MC 15
ABSOLUTE EXPOSED
LINEAR ENCODERS
SPECIAL FEATURES

Due to increasing demand for absolute position valuation RSF Elektronik offers the MC 15, an absolute exposed linear encoder.

- ABSOLUTE POSITION VALUATION
- LARGE MOUNTING TOLERANCES
- SERIAL INTERFACES

TERM EXPLANATIONS

Absolute position indexing
Serial encoding of a line sequence as a highly precise graduation.

Scanning head
Opto-electronic scanning device of a graduation.

Measuring step
The smallest digital counting step produced by an encoder.

Yaw angle, pitch angle, roll angle, lateral shift, airgap
Mounting tolerances of the encoder head relative to the scale.

Function reserve
Monitoring of the scanning signals.

Accuracy
This is a fundamental characteristic, which is specified with an accuracy grade (e.g. ±5 µm/m).

Abbe error
Measuring error due to lateral distance between the measuring system and the machining level.
FEATURES

To meet the increasing demand in the market for absolute position value determination, RSF Elektronik's product portfolio also includes an absolute open linear encoder with the MC 15. This is driven by steadily increasing demands for:

- AVOIDING REFERENCING
- ADVANCED OPERATIONAL SAFETY
- HIGH TRAVERSING SPEED
- SMALL DIMENSIONS
- NO MECHANICAL BACKLASH
- ZERO FRICTIONAL FORCE
- WEAR-FREE OPERATION

ABSOLUTE MEASUREMENT PRINCIPLE

This means the position valuation from evaluating one unique code information at any point over the entire measuring length. For this the scanning head needs not to be moved relative to the scale, so that the position value is available immediately after power-on. Reference points and reference drives are thus not required. The subsequent electronics may access this position value at any time.
SHIELDING, PIN ASSIGNMENTS

Shielded PUR-cable, Ø 3.7 mm
Drag chain qualified.

Bending radius fixed mounting
Bending radius continuous flexing

Pin assignment EnDat 2.2

<table>
<thead>
<tr>
<th>Voltage supply</th>
<th>Absolute position values</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
</tr>
</tbody>
</table>

- **Up** = power supply voltage
- **Sensor** Up = 0 V
- **Sensor** 0 V = 5 V
- **DATA** = Grey
- **DATA** = Pink
- **CLOCK** = Violet
- **CLOCK** = Yellow

According to IEC 61076-2-101 LM008–Gxx–A

- **8-pin M12-connector**
- **15-pin D-sub**
Pin assignment Mitsubishi

**8-pin M12-connector** according to IEC 61076-2-101 LM008–Gxx-A

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</table>

Mit03-4

<table>
<thead>
<tr>
<th>Brown/Green</th>
<th>Up</th>
<th>Sensor</th>
<th>0 V</th>
<th>Sensor</th>
<th>0 V</th>
<th>Serial Data</th>
<th>Serial Data</th>
<th>Request Frame</th>
<th>Request Frame</th>
</tr>
</thead>
</table>

Mit02-2

| Brown/Green | Blue | White/Green | White | Grey | Pink | Violet | Yellow |

- **Up** = power supply voltage
- **Sensor**: The sensor pins are bridged in the scanning head with the particular power supply.
- The shield is connected with the chassis.
- Not connected pins or wires must not be used.
- * Required for adjustment/inspection by PWT 100.

Pin assignment Panasonic

**8-pin M12-connector** according to IEC 61076-2-101 LM008–Gxx-A

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<table>
<thead>
<tr>
<th>Brown/Green</th>
<th>Up</th>
<th>Sensor</th>
<th>0 V</th>
<th>Sensor</th>
<th>0 V</th>
<th>Occupied *</th>
<th>Occupied *</th>
<th>Request/ Data</th>
<th>Request/ Data</th>
</tr>
</thead>
</table>

- **Up** = power supply voltage
- **Sensor**: The sensor pins are bridged in the scanning head with the particular power supply.
- The shield is connected with the chassis.
- Not connected pins or wires must not be used.
- * Required for adjustment/inspection by PWT 100.
SERIAL INTERFACES

EnDat 2.2

The EnDat interface is a digital, bidirectional interface for encoders. It is capable both of transmitting position values as well as transmitting or updating information stored in the encoder, or of saving new information. Thanks to the serial transmission method, only four signal lines are required. The data is transmitted in synchronism with the clock signal from the subsequent electronics. The type of transmission (position values, parameters, diagnostics, etc.) is selected through mode commands that the subsequent electronics send to the encoder.

CLOCK FREQUENCY

The clock frequency is variable—depending on the cable length (max. 150 m)—between 100 kHz and 2 MHz. With propagation-delay compensation in the subsequent electronics, either clock frequencies up to 16 MHz are possible or cable lengths up to 100 m. The maximum clock frequency is stored in the encoder memory.

Transmission frequencies up to 16 MHz in combination with large cable lengths place high technological demands on the cable. Due to the data transfer technology, the cable connected directly to the encoder must not be longer than 20 m. Greater cable lengths can be realized with a cable no longer than 6 m and an extension cable. As a rule, the entire transmission path must be designed for the respective clock frequency.

POSITION VALUES

The position value can be transmitted with or without additional data. It is not transmitted to the subsequent electronics until after the calculation time $t_{cal}$ has passed. The calculation time is ascertained at the highest clock frequency permissible for the encoder, but at no greater than 8 MHz. Only the required number of bits is transferred for the position value. The bit number can be read out from the encoder for automatic parameterization.

MEMORY AREAS

The encoder provides several memory areas for parameters. These can be read from by the subsequent electronics, and some can be written to by the encoder manufacturer, the OEM, or even the end user. The parameter data are stored in a permanent memory. This memory permits only a limited number of write access events and is not designed for cyclic data storage. Certain memory areas can be write-protected (this can only be reset by the encoder manufacturer).

Parameters are saved in various memory areas, e.g.:
- Encoder-specific information
- Informationen of the OEM (e.g. „electronic ID-label“ of the motor)
- Operating parameters (datum shift, instruction, etc.)
- Operating status (alarm or warning messages)

Monitoring and diagnostic functions of the EnDat interface make a detailed inspection of the encoder possible.
- Error messages
- Warnings
- Online diagnostics based on valuation numbers (EnDat 2.2)

ADDITIONAL DATA

One or two items of additional data can be appended to the position value, depending on the type of transmission (selection via MRS code). The additional data supported by the respective encoder is saved in the encoder parameters.
INPUT CIRCUITRY OF SUBSEQUENT ELECTRONICS

Dimensioning
IC1 = RS 485 differential line receiver
Z₀ = 120 Ω

EnDat2.2 is a bidirectional interface of HEIDENHAIN. Detailed information you will find on: www.endat.de

CUSTOMER-SPECIFIC SERIAL INTERFACES

Mitsubishi
RSF Elektronik encoders with the Code M after the model designation are suited for connection to Mitsubishi controls with Mitsubishi high speed interface

- Ordering designation: Mit02-2
  Generation 1, one-pair transmission
- Ordering designation: Mit03-4
  Generation 2, two-pair transmission

Panasonic
RSF Elektronik encoders with the Code P after the model designation are suited for connection to Panasonic controls with Panasonic Serial Interface

- Ordering designation: Pana01
## TECHNICAL DATA

### SCANNING HEAD

<table>
<thead>
<tr>
<th>Interface</th>
<th>EnDat 2.2</th>
<th>Mitsubishi high speed interface</th>
<th>Panasonic serial interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version</td>
<td>EnDat 2.2</td>
<td>Mit03-4</td>
<td>Mit02-2</td>
</tr>
<tr>
<td>Model</td>
<td>MC 15</td>
<td>MC 15 M</td>
<td>MC 15 P</td>
</tr>
<tr>
<td>Measuring step</td>
<td>0.1 µm (100 nm)</td>
<td>0.05 µm (50 nm)</td>
<td></td>
</tr>
<tr>
<td>Calculation time $t_{cal}$</td>
<td>≤ 5 µs</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Clock frequency</td>
<td>≤ 16 MHz</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Traversing speed</td>
<td>≤ 600 m/min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpolation error</td>
<td>&lt; ±2 µm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical connection</td>
<td>Cable, 1 m or 3 m with M12-connector 8-pin or D-sub connector 15-pin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cable length</td>
<td>≤ 100 m</td>
<td>≤ 30 m</td>
<td>≤ 50 m</td>
</tr>
<tr>
<td>Voltage supply</td>
<td>DC 3.6 V to 14 V (3.6 V at least required in the scanning head)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power consumption max.</td>
<td>At 3.6 V: ≤ 800 mW</td>
<td>At 3.6 V: ≤ 900 mW</td>
<td>At 3.6 V: ≤ 950 mW</td>
</tr>
<tr>
<td></td>
<td>At 14 V:  ≤ 900 mW</td>
<td>At 14 V:  ≤ 1050 mW</td>
<td></td>
</tr>
<tr>
<td>Current consumption typ.</td>
<td>At 5 V: 80 mA (without load)</td>
<td>At 5 V: 100 mA (without load)</td>
<td></td>
</tr>
<tr>
<td>Vibration 55 Hz to 2000 Hz</td>
<td>≤ 500 m/s² (EN 60 068-2-6)</td>
<td>≤ 1000 m/s² (EN 60 068-2-27)</td>
<td></td>
</tr>
<tr>
<td>Shock 6 ms</td>
<td>≤ 6 ms (EN 60 068-2-6)</td>
<td>≤ 10 ms (EN 60 068-2-27)</td>
<td></td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-10 °C to 50 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight Scanning head</td>
<td>≤ 18 g (without cable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecting cable</td>
<td>20 g/m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connector</td>
<td>M12-connector: 15 g; D-sub connector: 28 g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduation carrier</td>
<td>MK: Steel tape scale with absolute track and adhesive tape</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coefficient of linear expansion</td>
<td>MP: Steel tape scale with absolute track in aluminum carrier with clamping element</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy grade</td>
<td>± 15 µm/m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring length ML</td>
<td>Up to 3020 mm; longer lengths on request</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight Scale tape</td>
<td>20 g/m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum carrier + Clamping element</td>
<td>12 g/m +</td>
<td>15 g</td>
<td></td>
</tr>
</tbody>
</table>
MC 15 MK

- Steel tape scale with absolute track and adhesive tape

Dimensions, mounting tolerances:

- Mount TMT 14 MK instead of the MC 15 scanning head.
- Thread steel tape scale (version MK) and move along the scale length.
- Remove TMT 14 MK, mount MC 15 scanning head.
**MC 15 MP**

- Steel tape scale in aluminum carrier with clamping element
- Clamping element bolted
- Carrier with adhesive tape

Dimensions, mounting tolerances:

- **OL** = ML + 20 ±1 (steel tape scale)
- Position sensor
- Clamping element/thermal fixed-point
- Scale carrier segmented if appropriate/expansion joint 0.5
- Reference plane

**Symbols:**
- **M** = Machine guideway
- **ML** = Measuring length
- **OL** = Overall length
- **S, S + ML**
- **f** = OL/2 (standard) any position of the clamping element (optional)
- **C** = Cable
- **R** = Bending radius: stat, R ≥ 8 mm, dyn, R ≥ 40 mm
- **S** = Code start value not defined

**Permissible position deviation of the scanning unit + scale tape:**
- Z = ±0.25 mm-0.2 (airgap)
- Y = ±0.5 mm (lateral shift)
- Z = ±20 mrad or ±1.15° (yaw angle)
- Y = ±20 mrad or ±1.15° (pitch angle)
- X = ±20 mrad or ±1.15° (roll angle)

**Tolerancing ISO 8015:**
- ISO 2768 - m H
- ±6 mm, ±0.2 mm
The PWT 100 is a testing device for checking the function and adjustment of absolute RSF Elektronik encoders. Thanks to its compact dimensions and robust design, the PWT 100 is ideal for mobile use. A 4.3-inch touchscreen provides for display and operation.

For example, for encoders with EnDat interface you can not only display the position value but also export the online diagnosis, shift datums, and perform further inspection functions.

**AVAILABLE FUNCTIONS**

The performance range of the PWT 100 can be expanded by firmware update. Appropriate firmware files that can be imported to the PWT 100 through a memory card (not included in delivery) will be made available at www.heidenhain.de.

**MOUNTING WIZARD**

During the adjustment of encoders the PWT 100 can only display the online diagnostics.

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**ACCESSORY EXTERNAL TESTING DEVICE PWT 100**

**Feature content of the PWT 100**

<table>
<thead>
<tr>
<th>Feature content of the PWT 100</th>
<th>EnDat 2.2</th>
<th>Mitsubishi</th>
<th>Panasonic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Position display</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Display of the absolute position</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Display and resetting of error messages</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Display and resetting of warnings</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Display of transmission status</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Diagnostics</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Display of online diagnostics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Display of supply voltage and supply current</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Additional functions (if supported by the encoder)</strong></td>
<td>✓</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Datum shift (‘electrical zeroing of position’)</td>
<td>✓</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td><strong>Memory contents</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Display of encoder information</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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