Incremental Linear Encoders
Enclosed Models
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 built Distribution contacts in the most important markets.

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.

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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 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.
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.

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.

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

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.

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 an 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 beams, depending on the change of position phase shifted, 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 grating pitch.

The cause of the optical scanning version a accurate Reference Mark is warranted.
Output signals

Sinusoidal voltage signals
There are 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)
Track signals (differential voltage A1 to A1 resp. A2 to A2):
Phaseshift 90° ±10° el.
electrical offset ±10% of the signal amplitude
Signal amplitude 0.6 Vpp to 1.2 Vpp
typ. 1 Vpp with terminating impedance Z0 = 120 Ω

Reference Mark
(differential voltage RI to RI):
El. position typically 135°
(referenced to A1)
El. width typically 270°
Useable component 0.2 up to 0.85 V,
typical 0.5 V with terminating impedance Z0 = 120 Ω

Advantage: High traversing speed with long cable lengths possible.
These signals are suitable for the connection to appropriate CNC and/or Feedback Systems.

Sinusoidal micro-current signals
There are 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
With a Schmitt-Trigger (for times 1) or interpolation electronics (for times 5, -10, -20, -25, -50 or -100) the photoelement output signals are converted into two square wave signals that have a phase shift of 90°. Output signals either can be single ended or Line Driver differential (RS 422).

For measuring systems with single ended output signals the max. cable length is 10 m, including extension cable. 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
The control/DRO must be able to detect 100ns - 10ns - 10 x 0.2ns - 10ns = 78ns

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

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**Drawing in "positive counting direction"**

**Recommended Line Receiver circuit**

**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.

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<tr>
<th>Output signals resp. constructional features</th>
<th>Cable Ø mm</th>
<th>Shield</th>
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<td>Sinusoidal micro-current signals and sinusoidal voltage signals</td>
<td>5.7</td>
<td>double, high flex</td>
<td>45 mm</td>
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<td></td>
<td>4.4</td>
<td>double, ultra high flex</td>
<td>35 mm</td>
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<td></td>
<td>3.9</td>
<td></td>
<td>30 mm</td>
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<tr>
<td>Square wave signals</td>
<td>5.7</td>
<td>single</td>
<td>45 mm</td>
</tr>
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<td>MSA 65x and MSA 35x</td>
<td>4.8</td>
<td>single, with metal braiding</td>
<td>25 mm</td>
</tr>
<tr>
<td></td>
<td>4.3</td>
<td>single</td>
<td>25 mm</td>
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</tbody>
</table>

* 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 thermoplastic, 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
Environmental sealing

For applications where the Linear Encoders are used in harsh environments (e.g. oil and coolants), there are two methods of extra protection beyond the enclosed unit’s standard set of sealing lips.

1. An air inlet can be provided for filtered air to be input into the scale spar. A limiting flow restrictor helps set the optimum overpressure airflow inside the scale spar to further prevent oil and coolants from entering the seal.
2. Scale spars with two sets of sealing lips are available. The area between the two sets of sealing lips can also be pressurized to achieve the best possible environmental sealing.

When filtered air is not available, the RSF Air Pressure Unit DA300, or an equivalent, should be used. Pressure is adjustable. To avoid measuring errors due to thermal differences, it is absolutely necessary to provide pressurized air that has the same temperature as the machine tool. The DA300 requires standard compressed air at the input.

Commonly used sealing lips are resistant to all coolants and lubricants.

Air pressure unit DA300

Air supply ➔ filtered air to the linear encoder

Shield connections

Sinusoidal micro-current signals
Sinusoidal voltage signals
The inner shield connector pin must be connected to protective ground with 0V

outer shield on the surface of the reading head

inner shield on connector pin

double shielded cable, standard

standard cable length 3 m

connector pin

reading head

0V

Shield connections

Square wave signals
The inner shield connector pin must be connected to protective ground with 0V

outer shield on the surface of the reading head

inner shield not connected

single shielded cable, standard

standard cable length 3 m

connector pin

reading head

0V

Shield connections

Square wave signals
The inner shield connector pin must be connected to protective ground with 0V

outer shield on the surface of the reading head

inner shield not connected

double shielded cable, optional

standard cable length 3 m

connector pin

reading head

0V

Shield connections

Environmental sealing

Commonly used sealing lips are resistant to all coolants and lubricants.
Nomenclature

Encoder Name

Encoder Type
(design features)

Output signals and integrated Subdividing

Grating pitch

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

Possible options

For example:

**MSA690 .63-1 P**

- small cross-section, mounting holes on the extrusion ends, with switch magnets
- square wave output signals, integrated Subdividing times 5
- grating pitch 20 µm
- switch signal with TTL output (active high)
- input for compressed air
### Overview, Selection guide

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<td>ML = measuring length</td>
<td>MSA 170</td>
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<td>• guided by ball bearings</td>
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<tr>
<td>• distance coded Reference Marks (K)</td>
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<td></td>
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<tr>
<td>• max. measuring length 520 mm</td>
<td></td>
<td></td>
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<tr>
<td>• enclosed version</td>
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<tr>
<td>• mounting holes on the extrusion ends</td>
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<tr>
<td>• resolution from 5 µm up to 0,1 µm</td>
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<td>• distance coded Reference Marks (K)</td>
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<td>• max. measuring length 2240 mm</td>
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<td>MSA 690</td>
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<td>• small cross-section</td>
<td></td>
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<tr>
<td>• enclosed version</td>
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<td></td>
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<tr>
<td>• mounting holes on the extrusion ends</td>
<td></td>
<td></td>
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<tr>
<td>• resolution from 10 µm up to 0,1 µm</td>
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</tr>
<tr>
<td>• free positionable switching magnets for special functions (MSA 690)</td>
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<td>MSA 671</td>
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<td></td>
<td>MSA 691</td>
<td></td>
</tr>
<tr>
<td>• small cross-section</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
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<tr>
<td>• mounting holes on top of the extrusion improves vibration rating</td>
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</tr>
<tr>
<td>• resolution from 10 µm up to 0,1 µm</td>
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</tr>
<tr>
<td>• free positionable switching magnets for special functions (MSA 691)</td>
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<td>• two sets of sealing lips for additional contamination protection</td>
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<td>• distance coded Reference Marks (K)</td>
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<tr>
<td>• max. measuring length 2240 mm</td>
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<tr>
<td>• small cross-section</td>
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<tr>
<td>• enclosed version</td>
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<tr>
<td>• mounting holes on the extrusion ends</td>
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<tr>
<td>• resolution from 10 µm up to 0,1 µm</td>
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</table>
### Design features

- with optimized thermal performance
- distance coded Reference Marks (K)
- max. measuring length 1240 mm
- small cross-section
- enclosed version
- mounting holes on the extrusion ends
- resolution from 5 µm up to 0.1 µm

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<td>MSA 680</td>
<td>22-23</td>
</tr>
<tr>
<td>ML + 143 mm</td>
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</tr>
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<td>18</td>
<td>35</td>
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<tr>
<td>46</td>
<td>54.5</td>
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</tbody>
</table>

### Basic dimensions

- distance coded Reference Marks (K)
- max. measuring length 3040 mm
- rigid mounting
- large cross-section
- enclosed version
- mounting holes on the extrusion ends and with mounting supports
- resolution from 10 µm up to 0.1 µm
- individual choosing of the reference mark (MSA390)
- free positionable switching magnets for special functions (MSA 390)

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<td>MSA 370</td>
<td>24-25</td>
</tr>
<tr>
<td>ML + 150 mm</td>
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<tr>
<td>27</td>
<td>37</td>
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<tr>
<td>MSA 390</td>
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<td>MSA 371</td>
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<tr>
<td>MSA 391</td>
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</tbody>
</table>

### Basic dimensions

- distance coded Reference Marks (K)
- max. measuring length 3040 mm
- rigid mounting
- mounting holes on top of the extrusion improves vibration rating
- large cross-section
- enclosed version
- resolution from 10 µm up to 0.1 µm
- individual choosing of the reference mark (MSA 391)
- free positionable switching magnets for special functions (MSA 391)
### Overview, Selection guide

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<tbody>
<tr>
<td>- two sets of sealing lips for additional contamination protection</td>
<td>ML = measuring length</td>
<td>MSA 372</td>
<td>28-29</td>
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<td>- distance coded Reference Marks (K)</td>
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<td>- max. measuring length 7040 mm</td>
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<tr>
<td>- rigid mounting</td>
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<tr>
<td>- large cross-section</td>
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<tr>
<td>- enclosed version</td>
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<tr>
<td>- mounting holes on the extrusion ends and with mounting supports</td>
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<tr>
<td>- resolution from 10 µm up to 0,1 µm</td>
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<td>- self guided Encoder</td>
<td>MSA 373</td>
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<tr>
<td>- for application on presses, bending machines and hydraulic cylinders</td>
<td></td>
<td>MSA 374</td>
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<tr>
<td>- free positionable switching magnets for special functions</td>
<td></td>
<td>MSA 375</td>
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<tr>
<td>- integrated, protected guideway</td>
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<td>- max. measuring length 720 mm</td>
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<tr>
<td>- rigid mounting</td>
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<tr>
<td>- enclosed version</td>
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<tr>
<td>- mounting holes on the extrusion ends</td>
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<tr>
<td>- encoder head attached to machine with rod in end of head bracket</td>
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<tr>
<td>- resolution: 5 µm or 0,1 µm</td>
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<td>- for retrofit of machine tools</td>
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<td>MSA 650</td>
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<td>- high mounting tolerances</td>
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<td>- distance coded Reference Marks (K)</td>
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<td>- max. measuring length 1740 mm</td>
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<td>- small cross-section</td>
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<td>- resolution from 10 µm up to 0,5 µm</td>
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<tr>
<td>Design features</td>
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<tr>
<td>for retrofit of machine tools</td>
<td>for retrofit of machine tools</td>
<td>MSA 651</td>
<td>36-37</td>
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<tr>
<td>high mounting tolerances</td>
<td>high mounting tolerances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>distance coded Reference Marks (K)</td>
<td>distance coded Reference Marks (K)</td>
<td></td>
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</tr>
<tr>
<td>max. measuring length 2240 mm</td>
<td>max. measuring length 3040 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>small cross-section</td>
<td>rigid mounting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>enclosed version</td>
<td>large cross-section</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mounting holes on top of the extrusion improves vibration rating</td>
<td>mounting holes on the extrusion ends and with mounting supports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>resolution from 10 µm up to 0,5 µm</td>
<td>resolution from 10 µm up to 0,5 µm</td>
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<tr>
<td>for retrofit of machine tools</td>
<td>for retrofit of machine tools</td>
<td>MSA 350</td>
<td>38-39</td>
</tr>
<tr>
<td>high mounting tolerances</td>
<td>high mounting tolerances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with two sets of sealing lips</td>
<td>with two sets of sealing lips</td>
<td></td>
<td></td>
</tr>
<tr>
<td>distance coded Reference Marks (K)</td>
<td>distance coded Reference Marks (K)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>max. measuring length 3040 mm</td>
<td>max. measuring length 3040 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>small cross-section</td>
<td>rigid mounting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>enclosed version</td>
<td>large cross-section</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mounting holes on the extrusion ends and with mounting supports</td>
<td>mounting holes on the extrusion ends and with mounting supports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>resolution from 10 µm up to 0,5 µm</td>
<td>resolution from 10 µm up to 0,5 µm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Signal-outputs (optional):

- Sinusoidal voltage signals
  MSA 170.03
  Power supply:
  +5V ±5%, max. 75 mA (unloaded)
  Output signals:
  Encoder signals: 0.6 to 1.2 Vpp, typical 1 Vpp
  with terminating resistor Zo = 120Ω
  Reference pulse:
  0.2 to 0.85 Vpp, typical 0.4 V(useable component)
  with terminating resistor Zo = 120Ω
  Max. output frequency:
  100 kHz (with 3 m cable)

- Sinusoidal micro-current signals
  MSA 170.13
  Power supply:
  +5 V ±5%, max. 75 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
  Max. output frequency:
  50 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
  MSA 170.23 = times 1
  MSA 170.63 = times 5
  MSA 170.73 = times 10
  MSA 170.53 = times 25
  MSA 170.83 = times 50
  Power supply:
  +5 V ±5%, max. 120 mA (unloaded)
MSA 170  Dimensions - Mounting tolerances - Mounting possibilities:

overall length = measuring length + 80

M = machine guideway

length of cable 3 m

air inlet M3 (both sides)
MSA 670
MSA 690 (with switch signals)

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch (Edge separation a min)</th>
<th>Max. velocity (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Sinusoidal voltage signals 1 V pp</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 670.03</td>
<td>depending on external subdividing</td>
<td>±3, ±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 670.01</td>
<td>depending on external subdividing</td>
<td>±2, ±3 µm/m</td>
<td>10 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>* Sinusoidal micro-current signals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 670.13</td>
<td>depending on external subdividing</td>
<td>±3, ±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 670.11</td>
<td>depending on external subdividing</td>
<td>±2, ±3 µm/m</td>
<td>10 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>* Square wave Line Driver signals with integrated Subdividing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 670.24</td>
<td>10 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s (6.6 µs)</td>
</tr>
<tr>
<td>MSA 670.23</td>
<td>5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s (3.3 µs)</td>
</tr>
<tr>
<td>MSA 670.64</td>
<td>2 µm</td>
<td>±5 µm/m</td>
<td>40 µm</td>
<td>1 m/s (600 ns)</td>
</tr>
<tr>
<td>MSA 670.63</td>
<td>1 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s (600 ns)</td>
</tr>
<tr>
<td>MSA 670.73</td>
<td>0.5 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s (300 ns)</td>
</tr>
<tr>
<td>MSA 670.71</td>
<td>0.25 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0.5 m/s (300 ns)</td>
</tr>
<tr>
<td>MSA 670.51</td>
<td>0.1 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0.45 m/s (200 ns)</td>
</tr>
</tbody>
</table>

* Other accuracy grades or grating pitches (e.g. Inch) upon request

Signal-outputs (optional):

- * Sinusoidal voltage signals
  - MSA 670.03
  - MSA 670.01

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 = 120Ω
- Reference pulse: 0.2 to 0.85 Vpp, typical 0.4 V (useable component) with terminating resistor Zo = 120Ω

Max. output frequency:

- 100 kHz (with 3 m cable)

- * Sinusoidal micro-current signals
  - MSA 670.13
  - MSA 670.11

Power supply:

- +5V ±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

Max. output frequency:

- 100 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
  - MSA 670.23 = times 1
  - MSA 670.24 = times 1
  - MSA 670.63 = times 5
  - MSA 670.64 = times 5
  - MSA 670.73 = times 10
  - MSA 670.71 = times 10
  - MSA 670.51 = times 25

Power supply:

- +5 V ±5%, max. 150 mA (unloaded)

Standard measuring lengths (mm)

- 70, 120, 170, 220, 270, 320, 370, 420, 470, 520, 620, 720, 820, 920, 1040, 1140, 1240, 1340, 1440, 1540, 1640, 1740, 1840, 2040, 2240

Measuring type: glass scale

Reference Mark (R1): selectable
- MSA 670.xx K, MSA 690.xx K: Distance coded Reference Marks (K): after travelling 20 mm the absolute position will be shown on the display.

MSA 670.xx, MSA 690.xx:

- Up to a measuring length of 920 mm, one Reference Mark can either be placed in the middle of scales 1040 mm or longer, or 35 mm from either end of measuring length.
- With a measuring length of 1040 mm or longer, a Reference Mark will be placed 45 mm from either end of the measured length.

Option:

- One Reference Mark at any location, or two or more Reference Marks separated by distances of n x 50 mm

MSA 690.xx

Free positionable switching magnets for special functions:

The position of the 2 switch points (S1 and S2) within the measured length can be selected by the customer (details on page 32 and 33)

Required moving force:

- with standard sealing lips < 3 N
- with low drag sealing lips < 0.2 N

Environmental sealing DIN 40050:

- IP 53 (with standard sealing lips)
- IP 64 with DA300 (DA300 see page 45)

Permissible vibration: 100 m/s² (40 to 2000 Hz), Permissible shock: 200 m/s² (8 ms)

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

Weight (approx.):

- 0.8 kg/m (scale spar) + 75 g (scanning head without cable)
MSA 670, MSA 690 Dimensions - Mounting tolerances - Mounting possibilities:

For measuring lengths over 620 mm, scale should be affixed with epoxy resin adhesive (e.g., UHU-Plus). Cementing gap max. 0.2 mm.

Length of cable 3 m**

** armoured cable optional
MSA 671  
MSA 691 (with switch signals)

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge separation a_{min})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinusoidal voltage signals 1 V_{pp}</td>
<td>depending on external subdividing</td>
<td>±3, ±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s, 2 m/s</td>
</tr>
<tr>
<td>MSA 671.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 671.01</td>
<td></td>
<td>±2, ±3 µm/m</td>
<td>10 µm</td>
<td>1 m/s, 1 m/s</td>
</tr>
</tbody>
</table>

- Sinusoidal micro-current signals

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge separation a_{min})</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA 671.13</td>
<td></td>
<td>±3, ±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s, 2 m/s</td>
</tr>
<tr>
<td>MSA 671.11</td>
<td></td>
<td>±2, ±3 µm/m</td>
<td>10 µm</td>
<td>1 m/s, 1 m/s</td>
</tr>
</tbody>
</table>

- Square wave Line Driver signals with integrated Subdividing

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge separation a_{min})</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA 671.24</td>
<td>10 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s (6.6 µs), 2 m/s (3.3 µs)</td>
</tr>
<tr>
<td>MSA 671.23</td>
<td>5 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s (3.3 µs), 2 m/s (1.6 µs)</td>
</tr>
<tr>
<td>MSA 671.64</td>
<td>2 µm</td>
<td>±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s (1.2 µs), 2 m/s (600 ns)</td>
</tr>
<tr>
<td>MSA 671.63</td>
<td>1 µm</td>
<td>±3, ±5 µm/m</td>
<td>40 µm</td>
<td>1 m/s (600 ns), 1 m/s (600 ns)</td>
</tr>
<tr>
<td>MSA 671.73</td>
<td>0.5 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s (300 ns), 1 m/s (300 ns)</td>
</tr>
<tr>
<td>MSA 671.71</td>
<td>0.25 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0.5 m/s (300 ns), 0.5 m/s (300 ns)</td>
</tr>
<tr>
<td>MSA 671.51</td>
<td>0.1 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0.45 m/s (200 ns), 0.45 m/s (200 ns)</td>
</tr>
</tbody>
</table>

* Other accuracy grades or grating pitches (e.g. Inch) upon request

Signal-outputs (optional):

- Sinusoidal voltage signals
  MSA 671.03
  MSA 671.01
  Power supply:
  +5V ±5%, max. 120 mA (unloaded)

- Sinusoidal micro-current signals
  MSA 671.13
  MSA 671.11
  Power supply:
  +5V ±5%, max. 120 mA

- Square wave signals (
  single ended)

  via Line Driver RS 422 standard

  MSA 671.23 = times 1
  MSA 671.24 = times 1
  MSA 671.63 = times 5
  MSA 671.64 = times 5
  MSA 671.73 = times 10
  MSA 671.71 = times 10
  MSA 671.51 = times 25

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

- Square wave signals (differential)

  with integrated Subdividing Electronics

  MSA 671.23 = times 1
  MSA 671.24 = times 1
  MSA 671.63 = times 5
  MSA 671.64 = times 5
  MSA 671.73 = times 10
  MSA 671.71 = times 10
  MSA 671.51 = times 25

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

- Square wave signals (differential)

  via Line Driver RS 422 standard

  with integrated Subdividing Electronics

  MSA 671.23 = times 1
  MSA 671.24 = times 1
  MSA 671.63 = times 5
  MSA 671.64 = times 5
  MSA 671.73 = times 10
  MSA 671.71 = times 10
  MSA 671.51 = times 25

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

Other information:

- Standard measuring lengths: (mm)
  70, 120, 170, 220, 270, 320, 370, 420, 470, 520, 620, 720, 820, 920, 1040, 1140, 1240, 1340, 1440, 1540, 1640, 1740, 1840, 2040, 2240

- Measuring type: glass scale

- Reference Mark (R1); selectable
  MSA 671.xx K, MSA 691.xx K:
  Distance coded Reference Marks (K): after travelling 20 mm the absolute position will be shown on the display.

- MSA 671.xx, MSA 691.xx:
  Up to a measuring length of 920 mm, one Reference Mark can either be placed in the middle of scales 1040 mm or longer, or 35 mm from either end of measuring length.
  With a measuring length of 1040 mm or longer, a Reference Mark will be placed 45 mm from either end of the measured length.

- Option:
  One Reference Mark at any location, or two or more Reference Marks separated by distances of n x 50 mm

- MSA 691.xx
  Free positionable switching magnets for special functions:
  The position of the 2 switch points (S1 and S2) within the measured length can be selected by the customer (details on page 32 and 33)

- Required moving force:
  with standard sealing lips < 3 N
  with low drag sealing lips < 0.2 N

- Environmental sealing DIN 40050: IP 53 (with standard sealing lips)
  IP 64 with DA300 (DA300 see page 45)

- Permissible vibration: 150 m/s² (40 to 2000 Hz), Permissible shock: 300 m/s² (8 ms)

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

- Weight (approx.): 0.8 kg/m (scale spar) + 75 g (scanning head without cable)
MSA 671, MSA 691 Dimensions - Mounting tolerances - Mounting possibilities:

**armoured cable optional**
MSA 672

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge separation aₘₚₙ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA 672.03</td>
<td>depending on external subdividing</td>
<td>±3, ±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 672.01</td>
<td>depending on external subdividing</td>
<td>±2, ±3 µm/m</td>
<td>10 µm</td>
<td>1 m/s</td>
</tr>
</tbody>
</table>

• Sinusoidal voltage signals 1 Vₚₚ

• Sinusoidal micro-current signals

• Square wave Line Driver signals with integrated Subdividing

MSA 672.24
10 µm | ±10 µm/m | 40 µm | 1 m/s (6.6 µs) | 2 m/s (3.3 µs) |

MSA 672.23
5 µm | ±5 | ±10 µm/m | 20 µm | 1 m/s (3.3 µs) | 2 m/s (1.6 µs) |

MSA 672.64
2 µm | ±5 | ±5 µm/m | 40 µm | 1 m/s (600 ns) | 2 m/s (600 ns) |

MSA 672.63
1 µm | ±3, ±5 µm/m | 40 µm | 1 m/s (600 ns) | 1 m/s (600 ns) |

MSA 672.73
0.5 µm | ±3, ±5 µm/m | 20 µm | 1 m/s (300 ns) | 1 m/s (300 ns) |

MSA 672.71
0.25 µm | ±2, ±3, ±5 µm/m | 10 µm | 0.5 m/s (300 ns) | 0.5 m/s (300 ns) |

MSA 672.51
0.1 µm | ±2, ±3, ±5 µm/m | 10 µm | 0.45 m/s (200 ns) | 0.45 m/s (200 ns) |

* Other accuracy grades or grating pitches (e.g. Inch) upon request

Standard measuring lengths: (mm)
70, 120, 170, 220, 270, 320, 370, 420, 470, 520, 620, 720, 820, 920, 1040, 1140, 1240, 1340, 1440, 1540, 1640, 1740, 1840, 2040, 2240

Measuring type: glass scale

Reference Mark (RI): selectable
MSA 672.xx K:
Distance coded Reference Marks (K): after travelling 20 mm the absolute position will be shown on the display.

MSA 672.xx:
Up to a measuring length of 920 mm, one Reference Mark can either be placed in the middle of scales 1040 mm or longer, or 35 mm from either end of measuring length. With a measuring length of 1040 mm or longer, a Reference Mark will be placed 45 mm from either end of the measured length.

Option:
One Reference Mark at any location, or two or more Reference Marks separated by distances of n x 50 mm

Required moving force:
< 6 N (two sets of sealing lips)

Environmental sealing DIN 40050:
IP 54 (two sets of sealing lips)
IP 64 with DA300 (DA300 see page 45)

Permissible vibration: 150 m/s² (40 to 2000 Hz)
Permissible shock: 300 m/s² (8 ms)

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

Weight (approx.): 0.8 kg/m (scale spar) + 80 g (scanning head without cable)

Signal-outputs (optional):

• Sinusoidal voltage signals
  MSA 672.03
  MSA 672.01

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 = 120Ω
Reference pulse:
0.2 to 0.85 Vpp, typical 0.4 V (useable component) with terminating resistor Zo = 120Ω

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

• Sinusoidal micro-current signals
  MSA 672.13
  MSA 672.11

Power supply:
+5 V ±5%, max. 120 mA

Output signals:
Encoder signals: 7 to 6 µA, typical 0.5 µA at 1 KΩ
Reference pulse: 2 to 8 µA, typical 5 µA (useable component) at 1 KΩ

Max. output frequency:
100 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

MSA 672.23 = times1
MSA 672.24 = times1
MSA 672.63 = times5
MSA 672.64 = times5
MSA 672.73 = times10
MSA 672.71 = times10
MSA 672.51 = times25

Power supply:
+5 V ±5%, max. 150 mA (unloaded)
MSA 672 Dimensions - Mounting tolerances - Mounting possibilities:

**armoured cable optional**
**MSA 680**

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch (Edge separation $a_{\text{min}}$)</th>
<th>Max. velocity $v$</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sinusoidal voltage signals 1 V$_{pp}$</td>
<td></td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s, 2 m/s</td>
</tr>
<tr>
<td>MSA 680.03</td>
<td>depending on external subdividing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 680.01</td>
<td>depending on external subdividing</td>
<td>±2, ±3 µm/m</td>
<td>10 µm</td>
<td>1 m/s, 1 m/s</td>
</tr>
<tr>
<td>• Sinusoidal micro-current signals</td>
<td></td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s, 2 m/s</td>
</tr>
<tr>
<td>MSA 680.13</td>
<td>depending on external subdividing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 680.11</td>
<td>depending on external subdividing</td>
<td>±2, ±3 µm/m</td>
<td>10 µm</td>
<td>1 m/s, 1 m/s</td>
</tr>
<tr>
<td>• Square wave Line Driver signals with integrated Subdividing</td>
<td></td>
<td>5 µm</td>
<td>±5 µm/m</td>
<td>20 µm</td>
</tr>
<tr>
<td>MSA 680.23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 680.64</td>
<td></td>
<td>2 µm</td>
<td>±5 µm/m</td>
<td>40 µm</td>
</tr>
<tr>
<td>MSA 680.63</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>MSA 680.73</td>
<td></td>
<td>0.5 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
</tr>
<tr>
<td>MSA 680.71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 680.51</td>
<td></td>
<td>0.25 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
</tr>
<tr>
<td>MSA 680.51</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 680.51</td>
<td></td>
<td>0.1 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
</tr>
<tr>
<td>MSA 680.51</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Other accuracy grades or grating pitches (e.g. Inch) upon request

**Signal outputs (optional):**

- **Sinusoidal voltage signals**
  MSA 680.03
  MSA 680.01

**Power supply:**

- +5V ±5%, max. 120 mA (unloaded)

**Output signals:**

- Encoder signals: 0.6 to 1.2 V$_{pp}$, typical 1 V$_{pp}$ with terminating resistor Zo = 120 Ω
- Reference pulse: 0.2 to 0.85 V$_{pp}$, typical 0.4 V (useable component) with terminating resistor Zo = 120 Ω

**Max. output frequency:**

- 100 kHz (with 3 m cable)

- **Sinusoidal micro-current signals**
  MSA 680.13
  MSA 680.11

**Power supply:**

- +5 V ±5%, max. 120 mA

**Output signals:**

- Encoder signals: 7 to 6 µApp, typical 0.5 µApp at 1 KΩ
- Reference pulse: 2 to 8 µA, typical 5 µA (useable component) at 1 KΩ

**Max. output frequency:**

- 100 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

  MSA 680.23 = times 1
  MSA 680.63 = times 5
  MSA 680.64 = times 5
  MSA 680.73 = times 10
  MSA 680.71 = times 10
  MSA 680.51 = times 25

**Power supply:**

- +5 V ±5%, max. 150 mA (unloaded)

**Standard measuring lengths:** (mm)

- 70, 120, 170, 220, 270, 320, 370, 420, 470, 520, 620, 720, 820, 920, 1040, 1140, 1240

**Measuring type:** glass scale

**Reference Mark (RL):** selectable

MSA 680.xx K:
Distance coded Reference Marks (K): after travelling 20 mm the absolute position will be shown on the display.

MSA 680.xx:
Up to a measuring length of 920 mm, one Reference Mark can either be placed in the middle of scales 1040 mm or longer, or 35 mm from either end of measuring length. With a measuring length of 1040 mm or longer, a Reference Mark will be placed 45 mm from either end of the measured length.

**Option:**

One Reference Mark at any location, or two or more Reference Marks separated by distances of n x 50 mm

**Required moving force:**

- with standard sealing lips < 3 N
- with low drag sealing lips < 0.2 N

**Environmental sealing DIN 40050:**

- IP 53 (with standard sealing lips)
- IP 64 with DA300 (DA300 see page 45)

**Permissible vibration:** 100 m/s$^2$ (40 to 2000 Hz)

**Permissible shock:** 200 m/s$^2$ (8 ms)

**Permissible temperature:**

- -20°C to +70°C (storage), 0°C to +50°C (operation)

**Weight (approx.):**

- 0.8 kg/m (scale spar) + 75 g (scanning head without cable)
MSA 680  Dimensions - Mounting tolerances - Mounting possibilities:

** armoured cable optional
**MSA 370**

**MSA 390** (with switch signals and selectable Reference Mark)

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (m/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sinusoidal voltage signals 1 Vpp</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 370.03</td>
<td>depending on external subdividing</td>
<td>±3, ±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s 2 m/s</td>
</tr>
<tr>
<td>MSA 370.01</td>
<td>depending on external subdividing</td>
<td>±2, ±3 µm/m</td>
<td>10 µm</td>
<td>1 m/s 1 m/s</td>
</tr>
</tbody>
</table>

| **Sinusoidal micro-current signals** | | | | |
| MSA 370.13 | depending on external subdividing | ±3, ±5, ±10 µm/m | 20 µm | 1 m/s 2 m/s |
| MSA 370.11 | depending on external subdividing | ±2, ±3 µm/m | 10 µm | 1 m/s 1 m/s |

| **Square wave Line Driver signals with integrated Subdividing** | | | | |
| MSA 370.24 | 10 µm | ±10 µm/m | 40 µm | 1 m/s 2 m/s |
| MSA 370.23 | 5 µm | ±5, ±10 µm/m | 20 µm | 1 m/s 2 m/s |
| MSA 370.64 | 2 µm | ±5 µm/m | 40 µm | 1 m/s 2 m/s |
| MSA 370.63 | 1 µm | ±3, ±5 µm/m | 20 µm | 1 m/s 1 m/s |
| MSA 370.73 | 0.5 µm | ±3, ±5 µm/m | 20 µm | 1 m/s 1 m/s |
| MSA 370.71 | 0.25 µm | ±2, ±3, ±5 µm/m | 10 µm | 0.5 m/s 0.5 m/s |
| MSA 370.51 | 0.1 µm | ±2, ±3, ±5 µm/m | 10 µm | 0.45 m/s 0.45 m/s |

* Other accuracy grades or grating pitches (e.g. Inch) upon request

**Signal-outputs (optional):**

- **Sinusoidal voltage signals**
  MSA 370.03
  MSA 370.01

**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 Vpp, typical 0.4 V (useable component) with terminating resistor Zo = 120 Ω

Max. output frequency:

100 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

MSA 370.23 = times 1
MSA 370.24 = times 1
MSA 370.63 = times 5
MSA 370.64 = times 5
MSA 370.73 = times 10
MSA 370.71 = times 10
MSA 370.51 = times 25

**Power supply:**

+5 V ±5%, max. 150 mA (unloaded)

**Environmental sealing DIN 40050:**

IP 53 (with standard sealing lips)
IP 64 with DA300 (DA300 see page 45)

**Permissible vibration:** 150 m/s² (40 to 2000 Hz)
**Permissible shock:** 300 m/s² (8 ms)

**Permissible temperature:**

-20°C to +70°C (storage), 0°C to +50°C (operation)

**Weight (approx.):**

3 kg/m (scale spar) + 245 g (scanning head without cable)
**armoured cable optional**

MSA 370, MSA 390 Dimensions - Mounting tolerances - Mounting possibilities:

```
m = machine guideway
```

<table>
<thead>
<tr>
<th>Quantity and position of the mounting support per measuring length</th>
</tr>
</thead>
<tbody>
<tr>
<td>170 - 520 mm</td>
</tr>
</tbody>
</table>

**armoured cable optional**
**MSA 371**

**MSA 391** (with switch signals and selectable Reference Mark)

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (f[\text{m}/\text{s}])</th>
<th>Continuous momentary</th>
</tr>
</thead>
</table>

- **Sinusoidal voltage signals 1 V_{pp}**
  - MSA 371.03: depending on external subdividing ±3, ±5, ±10 µm/m  20 µm  1 m/s  2 m/s
  - MSA 371.01: depending on external subdividing ±2, ±3 µm/m  10 µm  1 m/s  1 m/s

- **Sinusoidal micro-current signals**
  - MSA 371.13: depending on external subdividing ±3, ±5, ±10 µm/m  20 µm  1 m/s  2 m/s
  - MSA 371.11: depending on external subdividing ±2, ±3 µm/m  10 µm  1 m/s  1 m/s

- **Square wave Line Driver signals with integrated Subdividing**
  - MSA 371.24: 10 µm  ±10 µm/m  40 µm  1 m/s (6.6 µs)  2 m/s (3.3 µs)
  - MSA 371.23: 5 µm  ±5, ±5 µm/m  20 µm  1 m/s (3.3 µs)  2 m/s (1.6 µs)
  - MSA 371.64: 2 µm  ±5 µm/m  20 µm  1 m/s (1.2 µs)  2 m/s (600 ns)
  - MSA 371.63: 1 µm  ±3, ±5 µm/m  20 µm  1 m/s (600 ns)  1 m/s (600 ns)
  - MSA 371.73: 0.5 µm  ±3, ±5 µm/m  20 µm  1 m/s (300 ns)  1 m/s (300 ns)
  - MSA 371.71: 0.25 µm  ±2, ±3, ±5 µm/m  10 µm  0.5 m/s (300 ns)  0.5 m/s (300 ns)
  - MSA 371.51: 0.1 µm  ±2, ±3, ±5 µm/m  10 µm  0.45 m/s (200 ns)  0.45 m/s (200 ns)

* Other accuracy grades or grating pitches (e.g. Inch) upon request

**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

**Measuring type:** glass scale

- **Reference Mark (RI):** selectable

  - **MSA 371.xx K:**
    - Distance coded Reference Marks (K): after travelling 20 mm the absolute position will be shown on the display.

  - **MSA 371.xx (MSA 391.xx Option):**
    - Up to a measuring length of 920 mm, one Reference Mark can either be placed in the middle of scales 1040 mm or longer, or 35 mm from either end of measuring length.
    - With a measuring length of 1040 mm or longer, a Reference Mark will be placed 45 mm from either end of the measured length.

  - **MSA 371.xx Option:**
    - One Reference Mark at any location, or two or more Reference Marks separated by distances of n x 50 mm

- **MSA 391.xx Selectable Reference Mark (RI):**

  - **Standard:** A customized positioned switch magnet activates one of the Reference Marks, which are disposed by distances of n x 50 mm.
  - The label at the extrusion marks the position of the first Reference Mark.

- **The free positionable switching magnet is used for individual function (instead selectable Reference Mark):**

  - The switch track (S-Ri) will be accomplished (details on page 32 and 33).

- **MSA 391.xx Free positionable switching magnets for special functions:**

  - The position of the 2 switch points (S1 and S2) within the measured length can be selected by the customer (details on page 32 and 33).

**Required moving force:**

- with standard sealing lips < 3 N
- with low drag sealing lips < 0.2 N

**Environmental sealing DIN 40050:**

- IP 53 (with standard sealing lips)
- IP 64 with DA300 (DA300 see page 57)

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

**Permissible shock:** 300 m/s² (8 ms)

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

**Weight (approx.):**

- 3 kg/m (scale spar) + 245 g (scanning head without cable)
**armoured cable optional**
Signal-outputs (optional):

• Sinusoidal voltage signals
  MSA 372.03
  MSA 372.01
  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 = 120Ω
  Reference pulse:
  0.2 to 0.85 Vpp, typical 0.4 V (useable component)
  with terminating resistor Zo = 120Ω

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

• Sinusoidal micro-current signals
  MSA 372.13
  MSA 372.11
  Power supply:
  +5 V ±5%, max. 0 mA

Output signals:
  Encoder signals: 7 to 6 µApp, typical 5 µApp
  at 1 KΩ
  Reference pulse: 2 to 8 µA,
  typical 5 µA (useable component) at 1 KΩ

Max. output frequency:
100 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
  MSA 372.23 = times 1
  MSA 372.24 = times 1
  MSA 372.63 = times 5
  MSA 372.64 = times 5
  MSA 372.73 = times 10
  MSA 372.71 = times 10
  MSA 372.51 = times 25

Power supply:
+5 V ±5%, max. 150 mA (unloaded)
MSA 372  Dimensions - Mounting tolerances - Mounting possibilities:

** armoured cable optional
### MSA 373, MSA 374, MSA 375

**Dimensions - Mounting tolerances**

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch (Edge separation $a_{\text{min}}$)</th>
<th>Max. velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA 374.65</td>
<td>5 µm</td>
<td>±10 µm/m</td>
<td>100 µm</td>
<td>1 m/s (1.6 µs)</td>
</tr>
<tr>
<td>MSA 374.55</td>
<td>1 µm</td>
<td>±10 µm/m</td>
<td>100 µm</td>
<td>1 m/s (800 ns)</td>
</tr>
</tbody>
</table>

**Signal-outputs (optional):**

- Square wave Line Driver signals with integrated Subdividing Electronics

**MSA 374.65:** times 5

**MSA 374.55:** times 25

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

**Standard measuring lengths (mm):**
- 70, 120, 170, 220, 270, 320, 370, 420, 470, 520, 620, 720 (longer measuring lengths on request)

Max. range of traverse = $ML + 6$ mm ($ML + x\text{ Overtravel}$)

**Measuring type:** glass scale

**Optional:**

**Free positionable switching magnets for special functions:**

The position of the 2 switch points (S1 and S2) within the measured length can be selected by the customer.

**Reference Mark (RI):**

**Standard:** One Reference Mark in the middle of the measuring length, or 35 mm from either end of the measured length.

**Option:** One Reference Mark at any location, or two or more Reference Marks separated by distances of $n\times 50$ mm.

**Required moving force:** < 5 N

**Environmental sealing DIN 40050:**

- IP 53 (with standard sealing lips), IP 64 with DA300 (optional)

**Permissible vibration:** 150 m/s² (40 to 2000 Hz), **Permissible shock:** 300 m/s² (8 ms)

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

**Weight MSA 374 (approx.):** 280 g + 1.34 g pro mm (scale spar) + 210 g (scanning head without cable)

### MSA 374 Dimensions - Mounting tolerances

**Diagram:**

- Overall length = $ML = 164$
- Cable outlet (left side optional)
- Spring rod: permitted offset angular $\Delta V_W = 6.5°$, lateral $\Delta V_l = 1.7$ mm

- Screw for spring rod clamping
- Magnet holder for S1
- Switching length typ. 12
- Magnet holder for S2
- ML = measuring length
- M = machine guideway
- OT = overtravel
- K = customer mounting dimensions

S1, S2 position of the sensors in the encoder head, switching length typ. 12 mm

Switch position S1 and S2 free selectable (allen wrench 0.9 mm)

Spring rod clamping left side possible (allen wrench 3 mm)

* Clamping length spring rod
Accessory:

**CB8 - 150 Coupling bar** (only for MSA 373 and 375)

Axis distance 150 mm (Other axis distances on request)

Included in delivery: 2 Hexagon socket screws M8 x 20 ISO 4762 for mounting

**Caution:**
Observe maximum angular deflection!
Positioning of the switching magnets

Switch points S1 and S2 for individual function
MSA 690

MSA 373, MSA 374, MSA 375

Selectable Reference mark (RI)
MSA 390

Version without RI-variety: Switch point S3 for additionally individual function
MSA 390

MSA 691

MSA 391

MSA 391
Pin-outs

MSA 690, MSA 691, MSA 390, MSA 391, MSA 373, MSA 374, MSA 375

SUB MIN-D connector 15-pin

<table>
<thead>
<tr>
<th>PIN</th>
<th>1*</th>
<th>2**</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6***</th>
<th>7***</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>square wave signals via Line Driver</td>
<td>nc</td>
<td>GND</td>
<td>nc</td>
<td>Ri</td>
<td>T2</td>
<td>T1</td>
<td>+5V</td>
<td>+5V</td>
<td>GND</td>
<td>S1</td>
<td>S2</td>
<td>Ri</td>
<td>T2</td>
<td>T1</td>
<td>shield</td>
</tr>
<tr>
<td>sinusoidal micro-current signals</td>
<td>nc</td>
<td>GND</td>
<td>nc</td>
<td>Ri</td>
<td>R0</td>
<td>0*</td>
<td>+5V</td>
<td>+5V</td>
<td>GND</td>
<td>S1</td>
<td>S2</td>
<td>Ri+</td>
<td>S9+</td>
<td>0*+</td>
<td>inner shield</td>
</tr>
<tr>
<td>sinusoidal voltage signals</td>
<td>nc</td>
<td>GND</td>
<td>nc</td>
<td>Ri</td>
<td>R2</td>
<td>A4</td>
<td>+5V</td>
<td>+5V</td>
<td>GND</td>
<td>S1</td>
<td>S2</td>
<td>Ri</td>
<td>A2</td>
<td>A1</td>
<td>inner shield</td>
</tr>
</tbody>
</table>

* exception at MSA 390 and MSA 391 (Version without RI-variety): PIN 1 = S-RI (switch output)
** PIN 2 = GND (bridge to PIN 9) or sensor
*** PIN 7 = +5V (bridge to PIN 8) or sensor
outer shield on chassis

Switch signals

MSA 690, MSA 691, MSA 390, MSA 391, MSA 373, MSA 374, MSA 375

Version 1
TTL output (active high)

Output signals S1, S2, S-RI

Version 2
open collector output (active high impedance)

Output signals S1, S2, S-RI

Version 3
TTL output (active low)

Output signals S1, S2, S-RI

Version 4
open collector output (active low)

Output signals S1, S2, S-RI

S1, S2, S-RI = TTL output
$I_{\text{source}} = 1 \text{ mA} \ (\text{high level} > 2 \text{ V})$
$I_{\text{sink}} = 20 \text{ mA} \ (\text{low level} < 0.8 \text{ V})$

S1, S2, S-RI = open collector output
$I_{\text{source}} = 1 \text{ mA} \ (\text{high level} > 2 \text{ V})$
$I_{\text{sink}} = 20 \text{ mA} \ (\text{low level} < 0.8 \text{ V})$
MSA 650

**Scale model** | **System resolution** | **Accuracy grades** | **Grating pitch (Edge separation a<sub>min</sub>)** | **Max. velocity** | **Continuous momentary**
---|---|---|---|---|---
MSA 650.24 | 10 µm | ±10 µm/m | 40 µm | 1 m/s (5 µs) | 2 m/s (2.5 µs)
MSA 650.23 | 5 µm | ±5, ±10 µm/m | 20 µm | 1 m/s (2.5 µs) | 2 m/s (1.2 µs)
MSA 650.64 | 2 µm | ±5, ±10 µm/m | 40 µm | 1 m/s (800 ns) | 2 m/s (400 ns)
MSA 650.63 | 1 µm | ±5, ±10 µm/m | 20 µm | 1 m/s (400 ns) | 1 m/s (400 ns)
MSA 650.73 | 0.5 µm | ±5, ±10 µm/m | 20 µm | 1 m/s (200 ns) | 1 m/s (200 ns)

* Other accuracy grades or grating pitches (e.g. Inch) upon request

**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

**Measuring type:** glass scale

**Reference Mark (R):** selectable

**MSA 650.xx K:**
Distance coded Reference Marks (K): after travelling 20 mm the absolute position will be shown on the display.

**MSA 650.xx:**
Up to a measuring length of 920 mm, one Reference Mark can either be placed in the middle of scales 1040 mm or longer, or 35 mm from either end of measuring length. With a measuring length of 1040 mm or longer, a Reference Mark will be placed 45 mm from either end of the measured length.

**Option:**
One Reference Mark at any location, or two or more Reference Marks separated by distances of n x 50 mm

**Required moving force:**
with standard sealing lips < 3 N
with low drag sealing lips < 0.2 N

**Environmental sealing DIN 40050:**
IP 53 (with standard sealing lips)

**Permissible vibration:** 80 m/s<sup>2</sup> (40 to 2000 Hz)

**Permissible shock:** 200 m/s<sup>2</sup> (8 ms)

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

**Weight (approx.)**
0.8 kg/m (scale spar) + 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

**Power supply:**
+5 V ±5%, < 150 mA (with interpolation, unloaded)
< 200 mA (without interpolation, unloaded)
MSA 650  Dimensions - Mounting tolerances - Mounting possibilities:

Overall length = measuring length + 105 mm

For measuring length over 520 mm scale should be affixed on 20 mm length with epoxy resin adhesive (e.g. UHU-Plus) cementing gap max. 0.2 mm or with screw (e.g. ISO 4762 - M4)

M = Machine guideway

Length of cable 3m
MSA 651

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch (Edge separation $a_{\text{min}}$)</th>
<th>Max. velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>continuous momentary</td>
<td></td>
</tr>
</tbody>
</table>

- **Square wave Line Driver signals with integrated Subdividing**

<table>
<thead>
<tr>
<th>Model</th>
<th>Resolution (µm)</th>
<th>Accuracy ± (µm/m)</th>
<th>Pitch (µm)</th>
<th>Max. velocity (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA 651.24</td>
<td>10</td>
<td>±10</td>
<td>40</td>
<td>1 m/s (5 µs)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 m/s (2.5 µs)</td>
</tr>
<tr>
<td>MSA 651.23</td>
<td>5</td>
<td>±5, ±10</td>
<td>20</td>
<td>1 m/s (2.5 µs)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 m/s (1.2 µs)</td>
</tr>
<tr>
<td>MSA 651.64</td>
<td>2</td>
<td>±5, ±10</td>
<td>40</td>
<td>1 m/s (800 ns)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 m/s (400 ns)</td>
</tr>
<tr>
<td>MSA 651.63</td>
<td>1</td>
<td>±5, ±10</td>
<td>20</td>
<td>1 m/s (400 ns)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 m/s (400 ns)</td>
</tr>
<tr>
<td>MSA 651.73</td>
<td>0.5</td>
<td>±5, ±10</td>
<td>20</td>
<td>1 m/s (200 ns)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 m/s (200 ns)</td>
</tr>
</tbody>
</table>

* Other accuracy grades or grating pitches (e.g. Inch) upon request

---

**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

<table>
<thead>
<tr>
<th>Model</th>
<th>Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA 651.23</td>
<td>times1</td>
</tr>
<tr>
<td>MSA 651.24</td>
<td>times1</td>
</tr>
<tr>
<td>MSA 651.63</td>
<td>times5</td>
</tr>
<tr>
<td>MSA 651.64</td>
<td>times5</td>
</tr>
<tr>
<td>MSA 651.73</td>
<td>times10</td>
</tr>
</tbody>
</table>

**Power supply:**

- +5 V ±5%, < 150 mA (with interpolation, unloaded)
- < 200 mA (without interpolation, unloaded)

---

**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

**Measuring type:** glass scale

**Reference Mark (RI):** selectable

- MSA 651.xx K:
  Distance coded Reference Marks (K): after travelling 20 mm the absolute position will be shown on the display.

- MSA 651.xx:
  Up to a measuring length of 920 mm, one Reference Mark can either be placed in the middle of scales 1040 mm or longer, or 35 mm from either end of measuring length. With a measuring length of 1040 mm or longer, a Reference Mark will be placed 45 mm from either end of the measured length.

**Option:**

- One Reference Mark at any location, or two or more Reference Marks separated by distances of n x 50 mm

**Required moving force:**

- with standard sealing lips < 3 N
- with low drag sealing lips < 0.2 N

**Environmental sealing DIN 40050:**

- IP 53 (with standard sealing lips)

**Permissible vibration:** 80 m/s² (40 to 2000 Hz)

**Permissible shock:** 200 m/s² (8 ms)

**Permissible temperature:**

- -20°C to +70°C (storage), 0°C to +50°C (operation)

**Weight (approx.):**

- 0.8 kg/m (scale spar) + 85 g (scanning head without cable)
MSA 651 Dimensions - Mounting tolerances - Mounting possibilities:

Overall length = measuring length + 100 mm

Length of cable 3m

M = Machine guideway

Dimensions:
- Overall length: Measuring length + 100 mm
- Measuring length: 200 ±0.15 continued graduated
- Length of cable: 3m

Mounting possibilities:
- M4/DIN912
- M4/DIN912
- M4/DIN912
- M4/DIN912
- M4/DIN912
**MSA 350**

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades *</th>
<th>Grating pitch *</th>
<th>Max. velocity (Edge separation (r_{\min}))</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA 350.24</td>
<td>10 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s (5 µs) 2 m/s (2.5 µs)</td>
<td></td>
</tr>
<tr>
<td>MSA 350.23</td>
<td>5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s (2.5 µs) 2 m/s (1.2 µs)</td>
<td></td>
</tr>
<tr>
<td>MSA 350.64</td>
<td>2 µm</td>
<td>±5, ±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s (800 ns) 2 m/s (400 ns)</td>
<td></td>
</tr>
<tr>
<td>MSA 350.63</td>
<td>1 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s (400 ns) 1 m/s (400 ns)</td>
<td></td>
</tr>
<tr>
<td>MSA 350.73</td>
<td>0.5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s (200 ns) 1 m/s (200 ns)</td>
<td></td>
</tr>
</tbody>
</table>

* Other accuracy grades or grating pitches (e.g. Inch) upon request

**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
  
  MSA 350.23 = times 1  
  MSA 350.24 = times 1  
  MSA 350.63 = times 5  
  MSA 350.64 = times 5  
  MSA 350.73 = times 10

**Power supply:**

+5 V ±5% < 150 mA (with interpolation, unloaded)  
< 200 mA (without interpolation, unloaded)

**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

**Measuring type:** glass scale

**Reference Mark (RI):** selectable  
MSA 350.xx K:  
Distance coded Reference Marks (K): after travelling 20 mm the absolute position will be shown on the display.

MSA 350.xx:  
Up to a measuring length of 920 mm, one Reference Mark can either be placed in the middle of scales 1040 mm or longer, or 35 mm from either end of measuring length. With a measuring length of 1040 mm or longer, a Reference Mark will be placed 45 mm from either end of the measured length.

**Option:**  
One Reference Mark at any location, or two or more Reference Marks separated by distances of \(n \times 50 \text{ mm}\)

**Required moving force:**  
with standard sealing lips < 3 N  
with low drag sealing lips < 0.2 N

**Environmental sealing DIN 40050:**  
IP 53 (with standard sealing lips)  
IP 64 with DA300 (DA300 see page 45)

**Permissible vibration:** 80 m/s² (40 to 2000 Hz)  
**Permissible shock:** 200 m/s² (8 ms)

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

**Weight (approx.)**  
3 kg/m (scale spar) + 180 g (scanning head without cable)
MSA 350 Dimensions - Mounting tolerances - Mounting possibilities:

Overall length = measuring length = 150 mm

Mounting support

Lenght of cable 3 m

M = Machine guideway

Quantity and position of the mounting support per measuring length

170 - 520 mm
620 - 1020 mm 1x
1140 - 2040 mm 2x
2240 - 3040 mm 3x
**MSA 352**

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA 352.24</td>
<td>10 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s (5 µs)</td>
</tr>
<tr>
<td>MSA 352.23</td>
<td>5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s (2.5 µs)</td>
</tr>
<tr>
<td>MSA 352.64</td>
<td>2 µm</td>
<td>±5, ±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s (800 ns)</td>
</tr>
<tr>
<td>MSA 352.63</td>
<td>1 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s (400 ns)</td>
</tr>
<tr>
<td>MSA 352.73</td>
<td>0.5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s (200 ns)</td>
</tr>
</tbody>
</table>

* Other accuracy grades or grating pitches (e.g. Inch) upon request

**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

**Power supply:**
- +5 V ±5% < 150 mA (with interpolation, unloaded)
- < 200 mA (without interpolation, unloaded)

**Other accuracy grades or grating pitches (e.g. Inch) upon request**

**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

**Measuring type:** glass scale

**Reference Mark (RI):** selectable

**MSA 352.xx K:**
- Distance coded Reference Marks (K): after travelling 20 mm the absolute position will be shown on the display.

**MSA 352.xk:***
- Up to a measuring length of 920 mm, one Reference Mark can either be placed in the middle of scales 1040 mm or longer, or 35 mm from either end of measuring length. With a measuring length of 1040 mm or longer, a Reference Mark will be placed 45 mm from either end of the measured length.

**Option:**
- One Reference Mark at any location, or two or more Reference Marks separated by distances of n x 50 mm

**Required moving force:**
- < 6 N (two set of sealing lips)

**Environmental sealing DIN 40050:**
- IP 54 (two set of sealing lips)
- IP 64 with DA300 (DA300 see page 45)

**Permissible vibration:** 80 m/s² (40 to 2000 Hz)
**Permissible shock:** 200 m/s² (8 ms)

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

**Weight (approx.)**
- 3 kg/m (scale spar) + 180 g (scanning head without cable)
MSA 352 Dimensions - Mounting tolerances - Mounting possibilities:

Overall length = measuring length = 150 mm

Mounting support

Length of cable 3 m

M = Machine guideway

Quantity and position of the mounting support per measuring length

170 - 520 mm

620 - 1020 mm 1x

1140 - 2040 mm 2x

2240 - 3040 mm 3x
Subdividing Electronics ZE

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.

Connections:
- 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

Interpolation:
- ZE-Sx = times 5
  - ZE-S5, ZE-V5
  - 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 = times 100
  - ZE-S200, ZE-V200 = times 200
  - ZE-S400, ZE-V400 = times 400

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
    - 0.2 to 0.85 Vpp
    - typical 0.4 V (useable component)

Input signals ZE-Vx:
- Encoder signals: sinusoidal micro-current signals 7 to 16 µA (11.5 µA typical)
  - Reference pulse: 2 to 8 µA (5 µA typical)

Max. input frequency:
- ZE-S5, ZE-V5 = 100 kHz, \( a_{\text{min}} = 300 \, \text{ns} \)
- ZE-S10, ZE-V10 = 50 kHz, \( a_{\text{min}} = 300 \, \text{ns} \)
- ZE-S20, ZE-V20 = 25 kHz, \( a_{\text{min}} = 200 \, \text{ns} \)
- ZE-S25, ZE-V25 = 45 kHz, \( a_{\text{min}} = 200 \, \text{ns} \)
- ZE-S50, ZE-V50 = 45 kHz, \( a_{\text{min}} = 100 \, \text{ns} \)
- ZE-S100, ZE-V100 = 22.5 kHz, \( a_{\text{min}} = 100 \, \text{ns} \)
- ZE-S200, ZE-V200 = 10 kHz, \( a_{\text{min}} = 100 \, \text{ns} \)
- ZE-S400, ZE-V400 = 5 kHz, \( a_{\text{min}} = 100 \, \text{ns} \)

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

Power supply: +5 V ±5%

Current consumption: 150 mA
  - (< 270 mA for ZE-S/V200 and ZE-S/V400)
  - Linear Encoder not connected
  - output signals loaded

Dimensions:

![Dimensions Diagram]

from Encoder

138

86

99

26

34

cable length: 1 m

to DRO/couter

from Encoder

128
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 channels 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) for 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 I/O-signals
## Connectors, pin-outs

### DIN

**Male connector L 120**
- **12-pin**

**Female connector K 120**
- **12-pin**

**Female connector panel mountable F 120**
- **12-pin**

### L120

**PIN**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage signals</td>
<td>inner</td>
<td>0 V</td>
<td>A1</td>
<td>A1</td>
<td>A2</td>
<td>0 V</td>
<td>RI</td>
<td>RI'</td>
<td>0 V</td>
<td>+5 V</td>
<td>A2</td>
</tr>
</tbody>
</table>

### L120, K120, F120

**PIN**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square wave signals + LD shield*</td>
<td>GND</td>
<td>T1/0°</td>
<td>T1/0°</td>
<td>T2/90°</td>
<td>GND</td>
<td>RI</td>
<td>RI'</td>
<td>GND</td>
<td>5 V</td>
<td>T2/90°</td>
<td>5 V</td>
</tr>
</tbody>
</table>

* shield is on housing additional

### CONNEI

**Male connector L 91**
- **9-pin**

**Female connector K 91**
- **9-pin**

**Female connector KM 91**
- **9-pin**

### L 91, K 91, KM 91

**PIN**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinusoidal micro-current signals</td>
<td>0°+</td>
<td>0°-</td>
<td>5 V</td>
<td>0 V</td>
<td>90°+</td>
<td>90°-</td>
<td>RI+</td>
<td>RI-</td>
</tr>
</tbody>
</table>

### CONNEI

**Male connector L 121**
- **12-pin**

**Female connector K121**
- **12-pin**

**Female connector KM 121**
- **12-pin**

### L 121

**PIN**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage signals</td>
<td>A2</td>
<td>+5 V</td>
<td>Sensor</td>
<td>RI</td>
<td>RI</td>
<td>A1</td>
<td>A1</td>
<td>+5 V</td>
<td>A2</td>
<td>inner</td>
<td>shield</td>
</tr>
</tbody>
</table>

### L121, K121, KM 121

**PIN**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square wave signals + LD T2/90°</td>
<td>5 V</td>
<td>RI</td>
<td>RI</td>
<td>T1/0°</td>
<td>T1/0°</td>
<td>T2/90°</td>
<td>5 V</td>
<td>T1/0°</td>
<td>5 V</td>
<td>0 V</td>
<td></td>
</tr>
</tbody>
</table>

* shield is on housing additional

### SUB MIN-D

**LD 9**
- **9-pin**

**PIN**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square wave signals (single ended)</td>
<td>shield*</td>
<td>RI</td>
<td>T2</td>
<td>T1</td>
<td>+V</td>
<td>nc</td>
<td>nc</td>
<td>nc</td>
</tr>
</tbody>
</table>

**LD 9**

**PIN**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square wave signals (differential)</td>
<td>T1</td>
<td>T1</td>
<td>T2</td>
<td>T2</td>
<td>RI</td>
<td>RI</td>
<td>+5 V</td>
<td>0 V</td>
</tr>
</tbody>
</table>

* shield is on housing additional
Air Pressure Unit DA300

In harsh environments, where oil and coolants are present, additional precautions should be taken. To insure fail-safe operation of the Linear Encoder, only "clean" air should be put into the scale housing. The air should be free of oil mist and water vapor. The air has to be cleaned using a good filtration system.

The scale cavity should have a maximum overpressure of 0.3 to 0.6 bar at a flow rate of about 4 l/min (per Linear Encoder). DA300 consists of a pressure regulator with gauge, prefilter, and an automatic drain with microfilter. The required supply overpressure is min. 4 bar, max. 16 bar. To avoid measuring errors due to thermal differences, it is absolutely necessary to provide pressurized air that has the same temperature as the machine tool. This is especially important with single sets of sealing lips (see also page 8, sealing).

Dimensions:

![Diagram showing dimensions of the Air Pressure Unit DA300]
Other RSF-Products

**MS 20, MS 21**
Reflective scanning Linear Encoder
- two independent switch signals for individual functions (MS 20)
- position of Reference Mark can be selected by the customer (MS 21)
- easy mounting as a result of large mounting tolerances
- high traversing speed
- high insensitivity to contamination
- integrated subdividing up to times 100 interpolation
- max. measuring length: glass scale 3140 mm steel tape scale 9440 mm

**MS 30**
Reflective scanning Linear Encoder
- two independent switch signals for individual functions
- easy mounting as a result of large mounting tolerances
- high traversing speed
- high insensitivity to contamination
- integrated subdividing up to times 100 interpolation
- max. measuring length 9440 mm

**MS 40**
Reflective scanning Linear Encoder
- with low price and high quality
- easy mounting as a result of large mounting tolerances
- high traversing speed
- high insensitivity to contamination
- integrated subdividing up to times 100 interpolation
- max. measuring length unlimited

**MS 8x**
Interferential Linear Encoder
- two switch tracks for individual special functions
- non-contact reflective scanning
- for high displacement velocities
- small dimensions
- scale versions: glass scale or ROBAX glassceramic with phase grating
- max. measuring length to 3240 mm

**TDE 60**
Two dimensional Encoder
- non-contact reflective scanning
- small dimensions
- scale version: glass scale
- measuring range 360 x 360 mm

**DG 118, DG 120**
Standard Rotary Encoder
- Rotary Encoder for universal application
- standard lines/rev. graduated from 100 to 5,400

**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)
Digital Readouts

<table>
<thead>
<tr>
<th>Features:</th>
<th>Z 710</th>
<th>Z 720</th>
<th>Z 730</th>
<th>Z 715</th>
<th>Z 725</th>
<th>Z 735</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of axis</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>programming of system parameters</td>
<td>●</td>
<td></td>
<td></td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>selectable axis name</td>
<td>●</td>
<td></td>
<td></td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>switchable for use on a lathe or milling machine</td>
<td>●</td>
<td></td>
<td></td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>programmable resolution and counting direction</td>
<td>●</td>
<td></td>
<td></td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reset- and Preset input</td>
<td>●</td>
<td></td>
<td></td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>addition/subtraction with the keyboard</td>
<td>●</td>
<td></td>
<td></td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bolt hole pattern, rectangular drilling pattern</td>
<td>●</td>
<td></td>
<td></td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference mark evaluation (quasi-absolut)</td>
<td>●</td>
<td></td>
<td></td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardware test and display test</td>
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(¹ = DRO for spark erosion machines, ² = DRO for surface grinders, ● = standard, ○ = optional with the additional price)
## Distribution contacts

<table>
<thead>
<tr>
<th>Country</th>
<th>Contact Details</th>
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</table>
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