Incremental Linear Encoders
Enclosed Models
# Table of contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>General description</td>
<td>4/5</td>
</tr>
<tr>
<td>Design and operation</td>
<td>4/5</td>
</tr>
<tr>
<td>Output signals</td>
<td>6</td>
</tr>
<tr>
<td>Subdividing Electronics, connecting cables</td>
<td>7</td>
</tr>
<tr>
<td>Shield connections</td>
<td>8</td>
</tr>
<tr>
<td>Environmental sealing</td>
<td>8</td>
</tr>
<tr>
<td>Overview</td>
<td>9</td>
</tr>
<tr>
<td>Nomenclature</td>
<td>9</td>
</tr>
<tr>
<td>Selection guide</td>
<td>10-13</td>
</tr>
<tr>
<td>Technical data, Dimensions, Mounting tolerances, Mounting possibilities</td>
<td>14/15</td>
</tr>
<tr>
<td>MSA 170</td>
<td>14/15</td>
</tr>
<tr>
<td>MSA 002, MSA 003</td>
<td>16/17</td>
</tr>
<tr>
<td>MSA 670</td>
<td>18/19</td>
</tr>
<tr>
<td>MSA 671</td>
<td>20/21</td>
</tr>
<tr>
<td>MSA 672</td>
<td>22/23</td>
</tr>
<tr>
<td>MSA 680</td>
<td>24/25</td>
</tr>
<tr>
<td>MSA 370</td>
<td>26/27</td>
</tr>
<tr>
<td>MSA 371</td>
<td>28/29</td>
</tr>
<tr>
<td>MSA 372</td>
<td>30/31</td>
</tr>
<tr>
<td>MSA 673</td>
<td>32/33</td>
</tr>
<tr>
<td>MSA 373</td>
<td>34/35</td>
</tr>
<tr>
<td>MSA 690</td>
<td>36/37</td>
</tr>
<tr>
<td>MSA 691</td>
<td>38/39</td>
</tr>
<tr>
<td>MSA 390</td>
<td>40/41</td>
</tr>
<tr>
<td>MSA 391</td>
<td>42/43</td>
</tr>
<tr>
<td>MSA 690, MSA 691 switching magnets</td>
<td>44</td>
</tr>
<tr>
<td>MSA 373, MSA 390, MSA 391 switching magnets</td>
<td>44</td>
</tr>
<tr>
<td>MSA 690, MSA 691 pin outs, switching signals</td>
<td>45</td>
</tr>
<tr>
<td>MSA 373, MSA 390, MSA 391 pin outs, switching signals</td>
<td>45</td>
</tr>
<tr>
<td>MSA 650</td>
<td>46/47</td>
</tr>
<tr>
<td>MSA 651</td>
<td>48/49</td>
</tr>
<tr>
<td>MSA 350</td>
<td>50/51</td>
</tr>
<tr>
<td>MSA 352</td>
<td>52/53</td>
</tr>
<tr>
<td>Accessories</td>
<td>54</td>
</tr>
<tr>
<td>Subdividing Electronics ZE</td>
<td>54</td>
</tr>
<tr>
<td>InterFaceCard IFC 430R</td>
<td>55</td>
</tr>
<tr>
<td>Male and female connectors, pin-outs</td>
<td>56</td>
</tr>
<tr>
<td>Air Pressure Unit DA300</td>
<td>57</td>
</tr>
<tr>
<td>Other RSF-Products</td>
<td>58</td>
</tr>
<tr>
<td>Open Linear Encoder</td>
<td>58</td>
</tr>
<tr>
<td>(extract from the catalog &quot;Incremental Linear Encoder open models)</td>
<td>59</td>
</tr>
<tr>
<td>Digital Readouts</td>
<td>59</td>
</tr>
<tr>
<td>Branch Offices</td>
<td>60</td>
</tr>
<tr>
<td>Addresses</td>
<td>60</td>
</tr>
</tbody>
</table>
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.

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.
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 tool position is available after a measuring move of 20 mm maximum.

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 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.
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 Vpp 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 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 tF 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.

<table>
<thead>
<tr>
<th>Output signals resp. constructional features</th>
<th>Cable Ø mm</th>
<th>Shield</th>
<th>Minimum Bend radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinusoidal micro-current signals and sinusoidal voltage signals</td>
<td>5.7</td>
<td>double</td>
<td>45 mm 85 mm</td>
</tr>
<tr>
<td></td>
<td>4.4</td>
<td>double, high flex</td>
<td>35 mm 70 mm</td>
</tr>
<tr>
<td></td>
<td>3.9</td>
<td>double, ultra high flex</td>
<td>30 mm 60 mm</td>
</tr>
<tr>
<td>Square wave signals</td>
<td>5.7</td>
<td>single</td>
<td>45 mm 85 mm</td>
</tr>
<tr>
<td>MSA 65x and MSA 35x</td>
<td>4.8</td>
<td>single, with metal braiding</td>
<td>25 mm 50 mm</td>
</tr>
<tr>
<td></td>
<td>4.3</td>
<td>single</td>
<td>25 mm 45 mm</td>
</tr>
</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

**Definition of the cable length**

![Diagram of cable length 3m]
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 improve the sealing against oil and coolants.

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.
### Encoder Name

<table>
<thead>
<tr>
<th>Encoder Type</th>
<th>(design features)</th>
</tr>
</thead>
</table>

### Output signals and integrated Subdividing

- 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

<table>
<thead>
<tr>
<th>Grating pitch</th>
<th>0 = 8 µm</th>
<th>1 = 10 µm</th>
<th>2 = 16 µm</th>
<th>3 = 20 µm</th>
<th>4 = 40 µm</th>
<th>5 = 100 µm</th>
<th>6 = 200 µm</th>
<th>7 = 400 µm</th>
<th>8 = 50 µm</th>
<th>A = 6.35 µm</th>
<th>B = 10.16 µm</th>
<th>C = 12.70 µm</th>
<th>D = 20.32 µm</th>
<th>E = 50.80 µm</th>
<th>F = 101.60 µm</th>
<th>G = 25.40 µm</th>
<th>H = 35 µm</th>
<th>K = 2160 L/Inch</th>
<th>L = 21.167 µm</th>
</tr>
</thead>
</table>

### Version of the switch signal

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

### Possible options

<table>
<thead>
<tr>
<th>K = distance coded Reference marks</th>
<th>P = input for compressed air</th>
</tr>
</thead>
</table>

### 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

<table>
<thead>
<tr>
<th>Design features</th>
<th>Overall measuring</th>
<th>Scale type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ML = measuring length</td>
<td>MSA 170</td>
<td>14-15</td>
</tr>
<tr>
<td>• extremely small cross section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• guided by ball bearings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 520 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the extrusion ends</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MSA 002</td>
<td>16-17</td>
</tr>
<tr>
<td>• extremely small cross section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MSA 002 with stainless steel construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for optimal thermal characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MSA 003 with aluminium construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 520 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version with sealing lips</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the extrusion ends</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MSA 003</td>
<td>16-17</td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 2240 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• small cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the extrusion ends</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MSA 670</td>
<td>18-19</td>
</tr>
<tr>
<td>• two sets of sealing lips for additional</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>contamination protection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 2240 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• small cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on top of the extrusion improves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>vibration rating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MSA 671</td>
<td>20-21</td>
</tr>
<tr>
<td>• with optimized thermal performance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 1240 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• small cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the extrusion ends</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** RSF Elektronik
<table>
<thead>
<tr>
<th>Design features</th>
<th>Overall measuring</th>
<th>Scale type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td>MSA 370</td>
<td>26-27</td>
</tr>
<tr>
<td>• max. measuring length 3040 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• rigid mounting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• large cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the extrusion ends and with mounting supports</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design features</th>
<th>Overall measuring</th>
<th>Scale type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td>MSA 371</td>
<td>28-29</td>
</tr>
<tr>
<td>• max. measuring length 3040 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• rigid mounting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on top of the extrusion improves vibration rating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• large cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design features</th>
<th>Overall measuring</th>
<th>Scale type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>• two sets of sealing tips for additional contamination protection</td>
<td></td>
<td>MSA 372</td>
<td>30-31</td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 3040 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• rigid mounting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• large cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the extrusion ends and with mounting supports</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design features</th>
<th>Overall measuring</th>
<th>Scale type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>• for application on presses, bending machines and hydraulic cylinders</td>
<td></td>
<td>MSA 673</td>
<td>32-33</td>
</tr>
<tr>
<td>• with self-guided bearing pack</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 620 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• encoder head attached to machine with rod in end of head bracket</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design features</th>
<th>Overall measuring</th>
<th>Scale type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>• for application on presses, bending machines and hydraulic cylinders</td>
<td></td>
<td>MSA 373</td>
<td>34-35</td>
</tr>
<tr>
<td>• free positionable switching magnets for special functions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• integrated, protected guideway</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 620 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• rigid mounting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the extrusion ends</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• encoder head attached to machine with rod in end of head bracket</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Overview, Selection guide

<table>
<thead>
<tr>
<th>Design features</th>
<th>Overall measuring</th>
<th>Scale type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>• free positionable switching magnets for special functions</td>
<td>ML = measuring length</td>
<td>MSA 690</td>
<td>36-37</td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 2240 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• small cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the extrusion ends</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• individual choosing of the reference mark</td>
<td></td>
<td>MSA 691</td>
<td>38-39</td>
</tr>
<tr>
<td>• free positionable switching magnets for special functions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 2240 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• small cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the top of the extrusion improves vibration rating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• individual choosing of the reference mark</td>
<td></td>
<td>MSA 390</td>
<td>40-41</td>
</tr>
<tr>
<td>• free positionable switching magnets for special functions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 3040 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• rigid mounting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• large cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the extrusion ends and with mounting supports</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• individual choosing of the reference mark</td>
<td></td>
<td>MSA 391</td>
<td>42-43</td>
</tr>
<tr>
<td>• free positionable switching magnets for special functions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 3040 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• rigid mounting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• large cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the top of the extrusion improves vibration rating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design features</td>
<td>Overall measuring</td>
<td>Scale type</td>
<td>Page</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------</td>
<td>------------</td>
<td>------</td>
</tr>
<tr>
<td>• for retrofit of machine tools</td>
<td>ML = measuring length</td>
<td>MSA 650</td>
<td>46-47</td>
</tr>
<tr>
<td>• high mounting tolerances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 1740 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• small cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the extrusion ends</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design features</th>
<th>Overall measuring</th>
<th>Scale type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>• for retrofit of machine tools</td>
<td>ML = measuring length</td>
<td>MSA 651</td>
<td>48-49</td>
</tr>
<tr>
<td>• high mounting tolerances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 2240 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• small cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on top of the extrusion improves vibration rating</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design features</th>
<th>Overall measuring</th>
<th>Scale type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>• for retrofit of machine tools</td>
<td>ML = measuring length</td>
<td>MSA 350</td>
<td>50-51</td>
</tr>
<tr>
<td>• high mounting tolerances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 3040 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• rigid mounting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• large cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the extrusion ends and with mounting supports</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design features</th>
<th>Overall measuring</th>
<th>Scale type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>• for retrofit of machine tools</td>
<td>ML = measuring length</td>
<td>MSA 352</td>
<td>52-53</td>
</tr>
<tr>
<td>• high mounting tolerances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• with two sets of sealing lips</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• distance coded Reference marks (K)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 3040 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• rigid mounting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• large cross-section</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• enclosed version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting holes on the extrusion ends and with mounting supports</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MSA 170 Technical data

### Signal-outputs (optional):

- **sinusoidal voltage signals**
  
  **MSA 170.03**
  
  Power supply:
  +5V ±5%, max. 90 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
  
  Max. output frequency:
  100 kHz (with 3 m cable)

- **sinusoidal micro-current signals**
  
  **MSA 170.13**
  
  Power supply:
  +5 V ±5%, max. 90 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

  **MSA 170.23**
  
  Power supply:
  +5 V ±5%, max. 200 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** (differential)
  via Line Driver RS 422 standard
  with integrated Subdividing Electronics

  **MSA 170.03**
  
  Power supply:
  +5 V ±5%, max. 90 mA (unloaded)

  **MSA 170.63**
  
  Power supply:
  +5 V ±5%, max. 90 mA

  **MSA 170.73**
  
  Power supply:
  +5 V ±5%, max. 90 mA

  **MSA 170.53**
  
  Power supply:
  +5 V ±5%, max. 90 mA

  **MSA 170.83**
  
  Power supply:
  +5 V ±5%, max. 90 mA

### Standard measuring lengths: (mm)

50, 70, 120, 170, 220, 270, 320, 370, 420, 470, 520,

### Measuring type: glass scale

- **Reference mark (RI):** selectable
- **MSA 170.xx K**
  
  Distance coded Reference marks (K): after travelling 20 mm the absolute position will shown on the display.

- **MSA 170.xx**
  
  One Reference mark in the middle of the measuring length or 10 mm from both ends of measuring length. (excluding ML 50 mm)

### Option:

One Reference mark at any location, or two or more RI’s separated by distances of n x 25 mm.

### Required moving force: < 1 N

### Environmental sealing DIN 40050: IP 53

IP 64 with DA300 (DA300 see page 57)

### Permissible vibration: 100 m/s² (40 to 2000 Hz)

### Permissible shock: 150 m/s² (8 ms)

### Permissible temperature:

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

### Weight (approx.):

22 g/100 mm (scale spar) + 35 g (scanning head without cable)

---

### Table: System Accuracy Grating Max. velocity

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</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><strong>MSA 170.03</strong></td>
<td>depending on external Subdividing</td>
<td>±3, ±5, µm/m</td>
<td>20 µm</td>
<td>1 m/s (&gt; 3.3 µs)</td>
</tr>
<tr>
<td><strong>Sinusoidal micro-current signals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MSA 170.13</strong></td>
<td>depending on external Subdividing</td>
<td>±3, ±5, µm/m</td>
<td>20 µm</td>
<td>1 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td><strong>Square wave Line Driver signals with integrated Subdividing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MSA 170.23</strong></td>
<td>5 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td><strong>MSA 170.63</strong></td>
<td>1 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td><strong>MSA 170.73</strong></td>
<td>0.5 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>0.4 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td><strong>MSA 170.53</strong></td>
<td>0.2 µm</td>
<td>±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0.2 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td><strong>MSA 170.83</strong></td>
<td>0.1 µm</td>
<td>±2, ±3 µm/m</td>
<td>10 µm</td>
<td>0.2 m/s (&gt; 250 ns)</td>
</tr>
</tbody>
</table>

* Other accuracy grades or grating pitches (e.g. Inch) upon request
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 002, MSA 003  Technical data

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades (µm/m)</th>
<th>Grating pitch (µm)</th>
<th>Max. velocity (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sinusoidal micro-current signals</strong>&lt;br&gt;MSA 002.13</td>
<td>depending on external Subdividing</td>
<td>±3, ±5, ±10</td>
<td>20 µm</td>
<td>2 m/s (600 ns)</td>
</tr>
<tr>
<td><strong>Sinusoidal micro-current signals</strong>&lt;br&gt;MSA 002.11</td>
<td>depending on external Subdividing</td>
<td>±3, ±2</td>
<td>10 µm</td>
<td>1 m/s (300 ns)</td>
</tr>
<tr>
<td><strong>Square wave Line Driver signals with integrated Subdividing</strong>&lt;br&gt;MSA 002.63</td>
<td>1 µm</td>
<td>±3, ±5</td>
<td>20 µm</td>
<td>1 m/s (300 ns)</td>
</tr>
<tr>
<td><strong>Square wave Line Driver signals with integrated Subdividing</strong>&lt;br&gt;MSA 002.73</td>
<td>0.5 µm</td>
<td>±3, ±5</td>
<td>20 µm</td>
<td>1 m/s (300 ns)</td>
</tr>
<tr>
<td><strong>Square wave Line Driver signals with integrated Subdividing</strong>&lt;br&gt;MSA 002.71</td>
<td>0.25 µm</td>
<td>±2, ±3, ±5</td>
<td>10 µm</td>
<td>0.45 m/s (200 ns)</td>
</tr>
<tr>
<td><strong>Square wave Line Driver signals with integrated Subdividing</strong>&lt;br&gt;MSA 002.51</td>
<td>0.1 µm</td>
<td>±2, ±3, ±5</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

**System Accuracy Grating Max. velocity**

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades (Edge distance)</th>
<th>Max. velocity (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA 002.13</td>
<td>depending on external Subdividing</td>
<td>±3, ±5, ±10 µm/m</td>
<td>20 µm</td>
</tr>
<tr>
<td>MSA 002.11</td>
<td>depending on external Subdividing</td>
<td>±3, ±2 µm/m</td>
<td>10 µm</td>
</tr>
<tr>
<td>MSA 002.63</td>
<td>1 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
</tr>
<tr>
<td>MSA 002.73</td>
<td>0.5 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
</tr>
<tr>
<td>MSA 002.71</td>
<td>0.25 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
</tr>
<tr>
<td>MSA 002.51</td>
<td>0.1 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
</tr>
</tbody>
</table>

**Signal-outputs (optional):**

- **sinusoidal micro-current signals**
  - MSA 002.13
  - MSA 002.11
- **Square wave signals with integrated Subdividing** via Line Driver RS 422 standard
  - MSA 002.63 = times 5
  - MSA 002.73 = times 10
  - MSA 002.71 = times 10
  - MSA 002.51 = times 10

**Power supply:**
- +5 V ±5%, max. 150 mA (only for times 25, unloaded)

**Output signals:**
- **Encoder signals:** 7 to 16 µApp, typical 11.5 µApp at 1 KΩ
- **Reference pulse:** 2 to 8 µA, typical 5 µA (usable component) at 1 KΩ

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

**Technical data**

- MSA 002 with stainless steel construction for optimal thermal characteristics
- MSA 003 with aluminium construction
- MSA 002 and MSA 003 are without sealing lips

- **Standard measuring lengths:** (mm)
  - 50, 70, 120, 170, 220, 270, 320, 370, 420, 470, 520

- **Measuring type:** glass scale

- **Reference mark (RI):**
  - **Standard:** One Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length.
  - **Option:** One Reference mark at any location, or two or more RI’s separated by distances of n x 50 mm.

- **Required moving force:** < 0.1 N

- **Permissible vibration:** 30 m/s² (40 to 2000 Hz)
- **Permissible shock:** 150 m/s² (8 ms)

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

- **Weight (approx.):**
  - 70 g/100 mm (scale spar) + 25 g (scanning head without cable)
**MSA 002, MSA 003** Dimensions - Mounting tolerances - Mounting possibilities:

- **MSA 002**
  - Overall length = measuring length + 81mm
  - Measuring length = 76mm

- **MSA 003**
  - Length of cable 0.5m

- **M = machine guideway**

- **square wave signals**
  - Length of cable 2.5m

- **sinusoidal micro-current signals**
  - Length of cable 3m
**MSA 670 Technical data**

### 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 = 120 Ω
  - Reference pulse:
    - 0.2 to 0.85 Vss, 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 670.13
  - MSA 670.11

  **Power supply:**
  - +5 V ±5%, max. 120 mA

  **Output signals:**
  - Encoder signals:
    - 0.25 to 1.6 µApp, typical 1.15 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)
  - (differential) via Line Driver RS 422 standard

  **Power supply:**
  - +5 V ±5%, max. 150 mA

  **Output signals:**
  - Encoder signals:
    - 5 µApp at 1 KΩ
  - Reference pulses:
    - 2 to 8 µA, typical 5 µA (useable component) at 1 KΩ

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

### System Specifications:

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity</th>
<th>Continuous momentary</th>
</tr>
</thead>
<tbody>
<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>
<td>2 m/s</td>
</tr>
<tr>
<td>MSA 670.01</td>
<td>depending on external Subdividing</td>
<td>±2, ±5 µm/m</td>
<td>10 µm</td>
<td>1 m/s</td>
<td>1 m/s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity</th>
<th>Continuous momentary</th>
</tr>
</thead>
<tbody>
<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>
<td>2 m/s</td>
</tr>
<tr>
<td>MSA 670.11</td>
<td>depending on external Subdividing</td>
<td>±2, ±5 µm/m</td>
<td>10 µm</td>
<td>1 m/s</td>
<td>1 m/s</td>
</tr>
</tbody>
</table>

### 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 670.xx K:
  - Distance coded Reference marks (K): after travelling 20 mm the absolute position will shown on the display.

  MSA 670.xx:
  - Up to measuring length 920 mm one Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length, measuring length 1040 mm and longer, 45 mm from both ends of measuring length.

#### Option:
- One Reference mark at any location, or two or more RIs 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 57)

#### 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)
**armoured cable optional**
### MSA 671 Technical data

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sinusoidal voltage signals 1 V&lt;sub&gt;pp&lt;/sub&gt;</strong></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 671.03 depending on external Subdividing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 671.01 depending on external Subdividing</td>
<td></td>
<td>±2, ±3 µm/m</td>
<td>10 µm</td>
<td>1 m/s 1 m/s</td>
</tr>
<tr>
<td><strong>Sinusoidal micro-current signals</strong></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 671.13 depending on external Subdividing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 671.11 depending on external Subdividing</td>
<td></td>
<td>±2, ±3 µm/m</td>
<td>10 µm</td>
<td>1 m/s 1 m/s</td>
</tr>
<tr>
<td><strong>Square wave Line Driver signals with integrated Subdividing</strong></td>
<td></td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s 2 m/s</td>
</tr>
<tr>
<td>MSA 671.24</td>
<td></td>
<td>5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
</tr>
<tr>
<td>MSA 671.23</td>
<td></td>
<td>2 µm</td>
<td>±5 µm/m</td>
<td>40 µm</td>
</tr>
<tr>
<td>MSA 671.64</td>
<td></td>
<td>1 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
</tr>
<tr>
<td>MSA 671.63</td>
<td></td>
<td>0.5 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
</tr>
<tr>
<td>MSA 671.73</td>
<td></td>
<td>0.25 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
</tr>
<tr>
<td>MSA 671.71</td>
<td></td>
<td>0.1 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
</tr>
<tr>
<td>MSA 671.51</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*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 671.xx K:
Distance coded Reference marks (K): after travelling 20 mm the absolute position will shown on the display.

MSA 671.xx:
Up to measuring length 920 mm one Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length, measuring length 1040 mm and longer, 45 mm from both ends of measuring length.

Option:
One Reference mark at any location, or two or more RI’s 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 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.)
0,8 kg/m (scale spar) + 75 g (scanning head without cable)

### Signal-outputs (optional):

- **sinusoidal voltage signals**
  - MSA 671.03
  - MSA 671.01

**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 Vss, 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 671.13
  - MSA 671.11

**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

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

**Power supply:**
+5 V ±5%, max. 150 mA (unloaded)
MSA 671 Dimensions - Mounting tolerances - Mounting possibilities:

M = machine guideway

**armoured cable optional**
**MSA 672 Technical data**

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</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 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>
<tr>
<td><strong>Sinusoidal micro-current signals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 672.13</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 672.11</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><strong>Square wave Line Driver signals with integrated Subdividing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 672.24</td>
<td>10 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 672.23</td>
<td>5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 672.64</td>
<td>2 µm</td>
<td>±5 µm/m</td>
<td>40 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 672.63</td>
<td>1 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 672.73</td>
<td>0.5 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 672.71</td>
<td>0.25 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0.5 m/s</td>
</tr>
<tr>
<td>MSA 672.51</td>
<td>0.1 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0.45 m/s</td>
</tr>
</tbody>
</table>

* 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 shown on the display.

MSA 672.xx:
Up to measuring length 920 mm one Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length, measuring length 1040 mm and longer, 45 mm from both ends of measuring length.

Option:
One Reference mark at any location, or two or more RI’s 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 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.)
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:
  +5 V ±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

  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 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 672.24 = times 1
  MSA 672.23 = times 1
  MSA 672.64 = times 5
  MSA 672.63 = times 5
  MSA 672.74 = times 10
  MSA 672.73 = times 10
  MSA 672.51 = times 25

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

*MSA 672* Dimensions - Mounting tolerances - Mounting possibilities:

M = machine guideway

**armoured cable optional**
**MSA 680** Technical data

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</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 680.03</td>
<td>depending on external Subdividing</td>
<td>±3, ±5 μm/m</td>
<td>20 μm</td>
<td>1 m/s 2 m/s</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><strong>Sinusoidal micro-current signals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 680.13</td>
<td>depending on external Subdividing</td>
<td>±3, ±5 μm/m</td>
<td>20 μm</td>
<td>1 m/s 2 m/s</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><strong>Square wave Line Driver signals with integrated Subdividing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 680.23</td>
<td>5 μm</td>
<td>±5 μm/m</td>
<td>20 μm</td>
<td>1 m/s 2 m/s (&gt; 3,3 μs) (&gt; 1,6 μs)</td>
</tr>
<tr>
<td>MSA 680.64</td>
<td>2 μm</td>
<td>±5 μm/m</td>
<td>40 μm</td>
<td>1 m/s 2 m/s (&gt; 1,2 μs) (&gt; 600 ns)</td>
</tr>
<tr>
<td>MSA 680.63</td>
<td>1 μm</td>
<td>±3, ±5 μm/m</td>
<td>20 μm</td>
<td>1 m/s 1 m/s (&gt; 600 ns) (&gt; 600 ns)</td>
</tr>
<tr>
<td>MSA 680.73</td>
<td>0,5 μm</td>
<td>±3, ±5 μm/m</td>
<td>20 μm</td>
<td>1 m/s 1 m/s (&gt; 600 ns) (&gt; 600 ns)</td>
</tr>
<tr>
<td>MSA 680.71</td>
<td>0,25 μm</td>
<td>±2, ±3, ±5 μm/m</td>
<td>10 μm</td>
<td>0,5 m/s 0,5 m/s (&gt; 300 ns) (&gt; 300 ns)</td>
</tr>
<tr>
<td>MSA 680.51</td>
<td>0,1 μm</td>
<td>±2, ±3, ±5 μm/m</td>
<td>10 μm</td>
<td>0,45 m/s 0,45 m/s (&gt; 200 ns) (&gt; 200 ns)</td>
</tr>
</tbody>
</table>

*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

Measuring type: glass scale

Reference mark (RI): selectable

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

MSA 680.xx:
Up to measuring length 920 mm one Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length, measuring length 1040 mm and longer, 45 mm from both ends of measuring length.

Option:
One Reference mark at any location, or two or more RI’s 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 57)

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)

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 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

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 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 680.23 = times 1
MSA 680.63 = times 5
MSA 680.64 = times 5
MSA 680.73 = times 10
MSA 680.74 = times 10
MSA 680.51 = times 25

Power supply:
+5 V ±5%, max. 150 mA (unloaded)
**armoured cable optional**
**MSA 370 Technical data**

### Signal-outputs (optional):

- **Sinusoidal voltage signals**
  - MSA 370.03
  - 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
  - Max. output frequency: 100 kHz (with 3 m cable)

- **Sinusoidal micro-current signals**
  - MSA 370.13
  - 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
  - Max. output frequency: 100 kHz (with 3 m cable)

- **Square wave Line Driver signals with integrated Subdividing**
  - MSA 370.24
  - Power supply: +5 V ±5%, max. 150 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
  - 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

### Additional Information:

- **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 370.xx K:
    - Distance coded Reference marks (K): after travelling 20 mm the absolute position will shown on the display.

- **Option:**
  - One Reference mark at any location, or two or more RI’s 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 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**
**MSA 371 Technical data**

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sinusoidal voltage signals 1 V&lt;sub&gt;pp&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 371.03</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 371.01</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></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 371.13</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 371.11</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></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 371.24</td>
<td>10 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s 2 m/s (&gt; 6,6 µs) (&gt; 3,3 µs)</td>
</tr>
<tr>
<td>MSA 371.23</td>
<td>5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s 2 m/s (&gt; 3,3 µs) (&gt; 1,6 µs)</td>
</tr>
<tr>
<td>MSA 371.64</td>
<td>2 µm</td>
<td>±5 µm/m</td>
<td>40 µm</td>
<td>1 m/s 2 m/s (&gt; 1,2 µs) (&gt; 600 ns)</td>
</tr>
<tr>
<td>MSA 371.63</td>
<td>1 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s 1 m/s (&gt; 600 ns) (&gt; 600 ns)</td>
</tr>
<tr>
<td>MSA 371.73</td>
<td>0,5 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s 1 m/s (&gt; 300 ns) (&gt; 300 ns)</td>
</tr>
<tr>
<td>MSA 371.71</td>
<td>0,25 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0,5 m/s 0,5 m/s (&gt; 300 ns) (&gt; 300 ns)</td>
</tr>
<tr>
<td>MSA 371.51</td>
<td>0,1 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0,45 m/s 0,45 m/s (&gt; 200 ns) (&gt; 200 ns)</td>
</tr>
</tbody>
</table>

* 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, 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 shown on the display.

**MSA 371.xx:**
Up to measuring length 920 mm one Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length, measuring length 1040 mm and longer, 45 mm from both ends of measuring length.

**Option:**
One Reference mark at any location, or two or more RI's 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 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)

**Signal-outputs (optional):**

* Sinusoidal voltage signals
  MSA 371.03
  MSA 371.01

**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 Vss, 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 371.13
  MSA 371.11

**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 371.23 = times 1
  MSA 371.24 = times 1
  MSA 371.63 = times 5
  MSA 371.64 = times 5
  MSA 371.73 = times 10
  MSA 371.74 = times 10
  MSA 371.51 = times 25

**Power supply:**
+5 V ±5%, max. 150 mA (unloaded)
**armoured cable optional**
### MSA 372 Technical data

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sinusoidal voltage signals 1 V_pp</strong></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 372.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 372.01</td>
<td></td>
<td>±2, ±3 µm/m</td>
<td>10 µm</td>
<td>1 m/s 1 m/s</td>
</tr>
<tr>
<td><strong>Sinusoidal micro-current signals</strong></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 372.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 372.11</td>
<td></td>
<td>±2, ±3 µm/m</td>
<td>10 µm</td>
<td>1 m/s 1 m/s</td>
</tr>
<tr>
<td><strong>Square wave Line Driver signals with integrated Subdividing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 372.24</td>
<td>10 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s 2 m/s</td>
</tr>
<tr>
<td>MSA 372.23</td>
<td>5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s 2 m/s</td>
</tr>
<tr>
<td>MSA 372.64</td>
<td>2 µm</td>
<td>±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s 2 m/s</td>
</tr>
<tr>
<td>MSA 372.63</td>
<td>1 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s 1 m/s</td>
</tr>
<tr>
<td>MSA 372.73</td>
<td>0.5 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s 1 m/s</td>
</tr>
<tr>
<td>MSA 372.71</td>
<td>0.25 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0.5 m/s 0.5 m/s</td>
</tr>
<tr>
<td>MSA 372.51</td>
<td>0.1 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0.45 m/s 0.45 m/s</td>
</tr>
</tbody>
</table>

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

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

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

**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

**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

**Power supply:**  
+5 V ±5%, max. 150 mA (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, 1840, 2040, 2240, 2440, 2640, 2840, 3040

**Measuring type:** glass scale

**Reference mark (RI):** selectable  
MSA 372.xx K:  
Distance coded Reference marks (K): after travelling 20 mm the absolute position will shown on the display.

**MSA 372.xx:**  
Up to measuring length 920 mm one Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length, measuring length 1040 mm and longer, 45 mm from both ends of measuring length.

**Option:**  
One Reference mark at any location, or two or more RI’s separated by distances of n × 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 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**

**Armoured Cable Optional**

**MSA 372** Dimensions - Mounting tolerances - Mounting possibilities:

- Overall length - Measuring length + 150mm
- 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 673 Technical data**

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades (µm/m)</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA 673.13</td>
<td>±3, ±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s</td>
<td>2 m/s</td>
</tr>
</tbody>
</table>

- **Sinusoidal micro-current signals**

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

  | MSA 673.24 | 10 µm | ±10 µm/m | 40 µm | 1 m/s (> 6.6 µs) | 2 m/s (> 3.3 µs) |
  | MSA 673.23 | 5 µm | ±5, ±10 µm/m | 20 µm | 1 m/s (> 1.2 µs) | 2 m/s (> 600 ns) |
  | MSA 673.64 | 2 µm | ±5 µm/m | 40 µm | 1 m/s (> 1.2 µs) | 2 m/s (> 600 ns) |
  | MSA 673.63 | 1 µm | ±5 µm/m | 20 µm | 1 m/s (> 1.2 µs) | 2 m/s (> 600 ns) |

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

**Signal-outputs (optional):**

- **sinusoidal micro-current signals**
  **MSA 673.13**

  - **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
  - **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 673.23 | = times 1 |
  | MSA 673.24 | = times 1 |
  | MSA 673.63 | = times 5 |
  | MSA 673.64 | = times 5 |

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

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

**Measuring type:** glass scale

**Reference mark (Rl):** selectable
**MSA 673.xx K:**
Distance coded Reference marks (K): after travelling 20 mm the absolute position will be shown on the display.

**MSA 673.xx:**
One Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length.

**Option:**
One Reference mark at any location, or two or more RI’s separated by distances of n x 50 mm.

**Required moving force:** < 10 N

**Environmental sealing DIN 40050:**
IP 53 (with standard sealing lips)
IP 64 with DA300 (DA300 see page 57)

**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) + 200 g (scanning head without cable)
**armoured cable optional

MSA 673 Dimensions - Mounting tolerances - Mounting possibilities:

**

self aligning rod ends M6
hexagon nut M6 / DIN 934

overall length = measuring length + 120 mm

M = machine guideway

\( \alpha < 10^\circ \) (max. tilt angle of the rod)

rod optional
**MSA 373** Technical data

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>• Square wave Line Driver signals with integrated Subdividing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MSA 373.65</strong></td>
<td>5 µm</td>
<td>±5, ±10 µm/m</td>
<td>100 µm</td>
<td>1 m/s (&gt; 500 ns)</td>
</tr>
<tr>
<td><strong>MSA 373.55</strong></td>
<td>1 µm</td>
<td>±5, ±10 µm/m</td>
<td>100 µm</td>
<td>1,8 m/s (&gt; 500 ns)</td>
</tr>
</tbody>
</table>

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

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

**Measuring type:** glass scale

**Free positionable switching magnets for special functions:**
The position of the 2 switch points (S1 and S2) within the measuring length can be selected by the customer (details on page 44 and 45)

**Reference mark (RI):**
*Standard:*
One Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length.

*Option:*
One Reference mark at any location, or two or more RI’s separated by distances of n x 50 mm.

**Required moving force:** < 5 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.)**
1.2 kg/m (scale spar) + 245 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

**MSA 373.65** = times 5
**MSA 373.55** = times 25
**MSA 373** Dimensions - Mounting tolerances - Mounting possibilities:

overall length = measuring length = 164 mm

M = machine guideway

*S1, S2; position of the sensors in the encoder head

switching length typ. 12 mm

switch positions with magnet holder S1 and S2 free selectable.

place the magnet holder and tighten the set screw

with 1,27 mm allen wrench

**armoured cable optional**

max. tilt angle 10°

permitted offset

angular \( \Delta \varphi = 6,5° \)

lateral \( \Delta y = 1,7 \text{ mm} \)

spring rod Ø2

armoured cable optional

Magnet holder for S1

Magnet holder for S2

Air inlet M5 on both sides

Dimensions - Mounting tolerances - Mounting possibilities:

max. tilt angle 10°

permitted offset

angular \( \Delta \varphi = 6,5° \)

lateral \( \Delta y = 1,7 \text{ mm} \)

spring rod Ø2

rod
**MSA 690 Technical data**

**Signal-outputs (optional):**

- **sinusoidal voltage signals**
  - MSA 690.03
  - MSA 690.01

  **Power supply:**
  - +5 V ±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 (usable component)
    - with terminating resistor Zo = 120 Ω

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

- **sinusoidal micro-current signals**
  - MSA 690.13
  - MSA 690.11

  **Power supply:**
  - +5 V ±5%, max. 120 mA

  **Output signals:**
  - Encoder signals: 7 to 16 µA, typical 11.5 µA at 1 KΩ
  - Reference pulse: 2 to 8 µA, typical 5 µA (usable 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

**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

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

The position of the 2 switch points (S1 and S2) within the measuring length can be selected by the customer (details on page 44 and 45)

**Reference mark (RI):** selectable

**MSA 690.xx K:**
- Distance coded Reference marks (K): after travelling 20 mm the absolute position will be shown on the display.

**MSA 690.xx:**
- Up to measuring length 920 mm one Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length, measuring length 1040 mm and longer, 45 mm from both ends of measuring length.

**Option:**
- One Reference mark at any location, or two or more RI's 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 57)

**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 690** Dimensions - Mounting tolerances - Mounting possibilities:

- **Armoured cable optional**

---

- **S1, S2 sensor position in the encoder head**
- **Contact-break distance 12 mm (typ.)**
- **Customers choice of magnet position (i.e. switching point)**
- **Magnets must be affixed with glue**
  - (UHU plus included at the shipment)

---

* S1, S2 sensor position in the encoder head
Contact-break distance 12 mm (typ.)
Customers choice of magnet position
(i.e. switching point)
Magnets must be affixed with glue
(UHU plus included at the shipment)

---

**M = machine guideway**
MSA 691 Technical data

**Signal-outputs (optional):**

- **sinusoidal voltage signals**
  - **MSA 691.03**
  - **MSA 691.01**

Power supply:
- +5 V ±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

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

- **sinusoidal micro-current signals**
  - **MSA 691.13**
  - **MSA 691.11**

Power supply:
- +5 V ±5%, max. 120 mA

Output signals:
- Encoder signals: 7 to 16 µApp, typical 11.5 µApp at 1 K Ω
- Reference pulse: 2 to 8 µA, typical 5 µA (useable component) at 1 K 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 691.24**
  - **MSA 691.23**
  - **MSA 691.64**
  - **MSA 691.63**
  - **MSA 691.73**
  - **MSA 691.71**
  - **MSA 691.51**

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

Output signals:
- Encoder signals: 7 to 16 µApp, typical 11.5 µApp at 1 K Ω
- Reference pulse: 2 to 8 µA, typical 5 µA (useable component) at 1 K Ω

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

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades *</th>
<th>Grating pitch *</th>
<th>Max. velocity (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sinusoidal voltage signals 1 Vpp</strong></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 691.03</td>
<td>depending on external Subdividing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 691.01</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><strong>Sinusoidal micro-current signals</strong></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 691.13</td>
<td>depending on external Subdividing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 691.11</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><strong>Square wave Line Driver signals with integrated Subdividing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 691.24</td>
<td>10 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s (&gt; 6.6 µs) (&gt; 3.3 µs)</td>
</tr>
<tr>
<td>MSA 691.23</td>
<td>5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s (&gt; 1.2 µs) (&gt; 0.6 µs)</td>
</tr>
<tr>
<td>MSA 691.64</td>
<td>2 µm</td>
<td>±5 µm/m</td>
<td>40 µm</td>
<td>1 m/s (&gt; 1 µs) (&gt; 600 ns)</td>
</tr>
<tr>
<td>MSA 691.63</td>
<td>1 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s (&gt; 600 ns) (&gt; 600 ns)</td>
</tr>
<tr>
<td>MSA 691.73</td>
<td>0.5 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>0.5 m/s (&gt; 300 ns) (&gt; 300 ns)</td>
</tr>
<tr>
<td>MSA 691.71</td>
<td>0.25 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0.45 m/s (&gt; 200 ns) (&gt; 200 ns)</td>
</tr>
<tr>
<td>MSA 691.51</td>
<td>0,1 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0.45 m/s (&gt; 200 ns) (&gt; 200 ns)</td>
</tr>
</tbody>
</table>

* 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

Free positionable switching magnets for special functions:
The position of the 2 switch points (S1 and S2) within the measuring length can be selected by the customer (details on page 44 and 45)

Reference mark (RI): selectable
- MSA 691.xx K:
  - Distance coded Reference marks (K): after travelling 20 mm the absolute position will shown on the display.

MSA 691.xx:
Up to measuring length 920 mm one Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length, measuring length 1040 mm and longer, 45 mm from both ends of measuring length.

Option:
One Reference mark at any location, or two or more RI’s 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 57)

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)
** armoured cable optional

**S1, S2 sensor position in the encoder head**

Contact-break distance 12 mm (typ.)

Customers choice of magnet position (i.e. switching point)

Magnets must be affixed with glue (UHU plus included at the shipment)

\( M = \) machine guideway
## MSA 390 Technical data

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades ±</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sinusoidal voltage signals 1 V&lt;sub&gt;pp&lt;/sub&gt;</strong></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 390.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 390.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sinusoidal micro-current signals</strong></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>MSA 390.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSA 390.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Square wave Line Driver signals with integrated Subdividing</strong></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 390.24</td>
<td>10 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 390.23</td>
<td>5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 390.64</td>
<td>2 µm</td>
<td>±5 µm/m</td>
<td>40 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 390.63</td>
<td>1 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 390.73</td>
<td>0,5 µm</td>
<td>±3, ±5 µm/m</td>
<td>20 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 390.71</td>
<td>0,25 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0,5 m/s</td>
</tr>
<tr>
<td>MSA 390.51</td>
<td>0,1 µm</td>
<td>±2, ±3, ±5 µm/m</td>
<td>10 µm</td>
<td>0,45 m/s</td>
</tr>
</tbody>
</table>

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

### Signal-outputs (optional):

- **sinusoidal voltage signals**
  - MSA 390.03
  - MSA 390.01

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 Vss, 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 390.13
  - MSA 390.11

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

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 390.23 = times 1
  - MSA 390.24 = times 1
  - MSA 390.63 = times 5
  - MSA 390.64 = times 5
  - MSA 390.73 = times 10
  - MSA 390.74 = times 10
  - MSA 390.51 = times 25

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

Free positionable switching magnets for special functions:
The position of the 2 switch points (S1 and S2) within the measuring length can be select by the customer (details on page 44 and 45)

**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 remarks the position of the first reference mark.

**Option:** (positioning by works)

Up to measuring length 920 mm one Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length, measuring length 1040 mm and longer, 45 mm from both ends of measuring length.

The free positionable switching magnets are used for individual function (instead selectable RI-mark).
The switch track (S3) will be accomplished (details on page 44 and 45).

Required moving force: < 3 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**

**MSA 390** Dimensions - Mounting tolerances - Mounting possibilities:

- Overall length = measuring length + 150 mm
- Magnet holder for S1 and S2
- Magnet holder for S3*
- Overall length = measuring length + 150 mm on both sides
- Magnet holder for S1 and S2 free selectable switch positions
- With magnet holder S3 select the RI-mark
- Place the magnet holder and tighten the set screw with a 1.27 mm allen wrench

**S1, S2, S3 position of the sensors in the encoder head**
- Switching length typ. 12 mm
- With magnet holder S1 and S2 free selectable switch positions
- With magnet holder S3 select the RI-mark

**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 391 Technical data

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades *</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td></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 391.03</td>
<td>depending on external Subdividing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></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 voltage signals 1 Vpp

- **MSA 391.03**
  - depending on external Subdividing
  - ±3, ±5, ±10 µm/m
  - 20 µm
  - 1 m/s 2 m/s

- **MSA 391.01**
  - depending on external Subdividing
  - ±2, ±3 µm/m
  - 10 µm
  - 1 m/s 1 m/s

### Sinusoidal micro-current signals

- **MSA 391.13**
  - depending on external Subdividing
  - ±3, ±5, ±10 µm/m
  - 20 µm
  - 1 m/s 2 m/s

- **MSA 391.11**
  - 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 391.24**
  - 10 µm ±10 µm/m
  - 40 µm
  - 1 m/s (>) 6.6 µs (> 3.3 µs)

- **MSA 391.23**
  - 5 µm ±5, ±10 µm/m
  - 20 µm
  - 1 m/s (> 3.3 µs) (> 1.6 µs)

- **MSA 391.64**
  - 2 µm ±15 µm/m
  - 40 µm
  - 1 m/s (> 1.2 µs) (> 600 ns)

- **MSA 391.63**
  - 1 µm ±3, ±5 µm/m
  - 20 µm
  - 1 m/s (> 600 ns) (> 600 ns)

- **MSA 391.73**
  - 0.5 µm ±3, ±5 µm/m
  - 20 µm
  - 1 m/s (> 300 ns) (> 300 ns)

- **MSA 391.71**
  - 0.25 µm ±2, ±3, ±5 µm/m
  - 10 µm
  - 0.5 m/s (> 300 ns) (> 300 ns)

- **MSA 391.51**
  - 0.1 µm ±2, ±3, ±5 µm/m
  - 10 µm
  - 0.45 m/s (> 200 ns) (> 200 ns)

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

#### 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

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

### Square wave signals (single ended)

- **MSA 391.51**
  - ±5 µm/m
  - 20 µm
  - 1 m/s (> 300 ns) (> 300 ns)

- **MSA 391.73**
  - ±3, ±5 µm/m
  - 20 µm
  - 1 m/s (> 600 ns) (> 600 ns)

- **MSA 391.71**
  - ±2, ±3, ±5 µm/m
  - 10 µm
  - 0.5 m/s (> 300 ns) (> 300 ns)

- **MSA 391.51**
  - ±0.25 µm
  - 20 µm
  - 0.45 m/s (> 200 ns)

#### Power supply:
- +5 V ±5%, max. 120 mA

#### 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 391 Dimensions - Mounting tolerances - Mounting possibilities:

* S1, S2, S3 position of the sensors in the encoder head
  switching length typ. 12 mm
  with magnet holder S1 and S2 free selectable switch positions
  with magnet holder S3 select the RI-mark
  place the magnet holder and tighten the set screw with 1.27 mm allen wrench

M = machine guideway

overall length = measuring length + 110 mm

length of cable 3 m **
Positioning of the switching magnets

Switch points S1 and S2 for individual function
MSA 690

MSA 373

MSA 390

MSA 391

Selectable Reference mark (RI)
MSA 390

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

MSA 391
**MSA 690, MSA 691, MSA 390, MSA 391, MSA 373 pin-outs**

<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>-90°</td>
<td>0°</td>
<td>+5V</td>
<td>+5V</td>
<td>GND</td>
<td>S1</td>
<td>S2</td>
<td>RI</td>
<td>+90°</td>
<td>0°</td>
<td>shield</td>
</tr>
<tr>
<td>sinusoidal voltage signals</td>
<td>nc</td>
<td>GND</td>
<td>nc</td>
<td>RI</td>
<td>A2</td>
<td>AT</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>shield</td>
</tr>
</tbody>
</table>

* exception at MSA 390 and MSA 391 (Version without RI-variety): PIN 1 = S3 (switch output)  
** PIN 2 = GND (bridge to PIN 9) or sensor  
*** PIN 7 = +5V (bridge to PIN 8) or sensor

*Magnet*  
Fastening elements for connections (minimum: 3)

**MSA 690, MSA 691, MSA 390, MSA 391, MSA 373 switch signals**

**Version 1**  
TTL output (active high)

**Version 2**  
Open collector output (active high impedance)

**Version 3**  
TTL output (active low)

**Version 4**  
Open collector output (active low)
**MA650 Technical data**

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sinusoidal micro-current signals</strong></td>
<td></td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s 2 m/s</td>
</tr>
<tr>
<td>MSA 650.13</td>
<td>depending on external Subdividing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Square wave Line Driver signals with integrated Subdividing</strong></td>
<td></td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s 2 m/s</td>
</tr>
<tr>
<td>MSA 650.24</td>
<td>10 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>(&gt; 5 ms) (&gt; 2.5 µs)</td>
</tr>
<tr>
<td>MSA 650.23</td>
<td>5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s 2 m/s</td>
</tr>
<tr>
<td>MSA 650.33</td>
<td>2.5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s 1 m/s 1 m/s</td>
</tr>
<tr>
<td>MSA 650.63</td>
<td>1 µm</td>
<td>±5, ±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s 1 m/s 1 m/s</td>
</tr>
<tr>
<td>MSA 650.73</td>
<td>0.5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s 1 m/s 1 m/s</td>
</tr>
</tbody>
</table>

* 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 (RI):** selectable

MSA 650.xx K:

Distance coded Reference marks (K): after travelling 20 mm the absolute position will shown on the display.

MSA 650.xx:

Up to measuring length 920 mm one Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length, measuring length 1040 mm and longer, 45 mm from both ends of measuring length.

**Option:**

One Reference mark at any location, or two or more RI’s 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)

**Signal-outputs (optional):**

- **sinusoidal micro-current signals**

  MSA 650.13

  **Power supply:**

  +5 V ±5%, max. 90 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 650.23 = times 1

  MSA 650.24 = times 1

  MSA 650.33 = times 2

  MSA 650.63 = times 5

  MSA 650.64 = times 5

  MSA 650.73 = times 10

  **Power supply:**

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

M = machine guideway

at measuring lengths over 520 mm fix with screw M4 DIN912

overall length = measuring length + 105mm

length of cable 3m
**MSA 651** Technical data

### System resolution

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA 651.13</td>
<td>depending on external Subdividing</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s 2 m/s</td>
</tr>
<tr>
<td>MSA 651.24</td>
<td>10 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>(&gt; 1 m/s) (&gt; 2,5 µs)</td>
</tr>
<tr>
<td>MSA 651.23</td>
<td>5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>(&gt; 1,2 µs) (&gt; 2,5 µs)</td>
</tr>
<tr>
<td>MSA 651.33</td>
<td>2,5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>(&gt; 1,2 µs) (&gt; 2,5 µs)</td>
</tr>
<tr>
<td>MSA 651.64</td>
<td>2 µm</td>
<td>±5, ±10 µm/m</td>
<td>40 µm</td>
<td>(&gt; 800 ns) (&gt; 400 ns)</td>
</tr>
<tr>
<td>MSA 651.63</td>
<td>1 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>(&gt; 800 ns) (&gt; 400 ns)</td>
</tr>
<tr>
<td>MSA 651.73</td>
<td>0,5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>(&gt; 200 ns) (&gt; 200 ns)</td>
</tr>
</tbody>
</table>

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

### Signal outputs (optional):

- **sinusoidal micro-current signals**
  - MSA 651.13

- **Square wave Line Driver signals with integrated Subdividing**
  - MSA 651.24
  - MSA 651.23
  - MSA 651.63
  - MSA 651.73

### Power supply:

- +5 V ±5%, max. 90 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)

### 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

### 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 shown on the display.

- MSA 651.xx:
  - Up to measuring length 920 mm one Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length, measuring length 1040 mm and longer, 45 mm from both ends of measuring length.

### Option:

- One Reference mark at any location, or two or more RI’s 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:

M = machine guideway
### MSA 350 Technical data

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA 350.13</td>
<td>depending on external Subdividing</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s</td>
</tr>
<tr>
<td>MSA 350.24</td>
<td>10 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s</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</td>
</tr>
<tr>
<td>MSA 350.33</td>
<td>2,5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s</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</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</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</td>
</tr>
</tbody>
</table>

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

**Sinusoidal micro-current signals**

- MSA 350.13
- MSA 350.24
- MSA 350.23
- MSA 350.33
- MSA 350.64
- MSA 350.63
- MSA 350.73

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

- MSA 350.24
- MSA 350.33
- MSA 350.64
- MSA 350.63
- MSA 350.73

### Signal-outputs (optional):

- **sinusoidal micro-current signals**
  - MSA 350.13
  - Power supply:
    - +5 V ±5%, max. 90 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
  - MSA 350.24 = times 1
  - MSA 350.33 = times 2
  - 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)

- **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 350.33 = times 2
  - 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 shown on the display.

### MSA 350.xx:

- Up to measuring length 920 mm one Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length, measuring length 1040 mm and longer, 45 mm from both ends of measuring length.

### Option:

- One Reference mark at any location, or two or more RI's 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 57)

### 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)
M = machine guideway

**MSA 350** Dimensions - Mounting tolerances - Mounting possibilities:

- Overall length = measuring length + 150 mm

**Dimensions - Mounting possibilities:**

- 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

**Length of cable tr.:**

- M6/C 0.5

**Mounting support:**

- M6/C 0.2

**M6/T:Oeep:**

- M6/C 0.2

**Notes:**

- M = machine guideway

**Dimensions - Mounting possibilities:**

- M6/C 0.5

**Mounting support:**

- M6/C 0.2

**M6/T:Oeep:**

- M6/C 0.2

**Notes:**

- M = machine guideway

**Dimensions - Mounting possibilities:**

- M6/C 0.5

**Mounting support:**

- M6/C 0.2

**M6/T:Oeep:**

- M6/C 0.2

**Notes:**

- M = machine guideway

**Dimensions - Mounting possibilities:**

- M6/C 0.5

**Mounting support:**

- M6/C 0.2

**M6/T:Oeep:**

- M6/C 0.2

**Notes:**

- M = machine guideway
**MSA 352** Technical data

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sinusoidal micro-current signals</strong></td>
<td>depending on external Subdividing</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>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 distance)</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 (&gt; 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 (&gt; 2.5 µs)</td>
</tr>
<tr>
<td>MSA 352.33</td>
<td>2.5 µm</td>
<td>±5, ±10 µm/m</td>
<td>20 µm</td>
<td>1 m/s (&gt; 1.2 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 (&gt; 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 (&gt; 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 (&gt; 200 ns)</td>
</tr>
</tbody>
</table>

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

**Signal-outputs (optional):**

- **sinusoidal micro-current signals**
  **MSA 352.13**
  - Power supply: +5 V ±5%, max. 90 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 (usable component) at 1 KΩ
  - Max. output frequency: 100 kHz (with 3 m cable)

- **square wave signals** (single ended) with integrated Subdividing Electronics
  **MSA 352.23** = times 1
  **MSA 352.24** = times 1
  **MSA 352.33** = times 2
  **MSA 352.63** = times 5
  **MSA 352.64** = times 5
  **MSA 352.73** = times 10
  - Power supply: +5 V ±5%, < 150 mA (with interpolation, unloaded) < 200 mA (without interpolation, unloaded)

- **square wave signals** (differential) via Line Driver RS 422 standard with integrated Subdividing Electronics
  **MSA 352.23** = times 1
  **MSA 352.24** = times 1
  **MSA 352.33** = times 2
  **MSA 352.63** = times 5
  **MSA 352.64** = times 5
  **MSA 352.73** = 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 352.xx K:**
Distance coded Reference marks (K): after travelling 20 mm the absolute position will be shown on the display.

MSA 352.xx:
Up to measuring length 920 mm one Reference mark in the middle of the measuring length or 35 mm from both ends of measuring length, measuring length 1040 mm and longer, 45 mm from both ends of measuring length.

Option:
One Reference mark at any location, or two or more RI’s 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 57)

**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 span) + 180 g (scanning head without cable)
**MSA 352** Dimensions - Mounting tolerances - Mounting possibilities:

- **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.

**ZE-Sx**
- for Linear Encoders with sinusoidal voltage signals

**ZE-Vx**
- 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 = times 100
- 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:**
(pin-outs and dimensions on page 56)
- 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 (1Vss typical)
  Reference pulse: 0.2 to 0.85 V
  0.2 to 0.85 Vpp
  typical 0.4 V (useable component)
  with terminating impedance Zo = 120 Ω

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

- from Encoder
  - 128
  - to DRO/counter
  - cable length 1 m
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
Connectors, pin-outs

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

#### L120
- **PIN**
  - Voltage signals
    - inner shield 0 V A1 A2 0 V RI 0 V +5 V A2 +5 V (outer shield on chassis)

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

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

### L 91, K 91, KM 91
- **9-pin**

#### L 91, K 91, KM 91
- **PIN**
  - Sinusoidal micro-current signals
    - 0°+ 0°- 5 V 0 V 90°+ 90°- RI+ RI- inner shield (outer shield on chassis)

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

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

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

### L 121, K 121, KM 121
- **12-pin**

#### L 121
- **PIN**
  - Voltage signals
    - A2 +5 V Sensor RI A1 A2 +5 V A2 inner shield GND GND +5 V (outer shield on chassis)

### SUB MIN-D

#### Male connector LD 9
- **9-pin**

### Square wave signals (single ended)
- shield* RI T2 T1 +V nc nc nc GND

### Square wave signals (differential)
- T1 T2 T2 RI RI +5 V 0 V shield*
Air Pressure Unit DA300

In harsh environments, where oil and coolant 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 from 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:

* = Space necessary for filter change
Other RSF-Products

MS 50
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 61
Reflective scanning
Linear Encoder
• two switch tracks for individual special functions
• 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 8x
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

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

MSG 10
Linear Encoder with self-guided scanning head
• easy mounting
• for high displacement velocities
• scale version: steel tape scale on aluminium carrier
• max. measuring length 400 mm

MSR 50 MS
Modular Ring Rotary Encoder
• steel tape scale on steel ring
• on printer and roundtables
• non-contact reflective scanning
• available diameter Ø80 mm to Ø165 mm

MSR 50 MK
Modular Ring Rotary Encoder
• steel tape scale on sandwich clamping ring
• for application at the robotik on printers and roundtables
• non-contact reflective scanning
• available diameter Ø150 mm to Ø500 mm

DIT 10, DIT 30, DIT 48
Precision measuring Probes
• for universal applications
• stroke length 10, 30, 48 mm
• mounting on shaft sleeve
• mounting with two tapped holes on body (DIT 30, DIT 48)
• with cable lifter
• integrated pneumatic lifter optional
• sealing bellows optional (DIT 30, DIT 48)
## Other RSF-Products

### 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>
<th>Z 820</th>
<th>Z 830</th>
<th>Z 840</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>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>programming of system parameters</td>
<td>●</td>
<td>●</td>
<td>●</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>
<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>
<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>
<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>
<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>
<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>
<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>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Hardware test and display test</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>99 tool corrections (lathe mode)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>99 datum points (milling mode)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>store values for axis display</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>absolute/incremental</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>mm/inch conversion</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>centering (divide by 2)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>radius/diameter</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>adjustable for Rotary or Linear Encoder input.</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>linear error correction programmable</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>nonlinear axes-error correction</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>summing for two axis (Z + Z1)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>axes movements with displayed remaining travel way</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>display for approximation to zero point</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>feed display</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>inbuilt stop-watch</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>taper function</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>display of spindle speed</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>skew compensation</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Bi-directional RS 232 interface</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>free programmable switch off and pre-switch off points</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>edge probe input</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>output for constant surface speed</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>external Reset for each axis</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>external input</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>program store for 500 sets</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>special display for spark erosion</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>compensation for grinding wheels</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

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