RSF Elektronik

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MS 14 Series

Exposed Linear Encoders with Singlefield Scanning

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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.

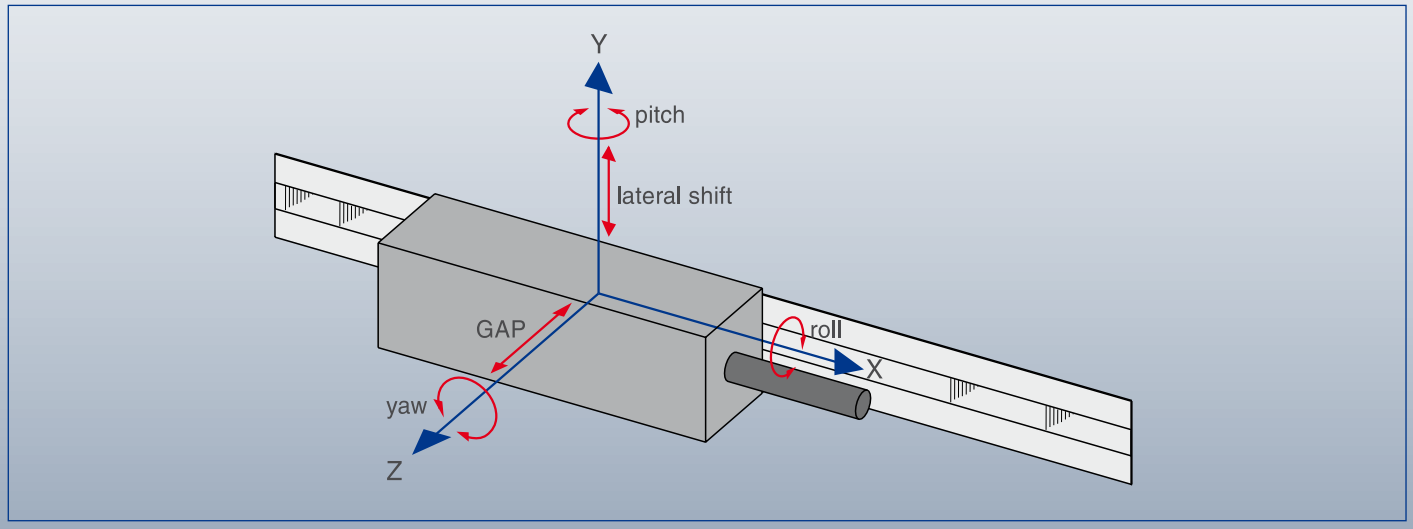
Reference Pulse (Reference Mark)
There is an additional track of marks printed next to the grating to allow a user to find an absolute position along the length of the scale. A one increment wide signal is generated when the encoder head passes the reference mark on the scale. This is called a “true”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

The new MS 14 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 14 encoders´ 40 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 14 encoders´ unique optical design minimizes the effect of dirt and contamination normally associated with the exposed Linear Encoders.

The MS 14 utilizes a unique scanning principle which allows high traversing speeds (up to 10 m/s), large mounting tolerances, and contamination on the scale.

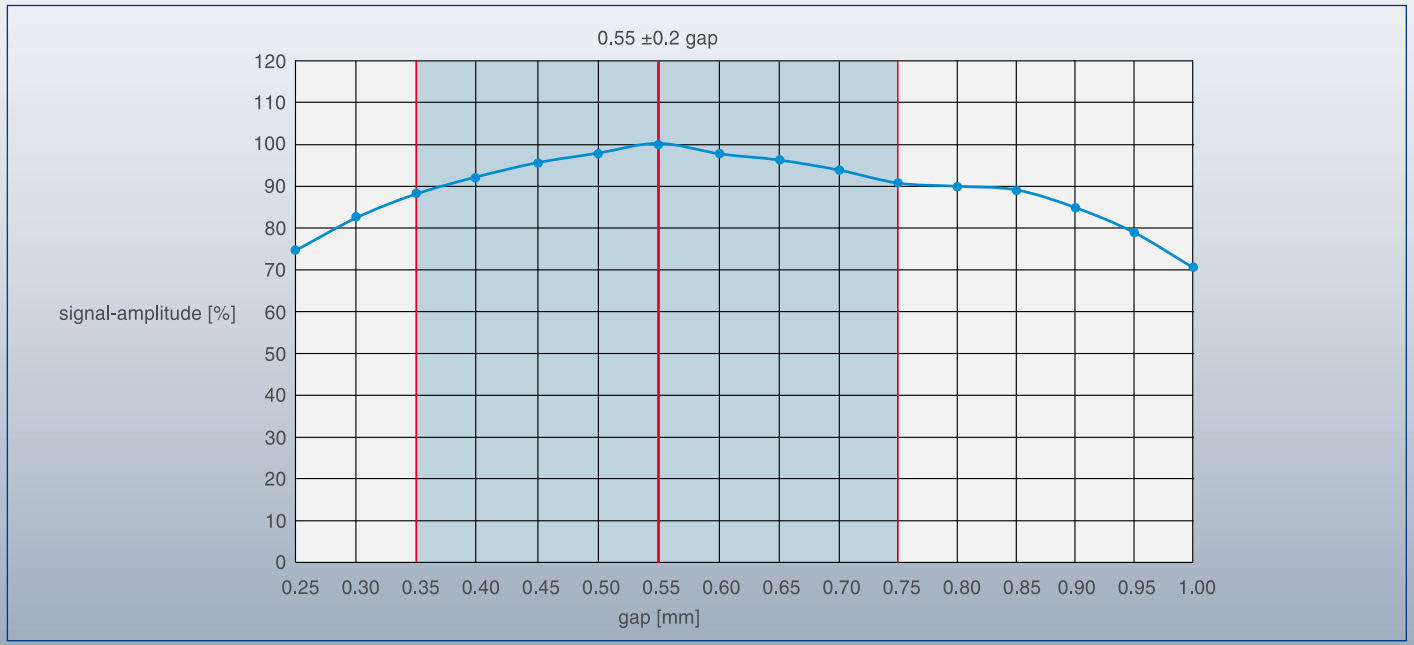
Reference marks, accurate and repeatable from both traversing directions, are standard.

A wide range of interpolation electronics, integrated into the encoder head, enable resolutions from 2 µm to 100 nm. 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

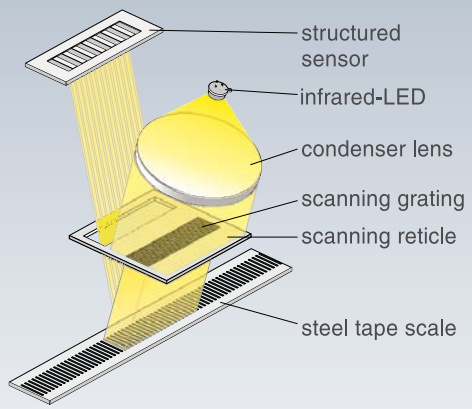
The model MS 14 incremental Linear Encoder works with the imaging, photoelectric measuring principle and a **singlefield reflective scanning** method.

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.

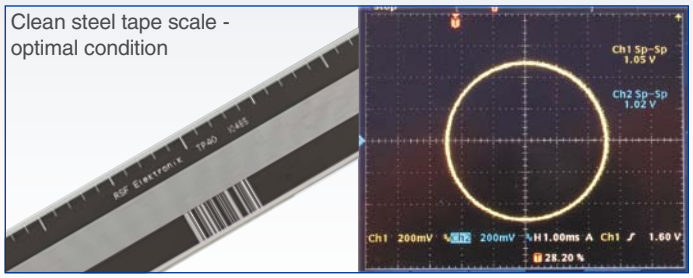
The regulation of the LED ensures a constant light output, guaranteeing stability in the case of temperature fluctuations as well as with long-run operation.

Scanning principle

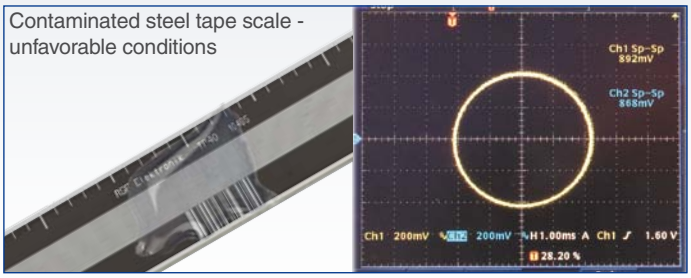


Effect of contamination on the quality and size of the measuring signal

Clean steel tape scale - optimal condition



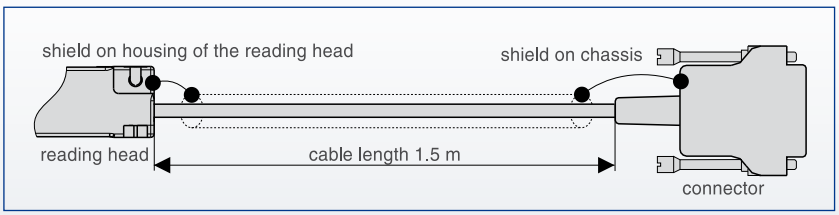
Contaminated steel tape scale - unfavorable conditions



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

SHIELDING, PIN ASSIGNMENTS

Shielded PUR-cable, Ø: 4.3 mm
Bending radius fixed mounting: >10 mm,
continuous flexing: >20 mm
Drag chain qualified
Cables for use in vacuum applications are available on request.

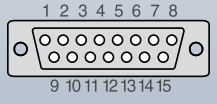


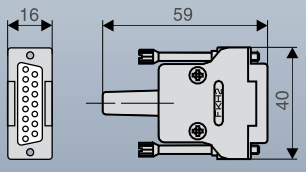
Connector LD15 15-pin

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	nc
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	nc

- Sensor: The sensor-pins are bridged with the particular power supply.

PIN assignment
(view on pins)





OUTPUT SIGNALS

Sinusoidal voltage signals 1Vpp

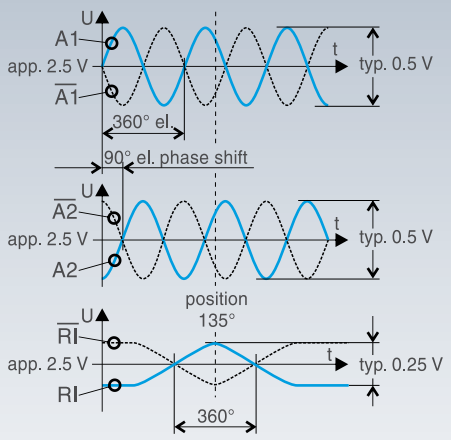
(drawing shows “positive counting direction”)
Two sinusoidal voltage signals A1 and A2 and one reference mark signal (all with inverted signals).

Power supply: +5 V ±5 %, max. 100 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, -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

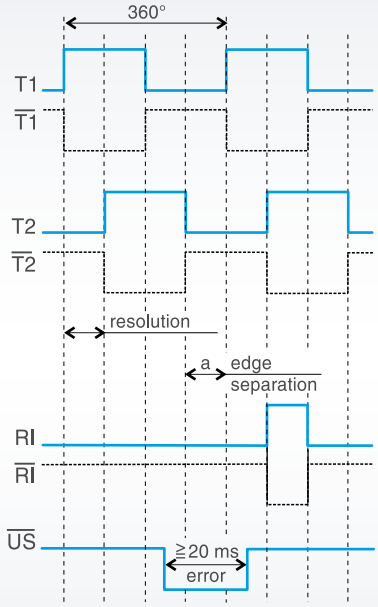
To prevent counting errors, the controls/DRO´s must be able to process the resulting edge separation.

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

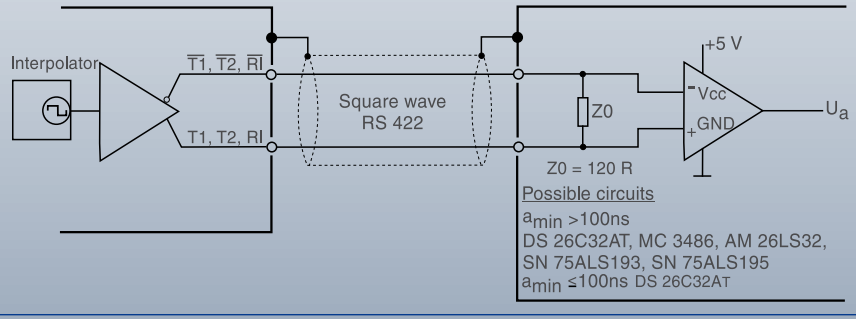
Power supply: +5 V ±5%, max. 120 mA (unloaded)

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

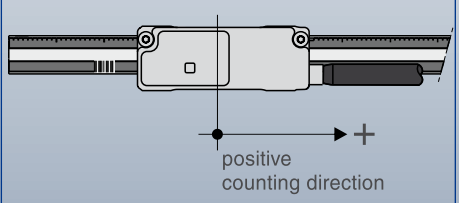
Square-wave signals „differential“



Recommended Line Receiver circuit



Counting direction



MS 14 WITH 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 14 with square-wave signals, no analogue-signal switch-over for mounting control is provided

MS 14 TECHNICAL DATA

Reading head: 40 µm grating pitch

Scale model	Output signals	System resolution [µm]	Integrated interpolation	Max. velocity [m/s]	Max. output frequency [kHz]
MS 14.04	~ 1 Vss	depending on external interpolation	--	10	250
					Edge separation a_{min}
MS 14.64	⎍	2	times 5	6.4	300 ns
MS 14.74	⎍	1	times 10	3.2	300 ns
MS 14.44	⎍	0.5	times 20	2.4	200 ns
MS 14.54	⎍	0.4	times 25	1.92	200 ns
MS 14.84	⎍	0.2	times 50	1.92	100 ns
MS 14.94	⎍	0.1	times 100	0.96	100 ns

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

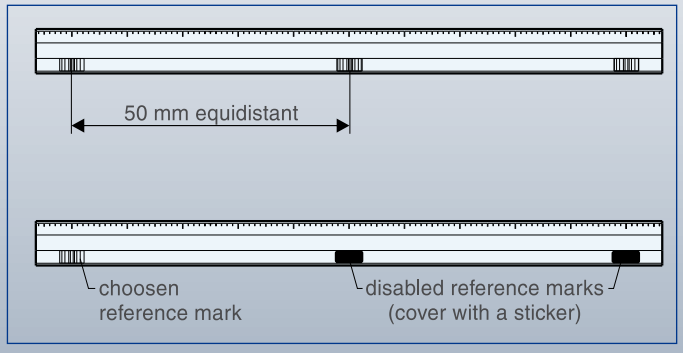
Permissible shock:
750 m/s² (8 ms)

Permissible temperature:
–20 °C up to +70 °C (storage), 0 °C up to +55 °C (operation)

Scale unit

Mechanical features of the scale unit	
Grating carrier	steel
Grating pitch (T)	40 µm
Accuracy grades	±5, ±15 µm/m
Non-linearity	±3 µm/m
Maximum measuring length (ML)	20 000 mm
Reference marks (RI)	standard: 50 mm equidistant
	at any location, on request

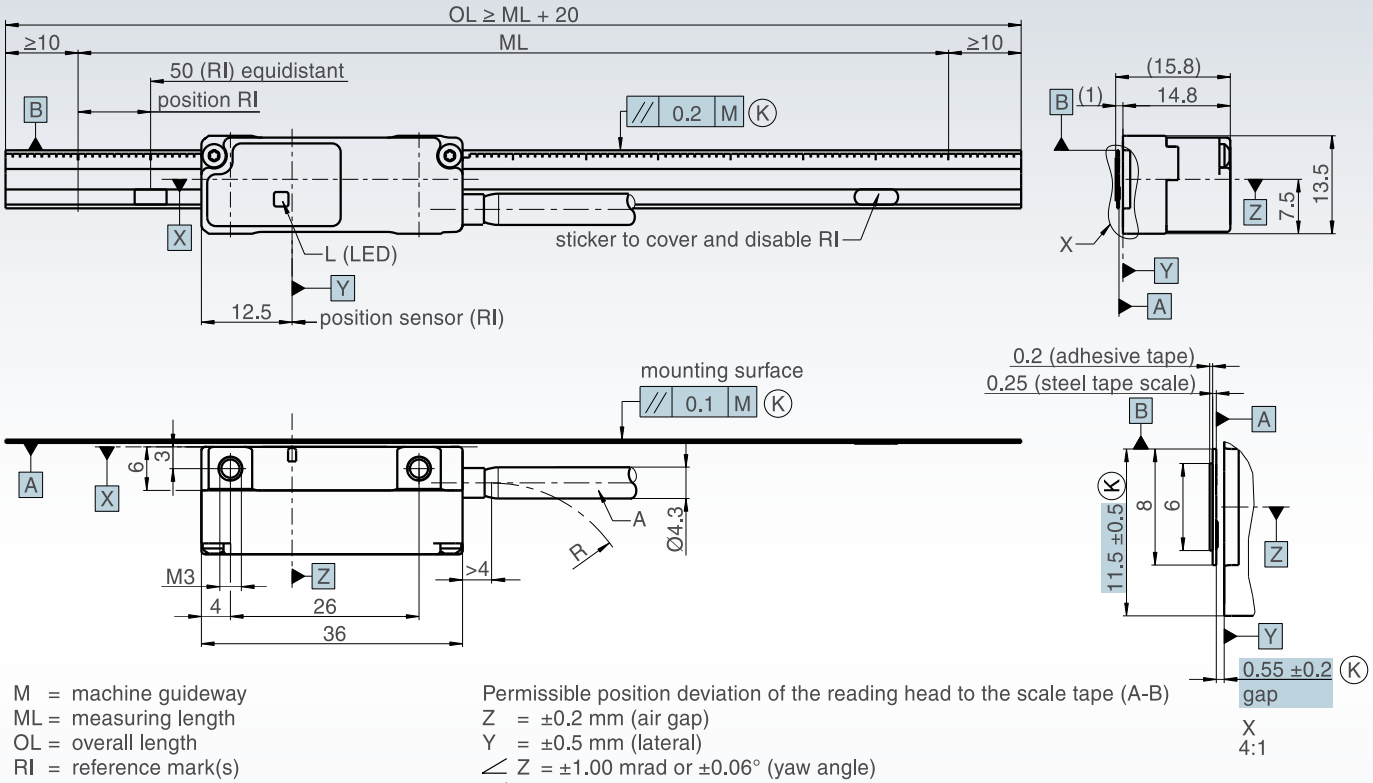
Pattern standard reference marks



MS 14 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
RI = reference mark(s)
A = cable
K = customer mounting dimensions
L (LED) = integrated mounting control
R = bending radius

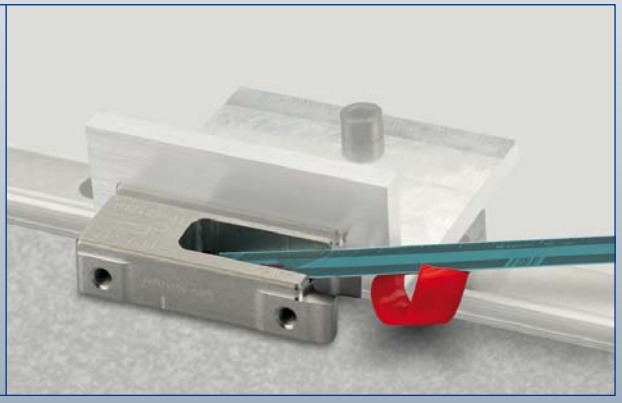
Permissible position deviation of the reading head to the scale tape (A-B)
Z = ±0.2 mm (air gap)
Y = ±0.5 mm (lateral)
∠ Z = ±1.00 mrad or ±0.06° (yaw angle)
∠ Y = ±3.50 mrad or ±0.20° (pitch angle)
∠ X = ±4.00 mrad or ±0.23° (roll angle)

Weight (approx.):
- Version MO: 16 g/m
- Version MK: 17 g/m

+ 12 g (reading head without cable)

Tape mounting tool **TMT 14 MK** (optional)
For safe and precise mounting of the steel tape scale.

- Mount TMT 14 MK instead of the reading head MS 14
- Thread steel tape scale (version MK) and move along the scale length
- Remove TMT 14 MK, mount the reading head MS 14



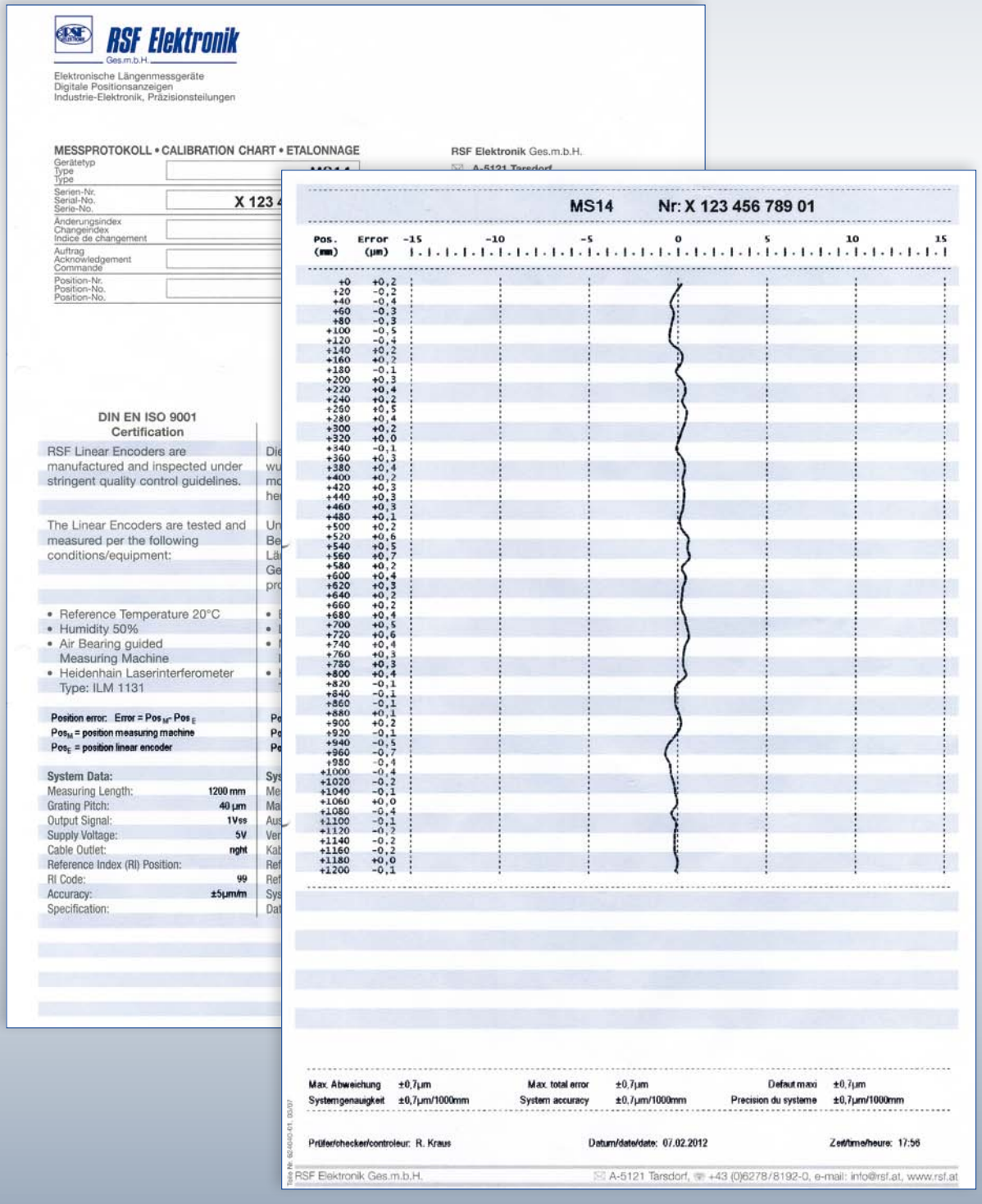
ACCURACY

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 14 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.

Gerätetyp / Type / Type
Serien-Nr. / Serial-No. / Serie-No. X 123 4
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

Position error: Error = Pos_M - Pos_E
Pos_M = position measuring machine
Pos_E = position linear encoder

System Data:

Measuring Length:	1200 mm
Grating Pitch:	40 µm
Output Signal:	1Vss
Supply Voltage:	5V
Cable Outlet:	right
Reference Index (RI) Position:	
RI Code:	99
Accuracy:	±5µm/m
Specification:	

MS14 Nr: X 123 456 789 01

Pos. (mm)	Error (µm)
+0	+0,2
+20	-0,2
+40	-0,4
+60	-0,3
+80	-0,3
+100	-0,5
+120	-0,4
+140	+0,2
+160	+0,2
+180	-0,1
+200	+0,3
+220	+0,4
+240	+0,2
+260	+0,5
+280	+0,4
+300	+0,2
+320	+0,0
+340	-0,1
+360	+0,3
+380	+0,4
+400	+0,2
+420	+0,3
+440	+0,3
+460	+0,3
+480	+0,1
+500	+0,2
+520	+0,6
+540	+0,5
+560	+0,7
+580	+0,2
+600	+0,4
+620	+0,3
+640	+0,2
+660	+0,2
+680	+0,4
+700	+0,5
+720	+0,6
+740	+0,4
+760	+0,3
+780	+0,3
+800	+0,4
+820	-0,1
+840	-0,1
+860	-0,1
+880	+0,1
+900	+0,2
+920	-0,1
+940	-0,5
+960	-0,7
+980	-0,4
+1000	-0,4
+1020	-0,2
+1040	-0,1
+1060	+0,0
+1080	-0,4
+1100	-0,1
+1120	-0,2
+1140	-0,2
+1160	-0,2
+1180	+0,0
+1200	-0,1

Max. Abweichung	±0,7µm	Max. total error	±0,7µm	Default maxi	±0,7µm
Systemgenauigkeit	±0,7µm/1000mm	System accuracy	±0,7µm/1000mm	Precision du système	±0,7µm/1000mm

Prüfer/checker/controleur: R. Kraus Datum/date/date: 07.02.2012 Zeit/time/heure: 17:56

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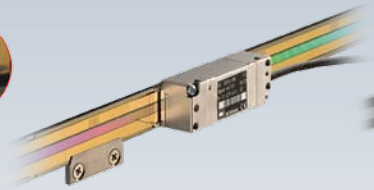
PRODUCT DIRECTORY

MS 2x Series

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

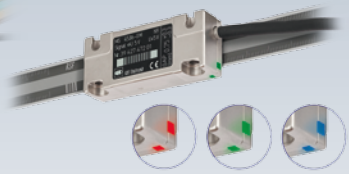
- Easy mounting; no test box or oscilloscope needed
- Quality of the scanning signals is directly visible at the reading head via a 3-coloured LED
- Two independent switch signals for individual special functions
- Position of reference mark selectable
- High insensitivity against contamination
- High 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

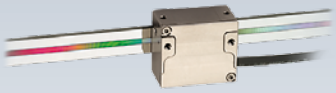
- Two independent switch signals for individual special functions
- Position of reference mark selectable
- Small dimensions
- Easy mounting as a result of large mounting tolerances
- High traversing speed
- High insensitivity against contamination
- Integrated subdividing: up to times 100 interpolation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



MS 45 Series

Reflective scanning Linear Encoder with integrated mounting control

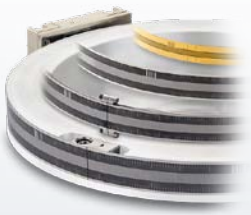
- Easy mounting; no test box or oscilloscope needed
- Quality of the scanning signals is directly visible at the reading head via a 3-coloured LED
- Small dimensions
- Easy mounting as a result of large mounting tolerances
- High insensitivity against contamination
- High traversing speed
- Integrated 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

DG 118, DG 120

Rotary Encoder for universal application

- Standard line/rev.: graduated from 100 to 5400

UFC 430

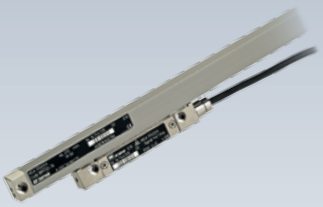
USB-Interface-Module

- USB-interface acc. to spec. 2.0
- Available inputs: 1 Vpp max. 200 kHz or TTL (RS 422) max. 500 kHz
- Interpolation: up to times 400 for measuring systems with output 1 Vpp and up to times 4 for measuring systems with square-wave Line Driver signals
- Three 15-pin Sub-D female connectors for 3 encoder inputs
- 32 Bit counter with preset and latch register

IFC 430R

Encoder-interface-card

- PC interface board for quadrature encoder signal evaluation: times 1, -2 or -4
- Latch logic for measured values
- Three counter channels à 32 bit, one load and two latch registers for each channel
- PC bus
- Signal edge separation: up to 100 ns
- Demo program with examples and driver software



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

MSA 65x, MSA 35x

Sealed Linear Encoders

- For retrofit of machine tools
- Large mounting tolerances
- Guided by ball bearings
- Distance-coded reference marks
- Two sets of sealing lips for additional contamination protection (only MSA 352)
- Mounting holes on the extrusion ends (MSA 650, MSA 35x)
- Mounting holes on top of the extrusion - improves vibration rating (MSA 651)
- Mounting supports (MSA 35x)
- Max. measuring lengths:
  MSA 650: 1740 mm
  MSA 651: 2240 mm
  MSA 35x: 3040 mm

DIT 10, DIT 30, DIT 48

Precision Measuring Probes

- For universal applications
- Stroke length: 10, 30, 48 mm
- Mounting on shaft sleeve
- Mounting with two tapped holes on body (DIT 30, DIT 48)
- With cable lifter
- Integrated pneumatic lifter optional
- Sealing bellows optional (DIT 30, DIT 48)

Precision Graduations

- Length graduations on glass, chromium coated
- Length graduations on steel tape, gold coated or polished surface
- Circular graduations on glass, chromium coated
- Graticules
- Antireflex coatings
- Coatings

Cable Systems

- Individual cable design
- Hybrid cable
- Trailing cable
- System solutions
- Function control

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