LVDT Distance add-on

for cylindrical CompreCells

User Manual

Version 1.0 EN

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rhd instruments GmbH & Co. KG

Contents

1 Product description

The LVDT Distance add-on for cylindrical CompreCells is designed to enable the electrochemical characterization of solid samples like solid electrolytes or all-solid-state batteries while precisely monitoring the thickness changes of the sample during measurement. The product is designed to be used only in combination with the corresponding measuring cells (cylindrical CompreCells such as CompreCell 12 or CompreCell 12DP).

The LVDT Distance add-on for cylindrical CompreCells provides three LVDT distance sensors which can be directly mounted on cylindrical CompreCells. The small and light-weight sensors are connected to the RHD Multi Data Sampler. The data is transferred via a serial interface and can directly be recorded alongside with all other data using CompreDriveControl software.

The LVDT sensor combination offers a total measuring range of 10 mm with a resolution of 0.1 µm.

2 General information

Thank you for your confidence in our products and services. We wish you pleasure and success with your new LVDT Distance add-on system. It has been developed especially for professional electrochemical material characterization.

» **To avoid physical injuries and damages, please read this instruction manual carefully before using the device for the first time.**

» **Please pay attention to all safety notes in this instruction manual.**

» **Please keep this manual safe. In case of selling or leaving the device to third parties, please do not forget to hand this manual over as well.**

» **The operation of the LVDT Distance add-on for cylindrical CompreCells should only be performed by properly trained and experienced members of staff.**

» **The setup is developed to measure sample thickness changes in your CompreCell electrochemical measuring cells and must not be used for any other purpose.**

» **To avoid unstable operating conditions and injury, the LVDT Distance setup as well as the individual components should not be used if**

- **they show noticeable damage,**
- **they were stored or operated under unapproved conditions (see operational condition, storage and rated values),**
- **they were exposed to high mechanical stress, exceeding normal usage,**
- **they were altered by members of staff not authorized by rhd instruments.**

The instructions in this manual were carefully checked for correctness. However, liability for any mistakes in form and content will not be assumed. Additionally, rhd instruments GmbH & Co. KG (in the following declared as rhd instruments) reserves the right to change the setup and design of the products presented and described within this manual. Such changes are necessary to guarantee the continuous development of the products and, thus, the improvement of product quality and reliability.

Markings in this manual

Marking	Meaning
WARNING	Indicates a hazardous situation which, if not avoided, could result in a serious injury or death.
ADVICE	Indicates potential physical damages and other important information associated with your device.

3 Important general safety notes

» Connect the power supply according to the safety regulations for electrical equipment. Otherwise, there is risk of injury, damage to or destruction of the sensor and/or the controller

» The supply voltage must not exceed the specified limits to avoid damage to or destruction of the sensor and/or the controller

» Only use the original parts included in delivery. They are prepared for your device and guarantee the necessary safety for operator and device.

» Do not operate the device with wet hands. Operate the device only in dry rooms.

» Do not operate the device outdoors.

» Please follow only the instructions in this manual for cleaning the device.

» Make sure that cables and conductors are not damaged. Damage could be caused by heat, impact, contact with chemicals, or mechanical impacts like rubbing, bending, tearing, and rolling-over.

» Prevent the device from mechanical impact. In case the device fell down, please contact rhd instruments or a technician authorized by rhd instruments before switching it on again.

» If your device shows any visible damage or defect: Disconnect the power supply by pulling out the power connector. Never operate your device in a damaged state. Never repair the device on your own. The device should only be repaired by either rhd instruments or by a technician authorized by rhd instruments.

» Do not open the device. There are no user-serviceable parts inside.

» Please follow this instruction manual for maintaining your device.

» Only use original spare parts delivered by rhd instruments.

ADVICE: Connect and disconnect any cable connection carefully.

ADVICE: Handle chemicals with care.

» When handling chemicals during preparation and execution of measurements with the CompreDrive LVDT Distance add-on, the usual safety advice in accordance with the H, EUH, and P statements (in the European Union: rating principles according to the CLP regulation) and appropriate safety measures have to be observed. This applies to subsequent cleaning and decontamination as well.

ADVICE: Sufficient cleaning increases the lifetime of your system.

» After using the add-on for electrochemical measurements, all components in contact with chemicals need to be thoroughly cleaned. Insufficient cleaning, decontamination, and drying of the components may result in damage due to corrosion and, thus, may affect the quality of your measurement results.

4 Components of the CompreDrive Distance add-on system

» Please unpack your device carefully.

» Please check if the delivery is complete:

- 1x sensor holder
- 3x LVDT sensors with cable
- 1x Multi Data Sampler
- 1x power supply unit 24 V
- 1x hex screw driver (1.5 mm)
- 1x stand for 3 LVDT sensors
- 1x lower assembly aid
- 1x 2m serial cable
- 1x USB to serial adapter
- 1x manual “Multi Data Sampler“
- 1x USB-Stick with Manuals

- **To be ordered sperately:**
  1x Upper plate (cantilever) for LVDT Distance add-on (either 12, 10 or 6 mm) including
    - 1x upper assembly aid
    - 1x upper assembly aid for CompreFrame

» Please check if the delivered items are undamaged.

ADVICE: If the delivered items are incomplete or damaged, please contact rhd instruments via e-mail (info@rhd-instruments.de) or via phone (+49-6151-8707187).

rhd instruments will reject any claims for warranty or responsibility in case damaged equipment is used.

In case any accessory of other manufacturers is used, rhd instruments will accept no liability.

5 Operation conditions, storage and rated values

- Temperature range during operation
  Sensor: $T_{env.\ operation}$ = -25 °C to +85 °C, low humidity, not freezing.
- Temperature range during storage
  Sensor: -40 to +85 °C
- Atmosphere during storage: Non-corrosive

LVDT sensor characteristics

Measuring range	10 mm
Linearity (displacement and distance measurement)	<+-0.25% F.S.
Temperature Coefficient	+-0,4 % FS / 10K
Displacement Range	10 mm
Output Ripple	<5 mV RMS

6 Essential features at a glance

» High-precision distance measuring system for cylindrical CompreCells, i.e. CompreCell 12 or CompreCell 12 DP etc.

» Measurement of sample thickness changes during electrochemical experiments.

» Measuring points as close to the sample as technically possible, to exclude influences from the main pressure frame.

» Robust assembly and handling.

» Fully included data handling and processing into CompreDriveControl software.

» Retrofittable to all CompreDrive and CompreFrame systems.

» Compatible with CompreDrive HC and H temperature control options.

Note:

If you have any questions, for example with regard to the compatibility of your measurement devices, do not hesitate to contact us via email (info@rhd-instruments.de) or phone (+49-6151-8707187).

7 Getting started

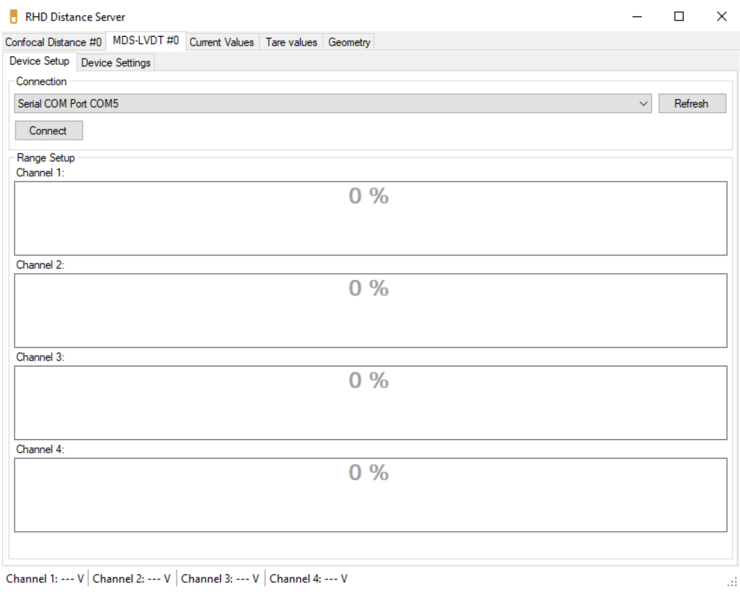
7.1 Setting up the LVDT Distance Addon

The LVDT distance addon needs to be mounted on the cell you plan to use ahead of the measurement. Prepare the setup by connecting the LVDT device to the computer, then proceed to mount the sensor holders.

Connect the sensors to the MultiDataSampler, connect the MultiDataSampler to the computer, connect the 24V power supply and switch the device on.

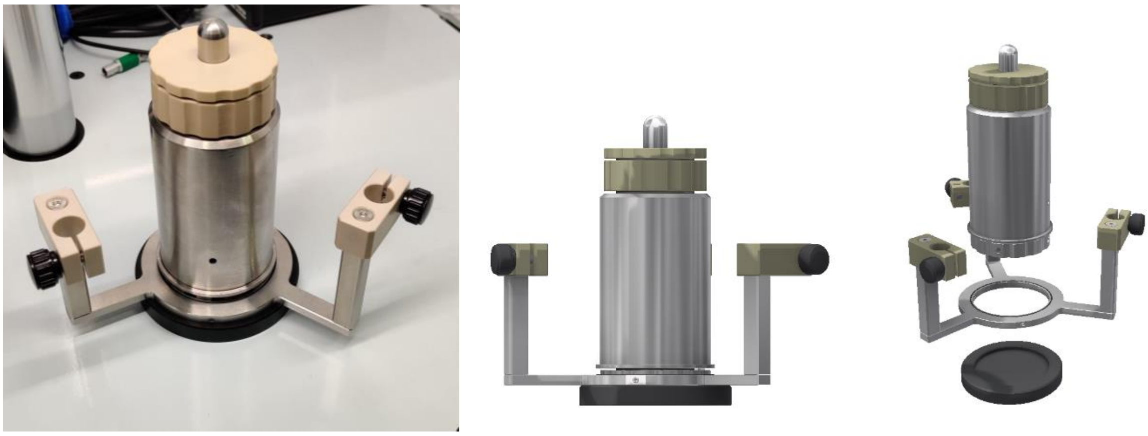
Step 1: Connect the sensors to the RHD MultiDataSampler via the 4-pin LEMO connectors. Connect the MultiDataSampler to the computer using RS-232 or USB via the adaptor, connect the 24V DC power supply and switch on.

Start the RHD Distance server software and connect the device (for initial software setup refer to section 8). Navigate to MDS-LVDT #0, select the appropriate COM device and click the connect button.



Step 2: Start the RHD.DistanceServer application, navigate to the LVDT ribbon and select the appropriate COM device.

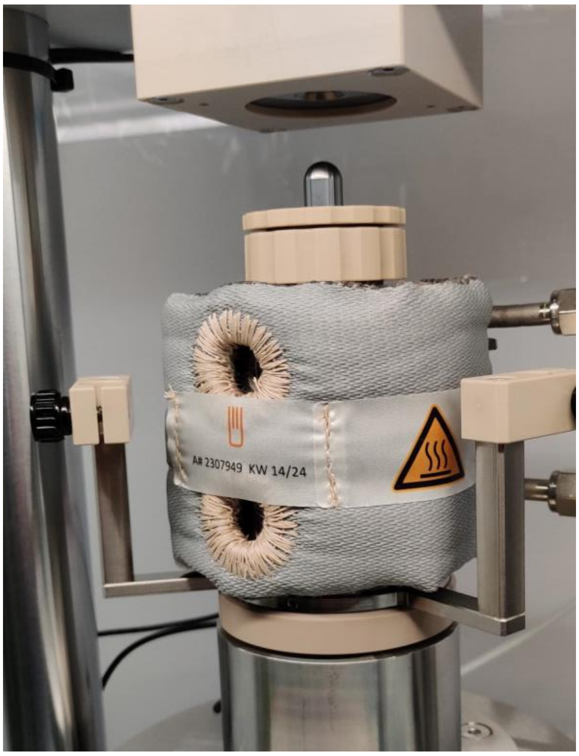
Place the bottom sensor holder on top of the bottom mounting aid and insert your CompreCell into the mould in the middle. Use the 1.5 mm hex key to tighten the screws.



Step 3: Place the bottom mounting aid on a flat surface, place the bottom sensor holder on it and insert the CompreCell into the cavity.

Now move the cell to the CompreDrive or CompreFrame. Slide the thermal jacket on the cell, making sure that no parts of the sensor holder touch the thermal jacket or the hoses. Place it altogether on the platform of the CompreDrive or CompreFrame. Insert the temperature sensor (Pt100) into the CompreCell. Make sure that the temperature sensor does not touch parts of the LVDT device. If you cannot avoid contact, between the Pt100 and the LVDT sensors, use tape (e.g. capton or insulation tape) to insulate the contact areas.

ADVICE	Make sure that the LVDT sensors do not touch the metal frame of the sensor holder, the cell body, the thermal sleeve and hoses or the temperature sensor. Contact may lead to damage to your sample or damage to the sensors and MultiDataSampler (AD converter). Reason is, that the sensors are connected to the ground of the MultiDataSampler.



Step 4: Placement of the cell on the CD stage with attached thermal sleeve and sensor holders.

Slide the upper cantilever on the top piston. Leave an air-gap of approximately 2 mm to the PEEK lid. Use the cantilever placement aid to adjust the airgap between the lids and the cantilever. Select the placement aid according to the lids in use. If using short lids (Figure 1 , mandatory for CompreFrame), use the long cantilever placement aid and vice versa. Before tightening the screws gently rotate cantilever to align it with the bottom sensor holders. Tighten the screws to fix the cantilever to the piston. Afterwards, remove the cantilever placement aid.

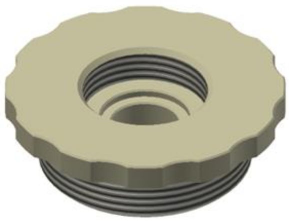
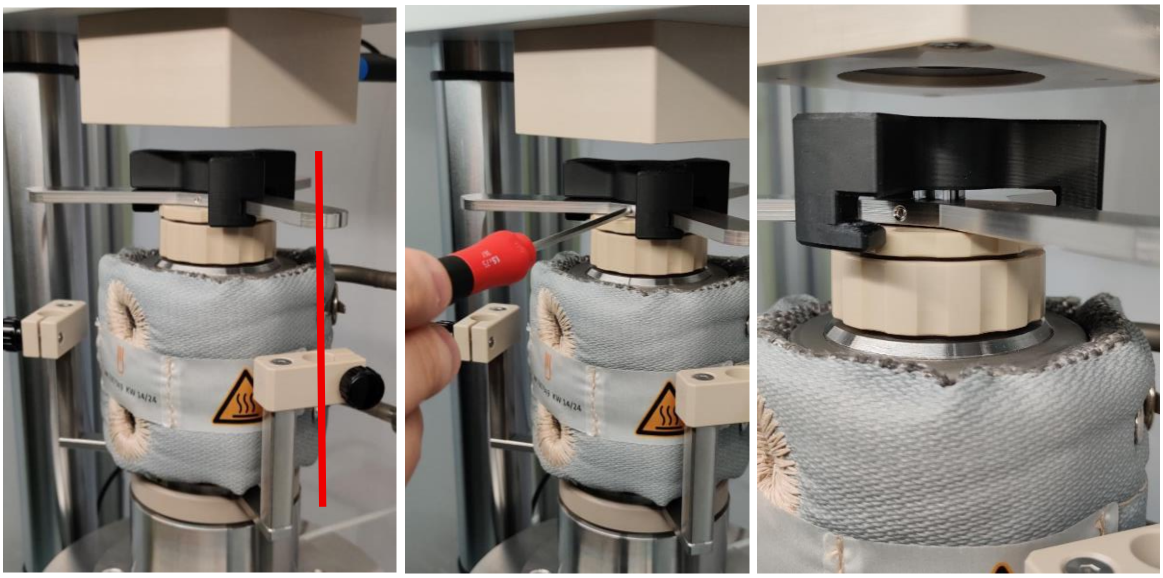


Figure 1: Short lid for use with CompreFrame. Optional for use with CompreDrive.

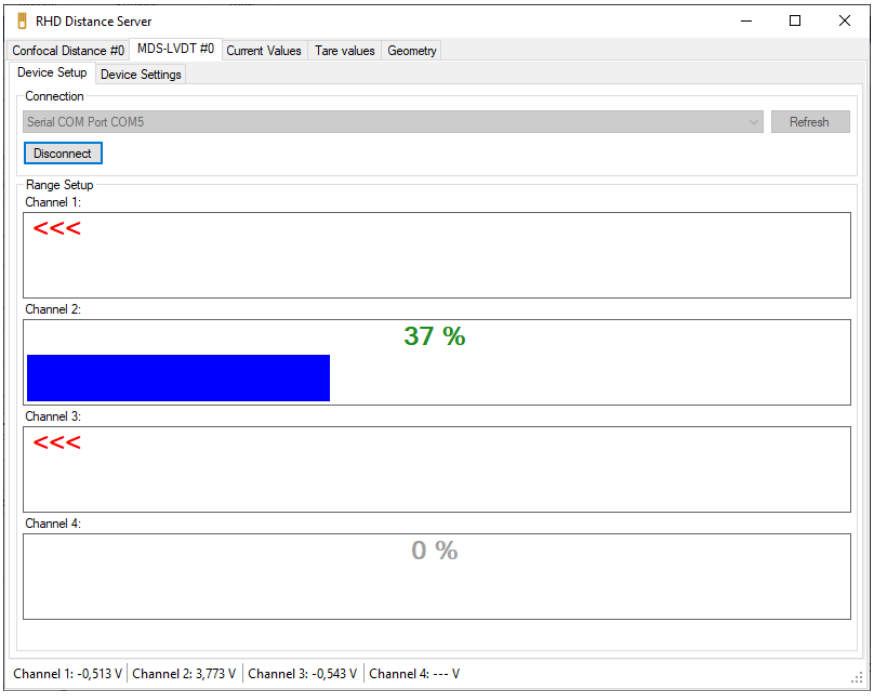
CAUTION	If you are using the distance addon with a CompreFrame you need to replace the standard double lid assembly with a short lid, delivered with the

	addon in case you ordered it for use with a CompreFrame. Failure to do so may lead to damage to the CompreFrame, Distance Addon and your Cell.
ADVICE	Make sure that the top cantilever does not touch parts of the CompreDrive during approach or operation. Mount the cantilever with appropriate clearance. Failure to do so may result in damage to the LVDT sensors and the cell and CompreDrive device.

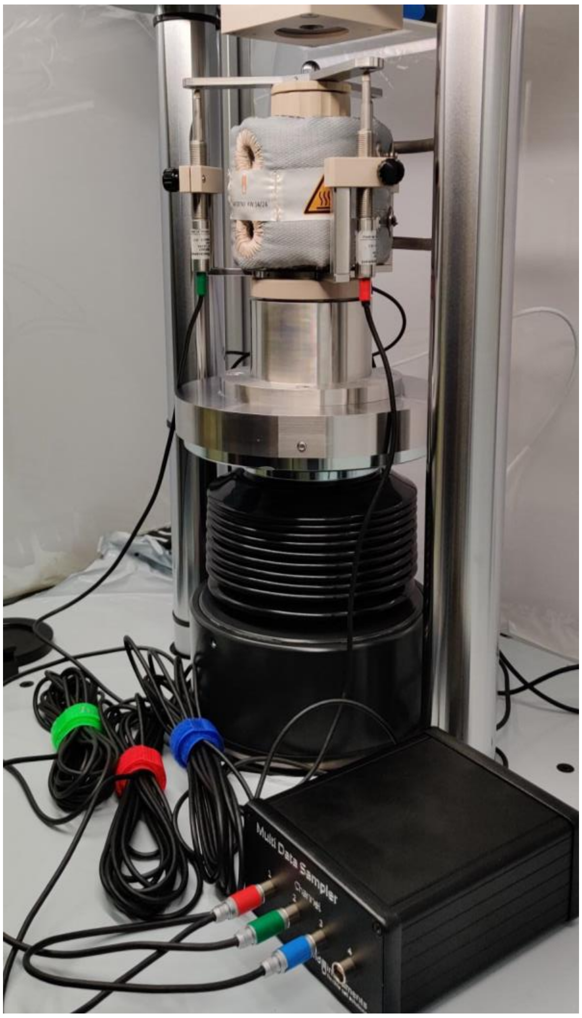


Step 5: Align the top cantilever with the sensor holders before tightening the screws. Do not rotate the cantilever afterwards.

Use the approach procedure of CDC or set the CompreFrame to 150N. Then insert the sensors into the bottom sensor holders. Adjust the sensors to a deflection of 30-40%.

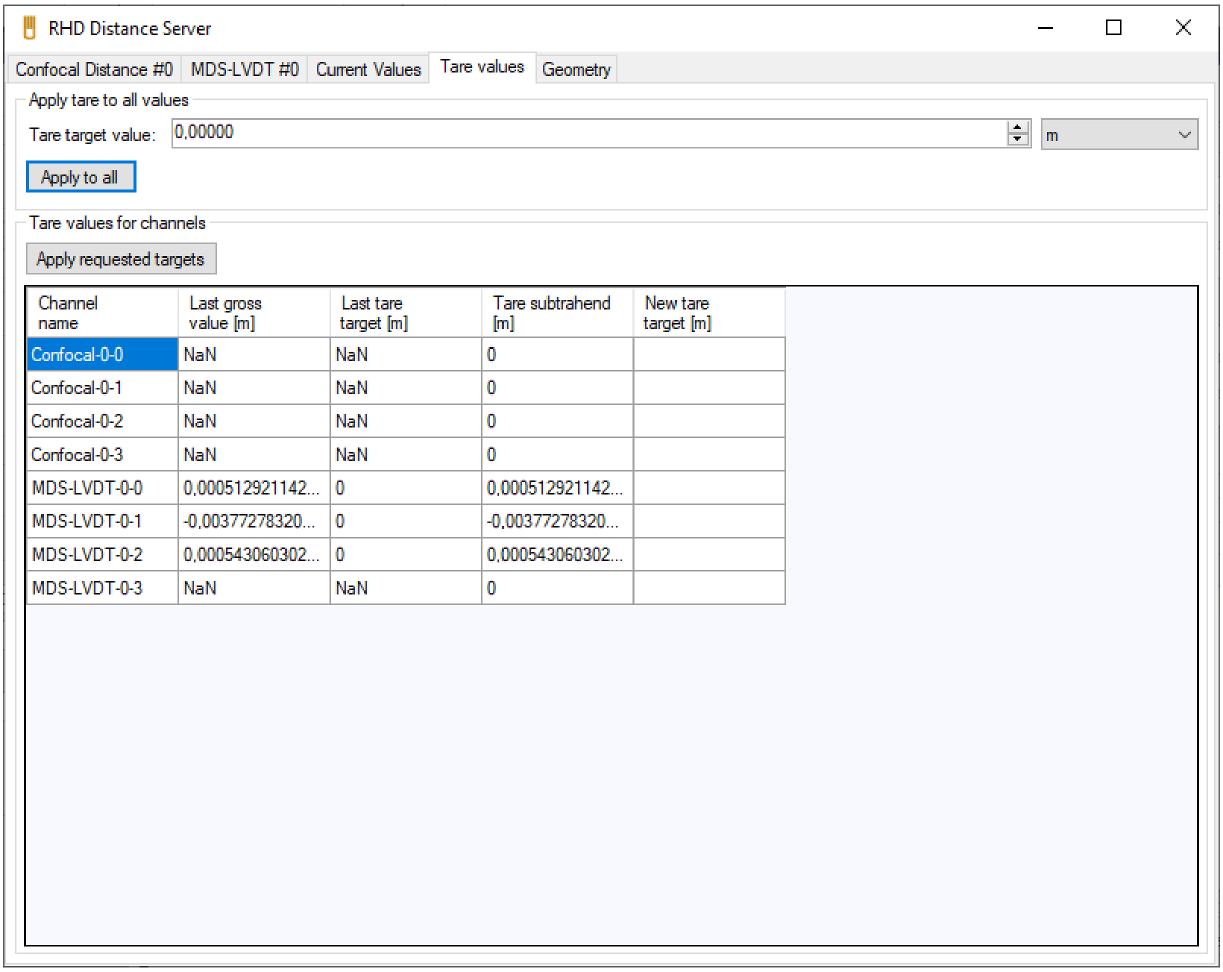


Use the included finger screws to tighten the PEEK holders. Do not overtighten the screws.

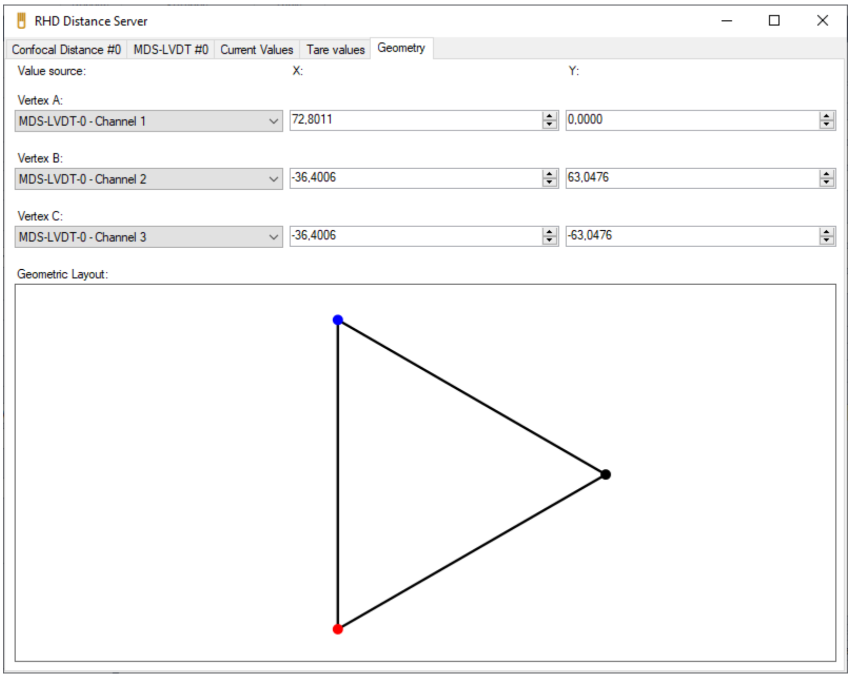


Step 6: Assembled cell+ thermal sleeve + sensor.

Before you start your measurement, or at any necessary point you may navigate to the tare values ribbon and apply a tare value to the sensors.



The RHD.DistanceServer works with LVDT sensors and confocal sensors. You have to select the sensors you are using in the dropdown menus on the left side in the geometry ribbon. If you are using a distance addon manufactured by rhd, do not change the geometry values. If you are using sensor mounts of your own design you may still use the sensors at your own risk. In that case, enter the mount points for each individual sensor.



For disassembly follow the instructions in reverse order.

8 Initial software setup

The CompreDriveControl software can be used to establish automated electrochemical measurements including the communication with the LVDT sensor system. For further details please refer to the CompreDriveControl user manual.

To establish a connection, the RHD.DistanceServer plugin needs to be running on the same computer as CompreDrive Control. Install the RHD.DistanceServer application using the instal.exe delivered with the Multi Data Sampler. Start the application by executing the RHD.DistanceServer.exe.

9 Troubleshooting

9.1 No Connection to LVDT system

Make sure the RHD Serial adaptor is properly connected and the drivers are installed. The adaptor LED should be flashing blue when it is connected to the computer. Make sure that you select the right COM device and that it is not blocked by another application.

9.2 LVDT system connected, but no data is transferred to CompreDrive-Control

Make sure that the Pipe and WCF Interface indicators in CDC light up green. When the interfaces don't work try to restart CompreDrive Control or restart the computer.

10 Settlement

Warranty will be granted for a period of 2 years starting at the date of delivery.

Explicitly left out from warranty are parts that are subject to premature wear and tear due to use or other natural wear and tear. These components are regarded as consumables. Damage on the optical cable is excluded from warranty.

The costs for sending repaired or exchanged goods to the costumer will be paid for by rhd instruments.

rhd instruments has to be notified of apparent defects and damages which occurred during production or delivery within 14 days after receiving the delivery. If a notification of apparent defects and damages does not occur within this period of time, the goods shall be deemed to have been accepted; as a result, the order will be assumed to be completed and approved.

Please note: Only workshops authorized by rhd instruments are allowed to perform repairs on the devices. If any mechanical or electronic components of the products are altered by customers themselves or by unauthorized workshops, a claim for warranty against rhd instruments is forfeited.

In case of a claim or sending back goods for repairs to be performed, please ask for the decontamination form beforehand. In general, rhd instruments must be contacted via e-mail or phone prior to any shipping of damaged goods.

11 Contact and Technical Support

For any questions with regard to our products, orders, or request for repairs please contact rhd instruments:

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