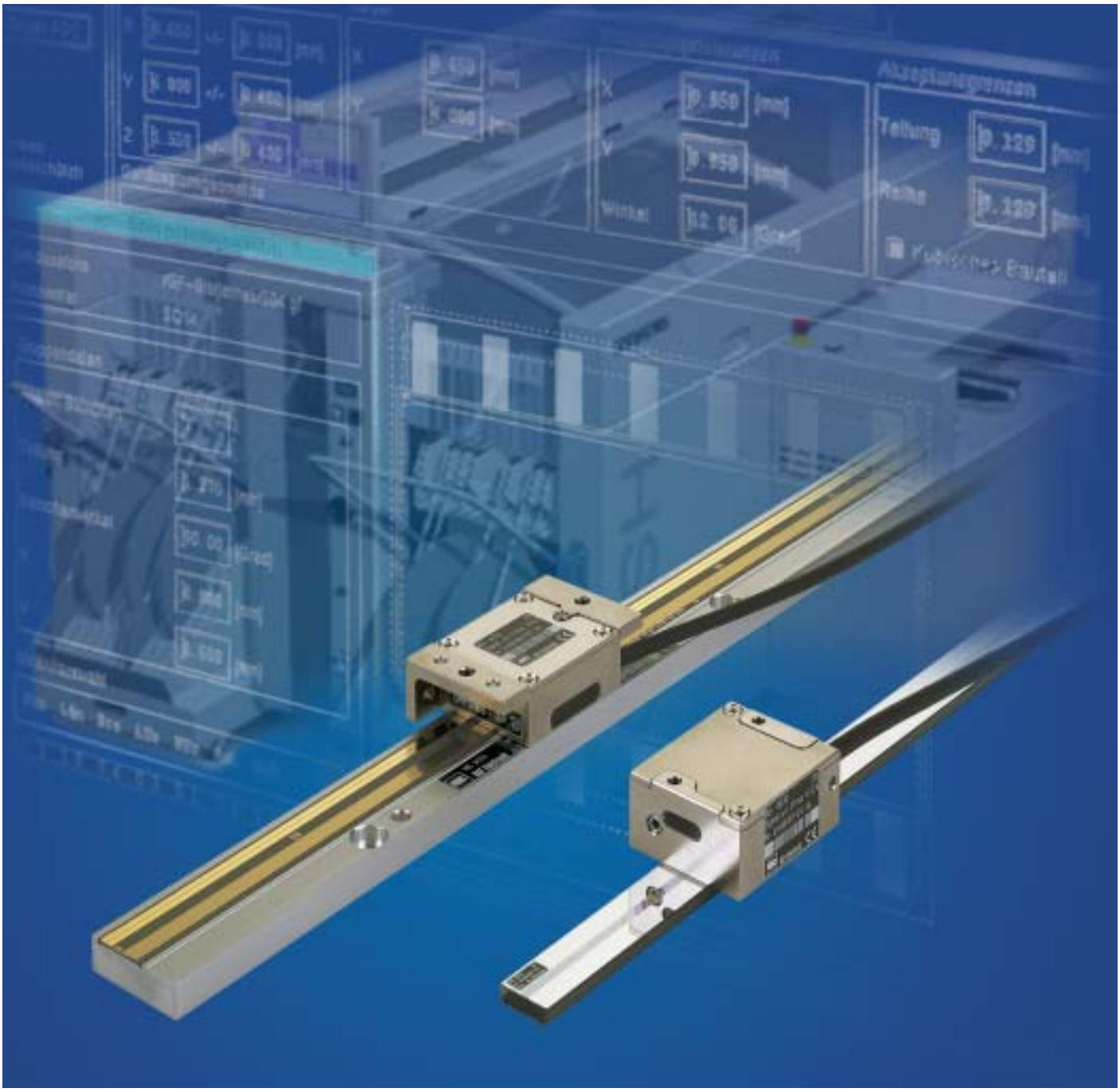
RSF Elektronik

Technik, die zählt
Technology that counts

Incremental Linear Encoders

Open Models



RSF Elektronik Ges.m.b.H.

The main plant in Tarsdorf/Austria

RSF Elektronik was founded 1973 in
St. Georgen near Salzburg, Austria.

From the beginning, the objective was
to develop and produce Linear and
Rotary Encoders and Digital Readouts.
Our products were well accepted
in the market, and after some years,
the company employed more than 100 people.

Due to growth, it was then necessary
for RSF Elektronik to move into larger facilities.
The company moved in 1978 to our current location.
Today, the largest percentage of our shipments are
Incremental Linear Encoders.

To guarantee the best possible support, we have regional offices in the USA, Southkorea, Switzerland and Slowenia. We also have distributors in nearly every industrialized country in the world.

One of the main internal elements of opto-electronic measuring systems are high precision divisions on glass and/or steel carriers.
Under the trade name “SENTOP”, RSF Elektronik manufactures Precision Graduations
in thin layer technology.
2002 a new production plant has been equipped to the latest international standards what the todays technique in clean room conditions fulfiles.

Our quality, performance and environment management comply with DIN EN ISO 9001 and DIN EN ISO 14001 standards.

distributors in Rancho Cordova/USA

distributors in SUNGSEOK-Dong/Korea R.O.K.

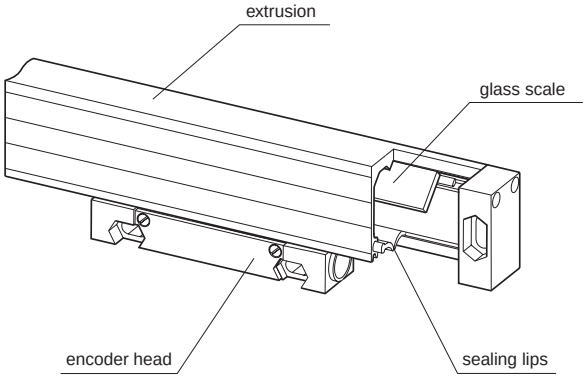
Table of contents

Design and operation

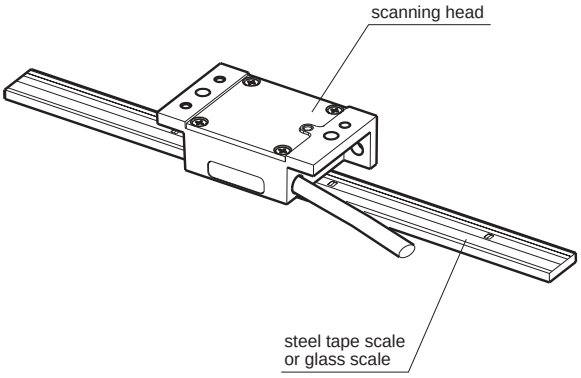
RSF manufactures linear encoders in enclosed and open versions.
The enclosed models are easy to install with large mounting tolerances.
They are also best suited for harsh environments. The sealing lips on the extrusion keep out coolants and contamination.

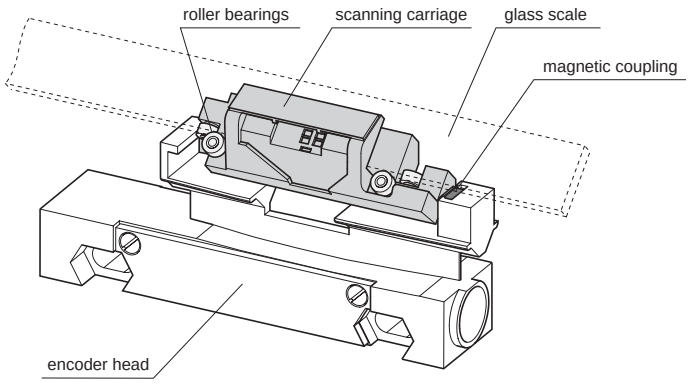
The non-contact open measuring systems are for high displacement velocities and high accuracies, commonly used in clean environments.

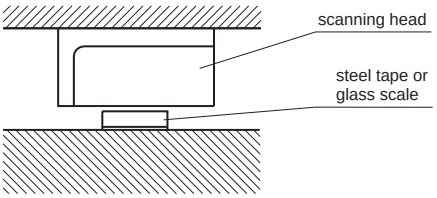
Enclosed systems with guided scanning carriage



Open systems with non-contact scanning carriage





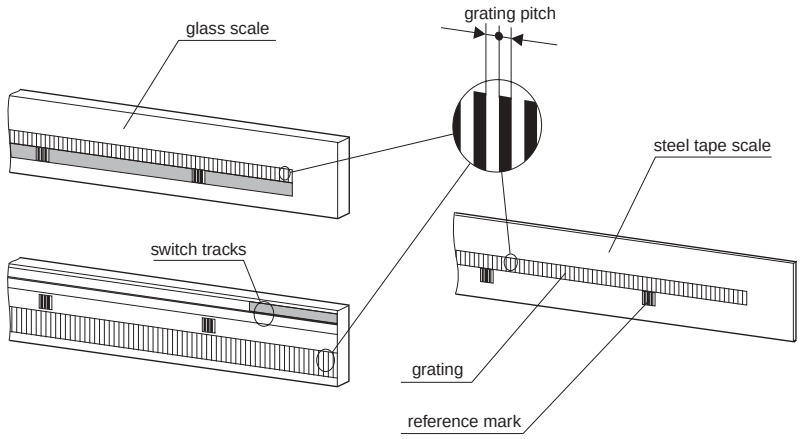


Enclosed Linear Encoders have a roller bearing self-guided scanning carriage. The scanning carriage is spring loaded to track properly within the encoder head mounting tolerance range. A set of rare earth magnets couple the scanning carriage to the mounting base of the encoder head.

This magnetic coupling compensates allowable mounting tolerances and machine guide non-parallelism.
Non-contact open encoders rely on the air gap between the encoder head and scale to be uniform over the measuring range. The flatness of the mounting surface and the parallelism of the machine guideway is important.

The scale graduation pattern has a high accuracy grating.
Scales can be produced on metal tape or spars, or glass substrates.
One cycle (period) of grating pitch, is defined as one chrome line and one corresponding line space, each with the same width.
The total width of one chrome line and one line space is called grating pitch.
A second track adjacent to the graduation pattern, contains the Reference mark(s). There are standard Reference mark locations, or they can be specified upon request.
Multiple Reference marks must be separated by n x 50 mm distances.

Scale graduation pattern

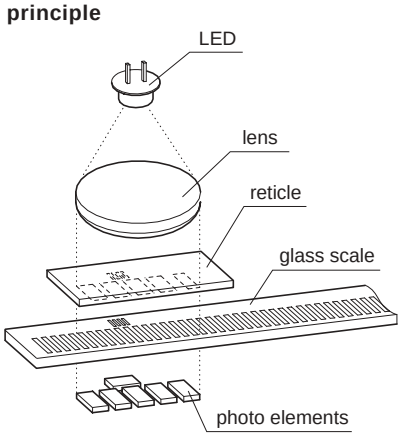


Linear Encoders with the suffix "**K**" in the model type have distance coded Reference marks. The absolute tool position is available after a measuring move of 20 mm maximum.

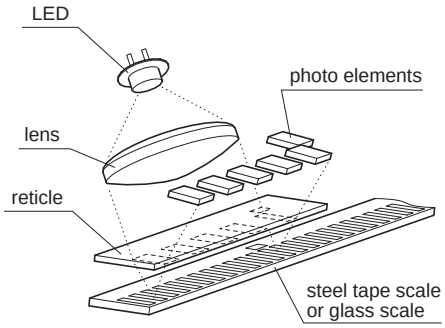
Cause of the optical scanning version a accurate reference mark is warranted.

When there is relative movement between the encoder head and the linear scale, LED light is modulated by the scale grating pitch and converted into electrical signals by the photo-elements. Solid state LEDs and silicon photo-elements are used for high reliability and durability.

Transmissive scanning principle



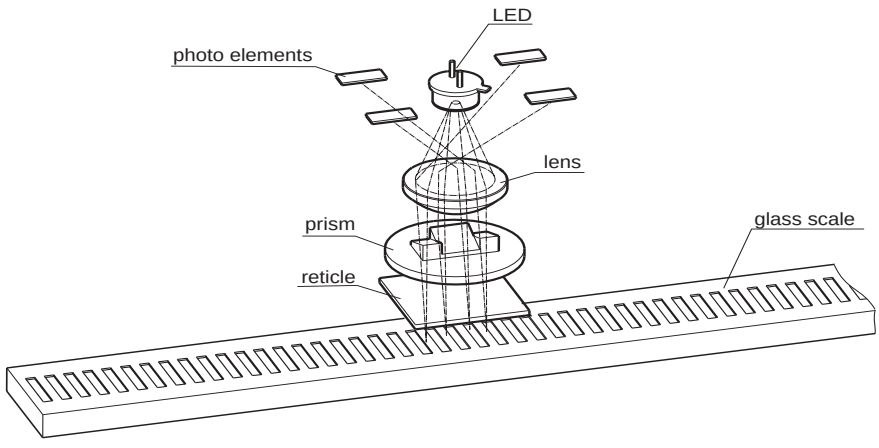
Reflective scanning principle



The scale consists of a glass carrier and reflection-type phase grating.
The scanning reticle acts as transmission phase grating.

The light beam, produced by a LED and collimated by a lens, is deflected by prisms and the phase grating of the reticle in different directions.
After reflection and diffraction at the scale grating the different, depending on the change of position phase shifted, beams interfere after passing the reticle again, thus producing 2 by 90° shifted, sinusoidal measuring signals.
Using this interferential measuring principle, one signal period equals half of the scale.

Reflection-type phase grating



Output signals

Sinusoidal voltage signals
Two sinusoidal voltage signals A1 and A2 and one Reference index (with inverted signals).

Reference voltage of the output signals: V+/2 (approx. 2,5 V)
output signals A1 and A2:
Phaseshift 90° ±10° el.
Signal amplitude 0,6 Vss to 1,2 Vpp typ. 1 Vpp with terminating impedance Zo = 120 Ω

Output signal Reference mark (RI):
El. position typical 135° (referenced to A1)
El. width typical 270° 0,2 to 0,85 V typical 0,4 V (effective quota) with terminating impedance Zo = 120 Ω

Advantage: High output frequency even with long cable length.
Connection possibilities any suitable CNC resp. Feed-back-Systems.

Sinusoidal micro-current signals
Two sinusoidal micro-current signals 0° and 90° and one Reference index (with inverted signals).

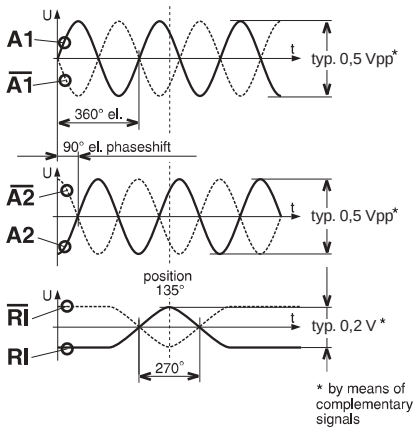
Output signals 0° and 90°:
Phaseshift 90° ±10° el.
electrical offset ±10% of the signal amplitude
Signal amplitude with a load of 1 kΩ:
7 to 16 µApp (11,5 µApp typical)

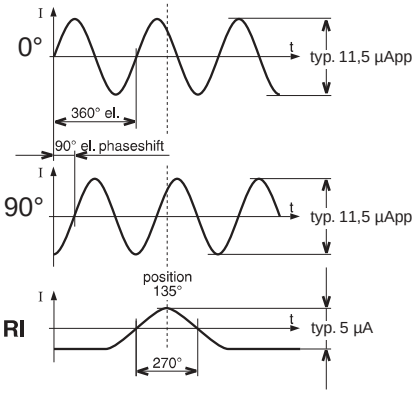
Output signal Reference mark (RI):
El. Position typical 135° (referenced to 0°)
El. width typical 270°
2 to 8 µA, (typical 5 µA)

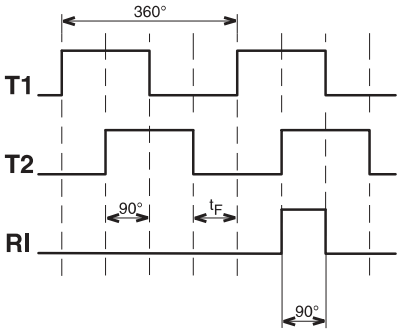
These signals can be input to External Subdividing Electronics or NC Controls with built-in Subdividing Electronics.

Square wave signals
The sinusoidal micro-current signals are converted into two square wave signals that have a phase shift of 90° either with a Schmitt-Trigger (times 1) or interpolation electronics (times 2, -5, -10, -25, -50 or -100) output can be differential RS 422 Line Driver.
One counting step is the distance between the rising or falling edge of channels T1 and T2.
Machine controls/DROs have a minimum allowable distance between channels A and B changes of state, measured in time (inverse of maximum counting frequency).
The minimum edge distance t_F is shown in the technical data.

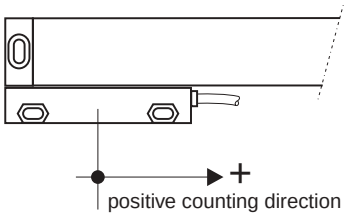
Drawing in "positive counting direction"

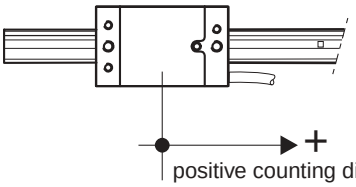




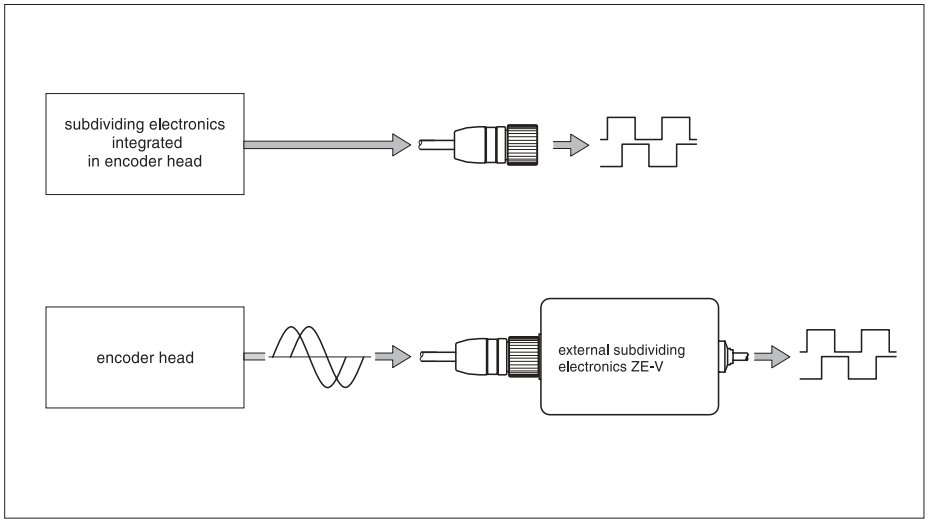


Positive counting direction orientation





Subdividing Electronics, Connecting cables



Signal interpolation is available in two versions.

- Subdividing Electronics integrated in the encoder head offer the advantage of reduced parts and labor, lower hardware cost, and it eliminates the need for space to mount an external subdividing electronic unit.
- external Subdividing Electronics require sinusoidal micro-current input signals (ZE-Vx) or sinusoidal voltage signal (ZE-Sx)

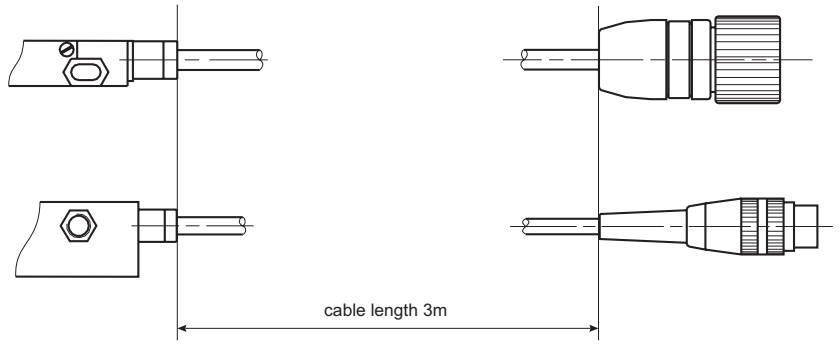
Both versions can output differential Line Driver RS 422 square wave signals.

Output signals resp. constructional features	Cable Ø mm	Shield	**Minimum Bend radius** Fixed mount	Continuous bending *
Sinusoidal micro-current signals and sinusoidal voltage signals	5,7 4,5 3,9	double double, high flex double, ultra high flex	45 mm 35 mm 30 mm	85 mm 70 mm 60 mm
Square wave signals	5,7 4,3	single single	45 mm 25 mm	85 mm 45 mm

*** cycle of bending typical 50 million**

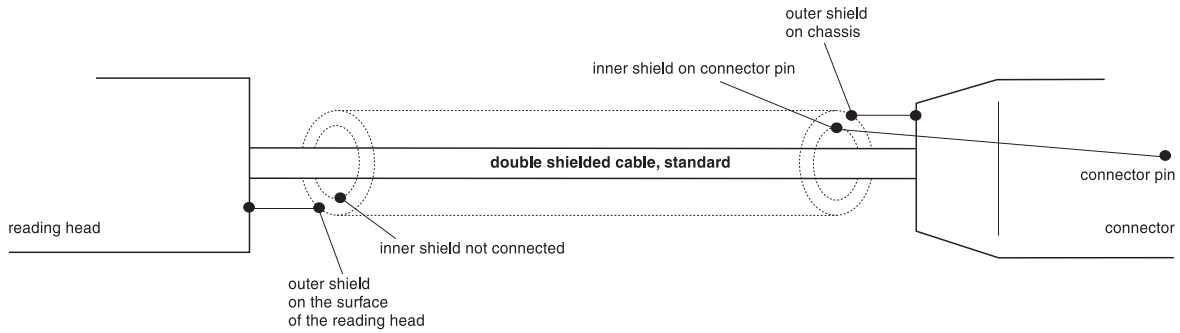
Encoder heads have cables designed for the specific signal outputs.
Standard cable length is 3 m.
The cable jacket is a special thermo-plastic, resistant to commercial coolants and lubricants.
Cables should be protected with a metallic armor if exposed to a harsh environment like "hot metal chips".
The cables can be used in the following temperature ranges:
Fixed cable mounting: -20°C to +70°C
Continuous flexing: -5°C to +70°C

Definition of the cable length

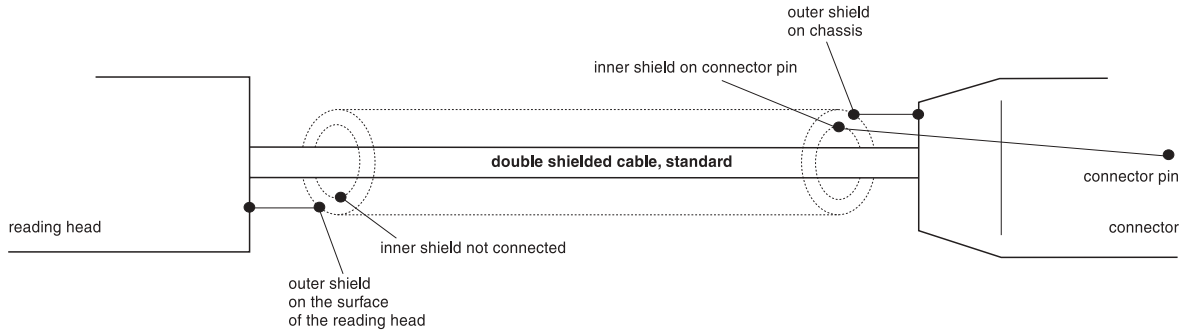


Shield connections

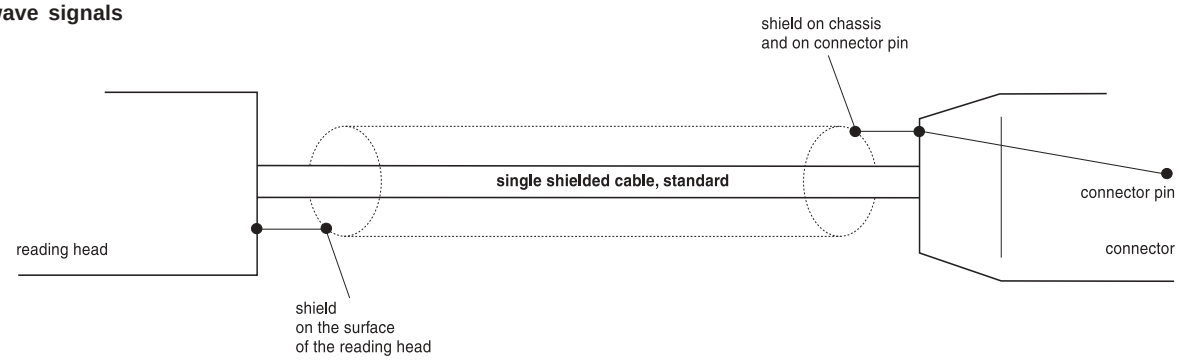
sinusoidal micro-current signals



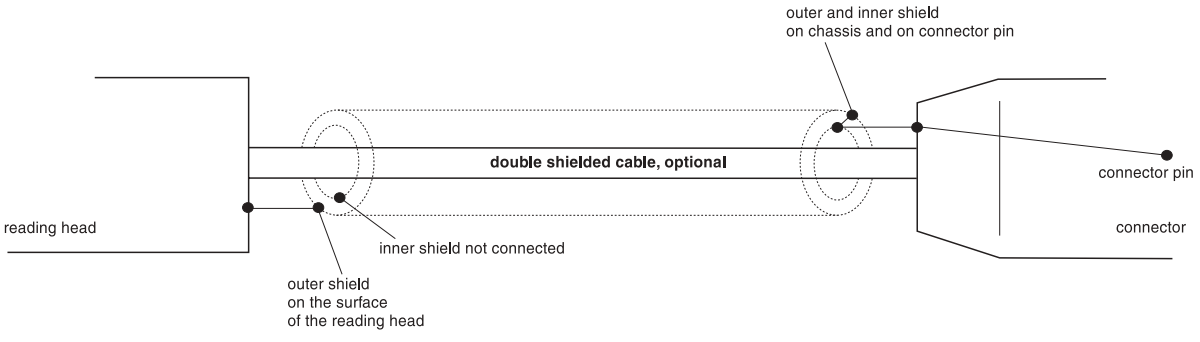
sinusoidal voltage signals



square wave signals



square wave signals



Nomenclature

Encoder Name
(Multiple digit also possible)

XX XX.XX-X XX X

Encoder Type
(Stroke length for DIT)

XX XX.XX-X XX X

Outputsignals and integrated Subdividing

XX XX.X X-X XX X

0 = sinusoidal voltage signals 1 Vpp
1 = sinusoidal micro-current signals 7 to 16 µApp
2 = square wave signals, times 1
3 = square wave signals, times 2
4 = square wave signals, times 20
5 = square wave signals, times 25
6 = square wave signals, times 5
7 = square wave signals, times 10
8 = square wave signals, times 50
9 = square wave signals, times 100

Grating pitch

XX XX.X X-X XX X

0 = 8 µm
1 = 10 µm
2 = 16 µm
3 = 20 µm
4 = 40 µm
5 = 100 µm
6 = 200 µm
7 = 400 µm
8 = 50 µm
A = 6,35 µm
B = 10,16 µm
C = 12,70 µm
D = 20,32 µm
E = 50,80 µm
F = 101,60 µm
G = 25,40 µm
H = 35 µm
K = 2160 L/Inch
L = 21,167 µm

Version of the switch signal
(only for Linear Encoder with switch track)

XX XX.XX-X XX X

-0 = without switch signal
-1 = TTL Ausgang (active high)
-2 = open collector Ausgang (active high impedance)
-3 = TTL Ausgang (active low)
-4 = open collector Ausgang (active low impedance)

Scale versions

XX XX.XX-X XX X

BA = Robax scale on aluminium carrier
BK = Robax scale with adhesive tape
BO = Robax scale without adhesive tape
BS = Robax scale on steel carrier
GA = glass scale on aluminium carrier
GK = glass scale with adhesive tape
GO = glass scale without adhesive tape
GS = glass scale on steel carrier
MA = steel tape on aluminium carrier
ME = steel tape on aluminium carrier with stretching elements
MK = steel tape with adhesive tape
MO = steel tape without adhesive tape
MS = steel tape on steel carrier

Possible options
K = distance coded Reference marks
B = sealing bellow (only DIT)

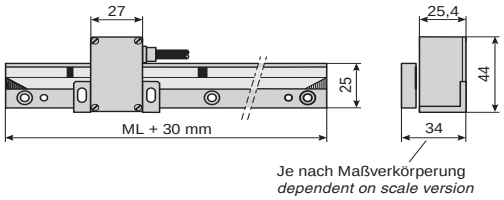
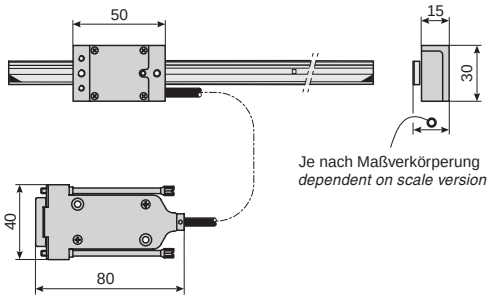
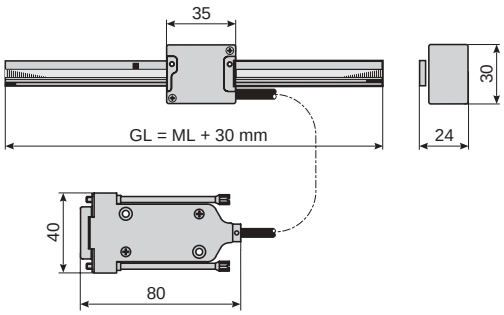
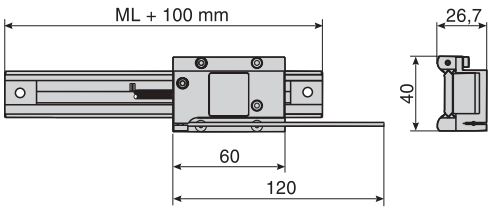
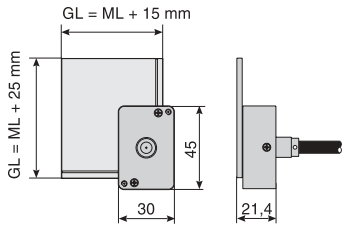
XX XX.XX-X XX X

For example:

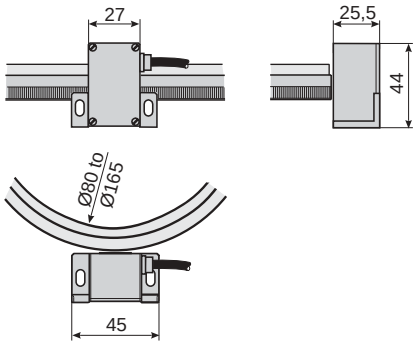
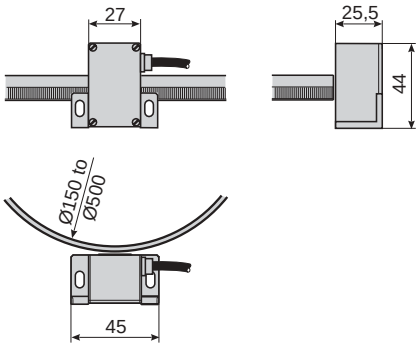
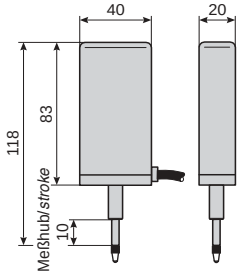
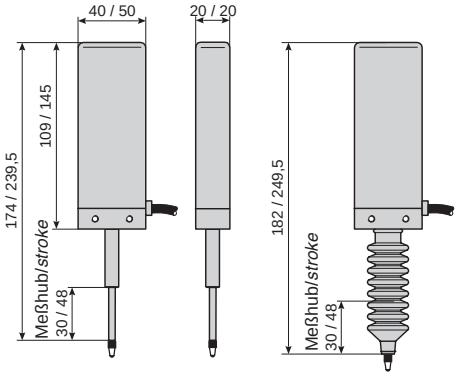
MS 61.74-1 GA

small version, AWS-connector, with switch tracks
square wave output signals, integrated Subdividing times 10
grating pitch 40 µm
switch signal with TTL output active high (only at reading head)
glass scale on aluminium carrier (only at graduation carrier)

Overview, Selection guide

Design features	Overall measunring ML = measuring length	Scale type	Page
Reflective scanning Linear Encoder • non-contact reflective scanning • for high displacement velocities • small version • different scale versions • max. measuring length (depends on scale version) - glass scale to 3040 mm - steel tape scale to 30 m		**MS 50**	12-17
Reflective scanning Linear Encoder • two switch tracks for individual special function • non-contact reflective scanning • for high displacement velocities • flat version • different scale versions • max. measuring length (depends on scale version) - glass scale to 3040 mm - steel tape scale to 30 m		**MS 61**	18-21
Interferential Linear Encoder • two switch tracks for individual special functions • non-contact reflective scanning • for high displacement velocities • small version • scale version: glass scale or ROBAX glassceramic with phase grating • max. measuring length to 2440 mm		**MS 8x**	22-23
Linear Encoder with self-guided scanning head • scale version: steel tape scale on aluminium carrier • easy mounting • flat version • max. measuring length 400 mm		**MSG 10**	24-25
Two dimensional Encoder • non-contact reflective scanning • scale version: chrome on glass • measuring range 360 x 360 mm • small version		**TDE 60**	26-27

Overview, Selection guide

Design features	Overall measunring ML = measuring length	Scale type	Page
Modular Ring Rotary Encoder • steel tape scale on steel ring • for applications at the robotik, on printer and roundtables • available diameter Ø80 mm to Ø165 mm • non-contact reflective scanning		**MSR 50 MS**	28-29
Modular Ring Rotary Encoder • steel tape scale on sandwich clampingring • for application at the robotik on printers and roundtables • available diameter from Ø150 mm up to Ø500 mm • non-contact reflective scanning		**MSR 50 MK**	30-31
Precision measuring Probes • for universal applications • stroke length 10 mm • mounting on shaft sleeve • with cable lifter • integrated pneumatic lifter optional		**DIT 10**	32-33
Precision measuring Probes • for universal applications • stroke length 30 / 48 mm • mounting on shaft sleeve • mounting with two tapped holes on body • with cable lifter • integrated pneumatic lifter optional • sealing bellows optional		**DIT 30** **DIT 48**	32-33 34-35

MS 50 Technical data:

Scale model	System resolution	Accuracy grades *	Grating pitch	Max. velocity (Edge distance)
• Sinusoidal voltage signals				
MS 50.06	depending on external Subdividing	±5, ±10 µm/m	200 µm	16 m/s
MS 50.05	depending on external Subdividing	±3, ±5, ±10 µm/m	100 µm	8 m/s
MS 50.04	depending on external Subdividing	±3, ±5, ±10 µm/m	40 µm	3,2 m/s
• Sinusoidal micro-current signals				
MS 50.16	depending on external Subdividing	±5, ±10 µm/m	200 µm	16 m/s
MS 50.15	depending on external Subdividing	±3, ±5, ±10 µm/m	100 µm	8 m/s
MS 50.14	depending on external Subdividing	±3, ±5, ±10 µm/m	40 µm	3,2 m/s
• Square wave Line Driver signals with integrated Subdividing				
MS 50.27	100 µm	±20 µm/m	400 µm	30 m/s (> 2 µs)
MS 50.66	10 µm	±5, ±10 µm/m	200 µm	10 m/s (> 600 ns)
MS 50.76	5 µm	±5, ±10 µm/m	200 µm	10 m/s (> 300 ns)
MS 50.65	5 µm	±3, ±5, ±10 µm/m	100 µm	5 m/s (> 600 ns)
MS 50.46	2,5 µm	±5, ±10 µm/m	200 µm	11,2 m/s (> 200 ns)
MS 50.75	2,5 µm	±3, ±5, ±10 µm/m	100 µm	5 m/s (> 300 ns)
MS 50.56	2 µm	±5, ±10 µm/m	200 µm	9 m/s (> 200 ns)
MS 50.64	2 µm	±3, ±5, ±10 µm/m	40 µm	2 m/s (> 600 ns)
MS 50.45	1,25 µm	±3, ±5, ±10 µm/m	100 µm	5,6 m/s (> 200 ns)
MS 50.86	1 µm	±5, ±10 µm/m	200 µm	0,9 m/s (> 100 ns)
MS 50.55	1 µm	±3, ±5, ±10 µm/m	100 µm	4,5 m/s (> 200 ns)
MS 50.74	1 µm	±3, ±5, ±10 µm/m	40 µm	2 m/s (> 300 ns)
MS 50.96	0,5 µm	±5, ±10 µm/m	200 µm	4,5 m/s (> 100 ns)
MS 50.85	0,5 µm	±3, ±5, ±10 µm/m	100 µm	4,5 m/s (> 100 ns)
MS 50.44	0,5 µm	±3, ±5, ±10 µm/m	40 µm	2,2 m/s (> 200 ns)
MS 50.54	0,4 µm	±3, ±5, ±10 µm/m	40 µm	1,8 m/s (> 200 ns)
MS 50.95	0,25 µm	±3, ±5, ±10 µm/m	100 µm	2,2 m/s (> 100 ns)
MS 50.84	0,2 µm	±3, ±5, ±10 µm/m	40 µm	1,8 m/s (> 100 ns)
MS 50.94	0,1 µm	±3, ±5, ±10 µm/m	40 µm	9 m/s (> 100 ns)

*** Accuracy grades dependent on scale version**

Signal-outputs (optional):

• sinusoidal voltage signals
MS 50.06
MS 50.05
MS 50.04

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

Output signals:
Encoder signals: 0,6 to 1,2 Vpp, typical 1 Vpp
with terminating resistor Zo = 120 Ω
Reference pulse:
0,2 to 0,85 Vss, typical 0,4 V(useable component)
with terminating resistor Zo = 120 Ω

Moirè-adjustment:
with electronic mounting controller PG1-U
(accessoriers Page 41)

Max. output frequency:
80 kHz (with 3 m cable)

• sinusoidal micro-current signals
MS 50.16
MS 50.15
Ms 50.14

Power supply:
+5 V ±5%, max. 120 mA

Output signals:
Encoder signals: 7 to 16 µApp,
typical 11,5 µApp at 1 KΩ

Reference pulse: 2 to 8 µA,
typical 5 µA (useable component) at 1 KΩ

Moirè-adjustment:
with electronic mounting controller PG1-I
(accessoriers Page 41)

Max. output frequency:
80 kHz (with 3 m cable)

MS 50 Technical data:

Scale versions:
different types are available (Pages 14 to 17)
MS 50.xx MA = steel tape scale glued onto aluminium carrier
MS 50.xx MS = steel tape scale on steel carrier
MS 50.xx GA = glass scale glued onto aluminium carrier
MS 50.xx GS = glass scale glued onto steel carrier
MS 50.xx GO = glass scale without carrier
MS 50.xx GK = glass scale with adhesive tape
MS 50.xx MO = steel tape scale without carrier
MS 50.xx MK = steel tape scale with adhesive tape
MS 50.xx ME = steel tape scale on aluminium carrier with strechting elements

Max. measuring length:
- glass scale 3040 mm (GA, GS, GO, GK)
  (grating pitch: 40, 100, 200 µm)
- steel tape scale 3000 mm (MA, MS)
  (grating pitch: 40, 100, 200 µm)
- steel tape scale 30 m (MO, MK)
  (grating pitch: 100, 200, 400 µm)
- steel tape scale with stretching elements 30 m (ME)
  (grating pitch: 200 µm)

Standard measuring lengths: (mm)
170, 220, 270, 320, 370, 420, 470, 520, 620, 720, 770, 820, 920, 1040, 1140, 1240, 1340, 1440, 1540, 1640, 1740, 1840, 2040, 2240, 2440, 2640, 2840, 3040

Reference mark (RI):
One Reference mark at any location, or two or more RI´s separated by distances of n x 50 mm
(see legend, drawing k and j).

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 +50°C (operation)

Weight (approx.):
100 g/m (glass scale), 1500 g/m (steel tape scale in steel extrusion) or 35 g/m (steel tape scale) + 85 g (scanning head without cable)

Signal-outputs (optional):

- **square wave signals** (single ended)
  with integrated Subdividing Electronics

- **square wave signals** (differential)
  via Line Driver RS 422 standard
  with integrated Subdividing Electronics
  with analog signal switch-over for setup
  (see page 36/37 and 41)
  MS 50.27 = times 1
  MS 50.64 = times 5
  MS 50.65 = times 5
  MS 50.66 = times 5
  MS 50.74 = times 10
  MS 50.75 = times 10
  MS 50.76 = times 10
  MS 50.44 = times 20
  MS 50.45 = times 20
  MS 50.46 = times 20
  MS 50.54 = times 25
  MS 50.55 = times 25
  MS 50.56 = times 25
  MS 50.84 = times 50
  MS 50.85 = times 50
  MS 50.86 = times 50
  MS 50.94 = times 100
  MS 50.95 = times 100
  MS 50.96 = times 100

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

Moirè-adjustment:
with electronic mounting controller PG1-I
(accessoriers Page 41)

Ordering Example
for a graduation carrier:

MS 5x.x**4 MS** / masuring length / accuracy / Reference mark

scale name / model

grating pitch 40 µm

scale version: steel tape scale on steel carrier

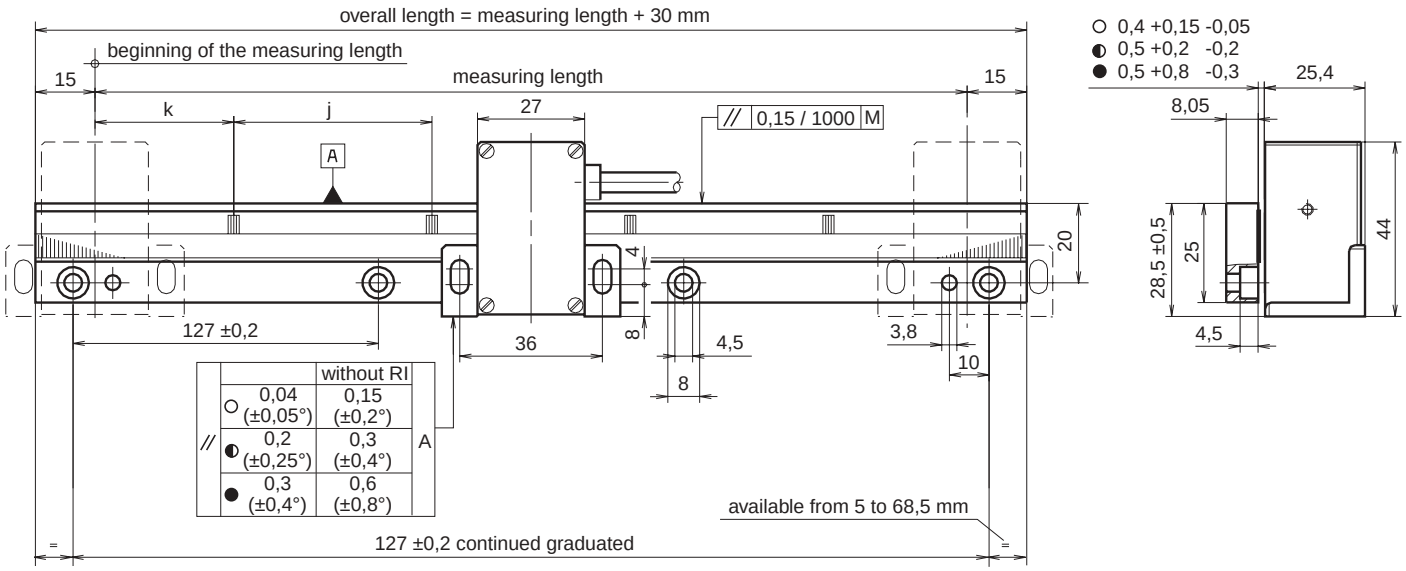
2840 mm

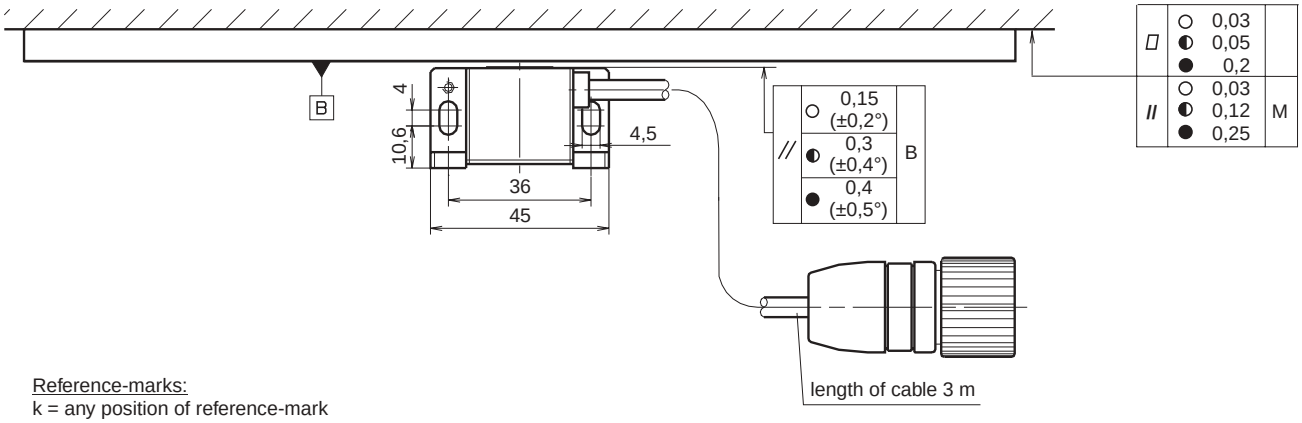
±3 µm/m, ±5 µm/m oder ±10 µm/m

position of the Reference mark

Dimensions - Mounting tolerances - Mounting possibilities:

Version: **MS 50.xx MA** = steel tape scale glued onto aluminium carrier, **MS 50.xx MS** = steel tape scale on steel carrier



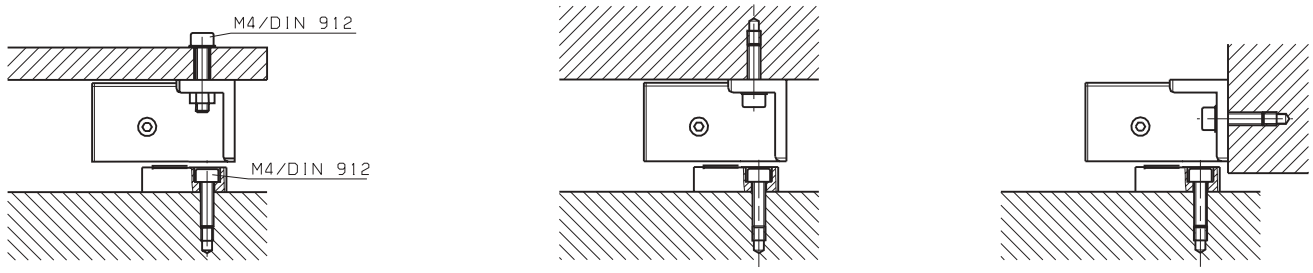


Reference-marks:
k = any position of reference-mark
j = additional reference-marks separated by n x 50 mm

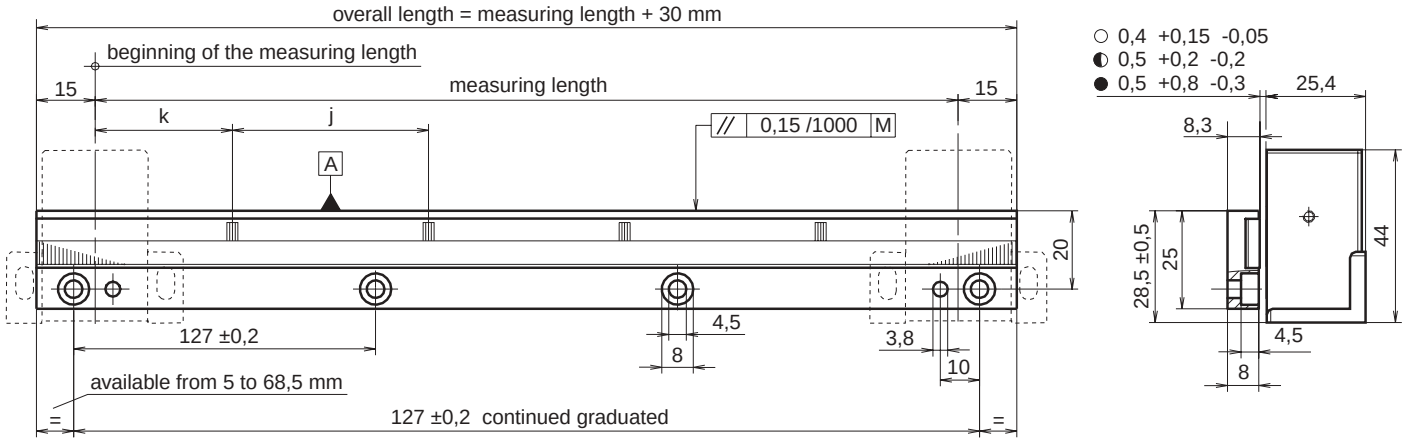
M = machine guideway

grating pitch
40 µm
100 µm
200 µm

Mounting possibilities:



Version: MS 50.xx GA = glass scale on aluminium carrier

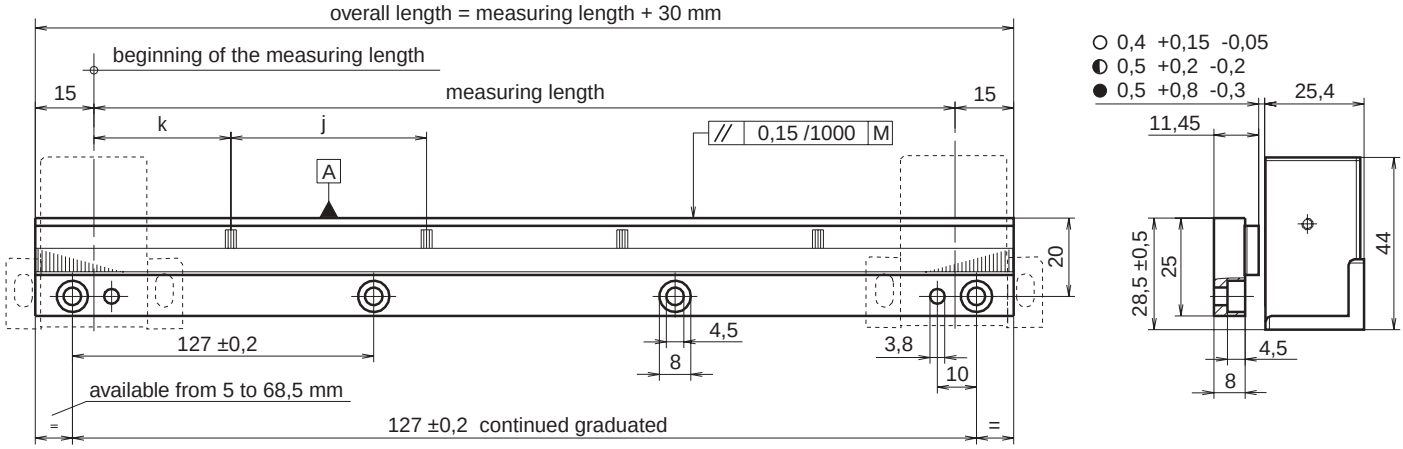


Reference-marks:
k = any position of reference-mark
j = additional reference-marks
separated by n x 50 mm

M = machine guideway

grating pitch	
○	40 µm
◐	100 µm
●	200 µm

Version: MS 50.xx GS = glass scale on steel carrier



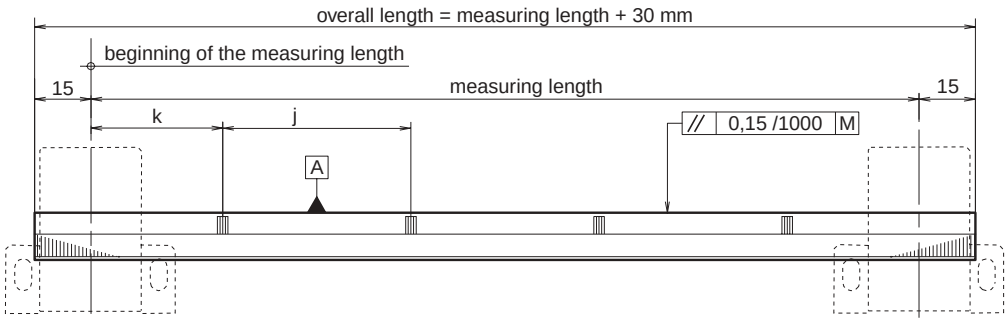
Reference-marks:
k = any position of reference-mark
j = additional reference-marks
separated by n x 50 mm

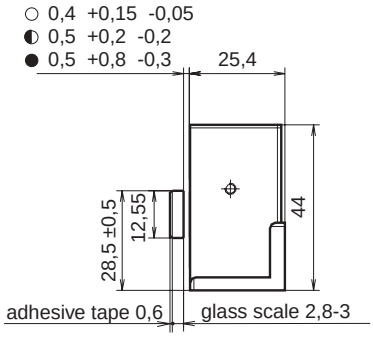
M = machine guideway

grating pitch	
○	40 µm
◐	100 µm
●	200 µm

Dimensions - Mounting tolerances:

Version: **MS 50.xx GO** = glass scale, **MS 50.xx GK** = glass scale with adhesive tape



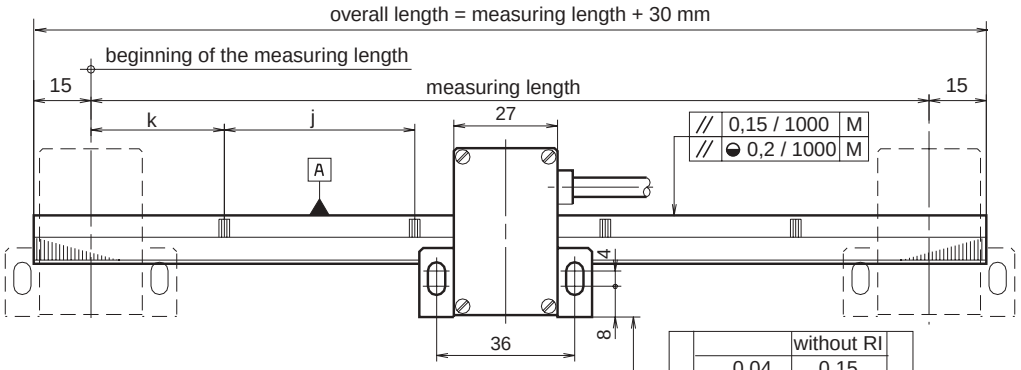


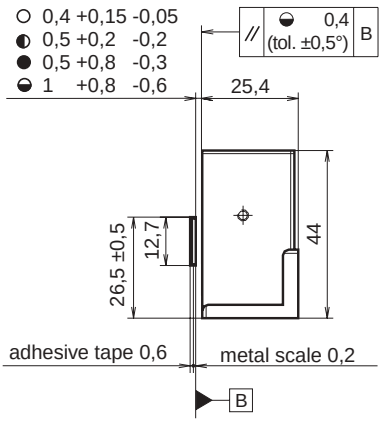
Reference-marks:
k = any position of reference-mark
j = additional reference-marks
separated by n x 50 mm

M = machine guideway

grating pitch	
○	40 µm
◐	100 µm
●	200 µm

Version: **MS 50.xx MO** = steel tape scale, **MS 50.xx MK** = steel tape scale with adhesive tape

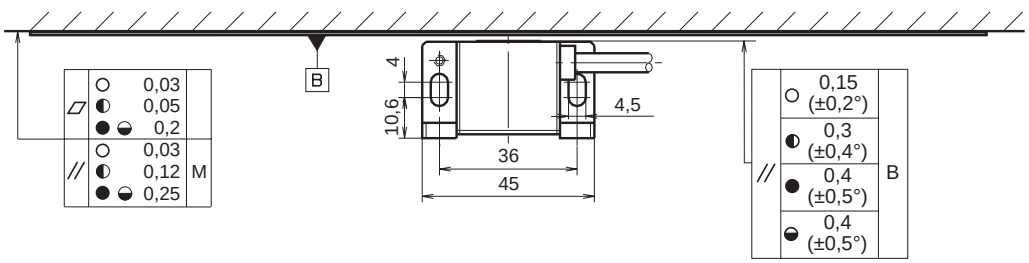




Reference-marks:
k = any position of reference-mark
j = additional reference-marks
separated by n x 50 mm

		without RI	
//	○	0,04 (±0,05°)	0,15 (±0,2°)
	◐	0,2 (±0,25°)	0,3 (±0,4°)
	●	0,3 (±0,4°)	0,6 (±0,8°)
	◒	0,4 (±0,5°)	0,8 (±1°)

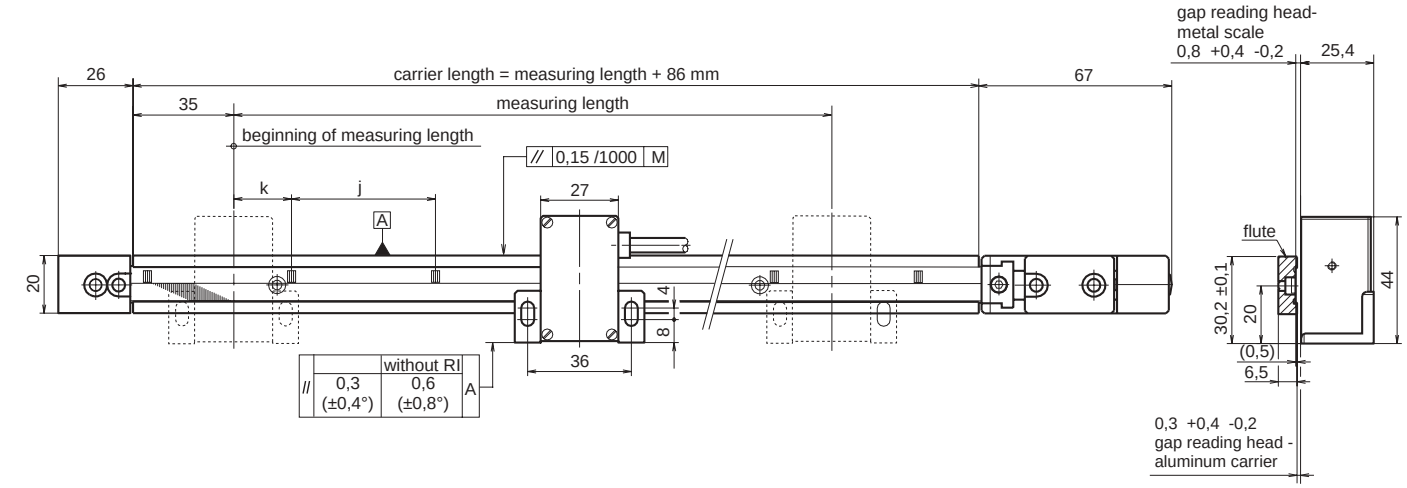
A

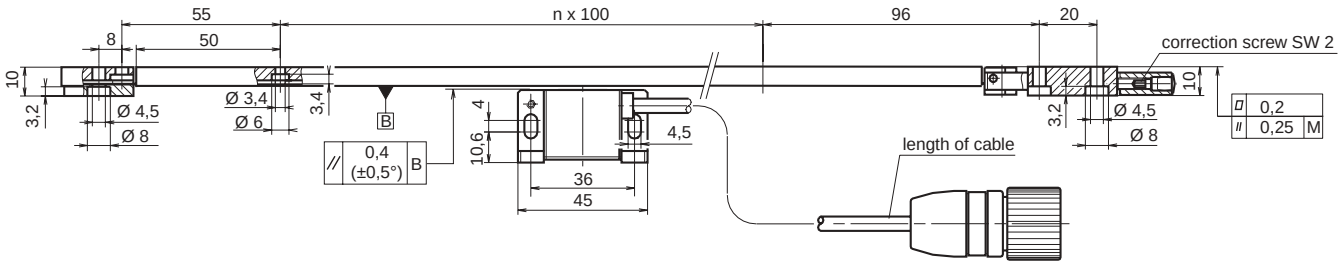


grating pitch	
○	40 µm
◐	100 µm
●	200 µm
◒	400 µm

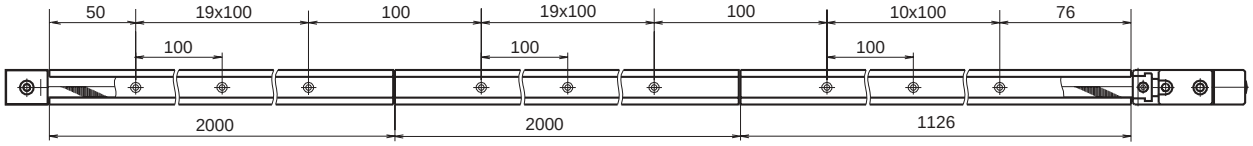
M = machine guideway

Version: MS 50.xx ME = steel tape scale on aluminium carrier with stretching elements





measuring length exceeding 3040 mm (e.g. 5040 mm)



Reference-marks:
k = any position of reference-mark
j = additional reference-marks
separated by n x 50 mm

M = machine guideway

grating pitch
200 µm

MS 61 Technical data:

Scale model	System resolution	Accuracy grades *	Grating pitch	Max. velocity (Edge distance)
• Sinusiodal voltage signals				
MS 61.06	depending on external Subdividing	±5, ±10 µm/m	200 µm	20 m/s
MS 61.05	depending on external Subdividing	±3, ±5, ±10 µm/m	100 µm	10 m/s
MS 61.04	depending on external Subdividing	±3, ±5, ±10 µm/m	40 µm	4 m/s
• Sinusoidal micro-current signals				
MS 61.16	depending on external Subdividing	±5, ±10 µm/m	200 µm	20 m/s
MS 61.15	depending on external Subdividing	±3, ±5, ±10 µm/m	100 µm	10 m/s
MS 61.14	depending on external Subdividing	±3, ±5, ±10 µm/m	40 µm	4 m/s
• Square wave Line Driver signals with integrated Subdividing				
MS 61.66	10 µm	±5, ±10 µm/m	200 µm	10 m/s (> 500 ns)
MS 61.24	10 µm	±3, ±5, ±10 µm/m	40 µm	4 m/s (> 1,6 µs)
MS 61.76	5 µm	±5, ±10 µm/m	200 µm	10 m/s (> 250 ns)
MS 61.65	5 µm	±3, ±5, ±10 µm/m	100 µm	5 m/s (> 500 ns)
MS 61.46	2,5 µm	±5, ±10 µm/m	200 µm	11,2 m/s (> 200 ns)
MS 61.75	2,5 µm	±3, ±5, ±10 µm/m	100 µm	5 m/s (> 250 ns)
MS 61.68	2,5 µm	±3, ±5, ±10 µm/m	50 µm	2,5 m/s (> 500 ns)
MS 61.56	2 µm	±5, ±10 µm/m	200 µm	9 m/s (> 200 ns)
MS 61.64	2 µm	±3, ±5, ±10 µm/m	40 µm	2 m/s (> 500 ns)
MS 61.45	1,25 µm	±3, ±5, ±10 µm/m	100 µm	5,6 m/s (> 200 ns)
MS 61.78	1,25 µm	±3, ±5, ±10 µm/m	50 µm	2,5 m/s (> 250 ns)
MS 61.86	1 µm	±5, ±10 µm/m	200 µm	9 m/s (> 100 ns)
MS 61.55	1 µm	±3, ±5, ±10 µm/m	100 µm	4,5 m/s (> 200 ns)
MS 61.74	1 µm	±3, ±5, ±10 µm/m	40 µm	2 m/s (> 250 ns)
MS 61.96	0,5 µm	±5, ±10 µm/m	200 µm	4,5 m/s (> 100 ns)
MS 61.85	0,5 µm	±3, ±5, ±10 µm/m	100 µm	4,5 m/s (> 100 ns)
MS 61.58	0,5 µm	±3, ±5, ±10 µm/m	50 µm	2,2 m/s (> 200 ns)
MS 61.44	0,5 µm	±3, ±5, ±10 µm/m	40 µm	2,2 m/s (> 200 ns)
MS 61.84	0,2 µm	±3, ±5, ±10 µm/m	40 µm	1,8 m/s (> 100 ns)
MS 61.95	0,25 µm	±3, ±5, ±10 µm/m	100 µm	2,2 m/s (> 100 ns)
MS 61.88	0,25 µm	±3, ±5, ±10 µm/m	50 µm	2,2 m/s (> 100 ns)
MS 61.98	0,125 µm	±3, ±5, ±10 µm/m	50 µm	1,1 m/s (> 100 ns)
MS 61.94	0,1 µm	±3, ±5, ±10 µm/m	40 µm	0,9 m/s (> 100 ns)

***accuracy grades dependent on scale versions**

Signal-outputs (optional):

• sinusoidal voltage signals
MS 61.06
MS 61.05
MS 61.04

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

Output signals:
Encoder signals: 0,6 to 1,2 Vpp, typical 1 Vpp
with terminating resistor Zo = 120 Ω
Reference pulse:
0,2 to 0,85 Vss, typical 0,4 V(useable component)
with terminating resistor Zo = 120 Ω

Moirè-adjustment:
with electronic mounting controller PG1-U
(accessoriers Page 41)

Max. output frequency:
100 kHz (with 3 m cable)

• sinusoidal micro-current signals
MS 61.16
MS 61.15
MS 61.14

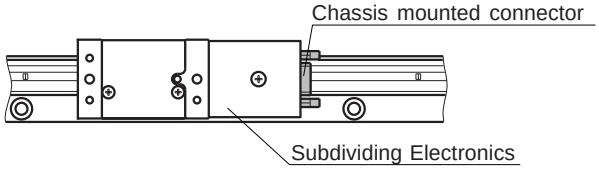
Power supply:
+5 V ±5%, max. 120 mA

Output signals:
Encoder signals: 7 to 16 µApp,
typical 11,5 µApp at 1 KΩ
Reference pulse: 2 to 8 µA,
typical 5 µA (useable component) at 1 KΩ

Moirè-adjustment:
with electronic mounting controller PG1-I
(accessoriers Page 41)

Max. output frequency:
100 kHz (with 3 m cable)

MS 60 (optional) = with 15-pin chassis mounted connector MDSM-15PE
The Subdividing Electronic is mounted right at the scanning head



MS 61 Technical data:

Scale versions:
different types are available. (Pages 20 to 21)
MS 61.xx-x MS = steel tape scale on steel carrier
MS 61.xx-x MA = steel tape scale glued onto aluminium carrier
MS 61.xx-x GA = glass scale glued onto aluminium carrier
MS 61.xx-x GS = glass scale glued onto steel carrier
MS 61.xx-x GO = glass scale without carrier
MS 61.xx-x GK = glass scale with adhesive tape
MS 61.xx-x MO = steel tape scale without carrier
MS 61.xx-x MK = steel tape scale with adhesive tape

max. measuring length:
- glass scale 3040 mm (GA, GS, GO, GK)
  (grating pitch: 40, 50, 100 or 200 µm)
- steel tape scale 3000 mm (MA, MS)
  (grating pitch: 40, 100 or 200 µm)
- steel tape scale 30 m (MO, MK)
  (grating pitch: 100 oder 200 µm)

Standard measuring length: (mm) 120, 170, 220, 270, 320, 370, 420, 470, 520, 620, 720, 820, 920, 1040, 1140, 1240, 1340, 1440, 1540, 1640, 1740, 1840, 2040, 2240, 2440, 2640, 2840, 3040

Reference mark (RI):
One Reference mark at any location, or two or more RI´s separated by distances of n x 50 mm

Special feature:
2 switch tracks (S1, S2) **for individual special functions** (reflection light barrier). The desired switch positions (Y1, Y2) are determined by the customer with adhesive cover tapes (X1, Y2).

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 +50°C (operation)

Weight (approx.)
100 g/m (glass scale) or 35 g/m (steel tape scale)
35 g (scanning head without cable)

Signal-outputs (optional):

- **square wave signals** (single ended)
  with integrated Subdividing Electronics

- **square wave signals** (differential)
  via Line Driver RS 422 standard
  with integrated Subdividing Electronics
  with analog signal switch-over for setup
  (see page 36/37 and 41)

MS 61.24	=	time	1
MS 61.64	=	times	5
MS 61.65	=	times	5
MS 61.66	=	times	5
MS 61.68	=	times	5
MS 61.74	=	times	10
MS 61.75	=	times	10
MS 61.76	=	times	10
MS 61.78	=	times	10
MS 61.44	=	times	20
MS 61.45	=	times	20
MS 61.46	=	times	20
MS 61.55	=	times	25
MS 61.56	=	times	25
MS 61.58	=	times	25
MS 61.84	=	times	50
MS 61.85	=	times	50
MS 61.86	=	times	50
MS 61.88	=	times	50
MS 61.94	=	times	100
MS 61.95	=	times	100
MS 61.96	=	times	100
MS 61.98	=	times	100

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

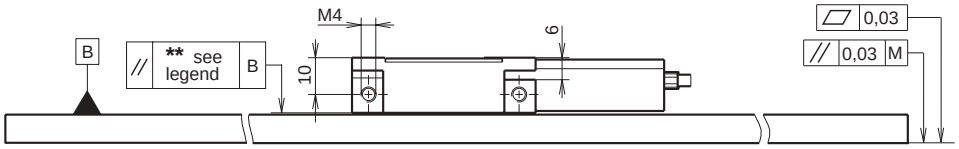
Moirè-adjustment:
with electronic mounting controller PG1-I
(accessoriers Page 41)

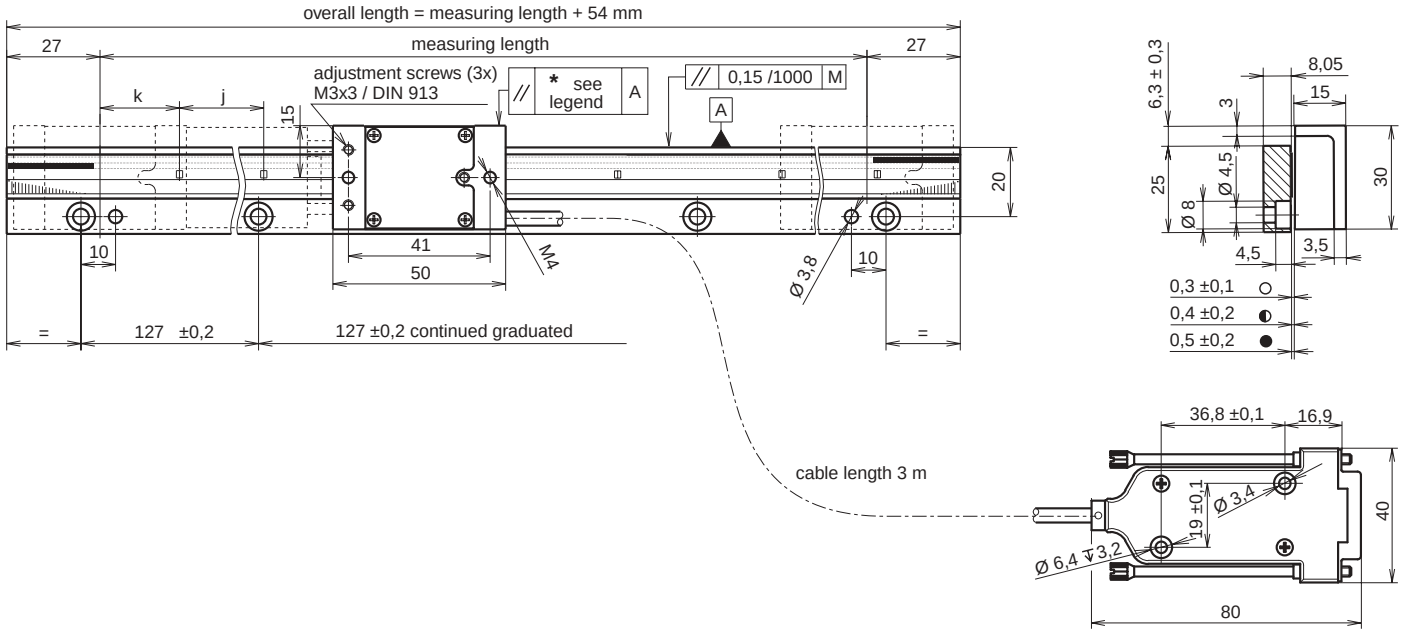
Ordering Example
for a graduation carrier: **MS 6x.x5-x GA** / masuring length / accuracy / Reference mark

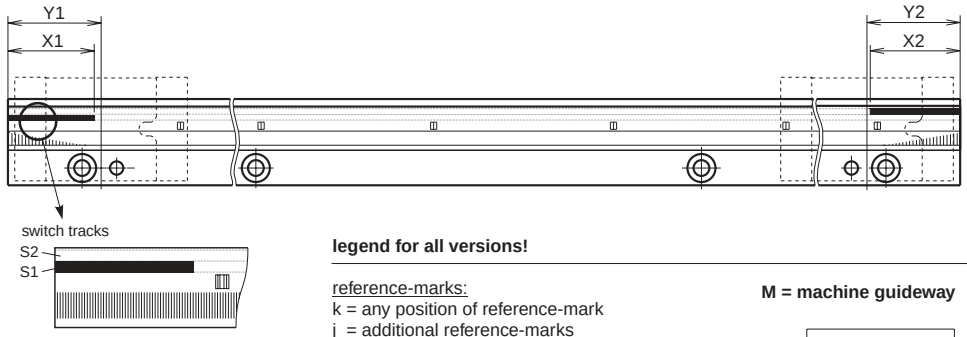
- scale name / model
- grating pitch 50 µm
- scale version: glass scale on aluminium carrier
- 3040 mm
- ±3 µm/m, ±5 µm/m oder ±10 µm/m
- position of the Reference mark

Dimensions - Mounting tolerances - Mounting possibilities:

Version: **MS 61.xx-x MA** = steel tape scale glued onto aluminium carrier, **MS 61.xx-x MS** = steel tape scale on steel carrier







legend for all versions!

reference-marks:
k = any position of reference-mark
j = additional reference-marks
separated by n x 50 mm

switch tracks:
x1, x2 = length of cover tapes
switch position left y1 = x1+ 2 mm
switch position right y2 = x2 + 0,5 mm

M = machine guideway

grating pitch
○ 40 µm
◎ 50 µm
◐ 100 µm
● 200 µm

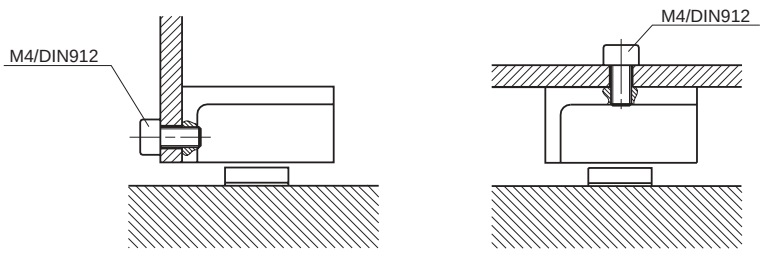
*

//		without RI	
	○ 0,1 (±0,1°)	0,3 (±0,35°)	A
	◎ 0,1 (±0,1°)	0,3 (±0,35°)	
	◐ 0,2 (±0,25°)	0,5 (±0,6°)	
	● 0,4 (±0,5°)	0,8 (±1°)	

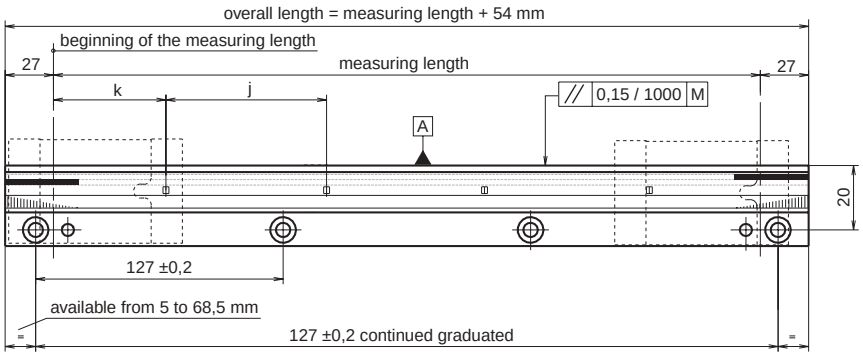
**

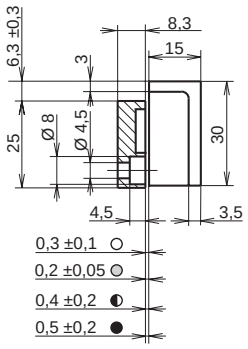
//		
	○ 0,2 (±0,2°)	B
	◎ 0,1 (±0,1°)	
	◐ 0,25 (±0,3°)	
	● 0,4 (±0,5°)	

Mounting possibilities:

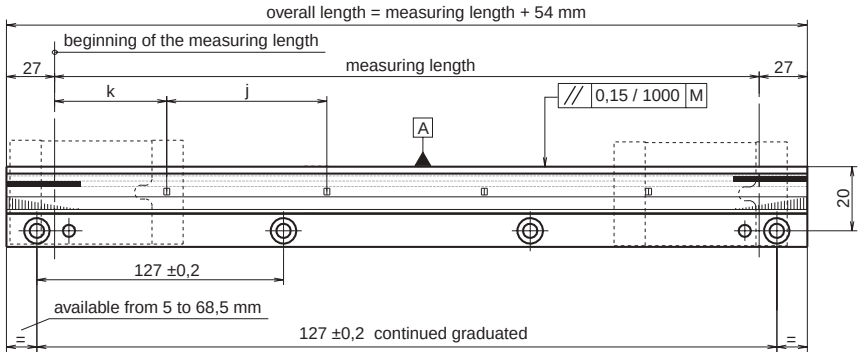


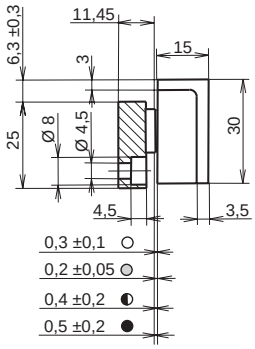
Version: MS 61.xx-x GA = glass scale on aluminium carrier



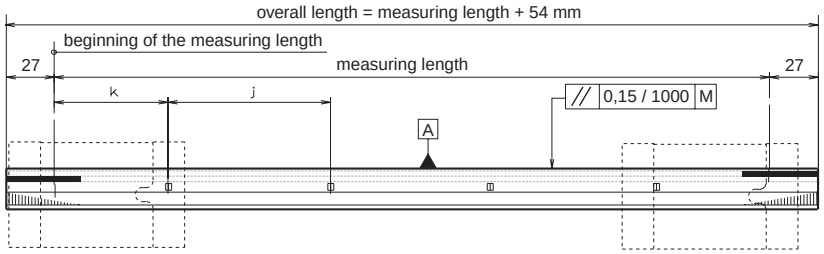


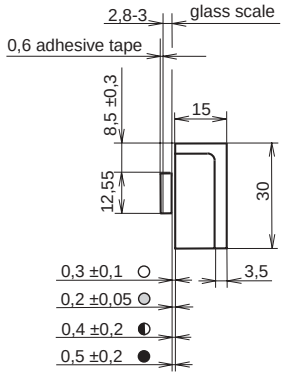
Version: MS 61.xx-x GS = glass scale on steel carrier



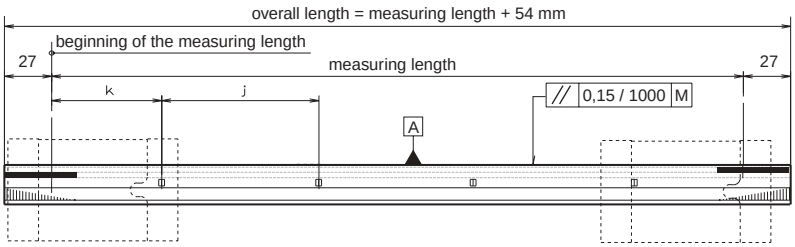


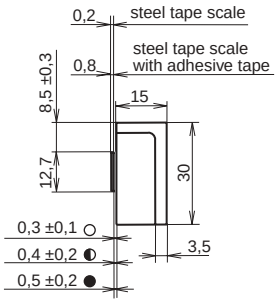
Version: MS 61.xx-x GO = glass scale, **MS 61.xx-x GK** = glass scale with adhesive tape





Version: MS 61.xx-x MO = steel tape scale, **MS 61.xx-x MK** = steel tape scale with adhesive tape





MS 80 Technical data:

Scale model	System resolution	Accuracy grades *	Grating pitch	Max. velocity (Edge distance)
• Sinusiodal voltage signals				
MS 80.00	depending on external Subdividing	±2, ±3 µm/m	4 µm	1,2 m/s
• Square wave Line Driver signals with integrated Subdividing				
MS 80.70	0,1 µm	±2, ±3 µm/m	4 µm	1 m/s (> 25 ns)
MS 80.30	0,05 µm	±2, ±3 µm/m	4 µm	0,45 m/s (> 100 ns)
MS 80.50	0,04 µm	±2, ±3 µm/m	4 µm	0,36 m/s (> 100 ns)
MS 80.80	0,02 µm	±2, ±3 µm/m	4 µm	0,18 m/s (> 100 ns)
MS 80.90	0,01 µm	±2, ±3 µm/m	4 µm	0,09 m/s (> 100 ns)

Scale version: glass scale
For applications, where the co-efficient of termic expansion should be very small, we are recommending the scale version ROBAX glassceramic.

Grating pitch: 8 µm phase grating (4 µm signal periode)

max. measuring length: glass scale 2440 mm, ROBAX 1020 mm

Standard measuring lengths: (mm)
170, 220, 270, 320, 370, 420, 470, 520, 620, 720, 770, 820, 920, 1040, 1140, 1240, 1340, 1440, 1540, 1640, 1740, 1840, 2040, 2240, 2440
(longer measuring lengths upon request)

Special features:
2 switch tracks (S1, S2) **for individual special functions** (reflection light barrier). The desired switch positions (Y1, Y2) are determined by the customer with adhesive cover tapes (X1, X2)

Reference mark (RI):
Any position within the measuring length
MS 80 = RI repeatable only from one direction, to get a reproduce result.
MS 81 (optional) = RI repeatable from both direction, to get a reproduce result. This version requires a more precise mounting than MS 80.

Moirè-adjustment with socket screw (see dimensions):
Adjust the yaw angle for maximum signal amplitude.

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 +50°C (operation)

Weight (approx.):
100 g/m (glass scale) + 45 g (scanning head without cable)

Signal-outputs (optional):

• sinusoidal voltage signals
MS 80.00

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

Output signals:
Encoder signals: 0,6 to 1,2 Vpp, typical 1 Vpp
with terminating resistor Zo = 120 Ω
Reference pulse:
0,2 to 0,85 Vss, typical 0,4 V(useable component)
with terminating resistor Zo = 120 Ω

Moirè-adjustment:
with electronic mounting controller PG1-U
(accessoriers Page 41)

Max. output frequency:
300 kHz

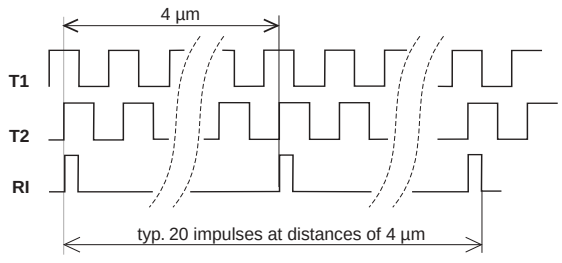
• square wave signals (differential)
via Line Driver RS 422 standard
with integrated Subdividing Electronics
with analog signal switch-over for setup
(see page 36/37 and 41)
MS 80.70 = times 10
MS 80.30 = times 20
MS 80.50 = times 25
MS 80.80 = times 50
MS 80.90 = times 100

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

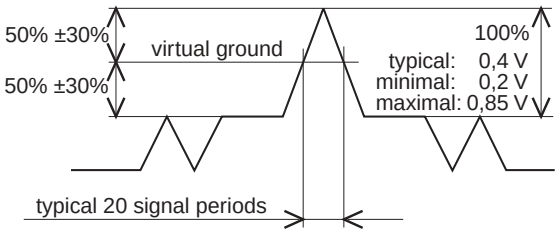
Moirè-adjustment:
with electronic mounting controller PG1-I
(accessoriers Page 41)

Reference impuls:

• Version with integrated Subdividing Electronics

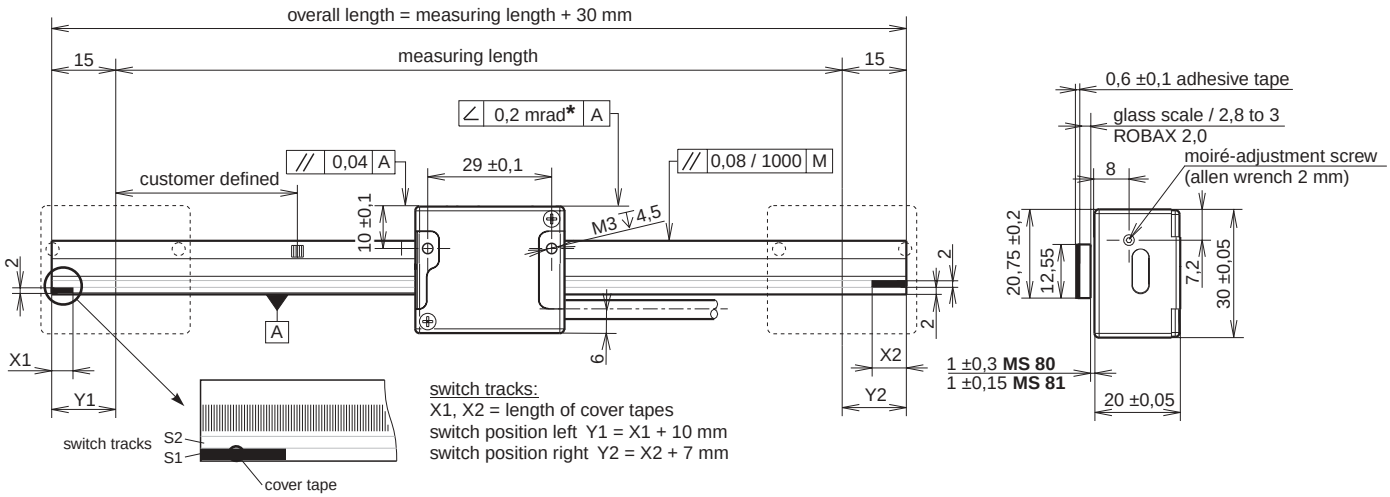


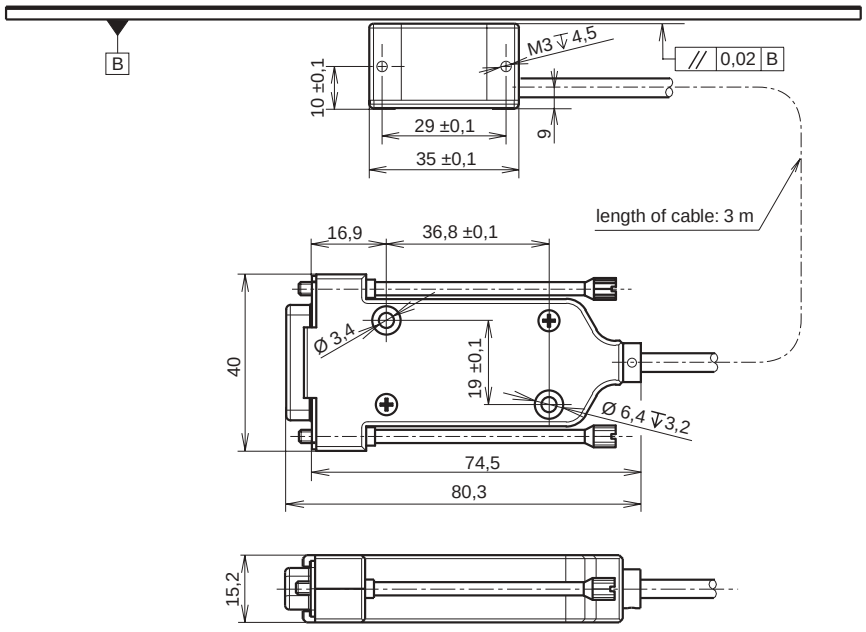
• Version with sinusoidal voltage signals



Dimensions - Mounting tolerances - Mounting possibilities:

Version: **MS 8**x.xx-x **GO** = glass scale without carrier, **MS 8**x.xx-x **GK** = glass scale with adhesive tape
MS 8x.xx-x **BO** = ROBAX without carrier, **MS 8**x.xx-x **BK** = ROBAX with adhesive tape



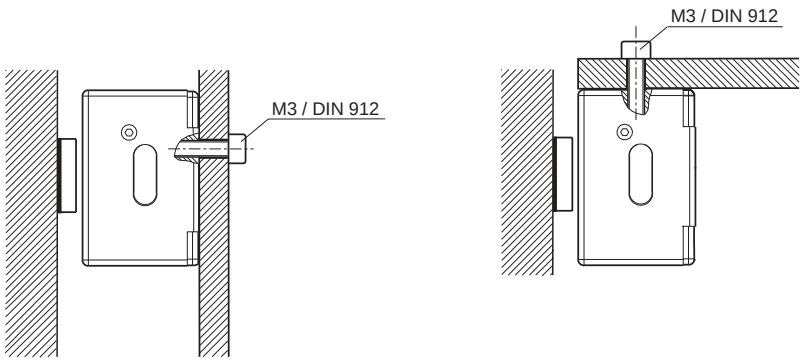


M = machine guideway

*** = after moirè-justage**

For optimum termic behavior
we are recommending to stick the scale at one end
or near the RI mark.

Mounting possibilities:



MSG 10 Technical data:

Scale model	System resolution	Accuracy grades *	Grating pitch	Max. velocity (Edge distance)
• **Square wave Line Driver signals with integrated Subdividing**				
MSG 10.45	1,25 µm	±10 µm/m	100 µm	1 m/s (> 800 ns)
MSG 10.55	1 µm	±10 µm/m	100 µm	1 m/s (> 800 ns)
MSG 10.74	1 µm	±10 µm/m	40 µm	1 m/s (> 800 ns)
MSG 10.85	0,5 µm	±10 µm/m	100 µm	1 m/s (> 400 ns)
MSG 10.95	0,25 µm	±10 µm/m	100 µm	1 m/s (> 200 ns)
MSG 10.94	0,1 µm	±10 µm/m	40 µm	0,9 m/s (> 100 ns)

Scanning read: guided by ball bearings, coupling over spring-steel rod

Scale version: steel tape scale on aluminium carrier

Max. measuring length: 400 mm

Reference mark (RI):
optional:
One Reference mark at any location, or two or more RI´s separated by distances of n x 50 mm

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 +50°C (operation)

Weight (approx.):
30 g/100 mm (steel tape scale on aluminium carrier) + 85 g
(scanning head without cable)

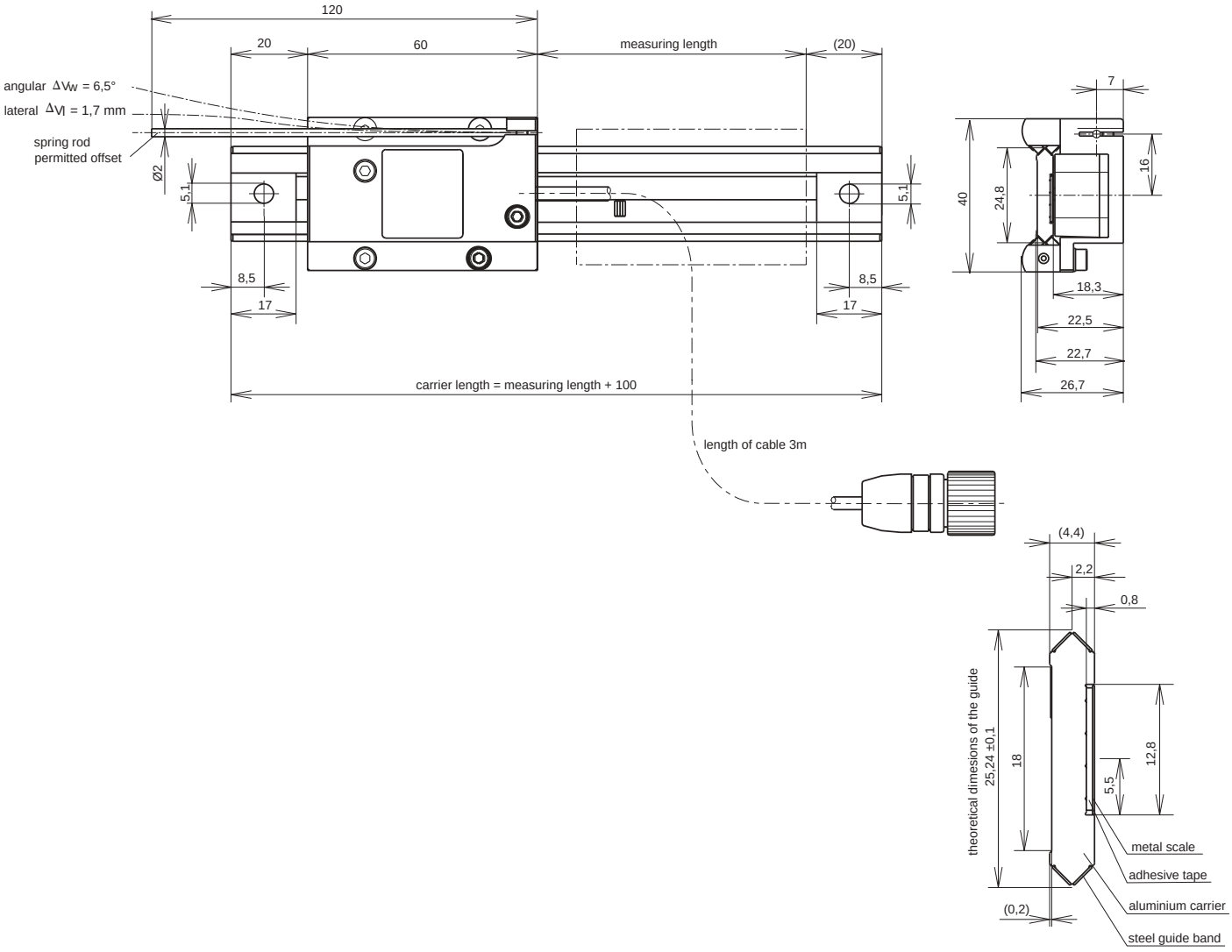
Signal-outputs (optional):

• **square wave signals** (differential)
via Line Driver RS 422 standard
with integrated Subdividing Electronics
MSG 10.74 = times 10
MSG 10.45 = times 20
MSG 10.55 = times 25
MSG 10.85 = times 50
MSG 10.95 = times 100
MSG 10.94 = times 100

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

Dimensions - Mounting tolerances - Mounting possibilities:

MSG 10.xx MA = steel tape scale on aluminium carrier



TDE 60 Technical data:

Scale model	System resolution	Accuracy grades *	Grating pitch	Max. velocity (Edge distance)
• Sinusoidal voltage signals 1 Vpp				
TDE 60.04	depending on external Subdividing	±3 µm/m	40 µm	2 m/s
• Sinusoidal micro-current signals				
TDE 60.14	depending on external Subdividing	±3 µm/m	40 µm	4 m/s
• Square wave Line Driver signals with integrated Subdividing				
TDE 60.64	2 µm	±3 µm/m	40 µm	2 m/s (> 600 ns)
TDE 60.74	1 µm	±3 µm/m	40 µm	2 m/s (> 300 ns)
TDE 60.44	0,5 µm	±3 µm/m	40 µm	2,2 m/s (> 200 ns)
TDE 60.54	0,4 µm	±3 µm/m	40 µm	1,8 m/s (> 200 ns)
TDE 60.84	0,2 µm	±3 µm/m	40 µm	1,8 m/s (> 100 ns)
TDE 60.94	0,1 µm	±3 µm/m	40 µm	0,9 m/s (> 100 ns)

Scale version: chrome on glass

Measuring length: 360 x 360 mm (other measuring range upon request)

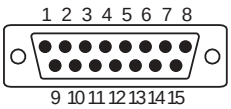
Reference mark (RI):
position at the beginning of the measuring range (X- and Y-Axis)

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 +50°C (operation)

Weight (approx.):
0,8 g/cm² (glass plate) + 35 g (scanning head without cable)

PIN assignment
(view on pins)



Signal-outputs (optional):

• sinusoidal voltage signals
TDE 60.04

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

Output signals:
Encoder signals: 0,6 to 1,2 Vpp, typical 1 Vpp
with terminating resistor Zo = 120 Ω
Reference pulse: 0,2 to 0,85 V, typical 0,4 V
(useable component), with terminating resistor Zo = 120 Ω

Moirè-adjustment:
with electronic mounting controller PG1-U
(accessoriers Page 41)

Max. output frequency: 100 kHz (with 3 m cable)

• sinusoidal micro-current signals
TDE 60.14

Power supply: +5 V ±5%, max. 180 mA

Output signals:
Encoder signals: 7 to 16 µApp, typical 11,5 µApp at 1 KΩ
Reference pulse: 2 to 8 µA,
typical 5 µA (useable component) at 1 KΩ

Moirè-adjustment:
with electronic mounting controller PG1-I
(accessoriers Page 41)

Max. output frequency: 100 kHz (with 3 m cable)

• square wave signals (differential)
via Line Driver RS 422 standard
with integrated Subdividing Electronics
with analog signal switch-over for setup
(see AWS assignment below and page 41)
TDE 60.64 = times 5
TDE 60.74 = times 10
TDE 60.44 = times 20
TDE 60.54 = times 25
TDE 60.84 = times 50
TDE 60.94 = times 100

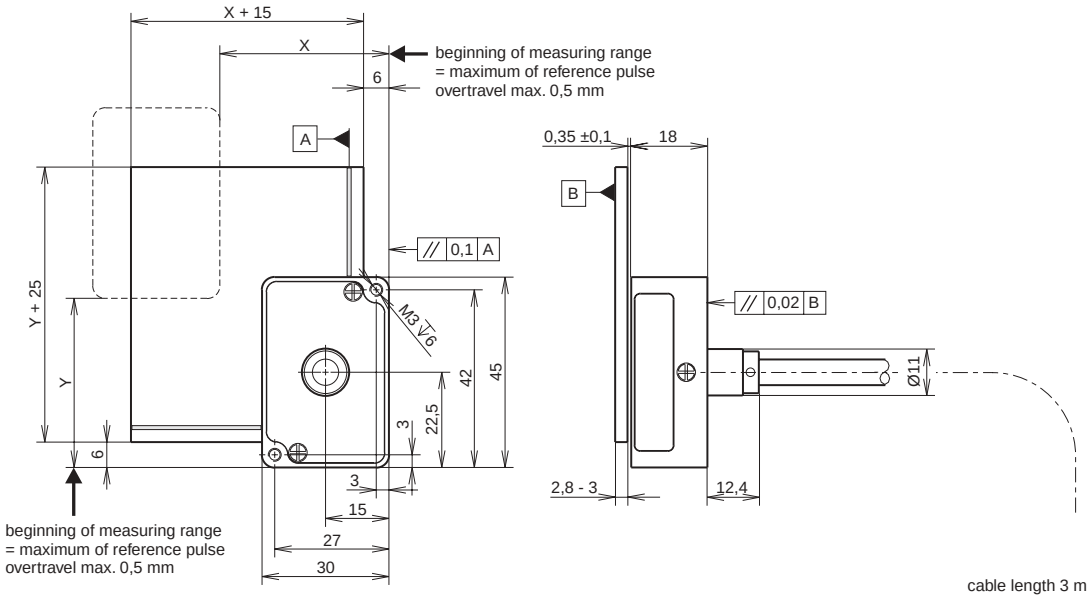
Power supply: +5 V ±5%, max. 400 mA (unloaded)

Moirè-adjustment:
with electronic mounting controller PG1-I
(accessoriers Page 41)

	X-axis							Y-axis							
LD15 PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
voltage signals	A1	$\overline{A1}$	A2	$\overline{A2}$	RI	$\overline{RI}$	+5 V	GND	A1	$\overline{A1}$	A2	$\overline{A2}$	RI	$\overline{RI}$	+5 V
micro-current signals	0°+	0°-	90°+	90°-	RI+	RI-	+5 V	GND	0°+	0°-	90°+	90°-	RI+	RI-	+5 V
AWS PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
square wave signals via Line Driver	T1	$\overline{T1}$	T2	$\overline{T2}$	RI	$\overline{RI}$	+5 V	GND	T1	$\overline{T1}$	T2	$\overline{T2}$	RI	$\overline{RI}$	test

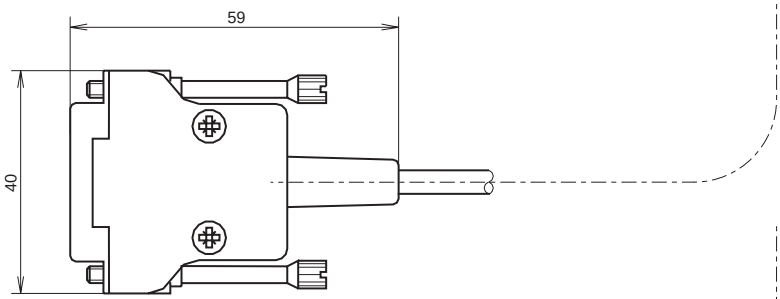
- Test = **analog signal switch-over for setup**
  By applying +5V to the test pin, instead of the square wave signals the test signals (analog) are switched to the output connector.
- The shield is connected with the chassis

TDE 60 Dimensions - Mounting tolerances:



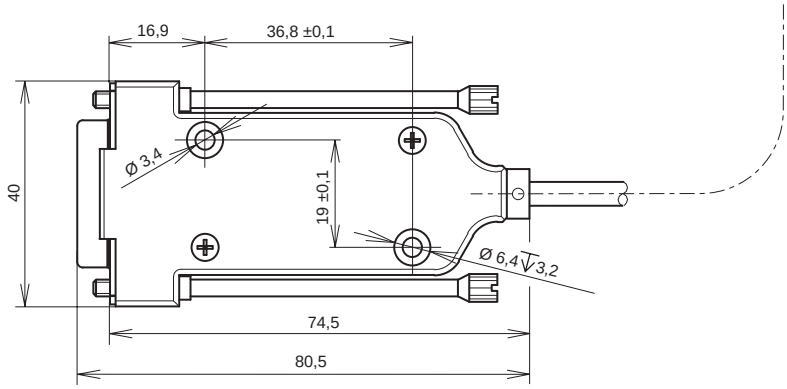
Connector LD15 15-pin

Version:
- **voltage signals**
- **micro-current signals**



Connector AWS 15-pin

Version:
- **square wave Line Driver signals**



MSR 50 MS Technical data:

Encoder type	Grating pitch	Max. velocity (Edge distance)
• **Sinusiodal voltage signals**		
MSR 50.06 MS	200 µm	16 m/s
• **Sinusiodal micro-current signals**		
MSR 50.16 MS	200 µm	16 m/s
• **Square wave Line Driver signals with integrated Subdividing**		
MSR 50.66 MS	200 µm	10 m/s (> 600 ns)
MSR 50.76 MS	200 µm	10 m/s (> 300 ns)
MSR 50.56 MS	200 µm	9 m/s (> 200 ns)
MSR 50.86 MS	200 µm	9 m/s (> 100 ns)
MSR 50.46 MS	200 µm	11 m/s (> 200 ns)
MSR 50.96 MS	200 µm	4,5 m/s (> 100 ns)

Resolution = $\frac{360° \times \text{Grating pitch}}{Da \times \pi \times 4 \times \text{Subdividing}}$

Resolution [°]
Grating pitch [mm] = 0,2 mm
Da = shaft diameter [mm] + 32 mm
Subdividing with integrated Subdividing Electronics

Measuring failure: $\frac{412 \times E}{Da}$

Measuring failure ["]
E = eccentricity [µm]
Da = shaft diameter [mm] + 32 mm

Accuracy: 30 "

Scale version: steel tape scale on steel ring

Available diameter:
Ø80 mm to Ø165 mm
Smaller or larger diameter on request

Reference mark (RI):
One Reference mark at any location

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 bis +50°C (operation)

Weight (approx.):
85 g (scanning head without cable)

Signal-outputs (optional):

• **sinusoidal voltage signals**
MSR 50.06 MS

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

Encoder signals: 0,6 to 1,2 Vpp, typical 1 Vpp
with terminating resistor Zo = 120 Ω
Reference pulse:
0,2 to 0,85 V, typical 0,4 V(useable component)
with terminating resistor Zo = 120 Ω

Moirè-adjustment:
with electronic mounting controller PG1-U
(accessoriers Page 41)

Max. output frequency:
80 kHz (with 3 m cable)

• **sinusoidal micro-current signals**
MSR 50.16 MS

Power supply:
+5 V ±5%, max. 120 mA

Encoder signals: 7 to 16 µApp,
typical 11,5 µApp at 1 KΩ
Reference pulse: 2 to 8 µA,
typical 5 µA (useable component) at 1 KΩ

Moirè-adjustment:
with electronic mounting controller PG1-I
(accessoriers Page 41)

Max. output frequency:
80 kHz (with 3 m cable)

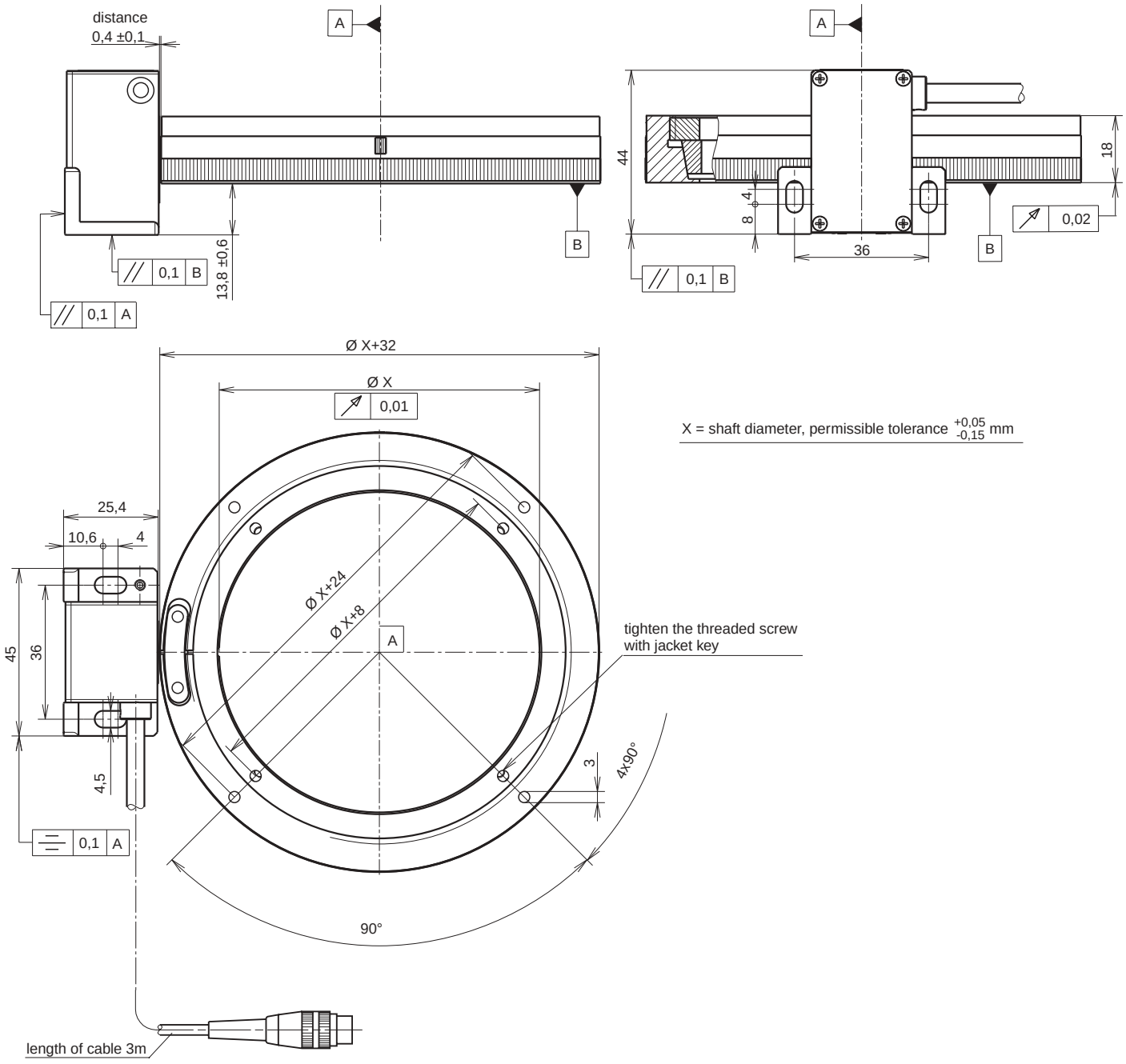
• **square wave signals** (single ended)
with integrated Subdividing Electronics

• **square wave signals** (differential)
via Line Driver RS 422 standard
with integrated Subdividing Electronics
with analog signal switch-over for setup
(see page 36/37 and 41)
MSR 50.66 MS = times 5
MSR 50.76 MS = times 10
MSR 50.46 MS = times 20
MSR 50.56 MS = times 25
MSR 50.86 MS = times 50
MSR 50.96 MS = times 100

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

Moirè-adjustment:
with electronic mounting controller PG1-I
(accessoriers Page 41)

MSR 50.xx MS Dimensions - Mounting tolerances:



MSR 50 MK Technical data:

Encoder type	Grating pitch	Max. velocity (Edge distance)
• Sinusiodal voltage signals		
MSR 50.04 MK	40 µm	16 m/s
MSR 50.06 MK	200 µm	16 m/s
• Sinusiodal micro-current signals		
MSR 50.14 MK	40 µm	16 m/s
MSR 50.16 MK	200 µm	16 m/s
• Square wave Line Driver signals with integrated Subdividing		
MSR 50.64 MK	40 µm	10 m/s (> 600 ns)
MSR 50.66 MK	200 µm	10 m/s (> 600 ns)
MSR 50.74 MK	40 µm	10 m/s (> 300 ns)
MSR 50.76 MK	200 µm	10 m/s (> 300 ns)
MSR 50.54 MK	40 µm	9 m/s (> 200 ns)
MSR 50.56 MK	200 µm	9 m/s (> 200 ns)
MSR 50.84 MK	40 µm	9 m/s (> 100 ns)
MSR 50.86 MK	200 µm	9 m/s (> 100 ns)
MSR 50.44 MK	40 µm	11 m/s (> 200 ns)
MSR 50.46 MK	200 µm	11 m/s (> 200 ns)
MSR 50.94 MK	40 µm	4,5 m/s (> 100 ns)
MSR 50.96 MK	200 µm	4,5 m/s (> 100 ns)

Resolution = $\frac{360° \times \text{Grating pitch}}{Da \times \pi \times 4 \times \text{Subdividing}}$

Resolution [°]
Grating pitch [mm] = 0,04 mm or 0,2 mm
Da = shaft diameter [mm] + 7,2 mm
Subdividing with integrated Subdividing Electronics

Measuring failure: $\frac{412 \times E}{Da}$

Measuring mfailure ["]
E = eccentricity [µm]
Da = shaft diameter [mm] + 7,2 mm

Accuracy: 1'

Scale version: Steel tape scale on sandwich-clampingring

Available diameter:
Ø150 mm to Ø500 mm, smaller or larger diameter on request

Reference mark (RI): One Reference mark at any location

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 bis +50°C (operation)

Weight (approx.): 85 g (scanning head without cable)

Signal-outputs (optional):

• sinusoidal voltage signals
MSR 50.04 MK
MSR 50.06 MK

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

Encoder signals: 0,6 to 1,2 Vpp, typical 1 Vpp
with terminating resistor Zo = 120 Ω
Reference pulse:
0,2 to 0,85 V, typical 0,4 V(useable component)
with terminating resistor Zo = 120 Ω

Moirè-adjustment:
with electronic mounting controller PG1-U
(accessoriers Page 41)

Max. output frequency:
80 kHz (with 3 m cable)

• sinusoidal micro-current signals
MSR 50.14 MK
MSR 50.16 MK

Power supply:
+5 V ±5%, max. 120 mA

Encoder signals: 7 to 16 µApp,
typical 11,5 µApp at 1 KΩ
Reference pulse: 2 to 8 µA,
typical 5 µA (useable component) at 1 KΩ

Moirè-adjustment:
with electronic mounting controller PG1-I
(accessoriers Page 41)

Max. output frequency:
80 kHz (with 3 m cable)

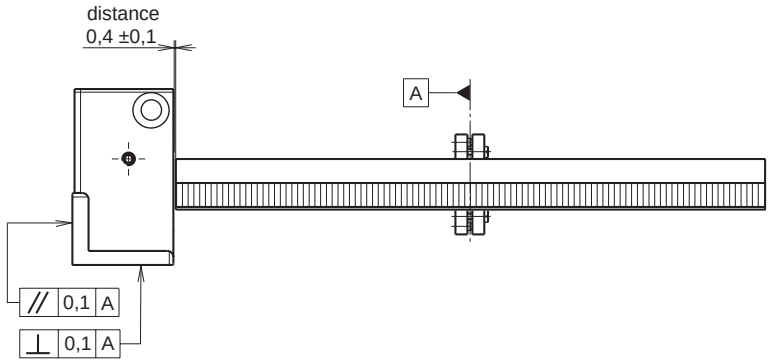
• square wave signals (single ended)
with integrated Subdividing Electronics

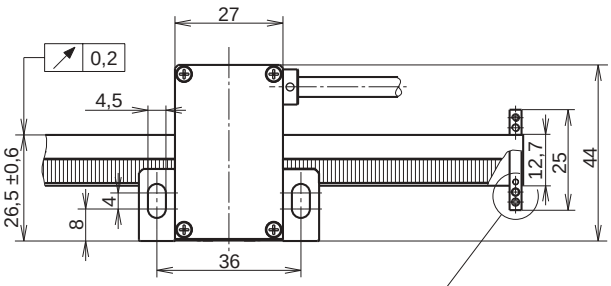
• square wave signals (differential)
via Line Driver RS 422 standard
with integrated Subdividing Electronics
with analog signal switch-over for setup
(see page 36/37 and 41)
MSR 50.64 MK = times 5
MSR 50.66 MK = times 5
MSR 50.74 MK = times 10
MSR 50.76 MK = times 10
MSR 50.44 MK = times 20
MSR 50.46 MK = times 20
MSR 50.54 MK = times 25
MSR 50.56 MK = times 25
MSR 50.84 MK = times 50
MSR 50.86 MK = times 50
MSR 50.94 MK = times 100
MSR 50.96 MK = times 100

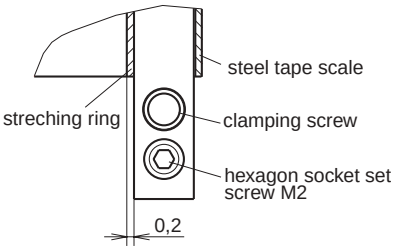
Power supply:
+5 V ±5%, max. 200 mA (unloaded)

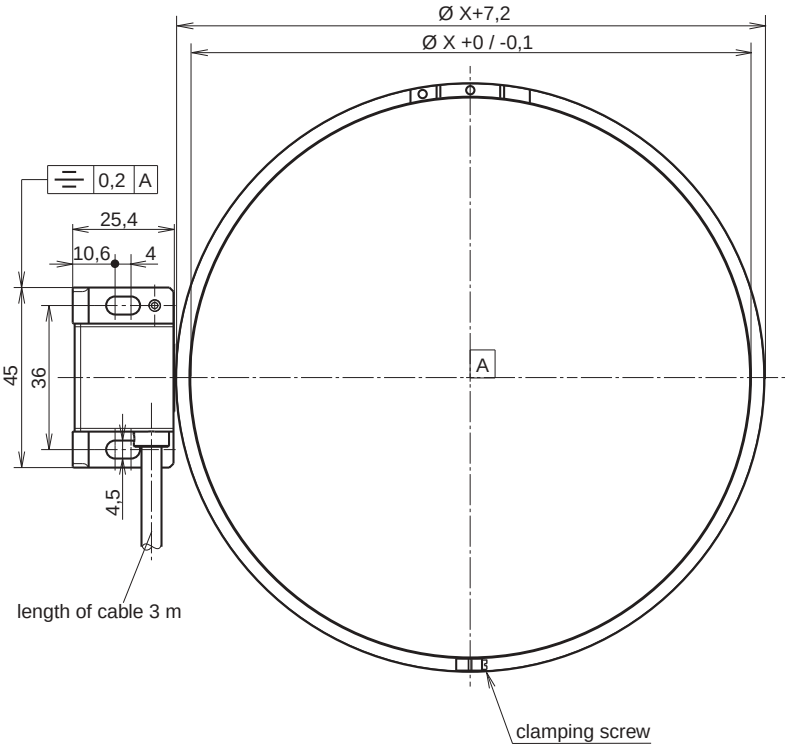
Moirè-adjustment:
with electronic mounting controller PG1-I
(accessoriers Page 41)

MSR 50.xx MK Dimensions - Mounting tolerances:









X = shaft diameter

mounting instruction
1. stretch the ring with hexagon socket set screws
2. bring the ring over the shaft
3. remove hexagon socket set screws
4. tigthen clamping screws

DIT 10, DIT 30 Technical data:

Scale model	System resolution	Accuracy grades *	Grating pitch	Max. velocity (Edge distance)
• **Sinusoidal voltage signals**				
DIT 10.13	depending on external Subdividing	±1 µm	20 µm	2 m/s
DIT 10.11	depending on external Subdividing	±1 µm	10 µm	1 m/s
DIT 30.13	depending on external Subdividing	±1 µm	20 µm	2 m/s
DIT 30.11	depending on external Subdividing	±1 µm	10 µm	1 m/s
• **Square wave Line Driver signals with integrated Subdividing**				
DIT 10.23	5 µm	±1 µm	20 µm	2 m/s (> 1,6 µs)
DIT 10.63	1 µm	±1 µm	20 µm	1 m/s (> 500 ns)
DIT 10.73	0,5 µm	±1 µm	20 µm	1 m/s (> 250 ns)
DIT 10.71	0,25 µm	±1 µm	10 µm	0,5 m/s (> 250 ns)
DIT 10.51	0,1 µm	±1 µm	10 µm	0,3 m/s (> 100 ns)
DIT 10.81	0,05 µm	±1 µm	10 µm	0,45 m/s (> 100 ns)
DIT 10.91	0,025 µm	±1 µm	10 µm	0,225 m/s (> 100 ns)
DIT 30.23	5 µm	±1 µm	20 µm	2 m/s (> 1,6 µs)
DIT 30.63	1 µm	±1 µm	20 µm	1 m/s (> 500 ns)
DIT 30.73	0,5 µm	±1 µm	20 µm	1 m/s (> 250 ns)
DIT 30.71	0,25 µm	±1 µm	10 µm	0,5 m/s (> 250 ns)
DIT 30.51	0,1 µm	±1 µm	10 µm	0,3 m/s (> 100 ns)
DIT 30.81	0,05 µm	±1 µm	10 µm	0,45 m/s (> 100 ns)
DIT 30.91	0,025 µm	±1 µm	10 µm	0,225 m/s (> 100 ns)

Stroke length:
DIT 10 = 10 mm
DIT 30 = 30 mm
DIT 30.xx B (version with sealing bellows) = 30 mm

Scale version:
glass scale rigidly attached to the sleeve which is a guided shaft ball bearing

Reference mark (RI):
In the middle of the measuring length (standard), or at any location (option)

Mounting of the probe:
shaft sleeve Ø8 h6 DIN 878 (for hole Ø8H7), two tapped holes on body (DIT 30)
measuring contact-holder M2,5

Measuring force: <1,6 N (shaft oriented downward)

Permissible lateral force at the shaft: 0,2 N

Accessories: cable lifter

Optional: integrated pneumatic lifter (on request)

Permissible temperature: -20°C to +70°C (storage), 0°C to +40°C (operative)

Environmental sealing DIN 40050:
DIT 10, DIT 30 = IP 50
DIT 30.xx B (version with sealing bellows) = IP 64

Signal-outputs (optional):

• **sinusoidal micro-current signals**
DIT 10.13
DIT 10.11

DIT 30.13
DIT 30.11

Power supply:
+5 V ±5%, max. 120 mA

Encoder signals: 7 to 16 µApp,
typical 11,5 µApp at 1 KΩ
Reference pulse: 2 to 8 µA,
typical 5 µA (useable component) at 1 KΩ

• **square wave signals** (single ended)
with integrated Subdividing Electronics

• **square wave signals** (differential)
via Line Driver RS 422 standard
with integrated Subdividing Electronics

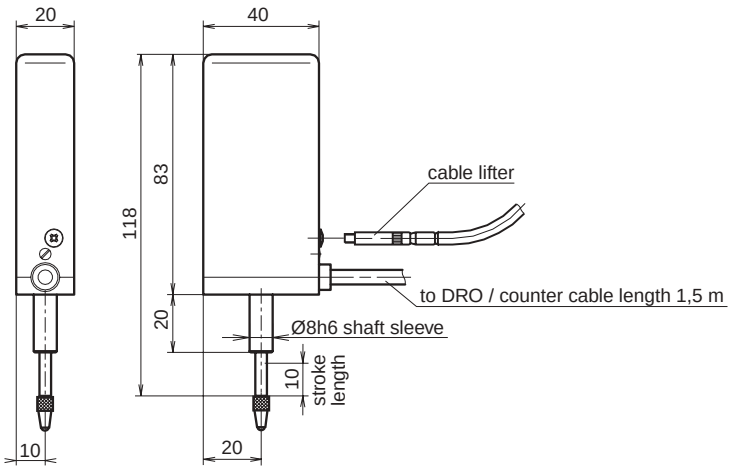
DIT 10.23 = time 1
DIT 10.63 = times 5
DIT 10.73 = times 10
DIT 10.71 = times 10
DIT 10.51 = times 25
DIT 10.81 = times 50
DIT 10.91 = times 100

DIT 30.23 = time 1
DIT 30.63 = times 5
DIT 30.73 = times 10
DIT 30.71 = times 10
DIT 30.51 = times 25
DIT 30.81 = times 50
DIT 30.91 = times 100

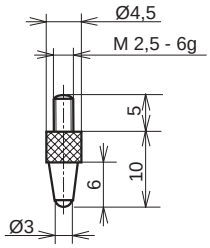
Power supply:
+5 V ±5%, max. 150 mA (unloaded)

Dimensions:

DIT 10

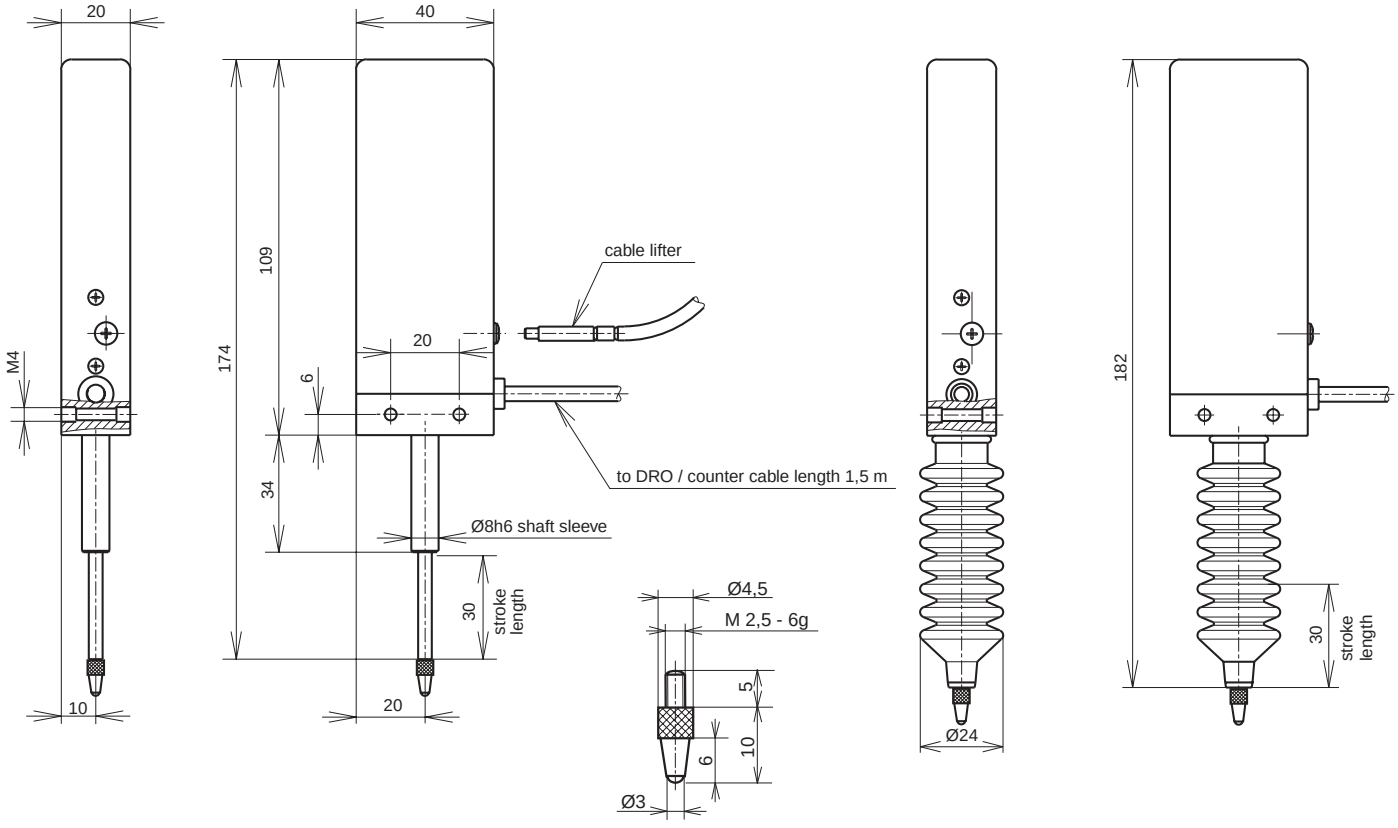


Standard measuring contact
(included at the shipment)



DIT 30

Version: DIT 30.xx B



Standard measuring contact
(included at the shipment)

DIT 48 Technical data:

Scale model	System resolution	Accuracy grades *	Grating pitch	Max. velocity (Edge distance)
• **Sinusoidal micro-current signals**				
DIT 48.13	depending on external Subdividing	±1 µm	20 µm	2 m/s
DIT 48.11	depending on external Subdividing	±1 µm	10 µm	1 m/s
• **Square wave Line Driver signals with integrated Subdividing**				
DIT 48.23	5 µm	±1 µm	20 µm	2 m/s (> 1,6 µs)
DIT 48.63	1 µm	±1 µm	20 µm	1 m/s (> 500 ns)
DIT 48.73	0,5 µm	±1 µm	20 µm	1 m/s (> 250 ns)
DIT 48.71	0,25 µm	±1 µm	10 µm	0,5 m/s (> 250 ns)
DIT 48.51	0,1 µm	±1 µm	10 µm	0,3 m/s (> 100 ns)
DIT 48.81	0,05 µm	±1 µm	10 µm	0,45 m/s (> 100 ns)
DIT 48.91	0,025 µm	±1 µm	10 µm	0,225 m/s (>100 ns)

Stroke length: 48 mm

Scale version:
glass scale rigidly attached to the sleeve which is a guided shaft ball bearing

Reference mark (RI):
In the middle of the measuring length (standard), or at any location (optional)

Mounting of the probe:
Shaft sleeve Ø8 h6 DIN 878 (for hole Ø8H7)
or two tapped holes on body
measuring contact-holder M2,5

Meßkraft: 1,6 N (shaft oriented downward)

Permissible lateral force at the shaft: 0,2 N

Accessories: cable lifter

Optional: integrated pneumatic lifter (on request)

Permissible temperature:
-20°C to +70°C (storage), 0°C to +40°C (operation)

Environmental sealing DIN 40050:
DIT 48 = IP 50
DIT 48.xx B (version with sealing bellows) = IP 64

Signal-outputs (optional):

• **sinusoidal micro-current signals**
DIT 48.13
DIT 48.11

Power supply:
+5 V ±5%, max. 120 mA

Encoder signals: 7 to 16 µApp,
typical 11,5 µApp at 1 KΩ
Reference pulse: 2 to 8 µA,
typical 5 µA (useable component) at 1 KΩ

• **square wave signals** (single ended)
with integrated Subdividing Electronics

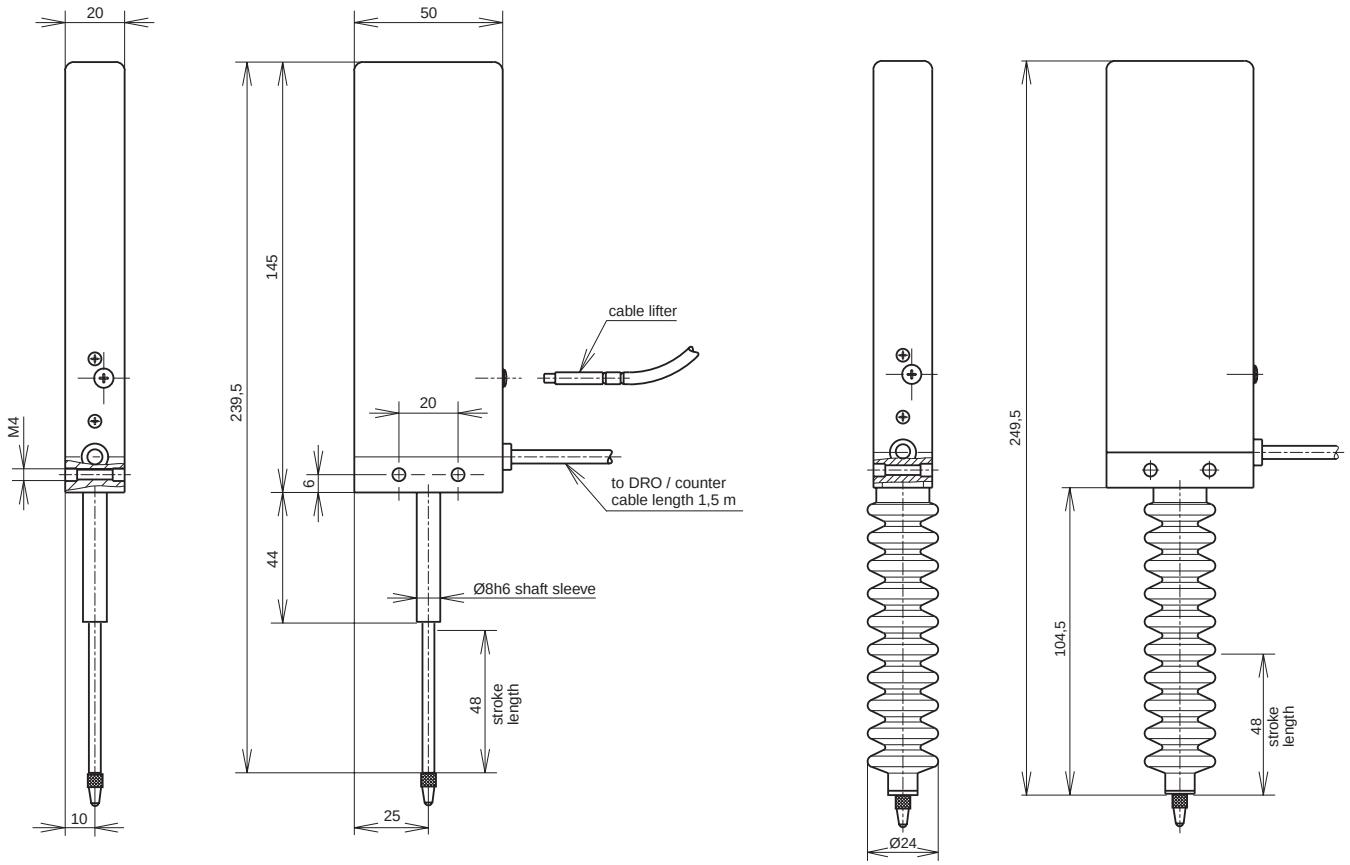
• **square wave signals** (differential)
via Line Driver RS 422 standard
with integrated Subdividing Electronics
DIT 48.23 = time 1
DIT 48.63 = times 5
DIT 48.73 = times 10
DIT 48.71 = times 10
DIT 48.51 = times 25
DIT 48.81 = times 50
DIT 48.91 = times 100

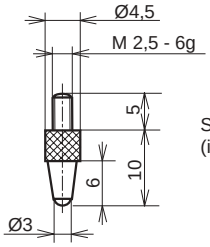
Power supply:
+5 V ±5%, max. 150 mA (unloaded)

Dimensions:

DIT 48

Version: DIT 48.xx B



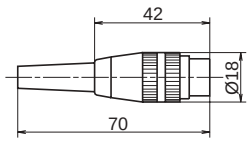


Standard measuring contact
(included at the shipment)

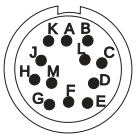
Connector, female connector, pin outs, analogsignal switch-over

DIN

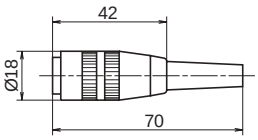
Male connector L 120
12-pin



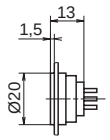
PIN outs connector
(view on pins)



Female connector K 120
12-pin



Female connector panel mountable F 120 12-pin



L120

PIN	A	B	C	D	E	F	G	H	J	K	L	M	
Voltage signals	inner shield	0 V	A1	$\overline{A1}$	A2	0 V	RI	$\overline{RI}$	0 V	+5 V	$\overline{A2}$	+5 V	(outer shield on chassis)

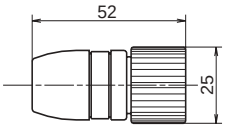
L120, K120, F120

PIN	A	B	C	D	E	F	G	H	J	K	L	M
Square wave signals + LD	shield or test	GND	T1	$\overline{T1}$	T2	GND	RI	$\overline{RI}$	GND	5 V	$\overline{T2}$	5 V

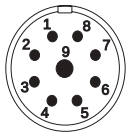
- Test = **analog signal switch-over for setup**
  By applying +5V to the test pin, instead of the square wave signals the test signals (analog) are switched to the output connector.
- The shield is connected with the chassis

CONNEI

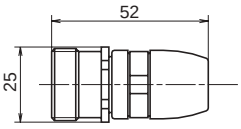
Male connector L 91
9-pin



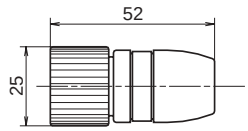
PIN outs connector
(view on pins)



Female connector K 91
9-pin



Female connector KM 91
9-pin

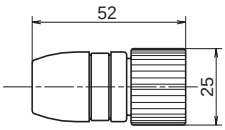


L 91, K 91, KM 91

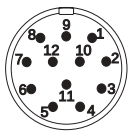
PIN	1	2	3	4	5	6	7	8	9	
Sinusoidal micro-current signals	0°+	0°-	5 V	0 V	90°+	90°-	RI+	RI-	inner shield	(outer shield on chassis)

CONNEI

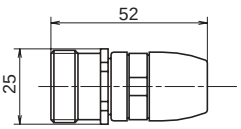
Male connector L 121
12-pin



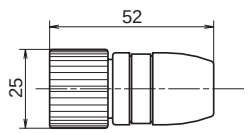
PIN outs connector
(view on pins)



Female connector K121
12-pin



Female connector KM 121
12-pin



L 121

PIN	1	2	3	4	5	6	7	8	9	10	11	12	
Voltage signals	$\overline{A2}$	+5 V Sensor	RI	$\overline{RI}$	A1	$\overline{A1}$	+5 V	A2	inner shield	GND	GND Sensor	+5 V	(outer shield on chassis)

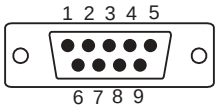
L121, K121, KM 121

PIN	1	2	3	4	5	6	7	8	9	10	11	12
Square wave signals + LD	$\overline{T2}$	5 V	RI	$\overline{RI}$	T1	$\overline{T1}$	5 V	T2	shield or test	0 V	0 V	5 V

- Test = **analog signal switch-over for setup**
  By applying +5V to the test pin, instead of the square wave signals the test signals (analog) are switched to the output connector.
- The shield is connected with the chassis

SUB MIN-D

PIN outs
(view on pins)



LD9

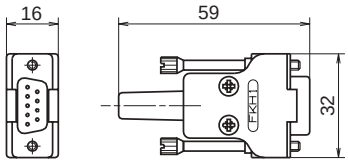
PIN	1	2	3	4	5	6	7	8	9
Square wave signals (single ended)	test	RI	T2	T1	+V	nc	nc	nc	GND

PIN	1	2	3	4	5	6	7	8	9
Square wave signals (differential)	T1	$\overline{T1}$	T2	$\overline{T2}$	RI	$\overline{RI}$	+5V	0V	test

shield is connected with the chassis

PIN	1	2	3	4	5	6	7	8	9
Voltage signals	A1	$\overline{A1}$	A2	$\overline{A2}$	RI	$\overline{RI}$	+5V	0V	inner shield

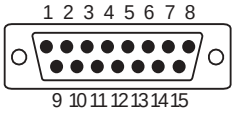
Connector LD9 9-pin



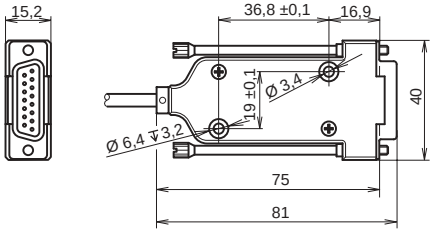
- Test = **analog signal switch-over for setup**
  By applying +5V to the test pin, instead of the square wave signals the test signals (analog) are switched to the output connector.
- The shield is connected with the chassis

Evaluation-connector AWS

PIN outs
(view on pins)



connector AWS 15-pin



PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Square wave signals + LD	test	GND	nc	$\overline{RI}$	$\overline{T2}$	$\overline{T1}$	+5 V	+5 V	GND	S1	S2	RI	T2	T1	shield

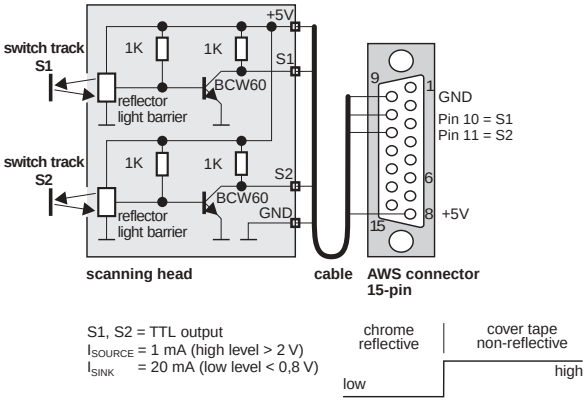
PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Micro-current signals	nc	GND	nc	RI -	90° -	0° -	+5 V	+5 V	GND	S1	S2	RI +	90° +	0° +	shield

PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Voltage signals	nc	GND	nc	$\overline{RI}$	$\overline{A2}$	$\overline{A1}$	+5 V	+5 V	GND	S1	S2	RI	A2	A1	shield

- Test = **analog signal switch-over for setup**
  By applying +5V to the test pin, instead of the square wave signals the test signals (analog) are switched to the output connector.
- S1, S2 = switch signals
- The shield is connected with the chassis

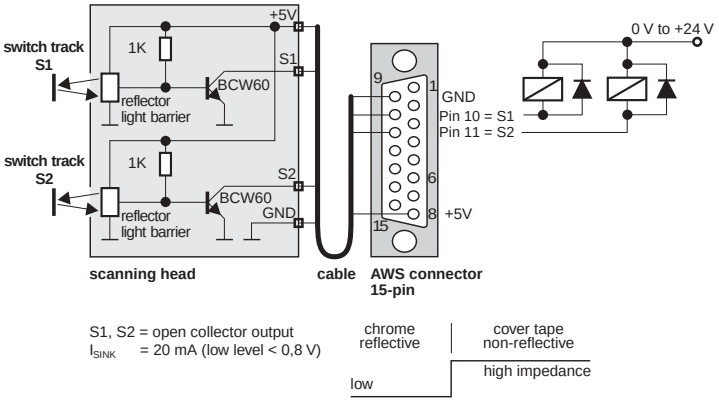
Switch outs MS 61, MS 81

Version 1
TTL output (active high)



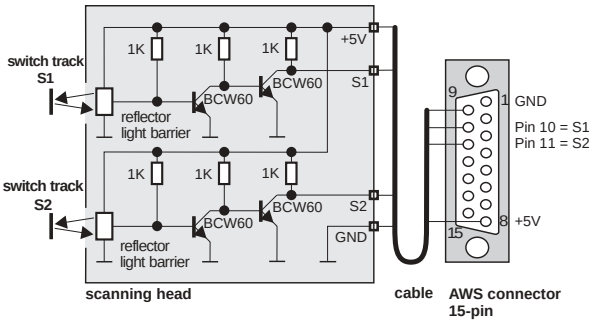
S1, S2 = TTL output
I_{SOURCE} = 1 mA (high level > 2 V)
I_{SINK} = 20 mA (low level < 0,8 V)

Version 2
open collector output (active high impedance)

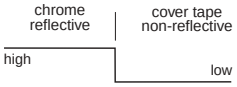


S1, S2 = open collector output
I_{SINK} = 20 mA (low level < 0,8 V)

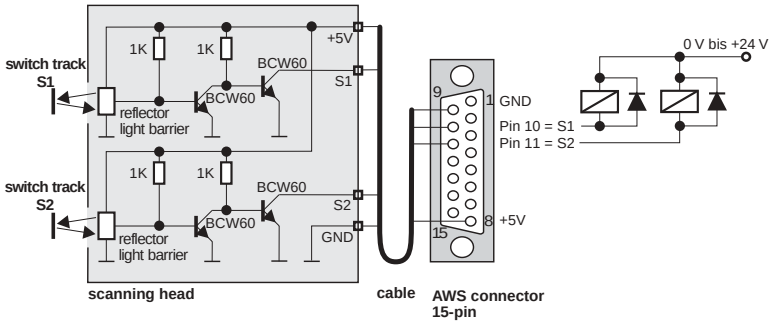
Version 3
TTL output (active low)



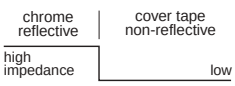
S1, S2 = TTL output
I_{SOURCE} = 1 mA (high level > 2 V)
I_{SINK} = 20 mA (low level < 0,8 V)



Version 4
open collector output (active low)



S1, S2 = open collector output
I_{SINK} = 20 mA (low level < 0,8 V)



Subdividing Electronics ZE-xx

ZE-xx Subdividing Electronic is available for applications where the Linear Encoder has a sinusoidal micro-current or sinusoidal voltage output. It is connected between the Linear Encoder and the Control or Digital Readout.

The ZE-xx divides the scale grating pitch to achieve finer resolutions and outputs square wave signals.
In addition, differential (complementary) Line Driver signals are output.
The Subdividing Electronic units are supplied in rugged housings, meeting the sealing requirements of IP 64.

ZE-**S**x
- for Linear Encoders with sinusoidal voltage signals

ZE-**V**x
- for Linear Encoders with sinusoidal micro-current signals

Interpolation:

ZE-S5,	**ZE-V5**	=	times 5
ZE-S10,	**ZE-V10**	=	times 10
ZE-S20,	**ZE-V20**	=	times 20
ZE-S25,	**ZE-V25**	=	times 25
ZE-S50,	**ZE-V50**	=	times 50
ZE-S100,	**ZE-V100**	=	times100
ZE-S200,	**ZE-V200**	=	times 200

(in preparation)

ZE-S400,	**ZE-V400**	=	times 400

(in preparation)

Power supply: +5 V ±5%

Current consumption: 150 mA
- Linear Encoder not connected
- output signals loaded

Connectors:
Input: chassis connector female
9-pin FB 91 (ZE-**V**) or 12-pin FB 121 (ZE-**S**)
Output: chassis connector male
12-pin FS 121 or 1 m cable with male connector 12-pin L121

Input signals ZE-Sx:
Encoder signals: sinusoidal voltage signals 0,6 to 1,2 Vpp (1Vpp typical)
Reference pulse: 0,2 to 0,85 V
typical 0,4 V (effective quota) with terminating impedance Zo = 120 Ω

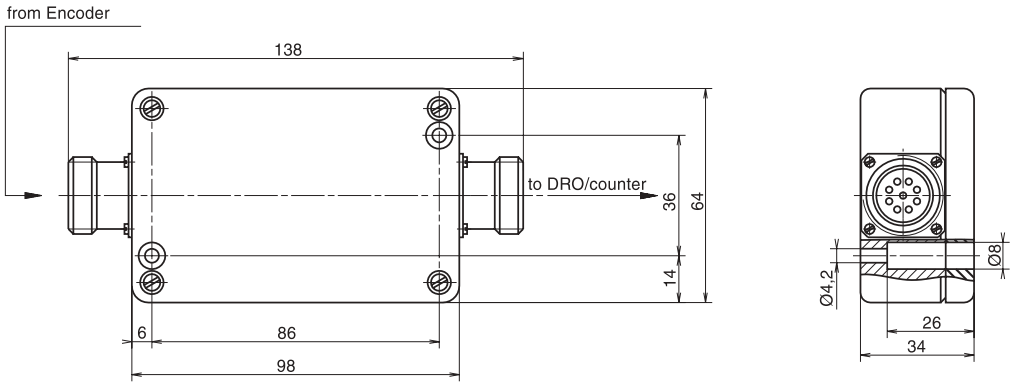
Input signals ZE-Vx:
Encoder signals: sinusoidal micro-current signals 7 to 16 µApp (11,5 µA typical)
Reference pulse: 2 to 8 µApp (5 µA typical)

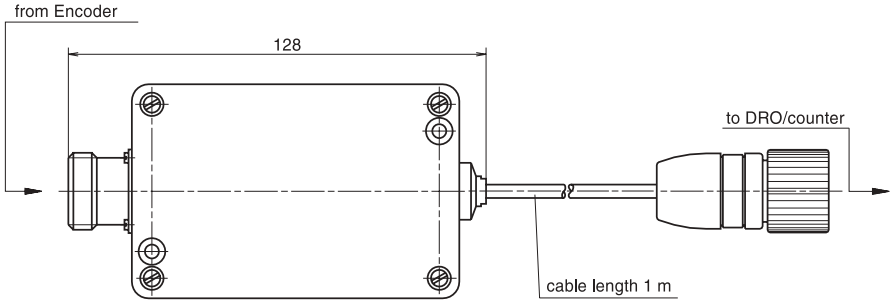
Max. input frequency:

ZE-S5,	**ZE-V5**	=	100 kHz, t_F > 300 ns
ZE-S10,	**ZE-V10**	=	50 kHz, t_F > 300 ns
ZE-S20,	**ZE-V20**	=	56 kHz, t_F > 200 ns
ZE-S25,	**ZE-V25**	=	45 kHz, t_F > 200 ns
ZE-S50,	**ZE-V50**	=	45 kHz, t_F > 100 ns
ZE-S100,	**ZE-V100**	=	22,5 kHz, t_F > 100 ns

Output signals:
Square wave signals + Reference pulse via Line Driver RS 422 standard or single ended phaseshift 90° el.

Dimensions:





Interface Card IFC 430R

PC expansion board with PCI interface,
serves to collect and evaluate encoder signals

Latch logic of the count values
- Asynchronous latch individually for each channel by software, encoder reference mark or external signal
- Synchronous latch of several channel by software, timer or external signal
- Output signal for cascading several cards; can be programmed for software sync or timer sync.

Counter operating modes
- Three counter channels (32 bits each) with one load and two latch registers
- Counting of encoder square-wave signals with one-fold, two-fold or four-fold evaluation
- Event counter with direction and clear input
- Integral timer for measuring the pulse widths, the frequency and the velocity.

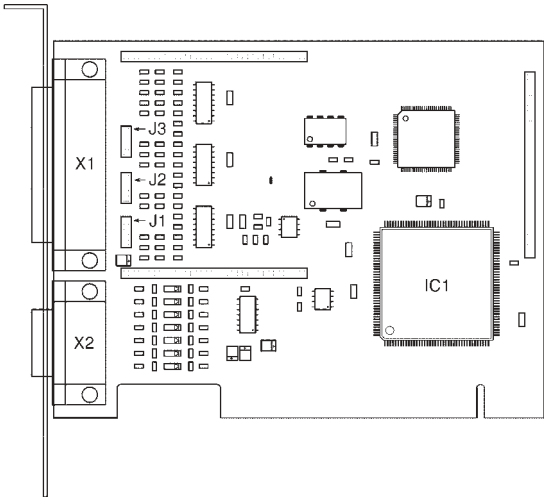
PC bus
- PCI connector, 5 V, 32-bit, 2 x 60 pins
- Target interface (slave) as per specifications Rev. 2.1
- Current consumption at +5 V approx. 0.,5 A, without encoders
- Power supply of the encoders:
  +5 V or +12 V from PCI power supply
  (current consumption depends on encoders connected)

Counter interface (X1)
- Nine RS 422 or. TTL inputs for three encoders with square-wave signals and reference mark
- Maximum input frequency
  5 MHz with delta signals (Line Driver RS 422 standard)
  2 MHz with single-end signals
- Perceives edge distances up to 80 ns
- One TTL input for interfering-signal monitoring
- Separate power supply lines for each encoder

I/O interface (X2)
- Six inputs (3 to 30 V) that can be used as reference pulse inhibitors or as asynchronous latch signals
- One input (3 to 30 V) for synchronous latch of several channels
- One output (TTL) for cascading several cards

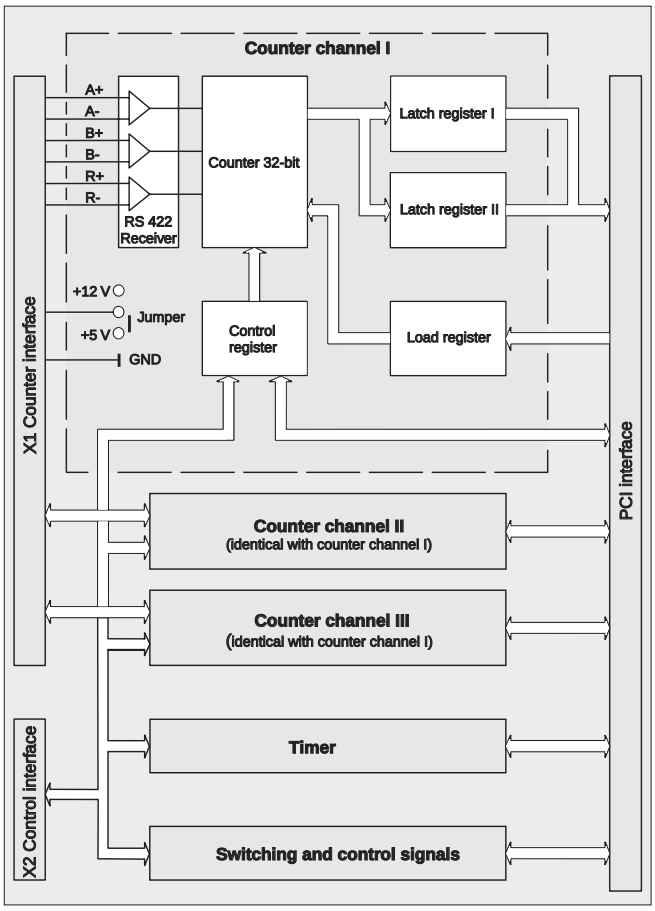
Software
- DLL (Dynamic Link Library) for operation with Windows 95/98/ME and NT
- VxD driver for Windows 95/98/ME
- Sys driver for Windows NT
- Test and demo software with sample programs

Mechanical design and environment
- Dimensions (of the PCB) approx. 120 x 92 mm width = one slot
- Maximum permissible ambient temperature +40°C
- One D-sub female terminal strip, 25-pin for the counter inputs
- One D-sub female terminal strip, 9-pin for the for I/O-signals



X1 = female D-sub terminal strip, 25-pin for counter interface
X2 = female D-sub terminal strip, 9-pin for switching and control signals
J1-J3 = jumper for the selection of the encoder operating voltage (5 V or 12 V)
IC1 = PCI interface

Block Diagram



Electronic mounting controller PG1-x

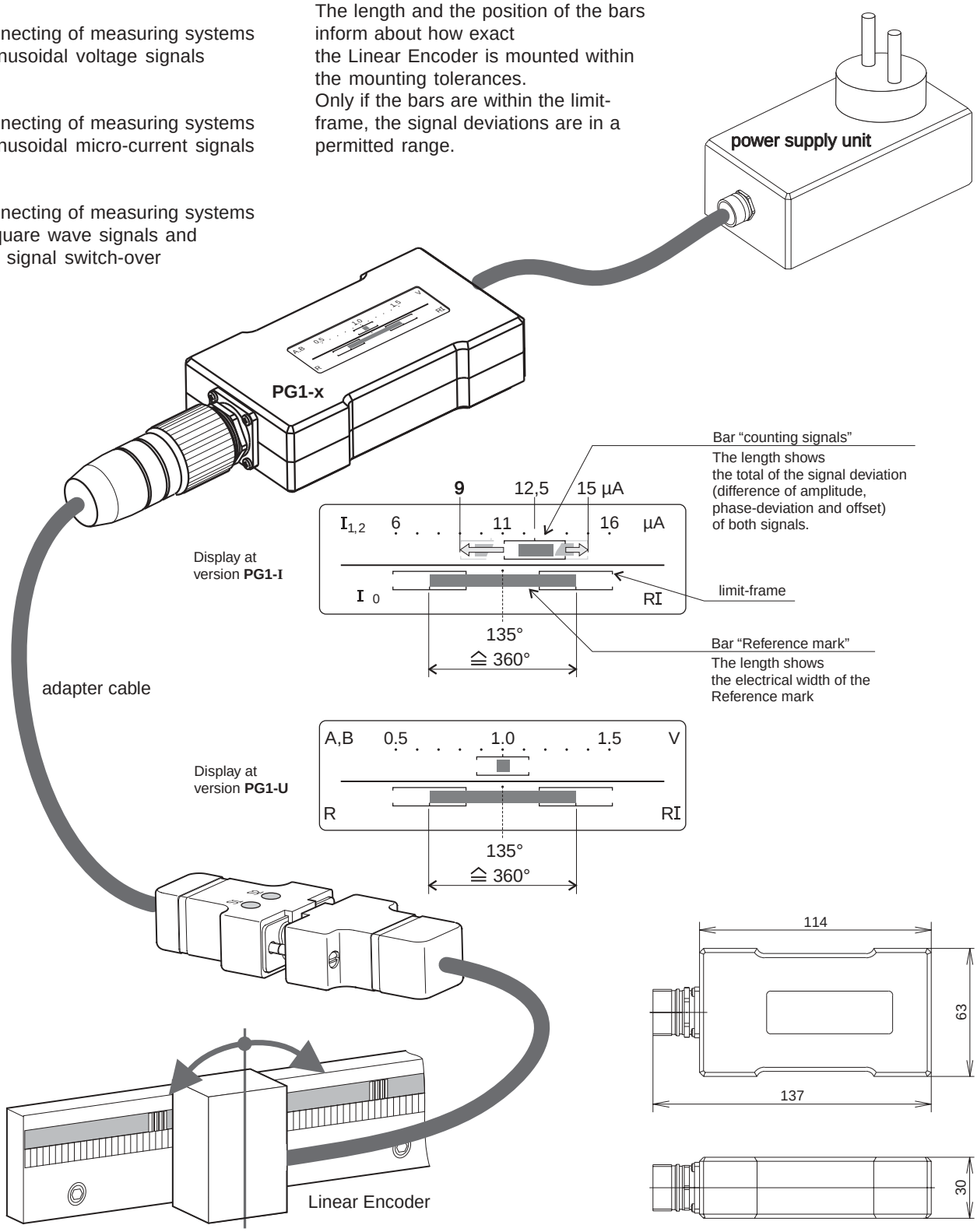
To optimize or check the mounting, the Linear Encoder must be connect to the electronic mounting controller PG1-x. Corresponding the possible output signals there are different versions to select.

PG1-**U**
- for connecting of measuring systems with sinusoidal voltage signals

PG1-**I**
- for connecting of measuring systems with sinusoidal micro-current signals

PG1-**I**
- for connecting of measuring systems with square wave signals and analog signal switch-over

Depending on the type of the Linear Encoder an appropriate adapter cable is needed.
In the display of the PG1-x the quality of the counting signals and the reference mark (RI) is shown in form of bars.
The length and the position of the bars inform about how exact
the Linear Encoder is mounted within the mounting tolerances.
Only if the bars are within the limit-frame, the signal deviations are in a permitted range.



Other RSF products, short description

MSA 170
- max. measuring length 520 mm
- distance coded RI marks (K)
- extremely small cross section
- guided by ball bearings
- enclosed version
- mounting holes on the extrusion ends

MSA 670
- max. measuring length 2240 mm
- distance coded RI marks (K)
- small cross-section
- enclosed version
- mounting holes on the extrusion ends

MSA 370
- max. measuring length 3040 mm
- distance coded RI marks (K)
- rigid mounting
- large cross-section
- enclosed version
- mounting holes on the extrusion ends and with mounting supports

MSA 690, MSA 691
- with switch tracks for special functions
- max. measuring length 2240 mm
- small cross-section
- enclosed version
- mounting holes on the extrusion ends (MSA 690)
- mounting holes on the top of the extrusion improves vibration rating (MSA 691)

MSA 390, MSA 391
- individual choosing of the reference mark
- with switch tracks for special functions
- max. measuring length 3040 mm
- rigid mounting
- large cross-section
- enclosed version
- mounting holes on the extrusion ends and with mounting supports (MSA 390)
- mounting holes on the top of the extrusion improves vibration rating (MSA 391)

MSA 650, MSA 651
- distance coded RI marks (K)
- max. measuring length 1740 mm
- small cross-section
- enclosed version
- mounting holes on the extrusion ends (MSA 650)
- mounting holes on top of the extrusion improves vibration rating (MSA 651)

MSA 350, MSA 352
- with two sets of sealing lips (only MSA 352)
- distance coded RI marks (K)
- max. measuring length 3040 mm
- rigid mounting
- large cross-section
- enclosed version
- mounting holes on the extrusion ends and with mounting supports

DG 118, DG 120
- Rotary Encoder for unsiversal application
- standard line/rev. graduated from 100 up to 5.400

Other RSF-Products



Digital Readouts

Features:	**Z 710**	**Z 720**	**Z 730**	**Z 715**	**Z 725**	**Z 735** **Z 735E** (1 **Z 735S** (2	**Z 820**	**Z 830** **Z 830E** (1 **Z 830S** (2	**Z 840**
number of axis	1	2	3	1	2	3	2	3	4
programming of system parameters		●			●			●	
selectable axis name		●			●			●	
switchable for use on a lathe or milling machine		●			●			●	
programmable resolution and counting direction		●			●			●	
Reset- and Preset input		●			●			●	
addition/subtraction with the keyboard		●			●			●	
bolt hole pattern, rectangular drilling pattern		●			●			●	
Reference mark evaluation (quasi-absolut)		●			●			●	
Hardware test and display test		●			●			●	
99 tool corrections (lathe mode)					●			●	
99 datum points (milling mode)					●			●	
store values for axis display		●			●			●	
absolute/incremental		●			●			●	
mm/inch conversion		●			●			●	
centering (divide by 2)		●			●			●	
radius/diameter		●			●			●	
adjustable for Rotary or Linear Encoder input.					●			●	
linear error correction programmable		●			●			●	
nonlinear axes-error correction					●	100 correction points		●	4 correction points
summing for two axis (Z + Z1)		●			●			●	
axes movements with displayed remaining travel way					●				
display for approximation to zero point		●			●			●	
feed display					●			●	
inbuilt stop-watch					●			●	
taper function					●			●	
display of spindle speed					●			●	
skew compensation					●			●	
Bi-directional RS 232 interface					○			○	
free programmable switch off and pre-switch off points					○			○	
edge probe input					○			●	
output for constant surface speed					○			○	
external Reset for each axis								○	
external input								○	
program store for 500 sets								○	
special display for spark erosion					○			○	
compensation for grinding wheels					○			○	

(1 = DRO for spark erosion machines, (2 = DRO for surface grinders, ● = standard, ○ = optional with the additional price

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