

Linear measuring technology

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



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 types¹⁾

- 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

Cable connection, standard lengths²⁾

- 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 ... A33
- 5-pin for sensor type CC1 ... RC1
- 8-pin for sensor type R11 ... R33

Relationship measuring length – wire types – linearity


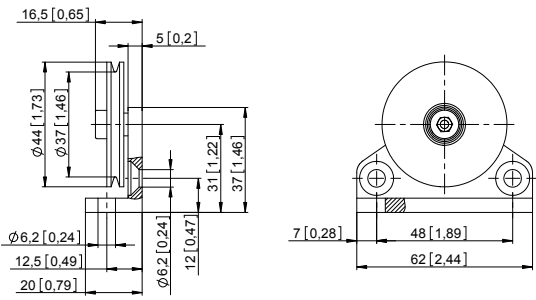

| Measuring length | [m] | 3 / 4 / 5 / 6 | | | 7 / 8 | | | 9 / 10 | | | |
|----------------------------|-------------------------|---------------------|---|----------|----------|---------------------|----------|--------|---------------------|---|---|
| | | order code a | 3 / 4 / 5 / 6 | | | 7 / 8 | | | 9 / A | | |
| Wire type | ø [mm] | 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) Wire type availability depends on the selected measuring range, refer to the technical data.
 2) Other cable length on request.

Linear measuring technology

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

| 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 |
| 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. |
| Preassembled cables | M12 female connector with coupling nut, 4-pin, A coded, straight single ended 2 m [6.56'] PUR cable M12 female connector with coupling nut, 5-pin, A coded, straight single ended 2 m [6.56'] PVC cable M12 female connector with coupling nut, 8-pin, A coded, straight single ended 2 m [6.56'] PVC cable | 05.00.6061.6211.002M 05.00.6081.2211.002M 05.00.6041.8211.002M |
| Connectors | M12 female connector with coupling nut, 4-pin, A coded, straight (plastic) M12 female connector with coupling nut, 5-pin, A coded, straight (metal/plastic) M12 female connector with coupling nut, 8-pin, A coded, straight (metal) | 05.B8141-0 05.B-8151-0/9 05.CMB 8181-0 |

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

Linear measuring technology

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

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, 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 -20 °C ... +85 °C [-4 °F ... +185 °F] as extended order option (s.page 6) -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 | A22 / R22 | A33 / R33 |
|------------------------------------|---|--|---------------------------------|
| Output | 4 ... 20 mA | 0 ... 10 V | 1 kΩ, potentiometer |
| Output current | max. 50 mA in case of a failure | max. 10 mA, min. load 10 kΩ | – |
| Max. current consumption | – | 22.5 mA (non load) | – |
| Supply voltage | 12 ... 30 V DC | 12 ... 30 V DC | max. 30 V DC |
| Response time | < 1 ms from 0 ... 100 % and 100 ... 0 % | < 3 ms from 0 ... 100 % and 100 ... 0 % | – |
| Resolution | limited by the noise | limited by the noise | theoretically unlimited |
| Noise | 0.03 mA _{pp} = 6 mV _{pp} at 200 Ω | typ. 3 mV _{pp} , max. 37 mV _{pp} | depending on the supply voltage |
| Recommended slider current | – | – | < 1 μA |
| Reverse polarity protection | yes | yes | – |
| Short circuit proof | – | yes, sustained short-circuit proof | – |
| Temperature coefficient | 0.0079 %/K | 0.0037 %/K | ±0.0025 %/K |

Characteristics measuring wire (plastic coated)

| | | |
|----------------------|-----------------|---|
| V4A, ø 0.5 mm | measuring range | 3 ... 10 m |
| | no. | 1.4401 |
| | breaking force | 262 N TK 16 x 10 ⁻⁶ K ⁻¹ |
| V4A, ø 1.0 mm | measuring range | 3 ... 8 m |
| | no. | 1.4401 |
| | breaking force | 942 N TK 16 x 10 ⁻⁶ K ⁻¹ |
| V4A, ø 1.5 mm | measuring range | 3 ... 6 m |
| | no. | 1.4401 |
| | breaking force | 1.890 N TK 16 x 10 ⁻⁶ K ⁻¹ |

Approvals

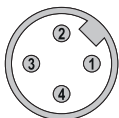
| | |
|--|----------------------------------|
| Electromagnetic compatibility | acc. to EN 61326-1, EN 61326-3-1 |
| CE compliant in accordance with | |
| EMC Directive | 2014/30/EU |
| RoHS Directive | 2011/65/EU |
| UKCA compliant in accordance with | |
| EMC Regulations | S.I. 2016/1091 |
| RoHS Regulations | S.I. 2012/3032 |

1) Depends on the measuring length.

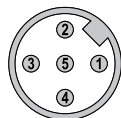
Linear measuring technology

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

| | | | | | | | | | | | |
|---|----------------------|-------------|-----------------------|--------------------|------------------|----------------------|-------|--------------------|-------|----------------------|--|
| Analog sensor A11 (4 ... 20 mA) | | | R/I converter | | | | | | | | |
| | Cable ¹⁾ | Signal: | +V | n.c. | I _{out} | n.c. | | | | | |
| | M12 connector, 4-pin | Core color: | BN | WH | BU | BK | | | | | |
| | | Pin: | 1 | 2 | 3 | 4 | | | | | |
| Analog sensor R11 , redundant (2 x 4 ... 20 mA) | | | R/I converter 1 | | R/I converter 2 | | | | | | |
| | Cable ¹⁾ | Signal: | +V 1 | I _{out 1} | +V 2 | I _{out 2} | n.c. | n.c. | n.c. | n.c. | |
| | M12 connector, 8-pin | Core color: | WH | GN | GY | BU | BN | YE | PK | RD | |
| | | Pin: | 1 | 3 | 5 | 7 | 2 | 4 | 6 | 8 | |
| Analog sensor A22 (0 ... 10 V DC) | | | R/U converter | | | | | | | | |
| | Cable ¹⁾ | Signal: | +V | U _{out} | 0 V | 0 V _{out} | | | | | |
| | M12 connector, 4-pin | Core color: | BN | WH | BU | BK | | | | | |
| | | Pin: | 1 | 2 | 3 | 4 | | | | | |
| Analog sensor R22 , redundant (2 x 0 ... 10 V DC) | | | R/U converter 1 | | R/U converter 2 | | | | | | |
| | Cable ¹⁾ | 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} | |
| | M12 connector, 8-pin | Core color: | WH | BN | GN | YE | GY | PK | BU | RD | |
| | | Pin: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| Analog sensor A33 (Potentiometer 1 kΩ) | | | Potentiometer | | | | | | | | |
| | Cable ¹⁾ | Signal: | +V | Out | 0 V | n.c. | | | | | |
| | M12 connector, 4-pin | Core color: | BN | WH | BU | BK | | | | | |
| | | Pin: | 1 | 2 | 3 | 4 | | | | | |
| Analog sensor R33 , redundant (2 x Potentiometer 1 kΩ) | | | Potentiometer 1 | | Potentiometer 2 | | | | | | |
| | Cable ¹⁾ | Signal: | +V 1 | Out 1 | 0 V 1 | n.c. | +V 2 | Out 2 | 0 V 2 | n.c. | |
| | M12 connector, 8-pin | Core color: | WH | BN | GN | YE | GY | PK | BU | RD | |
| | | Pin: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| Digital sensor CC1 (CANopen) | | | CANopen | | | | | | | | |
| | Cable ¹⁾ | Signal: | +V | 0 V | CAN_GND | CAN_H | CAN_L | | | | |
| | M12 connector, 5-pin | Core color: | WH | BU | BN | BK | GY | | | | |
| | | Pin: | 2 | 3 | 1 | 4 | 5 | | | | |
| Digital sensor RC3 , redundant (2 x CANopen) | | | CANopen 1 + CANopen 2 | | | | | | | | |
| | Cable ¹⁾ | Signal: | +V | 0 V | CAN_GND | CAN_H | CAN_L | | | | |
| | M12 connector, 5-pin | Core color: | WH | BU | BN | BK | GY | | | | |
| | | 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.

Linear measuring technology

| | | |
|-------------------------------|--------------------|-----------------------------------|
| 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.

Wire fastenings

| Carabiner ring | M4 thread ¹⁾ | eyelet | clip |
|------------------------|-----------------------------|-----------------------------|-----------------------------|
| D8.D120.xxxx.xxxx.xxxx | D8.D120.xxxx.xxxx.xxxx.V001 | D8.D120.xxxx.xxxx.xxxx.V002 | D8.D120.xxxx.xxxx.xxxx.V007 |

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

rubber stopper

measuring wire

Wire types

- V4A, ø 0.5 mm, order option **b** = 1
- V4A, ø 1.0 mm, order option **b** = 2
- V4A, ø 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, A22, A33 and R11, R22, R33).

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.xxxx.xxxx.xxxx.V003 |
| With M4 thread ¹⁾ : | D8.D120.xxxx.xxxx.xxxx.V004 |
| With eyelet: | D8.D120.xxxx.xxxx.xxxx.V005 |
| With clip: | D8.D120.xxxx.xxxx.xxxx.V008 |

Application-specific installation possibilities

guide pulley

guide pulley

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

Linear measuring technology

Draw-wire encoder D120

Robust-Line

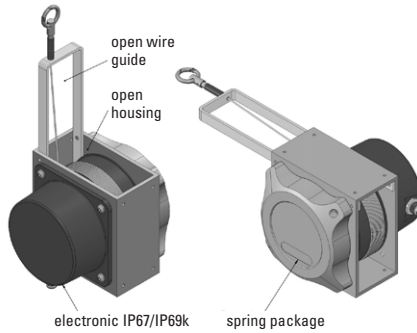
Measuring length max. 10 m

Technology in detail

Housing types (the suitable housing type for every application)

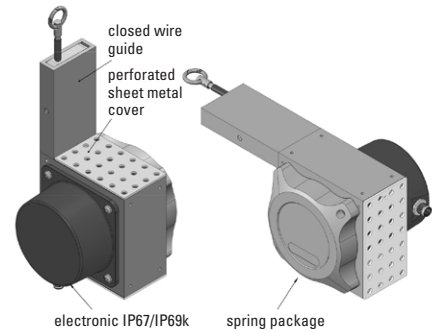
Open housing, open wire guide

For use in the presence of fine dust and liquids.



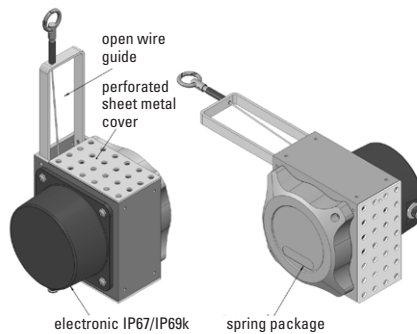
Housing with perforated sheet metal cover, closed wire guide

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



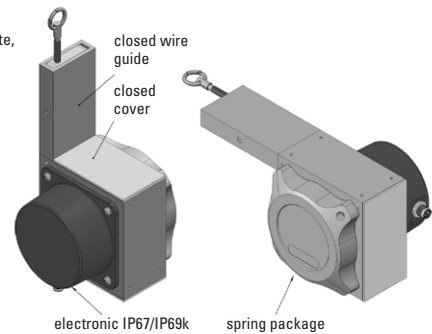
Housing with perforated sheet metal cover, open wire guide

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).



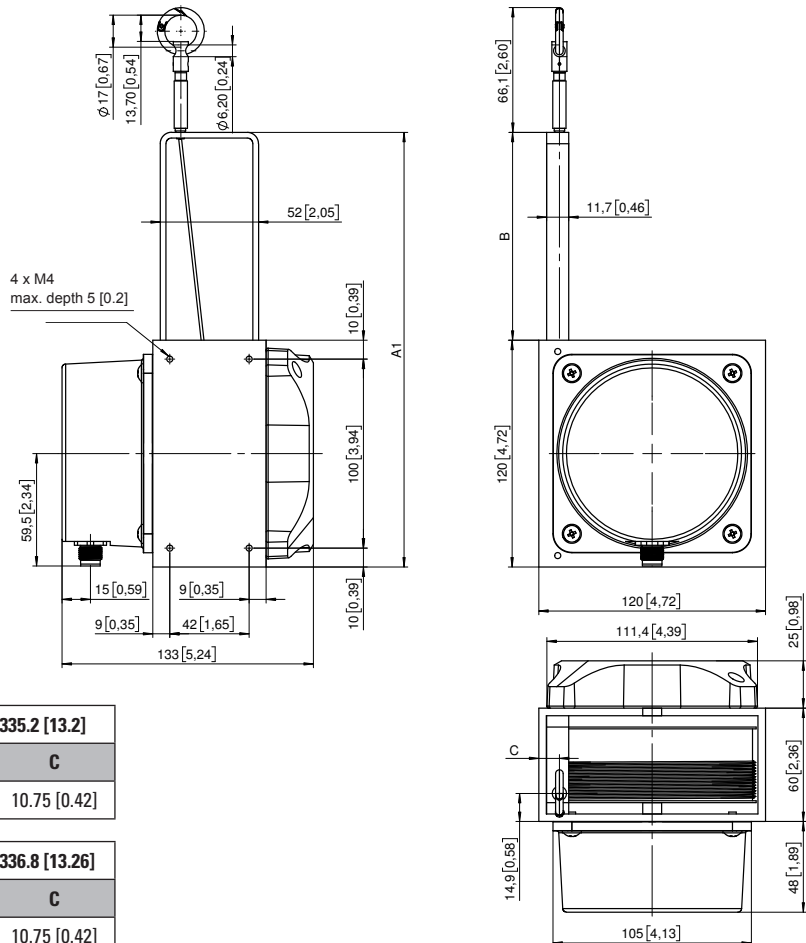
Linear measuring technology

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

Dimensions

Dimensions in mm [inch]

Open housing,
open wire guide



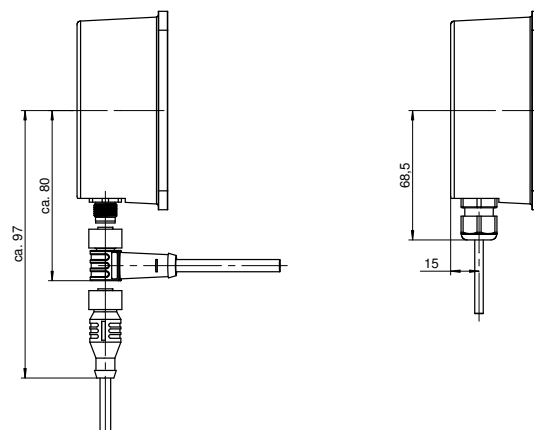
| Wire diameter \varnothing 0.5 mm – drum pitch circumference: 335.2 [13.2] | | | |
|---|------------|------------|--------------|
| Measuring length | A1 | B | C |
| 3 ... 10 m | 230 [9.06] | 110 [4.33] | 10.75 [0.42] |

| 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

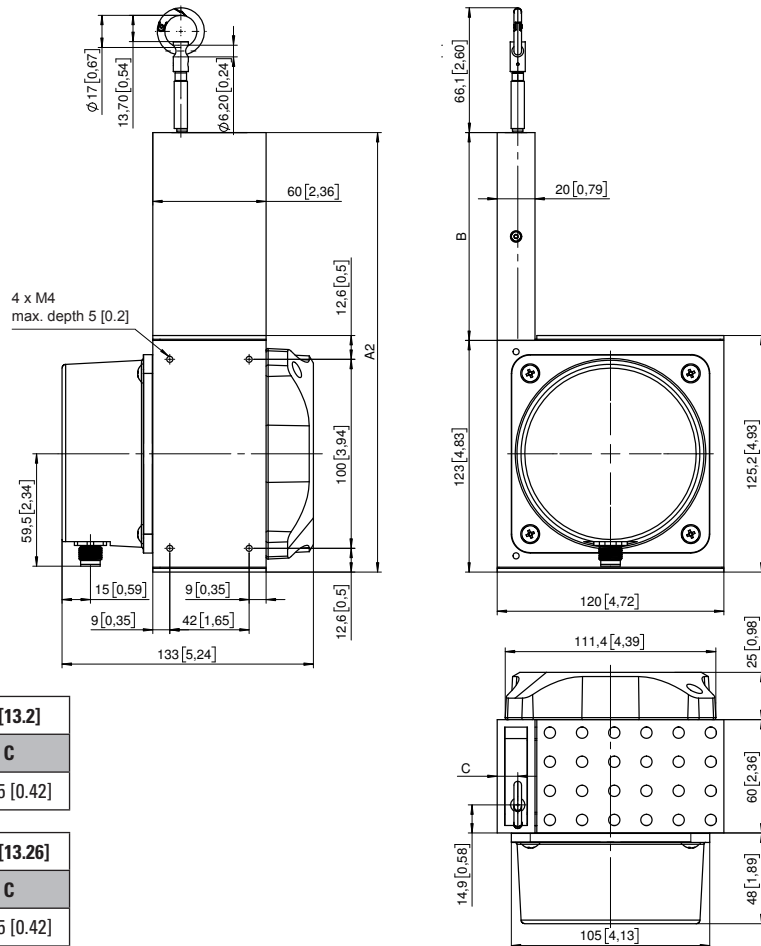
Robust-Line

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] |