



**MAX<sup>®</sup>**

Integrated cylinder position measurement for mobile machines

**MAGNETOSTRICTIVE LINEAR ENCODERS**

**SICK**  
Sensor Intelligence.

Advantages



**Compatible with all common cylinder designs**

With linear encoders from the MAX<sup>®</sup> product family, you can quickly and easily switch from previously used devices to reliable and flexible encoders: MAX<sup>®</sup> encoders are designed with dimensions that make them very easy to integrate into hydraulic cylinders on mobile machines. The advantage: When the linear encoder is switched, existing cylinder designs can still be used. This makes additional milling or drilling processes and complete redesign of the cylinder unnecessary. Changing the encoder therefore saves time, minimizes effort and reduces costs. In addition, the MAX<sup>®</sup> is available with all common interfaces, e.g. analog interfaces (V DC, mA) and PWM, as well as with the CANopen and SAE J1939 protocols.

**Quick replacement for permanent benefit**



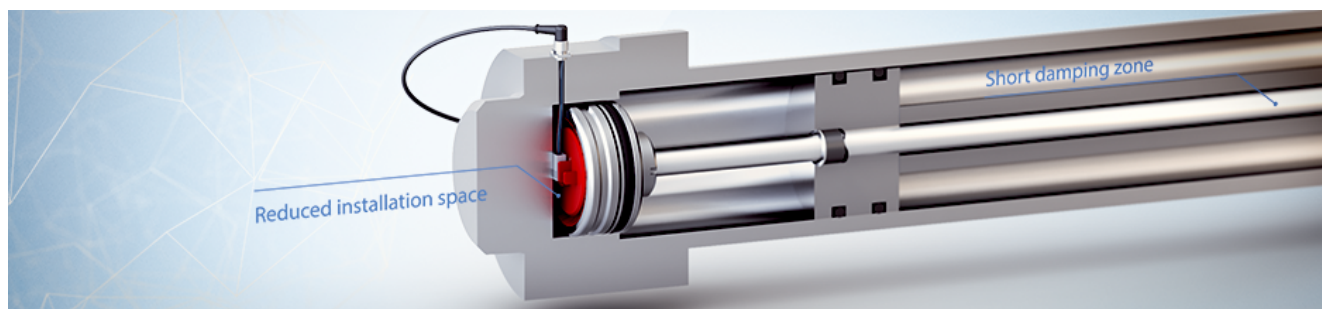
Smart switch: MAX30N, MAX48N and MAX48A devices can be easily integrated into hydraulic cylinders without modifications to existing cylinder designs and without additional milling or drilling.

System upgrade: The internal diagnostic capability (monitoring of cylinder operating states) makes it possible to extend functional and operational checks.

The MAX<sup>®</sup> product family offers all common interfaces on the market: Analog interfaces (V DC, mA) and PWM. In addition, the MAX<sup>®</sup> is available with the CANopen and SAE J1939 protocols.



**Many cylinders, one solution: MAX<sup>®</sup> linear encoders can be integrated into new as well as existing cylinder designs in a time- and cost-saving manner.**



## Opens up new possibilities with space-saving design

The MAX48N and MAX48A linear encoders score on several levels with their compact design. Due to the radial electrical connection of the MAX48N, the required installation space for the electrical connection in the cylinder is significantly reduced. Compared to the devices common on the market, the MAX® linear encoder offers a shorter damping zone as well as selection of the measuring range in 1 mm steps. This shortens the installation space in the cylinder because the bore depth in the piston rod is reduced. This means shorter processing times with less material loss. The reduction in the installation dimensions saves valuable space in the cylinder. And this saves time and money.

**The highlight:** With the very compact MAX30N linear encoder, position measurements can be carried out in very small cylinders. This makes it possible to automate applications whose automation was previously technically unfeasible.

## Reduced installation space, extended range of applications



Saves time, material and costs: Small dimensions are sufficient for installation of the encoder, which reduces the machining time of the cylinder. The space required for the electrical connection is also reduced – this saves valuable space in the very tight installation area of the cylinder.



Convenient installation: The position magnet in the piston does not require an additional spacer disk, thus simplifying mounting processes.



Due to its compact size, the MAX30N makes completely new applications possible, even for extremely compact cylinder dimensions with very limited installation options.



**Compact, flexible and innovative: MAX30N, MAX48N and MAX48A devices expand the range of uses and applications for linear encoders thanks to the small dimensions and novel functions.**



## Rugged and reliable, even under very demanding conditions

The requirements in mobile machines are strict: Sensors must provide consistently reliable measured values in large temperature and pressure ranges as well as under high mechanical loads. The MAX<sup>®</sup> relies on proven magnetostrictive technology that allows accurate position measurements at temperatures up to 95 °C. A high power reserve enables measurement of the cylinder position even at critical temperatures and also has a positive effect on the service life of the encoder. In addition to high resistance to impact loads and vibration, MAX30N, MAX48N and MAX48A devices meet common market EMC requirements for a wide range of machine types.

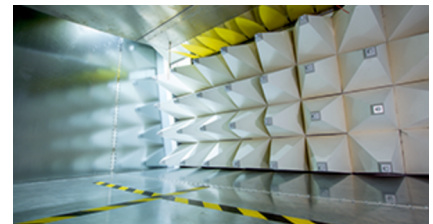
### More power reserves, more reliability.



Very high reliability, even when oil temperatures in hydraulic cylinders reach critical values of up to 95 degrees Celsius.



Thanks to its particularly rugged design, the MAX<sup>®</sup> linear encoder is able to withstand high mechanical loads such as shocks and vibrations.



The high EMC protection measures in the MAX<sup>®</sup> prevent electromagnetic interference from motors, power electronics and alternators. The encoder meets EMC requirements for mobile machines as well as industry standards.



**When the going gets rough: As linear encoders for mobile machines, MAX30N, MAX48N and MAX48A devices are designed for reliable position measurements under extreme ambient conditions and full load.**



## With numerous diagnostic functions for higher efficiency and reliability

With MAX30N, MAX48N and MAX48A devices, machine manufacturers, cylinder manufacturers and operators of mobile machines now finally have access to system-relevant status data of cylinders, such as temperature, supply voltage, piston travel or number of operating cycles and operating hours. As a result, these linear encoders enable the integration of hydraulic cylinders into maintenance systems and intelligent controls. By evaluating stroke lengths or temperature curves, for example, statements can be made about the stress on the cylinder and the operating states of the encoder. In this way, it is possible to get to the bottom of possible causes of failure and use data to advance the development of hydraulic cylinders and hydraulic drive systems. During operation, MAX30N, MAX48N or MAX48A devices keep all important parameters in view. This effectively prevents critical operating states, increases machine availability and extends the service life of the hydraulic drive systems.

### Increase transparency, improve reliability



The diagnostic functions of the MAX30/48 allow relevant status data of the cylinder to be recorded.



Integrated intelligence: Cylinders provide important status data of the mobile machines with MAX30N, MAX48N and MAX48A devices.



In the case of cylinders, maintenance and servicing costs can be significantly reduced with diagnostic data and predictive maintenance.



**The MAX30N, MAX48N and MAX48A diagnostic functions are used to generate encoder operating histograms. This allows, for example, the load limits of hydraulic cylinders to be identified and avoided in the future. The diagnostic data thus provides the basis for long-term reliability of hydraulic cylinders and entire hydraulic systems.**



### Technical data overview

<b>Measuring length</b>	0.05 m ... 2.5 m (depending on type)
<b>Communication interface</b>	Analog, PWM, CANopen, SAE J1939 (depending on type)
<b>Communication Interface detail</b>	Current / Voltage (depending on type)
<b>Resolution</b>	Typ. 0.1 mm (noise-free)
<b>Connection type</b>	Male connector, M12 type S (20x20 mm), 4-pin Male connector, M12 type L (24x24 mm), 4-pin Connecting cable, 3-wire Male connector, M12 type S (20x20 mm), 5-pin Male connector, M12 type L (24x24 mm), 5-pin Without electrical connection Connecting cable, 4-wire

### Product description

The MAX<sup>®</sup> linear encoder is designed for position measurements in mobile hydraulic applications in hydraulic cylinders and controls hydraulic components of self-driving mobile machines. The magnetostriction technology provides highly reliable, wear- and maintenance-free absolute position detection. The pressure-resistant housing protects the encoder in the hydraulic cylinder from influences during operation, such as fluid temperatures, vibrations, hydraulic oil, electrical and magnetic fields.

Different sizes offer numerous installation options:

MAX30N with a 30 mm housing for very small hydraulic cylinders.

MAX48N with radial cable entry for space-saving electrical connection.

MAX48A with axial cable entry and rugged stainless-steel housing.

The diagnostic functions of the MAX<sup>®</sup> can be used to examine the operating cycles of hydraulic cylinders.

### At a glance

- Measuring range: 50 to 2,500 mm (for MAX48N and MAX48A) or 1,500 (for MAX30N), 1 mm increments, typical resolution 0.1 mm
- Analog, CANopen, SAE J1939 and PWM interfaces are available
- Pressure-resistant housing, designed for hydraulic operating pressures of up to 400 bar
- High operating temperature (electronics) up to +105 °C
- Fluid temperature (hydraulic oil) up to max. +95 °C
- Compact dimensions: 10 mm installation space, 30 mm cushion zone
- Position magnet does not need a spacer disk

### Your benefits

- Magnetostriction: Reliable, safe and wear-free
- 100% mechanical and electrically compatible with existing cylinder constructions
- Save-spacing installation: Better utilization of the piston stroke in tight installation space of the cylinder
- Extremely stable signal behavior and very good EMC properties: Resistant to extreme electrical influences, such as radiated or coupled faults in the on-board power supply
- Status monitoring: Monitoring of piston strokes, operating hours and max. oil temperature provides a statement about the cost-optimized operation of the machine
- Favorable cost-benefit ratio

### Fields of application

Mobile work equipment

- Steering cylinder and spring systems
- Lifting and press cylinders on garbage trucks
- Stroke, swivel and tilt cylinders on telescopic handlers
- Support cylinders on work platforms
- Cutting system adjustment, steering assistance
- Loading crane monitoring, boom cylinders
- Gripper monitoring field on container cranes



- 3) Only in combination with CANopen communication interface.
- 4) Only in combination with communication interface SAEJ 1939.
- 5) Only in combination with MAX48N and MAX30N.
- 6) \* Full scale (measuring range end value).

PWM

Size

3	0
4	8

Material of housing cover / Cable connection direction

A	Stainless steel / axial <sup>1)</sup>
N	Plastic / radial

Pipe diameter / attenuation / end cap

1	10 mm / 30 mm / flat <sup>1)</sup>
2	10 mm / 36 mm / flat <sup>1)</sup>
3	10 mm / 63 mm / flat <sup>1)</sup>
7	7 mm / 30 mm / flat <sup>2)</sup>
8	7 mm / 36 mm / flat <sup>2)</sup>
9	7 mm / 63 mm / flat <sup>2)</sup>

Supply voltage

2	24 V DC (8 ... 32 V DC)
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Communication interface

P	PWM
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Pulse width

A	05 ... 95%
B	10 ... 90%
C	15 ... 85%
D	20 ... 80%
E	25 ... 75%

Frequency

D	250 Hz
E	300 Hz
F	400 Hz
H	500 Hz

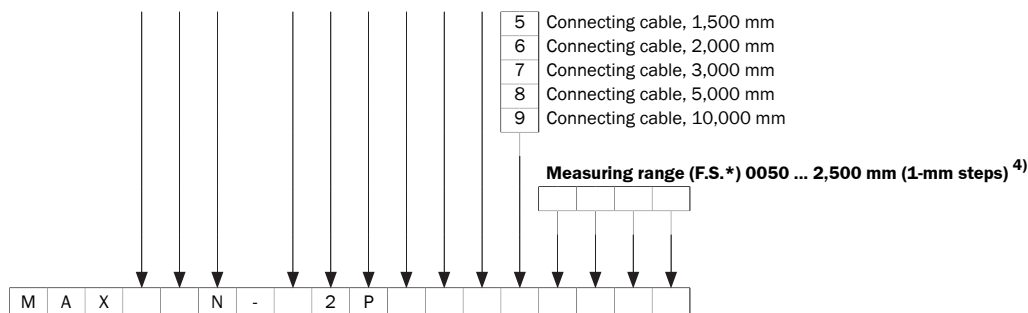
Connection type

A	M12 male connector, type S, 4-pin (strands): 1 = V DC; 2 = n.c.; 3 = GND; 4 = SIG <sup>3)</sup>
B	M12 male connector, type S, 4-pin (strands): 1 = V DC; 2 = SIG; 3 = GND; 4 = n.c. <sup>3)</sup>
M	M12 male connector, type S, 4-pin (strands): 1 = n.c.; 2 = V DC; 3 = GND; 4 = SIG <sup>3)</sup>
E	M12 male connector, type L, 4-pin (strands): 1 = n.c.; 2 = V DC; 3 = GND; 4 = SIG
G	M12 male connector, type L, 4-pin (strands): 1 = V DC; 2 = n.c.; 3 = GND; 4 = SIG
H	M12 male connector, type S, 4-pin (strands): 1 = V DC; 2 = SIG; 3 = GND; 4 = n.c.
K	3-wire connecting cable, strands stripped

Connector length

A	Strands, 60 mm
B	Strands, 70 mm
C	Strands, 80 mm
D	Strands, 90 mm
E	Strands, 100 mm
F	Strands, 110 mm
G	Strands, 120 mm
H	Strands, 140 mm
J	Strands, 160 mm
K	Strands, 180 mm
M	Strands, 200 mm
N	Strands, 220 mm
P	Strands, 240 mm
1	Connecting cable, 300 mm
2	Connecting cable, 500 mm
3	Connecting cable, 750 mm
4	Connecting cable, 1,000 mm





- 1) Only in combination with size 48.
- 2) Only in combination with size 30.
- 3) Only in combination with MAX48N and MAX30N.
- 4) \* F.S. = Full scale (measuring range end value).

Analog

Size

3	0
4	8

Material of housing cover / Cable connection direction

A	Stainless steel / axial <sup>1)</sup>
N	Plastic / radial

Pipe diameter / attenuation / end cap

1	10 mm / 30 mm / flat <sup>1)</sup>
2	10 mm / 36 mm / flat <sup>1)</sup>
3	10 mm / 63 mm / flat <sup>1)</sup>
7	7 mm / 30 mm / flat <sup>2)</sup>
8	7 mm / 36 mm / flat <sup>2)</sup>
9	7 mm / 63 mm / flat <sup>2)</sup>

Supply voltage

1	12 V DC (8 ... 16 V DC) <sup>3)</sup>
2	24 V DC (8 ... 32 V DC)

Communication interface

V	Voltage
A	Current

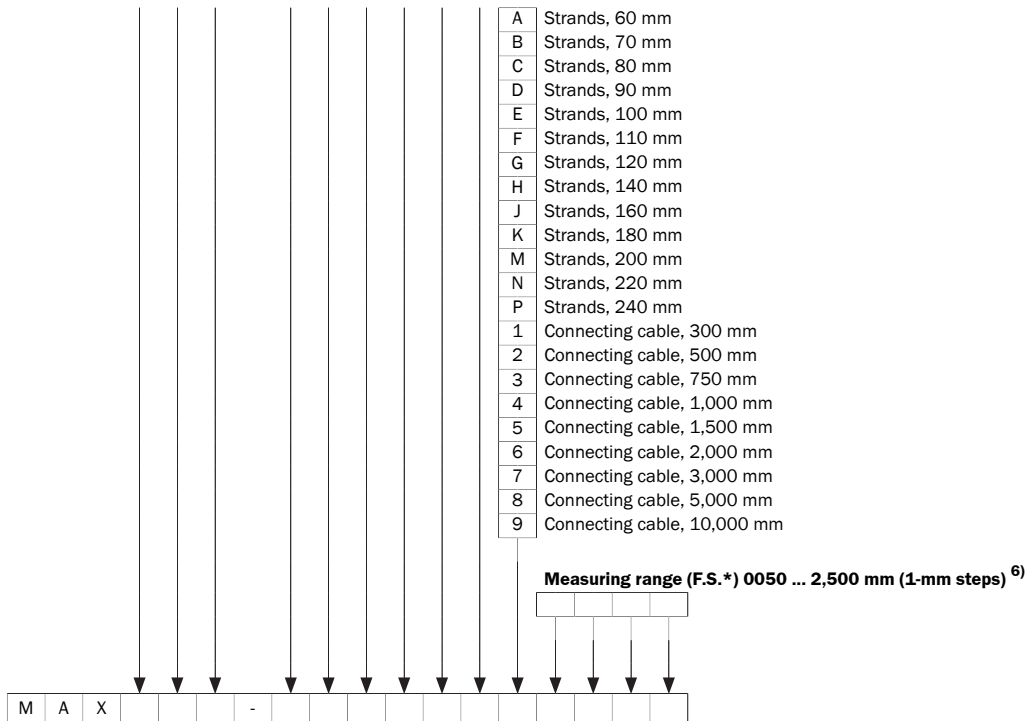
Signal type

1	0	0.50 ... 4.50 V
1	1	4.50 ... 0.50 V
2	0	0.25 ... 4.75 V
2	1	4.75 ... 0.25 V
3	0	0.50 ... 9.50 V
3	1	9.50 ... 0.50 V
4	0	1.00 ... 9.00 V
4	1	9.00 ... 1.00 V
1	0	4.00 ... 20.00 mA <sup>4)</sup>
1	1	20.00 ... 4.00 mA <sup>4)</sup>

Connection type

A	M12 male connector, type S, 4-pin (strands: 1 = V DC; 2 = n.c.; 3 = GND; 4 = SIG) <sup>5)</sup>
B	M12 male connector, type S, 4-pin (strands: 1 = V DC; 2 = SIG; 3 = GND; 4 = n.c.) <sup>5)</sup>
M	M12 male connector, type S, 4-pin (strands: 1 = n.c.; 2 = V DC; 3 = GND; 4 = SIG) <sup>5)</sup>
E	M12 male connector, type L, 4-pin (strands: 1 = n.c.; 2 = V DC; 3 = GND; 4 = SIG)
G	M12 male connector, type L, 4-pin (strands: 1 = V DC; 2 = n.c.; 3 = GND; 4 = SIG)
H	M12 male connector, type S, 4-pin (strands) 1 = V DC; 2 = SIG; 3 = GND; 4 = n.c.
K	3-wire connecting cable, strands stripped

Connector length



- 1) Only in combination with size 48.
- 2) Only in combination with size 30.
- 3) Only in combination with voltage output (signal type V10, V11, V20, V21).
- 4) Only in combination with communication interface A.
- 5) Only in combination with MAX48N and MAX30N.
- 6) \* F.S. = Full scale (measuring range end value).

## SICK AT A GLANCE

SICK is one of the leading manufacturers of intelligent sensors and sensor solutions for industrial applications. A unique range of products and services creates the perfect basis for controlling processes securely and efficiently, protecting individuals from accidents and preventing damage to the environment.

We have extensive experience in a wide range of industries and understand their processes and requirements. With intelligent sensors, we can deliver exactly what our customers need. In application centers in Europe, Asia and North America, system solutions are tested and optimized in accordance with customer specifications. All this makes us a reliable supplier and development partner.

Comprehensive services complete our offering: SICK LifeTime Services provide support throughout the machine life cycle and ensure safety and productivity.

For us, that is “Sensor Intelligence.”

## WORLDWIDE PRESENCE:

Contacts and other locations –[www.sick.com](http://www.sick.com)