Motor Feedback

Hengstler offers Motor Feedback systems in all performance classes and with the most commonly used interfaces

From modular miniature incremental encoders for **DC and Stepper Motors** in 22 mm diameter up to the absolute AC110 with 50mm hollow shaft Hengstler provides a complete range of Motor Feedback systems.

For asynchronous motors and elevators the offering comprises incremental and absolute hollow shaft encoders in singleturn and multiturn versions. Trend-setting is the Incremental OptoAsic with diagnosis system and integrated interpolation electronic which is for the first time used in RI80-E. This enables resolutions of up to 200 000 pulses for good synchronism of electric machines running at low revs.

For AC Servo Motors there is an extensive range of feedback products available: Brushless resolvers size 10, 15 and 21 uniquely robust and low priced, incremental comcoders for direct block commutation of BLDC motors in low cost modular version or with integrated bearings and resolutions up to 10000 pulses per revolution.

Your application requires highest precision and dynamics? Than you are on the right track with the Sine-wave encoder S21 and the absolute Acuro-Drive encoder. Latest OptoAsic technology and a true geared multiturn provides obvious advantages regarding performance and reliability. Hengstler offers the Acuro-Drives series with the open, highspeed, digital interface BiSS. With the open source BiSS interface the proprietary lock-in situation with absolute motorfeedback systems is broken up with the benefit of an increasing range of suppliers.

One Size fits all:
No matter whether your servo application requires resolvers, incremental comcoders or absolute Multiturn encoders - the complete range in size 15 with resolver compatible mounting is available from Hengstler. The benefit of this is, that the B-side of the motor can be resolver style and doesn't need to be customized, depending on the feedback. The Feedback type can be selected according to customer demands or required resolution and technology. This helps reducing variation of parts and stock and enables improved delivery times.

Miniature, DC & Stepper Motors Incremental

- Ideal for position and speed sensing in small machines and actuators
- Low power standby mode is ideal for battery powered devices
- Max. output frequency: 200 kHz
- Resolution to 512 lines/rev

GENERAL INFORMATION

The type E9 incremental optical encoder provides high performance feedback for precision motion control in a very small package.

Its small envelope makes it ideal for instrument axes for position and speed control in mechanisms too small to accept standard encoders.

Its high performance, advanced features, and competitive pricing make it the encoder of choice for a broad range of applications.

The E9 optical encoders utilize a patentpending ASIC that integrates all encoder electronics, including the optoelectronic sensors, which enhances reliability and accuracy. Outputs are quadrature A and B channels with up to 512 lines per rev, an index pulse, unique up/down and rotation direction signals (version 2) or complementary CMOS compatible (version 1). The E9 also has a low-power standby mode to conserve power in battery-operated applications.

TECHNICAL DATA mechanical

Housing diameter	22 mm
Mounting depth	20 mm
Shaft diameter	1.5 mm / 2 mm / 2.5 mm / 3 mm / 4 mm / 1⅛" / 0.156" (Hub shaft)
Hollow shaft tolerance	+0.010 / -0.000 mm
Axial endplay of mounting shaft (hubshaft)	± 0.076 mm + 0.127 mm / - 0.076 mm + 0.187 mm / - 0.076 mm
Radial runout of mating shaft (hubshaft)	± 0.0125 mm
Max. speed	max. 12 000 rpm
Moment of inertia	approx. 0.2 gcm²
Operating temperature	-40 °C ... +100 °C
Storage temperature	-50 °C ... +125 °C
Relative humidity	90 %, non-condensing
Weight	5.07 g
Connection	10 pole header (Accessory: 30 cm ribbon cable with connector, ordering code CA0040012)
Recommended mating connector	Thomas & Betts, ordering code 622-1030 (on request)

TECHNICAL DATA electrical

Supply voltage	DC 5 V ±10 %
Max. current w/o load	10 mA
Standby current	50 µA
Code	Incremental, optical
Max. pulse frequency	200 kHz

Miniature, DC & Stepper Motors Incremental

TECHNICAL DATA
electrical (continued)

Index pulse width (N)	90° ± 36° electrical
Phasing	90° ± 18° electrical
Symmetry	180° ± 18° electrical
Number of pulses	100 ... 512
Output signals	min. 2.5 V high (VOH), max. 0.5 V low (VOL)
Output current	3 mA sink/source (25°C), 2 mA (100°C)
Pulse shape	Square wave

OUTPUT WAVEFORMS AND CONNECTIONS (Direction viewing encoder cover)

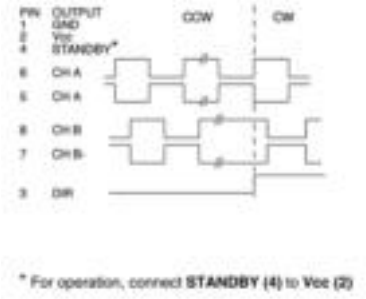


Figure 1

Code **00** for ordering information

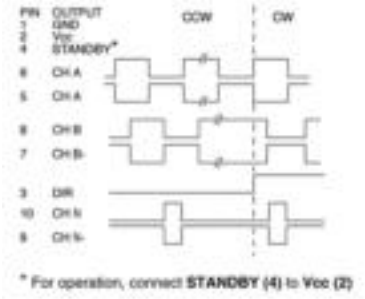


Figure 2

Code **01** for ordering information

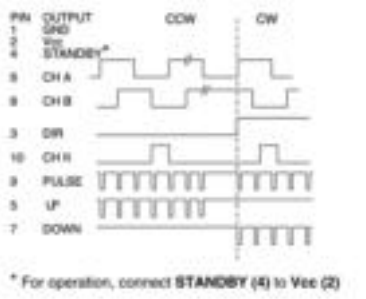
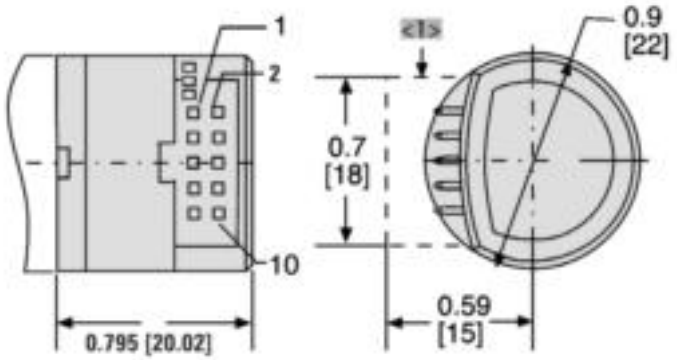


Figure 3

Code **02** for ordering information

DIMENSIONED DRAWINGS



<1> Thomas Betts #622-1030

Dimensions in inch [mm]

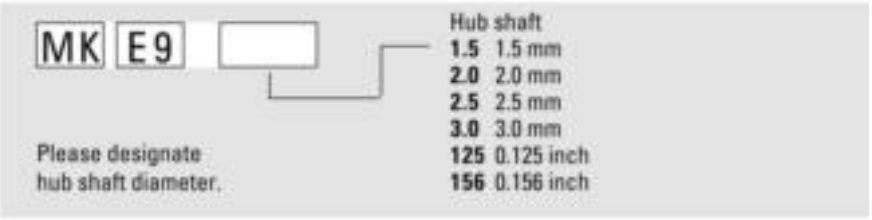
Miniature, DC & Stepper Motors Incremental

ORDERING INFORMATION

Type	Number of pulses / poles	Shaft Ø	Output	Mounting [1]
☐	☐	☐	☐	☐
E9	0100 / 0 0144 / 0 0200 / 0 0256 / 0 0300 / 0 0360 / 0 0500 / 0 0512 / 0	**1,5** 1.5 mm **2,0** 2.0 mm **2,5** 2.5 mm **3,0** 3.0 mm **125** 0.125" **156** 0.156"	**00** see Fig. 1 **01** see Fig. 2 **02** see Fig. 3	**0** No mounting base **A** 4 x M1,6 on 18,5 mm (0,728") B.C. **C** 2 x #2-56 on 19,05 mm (0,75") B.C. **D** 3 x #0-80 on 20,9 mm (0,823") B.C. **E** 2 x #2-56 on 46,02 mm (1,812") B.C.

[1] Further information (drawings and mounting) see homepage www.hengstler.com

Important:
To properly install type E9, a specialized **mounting kit** must be purchased.
Only one kit is required to install any number of encoders with the same hub shaft size.



Example: Kit for installing encoders with 3.0 mm hub shaft = MK E9 3.0

ACCESSORIES

see chapter "Accessories", starting page 322

Miniature, DC & Stepper Motors Incremental

- Ideal for position and speed sensing in small machines and actuators
- Max. output frequency: 200 kHz
- Resolution to 512 lines/rev

GENERAL INFORMATION

With a total length less than 15mm and a very low mass, the type M9 incremental optical encoder is ideally suited for use on the moving heads of pick-and-place type machines.

The M9 may be used as direct replacements for most Hewlett Packard HEDS-5XXX encoders with no changes to the motor or cable.

The M9 provides high performance feedback for precision motion control in a very small package. Its small envelope makes it ideal for instrument axes for position and speed control in mechanisms too small to accept standard encoders.

Its high performance, advanced features, and competitive pricing make it the encoder of choice for a broad range of applications.

It utilizes an ASIC that integates all encoder electronics, including the optoelectronics sensors, which enhances reliability and accuracy.

Outputs are single-ended quadrature A and B channels with up to 512 lines per rev plus an index pulse.

TECHNICAL DATA mechanical

Housing diameter	22 mm
Mounting depth	14.8 mm
Shaft diameter	1.5 mm / 2 mm / 2.5 mm / 3 mm / 4 mm / 1⅛" / 0.156" (Hub shaft)
Hollow shaft tolerance	+0.010 / -0.000 mm
Axial endplay of mounting shaft (hubshaft)	± 0.076 mm + 0.127 mm / - 0.076 mm + 0.178 mm / - 0.076 mm
Radial runout of mating shaft (hubshaft)	± 0.0125 mm
Max. speed	max. 12000 rpm
Moment of inertia	approx. 0.11 gcm²
Operating temperature	-40 °C ... +100 °C
Storage temperature	-50 °C ... +125 °C
Relative humidity	90 %, non-condensing
Weight	4.14 g
Connection	5 pole header (Accessory: 30 cm ribbon cable with connector, ordering code CA0050012)
Recommended mating connector	AMP, ordering code 103675-4 (on request)

TECHNICAL DATA electrical

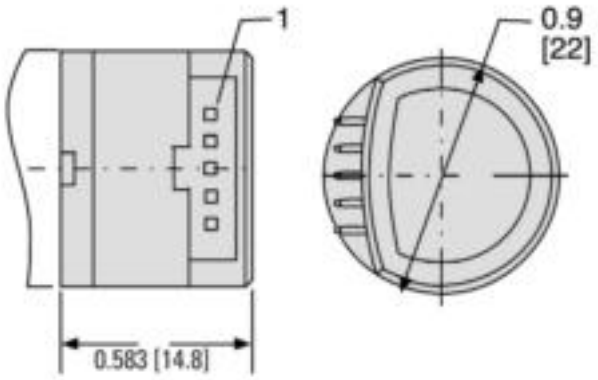
Supply voltage	DC 5 V ±10 %
Max. current w/o load	10 mA
Code	Incremental, optical

Miniature, DC & Stepper Motors Incremental

TECHNICAL DATA
electrical (continued)

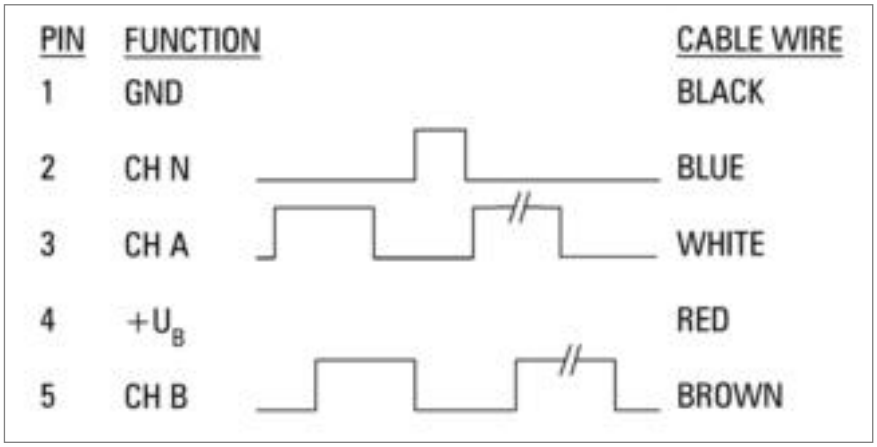
Max. pulse frequency	200 kHz
Index pulse width (N)	90° ± 36° electrical
Phasing	90° ± 18° electrical
Symmetry	180° ± 18° electrical
Number of pulses	100 ... 512
Output signals	min. 2.5 V high, max. 0.5 V low
Output current	6 mA (25°C), 4 mA (100°C)

DIMENSIONED DRAWINGS



Dimensions in inch [mm]

OUTPUT WAVEFORMS AND CONNECTIONS (Direction viewing encoder cover)



ORDERING INFORMATION

Type	Number of pulses / poles	Mounting [1]	Shaft Ø	Connection
☐	☐	☐	☐	☐
M9	0100 / 0 0144 / 0 0200 / 0 0256 / 0 0300 / 0 0360 / 0 0500 / 0 0512 / 0	**0** No mounting base **A** 4 x M1,6 on 18,5 mm (0,728") B.C. **C** 2 x #2-56 on 19,05 mm (0,75") B.C. **D** 3 x #0-80 on 20,9 mm (0,823") B.C. **E** 2 x #2-56 on 46,02 mm (1,812") B.C.	**1,5** 1.5 mm **2,0** 2.0 mm **2,5** 2.5 mm **3,0** 3.0 mm **4,0** 4.0 mm **125** 0.125" **156** 0.156"	**2** Flying leads **1** 5 pole header

[1] Further information (drawings and mounting) see homepage www.hengstler.com

Important:
To properly install type M9, a specialized **mounting kit** must be purchased.
Only one kit is required to install any number of encoders with the same hub shaft size.

Example: Kit for installing encoders with 3.0 mm hub shaft = MK M9 3.0

ACCESSORIES

see chapter "Accessories", starting page 322

Motor Feedback M 14

Miniature, DC & Stepper Motors Incremental

- Ideal economical feedback device for servo and step motors
- Short axial length and compact 1.5 inch diameter
- Easy "snap-on" installation
- High resolution to 1024 lines/rev and 200 kHz bandwidth
- Max. output frequency: 200 kHz
- Replacement for HP 5540
- CE qualified

GENERAL INFORMATION

The type M14 of incremental optical encoders provides high performance feedback for precision motion control in a small, low cost package.

Its high performance, advanced features, and competitive pricing make it the encoder of choice for a broad range of applications.

The M14 optical encoder utilizes a patentpending ASIC that integrates all encoder electronics, including the optoelectronic sensors, which enhances reliability and accuracy.

Quadrature A and B channels with up to 1024 lines per revolution and reference pulse are output as single-ended TTL/CMOS compatible signals.

The M 14 can be used as drop-in replacement for HP 5540.

TECHNICAL DATA
mechanical

Housing diameter	38 mm
Mounting depth	17.2 mm
Shaft diameter	3 mm / 4 mm / 5 mm / 6 mm / 8 mm / 0.1248" / 0.1873" / 0.2498" / 0.2501" / 0.3123" / 0.3748" / 3/4" (Hub shaft)
Hollow shaft tolerance	+0.010 / -0.000 mm
Axial endplay of mounting shaft (hubshaft)	± 0.076 mm + 0.127 mm / - 0.076 mm + 0.178 mm / - 0.076 mm
Radial runout of mating shaft (hubshaft)	± 0.0125 mm
Max. speed	max. 12000 rpm
Moment of inertia	approx. 0.13 gcm²
Operating temperature	-40 °C ... +100 °C
Storage temperature	-50 °C ... +125 °C
Relative humidity	90 %, non-condensing
Weight	6.2 g
Connection	5 pole header (Accessory: 30 cm ribbon cable with connector, ordering code CA0050012)
Recommended mating connector	AMP, ordering code 103969-4 (on request)

TECHNICAL DATA
electrical

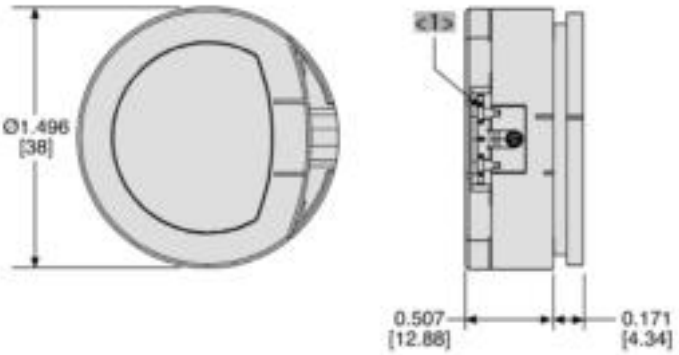
Supply voltage	DC 5 V ±10 %
Max. current w/o load	10 mA
Code	Incremental, optical
Max. pulse frequency	200 kHz
Index pulse width (N)	90° ± 36° electrical
Phasing	90° ± 18° electrical
Symmetry	180° ± 18° electrical

Miniature, DC & Stepper Motors Incremental

TECHNICAL DATA
electrical (continued)

Number of pulses	200 ... 1024
Output signals	min. 2.5 V high, max. 0.5 V low
Output current	6 mA (25°C), 4 mA (100°C)

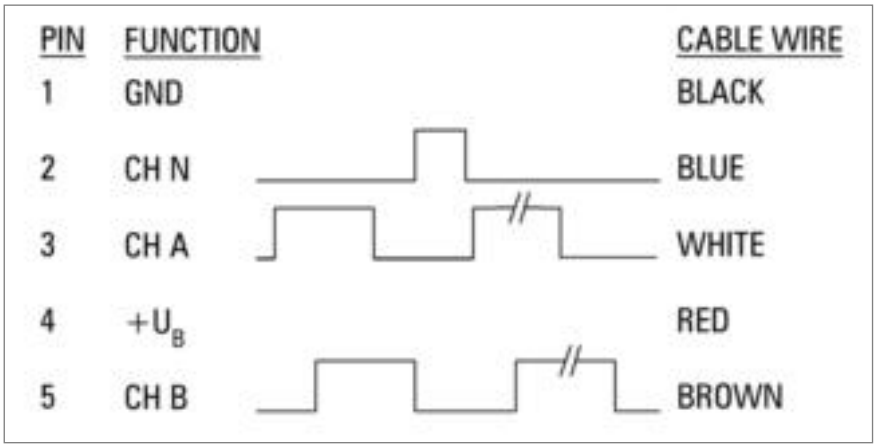
DIMENSIONED DRAWINGS



<1> Pin 1

Dimensions in inch [mm]

OUTPUT WAVEFORMS AND CONNECTIONS (Direction viewing encoder cover)



ORDERING INFORMATION

Type	Number of pulses / poles	Mounting [1]	Shaft Ø
☐	☐	☐	☐
M14	0200 / 0 0400 / 0 0500 / 0 0512 / 0 Higher on request	**0** No mounting base **A** 2 x #2-56 on 32,51 mm (1,28") B.C. **B** 3 x #0-80 on 20,9 mm (0,823") B.C. **C** 2 x #2-56 on 19,05 mm (0,75") B.C.	**3,0** 3.0 mm **4,0** 4.0 mm **5,0** 5 mm **6,0** 6 mm **8,0** 8 mm **125** 0.125" **187** 0.1873" **249** 0.2498" **250** 0.2501" **312** 0.2501" **374** 0.3748" **375** 0.3748"

[1] Further information (drawings and mounting) see homepage www.hengstler.com

Important:
To properly install type M14, a specialized **mounting kit** must be purchased.
Only one kit is required to install any number of encoders with the same hub shaft size.

MK M14 ☐

Please designate hub shaft diameter.

Hub shaft

3.0	3 mm	**187**	0.1873 inch
4.0	4 mm	**249**	0.2498 inch
5.0	5 mm	**250**	0.2501 inch
6.0	6 mm	**312**	0.3123 inch
8.0	8 mm	**374**	0.3748 inch
125	0.1248 inch	**375**	0.3750 inch

Example: Kit for installing encoders with 0.1248" mm hub shaft = MK M14 125

ACCESSORIES

see chapter "Accessories", starting page 322

Asynchronous & DC Motors Incremental

OVERWIEW

Our hollow shaft encoder industry types are particularly suitable as a motor feedback product for asynchronous- and DC motors. Due to the partially higher requirements on the operating temperature, there are specially developed high temperature versions (-TD) available, among certain types.

HOLLOW SHAFT ENCODER RI36-H

- Miniature industry encoder for high numbers of pulses (5 .. 3600)
- Hollow shaft (up to 10mm)
- Short overall length
- Easy and quick mounting procedure

There are two different spring tethers availbale.

Detailed description: Page 104

HOLLOW SHAFT ENCODERS RI58-D, TD, -G, TG

- Flexible hollow shaft design up to diameter 14 mm (-D,TD), 15mm hollow shaft (-G,TG)
- Short overall length
- Easy installation by means of clamping ring or blind shaft
- Operating temperature up to 100°C (RI58 TD and TG)
- High number of pulses (5 .. 5000) with -D
- Limited number of pulses (4 .. 2500) with TD and (50 .. 2500) with TG

The RI58 hollow shaft family offers a broad spectrum of mounting possibilities and is the right choice for all drive systems because of its high temperature option.

Detailed description of RI58-D, TD: Page 113
Detailed information of RI58-G, TG Page 122

HOLLOW SHAFT ENCODER RI76TD

- Through hollow shaft with up to diameter 42 mm
- Short overall length with an outside diameter of only 76 mm
- Easy installation by means of clamping ring
- Operating temperature up to 100 °C

Different Mounting options are available.

Detailed description: Page 132

HOLLOW SHAFT ENCODER RI80-E

- Incremental Output
- 30...45 mm hollow shaft
- Rugged mechanical design
- Unbreakable disc
- Integrated diagnostic system
- Wide voltage range DC 5 … 30 V

The RI80-E is the first encoder using the latest Hengstler OptoAsic technology.

Detailed description: Page 136

Asynchronous & DC Motors Absolute

OVERVIEW

Our absolute hollow shaft encoders of the Acuro family are particularly suitable as a motor feedback product for asynchronous- and DC motors, with special requirements concerning dynamics and absolute positioning. Besides the standard interfaces BiSS and SSI they offer additional Sin Cos of output signals.

ABSOLUTE HOLLOW SHAFT ENCODER AC58

- Absolute standard industry encoder with high resolution
- Hollow shaft (up to 12 mm)
- Short overall length
- Easy and quick mounting procedure

The AC58 offers all characteristics of the Acuro family in one universal design.

Detailed description: Page 147

ABSOLUTE HOLLOW SHAFT ENCODER AC110

- Robust absolute industry encoder with high resolution
- Hollow shaft (up to 50mm)
- Short overall length
- Easy and quick mounting procedure

The AC110 offers all characteristics of the Acuro family for applications with large shaft diameters (elevators, direct drives).

Detailed description: Page 194

AC-Synchronous & BLDC Motors Incremental

- Modular hollow shaft encoder, ideal for BLDC, DC-Servo and Stepper feedback
- Through hollow shaft Ø 6 ... 12,7 mm
- Incremental + Commutation
- Incremental signals A, B, N and 4, 6 or 8 pole
- Outside diameter 53 mm
- Mounting depth: only 23 mm
- Maximum speed: 12,000 rpm
- Standard Operating temperature: -40 ... +120°C
- Easy installation and alignment

TECHNICAL DATA
mechanical

Housing diameter	53 mm
Mounting depth	22.9 mm
Shaft diameter	6 mm / 6.35 mm / 8 mm / 9.52 mm / 10 mm / 11.11 mm / 12 mm / 12.7 mm (Hub shaft)
Protection class shaft input (EN 60529)	IP50
Protection class housing (EN 60529)	with cover: IP50
Hollow shaft tolerance	+0.026 mm/ -0.000 mm
Mating shaft length	min. 12 mm max. 19 mm
Axial endplay of mounting shaft (hubshaft)	+ 0.3 mm / - 0.21 mm
Radial runout of mating shaft (hubshaft)	Includes shaft perpendicularity to mounting surface: ± 0.05 mm
Max. speed	max. 12 000 rpm
Acceleration	100 000 rad/s²
Moment of inertia	approx. 4.7 gcm²
Vibration resistance (DIN EN 60068-2-6)	25 m/s² (5 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	500 m/s² (11 msec)
Operating temperature	-40 °C ... +120 °C
Storage temperature	-40 °C ... +85 °C
Relative humidity	90% noncondensing
Material shaft	Aluminum
Material housing	Glass fiber-reinforced plastic
Weight	max. 85g
Connection	Shielded cable or dual row connector

TECHNICAL DATA
electrical

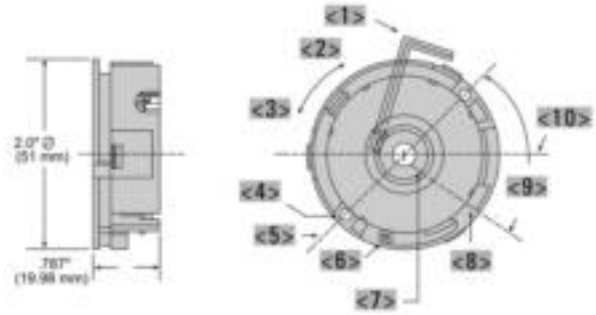
Supply voltage	DC 5 V or DC 12 V ±10 %
Max. current w/o load	100 mA (Incremental: DC 5 or 12 V ± 10 % (excluding output load)), 75 mA (Commutation: DC 5 or 12 V ± 10 % (excluding output load))
Code	Incremental with commutation, optical
Accuracy	Incremental signals: ± arc-mins max. edge to edge Commutation signals: ± arc-mins max.
Max. pulse frequency	200 kHz

AC-Synchronous & BLDC Motors Incremental

TECHNICAL DATA
electrical (continued)

Phasing	Incremental signals (A leads B): 90° ± 18° electrical Commutation signals (U leads V leads W): 8 Pole: 30°, 6 Pole: 60°, 4 Pole ° mechanical
Index pulse width (N)	Incremental signals: 180° ± 18° electrical 180° ± 36° elektrisch
Standard output versions	NPN-O.C.: A, B, N RS422: A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$ NPN-O.C. (commutation): U, V, W RS422 (commutation): U, V, W, $\overline{U}$, $\overline{V}$, $\overline{W}$

DIMENSIONED DRAWINGS



<1> 5/64'' (2 mm) hex key
<2> cw (clockwise)
<3> ccw (counter clockwise)
<4> 2 x 0.125" Ø (3.2 mm) on 1.812" Ø B.C.(46 mm)
<5> Mounting hole axis
<6> #1 Phillips alignment screw
<7> Index mark on hub
<8> for blind hub clamp screw: align index mark on hub with vertical edge on housing to properly orient hub clamp screw to hex key access hole thru side of housing
<9> 80 offset between mounting hole axis and active index output (centered in adjustment range)
◘ Index sensor position

Dimensions in inch (mm)

ORDERING INFORMATION

Type	Number of pulses	Poles commutation [2]	Housing	Electrical [3, 4, 5]	Shaft Ø	Connection
☐	☐	☐	☐	☐	☐	☐
M53	**0500** **0512** **1000**	**0** Without **4** 4 pole **6** 6 pole **8** 8 pole	**0** Without cover **2** Axial exit (for shielded cable with pcb connector) **1** Radial exit cover (for shielded cable)	**0** U inc = DC 5 V, output inc = NPN-O.C. **1** U inc = DC 12 V, output inc = NPN-O.C. **3** U inc = DC 5 V, output inc = RS422 **6** U inc = DC 5 V, output inc = RS422, U com = DC 5 V, output com = NPN-O.C. **9** U inc = DC 5 V, output inc = RS422, U com = DC 5 V, output com = RS422	**A** 6.35 mm (1/4") **B** 6.35 mm (1/4") **C** 11.11 mm (7/16") **D** 12.7 mm (1/2") **E** 6 mm **F** 8 mm **G** 10 mm **H** 12 mm	**A ... H** Screened cable radial (A = 30 cm, B = 60 cm ...) **1 ... 8** Dual row connector with mating ribbon cable (1 = 30 cm, 2 = 60 cm ...)

[1] allowed combinations see available combinations (pulses/poles)
[2] allowed combinations see available combinations (pulses/poles)
[3] U inc: Supply voltage incremental, U com: Supply voltage commutation (only if commutation selected)
[4] Code Electrical "0", "1", "3": only incremental, without commutation
[5] Code Electrical "6", "9": inkremental plus commutation signals
[6] Connection code "A" ... "H": only with output = RS 422

AC-Synchronous & BLDC Motors Incremental

- Compact hollowshaft motor encoder, ideal for BLDC, DC-Servo and Stepper feedback
- Through hollow shaft Ø 6 mm
- Incremental signals A, B, N
- Resolution up to 2048 ppr
- 6 or 10 pole commutation signals
- Frequency response to 300 kHz
- Resolver compatible mounting
- Operating temperature up to 120 °C
- Mounting depth: 22.4 mm

NUMBER OF PULSES

1024, 2048;
optional 6 or 10 pole commutation signals

GENERAL INFORMATION

The type F10 encoder provides high performance, cost effective feedback for stepper and servo motor applications. The F10 offers compact package dimensions and flying leads for a low-profile installation. A size 10 servo ring allows easy mounting and replacement of pancake resolvers with high tolerance to motor shaft movement and 360 degrees of adjustment to align the signal outputs to the shaft position.

TECHNICAL DATA
mechanical

Housing diameter	31.7 mm
Mounting depth	22.5 mm
Shaft diameter	6 mm (Hub shaft)
Flange (Mounting of housing)	Servo flange
Hollow shaft tolerance	+0.025 mm/ -0.000 mm (+0.001"/ -0.000")
Mounting	26.54 mm (1.045") flexible servo ring (size 10 pancake resolver equivalent)
Axial endplay of mounting shaft (hubshaft)	± 0.25 mm
Radial runout of mating shaft (hubshaft)	Includes shaft perpendicularity to mounting surface: 0.05 mm
Max. speed	max. 5000 rpm (continuous), max. 12000 rpm (short term)
Acceleration	100000 rad/s²
Bearing life	[(3.6 x 10^9) / rpm] hours, e.g. 605 000 hours at 6000 rpm
Moment of inertia	approx. 1.6 gcm²
Vibration resistance (DIN EN 60068-2-6)	2.5 g at 5 to 2000 Hz
Shock resistance (DIN EN 60068-2-27)	50 g for 6 ms duration
Operating temperature	0 °C ... +120 °C
Storage temperature	0 °C ... +120 °C
Relative humidity	90 %, non-condensing
Material shaft	Brass
Material housing	Cast aluminum
Material flange	Aluminum
Material disk	0.76 mm thick glass
Weight	approx. 45 g
Connection	Flying leads

AC-Synchronous & BLDC Motors Incremental

TECHNICAL DATA
electrical

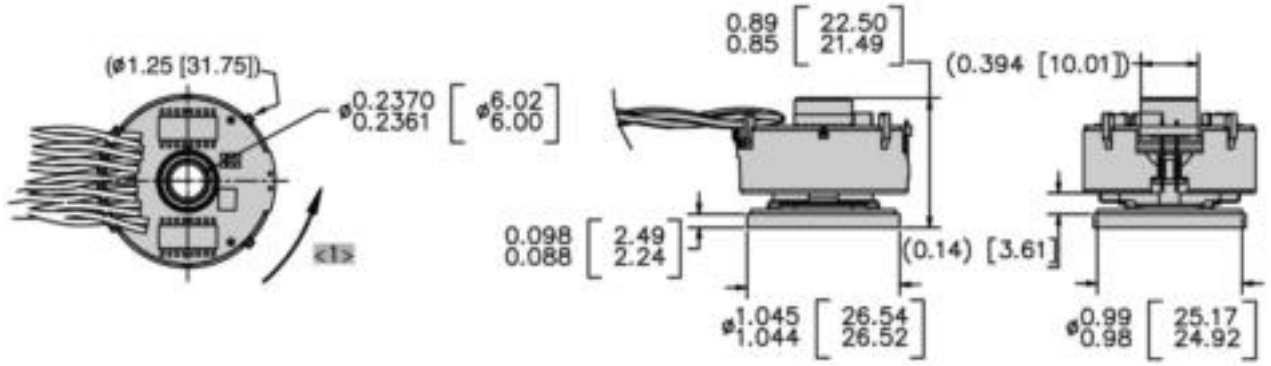
Supply voltage	DC 5 V ±10 %
Max. current w/o load	100 mA (Incremental and Commutation, w/o load)
Code	Incremental with commutation, optical
Accuracy	Incremental signals: ±2.5 arc-mins. max. (edge to edge) Commutation signals: ±6 arc-mins. max.
Max. pulse frequency	300 kHz
Phasing	Incremental signals (A leads B): A leads B by 90° for ccw shaft rotation viewing the shaft clamp end of the encoder Commutation signals (U leads V leads W): U leads V leads W by 120°
Index to u channel	±1° mech. index pulse center to U channel edge
Index pulse width (N)	90° gated A and B low
Standard output versions	NPN-O.C. (S): A, B, N RS422: A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$ NPN-O.C. (commutation): U, V, W RS422 (commutation): U, V, W, $\overline{U}$, $\overline{V}$, $\overline{W}$
Number of pulses	1024, 2048
Output current	Incremental: ±40 mA (RS422) Commutation: 8 mA (NPN-O.C) or ±40 mA (RS 422)

ELECTRICAL CONNECTIONS

Function [1]	**Colour**
VCC	red
GND	black
$\overline{A}$	blue/black
A	blue
$\overline{B}$	green/black
B	green
$\overline{N}$	violet/black
N	violet
$\overline{U}$	brown/black
U	brown
$\overline{V}$	grey/black
V	grey
$\overline{W}$	white/black
W	white

[1] availability of function depends on version

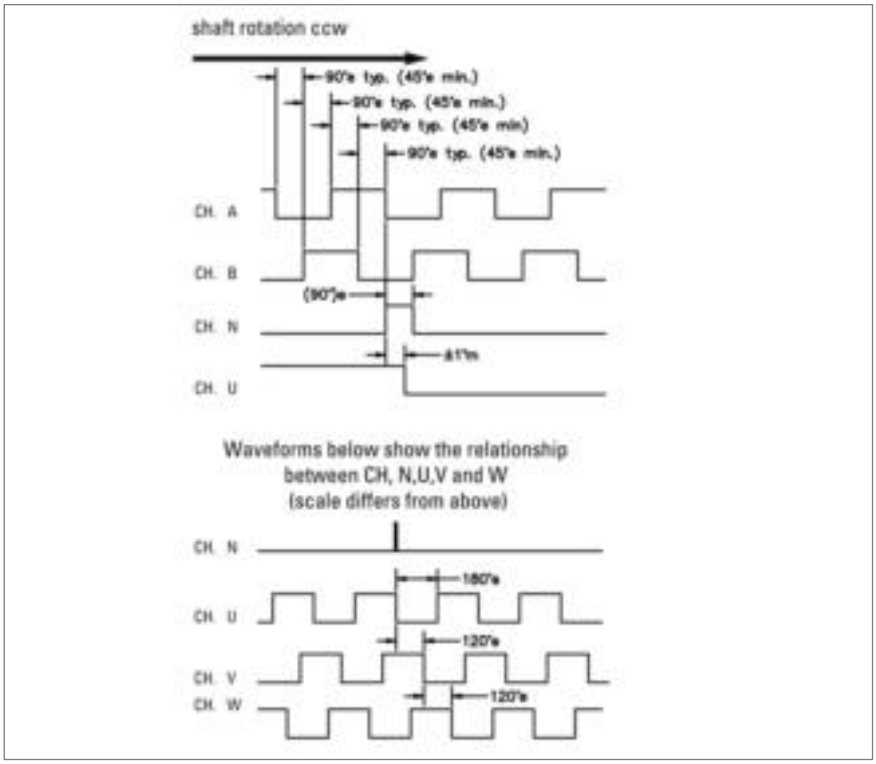
DIMENSIONED DRAWINGS



<1> ccw (counter clockwise)

Dimensions in inch [mm]

OUTPUT WAVEFORMS



AC-Synchronous & BLDC Motors Incremental

ORDERING INFORMATION

Type	Number of pulses [1]	Poles commutation [2]	Electrical [3, 4, 5]	Shaft / bore	Connection	Mounting
☐	☐	☐	☐	☐	☐	☐
F10	**1024** **2048**	**0** Without **6** 6 pole **C** 10 pole	**3** U inc = DC 5 V, output inc = RS422 **6** U inc = DC 5 V, output inc = RS422, U com = DC 5 V, output com = NPN-O.C. **9** U inc = DC 5 V, output inc = RS422, U com = DC 5 V, output com = RS422	**4** 6 mm/ through bore	**0** 16.5 cm flying leads	**0** Servo ring size 10

[1] allowed combinations see available combinations (pulses/poles)
[2] allowed combinations see available combinations (pulses/poles)
[3] U inc: Supply voltage incremental, U com: Supply voltage commutation (only if commutation selected)
[4] Code Electrical "3": only incremental, without commutation
[5] Code Electrical "6", "9": inkremental plus commutation signals

Available combinations (pulses/poles)

Pulses ppr	Number of poles		
	0	6	10 (=C)
1024	X	X	X
2048	X	X	X

AC-Synchronous & BLDC Motors Incremental

- Compact hollowshaft motor encoder, ideal for BLDC, DC-Servo and Stepper feedback
- Through hollow shaft Ø 9.52 mm
- Incremental signals A, B, N
- Resolution up to 2048 ppr
- 6, 8 or 10 pole commutation signals
- Frequency response to 300 kHz
- Resolver compatible mounting
- Operating temperature up to 120 °C
- Mounting depth: 22.4 mm

NUMBER OF PULSES

1024, 2048;
optional 6, 8 or 10 pole commutation signals

GENERAL INFORMATION

The type F15 encoder provides high performance, cost effective feedback for stepper and servo motor applications. The F15 offers compact package dimensions and flying leads for a low-profile installation. A size 15 servo ring allows easy mounting and replacement of pancake resolvers with high tolerance to motor shaft movement and 360 degrees of adjustment to align the signal outputs to the shaft position.

TECHNICAL DATA
mechanical

Housing diameter	36.8 mm
Mounting depth	22.1 mm
Shaft diameter	9.52 mm (Through hollow shaft)
Flange (Mounting of housing)	Servo flange
Hollow shaft tolerance	+0.025 mm/ -0.000 mm (+0.001"/ -0.000")
Mounting	36.83 mm (1.450") flexible servo ring (size 15 pancake resolver equivalent)
Axial endplay of mounting shaft (hubshaft)	± 0.25 mm
Radial runout of mating shaft (hubshaft)	Includes shaft perpendicularity to mounting surface: ± 0.05 mm
Max. speed	max. 5000 rpm (continuous), max. 12000 rpm (short term)
Acceleration	100000 rad/s²
Bearing life	[(3.6 x 10^9) / rpm] hours, e.g. 605 000 hours at 6000 rpm
Moment of inertia	approx. 2.5 gcm²
Vibration resistance (DIN EN 60068-2-6)	2.5 g at 5 to 2000 Hz
Shock resistance (DIN EN 60068-2-27)	50 g for 6 ms duration
Operating temperature	0 °C ... +120 °C
Storage temperature	0 °C ... +120 °C
Relative humidity	90 %, non-condensing
Weight	approx. 45 g
Connection	Flying leads

TECHNICAL DATA
electrical

Supply voltage	DC 5 V ±10 %
Max. current w/o load	100 mA (Incremental and Commutation, w/o load)
Code	Incremental with commutation, optical

AC-Synchronous & BLDC Motors Incremental

TECHNICAL DATA
electrical (continued)

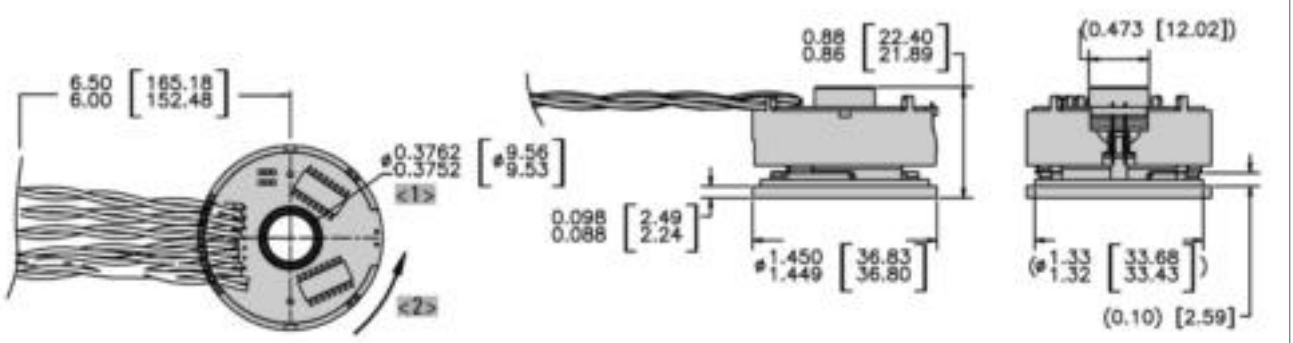
Accuracy	Incremental signals: max. ±2,5 arc-mins. Incremental signals: max. ±6 arc-mins.
Max. pulse frequency	300 kHz
Phasing	Incremental signals (A leads B): A leads B by 90° for ccw shaft rotation viewing the shaft clamp end of the encoder Commutation signals (U leads V leads W): U leads V leads W by 120° for ccw shaft rotation viewing the shaft clamp end of the encoder
Index to u channel	±1° mech. index pulse center to U channel edge
Index pulse width (N)	90° gated A and B low
Standard output versions	RS422: A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$ NPN-O.C.: U, V, W RS422 (commutation): U, V, W, $\overline{U}$, $\overline{V}$, $\overline{W}$
Number of pulses	1024, 2048
Output current	Incremental: max. ±40 mA (RS 422) Commutation: max. ±8 mA (NPN-O.C) or ±40 mA (RS 422)

ELECTRICAL CONNECTIONS

Function [1]	**Colour**
VCC	red
GND	black
$\overline{A}$	blue/black
A	blue
$\overline{B}$	green/black
B	green
$\overline{N}$	violet/black
N	violet
$\overline{U}$	brown/black
U	brown
$\overline{V}$	grey/black
V	grey
$\overline{W}$	white/black
W	white

[1] availability of function depends on version

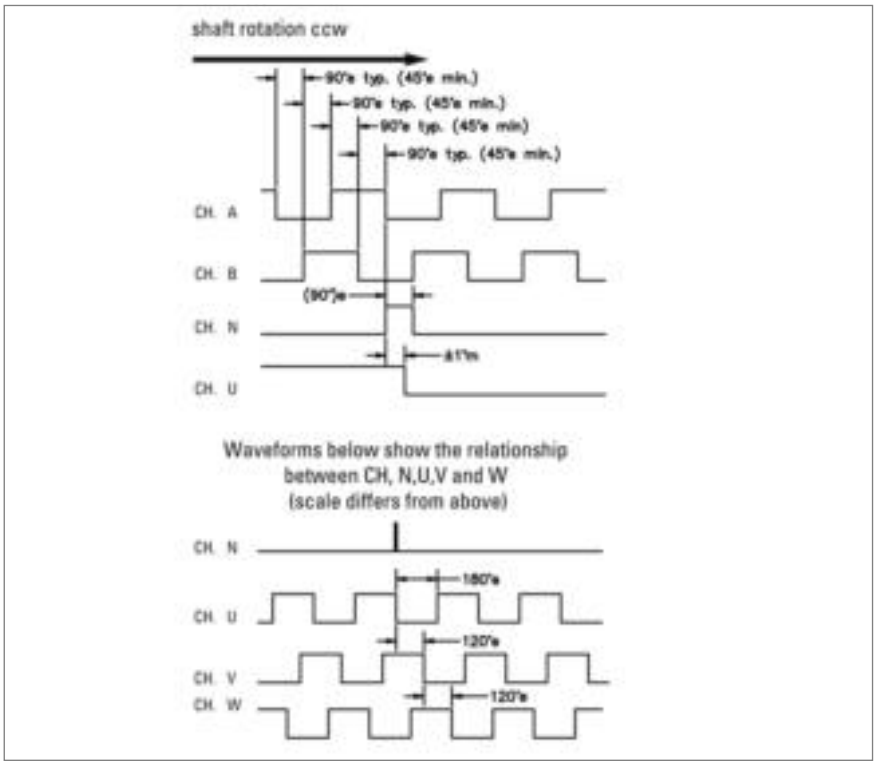
DIMENSIONED DRAWINGS



<1> Thru bore <2> ccw (counter clockwise) Dimensions in inch [mm]

AC-Synchronous & BLDC Motors Incremental

OUTPUT WAVEFORMS



ORDERING INFORMATION

Type	Number of pulses [1]	Poles commutation [2]	Mounting	Electrical [3, 4, 5]	Shaft / bore	Connection
☐	☐	☐	☐	☐	☐	☐
F15	**1024** **2048**	**0** Without **6** 6 pole **8** 8 pole **C** 10 pole	**0** Servo ring size 15	**3** U inc = DC 5 V, output inc = RS422 **6** U inc = DC 5 V, output inc = RS422, U com = DC 5 V, output com = NPN-O.C. **9** U inc = DC 5 V, output inc = RS422, U com = DC 5 V, output com = RS422	**1** 9.52 mm/ through bore	**0** 16.5 cm flying leads

[1] allowed combinations see available combinations (pulses/poles)
[2] allowed combinations see available combinations (pulses/poles)
[3] U inc: Supply voltage incremental, U com: Supply voltage commutation (only if commutation selected)
[4] Code Electrical "3": only incremental, without commutation
[5] Code Electrical "6", "9": inkremental plus commutation signals

Available combinations (pulses/poles)

Pulses ppr	Number of poles			
	0	6	8	10 (=C)
1024	X	X	X	X
2048	X	X	X	X

AC-Synchronous & BLDC Motors Incremental

- Compact hollowshaft motor encoder, ideal for BLDC, DC-Servo and Stepper feedback
- Through hollow shaft Ø 12.7 mm
- Incremental signals A, B, N
- Resolution up to 2048 ppr
- 6, 8, 10, 12 or 16 pole commutation signals
- Frequency response to 300 kHz
- Resolver compatible mounting
- Operating temperature up to 120 °C
- Mounting depth max.: 26 mm

NUMBER OF PULSES

1024, 2048;
optional 6, 8, 10, 12 or 16 pole commutation signals

GENERAL INFORMATION

The type F21 encoder provides high performance, cost effective feedback for stepper and servo motor applications. The F21 offers compact package dimensions and flying leads for a low-profile installation. A size 21 servo ring allows easy mounting and replacement of pancake resolvers with high tolerance to motor shaft movement and 360 degrees of adjustment to align the signal outputs to the shaft position.

TECHNICAL DATA
mechanical

Housing diameter	53 mm
Mounting depth	26 mm
Shaft diameter	12.7 mm (Hub shaft)
Flange (Mounting of housing)	Servo flange
Hollow shaft tolerance	+0.025 mm/ -0.000 mm (+0.001"/ -0.000")
Mounting	52.37 mm (2.062") flexible servo ring (size 21 pancake resolver equivalent)
Axial endplay of mounting shaft (hubshaft)	± 0.25 mm
Radial runout of mating shaft (hubshaft)	Includes shaft perpendicularity to mounting surface: + 0.05 mm
Max. speed	max. 5000 rpm (continuous), max. 12 000 rpm (short term)
Acceleration	100 000 rad/s²
Bearing life	[(3.6 x 10^9) / rpm] hours, e.g. 605 000 hours at 6000 rpm
Moment of inertia	approx. 2.5 gcm²
Vibration resistance (DIN EN 60068-2-6)	2.5 g at 5 to 2000 Hz
Shock resistance (DIN EN 60068-2-27)	50 g for 6 ms duration
Operating temperature	0 °C ... +120 °C
Storage temperature	0 °C ... +120 °C
Relative humidity	90 %, non-condensing
Material shaft	Brass
Material housing	Cast aluminum
Material flange	Aluminum
Material disk	0.76 mm thick glass
Weight	approx. 90 g
Connection	Flying leads

AC-Synchronous & BLDC Motors Incremental

TECHNICAL DATA
electrical

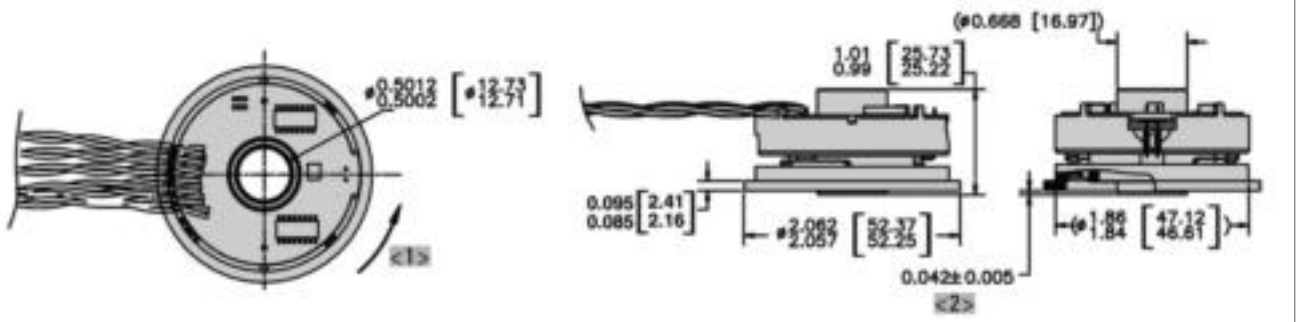
Supply voltage	DC 5 V ±10 %
Max. current w/o load	100 mA (Incremental and Commutation, w/o load)
Code	Incremental with commutation, optical
Accuracy	Incremental signals: max. ±2,5 arc-mins. Commutation signals: max. ±6 arc-mins.
Max. pulse frequency	300 kHz
Phasing	Incremental signals (A leads B): A leads B by 90° for ccw shaft rotation viewing the shaft clamp end of the encoder Commutation signals (U leads V leads W): U leads V leads W by 120° for ccw shaft rotation viewing the shaft clamp end of the encoder
Index to u channel	±1° mech. index pulse center to U channel edge
Index pulse width (N)	90° gated A and B low
Standard output versions	RS422: A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$ RS422 (commutation): U, V, W, $\overline{U}$, $\overline{V}$, $\overline{W}$ NPN-O.C. (commutation): U, V, W
Number of pulses	1024, 2048
Output current	Incremental: ±40 mA (RS 422) Commutation: 8 mA (NPN-O.C) or ±40 mA (RS 422)

ELECTRICAL CONNECTIONS

Function [1]	**Colour**
VCC	red
GND	black
$\overline{A}$	blue/black
A	blue
$\overline{B}$	green/black
B	green
$\overline{N}$	violet/black
N	violet
$\overline{U}$	brown/black
U	brown
$\overline{V}$	grey/black
V	grey
$\overline{W}$	white/black
W	white

[1] availability of function depends on version

DIMENSIONED DRAWINGS

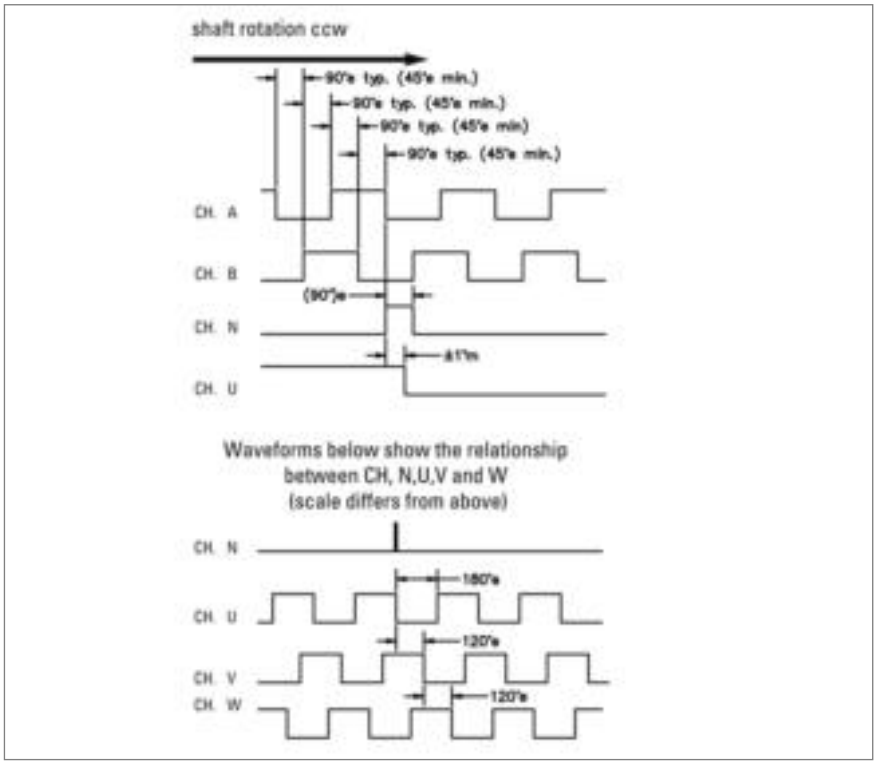


<1> ccw (counter clockwise)

<2> Shaft extension

Dimensions in inch [mm]

OUTPUT WAVEFORMS



AC-Synchronous & BLDC Motors Incremental

ORDERING INFORMATION

Type	Number of pulses [1]	Poles commutation [2]	Mounting	Electrical [3, 4, 5]	Shaft / bore	Connection
☐	☐	☐	☐	☐	☐	☐
F21	**1024** **2048**	**0** Without **6** 6 pole **8** 8 pole **C** 10 pole **E** 12 pole **I** 16 pole	**0** Servo ring size 21	**3** U inc = DC 5 V, output inc = RS422 **6** U inc = DC 5 V, output inc = RS422, U com = DC 5 V, output com = NPN-O.C. **9** U inc = DC 5 V, output inc = RS422, U com = DC 5 V, output com = RS422	**3** 12.7 mm/ through bore	**0** 16.5 cm flying leads

[1] allowed combinations see available combinations (pulses/poles)
[2] allowed combinations see available combinations (pulses/poles)
[3] U inc: Supply voltage incremental, U com: Supply voltage commutation (only if commutation selected)
[4] Code Electrical "3": only incremental, without commutation
[5] Code Electrical "6", "9": inkremental plus commutation signals

Available combinations (pulses/poles)

Pulses ppr	Number of poles					
	0	6	8	10 (=C)	12 (=E)	16 (=I)
1024	X	X	X	X	X	X
2048	X	X	X	X	X	X

AC-Synchronous & BLDC Motors Incremental

- Compact hollowshaft motor encoder, ideal for BLDC, DC servo and Stepper feedback
- Incremental + commutation
- Phased Array Technology
- Frequency response to 500 kHz
- Operating temperature up to 120 °C
- Outside diameter 50 mm
- Cable plug-in radial/axial

500, 512, 1000, 1024, 2000, 2048, 2500;
optional 4, 6 or 8 pole commutation signals

GENERAL INFORMATION

The type HC20 encoder provides high performance, cost effective feedback for stepper and servo motor controls. A compliant tether allows easy mounting with high tolerance to motor shaft movement and 20 degrees of adjustment to align the signal outputs to the shaft position.

A superior optical configuration allows for generous internal component celerance eliminating potential damage at high ambient operating temperatures. High temperature rated grease is standard for extended bearing life. No special tools are required for installation.

TECHNICAL DATA
mechanical

Housing diameter	50 mm
Mounting depth	36"
Shaft diameter	6 mm / 8 mm
Flange (Mounting of housing)	Tether
Mounting of shaft	Front clamping ring
Protection class shaft input (EN 60529)	IP50
Protection class housing (EN 60529)	IP50
Axial endplay of mounting shaft (hubshaft)	± 0.8 mm
Radial runout of mating shaft (hubshaft)	± 0.2 mm
Max. speed	max. 12 000 rpm
Operating temperature	0 °C ... +120 °C
Storage temperature	-40 °C ... +120 °C
Material housing	Aluminum
Material flange	Aluminum
Connection	Cable, axial or radial

TECHNICAL DATA
electrical

Supply voltage	DC 5 V ±10 %
Max. current w/o load	150 mA (incremental), 175 mA (incremental + commutation)
Code	Incremental with commutation, optical
Accuracy	max. 40 arc-sec.
Max. pulse frequency	500 kHz

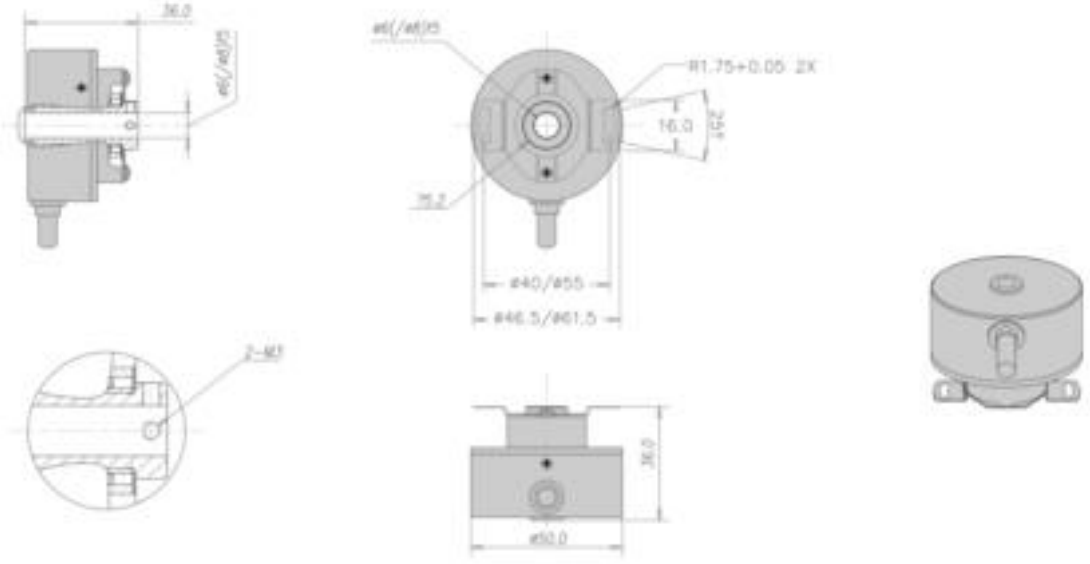
AC-Synchronous & BLDC Motors Incremental

TECHNICAL DATA
electrical (continued)

Phasing	Incremental signals (A leads B): A leads B by 90° for ccw shaft rotation viewing the shaft clamp end of Commutation signals (U leads V leads W): U leads V leads W by 120° for ccw shaft rotation viewing the shaft clamp end of the encoder
Index pulse width (N)	90° gated A and B high
Tolerance N to U	± 1° mech. index pulse center N to U channel edge
Standard output versions	NPN-O.C.: A, B, N RS422: A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$ NPN-O.C.: U, V, W RS422: U, V, W, $\overline{U}$, $\overline{V}$, $\overline{W}$

DIMENSIONED DRAWINGS

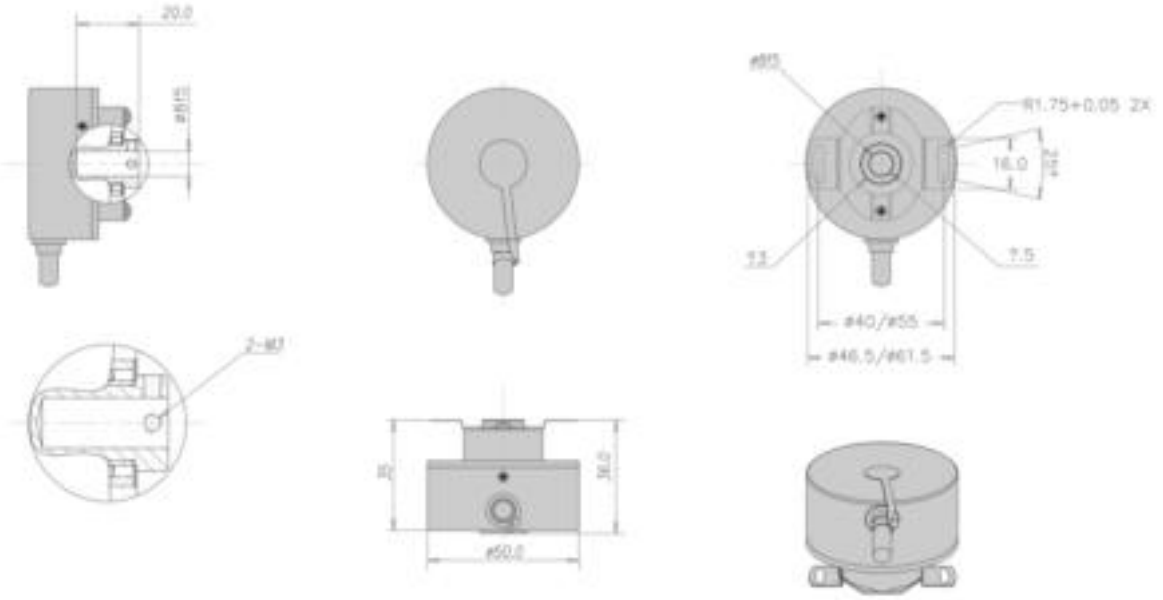
Hollow shaft



Dimensions in mm

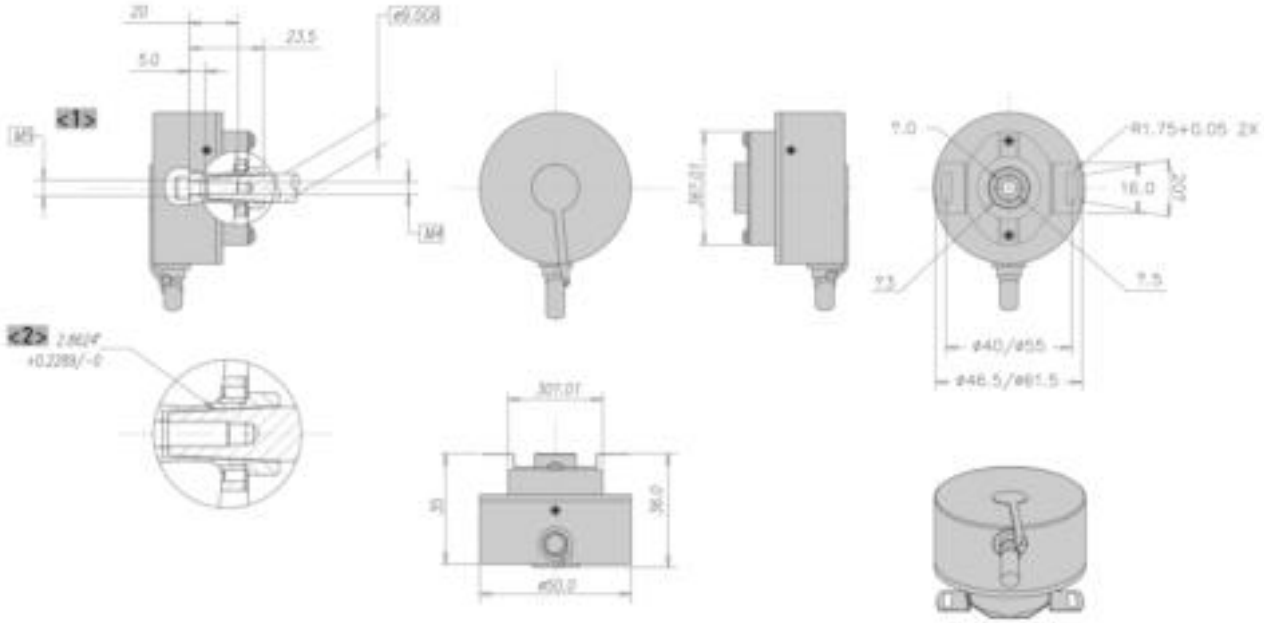
DIMENSIONED DRAWINGS (continued)

Hubshaft



Dimensions in mm

Taper shaft



<1> used for dismounting

<2> Taper

Dimensions in mm

AC-Synchronous & BLDC Motors Incremental

ORDERING INFORMATION

Type	Number of pulses [1]	Poles commutation	Mounting	Electrical [3, 4, 5, 6]	Shaft	Connection
☐	☐	☐	☐	☐	☐	☐
HC20	**0500** **1000** **1024** **2000** **2048** **2500**	**0** Without **4** 4 pole **6** 6 pole **8** 8 pole	**0** No mounting base	**0** U inc = DC 5 V, output inc = NPN-O.C. **3** U inc = DC 5 V, output inc = RS422 **6** U inc = DC 5 V, output inc = RS422, U com = DC 5 V, output com = NPN-O.C. **9** U inc = DC 5 V, output inc = RS422, U com = DC 5 V, output com = RS422	**1** Hub shaft, 6 mm **2** Hub shaft, 8 mm **0** Tapered shaft (9 mm; 1:10) **3** Through hollow shaft, 6 mm **4** Through hollow shaft, 8 mm	**A** Cable, 25 mm, radial **2** Cable, 50 mm, axial **B** Cable, 50 mm, radial **3** Cable, 76 mm, axial **C** Cable, 76 mm, radial **4** Cable, 0.1 m, axial **D** Cable, 0.1 m, radial

[1] allowed combinations see available combinations (pulses/poles)
[2] allowed combinations see available combinations (pulses/poles)
[3] U inc: Supply voltage incremental, U com: Supply voltage commutation (only if commutation selected)
[4] Code Electrical "0": only incremental, < 2 048/0 (ppr/poles)
[5] Code Electrical "3": only incremental, without commutation
[6] Code Electrical "6", "9": inkremental plus commutation signals

AC-Synchronous & BLDC Motors Incremental

RF 53 with rear tether

- Solid shaft motor encoder for BLDC and gearless elevator traction machines
- Incremental + commutation
- Up to 10 000 ppr
- Operating temperature up to 120 °C
- IP54
- Outside diameter 53 mm

NUMBER OF PULSES

500 to 10 000 ppr;
optional 4, 6, 8, 10, 12, 16, 20, 24 or 32 pole commutation signals

TECHNICAL DATA
mechanical

Housing diameter	53 mm
Shaft diameter	Cone solid shaft
Flange (Mounting of housing)	Tether
Mounting of shaft	Center bolt
Protection class shaft input (EN 60529)	IP54
Protection class housing (EN 60529)	IP54
Shaft load axial / radial	20 N / 90 N
Axial endplay of mounting shaft (hubshaft)	± 1.4 mm
Radial runout of mating shaft (hubshaft)	± 0.18 mm
Max. speed	max. 12 000 rpm (continuous), max. 5000 rpm (short term)
Vibration resistance (DIN EN 60068-2-6)	25 m/s²
Shock resistance (DIN EN 60068-2-27)	1000 m/s²
Operating temperature	-20 °C ... +120 °C
Storage temperature	-40 °C ... +120 °C
Relative humidity	95 %, non-condensing
Material shaft	Stainless Steel
Material housing	Aluminum
Weight	approx. 200 g

AC-Synchronous & BLDC Motors Incremental

TECHNICAL DATA
mechanical (continued)

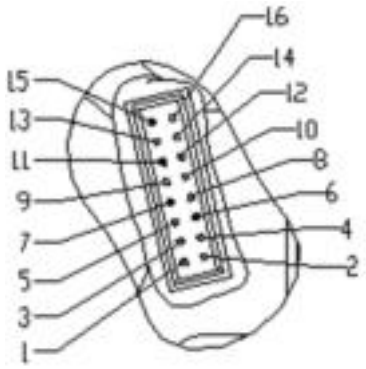
Connection	Cable Cable with Sub-D connector PCB connector

TECHNICAL DATA
electrical

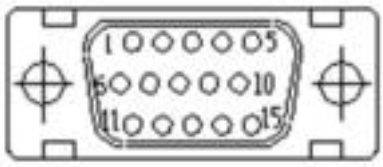
Supply voltage	DC 5 V ±10 %
Max. current w/o load	100 mA
Code	Incremental with commutation, optical
Accuracy	Incremental signals: ±2.5 arc-mins. max. (edge to edge) Commutation signals: ±6 arc-mins. max.
Max. pulse frequency	100 kHz
Phasing	Incremental signals (A leads B): 90° Commutation signals (U leads V leads W): U zu V zu W um 120°
Standard output versions	RS422: A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$ NPN-O.C.: A, B, N
Number of pulses	500 ... 10 000

ELECTRICAL CONNECTIONS
PIN NUMBERING

PCB connector



Sub-D connector

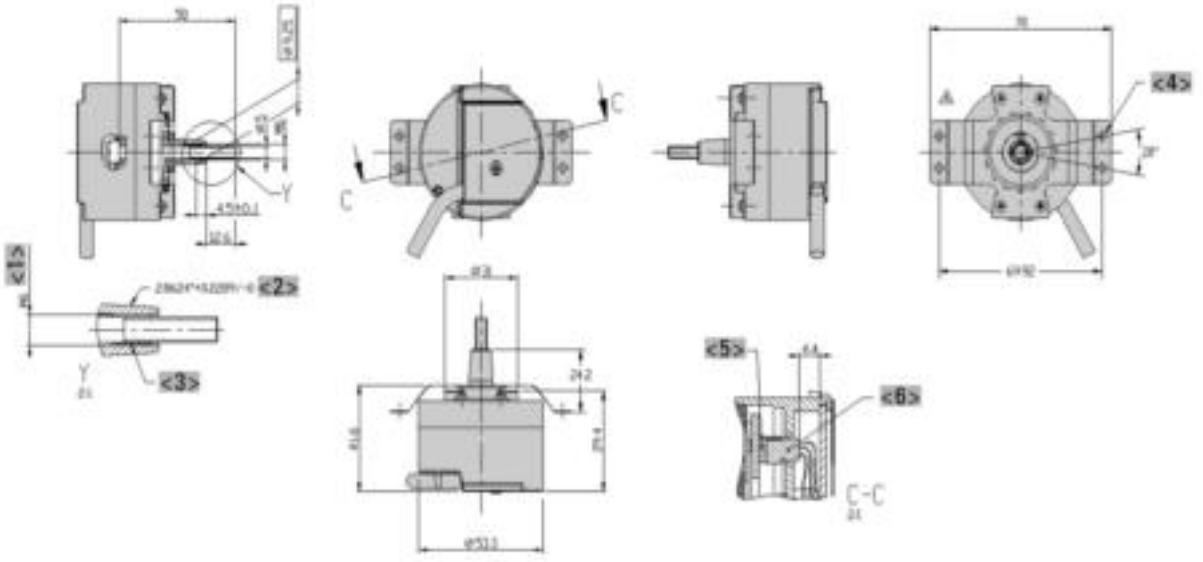


ELECTRICAL CONNECTIONS
Cable / Sub-D connector, 15 pole

PIN	Signal	Color	SUB-D 15 PIN
1	DC 5 V	red	13
2	U	brown	7
3	0 V	black	14
4	V	grey	9
5	A	blue	1
6	W	white	11
7	$\overline{A}$	blue/black	2
8	N.C.		
9	B	green	3
10	$\overline{U}$	brown/black	8
11	$\overline{B}$	green/black	6
12	$\overline{V}$	grey/black	10
13	N	violet	N.C.
14	$\overline{W}$	white/black	12
15	$\overline{N}$	violet/black	N.C.
16	N.C.		

DIMENSIONED DRAWINGS

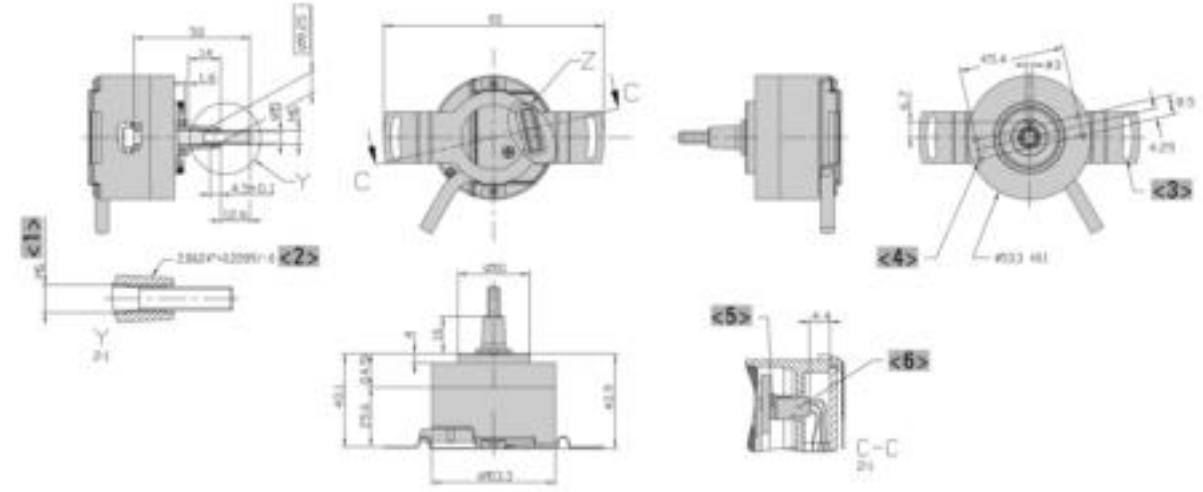
Front tether



<1> M6 (used for dismounting)
<2> Taper
<3> Internal thread M6x1 x 12 mm deep
<4> Ø 3.2 4x on a 71 mm bolt circle (B.C.)
<5> Cable connector 1
<6> Cable connector 2

Dimensions in mm

Rear tether

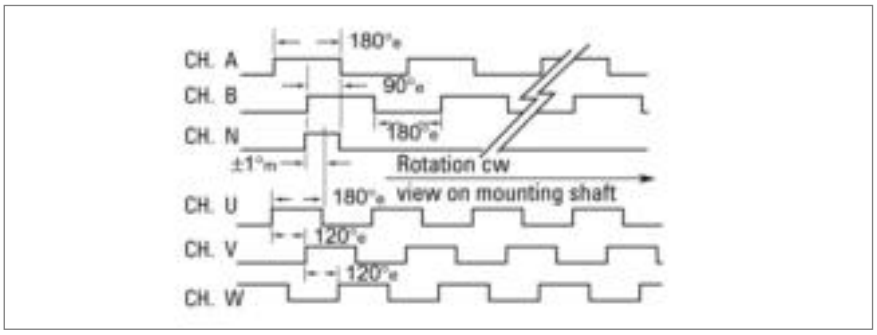


<1> M6 (used for dismounting)
<2> Taper
<3> 3.8 wide slot on a Ø 85 bolt circle (B.C.)
<4> M2.5 x 6 mm DP. (4x)
<5> Cable connector 1
<6> Cable connector 2

Dimensions in mm

AC-Synchronous & BLDC Motors Incremental

OUTPUT WAVEFORMS



ORDERING INFORMATION

Type	Number of pulses [1, 2]	Poles commutation	Spring tether	Electrical [3, 4, 5, 6]	Connection
☐	☐	☐	☐	☐	☐
RF53	**0500** **0512** **1000** **1024** **2000** **2048** **2500** **4096** **5000** **8129** **10E3** = 10 000	**0** Without **4** 4 pole **6** 6 pole **8** 8 pole **A** 10 pole **C** 12 pole **G** 16 pole **K** 20 pole **O** 24 pole **W**32 pole	**1** Spring tether rear **2** Spring tether front	**0** U inc = DC 5 V, output inc = NPN-O.C. **3** U inc = DC 5 V, output inc = RS422 **6** U inc = DC 5 V, output inc = RS422, U com = DC 5 V, output com = NPN-O.C. **9** U inc = DC 5 V, output inc = RS422, U com = DC 5 V, output com = RS422	**E** Cable, 7 m **K** Cable, 10 m **P** Cable, 15 m **1** Sub-D connector at 3 m cable **2** Sub-D connector at 5 m cable **3** Sub-D connector at 10 m cable **0** PCB connector, 16 pole

[1] Option redundant on request
[2] allowed combinations see available combinations (pulses/poles)
[3] U inc: Supply voltage incremental, U com: Supply voltage commutation (only if commutation selected)
[4] Code Electrical "0": only incremental, <= 2 048/0 (ppr/poles)
[5] Code Electrical "3": only incremental, without commutation
[6] Code Electrical "6", "9": inkremental plus commutation signals

Available combinations (pulses/poles)

	Number of poles									
Pulses ppr	0	4	6	8	10 (=A)	12 (=C)	16 (=G)	20 (=K)	24 (=O)	32 (=W)
0500	X	X	X	X	X	X				
0512	X	X	X	X						
1000	X	X	X	X	X	X				
1024	X	X	X	X		X				
2000	X	X	X	X	X	X				
2048	X	X	X	X	X	X	X	X	X	X
2500	X	X	X	X	X	X				
4096	X	X	X	X	X	X	X	X	X	X
5000	X	X	X	X	X	X				
8192	X	X	X	X	X	X	X	X	X	X
10E3 =10 000	X	X	X	X	X	X				

AC-Synchronous & BLDC Motors Absolute

- For brushless servo motors
- Light duty encoder
- Notched shaft 6 mm
- Mounting Depth: 25 mm
- Up to 17 Bit Resolution
- +120°C operating temperature
- 10,000 rpm continous operation
- BiSS or SSI interface
- Sinewave 1 Vpp
- Bandwidth 500 kHz

GENERAL INFORMATION

The AD34 is the most compact absolute encoder in class. It is available with a resolution up to 17 Bit Singleturn. The mechanical design consists of two ball bearings and a flexible torque support. The AD34 complements the ACURO-DRIVE series and is appropriate for use within BLDC servo motors with small frame sizes. The AD34 is available with a notched shaft, which saves installation time.

Notched shaft saves installation cost
Because of its innovative shaft mounting the AD34 saves work on the motor shaft. A common 6 mm bore on the motor B – side is enough. AD34's notched shaft is inserted in the B side of the motor shaft in one process step.

Fully digital control loop
The new and completely digital OptoAsic technology enables the transition to a truly digital drive system. The conventional absolute encoders still have analog sine wave signals for the feedback of speed and position data. The AD34, however, provides fully digital position data up to 17 Bit over the BiSS interface with a variable clock rate up to 10 MHz. BiSS is the only open high speed bidirectional sensor interface available on the market. Backward compatibility to most of the existing drives is realized through the variant with SSI interface together with 2048 sine –cosine periods per revolution.

Integrated diagnostic system
The AD34 has an integrated diagnostic system that controls and regulates the internal signals. Maximum motor uptime is achieved through the pre warning in case of any system error or aging effects well before they affect the function of the encoder. A code plausibility check guarantees that the output data represents always the true position. Also the operating temperature can be measured and read out with 8 Bit resolution. If programmable limits are exceeded or under run this is indicated over warn and alarm bits.

TECHNICAL DATA
mechanical

Housing diameter	37.5 mm
Shaft diameter	6 mm (Notched Shaft)
Flange (Mounting of housing)	Tether
Protection class shaft input (EN 60529)	IP40
Protection class housing (EN 60529)	IP40
Axial endplay of mounting shaft (hubshaft)	± 0.5 mm
Radial runout of mating shaft (hubshaft)	± 0.05 mm

AC-Synchronous & BLDC Motors Absolute

TECHNICAL DATA
mechanical (continued)

Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Torque	0.01 Ncm
Moment of inertia	ca. 2.5 x 10^{-6} kgm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-15 °C ... +120 °C
Storage temperature [1]	-15 °C ... +85 °C
Weight	approx. 80 g (ST)
Connection	Cable, radial PCB connector, 12 pole

[1] due to packing

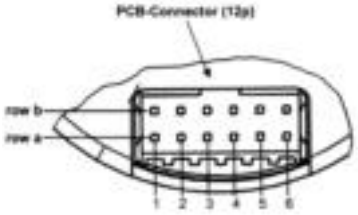
TECHNICAL DATA
electrical

Supply voltage	DC 5 V -5 %/+10 % or DC 7 - 30 V
Max. current w/o load	50 mA
Resolution singleturn	12 -17 Bit
Output code	Gray
Drives	Clock and Data / RS422
Incremental signals optional	Sinus-Cosinus 1 Vpp
Number of pulses	2048
3dB limiting frequency	500 kHz
Absolute accuracy	±35"
Repeatability	±7"
Alarm output	Alarm bit (SSI Option), warning bit and alarm bit (BiSS)

ELECTRICAL CONNECTIONS
PCB connector, 12 pole

Color	PIN	Signals
grey	1a	$\overline{\text{Data}}$
white/green	2a	A +
black	3a	0 V Sensor
red/blue	4a	B +
green	5a	$\overline{\text{Clock}}$
violet	6a	5 V Sensor
white	1b	DC 5 V/ 7 - 30 V
yellow	2b	Clock
grey/pink	3b	B -
brown	4b	0 V (U_N)
brown/green	5b	A -
pink	6b	Data

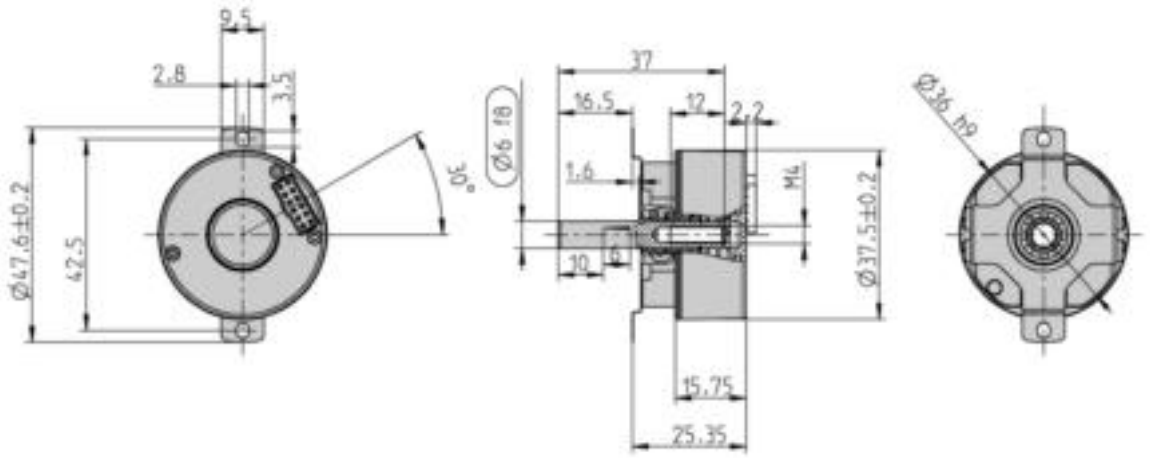
CONNECTION ENCODER SIDE



12 pin PCB connector
manufacture Berg, type Minitek

DIMENSIONED DRAWINGS

Singleturn



Dimensions in mm

ORDERING INFORMATION

Type	Resolution	Supply voltage [1]	Flange, Protection, Shaft	Interface	Connection
AD34	**0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0017** 17 Bit ST	**A** DC 5 V **E** DC 7 - 30 V	**U.0N** Spring tether, IP40, 6mm Notched Shaft	**BI** BiSS **SG** SSI Gray **SC** SSI Gray (+SinCos 1Vpp)	**0** PCB connector, 12 pole **B** PCB connector, 12 pole, with mating connector and 0.5 m cable

[1] No inverse-polarity protection for 5 V power supply

Motor Feedback AD 35

AC-Synchronous & BLDC Motors Absolute

- Shortes absolute encoder world wide
- Mounting depth: 23.65 mm
- Hub shaft 8 mm
- Resolution up to 22 Bit Singleturn
- +120°C operating temperature
- 10,000 rpm continous operation
- BiSS or SSI interface
- Bandwidth 500kHz

GENERAL INFORMATION

Hengstler presents the shortest hollowshaft encoder world wide: The AD35. It is available with a 8 mm hub shaft and and a resolution up to 22 Bit Singleturn. The mechanical design consists of two ball bearings and a flexible torque support. The AD35 complements the ACURO-DRIVE series and is appropriate for use within BLDC servo motors with small frame sizes.

Further fields of Application:
- Medical
- Measuring instrument
- Military
- Robotics

Fully digital control loop
The new and completely digital OptoAsic technology enables the transition to a truly digital drive system. The conventional absolute encoders still have analog sine wave signals for the feedback of speed and position data. The AD35, however, provides fully digital position data up to 22 Bit over the BiSS interface with a variable clock rate up to 10 MHz. BiSS is the only open high speed bidirectional sensor interface available on the market. Backward compatibility to most of the existing drives is realized through the variant with SSI interface together with 2048 sine –cosine periods per revolution.

Integrated diagnostic system
The AD35 has an integrated diagnostic system that controls and regulates the internal signals. Maximum motor uptime is achieved through the pre warning in case of any system error or aging effects well before they affect the function of the encoder. A code plausibility check guarantees that the output data represents always the true position. Also the operating temperature can be measured and read out with 8 Bit resolution. If programmable limits are exceeded or under run this is indicated over warn and alarm bits.

TECHNICAL DATA
mechanical

Housing diameter	37.5 mm
Shaft diameter	8 mm (Hubshaft)
Flange (Mounting of housing)	Tether
Protection class shaft input (EN 60529)	IP40
Protection class housing (EN 60529)	IP40
Axial endplay of mounting shaft (hubshaft)	± 0.5 mm

TECHNICAL DATA
mechanical (continued)

Radial runout of mating shaft (hubshaft)	± 0.05 mm
Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Torque	0.01 Ncm
Moment of inertia	ca. 2.5 x 10^{-6} kgm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-15 °C ... +120 °C
Storage temperature [1]	-15 °C ... +85 °C
Material housing	Plastic
Weight	approx. 80 g (ST)
Connection	Cable, radial PCB connector, 12 pole

[1] due to packing

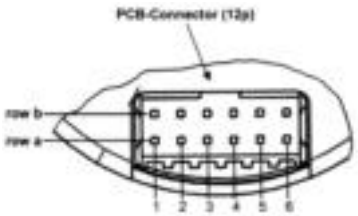
TECHNICAL DATA
electrical

Supply voltage	DC 5 V -5 %/+10 % or DC 7 - 30 V
Max. current w/o load	50 mA
Resolution singleturn	12 - 22 Bit
Resolution multiturn	12 Bit
Output code	Gray
Drives	Clock and Data / RS422
Incremental signals optional	Sinus-Cosinus 1 Vpp
Number of pulses	2048
3dB limiting frequency	500 kHz
Absolute accuracy	±35"
Repeatability	±7"
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)

ELECTRICAL CONNECTIONS
PCB connector, 12 pole

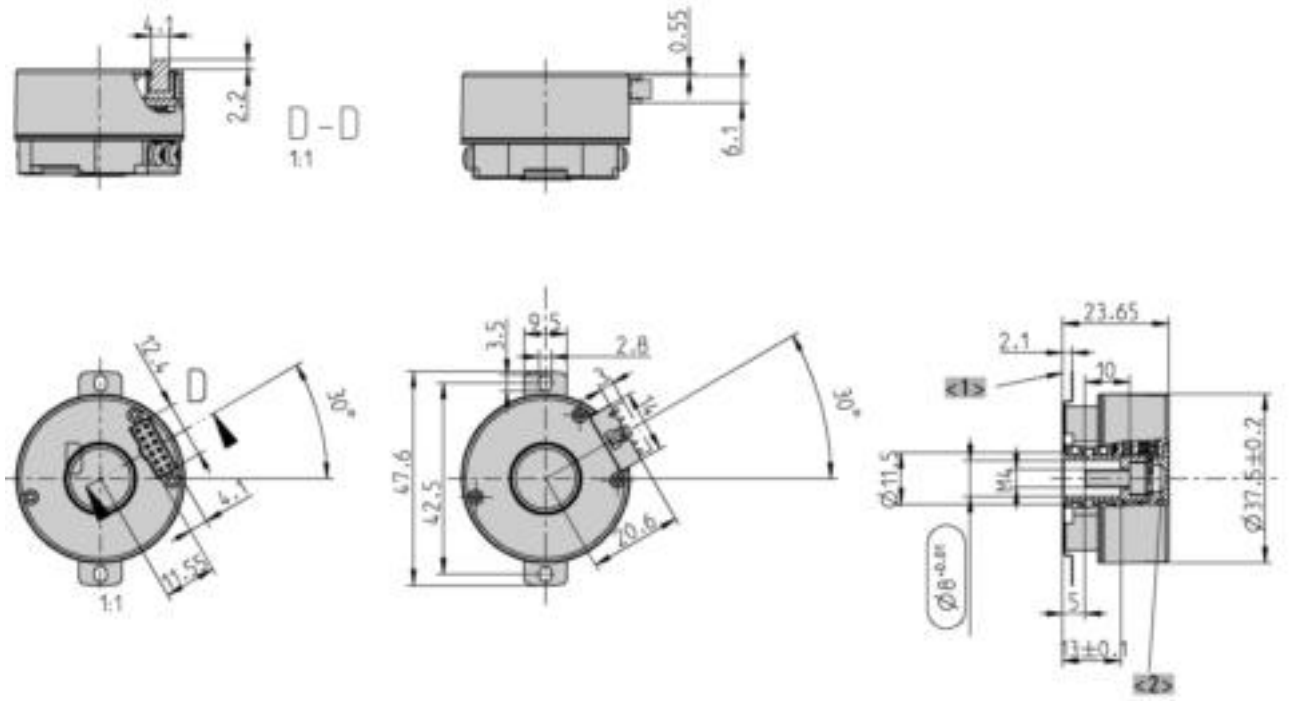
Color	PIN	Signals
grey	1a	$\overline{\text{Data}}$
white/green	2a	A +
black	3a	0 V Sensor
red/blue	4a	B +
green	5a	$\overline{\text{Clock}}$
violet	6a	5 V Sensor
white	1b	DC 5 V/ 7 - 30 V
yellow	2b	Clock
grey/pink	3b	B -
brown	4b	0 V (U_N)
brown/green	5b	A -
pink	6b	Data

CONNECTION ENCODER SIDE



12 pin PCB connector
manufacture Berg, type Minitek

DIMENSIONED DRAWINGS



<1> Basis shaft
<2> Screw DIN EN ISO 4762, mounting torque 2 Nm

Dimensions in mm

ORDERING INFORMATION

Type	Resolution	Supply voltage [1]	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AD35	**0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0017** 17 Bit ST **0019** 19 Bit ST (BiSS) **0022** 22 Bit ST (BiSS)	**A** DC 5 V **E** DC 7 - 30 V	**F.0R** Spring tether, IP40, 8 mm hub shaft	**BI** BiSS **SG** SSI Gray **SC** SSI Gray (+SinCos 1Vpp)	**0** PCB connector, 12 pole **B** PCB connector, 12 pole, with mating connector and 0.5 m cable

[1] No inverse-polarity protection for 5 V power supply

AC-Synchronous & BLDC Motors Absolute

- For brushless servo motors
- Resolver size 15 compatible
- Through hollow shaft 8 mm
- 19 Bit Singleturn + 12 Bit Multiturn
- +120°C operating temperature
- 10,000 rpm continous operation
- Optical encoder with a true geared multiturn
- BiSS or SSI interface
- Sinewave 1 Vpp
- Bandwidth 500 kHz

GENERAL INFORMATION

The AD36 is an absolute encoder with a true geared Multiturn, optical sensing technology and 36 mm diameter. Unique is the through hollow shaft which enables an assembly that is compatible with resolver size 15. The mechanical design consists of two ball bearings and a flexible torque support. The AD36 complements the **ACURO-DRIVE** series and is appropriate for use within BLDC servo motors with small frame sizes.

Fully digital control loop
The new and completely digital OptoAsic technology enables the transition to a truly digital drive system. The conventional absolute encoders still have analog sine wave signals for the feedback of speed and position data. The AD36, however, provides fully digital position data up to 19 Bit (Singleturn) and 12 Bit (Multiturn) over the BiSS interface with a variable clock rate up to 10 MHz. BiSS is the only open high speed bidirectional sensor interface available on the market. Backward compatibility to most of the existing drives is realized through the variant with SSI interface together with 2048 sine –cosine periods per revolution.

Integrated diagnostic system
The AD36 has an integrated diagnostic system that controls and regulates the internal signals. Maximum motor uptime is achieved through the pre warning in case of any system error or aging effects well before they affect the function of the encoder. A code plausibility check guarantees that the output data represents always the true position. Also the operating temperature can be measured and read out with 8 Bit resolution. If programmable limits are exceeded or under run this is indicated over warn and alarm bits.

TECHNICAL DATA
mechanical

Housing diameter	37.5 mm
Shaft diameter	8 mm (Through hollow shaft) 8 mm (Hubshaft)
Flange (Mounting of housing)	Tether
Protection class shaft input (EN 60529)	IP40
Protection class housing (EN 60529)	IP40
Axial endplay of mounting shaft (hubshaft)	± 0.5 mm
Radial runout of mating shaft (hubshaft)	± 0.05 mm
Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Torque	0.01 Ncm

TECHNICAL DATA
mechanical (continued)

Moment of inertia	ca. 2.5 x 10^{-6} kgm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-15 °C ... +120 °C
Storage temperature [1]	-15 °C ... +85 °C
Weight	approx. 80 g (ST) / 130 g (MT)
Connection	Cable, radial PCB connector, 12 pole

[1] due to packing

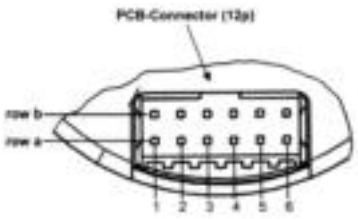
TECHNICAL DATA
electrical

Supply voltage	DC 5 V -5 %/+10 % or DC 7 - 30 V
Max. current w/o load	50 mA (ST), 100 mA (MT)
Resolution singleturn	12 - 19 Bit (BiSS) 12 - 17 Bit (SSI)
Resolution multiturn	12 Bit
Output code	Gray
Drives	Clock and Data / RS422
Incremental signals optional	Sinus-Cosinus 1 Vpp
Number of pulses	2048
3dB limiting frequency	500 kHz
Absolute accuracy	±35"
Repeatability	±7"
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)

ELECTRICAL CONNECTIONS
PCB connector, 12 pole

Color	PIN	Signals
grey	1a	$\overline{\text{Data}}$
white/green	2a	A +
black	3a	0 V Sensor
red/blue	4a	B +
green	5a	$\overline{\text{Clock}}$
violet	6a	5 V Sensor
white	1b	DC 5 V/ 7 - 30 V
yellow	2b	Clock
grey/pink	3b	B -
brown	4b	0 V (U_N)
brown/green	5b	A -
pink	6b	Data

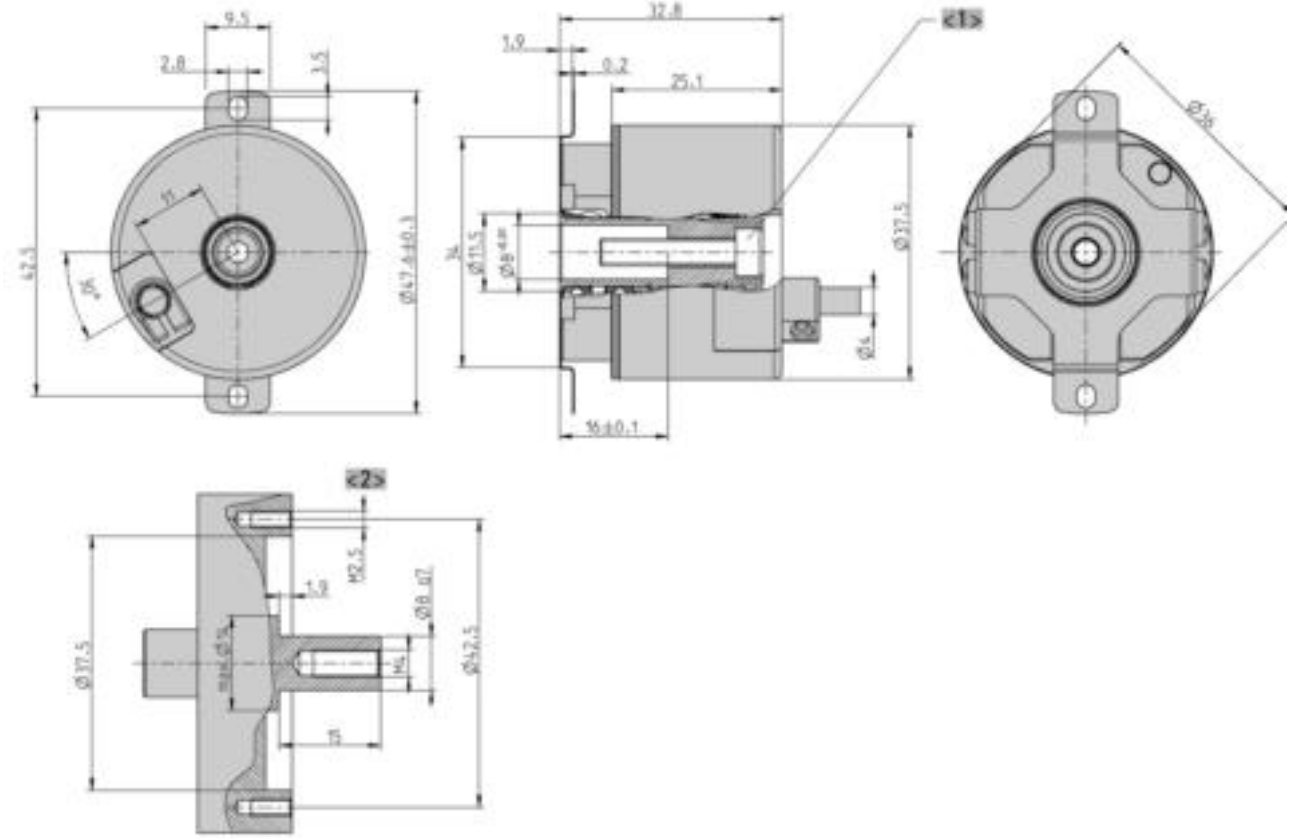
CONNECTION ENCODER SIDE



12 pin PCB connector
manufacture Berg, type Minitek

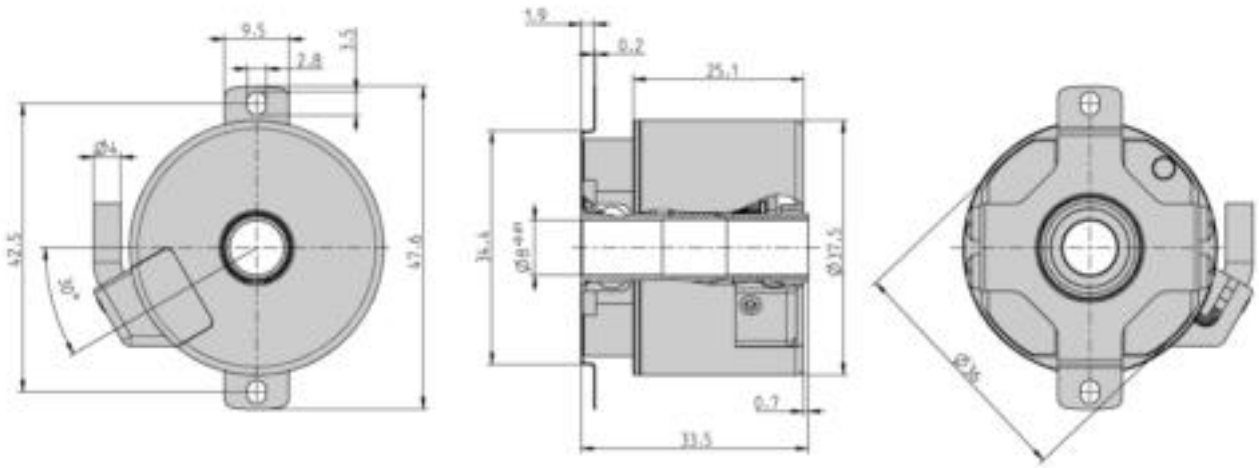
DIMENSIONED DRAWINGS

Hubshaft



<1> ISO 4762 M4x20 <2> Mounting hollow shaft Dimensions in mm

Through hollow shaft



Dimensions in mm

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AD36	**0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0017** 17 Bit ST **0019** 19 Bit ST (BiSS) **1213** 12 Bit MT + 13 Bit ST **1217** 12 Bit MT + 17 Bit ST **1219** 12 Bit MT + 19 Bit ST (BiSS)	**A** DC 5 V **E** DC 7 - 30 V	**F.0C** Spring tether, IP40, 8 mm trough hollow shaft **F.0R** Spring tether, IP40, 8 mm hub shaft	**BI** BiSS **SC** SSI Gray (+SinCos 1Vpp)	**0** PCB connector, 12 pole **B** PCB connector, 12 pole, with mating connector and 0.5 m cable

ACCESSORIES

see chapter "Accessories", starting page 322

AC-Synchronous & BLDC Motors Absolute

- For brushless servo motors
- All-digital and highspeed
- +120°C operating temperature
- 10,000 rpm continous operation
- Optical encoder with a true geared multiturn
- BiSS or SSI interface
- Option Sinewave 1 Vpp: Harmonic distortion less than 1%
- Bandwidth 500 kHz

GENERAL INFORMATION

The AD58 is an absolute encoder with a true geared Multiturn and optical sensing technology: The mechanical design consists of two ball bearings and a flexible torque support. The AD58 is ideally suited for integration into BLDC servo motors for demanding applications such as CNC precision machining and printing in professionell quality. Through its low current consumption the AD58 is contributing to lowering cost of ownership.

Fully digital control loop
The new and completely digital OptoAsic technology enables the transition to a truly digital drive system. The conventional absolute encoders still have analog sine wave signals for the feedback of speed and position data. The AD 58, however, provides fully digital position data up to 22 Bit (Singleturn) and 12 Bit (Multiturn) over the BiSS interface with a variable clock rate up to 10 MHz. This corresponds a singleturn resolution of morethan 4 million measured steps.

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	10 mm (Cone hollow shaft) 10 mm (Cone solid shaft)
Flange (Mounting of housing)	Tether
Protection class shaft input (EN 60529)	IP40
Protection class housing (EN 60529)	IP40
Axial endplay of mounting shaft (hubshaft)	± 0.5 mm
Radial runout of mating shaft (hubshaft)	± 0.1 mm
Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Torque	0.01 Ncm
Moment of inertia	ca. 3.8 x 10^{-6} kgm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-15 °C ... +120 °C
Storage temperature [1]	-15 °C ... +85 °C
Weight	approx. 260 g (ST) / 310 g (MT)
Connection	PCB connector, 12 pole

AC-Synchronous & BLDC Motors Absolute

TECHNICAL DATA
mechanical (continued)

[1] due to packing

TECHNICAL DATA
electrical

Supply voltage	± 10% DC 5 V or DC 10 - 30 V
Max. current w/o load	50 A (ST), 100 A (MT)
Resolution singleturn	13 Bit (SSI) max. 22 Bit (BiSS)
Resolution multiturn	12 Bit
Output code	Binary, Gray
Incremental signals optional	Sinus-Cosinus 1 Vpp
Number of pulses	2048
3dB limiting frequency	500 kHz
Absolute accuracy	±35"
Repeatability	±7"
Parametrization	Resolution, Code type, Direction, Warning, Alarm
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)

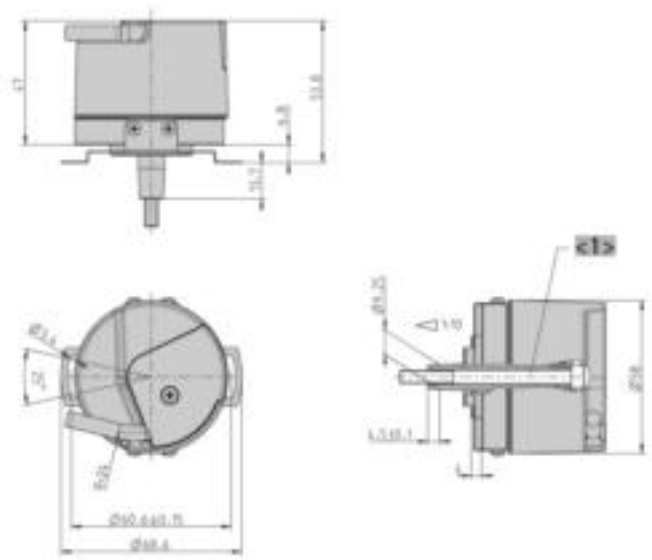
ELECTRICAL CONNECTIONS
PCB connector, 12 pole

Colour	PIN	Signals
violet	1a	$\overline{\text{Data}}$
green	2a	A+
brown/green	3a	0 V Sensor
blue	4a	B+
brown	5a	$\overline{\text{Clock}}$
red//blue	6a	5 V Sensor
green/pink	1b	DC 5 V/ 7 -30 V
white	2b	Clock
red	3b	B-
white/green	4b	0 V (U_N)
yellow	5b	A-
black	6b	Data

CONNECTION ENCODER SIDE

12 pin PCB connector
manufacture Berg, type Minitek
Screen is connected over a
length of 10 mm with
encoder housing.

DIMENSIONED DRAWINGS



<1> Central mounting screw, Singleturn: DIN 912 M5x50
<1> Central mounting screw, Multiturn: DIN 912 M5x65

Shaft code: "K"
Flange code: "T" (with tether), "O" (without tether)

Dimensions in mm

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AD58	**0013** 13 Bit ST **0022** 22 Bit ST (BiSS) **1213** 12 Bit MT + 13 Bit ST **1222** 12 Bit MT + 22 Bit ST (BiSS)	**A** DC 5 V **E** DC 10 - 30 V	**1.0K** Spring tether, IP40, cone 10 mm	**BI** BiSS **SC** SSI Gray (+SinCos 1Vpp)	**0** PCB connector, 12 pole **B** PCB connector, 12 pole, with mating connector and 0.5 m cable

ACCESSORIES

see chapter "Accessories", starting page 322

AC-Synchronous & BLDC Motors Sine-wave

- Wide operating temperature range of –15 °C up to +120 °C, therefore optimum use of motor capacity
- High limiting frequency with excellent signal quality, allowing highest peak speeds and reduced non-productive time wastage
- Excellent immunity to interference (EN 61000-4-4, Class 4)
- High functional safety due to signal control and system monitoring (under-voltage, pollution, disc damage, end of LED service life)
- High signal quality through control and error compensation

TECHNICAL DATA
mechanical

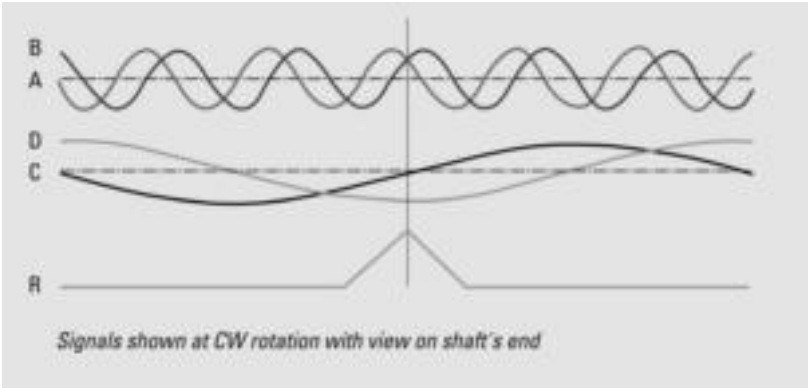
Housing diameter	53 mm
Shaft diameter	Cone 1/10
Protection class shaft input (EN 60529)	IP40
Protection class housing (EN 60529)	IP40
Shaft load axial / radial	for tapered solid shaft: 20 N / 90 N
Axial endplay of mounting shaft (hubshaft)	± 0.5 mm
Radial runout of mating shaft (hubshaft)	± 0.1 mm
Max. speed	max. 12000 rpm (continuous), max. 15000 rpm (short term)
Torque	≤ 1 Ncm
Vibration resistance (DIN EN 60068-2-6)	≤ 100 m/s² (10 ... 2,000 Hz)
Shock resistance (DIN EN 60068-2-27)	≤ 1,000 m/s² (6 ms)
Operating temperature	-15 °C ... +120 °C
Storage temperature	-20 °C ... +80 °C
Material housing	Aluminum
Weight	approx. 170 g
Connection	PCB connector and cable

TECHNICAL DATA
electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage	DC 5 V ±10 %
Max. current w/o load	120 mA
Reference signal R	> 0.4 V (1 pulse per revolution)
Commutation signals C, D	Sine - Cosine 1 Vpp (1 period per rev.)
Incremental signals optional	Sinus-Cosinus 1 Vpp
Number of pulses	2048
3dB limiting frequency	500 kHz
Absolute accuracy	±35"
Repeatability	±7"

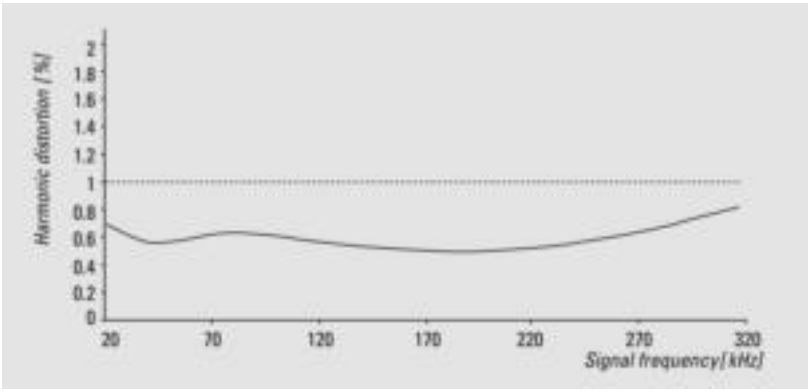
AC-Synchronous & BLDC Motors Sine-wave

S 21 SIGNALS



The incremental signals A and B and the zero signal R are differential voltage signals. The differential signal level is 1 Vpp. The zero signal appears once per revolution and reaches its maximum value at the angle where the amplitudes of A and B Signals are equal. The coarse tracks C and D deliver one sinewave period per revolution and are utilized to determine the absolute rotor position of Brushless DC motors for startup commutation. All signals have a DC offset of 2.5 V.

S 21 SIGNAL QUALITY



The quality of the servo loop is determined to a large extent by the absence of harmonics in the encoder's sinewave signals, particularly at low speed. In order to achieve high interpolation factors in the sequencing control, the incremental sinewave signals A and B are available with a harmonic distortion significantly under 1% throughout the specified temperature range. This delivers excellent synchronism and a high level of positional accuracy with servo axes.

AC-Synchronous & BLDC Motors Sine-wave

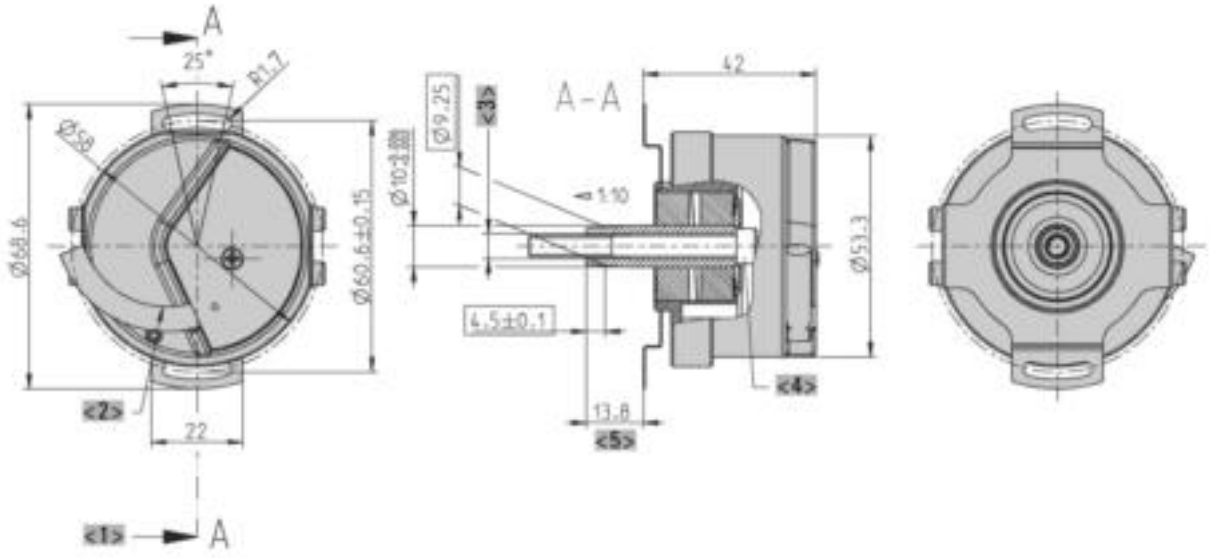
ELECTRICAL CONNECTIONS

PCB connector

Colour	PIN	Signals
brown	1a	C-
grey/pink	1b	U_B
yellow	2a	A-
black	2b	D+
green/brown	3a	0 V Sense
blue	3b	B+
pink	4a	R-
grey	4b	R+
red	5a	B-
white/green	5b	GND
violet	6a	D-
green	6b	A+
red/blue	7a	DC 5 V Sense
white	7b	C+

DIMENSIONED DRAWINGS

Tapered solid shaft



<1> Shaft exterior
<2> Cable bending radius R ≥ 24mm (for fixed installation)
<3> M6 jack-out thread
<4> Central mounting screw DIN 912 M5x20
<5> Mounting dimensions spring thether on shaft

Dimensions in mm

ORDERING INFORMATION

	Ordering code
Tapered solid shaft with mounting support	0 548 011

ACCESSORIES

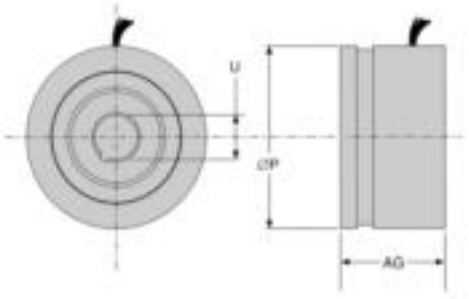
see chapter "Accessories", starting page 322

- Provide accurate, absolute position feedback
- Rugged and able to withstand high shock and vibration levels
- Impervious to most industrial contaminant and temperature extremes
- High temperature up to 220°C
- Operation in non electroconductive liquids possible
- Maintenance-free (brushless)
- Aging resistant (no electronic components)
- Low-priced
- Applications: Servo drives, medical technologie (sterilisable), robots, gearless drives, military engineering

GENERAL INFORMATION

Brushless resolvers are the ideal rotor position indicators for the position feedback of brushless motors, robots or direct drives. They are robust, reliable and suitable for high operating temperatures until 155 °C and resistant to most process liquids, contaminations, radiation and EMC-Interferences as well as highly shock-proof and vibration-resistant. These resolvers deliver absolute position information and can be combined with low cost integrated circuits, to generate an up to 16 bit digital position-value or, to produce an emulated incremental encoder output signal, as well as direction and analogue speedsignals.

DIMENSIONED DRAWINGS



OVERVIEW TYPES (models)

Type (model)	AG	P	U maximal
10BRCX	16.5 mm	26.5 mm	6.0 mm
15BRCX	25.4 mm	36.8 mm	12.0 mm
21BRCX	31.8 mm	52.4 mm	20.3 mm
31BRCX	31.8 mm	77.5 mm	40.0 mm
55BRCX	31.8 mm	139.7 mm	92.7 mm

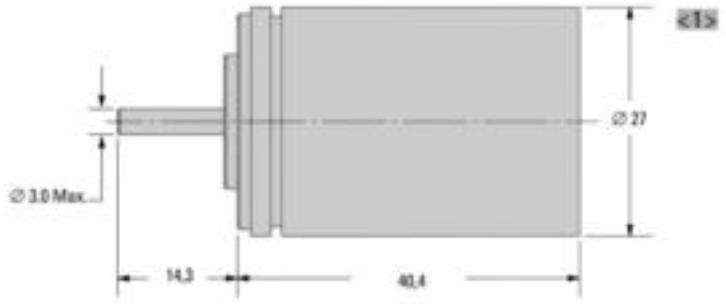
Ordering information:
Since resolvers are produced according to special applications, the production takes place only in big batch sizes. For replacement needs, please contact your drive-manufacturer.

Housed Resolvers Series R11

- Brushless construction
- Rugged housing
- Maintenance free
- Able to withstand high shock and vibration levels
- Insensitive to most industrial contaminant and temperature extremes
- High temperature up to 115°C

Housed Resolvers distinguish themselves through high reliability in harsh environments, operating temperatures up to 155 °C and high shock resistance. Based on their brushless design they are the ideal supplement to brushless servo motors. The accuracy as well as the repeatability are excellent. These resolvers are equipped with precision bearings and are maintenance-free. They are also the shortest resolvers, that are available on the market.

DIMENSIONED DRAWINGS



<1> 6X #28 AWG (ET) leads 10" min.length

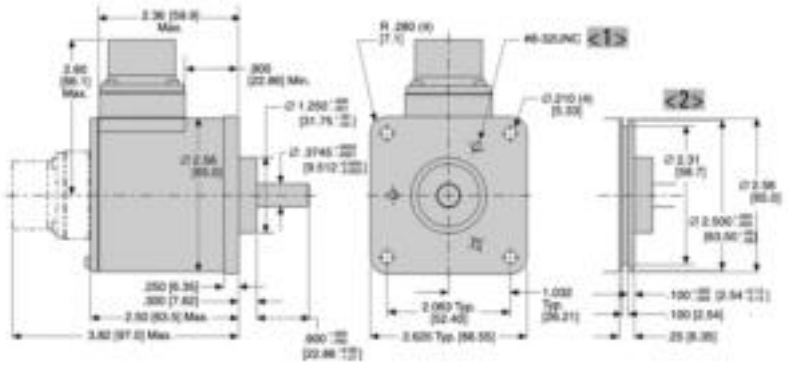
Dimensions in mm

Housed Resolvers Industry Series R25

- Rugged housing with IP65
- Able to withstand high shock and vibration levels
- Insensitive to most industrial contaminant and temperature extremes
- High temperature up to 125°C
- Flange- and servo-mount styles

Industry resolvers possess especially robust casings with protection class IP65. They are especially suitable for the use with high temperatures (+125 °C in long-term operation), and offer extraordinary values of vibration and shock resistance (40g as well as 200g), as well as noise immunity. The user is flexible in the application because of the corrosion resistant versions for integration or extension , the connection could easily be done by Standard MS-style connectors. The accuracy has a spread of ± 7 up to ± 200 arc-minutes.

DIMENSIONED DRAWINGS



0.18 DP (3) on Ø 1.875 BC, 120 apart (Typical of both mounting styles)

Optional Servo Mounting

Dimensions in inch [mm]