



# HEIDENHAIN



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

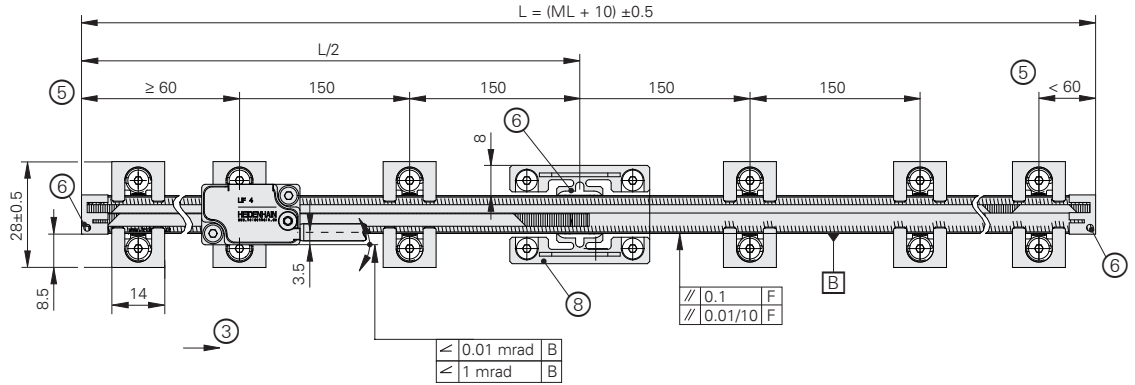
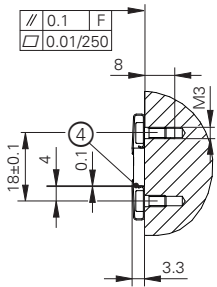
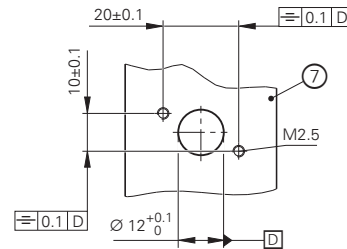
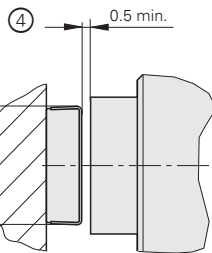
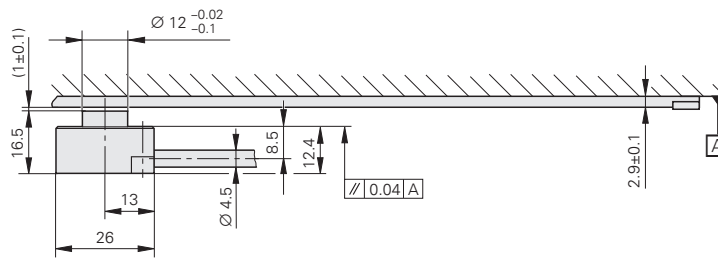
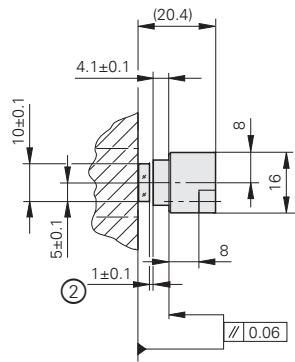
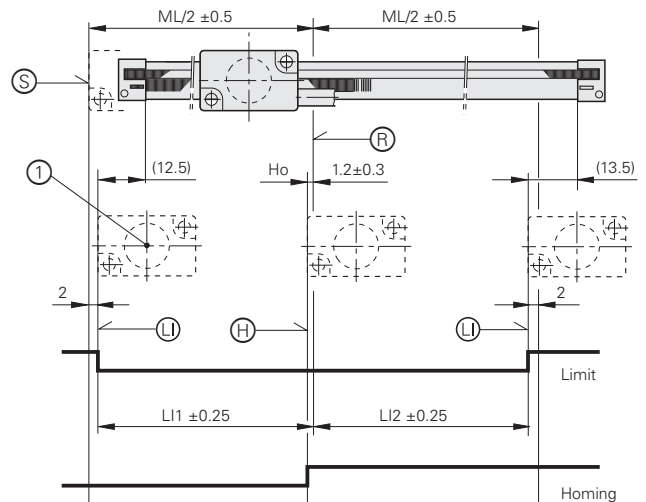
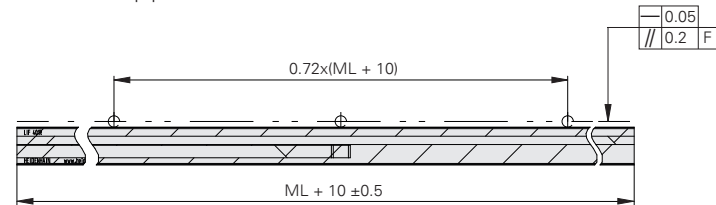


Illustration without fixing clamps, limit plates, and fixed point



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



<b>Scale</b>	<b>LIF 401 R</b>													
<b>Measuring standard*</b> 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); $\alpha_{\text{therm}} \approx 8 \cdot 10^{-6} \text{ K}^{-1}$ (glass)													
<b>Accuracy grade</b>	±3 μm													
<b>Baseline error</b>	≤ ±0.225 μm/5 mm													
<b>Measuring length (ML)*</b> in mm	70	120	170	220	270	320	370	420	470	520	570	620	670	
	720	770	820	870	920	970	1020	1140	1240	1340	1440	1540	1640	
Reference marks	One at midpoint of measuring length													
<b>Mass</b>	0.8 g + 0.08 g/mm of measuring length													

<b>Scanning head</b>	<b>LIF 48V</b>	<b>LIF 47V</b>					
<b>Interface</b>	~ 1 V <sub>PP</sub>	□□TTL					
Integrated interpolation* Signal period	– 4 μm	5-fold 0.8 μm	10-fold 0.4 μm	20-fold 0.2 μm	50-fold 0.08 μm	100-fold 0.04 μm	
Cutoff frequency –3 dB	≥ 1 MHz	–					
Scanning frequency*	–	≤ 500 kHz ≤ 250 kHz ≤ 125 kHz	≤ 250 kHz ≤ 125 kHz ≤ 62.5 kHz	≤ 250 kHz ≤ 125 kHz ≤ 62.5 kHz	≤ 100 kHz ≤ 50 kHz ≤ 25 kHz	≤ 50 kHz ≤ 25 kHz ≤ 12.5 kHz	
Edge separation <i>a</i>	–	≥ 0.080 μs ≥ 0.175 μs ≥ 0.370 μs	≥ 0.080 μs ≥ 0.175 μs ≥ 0.370 μs	≥ 0.040 μs ≥ 0.080 μs ≥ 0.175 μs	≥ 0.040 μs ≥ 0.080 μs ≥ 0.175 μs	≥ 0.040 μs ≥ 0.080 μs ≥ 0.175 μs	
<b>Traversing speed<sup>1)</sup></b>	≤ 240 m/min	≤ 120 m/min ≤ 60 m/min ≤ 30 m/min	≤ 60 m/min ≤ 30 m/min ≤ 15 m/min	≤ 60 m/min ≤ 30 m/min ≤ 15 m/min	≤ 24 m/min ≤ 12 m/min ≤ 6 m/min	≤ 12 m/min ≤ 6 m/min ≤ 3 m/min	
<b>Interpolation error RMS position noise</b>	±12 nm 0.6 nm (1 MHz <sup>2)</sup> )	–					
<b>Electrical connection*</b>	<ul style="list-style-type: none"> <li>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</li> <li>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)</li> </ul>						
Cable length	See interface description; however, <i>incremental</i> : ≤ 30 m; <i>homing, limit</i> : ≤ 10 m; (with HEIDENHAIN cable)						
Supply voltage	DC 5 V ±0.25 V						
Current consumption	< 150 mA	< 165 mA (without load)					
<b>Vibration</b> 55 Hz to 2000 Hz <b>Shock</b> 11 ms	≤ 400 m/s <sup>2</sup> (EN 60068-2-6) ≤ 500 m/s <sup>2</sup> (EN 60068-2-27)						
<b>Operating temperature</b>	0 °C to 50 °C						
<b>Baking temperature</b>	100 °C						
<b>PCB material</b>	FR4						
<b>Mass</b>	Scanning head	9 g					
	Cable	38 g/m					
	Connector	75 g					

\* Please select when ordering

<sup>1)</sup> With TTL: maximum traversing speed during referencing: 9.6 m/min (40 kHz)

<sup>2)</sup> –3 dB cutoff frequency of subsequent electronics

# Encoders for use in a vacuum

These vacuum-compatible encoders feature the following characteristics:

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

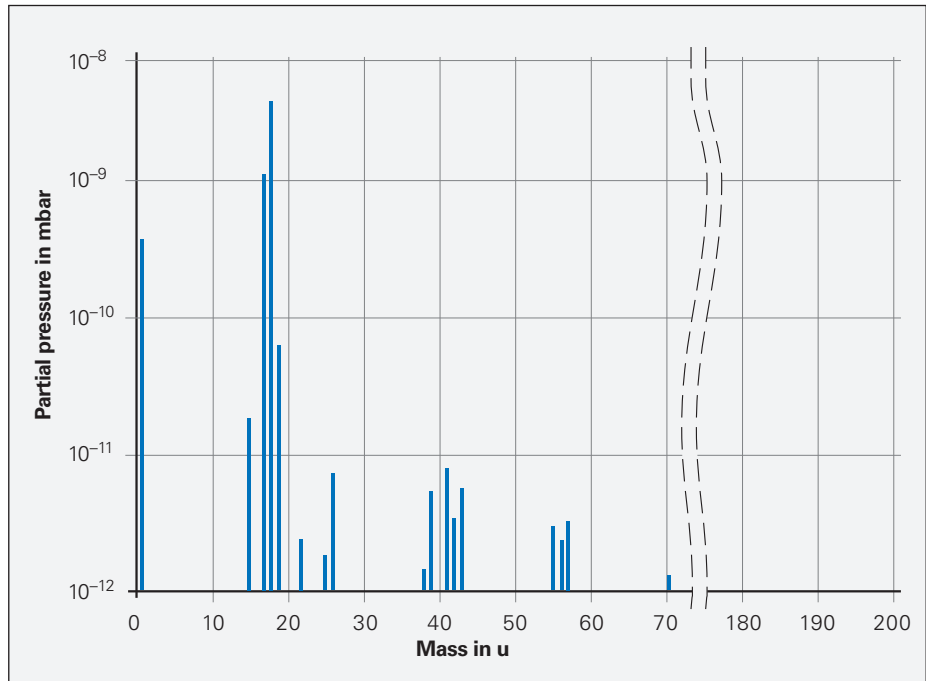
## Residual gas analysis of HEIDENHAIN vacuum components

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

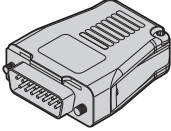

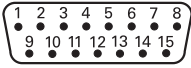



The following spectrum typically results for an LIF 48 V or LIF 47 V scanning head with a one-meter cable and APE (connector) interface electronics after having been baked in a high vacuum for 48 hours at 100 °C.



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.



## Pin layout

15-pin D-sub connector															
  															
	Power supply				Incremental signals						Other signals				
	4	12	2	10	1	9	3	11	14	7	13	8	6	15	5
 TTL	$U_P$	Sensor 5V	0V	Sensor 0V	$U_{a1}$	$\overline{U}_{a1}$	$U_{a2}$	$\overline{U}_{a2}$	$U_{a0}$	$\overline{U}_{a0}$	$\overline{U}_{aS}$	H	L	PWT <sup>1)</sup>	Vacant
 1V <sub>PP</sub>	● — ●		● — ●		A+	A-	B+	B-	R+	R-	As- signed			As- signed	Vacant
	Brown/ Green	Blue	White/ Green	White	Brown	Green	Gray	Pink	Red	Black	Violet	Green/ Black	Yellow/ Black	Yellow	/

**Cable shield** on housing; **U<sub>P</sub>** = 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.

<sup>1)</sup> TTL/11 μA<sub>PP</sub> conversion for the PWT

# HEIDENHAIN

**DR. JOHANNES HEIDENHAIN GmbH**

Dr.-Johannes-Heidenhain-Straße 5

83301 Traunreut, Germany

☎ +49 8669 31-0

FAX +49 8669 32-5061

E-mail: info@heidenhain.de

[www.heidenhain.de](http://www.heidenhain.de)

This Product Information document supersedes all previous editions, which thereby become invalid. The basis for ordering from HEIDENHAIN is always the Product Information document valid when the contract is made.



### 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