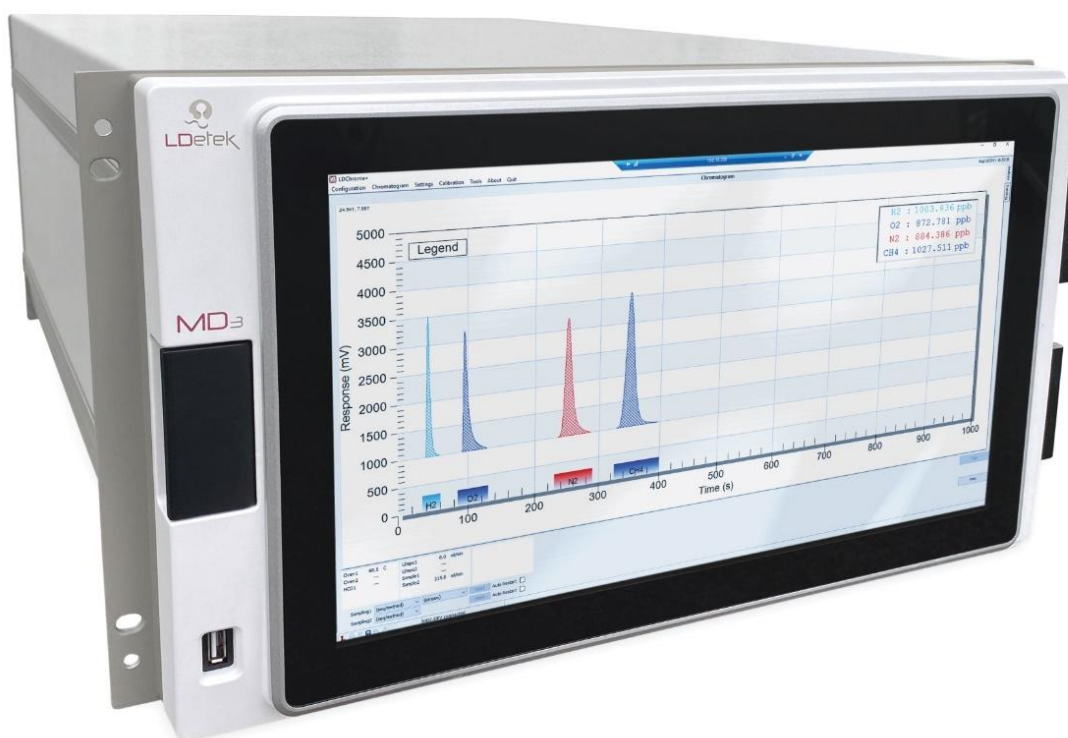




MD₃

MULTIDETEK 3

USER'S MANUAL

COMPACT GAS CHROMATOGRAPH
FOR INDUSTRIAL AND LAB APPLICATIONS



MultiDetek 3

Trace impurities analyzer

USER'S MANUAL
V1.6

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1. Forewarning

Any user that wants to use the MultiDetek3 Trace Impurity analyzer must read this manual. It contains important information to successfully operate this instrument. LDetek assumes that all operators have taken the time to read this information before installing, operating and troubleshooting this analyzer.

If any error is suspected by the reader, please contact LDetek. LDetek reserves the right to make any changes to subsequent editions of this document without prior notice to holders of this edition.

We want to thank you for choosing LDetek as your gas analyzer supplier.

2. Warranty, maintenance, and service policies

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

The Seller shall not be liable to the Buyer, or any other person, for the loss or damagedirectly or indirectly, arising from the use of the equipment of goods, from breach of anywarranty, or any other cause.

**ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED ARE HEREBYEX-
CLUDED.**

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

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

Limitations of Remedy. SELLER SHALL NOT BE LIABLE FOR DAMAGES CAUSED BY DELAY IN PERFORMANCE. THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF WARRANTY SHALL BE LIMITED TO REPAIR OR REPLACEMENT UNDER THE STANDARD WARRANTY CLAUSE. IN NO CASE, REGARDLESS OF THE FORM OF THE CAUSE OF ACTION, SHALL THE SELLER'S LIABILITY EXCEEDS THE PRICE TO THE BUYER OF THE SPECIFIC GOODS

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Major force. The seller is not liable for failure to perform due to labour strikes or acts beyond the seller's direct control.

SERVICE POLICY

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

RETURNING A PRODUCT FOR REPAIR

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

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

Other conditions and limitations may apply to international shipments.

PROPRIETARY RIGHTS

Buyer agrees that any LDetek's software, firmware and hardware products ordered or included in the goods ordered are proprietary of LDetek. No change, modification, defacement, alteration, reverse engineering, neither software de-compilations nor reproductions of such software or hardware products, or disclosures of programming content to other parties are authorized without the express written consent of LDetek.

To maintain LDetek's trade secret and other proprietary protection of such software and firmware, such items are not sold hereunder but are licensed to the buyer.

LDetek Inc. reserves the right to interrupt all business relationships and warranty or service if there is any tentative from any customers to reverse engineer any of LDetek products or to tamper with any sealed module.

Trademarks and product identification as MULTIDETEK3 are the property of LDetek Inc. and shall be used only in connection with LDetek's products. No third party could remove or deface any model number or marks.

3. Declaration of conformity

EU Declaration of Conformity



1. **Product model:** MultiDetek 3 Compact gas chromatograph

2. **Name and address of the manufacturer:**

LDetek Inc.
990 Monfette E.
Thetford Mines, QC G6G 7K6
+1 (418) 755-1319
Email: info@ldetek.com



This product is in conformity with the following EU Directives ,Standard(s) or Normative Document(s):

3. **Directives.**

Low Voltage Directive (LVD) 2014/35/EU,

Electromagnetic Compatibility Directive (EMC) 2014/30/EU,

Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU/2014/68/EU

Pressure Equipment Directive

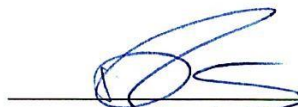
This product does not bear CE marking for the Pressure Equipment Directive, but are supplied in accordance with Article 4, paragraph 3 of 2014/68/EU by using SEP (sound engineering practice) in the design and manufacturer and are provided with adequate instructions for use.

4. **Standards:**

CISPR 32: 2015 A1: 2019, Class A : Electromagnetic compatibility of multimedia equipment - Emission requirements

EN61010-1:2010 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements

5. **On behalf of the above-named company, I declare that under our sole responsibility, on the date that the equipment accompanied by this declaration is placed on the market, it conforms with all technical and regulatory requirements of the above listed EU Directives.**



Dany Gagné / CTO
Thetford Mines, QC
Date: 03/2022

UK Declaration of Conformity



1. **Product model:** MultiDetek 3 Compact gas chromatpgraph

2. **Name and address of the manufacturer:**

LDetek Inc.
990 Monfette E.
Thetford Mines, QC G6G 7K6
+1 (418) 755-1319
Email: info@ldetek.com



This product is in conformity with the following UK Directives ,Standard(s) or Normative Document(s):

3. **Directives.**

Electrical Equipment (Safety) Regulations 2016 : S.I. 2016:1101

Electromagnetic Compatibility Regulations 2016: S.I. 2016:1091

The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 : S.I. 2012:3032

Pressure Equipment (Safety) Regulations 2016: S.I. 2016:1105

4. **On behalf of the above-named company, I declare that under our sole responsibility, on the date that the equipment accompanied by this declaration is placed on the market, it conforms with all technical and regulatory requirements of the above listed UK Directives.**



Dany Gagné / CTO
Thetford Mines, QC
Date: 03/22

4. Specifications

Gas Chromatography Detector:	• PED / TCD / FID
Online Detectors:	• Quartz Crystal Microbalance / Ceramic Metal-Oxide / Electrochemical / Zirconia
Standard features:	• Temperature-controlled process GC • 15,6'' wide touchscreen with 1366 x 768 HD resolution (IP65) • Windows 10 IoT • Ethernet ports available for remote control and Modbus • Self-diagnostic system with maintenance planning • Isothermal and/or programmable ramping ovens • Electronic flow control regulators for carrier & sample gases • 4-20 mA isolated outputs • Alarm Historic • Digital system output for remote monitoring (dry relay contact) • 2 alarms contact • High-resolution Chromatogram output
Options:	• Serial communication (RS232/485) / Profibus / Modbus / Ethernet • Compact purifier attached to the chassis for generating high-purity carrier gas • Integrated stream selector system • Digital inputs for remote starting (24V) • Analog inputs for connecting external instruments • Remote control for stream selector (LDGSS) • Split/splitless injector (can be heated) • Dual sample inlets with simultaneous analysis • Built-in online sensor module for trace moisture: Quartz Crystal (ppb/ppm) or Ceramic (ppm) • Built-in online sensor module for trace oxygen: Electrochemical (ppm) or Zirconia (ppm)
Gas connections:	• 1/8'' or 1/4'' face seal or compression fittings
Carrier pressure:	• 100 PSIG (other carrier pressure available on request)
Ambient temperature range:	• 10 °C - 45 °C
Ambient temperature control range feature:	• 20°C - 40°C (out of this range, surrounding ambient temperature must be stabilized)
Calibration gas:	• 50% to 90% of the full scale
Sample pressure:	• 5 to 30 PSIG (other pressures available on request)
Supply:	• 115 VAC, 50 – 60 Hz or 220 VAC, 50 – 60 Hz
Power consumption:	• Maximum 500 Watts
Repeatability:	• Three times the percentage of deviation (3*CV %) of each component has to be smaller than 5% on ten consecutive cycles
Accuracy:	• Better than +/- 1% error or LDL whichever is higher
LDL:	• 3 times the noise level
LOQ:	• 3 times LDL value
Long-term stability & drift:	• Three times the percentage of deviation (3*CV %) of each component has to be smaller than 10% for 8 hours
Linearity:	• For 5 points within the measuring range, the linear curve must have its R2 at a value between 0.998 and 1.00

5. Installation

5.1. Storage and handling instructions

5.1.1. Analyzer storage instructions

In order for this product to be functional upon installation it should be stored in accordance with the guidelines below:

- The product must be housed in a sheltered area, out of direct sunlight and rain.
- The product should be stored to minimize the possibility of sitting in ground water.
- The temperature within the storage environment should be maintained between +10 and +30 °C (50 and +85 °F).
- The humidity within the storage environment must be 10 to 95 %RH
- The storage environment must not expose the analyzer to any corrosive elements.
- All electrical and process connections should remain disconnected and capped.
- All protective coatings should remain in place until installation.
- Any documentation supplied with the product should be removed from the packing crate and stored elsewhere to protect its integrity.
- Storing the product for longer than 6 months could affect the time required for start-up.

5.1.2. Detector cautions

The MultiDetek3 utilizes multiple detection techniques that have been well-established in the industry for many years, including Plasma Emission Detector (PED), Flame Ionization Detector (FID), Thermal Conductivity Detector (TCD), and others upon request.

PED

The PED operates on the principle of spectroscopic emission. A pure quartz cell is placed in an electromagnetic field generated by a specific high-intensity generator. This electromagnetic field creates plasma, which emits light at different wavelengths. By using appropriate optical filters, the detector can detect the desired impurities. One of the key benefits of the PED is its ability to offer a selective mode based on the spectral line used to measure specific impurities, providing both selectivity and sensitivity.

To prevent the quartz cell from cracking, it is important to maintain **atmospheric pressure in the analyzer vent**. Any back pressure on the detector vent connection can cause damage and require the replacement of the plasma detector module. However, the PED is a low-maintenance device that does not require regular upkeep.

FID

The FID is a commonly used gas chromatography detector for the analysis of organic compounds. It operates on the principle that when organic molecules pass through a hydrogen

flame, they are ionized, creating a current that is measured. The magnitude of the current is proportional to the concentration of the organic compound. The FID requires a fuel gas (usually hydrogen) and an oxidant gas (usually air) to sustain the flame. The FID is highly sensitive to most organic compounds, making it a popular choice for a wide range of applications.

TCD

A TCD is a type of detector commonly used in gas chromatography. It operates by measuring changes in the thermal conductivity of the carrier gas flowing through the detector caused by the presence of analytes. The TCD consists of a sensing element and two reference elements, all of which are housed in an oven. When the carrier gas passes through the sensing element, it transfers heat away from a filament that is heated to a constant temperature. As the analytes pass through the sensing element, they displace the carrier gas, causing a decrease in thermal conductivity and a corresponding increase in filament temperature. This temperature change is detected and measured by the reference elements, allowing for the quantification of the analytes. The TCD is highly selective and sensitive and is commonly used for the detection of non-volatile or semi-volatile compounds, such as gases, inorganic compounds, and some organic compounds.

5.2. Analyzer application

The MultiDetek3 is specifically designed for analyzing impurities and samples as outlined in the instrument's specification sheet. Using this instrument with any **other gas type may cause damage** to the analyzer. To ensure safe and proper use, refer to the "Operating Parameters" document that accompanies the unit. It is important to note that the GC is not intended for use in hazardous areas.

5.3. Start-up

To ensure the proper start-up of the MultiDetek3, it is important to follow the steps below. All LDeTek products are carefully packaged in a sturdy cardboard box, and each instrument is accompanied by a USB drive containing relevant documentation. If you require any assistance, please do not hesitate to contact us at support@ldetek.com.

1. Carefully unpack the instrument from the box and inspect it to ensure that it is in good condition and has not been damaged during shipping.
2. Locate the documents, USB drive, fuse kit and power cables.
3. Choose whether to install the unit on a table or mount it on a rack. If mounting on a rack, refer to section 10 for panel cutout drawings and to determine the required space.
4. Carefully install the instrument in its designated location and inspect it to ensure that it is in good condition and undamaged. Before connecting the carrier gas lines to the MultiDetek3, it is necessary to install and purge the lines. Please consult the "Operating Parameters" document included on the USB drive for information on the appropriate carrier gas type, pressure and gas line connections.
5. The carrier gas purifier (LDP1000) must be started first and to install it, follow the steps in the LDP1000 user's manual.
6. After the LDP1000 has been purged, connect its outlet to the back panel connection of the MultiDetek3 named "Carrier Inlet". Before connecting the carrier, it is very important to remove all the caps installed on the MultiDetek3 back panel. **Any back pressure on the detector vent connection can cause damage and require the replacement of the plasma detector module.**
7. Once the gas lines have been purged and the carrier gas is connected, connect the power source. Check the "Operating Parameters" document to verify that the voltage is correct (either 120VAC or 240VAC), and make sure that the voltage indicated on the red indicator of the power inlet module on the back panel matches the voltage of the power source. **Using the wrong voltage source can cause severe damage to the instrument.**
8. Turn ON the unit by switching on the back panel switch and wait for the unit to boot. The MultiDetek3 works within a Windows-based environment. LDChroma+ will start automatically after the start-up. After each boot-up, the chromatogram screen shown below will appear.

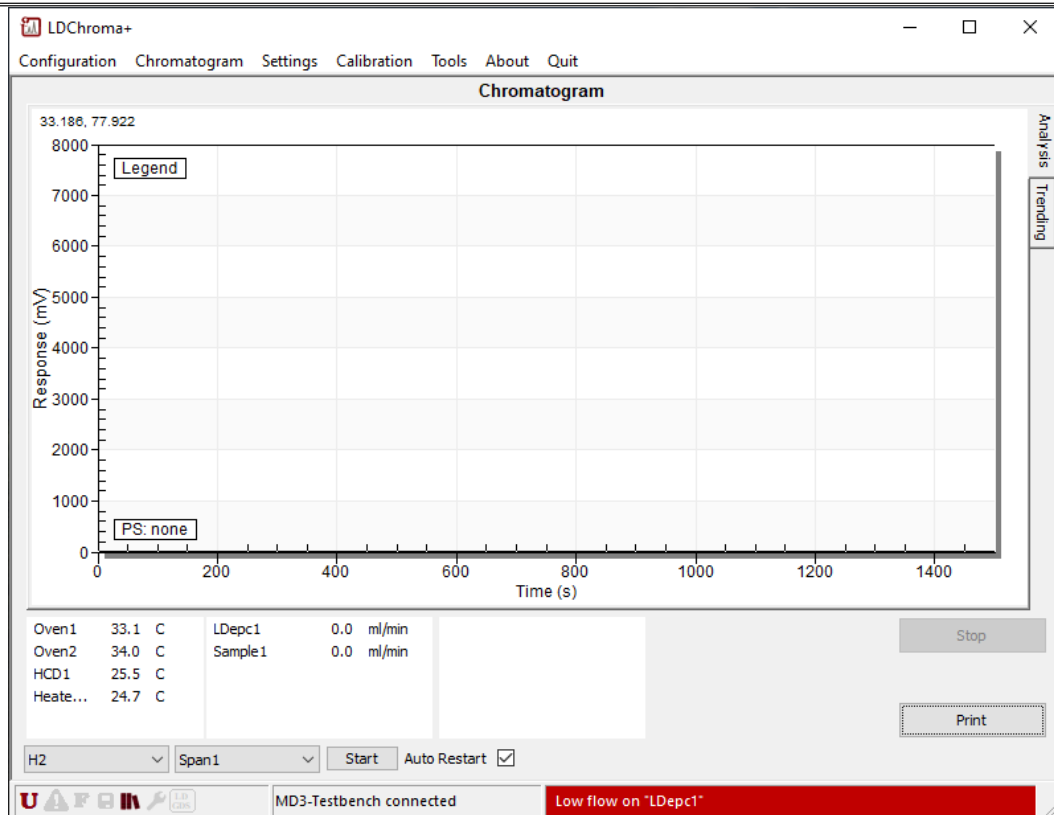


Figure 1: Boot up screen

9. Before proceeding, it is essential to resolve all active alerts, except for "Flow deviation on Sample" and "Low flow on Sample". To view the list of active alerts, double-click on the red alert bar to open the alert menu.

Alerts	
Active Historic Setup	
Description	Date
[3.00] Temperature deviation on "Oven1"	2022-12-22 14:46:12
[3.01] Temperature deviation on "Oven2"	2022-12-22 14:46:12
[3.02] Temperature deviation on "HCD1"	2022-12-22 14:46:12
[3.03] Temperature deviation on "Heatedzone"	2022-12-22 14:46:12
[1.00] Low flow on "LDepc1"	2022-12-22 14:45:02
[1.01] Low flow on "Sample1"	2022-12-22 14:45:02
[2.00] Flow deviation on "LDepc1"	2022-12-22 14:45:02
[2.01] Flow deviation on "Sample1"	2022-12-22 14:45:02
< > Acknowledge All Acknowledge Refresh	

Figure 2: Boot-up alerts

Below are the principal alerts that you may encounter:

Temperature deviation: This type of alert is normal during initial start-up and will typically resolve itself after a few minutes as the ovens, HCD or heated zone warm up. However, if the alert persists and no temperature change occurs, it may indicate a problem that requires further attention. To check the set points for each module, refer to the "Operating Parameters" document or go to the settings menu (Settings>>Settings>>Oven or Settings>>Settings>>HCD) and click on the "+" beside the module you want to check. Then, click on "Time Table" and check the first value in the timetable (besides "at start"). If the alert remains active after a few minutes, please contact LDeTek support for further assistance

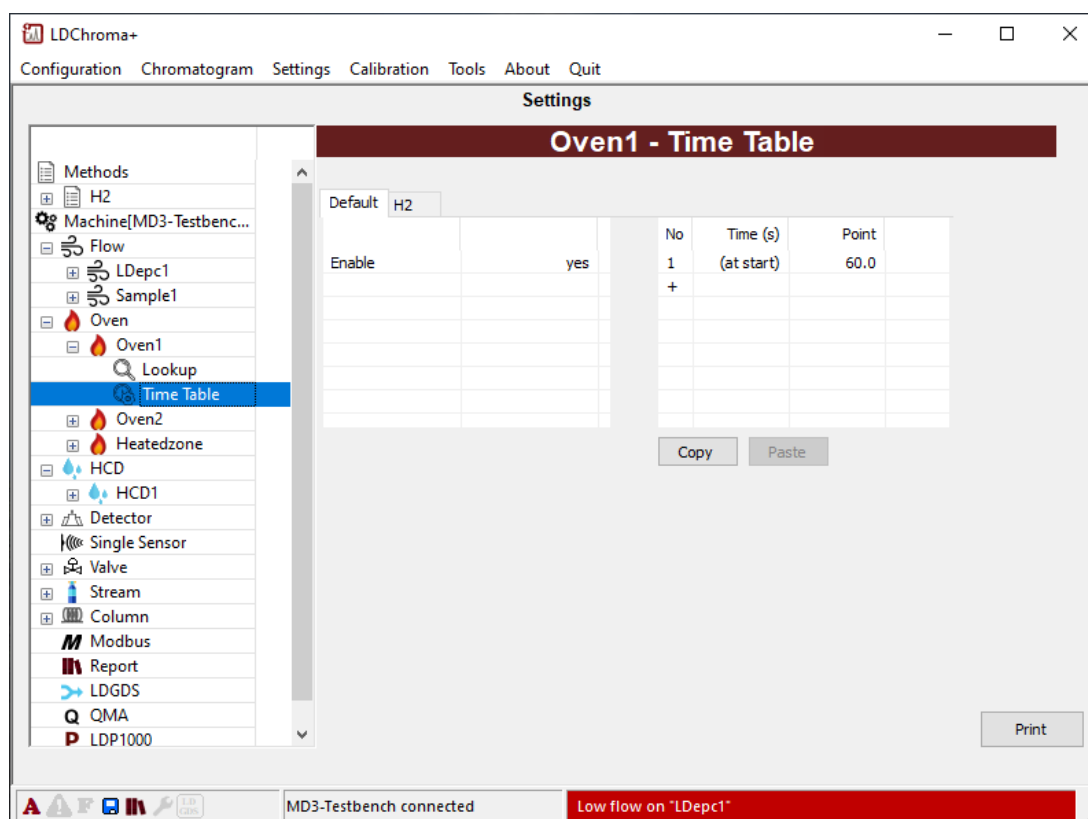


Figure 3: Oven setpoint

Flow deviation on LDepc #: Flow deviation on LDepc#: This alert may appear after the initial start-up, and can take a few minutes to disappear as the LDEPC must stabilize to their setpoint. The setpoints for each LDEPC are listed in the document "Operating Parameters," or can also be seen from the settings menu (Settings>>Settings>>Flow). Check the first value in the timetable (besides "at start") to confirm the setpoints. If the alert persists after a few minutes, ensure that the inlet pressure is set to the value specified in the "Operating Parameters" document (typically 100 psig) and that there are no restrictions in the carrier gas line between the source and the analyzer's carrier inlet. If the above checks do not resolve the alert, please contact LDeTek support for further instructions.

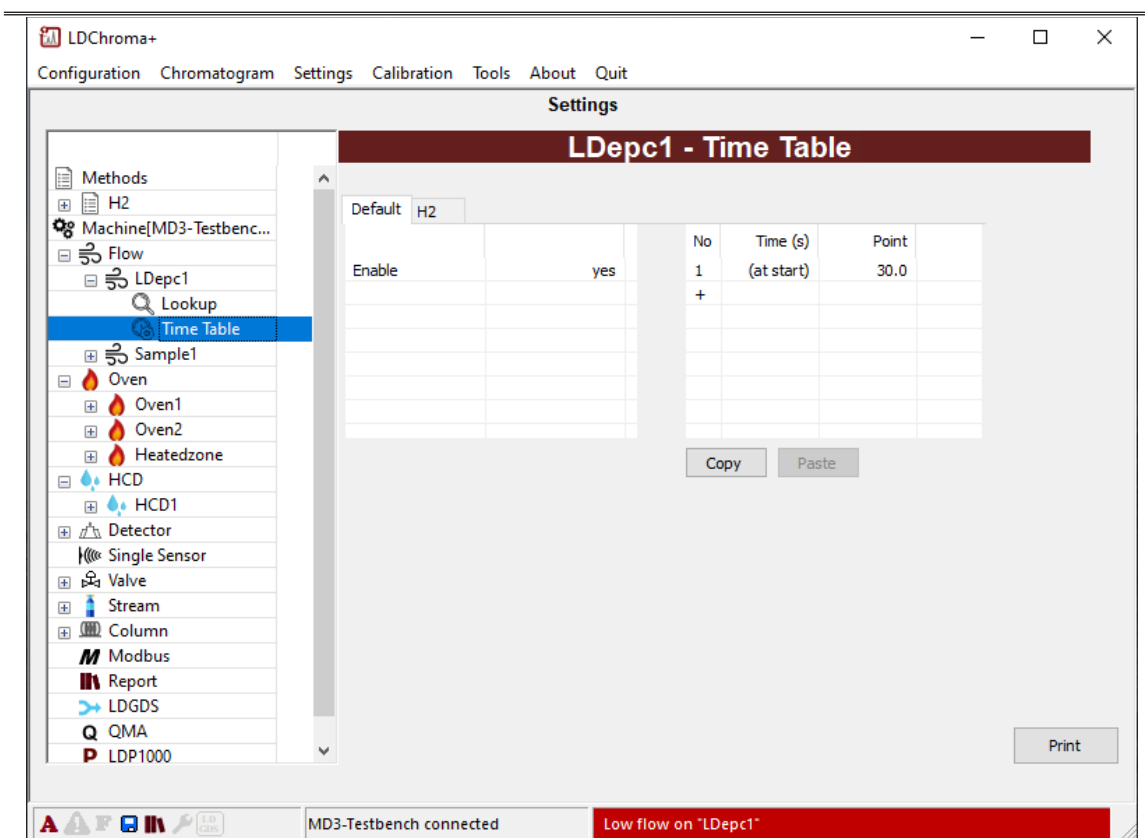


Figure 4: Flow setpoint

Low flow on sample: This alert will typically resolve automatically within a few minutes. During initial start-up, the sample proportional valve needs some time to stabilize. The setpoint for the sample flow can be found in the document “Operating Parameters”. You can also check the sample setpoint in the settings menu (Settings>>Settings>>Flow). Select the sample flow and look at the first value in the timetable (besides “at start”). If the alert persists and no flow change is detected after a few minutes, please verify that the sample pressure is set to the value specified in the document “Operating Parameters” (typically 5-30 psig). Additionally, make sure that the right stream is selected, and finally, ensure that there are no obstructions between the sample source and the analyzer's sample inlet. If the alert remains active after these checks, please contact LDeTek support for further assistance.

Detector # off: This alert may be resolved automatically after a few minutes. It is the time required for the detectors to stabilize and purge after the initial start-up. Once the LDEPC reaches their setpoints and a partial purge is achieved, the detectors will turn on automatically. To confirm the setpoints for each sensor, refer to the document "Operating Parameters". If the alert persists after a few minutes, please ensure that the LDEPC is functioning properly and the carrier inlet pressure is set to the value indicated in the document "Operating Parameters". Additionally, make sure that there are no obstructions in the carrier gas flow path. If you still have an active "Detector # off" alert after confirming the above steps, please contact LDeTek support for further instructions.

10. After resolving all active alerts, except for "Flow deviation on Sample" and "Low flow on Sample", the system must purge. A partial purge will take about 2-3 hours and a good purge will take 12-24 hours depending on the system configuration. Note that for ppb systems with ranges of measurements below 1000 ppb, the purge may take 2-3 days.

To ensure that the system is well purged, you can compare the sensor voltages with the values specified in the "Operating Parameters" document. To access the voltage chart on the MultiDetek3, click on Tools >> Diagnostics >> Analog Input >> Page 3. The rule of thumb is to have signals between +/-25% of the values specified in the "Operating Parameters". The number of sensors depends on the MultiDetek3's configuration. The figure below shows an example of a voltage chart found in the "Operating Parameters" document.

Number of detectors :		3	
Detector1 - Plasma			
Sensor	Peak	Baseline Offset	Voltage
Sensor1	N2 / Leak	1000 mV	479 mV
Sensor2	H2-O2-CH4	1000 mV	2491 mV
Sensor3	CO-CO2	1000 mV	1530 mV
Detector2 - Plasma			
Sensor	Peak	Baseline Offset	Voltage
Sensor4	Leak	1000 mV	486 mV
Sensor5	NMHC	1000 mV	1583 mV

Figure 5: Operating Parameters

11. Once the sensor voltages are within +/- 25% of the values shown in the "Operating Parameters" document, you can connect the calibration gas cylinder (span) to the system. When selecting a span gas cylinder, ensure that the concentration range for each impurity is within 50% to 90% of the full-scale range. Additionally, the balance gas of the cylinder should match the carrier gas or sample gas.

For example, if the MultiDetek3 is configured to measure 0-10ppm Ar and 0-50ppm N2 in Oxygen using Helium as the carrier gas, a certified span gas with a concentration range between 5-9ppm Ar and 25-45ppm N2 in Helium or Oxygen can be used. It is recommended to use the same balance gas as the carrier gas, as it simplifies troubleshooting.

Depending on the system configuration, the span gas cylinder must be connected to the appropriate inlet to calibrate the system. If the system has an integrated stream selector, the span gas must be connected to the span inlet. Otherwise, it should be connected to the sample inlet. For systems with a dilution system (LDGDSA), refer to the user manual for specific instructions. Make sure to set the span gas pressure according to the values indicated in the "Operating Parameters" document. Once the span gas is connected, the "Sample Low Flow" alert should disappear. It might be required to select the span stream from the chromatogram menu (Figure 24). When the alerts are all resolved, the red alert bar on the bottom will automatically disappear.

Once the sample lines are properly purged, simply start a cycle from the chromatogram

menu. At the end of the analysis, it is important to look at the chromatogram to make sure all peak(s) fit completely in their respective window(s). If some peaks aren't perfectly integrated into their respective window, restart the analysis several times. If the issue persists, it is recommended to send the machine file (.md3m) to LDetek support for further instructions. Refer to section 7.1.1 for further details on Machine file exporting.

During shipping, the system may experience vibrations that can lead to changes in its properties, including retention time. If this occurs and peaks no longer fit within their integration windows, LDetek experts can analyze the machine file and help modify the parameters to correct the issue.

12. When all peaks are within their integration window, the span calibration of the system can be done. Refer to section 7.4 for details about calibration.

13. After the calibration, the system can be switched to the process/sample gas and is ready for normal operation.

5.4. Shut-off

During normal operation, the MultiDetek3 must always be purged with carrier gas. Leaving the system without carrier gas may result in air contamination that could damage the analyzer permanently.

If the system needs to be stopped, the connections on the back panel must be capped. Make sure that the carrier gas is closed before capping the analyzer because **any back pressure to the detector vent connections will damage the plasma detector modules**. Refer to the steps below to ensure the proper shut-off of the unit:

1. In LDChroma+, make sure you are in Admin mode on LDChroma+. If needed, refer to section 7.1.6 User and Admin Mode.
2. Once in admin mode, click on "Quit". A window will pop up asking you if you want to power off the system. Click on "Ok" and the panel PC will turn OFF.
3. It takes 30 seconds for the panel PC to turn off. Once it is powered OFF, the green LED at the bottom right of the screen will turn OFF. You can now turn OFF the MultiDetek3 by switching the power switch located on the back panel.
4. Close the sample gas supply by closing the cylinder or any valve that controls it.
5. Disconnect the sample inlet and sample outlet tubes from the analyzer back panel.
6. If needed, repeat steps 4 and 5 for span gas, and O₂ doping gas.
7. Decrease the carrier gas pressure to 20 psi and disconnect the carrier inlet tube from the

analyzer back panel.

8. Put a male cap over the carrier inlet tube that was removed.
9. If the actuation gas is coming from the same source as the carrier gas, repeat steps 7 and 8 for the actuation gas inlet.
10. Remove all the remaining vents tubes on the back panel.
11. Install all the caps on the MultiDetek3 back panel.
12. Power OFF the LDP1000 by moving its power switch to OFF and then, remove the power cable.
13. Wait until the LDP1000 reaches the ambient temperature (about 2 hours).
14. Remove the tube connected at the outlet connection of LDP1000 and quickly cap the outlet connection of the purifier with a male or female cap. The type of caps depends on your LDP1000 model.
15. Remove the tube connected at the inlet connection of LDP1000 and quickly cap the inlet connection of the purifier with a female cap. The type of caps depends on your LDP1000 model.
16. Shut down the carrier gas source on the cylinder or tank.

5.5. Typical installation

5.5.1. Carrier gas

For the GC to operate properly, it is very important to give the best reference baseline to ensure the reliability and durability of the internal components. In this section, we will explain the importance of the continuous supply of carrier gas and its purity.

Figure 6 shows a typical installation of a MultiDetek3. The carrier gas is supplied with an automatic switchover system (LDASS). This system also includes a 2 inlets integrated stream selector (ISS). This allows the operator to switch between the sample and span gas. As shown in Figure 7, some installations might use an LDGSS instead of an ISS. On these installations, streams are connected to the LDGSS before going to the MultiDetek3. Figure 6 also shows that an Oxygen doping system has been added for trace O₂ measurement. For more details, please refer to section 5.5.4. Generally speaking, Argon, Helium or Nitrogen are used as carrier gas. Their physical properties make these gases the top choices for use in gas chromatography. However, the purity of these carriers is critical to ensure stable, accurate and reliable results.

The carrier gas is used to carry the sample gas to the chromatographic columns and gas

detectors, therefore, the purity of the carrier gas is very important. To maintain the equilibrium inside the analyzer, we must start with a certified carrier gas with a purity of grade 5 or higher (>99.999%). This grade is certified to have a maximum concentration of 10 ppm of total impurities. The grade 5 carrier is then purified by a filter-type heated gas purifier (LDP1000). Starting from grade 5, the outlet purity of the purifier will be 99.999999% (grade 8.0). Some applications might require different grades of carrier gas. Please refer to the document "Operating Parameters" to see what the specification is for your analyzer.

As demonstrated in Figure 6, an automatic switchover system is required to automatically switch the carrier gas cylinder when the pressure reaches 200-250psig. This automatic switchover system ensures that there is no carrier flow interruption in the system. Once the system is switched to the backup bottle, it is the responsibility of the user to replace the empty bottle. The lifetime of a carrier bottle is application dependent but a small to mid-size GC requires a 50 litres (9 cubic meters) bottle once a month.

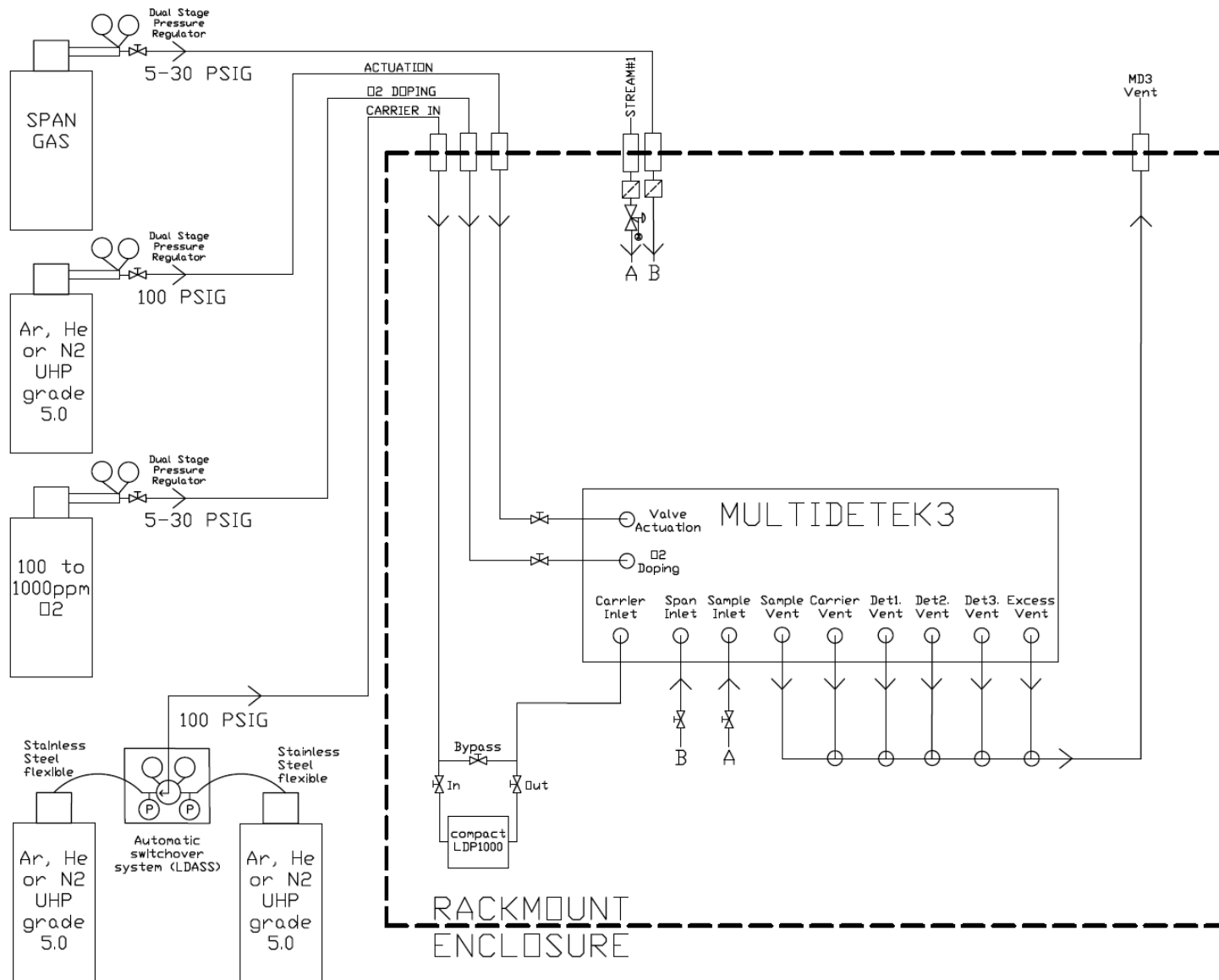


Figure 6: Typical Installation

5.5.2. Valves actuation

Separating the actuation from the reference carrier gas allows our gas chromatograph MultiDetek3 to achieve better results and more stability. The reason for it is mainly because of pressure changes when valves are actuating during cycles. This causes an impact on the carrier gas pressure and results in baseline fluctuation which can affect the response of the detector. Such events are more visible when low ppb analysis is required. This is due to the high level of sensitivity required for such applications.

Figure 7 and Figure 8 show a typical example of a GC plumbing diagram having a carrier gas supply configured with an automatic switchover system (LDASS). Both figures show a different way to make the gas connections to the actuation. The demonstrated system also includes a stream selector system (LDGSS) allowing different streams to be selected for analysis.

Generally, Argon, Helium or Nitrogen are used as carrier gas. It is important to use an actuation gas having the same specifications as the carrier gas to avoid any hardware damage that could occur if the actuation and carrier gas are mixed unexpectedly. It is worth noticing that the gas consumption for valve actuation will be negligible. A mid-size will consume about 10ml per cycle which is small compared to the few hundred ml/min of carrier consumption.

Figure 7 is the low-cost and easiest way to interconnect the actuation gas to the carrier gas source. This technique avoids the need of installing a second source of gas for actuation. Having a reasonable long volume of piping externally to the GC system acts like a buffer and will absorb the pressure shocks during valve actuation.

Figure 8 is the high-class technique and consists of feeding the GC system with two separate sources. Using this method, the system is completely independent of any variation caused by valve actuation. This is what LDetek recommends for low ppb applications where extreme stability is required to achieve a high level of sensitivity. To implement this method, a second double-stage stainless steel pressure regulator is mounted on a gas bottle separated from the carrier gas source. As explained above, the actuation gas should be the same type as the carrier.

Using stainless steel pressure regulator/diaphragm/piping/valve/pigtail hoses is required to maintain the leak integrity and purity. A dual-stage control is also needed to avoid pressure fluctuation. Depending on the GC application, other requirements may be necessary. We strongly suggest asking our experts to provide you with the most suitable automatic switchover system for LDetek instruments.

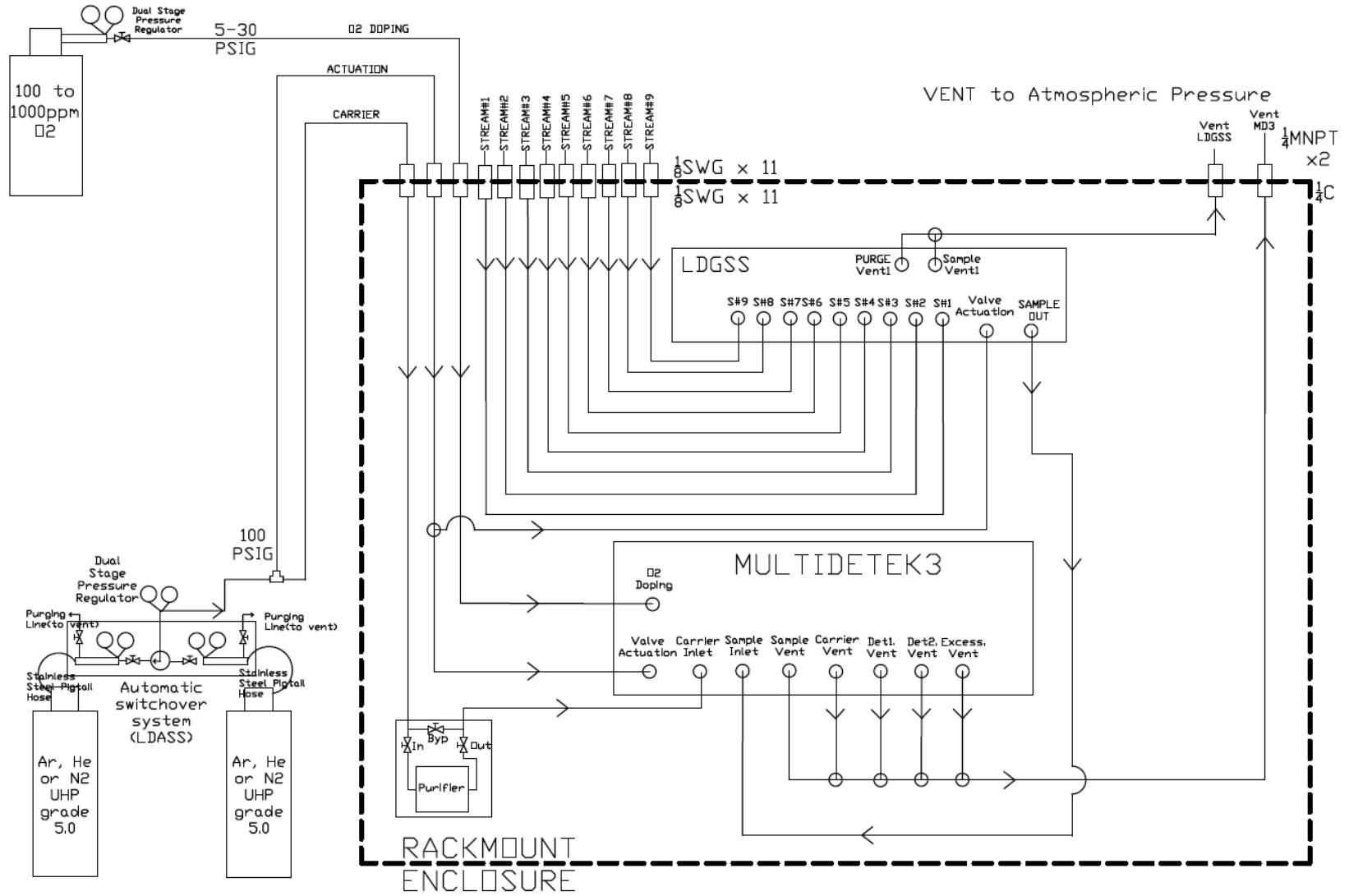


Figure 7: Same source actuation

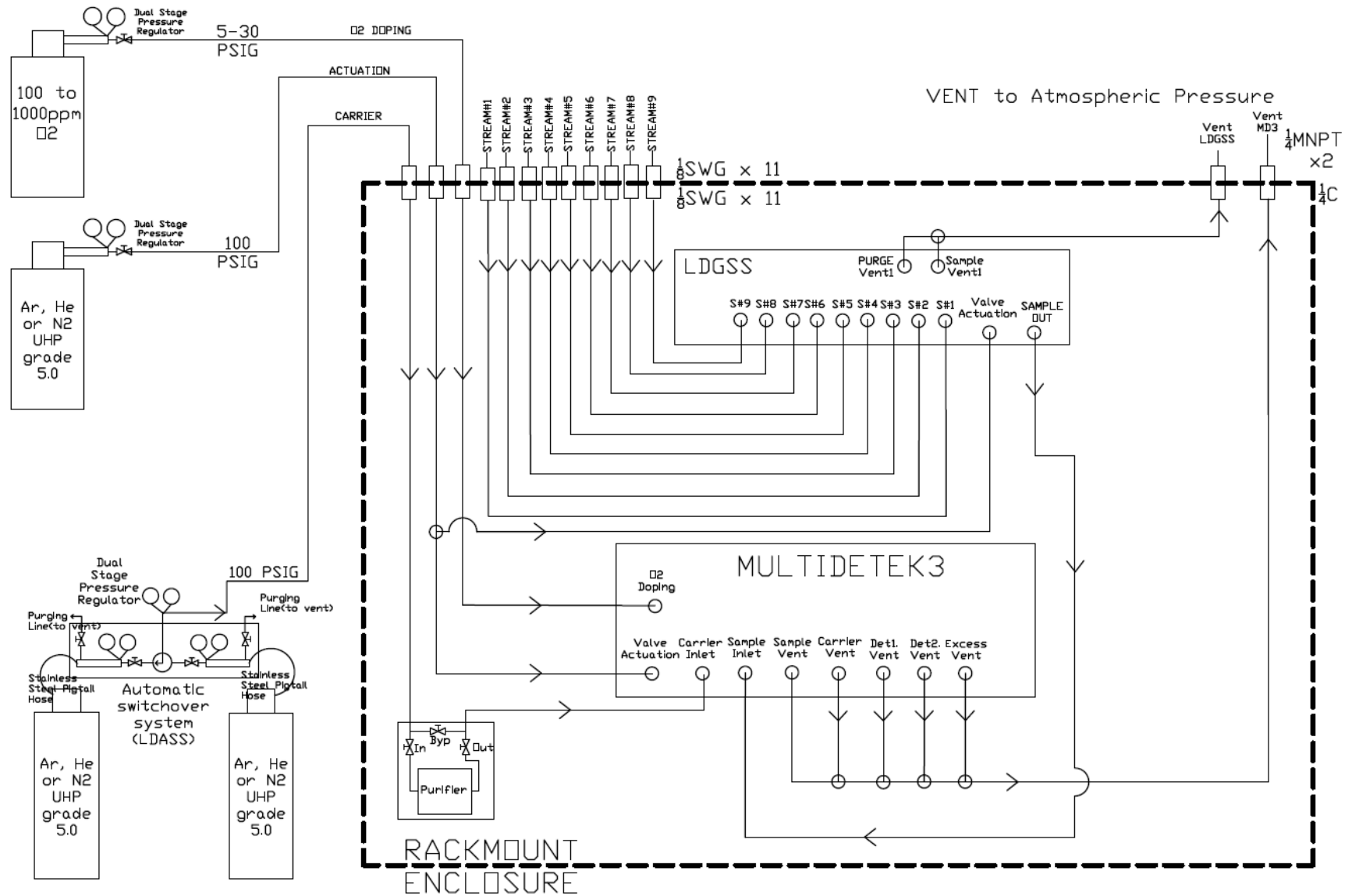


Figure 8: 2 sources of actuation

5.5.3. Installation with Recovery System (LDRPS)

Figure 9 shows a typical installation with an LDRPS. The LDeTek Recovery and Purification System reduce helium consumption while maintaining the stability and purity required by the Multidetek3 gas chromatograph.

In this setup, the carrier gas cylinders and the recoverable vents from the MD3 and LDGDSA are connected to the LDRPS. The system reuses helium recovered from these vents and, when the recovered volume is insufficient, automatically supplements it with fresh helium from the cylinders.

The outlet of the LDRPS is directed to the LDCryo cryogenic trap for additional purification and moisture removal. The stream is then routed back to the rack, passed through an LDP1000 purifier for final conditioning, and supplied to the GC and LDGDSA.

This configuration ensures ultra-high-purity helium, provides the stability needed for low-ppb analyses, and significantly reduces overall helium consumption. The combined action of the LDRPS, LDCryo, and LDP1000 delivers both purity and efficiency.

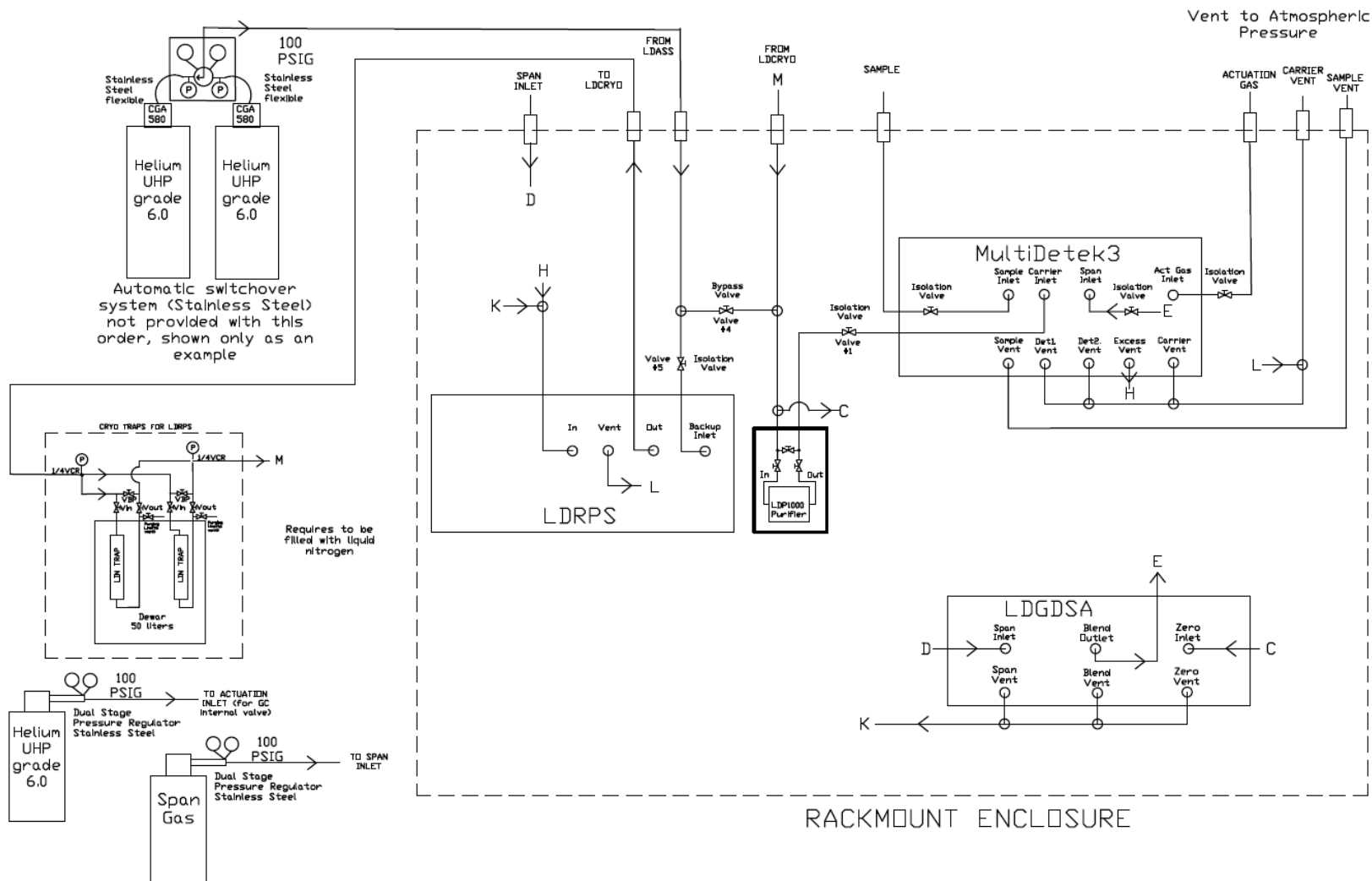


Figure 9: Installation with LDRPS

5.5.4. O₂ doping MULTIDETEK3 User's manual

Figure 6 shows a typical installation that requires O₂ doping. This feature is only required when O₂ is measured at the ppm/ppb level and is used to keep our system saturated with Oxygen. In chromatography, it is well known that oxygen is adsorbed by the Molecular Sieve and the porous polymer-type columns used for separating and measuring trace oxygen. Even if a good column activation is performed at the beginning, over time the oxygen will slowly desorb from the column, and the column will start to adsorb the oxygen content coming from the volume of sample gas injected. This phenomenon has a big impact on the analysis accuracy for measuring Oxygen at ppm/ppb due to a part of the sample staying inside the columns. It generally results in a loss of the ppb/ppm peak of Oxygen even on the span calibration gas. By adding an Oxygen doping gas, the active sites inside the columns are permanently filled with Oxygen. It stabilizes the system and ensures good reproducibility and accuracy resulting in better sensitivity.

Figure 10 shows a typical example of a GC plumbing diagram having an O₂ doping option. Valve 10 is a 2 streams selector that switches between the sample gas and the doping gas. The doping inlet must be connected to a certified gas bottle containing a known concentration of O₂ in a balance gas being the same as the carrier gas. In general, the concentration of the doping gas varies between 100-1000ppm O₂. A rule of thumb is to have the doping concentration 10 times higher than the measuring range. For instance, if the MultiDetek3 is configured to measure 0-20ppm O₂, the O₂ doping bottle should be about 200ppm.

The pressure of that said bottle must be set at a value between 5-30psig. Depending on the GC application, the flow consumption of the doping gas will be as low as 100sccm for a period varying from 2-7 minutes per cycle. When the GC is idle, there is no doping gas consumption. Therefore, such a bottle can last for a long period before needing to be replaced.

Valve 10 is switching to the doping gas at the beginning of an analysis cycle and the doping gas is injected into the channel used to measure the trace oxygen. Generally, the sampling loop of this channel is the first to be injected to ensure that the oxygen doping gas can be injected as quickly as possible, eventually being flushed out of the system rapidly.

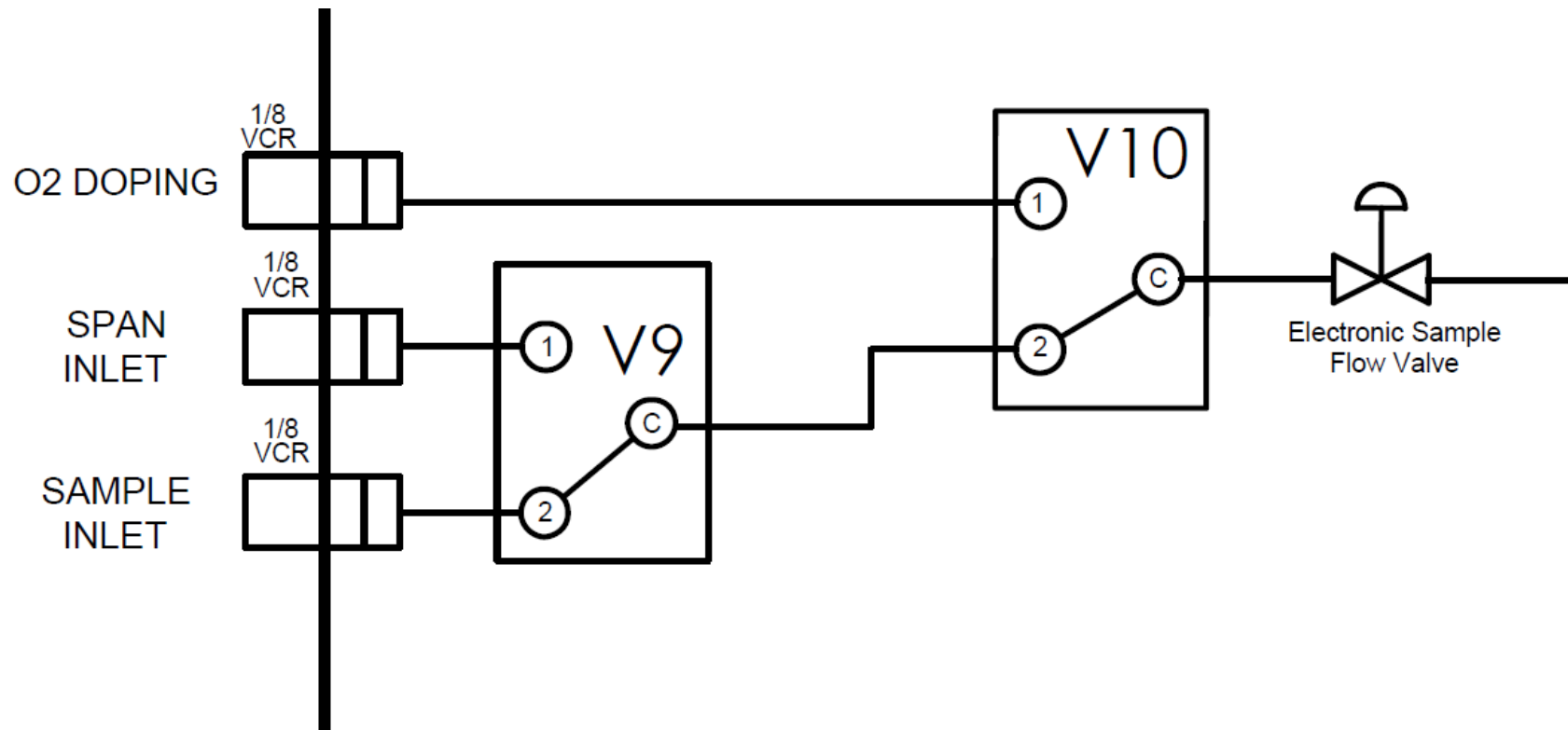


Figure 10: O2 doping

6. Hardware description

The MultiDetek3 has major components included in its chassis. This section will describe each component that can be replaced for maintenance or upgrade.

6.1. Detectors

The **PED** detector module is a 155 mm (6.1") x 82 mm (3.22") x 63 mm (2.48") box that contains all components needed to proceed to accurate measurement. The MultiDetek3 can accept up to 3 PEDs in the same chassis. This module is maintenance-free. The PED is very sensitive and selective detector perfect for trace impurities. It can only be defective if the detector has been pressurized or contaminated with liquid or high-concentration hydrocarbons. The PED design is modular and can be easily replaced on-site.

The **FID** detector is used to measure hydrocarbons and its design makes it suitable for easy operation. The maintenance is easy since it offers easy access. As with any FID, maintenance consists of cleaning the interior of the detector. Its compact design makes it possible to install up to 2 FID in the same MultiDetek3 chassis or in a combination with other detectors.

The **TCD** is used to measure impurities at a high concentration and is used to be a complement to the PED detector. It can be installed in series or parallel with the PED and then offers a very wide dynamic range of measurement. The TCD is also modular and is easy to manipulate for maintenance.

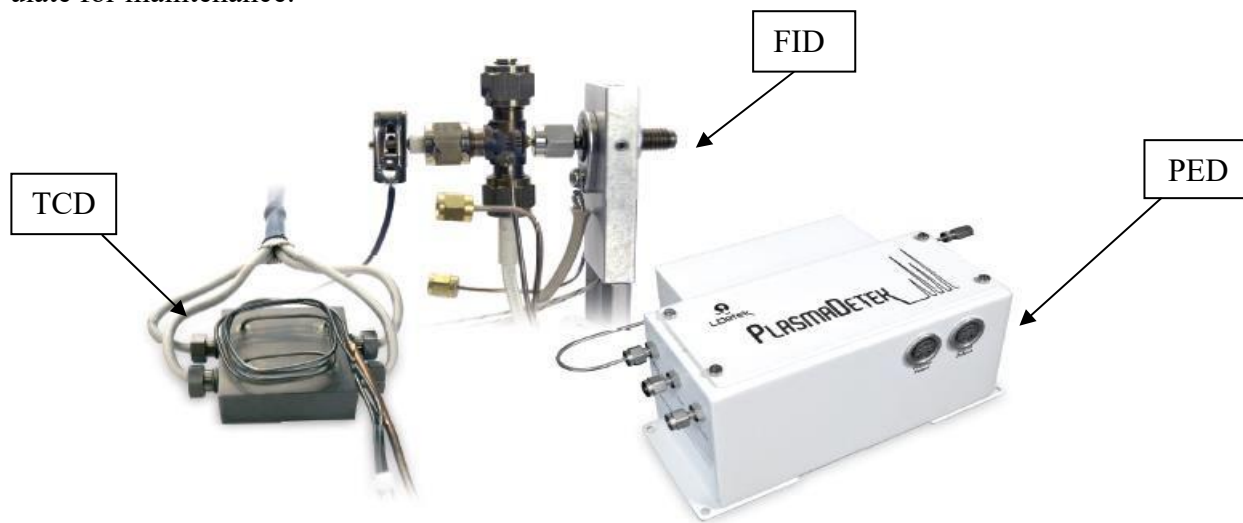


Figure 11: Type of Detectors

6.2. Online Sensors

The **SenzTx** is an oxygen transmitter available with either zirconia or electrochemical sensing technology. It provides continuous measurement of oxygen concentration across a wide range, from 0.5 ppm to 96 % O₂, depending on the selected configuration. The sensor is designed for stable, long-term operation in process environments.

The **Easidew** sensor measures moisture in terms of both dew point and moisture content. It operates over a range from -110 °C to +20 °C dew point (-166 °F to +68 °F) and uses a ceramic sensing element with integrated microprocessor-based electronics to ensure accurate and repeatable readings throughout the service life of the transmitter.

The **QMA** sensor determines trace moisture concentration by monitoring the frequency modulation of a hygroscopic-coated quartz crystal. This method provides high sensitivity to water vapor, with a detection limit down to 20 ppb H₂O, making it suitable for trace-level moisture applications.



▲ SenzTx



▲ Easidew



▲ QMA

6.3. Motherboard

This I/O board controls all components inside the analyzer (flow, detectors acquisition, temperatures, etc.). When replacing this motherboard be sure to avoid any electrostatic contact.

The motherboard conception is modular, which makes it easy to replace even on the field. Flow sensors for the carrier and sample, the 4-20 mA modules and the microcontroller can also all be replaced on-site. This modular conception was developed to facilitate the maintenance of the MultiDetek3 without returning it to the factory.

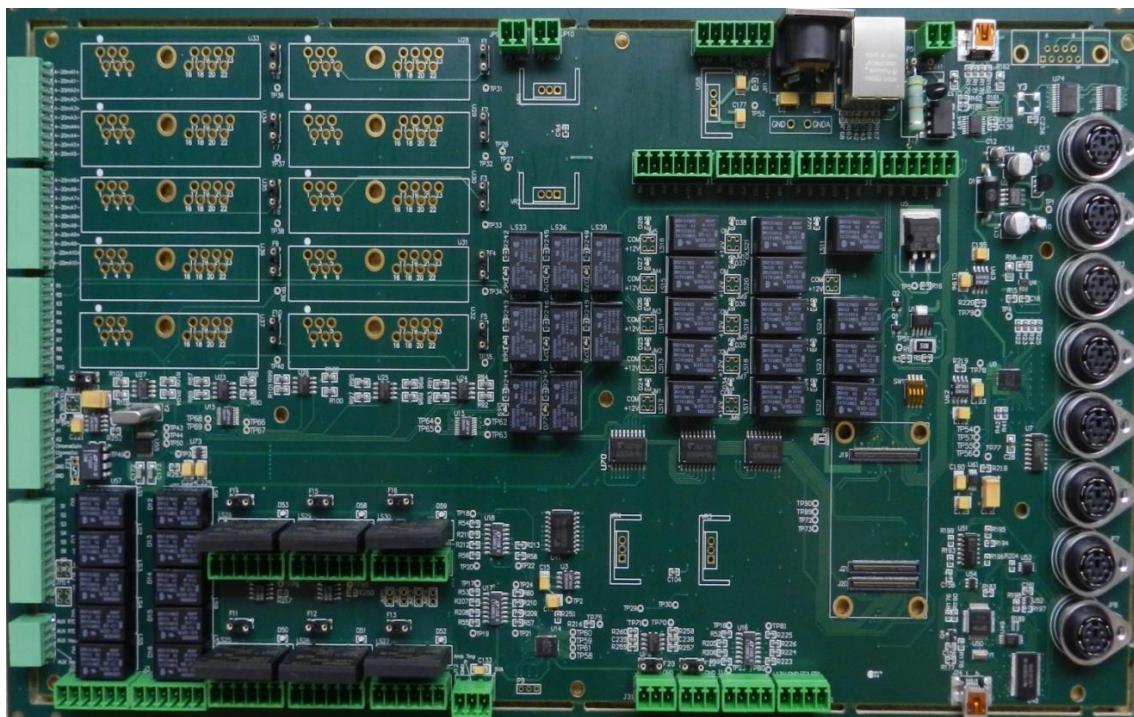


Figure 12: MultiDetek3 printed circuit board (PCB)

6.4. *Sample gas proportional valve, mini pump and septum injector*

This valve is used to control the sample flow inside the instrument. This is a very low dead volume valve that allows minimal purging time at start-up and is very quick for flow stabilization. This valve has been designed by LDetek to achieve good stability and the possibility of working at ppb level without contamination. This valve can be ordered as spareparts and can easily be replaced on-site.

For some applications where sample gas is at ambient pressure or has a limited volume, a mini pump can be mounted to pump the sample gas and fill the sampling loop. If needed, an intelligent system can also be integrated to pump a precise gas volume to fill the loop. Please contact LDetek for more information.



A split/splitless septum injector can also be mounted for syringe injection. It can also be heated.

6.5. *Diaphragm valve and purged/heated valve box*

LDetek has worked in collaboration with its valve suppliers to get the right diaphragm valves to offer extended lifetime and high performance. Many methods have been developed and tested to allow high-purity measurement without having cross ports or outboard contaminations. Valves for aggressive gases are also available with different coating materials. All the valves are installed in the MultiDetek3 and the maintenance can be done on-site. LDetek suggests doing the valve maintenance every 3-5 years.



For some applications with condensable gases, the valves can be mounted in a heated box. That heated box can also be purged with inert gas when hazardous or toxic gases are present. Please contact LDetek for more information.

6.6. Carrier gas electronic pressure regulator (LDepc)

The carrier gas flow control in the MultiDetek3 is managed by a high-purity LDetek electronic pressure controller (EPC). The carrier flow control can be mounted inline or in bypass mode depending on the application.

A manual version of the high-purity pressure regulator is also available in the MultiDetek3. Both versions are available and can be easily replaced because of their modular designs.



6.7. Ovens and columns

The MultiDetek3 can have up to 6 isothermals. These ovens can be accessed from the front door which facilitates column replacement. Each oven can fit up to 2 x packed, micro-packed or PLOT-type columns. The columns can be 1/8" OD, 1/16" or PLOT type and the maximum operating temperature of each oven is 200 Celsius degrees. A safety temperature cut-off switch protection is installed in each oven to avoid overheating.

A programmable oven version is also available in the MultiDetek3. It has the same internal dimension as the isothermal version and can then offer the same columns configuration. The MultiDetek3 platform can accept up to 3 programmable ovens or a combination of isothermal ovens and programmable ovens. It offers a lot of flexibility.



Figure 14: Isothermal and programmable oven

6.8. Large 15.6" touch screen LCD & LDChroma+

The MultiDetek3 offers an easy and complete interface working on Windows 10 IoT. With its clear 15.6" touch screen LCD, it allows the operator to easily navigate through the different menus. Moreover, the system includes an Ethernet port for remote control.



6.9. Built-in sample purging and monitoring system

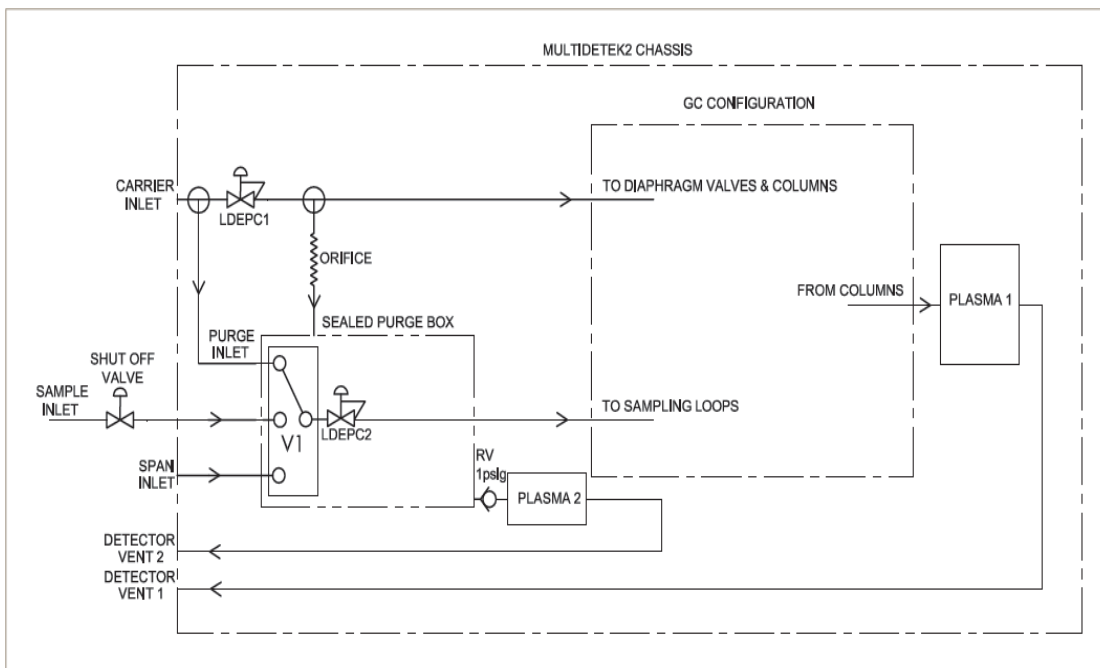


Figure 15: Built-in sample purging and monitoring system

Handling highly flammable gas like silane or any other hazardous or explosive gases requires a high level of safety, and it is what LDetek offers with its built-in sample purging and monitoring system inside the MultiDetek3 compact GC. This system consists of 4 steps of safety:

Step 1: The sample gas flow path external to the purged box is fully welded offering no possibility of leakage.

Step 2: A selection valve (V1) is mounted before the sampling loops. That selection valve is configured to allow the hazardous gas to go to the sampling loops only for a short and predetermined duration just before starting the analysis. The duration the sample is flowing is configured in the factory and is dependent on the configuration. The rest of the time, the selection valve is switched on a purged gas which is normally the same gas type as the carrier gas. In the eventuality of leakage on the sampling loops or the injection diaphragm valves, the risk of a hazardous situation will be reduced because the sample is only flowing for a short duration.

Step 3: A sealed purge box containing the sample flow electronic pressure controller (LDEPC2) and the diaphragm selection valve (V1) is mounted in the MultiDetek3 chassis. That box is normally purged with the same gas as the carrier gas. That environment requires a low purge flow rate of about 10-30 sccm through a fixed orifice. The box is ambient air-free, and the system is ready to use after a short period of about 20-30 minutes. This waiting period is only required during the initial start-up because the box is continuously purged once the MultiDetek3 is connected to the carrier. Having a box fully purged with UHP carrier gas eliminates the ignition risk in the potential presence of silane or any other explosive gases. A 1 psig relief valve (RV) is mounted on the box to build up a minimum sealing pressure and to maintain a constant purge with the carrier gas.

Step 4 (optional): The sealed purge box could be continuously monitored using a micro-PED to selectively measure trace N₂ to ensure there is no air contamination in the sealed box and to avoid ignition in the presence of hazardous gas. If traces of air are measured in the purged box by the micro-PED (PLASMA2), then an alarm is activated to shut off the flow of hazardous gas inside the MultiDetek3. The shut-off valve must be mounted externally to the MultiDetek3 chassis. The feedback signal controlling the shut-off valve comes from the MultiDetek3. It is required to maintain the sample gas pressure coming to the shut-off valve below 10 psig to minimize the risk of ignition. The flow type selected by the selection valve (V1) is controlled with the electronic flow controller (LDEPC2) to ensure a stable and constant flow rate regardless of the gas type selected.

6.10. Bolt-on compact purifier

A compact purifier can be bolted on the MultiDetek3 back panel. It offers the same performance as the standard gas purifier but with a more compact design. The maintenance is easy since the compact unit is mounted on the back panel of the MultiDetek3. The unit offers intelligence, and the LED diagnostic system will turn red when the unit must be replaced. In normal operation, the lifetime is 3-5 years on average.



Figure 16: Compact LDP-1000

6.11. Advanced Quartz Crystal Microbalance sensor

The Advanced Quartz Crystal Microbalance sensor from Michell Instruments is now integrated inside the MultiDetek3 GC to provide reliable, fast, and accurate measurement of trace moisture content in a variety of applications where keeping moisture to a minimum is of critical importance. The analyzer provides consistently accurate measurements of trace moisture. This consistency is achieved using a self-calibration system, which adjusts the sensor with an internal moisture generator. The moisture generator is supplied with a calibration traceable to NPL and NIST, so the long-term stability of its measurements is guaranteed. Having such a module inside a GC allows for combining multiple impurities analysis with trace moisture inside the same instrument.

6.12. Filters

To ensure reliable operation of the Multidetek3 (MD3) and to protect the internal components, 5-15-micron particulate filters are required on all gas inlets.

1/4" face seal (VCR), 1/4" Compression, and 1/8" Compression Bulkheads

These ports are equipped with integrated 10-micron filters installed inside the bulkhead fittings. They act as a preventive measure to protect against small particles.

These internal filters are not intended to replace the primary external filtration. A dedicated

external particulate filter must always be installed upstream of the analyzer to guarantee long-term protection and stable operation.

1/8" face seal (VCR) Bulkheads

No internal filter is included in these bulkhead fittings. For these connections, LDetek supplies external 10-micron filter assemblies (male VCR to female VCR) that must be installed directly at the inlet ports.

The required ports are:

- Actuation gas
- O₂ doping gas
- Sample inlet
- Span inlet

When installing these filters, always use new face-seal gaskets on both ends to ensure proper sealing.



Figure 17: External 10-micron filter

7. LDChroma+

The MultiDetek3 system is powered by a powerful dual-core microcontroller, with one core specifically dedicated to digital signal processing (DSP). This microcontroller communicates with a 15.6-inch touchscreen panel PC that runs on the Windows 10 operating system. The system is designed to offer users a user-friendly and comprehensive interface called LDChroma+. Moreover, a USB connector is available on the front panel to enable easy connection to a keyboard. In the following section, we will explore the different tabs and menus available on the LDChroma+ interface.

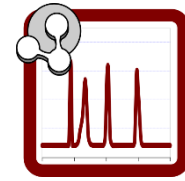


Figure 18: LDChroma+ logo

7.1. Configuration

The configuration tab shows different menus describe below.

7.1.1. Machine Manager

The Machine Manager menu provides the option to import or export all the settings of the MultiDetek3 in a machine file format (.md3m). This file encompasses all the settings and the history of the device and can be easily opened on another computer that has LDChroma+ installed. This feature is particularly useful for diagnostic and backup purposes.

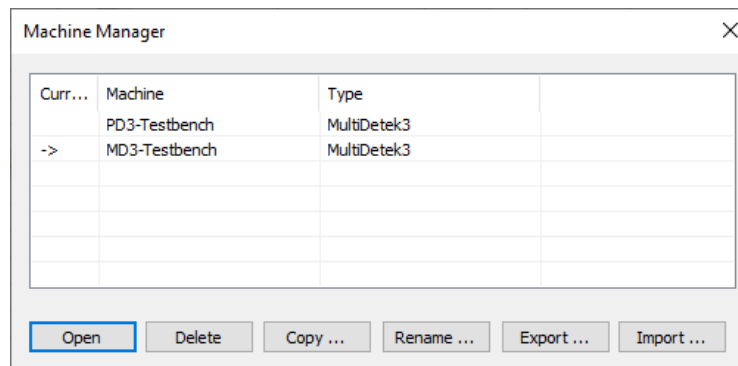


Figure 19: Machine Manager

Open: This button allows you to open the selected machine.

Delete: This button allows you to delete the selected machine.

Copy: This button allows s you to copy the selected machine.

Rename: This button allows you to rename the selected machine.

Export: This button allows you to export the selected machine into a machine file (.md3h).

Import: This button allows you to import a machine file (.md3h).

7.1.2. Method Manager

The Method Manager allows you to manage all the methods you have on your Multi-Detek3. You can double-click on a row to open the method.

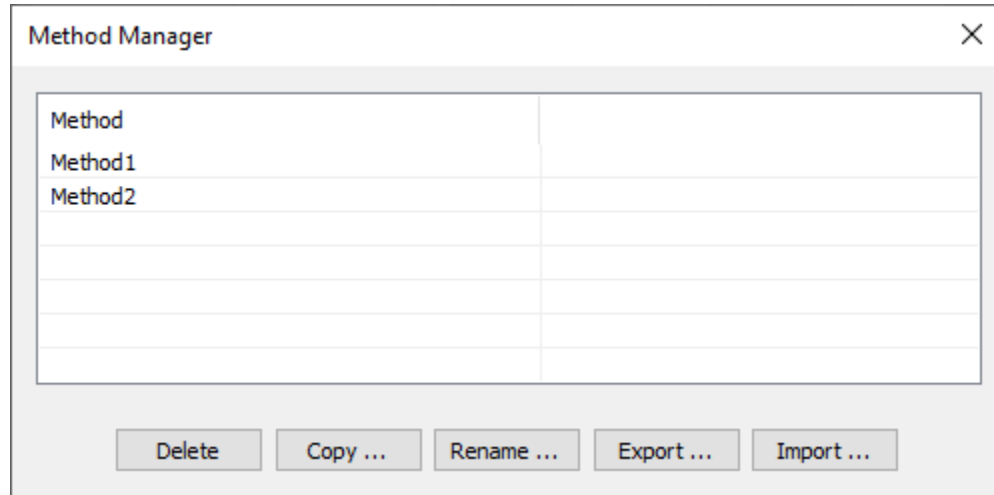


Figure 20: Method Manager

Delete: This button allows you to delete the selected method.

Copy: This button allows s you to copy the selected method.

Rename: This button allows you to rename the selected method.

Export: This button allows you to export the selected method into a method file (.md3c).

Import: This button allows you to import a method file (.md3c)

7.1.3. Calib Manager

The Calib Manager allows you to manage all the calibrations you have on your Multi-Detek3.

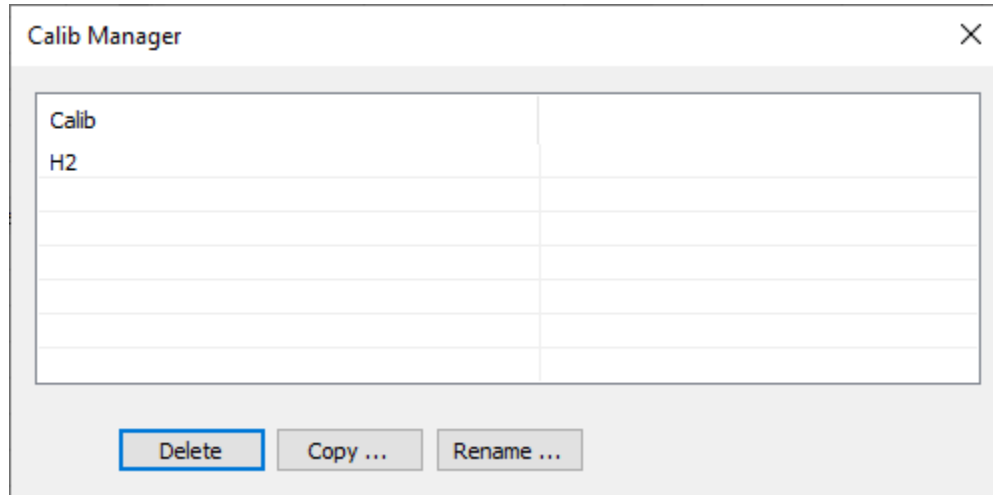


Figure 21: Calib Manager

Delete: This button allows you to delete the selected calibration.

Copy: This button allows you to copy the selected calibration.

Rename: This button allows Allows you to rename the selected calibration.

7.1.4. Factory

The Factory menu is used to restore the factory settings.

7.1.5. Network

The Network menu is used to show the current network settings.

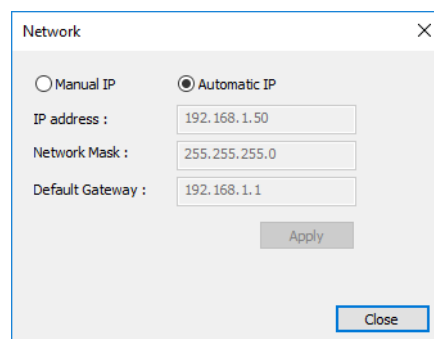


Figure 22: Network

7.1.6. User and Admin Mode

User Mode: In this mode, the user has limited access to settings. He cannot change settings or force the analog and digital I/O.

Admin Mode: In this mode, the user has access to all the menus. By default, the password to access the admin mode is “12345”, but it can be changed in the setting menu (see section 7.3.1.8).

7.1.7. Set Language

The language menu is used to select the language of LDChroma+.

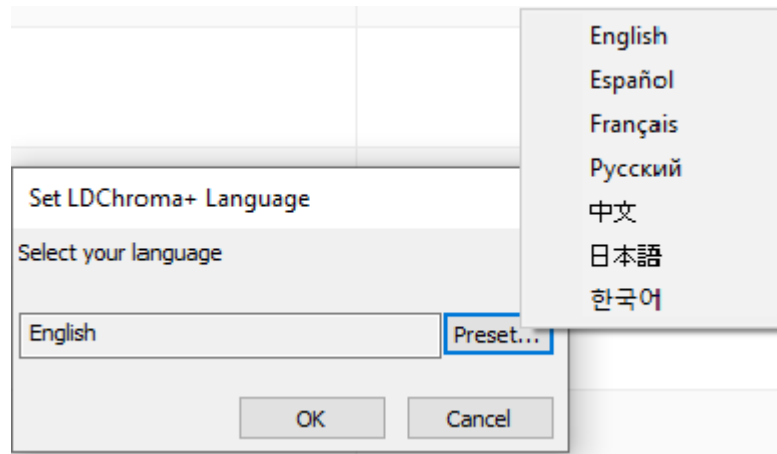


Figure 23: Set Language

7.2. Chromatogram tab

7.2.1. Chromatogram

The Chromatogram menu is the hub for running analyses, providing access to crucial information such as chromatograms, results, alerts, oven temperature, sample flow, and carrier flow. This section aims to provide a comprehensive overview of the menu, enabling users to easily navigate its features and capabilities.

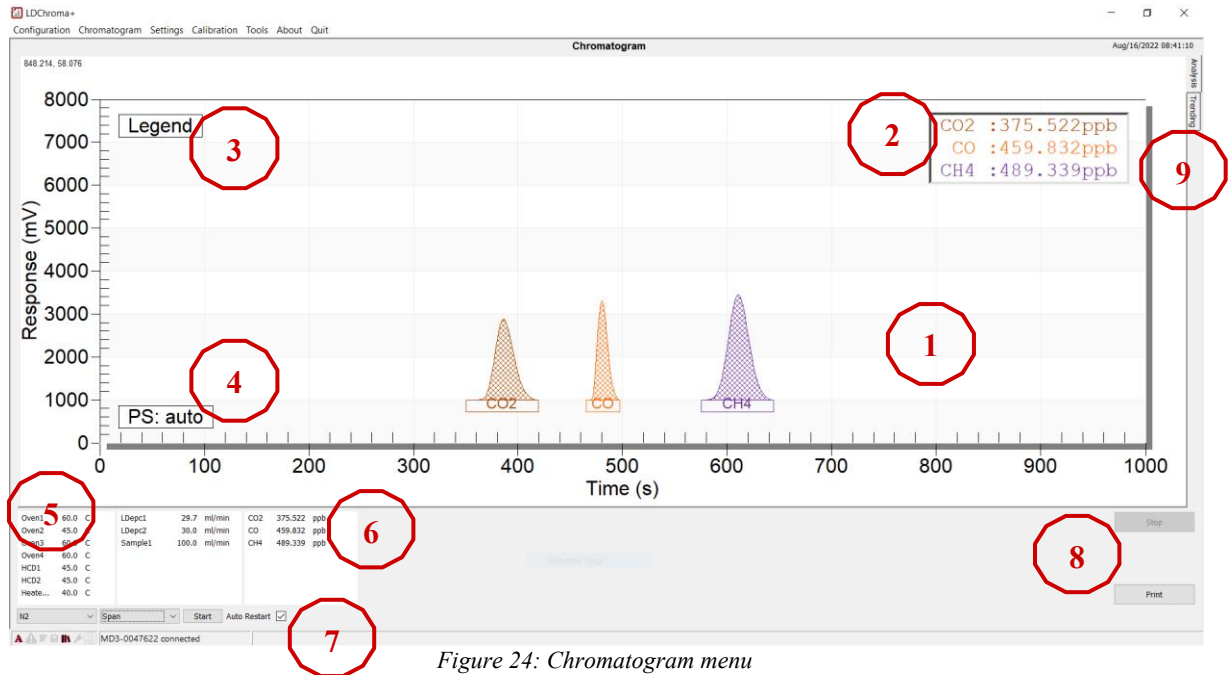


Figure 24: Chromatogram menu

- 1- The chromatogram displays real-time data from ongoing analyses, with the X-axis indicating the time in seconds and the Y-axis representing voltage in mV. During an active cycle, a live view of the chromatogram is displayed. If a previous analysis is open from the historic menu, it can also be viewed within the chromatogram display.
- 2- Once peaks are integrated by the software, their corresponding concentrations will be displayed in the top right corner of the screen.
- 3- To access the legend, click on the "Legend" button located in the top left corner. From the legend, you can show or hide peaks and display the raw signal of each sensor. When you hover the cursor over the chromatogram, the voltage of each sensor is shown in the legend. Additionally, the menu allows displaying valve timings on the chromatogram, which can be useful for troubleshooting purposes.

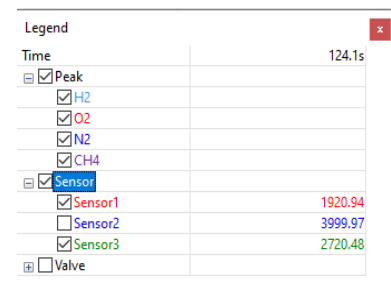


Figure 25: Legend menu

- 4- The button located at the bottom left is called Peak Scale (PS), which allows users to adjust the display of the chromatogram. By clicking on the PS button, three display modes become available - on sensor, automatic, and manual. In the 'on sensor' mode, peaks are integrated directly onto the raw signal. The 'automatic' mode reprocesses peaks and displays them on a single line at 1000mV. Reprocessing includes adjusting the polarity and applying software gain, which is automatically calculated based on the calibration. By default, the gain is set to display peaks at 3500mV with the calibration gas. Users can change these parameters by accessing the settings menu (section 7.3.1.1). In the 'manual' mode, users can adjust the gain and polarity manually via the settings menu (section 7.3.1.2).
- 5- The first table located in the bottom left corner of the Chromatogram menu displays temperature information, including the oven temperature, HCD temperature, and heated zone temperature. The second table shows the carrier flow (LDEPC) and sample flow rate.
- 6- The last table shows the concentration of each peak after they have been integrated.
- 7- The first menu is used to select the method, while the second menu is used to select the stream. The 'Start' button initiates an analysis, and during an active cycle, it changes to 'Stop.' Clicking on the 'Stop' button will terminate the analysis prematurely. The 'Auto Restart' checkbox is used to enable automatic restarting of the analysis or sequence once the cycle ends.
- 8- The "Print" button is used to print the current chromatogram and data.
- 9- The Trending tab displays a graph of the sensor's raw signal over time. This feature can be especially useful for troubleshooting purposes as it allows the user to visually identify any irregularities or anomalies in the signals.

7.2.2. Bottom bar



Figure 26: Bottom bar

The bottom bar is split into 3 sections and contains critical information about the system.

7.2.2.1. Left-bottom bar

The left section of the bottom bar contains seven icons. The first icon displays a letter which indicates the system's mode. A 'A' icon indicates that the system is in admin mode, while a 'U' icon indicates that it is in user mode.

The second icon displays an exclamation mark '⚠'. If the icon is coloured, it indicates that the current settings differ from the ones on the motherboard. In this case, you will need to download the settings to the DSP before starting an analysis. To download the settings, right-click on the left-bottom bar and select 'Download settings'.

The third icon displays the letter '**F**'. If it is coloured, it indicates that one or more outputs are forced. This may occur when the system's outputs have been manually forced for diagnostic purposes. The icon serves as a reminder to the user that the system's outputs are currently forced. To remove the forced outputs, right-click on the left-bottom bar and select 'Reset All Forces'.

The next icon displays a floppy disk '

The next icon displays three books '

The wrench key icon '

For systems with a dilution system (LDGDSA), the next icon is used to confirm whether LDChroma+ is properly connected to LDGDSA. If the icon is coloured, it confirms that the connection is established.

As discussed above, if you right-click on the left-bottom bar, a context menu will appear.

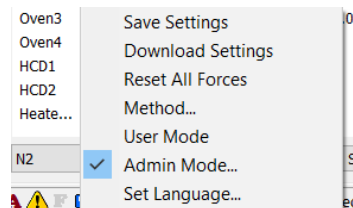


Figure 27: Left-bottom bar menu

Save Settings: Save all the settings to the disk and clear the floppy disk icon.

Download Settings: Selecting this button will download the setting to the motherboard and clear the exclamation point icon. This button is only shown when the exclamation sign is coloured.

Reset All Forces: Save all the settings to the disk and clear the floppy disk icon.

Method: Open the method manager.

User Mode: Switch to the user mode.

Admin Mode: Switch to Admin mode.

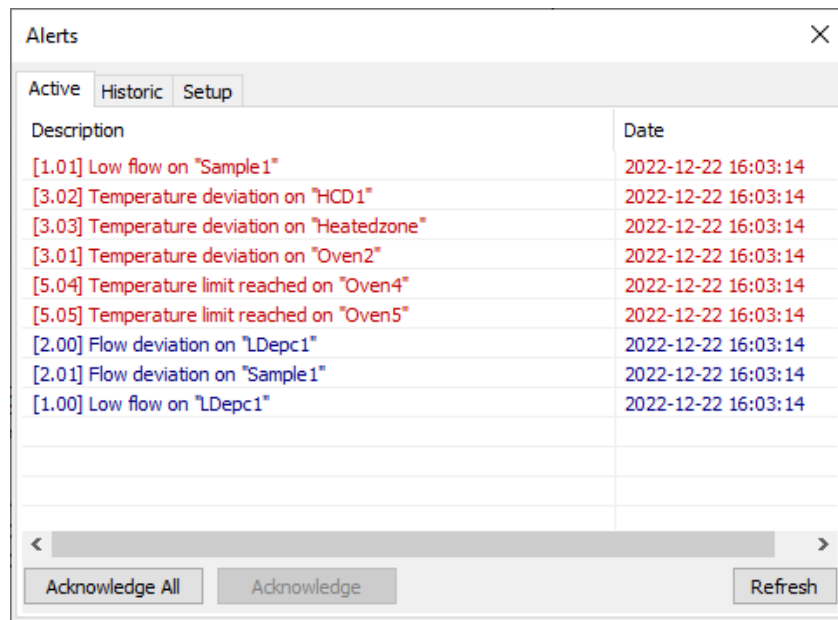
Set Language: Open the language menu.

7.2.2.2. Middle-bottom bar

The middle part of the bottom bar displays the "device status", which indicates the status of communication between the panel PC and the motherboard. When the communication is established, it shows "MD3-XXXX connected". If there is no communication between the two, it will display "MD3-XXXX not connected". By right-clicking on the bottom bar, a menu will appear showing information about USB communication.

7.2.2.3. Right-bottom bar

The right bottom bar provides vital information about the alerts on the MultiDetek3 system. The colour of the bar changes to red when one or more alerts are active and yellow when there is a warning. If the bar is gray, it indicates that there are no alerts, and the system is ready for analysis. Double-clicking on the bar will open the alert menu, where users can view detailed information about the alerts, including their type and the date they occurred. To acknowledge an active alert, users can right-click on the right-bottom bar.



The screenshot shows the 'Alerts' window with three tabs: 'Active', 'Historic', and 'Setup'. The 'Active' tab is selected, displaying a table of active alerts. The table has two columns: 'Description' and 'Date'. The descriptions are color-coded: red for active alerts and blue for acknowledged alerts. At the bottom of the window, there are three buttons: 'Acknowledge All', 'Acknowledge', and 'Refresh'.

Description	Date
[1.01] Low flow on "Sample1"	2022-12-22 16:03:14
[3.02] Temperature deviation on "HCD1"	2022-12-22 16:03:14
[3.03] Temperature deviation on "Heatedzone"	2022-12-22 16:03:14
[3.01] Temperature deviation on "Oven2"	2022-12-22 16:03:14
[5.04] Temperature limit reached on "Oven4"	2022-12-22 16:03:14
[5.05] Temperature limit reached on "Oven5"	2022-12-22 16:03:14
[2.00] Flow deviation on "LDepc1"	2022-12-22 16:03:14
[2.01] Flow deviation on "Sample1"	2022-12-22 16:03:14
[1.00] Low flow on "LDepc1"	2022-12-22 16:03:14

Figure 28: Alerts menu

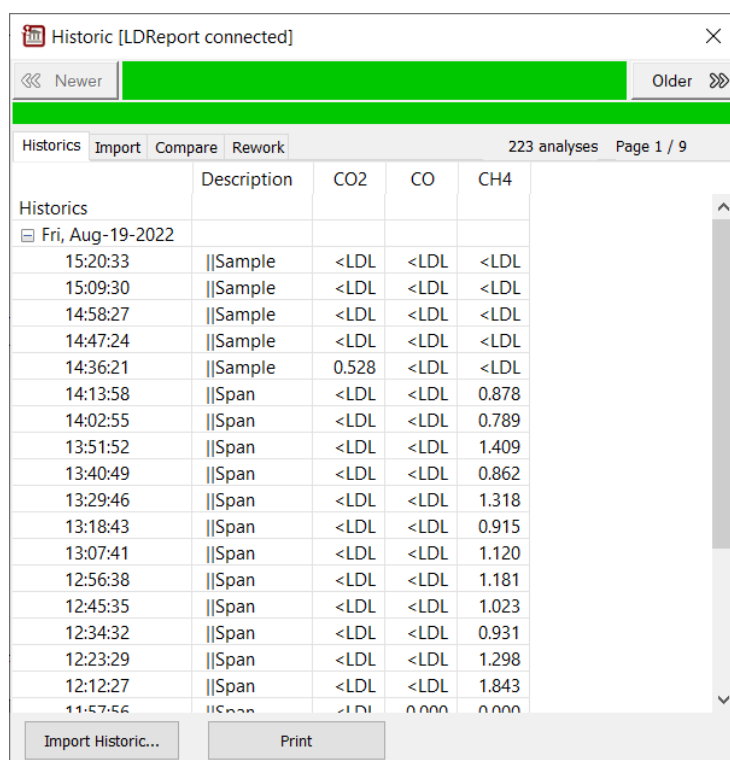
Active tab: The Active tab displays a list of all currently active alerts. Active alerts are shown in red, while those that have been acknowledged are displayed in blue. At the bottom of the tab, there are buttons to acknowledge all active alerts or individual alerts. Additionally, a button to refresh the alert list is also available.

Historic tab: It contains a history of all the last activated alerts.

Setup tab: From that tab, alerts can be configured. It is possible to change the way they behave, assign them to an output relay or disable them completely.

7.2.3. Historic

The Historic menu enables users to access previous analysis results. By clicking on a row, the selected analysis will automatically load into the chromatogram menu. A green bar situated at the top of the historic menu indicates that LDChroma+ is connected to LDReport, and it turns red if the connection is not established. If disconnected, users can right-click on the red bar to access analyses stored locally within LDChroma+. There are navigation buttons located on both sides of the green bar that allow users to move between pages and view older or newer analyses. At the bottom of the historic menu, users can find a button to import historic files (.md3h) and another button to print the current table.



Historic [LDReport connected]

Newer Older

Historics Import Compare Rework 223 analyses Page 1 / 9

Historics	Description	CO2	CO	CH4
Fri, Aug-19-2022				
15:20:33	Sample	<LDL	<LDL	<LDL
15:09:30	Sample	<LDL	<LDL	<LDL
14:58:27	Sample	<LDL	<LDL	<LDL
14:47:24	Sample	<LDL	<LDL	<LDL
14:36:21	Sample	0.528	<LDL	<LDL
14:13:58	Span	<LDL	<LDL	0.878
14:02:55	Span	<LDL	<LDL	0.789
13:51:52	Span	<LDL	<LDL	1.409
13:40:49	Span	<LDL	<LDL	0.862
13:29:46	Span	<LDL	<LDL	1.318
13:18:43	Span	<LDL	<LDL	0.915
13:07:41	Span	<LDL	<LDL	1.120
12:56:38	Span	<LDL	<LDL	1.181
12:45:35	Span	<LDL	<LDL	1.023
12:34:32	Span	<LDL	<LDL	0.931
12:23:29	Span	<LDL	<LDL	1.298
12:12:27	Span	<LDL	<LDL	1.843
11:57:56	Span	<LDL	0.000	0.000

Import Historic... Print

Figure 29: Historic menu

Newer: Show newer analysis.

Older: Show older analysis.

Import Historic: The import button allows you to import historics from the hard drive or external storage. The analyses that were imported will appear in the “Import” tab.

Print: The “Print” button allows you to print the current table.

Moreover, a context menu will open after you right-click on an analysis.

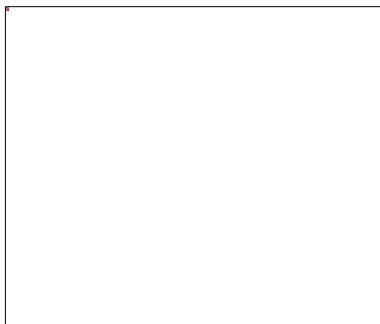


Figure 30: Historic advanced tools

Export Historic: The export button allows you to export the selected historic on the hard drive or external storage. Chromatograms can be exported in .md3h or .xls.

Calib Method: Allows you to calibrate a method using the selected analysis.

Compare...: This allows you to compare different chromatograms. The selected analysis will appear in the “Compare” tab.

Set Description: This allows you to edit the historic description.

Rework Raw Data: This feature allows the user to resend historic data to the DSP for re-processing. Before sending the data, the user can modify the sensor's filter settings according to their needs.

Tools: To add offset or gain on historic sensor data.

By right-clicking on the top-bar, a context menu opens up that allows the user to select different filters. For example, selecting the "Today" filter will display only the analyses performed on the current day.

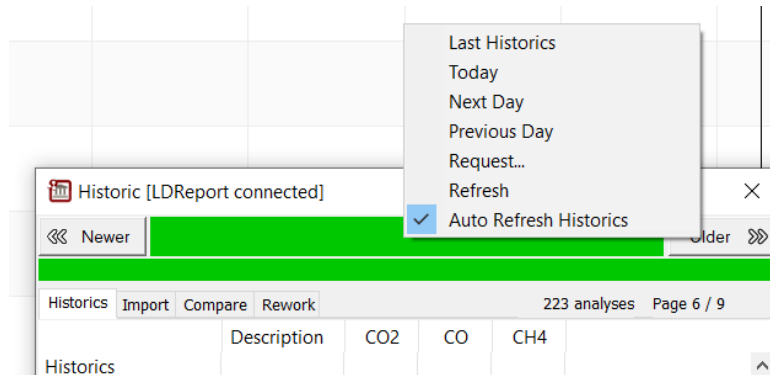


Figure 31: Historic list window

Last Histories: Shows the most recent historical data.

Today: Filters the table to show results from the current day.

Next Day: Filters the table to show results from the following day. If for instance, the view is showing results from 4 days ago, this button can be used to show results from 3 days ago.

Previous Day: Filters the table to show results from the day before.

Request: Allows users to request historical data from LDReport.

Refresh: Manually refreshes the historical data table.

Auto Refresh Historic: Automatically refreshes the historical data table when a new analysis is done.

After double-clicking on a row in the historic menu, a new window will appear displaying more detailed information about the analysis, such as concentration, area, retention time, height, and noise.

The top-left section of this window displays the currently selected peak, and the top-right section allows you to modify detection parameters. Here, you can select the detection algorithm you want to use by editing the “Peak type” parameter. Additionally, you can manually integrate the peak enabling “Use Manual Detection.”

The bottom section of the window allows the user to select the peak they want to work on and view information such as area, retention time, and noise.

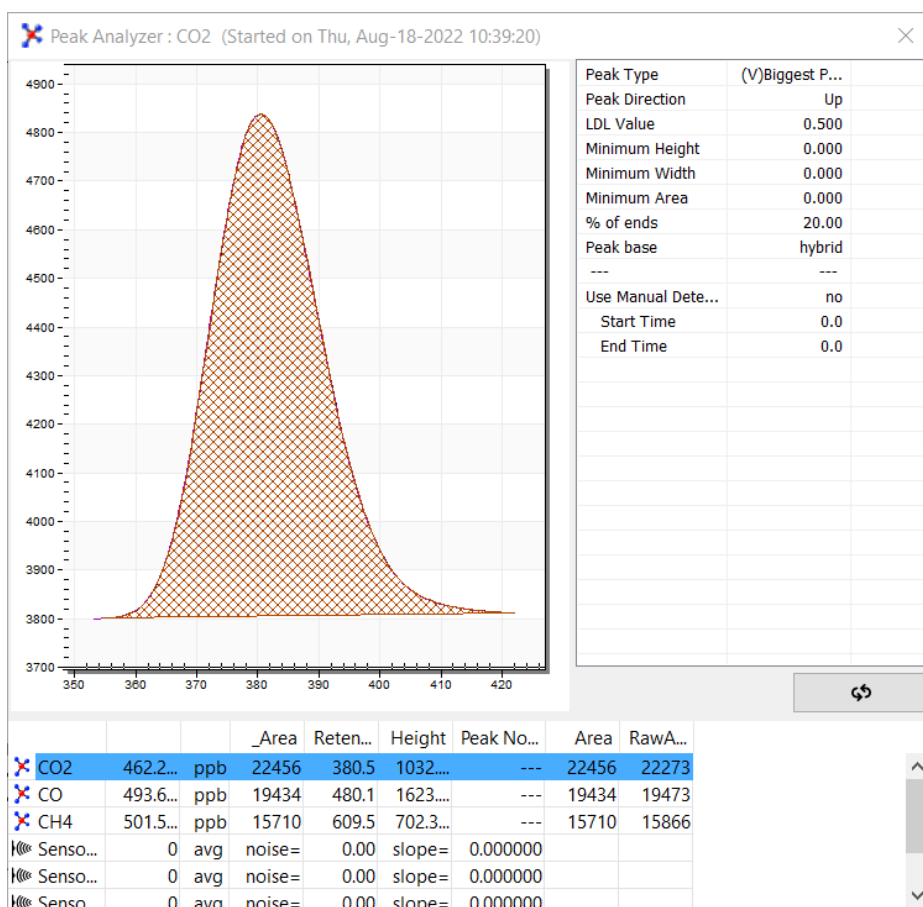


Figure 32: Peak Results

7.3. Settings Menu

7.3.1. Setting

The MultiDetek3 has a menu where all the parameters of the system can be accessed. However, It is important to note that making changes to these settings without proper knowledge and guidance can negatively impact the performance of the system. Therefore, any changes made to the settings in this category should be done only after consulting with LDetek support. Furthermore, the available settings may vary depending on the software version installed. To update the software, please contact LDetek support to ensure that the versions are compatible with your system.

The settings in the menu are split into two categories. The first category is called "Methods" and contains the settings related to the analysis methods, including parameters such as peak and peakset.

The second category is called "Machine" and contains the settings related to the GC, such as flows, ovens, detectors, sensors, valves, streams, sequences, columns, and 4-20mA modules.

The following section will showcase the different parameters configurable from the setting menu.

7.3.1.1. Methods

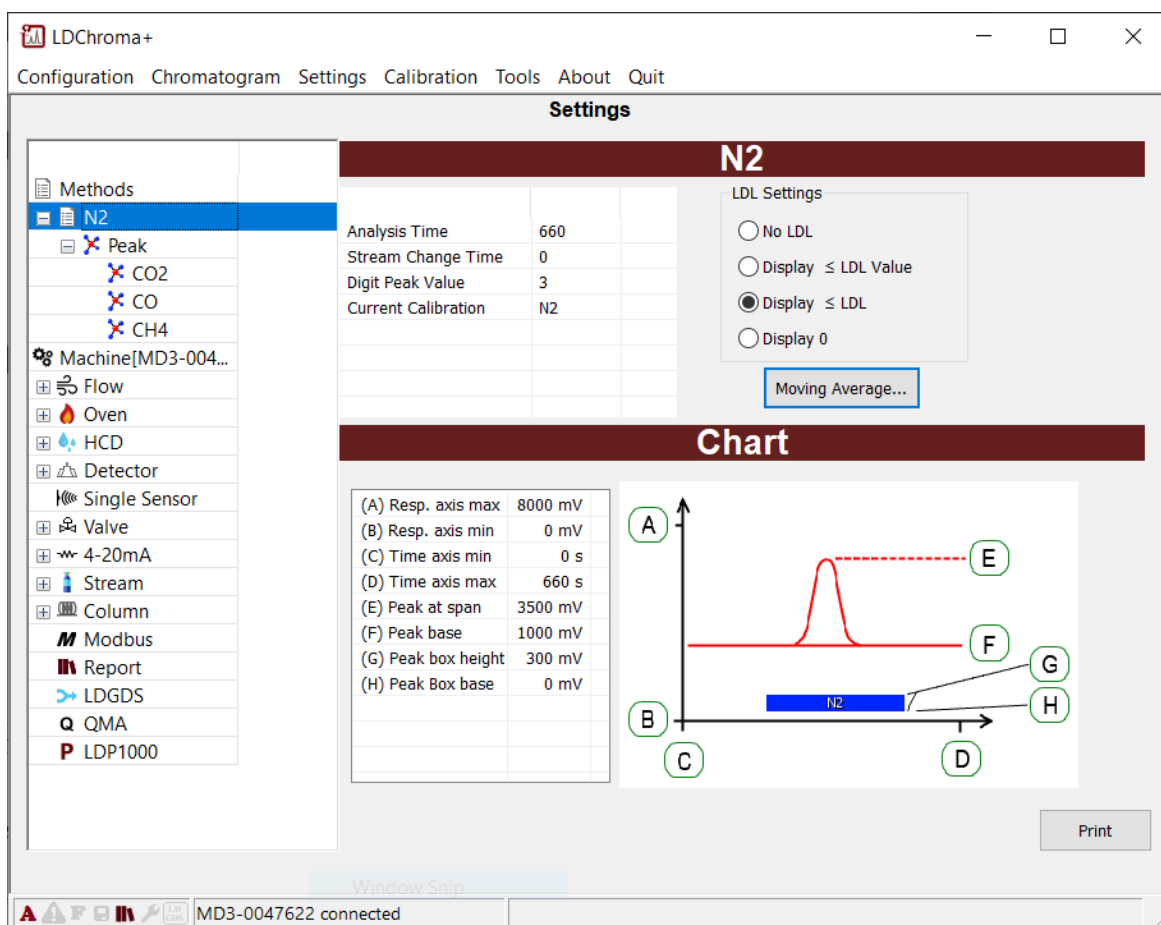


Figure 33: Settings menu

Analysis Time: The cycle time of the method.

Stream ChangeTime: It is the time when it is possible to change the current stream without affecting this analysis. This parameter is used only when running a sequence and if the next analysis in the sequence has a different stream. When the value is 0, the stream will never change during this analysis

Digit Peak Value: The number of digits displayed in the results (resolution).

Current Calibration: It is the calibration associated with the method.

LDL Settings: To change the way the results are displayed when the reading is below the detection limit. When set to “no LDL”, LDChroma+ will show any values even if the result is below the detection limit. If “Display $<$ LDL Value” is enabled and if the LDL is 0.010ppm, LDChroma+ will show “<0.010 ppm. If “Display $<$ LDL Value” is enabled, LDChroma+ will simply show “<LDL and if “Display 0” is enabled, it will show “0”.

Moving Average: This button opens a window that allows the user to configure the moving average.

(A) Resp axis max: The maximum value of the chromatogram's Y axis.

(B) Resp axis min: The minimum value of the chromatogram's Y axis.

(C) Time axis min: The minimum value of the chromatogram's X axis.

(D) Time axis max: The maximum value of the chromatogram's X axis.

(E) Peak at span: The height of the peak in mV at span.

(F) Peak base: The height of the zero baselines.

(G) Peak box height: The height of the peak box.

(H) Peak box base: The height between the peak box and the X-axis.

7.3.1.2. Peak

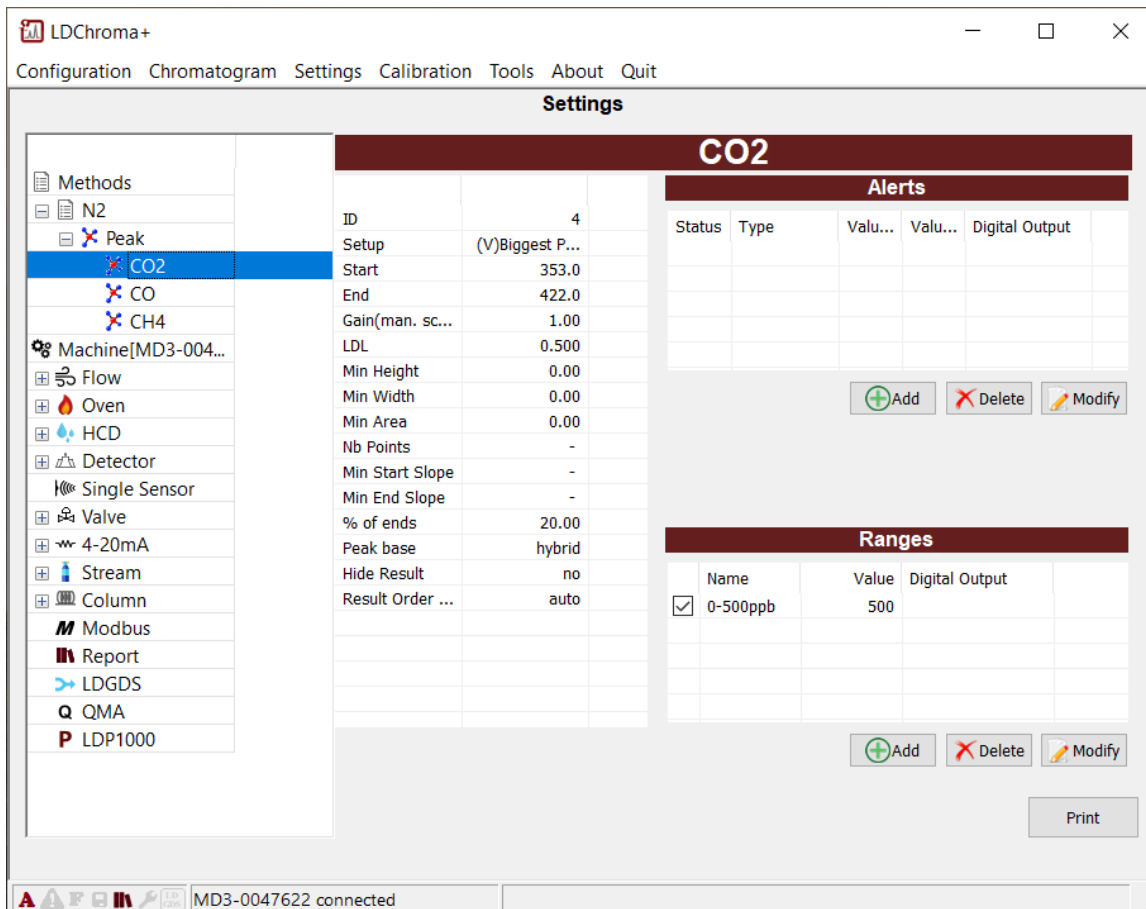


Figure 34: Peak setting menu

- Setup:** The peak detection algorithm can be changed by double-clicking on “setup”
- Start:** The start time of the current peak
- End:** The stop time of the current peak
- LDL:** The lowest detectable limit (LDL). Any result with a concentration lower than this value will be considered LDL.
- Alert:** It is where you can define an alert level for each peak
- Ranges:** The ranges are used for the 4-20mA scale; 0 “unit” (ppb, ppm or %) = 4mA Range Value = 20mA

The parameters below “LDL” may vary depending on the peak detection algorithm used. The detection algorithms are described below.

There are 7 types of detection for a peak.

- | | |
|--------------------------|---|
| Biggest Peak: | The algorithm will detect every rise and every drop using the start and end slopes. A rise followed by a drop is considered a peak. In the Biggest Peak mode, the biggest peak detected in the window will be kept. |
| Multi Peak: | In the peak window, the algorithm will detect every rise and every drop. A rise followed by a drop is considered a peak. In the Multi Peak mode, the first rise and the last drop is considered as the peak. |
| Bypass detection: | In this mode, we compute the area of everything upward at the start and the end of the window. |
| FWHM: | This is a mode currently in development. |
| Averaging: | Instead of computing an area, this mode makes an average of the reading during the window. This is used for online sensors. |
| Follower: | Same as “Averaging” except that the 4-20mA is continuously refreshed. |
| (V)Biggest Peak: | Same as “Biggest Peak” except that the detection is made by using vectors. |

7.3.1.3. Flow

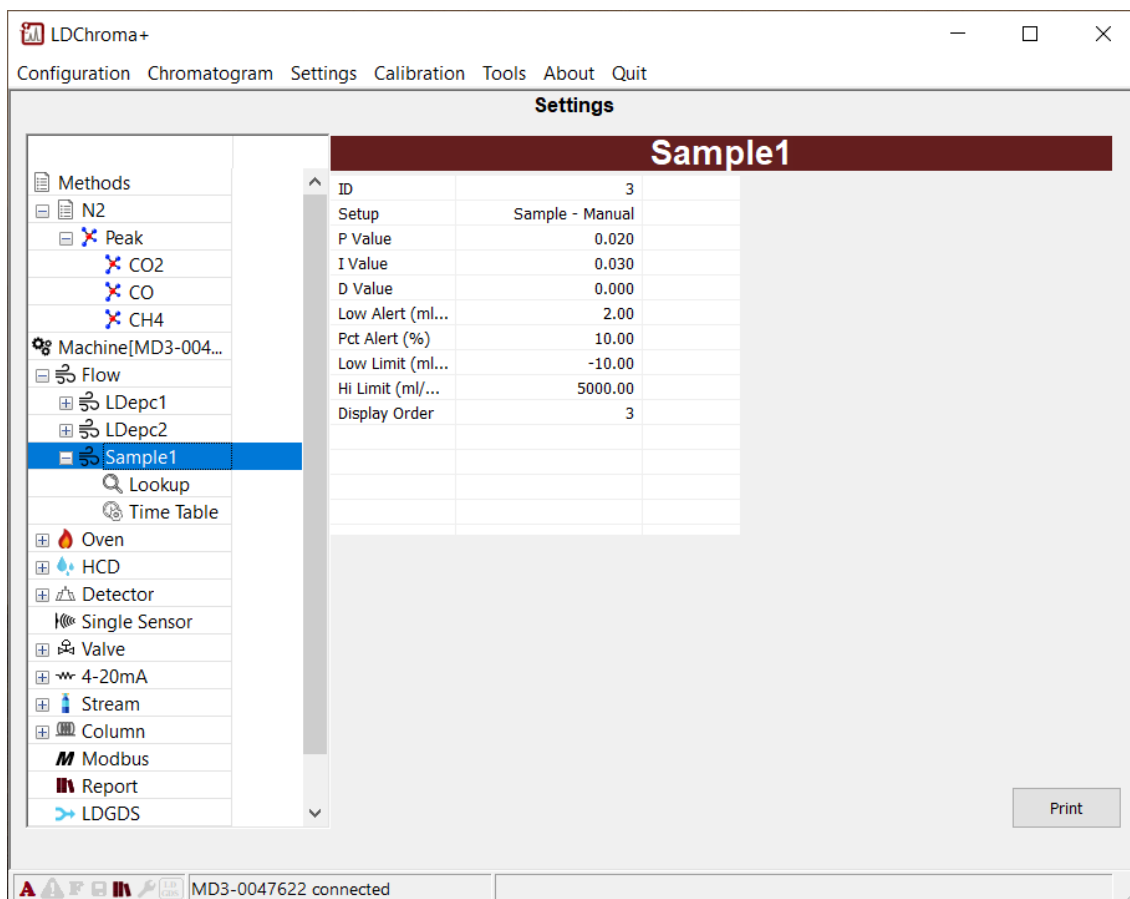


Figure 35: Flow setting menu

Setup:

By double-clicking on it you can change:

- The name of the flow
- The type of flow
 - Sample
 - Carrier
- The flow control type
 - Automatic (closed-loop control)
 - Manual (just for reading, no output)
 - LDepc (extern control)
- Input / Output used for the control

P Value:

Proportional gain for the closed-loop control

I Value:

Integral gain for the closed-loop control

D Value:

Derivate gain for the closed-loop control

Low Alert:	Below this value, the Low Flow alert will turn ON
Pct Alert:	The percentage of deviation allowed before the flow deviation alert
Low Limit:	The lowest value to be considered as a normal condition. If we have readings lower than that, the system will stop trying to control it. Because there is probably something wrong, a broken sensor for instance.
Hi Limit:	The highest value to be considered as a normal condition. If we have readings higher than that, the system will stop trying to control it. Because there is probably something wrong, a broken cable for instance.
Lookup Table:	This is the table to convert the sensor reading into units

7.3.1.4. Oven

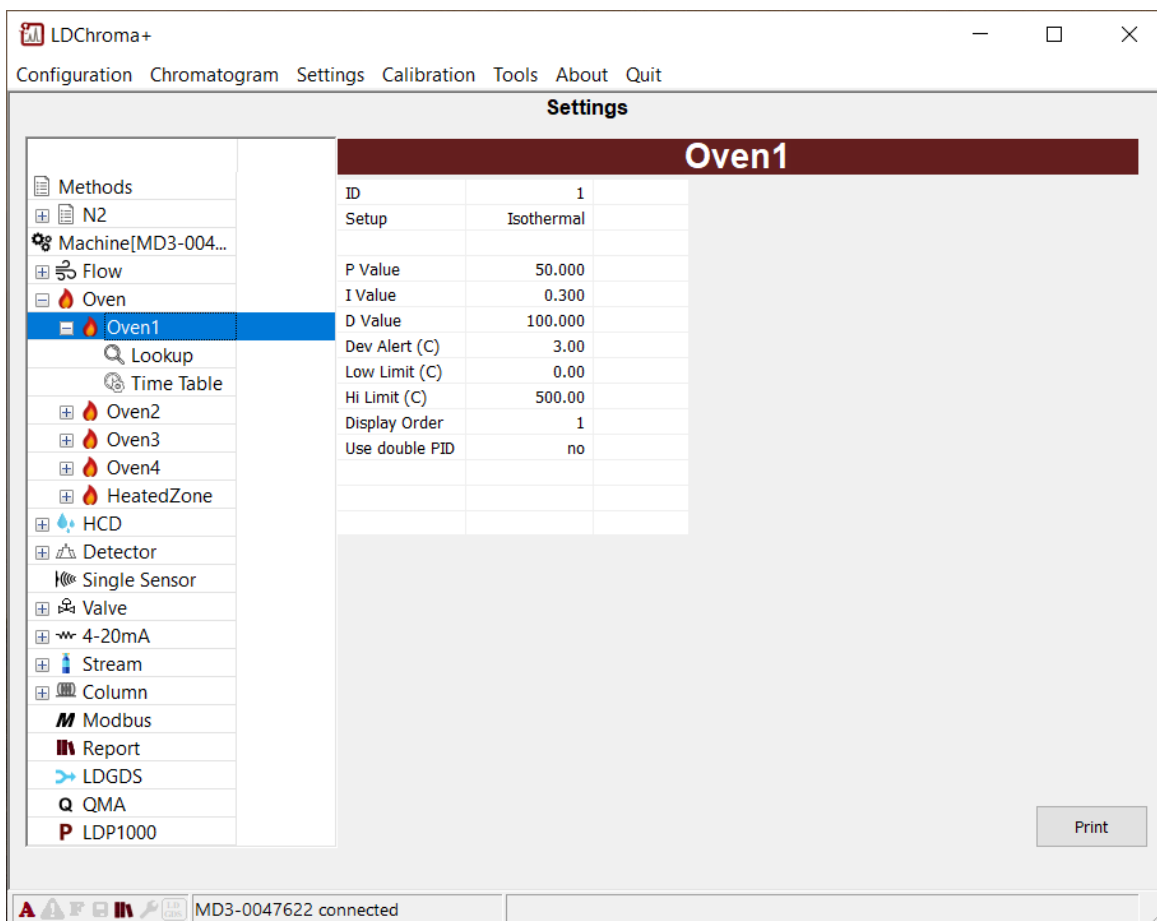


Figure 36: Oven setting menu

Setup:

By double-clicking on it you can change:

- The name of the oven
- T° sensor you want to use for this oven
- The type of oven
 - On/Off (isothermal oven)
 - On/Off+fan (programmed ramping oven)
 - Proportional (HCD)
- Input / Output needed for the control

P Value:

Proportional gain for the closed-loop control

I Value:

Integral gain for the closed-loop control

D Value:

Derivate gain for the closed-loop control

Dev Alert:

The percentage of deviation allowed before the oven temperature deviation alert

Low Limit:	The lowest value to be considered as a normal condition. If we have readings lower than that, the system will stop trying to control it. Because there is probably something wrong, a broken sensor for instance.
Hi Limit:	The highest value to be considered as a normal condition. If we have readings higher than that, the system will stop trying to control it. Because there is probably something wrong, a broken cable for instance.

7.3.1.5. Detector

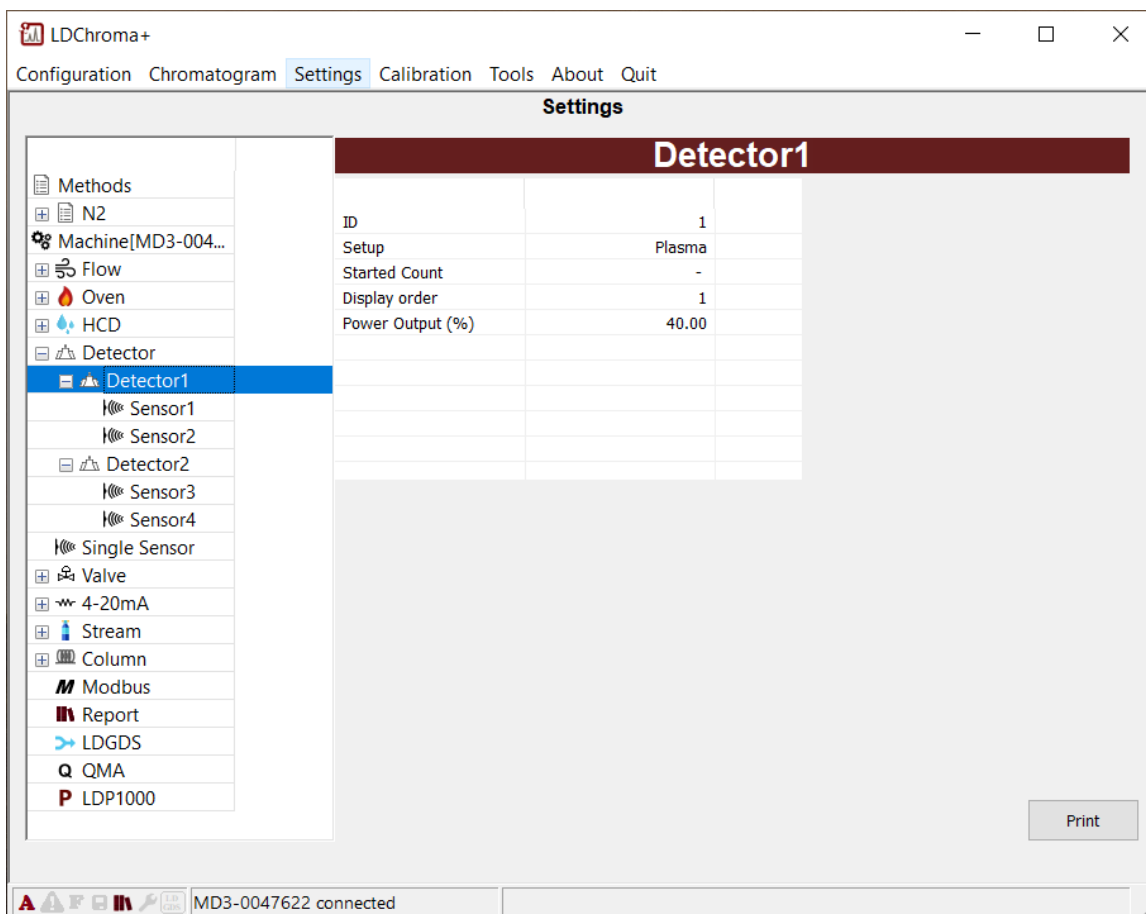


Figure 37: Detector setting menu

Setup:

By double-clicking on it you can change:

- The name of the detector
- The type
 - Plasma
 - TCD
 - FID
- Input / Output needed for the control and monitoring

Power Output:

The value in % for the power delivered to the detector

Power Relay:

Selection of a relay to cut power to the detector. Only used for TCD detectors.

Started Count:

The number of counts where the detector is considered ON

7.3.1.6. Sensor

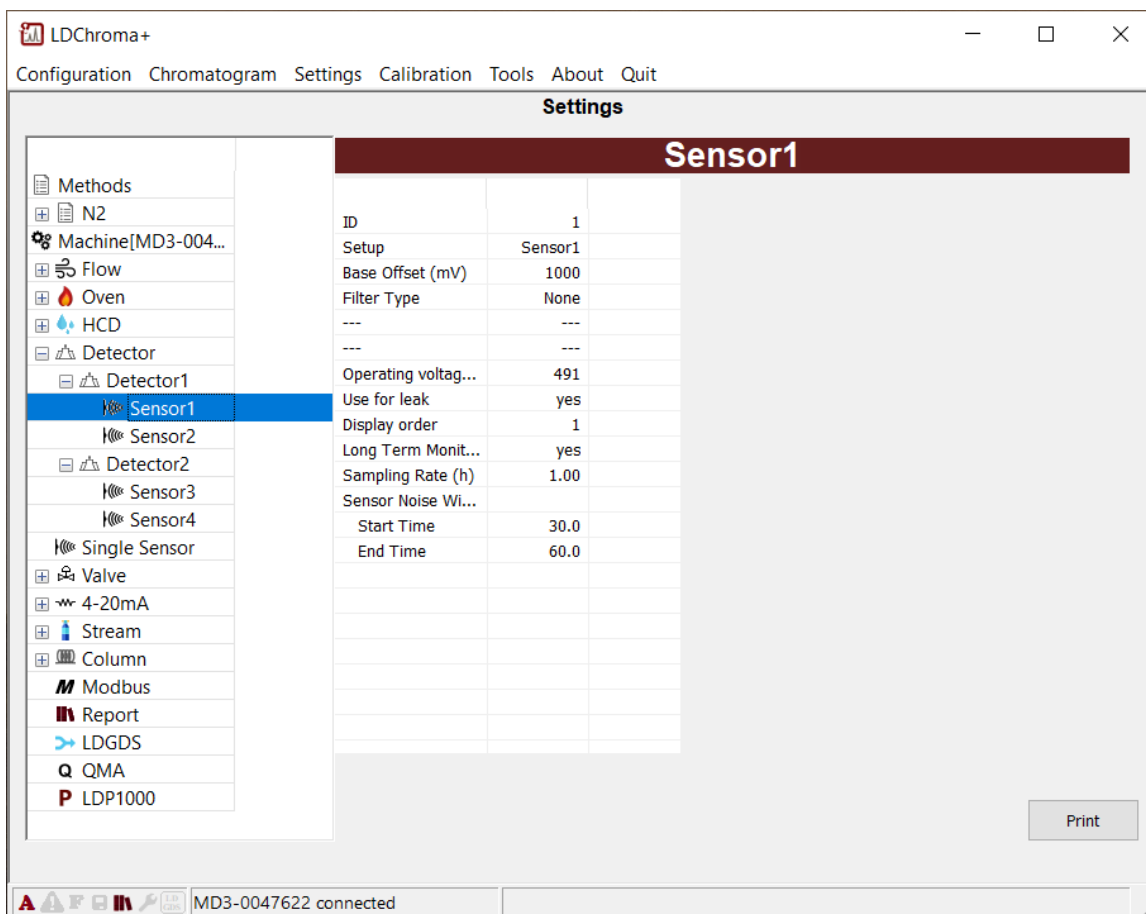


Figure 38: Sensor setting menu

Setup:

By double-clicking on it you can change:

- The name of the sensor
- The colour on the chart
- The type of filter: Average, Median, FIR or Curve Fitting

Base Offset:

If you enter 0, this parameter has no effect. If you put any other value, outside a peak window the filtered value of this sensor will be set at this value.

Filter Level:

This is a value in second. The more seconds you put in, the more effective the filter will be. For instance, if you put 10 seconds with an "Average" filter, the filtered value will average 10 seconds of raw data.

Operating Voltage:

Factory normal sensor operation voltage

7.3.1.7. Valve

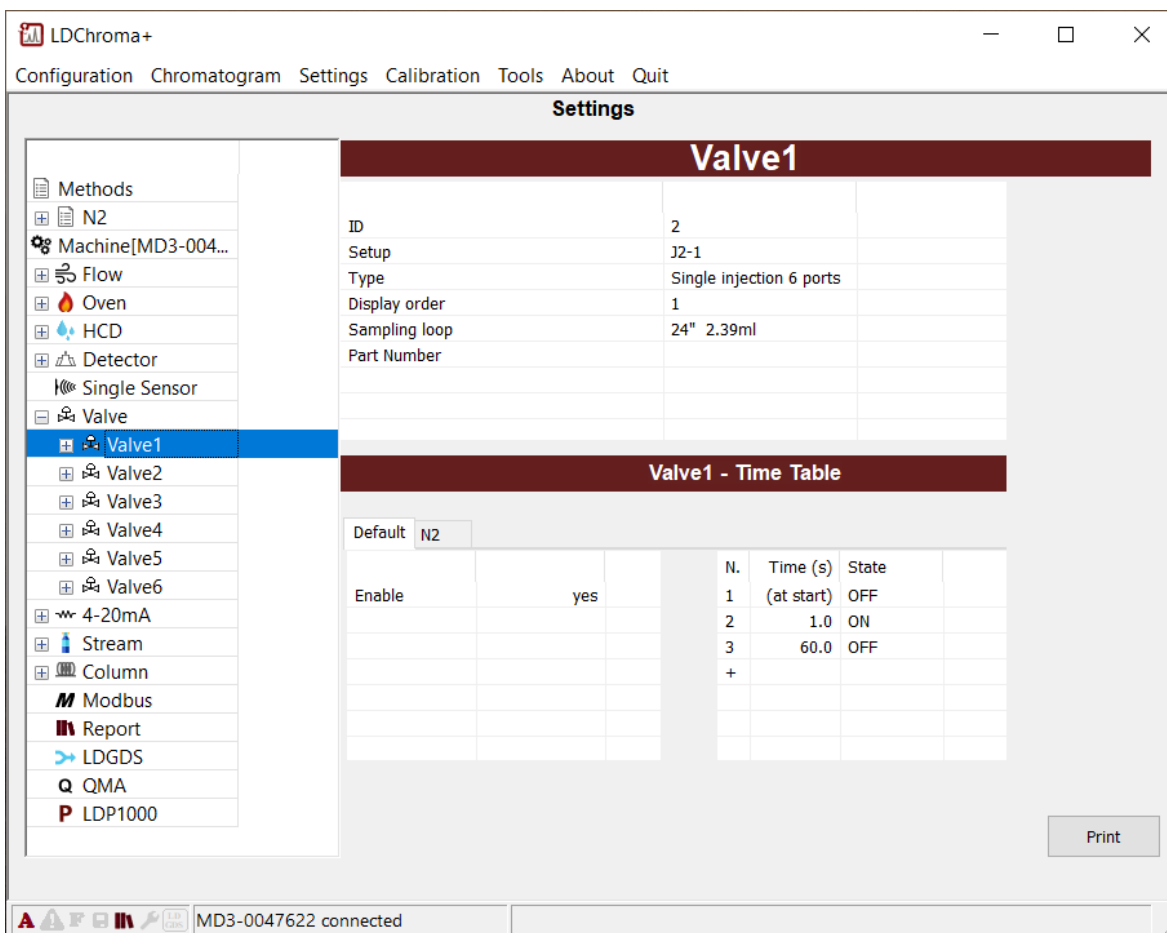


Figure 39: Valve setting menu

Setup:

By double-clicking on it you can change:

- The name of the valve
- The digital output associated with it

Type:

Configuration of the valve (Injection, Heartcut, Backflush, etc.)

Sampling Loop:

It shows the sampling loop volume if it is a valve that contains a sample loop.

Display Order:

This determines the order the valve will have in the menu.

Time Table:

The table contains the time when the state of the valve change.

7.3.1.8. Machine

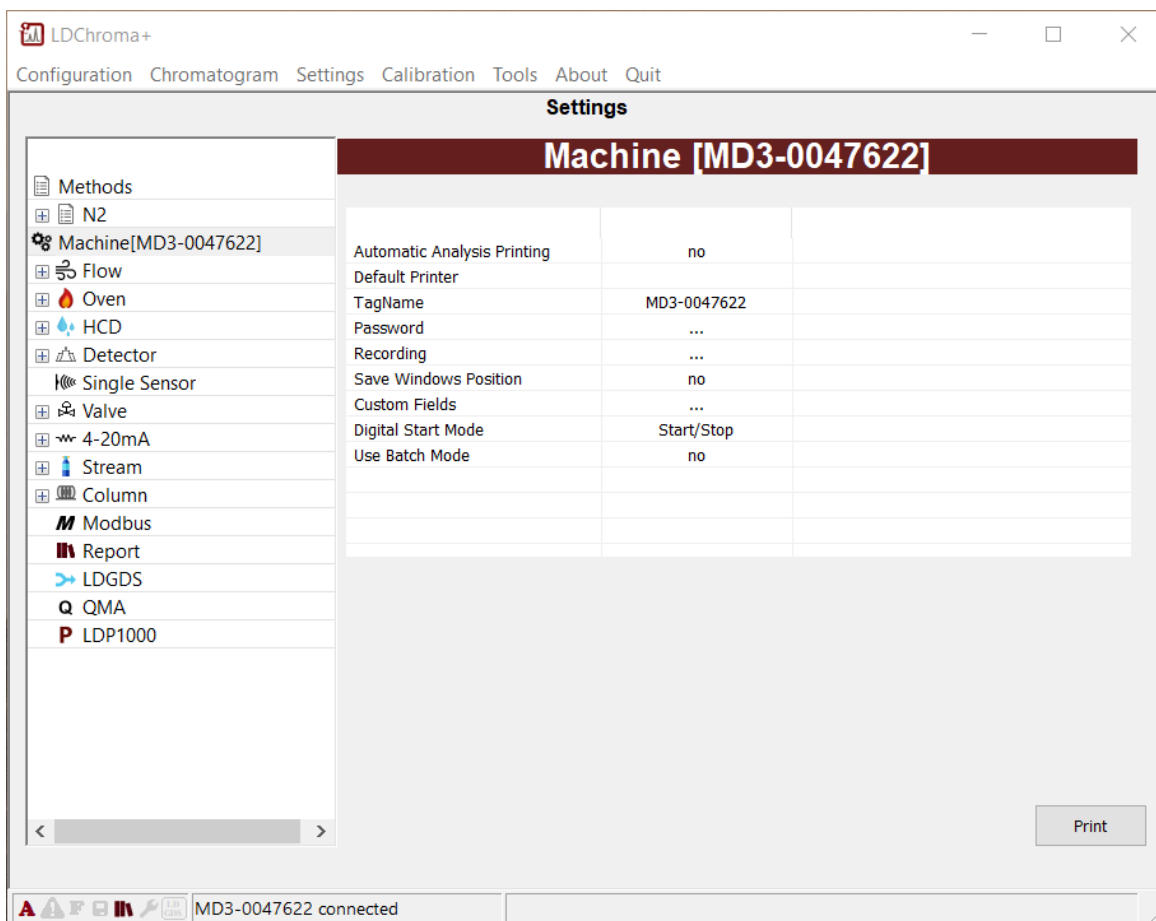


Figure 40: Machine setting menu

Automatic Analysis printing:	To activate automatic printing after each analysis
Default Printer:	To select a default printer
TagName:	Alias of MD3
Password:	To manage passwords for the admin mode
Recording:	To manage the folder or drive where the analysis results are recorded
Save Windows Position:	To activate the windows position feature
Custom Field:	To setup custom fields associated with results

7.3.1.9. 4-20mA

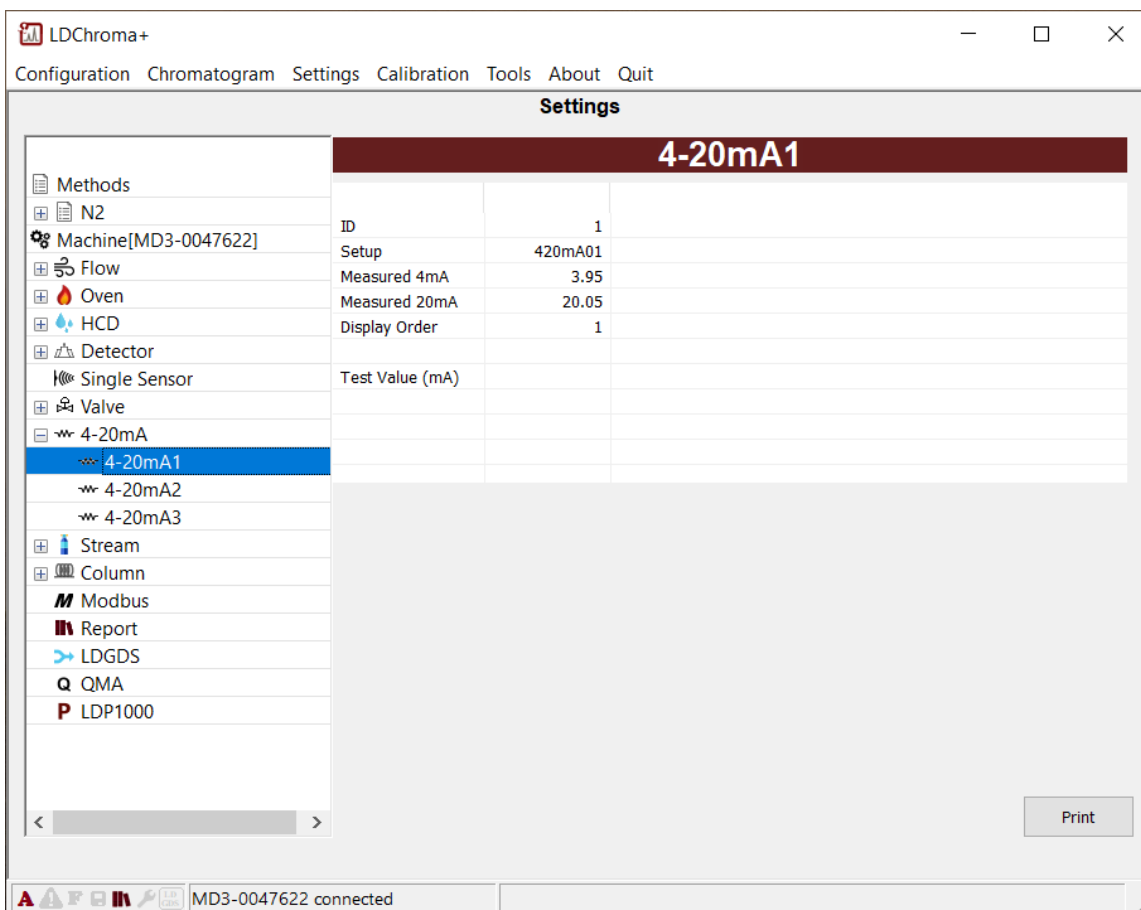


Figure 41: 4-20mA settings menu

Setup:

By double-clicking on it you can change:

- The name of the 4-20mA
- The analog output associated with it

Measured 4mA:

The current measured during the calibration should be put there. By double-clicking on the field, the output will be set to 4mA.

Measured 20mA:

The current measured during the calibration should be put there

Test Value (mA):

To force the selected 4-20mA output at the desired value

Display Order:

This determines the order this 4-20mA out will have in the menu.

7.3.1.10.Stream

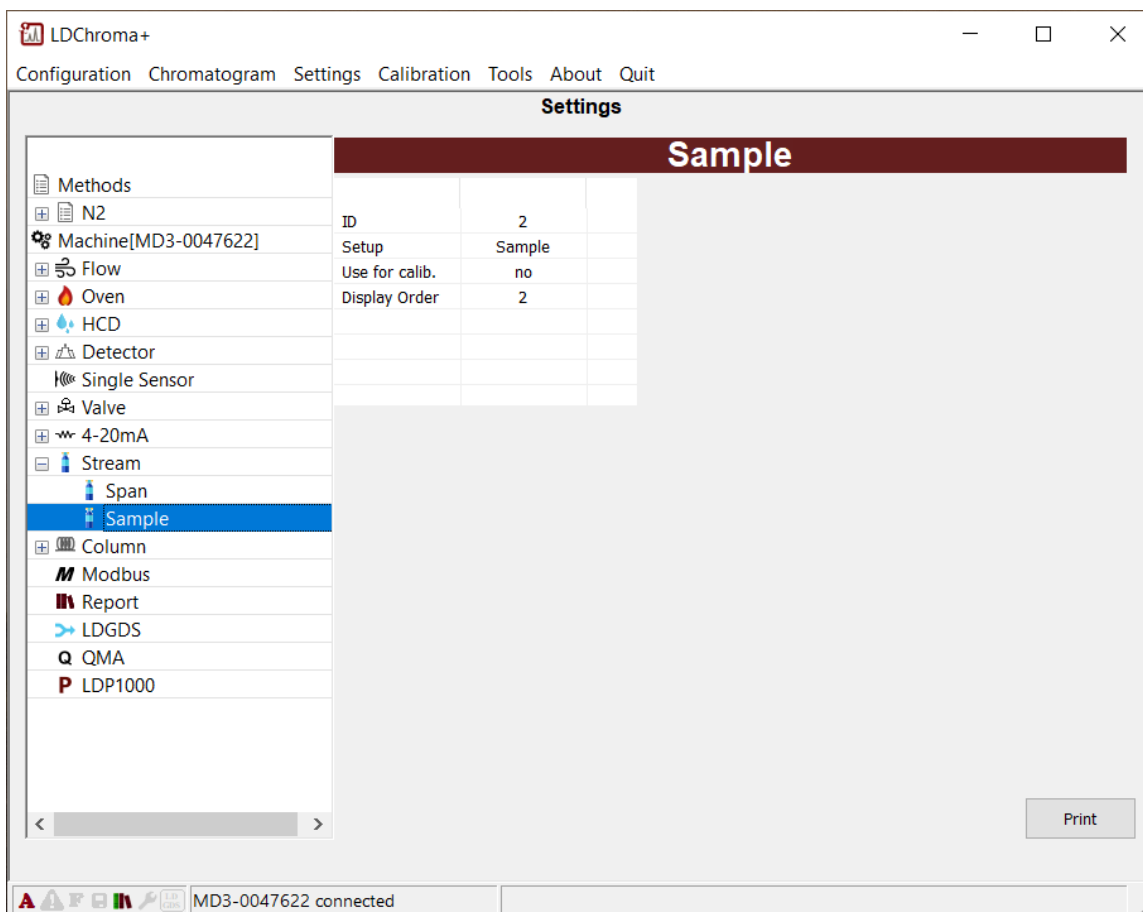


Figure 42: Stream settings menu

Setup:

By double-clicking on it you can change:

- The name of the stream
- The digital output associated with it

Use for Calib.:

This is used to determine the stream used for calibration of the analyzer

Display order:

This determines the order this stream will have in the menu.

7.3.1.11. Sequence

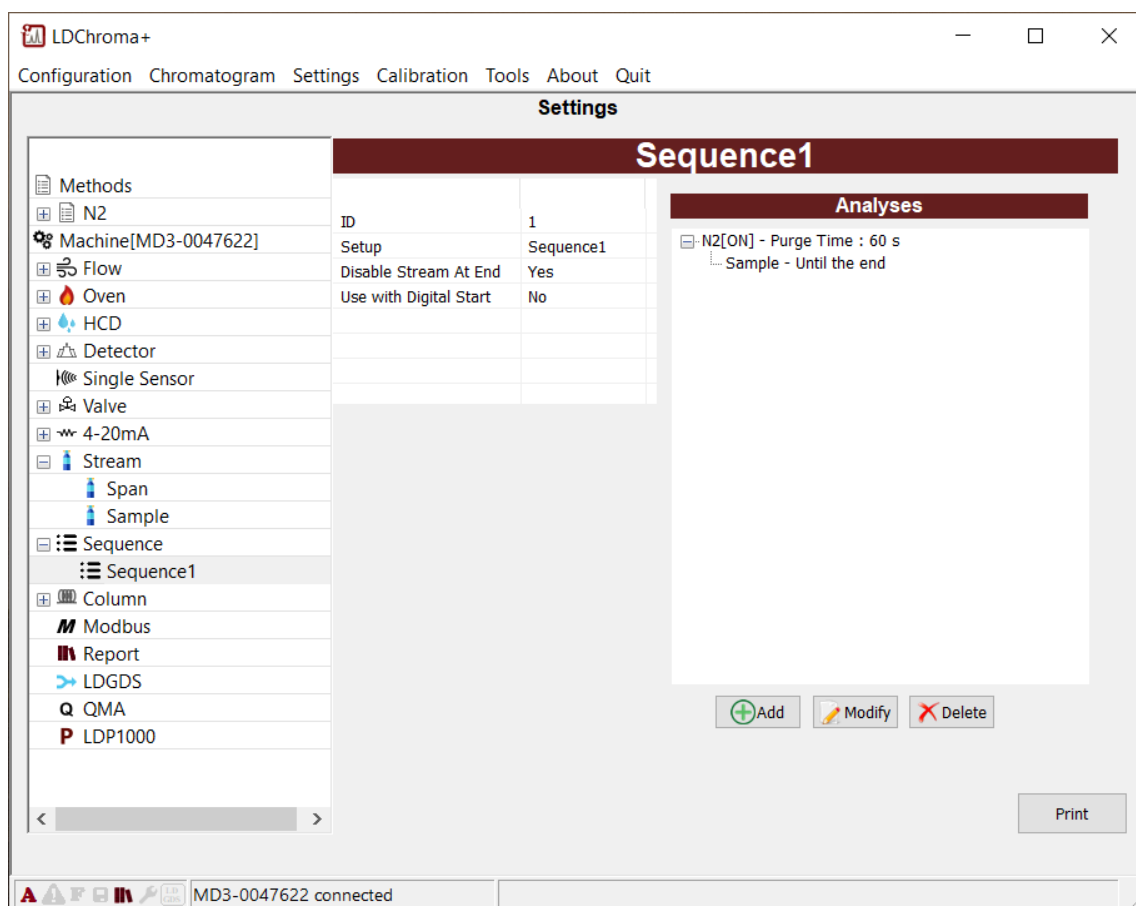


Figure 43: Sequence setting menu

Setup: By double-clicking on it you can change the name of the Sequence

Disable Stream at End If it is enabled, at the end of the sequence, no stream will be selected

Add: To add analysis to the current sequence

Modify: To modify an analysis in the current sequence

Delete: To delete an analysis in the current sequence

Analysis selection: By double clicking modify on one line in the analysis area you can change:

- The method selected for this analysis
- Purge time before starting this analysis
- The stream selected for this analysis

Select between Until analysis end or a pre-set time

7.3.1.12.Column

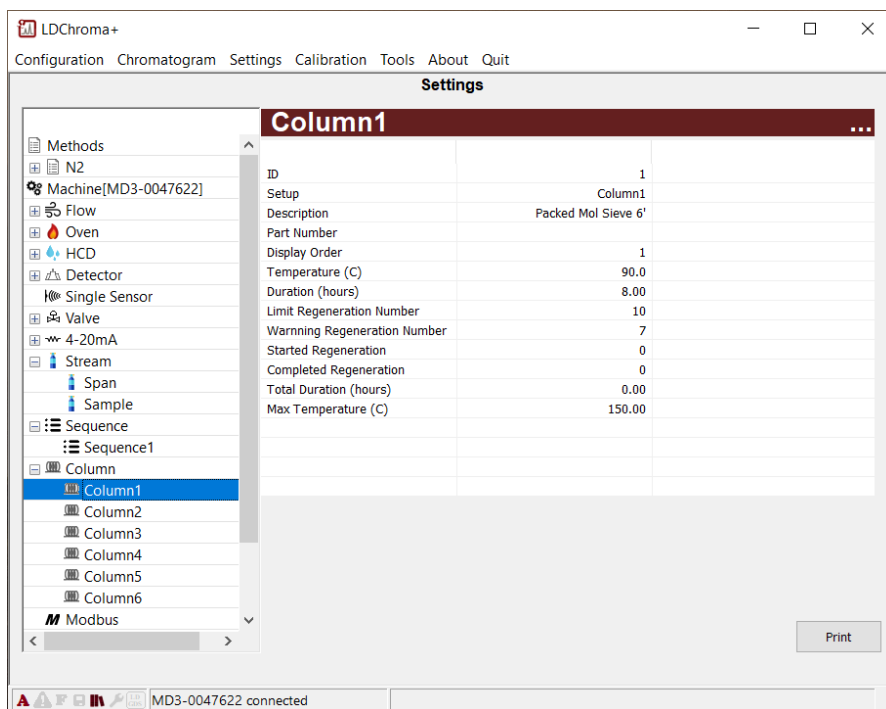


Figure 44: Column setting menu

- Setup:** By double-clicking on it you can change
- the name of the column
 - the oven that contains this column
 - the valve(s) and state of it(them) when column regeneration is in process
- Description:** Additional description in the column
- Temperature:** Temperature setpoint of the regeneration
- Duration:** Duration of the regeneration
- Limit Reg. Nb:** The maximum setting suggested for regeneration
- Warning Reg.Nb:** Settings for warning on suggested max. regeneration process.
- Started Regen.:** Indication of how many regeneration processes started.
- Completed Reg.:** Indication of how many regeneration processes were completed.
- Total Duration:** Indication of how much time of regeneration the column had

7.3.1.13. Modbus

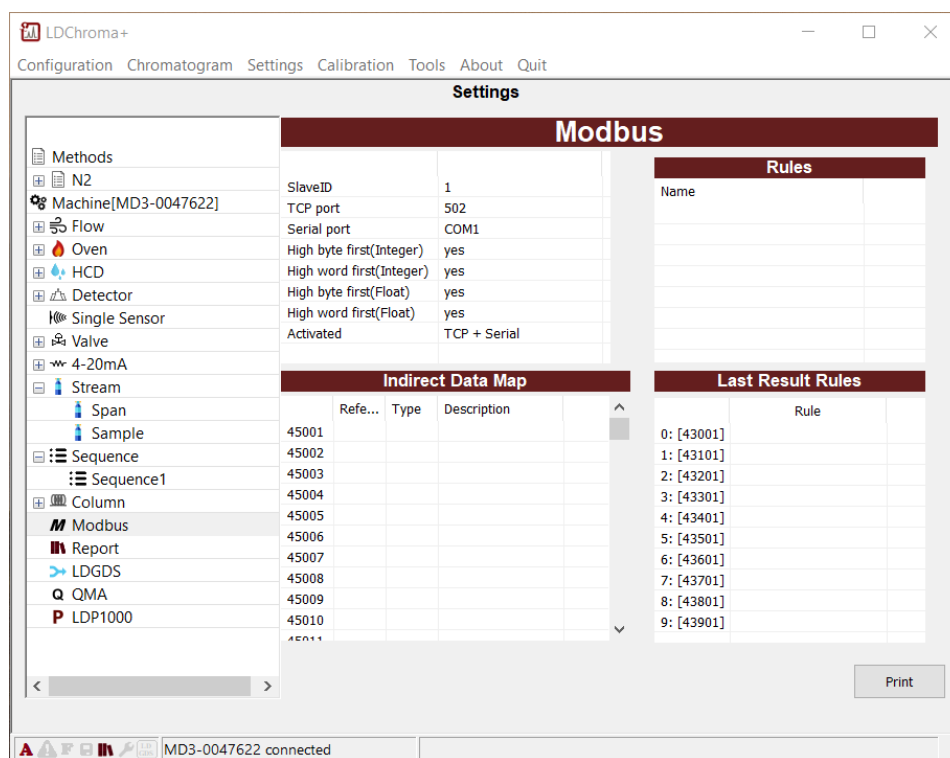


Figure 45: Modbus setting menu

Slave ID: The SlaveID is a unique number for each Slave in your Modbus network. The SlaveID can be any number between 1 and 254. If a Slave receives a communication with the wrong SlaveID, it will be ignored

High byte /High word options: Options to adapt the communication to different DCS default language

TCP port: This is the TCP port used for Modbus. For now, it is impossible to choose another value than 502

Indirect Data Map: Indirect Data Map is an advanced feature to regroup any other register in a single adjacent area

Rules: Rules are used with the Last Results Registers

Last Result: Rules In the Modbus mapping, there is an area for the 10 last results. By default (if no rules are used) the latest result is in result[0], and the oldest is in result[9]. So when a new result arrived, result[9] is discarded, result[8] becomes result[9] and so on. If you assign a rule to a result, the result will be replaced only if the rule is respected. Could be useful if we want to assign a stream to a certain result

7.3.1.14.QMA

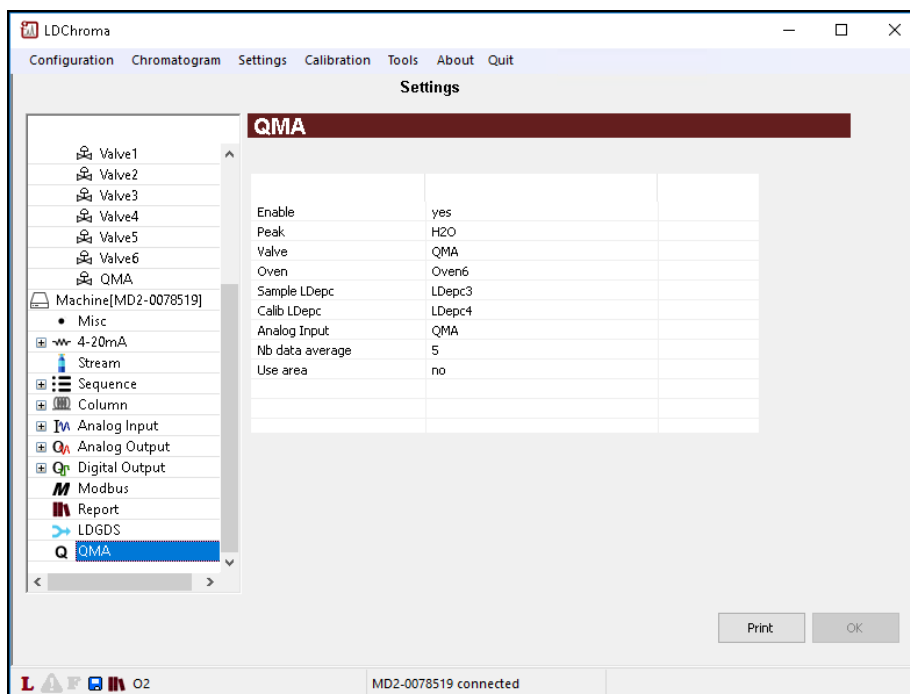


Figure 46: QMA setting menu

- Enable:** Enable or disable the QMA
- Peak:** Assign the QMA to a peak.
- Valve:** Assign a valve to the QMA. The selected valve will control the sensor.
- Oven:** Assign an oven to the QMA. The selected oven will control the sensor temperature.
- Sample LDepc:** Assign the LDepc that will control the sample flow.
- Calib LDepc:** Assign the LDepc that will control the dry gas flow for QMA calibration.
- Analog input:** Select the analog input used for QMA. It has to be created as a "SingleDetector" first.
- Nb data average:** Choose the number of points that will be used for averaging.
- Use Area:** Chose between the calculation algorithms. The Area mode will calculate the area of a complete cycle. The Delta mode will calculate the height of the signal during each cycle.

7.3.2. Maintenance

This menu showcases the percentage of use of various components. **These parameters should not be changed without contacting LDefek support.** The available settings may vary depending on the software version. To update the software, **please contact LDefek support to ensure the versions are compatible with your system.**

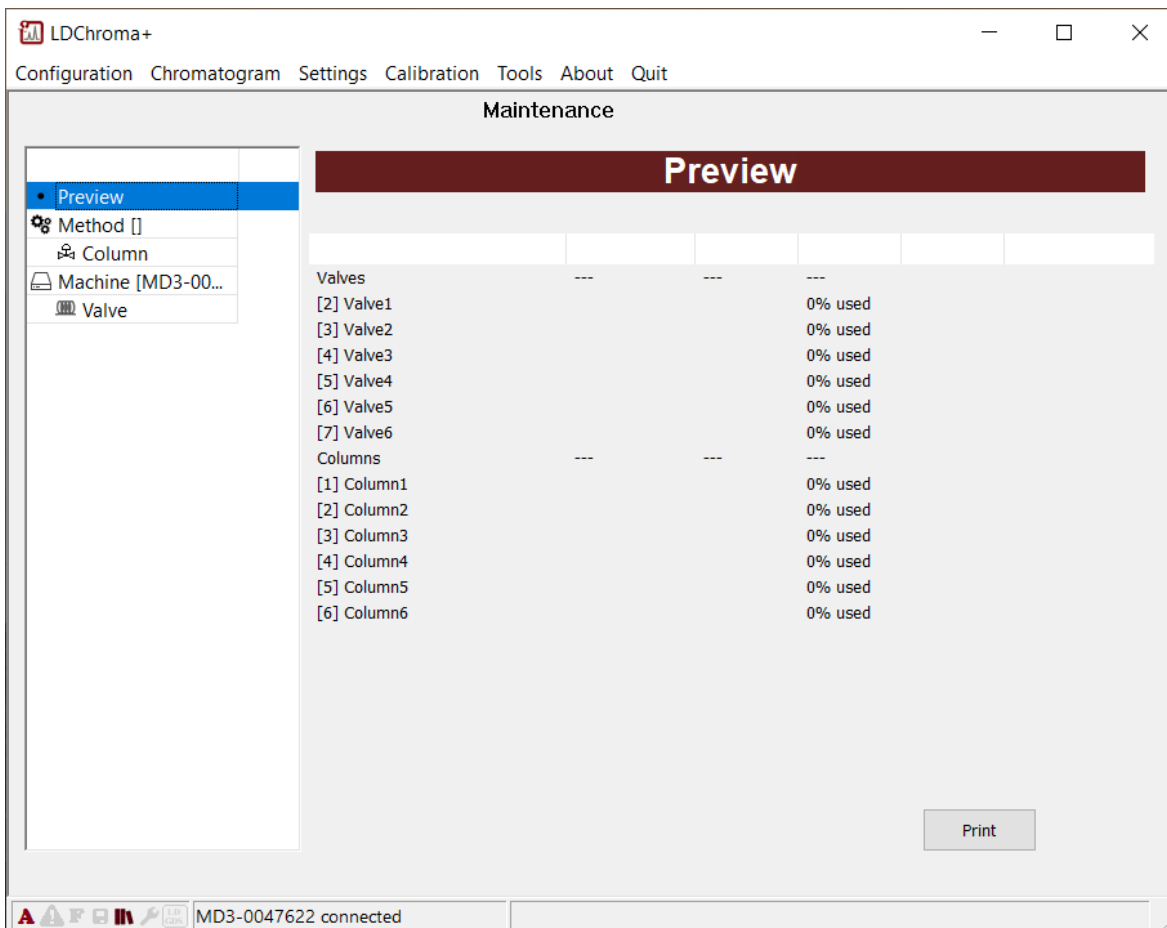


Figure 47: Maintenance menu

7.4. Calibration Menu

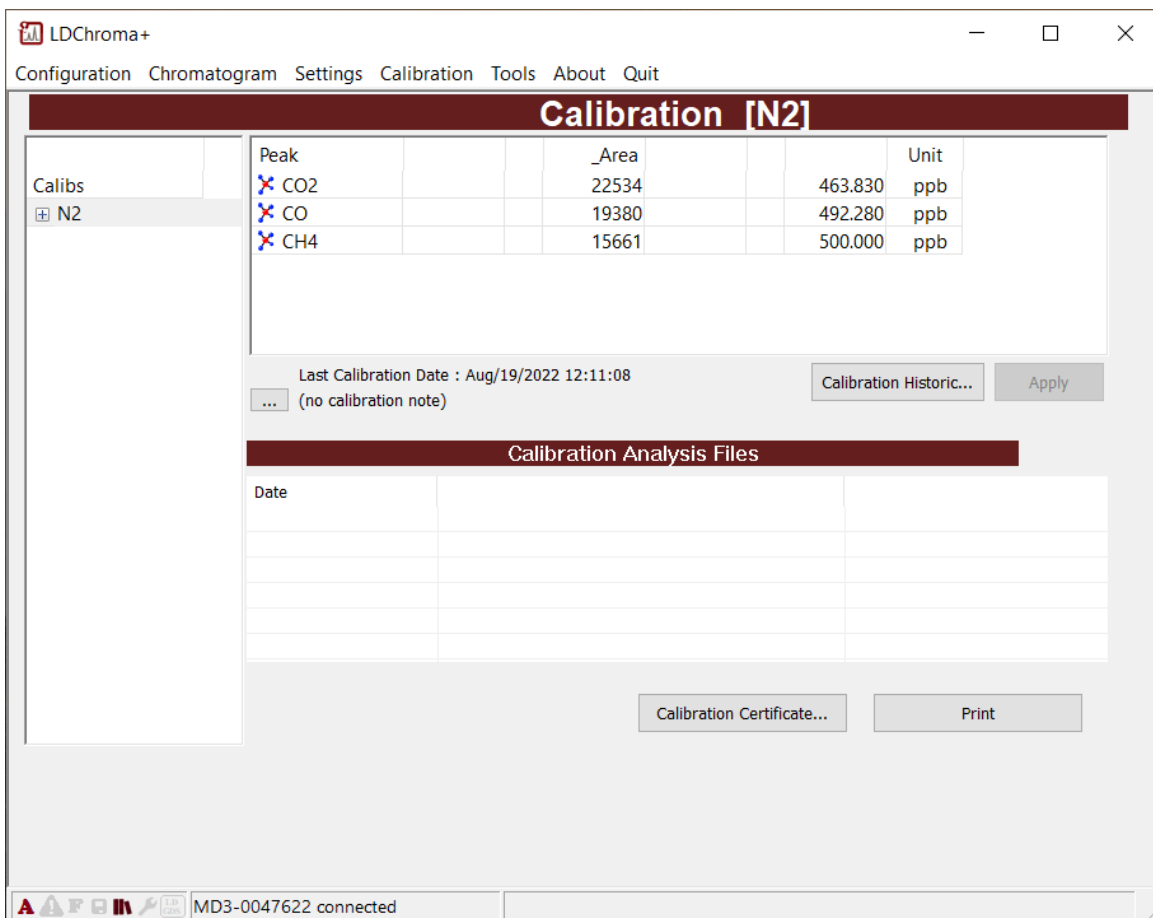


Figure 48: Calibration menu

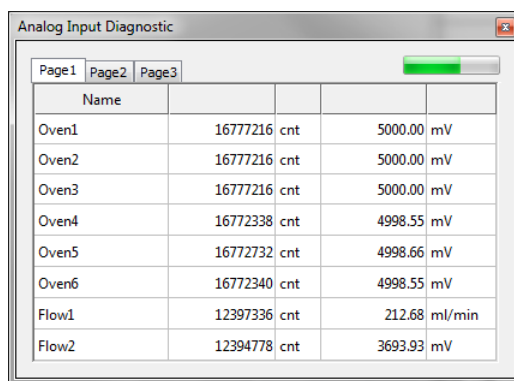
- Peak:** The name of the impurities
- _Area:** The area of calibration
- Unit:** The concentration calibration
- Apply:** To save all the change that were made
- Calibration Historic:** It displays the historic of the previous calibration. It is possible to load a previous one if needed.

7.5. Diagnostics Menu

7.5.1. Analog input

This menu displays all analog inputs in the MultiDetek3 with their actual value in counts and converted into units.

The progress bar in the corner shows the refreshing rate



The window titled "Analog Input Diagnostic" shows a table of input data. It has three tabs: Page1, Page2, and Page3. A green progress bar is visible in the top right corner. The table lists eight inputs: Oven1 through Oven6, and Flow1 through Flow2. Each row displays the Name, a numerical value in counts (cnt), and a converted value in units (mV or ml/min).

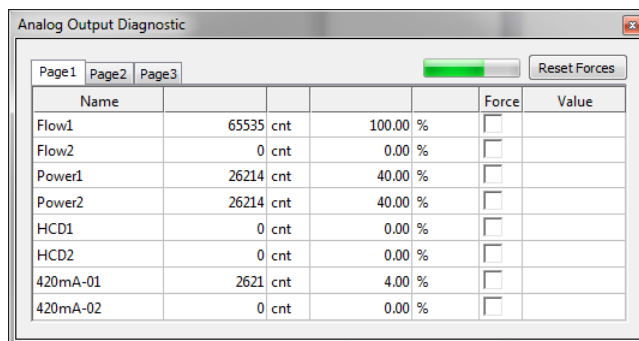
Name	Value (cnt)	Unit
Oven1	16777216	5000.00 mV
Oven2	16777216	5000.00 mV
Oven3	16777216	5000.00 mV
Oven4	16772338	4998.55 mV
Oven5	16772732	4998.66 mV
Oven6	16772340	4998.55 mV
Flow1	12397336	212.68 ml/min
Flow2	12394778	3693.93 mV

Figure 49: Analog input window

7.5.2. Analog output

This menu displays all analog output in the MultiDetek3 with their actual value in counts and converted into units. You can also force any value for diagnostic purposes.

The progress bar in the corner shows the refreshing rate.



The window titled "Analog Output Diagnostic" shows a table of output data. It has three tabs: Page1, Page2, and Page3. A green progress bar is visible in the top right corner, along with a "Reset Forces" button. The table lists eight outputs: Flow1, Flow2, Power1, Power2, HCD1, HCD2, 420mA-01, and 420mA-02. Each row displays the Name, a numerical value in counts (cnt), a percentage value, a "Force" checkbox, and a "Value" column.

Name	Value (cnt)	Percentage	Force	Value
Flow1	65535	100.00 %	☐	
Flow2	0	0.00 %	☐	
Power1	26214	40.00 %	☐	
Power2	26214	40.00 %	☐	
HCD1	0	0.00 %	☐	
HCD2	0	0.00 %	☐	
420mA-01	2621	4.00 %	☐	
420mA-02	0	0.00 %	☐	

Figure 50: Analog output window

7.5.3. Digital output

This menu displays all digital output in the MultiDetek3 with their actual value. If the square is grey, the state of the output is unknown (probably a communication problem), if the square is dark green, the output is OFF, if the square is light green, the output is ON.

You can force any output OFF or ON. When a state is forced, an "F" is displayed in the square.

The progress bar in the corner shows the refreshing rate.

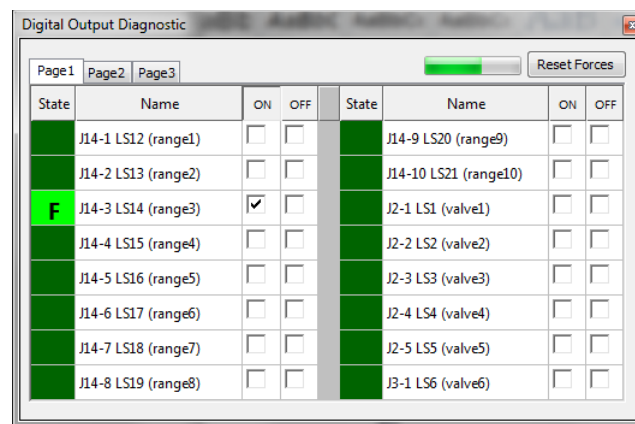


Figure 51: Digital output window

7.5.4. LDepc

This menu displays the communication status, the actual flow, the actual pressure, the flow table and the PID of the LDepc.

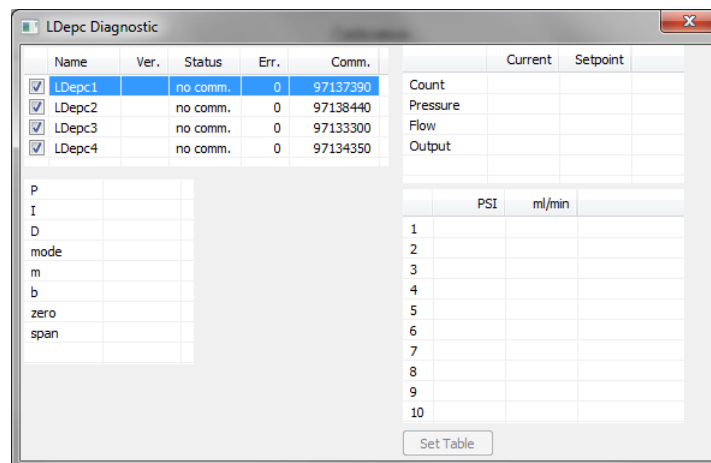


Figure 52: LDepc diagnostic window

7.5.5. Modbus/Register

This menu displays the actual values of every Modbus registers

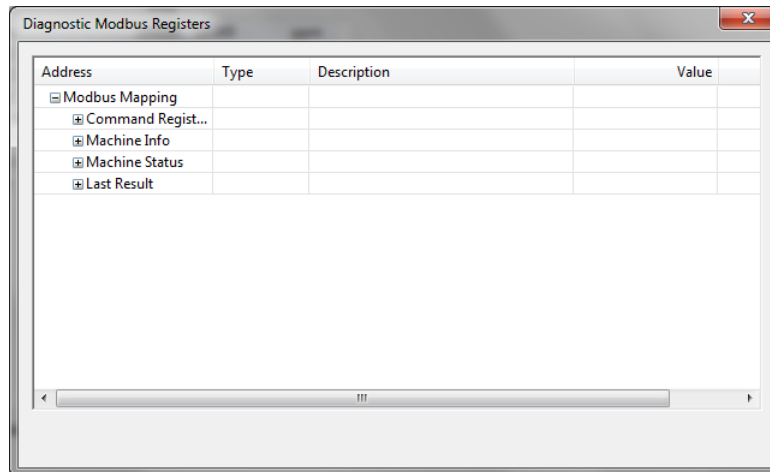


Figure 53: Modbus register window

7.5.6. Modbus/Connection

This menu displays which IP is connected the MD3 and if there is some activity (send and receive data)

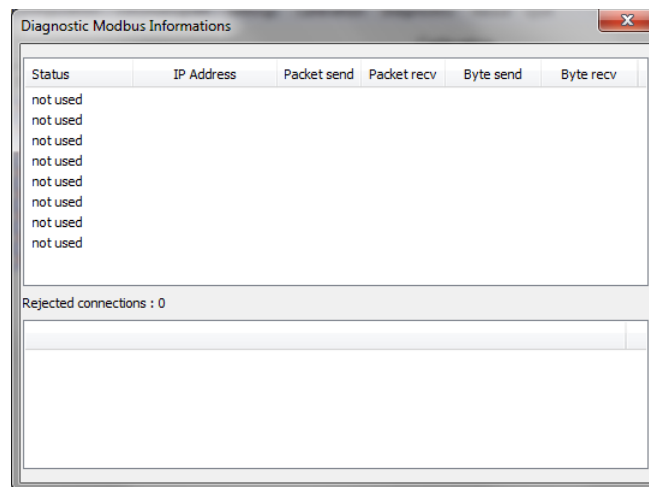


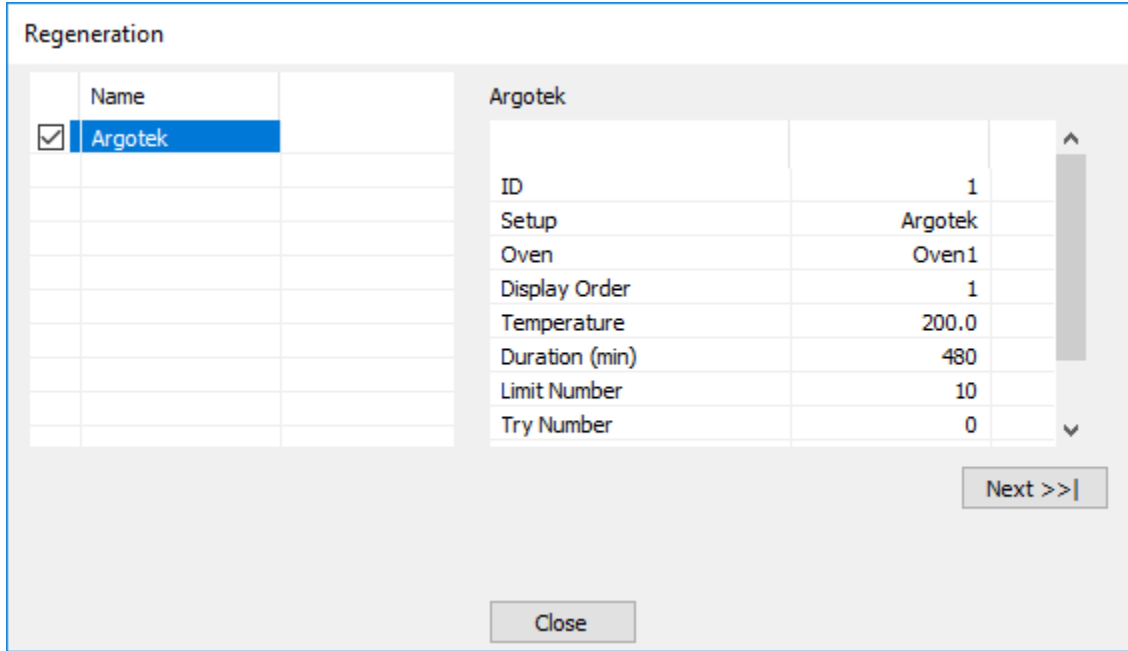
Figure 54: Modbus information window

7.5.7. Idle Sensor

This menu is used to save all sensors voltages when the system is at factory. These voltages become the reference voltages.

7.6. Regeneration

This menu is used to start a regeneration. The settings are pre-configured in the setting menu.



The screenshot shows the 'Regeneration' window. On the left, there is a table with a header 'Name' and a checkbox column. The first row, 'Argotek', is selected. On the right, under the 'Argotek' heading, there is a table of settings. The settings are: ID (1), Setup (Argotek), Oven (Oven1), Display Order (1), Temperature (200.0), Duration (min) (480), Limit Number (10), and Try Number (0). At the bottom right is a 'Next >>|' button, and at the bottom center is a 'Close' button.

Regeneration	
☐	Name
☒	Argotek
☐	
☐	
☐	
☐	
☐	
☐	
☐	
☐	
☐	

Argotek	
ID	1
Setup	Argotek
Oven	Oven1
Display Order	1
Temperature	200.0
Duration (min)	480
Limit Number	10
Try Number	0

Next >>|

Close

Figure 55:Regeneration window

7.7. About menu

The PC software version appears in this menu. The serial # of the unit appears as well. The firmware version of the LDPECs and motherboard installed are also displayed. It is used to evaluate the compatibility of parts and software versions installed in the unit.

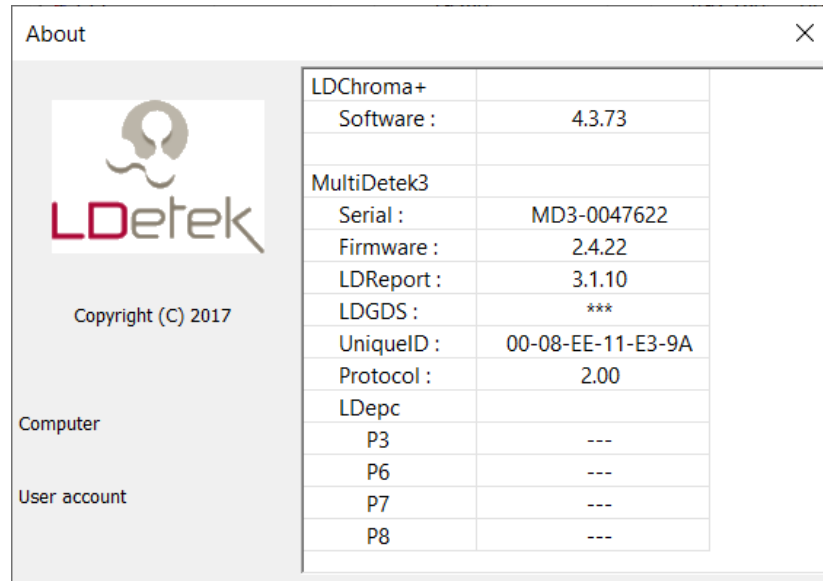


Figure 56: About menu

7.8. Firmware Update

This menu is used to update the firmware of the MultiDetek3. **A firmware update should not be done without contacting LDetek support.**

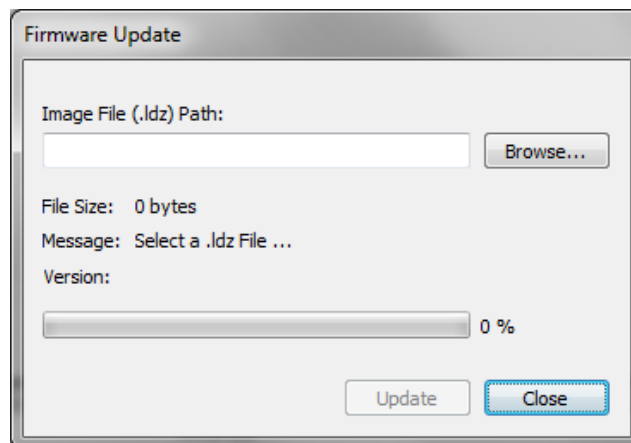


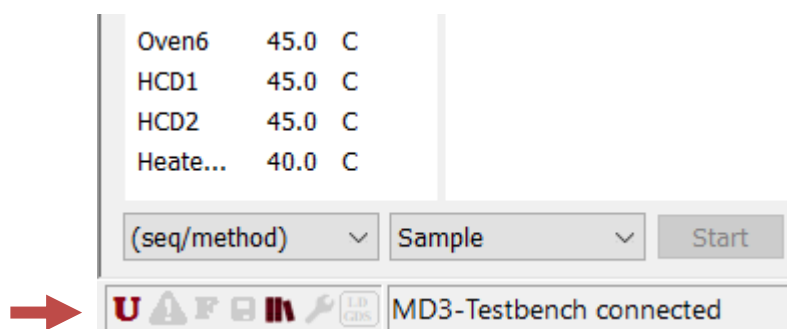
Figure 57: Firmware Update

7.9. LDChroma+ Procedures

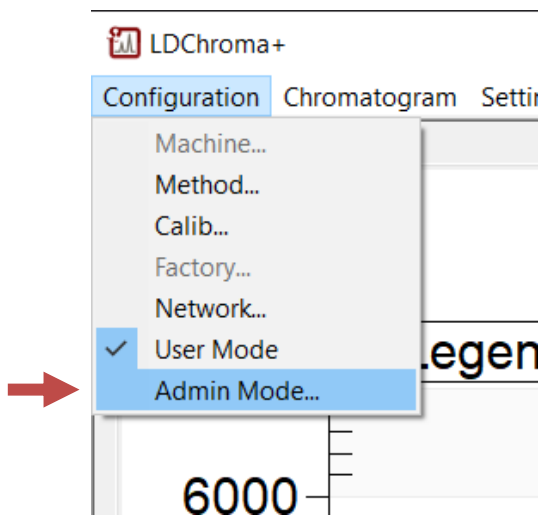
This section will show a few procedures that can be helpful while using LDChroma+. Feel free to contact us at support@ldetek.com if you have any questions.

7.9.1. How to switch from the user to the admin mode

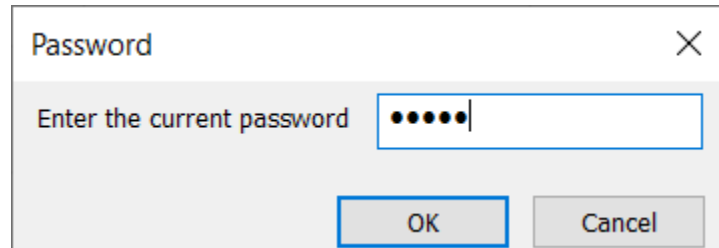
1. If you are in user mode, you will see the “U” icon in the bottom left of LDChroma+.



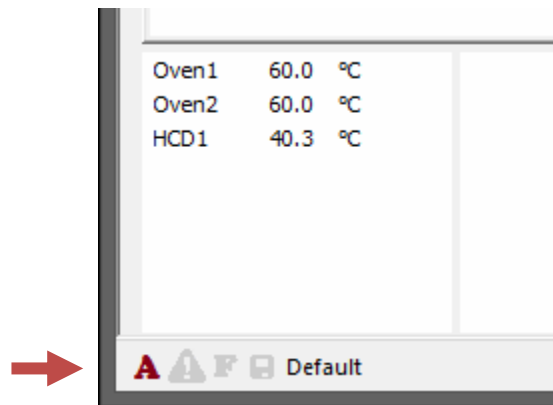
2. Click on Configuration >> Admin Mode...



3. This window will open and you need to enter the password. By default, it is “12345”

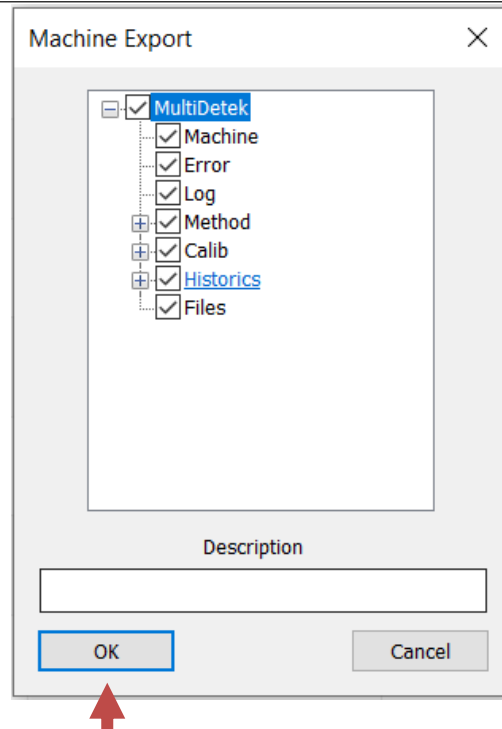


4. Once in admin mode, you will see the “A” icon in the bottom left.



7.9.2. How to export a machine file

1. If you are in user mode, you will see the “U” icon in the bottom left of LDChroma+. If that is the case, you must switch to admin mode by following procedure from section 7.9.1.
2. Open LDChroma+ and click on Configuration >> Machine...
3. Once the machine manager open, select the machine you want to export and click on the button “Export ...”.
4. The save as dialog box will open. Select where you want to save the file .md3m and press “Save”.
5. The following window will open. Make sure all the checkboxes are checked and press “Ok”.

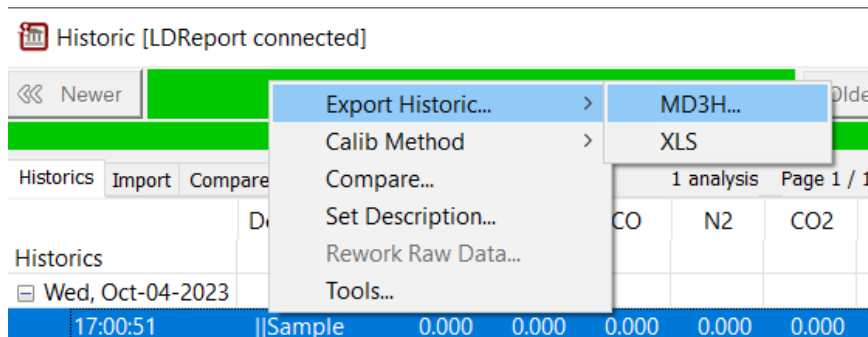


7.9.3. How to import a machine file

1. If you are in user mode, you will see the “U” icon in the bottom left of LDChroma+. If that is the case, you must switch to admin mode by following procedure from section 7.9.1.
2. Open LDChroma+ and click on Configuration >> Machine...
3. Once the machine manager open, click on the button ‘Import...’ and select the machine file that you want to import.
4. If the machine already exists, a pop-up window will appear asking if you want to overwrite it with the new file.

7.9.4. How to export a historic file

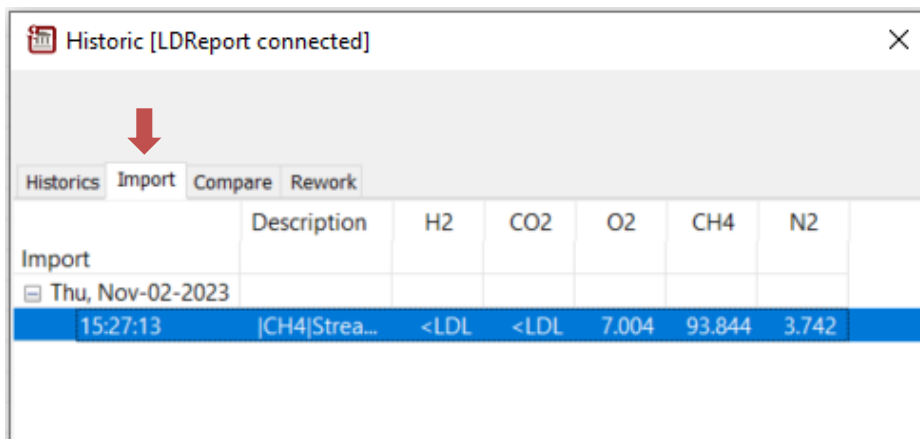
1. Open LDChroma+ and click on Chromatogram >> Historic
2. Right-click on the analyse you want to export and select "Export Historic...". You can chose between exporting a historic file (.md3h) or an Excel file (.xls).



3. The save as dialog box will open. Select where you want to save the file and press "Save". Note that LDChroma+ can only import historic files (.md3h).

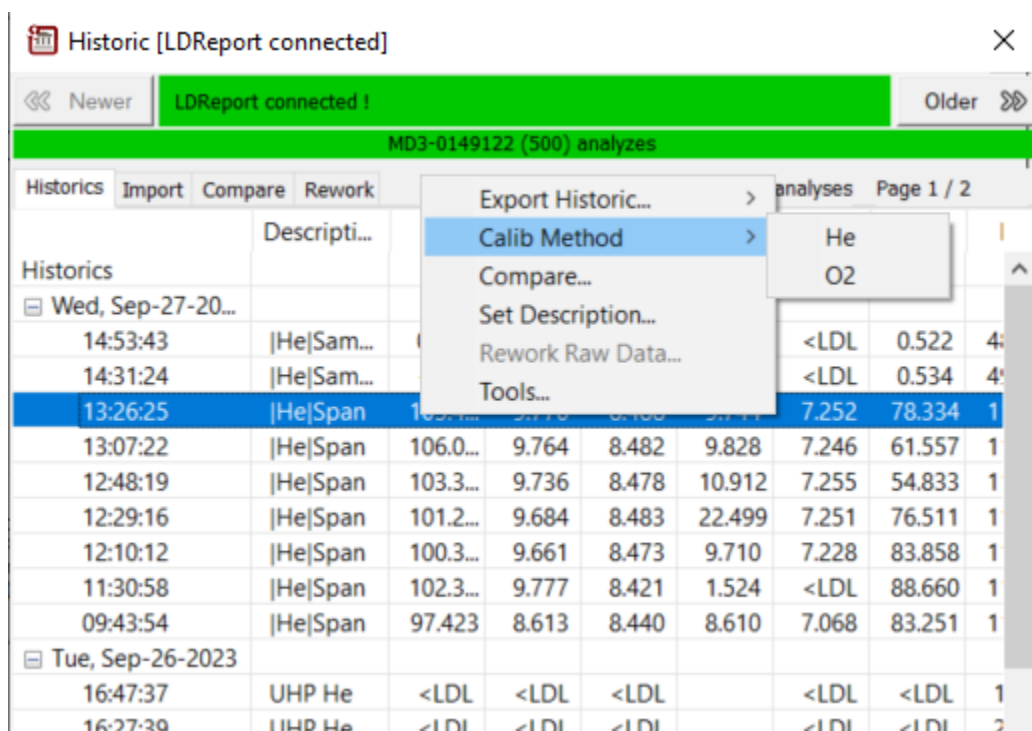
7.9.5. How to import a historic file

1. Open LDChroma+ and click on Chromatogram >> Historic
2. On the bottom, click on the button "Import Historic...".
3. Browse on the computer to find the file that you want to import. Note that LDChroma+ can only import historic files (.md3h).
4. Open the tab "Import" to see the files that you imported.

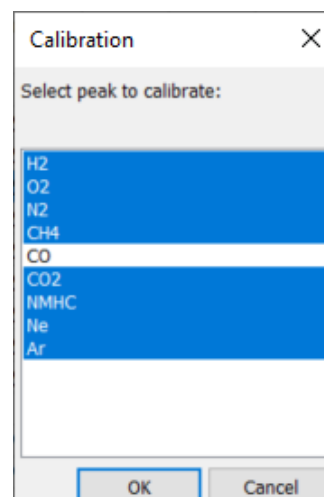


7.9.6. How to do a calibration

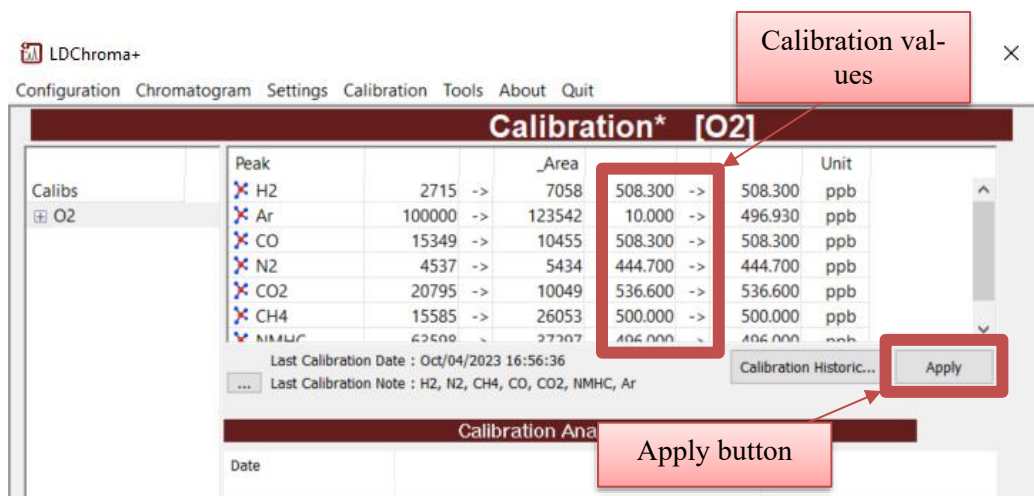
1. LDetek recommend to run at least 3 cycles before calibration. Once you are ready, go to Chromatogram>>Historic.
2. Right-click on the cycle that you want to use for calibration. You can use the latest analyse or if needed, you can calibrate with an older analysis.
3. Click on “Calib Medhod” and select the method that you want to calibrate.



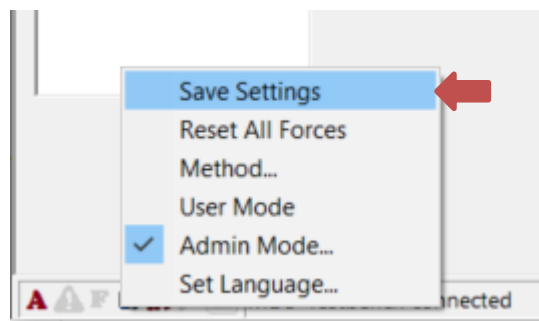
4. The calibration menu will open and you will be asked for the components that you want to calibrate. Those that are not selected won't be calibrated. This is useful when you do not have all of the component in the same cylinder or for system with integrated moisture measurement (QMA and Ceramic sensor).



- Makes sure that the calibration value matches your certificate of analyse (COA). If they don't, double-click on the cell to edit the value.
- Click on "Apply".



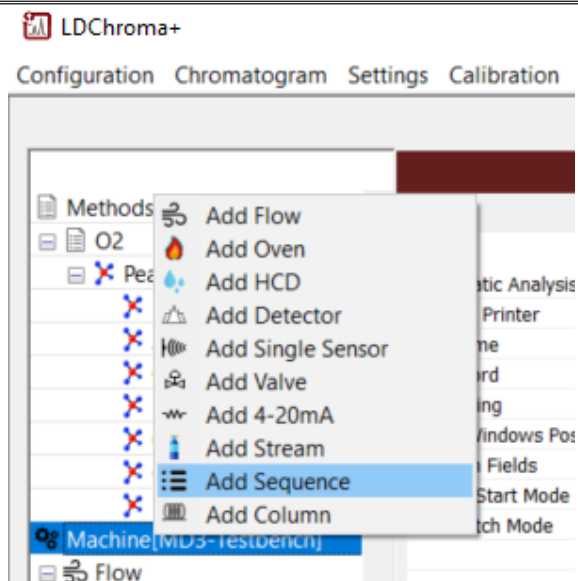
- Right-click on the left-bottom bar and click on "Save Settings".



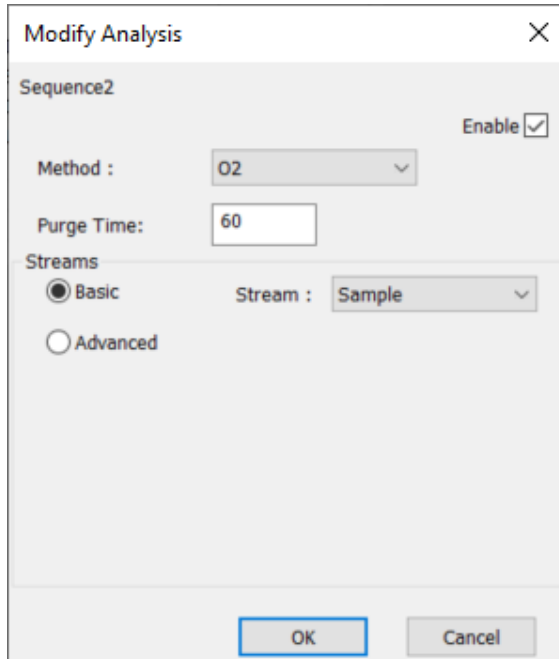
7.9.7. How to create a sequence

Sequences work only on systems that has integrated stream selector (ISS) or LDGSS.

- If you are in user mode, you will see the "U" icon in the bottom left of LDChroma+. If that is the case, you must switch to admin mode by following procedure from section 7.9.1.
- Go to Settings>>Settings, right-click on "Machine" and click on "Add Sequence".



3. Give a name to the new sequence and click “OK”.
4. Click on “Add” to add an analysis to the sequence. For each analysis, you must select the method, the purge time and the stream.

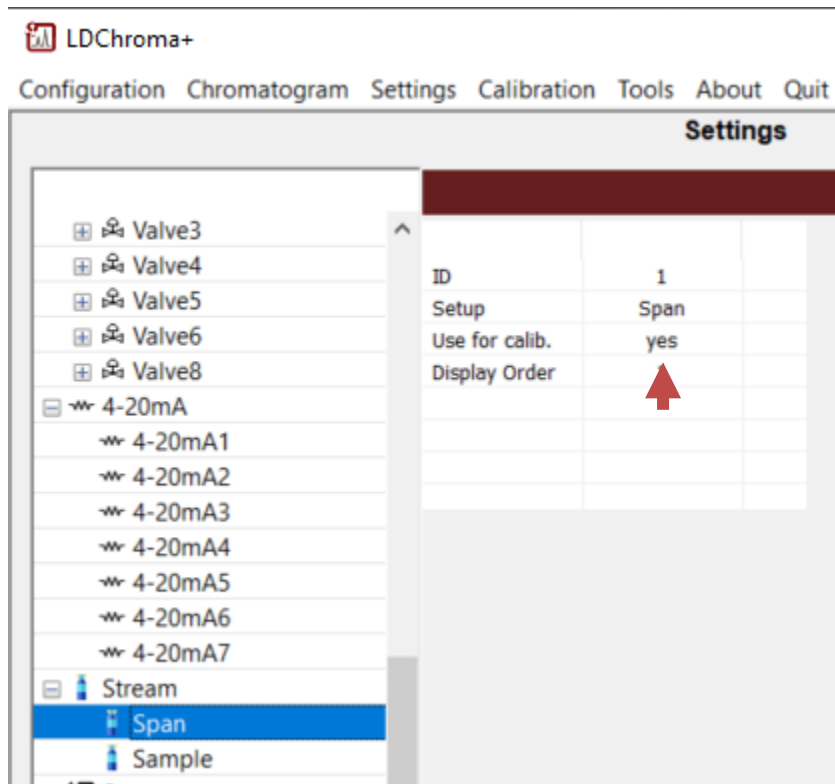


5. Repeat point 4 for each analysis you need in the sequence.
6. Right-click on the left-bottom bar and click on “Save Settings”.

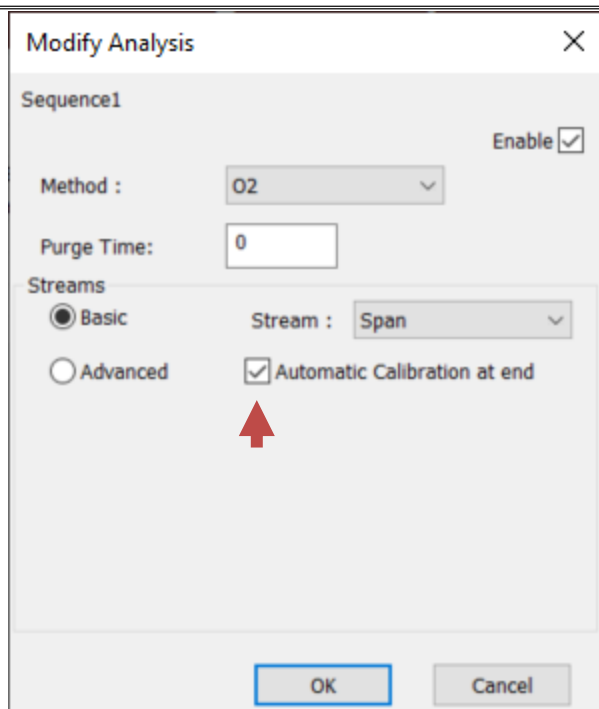
7.9.8. How to automatically calibrate at the end of a sequence

Sequences work only on systems that has integrated stream selector (ISS) or LDGSS.

1. If you are in user mode, you will see the “U” icon in the bottom left of LDChroma+. If that is the case, you must switch to admin mode by following procedure from section 7.9.1.
2. Go to Settings>>Settings>>Stream and select the calibration stream.
3. Make sure that “Used for calib.” is set to “yes”. If it isn't, double-click on “no” to toggle the value.



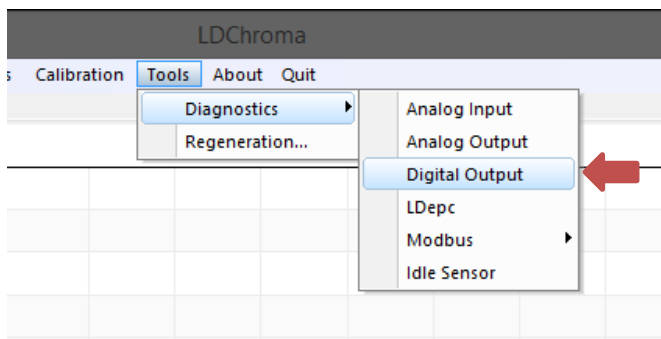
4. Create a calibration sequence by following the steps from section 7.9.7. As shown in the below picture, the last analysis in the sequence must be set to “Automatic Calibration at End”.



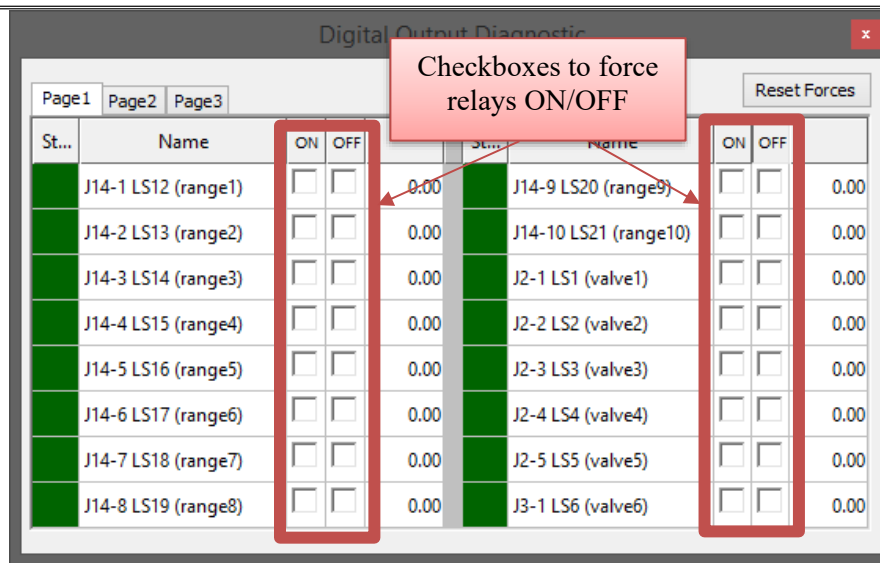
7.9.9. How to force a valve or a relay ON/OFF

For diagnostic purpose, you might be ask to force relays ON or OFF. The following procedure will show you how.

1. If you are in user mode, you will see the “U” icon in the bottom left of LDChroma+. If that is the case, you must switch to admin mode by following procedure from section 7.9.1.
2. Go to Tools>>Diagnostics>>Digital output.



3. The window “Digital Output Diagnostic” will open. The checkboxes in the column “ON” are used to force the relays ON and the checkboxes in the column “OFF” are used to force the relays OFF.

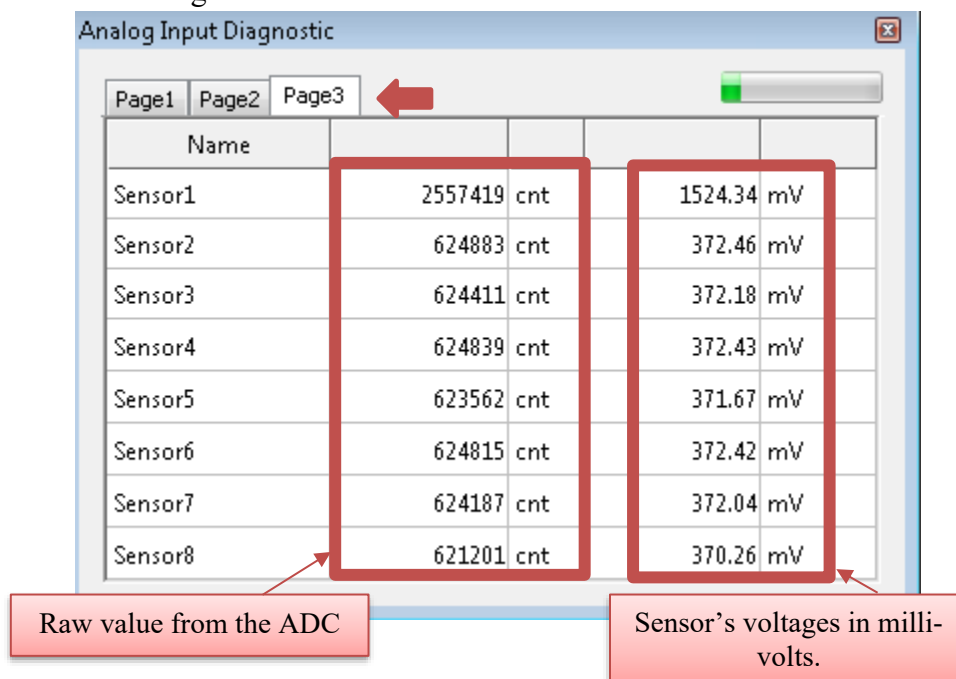


7.9.10. How to see the sensors voltages

For diagnostic purpose, you might be asked to monitor the sensors' voltages. The following procedure will show you how. Note that in most cases, voltage should be checked when the analyzer is idle (not running cycles).

7.9.10.1. Method 1

1. Go to Tools>>Diagnostics>>Analog Input.
2. The window "Analog Input Diagnostic" will open. By clicking on "Page 3", you will be able to see the voltages of each sensor.



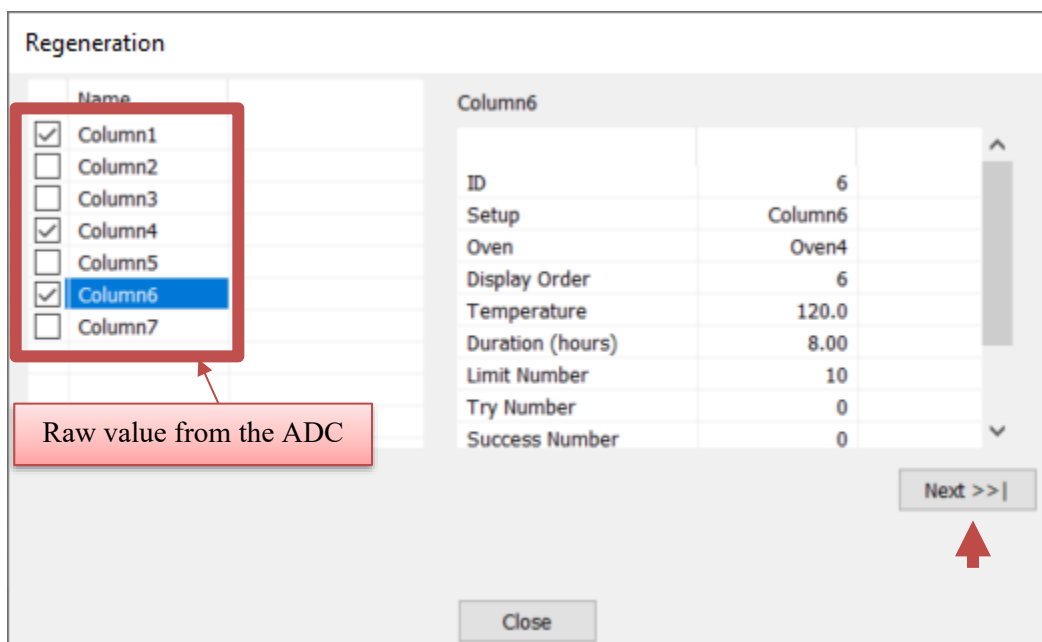
7.9.10.2. Method 2

1. If you are in user mode, you will see the “U” icon in the bottom left of LDChroma+. If that is the case, you must switch to admin mode by following procedure from section 7.9.1.
2. Go to Tools>>Operating Parameters.
3. The window “Operating Parameters” will open. By clicking on the third tab, you will be able to see the voltages of each sensor as well as the factory value.

7.9.11. How to regenerate the column(s)

Regeneration can damage the column, so it should be avoided when not needed. In case of doubt, please contact us at support@ldetek.com.

1. If you are in user mode, you will see the “U” icon in the bottom left of LDChroma+. If that is the case, you must switch to admin mode by following procedure from section 7.9.1.
2. Go to Tools>>Regeneration.
3. Use the checkboxes to select the columns that you want to regenerate. Then, click on “Next >>”.



Regeneration

Name	Value
☒ Column1	
☐ Column2	
☐ Column3	
☒ Column4	
☐ Column5	
☒ Column6	
☐ Column7	

Raw value from the ADC

Column6

ID	6
Setup	Column6
Oven	Oven4
Display Order	6
Temperature	120.0
Duration (hours)	8.00
Limit Number	10
Try Number	0
Success Number	0

Next >> |

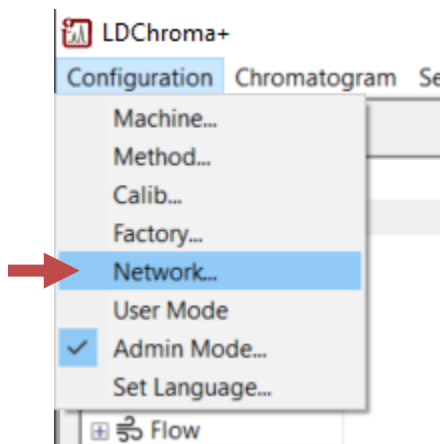
Close

4. Click on “Start Regeneration”.

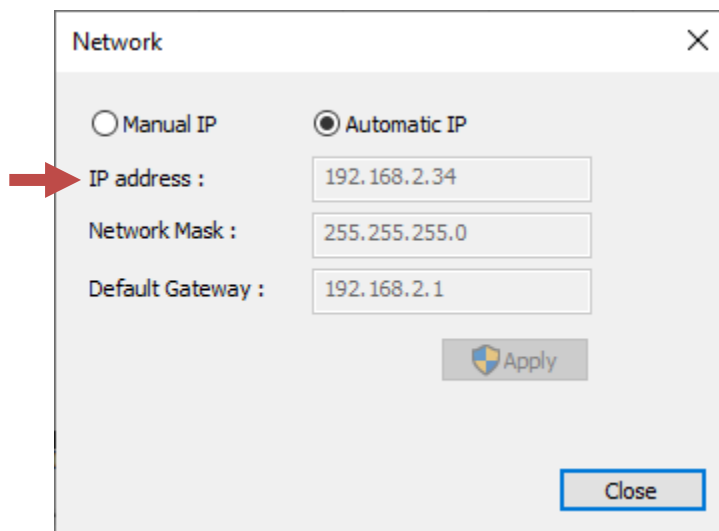
5. Once the regeneration started, you have to wait until it end. By default most column are configured for an 8 hours regeneration.

7.9.12.How to use remote desktop to control the analyzer remotely

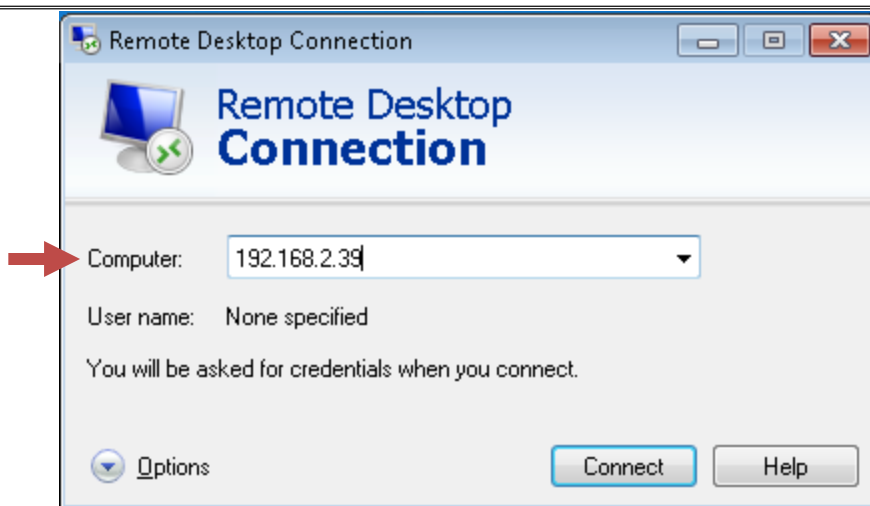
1. To use Remote Desktop, you must know the IP address of the MultiDetek3. To see it, open LDChroma+ and click on Configuration>>Network...



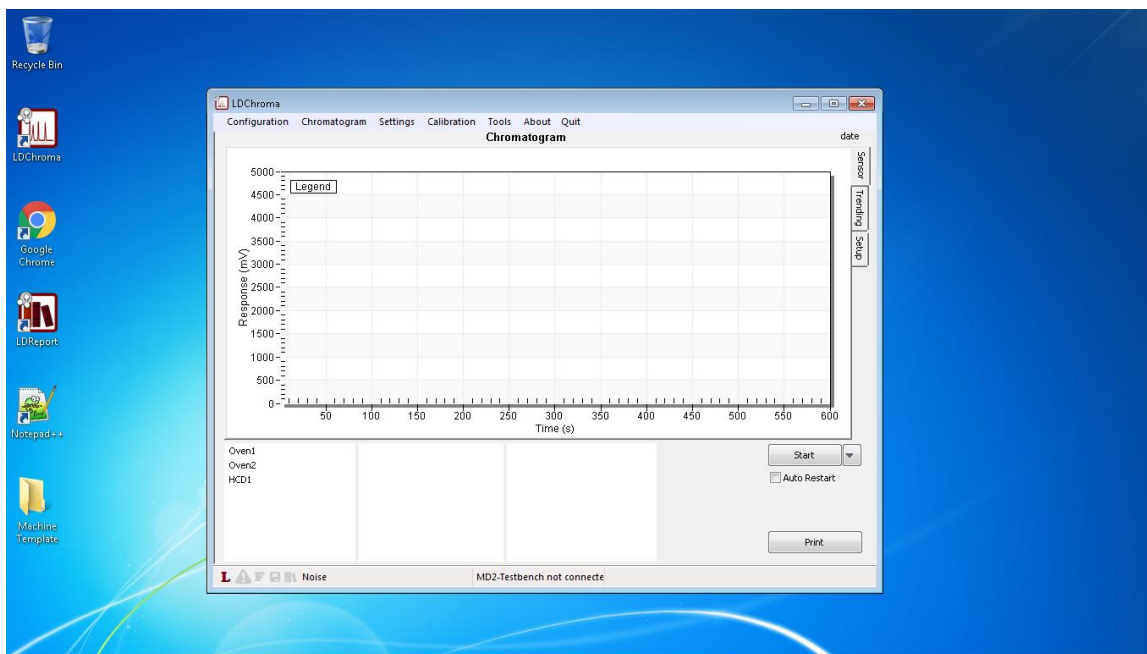
2. A new window will appear in which you will be able to see the IP address.



3. On the host computer, open Remote Desktop, enter the IP address of the MultiDetek3. Then, click on "Connect".



4. Remote desktop will ask for the login information. By default, the username is “user” and the password is “ldetek”.
5. You can now control the MultiDetek2 remotely. If needed, you can create a shortcut that opens Remote Desktop with the right IP or pins it to Windows launch bar.



7.10. Modbus

As an option, the MultiDetek3 can come with Modbus TCP/IP, RS-232, or RS-485. This section explains how Modbus communication is implemented within LDChroma+. Please note that the mapping below might not reflect the latest version. For the most up-to-date information, contact us at support@ldetek.com.

7.10.1. Glossary

Analysis: The period during which the analyzer separates and quantifies the components present in a sample. During this period, a method and a stream are selected.

Method: A set of parameters (e.g., valve timing, oven temperature) that are used during an analysis.

Stream: A stream is one of the multiple sampling points connected to the analyzer.

Sequence: A sequence can consist of a series of one or more analysis and can be configured to restart automatically. Analysis in a sequence can be enabled or disabled, meaning that the sequence will skip to the next enabled analysis.

ID: A unique identifier assigned to each sampling point or stream; values range from 1 to 32000, with zero indicating no ID assigned.

Sampling: A sampling is one of the 2 sample input of the MultiDetek3 with the dual-train option.

7.10.2. Introduction

By default, LDChroma+ uses port 502 for Modbus TCP/IP communication. For Modbus RS-232 and RS-485, the serial port is located on the back panel. Note that LDChroma+ does not support ASCII mode.

The following functions are supported:

- **Function 3:** Read Multiple Holding Registers
- **Function 6:** Write Single Holding Register
- **Function 16:** Write Multiple Holding Register

The mapping is divided into different sections. When reading or writing multiple registers, it is essential to remain within the same section.

7.10.3.Command registers

The command registers enable sending commands to LDChroma+, allowing you to do things like initiate analyses or calibrate the MultiDetek3 from a PLC/DCS. Note that reading command registers will return 0.

When using function 16, a command can be sent with a single transaction. For instance, command 3 (select sequence) requires you to write values to registers 40801 to 40804. This can be achieved using function 16 and is the method recommended by LDefek.

Alternatively, you can use function 3 to write one register at a time. When doing so, initialize the required parameters in registers 40802-40804. Then, trigger the command by writing the value to register 40801.

Register	R/W	Type	Description
40801	W	UINT16	Command Register (see #Cmd in command list below)
40802	W	(see cmd list)	Parameters
...			
41000			

Table 1: Command register

#Cmd	Name	Nb. Param	Description
0	Nop	0	No operation (could be used to test the communication)
1	Quick Start	1	Start the current sequence (like pushing the start button on the screen) - 40802 UINT16 Index of the sampling (starts at 1)
2	Quick Stop	1	Immediately stop the current analysis (like pushing the stop button on the screen) - 40802 UINT16 Index of the sampling (starts at 1)
3	Select Sequence	3	Select a sequence - 40802 UINT16 ID of the sequence - 40803 UINT16 Index of the analysis in the sequence to select (starts at 1) - 40804 UINT16 Index of the sampling (starts at 1)
4	Select Method	2	Select and load a method - 40802 UINT16 ID of the method - 40803 UINT16 Index of the sampling (starts at 1)
5	Select Stream	2	Select a stream - 40802 UINT16 ID of the stream - 40803 UINT16 Index of the sampling (starts at 1)
6	Enable Seq. Analysis	2	Enable an analysis in a sequence - 40802 UINT16 ID of the sequence - 40803 UINT16 Index of the sampling (starts at 1)
7	Disable Seq. Analysis	2	Disable an analysis in a sequence - 40802 UINT16 ID of the sequence - 40803 UINT16 Index of the sampling (starts at 1)
8	[Not used anymore]	0	[Not used anymore]

9	Calib. One Peak (by ID)	3	Calibrate the peak - 40802 UINT16 ID of the peak to calibrate - 40803 UINT16 Calibration value (e.g. 10ppm) - 40804 UINT16 ID of the method *If the calibration value is zero or less, the last calibration value will be use.
10	Calib. All Peak	2	Calibrate all peaks - 40802 FLOAT32 Calibration value (e.g. 10ppm) - 40803 UINT16 ID of the method *If the calibration value is zero or less, the last calibration value will be use.
20	Reset Modbus Error	0	Reset the flag Modbus Error
21	Start Sequence	2	Start the current sequence - 40802 UINT32 Number of sequences to run (0 = infinite) - 40803 UINT16 Index of the sampling (starts at 1)
22	Stop Sequence	1	Stop the current sequence - 40802 UINT16 Index of the sampling (starts at 1) * If an analysis is in progress, the analysis will continue until it ends. But the next analysis in the sequence won't start.
23	Calib. One Peak (by index)	3	Calibrate the peak - 40802 UINT16 Index of the peak to calibrate (starts at 1) - 40803 FLOAT32 Calibration value (e.g. 10ppm) - 40804 UINT16 ID of the method *If the calibration value is zero or less, the last calibration value will be use.
24	Set LDGDSA Impurity Concentration	2	Set the desired Concentration on LDGDSA - 40802 UINT16 Index of the LDGDSA impurity* (start at 1) - 40803 FLOAT32 Desired concentration (e.g. 100ppb) *The index is listed in the Chromatogram page of LDChroma+
30	Force Valve	2	Force a valve stat ON or OFF - 40802 UINT16 Index of the valve (1 to 16) - 40803 UINT16 Force state (0=off, 1=on)
31	Reset Force Valve	1	Reset the valve force - 40802 UINT16 Index of the valve (0=all, 1 to 16)
100	Set Time	6	Set date and time on the computer - 40802 UINT16 Year (e.g. 2022) - 40803 UINT16 Month (1=Jan to 12=Dec) - 40804 UINT16 Day (1 to 31) - 40805 UINT16 Hour (0 to 23) - 40806 UINT16 Minute (0 to 59) - 40807 UINT16 Second (0 to 59)

7.10.4.Device Info

The device info registers show general information specific to the analyzer.

Register	R/W	Type	Description
41001	R	UINT16	LDetek Identification number, always 31307
41002	R	UINT16	Modbus version
41003	R	ASCII[16]	Product name
41011	R	ASCII[16]	Model name
41019	R	ASCII[16]	Serial number
41027	R	ASCII[16]	Software version (LDChroma+ version)
41035	R	ASCII[16]	Firmware version (the version of the MCU connected to the LDChroma+)

41501	R/W	ASCII[32]	Analysis Custom Field1
41517	R/W	ASCII[32]	Analysis Custom Field2
41533	R/W	ASCII[32]	Analysis Custom Field3
41549	R/W	ASCII[32]	Analysis Custom Field4
41565	R/W	ASCII[32]	Analysis Custom Field5
41581	R/W	ASCII[32]	Analysis Custom Field6
41597	R/W	ASCII[32]	Analysis Custom Field7
41613	R/W	ASCII[32]	Analysis Custom Field8
41629	R/W	ASCII[32]	Analysis Custom Field9
41645	R/W	ASCII[32]	Analysis Custom Field10
41701	R	ASCII[8]	Valve name 1
41705	R	ASCII[8]	Valve name 2
41709	R	ASCII[8]	Valve name 3
41713	R	ASCII[8]	Valve name 4
41717	R	ASCII[8]	Valve name 5
41721	R	ASCII[8]	Valve name 6
41725	R	ASCII[8]	Valve name 7
41729	R	ASCII[8]	Valve name 8
41733	R	ASCII[8]	Valve name 9
41737	R	ASCII[8]	Valve name 10
41741	R	ASCII[8]	Valve name 11
41745	R	ASCII[8]	Valve name 12
41749	R	ASCII[8]	Valve name 13
41753	R	ASCII[8]	Valve name 14
41757	R	ASCII[8]	Valve name 15
41761	R	ASCII[8]	Valve name 16
41765	R	UINT16	Valve type 1
41766	R	UINT16	Valve type 2
41767	R	UINT16	Valve type 3
41768	R	UINT16	Valve type 4
41769	R	UINT16	Valve type 5
41770	R	UINT16	Valve type 6
41771	R	UINT16	Valve type 7
41772	R	UINT16	Valve type 8
41773	R	UINT16	Valve type 9
41774	R	UINT16	Valve type 10
41775	R	UINT16	Valve type 11
41776	R	UINT16	Valve type 12
41777	R	UINT16	Valve type 13

41778	R	UINT16	Valve type 14
41779	R	UINT16	Valve type 15
41780	R	UINT16	Valve type 16

7.10.5. Device Status

The device status registers show the status of the analyzer.

Register	R/W	Type	Description
42001	R	UINT16	Status word 1 - Bit00: Ready to work (0=no communication, 1=communicating) * - Bit01: No alarm (0= no alarm, 1= at least one alarm) - Bit02: Status Relay State (0=relay off, 1=relay on) ** - Bit03: Analysis in progress (0=idle, 1=analysis in progress) *This bit is up when LDChroma+ is communicating with the motherboard. ** In LDChroma+, you can specify which alarms influence the Status Relay state. Under normal operation, the Status Relay remains on. If an alarm with the 'affect ready' option selected is triggered, the Status Relay will turn off.
42002	R	UINT16	Status word 2 Bit00: Modbus Error
42003	R	UINT16	Alarm Flow - Bit00: Flow at index 1 has an alarm ... - Bit15: Flow at index 16 has an alarm
42004	R	UINT16	Alarm Oven - Bit00: Oven at index 1 has an alarm ... - Bit15: Oven at index 16 has an alarm
42005	R	UINT16	Alarm Detector - Bit00: Detector at index 1 has an alarm ... - Bit15 : Detector at index 16 has an alarm
42006	R	UINT16	Alarm Peak 1 - Bit00: Peak at index 1 has an alarm ... - Bit15: Peak at index 16 has an alarm
42007	R	UINT16	Alarm Peak 2 - Bit00: Peak at index 17 has an alarm ... - Bit15: Peak at index 32 has an alarm
42011	R	UINT16	Current Stream ID
42012	R	UINT16	Current Method ID
42013	R	UINT16	Current Sequence ID
42014	R	UINT16	Current Sequence Analysis Index
42015	R	UINT16	Current Analysis Time
42016	R	UINT16	Total Analysis Time
42017	R	UINT16	Analysis Counter (Each time an analysis concludes, the counter increments by one.)
42018	R	UINT16	Sequence Counter (Each time a sequence concludes, the counter increments by one.)
42019	R	UINT16	Valve current state
42020	R	UINT16	Valve force state

42045	R	UINT16	Year of the computer clock (2022 for instance)
42046	R	UINT16	Month of the computer clock (1=Jan. to 12=Dec.)
42047	R	UINT16	Day of the computer clock (1 to 31)
42048	R	UINT16	Hour of the computer clock (0 to 23)
42049	R	UINT16	Minute of the computer clock (0 to 59)
42050	R	UINT16	Second of the computer clock (0 to 59)
42051	R	UINT16	Number of flows
42052	R	UINT16	Number of ovens
42053	R	UINT16	Number of detectors
42054	R	UINT16	Number of sensors
42055	R	UINT16	Number of peaks
42056	R	UINT16	Number of streams
42057	R	UINT16	Number of methods
42058	R	UINT16	Number of sequences
42059	R	UINT16	Number of analyses in the current sequence
42060	R	UINT16	Status of analysis in the current sequence • Bit00: Analysis at index 1 is enable • ... • Bit15: analysis at index 16 is enable
42061	R	UINT16	Number of LDGDS Impurities
42062	R	UINT16	Number of valves
42063	R	UINT16	Sensor uses for leak
42101	R	UINT32	Flow 1, count value
42103	R	FLOAT32	Flow 1, unit value
42105	R	FLOAT32	Flow 1, setpoint value in unit
42107	R	UINT32	Flow 2, count value
42109	R	FLOAT32	Flow 2, unit value
42111	R	FLOAT32	Flow 2, setpoint value in unit
42113	R	UINT32	Flow 3, count value
42115	R	FLOAT32	Flow 3, unit value
42117	R	FLOAT32	Flow 3, setpoint value in unit
42119	R	UINT32	Flow 4, count value
42121	R	FLOAT32	Flow 4, unit value
42123	R	FLOAT32	Flow 4, setpoint value in unit
42125	R	UINT32	Flow 5, count value
42127	R	FLOAT32	Flow 5, unit value
42129	R	FLOAT32	Flow 5, setpoint value in unit
42131	R	UINT32	Flow 6, count value
42133	R	FLOAT32	Flow 6, unit value
42135	R	FLOAT32	Flow 6, setpoint value in unit
42137	R	UINT32	Flow 7, count value

42139	R	FLOAT32	Flow 7, unit value
42141	R	FLOAT32	Flow 7, setpoint value in unit
42143	R	UINT32	Flow 8, count value
42145	R	FLOAT32	Flow 8, unit value
42147	R	FLOAT32	Flow 8, setpoint value in unit
42149	R	UINT32	Flow 9, count value
42151	R	FLOAT32	Flow 9, unit value
42153	R	FLOAT32	Flow 9, setpoint value in unit
42155	R	UINT32	Flow 10, count value
42157	R	FLOAT32	Flow 10, unit value
42159	R	FLOAT32	Flow 10, setpoint value in unit
42161	R	UINT32	Flow 11, count value
42163	R	FLOAT32	Flow 11, unit value
42165	R	FLOAT32	Flow 11, setpoint value in unit
42167	R	UINT32	Flow 12, count value
42169	R	FLOAT32	Flow 12, unit value
42171	R	FLOAT32	Flow 12, setpoint value in unit
42173	R	UINT32	Flow 13, count value
42175	R	FLOAT32	Flow 13, unit value
42177	R	FLOAT32	Flow 13, setpoint value in unit
42179	R	UINT32	Flow 14, count value
42181	R	FLOAT32	Flow 14, unit value
42183	R	FLOAT32	Flow 14, setpoint value in unit
42185	R	UINT32	Flow 15, count value
42187	R	FLOAT32	Flow 15, unit value
42189	R	FLOAT32	Flow 15, setpoint value in unit
42191	R	UINT32	Flow 16, count value
42193	R	FLOAT32	Flow 16, unit value
42195	R	FLOAT32	Flow 16, setpoint value in unit
42201	R	UINT32	Oven 1, count value
42203	R	FLOAT32	Oven 1, unit value
42205	R	FLOAT32	Oven 1, setpoint value in unit
42207	R	UINT32	Oven 2, count value
42209	R	FLOAT32	Oven 2, unit value
42211	R	FLOAT32	Oven 2, setpoint value in unit
42213	R	UINT32	Oven 3, count value
42215	R	FLOAT32	Oven 3, unit value
42217	R	FLOAT32	Oven 3, setpoint value in unit
42219	R	UINT32	Oven 4, count value
42221	R	FLOAT32	Oven 4, unit value

42223	R	FLOAT32	Oven 4, setpoint value in unit
42225	R	UINT32	Oven 5, count value
42227	R	FLOAT32	Oven 5, unit value
42229	R	FLOAT32	Oven 5, setpoint value in unit
42231	R	UINT32	Oven 6, count value
42233	R	FLOAT32	Oven 6, unit value
42235	R	FLOAT32	Oven 6, setpoint value in unit
42237	R	UINT32	Oven 7, count value
42239	R	FLOAT32	Oven 7, unit value
42241	R	FLOAT32	Oven 7, setpoint value in unit
42243	R	UINT32	Oven 8, count value
42245	R	FLOAT32	Oven 8, unit value
42247	R	FLOAT32	Oven 8, setpoint value in unit
42249	R	UINT32	Oven 9, count value
42251	R	FLOAT32	Oven 9, unit value
42253	R	FLOAT32	Oven 9, setpoint value in unit
42255	R	UINT32	Oven 10, count value
42257	R	FLOAT32	Oven 10, unit value
42259	R	FLOAT32	Oven 10, setpoint value in unit
42261	R	UINT32	Oven 11, count value
42263	R	FLOAT32	Oven 11, unit value
42265	R	FLOAT32	Oven 11, setpoint value in unit
42267	R	UINT32	Oven 12, count value
42269	R	FLOAT32	Oven 12, unit value
42271	R	FLOAT32	Oven 12, setpoint value in unit
42273	R	UINT32	Oven 13, count value
42275	R	FLOAT32	Oven 13, unit value
42277	R	FLOAT32	Oven 13, setpoint value in unit
42279	R	UINT32	Oven 14, count value
42281	R	FLOAT32	Oven 14, unit value
42283	R	FLOAT32	Oven 14, setpoint value in unit
42285	R	UINT32	Oven 15, count value
42287	R	FLOAT32	Oven 15, unit value
42289	R	FLOAT32	Oven 15, setpoint value in unit
42291	R	UINT32	Oven 16, count value
42293	R	FLOAT32	Oven 16, unit value
42295	R	FLOAT32	Oven 16, setpoint value in unit
42301	R	UINT32	Sensor 1, count value
42303	R	FLOAT32	Sensor 1, mV value
42305	R	UINT32	Sensor 2, count value

42307	R	FLOAT32	Sensor 2, mV value
42309	R	UINT32	Sensor 3, count value
42311	R	FLOAT32	Sensor 3, mV value
42313	R	UINT32	Sensor 4, count value
42315	R	FLOAT32	Sensor 4, mV value
42317	R	UINT32	Sensor 5, count value
42319	R	FLOAT32	Sensor 5, mV value
42321	R	UINT32	Sensor 6, count value
42323	R	FLOAT32	Sensor 6, mV value
42325	R	UINT32	Sensor 7, count value
42327	R	FLOAT32	Sensor 7, mV value
42329	R	UINT32	Sensor 8, count value
42331	R	FLOAT32	Sensor 8, mV value
42401	R	FLOAT32	Results in ppm for LDGDS Impurity 1
42403	R	FLOAT32	Results in ppm for LDGDS Impurity 2
42405	R	FLOAT32	Results in ppm for LDGDS Impurity 3
42407	R	FLOAT32	Results in ppm for LDGDS Impurity 4
42409	R	FLOAT32	Results in ppm for LDGDS Impurity 5
42411	R	FLOAT32	Results in ppm for LDGDS Impurity 6
42413	R	FLOAT32	Results in ppm for LDGDS Impurity 7
42415	R	FLOAT32	Results in ppm for LDGDS Impurity 8
42417	R	FLOAT32	Results in ppm for LDGDS Impurity 9
42419	R	FLOAT32	Results in ppm for LDGDS Impurity 10
42421	R	FLOAT32	Results in ppm for LDGDS Impurity 11
42423	R	FLOAT32	Results in ppm for LDGDS Impurity 12
42425	R	FLOAT32	Results in ppm for LDGDS Impurity 13
42427	R	FLOAT32	Results in ppm for LDGDS Impurity 14
42429	R	FLOAT32	Results in ppm for LDGDS Impurity 15
42431	R	FLOAT32	Results in ppm for LDGDS Impurity 16
Sampling 1			
42501	R	UINT16	Status word • Bit00: Analysis in progress • Bit01: Analysis completed • Bit02: Wait alarm • Bit03: In purge • Bit04: In validation analysis • Bit05: Auto-Calibration Failed • Bit06: Auto-Calibration Successful
42511	R	UINT16	Current Stream ID of the sampling index = 1
42512	R	UINT16	Current Method ID of the sampling index = 1
42513	R	UINT16	Current Sequence ID of the sampling index = 1
42514	R	UINT16	Current Sequence Analysis Index of the sampling index = 1
42515	R	UINT16	Current Analysis Time of the sampling index = 1

42516	R	UINT16	Total Analysis Time of the sampling index = 1
42517	R	UINT16	Analysis Counter of the sampling index = 1 (Every time an analysis ends on this sampling, it increments by one)
42518	R	UINT16	Sequence Counter of the sampling index = 1 (Every time a sequence ends on this sampling, it increments by one)
42551	R	UINT16	Number of flows of the sampling index = 1
42552	R	UINT16	Number of ovens of the sampling index = 1
42553	R	UINT16	Number of detectors of the sampling index = 1
42554	R	UINT16	Number of sensors of the sampling index = 1
42555	R	UINT16	Number of peaks of the sampling index = 1
42556	R	UINT16	Number of streams of the sampling index = 1
42557	R	UINT16	Number of methods of the sampling index = 1
42558	R	UINT16	Number of sequences of the sampling index = 1
42559	R	UINT16	Number of analyses in current sequence of the sampling index = 1
42560	R	UINT16	Status of analysis in the current sequence of the sampling index = 1 • Bit00: Analysis at index 1 is enable • ... • Bit15: analysis at index 16 is enable
Sampling 2			Same as Sampling 1 but add 100 to the register address
Sampling 3			Same as Sampling 1 but add 200 to the register address

7.10.6. Last Result

The Last Result section stores the results of the most recent analyses. This section contains 10 sets of results (Result[0], Result[1], ..., Result[9]). By default, LDChroma+ stores the results of the latest analysis in Result[0]. When a new analysis is performed, Result[0] shifts to Result[1], and the new results are written into Result[0].

If needed, this logic can be changed in the settings menu of LDChroma+. Using rules, you can configure results for specific streams or method to be stored in designated sets. For example, you can set LDChroma+ to write results for stream 1 in Result[0], stream 2 in Result[1], and so on.

For each set of results, the date is stored in a UINT16 register, with Bit00 as the LSB and Bit15 as the MSB:

- Bits 15-09 represent the year + 1980. For example, if bits 09, 11, and 14 are set to one (37), this represents the year 2017.
- Bits 08-05 represent the month, with January as 1, February as 2, and so on.
- Bits 04-00 represent the day, ranging from 1 to 31.

For example, if the value is 0x4B45, it represents October 5th, 2017.

Similarly, the time is stored in a UINT16 register, with Bit00 as the LSB and Bit15 as the MSB:

- Bits 15-11 represent the hour, ranging from 0 to 23.
- Bits 10-05 represent the minute, ranging from 0 to 59.
- Bits 04-00 represent the second, multiplied by 2. For example, a value of 3 represents 6 seconds.

For example, if the value is 0x92E6, it represents 18:23:12.

Register	R/W	Type	Description
Result[0]			
43001	R	UINT16	Date of this result (The date format is explained below)
43002	R	UINT16	Time of this result (The date format is explained below)
43003	R	UINT16	Method ID used to generate this result
43004	R	UINT16	Stream ID used to generate this result
43005	R	UINT16	Result Valid • Bit00: result is valid for peak 1 • ... • Bit15: result is valid for peak 16
43006	R	UINT16	Result <LDL (lower detection limit) • Bit00: result is <LDL for peak 1 • ... • Bit15: result is <LDL for peak 16
43007	R	UINT16	Result OS (overscale) • Bit00: result is OS for peak 1 • ... • Bit15: result is OS for peak 16
43008	R	UINT16	Result Miscellaneous Status • Bit00 : The stream was a validation stream
43009	R	UINT16	Calibration Validation • Bit00: result is valid for peak 1 according to its calibration value • ... • Bit15: result is valid for peak 16 according to its calibration value
43010	R	UINT16	Sampling index used to generate this result
43011	R	FLOAT32	Results in ppm for peak 1
43013	R	FLOAT32	Results in ppm for peak 2
43015	R	FLOAT32	Results in ppm for peak 3
43017	R	FLOAT32	Results in ppm for peak 4
43019	R	FLOAT32	Results in ppm for peak 5
43021	R	FLOAT32	Results in ppm for peak 6
43023	R	FLOAT32	Results in ppm for peak 7
43025	R	FLOAT32	Results in ppm for peak 8
43027	R	FLOAT32	Results in ppm for peak 9
43029	R	FLOAT32	Results in ppm for peak 10
43031	R	FLOAT32	Results in ppm for peak 11
43033	R	FLOAT32	Results in ppm for peak 12
43035	R	FLOAT32	Results in ppm for peak 13

43037	R	FLOAT32	Results in ppm for peak 14
43039	R	FLOAT32	Results in ppm for peak 15
43041	R	FLOAT32	Results in ppm for peak 16
43051	R	UINT32	Area count for peak 1
43053	R	UINT32	Area count for peak 2
43055	R	UINT32	Area count for peak 3
43057	R	UINT32	Area count for peak 4
43059	R	UINT32	Area count for peak 5
43061	R	UINT32	Area count for peak 6
43063	R	UINT32	Area count for peak 7
43065	R	UINT32	Area count for peak 8
43067	R	UINT32	Area count for peak 9
43069	R	UINT32	Area count for peak 10
43071	R	UINT32	Area count for peak 11
43073	R	UINT32	Area count for peak 12
43075	R	UINT32	Area count for peak 13
43077	R	UINT32	Area count for peak 14
43079	R	UINT32	Area count for peak 15
43081	R	UINT32	Area count for peak 16
43083	R	UINT16	Retention time in second for peak 1
43084	R	UINT16	Retention time in second for peak 2
43085	R	UINT16	Retention time in second for peak 3
43086	R	UINT16	Retention time in second for peak 4
43087	R	UINT16	Retention time in second for peak 5
43088	R	UINT16	Retention time in second for peak 6
43089	R	UINT16	Retention time in second for peak 7
43090	R	UINT16	Retention time in second for peak 8
43091	R	UINT16	Retention time in second for peak 9
43092	R	UINT16	Retention time in second for peak 10
43093	R	UINT16	Retention time in second for peak 11
43094	R	UINT16	Retention time in second for peak 12
43095	R	UINT16	Retention time in second for peak 13
43096	R	UINT16	Retention time in second for peak 14
43097	R	UINT16	Retention time in second for peak 15
43098	R	UINT16	Retention time in second for peak 16
Result[1]			Same as Result[0] but add 100 to the register address
Result[2]			Same as Result[0] but add 200 to the register address
Result[3]			Same as Result[0] but add 300 to the register address

Result[4]			Same as Result[0] but add 400 to the register address
Result[5]			Same as Result[0] but add 500 to the register address
Result[6]			Same as Result[0] but add 600 to the register address
Result[7]			Same as Result[0] but add 700 to the register address
Result[8]			Same as Result[0] but add 800 to the register address
Result[9]			Same as Result[0] but add 900 to the register address
ResultEx[0]			
44011	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 1 during this analysis
44013	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 2 during this analysis
44015	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 3 during this analysis
44017	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 4 during this analysis
44019	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 5 during this analysis
44021	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 6 during this analysis
44023	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 7 during this analysis
44025	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 8 during this analysis
44027	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 9 during this analysis
44029	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 10 during this analysis
44031	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 11 during this analysis
44033	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 12 during this analysis
44035	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 13 during this analysis
44037	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 14 during this analysis
44039	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 15 during this analysis
44041	R	FLOAT32	Current dilution in ppm for LDGDS Impurity 16 during this analysis
ResultEx[1]			Same as ResultEx[0] but add 100 to the register address
ResultEx[2]			Same as ResultEx[0] but add 200 to the register address
ResultEx[3]			Same as ResultEx[0] but add 300 to the register address
ResultEx[4]			Same as ResultEx[0] but add 400 to the register address
ResultEx[5]			Same as ResultEx[0] but add 500 to the register address
ResultEx[6]			Same as ResultEx[0] but add 600 to the register address
ResultEx[7]			Same as ResultEx[0] but add 700 to the register address
ResultEx[8]			Same as ResultEx[0] but add 800 to the register address
ResultEx[9]			Same as ResultEx[0] but add 900 to the register address

7.10.7. Indirect Data Map

The Indirect Data Map section allows you to customize your read and write operations. With LDChroma+, you can assign any register to the Indirect Data Map Register.

Register	R/W	Type	Description
45001 to 46000	R/W	(any)	Using the LDChroma+, you can customize any register in this area.

For example, if you want to monitor the values of Flow1, Oven1, and Sensor1, the registers to read are 42103, 42203, and 42303. Without the Indirect Data Map, you would need to read over 200 registers to access just these three. However, by using the Indirect Data Map, you can streamline this process as shown in the below table.

Register	Internally redirected to	Type	Description
45001	42103	FLOAT32	Flow1 unit value
45002	42104		
45003	42203	FLOAT32	Oven1 unit value
45004	42204		
45005	42303	FLOAT32	Sensor1 mV value
45006	42304		

By requesting a read from 45001 for 6 registers, you will receive your 3 float32 values in one transaction, without all the unnecessary registers in between.

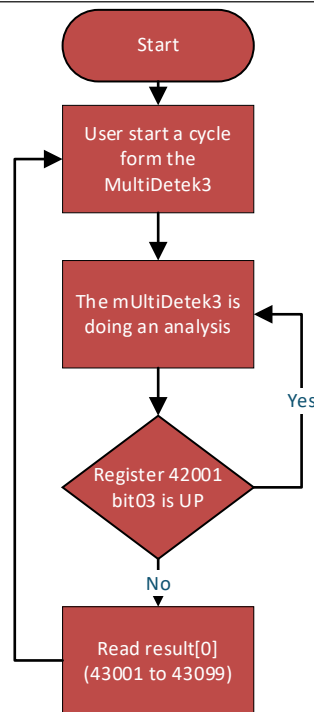
7.10.8.Example of Modbus implementation

The following section aims to explain different ways the Modbus logic can be implemented. The examples provided should give you a good idea of the various methods to control the MultiDetek3 using Modbus. This should serve as a starting point and help you implement a logic that fits your application and requirements.

7.10.8.1. Example 1: Read results

One of the simplest ways to use Modbus communication is to read the results. With this implementation, analyses should be started manually from the MultiDetek3. Once cycles are completed, results can be read by the PLC/DCS.

To implement this, you can monitor bit03 of the status register (42001). Once a cycle is completed (0=completed), results can be read from result[0] (registers 43001 to 43099).

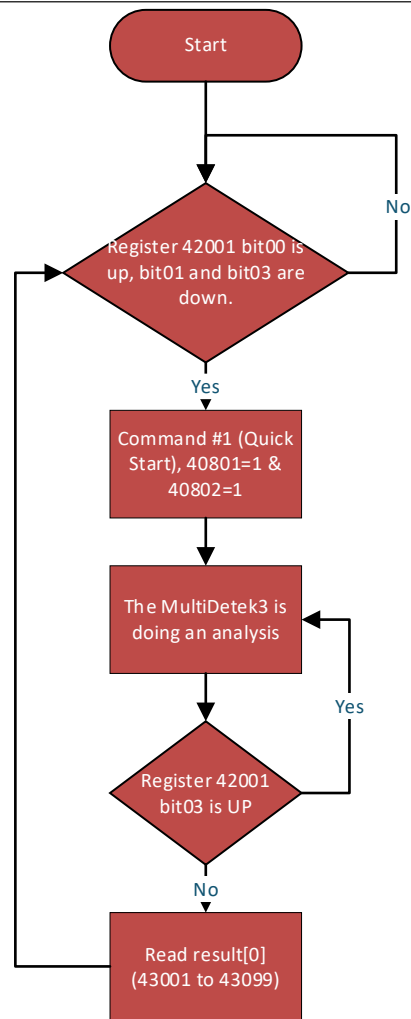


7.10.8.2.Example 2: Start analyses and read results

The previous example requires manual intervention, but Modbus can be leveraged to fully automate the process by starting an analysis from the PLC/DCS.

To implement this, you can monitor the status register (42001). Bit00 indicates if communication with the motherboard is established, bit01 shows if there is an alarm that could prevent a cycle from starting, and bit03 indicates if an analysis is in progress.

If bit00 is set, and bit01 and bit03 are clear, this means communication is established, there are no alarms, and no analysis is in progress. An analysis can then be started using command #1 by writing “1” into registers 40801 and 40802.

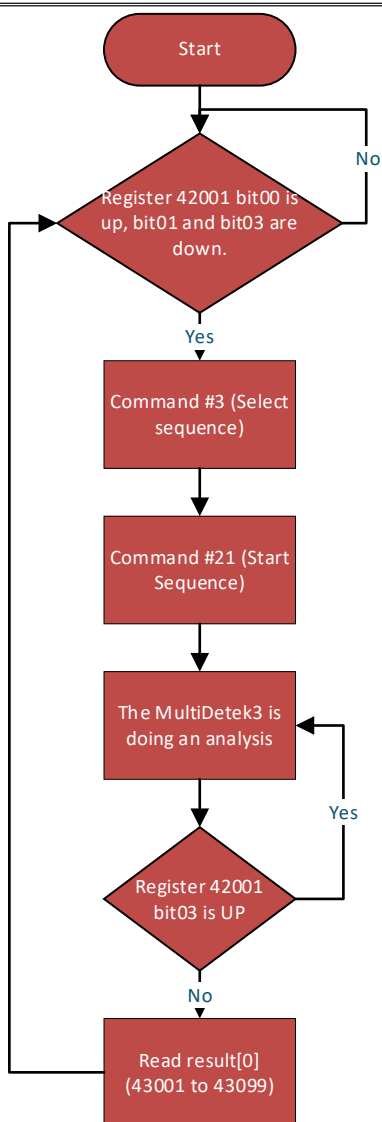


7.10.8.3.Example 3: Select sequences, start analyses and read results

The previous example assumed that only one stream is being analyzed. However, some processes might require the analysis of multiple sample points. When the MultiDetek3 is used with an LDGSS or an integrated stream selector, streams can be changed via Modbus.

To implement this, sequences must be created following the procedure in section 7.9.8. Each sequence will automatically select a stream and a method, and a purge time can also be added to the sequence.

Thus, you can use the same sequence as the previous example but use command #3 (select sequence) before starting an analysis. Additionally, command #21 (start sequence) should be used instead of command #1. The entire sequence would look like the following diagram.



8. LDReport

The MultiDetek3 has a built-in panel PC running LDChroma+ our chromatographic software. This software is used to control the internal components of the MD3 gas chromatograph offering full control of your instrument. LDReport is another software installed on the panel PC alongside with LDChroma. It is used as a complement and can perform tasks like database management and report generation.



Figure 58: LDReport logo

The database management feature allows users to consult the historic results of the analyzer. The data can be filtered using different parameters like streams, methods, date & time, etc. This data can also be exported in different formats like PDF or CSV (Excel). The report generation feature offers the possibility to generate customs reports. For each analysis, it is possible to generate a certificate of analysis (COA) or a certificate of calibration (COC).

The following sections will explain in more detail the different menus and features of LDReport.

8.1. Local and remote

LDReport works using the client-server model. Most of the time, a client-server structure communicates over a network on separate hardware. With LDReport, however, it is configured with the client and server within the panel PC. This configuration is represented in Figure 59. With that arrangement, LDReport is installed on the MultiDetek3's panel PC alongside LDChroma+ and both are communicating within the same computer. This is the configuration that comes pre-installed on the MultiDetek3, and it allows the user to work with both software locally.



MultiDetek3
(client-server)

Figure 59: LDReport local

For more complex installations, LDReport can be configured to work with the client and the server running on different hardware. LDReport (server) can be installed on a remote computer and the MultiDetek3 (client) would talk to it over the network. For installations with more than one analyzer, all the GCs can communicate with one centralized LDReport server. If for instance, a plant has three MultiDetek3, they could connect them to the same computer running LDReport. Such configuration is shown in Figure 60 and allows users to access all the analysis results on the remote computer.

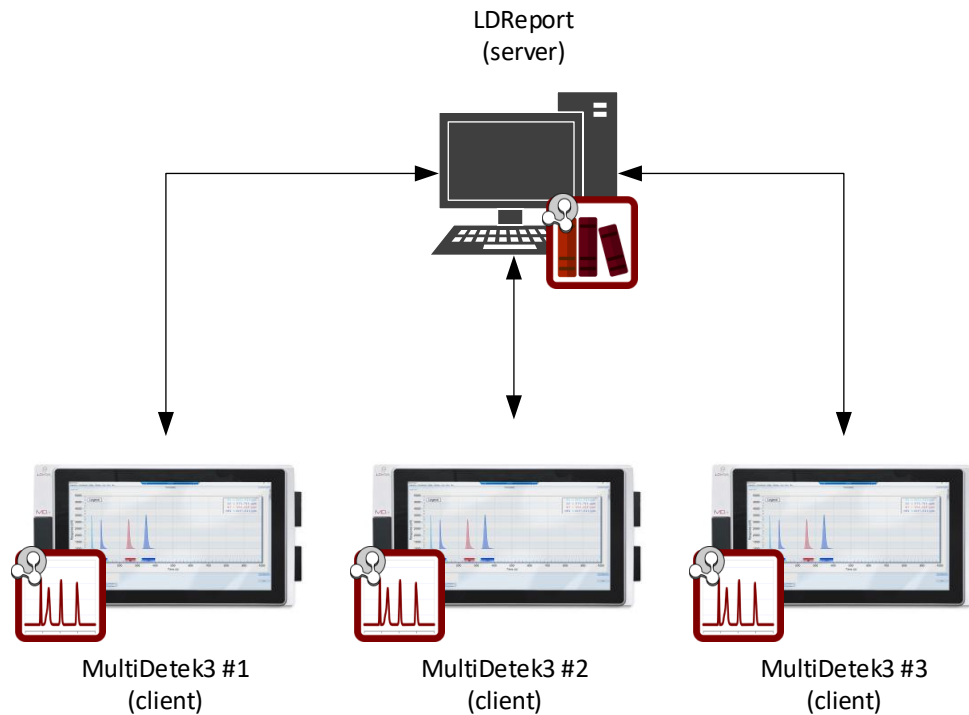


Figure 60: LDReport remote

8.2. Machine list

On the MultiDetek3's desktop, there is an icon you can use to open LDReport. By double-clicking on it, a web browser will open, and you will see the home page of LDReport as shown in Figure 61.

Machine List [Live data]

Name	Mac Address
MD3-005522	0x00005CA111EE0800
MD3-0094622	0x000067E311EE0800
MD2-0083322	0x0000078D12EE0800
MD3-0091922	0x00008AE411EE0800
MD3-0083022	0x00006CE311EE0800
MD3-0093822	0x000082E411EE0800
MD3-0085822	0x00006EE411EE0800
MD2-0067622	0x00008AA111EE0800
MD2-0055222	0x00005CA111EE0800

Language: v3.1.8

Figure 61: LDReport - Machine List

- 1- In the top-right corner, we can see if the LDReport is in user or admin mode. When in user mode, you can click on this button to switch it to admin mode. By default, the username is “admin”, and the password is “12345”. This button also allows you to access the user manager. From this menu, you can add and delete users as well as modify passwords.
- 2- In the center, we can see a table called the machine list. This table shows all the instruments connected to LDReport. When LDReport is installed locally, the list will show only one analyzer. If LDReport is installed on a remote computer and connected to many GCs, we will see all of their serial numbers. To access the data from an analyzer, you can click on the pencil located on the right “”.
- 3- The left menu allows you to switch between the different menus. By clicking on “Home”, you can go back to the machine list and by clicking on “Setting”, you can access the setting menu.
- 4- On the bottom bar, you can select the language and see the software version.

8.3. Settings menu

The settings menu is divided into 3 sections (Misc, Templates and Data). Figure 62 shows the Misc and Template sections and Figure 63 shows the Data section.

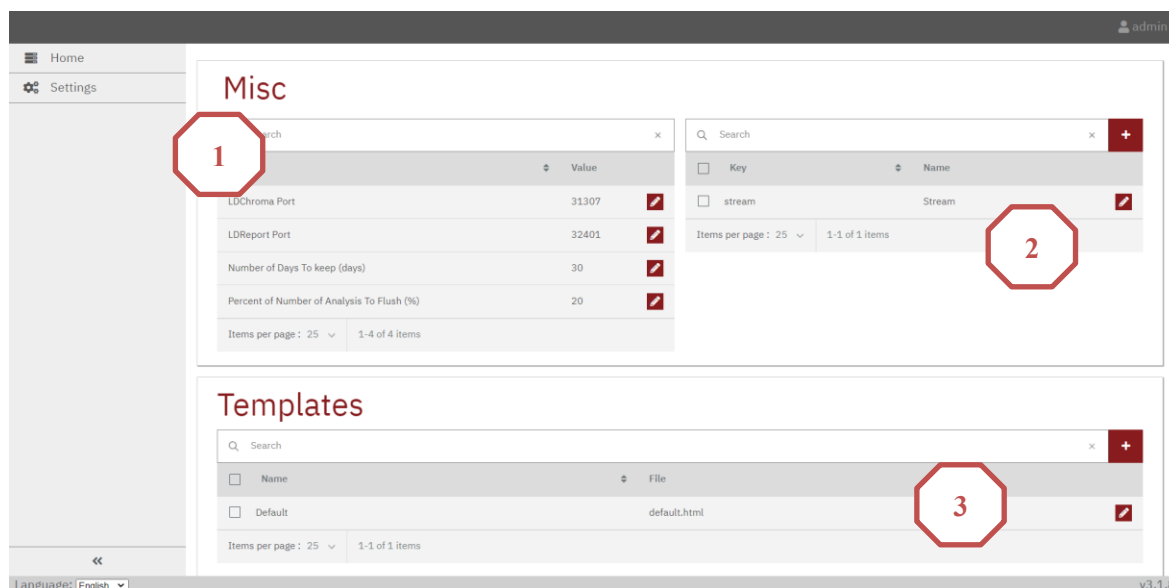


Figure 62: LDReport - Misc section

- 1- The first table allows you to change ports LDReport is using to communicate with LDChroma. The parameters “number of days to keep” and “Percent of the number of analysis to flush” are settings used for the auto-flush feature. Both are explained more in detail on the following page.
- 2- In the analysis menu of LDReport, you can see a table with the concentration of each impurity. Additional columns like stream names can be added by using key tokens. The second table of the Misc section allows you to add and remove these tokens.
- 3- Templates are used to generate custom reports. The section template allows you to add, remove and edit these HTML templates.

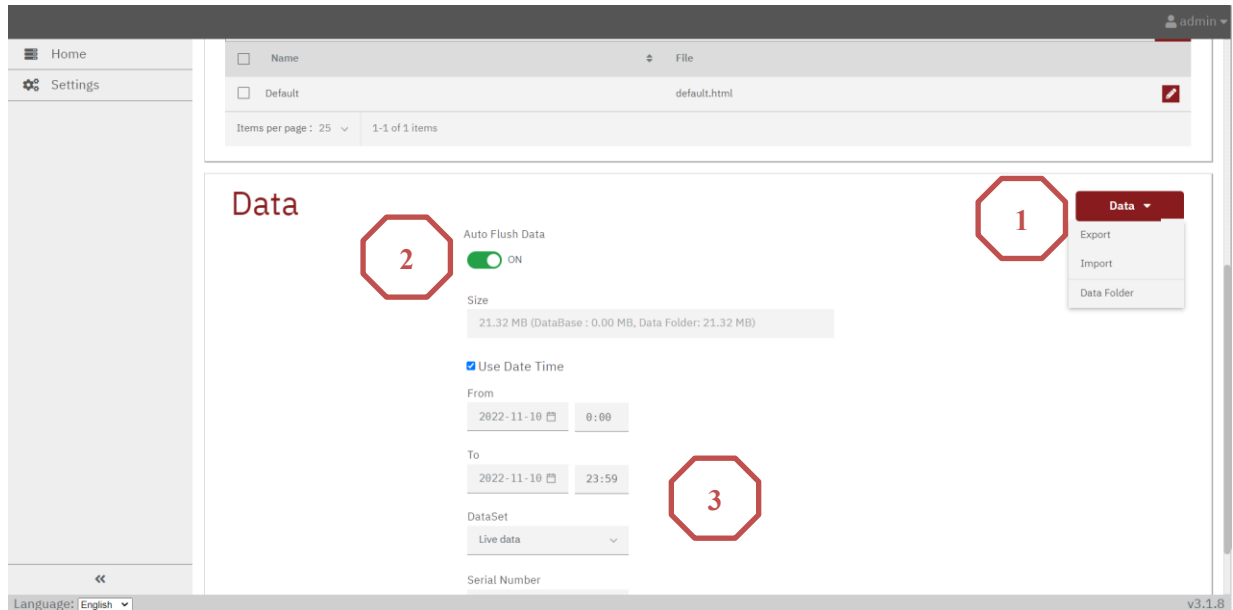


Figure 63: LDReport - Template and Data sections

- 1- The button “Data” allows you to export and import LDReport’s database. By clicking on “Data Folder”, you can see and change the folder path where the data is saved.
- 2- The auto-flush feature allows you to automatically delete old analyses when the hard drive is almost full (more than 90% of its capacity). In the misc section, the parameters “number of days to keep” and “Percent of the number of analysis to flush” will define how the auto flushing is working. By default, the number of days to keep is 30 and the percent of analysis to flush is 20%. This means that if the auto-flush feature is ON and if the hard drive is 90% full, LDReport will flush 20% of all the analyses that are older than 30 days. Kindly note that on average, the hard drive will take more than a year before being 90% full. This is considering a MultiDetek3 that is operating 24h per day and 7 days per week.

8.4. Analysis menu

From the machine list, it is possible to get to the analysis menu. To do so, you must click on the pencil “” beside the serial number of your analyzer. A new tab will open and will look like Figure 64.

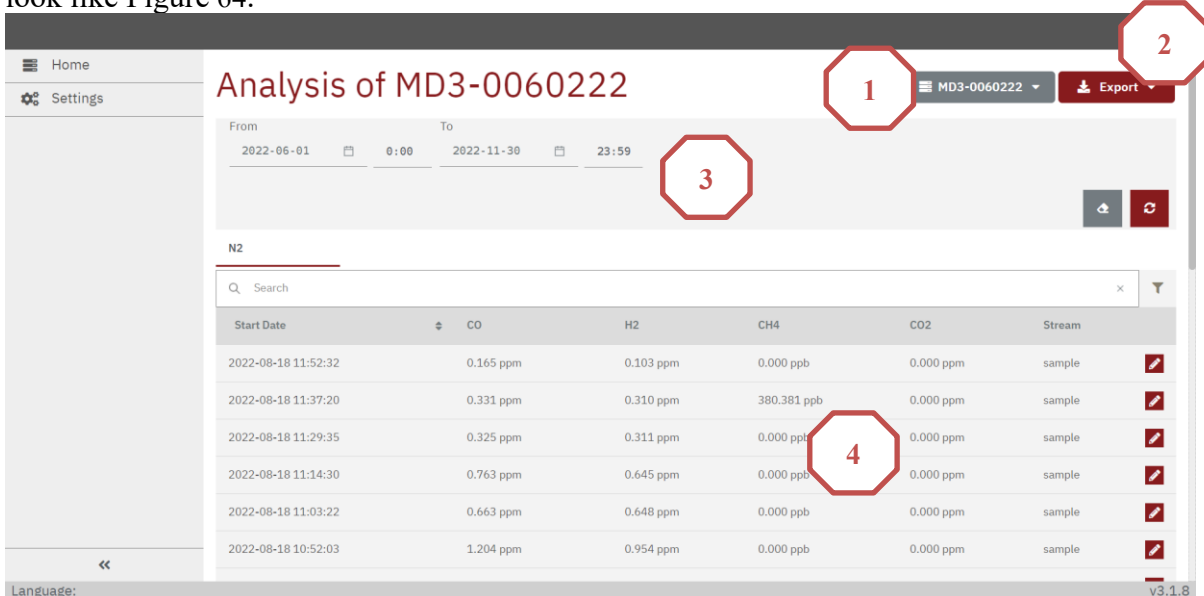


Figure 64: Analysis menu

- 1- This button allows you to see the peak graph and the sensor graph. As shown in Figure 65, the peak graph is a trending of the impurities' concentration. The sensor graph is trending like the peak graph, but it allows you to see the raw signal of the sensor over time. This feature can be useful for diagnostic and troubleshooting.
- 2- This button allows you to export the analysis table in PDF or CSV.
- 3- This section allows you to filter by date and time the results you see in the analysis table.
- 4- This section shows you the results of the previous analysis. There is a tab on top of the table that allows you to switch between methods. By clicking on the pencil, you will enter a menu called analyze menu which gives you more information about a specific analysis.

Peak Graph

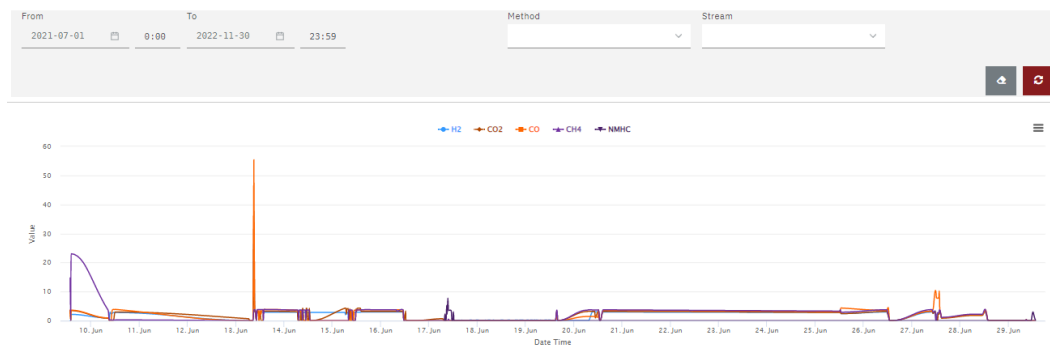


Figure 65: Peak graph

8.5. Analyze menu

From the analysis menu, it is possible to get to the analyze menu. To do so, you must click on the pencil “” beside the analysis you want to open. A new tab will open and will look like Figure 66.

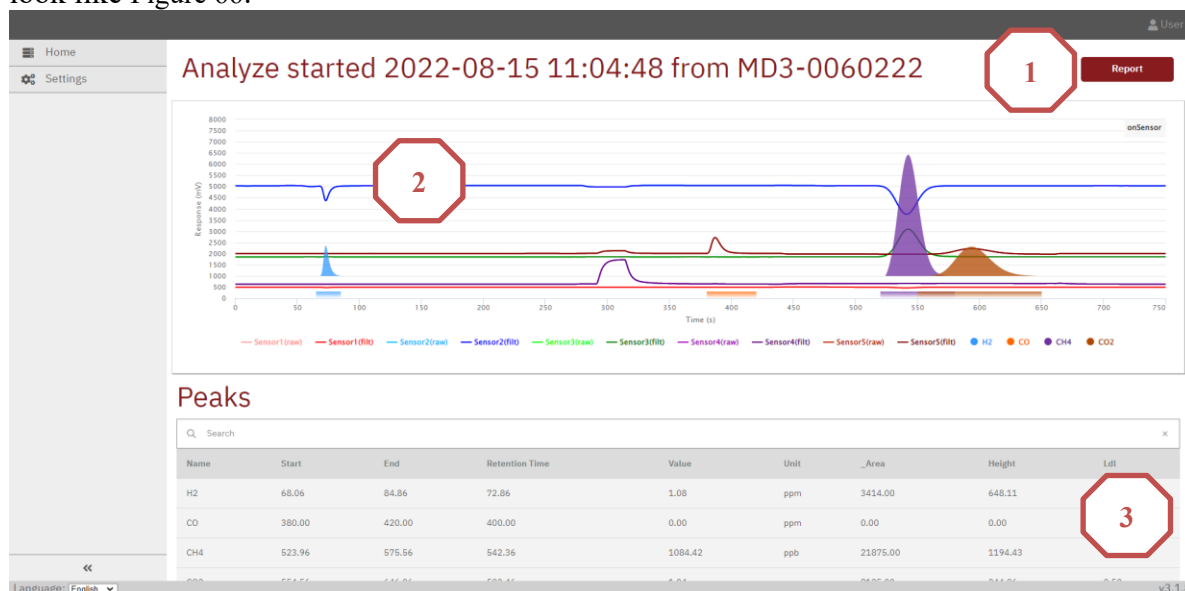


Figure 66: Analyze menu

- 1- By clicking on the button “Report”, you can print an analysis report based on the selected template. By default, LDReport comes with a standard template, but custom reports can be created on request. This feature is explored more in detail in the following section.
- 2- This section shows the chromatogram of the selected analysis. It is possible to zoom in on the graph and hide/show lines using the legend.
- 3- This section shows the peak table result. For each analysis, you can see the retention time, the concentration, the height, the area and the detection limit.

8.6. Report generation

As shown in the previous section, reports can be generated by pressing the button “Report” from the Analyze menu. Figure 67 shows an example of the report that comes standard with all the MultiDetek3. Details like analyzer model, stream ID, analysis date and calibration date are automatically read from the raw data and put on the report. At the bottom, a table shows the concentration, the retention time and the area count for each impurity that was measured. We understand that users might have different requirements. For that reason, LDReport is designed with the possibility of adding templates. By doing that, it is possible to generate reports that have been customized for your needs.

Figure 68 shows a report generated using a custom template written in HTML script. The template was made so the logo and address are displayed in the header. The below section shows the same information as the default template, but if needed, additional details can be added. It is also possible to display fields that have been entered manually. We can, for instance, open a prompt command every time a report is generated and allow the user to enter information like operator name, batch number, etc.

Figure 69 shows another example of a custom report. It differs from the previous template because logic is implemented in the table. The script has been modified so the column status shows “pass” when the concentration is below the specification and “fail” when it is the opposite. This example shows that because reports are generated from a script, any mathematical operation can be done inside the report.

Custom reports like Figure 68 and Figure 69 are optional so feel free to contact us at info@ldetek.com if this is a feature you need.

Certificate Of Analysis

Analyser Model: **MultiDetek3**

Analyser S/N: **7551319**

Stream: **Span**

Analysis Date: **2022-08-31 9:21:32**

Calibration Date: **2022-08-30 15:41:07**

Process date: **Wednesday, August 31, 2022**

Name	Value	Unit	Retention time	Area
H2	11.77	ppm	96.54	11659.00
O2	9.54	ppm	194.14	18461.00
N2	9.98	ppm	458.94	52824.00
CO	10.12	ppm	501.54	10796.00
CH4	10.11	ppm	649.84	10550.00
CO2	8.85	ppm	912.24	7682.00



Add your logo

Add your address

LDetek Inc
990, rue Monfette Est
Thetford Mines, Qc, G6G 7K6
Téléphone: +1-418-755-1319
Fax: +1-418-755-1329
Web-site: www.ldetek.com
Email: info@ldetek.com

Certificate Of Analysis

Analyser Model: **MultiDetek3**

Analyser S/N: **7551319**

Stream: **Span**

Analysis Date: **2022-08-31 7:15:23**

Calibration Date: **2022-08-30 15:41:07**

Process date: **Thursday, September 01, 2022**

Change text & font

Display custom data using prompt commands

Add or remove parameters

Name	Value	Unit	Retention time	Area
H2	11.78	ppm	96.85	11668.00
O2	9.80	ppm	194.55	18967.00
N2	10.26	ppm	460.45	54285.00
CO	10.10	ppm	501.25	10779.00
CH4	10.16	ppm	652.25	10599.00
CO2	11.58	ppm	893.95	10053.00

Add and/or remove columns and rows

1/1

Figure 68: Custom Report



LDetek Inc
990, rue Monfette Est
Thetford Mines, Qc, G6G 7K6
Téléphone: +1-418-755-1319
Fax: +1-418-755-1329
Web-site: www.ldetek.com
Email: info@ldetek.com

Certificate Of Analysis

Analyser Model: **MultiDetek3**
Analyser S/N: **7551319**
Stream: **Span**
Analysis Date: **2022-09-02 10:37:09**
Calibration Date: **2022-08-30 15:41:07**
Process date: **Friday, September 02, 2022**

Automatically show pass
or fail based on specifica-
tions

Name	Value (ppm)	Specification (ppm)	Status
H2	0.05	0.1	pass
O2	0.00	0.1	pass
Ar	2.18	0.1	fail
N2	0.00	0.5	pass
CO	0.00	0.1	pass
CH4	0.00	0.05	pass
CO2	0.00	1	pass

Figure 69: Pass-Fail template

8.7. LDReport's procedures

This section will show a few procedures that can be helpful while using LDReport. Feel free to contact us at support@ldetek.com if you have any questions.

8.7.1. How to switch from the user to the admin mode

1. From the machine list menu click on “User”. This button will be located in the top-right corner.
2. Click on “log in” to open the login screen.
3. Enter the username and password. By default, the username is “admin” and the password is “12345”

8.7.2. How to add a token

1. Make sure that you are in admin mode.
2. Go to the setting menu.
3. Click on the plus button → . It will be located on the right part of the section Misc.
4. In the field “Key” you can enter the token that you want to add. If needed, you can click on help to see the list of tokens.
5. In the field “Name”, you can enter the name you want to be displayed in the column.
6. Click on “Apply”

8.7.3. How to edit or remove a token

1. Make sure that you are in admin mode.
2. Go to the setting menu.
3. Tokens will be located on the right part of the section Misc
4. To edit a token click on the pencil “”, edit the values and click on “apply”.
5. To delete a token, click on the checkbox (on the left) and click on “Delete”.

8.7.4. How to add a custom template

1. Make sure that you are in admin mode.
2. Go to the setting menu.
3. Click on the plus button → . It will be located on the right part of the section Templates section.
4. In the field “Name”, put the name of the template.
5. Click on “+Add file”, and select the HTML template that you want to import.
6. Click on “Apply”.

8.7.5. How to export the database

1. Make sure that you are in admin mode.
2. Go to the setting menu and go to the section Data.
3. If you want to export the entire database, un-tick "Use Date Time". Alternatively, tick the checkbox if you want to export part of the database.
4. If you ticked the checkbox, enter the date and time.
5. Select the serial number of the analyzer that you want to export.
6. Click on "Data" and then click on "Export"
7. Click on "Ok" and wait until the data is exported. The progress will appear in the bottom bar.
8. Once the data is exported, you will be able to download it by clicking on this button "".

8.7.6. How to use the peak graph

1. From the analysis menu, select the start and end date you want to see on the graph.
2. Click on the refresh button "".
3. Click on the serial number of the analyzer. This grey button will be located on the top right beside the export button.
4. Click on "Peak graph".
5. In the peak graph menu, you can modify the start and end date.
6. You can also filter by Method and stream. Every time you make a change, make sure to press the refresh button.
7. On the legend, you can click on the impurity name to hide/show a line.
8. On the graphic, you can click and drag a box to zoom in. To zoom out, you can right-click.
9. To export this graph, you can click on the hamburger menu located on the top-right.

8.7.7. How to use the sensor graph

1. From the analysis menu, select the start and end date you want to see on the graph.
2. Click on the refresh button "".
3. Click on the serial number of the analyzer. This grey button will be located on the top right beside the export button.
4. Click on "Sensor graph".
5. In the sensor graph menu, you can modify the start and end date.
6. On the legend, you can click on the sensors to hide/show a line.
7. On the graphic, you can click and drag a box to zoom in. To zoom out, you can right-click.
8. To export this graph, you can click on the hamburger menu located on the top-right.

8.7.8. How to filter data by streams

1. From the analysis menu, select the start and end date you want to see on the graph.
2. Click on the refresh button “” to update the table.
3. By default, the table will have a column named “Stream”. If you can't see this column, you need to add the token “stream” by following the procedure “How to add a token”.
4. In the search bar, enter the name of the stream and press enter.

8.7.9. How to generate a report

1. From the analysis menu, click on the pencil “” beside the analysis you want to use.
2. Once in the analyze menu, click on the button “Report” located on the top-right.
3. Select the template that you want to use to generate the report and click on “Apply”.
4. In the template is configured with prompt commands, a new window will appear. You will be allowed to manually enter the values for all of the prompt commands. Once done, click on “Apply”.
5. A new tab will open. You can review the report and click on print if it fits your requirements.

8.7.10. How to connect LDReport to a remote computer

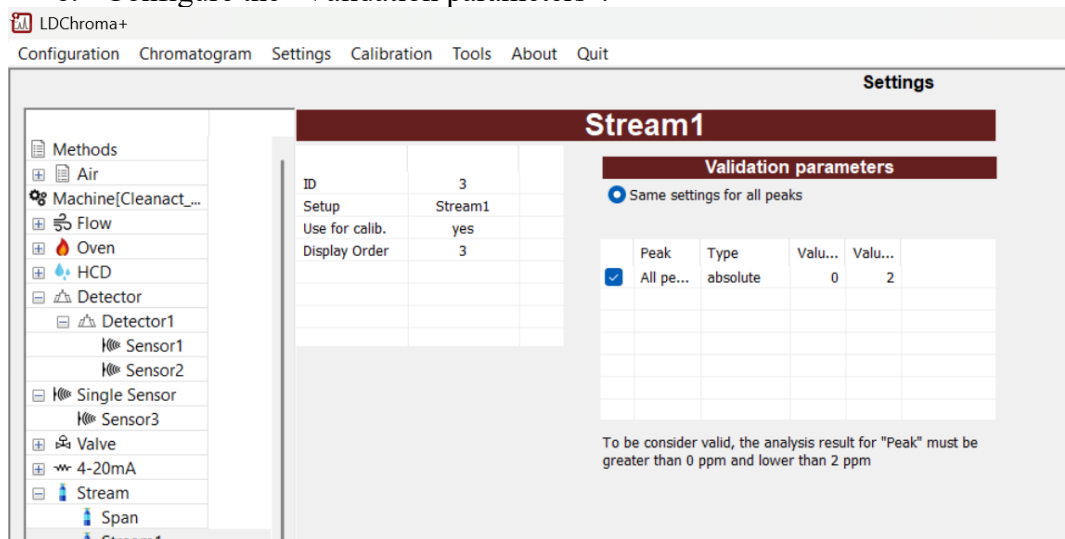
1. In section 8.1, we explained that LDReport can communicate with a remote computer. To do so LDReport must be installed on the remote computer. Further, you must know the IP address of this PC and your firewall setting must allow the communication.
2. If all the above are true, you can make LDChroma talk to the remote computer. You need to open LDChroma and go to the setting menu (Settings >> Settings).
3. Click on “Report” located at the bottom of the left menu.
4. By default, the Server IP will be set to 127.0.0.1. This is the localhost and it means that the server is installed in the MultiDetek3's panel PC.
5. Double-click on Server ID and enter the IP address of the remote computer.
6. Finally, right-click on the left-bottom bar and click on “Save setting”.
7. When the connection between LDChroma and LDReport is established, the LDReport icon on the bottom bar will become coloured “”.

8.8. LDScheduler

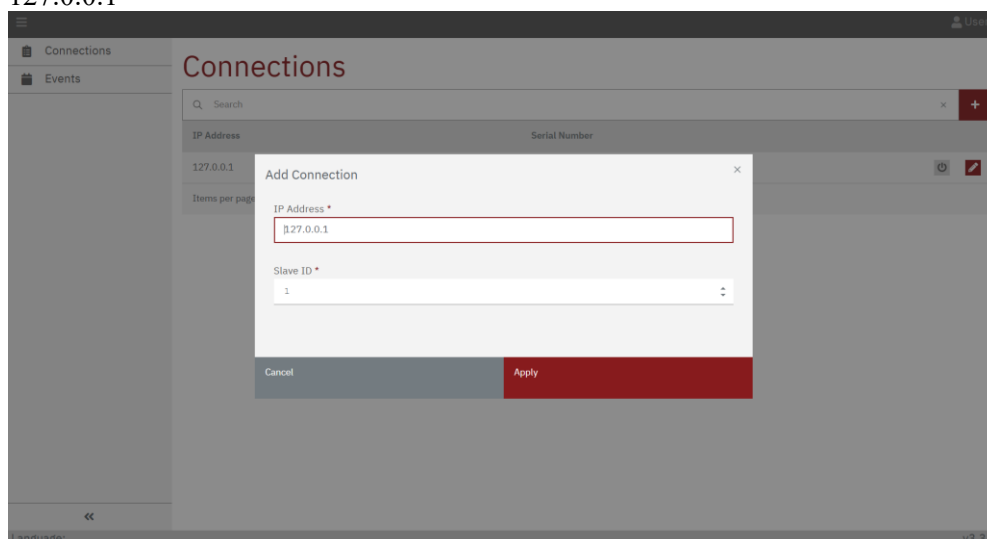
LDScheduler is an optional LDReport sub-module supplied with Multidetek3. It lets users schedule automatic calibrations and automatic sample runs. LDScheduler executes LDChroma+ sequences on a schedule, with stop conditions based on validity criteria defined in LDChroma+.

8.8.1. Typical workflow

1. Follow the procedure in section 7.9.7 to create a sequence.
2. In the setting menu of LDChroma+, select the calibration stream.
 - a. Ensure “Use for Calib.” is enable.
 - b. Configure the “Validation parameters”.

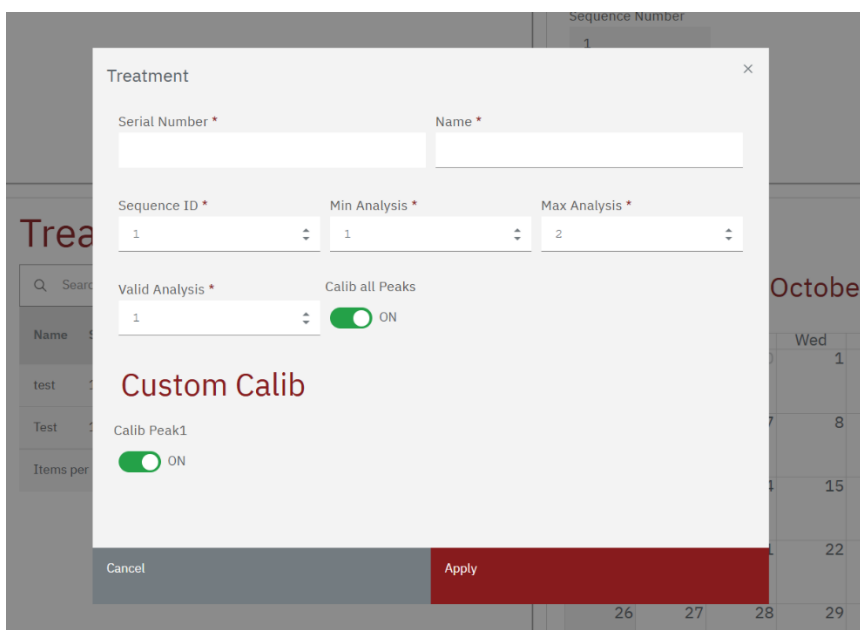


3. In LDReport, select LDScheduler and click “+”.
4. Enter the IP address of the MultiDetek3. If LDChroma+ is is on the same computer, enter” 127.0.0.1”



5. Create a treatment in LDScheduler:

- Select the Sequence to run.
- Set the Min and Max cycles.
- Set the number of valid analyses (treatment ends as soon as that many valid cycles have been achieved, or when Max is reached).
- Select whether you want the GC to perform calibration at the end and choose the peaks to calibrate if applicable.



Treatment

Serial Number * Name *

Sequence ID * Min Analysis * Max Analysis *

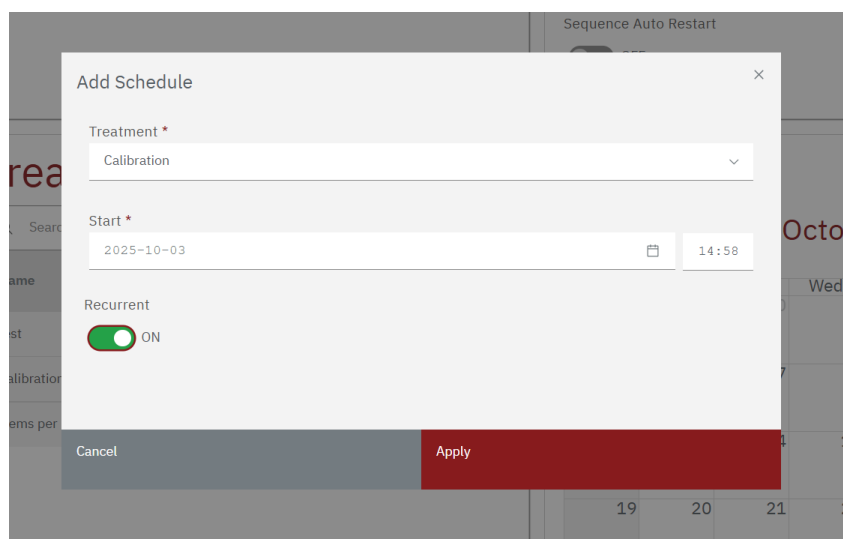
Valid Analysis * Calib all Peaks

Custom Calib

Calib Peak1

Cancel Apply

- Add the treatment to the Calendar
 - Click “+” to schedule the treatment.
 - Set recurrence (weekly).



Add Schedule

Treatment *

Start *

Recurrent

Cancel Apply

9. Back panel terminal identification

4-20mA1+
4-20mA1-
4-20mA2+
4-20mA2-
4-20mA3+
4-20mA3-
4-20mA4+
4-20mA4-
4-20mA5-

4-20mA6+
4-20mA6-
4-20mA7+
4-20mA7-
4-20mA8+
4-20mA8-
4-20mA9+
4-20mA9-
4-20mA10+
4-20mA10-

Range 1
Range 2
Range 3
Range 4
Range 5
Range 6
Range 7
Range 8
Range 9
Range 10

COM
STATUS
Aux.
Spare
ALARM 1
ALARM 2
ChromOut+
ChromOut-
GND
GND

Stream 1
Stream 2
Stream 3
Stream 4
Stream 5
Stream 6
Stream 7
Stream 8
Spare
Spare

AUX RID +
AUX RID -
AUX Heater+
AUX Heater-

4-20mA1+ to 4-20mA10+: Analog output positive terminals for peak #1 to peak #10. Use a 500ohm resistor between + and – terminals for 0-10VDC resolution on data recorders.

4-20mA1- to 4-20mA 10-: Analog output negative terminals for peak #1 to peak #10. Use a 500ohm resistor between + and – terminals for 0-10VDC resolution on data recorders.

Range 1 to Range 10: These dry contacts can be N.O. or N.C. selectable in the chromatogram menu. These relays are used to indicate which range is the instrument. One relay is used for each peak.(Example: Peak 1: Contact relay is between Range 1 and COM terminals)

COM: The COM is shared with Ranges, Status, Alarm1 and Alarm 2 terminals

STATUS: This dry contact is open when an alarm is active (The contact status is the user'sconfigurable)

Aux.: This dry contact is a spare contact (Used for options only)

ALARM1: This dry contact is open when the process value is higher than the alarm1 set value

ALARM2: This dry contact is open when the process value is higher than the alarm2 set value

ChromOut+: High-resolution voltage Chromatogram output+ terminal (output voltage is 0-5VDCbetween ChromOut+ and ChromOut- terminals)

ChromOut-: High-resolution voltage Chromatogram output GND terminal

GND: This is a common GND (Used as GND contact for options and Streams only)

Stream 1 to Stream 8: These dry contacts are closed when the associated stream has been selected.These contacts are used to remotely control the LDGSS stream selector system.

(Example: Stream 1: Contact relay is between Stream 1 and GND terminals.

Spare: spare relay for options

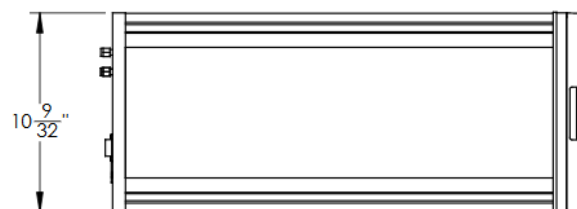
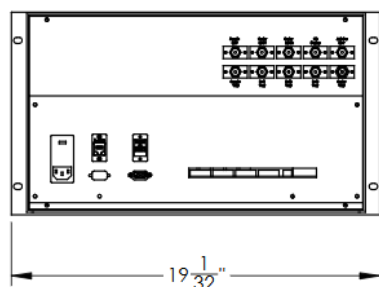
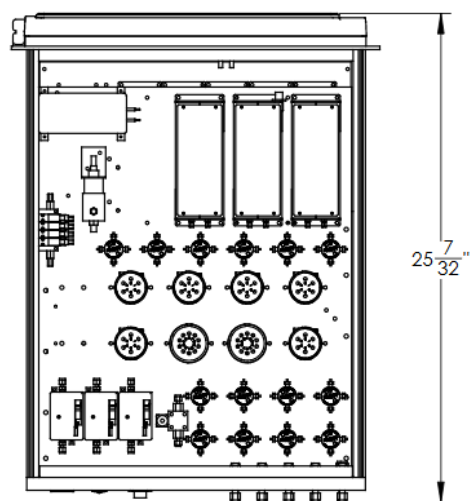
AUX RTD+: RTD+ contact (used for the auxiliary oven only)

AUX RTD-: RTD- contact (used for the auxiliary oven only)

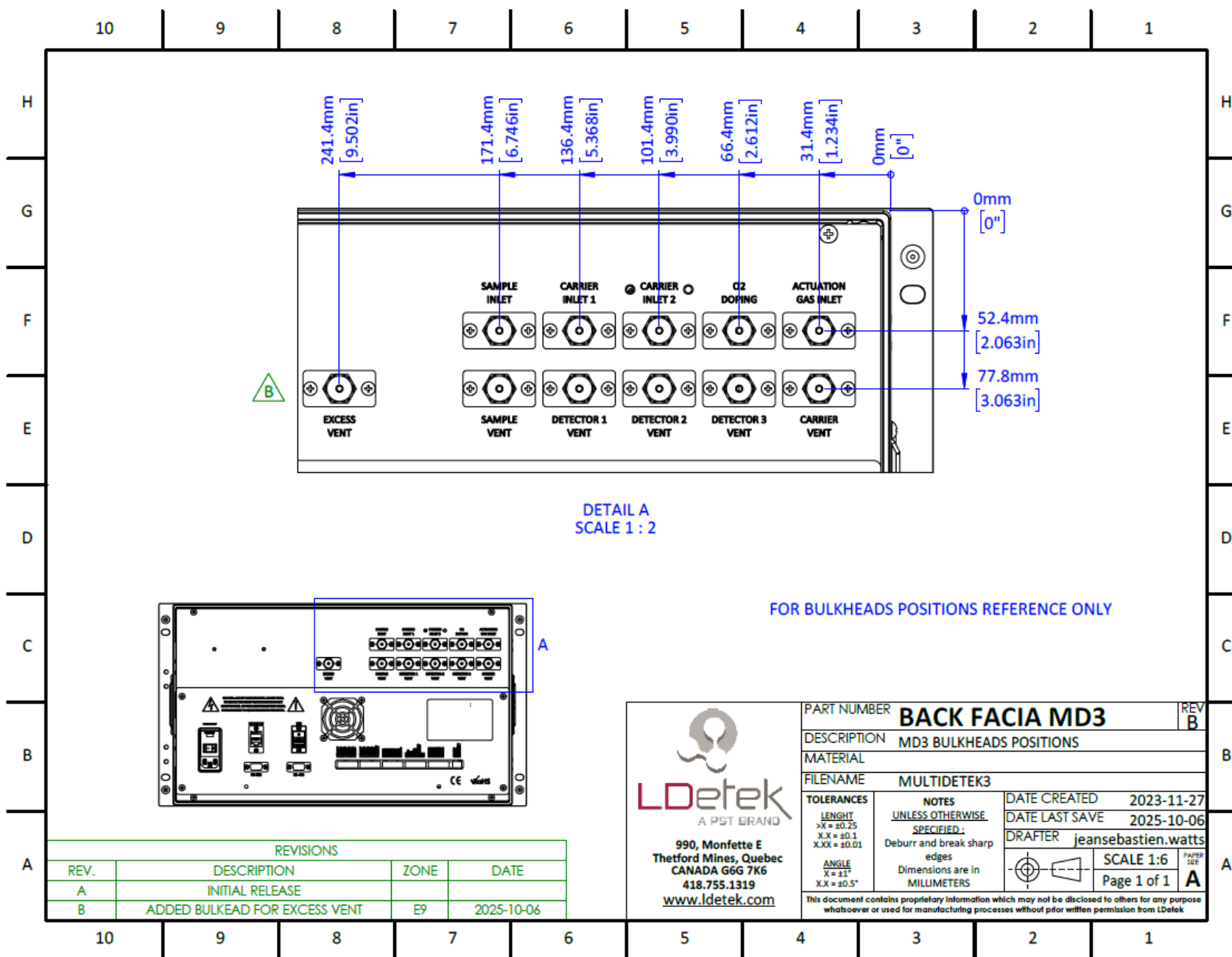
AUX Heater+: Heater+ contact (used for the auxiliary oven only)

AUX Heater-: Heater- contact (used for the auxiliary oven only)

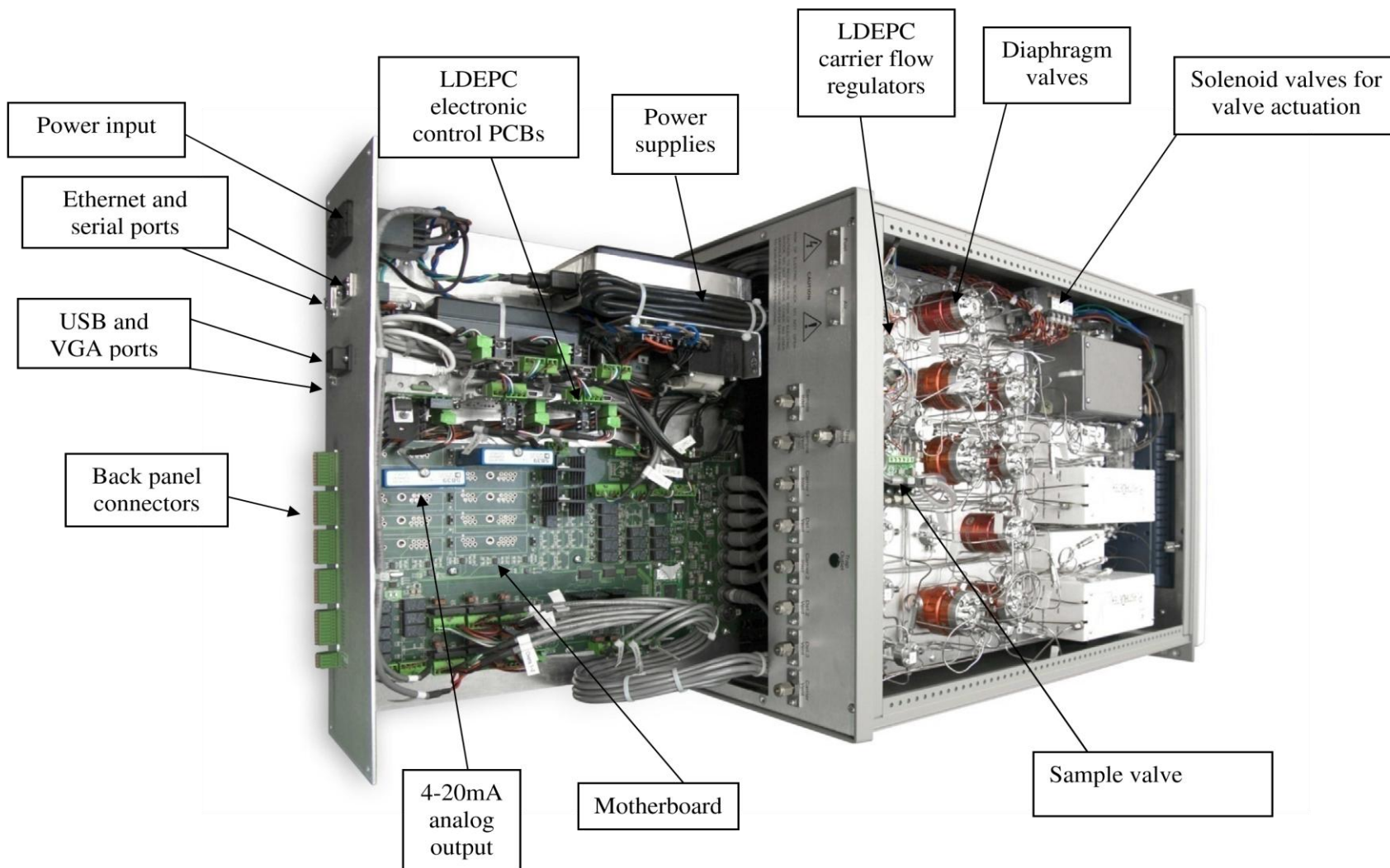
10. Drawings & Schematics

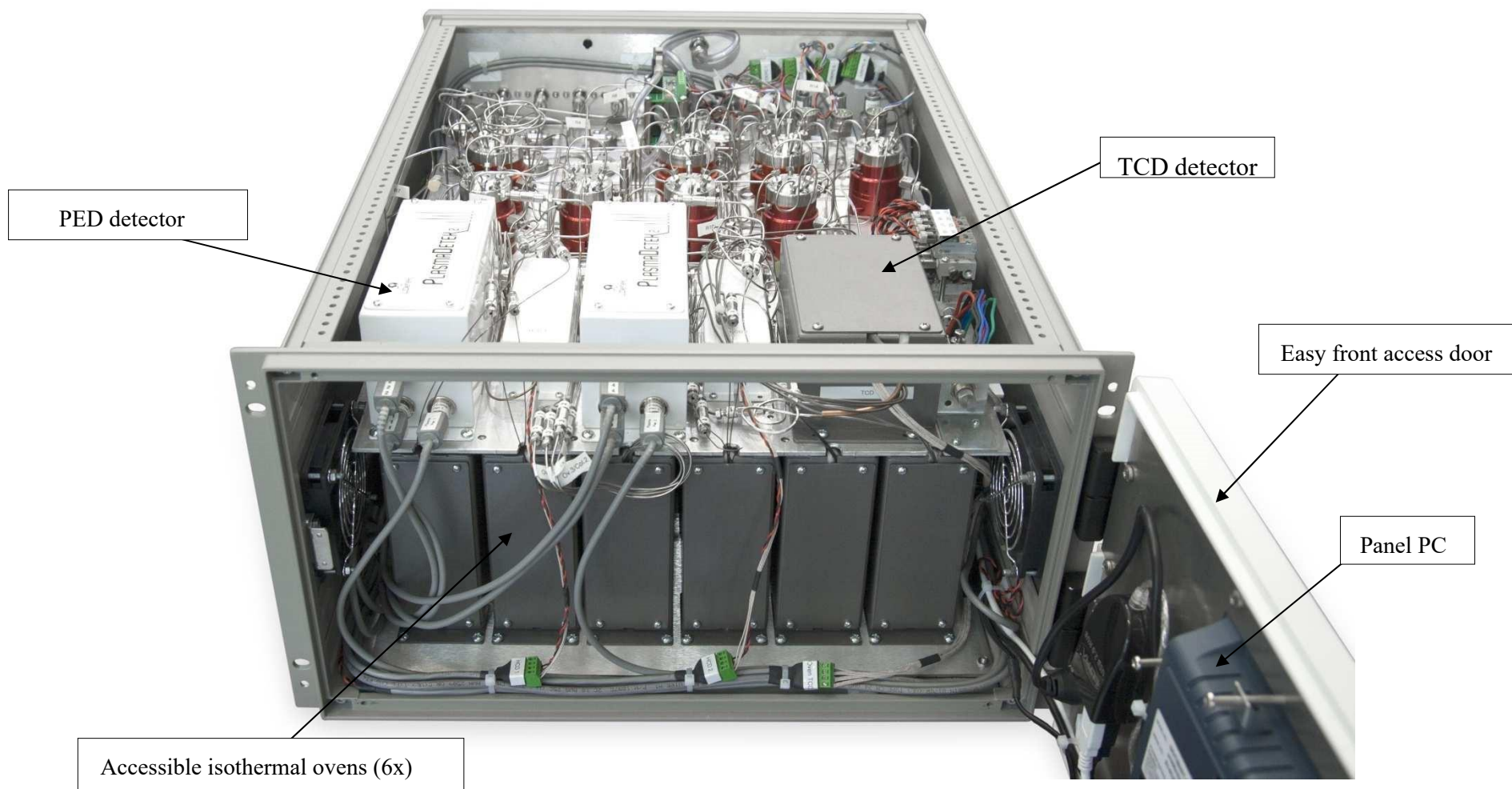


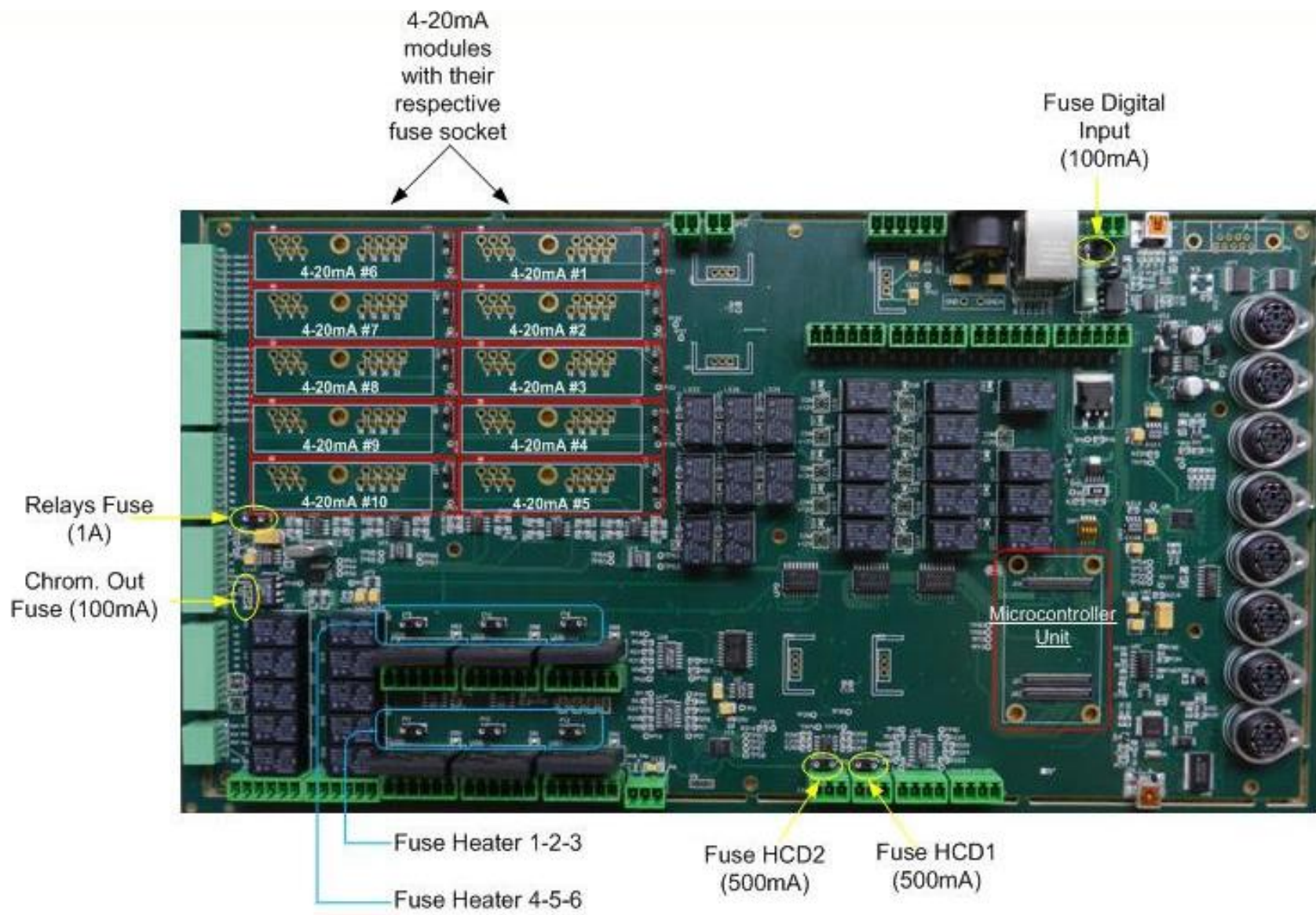
REV.	DESCRIPTION	DEMANDÉ PAR	FAIT PAR	DATE	
 990 RUE MONFETTE E THETFORD MINES, QC G6G 7K6 PHONE: (418) 755 - 1319 FAX: (418) 755 - 1329 WEB: WWW.LDETEK.COM CONFIDENTIAL THIS DRAWING CONTAINS PROPRIETARY INFORMATION WHICH MAY NOT BE DISCLOSED TO OTHERS FOR ANY PURPOSE WHATSOEVER OR USED FOR MANUFACTURING PROCESSES WITHOUT PRIOR WRITTEN PERMISSION FROM LDETEK INC. UNLESS OTHERWISE SPECIFIED: DEBURR AND BREAK SHARP EDGES DIMENSIONS ARE INCHES.	FORMAT: A	TITLE: MD3 OUTLINES			
		TOLERANCES:		MATERIAL:	QTY: 0
		ANGLE		DWG NO. MD3	DRAWN BY
		0 = ±1°			DATE 2020-01-04
		0.0 = ± 0.5°			
LENGHT		DO NOT SCALE DRAWING	SCALE: 1:8		
0.00 = ±0.01			SHEET 1 OF 1		
0.000 = ±0.005					
0.0000 = ±0.0005					



Top and bottom rack section







11. Maintenance and troubleshooting

Every MultiDetek3 is custom-built, therefore, the maintenance requirements will vary from system to system. Feel free to contact LDefek at support@ldetek.com. if you want the maintenance schedule specific to your analyzer.

11.1. Spare part list

The below table shows consumables and capital spare parts that can be required in a Multi-Detek3. Consumables are parts that will deteriorate over time and must be replaced periodically. For most MultiDetek3, preventive maintenance must be scheduled every 3 to 5 years to replace these consumables.

Capital parts on the other end are parts that are known to have a long life and/or a small chance of failure. However, failure would cause a shutdown of the equipment because it would take some time to get a replacement part.

The below table shows all the parts that could be required for a MultiDetek3. However, depending on its configuration, some parts might not be required for your system. For instance, Vpump-MD3 is a vacuum pump only required for systems using Nitrogen as the carrier gas. Therefore, this part is not required if your analyzer is using another type of carrier gas. Please contact LDefek to get a list of parts specific to your system.

Part #	Description	Type	Replacement frequency
D2-MD3	Replacement diaphragm for 2 streams valve (or O2 doping valve)	Consumable	3-5 years
D3-MD3	Replacement diaphragm for 3 streams valve	Consumable	3-5 years
D4-MD3	Replacement diaphragm for 4 streams valve	Consumable	3-5 years
D6-MD3	Replacement diaphragm for 6 ports valve	Consumable	3-5 years
D10-MD3	Replacement diaphragm for 10 ports valve	Consumable	3-5 years
DQMA-MD3	Replacement diaphragm for QMA's valve	Consumable	3-5 years
THCDFS-MD3	Replacement Tempered Humidity Control Device (HCD - Face seal Version)	Consumable	3-5 years
FanK-MD3	2 replacement fans	Consumable	3-5 years
Vpump-MD3	Pump for analyzers with Nitrogen Carrier	Consumable	3-5 years
MSP-MD3	Pump for analyzers with low sample pressure	Consumable	3-5 years
Compact-LDP1000,	Purifier for carrier gas	Consumable	3-5 years

LDP1000 or Large-LDP1000			
TCD-filament-MD3	Standard TCD filament	Consumable	3-5 years
TCDgold-filament-MD3	Gold-plated TCD filament	Consumable	3-5 years
Collector-MD3	Collector electrode for FID	Consumable	3 years
Ignitor-MD3	Ignitor element for FID	Consumable	3 years
FK-MD3	Fuse kit (2 x Fuse 3Amp glass + 2 fuse 100mA PCB + 2 fuse 1Amp PCB)	Capital part	N/A
FSM-MD3-NV	Flow sensor for carrier gas or sample gas + PCB	Capital part	N/A
AO-MD3	4-20mA Analog Output module	Capital part	N/A
Iso-Oven-MD3	Isothermal oven	Capital part	N/A
Ramp-Oven-MD3	Programmable ramping oven	Capital part	N/A
LCD-MD3	Panel PC for the MultiDetek3	Capital part	N/A
LDEPC-MD3	Electronic flow controller (LDEPC+PCB)	Capital part	N/A
MCU-MD3	Microcontroller unit	Capital part	N/A
Motherboard-MD3	Complete motherboard assembly (without MCU and 4-20mA)	Capital part	N/A
PS-MD3	Main Power Supply (+12, -12, +5)	Capital part	N/A
PS-LCD-MD3	Panel PC's power supply	Capital part	N/A
PED-MD3	Plasma module for MD3	Capital part	N/A
SV-MD3	Solenoid valve 12 VDC for MD3	Capital part	N/A

11.2. Tools

Some tools are required when doing a start-up, maintenance or troubleshooting on the MultiDetek3. The below table shows the list of tools that can become handy. These tools are separated into 2 categories – general and repair.

Tools in the category general are useful to do common tasks like start-ups, shut-offs or maintenance. For advanced users that intend to do repair tasks, tools in the category repair will be useful. Please note that to attend repairs, tools from the category general are required.

Part #	Description	Category
ScrewdriverPH2	Philips screwdriver #2	General
Wrench1/4	Wrench 1/4"	General
Wrench3/8	Wrench 3/8"	General
Wrench7/16	Wrench 7/16"	General
Flowmeter500ml	Flow meter 0-500ml/min	General
AngledWrench1/4	Angled wrench 1/4 for 1/16 fittings (10/32 thread)	General
Torkwrench	Tork wrench Wiha for valve screws	General
7/64"Hex Allen	7/64" Hex Allen Key for valve screws	General

Key		
9/64"Hex Allen Key	9/64" Hex Allen Key for valve screws	General
1/16TubeCuttingTool	1/16" Tube Cutting tool. Used to cut 1/16" tubing inside the analyzer.	Repair
FittingPliers	C-vice grip (4LW) 1/16 fittings pliers.	Repair
RestrictorPliers	Channellock909 reworked for orifices adjustment.	Repair
5/64"Hex Allen Key	5/64" Hex Allen Key for LDepc adjustment.	Repair

11.3. Maintenance procedures

This section will try to show maintenance procedures. Because every MultiDetek3 is custom-built, the procedures can vary slightly from system to system. Feel free to contact LDetek at support@ldetek.com. if you need clarifications.

11.3.1.How to replace the HCDs in a MultiDetek3

1. Note the sensor's signal (Tools>>Diagnostic>>Analog Input>> Page 3).
2. On LDChroma+, click on "Quit" to power off the panel PC.
3. Once the panel PC is powered off, turn off the MultiDetek3 by putting the power switch off.
4. Open the front door of the MultiDetek3 and locate the HCD on the top-right.
5. With a Philip screwdriver, remove the 2 screws on each side of the HCD box.
6. Carefully remove the HCDs from the box. The heater should be screwed on the HCD, and the temperature sensor will be mounted inside.
7. Remove the heater by unscrewing it from the stainless block and pull out the temperature sensor.
8. Remove the inlet and outlet of the HCD module using a wrench 7/16". The face seal gasket should fall out and you can discard it.
9. Place new gaskets on the new HCD and connect the inlet/outlet.
10. Re-install the temperature sensor and the heater on the new HCD.
11. Reinstall the HCD in its box and put back the 2 screws.
12. Restart the analyzer and note the sensor's signal.
13. Wait 2-4 hours and check the voltages again. If they are not close to the values from point 1, feel free to contact LDetek at support@ldetek.com.

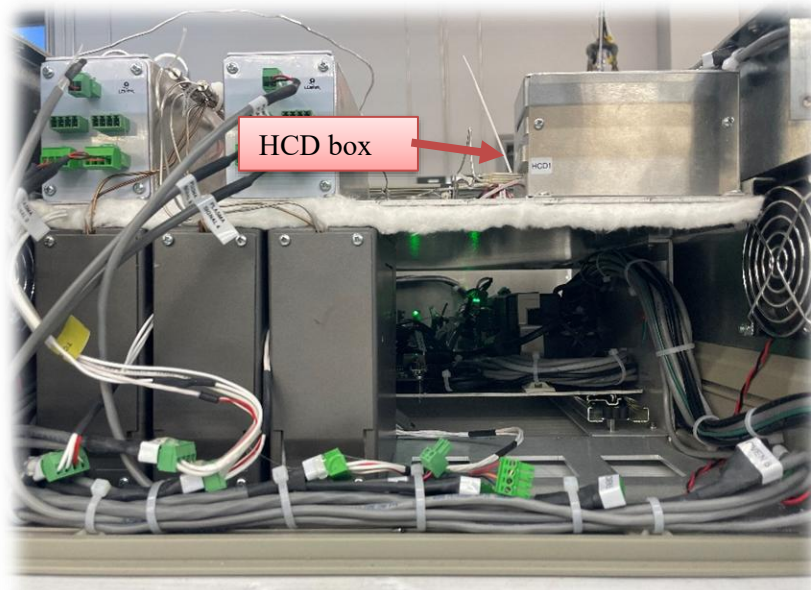


Figure 70: HCD box

11.3.2. How to replace the fans in a MultiDetek3

1. Open the front door of the MultiDetek3.
2. You will then have access to the 2 fans located on each side. Disconnect the green connector to remove the power from the fans.
3. Remove the fixing screws and replace the fans with new ones.
4. Reconnect the green connector and close back the door.

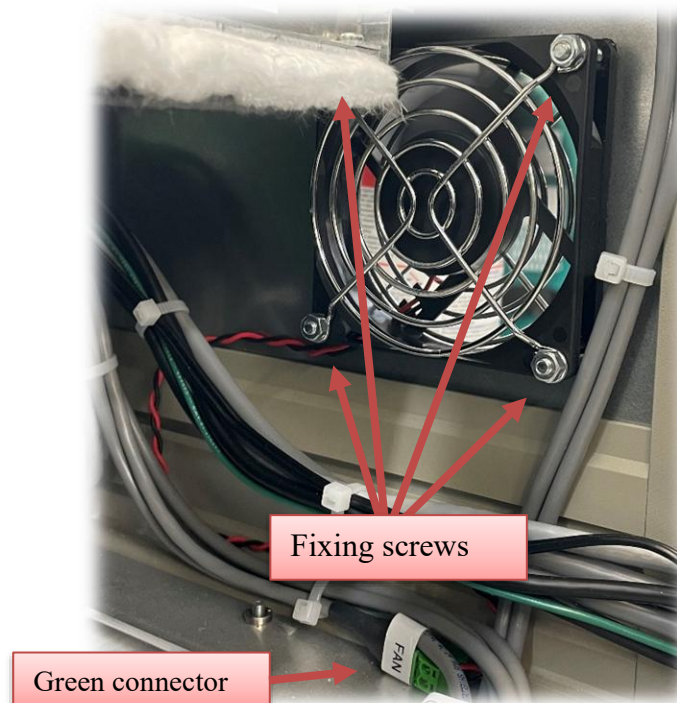


Figure 71: MultiDetek3 fans

11.3.3. How to replace the diaphragm in a MultiDetek3

Diaphragm replacement procedure.

The diaphragm replacement procedure is the same for six and ten port valves. If your valve has relief pin holes in the cylinder body, just follow the steps that refer to these pins. Skip those steps if your valve doesn't have these holes in the cylinder body.


WARNING
 Shut off carrier and sample gas before proceeding. If hydrogen, oxygen, or other hazardous gases are flowing into the valve, evacuate them by allowing inert gas to flow through the valve, make sure that no toxic or hazardous gas will leak into your working area.

Note: A visual inspection is necessary and recommended while the valve cap and the diaphragm are removed from the valve body. If there is any trace of contaminant on the valve cap wetted surface it must be cleaned following cleaning procedure.

Step 1 Skip this step if your valve doesn't have relief pins. Actuate the valve by pressurizing the actuator (ON position). When the actuator is pressurized, insert the relief pins into their respective holes as shown in figure 1. You may need to slightly increase the actuation pressure to ease the pins in. When the pins are properly inserted, depressurize the actuator (OFF position). This step makes sure that all the plungers are down, making it easier to install the diaphragm and properly align it.

Step 2 Unscrew first the three screws mounted on the outer edge of the valve cap and then unscrew the middle screw.

Note: The screw mounted in the middle of the valve cap is longer than the other ones. It must be re-installed at the same place.

Step 3 Carefully lift the valve cap.
Note: Don't touch the valve cap surface with your fingers.

Step 4 With the help of a small and clean plastic tweezer remove the used diaphragm.

Step 5 Remove the new diaphragm from the plastic bag. With the help of a small clean plastic tweezer install the diaphragm in place. Make sure that the diaphragm groove is aligned with the recess in the cylinder body.

Note: Manipulate the diaphragm only by its edge. Don't touch the process area with your fingers or dirty tools. This will affect the detector baseline and/or contaminate column.

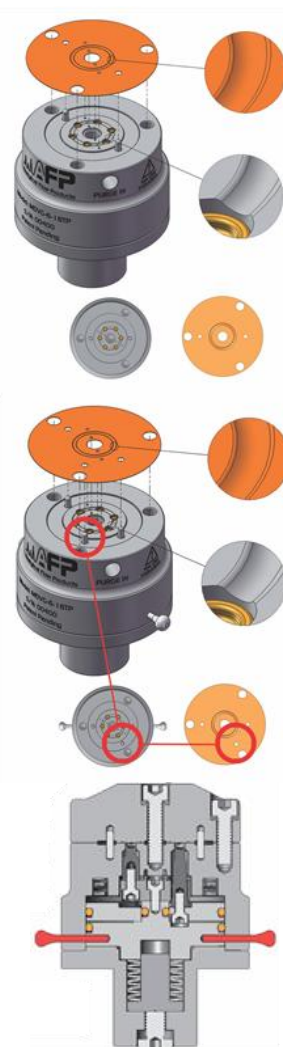


Figure 1

Step 6 Re-install the valve cap on the cylinder body by aligning the cylinder dowel pins with valve cap corresponding holes and gently depress the valve cap on the diaphragm. Make sure that the counter bore on the valve cap for the screws are aligned with the threads in the cylinder body.

Note: If you feel any resistance, you may not be aligned properly.

Step 7 Re-install the four mounting screws by beginning with the longer one that must be installed in the center hole of the valve cap. Tighten this screw to 5 lb-in (0.6 N-m) using a proper torquing tool and then continue with the 3 other ones.

Note: Make sure to have two compression washers per screw installed in the proper position.



Step 8 Tighten first the center screw to exactly 20 lb-in (2.3 N-m) using a proper touring tool and then continue with the 3 other ones.

Step 9 Skip this step if your valve doesn't have relief pins. Re-pressurize the actuator and remove the relief pins.

Step 10 The valve is now ready to be used.

11.3.4. How to replace a purifier with a MultiDetek3

1. Note the sensor's signal (Tools>>Diagnostic>>Analog Input>> Page 3).
2. Power off the old purifier and remove the power cable.
3. Remove the new purifier from the shipping box and protective wrapping. Make sure that both end caps are tight, and that the unit is in good condition. Also, make sure that the specifications match the old purifier (voltage, fittings type and gas type).
4. Disconnect the old purifier from the carrier gas line.
 - a. If your system has in, out and bypass valves, close the in/out and open the bypass valve. Then, disconnect the inlet and outlet fittings to remove the purifier.
 - b. If your system only has an inlet valve, close it to stop the carrier flow. Then, disconnect the inlet and outlet fittings to remove the purifier. The following steps must be done quickly to avoid contaminating the MultiDetek3 with Air.
 - c. If your system does not have valves, close the carrier from the source. Then, disconnect the inlet and outlet fittings to remove the purifier. The following steps must be done quickly to avoid contaminating the MultiDetek3 with Air.
5. Connect the new purifier by starting with the inlet fitting.
 - a. If your system has in, out and bypass valves, you can now open the in/out and close the bypass valve.
 - b. If your system only has an inlet valve, you can re-open it once both fittings are connected.
 - c. If your system does not have valves, you can re-open the carrier gas source.
6. Let the purifier purge for about 30 min. Then re-connect the power cable and power it on.
7. Wait 2-4 hours and check the voltages again. If they are not close to the values from point 1, feel free to contact LDetek at support@ldetek.com.

11.4. Troubleshooting

11.4.1. Alarm list

Alarm name	Description
Flow deviation on "FlowID"	This alarm shows that the flow of a specific module deviates from the setpoint. This alarm could happen for an LDEPC or a sample flow module.
Temperature deviation on "OvenID"	This alarm shows that the temperature of a specific oven deviates from the setpoint. This alarm could happen for an Oven, an HCD, an OvenQMA or on the heated zone.
Temperature limit reached on "OvenID"	This alarm indicate that the temperature measurement is outside of the sensor's limits. This generally happen if the sensor is disconnected or malfunctioning.
Flow limit reached on "FlowID"	This alarm indicate that the flow measurement is outside of the sensor's limits. This generally happen if the sensor is disconnected or malfunctioning.
No communication with LDepc on "LDepcID"	This alarm indicates that there is no communication between the motherboard and the LDepc.
Error in USB cmd size	This indicates a communication error between the motherboard and the computer running LDChroma+. This generally happens if LDChroma+ and the firmware aren't compatible.
Detector off on "DetectorID"	This alarm indicate that the detector is not powered ON.
Valve limit of use soon reached on "ValveID"	This alarm indicate that the valve will almost reach the maximum number of clicks the manufacturer recommends.
TCD low flow on "DetectorID" with "LDepcID"	This alarm indicate that the flow is too low on an LDepc that controls a TCD.
Peak alert is reached on	This alarm indicate that the peak

"PeakID"	concentration is above the threshold set in the settings menu.
LDGDS Timeout, something wrong in the serial communication cmd="0"	This alarm indicate that there is an issue with the communication between the LDGDSA and the MultiDetek3.
LDGDS deviation on "Zero", "Span" or "Blend"	This alarm indicates that there is a flow deviation on the LDepc that controls the LDGDSA.
TCP/IP Modbus is not activated. You can't process	This alarm indicate that Modbus TCP/IP is not activated, and the Modbus communication has been blocked.
Serial Modbus is not activated. You can't process	This alarm indicates that Modbus RS232 or RS485 is not activated, and the Modbus communication has been blocked.

11.4.2.Low flow/flow deviation on sample

1. Check if the sample flow setpoint matches the value in the document operating parameters. The flow setpoint can be found in the menu Settings>>Settings>>Flow>>Sample.
2. Check if the sample pressure matches the value in the document operating parameters. It should be 5-30 psig for most systems.
3. Measure the flow with a flow meter connected to the sample vent of the Multi-Detek3.
4. Contact LDetek support (support@ldetek.com) with the results obtained in the previous steps.

11.4.3. Low flow/flow deviation on LDepc

1. Check if the carrier pressure matches the value in the document operating parameters. Typically, this pressure is set to 100 psig (7 bars).
2. Increase the carrier pressure by 10 PSIG to see if the carrier flow stabilizes on the setpoint.
3. Put back the carrier pressure at the value in the operating parameters to see if the flow stabilizes on the setpoint.
4. Decrease the carrier pressure by 10 PSIG to see if the carrier flow stabilizes on the setpoint.
5. Try to bypass the gas purifier to see if the carrier setpoint comes back to normal.
6. Contact LDetek support (support@ldetek.com) with the results obtained in the previous steps.

11.4.4. Oven temperature deviation

1. Check if the carrier pressure matches the value in the document operating parameters.
2. Open the front door and check if the green connectors for each oven are well connected.
3. Refer to the drawing "Motherboard PCB" from section 10 to identify the fuse used for each oven. Check if the fuses are blown or not by removing them and measuring the continuity.
4. Check the status of the LED associated with the defective oven. Refer to the drawing "Motherboard PCB" from section 10. The green LED turns on when the oven is heating. Check if the LED is ON or OFF or blinking. If the setpoint is 45 Celsius and the reading value is 25 Celsius, then the LED should be continuously ON.
5. Contact LDetek support (support@ldetek.com) with the results obtained in the previous steps.

11.4.5. Detector off

1. Check if the raw signals for the sensors match the values shown in the document "Operating Parameters".
2. Open the front door and check if the connectors on the detectors are well connected.
3. Contact LDetek support (support@ldetek.com) with the results obtained in the previous steps.

11.4.6. Lost peaks

1. Check if there are flow alarms and resolve them.
2. Check if there are temperature deviation alarms and resolve them.
3. Check if the raw signals for the sensors match the values shown in the document "Operating Parameters".
4. Contact LDetek support (support@ldetek.com) with the results obtained in the previous steps.

11.4.7. Defective 4-20mA module

1. Refer to drawing "Motherboard PCB" from section 10 to identify the 4-20mA modules and fuses. Check if the fuse is blown or not by measuring its continuity.
2. Recalibrate the defective module as per section 7.3.1.9.
3. Swap the defective 4-20mA module with a known working module and check if the working module is still functioning.
4. Contact LDetek support (support@ldetek.com) with the results obtained in the previous steps.

11.4.8. Unstable measurements

1. Make sure that there is no active alarm. If there are alarms, they must be resolved.
2. Make sure that the calibration has been done properly.
3. Contact LDefek support (support@ldetek.com) with the results obtained in the previous steps.

11.4.9. The panel PC doesn't start

1. Confirm that the input voltage matches the value shown in the document "Operating Parameters".
2. Check if the green LED located on the right-bottom corner is ON.
3. If the green LED is OFF, make sure that the power switch is turned ON.
4. Check the connection between the power supply and the panel PC. To do that, refer to the drawing "Top and bottom rack section" from section 10. Further, open the front door and check the connections on the panel PC.
5. If the connections are good, measure the voltage on the connector on the Panel PC. The voltage should be 19VDC.
6. Contact LDefek support (support@ldetek.com) with the results obtained in the previous steps.



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