Product Information

LIF 471V/481V
Exposed Linear Encoders for High-Vacuum Technology
LIF 471V/LIF 481V

Incremental linear encoder for high-vacuum technology
- Special, vacuum-compatible version
- For measuring steps of down to 2 nm
- Position detection through homing track and limit switches

Illustration without limit plate and fixed point

Illustration without fixing clamps, limit plates, and fixed point

Position of stop pins

L = Scale length
F = Machine guideway
* = Maximum change during operation
ML = Measuring length
LI = Limit mark, adjustable
h = Switch for homing track, homing switching edges
Ho = Trigger point for homing
R = Position of reference mark
S = Beginning of measuring length
1 = Optical centerline
2 = Gap between scanning head / scale
3 = Positive direction of measurement
4 = Clearance set with spacer shim
5 = Additional pair of fixing clamps, depending on ML
6 = Vacuum adhesive, dries at room temperature in 24 h
7 = Mounting surface for scanning head
8 = Fixed-point element
### Scale

<table>
<thead>
<tr>
<th>LIF 401R</th>
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</thead>
</table>

#### Measuring standard*
- **Coefficient of linear expansion**
  - SUPRADUR phase grating on Zerodur glass ceramic or glass; grating period: 8 µm
  - $\alpha_{\text{therm}} = (0 \pm 0.1) \cdot 10^{-6} \, \text{K}^{-1}$ (Zerodur glass ceramic)
  - $\alpha_{\text{therm}} = 8 \cdot 10^{-6} \, \text{K}^{-1}$ (glass)

#### Accuracy grade
- ±3 µm

#### Baseline error
- ≤ ±0.225 µm/5 mm

#### Measuring length (ML)*

<table>
<thead>
<tr>
<th>in mm</th>
<th>70</th>
<th>120</th>
<th>170</th>
<th>220</th>
<th>270</th>
<th>320</th>
<th>370</th>
<th>420</th>
<th>470</th>
<th>520</th>
<th>570</th>
<th>620</th>
<th>670</th>
<th>720</th>
<th>770</th>
<th>820</th>
<th>870</th>
<th>920</th>
<th>970</th>
<th>1020</th>
<th>1140</th>
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#### Reference marks
- One at midpoint of measuring length

#### Mass
- 0.8 g + 0.08 g/mm of measuring length

### Scanning head

<table>
<thead>
<tr>
<th>LIF 48V</th>
<th>LIF 47V</th>
</tr>
</thead>
</table>

#### Interface
- < 1 Vpp
- TTL

#### Integrated interpolation*

<table>
<thead>
<tr>
<th>Signal period</th>
<th>5-fold</th>
<th>10-fold</th>
<th>20-fold</th>
<th>50-fold</th>
<th>100-fold</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 µm</td>
<td>0.8 µm</td>
<td>0.4 µm</td>
<td>0.2 µm</td>
<td>0.08 µm</td>
<td>0.04 µm</td>
</tr>
</tbody>
</table>

#### Cutoff frequency
- ≥ 1 MHz

#### Scanning frequency*  
- ≤ 500 kHz
- ≤ 250 kHz
- ≤ 125 kHz
- ≤ 62.5 kHz
- ≤ 25 kHz
- ≤ 12.5 kHz

#### Edge separation $a$

<table>
<thead>
<tr>
<th>Traversing speed $^1$</th>
</tr>
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<tbody>
<tr>
<td>≤ 240 m/min</td>
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<tr>
<td>≤ 120 m/min</td>
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<tr>
<td>≤ 60 m/min</td>
</tr>
<tr>
<td>≤ 30 m/min</td>
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</tbody>
</table>

#### Interpolation error
- ±12 nm
- 0.6 nm (1 MHz$^2$)

#### Electrical connection*
- **Interface electronics outside of the high vacuum:**
  - Cable (0.5 m, 1 m, 2 m, or 2.5 m) up to high-vacuum feedthrough; cable 0.5 m up to 15-pin D-sub connector with integrated interface electronics
- **Interface electronics in the high vacuum:**
  - Cable (0.5 m, 1 m, 2 m, or 3 m) with 15-pin D-sub connector (interface electronics integrated in connector)

#### Cable length
- See interface description; however, incremental: ≤ 30 m; homing, limit: ≤ 10 m; (with HEIDENHAIN cable)

#### Supply voltage
- DC 5 V ±0.25 V

#### Current consumption
- < 150 mA
- < 165 mA (without load)

#### Vibration
- 55 Hz to 2000 Hz
- ≤ 400 m/s² (EN 60068-2-6)
- ≤ 500 m/s² (EN 60068-2-27)

#### Shock
- ≤ 400 m/s² (EN 60068-2-6)
- ≤ 500 m/s² (EN 60068-2-27)

#### Operating temperature
- 0 °C to 50 °C

#### Baking temperature
- 100 °C

#### PCB material
- FR4

#### Mass
- **Scanning head**
  - 9 g
  - 38 g/m
  - 75 g

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* Please select when ordering

$^1$ With TTL: maximum traversing speed during referencing: 9.6 m/min (40 kHz)

$^2$ –3 dB cutoff frequency of subsequent electronics
These vacuum-compatible encoders feature the following characteristics:

- Air vents
- Specialized cleaning and packaging
- Cable with PTFE insulation and tin-plated copper braiding

**Residual gas analysis of HEIDENHAIN vacuum components**

The influence of vacuum components on the quality of a vacuum can be determined through residual gas analyses. In these analyses, a sample in a vacuum chamber is pumped out to at least 10^{-6} mbar (turbomolecular pump, pumping speed 15 l/s to 200 l/s). The residual gases are measured with a mass spectrometer (Pfeiffer QMA 200) and an absolute pressure sensor (VACOM ATMION). The outgassing behavior of the examined sample can then be deduced by subtracting the typical residual gases of the empty chamber. The amount of remaining residual gases depends not only on the cleanliness of the sample and the tested materials, but also on the pump type used and its pumping speed. The higher the pumping speed for the measurement is, and the longer the gas is pumped out, the lower the amount of residual gases will be.

To attain the lowest possible outgassing values HEIDENHAIN recommends baking at 100 °C for 48 hours under high vacuum conditions.

**Residual gas analysis for LIF 48V and LIF 47V**

The following spectrum typically results for an LIF 48V or LIF 47V scanning head with a one-meter cable and APE (connector) interface electronics after having been baked in a high vacuum for 48 hours at 100 °C.

The spectrum was determined with three scanning heads at an absolute pressure of 1.5•7 mbar and a pumping speed of 92 l/s.
Electrical connection

The LIF 471V/LIF 481V is available with two different cable versions:

**Interface electronics in the high vacuum:**
The scanning head cable has a 15-pin D-sub connector that contains the interface electronics. A vacuum feed-through (15-pin D-sub connector on DN63CF flange) and an extension cable are available as accessories.

**Interface electronics outside of the high vacuum:**
The scanning head cable has a high-vacuum-compatible round connector. Included with the encoder are the corresponding high-vacuum feedthrough and the adapter cable with a 15-pin D-sub connector with integrated interface electronics.

The built-in signal-quality indicator permits both a reliable assessment of the incremental signals and inspection of the reference mark signal. The quality of the **incremental signals** is indicated by a range of colors permitting quite detailed signal-quality differentiation. The tolerance conformity of the **reference mark signal** is shown by means of a pass/fail indicator.

### LED indicator for incremental signals

<table>
<thead>
<tr>
<th>LED color</th>
<th>Quality of the scanning signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>Optimal</td>
</tr>
<tr>
<td>●</td>
<td>Good</td>
</tr>
<tr>
<td>●</td>
<td>Acceptable</td>
</tr>
<tr>
<td>●</td>
<td>Unsatisfactory</td>
</tr>
</tbody>
</table>

**LED indicator for reference-mark-signal**

(operating check)

When the reference mark is traversed, the LED briefly lights up in red or blue:

- ● Out of tolerance
- ● Within tolerance
### Pin layout

**15-pin D-sub connector**

![15-pin D-sub connector](image)

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Incremental signals</th>
<th>Other signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>11</td>
<td>14</td>
<td>7</td>
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<tr>
<td>13</td>
<td>8</td>
<td>6</td>
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<tr>
<td>15</td>
<td>5</td>
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</table>

<table>
<thead>
<tr>
<th>TTL/11 µAPP conversion for the PWT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacant</td>
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</tbody>
</table>

- **Power supply**
  - `U_p` (5 V)
  - Sensor (0 V)

- **Incremental signals**
  - `U_a1`
  - `U_a2`
  - `U_a0`
  - `U_aS`

- **Other signals**
  - `H`
  - `L`
  - `PWT`

- **Cable shield**
  - On housing; `U_p` = Power supply voltage

**Sensor**: The sense line is connected in the encoder with the corresponding power line. Vacant pins or wires must not be used.

Further information:

- To ensure proper and intended use, comply with the specifications in the following documents:
  - Brochure: *Exposed Linear Encoders* ID 208960-xx
  - Technical Information: *Linear Encoders for Vacuum Technology* ID 627568-xx