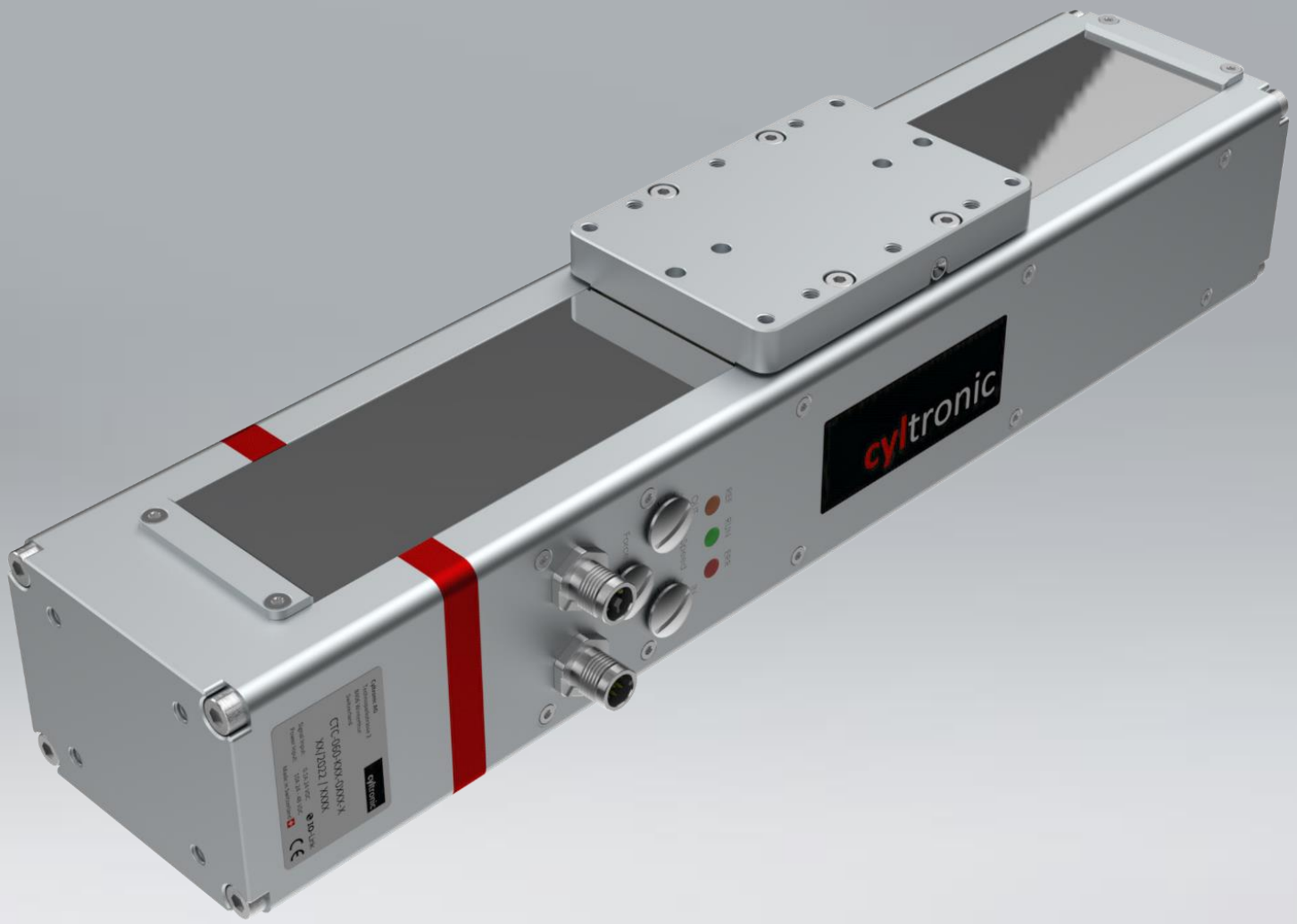
cyltronic



Linear Axis CTL

Operating instructions EN

CE

flexibility ***in motion***

1 General information

1.1 Document version

20230530 Operating Instructions CTL EN (replaces previous versions)

1.2 Manufacturer information

Cyltronic AG
Technoparkstrasse 2
8406 Winterthur
Switzerland

Tel +41 (0) 52 551 23 10
Web www.cyltronic.ch
Mail info@cyltronic.ch

Thank you for your confidence in our product. We recommend reading the entire operating instructions before commissioning.

Installation and commissioning may only be carried out by qualified personnel with appropriate qualifications in accordance with these operating instructions.

1.3 Device assignment

These instructions apply to the following devices:

Cyltronic linear axis:

- Type CTL

1.4 Scope of delivery

The scope of delivery includes only the linear axis, all accessories must be purchased separately.

2 Table of content

3 Safety information

3.1.1 Local safety regulations

Before using this product, make sure that it complies with all local safety regulations. Take all necessary safety precautions to ensure proper operating function during and after the period of use. You may also add additional external protective features or structures to the product as needed. Restrict access to hazardous areas appropriately.

3.1.2 Accident risk

Do not remove any parts from the product or attempt to open it, for example by loosening screws or other components.

3.1.3 Modification

No modifications may be made to the product. Modifications may cause the product to malfunction and void any warranty claims.

3.1.4 Qualified personnel

Installation, commissioning, as well as maintenance and disassembly may only be performed by qualified personnel. The personnel must be familiar with the installation of mechatronic drives.

3.2 Intended use

The product is an incomplete machine in the sense of the Machinery Directive (Directive 2006/42/EC) and is intended for installation in a complete machine. This must not be put into operation until it has been established that the machine into which this partly completed machine is to be incorporated complies with the provisions of Directive 2006/42/EC.

This product can be used in applications of various fields; therefore, the responsibility of the specific application passes to the user. The application or performance limits as well as the environmental or boundary conditions are described in chapter 6 "Technical data".

The risks associated with improper use lie solely with the user. No liability is accepted for damage resulting from improper use.

3.3 Foreseeable misuse

The product must not be used to transport or move people and animals. For example, the product must not be used for lifting suspended loads when direct failure may result in injury to a human being.

3.4 Safety instructions

3.4.1 General hazards

This product is built according to the current state of the art and is safe to operate. However, hazards may arise from the machine if it is not used by trained or at least instructed personnel, or if it is used improperly or for purposes other than those for which it is intended.

3.4.2 Warnings, notes

Warnings, notes and residual risks are identified by symbols in these operating instructions. It is essential to follow the instructions in order to avoid accidents, personal injury and damage to property.

Consider markings on the product.

Before mounting, installation and maintenance units: Switch off the power supply, check that no voltage is present and secure against being switched on again.

DANGER	
	...indicates a hazardous situation which, if not avoided, could result in death or serious injury.

WARNING	
	...indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION	
	...indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTE	
	...points out useful tips and work recommendations, which, however, have no influence on the safety and health of the personnel.

IMPORTANT	
	...indicates a possible harmful situation, which can lead to property damage if not avoided.

3.4.3 Residual risks

CAUTION	
	During operation, the product can become hot without affecting its function. The surface temperature can reach temperatures of up to reach 100 °C. Do not touch the product under any circumstances during operation and in the cooling phase after shutdown. Attach protective measures against contact at temperatures above 60 °C and contact duration of more than 1s. Ensure that no temperature-sensitive parts or objects are in contact with or attached to the product.

3.4.4 Product-specific warnings and notes

CAUTION	
	Depending on the operating conditions (speed, load, etc.), increased surface temperatures may occur on the product in the area of the drive. Touching the product during operation can cause minor burns. Do not touch the product during operation. During maintenance and repair work, make sure that the product has cooled down before starting work.

NOTE	
	The noise pattern does not necessarily indicate the service life of the product. Different noise patterns may occur depending on the production process.

4 Transport, handling, storage

Lift the product by the housing only. Weight acc. to chapter 6 Technical data. The carriage must be fixed and kept load-free during transport.

5 Functional description

The CTL linear axis functions as an electromechanical spindle drive for linear motion.

The main components are the brushless DC motor, the spindle drive and the integrated electronics.

All components are located in the housing. The retraction and extension speed as well as the force limitation can be continuously adjusted via rotary knobs directly on the housing.

5.1 Device overview

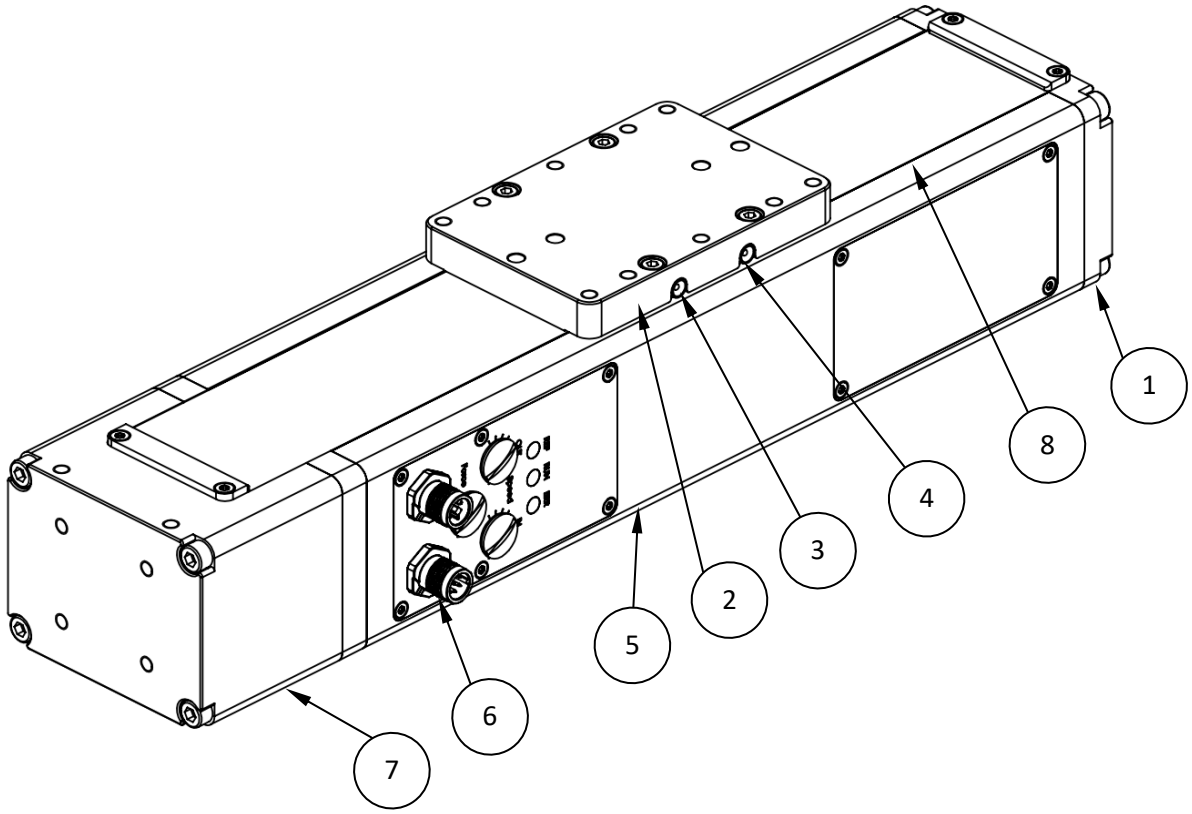


FIGURE 1: DEVICE OVERVIEW

Nr.	Description
1	Front cover
2	slide
3	Conical grease nipple for lubrication of the carriage
4	Conical grease nipple for lubricating the spindle
5	Profile housing
6	Control panel, connections, display
7	Rear cover
8	Cover plate

5.2 Control panel, connections, display

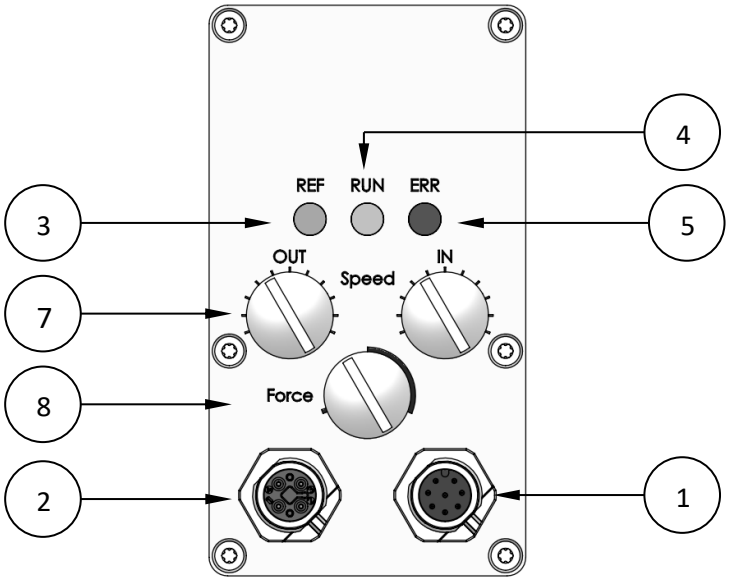


FIGURE 2: CONTROL PANEL

No.	Designation	Property
1	Connection for signal (M12 8-pin)	A-coded
2	Connection for power (M12 4-pin)	T-coded
3	LED display REF (orange)	Lights: Reference run required.
4	LED display RUN (green)	Lights: Ready for operation / In operation
5	LED indicator ERR (red)	Lights: Error / not ready for operation Flashes: Error code see chapter 12.1
6	Rotary knob for setting the retraction speed (under the screw plug)	+ clockwise - counterclockwise
7	Rotary knob for setting the extension speed (under the screw plug)	+ clockwise - counterclockwise
8	Rotary knob for setting the force (under the screw plug)	+ clockwise - counterclockwise

IMPORTANT	
	The scale on the rotary knob for setting the force only gives an indication of the continuous range and the peak force. An excessively long duty cycle with operation above the continuous range can lead to overheating. The unit has an internal temperature monitor which initiates a stop as soon as the temperature limit value is exceeded. However, damage due to overheating cannot be prevented.

5.2.1 Set speed / force

The rotary knobs for speed and force adjustment are exposed with a slotted screwdriver by removing the screw plugs. The retraction and extension speed as well as the force limitation are set via the rotary knobs (higher clockwise, lower counterclockwise).

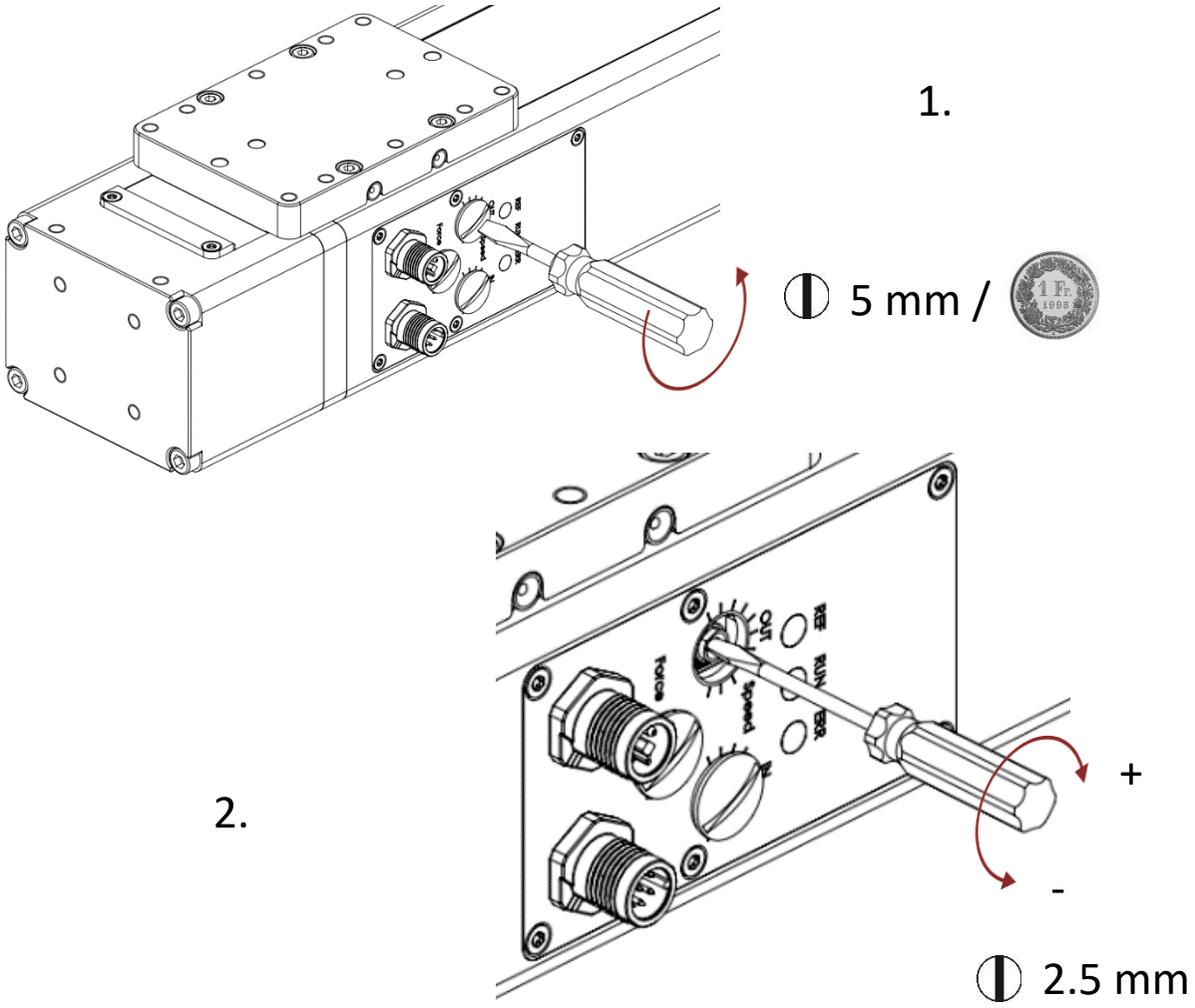


FIGURE 3: SET SPEED / FORCE

IMPORTANT	
	Turn the knobs for force and speed carefully (approx. 0.5-1 Ncm). Do not turn beyond the end positions, as this may cause damage to the product.

IMPORTANT	
	The screw plugs may only be removed when the ambient humidity is below 90%. To avoid damage to the seal, tighten the screw plugs carefully when closing (approx. 2-5 Ncm).

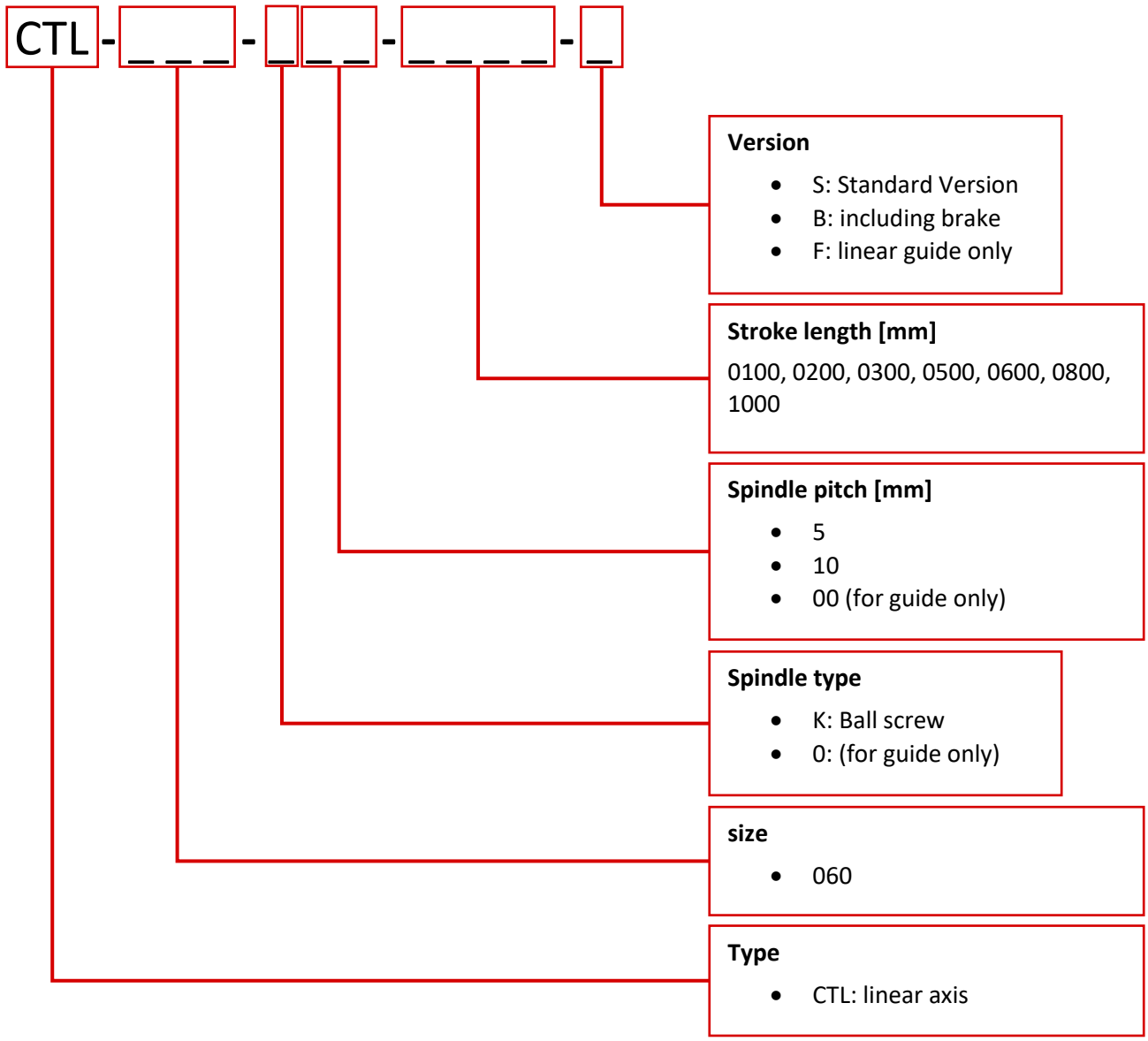
6 Technical data

Size		CTL-60	
Spindle pitch	[mm/U]	5	10
Spindle type		Ball screw	
Mounting position		any	
Ambient temperature	[°C]	0…+40	
Storage temperature	[°C]	-20…+60	
Protection class		IP40 according to EN 60529	
Relative humidity	[%]	0...90 (non-condensing)	
Max. Feed force (peak)	[N]	800	400
Max. Feed force (continuous operation)	[N]	400	200
Max. Speed **In 24V operation** **In 48V operation**	 [mm/s] [mm/s]	 150 300	 300 600
Max. Acceleration	[m/s²]	15	15
Positioning precision	[mm]	+/- 0.1mm	
Repeat precision	[mm]	+/- 0.02mm	

Materials	
Housing, cover, slide	Aluminium colourless anodized
Connecting piece	Aluminium, red anodized
Cover plate	Stainless steel hardened
Screws, Grease nipple	Steel Galvanized
Spindle	heat-treated steel
Spindle nut	Roller bearing steel
Guide rail	heat-treated steel
Guide carriage	steel, Plastic
Covers knobs	Stainless steel
Connector fittings	Zinc nickel plated
Note on materials	RoHS compliant

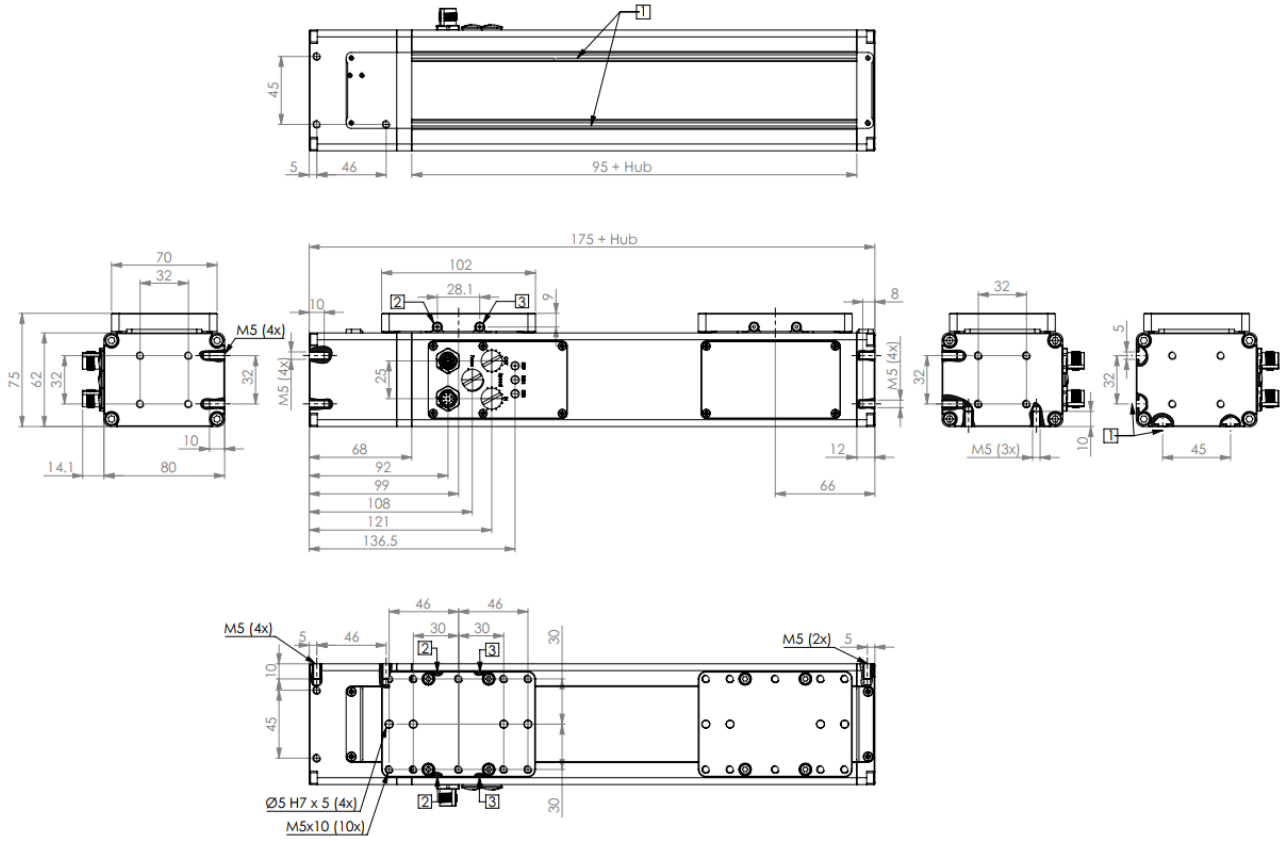
Weight (+/- 10%)			
For 100 mm stroke	[g]	CTL-060-__-S: CTL-060-__-B: CTL-060-__-F:	2871 3624 2220
Per 10mm stroke additionally	[g]	CTL-060-__-S / -B: CTL-060-__-F:	58 48
moving mass	[g]	CTL-060-__-S / -B: CTL-060-__-F:	588 487

6.1 Configuration Key



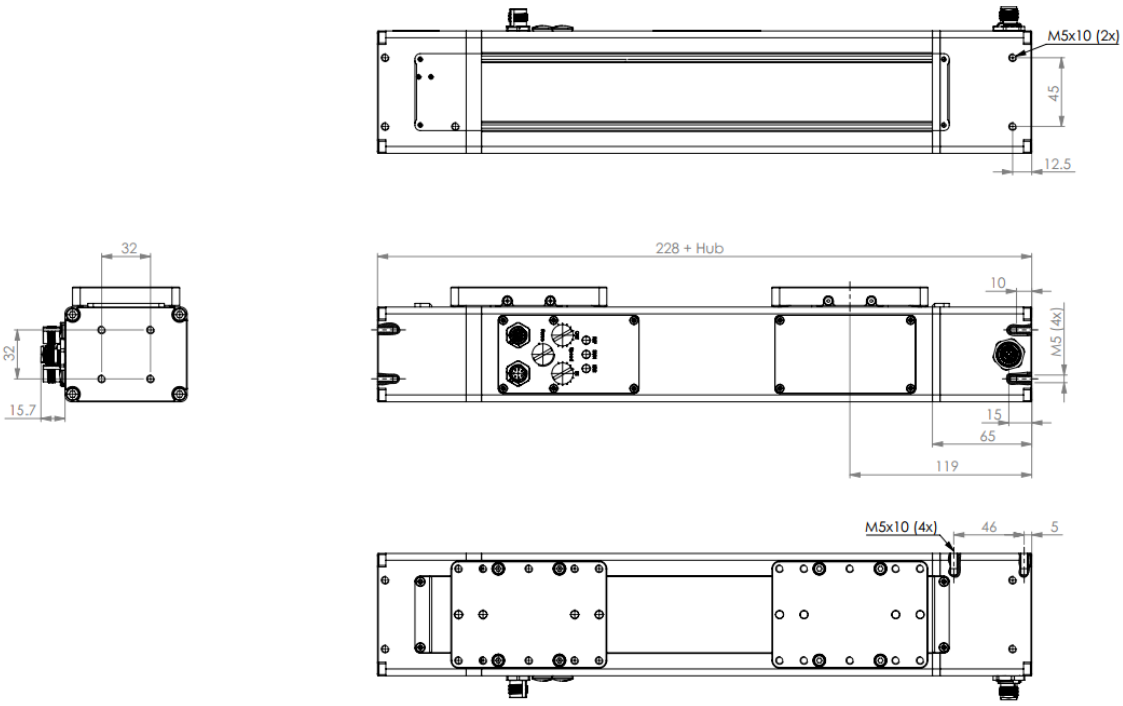
Example: CTL-060-K10-0100-S

6.2 Dimensions



[1] Mounting grooves for sliding block
[2] Tapered grease nipple for lubricating the guide
[3] Conical grease nipple for lubrication of the spindle

6.2.1 Supplementary dimensions for brake



6.3 Characteristic curves / design

6.3.1 Feed force F as a function of feed rate v

The force-velocity curves provide information about the continuous load (corresponds to a duty cycle of 100%) and the maximum available force / feed rate (peak). If an operating point is above the RMS line, continuous operation is not possible. The load must be reduced accordingly, otherwise overheating of the actuator must be expected. The internal temperature monitoring withdraws the operational readiness of the axis and puts it into an error state (ERR-LED flashing pattern see: Chapter 12.1).

If continuous operation is desired (100% duty cycle), all individual operating points must be below the peak line and the averaged effective load (FRMS) must be below the RMS line. The curves shown below are valid for an ambient temperature of 20° C.

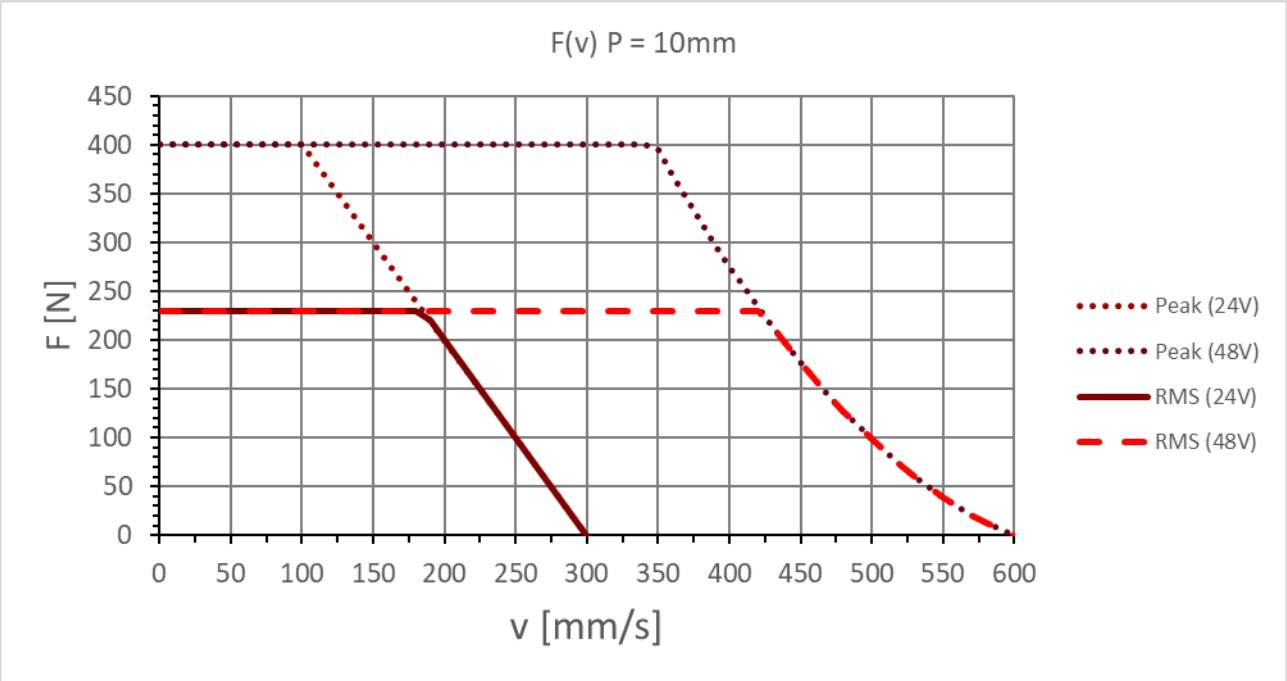


FIGURE 4: FORCE / SPEED CHARACTERISTIC 10MM SPINDLE PITCH

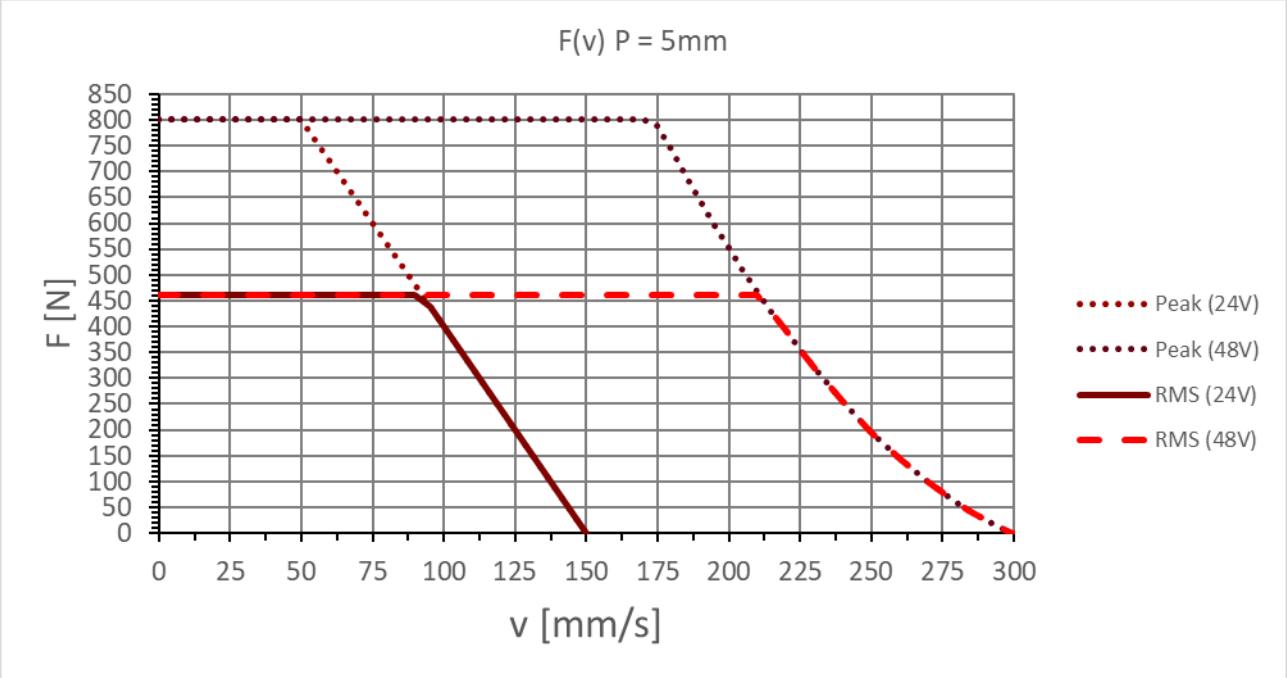


FIGURE 5: FORCE / SPEED CHARACTERISTIC 5MM SPINDLE PITCH

A stroke movement is typically divided into the following chapter:

- b: Accelerate
- c: Run at constant speed
- v: decelerate
- h: Hold / Pause

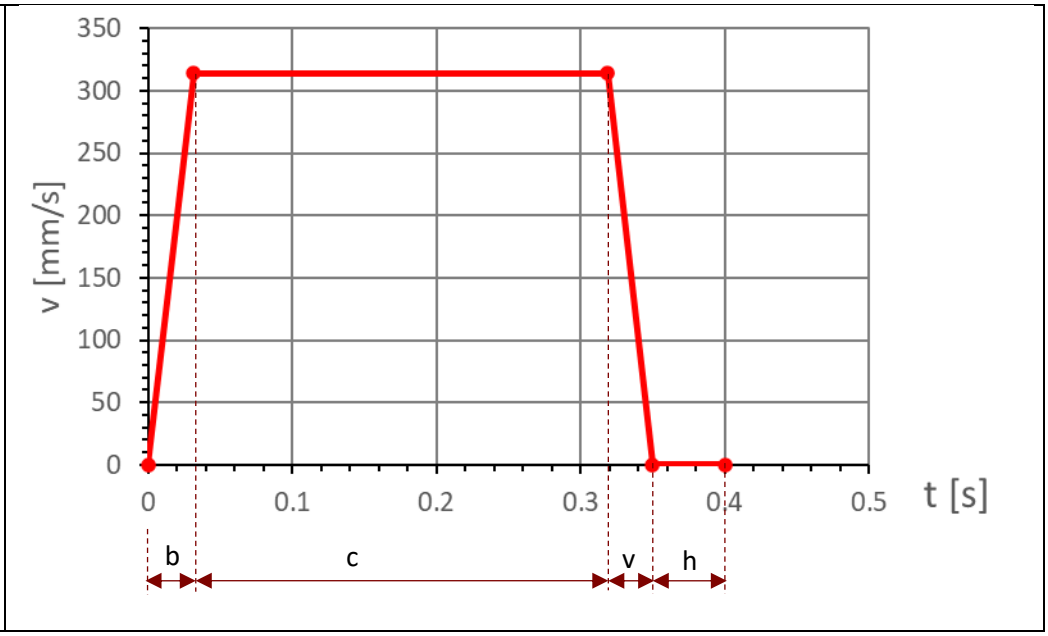


FIGURE 6: V-T DIAGRAM OF A TYPICAL STROKE MOVEMENT

The effective load must be calculated for each chapter. If the averaged effective load is above the RMS line, continuous operation is not possible. The peak curve indicates the load possible for a short time, although this cannot always be operated permanently for thermal reasons. The load during acceleration or deceleration can be above the RMS curve but must be below the peak curve so that the desired stroke time can be achieved.

NOTE	
	Under certain circumstances, the control must be deactivated at high loads (see chapter 7.2) Deactivating the control is only possible in bistable and omnistable mode.

6.3.1.1 Mean effective load (RMS)

The average effective load (RMS) is calculated using the following formula:

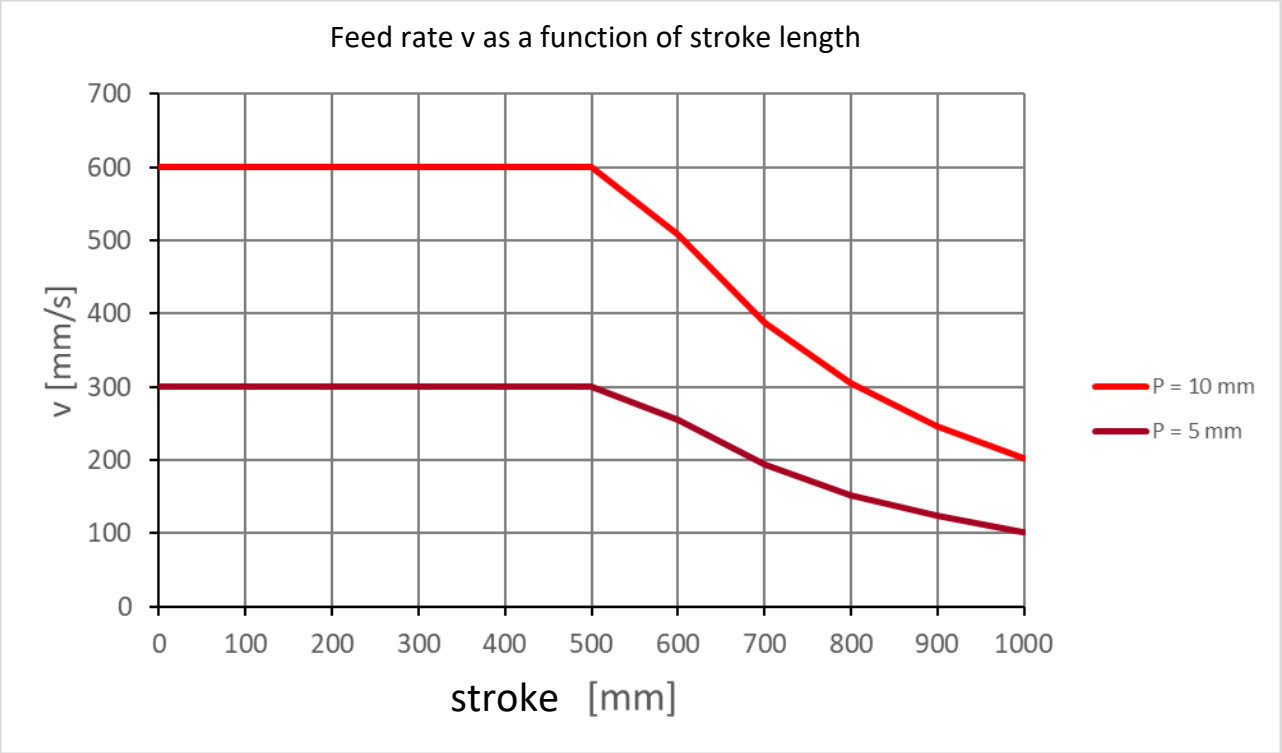
$$F_{RMS} = \sqrt{\frac{1}{t_{tot}} \cdot (t_b \cdot {F_b}^2 + t_c \cdot {F_c}^2 + t_v \cdot {F_v}^2 + t_h \cdot {F_h}^2)}$$ Average effective load in N

$t_b = \frac{v_{max}}{1000 * a_b}$	Acceleration time in s
$t_v = \frac{v_{max}}{1000 * a_v}$	Deceleration time in s
$t_c = \frac{s - \frac{v_{max}(t_b + t_v)}{2}}{v_{max}}$	Time for constant speed in s
t_h	Time for hold / pause in s
$t_{hub} = t_b + t_c + t_v$	Time for total stroke movement in s
$t_{tot} = t_b + t_c + t_v + t_h$	Time for total movement (incl. pause / hold) in s
$F_b = m \cdot a_b + m \cdot g \cdot \sin(\alpha)$	max. occurring load during acceleration in N
$F_c = m \cdot g \cdot \sin(\alpha)$	max. occurring load during constant speed in N
$F_v = m \cdot a_v + m \cdot g \cdot \sin(\alpha)$	max. occurring load during deceleration in N
$F_h = m \cdot g \cdot \sin(\alpha)$	max. occurring load during hold in N (for pause $F_h = 0$)
$v_b = \frac{v_{max}}{2}$	average velocity during acceleration in mm/s
$v_v = \frac{v_{max}}{2}$	average velocity during deceleration in mm/s
v_{max}	occurring velocity in mm/s
m	Mass in kg
s	Stroke in mm
a_b	in m/s² (for rough design 10 m/s²)
a_v	in m/s² (for rough design 10 m/s²)
g	acceleration due to gravity 9.81 m/s² (for simplicity 10 m/s²)
α	Mounting position (e.g., vertical: α = 90°, horizontal: α = 0°)

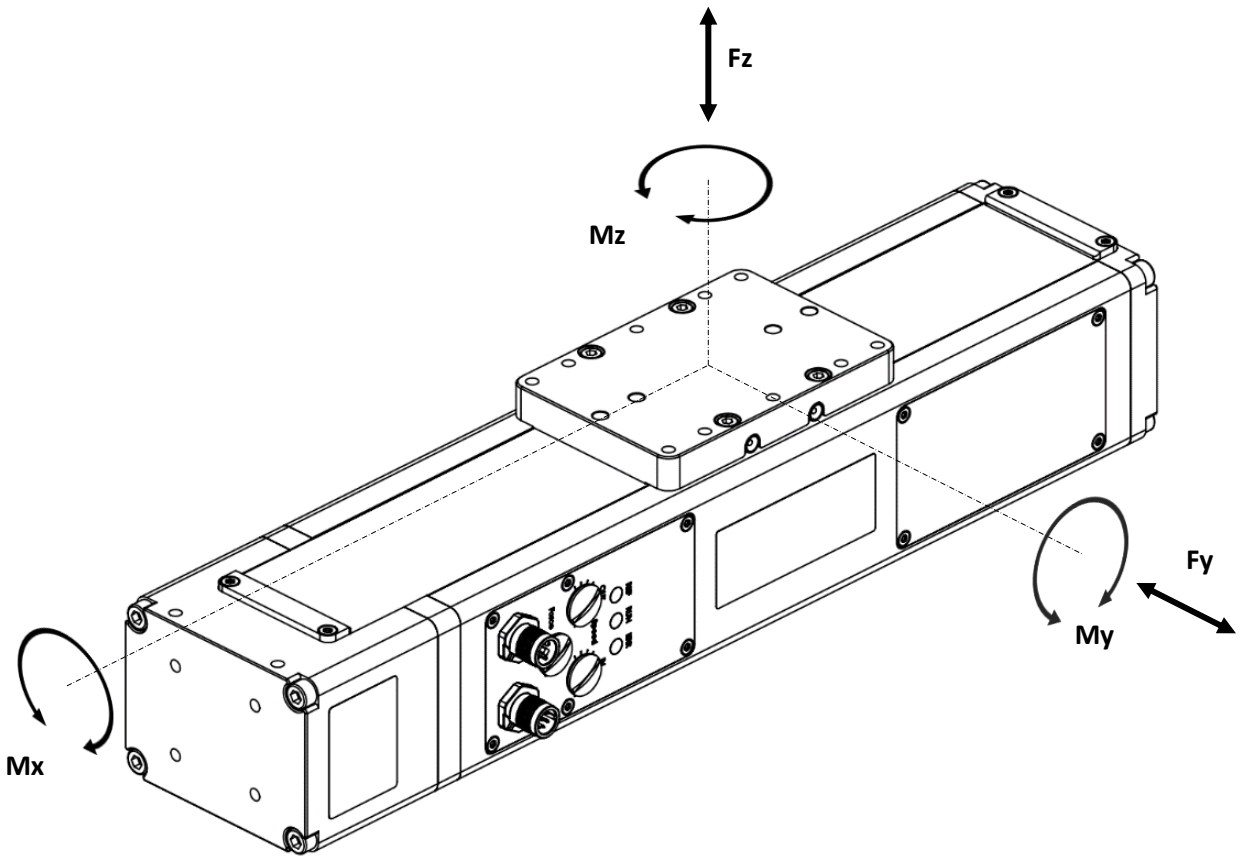
6.3.2 Feed rate v as a function of stroke length

Due to the larger bearing distances with longer strokes, the maximum spindle speed must be reduced accordingly. This also corresponds to a reduction in the feed rate.

The maximum feed rate depends on the spindle pitch P:



6.3.3 Permissible moment load M and payload F



Size	CTL-060 mounting trough lateral grooves	CTL-060 mounting through lower grooves
$F_{y\,max}$ [N]	1500	400
$F_{z\,max}$ [N]	1500	500
$M_{x\,max}$ [Nm]	20	12
$M_{y\,max}$ [Nm]	80	80
$M_{z\,max}$ [Nm]	30	30

Superposition factor fv

If several of the above-mentioned forces and moments act simultaneously, the following equation must also be fulfilled in addition to compliance with the listed maximum loads:

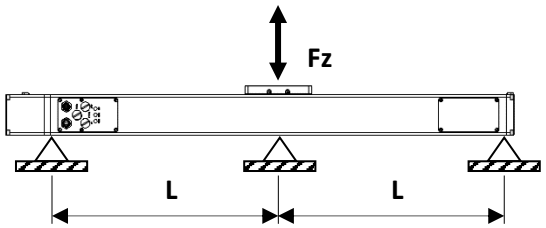
$$f_v = \frac{|F_y|}{F_{y\,max}} + \frac{|F_z|}{F_{z\,max}} + \frac{|M_x|}{M_{x\,max}} + \frac{|M_y|}{M_{y\,max}} + \frac{|M_z|}{M_{z\,max}} \leq 1$$

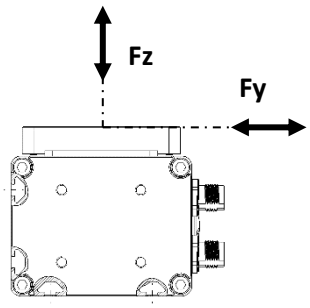
F_n / M_n = dynamic values

6.3.4 Maximum permissible support span L as a function of force F

In order to limit the deflection, the axis may have to be supported for larger strokes.

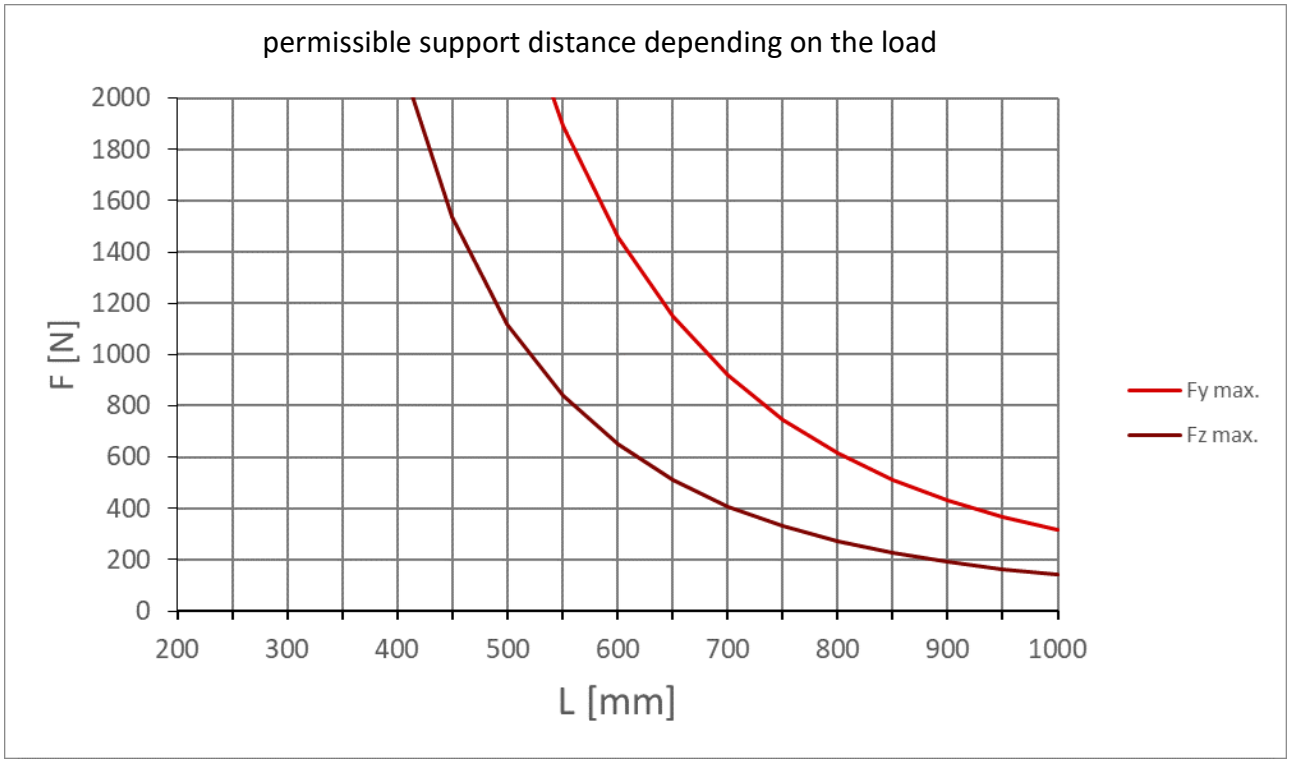
The following diagrams show the maximum permissible support distance as a function of the load. The basis is a maximum deflection of 0.1 mm.





In order not to impair the function and service life, compliance with the following deflection limits is recommended:

size	Dynamic deflection (load moved)	Static deflection (load at standstill)
CTL-060	0.05% of the nominal stroke length of the axis, max. 0.1 mm	0.1% of the nominal stroke length of the axis, max. 0.3 mm



6.3.5 Load ratings

The following basic load ratings apply to the linear guide:

	C_{dyn}	C_0	M_{dynX}	M_{dynY}	M_{dynZ}	M_{0X}	M_{0Y}	M_{0Z}
CTL-060	14700 N	19520 N	143	105	105	190	140	140

6.3.4.1 Static safety

For linear guidance systems at rest and in slow motion, the static load safety factor must be considered, which depends on the ambient and operating conditions. The static load safety factor is calculated as follows:

$$f_{SL} = \frac{C_0}{P} \quad ; \quad f_{SM} = \frac{M_0}{M}$$

f_{SL} Static structural safety

f_{SM} Static load safety factor for moment load

C_0 Basic static load rating [N]

M_0 Permissible static moment load [Nm]

P Equivalent static load [N]

M Statically equivalent moment load [Nm]

Static load safety	
Load	**f_{SL}; f_{SM} (min)**
Normal load	1.25 – 3.00
With shocks and vibrations	3.00 – 5.00

6.3.5 Generator / brake operation

IMPORTANT	
	Overvoltage can occur in the device and in the power supply unit during generator/brake operation. To avoid damage to other devices in the same voltage circuit due to overvoltage, the use of a braking resistor (braking chopper) is recommended.

A brake chopper is connected to the DC link. When a set limit voltage is reached, it transfers the excess power to a braking resistor and thus effectively limits the voltage in the DC link. Suitable braking resistors (braking choppers) are available on request.

7 Operating modes

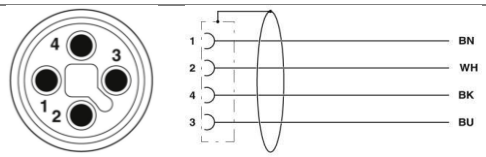
The linear axis can be controlled in two different operating modes. Mode 1 for monostable control and mode 2 for bistable control. **Mode 1** is the factory default state**. To** switch the operating modes, see chapter 7.2.1.2.

7.1 Mode 1: Monostable (& Omnistable)

7.1.1 Omnistable

In omni-stable mode, a stroke can be interrupted at any position. If neither a signal for retraction nor extension is detected, the linear axis stops and remains in control in the position reached. For a force-free state, the control can be interrupted (with DI Force-free).

7.1.1.1 Signal assignment Mode: Omnistable

Power	Signal
Plug M12x1, 4-pole T-coded according to EN 61076-2-11	**Plug M12x1, 8-pin** A-coded according to EN 61076-2-101 (Shielded cables are recommended)
	

Pin assignment Digital I/O

Pin	Color	Function
1	BN	Power voltage 24V-48V ± 15% (max. 10A) At 48V the use of a brake chopper is recommended.
2	WH	Functional earth (FE)
3	BU	GND 0V
4	BK	reserved, do not connect

Pin	Color	Function
1	WH	DO Ready
2	BN	Logic voltage 24V ± 15% (max. 500mA)
3	GN	DO is extended
4	YE	DO is retracted
5	GY	DI Retract*
6	PK	DI Extend*
7	BU	GND 0V
8	RD	DI Teach / Reset / Powerless

7.1.1.2 Truth Table Mode: Omnistable

Command	DI Extend	DI Retract	DI Teach	Comment
linear axis brakes and stops in regulation	0	0	0	
Retract	0	1	0	
Extend	1	0	0	
Teach run: Start with retracted	0	1	1	The linear axis moves slowly to both end stops, starting with retraction, and teaches the new stroke.
Teach run: Start with extension	1	0	1	The linear axis moves slowly to both end stops, starting with the extension, and teaches the new stroke.
undefined	1	1	0	A movement can be executed, this condition must be avoided!
undefined	1	1	1	A movement can be executed, this condition must be avoided!
Reset / powerless	0	0	1	- Control is deactivated, actuator goes into a powerless state, but remains ready for operation - Acknowledge errors

7.1.2 Monostable, normally retracted

Corresponds to a control and behaviour as in the operation of a pneumatic linear axis with a monostable pneumatic valve. In which the linear axis is hosed so that it retracts when the valve is in the rest position.

7.1.2.1 Signal assignment Mode: monostable, normally retracted

Signal connector assignment	Pin	Color	Function
Plug M12x1, 8-pin A-coded according to EN 61076-2-101 (shielded cables are recommended)	**1**	WH	DO Ready
	2	BN	Logic voltage 24V ± 15% (max. 500mA)
	3	GN	DO is extended
	**4**	YE	DO is retracted
	5	GY	**Logic voltage 24V (max. 500mA)**
	6	PK	**DI Extend**
	7	BU	GND 0V
	8	RD	DI Teach / Reset

7.1.2.2 Truth table mode: monostable, normally retracted

Command	DI Extend	DI Teach	Comment
Extend	1	0	
Retract	0	0	
Teach run: **Start with Retract**	0	1	The linear axis moves slowly to both end stops, starting with retraction, and teaches the new stroke.
undefined	1	1	Undefined state, this state must be avoided!

7.1.3 Monostable, normally extended

Corresponds to control and behaviour as in the operation of a pneumatic linear axis with a monostable pneumatic valve. In which the linear axis is hosed so that it extends when the valve is in the rest position.

7.1.3.1 Signal assignment Mode: monostable, normally extended

Signal connector assignment	Pin	Color	Function
Plug M12x1, 8-pin A-coded according to EN 61076-2-101 (Shielded cables are recommended)	**1**	WH	DO Ready
	2	BN	Logic voltage 24V ± 15% (max. 500mA)
	3	GN	DO is extended
	**4**	YE	DO is retracted
	5	GY	**DI Retract**
	6	PK	**Logic voltage 24V (max. 500mA)**
	7	BU	GND 0V
	8	RD	DI Teach / Reset

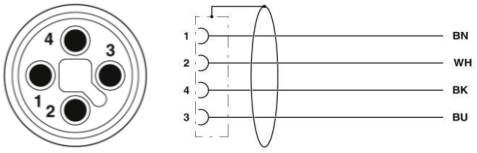
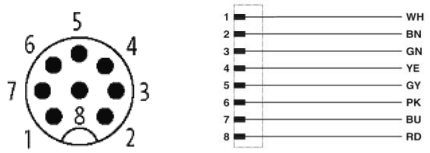
7.1.3.2 Truth table mode: monostable, normally extended

Command	DI Retract	DI Teach	Comment
Extend	0	0	
Retract	1	0	
Teach run: **Start with extension**	0	1	The linear axis moves slowly to both end stops, starting with the extension, and teaches the new stroke.
undefined	1	1	Undefined state, this state must be avoided!

7.2 Mode 2: Bistable

Corresponds to control and behaviour as in the operation of a pneumatic linear axis with a bistable pneumatic valve. If a run command is initiated, the linear axis runs the entire (taught-in) stroke, even if the signal drops. The linear axis remains in control in the corresponding end position until the counter signal is received. For a force-free state, the control can be interrupted (with DI Force-free).

7.2.1.1 Signal assignment Mode: Bistable

Power	Signal
Plug M12x1, 4-pole T-coded according to EN 61076-2-11	**Plug M12x1, 8-pin** A-coded according to EN 61076-2-101 (Shielded cables are recommended)
	

Pin assignment Digital I/O

Pin	Color	Function	Pin	Color	Function
1	BN	Power voltage 24V-48V ± 15% (max. 10A) At 48V the use of a brake chopper is recommended.	**1**	WH	DO Ready
2	WH	Functional earth (FE)	**2**	BN	Logic voltage 24V ± 15% (max. 500mA)
3	BU	GND 0V	**3**	GN	DO is extended
4	BK	reserved, do not connect	**4**	YE	DO is retracted
			5	GY	DI Retract
			6	PK	DI Extend
			7	BU	GND 0V
			8	RD	DI Teach / Reset / Powerless

7.2.1.2 Truth Table Mode: Bistable

Command	DI Extend	DI Retract	DI Teach	Comment
Extend	1	0	0	
set	0	0	0	Exit command remains active
Retract	0	1	0	
set	0	0	0	Retract command remains active
stops	1	1	0	
set	0	0	0	Stand command remains active
Reset / powerless	0	0	1	- Control is deactivated, actuator goes into a powerless state, but remains ready for operation - Acknowledge errors
Teach run: **Start with extension**	1	0	1	linear axis moves slowly to both end stops starting with extension and teaches the new stroke.
Teach run: **Start with retract**	0	1	1	linear axis moves slowly to both end stops starting with Retract and teaches the new stroke.
stops	1	1	1	Not allowed (programming mode can be reached accidentally)

7.3 Switching the operating modes

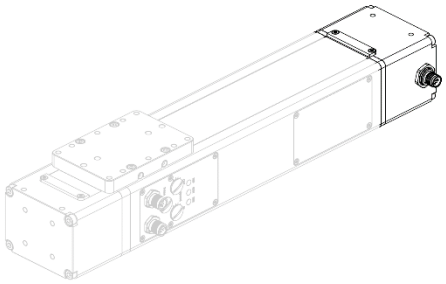
Perform the following steps to switch to another operating mode.

1. Disconnect the power and logic voltage supply
2. Connect the logic power supply and immediately activate the signals "DI Retract", "DI Extend" as well as "DI Teach".
3. The signals under point 2. must remain active for 3 seconds. As soon as the device is in programming mode, the LED display "REF" flashes with 2 Hz, deactivate the 3 signals.
4. To switch to another mode, switch the "DI Teach" signal on and off once:
    a. Blinking pattern for **mode 1 (mono-/omni-stable)**: LED "RUN" blinks **once**, then 1 s pause, ...
    b. Flashing pattern for **mode 2 (bistable)**: LED "RUN" flashes **twice**, then 1 s pause, ...
5. To confirm and exit the programming mode, disconnect the logic power supply

NOTE	
	Switching the operating modes is only possible when no power voltage is applied.

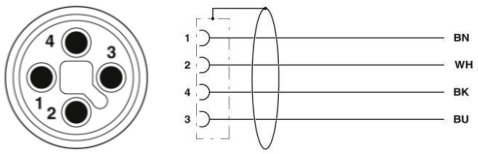
7.4 Operation with holding brake CTL-___-___-____-**B**

The CTL linear axis can be equipped with a holding brake. The brake prevents the spindle from rotating, thus blocking the slide. This enables loads to be held without current.



Size		CTL-60	
Function mode holding brake		Spring-loaded, current less activated	
Maximum holding force:		Spindle pitch	
		5 mm:	10 mm:
	[N]	800	400
Rated Voltage	[V]	24 +/- 10% V DC	
Rated Power	[W]	11.5 +/- 10%	

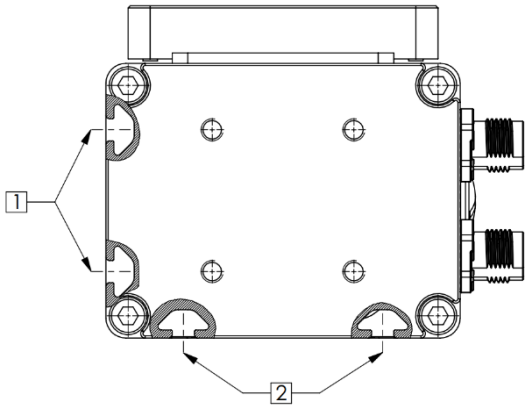
7.4.1 Electrical connection of the holding brake

connector	Pin	Farbe	Funktion
Plug M12x1, 4-Pol T-coded according to EN 61076-2-11 	1	BN	Power voltage 24V ± 10%
	2	WH	reserved, do not connect
	3	BU	GND 0V
	4	BK	reserved, do not connect

Important	
	The holding brake may only be used for hitching and not for decelerating loads. The holding brake may only be activated when the spindle drive is at a standstill. Motion commands that lead to a rotational movement of the spindle may only be given when the rotational movement of the spindle is released by the brake.

8 Installation, assembly

The simplest method of mounting is via the front and bottom mounting threads in the rear and front covers.



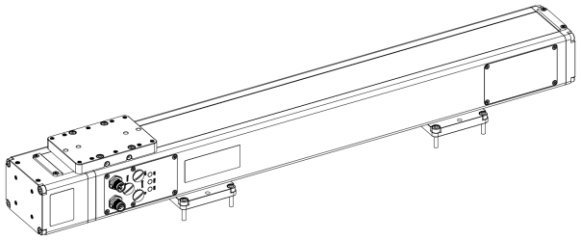
[1] Lateral fastening grooves

[2] lower Fastening grooves

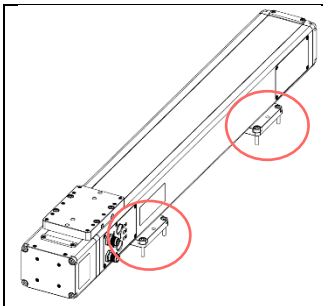
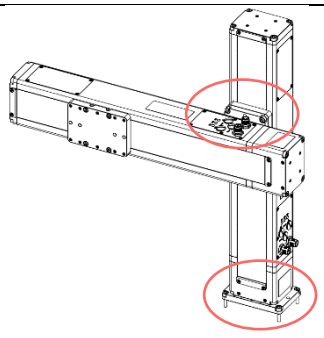
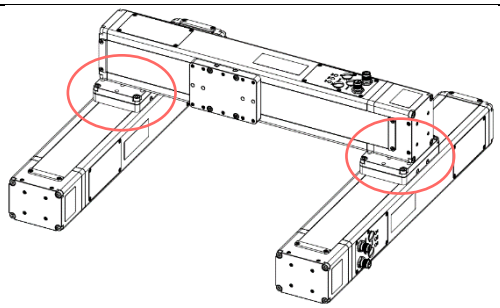
Important	
	Due to the design, the maximum load capacity differs in the type of fastening (grooves at the bottom / side). See Chapter 17

8.1 Fastening with connecting plates

When using connecting plates (available separately), make sure that the maximum permissible support distance according to chapter 6.3.3 is not exceeded



8.1.1 Application examples connecting plate

		
• - For mounting an axis on a flat surface	• For mounting an axis vertically on a flat surface • For mounting two axes crosswise, second axis "lying"	• For mounting an axis vertically on a surface • For mounting two axes crosswise, second axis "standing"

8.2 Tightening torques of screws

Axis size	Tightening torque for fastening holes at the front and at the bottom	Tightening torque For push tube attachments
CTL-060	4.8 max. Nm (+/- 10%)	20 max. Nm (+/- 10%)

WARNING	
	Failure to comply with the specifications may result in a failure of the bolted joint, which, depending on the situation, may result in serious injuries

WARNING	
	The internal ball screw is not self-locking! It must always be ensured (especially when the axis is mounted vertically) that the carriage is secured against moving out!

WARNING	
	The internal end stops of the linear axis must not be approached during operation under any circumstances. be approached under any circumstances. Only in the setup mode and only for determining the end positions The axis may only be moved to the internal end positions with minimum force and very slowly (max. 10 % of the nominal speed) during setup operation and only for determining the end positions or for relubrication. The service life of the linear axis is strongly dependent on the extent to which its its performance capacity is exhausted and whether - even if only briefly - inadmissible operating inadmissible operating conditions have occurred.

IMPORTANT	
	The linear axis must be mounted free of stress and distortion.

8.3 Connecting signal and power supply

Connect the cables according to the operating mode (see chapter 7). Depending on the mode (see chapter 7.1), inputs 5 or 6 are wired to the 24V power supply

DANGER	
	The connection of the electrical lines may only be carried out by qualified personnel.

IMPORTANT	
	To avoid interference with other components in the 24V mains / 48V mains, the power voltage supply of the linear axis must be connected to a separate power supply unit or to a mains filter. Several axis can be operated on the same power supply unit.

IMPORTANT	
	The signal power supply must not exceed 24V DC. A range of 24-48V DC is permissible for the power voltage supply, but in this case the signal voltage supply must be provided by a separate 24V power supply unit.

8.4 Commissioning

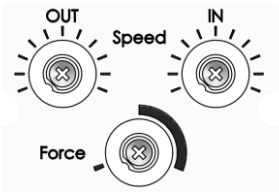
IMPORTANT	
	To prevent damage to the microprocessor, the "DI Retract", "DI Extend" and "DI Teach" signals must not be switched until the logic power supply is connected.

1. The Force and speed are to be set to the smallest position via the rotary knobs (Attention: Do not turn the rotary knobs out beyond the stop!)
2. Connect the power and control connection
3. Optional: Place the linear axis in such a way that the trust tube can move without obstruction and load during extension and retraction.
4. Perform a function check according to chapter 8.5.

8.5 Function control

First carry out all points according to chapters 8.3 and 8.4 through.

1. By signal input on "DI Extend" or "DI Retract", the linear axis starts to move at a reduced reference speed (reference run according to chapter 8.6)
2. The linear axis automatically moves to the corresponding end position and then stops.
3. Press the opposite signal ("DI retract" or "DI extend") to move the linear axis to the other end position. The linear axis now moves at the working speed.
4. Optional: Install the linear axis in its final mounting position.
5. If the linear axis does not perform the full stroke when installed, but is operated with external end stops, perform a teach run according to chapter 8.7 to teach in the new stroke.

	If the potentiometer is set to the black area, care must be taken that the maximum force is not applied at 100% for a duty cycle. On the other hand, the linear axis will heat up and the internal temperature monitoring will put the linear axis into an error state ("DO Ready" = 0).

8.6 Reference run

The reference run is used to move the linear axis slowly to an end position and to reference it there (set 0-position).

A reference run is always necessary when the logic voltage has been disconnected from the linear axis. A disconnection of the power voltage, on the other hand, does not require a new reference run.

A reference run is performed automatically as soon as a logic voltage is applied and a signal for retraction or extension is present. If the linear axis is already in the corresponding end position, no movement is performed, and the linear axis is referenced directly.

The reference run differs from the teach-in run in that a new stroke is taught in during the teach-in run. During the reference run, on the other hand, only the start position of the stroke is determined.

This request is represented by the simultaneous illumination of the "REF" and "RUN" LEDs.

8.7 Teach run

The teach-in run is used to teach-in a new stroke length (or external stops that are shorter than the nominal stroke). As a rule, the teach-in run only has to be performed once during initial startup or when replacing the linear axis. The linear axis moves at slow speed in the specified direction until an end stop is detected by setting a force threshold. The direction of movement is then changed until the second end stop has been detected by means of a force threshold.

The teach-in run is always initiated in combination by the two signals "DI Teach" and the "DI Retract" or the "DI Extend".

"DI Teach" and "DI Extend" → Teach run starting with Extend*.

"DI Teach" and "DI Retracted" → Teach run starting with Retracted*.

*Possible teach run initiations may differ depending on the operating modes, see truth tables in chapter 7 Operating modes.

Procedure Teach run:

1. Mount the linear axis in the intended installation location
2. Commissioning according to chapter 8.4 perform
3. Execute signal combination for teach-in operation:
    a. "DI Teach" and "DI Extend" → Teach run starting with Extend
    b. "DI Teach" and "DI Retracted" → Teach run starting with Retracted.
4. linear axis extends/retracts slowly to the internal or external end stop
5. linear axis changes direction of movement and moves to the opposite end stop
6. linear axis automatically saves the new stroke length.
    a. Green LED (RUN) lights up.
    b. Signal "DO linear axis is extended" or "DO linear axis is retracted" becomes active
7. Teach run completed

The teach-in operation can be aborted by pressing the "DI Teach" signal again, if required.

If the teach run fails, the red LED (ERR) lights up. Typically, this is because the power supply is too weakly dimensioned or set too low for the desired force value.

HINWEIS	
	Nach erfolgreicher Lernfahrt bremst der Aktor vor den Endanschlägen ab und bleibt bei den Endanschlägen in Position. Die Aufgebrachte Kraft des Aktors entspricht nur der nötigen Kraft, um die Endposition zu halten.

WARNUNG	
	Das Verwenden von externen Anschlägen, ohne eine Lernfahrt durchzuführen kann zu hohem Verschleiss und Beschädigung der Spindel führen. Ausserdem wird eine zu hohe Leistung abgerufen, da der Aktor immer versucht, die einprogrammierten Endpositionen mit der maximal eingestellten Kraft (Kraftschwelle) zu erreichen.

9 Maintenance and care

9.1 Maintenance plan

When	What	Action
After commissioning	Spindle	The linear axis is supplied lubricated from the factory. However, if the linear axis lies longer than 1 year in stock by the customer, it must be relubricated, see **9.2 Relubrication**
According to mileage ran	Spindle / linear guide	Relubrication of the spindle / linear guide, see **9.2 Relubrication**
Annual	Linear axis	Check for visible damage (external) Contact Cyltronic AG in the event of visible damage or damage caused externally.
Annual	Mounting fastener	Check screw tightening torques, see **assembly tightening torques chapter 8.1.1**

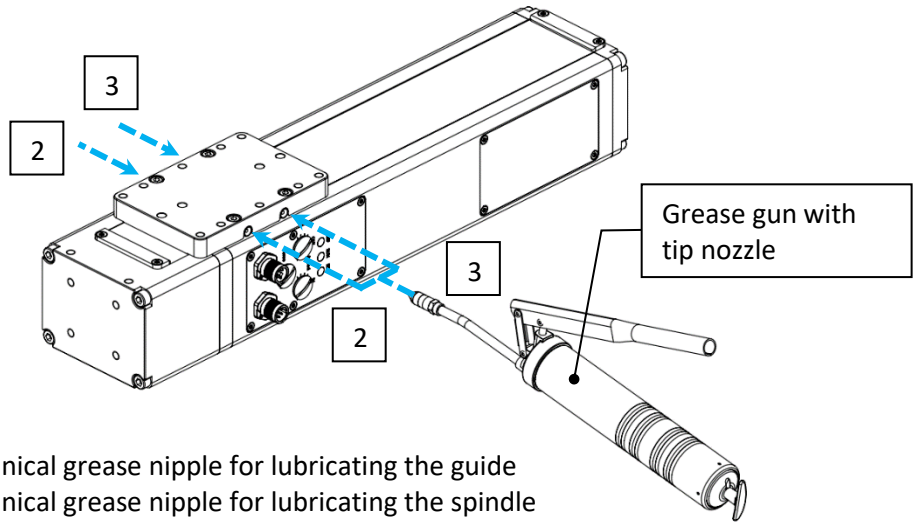
9.2 Relubrication

The CTL-S / -B linear axis includes a profile rail guide with a carriage and a ball screw drive, which are provided with initial lubrication at the factory. For relubrication, there are two grease nipples [2] / [3] on both sides of the carriage.

For the CTL-F linear axis, only relubrication of the guide is necessary.

Relubrication of the spindle must be carried out according to the running performance. The relubrication interval varies depending on the application and depends on the operating conditions (series, spindle pitch, speed, acceleration, loads, etc.). Environmental influences such as high loads, shocks and vibrations can shorten the lubrication intervals.

Lubricant: A food-grade grease is recommended (e.g. Fuchs Cassida Grease EPS 2).



[2] Conical grease nipple for lubricating the guide
[3] Conical grease nipple for lubricating the spindle

FIGURE 7: LUBRICATION POSITION OF THE SLIDE

9.2.1 9.2.1 Relubricating the spindle and the linear guide

The relubrication intervals, lubricant quantities and distances can be taken from Table 1.

For short-stroke applications, a lubrication run must be performed after a maximum of 1 million motion cycles. A lubrication run means that 4x one complete stroke is performed over the entire nominal stroke range of the actuator.

Relubrication intervals and lubricant quantities:

Type			Relubrication interval + lubricant quantity according to application							
Size	Nominal stroke [mm]	Spindle pitch	Continuous operation (> 3600 strokes / h)	Medium mileage (10 - 3600 strokes / h)	Low mileage (< 10 strokes / h)	short-stroke applications (< 20mm travel)	lubricant quantity spindle [3] [cm³]	Distance Lubrication position spindle [mm]	lubricant quantity linear guide [2] [cm³]	Distance Lubrication position linear guide [mm]
CTL-060	100 - 300	K05	250 Km	3 months	1 x / year	Lubrication run after1 million motion cycles (= 4x stroke over entire nominal stroke range required) Relubrication interval: 2 months	1.2	150	0.2	300
		K10	500 Km							
	400 - 600	K05	250 Km	3 months	1 x / year		0.6	150	0.2	300
		K10	500 Km							
	600 - 1000	K05	250 Km	3 months	1 x / year		0.6	150	0.2	300
		K10	500 Km							

TABLE 1: RELUBRICATION INTERVALS

Example lubrication process CTL-060-K10-0300 with medium mileage

→ Relubrication interval: 3 months

1. bring slide into end position (according to Figure 7).
2. 1.2 cm^3 lubricant into lubrication port of spindle [3].
3. 0.2 cm^3 lubricant into lubrication port of guide [2].
4. move slide 150mm from end position
5. 1.2 cm^3 lubricant into lubrication port of spindle [3].
6. move slide another 150mm from current position
7. 1.2 cm^3 lubricant into lubrication port of spindle [3].
8. 0.2 cm^3 lubricant into lubrication port of guide [2].
9. 5-10 complete strokes at slow speed over the entire nominal stroke range.

9.3 Cleaning

Important	
	Before cleaning, make sure that the screw plugs are correctly tightened. The product may only be cleaned when it is at a standstill. Only a slightly damp cloth with a mild cleaning agent may be used for cleaning. The ingress of water/moisture must generally be prevented. Direct jetting of water onto the actuator must be avoided and can lead to damage. Submersion of the product is not permitted. The product must be in a completely dry condition before recommissioning after cleaning.

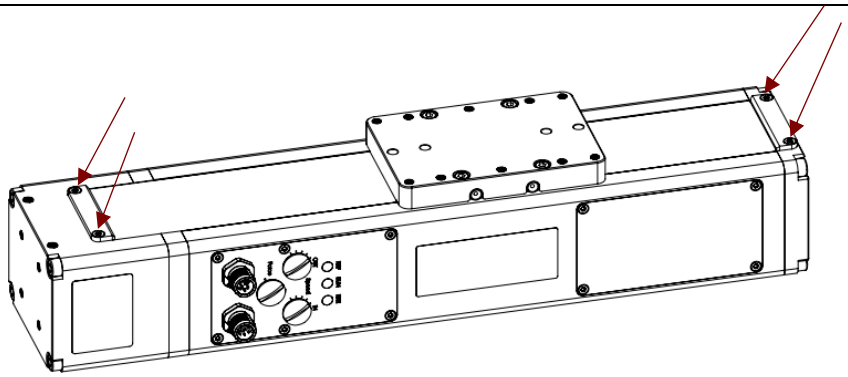
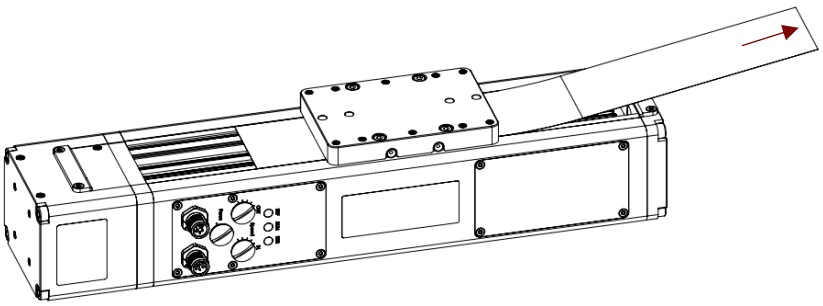
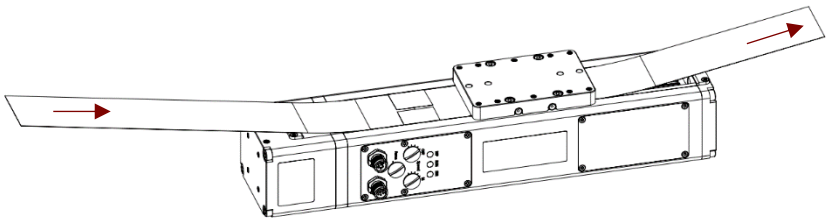
10 Removal and repair

In the event of damage or defect, the entire unit must be returned to Cyltronic AG. The repair may only be carried out by Cyltronic AG trained personnel.

10.1 Replacing the cover tape

CAUTION	
	The masking tape has sharp edges. Wearing gloves is recommended for the following work.

Important	
	Remove any dirt from the device before repairing it. Make sure that no dirt enters the device during repair.

Loosen the 4 screws of the two clamping parts that hold the cover plate in place:	
Pull the worn cover plate slightly (not completely) out from under the slide.	
Then attach the new cover plate to the old cover plate with a strip of adhesive tape. Pull on the old cover plate and push lightly on the new cover plate to guide it through the slide. Then remove the adhesive tape and any adhesive residue with a suitable degreaser. Then reattach the clamping parts. Push the carriage back and forth a few times to make sure that the new cover plate is mounted without distortion.	

11 Disposal

Dispose of the device properly according to the prevailing legal regulations or return it to Cyltronic AG.

12 Troubleshooting

IMPORTANT	
	Do not attempt to open the linear axis or remove individual parts. Improper disassembly may result in damage. Any warranty claims will be forfeited.

Malfunction	Possible cause	Remedy / further measures
Reversing backlash too large	Spindle nut defective / worn	Contact Cyltronic or your Cyltronic dealer.
Strong running noise	Guide, spindle or bearing defective / worn out	Contact Cyltronic or your Cyltronic dealer.
Slide cannot be moved by hand	Spindle nut wedged too tightly with stop	1. Electrically extend / retract 2. Increase force potentiometer 3. Contact Cyltronic or your Cyltronic dealer.
Carriage cannot be moved electrically	- Spindle nut wedged too tightly with end stop - force set too low	1. Increase force potentiometer 2. Contact Cyltronic or your Cyltronic dealer.

12.1 Error codes

Faults are indicated by the flashing pattern of the red LED on the device. If a fault occurs, the respective flashing pattern is repeated continuously with a pause of 1s. Faults can be acknowledged with the Teach command.

Blink / light pattern	Error Code	Possible cause	Remedy
LED red lights constantly (after teach or reference run)	Voltage dip during teach or reference run, teach or reference run could not be completed	The power supply delivers less current than the actuator requires. Force setting too high.	-Reduction of the force by means of potentiometer -test by a new run command whether sufficient reduction has been made, if not-> repeat -If the force should then no longer be sufficient, a voltage supply with a higher output current must be used.
LED flashes red: **1x, Pause, 1x, ...**	Power voltage too high	- Overvoltage generated by braking loads	- Checking the power supply - Speed reduction - Installation of a braking resistor
LED flashes red: **2x, pause, 2x, ...**	Temperature too high	Overload of the device	Allow the device to cool down. If the error occurs again, reduce the switch-on time.
LED flashes red: **3x, pause, 3x, ...**	Error current	Current internally too high	Indicates a defect in an internal electronic component. If the error occurs repeatedly or cannot be acknowledged, contact Cyltronic.
LED flashes red: **4x, pause, 4x, ...**	Internal error	Internal error	Indicates a defect in an internal electronic component. If the error occurs repeatedly or cannot be acknowledged, contact Cyltronic.
LED flashes red: **5x, pause, 5x, ...**	Signal voltage too high	- Overvoltage generated by braking loads - Overvoltage caused by another device in the 24V intermediate circuit	- Checking the signal power supply - If necessary, install a separate power supply unit for the signal voltage supply.
LED flashes red: **6x, pause, 6x, ...**	Signal voltage too low		- Checking the signal power supply

13 Appendix

13.1 Dimensioning example

A load of 15 kg is to be lifted vertically by 100mm at a maximum speed of 200 mm/s and held for 10 seconds. A value of 8 mm/s is [2]selected for the acceleration / deceleration.

The holding time is: $t_h = 10s$

The times for acceleration / deceleration are calculated as follows:

$$t_b = \frac{v_{max}}{1000 \cdot a_b} = \frac{200\ mm/s}{1000\ mm/m * 8\ m/s^2} = 0.025\ s$$

$$t_v = \frac{v_{max}}{1000 \cdot a_v} = \frac{200\ mm/s}{1000\ mm/m * 8\ m/s^2} = 0.025\ s$$

The time for run at constant speed is:

$$t_c = \frac{s - \frac{v_{max}(t_b + t_v)}{2}}{v_{max}} = \frac{100\ mm - \frac{200\ mm/s \cdot (0.025\ s + 0.025\ s)}{2}}{200\ mm/s} = 0.475s$$

The time for the entire movement including holding is:

$$t_{tot} = t_b + t_c + t_v + t_h = 0.025s + 0.475s + 0.025s + 10.525s$$

The average speed during acceleration / deceleration is:

$$v_b = v_v = \frac{v_{max}}{2} = \frac{200\ mm/s}{2} = 100\ mm/s$$

The loads during the individual sections are:

$$F_b = m \cdot a_b + m \cdot g \cdot \sin(\alpha) = 15\ kg \cdot 8\ m/s^2 + 15\ kg \cdot 10\ m/s^2 \cdot \sin(90°) = 270\ N$$

$$F_v = m \cdot a_b + m \cdot g \cdot \sin(\alpha) = 15\ kg \cdot 8\ m/s^2 + 15\ kg \cdot 10\ m/s^2 \cdot \sin(90°) = 270\ N$$

$$F_c = m \cdot g \cdot \sin(\alpha) = 15\ kg \cdot 9.81\ m/s^2 \cdot \sin(90°) = 150\ N$$

$$F_h = m \cdot g \cdot \sin(\alpha) = 15\ kg \cdot 9.81\ m/s^2 \cdot \sin(90°) = 150\ N$$

The average effective load F_{RMS} is calculated as follows:

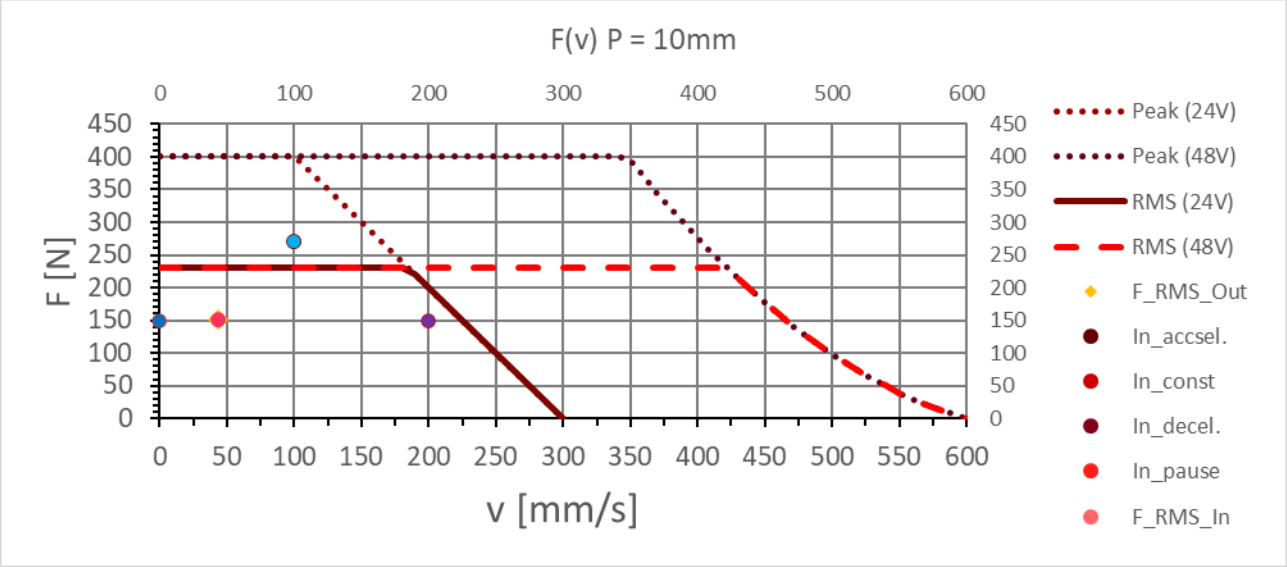
$$F_{RMS} = \sqrt{\frac{1}{t_{tot}} \cdot (t_b \cdot {F_b}^2 + t_c \cdot {F_c}^2 + t_v \cdot {F_v}^2 + t_h \cdot {F_h}^2)}$$

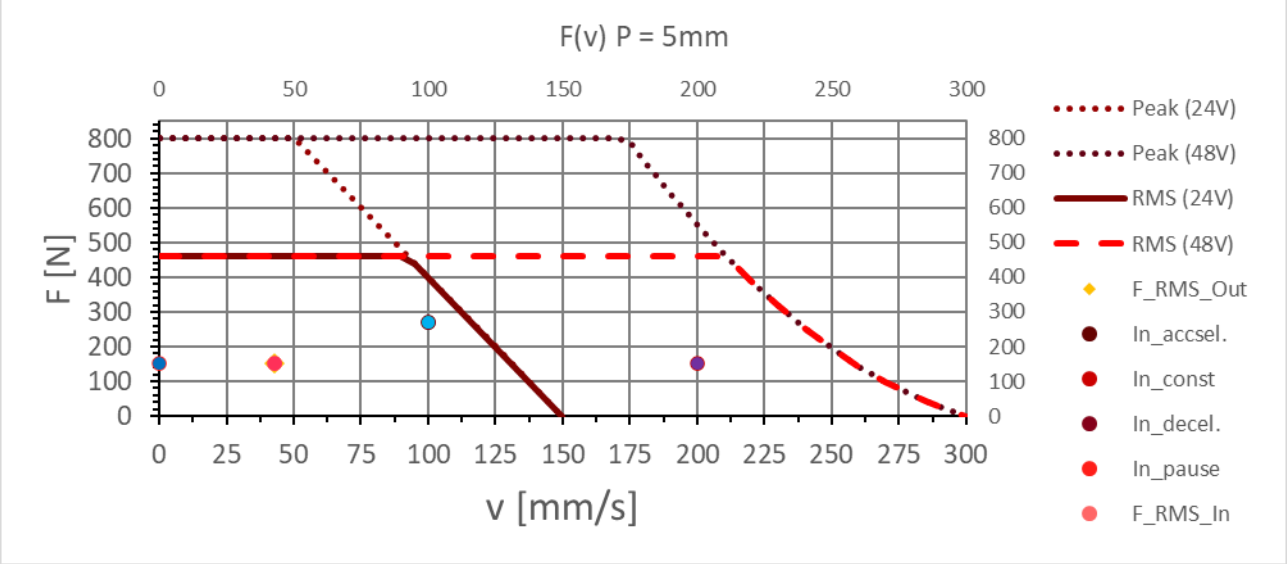
$$= \sqrt{\frac{1}{10.525s} \cdot (0.025s \cdot 270N^2 + 0.475 \cdot 150N^2 + 0.025s \cdot 270N^2 + 10s \cdot 150N^2)} = \mathbf{150.796\ N}$$

The following points must now be considered for the evaluation

Operating point	Load in N	Speed In mm/s	Evaluation
Accelerate	270	100	Operating point is below the peak line Operating point→ permissible
constant Speed	150	200	Operating point is below the peak line Operating point→ permissible
Deceleration	270	100	Operating point is below the peak line Operating point→ permissible
Hold	150	0	Operating point is below the peak line Operating point→ permissible
F_{RMS}	150.796	-	Load is below the RMS line → Operating point permissible

If the points are retracted in the respective F(v) diagrams, it becomes apparent that the 10mm spindle pitch is suitable for the selected application. The "acceleration" operating point is above the RMS curve, but still below the peak curve. The 5mm spindle pitch would also be conceivable for the set conditions, but here a 48V power supply is needed to achieve the desired feed rate. (Operating point above the 47V RMS line).





13.2 Declaration of incorporation

Declaration of incorporation CTL-060

in the sense of the Machinery Directive 2006/42/EC, Annex II, 1.B for partly completed machinery

The manufacturer:

Cyltronic AG
Technoparkstrasse 2
CH-8406 Winterthur

Confirms that the said product

Product name:	Cyltronic Linear Axis
Type designation:	CTL-060
Trade name:	CTL-060
Year of manufacture:	from 11/2022
Function:	Electromechanical back and forth movement of the slide to generate a linear motion

meets the requirements of an **incomplete machine** according to the EC Machinery Directive 2006/42/EC.

The following essential requirements of the Machinery Directive 2006/42/EC according to Annex I are applied and fulfilled:

Appendix I, Paragraph: 1, 1.1.2, 1.1.3, 1.1.5, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.5.1, 1.5.2, 1.5.4, 1.5.8, 1.6.1, 1.7.1, 1.7.1.1

Standard	Title	Edition
DIN EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction	12100:2010

It also declares that the specific technical documentation has been prepared in accordance with Annex VII, Part B.

It is expressly declared that the **incomplete machinery** complies with all relevant provisions of the following EC Directives:

2011/65/EU Directive 2011/65/EU of the European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Cyltronic AG undertakes to transmit the technical documentation on the partly completed machinery in electronic form to the national authorities upon justified request.

Person established in the Community authorized to compile the relevant technical documentation:

Jeremias Wehrli
Cyltronic AG
Technoparkstrasse 2
CH-8406 Winterthur

Commissioning is prohibited until the machine into which this incomplete machine is installed is installed complies with the provisions of EC Directive 2006/42/EC.

Before being placed on the market, this must comply with the CE directives, including documentation.

Winterthur / 07.10.2022 (Place/Date)


(Signature)

Jeremias Wehrli
Managing Director
(Information about the signatory)

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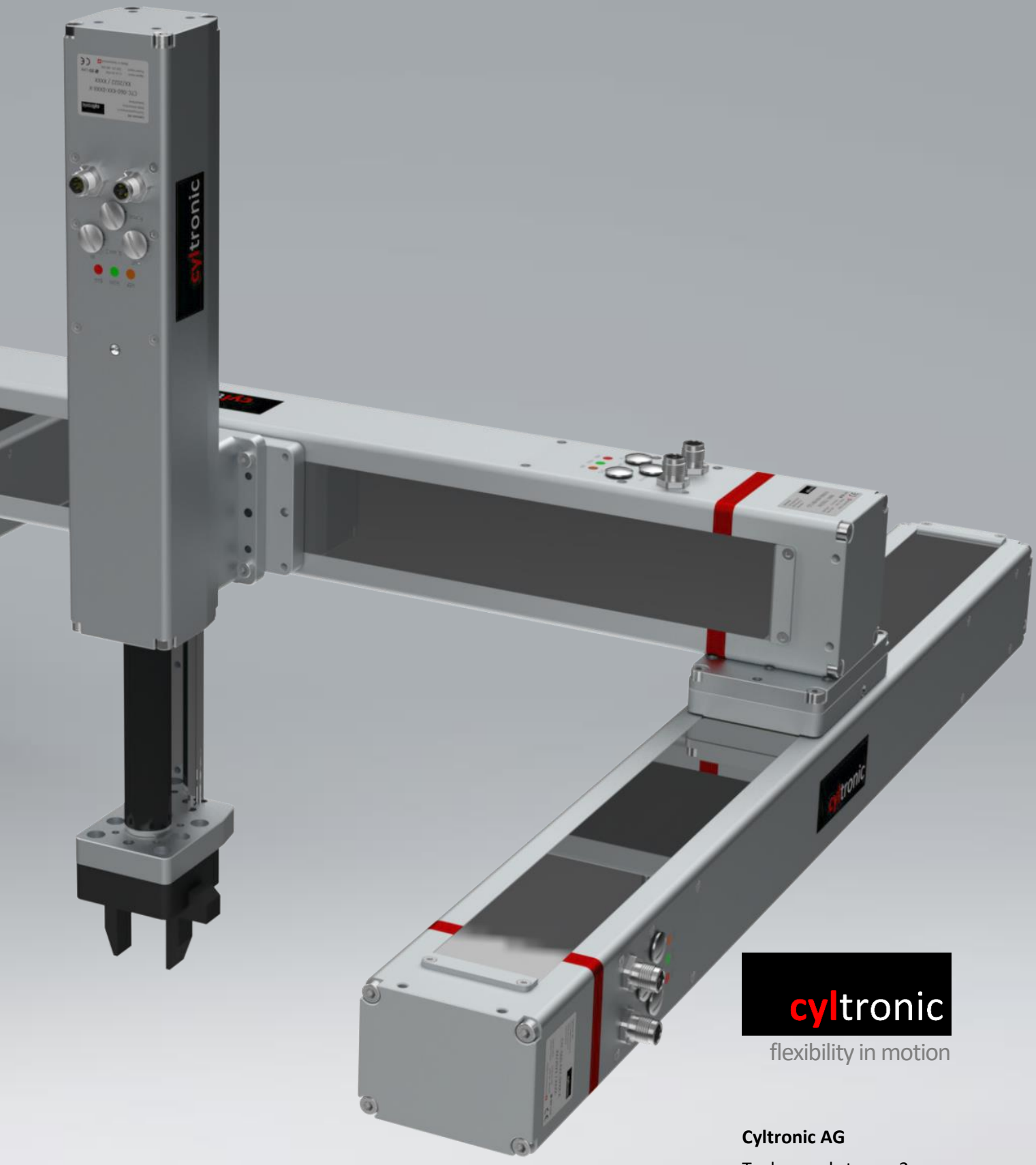
13.3 List of figures



cyltronic

flexibility in motion

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