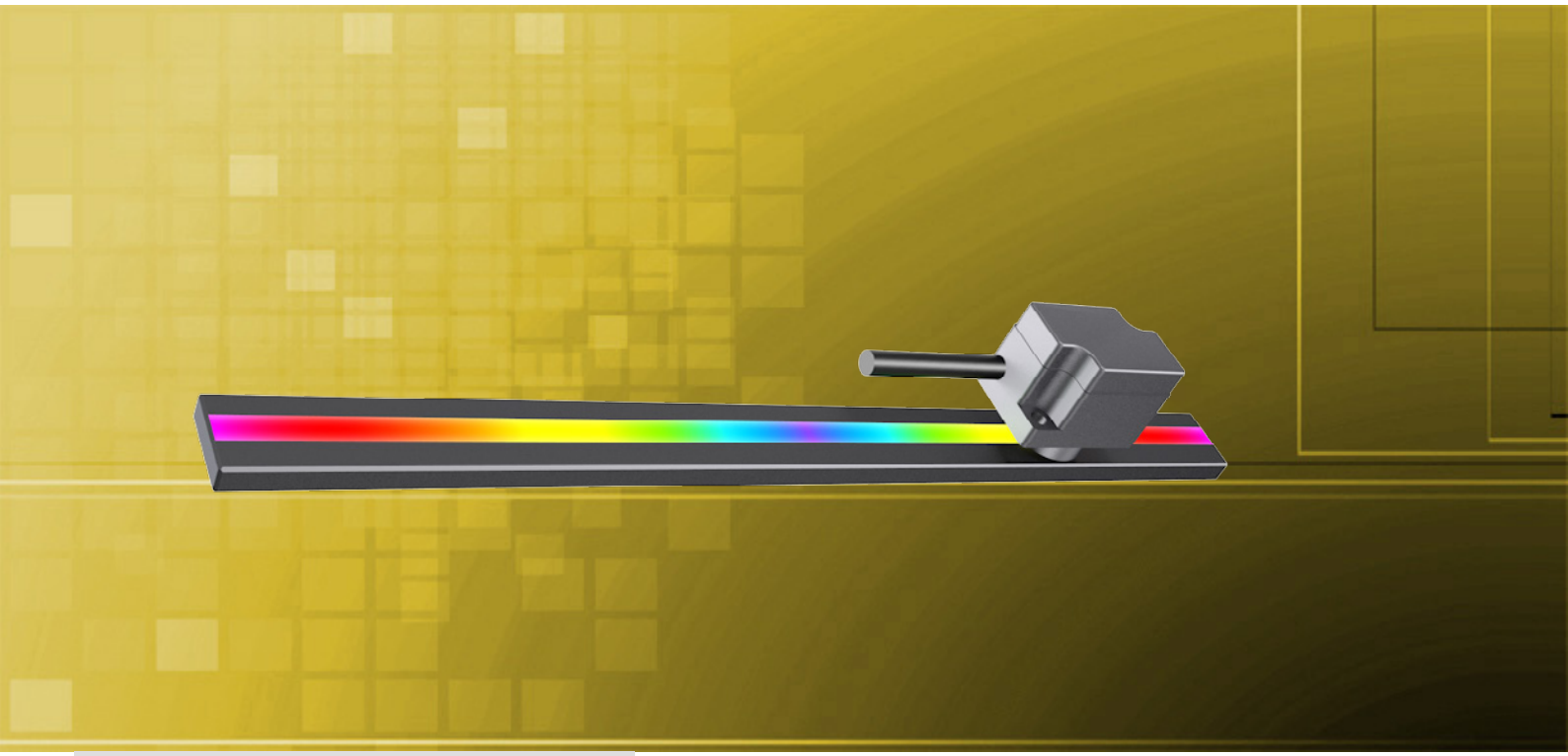
# DIGITAL LINEAR SCALE



## Series LIP 471 and LIP 481

***Key-Features:***

- *Measurement range up to 420 mm*
- *Output: 1 Vpp or TTL*
- *Accuracy up to ±0.5 µm*
- *Operating temperature 0 °C to +40 °C*
- *Interferential measurement principle*
- *For limited installation space*
- *Measuring standard is fastened by fixing clamps*
- *Versions with and without reference mark*

***Content:***



24.05.18

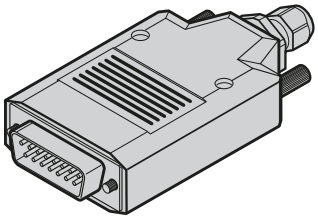
WayCon
Positionsmesstechnik

## TECHNICAL DATA

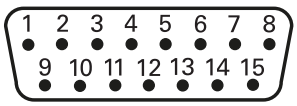
| | | LIP 471 A, LIP 471 R | | | | | | LIP 481 A , LIP 481 R |
|---|---|---|---|---|---|---|---|---|
| Measurement range | [mm] | 70, 120, 170, 220, 270, 320, 370, 420 | | | | | | |
| Measuring standard | | DIADUR phase grating on Zerodur glass ceramic or glass; grating period 4 µm | | | | | | |
| Coefficient of linear expansion | | $\alpha_{therm} = (0\pm0.1) \cdot 10^{-6}\ K^{-1}$ (Zerodur glass ceramic)<br>$\alpha_{therm} \approx 8 \cdot 10^{-6}\ K^{-1}$ (glass) | | | | | | |
| Accuracy grade | [µm] | ±0.5, ±1 (higher accuracy grades upon request) | | | | | | |
| Baseline error | | ≤ ±0.175 µm/5 mm | | | | | | |
| Reference marks | | **LIP A**: none; **LIP R**: one at midpoint of measuring length | | | | | | |
| Interface | | TTL | | | | | | 1 Vpp |
| Integrated interpolation | | 5-fold | | | 10-fold | | | - |
| Signal period | [µm] | 0.4 | | | 0.2 | | | 2 |
| Cutoff frequency (-3 dB) | [kHz] | - | | | | | | ≥ 300 |
| Scanning frequency<br>Edge separation a | [kHz]<br>[µs] | ≤ 200<br>≥ 0.22 | ≤ 100<br>≥ 0.465 | ≤ 50<br>≥ 0.95 | ≤ 100<br>≥ 0.22 | ≤ 50<br>≥ 0.465 | ≤ 25<br>≥ 0.95 | - |
| Traversing speed | [m/min] | ≤ 24 | ≤ 12 | ≤ 6 | ≤ 12 | ≤ 6 | ≤ 3 | ≤ 36 |
| Interpolation error | [nm] | ± 7 | | | | | | |
| Position noise RMS | | 2 nm (450 kHz)[1)] | | | | | | |
| Electrical connection | | Cable, 0.5 m, 1 m, 2 m or 3 m with 15-pin D-sub connector (male); interface electronics in the connector | | | | | | |
| Cable length max. | [m] | 30 | | | | | | |
| Voltage supply | [VDC] | 5 ±0,25 | | | | | | |
| Current consumption | [mA] | < 200 (without load) | | | | | | < 190 |
| Vibration 55 Hz to 2000 Hz | [m/s²] | ≤ 200 (EN 60 068-2-6) | | | | | | |
| Schock 11 ms | [m/s²] | ≤ 500 (EN 60 068-2-27) | | | | | | |
| Operating temperature | [°C] | 0...+40 | | | | | | |
| Mass | [g] | Scanning head: **LIP A**: 25; **LIP R**: 50 (each without cabel)<br>Linear scale: 5.6 + 0.2 per mm measurement length<br>Connecting cable: 38 per m<br>Connector: 140 | | | | | | |

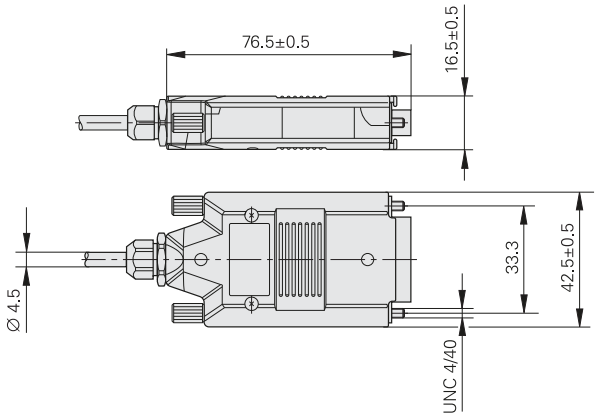
1) With –3 dB cutoff frequency of the subsequent electronics

## ELECTRICAL CONNECTION



interface electronics integrated



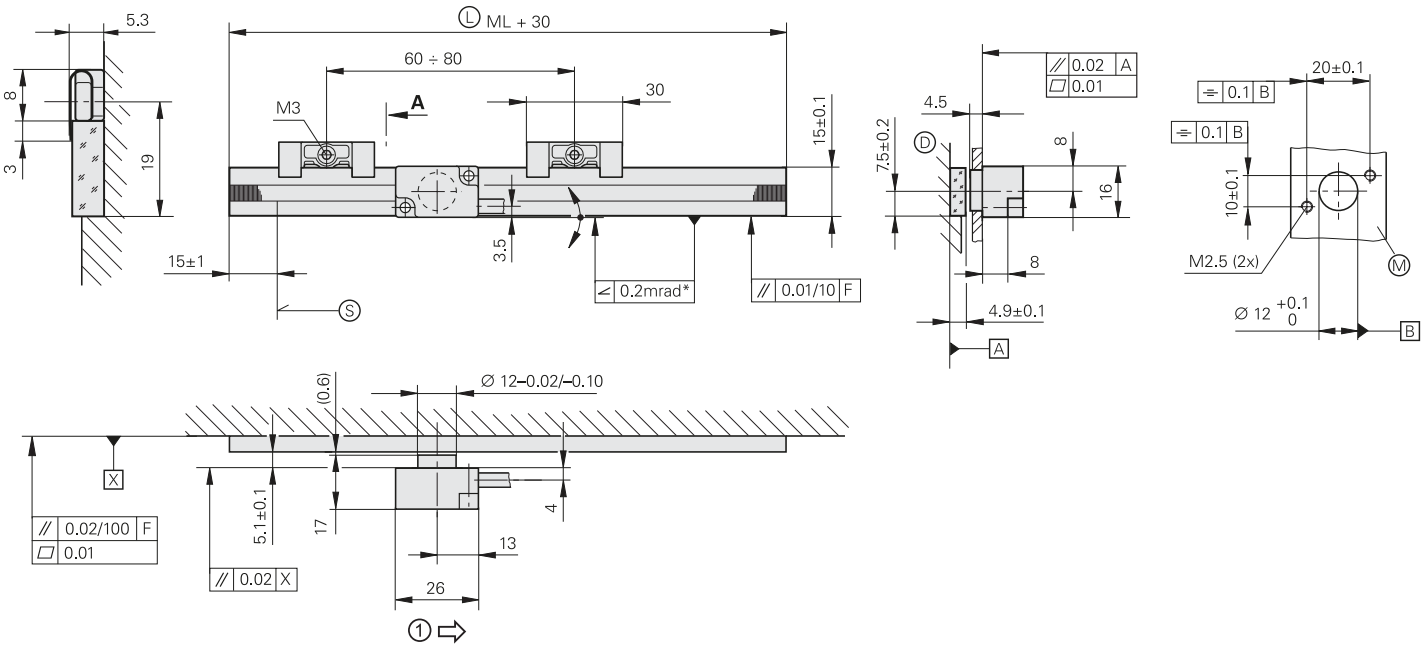




| | Voltage supply | | | | Incremental signals | | | | | | Other signals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sub-D-Connector (male), 15-pin** | 4 | 12 | 2 | 10 | 1 | 9 | 3 | 11 | 14 | 7 | 13 | 5/6/8 | 15 |
| **Signals TTL** | Up | Sensor Up | 0 V | Sensor 0 V | Ua1 | $\overline{\text{Ua1}}$ | Ua2 | $\overline{\text{Ua2}}$ | Ua0 | $\overline{\text{Ua0}}$ | $\overline{\text{UaS}}$ | n.c. | n.c. |
| **Signals 1 Vpp** | Up | Sensor Up | 0 V | Sensor 0 V | A+ | A- | B+ | B- | R+ | R- | n.c. | n.c. | n.c. |

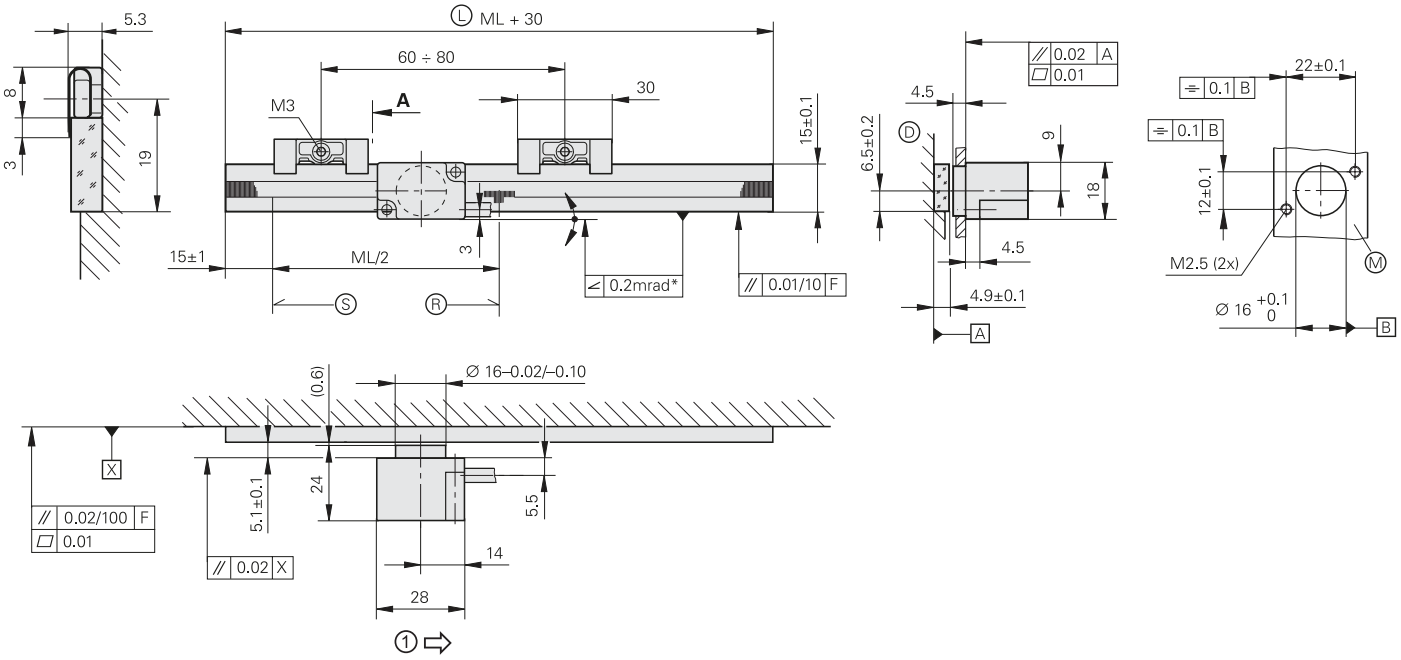
Shield on housing; Up = Power supply
Sensor: The sensor line is connected in the encoder with the corresponding power line.
Vacant pins or wires must not be used.

# TECHNICAL DRAWING

## LIP 471 A, LIP 481 A




## LIP 471 R, LIP 481 R




mm

Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

* = Max. change during operation
F = Machine guideway
Ⓛ = Scale length
Ⓓ = Shown without fixing clamps
Ⓢ = Beginning of measuring length ML
Ⓡ = Reference-mark position on LIP 4x1 R
Ⓜ = Mounting surface for scanning head
① = Direction of scanning unit motion for output signals in accordance with interface description

# INTERFERENTIAL SCANNING PRINCIPLE

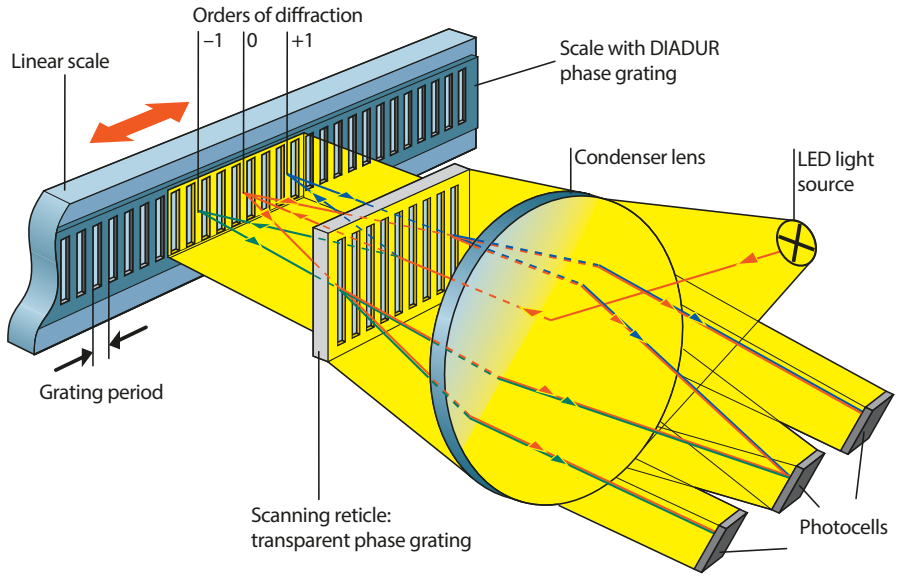
The interferential scanning principle exploits the diffraction and interference of light on a fine graduation to produce signals used to measure displacement.

A step grating is used as the measuring standard: reflective lines 0.2 µm high are applied to a flat, reflective surface. In front of that is the scanning reticle - a transparent phase grating with the same grating period as the scale.

When a light wave passes through the scanning reticle, it is diffracted into three partial waves of the orders -1, 0, and +1, with approximately equal luminous intensity. The waves are diffracted by the scale such that most of the luminous intensity is found in the reflected diffraction orders +1 and -1. These partial waves meet again at the phase grating of the scanning reticle where they are diffracted again and interfere. This produces essentially three waves that leave the scanning reticle at different angles. Photovoltaic cells convert this alternating light intensity into electrical signals.

A relative motion of the scanning reticle to the scale causes the diffracted wave fronts to undergo a phase shift: When the grating moves by one period, the wave front of the first order is displaced by one wavelength in the positive direction, and the wavelength of diffraction order -1 is displaced by one wavelength in the negative direction. Since the two waves interfere with each other when exiting the grating, the waves are shifted relative to each other by two wavelengths. This results in two signal periods from the relative motion of just one grating period.

Interferential encoders function with grating periods of, for example, 8 µm, 4 µm and finer. Their scanning signals are largely free of harmonics and can be highly interpolated. These encoders are therefore especially suited for small measuring steps and high accuracy. Even so, their generous mounting tolerances permit installation in a wide range of applications.



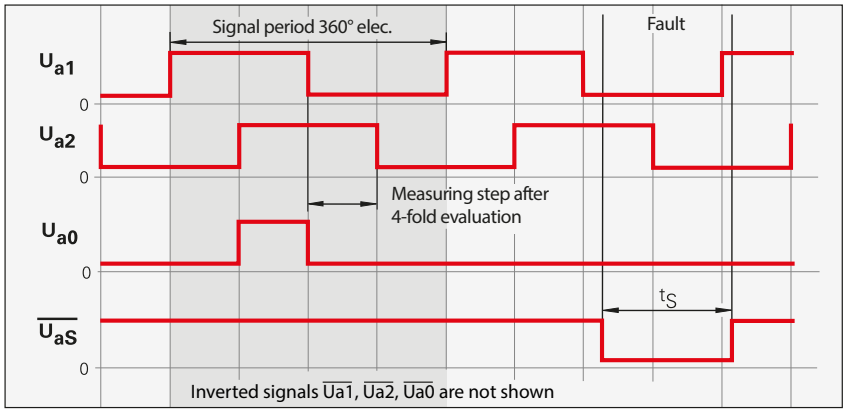
## INCREMENTAL SIGNAL TTL

WayCon encoders with TTL interface incorporate electronics that digitize sinusoidal scanning signals with or without interpolation.

The incremental signals are transmitted as the square-wave pulse trains Ua1 and Ua2, phase-shifted by 90° elec. The reference mark signal consists of one or more reference pulses Ua0, which are gated with the incremental signals. In addition, the integrated electronics produce their inverted signals $\overline{Ua1}$, $\overline{Ua2}$ and $\overline{Ua0}$ for noise-proof transmission. The illustrated sequence of output signals - with Ua2 lagging Ua1 - applies to the direction of motion shown in the dimension drawing.

The fault detection signal $\overline{UaS}$ indicates fault conditions such as an interruption in the supply lines, failure of the light source, etc.

The distance between two successive edges of the incremental signals Ua1 and Ua2 through 1-fold, 2-fold or 4-fold evaluation is one measuring step.

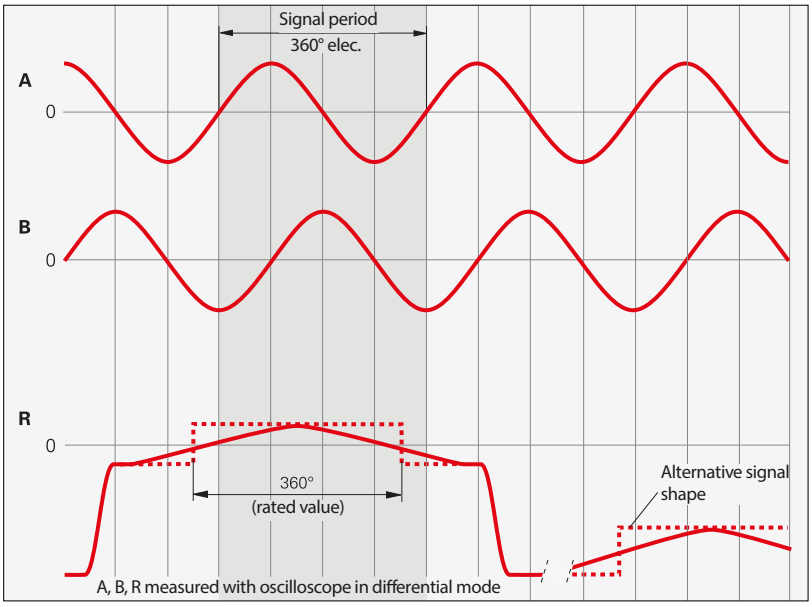



## INCREMENTAL SIGNAL 1 Vpp

WayCon encoders with 1 Vpp interface provide voltage signals that can be highly interpolated.

The sinusoidal incremental signals A and B are phase-shifted by 90° elec. and have amplitudes of typically 1 Vpp. The illustrated sequence of output signals - with B lagging A - applies for the direction of motion shown in the dimension drawing.

The reference mark signal R has an unambiguous assignment to the incremental signals. The output signal might be somewhat lower next to the reference mark.




## ACCESSORIES

| | |
|---|---|
| ID 270711-04 | clamping claws for mounting |
| ID 1130322-01 | silicone adhesive for additonal fixation |



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