

precision dots

VERMES

..... MICRODISPENSING

USER MANUAL

01.10.2025 Rev. 1

Drop Volume System DVS 31



User Manual for the DVS 31

The DVS 31 is compatible with the following devices.

System	Device
MDS 1560 Series	MDV 1560
MDS 3050	MDV 3050
MDS 3050-AC	MDV 3050-AC
MDS 3055	MDV 3055
MDS 3055-AC	MDV 3055-AC
MDS 3058	MDV 3058
MDS 3080	MDV 3080
MDS 3080-AC	MDV 3080-AC
MDS 3088	MDV 3088

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1 Introduction

With a drop volume system of the DVS line from VERMES Medical Equipment, you have bought a high quality product. Due to the longstanding experience of the team in regards to electronic devices and medical applications, these products provide highest functionality and reliability.

Thank you very much for your trust in us.

We will now show you how to assemble and use the drop volume system. In order not to impair the inherent safety concept of the system, you have to follow the procedures described in this manual consequently during installation and operation.

Read this manual before you start the assembly and always consult it during the use of the drop volume system.

Start with the chapter "Safety Notes" (see chapter 2, page 7). This will help to prevent any problems for the user or the equipment. In the case of further questions, consult our Technical Support.

Technical Support	VERMES Microdispensing GmbH Rudolf-Diesel-Ring 2 83607 Holzkirchen Tel.: +49 (0) 80 24 6 44-26 Fax.: +49 (0) 80 24 6 44-19 support@vermes.com www.vermes.com
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Service hours Monday - Friday 9.00 to 17.00 (CET). We recommend checking the relevant serial numbers (e.g. MDC and MDV) and the firmware revision before contacting the support.

The DVS 3x Product Family

The DVS models are members of the DVS 3x product family, specialized in most accurate drop volume measurements for dispensing systems and designed for flexible use with substances of low and medium viscosity (up to 12500 mPas). Applications can be found in the fields of medical and pharmaceutical work, including cell suspensions and protein solutions, but also in the production of electronics, semiconductors and precision mechanic modules and many more.

Each drop volume system belonging to the DVS 3x product family is composed of a high precision Drop Volume Detector (DVD series) and a control unit (DVC series).

Due to its compact modular design, the system can be integrated quickly into any existing production environment without major preparatory work. A change in the production line (e.g. a modification of the liquid to be processed) is easily possible. Fine-tuning of the sequence is therefore possible at any time.

A comprehensive choice of accessories is available, e.g. cartridge holders and DVD-holders, so that the system can easily be adapted to new challenges any time, without giving rise to major investment.

2 Safety Notes

This chapter summarizes the general safety aspects of the system. Further points to observe are emphasized in the corresponding subchapters.

2.1 Obligations and Liability

In order to protect the health of personnel and to avoid unnecessary damage, all of the recommendations of the manufacturer concerning safety must be explained to every member of the team taking part in installation, operation or maintenance of the system.

VERMES Microdispensing does not accept any liability for material damages or personal injury originating from inappropriate use, violation of safety prescriptions, or any procedure inconsistent with the instructions of this manual. The general rules for prevention of accidents as well as local environmental regulations must be in place and thoroughly followed by the personnel.

2.1.1 Obligations of the Customer

In view of a trouble-free operation of the microdispensing system, the customer has to select his personnel carefully:

- Unauthorized use must be prevented. Persons ignoring the fundamental requirements of industrial safety, environmental protection and prevention of accidents are not allowed to work with the system.
- New operators must correspondingly be instructed and trained, so that they can understand and put into practice the instructions of this manual. For certain measures, a particular qualification may be required.
- The manual must remain accessible at any time.

2.1.2 Obligations of the Operator

All persons in charge of the system must:

- Continuously respect the general rules for prevention of accidents.
- Be aware of the safety notes of this manual. This is necessary also for operators trained by the manufacturer or experienced in work with similar systems.
- Consult the manufacturer in any case of doubt. Applications beyond the scope of the specification and improvised repair work must be avoided.

2.2 Residual Risks

The drop volume system has been developed and designed with the common requirements of safety in mind, and corresponds to the current state of technology. In the delivered layout, it complies with the following regulations and directives:

- 2014/30/EU Electromagnetic Compatibility
- 2011/65/EU RoHS
- EN 61010-1
- EN 61326-1
- EN 55011
- EN 61000-3-2
- EN 61000-3-3
- EN 61000-6-2

Despite this comprehensive inherent safety structure, the operation of the drop volume system DVS may entail danger

- For the health of the operator or a third party,
- For the system itself,
- Or give rise to another material damage.

Therefore, the use has strictly to be limited:

- To the intended application.
- To a state in which the technical safety of the system can be guaranteed (i.e. it is strictly forbidden to start or continue the operation whenever a defect has become obvious).

You have to solve problems immediately, if they have a potential to impair safety aspects. For this reason, it is imperative that this manual remains accessible any time without delay. In an emergency, a short reaction time may be crucial.

If you transmit the system to any other department or institution, this manual must accompany it.

2.3 Contracted Use

The drop volume system has been designed for precise in-process measurement of the trigger specific dispensing volume, as a process control in a VERMES Microdispensing system, to be operated in a conveniently equipped industrial or laboratory environment.

Deviations from the instructions of this manual must explicitly be authorized by the manufacturer (in writing); otherwise his liability with regard to the guarantee becomes null and void.

This includes:

- Extensions and changes of design
- Modifications of the system, or spare parts not recommended by the manufacturer
- Inappropriate material selection (lack of compatibility between parts and dispensed fluids)
- Operation with damaged parts or after improvised repair
- Dispensing of fluids able to affect the functionality of the system (in case of doubt, consult manufacturer)
- Manipulation or absence of integrated safety devices or sealings
- Repair by persons or enterprises not authorized by the manufacturer
- Operation beyond the scope of the specification
- Auxiliary equipment not recommended by the manufacturer
- The system is not admitted for applications in hazardous locations (ATEX zones)

In no event shall we be liable under our guarantee or any other provision of the agreement for damages resulting from a violation of the instructions of this manual.

For further questions concerning current applications and modifications of the system with respect to new requirements, contact the manufacturer, the responsible sales partner or the Technical Support.

2.4 Specification and Technical Notes

- The system is designed for interior use only. Maximum altitude: 2000 m.
- The relative air humidity shall not surpass 90 % rH (non-condensing).
- Operating temperature range: 5 °C till 50 °C
- Admissible mains voltage fluctuations: Within the range of ± 10 % of rated voltage.
- Transient overvoltage tolerated acc. to IEC 60364-4-443, max. degree of soiling: 2
- Mains cables must feature a protective conductor. In the case of cables not delivered by Vermes Microdispensing, the guarantee for the drop volume system is valid only up from the interface.
- No cable may be longer than 30 m. This applies to power cables as well as data cables.
- Power outlets must comply with common safety prescriptions.
- During the application, you must guarantee sufficient air circulation. For further details, refer to the Installation chapter (see paragraph 6.3.1 "Installation of the Control Unit", page 39).

2.5 Warnings

- Handle the mains cables correctly: Always seize the cable at the plug. Never touch it with wet hands.
- Under no circumstances connect a Schuko-plug (type F, CEE 7/4) with a socket build for an unearthed plug (type C, CEE 7/17). The system would not be grounded.
- The cable should never be squeezed or kinked. Never place the instrumentation (or any other object) on the cable.
- Damaged cables may give rise to fire and danger caused by electricity. Inspect them visually in regular intervals. You should exchange damaged parts at once.
- In the case of a major disturbance, disconnect the equipment immediately from the mains.
- Spare parts not delivered or recommended by the manufacturer could affect the inherent safety of the system. The same problem arises, if the customer attempts to process substances not admitted for the dispensing system.
- Unqualified repair work often causes major damages, sometimes even personal injuries. Therefore, repair is reserved to our Technical Support and authorized subcontractors.
- Before removing the Sensor Bus Cable, the system must be switched OFF.
- For longer interruptions, make sure the power is OFF.
- Before disconnecting the control unit from the mains, make sure the power is OFF.
- Repeatedly powering the system ON and OFF may reduce the lifetime of the power unit.
- Before charging the fluid system with an aggressive, reactive or toxic substance, you have to verify that it is compatible with all of the contacting components inside the system.
- The maximum allowed supply pressure at the cartridge or in the pressure tank should never be exceeded.
- If you use the valve with a heater for the nozzle unit, do not touch it during operations and afterwards only once it had enough time to cool down.
- When cleaning the components in contact with the transported substance, you should place the device in a safe and stable position, without being subjected to vibrations.

2.6 Qualifications of Operators and Maintenance Personnel

The measuring system together with all attached accessories should only be used by competent personnel with an adequate qualification. They must know and understand the content of the manual. We do suppose that the department head is aware of possible dangers, and correspondingly assigns the tasks to persons able to execute their work in a responsible manner.

According to DIN VDE 0105 and IEC 364 qualified personnel refers to members of the team with a sufficient knowledge of relevant norms, directives and rules for prevention of accidents. They need the qualification and experience necessary, so that they are in a position to realize and to prevent possible dangers already at an early stage. Knowledge in First Aid and a direct contact to the local emergency units is required as well.

2.7 Protective Equipment and Safety Clothing

You should always wear suitable protective equipment, whenever handling or dispensing aggressive, reactive or toxic substances. The same is valid in the presence of a high supply pressure.

Safety Clothing	Safety Icon
Safety glasses	
Breathing apparatus	
Overall and gloves resistant to the corresponding chemical fluid	
When you work in the direct vicinity of the MDS for a prolonged period, you should also wear ear protection.	

Tab. 2: Protective Equipment and Safety Clothing

3 General Instructions

This chapter summarizes the content of this manual and contains general information for the user. Some pictures might differ slightly from the actual product.

3.1 How to Use this Manual

- Each step of installation, operation, calibration and cleaning has to be performed in accordance with this manual.
- You can find information about safety aspects and an efficient use of the system in the concerning chapters.
- This manual represents an integral part of the delivery and must be made available to every user working with this system. Always keep it in close vicinity.
- It must be preserved until the end of the lifetime of the system.

3.2 Legend

3.2.1 Danger Levels

Instruction	Possible Consequences
DANGER!	The damage is imminent! If the operating procedure is not strictly observed, this situation may result in death, considerable material damage or environmental contamination.
WARNING!	Warn of a potentially dangerous situation! The danger of death and serious injuring cannot be excluded.
CAUTION!	Cautions about a potential problem! Danger of minor or medium injuries.
IMPORTANT NOTE!	Warns about potential damage to the equipment! An operating procedure which, if not strictly observed, may result in damage to the equipment, unexpected interruptions or shutdown.
INFORMATION!	Supplementary recommendation for an economical and timesaving use of the equipment.

Tab. 3: Danger levels

3.2.2 Illustration Convention

Symbol	Explanation
Step 1: Step 2:	The sequence must be followed in correct order
–	Each step of this sequence is mandatory, none of them should be omitted
	Direction of movement
•	Lists

Tab. 4: Illustration convention

3.2.3 Abbreviations

Abbr.	Full Name
BY	Bayonet
CTK	Cleaning Tool Kit
DVC	Drop Volume Controller
DVD	Drop Volume Detector
DVS	Drop Volume System
FW	Firmware
GUI	Graphical User Interface
MDC	Controller (MicroDispensingControl unit)
MDF	Fluid box (MicroDispensingFluid box)
MDS	MicroDispensingSystem
MDT	Tool (MicrodispensingTool)
MDV	Valve (MicroDispensingValve)
PLC	Programmable Logic Controller
ST	Sample Time

Tab. 5: Abbreviations

3.3 Tools

The following tools are required to install and to operate the DVS:

- MDT 306 - Torque Wrench Tool VM black (Order no. 1015062)
- MDT 327 - Multi-Function Tool (Order no.1014440)
- MDT 329 – L-Shape Hexagon Key 2 mm (Order no.1015081)
- Hexagon Key Set (Order no. 1012993)

When you order tools, always specify the order number of the required item.

IMPORTANT NOTE

No foreign tools

Do not use auxiliary tools or foreign products, otherwise damages to the equipment might be possible.

3.3.1 MDT 327 - Multi-Function Tool

The knobs of the MDT 327 grip into the slots of the tightening screw (gearing VM-A). Other end open-ended wrenches (size 7) and (size 8).	
Intended Purpose: 1. Fixing the tightening screw to the fluid box	

Tab. 6: MDT 327 - Multi-Function Tool (Order no. 1014440)

3.3.2 MDT 329 - L-Shape Hexagon Key 2 mm

The MDT 329 - L-Shape Hexagon Key 2 mm is for hex-screws.	
Intended Purpose: 1. Mounting and demounting the DVD 3x DVD-holder	

Tab. 7: MDT 329 - L-Shape Hexagon Key 2 mm (Order no. 1015081)

3.3.3 Hexagon Key Set

The set includes three hexagon keys (sizes 2, 2.5 and 3) for hex-screws, with blades made of hardened steel and ergonomic grips.	
Intended Purpose: 1. Mounting and demounting the DVD 3x DVD-holder (2)	

Tab. 8: Hexagon Key Set (Order no. 1012993)

3.3.4 MDT 306 - Torque Wrench Tool VM black

The MDT 306 allows you to screw tight screws with an exactly set tightening torque. The value can be adjusted continuously at the torque wrench tool.
 You can order the necessary bits separately or together with the torque wrench as a set in a tool box (MDTS 1 - Torque Wrench Tool Set TA, order no. 1013521). Additional information is in the Quick Reference Guide "Torque Wrench Tool VM MDT 306". You can download it from the VERMES homepage (www.vermes.com). The necessary password you can get from our sales (sales@vermes.com).

Intended Purpose:

1. Screws for DVD-holder
2. Tightening screw



Tab. 9: MDT 306 - Torque Wrench Tool VM (Order no. 1015062)

3.3.5 Torques (in cN.m)

Element	Gearing Profile	Bit Order No.	Torque (cN.m)		Cross Reference
			Min.	Max.	
Screws for cartridge holder MDV 305x (hexagon socket, size 2)		1013294	60	70	Page 35
Screws for cartridge holder MDV 1560 (hexagon socket, size 2)		1013294	50	60	Page 35
Fluid Box Connector DVD (gearing VM-A)		1014519			See tightening screw in respective MDS user manual

Tab. 10: Torques (in cN.m)

4 Control Unit DVC

This chapter contains relevant information about the control unit. It describes the connections and functions of the control unit, as well as the use of the graphical user interface.

4.1 Technical Data

	Value
Dimensions	57.3 mm H x 95 mm W x 107 mm D (see dimensional drawing, Page 103)
Weight	ca. 217.7 g
Supply Voltage	24 V DC
Current Consumption	Max. 500 mA
Ambient Temperature	10 °C - 50 °C
Air Humidity	The relative humidity rH might not surpass 90% (non-condensing).
Casing Type	For DIN rail
Color of Casing	gray, with anthracite-gray bottom
Ventilation	Convection
Reset Button (Top)	1 button
Control Lamps (Top)	1x Status (green/red)
Plug Contacts (Side)	1x RJ45 (Sensor Bus connection with DVD)
Plug Contacts (Top)	1x 3-pin connector for power connection (24 V DC) 2x 9 pin Sub-D RS-232C 2x 15 pin Sub-D PLC 1x Flex IO 7 pin Phoenix Contact MSTBVA connector (<i>not yet functional</i>) 1x Ethernet socket RJ45
Response Time (PLC-interface)	Depends on the connected MDC

4.2 Top Side

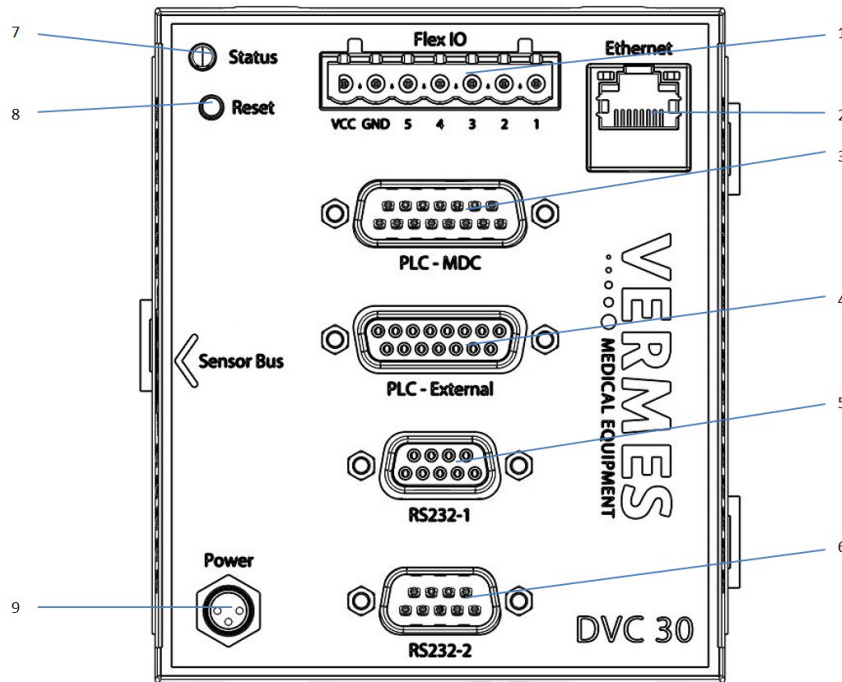


Fig. 1: Top Side

- | | |
|---|--|
| 1 Flex IO (<i>not yet functional</i>) | 6 RS232 to MDC (<i>not yet functional</i>) |
| 2 Ethernet | 7 Status LED |
| 3 PLC to MDC | 8 Reset Button |
| 4 PLC to Client | 9 Power |
| 5 RS232 to Client | |

Flex IO

(Not yet functional)

Ethernet connection:

An Ethernet port is available to provide a web-based user interface. It also supports a Telnet connection for data exchange as an alternative to the RS232-port.

PLC connection to MDC (Sub-D, 15-pin):

Different inputs and outputs may be connected. For the pin assignment, refer to paragraph 8.4, page 84.

PLC connection to client (Sub-D, 15-pin):

Different inputs and outputs may be connected. For the pin assignment, refer to paragraph 8.4, page 84.

RS232 connection to client (Sub-D, 9-pin):

Connects the user's PC to receive data.

RS232 connection to MDC (Sub-D, 9-pin):

(Not yet functional)

Control lamp for status:

This LED indicates the status of the DVC. It lights red during booting and in an error state. It flashes green in normal operation.

Reset button:

By pressing this button, the DVC reboots.

Power supply port:

Connection for 24 V DC 4A power supply (order no. 1014501).

4.3 Side

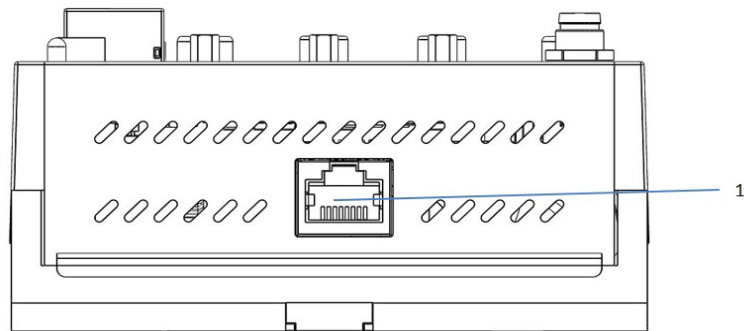


Fig. 2: Side view

1 Sensor Bus connection

Socket for Sensor Bus connection:

The Sensor Bus connects the DVC with the Drop Volume Detector (DVD) at the valve via Sensor Bus connector RJ45.

4.4 Structure of the GUI

The DVS can be controlled via a web-based GUI (= graphical user interface), though it does not provide all the functionalities you can access via terminal commands. As default, the DHCP client is active to get an IP address from the network. If deactivated, the default static IP address is set to 0.0.0.0. Use the terminal command "DVC:SYSTEM:NETWORK:IP <IP Address>" to change the IP address (check with your IT, if you need input on local settings). Once you have started, you are in the graphics screen (see Fig. 3). This chapter describes the different features of the GUI.

Recommended browsers:

- Chrome (131.0.6778.86 or above; 64-Bit)
- Edge (131.0.2903.70 or above; 64-Bit)

INFORMATION

Network protocol

The DVC device supports by default the network management protocol DHCP or a static IP assignment. Please refer to the RS232 commands for further information (see paragraph 8.3.2.2, page 73).

INFORMATION

Use full size of monitor for display

Display errors might occur, if the browser window is reduced in size. Therefore, please use the full size of the monitor. For best results, resolution should be set to 1080p.

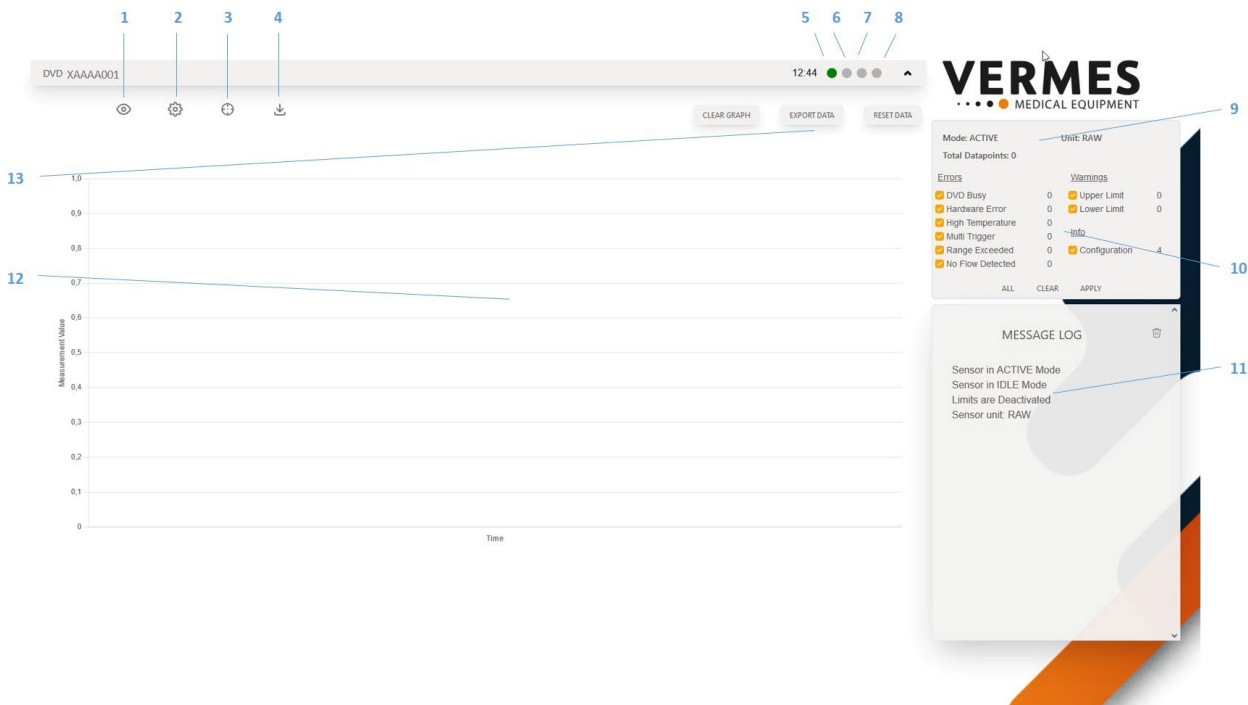


Fig. 3: Starting screen - overview

The screen of the GUI for the DVS consists of the following main elements:

Submenus, status lights, message log with filter function and main screen. The numbers in the explanations refer to the numbers in the figure (see Fig. 3).

Submenus

This section consists of four buttons (see Fig. 4, page 22):

- Graphic (1)
- Configuration (2)
- Calibration (3)
- Firmware Update (4)

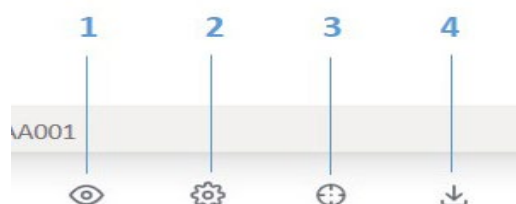


Fig. 4: Starting screen - submenus

Graphic (1)

With this button, you switch back to the graph showing your measurement result.

Configuration (2)

Here you can change the following settings (see Fig. 5, page 23). After making a change, you need to click on "Apply". If you click on "Cancel" instead, the change will not be applied.

- Sensor Mode (Active/Idle)
- Unit (Calibrated/RAW)
- Limits [mg] (Upper limit/Lower limit)
- Sample Time [ms]

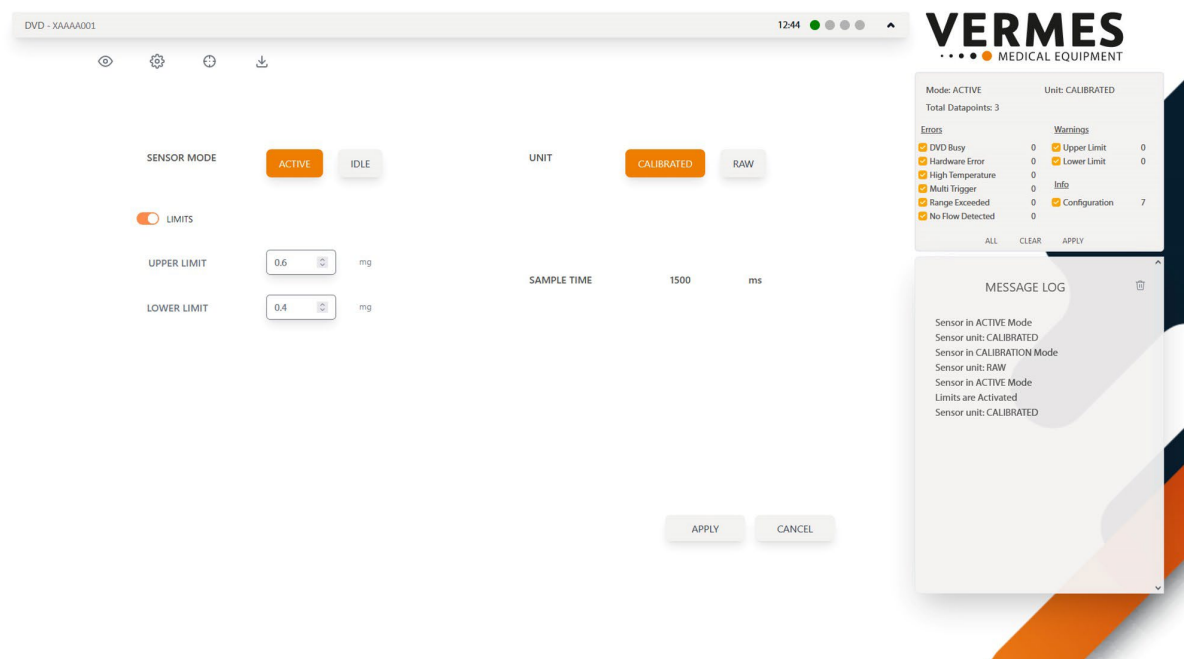


Fig. 5: GUI - Configuration

Calibration (3)

By pressing this button, you start a calibration. You can find all the information about calibration in paragraph 6.4, page 44.

IMPORTANT NOTE

Wait while calibration starts and ends

While the calibration is starting or when it is ended, a few seconds pass before the next entry can be made. Please do not click any buttons during this time.

Also, during calibration some steps may take a moment. You have to wait at each step until the GUI is finished. Do not press any buttons prematurely, or you might cause an error (“General Process Error”). If that happens, you have to re-start the calibration from the beginning.

DVD Firmware Update (4)

Here you can upload a new DVD firmware revision (see Fig. 6). The firmware revisions of the DVC and of the GUI are shown as well, but cannot be updated here in the GUI.

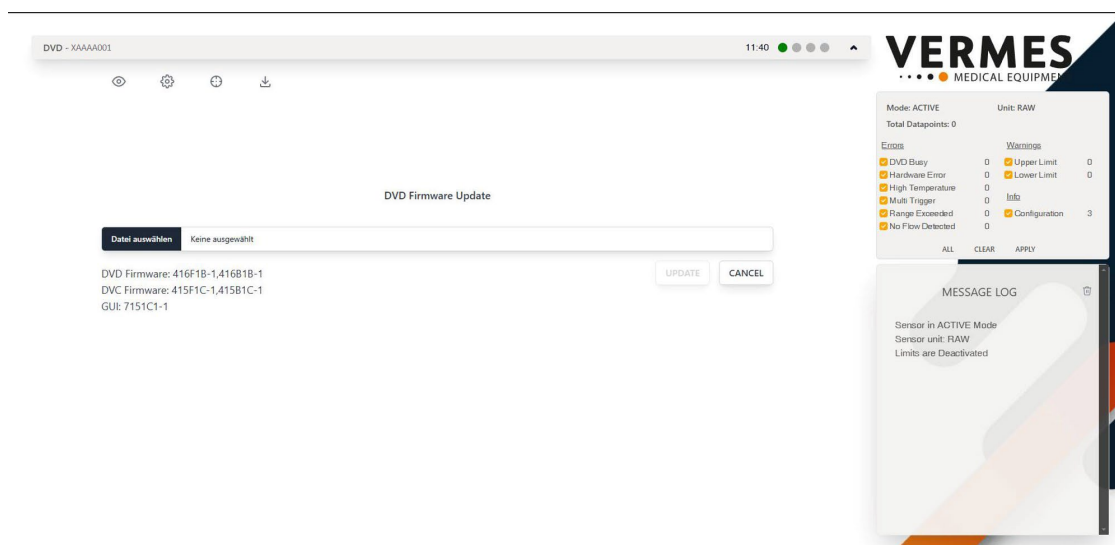


Fig. 6: DVD Firmware update

Status lights

This section consists of four status lights (see Fig. 7):

- Active (green, 5)
- Idle (yellow, 6)
- Calibration (blue, 7)
- Error (red, 8)



Fig. 7: Starting screen – status lights

Active (green, 5)

While the system is active and ready for measuring, this green light is ON. For more information about performing a measurement, see paragraph 7.2, page 60.

Idle (yellow, 6)

While the system is in idle mode, this yellow light is ON. Being in idle mode means, the system waits for further input. No measurement can be performed while in idle mode.

Calibration (blue, 7)

This blue light is ON, while the calibration is running. For more information about the calibration, see paragraph 6.4, page 44.

Error (red, 8)

Whenever there is an error, this red light is ON. For more information about errors, see paragraph 10, page 92.

Messages

This section has three parts (see Fig. 8, page 25):

- Basic setup information (9)
- Message filters (10)
- Message log (11)

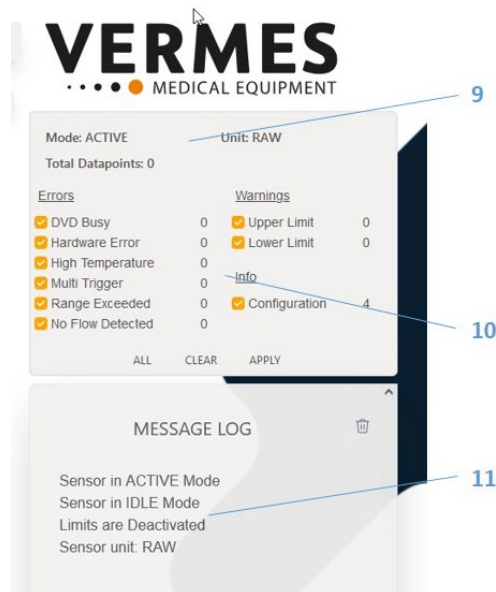


Fig. 8: Starting screen - messages

Basic setup information (9)

Here you can find information about:

- Sensor mode
- Measurement unit
- Total datapoints (counter of trigger-dependent measurements, can be reset)

Message filters (10)

With the message filters you can select, which messages are shown in the message log. Messages fall into the categories error, warning, or info. Only the selected events will be displayed in the message log (see Fig. 9 and see Fig. 10, page 26). Next to each event is a counter that shows the number of times an event has occurred.

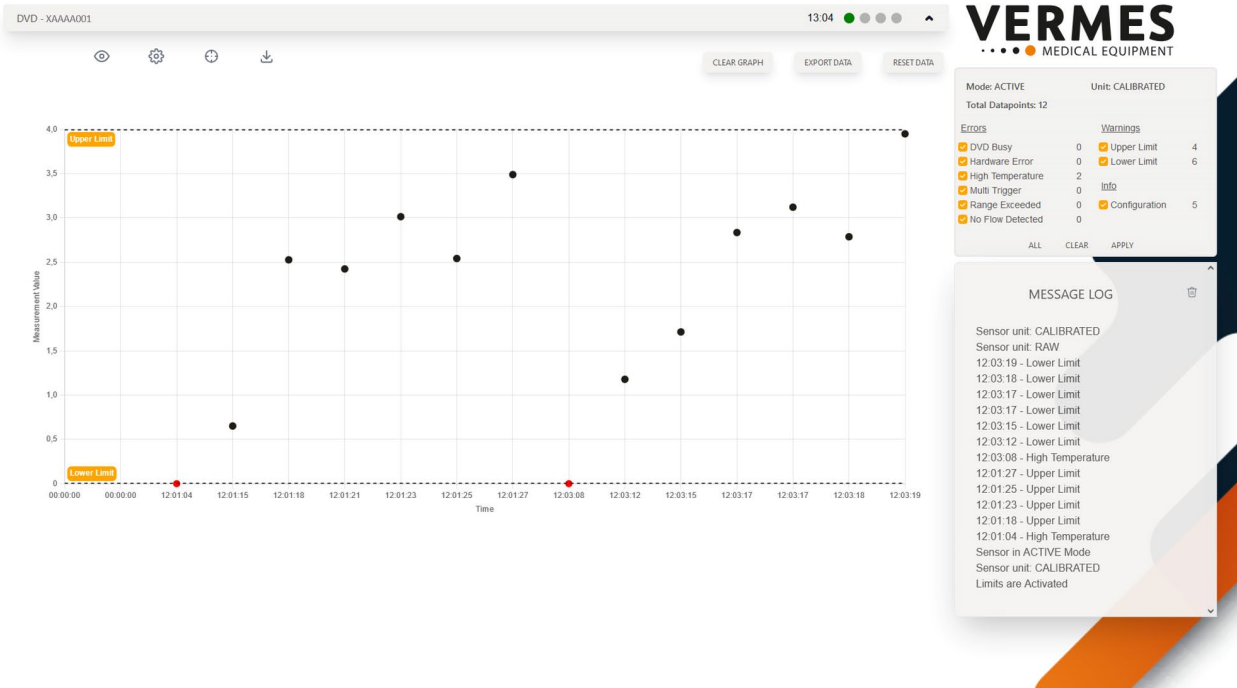


Fig. 9: Message Log – all messages activated

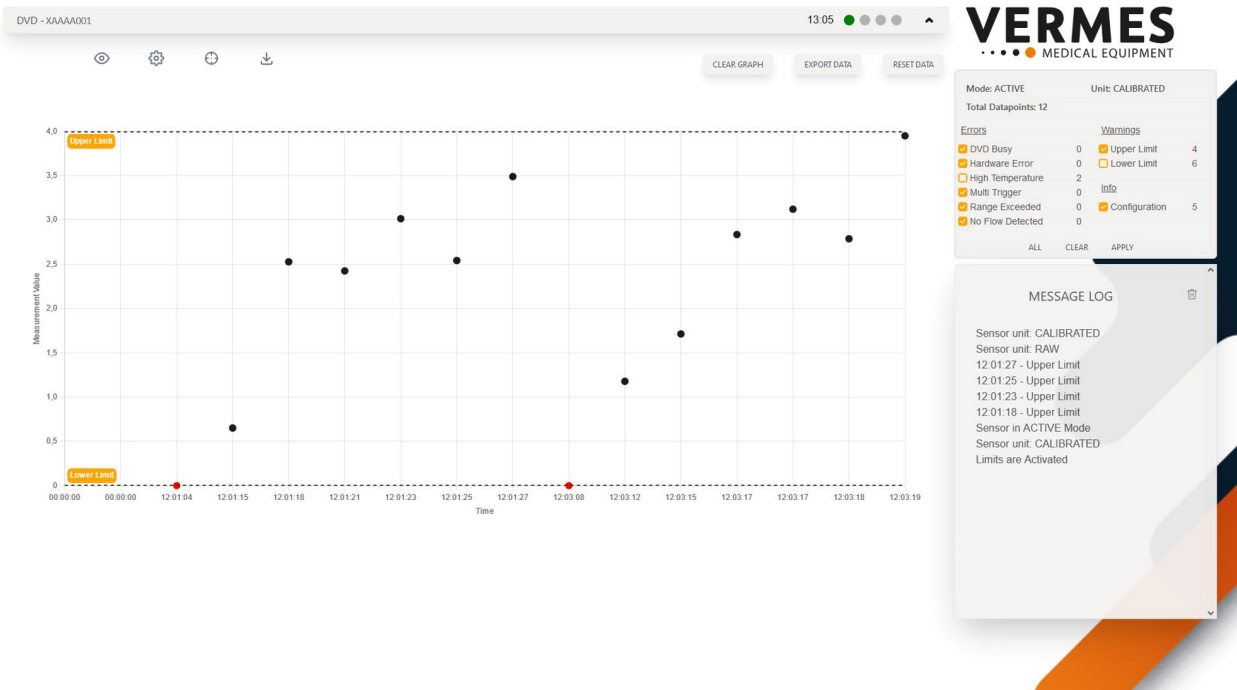


Fig. 10: Message Log – some messages deactivated

Message log (11)

This log shows the latest error, warning, and info messages. The selection of messages shown depends on the settings in the message filters (10).

Main screen

The main screen (12) either shows a graph with the current data (e.g. for measurements or calibration, see Fig. 11) or important pop-up information. In the starting screen, the graph shown is empty, since there is not yet any data available.

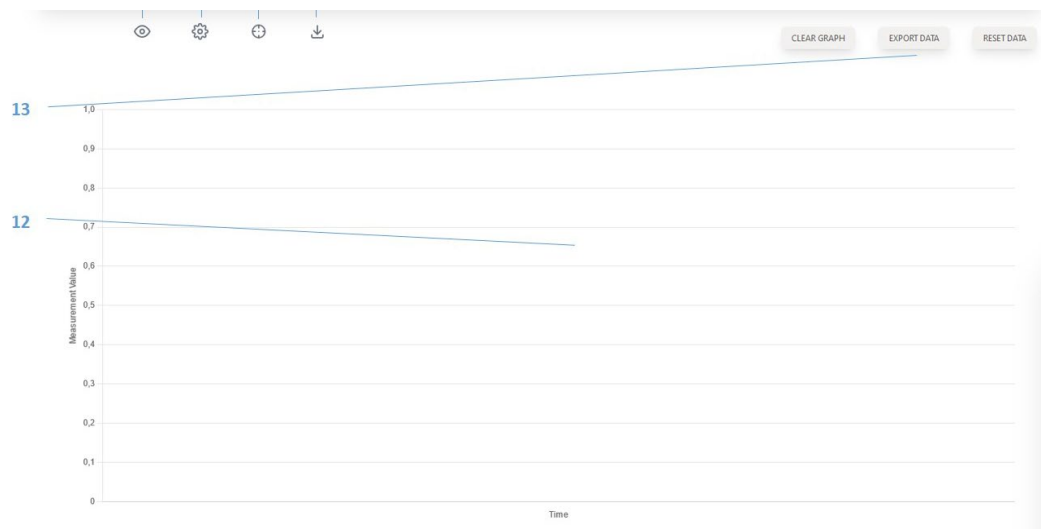


Fig. 11: Starting screen – main screen

You have three tools (13) available while working on the main screen:

- Clear Graph
- Export Data
- Reset Data

Clear Graph

You can use this button to clear the graph. This is just presentational. The data in the memory will not be deleted by clearing the graph (to delete data, use the button “Reset Data”, see below).

Export Data

You can use this button to export the measurement data into a csv-file (for an example, see Fig. 12, page 28). Each line in the csv-file contains a time stamp, the measurement value and the tag (type of event/message).

Time	Value	Tag
11:52:41	0.1585	NO_LIMITS_CHECK
11:52:42	0.1617	NO_LIMITS_CHECK
11:52:43	0.1624	NO_LIMITS_CHECK
11:52:44	0.154	NO_LIMITS_CHECK
11:52:44	0.1397	NO_LIMITS_CHECK
11:52:45	0.1923	NO_LIMITS_CHECK
11:52:45	0.16	NO_LIMITS_CHECK
11:52:45	0.1634	NO_LIMITS_CHECK
11:52:46	0.1867	NO_LIMITS_CHECK
11:52:46	0.1599	NO_LIMITS_CHECK
11:52:46	0.151	NO_LIMITS_CHECK
11:52:46	0.1492	NO_LIMITS_CHECK
11:52:47	0.1625	NO_LIMITS_CHECK
11:52:47	0.1772	NO_LIMITS_CHECK
11:52:47	0.1847	MULTI_TRIGGER
11:52:48	0.1439	NO_LIMITS_CHECK
11:52:48	0.1521	NO_LIMITS_CHECK
11:52:48	0.1658	MULTI_TRIGGER
11:52:48	0.1467	NO_LIMITS_CHECK
11:52:49	0.1799	NO_LIMITS_CHECK
11:52:49	0.1675	NO_LIMITS_CHECK
11:52:49	0.1258	NO_LIMITS_CHECK
11:52:49	0.1309	NO_LIMITS_CHECK
11:52:53	0.1588	NO_LIMITS_CHECK

Fig. 12: Data Export - Example

Reset Data

You can use this button to reset the measurement data. Errors in the message log will **not** be deleted.

5 Drop Volume Detector

This chapter contains relevant information about the Drop Volume Detector. It describes the structure and the basic configuration, as well as the specific features of the device relevant for this user manual. For a view from different angles, see Fig. 13.



Fig. 13: DVD 31 – from different angles

5.1 Composition of the Detector

The drop volume detectors of Vermes Medical Equipment are modular. A detector has four main components:

- Base unit (1)
- Fluid Box Connector DVD (with O-ring, 2)
- DVD-holder (variant) (3)
- Cartridge holder DVD (variant) (4)

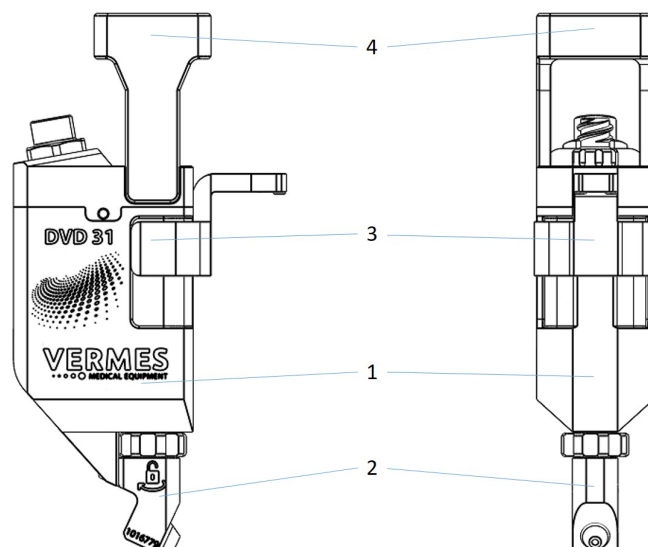


Fig. 14: Composition

The base unit (1) is the core of the DVD. The cartridge is screwed onto the luer lock connector on top of the base unit. On the front of the DVD base unit is a status LED, which can show the colors green (ready for use), yellow (idle mode), red (hardware error) or blue (calibration mode). For more details about the LEDs, see Tab. 11.

The Fluid Box Connector DVD (2) will be placed into the fluid box body, instead of the cartridge base that would usually sit there.

There are different variants of the DVD-holder (3), depending on the microdispensing valve (MDV) you are using. You need the DVD-holder to attach the DVD to the MDV.

There are different variants of the Cartridge holder DVD (4), depending on the size of the cartridge. Possible sizes are 3 ccm, 5 ccm, 10 ccm and 30/55 ccm.

LED Color	LED mode	Explanation
Blue	Permanently lit	DVS in calibration mode
Blue	Flashing	DVS initialization
Yellow	Permanently lit	DVS in quiet mode
Yellow	Flashing	DVS in idle mode
Green	Permanently lit	DVS in active mode
Green	Flashing	During firmware update
Red	Flashing	Hardware error

Tab. 11: LEDs of the DVD

5.2 Explosion View DVD

The explosion view shows a DVD 31 as an example. The other compatible DVD models are built similarly.

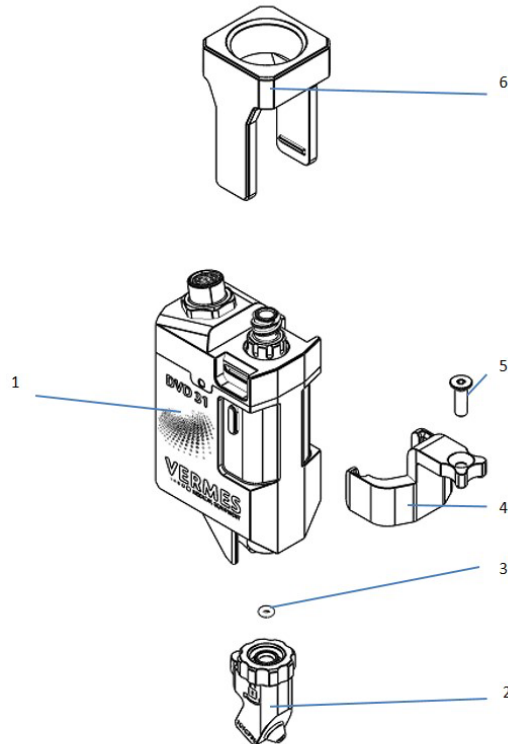


Fig. 15: Explosion view DVD

- | | |
|----------------------------------|----------------------------------|
| 1 Base unit | 4 DVD-holder (variant) |
| 2 Fluid Box Connector DVD | 5 Screw for DVD-holder |
| 3 O-Ring for Fluid Box Connector | 6 Cartridge holder DVD (variant) |

5.3 Technical Data

Parameter	Value
Dynamic Viscosity of Fluids	Low to medium viscosity up to 12500 mPas
Compatibility	Fluids of low to medium viscosity up to 12500 mPas (e.g. aqueous solutions, organic solvent based solutions, oils, alcohols, paints UV adhesives etc.)
For drop sizes	approx. nl to µl range
Ambient Temperature	10 °C - 50 °C
Air Humidity	The relative humidity rH might not surpass 90% (non-condensing).
Max. allowed pressure for DVD	12 bar (but also be aware of any limits your cartridge might have)
Dimensions (basic model)	70.4 mm x 26 mm x 40 mm
Weight	ca. 65 g (depending on configuration)
Control Lamp (Front)	1x Status (red, green, yellow, blue)
Plug Contact (Top)	1x Sensor Bus M8 8-pin connector (connection with DVC)

5.4 Detector Types

Compatible with the DVC 30 are drop volume detectors of the following series.

- DVD 31 (low flow)
- DVD 32 (high flow)

This is a complete list.

- DVD 31 (Order no. 1016739)
- DVD 32 (Order no. 1016319)

Which type is best suited for your application? This depends mainly on the media flow in your application. With a low media flow, DVD 31 is more precise. With a higher media flow, maybe the DVD 32 is better suited for your application. If in doubt, please contact our Technical Support to find the best solution for your needs.

6 Initial Operation

6.1 Delivery

VERMES systems are shipped in carefully packed state. Transport damages however can never be totally excluded, and deadlines stated in insurance contracts should not be exceeded.

6.1.1 Unpacking

After receiving the merchandise:

- Check the package visually for any kind of damage.

If yes:

Detected damages must be notified to the carrier. As soon as the complaint has been confirmed in writing, contact the responsible forwarder and inform VERMES Medical Equipment.

If no damage is detected:

- Open the package.
- Remove any contained subcomponents and parts of the drop volume system from the package and check the delivery for completeness.

6.1.2 Content

According to the purchase order, the following components may be included; some of them are already preassembled:

1 Drop Volume Control unit DVC	5 DVD-holder*
2 Drop Volume Detector DVD	6 Power Supply
3 Fluid Box Connector DVD*	7 Sensor Bus Cable 5 m*
4 Cartridge holder DVD*	

*These parts are included only, if ordered explicitly.



Fig. 16: Content

Options	Recommended options
Different models of cartridge holders (depending on cartridge) Different models of DVD-holders (depending on MDV)	Cleaning set

If the intended application needs particular accessories (e.g. seals made of special material), consult our Technical Support at once (see Page 6). Do not start the system in incomplete state.

6.2 First Assembling of the DVD

This chapter describes how to mount your drop volume detector onto the valve.

INFORMATION

Different types of MDVs and cartridges

There are different types of compatible MDVs, where slightly different DVD-holders are necessary. The principle how to mount them is always similar to the example pictured below (which is with the MDV 3050). The same is true for the different cartridge sizes and the respective cartridge holders.

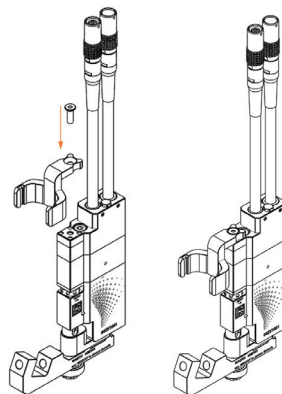
Proceed as follows:

Step 1 (Fasten the DVD-Holder)

Push the DVD-Holder onto the valve. Fasten the holder by screwing in the screw with the MDT 329.

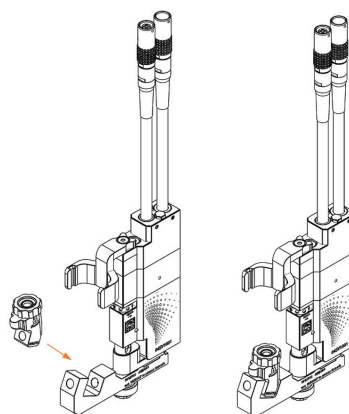
Important Note!

Never use a DVD without the DVD-Holder. The results would not be stable and you would risk damage to your system.



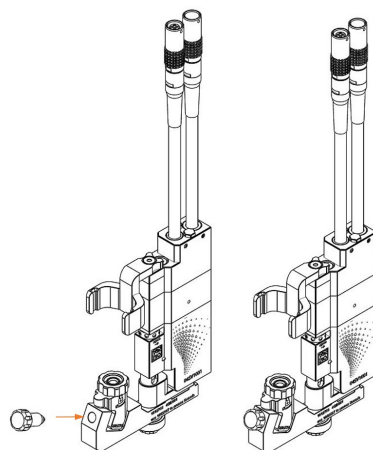
Step 2 (Place the Fluid Box Connector DVD in the Fluid Box Body)

Place the Fluid Box Connector DVD in the fluid box body.



Step 3 (Fasten the Fluid Box Connector DVD with the Tightening Screw)

Use MDT 327 - Multi-Function Tool to screw in the tightening screw.

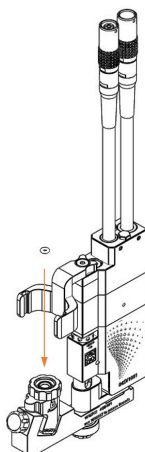


Step 4 (Insert the O-Ring)

Place the O-Ring-F in the Fluid Box Connector DVD. Make sure the O-Ring-F is placed flat.

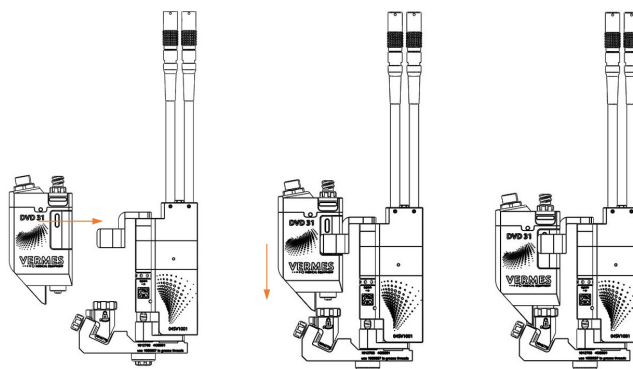
Important Note!

The O-Ring-F is available in different versions (see paragraph 12.1, page 99). Make sure the O-Ring-F material is compatible with your intended dispensing medium.



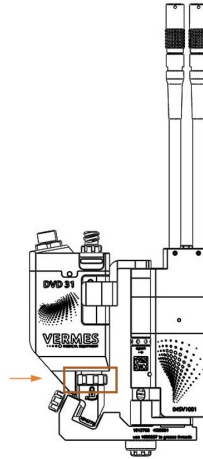
Step 5 (Mount the DVD)

Push the DVD into the DVD-Holder. Push the DVD down onto the Fluid Box Connector DVD.



Step 6 (Lock the DVD on the valve)

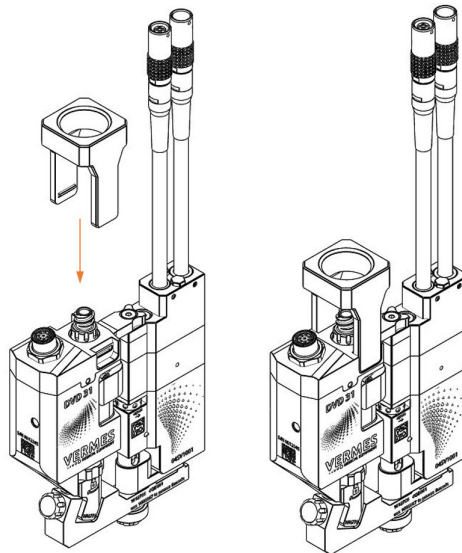
Close the connection and lock it by turning the union nut.

**Step 7 (Fasten the Cartridge holder)**

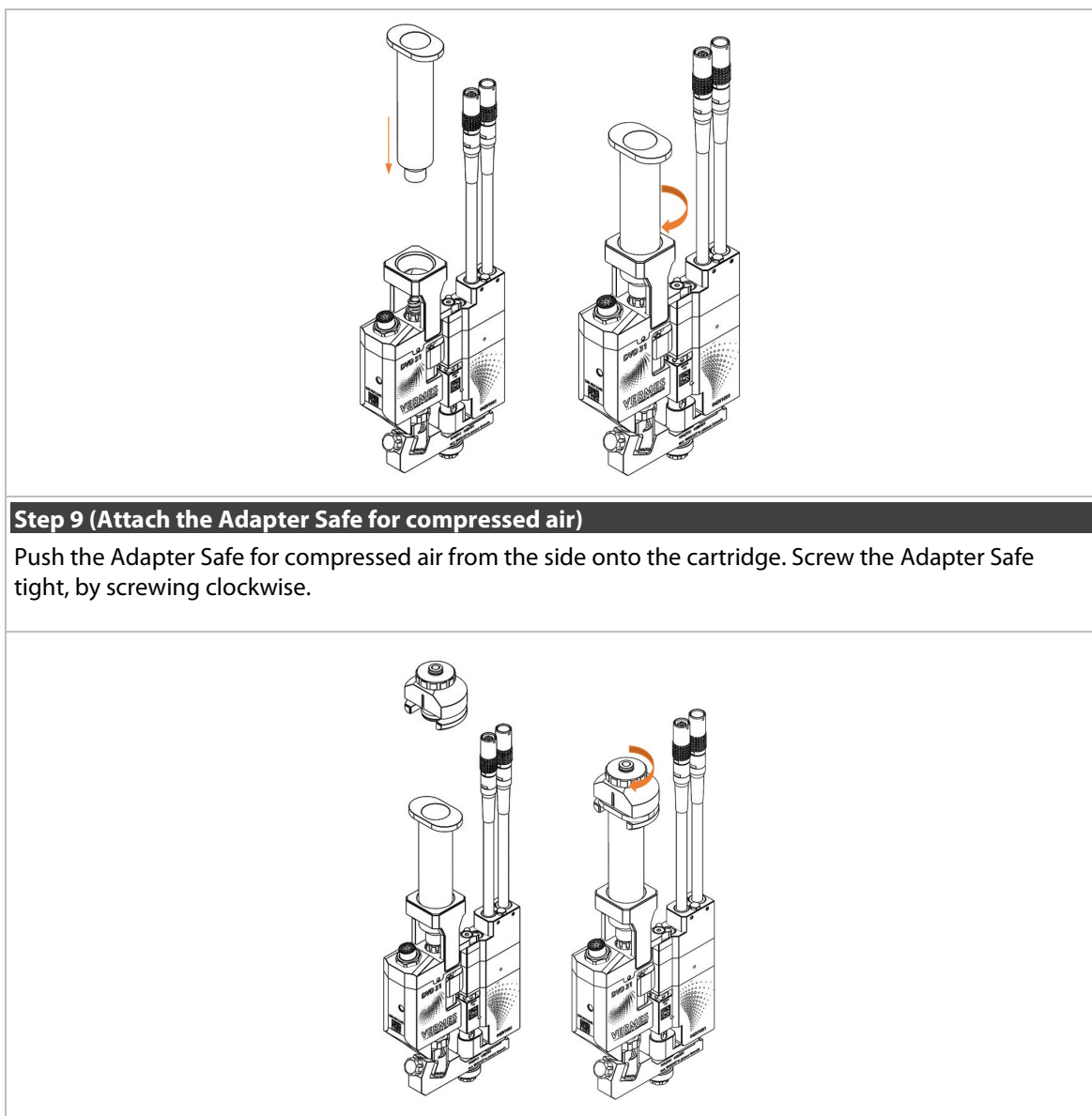
Push the Cartridge Holder DVD onto the DVD, until the extensions of the holder snap into the grooves of the DVD.

Important Note!

Be careful with handling the cartridge holder extensions. Do not bend them apart too strongly, since then the extensions could break.

**Step 8 (Insert the cartridge)**

Push the cartridge into the Cartridge Holder DVD. Screw it clockwise onto the Luer Lock connection.



Step 9 (Attach the Adapter Safe for compressed air)

Push the Adapter Safe for compressed air from the side onto the cartridge. Screw the Adapter Safe tight, by screwing clockwise.

Tab. 12: First assembling of the DVD

6.3 Installation of the Drop Volume System

This chapter describes how to prepare your drop volume system for the first measuring session.

Prior to installation, verify the conditions in the intended location with respect to the specification of the system and information detailed in this chapter.

The control unit and the detector have to be installed strictly in conformity with the procedures described below. The system requires:

- Power supply

INFORMATION

Read chapter “Safety Notes” first

The entire procedure of installation is reserved to persons reliably informed about the safety considerations (see chapter 2, page 7).

6.3.1 Installation of the Control Unit

The control unit is designed to be installed on a DIN rail. Leave sufficient space around the unit to simplify service. Ventilation should be available. Recommended are cases complying with enclosures according to EN 61010-1 with regard to fire protection.

To avoid overheating ensure proper ventilation, a minimum distance between the control unit and any other object should be maintained (at least 1.5 cm). Heat should neither be accumulated nor externally be introduced. Do not obstruct natural convection.

6.3.2 Wiring of the DVS

The DVD is connected to the control unit by means of the Sensor Bus Cable.

CAUTION

Plan your cable connections carefully

Make sure to plan your cable run carefully, when considering the wiring, especially if the microdispensing valve is included into a more complex system. Your cables cannot hang too loose, since then they might start to swing and be damaged, because of the vibrations of the valve. On the other hand, you need enough length in your cables, if the valve is moved.

IMPORTANT NOTE

Cable length

No cable may be longer than 30 m. This applies to power cables as well as data cables.

For a connection diagram, showing all the different connections, see Fig. 26, page 43.

6.3.2.1 Connecting the Sensor Bus Cable with the DVC

Plug the RJ45 at one end of the Sensor Bus Cable into the Sensor Bus connection at the side of the DVC.



Fig. 17: DVC without any connection cables

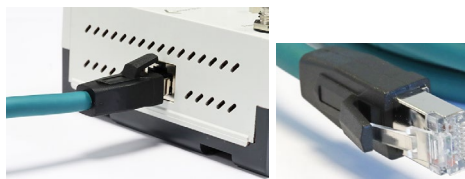


Fig. 18: Sensor Bus Cable plugged into DVC (and RJ 45 plug)

6.3.2.2 Connecting the Sensor Bus Cable with the DVD

Plug the M8 connector at the other end of the Sensor-Bus Cable into the connection at the DVD and screw it tight.



Fig. 19: Sensor Bus Cable plugged into the DVD (and M8 plug)

6.3.2.3 Connecting the DVC PLC-Connection with the MDC

Connect the MDC with a 15-pin SUB-D PLC cable to the PLC to MDC-Connector on top of the DVC (see also Page 18, 3).

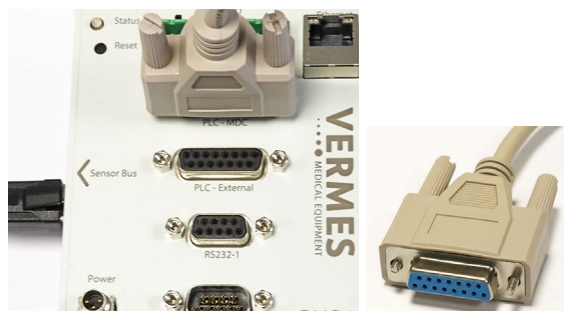


Fig. 20: PLC connection to MDC (and female 15-pin SUB-D plug)

6.3.2.4 Connecting the DVC PLC-Connection with the client PLC/Machine

Connect the PLC/machine with a 15-pin SUB-D PLC cable to the PLC to MDC-Connector on top of the DVC (see also Page 18, 4).



Fig. 21: PLC connection to PLC/machine (and male 15-pin SUB-D plug)

6.3.2.5 Connecting the DVC RS232-Connection with the PC/Machine

Connect the PLC/PC with a RS232 cable to the DVC at the connector named "RS232-1" (see also Page 18, 5).

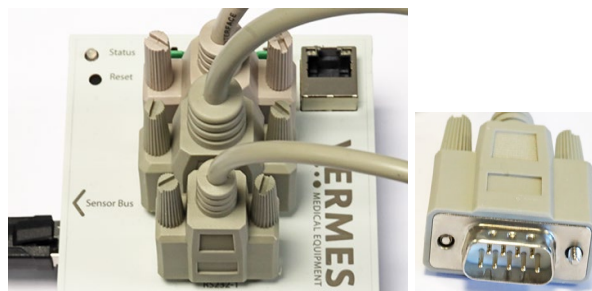


Fig. 22: RS232 connection to PC/machine (and male 9-pin SUB-D plug)

6.3.2.6 Connecting the Ethernet Connection with the PC/Machine

Connect the PC/machine with an Ethernet cable to the Ethernet connector on top of the DVC (see also Page 18, 2).

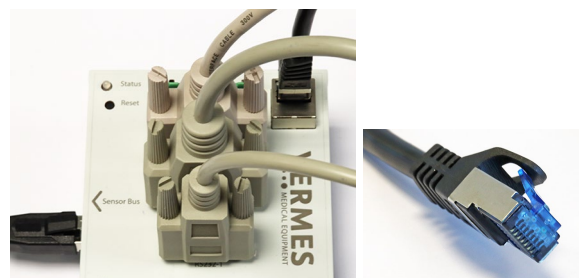


Fig. 23: Ethernet connection to PC/machine (and plug)

6.3.2.7 Power Supply

Power to the control unit is supplied by the 24 V DC power supply (order no. 1014501, Power Supply 24 V 4 A, see Fig. 24).



Fig. 24: Power Supply 24 V 4 A

- Step 1: Plug the cable from the power supply into the socket at the top of the control unit (see also Page 18, 9).

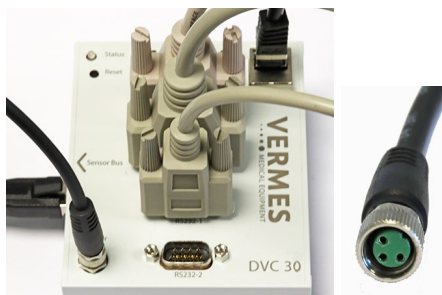


Fig. 25: Power supply plugged in at DVC (and female 3-pin plug)

- Step 2: Connect the power supply with your mains.

6.3.2.8 Connection Diagram

The following connection diagram shows as an example all the necessary connections for the DVS 3x with an MDS 3050.

Connection Diagram DVS 3x with MDS 3050

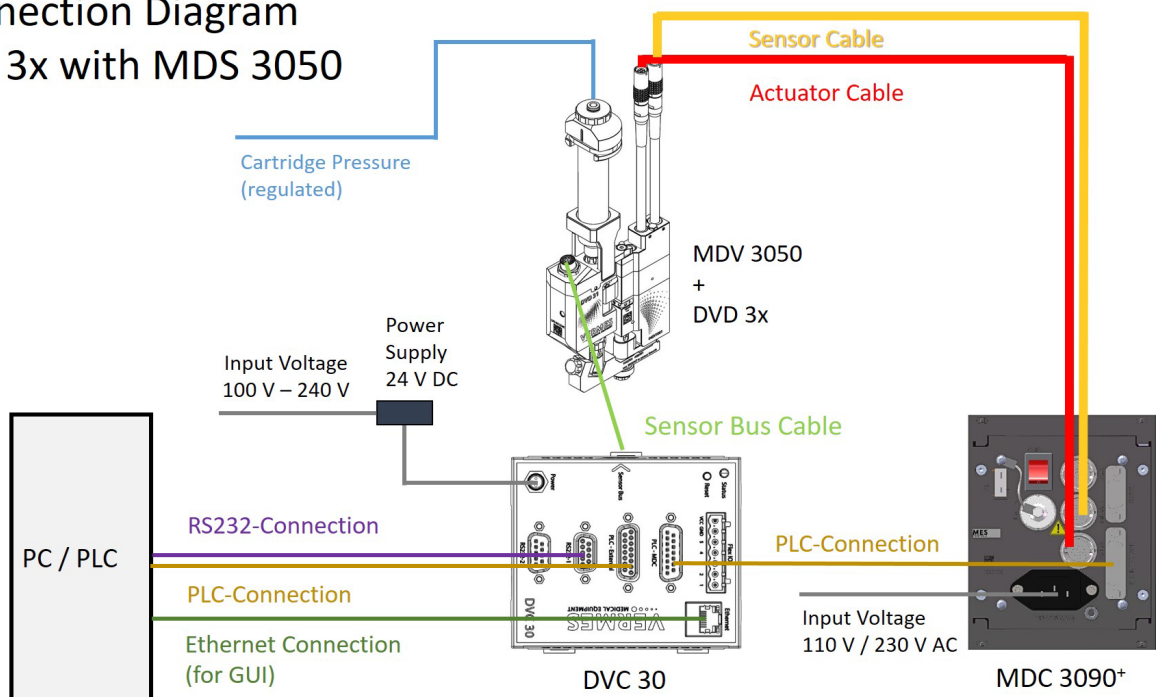


Fig. 26: Connection diagram DVS 3x with MDS 3050

6.4 The Calibration Process

This chapter explains the calibration process. It starts with the basics, then describes how to perform the calibration via GUI or via terminal commands and how to interpret the results.

6.4.1 Basics of the Calibration Process

This paragraph explains the basic facts about the calibration process. A thorough calibration is the basis for accurate drop volume measurements. The process-dependent calibration is necessary to convert the initially acquired, trigger-dependent raw value of the sensor (RAW) into a utilizable unit (e.g. mass, UNIT). Recalibration is necessary for the following events:

- Change of dispensing parameters
- Change of medium
- Adjust of the MDV used
- Unusual deviations in the measurement results

For the calibration, a measurement is taken at three slightly different cartridge pressure values. We recommend to use the planned working pressure point for the application, and values approx. 10% above and below this pressure point.

IMPORTANT NOTE

Pressure values

For a good calibration result, the three pressure values should be as different as possible. But on the other hand, the pressure range is limited, since the system needs to be able to dispense cleanly at each of the three pressure values. You should make a dispensing test with all three pressure values before you start the calibration, to be sure that they work fine.

Also, be aware of the information about flow resistance in paragraph 7.2, page 60.

At the beginning of the calibration, you have to set the following four parameters.

- Sample time (ms)
- Trigger delay (ms)
- Trigger count
- Medium (water-based or non water-based)

The following paragraphs explain these parameters and their importance.

Sample time

The sample time is the time the system takes to gather the information for one data point. In single shot mode, it should be long enough to collect all the information from a single dispense event, and short enough so that the next dispense is started after the first measurement.

The potential range is from 1 ms to 60000 ms (default value is 100 ms).

Recommended sample time

The system allows you to ask for a recommended sample time for your setup. In most applications, this recommendation will be okay to work with. In applications, where accuracy is very important, you can use the recommended value as a starting point, from where to find your own sample time with the help of manual tests. Getting a recommendation takes approx. 60 s.

Trigger delay

The trigger delay is the time span between the Sample Time's end and the beginning of the next trigger.

Trigger count

This is the number of triggers generated for each calibration step.

Medium

Dispensing media behave very differently, depending on if they are water-based or non water-based (default is non water-based). Therefore, it is important to enter this information correctly. Also, your medium should be free of air bubbles.

IMPORTANT NOTE**Compatible dispensing media**

Before you start a calibration, make sure your dispensing medium is compatible with the materials of the drop volume system. For a list of wetted materials, see paragraph 7.1, page 59.

INFORMATION**Noise band**

The detector will always have a slight background noise. It is a sign for problems, if a significant number of data points fall within the noise band.

6.4.2 Performing the Calibration Process

This paragraph explains how to perform the calibration. You can perform the calibration either via the GUI or via terminal commands. This chapter first shows how to perform the calibration via the GUI (see paragraph 6.4.2.1, page 45). Then it shows how to perform the calibration via terminal commands (see paragraph 6.4.2.2, page 53).

6.4.2.1 Performing the Calibration via the GUI**Calibration via the GUI****Preparations for the calibration:**

- Make dispensing tests with all three pressure values you intend to use, to make sure you can dispense cleanly in all three settings. Find new pressure values, in case they do not work as planned.
- Make sure the microdispensing system is adjusted and has the correct parameter set (but is not dispensing currently).
- To optimize the calibration result, switch on the medium filled DVD and wait for approx. 20 minutes, before you start the calibration.

Important Note!

Some steps may take a moment. You have to wait at each step until the GUI is finished. Do not press any buttons prematurely, or you might cause an error ("General Process Error"). If that happens, you have to re-start the calibration from the beginning.

Information!

In case you want to cancel the calibration, you need to press the button "Cancel".

The DVD will switch to idle mode, with unit RAW. The DVC switches back to standard mode. The PLC trigger input of the DVC is not blocked anymore. You will then have re-start the calibration from the beginning!

Step 1 (starting the calibration):

You start the calibration by pressing the button "Calibration". The DVD and DVC switch to calibration mode and any external trigger signals are blocked.

In the new menu, you set the following parameters:

- Sample time (ms)
- Trigger delay (ms)
- Trigger count
- Medium (water-based or non water-based)

You have to mark, that the reference measurement system is ready and MDC parameters are set correctly. Then you click on the button "Continue".

Important Note!

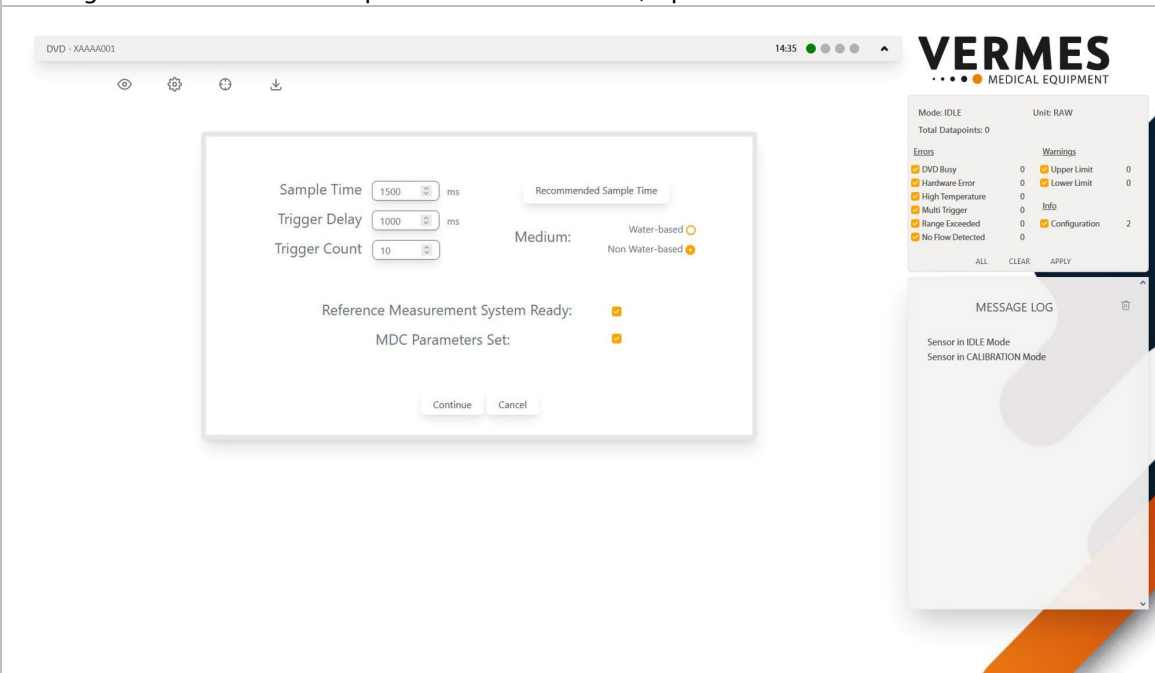
While the calibration is starting or when it is ended, a few seconds pass before the next entry can be made. Please do not click any buttons during this time.

Information!

You can ask for a recommended sample time by pressing the button "Recommended Sample Time". This starts the evaluation of the recommended sample time which takes about 1 minute.

Information!

Starting a calibration deletes all previous calibration data, if present.



Step 2 (set pressure for first calibration set point):

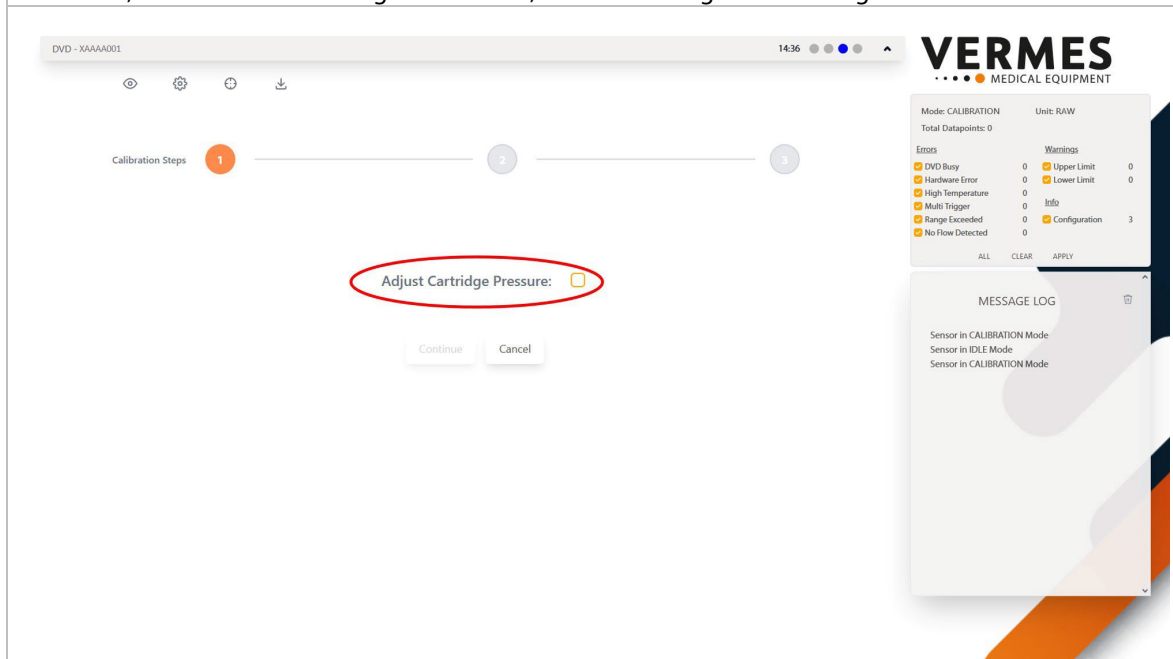
The message "Adjust Cartridge Pressure" appears. Set the pressure for the first calibration set point.

Important Note!

For a good calibration result, the three pressure values should be as different as possible. But on the other hand, the pressure range is limited, since the system needs to be able to dispense cleanly at each of the three pressure values.

Information!

In the GUI, the blue calibration light is now ON, instead of the green status light.

**Step 3 (confirm the pressure for the first calibration set point):**

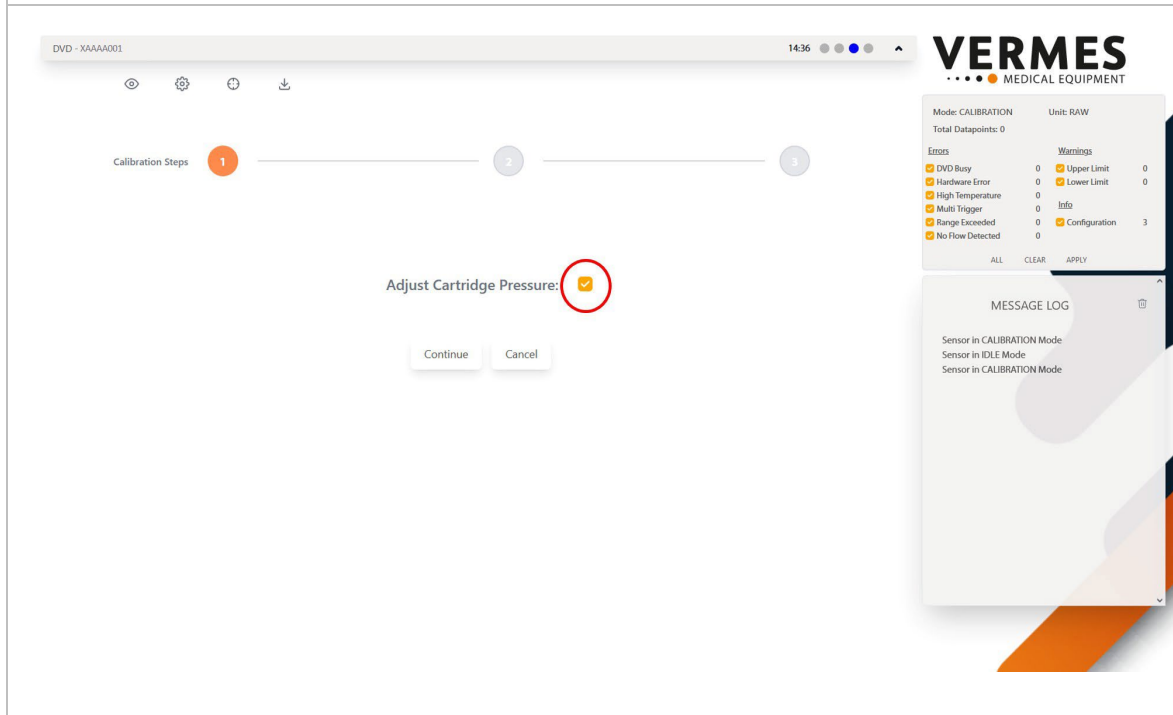
Confirm the correct pressure by ticking the box and click on "Continue".
The DVD initiates the trigger.

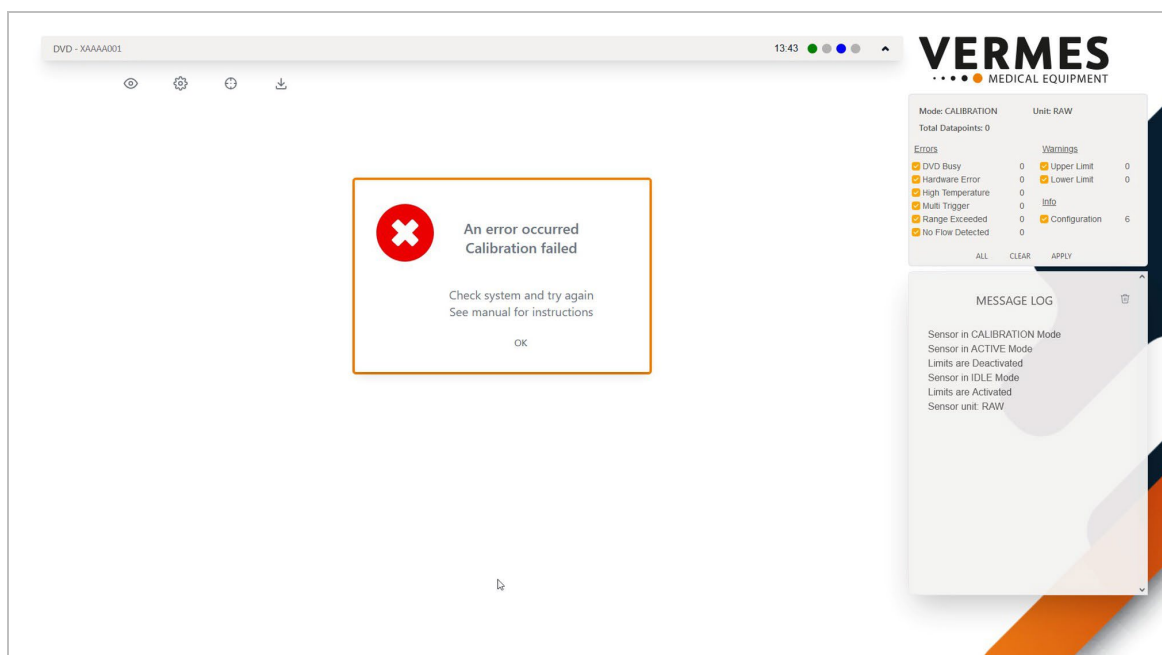
Information!

In case of an error, the DVD sends a message:

"An error occurred – Calibration failed" (see second picture below)

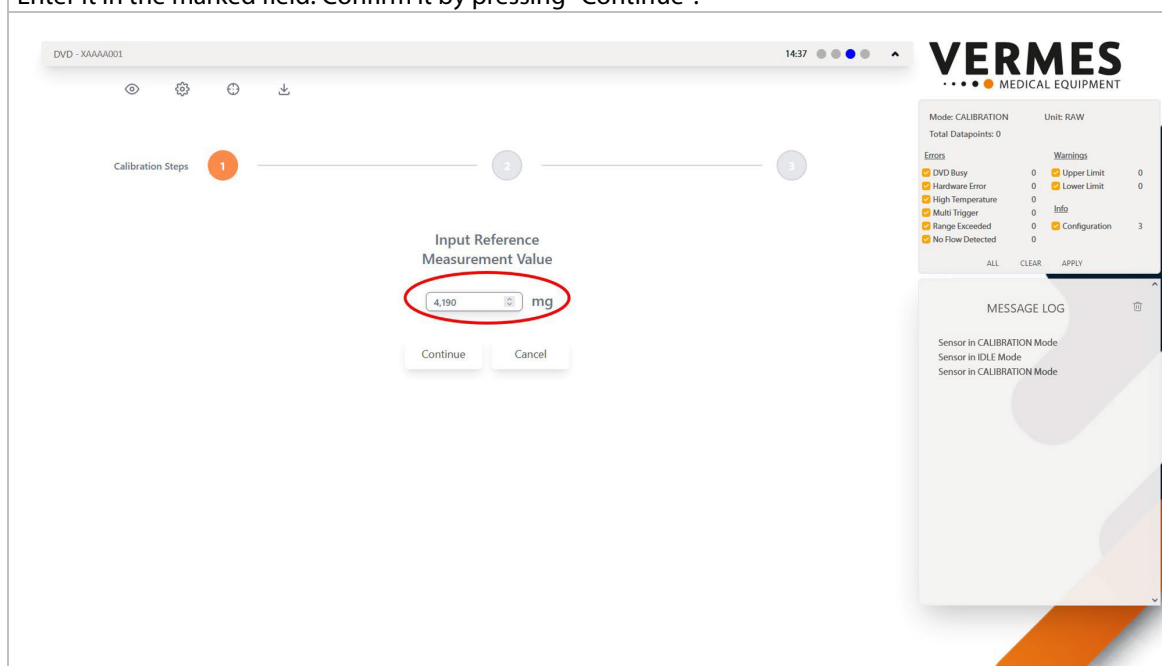
The DVD switches back to idle mode and the DVC switches to standard mode.





Step 4 (enter RMV for first calibration set point):

The system now asks for the Reference Measurement Value (RMV) for the first calibration set point. Enter it in the marked field. Confirm it by pressing "Continue".

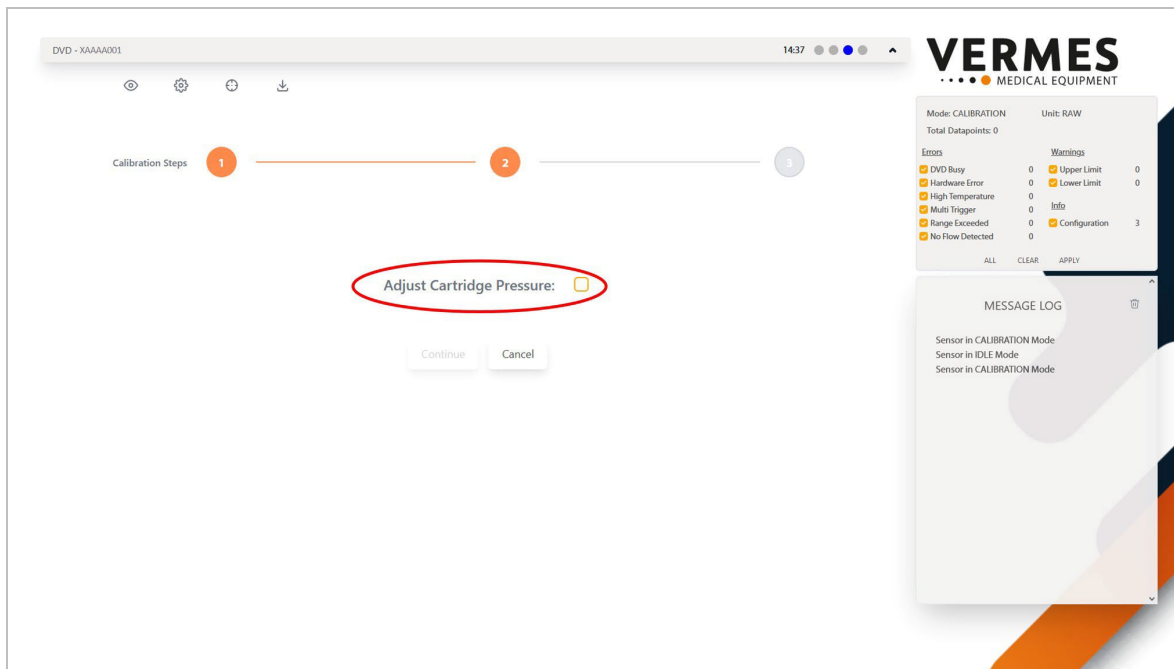


Step 5 (set pressure for second calibration set point):

The message "Adjust Cartridge Pressure" appears. Set the pressure for the second calibration set point.

Important Note!

For a good calibration result, the three pressure values should be as different as possible. But on the other hand, the pressure range is limited, since the system needs to be able to dispense cleanly at each of the three pressure values.


Step 6 (confirm the pressure for the second calibration set point):

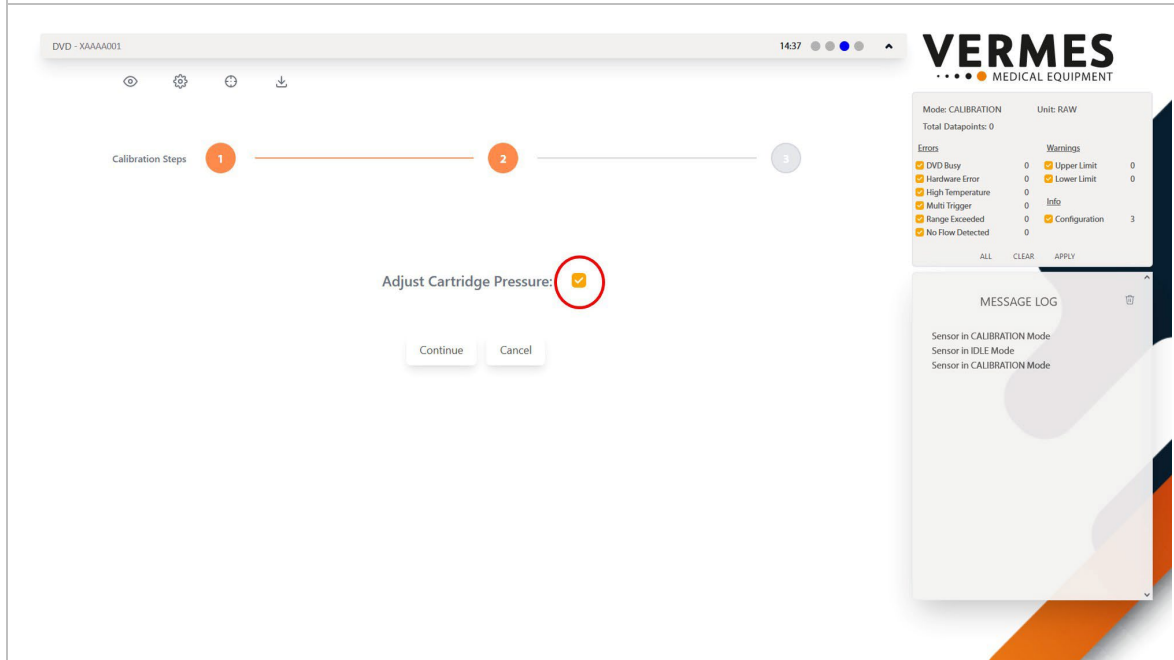
Confirm the correct pressure by ticking the box and click on “Continue”.
The DVD initiates the trigger.

Information!

In case of an error, the DVD sends a message:

CAL: Calibration process error <X>, exit calibration mode

The DVD switches back to idle mode and the DVC switches to standard mode.


Step 7 (enter RMV for second calibration set point):

The system now asks for the Reference Measurement Value (RMV) for the second calibration set point.
Enter it in the marked field. Confirm it by pressing “Continue”.

DVD - XAAAA001 14:38

Calibration Steps 1 2 3

Input Reference Measurement Value

4.804 mg

Continue Cancel

VERMES
MEDICAL EQUIPMENT

Mode: CALIBRATION Unit: RAW
Total Datapoints: 0

Errors	Warnings
☒ DVD Busy	☐ Upper Limit 0
☒ Hardware Error	☐ Lower Limit 0
☐ High Temperature	☐ Info
☒ Multi Trigger	☐ Configuration 3
☒ Range Exceeded	☐
☒ No Flow Detected	☐

ALL CLEAR APPLY

MESSAGE LOG

Sensor in CALIBRATION Mode
Sensor in IDLE Mode
Sensor in CALIBRATION Mode

Step 8 (set pressure for third calibration set point):

The message "Adjust Cartridge Pressure" appears. Set the pressure for the third calibration set point.

Important Note!

For a good calibration result, the three pressure values should be as different as possible. But on the other hand, the pressure range is limited, since the system needs to be able to dispense cleanly at each of the three pressure values.

DVD - XAAAA001 14:38

Calibration Steps 1 2 3

Adjust Cartridge Pressure:

Continue Cancel

VERMES
MEDICAL EQUIPMENT

Mode: CALIBRATION Unit: RAW
Total Datapoints: 0

Errors	Warnings
☒ DVD Busy	☐ Upper Limit 0
☒ Hardware Error	☐ Lower Limit 0
☐ High Temperature	☐ Info
☒ Multi Trigger	☐ Configuration 3
☒ Range Exceeded	☐
☒ No Flow Detected	☐

ALL CLEAR APPLY

MESSAGE LOG

Sensor in CALIBRATION Mode
Sensor in IDLE Mode
Sensor in CALIBRATION Mode

Step 9 (confirm the pressure for the third calibration set point):

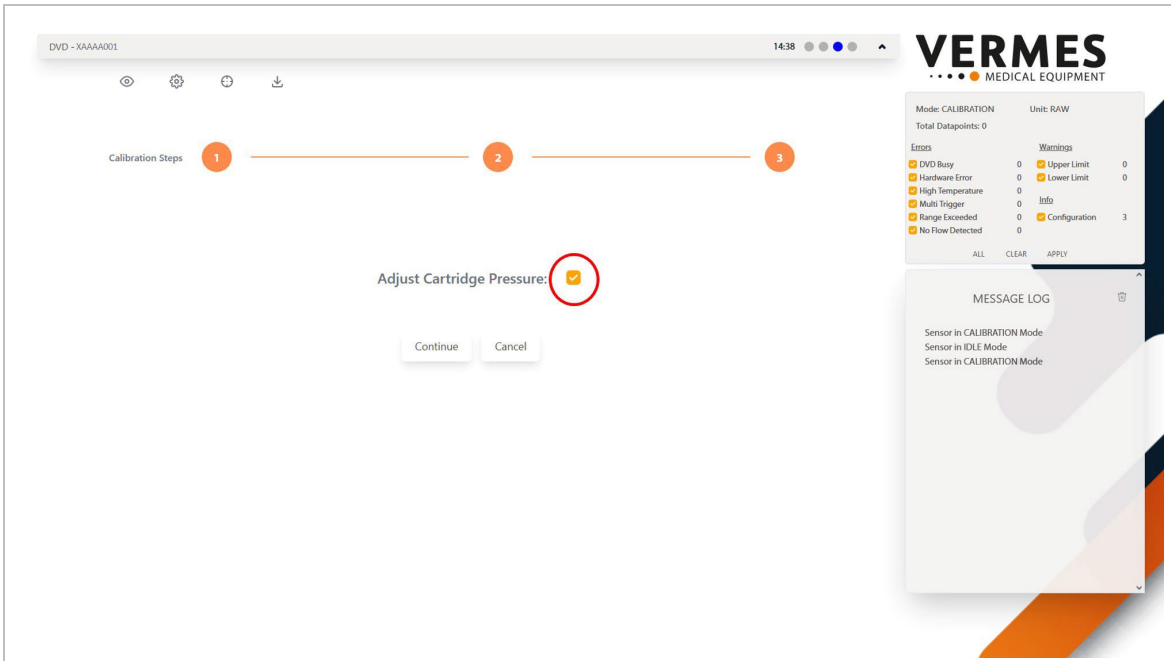
Confirm the correct pressure by ticking the box and click on "Continue".
The DVD initiates the trigger.

Information!

In case of an error, the DVD sends a message:

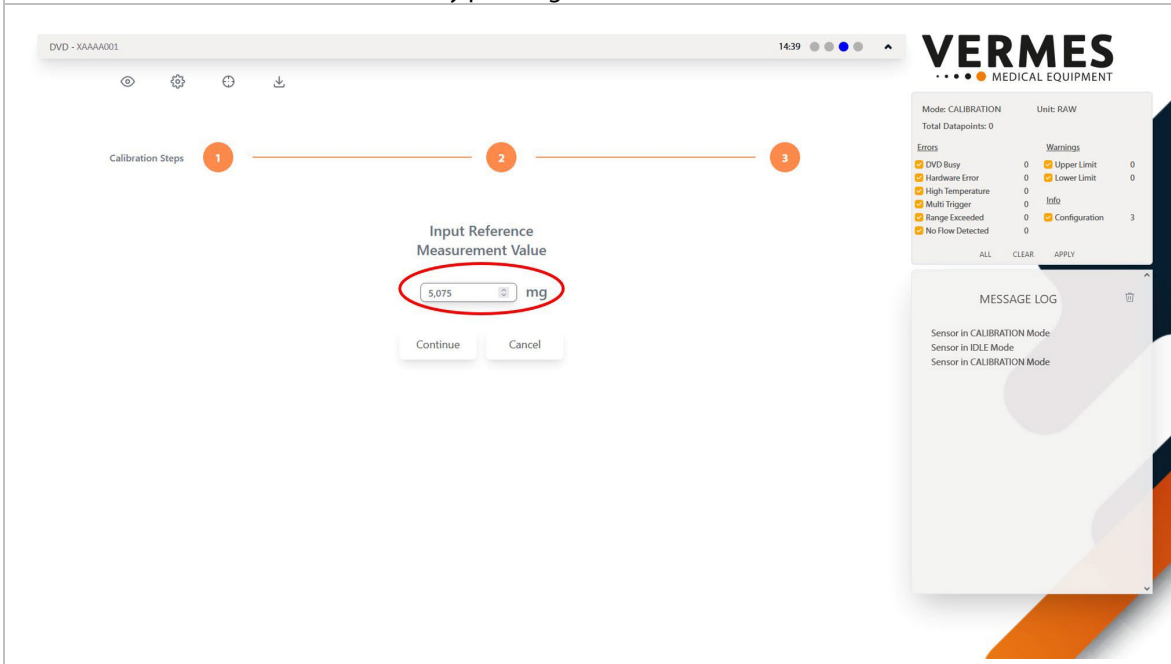
CAL: Calibration process error <X>, exit calibration mode

The DVD switches back to idle mode and the DVC switches to standard mode.



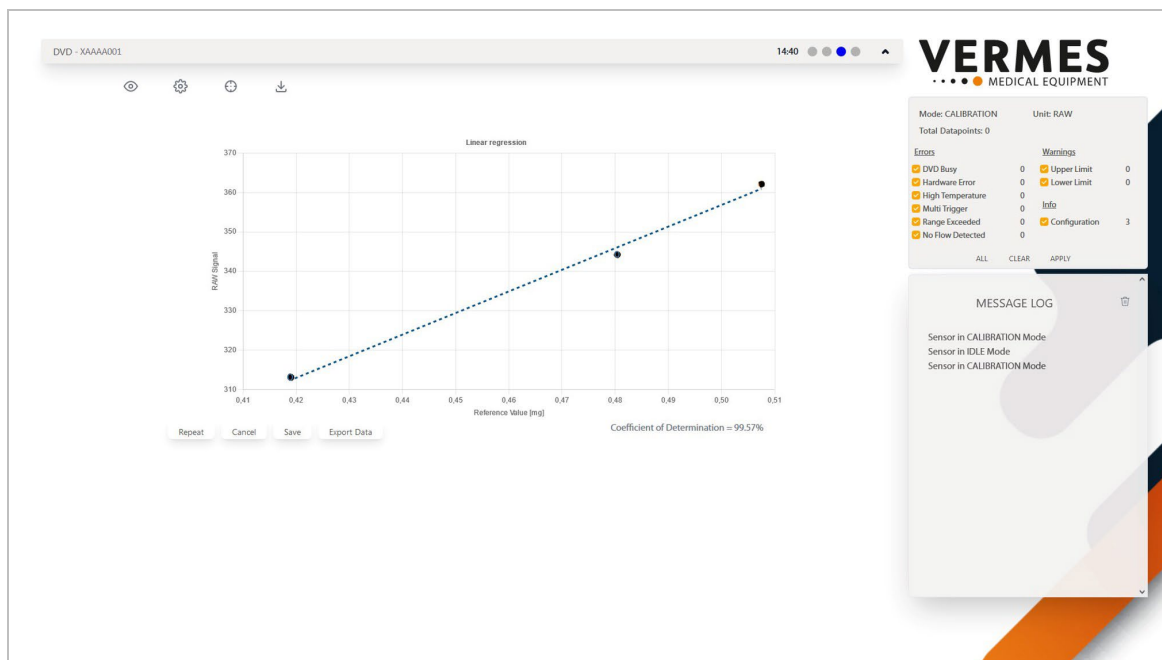
Step 10 (enter RMV for third calibration set point):

The system now asks for the Reference Measurement Value (RMV) for the third calibration set point. Enter it in the marked field. Confirm it by pressing “Continue”.



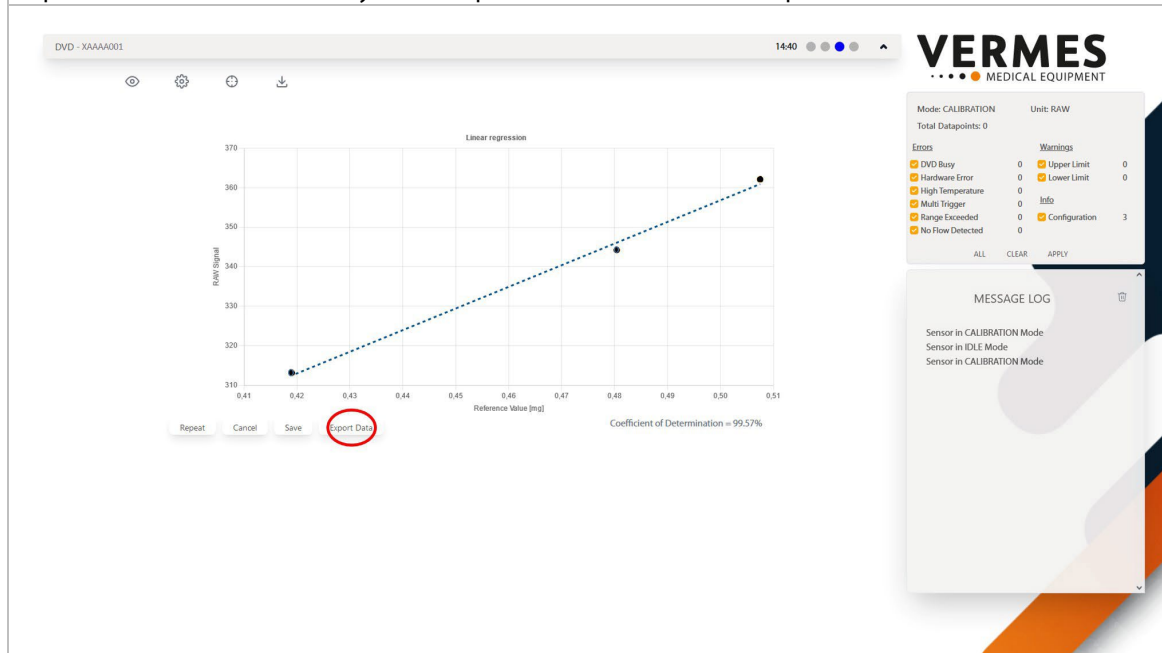
Step 11 (calibration results are shown):

A couple of seconds later a graph with the results appears.



Step 12 (requesting detailed data; optional):

For external handling of the results, click on "Export Data", to secure the data on your computer. The export creates a csv file. Below you find a picture of the data that is exported.



Data Points
Calibration Point, Reference Measurement (x), DVD-Data (y)
1,0.4529,26.3316
2,0.4935,27.4318
3,0.5367,28.4681

Coefficients
Gradient (c1),25.5100
Intercept (c0),14.7992
Coefficient of Determination,0.9988

Step 13 (save calibration results):

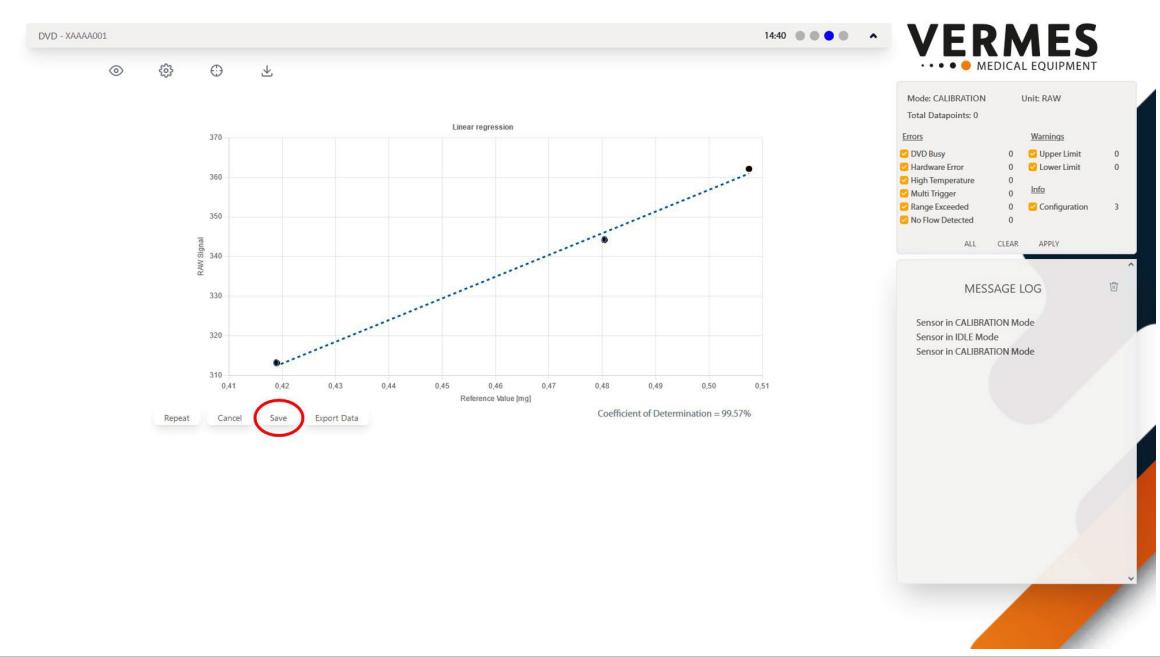
You can save the results in the DVS by clicking on the button "Save".

Information!

After clicking on “Save”, your DVS is now calibrated. But you can no longer see the graph or export the data.

In case the results are not satisfactory, you can click on “Cancel”, with the same effect as explained in “Preparations of the Calibration”.

For some advice on how to interpret the calibration results, see paragraph 6.4.3, page 56.



Tab. 13: The calibration process via the GUI

6.4.2.2 Performing the Calibration via Terminal Commands

Calibration via Terminal Commands

Preparations for the calibration:

- Make dispensing tests with all three pressure values you intend to use, to make sure you can dispense cleanly in all three settings. Find new pressure values, in case they do not work as planned.
- Make sure the microdispensing system is adjusted and has the correct parameter set (but is not dispensing currently).
- To optimize the calibration result, switch on the medium filled DVD and wait for approx. 20 minutes, before you start the calibration.

Information!

In case you want to cancel the calibration, you have to send the command
DVD:CALIBRATION:CANCEL
The DVD will respond with OK. The DVD will delete all calibration settings stored up to that point. Then the DVD will switch to idle mode, with unit RAW. The DVC switches back to standard mode. The PLC trigger input of the DVC is not blocked anymore. You will then have re-start the calibration from the beginning!

Step 1 (starting the calibration):

Start the calibration with the command:

DVD:CALIBRATION:START <sample time>,<trigger delay>,<trigger count>,<WB/NWB>.
The DVD and DVC switch to calibration mode and any external trigger signals are blocked.
The necessary parameters are the following (see paragraph 6.4.1, page 44 for explanations):

- Sample time
- Trigger delay
- Trigger count
- WB/NWB (medium is water-based or non water-based)

Information!

Starting a calibration deletes all previous calibration data, if present.

Step 2 (set pressure for first calibration set point):

The system requests you to set the cartridge pressure for the first calibration set point with the message:

"CAL: Please set pressure to level 1"

Set the cartridge pressure for the first calibration set point.

Important Note!

For a good calibration result, the three pressure values should be as different as possible. But on the other hand, the pressure range is limited, since the system needs to be able to dispense cleanly at each of the three pressure values.

Step 3 (confirm the pressure for the first calibration set point):

Confirm the correct cartridge pressure by sending the command:

DVD:CALIBRATION:PRESSURE

The DVD initiates the trigger.

In case no error occurred, the DVD asks for the reference measurement value.

Information!

In case of an error, the DVD sends a message:

CAL: Calibration process error <X>, exit calibration mode

The DVD switches back to idle mode and the DVC switches to standard mode.

Step 4 (send RMV for first calibration set point):

Send the reference measurement value (RMV) with the command:

DVD:CALIBRATION:RMV <value>

Step 5 (set pressure for second calibration set point):

The system requests you to set the cartridge pressure for the second calibration set point with the message:

"CAL: Please set pressure to level 2"

Set the cartridge pressure for the second calibration set point.

Important Note!

For a good calibration result, the three pressure values should be as different as possible. But on the other hand, the pressure range is limited, since the system needs to be able to dispense cleanly at each of the three pressure values.

Step 6 (confirm the pressure for the second calibration set point):

Confirm the correct cartridge pressure by sending the command:

DVD:CALIBRATION:PRESSURE

The DVD initiates the trigger.

In case no error occurred, the DVD asks for the reference measurement value.

Information!

In case of an error, the DVD sends a message:
 CAL: Calibration process error <X>, exit calibration mode
 The DVD switches back to idle mode and the DVC switches to standard mode.

Step 7 (send RMV for second calibration set point):

Send the reference measurement value (RMV) with the command:
 DVD:CALIBRATION:RMV <value>

Step 8 (set pressure for third calibration set point):

The system requests you to set the cartridge pressure for the third calibration set point with the message:

"CAL: Please set pressure to level 3"

Set the cartridge pressure for the third calibration set point.

Important Note!

For a good calibration result, the three pressure values should be as different as possible. But on the other hand, the pressure range is limited, since the system needs to be able to dispense cleanly at each of the three pressure values.

Step 9 (confirm the pressure for the third calibration set point):

Confirm the correct cartridge pressure by sending the command:
 DVD:CALIBRATION:PRESSURE
 The DVD initiates the trigger.
 In case no error occurred, the DVD asks for the reference measurement value.

Information!

In case of an error, the DVD sends a message:
 CAL: Calibration process error <X>, exit calibration mode
 The DVD switches back to idle mode and the DVC switches to standard mode.

Step 10 (send RMV for third calibration set point):

Send the reference measurement value (RMV) with the command:
 DVD:CALIBRATION:RMV <value>

Step 11 (calibration results are send):

After the system finishes the calibration, the DVD sends the result:
 CAL: Calibration coefficients determined, rsquared = x (e.g. x could be 9.832e-01)
 Do you want to save? Please use command: DVD:CALIBRATION:SAVE YES/NO

Step 12 (requesting detailed data; optional):

You can optionally request detailed data. There is a different command for each set of additional data.

To see the actual calibration coefficients, send the command:
 DVD:CALIBRATION:COEFFICIENTS?

To see the actual calibration data points, send the command:
 DVD:CALIBRATION:DATA?

To see the actual coefficient of determination (rsquared), send the command:
 DVD:CALIBRATION:RSQUARED?

Step 13 (save calibration results):

To save the results, send the command:
DVD:CALIBRATION:SAVE yes

In case you do not want to save the results, send the command:
DVD:CALIBRATION:SAVE no

Then the effect is the same as when sending earlier the command DVD:CALIBRATION:CANCEL (for reference see the information in "Preparations of the calibration" at the beginning of the table).

For some advice on how to interpret the calibration results, see paragraph 6.4.3, page 56.

Tab. 14: The calibration process via terminal commands

6.4.3 Interpreting the Calibration Results

This part will help you to interpret, if a calibration result is good or not. There are examples for good and bad results. The main indicator is the "Coefficient of Determination", which should be close to 100%. The lower this value is, the higher is the measurement inaccuracy. Below is an example for such a good result.

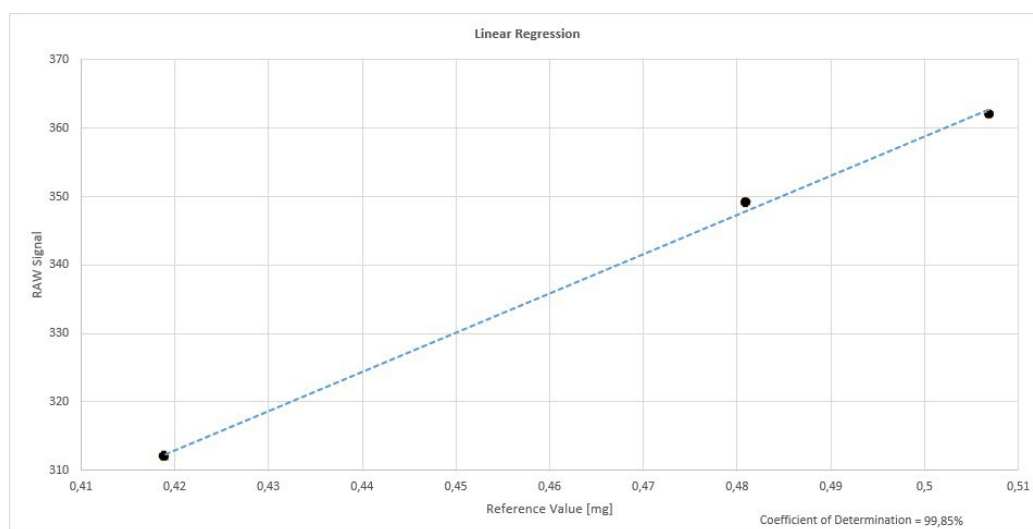


Fig. 27: Example for a good calibration result

In the next figure, you see an example for a bad result. In this case, you should repeat the calibration, since this measurement will have a high measurement inaccuracy.

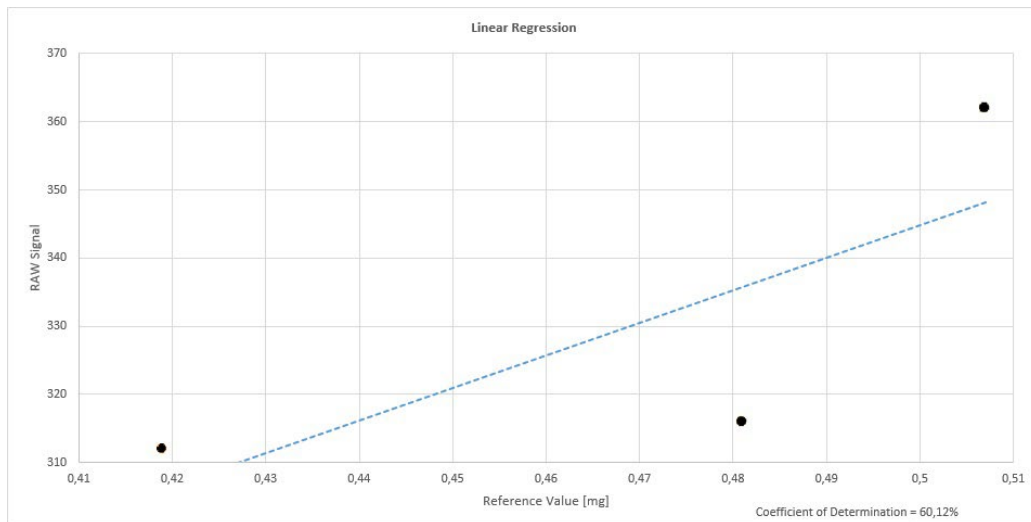


Fig. 28: Example for a bad calibration result – low Coefficient of Determination

You have to be aware though, that the coefficient of determination is an important indicator for the measurement quality, but not the only one. This is shown by the next example (see figure below). While the coefficient of Determination has a good value, two of the measurement points are too close to each other. This means that the result is less accurate as it would seem at first. You should repeat the calibration.

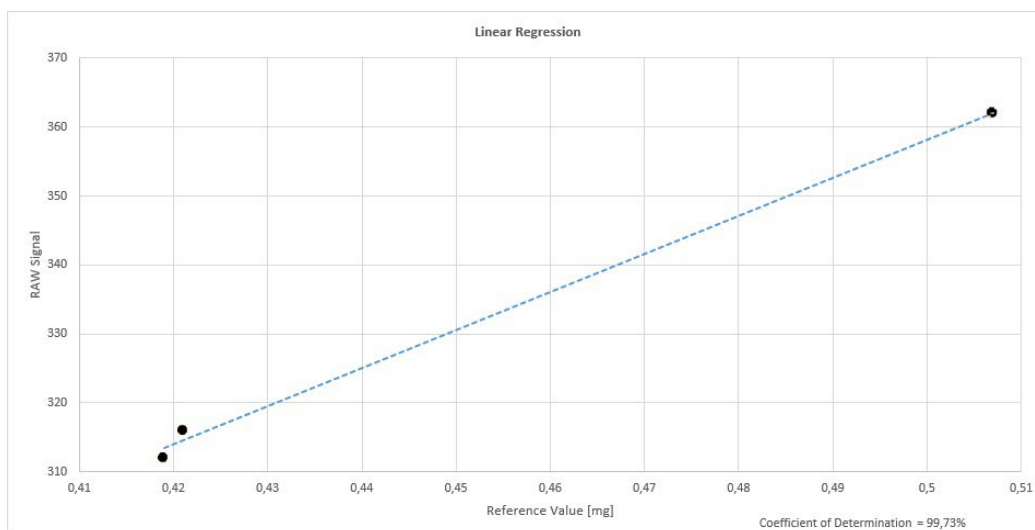


Fig. 29: Example for a bad calibration result – high Coefficient of Determination, but measurement points too close to each other

Another point to remember is that many factors can influence the coefficient of determination. E.g. those could be:

- Accuracy of the scales you use
- Positioning of the scales (distance)
- Temperature fluctuations during the calibration
- Setup of the dispensing application
- Unclean tearing off of the droplets
- Operating mistakes

The detector will always have a slight background noise. It is a sign for problems, if a significant number of data points fall within the noise band.

7 Operation

7.1 Compatibility of the Dispensing Medium

When working with the DVS, you have to consider the chemical compatibility of your dispensing medium with the wetted materials of the DVD. This chapter contains a list of the wetted materials, i.e. the materials that come in regular contact with the dispensing medium.

- PEEK
- PPS
- Stainless steel 316L
- Epoxy based adhesive
- EPDM (in the O-Ring-F for the Fluid Box Connector DVD; can be changed if required (see paragraph 12.1, page 99))

You can find further information regarding compatibility of materials in paragraph 9.2, page 88.

IMPORTANT NOTE

No abrasive or hotmelt media

You cannot use the DVS with abrasive and/or hotmelt media. Abrasive media would damage the inner channel of the DVD. Hotmelt media would need to be dispensed at a temperature that is too high for the DVS. The maximum allowed temperature is 50 °C.

7.2 Performing a Drop Volume Measurement

Once the DVC and the DVD are connected correctly and in active mode, measurements are taken automatically. You can see the results in four ways.

- Via the serial connection you receive the result after each trigger (only in active mode, see below “Collecting the results via the serial connection” for more information)
- Via the terminal command “DVD:DAQ:GETLASTRESULT?” (only for the last measurement)
- In the graph in the main screen of the GUI (set to Graph, only in active mode, see below “Showing the results in the GUI” for further information)
- As data export from the main screen of the GUI (set to Graph, only in active mode)

INFORMATION

Flow Resistance of the DVD

If you bring the DVS into an established process, you will need to slightly adapt the parameters of your application. This is caused by the small change of flow resistance caused by the DVD, compared to the application without it. Usually, it will be enough to slightly increase the supply pressure.

INFORMATION

Noise band / WB/NWB medium

The detector will always have a slight background noise. It is a sign for problems, if a significant number of data points fall within the noise band. One possible reason might be, that you incorrectly selected your medium to be water based or non-water based. Usually, you make the selection in preparation for the calibration, but you can use the terminal command “DVD:CALIBRATION:MEDIUMTYPE <WB/NWB>” to change the setting outside the calibration as well.

Mode

Usually, you will set the mode to “active” for performing a measurement. Then, the system will relay a data point for every trigger. You could also use the quiet mode, but then you would need to query for each individual result with the command “DVD:DAQ:GETLASTRESULT?”, as they are not shown automatically. For this reason, we recommend the active mode. You can set the mode in two ways.

- Via the Main screen of the GUI (set to Settings, only active mode and idle mode available)
- Via terminal commands (DVD:DAQ:MODE <ACTIVE/QUIET/IDLE>)

Unit

Usually, you will calibrate your system before any measurement and have the unit set as “CALIBRATED”. Theoretically, you could also perform a measurement without calibrating the system, but it would be more difficult to interpret the data, as without calibrating the DVD the graph would not go through the zero point. With unit at “RAW”, it is also impossible to set threshold limits (see below).

Limits

Once you have calibrated your system, you can define threshold limits for the measurement results of your application. Values outside these limits would be marked as too high or too low, when exported. In the GUI, those limits would be marked by dotted lines in the graph (see Fig. 30, page 62). For results connected to an error (e.g. multitrigger error), the dots of the

measurement data points will be shown in red instead of black (see figures below). You can set the limits in two ways.

- Via the Main screen of the GUI (set to Settings)
- Via terminal commands (DVD:DAQ:LIMIT <lower limit>,<upper limit>)

Collecting the results via the serial connection

For each trigger, the system will send you the result of the measurement and add a status message. You have to set up your PC/machine to collect and analyze this information. This is the most common method in a production site.

For valid measurements, the terminal output is of the form:

OK <time stamp> <measurement value> <message>

Example:

OK 08:36:08 4.585e-01 within limit range

For invalid measurements, the terminal output is of the form:

NOK <time stamp> <message>

Example:

NOK 08:36:08 multi trigger within sample time

The DVD determines a hierarchy based on the severity of each error, warning or info. Only the message with the highest priority is shown in terminal output with each measurement.

Showing the results in the GUI

You can view the results in the graph of the GUI. This is the most common method in a laboratory environment, e.g. to check the results after a calibration.

INFORMATION

Graph during measurements

If you jump to a different menu in the GUI during a measurement, no data points are added to the graph. They will still be missing, when you return to the graph. This is only a presentational issue. The data points are stored and included in the exported data, just not shown on the screen.

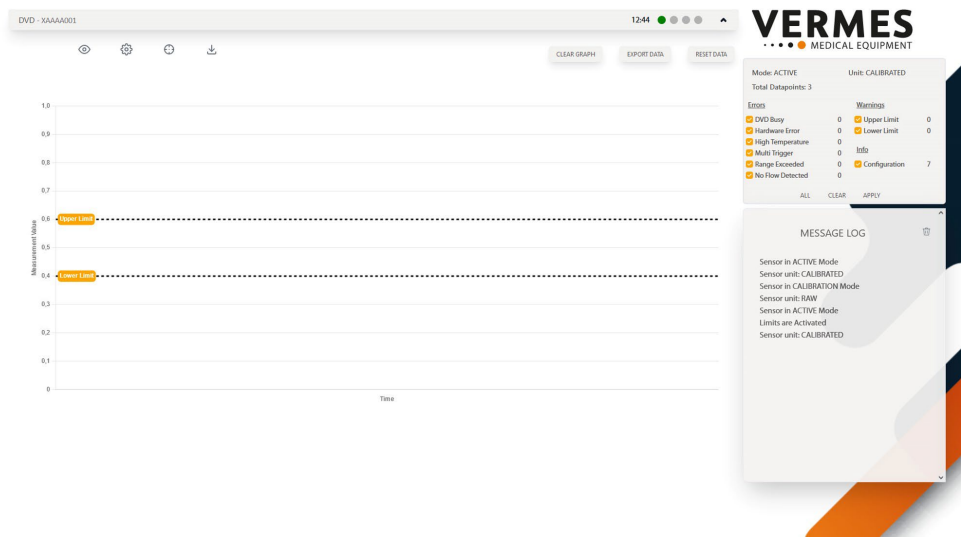


Fig. 30: Limits without data points



Fig. 31: Limits with data points

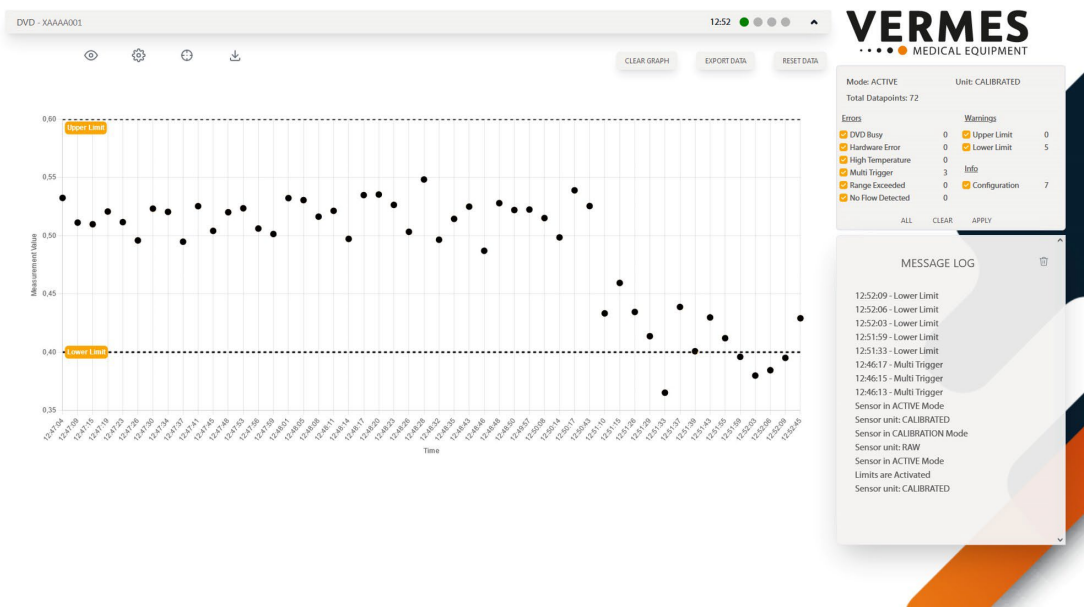


Fig. 32: Limits with some data points outside the limits

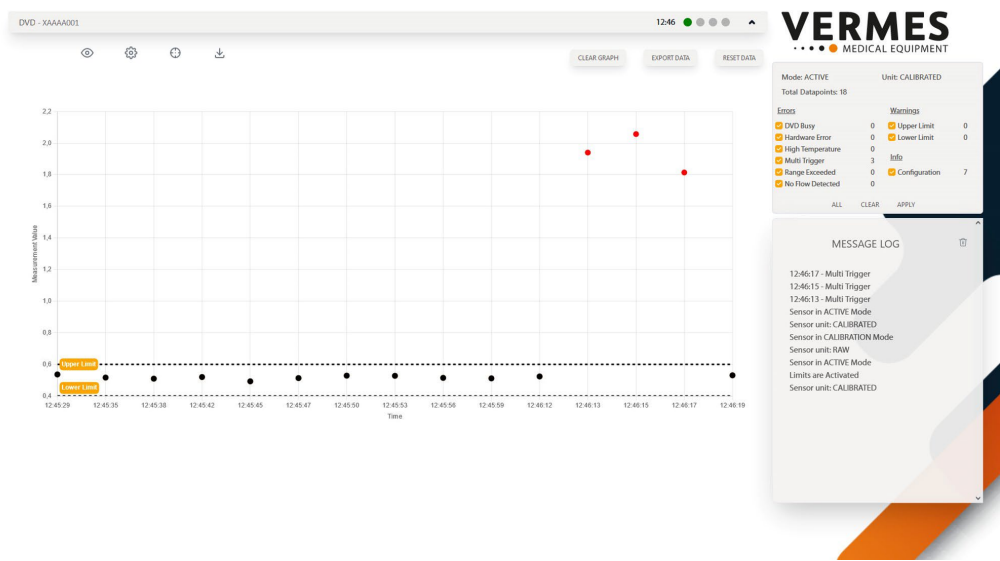


Fig. 33: Limits with error

IMPORTANT NOTE

Clean DVD regularly

It is very important to rinse the inner channel of the DVD regularly. Otherwise, residue starts to build and will have a negative impact on the accuracy of your measurements. Detailed information about cleaning can be found in the cleaning chapter (see chapter 9, page 87).

IMPORTANT NOTE

Maximum temperature 50 °C

The drop volume system must never be used at an internal temperature of above 50 °C.

7.3 Sensor Modes of the DVS

The DVS can work in four different sensor modes, which are explained in this chapter. These are the four sensor modes.

- Active mode
- Quiet mode
- Idle mode
- Calibration mode

You can change the sensor mode either through the GUI (only active or idle, see paragraph 4.4, page 21) or with the terminal command "DVD:DAQ:MODE <ACTIVE/QUIET/IDLE>" (active, quiet or idle, see paragraph 8.3.3.2, page 78). The calibration mode is automatically activated, when a calibration is started.

You can use the terminal command "DVD:DAQ:MODE?" to show the current sensor mode (including calibration mode, see paragraph 8.3.3.2, page 78).

The following table explains the four sensor modes of the DVS.

Sensor Mode	Explanation
Active mode	In the active mode, the DVD performs measurements. In active mode, a measurement starts once a trigger impulse is detected. The results are send via the serial connection (including the connected status message) and will also be shown in the graph on the main screen of the GUI (see paragraph 4.4, page 21). From the GUI, they can also be collected via a data export.
Quiet mode	In the quiet mode, the DVD performs measurements, but the results will not be send actively or shown in the GUI. You can only receive the last result by using the terminal command "DVD:DAQ:GETLASTRESULT?". The measurement starts once a trigger impulse is detected. You can only switch the system to quiet mode via the terminal command "DVD:DAQ:MODE QUIET".
Idle mode	In the idle mode you cannot make a measurement. The DVD is inactive.
Calibration mode	The system automatically switches into the calibration mode, when you start a calibration. Other than starting a calibration, you cannot actively enter into this mode. During a calibration, the mode "calibrated" would be shown via the terminal command "DVD:DAQ:MODE?".

Tab. 15: Modes of the DVS

8 Communication Interfaces

The control unit has four types of communication interfaces. There is a 9-pin serial RS-232C interface for PC/machine (a second one for MDC is not yet functional), two 15-pin PLC interfaces (for MDC and PC/machine), and an Ethernet connection (to the PC/machine). The last connection is the Sensor Bus connection with the DVD.

8.1 Ethernet Interface

The DVC 30 has an Ethernet interface with integrated DHCP client. It allows to control the DVC remotely. You can activate the DHCP client or set a static IP-Address via serial interface (explanation of terminal commands, see paragraph 8.3.2.2, page 73).

Characteristics:

- 10BaseT/100BaseTX Ethernet
- Supports Auto Negotiation (Full and half duplex, 10 and 100-based)
- Supports static IPv4 configuration or DHCP, IPv6 is not supported
- Access to command terminal over TCP port 5000

You can find the current IP address as well as the MAC address via terminal commands (see paragraph 8.3.2.2, page 73). You can also enter/change the Ethernet settings via terminal commands. As default, the IP address is taken via DHCP.

To be able to use the terminal commands via Ethernet, the option "Telnet" has to be activated (this is the default).

To send terminal commands via RS232 Telnet protocol, you need a TCP connection to port 5000. The commands (and responses) will be send as plaintext ASCII, following the format described in paragraph 8.3, page 68.

IMPORTANT NOTE

Only one connection at port 5000

At any time, only one telnet connection can be open at port 5000.

8.2 Serial Interface RS-232C: 9-Pin Sub-D

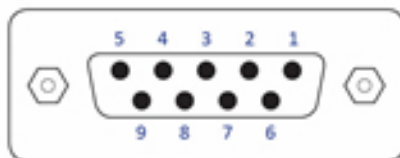


Fig. 34: Serial interface

The serial interface is structured according to SCPI Standard.

These “Standard Commands for Programmable Instruments” represent a standardized set of instructions used for control and programming, transmitted in form of ASCII text. They can be generated by any selectable programming language in any environment. The serial interface operates by means of software handshake. The hardware handshake communications are not in use.

After sending data or parameters to the control unit, you have to wait for the “OK” signal before you can start further actions.

8.2.1 Pin Functions

PIN	Characteristics	Level	Function
1	Reserved	_____	_____
2	Output	TX	Serial transmission signal
3	Input	RX	Serial reception signal
4	Reserved	_____	_____
5	Ground		Ground
6	Reserved	_____	_____
7	Reserved	_____	_____
8	Reserved	_____	_____
9	Reserved	_____	_____

The RS-232C log of the control unit uses RS-232C standard and is designed for communication via a serial cable, connected 1:1, with a Sub-D nine pin connector.

The following parameter configuration is used for the communication with the control unit:

- Synchronous mode: Half-duplex
- Bits/s: 115200
- Start bit: 1
- String length: 8 bit (ASCII)
- Parity: None
- Stop bit: 1
- Log: None

8.3 Terminal Commands

The available commands are listed below. They are explained on the following pages, together with short examples. The commands are arranged thematically and alphanumerically. This list is according to firmware revision 415F1C-1.

Each command is terminated with a carriage return + a line feed (CRLF, `\r\n`, 0x0d0a). Stringing together multiple commands on one line is not supported.

If the command needs a parameter, place a space before the parameter. In case there are several parameters, separate them by commas. There must be no space after the comma.

INFORMATION

Response to commands

The control unit gives a response to every command send to it. Possible answers are:

- OK, to acknowledge a command sent
- OK, followed by a value/set of values/status, asked for in the command
- NAK ("not acknowledged"), if the command is unknown/incorrect
- NOK ("not OK"), if the command was executed, but something went wrong

Every command response ends with `"\r\n"`. If a command has multiple lines of response (e.g. DVC:HELP), then each line ends with `"\r"` and the overall response ends with `"\r\n"`.

If there is no response to a command, either the connection is interrupted (e.g. malfunctioning cable or interface) or the command did not end in a carriage return + line feed (CRLF, `\r\n`, 0x0d0a).

Unit prefixes for numerical values

To make it easier for you to enter small numerical values, you can use the unit prefix milli. You simply add the corresponding abbreviation letter at the end of the value (see table below; other prefixes are theoretically possible, but are not needed with the DVS).

Prefix	Abbreviation	Factor	Example
		1	5 -> 5
milli	m	0.001	25m -> 0.025

Tab. 16: Unit prefixes for numerical values

8.3.1 Overview

Terminal commands	Device	Module
1. DVC:HELP	DVC	
2. DVC:HELP:MARKDOWN	DVC	
3. DVC:*IDN?	DVC	
4. DVC:SENSORBUS:TRIGGER	DVC	SensorBus
5. DVC:SYSTEM:DATETIME?	DVC	System
6. DVC:SYSTEM:DATETIME <hh>,<mm>,<ss>,<dd>,<MM>,<YYYY>	DVC	System
7. DVC:SYSTEM:NETWORK:DHCP <ON/OFF>	DVC	System
8. DVC:SYSTEM:NETWORK:DHCP?	DVC	System
9. DVC:SYSTEM:NETWORK:HTTP <ON/OFF>	DVC	System
10. DVC:SYSTEM:NETWORK:HTTP?	DVC	System
11. DVC:SYSTEM:NETWORK:IP <IP address>	DVC	System
12. DVC:SYSTEM:NETWORK:IP?	DVC	System
13. DVC:SYSTEM:NETWORK:MAC?	DVC	System
14. DVC:SYSTEM:NETWORK:TELNET <ON/OFF>	DVC	System
15. DVC:SYSTEM:NETWORK:TELNET?	DVC	System
16. DVC:SYSTEM:RESET	DVC	System
17. DVD:*IDN?	DVD	
18. DVD:CALIBRATION:CANCEL	DVD	Calibration
19. DVD:CALIBRATION:COEFFICIENTS?	DVD	Calibration
20. DVD:CALIBRATION:DATA?	DVD	Calibration
21. DVD:CALIBRATION:MEDIUMTYPE <WB/NWB>	DVD	Calibration
22. DVD:CALIBRATION:MEDIUMTYPE?	DVD	Calibration
23. DVD:CALIBRATION:PRESSURE	DVD	Calibration
24. DVD:CALIBRATION:RMV <value>	DVD	Calibration
25. DVD:CALIBRATION:RSQUARED?	DVD	Calibration
26. DVD:CALIBRATION:SAVE <YES/NO>	DVD	Calibration
27. DVD:CALIBRATION:START <sample time>,<trigger delay>,<trigger count>,<WB/NWB>	DVD	Calibration
28. DVD:DAQ:GETLASTRESULT?	DVD	DAQ
29. DVD:DAQ:LIMIT <ON/OFF>	DVD	DAQ
30. DVD:DAQ:LIMIT STATE?	DVD	DAQ
31. DVD:DAQ:LIMIT <lower limit>,<upper limit>	DVD	DAQ
32. DVD:DAQ:LIMIT?	DVD	DAQ
33. DVD:DAQ:MODE <ACTIVE/QUIET/IDLE>	DVD	DAQ
34. DVD:DAQ:MODE?	DVD	DAQ
35. DVD:DAQ:SAMPLETIME <sample time>	DVD	DAQ

Terminal commands	Device	Module
36. DVD:DAQ:SAMPLETIME?	DVD	DAQ
37. DVD:DAQ:SAMPLETIME:RECOMMENDED DETECT	DVD	DAQ
38. DVD:DAQ:SAMPLETIME:RECOMMENDED?	DVD	DAQ
39. DVD:DAQ:UNIT <RAW/CALIBRATED>	DVD	DAQ
40. DVD:DAQ:UNIT?	DVD	DAQ
41. DVD:SYSTEM:RESET	DVD	System
42. DVD:SYSTEM:UPDATE <file name>	DVD	System
43. DVD:SYSTEM:UPDATE?	DVD	System

8.3.2 Explanations of DVC Commands

1	DVC:HELP		
	Description:	Shows a list with all available terminal commands. These include DVC-commands as well as DVD-commands.	
	Example:	Input:	DVC:HELP
		Result:	List with all active terminal commands.
		Return:	List with all commands

2	DVC:HELP:MARKDOWN		
	Description:	Shows the terminal command documentation in markdown format.	
	Example:	Input:	DVC:HELP:MARKDOWN
		Result:	Documentation of all active terminal commands in markdown format.
		Return:	Documentation of all commands in markdown format

3	DVC:*IDN?		
	Description:	Returns the identification string of the device in the format <manufacturer>, <model>, <serial number>, <firmware revision>.	
	Example:	Input:	DVC:*IDN?
		Result:	Identification string is returned.
		Return:	OK VERMES Microdispensing, DVC 30,X0001577,415F1C-1

8.3.2.1 DVC Commands - Module Sensor Bus

4	DVC:SENSORBUS:TRIGGER		
	Description:	Generates a trigger signal in the Sensor Bus. When the DVD is in active mode, each trigger impulse initiates a measurement. After sample time, the DVD sends the result automatically to the DVC that redirects the result to the terminal interface. The response depends on the outcome of the measurement (see paragraph 8.3, page 68 for a list of potential responses). Information! In case there is no active DVD connected, the response is simply "OK".	
	Example:	Input:	DVC: SENSORBUS:TRIGGER
		Result:	A trigger signal is generated in the Sensor Bus (here: no error occurred during measurement and the measurement result is within the user specific range).
		Return:	OK 08:36:08 4.585e01 within limit range

8.3.2.2 DVC Commands - Module System

5	DVC:SYSTEM:DATETIME <hour>,<minute>,<second>,<day>,<month>,<year>		
	Description:	Sets the system time. You need first to enter the time (hh:mm:ss) and then the date (dd.MM.yyyy).	
	Example:	Input:	DVC:SYSTEM:DATETIME 10,12,00,01,03,2020
		Result:	Sets system time to 10:12 AM, March 1, 2020.
		Return:	OK

6	DVC:SYSTEM:DATETIME?		
	Description:	Reads the system time. The response contains first the time (hh:mm:ss) and then the date (dd.MM.yyyy).	
	Example:	Input:	DVC:SYSTEM:DATETIME?
		Result:	The current time and date are given.
		Return:	OK 10,12,04,01,03,2020

7	DVC:SYSTEM:NETWORK:DHCP <ON/OFF>		
	Description:	This command activates/deactivates the DHCP client (default is ON).	
	Example:	Input:	DVC:SYSTEM:NETWORK:DHCP OFF
		Result:	DHCP client is switched OFF.
		Return:	OK

8	DVC:SYSTEM:NETWORK:DHCP?		
	Description:	This command checks the status of the DHCP client (default is ON).	
	Example:	Input:	DVC:SYSTEM:NETWORK:DHCP?
		Result:	Current status of the DHCP client is given.
		Return:	OK ON

9	DVC:SYSTEM:NETWORK:HTTP <ON/OFF>		
	Description:	This command activates/deactivates the HTTP web server (default is ON).	
	Example:	Input:	DVC:SYSTEM:NETWORK:HTTP OFF
		Result:	HTTP web server is switched OFF.
		Return:	OK

10	DVC:SYSTEM:NETWORK:HTTP?		
	Description:	This command checks the status of the HTTP web server (default is ON).	
	Example:	Input:	DVC:SYSTEM:NETWORK:HTTP?
		Result:	Actual status of the HTTP web server is given.
		Return:	OK ON

11	DVC:SYSTEM:NETWORK:IP <IP address>		
	Description:	This command sets the static IP address. Using this command automatically disables the DHCP client.	
	Example:	Input:	DVC:SYSTEM:NETWORK:IP 192.168.2.167
		Result:	IP address is set to 192.168.2.167.
		Return:	OK

12	DVC:SYSTEM:NETWORK:IP?		
----	-------------------------------	--	--

	Description:	This command asks for the current IP address of the DVC.	
	Example:	Input:	DVC:SYSTEM:NETWORK:IP?
		Result:	Current IP address is given.
		Return:	OK 192.168.2.167

13	DVC:SYSTEM:NETWORK:MAC?		
	Description:	This command asks for the MAC identifier of the DVC.	
	Example:	Input:	DVC:SYSTEM:NETWORK:MAC?
		Result:	The MAC identifier is given.
		Return:	OK 0C:FE:5D:71:35:D5

14	DVC:SYSTEM:NETWORK:TELNET <ON/OFF>		
	Description:	This command activates/deactivates the telnet server (default is ON).	
	Example:	Input:	DVC:SYSTEM:NETWORK:TELNET OFF
		Result:	Telnet server is switched OFF.
		Return:	OK

15	DVC:SYSTEM:NETWORK:TELNET?		
	Description:	This command asks for the status of the telnet server (default is ON).	
	Example:	Input:	DVC:SYSTEM:NETWORK:TELNET?
		Result:	The status of the telnet server is given.
		Return:	OK ON

16	DVC:SYSTEM:RESET		
	Description:	This command forces a soft-reboot of the DVC, i.e. the configuration is maintained.	
	Example:	Input:	DVC:SYSTEM:RESET
		Result:	The DVC reboots.
		Return:	OK

8.3.3 Explanations of DVD Commands

17	DVD:*IDN?		
	Description:	Returns the identification string of the device in the format <manufacturer>, <model>, <serial number>, <firmware revision>.	
	Example:	Input:	DVD:*IDN?
		Result:	Identification string is returned.
		Return:	OK VERMES Microdispensing, DVD 31, X0004817, 416F1B-1

8.3.3.1 DVD Commands - Module Calibration

18	DVD:CALIBRATION:CANCEL		
	Description:	This command cancels the calibration process (see paragraph 6.4, page 44). The calibration data gathered during the calibration process are deleted and the unit is set to RAW. The DVD switches to idle mode and the DVC switches back to standard mode.	
	Example:	Input:	DVD:CALIBRATION:CANCEL
		Result:	The calibration process is canceled.
		Return:	OK

19	DVD:CALIBRATION:COEFFICIENTS?		
	Description:	This command names the coefficients for the calibration process (only if calibration data are available, see paragraph 6.4, page 44). The calibration polynomial is of order 1. Polynomial: $y(x) = \sum_{i=0}^1 c_i * x^i = c_0 + c_1 x$ The output is of the form <c0>,<c1>	
	Example:	Input:	DVD:CALIBRATION:COEFFICIENTS?
		Result:	The calibration coefficients are given.
		Return:	OK 1.003e-2, 5.041e1

20	DVD:CALIBRATION:DATA?		
	Description:	This command shows the calibration data points (see paragraph 6.4, page 44). The output is in the following form. <x0>,<y0>,<x1>,<y1>,<x2>,<y2> x refers to the reference data; y represents the raw volume data of the sensor. In case the DVD was not yet calibrated, the response will be as follows. "NAK DVD not calibrated yet" In case the DVD is currently in a calibration process, which is not finished yet, the response will be as follows. "NAK DVD calibration not finished yet"	
	Example:	Input:	DVD:CALIBRATION:DATA?
		Result:	The calibration data points are given.
		Return:	OK 3.003e2,5.041e-2,5.331e2,8.003e-2,7.041e2,1.231e-1

21	DVD:CALIBRATION:PRESSURE		
	Description:	This command is used to acknowledge that the cartridge pressure has been set by the operator to the requested level for the calibration process (see paragraph 6.4, page 44).	
	Example:	Input:	DVD:CALIBRATION:PRESSURE
		Result:	The cartridge pressure has been set by the operator.
		Return:	OK

22	DVD:CALIBRATION:RMV <value>		
----	--	--	--

	Description:	This command sets the reference value for the calibration process (see paragraph 6.4, page 44). The input value can be an integer, a real number (e.g. 0.1228) or a floating-point number (e.g. 122.8e-3) of any desired unit.	
	Example:	Input:	DVD:CALIBRATION:RMV 12.28e-5
		Result:	The RMV value is set to 12.28e-5.
		Return:	OK

23	DVD:CALIBRATION:RSQUARED?		
	Description:	This command shows the coefficient of determination (Rsquared) as a floating point number after the calibration (see paragraph 6.4, page 44). In case the DVD was not yet calibrated, the response will be as follows. "NAK DVD not calibrated yet" In case the DVD is currently in a calibration process, which is not finished yet, the response will be as follows. "NAK DVD calibration not finished yet"	
	Example:	Input:	DVD:CALIBRATION:RSQUARED?
		Result:	The coefficient of determination after the calibration is given.
		Return:	OK 9.9e-1

24	DVD:CALIBRATION:SAVE <YES/NO>		
	Description:	At the end of the calibration process (see paragraph 6.4, page 44), the DVD informs the user about the result. The user needs to inform the DVD, if the results should be accepted (saved) or not. If you send YES, the response is: "OK Calibration process completed" If you send NO, the response is: "OK Calibration process terminated"	
	Example:	Input:	DVD:CALIBRATION:SAVE YES
		Result:	The result of the calibration process is saved.
		Return:	OK Calibration process completed

25	DVD:CALIBRATION:START <sample time>,<trigger delay>,<trigger count>,<WB/NWB>		
	Description:	This command starts the calibration process (see paragraph 6.4, page 44). As parameters you enter the values for sample time, trigger delay, trigger count and water based medium or non-water based medium. Information! When you start the calibration process, the DVD and the DVC switch to sensor calibration mode. Information! Starting the calibration deletes all previous calibration data, if present.	
	Example:	Input:	DVD:CALIBRATION:START 100,500,5,WB
		Result:	The calibration process is started with the given parameters.
		Return:	OK

8.3.3.2 DVD Commands - Module DAQ

26	DVD:DAQ:GETLASTRESULT?		
	Description:	This command requests the result of the last completed measurement for the system. The response will also include a system message. In case, several events occur, it will be the message with the highest priority (see chapter 10, page 92). In case the last measurement was not successful, the response is a "NOK", together with a time stamp and the error (e.g. multi trigger within sample time).	
	Example:	Input:	DVD:DAQ:GETLASTRESULT?
		Result:	The system gets the results of the last completed measurement.
		Return:	OK 08:36:08 4.585e-01 lower limit undercut <i>(successful measurement)</i> or NOK 08:36:08 multi trigger within sample time <i>(unsuccessful measurement)</i>

27	DVD:DAQ:LIMIT <ON/OFF>		
	Description:	This command activates/deactivates the DVD limit check feature. In case the limit check feature is activated, the DVD examines, if the measurement results are inside of the limit values (IN) or not (LOW or HIGH). Default values for the limits are 0.000e+00 and 1.000e+03, if you do not set your own limits. Information! The limit check feature can only be activated, while UNIT is set to CALIBRATED.	
	Example:	Input:	DVD:DAQ:LIMIT ON
		Result:	The DVD limit check gets activated.
		Return:	OK

28	DVD:DAQ:LIMIT STATE?		
	Description:	This command checks, if the DVD limit check feature is activated or deactivated. In case the limit check feature is activated, the DVD examines, if the measurement results are inside of the limit values (IN) or not (LOW or HIGH). Information! The limit check feature can only be activated, while UNIT is set to CALIBRATED.	
	Example:	Input:	DVD:DAQ:LIMIT STATE?
		Result:	The system shows, if the DVD limit check is activated (here: yes, it is ON).
		Return:	OK ON

29	DVD:DAQ:LIMIT <lower limit>,<upper limit>		
----	--	--	--

	Description:	This command sets the threshold limits of the DVD. While there are threshold limits, the DVD designates results outside these thresholds to not be IN, but LOW or HIGH. Default values for the limits are 0.000e+00 and 1.000e+03, if you do not set your own limits.	
	Example:	Input:	DVD:DAQ:LIMIT 1.0e2,1.0e3
		Result:	The threshold limits are set.
		Return:	OK

30	DVD:DAQ:LIMIT?		
	Description:	This command requests the current threshold limits of the DVD. The limits are given as floating-point values. Default values for the limits are 0.000e+00 and 1.000e+03, if you do not set your own limits. While there are threshold limits, the DVD designates results outside these thresholds to not be IN, but LOW or HIGH. Information! To use the limits, you not only have to set them, you also need to activate them with the terminal command DVD:DAQ:LIMIT ON	
	Example:	Input:	DVD:DAQ:LIMIT?
		Result:	The current threshold limits are send.
		Return:	OK -1.000e+03,1.000e+03

31	DVD:DAQ:MEDIUMTYPE <WB/NWB>		
	Description:	This command sets the medium type (see paragraph 6.4, page 44). The medium type can either be water based (WB) or non-water based (NWB). Information! The medium type can only be changed while UNIT is set to RAW. In case the UNIT is set to CALIBRATED, you get an error.	
	Example:	Input:	DVD:DAQ:MEDIUMTYPE WB
		Result:	The medium type is set to water based.
		Return:	OK

32	DVD:DAQ:MEDIUMTYPE?		
	Description:	This command asks, which medium type is selected (see paragraph 6.4, page 44). The medium type can either be water based (WB) or non-water based (NWB).	
	Example:	Input:	DVD:DAQ:MEDIUMTYPE?
		Result:	The selected medium type is given (here: water based).
		Return:	OK water based medium

33	DVD:DAQ:MODE <ACTIVE/QUIET/IDLE>		
----	---	--	--

	Description:	This command sets the DVD mode (see paragraph 7.3, page 64). The possible parameters are: • active (activates DVD measurement with immediate result output) • quiet (activates DVD measurement, but results must be polled) • idle (deactivates DVD measurement)	
	Example:	Input:	DVD:DAQ:MODE ACTIVE
		Result:	The DVD mode is set to active.
		Return:	OK

34	DVD:DAQ:MODE?		
	Description:	This command shows the current DVD mode. The possible responses are: • active • quiet • idle • calibration (this mode can be read, but not be set with the command "DVD:DAQ:MODE <mode>")	
	Example:	Input:	DVD:DAQ:MODE?
		Result:	The DVD mode is shown to be active.
		Return:	OK ACTIVE

35	DVD:DAQ:SAMPLETIME <sample time>		
	Description:	This command sets the duration of the sample time (see paragraph 6.4, page 44). The default value is 100 ms. The valid range is from 1 ms to 60000 ms. Important Note! Since the sample time is fixed during calibration, setting new values is only possible in unit RAW. In unit CALIBRATED, the sample time can only be read, but not be set. Information! In case the command does not work and returns a NAK, it will provide additional information to understand the reason for the failure. Some examples: • NAK DVD SAMPLETIME is only adjustable when UNIT is RAW (No adjustment allowed, since sensor unit is CALIBRATED) • NAK DVD input value error (Valid range of sample time parameter is exceeded.) • NAK DVD hardware error (A hardware error occurred.)	
	Example:	Input:	DVD:DAQ:SAMPLETIME 200m
		Result:	The sample time is set to 200 ms.
		Return:	OK

36	DVD:DAQ:SAMPLETIME?		
----	----------------------------	--	--

	Description:	This command shows the duration of the sample time as it is currently set (see paragraph 6.4, page 44). The default value is 100 ms. The valid range is from 1 ms to 60000 ms. Information! Since the sample time is fixed during calibration, setting new values is only possible in unit RAW. In unit CALIBRATED, the sample time can only be read, but not be set.	
	Example:	Input:	DVD:DAQ:SAMPLETIME?
		Result:	The sample time is shown to be 200 ms.
		Return:	OK 200m

37	DVD:DAQ:SAMPLETIME:RECOMMENDED DETECT		
	Description:	This command determines the recommended duration of the sample time (see paragraph 6.4, page 44). External triggers are deactivated during this determination. The valid range for the sample time is from 1 ms to 60000 ms. The determination process last about 60 seconds. So after the determination starts, the user sees the result after 60 seconds. Important Note! After changing the medium type, you should repeat this command. Important Note! Do not set a sample time below the recommended sample time without thorough testing.	
	Example:	Input:	DVD:DAQ:SAMPLETIME:RECOMMENDED DETECT
		Result:	The recommended sample time is determined.
		Return:	OK DVD RECOMMENDED SAMPLETIME process will last 60 seconds CAL: Trigger. 3016m WARNING: DVD signal low

38	DVD:DAQ:SAMPLETIME:RECOMMENDED?		
	Description:	This command shows the last result of the command DVD:DAQ:SAMPLETIME:RECOMMENDED DETECT (paragraph 6.4, page 44). The valid range for the sample time is from 1 ms to 60000 ms. Information! In case there was no recommended sample time determined yet, the response will be: NAK DVD RECOMMENDED SAMPLETIME process not yet executed	
	Example:	Input:	DVD:DAQ:SAMPLETIME:RECOMMENDED?
		Result:	The recommended sample time is shown to be 100 ms.
		Return:	OK 100m

39	DVD:DAQ:UNIT <RAW/CALIBRATED>		
-----------	--	--	--

	Description:	This command sets, if RAW or CALIBRATED units are used for the data. The options are: RAW: Sets the raw data format for the output of the measured value without using any scaling. Particularly interesting to check whether the sensor signal is within the sensor measurement limits. CALIBRATED: If calibration data is available (i.e. a calibration took place successfully), the measured value is scaled to the unit of the reference system (mass in mg/ug). Information! If you try to set the unit to "CALIBRATED", but the DVD has not been calibrated yet, the response is: NAK DVD not calibrated yet	
	Example:	Input:	DVD:DAQ:UNIT RAW
		Result:	The type of unit used is set (here: RAW).
		Return:	OK

40	DVD:DAQ:UNIT?		
	Description:	With this command, the user can check, which unit is currently active (i.e. RAW or CALIBRATED). The options are: RAW: Sets the raw data format for the output of the measured value without using any scaling. Particularly interesting to check whether the sensor signal is within the sensor measurement limits. CALIBRATED: Measured value is scaled to the unit of the reference system (e.g. a mass in mg/ug).	
	Example:	Input:	DVD:DAQ:UNIT?
		Result:	The type of unit used is shown (here: RAW).
		Return:	OK RAW

8.3.3.3 DVD Commands - Module System

41	DVD:SYSTEM:RESET		
	Description:	This command forces a reboot of the DVD. Saved values are maintained.	
	Example:	Input:	DVD:SYSTEM:RESET
		Result:	The DVD is reset.
		Return:	OK

42	DVD:SYSTEM:UPDATE <file name>		
	Description:	This command updates the DVD device with a new revision of the Vermes Microdispensing Firmware. As parameter, you have to enter the name of the update file.	
		Important Note! As a requirement, you need the vmf (Vermes Microdispensing Firmware) file. You need to upload it via the web browser to the folder "update/". Make sure to keep the system powered on, until the process is finished.	
		Information! The update process takes a while. Please be patient and wait until the update process is finished.	
	Example:	Input:	DVD:SYSTEM:UPDATE firmwareDVD60.vmf
		Result:	The DVD is updated with a new firmware revision.
		Return:	OK DVD updating (0%)... DVD updating (1%)... DVD updating (2%)... ... DVD updating (99%)... DVD updating (100%)... DVD update succeeded

43	DVD:SYSTEM:UPDATE?		
	Description:	This command gives you the status of the last firmware updates of the DVD device.	
	Example:	Input:	DVD:SYSTEM:UPDATE?
		Result:	The status of the last DVD firmware update is shown.
		Return:	OK DVD update succeeded

8.4 PLC-Interface: 15-pin, Sub-D

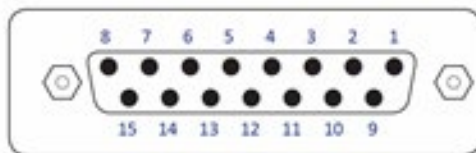


Fig. 35: PLC Interface: 15-pin, Sub-D

The PLC interface (female example illustrated above) works on digital basis without a particular syntax. It allows for controlling a machine or device by means of a remote master device. Transmission of data is possible in either direction. The trigger delay of this interface amounts to 96 μ s.

The DVC contains two PLC connectors (see also paragraph 4.2, page 18).

- A male connector for the connection with the MDC
- A female connector for the connection with the client

Access is possible to:

- Status bits
- Values of voltage and current
- Set-Trigger signals initiating dispensing cycles (pulses) or complete packages of pulses (bursts)

INFORMATION

PLC signal only looped through

The PLC signal is only looped through the DVC from your System/PLC to the MDC and vice versa. A connection diagram can be found in paragraph 13.5, page 106.

In the following paragraphs, you can find tables with the pin functions, one for the combination with dispensing systems of the MDS 30xx series, and one for the combination with dispensing systems of the MDS 15xx series.

IMPORTANT NOTE

Pin 4 and Pin 10 on ground

Make sure both Pin 4 and Pin 10 are connected to ground.

8.4.1 Pin Functions Connected with MDS 30xx

PIN	Characteristics	Level	Function
1	Output	0 / +24 V, $R_a=2.2\text{ k}\Omega$ (valid for 0 V)	SingleDosOK
2	Input	0 / +24 V $R_i=1.3\text{ k}\Omega$	Trigger Voltage Input 0 ... +5 V "Valve closed" +12 V ... +30 V "Valve opened" Positive edge triggering
3	Input	0 / +5 V $R_i=400\text{ }\Omega$	Trigger Voltage Input 0 ... +0.8 V "Valve closed" +3 V ... +5 V "Valve opened" Positive edge triggering
4	Ground	_____	Ground
5	Output	0 / +24 V, $R_a=2.2\text{ k}\Omega$ (valid for 0 V)	Set point Heating OK
6	Output	0 / +24 V, $R_a=2.2\text{ k}\Omega$ (valid for 0 V)	Nozzle unit "adjusted" OK (means green adjust LED)
7	Output	0 / +24 V, $R_a=2.2\text{ k}\Omega$ (valid for 0 V)	Mains voltage OK
8	Output	0 ... +5 V, $R_a=20\text{ k}\Omega$	U-Needle – sensor signal (needle lift)
9	Output	24 V/50 mA	Power supply to external trigger
10	Ground	_____	Ground
11	Input	12-24 V	Connection for an external voltage source for output pins of the DVC "PLC-External" connection
12	Reserved	_____	_____
13	Output	0 / +24 V, $R_a=2.2\text{ k}\Omega$ (valid for 0 V)	For adjust: adjust failed. Nozzle unit screwed in too deep or not enough. Outside adjust: general error (24 V = error)
14	Output	0 / +24 V, $R_a=2.2\text{ k}\Omega$ (valid for 0 V)	DosOK – Ready for dispensing (in the case of a pulse package, at the end of the entire burst)
15	Input	_____	Trigger Abort, connection to ground, to interrupt dispensing cycle

8.4.2 Pin Functions Connected with MDS 15xx

PIN	Characteristics	Level	Function
1	Output	0 / +24 V, $R_a=2.2\text{ k}\Omega$ (valid for 0 V)	SingleDosOK
2	Input	0 / +24 V $R_i=1.3\text{ k}\Omega$	Trigger Voltage Input 0 ... +5 V "Valve closed" +12 V ... +30 V "Valve opened" Positive edge triggering
3	Input	0 / +5 V $R_i=400\text{ }\Omega$	Trigger Voltage Input 0 ... +0.8 V "Valve closed" +3 V ... +5 V "Valve opened" Positive edge triggering
4	Ground	_____	Ground
5	Output	_____	Heater ON, not supported for MDC 1500
6	Output	0 / +24 V, $R_a=2.2\text{ k}\Omega$ (valid for 0 V)	Set point Heating OK
7	Output	_____	No connection
8	Reserved	_____	_____
9	Output	24 V/50 mA	Power supply to external trigger
10	Ground	_____	Ground
11	Input	12-24 V	Connection for an external voltage source for output pins of the DVC "PLC-External" connection
12	Reserved	_____	_____
13	Output	0 / +24 V, $R_a=2.2\text{ k}\Omega$ (valid for 0 V)	General error (24 V = error)
14	Output	0 / +24 V, $R_a=2.2\text{ k}\Omega$ (valid for 0 V)	DosOK – Ready for dispensing (in the case of a pulse package, at the end of the entire burst)
15	Input	_____	No connection

9 Cleaning

A cleaning procedure is recommended in the following situations.

- Before longer periods of inactivity
- Change of medium (to remove any transient deposits)
- Before calibration
- Before storage of the DVD

Any cleaning procedure should involve the DVD (paragraph 9.3.1, page 89) and all other surfaces in contact with the fluid (mainly the Fluid Box Connector DVD, paragraph 9.3.2, page 90).

Different methods of cleaning are described in the following chapter. The proper choice depends on the degree of contamination and the dispense medium used.

For information about the cleaning of other parts of your application (e.g. fluid box, nozzle insert), see the user manual of your respective microdispensing system.

9.1 Preliminary Notes

IMPORTANT NOTE

Prepare cleaning in advance

It is recommended to prepare the cleaning procedure in advance. Do not drop the device or its subcomponents.

CAUTION

Liquid spurts possible

Residual liquids may spurt when handling components during the cleaning process. Therefore, protective clothes are recommended:

- Safety goggles
- Gloves (chemical resistant)
- Overall (chemical resistant)
- Surgical mask

WARNING

Potential chemical reaction!

The dispensed medium and the cleaning agent must be compatible to each other. Otherwise, they might cause unwanted chemical reactions, toxic vapor, increase of temperature etc. Consult the manufacturer in case of doubt.

IMPORTANT NOTE

No mechanical cleaning of DVD

Do not use any kind of mechanical tools like brushes or wires to clean the flow channel of the Drop Volume Detector DVD. The inner surface is too sensitive and could be damaged permanently. Only rinse the inner channel with a compatible cleaning solvent.

Before introducing aggressive purifying agents or solvents to the system, verify compatibility with the material of all adjacent parts. Refer to the list in paragraph 9.2, page 88.

In case of materials you cannot find on the list, please consult the manufacturer or the Technical Support of VERMES Microdispensing (see Page 6).

9.2 Compatibility between Sealing Materials and Selected Media

	NBR	EPDM	VITON	SILICONE	PE	PTFE	CeTeDur
Acetone	---	+++	---	- +	+++	+++	+++
Ammonia	---	---	---	+++	+++	+++	+++
Chloroform	---	---	+++	---	+++	+++	+++
Cyclohexane	+++	---	+++	---	+++	+++	+++
Cyclohexanol	+++	---	+++	- +	+++	+++	+++
Cyclohexanone	---	---	---	---	---	+++	+++
Dimethylformamide	---	+++	---	- +	+++	+++	+++
Acetic acid	---	---	---	- +	+++	+++	+++
Ethanol	+++	+++	---	+++	+++	+++	+++
Heptane	+++	---	+++	---	- +	+++	+++
Hexane	+++	---	+++	---	- +	+++	+++
Isopropanol	- +	+++	+++	+++	+++	+++	+++
Methylene Chloride	---	---	- +	---	---	+++	+++
Nitromethane	---	- +	---	---	+++	+++	+++
Pentane	+++	---	+++	---	---	+++	+++
Mercury	+++	+++	+++	+++	+++	+++	+++
Silicone Oil	+++	+++	+++	- +	+++	+++	+++
Toluene	---	---	---	---	- +	+++	+++
Water	+++	+++	+++	+++	+++	+++	+++
Xylene	---	---	+++	---	- +	+++	+++
Legend							
Excellent compatibility +++	No or only a marginal influence on the component.						
Moderate compatibility - +	Limited contact and sporadic exposure to the media will allow some usability, but long term it will lead to malfunctions of the component. If possible, use materials with a higher compatibility.						
No compatibility ---	Usage is not recommended.						

Tab. 17: Compatibility between Sealing Material and Selected Media

9.3 Cleaning of the Components

9.3.1 Cleaning the DVD

After using the DVS during a dispensing process, make sure to clean the DVD, before any residual media inside the flow channel can dry out. Potential signs for residue are measurement deviations over the whole flow range and/or offsets of the measurement. First, you must clean the flow channel of the DVD.

IMPORTANT NOTE

No mechanical cleaning of DVD

Do not use any kind of mechanical tools like brushes or wires to clean the flow channel of the Drop Volume Detector DVD. The inner surface is too sensitive and could be damaged permanently. Only rinse the flow channel with a compatible cleaning solvent.

- Rinse the flow channel of the DVD with a purifying agent. You can find a list of recommended solvents for different dispensing media in the table below.

Type of dispensing medium	Recommended solvents	Notes
Alcohols/solvents	Isopropanol or acetone, followed by isopropanol	Alcohols and solvents are usually not critical. The medium must be compatible with all the parts.
Paints/glues	Cleaning agents as recommended by the manufacturer	With paints/glues it is very critical that the sensor does not dry out. Residues of paints/glues are sometimes impossible to remove after drying out. Make sure the cleaning agents are compatible with all parts with media contact. Important Note! Always clean immediately after emptying the DVD.
Silicone oils	Acetone / special cleaners	Check with silicone oil supplier about cleaning agents which are compatible.
Oils	Isopropanol, methanol, ethanol, acetone etc. or cleaning detergent	Edible oils can become rancid, dry out or change their composition over time. They might leave sticky films on the walls, especially if the system is only drained out, but not cleaned. The sooner they are cleaned out, the better.
Clean water	Purified water; in case of problems, slightly acidic cleaning agent	Salts and minerals in the water will create deposits. Rinse regularly with purified water to prevent deposits.
Non-purified water	Isopropanol, ethanol, methanol, acetone or cleaning detergents (for organic residues: Terg-a-zyne® or IO-Biofilmentferner)	Within non-purified water, especially when organic materials are involved, microorganisms can grow and form an organic film inside the flow channel.
Multiple liquids	Depending on liquid	Switching between different liquids can lead to transient deposits. If possible, dedicate a different sensor for each liquid. Otherwise, make sure to clean thoroughly between each change of liquid.

Tab. 18: Recommended cleaning solvents for different dispensing media

- Leave the purifying agent for a moment inside the flow channel, to give it time to have an effect. The amount of time depends on both the dispensing medium and the purifying agent.
- After cleaning, rinse the flow channel of the DVD one more time with isopropanol, since clean isopropanol evaporates without residue.
- After rinsing, the flow channel of the DVD needs to dry out.
- Finally, clean the outside of the DVD with a lint-free cloth.

IMPORTANT NOTE

Demounting the DVD for cleaning

Depending on your application, you might have to demount the DVD to clean it. This would e.g. be the case, if you demount the valve for cleaning as well.

Preliminary steps:

- The dispensing process must be completed.
- Deactivate the compressed air supply and remove the Adapter for Compressed Air.
- Unplug the Sensor Bus Cable from the DVD.
- Detach the DVD from the valve (in the reverse order as mounting it, see paragraph 6.2, page 35 for details).

9.3.2 Cleaning the Fluid Box Connector DVD

Detach the fluid box connector DVD from the fluid box.

IMPORTANT NOTE

Do not use wire brushes for cleaning

Do not use wire brushes and other inappropriate tools. A specially developed cleaning tool kit (CTK 2.5; with Fluid Box Cleaners, Cleaning Rods 2.5 and Fluidic Brushes 2.5) is available upon request (order no. 1014632), which is of particular interest for all surfaces in direct contact with the fluid.

You can clean the fluid box connector DVD in an ultrasonic bath.

- Remove the O-Ring-F from the fluid box connector DVD. The O-Ring-F should not be placed into the ultrasonic bath.
- Push a cleaning rod or a fluidic brush through the media carrying channels of the fluid box connector DVD.
- Place a beaker in the ultrasonic bath. Make sure it is large enough.
- Place the fluid box connector in the beaker.



- Fill the beaker with an appropriate solvent (e.g. Isopropanol).

IMPORTANT NOTE**Use compatible solvent**

Make sure that the solvent you use is compatible with the materials of the fluid box connector DVD. It is made of PEEK and POM.

- Leave the components for ca. 15 min inside.

⚠ WARNING**High temperature, danger of burns**

Be aware of your dispensing medium when setting the temperature, if the dispensing medium is inflammable. Otherwise, with too high temperatures deflagration might occur. Set the temperature as low as possible within the effective range.

- Take the beaker with the fluid box connector DVD out of the ultrasonic bath. Then use tweezers to take the components out of the beaker.

Next, clean the fluid box connector DVD by hand.

- You have to clean the fluid box connector by hand. In general, you should take special care about those places, which get in contact with the medium or where two different parts fit together.
- Start with the fluidic brush to clean all bores and openings.
- Next clear the bore with a cleaning rod.
- Use a fluid box cleaner to clean the wide opening of the bore.
- Finally, make sure the inner thread of the union nut is clean and free of residue. Otherwise, you would have problems when you re-mount the fluid box connector DVD.
- Dry the fluid box connector DVD in the air or with compressed air.
- Clean the O-Ring-F with a lint-free cloth.

In case you still have parts which are not completely clean at this point, repeat the corresponding cleaning steps for those components several times, if necessary. If that is still not helping, contact our Technical Support.

Re-attach the fluid box connector DVD to the fluid box.

9.3.3 Assembling of the DVD (optional)

In case you had to disassemble your DVD for cleaning, re-assemble the DVD as described in paragraph 6.2, page 35.

- Finally, re-connect the compressed air. You can find more detailed information in paragraph 6.3, page 39.

10 System Messages (Errors, Warnings and Information Messages)

The following pages list all the system messages (errors, warnings and information) you could encounter when using this system. The table in paragraph 10.1, page 92 will give you a quick overview. In the following chapters, every message is explained in detail.

If an error keeps occurring repeatedly, please contact the Technical Support at VERMES Microdispensing or your local supplier (see Page 6).

10.1 Table of Error and Status Messages

The following table lists all error, warning and status messages with their error type. The order in the table represents the priority of the message (e.g. errors have higher priority than warnings).

No.	Message shown in terminal	Message type	Note
1	hardware error	Error	The sensor is not functional.
2	sensor is in idle mode	Error	The sensor was set to idle mode.
3	sensor is busy	Error	The sensor is busy with another measurement.
4	valid sensor temperature range exceeded	Error	Sensor temperature was not in its valid range (between 5 °C and 50 °C).
5	multi trigger within sample time	Error	An additional trigger was detected during an active measurement.
6	sensor range exceeded	Error	Data samples exceed sensor acquisition range.
7	no flow detected	Error	No data sample exceeded sensor's specified noise band.
8	upper limit exceeded	Warning	Valid measurement, but the value exceeded upper limit specified by user.
9	lower limit undercut	Warning	Valid measurement, but the value fell below lower limit specified by user.
10	no limit set	Information	Valid measurement without a specified limit range.
11	within limit range	Information	Valid measurement within the specified limit range.
12	DVD not calibrated yet	Information	In case the DVD was not yet calibrated.
13	DVD calibration not finished yet	Information	In case the DVD is in calibration process which was not finished yet.
14	DVD SAMPLE TIME is only adjustable when UNIT is RAW	Information	No adjustment allowed, since sensor unit is CALIBRATED.
15	DVD valid range exceeded	Information	Valid range of sample time parameter is exceeded.
16	Please run sample time detection first	Information	Answer to the request, when no recommended sample time determination was started before.

10.2 Explanations of Error Messages

1	hardware error	
	The sensor is not functional.	
	Message type:	Error
	DVD LED status:	Red (flashing)
	Consequences:	No measurements possible
2	Error handling:	- Re-start the system. - In case the error appears repeatedly, please contact the VERMES support team.
	sensor is in idle mode	
	The sensor was set to "idle" mode.	
	Message type:	Error
	DVD LED status:	Yellow (flashing)
3	Consequences:	No measurement results are given
	Error handling:	Change mode to "active" with the command "DVD:DAQ:MODE active" (see paragraph 8.3.3.2, page 78).
	sensor is busy	
	The sensor is busy because of another measurement.	
	Message type:	Error
4	DVD LED status:	Green (permanently on)
	Consequences:	No measurement results are given / command will not be executed
	Error handling:	Wait (you need to be aware of the process times).
	valid sensor temperature range exceeded	
	The temperature of the sensor exceeds the valid range (between 5 °C to 50 °C).	
5	Message type:	Error
	DVD LED status:	Green (permanently on)
	Consequences:	No measurement results are given
	Multi trigger within sample time	
	During an active measurement another trigger event is detected.	

	Error handling:	• Increase the time between two triggers or alternatively, reduce the sample time duration (you need to be aware of the process times). The time between two triggers needs to be longer than the sample time. A recommended sample time can be determined by the DVD. Use the command "DVD:DAQ:SAMPLETIME:RECOMMENDED DETECT"
--	-----------------	--

6	sensor range exceeded	
	The data samples exceed the acquisition range of the sensor. Usually, this error means that the flow rate is too high.	
	Message type:	Error
	DVD LED status:	Green (permanently on)
	Consequences:	No measurement results are given
	Error handling:	• Remove air bubbles from the system. • Make sure the system has been cleaned successfully. • Adjust the dispensing parameters / the dispensing system and reduce the flow rate. • Change the media type from "non water based" to "water based" (see paragraph 6.4, page 44).

7	no flow detected	
	The measured values stay completely within the specified noise band.	
	Message type:	Error
	DVD LED status:	Green (permanently on)
	Consequences:	No measurement results are given
	Error handling:	• Make sure the system is filled with medium. • Remove air bubbles from the system. • Make sure the system has been cleaned successfully. • Adjust the dispensing parameters / the dispensing system. • Reduce the noise band (see paragraph 6.4, page 44).

10.3 Explanations of Warning Messages

8	upper limit exceeded	
	The measurement was valid, but the measured values exceed the upper limit specified by the user.	
	Message type:	Warning
	DVD LED status:	Green (permanently on)
	Consequences:	The measurement results come with a warning
	Error handling:	• Make sure the system has been cleaned successfully. • Adjust the dispensing parameters / the dispensing system. • Maybe the upper limit was set too low. Adjust it.

9	lower limit undercut	
	The measurement was valid, but the measured values are below the lower limit specified by the user.	
	Message type:	Warning
	DVD LED status:	Green (permanently on)
	Consequences:	The measurement results come with a warning
	Error handling:	• Make sure the system is filled with medium. • Remove air bubbles from the system. • Make sure the system has been cleaned successfully. • Adjust the dispensing parameters / the dispensing system. • Maybe the lower limit was set too high. Adjust it.

10.4 Explanations of Status Messages

10	no limits set	
	The measurement was valid. There were no limits set.	
	Message type:	Information
	DVD LED status:	Green (permanently on)
	Consequences:	The measurement results are given without regards for any limits
	Handling:	There is no error.

11	within limit range	
	The measurement was valid within the limits that were specified.	
	Message type:	Information
	DVD LED status:	Green (permanently on)
	Consequences:	The measurement results are given
	Handling:	There is no error.

12	DVD not calibrated yet	
	The DVD has not been calibrated yet.	
	Message type:	Information
	DVD LED status:	Green (permanently on)
	Consequences:	The data cannot be found, since no calibration has been performed yet
	Handling:	Perform a calibration (see paragraph 6.4, page 44).

13	DVD calibration not finished yet	
	The DVD calibration has not been finished yet.	
	Message type:	Information
	DVD LED status:	Blue (permanently on)
	Consequences:	The data cannot be found, since the calibration is still running
	Handling:	Finish the calibration process or cancel it (see paragraph 6.4, page 44).

14	DVD sample time is only adjustable when UNIT is RAW	
	Changing the sample time is not allowed, since the sensor has been calibrated.	
	Message type:	Information
	DVD LED status:	Green (permanently on)
	Consequences:	The sample time cannot be changed
	Handling:	- Set the unit to RAW. - Perform a calibration with the new sample time (see paragraph 6.4, page 44).

15	DVD valid range exceeded	
	The value of the sample time exceeds the valid range (10 to 60000 ms).	
	Message type:	Information
	DVD LED status:	Green (permanently on)

	Consequences:	The sample time will not be saved
	Handling:	Select a sample time in the valid range (10 to 60000 ms).

16	please run sample time detection first	
	Response to a sample time request, if there has no recommended sample time been determined before.	
	Message type:	Information
	DVD LED status:	Green (permanently on)
	Consequences:	The sample time will not be saved
	Handling:	To find a recommended sample time, use the terminal command "DVD:DAQ:SAMPLETIME:RECOMMENDED DETECT?" (see paragraph 8.3.3.2, page 78).

11 Transport, Storage and Disposal

11.1 Transport

For shipment, the system is packed in an appropriate case. Preserve it for further transport procedures in the future. The necessity can never be excluded, e.g. for purposes of maintenance. Observe the following measures.

- If the original packaging is no longer available, select a suitable material for the package.
- Pack in a way that protects the delivery against shock and vibrations.
- Fill empty spaces with appropriate material (e.g. paper, insulating air cushion, Styrofoam).
- Decontaminate the system completely before shipping it.
- Fill out the corresponding Declaration of harmlessness completely. Attach it clearly visible at the exterior of the package. The document can be downloaded from the VERMES website:

https://www.vermes.com/Declaration_of_harmlessness.pdf

⚠ CAUTION

Decontamination

The customer is liable for all consequences resulting from insufficient decontamination of the system (health of transport personnel)!

11.2 Storage

The environmental conditions in the room intended for storage should fulfill the requirements of the system.

Observe the following storage conditions.

- The room should be sufficiently ventilated and free of dust
- Admissible temperature: Between +5 °C and +30 °C
- Rel. humidity < 50 %
- The system should not be stored together with fuel, solvents, lubricants, acids and other chemicals able to develop vapors, which may aggress to the surface of the components.

Air-tight foil sheathing with included desiccants may be useful.

11.3 Recycling and Disposal

	The entire packaging consists of 100 % recyclable material.
	At the end of its lifetime, the product itself should be discarded in conformity with local regulations. Prescriptions with respect to handling of electrical scrap have to be observed.

12 Spare Parts and Tools

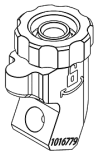
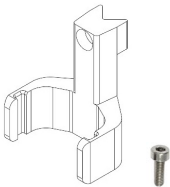
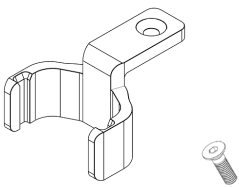
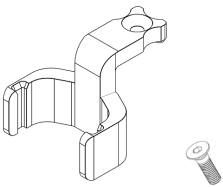
Here are some of the most important spare and extra parts as well as tools. For the latest and complete list, please check our homepage at www.vermes.com.

12.1 Sealings

		
O-Ring-F (10 pieces) EPDM Order no. 1007062 (black) NBR Order no. 1007061 (black) VITON Order no. 1008763 (green) Silicone Order no. 1010486 (red)		

Tab. 19: Sealings

12.2 Supply Unit

		
Cartridge 10 ccm Order no. 1008361 30 ccm Order no. 1007087 (also available nontransparent for light or UV light)	Cartridge Holder DVD 30/55 ccm Order no. 1016325 10 ccm Order no. 1016326	Fluid Box Connector DVD Order no. 1016779
		
DVD-Holder-30xx-Top-Adjust Order no. 1017441 (includes screw)	DVD-Holder-1560 Order no. 1017130 (includes screw)	DVD-Holder-30xx-Side-Adjust Order no. 1017264 (includes screw)

Tab. 20: Supply unit

12.3 Tools

		
MDT 306 - Torque Wrench Tool VM Order no. 1015062 BitVM Set Order no. 1013398	MDT 307 - Adjust Tool TA Hot Melt Handle Order no. 1014143	MDT 327 - Multi-Function Tool Order no. 1014440
		
Hexagon Key Set Order no. 1012993 (can be ordered separately)		

Tab. 21: Tools

12.4 Other Parts

		
DVC 30 Order no. 1017442	DVD 31 Order no. 1016739	DVD 32 Order no. 1016319
		
Power Supply 24 V 4 A Order no. 1014501	Sensor Bus Cable 5m Order no. 1017443	DVS PLC Cable 15 pin SubD 2m Order no. 1017699

Tab. 22: Other Parts

13 Attachments

13.1 EU Declaration of Conformity



EU Declaration of Conformity

**EU Declaration of Conformity according to European directives
In Accordance with DIN EN ISO/IEC 17050-1:2018-08**

Company Name: **VERMES Microdispensing GmbH**

Address: **Rudolf-Diesel-Ring 2
83607 Holzkirchen**

Product Name: **Drop Volume Systems (DVS 3x Series)**

Model Number:

System	Control Unit	Detector
DVS 31	DVC 30	DVD 31
DVS 32	DVC 30	DVD 32

We declare that these products are specified to the relevant EC Guidelines.

The Conformity is approved by the following guidelines and harmonized standards:

Directive 2014/30/EU	Electromagnetic Compatibility Directive (EMC)
Directive 2011/65/EU (with EU 2015/863)	Restriction of Hazardous Substances (RoHS 2) (with amendment)

Holzkirchen, 18/2/25

Place and date of issue

[Signature]

Stefan Hirte
Managing Director

VTK-GF-VT-075e-1

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Fig. 36: EU Declaration of Conformity

13.2 Dimensional Drawing DVC 30

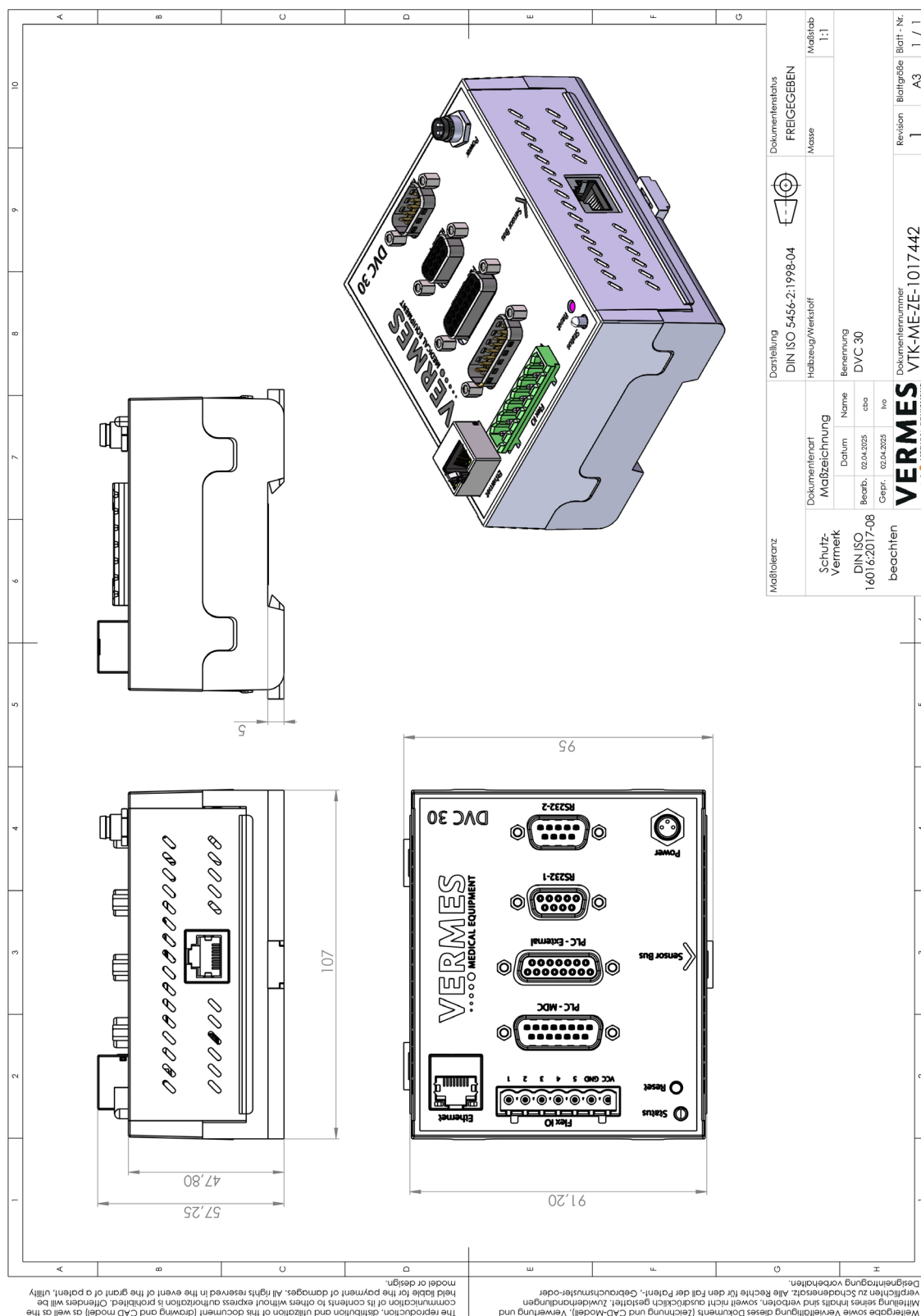


Fig. 37: Dimensional Drawing DVC 30

13.3 Dimensional Drawing DVD 31

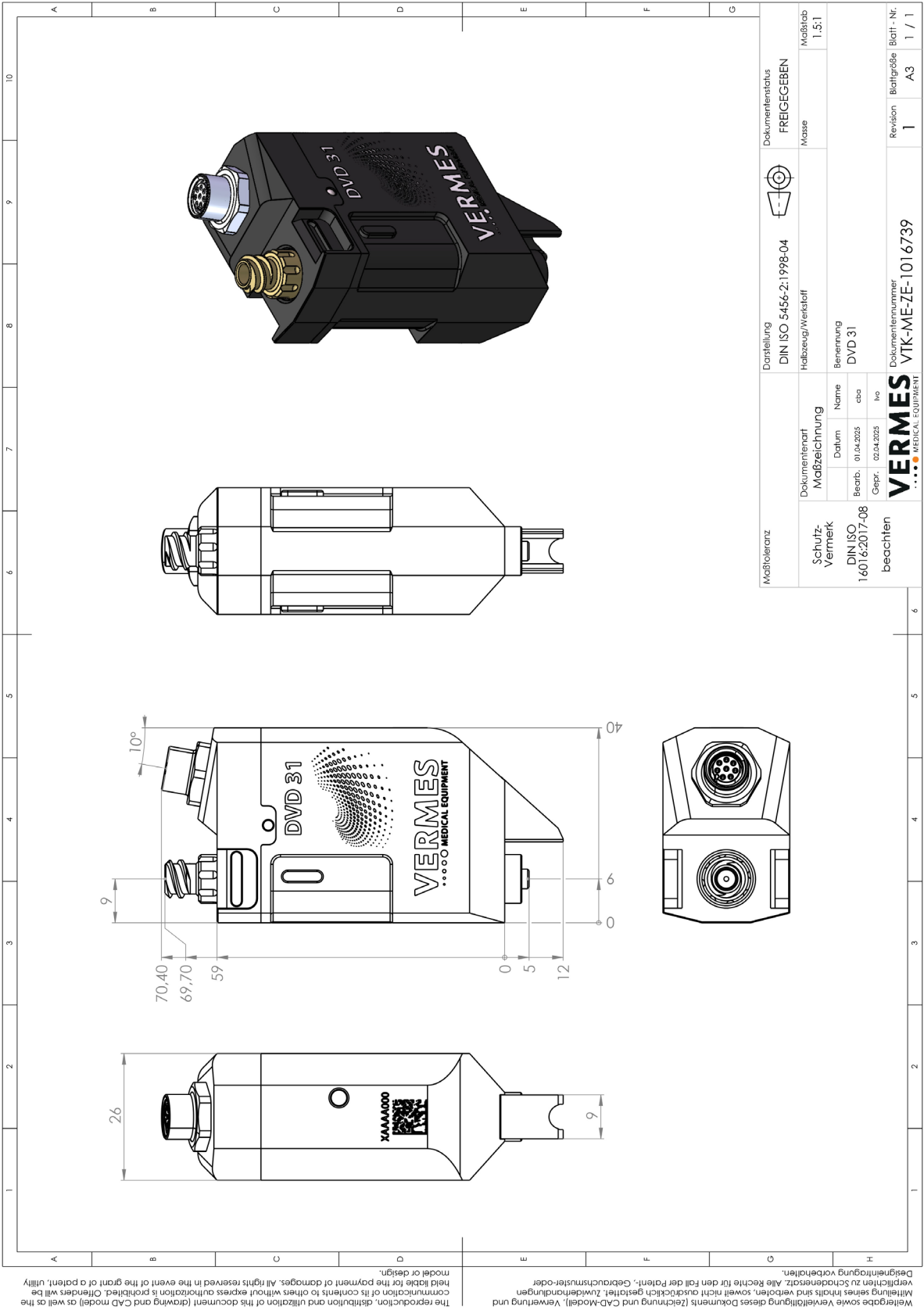


Fig. 38: Dimensional Drawing DVD 31

13.4 Connection Diagram DVS 3x

This diagram shows the connections of a DVS 3x with an MDS 3050.

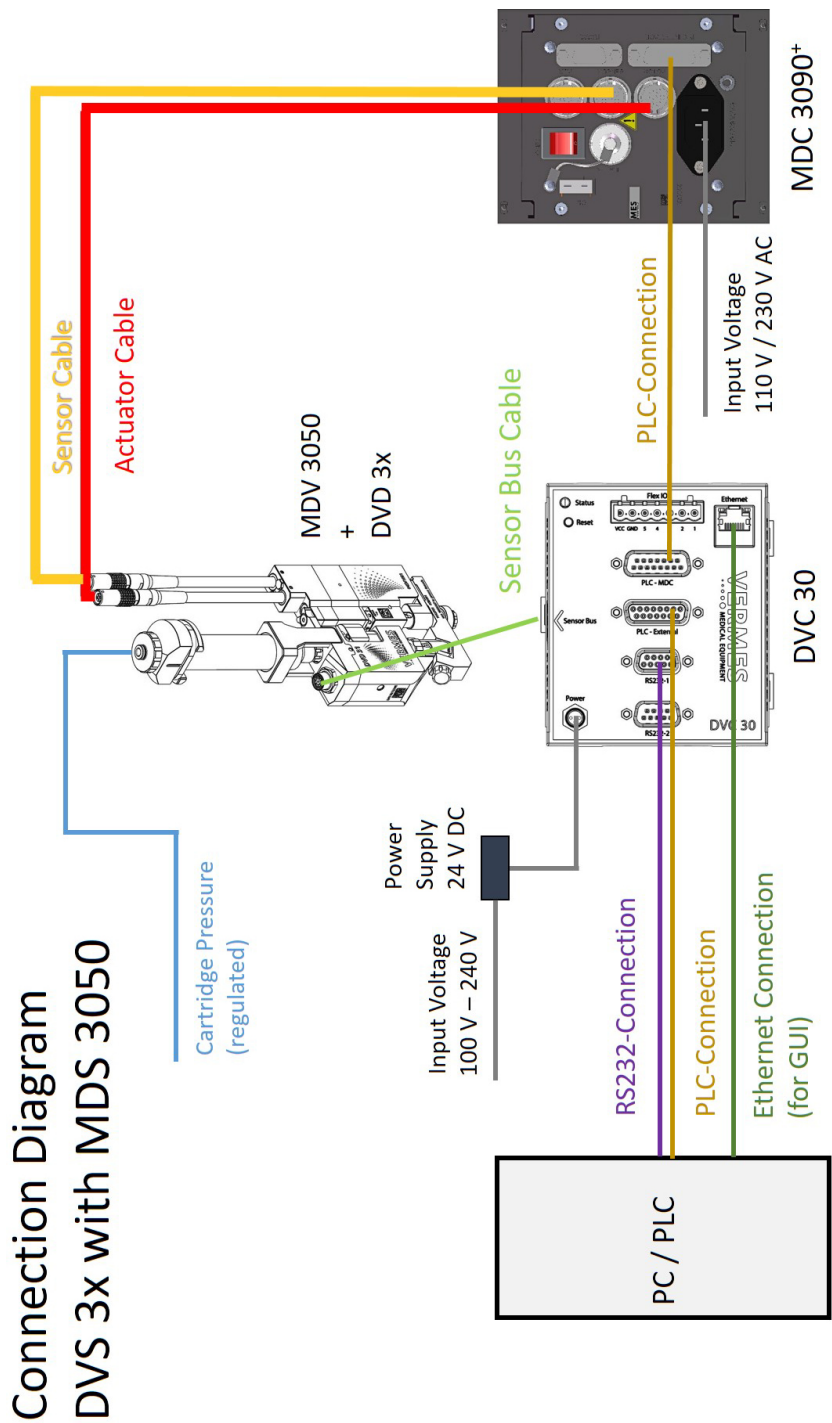


Fig. 39: Connection Diagram DVS 3x

13.5 Connection Diagram PLC-interface

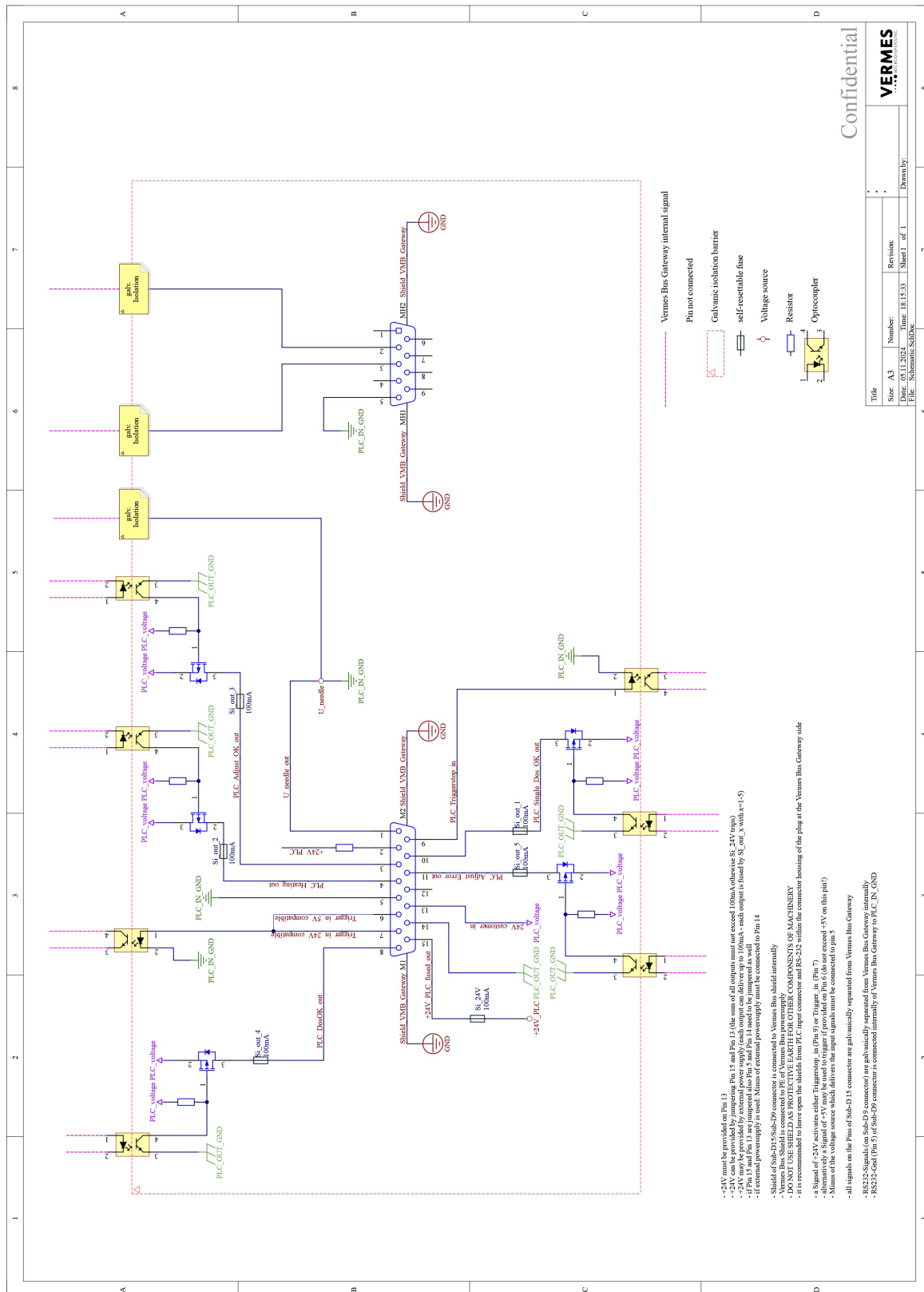


Fig. 40: Connection Diagram PLC interface

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