



MBE

KOMPONENTEN | DR. EBERL

OPERATING INSTRUCTIONS

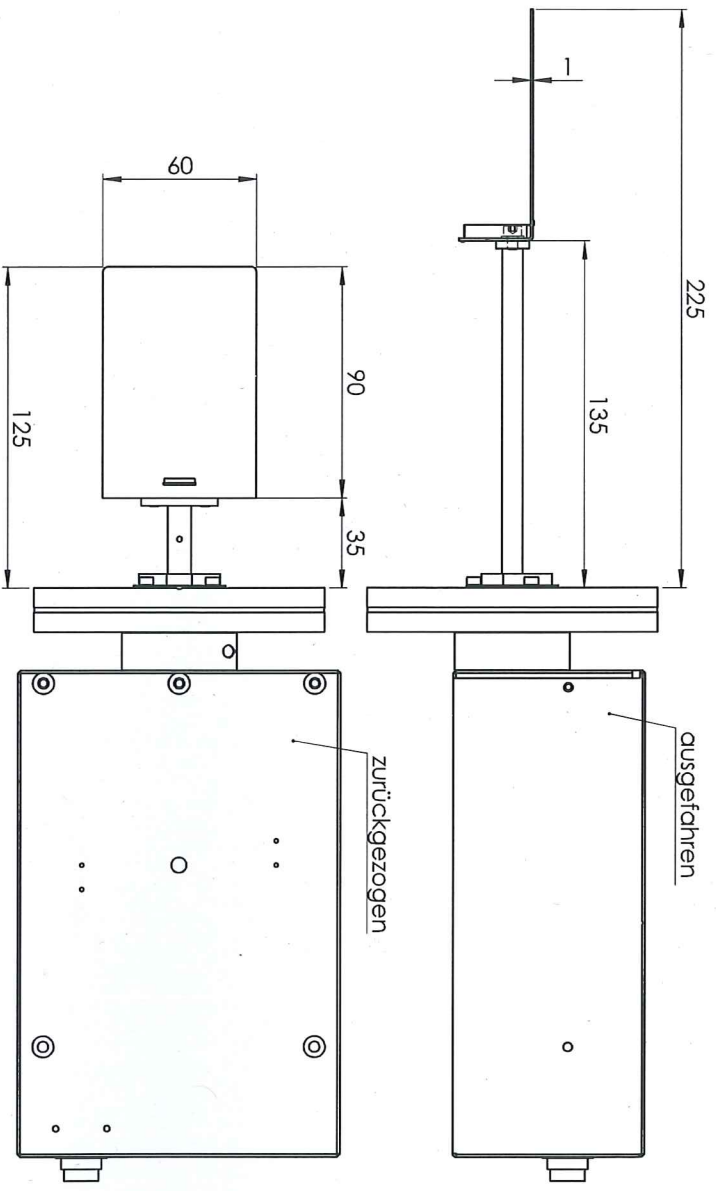
Dr. Eberl MBE-Komponenten GmbH

Josef-Beyerle-Str. 18/1
D-71263 Weil der Stadt
(Germany)

**Linear Soft-Acting Shutter Drive Unit
100mm travel**

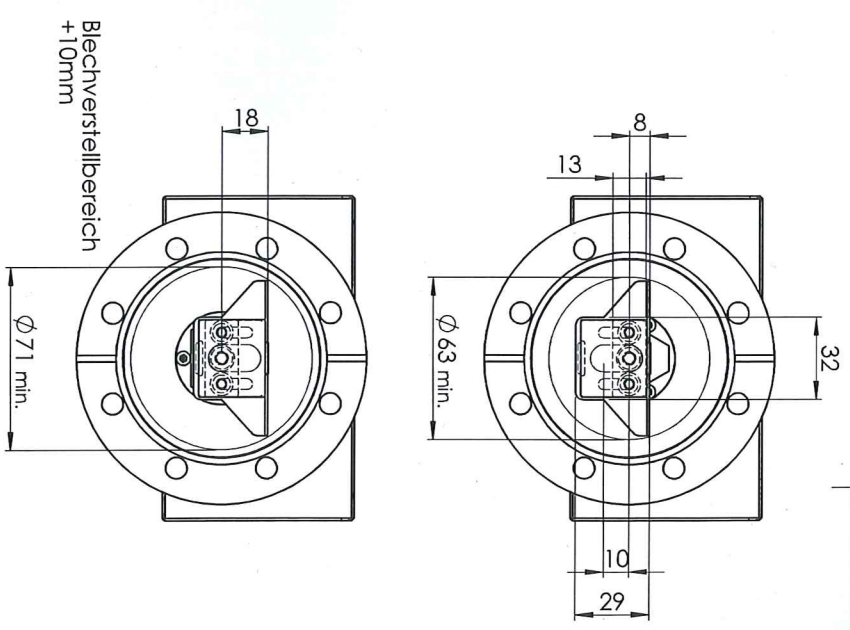
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LSM DU - 100-0,2 - 2102775



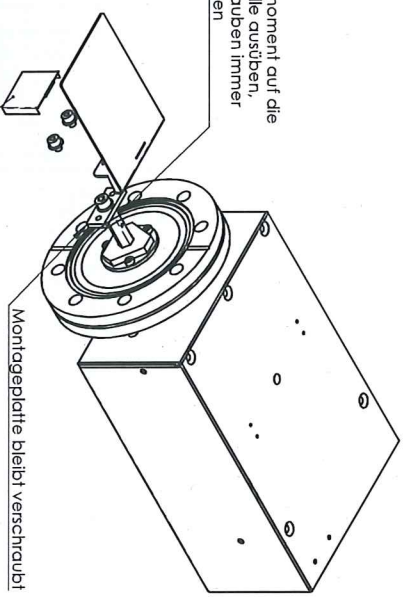
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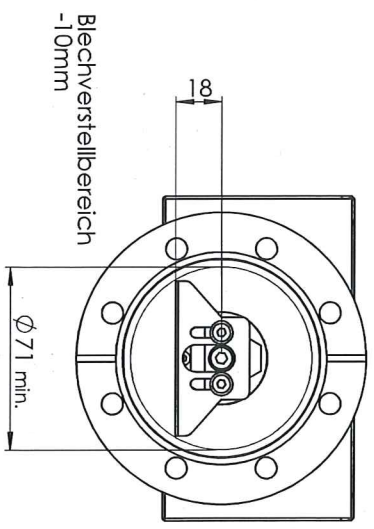
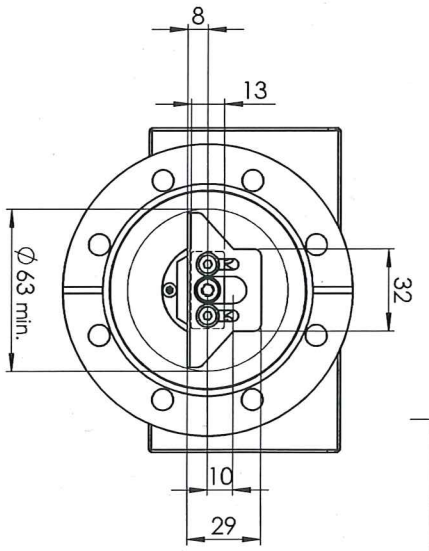
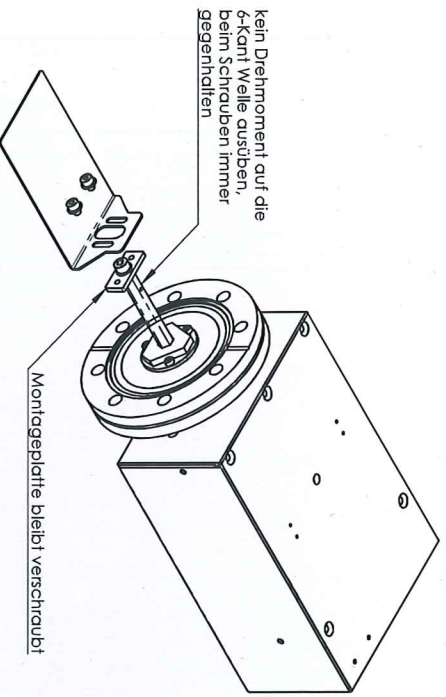
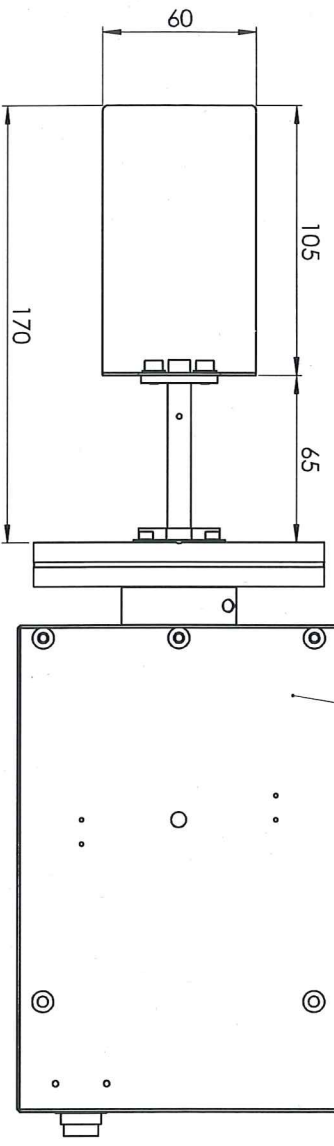
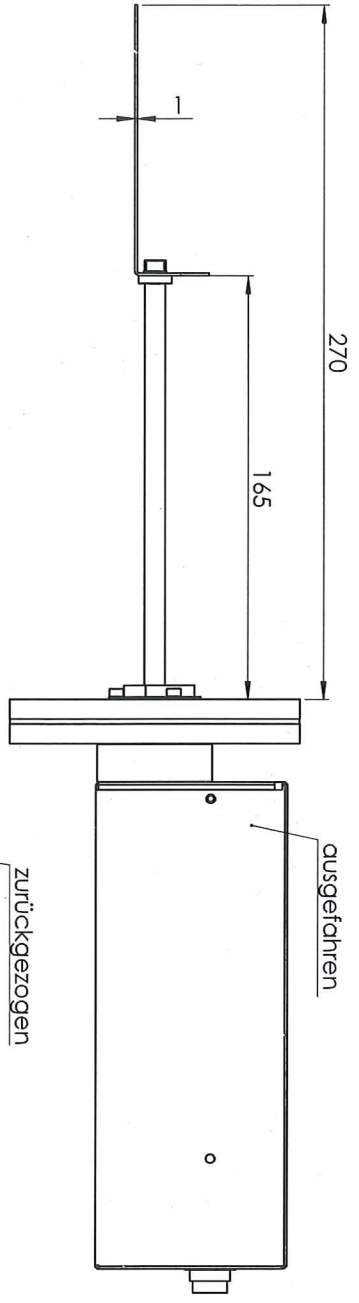
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Verschraubung, eingeklipst, wechselbar

Montageplatte bleibt verschraubt

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Zust.	Änderung	Datum	Nam

MBE KOMponenten Dr. Eberl Jäger/Bayerstraße, 1971 D - 71283 Weil der Stadt		Datum Bearb. 10.07.2015 O. Leiferl Gepr. Name Gewicht	(Ober- fläche) Allgmein- toleranz ISO 2768 - m	Name O. Leiferl	Benennung (TITLE) Kundenspez. Shutterblech 1 an LSM63 P215 086, 142 & 143 RWTH Ac Schnabel	Zeichnung DIN A3 Q Zeichnungsnummer (DRAWING No.) Shutterbox RWTH-Aachen-Schnabel	Blatt
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MBE		KOMponenten Dr. Eberl		Zeichnungsnummer (DRAWING No.)		Blatt	
Johann-Bayerle-Str. 18/1 D - 71283 Weil der Stadt		Shutterbox22+3_RWTH-Aachen-Schnabel		Erst.für:		Ers.durch:	

Symbols and Abbreviations

	GENERAL DANGER SIGN; pay attention and follow precautions given in accompanying text.
	ELECTRICITY danger of life from electric current or high voltage
	HIGH TEMPERAURE SURFACE danger of burns when touching
	TOXIC MATERIAL danger of life to personnel when absorbing particles or fumes, wear protective gear
	IRRITATING MATERIAL danger of irritations to tissue when touching or inhaling particles or fumes, wear protection
	RISK OF FIRE
	WEAR GLOVES (vinyl or latex) to prevent contamination of vacuum equipment by fingerprints and/or to protect personnel from contamination by hazardous substances
	HINTS AND BACKGROUND INFO facilitate to understand properties of the equipment and how to get the best results out of it

Abbreviations used in this manual

MBE	m olecular b eam e pitaxy
UHV	u ltra- h igh v acuum
HV	h igh- v oltage or h igh- v acuum, depending on context
PGR	p yrolytic g raphite, highest purity graphite, manufactured in a high temperature gas phase epitaxy process
PBN	p yrolytic b oron- n itride, highest purity boron nitride, manufactured in a high temperature gas phase epitaxy process
TC	t hermocouple
WRe	T ungsten- R henium, TC-alloy suitable for high temperature
SCU	s hutter c ontrol u nit, electronic unit controlling shutter action
LSM	l inear soft-acting s hutter d rive u nit
LSM DU	l inear soft-acting s hutter d rive u nit
DN	n ominal inside d iameter of flange-bores or tubes (used in descriptions of vacuum flanges)
CF	C onflat flange, specifies flange sealing mechanism by flat copper gaskets and a knife-edge on each flange (TM of VARIAN), e.g. DN 63 CF
BNC	(B ayonet N eil- C oncelman, or sometimes B ritish N aval C onector); circular connector used on coaxial cable
PID	p roportional, i ntegral, d ifferential; refers to the operating principle of controllers and regulators, e.g. to keep a constant temperature
U	Voltage (unit Volts, V)
I	electric current (unit Amperes, A)
O.D.	o utside d iameter
I.D.	i nside d iameter
p	p ressure (here usually vacuum)
mbar	pressure unit, millibars (10^{-3} bar)
bar	SI – unit for pressure, 1bar = 10^5 N/m ²

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1 Short description

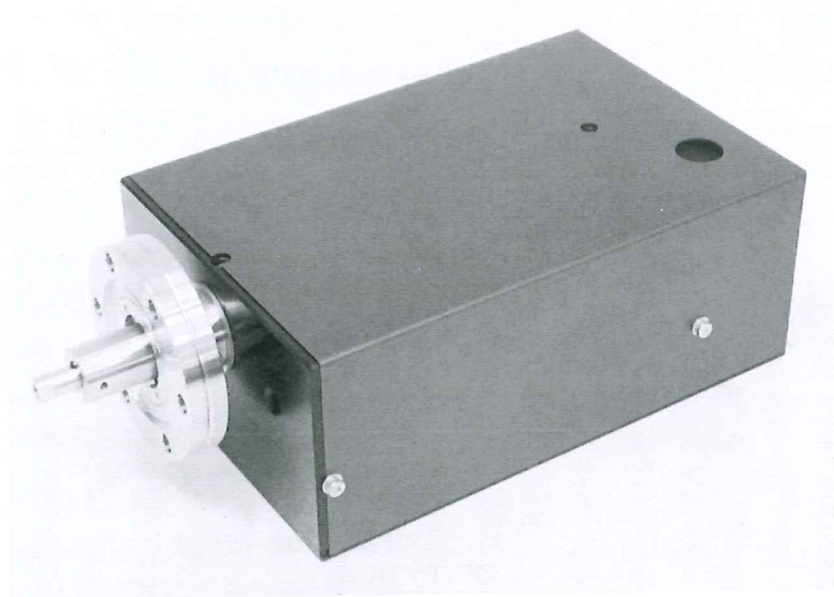


Figure 1: Linear soft-acting shutter drive unit mounted on a DN40CF linear feedthrough

The Linear Soft-acting Shutter Drive Unit – LSM DU – is a drive unit for linear shutter motion.

A special designed gear driven by an electric motor provides a "soft", sinusoidal angular velocity profile between two shutter positions. The soft-action reduces particle generation and greatly increases shutter lifetime under UHV conditions.

Fast shutter action times of less than 200ms (open-close) are achieved without mechanical shock and with minimum vibrations. This high shutter speed easily allows for sub-monolayer control of epitaxial growth.

The LSM DU is designed to be mounted on our magnetically coupled linear motion feedthrough LSM40 or LSM63 on DN40 CF (O.D. 2,75") or DN63 CF (O.D. 4,5") flanges, respectively. See Figure 1. The magnetic force between the LSM DU actuator and the internal magnet of the LSM40 or LSM63 feedthrough transmits the linear movement into the vacuum system to the effusion cell shutter.

Automated shutter action is obtained with the LSM DU connected to our shutter control unit SCU. The shutter control unit provides the power to the drive motor (24V DC) and controls the shutter action. Position feedback indicators show the actual shutter status. The SCU allows manual and remote shutter control. See SCU manual for details.

2 Safety Information

2.1 *General Safety Notes*



Before putting the linear soft-acting shutter drive unit LSM DU into operation, please read the operating instructions thoroughly and follow them in every respect!

Ignoring any instruction given in this manual may result in fatal damage of the vacuum system or even personal injury.

Handle the shutter drive unit and its parts carefully!

If in doubt ask!

2.2 *Important Notes*



CAUTION:

The force of the shutter drive unit can easily damage components of your vacuum system, if improperly used!

Make sure the shutter assembly that you use the LSM on can move freely within the range of linear motion without interference with other equipment in your chamber

The LSM DU is not designed to withstand temperatures in excess of 80°C. It contains plastic parts and electronic / electro mechanic components.

Remove the LSM DU from your vacuum system before any bakeout!

2.3 *Hazards*



HAZARD:	LINEAR FORCE AT OUTPUT SHAFT of feedthrough
RISK:	DAMAGE OR DESTRUCTION OF SYSTEM COMPONENTS
AVOIDANCE:	Mount LSM DU correctly. Avoid interference of shutter blade with other components inside vacuum system.



HAZARD:	INTERNAL MOVING PARTS
RISK:	PERSONAL INJURY IF BODY PARTS ARE INSERTED INTO THE LSM DU WHEN NOT MOUNTED TO A FEEDTHROUGH
AVOIDANCE:	Do not insert fingers into the mounting hole of the LSM DU. Disconnect cable when not mounted to a feedtrough.

3 Technical description

3.1 General

The LSM DU is recommended for use with linear motion shutters on vacuum systems that are designed for this purpose. It is mountable on the magnetically coupled linear motion feedthrough type LSM from MBE-Komponenten.

Figure 2 shows the basic features of the design.

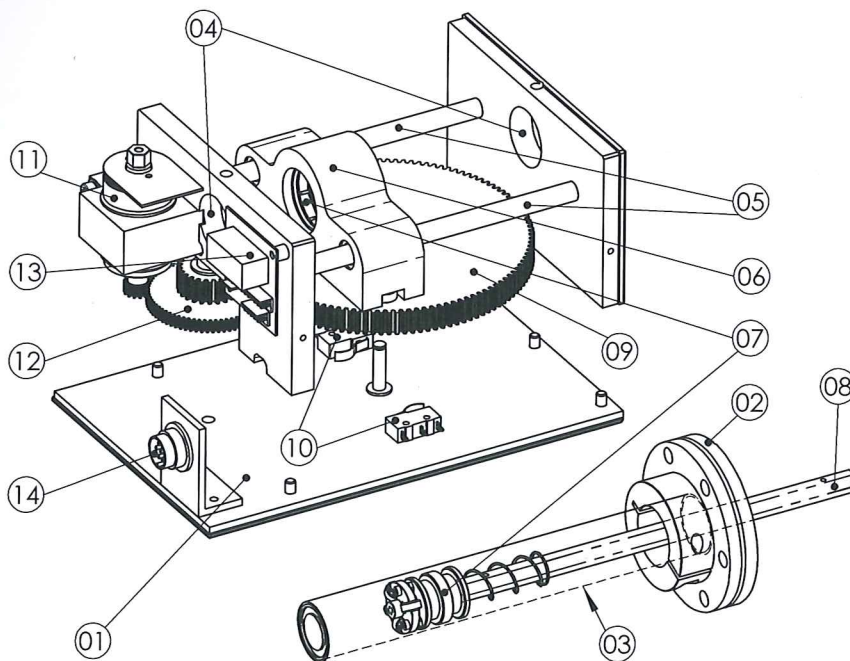


Figure 2: overview of the linear soft-acting shutter drive unit LSM DU with feedthrough LSM40

- (01) linear soft-acting shutter drive unit base plate
- (02) CF40 linear magnetically coupled vacuum feedthrough LSM40-100
- (03) tube OD 25mm (vacuum shell). LSM DU slides onto this tube
- (04) bores with clamp screws that are over feedthrough tube (03)
- (05) linear guide rods carrying the slider (07) with two linear bearings.
- (06) slider; moves along the feedthrough tube (03) without touching, inside slider there is....
- (07) ... the external magnet system, that couples to the in-vacuum magnets of the LSM40.
- (08) in-vacuum feedthrough rod
- (09) main gear carrying the excenter bearing that drives the slider (06)
- (10) two micro switches for end position detection and position feedback
- (11) electric motor acting on (12) intermediate gear
- (13) PCB with relays for motor control, wired to micro switches (10) and connector (14)

Linear travel distances of 80mm, 90mm and 100mm are available. Please specify when ordering.

The direction of linear motion also is factory-preset. The "close" position is when the shutter blade is engaged into the vacuum system, i.e. the front-most position. "Open" is defined as a retracted shutter blade.

The standard shutter speed is 0.2 s (open - close). For special applications, such as heavy shutter plates or other reasons, we provide slower versions with shutter speeds as slow as 1 s between the end positions.

3.2 Technical data

Mounting	two clamping ring Ø 25mm, to be mounted on linear feedthrough LSM
Travel length	80, 90 or 100mm, to be specified when ordering (special travel lengths on request)
Speed (open - close)	< 0.2 s (standard); 0.5 s, 1 s, (to be specified when ordering)
Power supply SCU)	24 V DC, min. 400mA (usually from shutter control unit
Dimensions	(L x W x H) 190(200) x 132 x 75 mm; see drawing

A dimensional drawing of the shutter drive unit LSM DU is shown in the appendix.

The following table lists the three most important parameters for the various versions of our shutter drive unit.

Table 1: Technical data for LSM DU linear soft-acting shutter drive units.

Product	LSM DU 80-0,2	LSM DU 90-0,2	LSM DU 100-0,2
Travel length	80mm	90mm	100mm
speed (approx.)	0,2 s	0,2 s	0,2 s

Product	LSM DU 80-0,5	LSM DU 90-0,5	LSM DU 100-0,5
Travel length	80mm	90mm	100mm
speed (approx.)	0,5 s	0,5 s	0,5 s

Product	LSM DU 80-1	LSM DU 90-1	LSM DU 100-1
Travel length	80mm	90mm	100mm
speed (approx.)	1 s	1 s	1 s

4 Installation

4.1 *Unpacking and shipping issues*



Before unpacking, please inspect the transport box for obvious damage. If any damage is found do not unpack and contact MBE-Komponenten GmbH immediately for advice!

Otherwise take the shutter drive unit out of its box and check for obvious transport damages on the module itself. In case you detect a damage contact MBE-Komponenten GmbH immediately!

MBE-Komponenten may also be reached via e-mail:

info@mbe-komponenten.de

4.2 *Inspection*

Before the LSM DU is mounted to a linear feedthrough, we recommend to perform the following tests that ensure the integrity of the module after shipment:

Function test:

Connect the LSM DU to the Shutter Control Unit SCU, using the supplied cable. The 7-pin connector has to be secured by screwing its sleeve onto the threaded 7-pin plug.

When the LSM DU is connected, it will stop automatically in one of its end positions. The corresponding position indicator LED will light up on the SCU. Switching the SCU to the other position, the LSM DU's internal linear slide moves by a fixed travel distance to the other end position. While running, the position LEDs will be off.

Toggle several times between "open" and "close" position.

If the LSM DU doesn't stop on one side, it will keep oscillating until the drive circuit (or SCU) is switched back to the other position. In this rare case, the end position switch is not properly adjusted, thus not stopping the rotation of the motor on that side. A readjustment of the respective micro-switch inside the LSM DU is necessary then. Refer to section 5.2 for instructions.

4.3 *Mounting:*

If the function test is passed, the LSM DU can be mounted to the linear feedthrough of your source shutter.

It is recommended to proceed as follows:

(numbers in brackets refer to items listed in Figure 2)

- Before adding the LSM DU onto the linear feedthrough LSM, check carefully hand, if the shutter feedthrough can be moved freely along the complete length of feedthrough motion. Use any kind of a small magnet to couple to the in-vacuum magnet system and move it along the feedthrough manually for this test.



Note: The force and velocity of the LSM DU may destroy internal parts of the vacuum system or the shutter assembly if the shutter plate is blocked by any obstacles in the vicinity of the effusion cell!

- Make sure the drive unit LSM DU is in its close position (e.g. by connecting it to the control unit SCU, checking the red LED). This setting ensures the external magnet system (07) is in the front most position.
- Loosen the M4 grub screws on the clamping bores (04)
- Slide the LSM DU over the linear feedthrough tube carefully. You will recognize the in-vacuum magnet system being repelled by the external magnets while pushing forward, thus shifting the shutter forward as well. Keep pushing carefully forward. At a certain point near the "shutter close" position the magnet systems "snap" together because the repelling force is overcome by an internal spring on the feedthrough shaft. After this "snap-in" the LSM DU is strongly coupled to the feedthrough magnets and will not come off during operation.
- Fasten the LSM DU clamp screws (04), but not too hard. They have a soft plastic tip to avoid leaving marks or scratches on the feedthrough tube.
- The LSM DU can be used in any orientation with respect to the feedthrough shaft.

Check the operation of the LSM DU again in the mounted state after connecting it to the SCU or your own drive circuit. The shutter plate should move smoothly and reproducibly between opened and closed state.

5 Operation

5.1 *Principle of operation*

The principle of operation of the Linear Soft-acting Shutter Drive Unit LSM DU is clarified by Figure 3, that shows top views onto the LSM DU gear in the "open shutter" and "closed shutter" states (after removal of the blue protective hood).

For each shutter motion, either "close → open" or "open → close", the main gear disk with the excenter bearing rotates by 180°, having the same sense of rotation for both movements (indicated by the arrows). The excenter bearing slides inside a channel inside the linear slide, thus translating this 180° to a linear sinusoidal movement. The main gear carries a "cam"-screw on its lower flange, that actuates the spring levers of the two micro switches. These determine the end positions and stop the motor.



The stroke between "open" and "close" is defined by the radial position geometry of the excenter bearing on the main gear disk. It is maximum 100mm and has pre-manufactured bores for 90mm and 80mm stroke. So in principal the stroke can be easily changed.

We do however not recommend to perform this change on your own, because a change of stroke might need a change of the linear feedthrough. We deliver matched sets of LSM and LSM DU.. MBE-Komponenten GmbH is not liable for any damages to equipment after such modifications. We advise to directly order the Linear soft-acting Shutter drive unit LSM DU together with the linear feedthrough in the configuration that suits your application.

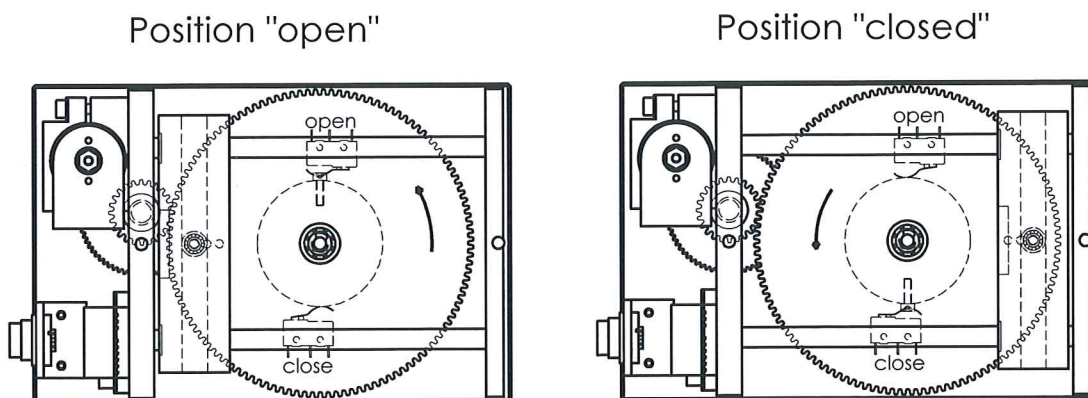


Figure 3: View onto the kinematics of the LSM DU gear with excenter drive disk, slider and end position switches. Assignment of "open" and "close" micro switches is depicted for the standard version.

Figure 4 shows the electrical wiring scheme of the linear shutter drive unit. The circuit consists of two mechanical micro-switches for end position detection, a relay and the electric motor.

In the depicted state of the circuit, the output shaft is in a position somewhere in between the end positions. So both micro switches are released, supplying the relays with 24V from pin 1 of the 7-pin plug. The closed relay contact connects the motor to the supply voltage of pin 1, i.e. the electric motor is running, the shutter is in motion.

Let us assume the shutter approaches the "shutter open" position. The lever of the corresponding micro switch is pressed, the relays falls off, shorts the two motor contacts and the motor stops immediately (E.M.F. brake). At the same time, the "pos. open"-micro switch connects pin 4 to the supply voltage (pin 1), generating the "shutter open" feedback signal that can be used to monitor the real shutter state e.g. on a shutter controller or within a MBE control software system.

On the Shutter control unit SCU from MBE-Komponenten GmbH, the feedback signal is displayed via respective LEDs.

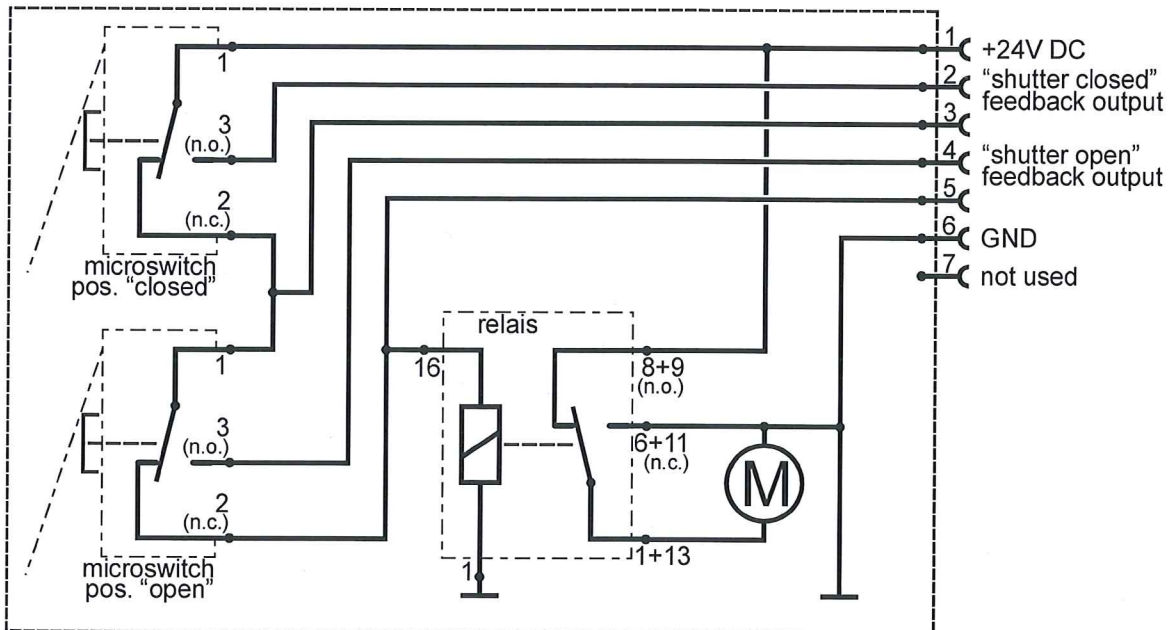


Figure 4: electrical wiring scheme of the LSM DU. Pins 3 and 5 are used to control the shutter position (see text). Pins 2 and 4 are used as position feedback outputs (carrying 24V when active)

In order to re-close the shutter, the relays has to be triggered as to start the electric motor again. In the "shutter open" state this is done by connecting pin 3 to pin 5 externally. Figure 5 gives the scheme for a simple shutter drive circuit that uses an "ON-ON" switch to perform this task. Pin 3 is carrying the 24V from pin 1 via the released "pos. closed"-micro switch. Pin 5 is directly wired to the relays coil. Thus the relays actuates the motor, the shutter starts moving, the "pos. open" micro switch is released, until at the other end of the motion the "pos. closed" micro switch lever is pressed. By

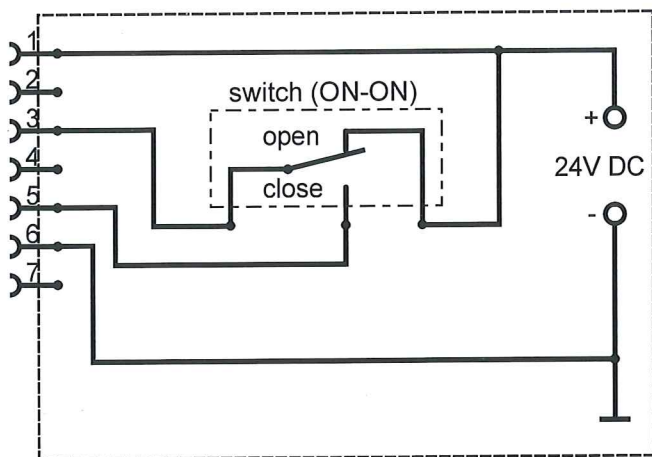


Figure 5: simple drive circuit for operation of the LSM DU without SCU (no position feedback)

this micro switch, the supply voltage from pin 1 is cut from the remaining circuit and passed to the pin 2 "pos. closed" monitor output. The relays falls off again, stopping the motor.

To go from this "shutter closed" to the "shutter open" state, the 24V supply needs to be connected to pin 3, triggering the relays and starting the motor. The drive circuit of Figure 5 uses the other position of the same switch for this. As a 24V power supply a transformer with rectifier and some condensers is sufficient. It should be able to deliver about 500mA for the motor.

Short instructions:

Connect a 24V DC power supply to pin 1 (+24V) and pin 6 ("- or GND).

In order to...

...move shutter from "close" to "open"..... apply 24V to pin 3

...move shutter from "open" to "close"..... connect pin 3 to pin 5

Remember that the electric motor is always turning in the same direction. The alternating direction of shutter motion is solely generated by the design of the gear.

The given assignment of the 7-pin plug contacts to the shutter states "open" and "closed" is valid for the factory preset direction of motion (opened shutter when feedthrough is retracted) with our Shutter Control Unit SCU with position feedback control.

If you should desire a reversed direction of motion you have to virtually reverse the pin assignments on your drive circuit and your position readout (basically replace each label "open" by "closed" and vice versa). When using our Shutter Control Unit SCU the micro switches have to be rewired in order to change their assignment and to keep the 7-pin plug compatible. Ask MBE-Komponenten GmbH for advice if you have any doubts how to perform this task.

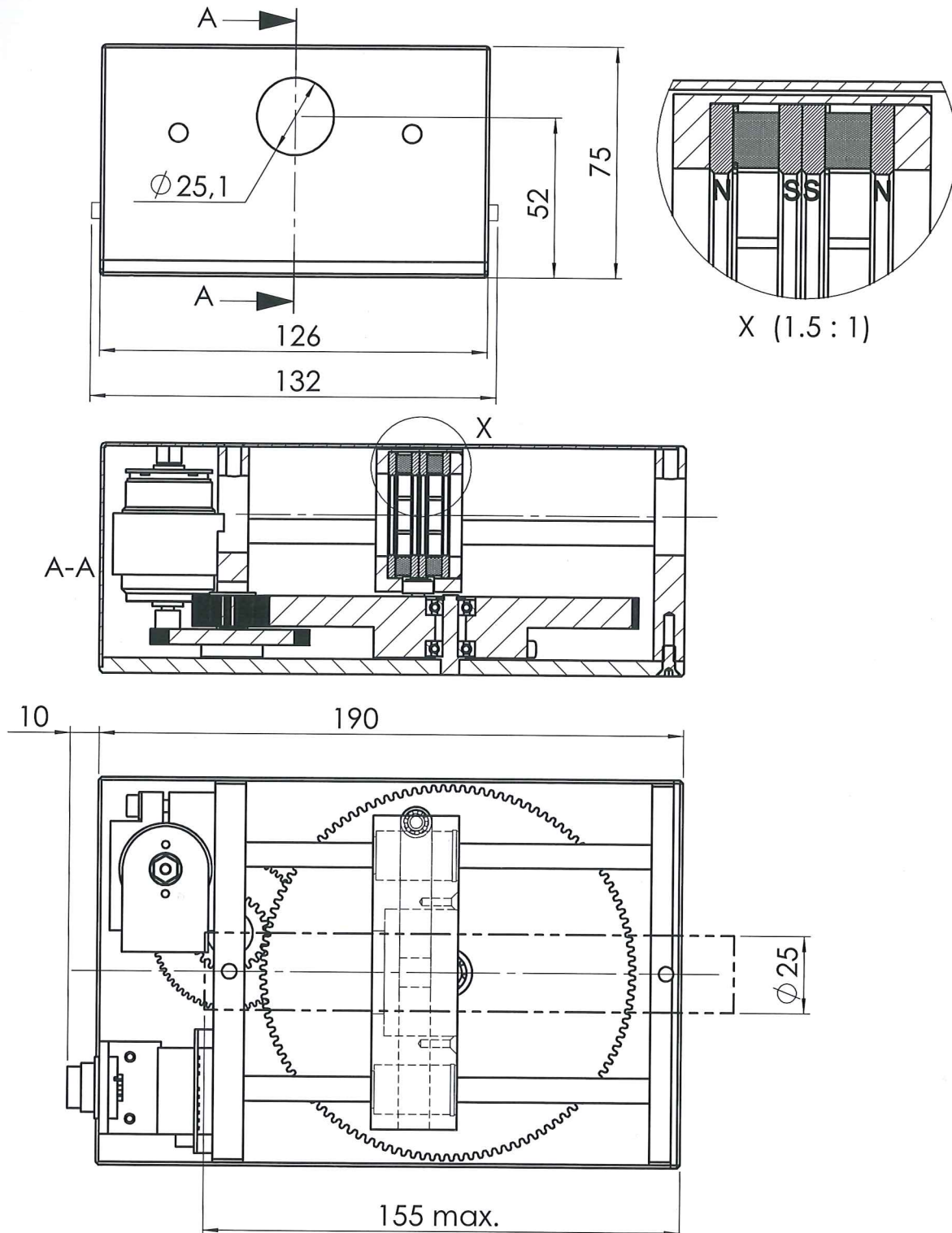
5.2 Troubleshooting

Symptom	possible causes	instruction
LSM DU does not move at all	<p>missing supply voltage (24V DC)</p> <p>micro switch failure or wiring problem inside module</p> <p>relays failure</p>	<p>Measure voltage between pin 1 and pin 6 of the 7-pin connector of your connection cable.</p> <p>Measure resistances between following pins of the 7-pin plug on the LSM DU: a) 1 → 2 ; b) 1 → 3 ; c) 3 → 4 and d) 3 → 5 At any time two of these combinations must be low ohmic simultaneously (i.e. switch contacts closed): a) and d) meaning "shutter in closed position" OR b) and c) meaning "shutter in open position" OR b) and d) meaning "shutter somewhere between" Any other combination or only 1 pair having low resistance indicates switch failure or broken wiring inside. Repair is needed. Contact factory for instructions.</p> <p>measure resistance between pins 5 → 6 of the LSM DU 7-pin plug. Relays coil resistance must be about 1,1... 1,2 kOhms. Significant deviations of this value indicate defective coil. Replace relays or contact factory.</p>
LSM DU does not stop at its "open" or "close" position	bad adjustment of micro switch	<p>Remove the protective housing to access the mechanics. Disconnect cable before!</p> <p>Remove the front part together with the guide rods and the slider</p>

	<p>micro switch contact failure</p>	<p>The main gear is now accessible (see Figure 3 on page 10). Identify the micro switch that does not stop the movement by running the opened LSM DU. Be careful!</p> <p>To readjust a micro switch the lever of the respective switch must be slightly bent.</p> <p>To do so, <i>disconnect cable each time</i>, remove the main gear disk and modify the respective switch lever. Add main gear again and connect cable. Careful!</p> <p>! LSM DU will move immediately upon connection!! Repeat adjustment until the LSM DU stops reliably.</p> <p>Check for the familiar clicking noise of the micro switch when actuating it by hand. If it does not click it is possibly defective. Check as described in the "micro switch failure" section above. Replace switch, if necessary.</p>

6 Appendix

6.1 Dimensional drawing



6.2 List of spare parts and accessories:

Spare parts:

Part Number	description	material	for cell type
LSM DU 100	Soft-acting Linear Shutter drive unit, stroke 100mm (other stroke length available,		
SCU	Shutter Control Unit, power supply and interface for shutter drive unit LSM DU		
LSM40 - 100	Magnetic Linear Feedthrough DN40CF, maximum stroke 100mm		
LSM63 - 100	Magnetic Linear Feedthrough DN63CF, maximum stroke 100mm		

EG Konformitätserklärung / EC Declaration of Conformity		Dr. Eberl MBE-Komponenten GmbH Gutenbergstr. 8 71263 Weil der Stadt, (Germany) Phone: +49 7033 6937-0 Fax: +49 7033 6937-20 email: info@mbe-komponenten.de http://www.mbe-komponenten.de
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Hiermit erklären wir (Dr. Eberl MBE-Komponenten GmbH), dass nachstehendes Produkt aufgrund seiner Konzeption und Bauart sowie der von uns in Verkehr gebrachten Ausführung den einschlägigen grundlegenden Sicherheits- und Gesundheitsanforderungen der EG-Richtlinien entspricht. Bei einer nicht mit uns abgestimmten Änderung des Produkts verliert diese Erklärung ihre Gültigkeit

We (Dr. Eberl MBE-Komponenten GmbH) herewith declare, that the product described below is in accordance with the relevant safety and health requirements of the EC standards regarding design and version when delivered from our factory. This declaration becomes invalid whenever the product has been modified without our consent.

Bezeichnung des Produkts
Description of product
Seriennummer / Serial Number

**Linear Soft-acting Shutter Drive Unit
LSM DU, alle Versionen / all versions**

LSM DU - 100-0,2 - 2102675 & 2102775

Das Produkt entspricht folgenden Richtlinien / The product is in conformity with the following directives

- EG Niederspannungsrichtlinie / EC low voltage directive (73/23/EWG (7/93))
- EMV Richtlinie / Electromagnetic Compatibility EMC (89/336/EWG)

Angewandte harmonisierte Normen / Applied harmonized standards

EN 50081-2	Elektromagnetische Verträglichkeit EMV, Störaussendung, Teil2 Industriebereich / Electromagnetic compatibility (EMC) Generic emission standard, part 2 Industrial environment
EN 61000-6-2	Elektromagnetische Verträglichkeit EMV, Störfestigkeit Industriebereich / Electromagnetic compatibility (EMC) Generic standards, Immunity for industrial environments
EN 61010-1 (DIN VDE0411)	Sicherheitsbestimmungen für elektrische Mess-, Steuer-, Regel- und Laborgeräte / Safety requirements for electrical equipment for measurement, control and laboratory use.

Weil der Stadt, den

3.7.2015

Datum / date

i.A. O. Cephal
(Frank Huber, Produktgruppenleiter/Product Manager)