Incremental Linear Encoders
Open Models
RSF Elektronik was founded 1973 in St. Georgen near Salzburg, Austria.

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

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

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

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

# 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>Overview</td>
<td></td>
</tr>
<tr>
<td>Nomenclature</td>
<td>9</td>
</tr>
<tr>
<td>Selection guide</td>
<td>10-11</td>
</tr>
<tr>
<td>Technical data</td>
<td></td>
</tr>
<tr>
<td>MS 50</td>
<td>12-17</td>
</tr>
<tr>
<td>MS 61</td>
<td>18-21</td>
</tr>
<tr>
<td>MS 80</td>
<td>22-23</td>
</tr>
<tr>
<td>MSG 10</td>
<td>24-25</td>
</tr>
<tr>
<td>TDE 60</td>
<td>26-27</td>
</tr>
<tr>
<td>MSR 50</td>
<td>28-31</td>
</tr>
<tr>
<td>DIT 10</td>
<td>32-33</td>
</tr>
<tr>
<td>DIT 30</td>
<td>32-33</td>
</tr>
<tr>
<td>DIT 48</td>
<td>34-35</td>
</tr>
<tr>
<td>Dimensions</td>
<td></td>
</tr>
<tr>
<td>Mounting tolerances</td>
<td></td>
</tr>
<tr>
<td>MSG 10</td>
<td>24-25</td>
</tr>
<tr>
<td>TDE 60</td>
<td>26-27</td>
</tr>
<tr>
<td>MSR 50</td>
<td>28-31</td>
</tr>
<tr>
<td>DIT 10</td>
<td>32-33</td>
</tr>
<tr>
<td>DIT 30</td>
<td>32-33</td>
</tr>
<tr>
<td>DIT 48</td>
<td>34-35</td>
</tr>
<tr>
<td>Mounting possibilities</td>
<td></td>
</tr>
<tr>
<td>Accessories</td>
<td></td>
</tr>
<tr>
<td>Male and female connectors, switch signals</td>
<td>36-38</td>
</tr>
<tr>
<td>Subdividing Electronics ZE-xx</td>
<td>39</td>
</tr>
<tr>
<td>InterFaceCard IFC 430 R</td>
<td>40</td>
</tr>
<tr>
<td>Electronic mounting controller PG1-x</td>
<td>41</td>
</tr>
<tr>
<td>Other RSF-Products</td>
<td></td>
</tr>
<tr>
<td>Incremental Linear Encoder, Rotary Encoder</td>
<td>42</td>
</tr>
<tr>
<td>(extract from the catalog &quot;Incremental Linear Encoder&quot; closed models)</td>
<td></td>
</tr>
<tr>
<td>Digital Read Outs</td>
<td>43</td>
</tr>
<tr>
<td>Branch Offices</td>
<td></td>
</tr>
<tr>
<td>Adresses</td>
<td>44</td>
</tr>
</tbody>
</table>
Design and operation

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

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.

The non-contact open measuring systems are for high displacement velocities and high accuracies, commonly used in clean environments. This magnetic coupling compensates allowable mounting tolerances and machine guide non-parallelism. Non-contact open encoders rely on the air gap between the encoder head and scale to be uniform over the measuring range. The flatness of the mounting surface and the parallelism of the machine guideway is important.
When there is relative movement between the encoder head and the linear scale, LED light is modulated by the scale grating pitch and converted into electrical signals by the photo-elements. Solid state LEDs and silicon photo-elements are used for high reliability and durability.

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

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

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.

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:
Phase shift 90° ±10° el.
Signal amplitude 0.6 Vss to 1.2 Vpp
Typ. 1 Vpp with terminating impedance Zo = 120 Ω

Output signal Reference mark (RI):
El. position typical 135° (referenced to A1)
El. width typical 270° ±0.2 to 0.85 V
Typical 0.4 V (effective quota) with terminating impedance Zo = 120 Ω

Advantage: High output frequency even with long cable length.

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

Output signals 0° and 90°:
Phase shift 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° ±0.2 to 0.85 V
Typical 0.4 V (effective quota) with terminating impedance Zo = 120 Ω

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

**Square wave signals**
The sinusoidal micro-current signals are converted into two square wave signals that have a phase shift of 90° either with a Schmitt-Trigger (times 1) or interpolation electronics (times 2, -5, -10, -25, -50 or -100) output can be differential RS 422 Line Driver.

One counting step is the distance between the rising or falling edge of channels T1 and T2.
Machine controls/DROs have a minimum allowable distance between channels A and B changes of state, measured in time (inverse of maximum counting frequency).
The minimum edge distance t_F is shown in the technical data.

---

**Drawing in “positive counting direction”**

**Positive counting direction orientation**
**Subdividing Electronics, Connecting cables**

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

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

**Table: Output signals resp. constructional features**

<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, high flex</td>
<td>45 mm 85 mm</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>double, ultra high flex</td>
<td>35 mm 70 mm</td>
</tr>
<tr>
<td></td>
<td>3.9</td>
<td></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></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**
Shield connections

**sinusoidal micro-current signals**

- Inner shield on connector pin
- Outer shield on surface of the reading head
- Double shielded cable, standard
- Connector pin
- Connector

**sinusoidal voltage signals**

- Inner shield on connector pin
- Outer shield on chassis
- Double shielded cable, standard
- Connector pin
- Connector

**square wave signals**

- Shield on chassis and on connector pin
- Single shielded cable, standard
- Connector pin
- Connector

**square wave signals**

- Outer and inner shield on chassis and on connector pin
- Double shielded cable, optional
- Connector pin
- Connector
Nomenclature

**Encoder Name**
(Multiple digit also possible)

**Encoder Type**
(Stroke length for DIT)

**Outputs signals and integrated Subdividing**

<table>
<thead>
<tr>
<th>Encoder Type</th>
<th>Grating pitch</th>
<th>Version of the switch signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = sinusoidal voltage signals 1 Vpp</td>
<td>0 = 8 µm</td>
<td>-0 = without switch signal</td>
</tr>
<tr>
<td>1 = sinusoidal micro-current signals 7 to 16 µApp</td>
<td>1 = 10 µm</td>
<td>-1 = TTL Ausgang (active high)</td>
</tr>
<tr>
<td>2 = square wave signals, times 1</td>
<td>2 = 16 µm</td>
<td>-2 = open collector Ausgang (active high impedance)</td>
</tr>
<tr>
<td>3 = square wave signals, times 2</td>
<td>3 = 20 µm</td>
<td>-3 = TTL Ausgang (active low)</td>
</tr>
<tr>
<td>4 = square wave signals, times 20</td>
<td>4 = 40 µm</td>
<td>-4 = open collector Ausgang (active low impedance)</td>
</tr>
</tbody>
</table>

**Grating pitch**

| 0 = 8 µm | 5 = 100 µm | A = 6.35 µm | F = 101.60 µm |
| 1 = 10 µm | 6 = 200 µm | B = 10.16 µm | G = 25.40 µm |
| 2 = 16 µm | 7 = 400 µm | C = 12.70 µm | H = 35 µm |
| 3 = 20 µm | 8 = 50 µm | D = 20.32 µm | K = 2160 L/Inch |
| 4 = 40 µm | 9 = 60.80 µm | L = 21.167 µm |

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

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

**Scale versions**

- BA = Robax scale on aluminium carrier
- BK = Robax scale with adhesive tape
- BO = Robax scale without adhesive tape
- BS = Robax scale on steel carrier
- GA = glass scale on aluminium carrier
- GK = glass scale with adhesive tape
- G0 = glass scale without adhesive tape
- GS = glass scale on steel carrier
- MA = steel tape on aluminium carrier
- ME = steel tape on aluminium carrier with stretching elements
- MK = steel tape with adhesive tape
- MO = steel tape without adhesive tape
- MS = steel tape on steel carrier

**Possible options**

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

**For example:**

*MS 61.74-1 GA*

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

<table>
<thead>
<tr>
<th>Design features</th>
<th>Overall measuring</th>
<th>Scale type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reflective scanning Linear Encoder</strong></td>
<td></td>
<td><strong>MS 50</strong></td>
<td>12-17</td>
</tr>
<tr>
<td>• non-contact reflective scanning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• for high displacement velocities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• small version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• different scale versions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length (depends on scale version)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- glass scale to 3040 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- steel tape scale to 30 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reflective scanning Linear Encoder</strong></td>
<td></td>
<td><strong>MS 61</strong></td>
<td>18-21</td>
</tr>
<tr>
<td>• two switch tracks for individual special function</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• non-contact reflective scanning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• for high displacement velocities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• flat version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• different scale versions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length (depends on scale version)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- glass scale to 3040 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- steel tape scale to 30 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Interferential Linear Encoder</strong></td>
<td></td>
<td><strong>MS 8x</strong></td>
<td>22-23</td>
</tr>
<tr>
<td>• two switch tracks for individual special functions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• non-contact reflective scanning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• for high displacement velocities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• small version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• scale version: glass scale or ROBAX glassceramic with phase grating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length to 2440 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Linear Encoder with self-guided scanning head</strong></td>
<td></td>
<td><strong>MSG 10</strong></td>
<td>24-25</td>
</tr>
<tr>
<td>• scale version: steel tape scale on aluminium carrier</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• easy mounting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• flat version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• max. measuring length 400 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Two dimensional Encoder</strong></td>
<td></td>
<td><strong>TDE 60</strong></td>
<td>26-27</td>
</tr>
<tr>
<td>• non-contact reflective scanning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• scale version: chrome on glass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• measuring range 360 x 360 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• small version</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><strong>Modular Ring Rotary Encoder</strong></td>
<td></td>
<td>MSR 50 MS</td>
<td>28-29</td>
</tr>
<tr>
<td>• steel tape scale on steel ring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• for applications at the robotik, on printer and roundtables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• available diameter Ø80 mm to Ø165 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• non-contact reflective scanning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MSR 50 MK</td>
<td>30-31</td>
</tr>
<tr>
<td>• steel tape scale on sandwich clamping ring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• for applications at the robotik on printers and roundtables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• available diameter from Ø150 mm up to Ø500 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• non-contact reflective scanning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Precision measuring Probes</strong></td>
<td></td>
<td>DIT 10</td>
<td>32-33</td>
</tr>
<tr>
<td>• for universal applications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• stroke length 10 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting on shaft sleeve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• with cable lifter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• integrated pneumatic lifter optional</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Precision measuring Probes</strong></td>
<td></td>
<td>DIT 30</td>
<td>32-33</td>
</tr>
<tr>
<td>• for universal applications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• stroke length 30 / 48 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting on shaft sleeve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• mounting with two tapped holes on body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• with cable lifter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• integrated pneumatic lifter optional</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• sealing bellows optional</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# MS 50 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</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS 50.06</td>
<td>depending on external Subdividing</td>
<td>±5, ±10 µm/m</td>
<td>200 µm</td>
<td>16 m/s</td>
</tr>
<tr>
<td>MS 50.05</td>
<td>depending on external Subdividing</td>
<td>±3, ±5, ±10 µm/m</td>
<td>100 µm</td>
<td>8 m/s</td>
</tr>
<tr>
<td>MS 50.04</td>
<td>depending on external Subdividing</td>
<td>±3, ±5, ±10 µm/m</td>
<td>40 µm</td>
<td>3.2 m/s</td>
</tr>
</tbody>
</table>

| **Sinusoidal micro-current signals** |
| MS 50.16     | depending on external Subdividing | ±5, ±10 µm/m | 200 µm | 16 m/s |
| MS 50.15     | depending on external Subdividing | ±3, ±5, ±10 µm/m | 100 µm | 8 m/s |
| MS 50.14     | depending on external Subdividing | ±3, ±5, ±10 µm/m | 40 µm | 3.2 m/s |

| **Square wave Line Driver signals with integrated Subdividing** |
| MS 50.27     | 100 µm | ±20 µm/m | 400 µm | 30 m/s (> 2 µs) |
| MS 50.66     | 10 µm  | ±5, ±10 µm/m | 200 µm | 10 m/s (> 600 ns) |
| MS 50.76     | 5 µm   | ±5, ±10 µm/m | 200 µm | 10 m/s (> 300 ns) |
| MS 50.65     | 5 µm   | ±3, ±5, ±10 µm/m | 100 µm | 5 m/s (> 600 ns) |
| MS 50.46     | 2.5 µm | ±5, ±10 µm/m | 200 µm | 11.2 m/s (> 200 ns) |
| MS 50.75     | 2.5 µm | ±3, ±5, ±10 µm/m | 100 µm | 5 m/s (> 300 ns) |
| MS 50.56     | 2 µm   | ±5, ±10 µm/m | 200 µm | 9 m/s (> 200 ns) |
| MS 50.64     | 2 µm   | ±3, ±5, ±10 µm/m | 40 µm | 2 m/s (> 600 ns) |
| MS 50.45     | 1.25 µm | ±3, ±5, ±10 µm/m | 100 µm | 5.6 m/s (> 200 ns) |
| MS 50.86     | 1 µm   | ±5, ±10 µm/m | 200 µm | 0.9 m/s (> 100 ns) |
| MS 50.55     | 1 µm   | ±3, ±5, ±10 µm/m | 100 µm | 4.5 m/s (> 200 ns) |
| MS 50.74     | 1 µm   | ±3, ±5, ±10 µm/m | 40 µm | 2 m/s (> 300 ns) |
| MS 50.96     | 0.5 µm | ±5, ±10 µm/m | 200 µm | 4.5 m/s (> 100 ns) |
| MS 50.85     | 0.5 µm | ±3, ±5, ±10 µm/m | 100 µm | 4.5 m/s (> 100 ns) |
| MS 50.44     | 0.5 µm | ±3, ±5, ±10 µm/m | 40 µm | 2.2 m/s (> 200 ns) |
| MS 50.54     | 0.4 µm | ±3, ±5, ±10 µm/m | 40 µm | 1.8 m/s (> 200 ns) |
| MS 50.95     | 0.25 µm | ±3, ±5, ±10 µm/m | 100 µm | 2.2 m/s (> 100 ns) |
| MS 50.84     | 0.2 µm | ±3, ±5, ±10 µm/m | 40 µm | 1.8 m/s (> 200 ns) |
| MS 50.94     | 0.1 µm | ±3, ±5, ±10 µm/m | 40 µm | 9 m/s (> 100 ns) |

* Accuracy grades dependent on scale version

**Signal-outputs (optional):**

- **sinusoidal voltage signals**
  - MS 50.06
  - MS 50.05
  - MS 50.04

**Power supply:**

- +5V ±5%, max. 120 mA (unloaded)

**Output signals:**

- Encoder signals: 0.6 to 1.2 Vpp, typical 1 Vpp
- Reference pulse: 0.2 to 0.85 Vss, typical 0.4 V (useable component)
  - with terminating resistor Zo = 120 Ω

**Moiré-adjustment:**

- with electronic mounting controller PG1-U (accessories Page 41)

**Max. output frequency:**

- 80 kHz (with 3 m cable)

- **sinusoidal micro-current signals**
  - MS 50.16
  - MS 50.15
  - MS 50.14

**Power supply:**

- +5 V ±5%, max. 120 mA

**Output signals:**

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

**Moiré-adjustment:**

- with electronic mounting controller PG1-I (accessories Page 41)

**Max. output frequency:**

- 80 kHz (with 3 m cable)
MS 50  Technical data:

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

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

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

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

Permissible vibration: 150 m/s² (40 to 2000 Hz)
Permissible shock: 750 m/s² (8 ms)

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

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

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

Moiré-adjustment:
with electronic mounting controller PG1-I (accessories Page 41)

Ordering Example
for a graduation carrier:  

<table>
<thead>
<tr>
<th>scale name / model</th>
<th>grating pitch 40 µm</th>
<th>scale version: steel tape scale on steel carrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS 5x.x4 MS</td>
<td>2840 mm</td>
<td>±3 µm/m, ±5 µm/m oder ±10 µm/m</td>
</tr>
<tr>
<td>masuring length / accuracy / Reference mark</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Dimensions - Mounting tolerances - Mounting possibilities:

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

**Dimensions - Mounting possibilities:**

<table>
<thead>
<tr>
<th>Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS 50.xx MA</td>
<td>Steel tape scale glued onto aluminium carrier.</td>
</tr>
<tr>
<td>MS 50.xx MS</td>
<td>Steel tape scale on steel carrier.</td>
</tr>
</tbody>
</table>

**Mounting possibilities:**

- **M4/DIN 912**

**Reference-marks:**

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

**M = machine guideway**

**Grating pitch:**

- **⊗** 40 µm
- **⊙** 100 µm
- **●** 200 µm
**Version: MS 50.xx GA** = glass scale on aluminium carrier

overall length = measuring length + 30 mm

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

M = machine guideway

<table>
<thead>
<tr>
<th>grating pitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 µm</td>
</tr>
<tr>
<td>100 µm</td>
</tr>
<tr>
<td>200 µm</td>
</tr>
</tbody>
</table>

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

overall length = measuring length + 30 mm

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

M = machine guideway

<table>
<thead>
<tr>
<th>grating pitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 µm</td>
</tr>
<tr>
<td>100 µm</td>
</tr>
<tr>
<td>200 µm</td>
</tr>
</tbody>
</table>
**Dimensions - Mounting tolerances:**

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

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

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

**M = machine guideway**

**grading pitch**
- ○ 40 µm
- 100 µm
- ● 200 µm

**Dimensions - Mounting tolerances:**

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

**Version: MS 50.xx MO** = steel tape scale, **MS 50.xx MK** = steel tape scale with adhesive tape
**Version:** MS 50.xx ME = steel tape scale on aluminium carrier with stretching elements

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

M = machine guideway

- 200 µm
### MS 61 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</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS 61.06</td>
<td>depending on external Subdividing</td>
<td>±5, ±10 µm/m</td>
<td>200 µm</td>
<td>20 m/s</td>
</tr>
<tr>
<td>MS 61.05</td>
<td>depending on external Subdividing</td>
<td>±3, ±5, ±10 µm/m</td>
<td>100 µm</td>
<td>10 m/s</td>
</tr>
<tr>
<td>MS 61.04</td>
<td>depending on external Subdividing</td>
<td>±3, ±5, ±10 µm/m</td>
<td>40 µm</td>
<td>4 m/s</td>
</tr>
<tr>
<td><strong>Sinusoidal micro-current signals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS 61.16</td>
<td>depending on external Subdividing</td>
<td>±5, ±10 µm/m</td>
<td>200 µm</td>
<td>20 m/s</td>
</tr>
<tr>
<td>MS 61.15</td>
<td>depending on external Subdividing</td>
<td>±3, ±5, ±10 µm/m</td>
<td>100 µm</td>
<td>10 m/s</td>
</tr>
<tr>
<td>MS 61.14</td>
<td>depending on external Subdividing</td>
<td>±3, ±5, ±10 µm/m</td>
<td>40 µm</td>
<td>4 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>MS 61.66</td>
<td>10 µm</td>
<td>±5, ±10 µm/m</td>
<td>200 µm</td>
<td>10 m/s (&gt; 500 ns)</td>
</tr>
<tr>
<td>MS 61.24</td>
<td>10 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>40 µm</td>
<td>4 m/s (&gt; 1.6 µs)</td>
</tr>
<tr>
<td>MS 61.76</td>
<td>5 µm</td>
<td>±5, ±10 µm/m</td>
<td>200 µm</td>
<td>10 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td>MS 61.65</td>
<td>5 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>100 µm</td>
<td>5 m/s (&gt; 500 ns)</td>
</tr>
<tr>
<td>MS 61.46</td>
<td>2.5 µm</td>
<td>±5, ±10 µm/m</td>
<td>200 µm</td>
<td>11.2 m/s (&gt; 200 ns)</td>
</tr>
<tr>
<td>MS 61.75</td>
<td>2.5 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>100 µm</td>
<td>5 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td>MS 61.68</td>
<td>2.5 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>50 µm</td>
<td>2.5 m/s (&gt; 500 ns)</td>
</tr>
<tr>
<td>MS 61.56</td>
<td>2 µm</td>
<td>±5, ±10 µm/m</td>
<td>200 µm</td>
<td>9 m/s (&gt; 200 ns)</td>
</tr>
<tr>
<td>MS 61.64</td>
<td>2 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>40 µm</td>
<td>2 m/s (&gt; 500 ns)</td>
</tr>
<tr>
<td>MS 61.45</td>
<td>1.25 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>100 µm</td>
<td>5.6 m/s (&gt; 200 ns)</td>
</tr>
<tr>
<td>MS 61.78</td>
<td>1.25 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>50 µm</td>
<td>2.5 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td>MS 61.86</td>
<td>1 µm</td>
<td>±5, ±10 µm/m</td>
<td>200 µm</td>
<td>9 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>MS 61.55</td>
<td>1 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>100 µm</td>
<td>4.5 m/s (&gt; 200 ns)</td>
</tr>
<tr>
<td>MS 61.74</td>
<td>1 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>40 µm</td>
<td>2 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td>MS 61.96</td>
<td>0.5 µm</td>
<td>±5, ±10 µm/m</td>
<td>200 µm</td>
<td>4.5 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>MS 61.85</td>
<td>0.5 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>100 µm</td>
<td>4.5 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>MS 61.58</td>
<td>0.5 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>50 µm</td>
<td>2.2 m/s (&gt; 200 ns)</td>
</tr>
<tr>
<td>MS 61.44</td>
<td>0.5 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>40 µm</td>
<td>2.2 m/s (&gt; 200 ns)</td>
</tr>
<tr>
<td>MS 61.84</td>
<td>0.2 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>40 µm</td>
<td>1.8 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>MS 61.95</td>
<td>0.25 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>100 µm</td>
<td>2.2 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>MS 61.88</td>
<td>0.25 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>50 µm</td>
<td>2.2 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>MS 61.98</td>
<td>0.125 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>50 µm</td>
<td>1.1 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>MS 61.94</td>
<td>0.1 µm</td>
<td>±3, ±5, ±10 µm/m</td>
<td>40 µm</td>
<td>0.9 m/s (&gt; 100 ns)</td>
</tr>
</tbody>
</table>

*accuracy grades dependent on scale versions

**Signal-outputs (optional):**

- **sinusoidal voltage signals**
  - MS 61.06
  - MS 61.05
  - MS 61.04

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

**Output signals:**
- Encoder signals: 0.6 to 1.2 Vpp, typical 1 Vpp with terminating resistor Z_0 = 120 Ω
- Reference pulse: 0.2 to 0.85 Vss, typical 0.4 V (useable component) with terminating resistor Z_0 = 120 Ω

**Moiré-adjustment:**
- with electronic mounting controller PG1-U (accessories Page 41)

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

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

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

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

**Moiré-adjustment:**
- with electronic mounting controller PG1-I (accessories Page 41)

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

**MS 60 (optional) = with 15-pin chassis mounted connector MDSM-15PE**
The Subdividing Electronic is mounted right at the scanning head.
## MS 61 Technical data:

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

### Order Example for a graduation carrier:

<table>
<thead>
<tr>
<th>Scale version</th>
<th>Measuring Length</th>
<th>Accuracy</th>
<th>Reference mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS 61.x-x MS</td>
<td>3000 mm</td>
<td>±3 µm/m</td>
<td></td>
</tr>
<tr>
<td>MS 61.x-x MA</td>
<td>3000 mm</td>
<td>±5 µm/m</td>
<td></td>
</tr>
<tr>
<td>MS 61.x-x GA</td>
<td>3000 mm</td>
<td>±10 µm/m</td>
<td></td>
</tr>
</tbody>
</table>

### Technical data:

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

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

**Standard measuring length:** (mm) 120, 170, 220, 270, 320, 370, 420, 470, 520, 620, 720, 820, 920, 1040, 1140, 1240, 1340, 1450, 1640, 1740, 1840, 2040, 2240, 2440, 2640, 2840, 3040

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

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

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

**Permissible shock:** 750 m/s² (8 ms)

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

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

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

**Moiré-adjustment:**
- with electronic mounting controller PG1-I (accessories Page 41)
Dimensions - Mounting tolerances - Mounting possibilities:

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

---

**Legend for all versions!**

- **M** = machine guideway
- k = any position of reference-mark
- j = additional reference-marks separated by \( n \times 50 \text{ mm} \)

**Switch tracks:**
- \( x_1, x_2 \) = length of cover tapes
- Switch position left: \( y_1 = x_1 + 2 \text{ mm} \)
- Switch position right: \( y_2 = x_2 + 0.5 \text{ mm} \)

---

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

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

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

**Version: MS 61.xx-x MO** = steel tape scale, **MS 61.xx-x MK** = steel tape scale with adhesive tape
**MS 80** Technical data:

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades</th>
<th>Grating pitch</th>
<th>Max. velocity</th>
</tr>
</thead>
</table>
| • Sinusoidal voltage signals
  **MS 80.00** | depending on external Subdividing | ±2, ±3 µm/m | 4 µm | 1,2 m/s |

• Square wave Line Driver signals with integrated Subdividing
  **MS 80.70** | 0,1 µm | ±2, ±3 µm/m | 4 µm | 1 m/s | (> 25 ns) |
  **MS 80.30** | 0,05 µm | ±2, ±3 µm/m | 4 µm | 0,45 m/s | (> 100 ns) |
  **MS 80.50** | 0,04 µm | ±2, ±3 µm/m | 4 µm | 0,36 m/s | (> 100 ns) |
  **MS 80.80** | 0,02 µm | ±2, ±3 µm/m | 4 µm | 0,18 m/s | (> 100 ns) |
  **MS 80.90** | 0,01 µm | ±2, ±3 µm/m | 4 µm | 0,09 m/s | (> 100 ns) |

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

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

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

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

(longer measuring lengths upon request)

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

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

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

Permissible vibration: 150 m/s² (40 to 2000 Hz)
Permissible shock: 750 m/s² (8 ms)
Permissible temperature:
-20°C to +70°C (storage), 0°C to +50°C (operation)

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

Signal-outputs (optional):
• sinusoidal voltage signals
  **MS 80.00**

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

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

  Moiré-adjustment:
  with electronic mounting controller PG1-U (accessories Page 41)

  Max. output frequency: 300 kHz

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

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

  Moiré-adjustment:
  with electronic mounting controller PG1-I (accessories Page 41)

Reference impuls:

**Version with integrated Subdividing Electronics**

**Version with sinusoidal voltage signals**
Dimensions - Mounting tolerances - Mounting possibilities:

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

For optimum termic behavior we are recommending to stick the scale at one end or near the RI mark.
MSG 10 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>MSG 10.45</td>
<td>1,25 µm</td>
<td>±10 µm/m</td>
<td>100 µm</td>
<td>1 m/s (&gt; 800 ns)</td>
</tr>
<tr>
<td>MSG 10.55</td>
<td>1 µm</td>
<td>±10 µm/m</td>
<td>100 µm</td>
<td>1 m/s (&gt; 800 ns)</td>
</tr>
<tr>
<td>MSG 10.74</td>
<td>1 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>1 m/s (&gt; 800 ns)</td>
</tr>
<tr>
<td>MSG 10.85</td>
<td>0,5 µm</td>
<td>±10 µm/m</td>
<td>100 µm</td>
<td>1 m/s (&gt; 400 ns)</td>
</tr>
<tr>
<td>MSG 10.95</td>
<td>0,25 µm</td>
<td>±10 µm/m</td>
<td>100 µm</td>
<td>1 m/s (&gt; 200 ns)</td>
</tr>
<tr>
<td>MSG 10.94</td>
<td>0,1 µm</td>
<td>±10 µm/m</td>
<td>40 µm</td>
<td>0,9 m/s (&gt; 100 ns)</td>
</tr>
</tbody>
</table>

- Scanning read: guided by ball bearings, coupling over spring-steel rod
- Scale version: steel tape scale on aluminium carrier
- Max. measuring length: 400 mm
- Reference mark (RI):
  - optional:
    - One Reference mark at any location, or two or more RI’s separated by distances of n x 50 mm
- Permissible vibration: 150 m/s² (40 to 2000 Hz)
- Permissible shock: 750 m/s² (8 ms)
- Permissible temperature:
  - -20°C to +70°C (storage), 0°C to +50°C (operation)
- Weight (approx.):
  - 30 g/100 mm (steel tape scale on aluminium carrier) + 85 g (scanning head without cable)

Signal-outputs (optional):

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

Power supply:
- +5 V ±5%, max. 200 mA (unloaded)
Dimensions - Mounting tolerances - Mounting possibilities:

**MSG 10.xx MA** = steel tape scale on aluminium carrier
TDE 60 Technical data:

<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>Sinusoidal voltage signals 1 Vpp</td>
<td>TDE 60.04</td>
<td>depending on external Subdividing</td>
<td>±3</td>
<td>40</td>
</tr>
<tr>
<td>Sinusoidal micro-current signals</td>
<td>TDE 60.14</td>
<td>depending on external Subdividing</td>
<td>±3</td>
<td>40</td>
</tr>
<tr>
<td>Square wave Line Driver signals with integrated Subdividing</td>
<td>TDE 60.64</td>
<td>2</td>
<td>±3</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>TDE 60.74</td>
<td>1</td>
<td>±3</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>TDE 60.44</td>
<td>0.5</td>
<td>±3</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>TDE 60.54</td>
<td>0.4</td>
<td>±3</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>TDE 60.84</td>
<td>0.2</td>
<td>±3</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>TDE 60.94</td>
<td>0.1</td>
<td>±3</td>
<td>40</td>
</tr>
</tbody>
</table>

Scale version: chrome on glass
Measuring length: 360 x 360 mm (other measuring range upon request)
Reference mark (RI): position at the beginning of the measuring range (X- and Y-Axis)
Permissible vibration: 150 m/s² (40 to 2000 Hz)
Permissible shock: 750 m/s² (8 ms)
Permissible temperature: -20°C to +70°C (storage), 0°C to +50°C (operation)
Weight (approx.): 0.8 g/cm² (glass plate) + 35 g (scanning head without cable)

Signal-outputs (optional):
- sinusoidal voltage signals
  TDE 60.04
  Power supply: +5V ±5%, max. 200 mA (unloaded)
  Output signals:
  Encoder signals: 0.6 to 1.2 Vpp, typical 1 Vpp with terminating resistor Zo = 120 Ω
  Reference pulse: 0.2 to 0.85 V, typical 0.4 V (useable component), with terminating resistor Zo = 120 Ω
  Moiré-adjustment:
  with electronic mounting controller PG1-U (accessories Page 41)
  Max. output frequency: 100 kHz (with 3 m cable)

- sinusoidal micro-current signals
  TDE 60.14
  Power supply: +5 V ±5%, max. 180 mA
  Output signals:
  Encoder signals: 7 to 16 µApp, typical 11.5 µApp at 1 KΩ
  Reference pulse: 2 to 8 µA, typical 5 µA (useable component) at 1 KΩ
  Moiré-adjustment:
  with electronic mounting controller PG1-I (accessories Page 41)
  Max. output frequency: 100 kHz (with 3 m cable)

- square wave signals (differential)
  via Line Driver RS 422 standard with integrated Subdividing Electronics with analog signal switch-over for setup (see AWS assignment below and page 41)
  TDE 60.64 = times 5
  TDE 60.74 = times 10
  TDE 60.44 = times 20
  TDE 60.54 = times 25
  TDE 60.84 = times 50
  TDE 60.94 = times 100
  Power supply: +5 V ±5%, max. 400 mA (unloaded)
  Moiré-adjustment:
  with electronic mounting controller PG1-I (accessories Page 41)

LD15 PIN
- Test = analog signal switch-over for setup
  By applying +5V to the test pin, instead of the square wave signals the test signals (analog) are switched to the output connector.
  The shield is connected with the chassis

<table>
<thead>
<tr>
<th>X-axis</th>
<th>Y-axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 9 10 11 12 13 14 15</td>
<td>8 9 10 11 12 13 14 15</td>
</tr>
<tr>
<td>voltage signals</td>
<td>A1 A1 A2 A2 RI RI +5 V</td>
</tr>
<tr>
<td>micro-current signals</td>
<td>0°+ 0°- 90°+ 90°- RI+ RI- +5 V</td>
</tr>
<tr>
<td>AWS PIN</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>8 9 10 11 12 13 14 15</td>
<td></td>
</tr>
<tr>
<td>square wave signals</td>
<td>T1 T1 T2 T2 RI RI +5 V</td>
</tr>
<tr>
<td>via Line Driver</td>
<td></td>
</tr>
<tr>
<td>8 9 10 11 12 13 14 15</td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td></td>
</tr>
</tbody>
</table>

Scale version: chrome on glass
Measuring length: 360 x 360 mm (other measuring range upon request)
Reference mark (RI): position at the beginning of the measuring range (X- and Y-Axis)
Permissible vibration: 150 m/s² (40 to 2000 Hz)
Permissible shock: 750 m/s² (8 ms)
Permissible temperature: -20°C to +70°C (storage), 0°C to +50°C (operation)
Weight (approx.): 0.8 g/cm² (glass plate) + 35 g (scanning head without cable)
TDE 60 Dimensions - Mounting tolerances:

- Connector LD15 15-pin
  - Version:
    - voltage signals
    - micro-current signals

- Connector AWS 15-pin
  - Version:
    - square wave Line Driver signals

beginning of measuring range = maximum of reference pulse
overtravel max. 0,5 mm

cable length 3 m
MSR 50 MS  Technical data:

<table>
<thead>
<tr>
<th>Encoder type</th>
<th>Grating pitch</th>
<th>Max. velocity (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sinusoidal voltage signals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSR 50.06 MS</td>
<td>200 µm</td>
<td>16 m/s</td>
</tr>
<tr>
<td><strong>Sinusoidal micro-current signals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSR 50.16 MS</td>
<td>200 µm</td>
<td>16 m/s</td>
</tr>
<tr>
<td><strong>Square wave Line Driver signals with integrated Subdividing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSR 50.66 MS</td>
<td>200 µm</td>
<td>10 m/s (&gt; 600 ns)</td>
</tr>
<tr>
<td>MSR 50.76 MS</td>
<td>200 µm</td>
<td>10 m/s (&gt; 300 ns)</td>
</tr>
<tr>
<td>MSR 50.56 MS</td>
<td>200 µm</td>
<td>9 m/s (&gt; 200 ns)</td>
</tr>
<tr>
<td>MSR 50.86 MS</td>
<td>200 µm</td>
<td>9 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>MSR 50.46 MS</td>
<td>200 µm</td>
<td>4.5 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>MSR 50.96 MS</td>
<td>200 µm</td>
<td>4.5 m/s (&gt; 100 ns)</td>
</tr>
</tbody>
</table>

### Signal-outputs (optional):

- **Sinusoidal voltage signals**
  MSR 50.06 MS
  - Power supply:
    +5V ±5%, max. 120 mA (unloaded)
  - Encoder signals: 0.6 to 1.2 Vpp, typical 1 Vpp with terminating resistor Zo = 120 Ω
  - Reference pulse:
    0.2 to 0.85 V, typical 0.4 V (useable component) with terminating resistor Zo = 120 Ω
  - Moiré-adjustment:
    with electronic mounting controller PG1-U
    (accessories Page 41)
  - Max. output frequency:
    80 kHz (with 3 m cable)

- **Sinusoidal micro-current signals**
  MSR 50.16 MS
  - Power supply:
    +5 V ±5%, max. 120 mA
  - Encoder signals: 7 to 16 µApp, typical 11.5 µApp at 1 kΩ
  - Reference pulse:
    2 to 8 µA, typical 5 µA (useable component) at 1 kΩ
  - Moiré-adjustment:
    with electronic mounting controller PG1-I
    (accessories Page 41)
  - Max. output frequency:
    80 kHz (with 3 m cable)

- **Square wave signals** (single ended) with integrated Subdividing Electronics
  - Power supply:
    +5 V ±5%, max. 200 mA
  - Encoder signals: 4.5 m/s (> 100 ns)
  - Reference mark (RI):
    One Reference mark at any location
  - Permissible vibration:
    150 m/s² (40 to 2000 Hz)
  - Permissible shock:
    750 m/s² (8 ms)
  - Permissible temperature:
    -20°C to +70°C (storage), 0°C bis +50°C (operation)
  - Weight (approx.)
    85 g (scanning head without cable)
**MSR 50.xx MS** Dimensions - Mounting tolerances:

- **length of cable**: 3m
- **distance**: 0.4 ±0.1
- **X = shaft diameter, permissible tolerance**: +0.05, 0.15 mm
- **tighten the threaded screw with jacket key**
**MSR 50 MK** Technical data:

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

**Resolution**:

\[
\text{Resolution} = \frac{360 \times \text{Grating pitch}}{\text{Da} \times 4 \times \text{Subdividing}}
\]

**Measuring failure**:

\[
\text{Measuring failure} = \frac{412 \times E}{\text{Da}}
\]

**Accuracy**:

1°

**Scale version**: Steel tape scale on sandwich-clamping ring

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

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

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

**Permissible shock**: 750 m/s² (8 ms)

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

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

### Signal-outputs (optional):

- **sinusoidal voltage signals**
  - MSR 50.04 MK
  - MSR 50.06 MK
  - Power supply: +5 V ±5%, max. 120 mA (unloaded)
  - Encoder signals: 0.6 to 1.2 Vpp, typical 1 Vpp
    - with terminating resistor Zo = 120 Ω
  - Reference pulse: 0.2 to 0.85 V, typical 0.4 V (useable component)
    - with terminating resistor Zo = 120 Ω
  - Moiré-adjustment:
    - with electronic mounting controller PG1-U
  - Max. output frequency:
    - 80 kHz (with 3 m cable)

- **sinusoidal micro-current signals**
  - MSR 50.14 MK
  - MSR 50.16 MK
  - Power supply: +5 V ±5%, max. 120 mA
  - Encoder signals: 7 to 16 µApp, typical 11.5 µApp at 1 KΩ
  - Reference pulse: 2 to 8 µA, typical 5 µA (useable component) at 1 KΩ
  - Moiré-adjustment:
    - with electronic mounting controller PG1-I
  - Max. output frequency:
    - 80 kHz (with 3 m cable)

- **square wave signals** (single ended) with integrated Subdividing Electronics
  - MSR 50.64 MK = times 5
  - MSR 50.66 MK = times 5
  - MSR 50.74 MK = times 10
  - MSR 50.76 MK = times 10
  - MSR 50.44 MK = times 20
  - MSR 50.46 MK = times 20
  - MSR 50.54 MK = times 25
  - MSR 50.56 MK = times 25
  - MSR 50.84 MK = times 50
  - MSR 50.86 MK = times 50
  - MSR 50.94 MK = times 100
  - MSR 50.96 MK = times 100
  - Power supply: +5 V ±5%, max. 200 mA (unloaded)
  - Moiré-adjustment:
    - with electronic mounting controller PG1-I

- **square wave signals** (differential) via Line Driver RS 422 standard with integrated Subdividing Electronics with analog signal switch-over for setup
  - (see page 36/37 and 41)
  - MSR 50.64 MK = times 5
  - MSR 50.66 MK = times 5
  - MSR 50.74 MK = times 10
  - MSR 50.76 MK = times 10
  - MSR 50.44 MK = times 20
  - MSR 50.46 MK = times 20
  - MSR 50.54 MK = times 25
  - MSR 50.56 MK = times 25
  - MSR 50.84 MK = times 50
  - MSR 50.86 MK = times 50
  - MSR 50.94 MK = times 100
  - MSR 50.96 MK = times 100
  - Power supply: +5 V ±5%, max. 200 mA (unloaded)
  - Moiré-adjustment:
    - with electronic mounting controller PG1-I
**Mounting Instruction**

1. Stretch the ring with hexagon socket set screws
2. Bring the ring over the shaft
3. Remove hexagon socket set screws
4. Tighten clamping screws

---

**Dimensions - Mounting Tolerances:**

- **X = shaft diameter**
- **length of cable 3 m**
- **clamping screw**
- **steel tape scale**
- **stretching ring**
- **hexagon socket set screw M2**
**Technical data:**

<table>
<thead>
<tr>
<th>Scale model</th>
<th>System resolution</th>
<th>Accuracy grades *</th>
<th>Grating pitch</th>
<th>Max. (Edge distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sinusoidal voltage signals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIT 10.13</td>
<td>depending on external Subdividing</td>
<td>±1 µm</td>
<td>20 µm</td>
<td>2 m/s (&gt; 1,6 µs)</td>
</tr>
<tr>
<td>DIT 10.11</td>
<td>depending on external Subdividing</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>1 m/s (&gt; 500 ns)</td>
</tr>
<tr>
<td>DIT 30.13</td>
<td>depending on external Subdividing</td>
<td>±1 µm</td>
<td>20 µm</td>
<td>2 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td>DIT 30.11</td>
<td>depending on external Subdividing</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>1 m/s (&gt; 100 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>DIT 10.23</td>
<td>5 µm</td>
<td>±1 µm</td>
<td>20 µm</td>
<td>2 m/s (&gt; 1,6 µs)</td>
</tr>
<tr>
<td>DIT 10.63</td>
<td>1 µm</td>
<td>±1 µm</td>
<td>20 µm</td>
<td>1 m/s (&gt; 500 ns)</td>
</tr>
<tr>
<td>DIT 10.73</td>
<td>0.5 µm</td>
<td>±1 µm</td>
<td>20 µm</td>
<td>0.5 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td>DIT 10.71</td>
<td>0.25 µm</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>0.3 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>DIT 10.51</td>
<td>0.1 µm</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>0.1 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td>DIT 10.81</td>
<td>0.05 µm</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>0.05 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>DIT 10.91</td>
<td>0.025 µm</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>0.025 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>DIT 30.23</td>
<td>5 µm</td>
<td>±1 µm</td>
<td>20 µm</td>
<td>2 m/s (&gt; 1,6 µs)</td>
</tr>
<tr>
<td>DIT 30.63</td>
<td>1 µm</td>
<td>±1 µm</td>
<td>20 µm</td>
<td>1 m/s (&gt; 500 ns)</td>
</tr>
<tr>
<td>DIT 30.73</td>
<td>0.5 µm</td>
<td>±1 µm</td>
<td>20 µm</td>
<td>0.5 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td>DIT 30.71</td>
<td>0.25 µm</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>0.3 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>DIT 30.51</td>
<td>0.1 µm</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>0.1 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td>DIT 30.81</td>
<td>0.05 µm</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>0.05 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>DIT 30.91</td>
<td>0.025 µm</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>0.025 m/s (&gt; 100 ns)</td>
</tr>
</tbody>
</table>

**Signal-outputs (optional):**

- **sinusoidal micro-current signals**
  - DIT 10.13
  - DIT 10.11
- **DIT 30.13**
- **DIT 30.11**

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

**Encoder signals:**
7 to 16 µApp, typical 11.5 µApp at 1 kΩ
Reference pulse: 2 to 8 µA, typical 5 µA (useable component) at 1 kΩ

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

- **square wave signals** (differential) via Line Driver RS 422 standard with integrated Subdividing Electronics
  - DIT 10.23 = time 1
  - DIT 10.63 = times 5
  - DIT 10.73 = times 10
  - DIT 10.71 = times 10
  - DIT 10.51 = times 25
  - DIT 10.81 = times 50
  - DIT 10.91 = times 100
  - DIT 30.23 = time 1
  - DIT 30.63 = times 5
  - DIT 30.73 = times 10
  - DIT 30.71 = times 10
  - DIT 30.51 = times 25
  - DIT 30.81 = times 50
  - DIT 30.91 = times 100

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

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

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

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

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

**Measuring force:** <1.6 N (shaft oriented downward)

**Permissible lateral force at the shaft:** 0.2 N

**Accessories:**
cable lifter

**Optional:**
integrated pneumatic lifter (on request)

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

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

**DIT 10**

![Diagram of DIT 10 dimensions](image)

- Dimensions:
  - Standard measuring contact (included at the shipment)
  - Ø4.5 M 2.5 - 6g

**DIT 30**

![Diagram of DIT 30 dimensions](image)

- Dimensions:
  - Standard measuring contact (included at the shipment)
  - Ø4.5 M 2.5 - 6g

Version: **DIT 30.xx B**
**DIT 48 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></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIT 48.13</td>
<td>depending on external Subdividing</td>
<td>±1 µm</td>
<td>20 µm</td>
<td>2 m/s (&gt; 1.6 µs)</td>
</tr>
<tr>
<td>DIT 48.11</td>
<td>depending on external Subdividing</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>1 m/s (&gt; 500 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>DIT 48.23</td>
<td>5 µm</td>
<td>±1 µm</td>
<td>20 µm</td>
<td>2 m/s (&gt; 1.6 µs)</td>
</tr>
<tr>
<td>DIT 48.63</td>
<td>1 µm</td>
<td>±1 µm</td>
<td>20 µm</td>
<td>1 m/s (&gt; 500 ns)</td>
</tr>
<tr>
<td>DIT 48.73</td>
<td>0,5 µm</td>
<td>±1 µm</td>
<td>20 µm</td>
<td>0,5 m/s (&gt; 250 ns)</td>
</tr>
<tr>
<td>DIT 48.71</td>
<td>0,25 µm</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>0,25 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>DIT 48.51</td>
<td>0,1 µm</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>0,3 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>DIT 48.81</td>
<td>0,05 µm</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>0,45 m/s (&gt; 100 ns)</td>
</tr>
<tr>
<td>DIT 48.91</td>
<td>0,025 µm</td>
<td>±1 µm</td>
<td>10 µm</td>
<td>0,225 m/s (&gt; 100 ns)</td>
</tr>
</tbody>
</table>

Stroke length: 48 mm

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

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

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

Meßkraft: 1,6 N (shaft oriented downward)

Permissible lateral force at the shaft: 0,2 N

Accessories: cable lifter

Optional: integrated pneumatic lifter (on request)

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

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

**Signal-outputs (optional):**

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

Power supply:
+5 V ±5%, max. 120 mA

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

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

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

DIT 48.23 = time 1
DIT 48.63 = times 5
DIT 48.73 = times 10
DIT 48.71 = times 10
DIT 48.51 = times 25
DIT 48.81 = times 50
DIT 48.91 = times 100

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

**DIT 48**

**Version: DIT 48.xx B**

- Strokelenqth
- Ø8h6 shaft sleeve
- Cable lifter
- Cable to PRO / counter cable length 1.5 m

**Standard measuring contact**
(included at the shipment)
Connector, female connector, pin outs, analog signal switch-over

**DIN**

**Male connector L 120**
12-pin

**PIN outs connector** (view on pins)

**Female connector K 120**
12-pin

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

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

**L 120, K 120, F 120**

**PIN**

Square wave signals + LD

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>shield or test</td>
<td>GND</td>
<td>T1</td>
<td>TT</td>
<td>T2</td>
<td>GND</td>
<td>RI</td>
<td>TT</td>
<td>GND</td>
<td>5 V</td>
<td>T2</td>
<td>5 V</td>
</tr>
</tbody>
</table>

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

**CONNEI**

**Male connector L 91**
9-pin

**PIN outs connector** (view on pins)

**Female connector K 91**
9-pin

**Female connector KM 91**
9-pin

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

- **L 91, K 91, KM 91**

<table>
<thead>
<tr>
<th>PIN A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>inner shield</td>
<td>+5 V</td>
<td>A2</td>
<td>+5 V</td>
<td>A1</td>
<td>AT</td>
<td>+5 V</td>
<td>A2</td>
<td>inner shield</td>
<td>GND</td>
<td>GND</td>
<td>+5 V (outer shield on chassis)</td>
</tr>
</tbody>
</table>

**CONNEI**

**Male connector L 121**
12-pin

**PIN outs connector** (view on pins)

**Female connector K121**
12-pin

**Female connector KM 121**
12-pin

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

**L 121, K121, KM 121**

<table>
<thead>
<tr>
<th>PIN A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square wave signals + LD</td>
<td>12</td>
<td>5 V</td>
<td>RI</td>
<td>TT</td>
<td>T1</td>
<td>TT</td>
<td>T2</td>
<td>T2</td>
<td>shield or test</td>
<td>0 V</td>
<td>0 V</td>
</tr>
</tbody>
</table>

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

<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>
</tr>
</thead>
<tbody>
<tr>
<td>Square wave signals (differential)</td>
<td>test</td>
<td>R1</td>
<td>T2</td>
<td>T1</td>
<td>+5V</td>
<td>nc</td>
<td>nc</td>
<td>nc</td>
<td>GND</td>
</tr>
<tr>
<td>Square wave signals (single ended)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage signals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

---

**Evaluation-connector AWS**

<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 + LD</td>
<td>test</td>
<td>GND</td>
<td>nc</td>
<td>R1</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>Micro-current signals</td>
<td></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>Voltage signals</td>
<td></td>
<td>GND</td>
<td>nc</td>
<td>RI</td>
<td>A2</td>
<td>A1</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>

- **Test** = analog signal switch-over for setup
- By applying +5V to the test pin, instead of the square wave signals the test signals (analog) are switched to the output connector.
- S1, S2 = switch signals
- The shield is connected with the chassis
Switch outs MS 61, MS 81

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

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

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

**Version 4**
open collector output (active low)
Subdividing Electronics ZE-xx

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

The ZE-xx divides the scale grating pitch to achieve finer resolutions and outputs square wave signals.

In addition, differential (complementary) Line Driver signals are output.

The Subdividing Electronic units are supplied in rugged housings, meeting the sealing requirements of IP 64.

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

**ZE-Vx**
- for Linear Encoders with sinusoidal micro-current signals

**Interpolation:**

<table>
<thead>
<tr>
<th>ZE-Sx</th>
<th>ZE-Vx</th>
<th>Interpolation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZE-S5</td>
<td>ZE-V5</td>
<td>times 5</td>
</tr>
<tr>
<td>ZE-S10</td>
<td>ZE-V10</td>
<td>times 10</td>
</tr>
<tr>
<td>ZE-S20</td>
<td>ZE-V20</td>
<td>times 20</td>
</tr>
<tr>
<td>ZE-S25</td>
<td>ZE-V25</td>
<td>times 25</td>
</tr>
<tr>
<td>ZE-S50</td>
<td>ZE-V50</td>
<td>times 50</td>
</tr>
<tr>
<td>ZE-S100, ZE-V100</td>
<td>times 100</td>
<td></td>
</tr>
<tr>
<td>ZE-S200, ZE-V200</td>
<td>times 200</td>
<td></td>
</tr>
<tr>
<td>ZE-S400, ZE-V400</td>
<td>times 400</td>
<td></td>
</tr>
</tbody>
</table>

**Connectors:**

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

**Power supply:** +5 V ±5%

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

**Input signals ZE-Sx:**
- Encoder signals: sinusoidal voltage signals 0.6 to 1.2 Vpp (1Vpp typical)
- Reference pulse: 0.2 to 0.85 V typical 0.4 V (effective quota) with terminating impedance Zo = 120 Ω

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

**Max. input frequency:**

<table>
<thead>
<tr>
<th>ZE-Sx</th>
<th>ZE-Vx</th>
<th>Max. input frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZE-S5</td>
<td>ZE-V5</td>
<td>100 kHz, t_τ &gt; 300 ns</td>
</tr>
<tr>
<td>ZE-S10</td>
<td>ZE-V10</td>
<td>50 kHz, t_τ &gt; 300 ns</td>
</tr>
<tr>
<td>ZE-S20</td>
<td>ZE-V20</td>
<td>56 kHz, t_τ &gt; 200 ns</td>
</tr>
<tr>
<td>ZE-S25</td>
<td>ZE-V25</td>
<td>45 kHz, t_τ &gt; 200 ns</td>
</tr>
<tr>
<td>ZE-S50</td>
<td>ZE-V50</td>
<td>45 kHz, t_τ &gt; 100 ns</td>
</tr>
<tr>
<td>ZE-S100, ZE-V100</td>
<td>22.5 kHz, t_τ &gt; 100 ns</td>
<td></td>
</tr>
</tbody>
</table>

**Output signals:**

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

**Dimensions:**

(from Encoder)

- 138 mm
- 6 mm
- 86 mm
- 98 mm
- 28 mm
- 34 mm
- 128 mm
- cable length 1 m

(from Encoder to DRO/counter)

- 39 mm
- 14 mm
- 30 mm
- 32 mm

(from Encoder to FS 121 or L121)

- 39 mm
- 14 mm
- 30 mm
- 32 mm
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 I/O-signals

---

**Block Diagram**

- X1 = female D-sub terminal strip, 25-pin for counter interface
- X2 = female D-sub terminal strip, 9-pin for switching and control signals
- J1-J3 = jumper for the selection of the encoder operating voltage (5 V or 12 V)
- IC1 = PCI interface
Electronic mounting controller PG1-x

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

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

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

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

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

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

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

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

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

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

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

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

DG 118, DG 120
- Rotary Encoder for universal application
- standard line/rev. graduated from 100 up to 5.400
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>100</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)
RSF Offices

Austria
RSF Elektronik Ges.m.b.H.
A-5121 Tarsdorf

Switzerland
RSF Elektronik (Schweiz) AG
Mühlstrasse 18
CH-8320 Fehraltorf
Telefon: +41 (0)1 955 10 50
Telefax: +41 (0)1 955 10 51
e-mail: rsf@bluewin.ch

USA
RSF Electronics Inc.
2880 Gold Tailings Court
Rancho Cordova, CA 95670
Telefon: +1 916 852 - 6660
Telefax: +1 916 852 - 6664
e-mail: al@rsf.net

Slovenia
RSF Elektronik prodaja, d.o.o.
Jozeta Jame 14
SI-61210 Ljubljana
Telefon: +386 1 519 88 80
Telefax: +386 1 519 88 80

Korea
RSF Electronics Ltd.
1224-7 SUNGSEOK-Dong
ILSAN-Ku, KOYANG-Si,
KYUNGGI-Do, Korea R.O.K.
Telefon: +82-31-977-4136
Telefax: +82-31-977-4139

Certified according to DIN EN ISO 9001
DIN EN ISO 14001