WELCH
by Gardner Denver

Operation Manual (EN)
Translation of the german original manual

Laboratory-Vacuum-System

Ultimate pressure < 2 mbar

Model:

► LVS 105 T – 10 ef

114184
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1 Important Information

1.1 General Information

The **Laboratory-Vacuum-System LVS 105 T – 10 ef** conform to the:

2006 / 42 / EC	Machinery Directive
2014 / 30 / EU	Electromagnetic Compatibility Directive

The CE sign is located on the rating plate. Observe the binding national and local regulations when fitting into installations!

Our products are sold worldwide and can therefore be equipped with the typical national plugs and for the various voltages. You will find more information about the available pump designs on our web page in the internet.

1.2 Target Groups

This Operating Manual is intended for the personnel planning, operating and maintaining Laboratory-Vacuum-Systems.

This group of people includes:

- Designers and fitters of vacuum apparatus,
- Employees working on commercial laboratory and industrial vacuum technology applications and
- Service personnel for Laboratory-Vacuum-Systems.

The personnel operating and maintaining the Laboratory-Vacuum-Systems must have the technical competence required to perform the work that has to be done.
The user must authorize the operating personnel to do the work that has to be done.
The personnel must have read and understood the complete Operating Manual before using the Laboratory-Vacuum-Systems.
The Operating Manual must be kept at the place of use and be available to the personnel when required.

1.3 Intended Use

- The Laboratory-Vacuum-System may only be operated under the conditions stated
  - in the "Technical Data" section,
  - on the type plate, and
  - in the technical specification for the order concerned.
- Laboratory-Vacuum-Systems are approved for extracting, pumping and compressing gases and vapours. If these gases and vapours are toxic or explosive, then the user must observe the currently valid safety regulations for this application. Special types of diaphragm pumps are available for aggressive and explosive gas mixtures.
- Laboratory-Vacuum-Systems are intended for generating vacuums with ultimate pressures of around 2 mbar.
- The in-built diaphragm pump has been designed to have high resistance to aggressive gases.
- The active heating of the pump heads eliminates the need for a gas ballast valve.

1.4 Use for an Unauthorized Purpose

It is forbidden to use the pump for applications deviating from the technical data stated on the type plate or the conditions stated in the supply contract, or to operate it with missing or defective protective devices.

1.5 Safety Devices

Measures such as the following are for the safety of the operating personnel:

- electrical connection with a protective conductor (operating mode S1) and an earthing plug
- fine-wire fuse (slow-blow)
- “Hot Surface" label on the pump body - warning notice 
- completely enclosed casing
- identification WEEE
- glass components with a transparent plastic coating which protects them against bursting and cracking, cooler isolated

The Laboratory-Vacuum-System must not be operated without these elements.

1.6 Meaning of the Warning Notes

Take note of the warning notices. They are in the following box:

	**CAUTION ! / WARNING !**
Hazard which may lead to serious injuries or material damage.	

1.7 Product Standards, Safety Regulations

Laboratory-Vacuum-System meet the following product standards:

DIN EN ISO 12100:2011-03	Safety of machinery - General principles for design - Risk assessment and risk reduction
DIN EN ISO 13857:2008-06	Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs
DIN EN 1012-2:2011-12	Compressors and vacuum pumps - Safety requirements - Part 2: Vacuum pumps
DIN EN ISO 2151:2009-01	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
DIN EN 60204-1:2014-02	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
DIN EN 61000-6-2:2011-06	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
DIN EN 61000-6-4:2011-09	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
DIN EN 61010-1/A1:2015-04	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements
DIN EN 50110-1:2014-02	Operation of electrical installations
Directive 2012/19/EU	Electrical and electronics - old devices (WEEE)
Directive 2011/65/EU	Dangerous materials in electrical and electronics devices (RoHS II)
China - RoHS II	Environment protection law - China 2016-01

The following additional safety regulations apply in the FR Germany:

BGV A3	Electrical equipment and operating materials
VBG 5	Power-driven machines
BGR 120	Guidelines for laboratories
BGI 798	Hazard assessment in the laboratory
BGG 919 (VBG 16)	Accident prevention regulations for "compressors"
BGR 189 (BGR 195;192;197)	Use of protective working clothes

Observe the standards and regulations applying in your country when you use the LVS.

2 Basic Safety Instructions

2.1 General Information

	**CAUTION !**
Warning notices must be observed. Disregarding them may lead to damage to health and property.	

The Laboratory-Vacuum-System must be operated by personnel who can detect impending dangers and take action to prevent them from materialising.

The user/operator is responsible for correct installation and safe operation.

Prevent condensate collecting in the pump. When pumping vapours which tend to condense please ensure that the pump is at operating temperature and that the gas ballast valve is open when the pump is switched on.

If there is more than one load on one LVS, they must be separated by check valves.

The manufacturer or authorized workshops will only service or maintain the Labo-ratory-Vacuum-System if it is accompanied by a fully completed damage report. Precise in-formation about the contamination (also negative information if necessary) and thorough cleaning of the Laboratory-Vacuum-System are legally binding parts of the contract.

Contaminated laboratory vacuum systems and their individual parts must be disposed of in accordance with the legal regulations.

The local regulations apply in foreign countries.

2.2 Electricity

The LVS 105 T - 10 ef are supplied for operating mode S1. Please note that the testing must be repeated in accordance with DIN EN 0105, DIN EN 0702 and BGV A2 in case of portable devices.

The local regulations apply in foreign countries.

Please note the following when connecting to the electrical power supply system:

- The electrical power supply system must have a protective connector according to DIN VDE 0100-410 (IEC 60364-4-41).
- The protective connector must not have any breaks.
- The connecting cable must not be damaged.
- All interfaces are under low voltage according to DIN VDE 0100-410.

2.3 Mechanical Systems

Improper use can lead to injuries or material damage. Observe the following instructions:

- Only operate the LVS with hoses of the specified dimensions.
- The maximum permissible pressure of 1 bar at the suction connection must not be exceeded.
- Solid particles in the pumping medium impair the pumping action and can lead to damage. Prevent solid particles penetrating into the pump.
- Hazardous substances must be separated out as far as this is technically possible before they reach the pump.
- External mechanical stresses and vibrations must not be transmitted to the pump. Only use flexible laboratory hoses for connecting laboratory vacuum systems.
- The overpressure generated at the pressure port must not exceed 1 bar.
- The pump must not be used to suck up fluids. Lay the exhaust pipe so that it slopes downwards, so allowing condensate to flow out of the pump. Collect the condensate and dispose of it in an environmentally compatible manner.

When handling glass vessels, pay attention to:

- Only use glass vessels with a plastic coating for splinter protection.
- Only use vessels which are suitable for use with vacuums (e.g. round-bottomed flasks). We recommend that only glass components supplied by the manufacturer are used. Do not use Erlenmeyer flasks.
- Before each evacuation, check glass vessels for damage which might impair their strength, replace them if any such damage is found.
- Do not heat glass vessels on one side only.
- Retardation of the boiling of the gases to be pumped can lead to a sudden pressure increase. Prevent retardation of boiling by means of suitable measures (e.g. turbulent agitation).

2.4 High Temperatures

Prevent the following maximum permissible temperatures from being exceeded.

- + 40 °C for the environment, and
- + 60 °C for the gas to be pumped.

The motor for single phase alternating current is protected against overload by an integrated motor protection switch.

2.5 Hazardous Substances

WARNING !

The operating company bears the responsibility for the use of the laboratory vacuum system.

Hazardous and harmful substances must be effectively prevented from escaping!

Ensure that all lines and connections are leak tight.

Handle exhaust gases in accordance with the requirements of the emission protection regulations.

Do not operate the Laboratory-Vacuum-System without a separator. The separator can only be emptied after the apparatus has been vented.

Dispose the condensate in an environmentally compatible manner!

Do not operate the Laboratory-Vacuum-System without a separator without a emission condenser. The separator can only be emptied after the apparatus has been vented.
Dispose the condensate in an environmentally compatible manner!

Hazardous substances in the gases to be pumped can cause personal injuries and property damage. Pay attention to the warning notices for handling hazardous substances.

The local regulations apply in foreign countries.

Combustible Gases

The user must assess the process in accordance with Directive 1999/92/EC (ATEX 137) for the extraction of explosive gas/air mixtures inside or outside a similar environment. In accordance with the requirements indicated by this assessment, a suitable device must be selected which fulfils the specifications of Directive 2014/34/EU.

Aggressive Gases

The diaphragm pump used is highly resistant to chemicals. In the case of particularly aggressive gases or products, the materials used for the pump parts in contact with gas must be assessed *(as described in chapter 3.1.2).*

Poisonous Gases

Use a separator when pumping poisonous or harmful gases. Prevent such substances from leaking out of the appliance or pump. Treat these substances according to the applicable environmental protection regulations.

The diaphragm pump, control valves and hose lines can be damaged by poisonous or aggressive gases.

Test the strength and leak-tightness of the connecting lines and the connected apparatus. Prevent environmental poisons, e.g. mercury, getting into the diaphragm pumps.

Fulfil the requirements, for example:

- German Hazardous Substances Regulation (GefStoffV) of 01. December 2010
- Regulations 2016/1179/EU
  (classification, packaging and identification of hazardous sub-stances),
- Manufacturer's safety data sheets on hazardous substances.

3 Description

3.1 Design and Function

3.1.1 Laboratory-Vacuum-System

A rotary evaporator can achieve its full performance capability as a result of precisely controlled, analytically pure vacuum.
The Laboratory-Vacuum-System **LVS 105 T – 10 ef** has been specifically designed to meet these requirements.
The chemically resistant diaphragm pump MPC 104 T provides an oil-free, dry and thus analytically pure vacuum to an ultimate pressure of < 2 mbar. The maximum pumping speed of 1.2 m^3/h is matched directly to the actual requirement by the speed control of the powerful and extremely quiet 24 V EC drive of the diaphragm pump.
The LVS thus always works optimally. With a high quantity of gas under full power = maximum speed, with a low quantity of gas correspondingly slower. That protects the diaphragm pump, reduces the already low energy consumption, and considerably reduces the noise level. At the same time, this desired reduction of the stroke rate leads to a reduction of the pump temperature and to increased condensation. To prevent this, the pump heads are held at a constant temperature by a control system.
Investigations have shown that this eliminates the need for a gas ballast valve. A gas ballast valve (*see chapter 3.4)* can be optionally mounted if this is not possible under certain conditions.
The new design, the functional and well-arranged structure, and the smaller dimensions allow trouble-free, time-saving cleaning.
The **LVS 105 T – 10 ef** is supplied complete with a suction-side separator and a pressure-side emission condenser in the form of an intensive cooler.

1	**Suction side connection** hose nozzle for hose DN8
2	**Separator** (round-bottomed flask) suction side
3	**Casing** Diaphragm pump MPC *(see fig. 2)* (fitted in the casing) with main switch
4	**Control level Vacuum Controller 521** with integrated grip recess
5	**Emission condenser KD 500/1 vacuum-isolated** at the pressure side with safety valve and cooling water connections, outgoing air connection (hose nozzle for hose DN8)
6	**Separator** (round-bottomed flask) outgoing air side
7	**Cooling water (feed flow / back flow)**
8	**Connection outgoing air** hose nozzle for hose DN8
9	**Main switch** (power)
10	**Main device fuse**
11	**Plug for non-heating device power cable** (main in)
12	**PC connector** (RS 232)
13	**Connector socket for water valve** (optional)
14	**Inert gas connection** DN 4

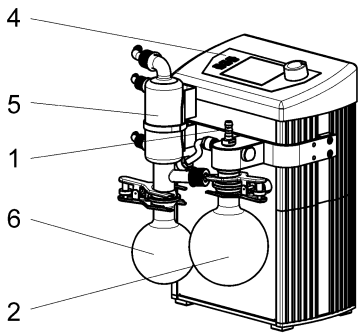


Fig. 1a LVS - Front view

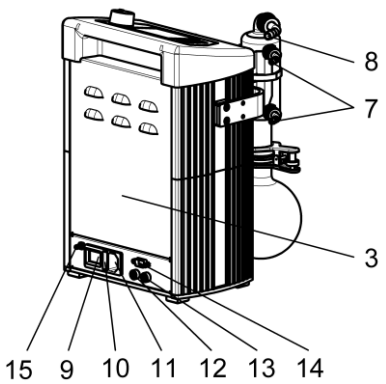
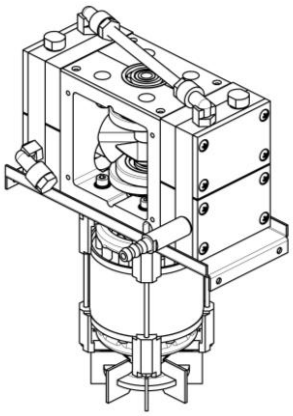


Fig. 1b LVS - Rear view

3.1.2 Diaphragm Pump

Design:

The diaphragm pump MPC 104 T consists of a pump body and a drive motor. The pump body consists of a drive shaft and four pump heads. Each pump head contains the form diaphragm and the work valves. The two pump heads are arranged opposite each other. In a three-stage (T) diaphragm pump, the two pump heads are connected in parallel, two further pumps in series. The pump heads are driven via an eccentric shaft with a connecting rod.	 *Fig. 2 Diaphragm pump MPC 104 T*

Function:

Motor, eccentric shaft and connecting rod set the form diaphragms in stroke movement. This changes the size of the space between the form diaphragms and pump head (pump chamber).
Increasing the size of the pump chamber opens the inlet valve while the outlet valve is closed (intake process). Decreasing the size of the pump chamber ejects the gas through the outlet valve.
The valves are actuated by the gas being pumped. A large proportion of fluid in the diaphragm pump minimizes the pumping efficiency.

Materials of the Medium-affecting Pump Parts:

Component	Materials
Seal	EPDM
Screw Fitting / Connecting Elements	PP, PVDF
Valve	PEEK
Form Diaphragm	Elastomer + PTFE Layer
Vacuum Hose	PTFE
Connection Head / Pump Head	PTFE with Carbon-fibre reinforcing *)

*) electrically conductive (with manufacturer's certificate of electrical conductivity)
Material resistance to aggressive media see: Publisher Hoppenstedt Publishing (18. September 2007)

3.1.3 Vacuum Controller 521

Into the existing hardware of the vacuum controller 521 a particularly developed software was installed.

Technical Data: *see chapter 4*
Operation: *see chapter 6*

3.2 Areas of Application

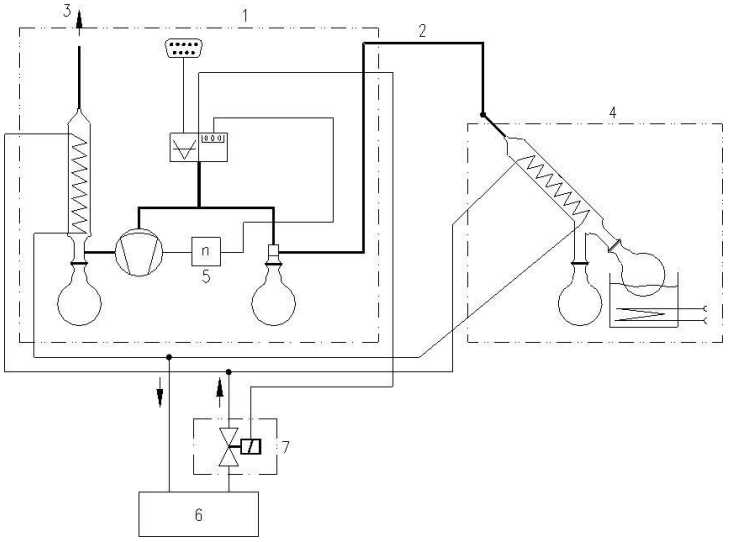
The Laboratory-Vacuum-Systems are intended for:

- vacuum filtration, vacuum distillation and vacuum drying
- use in physical and chemical laboratories in trade and industry
- pumping and compressing neutral and aggressive gases and vapours
- generating a vacuum up to an ultimate pressure of 2 mbar

Special Designs:

- Special LVS can be supplied after consultation with the manufacturer or for a corresponding supply contract.
- Motors for different voltages.

3.3 Example of Application

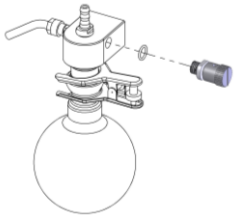


1	LVS 105 T – 10 ef
2	Suction line *
3	Outgoing air
4	Rotary vaporizer *
5	frequency-regulated pump motor
6	Coolant system, un pressurised run back *
7	Water valve WV *

Fig. 3 Example of Application

* Not included in the scope of delivery

3.4 Accessories

	**Operating Software „WELCH-Control 521“ on CD** to connect the vacuum controller to the PC **Order No. 620637**
	**Vacuum Control Box VCB 521 cv** Table model as digital, chemical-resistant vacuum regulator. With integrated sensor, airing -, control- and check valve. Connection vacuum apparatus: DN 8 Connection vacuum pump: DN 8 Connection inert gas: DN 4 Connection water valve: Binder plug 4-pole 24V DC **Order No. 600053**
	**Gas Ballast Valve** **Order No. 400599-01**
	**Inlet Fitting PP, DN 16 KF – ¼“** **Order No. 710116**
	**Mains Connection Cable IEC with Plug Type 12 (CH)** for LVS … in 230 V **Order No. 825877**

3.5 Scope of Delivery

The scope of delivery is specified in the supply contract.

4 Technical Data

4.1 View of Device and Dimensions

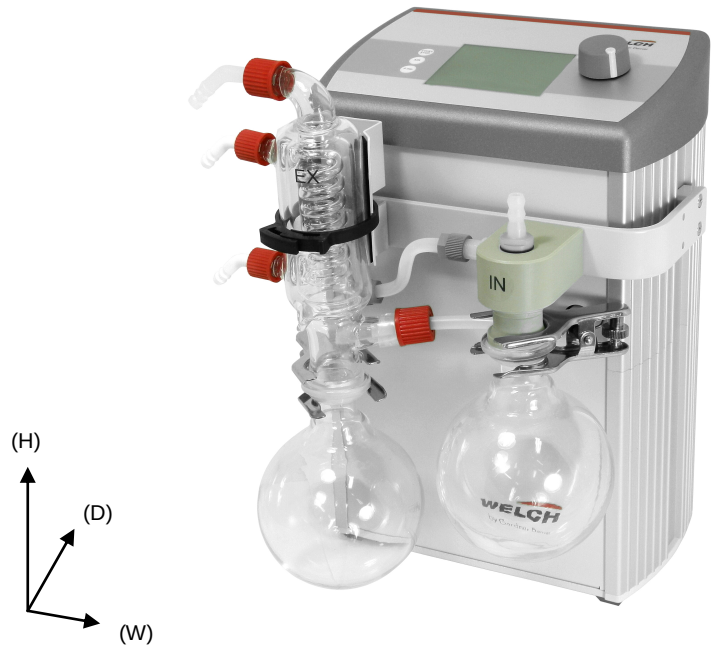


Fig. 4 View of Device, Dimensions see chapter 4.3

4.2 Intake Pressure / Pumping Speed – Diagram

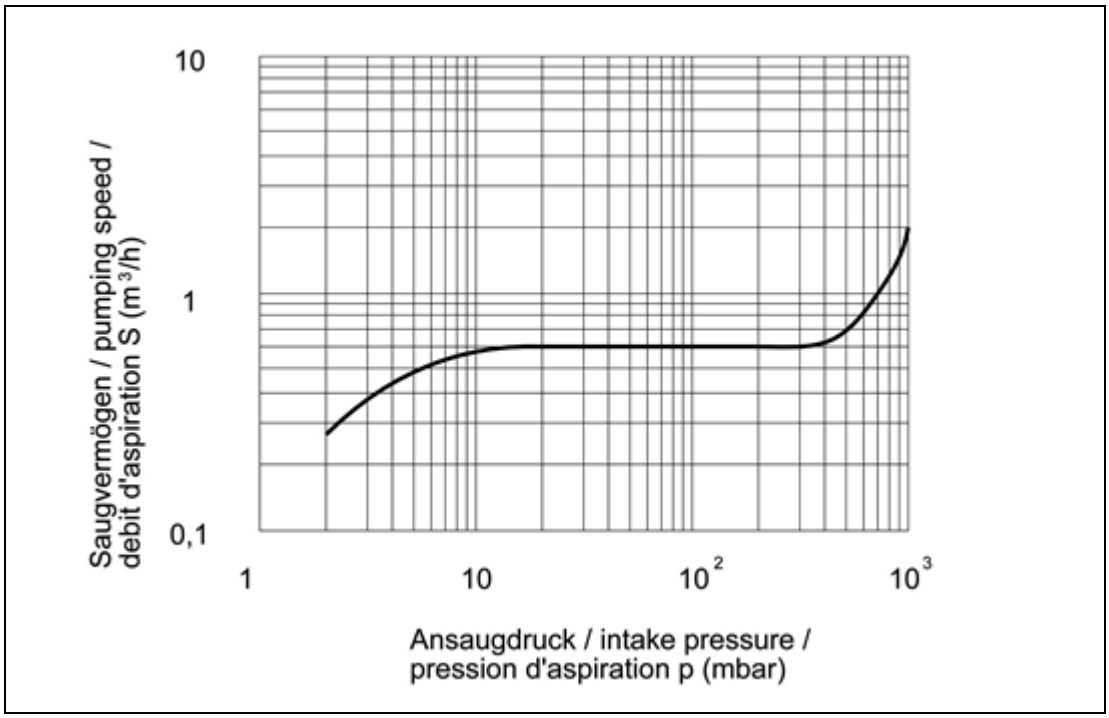


Fig. 5 Intake Pressure / Pumping Speed – Diagram

4.3 Device Data

Parameter	Data	Unit
Pumping speed 50/60 Hz	1.2	m^3 / h
at speed of 1500 rpm (DIN 28432)	20	l / min
Ultimate pressure at speed of 1500 rpm	< 2	mbar
Max. inlet pressure	1	bar
Max. outlet pressure	1	
Intake and pressure ports	Hose nozzle DN8 for hose inside diameter 8 mm	-
Ambient temperature	+ 10 to + 40	°C
Max. Operating gas temperature	+ 60	
Bearing	maintenance-free	-
Reference surface sound pressure level DIN EN ISO 2151	< 44	dB (A)
Voltage / Frequency (generally with motor protection switch, switch and cable)	90 – 260, 50 / 60	V-AC, Hz
Power	90	W
Operating mode	S 1	-
Type of protection DIN EN 60529	IP 20	
Motor / Class of insulation DIN EN 600034-1	F (160°C)	
Fine fuse (slow-acting)	T 6.3	A
Dimensions (W/D/H)	250 / 260 / 435	mm
Weight	9.5	kg
Order no.	114184	-
Vacuum Controller :		
Sensor interface :	3 conductor interface	-
- Scan frequency	10	Hz
- Resolution ADC	12	Bit
- Power supply	+ 5 stabilized	V
- Sensor signal	0.5 to 4.5 *(optionally also 4..20 mA per jumper possible)*	
Display of pressure	digital or graphic	-
Switching accuracy / control accuracy	±1	digit
Switching outputs :	digital	-
- Voltage level	0; 24	V
- Control power, single	2 x 6	W
- Control power, total	24	
Switching outputs used :	2	-
- Ventilation valve	x	
- Water valve	x	
Output frequency changer :	analog	-
- Voltage level	0 to 10	V
- Resolution DAC	16	Bit
Communication interface	RS 232	-
Power consumption - controller in normal operation	max. 15 *(depends upon the control power)*	W
Fuse (internal controller)	5	A
Sensor :	*integrated*	
Sensor type	ceramic sensor	-
Measuring range	1 - 1100	mbar
Accuracy in sum linearity, hysteresis and reproducibility	< ± 0,3 % FS	
Power pack :	*integrated*	
Operating voltage	90 – 260	V-AC
Operating frequency	50 / 60	Hz
Output voltage	24	V DC
Output current	1.25	A
Output power	100	W
Connections :		
IN/OUT : RS 232	SUB-D plug 9-pole	-
OUT: Water valve	Binder socket 4-pole, 24 V DC	
Connection: Inert gas	integrated, Hose nozzle DN 4	

The information presented in this material is based on technical data and test results of nominal units. It is believed to be accurate and reliable and is offered as and aid to help in the selection of products.
It is the responsibility of the user to determine the suitability of the product for the intended use and the user assumes all risk and liability whatsoever in connection therewith. Gardner Denver Thomas GmbH does not warrant, guarantee or assume any obligation or liability in connection with this information.

5 Assembly and Installation

5.1 Unpacking

Carefully unpack the Laboratory-Vacuum-System.

Check the system for:

- Transport damage,
- Conformity with the specifications of the supply contract (type, electrical supply data),
- Completeness of the delivery.

Please inform us without delay if there are discrepancies between the delivery and the contractually agreed scope of delivery, or if damage is detected.
Please take note of the general terms of business of the manufacturing firm.
In case of a claim under warranty, the device must be returned in packaging that is suitable for protecting it during transport.

5.2 Installation and Connection

- Set the Laboratory-Vacuum-System on a flat and horizontal surface.
- Remove the protective caps on the connections.
- Connect the intake connector of the LVS to your apparatus with vacuum hose DN 8.
- Connect the cooling water tube to the emission condenser.
- The cooling water return flow must be unpressurized.
- Connect the air exhaust to the central air exhaust system.
- Connect the Laboratory-Vacuum-System to the power supply.
- Check that the connections are properly seated.

5.2.1 General Instructions

	**CAUTION !**
Observe the basic safety instructions when using the LVS.	

The pressure device regulation 2014/68/EU must be observed if devices with an overpressure of 0.5 bar or more are connected.
The pressures at the suction and pressure sides of the diaphragm pump at the time it is switched on must correspond to the specifications of DIN 28432.
In order to avoid pumping speed losses, all the vacuum connecting hoses used should have a large nominal diameter and should be laid out so that the lengths are as short as possible. Avoid rigid connections. They must be assembled carefully in order to achieve a low leak rate.
We recommend fitting **non-return valves** (order no. 720327) for applications with several consumers.

The upstream **separator** on the suction-side serves to protect the diaphragm pump and the vacuum sensor from condensates and mechanical contamination. It must be used for an application.
The level in the separator must be monitored and the separator emptied regularly. The currently valid regulations must be observed when disposing of waste. The separator on the suction-side can only be removed and emptied after the system has been vented.

The **emission condenser** enables a 100 per cent recovery of the solvents led through the vacuum pump. Cooling takes place via the DN 8 hose nipples. Ensure that the outflow is clear. The **safety valve** is located at the gas inlet. The rubber valve seal must be checked for cracks at regular intervals and exchanged when necessary. The exhaust connection must be unpressurized. The exhaust can be led off through a DN 10 hose into a suitable evacuation duct. There is common solvent reclamation for all the connected systems. Mixing media must not lead to a hazard for persons, the environment of for the equipment.

In case of soiling by solid matter, the pump heads must be opened and the entire interior space, including valves and diaphragm, cleaned mechanically (*see chapter 7.2.1)*.

5.3 Storage

The pumps are to be stored in a low-dust, interior room within the temperature range from + 5 to + 40 °C and at a relative air humidity < 90%.
Leave the protective elements on the intake and exhaust ports. Another equally good protection may be used.

5.4 Scrap Disposal

	**CAUTION !**
The Laboratory-Vacuum-Systems must be disposed of in accordance with the 2012/19/EU guideline and the specific national regulations. **Contaminated pump systems must be decontaminated according to the laws.**	

6 Operation

6.1 Starting Up

The LVS is switched on by the rocker switch **POWER** located on the device.

The device is ready for operation after a short initializing routine, during which a signal tone sounds and all light elements light up briefly.

6.2 Operating modes of the Controller

The following modes are available:

0 -	STOP	Controller is inactive and can be configured
1 -	Manual operation	With specification of the setpoint and, if required, lowering
2 -	Automatic operation	The setpoint is detected automatically from the pressure development
3 -	Ultimate pressure	Pumping out at maximum motor output
4 -	Self cleaning	Motor runs for 2 minutes at open ventilation valve

6.2.1 Mode 1, Manual operation

The vacuum valve is closed when the pressure reaches the setpoint. Closed-loop control between the set hysteresis and the setpoint has been started.
For **operation with a frequency converter**, an analog voltage is output, which controls the speed according to the standard tolerance. If the set pressure is not reached, the speed is automatically adjusted to the pressure loss.
If the pressure is actively lowered, after the setpoint has been reached for the first time, it is lowered still further within a settable timeframe. The number of ramps can be set up to a maximum of 3. Each ramp starts with a holding time. The setpoint then falls in one step to the defined starting pressure. The setpoint then falls to the final value over the set time.
After the last ramp, there is a waiting time until the automatic **STOP**
(0 – the last set pressure is held indefinitely until **STOP** is pressed manually).

CAUTION !

When setting the ramps make sure that the set value is greater than or equal to the starting value of the first ramp.

The closed-loop control and hysteresis are always related to the current (reduced) setpoint. The changed setpoint always applies until the **STOP** button is pressed, then the configuration value applies once more. When the pressure reduction has finished, the control is stopped, and the system waits until the **STOP** button is pressed.

6.2.2 Mode 2, Automatic operation

After selection of the operating mode, the controller starts the evacuation. The pressure drop per minute is determined during this process. If increases during distillation by incipient boiling of the pressure, then this pressure value is taken as the setpoint and proceeds in the normal control operation.

6.2.3 Mode 3, Ultimate pressure

By pressing of the key **P min** evacuation takes place at maximum pump speed until the user presses **STOP**.

6.2.4 Mode 4, Self cleaning

The Mode "Self cleaning" is used for flushing the pump and can, if desired, also be carried out several times in succession. After a waiting period of 5 seconds, the evacuation for 2 minutes (at maximum pump power and open vent valve) is carried out. A aborting the process at any time by pressing the encoder **(4)** possible.
Self cleaning for Controller-version „cv“: The control valve (cv) remains closed when the mode **Manual** or **Automatic** the "ventilation at STOP" parameter = "0".

6.3 Monitoring by Level Sensor

If the level sensor input is activated (optional), the device goes into **STOP** status when "Tank full" is signalled.

6.4 Calibrating the Pressure Sensor

A two-point calibration is made with a comparison measurement device.

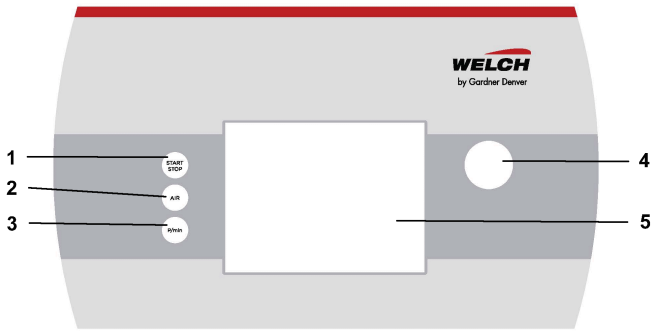
Calibration at ambient pressure:	Calibration at ultimate pressure:
- The diaphragm pump is switched off.	- The diaphragm pump is switched on.
- The venting valve is open.	- The venting valve will be closed.
- The vacuum valve is closed.	- The vacuum valve will be open.
- The ambient pressure to set.	- The ultimate pressure to set.

CAUTION !

Instead of measuring the pressure with a comparison measurement device, the ultimate pressure of the pump used may also be input if this is known with sufficient accuracy (take note of evacuation time).
Ensure that the set pressure is also present at the sensor.

6.5 Handling

6.5.1 Control panel



1	**START - STOP**	**4**	Encoder (turn / press)
2	**AIR** - ventilation		with marking point on encoder
3	**P min** - pressure drop	**5**	Display

Fig. 6 Control panel

6.5.2 Operating via Buttons and Encoder

The menu is operated with the encoder.
The menu option is selected by turning the encoder anticlockwise, and then confirmed by pressing.
A pop-up window is provided for changing numerical values. They are accepted by pressing the encoder.
The process can be cancelled by pressing **START - STOP**.

Key:	**Meaning**
AIR	- Switches the venting valve on if the control is inactive.
	- Opens the venting valve as long as the button remains pressed while control is active.
P min	- Starts "ultimate pressure" mode directly.
START STOP	- Starts the operating mode currently selected in the main menu and the corresponding set value.
	- Starts the operating mode manually with the currently selected setpoint in the solvent table, *see chapter 6.9.*
	- Stops the active mode
	- Cancels the input in the pop-up window.
	- Jumps back to the main menu from submenus.
Encoder:	**Meaning**
	- *Turn* to select the operating mode.
	- *Press* to select the setting menu for the corresponding operating mode.
	- *Turn* to select menu items.
	- *Press* to open Change pop-up window.
	- *Turn* to change values.
	- *Press* to confirm the changed value.
	- When active: *Turn* to change setpoint.
	- When active: *Press* to accept current value as setpoint.

After the current operating mode has been stopped by pressing **STOP**, the vacuum valve is closed.
The venting valve takes the selected status (Option: **AIR_ON_STOP**).
The originally selected values are retained on start.

6.5.3 Menu Guidance

After the start, the main menu appears with its 5 submenus, *which are shown below:*

- Manual
- Automatic
- Low pressure
- Configuration
- Self cleaning

Configuration: language

⇩

MAIN-MENU	
Manual Automatic Low pressure Configuration Self cleaning	VCZ 521 V 1.15
	P = 960 mbar

Configuration	
language display settings pressure unit calibrate back	VCZ 521 V 1.15
	P = 960 mbar

language	
English Deutsch Français Español back	VCZ 521 V 1.15
	P = 960 mbar

- Select one of the available languages

Configuration: display settings

⇩

MAIN-MENU	
Manual Automatic Low pressure Configuration Self cleaning	VCZ 521 V 1.15
	P = 960 mbar

Configuration	
language display settings pressure unit calibrate back	VCZ 521 V 1.15
	P = 960 mbar

display settings	
contrast brightness display interval min. pressure max. pressure back	VCZ 521 V 1.15
	P = 960 mbar

- Select contrast in the display
- Select brightness in the display
- Graphic display:
  - Number of measurements per second
  - Display of min. pressure
  - Display of max. pressure

Configuration: pressure unit

MAIN-MENU	
Manual Automatic Low pressure Configuration Self cleaning	VCZ 521 V 1.15
	P = 960 mbar

Configuration	
language display settings pressure unit calibrate back	VCZ 521 V 1.15
	P = 960 mbar

pressure unit	
mbar torr psi hPa back	VCZ 521 V 1.15
	P = 960 mbar

- Select measured values for display

Configuration: calibrate

MAIN-MENU	
Manual Automatic Low pressure Configuration Self cleaning	VCZ 521 V 1.15
	P = 960 mbar

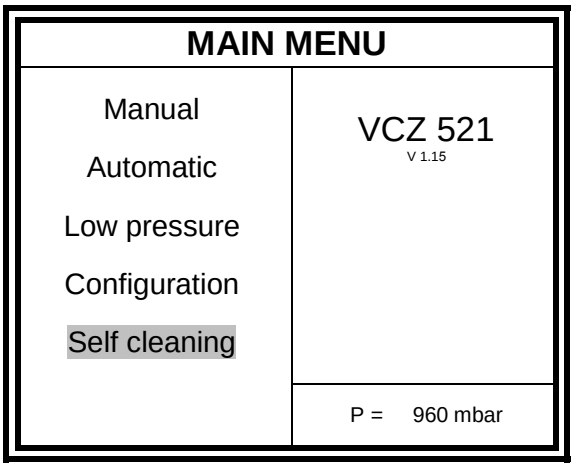
Configuration	
language display settings pressure unit calibrate back	VCZ 521 V 1.15
	P = 960 mbar

calibrate	
Cal. Start pressure Cal. Low pressure back	VCZ 521 V 1.15
	P = 960 mbar

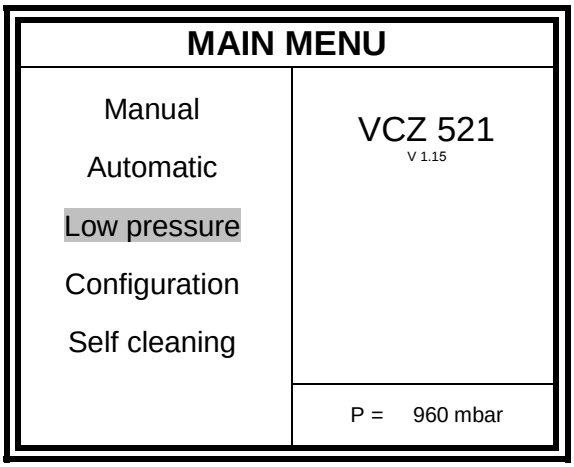
- Selection of the upper pressure value
- Calibration of the lower pressure value

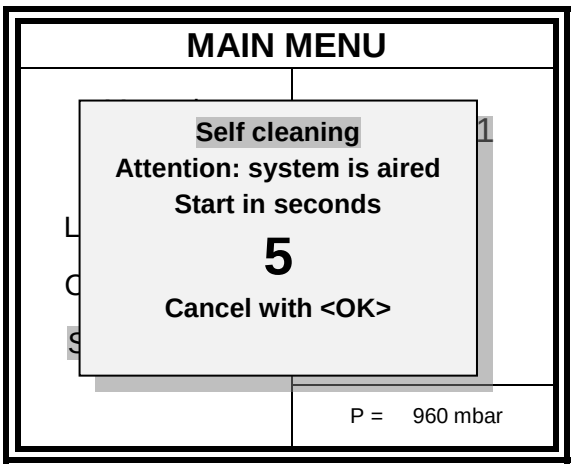
The current value of the comparison measurement device must always be entered for calibration. The correction values are then calculated from this. It is recommended to always make both calibrations.

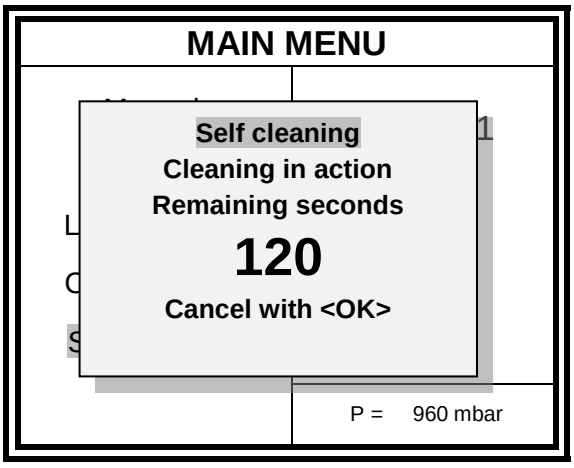
Self cleaning:



Low pressure:

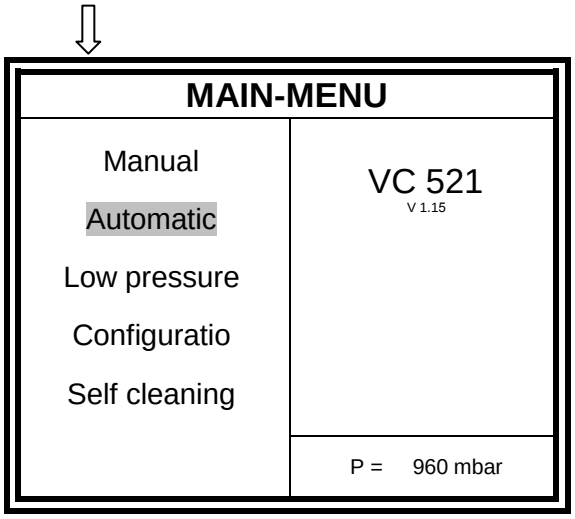


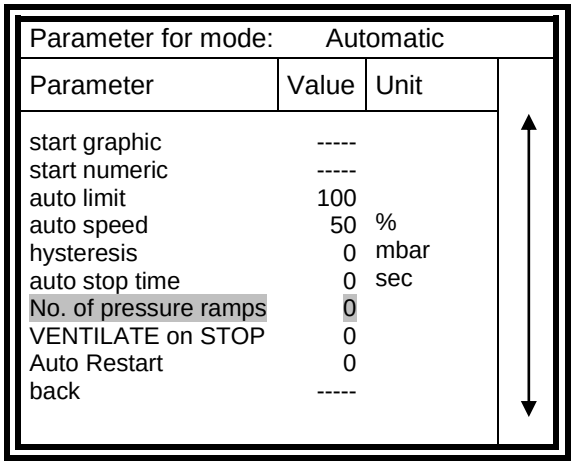


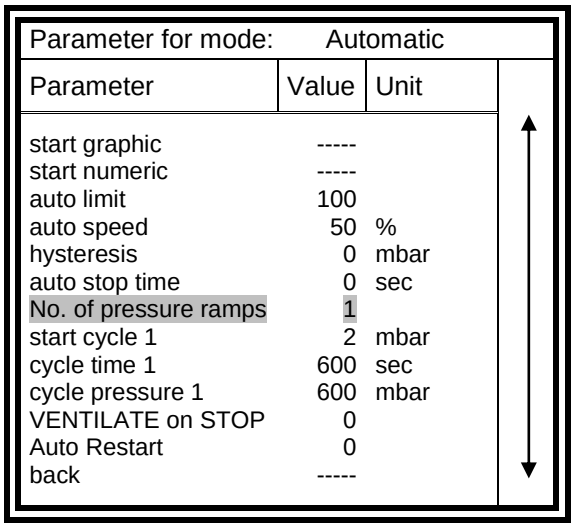


- Selection self-cleaning -
  for flushing the pump (Process several times in succession possible)
- Starting the pump system
  All control settings are ignored (P min).

Automatic:

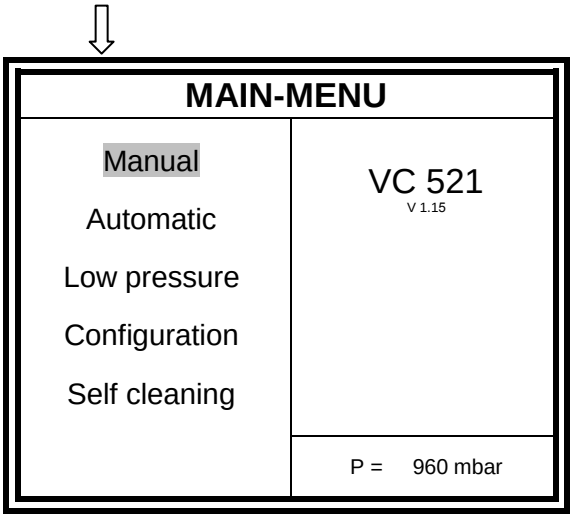


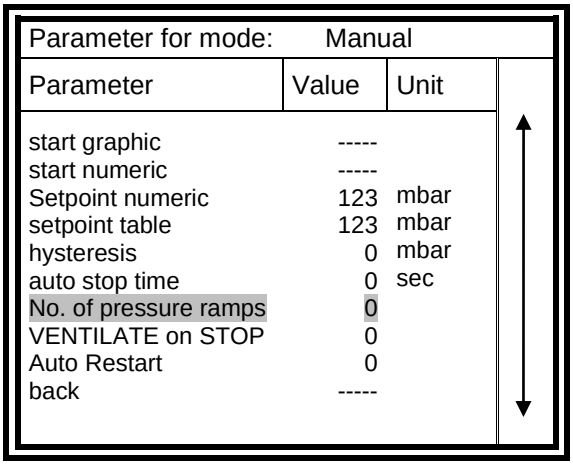


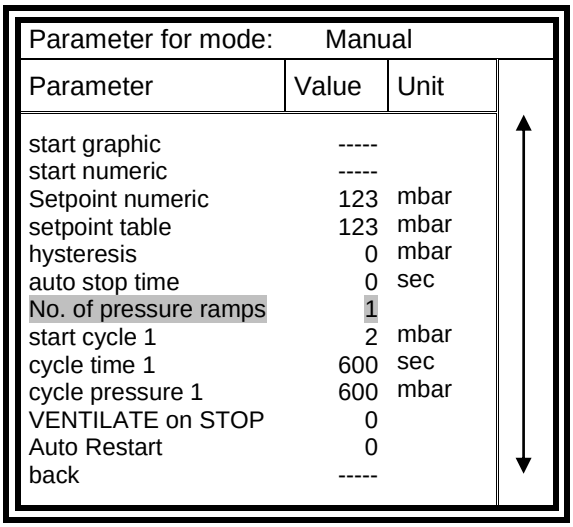


- Select and set the displayed values.
- Values that are not required are not displayed. Parameter display: "Hysteresis" only when operating without a FU-Motor (Factory settings!)

Manual:







- Select and set the displayed values.
- Values that are not required are not displayed. Parameter display: "Hysteresis" only when operating without a FU-Motor (Factory settings!)

6.6 Electrical parameters

6.6.1 Printed circuit board – Layout and Connections

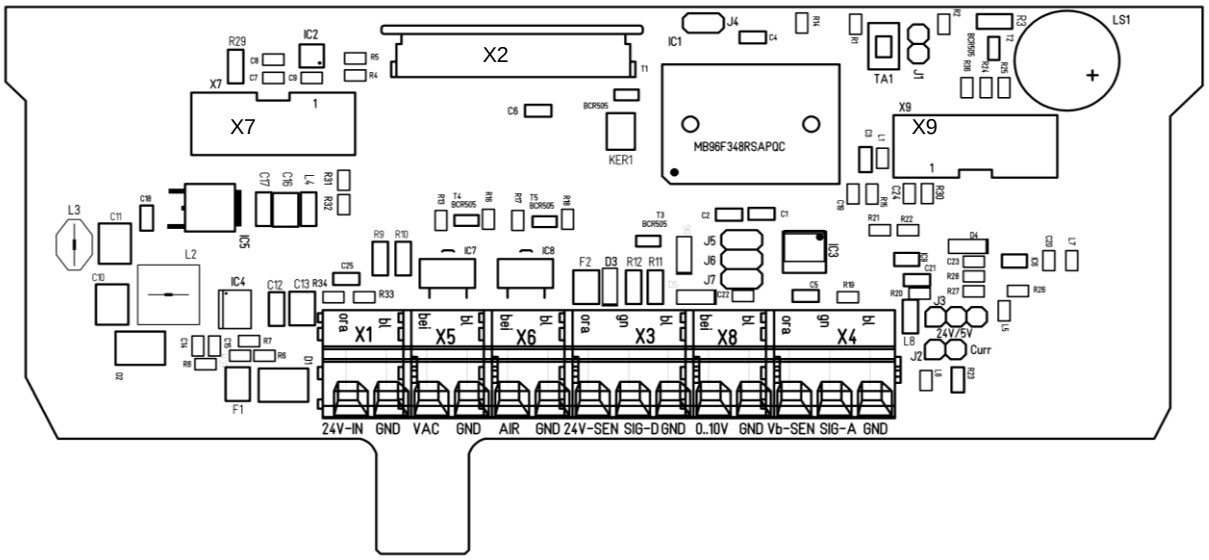


Fig. 7 Positions of components and interfaces

6.6.1.1 Electrical Interfaces

Location of interfaces, *see Figure 6*

The device is supplied with 24 V DC.

X1 Power supply input
Spring contact clamp Wago type 236 / 2-pole

Pin no.	Function	Specification	Comment
1	GND		reverse polarity protected / blue
2	Primary power supply	24V DC ± 10%, 1.5 A	reverse polarity protected / orange

X2 LCD Display BP320240E / INTERNAL
FFC Würth 686124144 24-pole / RM 1mm

Pin no.	Function	Specification	Comment
1	RESET		
2	/RD		
3	/WR		
4	/CS		
5	A0		
6	D0		
7	D1		
8	D2		
9	D3		
10	D4		
11	D5		
12	D6		
13	D7		
14	VDD		
15	VSS		
16	VLCD		
17	free		
18	SK/X1		
19	D0/X2		
20	D1/Y1		
21	CS/Y2		
22	INT		
23	LED+		
24	LED-		

X3 PLC input 1- Level sensor
Spring contact clamp Wago type 236 / 3-pole

Pin no.	Function	Specification	Comment
1	GND		bl
2	SENSOR 1 or PCL input 1	I in approx. 10 mA / $U_{threshold}$ approx. 13 V	gn
3	Sensor supply	Corresponds to the voltage at X1 / protected by 200 mA self-resetting circuit-breaker	orange

X4 Pressure sensor 1 input
Spring contact clamp Wago type 236 / 4-pole

Pin no.	Function	Specification	Comment
1	GND		blue
2	SENSOR 1 Signal	0..5 V or 0..20 mA	Resolution 5 mV / green
3	Sensor supply	5 V ± 5% or Corresponds to the voltage at X1 / protected by 200 mA self-resetting circuit-breaker	Not fused / beige

The input can be configured with jumper **J2**:

- J2 open: (Default) Voltage: 0..5 V
- J2 plugged: current 0..20 mA

The sensor supply voltage can be configured with jumper **J3**:

- J3 1-2: 24 V needed for current output
- J3 2-3: 5 V (Default) needed for voltage output (depending on sensor data sheet)

X5 PLC output 1 – vacuum valve

X6 PLC output 2 – venting valve
Spring contact clamp Wago type 236 / 2-pole

Pin no.	Function	Specification	Comment
1	GND output		bl
2	Output	Corresponds to the voltage infeed at X1 / pnp max. 0.5 A	with freewheeling diode / orange

X7 RS232 to the PC
Tub plug connector, 10 pin via FB to Sub-D-plug, 9-pin (Würth 618009221823)

Function	Pin at tub plug connector	Pin at SUB - D	Comment
RXD	3	2	
TXD	5	3	
GND	9	5	

X8 Analog output 1 – Frequency converter pump speed
Spring contact clamp Wago type 236 / 2-pole

Pin no.	Function	Specification	Comment
1	GND		bl
2	Output 1	0..10 V max. 10 mA	Resolution 2 mV / gr

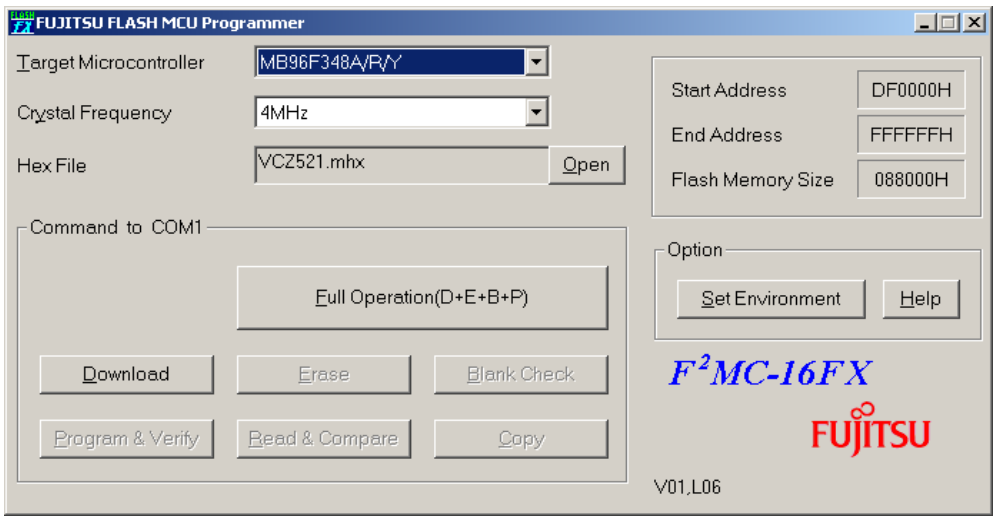
X9 DEBUG / INTERNAL
Tub plug connector, 10 pin / RM 2.5mm

Pin no.	Function	Specification	Comment
1			
2			
3			
4			
5	Level converter supply	5 V ± 5%	not fused
6			
7			
8	TXD	5 V level	
9	RXD	5 V level	
10	GND		

6.6.2 Software-Update

The software in the controller can be updated.
It can be re-input by the user. The Fujitsu Flash tool must be used for the Fujitsu 16FX CPU range.
The factory default settings can be made with a corresponding sequential number input again (VCZ521_XXX.mhx).

⚠	**NOTE !**
The highest sequential number VCZ521_XXX.mhx is always the most current software version. *(currently: VCZ521_115.mhx)*	



The following steps must be carried out:

- Switch off the controller
- Call the flash program.
- Select the processor MB96F348A/R/Y
- Select the quartz frequency 4 MHz
- Select the program file
  (Most Current Version = Highest Sequential Number, VCZ521_XXX.mhx)
- Select the serial interface used (Option / Set Environment)
- Start the programming with "Full Operation"
- Confirm the Box (PC) „Reset ...“ with OK
- Switch on the controller quickly (don't forget timeout of approx. 15 seconds!)
- The programming runs automatically.
- Switch off the controller again after the OK message
- Switch on the controller, and check the functions of the controller

⚠	**CAUTION !**
The controller should be switched off during each interruption.	

6.7 Operation using the "WELCH-Control 521" PC program

The "WELCH-Control" enables the vacuum controller to be operated simply and easily from the PC. The program can be purchased and installed as an option.

Make the cable connection (O-Modem) between PC and controller.

PC program	Most Current Version	Order no.
WELCH-Control 521	V 1.15	620637

CAUTION !

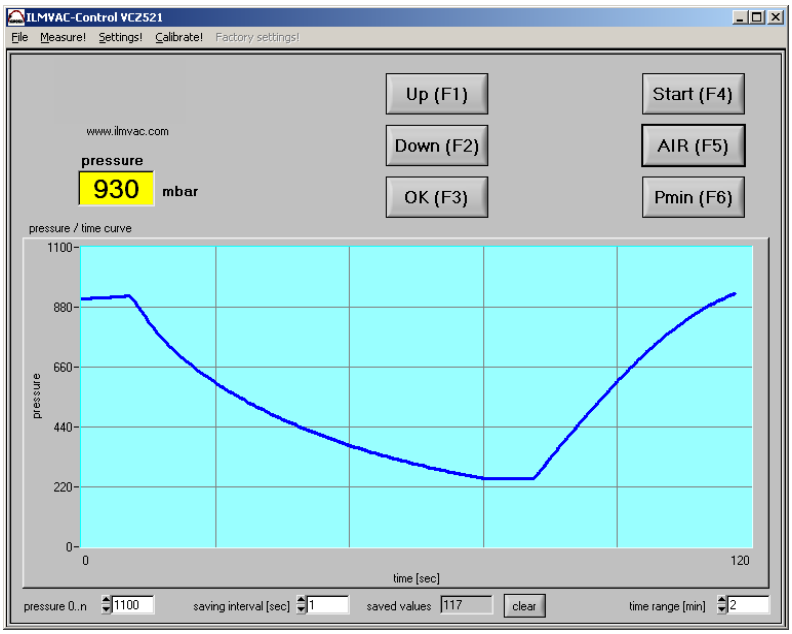
1.) "WELCH-Control 521" is currently version V 1.15.
2.) Flash software is also currently version VCZ521_115.mhx.
3.) Version 1.) and 2.) need not be identical!

The program attempts to find a switched-on controller on COM1 to 20. A COM-Port 1..255 can also be defined as a command line parameter: VCZ521.EXE 2 -> select COM2
If a controller cannot be found, the program goes into offline mode.
Here, a previously saved curve can be reloaded and printed out.

Internal wiring of the controller RS 232 port

PIN	Cable colour	Connection on the main board	
2	white	16	RS 232 - RXD
3	brown	17	RS 232 - TXD
5	green	18	GND
9	yellow	19	Flash - sets software update mode if on GND (18)

The following screen appears after the start:



The graph shows the pressure development. Both the chronological and the pressure display range can be set. Data can also be recorded in the PC memory, which can then be stored as an ASCII file in the "File / Save memory" menu.

In the PSI pressure range, the pressure values for the curve are multiplied by 100 to remain with integers.

The curve can be printed out by the system printer via the "File / Print curve" menu.

The buttons largely correspond to the buttons on the controller. However, the buttons cannot be held down.

- In active mode, the **AIR** button can be used with the mouse like on the controller. Pressing the mouse button opens the valve, releasing it closes the valve again. However, this only works if the mouse pointer is still on the **AIR** button.
- The **Up** and **Down** arrow buttons change the temporary setpoint in active mode.
- The **OK** button only works in active mode, and sets the current pressure as the new set value.
- The **Start** button starts or ends in the current operating mode.
- The **Pmin** button functions the same as without a controller.

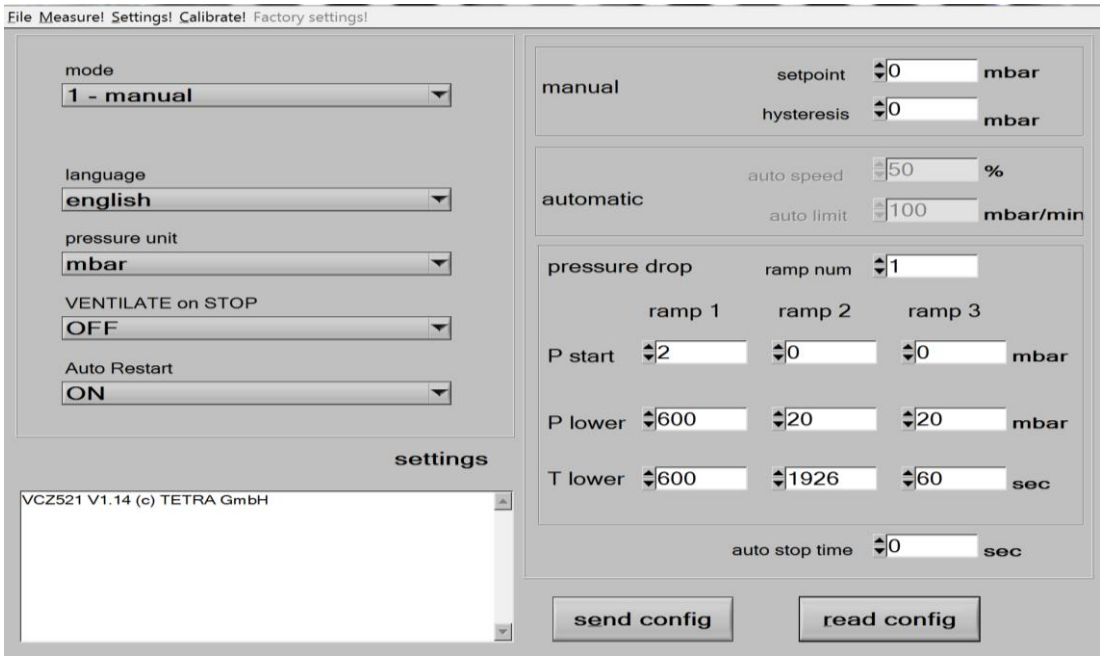
The following menu items can be selected from the menu bar:

- File
- Measure!
- Settings!
- Calibrate!
- Factory settings!

6.7.1 Menu item: „File“

File	
Save settings	Saving the Settings dialog settings in a file
Load settings	Loading the Settings dialog settings from a file
Print settings	Printing out an image of the Settings dialog on the standard printer
Save memory	Saving the pressure data in a file
Load memory	Load the print data from a file
Print curve	Printing out the current pressure curve on the standard printer
Password	Changing the basic setting of the controller is password-protected. Release is given by inputting the date as a hex number. **Example : 25.03.2015 = 250315 = 3D1CB** *(Required for activating the "Calibrate" and "Factory settings" menus and the direct input of pressure offset und pressure factor in the „Calibrate“ Dialog)*
Info	Information about the program version
Exit <ESC>	Exit program

6.7.2 Menu item: „Settings!“

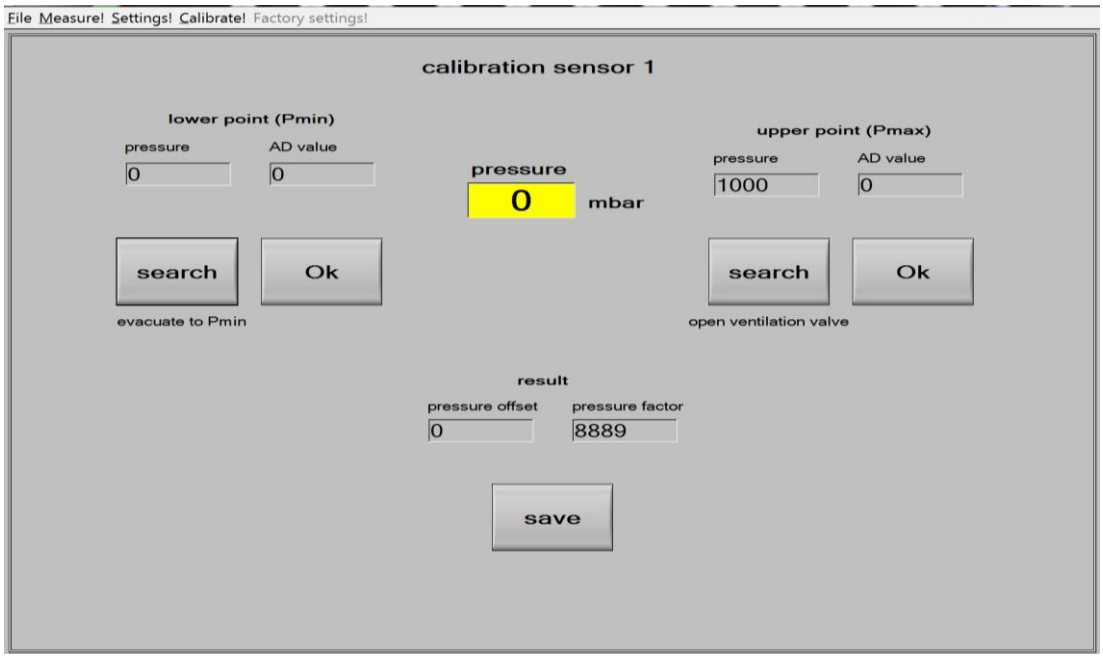


	CAUTION !
Settings not required for the selected operating mode are disabled and grayed out in the display. Appropriate error messages are displayed if the data ranges are exceeded or if inputs are illogical.	

Settings required for the control behaviour of the controller:

Designation		Explanation
Software WELCH-Control 521	**Control panel at the controller**	
mode	**MAIN MENU**	**1** - manual (manual pressure setting for boiling pressure)
		2 - automatic (automatic finding of the boiling pressure)
		3 - low pressure Operation without regulation
		There are only the modes meaningful for their application adjustable.
language	**-**	english, german, french, spain
-	**Configuration, language**	English, Deutsch, Français, Español
pressure unit	**pressure unit**	mbar, torr, psi, hPa
VENTILATE on STOP	**-**	**ON** - automatic venting after STOP is on
		OFF - automatic venting after STOP is off
-	**VENTILATE on STOP**	**0** - closed
		1 - open
Auto Restart	**-**	**OFF** - no function
		ON - The program works automatically continues after power failure or shutdown.
-	**Auto Restart**	**0** - no function
		1 - The program works automatically continues after power failure or shutdown.
manual, setpoint	**setpoint**	Enter a setpoint pressure value between 0 and 1100 mbar.
manual, hysteresis	**hysteresis**	Enter a hysteresis value between 0 and 1100 mbar.
pressure drop, ramp num	**No. of pressure ramps**	Number of possible ramps 1, 2 , 3
P start, ramp 1 – 3	**start cycle 1 – 3**	in adjusted pressure value (example: mbar)
P lower, ramp 1 – 3	**cycle time 1 – 3**	in second absolute
T lower, ramp 1 – 3	**cycle pressure 1 – 3**	in adjusted pressure value absolute (example: mbar)
auto stop time	**auto stop time**	Hunting time in second
auto limit	**auto limit**	Threshold value for detecting the boiling point (selected pressure unit / min)
auto speed	**auto speed**	0 ... 100% Reduces the frequency of rotation / rotational speed to a percentage of the maximum speed of the pump motor in order to determine the boiling point smoothly.
read config	**-**	Read out current parameter values from the controller and display in the Settings dialog.
send config	**-**	Values changed in the Settings dialog are stored in the controller. The controller confirms reception with a signal tone.

6.7.3 Menu item: „Calibrate“



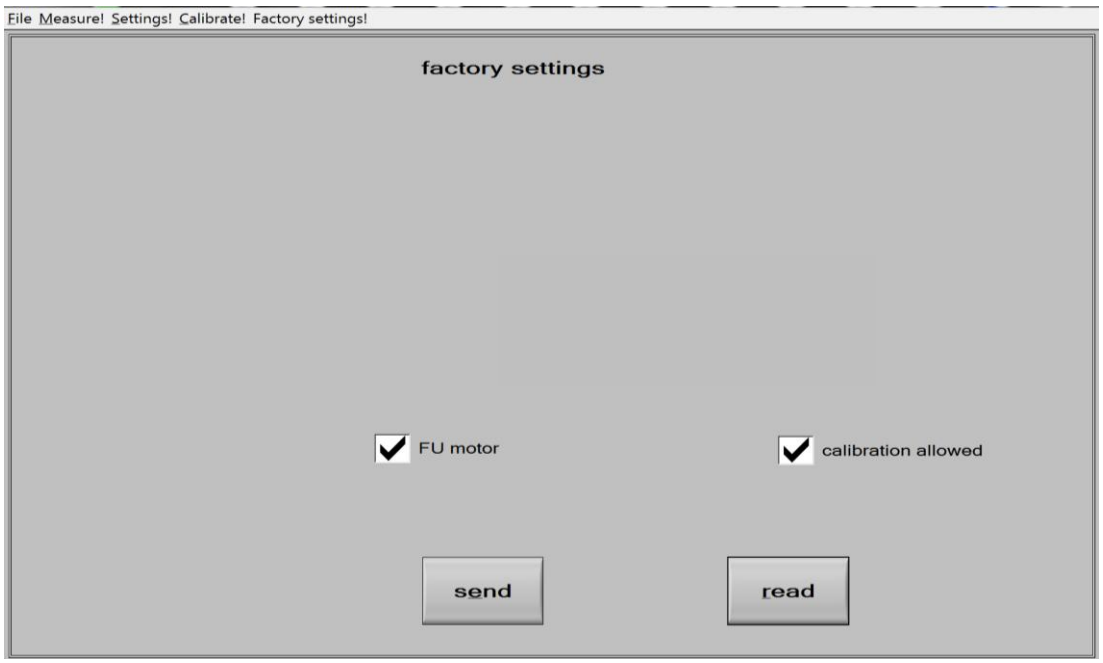
Calibration:

When **search lower point (Pmin)** is activated, evacuation is to the lower point. If the pressure does not fall any further, the value can be entered by using a comparison measurement device and confirmed with **Ok**. The system is vented and the ambient barometric pressure entered as the **upper point (Pmax)**. Do not confirm until the value has been established.
If the controller is integrated in a complete system or pump system (LVS), evacuation and venting take place automatically when the stated buttons are pressed.
The calculated correction values are displayed and can be stored with **save**.

⚠	**CAUTION !**
Ensure that the set pressure is also present at the sensor.	

Designation		Explanation
Software WELCH-Control 521	**Control panel at the controller**	
Lower point	**CL**	at low pressure - pressure of comparison measurement device (at lowest possible pressure, e.g. 10 mbar)
Upper point	**CH**	at normal pressure (high) - barometric pressure

6.7.4 Menu item: „Factory settings“



Designation		Explanation
Software WELCH-Control 521	**Control panel at the controller**	
FU motor	not settable	analog output active
calibration allowed	not settable	√ = present
		= not present
read	not settable	Reading the set values Confirmation of acceptance by signal tone
send	not settable	Transmission of changed values to the controller Confirmation of acceptance by signal tone

CAUTION !

These settings are adapted by the manufacturer to match the supplied configuration. The user can change the settings after inputting the password (“File” menu item).

6.8 Table of solvents

Solvent	Formula	Vacuum (mbar) for boiling point at 40 °C
Acetone	C_3H_6O	556
n-amyl alcohol, n-pentanol	$C_5H_{12}O$	11
Benzole	C_6H_6	236
n-butanol	C_4H_{10}	25
tert-butyl alcohol, 2-methyl-2-propanol	$C_4H_{10}O$	130
Tetrachlorometane	CCl_4	271
Chlorobenzene	C_6H_5Cl	36
Chloroform	$CHCl_3$	474
Cyclohexane	C_6H_{12}	235
Diethyl ether	$C_4H_{10}O$	no vacuum
1, 2, -dichlorethane	$C_2H_4Cl_2$	210
1, 2, -dichlorethylene (cis)	$C_2H_2Cl_2$	479
1, 2, -dichlorethylene (trans)	$C_2H_2Cl_2$	751
Diisopropyl ether	$C_6H_{14}O$	375
Dioxan	$C_4H_8O_2$	107
DMF	C_3H_7NO	11
Ethanol	C_2H_6O	175
Ethyl acetate	$C_4H_8O_2$	240
Heptane	C_7H_{16}	120
Hexane	C_6H_{14}	335
Isopropyl alcohol	C_3H_8O	137
Isoamyl alcohol, 3-methyl-1-butanol	$C_5H_{12}O$	14
Ethyl methyl keton	C_4H_8O	243
Methanol	CH_4O	337
Methylene dichloride, dichloromethane	CH_2Cl_2	no vacuum
Pentane	C_5H_{12}	no vacuum
n-propyl alcohol	C_3H_8O	67
Pentachlorpethane	C_2HCl_5	13
1, 1, 2, 2, -tetrachloroethane	$C_2H_2Cl_4$	35
1, 1, 1, -trichloroethane	$C_2H_3Cl_3$	300
Tetrachloroethylene	C_2Cl_4	53
THF	C_4H_8O	357
Toluol	C_7H_8	77
Trichloroethylene	C_2HCl_3	183
Water	H_2O	72
Xylol	C_8H_{10}	25

Vacuum in Torr/mmHg = X mbar x 0.75

7 Maintenance and Servicing

7.1 General Requirements

Repairs of the Laboratory-Vacuum-Systems may only be performed by the manufacturer or authorized workshops.

The prerequisites are a complete and factually correct damage report, and a clean and, if necessary, a decontaminate device.

The operator may perform maintenance work to the extent indicated below:

7.2 Maintenance Performed by the User

WARNING !

Only perform the work that is described here, and that which is permitted to be done by the user.
All other maintenance and service work may only be performed by the manufacturer or a dealer authorized by him.
Beware of the pump parts being possibly contaminated by hazardous substances. Wear protective clothing if there is contamination.

7.2.1 Maintenance of the Diaphragm Pump

- Check the pump daily for unusual running noises and heat building up on the surface of the pump.
- We recommend changing the diaphragm after 10,000 operating hours. The user may specify that the exchange be made earlier, depending upon the application process.
- Check the electrical and vacuum connections daily.

WARNING !

Before opening the unit unplug it from the mains.

Scope of permissible work:

- Inspect the pump chambers, diaphragms and valves,
- Deposits in the inside of the pump must be cleaned out,
- Change the diaphragms, valves and seals.

Tools required:

Tool kit: Order no. 402107, *consists of:*

- Order no. 826801-4 Cross-head screwdriver, size 2,
- Order no. 826801-2 Open spanner, size SW 14.

7.2.1.1 Disassembly

- Disconnect the power supply and ensure that it cannot be switched on again.
- Open the cover of the casing at the following operational sequence:

1. Release the suction and pressure side connections to the pump. Remove the holding bracket **(A)** with the separator.
2. Remove the elbow unions **(B)**.
3. Loosen at the device lower surface the four cross-head M4 **(C)**.
4. Pull the hood off upwards, and unplug the plug from the display panel.

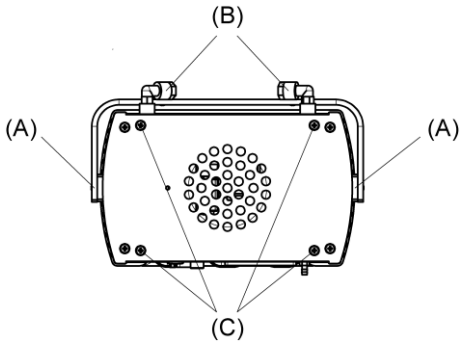


Fig. 8 Disassembly - lower surface casing

- Open the screw clamps of the hose link on the pump bodies with the SW 14 open spanner.
- Remove 2 x 4 screws **(1)** from each connecting head **(2)** with a cross-head screwdriver, size 2.
- Lift off the connecting head **(2)** and the pump head **(5)**. The diaphragm is now freely exposed.
- Loosen the defective diaphragm **(6)** by turning it anticlockwise.
- Valves **(4)** *(see Fig. 10)* and o-rings **(3)** are located between the connecting and the pump head. When dismounting both heads these parts are accessible.
- Clean the valves **(4)** *(see Fig. 10)*, o-rings **(3)** and diaphragm **(6)** with a soft cloth and ace-tone and replace defective items if necessary.

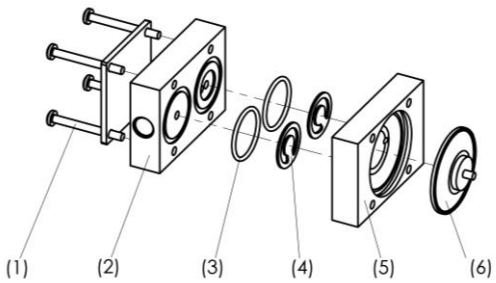


Fig. 9 Disassembly, assembly

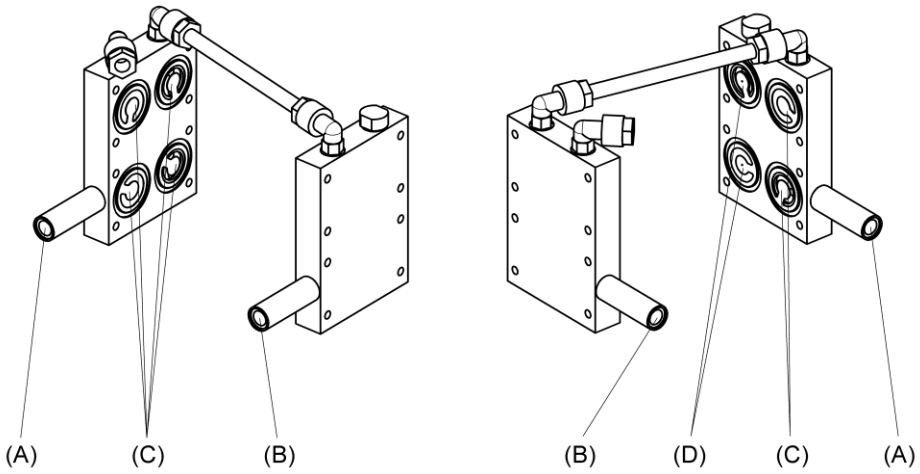
	WARNING !
Renew defective parts, if necessary! Wear protective gloves! Parts must be renewed at the intervals stated in this Operating Manual or as specified by the user internally! Do not clean with compressed air!	

7.2.1.2 Assembly *(see Fig. 8 - 11)*

- Place the pump so that the diaphragm **(6)** is lying in a horizontal position.
- Tighten the diaphragm **(6)** with the torque of 5 - 6 Nm.
- Bring the connecting rod *(see Fig. 11)* and the diaphragm (6) into the central position.
- Replace the pump head **(5)**.
- Insert the valves **(4)** *(see Fig. 10)* and the o-rings **(3)**.
  Ensure that they are lying completely flat. Do not insert the burred side facing the sealing surface.
- Replace the connecting head **(2)** and tighten the 2 x 4 cross head screws **(1)** with a torque of 3 - 4 Nm.
- Use an analogue assembly sequence for all heads.
- Reattach the hose connections with clamping ring screw fittings.
- Close the casing in the reverse order.

CAUTION !

Please pay attention to the valve arrangements (C) and (D)!



(A) - Connection suction side
(B) - Connection pressure side
(C) - Valve (400656)
(D) - Valve with hole (400656-4)

Fig. 10 Valve arrangement

7.2.1.3 Test

- Connect the system to the electrical supply.
- Connect a vacuum measuring device to the intake connector and measure the ultimate pressure.
  If the device is working properly, then the figure stated in the technical data must be attained within a maximum of one minute.
- The pump must not make any abnormal noises.
- Moving parts must not touch each other.

7.2.2 Maintenance of the Vacuum Controller

The controller is maintenance-free.

In case of damage, return the device to the manufacturer or to an authorized workshop.

7.2.3 Maintenance of other Components

- Empty the glass drip pan in a timely manner, observe all disposal specifications as applicable to hazardous substances.
- Screw connections must be checked for tightness and tightened when necessary.
- Check vacuum hoses for leaks and, if necessary, replace them.
- Check that the glass vessels are undamaged and if necessary replace.
- Check rubber gasket of the safety valve at the emission condenser and, if necessary, replace it.

7.3 Maintenance by the Manufacturer

Repairs and maintenance going beyond the extent of the work described *in chapter 7.2* or reconditioning or modification may only be performed by the manufacturer or authorized workshops.

	**WARNING !**
The user shall be liable for the consequences of an incorrect damage report or a contaminated pump. The statements in the damage report are legally binding.	

7.4 Damage Report

You find the form of the damage report to the Download on our web page in the menu "service" and "Downloads". www.welchvacuum.com

If you should not have an entrance to the Internet, you can request the form also gladly with us, under phone +49 3677 604 0.

	**WARNING !**
Incomplete or incorrectly completed damage reports may endanger the service personnel! **Provide full information about contamination, and clean the pump thoroughly before handing it over to third parties.**	

8 Troubleshooting

Only manufacturing firm and authorized service workshops may work on the Laboratory-Vacuum-System and their accessories during the warranty period.

Trouble	Cause	Remedy	
		by:	*with:*
Vacuum pump does not start	no power supply	***Qualified electrician***	Check electrical installation
	Motor defective	***Service workshop***	Exchange
	Pump body defective		Repair and/or exchange
Vacuum pump does not generate a vacuum or only an inadequate one	Connected apparatus and/or connecting elements leaking	***User or Service workshop***	Identify and seal the leak, replace the seals and/or hoses if necessary.
	Vacuum pump leaking		Check the hose connections between the pump heads, replace the hoses and/or fittings if necessary.
	Pump head leaking	***Service workshop***	Repair and/or exchange
	Diaphragm defective	***User or Service workshop***	Exchange of the diaphragm *(see chapter 7.2)*
	Valve defective		Exchange of the valve *(see chapter 7.2)*
	Vacuum pump dirty		General maintenance / leaning
	Valves dirty		Cleaning condensates and foreign objects out of the valves.
Running noise	Vacuum pump dirty	***User or Service workshop***	General maintenance / cleaning
Glass components	defective and/or leaking	***User***	Exchange of the glass parts or seals
Cable(s)	defective and/or brittle	***Qualified electrician***	Exchange of the cable(s)
No pressure indicated on the controller	no power supply	***Qualified electrician***	Electrical system to be checked
Controller cannot be set or programmed	Electronics / display defective	***Service workshop***	Repair and/or exchange
Missing control signal	Incorrect input	***User***	Check the input and correct if necessary
	Controller defective	***User***	Switch the device off, and switch it on again after three seconds
		User or Service workshop	Replace the controller

9 Spare Parts Overview

The spare parts list contains all the spare parts and all the information necessary for ordering.
When ordering, please quote the description, quantity, serial number and order number!

	**CAUTION !**
We are not liable for any damage caused by the installation of any parts not supplied by the manufacturer.	

9.1 Service kit - Diaphragm Pump

Designation	Order no.
Service kit	402044

The service kit consists of:

Designation	Piece	Order no.
O-Ring ø 25 x 2	8	829250-1
O-Ring ø 8 x 2	7	829210-3
Form diaphragm	4	828929-1
Valve	6	400656
Valve with hole	2	400656-4

9.2 Spare Parts View

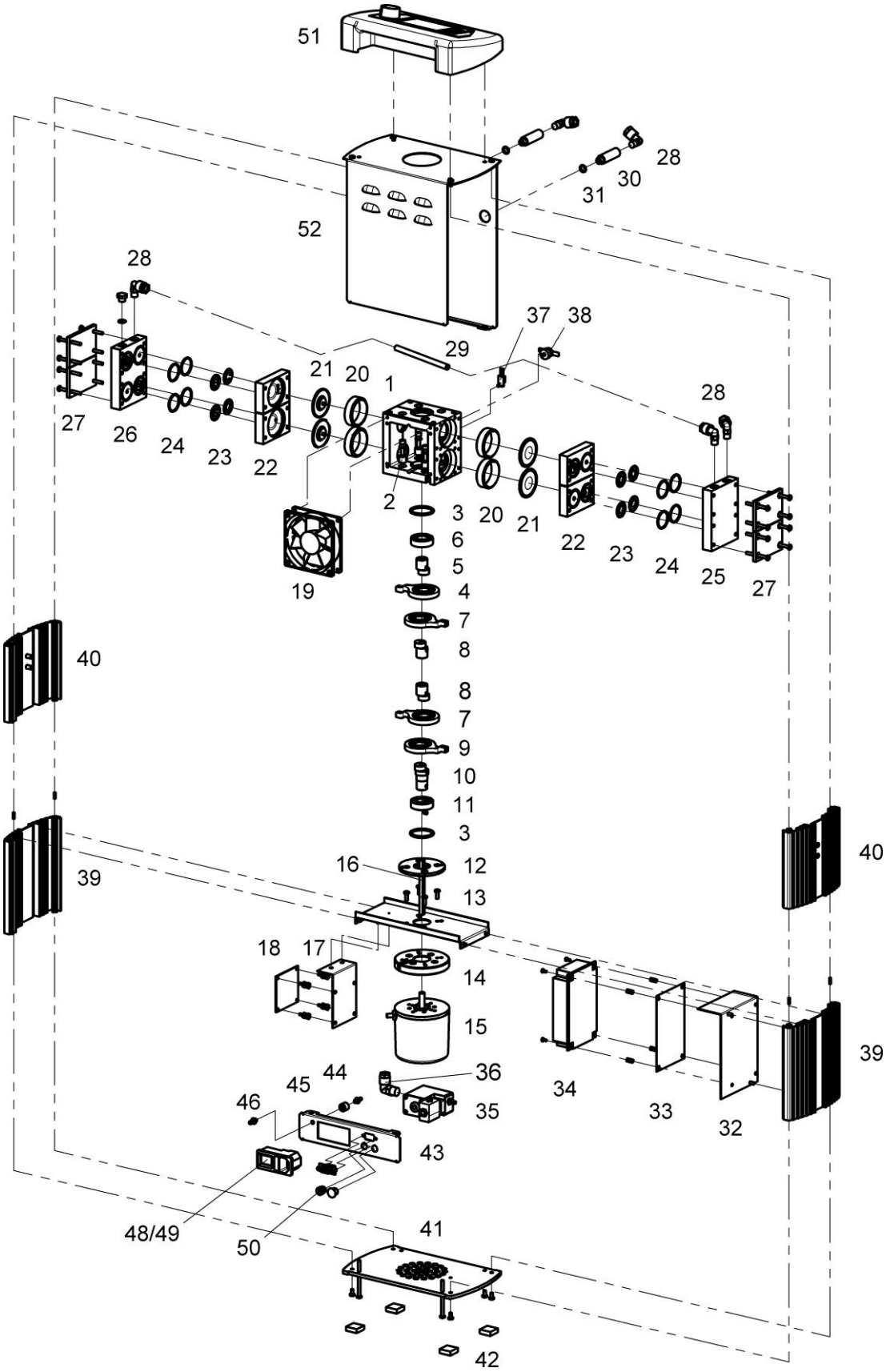


Fig. 11a Exploded view – part 1

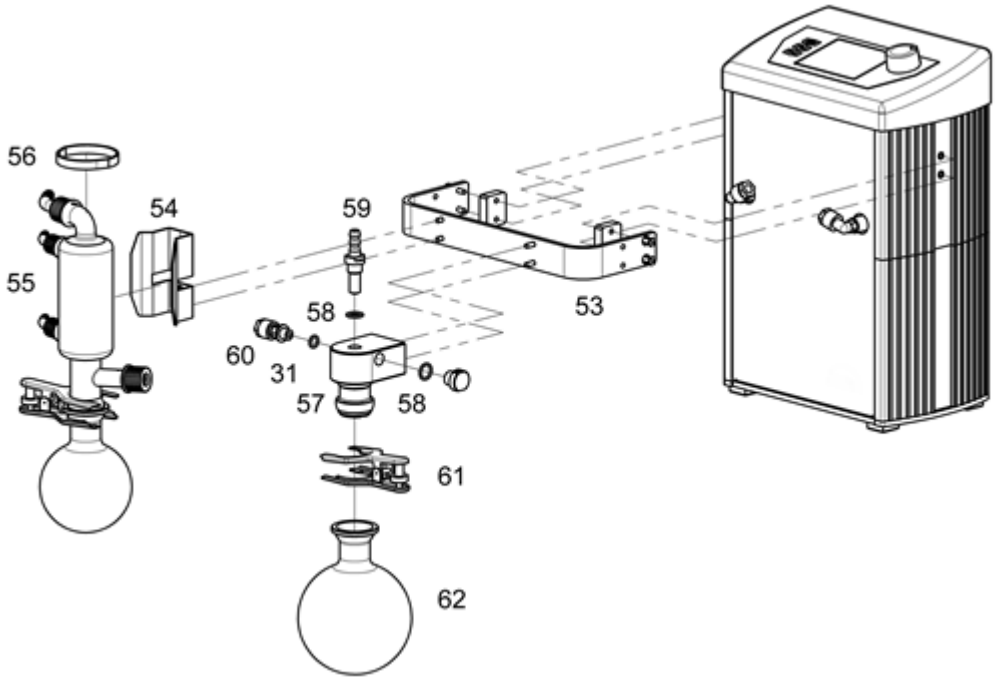


Fig. 11b Exploded view – part 2

9.2.1 Spare Parts List

Item	Designation	Piece	Order no.
- *)	**Basic pump MPC 104 T (24 V) on intermediate plate** *(consisting of position: 1 - 21)*	1	410202-03
1	- Pump casing	1	400913
2	- Rubber element	4	400916
3	- O-ring Ø 32 x 3	2	829258
-	**- Drive 1 complete** *(consisting of position: 4 - 6)*	2	400919
4	- Piston rod with ball bearing	1	400892-01
5	- Eccentric	1	400915
6	- Ball bearing	1	824963-1
-	**- Drive 2 complete** *(consisting of position: 7 - 8)*	2	400919-01
7	- Piston rod with ball bearing	1	400892-01
8	- Eccentric	1	400915
-	**- Drive 3 complete** *(consisting of position: 9 - 11)*	1	400919-03
9	- Piston rod with ball bearing	1	400892-01
10	- Eccentric	1	400915-03
11	- Ball bearing	1	824963-1
12	- Insulating washer	2	400893-04
13	- Intermediate plate	1	410215
14	- Space ring	1	400923
15	- Direct current motor	1	826393-1
16	- Shaft	1	400915-04
17	- Adapter plate	1	400949-04
18	- Printed circuit board	1	825685
19	- Axial fan	1	829820-1
20	- Cylinder	4	400914
21	- Form diaphragm	4	828929-1

Spare Parts Overview

Item	Designation	Piece	Order no.
22	Pump head, PTFE	4	400898-02
23	Valve	6	400656
	Valve with hole	2	400656-4
24	O-ring EPDM, Ø 25 x 2	8	829250-1
25	Connection head - suction side	1	400924
26	Connection head - pressure side	1	400924-01
27	Pressure plate	4	400935
28	Threaded elbow joint PVDF, 8 – 1/8“	5	829936-1
29	Vacuum hose PTFE, 8 / 6 x 1 mm	1 m	828331
30	Extension PP, G1/8“ – G1/8“	2	113527
31	O-ring EPDM, Ø 8 x 2	3	829210-3
32	Adapter plate	1	400949-01
33	Insulating plate	1	113526
34	Power pack 24V DC; 5.4 A	1	827397
35	Sensor for built-in controller 521	1	620052-16
36	Threaded elbow joint PVDF, 8 – 1/4“	1	829929
37	Semiconductor resistance 20 Ohms, 50 W	1	825495
38	Thermal switch (KO 140)	1	825158
39	Aluminium-Profile 155	2	400979
40	Aluminium-Profile 128	2	400979-01
41	Foot plate	1	410210
42	Casing foot	4	829112
43	Switch panel	1	114502
44	Screw-in socket	2	828791
45	Intermediate piece M5/M5	1	160529
46	Screw-in socket, modified	1	160837
47	Silicone hose (inside Ø = 3 mm x wall thickness 1.5 mm)	0,3 m	H100085
48	Plug for non-heating apparatus - combination	1	825274
49	Fine fuse T 6.3 A	1	825372
50	Sub miniature round plug - flange box 4 pole	1	825277-1
51	Casing cover	1	114506
52	Casing	1	113501
53	Holding bracket	1	114503
54	Cooler holder	1	114504-01
55	Emission condenser KD 500/1 vacuum-isolated, complete	1	700183-11
56	Retaining strap 53 – 57 mm	1	824128
57	Fixing PP, for separator	1	113525-1
58	Hose nozzle PP, DN 8 – G ¼” with lug	1	710798-06
59	Straight threaded joint PVDF 8 – 1/8”	1	829919
60	Blind plug	2	400568
61	Ball and socket clamp – KS 35	1	828845
62	Round-bottomed flask 500 ml – KS 35	1	828839
-	Mains connection cable IEC with plug CEE (D)	1	825885
	Mains connection cable IEC with plug BS (UK)	1	825878
	Mains connection cable IEC with plug NEMA5-15 (US)	1	825903

***)** The "basic pump" module (items 1 – 21) can only be supplied complete under order number 410202-03.

EG - Konformitätserklärung

EC Declaration of Conformity / *CE Déclaration de Conformité*

DIN EN ISO / IEC 17050

(de) **Hiermit erklären wir**	WELCH by Gardner Denver	**Gardner Denver Thomas GmbH** Am Vogelherd 20 98693 Ilmenau Germany	T +49 3677 604 0 F +49 3677 604 131 welch.emea@gardnerdenver.com www.welchvacuum.com

unter eigener Verantwortung, dass nachstehendes Produkt aufgrund seiner Konzipierung und Bauart sowie in den von uns in Verkehr gebrachten Unterlagen den nachfolgend aufgeführten EG-Richtlinien und Normen entspricht.
Bei einer nicht mit uns abgestimmten Änderung des Produkts verliert diese Erklärung ihre Gültigkeit.

(en) We (Gardner Denver Thomas GmbH) herewith declare under our sole responsibility that the product described below is in accordance with the following Directives standards and other technical specifications regarding design and version when delivered from our factory.
This declaration becomes invalid whenever the product has been modified without our consent.

(fr) *Nous (Gardner Denver Thomas GmbH) certifions par la présente, que le produit décrit ci-après est conforme, tant dans sa conception que dans sa réalisation, aux normes de sécurité et d'hygiène exigées par les standards de la CE.*
En cas de modification du produit sans notre accord, cette déclaration devient caduque.

Bezeichnung des Produkts (Pumpen / Pumpstände) Description of product (pumps / pump systems) *Description du produit (pompes / pompe systèmes)*	**Labor-Vakuum-System** / Laboratory-vacuum-system / *Système de laboratoire à vide* **LVS 105 T – 10 ef**
Artikel-Nr. / Fabrication No. / *No. de fabrication*	114184
Baujahr / Year of manufacture / *Annee de fabrication*	**2017**

Das Produkt entspricht folgenden Richtlinien und Normen: / The product is in conformity with the following Directives and standards: / *Le produit est conforme aux directives et standards suivants:*

X	**2006/42/EG**	**Maschinenrichtlinie** / EC machinery directive / *directive CE sur les machines* (17.05.2006)
	2014/34/EU	**ATEX-Richtlinie für Verwendungen in explosionsgefährdeten Bereichen, Anhang III** / ATEX Guideline for use in potentially explosive atmospheres, Appendix III / *ATEX Directive for applications in hazardous areas, Annex III*
X	**2014/30/EU**	**Elektromagnetische Verträglichkeit** / EC Electromagnetic Compatibility Directive / *Directive CE relative à la compatibilité électromagnétique*
X	**2011/65/EU**	**Gefährliche Stoffe in Elektro- und Elektronikgeräten (RoHS II) /** Dangerous materials in electrical and electronics devices (RoHS II) / *Substances dangereuses dans les appareils électriques et électroniques (RoHS II)*
X	**2012/19/EU**	**Elektro- und Elektronik - Altgeräte (WEEE)** / Electrical and electronics - old devices (WEEE) / *Électro et électronique - appareils de contralto (WEEE)*
X	**China – RoHS II**	**Umweltschutzgesetz** – China 2016-01 / Environment protection law / *Loi sur la protection de environnement*

Angewandte harmonisierte Normen: / Applied harmonized standards: / *Standards appliques et harmonises:*

	DIN EN 1127-1: 2011-10	**Explosionsfähige Atmosphären – Explosionsschutz - Teil 1: Grundlagen und Methodik** / Explosive atmospheres - Explosion prevention and protection - part 1: Basic concepts and methodology / *Atmosphères explosives - Protection contre les explosions - partie 1 : prescriptions et méthodologie*
	DIN EN 13463-1: 2009-07	**Nicht-elektrische Geräte für den Einsatz in explosionsgefährdeten Bereichen - Teil 1: Grundlagen und Anforderungen /** Non-electrical equipment for use in potentially explosive atmospheres - part 1: Basic method and requirements / *Appareils non électriques destinés à être utilisés en atmosphères explosibles - partie 1 : prescriptions et méthodologie*
	DIN EN 13463-5: 2011-10	**Nicht-elektrische Geräte für den Einsatz in explosionsgefährdeten Bereichen - Teil 5: Schutz durch konstruktive Sicherheit ‚c' /** Non-electrical equipment for use in potentially explosive atmospheres - part 5: Protection by constructional safety 'c' / *Appareils non électriques destinés à être utilisés en atmosphères explosibles - partie 5 : protection par sécurité de construction « c »*
X	**DIN EN ISO 12100: 2011-03**	**Sicherheit von Maschinen - Allgemeine Gestaltungsleitsätze Risikobeurteilung und Risikominderung /** Safety of machinery - General principles for design - Risk assessment and risk reduction / *Sécurité des machines - / Principes généraux pour l'évaluation des risques et la réduction des risques*
X	**DIN EN ISO 13857: 2008-06**	**Sicherheit von Maschinen - Sicherheitsabstände gegen das Erreichen von Gefährdungsbereichen mit den oberen und unteren Gliedmaßen** / Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs / *Sécurité des machines - Distances de sécurité empêchant les membres supérieurs et inférieurs d'atteindre les zones dangereuses*
X	**DIN EN 1012-2: 2011-12**	**Kompressoren und Vakuumpumpen - Sicherheitsanforderungen - Teil 2: Vakuumpumpen /** Compressors and vacuum pumps - Safety requirements - part 2: Vacuum pumps / *Compresseurs et pompes à vide - Exigences de sécurité - partie 2: pompes à vide*
X	**DIN EN ISO 2151: 2009-01**	**Akustik - Geräuschmessnorm für Kompressoren und Vakuumpumpen - Verfahren der Genauigkeitsklasse 2 /** Acoustics - Noise test code for compressors and vacuum pumps – Engineering method (grade 2) / *Acoustique - norme de mesure des émissions pour les compresseurs et les pompes à vide - Procédé de classe de précision 2*
X	**DIN EN 60204-1: 2014-10**	**Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen - Teil 1: Allgemeine Anforderungen /** Safety of machinery - Electrical equipment of machines - part 1: General requirements / *Sécurité des machines - Equipement électrique des machines - partie 1: Prescriptions générales*
X	**EN 61000-6-2: 2011-06**	**Elektromagnetische Verträglichkeit (EMV) - Teil 6-2: Fachgrundnormen - Störfestigkeit für Industriebereiche /** Electromagnetic compatibility (EMC) - part 6-2: Generic standards - Immunity for industrial environments / *Compatibilité électromagnétique (EMV) - partie 6-2: Normes génériques - Immunité pour les environnements industriels*
X	**EN 61000-6-4: 2011-09**	**Elektromagnetische Verträglichkeit (EMV) - Teil 6-4: Fachgrundnormen - Störaussendung für Industriebereiche** / Electromagnetic compatibility (EMC) - part 6-4: Generic standards - Emission standard for industrial environments environments / *Compatibilité électromagnétique - partie 6-4: Normes génériques - Emissions de parasites pour les activités industrielles*
X	**DIN EN 50110-1: 2014-02**	**Betrieb von elektrischen Anlagen /** Operation of electrical installations / *Fonctionnement des installations électriques*
X	**DIN EN 61010-1/A1:2015-04**	**Sicherheitsbestimmungen für elektrische Mess-, Steuer-, Regel- und Laborgeräte - Teil 1: Allgemeine Anforderungen** / Safety requirements for electrical equipment for measurement, control and laboratory use - part 1: General requirements / *Consignes de sécurité pour les appareils électriques de mesure, de commande, de régulation ou de laboratoire - partie 1: Prescriptions générales*

Datum / Data		**2017-02-16**
Qualitätsbeauftragter / Quality representative / *Délégué de qualité*	**Name** / Name / *Nom* **Gerd Reinhardt**	
Produktmanager / Product manager / *Directeur de produit*	**Name** / Name / *Nom* **Oliver Fickert**	