SCHAEFFLER

We pioneer motion

High Performance Short Stroke Actuators

Contents

Overview

Short stroke actuators

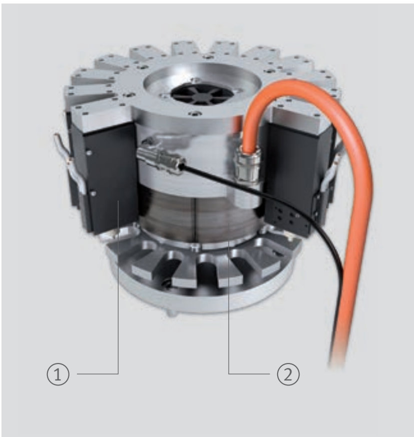
The perfect actuator for any application.
Especially for applications with highest requirements in terms of fast cycling short strokes, Schaeffler is your partner with long life products which meet especially the expectations in reliability for more than one billion cycles. Based on the experiences by solved challenges, Schaeffler is providing a variation of actuators with different optimized motors, bearings, encoders and featuring.

LDDS-078 and LDDS-081

The compact actuators LDDS-078 and LDDS-081 are predestined for test and inspection applications in the productronics industry. Especially in turret handlers with one independent Z-actuator per index position short stroke systems are used. They are characterized by their high efficiency, particularly long service life and maintenance-free operation.

Application example
Turret handler with independent Z-axes for each index position

Basic principle of application



Positioning system

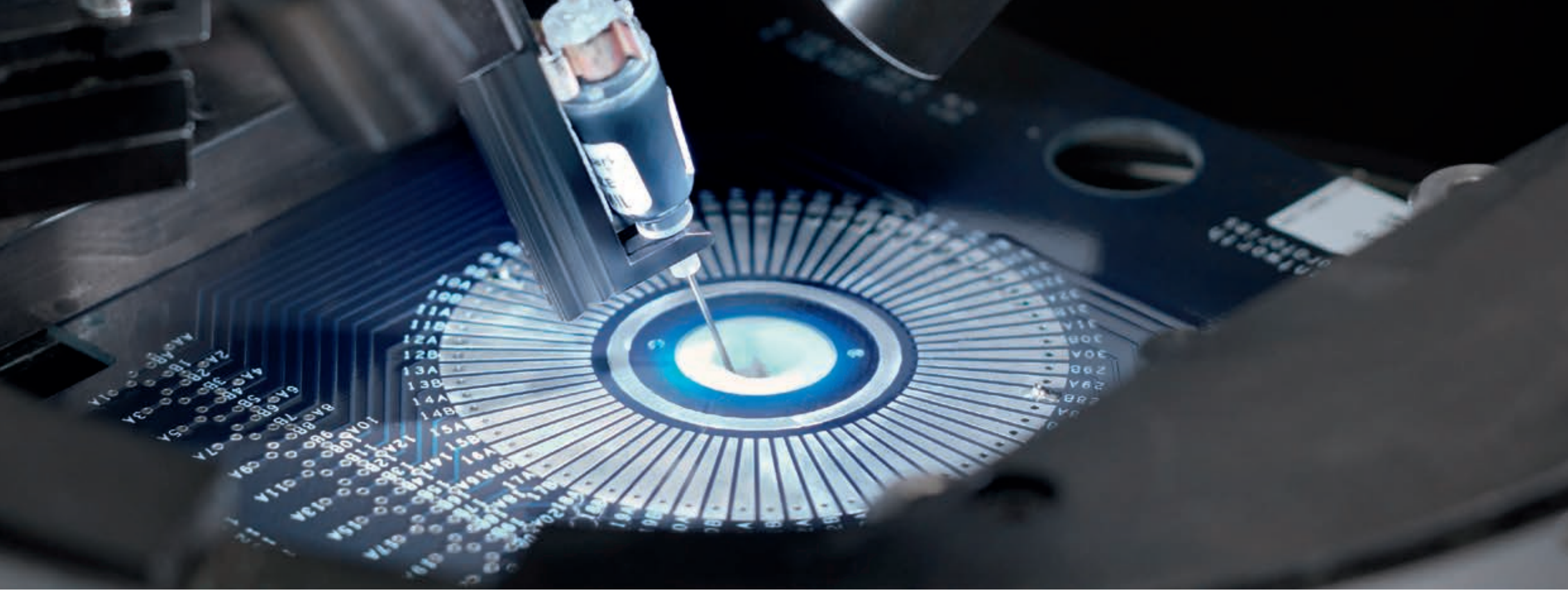
① Short stroke actuators LDDS-078/LDDS-081 (Z-axes)

② Rotary direct drive system RDDS-20

Features
- High force density at low moving mass
- Lowest power loss
- Weight compensated
- Optimized design for long life

Benefits
- Highest production output at highest reliability over 1 billion cycles
- Less required integration space
- High precision because of less warming and less impulse input by less moving mass

Applications
- Test and sorting machines
- Indexer, e.g. in the semiconductor industry, medical engineering



LDDS-032

The precision short stroke actuator LDDS-032 is a drive developed for high forces of up to 726 N. It is used for example in turret handlers with one central Z-actuator.

Application example

Turret handler with common central Z-actuator

Basic principle of application

Short stroke actuator LDDS-032

Features

- High force density
- Attraction force compensated for extending linear guidance life time
- No moving cables

Benefits

- Reduced envelope size for more freedom in machine
- Very long service life
- Low cabling effort
- Simple control

Applications

- Pick and place tasks

Overview

Short stroke actuators

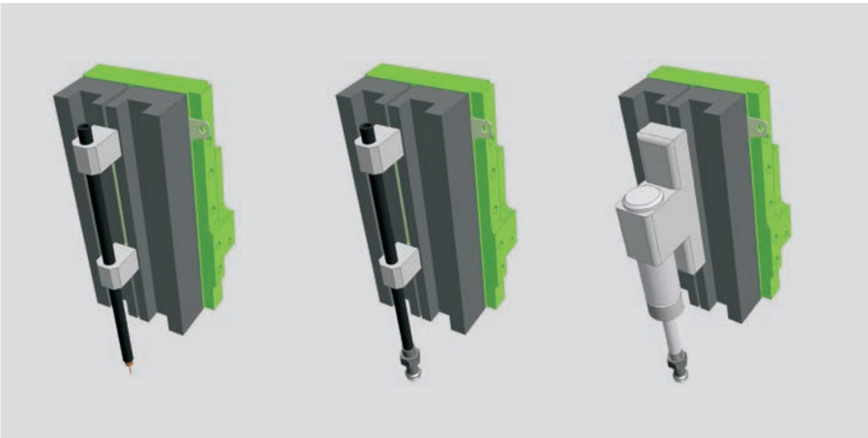
LRAM

Especially for short strokes, the positioning time is significantly influenced by the maximum achievable acceleration and thus by the force/mass ratio of the motor. By a patented solution of Schaeffler, the moving mass of this linear motor was reduced to a minimum.

The short stoke actuator LRAM-M-1.0-50/33/89-MR-K was especially designed for such ultra short positioning time of light weight payloads like probe needles. The moving part of the motor, a ceramic plate, can accelerate till 1000 m/s² and is absolutely wear-free. It's moving mass is only 10 g at a nominal motor force of 10 N.

Application example

Handling of lightweight parts



Actuators with different tools for various tasks

Short stroke actuator
LRAM-M-1.0-50/33/89-MR-K

Features

- Moving mass of only 10 g
- Wear and friction free air bearing
- No moving cables
- Maintenance-free

Benefits

- Increased throughput without compromise in precision
- Highest reliability

Applications

- Test applications like probers
- Pick and place tasks
- Indexer, adjuster, e.g. in the semi-conductor industry, medical engineering

Only the right drive solution makes motion cycles perfect. This is particularly important in high precision, rapidly recurring operations in the production of electronic components. Schaeffler Industrial Drives offers Z-axis systems for fast pick and place applications, optical inspections, testing machines etc. to increase your machine productivity.

High speed

Maintenance-free

High performance

Improvement in ROI

LDDS-078 · LDDS-081

Technical data

System data	Symbol	Unit	**LDDS-078** with M10x1 thread adapter	**LDDS-081** with M10x1 thread adapter
Width	W	mm	28.6 (without cover screw heads) 31.1 (with cover screw heads)	
Length	L	mm	46.6 (without cable outlet) 53.7 (with cable outlet)	
Height	H	mm	102.8	110.8
Total mass (without cable)	m	g	776	825
Moving mass	m_{mov}	g	77	88
Maximum stroke (from hard stop to hard stop)	s	mm	5	10
Maximum speed	v_{max}	m/s	2	2
Maximum acceleration	a_{max}	m/s²	300	300
Material			Steel	Steel
Cable length	L_{cable}	m	1	1

System components	Symbol	Unit	**LDDS-078** with M10x1 thread adapter	**LDDS-081** with M10x1 thread adapter
Guidance			Precision roller bearing	Precision roller bearing
Friction	F_{Fr}	N	< 0.6	< 0.6
Weight compensation (force)	F_{Wc}	N	1.5	0.4 (if available)
Encoder type (standard)			Linear magnetic incremental	
Resolution		µm	0.9765625 (1 mm/1024)	
Reference mark			Periodic at a distance of 4 mm, first one at approx. 0.3 mm from upper hard stop	
Accuracy		µm	±15	±20
Repeat accuracy		µm	±2	±2
Interface			RS 422 Output: quadratur signals A, B, Z and inverted signals	
Minimal edge spacing		ns	500	500
Power supply		V	5 (100 mA)	5 (100 mA)

LDDS-078 · LDDS-081

Technical data

System components	Symbol	Unit	LDDS-078 with M10x1 thread adapter	LDDS-081 with M10x1 thread adapter
Encoder type (optional)			Linear optical incremental	
Resolution		µm	0.1	0.1
Reference mark			1 (approx. 0.3 mm from upper hard stop)	
Accuracy		µm	±3	±3
Repeat accuracy		µm	±1	±1
Interface			RS 422 Output: quadratur signals A, B, Z and inverted signals, or sinusodial signal 1 V_{pp} (sin/cos), or absolute SSI or BiSS	
Minimal edge spacing		ns	37.5	37.5
Power supply		V	5 (100 mA)	5 (100 mA)

Motor data	Symbol	Unit	LDDS-078 with M10x1 thread adapter	LDDS-081 with M10x1 thread adapter
Motor type			1-phase moving coil	1-phase moving coil
Ultimate force (1 s) at I_u	F_u	N	65	64
Peak force (3 s) at I_p	F_p	N	48	48
Continuous force at I_c	F_c	N	24	23
Ultimate current (1 s)	I_u	A	8.0	8.0
Peak current (3 s)	I_p	A	6.0	6.0
Continuous current	I_c	A	3.0	3.0
Power loss at F_p	P_{lp}	W	22.0	28.0
Power loss at F_c	P_{lc}	W	5.5	6.5
Motor constant (25°C)	k_m	Nm/√W	10.3	9.1
Maximum force constant	k_f	N/A	8.1	8.0
Back EMF constant	k_u	V/(m/s)	8.1	8.0
Electrical resistance (25°C)	R_{25}	Ω	0.62	0.77
Electrical inductance	L	mH	0.5	0.5
Thermal time constant at housing	τ_{th}	min	30	30
Maximum DC link voltage	U_{DCL}	V	48	48

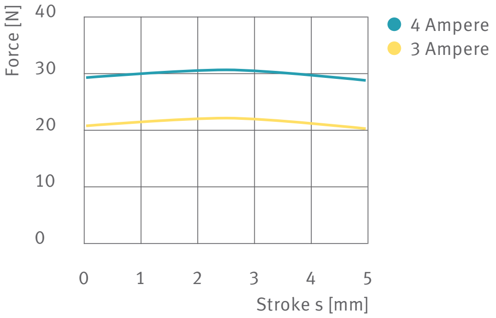
LDDS-078 · LDDS-081

Technical data

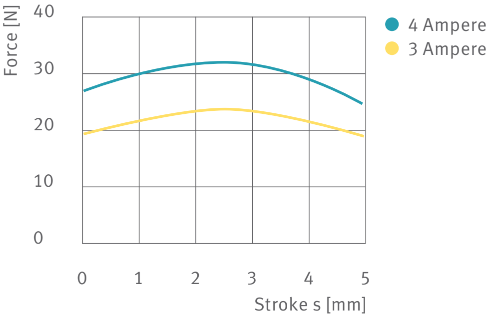
Moving direction of the linear direct drive system

When the motor is powered according to the circuit diagram, the push pin is moving out of the housing.

Force-stroke characteristics



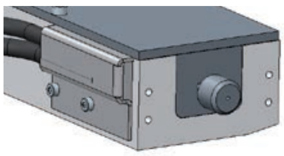
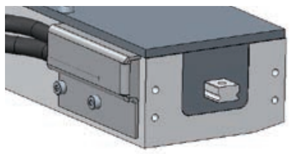
LDDS-078: force vs. stroke



Note: force without weight compensation force

LDDS-081: force vs. stroke

Interface to the application

M10x1 thread adapter (standard)	End of linear bearing
	

Motor terminal assignment

Cable, 2 x 0.34 mm²

Wire	Signal
WH	Phase 1-
BN	Phase 1+
BK	Shield

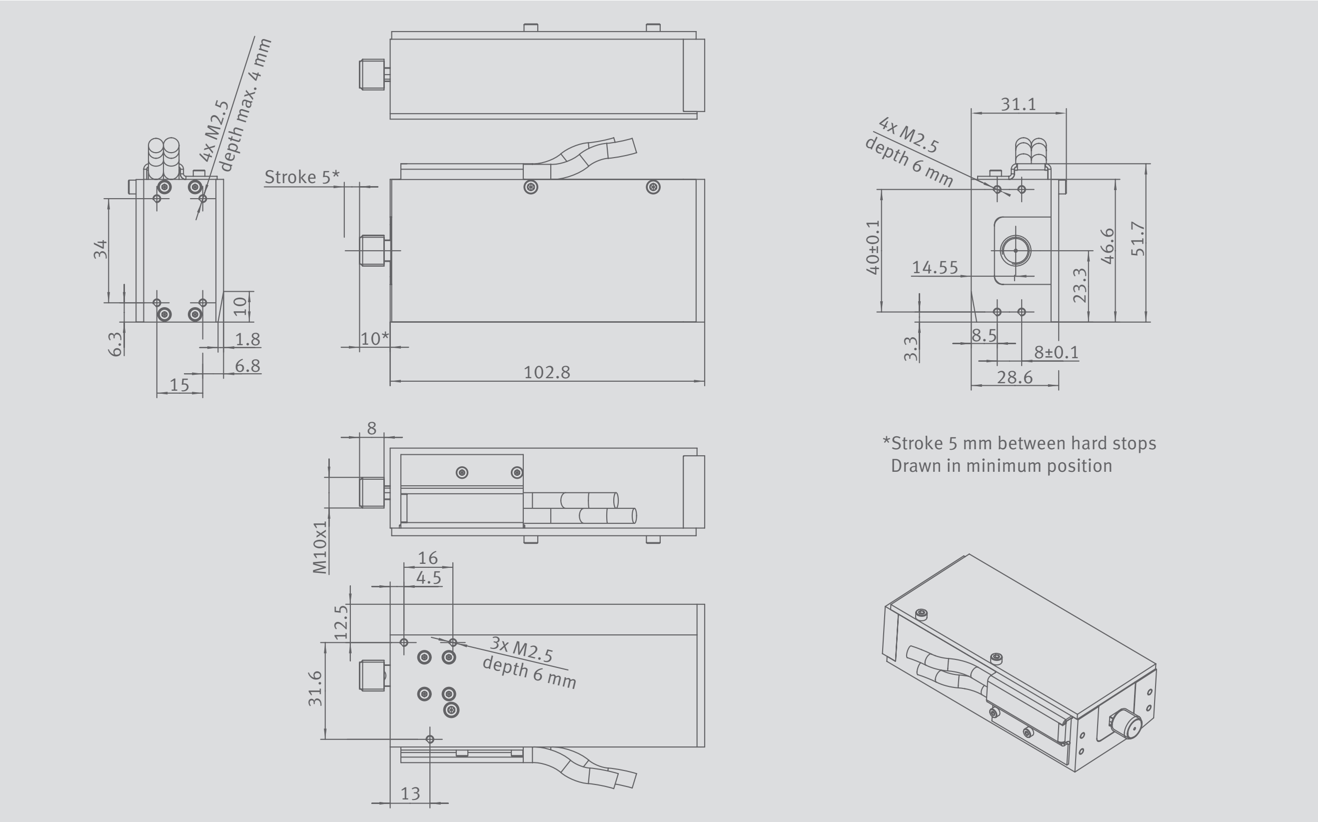
Encoder RS 422

D-connector, 9-pin, male · cable, 8 x 0.08 mm²

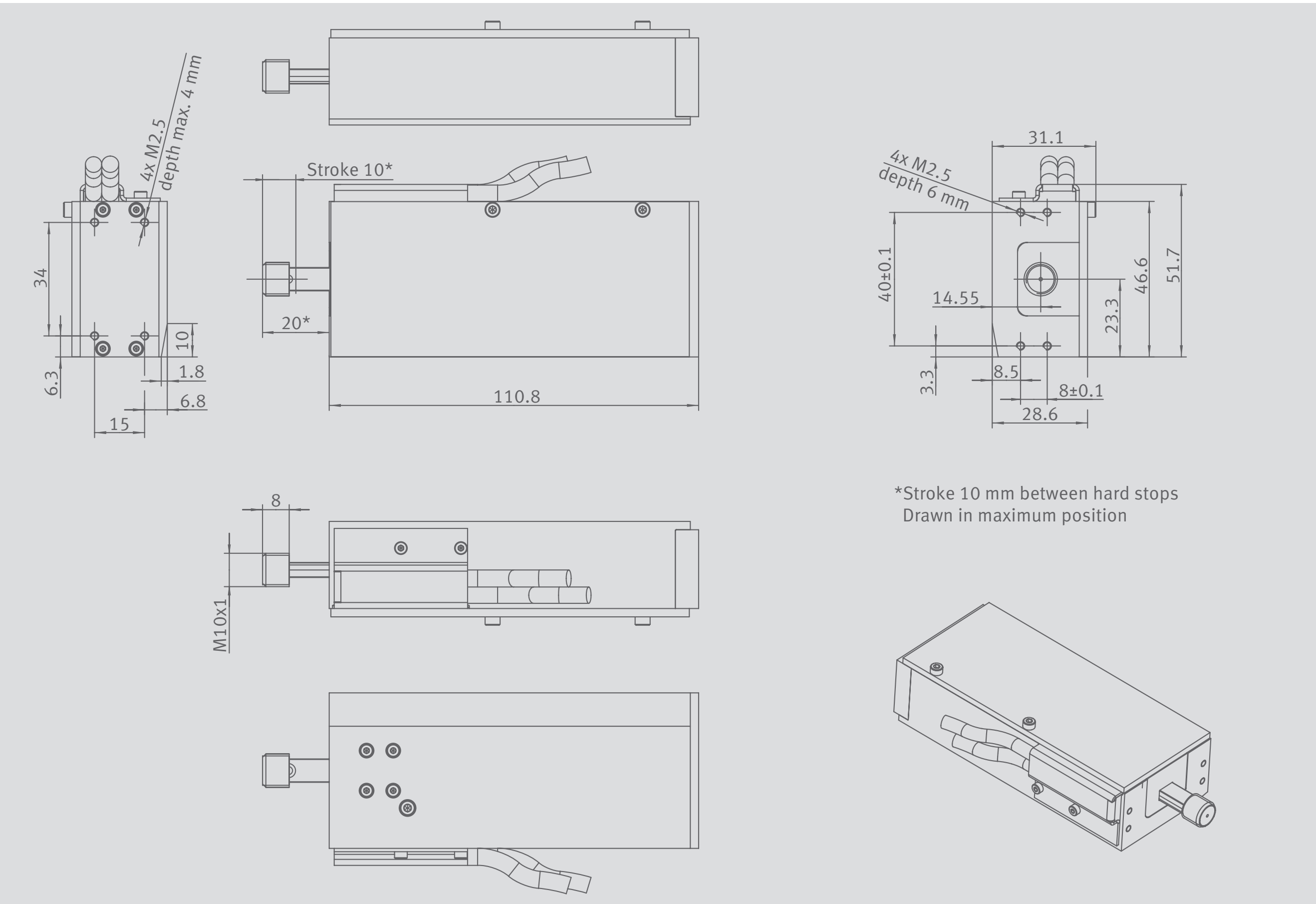
Pin	Wire	Signal
1	RD	+5 V
2	WH	A+
3	BN	A-
4	GN	B+
5	YE	B-
6	GY	Z+
7	PK	Z-
8	BU	GND
Case	Shield	

LDDS-078 · LDDS-081

Drawing



Drawing: LDDS-078 with M10x1 thread adapter



Drawing: LDDS-081 with M10x1 thread adapter

LDDS-032-C

Technical data

System data	Symbol	Unit	LDDS-032-C
Width	W	mm	100 (without connectors) 166 (with connectors)
Length	L	mm	157 (without cover screw heads) 163 (with cover screw heads)
Height	H	mm	120
Total mass	m	kg	10.5
Moving mass	m_{mov}	kg	1.4
Maximum payload	m	kg	3.5
Maximum stroke	s	mm	±5.5 (between limit positions) ±8.7 (between hard stops)
Maximum speed	v_{max}	m/s	0.6 (with max. payload) 1.1 (without max. payload)
Maximum acceleration	a_{max}	m/s^2	80 (with max. payload) 300 (without max. payload)

System components	Symbol	Unit	LDDS-032-C
Encoder type			Optic incremental
Resolution		µm	20
Reference mark			1 (in the centre of measuring length)
Accuracy (at 3 sigma)		µm	±5
Repeat accuracy		µm	±2
Interface			Sinusodial signal 1 V_{pp} (sin/cos)
Reference sensor type (S1)			NC MOS relay (max. 40 V_{DC} at 0.1 A)
Limit sensor type (S2)			NC MOS relay (max. 40 V_{DC} at 0.1 A)

LDDS-032-C

Technical data

Motor data	Symbol	Unit	LDDS-032-C
Motor type			2x L1B-3P-100x50 (linear motor with iron core)
Ultimate force (1 s) at I_u	F_u	N	726
Peak force (saturation range) at I_p	F_p	N	640
Peak force (linear range) at I_{pl}	F_{pl}	N	478
Continuous force at I_c	F_c	N	222
Cogging (ripple force)	F_r	N	24
Ultimate current (1 s)	I_u	A_{rms}	17.8
Peak current (saturation range, 3 s)	I_p	A_{rms}	14.2
Peak current (linear range)	I_{pl}	A_{rms}	8.0
Continuous current	I_c	A_{rms}	3.8
Power loss at F_p	P_{lp}	W	910
Power loss at F_{pl}	P_{lpl}	W	286
Power loss at F_c	P_{lc}	W	62
Motor constant (25°C)	k_m	N/√W	20.0
Back EMF constant, phase to phase	k_u	V/(m/s)	49.1
Electrical resistance, phase to phase (25°C)	R_{25}	Ω	3.0
Electrical inductance	L	mH	21.65
Electrical time constant	τ_{el}	ms	7.23
Magnetic period	$2\tau_p$	mm	38
Maximum winding temperature	ϑ	°C	100
Maximum DC link voltage	U_{DCL}	V	600

Moving direction of the linear direct drive system
When the motor is powered according to the circuit diagram, the push-rod is moving into the housing.

LDDS-032-C

Technical data

Motor terminal assignment

Connector type: 9 way M17 plug connector

Internal wye connection

Pin	Signal
1	Phase U
2	Phase V
3	Phase W
PE	PE
A	PTC (6x in series, all phases)
B	PTC (6x in series, all phases)
C	
D	+ Temperature sensor (any phase)
E	- Temperature sensor (any phase)
Case	Shield

Measuring system

Connector type: 17 way M17 plug connector

Pin	Signal
1	+5 V sense
2	S1 (ref)
3	
4	GND sense
5	S2 (LIM +/-)
6	S1/S2 supply
7	+5 V
8	
9	
10	GND
11	
12	U2+
13	U2-
14	U0+
15	U1+
16	U1-
17	U0-
Case	Shield

If using cable lengths of 5 m or more stress peaks can appear at the motor clamps because of harmonic waves and reflexions. These can exceed the DC link voltage and destroy the motor winding insulation. Use additional filters in this case. Please note further information in the operating manual.

LDDS-032-C

Technical data and drawing

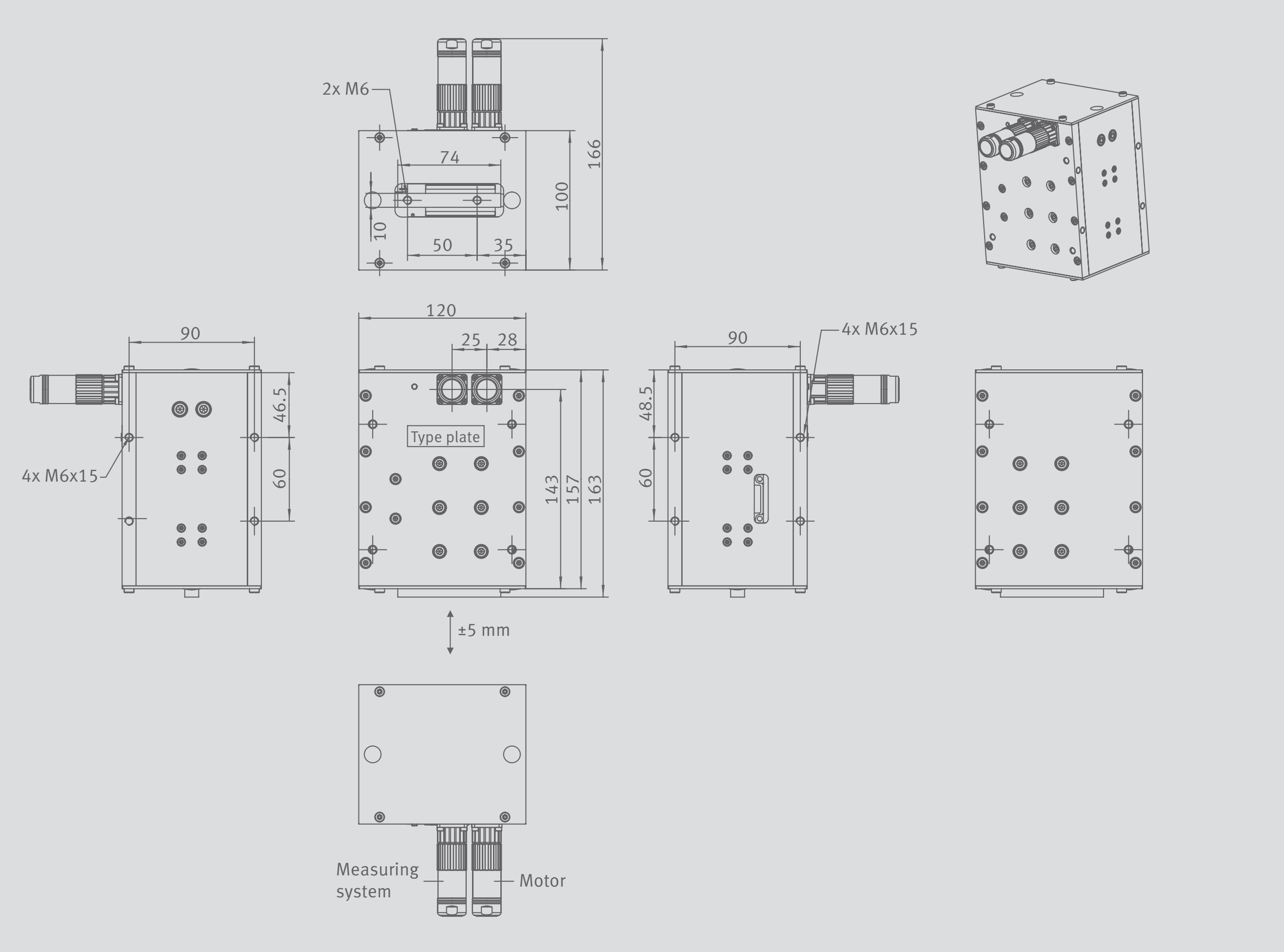
Thermal motor protection

Sensor	Sensor type
Temperature sensor 1	PTC (6x, serial connected)
Temperature sensor 2	Pt1000 temperature sensor (1x)

Description	
PTC type	Nominal switch temperature T_N: 100°C T_N -5 K: R_{PTC} < 550 Ω T_N +5 K: R_{PTC} > 1.33 kΩ
Pt1000 type	Temperature run linear: 3.851 Ω/K 0°C: R_{Pt1000} ≈ 1000 Ω

A safe electrical separation is not implemented in case of a direct connection of PTC or Pt1000 to the servo controller. The PTC is required to protect the motor from excessive temperature. The temperature sensor Pt1000 provides a monitoring of the temperature.

Drawing



Drawing: LDDS-032-C

LRAM-M-1.0-50/33/89-MR-K

Technical data

System data	Symbol	Unit	LRAM
Width	W	mm	50 (without connectors and air hoses)
Length	L	mm	32.6
Height	H	mm	89
Total mass	m	g	280
Moving mass	m_{mov}	g	10
Maximum stroke	s	mm	±10 (left/right limit position)
Maximum speed	v_{max}	m/s	1.5
Maximum acceleration (without payload)	a_{max}	m/s^2	1000

System components	Symbol	Unit	LRAM
Encoder type			Incremental, magneto-resistive
Resolution		µm	1000
Accuracy (at 3 sigma)		µm	±25
Repeat accuracy		µm	±2
Interface			Sinusodial signal 1 V_{pp} (sin/cos)
Air bearing			
Air gap		µm	≈10
Air pressure	p	bar	3 – 4
Air consumption (at 3 bar)		l/h	9

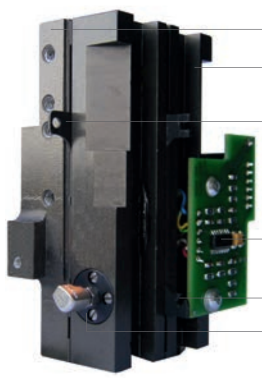
Motor data	Symbol	Unit	LRAM
Motor type			2-phase hybrid stepper motor
Peak force (3 s) at I_p	F_p	N	14
Continuous force at I_c	F_c	N	10 (holding force: 11 N)
Peak current	I_p	A_{rms}	5
Continuous current	I_c	A_{rms}	3
Power loss at F_c	P_{lc}	W	2
Motor constant (25°C)	k_m	N/√W	7.01

LRAM-M-1.0-50/33/89-MR-K

Technical data

Motor data	Symbol	Unit	LRAM
Electrical resistance, phase to phase (25°C)	R_{25}	Ω	0.25
Electrical inductance	L	mH	0.3
Electrical time constant	τ_{el}	ms	1.2
Pitch		mm	1
Maximum DC link voltage	U_{DCL}	V	50

Parts and interfaces



Motor terminal assignment

Connector type: single conductor, open ends

Pin	Signal
1	Phase 1+
2	Phase 1-
3	Phase 2+
4	Phase 2-

Measuring system

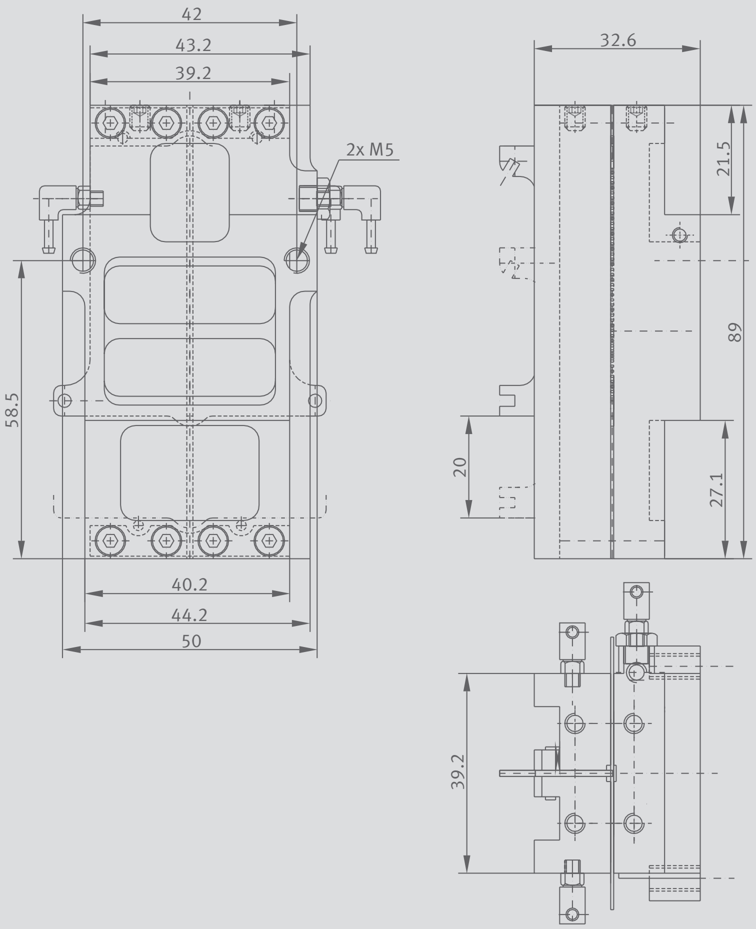
Connector type: ribbon cable, open ends

Wire	Signal
OG	+5 V
YE	GND
GN	sin
BN	/sin
BU	cos
RD	/cos

A signal adjustment of the sin/cos signals (amplitudes) is recommended.

LRAM-M-1.0-50/33/89-MR-K

Drawing



Drawing: LRAM-M-1.0-50/33/89-MR-K

Glossary

Symbol	Meaning	Unit	Explanation
F_u	Ultimate force	N	Force at high saturation in the magnetic circuit resulting from the ultimate current beyond the saturation point where is $F \nsim I$. The permitted duration of ultimate force is lower 1 s. The ultimate force should not be used as a dimensioning variable.
F_p	Peak force (saturation range)	N	Peak force is referred in the saturation range of the motor where is $F \nsim I$. This motor force is generated at peak current I_p. The permitted duration of peak force is heavily dependent on the current motor temperature and lasts only below 3 s.
F_{pl}	Peak force (linear range)	N	Peak motor force which is reached at the end of the linear range of the F/I curve of the motor with $F \sim I$ at I_{pl}. It results in a noticeable heating.
F_c	Continuous force, not cooled	N	Motor force at continuous current I_c if all motor phases have the same loads. In order not to exceed the permissible motor temperature, sufficient heat convection, conduction and radiation must be provided.
F_{Fr}	Friction	N	Displacement force because of friction.
F_r	Cogging (ripple force)	N	Cogging (ripple force) – the sum of forces arising from reluctance, which work in the feed direction when the motor is moved without current input and produce a rippling effect in the force during operation.
F_{Wc}	Weight compensation (force)		A vertical installed linear motor system has to work permanently against the force of gravity because of the weight of the moving parts. The weight compensation force F_{Wc} by a passive weight compensation unit is compensating the gravity. The weight compensation force F_{Wc} represents the force which is measured in vertical direction. This force pulls up the moving part because of an overcompensation.
I_u	Ultimate current	A_{rms}	Maximum effective motor current at which the motor achieves its ultimate force. At I_u the coil temperature can increase up to the permitted maximum within less than 1 s.
I_p	Peak current	A_{rms}	Maximum effective peak current in the range of a few seconds (max. 3 s). When the motor is working with I_p, then the coil temperature must not exceed the maximum permitted coil temperature.
I_{pl}	Peak current (linear range)	A_{rms}	Maximum effective peak current in the linear range of the motor where is $F \sim I$.
I_c	Continuous current, not cooled	A_{rms}	Effective current at related power loss without compulsory cooling option but at sufficient cooling by heat convection, radiation and conduction.

Glossary

Symbol	Meaning	Unit	Explanation
P_l	Power loss	W	The thermal output resulting in the motor winding which leads to a time-dependent temperature increase subject to the operating mode (current) and the environmental conditions (cooling). In the upper dynamic range (at F_p), P_l is particularly high due to the squared dependence on current, whereas the warming in the current range of I_c is relatively low. P_l is calculated (at 25°C) with the aid of the motor constant k_m for a movement section with the required force F: $P_l = (F/km)^2$.
P_{lp}	Power loss	W	Peak power loss at I_p (at 25°C)
P_{lc}	Power loss	W	Power loss at I_c (at 25°C)
k_m	Motor constant	N/√W	Motor constant which expresses the relation between the generated force and the power loss (efficiency of the motor). It is dependent on the temperature. k_m is referred to a coil temperature of 25°C.
k_f	Force constant	N/A_{rms}	Winding parameter which, when multiplied by the current in the linear dynamic range, represents the motor force that is being produced: $F = I_c \cdot k_f$
k_u	Back EMF constant	V/(m/s)	Winding parameter which represents the armature countervoltage arising at the motor terminals in generator operation, subject to the speed. Generator voltage: $U_g = k_u \cdot v$
v_{max}	Maximum speed	m/s	Maximum speed at U_{DCL}. The maximum speed is the limit speed that the motor can achieve. It is referred to F_p at I_p when the motor is working with U_{DCL}. At movement systems it can be restricted too because of mechanical factors.
a_{max}	Maximum acceleration	m/s^2	The maximum achievable acceleration of a movement system can refer to the peak forces or can be restricted because of mechanical factors.
R_{25}	Electrical resistance	Ω	Winding resistance at 25°C.
τ_{th}	Thermal time constant	s	Duration until the coil temperature reaches 63% of the coil end temperature when operating with constant power loss.
L	Inductance	mH	Motor inductance
τ_{el}	Electrical time constant	ms	Constant which describes the L/R ratio. The ratio is approximately constant, regardless of the winding system design. The controlled effective time constant decreases depending on the degree of voltage overshoot. At 1 τ_{el} the motor will achieve about 63% of the final value of the force – referred to the respective current command.

Symbol	Meaning	Unit	Explanation
ϑ	Winding temperature	°C	The maximum permitted temperature for the windings must not be exceed. The winding temperature is referred to the measured temperature by a sensor inside the motor. If no sensor is integrated inside the motor, then this temperature is referred at the housing.
U_{DCL}	DC link voltage	V	DC link voltage or supply voltage of the power actuators. The higher the speed and the countervoltage that rises with it and the greater the losses that depend on the frequency, the higher the voltage has to be.
$2\tau_p$	Magnetic period	mm	The magnet period (also pole pair width) $2\tau_p$ denotes the travel distance of a pole pair on the linear motors. At the same time, τ with index p is the pole width (magnet width) in the displacement direction with a magnetic field alternating between N and S.
	Accuracy Repeat accuray Resolution	mm	Accuracy, repeat accuracy (also known as repeatability) and resolution are in a context. The positioning accuracy of a motion system refers to maximum deviation respectively closeness of the approached position from the desired position. The positioning repeat accuracy refers to the distances respectively closeness between positions to each other which are reached when the same target position is approached again. Resolution of a positioning system is referred to the smallest distance which can get measured by an encoder.

Note:
Subject to modifications without prior notification, where they serve technical progress. Tolerance range for values: ±10%

Mechatronic solutions

High-performance. Precise. Application-oriented.

Benefits of Schaeffler‘s mechatronic solutions

Benefits of Schaeffler‘s mechatronic solutions

- Increase in machine availability and productivity
- Improvement in process stability and quality
- Reduced operating and maintenance costs
- Improvement in product quality

Mechatronic application solutions for automation

DuraSense

Linear guidance with integrated sensor technology for monitoring the lubrication system and for automated relubrication

P.ACT linear actuators

Electromechanical linear actuators with highest power density for flexible configuration for many industrial applications

Modules and tables

Plug-and-play linear modules and tables with perfectly matched components and optimally adapted to the respective application

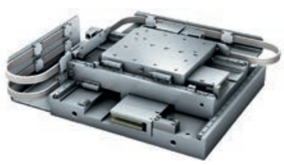
Positioning units

From standard to individual: cost-effective all-round service packages in great variety as ready-to-fit complete solutions

Rotary direct drive systems

Complete systems consisting of motor, bearing and measuring system as rotary tables, indexing tables for small installation spaces

Linear and multi-axis direct drive systems



Precise, high-performance systems with accelerations up to 1000 m/s^2 for high dynamics and shorter production cycles

Linear motors

Linear motor series with best force-mass ratio for more dynamic and precise positioning in a wide range of sizes and performance

Torque motors

High-performance torque motors for all rotary axes for maximum power density and perfect turning, swivelling and positioning

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