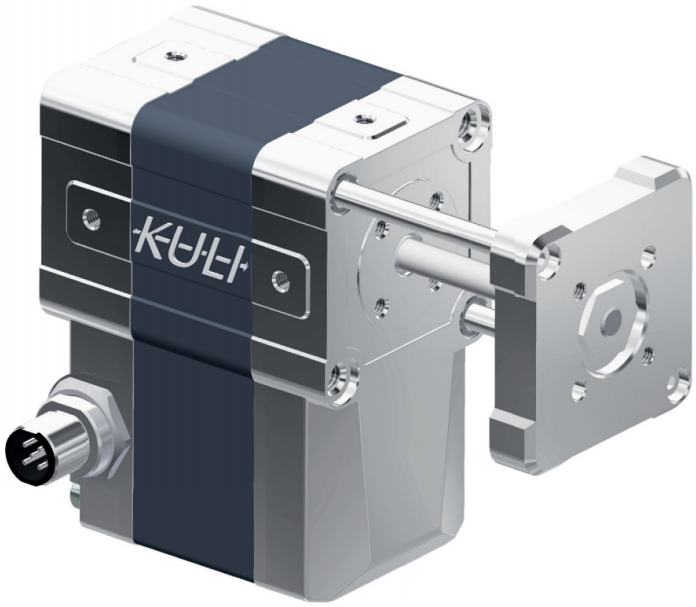
Assembly instructions

„KuLi - electric short stroke linear actuator“
3215.00-XXXX



Ketterer ANTRIEBE

Original assembly instructions for partly completed machines
According to machinery directive 2006/42/EG
Attachment VI

Document No. 3215.72-01i01

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Subject to modifications.

Scope

1 Introduction

1.1 Content

- This documentation is intended to help you work safely on and with the "Kuli". It contains safety instructions that must be followed for all work performed on and with the Kuli system.
- The documentation must be made accessible to all persons who work on and with the Kuli. They must have understood the documentation and follow the specifications and instructions relevant to them.
- The documentation must be always complete and in a clearly readable condition.

Please read these instructions carefully and follow the safety instructions!

Depending on the version or modification status of the product, there may be differences compared to these instructions.

1.2 Scope

These instructions are valid for the partly incomplete machine with article numbers:

3215.00-0005 to 3215.00-0020

3215.00-0034F001

Drawings dated 21/02/2022 are applicable.

1.3 Standards and directives

The KuLi is an "incomplete machine" according to Article 2, Paragraph g), MRL 2006/42/EC.

The conformity assessment procedure was carried out in accordance with Machinery Directive (MRL) 2006/42/EC.

The KuLi is designed according to compliance with 2011/65/EU (RoHs) and 2014/30/EU (EMC).

The manufacturer of the overall system in which the KuLi is installed must check and ensure compliance with the essential requirements of the MRL before placing the overall system on the market.

1.4 Warnings and symbols used

The safety sign visually represents a source of hazard. The safety signs in these assembly instructions comply with DIN EN ISO 7010.

The following pictograms and signal words are used in this documentation to indicate hazards and important information:

Pictogram	Description
	**Warning of a general hazard** This warning sign is placed in front of activities where several causes can lead to hazards.
	**Hot surface warning** This warning sign stands in front of activities where there is a hazard from hot surfaces which can lead to burns.
	**Warning of electric shock** This warning sign stands in front of activities where there is a risk of electric shock, possibly with lethal consequences.
	**Warning against non-ionizing radiation** This warning sign indicates activities involving hazards due to non-ionizing radiation.
	**Warning of magnetic fields** This warning sign indicates activities involving hazards due to magnetic fields.

Pictogram	Description
	**Warning of unexpected / automatic start-up.** This warning sign stands in front of activities where an unexpected / automatic start-up of rotating components can occur.
	**Warning of crushing hazard** This warning sign stands for activities where hazards exist due to crushing and shearing points which can lead to crushing injuries.
	**Follow instructions**
	**Information**

In these assembly instructions, the following danger levels are used to indicate potentially hazardous situations and important safety instructions:

Hazard level	Description
 **DANGER!**	Indicates a hazardous situation which, if not avoided, will result in death or serious irreversible injury.
 **WARNING!**	Indicates a hazardous situation which, if not avoided, could result in death or serious irreversible injury.
 **CAUTION!**	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
 **INFORMATION!**	Indicates a potentially hazardous situation. If not avoided, the equipment or something in its environment may be damaged.

1.4.1 Structure of the section-specific warnings

The section-specific warnings apply not only to one specific action, but to several actions within a chapter. The hazard symbols used indicate either a general or specific hazard.

The warning is structured as follows:

SIGNAL WORD!

Nature of the hazard and its source.
Possible Consequence(s) of disregard.

► Action(s) to avoid the hazard.

1.4.2 Structure of the embedded warnings

The embedded warnings are directly integrated into the action before the dangerous action step.

The embedded warning is structured as follows:

SIGNAL WORD! Nature of the hazard and its source.

Possible Consequence(s) of disregard.

Action(s) to avoid the hazard.

2 Safety Instructions

Read the safety instructions and information on safe operation in these assembly instructions carefully before starting work.

Keep these assembly instructions in a safe place and give them to others if necessary.

It is very important for your safety that you understand and follow all safety instructions.

Non-observance may result in danger to the life and health of persons and cause extensive damage to property.

2.1 Personnel - Qualification und obligations

Information

All activities on the KuLi may only be carried out by competent and qualified persons.

The competent and qualified persons must...

...know and be able to apply the relevant accident prevention regulations and safety instructions in the technical documentation.

...be suitably trained for electrical work (electrician).

...have been trained and instructed in accordance with the rules of behaviour in the event of a malfunction.

...have the physical and mental capabilities to carry out his responsibilities, tasks and activities at the KuLi.

2.2 Obligations of the operator

Every person who works with the Kuli has a responsibility to ensure safety and health protection. They must be trained in the use of the Kuli.

A safety-related condition and use of the Kuli is a requirement for safe operation. Therefore, the operator has the responsibility to ensure that the following points are complied with:

- Ensure that the Kuli is only operated by trained and authorized personnel!
- Prohibit safety-endangering and dangerous working methods! Check the actions of the personnel!
- Always keep this document in a complete and readable condition!
- Obligate the operating and maintenance personnel to report occurring and recognizable safety defects immediately to their superiors!
- During start-up and operation, the operator must ensure that there are no persons in the danger zone. The danger zone depends on the function and dimensions of the end product in which the Kuli is installed.
-

2.3 General safety instructions

- General legal regulations or guidelines on work safety, accident prevention regulations and environmental protection laws must be observed.

To be provided by the integrator:

- A stop device for the emergency of the KuLi (emergency stop or emergency shutdown) shall be provided by the integrator.

Personal Protective Equipment (PPE):

- The use of personal protective equipment (PPE) depends on the environmental conditions of the actual operating location in the overall system and is to be defined by the operator.

2.4 Use

The KuLi is only intended for industrial systems, for installation in machines within the meaning of MRL 2006/42/EC.

The KuLi has been designed and built for use in accordance with its intended use. If you use the KuLi for a purpose other than the one listed, the manufacturer cannot be made liable for any damage resulting from this.

2.4.1 Intended use

The intended use of the KuLi is to perform a centric pressure- or tension-loaded stroke. The loads can be moved, held or positioned.

The KuLi may only be operated with an anti-rotation lock on the plunger and in combination with a suitable higher-level control system.

The KuLi may only be used in indoor applications in industry.

The KuLi may only be operated within the operating conditions specified in this document (chapter 3.3 "Technical data / Operating conditions").

The KuLi may only be operated in one of the three operating modes. If operation outside of these modes is intended, this is only possible in consultation with the manufacturer.

2.4.2 Foreseeable misuse

Misuses are:

- Any use other than the intended use without the written consent of the manufacturer.
- Operation in the range outside the operating conditions specified in this document (chapter 3.3 "Technical data / operating conditions"), if these have not been agreed with the manufacturer.
- Interventions in the components or in the system during operation.
- Non-functional assembly in which the plunger rod / guide is firmly fixed and thus the housing of the KuLi carries out the stroke movement
- If the KuLi is in extended state connected to the PC/laptop and the Connect-Box and this link is disconnected when the supply voltage is switched on, the KuLi moves to the inner reference point.

2.5 Residual risks

Despite all actions taken to integrate safety in the design, safety provisions and additional protective actions, non-obvious residual risks cannot be completely avoided. You can reduce residual risks by carefully following the safety instructions and the intended use.

Life phase / Activity	Residual risk
Packing / Transport / Unpacking / Assembly / Maintenance / Disassembly / Service / Repair	**Cutting injuries** Despite strict quality controls, parts of the Kuli, as well as the accessories and packaging, may have sharp edges and corners which can lead to cuts. Make sure that you wear suitable protective gear whenever handling the Kuli.
Start-Up / Operation / Maintenance / Disassembly / Service / Repair	**Hot surfaces** Depending on the load and environmental temperature, the surfaces of the Kuli may reach temperatures of over 90 °C. Only perform necessary activities directly with the Kuli after it has cooled down completely.
Assembly / Start-Up / Operation / Maintenance / Disassembly / Service / Repair	**Electrical voltage / residual energy** Residual electrical energy may remain in lines, electrical components, equipment and devices when the Kuli is switched off. Only allow work on the electrical supply to be carried out by qualified electrical personnel. Make sure that all phases and the complete electrical system are voltage-free. There must be no residual voltage left in the system, so wait at least 5 minutes after complete disconnection from the power supply before carrying out the necessary work.
Start-Up / Operation	**Uncontrolled movements** Incorrect assembly or control of the KuLi can lead to uncontrolled movements. There is a risk of injury in this case. Only use the KuLi after it has been correctly installed in accordance with the installation instructions and only in combination with a suitable master control system.
Maintenance / Disassembly / Service / Repair	**Automatic start-up** If the KuLi is not secured against unauthorized restart when it is shut down, there is a risk of unexpected start-up, which can lead to serious injuries. Secure the mains disconnection device by suitable means (key, lock).
Start-Up / Operation / Maintenance	**Trapping, pulling in, gripping, crushing** The stroke movement of the KuLi can cause objects, items of clothing or body parts to be trapped, pulled in, gripped or crushed. Therefore, never carry out activities on the KuLi when it is in operation.
Start-Up / Operation	**Breakage** Overloading the KuLi above the specified load limits can lead to breakage and thus to injury or damage to property.

3 Product description

3.1 Description of the Kuli

The KuLi is a compact and fast electrically driven linear actuator. The Kuli is intended for use in automation and material handling technology. There it can replace pneumatic cylinders, for example. With a housing length of 68 mm, the KuLi performs a stroke of 40 mm. The push/pull forces are up to 300 N. Maximum speed in load-free condition is 445 mm/s. Parameters are set via a separately available connect box (described in chapter 6.4). The entire electronics for control are integrated.

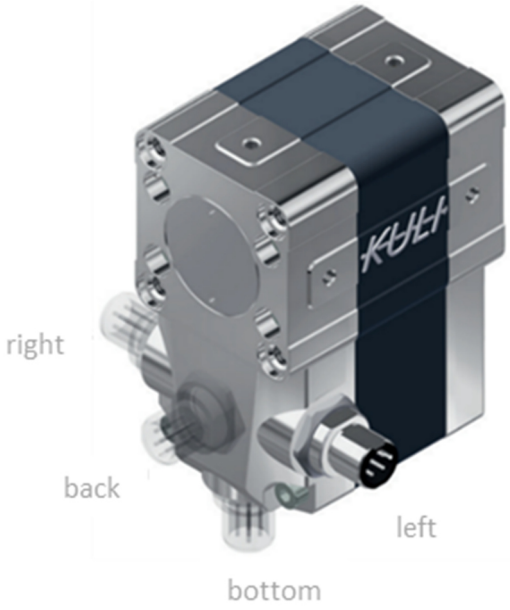
3.2 Product Versions

Short-stroke linear actuator KuLi is available in different versions. The versions are based on the ordering key shown below.

KuLi-	Variant	Drive					
3215.00		Max. stroke – Spindle pitch					
	B1	40 mm – 1 mm *(only with software variant EX)*					
	B6	40 mm – 6 mm (max. 300 N and 114 mm/s or 445 mm/s and load-free)					
		Assembly					
		VS	Anti-rotation device				
			Plug alignment				
			R	right			
			L	left			
			H	back			
			U	below			
				Software			
				DM	Dynamic Mode: fast and low load *(only for B6 variant)*		
				SM	Standard Mode: medium speed and medium load *(only for B6 variant)*		
				PM	Power Mode: slow and large load *(only for B6 variant)*		
				EX	Expert Mode		
					Interface		
					S	Standard: analog A5 I/O 5 pol. plug	
						Zulassungen	
						S	Standard CE
KuLi -	**B6 -**	**VS -**	**R -**	**SM -**	**S -**	**S**	

3.2.1 Visualization of the possible connector positions

- The following connector positions are possible:



3.2.2 Available accessories

- Connect Box (part number 3215.49-01)

The KuLi "Connect-Box" parameterization adapter is designed to transfer programming from the PC to the KuLi and, in combination with a PC software, it allows various parameters to be set. The Connect-Box can also be used as a display for the signals of the PLC interface.

3.3 Technical data / operating conditions

INFORMATION!

- The data was determined at an ambient temperature of 20°C.
- The technical data applies to KuLi versions with 6mm spindle pitch (KuLi-B6-XX-X-XX-X-X). The technical data for KuLi with 1mm pitch (KuLi-B1-XX-X-EX-X-X) are available in consultation with the manufacturer.

Technical data / operating conditions	
Dimensions (without connector)	Length: 81.8 mm, Width: 49 mm, Height: 90 mm
Weight	0,9 kg
Material of the housing	Zinc die casting ZP5 / aluminium
Stroke length / Max. stroke	40 mm
Spindle pitch	6 mm
Max. Push / Pull force (dynamic)	300 N (B6) / 500 N (B1)
Max. Speed (load-free)	445 mm/s
Max. Holding force (static)	500 N
Supply voltage	24V DC +10% / -25%
Current consumption	4 A
Max. Current consumption (peak)	10 A
Power consumption	240 W
Resolution of the encoder system	+/- 0,15 mm
Repeatability*	+/- 0,2 mm
IP protection class	IP24
Ambient temperature	+5 - +42°C
Lifetime at 10 N load *	20 Mio. Cycles
Shock resistance in static condition according to IEC/DIN EN 60068-2-27	50g; 11ms
Vibration resistance in static condition according to IEC/DIN EN 60068-2-6	10…2000 Hz 5g 10 frequency cycles

* One cycle = extend-pause-retract-pause

* Depending on load and cycles, a change in repeatability due to wear is to be expected.

Software-Version			
	Dynamic Mode	**Standard Mode**	**Power Mode**
Max. Push / pull force [N] (horizontal mounting position)	100	200	300
Average speed at 40mm* [mm/s]]	267	160	114
Average travel time [s]	150	250	350
Max. number of cycles* [Cycles / min.]	46	29	12
Duty cycle ED Time per cycle* Holding time per cycle*	23% 0,3 s 1 s	24 % 0,5 s 1,4 s	13 % 0,7 s 4,5s

* One cycle = extend-pause-retract-pause

If finer force/travel time settings are required, this can be done in 50N increments using the parameterization software via PC (see Chapter 7.1).

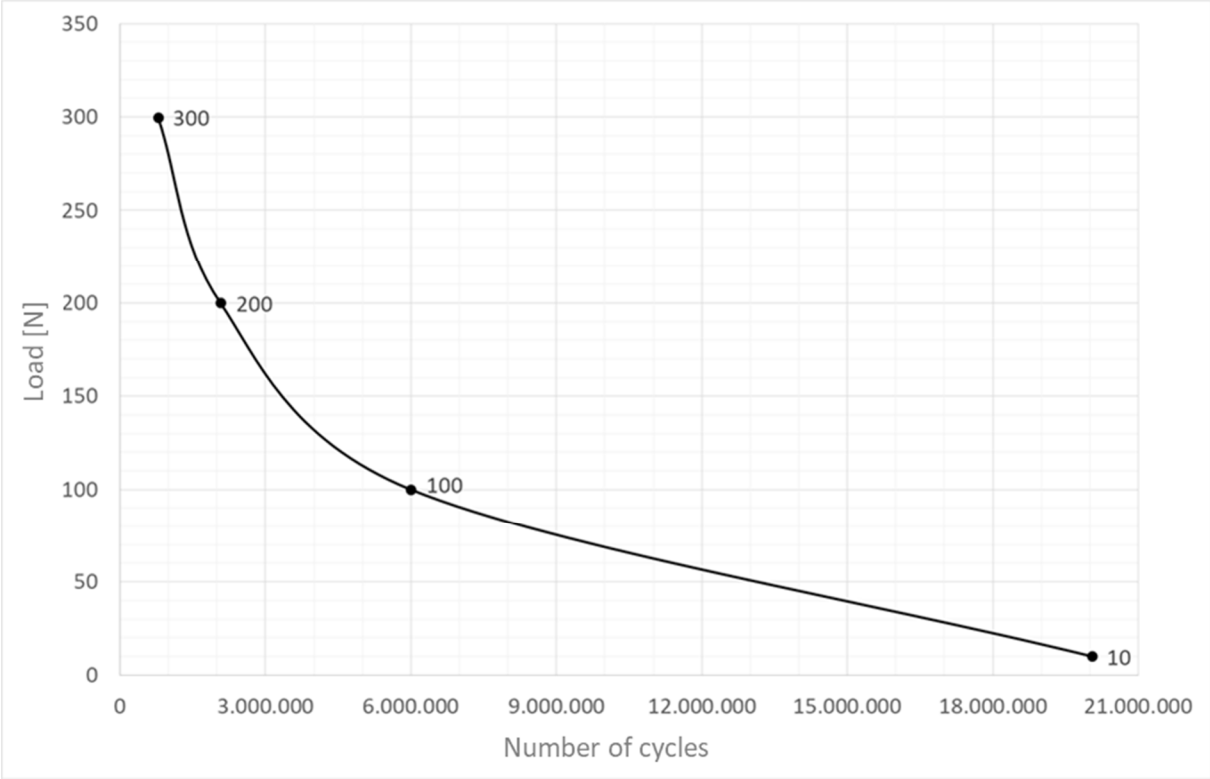
The Expert Mode software variant (EX: KuLi-BX-VS-X-EX-X-X) offers a maximum of adaptation options to your application. Individual parameterization in the EX software variant (Expert Mode) must be carried out by Ketterer. After parameterization, start-up must also be carried out in coordination with Ketterer.

The parameterization in Expert mode offers the following value ranges:

	Expert Mode KuLi-B6 (6mm)	**Expert Mode KuLi-B1 (1mm)**
Max. Push / pull force [N]	0 - 300	0 - 500
Ø Speed at 40mm [mm/s]	455 - 114	75 - 15
Travel time 40 mm [s]	0,09 – 0,35	0,54 – 2,67
Max. number of cycles* [Cycles / min.]	103 - 12	40 - 6

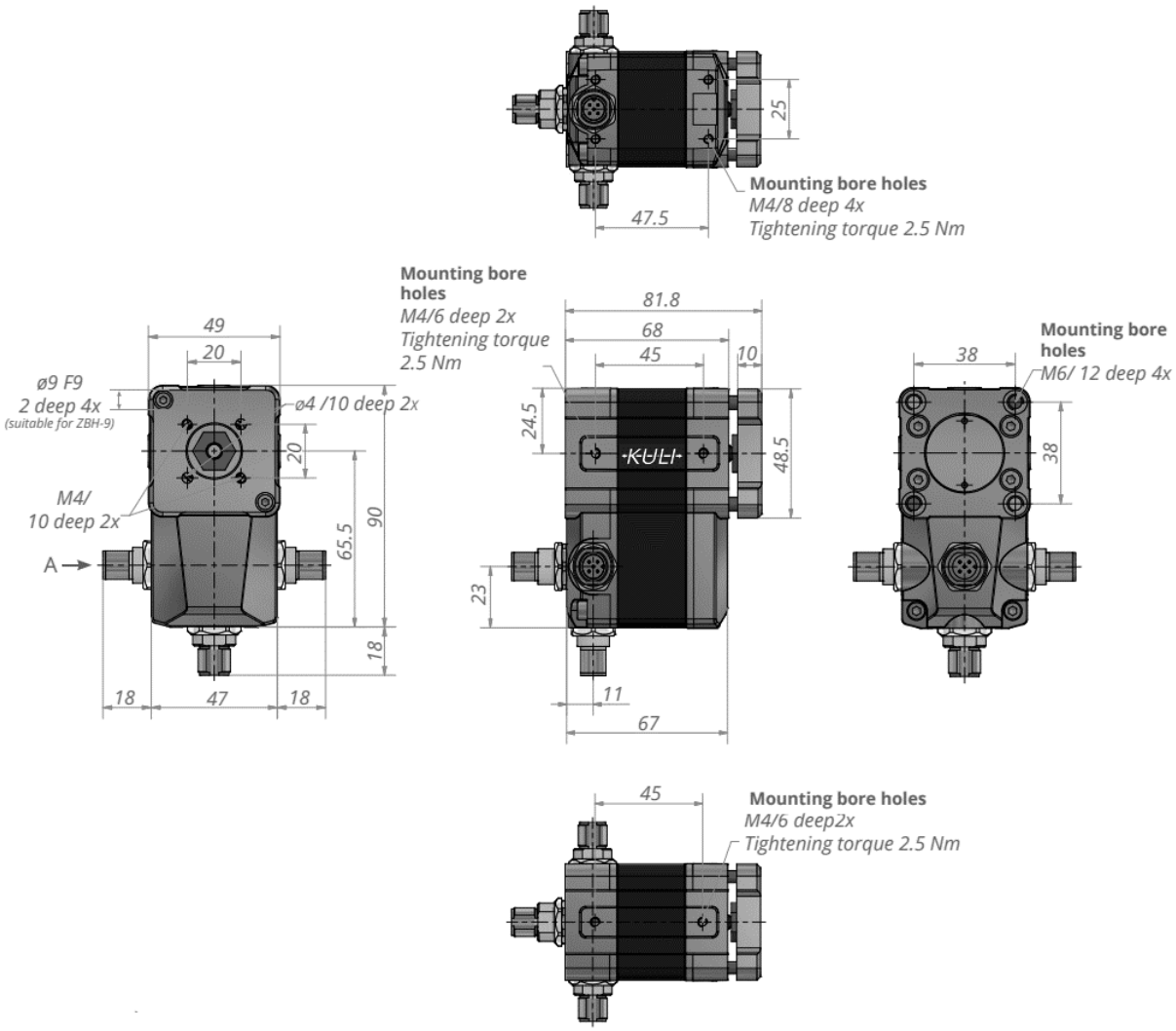
* One cycle = extend-pause-retract-pause

The lifetime may vary depending on operating and installation conditions and is load dependent. See following figure.



3.4 Dimensions

The dimensions of the KuLi for all possible connector positions are shown below:



3.5 General requirements for the master control system

The controller must have the following functionalities:

I/O control:

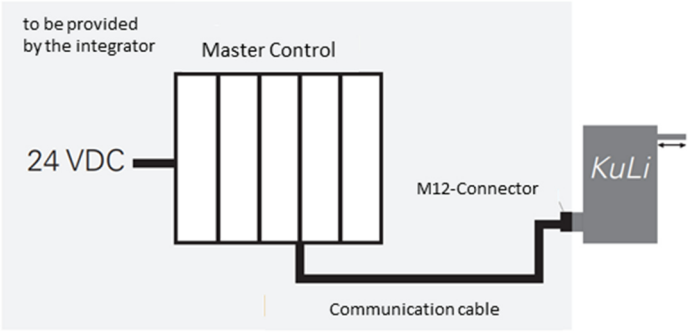
The KuLi short-stroke linear actuator can be connected to the control system using a simple M12 cable.

In I/O mode, the actuator is controlled via the digital input (control input).

Operation commands:

0V at control input → push rod retracts

24V at control input → push rod extends



4 Transport / Unpacking / Storage

CAUTION!

Danger due to sharp edges on parts of the housing.
When handling the KuLi, sharp edges and corners can cause cuts.

► Wear your personal protective equipment depending on the ambient conditions, but at least safety shoes protection class 2, suitable protective gloves.

4.1 Transport

- During transport, the KuLi must be protected from dust, shocks and moisture.
- Observe the temperature ranges (- 15°C to + 70°C) during transport.

4.2 Unpacking

- When removing the packaging, pay attention to the danger of cutting cardboard boxes.
- Do not use sharp objects for unpacking.
- Make sure that all packaging components are removed.
- Dispose of all packaging components in accordance with the disposal regulations applicable in the country of use.
- Do not remove the type plate / label from the KuLi

4.3 Storage

- During storage, the KuLi must be protected from dust, impact and moisture.
- Observe the temperature ranges (- 15°C to + 70°C) and humidity (up to 70%) during storage.
- Avoid storage in aggressive atmospheres.
- Store the KuLi only in its original packaging.

5 Assembly

5.1 Mechanical mounting instructions

CAUTION!

Danger due to sharp edges on parts of the housing.
When handling the KuLi, sharp edges and corners can cause cuts.

► Wear your personal protective equipment depending on the ambient conditions, but at least safety shoes protection class 2, suitable protective gloves.

CAUTION!

Danger due to crushing and impact points
When assembling the KuLi, crushing and impact points may occur in the area of the push rod / guide. This may result in injuries.

► Wear your personal protective equipment depending on the ambient conditions, but at least safety shoes protection class 2, protective gloves.

Preparatory activities:

- Inspect the KuLi for external mechanical damage before starting assembly.
- Remove all packaging components before starting assembly.

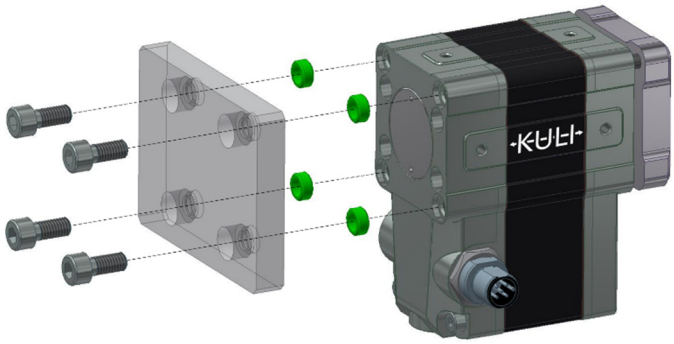
When mechanically mounting the KuLi, observe the following instructions:

5.1.1 Fixing the KuLi in the application

Fix the KuLi in your application using the 4x M6 (12 mm deep) mounting holes on the back. Use screws of a suitable length for your application. Tighten them with a torque according to the manufacturer's specifications of the screws.

The KuLi has centering countersinks (Ø9 f9) for corresponding centering sleeves in these mounting holes to achieve optimum alignment of the KuLi.

The illustration shows a mounting example. The centering sleeves, shown in green, are not included in the scope of delivery.

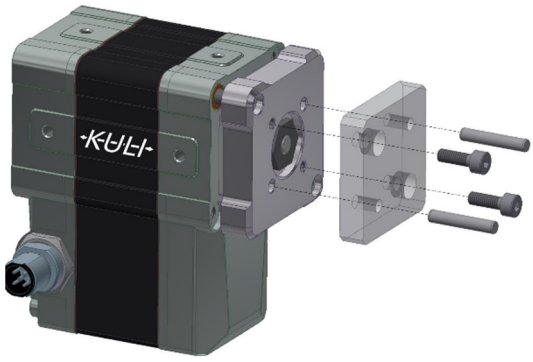


Note:

The KuLi also has additional holes on the side and top which can be used for mounting. Be sure to observe the smaller diameter of M4 and use screws suitable for your application. The maximum tightening torque is 2.5 Nm.

5.1.2 Connection to the lifting plate

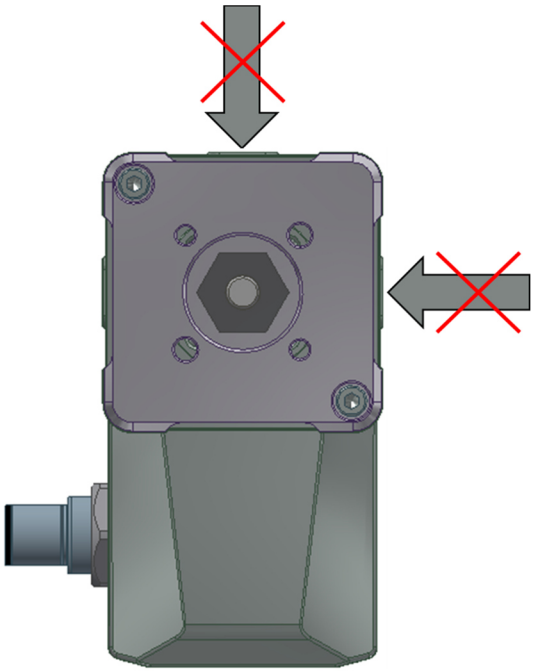
The KuLi is equipped with a lifting plate, which is provided with mounting holes 2x M4 (10 mm deep) and holes for alignment pins 2x Ø4 (10 mm deep). Use only these fastening points to connect the load. Use screws of a suitable length for your application. Tighten them with a torque according to the manufacturer's specifications of the screws. Observe the maximum torque of 2.5 Nm for the housing.



5.1.3 Effect of radial forces

CAUTION! Risk of damage to the KuLi due to the effect of radial forces.

The effect of radial forces may cause the KuLi to break. This may result in damage to the corresponding application. When connecting the KuLi to your application, avoid the effect of radial forces.



5.2 Installation instructions for the qualified electrician

DANGER!

Danger due to electric shock.
Incorrect installation or damage to the live cables during installation may result in an electrical hazard and thus in death or serious injury.

- ► Carry out all assembly work only in a de-energized state.
- ► The electrical connections may only be carried out by a trained electrician.

Preparatory activities:

- Inspect the KuLi for external mechanical damage before starting assembly.
- Remove all packaging components before starting assembly.

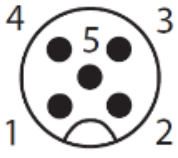
WARNING! The KuLi performs a reference run when the supply voltage is applied. This results in the risk of crushing in the travel range. The assembly may only be carried out in a voltage-free state!

Observe the following notes for the electrical installation of the KuLi:

- Power supply and control signals are realized via the following connection:

  5-pin M12 connector (A-coded), see pin assignment

Pin	Name	Description
1	+24VDC	Power supply
2	S1 (RS232 TXD)	Plunger retracted
3	GND	Ground
4	Control input (RS232-RXD)	0V = run in +24V = run out
5	S2	Plunger extended



- Make sure that the supply lines are not pinched or crushed
- The plug has a continuous load capacity of 4A/60V. For a short time, the current load of the plug may be equal to the peak current of the KuLi of 10A.

6 Start-Up

DANGER!

Danger due to electric shock.

Incorrect installation or damage to the live cables during installation can result in an electrical hazard and therefore death and serious injury.

- ► For safety reasons, be sure to connect all PE protective conductors and ground conductors before start-up.
- ► Have the electrical equipment checked by a qualified electrician.

WARNING!

Danger due to unexpected Start-Up.

During start-up, the KuLi may move unexpectedly, which may result in a crushing, shearing or impact point.

- ► Provide control-dependent safety features to adequately reduce the risk of unexpected start-up.
- ► Observe the reference run when applying the supply voltage.

WARNING!

Danger due to uncontrolled movements.

During start-up, uncontrolled movement of loads may occur due to faulty mounting or faulty control signals. This can result in crushing, shearing and impact points.

- ► Before commissioning, check whether all components of the KuLi have been correctly mounted.
- ► Only start-up the KuLi without a load.

WARNING!

Danger from radiation due to electromagnetic effects.

During commissioning of the KuLi, electromagnetic fields may occur which may have a negative effect on persons as well as on machines and devices in the environment.

- ► The Integrator must ensure EMC capability in the end device/installed condition.

WARNING!

Danger due to breakage.
Incorrect mounting or disregard of the permissible operating data of the KuLi can lead to breakage. Blocking or bending components can cause damage to the entire system.

► Observe the notes in these assembly instructions for correct assembly.

► Operate the KuLi only within the range of permissible operating conditions.

WARNING!

Risk of being pulled in, caught, trapped or crushed.

The stroke movement of the KuLi can cause objects, items of clothing or body parts to be pulled in, caught or crushed, resulting in serious injuries.

► Only touch the KuLi for start-up when it is no moving.

CAUTION!

Danger from hot surfaces.
Surfaces of the KuLi may be hot during operation and cause burns.

► Touching the components of the KuLi during start-up is only permitted after complete cooling and with personal protective equipment at least safety shoes protection class 2, safety gloves.

Preparatory activities for start-up:

- Before start-up, make sure that all PE protective conductors and ground conductors of your application are connected and that the supply voltage matches the product voltage.
- Make sure that the KuLi has been mounted in accordance with the mechanical and electrical instructions in these mounting instructions.
- Start-up is only permitted with a suitable master controller (→ see chapter 3.5 "Requirements for the master controller").

Start-Up:

1. Switch on the supply voltage.
2. In the standard version, the actuator is controlled via the control input. If 24 V is applied to this input, the actuator moves to the outer position (extended). When not triggered, the actuator moves to the inner position (retracted). 3.
3. The stroke movement is performed in accordance with the software variant parameters set at the production.
4. If other force/travel time settings are required, this can be done in 50N steps using the parameterization software via computer, see chapter 7.

Reference run after switching on:

- After switching on, the Kuli must perform a reference run. This is initiated when the Kuli detects the first flank change from 0 V to 24 V at the control input after being switched on. The Kuli then moves at reduced speed to its reference position, which must be realized by a mechanical end stop. Starting from this reference position, it then moves along the entire travel path to check whether the movement is possible. If this procedure is successfully completed, the Kuli is ready for operation and performs all further movements at the set speed.

7 Programming

7.1 Parameterization with software versions DM / SM / PM / EX

The behaviour of the KuLi in the standard versions DM (Dynamic Mode), SM (Standard Mode) and PM (Power Mode) can be adjusted to the respective application using the parameterization software and uploaded using the "Connect-Box" parameterization adapter. Please observe the following chapters for this purpose.

Individual parameterization in the EX software version (Expert Mode) must be carried out by Ketterer. After parameterization, start-up must also be carried out in cooperation with Ketterer.

Qualification of the personnel “Connect-Box”

- The installation and electrical connection of the device may only be carried out by a qualified electrician. The qualified personnel must be instructed and authorized by the system operator.
- Only persons who have been instructed and authorized by the system operator may use the device.
- Malfunctions or damage to the device must be reported immediately to the qualified personnel responsible for the electrical connection.
- The device must be taken out of operation by the responsible technical personnel until the fault has been corrected and secured against accidental use.

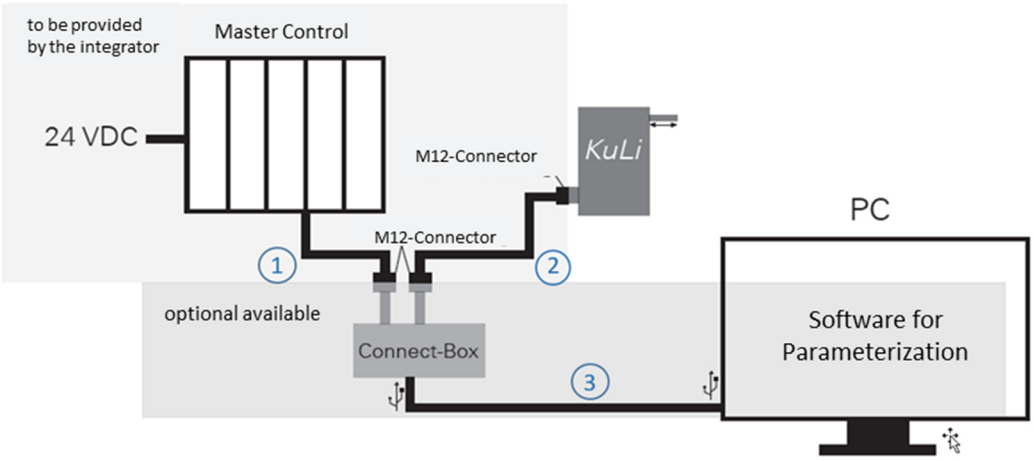
7.1.1 Assembly and start-up of the Connect Box

If the KuLi is connected to the PC/laptop and the connect box in the extended state and this connection gets disconnected when the supply voltage is switched on, the KuLi moves to the inner reference point.

The following cables are required to connect the Connect-Box:

(1)	Connection cable SPS	5 pol. M12-plug
(2)	Connection cable KuLi	5 pol. M12-connector
(3)	USB-connection	Type B

Parameterization via Connect Box:



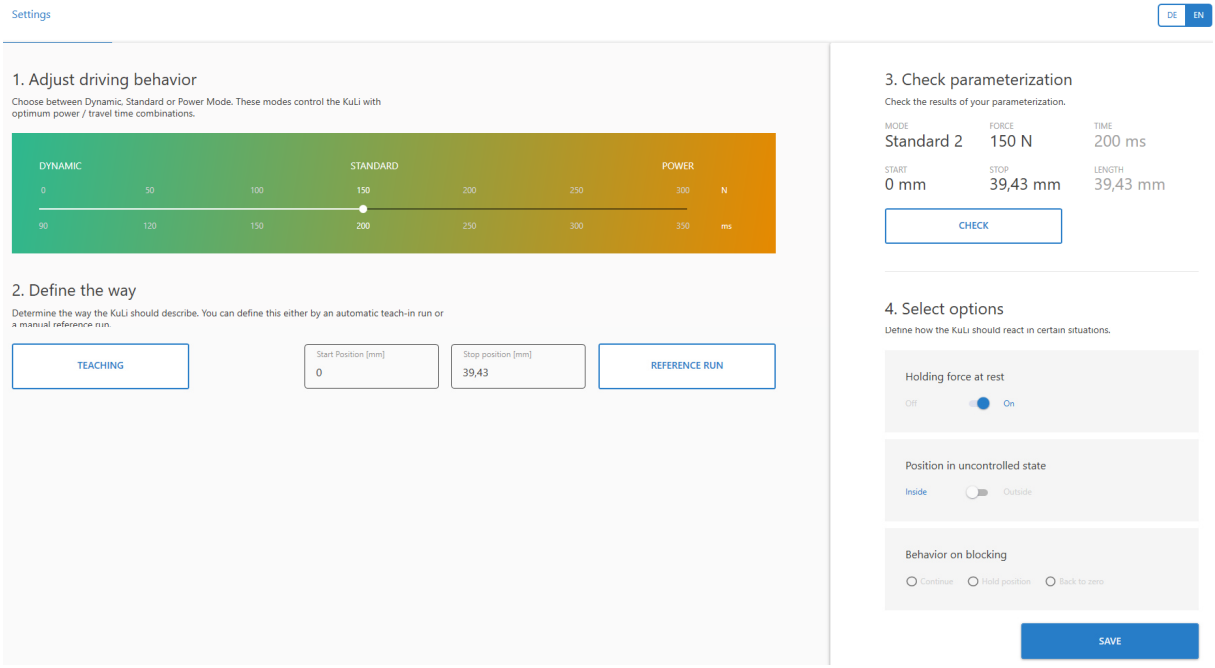
The Connect-Box is linked via the connection cables with 5-pin M12 plugs. Pin assignment see Chap. 5.2.

1. Disconnect the connection cable (1) to the PLC at the KuLi and connect it to the Connect-Box. 2.
2. Connect the second connection cable (2) from the connect box to the KuLi. 3.
3. The power supply and the interface signals for the KuLi are passed through the connect box and displayed via the LEDs on the connect box:

LED - S1	Plunger retracted/TXD PC software.
LED - SIGNAL IN	5-pin M12 socket/RXD PC software
LED - S2	Type B

4. By plugging in the USB cable (3), the two communication lines (Signal In and S1) are diverted to the USB connection.

7.1.2 Parameterization software



<u>Set the movement characteristics:</u>

For this purpose, the slider in the corresponding field is moved to the desired position. The corresponding setting data is automatically transferred to the KuLi. During this transfer, the other operating elements are deactivated.

The path to be moved by the KuLi can be set via the software. There are various options for this:

- Button "TEACHING“

  The KuLi moves with reduced force to the inner position, the outer position and then back to the inner position. The positions taught in this way are the maximum movement distance of the KuLi. The inner stop is used as a reference position.

- Input start position / stop position

  The Start position and Stop position fields can be used to manually set the movement path if the desired setting does not correspond to the positions defined via the "TEACHING" button.

- Button „REFERENCE RUN“

The KuLi does not have an absolute measuring system. Therefore, the positioning system must be referenced after each start-up. The "REFERENCE RUN" button starts this referencing, which is carried out with reduced force and speed settings. The Kuli first moves to the inner stop, which serves as the reference point, and then checks whether the set movement path is free of obstacles.

- Button „CHECK“

After the reference run has been successfully performed, the function of the selected setting can be checked under real conditions. If the "CHECK" button is pressed, the Kuli moves to the other end position in each case. The movement distance and the movement speed are measured and displayed. If necessary or desired, the movement behaviour can be changed again with the slider.

Options:

CAUTION! When the power supply is switched off, the KuLi cannot apply any holding force!

Holding force at rest

- If a permanent force is applied to the plunger of the KuLi in an end position, a holding force may have to be set. This can be activated or deactivated with the slider under "Holding force at rest".

- Position in uncontrolled state

  This setting can be used to select whether the KuLi should move to the inner or outer end position in the idle state (signal-In not active).

Behaviour on blocking

If an end position cannot be reached due to an excessive load, this is recognized by the KuLi as a blockage. The user can set how the KuLi should behave in this situation:

- Continue

  After a blockage, the KuLi attempts to move to the end position. For this purpose, new movement commands are periodically generated by the KuLi until the end position is reached or the control changes the end position.

- Hold position

  With this setting, the KuLi stops after a blockage and, if activated, switches on its holding force.

- Back to zero

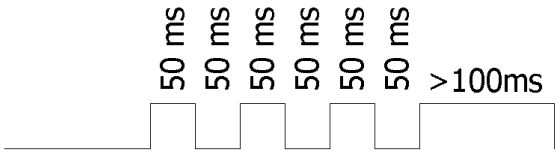
  With this setting, the KuLi moves back to the end position from which it came after a blockage. To trigger a new movement, the control signal must be reset and then activated again.

7.2 Programming via master control

The following programming / settings can be made on the KuLi by using the master control.

7.2.1 Reference run during operation

- It is also possible to perform a reference run during operation. For this purpose, a sequence of 4 pulses must be sent to the control input. The length of the first pulses and pauses should be between 30 and 60 ms. The first pulse still generates a movement command, the others are ignored until a pulse or a pause lasts >70 ms. If a reference or teach run is then detected, this is carried out, otherwise the Kuli moves to the end position corresponding to the control signal.



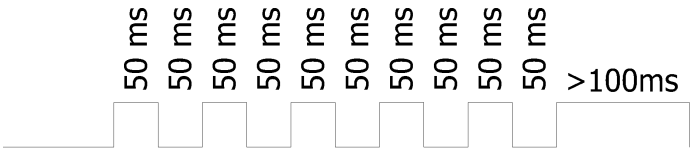
- After the fourth pulse, which is longer than 100 ms, the Kuli activates both outputs. The Kuli is now ready for reference run. This starts as soon as the control input changes from 24 V to 0 V. The two outputs are reset and the Kuli moves to its reference point, to its end position and back to the inner end position. The control input is inactive during the reference run.

Control input	Action	Output 1	Output 2
4 pulses	Initialize reference mode	24 V	24 V
24→0 V	Move to reference point	→24 V	→0 V
	Move to outer end point	→0	→24 V
	Move to inner end position	→24 V	→0 V

- If an error occurs during the reference run, both outputs are activated to indicate this situation to the user. In this case, the Kuli is not ready for operation and will start a reference run when activated again.

7.2.2 Teach run during operation

- It is also possible to perform a teach run during operation. For this purpose, a sequence with six pulses must be sent to the control input.



- After the sixth pulse, which is longer than 100 ms, the Kuli activates both outputs. The Kuli is now ready for the teach run. This starts as soon as the control input changes from 24V to 0V. Both outputs are reset and the Kuli moves to its reference point. Each time the input signal at the control input changes, a new position is approached and taught.

Control input	Action	Output 1	Output 2
6 Pulse	Activate teach mode	→24V	→24V
24->0V	Move to reference point	→24V	→0V
0→24V	Move to outer end point	→0	→24V
24→0V	Move to inner end position	→24V	→0V

- When an end point is reached, the respective output signal is activated as a feedback. The end positions must be realized by limiting the travel distance by a mechanical resistance as stable as possible, which leads to a blocking of the Kuli. In the parameter set of the Kuli, a safety distance can be defined for each end position, which prevents too frequent blocking.

7.2.3 Teaching the travel range after switching on

- If the control input remains at the 24 V level for more than five seconds after switching on and the first flank change, both outputs become active and the Kuli is in teach mode, i.e. it now wants to teach in the two end positions. This process is controlled by using the control input:

Control input	Action	Output 1	Output 2
0 V→24 V(> 5s)	Activate teach mode	→24 V	→24 V
24 V→0 V	Move to reference point	→24 V	→0 V
0 V→24 V	Move to outer end point	→0 V	→24 V
24 V→0 V	Move to inner end position	→24 V	→0 V

- When an end position is reached, the respective output signal is activated as feedback. The end positions must be realized by limiting the travel distance by a mechanical resistance as strong as possible, which leads to a blocking of the Kuli. In the parameter set of the Kuli, a safety distance can be defined for each end position, which prevents too frequent blocking.
- The Kuli has now learned its two end positions and is ready for operation, i.e. it is also referenced.

8 Operation

DANGER!

Danger due to electric shock.

Incorrect installation or damage to the live cables during installation can result in an electrical hazard and thus in death and serious injury.

- ► Have the electrical equipment checked by a qualified electrician.
- ► Do not reach into the KuLi during operation.

WARNING!

Danger due to unexpected operation.

During operation, the KuLi may start up unexpectedly, which may result in a crushing, shearing or impact point.

- ► Provide control-dependent safety features to adequately reduce the risk of unexpected start-up.
- ► A mains disconnecting device according to EN60204-1:2019 "Chapter 5.4" shall be provided by the integrator
- ► Do not reach into the KuLi during operation.

WARNING!

Danger due to uncontrolled movements.

During operation, loads may move in an uncontrolled manner due to incorrect installation. This may result in crushing, shearing or impact points.

- ► Do not interfere with the KuLi during operation.
- ► Before operation, check whether all components of the KuLi have been correctly mounted.

WARNING!

Danger from radiation due to electromagnetic effects.

Electromagnetic fields can occur during operation of the KuLi, which can have a negative effect on both persons and machines and devices in the environment.

- ► The Integrator must ensure EMC capability in the end device/installed condition.

WARNING!

Danger due to breakage.

Incorrect mounting or disregarding the permissible operating data of the KuLi can lead to breakage. Blocking or bending components can cause damage to the entire system.

- ► For correct mounting, observe the notes in these assembly instructions.
- ► The KuLi may only be operated within the range of the permissible operating conditions.
- ► No interference with the KuLi is permitted during operation.

WARNING!

Danger from being pulled in, caught, grasped and crushed.

The stroke movement of the KuLi can cause objects, items of clothing or body parts to be pulled in, caught or crushed, resulting in serious injuries.

- ► No interference with the KuLi is permitted during operation.

CAUTION!

Danger from hot surfaces.

Surfaces of the KuLi may be hot during operation and cause burns.

- ► Touching the components of the KuLi during operation is only permitted after it has completely cooled down and with personal protective equipment, at least safety shoes, protection class 2, safety gloves.

9 Disassembly / Shutdown

DANGER!

Danger due to electric shock.

Disassembly without prior shutdown may result in an electrical hazard and thus in death or serious injury.

- ► Only perform disassembly when all components are voltage-free.
- ► Observe the 5 electrical safety rules.

DANGER!

Danger due to residual electrical energy.

Even after disconnecting the power supply, residual electrical energy may still be in the system due to charged capacitors. This can result in electrical hazards and thus in death and serious injury.

- ► Only perform disassembly when the voltage-free condition of all components is ensured. Observe the 5 safety rules.
- ► Wait at least 5 minutes after ensuring that no voltage is present before starting disassembly work. This ensures that there is no residual electrical energy in the system.

CAUTION!

Danger due to sharp edges on parts of the housing.

When handling the KuLi, sharp edges and corners can cause cuts.

- ► Wear your personal protective equipment depending on the ambient conditions, but at least safety shoes protection class 2, suitable protective gloves.

CAUTION!

Danger from hot surfaces.

Surfaces of the KuLi may be hot during operation and cause burns.

- ► Touching the components of the KuLi during operation is only permitted after it has completely cooled down and with personal protective equipment, at least safety shoes, protection class 2, safety gloves.

WARNING!

Danger due to unauthorized restart.
During shutdown, the KuLi may start unexpectedly if it is started by a third party. This may result in a crushing, shearing or impact point.

► Protect the system against unauthorized restarting, e.g. by using a key / lock on the mains disconnection device / information sign.

► Only access the KuLi after you have disconnected the power supply.

Preparatory activities for disassembly / shutdown:

- Before disassembly, put the KuLi out of operation.
- Be sure to observe the 5 electrical safety rules.

General instructions for disassembly:

- Ensure careful handling and avoid mechanical overloading. Do not bend any components, cables or plug connections during disassembly.

10 Maintenance

DANGER!

Danger due to electric shock.
Damage to the live cables during maintenance may result in an electrical hazard and thus in death and serious injury.

► Only perform maintenance when all components are de-energized. Observe the 5 electrical safety rules.

WARNING!

Danger due to unauthorized restart.
During maintenance, the KuLi may start unexpectedly if it is started by a third party. This may result in a crushing, shearing or impact point.

► Protect the system against unauthorized restarting, e.g. by using a key / lock on the mains disconnection device / information sign.

► Only access the KuLi after you have disconnected the power supply.

CAUTION!

Danger due to sharp edges on parts of the housing.
When handling the KuLi, sharp edges and corners can cause cuts.

► Wear your personal protective equipment depending on the ambient conditions, but at least safety shoes protection class 2, suitable protective gloves.

CAUTION!

Danger from hot surfaces.
Surfaces of the KuLi may be hot during operation and cause burns.

► Touching the components of the KuLi during operation is only permitted after it has completely cooled down and with personal protective equipment, at least safety shoes, protection class 2, safety gloves.

Preparatory activities for maintenance:

- Maintenance work may only be performed by qualified personnel. Qualified personnel are persons with appropriate specialized training and experience who understand the construction requirements, the design of the KuLi and the safety regulations.
- Set the KuLi out of operation before maintenance.

Action	Maintenance intervals	Notes
Check KuLi for external damage	Daily before operation	Visual inspection
Check for blockage of the movement path	Daily before operation	Visual inspection
Check screws for fastening on torque	Every 6 months	Torque depends on the used screw
Tight fit of the screwed connection cables	Every 6 months	Hand-tighten
Lubrication	No action necessary	All motor components are lifetime lubricated

11 Self-help and diagnosis in case of malfunction

You can correct malfunctions of the device by observing the following table.

Malfunctions that cannot be corrected according to this table or damage to the device must be reported immediately to the qualified personnel responsible for the electrical connection.

Malfunction	Possible cause	Solution
No connection to the KuLi	KuLi is not connected	Connect KuLi
	USB connector is not connected	Connect USB plug
	Connection to PLC is not plugged in	Establish connection
LEDs do not light up	PLC is powerless	Switch on power supply
	USB plug is not connected	Connect USB plug

12 Disposal

The disposal of the KuLi (machine parts, operating materials) is subject to the local disposal regulations and the environmental protection laws in the country of use.

13 Repair

In case of service or repair contact:

B. Ketterer Söhne GmbH & Co. KG

Bahnhofstraße 20

78120 Furtwangen

Phone: +49(0)77 23 / 9323-0

E-mail: info@ketterer.de

Internet: www.ketterer.de

EC - Declaration of Incorporation

In terms of the EC Machinery Directive 2006/42/EC Annex II B

Manufacturer/ Distributor

B. Ketterer Söhne GmbH & Co. KG
Bahnhofstraße 20
78120 Furtwangen
Germany

We hereby declare that the following **incomplete machine**:

„KuLi - electric short stroke linear actuator“
Item no. 3215.00-0005 to 3215.00-0020 and 3215.00-0034F001

meets the applicable basic requirements of the **Machinery Directive 2006/42/EC**.

Compliance with other applicable directives/regulations for the product is declared:

2014/30/EU	EMC Directive
2011/65/EU	RoHs Directive

The following harmonised standards have been applied:

DIN EN ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
DIN EN 60204-1:2018	Safety of machinery - Electrical equipment of machines – Part 1: General requirements

In addition, we declare that the special technical documentation was compiled according to Appendix VII Part B.

Authorized to compile the technical documentation:

B. Ketterer Söhne GmbH & Co. KG
Bahnhofstrasse 20
78120 Furtwangen
Germany

The incomplete machine may not be put into operation until conformity of the machine into which the incomplete machine is to be installed with the provisions of the Machinery Directive (2006/42/EC) is confirmed.

R. Jäger

Furtwangen, 02.04.2022 Robert Jäger, Managing Director