RSF Elektronik

www.rsf.at

INCREMENTAL LINEAR ENCODERS

SEALED VERSIONS

INCREMENTAL LINEAR MEASURING DEVICES AND PRECISION GRADUATIONS

RSF Elektronik is one of the world's leading companies in the field of electronic linear measuring devices and it offers an extensive portfolio which includes almost all designs which are required by the market. The typical resolutions or measuring steps range from a few micrometres down to the nanometre range.

RSF Elektronik, corporate head quarters Tarsdorf, Austria

RSF Elektronik, manufacturing subsidiary Stříbro, Czech Republic

Another core element of the product range are high-precision and resistant graduations which are manufactured in thin-layer technology on glass or other carrier substrates. RSF Elektronik also develops customized cable devices for the widest range of sectors and areas of application, and these are manufactured by the Stříbro subsidiary. In order to safeguard the company's high quality standard, a comprehensive quality assurance and environmental management system – certified according to DIN EN ISO 9001 and DIN EN ISO 14001 – has been put in place. Thanks to the company's extensive distribution network, optimum customer service is guaranteed in practically all regions.

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DESIGN AND OPERATION

Linear encoders from RSF Eletronik are all-purpose. They are suited for manual applications; yet they are also particularly suitable for closed loop drive devices.

Owing to their sealed design, the linear encoders of the **MSA 7** and **MSA 8** series are predestined for applications in **automation** and **production technology**. They are ideally suited for **metrology**, **printing** and **robotics**, especially in applications where protection for the scale and reading head is required.

MSA 7 and **MSA 8** represent a systematic advancement of tried-and-tested devices and feature improved design details. During development, RSF Elektronik paid particular attention to the optimization of the accuracy of these devices. We achieved this goal thanks to the perfect combination of several individual components. Furthermore, the components that are subject to more stress have been optimized to increase system accuracy over the longer term.

Measuring devices are made up of two components: the **extrusion** and **reading head**. Preferably, the extrusion is to be mounted on the moveable part of the linear axis, and the reading head to the fixed part (cable duct) of the linear axis.

The **extrusion** consists of a stable aluminum profile, fastening elements, a scale and sealing lips.

Drip caps at the profile and specially formed sealing lips prevent the intrusion of dust and liquids into the extrusion. The fiber-reinforced sealing lips are highly abrasion-resistant. High velocities are feasible due to the high degree of rigidity of the unit, coupled with the ideally formed blade area of the reading head.

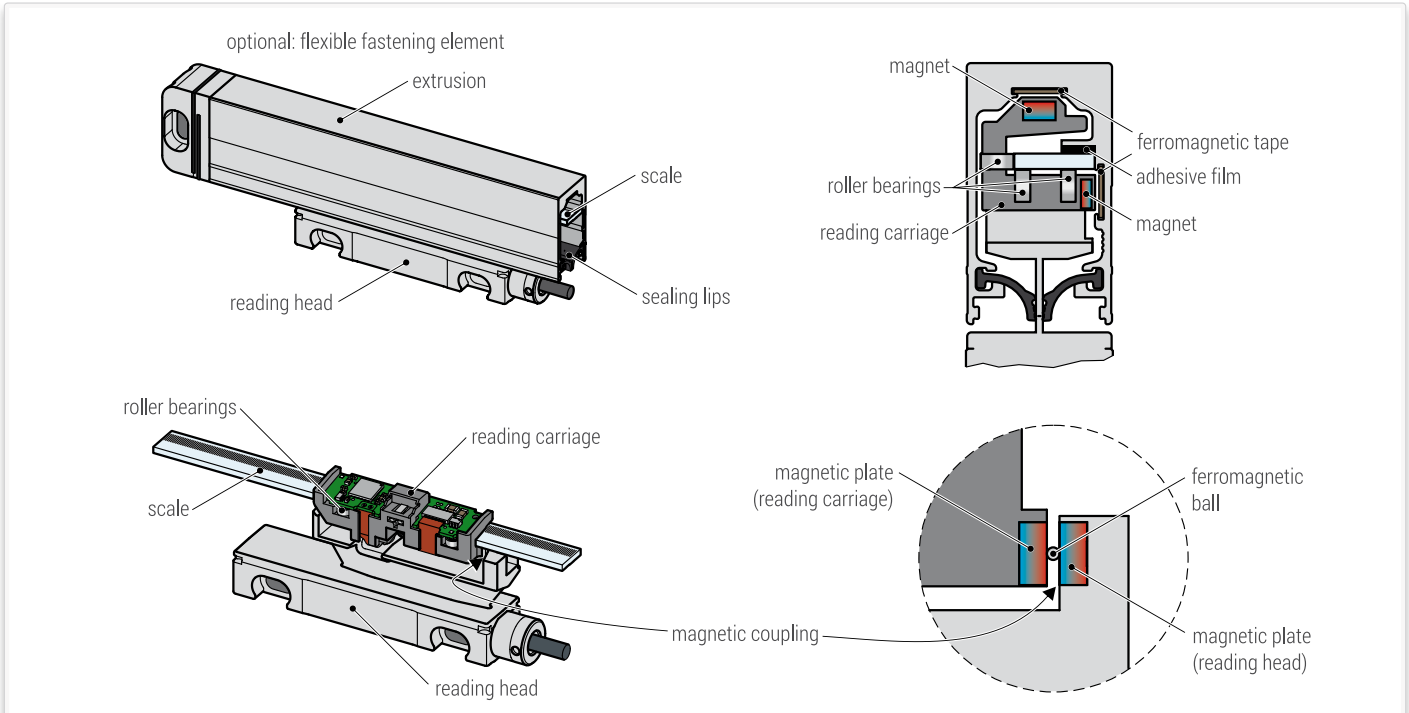
The **scale** is fastened by dint of a flexible adhesive film in the profile, which compensates for the differing linear expansion between the glass or glass ceramics and the aluminum. Thus a **reproducible thermal behavior** is ensured (expansion or shortening of the scale to the profile in case of temperature changes). The scale can additionally be fixed in the profile in order to adjust the thermal zero point to each measuring requirement. Expansion differences between aluminum profile and machine slide are evened out by flexible fastening elements. The **high accuracy of the measuring scale** is the result of a sophisticated lithographic process. A consistently accurate reproduction of the original measuring scale forms the basis for the manufacture of the highly accurate scales in RSF electronic measuring devices.

Depending on the model, the **reading head** is available with a **fixed** or **detachable cable**. The **reading carriage** includes a reticle and optoelectronics for signal generation. Hall-sensors are integrated in the reading head, which generate switch signals for an additional position detection or enable a selection of reference marks. They are activated by magnets that can be optionally positioned in any way on the extrusion by the customer. The evaluation electronics are positioned in the **reading carriage**, generating the evaluation signals (e.g. 1 Vpp or TTL).

Thanks to the design of the reading carriage alignment deviations between extrusion and machine guide are evened out. It rolls by dint of high-precision roller bearings on the scale and is pressed down by magnets that affect the ferromagnetic tapes on the extrusion (**magnet guide**). By mounting within the tolerance there are no forces between reading head and extrusion that could stress guide parts of the linear axis. Moreover, the extrusion is not subjected to any bending strain.

In the measuring direction, the reading carriage is connected by a wear-free and maintenance-free **magnetic coupling**. A ferromagnetic ball rolling freely between two magnetic plates makes for a connection that is very stiff in the measuring direction, yet flexible in all other degrees of freedom, minimizing the reversal error. Thus any deviation (within the tolerance) will be evened out by the ideal mounting of the measurement device.

The combination of magnetic guide and magnetic coupling allows for generous mounting tolerances without any negative influence on accuracy. Hence substantial benefits are achieved in comparison to traditional technologies.



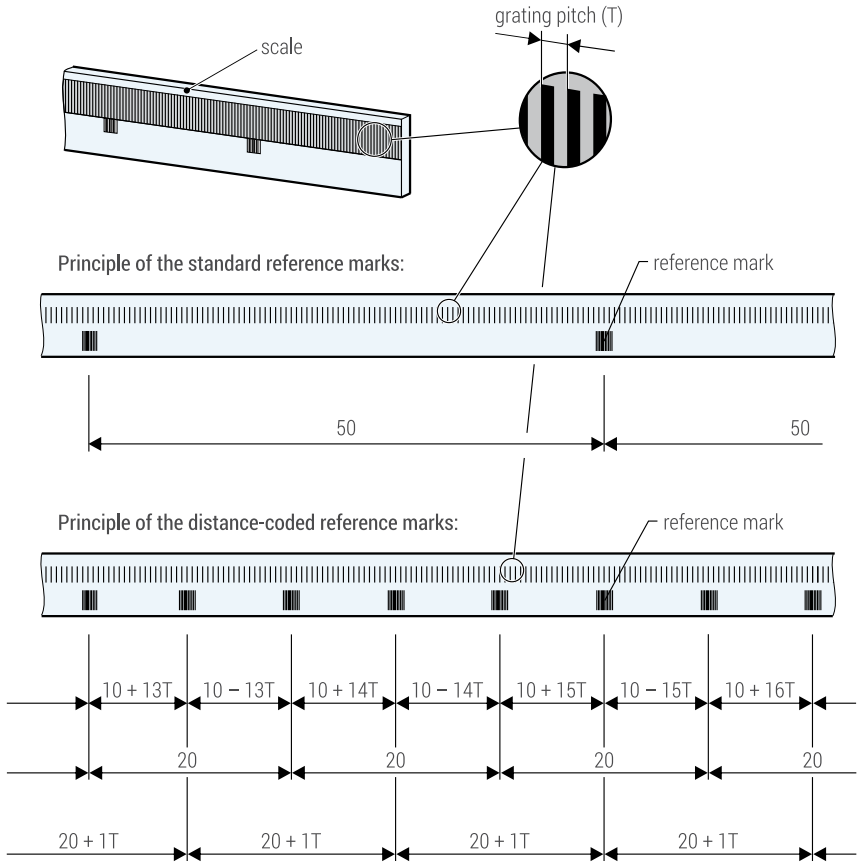
A high accuracy grating is deployed as scale graduation. Depending on the model, glass ($\alpha \approx 8{,}5 \times 10^{-6}$/K) or glass ceramics ($\alpha \approx 0 \times 10^{-6}$/K) is employed as base.

The grating is the consistent series of lines and spaces. The width of one line and one space is called a grating pitch (T).

Parallel to the grating, there are one or more reference marks on a second track. Within the measuring length, any position is possible and additional reference marks can be chosen at will in a distance of 50 mm.

Linear encoders with a suffix „**K**" in the model designation are equipped with distance-coded reference marks. After traveling a distance of 20 mm at maximum, the absolute tool position is available with these models.By dint of the optical scanning, a position-accurate evaluation of the reference marks is ensured.

Scale unit



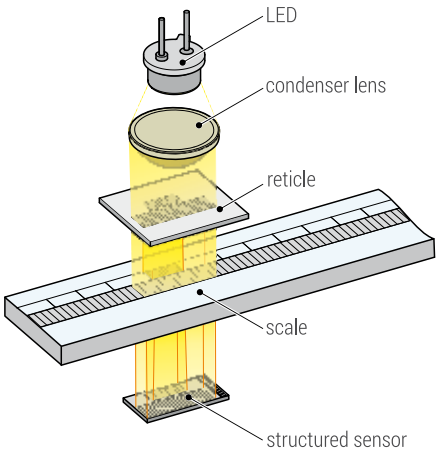
These incremental linear encoders work according to an imaging photoelectric measuring principle with a transmissive **singlefield scanning**.

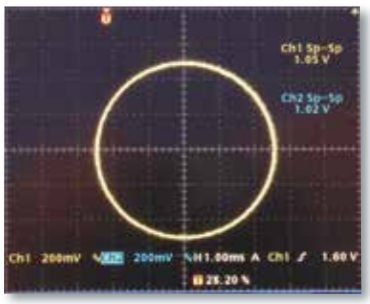
The regulated light of an infrared LED is collimated by a condenser lens, passes through the grid of the reticle and the scale and generates a periodic intensity distribution on the structured sensor.

The sensor generates sinusoidal signals of the highest quality that prove to be widely insensitive to possible contaminations, which can never be entirely ruled out despite all technical precautions.

The regulation of the LED ensures a constant light output, guaranteeing stability in the case of temperature fluctuations as well as with long-run operation.

Transmissive singlefield scanning





OVERVIEW

OVERVIEW, SELECTION GUIDE

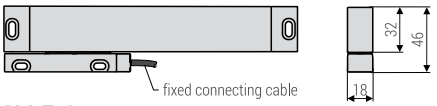
The linear encoders of the **MSA 7xx** series are equipped with a fixed connecting cable. Alternatively RSF offers the **MSA 8xx** series with a detachable connecting cable. Depending on the electrical version the detachable connecting cable is available in graduated lengths up to 9 m (other lengths on request).

All models are characterized by a considerably improved thermal behavior.
Flexible fastening elements at the scale unit compensate repeatably the length-extension resp. -contraction, which appears due to temperature variations at the machine.

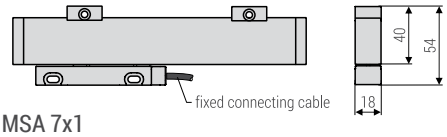
With a fixed fastening element (left side, middle or right side) a datum-point (thermal fixed-point) is defined.
Additionally it is also possible to fix the scale inside of the extrusion.

MSA 7XX.XX-X XX

- **Small** cross-section
- Max. measuring length: 3040 mm (only at 20 µm grating pitch)
- Fixed connecting cable
- System height: 46 resp. 54 mm



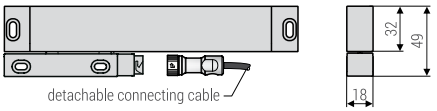
MSA 7x0



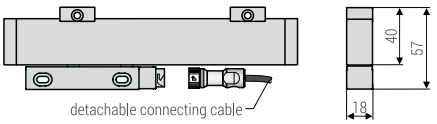
MSA 7x1

MSA 8XX.XX-X XX

- **Small** cross-section
- Max. measuring length: 3040 mm (only at 20 µm grating pitch)
- Detachable connecting cable
- System height: 49 resp. 57 mm



MSA 8x0



MSA 8x1

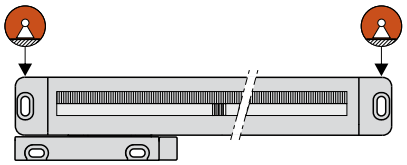
OVERVIEW, SELECTION GUIDE

Symbols:

= Fixed fastening element = Flexible fastening element = Additional fixed-point of the scale in the extrusion (optional)

MSA X70.XX-X XX

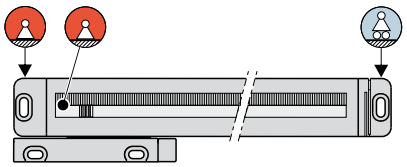
- Mounting holes at the ends
- Fixed fastening elements
- Max. measuring length: 1240 mm



MSA 770, MSA 870 *Page 12*

MSA X10.XX-X XX

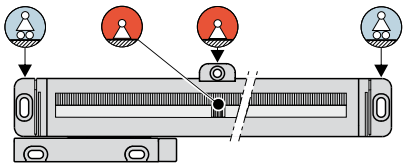
- Fixed mounting-point left
- Flexible fastening element right
- Max. measuring length: 1240 mm



MSA 710, MSA 810 *Page 13*

MSA X20.XX-X XX

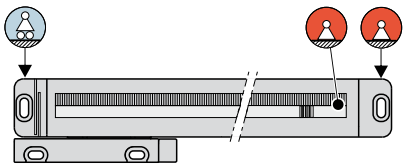
- Fixed mounting-point centered
- Flexible fastening element left and right
- Max. measuring length: 1240 mm



MSA 720, MSA 820 *Page 14*

MSA X30.XX-X XX

- Fixed mounting-point right
- Flexible fastening element left
- Max. measuring length: 1240 mm



MSA 730, MSA 830 *Page 15*

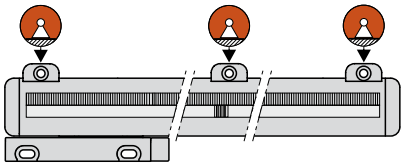
OVERVIEW, SELECTION GUIDE

Symbols:

= Fixed fastening element = Flexible fastening element = Additional fixed-point of the scale in the extrusion (optional)

MSA X71.XX-X XX

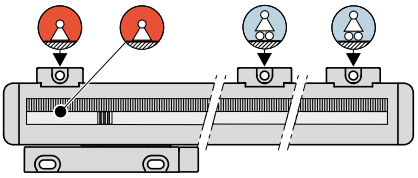
- Mounting holes along the scale unit
- Fixed fastening elements
- Max. measuring length: 3040 mm (only at 20 µm grating pitch)



MSA 771, MSA 871 *Page 16*

MSA X11.XX-X XX

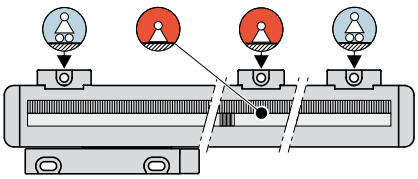
- Fixed mounting-point left
- All other fastening elements flexible
- Max. measuring length: 3040 mm (only at 20 µm grating pitch)



MSA 711, MSA 811 *Page 17*

MSA X21.XX-X XX

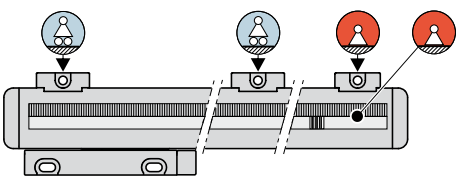
- Fixed mounting-point centered
- All other fastening elements flexible
- Max. measuring length: 3040 mm (only at 20 µm grating pitch)



MSA 721, MSA 821 *Page 18*

MSA X31.XX-X XX

- Fixed mounting-point right
- All other fastening elements flexible
- Max. measuring length: 3040 mm (only at 20 µm grating pitch)



MSA 731, MSA 831 *Page 19*

OVERVIEW, SELECTION GUIDE

Output signals and integrated subdividing

MSA XXX.XX-X XX

0 = sinusoidal voltage signals 1 Vpp
2 = square-wave signals, times 1
3 = square-wave signals, times 2
4 = square-wave signals, times 20
5 = square-wave signals, times 25
6 = square-wave signals, times 5
7 = square-wave signals, times 10
8 = square-wave signals, times 50
9 = square-wave signals, times 100

Grating pitch

MSA XXX.XX-X XX

0 = 8 µm
1 = 10 µm
3 = 20 µm

Reachable system resolution [µm] = $\left(\frac{\text{grating pitch [µm]}}{\text{subdividing}}\right) : 4$

Inch-graduation on request

Version of the switch signal
(only for linear encoders with actuator magnets)

MSA XXX.XX-X XX

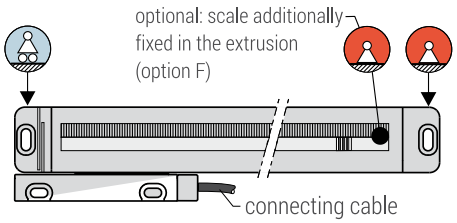
-0 = without switch signals
-1 = TTL output (active high)
-2 = open collector output (active high impedance)
-3 = TTL output (active low)
-4 = open collector output (active low)

Possible options

MSA XXX.XX-X XX

K = distance-coded reference marks
N = all reference marks active
F = fixed point-bonding scale with extrusion
B = glass ceramic scale

Example



MSA 730.63-1 F

Reading head with fixed connecting cable, mounting holes at the ends, fixed mounting-point right, flexible fastening element left

square-wave signals, integrated subdividing times 5

Grating pitch 20 µm

Switch signal with TTL output (active high)

Fixed point-bonding scale with the extrusion

TECHNICAL DATA MSA 7XX, MSA 8XX SERIES

Model electronic version	Output signal	System resolution [µm]	Accuracy grades [µm/m]	Grating pitch [µm]	Integrated interpolation	Maximum velocity [m/s]	Max. output frequency [kHz]
MSA xxx.**03**	~ 1 Vpp	dep. on external interpolation	±3, ±5	20	--	2.0	100
MSA xxx.**01**	~ 1 Vpp	dep. on external interpolation	±3, ±5	10	--	2.0	200
MSA xxx.**00**	~ 1 Vpp	dep. on external interpolation	±2, ±3, ±5	8	--	2.0	250
							Edge separation a_{min}
MSA xxx.**23**	⎍	5.0	±3, ±5	20	times 1	2.0	1.25 µs
MSA xxx.**33**	⎍	2.5	±3, ±5	20	times 2	2.0	625 ns
MSA xxx.**63**	⎍	1.0	±3, ±5	20	times 5	2.0	250 ns
MSA xxx.**73**	⎍	0.5	±3, ±5	20	times 10	1.92	250 ns
MSA xxx.**61**	⎍	0.5	±3, ±5	10	times 5	1.92	250 ns
MSA xxx.**71**	⎍	0.25	±3, ±5	10	times 10	0.96	250 ns
MSA xxx.**51**	⎍	0.1	±3, ±5	10	times 25	0.77	125 ns
MSA xxx.**81**	⎍	0.05	±3, ±5	10	times 50	0.38	125 ns
MSA xxx.**30**	⎍	1.0	±2, ±3, ±5	8	times 2	2.0	250 ns
MSA xxx.**70**	⎍	0.2	±2, ±3, ±5	8	times 10	0.77	250 ns
MSA xxx.**80**	⎍	0.04	±2, ±3, ±5	8	times 50	0.3	125 ns
MSA xxx.**90**	⎍	0.02	±2, ±3, ±5	8	times 100	0.15	125 ns

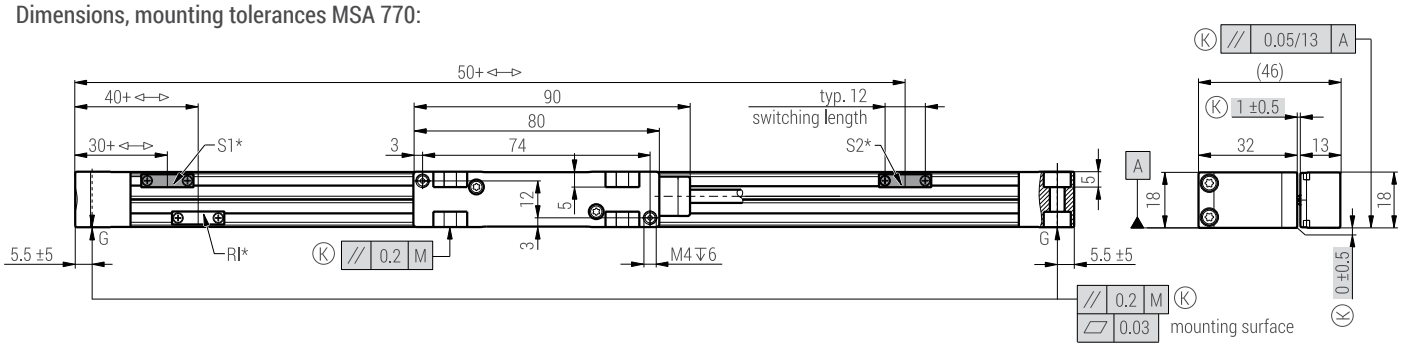
Standard measuring lengths (ML): [mm]	70, 120, 170, 220, 270, 320, 370, 420, 470, 520, 570, 620, 670, 720, 770, 820, 870, 920, 970, 1040, 1140, 1240, 1340, 1440, 1540, 1640, 1740, 1840, 1940, 2040, 2240, 2440, 2640, 2840, 3040 (only possible with 20 µm grating pitch), (8 or 10 µm grating pitch only possible up to measuring length 1220 mm) (other measuring lengths on request)
Scale unit:	▪ Glass scale ($\alpha \approx 8.5 \times 10^{-6}$/K) ▪ Glass ceramic scale ($\alpha \approx 0 \times 10^{-6}$/K) up to ML 1440 mm (longer ML on request)
Location of reference mark (RI):	▪ Distance-coded reference mark after travelling max. 20 mm the absolute position is available. ▪ Optional: one reference mark at any location additional reference marks can be selected by distances of n x 50 mm.
Required moving force:	▪ With standard sealing lips: < 2.0 N ▪ With low drag resp. without sealing lips: < 0.1 N
Environmental sealing acc. EN 60529:	▪ With standard sealing lips: IP 52
Permissible vibration:	100 m/s² (40 up to 2000 Hz)
Permissible shock:	200 m/s² (8 ms)
Permissible temperature:	▪ –20 °C up to +70 °C (storage) ▪ 0 °C up to +50 °C (operation)
Weight of linear encoder (approx.):	▪ MSA 7xx , MSA 8xx: 75 g + 0.57 g/mm (ML) + 50 g (reading head MSA **7**xx without cable) + 65 g (reading head MSA **8**xx without cable)
Weight of cable (approx.):	30 g/m
Power supply:	▪ Sinusoidal voltage signals ∿ 1 Vpp +5 V ±5 %, max. 150 mA (unloaded) ▪ Square-wave signals via line driver ⎍ +5 V ±5 %, max. 180 mA (unloaded)
RoHS-conformity:	The linear encoders of the MSA 7xx and MSA 8xx series comply with the guideline of the RoHS-directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

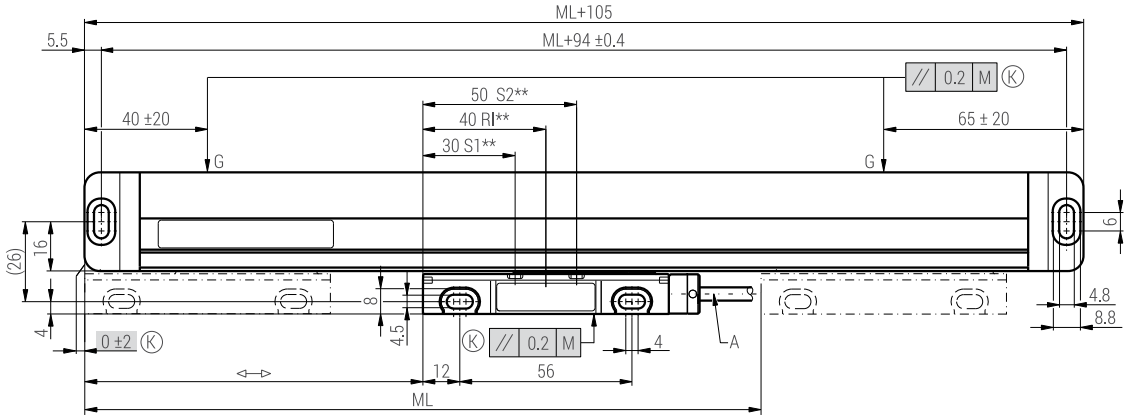
MSA 770, MSA 870

MSA 770

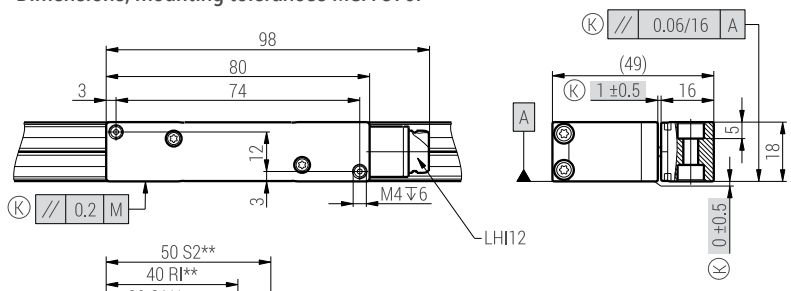
MSA 870

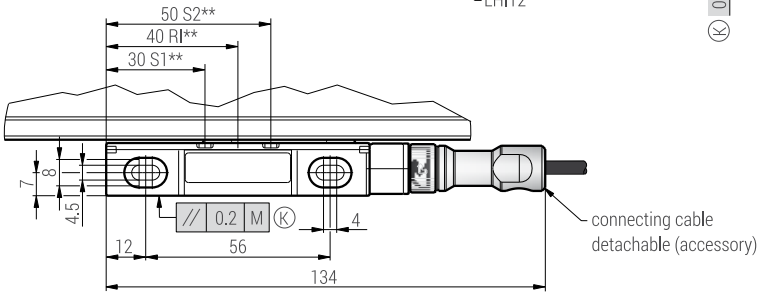
Dimensions, mounting tolerances MSA 770:





Dimensions, mounting tolerances MSA 870:





M = machine guideway
ML = measuring length
G = gauging points
◁▷ = 0 ... ML
A = cable

LHI12 = male connector

Ⓚ = required mating dimensions

OPTIONAL:
S1, S2 = switch signals
RI = selectable reference mark

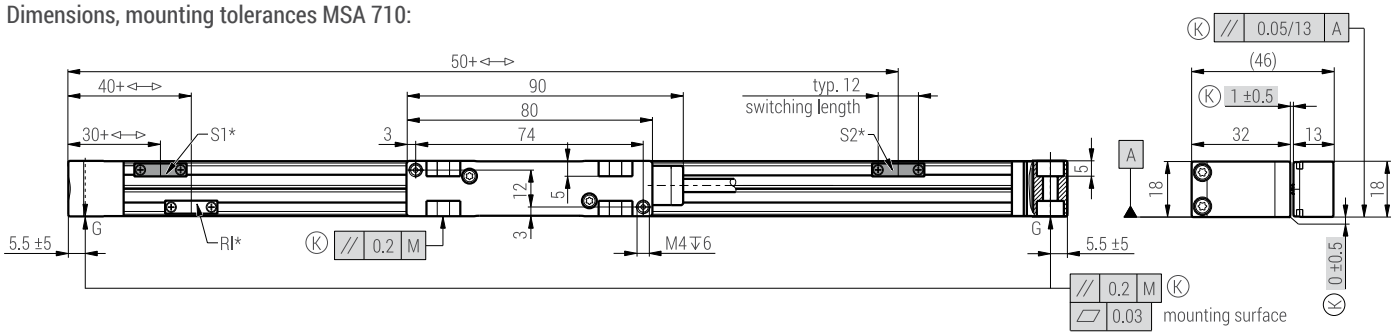
* = actuator magnet
** = sensor position

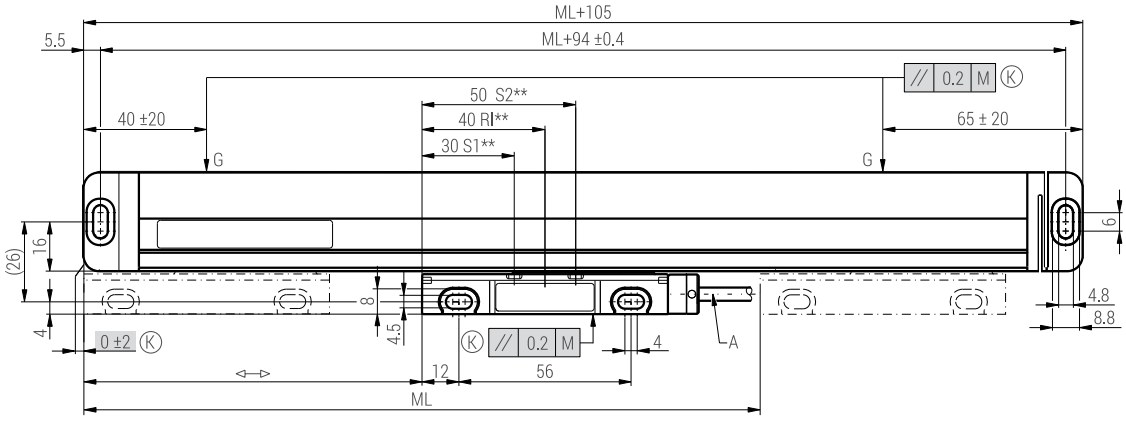
MSA 710, MSA 810

MSA 710

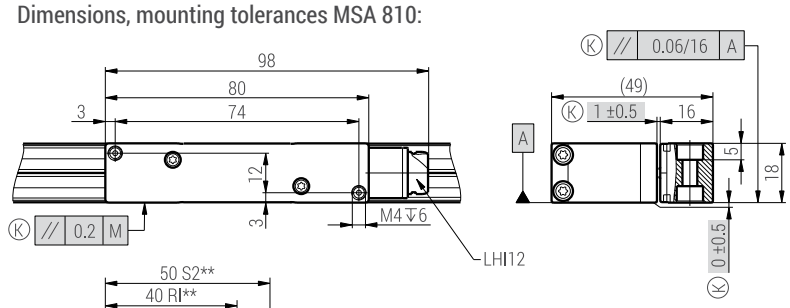
MSA 810

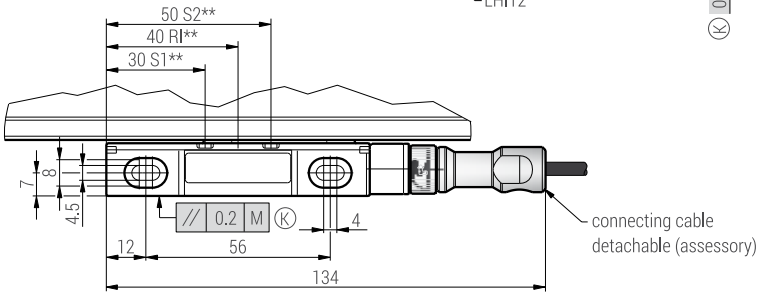
Dimensions, mounting tolerances MSA 710:





Dimensions, mounting tolerances MSA 810:





M = machine guideway
ML = measuring length
G = gauging points
◁▷ = 0 ... ML
A = cable

LHI12 = male connector

Ⓚ = required mating dimensions

OPTIONAL:
S1, S2 = switch signals
RI = selectable reference mark

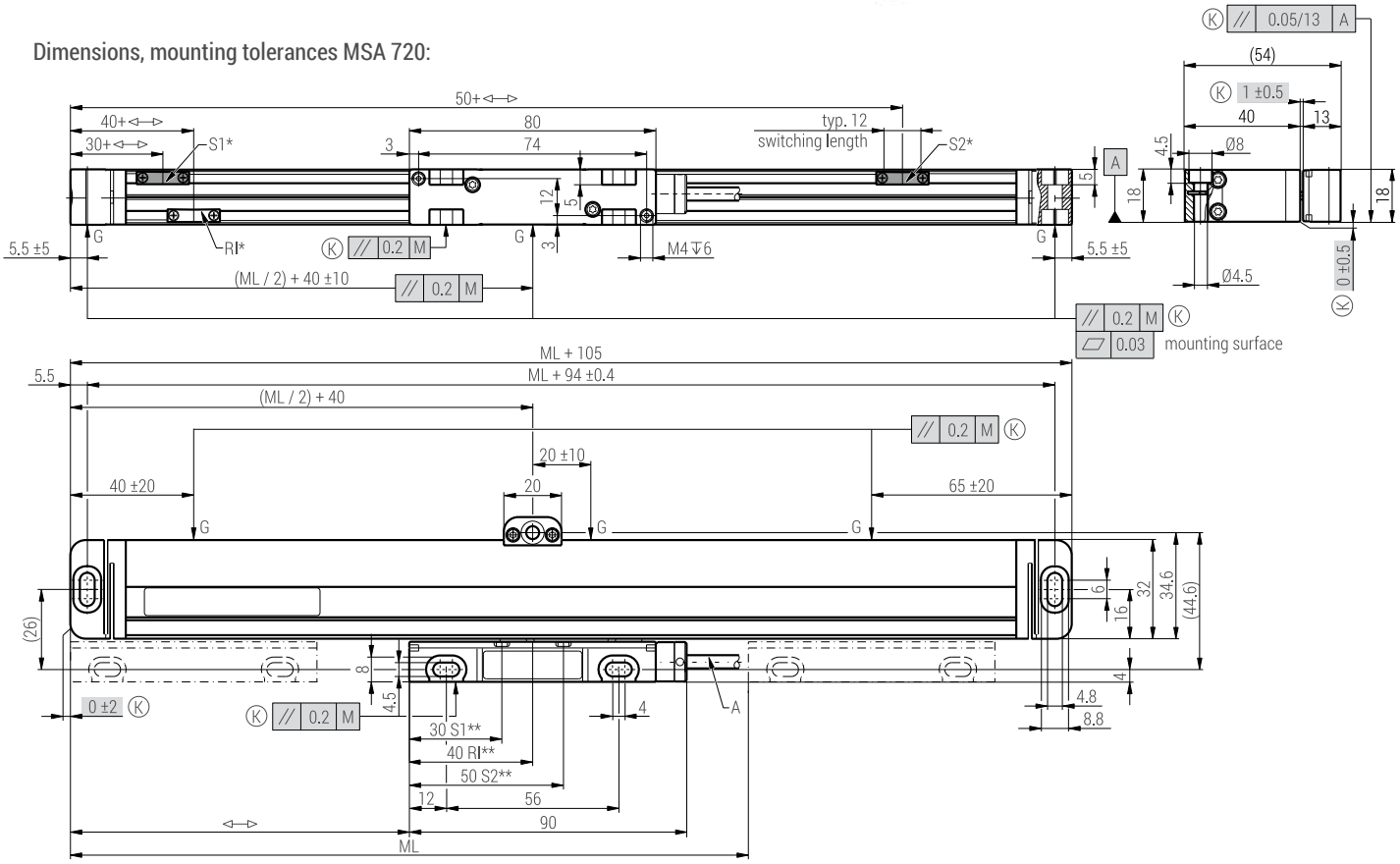
* = actuator magnet
** = sensor position

MSA 720, MSA 820

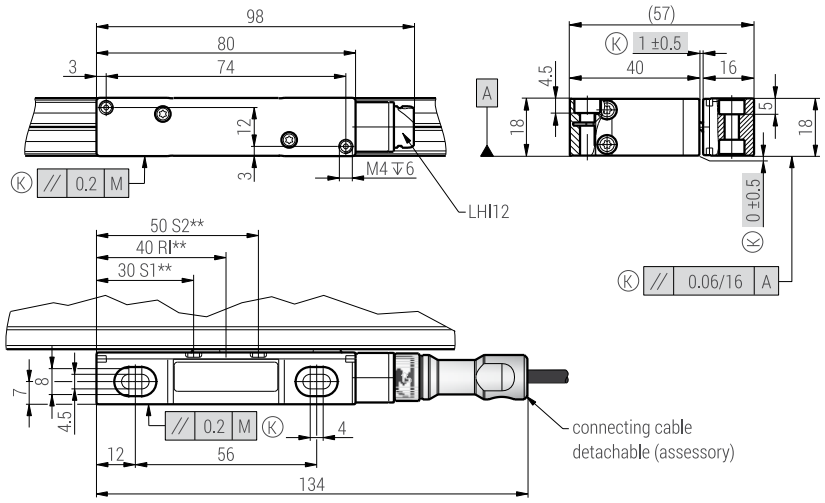
MSA 720

MSA 820

Dimensions, mounting tolerances MSA 720:



Dimensions, mounting tolerances MSA 820:



M = machine guideway
ML = measuring length
G = gauging points
◁▷ = 0 ... ML
A = cable

LHI12 = male connector

Ⓚ = required mating dimensions

OPTIONAL:
S1, S2 = switch signals
RI = selectable reference mark

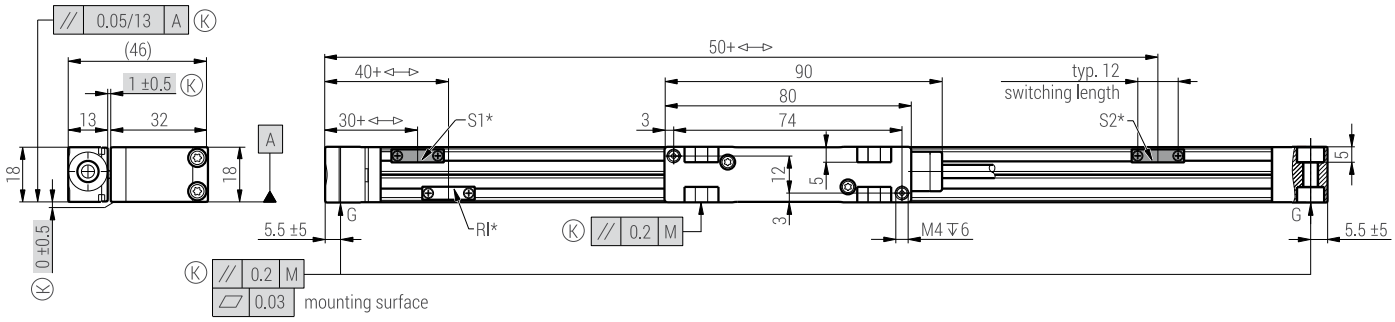
* = actuator magnet
** = sensor position

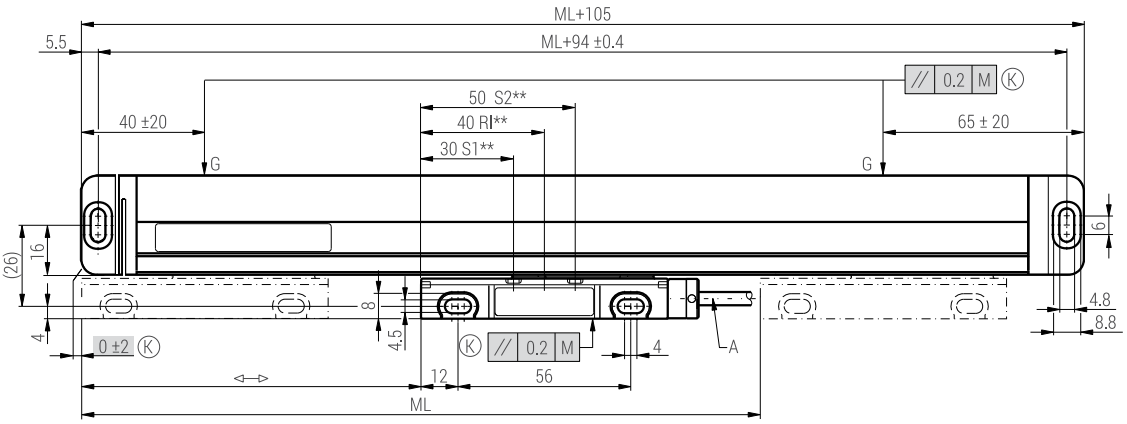
MSA 730, MSA 830

MSA 730

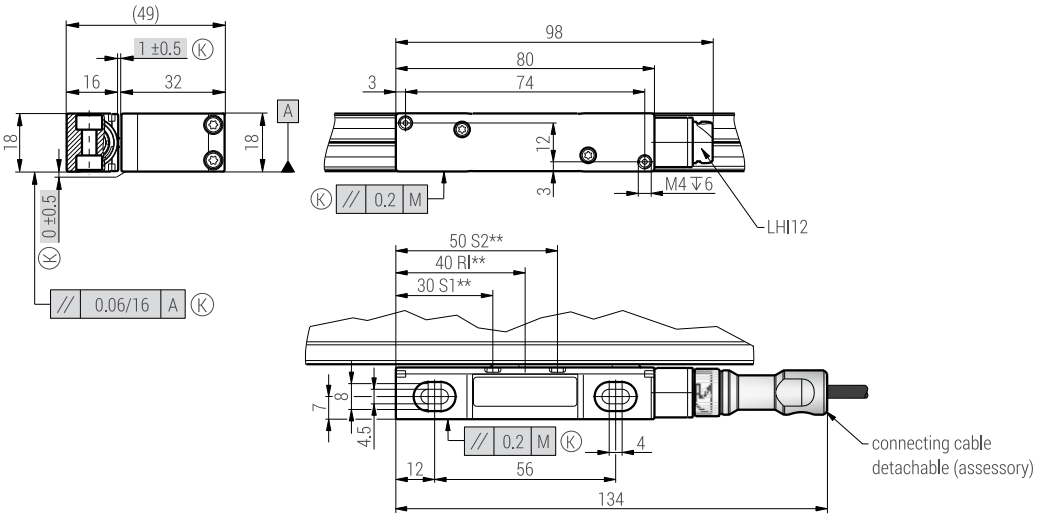
MSA 830

Dimensions, mounting tolerances MSA 730:





Dimensions, mounting tolerances MSA 830:



M = machine guideway
ML = measuring length
G = gauging points
◁▷ = 0 ... ML
A = cable

LHI12 = male connector

Ⓚ = required mating dimensions

OPTIONAL:
S1, S2 = switch signals
RI = selectable reference mark

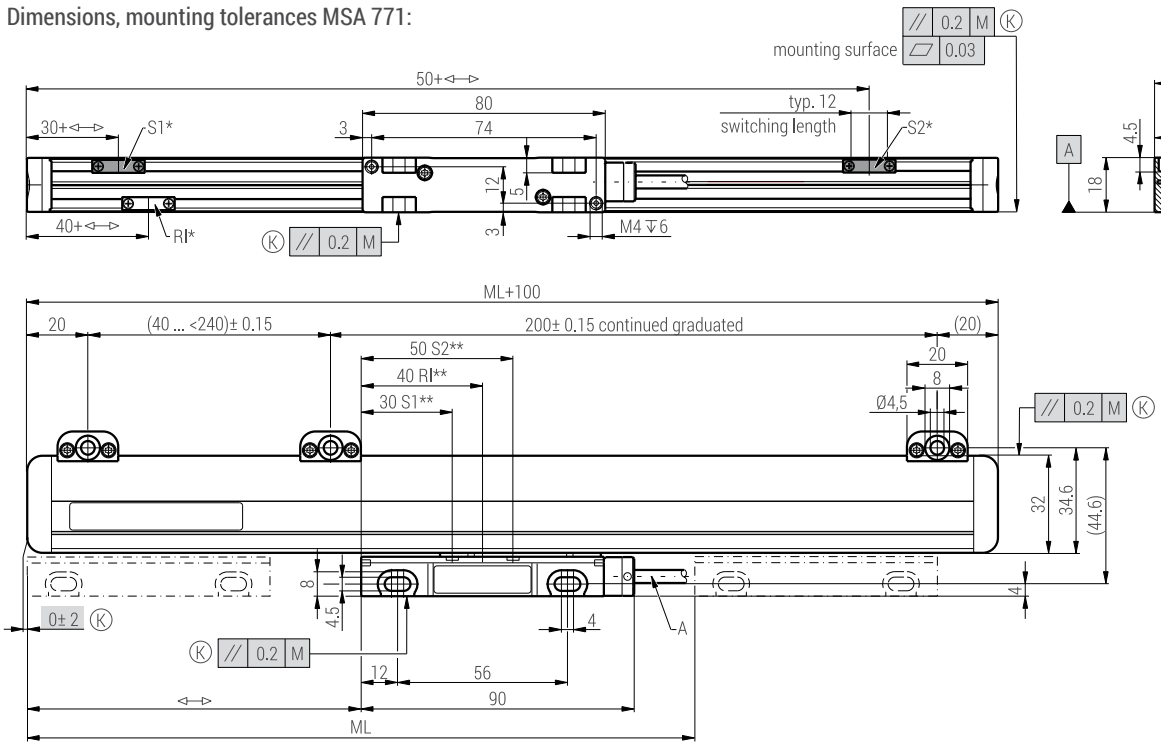
* = actuator magnet
** = sensor position

MSA 771, MSA 871

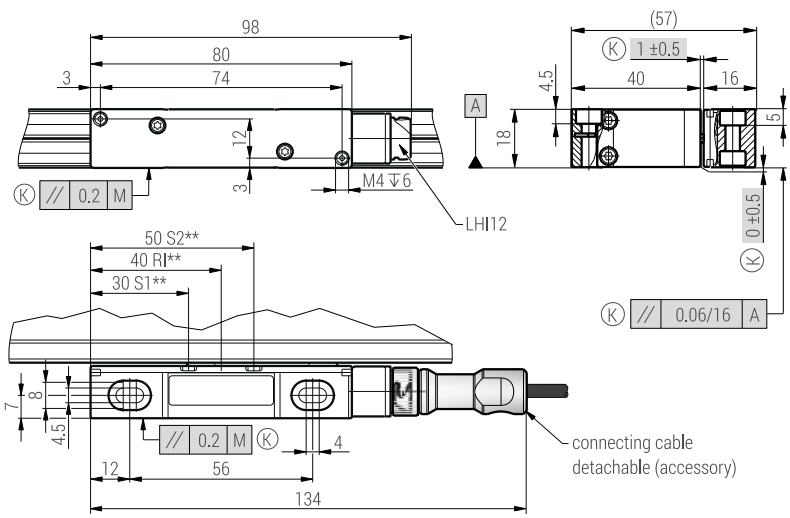
MSA 771

MSA 871

Dimensions, mounting tolerances MSA 771:



Dimensions, mounting tolerances MSA 871:



M = machine guideway
ML = measuring length
⟷ = 0 ... ML
A = cable

LHI12 = male connector

Ⓚ = required mating dimensions

OPTIONAL:
S1, S2 = switch signals
RI = selectable reference mark

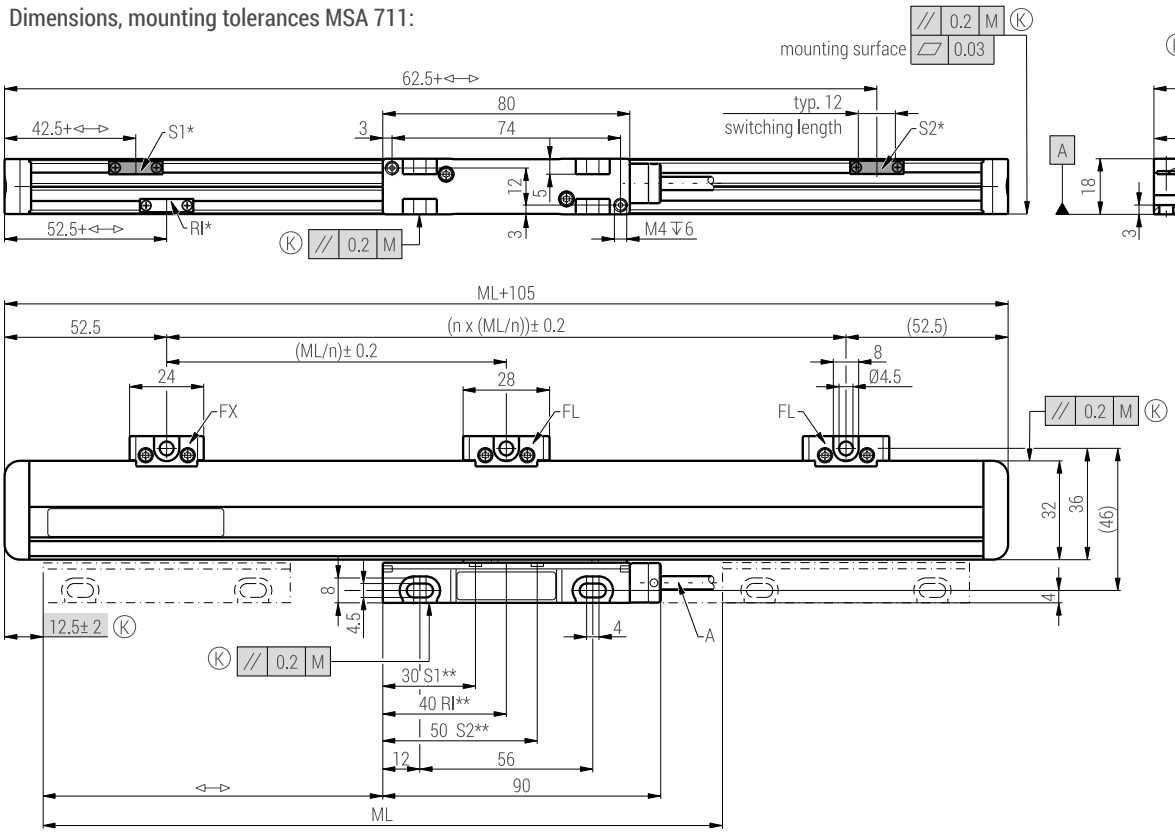
* = actuator magnet
** = sensor position

MSA 711, MSA 811

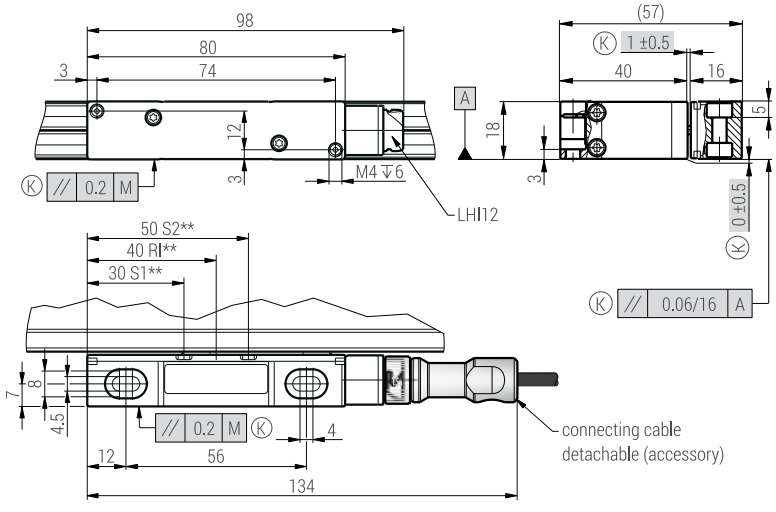
MSA 711

MSA 811

Dimensions, mounting tolerances MSA 711:



Dimensions, mounting tolerances MSA 811:



measuring length (ML)	n
ML > 56 - 600	2
ML > 600 - 1200	4
ML > 1200 - 1800	6
ML > 1800 - 2400	8
ML > 2400 - 3000	10
ML > 3000 - 3040	12

M = machine guideway
ML = measuring length
◁—▷ = 0 ... ML
A = cable

LHI12 = male connector

K = required mating dimensions

FX = fixed mounting
FL = flexible mounting

OPTIONAL:
S1, S2 = switch signals
RI = selectable reference mark

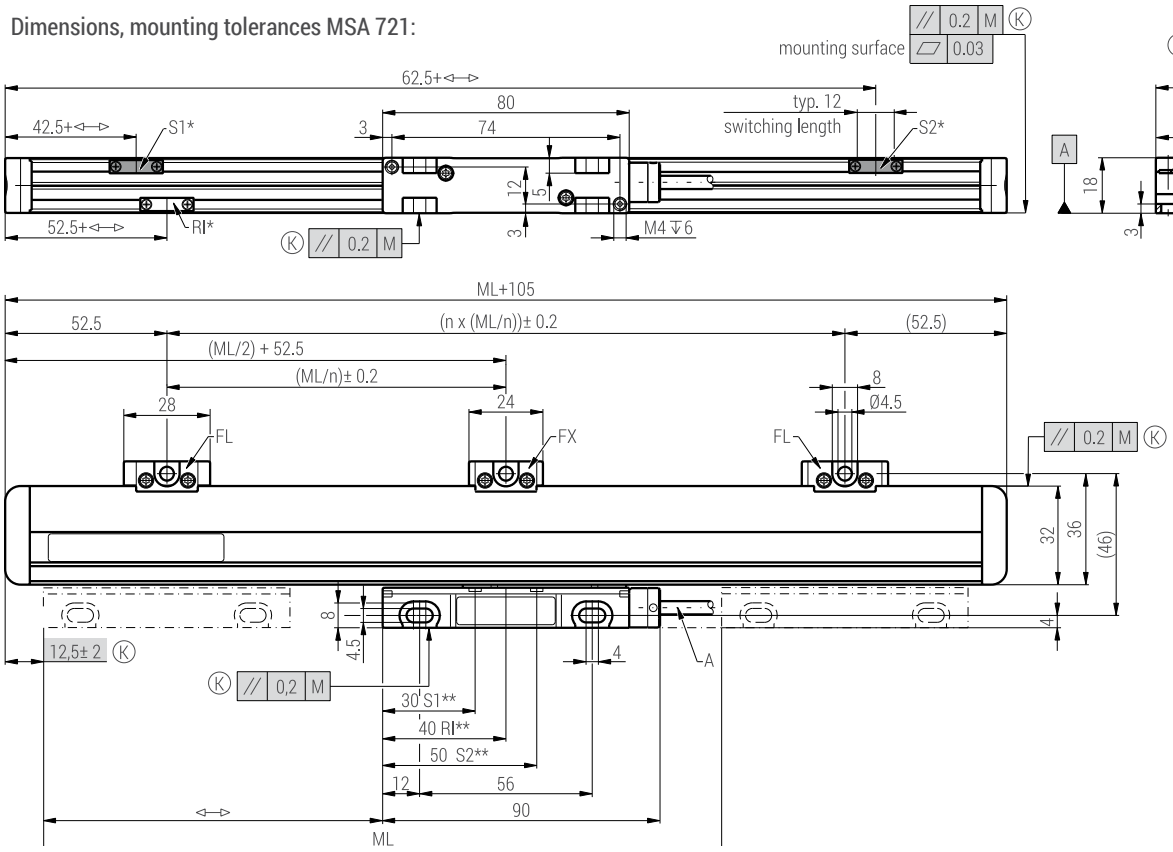
* = actuator magnet
** = sensor position

MSA 721, MSA 821

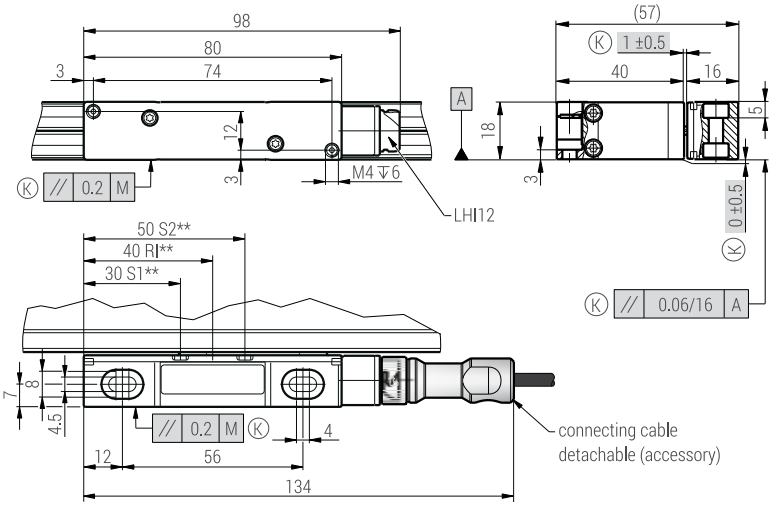
MSA 721

MSA 821

Dimensions, mounting tolerances MSA 721:



Dimensions, mounting tolerances MSA 821:



measuring length (ML)	n
ML > 56 - 600	2
ML > 600 - 1200	4
ML > 1200 - 1800	6
ML > 1800 - 2400	8
ML > 2400 - 3000	10
ML > 3000 - 3040	12

M = machine guideway
ML = measuring length
◁—▷ = 0 ... ML
A = cable

LHI12 = male connector

Ⓚ = required mating dimensions

FX = fixed mounting
FL = flexible mounting

OPTIONAL:
S1, S2 = switch signals
RI = selectable reference mark

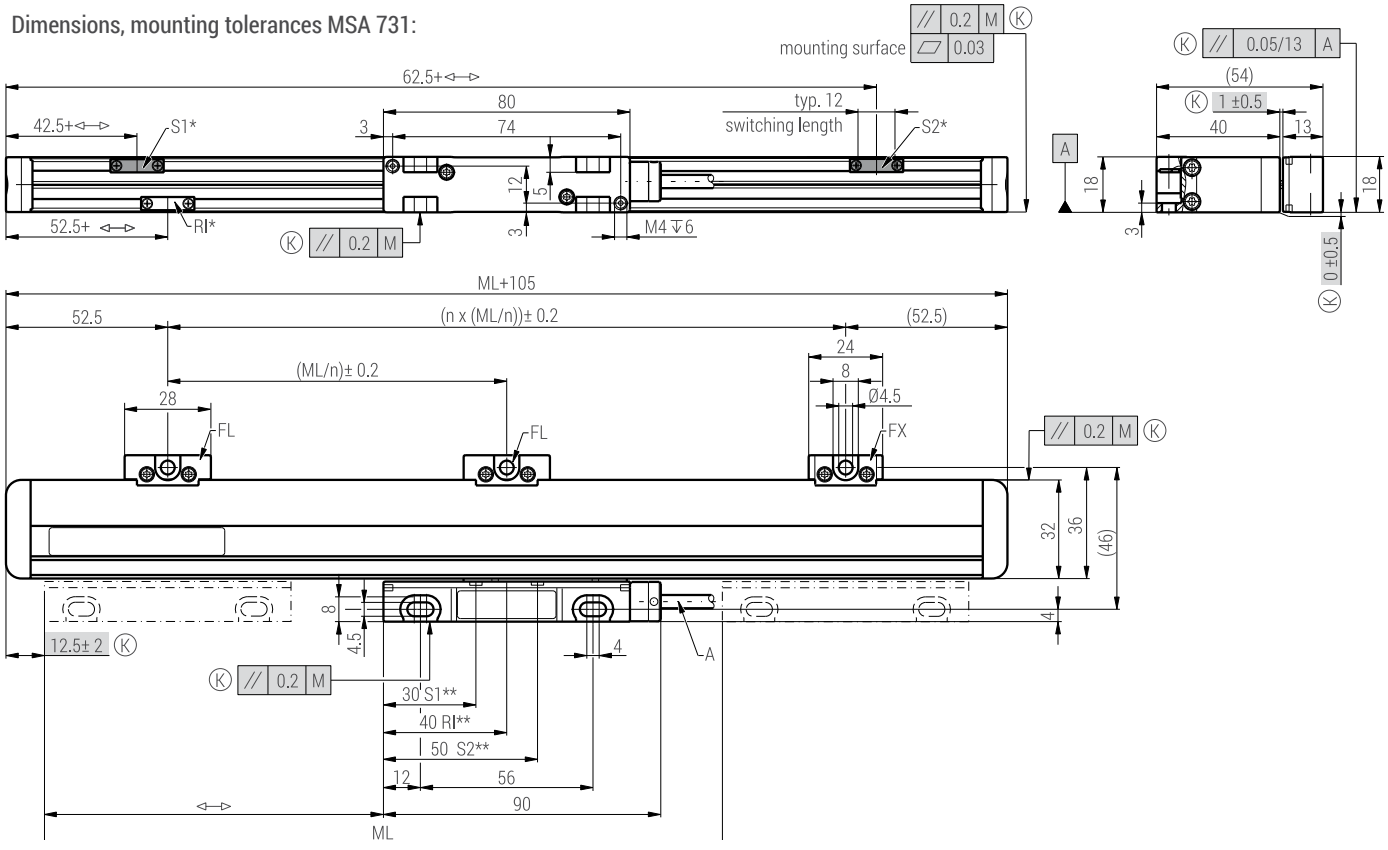
* = actuator magnet
** = sensor position

MSA 731, MSA 831

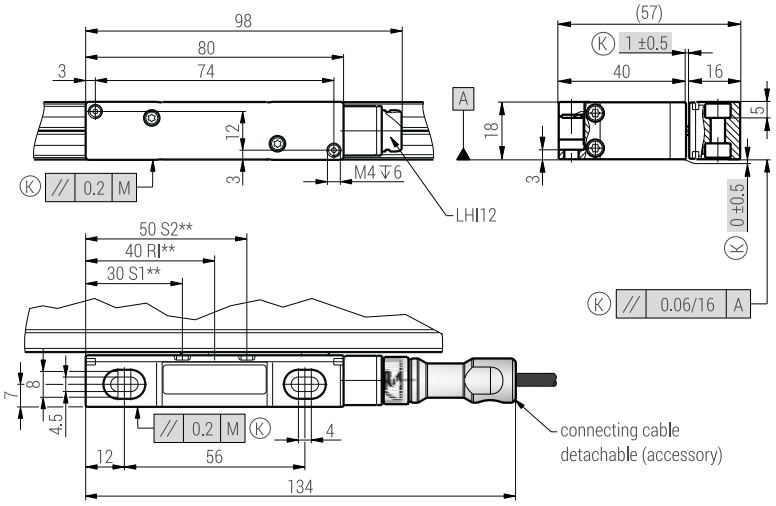
MSA 731

MSA 831

Dimensions, mounting tolerances MSA 731:



Dimensions, mounting tolerances MSA 831:



measuring length (ML)	n
ML > 56 - 600	2
ML > 600 - 1200	4
ML > 1200 - 1800	6
ML > 1800 - 2400	8
ML > 2400 - 3000	10
ML > 3000 - 3040	12

M = machine guideway
ML = measuring length
↔ = 0 ... ML
A = cable

LHI12 = male connector

K = required mating dimensions

FX = fixed mounting
FL = flexible mounting

OPTIONAL:
S1, S2 = switch signals
RI = selectable reference mark

* = actuator magnet
** = sensor position

MSA 373, MSA 374, MSA 375

MSA 373

Model	Output signals	System resolution [µm]	Accuracy grades [µm/m]	Maximum velocity [m/s]	Max. output frequency [kHz]
MSA 37x	⎍	5	±10	1.0	1.6 µs
MSA 37x	⎍	1	±10	1.0	800 ns

Standard measuring length: [mm]
70, 120, 170, 220, 270, 320, 370, 420, 470, 520, 620, 720, 770, 820, 920, 1040, 1140, 1240 ... 2270 (other ML on request)

Scale unit:
glass scale ($\alpha \approx 8.5 \times 10^{-6}$/K)

Free positionable actuator magnets for special functions:
The position of the two switch-points (S1 and S2) can be selected by the customer within measuring length.

Location of the reference marks:

- One reference mark in the center of measuring length, or 35 mm from either end of measuring length.
- Optional: one reference mark at any location, additional reference marks can be selected by distances of n x 50 mm.

Required moving force:
< 5 N

Environmental sealing acc. to EN 60529:
IP 52

Permissible vibration:
150 m/s² (40 up to 2000 Hz)

Permissible shock:
300 m/s² (8 ms)

Permissible temperature:

- –20 °C up to + 70 °C (storage)
- 0 °C up to +50 °C (operation)

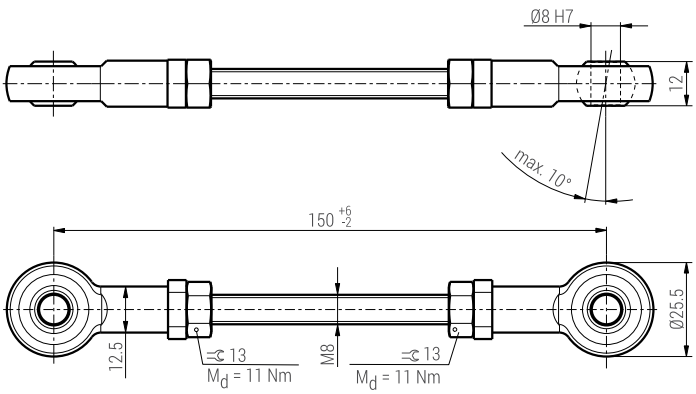
Weight (approx.):
237 g + 1.17 g/mm (ML) + 171 g (reading head without cable)

Power supply:
+5 V ±5 %, max. 120 mA (unloaded)

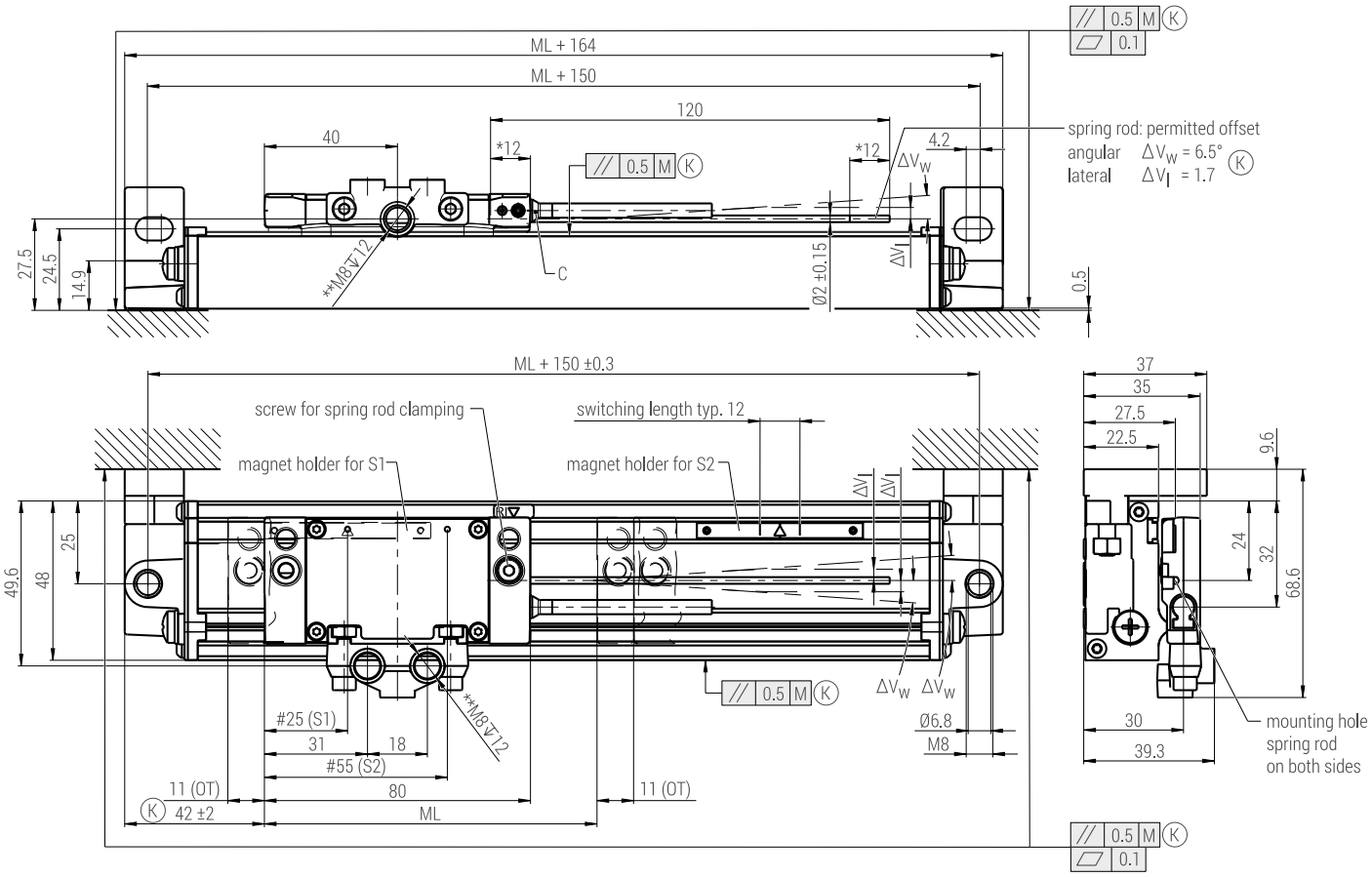
RoHS-conformity:
The MSA 373, MSA 374 and MSA 375 linear encoders comply with the guideline of the RoHS-directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

ACCESSORY: CB8-150 coupling bar (only for MSA 373 and MSA 375)

Axis distance: 150 mm (other axis distances on request)
Included in delivery: 2 hexagon socket screws M8 x 20 ISO 4762 for mounting



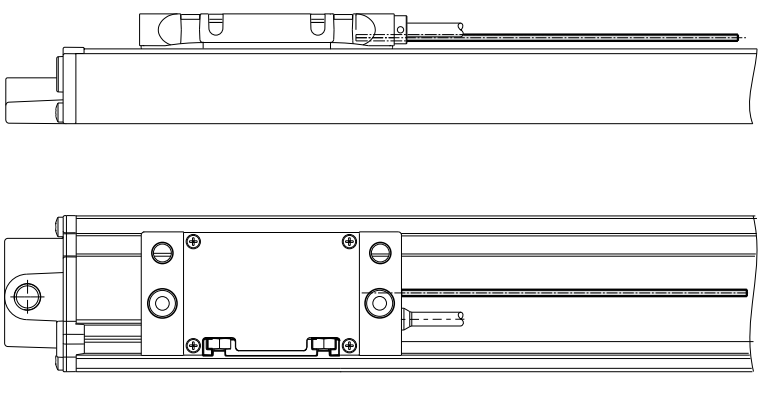
MSA 373



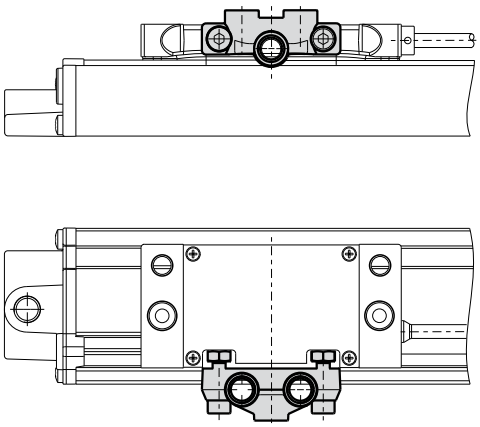
S1, S2 = switch signals
switch positions S1 and S2 free selectable (allen wrench 0.9 mm)
= sensor position
spring rod clamping on both sides possible (allen wrench 3 mm)
* clamping length spring rod
** fastening screw thread for coupling bar

C = cable - optional left side possible
ML = measuring length
M = machine guideway
OT = overtravel
Ⓚ = required mating dimensions

MSA 374



MSA 375



MSA 170

Model	Output signals	System resolution [µm]	Accuracy grades [µm/m]	Grating pitch [µm]	Integrated interpolation	Maximum velocity [m/s]	Max. output frequency [kHz]
MSA 170.03	~ 1 Vpp	dep. on external interpolation	±3, ±5	20	--	1.0	50
							Edge separation a_{min}
MSA 170.23	⎍	5.0	±3, ±5	20	times 1	1.0	3.3 µs
MSA 170.63	⎍	1.0	±3, ±5	20	times 5	1.0	500 ns
MSA 170.73	⎍	0.5	±3, ±5	20	times 10	1.0	300 ns
MSA 170.53	⎍	0.2	±3, ±5	20	times 25	0.64	300 ns
MSA 170.83	⎍	0.1	±3, ±5	20	times 50	0.32	300 ns

Standard measuring lengths (ML): [mm]
50, 70, 120, 170, 220, 270, 320, 370, 420, 470, 520

Scale unit: glass scale ($\alpha \approx 8{,}5 \times 10^{-6}$/K)

Location of reference mark:

- Distance-coded reference mark after travelling max. 20 mm the absolute position is available.
- One reference mark in the middle of measuring length, or 10 mm from either end measuring length (excluding ML 50 mm).
- Optional: one reference mark on any location, additional reference marks can be selected by distances of n x 25 mm.

Required moving force: < 1 N

Environmental sealing EN 60529: IP 53

Permissible vibration: 100 m/s² (40 to 2000 Hz)

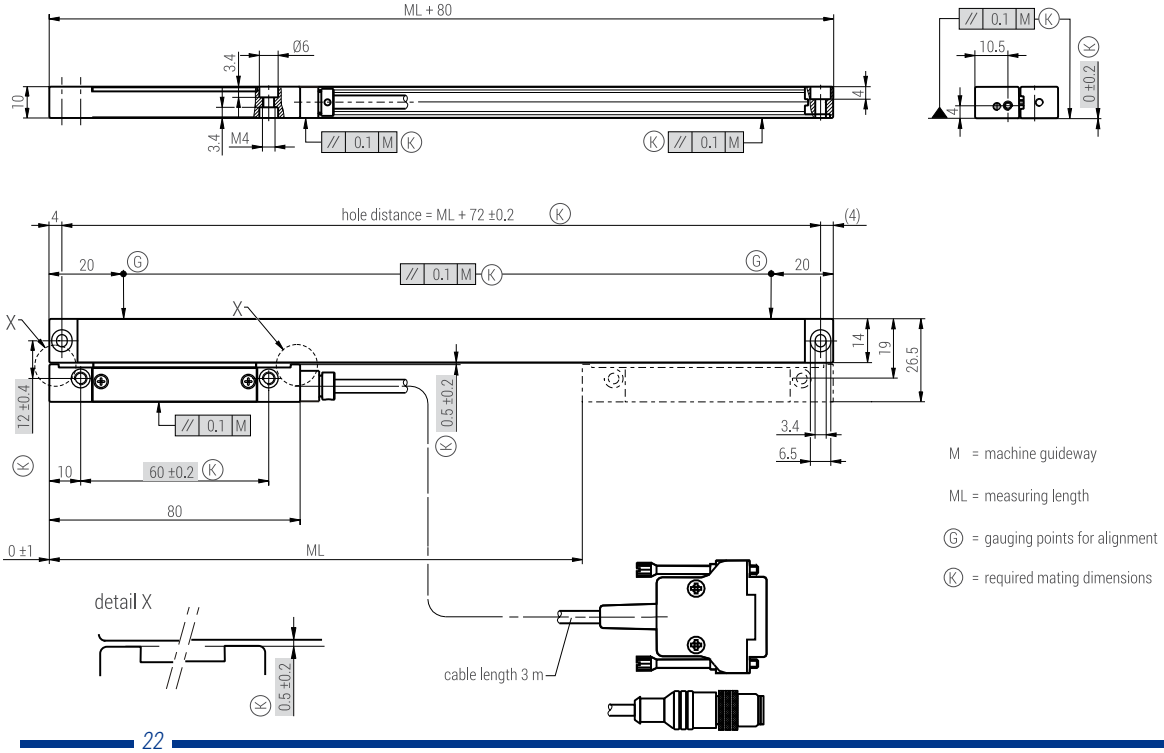
Permissible shock: 150 m/s² (8 ms)

Permissible temperature:
–20 °C to +70 °C (storage), 0 °C to +50 °C (operation)

Weight (approx.):
20 g + 0.17 g/mm (ML) + 35 g (reading head without cable)

Power supply: +5 V ±5 %
max. 75 mA (unloaded) ~ 1 Vpp, max. 120 mA (unloaded) ⎍

RoHS-conformity:
The MSA 170 linear encoders comply with the guideline of the RoHS-directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment.



M = machine guideway

ML = measuring length

G = gauging points for alignment

K = required mating dimensions

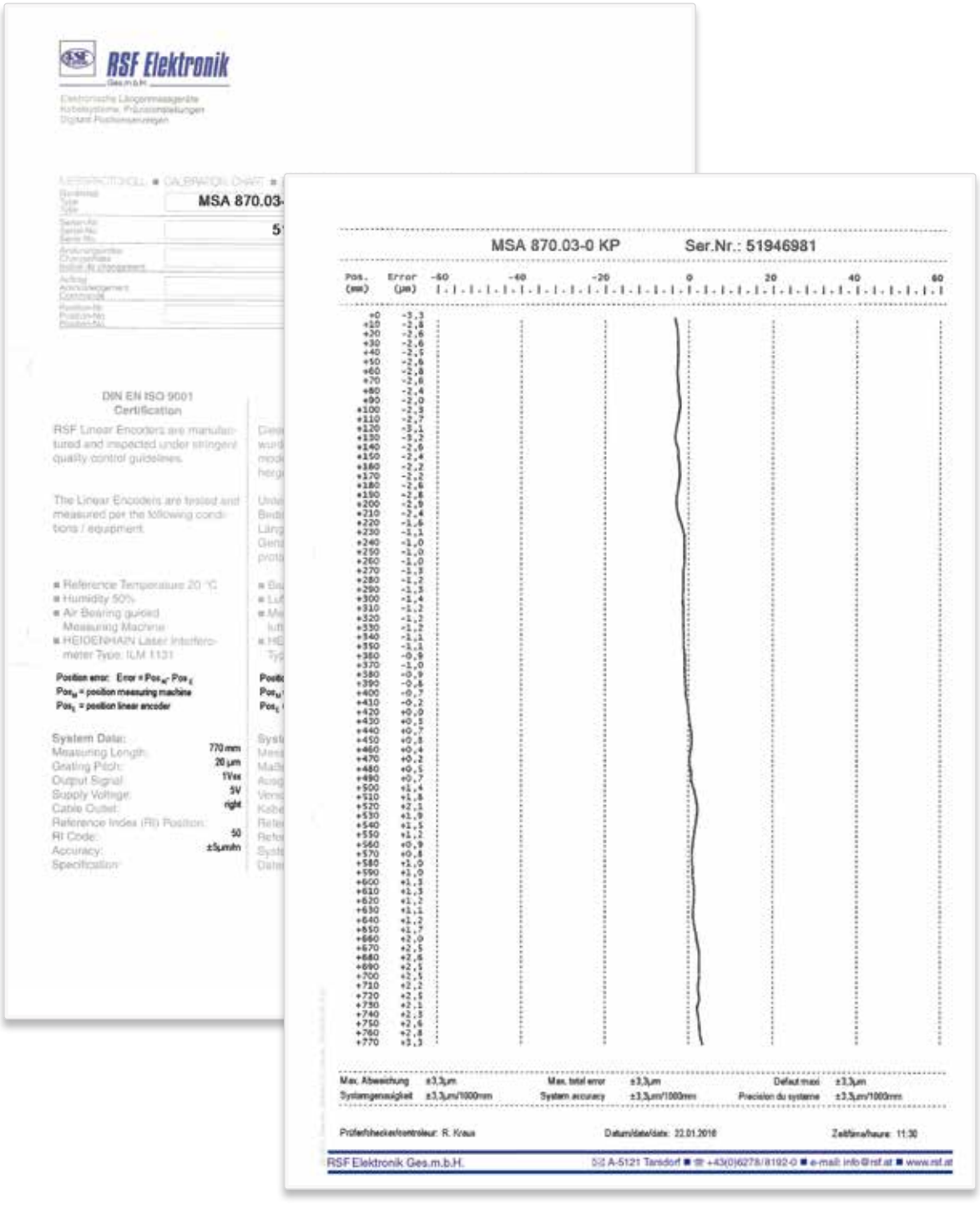
ACCURACY

The accuracy of the linear encoders is classified with a „± tolerance“ in µm/m (e.g. ±5 µm/m).

The accuracy refers to any meter within the measuring length.
For measuring lengths less than 1000 mm, the accuracy specification applies to the whole measuring length.

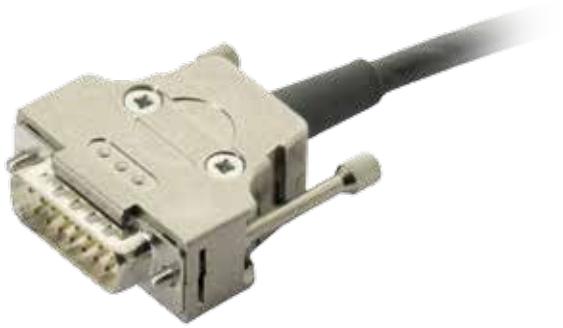
For best system accuracy, the encoder should be mounted near the measuring plane,
as parallel as possible to the machine guideway.

Example of a typical calibration chart for MSA 870:

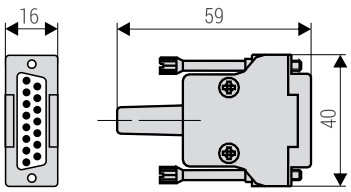


MALE CONNECTORS, PIN ASSIGNMENTS

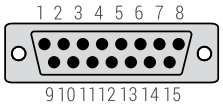
15-pin D-sub



Dimensions
(LD15, male, 15-pin, weight: 25 g)



Pin assignment
view on pins



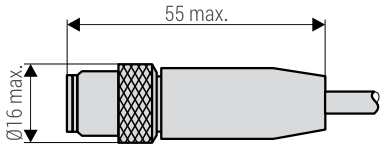
Pin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sinusoidal voltage signals 1 Vpp	occupied	0 V sensor	occupied	$\overline{RI}$	$\overline{A2}$	$\overline{A1}$	+5 V sensor	+5 V	0 V	S1*	S2*	RI	A2	A1	shield/ nc**
Square-wave signals via line driver	occupied	0 V sensor	$\overline{US}$	$\overline{RI}$	$\overline{T2}$	$\overline{T1}$	+5 V sensor	+5 V	0 V	S1*	S2*	RI	T2	T1	shield/ nc**

- Sensor: the sensor pins are bridged in the chassis with the particular power supply.
- * version without switch signals (version 0) = nc.
- ** on the following devices the shield is NOT connected on pin 15 : MSA 373, MSA 374, MSA 375.
- Shield is connected with the chassis.
- Not connected pins or wires (nc) must not be used.

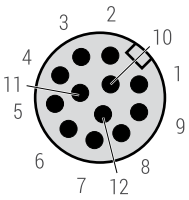
12-pin M12 connector

according to IEC 61076-2-101 LM012–Gxx-A

Dimensions
(M12, male, 12-pin, weight: approx. 15 g)



Pin assignment
view on pins



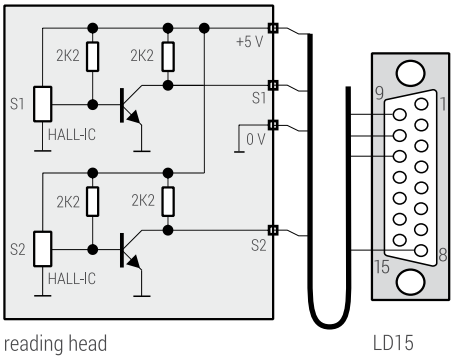
Pin	1	2	3	4	5	6	7	8	9	10	11	12
Sinusoidal voltage signals 1 Vpp	+5 V	$\overline{A1}$	A2	$\overline{A2}$	S2*	occupied	RI	$\overline{RI}$	occupied	A1	S1*	0 V
Square-wave signals via line driver	+5 V	$\overline{T1}$	T2	$\overline{T2}$	S2*	$\overline{US}$	RI	$\overline{RI}$	occupied	T1	S1*	0 V

- * version without switch signals (version 0) = nc.
- Shield is connected with the chassis.
- Not connected pins or wires (nc) must not be used.

SWITCH SIGNAL OUTPUT

VERSION 1

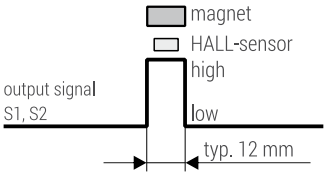
TTL output (active high)



reading head

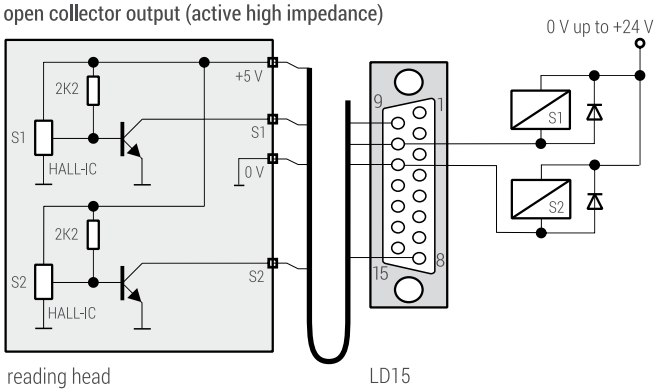
LD15
(Sub-D connector, male 15-pin)

S1, S2 = TTL output
I_{SOURCE} = 1 mA (high level > 2 V)
I_{SINK} = 20 mA (low level < 0.8 V)



VERSION 2

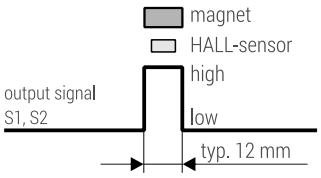
open collector output (active high impedance)



reading head

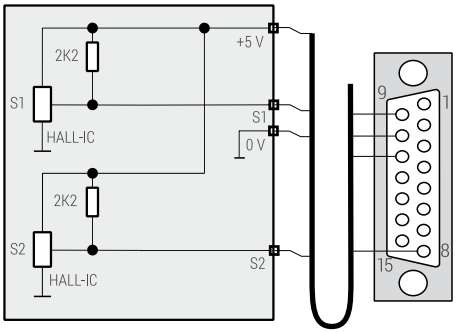
LD15
(Sub-D connector, male 15-pin)

S1, S2 = open collector output
I_{SINK} = 20 mA (low level < 0.8 V)



VERSION 3

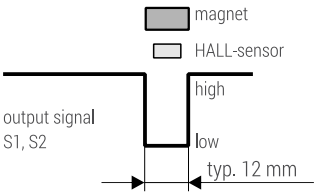
TTL output (active low)



reading head

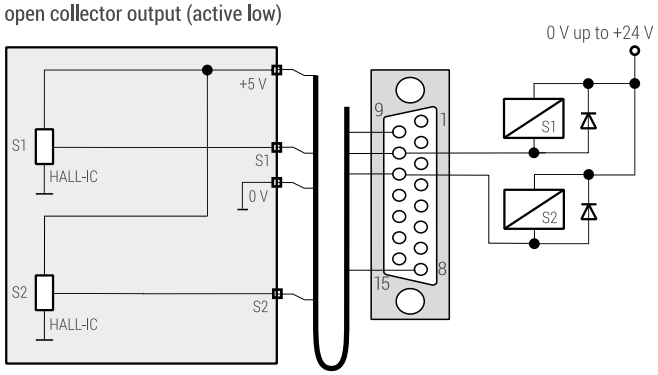
LD15
(Sub-D connector, male 15-pin)

S1, S2 = TTL output
I_{SOURCE} = 1 mA (high level > 2 V)
I_{SINK} = 20 mA (low level < 0.8 V)



VERSION 4

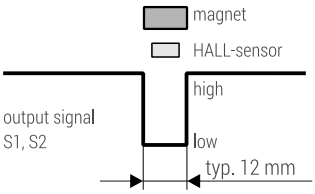
open collector output (active low)



reading head

LD15
(Sub-D connector, male 15-pin)

S1, S2 = open collector output
I_{SINK} = 20 mA (low level < 0.8 V)



According to factory default setting the actuator magnets are placed at the beginning (S1) and at the end (S2) of measuring length.
The magnets can be moved by the customer.

OUTPUT SIGNALS

SINUSOIDAL VOLTAGE SIGNALS 1 VPP

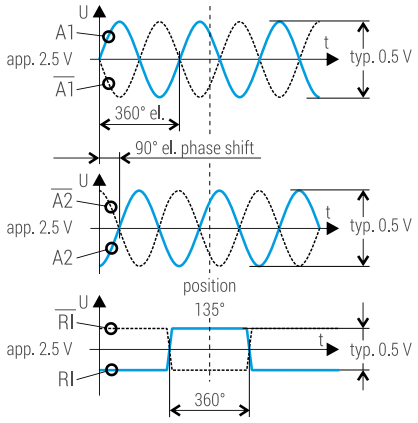
(drawing shows „positive counting direction“)
Two sinusoidal voltage signals A1 and A2 and one reference mark signals (all with inverted signals).

Power supply: +5 V ±5 %, max. 150 mA (unloaded)
Track signals (differential voltage A1 to $\overline{A1}$ resp. A2 to $\overline{A2}$):
Signal amplitude 0.6 Vpp to 1.2 Vpp; typ. 1 Vpp
(with terminating impedance Zo = 120 Ω between A1 to $\overline{A1}$ resp. A2 to $\overline{A2}$)

Reference mark (differential voltage RI to $\overline{RI}$):
Square-wave pulse with an amplitude of 0.8 to 1.2 V; typ. 1 V
(with terminating impedance Zo = 120 Ω between RI to $\overline{RI}$)

Advantage:
High traversing speed with long cable lengths possible.

Voltage signals (1 Vss)



SQUARE-WAVE SIGNALS

(drawing shows „positive counting direction“)
With a Schmitt-trigger (for times 1) or integrated interpolation electronics (for times 2, -5, -10, -20, -25, -50 or -100) the photoelement output signals are converted into two square-wave signals that have a phase shift of 90°. Output signals either can be „single ended“ or line driver „differential“ (RS 422). The resolution equates to the distance between two edges of the square-wave signals.

The controls/DRO's must be able to detect each edge of the square-wave signals. The minimun edge separation a_{min} is listed in the technical data and refers to a measurement at the output of the interpolator (inside the reading head). Propagation-time differences in the line driver, the cable and the line receiver reduce the edge separation.

Propagation-time differences:
Line driver: max. 10 ns
Cable: 0.2 ns/m
Line receiver: max. 10 ns (referred to the recommended line receiver circuit)

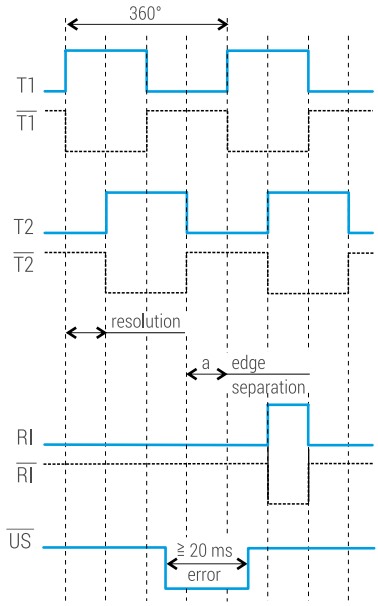
To prevent counting errors, the controls/DRO's must be able to process the resulting edge separation.

Exapmle:
a_{min} = 125 ns, 10 m cable
125 ns - 10 ns - 10 x 0.2 ns - 10 ns = 103 ns

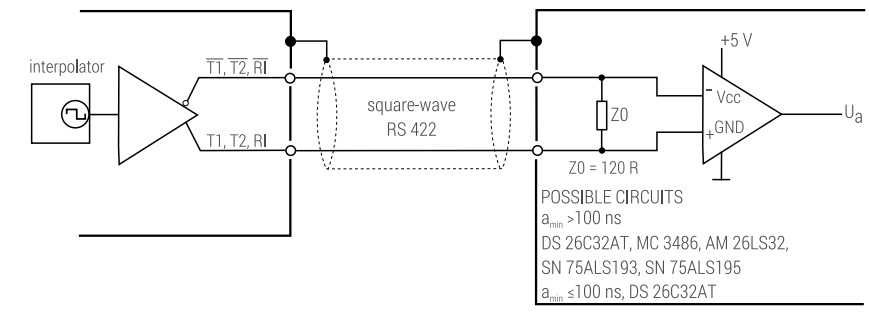
Power supply: +5 V ±5 %, max. 180 mA (unloaded)

Advantages:
- Noise immune signals
- No further subdividing electronics necessary

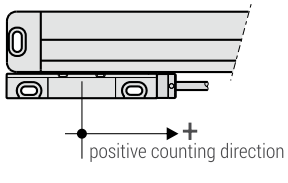
Square-wave signals „differential“



Recommended line receiver

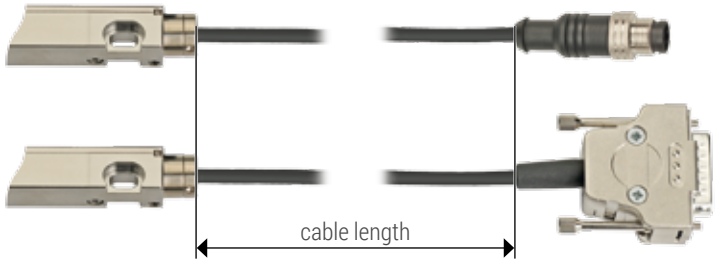


„Positive counting direction“



CONNECTING CABLE, SHIELDING

Definition of cable length



Cable outlet left side possible on request.

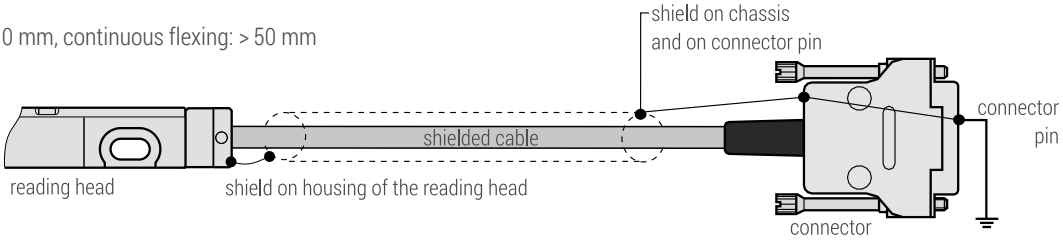
According to the specific signal outputs of the encoder, several connectors are possible.
Standard cable length is 3 m.
The cable jacket is a special thermoplastic, resistant to commercial coolants and lubricants.

The cables can be used in the following temperature ranges:

- fixed cable mounting: –20 °C to +70 °C
- continuous flexing: –5 °C to +70 °C.

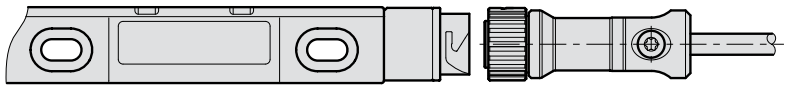
Shielding

Shielded cable, Ø: 4.3 mm
Bending radius fixed mounting: > 10 mm, continuous flexing: > 50 mm
Torsion: > 300.000 cycles
Drag chain: > 5.000.000 cycles

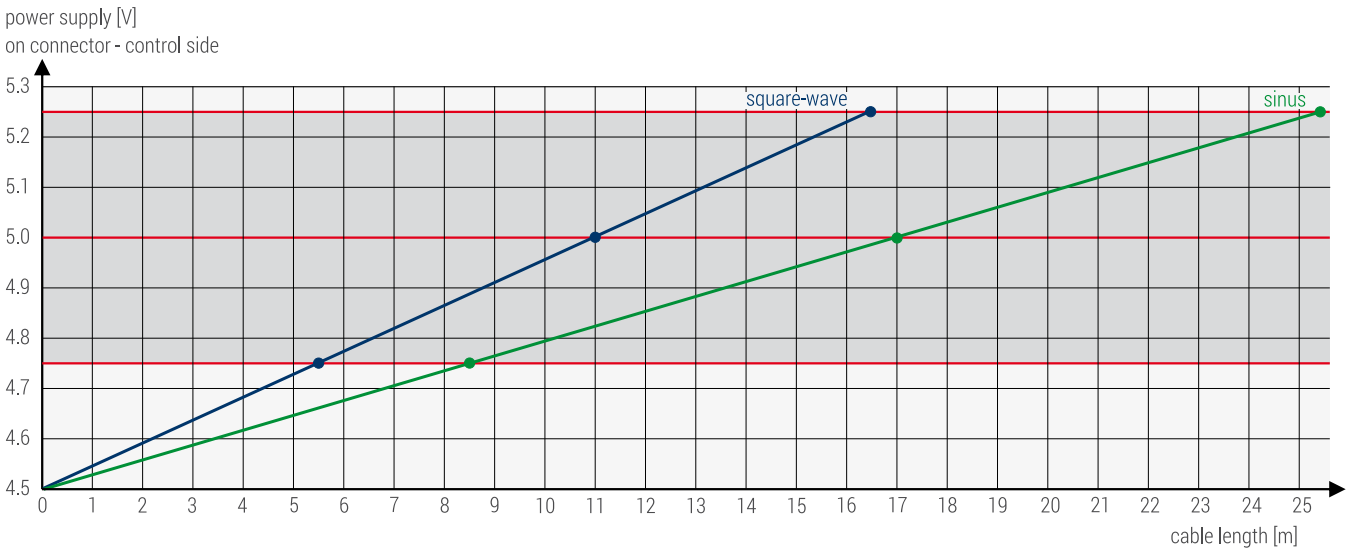


Detachable connecting cable MSA 8

Cable length is graduated up to 9 m (other lengths on request).



Max. permissible cable length according to power supply MSA 4, MSA 5, MSA 7 and MSA 8



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