RSF Elektronik

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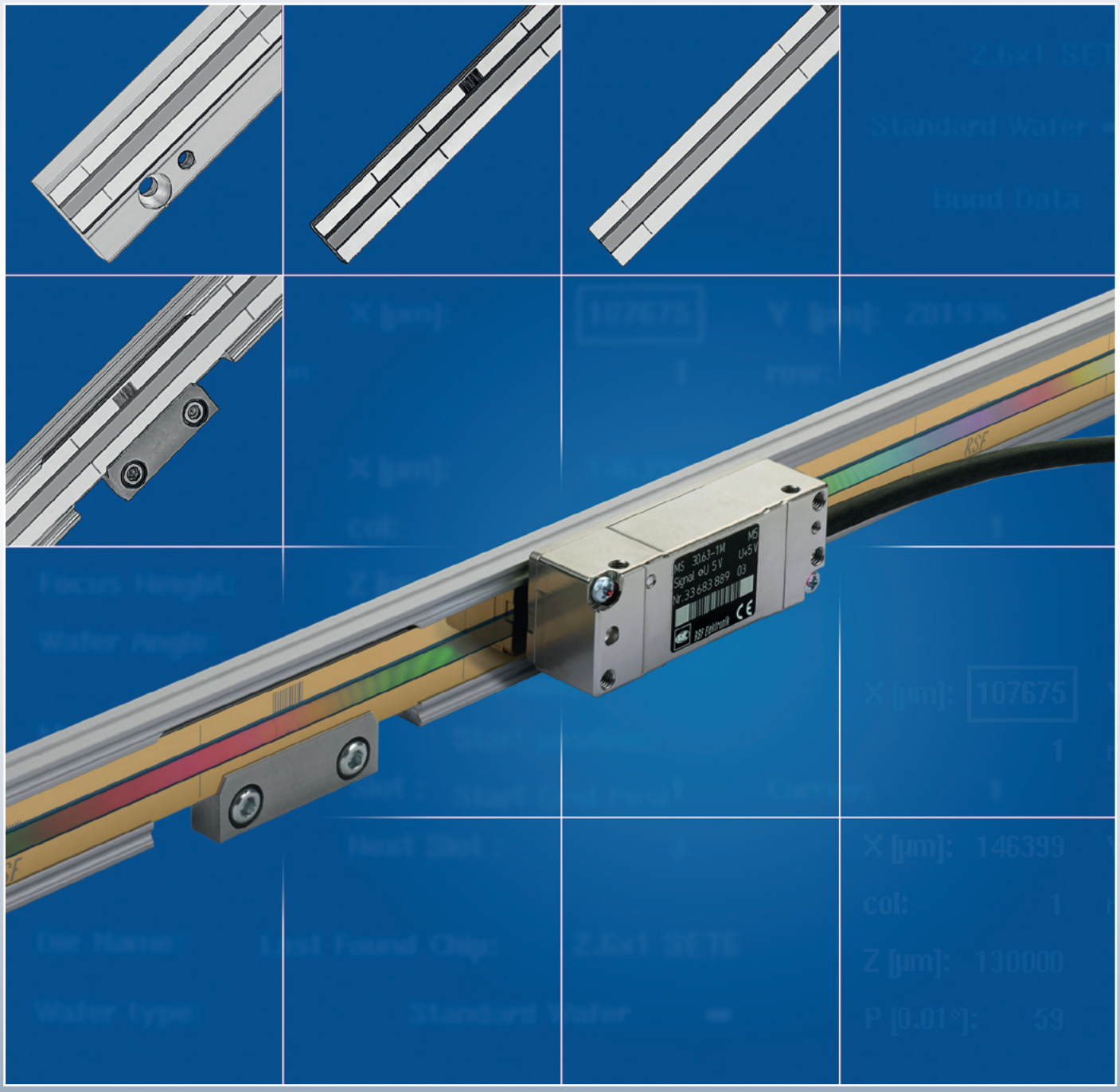
MS 3x Series

Exposed Linear Encoders with Singlefield Scanning



CONTENTS

TERM-EXPLANATIONS

Grating Pitch (Interval)
A grating is a continuous series of lines and spaces printed on the scale. The width of one line and one space is called the pitch (sometimes referred to as the interval) of the grating. The lines and spaces are accurately placed on the scale.

Signal Period
When scanning the grating, the encoder head produces sinusoidal signals with a period equal to the grating pitch.

Interpolation
The sinusoidal signal period can be electronically divided into equal parts. The interpolation circuitry generates a square-wave edge for each division.

Measuring Step (Resolution)
The smallest digital counting step produced by an encoder.

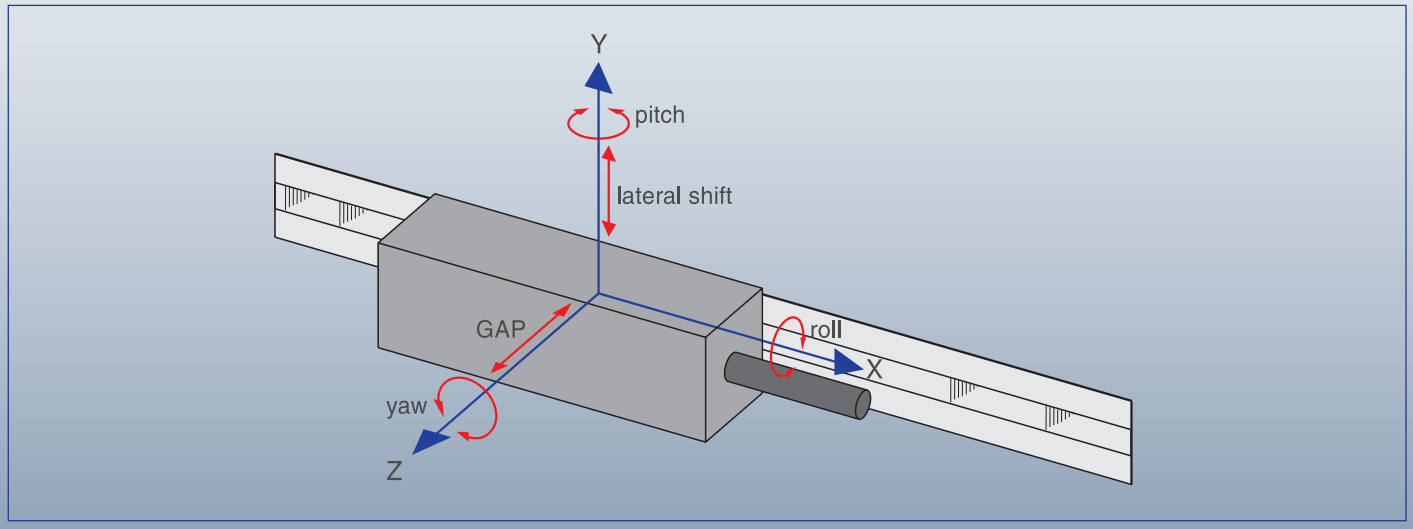
Reference Pulse (Reference Mark)
There is an additional track of marks printed next to the grating to allow a user to find an absolute position along the length of the scale. A one increment wide signal is generated when the encoder head passes the reference mark on the scale. This is called a “true” reference mark since it is repeatable in both directions. Subsequent electronics use this pulse to assign a preset value to the absolute reference mark position.

Error Signal
This signal appears when a malfunctioning encoder generates faulty scanning signals.

Accuracy
This is a fundamental characteristic, which is specified with an accuracy grade (e.g. ±5 µm/m).

Abbe Error
Measuring error due to lateral distance between the measuring system and the machining level.

Yaw Angle, Pitch Angle, Roll Angle, Lateral Shift, Airgap
Mounting tolerances of the encoder head relative to the scale.



WHAT DO YOU REQUIRE IN AN EXPOSED LINEAR ENCODER?

- Contamination resistance
- Immunity against aging and temperature changes
- High resolution
- High traversing speed
- Large mounting tolerances
- Small dimensions

The MS 3x series meets all these requirements!

The trend today in motion control applications is for exposed Linear Encoder systems.
This is driven by steadily increasing demands for
- higher traversing speed
- higher operating cycles
- lower mechanical backlash
- zero frictional force induced by the encoder.

Only exposed, non-contact encoders fulfill all these requirements.

It is important for high resolution applications to minimize interpolation errors. Historically, the small grating periods used had the disadvantages of smaller mounting gaps and very tight overall mounting tolerances. The MS 3x encoders´ 20 µm grating period minimizes interpolation errors but can be mounted with a large mounting gap and liberal mounting tolerances.

A drawback of many exposed Linear Encoders is their sensitivity to dirt and contamination on the scale.
The MS 3x encoders´ unique optical design minimizes the effect of dirt and contamination normally associated with the exposed Linear Encoders.

The MS 3x utilizes a unique scanning principle which allows high traversing speeds (up to 7 m/s), large mounting tolerances, and contamination on the scale.

Reference marks, accurate and repeatable from both traversing directions, are standard.

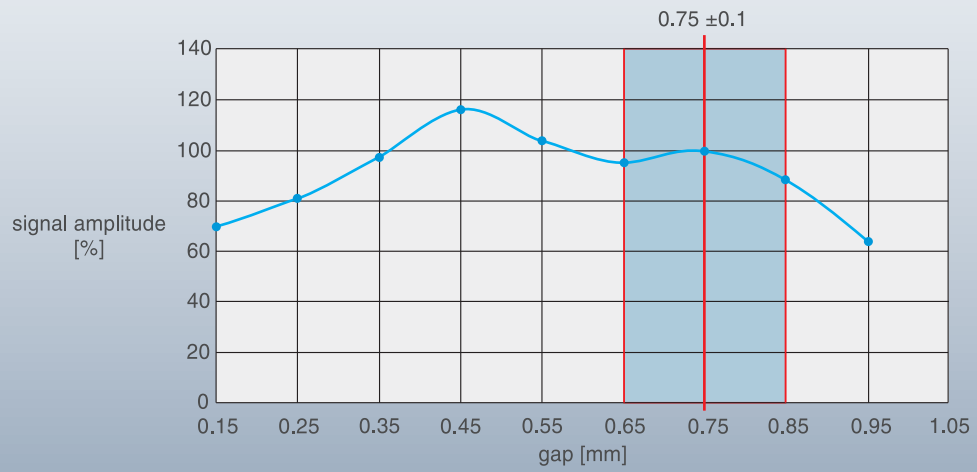
A wide range of interpolation electronics, integrated into the encoder head, enable resolutions from 5 µm to 50 nm. Square-wave signals, single ended, or via Line Driver RS 422, are provided at the output of the encoder head.

Units with sinusoidal output, 1 Vpp, are also available.

Two end of travel optical switch signals are available directly out of the reading head. The end of travel signal locations can be easily set by the user.

Due to recent advancements in technology, all of these benefits are now available in a small package design.

Signal amplitude vs. reading head gap



SCANNING PRINCIPLE

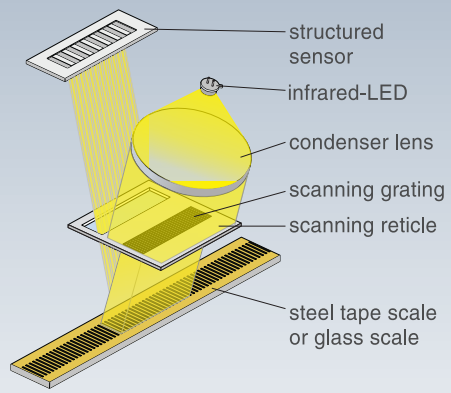
The model MS 3x incremental Linear Encoder works with the imaging, photoelectric measuring principle and a **singlefield reflective scanning** method.

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

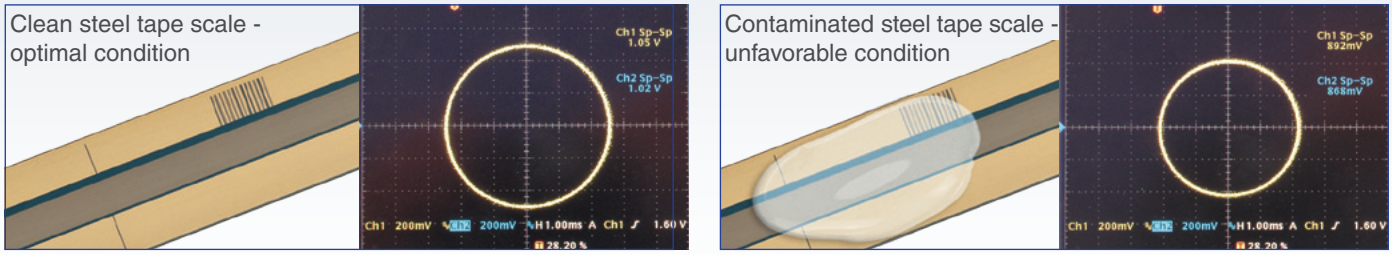
The sensor generates high qualitiy sinusoidal signals which are highly insensitive to possible contaminations.

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

Scanning principle



Effect of contamination on the quality and size of the measuring signal



High insensitivity to contamination by use of a new scanning principle.

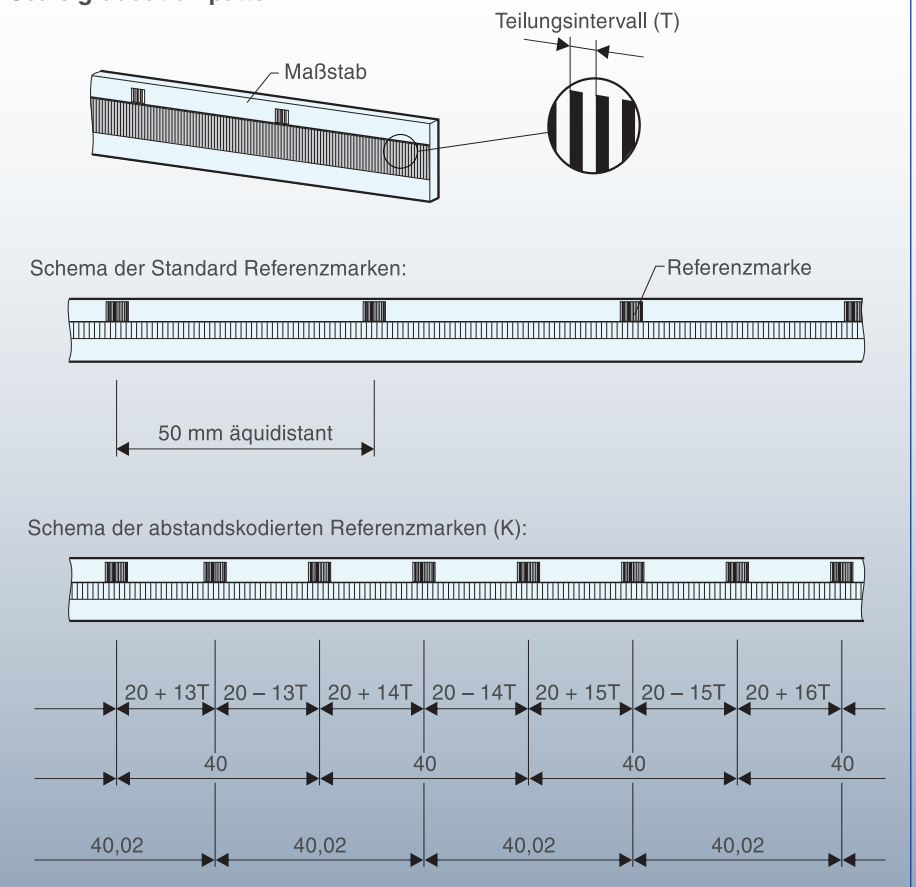
A high accuracy grating is deployed as scale graduation with 20 µm grating pitch. Depending on the model, glass (chrome grating) ($\alpha \approx 8{,}5 \times 10^{-6}$/K), glass ceramic (—„—) ($\alpha \approx 0 \times 10^{-6}$/K) or steel (gold grating) ($\alpha \approx 10{,}5 \times 10^{-6}$/K) is employed as base.

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

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

Linear Encoders with a suffix "**K**" in the model designation are equipped with distance-coded reference marks. After traveling a distance of 40 mm at maximum, the absolute tool position is available with these models. By dint of the optical scanning, a position-accurate evaluation of the reference marks is ensured.

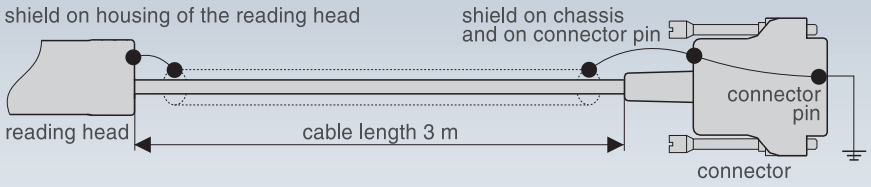
Scale graduation pattern



SHIELDING, PIN ASSIGNMENTS

Shielded PUR-cable, Ø 4.3 mm, Bending radius fixed mounting >10 mm, continuous flexing >50 mm
Torsion >300.000 cycles, Dragchain >5.000.000 cycles
Cables for use in vacuum applications are available on request.

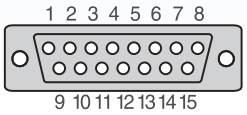
Shielding



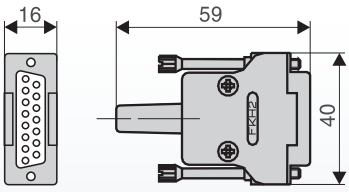
Connector LD15 15-pin

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

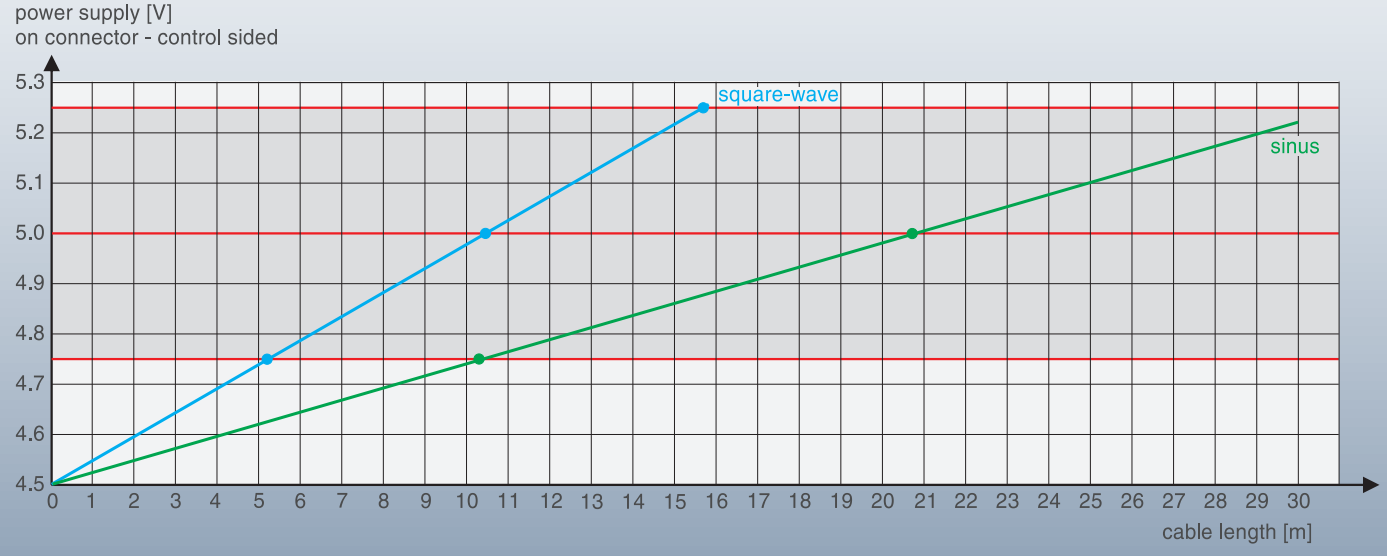
Pin Assignment
(view on pins)



- * Test: **analog signal switch-over for setup**
  By applying +5 V to the test-pin, the test signals (sinusoidal micro-current signals 11 µApp) are switched to the output connector.
- **MS 30**: S1, S2 = switch signals
- **MS 31**: S1 = conditionally useable as switch signal, S2 = switch signal
- ** Version without switch signals (version 0) = nc
- Sensor: the sensor-pins are bridged with the particular power supply.
- The shield is additional connected with the chassis.



Max. permissible cable length according to power supply



OUTPUT SIGNALS

Sinusoidal voltage signals 1Vpp

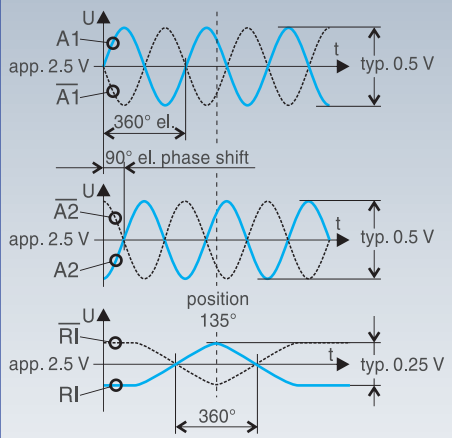
(drawing shows “positive counting direction”)
Two sinusoidal voltage signals A1 and A2 and one reference mark signal (all with inverted signals).

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

Reference mark
(differential voltage RI to $\overline{RI}$):
Useable component 0.2 up to 0.85 V; typical 0.5 V
(with terminating impedance Zo = 120 Ω between RI to $\overline{RI}$)

Advantage:
- High traversing speed with long cable lengths possible

Voltage signals (1 Vpp)



Square-wave signals

(drawing shows “positive counting direction”)
With a Schmitt-Trigger (for times 1) or interpolation electronics (for times -5, -10, -20, -25, -50 or -100) the photoelement output signals are converted into two square-wave signals that have a phase shift of 90°. Output signals either can be "single ended" or Line Driver "differential" (RS 422). One measuring step reflects the measuring distance between two edges of the square-wave signals.

The controls/DRO´s must be able to detect each edge of the square-wave signals. The minimum edge separation a_{min} is listed in the technical data and refers to a measurement at the output of the interpolator (inside the scanning head). Propagation-time differences in the Line Driver, the cable and the Line Receiver reduce the edge separation.

Propagation-time differences:
Line Driver: max. 10 ns
Cable: 0.2 ns per meter
Line receiver: max. 10 ns refered to the recommended Line Receiver circuit

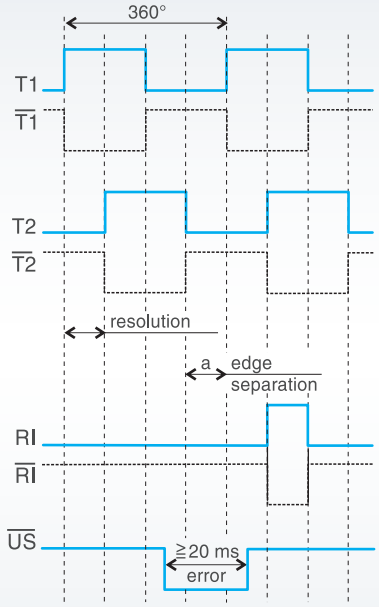
To prevent counting errors, the controls/DRO´s must be able to process the resulting edge separation.

Example:
a_{min} = 100 ns, 10 m cable
100 ns - 10 ns - 10 x 0.2 ns - 10 ns = 78 ns

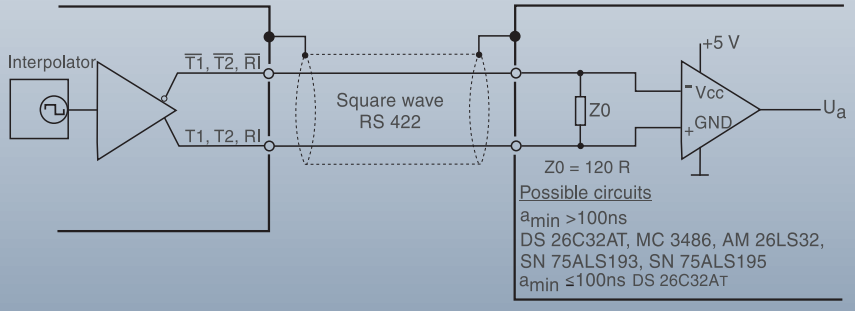
Power supply: +5 V ±5%, max. 200 mA (unloaded)

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

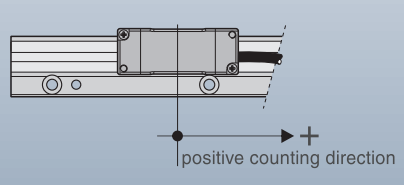
Square wave signals „differential“



Recommended Line Receiver circuit



Counting direction

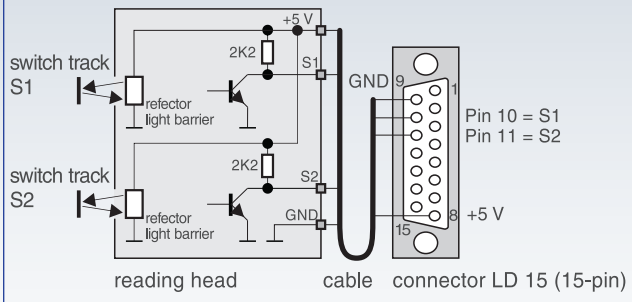


SWITCH SIGNAL OUTPUT

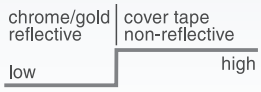
For individual special functions there are two additional switch tracks on the glass / glass ceramic or steel tape scale.
The switching point position can be chosen by the user by placing self-adhesive covering tapes.

With the MS 31.xx version there is just one switch signal available.
The second track of this version is used to select the reference mark.
This feature makes the selection of the reference mark position, by the user, very easy.

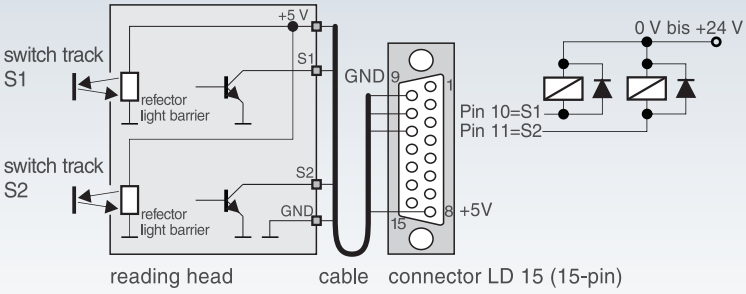
VERSION 1
TTL output (active high)



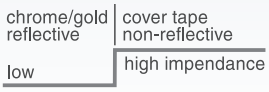
S1, S2 = TTL output
I_{SOURCE} = 1 mA (high level > 2 V)
I_{SINK} = 20 mA (low level < 0.8 V)



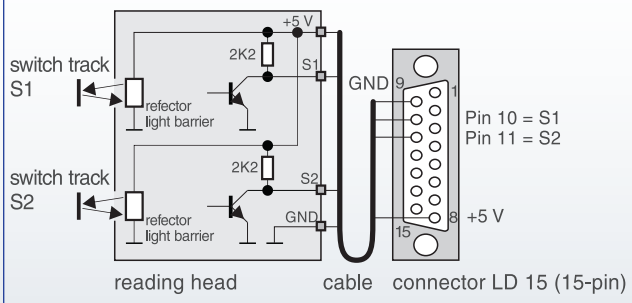
VERSION 2 (STANDARD)
open collector output (active high impedance)



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

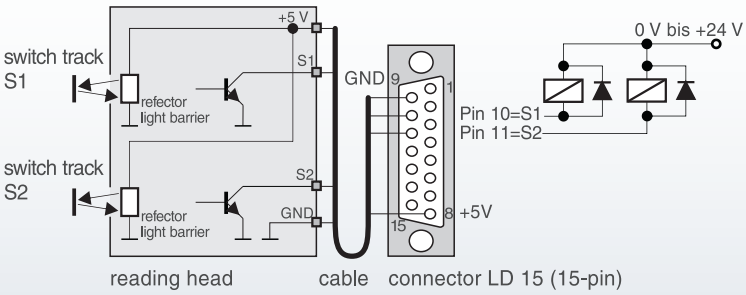


VERSION 3
TTL output (active low)

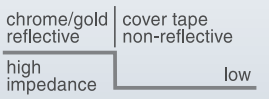


S1, S2 = TTL output
I_{SOURCE} = 1 mA (high level > 2 V)
I_{SINK} = 20 mA (low level < 0.8 V)

VERSION 4 (STANDARD)
open collector output (active low)



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



TECHNICAL DATA

- Small dimensions
- Easy mounting as a result of large mounting tolerances
- High insensitivity to contamination by use of an extensive singlefield scanning principle
- High traversing speed
- Integrated subdividing electronics: for up to times 100 (before quadrature)
- Reference mark accurate and repeatable from both traversing directions

MS 30: Two independent switch signals (optical) for individual functions

MS 31: Postition of reference mark can be selected by the customer
One switch signal (optical) for individual functions

Reading head: 20 µm grating pitch

Scale model	Output signals	System resolution [µm]	Integrated interpolation	Max. velocity [m/s]	Max. output frequency [kHz]
MS 3x.03	∿ 1 Vpp	depending on external interpolation	--	7.0	350
					Edge separation a_{min}
MS 3x.23	⎍	5	times 1	4.0	800 ns
MS 3x.63	⎍	1	times 5	3.2	300 ns
MS 3x.73	⎍	0.5	times 10	1.6	300 ns
MS 3x.43	⎍	0.25	times 20	1.2	200 ns
MS 3x.53	⎍	0.2	times 25	0.96	200 ns
MS 3x.83	⎍	0.1	times 50	0.96	100 ns
MS 3x.93	⎍	0.05	times 100	0.48	100 ns

Mounting-adjustment/Test:
To optimize or check the mounting we recommend to use a compatible electronic signal test/set-up box PG1 or PG3 (page 18).

Permissible vibration: 150 m/s² (40 up to 2000 Hz)
Permissible shock: 750 m/s² (8 ms)

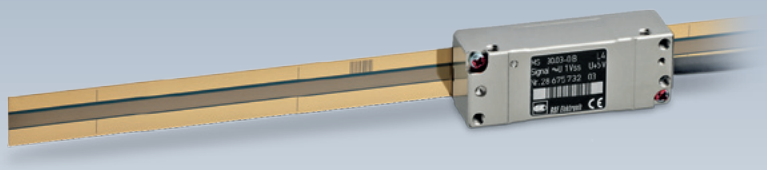
Permissible temperature:
–20 °C up to +70 °C (storage), 0 °C up to +50 °C (operation)

Scale unit: Grating carrier: Glass or steel

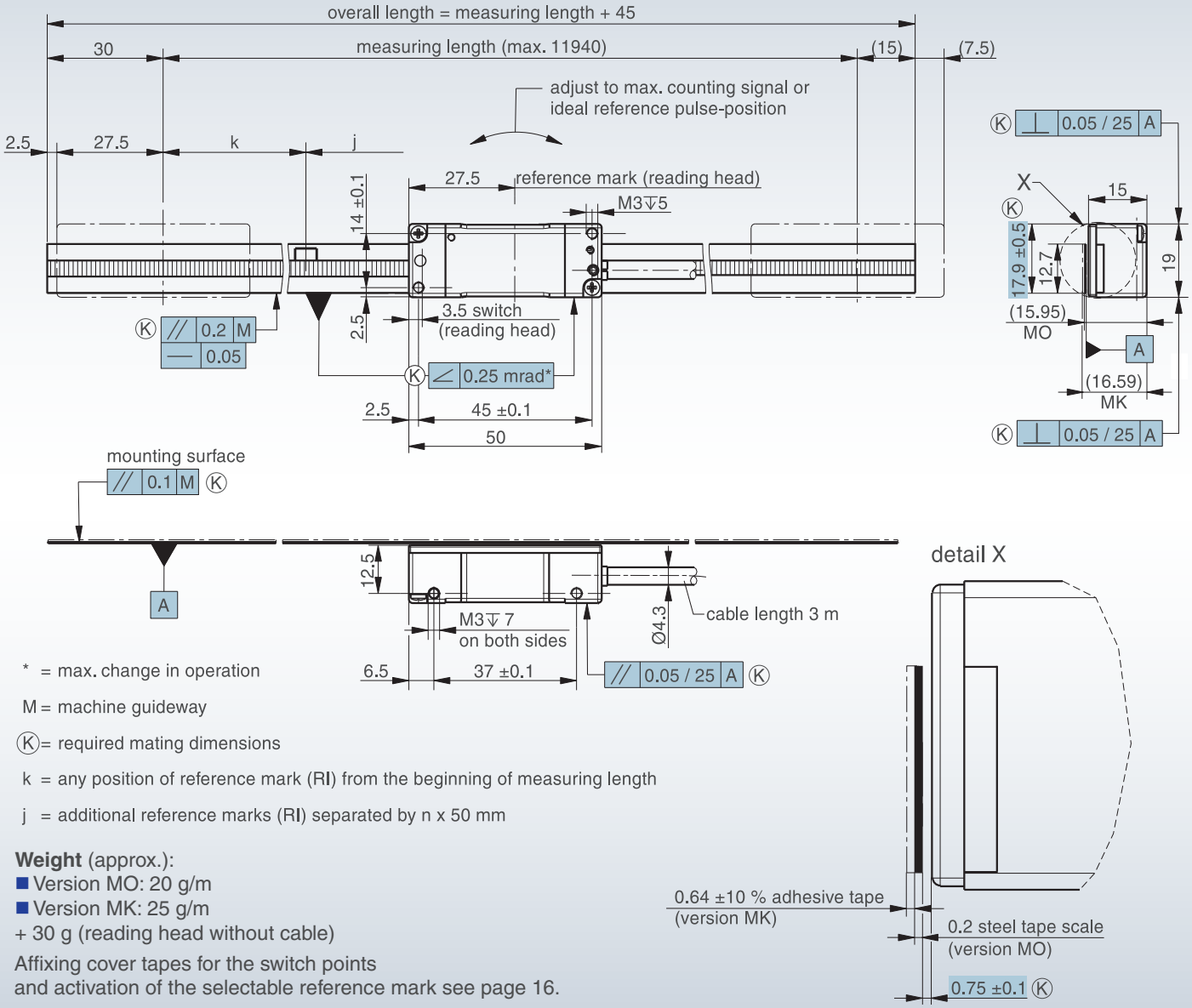
Mechanical features of the scale unit	MS 30		MS 31	
Grating carrier	glass	steel	glass	steel
Grating pitch (T)	20 µm	20 µm	20 µm	20 µm
Accuracy grades	±3, ±5 µm/m	±5, ±15 µm/m	±3, ±5 µm/m	±5, ±15 µm/m
Non-linearity	≦ ±1 µm/70 mm ≦ ±3 µm/1000 mm		≦ ±1 µm/70 mm ≦ ±3 µm/1000 mm	
Maximum measuring length (ML)	3140 mm	11 940 mm	3140 mm	11 940 mm
Reference marks (RI)				
Standard: 50 mm (equidistant)	■	■	■	■
At any location, on request		■	■	■
Distance-coded	■ up to ML 3140 mm	■ up to ML 6240 mm		
Position selectable by customer			■	■
Switch tracks	2	2	1	1

MS 30, MS 31 MO, MK

- Version MO: Steel tape scale
- Version MK: Steel tape scale with adhesive tape



Dimensions, mounting tolerances:



* = max. change in operation

M = machine guideway

Ⓚ = required mating dimensions

k = any position of reference mark (RI) from the beginning of measuring length

j = additional reference marks (RI) separated by n x 50 mm

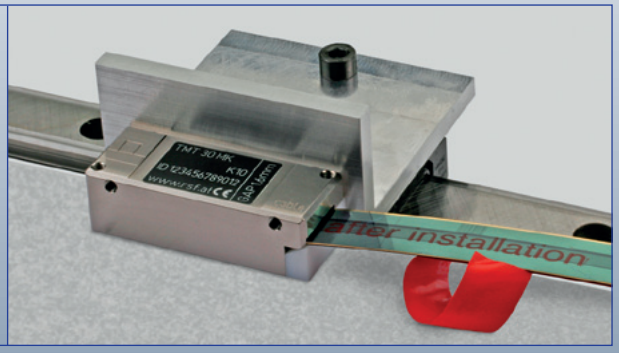
Weight (approx.):
- Version MO: 20 g/m
- Version MK: 25 g/m

+ 30 g (reading head without cable)

Affixing cover tapes for the switch points and activation of the selectable reference mark see page 16.

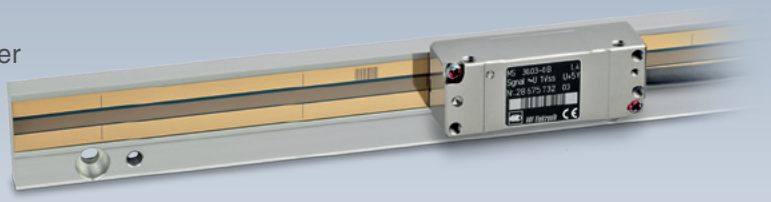
Tape mounting tool **TMT 30 MK** (optional)
For safe and precise mounting of the steel tape scale.

- Mount TMT 30 MK instead of the reading head MS 3x
- Thread steel tape scale (version MK) and move along the scale length
- Remove TMT 30 MK, mount reading head MS 3x

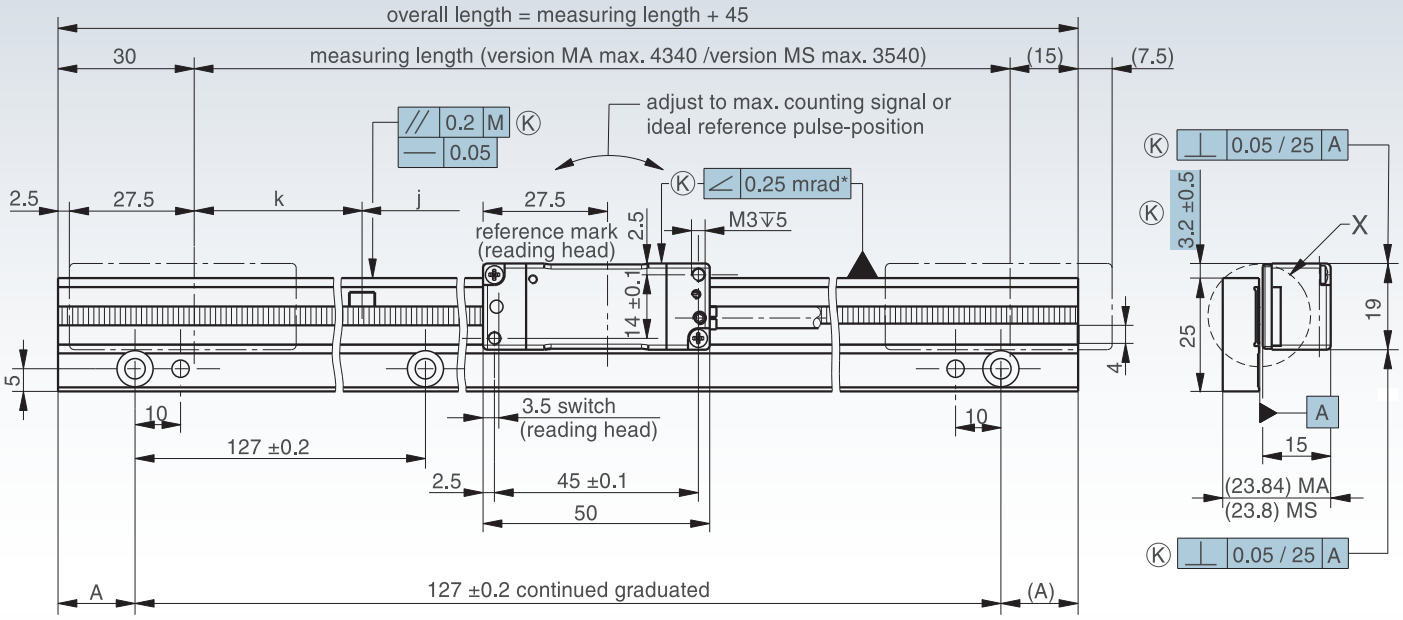


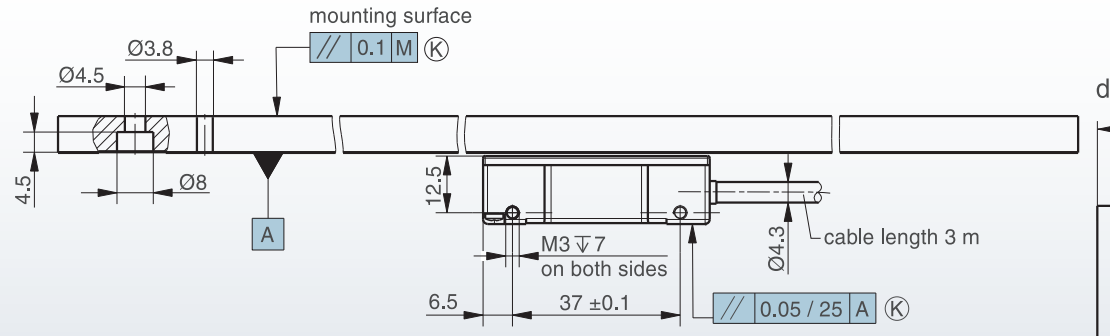
MS 30, MS 31 MA, MS

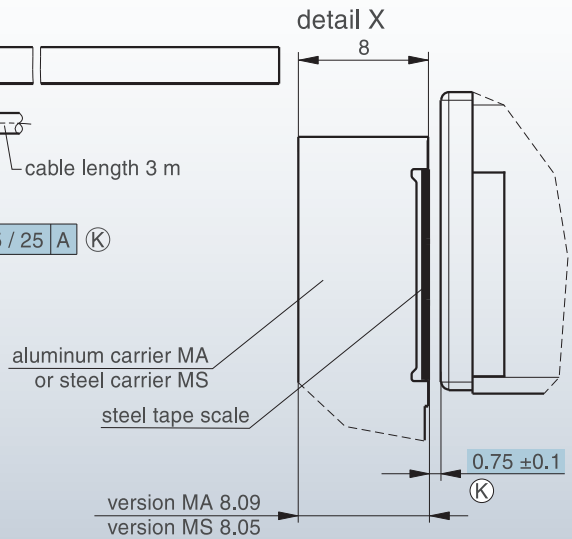
- Version MA: Steel tape scale on aluminum carrier
- Version MS: Steel tape scale on steel carrier
- Version MA, MS: Carrier bolted



Dimensions, mounting tolerances:







* = max. change in operation

M = machine guideway

A = 5 to 68.5

Ⓚ = required mating dimensions

k = any position of reference mark (RI) from the beginning of measuring length

j = additional reference marks (RI) separated by n x 50 mm

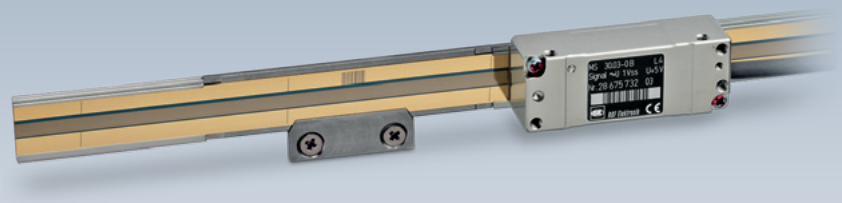
Weight (approx.):
- Version MA: 530 g/m
- Version MS: 1 525 g/m

+ 30 g (reading head without cable)

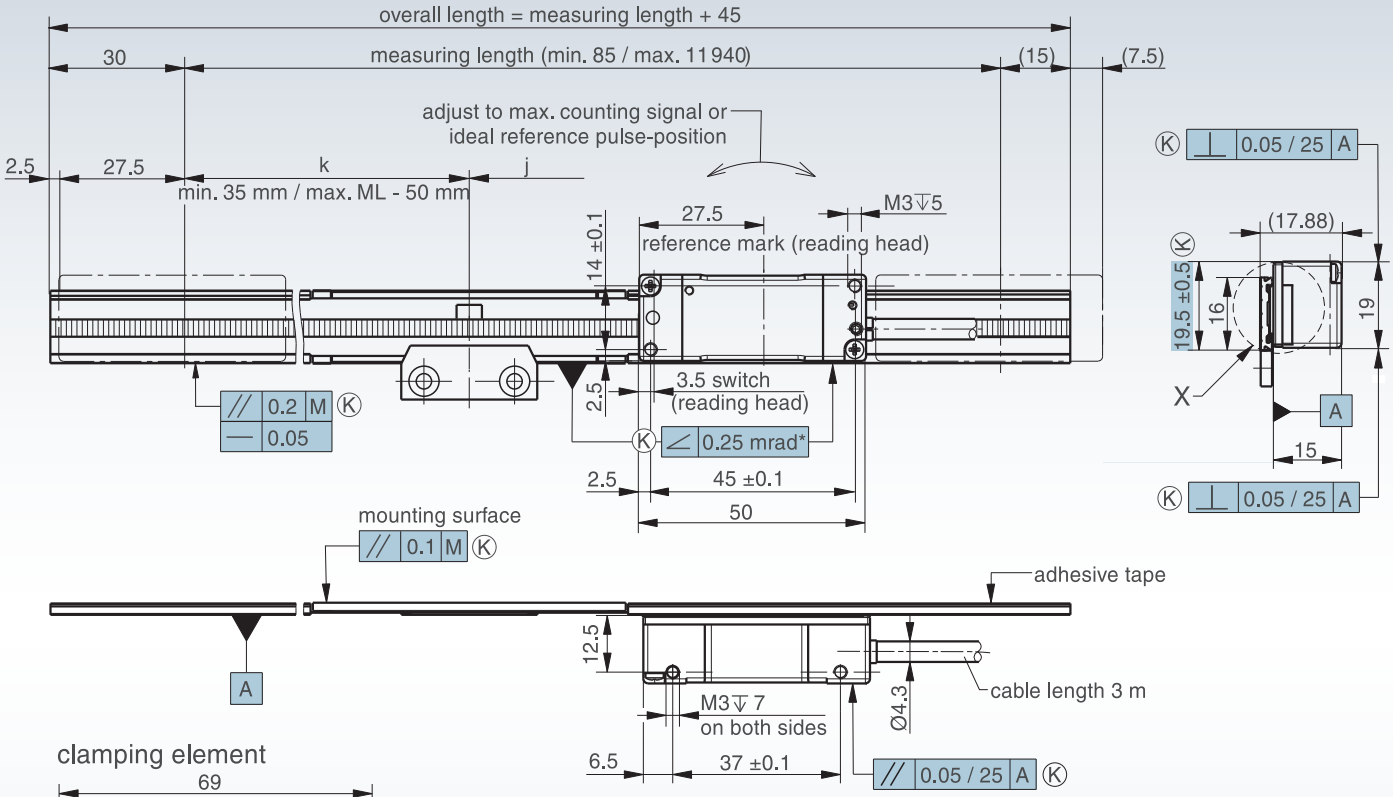
Affixing cover tapes for the switch points
and activation of the selectable reference mark see page 16.

MS 30, MS 31 MP

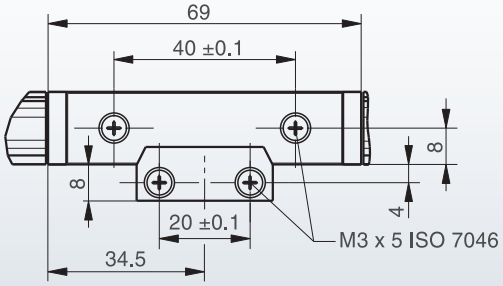
- Steel tape scale in aluminum carrier with clamping element
- Carrier with adhesive tape



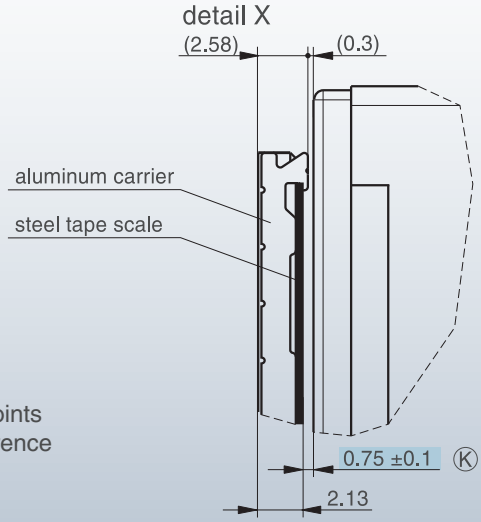
Dimensions, mounting tolerances:



clamping element



detail X



* = max. change in operation

M = machine guideway

Ⓚ = required mating dimensions

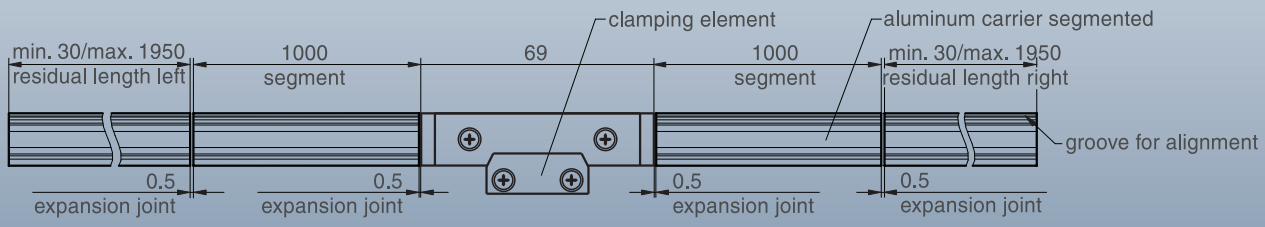
k = any position of reference mark (RI) from the beginning of measuring length

j = additional reference marks (RI) separated by n x 50 mm

Weight (approx.):
- 85 g/m + 30 g clamping element + 30 g (reading head without cable)

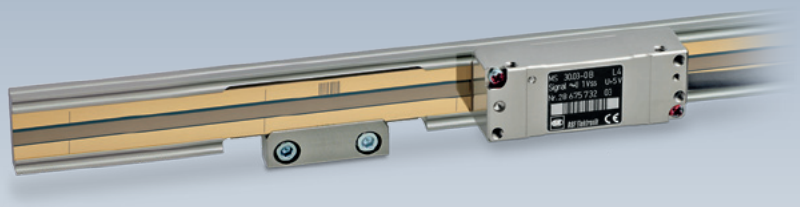
Affixing cover tapes for the switch points and activation of the selectable reference mark see page 16.

arrangement of the segments at large measuring lengths

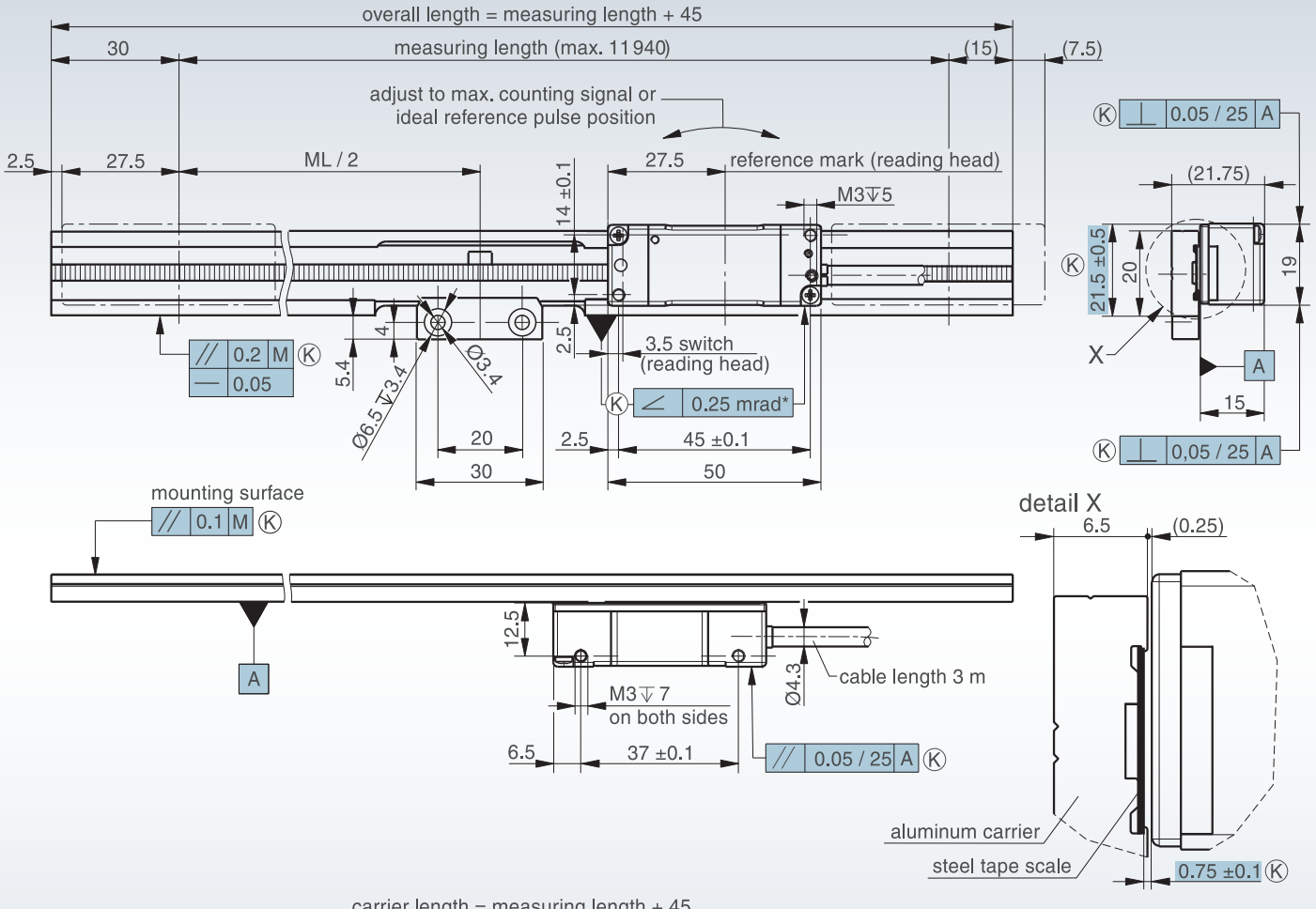


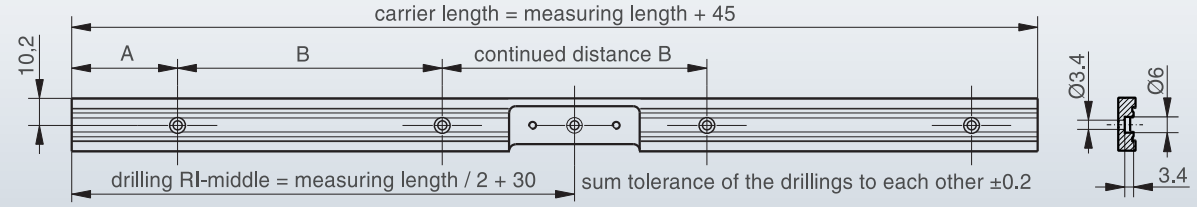
MS 30, MS 31 MT

- Steel tape scale in aluminum carrier with clamping element
- Carrier bolted



Dimension, mounting tolerances:





Measuring length (ML)	A	B
120	40	50
170	40	75
from ML 220	**A**	**B**
x20	40	100
e. g. 320		
x70	65	100
e. g. 770		
xxx40	50	100
e. g. 11040		

* = max. change in operation

M = machine guideway

Ⓚ = required mating dimensions

k = any position of reference mark (RI) from the beginning of measuring length

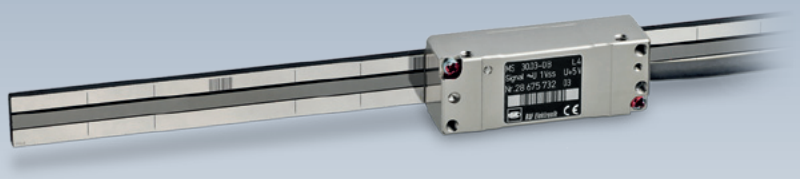
j = additional reference marks (RI) separated by n x 50 mm

Weight (approx.):
- 325 g/m + 30 g clamping element
+ 30 g (reading head without cable)

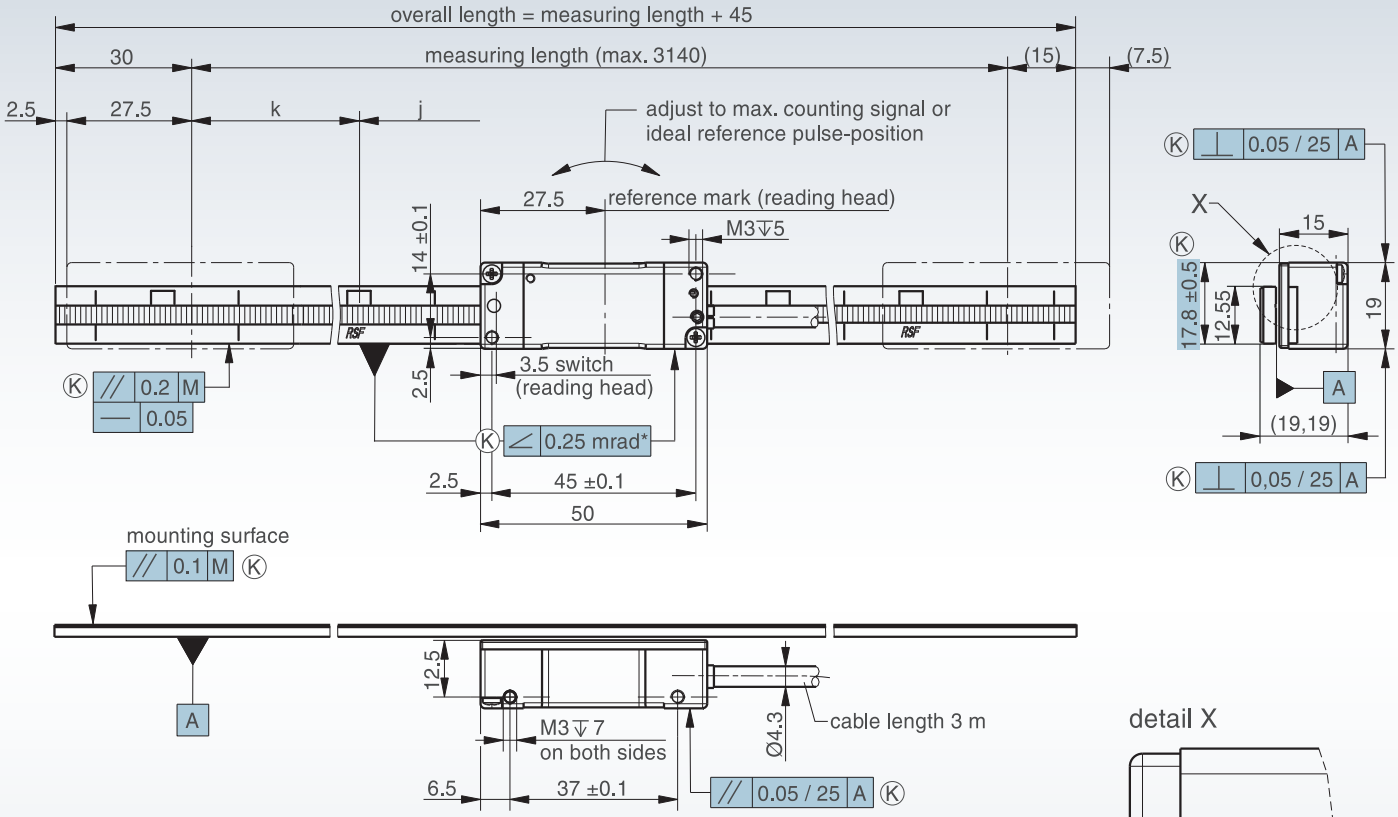
Affixing cover tapes for the switch points and activation of the selectable reference mark see page 16.

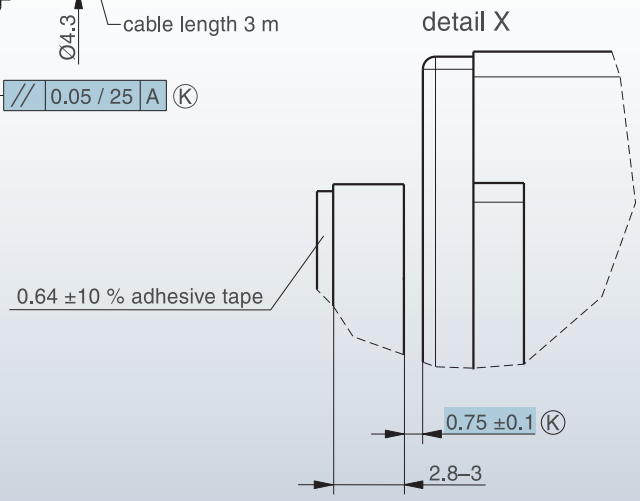
MS 30, MS 31 GK

- Glass scale with adhesive tape
- Standard: Sinusoidal output signals



Dimensions, mounting tolerances:





* = max. change in operation

M = machine guideway

Ⓚ = required mating dimensions

k = any position of reference mark (RI)
from the beginning of measuring length

j = additional reference marks (RI) separated by n x 50 mm

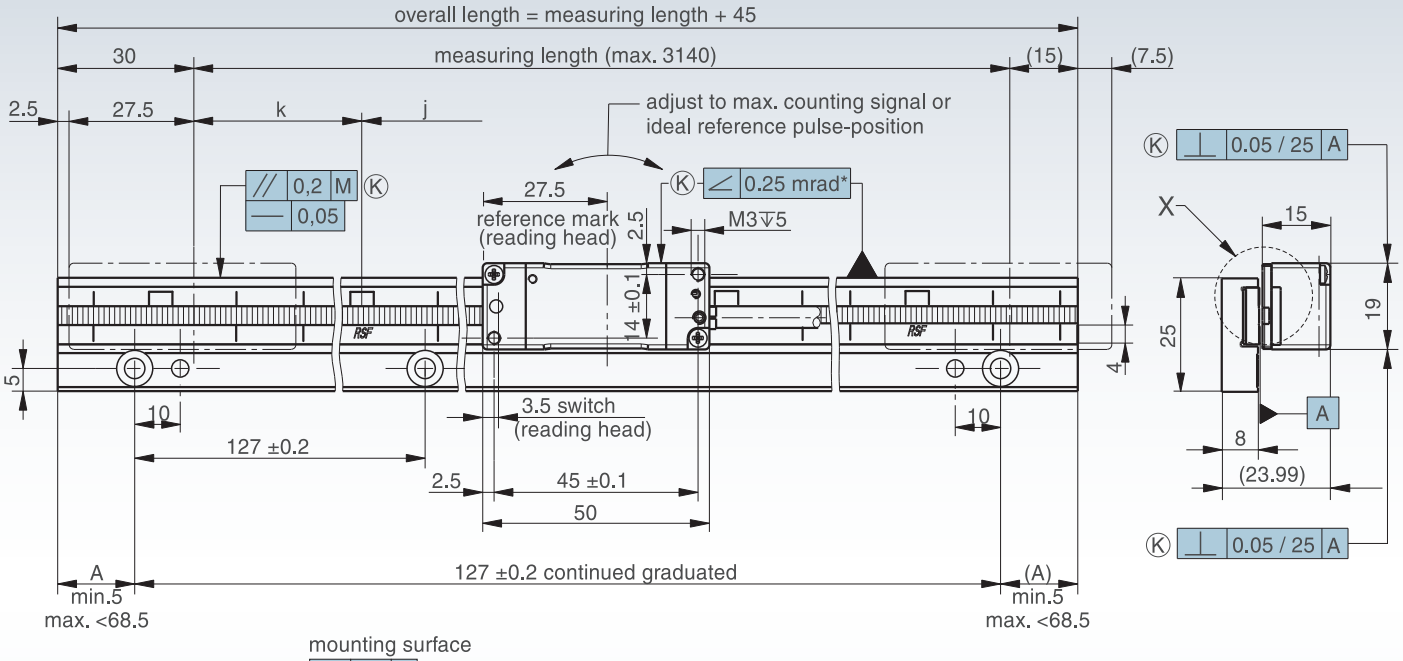
Weight (approx.):
■ 100 g/m
+ 30 g (reading head without cable)

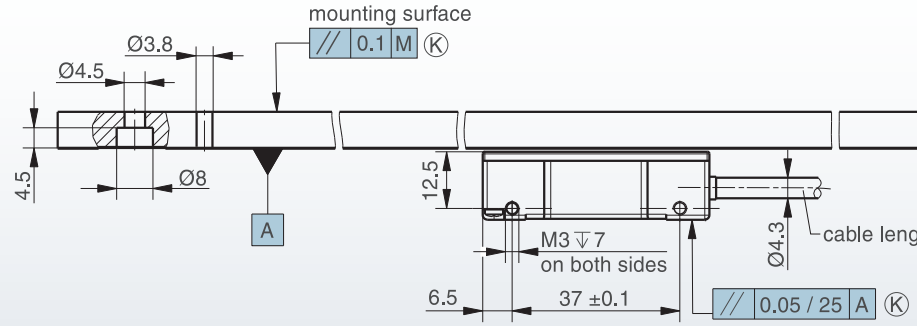
Affixing cover tapes for the switch points
and activation of the selectable reference mark see page 16

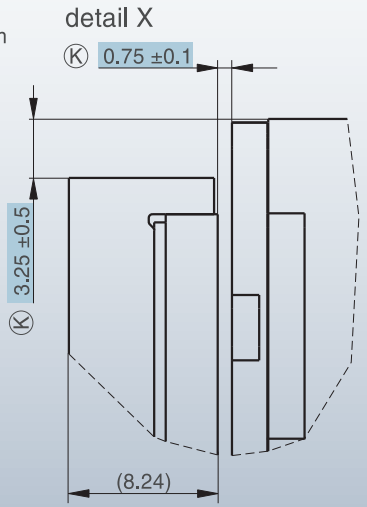
MS 30, MS 31 GA

- Glass scale in aluminum carrier
- Carrier bolted
- Standard: Sinusoidal output signals

Dimensions, mounting tolerances:







* = max. change in operation

M = machine guideway

Ⓚ = required mating dimensions

k = any position of reference mark (RI) from the beginning of measuring length

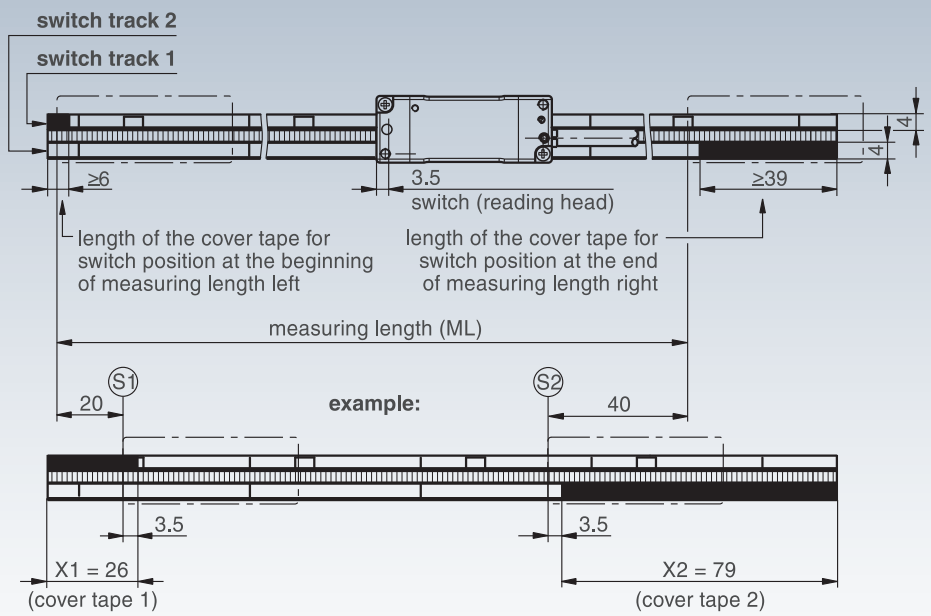
j = additional reference marks (RI) separated by n x 50 mm

Weight (approx.):
■ 515 g/m
+ 30 g (reading head without cable)

Affixing cover tapes for the switch points and activation of the selectable reference mark see page 16

SWITCH POINTS, REFERENCE MARK (RI)-SELECT

MS 30: Positioning of the switch points



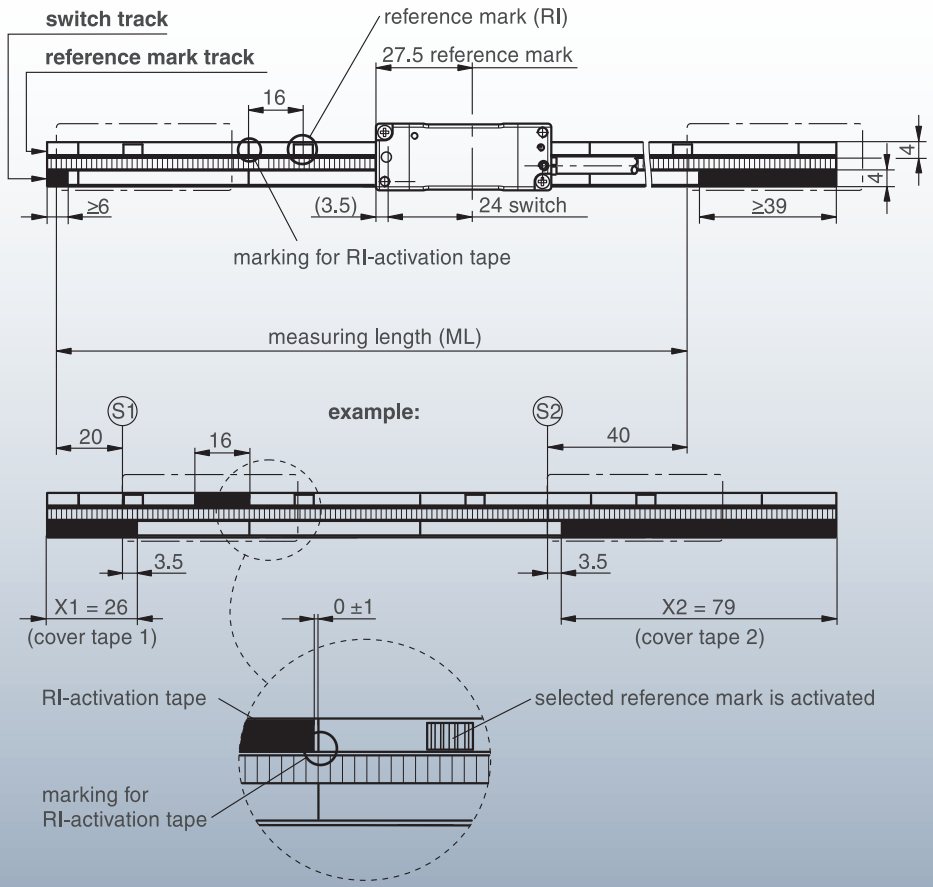
S1 = switch point 1
X1 = S1 + 6 (from left)

S2 = switch point 2
X2 = S2 + 39 (from right)

E.g.: S1: 20 mm from the beginning of ML (left)
Length X1 = 20 mm + 6 mm = 26 mm

S2: 40 mm from the end of ML (right)
Length X2 = 40 mm + 39 mm = 79 mm

MS 31: Reference mark (RI)-select, positioning of the switch points



S1 = switch point 1
X1 = S1 + 6 (from left)

S2 = switch point 2
X2 = S2 + 39 (from right)

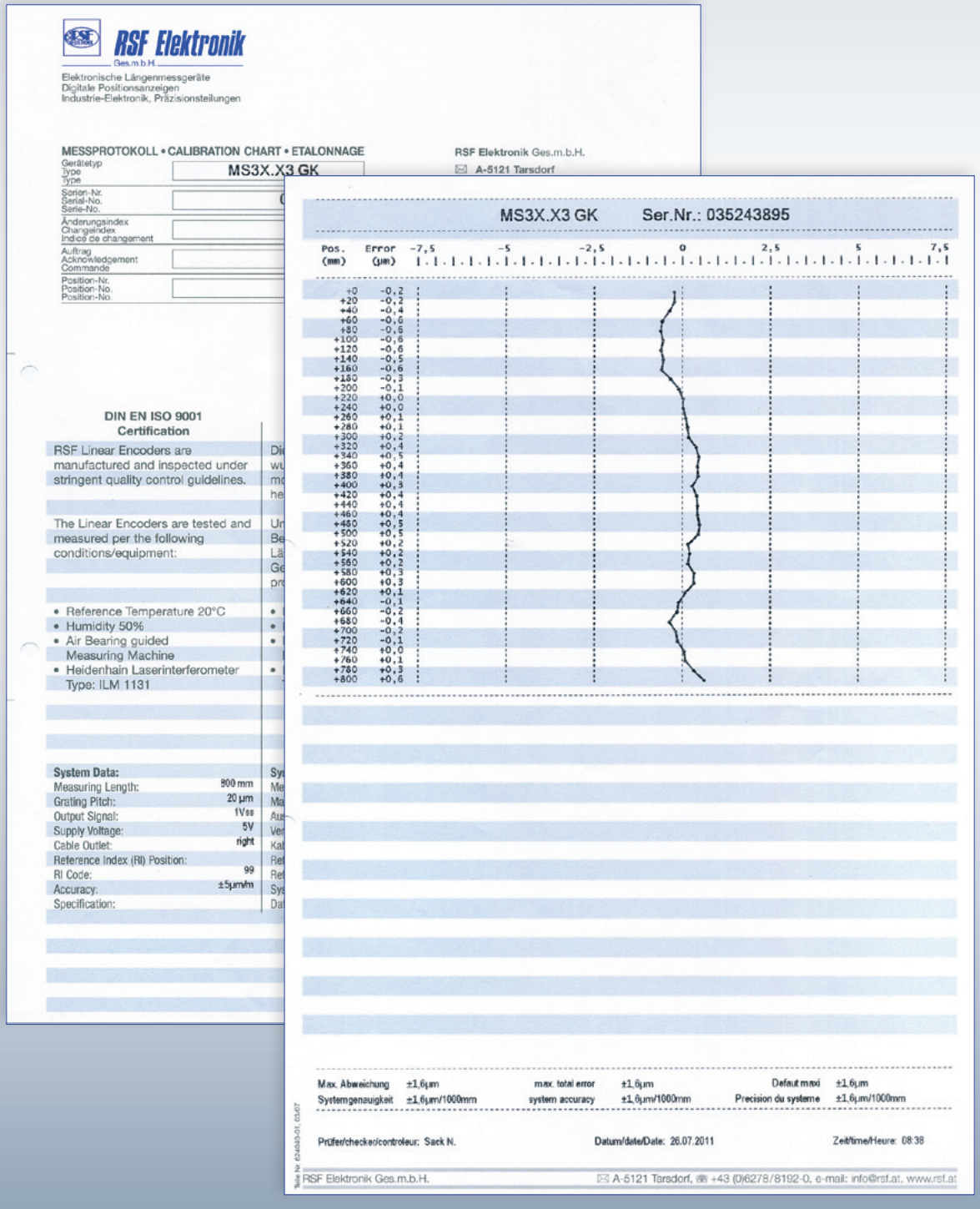
ACCURACY

The accuracy of the Linear Encoder is classified with a "± tolerance" in µm/m (e.g. ± 5 µm/m).

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

For best system accuracy, the encoder should be mounted near the machining level and as parallel as possible to the motion direction.

Example of a typical calibration chart for a MS 3x scale tape:



RSF Elektronik
Ges.m.b.H.
Elektronische Längenmessgeräte
Digitale Positionsanzeigen
Industrie-Elektronik, Präzisionsteilungen

MESSPROTOKOLL • CALIBRATION CHART • ETALONNAGE

RSF Elektronik Ges.m.b.H.
A-5121 Tarsdorf

Gerätetyp / Type / Type: MS3X.X3 GK
Serien-Nr. / Serial-No. / Serie-No.
Änderungsindex / Changeindex / Indice de changement
Auftrag / Acknowledgement / Commande
Position-Nr. / Position-No. / Position-No.

DIN EN ISO 9001
Certification

RSF Linear Encoders are manufactured and inspected under stringent quality control guidelines.

The Linear Encoders are tested and measured per the following conditions/equipment:

- Reference Temperature 20°C
- Humidity 50%
- Air Bearing guided Measuring Machine
- Heidenhain Laserinterferometer Type: ILM 1131

System Data:	
Measuring Length:	900 mm
Grating Pitch:	20 µm
Output Signal:	1Vss
Supply Voltage:	5V
Cable Outlet:	right
Reference Index (RI) Position:	
RI Code:	99
Accuracy:	±5µm/m
Specification:	

MS3X.X3 GK Ser.Nr.: 035243895

Pos. (mm)	Error (µm)
+0	-0,2
+20	-0,2
+40	-0,4
+60	-0,6
+80	-0,6
+100	-0,6
+120	-0,6
+140	-0,5
+160	-0,6
+180	-0,3
+200	-0,1
+220	+0,0
+240	+0,0
+260	+0,1
+280	+0,1
+300	+0,2
+320	+0,4
+340	+0,5
+360	+0,4
+380	+0,4
+400	+0,3
+420	+0,4
+440	+0,4
+460	+0,4
+480	+0,5
+500	+0,5
+520	+0,2
+540	+0,2
+560	+0,2
+580	+0,3
+600	+0,3
+620	+0,1
+640	-0,1
+660	-0,2
+680	-0,4
+700	-0,2
+720	-0,1
+740	+0,0
+760	+0,1
+780	+0,3
+800	+0,6

Max. Abweichung	±1,6µm	max. total error	±1,6µm	Defaut maxi	±1,6µm
Systemgenauigkeit	±1,6µm/1000mm	system accuracy	±1,6µm/1000mm	Precision du système	±1,6µm/1000mm

Prüfer/checker/controleur: Sack N. Datum/date/Date: 26.07.2011 Zeit/time/Heure: 08:38

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ELECTRONICAL SIGNAL TEST/SET-UP BOXES PG

Exposed Linear Encoders are adjusted at the factory to provide optimal signals at the specified mounting conditions.

Even though the Linear Encoders in the MS 3x series allow for large mechanical mounting tolerances,
it is recommended to inspect the mounting by checking the quality of the output signals.

There are various methods of checking the quality of the output signals.
The signals can be connected to an oscilloscope and checked for conformity with signal specifications. This method requires effort, training and expensive test equipment (oscilloscope). Often one or all of these items are unavailable to the installing technician.
As an alternative to this method, RSF offers different signal test boxes. With these test boxes all encoder signals can be quickly and easily checked.

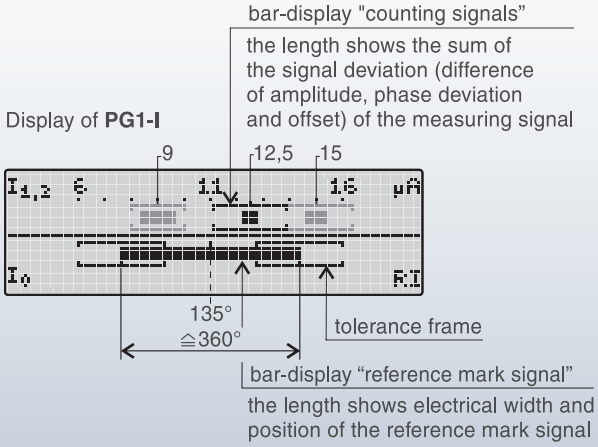
The **PG1-I** / **PG1-U** is an all-purpose signal test box where all the relevant signals are displayed on LCD Bars, and allows the quantitative as well as the qualitative evaluation of the encoder signals.

The **PG3-I** / **PG-U** test box checks all relevant signals; amplitude, phase and offset, and displays the results in a qualitative format on a polychromatic LED display.

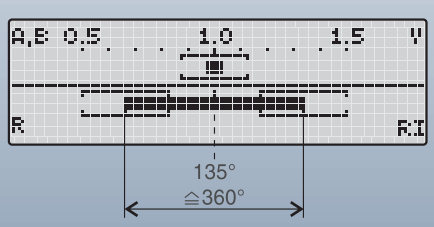
PG1-I / PG1-U

PG2-I / PG-U

Display of **PG1-I**



Display of **PG1-U**

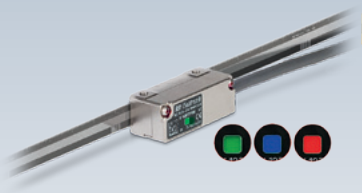


Intended PG-use	Output signals Square-wave	Sinus (1 Vpp)
PG1-I 	■	--
PG1-U 	--	■
PG2-I 	■	--
PG-U 	--	■

■ intended

-- not intended

PRODUCT DIRECTORY



MS 14 Series

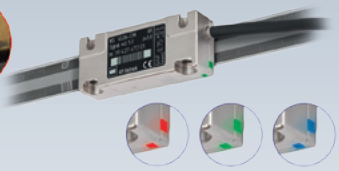
Reflective scanning Linear Encoder with integrated mounting

- Easy mounting; no test box or oscilloscope needed
- Quality of the scanning signals is directly visible at the reading head via a 3-coloured LED
- Extremely small dimensions
- Easy mounting as a result of large mounting tolerances
- High insensitivity against contamination
- High traversing speed
- Integrated subdividing: up to times 100 interpolation
- Max. measuring length Steel tape scale: 20 000 mm

MS 2x Series

Reflective scanning Linear Encoder with integrated mounting control (only MS 25, MS 26)

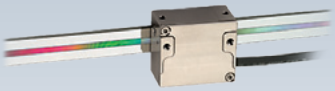
- Easy mounting; no test box or oscilloscope needed
- Quality of the scanning signals is directly visible at the reading head via a 3-coloured LED
- Two independent switch signals for individual special functions
- Position of reference mark selectable
- High insensitivity against contamination
- High traversing speed
- Integrated subdividing: up to times 100 interpolation
- Max. measuring length Glass scale: 3140 mm Steel tape scale: 20 000 mm



MS 45 Series

Reflective scanning Linear Encoder with integrated mounting control

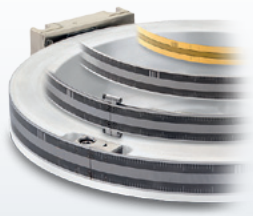
- Easy mounting; no test box or oscilloscope needed
- Quality of the scanning signals is directly visible at the reading head via a 3-coloured LED
- Small dimensions
- Easy mounting as a result of large mounting tolerances
- High insensitivity against contamination
- High traversing speed
- Integrated subdividing: up to times 100 interpolation
- Max. measuring length Steel tape scale: 30 000 mm



MS 82 Series

Interferential Linear Encoder

- Two switch tracks for individual special functions
- Non-contact reflective scanning
- High traversing speed
- Small dimensions
- Scale unit: glass scale or ROBAX® glass cramic scale with phasse grating
- Max. measuring length Glass scale: 3140 mm Glass ceramic: 1540 mm



MSR 40

Modular Rotary Encoder with steel tape scale

Different versions

- Full-circle or segment version
- Grating pitch: 200 µm
- Accuracy of the grating (stretched): ±30 µm/m
- High rotational speed resp. circumferential speed
- Integrated subdividing: up to times 100 interpolation

MSR 20

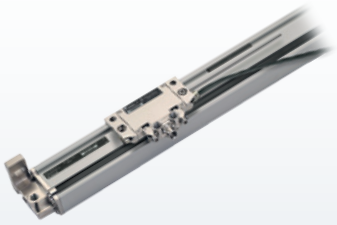
- Segment version
- Grating pitch: 40 µm
- Accuracy of the grating (stretched): ±15 µm/m
- High circumferential speed
- Integrated subdividing: up to times 100 interpolation

MSA 170 Series

- Sealed version
- Guided by ball bearings
- Distance-coded reference marks
- Mounting holes on the extrusion ends
- Max. measuring length: 520 mm

MSA 7xx, MSA 8xx Series (small dimensions)
MSA 4xx, MSA 5xx Series (large dimensions)

- Optimized thermal behavior
- Connection cable pluggable (optional)
- Sealed version
- Distance-coded reference marks
- Mounting holes at the ends or along the scale unit for improved vibration stability
- Max. measuring length: 3040 mm



MSA 374 Series

- With integrated guide rail system
- For application on presses bending machines and hydraulic cylinders
- Sealed version
- Roller bearing dual guided scanning carriage
- Free positionable switching magnets for special functions
- Distance-coded reference marks
- Mounting holes on the extrusion ends
- Max. measuring length: 720 mm

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