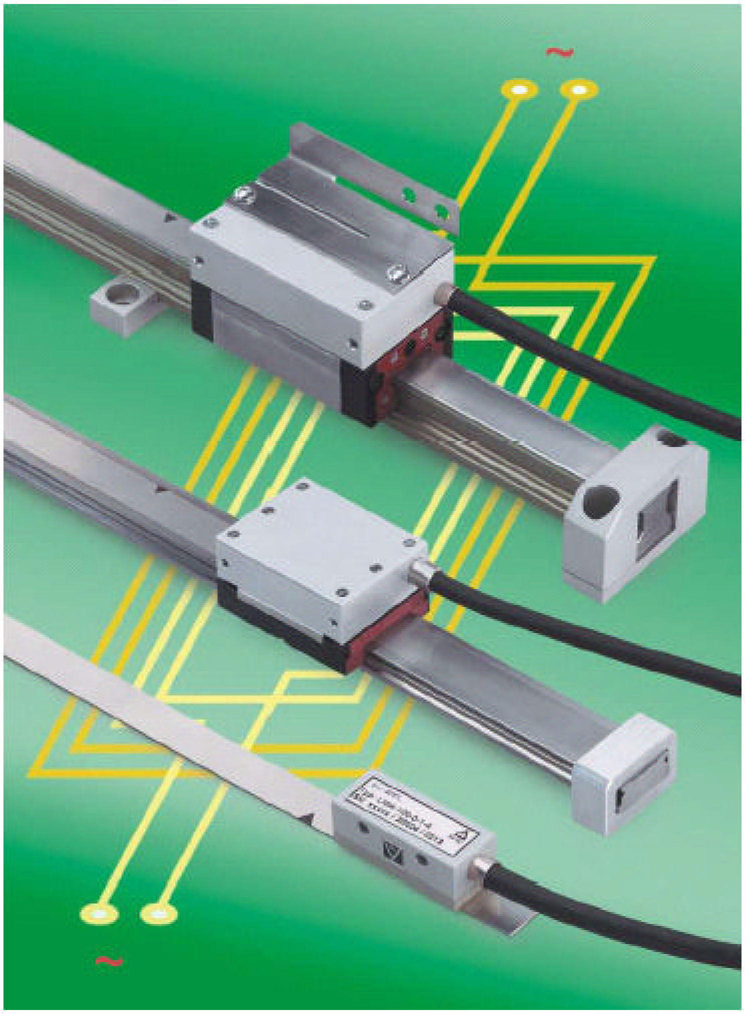
IntelliDrives
Linear Motion in its Simplest Form

TAPE LINEAR ENCODERS

Length Measuring System

AMOSIN Technology



AMOSIN Technology - General information

Based on the tried and tested AMO technology of length and angle acquisition where a high precision graduations with structures etched photolithographically in steel are scanned, a future-oriented generation of measuring systems has been created that incorporates newly developed inductive sensors and an integrated electronic evaluation circuitry (ASIC).

This generation of measuring systems opens up a vast range of applications from demanding machine tools or measuring machines through to handling systems or special installations for metal machining applications and the electronics industry. **AMOSIN** length measuring systems are available in an open variant LMI-100 or a guided-encapsulated variant LMI-200 and LMI-300.

As purely inductive operating devices, the **AMOSIN** systems achieve degrees of accuracy up to ±5μm/m. They are nevertheless extremely resilient to environmental influences such as solid particles, oil etc. and feature extremely high shock resistance and vibration strength. The coefficient of elongation of the measuring scalemeasuring scale is identical to that of steel (~11 ppm) so as to render expensive temperature compensation facilities unnecessary.
Thanks to the generous mounting tolerances, installation, especially of the guided-encapsulated systems LMI-200/300, is extremely simple and time-saving.

The high degree of accuracy is mainly attributed to the manufacturing process of the sturdy steel measuring scale and the outstanding sensor signal with sinusoidal accuracy deviations of <0.1% (harmonic content as measure of the attainable interpolation accuracy within one grating pitch).

As can be seen from the following description of the measuring principle, in contract to magnetic measuring systems, the **AMOSIN measuring principle has no magnetic parts** (neither the measuring scale nor the scanning head) and is therefore completely insensitive to all types of electromagnetic interference field.

The systems supply in real time either 1 Vpp sine/cosine signals with current signal periods of 1000μm or square-wave signals in accordance with RS-422.

Properties

- Insensitivity to all types of soiling
- Insensitivity to magnetic interference fields
- High accuracy and resolution
- High traverse speed
- Easy installation
- Integrated reference mark, also distance-coded

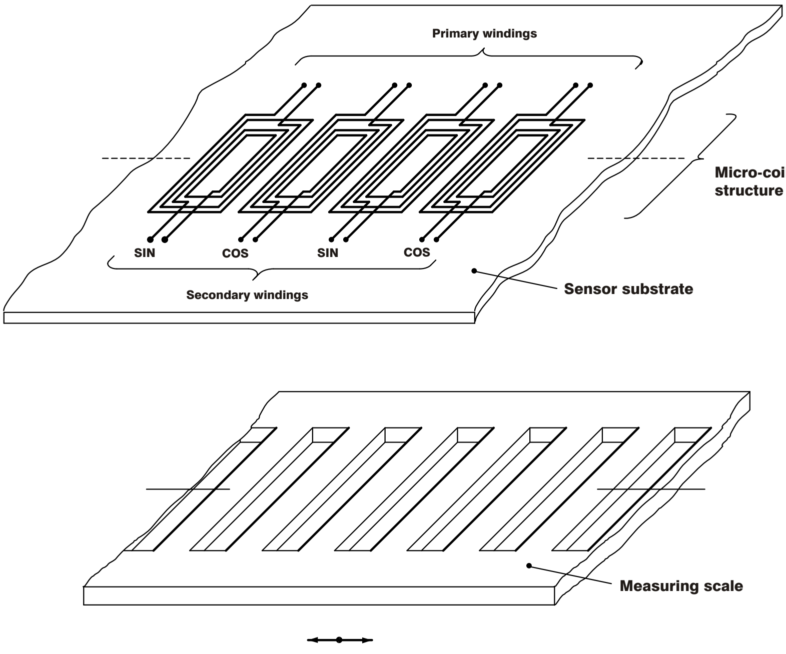
Applications

- Machine tools
- Sheet metal working machines
- Direct drives
- Automatic component mounting machines
- Measuring machines
- Printing machines etc.

AMOSIN - Measuring principle

AMOSIN measuring systems operate in accordance with the transformer principle with a moving reluctance core. The mutual inductance of the primary and secondary winding of a transformer changes as a function of the position of the core.

The AMOSIN system (Fig. 1) essentially consists of a planar coil structure and a measuring scale. The coil structure with several winding elements extended in measuring direction (individual main elements with primary and secondary SIN/COS coils) is realized on a substrate using micro-multilayer technology. The measuring scale is a stainless steel tape with a highly accurate photolithographically etched, period graduation (= 1mm) of variable reluctance.

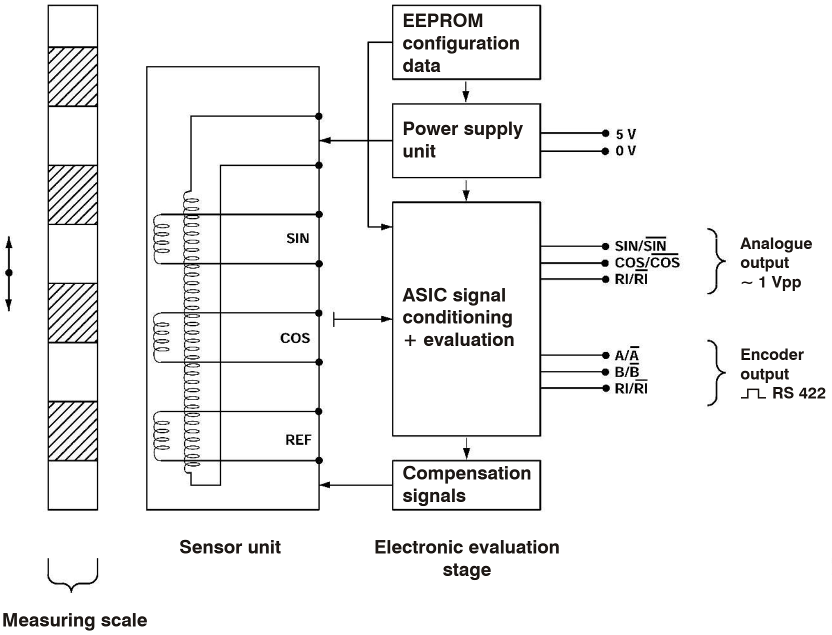


AMOSIN FUNCTIONAL PRINCIPLE
(Fig. 1)

The relative movement in measurement direction between the sensor structure (in the scanning head) and measuring scale periodically changes the mutual inductance of the individual coils and generates two sinusoidal, 90°-phase shifted signals (SIN and COS). The excellent signal quality and stability to environmental influences ensure that, after signal conditioning in the electronic evaluation stage (Fig. 2), deviations of only 0.1% of the ideal sine-wave form (harmonic content) remain. This feature enables high interpolation factors (subdividing stages) in signal digitisation either in the measuring system or in the subsequent electronic circuitry (CNC, etc.).

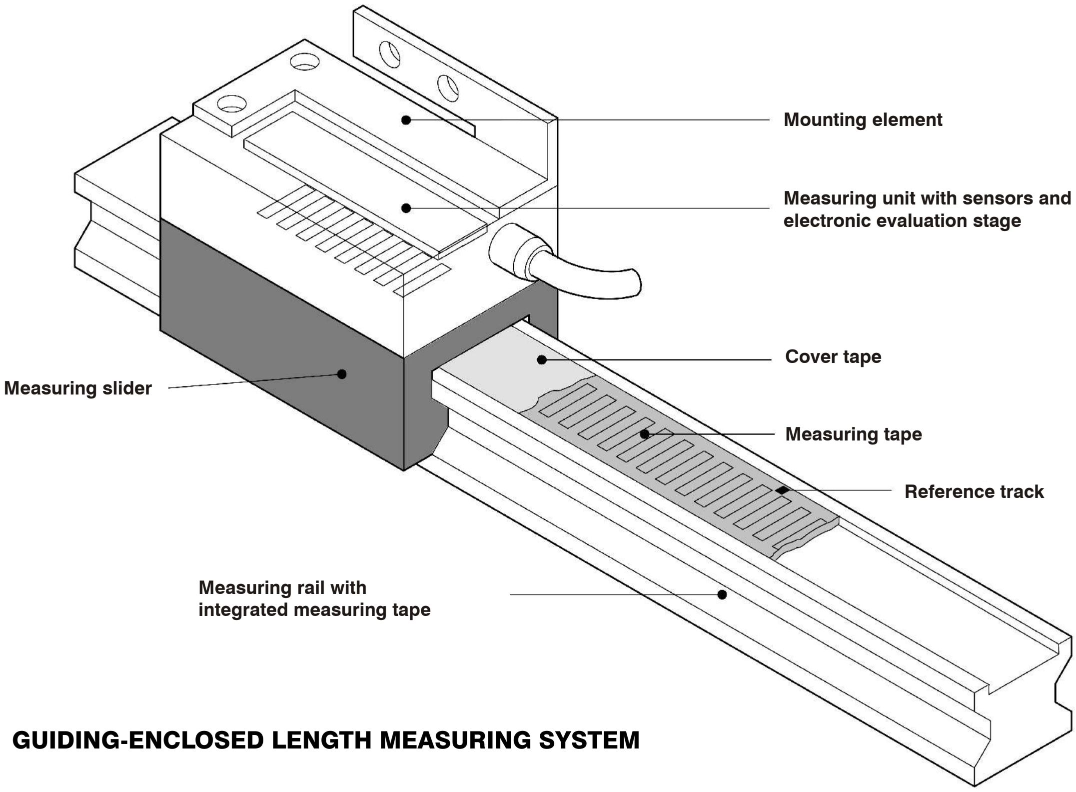
The electronic evaluation stage conditions the sensor signals, interpolates them continuously in accordance with a new type of circuitry principle without strobe times and makes available the measurement information, either as sine-wave signals or as square-wave signals at the output via differential interfaces and line drivers.

Apart from a few drivers and passive components, the entire evaluation application is realized by one single application-specific integrated circuit (ASIC).



AMOSIN MEASURING SYSTEM (Fig. 2)

Schematic measuring system structure



GUIDING-ENCLOSED LENGTH MEASURING SYSTEM

In the guided-encapsulated systems LMI-200/300, the stainless steel measuring scale is permanently welded to the Measuring rail. In the case of the open system LMI-100, a double-sided adhesive film is affixed at the factory directly to the machine bed. All systems are covered with a steel foil to provide effective protection against mechanical damage.

In all variants, scanning takes place based on a non-contact principle and therefore free of wear.

Measuring accuracy

The overall measuring accuracy of a measuring system can be influenced by following deviations:

1 Graduation deviations of the absolute reference length in the measuring scale (graduation accuracy)

2 Deviations within the grating pitch determined by the signal quality and internal electronic evaluation stage (interpolation error)

Since AMOSIN measuring systems are based on a modular design and the measuring scales as well as measuring slides of the same type are exchangeable, the system accuracy can be attributed to the two device components:

1 The accuracy of the measuring scale (measurement guide or measuring tape) is checked by means of a laser interferometer. A test report can be supplied with the system on request.

2 The accuracy of the measuring slide is checked for each unit to ensure it is within a deviation of up to ±1μm (corresponding to 0.1% of the grating pitch).

These accuracy tests are conducted with standard mounted system components under ideal metrological conditions.
The mounting position of the measuring system compared to the system working area (as close as possible) and the mounting tolerances (particularly in the case of the open systems) in connection with the accuracy requirements must be defined specifically for each application.

Measurement signal evaluation in the subsequent electronic circuitry could also represent an additional error source in the overall system accuracy when using systems with sine-wave signal output 1 Vpp. Ideally, the deviations in evaluation that has an influence on determining the position within a grating pitch should not exceed the range of $< \pm 0.1\%$.

General:

For highly accurate applications, the systematic deviations of the absolute position, caused by the sum of system components (including measuring system) can be measured and corrected in comparison with a standard measure (laser interferometer, gauge blocks, etc.) by means of a function integrated in the majority of controllers.

DESCRIPTION OF REFERENCE MARKS

A reference track is integrated on the measuring scale parallel to the measurement track for the purpose of determining the absolute position in measurement direction between the scanning head and scale ("machine slide" and "machine bed").

This reference track consists of one or several reference marks that are scanned by the system of sensors located in the scanning head. The reference marks can be arranged in the following configurations:

1) Individual reference marks:

They can be located in any position on a measuring tape (at distance n x 1mm, minimum distance 2mm) the reference mark is located as a standard in the centre of the measuring section

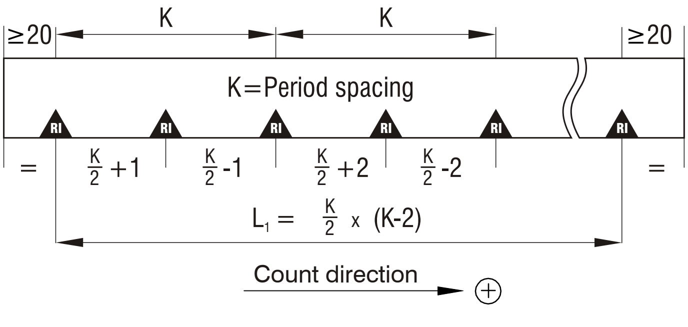
2) Distance-coded reference marks:

Due to the coded arrangement on the scale, if equipped with this function, the controller can determine the absolute position after passing over two adjacent marks.

The LMI system is available for all versions (square-wave or sine-wave output signals) with coded reference marks with following spacing:

	Period spacing K (mm)	Max. Length (mm) L_1
K 1	40	760
K 2	80	3120
K 3	120	7080

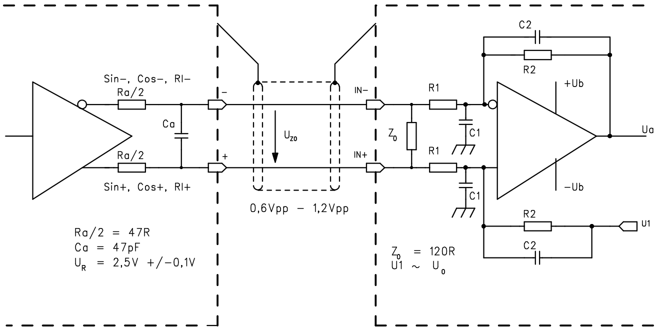
Example of the reference mark arrangement:

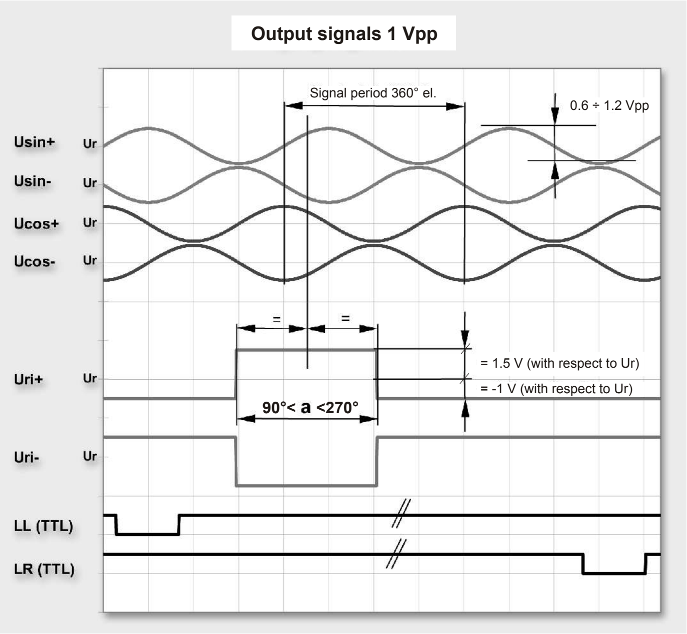


DESCRIPTION OF OUTPUT SIGNALS 1Vpp

Recommended circuitry of
subsequent electronic stages:

Signal diagram



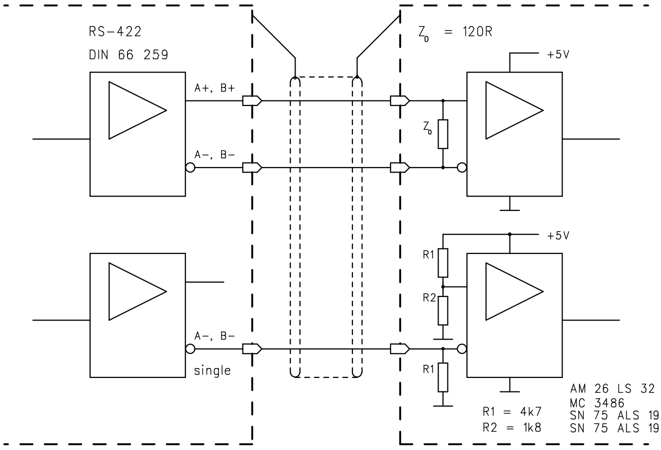


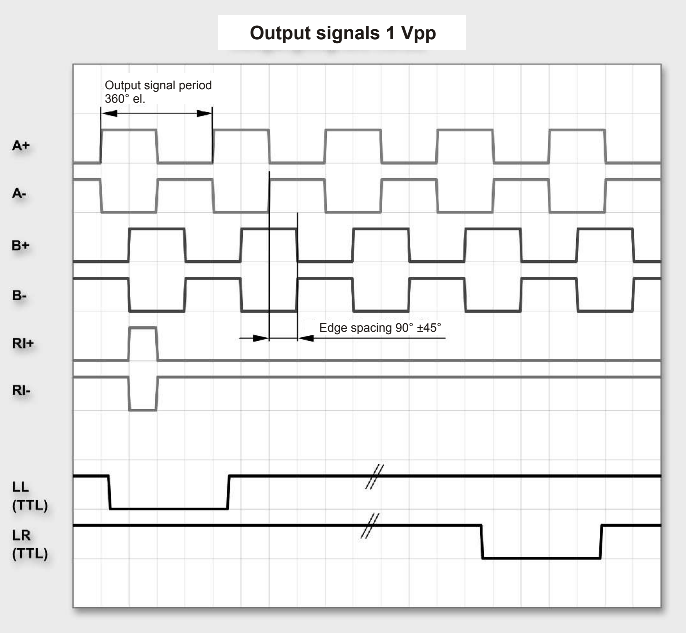
DESCRIPTION OF OUTPUT SIGNALS TTL - RS422

General interface description RS 422 complying with DIN 66 259 Part 3

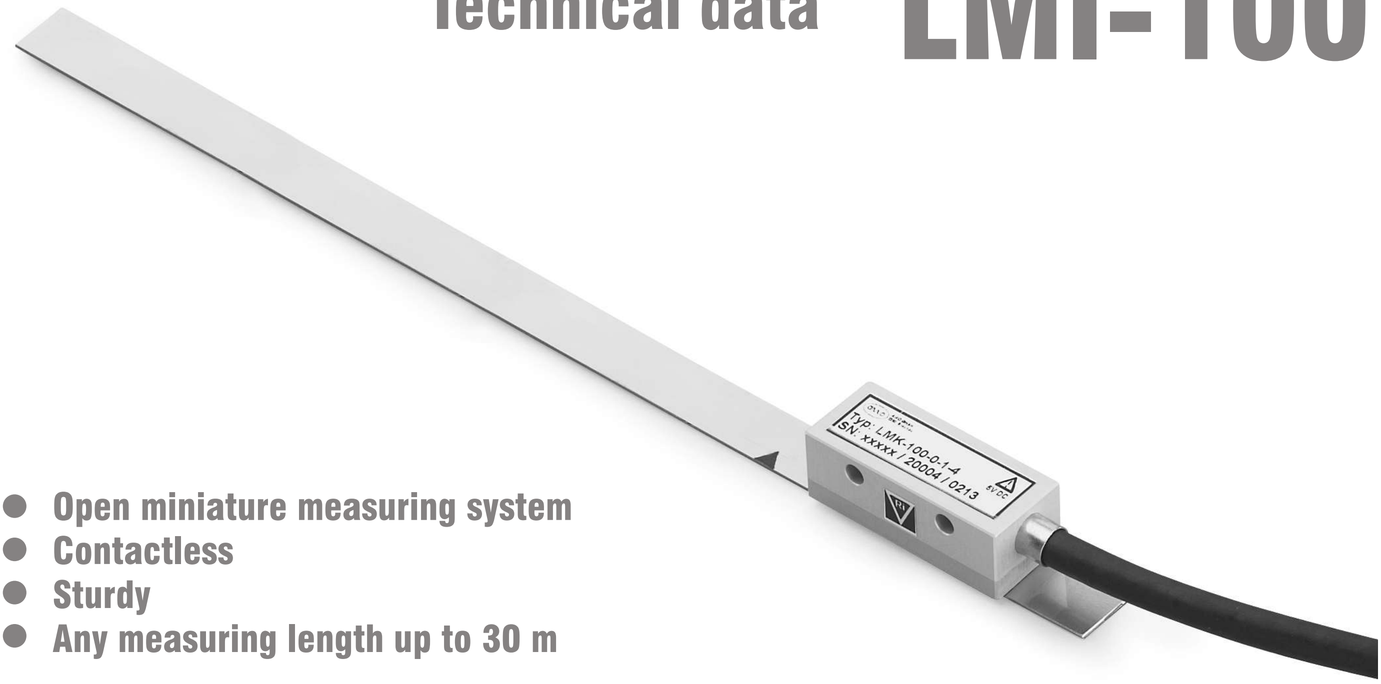
Recommended circuitry of
subsequent electronic stages:

Signal diagram





Technical data LMI-100



- **Open miniature measuring system**
- **Contactless**
- **Sturdy**
- **Any measuring length up to 30 m**

Measuring tape LMB-100

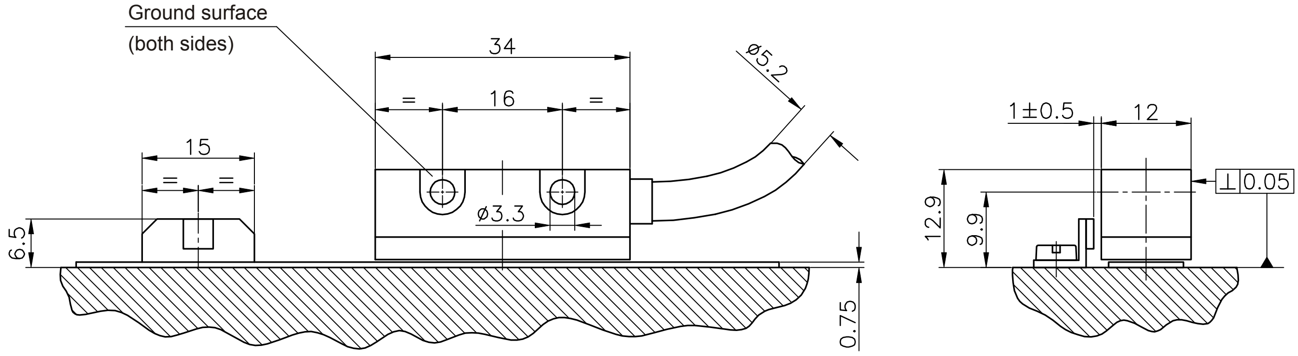
Grating pitch:	1mm
Linearity deviation:	LMB-100.0 = ±20 µm
	LMB-100.1 = ±10 µm
	LMB-100.2 = ± 5 µm
Coefficient of expansion:	~11 ppm
Measuring length:	maximum 30 m
Mechanical version:	Stainless steel measuring tape with adhesive coating for mounting
Reference position:	Centre as standard, any position and number or distance-coded

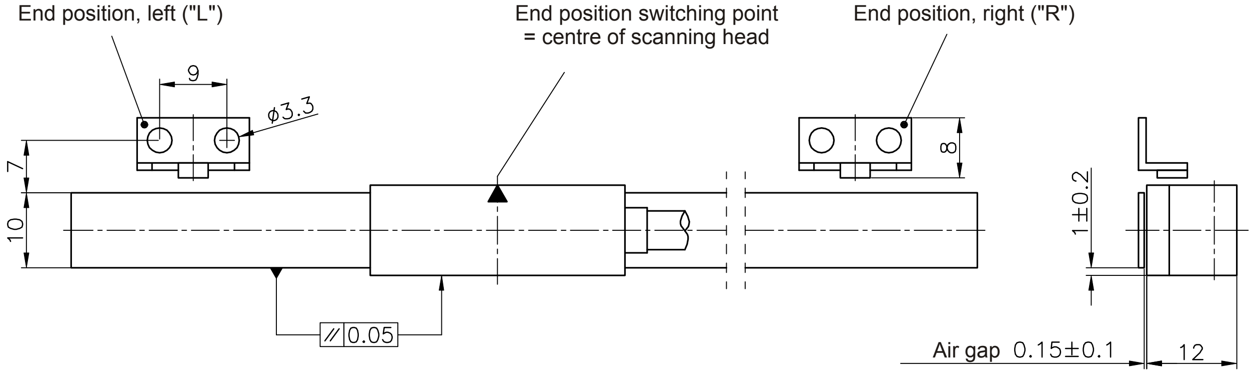
Scanning head LMK-100

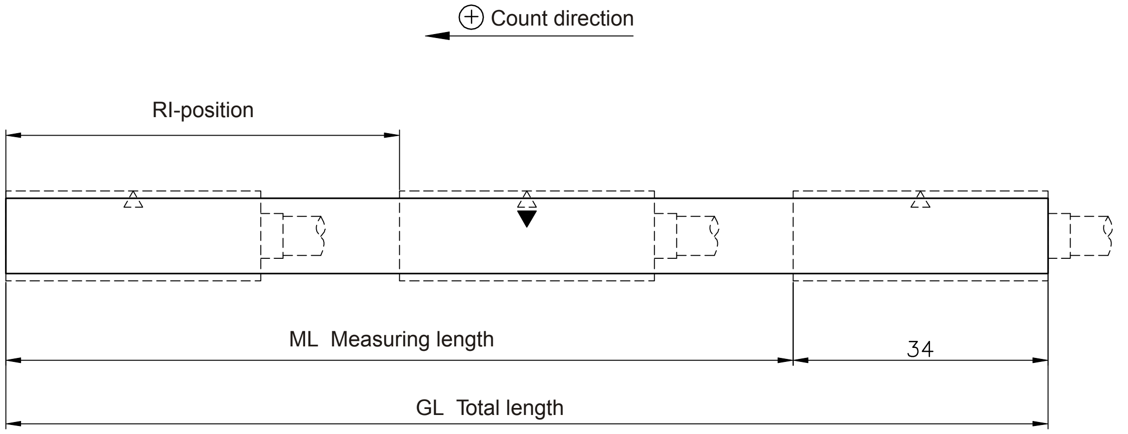
in connection with external electronic signal conditioning module SKE only *(see Page 12)*

Operating temperature:	0 °C to 50 °C (higher temperature on request)
Storage temperature:	-20 °C to 85 °C
Shock resistance (11 ms):	< 2000 m/s^2
Vibration resistance (55-2000 Hz):	< 200 m/s^2
Protection class:	IP 67 for electronics
Supply:	5 V ± 5% at device, 250 mA
Cable:	PUR sheath, highly flexible, ∅ ~ 5mm, 5 (2 x 0.05) + 1 (2 x 0.14)mm^2
	1m / 3m to SKE (maximum cable length)
- Bending radius	10 x d = 50mm permanent bending
	5 x d = 25mm one-off bending
Option:	Limit switch function

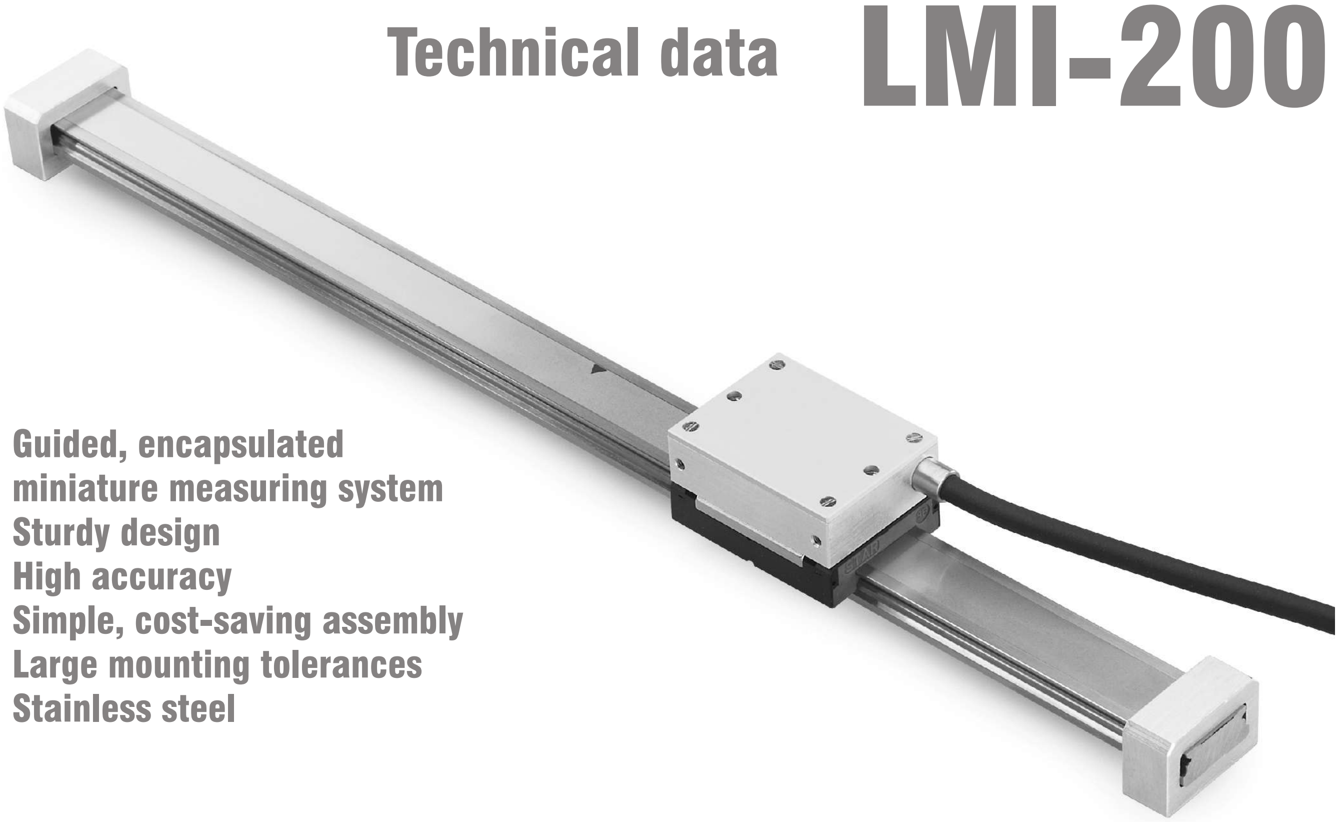
Dimensions


Ground surface
(both sides)
34
=
16
=
ø5.2
15
=
=
ø3.3
6.5
0.75
1±0.5
12
12.9
9.9
⊥ 0.05


End position, left ("L")
End position switching point
= centre of scanning head
End position, right ("R")
9
ø3.3
7
10
8
// 0.05
1±0.2
Air gap 0.15±0.1
12


+ Count direction
RI-position
ML Measuring length
34
GL Total length

Technical data LMI-200



- **Guided, encapsulated miniature measuring system**
- **Sturdy design**
- **High accuracy**
- **Simple, cost-saving assembly**
- **Large mounting tolerances**
- **Stainless steel**

Measuring rail LMF-200

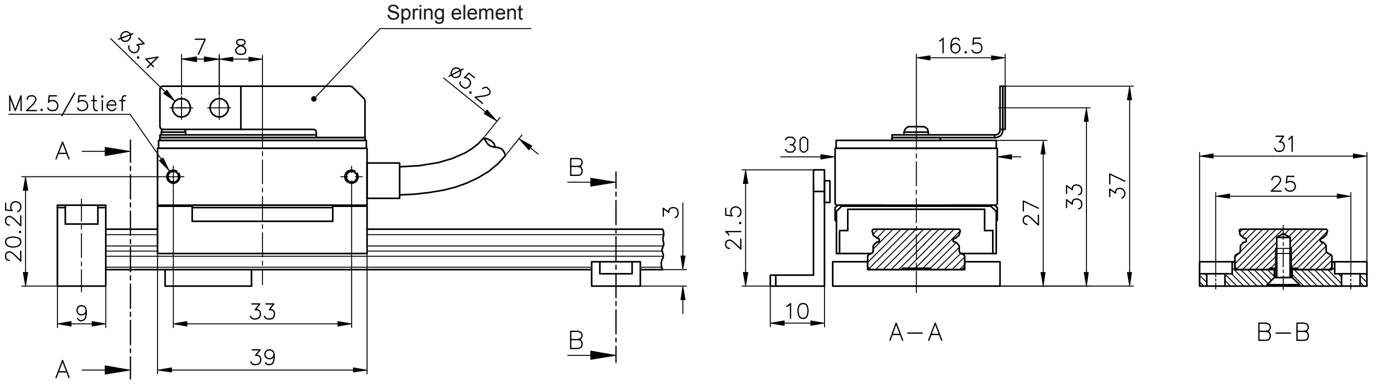
Grating pitch:	1mm
Graduation accuracy:	LMF-100.0 = ±20 μm LMF-100.1 = ±10 μm LMF-100.2 = ± 5 μm
Coefficient of expansion:	~11 ppm
Measuring length in mm - one-piece:	170 / 220 / 270 / 320 / 420 / 520 / 620 / 720 / 820 / 920 / 1020 Greater lengths on request
Reference position:	Centre as standard, any position and number or distance-coded

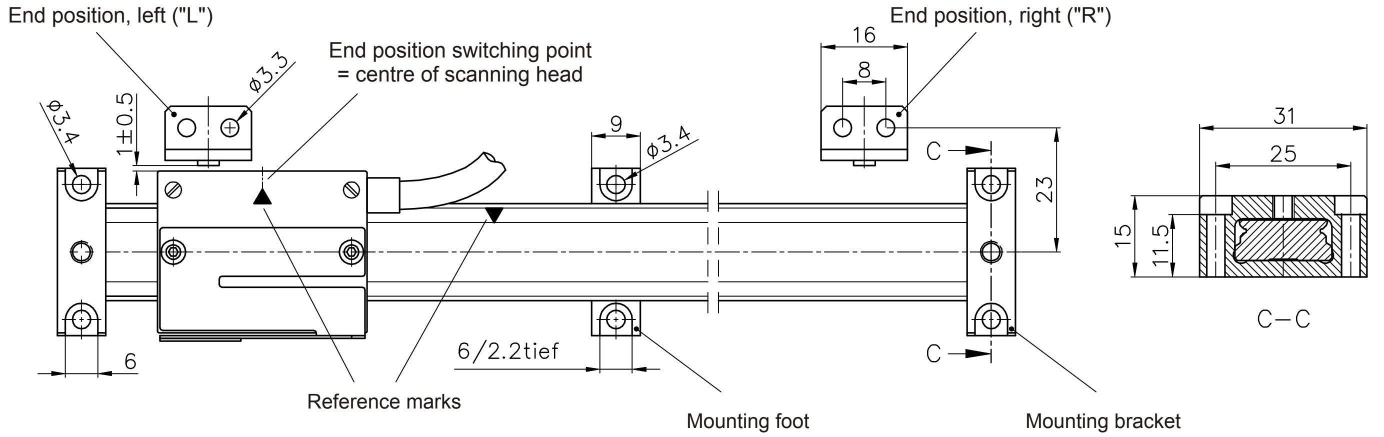
Measuring slider LMK-200

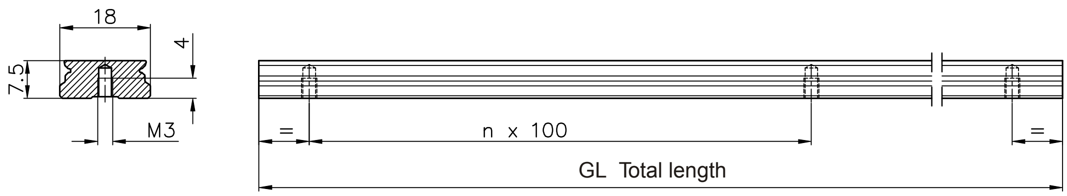
in connection with external electronic signal conditioning module SKE only *(see Page 12)*

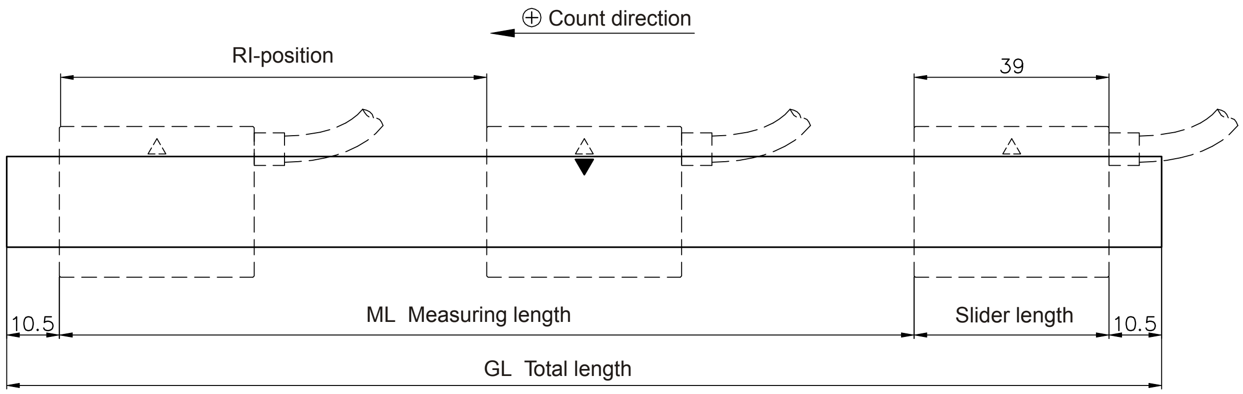
Traverse speed:	3 m/s (mechanisch)
Operating temperature:	0° to 50° C (higher temperature on request)
Storage temperature:	-20° to 85° C
Shock resistance (11 ms):	< 2000 m/s^2
Vibration resistance (55-2000 Hz):	< 200 m/s^2
Protection class:	IP 67 for electronics
Supply:	5 V ± 5% at device, 350 mA max.
Cable:	PUR sheath, highly flexible, ∅ ~ 5mm, 5 (2 x 0.05) + 1 (2 x 0.14)mm^2 1 m / 3 m to SKE
- Bending radius	10 x d = 50mm permanent bending 5 x d = 25mm one-off bending
Option:	Limit switch function

Dimensions

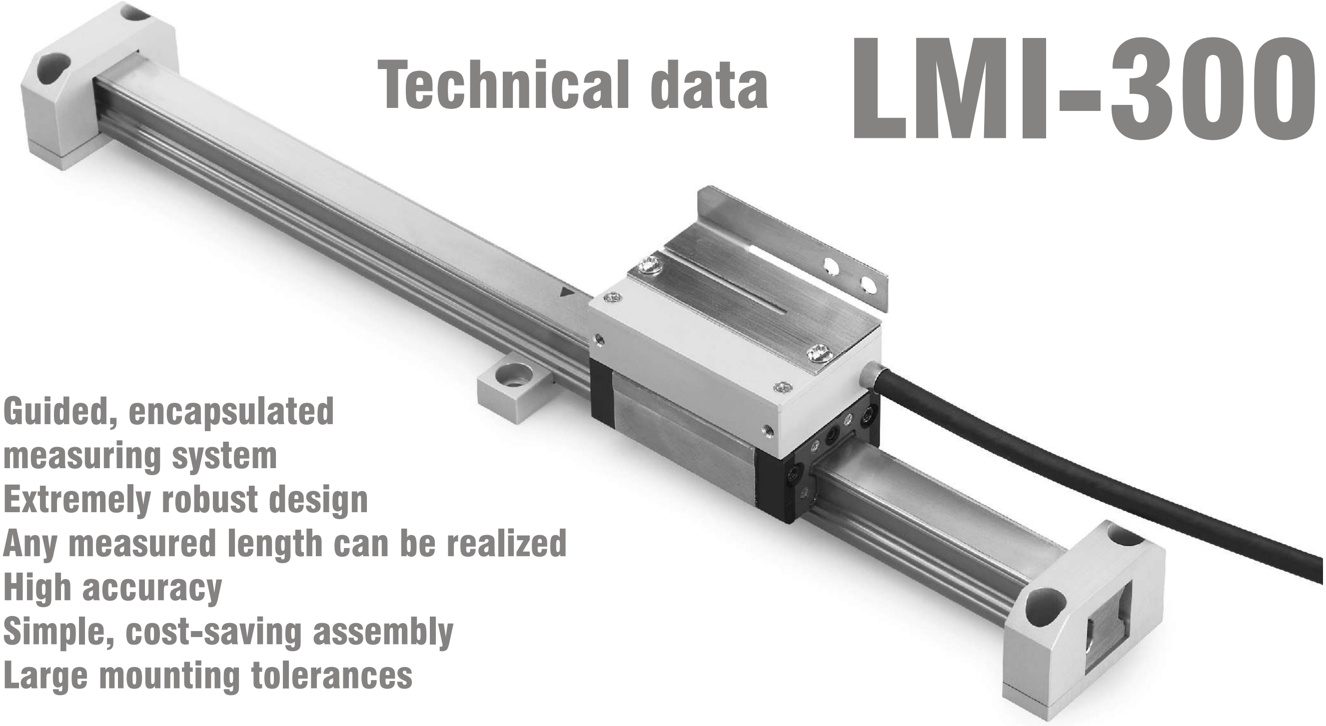

Spring element
ø3.4
7
8
ø5.2
M2.5/5tief
A
A
B
B
20.25
3
9
33
39
16.5
30
21.5
27
33
37
10
A–A
31
25
B–B


End position, left ("L")
End position switching point
= centre of scanning head
End position, right ("R")
ø3.3
ø3.4
1±0.5
16
8
9
ø3.4
C
C
23
6
6/2.2tief
Reference marks
Mounting foot
Mounting bracket
31
25
15
11.5
C–C


18
4
7.5
M3
=
n x 100
=
GL Total length


⊕ Count direction
RI-position
39
10.5
ML Measuring length
Slider length
10.5
GL Total length

Technical data LMI-300



- **Guided, encapsulated measuring system**
- **Extremely robust design**
- **Any measured length can be realized**
- **High accuracy**
- **Simple, cost-saving assembly**
- **Large mounting tolerances**

Measuring rail LMF-300

Grating pitch:	1mm
Graduation accuracy:	LMF-300. 0 = ±20 µm LMF-300. 1 = ±10 µm LMF-300. 2 = ± 5 µm
Coefficient of expansion:	~11 ppm
Measuring length in mm - one-piece:	170 / 220 / 270 / 320 / 420 / 520 / 620 / 720 / 820 / 920 / 1020 / 1140 / 1240 / 1340 / 1440 / 1540 / 1640 / 1740 / 1840 / 2040 / 2240 / 2440 / 2640 / 2840 / 3040 / 3240 / 3440 / 3640 / 3840 Any measured length in multi-part version
Reference position:	Centre as standard, any position and number or distance-coded
Option	Corrosion protection (ZnFe coating)

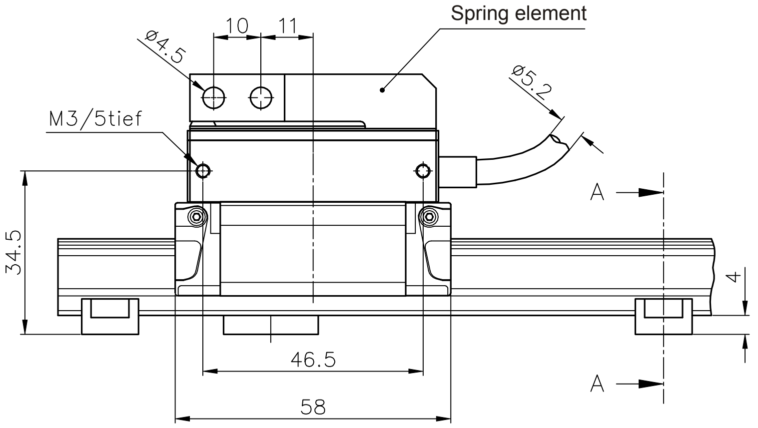
Measuring slider LMK-301

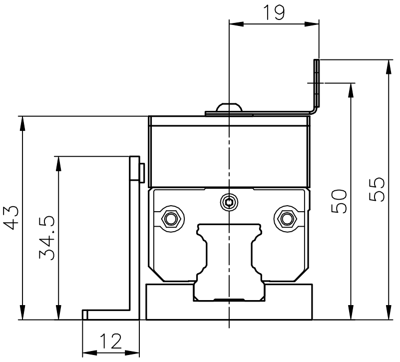
Output signal:	1 Vpp/1000µm referred to terminating resistor 120 Ω (see circuit and signal diagram)
Traverse speed:	5 m/s
Operating temperature:	0° to 50° C (higher temperature on request)
Storage temperature:	-20° to 85° C
Shock resistance (11 ms):	< 2000 m/s^2
Vibration resistance (55-2000 Hz):	< 200 m/s^2
Protection class:	IP 67 for electronics
Supply:	5 V ± 5% at device, 250 mA
Cable:	PUR sheath, highly flexible, ∅ ~ 5mm, 5 (2 x 0.05) + 1 (2 x 0.14)mm^2 1 m / 3 m, max. 100 m (with AMO extension cable)
- Bending radius	10 x d = 50mm permanent bending 5 x d = 25mm one-off bending
Option:	● Limit switch function ● Corrosion protection (ZnFe coating)

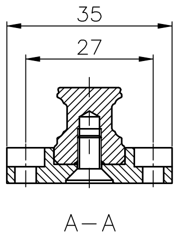
Measuring slider LMK-302, same as LMK-301 but with

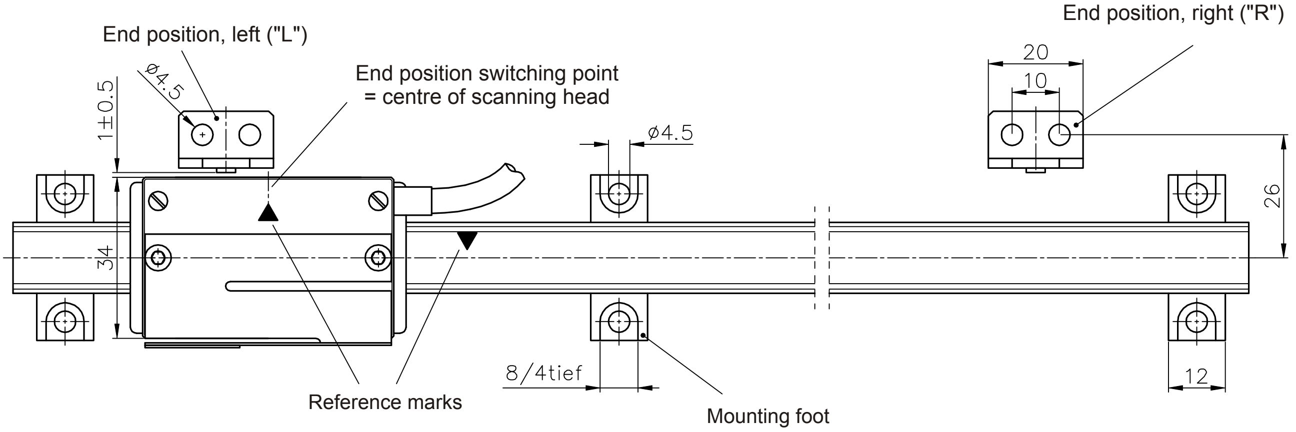
Output signal:	TTL in accordance with RS 422 A (see circuit and signal diagram)
Traverse speed:	LMK-302. 0 (resolution 10 µm): 5 m/s LMK-302. 1 (resolution 5 µm): 5 m/s LMK-302. 2 (resolution 1000/1024 µm): 1 m/s LMK-302. 3 (resolution 1000/4096 µm): 0.25 m/s
Supply:	5 V ± 5% at device, max. 350 mA
Cable:	max. 50 m (with AMO extension cable)

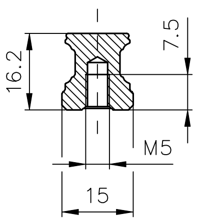
Dimensions

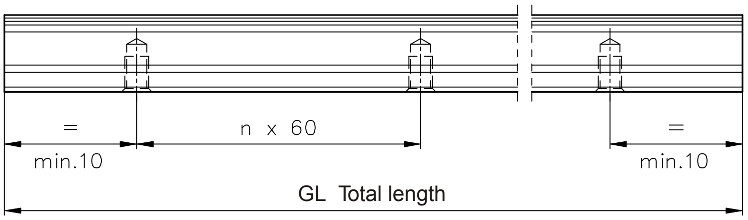

Spring element
10
11
ø4.5
ø5.2
M3/5tief
34.5
4
A
A
46.5
58

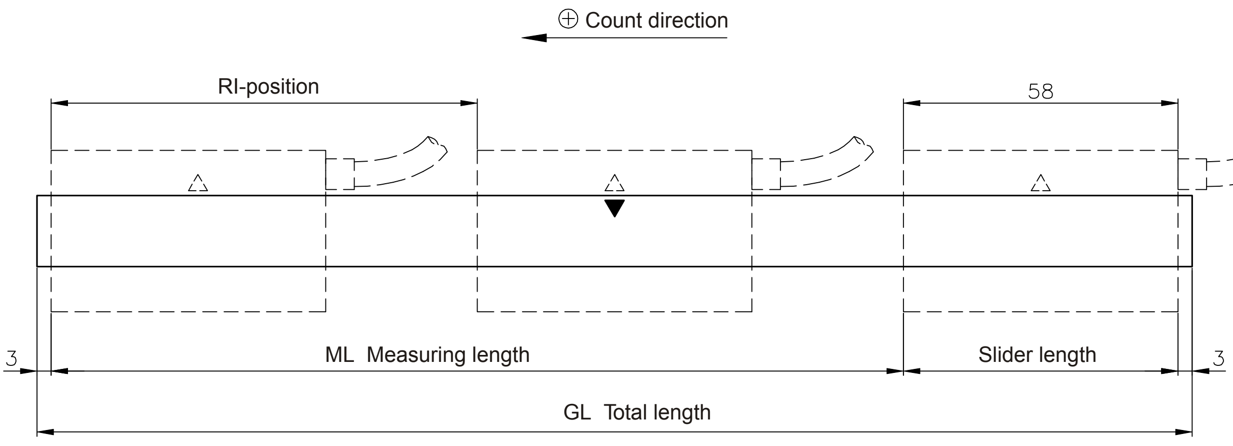

19
43
34.5
50
55
12


35
27
A–A


End position, left ("L")
ø4.5
1±0.5
End position switching point
= centre of scanning head
ø4.5
End position, right ("R")
20
10
26
34
8/4tief
12
Reference marks
Mounting foot

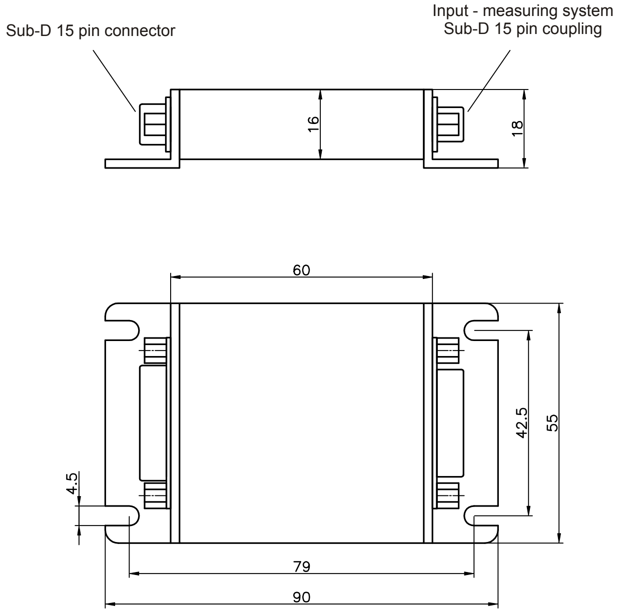

16.2
7.5
M5
15

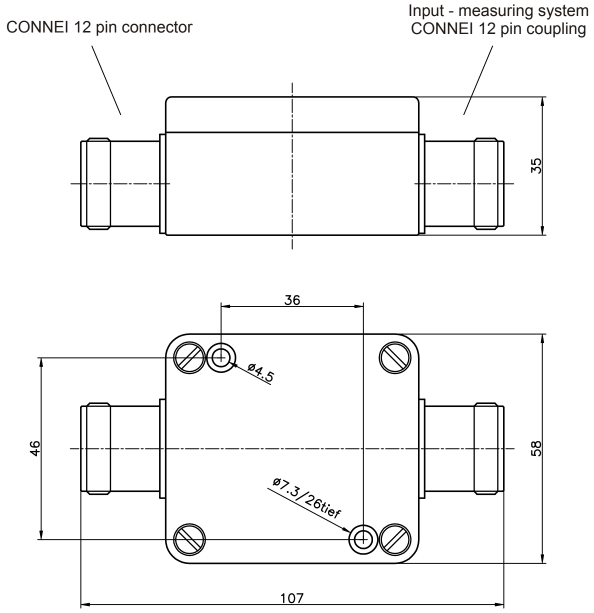

=
n x 60
=
min.10
min.10
GL Total length


⊕ Count direction
RI-position
58
3
ML Measuring length
Slider length
3
GL Total length

SKE - 1□

SKE - 2□





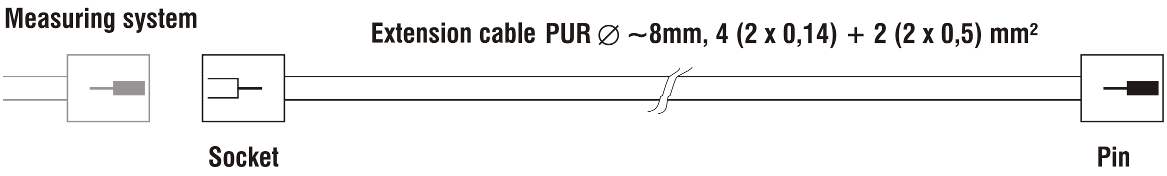
Signal conditioning SKE-□1 (For measuring system LMI-100 and LMI-200)

Output signal:	1 Vpp/1000μm referred to terminating resistor 120 Ω (see circuit and signal diagram)	
Traverse speed:	10 m/s (max. input frequency 10 kHz)	
Operating temperature:	0 °C to 50 °C	
Storage temperature:	-20 °C to 85 °C	
Protection class:	SKE-11-0	IP 54
	SKE-21-0	IP 66
Supply:	5 V ±5% at device, 250 mA incl. measuring slider	
Connection:	SKE-11-0	15-pin Sub-D
	SKE-21-0	12-pin Connei

Signal conditioning SKE-□2 same as SKE-□1, except

Output signal:	TTL in accordance with RS 422 A (see circuit and signal diagram)	
Traverse speed:	SKE-□2-0 (resolution 10μm)	10 m/s
	SKE-□2-1 (resolution 05μm)	10 m/s
	SKE-□2-2 (resolution 1000/1024μm)	2 m/s
	SKE-□2-3 (resolution 1000/4096μm)	0.5 m/s
Supply	5 V ±5% at device, max. 350 mA incl. measuring slider	

EXTENSION CABLE



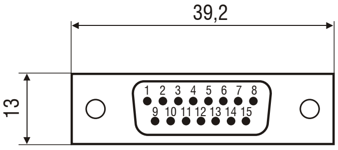
Order designation: VK - 4 - □□ - □□ - □□

- 10 ... with no Coupling
- 11 ... 12 pin DIN
- 13 ... 9 pin Sub-D (standard)
- 14 ... 12 pin Connei connector CW
- 15 ... 15 pin Sub-D
- 16 ... 12 pin Connei coupling CCW
- 19 ... Special connector or special pin assignments

Cable length
in metre

- 00 ... with no Connector
- 01 ... 12 pin DIN
- 03 ... 9 pin Sub-D
- 04 ... 12 pin Connei connectot CW
- 05 ... 15 pin Sub-D
- 06 ... 12 pin Connei coupling CCW
- 09 ... Special connector or special pin assignments

PLUG AND CONNECTION ASSIGNEMENTS



SUB-D connector 15-pin

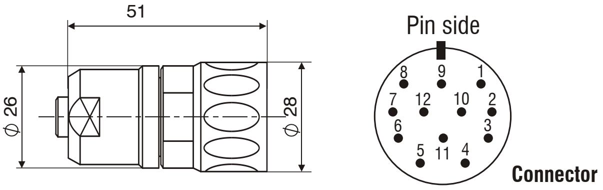
Sine-wave 1 Vpp or Square-wave output signals TTL

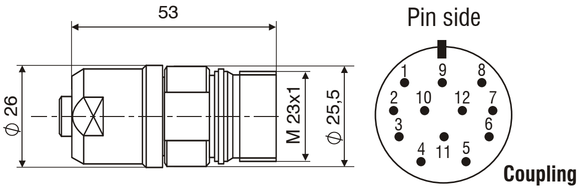
PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Signals	A+	0V	B+	+5V	—	LR	RI-	LL	A-	0V-Sensor	B-	5V-Sensor	—	RI+	—
Color	green	blue	brown	red	—	black	grey	violet	yellow	blue-white	white	red-white	—	pink	—

Shield on housing

CONNEI- connector adv. coupling 12-pin - plastic-sheathed metal body

Sine-wave 1 Vpp or Square-wave output signals TTL





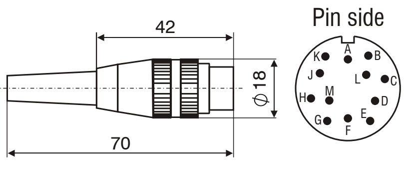
PIN	1	2	3	4	5	6	7	8	9	10	11	12
Signals	B-	5V-Sensor	RI+	RI-	A+	A-	LL	B+	LR	0V	0V-Sensor	+5V
Color	white	red-white	pink	grey	green	yellow	violet	brown	black	blue	blue-white	red

Shield on housing

The sensor lines 0V sensor and 5V sensor are connected internally to the corresponding supply lines. They serve the purpose of checking and readjusting the voltage at the device and can also be used parallel to the 0V and 5V supply lines for the purpose of reducing the voltage drop in the line.

DIN connector 12-pin L120

Square-wave output signals TTL
Sine-wave output signals 1 Vpp

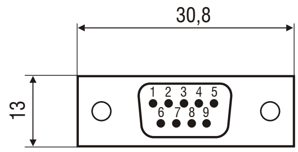


PIN	A	B	C	D	E	F	G	H	J	K	L	M
Signals	—	0V	A+	A-	B+	—	RI+	RI-	—	+5V	B-	—
Color	—	blue	green	yellow	brown	—	pink	grey	—	red	white	—

Shield on housing

SUB-D connector 9-pin

Sine-wave 1 Vpp or Square-wave output signals TTL



PIN	1	2	3	4	5	6	7	8	9
Signals	A-	0V	B-	—	RI-	A+	+5V	B+	RI+
Color	yellow	blue	white	—	grey	green	red	brown	pink

Shield on housing

Order designation LMI-100

Consisting of:
1. Measuring tape LMB-100
2. Scanning head LMK-100
3. Signal conditioning SKE

1. Order designation measuring tape LMB-100

LMB-100. ☐ - ☐☐☐☐☐ - ☐☐

Accuracy
0 ... ±20 μm/m
1 ... ±10 μm/m
2 ... ± 5 μm/m

Tape length
in mm

RI-position
0 ... None
1 ... 50 mm from left
2 ... Centre
3 ... 50 mm from right
4 ... 100 mm from left
5 ... 100 mm from right
6 ... 50 mm from both sides
7 ... 100 mm from both sides
8 ... Every 100 mm
9 ... Special-RI
K1 ... Distance-coded (basic distance 40 mm)
K2 ... Distance-coded (basic distance 80 mm)
K3 ... Distance-coded (basic distance 120 mm)

2. Order designation scanning head LMK-100

LMK-100. ☐ - ☐ - ☐

End position
0 ... Without
1 ... With

Cable length in „m“ for SKE
1 ... 1 m
2 ... 2 m
3 ... 3 m (max.)

Connector
5 ... 15 pin Sub-D connector for SKE 1 ☐
4 ... 12 pin Connei connector for SKE 2 ☐

Order designation LMI-200

Consisting of:
1. Measuring rail LMF-200
2. Measuring slider LMK-200
3. Signal conditioning SKE

1. Order designation measuring rail LMF-200

LMF-200. ☐ - ☐☐☐☐ - ☐☐

Accuracy
0 ... ±20 μm/m
1 ... ±10 μm/m
2 ... ± 5 μm/m

Measuring length
in mm
(see technical data)

RI-position
0 ... None
1 ... 50 mm from left
2 ... Centre
3 ... 50 mm from right
4 ... 100 mm from left
5 ... 100 mm from right
6 ... 50 mm from both sides
7 ... 100 mm from both sides
8 ... Every 100 mm
9 ... Special-RI
K1 ... Distance-coded (basic distance 40 mm)
K2 ... Distance-coded (basic distance 80 mm)
K3 ... Distance-coded (basic distance 120 mm)

2. Order designation measuring slider LMK-200

LMK-200. ☐ - ☐ - ☐

End position
0 ... Without
1 ... With

Cable length in „m“ for SKE
1 ... 1 m
2 ... 2 m
3 ... 3 m (max)

Connector
5 ... 15 pin Sub-D connector for SKE 1 ☐
4 ... 12 pin Connei connector for SKE 2 ☐

3. Order designation Signal conditioning SKE

for 1 Vpp output signals:

SKE - ☐ 1 - ☐

Type of enclosure
1 ... IP 54 (15 pin Sub-D)
2 ... IP 66 (12 pin Connei)

Signal periods
0 ... 1000 μm
Other Signal periods being prepared

for RS-422 (TTL) output signals:

SKE - ☐ 2 - ☐

Type of enclosure
1 ... IP 54 (15 pin Sub-D)
2 ... IP 66 (12 pin Connei)

Resoution after 4x edge evaluation
0 ... 10 μm
1 ... 5 μm
2 ... ~1 μm
3 ... ~0.25 μm

Order designation LMI-300

Consisting of: 1. Measuring rail LMF-300
2. Measuring slider LMK-301 or LMK-302

1. Order designation measuring rail LMF-300

LMF-300. ☐ ☐ - ☐☐☐☐ - ☐☐

0 ... Without coating
1 ... With ZnFe coating

Accuracy
0 ... ±20 μm/m
1 ... ±10 μm/m
2 ... ± 5 μm/m

Measuring length
in mm
(see technical data)

RI-position
0 ... None
1 ... 50 mm from left
2 ... Centre
3 ... 50 mm from right
4 ... 100 mm from left
5 ... 100 mm from right
6 ... 50 mm from both sides
7 ... 100 mm from both sides
8 ... Every 100 mm
9 ... Special-RI
K1 ... Distance-coded (basic distance 40 mm)
K2 ... Distance-coded (basic distance 80 mm)
K3 ... Distance-coded (basic distance 120 mm)

2. Order designation measuring slider- LMK-30☐

2.1 Measuring slider with output signal 1 Vpp - LMK-301

LMK-301. ☐ ☐ - ☐ - ☐☐ - ☐

0 ... Without coating
1 ... With ZnFe coating

Signal periods
0 ...1000 μm
Other Signal periods being prepared

End position
0 ... Without
1 ... With

Cable length
in metre

Connector
0 ... Without
1 ... 12 pin DIN connector
2 ... 9 pin Connei connector
3 ... 9 pin Sub-D connector
4 ... 12 pin Connei connector
5 ... 15 pin Sub-D connector
6 ... 12 pin Connei coupling
9 ... Special connector or special pin assignments

2.2 Measuring slider with output signal TTL (RS 422) - LMK-302

LMK-302. ☐ ☐ - ☐ - ☐☐ - ☐

0 ... Without coating
1 ... With ZnFe coating

Resoution after 4x edge evaluation
0 ... 10 μm
1 ... 5 μm
2 ... ~1 μm
3 ... ~0.25 μm

End position
0 ... Without
1 ... With

Cable length
in metre

Connector
0 ... Without
1 ... 12 pin DIN connector
2 ... 9 pin Connei connector
3 ... 9 pin Sub-D connector
4 ... 12 pin Connei connector
5 ... 15 pin Sub-D connector
6 ... 12 pin Connei coupling
9 ... Special connector or special pin assignments