Intelligence for hydraulic cylinders

LiView® Position Transducer

Smart: permanent self-monitoring

LIEBHERR
Intelligent measurement

**Key component hydraulic cylinder**
The importance of hydraulic cylinders in innovative machine concepts is steadily increasing. Cylinders are key components for assistance systems and automation solutions which improve efficiency. Precise real-time data of cylinder movements provide the basis for the implementation of such applications.

**Accurate data through unique measuring principle**
The intelligent position transducer LiView® determines the exact piston position and speed through high-resolution absolute measurement. The system utilizes the cylinder itself as very robust measuring distance for radio-frequency measurement. Thanks to this unique measuring principle, LiView® is suitable for all hydraulic cylinders, independent of cylinder length or diameter.
Ideal for mobile machinery
LiView® convinces by easy mechanical integration. The certified position transducer is suitable for safety-relevant applications. During development, we placed great importance on a high level of robustness. Thus, our intelligent position transducer LiView® is ideal for mobile machinery.

LiView® in detail

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration</td>
<td>4</td>
</tr>
<tr>
<td>Special features</td>
<td>6</td>
</tr>
<tr>
<td>Technical data and principle of operation</td>
<td>8</td>
</tr>
<tr>
<td>Application examples</td>
<td>10</td>
</tr>
</tbody>
</table>
Easy mechanical integration
LiView® consists of a high-performance electronic processing unit and two probes. The electronics can be flexibly installed either directly on or near the cylinder. The probes provide the connection to the piston rod bearing.

Direct connection to control system
LiView® supports the standardised protocols CANopen and CANopen Safety. Thus, LiView® can be easily integrated in the control system.

Full effective stroke
The space in the cylinder can be entirely used for the stroke, as the probe heads are integrated in the piston rod bearing. Therefore the entire cylinder length can be used with no need to change the machine’s construction.
One solution for all cylinders
The position transducer LiView® is suitable for all cylinder lengths and piston diameters – a state-of-the-art sensor system with smart technology for all hydraulic cylinders. That allows a time- and cost-saving integration.

Full stability of the piston rod
By integrating LiView®, there is no need for drilling the piston rod. This reduces costs and maintains the full stability of the cylinder.

No moving parts in oil
LiView® measures using fixed probe heads. No moving parts in oil (e.g. magnet), which may cause an oil contamination including a machine breakdown, are required.
Fast measuring cycle for highly dynamic cylinders
In addition to the precision of the measurements, a fast measuring cycle is essential. In particular for highly dynamic cylinders, fast measurement data acquisitions are required for efficient and safe (semi)automation.

Decentralized control
LiView® calculates piston speed in real time. This provides short latency periods for the control system, enabling high-performance position control of cylinders. This is especially advantageous if predefined workspace boundaries are dynamically approached.

Extremely robust
Severe heat up to +85 °C, fierce vibrations or aggressive salt water: LiView® defies adverse environmental conditions. This leads to long-term high system availability.
Fault detection and diagnosis
LiView’s condition monitoring function allows for autonomous fault detection and diagnosis, such as undervoltage or a defective probe. This reduces machine downtime and increases efficiency in the field.

Maintenance friendly
Easy access: The external processing electronics as well as the probes are easily accessible. This facilitates fast and simple maintenance without draining oil, dismantling or disassembling of the hydraulic cylinder.

Functional safety
EN ISO 13849 PL d and EN IEC 61508 SIL2: The usage of the TÜV-certified LiView® supports the machine manufacturer in the construction and certification of mobile machinery, allowing the implementation of safety-relevant functions, like safe load indicators.
Technical data

**Measurement performance**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring frequency</td>
<td>4,000 Hz</td>
</tr>
<tr>
<td>Measured quantities</td>
<td>Absolute piston position, piston speed</td>
</tr>
<tr>
<td>Resolution</td>
<td>100 μm</td>
</tr>
<tr>
<td>Nonlinearity</td>
<td>Max. 0.3% 1)</td>
</tr>
<tr>
<td>Repeatability</td>
<td>250 μm (typical)</td>
</tr>
<tr>
<td>Functional safety</td>
<td>PL d (EN ISO 13849), SIL2 (EN IEC 61508)</td>
</tr>
</tbody>
</table>

1) Actual nonlinearity depends on cylinder characteristics

**Interfaces and operating conditions**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating voltage</td>
<td>9 V to 32 V</td>
</tr>
<tr>
<td>Output signal digital</td>
<td>CANopen, CANopen Safety</td>
</tr>
<tr>
<td>Electrical connections</td>
<td>M12</td>
</tr>
<tr>
<td>Max. measurement range</td>
<td>10 m</td>
</tr>
<tr>
<td>Max. pressure</td>
<td>420 bar</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-40 °C to +105 °C (oil)</td>
</tr>
<tr>
<td></td>
<td>-40 °C to +85 °C (electronics)</td>
</tr>
<tr>
<td>IP rating</td>
<td>IP6K9K, IP67, IP68</td>
</tr>
</tbody>
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**Principle of operation**

LiView® measures the cylinder scattering parameters through proper signals at different frequencies injected into the cylinder structure. Piston position and speed are calculated by the processing electronics in real time.

**Measuring process in detail**

1) Electronics unit generates signal.
2) Signal is coupled into cylinder via probe (Port 1).
3) Signal travels towards piston and is reflected.
4) Reflected signal returns to electronics unit via second probe (Port 2).
5) Electronics unit calculates piston position and speed.
Application examples
Versatile position transducer
The characteristics of LiView® are ideal for mobile machinery. The high-performance sensor technology provides precise data which allows the implementation of automation solutions and assistance systems. Thanks to its certification according to EN ISO 13849 PL d and EN IEC 61508 SIL2, LiView® is also suitable for safety-relevant applications.

Semi/Complete automation
Fast supply of accurate piston position and speed information is the basis for reliable automation. LiView® enables precise control over cylinder movements through fast measuring cycles and accurate data. Thereby, dynamic motion sequences can be automated. For instance, this allows assisted grading, which coordinates all cylinders of the excavator boom and guides the driver horizontally. This relieves the driver and increases productivity.

Workspace limitations
The measurement data provided by LiView® allows for precise determination of the boom position. Thereby, the driver can define a workspace in which the boom is allowed to move freely. If the boom touches the defined workspace boundaries, the machine warns the driver or automatically stops the boom. This allows for safe operation underneath overhead lines.

Safe load indicators
Data of the accurate outrigger position plays a major role in avoiding tipping of the machine. LiView® is also suitable for very small cylinders and narrow installation spaces. The system supplies precise position data for the implementation of safe load indicators, providing increased safety.

Teach-in applications
Precise knowledge of the piston position is a prerequisite for the implementation of teach-ins. If a driver repeatedly stops at certain load and drop points, he can save these piston positions. Subsequently, the system supports the driver in approaching these points quickly and precisely. This semiautomatic positioning increases productivity.