preparation:

1. Perform an analysis of gas sample and make sure peak integration and calculation is enabled. Menu: Method → Properties

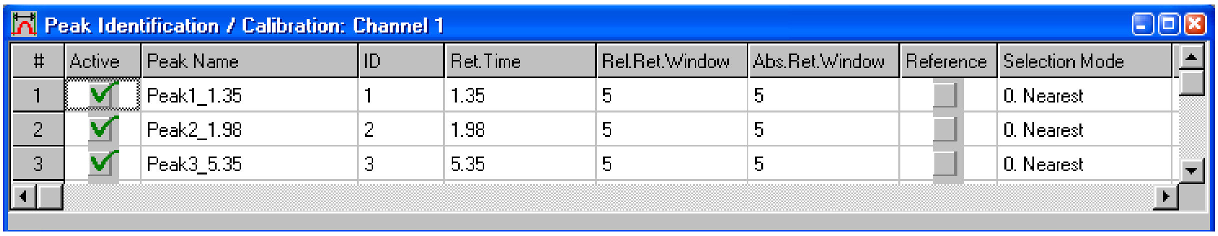


2. Make sure to enter some applicable integration events for the peaks to get properly identified



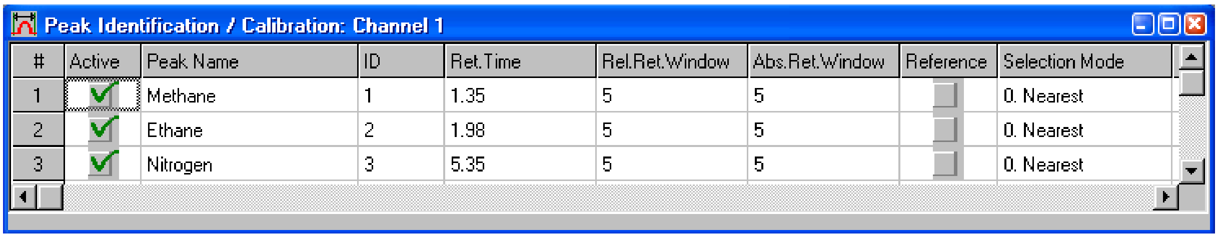
#	Active	Event ID	Start Time	Value
1	✓	1. Set Peak Width [s]	0	0.5
2	✓	10. Set Minimal Area	0	5
3	✓	2. Set Threshold [10 nV]	0	100

3. After the run has finished, all detected peaks should be visible in chromatogram and peak identification table should be filled with all detected peaks



#	Active	Peak Name	ID	Ret.Time	Rel.Ret.Window	Abs.Ret.Window	Reference	Selection Mode
1	✓	Peak1_1.35	1	1.35	5	5		0. Nearest
2	✓	Peak2_1.98	2	1.98	5	5		0. Nearest
3	✓	Peak3_5.35	3	5.35	5	5		0. Nearest

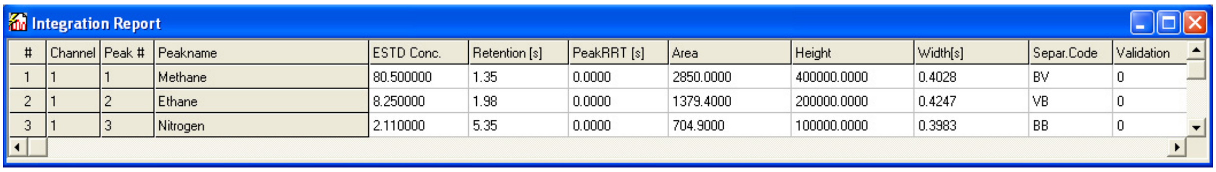
4. Name the identified peaks



#	Active	Peak Name	ID	Ret.Time	Rel.Ret.Window	Abs.Ret.Window	Reference	Selection Mode
1	✓	Methane	1	1.35	5	5		0. Nearest
2	✓	Ethane	2	1.98	5	5		0. Nearest
3	✓	Nitrogen	3	5.35	5	5		0. Nearest

Integration Report

After analysis or recalculation, the integration report is generated.

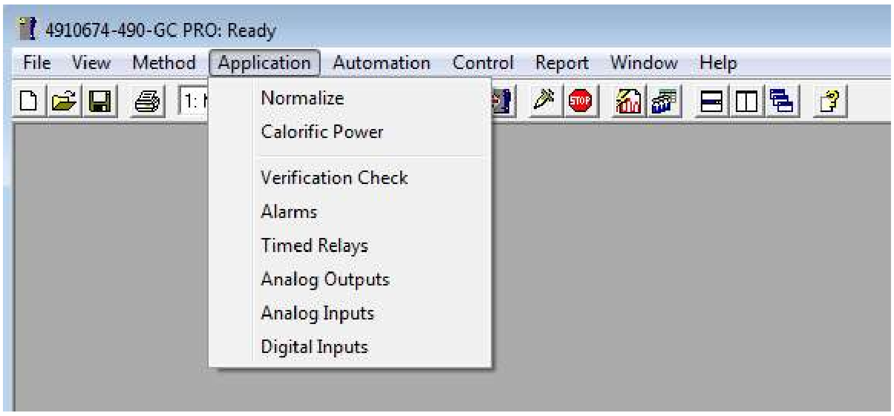


#	Channel	Peak #	Peakname	ESTD Conc.	Retention [s]	PeakRRT [s]	Area	Height	Width[s]	Separ.Code	Validation
1	1	1	Methane	80.500000	1.35	0.0000	2850.0000	400000.0000	0.4028	BV	0
2	1	2	Ethane	8.250000	1.98	0.0000	1379.4000	200000.0000	0.4247	VB	0
3	1	3	Nitrogen	2.110000	5.35	0.0000	704.9000	100000.0000	0.3983	BB	0

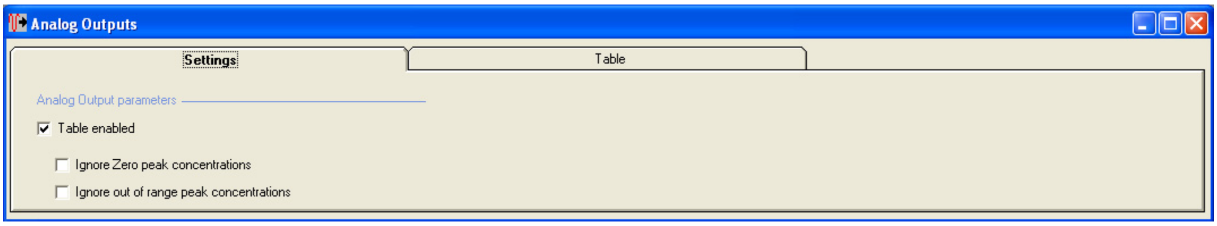
27.1 Case 1: Analog Output

This case describes the use of analog outputs. As can be seen in the automation tab on the last picture, there are 8 analog outputs configured.

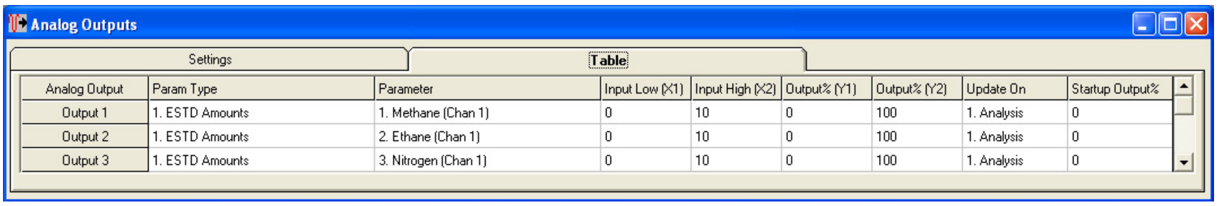
In PROstation go to Application in menubar and select Analog outputs



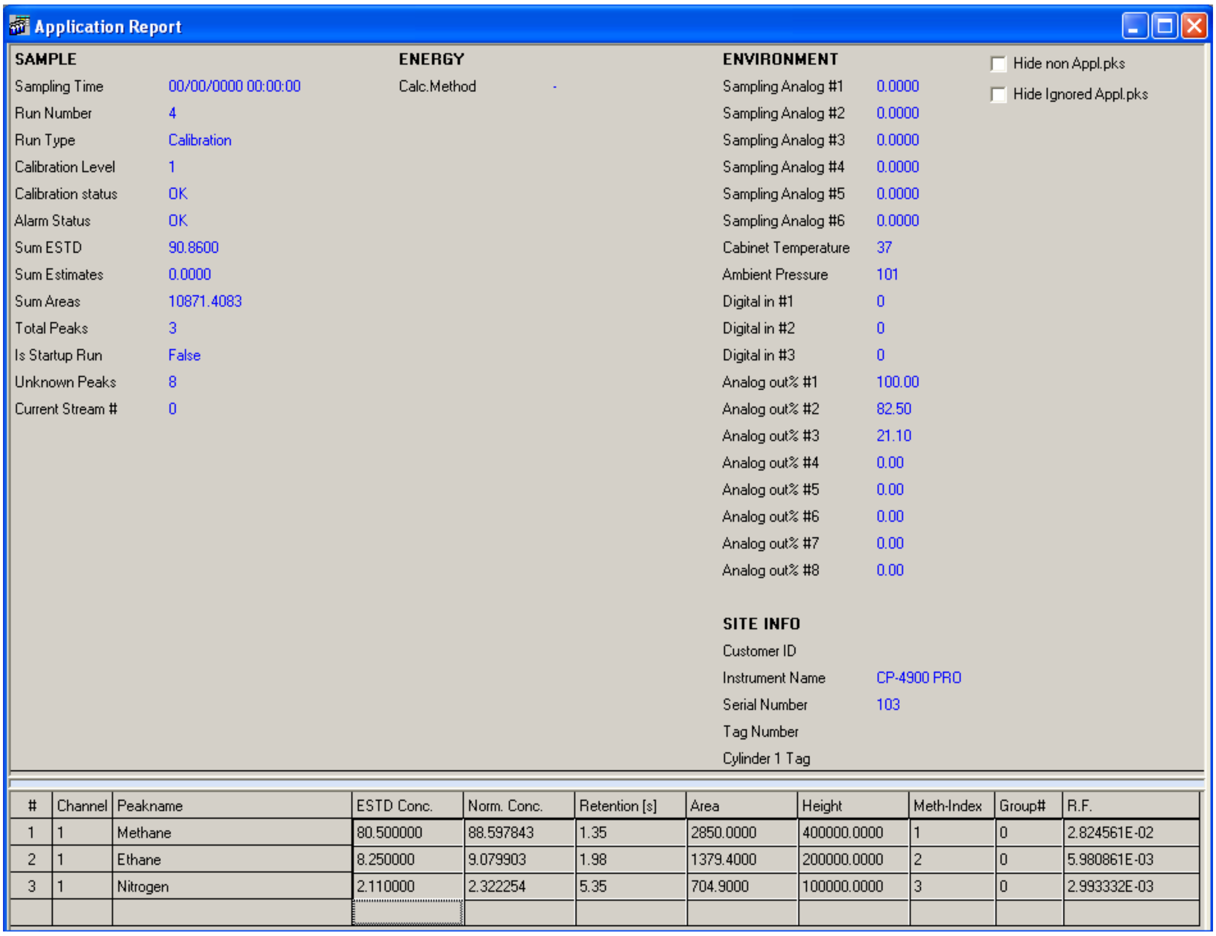
Make sure the analog outputs table is enabled by checking the checkbox



You can now scale lower and upper input values (X1, X2) to lower and upper output values (Y1, Y2) and select an occasion on which the outputs are updated.



If you look at the application report, you will see that the ESTD concentrations are properly scaled to set the specific analog output values; note that 80.5 ESTD concentration of Methane results in a 100% clipped output value, because the ESTD input value was limited to 10.


Application Report

SAMPLE

Sampling Time	00/00/0000 00:00:00
Run Number	4
Run Type	Calibration
Calibration Level	1
Calibration status	OK
Alarm Status	OK
Sum ESTD	90.8600
Sum Estimates	0.0000
Sum Areas	10871.4083
Total Peaks	3
Is Startup Run	False
Unknown Peaks	8
Current Stream #	0

ENERGY

Calc.Method	-

ENVIRONMENT

Sampling Analog #1	0.0000
Sampling Analog #2	0.0000
Sampling Analog #3	0.0000
Sampling Analog #4	0.0000
Sampling Analog #5	0.0000
Sampling Analog #6	0.0000
Cabinet Temperature	37
Ambient Pressure	101
Digital in #1	0
Digital in #2	0
Digital in #3	0
Analog out% #1	100.00
Analog out% #2	82.50
Analog out% #3	21.10
Analog out% #4	0.00
Analog out% #5	0.00
Analog out% #6	0.00
Analog out% #7	0.00
Analog out% #8	0.00

SITE INFO

Customer ID	
Instrument Name	CP-4900 PRO
Serial Number	103
Tag Number	
Cylinder 1 Tag	

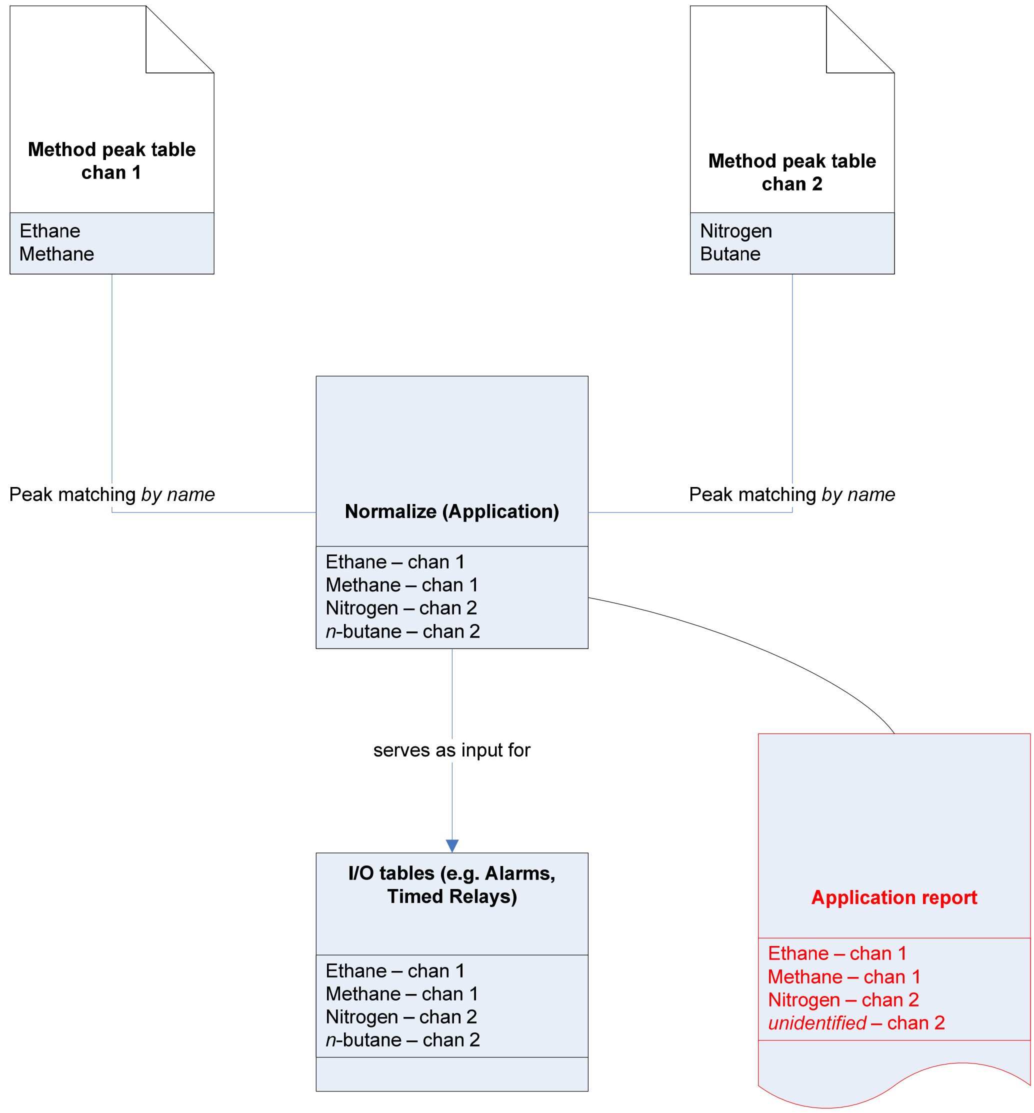
Hide non Appl.pks

Hide Ignored Appl.pks

#	Channel	Peakname	ESTD Conc.	Norm. Conc.	Retention [s]	Area	Height	Meth-Index	Group#	R.F.
1	1	Methane	80.500000	88.597843	1.35	2850.0000	400000.0000	1	0	2.824561E-02
2	1	Ethane	8.250000	9.079903	1.98	1379.4000	200000.0000	2	0	5.980861E-03
3	1	Nitrogen	2.110000	2.322254	5.35	704.9000	100000.0000	3	0	2.993332E-03

The link between the method peak tables and the Application report is defined by the normalization table. This table holds all system-wide parameters and defines which parameters are shown in the application report. On its turn the normalization table serves as an input to all I/O tables, including peak naming.

Below the schematic overview of and interaction between various tables / processes:



Normalization Table

#	Active	Peak Name	Channel	Ignore	Bridge Comp #	Estimate	Estim.Conc	Test.Conc	RefConcPeak#	RefPeakConc%	Group#
1	✓	Methane	1		0. None		0	0	0	0	0
2	✓	Ethane	1		0. None		0	0	0	0	0
3	✓	Nitrogen	1		0. None		0	0	0	0	0

Important note:
Be aware that the names in the normalization table must match the names in the peak table, otherwise wrongly named peaks (a.k.a. non-application peaks) will not show up in the report. These non-application peaks can be hidden by checking the “Hide non Appl.pks” checkbox in the application report.

27.2 Case 2: Alarms

Alarming can be used to inform the user (or a subsystem) that certain parameters are in or out of range. See table below as an example:

Alarms

Alarm Settings | **Alarm Table**

#	Active	Param Type	Parameter	Minimum	Maximum	Alarm On	Invert Alarm	Relay Alarm	Relay #	Invert Relay
1	✓	1. ESTD Amounts	1. Methanes (chan 1)	50	100	1. Analysis	✓	☐	1. Alarm Relay 1	✓
2	✓	3. Sample results	1. Sum ESTD	80	90	2. Calibration	☐	✓	2. Alarm Relay 2	
3	✓	5. Analog inputs	1. Sampling Analog Input 1	95	105	4. Verification	☐	✓	3. Alarm Relay 3	

1. The ESTD amount of Methane should be greater than 50 and less than 100. In our example the ESTD of Methane is 80.5, so this is within range and no alarming will occur.
2. The sum of all ESTD's should be greater than 80 and less than 90. The actual sum is 90.86, so the alarming condition is met and the alarm will be set.
3. Analog input #1 should be greater than 95 and less than 105. By using the analog input table, the equation for the input value can be defined. As an example, the following 'Analog Inputs' table has been defined:

Analog Inputs

Channel	Gain	Offset
1	3	5
2	2	6
3	5	0

Input x is tied to output value y by the following formula: y = *a*x + *b*, where *a* matches the 'Gain' factor and *b* matches the offset. If e.g. the analog input x (voltage) resembles the ambient pressure at time of sampling, we need to define the equation for converting Volts to Pa (or mbar if more suitable). In this specific Alarms table, line 3 should be interpreted the following way:

NOTE

If at time of sampling, pressure is less than 95 Pa or greater than 105 Pa on a verification analysis, Alarm Relay 3 will be energized. To get from input x [volts] to output value y [Pa], according to 'Analog Inputs' table the following equation should be used: y = 5x

27.3 Case 3: Timed Relays

Timed relays are relays that can be configured to switch on expiration of a selectable delay. Please consider the following example:

Timed Relays

#	Event	Delay [s]	Timed Relay	Relay State
1	4. Injection Started	20	1. Timed Relay 1	1. Energize
2	4. Injection Started	25	1. Timed Relay 1	0. De-energize
3	3. Sampling started	30	2. Timed Relay 2	1. Energize
4	3. Sampling started	35	2. Timed Relay 2	0. De-energize

Explanation:

1. 20 seconds after injection started, timed relay 1 will be energized.
2. 25 seconds after injection started, timed relay 1 will be de-energized

In other words:
relay 1 is energized for a period of 5 seconds from 20-25 seconds after start of injection.

3. 30 seconds after sampling started, timed relay 2 will be energized
4. 35 seconds after sampling started, timed relay 2 will be de-energized

In other words:
relay 2 is energized for a period of 5 seconds from 30-35 seconds after start of sampling.

Important note: this table does NOT force the relays in an initial state before they are energized, so it could well be the case that both timed relays are already energized before they are energized after expiration of the delay timer.

27.4 Case 4: Digital Inputs

Digital inputs can be used to start a function upon receiving a high-to-low transition on the input (pull to ground) or to monitor some external device status and display this status info in some report.

Digital Inputs

Digital Input	Function
Digital Input 1	4. Start Verification Table
Digital Input 2	5. Start Calibration Table
Digital Input 3	3. Stop Automation

A maximum numbers of 3 digital inputs can be configured. In the table above, an example is shown how these inputs could be set up. The descriptions speak for themselves.

28 Error handling

During operation a series of events and error messages are generated indicating start or end of certain actions and procedures as well as occurrence of smaller and fatal errors somewhere in the instrument. This section describes how 490-GC PRO Micro-GC reacts to these events or messages.

The following error classes as well as their subsequent actions are available:

Class 0 ***Internal event.***
Basically these are only events indicating a certain procedure has started or finished. In no way do they influence proper functioning of the instrument.

Class 1 ***Advisory fault*;** the instrument continues.
These are the less-critical errors, advisory errors do not require immediate action from the user. They have minimal impact on any run in progress and thus does not need to be stopped. Class 2 error messages indicate certain malfunctions of the instrument. Some errors of this type keep the instrument from becoming ready.

Class 2 ***Critical errors*** for logging; error LED ON.
These are critical errors for which the user should be warned immediately (window-pop at workstation as well as Error-LED). The run in progress should be stopped since its results will definitely be wrong. Corrective action by the user or instrument service may be required.

Class 3 ***Fatal errors*** for logging; instrument shut-down, error LED and buzzer ON.
These are fatal errors for which the user should be warned immediately (Error-LED and Buzzer ON). An instrument shut-down will be generated. Corrective action by the user or service is required.

All errors, independent of class, should be transferred to a client reader (PROstation or web browser) connected for display (trouble shooting information) under instrument status. All Class 1 and above errors will be logged on flash.
Individual numbers are used for identifying all errors; these numbers are built using the error class and a number. Events are not numbered.

28.1 Error list:

The General Error State as stored in UserDataStore address 1219 is composed of the following items:
The error must be handled as 'CLNNN' in which C=error class (severity), L=location and NNN=error number or event number.
The Error class ('C') could be one of the following values: 0=diagnostic error, 1=advisory error, 2=critical error, 3=fatal error.
There are five locations ('L'): 0=main board, 1=channel 1, 2=channel 2, 3=channel 3 and 4=channel 4.

Table with all error and event numbers

ErrorClass©)	Error number (NNN)	Event/Error code	Description	Action needed
0	1	Init passed (event)	End of initialization phase	NA
0	2	Pressure restored	Pressure restored after Too Low Pressure	NA
0	3	Start flush cycle	Is a part of the initialization cycle	NA
0	4	Flush cycle passed	Is a part of the initialization cycle	NA
0	5	TCD calibrating	Automatic generation after method activation or download.	TCD off and temp. control to default
1	6	Too low pressure	Pressure drops below 35 kPa	Check gas supply
1	7	Pressure fault	Pressure state not ready after 5 minutes	Check gas supply or replace manifold
1	8	Low battery 1	Battery 1 low power (portable Micro-GC only)	Recharge battery
1	9	Low battery 2	Battery 2 low power (portable Micro-GC only)	Recharge battery
2	10	Sample line sensor fault	Sample line temperature sensor error	Heater turned off
2	11	Sample line temperature fault	Temperature not reached within 35 min (heater error)	Replace sample line heater
2	12	Injector temperature fault	Temperature not reached within 35 min (heater error)	Replace module
2	13	Column temperature fault	Temperature not reached within 35 min (heater error)	Replace module
1	14	TCD Temperature limit activated	Hardware protection activated	NA
0	15	EDS logging error	Unable to update EDS log	Call service
1	16	Low power supply	Voltage < 10 Volt	Recharge battery
2	17	Injector sensor fault	Injector temperature sensor error	Replace module
2	18	Column temperature sensor fault	Column temperature sensor error	Replace module
2	19	TCD control error	TCD voltage not or incorrectly set	Call service
2	20	TCD calibration failed	Any error during TCD calibration	Replace module or TCD controller board
2	21	Hardware r"set"	Instrument reset request from WS	NA
2	22	Pressure too high	Pressure > 450 kPa for at least 2 minutes	Replace manifold
3	23	Initialization error	During initialize	Call service
3	24	Internal communication error	During/after initialization, between MPU and IOC/IOE	Call service
3	25	Instrument EDS incorrect	Instrument Electronic Datasheet incorrect	Call service
3	26	EDS incorrect	Electronic Datasheet incorrect	Call service
3	27	Internal power failure	During/after initialization, internal supplies	Call service
0	28	Flush cycle aborted	Flush cycle stopped before completion	NA
0	29	GC module changed	Changing a channel (controller or module) and restarting the instrument	NA
0	30	TCD Gain calibrated	End TCD Gain calibration	NA
0	31	TCD Offset calibrated	End of Offset calibration	NA
0	32	Null String	Not used	NA
0	33	ADC reading out of range	Analog Digital Control out of range	NA
0	34	EDS Analytical Module incorrect	Electronic Data Sheet Analytical Module incorrect	NA
0	35	EDS Config checksum incorrect	Electronic Data Sheet Configuration checksum incorrect	NA
0	36	EDS Logbook checksum incorrect	Electronic Data Sheet Logbook checksum incorrect	NA
0	37	EDS Protected checksum incorrect	Electronic Data Sheet Protected checksum incorrect.	NA
0	38	EDS C.C. Config checksum incorrect	Electronic Data Sheet Channel Control checksum incorrect.	NA

Error class	Error number NNN	Event/Error code	Description	Error handling instrument
0	39	EDS C.C. Logbook checksum incorrect	Electronic Data Sheet Channel Control Logbook checksum incorrect	NA
0	40	EDS C.C. Protected checksum incorrect	Electronic Data Sheet Channel Control Protected checksum incorrect	NA
0	41	EDS A.M. Config. checksum incorrect	Electronic Data Sheet Analytical Module Configuration checksum incorrect	NA
0	42	EDS A.M. Logbook checksum incorrect	Electronic Data Sheet Analytical Module Logbook checksum incorrect	NA
0	43	EDS A.M. Protected checksum incorrect	Electronic Data Sheet Analytical Module Protected checksum incorrect	NA
0	44	EDS Config SVER incorrect	Electronic Data Sheet Configuration Structure Version incorrect	NA
0	45	EDS Protected SVER incorrect	Electronic Data Sheet Protected Structure Version incorrect	NA
0	46	EDS C.C. Config SVER incorrect	Electronic Data Sheet Channel Control Structure Version incorrect	NA
0	47	EDS C.C. Protected SVER incorrect	Electronic Data Sheet Channel Control Protected Structure Version incorrect	NA
0	48	EDS A.M. Config SVER incorrect	Electronic Data Sheet Analytical Module Configuration incorrect	NA
0	49	EDS A.M. Protected SVER incorrect	Electronic Data Sheet Analytical Module Protected Structure Version incorrect	NA
0	50	Pressure Offset calibration complete	Notification Pressure Offset calibration is completed	NA
0	51	Pressure Offset calibration Failed	Calibration offset out of range	
0	52	Unable to store pressure offset	Pressure off set is out of valid range (range??)	
2	53	Temperature sensor disconnected	Temperature sensor not connect to instrument	Call Service
1	54	Not ready to start run	Issued by Safety Control Object in Hardware domain. Bridge Call to GC domain (Reporting Not Ready To Start Run Error)	Check Method
1	54	Stream selection failed	Stream selector (VICI) failed switching	Chck Valve
1	55	Ambient pressure or temperature alarm	Issued by Safety Control Object in Hardware domain whenever ambient temperature has passed a certain value.	
1	56	Column cleaning	Instrument in column cleaning state	NA
1	57	Equilibrating temperature zones	Instrument stabilizing after column cleaning	Wait till Ready
	60	DMD control to temperature setpoint	Notification that DMD is warming up.	Wait for completion
0	61	DMD start run		NA
0	62	DMD stop run		NA
0	63	DMD start tuning		NA
1	64	DMD case temperature error	Case Temperature reading is outside of acceptable tolerance range	Cool down
2	65	DMD sensor temperature error	Sensor temperature is outside of acceptable tolerance range. If temperature was just reset, please wait for stabilization	Call Service
2	66	DMD method file error	The method file is not loaded or the file data is corrupted	Reboot
2	67	DMD sensor voltage error	Saturated ± sensor readings	Call service
2	68	DMD RF voltage error	RF voltage is outside of acceptable tolerance range	Call service

Error class	Error number NNN	Event/Error code	Description	Error handling instrument
2	69	DMD Vc voltage error	Compensation voltage is outside of acceptable tolerance range	Call service
1	70	DMD sensor pressure error	Sensor pressure reading is outside of acceptable range	Call service
0	71	DMD tuning process error	Tuning process fail, previously calibrated values are kept for failed compounds	Confirm presence of compound in calibration gas
1	72	DMD gas flow error	Startup gas flow diagnostic fail	Check for empty gas tank or gas line leakage/ blockage
2	73	DMD system voltage error	Main supply voltage is outside of acceptable tolerance range	Call service
2	74	DMD communication error	Internal communication error	Reboot
2	75	DMD sensor error	Startup sensor diagnostic fail	Call service
3	76	IOC Communication error	MPU is not able to communicate with IOC	Call service
3	77	Read main board EDS error	Not able to read Main board EDS	Call service
3	78	Read channel controller EDS error	Unable to read EDS controller	Call service
3	79	Read channel analytical module EDS error	Not able to read analytical module EDS	Call service
3	990	Watchdog Error: Store Application report on flash error	Internal Software Error, can’t store application report on flash memory.	Auto reboot
3	991	Watchdog Error: Store ErrorLog report on flash error	Internal Software Error, can’t store ErrorLog reprt on flash memory.	Auto reboot
3	992	Watchdog Error: Instrument frozen (hazardous error)	Internal Software Error, software hanging	Auto reboot
3	993	Watchdog Error: OOA Timer error	Internal Software Error, OOA Timer could not be created.	Auto reboot
3	994	Watchdog Error: ACE reactor stopped	Internal Software Error, ACE reactor stopped.	Auto reboot
3	995	Watchdog Error: Event pump stopped for 20 s	Internal Software Error, Event pump stopped.	Auto reboot
3	996	Watchdog Error: IOC Fatal error 0)	Internal Software Error, IOC fatal error 0	Auto reboot
3	997	Watchdog Error: IOC Fatal error 1)	Internal Software Error, IOC fatal error 1	Auto reboot
3	998	Watchdog Error: IOC Fatal error 2)	Internal Software Error, IOC fatal error 2	Auto reboot
3	999	Watchdog Error: IOC Fatal error 3)	Internal Software Error, IOC fatal error 3	Auto reboot

29 WinDCS

The 490-GC PRO can be connected to a DCS (Distributed Control System) via Modbus on page 194. Before connecting check if the Modbus table downloaded to the 490-GC PRO is correct and communication parameters as well as communication hardware are correct. WinDCS simulates a Modbus master. By running WinDCS, real 490-GC data provided via Modbus can be validated.

NOTE

WinDCS must not be used to prove modbus communication stability.
WinDCS must not be used to continuously monitor analysis results.
It is only designed to validate registers.

First setup the Modbus table in PROstation, containing all the Modbus registers you want to provide to a DCS. Second setup the identical register numbers in WinDCS.

The WinDCS program consists of two part: a communication part and a table part. Both parts are discussed in the following chapters.

29.1 Setting up the WinDCS communication

To show the communication part click on the “Connect” button or select “Start communication” from the command menu.

Win DCS has 2 communication modi: Modbus Serial and Modbus TCP/IP. Also an offline mode is available.

29.1.1 Serial communication Settings

The following serial port parameter can be set:

- **Comport**
  Any of the PC’s comports can be selected to communicate with the Instrument.

- **Baudrate**
  Baudrate of the serial connection. The speed in characters per second in which data is transmitted over the serial connection between the GC and the DCS system.

- **Slave address**
  The Slave address of the 490-GC PRO as setup in PROstation.

- **Serial Protocol Mode**

  RTU
  RTU (Remote Terminal Unit)

  ASCII
  ASCII is a standard for sending over information (American Standard Code for Information Interchange).

  Note: Make sure this is identical to the Modbus setting as selected in PROstation.

29.1.2 Ethernet Communication settings

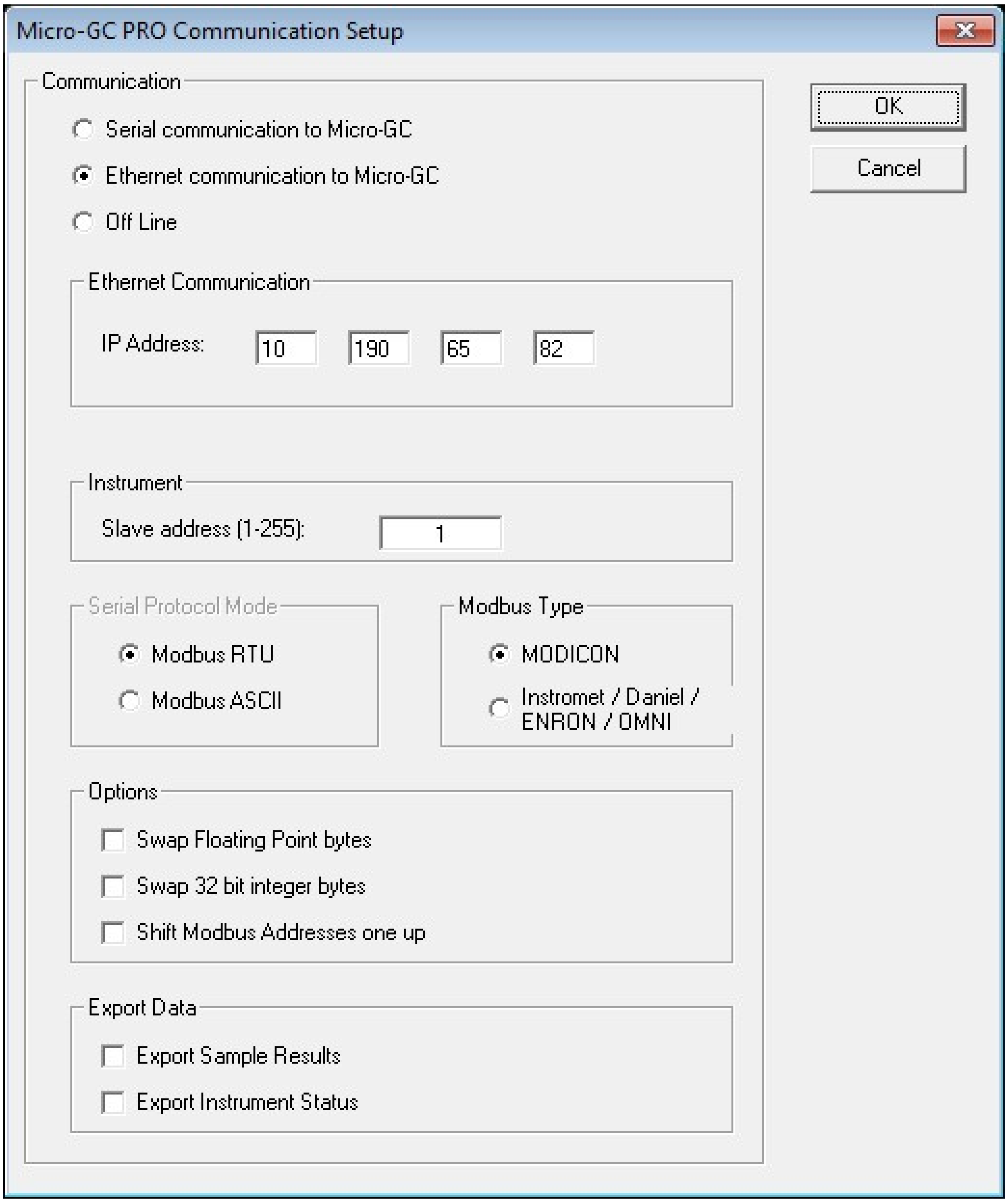
When selecting Ethernet communication settings, some fields in the layout of the communication settings will change and some will be disabled, since they are only valid when using Serial Communication. Modbus ASCII and Modbus RTU do not exist in Modbus TCP/IP.

29.1.2.1 IPAddress

Fill in the IP address of the 490-GC PRO you want to connect to.

29.1.2.2 Slave Address

The Slave address in Modbus TCP/IP is only used if a modbus bridge is used converting Modbus TCP/IP to serial. If this is not the case select 1.



29.1.3 General Modbus communication settings

If communication is set to a mode other than ‘Offline’, WinDCS will try to connect to the 490-GC PRO as soon as the OK button is clicked.

29.1.3.1 ModbusType

MODICON / Daniel and others
Change the protocol from standard MODICON to other derived protocols.

Difference will only be found in the holding and input registers above the address 5000 range and above the 7000 range. Above address 4999 the non-MODICON protocol will return 4 byte integers, above 6999 the protocol will provide 4 bytes floating point values.

29.1.3.2 Options

Swap Floating-Point bytes
A floating point consists of 4 bytes. Swapping floating points means that the first two bytes are swapped with the last two bytes. This option won’t be needed for connecting to the 490-GC PRO.

Swap 32 bit integer bytes
A 32-bit integer consists of 4 bytes. Swapping 32 bit integers means that the first two bytes are swapped with the last two bytes. This option won’t be needed for connecting to the 490-GC PRO.

Shift Modbus register one up
Some Modbus applications or Modbus devices count Modbus registers starting with 0 instead of 1, while the register count shown to the user starts at 1. When the Modbus table in such an application or device shows Register 7001, it will send a request for register 7000. This option won’t be needed for connecting to the 490-GC PRO.

29.1.3.3 Export Data

Export Sample Results
With selecting this option, Sample results recorded from the 490-GC PRO are stored on disk in the file WinDCS_Analysis.txt, located in the directory where WinDCS is installed.

Export Instrument Status
With selecting this option, Instrument Status recorded from the 490-GC PRO is stored on disk in the file WinDCS_Status.txt, located in the directory where WinDCS is installed.

29.2 WinDCS Modbus table

The Modbus table of WinDCS is quite similar to the Modbus table in the 490-GC PRO and PROstation or to any other Modbus table, but there are some differences.

29.2.1 Register type

In the WinDCS Modbus table, 4 types of Modbus registers can be used in the 'register' column:

Input Status(R): This is a single bit. Can only be read from the 490-GC PRO.

Coil status (RW): This is a single bit. Can be read from and written to the 490-GC PRO.

Input register (R): This is an integer register; Can only be read from the 490-GC PRO.

Holding register (RW): This is an integer register; Can be read from and written to the 490-GC PRO.

29.2.2 Data type

In the WinDCS Modbus table, 4 Datatypes can be used in the 'Type' column:

Bit: a single 0 or 1 value
Int16: 16-bit integer value.
Int32: 32-bit integer value.
Float: 4-byte floating-point value.

Note: Make sure the data type used is identical to the data type used in the PROstation table.

29.2.3 WinDCS Modbus Table Set-up

Register Type	Register #	Data Type	Parameter ID.	Channel	Peak#
0. Coil Status (RW)	1	0. Bit	16. Start Automation (Execute Cmd, MB)	0. Main board	0
0. Coil Status (RW)	2	0. Bit	17. Stop Automation (Execute Cmd, MB)	0. Main board	0
0. Coil Status (RW)	3	0. Bit	25. Start Verification Table (Execute Cmd, MB)	0. Main board	0
3. Input Register (R)	1	2. Int32	102. Status: Instrument State (Int32, MB)	0. Main board	0
3. Input Register (R)	3	2. Int32	103. Status: Cabinet Temperature (Int32, MB)	0. Main board	0
3. Input Register (R)	5	3. Float	104. Status: Ambient Pressure (Double, MB)	0. Main board	0
3. Input Register (R)	7	2. Int32	132. Status: Error Number (Int32, MB)	0. Main board	0
3. Input Register (R)	9	3. Float	105. Status: Power Supply Voltage (Double, MB)	0. Main board	0
3. Input Register (R)	11	2. Int32	2205. Application: Stream Position (Int32, MB)	0. Main board	0
2. Holding Register (RW)	13	2. Int32	2202. Sync: Data available counter (Int32, MB)	0. Main board	0
2. Holding Register (RW)	15	2. Int32	2201. Sync: Data available with reset(Int32, MB)	0. Main board	0
2. Holding Register (RW)	17	2. Int32	2216. Application: Total Peaks (Int32, MB)	0. Main board	0
2. Holding Register (RW)	19	2. Int32	2400. Appl.: Stream Component ESTD(Double, CHAN=stream, PEAK)	1. Stream 1	2
2. Holding Register (RW)	21	2. Int32	2400. Appl.: Stream Component ESTD(Double, CHAN=stream, PEAK)	2. Stream 2	2

All Modbus registers that are defined in the Modbus table in PROstation, should also be defined in the Modbus Table of WinDCS (or at least the ones you want to test). Make sure that address, type and datatype of all registers are the same as the registers in the Modbus table of the 490-GC PRO.

Opposite to the table in the 490-GC PRO, the registers are divided over the different parts of the WinDCS Modbus Table. The Register table of WinDCS consists of 4 parts. All registers in each part have a particular meaning. This way WinDCS is a neat testing tool. Registers used for GC Status, are put in the yellow part. Registers used for sending commands, are put in the pink part, new analysis data trigger in the green part and analysis results in the purple part.

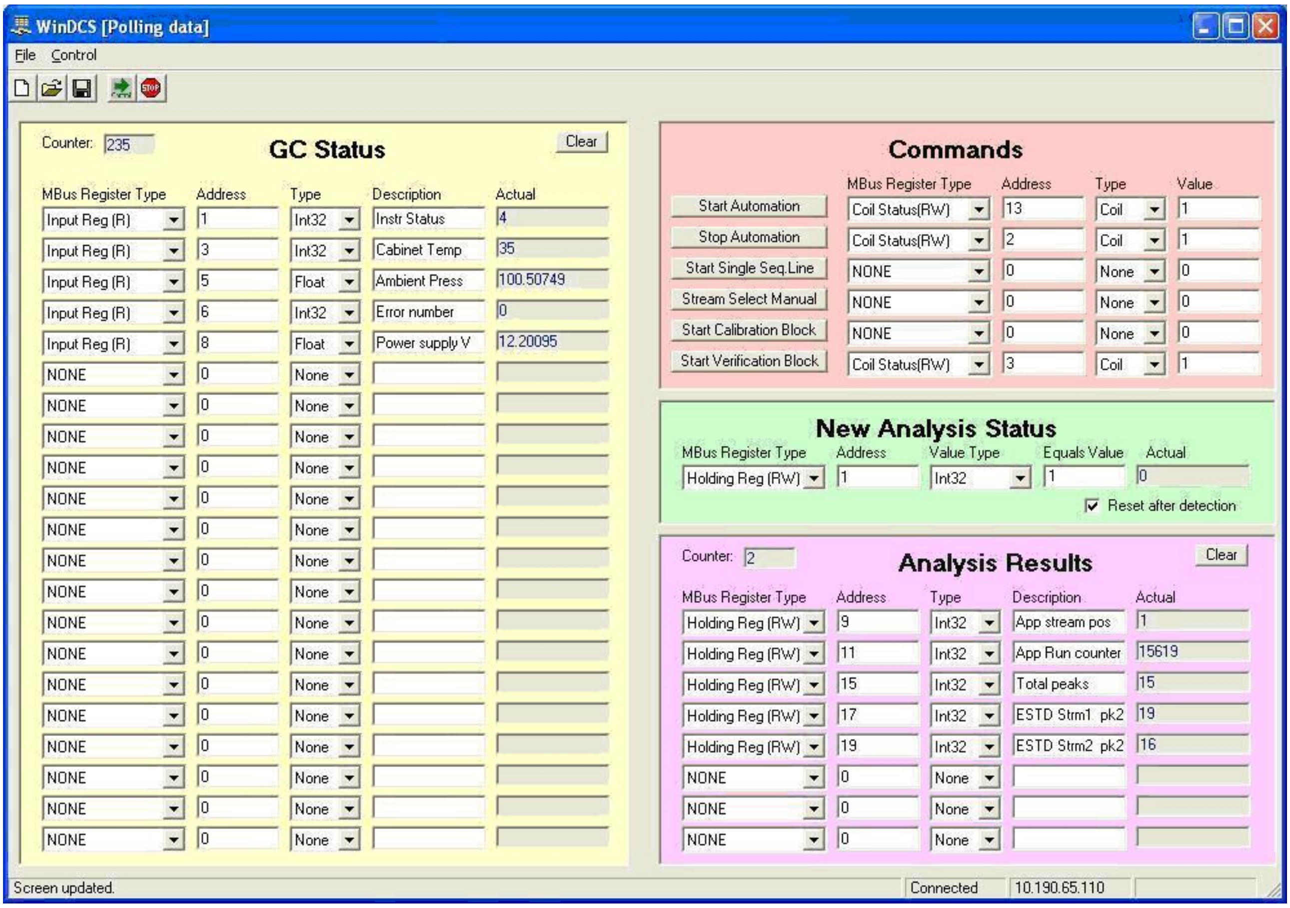
GCStatus – Yellow part
The Yellow part should contain Instrument status and it will be requested every 2 seconds.
The clear button resets all the actual values that were received the last cycle. The clear button does not reset the counter. The counter is reset each time the connection is closed and re-established again.

Commands – Pink part
The pink part should contain commands that can be fired to the 490-GC PRO.

New Sample Data detection – Green part
The Green part should contain the data available trigger as specified in the 490-GC PRO Modbus table. Make sure that both 490-GC PRO and WinDCS have the same setting for resetting. In the example, WinDCS has a trigger that will be reset after reading, and the 490-GC PRO knows that by means of the parameter selected (Modbus register 15 – Parameter ID 2201)

Sample results – Purple part
The purple part should contain sample data and it will be updated every time the data available trigger (in the green part) gets the trigger value as specified (Equals Value).

Note that editing the Modbus table of WinDCS is only possible when WinDCS is not connected (or trying to connect) to a 490-GC PRO or other device.


WinDCS [Polling data]
File Control
Counter: 235
GC Status
Clear
MBus Register Type
Address
Type
Description
Actual
Input Reg (R) 1 Int32 Instr Status 4
Input Reg (R) 3 Int32 Cabinet Temp 35
Input Reg (R) 5 Float Ambient Press 100.50749
Input Reg (R) 6 Int32 Error number 0
Input Reg (R) 8 Float Power supply V 12.20095
Commands
Start Automation Coil Status(RW) 13 Coil 1
Stop Automation Coil Status(RW) 2 Coil 1
Start Single Seq.Line NONE 0 None 0
Stream Select Manual NONE 0 None 0
Start Calibration Block NONE 0 None 0
Start Verification Block Coil Status(RW) 3 Coil 1
New Analysis Status
MBus Register Type Address Value Type Equals Value Actual
Holding Reg (RW) 1 Int32 1 0
Reset after detection
Counter: 2
Analysis Results
Clear
Holding Reg (RW) 9 Int32 App stream pos 1
Holding Reg (RW) 11 Int32 App Run counter 15619
Holding Reg (RW) 15 Int32 Total peaks 15
Holding Reg (RW) 17 Int32 ESTD Strm1 pk2 19
Holding Reg (RW) 19 Int32 ESTD Strm2 pk2 16
Screen updated.
Connected
10.190.65.110

30 History Log

This software will only run with the appropriate license installed.

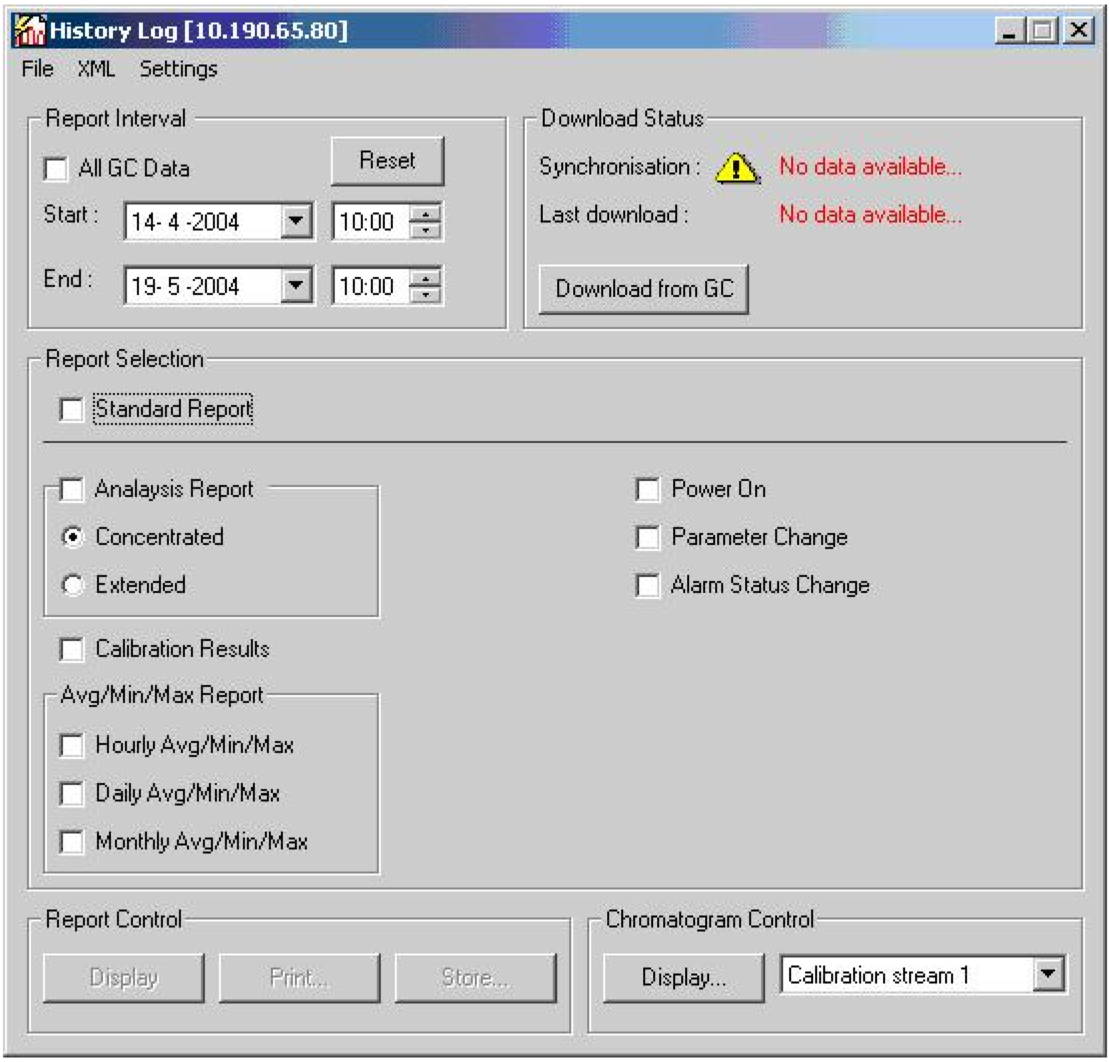
30.1 Operation

How to operate HistoryLog?

30.1.1 Starting the application

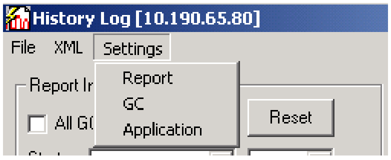
When the application 'History Log' is started for the first time, default settings are used. A default IP-address is selected. After saving a configuration, 'History Log' will start with the last configuration used. The warning 'no data available' indicates that no data is downloaded from the GC yet.

'History Log' is also started with default settings when no configuration file is found.

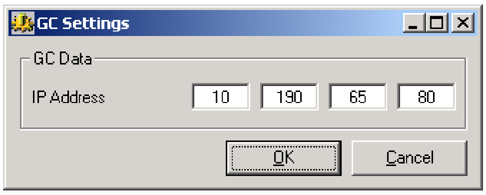


30.1.2 Set-up for data download

To download information from the 490-GC PRO, it is necessary to configure the application. Configure the IP-address where the 490-GC PRO is located by selecting: **Settings/GC**.



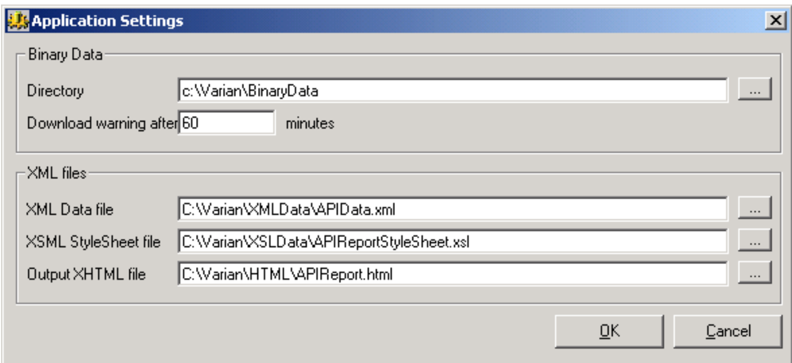
Select the IP-address where the 490-GC PRO is located in your network (Settings…GC). The IP-address is also shown in the titlebar of “History Log”.

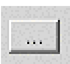


To select the files which are necessary for proper operation of History Log select: **Settings/Applications**.

In the ‘Binary Data’ window, two fields can be configured: the folder where the binary data is stored after a download. Location can be changed by pressing the button at the end of the input line.

You can also set the number of minutes after which HistoryLog will display a warning message, reminding you that data is older than the entered number of minutes.





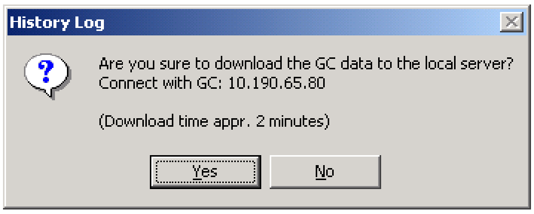
In the XML files box, the file for data storage is selected. When a non-existing *.xml file is typed, History Log will generate this file.

The XSML Style Sheet file is selected. This file is responsible for the lay-out of the output document. The XSML file is supplied with the installation.

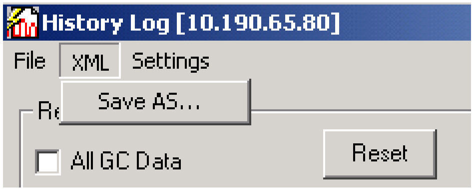
When a report is generated, it is stored in the XHTML output file. This file has an *.html extension. This file will also be generated by History Log if it does not exist.

30.1.3 Data download

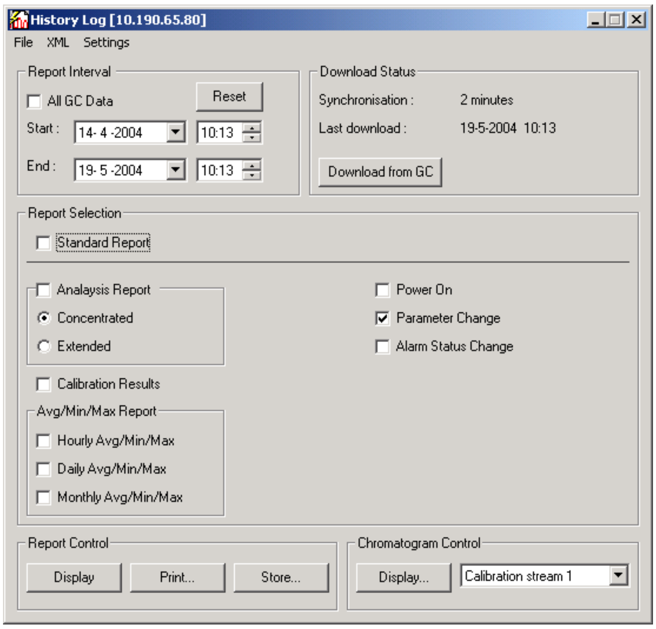
When everything is properly configured, a download can be performed. Press the button S**tart Download from GC**. When "*Yes*" is selected, a Processing bar will appear and the data is stored in the selected XML file under **'Settings/Application'**.

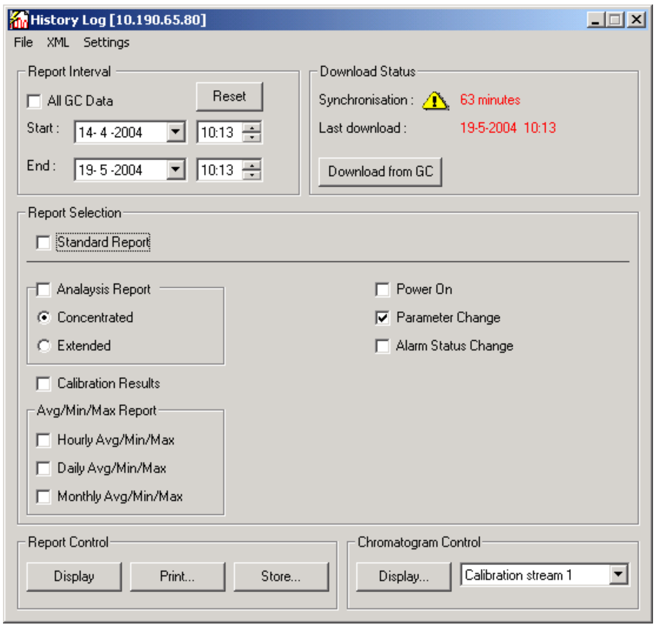


With each new download, the XML file with data from the last download is cleared and new data is stored in this file. When the last download has important data, it is possible to save this data first with the **XML/Save As** option.



After downloading the 490-GC PRO data, the screen will show that data is available and how old the data is. If the last data download exceeds the time selected in
Settings/Application a warning will appear. The text will become red and a warning icon is blinking.





30.1.4 Set-up for report

To mould the data of the *.xml file into an output *.html file with preferred data for the user, different options can be selected.

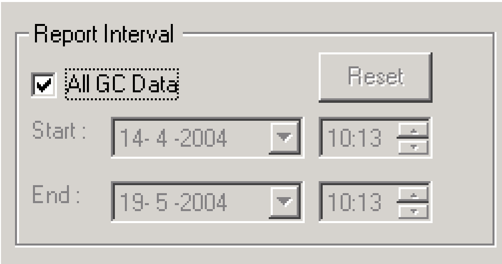
30.1.4.1 Report interval

The data which is selected as a standard of the History Log is between the date and time of download (start) and 35 days before (end)
With the arrows next to the time box it is possible to change the time, or by clicking on the time and enter a new time with the keyboard. To change the date, click on the arrow and in the drop-down menu a calendar is shown, It is also possible to change the date by clicking in the box and change the date by entering a number with the keyboard.

When the seltected time exceeds the end date of the download, a warning will appear, because no data is available after your last download. If you want this data, a new download is necessary.

When the selected time in the start box lies before 35 days, a warning will appear. However, it is still possible that this data is available. The 490-GC PRO buffers all its data and when the 490-GC PRO was shutdown for a few days, it is possible that data from 36 days ago is still available, because its buffer was not full yet.

Another option is to select all data available. With this option all the data stored until the last download is used for the report. It is possible that data older than 35 days is displayed, because the buffer of the 490-GC PRO was not full yet.



With the reset button the original start and end date are selected again.

30.1.4.2 Report selection

Two types of report selection are possible: a standard report selection or a report selection for one time purpose.

When the standard selection is not used, the user can rapidly select the options he/she wants. For example, if for some reason the 490-GC PRO stops working now and then, it is possible to only select "power on" events to see when and in what condition the 490-GC PRO stopped. But also other analysis options can be selected see Figure 77.

With the standard selection checkbox enabled, the options selected in ***Settings/Report*** are used see Figure 78.

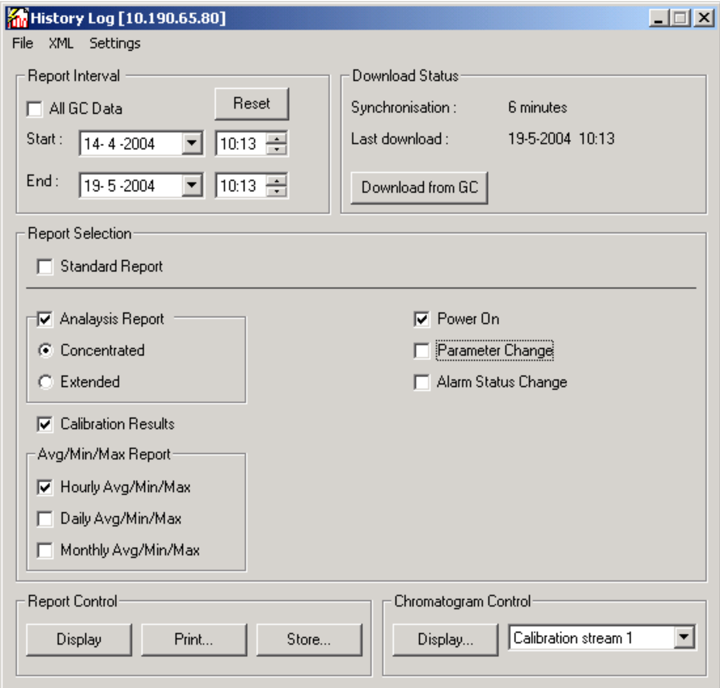


Figure 77, one time report selection

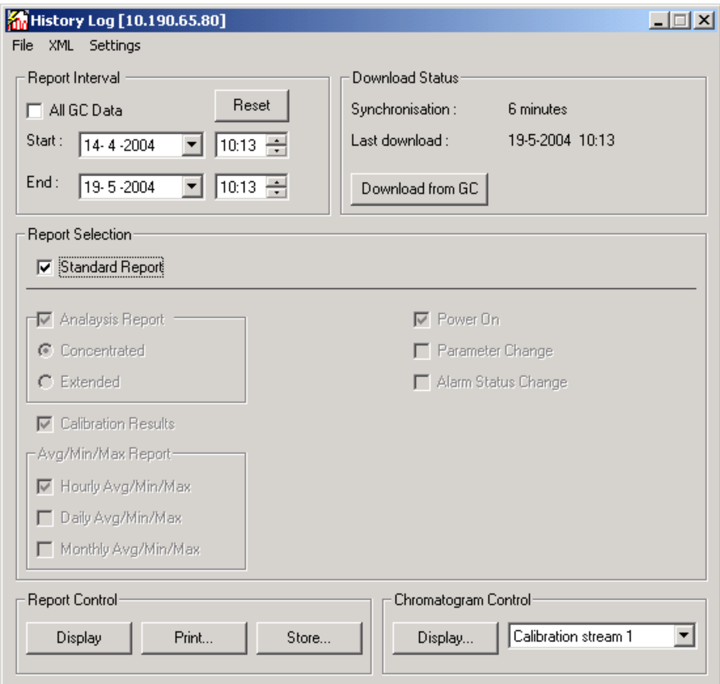
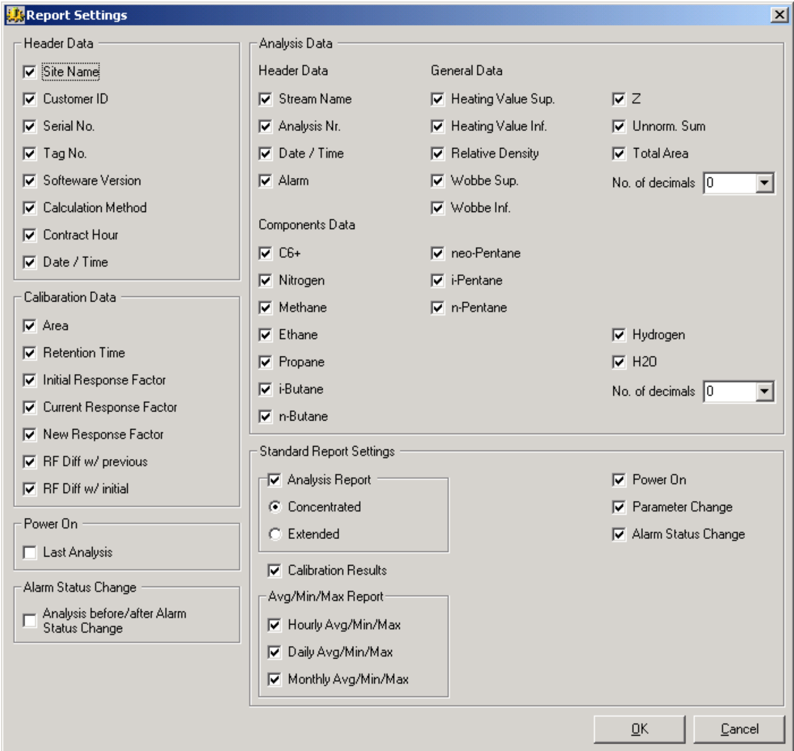


Figure 78, standard report selection

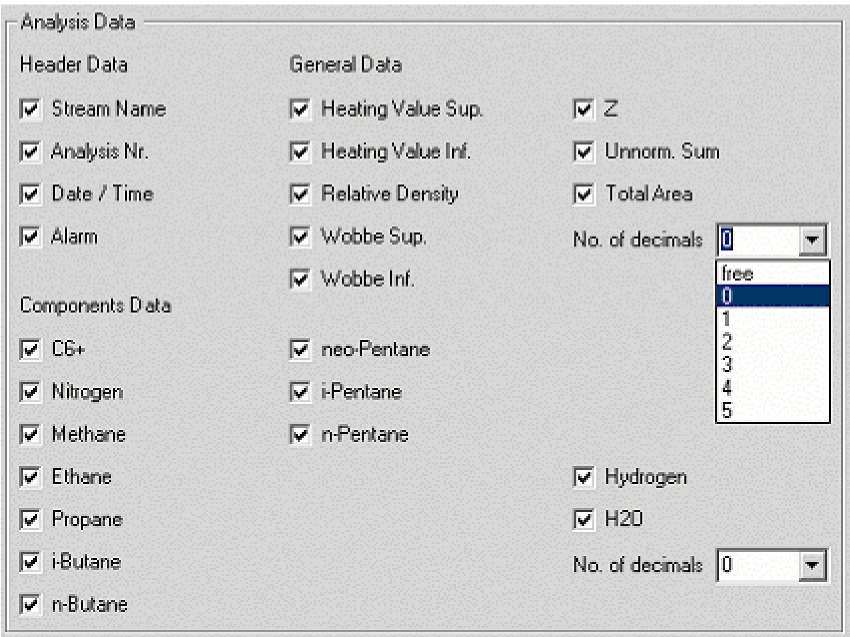
It is possible to change the standard report options in the menu **Settings/Report.**

By default all options are selected with the exception of **Power On -> Last Analysis** and **Alarm Status Change -> Analysis before/after Alarm status change.**

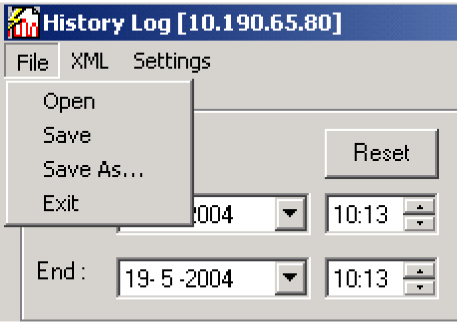


The Standard Report Settings resembles the settings for the one time report configuration.

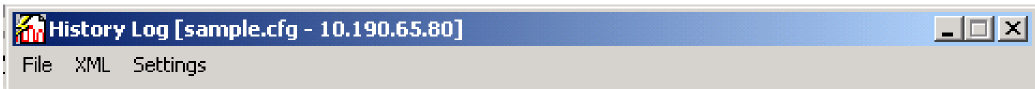
In the Header data, Calibration data, Power On, Alarm Status Change and Analysis Data all options desired can be selected. These options are used in both the ‘one time report’ as in the ‘standard report’.
For ‘Analysis Data’ it is possible to select the number of decimals used.
With the ‘free’ parameter, all decimals available in the data from the 490-GC PRO are used.



When all selections for the reports are made and are confirmed with “OK”, it is possible to save the configuration. Go to **File/Save As**.



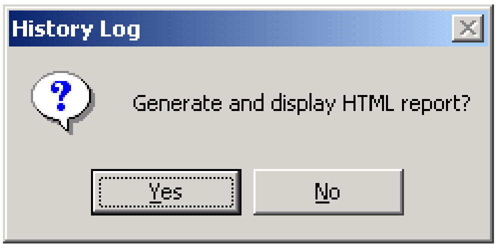
Select the directory where to save the configuration file (in this example the name “*sample.cfg*” is used). After saving the file, the next time the History Log is started this configuration is loaded. In the title bar “*sample.cfg*” and the IP-address is shown.



It is also possible to open a configuration which was already saved. Select **File/Open** and select the configuration you want to use.
When the configuration you are working in was modified, the user can save any changes by selecting **File/Save**.

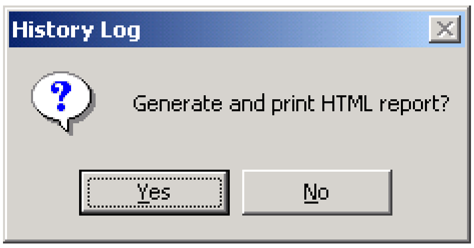
30.1.5 Report Control

In the report control box three options are available display, print and store report. When the user wants to display the report, a pop-up box appears as shown below



After confirmation, the processing bar will be shown and in your web browser the data is shown as an *.html file.

To print the report, a pop-up box appears as shown. When “*Yes*” is selected the default printer screen is shown (see Figure 79); this screen could differ for every computer.



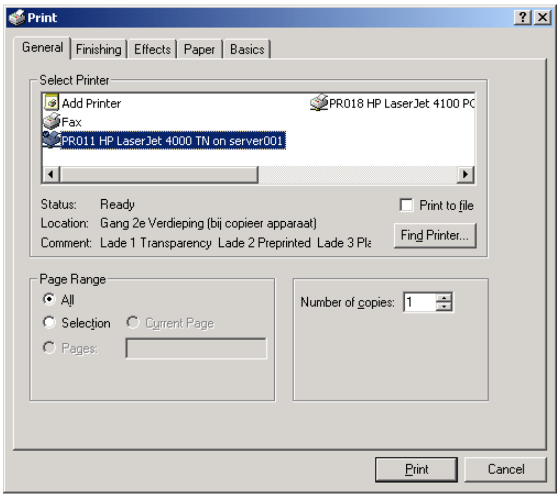
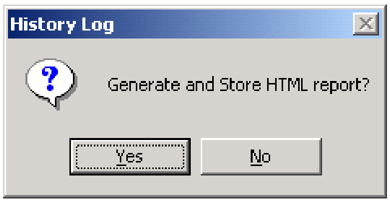
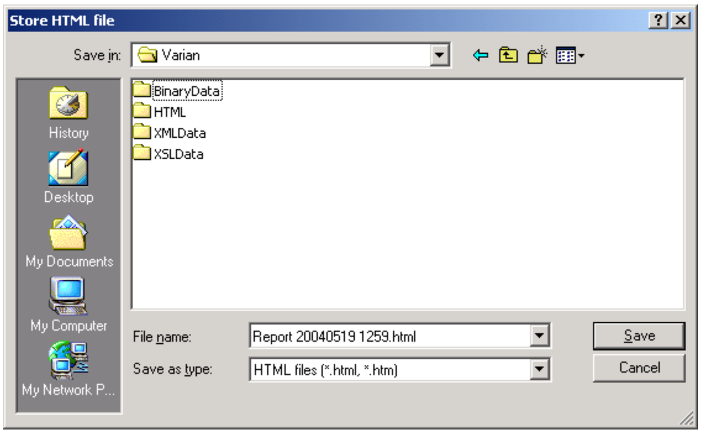


Figure 79, default printer screen

After selecting **Print** the report is printed.

The last option is to store the report. By clicking store the pop-up will appear. After confirmation the file can be stored in the selected directory.



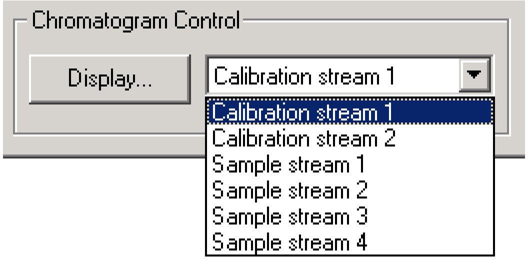


The file is stored in *.html format and gets a date and time stamp automatically. The name can be changed in a more intuitive name, like “power on events 20040519 1259.html”.

30.1.6 Chromatogram Control

With chromatogram control it is possible to show the analysis chromatogram for:

- the last five alarms;
- the last calibration for all two calibration streams;
- the last sample stream for all four sample streams.



After the selection shown and the display button is pressed the processing bar will appear and the chromatogram for the selected option is shown.

30.1.7 Exit History Log

When you want to exit the History Log you can select **File/Exit**. The application will exit. When a change is made to the configuration a pop-up box will appear.

To save the settings click Yes, to ignore the changes click No, to stop exiting click Cancel.

30.2 Report Data

HistoryLog can generate different type of reportings.

30.2.1 Header

Every report has a header. In this header information about the company selected in report settings is shown. For example when the checkboxes Site Name, Company ID and Software Version are selected, these items are shown in the header.

30.2.2 Calibration Results

If the checkbox Calibration Results is selected, calibration data is shown. In the report settings it is possible to select some options to be shown in the report, for example Area, Retention Time and Initial Response factor.

30.2.3 Analysis Data

When analysis data is selected it is possible to display the data concentrated or extended. In the concentrated version all data is placed on one line after each other. In the extended version all data is stretched out in separated headers. This makes it easier to read one analysis. However for a lot of analysis the concentrated report is preferred.

In the report settings all options for general and component data for the analysis can be selected. It is also possible to configure the number of digitals. When 'free' is selected, all digitals available are shown in the analysis data.

30.2.4 Avg/Min/Max

The Avg/Min/Max makes it possible to see the average, minimum and maximum values of all selected general and component analysis for every stream.

There are three types of Avg/Min/Max:
- Hourly;
- Daily;
- Monthly;

When an hourly Avg/Min/Max is selected and two days are filtered then 48 separate data of Average, Minimum and Maximum are shown. For each stream there is also an Average, Minimum and Maximum available, which means that 4 * 48 analyses are shown.

The Avg/Min/Max report is dependant on the contract hour. For example the contract hour is set on 06:00:00 and the filter is between 12 may 07:00 and 17 may 07:00, then for a daily report 13, 15, 16 and 17 may are displayed (until 18 may 05:59). The selection is ON 06:00 AM!

This selection is also for monthly report. The month starts on the first day of the month. When the filter is selected between 02 March and 02 May, two months will be displayed April and May. March is not displayed because the trigger is set on the first day of the month.

For an hourly report the contract hour is not used.

In the Micro-GC PRO no distinction is made between standard time and daylight saving time, so mind out that the time stamp of the data in this switch is not changed and might have a different time stamp than you expect.

30.2.5 Power On

With the Power On option it is possible to see when the Micro-GC PRO was started. Only the last ten Power On events are stored. In the report settings it is possible to enable the "*Last Analysis*" at the power on events. With this option selected the power on event and its last known analysis is shown. The user might find a reason why the Micro-GC PRO shut itself down, in case of malfunctioning.

30.2.6 Alarm Status Change

The option alarm status change displays the status when an alarm occurs or is cleared. When the option "*Analysis before/after Alarm Status Change*" is checked the analysis is displayed before and after an alarm change. With this option there is possibility to see on what condition an alarm is set or reset. In case of a malfunctioning Micro-GC PRO it might help the user a lot.

30.2.7 Parameter Change

With parameter change selected all parameters changed in the Micro-GC PRO with their old and new value. Parameters are some of the header values like contract hour, Date/Time of GC, Calculation Method, Tag No. et cetera. But also pressure and temperature settings, which are changed with the PROStation tool are displayed.