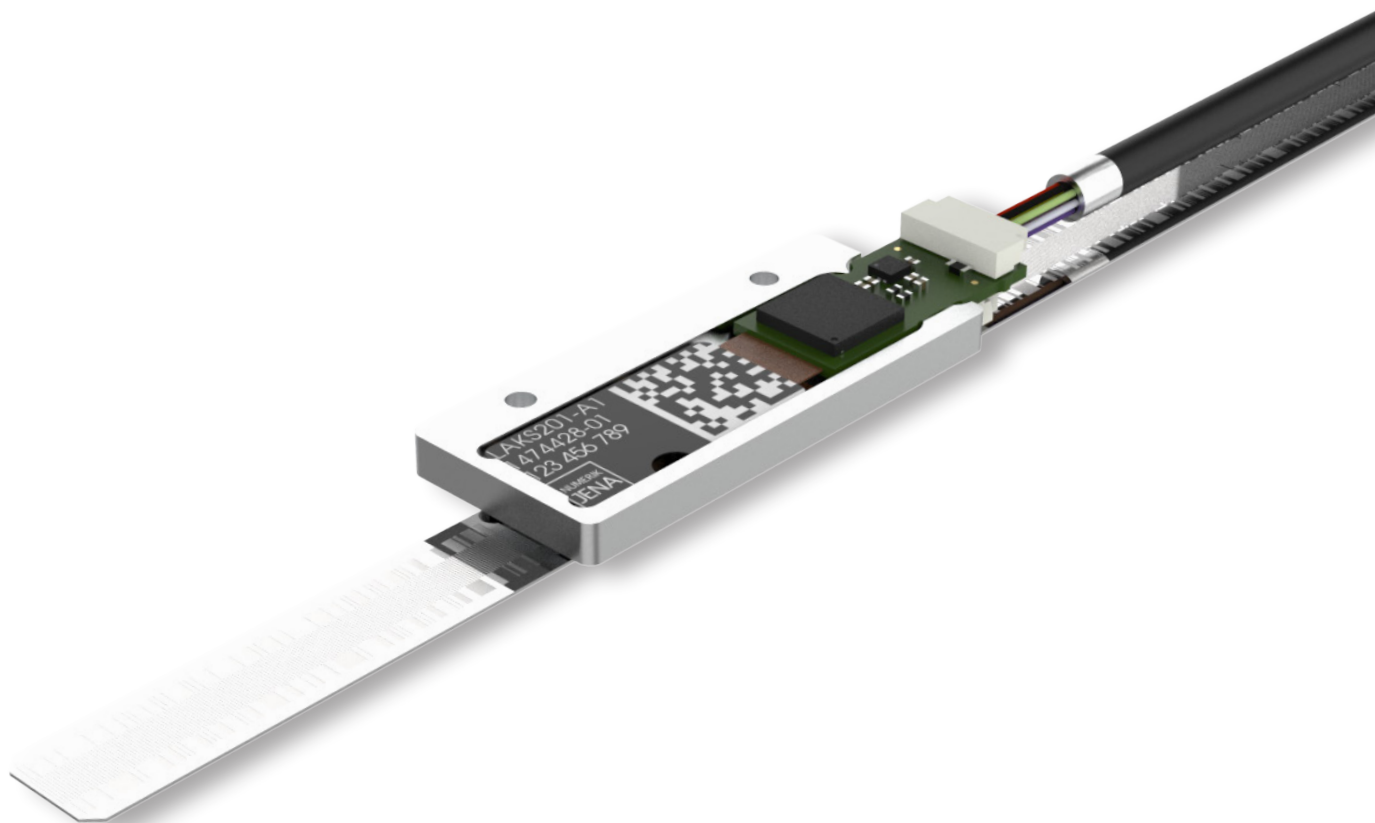




LAK*select*

Absolute Linear Encoder



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1. Overview

Position encoders in drive systems have to meet high and controversial demands, especially in linear drive systems. The demands opposing each other are high accuracy and resolution on the one hand and low mass, small dimensions and high measuring speed on the other hand.

The LAKselect encoders from NUMERIK JENA are equipped with features that fulfill these high requirements in an ideal manner. The special combination of incremental and absolute encoder does not only guarantee stable operation but also enables high speed measuring with high resolution while still maintaining very small dimensions. Furthermore NUMERIK JENA set great value to customization possibilities during the development. Therefore the LAKselect measuring system offers a large number of customization options as well as various interfaces:

- Possibility of an electronic adjustment after mounting to reduce static mounting errors
- Individual measuring lengths of the scales available (up to 3.70 m)
- Several interfaces usable
- Wide range of supply voltages to compensate conduction losses
- Extensive diagnostic and monitoring functions (e.g. read head temperature)
- High control dynamics due to low calculation time
- Two absolute tracks and two incremental sensors ensure high contamination immunity

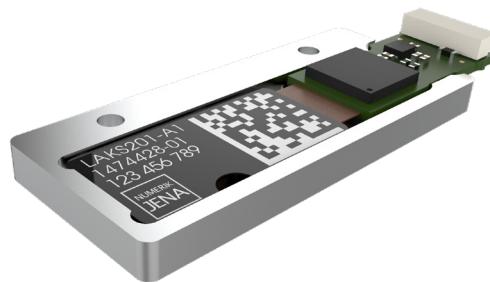


Image 1

2. Application Examples

- Production and inspection machines for the semiconductor industry
- Linear units and linear drives
- Coordinate tables
- Measuring machines and measuring microscopes
- Robotics
- Precision devices in reprography
- Precise machining
- Positioning and measuring devices in medical technology

3. Technical Data

3.1 Resolution and Accuracy (Definition)

Basically one has to differentiate between the resolution and the accuracy of a measuring system. The two parameters are not directly interdependent and may differ from each other.

Resolution

The resolution of linear system describes the least possible displacement of scanning head against the scale which can still be discerned by the evaluation electronics (display, control). It depends on:

- the graduation period of the scale
- the signal interpolation factor (internally or in auxiliary electronic unit)

Accuracy

The accuracy of linear measuring systems is specified in accuracy classes.

The extreme error values for any max. one-meter section of the measured length lie within the specified accuracy class of $\pm a \text{ }\mu\text{m}$ with respect to their mean value.

For measuring length up to 1 m, the tolerance ($\pm a \text{ }\mu\text{m}$) refers to the actual measuring lengths. The accuracy applies to a reference temperature of 20°C.

With exposed linear measuring systems, the definition of the accuracy class applies only to the scale. This is called scale accuracy.

3.2 Mechanical Data

3.2.1 Scanning Head

LAKselect		
Dimensions of scan head [mm]	depending on the frame (example: 43.9 x 16 x 5.2)	
Area of sensor glass [mm]	18.7 x 9	
Weight of scan head (w/o cable)	depending on the frame (example: 5.0 g)	
Measuring steps	EnDat 2.2	SSI, HIPERFACE ¹ compatible, BiSS C ² (unidirectional)
	10 nm	1.25 µm 625.0 nm 312.5 nm 156.25 nm 78.125 nm
Max. traversing speed	10 m/s	
Working distance (air gap)	0.85 mm	
Interpolation error	Ideal (perfect mounting conditions)	Typical (within mounting tolerances)
	30 nm _{rms}	50 nm _{rms}
Mounting tolerances scan head with scale tape as reference base	Δ Y = ±0.5 mm Δ Z = ±0.2 mm	Δ φX = ±0.5° Δ φY = ±0.5° Δ φZ = ±0.25°

Chart 1

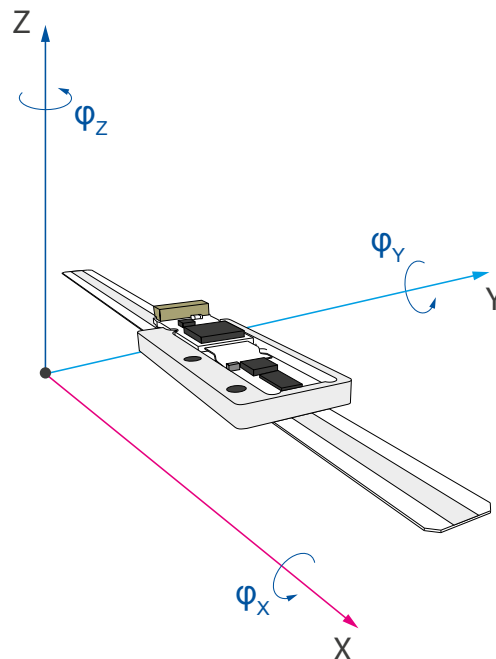


Image 2

¹ HIPERFACE is a trade mark of SICK Stegmann GmbH

² BiSS is a trade mark of iC-Haus GmbH

3.2.2 Scale Tape

Scale tape	
Material	Stainless steel
Absolute track	Pseudo Random Code (PRC)
Incremental track	20 µm grating period (TP)
Measuring length (ML)	
SINGLEFLEX scale tape	up to 3.70 m
DOUBLEFLEX scale tape	up to 3.70 m
Linear thermal expansion coefficient	
SINGLEFLEX scale tape	$10.6 \times 10^{-6} \text{ K}^{-1}$ (expansion will be influenced by the mounting surface)
DOUBLEFLEX scale tape	$10.6 \times 10^{-6} \text{ K}^{-1}$
Accuracy class (a)	
SINGLEFLEX, DOUBLEFLEX scale tape	$\pm 3 \text{ µm}$ (based on a scale tape length of 1 m)

Chart 2

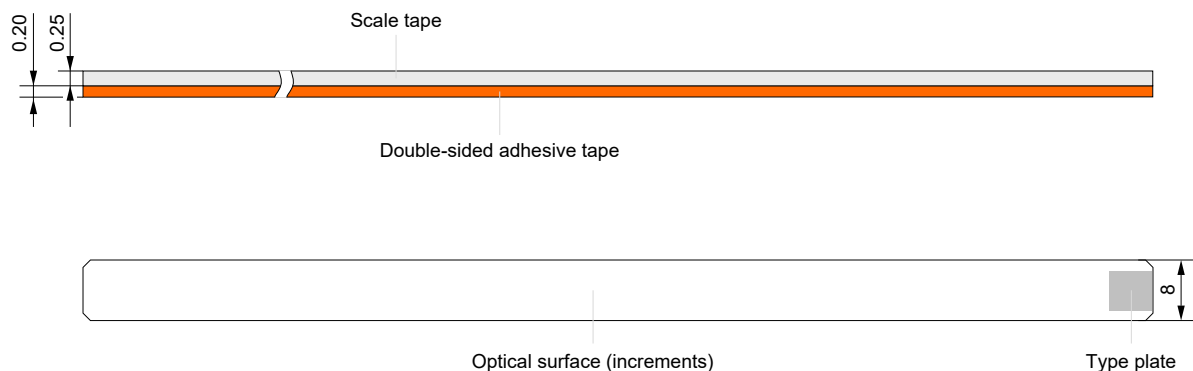
3.2.3 SINGLEFLEX and DOUBLEFLEX Scale Tape

The steel scale tapes from NUMERIK JENA are available in two different versions:

- SINGLEFLEX
- DOUBLEFLEX

SINGLEFLEX

The SINGLEFLEX-scale tape consists of a single steel tape with applied incremental and absolute tracks. The scale tape is equipped with a double-sided adhesive tape and can be mounted easily on the machine element.



Dimensions in [mm]

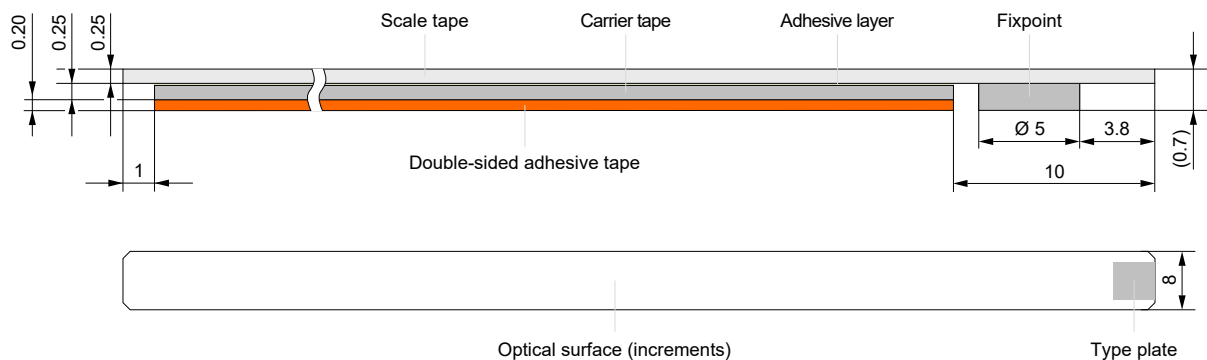
Image 3

DOUBLEFLEX

The DOUBLEFLEX scale tape is a special version of the SINGLEFLEX scale tape. It was specially developed for applications in which significant temperature fluctuations occur during operation, which have a negative effect on the measurement result or the accuracy of the measurement.

It consists of two superimposed steel tapes. Both are separated from each other by a thin, tension-decoupling oil film, which also ensures adhesion between the tapes. Increments, which are required for position detection, are applied to the upper scale tape. The lower tape is the carrier tape, which is provided with a double-sided adhesive tape and can simply be fixed to the machine element.

Both tapes are mechanically decoupled from each other so that the scale tape can expand linearly independently of the carrier tape in the event of fluctuations in the ambient temperature. The positioning of the fixed point determines the direction of the expansion. By referencing the ambient temperature parameters and the thermal expansion coefficient of the steel tape, any deviations in the grid spacing can be determined and compensated in the measurement result.



Dimensions in [mm]

Image 4

PLEASE NOTE

The DOUBLEFLEX scale tape must not be exposed to strong acceleration or vibration forces during installation or operation. The connection between the carrier and scale tape is sensitive to mechanical influences. It can be damaged by excessive force or oil can leak from the intermediate layer, which can interfere with the optical properties of the measuring system due to contamination.

In the case of moving axes, the scanning head should preferably be the moving component, not the DOUBLEFLEX scale tape. Especially with fast or abrupt movements.

3.2.4 Cable

Cable	
Cable diameter	3.7 mm
Permissible bending radius	Occasional flexing ~8 mm Constant flexing ~40 mm
From scan head to the D-Sub connector	0.3 m, 0.5 m, 1.0 m, 1.5 m, 2.0 m, 3.0 m (other on request)
From D-Sub connector to the controller (extension cable)	The maximum possible cable length depends on the interface and clock frequency. For more details, please refer to the interface brochure at: www.numerikjena.com/downloads-en/documents-software/

Chart 3

Scanning Head Cable (Connection Cable from Scanning Head to D-Sub Connector)

- Please mount the scanning head preferably on the rigid part and the scale tape on the mobile part of the machine. If this is not possible, provide a strain relief for the cable near the scanning head.
- The encoder cables and connecting cables must be laid away from sources of interference (e.g. mains cables, fuses, motors, magnetic valves or power supplies). Normally a distance of ≥ 100 mm will be sufficient.
- Install the cable in a way that it cannot be damaged by the moving carriage. Please pay attention to the permissible bending radius!

Extension Cable (Connection Cable from D-Sub Connector to Controller)

- Use preferably original extension cables made by NUMERIK JENA. This guarantees an optimum compatibility with the encoders and ensures a maximum protection against electromagnetic interferences.
- Please consult the technical support of NUMERIK JENA before using selfmanufactured extension cables.
- Do not install any other signal lines in the encoder cable!

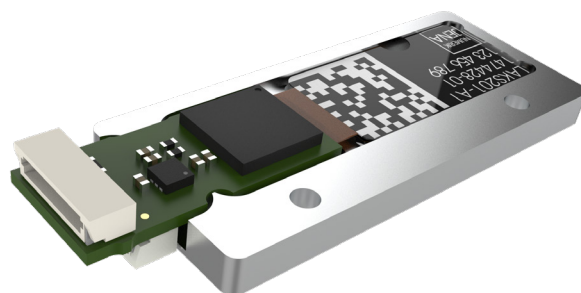


Image 5

3.3 Electrical Data

EnDat 2.2			
Parameter	Min.	Typ.	Max.
Supply voltage (at connector)*	3.6 V	5.0 V	14.0 V
Current consumption**	-	250 mA	335 mA
Power Consumption**	-	1250 mW	1500 mW
Calculation time	≤5 µs		
Max. boot time at power-on	500 ms		
Output interfaces	Serial: • EnDat 2.2 Usable simultaneously: • USB 2.0 (diagnostics and user interface)		

Chart 4

SSI, HIPERFACE ¹ compatible, BiSS C ² (unidirectional)			
Parameter	Min.	Typ.	Max.
Supply voltage (at scanning head)*	3.5 V	5.0 V	5.5 V
Current consumption**	-	145 mA	165 mA
Power Consumption**	-	725 mW	910 mW
Calculation time	≤1 µs		
Max. boot time at power-on	200 ms		
Output interfaces	Serial: • SSI • HIPERFACE compatible interface ¹ • BiSS C (unidirectional) interface ² Usable simultaneously: • USB 2.0 (diagnostics and user interface) • 1 V _{pp} (SIN+, COS+, SIN-, COS-)		

Chart 5

* Total voltage drop: 0.7 V (ABSOFLEX Adapter) + voltage drop in the cable

** Current and power consumption are dependent on used interfaces due to load variation on internal driver modules.

¹ HIPERFACE is a trade mark of SICK Stegmann GmbH

² BiSS is a trade mark of iC-Haus GmbH

3.4 PIN Assignment 15 Pin D-Sub Connector

EnDat 2.2																
PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Housing
Signal	-	0 V	-	5 V	DAT+	-	USBD-	CLK+	-	-	-	-	DAT-	USBD+	CLK-	Shield

Each differenetial pair of wires is twisted, Cable-Ø = 3.7 mm Chart 6



Image 6

SSI, HIPERFACE compatible, BiSS C (unidirectional)																
PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Housing
Signal	U ₁₊	0 V	U ₂₊	5 V	DAT+	-	USBD-	CLK+	U ₁₋	-	U ₂₋	-	DAT-	USBD+	CLK-	Shield
Color	green	blue	white green	brown green	grey	-	black	violet	brown	-	white	-	pink	red	yellow	-

Each differenetial pair of wires is twisted, Cable-Ø = 3.7 mm Chart 7



Image 7

3.5 PIN Assignment 12 Pin JST Mini-Connector

PIN X ₁	1	2	3	4	5	6						
PIN X ₂							1	2	3	4	5	6
Signal	U ₂₋	U ₂₊	U ₁₋	U ₁₊	USBD-	USBD+	Sdata-	Sdata+	Sclk-	Sclk+	5 V	0 V
Color	white	white green	brown	green	black	red	pink	grey	yellow	violet	brown green	blue
PIN X ₃	1	2	3	4	5	6	7	8	9	10	11	12

Each differenetial pair of wires is twisted.

Chart 8

1 V_{PP}

U₁₊ Counting signal 0° (sin)

U₁₋ Counting signal 180° (-sin)

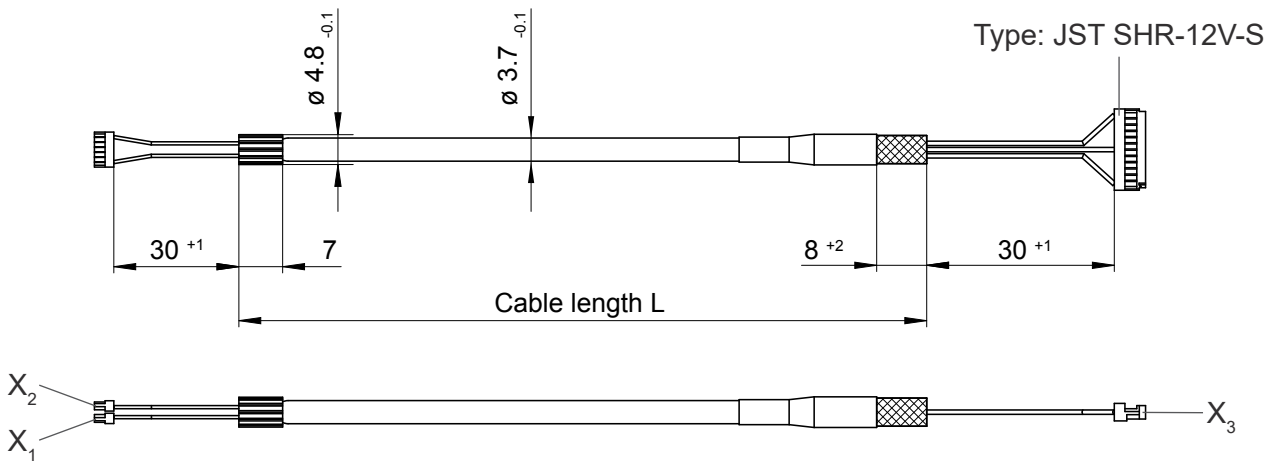
U₂₊ Counting signal 90° (cos)

U₂₋ Counting signal 270° (-cos)

0 V Ground (GND)

5 V Operating voltage (U_B)

3.6 Cable Layout



Tolerance cable length L: L < 1 m: L + 10 mm
L > 1 m: L + 30 mm

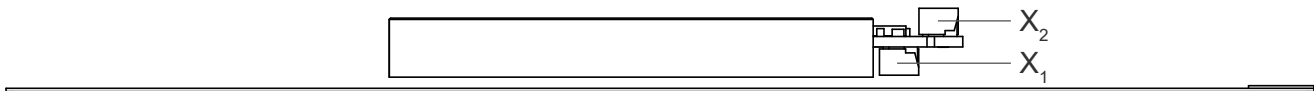


Image 8

3.7 Electromagnetic Compatibility (EMC)



Please observe the following to ensure maximum protection against electrical and magnetic fields:

- The encoder must be mounted to a galvanic conductive surface. The mounting surfaces, the threads of the mounting screws and the threads in the machine must be free from electrically non-conductive coatings.
- Maintain the NUMERIK JENA shielding concept for the measuring system (see also Image 9)!
- Shielding for encoders without connectors:
 - When connected directly with the evaluation electronics, ensure that the external shield of the cable is well grounded
 - If cable connectors (e.g. terminal strips, etc.) are used, connect the external shields of the cables with each other and with the shielding of the cable connector
- When using additional electronics, connect the housing electrically conducting to ensure good galvanic conductivity. For insulated installation the housing should be connected at the shortest distance by an additional potential equalization line (Cu line with cross section $\geq 6 \text{ mm}^2$) with the machine's protective ground.
- Please contact the NUMERIK JENA support or that of the appropriate manufacturer if you experience any problems when working with specific display or control units.

3.8 Shielding Concepts

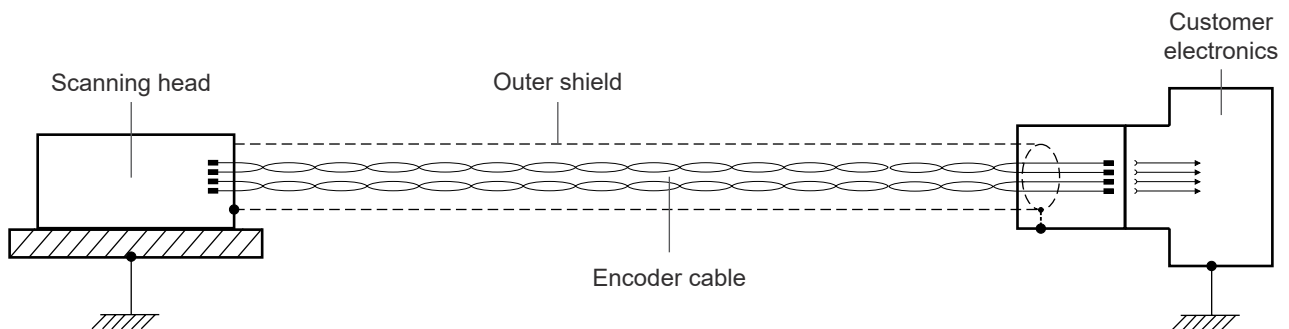


Image 9

3.9 Ambient Conditions

LAKselect scanning head	
Operating temperature range	0°C to +55°C (+32°F to +131°F)
Storage temperature range	-20°C to +70°C (-4°F to +158°F)
Vibration (50 Hz ... 2,000 Hz)	≤200 ms ⁻² (20 g)
Shock (11 ms)	≤400 ms ⁻² (40 g)
Humidity	93% relative humidity (non-condensing)

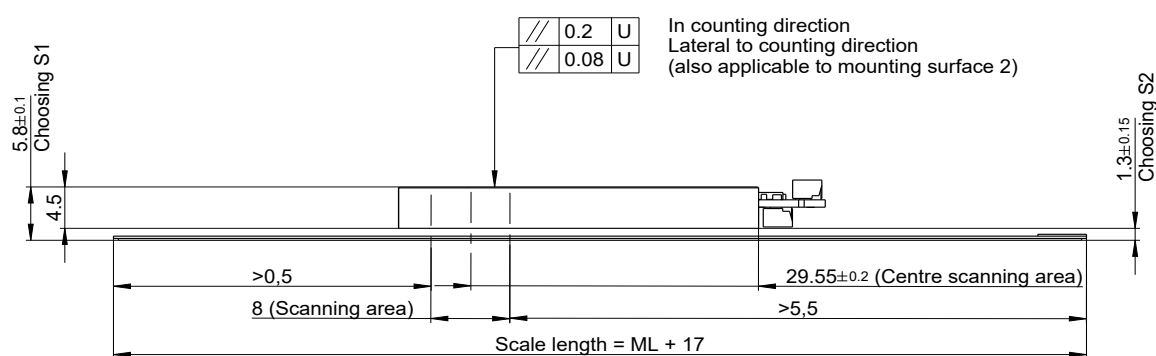
Chart 9

PLEASE NOTE

The values listed in the chart were determined exclusively for the scanning head component, not for the measuring standard. Measuring standards may be subject to different ambient conditions or limit values depending on the type, intended use, mounting variant and installation position.

4. Dimensions and Mounting Conditions

4.1 SINGLEFLEX Scale Tape

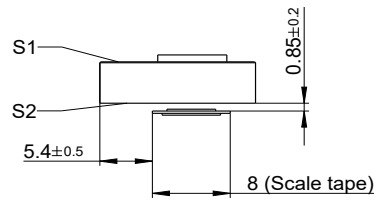


Example LAKselect with Standard Frame

Image 10

M =	 0.03 / Mounting surface (S)
U =	 0.05/100
	 0.009/10
	 0.05 F

F	Machine guideway
U	Ground surface that supports SINGLEFLEX, DOUBLEFLEX scale tape
S	Mounting surface
M	Mounting surface of the machine for chosen mounting surface S1 or S2
ML	Measuring length



Example LAKselect with Standard Frame

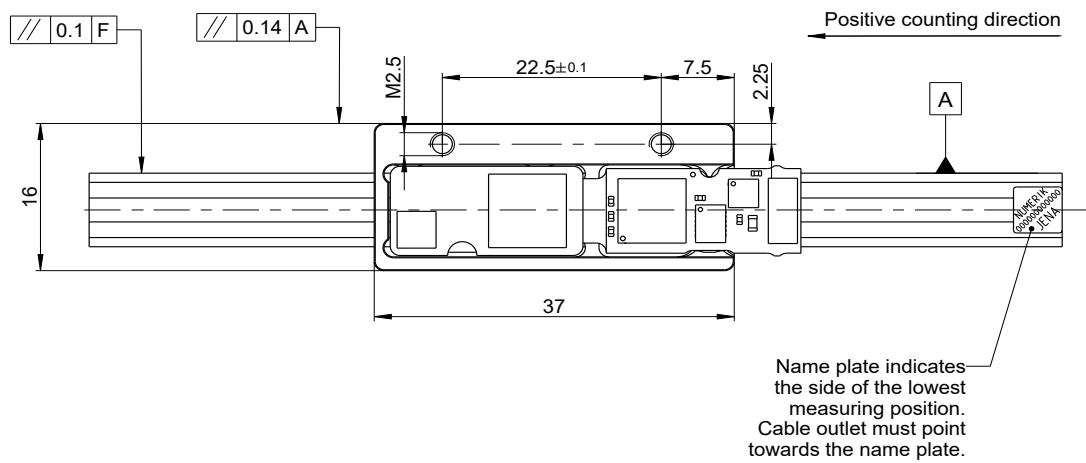


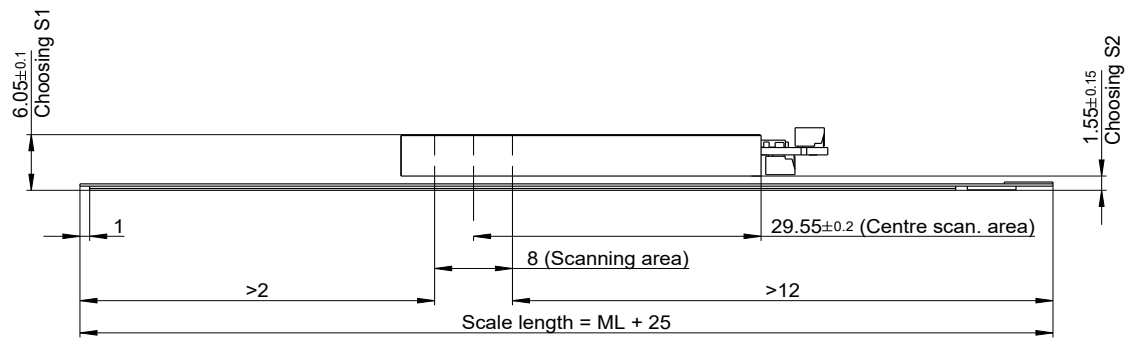
Image 11

M = 0.03 / Mounting surface (S)

U = 0.05/100
 0.009/10
 0.05 F

F	Machine guideway
U	Ground surface that supports SINGLEFLEX, DOUBLEFLEX scale tape
S	Mounting surface
M	Mounting surface of the machine for chosen mounting surface S1 or S2
ML	Measuring length

4.2 DOUBLEFLEX Scale Tape



Example LAKselect with Standard Frame

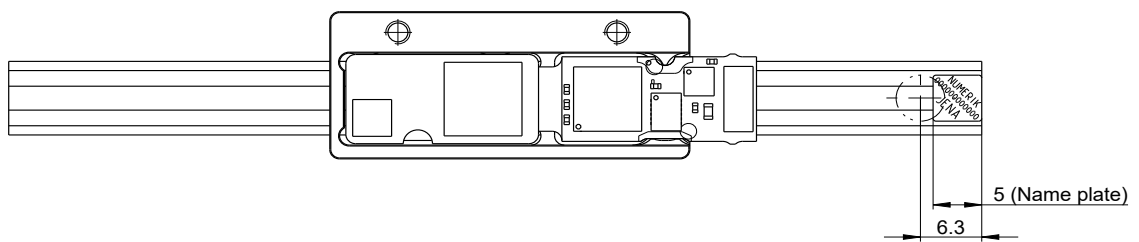


Image 12

ML - measuring length

4.3 LAKselect Standard Frame - Dimensions

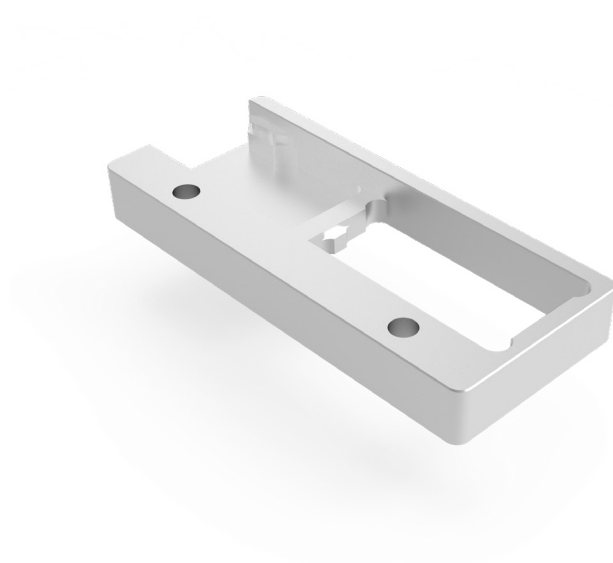


Image 13

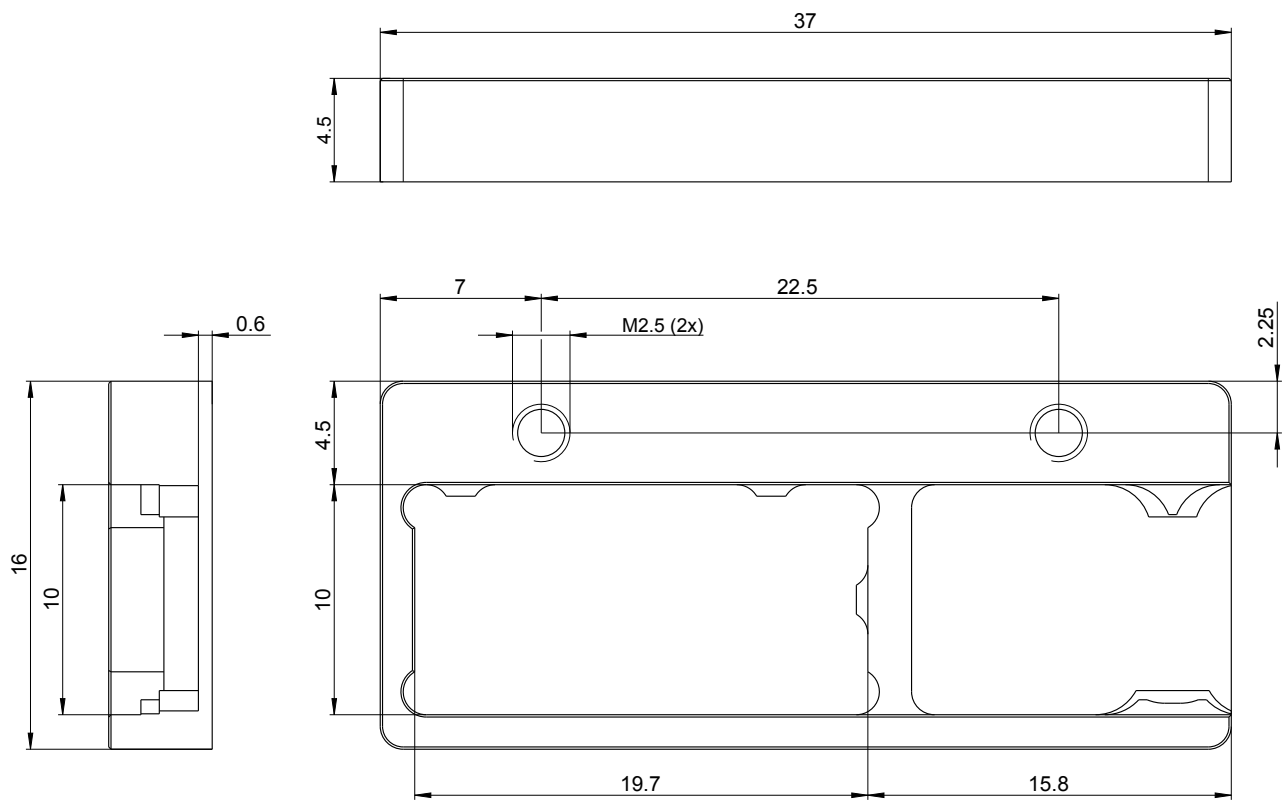


Image 14

5. Ordering Key

5.1 Scanning Head

Ordering key - example

	LAKS	2	0	2	-	3	0	2	C	01	A	-	P	O
--	------	---	---	---	---	---	---	---	---	----	---	---	---	---

Product name

LAKS	LAKselect
------	-----------

Version

2	For max. ML 3.700 mm
---	----------------------

Flex cable

0	Without flex cable
---	--------------------

Data interface

1	EnDat 2.2 ¹
2	SSI, USB, 1 V _{PP}
3	HIPERFACE compatible ^{1, 2, 3} , USB, 1 V _{PP}
4	BiSS C (unidirectional) ⁴ , USB, 1 V _{PP}

Grating period of the incremental track

-	20	μm
---	----	----

Measuring step (EnDat 2.2)

A	0.01	μm
---	------	----

Measuring step (SSI, HIPERFACE, BiSS C)

3	1.25	μm
4	0.625	μm
5	0.3125	μm
6	0.15625	μm
7	0.078125	μm

Serial data word length

0	24 bit (ML ≤ 1,200 mm)
1	32 bit (ML > 1,200 mm)

Technical design

2	Standard
---	----------

Electrical connection

Z	D-Sub connector plug, 15-pin, straight cable outlet, electronics in the connector, with Status-LED for EnDat 2.2
O	D-Sub connector plug, 15-pin, straight cable outlet for SSI, HIPERFACE, BiSS C
A18	JST connector ⁷ (SHR-12V-S) socket, 12-pin for SSI, HIPERFACE, BiSS C

Cable (Ø 3.7 mm, single-shielded)

R	0.3	m
S	0.5	m
T	1.0	m
P	1.5	m
V	2.0	m
W	3.0	m
U	Special cable length ⁶	m

Design

-	Standard
---	----------

Frame - Material

Z	Without frame (for Frame-Type „A“)
A	Aluminium

Frame - Variant

00	Without frame (for Frame-Type „A“)
01	With thread M2.5

Frame - Type

A	Without frame
C	Standard plate ⁵

Housing version

¹ Only in combination with 32 bit serial data word length

² Only in combination with measuring step 0.625 μm

³ HIPERFACE is a trade mark of SICK Stegmann GmbH

⁴ BiSS is a trade mark of iC-Haus GmbH

⁵ Dimensions of the scanning head (L × W × H) in mm:
37.0 × 16.0 × 4.5

⁶ Up to 5.0 m and for a surcharge

⁷ Adjustment with the ABSOFLEX USB-Adapter-SET requires an adapter for a D-Sub connector

ML = Measuring length

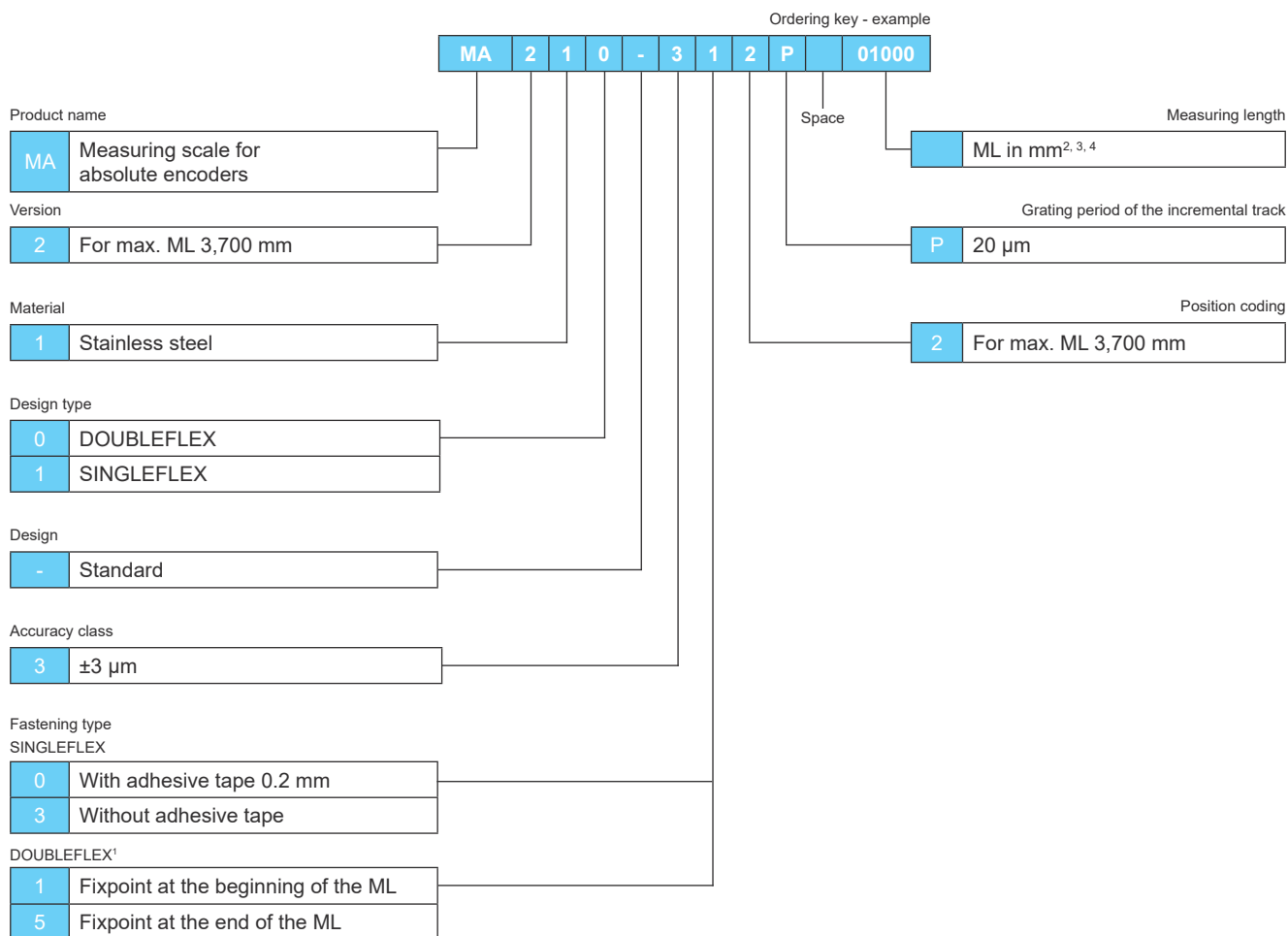
NOTE

Deviations from the standard configurations listed here are possible in principle. We would be happy to work with you to develop your individual solution. Simply get in touch with your local contact person. You will find a corresponding contact list on our website under "Contact".

Optional Accessory

Description	Order-no. (ID)
ABSOFLEX USB-Adapter-SET	344220-70
Included in the set:	
ABSOFLEX USB-Adapter	1135558-01
Adapter cable (Type A to Mini-USB Type B, 1.8 m)	687661-01

5.2 Scale Tape



¹ With a fixpoint and adhesive tape 0.2 mm

² ML > 1,200 mm only in combination with 32 bit serial data word length

³ DOUBLEFLEX min. ML = 100 mm, max. ML = 3,700 mm, TL = ML + 25 mm

⁴ SINGLEFLEX max. ML = 3,700 mm, TL = ML + 17 mm

ML = Measuring length

TL = Total length

NOTE

Deviations from the standard configurations listed here are possible in principle. We would be happy to work with you to develop your individual solution. Simply get in touch with your local contact person. You will find a corresponding contact list on our website under "Contact".



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