mm Model FD60, FD96 & FD115

Instruction manual
Draw-wire displacement sensors

FD60
FD96
FD115

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1. Safety

Knowledge of the operating instructions is a prerequisite for sensor operation.

1.1 Symbols Used

The following symbols are used in this instruction manual:

⚠ CAUTION	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a situation which, if not avoided, may lead to property damage.
➡	Indicates an user action.
i	Indicates an user tip.

1.2 Warnings

⚠ CAUTION

The power supply may not exceed the specified limits.
> Danger of injury

> Damage to or destruction of the sensor

Do not open the sensor housing.
> Danger of injury from pre-tensioned spring motor

Do not pull or loop the measuring wire around unprotected parts of the body.
> Danger of injury

Do not let the measuring wire rewind without control (snap back).
> Danger of injury from whiplash effect of the wire with assembly bolts/clips

> Destruction of wire

> Destruction of sensor

Do not pull the measuring wire over measuring range.
> Destruction of the measuring wire

> Destruction of the sensor

> Danger of injury

NOTICE

Power supply and the display/output device must be connected in accordance with the safety regulations for electrical equipment.
> Damage to or destruction of the sensor

Avoid shock and vibration to the sensor.
> Damage to or destruction of the sensor

1.3 Notes on CE Identification

The following applies to series draw wire sensors: Machinery Directive 2006/42/EC

The following applies to series draw wire sensors with voltage, current or digital output:

EMC regulation 2004/108/EC

Products which carry the CE mark satisfy the requirements of the EMC regulation 2004/108/EC ‘Electromagnetic Compatibility’ and the European standards (EN) listed therein. The EU declaration of conformity is kept available according to EU regulation, article 10 by the authorities responsible.

Draw wire sensors with potentiometer output are not automatically operable devices (components). An EC declaration of conformity or CE identification is therefore not issued by EMC law.

Sources: EMC law, guidelines on the application of council directive 2004/108/EC, directive 2006/42/EC.

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The draw wire sensors are designed for use in industry and satisfy the requirements of the standards
- DIN EN 61326-1: 2006-10
- DIN EN 61326-2-3: 2007-05

The draw wire sensors satisfy the requirements if they comply with the regulations described in the instruction manual for installation and operation.

The draw wire sensors have been tested according to the following EMC standards:

EN 55 011

Emission of electromagnetic fields	Group1 / Class B
RFI emission over mains cable	Group1 / Class B

EN 61 000-6-2

ESD (air and contact discharge)	EN 61000-4-2	Criterion B
Transient disturbance variables (burst)	EN 61000-4-4	Criterion B
Magnetic fields	EN 61000-4-8	Criterion A
Mains-borne disturbance	ENV 50141	Criterion A
Radiated interference	ENV 50140	Criterion A

1.4 Proper Use

Draw wire sensors are used for
- distance or displacement measuring
- position determination

of components or moving machine parts.
- The sensors may only be operated within the limits specified in the technical data, see Chap. 2.
- Draw wire sensors should only be used in such a way that in case of malfunction or failure personnel or machinery are not endangered.
- Additional precautions for safety and damage prevention must be taken for safety-related applications.

1.5 Proper Environment

- Protection class for sensor: IP 65 [1]
- Operating temperature: -20 to +80 °C, (-4 to +176 °F)
- Storage temperature: -40 to +80 °C, (-40 to +176 °F)
- Humidity: 5 - 95 % (no condensation)
- Ambient pressure: Atmospheric pressure
- Vibration: According to IEC 68-2-6
- Mechanical shock: According to IEC 68-2-27
- EMC: According to DIN EN 61326-1: 2006-10
  DIN EN 61326-2-3: 2007-05
- ¡Note the slight power dissipation of the potentiometer above +40 °C (+104 °F)! (-0.15 W/10 K)

1.6 Foreseeable Misuse

To this date, no misuse is known.

1) Models with male plug connection only with gasketed female plug

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2. Functional Principle, Technical Data

2.1 Functional Principle

With the wire principle, a linear motion is transformed into a change in resistance by a rotation.

A measuring wire made of highly flexible stainless steel wires is wound onto a drum with the aid of a long life spring motor.

The winding drum is coupled axially with a
- multi-turn potentiometer (Type ... - FDxx- ... - P/U/I) respectively with an
- encoder (Type ... - FDxx - ... - E/A).

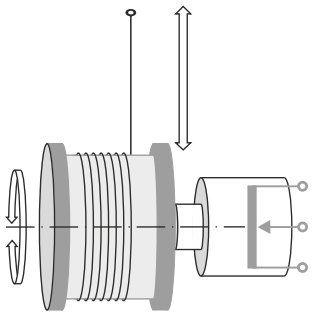

Fig. 1 Draw-wire sensor with potentiometer

2.2 Structure, Electrical Connection

The draw wire principle is used in the housing design FD60 / FD96 / FD115 with different measuring lengths from 100 to 15,000 mm (3.93 to 591 in).

Five versions of the electrical connection are possible
- Potentiometer output (resistance divider)
- Voltage output (with integrated electronics)
- Current output (with integrated electronics)
- Incremental encoder (with integrated electronics, output: HTL- or TTL-level)
- Absolute encoder (with integrated electronics) [1]

1) Outputs:
- CAN-Bus,
- SSI,
- Profi-Bus

Electrical Connection

	Measuring range	
Output	up to 5,000 mm	from 7,500 mm
P	CA	SA
U/I	SR	SA
HTL/TTL	CR	CR
SSI	SR	SR
CO/PB	BH	BH

2.3 Technical Data Model FD60 Analog

Model			**100-FD60**	**150-FD60**	**300-FD60**	**500-FD60**	**750-FD60**	**1000-FD60**	**1500-FD60**
Output type			P/U/I	P/U/I	P/U/I	P/U/I	P/U/I	P/U/I	P/U/I
Measuring range		mm (inch)	100 (3.94)	150 (5.91)	300 (11.8)	500 (19.7)	750 (29.5)	1000 (39.4)	1500 (59.1)
Linearity	±0.1 % FSO	±mm (inch)				0.5 (0.02)	0.75 (0.03)	1 (0.04)	1.5 (0.06)
	±0.25 % FSO	±mm (inch)			0.75 (0.03)				
	±0.5 % FSO	±mm (inch)	0.5 (0.02)	0.75 (0.03)					
Resolution	% FSO		quasi infinite						
Sensor element			Conductive plastic potentiometer		Hybrid-potentiometer				
Temperature range		-20 ... +80 °C (-4 ... +178 °F)							
Material	Housing		Aluminium						
	Wire		Stainless steel with polyamid sheath						
Wire acceleration		g	approximately 10 ... 30 g (depends on measuring range)						
Wire retraction force (min)		N	6.5	4.5	6	6	4	5	3.5
Wire retraction force (max)		N	7.5	5.5	7.5	7.5	5.5	7.5	5.5
Sensor mounting			Mounting grooves in the housing						
Wire mounting			Wire clip						
Weight		g	approximately 370 (... - FD60 - CR -P) approximately 455 (... - FD60 - SR -U/I)						appr. 500
Wire misalignment			max. 3 degrees						
Protection class	EN 60529: 1991		IP 65 (Only if plug is connected to socket)						
Vibration	IEC 68-2-6		20 g, 20 Hz, ... 2 kHz						
Shock	IEC 68-2-27		50 g, 10 ms						
Electrical connection	Output P/E Output U/I		integral cable, radial, 1 m long flange connector, radial, 8-pin, DIN45326						

FSO = Full Scale Output

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2.4 Technical Data Model FD96 and FD115 Analog

Model		2000-FD96	2500-FD96	3000-FD115	4000-FD115	5000-FD115	7500-FD115	10000-FD115	15000-FD115
Output type		P/U/I							
Measuring range	mm (inch)	2000 (78.7)	2500 (98.4)	3000 (118)	4000 (157)	5000 (197)	7500 (295)	10000 (394)	15000 (591)
Linearity ±0.1 % FSO	±mm (inch)	2 (0.08)	2.5 (0.10)	3 (0.12)					
Linearity ±0.15 % FSO	±mm (inch)				6 (0.24)	7.5 (0.30)	11.3 (0.44)	15 (0.59)	22.5 (0.89)
Resolution % FSO		quasi infinite							
Sensor element		Hybrid-potentiometer							
Temperature range		-20 ... +80 °C (-4 ... +178 °F)							
Material Housing		Aluminium							
Material Wire	mm	Stainless steel with polyamid sheath (wire)							
		ø 0.8 (0.03 dia.)		ø 0.45 (0.02 dia.)			ø 1.0 (0.04 dia.)		
Wire acceleration	g	8		6					
Wire retraction force (min)	N	5	5.5	4.5	4	4	8	8	8
Wire retraction force (max)	N	10	9	8	8.5	9	24	21	25
Sensor mounting		Mounting grooves in the housing							
Wire mounting		wire clip							
Weight	kg	1.1					2.2	3.2	3.5
Wire misalignment		max. 3 degrees							
Protection class EN 60529: 1991		IP 65 (only if plug is connected to socket)							
Vibration IEC 68-2-6		20 g, 20 Hz, ... 2 kHz							
Shock IEC 68-2-27		50 g, 10 ms		50 g, 20 ms					

FSO = Full Scale Output

Models with potentiometric output .... - FDxx - CR - P

Electrical data

Supply voltage: max. 32 VDC at 1 kOhm / max. 1 W
Resistance: 1 kOhm ±10 % (potentiometer)
Viper current: ≤ 3 mA
Temperature coefficient: ±0.0025 % FSO/K (±0.0014 % FSO/°F)
Sensitivity: depends on measuring range, individually reported on product label
Electrical connection: Integral cable, radial, 3 wire, 1 m long

i Note the slight power dissipation of the potentiometer above +40 °C (+104 °F)! (-0.15 W/10 K)

Models with voltage output .... - FDxx - SR - U

Electrical data

Supply voltage: 14 to 27 VDC non stabilized
Current consumption: 30 mA max.
Output voltage: 0 to 10 VDC (Options: 0 - 5 / ±5 V)
Output current: 2 mA max.
Load impedance: > 5 kOhm
Output noise: 0.5 mV_{eff}
Temperature coefficient: ±0.005 % FSO/K (±0.0028 % FSO/°F)

Adjustment ranges

Zero: ±20 % FSO
Sensitivity: ±20 %
Electromagnetic compatibility (EMC): acc. DIN EN 61326-1: 2006-10 and DIN EN 61326-2-3: 2007-05

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Models with current output (2-wire) .... - FDxx - SR - I

Electrical data

Supply voltage:	14 to 27 VDC non stabilized (measured on the input terminal of the sensor)
Current consumption:	35 mA max.
Output current:	4 to 20 mA
Load:	< 600 Ohm
Temperature coefficient:	±0.01 % FSO/K (±0.005 % FSO/°F)
Output noise:	< 1.6 μA_{eff}

Adjustment ranges

Zero:	±18 % FSO
Sensitivity:	±15 %
EMC:	acc. DIN EN 61326-1: 2006-10 and DIN EN 61326-2-3: 2007-05

2.5 Technical Data Model FD60 Digital

Model		**1000-FD60**	**1500-FD60**
Output		HTL, TTL, PB, CO, SSI	
Measuring range		1000 mm	1500 mm
Linearity	±0.02 % FSO	±0.2 mm	±0.3 mm
Resolution HTL, TTL		0.067 mm (15 pulses/mm)	0.1 mm (10 pulses/mm)
Resolution SSI, PB, CO		0.024 mm	0.03 mm
Sensor element		Incremental encoder	
Temperature range		-20 ... +80 °C	
Material	Housing	Aluminum	
	Draw wire	Coated polyamid stainless steel (ø 0.45 mm)	
Sensor mounting		Mounting grooves in the housing	
Wire mounting		Wire clip	
Wire acceleration		10 g	15 g
Wire retraction force (min)		5 N	3,5 N
Wire extension force (max)		7.5 N	5.5 N
Protection class		IP 65 (only if connected)	
Vibration	IEC 68-2-6	20 g, 20 Hz - 2 kHz	
Mechanical shock	IEC 68-2-27	50 g, 10 ms	
Electrical connection	Output HTL, TTL	Integral cable, radial, 1 m long	
	Output SSI	Connector, radial, 12-pin	
	Output PB, CO	Bus cover	
Weight		approximately 1 kg	

FSO = Full Scale Output

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2.6 Technical Data Model FD96 Digital

Model		**3000-FD96**
Output		HTL, TTL, SSI, PB, CO
Measuring range		3000 mm
Linearity	±0.02 % FSO	±0.6 mm
Resolution HTL, TTL		0.087 mm (11.53 pulses/mm)
Resolution SSI, PB, CO		0.032 mm
Sensor element		Incremental-/absolute-encoder
Temperature range		-20 ... +80 °C
Material	Housing	Aluminum
	Draw wire	Coated polyamid stainless steel (ø 0.8 mm)
Sensor mounting		Slot nuts
Wire mounting		Wire clip
Wire acceleration		7 g
Wire retraction force (min)		5.5 N
Wire extension force (max)		9 N
Protection class		IP 65 (only if connected)
Vibration	IEC 68-2-6	20 g, 20 Hz - 2 kHz
Mechanical shock	IEC 68-2-27	50 g, 10 ms
Electrical connection	Output HTL, TTL	Integral cable, radial, 1 m long
	Output SSI	Connector, radial, 12-pin
	Output PB, CO	Bus cover
Weight		approximately 1.7 kg

FSO = Full Scale Output

2.7 Technical Data Model FD115 Digital

Model		**5000-FD115**	**7500-FD115**	**10000-FD115**	**15000-FD115**
Measuring range		5000 mm	7500 mm	10000 mm	15000 mm
Output		HTL, TTL, SSI, PB, CO			
Linearity	±0.01 % FSO	-	-	±1 mm	±1.5 mm
	±0.02 % FSO	±1 mm	±1.5 mm	-	-
Resolution	HTL, TTL	0.105 mm (9.52 pulses/mm)			
	SSI, PB, CO	0.038 mm			
Sensor element		Incremental-/absolute-encoder			
Temperature range		-20 ... +80 °C			
Material	Housing	Aluminum			
	Draw wire	Coated polyamid stainless steel (ø 1.0 mm)			
Sensor mounting		Slot nuts			
Wire mounting		Eyelet			
Wire acceleration		5 g	6 g	3 g	3 g
Wire retraction force (min)		4 N	8 N	8 N	8 N
Wire extension force (max)		16 N	24 N	21 N	25 N
Protection class		IP 65 (only if connected)			
Vibration	IEC 68-2-6	20 g, 20 Hz - 2 kHz			
Mechanical shock	IEC 68-2-27	50 g, 10 ms			
Elektrical connection	Output HTL/TTL	Integral cable, radial, 1 m lang			
	Output SSI	Connector, radial, 12-pin			
	Output PB, CO	Bus cover			
Weight		approx. 2 kg	approx. 2.5 kg	approx. 3.5 kg	approx. 4.5 kg

FSO = Full Scale Output

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3. Delivery

3.1 Unpacking

- Do not unpack the sensor by pulling the wire or wire bolt / clip.
- Ship the sensors so, that no damage can appear.
- Check for completeness and shipping damages immediately after unpacking.
- In case of damage or missing parts, please contact the manufacturer or supplier.

i Remove shipping protection of measuring wire by qualified personnel only and immediately before mounting.

3.2 Storage

- Store only with the transport protection in place.

This prevents the measuring wire being pulled out and accidental is snapping back.

- Temperature -40 to +80 °C, (-40 to +176 °F)
- Humidity 5 - 95 % (no condensation)
- Atmospheric pressure

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⚠ CAUTION

Uncontrolled retraction of the measuring wire is incorrect!
> Danger of injury from whiplash effect of the wire with assembly bolts/clips

> Destruction of wire and/or of sensor.

Save the wire during installation work.

4. Installation and Mounting

4.1 Precautionary Measures

Do not pull the measuring wire over range
> Damage to or destruction of the sensor is possible.

Do not damage the measuring wire.

Do not oil or grease the measuring wire.

Do not bend the measuring wire

Do not pull the measuring wire at an angle

Do not allow to loop the measuring wire around objects.

Do fix the measuring wire to the target when wound up.

Do not loop the measuring wire round parts of the body.

4.2 Sensor Assembly

- Mount the sensor through mounting grooves for nut M4 DIN 934 or bolt M4 DIN 931, see Fig. 2 up to, see Fig. 16
- Mount the sensor through mounting clips MT60, see Fig. 28.

The sensor does not have to be oriented in a special way.

➡ Choose the installation position so that damage and soiling of the measuring wire is avoided.

➡ Prefer an installation position with measuring wire outlet facing downwards.

This prevents that liquids penetrate the measuring wire outlet.

i Do not let snap the measuring wire!
No warranty by damage through snapping.

⚠ CAUTION

A measuring wire under tension where operators are standing can lead to injuries.
> Danger of damage to wire and sensor.

NOTICE

Do not twist the measuring wire.

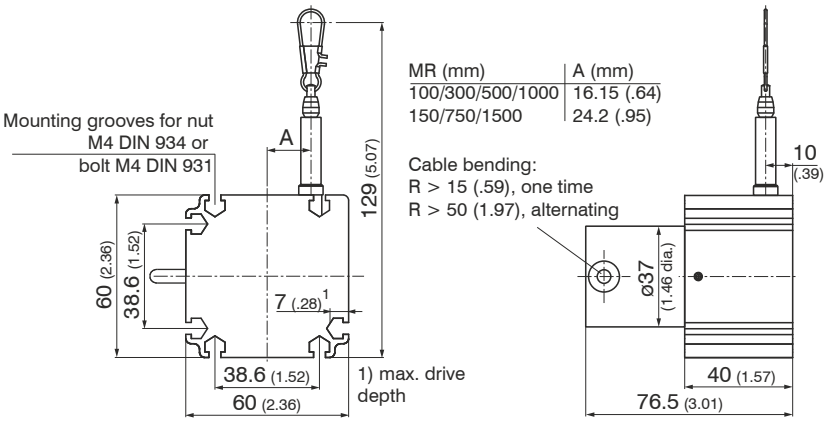

Fig. 2 Dimensional drawing ... - FD60 - CR - P, dimensions in mm (inches), not to scale

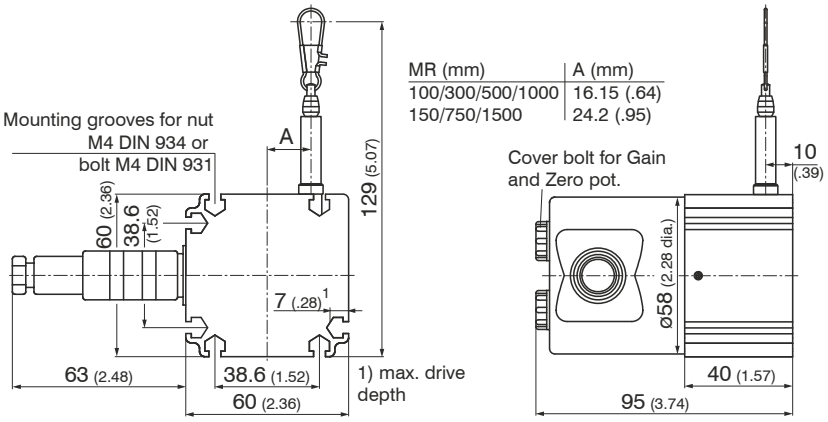

Fig. 3 Dimensional drawing ... - FD60 - SR - U/I, dimensions in mm (inches), not to scale

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⚠ CAUTION

A measuring wire under tension where operators are standing can lead to injuries.

> Danger of damage to wire and sensor.

NOTICE

Do not twist the measuring wire.

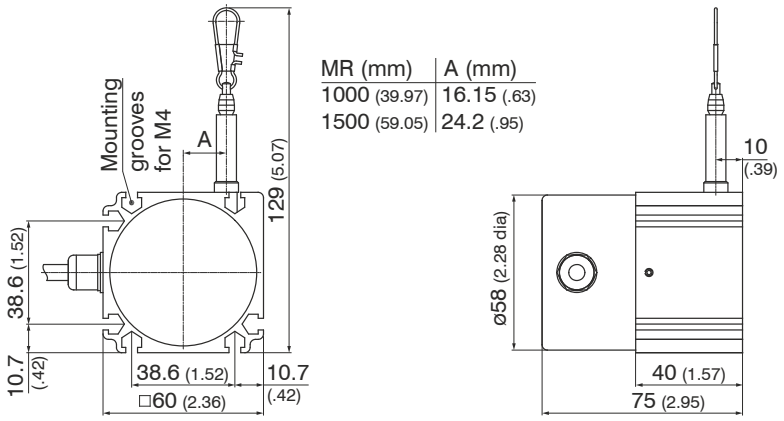

Fig. 4 Dimensional drawing ... - FD60 - CR - HTL/TTL, dimensions in mm (inches), not to scale

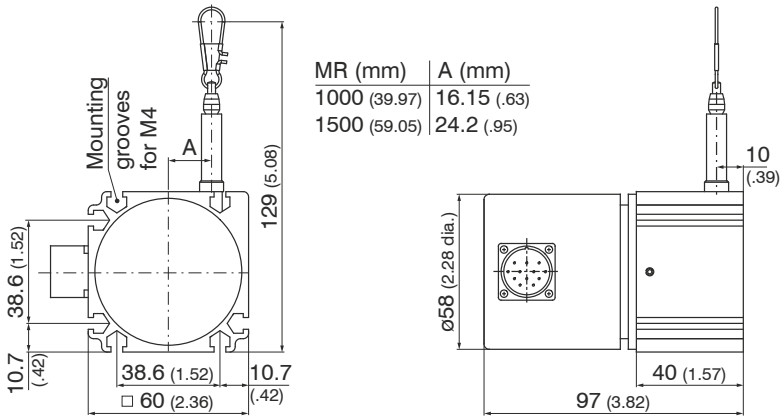

Fig. 5 Dimensional drawing ... - FD60 - CR - SSI, dimensions in mm (inches), not to scale

⚠ CAUTION

A measuring wire under tension where operators are standing can lead to injuries.

> Danger of damage to wire and sensor.

NOTICE

Do not twist the measuring wire.

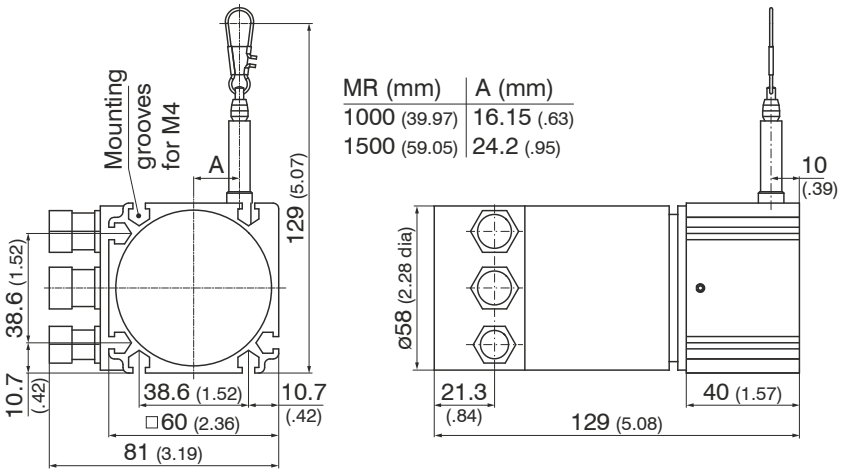

Fig. 6 Dimensional drawing ... - FD60 - CAN/PB, dimensions in mm (inches), not to scale

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⚠ CAUTION

A measuring wire under tension where operators are standing can lead to injuries.
> Danger of damage to wire and sensor.

NOTICE

Do not twist the measuring wire.

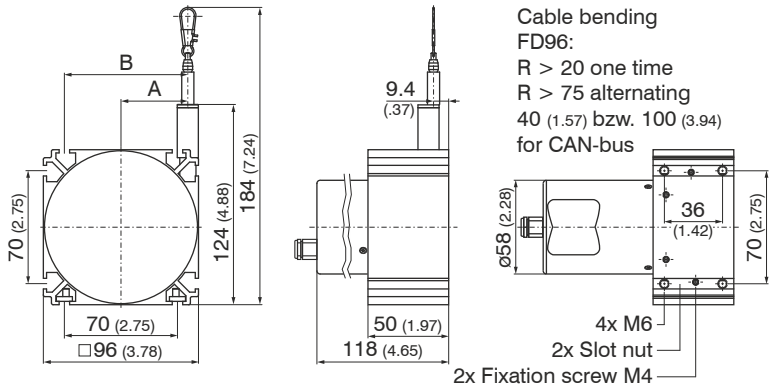

Fig. 7 Dimensional drawing ... - FD96 - CA - P, dimensions in mm (inches), not to scale

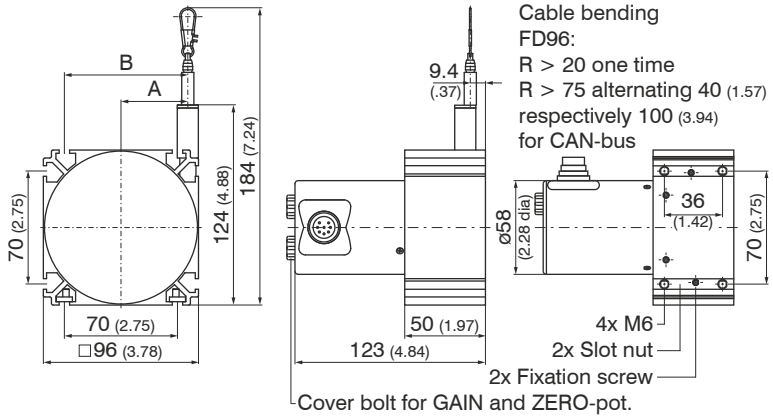

Fig. 8 Dimensional drawing ... - FD96 - SR - U/I, dimensions in mm (inches), not to scale

⚠ CAUTION

A measuring wire under tension where operators are standing can lead to injuries.
> Danger of damage to wire and sensor.

NOTICE

Do not twist the measuring wire.

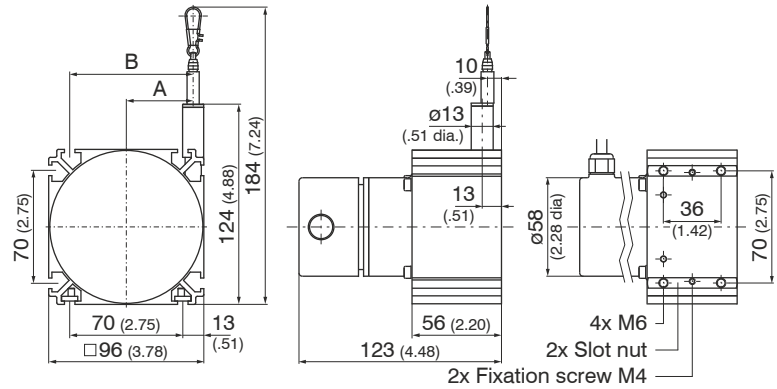

Fig. 9 Dimensional drawing ... - FD96 - HTL/TTL, dimensions in mm (inches), not to scale

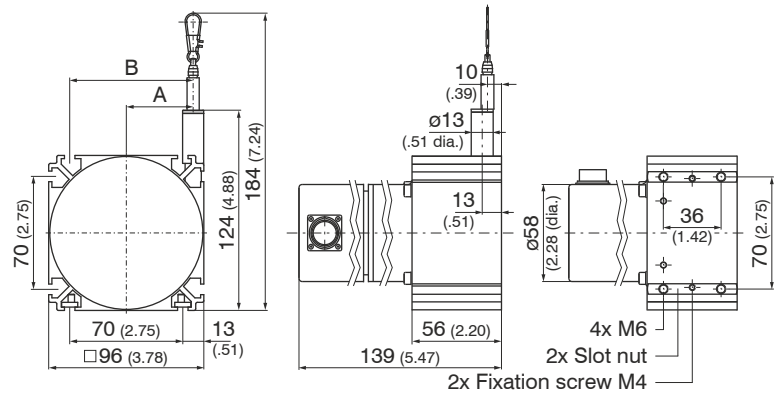

Fig. 10 Dimensional drawing ... - FD96 - SSI, dimensions in mm (inches), not to scale

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⚠ CAUTION

A measuring wire under tension where operators are standing can lead to injuries.
> Danger of damage to wire and sensor.

NOTICE

Do not twist the measuring wire.

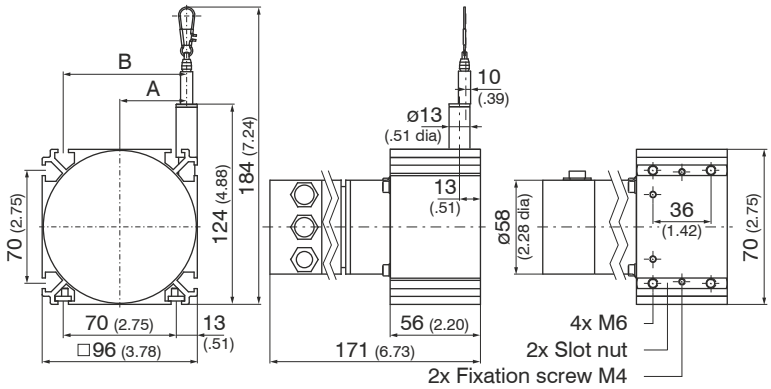

Fig. 11 Dimensional drawing ... - FD96 - CO/PB, dimensions in mm (inches), not to scale

Model		A	B
FD96 - CA - P FD96 -SR - U/I	2000-FD96	32 (1.26)	67 (2.64)
	2500-FD96	41.4 (1.36)	76.4 (3.00)
FD96 - HTL/TTL FD96 - SSI FD96 - CO/PB	2000-FD96	26 (1.02)	61 (2.40)
	3000-FD96	41.4 (1.63)	76.4 (3.00)

Dimensions in mm (inches)

⚠ CAUTION

A measuring wire under tension where operators are standing can lead to injuries.
> Danger of damage to wire and sensor.

NOTICE

Do not twist the measuring wire.

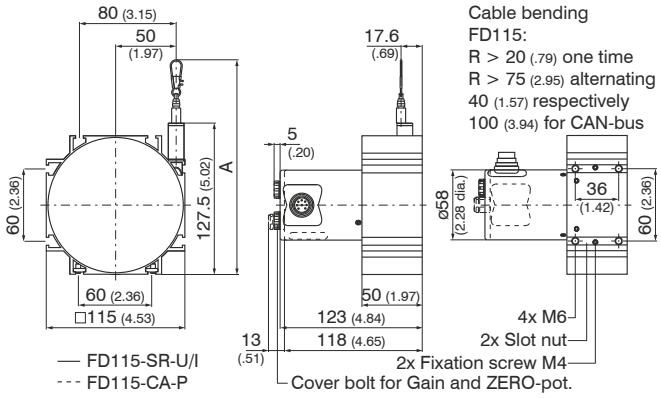

Fig. 12 Dimensional drawing ... - FD115 - U/I/P, measuring ranges 3,000 ... 5,000 mm, dimensions in mm (inches), not to scale

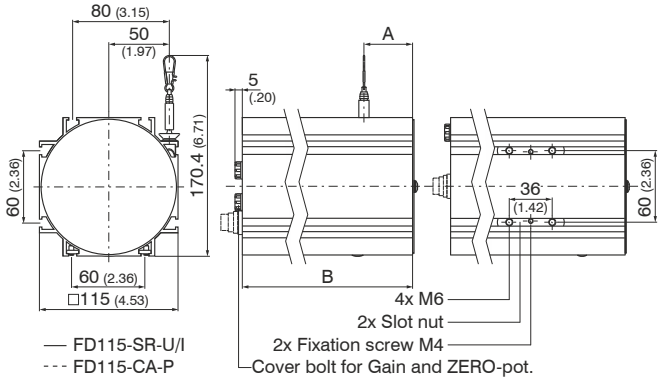

Fig. 13 Dimensional drawing ... - FD115 - U/I/P, measuring ranges 7.500 ... 15,000 mm dimensions in mm (inches), not to scale

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⚠ CAUTION

A measuring wire under tension where operators are standing can lead to injuries.

> Danger of damage to wire and sensor.

NOTICE

Do not twist the measuring wire.

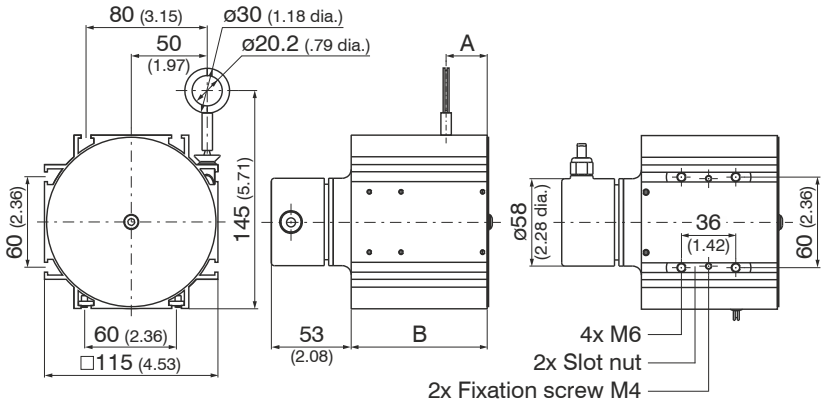

Fig. 14 Dimensional drawing ... - FD115 - HTL/TTL, dimensions in mm (inches), not to scale

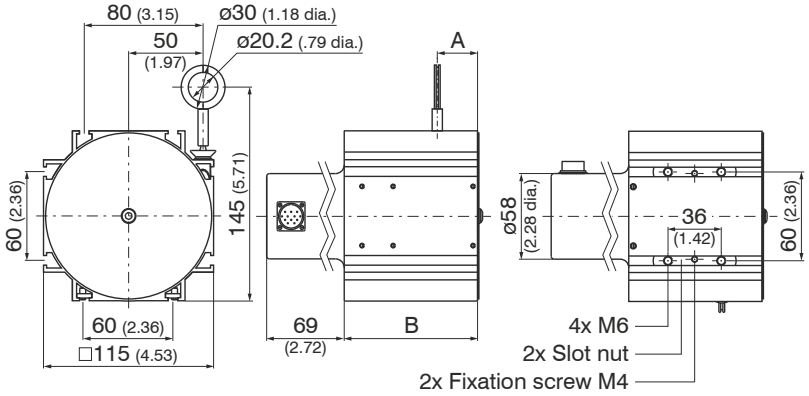

Fig. 15 Dimensional drawing ... - FD115 - SSI, dimensions in mm (inches), not to scale

⚠ CAUTION

A measuring wire under tension where operators are standing can lead to injuries.

> Danger of damage to wire and sensor.

NOTICE

Do not twist the measuring wire.

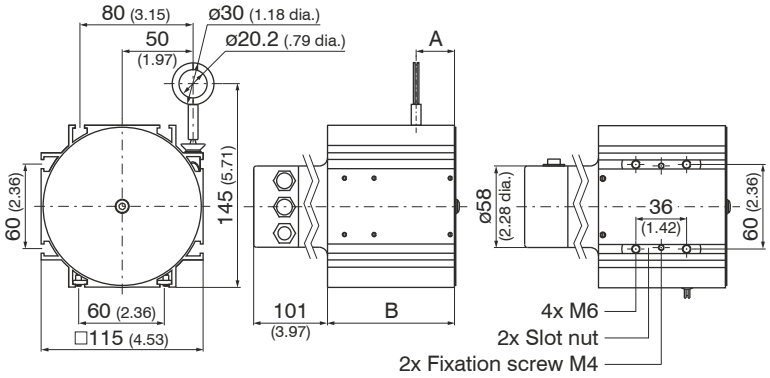

Fig. 16 Dimensional drawing ... - FD115 - CO/PB, dimensions in mm (inches), not to scale

Model		A	B
FD115 - U/I/P	3000-FD115	186 (7.32)	-
	4000-FD115	180 (7.09)	-
	5000-FD115	180 (7.09)	-
FD115 - U/I/P	7500-FD115	37 (1.46)	153 (6.02)
	10000-FD115	44,5 (1.75)	196 (7.72)
	15000-FD115	60,5 (2.38)	228 (8.89)
FD115- HTL/TTL FD115 - SSI FD115 - CO/PB	5000-FD115	28,5 (1.12)	91 (3.58)
	7500-FD115	37 (1.46)	112 (4.40)
	10000-FD115	44,5 (1.75)	155 (6.10)
	15000-FD115	60,5 (2.38)	187 (7.36)

Dimensions in mm (inches)

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⚠ CAUTION

A measuring wire under tension where operators are standing can lead to injuries.

> Danger of damage to wire and sensor.

NOTICE

Do not twist the measuring wire.

4.3 Wire Guide and Fastening

➡ Fix the measuring wire to the target using a wire clip.

➡ Fed the measuring wire perpendicularly from the sensor housing.

Misalignment is only permissible up to 3 degrees.

Dragging of the measuring wire on the inlet hole or other objects leads to damage and/or snapping of the measuring wire.

If the measuring wire cannot be fed vertically out of the housing, it is essential to use a guide pulley (accessory TR1).

➡ Keep the measuring wire in an area where it cannot be snagged or otherwise be violated.

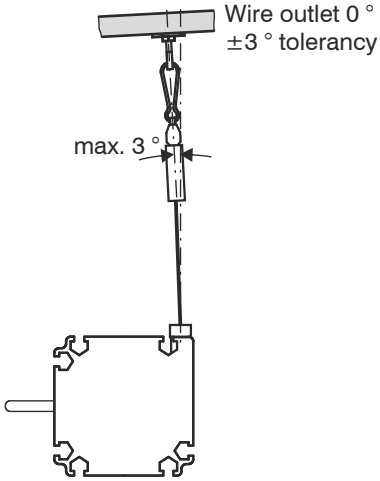
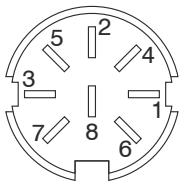


Fig. 17 Wire fastening and misalignment

4.4 Pin Assignment

4.4.1 Potentiometer, Current- and Voltage Output



View of solder pin side 8-pole socket

Electrical connection		Output
- CR - Integr. cable	- SR - Connector	- P - Potentiometer
Color DIN 47 100	Pin	
white	1	Input +
brown	2	Ground
green	3	Signal
Screen	Screen	Housing

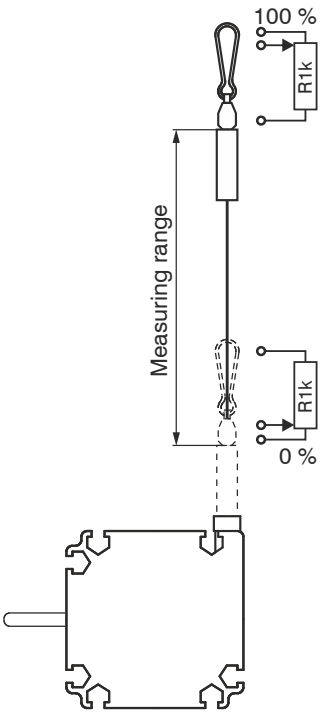
Fig. 18 Connection pin assignment ... - FDxx - CR - P

Electrical connection		Output
- SR - [1] Device plug DIN 45 326	- U - Voltage	- I - Current
Pin-Number		
1	Supply +	Supply +
2	Ground	Ground
3	Signal	---
4	Ground (Signal)	---

Fig. 19 Connection pin assignment ... - FDxx - SR - U/I

1) Pin 5 - 8 are not connected.

Draw wire sensors with potentiometer output are connected according to the pin assignment, see Fig. 18, see Fig. 20.



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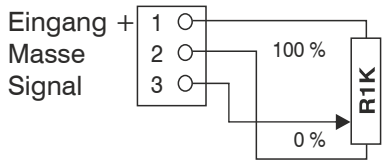


Fig. 20 Model with potentiometer output

Use the potentiometer only as a voltage divider, not as variable series resistor!

Using them as a variable resistor, destroys the element.

➡ Ensure that the maximum current through the viper is limited.

Draw wire sensors with voltage or current output are connected by the 8-pin built-in plug according to the pin assignment, see Fig. 19, see Fig. 21, see Fig. 22.

An 8-pin cable socket for the user-side assembly of your own connecting cable is part of the delivery scope of the standard sensors.

Note when assembling (Requirements of power and output cables to satisfy the EMC regulations):

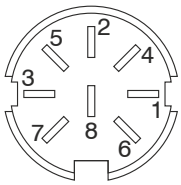
➡ Use a screened cable.

➡ Earth screen on electronics side.

- Recommended conductor cross-section 0.14 mm ² (up to 9 m/30 ft cable length)
- Maximum cable diameter 8 mm / 0.3 inch.

The EMC regulations are only satisfied under these basic conditions.

A pre-assembled connecting cable PC3/8 is available as an accessory, see Chap. 8.2.



View of solder pin side 8-pole socket

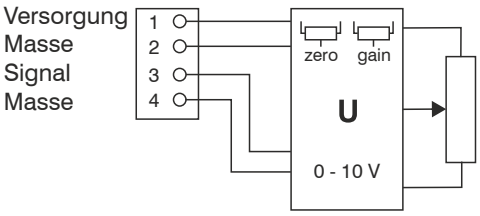


Fig. 21 Model with voltage output

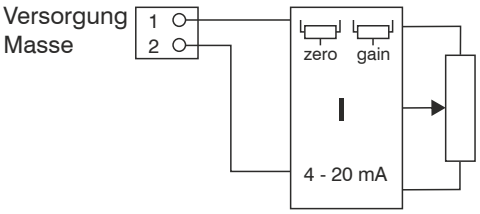


Fig. 22 Model with current output

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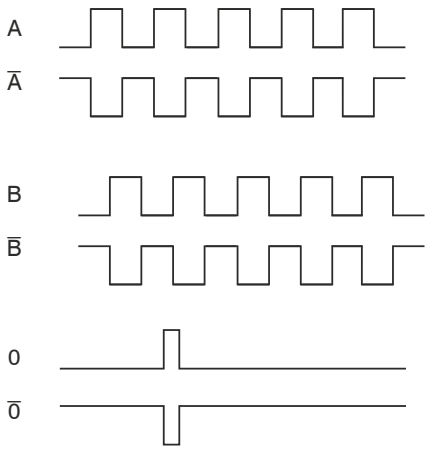
4.4.2 TTL, HTL

Note the pin assignment for draw-wire displacement sensors with **encoder output**. The sensor contains an additional supplement for detailed information.

Output signals



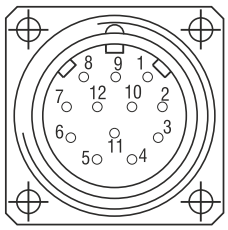
Output TTL		Linedriver (5 VDC)	
Level High		≥ 2.5 V	(with I = -20 mA)
Level Low		≤ 0.5 V	(with I = 20 mA)
Load High		≤ 20 mA	
Output		A, $\overline{A}$, B, $\overline{B}$, O	

Output HTL		Push-pull (10 ... 30 VDC)	
Level High		≥ UB -3 V	(with I = -20 mA)
Level Low		≤ 1.5 V	(with I = 20 mA)
Load High		≤ 40 mA	
Output		A, $\overline{A}$, B, $\overline{B}$, O	

Output E		Push-pull (5 ... 30 VDC)
Level High		UB -2.5 V
Level Low		≤ 0,5 V
Load High		≤ 50 mA
Output		A, B, O

Output E 830		Push-pull (5 ... 30 VDC)
Level High		UB -3 V
Level Low		≤ 2.5 V
Load High		≤ 50 mA
Output		A, B, O

Pin assignment TTL, HTL		
Pin	**Cable color**	**Assignment**
1	pink	B inv.
2	blue	UB Sense
3	red	N (reference pulse)
4	black	N inv. (reference pulse inv.)
5	brown	A
6	green	A inv.
7	-	-
8	grey	B
9	-	-
10	white/green	GND
11	white	GND Sense
12	brown/green	UB



Pin-side sensor male connector

Pin 2 and Pin 12 are internally connected as well as Pin 11 and 10.

Recommendation:

Require twisted pair wires for cable length > 10 m.

Pin assignment E, E 830		
Pin	Cable color	Assignment
-	white	0 V
-	brown	+UB
-	green	A
-	-	$\overline{A}$
-	yellow	B
-	-	$\overline{B}$
-	grey	0

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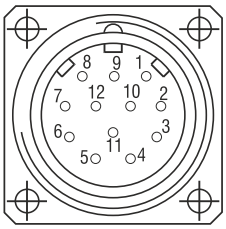
4.4.3 SSI

Contact description

1 UB	Encoder power supply connection.
2 GND	Encoder ground connection. The voltage drawn to GND is UB.
3 Pulses +	Positive SSI pulse input. Pulses + forms a current loop with pulse -. A current of approx. 7 mA indirection of pulse + input generates a logical 1 in positive logic.
4 Data +	Positive, serial data output of the differential line driver. A High level at the output corresponds to logical 1 in positive logic.
5 ZERO	Zero setting input for setting a zero point at any desired point within the entire resolution. The zeroing process is triggered by a High pulse (pulse duration ≥ 100 ms) and must take place after the rotating direction selection (UP/DOWN). For maximum interference immunity, the input must be connected to GND after zeroing.
6 Data -	Negative, serial data output of the differential line driver. A High level at the output corresponds to logical 0 in positive logic.
7 Pulses -	Negative SSI pulse input. Pulse - forms a current loop with pulse +. A current of approx. 7 mA in direction of pulse - input generates a logical 0 in positive logic.
8 / 10 $\overline{\text{DATAVALID}}$ $\overline{\text{DATAVALID}}$ $\overline{\text{MT}}$	Diagnosis outputs $\overline{\text{DV}}$ and $\overline{\text{DV}}$ $\overline{\text{MT}}$ Jumps in data word, e.g. due to defective LED or photoreceiver, are displayed via the $\overline{\text{DV}}$ output. In addition, the power supply of the multiturn sensor unit is monitored and the $\overline{\text{DV}}$ $\overline{\text{MT}}$ output is set when a specified voltage level is dropped below Both outputs are Low-active, i.e. are switched through to GND in the case of an error.
9 UP/DOWN	UP/DOWN counting direction input. When not connected, this input is on High. UP/ $\overline{\text{DOWN}}$-High means increasing output data with a clockwise shaft rotating direction when looking at the flange. UP/ $\overline{\text{DOWN}}$-Low means increasing values with a counter-clockwise shaft rotating direction when looking at the flange.
11 / 12	Not in use

Pin assignment SSI		
Pin	**Cable color**	**Assignment**
1	brown	UB
2	black	GND
3	blue	Pulse +
4	beige	Data +
5	green	ZERO
6	yellow	Data -
7	violet	Pulse -
8	brown/yellow	$\overline{\text{DATAVALID}}$
9	pink	V/$\overline{\text{R}}$
10	black/yellow	$\overline{\text{DATAVALID}}$ $\overline{\text{MT}}$
11	-	-
12	-	-



Pin-side sensor male connector

➡ Please use leads twisted in pairs for extension cables.

Inputs	
Control signals UP/DOWN and Zero	
Level High	> 0.7 UB
Level Low	< 0.3 UB
Connection:	UP/DOWN input with 10 kohms to UB, zeroing input with 10 kohms to GND.
SSI pulse	
Optocoupler inputs for electrical isolation	

Outputs	
SSI data	RS485 driver
Diagnostic outputs	
Push-pull outputs are short-circuit-proof	
Level High	> UB -3.5 V (with I = -20 mA)
Level Low	≤ 0.5 V (with I = 20 mA)

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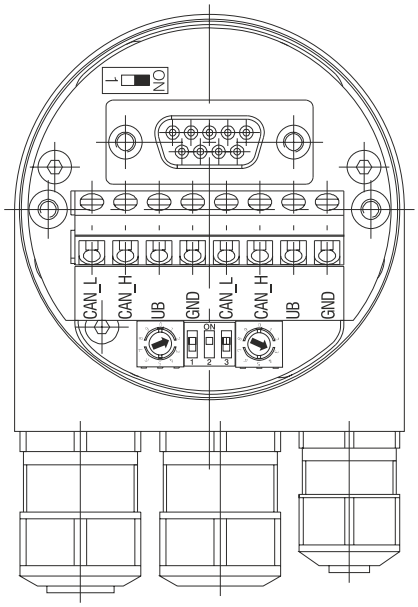
4.4.4 CANopen

CANopen features

Bus protocol	CANopen
Device profile	CANopen - CiA DSP 406, V 3.0
CANopen features	Device Class 2, CAN 2.0B
Operating modes	Polling Mode (asynch, via SDO)
(with SDO progr.)	Cyclic Mode (asynch-cyclic): The encoder cyclically sends the current process actual value without a request by a master. The cycle time can be parameterized for values between 1 and 65535 ms. Synch Mode (synch-cyclic): The encoder sends the current actual process value after receiving a synch telegram sent by a master. The synch counter in the encoder can be parameterized so that the position value is not sent until after a defined number of synch telegrams. Acyclic Mode (synch-acyclic)
Preset value	With the „Preset“ parameter the encoder can be set to a desired actual process value that corresponds to the defined axis position of the system. The offset value between the encoder zero point and the mechanical zero point of the system is saved in the encoder.
Rotating direction	With the operating parameter the rotating direction in which the output code is to increase or decrease can be parameterized. Scaling the steps per revolution and the total revolution can be parameterized.
Scaling:	The steps per revolution and the total revolution can be parameterized.
Diagnose	The encoder supports the following error messages: - Position and parameter error - Lithium cell voltage at lower limit (Multiturn)
Default setting	50 kbit/s, node number 0

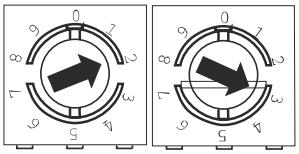


Setting of terminating resistor for CANopen

ON = Last user
OFF = User X

Settings of user address for CANopen

Adress can be set with rotary switch.
Example: User address 23



Setting CANopen baud rate			
Baud rate	Setting dip switch		
	1	2	3
10 kBit/s	OFF	OFF	OFF
20 kBit/s	OFF	OFF	ON
50 kBit/s	OFF	ON	OFF
12 kBit/s	OFF	ON	ON
250 kBit/s	ON	OFF	OFF
500 kBit/s	ON	OFF	ON
800 kBit/s	ON	ON	OFF
1 MBit/s	ON	ON	ON

Contact description CANopen	
CAN_L	CAN Bus Signal (dominant Low)
CAN_H	CAN Bus Signal (dominant High)
UB	Supply voltage 10 ... 30 VDC
GND	Ground contact for UB (Terminals with the same designation are internally interconnected).

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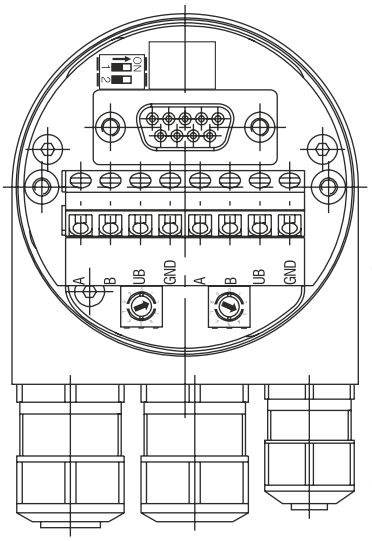
4.4.5 Profibus

Profibus-DP features

Bus protocol	Profibus-DP
Profibus features	Device Class 1 and 2
Data exchange functions	Input: Position value Additional parameterized speed signal (readout of the current rotary speed) Output: Preset value
Preset value	With the „Preset“ parameter the encoder can be set to a desired actual value that corresponds to the defined axis position of the system.
Parameter functions	Rotating direction: With the operating parameter the rotating direction for which the output code is to increase or decrease can be parameterized.
Diagnose	The encoder supports the following error messages: - Position error - Lithium cell voltage at lower limit (Multiturn)
Default setting	User address 00



Settings of terminating resistor for Profibus-DP

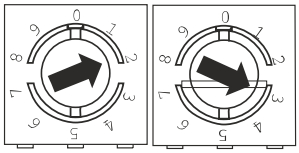
ON = Last user
OFF = User X

Contact description Profibus-DP	
A	Negative serial data line
B	Positive serial data line
UB	Supply voltage 10 ... 30 VDC
GND	Ground contact for UB (Terminals with the same designation are internally interconnected.)

Settings of user address for Profibus

Adress can be set with rotary switch.

Example: User adress 23



5. Operation

For draw wire sensors with potentiometer output (P) there are no adjustment and setting elements.

Draw wire sensors with voltage output (U) or current output (I) are equipped with integrated electronics with setting potentiometers (trimmers) for zero and gain.

The access holes for the trimmers are located in the housing cover.

With the zero trimmer the zero point can be shifted by ±20 % of the range with voltage output (±18 % with current output).

With the gain trimmer the signal span (sensitivity) is adjusted by ±20 % with voltage output (±15 % with current output). For draw wire sensors with encoder output (E,A) there are no adjustment and setting elements.

Standard setting:

U-output: 0 - 10 Volt

I-output: 4 - 20 mA

6. Operation and Maintenance

➡ Do not grease or oil the measuring wire, the wire drum, the spring motor and the potentiometer.

➡ Observe the notes on wire guiding, see Chap. 4.3, during operation.

Imperfect wire guiding can lead to increased wear and premature defects.

The warranty and all liability claims are null and void if the device is manipulated by unauthorised persons.

Repairs are to be made exclusively by Altheris bv.

7. Warranty

All components of the device have been checked and tested for perfect function in the factory.

In the unlikely event that errors should occur despite our thorough quality control, this should be reported immediately to Altheris bv.

The warranty period lasts 12 months following the day of shipment. Defective parts, except wear parts, will be repaired or replaced within this period if you return the device to Altheris bv free of charge.

This warranty does not apply towards damages resulting from abuse of the equipment and devices, from forceful handling or installation of the devices or from repair or modifications performed by third parties.

Repairs must be done exclusively via Altheris bv.

No other claims, except as warranteed, are accepted.

The terms of the purchasing contract apply in full.

Altheris bv will specifically not be responsible for eventual consequential damages.

Altheris bv always strives to supply customers with the finest and most advanced equipment. Development and refinement is therefore performed continuously and the right for design changes without prior notice is accordingly reserved.

i There is no warranty when opening the locked housing screws.

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8. Appendix

8.1 Accessories and Spare Parts

PC3/8	Sensor connecting cable, 3 m (10 ft) long with a female plug/and free leads, IP 40
FC8	Cable female plug for standard models, inclusive screwdriver, 8-pin DIN 45 326, IP 40
FC8/90	Cable female plug 90 ° angled for standard models, 8-pin DIN 45 326, IP 65
MH1	Magnetic holder with hole for M4 wire coupling, wire clip or attachment head, see Fig. 23.
H2	Magnetic holder, threaded M4/nut M4 for FD60-mounting in mounting groove, see Fig. 24.
TR1	Guide pulley adjustable with mounting socket, see Fig. 25.
TR3	Guide pulley fix with mounting socket, see Fig. 26.
GK1	Attachment head with mounting thread, see Fig. 27, DIN 71 752 G4 x 3, weight appr. 7 g
MT60	Mounting clamps for FD60-mounting, see Fig. 28.
WE-xxxx-M4	Wire extension with 2 x M4 thread, see Fig. 29, wire length in millimetres for xxxx, max. 10,000 mm (33 ft)
WE-xxxx-CLIP	Wire extension with wire clip, see Fig. 30, wire length in millimetres for xxxx, max. 10,000 mm (33 ft)

8.2 Cable Connection and Color Code

Connection cable PC3/8

PIN	Color	Assignment			
		- P	- U	- I	
1	white	Input +	Supply +	Supply +	Outer cable area with total screen
6	green	n.c. [1]	n.c.	n.c.	
2	brown	Ground	Ground	Ground	
4	yellow	n.c.	Ground	n.c.	
5	grey	n.c.	n.c.	n.c.	
3	green	Signal	Signal	n.c.	Inner cable 3-wire with screen
7	blue	n.c.	n.c.	n.c.	
8	red	n.c.	n.c.	n.c.	

	black	Outer screen			Grounding at electronics side
	bare	Inner Screen			

1) n.c. = not connected

8.3 Drawings and References for Attachment

Mounting Instructions for magnetic holder MH1

The force normal to the St 37 plate is approximately 18 kg (635 oz) at 20 °C (+68 °F).

The lateral force sustainable is, dependent on the surface, about 20 - 35 % of normal adhesion.

Operation temperature: -40 to +120 °C (-40 °F to +248 °F)

Temperature coefficient of the adhesion (reversible): -4 % per 10 °C at 20 °C

Strong vibration may cause a displacement of the magnetic holder when subject to a strong lateral force.

Weight appr. 100 g

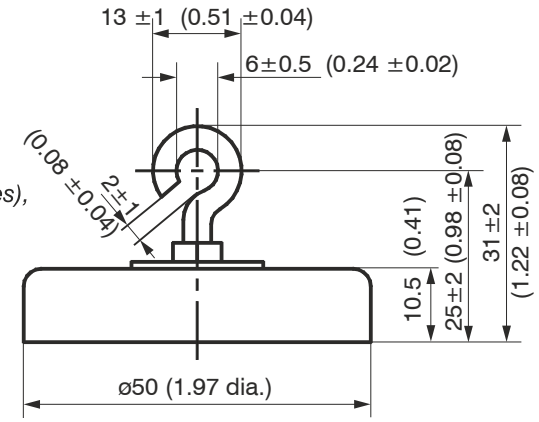

Fig. 23 Magnetic holder MH1, dimensions in mm (inches), not to scale

- When mounting, make sure there is adequate adhesion! Uneven surfaces, layers of lacquer and rust reduce adhesion.

Mounting instructions for magnetic holder MH2

The force normal to the St 37 plate is approximately 13 kg / 459 oz at +20 °C (+68 °F).
The lateral force sustainable is, dependent on the surface, about 20 - 35 % of normal adhesion.
Operation temperature: -40 to +120 °C (-40 °F to +248 °F)
Temperature coefficient of the adhesion (reversible): -4 % per 10 °C at 20 °C
Strong vibration may cause a displacement of the magnetic holder when subject to a strong lateral force.
Weight appr. 55 g

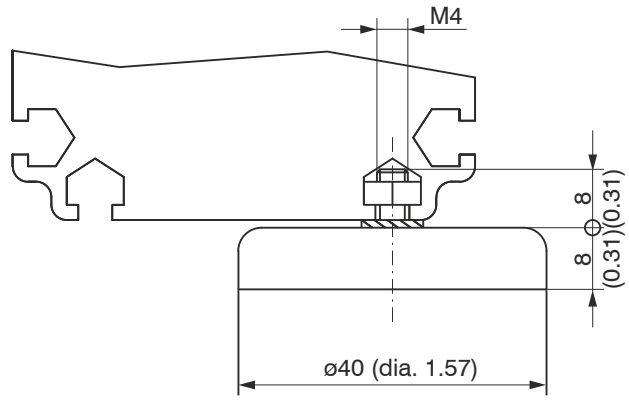

Fig. 24 Magnetic holder MH2, dimensions in mm (inches), not to scale

i When mounting, make sure there is adequate adhesion!
Uneven surfaces, layers of lacquer and rust reduce adhesion.

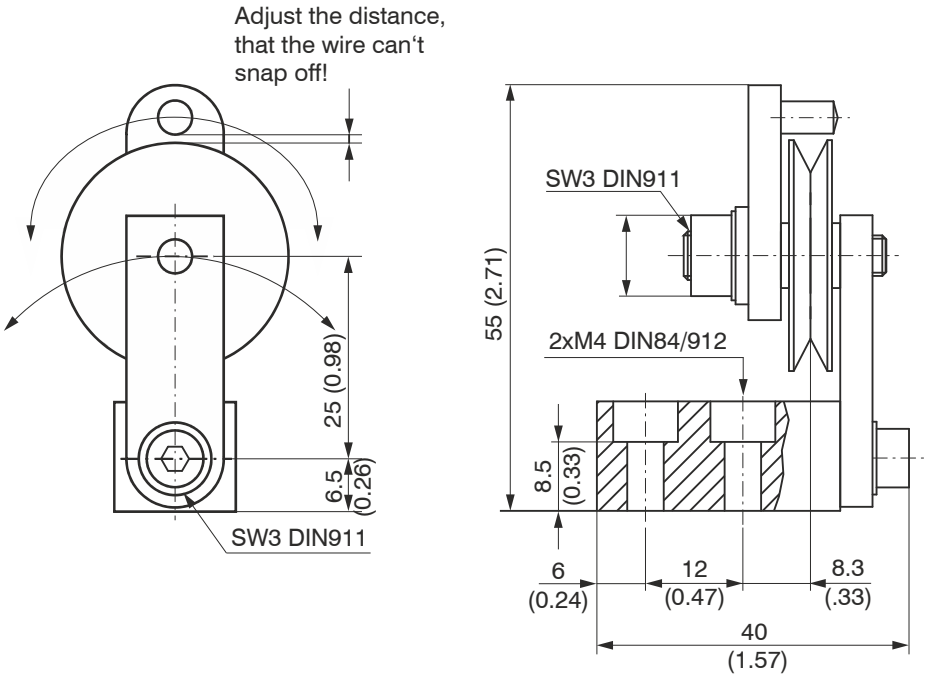

Fig. 25 Guide pulley TR1 with mounting socket, dimensions in mm (inches), not to scale

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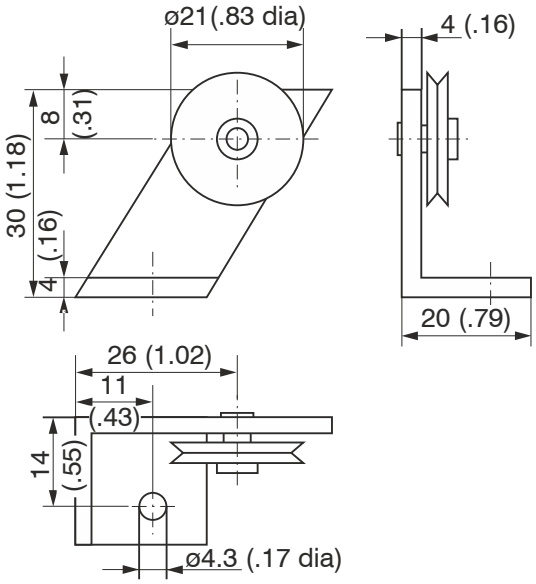


Fig. 26 Guide pulley TR3 fix with mounting socket, dimensions in mm (inches), not to scale

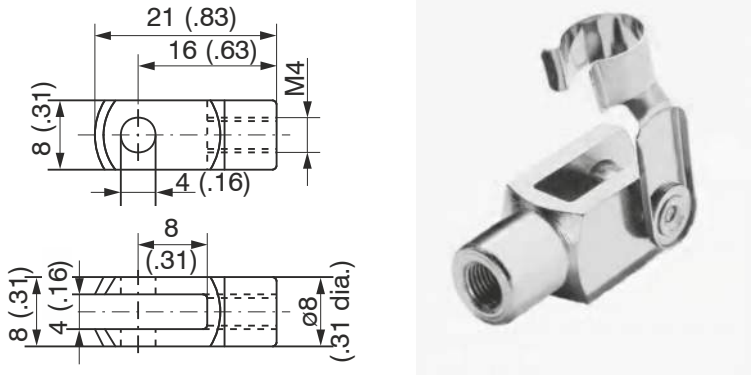
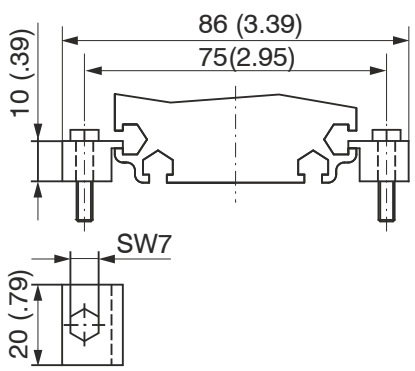


Fig. 27 Attachment head GK1, dimensions in mm (inches), not to scale



1 Set contains:

2 Pieces	mounting clamp Alu anodized
2 Pieces	bolt M4x20 DIN 933-A2
2 Pieces	antiturn washer J4.3 DIN 6797
2 Pieces	nut M4 DIN 934-A2

Fig. 28 Mounting clamp MT60, dimensions in mm (inches), not to scale

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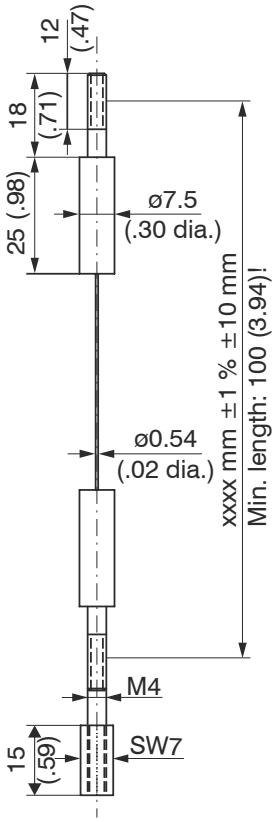

The delivery includes:

1 Pieces	wire extension
2 Pieces	nut M4 DIN 934-A2
2 Pieces	antiturn washer J4.3 DIN 6797
1 Pieces	distance piece M4 15 mm long

Fig. 29 Wire extension WE-xxxx-M4, dimensions in mm (inches), not to scale

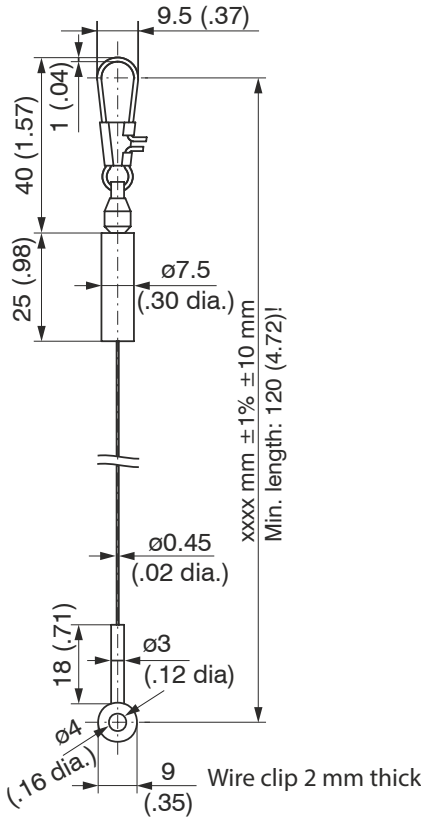

Fig. 30 Wire extension WE-xxxx-CLIP, dimensions in mm (inches), not to scale

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9. Decommissioning, Disposal

➡ Disconnect the power supply and output cable on the sensor.

Sensors of the draw-wire sensor series are produced according to the directive 2002/95/EC („RoHS“).

➡ Do the disposal according to the legal regulations (see directive 2002/96/EC).

Declaration of incorporation

Declaration of incorporation as defined by the EC Directives Machinery 2006/42/EC, Annex II, section B

We herewith declare that the partly completed machinery
Type of machinery: wiresensor, Type/Model: xxx, xxx
fulfills the relevant essential requirements of the EC Directives Machinery 2006/42/EC
and depending on the delivery the EC Directives Electromagnetic Compatibility 2004/108/EC.

Furthermore, we declare that the relevant technical documentation for this partly completed machinery is prepared as described in Annex VII, part B.

We commit ourselves to transmit the relevant technical documentation to the national authorities on request.
The partly completed machinery must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the provisions of the EC Machinery Directives and for which a declaration of conformity exists referred to Annex II A.