



## **LIE 4**

**Open linear measuring system**

# LIE 4 Open Linear Measuring System

*Innovation and  
high technology  
to your advantage*

## *Features*

## *Applications*

### *What we offer*

- Open linear measuring system based on state-of-the-art measuring principles and manufacturing technologies, consisting of:
  - Scanning head with EPIFLEX measuring module\*
  - SINGLEFLEX scale tape with grating scale *or*
  - DOUBLEFLEX scale tape\* with grating scale
- \*) patent application lodged
- Accessories for installation

### *Hallmarks of the LIE 4 series*

- Minimum time and cost involved in installation and start-up, especially for long measuring distances and wide temperature ranges
- High measuring speed
- High resolution
- High accuracy
- Minimum space requirements
- Wide mounting tolerances
- Precise measurement over a wide temperature range due to thermally defined behavior
- Optional, integrated signal interpolation
- Highly versatile application due to customized scale options

### *Fields of use of the LIE 4*

- All applications where distances need to be measured with utmost precision and resolution
- All applications where precision measurements are required with high repeatability over a wide temperature range such as
  - Coordinate measuring machines
  - Measuring machines
  - X-Y tables
  - PCB assembly tools
  - Precision machine tools
  - Medical systems
  - Linear guide systems, linear units
  - Linear drives

## Description

### Scanning head

The centerpiece of the scanning head is the EPIFLEX measuring module, a compact, miniaturized, multi-function component.

It is based on a new reflected-light scanning principle and an entirely new design employing the latest and most efficient microelectronics technology.

The use of this scanning head ensures a previously unknown measuring speed and reliability, combined with minimum dimensions and wide mounting tolerances.

An analog signal interpolator can optionally be integrated in the miniaturized scanning head so that all functions of LIE 4 are internally monitored.

The scanning head is available with the following optional signal interfaces:

- Voltage output  $1 V_{SS}$  with integrated line driver
- Current output  $11 \mu A_{SS}$
- RS 422 A and optional 5x, 10x, 25x, 50x signal interpolation

The hallmark of the scanning head is its wide diversity of mounting possibilities.

### Dimensional standard

In dependence on working conditions two types of scale tapes are deliverable: DOUBLEFLEX scale tapes and SINGLEFLEX scale tapes

On the back of both types are adhesive tapes for glueing the scale tapes on mounting surface.

Guide tapes including guide tape mounting devise for mounting the scale tape are deliverable.

### DOUBLEFLEX scale tape with grating scale

The accuracy of the LIE 4 is determined by the DOUBLEFLEX scale tape with the following outstanding features:

- Defined thermal expansion coefficient, also when mounted, of  $\alpha = 10.5 \cdot 10^{-6} \text{ deg}^{-1}$
- No thermally induced warping of the DOUBLEFLEX tape; the elongation is tension-free even with pronounced temperature fluctuations and if the expansion coefficient of the base material (e.g. aluminum) differs drastically
- No mechanically induced warping of the DOUBLEFLEX tape during installation; tension in the scale tape is eliminated ensuring that the high production accuracy is maintained
- Clear bending error reduction in the installed DOUBLEFLEX tape, therefore higher accuracy than with glass scales and conventional steel scale tapes

Two pliable steel tapes are bonded by means of a tension-eliminating intermediate layer:

- One steel tape carries the grating scale and serves as measuring scale
- The other steel tape serves as carrier tape

The intermediate layer connects the two tapes and constitutes a stable bond, with the tension of the scale tape being eliminated by a defined amount in the measuring direction as referred to a fixed point.

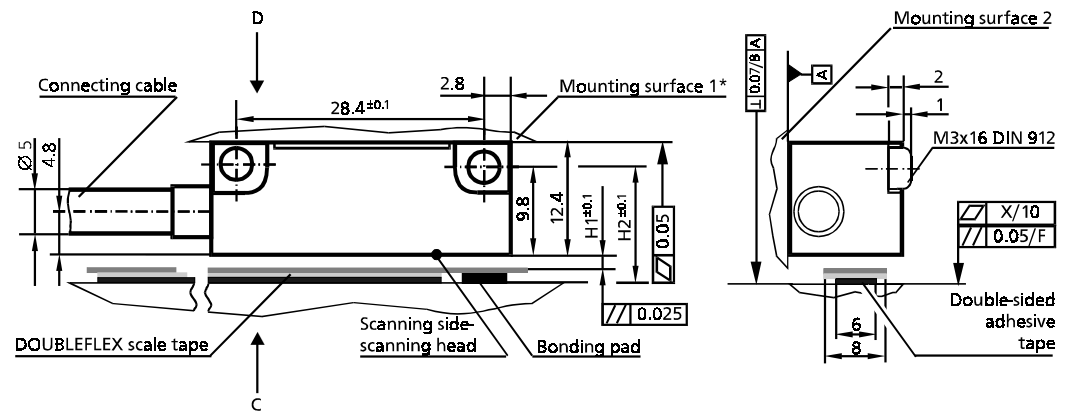
### SINGLEFLEX scale tape with grating scale

SINGLEFLEX scale tapes without tensioneliminating layer are deliverable for

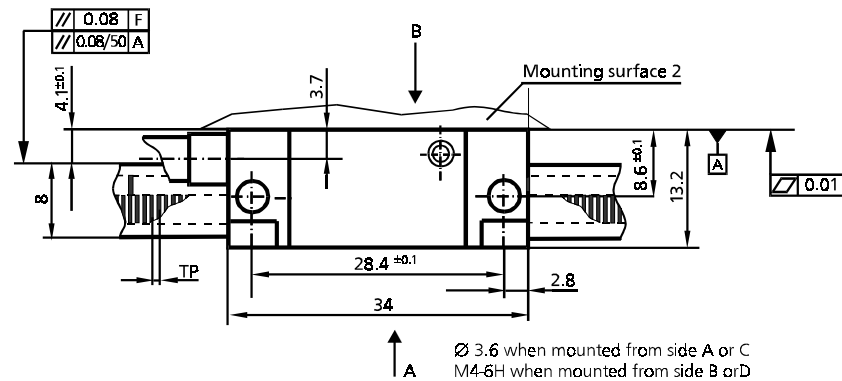
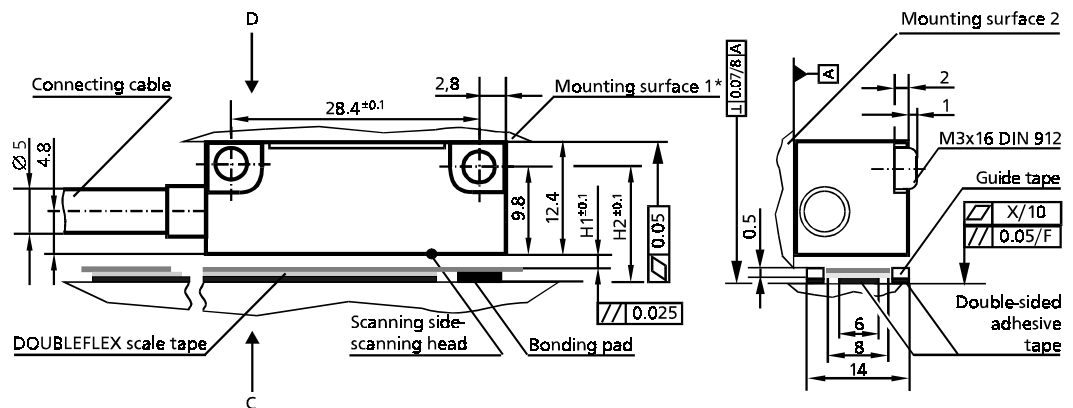
- lower accuracies
- lower variation of temperature
- lower differences of thermal expansion coefficient between scale tape and mounting surface

# Installation

Installation outline without guide tapes



Installation outline with guide tapes



$\varnothing 3.6$  when mounted from side A or C  
 M4-6H when mounted from side B or D

Grating period	DOUBLEFLEX scale tape		SINGLEFLEX scale tape	
	H1	H2	H1	H2
20 $\mu\text{m}$	0.6 mm	11.1 mm	0.6 mm	10.9 mm
100 $\mu\text{m}$	0.8 mm	11.3 mm	0.8 mm	11.1 mm

\* The mounting surface 1 must be vertically adjustable to ensure that the distance parameter  $H1 \pm 0.1$  and the parallelism 0.025 can be achieved.

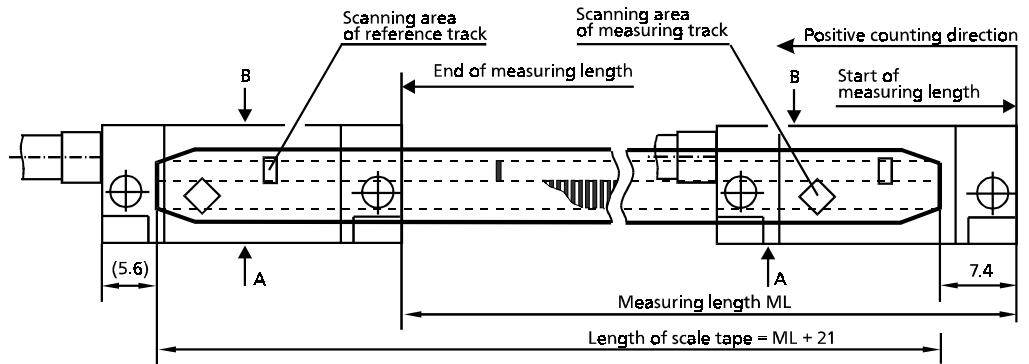
Accuracy classes	X
$\pm 1 \mu\text{m}$	0.003
$\pm 2 \mu\text{m}$	0.006
$\pm 3 \mu\text{m}$	0.009
$\pm 5 \mu\text{m}$	0.009

## Installation

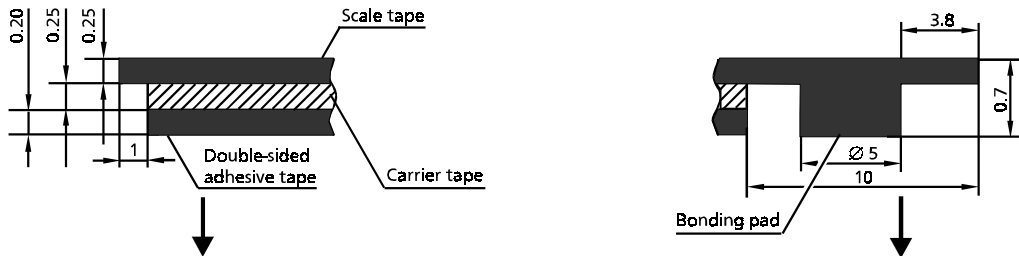
### Note

- Use double-sided adhesive tape to attach the steel scale tape to the base or glue it directly on the base.
- Guiding tapes are usable for orientation and mounting the scale tapes.

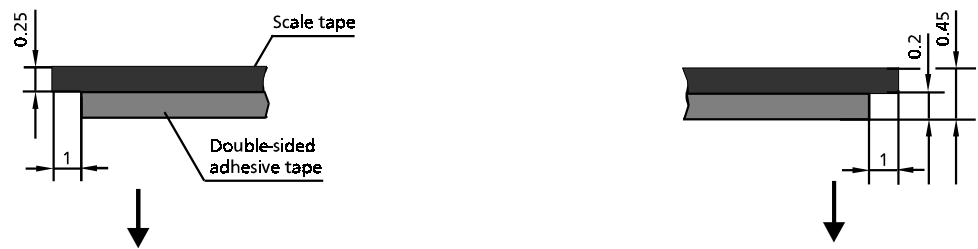
### Definition of measuring length



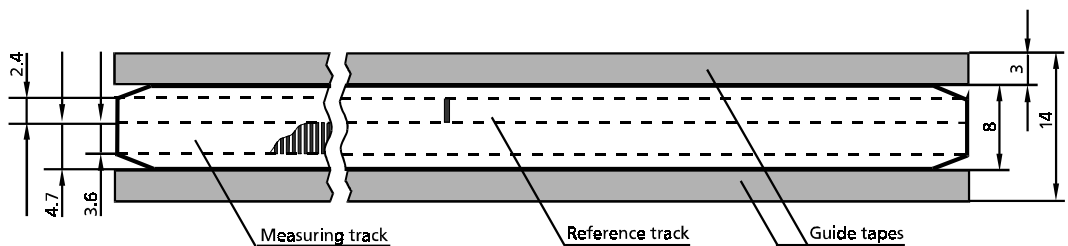
### DOUBLEFLEX scale tape



### SINGLEFLEX scale tape



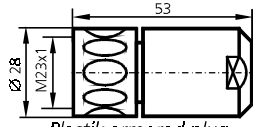
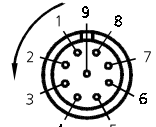
### DOUBLEFLEX scale tape SINGLEFLEX scale tape with guide tapes



## Connectors, Pin Definition

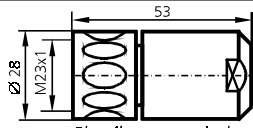
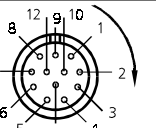
### Current Interface


 $11\mu A_{SS}$   
 9 Pin Plug  
 9 Pin Coupling


												
PIN	1	2	3	4	5	6	7	8	9	Housing		
Signal	$I_{1+}$	$I_{1-}$	5 V	0 V	$I_{2+}$	$I_{2-}$	$I_{0+}$	$I_{0-}$	-	External shield		
Color	green	yellow	brown	white	blue	red	grey	pink	-	-		

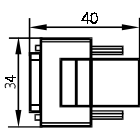
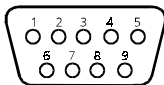
### Voltage Interface


 $1V_{SS}$   
 12 Pin Plug  
 12 Pin Coupling

													
PIN	1	2	3	4	5	6	7	8	9	10	11	12	Housing
Signal	$U_{2-}$	Sensor 5 V	$U_{0+}$	$U_{0-}$	$U_{1+}$	$U_{1-}$	-	$U_{2+}$	-	0 V	Sensor 0 V	5 V	Shield
Color	red	brown	grey	pink	green	yellow	-	blue	-	white	white	brown	-

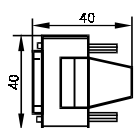
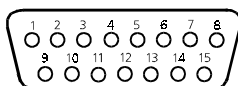
### Current Interface


 $11\mu A_{SS}$   
 9 Pin Sub-D-Plug


												
PIN	1	2	3	4	5	6	7	8	9	Housing		
Signal	$I_{1-}$	0 V	$I_{2-}$	-	$I_{0-}$	$I_{1+}$	5 V	$I_{2+}$	$I_{0+}$	External shield		
Color	yellow	white	red	-	pink	green	brown	blue	grey	-		

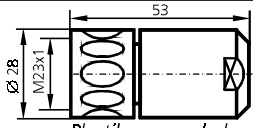
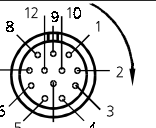
### Current Interface


 $11\mu A_{SS}$   
 15 Pin Sub-D-Plug

												
PIN	1	2	3	4	5	6	7	10	12	Housing		
Signal	5 V	0 V	$I_{1+}$	$I_{1-}$	-	$I_{2+}$	$I_{2-}$	$I_{0+}$	$I_{0-}$	External shield		
Color	brown	white	green	yellow	-	blue	red	grey	pink	-		

### Square Wave Interface


 RS 422 A  
 12 Pin Plug  
 12 Pin Coupling




													
PIN	1	2	3	4	5	6	7	8	9	10	11	12	Housing
Signal	$\bar{Z}_2$	Sensor 5 V	R	$\bar{R}$	$Z_1$	$\bar{Z}_1$	NAS	$Z_2$	Screen	0 V	Sensor 0 V	5 V	Shield
Color	red	brown	grey	pink	green	yellow	violett	blue	-	white	white	brown	-

## Specifications

### Mechanical components

Recommended measuring increments	0.1 $\mu\text{m}$ ; 0.2 $\mu\text{m}$ ; 0.5 $\mu\text{m}$ ; 1 $\mu\text{m}$ ; 5 $\mu\text{m}$
Dimensions of scanning head	34 x 13.2 x 12.4 mm <sup>3</sup>
Max. traversing speed as function of electronic system	480 m/min without interpolator for GP = 20 $\mu\text{m}$ 2400 m/min without interpolator for GP = 100 $\mu\text{m}$ 120 m/min with 50x interpolator for GP = 20 $\mu\text{m}$ 600 m/min with 50x interpolator for GP = 100 $\mu\text{m}$
Measuring length	up to 30 m
Scale tape	
Material	Steel
Grating period (GP)	20 $\mu\text{m}$ ; 100 $\mu\text{m}$
Reference marks	At regular distances of 50 mm; distance coded at 1000 • GP in the center of the measuring distance
Linear expansion coefficient	DOUBLEFLEX scale tape: $10.5 \cdot 10^{-6} \text{ grad}^{-1}$ SINGLEFLEX scale tape: as function of material of the seating surface
Accuracy classes	DOUBLEFLEX scale tape: $\pm 1 \mu\text{m}$ , $\pm 2 \mu\text{m}$ ; $\pm 3 \mu\text{m}$ ; $\pm 5 \mu\text{m}$ SINGLEFLEX scale tape: $\pm 5 \mu\text{m}$ others on request

### Electrical data

Scanning frequency	max. 400 kHz for counting signal max. 50 kHz for reference signal
Output interfaces	
Voltage output	 1 V <sub>SS</sub> with integrated line driver
Current output	 11 $\mu\text{A}_{\text{SS}}$
Square-wave output	 RS 422 A optionally with internal signal interpolation 5x, 10x, 25x, 50x
Supply voltage	5 Vdc $\pm$ 20%
Power consumption	
Voltage output	< 50 mA
Current output	< 25 mA
Square-wave output (RS 422 A)	< 100 mA
Cable lengths	
Cable permanently fixed to scanning head	up to 3 m with plug
Permissible cable lengths (with extension cable)	max. 18 m with current output 11 $\mu\text{A}_{\text{SS}}$ max. 100 m with voltage output 1 V <sub>SS</sub> max. 100 m with square-wave output RS 422 A
Operating temperatures	0°C ... +55°C
Storage temperatures	-20°C ... +70°C
Vibration (50 Hz ... 2000 Hz)	$\leq 200 \text{ ms}^{-2}$
Shock (11 ms)	$\leq 400 \text{ ms}^{-2}$

### Ambient conditions

## Ordering key

Designation example

**LIE 4 1 P B X K F**

Scanning head

Model type

L	Length-measuring system
I	incremental
S	open

Installation conditions

1	Mounted from side A or C
2	Mounted from side B or D

Grating period GP

P	20 $\mu\text{m}$
R	100 $\mu\text{m}$

Output signals

B	Sinusoidal signal 11 $\mu\text{A}_{\text{SS}}$
C	Sinusoidal signal 1 $\text{V}_{\text{SS}}$
K	Square-wave signal RS 422 A without interpolation
L	Square-wave signal RS 422 A with interpolation 5x
M	Square-wave signal RS 422 A with interpolation 10x
I	Square-wave signal RS 422 A with interpolation 25x
N	Square-wave signal RS 422 A with interpolation 50x

X	Distinguishing mark for clock frequency of counter on request
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Connectors on cable

A	no connector
D	9pin; D-Sub; Pin; straight
E	9pin; D-Sub; Pin; 45° *)
F	9pin; plug; round; Pin; metal
G	12pin; plug; round; Pin; metal
H	12pin; plug; round; Pin; plastic-armored
I	9pin; plug; round; Pin; plastic-armored
K	12pin; coupling; Pin; plastic-armored
M	Assambly base with flange socket *)
O	15pin; D-Sub; Pin; straight
R	15pin; D-Sub; Pin; 45° *)
T	12pin; coupling; Pin; metal *)
S	Customized plug on request *)

Cable fixed to scanning head

F	1 m
G	2 m
K	3 m
O	other length

O Cable length specified on XX.X m as additional information; max. cable length 3 m, for greater lengths use extension cable

\*) No standard, supplied against surcharge

Designation example

**MV 1 0 - 1 0 B P 00770**

Scale tape

Material

1	Steel tape
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Measuring length (ML) [mm]

Design type

O	DOUBLEFLEX, standard
1	SINGLEFLEX, standard
2	DOUBLEFLEX, with guide tape
3	SINGLEFLEX, with guide tape

Grating period GP

P	20 $\mu\text{m}$
R	100 $\mu\text{m}$

Accuracy classes

1	$\pm 1 \mu\text{m}$
2	$\pm 2 \mu\text{m}$
3	$\pm 3 \mu\text{m}$
4	$\pm 5 \mu\text{m}$

E: Specified in xxxxx mm, starting from front end

Position of reference mark

O	None
B	Center of measuring length
C	35 mm from front of measuring length*)
D	35 mm from front and 35 mm from back of measuring length*)
E	Customized version
F	Distance coded at 1000 • GP
N	At 50 mm spacings starting at center of measuring length

Bonding pad positions

1	none
2	Front end

\*) No standard, supplied against surcharge

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Subject to change without notice – 08/97