

Linear measuring technology

Draw-wire encoder D120	Robust-Line	Measuring length max. 10 m
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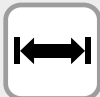
With their extremely robust construction, their high IP69k protection level and their wide temperature range up to -40 °C ... +85 °C the D120 draw-wire encoders are specially developed for outdoor applications.

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

CANopen



Long service
life



Wide tempera-
ture range



IP69k
High protection
level



Redundancy



V4A



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 \varnothing 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 plate cover.

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Order code	D8.D120 <small>Type</small>	. XXXXX .	XXX X .	0000 .	XXXX
		a b c d	e f		g

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 (stainless steel V4A)

- 1 = ø 0.5 mm
- 2 = ø 1.0 mm (not for measuring length 9 ... 10 m)
- 3 = ø 1.5 mm (not for measuring length 7 ... 10 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 plate cover, open wire guide
- 4 = with perforated plate cover, closed wire guide
- 6 = closed housing, closed wire guide

e Single sensor / supply voltage

- A11 = 4 ... 20 mA / 12 ... 30 V DC
- A22 = 0 ... 10 V / 12 ... 30 V DC
- A33 = 1 kΩ / max. 30 V DC
- A44 = 0.5 ... 4.5 V / 8 ... 30 V DC
- A55 = 0 ... 5 V / 8 ... 30 V DC
- CC1 = CANopen / 8 ... 30 V DC

Redundant sensor / supply voltage

- R11 = 2 x 4 ... 20 mA / 12 ... 30 V DC
- R22 = 2 x 0 ... 10 V / 12 ... 30 V DC
- R33 = 2 x 1 kΩ / max. 30 V DC
- R44 = 2 x 0.5 ... 4.5 V / 8 ... 30 V DC
- R55 = 2 x 0 ... 5 V / 8 ... 30 V DC
- RC1 = 2 x CANopen / 8 ... 30 V DC

f Type of connection / protection level sensor

Cable connection, standard lengths ¹⁾

- 1 = radial cable, 2 m [6.56'] TPE / IP69k
- 2 = radial cable, 2 m [6.56'] TPE / IP67
- C = radial cable, 5 m [16.40'] TPE / IP69k
- E = radial cable, 5 m [16.40'] TPE / IP67
- D = radial cable, 10 m [32.81'] TPE / IP69k
- F = radial cable, 10 m [32.81'] TPE / IP67

Connector

- 3 = radial M12 connector / IP67
- 4-pin for sensor type A11 ... A55
- 5-pin for sensor type CC1 ... RC1
- 8-pin for sensor type R11 ... R55

g Extended order options (optional)

Wire fastenings (standard = carabiner ring)

- V001 = M4 thread ²⁾
- V002 = eyelet
- V007 = clip

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

(only in combination with the standard linearity 0.5 %, **c** = 1)

- V003 = with carabiner ring
- V004 = with M4 thread ²⁾
- V005 = with eyelet
- V008 = with clip

Relationship measuring length – wire types – linearity


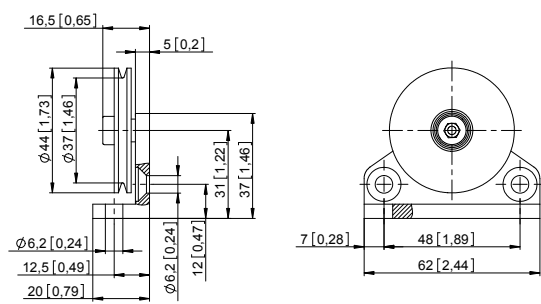

Measuring length [m]		3 / 4 / 5 / 6			7 / 8			9 / 10		
order code a		3 / 4 / 5 / 6			7 / 8			9 / A		
Wire type	ø [mm]	0.5	1.0	1.5	0.5	1.0	1.5	0.5	1.0	1.5
	order code b	1	2	3	1	2	–	1	–	–
Standard linearity ±0.5 %	order code c = 1	✓	✓	✓	✓	✓	–	✓	–	–
Improved linearity ±0.25 %	order code c = 2	✓	✓	✓	✓	✓	–	✓	–	–
Improved linearity ±0.1 %	order code c = 3	✓	✓	✓	✓	✓	–	✓	–	–

✓ feasible / – not feasible

1) Other cable length on request.

2) Not available with wire type V4A ø 1.5 mm – order option **b** = 3.

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Accessories for draw-wire encoder		Dimensions in mm [inch]	Order no.
Guide pulley for wire type 1 (0.5 mm) 		Technical data: - mounting bracket (anodized alum.) - guide pulley (plastic POM) - ball bearing (type 696-2R5)	Scope of delivery: - 2 x countersunk screws for lateral fixing - 2 x hexagonal screws for fixing on a flat surface
			8.0000.7000.0045 ¹⁾
Extension cable (further on request) 		0.5 m with clip 1.0 m with clip 2.0 m with clip	8.0000.7000.0051 8.0000.7000.0052 8.0000.7000.0054
Cables and connectors			Order no.
Preamsembled cables		M12 female connector with coupling nut, 4-pin, A coded, straight single ended 2 m [6.56'] PUR cable	05.00.6061.6211.002M
		M12 female connector with coupling nut, 5-pin, A coded, straight single ended 2 m [6.56'] PVC cable	05.00.6081.2211.002M
		M12 female connector with coupling nut, 8-pin, A coded, straight single ended 2 m [6.56'] PVC cable	05.00.6041.8211.002M
Connectors		M12 female connector with coupling nut, 4-pin, A coded, straight (plastic)	05.B8141-0
		M12 female connector with coupling nut, 5-pin, A coded, straight (metal/plastic)	05.B-8151-0/9
		M12 female connector with coupling nut, 8-pin, A coded, straight (metal)	05.CMB 8181-0

Further Kübler cables and connectors can be found at: kuebler.com/connection-technology

1) Stock types.

Linear measuring technology

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Technical data

General technical data		Interface characteristics CANopen – Sensor type CC1, RC1	
Linearity	±0.5 %	CAN specification	Full CAN 2.0B (ISO11898)
Improved linearity	±0.25 % or ±0.1 %	Communication profile	CANopen CiA 301 V 4.2.0
Resolution	see electrical characteristics	Device profile	encoder, absolute linear; CiA 406 V 3.2.0
Sensor element	potentiometer	Error monitoring	Producer Heartbeat, Emergency Message, Node Guarding
Output signal (others on request)	4 ... 20 mA 0 ... 10 V, 0.5 ... 4.5 V, 0 ... 5 V Potentiometer CANopen	Node ID	default: 7, adjustable via SDO
Connection	radial M12 connector or radial cable outlet (TPE cable), standard length 2, 5, 10 m	PDO	1 x TPDO, static mapping
Protection	M12 connector IP67 cable IP67, IP69k	PDO functions	event-triggered, time-triggered, Sync-cyclic, Sync-acyclic
Humidity	max. 90 % relative, no condensing	Transmission rate	Default 250 kbit/s, 1 Mbps, 800, 500, 250, 125, 50, 20 kbps adjustable via SDO
Working temperature standard as extended order option (s. page 6)	-20 °C ... +85 °C [-4 °F ... +185 °F] -40 °C ... +85 °C [-40 °F ... +185 °F]	Bus connection	M12 connector, 5-pin or axial cable outlet (TPE cable), standard length 2 m
Speed max.	3.0 m/s	Integrated bus terminating resistor	120 ohms ready-to-activate via SDO
Acceleration max.	50 m/s ²	Bus, galvanic isolation	no
Weight	1300 ... 1600 g [45.87 ... 56.44 oz] depending on measuring range	Supply voltage	8 ... 30 V DC
Housing	aluminum, spring housing PA6	Current consumption	typ. 10 mA at 24 V, typ. 20 mA at 12 V
Spring force	min. 7 N / max. 13 N ¹⁾	Measuring rate	1 kHz with 16 bit resolution
		Resolution	0.002 % of the measuring range
		Electrical protection	reverse polarity protection

Electrical characteristics (analog sensor, scaled to measuring range)

Sensor type	A11 / R11 Current output	A22, R22	A44, R44 Voltage outputs	A55, R55	A33 / R33 Potentiometer
Output	4 ... 20 mA	0 ... 10 V	0.5 ... 4.5 V	0 ... 5 V	1 kΩ
Supply voltage	12 ... 30 V DC	12 ... 30 V DC	8 ... 30 V DC	8 ... 30 V DC	max. 30 V DC
Recommended slider current	–		–		< 1 μA
Current consumption	–		25 mA (non load)		–
Output current	max. 50 mA in case of a failure		max. 10 mA, min. load 10 kΩ		–
Response time	< 1 ms from 0 ... 100 % and 100 ... 0 %		< 3 ms from 0 ... 100 % and 100 ... 0 %		–
Resolution		theoretically unlimited, limited by the noise			
Noise	1.6 mA _{eff}		0.5 mV _{eff}		depending on the supply voltage
Reverse polarity protection	–		ja		–
Short circuit proof	–		ja		–
Temperature coefficient	0.0079 %/K		0.0037 %/K		±0.0025 %/K

Characteristics measuring wire		Approvals	
Material	stainless steel V4A (1.4401)	Electromagnetic compatibility	acc. to EN 61326-1, EN 61326-3-1
Measuring range	ø 0.5 mm 3 ... 10 m ø 1.0 mm 3 ... 8 m ø 1.5 mm 3 ... 6 m	CE compliant in accordance with	
Breaking force	ø 0.5 mm 262 N ø 1.0 mm 942 N ø 1.5 mm 1.890 N	EMC Directive	2014/30/EU
Temperature coefficient	16 x 10 ⁻⁶ K ⁻¹	RoHS Directive	2011/65/EU

1) Depends on the measuring length.

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Terminal assignment

Analog sensor A11 (4 ... 20 mA)			R/I converter							
		Signal:	+V	n.c.	I _{out}	n.c.				
	Cable ¹⁾	Core color:	BN	WH	BU	BK				
	M12 connector, 4-pin	Pin:	1	2	3	4				

Analog sensor redundant R11 (2 x 4 ... 20 mA)			R/I converter 1		R/I converter 2					
		Signal:	+V 1	I _{out} 1	+V 2	I _{out} 2	n.c.	n.c.	n.c.	n.c.
	Cable ¹⁾	Core color:	WH	GN	GY	BU	BN	YE	PK	RD
	M12 connector, 8-pin	Pin:	1	3	5	7	2	4	6	8

Analog sensor A22 (0 ... 10 V DC) A44 (0.5 ... 4.5 V) A55 (0 ... 5 V)			R/U converter							
		Signal:	+V	U _{out}	0 V	0 V _{out}				
	Cable ¹⁾	Core color:	BN	WH	BU	BK				
M12 connector, 4-pin	Pin:	1	2	3	4					

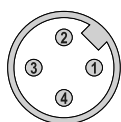
Analog sensor redundant R22 (2 x 0 ... 10 V DC) R44 (2 x 0.5 ... 4.5 V) R55 (2 x 0 ... 5 V)			R/U converter 1				R/U converter 2			
		Signal:	+V ₁	U _{out 1}	0 V ₁	0 V _{out 1}	+V ₂	U _{out 2}	0 V ₂	0 V _{out 2}
	Cable ¹⁾	Core color:	WH	BN	GN	YE	GY	PK	BU	RD
M12 connector, 8-pin	Pin:	1	2	3	4	5	6	7	8	

The diagram illustrates the electrical connection for the sensors. A battery is connected to the +V terminal. The U_{out} terminal is connected to the positive terminal of a voltmeter (V). The 0 V and 0 V_{out} terminals are connected to the negative terminal of the voltmeter, which is also connected to ground.

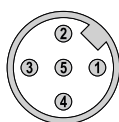
Analog sensor A33 (potentiometer 1 kΩ)			Potentiometer							
		Signal:	+V	Out	0 V	n.c.				
	Cable ¹⁾	Core color:	BN	WH	BU	BK				
	M12 connector, 4-pin	Pin:	1	2	3	4				
Analog sensor redundant R33 (2 x potentiometer 1 kΩ)			Potentiometer 1				Potentiometer 2			
		Signal:	+V ₁	Out ₁	0 V ₁	n.c.	+V ₂	Out ₂	0 V ₂	n.c.
	Cable ¹⁾	Core color:	WH	BN	GN	YE	GY	PK	BU	RD
	M12 connector, 8-pin	Pin:	1	2	3	4	5	6	7	8

Digital sensor CC1 (CANopen)			CANopen				
		Signal:	+V	0 V	CAN_GND	CAN_H	CAN_L
	Cable ¹⁾	Core color:	WH	BU	BN	BK	GY
	M12 connector, 5-pin	Pin:	2	3	1	4	5
Digital sensor redundant RC1 (2 x CANopen)			CANopen 1 + CANopen 2				
		Signal:	+V	0 V	CAN_GND	CAN_H	CAN_L
	Cable ¹⁾	Core color:	WH	BU	BN	BK	GY
	M12 connector, 5-pin	Pin:	2	3	1	4	5

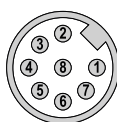
Top view of mating side, male contact base



M12 connector, 4-pin



M12 connector, 5-pin



M12 connector, 8-pin

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

Draw-wire encoder D120

Robust-Line

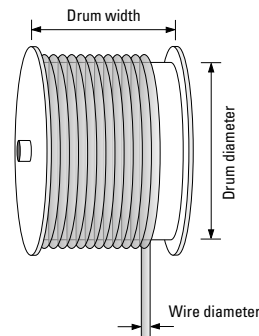
Measuring length max. 10 m

Technology in detail

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. In addition, snapping of the cable during installation must imperatively be avoided, as this can also lead to damages.

Wire fastenings

Carabiner ring
D8.D120...xxx.xxx.V000

M4 thread ¹⁾
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

- Stainless steel V4A, \varnothing 0.5 mm, order option **b** = 1
- Stainless steel V4A, \varnothing 1.0 mm, order option **b** = 2
- Stainless steel V4A, \varnothing 1.5 mm, order option **b** = 3



Ideally suited for long-term outdoor use.

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 ... A55 and R11 ... R55).



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

(only in combination with the standard linearity 0.5 %, **c** = 1)

By using special components.

Order code extensions for the extended temperature range:

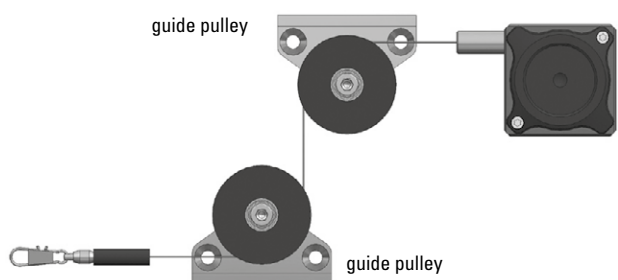
With carabiner ring: D8.D120...xxx.xxx.V003

With M4 thread ¹⁾: D8.D120...xxx.xxx.V004

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

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

Application-specific installation possibilities



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

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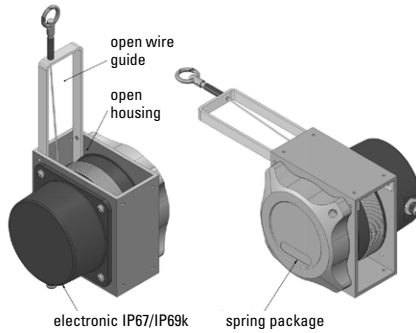
Draw-wire encoder D120	Robust-Line	Measuring length max. 10 m
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Technology in detail

Housing types (the suitable housing type for every application)

Open housing, open wire guide

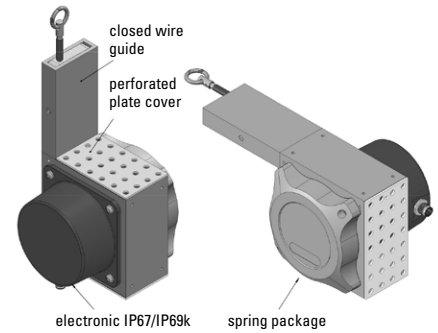
For use in the presence of fine dust and liquids.



Housing with perforated plate cover, closed wire guide

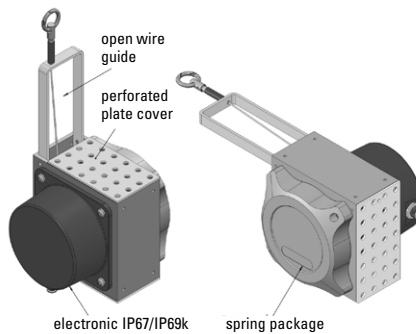
For use in the presence of dirt, particles size > 2 mm and liquids.

Shock protection, wire cleaning device (in preparation).



Housing with perforated plate cover, open wire guide

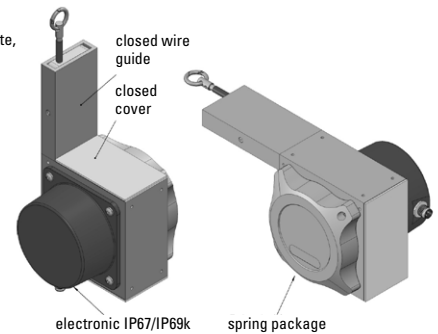
For use in the presence of dirt, particles size > 2 mm and liquids



Closed housing, closed wire guide

For use in the presence of sticky dust, cement, concrete, clay.

Shock protection, wire cleaning device (in preparation).



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Draw-wire encoder D120

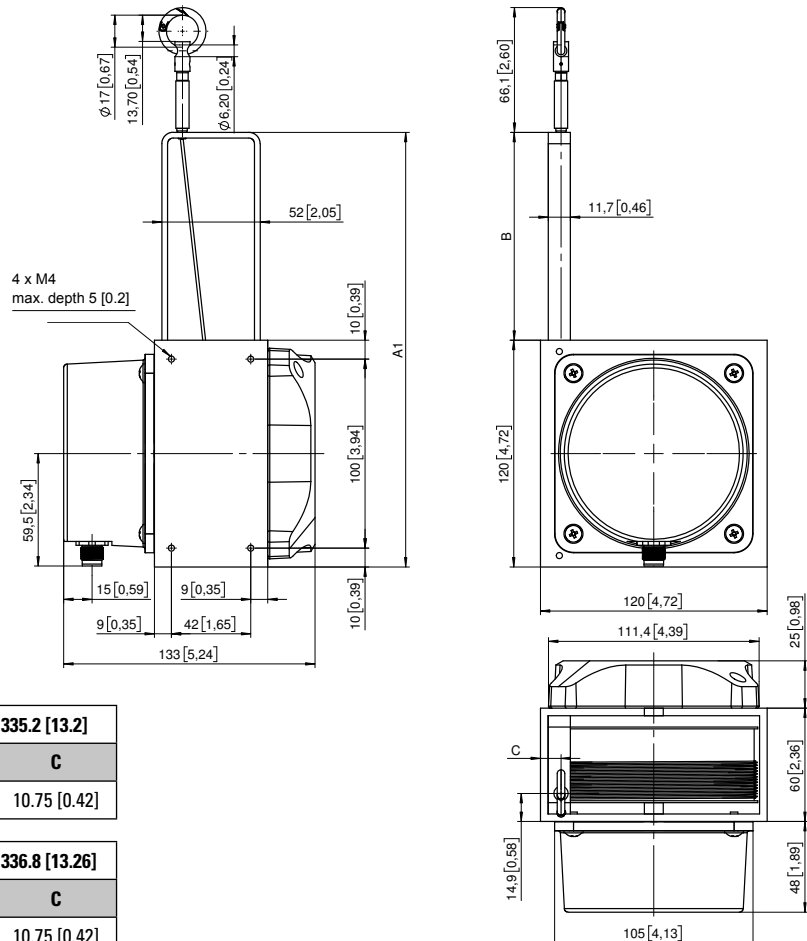
Robust-Line

Measuring length max. 10 m

Dimensions

Dimensions in mm [inch]

Open housing,
open wire guide



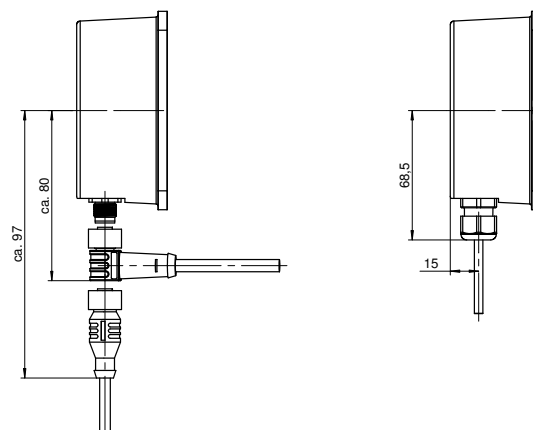
Wire diameter \varnothing 0.5 mm – drum pitch circumference: 335.2 [13.2]			
Measuring length	A1	B	C
3 ... 10 m	230 [9.06]	110 [4.33]	10.75 [0.42]

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.

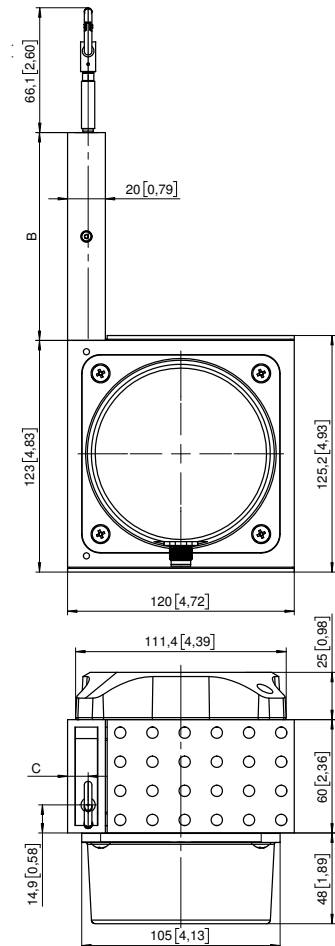
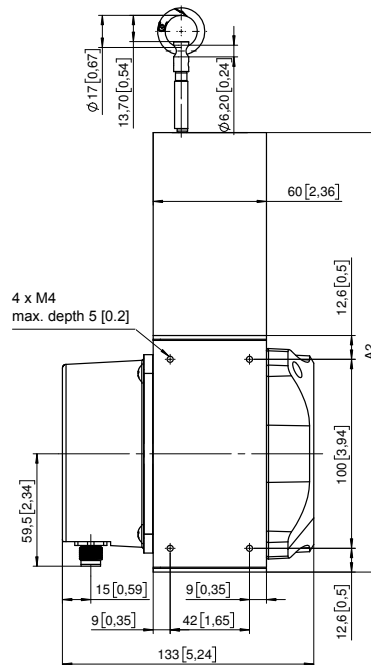


Draw-wire encoder D120	Robust-Line	Measuring length max. 10 m
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Dimensions

Dimensions in mm [inch]

Housing with perforated plate 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]