RSF Elektronik

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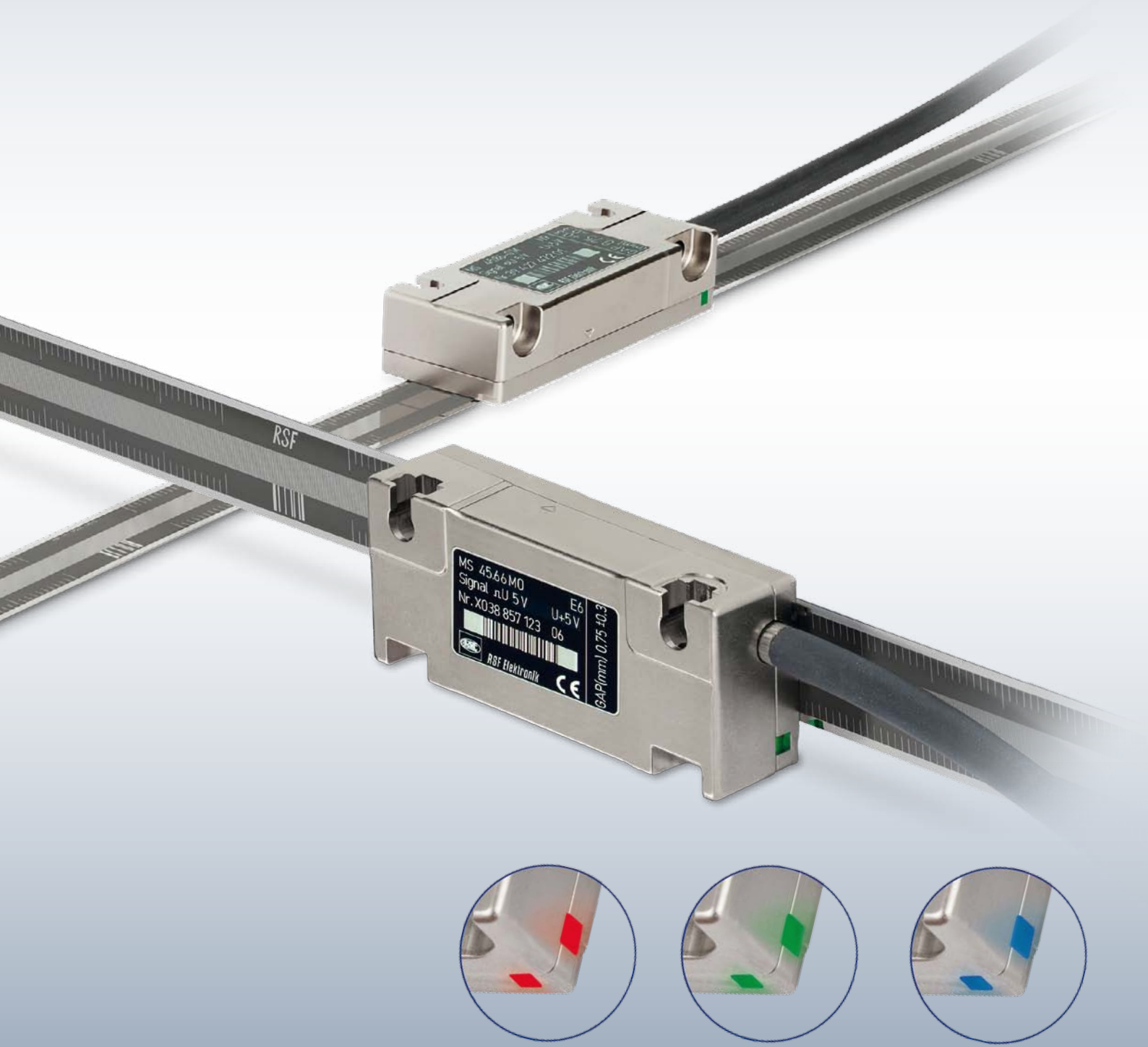
MS 45 Series

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.

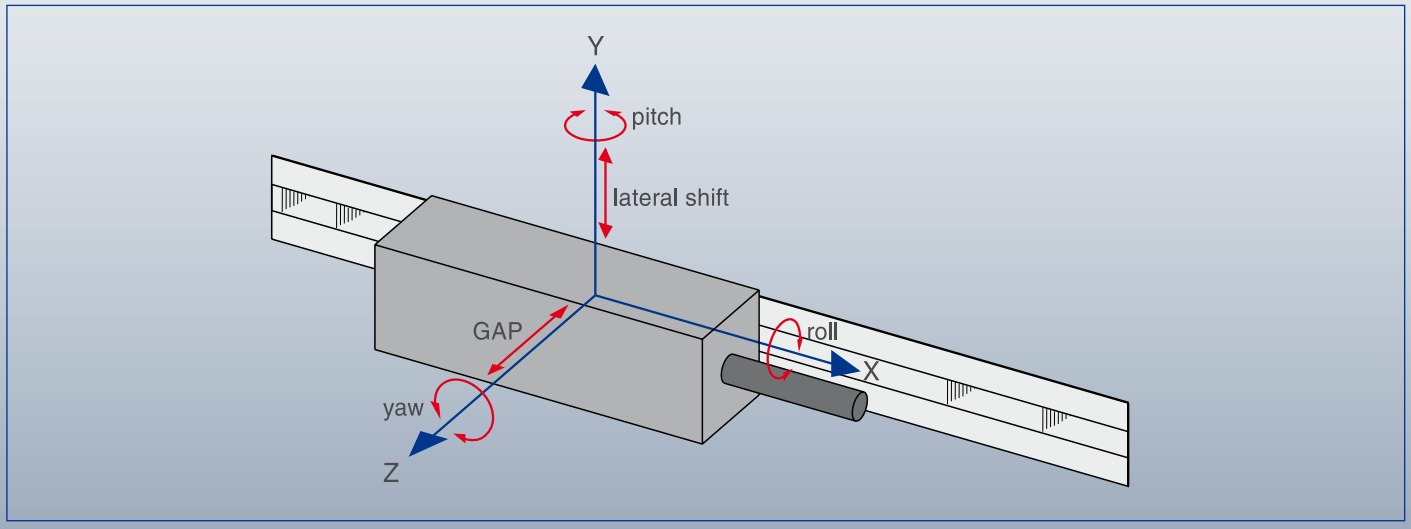
Reference Pulse (Reference Mark)
There is an additional track of marks printed next to the grating to allow a user to find an absolute position along the length of the scale. A one increment wide signal is generated when the encoder head passes the reference mark on the scale. This is called a “true” 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.



REQUIREMENTS OF AN EXPOSED LINEAR ENCODER

- Contamination resistance
- High resolution
- High traversing speed
- Easy mounting due to large mounting tolerances
- Low cost and high quality
- Small dimensions
- With integrated mounting control

The MS 4x 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.

A drawback of many exposed Linear Encoders is their sensitivity to dirt and contamination on the scale.
The MS 45 encoders´ unique optical design minimizes the effect of dirt and contamination normally associated with the exposed Linear Encoders.

The MS 45 utilizes a unique scanning principle which allows high traversing speeds (up to 15 m/s), large mounting tolerances, and contamination on the scale.

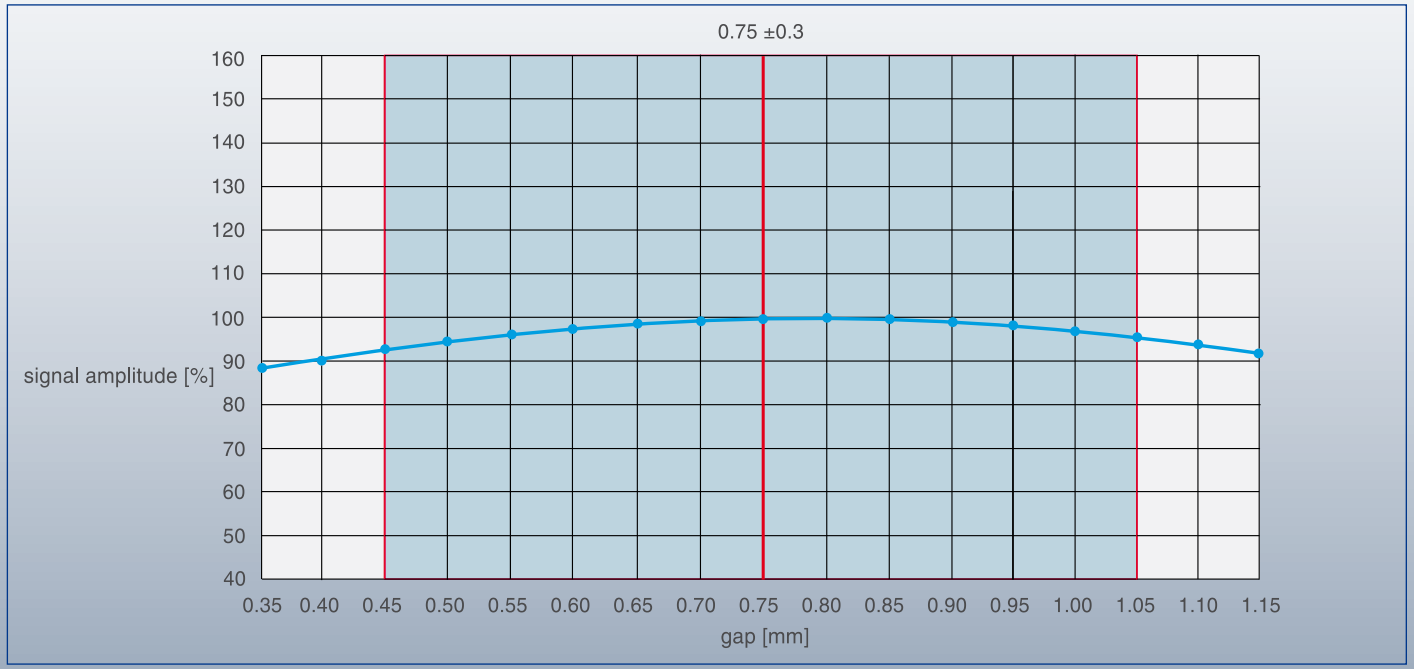
Reference marks, accurate and repeatable from both traversing directions, are standard.

A wide range of interpolation electronics, integrated into the encoder head, enable resolutions from 10 µm to 0.5 µm. Square-wave signals via Line Driver RS 422, are provided at the output of the encoder head.

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

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

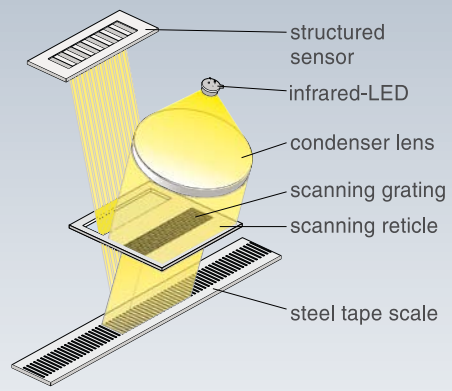
The model MS 45 incremental Linear Encoder works with the imaging, photoelectric measuring principle and a singlefield reflective scanning method. A scale graduation pattern with 200 µm grating pitch is used on a steel tape.

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.

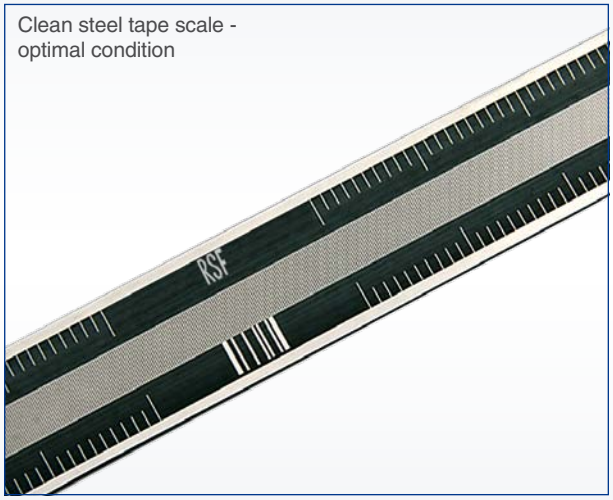
The regulation of the LED ensures a constant light output, guaranteeing stability in the case of temperature fluctuations as well as with long-run operation.

Scanning principle

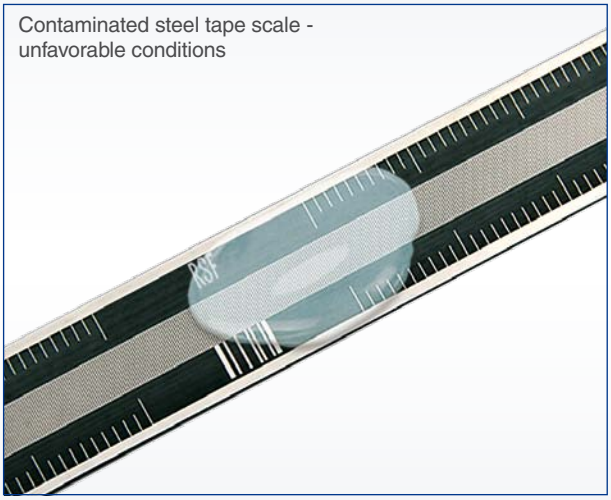


Effect of contamination on the quality and size of the measuring signal

Clean steel tape scale - optimal condition



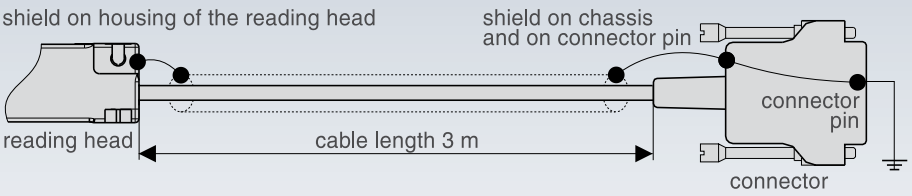
Contaminated steel tape scale - unfavorable conditions



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

SHIELDING, PIN ASSIGNMENT

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

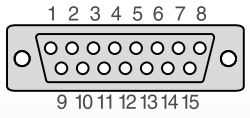


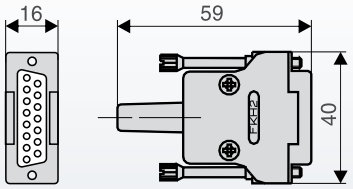
Connector LD15 15-pin

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	nc	nc	RI	A2	A1	shield
Square-wave signals via Line Driver	nc	0 V sensor	$\overline{US}$	$\overline{RI}$	$\overline{T2}$	$\overline{T1}$	+5 V sensor	+5 V	0 V	nc	nc	RI	T2	T1	shield

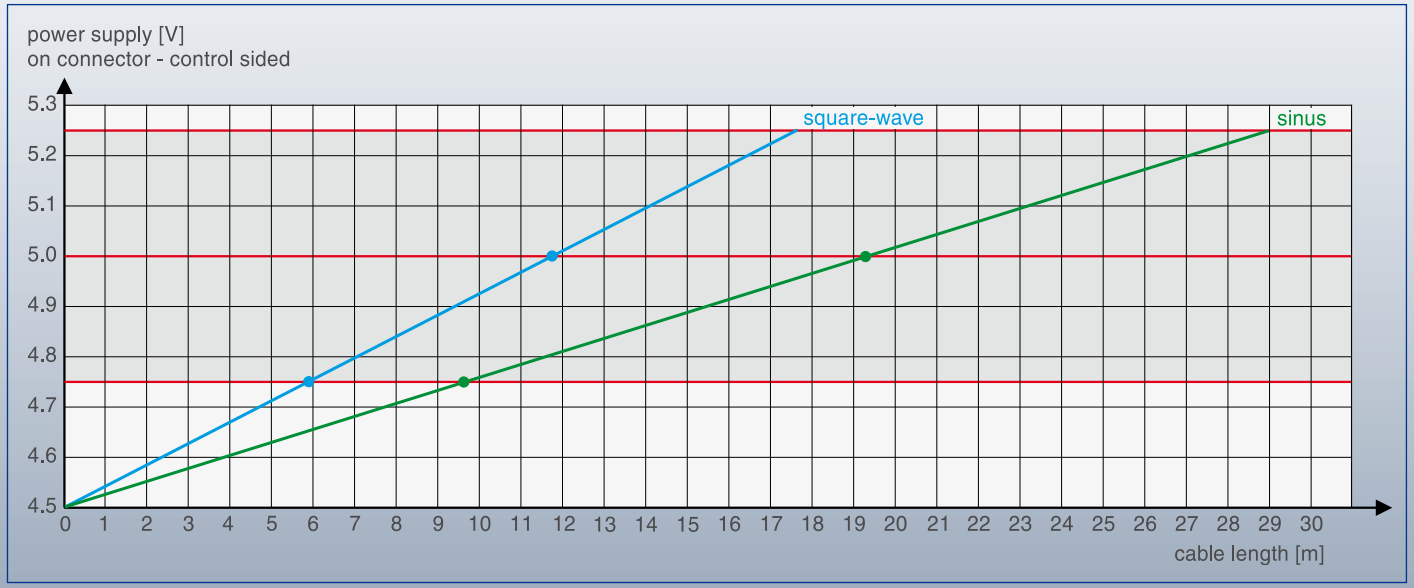
- Sensor: The sensor-pins are bridged with the particular power supply.
- The shield is additional connected with the chassis.

PIN assignment
(view on pins)





Max. permissible cable length according to power supply



OUTPUT SIGNALS

Sinusoidal voltage signals 1Vpp

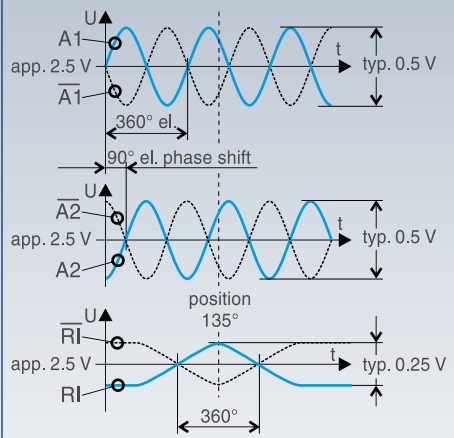
(drawing shows “positive counting direction”)
Two sinusoidal voltage signals A1 and A2 and one reference mark signal (all with inverted signals).

Power supply: +5 V ±5 %, max. 130 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 an interpolation electronics (for times -5, -10, -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

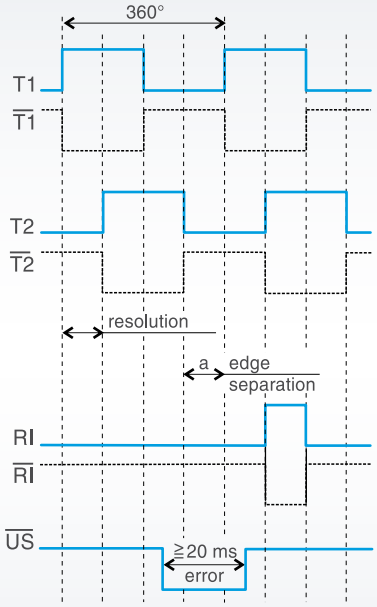
To prevent counting errors, the controls/DRO´s must be able to process the resulting edge separation.

Example:
a_{min} = 200 ns, 10 m cable
200 ns - 10 ns - 10 x 0.2 ns - 10 ns = 178 ns

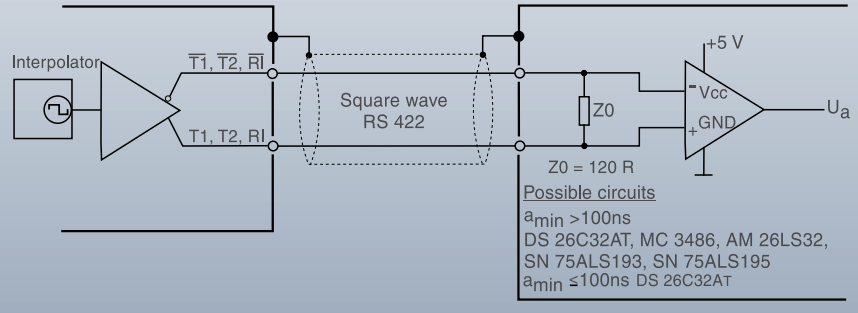
Power supply: +5 V ±5%, max. 145 mA (unloaded)

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

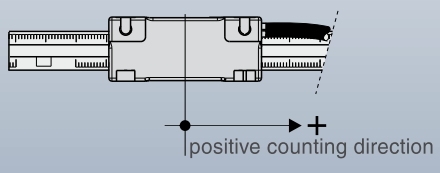
Square wave signals „differential“



Recommended Line Receiver circuit



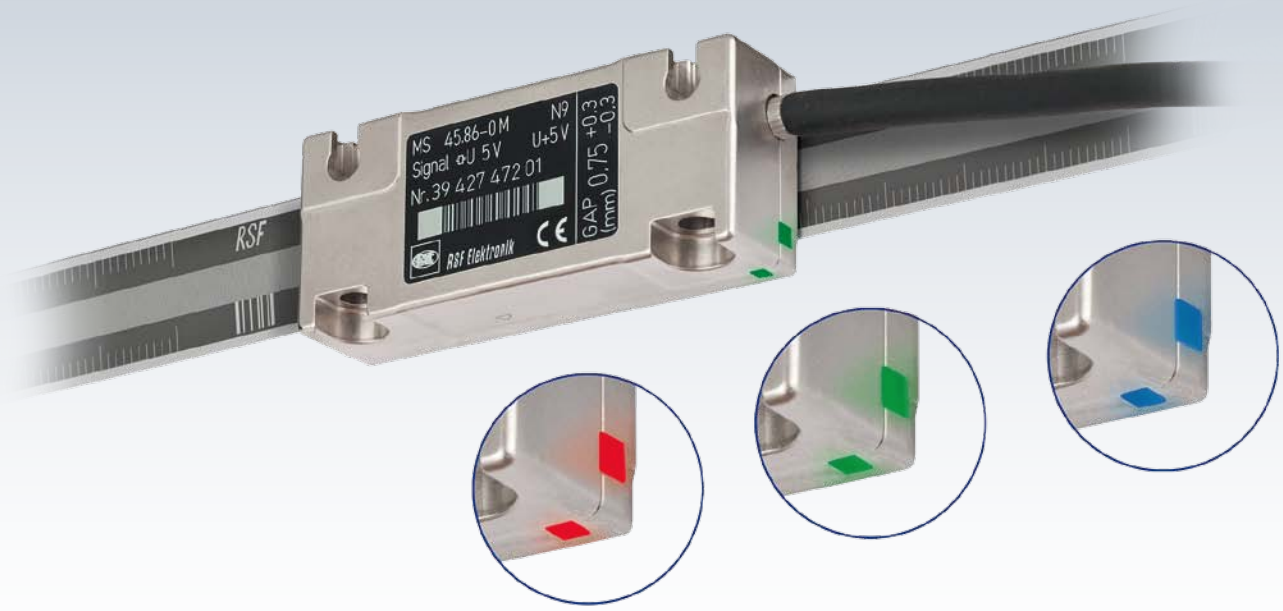
Counting direction



INTEGRATED MOUNTING CONTROL

Features:

- Easy mounting; No test box or oscilloscope needed
- The quality of the scanning signals is visible via a tricoloured LED directly at the reading head
- Permanent-control of the scanning signals over the whole measuring length
- Function-control of the reference impulse



LED-display to evaluate the „counting signals“

Amplitude-range sin cos	LED flashes	LED colour	Mounting is …
1.35 V - 1.45 V	5x	●	insufficient
1.25 V - 1.35 V	4x	●	insufficient
1.15 V - 1.25 V	3x	●	acceptable
1.05 V - 1.15 V	2x	●	good
0.95 V - 1.05 V	1x	●	**best**
0.85 V - 0.95 V	2x	●	good
0.75 V - 0.85 V	3x	●	acceptable
0.65 V - 0.75 V	4x	●	insufficient
0.55 V - 0.65 V	5x	●	insufficient
0.45 V - 0.55 V	6x	●	insufficient
0.35 V - 0.45 V	7x	●	insufficient
< 0.35 V	8x	●	insufficient

Function-control reference impulse (RI)

While passing the reference mark,
the LED switches shortly into blue resp. red

- ● RI out of tolerance
- ● RI within tolerance

Note! The status display of the reference mark signal is switched off at higher velocities, in order to avoid permanent blinking. The information of the incremental signals would otherwise no longer be displayed.

Attention:

- At MS 45 with square-wave output signals, no analogue-signal switch-over for mounting control is provided

TECHNICAL DATA

Reading head: 200 µm grating pitch

Scale model	Output signals	System resolution [µm]	Integrated interpolation	Max. velocity [m/s]	Max. output frequency [kHz]
MS 45.06	~ 1 Vpp	depending on external interpolation	--	15	75
					Edge separation amin
MS 45.66	⎍	10	times 5	10.0	500 ns
MS 45.76	⎍	5	times 10	9.6	500 ns
MS 45.86	⎍	1	times 50	4.8	200 ns
MS 45.96	⎍	0.5	times 100	2.4	200 ns

Permissible vibration:
150 m/s² (40 to 2000 Hz)

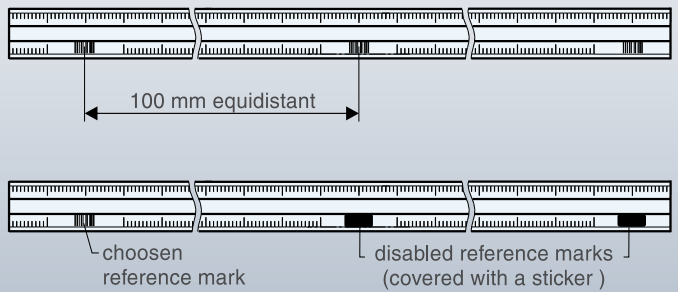
Permissible shock:
750 m/s² (8 ms)

Permissible temperature:
–20 °C to +70 °C (storage), 0 °C to +60 °C (operation)

Scale unit

Mechanical features of the scale unit	
Grating carrier	steel
Grating pitch (T)	200 µm
Accuracy grades	±30 µm/m
Non-linearity	±5 µm/m
Maximum measuring length (ML)	30 000 mm
Reference marks (RI)	standard: 100 mm (equidistant)
	at any location, on request

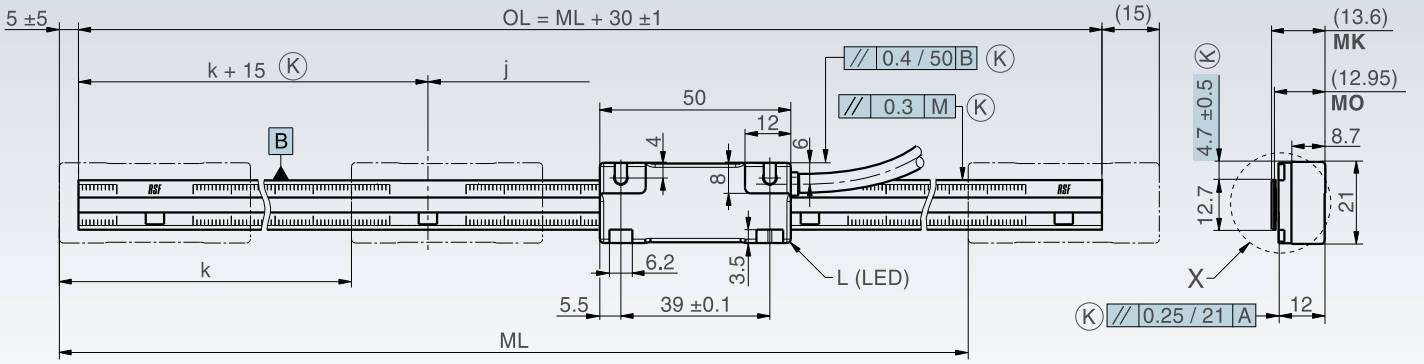
Pattern of standard reference marks

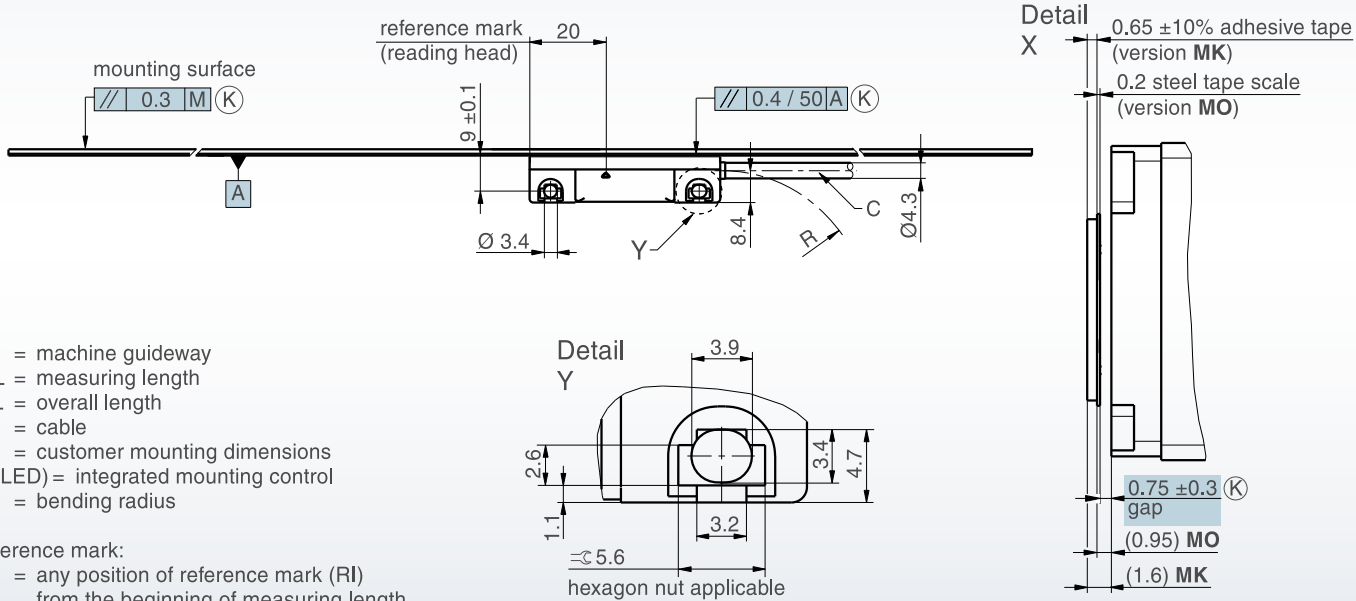


MS 45 MO/MK

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

Dimensions, mounting tolerances:





M = machine guideway
ML = measuring length
OL = overall length
C = cable
Ⓚ = customer mounting dimensions
L (LED) = integrated mounting control
R = bending radius

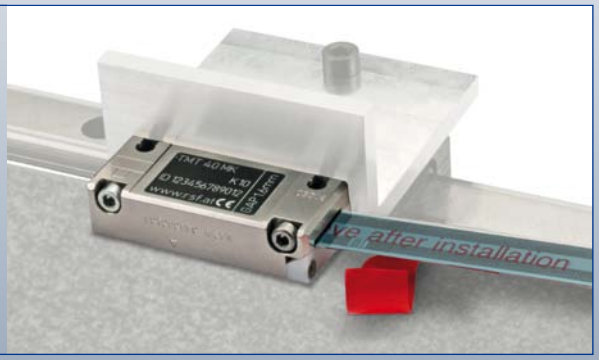
reference mark:
k = any position of reference mark (RI) from the beginning of measuring length
j = additional reference marks (RI) separated by n x 100 mm

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

+ 17 g (reading head without cable)

Tape mounting tool **TMT 40 MK** (optional)
For safe and precise mounting of the steel tape scale.

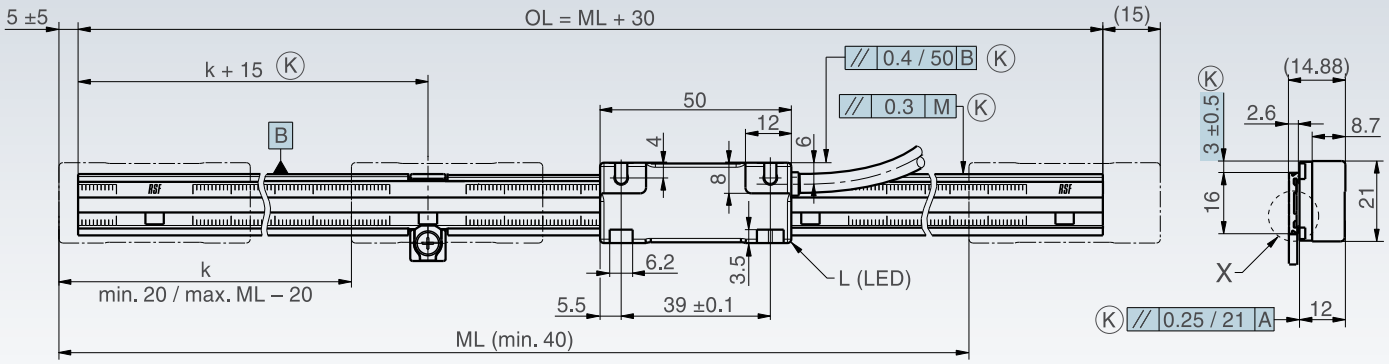
- Mount TMT 40 MK instead of the reading head MS 4x
- Thread steel tape scale (version MK) and move along the scale length
- Remove TMT 40 MK, mount the reading head MS 4x

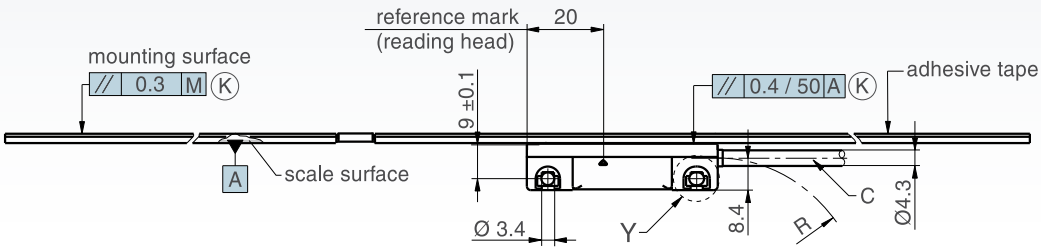


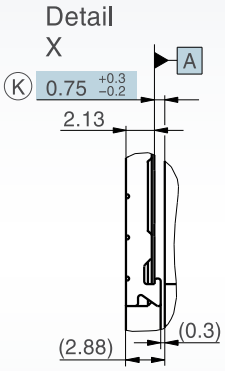
MS 45 MP

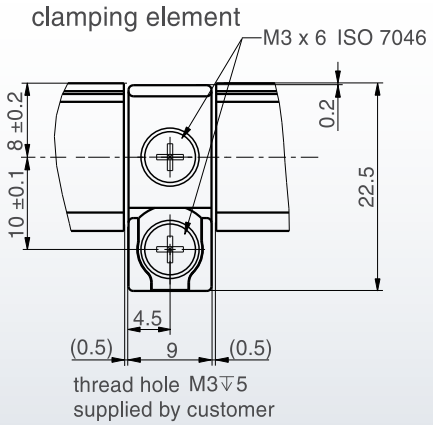
- Steel tape scale in aluminum carrier with clamping element
- Carrier with adhesive tape

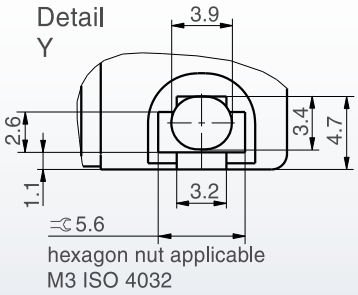
Dimensions, mounting tolerances:









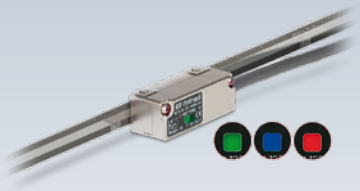


M = machine guideway
ML = measuring length
OL = overall length
C = cable
(K) = customer mounting dimensions
L (LED) = integrated mounting control
R = bending radius

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

Weight (approx.):
115 g/m + 2 g clamping element
+ 17 g (reading head without cable)

PRODUCT DIRECTORY



MS 14 Series

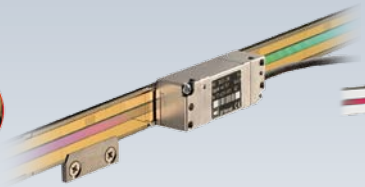
Reflective scanning Linear Encoder with integrated mounting

- 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)

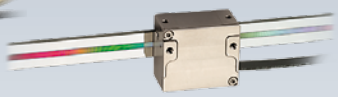
- Easy mounting; no test box or oscilloscope needed
- Quality of the scanning signals is directly visible at the reading head via a 3-coloured LED
- Two independent switch signals for individual special functions
- Position of reference mark selectable
- High insensitivity against contamination
- High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



MS 30, MS 31 Series

Reflective scanning Linear Encoder

- Two independent switch signals for individual special functions
- Position of reference mark selectable
- Small dimensions
- Easy mounting as a result of large mounting tolerances
- High traversing speed
- High insensitivity against contamination
- Integrated subdividing: up to times 100 interpolation
- Max. measuring length Glass scale: 3140 mm Steel tape scale: 11 940 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

E. g.: MSA 470

E. .g.: MSA 730

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

DISTRIBUTION CONTACTS

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Date 10/2012 ■ Art.Nr. 1034109-01 ■ Doc.Nr. D1034109-00-A-01 ■ Technical adjustments in reserve!