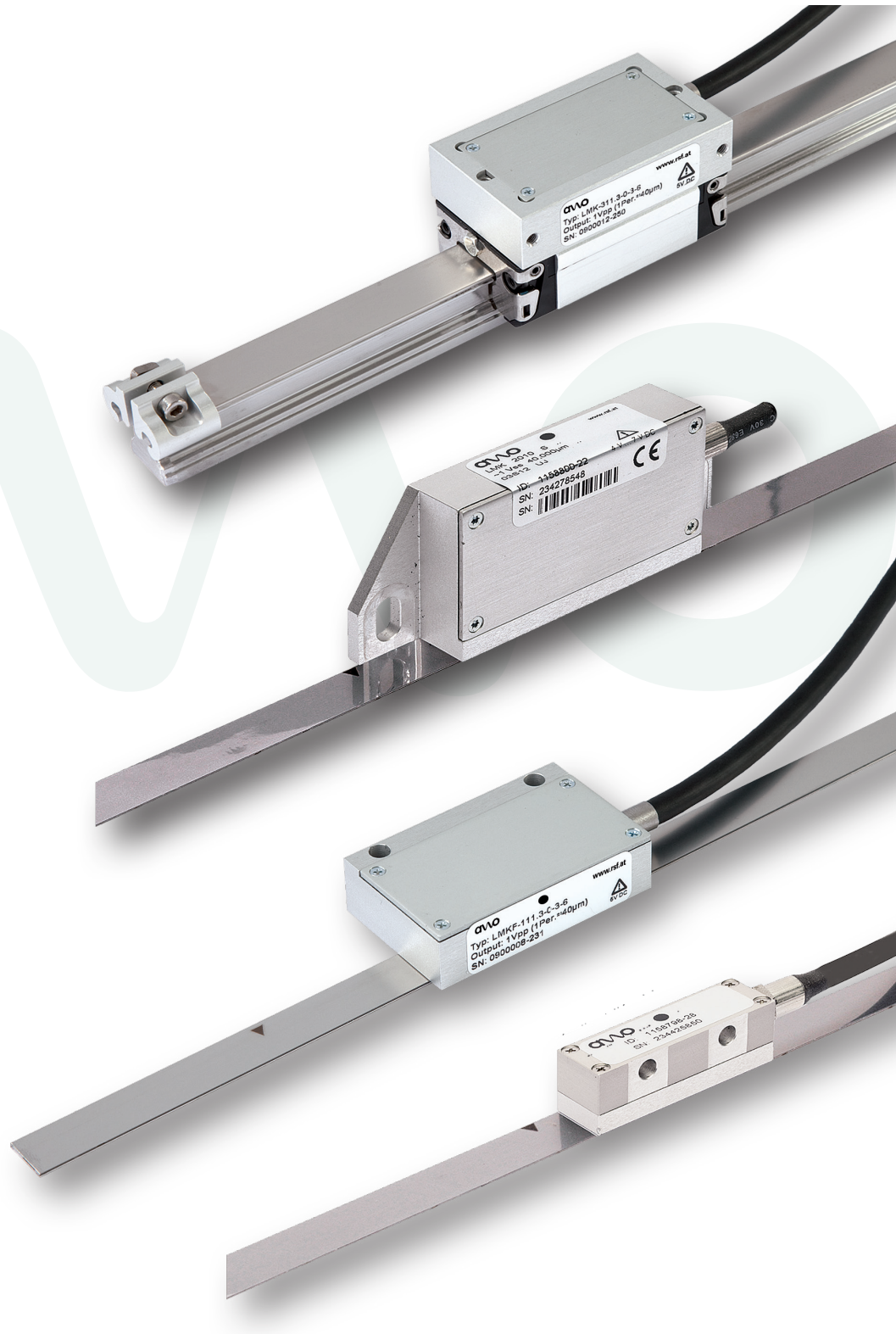


Linear Encoders
based on the inductive
AMOSIN®– measuring principle

awo



This document was created very carefully. If there are any technical changes, they will promptly updated in the documents on our website www.amo.at.

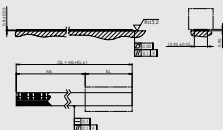
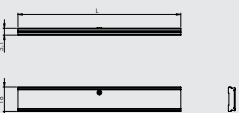
This brochure supersedes all previous editions, which thereby become invalid.

Standards (ISO, EN, etc.) apply only where explicitly stated in the catalog.

The basis for ordering from RSF Elektronik is always the brochure edition valid when the order is made.

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	Functional Safety	absolute and incremental linear encoder		15
Specifications	Linear encoder	Design	Grating period	
	with absolute interface	LMBA 2010 LMTA 4010	1000 µm	20
		LMKA 2010	1000 µm	22
		LMFA 3010 LMKA 3010	1000 µm	27
	with incremental interface	LMB 1010 LMT 4010	1000 µm	32
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SELECTION TABLE - ABSOLUTE LINEAR ENCODER

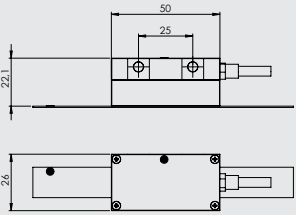
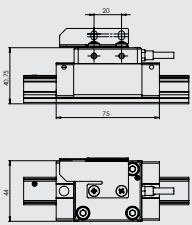
Grating period	Scale			
	Dimensions	Accuracy class	Accuracy after linear compensation ¹⁾	Measuring length ML
1000 μm	Type LMBA 2010  Type LMTA 4010 	$\pm 20 \mu\text{m/m}$ or $\pm 50 \mu\text{m/m}$	$\pm 3 \mu\text{m/m}^{2)}$ $\pm 5 \mu\text{m/m}$ $\pm 10 \mu\text{m/m}$	up to 32 m
	Type LMFA 3010 	$\pm 20 \mu\text{m/m}$ or $\pm 50 \mu\text{m/m}$	$\pm 3 \mu\text{m/m}^{3)}$ $\pm 5 \mu\text{m/m}$ $\pm 10 \mu\text{m/m}$	up to 32 m

¹⁾ After linear length-error compensation in the evaluation electronics

²⁾ LMBA 2010 : up to measuring length ML = 2950 mm

LMTA 4010 : up to measuring length ML = 2930 mm

³⁾ Up to measuring length ML = 2960 mm

Scanning head				
Dimensions	Interfaces	Resolution	Max. speed	Type
Type LMKA 2010 Design: 20 	EnDat 3 EnDat 2.2 FANUC αi SSI+1Vpp Mitsubishi BiSS/C	1 μm to 0,1 μm	20 m/s	LMKA 2010 LMBA 2010 LMTA 4010
Type LMKA 3010 Design: 30 	EnDat 3 EnDat 2.2 FANUC αi SSI+1Vpp Mitsubishi BiSS/C	1 μm to 0,1 μm	3 m/s	LMKA 3010 LMFA 3010



LMKA 2010 LMBA 2010

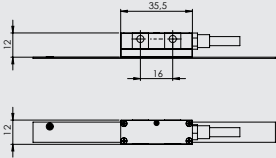
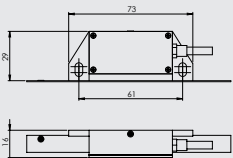
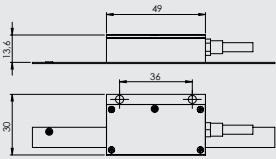
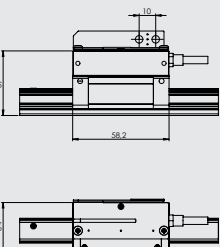
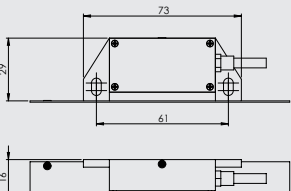
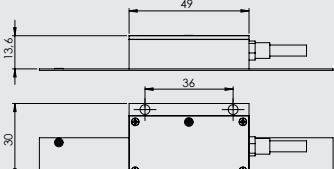


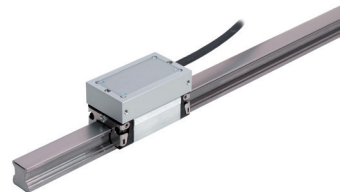
LMKA 3010 LMFA 3010

Grating period	Scale			
	Dimensions	Accuracy class	Accuracy after linear compensation ¹⁾	Measuring length ML
1000 µm	Type LMB 1010 	$\pm 20 \mu\text{m/m}$ or $\pm 50 \mu\text{m/m}$	$\pm 3 \mu\text{m/m}^{2)}$ $\pm 5 \mu\text{m/m}$ $\pm 10 \mu\text{m/m}$	Any measuring length
	Type LMF 3010 	$\pm 20 \mu\text{m/m}$ or $\pm 50 \mu\text{m/m}$	$\pm 5 \mu\text{m/m}$ $\pm 10 \mu\text{m/m}$	Any measuring length
3000 µm	Type LMB 1030 	$\pm 50 \mu\text{m/m}$	$\pm 10 \mu\text{m/m}$ $\pm 20 \mu\text{m/m}$	Any measuring length
	Type LMT 4030 			

¹⁾ After linear length-error compensation in the evaluation electronics

²⁾ Up to total length GL = 3000 mm

Scanning head				
Dimensions	Resolution		Max. speed	Type
	 1Vpp	 TTL		
Design: 10,12 				
Design: 20 				
Design: 21 				
Design: 30 				
Design: 20 				
Design: 21 				

**LMB 1010 LMK 1010****LMB 1010 LMK 2010****LMT 4010 LMK 2010****LMF 3010 LMK 3010****LMB 1030 LMK 2030****LMT 4030 LMK 2030**

MEASURING PRINCIPLE

Grating

AMO encoders function on the inductive AMOSIN® measuring principle. The encoders incorporate gratings of periodic structures known as graduations.

The measuring scale is a stainless-steel tape on which a high precision periodical graduation is introduced.

Absolute gratings consists of a 1000µm incremental track and an additional absolute track, using a serial code.

For incremental encoders a reference mark is located on a separate track. This makes it possible to assign this absolute position value to exactly one measuring step.

The following grating periods are possible for incremental encoders:

- 1000 µm
- 3000 µm

Inductive scanning

AMO encoders are using an unique coil structure, with a number of coils aligned in the direction of measurement, which is implemented on a substrate using micro-multi-layer technology.

An important feature of the patented AMOSIN® measuring principle is the accuracy of the signal generation, using a high-frequency alternating field which suppresses any hysteresis in the material.

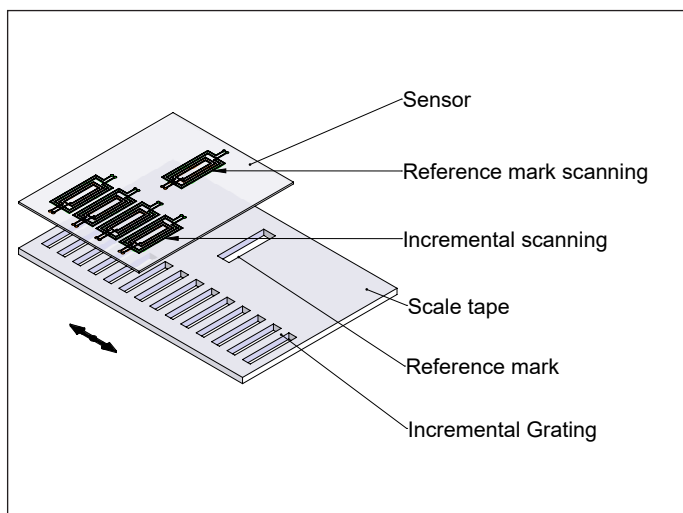
The relative angular movement in the direction of measurement between the sensor structure (in the scanning head) and the measuring scale periodically changes the mutual inductance of the individual coils, generating two sinusoidal signals with a 90° phase difference.

The extremely accurate signal, and it's immunity to environmental influences, has the effect that, after conditioning of the signal in the evaluation electronics, deviations of no more than 0.1% from the ideal sinusoidal form (harmonic content) remains. This allows high interpolation factors to be carried out in the course of signal digitisation. This can either be done in the encoder itself, or in the subsequent electronics (CNC etc.).

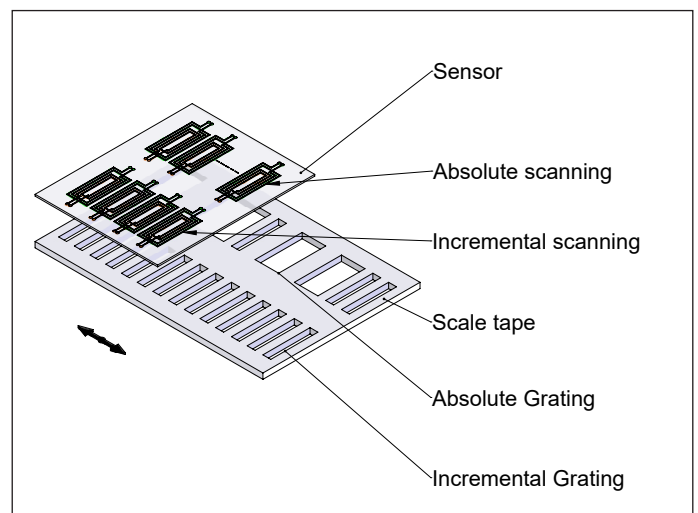
With the absolute measuring method, the position value is available from the encoder immediately upon switch-on and can be called at any time by the subsequent electronics. There is no need to move the axis to find the reference position.

The absolute position information is read from the scale graduation, which is formed from a absolute code structure. A separate incremental track is interpolated for the position value.

With the incremental measuring method the graduation consists of a periodic grating structure. The position information is obtained by counting the individual increments from some point of origin. Since an absolute reference is required to a certain position, the scales are provided with an additional track that bears a reference mark. The absolute position on the scale, established by the reference mark, is gated with exactly one signal period.



Incremental scanning



Absolute scanning

MEASURING ACCURACY

The accuracy of linear measurement is mainly determined by:

- the quality of the graduation
- the stability of the graduation carrier
- the quality of the scanning process
- the quality of the signal processing electronics
- the installation of the encoder in the machine

These factors of influence are comprised of encoder-specific position error and application-dependent issues. All individual factors of influence must be considered in order to assess the attainable overall accuracy.

Encoder-specific position error

The encoder-specific position error is specified in the technical data:

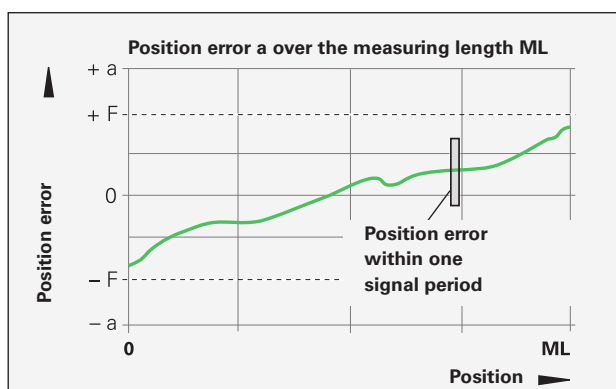
- accuracy of the graduation
- position error within one signal period

Accuracy of the scale

The accuracy of the scale is mainly determined by:

- the homogeneity of the graduation
- the alignment of the graduation on the carrier
- the stability of the graduation carrier

A distinction is made between interpolation errors over relatively large paths of traverse- for example the entire measuring length- and those within one signal period.



Position error over the measuring range

The accuracy of linear encoders is specified in accuracy classes, which are defined as follows:

The extreme values $\pm F$ of the measuring curves over any max. one-meter section of the measuring length are within the accuracy class $\pm a$. They are measured during the final inspection, under ideal conditions, by measuring the position error with a serial scanning head

The accuracy achievable after linear length-error compensation in the evaluation electronics is specified as accuracy after linear compensation.

Position error within one signal period

The position error within one signal period $\pm u$ results from the quality of the scanning and the quality of the internal signal-processing electronics. For encoders with sinusoidal output signals, the errors of the signal processing electronics caused by the subsequent electronics must be considered.

The following individual factors influence the result:

- the size of the signal period
- the homogeneity of the graduation
- the quality of scanning
- the characteristics of the sensors
- the stability and dynamics of further processing of the analog signals

These factors of influence are to be

considered when specifying position error within one signal period.

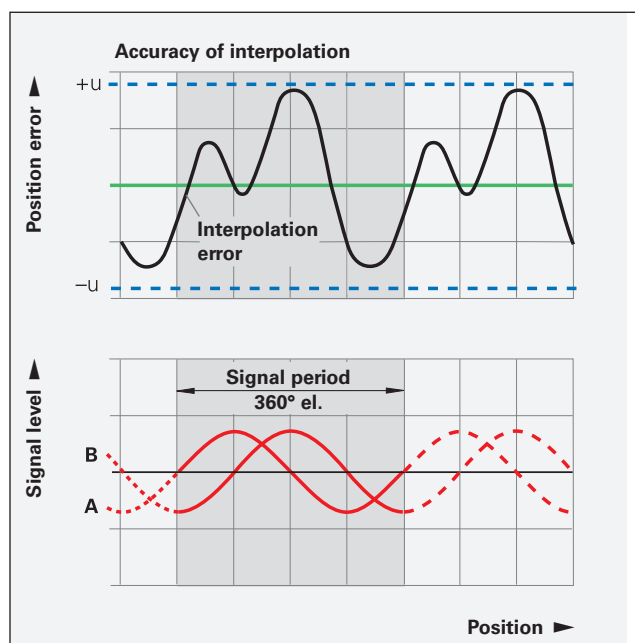
Position error within one signal period $\pm u$ is specified in the technical data in this document. Position errors within one signal period has an effect in very small traversing speed and in repeated measurements. Especially in the speed control loop, it leads to fluctuations in traversing speed.

Application-dependent error

The mounting and adjustment of the scanning head, in addition to the given encoder-specific error, normally have a significant effect on the accuracy that can be achieved by modular encoders. The application-dependent error values must be measured and calculated individually in order to evaluate the overall accuracy.

Deformation of the graduation

Errors due to deformation of the graduation are not to be ignored. It occurs when the scale is mounted on an uneven, for example convex, surface.



MECHANICAL DESIGN TYPES - LINEAR SCALES

General information

Linear encoders from AMO are amongst others designed for use in applications with harsh environmental conditions. All modular linear encoders are free from wear because of the non-contact scanning. The mechanical design of absolute and incremental scales is quite similar.

The absolute position information on an absolute grating is formed with an serial absolute code track and a separate incremental track.

An incremental scale contains an incremental track and an additional track with single or distance coded reference marks.

Mechanical design of modular linear scales

For modular linear encoders AMO offers two different mechanical scale design types:

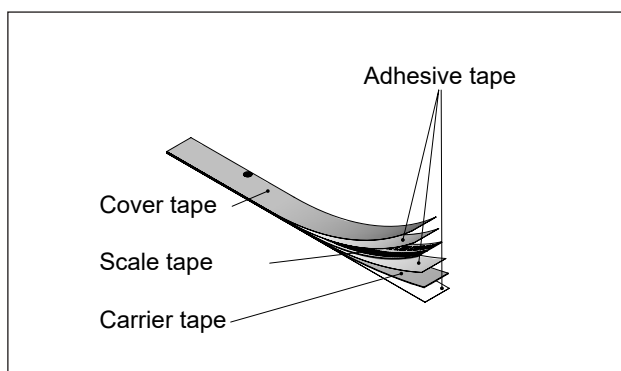
- LMBA/LMB- Scale tape to stick
- LMTA/LMT- Scale tape in stainless steel carrier

The materials used for the components in both scale types are stainless steel.

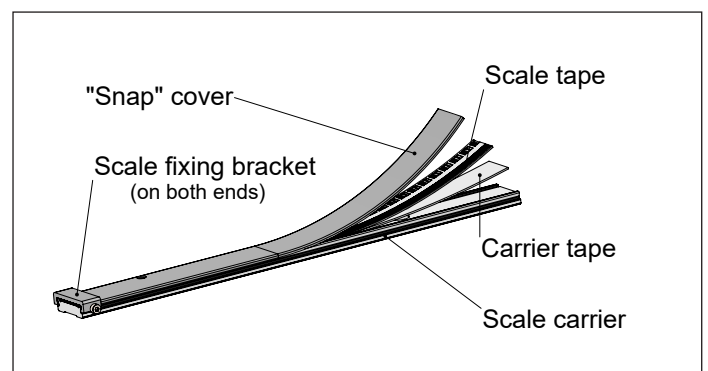
LMB/LMBA scales are equipped with an adhesive film on the bottom side. This allows to glue the scale directly to the mounting surface.

On LMTA/LMT scales stainless steel carrier sections are screwed onto the mounting surface first. The one-piece scale tape is pulled into the carrier, closes with the snap-cover and fixed at both ends with fixing brackets.

This scale tape solution offers the possibility of a repeated mounting and dismounting procedure combined with a high resistance against aggressive medium.



Design LMBA/LMB



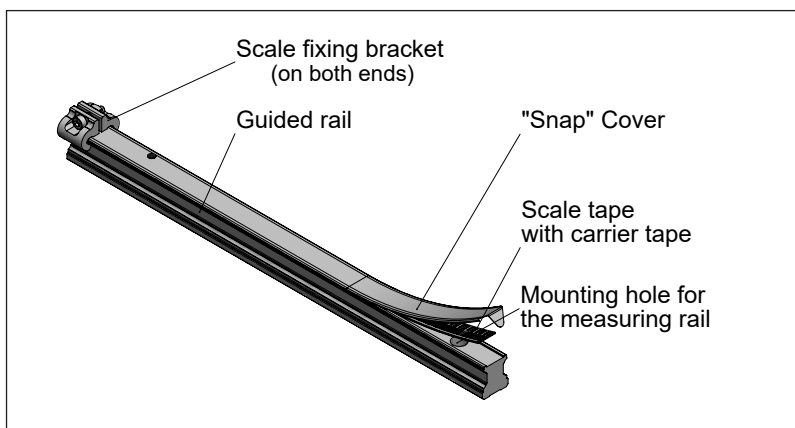
Design LMTA / LMT

Mechanical design of guided linear scales

The scale tape versions LMFA/LMF integrated in a guided rail are designed quite similar to the scale type LMTA/LMT mounted in a stainless steel carrier.

A single or multiple sections of a guided rail are screwed onto the mounting surface first.

The one-piece scale tape is pulled into the carrier, closes with the snap-cover and fixed at its ends with fixing brackets.



Design LMFA/LMF

REFERENCE MARKS AT INCREMENTAL LINEAR ENCODERS

With the incremental measuring method, the graduation consists of a periodic grating structure.

The position information is obtained by counting the individual increments (measuring steps) from some point of origin. Since an absolute reference is required at a certain position, the scale tape is provided

with an additional track that bears a reference mark. The absolute position on the scale, established by the reference mark, is gated with exactly one measuring step.

Therefore the reference mark must be scanned to establish an absolute reference or to find the last selected datum.

To speed and simplify such "reference runs", many AMO encoders feature distance-coded reference marks – multiple reference marks that are individually spaced according to a mathematical algorithm.

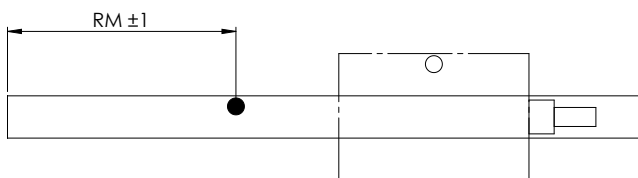
Individual reference marks

As a standard, a single reference mark is positioned centered on the scale tape related to the total scale length. The reference mark position on the scale tape is marked with a black dot.

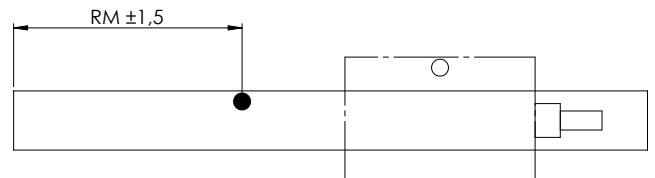
the scale as the distance from one end of the scale to the reference mark. The position of the scanning unit for the reference mark in the scanning head is centrally arranged.

A single reference mark can also be placed on a custom-designed position on the scale. Therefore the reference mark position has to be defined in the ordering code of

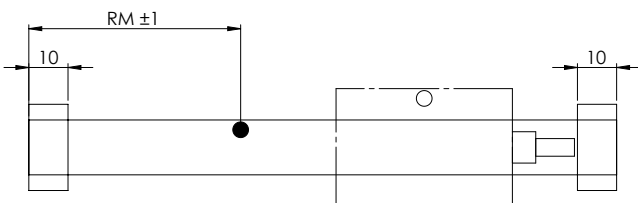
Reference mark position LMB 1010



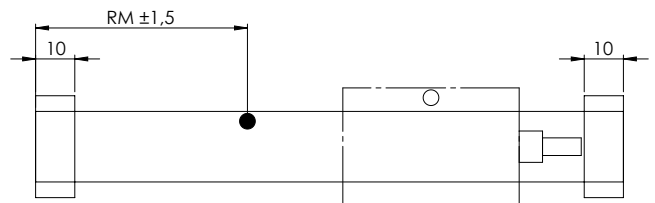
Reference mark position LMB 1030



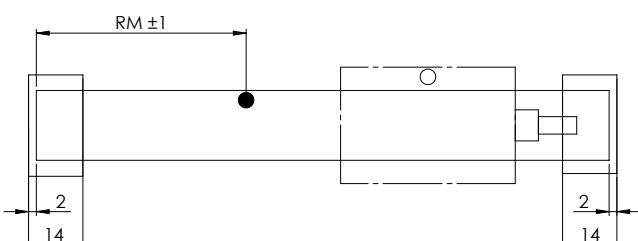
Reference mark position LMT 4010



Reference mark position LMT 4030



Reference mark position LMF 3010



RM = Reference mark position

GENERAL TECHNICAL INFORMATION

Acceleration

Encoders are subject to various types of acceleration during operation and mounting:

- The indicated maximum values for vibration resistance are valid according to EN 60 068-2-6 at frequency of 55 Hz to 2000 kHz
- The maximum permissible acceleration values (semi-sinusoidal shock) for shock and impact are valid for 6 ms (EN 60 068-2-27).

Under no circumstances should a hammer or similar implement be used to adjust or position the encoder.

Temperature range

The **operating temperature** range indicates the ambient temperature limits between which the encoders will work properly.

The **storage temperature** range applies when the unit remains in its packaging. The operating and storage temperature range are specified in the technical data.

Thermal characteristics

The thermal behavior of the linear encoder is an essential criterion for the working accuracy of the machine. As a general rule, the thermal behavior of the linear encoder should match that of the workpiece or measured object. During temperature changes, the linear encoder should expand or contract in a defined, reproducible manner.

Expendable parts

Due to the contactless inductive scanning principle of the linear modular encoders from AMO only a continuously moving cable is subject to wearing. Pay attention to the minimum permissible bending radius.

Conformity and Certificates

- RoHS: 2011/65/EU
- Product Certification: UL, CSA, EN, IEC 61010-01
- EMV: 2014/30/EU

Mounting

Work steps to be performed and dimensions to be maintained during mounting are specified solely in the mounting instructions supplied with the unit.

All data in this catalog regarding mounting are therefore provisional and not binding; they do not become terms of a contract.

System tests

Encoders from AMO are usually integrated as components in larger systems. Such applications require comprehensive tests of the entire system regardless of the specifications of the encoder.

The specifications shown in this brochure apply to the specific encoder, and not to the entire system. Any operation of the encoder outside of the specified range or for any applications other than the intended applications is at the user's own risk.

In safety-related systems, the higher-level system must verify the position value of the encoder after switch-on

General electrical information

Supply voltage

Connect AMO-Encoders only to subsequent electronics whose supply voltage comes from PELV systems (for a definition, see EN 50178).

AMO-Encoders meet the requirements of the IEC 61010-1 standard if power is supplied from a secondary circuit with limited energy as per IEC 61010-1, or with limited power as per IEC 62368-1, PS2 or from a Class 2 secondary circuit as per UL1310.1)

A stabilized DC voltage UP is required for powering the encoders. Information on voltage and current consumption or power consumption can be obtained from the respective specifications.

Regarding the ripple voltage of the DC power, the following parameters apply:

- High-frequency interference
UPP < 250 mV with dU/dt > 5 V/μs
- Low-frequency fundamental ripple
UPP < 100 mV

However, the limits of the supply voltage must not be violated by the ripple content.

The required supply voltage depends on the encoder interface. A distinction is made between encoders without an extended supply voltage range (e.g., DC 5.0 V ±0.25 V) and those with an extended supply voltage range (e.g., DC 3.6 V to 14 V).

¹⁾ In place of IEC 61010-1, the corresponding sections of the following standards can be used: DIN EN 61010-1, EN 61010-1, UL 61010-1, and CAN/CSA-C22.2 No. 61010-1. In place of IEC 62368-1, PS2 the corresponding sections of the following standards can be used: DIN EN 62368-1, EN 62368-1, UL 62368-1, and CAN/CSA-C22.2 No. 62368-1.

FUNCTIONAL SAFETY - LINEAR ENCODERS

The absolute and incremental linear encoders from AMO can be used for position determination on linear axes for safety related applications.

For the use in safety related applications all encoder types with ordering code „FA“ (see also the option „Functional Safety“ in the ordering code) are applicable. These are scanning heads with an purely analog 1Vpp output signal. The signal period corresponds to the grating period. In order to be able to implement a linear encoder in a safety-related application, a

suitable control is required. The control assumes the fundamental task of communicating with the encoder and safely evaluating the encoder data. AMO provides on request a technical information with MTTF values and a fault model with comments to table D8 (Motion and position feedback sensors) of the standard EN 61800-5-2.

For all linear encoders without a specified value („FA“ or „FS“) for Functional Safety in the ordering code, no suitable fault-detection measures are implemented.

Those encoders provide no or a synthetical 1Vpp output signal.

Therefore the assumed faults in accordance with EN 61800-5-2, table D8 can lead to an incorrect but plausible position value. To what extent such linear encoders can be used in safety-related applications depends on the architecture of the safety system and the fault-detection measures in the evaluating safety module.

Fault exclusion for the loosening of the mechanical connection

The machine manufacturer is responsible for the dimensioning of mechanical connections in a drive system. The OEM should ideally consider the application conditions for the mechanical design. Providing objective evidence of a safe connection is time-consuming.

For this reason, AMO has developed and confirmed by a type examination a mecha-

nical fault exclusion for the linear encoders. The qualification of the mechanical fault exclusion was performed for a broad application range of the encoders. This means that fault exclusion is ensured under the operating conditions listed below.

All information is given with respect to a mounting temperature of 15°C to 35°C. Mounting surfaces must be clean and free

of burrs. Thread surfaces must be secured with material bonding thread-locking fluid. All mounting screws have to be tightened torque controlled.

Fault exclusion - Scale tape to stick LMBA and LMB

The installation of the scale tape must be carried out according to the mounting instructions. As guidance for the measuring tape in the direction of travel, an insertion or stop shoulder can be provided in the machine base.

If this is not possible, an auxiliary stop can also be used to achieve sufficient straightness of the measuring tape in the direction of travel.

Scale tape to stick LMBA / LMB	
Machine base	
Coefficient of thermal expansion α	(10 to 16) 10^{-6} K^{-1}
Environmental conditions	
Pollution	dry environment, no oils, cutting fluid or other liquid substances
Operating temperature	-10 °C to 85 °C
Max. acceleration	$\pm 50 \text{ m/s}^2$ in direction of movement
Shock 6ms	$< 1000 \text{ m/s}^2$ (EN 60068-2-27)

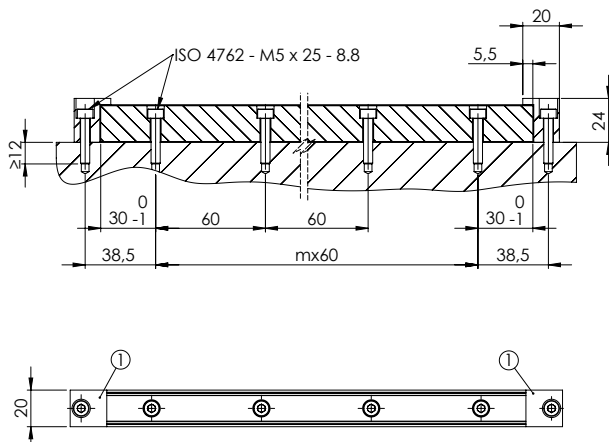
Fault exclusion Measuring rail LMFA and LMF

The mounting of the measuring rail must be carried out according to the mounting instructions. The screws and the end clamps, necessary to achieve the mechanical fault exclusion are not included in the scope of delivery.

Minimum screw length L is the sum of the length of engagement and the free clamped length.

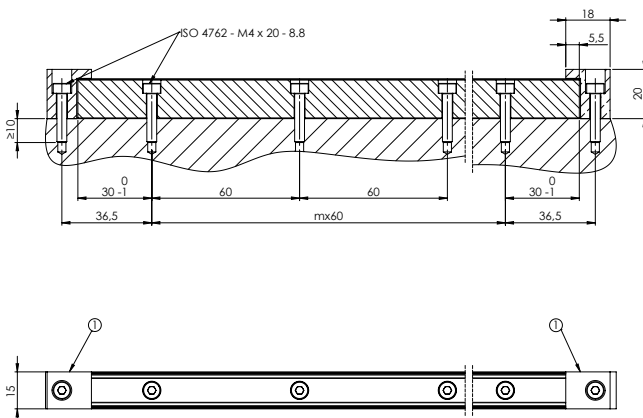
Measuring rail	LMFA 3010	LMF 3010
Machine base		
Coefficient of thermal expansion α	(10 to 16) 10^{-6} K^{-1}	
Tensile strength R_m	$\geq 360 \text{ N/mm}^2$	
Measuring rail assembly		
Screws	ISO 4762- M5 x L- 8.8	
Torque M_d	5,0 $\pm$ 0,2 Nm	3,0 $\pm$ 0,2 Nm
Length of thread engagement	$\geq 10 \text{ mm}$	$\geq 8 \text{ mm}$
Free clamped length	$\geq 13,2 \text{ mm}$	$\geq 10,2 \text{ mm}$
Environmental conditions		
Operating temperature	-10°C to 85 °C	
Max. acceleration	$\pm 50 \text{ m/s}^2$ in direction of movement	
Shock 6ms	$< 1000 \text{ m/s}^2$ (EN 60068-2-27)	

Recommended assembly LMFA 3010



① Accessory 1244592-04 End Clamp LMFA

Recommended assembly LMF 3010



① Accessory 1244592-05 End Clamp LMF

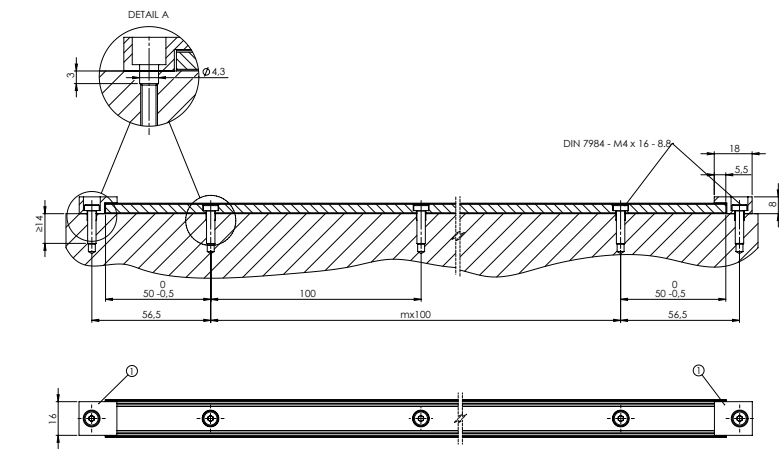
Fault exclusion - Scale tape in stainless steel carrier LMTA and LMT

The mounting of the stainless steel carrier must be carried out according to the mounting instructions. The screws and the end clamps, necessary to achieve the mechanical fault exclusion are not included in the scope of delivery.

Minimum screw length L is the sum of the length of engagement and the free clamped length.

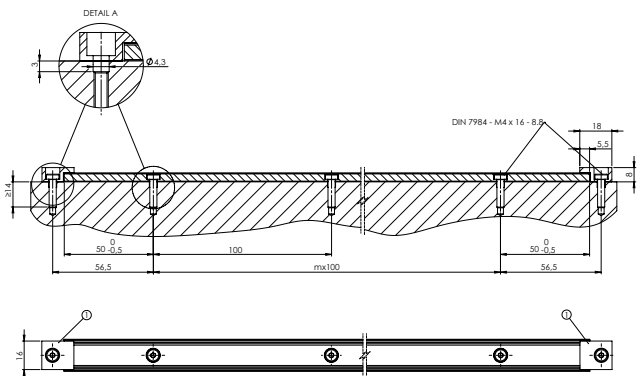
Scale tape in stainless steel carrier LMTA 4010 / LMT 4010	
Machine base	
Coefficient of thermal expansion α	$(10 \text{ to } 16) \cdot 10^{-6} \text{ K}^{-1}$
Tensile strength R_m	$\geq 360 \text{ N/mm}^2$
Carrier assembly	
Screws	DIN 7984- M4 x L- 8.8
Torque M_d	$2,0 \pm 0,2 \text{ Nm}$
Length of thread engagement	$\geq 8 \text{ mm}$
Free clamped length	$\geq 5 \text{ mm}$
Environmental conditions	
Operating temperature	$-10^\circ\text{C to } 100^\circ\text{C}$
Max. acceleration	$\pm 50 \text{ m/s}^2$ in direction of movement
Shock 6ms	$< 1000 \text{ m/s}^2$ (EN 60068-2-27)

Recommended assembly LMTA 4010



① Accessory 1244592-03 End Clamp LMT(A)

Recommended assembly LMT 4010



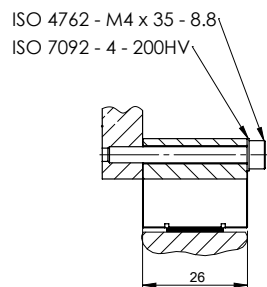
① Accessory 1244592-03 End Clamp LMT

Fault exclusion against loosening of the mounting screws on the scanning head

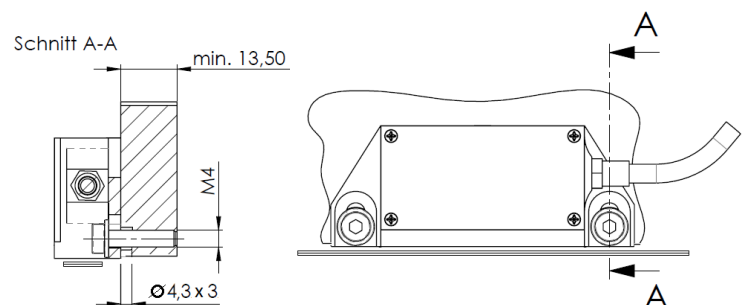
	LMKA 2010	LMK 1010	LMK 2010
	LMKA 2110		LMK 2030
Design	20	10, 12	20 ¹⁾
Mounting screws			
Screws	ISO 4762 M4 x 35- 8.8	ISO 4762 M3 x 16- 8.8	BN 1392 M4 x 16- 12.9
Washer	ISO 7092- 4- 200 HV	-	-
Torque M _d	2,0 ± 0,2Nm	1,0 ± 0,1Nm	2,0 ± 0,2Nm
Length of thread engagement	≥ 9mm	≥ 4mm	≥ 13,5mm
Mating stator			
Material	Steel		
Tensile strength R _m	≥ 360 N/mm ²		
Surface roughness Rz	10 µm to 40 µm		
Coefficient of thermal expansion α	(10 to 16) · 10 ⁻⁶ K ⁻¹		
Shock	6ms < 1000 m/s ² (EN 600068-2-27)		
Mounting surface	clean and burr free		

¹⁾ There must be a blind hole ø 4,3 x 3mm on the stator side at the mounting holes or a countersink with a corresponding depth can be provided.
See Figure LMK 20xx

LMKA 2010 LMKA 2110



LMK 2010

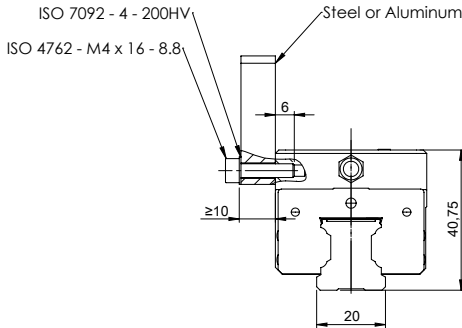


Fault exclusion against loosening of the mounting screws on the scanning head

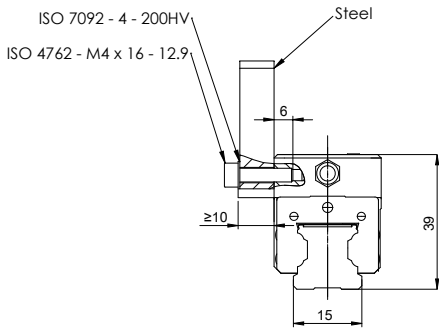
	LMKA 3010	LMK 3010
	LMKA 3110	
Design	30	30
Mounting screws ¹⁾		
Screws	ISO 4762 M4 x 16- 8.8	ISO 4762 M4 x 16- 12.9
Washer	ISO 7092- 4- 200 HV	
Torque M _d ²⁾	2,9 ± 0,2Nm	5,0 ± 0,2Nm
Length of thread engagement	6mm	
Mating stator		
Material	Steel or Aluminium	Steel
Tensile Strength R _m	≥ 360 N/mm²	
Surface roughness R _z	10 µm to 40 µm	
Coefficient of thermal expansion α	(10 to 16) · 10 ⁻⁶ K ⁻¹	
Maximum acceleration in direction of movement	50m/s²	100m/s²
Shock	6ms <1000 m/s² (EN 600068-2-27)	
Mounting surface	clean and burr free	

¹⁾ A compatible screw locking device must be used for the screw connections. (Assembly, Service)
²⁾ Tightening prozess: Torques monitored Mounting at room temperature; Components must be balanced regarding temperature
³⁾ There must be a blind hole ø 4,3 x 3mm on the stator side at the mounting holes or a countersink with a corresponding depth can be provided.
 See Figure. 01

LMKA 3010
LMKA 3110

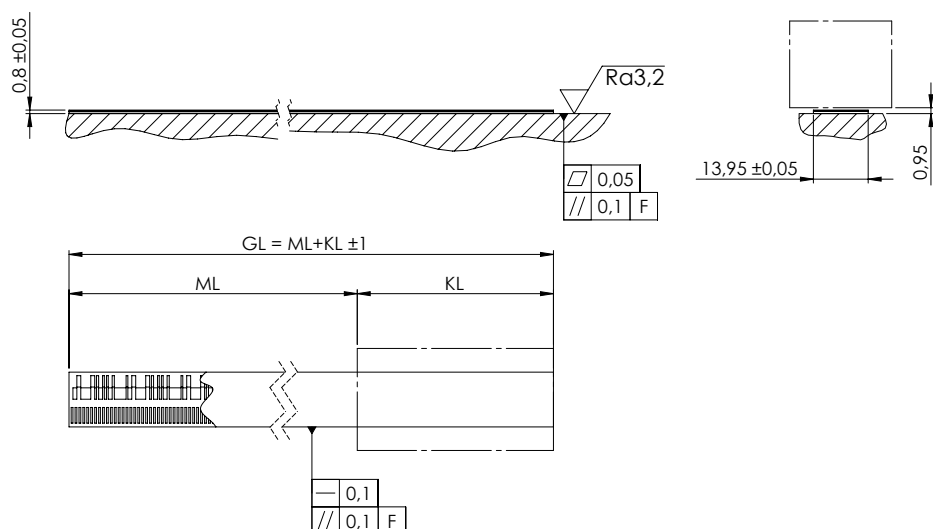


LMK 3010



SCALE TAPE TO STICK LMBA 2010

- Scale tape to stick, for modular linear encoders
- Grating period 1000µm
- In combination with scanning head LMKA 2010



F = Machine guidance

GL = Total length

ML = Measuring length :

BF 20 : ML = GL - 50 mm

KL = Scanning head length :

BF 20 : 50 mm

Tolerance principle in accordance with ISO 8015
General tolerances in accordance with ISO 2768-fH
All dimensions in mm

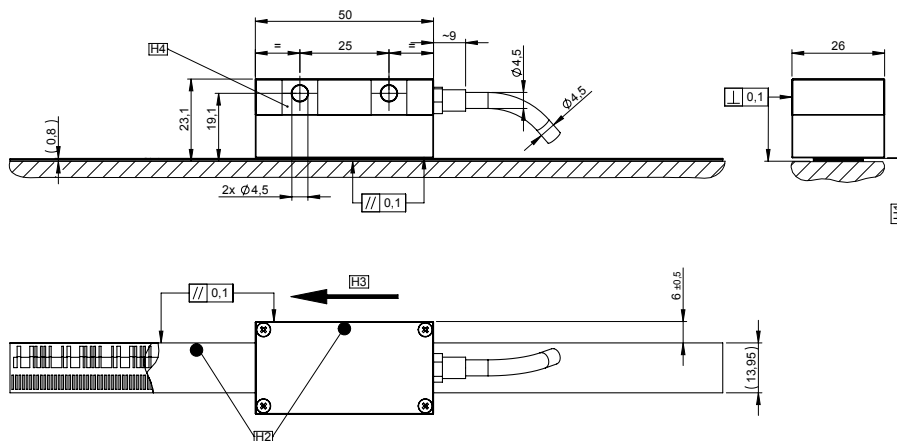
Technical data

Absolute scale tape	LMBA 2010		
Grating period	1000µm		
Accuracy class	± 20µm/m	± 20µm/m	± 50µm/m
Accuracy after linear compensation	± 3µm/m	± 5µm/m	± 10µm/m
Total length GL	Standard length see ordering code		
Mechanical design	Stainless steel scale tape with adhesive layer for mounting		
Coefficient of expansion	~ 11 ppm/K		
Mass	60 g/m Total length		

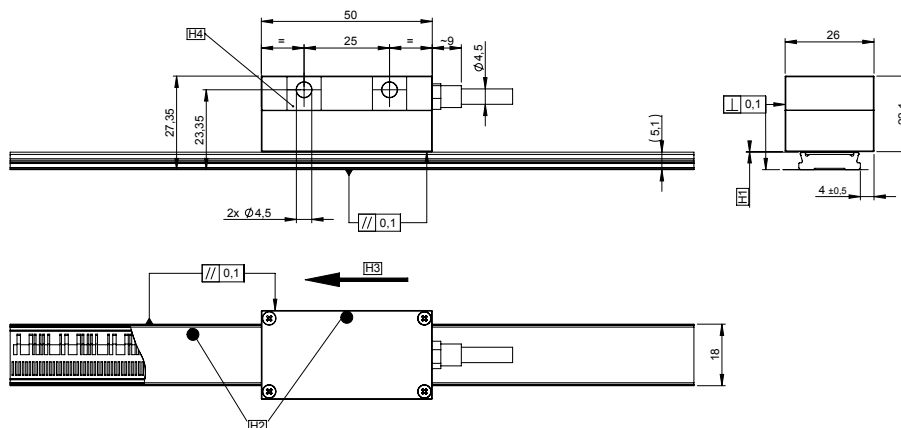
SCANNING HEAD - LMKA 2010 SERIES

- Absolute, modular linear encoder
- Grating period 1000µm
- Encoder with integrated electronics
- In combination with scale type LMBA 2010 and LMTA 4010

Design 20 with scale type LMBA 2010



Design 20 with scale type LMTA 4010



Tolerance principle in accordance with ISO 8015
General tolerances in accordance with ISO 2768-fH
All dimensions in mm

H1 = Air gap 0,15 ± 0,10mm, set with spacer foil

H2 = Absolute track marking

H3 = Direction of scanning head movement for positive counting

H4 = Ground plane

Technical data

- LMKA - Scanning head for modular linear encoders
- Grating period 1000µm

Scanning head	LMKA 2010 / 2110					
Interface	EnDat 2.2	Fanuc αi	BiSS/C	Mitsubishi one-pair transmission	Mitsubishi two-pair transmission	SSI + 1Vpp
Designation	EnDat 22	Fanuc05	BiSS	Mit03-2	Mit03-4	SSI- 1Vpp
Clock frequency	≤ 16 MHz	-	≤ 2,5 MHz	-	-	≤ 1 MHz
Measuring step						
Standard	1µm or 0,25µm					
High Accuracy	0,1µm					-
Position error per grating pitch ¹⁾						
Standard	± 2µm					
High Accuracy	± 0,5µm					-
Max. speed	20m/s					
Cable length on scanning head	0,5m to 6m					
Electrical Connection	Cable with M12 coupling, 8pin male					Cable with M23 coupling, 17pin male
Voltage supply	DC 3,6V to 14V					
Power consumption	≤ 1,5W at 5V					
Typical current consumption	300mA at 5V					
Vibration 55 to 2000 Hz	< 200m/s² (EN 60068-2-6)					
Shock 6 ms	< 2000m/s² (EN 60068-2-27)					
Operating temperature	-10°C to 85°C					
Storage temperature	-20°C to 85°C					
Protection	IP67					
Mass	40g					

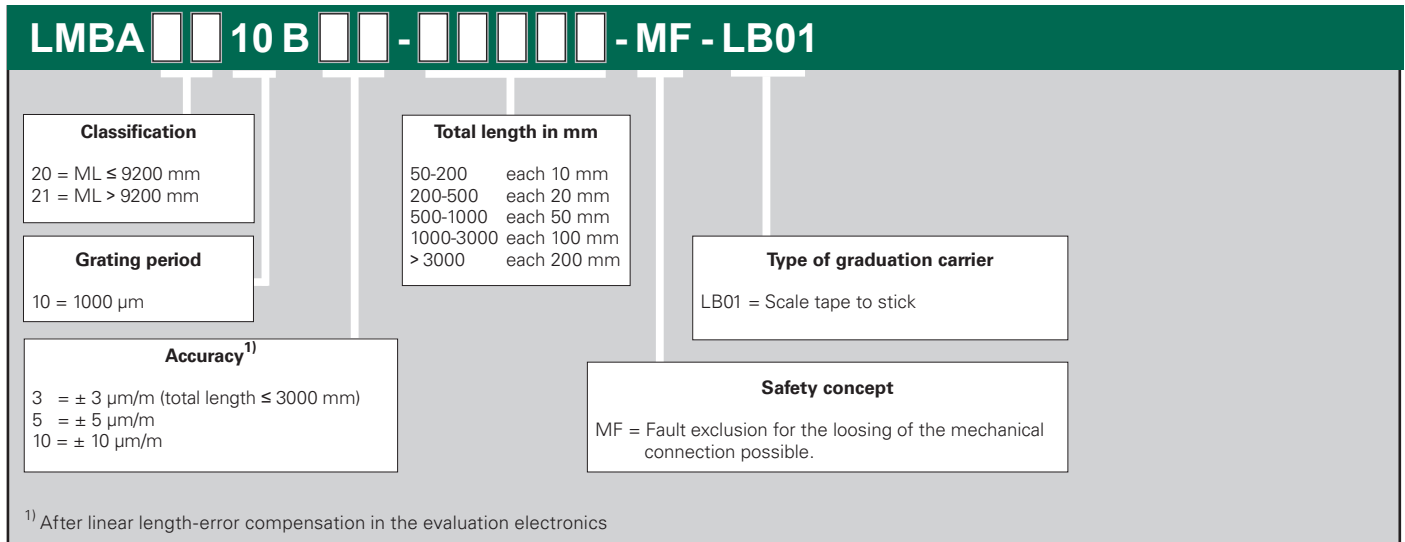
¹⁾ The position error per grating period and the accuracy of the grating results together in the encoder specific error; additional deviations caused by mounting and bearing are not considered in this error.

Technical data

Scanning head		LMKA 2010 / 2110	
Interface	EnDat 3		
Designation	E30- R2	E30- R4	E30- RB
XEL.time HPFout Data rate	≤ 11µs to 12,5Mbit/s ≤ 8,2µs to 25Mbit/s		≤ 13µs to 12,5Mbit/s ≤ 10,2µs to 25Mbit/s
Interpolation factor digital	Performance Standard: 12bit Performance High Accuracy: 14bit		
Cable length on the encoder	0,5m to 6m		
Cable length overall	≤ 100m at 12,5MBit/s ≤ 40m at 25MBit/s		
Number of participants	-	-	at 12,5MBit/s max. 6 participants at 25MBit/s max. 3 participants
Electrical connection	Cable with M12 coupling, 8-pin, male		
Voltage supply	DC 4,0V to 14V	DC 3,6V to 14V	
Power consumption	1,5W		
Typical current consumption	12V : 115mA		
Shock 6ms	< 1000m/s² (EN 60068-2-27)		
Vibration 55 to 2000 Hz	< 200m/s² (EN 60068-2-6)		
Operating temperature	-10°C to 85°C		
Storage temperature	-20°C to 85°C		
Protection	IP67		
Mass approximate	LMKA 2010/2110: 40g		

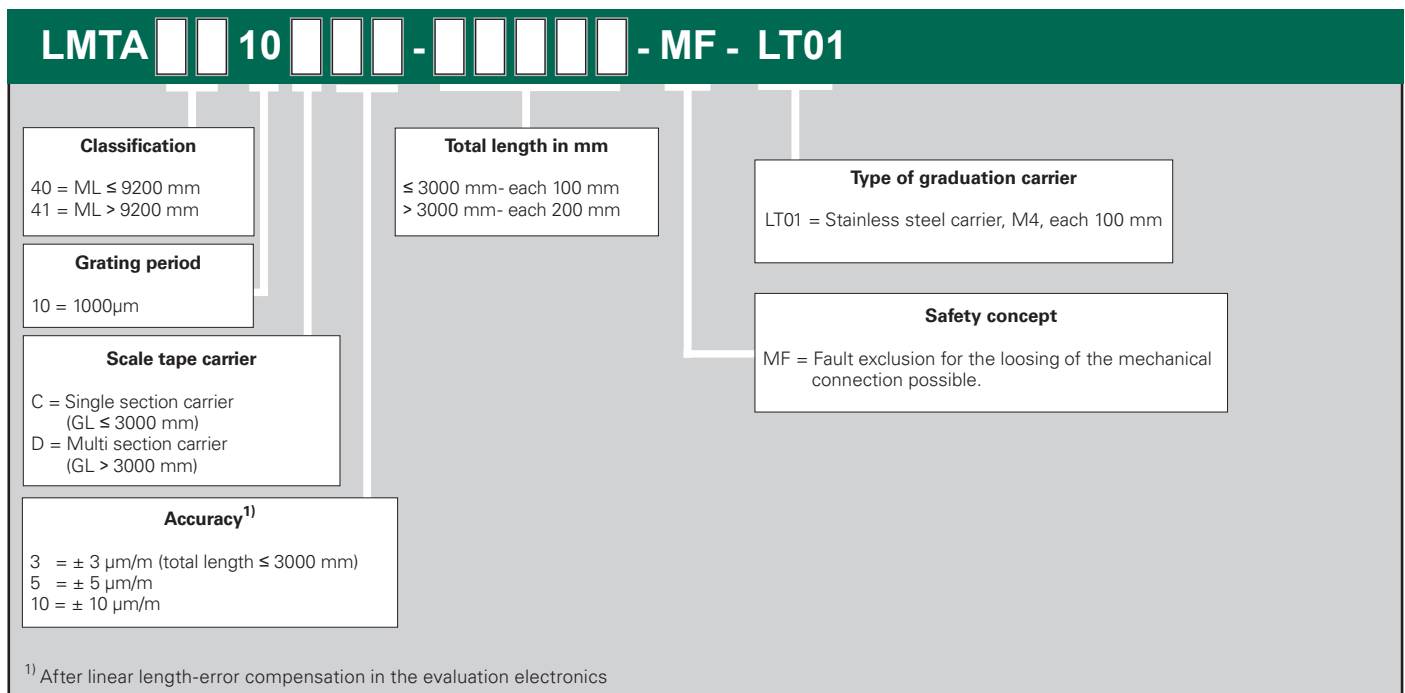
ORDERING CODE

- LMBA - Scale tape to stick for modular linear encoders
- Grating period 1000µm



Ordering code

- LMTA - Scale tape in stainless-steel carrier for modular linear encoders
- Grating period 1000µm



ORDERING CODE

- LMKA - Scanning head for modular linear encoders
- Grating period 1000 μ m

LMKA - 10 - 20 - , - - - - -

Scanning

20 = ML ≤ 9200 mm
21 = ML > 9200 mm

Grating period

S = Standard
HA = High Accuracy

Interface

01 = EnDat 2.2
05 = Fanuc Serial Interface- αi Interface
15 = SSI, additional incremental signals 1Vpp
16 = BiSS/C
24 = EnDat 3-E30-RB
25 = Mitsubishi High Speed Serial Interface
 (Two-pair transmission)
26 = Mitsubishi High Speed Serial Interface
 (One-pair transmission)
29 = EnDat 3-E30-R2
30 = EnDat 3-E30-R4

Dividing factor 1Vpp

01	1-fold	SSI
25	25-fold	x
NN	Without incremental signals	

Pin configuration

C4 = 1SS08
IS = 03S17, 01
WF = 1SS08 (Mit03-2)
Ed = EnDat 3-E30-RB
Iu = EnDat 3-E30-R2
Ix = EnDat 3-E30-R4

Electrical connection

01 = Free cable end
1SS08 = M12 8pin coupling male
03S17 = M23 17pin coupling male

Cable length

0,50 = 0,50 m
1,00 = 1,00 m
1,50 = 1,50 m
2,00 = 2,00 m
2,50 = 2,50 m
3,00 = 3,00 m
4,00 = 4,00 m
5,00 = 5,00 m
6,00 = 6,00 m

Measuring step

10 = 1 µm
12 = 0,25 µm²⁾
14 = 0,1 µm²⁾

Functional safety

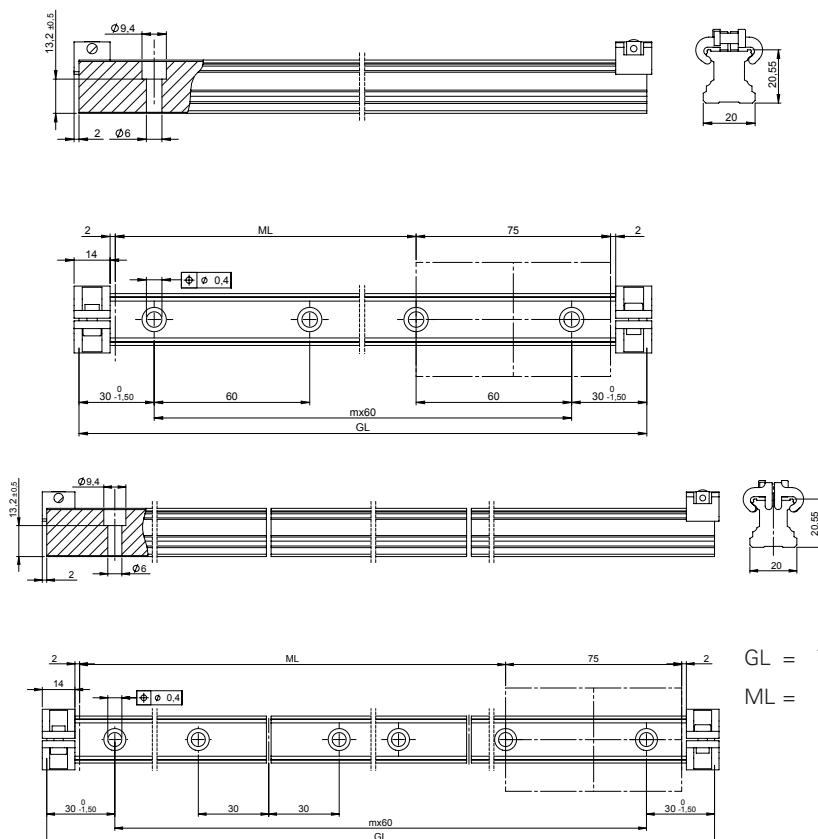
.. = No
FA = Analog signal (1Vpp) can be used for safety-related equipment¹⁾

¹⁾ Option „FA“ only for SSI and 1Vpp interface with dividing factor „01“.

²⁾ Not for SSI interface.

SCALE TAPE IN MEASURING RAIL LMFA 3010

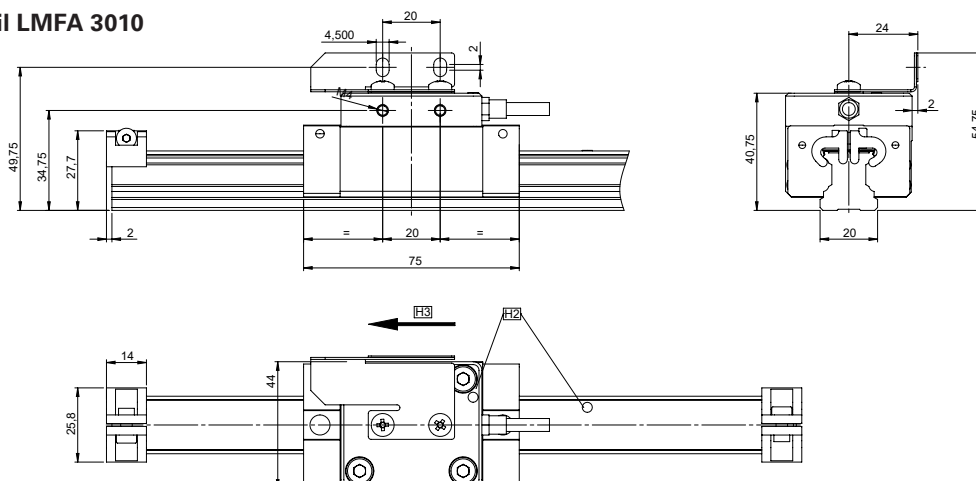
- Scale tape in measuring rail, for guided linear encoders
- Grating period 1000µm
- In combination with LMKA 3010



SCANNING HEAD - LMKA 3010 SERIES

- Absolute, guided linear encoder
- Grating period 1000µm
- Guided scanning head with integrated electronics
- In combination with measuring rail LMFA 3010

Design 30
with measuring rail LMFA 3010



Tolerance principle in accordance with ISO 8015
General tolerances in accordance with ISO 2768-fH
All dimensions in mm

H2 = Absolute track marking
H3 = Direction of scanning head movement for positive counting

Technical data

- LMFA - Measuring rail for guided linear encoders
- Grating period 1000µm

Absolute measuring rail	LMFA 3010	
Grating period	1000µm	
Accuracy class	± 20µm/m	± 50µm/m
Accuracy after linear compensation	± 5µm/m	± 10µm/m
Total length GL	Standard length see ordering code	
Mechanical design	Standard guide rail with integrated scale tape	
Coefficient of expansion	~ 11 ppm/K	
Mass	2400 g/m Total length	

Technical data

- LMKA - Scanning head for guided linear encoders
- Grating period 1000µm

Scanning head	LMKA 3010					
Interface	EnDat 2.2	Fanuc αi	BiSS/C	Mitsubishi one-pair transmission	Mitsubishi two-pair transmission	SSI + 1Vpp
Designation	EnDat 22	Fanuc05	BiSS	Mit03-2	Mit03-4	SSI- 1Vpp
Clock frequency	≤ 16 MHz	-	≤ 2,5 MHz	-	-	≤ 1 MHz
Measuring step						
Standard	1µm or 0,25µm					
High Accuracy	0,1µm					-
Position error per grating pitch ¹⁾						
Standard	± 2µm					
High Accuracy	± 0,5µm					-
Max. speed	5m/s, limited by the mechanics					
Cable length on scanning head	0,5m to 6m					
Electrical Connection	Cable with M12 coupling, 8pin male					Cable with M23 coupling, 17pin male
Voltage supply	DC 3,6V at 14V					
Power consumption	≤ 1,5W at 5V					
Typical current consumption	300mA at 5V					
Vibration 55 to 2000 Hz	< 200m/s² (EN 60068-2-6)					
Shock 6 ms	< 2000m/s² (EN 60068-2-27)					
Operating temperature	-10°C to 85°C					
Storage temperature	-20°C to 85°C					
Protection	IP67					
Mass	200g					

¹⁾ The position error per grating period and the accuracy of the grating results together in the encoder specific error; additional deviations caused by mounting and bearing are not considered in this error.

Technical data

Scanning head		LMKA 3010 / 3110	
Interface	EnDat 3		
Designation	E30- R2	E30- R4	E30- RB
XEL.time HPFout Data rate	≤ 11µs to 12,5Mbit/s ≤ 8,2µs to 25Mbit/s		≤ 13µs to 12,5Mbit/s ≤ 10,2µs to 25Mbit/s
Interpolation factor digital	Performance Standard: 12bit Performance High Accuracy: 14bit		
Cable length on the encoder	0,5m to 6m		
Cable length overall	≤ 100m at 12,5MBit/s ≤ 40m at 25MBit/s		
Number of participants	-	-	at 12,5MBit/s max. 6 participants at 25MBit/s max. 3 participants
Electrical connection	Cable with M12 coupling, 8-pin, male		
Voltage supply	DC 4,0V to 14V	DC 3,6V to 14V	
Power consumption	1,5W		
Typical current consumption	12V : 115mA		
Shock 6ms	< 1000m/s² (EN 60068-2-27)		
Vibration 55 to 2000 Hz	< 200m/s² (EN 60068-2-6)		
Operating temperature	-10°C to 85°C		
Storage temperature	-20°C to 85°C		
Protection	IP67		
Mass approximate	LMKA 3010/3110: 200g		

- LMKA** [] [] 10 [] [] . [] [] [] [] [] [] - 30 - [] , [] [] - [] [] [] [] [] [] - [] []

Scanning

30 = ML ≤ 9200 mm
31 = ML > 9200 mm

Performance

S = Standard
HA = High Accuracy

Interface

01 = EnDat 2.2
05 = Fanuc Serial Interface- αi Interface
15 = SSI, additional incremental signals 1Vpp
16 = BiSS/C
24 = EnDat 3-E30-RB
25 = Mitsubishi High Speed Serial Interface (Two-pair transmission)
26 = Mitsubishi High Speed Serial Interface (One-pair transmission)
29 = EnDat 3-E30-R2
30 = EnDat 3-E30-R4

Dividing factor 1Vpp

01	1-fold	SSI
25	25-fold	x
NN	Without incremental signals	

Pin configuration

C4 = 1SS08
IS = 03S17, 01
WF = 1SS08 (Mit03-2)
Ed = EnDat 3-E30-RB
lu = EnDat 3-E30-R2
lx = EnDat 3-E30-R4

Electrical connection

01 = Free cable end
1SS08 = M12 8pin coupling male
03S17 = M23 17pin coupling male

Functional safety

.. = No
FA = Analog signal (1Vpp) can be used for safety-related equipment¹⁾

Measuring step

10 = 1 μm
12 = 0,25 μm²⁾
14 = 0,1 μm²⁾

Cable length

0,50 = 0,50 m
1,00 = 1,00 m
1,50 = 1,50 m
2,00 = 2,00 m
2,50 = 2,50 m
3,00 = 3,00 m
4,00 = 4,00 m
5,00 = 5,00 m
6,00 = 6,00 m

¹⁾ Option „FA“ only used for SSI and 1Vpp interface with dividing factor „01“.
²⁾ Not for SSI interface.

ORDERING CODE

- LMFA - Measuring rail for guided linear encoders
- Grating period 1000µm

LMFA

10

-

-

- MF - LF02

Classification
30 = ≤ 9200 mm
31 = > 9200 mm

Grating period
10 = 1000 µm

Scale tape carrier
E = Single section measuring rail
 < 3600 mm
F = Multi section measuring rail
 > 3600 mm

Accuracy ¹⁾
3 = 3 µm/m (total length ≤ 3060 mm)
5 = 5 µm/m
10 = 10 µm/m

Type of graduation carrier
LF02 = Measuring rail, mounting thread M5, each 60 mm

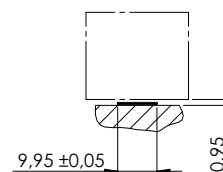
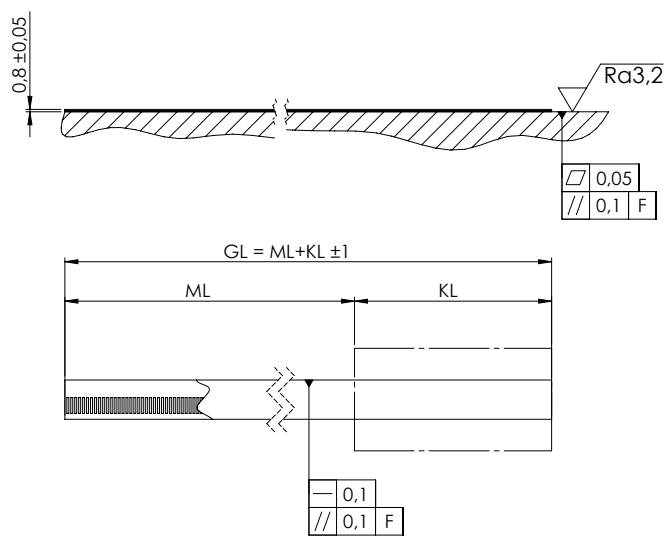
Safety concept
MF = Fault exclusion for the loosening of the mechanical connection possible

Total length in mm
E = Scale tape carrier
 180-3600 mm every 180 mm
F = Scale tape carrier
 3600 mm-xxxx every 180 mm

¹⁾ After linear length-error compensation in the evaluation electronics

SCALE TAPE TO STICK LMB 1010

- Scale tape to stick, for modular linear encoders
- Grating period 1000µm
- In combination with scanning head LMK 1010 or LMK 2010



F = Machine guidance

GL = Total length

ML = Measuring length :

BF 20 / BF 21 : ML = GL - 49 mm

BF 10 / BF 12 : ML = GL - 36 mm

KL = Scanning head length :

BF 20 / BF 21 : 49 mm

BF 10 / BF 12 : 36 mm



Tolerance principle in accordance with ISO 8015

General tolerances in accordance with ISO 2768-fH

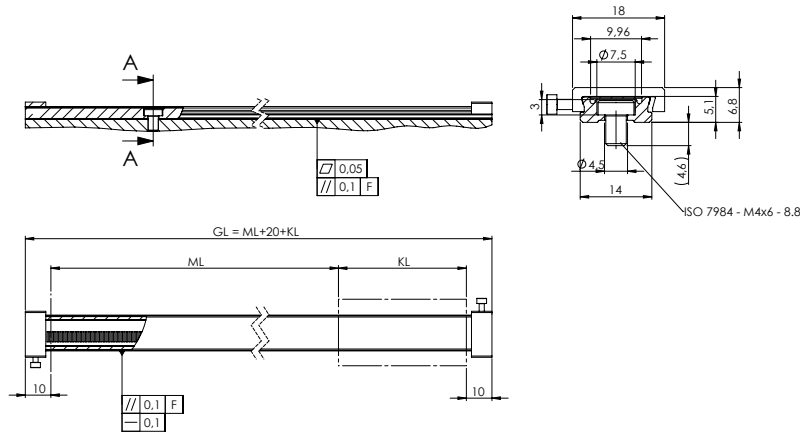
All dimensions in mm

Technical data

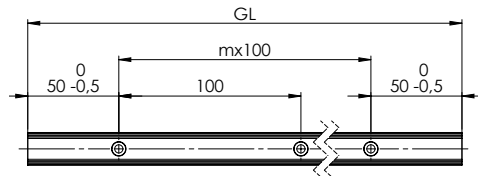
Incremental scale tape	LMB 1010		
Grating period	1000µm		
Accuracy class	± 20µm/m	± 20µm/m	± 50µm/m
Accuracy after linear compensation	± 3µm/m	± 5µm/m	± 10µm/m
Total length GL	Standard length see ordering code		
Mechanical design	Stainless steel scale tape with adhesive layer for mounting		
Reference marks	Single or distance coded reference marks – Customized reference mark positions on request.		
Coefficient of expansion	~ 11 ppm/K		
Mass	50 g/m Total length		

SCALE TAPE IN STAINLESS STEEL CARRIER LMT 4010

- Scale tape in stainless steel carrier, for modular linear encoders
- Grating period 1000µm
- In combination with scanning head LMK 1010 or LMK 2010



Single section carrier LMT 4010 C

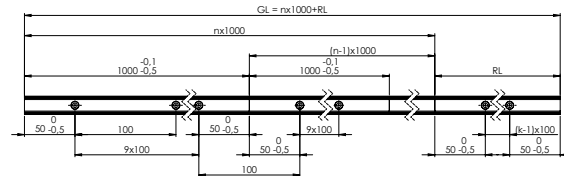


F = Machine guidance

GL = Total length

ML = Measuring length :

Multi section carrier LMT 4010 D



BF 20 : ML = GL - 93mm

BF 21 : ML = GL - 69mm

BF 10/BF 12 : ML = GL - 56mm

KL = Scanning head length :

BF 20 : 73mm

BF 21 : 49mm

BF 10 / BF 12 : 36mm

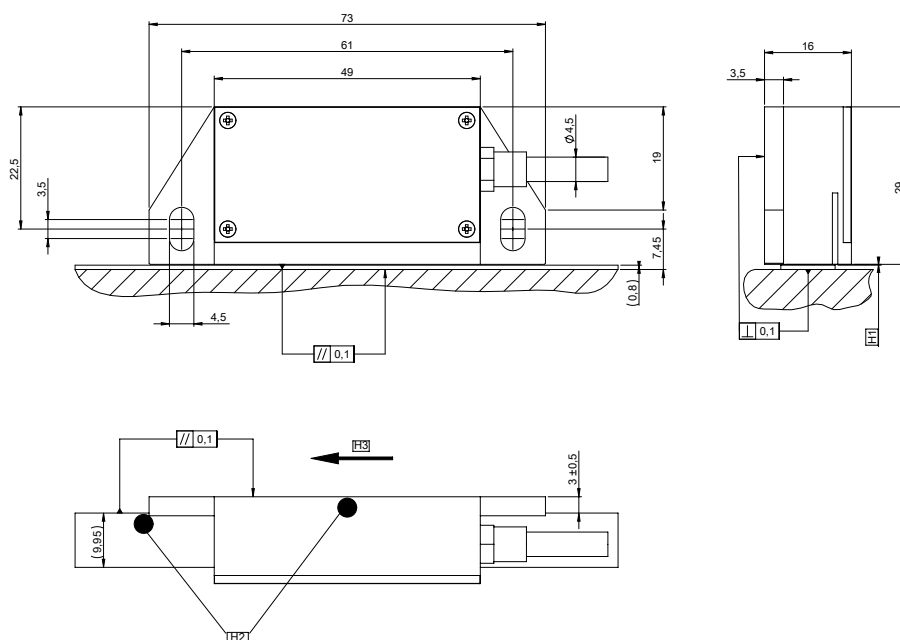
Technical data

Incremental scale tape	LMT 4010		
Grating period	1000µm		
Accuracy class	± 20µm/m	± 20µm/m	± 50µm/m
Accuracy after linear compensation	± 3µm/m	± 5µm/m	± 10µm/m
Total length GL	Standard length see ordering code		
Mechanical design	Stainless steel carrier with integrated scale tape		
Reference marks	Single or distance coded reference marks – Customized reference mark positions on request.		
Coefficient of expansion	~ 11 ppm/K		
Mass	500 g/m Total length		

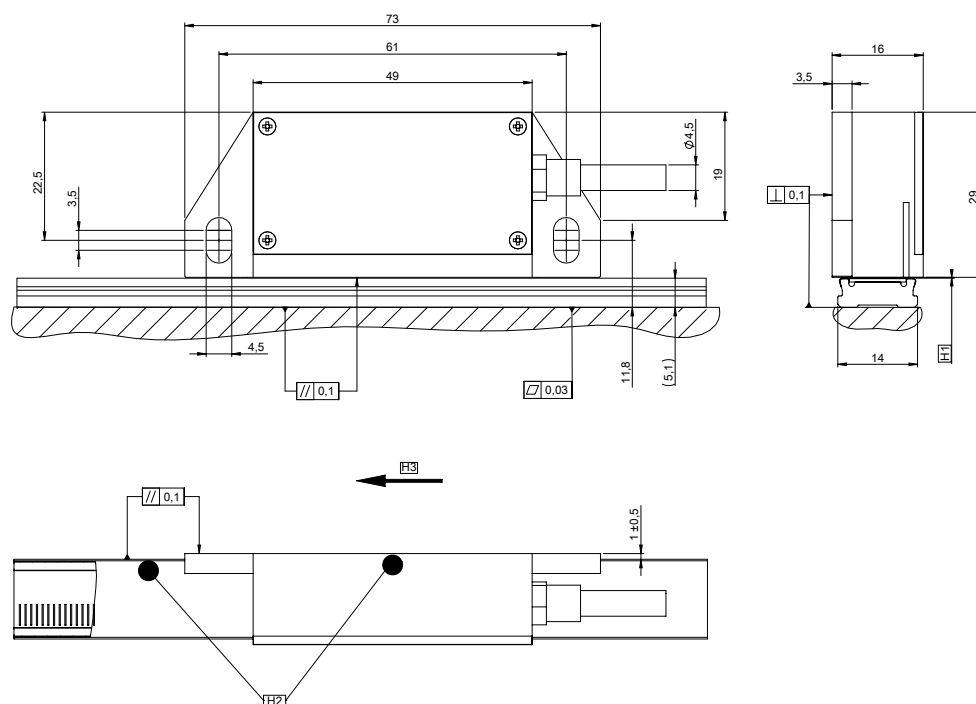
SCANNING HEAD - LMK 2010 SERIES

- Incremental, modular linear encoders
- Grating period 1000µm
- Scanning head with integrated electronics
- In combination with scale type LMB 1010 and LMT 4010

Design 20 with scale type LMB 1010



Design 20 with scale type LMT 4010



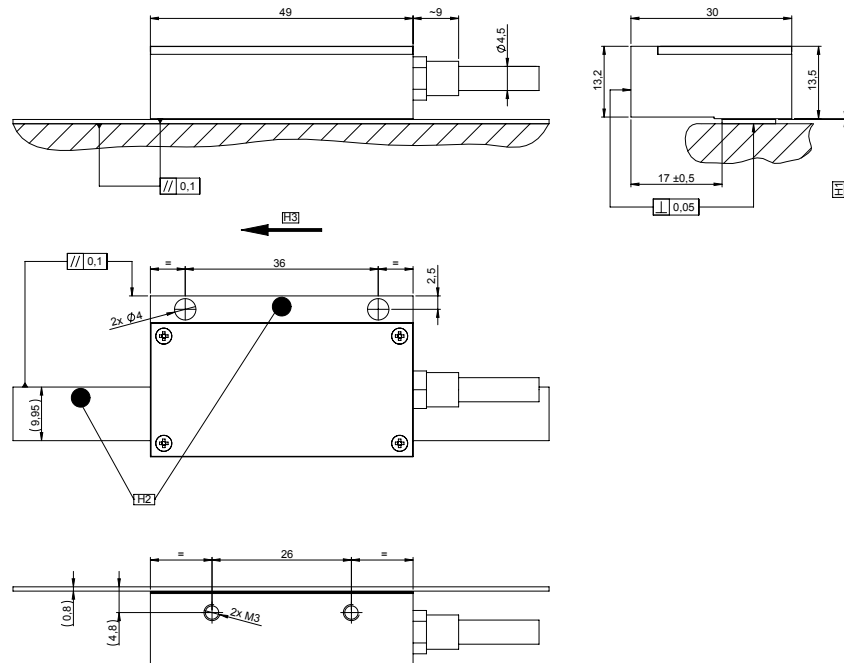
Tolerance principle in accordance with ISO 8015
General tolerances in accordance with ISO 2768-fH
All dimensions in mm

H1 = Air gap $0,15 \pm 0,10$ mm, set with spacer foil
H2 = Reference track marking
H3 = Direction of scanning head movement for positive counting
H4 = Ground plane

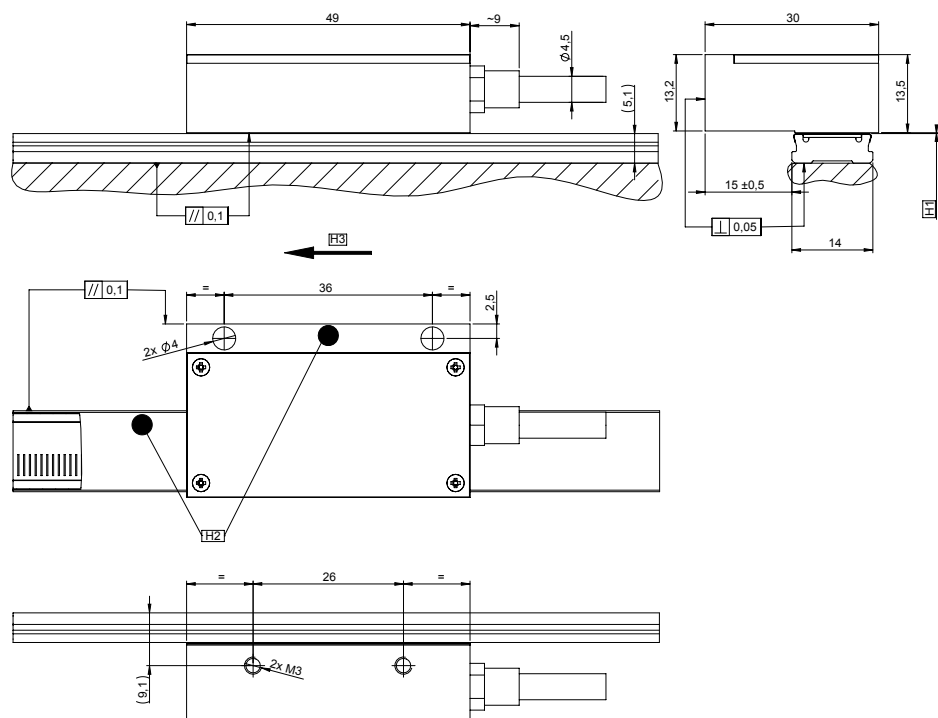
SCANNING HEAD - LMK 2010 SERIES

- Incremental, modular linear encoders
- Grating period 1000µm
- Scanning head with integrated electronics
- In combination with scale type LMB 1010 and LMT 4010

Design 21
with scale type LMB 1010



Design 21
with scale type LMT 4010



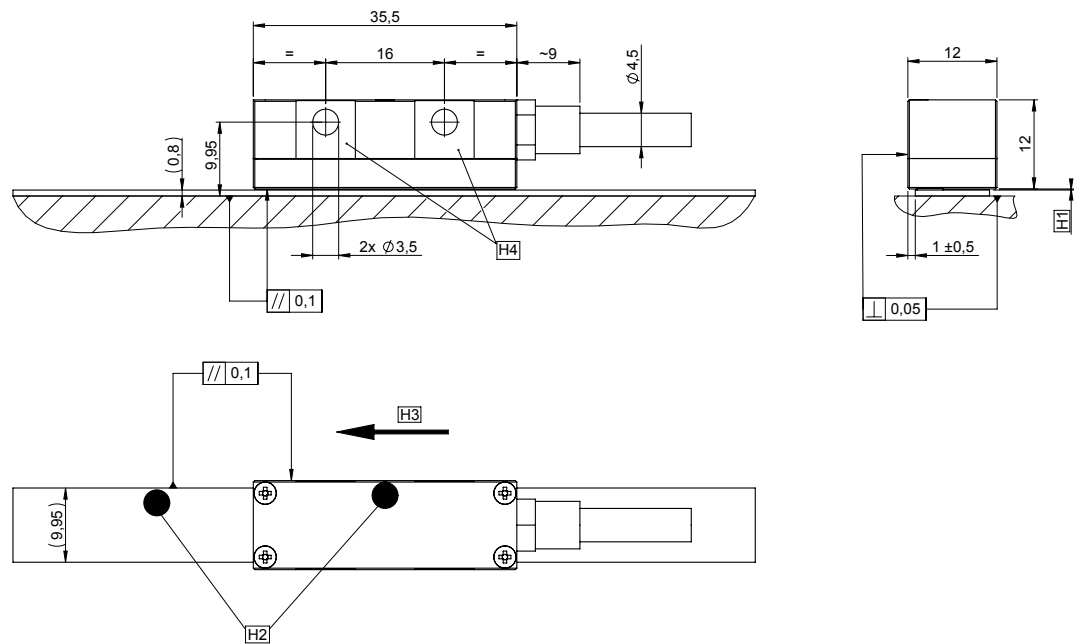
Tolerance principle in accordance with ISO 8015
General tolerances in accordance with ISO 2768-fH
All dimensions in mm

H1 = Air gap $0,15 \pm 0,10$ mm, set with spacer foil
H2 = Reference track marking
H3 = Direction of scanning head movement for positive counting
H4 = Ground plane

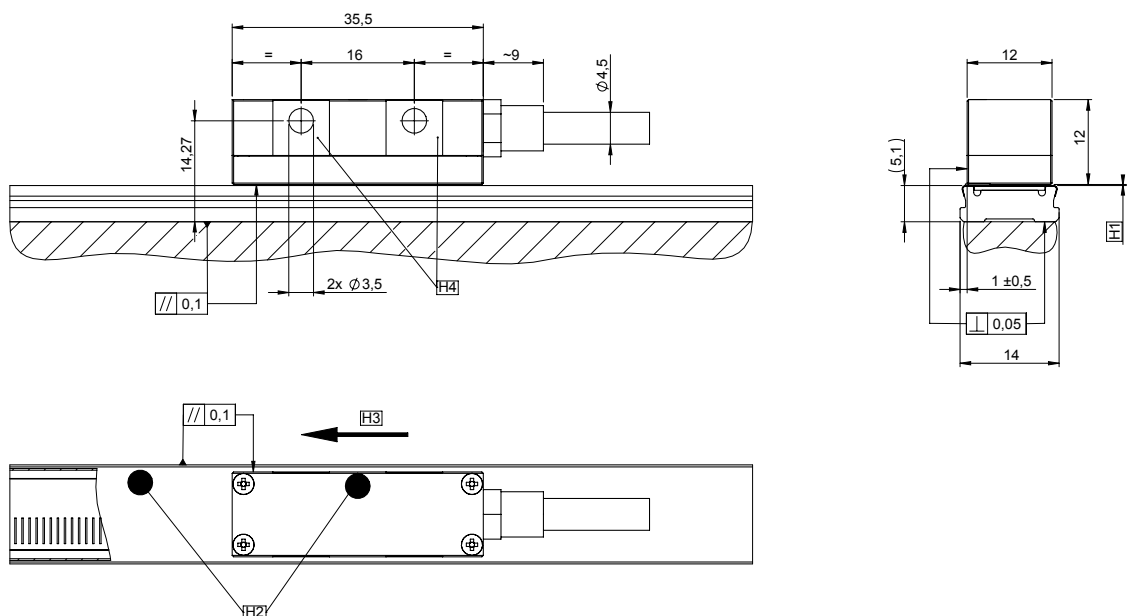
SCANNING HEAD - LMK 1010 SERIES

- Incremental, modular linear encoders
- Grating period 1000µm
- Miniature scanning head with external electronics
- In combination with scale type LMB 1010 and LMT 4010

Design 10 and 12 with scale type LMB 1010



Design 10 and 12 with scale type LMT 4010



Tolerance principle in accordance with ISO 8015
General tolerances in accordance with ISO 2768-fH
All dimensions in mm

H1 = Air gap $0,15 \pm 0,10$ mm, set with spacer foil
H2 = Reference track marking
H3 = Direction of scanning head movement for positive counting
H4 = Ground plane (both sides)

Technical data

- LMK - Scanning head for modular linear encoders
- Grating period 1000µm

Scanning head 1000µm	LMK 2010/LMK 1010			
Performance	Standard		High Accuracy	
Interface	1Vpp	TTL	1Vpp	TTL
Position error per signal period ¹⁾	± 2µm		± 0,5µm	
Maximum speed	20m/s			
TTL - Interpolation/ 1Vpp signal period				
Signal period ²⁾ Interpolation	- -	250µm to 1µm 1 to 250	- -	0,5µm or 0,1µm 500 or 2500
Signal period Dividing factor	1000µm or 40µm 1 or 25	- -	20µm 50	- -
Max. output frequency	400kHz	5MHz	400kHz	5MHz
Electrical connection	Cable with M23 coupling 12pin male			
Cable length on the encoder	0,50m - 6,00m			
Power supply	1Vpp: DC 4,0V to 7,0V TTL: DC 5,0V +/- 0,5V			
Power consumption	Design 20, 21: ≤ 1300mW at 5V Design 10, 12: ≤ 1500mW at 5V			
Typ. current consumption	Design 20,21: ≤ 220mA at 5V (without load) Design 10,12: ≤ 240mA at 5V (without load)			
Vibration 55 to 2000 Hz	< 200m/s² (EN 60068-2-6)			
Shock 6 ms	< 2000m/s² (EN 60068-2-27)			
Operating temperature	-10°C to 100°C			
Storage temperature	-20°C to 100°C			
Protection	IP67			
Mass	38g Design 20, 21 / 10g Design 10,12			

¹⁾ The position error per grating period and the accuracy of the grating results together in the encoder specific error; additional deviations caused by mounting and bearing are not considered in this error.

²⁾ After 4-edge-evaluation.

ORDERING CODE

- LMB - Incremental scale tape to stick for modular linear encoders
- Grating period 1000µm

LMB 1010B - - MF - LB01 -

Accuracy ¹⁾	
3	= 3 µm/m (Total length ≤ 3000 mm)
5	= 5 µm/m
10	= 10 µm/m

Total length in mm	
50- 200	each 10 mm
200- 500	each 20 mm
500- 1000	each 50 mm
1000- 3000	each 100 mm
3000- xxxx	each 200 mm

Reference mark	
ORM	= Without reference mark
1RM-M	= 1 Reference mark- middle
B050	= Reference mark 50mm from both sides
L25	= Reference mark 25mm from left
L50	= Reference mark 50mm from left
R50	= Reference mark 50mm from right
K120	= Distance-coded reference marks, nominal increment 120 grating period
K240	= Distance-coded reference marks, nominal increment 240 grating period

Safety concept	
MF	= Fault exclusion for the loosening of the mechanical connection possible

Type of graduation carrier	
LB01	= Scale tape to stick

¹⁾ After linear length-error compensation in the evaluation electronics

ORDERING CODE

- LMT - Incremental scale tape in stainless steel carrier for modular linear encoders
- Grating period 1000µm

LMT 4010 - - - MF - LT01 -

Scale tape carrier	
C	= Single section carrier (GL ≤ 3000 mm)
D	= Multi section carrier (GL > 3000 mm)

Accuracy ¹⁾	
3	= 3 µm/m (total length ≤ 3000 mm)
5	= 5 µm/m
10	= 10 µm/m

Total length in mm	
≤ 3000 mm	- each 100 mm
> 3000 mm	- each 200 mm

Reference mark	
ORM	= Without reference mark
1RM-M	= 1 Reference mark- middle
B050	= Reference mark 50mm from both sides
L25	= Reference mark 25mm from left
L50	= Reference mark 50mm from left
R50	= Reference mark 50mm from right
K120	= Distance-coded reference marks, nominal increment 120 grating period
K240	= Distance-coded reference marks, nominal increment 240 grating period

Type of graduation carrier	
LT01	= Stainless steel carrier, M4, each 100 mm

Safety concept	
MF	= Fault exclusion for the loosening of the mechanical connection possible

¹⁾ After linear length-error compensation in the evaluation electronics

ORDERING CODE

- LMK - Scanning head for modular linear encoders
- Grating period 1000 μ m

LMK 10

Scanning

10 = Encoder, miniature
20 = Encoder, with integrated electronics

Performance

S = Standard
HA = High Accuracy

Interface

07 = TTL
08 = 1Vpp

Reference mark

RV = Rectangle pulse linked (90° el.) for TTL
RI = Rectangle pulse linked (360° el.) for 1Vpp

Functional safety

.. = No
FA = Analog signal (1Vpp) can be used for safety related equipment ²⁾

Pin configuration

UJ = 01, 02S12, 03S12, 27S12
J5 = 16S15

Cable length

0,50 = 0,50m
1,00 = 1,00m
1,50 = 1,50m
2,00 = 2,00m
2,50 = 2,50m
3,00 = 3,00m
4,00 = 4,00m
5,00 = 5,00m
6,00 = 6,00m

Electrical connection

01 = Free cable end
02S12 = M23-12 pin connector male
03S12 = M23-12 pin coupling male
16S15 = D-SUB-15 pin 2-row male
27S12 ¹⁾ = Flange socket M23 12 pin male

Design of the scanning head

10 = Miniaturized, connector with electronics on cable
12 = Miniaturized, pluggable connector with electronics on cable via M12 connector

20 = Standard
21 = Standard, flat

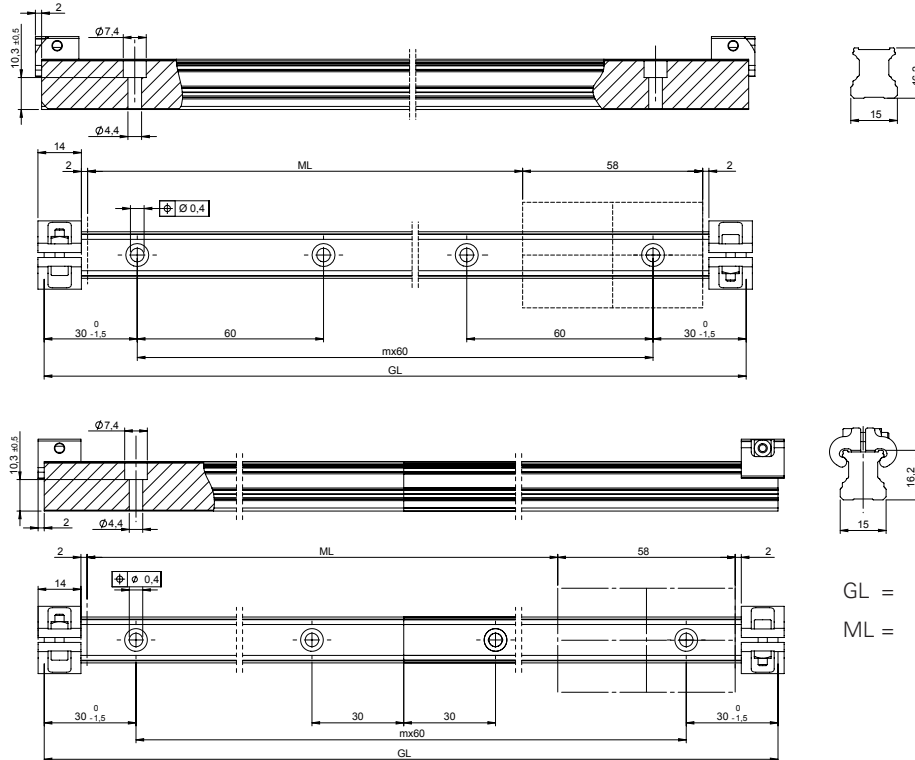
Incremental/Multiplication

		1Vpp		TTL	
		S	HA	S	HA
01	1-fold	x		x	
05	5-fold			x	
10	10-fold			x	
25	25-fold	x		x	
50	50-fold		x	x	
A3	250-fold			x	
A4	500-fold				x
A9	2500-fold				x

¹⁾ Electrical connection for miniaturized design of the scanning head 10 and 12.
²⁾ Option „FA“ only used for dividing factor „01“.

SCALE TAPE IN MEASURING RAIL LMF 3010

- Scale tape in measuring rail, for guided linear encoders
- Grating period 1000µm
- In combination with LMK 3010



GL = Total length

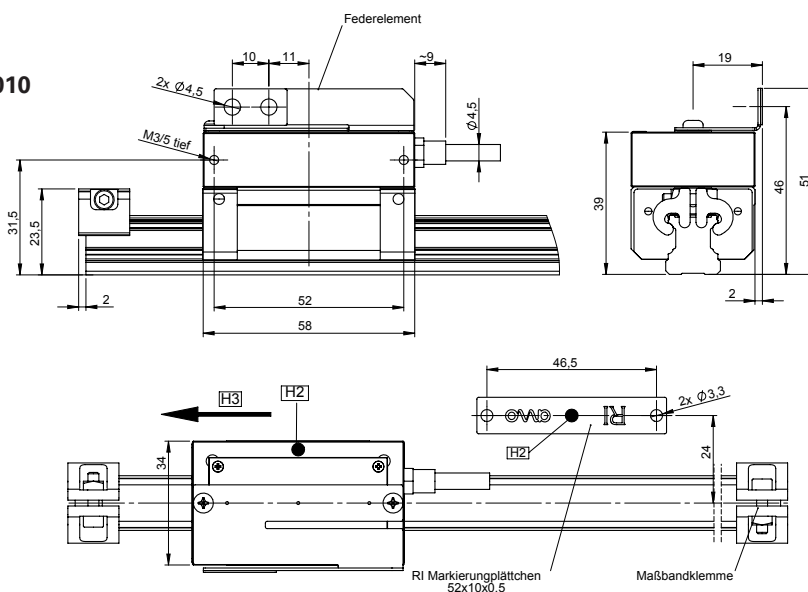
ML = Measuring length :

BF 30 : ML = GL - 86 mm

SCANNING HEAD - LMK 3010 SERIES

- Incremental, guided linear encoders
- Grating period 1000µm
- Guided scanning head with integrated electronics
- In combination with scale type LMF 3010

Design 30 with scale type LMF 3010



Tolerance principle in accordance with ISO 8015

General tolerances in accordance with ISO 2768-fH

All dimensions in mm

H2 = Reference track marking

H3 = Direction of scanning head movement for positive counting

Technical data

- LMF - Measuring rail for guided linear encoders
- Grating period 1000µm

Incremental measuring rail	LMF 3010	
Grating period	1000µm	
Accuracy class	± 20µm/m	± 50µm/m
Accuracy after linear compensation	± 5µm/m	± 10µm/m
Total length GL	Standard length see ordering code	
Mechanical design	Standard guide rail with integrated scale tape	
Reference marks	Single or distance coded reference marks – Customized reference mark positions on request.	
Coefficient of expansion	~ 11 ppm/K	
Mass	1400 g/m Total length	

Technical data

- LMK - Scanning head for guided linear encoders
- Grating period 1000µm

Scanning head guided	LMK 3010			
Grating period	1000µm			
Performance	Standard		High Accuracy	
Interface	1Vpp	TTL	1Vpp	TTL
Position error per grating period ¹⁾	± 2µm		± 0,5µm	
Maximum speed	5m/s limited by the mechanics			
TTL - Interpolation/ 1Vpp signal period				
Signal period ²⁾ Interpolation	- -	250µm to 1µm 1 to 250	- -	0,5µm or 0,1µm 500 or 2500
Signal period Dividing factor	1000µm or 40µm 1 or 25	- -	20µm 50	- -
Max. output frequency	400kHz	5MHz	400kHz	5MHz
Electrical connection	Cable with M23 coupling 12pin male			
Cable length on the encoder	0,50m - 6,00m			
Power supply	1Vpp: DC 4,0V to 7,0V TTL: DC 5,0V +/- 0,5V			
Power consumption	≤ 1300mW at 5V			
Typ. current consumption	≤ 220mA at 5V (without load)			
Vibration 55 to 2000 Hz	< 200m/s² (EN 60068-2-6)			
Shock 6 ms	< 2000m/s² (EN 60068-2-27)			
Operating temperature	-0°C to 80°C			
Storage temperature	-20°C to 100°C			
Protection	IP67			
Mass	200g			

¹⁾ The position error per grating period and the accuracy of the grating results together in the encoder specific error; additional deviations caused by mounting and bearing are not considered in this error.

²⁾ After 4-edge-evaluation.

ORDERING CODE

- LMF- Measuring rail for guided linear encoders
- Grating period 1000µm

LMF 3010 - - - **MF** - **LF01** -

Classification 30 = LMF 3010 Grating period 10 = 1000 µm Scale tape carrier E = Single section measuring rail < 3600 mm F = Multi section measuring rail > 3600 mm Accuracy¹⁾ 5 = 5 µm/m 10 = 10 µm/m Total length in mm E = Scale tape carrier 180-3600 mm every 180 mm F = Scale tape carrier 3600 mm-xxxx every 180 mm	Reference mark ORM = Without reference mark 1RM-M = 1 Reference mark- middle B050 = Reference mark 50mm from both sides L50 = Reference mark 50mm from left R50 = Reference mark 50mm from right K120 = Distance-coded reference marks, nominal increment 120 grating period K240 = Distance-coded reference marks, nominal increment 240 grating period Type of graduation carrier LF01 = Measuring rail, mounting thread M4, each 60 mm Safety concept MF = Fault exclusion for the loosening of the mechanical possible
---	--

¹⁾ After linear length-error compensation in the evaluation electronics

ORDERING CODE

- LMK - Scanning head for guided linear encoders
- Grating period 1000 μ m

LMK 3010

Grating period
 $10 = 1000 \mu\text{m}$

Performance
 S = Standard
 HA = High Accuracy

Interface
 07 = TTL
 08 = 1Vpp

Reference mark
 RV = Rectangle pulse linked (90° el.) for TTL
 RI = Rectangle pulse linked (360° el.) for 1Vpp

Functional safety
 .. = No
 FA = Analog signal (1Vpp) can be used for safety related equipment

Pin configuration
 UJ = 01, 02S12, 03S12
 J5 = 16S15

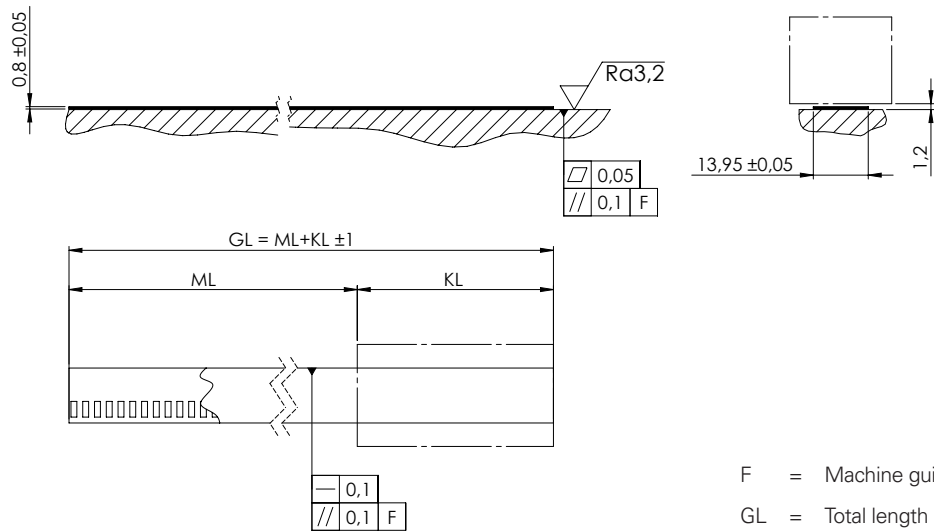
Electrical connection
 01 = Free cable end
 02S12 = M23-12pin connector male
 03S12 = M23-12pin coupling male
 16S15 = D-SUB-15pin 2-row male

Cable length
 0,50 = 0,50 m
 1,00 = 1,00 m
 1,50 = 1,50 m
 2,00 = 2,00 m
 2,50 = 2,50 m
 3,00 = 3,00 m
 4,00 = 4,00 m
 5,00 = 5,00 m
 6,00 = 6,00 m

		1Vpp		TTL	
		S	HA	S	HA
01	1-fold	x		x	
05	5-fold			x	
10	10-fold			x	
25	25-fold	x		x	
50	50-fold		x	x	
A3	250-fold			x	
A4	500-fold				x
A9	2500-fold				x

SCALE TAPE TO STICK LMB 1030

- Scale tape to stick, for modular linear encoders
- Grating period 3000µm
- In combination with scanning head LMK 2030



F = Machine guidance

GL = Total length

ML = Measuring length :

BF 20 / BF 21 : ML = GL - 49 mm

KL = Scanning head length :

BF 20 / BF 21 : 49 mm



Tolerance principle in accordance with ISO 8015

General tolerances in accordance with ISO 2768-fH

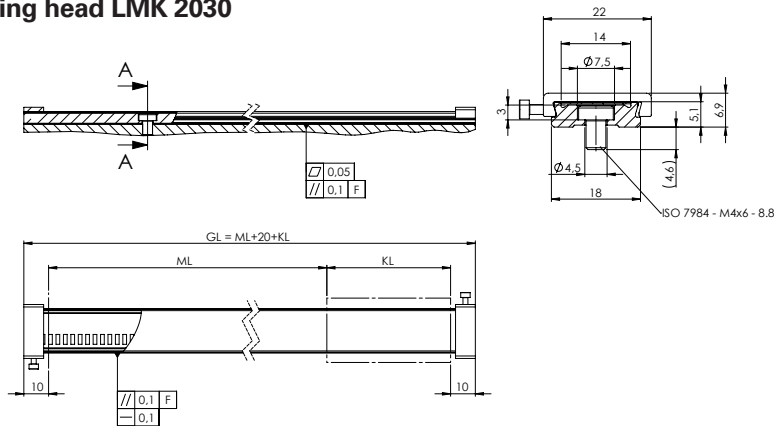
All dimensions in mm

Technical data

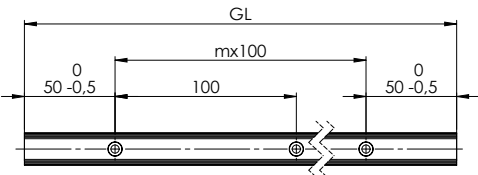
Incremental scale tape	LMB 1030	
Grating period	3000µm	
Accuracy class	± 50µm/m	± 50µm/m
Accuracy after linear compensation	± 10µm/m	± 20µm/m
Total length GL	Standard length see ordering code	
Mechanical design	Stainless steel scale tape with adhesive layer for mounting	
Reference marks	Single or distance coded reference marks – Customized reference mark positions on request.	
Coefficient of expansion	~ 11ppm/K	
Mass	70 g/m Total length	

SCALE TAPE IN STAINLESS STEEL CARRIER LMT 4030

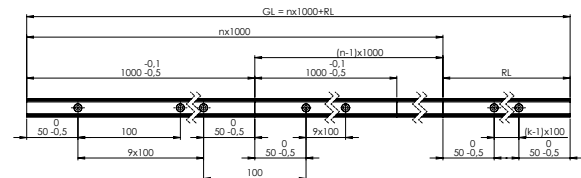
- Scale tape in stainless steel carrier, for modular linear encoders
- Grating period 3000µm
- In combination with scanning head LMK 2030



Single section carrier LMT 4030 C



Multi section carrier LMT 4030 D



F = Machine guidance

GL = Total length

ML = Measuring length :

BF 20 : ML = GL - 93mm

BF 21 : ML = GL - 69mm

KL = Scanning head length :

BF 20 : 73mm

BF 21 : 49 mm

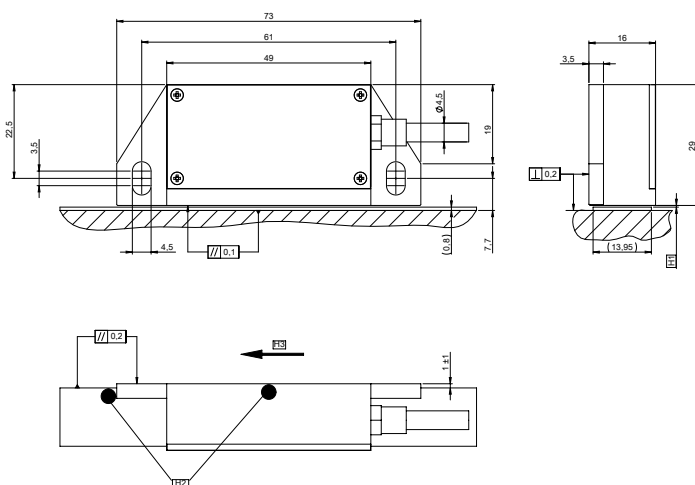
Technical data

Incremental scale tape	LMT 4030	
Grating period	3000µm	
Accuracy class	± 50µm/m	± 50µm/m
Accuracy after linear compensation	± 10µm/m	± 20µm/m
Total length GL	Standard length see ordering code	
Mechanical design	Stainless steel carrier with integrated scale tape	
Reference marks	Single or distance coded reference marks – Customized reference mark positions on request.	
Coefficient of expansion	~ 11ppm/K	
Mass	650 g/m Total length	

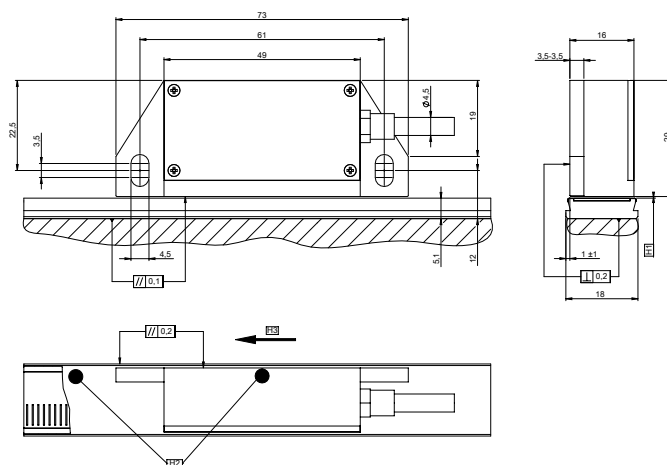
SCANNING HEAD - LMK 2030 SERIES

- Incremental, modular linear encoders
- Grating period 3000µm
- Scanning head with integrated electronics
- In combination with scale type LMB 1030 and LMT 4030

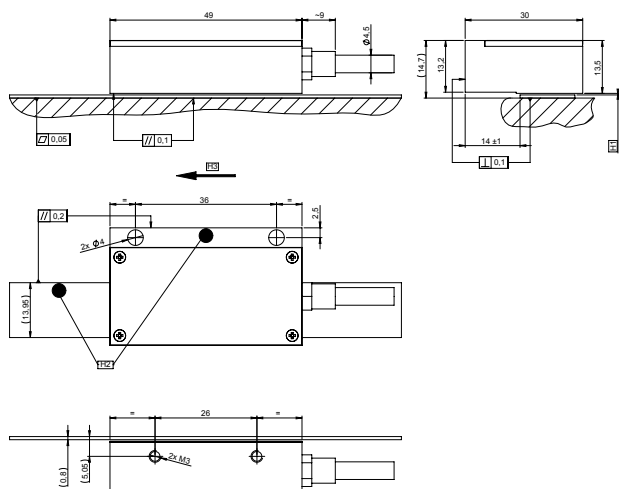
Design 20
with scale type LMB 1030



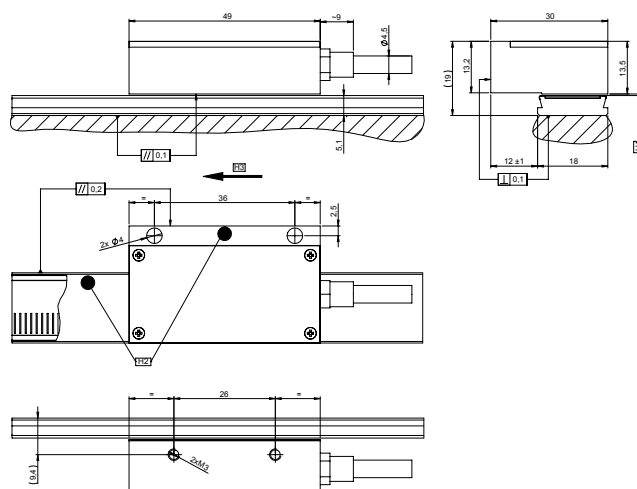
Design 20
with scale type LMT 4030



Design 21
with scale type LMB 1030



Design 21
with scale type LMT 4030



Tolerance principle in accordance with ISO 8015
General tolerances in accordance with ISO 2768-fH
All dimensions in mm

H1 = Air gap $0,40 \pm 0,20$ mm, set with spacer foil
H2 = Reference track marking
H3 = Direction of scanning head movement for positive counting
H4 = Ground plane

Technical data

- LMK - Scanning head for modular linear encoders
- Grating period 3000µm

Scanning head 3000 µm	LMK 2030			
Performance	Standard		High Tolerance	
Interface	1Vpp	TTL	1Vss	TTL
Position error per grating period ¹⁾	± 4µm		± 4µm	
Maximum speed	60m/s			
TTL - Interpolation/ 1Vpp signal period				
Signal period ²⁾ Interpolation	- -	750µm to 3µm 1 to 250	- -	750µm to 3µm 1 to 250
Signal period Dividing factor	3000µm to 93,75µm 1 to 32	- -	750µm to 93.75µm 4 to 32	- -
Max. output frequency	400kHz	5MHz	400kHz	5MHz
Electrical connection	Cable with M23 coupling 12pin male			
Cable length on the encoder	0,50m - 6,00m			
Power supply	DC 4,0V to 7,0V	DC 5,0V ± 0,5V	DC 4,0V +/- 7,0V	DC 5,0V +/- 0,5V
Power consumption	Design 20, 21: ≤ 1300mW at 5V			
Typ. current consumption	Design 20,21: ≤ 220mA at 5V (without load)			
Vibration 55 to 2000 Hz	< 200m/s² (EN 60068-2-6)			
Shock 6 ms	< 2000m/s² (EN 60068-2-27)			
Operating temperature	-10°C to 100°C			
Storage temperature	-20°C to 100°C			
Protection	IP67			
Mass	38g Design: 20, 21			

¹⁾ The position error per grating period and the accuracy of the grating results together in the encoder specific error; additional deviations caused by mounting and bearing are not considered in this error.

²⁾ After 4-edge-evaluation.

ORDERING CODE

- LMB - Incremental scale tape to stick for modular linear encoders
- Grating period 3000µm

LMB 1030B - - MF - LB01 -

Accuracy ¹⁾

10 = 10 µm/m
20 = 20 µm/m

Total length in mm

50- 200	each 10 mm
200- 500	each 20 mm
500- 1000	each 50 mm
1000- 3000	each 100 mm
3000- xxxx	each 200 mm

Safety concept

MF = Fault exclusion for the loosening of the mechanical connection possible

Reference mark

ORM = Without reference mark
1RM-M = 1 Reference mark- middle
B050 = Reference mark 50mm from both sides
L25 = Reference mark 25mm from left
L50 = Reference mark 50mm from left
R50 = Reference mark 50mm from right
K120 = Distance-coded reference marks, nominal increment 120 grating period
K240 = Distance-coded reference marks, nominal increment 240 grating period

Type of graduation carrier

LB01 = Scale tape to stick

¹⁾ After linear length-error compensation in the evaluation electronics

ORDERING CODE

- LMT - Incremental scale tape in stainless steel carrier for modular linear encoders
- Grating period 3000µm

LMT 4030 - - MF - LT01 -

Scale tape carrier

C = Single section carrier (GL ≤ 3000 mm)
D = Multi section carrier (GL > 3000 mm)

Accuracy ¹⁾

10 = 10 µm/m
20 = 20 µm/m

Total length in mm

≤ 3000 mm	each 100 mm
> 3000 mm	each 200 mm

Reference mark

ORM = Without reference mark
1RM-M = 1 Reference mark- middle
B050 = Reference mark 50mm from both sides
L25 = Reference mark 25mm from left
L50 = Reference mark 50mm from left
R50 = Reference mark 50mm from right
K120 = Distance-coded reference marks, nominal increment 120 grating period
K240 = Distance-coded reference marks, nominal increment 240 grating period

Type of graduation carrier

LT01 = Stainless steel carrier, M4, each 100 mm

Safety concept

MF = Fault exclusion for the loosening of the mechanical connection possible

¹⁾ After linear length-error compensation in the evaluation electronics

ORDERING CODE

- LMK - Scanning head for modular linear encoders
- Grating period 3000 μ m

LMK 2030 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 20 21 25 50 A3

Performance
S = Standard
HT = High Tolerance

Interface
07 = TTL
08 = 1Vpp

Reference mark
RV = Rectangle pulse linked (90° el.) for TTL
RI = Rectangle pulse linked (360° el.) for 1Vpp

Functional safety
.. = No
FA = Analog signal (1Vpp) can be used for safety related equipment¹⁾

Incremental signals/Multiplication

		1Vpp		TTL	
		S		S	
01	1-fold	x			
05	5-fold				x
10	10-fold				x
25	25-fold	x		x	
50	50-fold			x	
A3	250-fold			x	

Pin configuration
UJ = 01, 02S12, 03S12
J5 = 16S15

Electrical connection
01 = Free cable end
02S12 = M23-12 pin connector male
03S12 = M23-12 pin coupling male
16S15 = D-SUB-15 pin 2-row male

Cable length
0,50 = 0,50 m
1,00 = 1,00 m
1,50 = 1,50 m
2,00 = 2,00 m
2,50 = 2,50 m
3,00 = 3,00 m
4,00 = 4,00 m
5,00 = 5,00 m
6,00 = 6,00 m

Design of the scanning head
20 = Standard
21 = Standard, flat

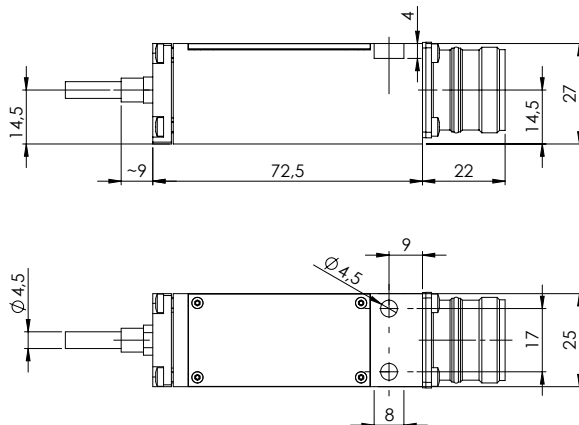
¹⁾ Option „FA“ only used for dividing factor „01“.

EXTERNAL ELECTRONICS

- General information
- Dimensions

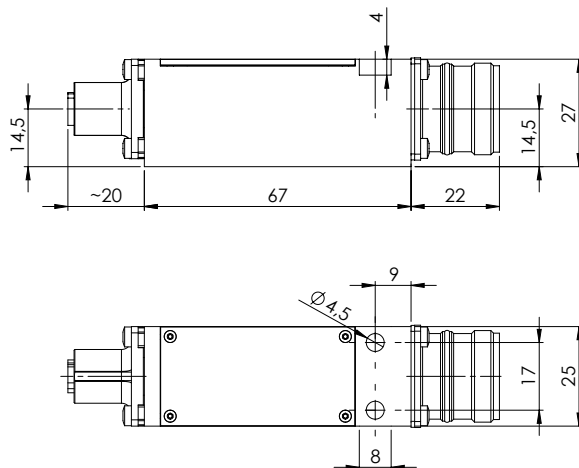
Design 10

- Miniaturized scanning head
- with external electronics on the cable
- Output: Flange socket M23



Design 12

- Miniaturized scanning head
- with external electronics, pluggable on cable via M12 connector
- Output: Flange socket M23



Tolerance principle in accordance with ISO 8015

General tolerances in accordance with ISO 2768-fH

All dimensions in mm

INTERFACES EnDat 2.2

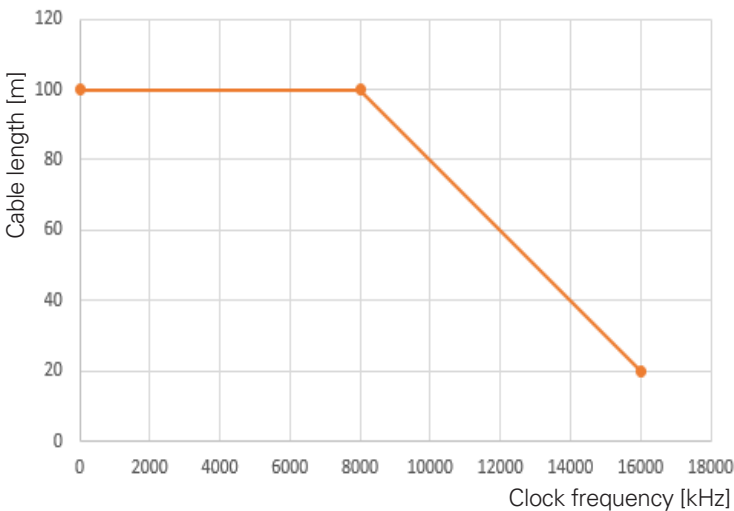
Position values

The EnDat-Interface is a digital, **bi-directional** Interface for encoder. With this interface you can read out **position values**. This value can also be updated or new values can be saved. Due to the **serial data transfer four signal wires** are enough. The data DATA gets transferred **synchronously** to the form the subsequent electronics given clock frequency CLOCK. The selection from the mode of transmission (position values, parameter, diagnostics,...) is done with mode-commands which are sent from the subsequent electronics to the encoder.

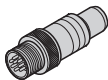
The clock frequency is variable- depending on the cable lenght (max. 100m). With subsequent electronics, either clock frequencies up to 16MHz are possible or cable lenght up to 100m. For EnDat encoders the maximum clock frequency is sored in the encoder memory. Propagation-delay compensation is provided only for EnDat22.

Transmission frequencies up to 16MHz in combination with large cable lenght place high technological demands in the cable. Greater cable lenghts can be realized with an adapter cable no longer than 6m and an extension cable. As a rule, the entire transmission path must be designed for the respective clock frequency.

Order code	Instruction set	Incremental signals
EnDat2.2	EnDat 2.2	Without



Pin configuration

Electrical connection: 1SS08 8-pin coupling M12 								
	Power supply				Absolute position values			
	8	2	5	1	3	4	7	6
	U _P	Sensor U _P	0V	Sensor 0V	DATA+	DATA-	CLOCK+	CLOCK-
	brown/green	blue	white/green	white	grey	pink	violet	yellow

Cable Shield is connected with the housing; **U_P** = Power supply voltage
Sensor: The sensor wire is connected internally with the corresponding power supply.
Non-used pins or wires must not be assigned!

INTERFACES

Pin layouts Fanuc, Mitsubishi BiSS/C[®]

Fanuc

AMO-Encoder with Fanuc Interface are for connection to a Fanuc-Control.

Fanuc Serial Interface - α Interface

Order code: Fanuc02
normal and high speed, two-pair transmission

Fanuc Serial Interface - αi Interface

Order code: Fanuc05
high speed, one-pair transmission
includes the α Interface (normal and high speed two-pair transmission)

BiSS/C

AMO-Encoder with BiSS/C[®] Interface are suitable for the connection with controls, which have the BiSS/C Interface implemented.

BiSS/C bidirektionales Protokoll

Order code: BiSS
The Standard Encoder Profile- 32bit will be used.

Mitsubishi

AMO encoder with Mitsubishi Interface are for connection to a Mitsubishi-Control.

Mitsubishi high speed interface

Order code: Mit03-4→ two pair transmission
Order code: Mit03-2→ one pair transmission

Pin configuration

Electrical connection: 1SS08 / C4 for Fanuc, Mitsubishi two-pair transmission, BiSS/C 1SS08 / WF for Mitsubishi one-pair transmission 8-pin coupling M12								
	Power supply				Absolute position values			
	8	2	5	1	3	4	7	6
1SS08 / C4	U_P	Sensor U _P	0V	Sensor 0V	DATA+	DATA-	CLOCK+	CLOCK-
1SS08 / WF					-	-		
	brown/green	blue	white/green	white	grey	pink	violet	yellow

Cable Shield is connected with the housing; **U_P** = Power supply voltage

Sensor: The sensor wire is connected internally with the corresponding power supply.
Non-used pins or wires must not be assigned!

Interface

EnDat 3 carries forward the features and benefits of EnDat into the future of digital manufacturing. To achieve this feat, EnDat3 relies on a new architecture that builds upon proven technology, ensuring optimal continuity and compatibility with predecessor interfaces.

EnDat3 characteristics:

- Hybrid cable transmission
- Bus topologies
- Sensors: versatile data contents and sensor box
- Functional safety: black channel communication
- Higher data bandwidth
- Definable send lists
- System installation: introduction of access levels

Interface	
Protocol	Request-response-procedures in half-duplex mode
Physical layer	RS-485: 4-wires oder 2-wires
Data rate	12,5 Mbit/s (25 Mbit/s)
Cable length	max. 100m at 12,5 Mbit/s / max. 40m at 25 Mbit/s
HPF- send time (position availability in the master)	Typically 10µs (the parameter XEL.timeHPFout indicates the duration between position value generation (stored via latch) and transmission of the complete HPF, without cable impacts)
cycle time	Typically > 25µs

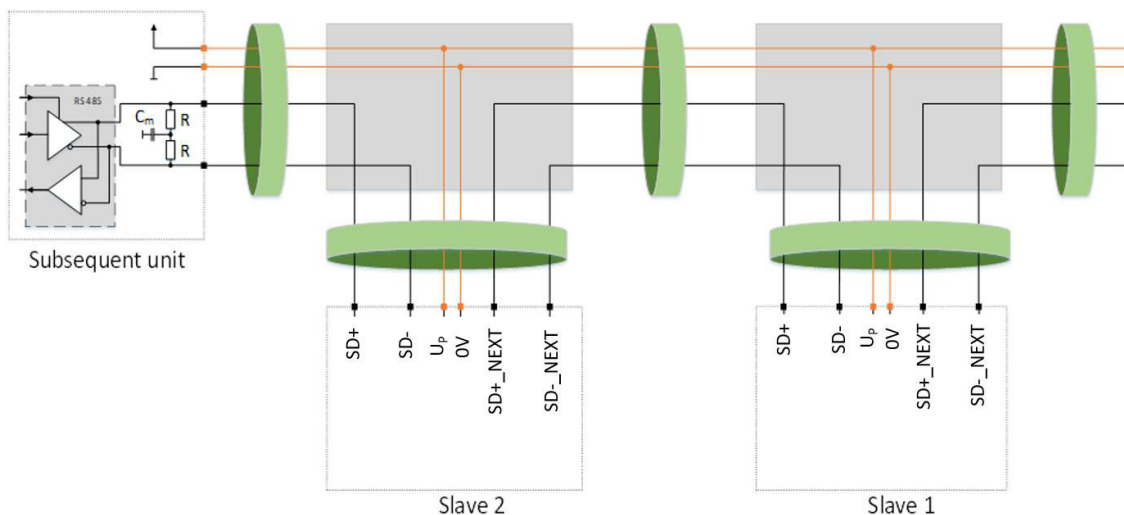
supported communications	E30-R2	E30-R4	E30-RB
EnDat 3: Communication modulated onto power supply wires	✓	-	-
Endat 3: Communication + separate power supply wires (4 wires)	-	✓	✓
EnDat 3: bus operation	-	-	✓
Sensor box integration	-	✓	✓

Bus operation

Basic principle

EnDat 3 enables bus operation in daisy-chain mode. For connection to the EnDat 3 Master, the connection for the power supply and a wire pair for communication are required. The encoders have two connectors for one communication wire pair each.

Communication is passed on by the slaves, and the slave listens to the entire communication. The following image illustrates the basic principle:



Broadcast

The master sends a request as a broadcast and anticipates responses from all connected participants. The participant with Address "1" (designated "Slave 1" in the image) sends its response first (designated "RSP1" in the image).

The next participant (Slave 2) listens to the response and sends its own response immediately after completion of its own response. The following image shows the procedure based on an example with three participants:

Address assignment

For the bus communication the corresponding bus addresses must be programmed in the encoder. This can be done with subsequent electronics or e.g. with the test equipment PWM 21 + ATS-software.

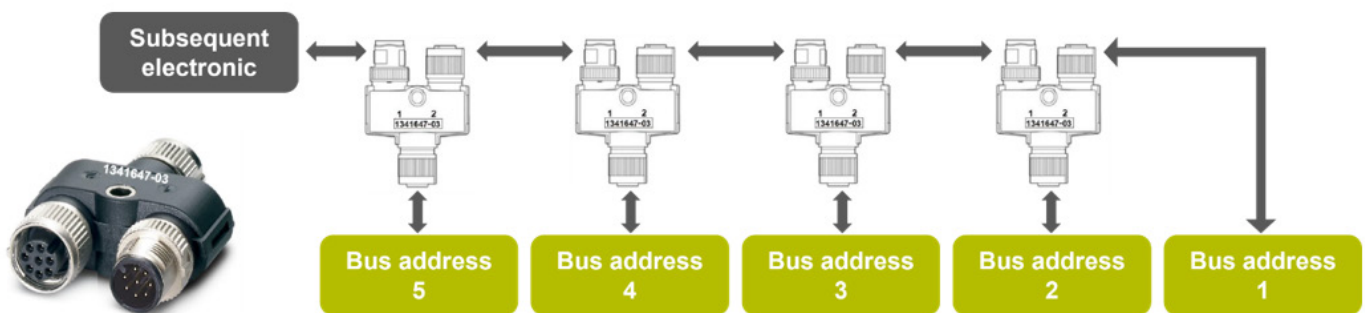


Power supply and cable requirements

By interconnecting several encoders, a relatively high supply current is created in the individual sub-areas. It is therefore important to ensure that the supply wires have a sufficient cross section.

To limit losses in the cables, the following recommendation applies: The furthest away participant (bus address 1) should be supplied with at least 9 V. The cables must be suitable for EnDat 3 communication.

It is recommended to use the Y-coupler (ID 1341647-03) and original HEIDENHAIN cable. The following graphic shows the basic structure:



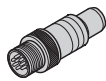
The connection of the encoder to the Ycoupler can be done via the encoder cable. For the cabling from Y-coupler to Y-coupler EnDat22 cables can be used,

according to the brochure "Cables and Connectors".

Please note the "General Electrical Information" section in the "Interfaces of HEIDENHAIN encoders" brochure.

Pin configuration

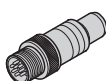
Pin configuration for EnDat 3 E30-R2

Electrical connection: 1SS08 8-pin coupling M12								
  								
Power supply / serial data transfer								
	7	6	8	2	5	1	3	4
	P_SD+¹⁾	P_SD-¹⁾	-	-	-	-	-	-
	violet	yellow	-	-	-	-	-	-

Cable shield is connected with the housing; **U_P** = Power supply voltage

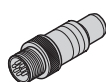
¹⁾ **Power supply and Data:** **P_SD+** included **U_P**; **P_SD-** includes 0V

Pin configuration for EnDat 3 E30-R4

Electrical connection: 1SS08 8-pin coupling M12								
  								
Power supply / serial data transfer								
	8	5	7	6				
	+V (U_P)	0V (U_N)	SD+	SD-				
	brown-green	white-green	violet	yellow				

Cable shield is connected with the housing; **U_P** = Power supply voltage

Pin configuration for EnDat 3 E30-RB

Electrical connection: 1SS08 8-pin coupling M12								
  								
Power supply / serial data transfer								
	7	6	8	2	5	1	3	4
	SD+	SD-	+V (U_P)	+V (Sensor)	0V (U_N)	0V (Sensor)	SD+_Next	SD-_Next
	violet	yellow	brown-green	blue	white-green	white	grey	pink

Cable shield is connected with the housing; **U_P** = Power supply voltage

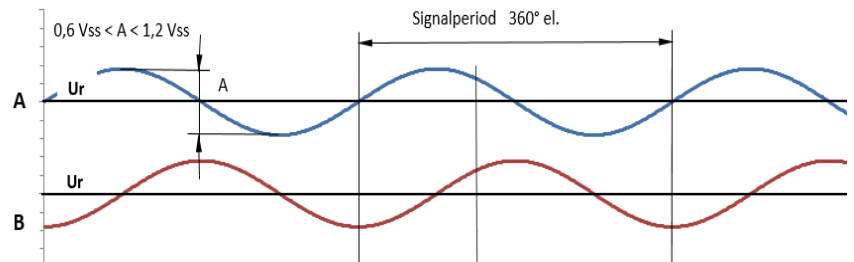
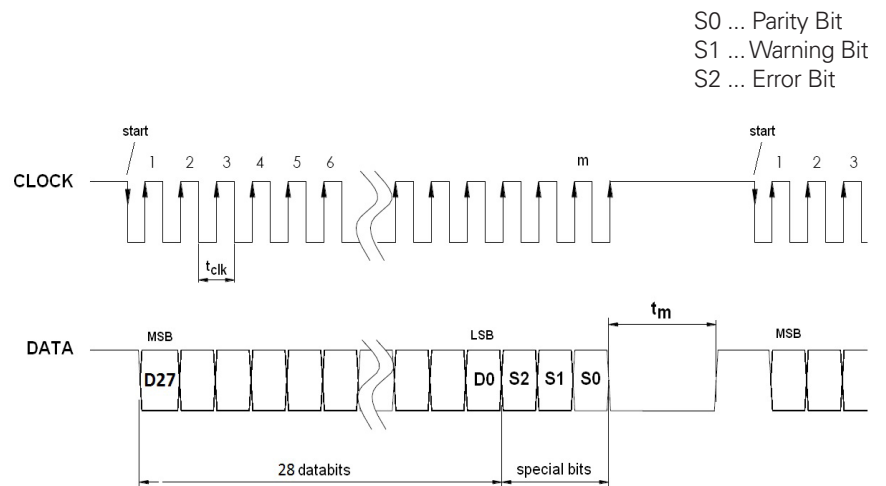
INTERFACES

SSI + $\sim 1V_{pp}$

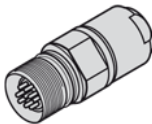
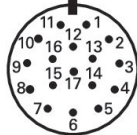
SSI Interface is an unidirectional Interface which can output position values. The data DATA gets transferred synchronously to the from the subsequent electronic given clock frequency CLOCK. Additionally three special bits (Error, Warning and Parity) will be transferred

AMO-Encoder with $\sim 1V_{pp}$ -Interface are outputting signals which can be highly interpolated.

The sine shaped **incremental signals** A and B are electrically 90° phase shifted and have a signal- B after A- is valid for the in the connection drawing stated movement direction.



Pin configuration

Electrical connection: 03S17 17-pin coupling M23   												
	Power supply				Increment signals				Absolut position value			
	7	1	10	4	15	16	12	13	14	17	8	9
	U _P	Sensor U _P	0V	Sensor 0V	A+	A-	B+	B-	DATA+	DATA-	CLOCK+	CLOCK-
	brown/green	blue	white/green	white	brown	green	grey	pink	red	black	violet	yellow

Cable Shield is connected with the housing; **U_P** = Power supply voltage

Sensor: The sensor wire is connected internally with the corresponding power supply.

Non-used pins or wires must not be assigned!

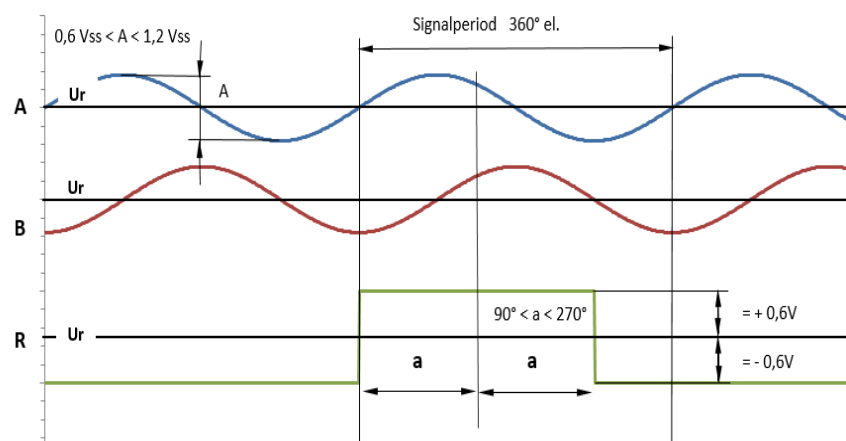
INTERFACE

Incremental signals $\sim 1V_{pp}$

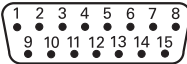
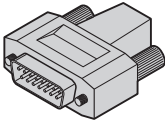
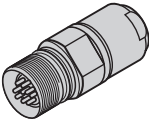
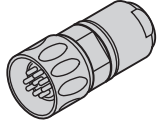
AMO-Encoder with $\sim 1 V_{pp}$ -Interface are outputing signals which can be highly interpolated.

The sine shaped incremental signals A and B are electrically 90° phase shifted and have a signal strenght from 1Vpp. The showed sequence of the outputet signals- B after A- is valid for the in the connection drawing stated movement direction.

The reference mark signal R has a clear as-
signment to the incremental signals.



Pin configuration

Electrical connection: 16S15 15-pin Sub-D-connector 													
Electrical connection: 03S12 12-pin coupling M23 					Electrical connection: 02S12 12-pin connector M23 								
	Power supply				Incremental signals						Other signals		
	4	12	2	10	1	9	3	11	14	7	5/15	8	6
	12	2	10	11	5	6	8	1	3	4	/	7	9
	U_P	Sensor U_P	0 V	Sensor 0 V	A+	A-	B+	B-	R+	R-	Frei	Diag+	Diag-
	brown/ green	blue	white/ green	white	brown	green	grey	pink	red	black	/	violet	yellow

Cable Shield is connected with the housing; **U_P** = Power supply voltage

Sensor: The sensor wire is connected internally with the corresponding power supply.

Non-used pins or wires must not be assigned!

DIAG-wires must not be assigned.

DIAG-signals are for checking the encoder with AMO-STU-60.

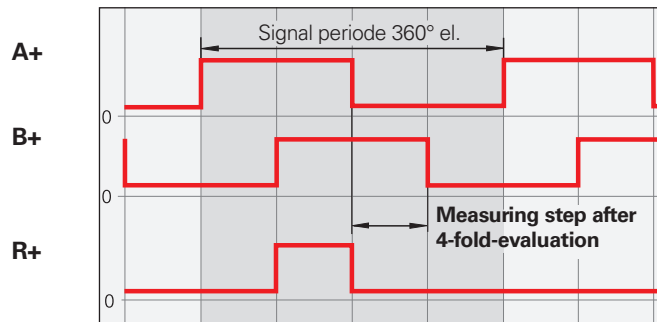
INTERFACES

Incremental signals □ TTL

AMO-Encoder with □ TTL Interface contain electronic, which form the sine-wave signals- with or without- Interpolation into digital signals.

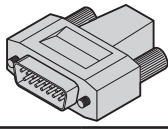
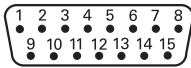
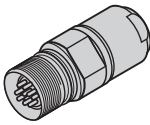
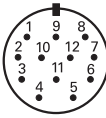
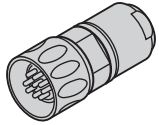
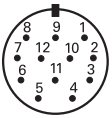
The **incremental signals** are outputted as rectangle pulses A+ and B+ with 90° el. phase shifting. The **rectangle-mark-signal** is composed from one or more reference impulses R+, which are assigned with the incremental signals. The integrated electronic additionally creates the **inverse signals** A-, B- and R- for a safe transmission. The showed sequence of the outputted signals- B after A- is valid for the in the connection drawing stated movement direction.

The **measuring step** results through the distance between two flanks from the incremental signals A+ and B+ through 1-fold, 2-fold or 4-fold evaluation.



The inverse signals A-, B- und R- are not shown.

Pin configuration

Electrical connection: 16S15 15-pin Sub-D-connector   													
Electrical connection: 03S12 12-pin coupling M23   					Electrical connection: 02S12 12-pin connector M23   								
	Power supply				Incremental signals						Other signals		
	4	12	2	10	1	9	3	11	14	7	5/15	8	6
	12	2	10	11	5	6	8	1	3	4	/	7	9
	U _P	Sensor U _P	0V	Sensor 0V	A+	A-	B+	B-	R+	R-	Frei	Diag+	Diag-
	brown/green	blue	white/green	white	brown	green	grey	pink	red	black	/	violet	yellow

Cable Shield is connected with the housing; **U_P** = Power supply voltage

Sensor: The sensor wire is connected internally with the corresponding power supply.

Non-used pins or wires must not be assigned!

DIAG-wires must not be assigned!

DIAG-signals are for checking the encoder with AMO-STU-60

ENCODER CABLE

Technical Data

	Cable for incremental encoder and SSI+1Vpp	Cable for encoder with pure serial interfaces
Jacket	PUR, high flexible, suitable for energy chains	
Diameter	4,5 +/-0,1mm	
Wires	6x2x0,09mm ²	1x(4*0,09mm ²) + 4x0,14mm ²
Bending radius	≥ 10mm for single bending	
	≥ 50mm for continuous bending	
Max. length	6m	
Resistance according to	UL according to Style 20963 80°C 30V	

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