

# Linear measuring technology

<b>Draw-wire encoder D120</b>	<b>Robust-Line</b>	<b>Measuring length max. 10 m</b>
-------------------------------	--------------------	-----------------------------------



With their extremely robust construction, their high IP69k protection level and their wide temperature range up to -40 °C ... +85 °C the D120 draw-wire encoders are specially developed for outdoor applications.

Their flexibility and adaptability reflects in the wide range of housing and wire types, the long measuring range and the various interfaces. The possibility of redundancy must be particularly pointed out.



Analog output



Long service life	Wide temperature range -40° ... +85°C	High protection level IP69k	Redundancy	V4A 1.4404	Integrated swivel	For outdoor applications	3 housing types

## Robust

- Protection level up to IP69k and wide temperature range up to -40 °C ... +85 °C.
- The titanium-anodized aluminum housing and the stainless steel wires allow using the mechanics even in harsh conditions.
- Wire diameter (stainless steel, V4A) up to ø 1.5 mm - ideal for outdoor applications.

## Versatile

- Measuring length up to 10 m.
- Redundant outputs (mA, V, R, CANopen).
- The right measuring wire and the right wire fastening for every application.
- Linearity up to ±0.1 % of the measuring range.
- Various constructions: open, closed housing or housing with perforated sheet steel cover.

## Order code

**D8.D120** . **XXXXX** . **XXX** **X** . **0000**  
 Type                      **a** **b** **c** **d**                      **e** **f**

See also the extended ordering options on page 6

### **a** Measuring length

- 3 = 3 m
- 4 = 4 m
- 5 = 5 m
- 6 = 6 m
- 7 = 7 m
- 8 = 8 m
- 9 = 9 m
- A = 10 m

### **b** Wire types <sup>1)</sup> (plastic coated)

- 1 = V4A, ø 0.5 mm
- 2 = V4A, ø 1.0 mm (measuring length 3 ... 8 m)
- 3 = V4A, ø 1.5 mm (measuring length 3 ... 6 m)

### **c** Linearity

- 1 = standard linearity 0.5 %
- 2 = improved linearity 0.25 %
- 3 = improved linearity 0.1 %

### **d** Housing

- 1 = open housing, open wire guide
- 3 = with perforated sheet metal cover open wire guide
- 4 = with perforated sheet metal cover closed wire guide
- 6 = closed housing, closed wire guide

### **e** Single sensor / Supply voltage

- A11 = 4 ... 20 mA / 12 ... 30 VDC
- A22 = 0 ... 10 V / 12 ... 30 VDC
- A33 = 1 kΩ / max. 30 VDC
- CC1 = CANopen / 8 ... 30 VDC

### Redundant sensors / Supply voltage

- R11 = 2 x 4 ... 20 mA / 12 ... 30 VDC
- R22 = 2 x 0 ... 10 V / 12 ... 30 VDC
- R33 = 2 x 1 kΩ / max. 30 V
- RC1 = 2 x CANopen / 8 ... 30 VDC

### **f** Type of connection / protection level sensor

- 1 = radial cable, 2 m [6.56'] TPE / IP69k <sup>2)</sup>
- 2 = radial cable, 2 m [6.56'] TPE / IP67 <sup>2)</sup>
- 3 = radial M12 connector / IP67
- 4-pin for sensor type A11 ... A33
- 5-pin for sensor type CC1 ... RC1
- 8-pin for sensor type R11 ... R33

## Relationship measuring length – wire types – linearity


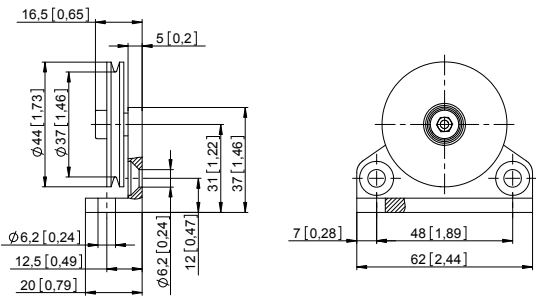

Measuring length	[m]	3 / 4 / 5 / 6			7 / 8			9 / 10			
		order code <b>a</b>	<b>3</b> / <b>4</b> / <b>5</b> / <b>6</b>			<b>7</b> / <b>8</b>			<b>9</b> / <b>A</b>		
Wire type	ø [mm]	order code <b>b</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>2</b>	–	<b>1</b>	–	–
Standard linearity ±0.5 %	order code <b>c</b> = 1	✓	✓	✓	✓	✓	–	✓	–	–	
Improved linearity ±0.25 %	order code <b>c</b> = 2	✓	✓	✓	✓	✓	–	✓	–	–	
Improved linearity ±0.1 %	order code <b>c</b> = 3	✓	✓	✓	✓	✓	–	✓	–	–	

✓ feasible / – not feasible

1) Wire type availability depends on the selected measuring range, refer to the technical data.  
 2) Other cable length on request.

# Linear measuring technology

<b>Draw-wire encoder D120</b>	<b>Robust-Line</b>	<b>Measuring length max. 10 m</b>
-------------------------------	--------------------	-----------------------------------

Accessories for draw-wire encoder	Dimensions in mm [inch]	Order no.
<p><b>Guide pulley for wire type 1</b> (0.5 mm)</p> 	<p>Technical data:</p> <ul style="list-style-type: none"> <li>- mounting bracket (anodized alum.)</li> <li>- guide pulley (plastic POM)</li> <li>- ball bearing (type 696-2R5)</li> </ul> <p>Scope of delivery:</p> <ul style="list-style-type: none"> <li>- 2 x countersunk screws for lateral fixing</li> <li>- 2 x hexagonal screws for fixing on a flat surface</li> </ul> 	<p><b>8.0000.7000.0045</b></p>
<p><b>Extension cable</b> (further on request)</p> 	<ul style="list-style-type: none"> <li>0.5 m with clip</li> <li>1.0 m with clip</li> <li>2.0 m with clip</li> </ul>	<p><b>8.0000.7000.0051</b> <b>8.0000.7000.0052</b> <b>8.0000.7000.0054</b></p>
Connection technology		Order no.
<b>Cordset, pre-assembled</b>	<p>M12 female connector with coupling nut, 4-pin, A coded, straight single ended 2 m [6.56'] PUR cable</p> <p>M12 female connector with coupling nut, 5-pin, A coded, straight single ended 2 m [6.56'] PVC cable</p> <p>M12 female connector with coupling nut, 8-pin, A coded, straight single ended 2 m [6.56'] PVC cable</p>	<p><b>05.00.6061.6211.002M</b> <b>05.00.6081.2211.002M</b> <b>05.00.6041.8211.002M</b></p>
<b>Connector, self-assembly</b>	<p>M12 female connector with coupling nut, 4-pin, A coded, straight (plastic)</p> <p>M12 female connector with coupling nut, 5-pin, A coded, straight (metal/plastic)</p> <p>M12 female connector with coupling nut, 8-pin, A coded, straight (metal)</p>	<p><b>05.B8141-0</b> <b>05.B-8151-0/9</b> <b>05.CMB 8181-0</b></p>

Additional connectors can be found in the connection technology section or in the connection technology area of our website at: [www.kuebler.com/connection\\_technology..](http://www.kuebler.com/connection_technology..)

# Linear measuring technology

<b>Draw-wire encoder D120</b>	<b>Robust-Line</b>	<b>Measuring length max. 10 m</b>
-------------------------------	--------------------	-----------------------------------

## Technical data

General technical data	
<b>Linearity</b>	±0.5 %
<b>Improved linearity</b>	±0.25 % or ±0.1 %
<b>Resolution</b>	see electrical characteristics
<b>Sensor element</b>	potentiometer
<b>Output signal (others on request)</b>	4 ... 20 mA, 0 ... 10 V, potentiometer, CANopen
<b>Connection</b>	radial M12 connector or radial cable outlet (TPE cable), standard length 2 m
<b>Protection</b>	M12 connector IP67 cable IP67, IP69k
<b>Humidity</b>	max. 90 % relative, no condensing
<b>Working temperature</b>	standard -20 °C ... +85 °C [-4 °F ... +185 °F] as extended order option (s.page 6) -40 °C ... +85 °C [-40 °F ... +185 °F]
<b>Speed max.</b>	3.0 m/s
<b>Acceleration max.</b>	50 m/s <sup>2</sup>
<b>Weight</b>	1300 ... 1600 g [45.87 ... 56.44 oz] depending on measuring range
<b>Housing</b>	aluminum, spring housing PA6
<b>Spring force</b>	min. 7 N / max. 13 N <sup>1)</sup>

Characteristics measuring wire (plastic coated)		
<b>V4A, ø 0.5 mm</b>	measuring range	3 ... 10 m
	no.	1.4401
	breaking force	262 N
	TK	16 x 10 <sup>-6</sup> K <sup>-1</sup>
<b>V4A, ø 1.0 mm</b>	measuring range	3 ... 8 m
	no.	1.4401
	breaking force	942 N
	TK	16 x 10 <sup>-6</sup> K <sup>-1</sup>
<b>V4A, ø 1.5 mm</b>	measuring range	3 ... 6 m
	no.	1.4401
	breaking force	1.890 N
	TK	16 x 10 <sup>-6</sup> K <sup>-1</sup>

Interface characteristics CANopen – Sensor type CC1, RC1	
<b>CAN specification</b>	Full CAN 2.0B (ISO11898)
<b>Communication profile</b>	CANopen CiA 301 V 4.2.0
<b>Device profile</b>	encoder, absolute linear; CiA 406 V 3.2.0
<b>Error monitoring</b>	Producer Heartbeat, Emergency Message, Node Guarding
<b>Node ID</b>	default: 7, adjustable via SDO
<b>PDO</b>	1 x TPDO, static mapping
<b>PDO functions</b>	event-triggered, time-triggered, Sync-cyclic, Sync-acyclic
<b>Transmission rate</b>	Default 250 kbit/s, 1 Mbps, 800, 500, 250, 125, 50, 20 kbps adjustable via SDO
<b>Bus connection</b>	M12 connector, 5-pin or axial cable outlet (TPE cable), standard length 2 m
<b>Integrated bus terminating resistor</b>	120 ohms ready-to-activate via SDO
<b>Bus, galvanic isolation</b>	no
<b>Supply voltage</b>	8 ... 30 V DC
<b>Current consumption</b>	typ. 10 mA at 24 V, typ. 20 mA at 12 V
<b>Measuring rate</b>	1 kHz with 16 bit resolution
<b>Resolution</b>	0.002 % of the measuring range
<b>Electrical protection</b>	reverse polarity protection
<b>Electromagnetic compatibility</b>	acc. to EN 61326-1:2013
<b>CE compliant acc. to</b>	EMC guideline 2014/30/EU RoHS guideline 2011/65/EU

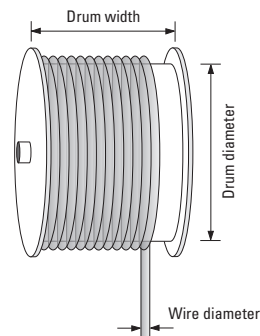
## Operating principle

### Construction

The core of a draw-wire device is a drum mounted on bearings, onto which a wire is wound. Winding takes place via a spring-loaded device. The single-layer wire winding ensuring the best linearity possible is a specific feature of Kübler draw-wire encoders.

### Note

Exceeding the maximum extension length of the draw-wire will lead to damage to the wire and the mechanics.



1) Depends on the measuring length.

## Linear measuring technology

Draw-wire encoder D120	Robust-Line	Measuring length max. 10 m	
<b>Electrical characteristics (analog sensor, scaled to measuring range)</b>			
<b>Sensor type</b>	<b>A11 / R11</b>	<b>A22 / R22</b>	<b>A33 / R33</b>
<b>Output</b>	4 ... 20 mA	0 ... 10 V	1 k $\Omega$ , potentiometer
<b>Output current</b>	max. 50 mA in case of a failure	max. 10 mA, min. load 10 k $\Omega$	–
<b>Max. current consumption</b>	–	22.5 mA (non load)	–
<b>Supply voltage</b>	12 ... 30 V DC	12 ... 30 V DC	max. 30 V DC
<b>Response time</b>	< 1 ms from 0 ... 100 % and 100 ... 0 %	< 3 ms from 0 ... 100 % and 100 ... 0 %	–
<b>Resolution</b>	limited by the noise	limited by the noise	theoretically unlimited
<b>Noise</b>	0.03 mA <sub>pp</sub> = 6 mV <sub>pp</sub> at 200 $\Omega$	typ. 3 mV <sub>pp</sub> , max. 37 mV <sub>pp</sub>	depending on the supply voltage
<b>Recommended slider current</b>	–	–	< 1 $\mu$ A
<b>Reverse polarity protection</b>	yes	yes	–
<b>Working temperature</b>	standard as optional order code extension (s. below)		
	-20 °C ... +85 °C [-4 °F ... +185 °F] -40 °C ... +85 °C [-40 °F ... +185 °F]	-20 °C ... +85 °C [-4 °F ... +185 °F] -40 °C ... +85 °C [-40 °F ... +185 °F]	-20 °C ... +85 °C [-4 °F ... +185 °F] -40 °C ... +85 °C [-40 °F ... +185 °F]
<b>Short circuit proof</b>	–	yes, sustained short-circuit proof	–
<b>Temperature coefficient</b>	0.0079 %/K	0.0037 %/K	$\pm$ 0.0025 %/K
<b>Electromagnetic compatibility</b>	acc. to EN 61326-1:2013	acc. to EN 61326-1:2013	acc. to EN 61326-1:2013
<b>CE compliant</b> acc. to	EMC guideline 2014/30/EU RoHS guideline 2011/65/EU	EMC guideline 2014/30/EU RoHS guideline 2011/65/EU	EMC guideline 2014/30/EU RoHS guideline 2011/65/EU

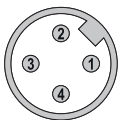
# Linear measuring technology

<b>Draw-wire encoder D120</b>	<b>Robust-Line</b>	<b>Measuring length max. 10 m</b>
-------------------------------	--------------------	-----------------------------------

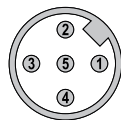
## Terminal assignment

Analog sensor <b>A11</b> (4 ... 20 mA)			R/I converter								
	Cable <sup>1)</sup>	Signal:	+V	n.c.	I <sub>out</sub>	n.c.					
	M12 connector, 4-pin	Core color:	BN	WH	BU	BK					
Analog sensor <b>R11</b> , redundant (2 x 4 ... 20 mA)			R/I converter 1		R/I converter 2						
	Cable <sup>1)</sup>	Signal:	+V <sub>1</sub>	I <sub>out 1</sub>	+V <sub>2</sub>	I <sub>out 2</sub>	n.c.	n.c.	n.c.	n.c.	
	M12 connector, 8-pin	Core color:	WH	GN	GY	BU	BN	YE	PK	RD	
Analog sensor <b>A22</b> (0 ... 10 V DC)			R/U converter								
	Cable <sup>1)</sup>	Signal:	+V	U <sub>out</sub>	0 V	0 V <sub>out</sub>					
	M12 connector, 4-pin	Core color:	BN	WH	BU	BK					
Analog sensor <b>R22</b> , redundant (2 x 0 ... 10 V DC)			R/U converter 1		R/U converter 2						
	Cable <sup>1)</sup>	Signal:	+V <sub>1</sub>	U <sub>out 1</sub>	0 V <sub>1</sub>	0 V <sub>out 1</sub>	+V <sub>2</sub>	U <sub>out 2</sub>	0 V <sub>2</sub>	0 V <sub>out 2</sub>	
	M12 connector, 8-pin	Core color:	WH	BN	GN	YE	GY	PK	BU	RD	
Analog sensor <b>A33</b> (Potentiometer 1 kΩ)			Potentiometer								
	Cable <sup>1)</sup>	Signal:	+V	Out	0 V	n.c.					
	M12 connector, 4-pin	Core color:	BN	WH	BU	BK					
Analog sensor <b>R33</b> , redundant (2 x Potentiometer 1 kΩ)			Potentiometer 1		Potentiometer 2						
	Cable <sup>1)</sup>	Signal:	+V <sub>1</sub>	Out <sub>1</sub>	0 V <sub>1</sub>	n.c.	+V <sub>2</sub>	Out <sub>2</sub>	0 V <sub>2</sub>	n.c.	
	M12 connector, 8-pin	Core color:	WH	BN	GN	YE	GY	PK	BU	RD	
Digital sensor <b>CC1</b> (CANopen)			CANopen								
	Cable <sup>1)</sup>	Signal:	+V	0 V	CAN_GND	CAN_H	CAN_L				
	M12 connector, 5-pin	Core color:	WH	BU	BN	BK	GY				
Digital sensor <b>RC3</b> , redundant (2 x CANopen)			CANopen 1 + CANopen 2								
	Cable <sup>1)</sup>	Signal:	+V	0 V	CAN_GND	CAN_H	CAN_L				
	M12 connector, 5-pin	Core color:	WH	BU	BN	BK	GY				

## Top view of mating side, male contact base



M12 connector, 4-pin



M12 connector, 5-pin



M12 connector, 8-pin

1) Isolate unused cores individually before initial start-up.

# Linear measuring technology

**Draw-wire encoder D120**

**Robust-Line**

**Measuring length max. 10 m**

## Technology in detail

### Wire fastenings

Carabiner ring  
D8.D120.xxx.xxx.V001

M4 thread <sup>1)</sup>  
D8.D120.xxx.xxx.V001

eyelet  
D8.D120.xxx.xxx.V002

clip  
D8.D120.xxx.xxx.V007



ball-bearing swivel  
(no torsion of the measuring wire during installation)

rubber stopper

measuring wire

### Wire types

- V4A plastic coated,  $\varnothing$  0.5 mm, order option **b** = 1
- V4A plastic coated,  $\varnothing$  1.0 mm, order option **b** = 2
- V4A plastic coated,  $\varnothing$  1.5 mm, order option **b** = 3



Ideally suited for long-term outdoor use.

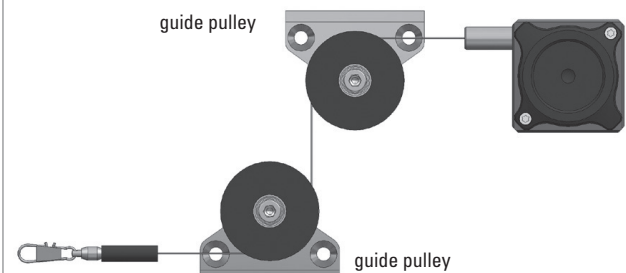
The plastic coating has a dirt-repellent effect and has in the same time optimum sliding properties.

### Extension wire

For optimum use of the measuring range by extending the wire length, e. g. to allow realizing a pre-extension in the application. Especially combined with analog interfaces (options A11, A22, A33 and R11, R22, R33).



### Application-specific installation possibilities



### Extended temperature range -40 °C ... +85 °C

(only in combination with the standard linearity 0.5 %)

By using special components.

Order code extensions for the extended temperature range:

With carabiner ring: D8.D120.xxx.xxx.V003

With M4 thread <sup>1)</sup>: D8.D120.xxx.xxx.V004

With eyelet: D8.D120.xxx.xxx.V005

With clip: D8.D120.xxx.xxx.V008

<sup>1)</sup> Not available with wire type V4A,  $\varnothing$  1.5 mm – order option **b** = 3.

# Linear measuring technology

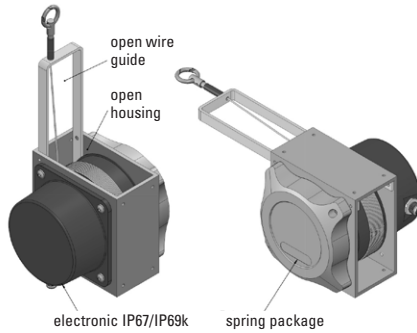
<b>Draw-wire encoder D120</b>	<b>Robust-Line</b>	<b>Measuring length max. 10 m</b>
-------------------------------	--------------------	-----------------------------------

## Technology in detail

### Housing types (the suitable housing type for every application)

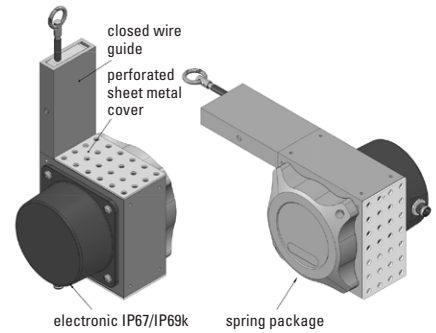
#### Open housing, open wire guide

For use in the presence of fine dust and liquids.



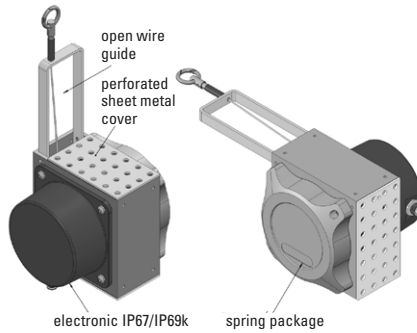
#### Housing with perforated sheet metal cover, closed wire guide

For use in the presence of dirt, particles size > 2 mm and liquids. Shock protection, wire cleaning device (in preparation).



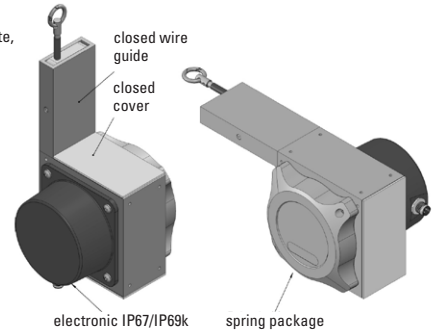
#### Housing with perforated sheet metal cover, open wire guide

For use in the presence of dirt, particles size > 2 mm and liquids



#### Closed housing, closed wire guide

For use in the presence of sticky dust, cement, concrete, clay. Shock protection, wire cleaning device (in preparation).



# Linear measuring technology

## Draw-wire encoder D120

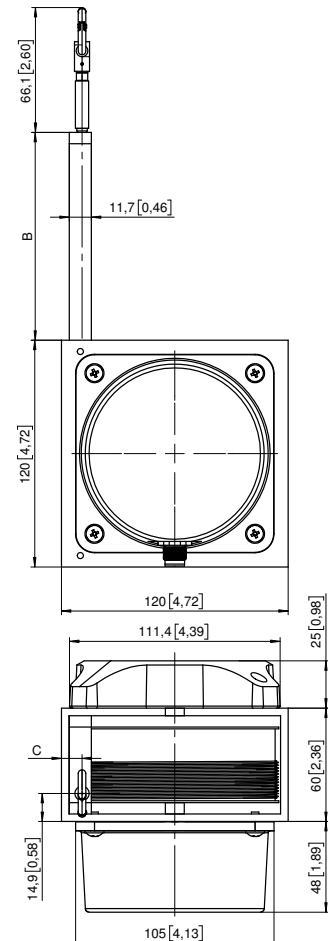
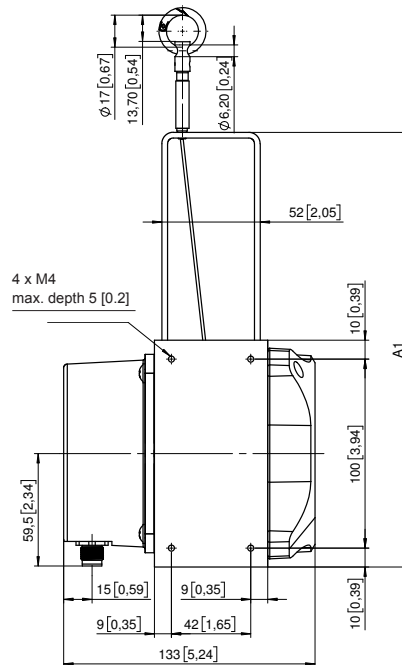
## Robust-Line

## Measuring length max. 10 m

### Dimensions

Dimensions in mm [inch]

Open housing,  
open wire guide



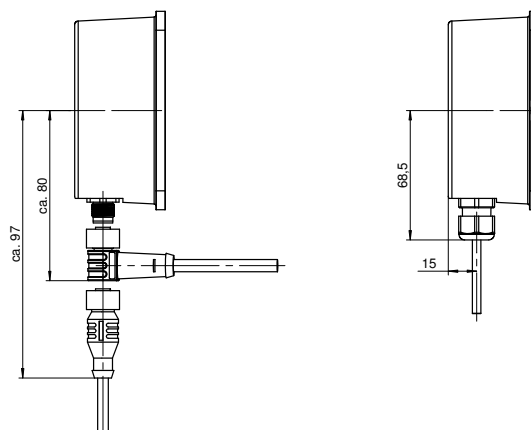
Wire diameter $\varnothing$ 0.5 mm – drum pitch circumference: 335.2 [13.2]			
Measuring length	A1	B	C
3 ... 10 m	230 [9.06]	110 [4.33]	10.75 [0.42]

Wire diameter $\varnothing$ 1.0 mm – drum pitch circumference: 336.8 [13.26]			
Measuring length	A1	B	C
3 ... 5 m	230 [9.06]	110 [4.33]	10.75 [0.42]
6 ... 8 m	320 [12.6]	200 [7.87]	12.25 [0.48]

Wire diameter $\varnothing$ 1.5 mm – drum pitch circumference: 338.3 [13.32]			
Measuring length	A1	B	C
3 ... 4 m	230 [9.06]	110 [4.33]	10.75 [0.42]
5 ... 6 m	320 [12.6]	200 [7.87]	12.25 [0.48]

### Connector output / Cable outlet

The cable must be protected in case of steam and high-pressure cleaning.





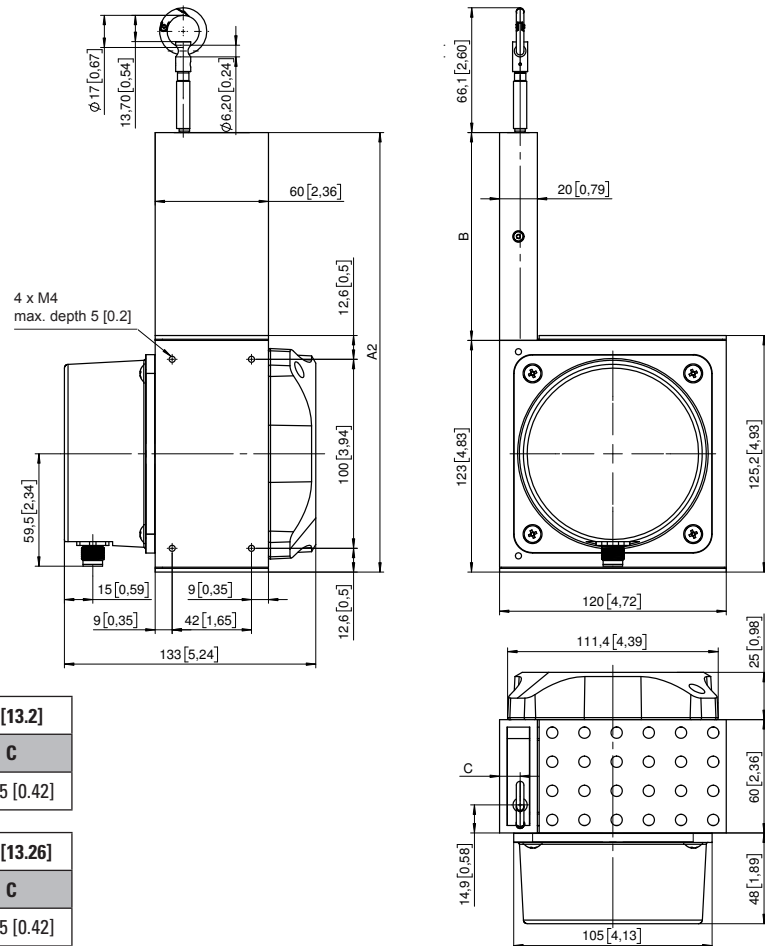
# Linear measuring technology

## Draw-wire encoder D120      Robust-Line      Measuring length max. 10 m

### Dimensions

Dimensions in mm [inch]

Housing with perforated sheet metal cover,  
closed wire guide



Wire diameter $\varnothing$ 0.5 mm – drum pitch circumference: 335.2 [13.2]			
Measuring length	A2	B	C
3 ... 10 m	233 [9.17]	110 [4.33]	10.75 [0.42]

Wire diameter $\varnothing$ 1.0 mm – drum pitch circumference: 336.8 [13.26]			
Measuring length	A2	B	C
3 ... 5 m	233 [9.17]	110 [4.33]	10.75 [0.42]
6 ... 8 m	323 [12.7]	200 [7.87]	12.25 [0.48]

Wire diameter $\varnothing$ 1.5 mm – drum pitch circumference: 338.3 [13.32]			
Measuring length	A2	B	C
3 ... 4 m	233 [9.17]	110 [4.33]	10.75 [0.42]
5 ... 6 m	323 [12.7]	200 [7.87]	12.25 [0.48]