HENGSTLER

Your Solution ...

AUTOMATION

... for speed and position feedback

Encoders, as versatile as your application.

Hengstler offers a complete portfolio of incremental and absolute single- or multiturn encoders. Depending on performance levels various options are available:

- optical as well as magnetic encoders
- high resolutions
- 30 mm to 80 mm outside diameter
- hollow and solid shaft types
- standard electrical and mechanical interfaces
- Encoders with stainless housing and for hazardous environments

With Hengstler you'll find a solution for any kind of general machinery and factory automation applicaton. In total you can choose between up to 2 Mio variants.

MOTORFEEDBACK

... for all performance classes

Your application defines the type.

Hengstler provides a complete portfolio of Motorfeedback systems for your entire motor range, starting from standard electric and servo motors to DC motor systems, fitting B-side shaft diameters from 6 up to 50 mm.

For asynchronous motors and elevators the offering comprises incremental and absolute hollow shaft encoders in singleturn and multiturn versions.

For AC servo motors there is an extensive range of feedback products available:

- for highest precision and dynamics requirement: Sine-wave and absolute encoder series
- resolvers: size 10, 15 and 21
- for direct block commutation: incremental comcoders

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

HENGSTLER

Your solution ...

WIND ENERGY

... for all climate areas

Encoders built for increasing efficiency of wind plants, Onshore and Offshore.

Hengstler offers long-standing experience in the wind energy sector and optimized solutions for your wind power stations. Our encoders used for pitch and yaw control as well as for generator speed feedback come with features like:

- wide temperature ranges from -40°C ... +100°C
- reliable operation in "Cold Climate Areas"
- sea water resistant housing materials for offshore plants
- incremental or absolute single and multi turn versions
- integrated diagnostic functions

Hengstler encoders are an ideal and reliable solution for all climate areas.

HEAVY DUTY

... for toughest applications

Extreme robust Encoders for harsh and hazardous environments.

Hengstler offers a series of incremental and absolut encoders in compact size that provide the ruggesdness of big magnetic ring kit encoders. Choose from a growing line of Heavy Duty encoders designed for reliable operation in extraordinary environments like:

- extreme temperatures from -40°C to +100°C,
- extreme shock and vibration resistance,
- wash down protection (Protection class up to IP69k),
- ATEX certified for hazordous environments,
- extreme corrosion resistant (offshore, maritme)

Hengstler Heavy Duty encoders provides you with the best solution for applications with extreme requirements.

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Technical Basics

NorthStar™

Type	HD 20	HD 25	HSD 25
Special features	■ Single or Dual output ■ ATEX Certfication available for Intrinsically Safe application ■ High Resolution Unbreakable Disk ■ Industrial Duty Connector ■ NEMA 4X / IP67 Rated ■ Nickel or Stainless Steel Housing available	■ Single or Dual output ■ Optional high current line driver ■ ATEX Certfication available for Intrinsically Safe application ■ High Resolution Unbreakable Disk ■ Industrial Duty Connector ■ NEMA 4X / IP67 Rated ■ Nickel or Stainless Steel Housing available	■ Single or Dual output ■ ATEX Certfication available for Intrinsically Safe application ■ High Resolution Unbreakable Disk ■ Industrial Duty Connector ■ NEMA 4X, 6 / IP66, 67 Rated ■ Nickel or Stainless Steel Housing available
Technical Data - mechanical			
Housing diameter	52.3 mm	67.3 mm	58.93 mm
Shaft diameter	9.52 mm ... 10 mm (Solid shaft)	9.525 mm ... 10 mm (Solid shaft)	9.525 mm ... 19.05 mm (Hubshaft)
Flange (Mounting of housing)	Square flange	Square flange	Tether
Protection class shaft input	NEMA 4X or IP67	NEMA 4X or IP67	NEMA 4X or NEMA 6 IP66 or IP67
Protection class housing	NEMA 4X or IP67	NEMA 4X or IP67	NEMA 4X or NEMA 6 IP66 or IP67
Shaft load axial / radial	max.: 440 N / 440 N	max.: 440 N / 440 N	
Max. speed	max. 6000 rpm	max. 6000 rpm	
Vibration resistance	200 m/s² (5 ... 2000 Hz)	200 m/s² (5 ... 2000 Hz)	200 m/s² (5 ... 2000 Hz)
Shock resistance	500 m/s² (11 ms)	500 m/s² (11 msec)	500 m/s² (11 sec)
Operating temperature	-40 °C ... +100 °C ATEX: -40 °C ... +80 °C	-40 °C ... +100 °C ATEX: -40 °C ... +80 °C	-40 °C ... +100 °C ATEX: -40 °C ... +80 °C
Connection	MS / M12	MS / M12	MS / M12
Technical Data - electrical			
Supply voltage	DC 5 - 26 V		
Current w/o load typ.	max. 50 mA	max. 50 mA	max. 50 mA
Max. pulse frequency	125 kHz	125 kHz	125 kHz
Output	RS422 / Push-Pull / NPN-O.C.	RS422 / Push-Pull / NPN-O.C.	RS422 / Push-Pull / NPN-O.C.
Pulse shape	Square wave	Square wave	Square wave
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Heavy Duty - Inkremental

NorthStar™

Type	HSD 37	HSD 38	HSD 44
Special features	■ Single or Dual Output ■ Double-Sealed Housing ■ ATEX Certification for Intrinsically Safe Applications ■ High Resolution Unbreakable Disk ■ Electrically and Thermally Isolated ■ Industrial Duty Connector ■ NEMA 4X, 6 / IP66, 67 Rated ■ Rugged Cast-Aluminum Housing ■ Stainless Steel Housing Available	■ Double-Sealed Housing ■ High Resolution Unbreakable Disk ■ Electrically and Thermally Isolated ■ Industrial Duty Connector ■ NEMA 4X, 6 / IP66 or IP67 Rated ■ Rugged Cast-Aluminum Housing	■ Sealed against dust, oil, grease, liquids, vapor and mud ■ Designed for high shock and vibration applications ■ Electrically isolated from motor shaft ■ Rugged cast-aluminum housing ■ Advanced ASIC technology and optics ■ Easy, hex wrench installation ■ High temperature range: -40 ... +100°C
Technical Data - mechanical			
Housing diameter	95.25 mm	96.52 mm	112 mm
Mounting depth			60 mm
Shaft diameter	12 mm ... 22.225 mm (Through hollow shaft)	12 mm ... 22.225 mm (Hubshaft)	16 mm (Flexible coupling)
Flange (Mounting of housing)	Tether	Tether	
Protection class shaft input	NEMA 4X or NEMA 6 IP66 or IP67	NEMA 4X or NEMA 6 IP66 or IP67	NEMA 6 IP67
Protection class housing	NEMA 4X or NEMA 6 IP66 or IP67	NEMA 4X or NEMA 6 IP66 or IP67	
Max. speed			max. 6000 rpm
Vibration resistance	200 m/s² (5 ... 2000 Hz)	200 m/s² (5 ... 2000 Hz)	30 g
Shock resistance	500 m/s² (11 msec)	500 m/s² (11 msec)	200 g
Operating temperature	-40 °C ... +100 °C ATEX: -40 °C ... +80 °C	-40 °C ... +100 °C	-40 °C ... +100 °C
Connection	MS / M12	MS / M12	MS / M12
Technical Data - electrical			
Supply voltage		DC 5 - 26 V	
Current w/o load typ.	max. 50 mA	max. 50 mA	max. 50 mA
Max. pulse frequency	125 kHz	125 kHz	125 kHz
Output	RS422 / Push-Pull / NPN-O.C.	RS422 / Push-Pull / NPN-O.C.	RS422 / Push-Pull
Pulse shape	Square wave	Square wave	
Page	50	54	58

Heavy Duty - Absolute

ACURO®-XRobust BISS INTERFACE SSI CANopen

Type	AR 62/63
Special features	■ Single -and multi turn: Resolution up to 28 Bit ■ Wearless electronic multi turn: contact -and batterie less, self-energetic ■ 300 N axial and radial load ■ 200 g shock resistance/ 20 g vibration resistance ■ Submersible: Protection class up to IP69K ■ High temperature range: -40 ... +100°C ■ Compact design: 32 mm mounting depth ■ Option: Stainless steel housing
Technical Data - mechanical	
Housing diameter	58 mm
Mounting depth	32 mm
Shaft diameter	10 mm (Solid shaft)
Flange (Mounting of housing)	Synchro clamping flange
Protection class shaft input	IP67 or IP69k
Protection class housing	IP67 or IP69k
Shaft load axial / radial	max.: 300 N / 300 N
Max. speed	max. 5000 rpm
Vibration resistance	200 m/s²
Shock resistance	2000 m/s² (6 ms)
Operating temperature	SSI, BiSS: -40 °C ... +100 °C CANopen, Analog: -40 °C ... +85 °C
Connection	Cable / M12
Technical Data - electrical	
Supply voltage	DC 17 - 30 V / DC 10-30 V
EMC	EN 61326-1
Resolution singleturn	12 Bit
Resolution multiturn	12 Bit, 16 Bit
Control inputs	Preset, Direction
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Solid shaft

Type	RI 30-O	RI 36-O	RI 58-O / RI 58-T
Special features	■ Miniature encoder for industrial use ■ Low current consumption ■ High noise interference immunity ■ Cable lengths of up to 100 m ■ Suitable for high pulse frequencies ■ High protection class ■ Applications: CNC machines, manipulators, motors, medical technology, textile machines	■ Miniature industry standard encoder for high numbers of pulses ■ High reliability ■ Applications: CNC axles, machine tools, robots, special purpose machines, high-speed winding machines	■ Universal industry standard encoder ■ Up to 40 000 steps with 10 000 pulses ■ High signal accuracy ■ Protection class up to IP67 ■ Flexible due to many flange and configuration variants ■ Suitable for high shock ratings ■ Applications: machine tools, CNC axles, packing machines, motors/ drives, injection moulding machines, sawing machines, textile machines ■ For EX version, see RX 70-I ■ Operating temperature up to 100 °C (RI 58-T)
Number of pulses	5 ... 1500	5 ... 3600	1 ... 10 000
Technical Data - mechanical			
Housing diameter	30 mm	36 mm	58 mm
Shaft diameter	5 mm (Solid shaft)	6 mm ... 6.35 mm (Solid shaft)	6 mm ... 12 mm (Solid shaft)
Flange (Mounting of housing)	Synchro flange, Pilot flange	Synchro flange, Pilot flange	Synchro flange, Clamping flange, Square flange, Synchro clamping flange
Protection class shaft input	IP64	IP64	IP64 or IP67
Protection class housing	IP64	IP64	IP65 or IP67
Shaft load axial / radial	5 N / 10 N	5 N / 10 N	Ø 6 mm / 6,35 mm: 20 N / 40 N Ø 7 ... 10 mm: 40 N / 60 N Ø 12 mm: 60 N / 80 N
Max. speed	max. 10 000 rpm	max. 10 000 rpm	max. 10 000 rpm
Vibration resistance	100 m/s² (10 ... 2000 Hz)	100 m/s² (10 ... 2000 Hz)	100 m/s² (10 ... 2000 Hz)
Shock resistance	1000 m/s² (6 ms)	1000 m/s² (6 ms)	1000 m/s² (6 ms)
Operating temperature	-10 °C ... +70 °C	-10 °C ... +70 °C	RI 58-O: -10 °C ... +70 °C RI 58-T: -25 °C ... +100 °C
Connection	Cable / M16	Cable / M16	Cable / M23 / M16 / MS
Technical Data - electrical			
Supply voltage	DC 5 V / DC 10-30 V	DC 5 V / DC 10-30 V	DC 5 V / DC 10-30 V
Current w/o load typ.	max. 30 mA	max. 30 mA	max. 30 mA
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz	RS422: 300 kHz Push-pull: 200 kHz	RS422: 300 kHz Push-pull: 200 kHz
Output	RS422 / Push-Pull	RS422 / Push-Pull / Push-pull complementary (I)	RS422 / Push-Pull / Push-pull complementary (I)
Alarm output	NPN-O.C., max. 5 mA	NPN-O.C., max. 5 mA	NPN-O.C., max. 5 mA
Pulse shape	Square wave	Square wave	Square wave
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Hollow shaft

Type	RI 36-H	RI 58-H	RI 58-D / RI 58TD
Special features	■ Miniature industry encoder for high number of pulses ■ Short mounting length ■ Easy mounting procedure ■ Applications: motors, machine tools, robots, automated SMD equipment	■ Through hollow shaft ■ High accuracy by means of integrated flexible coupling ■ Safe shaft mounting ■ Applications: textile machines, motors, drives, copiers	■ Direct mounting without coupling ■ Flexible hollow shaft design up to diameter 14 mm ■ Through hollow shaft or as end shaft (blind shaft) ■ Easy installation by means of clamping shaft or blind shaft ■ Short overall length of 33 mm ■ Fixing of flage by means of a stator coupling or set screw ■ Various shaft versions ■ Applications: actuators, motors ■ Operating temperature up to 100 °C (RI 58TD)
Number of pulses	5 ... 3600	1 ... 5000	1 ... 5000
Technical Data - mechanical			
Housing diameter	36 mm	58 mm	58 mm
Shaft diameter	4 mm ... 10 mm (Hubshaft)	10 mm ... 12 mm (Hubshaft)	10 mm ... 12 mm (Through hollow shaft) 10 mm ... 14 mm (Hubshaft)
Flange (Mounting of housing)	Tether	Synchro flange	Synchro flange
Protection class shaft input	IP64	IP64	IP64
Protection class housing	IP64	IP64	Through hollow shaft - D: IP64 Hubshaft - E,F: IP65
Max. speed	max. 10 000 rpm	max. 3000 rpm	max. 4000 rpm
Vibration resistance	100 m/s² (10 ... 2000 Hz)	10 g = 100 m/s² (10 ... 2000 Hz)	10 g = 100 m/s² (10 ... 2000 Hz)
Shock resistance	1000 m/s² (6 ms)	100 g = 1000 m/s² (6 ms)	100 g = 1000 m/s² (6 ms)
Operating temperature	-10 °C ... +70 °C	-10 °C ... +70 °C	RI 58-D: -10 °C ... +70 °C RI 58TD: -25 °C ... +100 °C
Connection	Cable	Cable	Cable / M23
Technical Data - electrical			
Supply voltage	DC 5 V / DC 10-30 V	DC 5 V / DC 10-30 V	DC 5 V / DC 10-30 V
Current w/o load typ.	max. 30 mA	max. 30 mA	max. 30 mA
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz	RS422: 300 kHz Push-pull: 200 kHz	RS422: 300 kHz Push-pull: 200 kHz
Output	RS422 / Push-Pull / Push-pull complementary (I)	RS422 / Push-Pull / Push-pull complementary (I)	RS422 / Push-Pull / Push-pull complementary (I)
Alarm output	NPN-O.C., max. 5 mA		NPN-O.C., max. 5 mA
Pulse shape	Square wave	Square wave	Square wave
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Hollow shaft

Type	RI 58-G / RI 58TG	RI 58-F	RI 64
Special features	■ Direct mounting without coupling ■ Through hollow shaft Ø 14 mm and 15 mm ■ Easy installation by means of clamping ring ■ Fixing of flage by means of a stator coupling or set screw ■ Applications: actuators, motors	■ Incremental hollow shaft encoder ■ Up to 10 000 ppr ■ Through hollow shaft and hubshaft up to 12 mm (14 mm optional) ■ Optimized stator coupling ■ Applications: Feedback for asynchronous motors, industrial applications	■ Through hollow shaft and hubshaft up to 16 mm ■ Robust design ■ High shock and vibrations resistance ■ PPR: Up to 5000 ■ Electrically insulated shaft: protection from shaft currents ■ High temperature range: -40°C ... + 100°C ■ Protection class IP67: also for through hollow shaft ■ Applications: Feedback for asynchronous motors, industrial applications
Number of pulses	50 ... 2500	1 ... 10 000	1 ... 5000
Technical Data - mechanical			
Housing diameter	58 mm	58 mm	63 mm
Mounting depth			54"
Shaft diameter	14 mm ... 15 mm (Through hollow shaft)	6 mm ... 12 mm (Hubshaft) 6 mm ... 12 mm (Through hollow shaft)	10 mm ... 16 mm (Hubshaft) 12 mm ... 16 mm (Through hollow shaft)
Flange (Mounting of housing)	Synchro flange	Tether	Tether
Protection class shaft input	IP64	IP64	IP64 or IP67
Protection class housing	IP64	Through hollow shaft - D: IP64 Hubshaft - F: IP67	
Max. speed	max. 4000 rpm	max. 6000 rpm	max. 6000 rpm
Vibration resistance	10 g = 100 m/s² (10 ... 2000 Hz)	100 m/s²	100 m/s²
Shock resistance	100 g = 1000 m/s² (6 ms)	1000 m/s²	1000 m/s²
Operating temperature	RI 58-G: -10 °C ... +70 °C RI 58TG: -10 °C ... +100 °C	-10 °C ... +70 °C	-40 °C ... +100 °C
Connection	Cable	Cable / M23	Cable / M23
Technical Data - electrical			
Supply voltage	DC 5 V / DC 10-30 V	DC 5 V / DC 10-30 V	DC 5 V ±10 % / DC 5 - 26 V
Current w/o load typ.	max. 30 mA	max. 30 mA	
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz		300 kHz
Output	RS422 / Push-Pull / Push-pull complementary (I)	RS422 / Push-Pull / Push-pull complementary (I)	RS422 / Push-pull complementary (I)
Alarm output	NPN-O.C., max. 5 mA		
Pulse shape	Square wave		Square wave
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Hollow shaft

Type	RI 76TD	RI 80-E
Special features	■ Through hollow shaft Ø 15 bis 42 mm ■ Outside diameter only 76 mm ■ Easy installation by means of clamping ring front or rear ■ Operating temperature up to 100 °C ■ Applications: motors, printing machines, lifts	■ Incremental ■ 30 - 45 mm hollow shaft ■ Rugged mechanical design ■ Unbreakable disc ■ Integrated diagnostic system ■ Wide voltage range DC 5 - 30 V ■ Option: Isolated shaft and spring tether
Number of pulses	1 ... 10 000	1024, 2048, 2500, 4096, 5000, 10 000, (other number of pulses on request)
Technical Data - mechanical		
Housing diameter	76 mm	100 mm
Shaft diameter	15 mm ... 40 mm (Hub shaft)	30 mm ... 45 mm (Through hollow shaft)
Flange (Mounting of housing)	Tether	Tether
Protection class shaft input	IP40 or IP64	IP50 or IP64
Protection class housing	IP50 (IP65 optional)	IP50 or IP64
Max. speed	max. 1800 rpm	max. 1500 rpm
Vibration resistance	10 g = 100 m/s² (10 ... 2000 Hz)	10 g (10 ... 2000 Hz)
Shock resistance	100 g = 1000 m/s² (6 ms)	100 g (6 ms)
Operating temperature	-25 °C ... +100 °C	-25 °C ... +85 °C
Connection	Cable	Sub-D
Technical Data - electrical		
Supply voltage	DC 5 V / DC 10-30 V	DC 5 V ±10 % / DC 5-30 V
Current w/o load typ.	max. 35 mA	max. 35 mA
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz	RS422: 600 kHz Push-pull: 200 kHz
EMC		EN 61326 Class A
Output	RS422 / Push-Pull / Push-pull complementary (I)	RS422 / Push-Pull / Push-pull complementary (I)
Alarm output	NPN-O.C., max. 5 mA	NPN-O.C., max. 5 mA
Pulse shape	Square wave	Square wave
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Type	AC 58-I - SSI
Number of pulses	512, 1024, 2048
Technical Data - mechanical	
Housing diameter	58 mm
Shaft diameter	10 mm ... 10 mm (Solid shaft) 10 mm ... 12 mm (Hubshaft)
Protection class shaft input	IP64 or IP67
Protection class housing	IP64 or IP67
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 12 000 rpm
Vibration resistance	100 m/s² (10 ... 2000 Hz)
Shock resistance	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +100 °C
Connection	M23
Technical Data - electrical	
Current w/o load typ.	max. 200 mA
Max. pulse frequency	200 kHz
Resolution singleturn	12 -17 Bit
Resolution multiturn	12 Bit
Output code	Gray
Control inputs	Preset, Direction
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AC 36 - BiSS / SSI

- Compact design for single or multiturn
- Interfaces: standard SSI, expanded SSI mode or BiSS
- Use of sine / cosine signals for fast control tasks possible

Type	AC 36 - BiSS / SSI
Technical Data - mechanical	
Housing diameter	37.5 mm
Shaft diameter	6 mm (Solid shaft)
Flange (Mounting of housing)	Pilot flange
Protection class shaft input	IP64
Protection class housing	IP64
Max. speed	max. 12 000 rpm
Vibration resistance	100 m/s² (10 ... 2000 Hz)
Shock resistance	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +100 °C
Connection	Cable
Technical Data - electrical	
Supply voltage	-5%/ 10% DC 5 V / DC 7-30 V
Current w/o load typ.	max. 100 mA
Resolution singleturn	12 -17 Bit
Resolution multiturn	12 Bit
Output code	Gray, Binary
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)
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AC 58 - BiSS / SSI, Parallel

- Compact design for single or multiturn
- Aids for start-up and operation: diagnostic LED, preset key with optical response
- Interfaces: standard SSI, expanded SSI mode or BiSS
- Use of sine / cosine signals for fast control tasks possible

Type	AC 58 - BiSS / SSI	AC 58 - Parallel
Technical Data - mechanical		
Housing diameter	58 mm	58 mm
Shaft diameter	6 mm ... 10 mm (Solid shaft) 10 mm ... 12 mm (Hub shaft)	6 mm ... 10 mm (Solid shaft) 10 mm ... 12 mm (Hub shaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Tether, Square flange	Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input	IP64 or IP67	IP64 or IP67
Protection class housing	IP64 or IP67	IP64 or IP67
Shaft load axial / radial	40 N / 60 N	40 N / 60 N
Max. speed	max. 12000 rpm	max. 12000 rpm
Vibration resistance	100 m/s² (10 ... 2000 Hz)	100 m/s² (10 ... 2000 Hz)
Shock resistance	1000 m/s² (6 ms)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +100 °C	-40 °C ... +100 °C
Connection	Cable / M23 / M12	Cable / M23 / Sub-D
Technical Data - electrical		
Supply voltage	-5%/ 10% DC 5 V / DC 10-30 V	DC 10-30 V
Current w/o load typ.	max. 100 mA	max. 300 mA
Resolution singleturn	10 - 17 Bit Gray Excess: 360, 720 increments	10 - 14 Bit Gray Excess: 360, 720 increments
Resolution multiturn	12 Bit	12 Bit
Output code	Binary, Gray	Binary, Gray, Gray Excess
Parametrization	Code type, Direction, Warning, Alarm	
Output current		30 mA per Bit, short-circuit-proof
Control inputs	$\overline{\text{Direction}}$	$\overline{\text{Latch}}$, $\overline{\text{Direction}}$, $\overline{\text{Tristate}}$ with ST, Tristate with MT
Reset key	Disable via parameterization	
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)	NPN-O.C., max. 5 mA
Status LED	Green = ok, red = alarm	Green = ok, red = alarm
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AC 58 with Fieldbus Interfaces

- Overall length: 63 mm for singleturn, 73 mm for multiturn, including bus cover
- The complete bus specific electronics is integrated in the bus cover
- Option: Display "tico"
- Diagnostic LEDs in the bus cover

Type	AC 58 - Profibus	AC 58 - CANopen	AC 58 - CANlayer2
Technical Data - mechanical			
Housing diameter	58 mm	58 mm	58 mm
Shaft diameter	6 mm ... 10 mm (Solid shaft) 10 mm ... 12 mm (Hub shaft)	6 mm ... 10 mm (Solid shaft) 10 mm ... 12 mm (Hub shaft)	6 mm ... 10 mm (Solid shaft) 10 mm ... 12 mm (Hub shaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Tether, Square flange	Synchro flange, Clamping flange, Tether, Square flange	Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input	IP64 or IP67	IP64 or IP67	IP64 or IP67
Protection class housing	IP67	Connection bus cover: IP67 Connection cable or M23 (conin): IP64 (IP67 optional)	IP67 or IP64 (IP67 optional)
Shaft load axial / radial	40 N / 60 N	40 N / 60 N	40 N / 60 N
Max. speed	max. 12000 rpm	max. 12000 rpm	max. 12000 rpm
Vibration resistance	100 m/s² (10 ... 500 Hz)	100 m/s² (10 ... 500 Hz)	100 m/s² (10 ... 500 Hz)
Shock resistance	1000 m/s² (6 ms)	1000 m/s² (6 ms)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +85 °C	-40 °C ... +85 °C	-40 °C ... +85 °C
Connection	Cable / Bus cover	Cable / M23 / Bus cover	Cable / M23 / Bus cover
Technical Data - electrical			
Supply voltage	DC 10-30 V	DC 10-30 V	DC 10-30 V
Current w/o load typ.	max. 250 mA	max. 250 mA	max. 250 mA
EMC	EN 61326: Class A		
Resolution singleturn	10 - 14 Bit	10 - 16 Bit	10 - 14 Bit
Resolution multiturn	12 Bit	12 Bit	12 Bit
Output code	Binary	Binary	Binary
Profile/ protocol	Profibus DP with encoder profile class C2 (parameterizable)	CANopen according to DS 301 with profile DSP 406, programmable encoder according class C2	CAN 2.0 A
Programmable	Resolution, Preset, Direction	Resolution, Preset, Offset, Direction	Direction, Limit values
Integrated special functions	Speed, Acceleration, Operating time	Speed, Acceleration, Limit values, Operating time	
Baud rate	is automatically set within a range of 9.6 KBaud through 12 MBaud	set via DIP switches within a range of 10 through 1000 Kbit/s	set via DIP switches within a range of 10 through 1000 Kbit/s
Device address	adjustable with DIP switches, via fieldbus (optional)		
Bus termination resistor	set via DIP switches	set via DIP switches	set via DIP switches
Basic identifier		set via DIP switches	set via DIP switches
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AC 58 with Fieldbus Interfaces

- Overall length: 63 mm for singleturn, 73 mm for multiturn, including bus cover
- The complete bus specific electronics is integrated in the bus cover
- Option: Display "tico"
- Diagnostic LEDs in the bus cover

Type	AC 58 - DeviceNet	AC 58 - Interbus	AC 58 - SUCOnet
Technical Data - mechanical			
Housing diameter	58 mm	58 mm	58 mm
Shaft diameter	6 mm ... 10 mm (Solid shaft) 10 mm ... 12 mm (Hub shaft)	6 mm ... 10 mm (Solid shaft) 10 mm ... 12 mm (Hub shaft)	6 mm ... 10 mm (Solid shaft) 10 mm ... 12 mm (Hubshaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Tether, Square flange	Synchro flange, Clamping flange, Tether, Square flange	Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input	IP64 or IP67	IP64 or IP67	IP64 or IP67
Protection class housing	IP67	Connection bus cover: IP67 Connection cable or M23 (conin): IP64 (IP67 optional)	IP64
Shaft load axial / radial	40 N / 60 N	40 N / 60 N	40 N / 60 N
Max. speed	max. 12000 rpm	max. 12000 rpm	max. 12000 rpm
Vibration resistance	100 m/s² (10 ... 500 Hz)	100 m/s² (10 ... 500 Hz)	100 m/s²
Shock resistance	1000 m/s² (6 ms)	1000 m/s² (6 ms)	1000 m/s²
Operating temperature	-40 °C ... +85 °C	-40 °C ... +70 °C	-10 °C ... +60 °C
Connection	Cable / Bus cover	Cable / Bus cover / M23	Cable
Technical Data - electrical			
Supply voltage	DC 10-30 V	DC 10-30 V	DC 10-30 V
Current w/o load typ.	max. 250 mA	max. 250 mA	max. 200 mA
EMC	Noise emission according to EN 50081-2, Immunity to interference according to EN 50082-2	Noise emission according to EN 50081-2, Immunity to interference according to EN 50082-2	
Resolution singleturn	10 - 14 Bit	10 - 12 Bit	10 - 13 Bit
Resolution multiturn	12 Bit	12 Bit	12 Bit
Output code	Binary	32 Bit binary	Binary
Interface	CAN High-Speed according to ISO/DIS 11898, CAN specification 2.0 A (11-Bit-Identifier)		
Profile/ protocol	DeviceNet according to Rev. 2.0, progammable encoder	ENCOM-Profil K3 = ID-Code 37, K2 = ID-Code 36	SUCOnet-K1 or Hengstler-G1
Programmable	Resolution, Preset, Direction	Resolution, Preset, Offset, Direction	Resolution, Direction
Output current		max. 4.5 A for bus cover with 2x M23, max. 2 A for all other connections	
Baud rate	set via DIP switches to 125, 250, 500 KBaud	500 KBaud	
Address switch			set via DIP switches
Bus termination resistor	set via DIP switches		set via DIP switches
MAC-ID	set via DIP switches		
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AC 58 - SSI programmable

- Compact design: 59mm length for single or multiturn
- Aids for start-up and operation: diagnostic LED, preset key with optical response
- Parameterization: resolution, code type, sense of rotation, output format, warning, alarm
- Parameters can be stored in a non-volatile memory

Type	AC 58 - SSI-P
Technical Data - mechanical	
Housing diameter	58 mm
Shaft diameter	6 mm ... 10 mm (Solid shaft) 10 mm ... 12 mm (Hub shaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input	IP64 or IP67
Protection class housing	IP64 (IP67 optional)
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 12000 rpm
Vibration resistance	100 m/s² (10 ... 500 Hz)
Shock resistance	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +100 °C
Connection	Cable / M23
Technical Data - electrical	
Supply voltage	DC 10-30 V
Current w/o load typ.	max. 250 mA
Resolution singleturn	10 - 17 Bit
Resolution multiturn	12 Bit
Output code	Binary, Gray
Parametrization	Resolution, Code type, Direction, Output format, Warning, Alarm
Control inputs	Direction, Preset 1, Preset 2
Alarm output	Alarm bit
Status LED	Green = ok, red = alarm
Page	173

AC 110 - BiSS / SSI

- Hollow shaft up to 50 mm
- Singleturn up to 17 Bit

Type	AC 110 - BiSS / SSI
Number of pulses	4096
Technical Data - mechanical	
Housing diameter	110 mm
Shaft diameter	50 mm (Hub shaft)
Protection class shaft input	IP50 or IP64
Protection class housing	IP40 or IP64
Max. speed	max. 1500 rpm
Vibration resistance	100 m/s² (10 ... 500 Hz)
Shock resistance	1000 m/s² (6 ms)
Operating temperature	-20 °C ... +70 °C
Connection	Cable / M23
Technical Data - electrical	
Supply voltage	-5%/ 10% DC 5 V / DC 10-30 V
Current w/o load typ.	max. 120 mA
Resolution singleturn	11 - 19 Bit (22 Bit on request)
Output code	Binary, Gray
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)
Page	189

Type	RI 59
Special features	■ Stainless steel encoder with high protection class ■ High corrosion resistance ■ Use in the area of food production ■ Applications: packing machines, bottling machines, washing plants, mixers, cranes, hoists, marine outfitters
Number of pulses	1 ... 10 000
Technical Data - mechanical	
Housing diameter	58 mm
Shaft diameter	9.52 mm ... 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange 63.5 mm
Protection class shaft input	IP67
Protection class housing	IP67
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 10 000 rpm
Vibration resistance	100 m/s² (10 ... 2000 Hz)
Shock resistance	1000 m/s² (6 ms)
Operating temperature	-10 °C ... +70 °C
Connection	Cable
Technical Data - electrical	
Supply voltage	DC 5 V / DC 10-30 V
Current w/o load typ.	max. 30 mA
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz
Output	RS422 / Push-Pull / Push-pull complementary (I)
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Page	194

Stainless Industrial types - Absolute

ACURO industry | BiSS INTERFACE | SSI | PROFIBUS

- Compact and robust design, high corrosion resistance
- Protection class IP67
- Resolution up to 29 Bit (17 Bit ST, 12 Bit MT)
- Versions with cable or demontable bus cover

Type	AC 59 - BiSS/SSI	AC 59 / AC 61 - Parallel	AC 61 - Profibus
Technical Data - mechanical			
Housing diameter	58 mm	AC 59 - Parallel: 58 mm AC 61 - Parallel: 61.5 mm	61.5 mm
Shaft diameter	9.52 mm ... 10 mm (Solid shaft)	9.52 mm ... 10 mm (Solid shaft)	9.52 mm ... 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange 63.5 mm	Square flange 63.5 mm	Square flange 63.5 mm
Protection class shaft input	IP67	IP67	IP67
Protection class housing	IP67	IP67	IP67
Shaft load axial / radial	40 N / 60 N	40 N / 60 N	40 N / 60 N
Max. speed	max. 10 000 rpm	max. 10 000 rpm	max. 10 000 rpm
Vibration resistance	100 m/s² (10 ... 500 Hz)	100 m/s² (10 ... 500 Hz)	100 m/s² (10 ... 500 Hz)
Shock resistance	1000 m/s² (6 ms)	1000 m/s² (6 ms)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +100 °C	-40 °C ... +100 °C	-40 °C ... +85 °C
Connection	Cable	Cable	Cable
Technical Data - electrical			
Supply voltage	-5%/ 10% DC 5 V / DC 10-30 V	DC 10-30 V	DC 10-30 V
Current w/o load typ.	max. 100 mA	max. 300 mA	max. 250 mA
EMC			EN 61326: Class A
Resolution singleturn	10 - 17 Bit Gray Excess: 360, 720 increments	10 - 14 Bit Gray Excess: 360, 720 increments	10 - 14 Bit
Resolution multiturn	12 Bit	12 Bit	12 Bit
Output code	Binary, Gray	Binary, Gray, Gray Excess	Binary
Profile/ protocol			Profibus DP with encoder profile class C2 (parameterizable)
Parametrization	Code type, Direction, Warning, Alarm		
Programmable			Resolution, Preset, Direction
Integrated special functions			Speed, Acceleration, Operating time
Output current		30 mA per Bit, short-circuit-proof	
Control inputs	$\overline{\text{Direction}}$	$\overline{\text{Latch}}$, $\overline{\text{Direction}}$, $\overline{\text{Tristate}}$ with ST, Tristate with MT	
Reset key	Disable via parameterization		
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)	NPN-O.C., max. 5 mA	
Baud rate			is automatically set within a range of 9.6 KBaud through 12 MBaud
Device address			adjustable with DIP switches, via fieldbus (optional)
Bus termination resistor			set via DIP switches
Status LED	Green = ok, red = alarm	Green = ok, red = alarm	
Page	197	202	206

Stainless Industrial types - Absolute

ACURO industry | CAN | CANopen | DeviceNet

- Compact and robust design, high corrosion resistance
- Protection class IP67
- Resolution up to 29 Bit (17 Bit ST, 12 Bit MT)
- Versions with cable or demontable bus cover

Type	AC 61 - CANopen	AC 61 - CANlayer2	AC 61 - DeviceNet
Technical Data - mechanical			
Housing diameter	61.5 mm	61.5 mm	61.5 mm
Shaft diameter	9.52 mm ... 10 mm (Solid shaft)	9.52 mm ... 10 mm (Solid shaft)	9.52 mm ... 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange 63.5 mm	Square flange 63.5 mm	Square flange 63.5 mm
Protection class shaft input	IP67	IP67	IP67
Protection class housing	IP67	IP67	IP67
Shaft load axial / radial	40 N / 60 N	40 N / 60 N	40 N / 60 N
Max. speed	max. 10 000 rpm	max. 10 000 rpm	max. 10 000 rpm
Vibration resistance	100 m/s² (10 ... 500 Hz)	100 m/s² (10 ... 500 Hz)	100 m/s² (10 ... 500 Hz)
Shock resistance	1000 m/s² (6 ms)	1000 m/s² (6 ms)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +85 °C	-40 °C ... +85 °C	-40 °C ... +85 °C
Connection	Cable	Cable	Cable
Technical Data - electrical			
Supply voltage	DC 10-30 V	DC 10-30 V	DC 10-30 V
Current w/o load typ.	max. 250 mA	max. 250 mA	max. 250 mA
EMC			Noise emission according to EN 50081-2, Immunity to interference according to EN 50082-2
Resolution singleturn	10 - 16 Bit	10 - 14 Bit	10 - 14 Bit
Resolution multiturn	12 Bit	12 Bit	12 Bit
Output code	Binary	Binary	Binary
Interface			CAN High-Speed according to ISO/DIS 11898, CAN specification 2.0 A (11-Bit-Identifier)
Profile/ protocol	CANopen according to DS 301 with profile DSP 406, programmable encoder according class C2	CAN 2.0 A	DeviceNet according to Rev. 2.0, progammable encoder
Programmable	Resolution, Preset, Offset, Direction	Direction, Limit values	Resolution, Preset, Direction
Integrated special functions	Speed, Acceleration, Limit values, Operating time		
Baud rate	set via DIP switches within a range of 10 through 1000 Kbit/s	set via DIP switches within a range of 10 through 1000 Kbit/s	set via DIP switches to 125, 250, 500 KBaud
Bus termination resistor	set via DIP switches	set via DIP switches	set via DIP switches
Basic identifier	set via DIP switches	set via DIP switches	
MAC-ID			set via DIP switches
Page	209	212	215

Stainless Industrial types - Absolute

- Compact and robust design, high corrosion resistance
- Protection class IP67
- Resolution up to 29 Bit (17 Bit ST, 12 Bit MT)
- Versions with cable or demontable bus cover

Type	AC 61 - Interbus	AC 61 - SSI-P
Technical Data - mechanical		
Housing diameter	61.5 mm	61.5 mm
Shaft diameter	9.52 mm ... 10 mm (Solid shaft)	9.52 mm ... 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange 63.5 mm	Square flange 63.5 mm
Protection class shaft input	IP67	IP67
Protection class housing	IP67	IP67
Shaft load axial / radial	40 N / 60 N	40 N / 60 N
Max. speed	max. 10 000 rpm	max. 10 000 rpm
Vibration resistance	100 m/s² (10 ... 500 Hz)	100 m/s² (10 ... 500 Hz)
Shock resistance	1000 m/s² (6 ms)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +70 °C	-40 °C ... +70 °C
Connection	Cable	Cable
Technical Data - electrical		
Supply voltage	DC 10-30 V	DC 10-30 V
Current w/o load typ.	max. 250 mA	max. 250 mA
EMC	Noise emission according to EN 50081-2, Immunity to interference according to EN 50082-2	
Resolution singleturn	10 - 12 Bit	10 - 17 Bit
Resolution multiturn	12 Bit	12 Bit
Output code	32 Bit binary	Binary, Gray
Profile/ protocol	ENCOM-Profil K3 = ID-Code 37, K2 = ID-Code 36	
Parametrization		Resolution, Code type, Direction, Output format, Warning, Alarm
Programmable	Resolution, Preset, Offset, Direction	
Output current	max. 4.5 A for bus cover with 2x M23, max. 2 A for all other connections	
Control inputs		Direction, Preset 1, Preset 2
Alarm output		Alarm bit
Baud rate	500 KBaud	
Status LED		Green = ok, red = alarm
Page	218	221

EEx Industrial types - Incremental

ATEX

Type	RX 70TI / RX 71TI
Special features	■ Explosion proof class II according to EX II 2 G/D EEX d IIC T6/T4 ■ Highest working reliability ■ Applications: enamelling production line, surfacing machines, bottling machines, mixers, silo works ■ Resolution up to 10.000 ppr (RX 70TI) ■ Stainless steel version RX71 available (RX 70TI) ■ Stainless steel housing (RX 71TI) ■ Resolution up to 10 000 ppr (RX 71TI)
Number of pulses	1 ... 10 000
Technical Data - mechanical	
Housing diameter	70 mm
Shaft diameter	10 mm (Solid shaft)
Flange (Mounting of housing)	Clamping flange
Protection class shaft input	T4: IP64 or IP67 T6: IP64
Protection class housing	T4: IP65 or IP67 T6: IP65
Shaft load axial / radial	50 N / 100 N
Max. speed	max. 6000 rpm
Vibration resistance	10 g = 100 m/s² (10 ... 2000 Hz)
Shock resistance	100 g = 1000 m/s² (6 ms)
Ambient temperature	T4: -25 °C ... +60 °C T6: -25 °C ... +40 °C
Connection	Cable
Technical Data - electrical	
Supply voltage	DC 5 V / DC 10-30 V
Current w/o load typ.	max. 30 mA
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz
Output	RS422 / Push-Pull / Push-pull complementary (I)
Output current	RS 422: ±30 mA Push-pull with short-circuit protection: 30 mA (DC 10 - 30 V)
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Page	230

EEx Industrial types - Absolute

ACURO industry · ATEX · SSI · PROFIBUS

- ATEX certification for gas and dust explosion proof, protection class up to IP67
- Same electrical performance as ACURO industry
- Resolution up to 29 Bit (17 Bit ST, 12 Bit MT)
- Diameter only 70 mm, robust design, also available with stainless steel housing

Type	AX 70 / AX 71 - SSI	AX 70 / AX 71 - Profibus	AX 70 / AX 71 - CANopen
Technical Data - mechanical			
Housing diameter	70 mm	70 mm	70 mm
Shaft diameter	10 mm (Solid shaft)	10 mm (Solid shaft)	10 mm (Solid shaft)
Flange (Mounting of housing)	Clamping flange	Clamping flange	Clamping flange
Protection class shaft input	T4: IP64 or IP67 T6: IP64	T4: IP64 or IP67 T6: IP64	T4: IP64 or IP67 T6: IP64
Protection class housing	T4: IP65 or IP67 T6: IP65	T4: IP65 or IP67 T6: IP65	T4: IP65 or IP67 T6: IP65
Shaft load axial / radial	40 N / 100 N	40 N / 100 N	40 N / 100 N
Max. speed	max. 6000 rpm	max. 6000 rpm	max. 6000 rpm
Vibration resistance	100 m/s² (10 ... 500 Hz)	100 m/s² (10 ... 500 Hz)	100 m/s² (10 ... 500 Hz)
Shock resistance	1000 m/s² (6 ms)	1000 m/s² (6 ms)	1000 m/s² (6 ms)
Ambient temperature	T4: -40 °C ... +60 °C T6: -40 °C ... +40 °C	T4: -40 °C ... +60 °C T6: -40 °C ... +40 °C	T4: -40 °C ... +60 °C T6: -40 °C ... +40 °C
Connection	Cable	Cable	Cable
Technical Data - electrical			
Current w/o load typ.	max. 250 mA	max. 250 mA	max. 250 mA
Resolution singleturn	10 - 17 Bit	10 - 14 Bit	10 - 14 Bit
Resolution multiturn	12 Bit	12 Bit	12 Bit
Output code	Binary, Gray	Binary	Binary
Profile/ protocol		Profibus DP with encoder profile class C2 (parameterizable)	CANopen according to DS 301 with profile DSP 406, programmable encoder according class C2
Parametrization		Resolution, Preset, Direction	Resolution, Preset, Offset, Direction
Integrated special functions		Speed, Acceleration, Operating time	Speed, Acceleration, Rotery axis, Limit values, Operating time
Control inputs	Direction		
Alarm output	Alarm bit (SSI Option)		
Baud rate		is automatically set within a range of 9.6 KBaud through 12 MBaud	
Device address		set via Bus	
Bus termination resistor		external mounting	external mounting
Page	234	237	240

EEx Industrial types - Absolute

ACURO industry · ATEX

- ATEX certification for gas and dust explosion proof, protection class up to IP67
- Same electrical performance as ACURO industry
- Resolution up to 29 Bit (17 Bit ST, 12 Bit MT)
- Diameter only 70 mm, robust design, also available with stainless steel housing

Type	AX 70 / AX 71 - SSI-P
Technical Data - mechanical	
Housing diameter	70 mm
Shaft diameter	10 mm (Solid shaft)
Flange (Mounting of housing)	Clamping flange
Protection class shaft input	T4: IP64 or IP67 T6: IP64
Protection class housing	T4: IP65 or IP67 T6: IP65
Shaft load axial / radial	40 N / 100 N
Max. speed	max. 6000 rpm
Vibration resistance	100 m/s² (10 ... 500 Hz)
Shock resistance	1000 m/s² (6 ms)
Ambient temperature	T4: -40 °C ... +60 °C T6: -40 °C ... +40 °C
Connection	Cable
Technical Data - electrical	
Current w/o load typ.	max. 250 mA
Resolution singleturn	10 - 17 Bit
Resolution multiturn	12 Bit
Output code	Binary, Gray
Parametrization	Resolution, Code type, Direction, Output format, Warning, Alarm, Preset values
Control inputs	Direction, Preset 1, Preset 2
Alarm output	Alarm bit
Page	243

Type	PC 9 / PC 9S	RI 32-O	RI 38
Special features	■ Provides digital control inputs from operators´s panel ■ Bidirectional squarewave signal outputs ■ Up to 512 increments ■ Continuous and reversible rotation ■ Non-contacting ■ Operating temperature -40 ... 100 °C	■ Replacement for type Typ RIS and RI 31 ■ The economical encoder for small appliances ■ High efficiency by means of ball bearing ■ Small torque ■ Applications: laboratory equipment, training equipment, crimping machines, tampon printing machines, miniature grinding machines	■ Replacement for type RI 39 ■ Encoder for universal installation by means of front/back panel mounting ■ High efficiency by means of ball bearing ■ Small torque ■ Applications: FHP motors, laboratory equipment, labelling machines, plotters, length measuring machines
Number of pulses	100 ... 512	5 ... 1500	5 ... 1024
Technical Data - mechanical			
Housing diameter	PC 9: 22 mm PC 9S: 22.86 mm	30 mm	39 mm
Shaft diameter	3.175 mm ... 0.25	5 mm ... 6 mm (Solid shaft)	6 mm (Solid shaft)
Flange (Mounting of housing)		Pilot flange	Square flange
Protection class shaft input		IP40	IP40
Protection class housing		IP50	IP50
Shaft load axial / radial	1/8" shaft: 4 N / 27 N 1/4" shaft: 4 N / 4 N	5 N / 10 N	5 N / 10 N
Max. speed		max. 6000 rpm	max. 10 000 rpm
Vibration resistance		100 m/s² (10 ... 2000 Hz)	100 m/s² (10 ... 2000 Hz)
Shock resistance		1000 m/s² (6 ms)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +100 °C	-10 °C ... +60 °C	-10 °C ... +60 °C
Connection	PC 9: 10 pole header PC 9S: 5 pole header	Cable	Cable
Technical Data - electrical			
Supply voltage	DC 5 V ±10 %	DC 5 V / DC 10-30 V	DC 5 V / DC 10-30 V
Current w/o load typ.		max. 30 mA	max. 30 mA
Max. pulse frequency	200 kHz	DC 5 V: 300 kHz DC 10 - 30 V: 200 kHz	DC 5 V: 300 kHz DC 10 - 30 V: 200 kHz
Output		Push-Pull	Push-Pull
Output signals	min. 2.5 V high (VOH), max. 0.5 V low (VOL)		
Output current	PC 9: 3 mA sink/source (25 °C), 2 mA (100 °C) PC 9S: 6 mA sink/source (25 °C), 4 mA (100 °C)		
Alarm output		NPN-O.C., max. 5 mA	NPN-O.C., max. 5 mA
Pulse shape	Square wave	Square wave	Square wave
Page	249	252	255

Light Duty types - Incremental

Type	RI 41-O	RI 42-O
Special features	■ Replacement for type RIM ■ Economical miniature encoder ■ Up to 14,400 steps with 3,600 pulses ■ High mechanical efficiency ■ Applications: wood working machines, FHP motors, graphic machines, table robots	■ Economical miniature encoder ■ High protection IP65 ■ Output Push-pull or NPN-O.C. ■ High mechanical efficiency ■ Applications: textile machinery
Number of pulses	5 ... 3600	5 ... 1024
Technical Data - mechanical		
Housing diameter	40 mm	40 mm
Shaft diameter	6 mm (Solid shaft)	6 mm (Solid shaft)
Flange (Mounting of housing)	Pilot flange	Pilot flange
Protection class shaft input	IP40	IP64
Protection class housing	IP50	IP65
Shaft load axial / radial	5 N / 10 N	5 N / 10 N
Max. speed	max. 10 000 rpm	max. 10 000 rpm
Vibration resistance	100 m/s² (10 ... 2000 Hz)	100 m/s² (10 ... 2000 Hz)
Shock resistance	1000 m/s² (6 ms)	1000 m/s² (6 ms)
Operating temperature	-10 °C ... +70 °C	0 °C ... +60 °C
Connection	Cable	Cable
Technical Data - electrical		
Supply voltage	DC 5 V / DC 10-30 V	DC 5 V / DC 10-30 V / DC 10-24 V
Current w/o load typ.	max. 30 mA	max. 40 mA
Max. pulse frequency	DC 5 V: 300 kHz DC 10 - 30 V: 200 kHz	DC 5 V: 300 kHz DC 10 - 30 V: 200 kHz DC 10 - 24 V: 50 kHz
Output	Push-Pull	Push-Pull / Push-pull complementary (I) / NPN-O.C.
Alarm output	NPN-O.C., max. 5 mA	NPN-O.C., max. 5 mA
Pulse shape	Square wave	Square wave
Page	258	261

Miniature, DC & Stepper Motors

			
Type	**E 9**	**M 9**	**M 14**
Special features	■ 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	■ Ideal for position and speed sensing in small machines and actuators ■ Max. output frequency: 200 kHz ■ Resolution to 512 lines/rev	■ 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
Number of pulses	100 ... 512	100 ... 512	200 ... 1024
Technical Data - mechanical			
Housing diameter	22 mm	22 mm	38 mm
Mounting depth	20 mm	14.8 mm	17.2 mm
Shaft diameter	1.5 mm ... 3.962 mm (Hub shaft)	1.5 mm ... 3.962 mm (Hub shaft)	3 mm ... 19.05 mm (Hub shaft)
Max. speed	max. 12 000 rpm	max. 12 000 rpm	max. 12 000 rpm
Operating temperature	-40 °C ... +100 °C	-40 °C ... +100 °C	-40 °C ... +100 °C
Connection	10 pole header	5 pole header	5 pole header
Technical Data - electrical			
Supply voltage	DC 5 V ±10 %	DC 5 V ±10 %	DC 5 V ±10 %
Current w/o load typ.	max. 10 mA	max. 10 mA	max. 10 mA
Max. pulse frequency	200 kHz	200 kHz	200 kHz
Output	TTL	TTL	TTL
Output signals	min. 2.5 V high (VOH), max. 0.5 V low (VOL)	min. 2.5 V high, max. 0.5 V low	min. 2.5 V high, max. 0.5 V low
Output current	3 mA sink/source (25°C), 2 mA (100°C)	6 mA (25°C), 4 mA (100°C)	6 mA (25°C), 4 mA (100°C)
Pulse shape	Square wave		
Page	265	268	271

Asynchronous & DC Motors

			
Type	**RI 64**	**RI 36-H**	**RI 58-D / RI 58TD**
Special features	■ Through hollow shaft and hubshaft up to 16 mm ■ Robust design ■ High shock and vibrations resistance ■ PPR: Up to 5000 ■ Electrically insulated shaft: protection from shaft currents ■ High temperature range: -40°C ... + 100°C ■ Protection class IP67: also for through hollow shaft ■ Applications: Feedback for asynchronous motors, industrial applications	■ Miniature industry encoder for high number of pulses ■ Short mounting length ■ Easy mounting procedure ■ Applications: motors, machine tools, robots, automated SMD equipment	■ Direct mounting without coupling ■ Flexible hollow shaft design up to diameter 14 mm ■ Through hollow shaft or as end shaft (blind shaft) ■ Easy installation by means of clamping shaft or blind shaft ■ Short overall length of 33 mm ■ Fixing of flage by means of a stator coupling or set screw ■ Various shaft versions ■ Applications: actuators, motors ■ Operating temperature up to 100 °C (RI 58TD)
Number of pulses	1 ... 5000	5 ... 3600	1 ... 5000
Technical Data - mechanical			
Housing diameter	63 mm	36 mm	58 mm
Mounting depth	54"		
Shaft diameter	10 mm ... 16 mm (Hubshaft) 12 mm ... 16 mm (Through hollow shaft)	4 mm ... 10 mm (Hubshaft)	10 mm ... 12 mm (Through hollow shaft) 10 mm ... 14 mm (Hubshaft)
Flange (Mounting of housing)	Tether	Tether	Synchro flange
Protection class shaft input	IP64 or IP67	IP64	IP64
Protection class housing		IP64	Through hollow shaft - D: IP64 Hubshaft - E,F: IP65
Max. speed	max. 6000 rpm	max. 10 000 rpm	max. 4000 rpm
Vibration resistance	100 m/s²	100 m/s² (10 ... 2000 Hz)	10 g = 100 m/s² (10 ... 2000 Hz)
Shock resistance	1000 m/s²	1000 m/s² (6 ms)	100 g = 1000 m/s² (6 ms)
Operating temperature	-40 °C ... +100 °C	-10 °C ... +70 °C	RI 58-D: -10 °C ... +70 °C RI 58TD: -25 °C ... +100 °C
Connection	Cable / M23	Cable	Cable / M23
Technical Data - electrical			
Supply voltage	DC 5 V ±10 % / DC 5 - 26 V	DC 5 V / DC 10-30 V	DC 5 V / DC 10-30 V
Current w/o load typ.		max. 30 mA	max. 30 mA
Max. pulse frequency	300 kHz	RS422: 300 kHz Push-pull: 200 kHz	RS422: 300 kHz Push-pull: 200 kHz
Output	RS422 / Push-pull complementary (I)	RS422 / Push-Pull / Push-pull complementary (I)	RS422 / Push-Pull / Push-pull complementary (I)
Alarm output		NPN-O.C., max. 5 mA	NPN-O.C., max. 5 mA
Pulse shape	Square wave	Square wave	Square wave
Page	111	85	94

Motorfeedback - Incremental

Asynchronous & DC Motors



Type	RI 58-G / RI 58TG	RI 76TD	RI 80-E
Special features	■ Direct mounting without coupling ■ Through hollow shaft Ø 14 mm and 15 mm ■ Easy installation by means of clamping ring ■ Fixing of flage by means of a stator coupling or set screw ■ Applications: actuators, motors	■ Through hollow shaft Ø 15 bis 42 mm ■ Outside diameter only 76 mm ■ Easy installation by means of clamping ring front or rear ■ Operating temperature up to 100 °C ■ Applications: motors, printing machines, lifts	■ Incremental ■ 30 - 45 mm hollow shaft ■ Rugged mechanical design ■ Unbreakable disc ■ Integrated diagnostic system ■ Wide voltage range DC 5 - 30 V ■ Option: Isolated shaft and spring tether
Number of pulses	50 ... 2500	1 ... 10 000	1024, 2048, 2500, 4096, 5000, 10 000, (other number of pulses on request)
Technical Data - mechanical			
Housing diameter	58 mm	76 mm	100 mm
Shaft diameter	14 mm ... 15 mm (Through hollow shaft)	15 mm ... 40 mm (Hub shaft)	30 mm ... 45 mm (Through hollow shaft)
Flange (Mounting of housing)	Synchro flange	Tether	Tether
Protection class shaft input	IP64	IP40 or IP64	IP50 or IP64
Protection class housing	IP64	IP50 (IP65 optional)	IP50 or IP64
Max. speed	max. 4000 rpm	max. 1800 rpm	max. 1500 rpm
Vibration resistance	10 g = 100 m/s² (10 ... 2000 Hz)	10 g = 100 m/s² (10 ... 2000 Hz)	10 g (10 ... 2000 Hz)
Shock resistance	100 g = 1000 m/s² (6 ms)	100 g = 1000 m/s² (6 ms)	100 g (6 ms)
Operating temperature	RI 58-G: -10 °C ... +70 °C RI 58TG: -10 °C ... +100 °C	-25 °C ... +100 °C	-25 °C ... +85 °C
Connection	Cable	Cable	Sub-D
Technical Data - electrical			
Supply voltage	DC 5 V / DC 10-30 V	DC 5 V / DC 10-30 V	DC 5 V ±10 % / DC 5-30 V
Current w/o load typ.	max. 30 mA	max. 35 mA	max. 35 mA
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz	RS422: 300 kHz Push-pull: 200 kHz	RS422: 600 kHz Push-pull: 200 kHz
EMC			EN 61326 Class A
Output	RS422 / Push-Pull / Push-pull complementary (I)	RS422 / Push-Pull / Push-pull complementary (I)	RS422 / Push-Pull / Push-pull complementary (I)
Alarm output	NPN-O.C., max. 5 mA	NPN-O.C., max. 5 mA	NPN-O.C., max. 5 mA
Pulse shape	Square wave	Square wave	Square wave
Page	102	116	120

Motorfeedback - Absolute

Asynchronous & DC Motors



Type	AC 110 - BiSS / SSI	AC 58-I - SSI	AC 58 - BiSS / SSI
Special features	■ Hollow shaft absolute encoder ■ ST - Resolution up to 19 Bit ■ Compact design: 50 mm ■ Robust bearings for long life ■ Hollow shaft up to 50 mm ■ BiSS or SSI interface ■ Optional: Sine-Cosine 4096 increments ■ Integrated diagnostic system	■ Positioning and Speed feedback in one Encoder ■ MT Absolute encoder + Incremental output TTL or HTL ■ Broad temperature range: -40 to + 100°C ■ Control input: Preset and Direction ■ Resolution: Up to 29 Bit; PPR: 512, 1024, 2048 ■ Compact design: 50 mm length ■ High EMC - Resistance ■ Appropriate for standard frequency converter and asynchron motors	■ Compact design: 50 mm length for single or multiturn ■ Aids for start up and operation: diagnostic LED, preset key with optical response, status information ■ Use of sine/ cosine signals for fast control task possible ■ Control input: Direction ■ Resolution up to 29 Bit
Number of pulses	4096	512, 1024, 2048	2048
Technical Data - mechanical			
Housing diameter	110 mm	58 mm	58 mm
Shaft diameter	50 mm (Hub shaft)	10 mm ... 10 mm (Solid shaft) 10 mm ... 12 mm (Hubshaft)	6 mm ... 10 mm (Solid shaft) 10 mm ... 12 mm (Hub shaft)
Flange (Mounting of housing)			Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input	IP50 or IP64	IP64 or IP67	IP64 or IP67
Protection class housing	IP40 or IP64	IP64 or IP67	IP64 or IP67
Shaft load axial / radial		40 N / 60 N	40 N / 60 N
Max. speed	max. 1500 rpm	max. 12 000 rpm	max. 12 000 rpm
Vibration resistance	100 m/s² (10 ... 500 Hz)	100 m/s² (10 ... 2000 Hz)	100 m/s² (10 ... 2000 Hz)
Shock resistance	1000 m/s² (6 ms)	1000 m/s² (6 ms)	1000 m/s² (6 ms)
Operating temperature	-20 °C ... +70 °C	-40 °C ... +100 °C	-40 °C ... +100 °C
Connection	Cable / M23	M23	Cable / M23 / M12
Technical Data - electrical			
Supply voltage	-5%/ 10% DC 5 V / DC 10-30 V		-5%/ 10% DC 5 V / DC 10-30 V
Current w/o load typ.	max. 120 mA	max. 200 mA	max. 100 mA
Max. pulse frequency		200 kHz	
Resolution singleturn	11 - 19 Bit (22 Bit on request)	12 -17 Bit	10 - 17 Bit Gray Excess: 360, 720 increments
Resolution multiturn		12 Bit	12 Bit
Output code	Binary, Gray	Gray	Binary, Gray
Parametrization			Code type, Direction, Warning, Alarm
Control inputs		Preset, Direction	Direction
Reset key			Disable via parameterization
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)		Alarm bit (SSI Option), warning and alarm bit (BiSS)
Status LED			Green = ok, red = alarm
Page	189	126	145

AC-Synchronous & BLDC Motors

Type	M 53
Special features	■ 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 ... 12.7 mm (Hub shaft)
Protection class shaft input	IP50
Protection class housing	with cover: IP50
Max. speed	max. 12 000 rpm
Vibration resistance	25 m/s² (5 ... 2000 Hz)
Shock resistance	500 m/s² (11 msec)
Operating temperature	-40 °C ... +120 °C
Connection	Shielded cable or dual row connector
Technical Data - electrical	
Supply voltage	DC 5 V or DC 12 V ±10 %
Current w/o load typ.	max. 75 mA
Max. pulse frequency	200 kHz
Page	276

AC-Synchronous & BLDC Motors

Type	F 10	F 15	F 21
Special features	■ 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	■ 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	■ 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	1024, 2048	1024, 2048
Commutation	optional additional 6 or 10 pole commutation signals	optional additional 6, 8 or 10 pole commutation signals	optional additional 6, 8, 10,12 or 16 pole commutation signals
Technical Data - mechanical			
Housing diameter	31.7 mm	36.8 mm	53 mm
Mounting depth	22.5 mm	22.1 mm	26 mm
Shaft diameter	6 mm (Hub shaft)	9.52 mm (Through hollow shaft)	12.7 mm (Hub shaft)
Flange (Mounting of housing)	Servo flange	Servo flange	Servo flange
Max. speed	max. 12 000 rpm	max. 12 000 rpm	max. 12 000 rpm
Vibration resistance	2.5 g at 5 to 2000 Hz	2.5 g at 5 to 2000 Hz	2.5 g at 5 to 2000 Hz
Shock resistance	50 g for 6 ms duration	50 g for 6 ms duration	50 g for 6 ms duration
Operating temperature	0 °C ... +120 °C	0 °C ... +120 °C	0 °C ... +120 °C
Connection	Flying leads	Flying leads	Flying leads
Technical Data - electrical			
Supply voltage	DC 5 V ±10 %	DC 5 V ±10 %	DC 5 V ±10 %
Current w/o load typ.	max. 100 mA	max. 100 mA	max. 100 mA
Max. pulse frequency	300 kHz	300 kHz	300 kHz
Output current	Incremental: ±40 mA (RS422) Commutation: 8 mA (NPN-O.C) or ±40 mA (RS 422)	Incremental: max. ±40 mA (RS 422) Commutation: max. ±8 mA (NPN-O.C) or ±40 mA (RS 422)	Incremental: ±40 mA (RS 422) Commutation: 8 mA (NPN-O.C) or ±40 mA (RS 422)
Page	285	289	292

Motor Feedback - Incremental

AC-Synchronous & BLDC Motors

Type	HC 20	RF 53
Special features	■ 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	■ 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 ... 10 000
Technical Data - mechanical		
Housing diameter	50 mm	53 mm
Mounting depth	36"	
Shaft diameter	6 mm ... 8 mm	Cone solid shaft
Flange (Mounting of housing)	Tether	Tether
Protection class shaft input	IP50	IP54
Protection class housing	IP50	IP54
Shaft load axial / radial		20 N / 90 N
Max. speed	max. 12 000 rpm	max. 5000 rpm
Vibration resistance		25 m/s²
Shock resistance		1000 m/s²
Operating temperature	0 °C ... +120 °C	-20 °C ... +120 °C
Connection	Cable	Cable / Sub-D / PCB
Technical Data - electrical		
Supply voltage		DC 5 V ±10 %
Current w/o load typ.	max. 175 mA	max. 100 mA
Max. pulse frequency	500 kHz	100 kHz
Output		NPN-O.C. / RS422
Page	296	300

Motor Feedback - Absolute

Asynchronous & DC Motors

Type	AD 34	AD 35	AD 36
Special features	■ For brushless servo motors ■ Light duty encoder ■ Unique mounting concept: Save installation time and cost ■ Mounting Depth: 25 mm (ST), 34 mm (MT) ■ Up to 19 Bit ST - resolution + 12 Bit MT - resolution ■ +120°C operating temperature ■ 10,000 rpm continous operation ■ BiSS or SSI interface ■ Sinewave 1 Vpp ■ Bandwidth 500 kHz	■ 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 ■ BiSS or SSI interface ■ Bandwidth 500kHz ■ Bandwidth 500 kHz	■ 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
Number of pulses	2048	2048	2048
Technical Data - mechanical			
Housing diameter	37.5 mm	37.5 mm	37.5 mm
Shaft diameter	6 mm (Notched Shaft)	8 mm (Hubshaft)	8 mm (Through hollow shaft) 8 mm (Hubshaft)
Flange (Mounting of housing)	Tether	Tether	Tether
Protection class shaft input	IP40	IP40	IP40
Protection class housing	IP40	IP40	IP40
Max. speed	max. 12 000 rpm	max. 12 000 rpm	max. 12 000 rpm
Vibration resistance	100 m/s² (10 ... 2000 Hz)	100 m/s² (10 ... 2000 Hz)	100 m/s² (10 ... 2000 Hz)
Shock resistance	1000 m/s² (6 ms)	1000 m/s² (6 ms)	1000 m/s² (6 ms)
Operating temperature	-15 °C ... +120 °C	-15 °C ... +120 °C	-40 °C ... +120 °C
Connection	Cable / PCB	Cable / PCB	Cable / PCB
Technical Data - electrical			
Supply voltage	DC 5 V -5 %/+10 % or DC 7 - 30 V	DC 5 V -5 %/+10 % or DC 7 - 30 V	DC 5 V -5 %/+10 % or DC 7 - 30 V
Current w/o load typ.	max. 100 mA	max. 100 mA	max. 100 mA
Resolution singleturn	12 - 17 Bit (SSI) 12 - 19 Bit (BiSS)	12 - 22 Bit	12 - 19 Bit (BiSS) 12 - 17 Bit (SSI)
Resolution multiturn	12 Bit	12 Bit	12 Bit
Output code	Gray	Gray	Gray
Alarm output	Alarm bit (SSI Option), warning bit and alarm bit (BiSS)	Alarm bit (SSI Option), warning and alarm bit (BiSS)	Alarm bit (SSI Option), warning and alarm bit (BiSS)
Page	304	309	312

Motor Feedback - Absolute

AC-Synchronous & BLDC Motors

Type	AD 58
Special features	■ 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
Number of pulses	2048
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	IP40
Protection class housing	IP40
Max. speed	max. 12 000 rpm
Vibration resistance	100 m/s² (10 ... 2000 Hz)
Shock resistance	1000 m/s² (6 ms)
Operating temperature	-15 °C ... +120 °C
Connection	PCB
Technical Data - electrical	
Supply voltage	± 10% DC 5 V or DC 10 - 30 V
Current w/o load typ.	max. 100 mA
Resolution singleturn	13 Bit (SSI) max. 22 Bit (BiSS)
Resolution multiturn	12 Bit
Output code	Binary, Gray
Parametrization	Resolution, Code type, Direction, Warning, Alarm
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)
Page	316

Motor Feedback - Sine-wave

AC-Synchronous & BLDC Motors

Type	S 21
Special features	■ 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
Number of pulses	2048
Technical Data - mechanical	
Housing diameter	53 mm
Shaft diameter	Cone 1/10
Protection class shaft input	IP40
Protection class housing	IP40
Shaft load axial / radial	for tapered solid shaft: 20 N / 90 N
Max. speed	max. 15 000 rpm
Vibration resistance	≤ 100 m/s² (10 ... 2,000 Hz)
Shock resistance	≤ 1,000 m/s² (6 ms)
Operating temperature	-15 °C ... +120 °C
Connection	PCB connector and cable
Technical Data - electrical	
Supply voltage	DC 5 V ±10 %
Current w/o load typ.	max. 50 mA
Page	319

Motor Feedback - Resolvers

			
Type	**Frameless Resolvers**	**Housed Resolvers Series R 11**	**Housed Industry Resolvers Series R 25**
Special features	■ 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	■ 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	■ 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
Technical Data - mechanical			
Housing diameter	26.5 mm	27 mm	26.5 mm
Technical Data - electrical			
Page	322	323	324

ACURO®-XRobust HENGSTLER

NorthStar™

Heavy Duty Types

Hengstler offers a new series of incremental and abolute encoders in compact size that provide the ruggedness of big magnetic ring kit encoders. Choose from a growing line of Heavy Duty encoders designed to provide reliable operation in harsh duty industrial applications that will not corrode and can withstand temperature extremes from -40°C to +100°C.

Hengstler's Heavy Duty product line offers extreme shock and vibration resistance, special labyrinth sealing options on select models, hazardous environment ATEX certification as well as extreme corrosion and wash down resistant stainless and nickel plated models designed for the special application needs of the food and beverage industry among others.

Examples of applications for Heavy Duty encoders:

- Wind power plants
- Commercial solar plants
- Oil field exploration
  - draw works
  - rough necks
- Construction machinery
- Utility vehicles/ tucks
- Steel mills
- Paper mills
- Saw mills
- Gantry cranes
- Marine equipment
- Offshore applications
- Food & beverage
- Filling plants
- Paper processing
- Converting machinery
- Material handling
- Your individual application

Incremental

- Single or Dual output
- ATEX Certfication available for Intrinsically Safe application
- High Resolution Unbreakable Disk
- Industrial Duty Connector
- NEMA 4X / IP67 Rated
- Nickel or Stainless Steel Housing available

NUMBER OF PULSES

0001 / 0024 / 0025 / 0035 / 0040 / 0060 / 0100 / 0120 / 0192 / 0200 / 0240 / 0250 / 0256 / 0300 / 0360 / 0500 / 0512 / 0600 / 0625 / 0720 / 1000 / 1024 / 1200 / 1250 / 1440 / 2000 / 2048 / 2500 / 2540 / 3600

GENERAL INFORMATION

HARSH-DUTY OPTICAL ENCODER

The HD20 Harsh-Duty Optical Encoder is a compact heavy-duty encoder designed to exceed IP66/IP67 and NEMA 6 enclosure requirements. It is also available in stainless steel that exceeds NEMA 4X and NEMA 6P requirements and is ideal for stringent wash down environments, including those where high pressure steam or caustic chemicals are needed to meet regulatory requirements.

The HD20 features max. 440N Axial and Radial Bearings, -40° to +100°C temperature range and unique labyrinth double-sealed housing, and optional dual "redundant" outputs and is covered by a two-year warranty (one year for bearings). NorthStar's traditional quality, reliability and value are built-in to every HD20 encoder.

Also available in this series, is an Intrinsically Safe version certified to ATEX EEx ia IIB T4 when used with the appropriate IS Barrier. Accessory barriers can be supplied with the encoder.

APPLICATIONS

The HD20 Harsh-Duty Optical Encoder is ideal for machine applications with corrosive environments that demand heavy washdown protection. This compact, special-duty encoder is designed to excede IP66/IP67 and NEMA 6 enclosure requirements with a PPR range through 3600. ATEX certification is also available for intrinsically safe applications.

- Converting Machinery
- Material Handling
- Packaging Equipment
- Pickling Equipment
- Processing Equipment

Industries

Chemical, Food & Beverage, Oil & Gas, Paper, Steel and any other where a precise encoder is needed to operate in harsh environments.

TECHNICAL DATA
mechanical

Housing diameter	52.3 mm
Shaft diameter	9.52 mm / 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange
Protection class shaft input (EN 60529)	NEMA 4X or IP67
Protection class housing (EN 60529)	NEMA 4X or IP67

Heavy Duty HD 20

Incremental

TECHNICAL DATA
mechanical (continued)

Shaft load axial / radial	max.: 440 N / 440 N
Max. speed	max. 6000 rpm
Bearing life	max. 5 x 10^{11} revs.
Starting torque typ.	< 1.76 Ncm
Vibration resistance (DIN EN 60068-2-6)	200 m/s² (5 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	500 m/s² (11 ms)
Operating temperature	-40 °C ... +100 °C ATEX: -40 °C ... +80 °C
Material shaft	Stainless Steel
Material housing	Hard anodized Aluminum, Nickel
Weight	approx. 430 g
Connection	MS, radial M12 connector, radial Cable, radial

TECHNICAL DATA
electrical

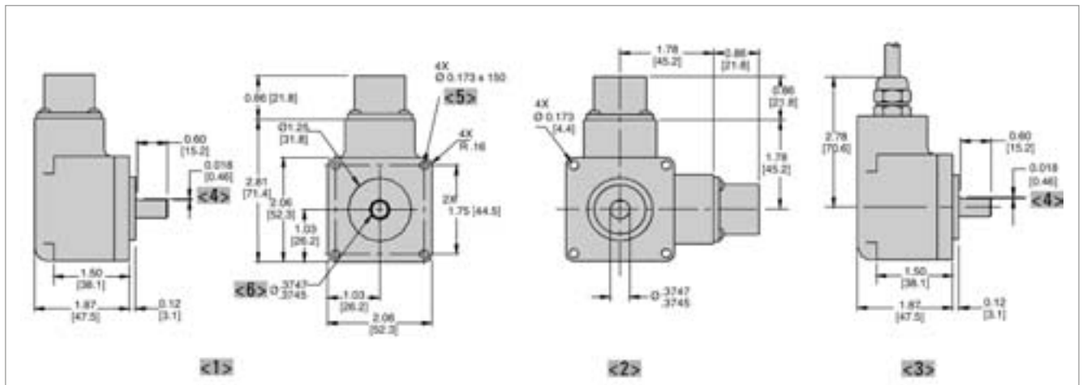
Supply voltage	DC 5 - 26 V ATEX: DC 5 V ATEX: DC 7 - 26 V
Current w/o load typ.	50 mA
Code	Incremental, optical
Max. pulse frequency	125 kHz
Phasing	Incremental signals (A leads B): A leads B by 90° for ccw shaft rotation viewing the shaft clamp end of the encoder
Pulse shape	Square wave

ELECTRICAL CONNECTIONS
6, 7 & 10 Pin MS connector / Cable

Encoder Function	Cable 6 Pin Single Ended		Cable 7 Pin Single Ended		Cable 7 Pin Dif Line Drv w/o Idx		Cable 10 Pin Dif Line Drv w/ Idx		Cable Exit with Seal
	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Wire Color
Sig. A	E	brown	A	brown	A	brown	A	brown	green
Sig. B	D	orange	B	orange	B	orange	B	orange	blue
Sig. Z	C	yellow	C	yellow	--	--	C	yellow	orange
Power +V	B	red	D	red	D	red	D	red	red
Com	A	black	F	black	F	black	F	black	black
Case	--	--	G	green	G	green	G	green	white
N/C	F	--	E	--	--	--	E	--	--
Sig $\overline{A}$	--	--	--	--	C	brown/white	H	brown/white	violet
Sig $\overline{B}$	--	--	--	--	E	orange/white	I	orange/white	brown
Sig $\overline{Z}$	--	--	--	--	--	--	J	yellow/white	yellow

Incremental

DIMENSIONED DRAWINGS



<1> Standard Housing
<2> Dual Redundant Outputs
<3> Cable Exit

<4> Flat
<5> Thru hole for 8-32
<6> Shaft diameter

Dimensions in inch [mm]

Heavy Duty HD 20

Incremental

ORDERING INFORMATION

Type	Format	Number of pulses	Shaft Ø	Output [6]	Connection [1]	Housing, Tether, Options [2, 3, 4, 5]
HD20	**3** Bidirectional with Index	**1 ... 3600**	**0** 9.52 mm (3/8") Solid shaft, with flat **4** 10 mm Solid shaft, no flat	**2** 5-26V in, 5-26V Push-Pull out **3** 5-26V in, 5-26V Differential Line Driver out (7272) **4** 5-26V in, 5V Differential Line Driver out (7272)	**3** 7 pin connector **5** 10 pin connector **D** Sealed cable, 0.45 m **E** Sealed cable, 0.9 m **F** Sealed cabel, 1.8 m **G** Sealed cable, 3.0 m **H** Sealed cable, 4.5 m	**0** No Options **1** Nickel Finish Housing **2** Stainless Steel Housing **3** Redundant Outputs (Dual Connector Housing) **4** Nickel Finish Housing with Redundant Outputs **5** Stainless Steel Housing with Redundant Outputs **A** Same as "0" with ATEX Typ 1 **B** Same as "1" with ATEX Typ 1 **C** Same as "2" with ATEX Typ 1 **D** Same as "3" with ATEX Typ 1 **E** Same as "4" with ATEX Typ 1 **F** Same as "5" with ATEX Typ 1 **G** Same as "0" with ATEX Typ 2 **H** Same as "1" with ATEX Typ 2 **I** Same as "2" with ATEX Typ 2 **J** Same as "3" with ATEX Typ 2 **K** Same as "4" with ATEX Typ 2 **L** Same as "5" with ATEX Typ 2 **M** Same as "0" with ATEX Typ 3 **N** Same as "1" with ATEX Typ 3 **O** Same as "2" with ATEX Typ 3 **P** Same as "3" with ATEX Typ 3 **Q** Same as "4" with ATEX Typ 3 **R** Same as "5" with ATEX Typ 3

[1] Connection Code "3" only available with Output Code "2"
[2] Available ATEX certified options:
ATEX Type 1: 5 V in, 5 V out
ATEX Type 2: 7-26V in, 7-26V out
ATEX Type 3: 7-26V in, 5V out
Note: When selecting ATEX models, ATEX voltages replace those shown in Output Code.
[3] Housing/Tether/Options Code "G" to "L" only available with Output Code "2" and "3"
[4] Housing/Tether/Options Code "M" to "R" only available with Output Code "4"
[5] Note for Housing with redundant outputs: Simultaneous use of redundant outputs may void ATEX certification. Consult us for details.
[6] Open Collector Output on request

Incremental

- Single or Dual output
- Optional high current line driver
- ATEX Certfication available for Intrinsically Safe application
- High Resolution Unbreakable Disk
- Industrial Duty Connector
- NEMA 4X / IP67 Rated
- Nickel or Stainless Steel Housing available

NUMBER OF PULSES

0001 / 0025 / 0035 / 0040 / 0050 / 0060 / 0100 / 0120 / 0192 / 0200 / 0240 / 0250 / 0256 / 0300 / 0360 / 0500 / 0512 / 0600 / 0625 / 0720 / 0900 / 1000 / 1024 / 1200 / 1250 / 1440 / 1524 / 1600 / 1800 / 2000 / 2048 / 2500 / 2540 / 3000 / 3048 / 3600 / 4096 / 5000

GENERAL INFORMATION

HARSH-DUTY OPTICAL ENCODER

The HD25 Harsh-Duty Optical Encoder is a compact heavy-duty encoder designed to exceed IP66/IP67 and NEMA 6 enclosure requirements. It is also available in stainless steel that exceeds NEMA 4X and NEMA 6P requirements and is ideal for stringent wash down environments, including those where high pressure steam or caustic chemicals are needed to meet regulatory requirements.

The HD25 features max. 440N Axial and Radial Bearings, -40° to +100°C temperature range and unique labyrinth double-sealed housing, and optional dual "redundant" outputs and is covered by a two-year warranty (one year for bearings). NorthStar's traditional quality, reliability and value are built-in to every HD25 encoder.

Also available in this series, is an Intrinsically Safe version certified to ATEX EEx ia IIB T4 when used with the appropriate IS Barrier. Accessory barriers can be supplied with the encoder.

APPLICATIONS

The HD25 Harsh-Duty Optical Encoder is ideal for machine applications with corrosive environments that demand heavy washdown protection. This compact, special-duty encoder is designed to excede IP66/IP67 and NEMA 6 enclosure requirements with a PPR range through 5000. ATEX certification is also available for intrinsically safe applications.

- Converting Machinery
- Material Handling
- Packaging Equipment
- Pickling Equipment
- Processing Equipment

Industries

Chemical, Food & Beverage, Oil & Gas, Paper, Steel and any other where a precise encoder is needed to operate in harsh environments.

TECHNICAL DATA
mechanical

Housing diameter	67.3 mm
Shaft diameter	3/8" / 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange
Protection class shaft input (EN 60529)	NEMA 4X or IP67

Heavy Duty HD 25

Incremental

TECHNICAL DATA
mechanical (continued)

Protection class housing (EN 60529)	NEMA 4X or IP67
Shaft load axial / radial	max.: 440 N / 440 N
Max. speed	max. 6000 rpm
Bearing life	max. 5 x 10^{11} revs.
Starting torque typ.	< 1.76 Ncm
Vibration resistance (DIN EN 60068-2-6)	200 m/s² (5 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	500 m/s² (11 msec)
Operating temperature	-40 °C ... +100 °C ATEX: -40 °C ... +80 °C
Material shaft	Stainless Steel
Material housing	Hard anodized Aluminum, Nickel, Stainless Steel
Weight	approx. 430 g
Connection	MS, radial M12 connector, radial

TECHNICAL DATA
electrical

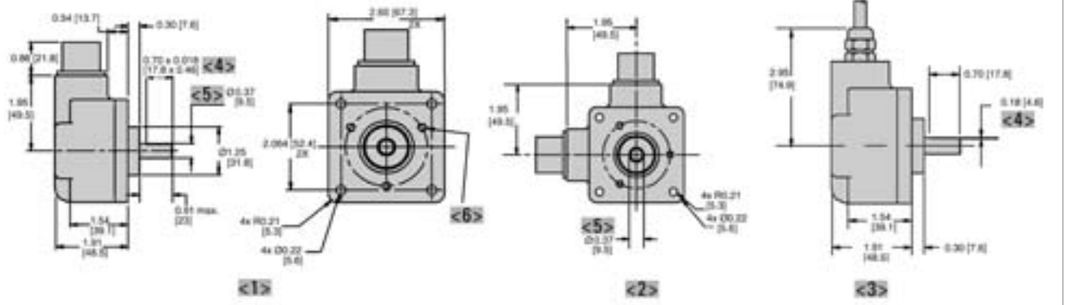
Supply voltage	DC 5 - 26 V ATEX: DC 5 V ATEX: DC 7 - 26 V
Current w/o load typ.	50 mA
Code	Incremental, optical
Max. pulse frequency	125 kHz
Phasing	Incremental signals (A leads B): A leads B by 90° for ccw shaft rotation viewing the shaft clamp end of the encoder
Pulse shape	Square wave

ELECTRICAL CONNECTIONS
6, 7 & 10 Pin MS connector / Cable

Encoder Function	Cable 6 Pin Single Ended		Cable 7 Pin Single Ended		Cable 7 Pin Dif Line Drv w/o Idx		Cable 10 Pin Dif Line Drv w/ Idx		Cable Exit with Seal
	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Wire Color
Sig. A	E	brown	A	brown	A	brown	A	brown	green
Sig. B	D	orange	B	orange	B	orange	B	orange	blue
Sig. Z	C	yellow	C	yellow	--	--	C	yellow	orange
Power +V	B	red	D	red	D	red	D	red	red
Com	A	black	F	black	F	black	F	black	black
Case	--	--	G	green	G	green	G	green	white
N/C	F	--	E	--	--	--	E	--	--
Sig $\overline{A}$	--	--	--	--	C	brown/white	H	brown/white	violet
Sig $\overline{B}$	--	--	--	--	E	orange/white	I	orange/white	brown
Sig $\overline{Z}$	--	--	--	--	--	--	J	yellow/white	yellow

Incremental

DIMENSIONED DRAWINGS



<1> Standard Housing
<2> Dual Redundant Outputs
<3> Cable Exit
<4> Flat

<5> Shaft diameter
<6> 10-32 UNF 2B x 0.38" deep on 1.875" bolt circle

Dimensions in inch [mm]

Incremental

ORDERING INFORMATION

Type	Format	Number of pulses	Shaft Ø [7]	Output [6]	Connection [1]	Housing, Tether, Options [2, 3, 4, 5]
HD25	**3** Bidirectional with Index	**1 ... 5000**	**0** 9.52 mm (3/8") **4** 10 mm **6** 12 mm	**2** 5-26V in, 5-26V Push-Pull out **3** 5-26V in, 5-26V Differential Line Driver out (7272) **4** 5-26V in, 5V Differential Line Driver out (7272) **6** 5-15V in, 5-15V Differential Line Driver out (4469)	**3** 7 pin connector **5** 10 pin connector **D** Sealed cable, 0.45 m **E** Sealed cable, 0.9 m **F** Sealed cabel, 1.8 m **G** Sealed cable, 3.0 m **H** Sealed cable, 4.5 m **P** Sealed cable, 5.0 m	**0** No Options **1** Nickel Finish Housing **2** Stainless Steel Housing **3** Redundant Outputs (Dual Connector Housing) **4** Nickel Finish Housing with Redundant Outputs **5** Stainless Steel Housing with Redundant Outputs **A** Same as "0" with ATEX Typ 1 **B** Same as "1" with ATEX Typ 1 **C** Same as "2" with ATEX Typ 1 **D** Same as "3" with ATEX Typ 1 **E** Same as "4" with ATEX Typ 1 **F** Same as "5" with ATEX Typ 1 **G** Same as "0" with ATEX Typ 2 **H** Same as "1" with ATEX Typ 2 **I** Same as "2" with ATEX Typ 2 **J** Same as "3" with ATEX Typ 2 **K** Same as "4" with ATEX Typ 2 **L** Same as "5" with ATEX Typ 2 **M** Same as "0" with ATEX Typ 3 **N** Same as "1" with ATEX Typ 3 **O** Same as "2" with ATEX Typ 3 **P** Same as "3" with ATEX Typ 3 **Q** Same as "4" with ATEX Typ 3 **R** Same as "5" with ATEX Typ 3

[1] Output Code "3" only available with Format Code "2"
[2] Available ATEX certified options:
ATEX Type 1: 5 V in, 5 V out
ATEX Type 2: 7-26V in, 7-26V out
ATEX Type 3: 7-26V in, 5V out
Note: When selecting ATEX models, ATEX voltages replace those shown in Output Code.
[3] Housing/Tether/Options Code "G" to "L" only available with Output Code "2" and "3"
[4] Housing/Tether/Options Code "M" to "R" only available with Output Code "4"
[5] Note for Housing with redundant outputs: Simultaneous use of redundant outputs may void ATEX certification. Consult us for details.
[6] Open Collector Output on request
[7] Shaft options 9.52 mm and 10 mm with flat

Incremental

- Single or Dual output
- ATEX Certfication available for Intrinsically Safe application
- High Resolution Unbreakable Disk
- Industrial Duty Connector
- NEMA 4X, 6 / IP66, 67 Rated
- Nickel or Stainless Steel Housing available

NUMBER OF PULSES

0001 / 0024 / 0035 / 0040 / 0050 / 0060 / 0100 / 0120 / 0192 / 0200 / 0240 / 0250 / 0256 / 0300 / 0360 / 0500 / 0512 / 0600 / 0625 / 0720 / 1000 / 1024 / 1200 / 1250 / 1440 / 2000 / 2048 / 2500 / 2540 / 3000 / 3600

GENERAL INFORMATION

HARSH-DUTY OPTICAL HUB SHAFT ENCODER

NorthStar's HSD25 Harsh-Duty Optical Hub Shaft Encoder accepts up to 0.75" diameter shafts and operates reliably from -40 to +100°C. The hard anodized finish encoder exceeds IP66/IP67 and NEMA 6 enclosure requirements.

This robust encoder is also available in Stainless Steel to meet NEMA 4x and 6P requirements and its sealed housing allows the Encoder to be operated when regulatory washdown and high pressure steam or caustic chemicals are required. Utilization of an advanced Opto ASIC with innovative packaging techniques enables the encoder to operate in high shock and vibration environments.

The HSD25 is also available in an Intrinsically Safe version certified to ATEX EEx ia IIB T4 when used with the appropriate IS barrier.

APPLICATIONS

The HSD25 Harsh-Duty Optical Encoder features simple installation on motor or machine hub shafts. It is often mounted on the back of motors where encoder feedback is needed in harsh environment applications. Available housing options make it ideal use in corrosive environments that demand heavy washdown protection. ATEX certification is also available for intrinsically safe applications.

- Converting Machinery
- Material Handling
- Packaging Equipment
- Oil Field Exploration
- Processing Equipment

INDUSTRIES

Chemical, Food & Beverage, Oil & Gas, Paper, Steel and any other where a precise encoder is needed to operate in harsh environments.

TECHNICAL DATA mechanical

Housing diameter	58.93 mm
Shaft diameter	3/8" / 10 mm / 12.7 mm / 5/8" / 3/4" (Hubshaft)
Flange (Mounting of housing)	Tether
Mounting of shaft	Front clamping ring
Protection class shaft input (EN 60529)	NEMA 4X or NEMA 6 IP66 or IP67

Heavy Duty HSD 25

Incremental

TECHNICAL DATA mechanical (continued)

Protection class housing (EN 60529)	NEMA 4X or NEMA 6 IP66 or IP67
Bearing life	max. 5 x 10^{11} revs.
Starting torque typ.	< 1.76 Ncm
Vibration resistance (DIN EN 60068-2-6)	200 m/s² (5 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	500 m/s² (11 sec)
Operating temperature	-40 °C ... +100 °C ATEX: -40 °C ... +80 °C
Material shaft	Stainless Steel
Material housing	Hard anodized Aluminum, Nickel, Stainless Steel
Weight	approx. 600 g
Connection	MS, radial M12 connector, radial Cable, radial

TECHNICAL DATA electrical

Supply voltage	DC 5 - 26 V ATEX: DC 5 V ATEX: DC 7 - 26 V
Current w/o load typ.	50 mA
Code	Incremental, optical
Max. pulse frequency	125 kHz
Phasing	Incremental signals (A leads B): A leads B by 90° for ccw shaft rotation viewing the shaft clamp end of the encoder
Pulse shape	Square wave

ELECTRICAL CONNECTIONS 6, 7 & 10 Pin MS connector / Cable

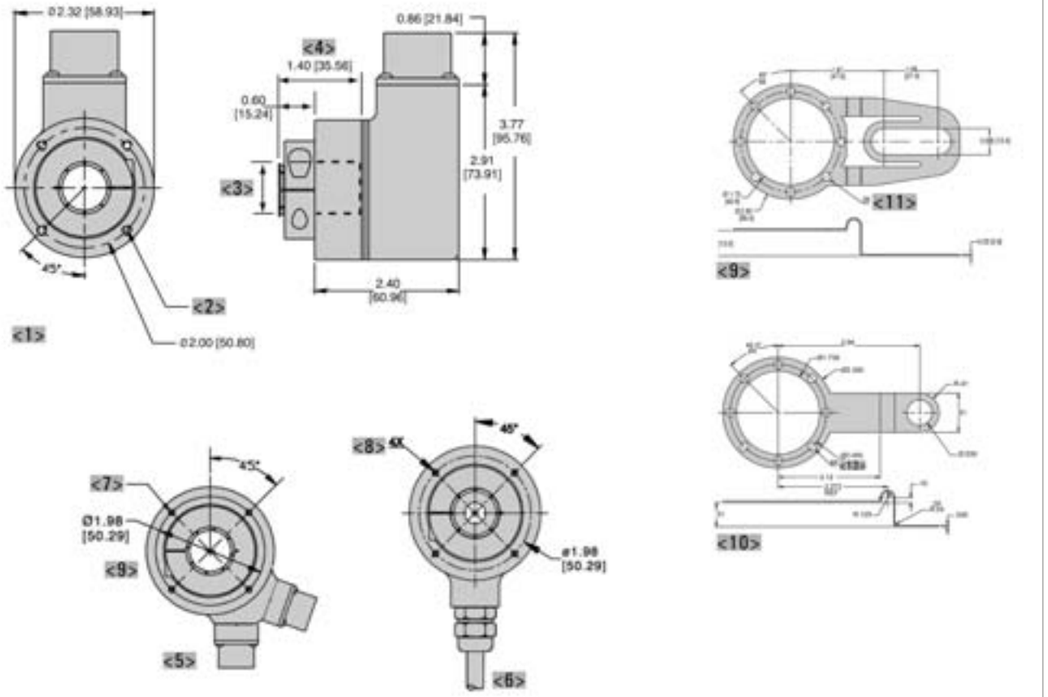
Encoder Function	Cable 6 Pin Single Ended		Cable 7 Pin Single Ended		Cable 7 Pin Dif Line Drv w/o Idx		Cable 10 Pin Dif Line Drv w/ Idx		Cable 12 Pin CCW		Cable Exit with Seal
	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Wire Color
Sig. A	E	brown	A	brown	A	brown	A	brown	5	brown	green
Sig. B	D	orange	B	orange	B	orange	B	orange	8	orange	blue
Sig. Z	C	yellow	C	yellow	--	--	C	yellow	3	yellow	orange
Power +V	B	red	D	red	D	red	D	red	12	red	red
Com	A	black	F	black	F	black	F	black	10	black	black
Case	--	--	G	green	G	green	G	green	9	--	white
N/C	F	--	E	--	--	--	E	--	7	--	--
Sig. $\overline{A}$	--	--	--	--	C	brown/white	H	brown/white	6	brown/white	violet
Sig. $\overline{B}$	--	--	--	--	E	orange/white	I	orange/white	1	orange/white	brown
Sig. $\overline{Z}$	--	--	--	--	--	--	J	yellow/white	4	yellow/white	yellow
0 Volt Sense	--	--	--	--	--	--	--	--	2	green	--
5 Volt Sense	--	--	--	--	--	--	--	--	11	black/white	--

Incremental

ELECTRICAL CONNECTIONS
5 & 8 Pin M12 Accessory Cable

Encoder Function	Cable 5 Pin Single Ended		Cable 8 Pin Single Ended		Cable 8 Pin Differential	
	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color
Sig. A	4	black	1	brown	1	brown
Sig. B	2	white	4	orange	4	orange
Sig. Z	5	grey	6	yellow	6	yellow
Power +V	1	brown	2	red	2	red
Com	3	blue	7	black	7	black
Sig. $\overline{A}$					3	brown/white
Sig. $\overline{B}$					5	orange/white
Sig. $\overline{Z}$					8	yellow/white

DIMENSIONED DRAWINGS



<1> Standard Housing
<2> 8-32 UNC x .28 deep on 2.000 bolt circel 4 places 90° apart
<3> Bore diameter
<4> Hub shaft cavity maximum depth
<5> Dual Redundant Outputs
<6> Cable Exit
<7> 4-40 x .25 deep 4 places - 90° apart
<8> 4-40 x .25 deep 90° apart
<9> Slotted Tether
<10> Single Point Tether
<11> Ø 0.172 [43.7] ON Ø 2.00 [50.8] B.C.

Dimensions in inch [mm]

Incremental

ORDERING INFORMATION

Type [1]	Number of pulses	Shaft Ø	Output format [2,3]	Connection	Options	Special options
☐	☐	☐	☐	☐	☐	☐
HSD25 Heavy Duty Solid shaft encoder **ISD25** ATEX Heavy Duty Solid shaft encoder	**1 ... 3600**	**0** 6.0 mm **3** 8.0 mm **4** 9.25 mm (3/8") **5** 10.00 mm **6** 12.00 mm **7** 12.7 mm (1/2") **8** 5/8" **9** 15.00 mm **A** 16.00 mm **C** 19.00 mm	**0** bidirectional with index, 5-26 V push-pull **6** bidirectional, inverted with index, 5 V out (7272) **7** bidirectional, inverted with index, 5-26 V out (7272) **A** bidirectional with index 7-26 V in, 7-26 V out push pull (7272) **C** bidirectional with index, 5 V in, 5 V out push pull (7272) **K** bidirectional, inverted with index, 5 V in, 5 V out (7272) **L** bidirectional, inverted with index, 7-26 V in, 7-26 V out (7272) **M** bidirectional, inverted with index, 7-26 V in, 5 V out (7272)	**1** 7 pin connector **2** 10 pin connector **6** 7 pin connector plus mating connector **7** 10 pin connector plus mating connector **8** 12 pin connector plus mating connector **A** Cable 0,5 m **C** Cable 1 m **D** Cable 2 m **E** Cable 3 m **L** Cable 4 m **J** M12 connector, 8 pole **K** 0.45 m cable with in line 10 pin connector **M** M12 connector, 8 pole **N** M12 connector, 8 pole	**0** No Options **1** Slotted Tether **2** Single point Tether **3** No tether, Dual isolated outputs **4** Slotted Tether, Dual isolated outputs **5** Single Point Tether, isolated Outputs	**Blank** None **01** Nickel Plated **02** Stainless Steel

[1] Type HSD25 is only available with Output format "0", "6" and "7"; Output formats "A", "C", "K", "L" and "M" are available with Type ISD25
[2] Output format "K", "L", "M", "6" and "7" are not available in the combination with Connection "1", "6", "H" respectively Option "3", "4" and "5"
[3] Output format Open collector on request

Incremental

- Single or Dual Output
- Double-Sealed Housing
- ATEX Certification for Intrinsically Safe Applications
- High Resolution Unbreakable Disk
- Electrically and Thermally Isolated
- Industrial Duty Connector
- NEMA 4X, 6 / IP66, 67 Rated
- Rugged Cast-Aluminum Housing
- Stainless Steel Housing Available

NUMBER OF PULSES

0015 / 0032 / 0100 / 0200 / 0240 / 0250 / 0500 / 0512 / 0600 / 1000 / 1024 / 1200 / 2000 / 2048 / 2500 / 4000 / 5000

GENERAL INFORMATION

EXTREME HEAVY DUTY HOLLOWSHAFT ENCODER

NorthStar's HSD37 Extreme Duty Industrial Hollowshaft Encoder accepts up to 1" diameter shafts and operates reliably from -40 to +100°C. Its Hard Anodized finish enclosure exceeds IP66/IP67 and NEMA 6 enclosure requirements.

This robust encoder features a double-sealed housing that allows application where regulatory washdown or caustic chemicals are present. Utilization of an advanced Opto ASIC with innovative packaging techniques enables the encoder to operate in high shock and vibration environments.

It is also available in an Intrinsically Safe version, certified to ATEX EEx ia IIB T4, when used with the appropriate IS Barrier.

APPLICATIONS

The HSD37 extreme duty encoder features simple installation on motor or machine shafts. It is often mounted on the back of motors where encoder feedback is needed in harsh environment applications. It is ideal for use in environments that demand heavy washdown protection.

- Converting Machinery
- Material Handling
- Packaging Equipment
- Processing Equipment

Industries

Chemical, Food & Beverage, Oil & Gas, Paper, Steel and any other where a precise encoder is needed to operate in harsh environments.

TECHNICAL DATA
mechanical

Housing diameter	95.25 mm
Shaft diameter	12 mm / 1/2" / 15 mm / 5/8" / 16 mm / 3/4" / 0.875" (Through hollow shaft)
Flange (Mounting of housing)	Tether
Mounting of shaft	Front clamping ring
Protection class shaft input (EN 60529)	NEMA 4X or NEMA 6 IP66 or IP67

Incremental

TECHNICAL DATA
mechanical (continued)

Protection class housing (EN 60529)	NEMA 4X or NEMA 6 IP66 or IP67
Shaft tolerance	31,75 mm
Bearing life	max. 5 x 10^{11} revs.
Starting torque typ.	2.8 Ncm
Vibration resistance (DIN EN 60068-2-6)	200 m/s² (5 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	500 m/s² (11 msec)
Operating temperature	-40 °C ... +100 °C ATEX: -40 °C ... +80 °C
Material shaft	Aluminum
Material housing	Hard anodized Aluminum, Stainless Steel
Weight	approx. 1000 g
Connection	MS, radial Cable, radial with M12 connector

TECHNICAL DATA
electrical

Supply voltage	DC 5 - 26 V
Current w/o load typ.	50 mA
Code	Incremental, optical
Max. pulse frequency	125 kHz
Phasing	Incremental signals (A leads B): A leads B by 90° for ccw shaft rotation viewing the shaft clamp end of the encoder
Pulse shape	Square wave

ELECTRICAL CONNECTIONS
6, 7 & 10 Pin MS connector / Cable

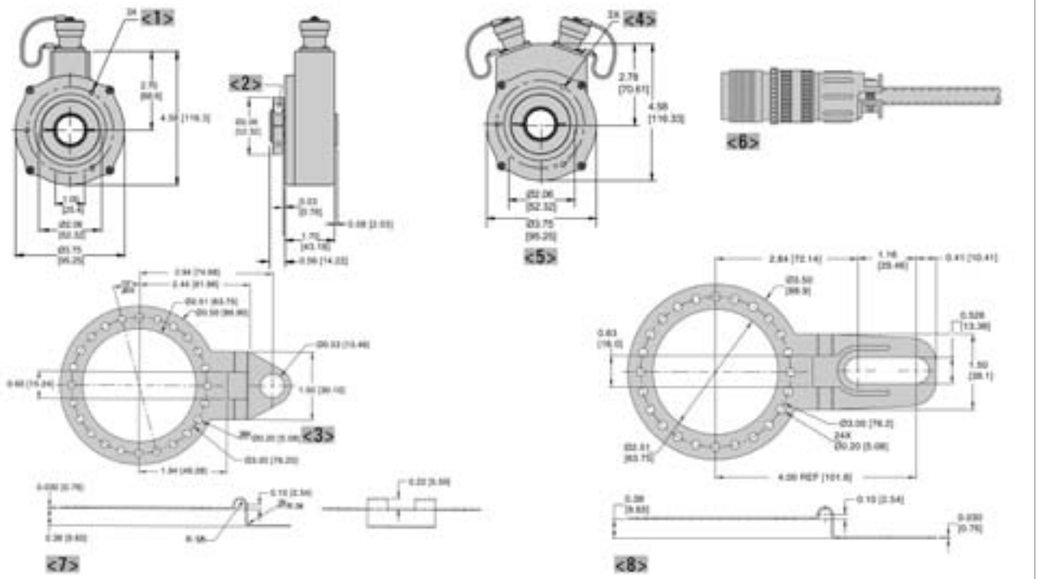
Encoder Function	Cable 6 Pin Single Ended		Cable 7 Pin Single Ended		Cable 7 Pin Dif Line Drv w/o Idx		Cable 10 Pin Dif Line Drv w/ Idx		Cable Exit with Seal
	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Wire Color
Sig. A	E	brown	A	brown	A	brown	A	brown	green
Sig. B	D	orange	B	orange	B	orange	B	orange	blue
Sig. Z	C	yellow	C	yellow	--	--	C	yellow	orange
Power +V	B	red	D	red	D	red	D	red	red
Com	A	black	F	black	F	black	F	black	black
Case	--	--	G	green	G	green	G	green	white
N/C	F	--	E	--	--	--	E	--	--
Sig $\overline{A}$	--	--	--	--	C	brown/white	H	brown/white	violet
Sig $\overline{B}$	--	--	--	--	E	orange/white	I	orange/white	brown
Sig $\overline{Z}$	--	--	--	--	--	--	J	yellow/white	yellow

Incremental

ELECTRICAL CONNECTIONS
5 & 8 Pin M12 Accessory Cable

Encoder Function	Cable 5 Pin Single Ended		Cable 8 Pin Single Ended		Cable 8 Pin Differential	
	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color
Sig. A	4	black	1	brown	1	brown
Sig. B	2	white	4	orange	4	orange
Sig. Z	5	grey	6	yellow	6	yellow
Power +V	1	brown	2	red	2	red
Com	3	blue	7	black	7	black
Sig. $\overline{A}$					3	brown/white
Sig. $\overline{B}$					5	orange/white
Sig. $\overline{Z}$					8	yellow/white

DIMENSIONED DRAWINGS



<1> 10-32 UNF x .38 deep on a Ø 3.000 bolt circle
<2> 10-32 clamp screw
<3> on 3.00 [76.20] bolt circle
<4> 10-32 UNF x .38 deep on a Ø 3.000 bolt circle
<5> Redundant Version
<6> Pigtail with MS Connector (K Option)
<7> Single Point Tether
<8> Slotted Tether

Dimensions in inch [mm]

Incremental

ORDERING INFORMATION

Type [1]	Number of pulses	Shaft Ø	Output format [2,3]	Connection	Options	Special options
☐	☐	☐	☐	☐	☐	☐
HSD37 Heavy Duty Hollow-shaft encoder **ISD37** Atex Intrinsically Safe	**15 ... 5000**	**0** 6 mm **1** 1/4" **2** 5/16" **3** 8 mm **4** 3/8" **5** 10 mm **6** 12 mm **7** 1/2" **8** 5/8" **9** 15 mm **A** 16 mm **C** 19 mm **D** 3/4" **E** 20 mm **H** 1" Non Isolated **P** 25 mm Non Isolated **R** 1" Isolated	**0** Single Ended, 5-26 VDC push pull **6** Differential ABZ, 5-26 in, 5V out (7272) **7** Differential ABZ, 5-26 in, 5-26 out (7272) **A** Single Ended ABZ, 7-26V in, 7-26V out push-pull (7272) **C** Single Ended ABZ, 5V in, 5V out push-pull (7272) **K** Differential ABZ, 5V in, 5V out (7272) **L** Differential ABZ, 7-26 in, 7-26 out (7272) **M** Differential ABZ, 7-26 in, 5V out (7272)	**0** 6 pin connector **1** 7 pin connector **2** 10 pin connector **4** 10 pin Bayonet connector **6** 7 pin+mating connector **7** 10 pin+mating connector **8** 12 CW pin+mating connector **9** 10 pin Bayonet+mating connector **A** 0.5 m (18") cable **C** 1 m (36") cable **D** 2 m (72") cable **H** 5 pin M12 connector **J** 8 pin M12 connector **K** 1.5 ft (18") cable w/ in line 10 pin connector **M** 5 ft (60") cable **N** 10 ft (120") cable **T** Terminal box w/ conduit entry	**0** No options **1** Slotted Tether **2** Single point 4.5" C-face tether **3** Single point 8.5" C-face tether **4** Dual isolated Outouts, No tether **5** Dual isolated Outputs, Slotted Tether **6** Dual Isolated Outouts, 4.5" C-face tether **7** Dual isolated Outputs, 8.5" C-face Tether **A** Swivel Rod tether **C** Metric Swivel Rod tether **D** Dual Isolated Outputs, Swivel Rod Tether **E** Dual Isolated Outputs, Metric Swivel Rod Tether **A** 7pin+mating connector **7** 10 pin+mating	**Blank** None **01** Nickel Plated **02** Stainless Steel

[1] Type HSD 37 only available with Output format "0", "6" und "7"
[2] Output format "6", "7", "K", "L" and "M" are not available with connector "1" and "6"
[3] Output format Open Collector on request

Incremental

- Double-Sealed Housing
- High Resolution Unbreakable Disk
- Electrically and Thermally Isolated
- Industrial Duty Connector
- NEMA 4X, 6 / IP66 or IP67 Rated
- Rugged Cast-Aluminum Housing

NUMBER OF PULSES

0015 / 0032 / 0100 / 0200 / 0240 / 0250 / 0500 / 0512 / 0600 / 1000 / 1024 / 1200 / 2000 / 2048 / 2500 / 4000 / 5000

GENERAL INFORMATION

EXTREME HEAVY DUTY HOLLOWSHAFT ENCODER

NorthStar's HSD38 Extreme Duty Industrial Hollowshaft Encoder accepts up to 1" (25,4 mm) diameter shafts and operates reliably from -40 to +100°C. Its Hard Anodized finish enclosure exceeds IP66/IP67 and NEMA 6 enclosure requirements.

This robust encoder features a double-sealed housing that allows application where regulatory washdown and high pressure steam or caustic chemicals are present. Utilization of an advanced Opto ASIC with innovative packaging techniques enables the encoder to operate in high shock and vibration environments.

APPLICATIONS

The HSD38 extreme duty encoder features simple installation on motor or machine shafts. It is often mounted on the back of motors where encoder feedback is needed in harsh environment applications. It is ideal for use in environments that demand heavy washdown protection.

- Converting Machinery
- Material Handling
- Packaging Equipment
- Processing Equipment

Industries

Chemical, Food & Beverage, Paper, Steel and any other where a precise encoder is needed to operate in harsh environments.

TECHNICAL DATA
mechanical

Housing diameter	96.52 mm
Shaft diameter	12 mm / 15 mm / 1/2" / 5/8" / 16 mm / 3/4" / 0.875" (Hubshaft)
Flange (Mounting of housing)	Tether
Mounting of shaft	Front clamping ring
Protection class shaft input (EN 60529)	NEMA 4X or NEMA 6 IP66 or IP67
Protection class housing (EN 60529)	NEMA 4X or NEMA 6 IP66 or IP67
Bearing life	max. 5 x 10^{11} revs.
Starting torque typ.	< 2.8 Ncm
Vibration resistance (DIN EN 60068-2-6)	200 m/s² (5 ... 2000 Hz)

Heavy Duty HSD 38

Incremental

TECHNICAL DATA
mechanical (continued)

Shock resistance (DIN EN 60068-2-27)	500 m/s² (11 msec)
Operating temperature	-40 °C ... +100 °C
Storage temperature	-40 °C ... +100 °C
Material shaft	Aluminum
Material housing	Hard anodized Aluminum
Weight	approx. 800 g
Connection	MS, radial Cable, radial with M12 connector

TECHNICAL DATA
electrical

Supply voltage	DC 5 - 26 V
Current w/o load typ.	50 mA
Code	Incremental, optical
Max. pulse frequency	125 kHz
Phasing	Incremental signals (A leads B): A leads B by 90° for ccw shaft rotation viewing the shaft clamp end of the encoder
Pulse shape	Square wave

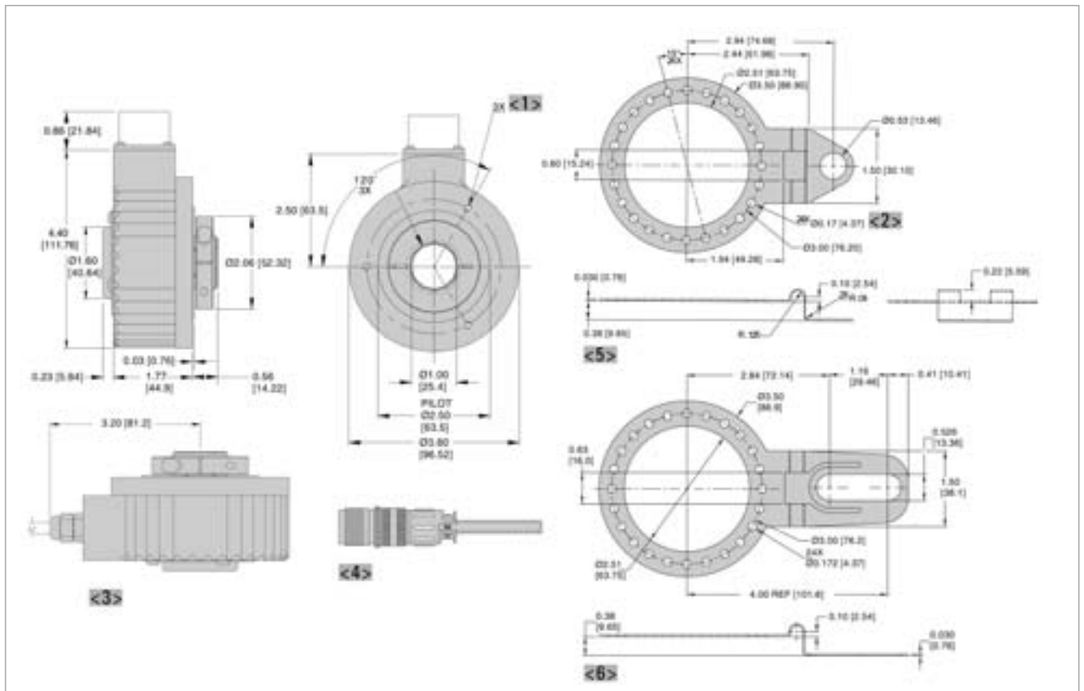
ELECTRICAL CONNECTIONS
6, 7 & 10 Pin MS connector / Cable

Encoder	Cable 6 Pin		Cable 7 Pin		Cable 7 Pin		Cable 10 Pin		Cable Exit
Function	Single Ended		Single Ended		Dif Line Drv w/o Idx		Dif Line Drv w/ Idx		with Seal
	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Wire Color
Sig. A	E	brown	A	brown	A	brown	A	brown	green
Sig. B	D	orange	B	orange	B	orange	B	orange	blue
Sig. Z	C	yellow	C	yellow	--	--	C	yellow	orange
Power +V	B	red	D	red	D	red	D	red	red
Com	A	black	F	black	F	black	F	black	black
Case	--	--	G	green	G	green	G	green	white
N/C	F	--	E	--	--	--	E	--	--
Sig $\overline{A}$	--	--	--	--	C	brown/white	H	brown/white	violet
Sig $\overline{B}$	--	--	--	--	E	orange/white	I	orange/white	brown
Sig $\overline{Z}$	--	--	--	--	--	--	J	yellow/white	yellow

ELECTRICAL CONNECTIONS
5 & 8 Pin M12 Accessory Cable

Encoder Function	Cable 5 Pin Single Ended		Cable 8 Pin Single Ended		Cable 8 Pin Differential	
	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color
Sig. A	4	black	1	brown	1	brown
Sig. B	2	white	4	orange	4	orange
Sig. Z	5	grey	6	yellow	6	yellow
Power +V	1	brown	2	red	2	red
Com	3	blue	7	black	7	black
Sig. $\overline{A}$					3	brown/white
Sig. $\overline{B}$					5	orange/white
Sig. $\overline{Z}$					8	yellow/white

DIMENSIONED DRAWINGS



<1> 8-32 x .22 deep on 3.000 bolt circle
<2> On 3.00 [76.20] bolt circle
<3> Optional cable output
<4> Pigtail with MS Connector (K Option)
<5> Single Point Tether
<6> Slotted Tether

Dimensions in inch [mm]

Heavy Duty HSD 38
Incremental

ORDERING INFORMATION

Type	Number of pulses	Shaft Ø	Output format [1]	Connection	Safety	Special options
☐	☐	☐	☐	☐	☐	☐
HSD38	**15 ... 5000**	**6** 12 mm **7** 12.7 mm (1/2") **9** 15 mm **A** 16 mm **C** 3/4"	**22** bidirectional with index, 5-26 V push-pull out **43** birectional inverted with index, 5-26 V differential kine driver out (7272) **44** birectional inverted with index, 5-26 V in, 5 V differential line driver out (7272)	**1** 7 pin connector **2** 10 pin connector **6** 7 pin connector plus mating connector **7** 10 pin connector plus mating connector **A** Cable 0,5 m **G** Cable, 0.3 m **J** M12 connector, 8 pole **K** 0.5 m cable with 10 pin in-line connector	**0** Reserved for Future Options	**0** Cast Aluminum Housing, Slotted Tether **C** Cast Aluminum Housing, Single-Point Tether Included (NEMA 4.5" C-face) **6** Cast Aluminum Housing, No Tether **M** Swivel-Rod tether with metric hardware

[1] Output format "44" is only available with connection "2", "7", "A", "G", "J" and "K"

Incremental

- Sealed against dust, oil, grease, liquids, vapor and mud
- Designed for high shock and vibration applications
- Electrically isolated from motor shaft
- Rugged cast-aluminum housing
- Advanced ASIC technology and optics
- Easy, hex wrench installation
- High temperature range: -40 ... +100°C

HEAVY DUTY NorthStar CE

GENERAL INFORMATION

EXTREME HEAVY DUTY HOLLOWSHAFT ENCODER

Even electric motors in the harshest environmentsrequire feedback to ensure smooth speed control. In the past, engineers have applied encoders and sensors designed for standard industrial environments into these extremely harsh environments, impacting system reliability and increasing life-cycle costs. Hengstler has the solution.
The heavy rail proven NorthStar HSD44 series optical encoder was designed to be a survivor. This anodized aluminum encoder can survive high levels of shock and vibration, wide temperature extremes, and operating environment contaminants. The HSD44 can withstand the harshest outdoor environments and the toughest industrial applications.
The 1024 pulses-per-revolution (PPR) are provided by arugged, stainless steel disk, which is read from aspecially designed optical sensor. An enormous 0.025"sensor gap reduces sensitivity to shock, vibration, and motor bearing wear. The counter-spiral shaft-coupler-provides a flexible mount that eliminates resonance throughout the operating range and will not fatigue under vibration. Electronics are condensed down to a single ASIC, reducing the likelihood of electronic component failure.
The HSD44 is designed for end-of-motorapplication. Adapter plates are available for common motor styles, and custom adapter plates can be created to fit any application.

APPLICATIONS

The HSD44 is the ideal source of control feedback formotors that drive heavy electric, and hybrid-electricvehicles. It is field proven for reliable operation insevere transportation and industrial environments.

Designed for :

- Heavy Rail
- Commercial Hybrid Electric and Electric Vehicles
- Heavy Duty cranes
- Mining Transport
- Conveyors

INDUSTRIES

Transportation, paper, steel, mining, material handlingand other industries with harsh environments whereprecise and reliable encoder feedback is needed.

TECHNICAL DATA
mechanical

Housing diameter	112 mm
Mounting depth	60 mm
Shaft diameter	16 mm (Flexible coupling)
Protection class shaft input (EN 60529)	NEMA 6 IP67
Shaft tolerance	11.9 to 15.9 mm
Max. speed	max. 6000 rpm
Bearing life	max. 5 x 10^{11} revs.

Heavy Duty HSD 44

Incremental

TECHNICAL DATA
mechanical (continued)

Vibration resistance (DIN EN 60068-2-6)	30 g
Shock resistance (DIN EN 60068-2-27)	200 g
Operating temperature	-40 °C ... +100 °C
Material housing	Hard anodized Aluminum
Weight	ca. 1.8 Kg
Connection	MS, radial Cable, radial with M12 connector

TECHNICAL DATA
electrical

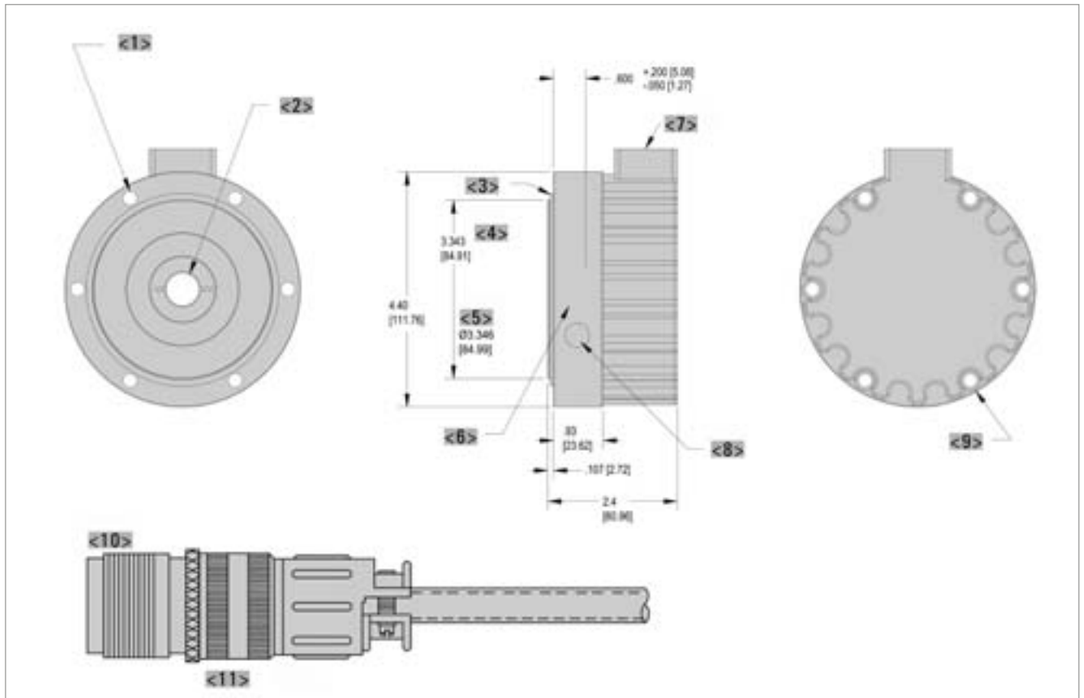
Supply voltage	DC 5-30 V
Current w/o load typ.	50 mA
Code	Incremental, optical
Max. pulse frequency	125 kHz
Phasing	Incremental signals (A leads B): A leads B by 90° for ccw shaft rotation viewing the shaft clamp end of the encoder

ELECTRICAL CONNECTIONS
Cable, MS connector 10 poles

Kabelfarbe	Stecker	Signal
braun	A	Sig.A
orange	B	Sig.B
gelb	C	Sig.Z
rot	D	+UB
schwarz	E	Com.
grün	F	0V
-	G	N.C.
braun/ weiß	H	Sig.A-
orange/ weiß	I	Sig.B-
gelb/ weiß	J	Sig.Z-

Incremental

DIMENSIONED DRAWINGS



<1> Clearance for 1/4-20 SHCS (6) on 03.937(100.0] BC equally spaced
<2> Collar: 10-32 x 1/2 SS SHCS tightened with a 5/32 ball driver allen wrench
<3> O ring
<4> Pilot
<5> Pilot cavity
<6> 16 MM shaft extension I.D. .6295 +.0/-.0005
<7> Cable exit
<8> Shaft clamp access plug
<9> 1/4-20 x 1 SS SHCS supplied with the encoder
<10> MS3101A-18-1P
<11> Pigtail with MS connector (K Option) Dimensions in inch [mm]

ORDERING INFORMATION

Type	Number of pulses	Shaft Ø	Output	Connection
☐	☐	☐	☐	☐
HSD44T	**1024**	**A** 16 mm	**3** 5-26V in, 5-26V Differential Line Driver out (7272)	**A** Cable, 0.5 m **K** 0.5 m cable with 10 pin in-line connector

Absolute


AR 62


AR 63 Stainless

- Single -and multi turn: Resolution up to 28 Bit
- Wearless electronic multi turn: contact -and batterie less, self-energetic
- 300 N axial and radial load
- 200 g shock resistance/ 20 g vibration resistance
- Submersible: Protection class up to IP69K
- High temperature range: -40 ... +100°C
- Compact design: 32 mm mounting depth
- Option: Stainless steel housing

ACURO®-XRobust HEAVY DUTY BISS INTERFACE

SSI CANopen

GENERAL INFORMATION

AR62/ 63 - THE ROBUST ENCODER FOR ALL ENVIRONMENTAL CONDITIONS!

The special features of the AR62/ 63 not only comprise its particularly rugged enclosure, but also generously dimensioned, rigid ball-bearings. Capable of withstanding even high axial and radial loads on its shaft axis, this encoder type easily achieves a mechanical life of 10^9 rotations at a permanent radial load of 200 N and simultaneously, an axial load of 200N.

The AR62/ 63 was designed to easily withstands highest accelerations, extreme climatic fluctuations and even underwater operation. In this way, our rugged absolute encoder is ideally suitable for applications in wind farms, marine or utility vehicle applications, as well as for use in presses or wood and stone processing machinery: applications where high resistance to harsh environments and maximum reliability are required at the same time.

The AR62 is electrically compatible with standard industrial drives. Available interfaces are SSI, BiSS, CANopen and Analogue (0 ... 10 V or 4 ... 20 mA).

Single turn resolution is 12 bit, i.e. one revolution (360°) is resolved into 4096 measuring steps. The AR62/23 comes with a breakthrough multiturn technology, that provides a unique set of advantages:
it operates contact less, self energetic, without battery and moving parts. Standard multi turn resolution is 16 Bit.

With an installed depth of only 32 mm, this encoder is the most compact type in its class. Valuable space has been saved - to the benefit of the overall machinery design.

Absolute

APPLICATIONS

Fields of application that clearly unfold the benefits of ACURO-XR:

- Construction machinery
- Utility vehicles / trucks
- Gantry cranes
- Marine equipment
- Offshore plants
- Wind power plants
- Commercial solar plants
- Food & Beverage Industry
- Filling plants
- Presses
- Your individual application

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Mounting depth	32 mm
Shaft diameter [1]	10 mm (Solid shaft)
Flange (Mounting of housing)	Synchro clamping flange
Protection class shaft input (EN 60529)	IP67 or IP69k
Protection class housing (EN 60529)	IP67 or IP69k
Shaft load axial / radial	max.: 300 N / 300 N
Max. speed	max. 5000 rpm
Starting torque typ.	≤ 4.5 Ncm
Moment of inertia	25 gcm²
Vibration resistance (DIN EN 60068-2-6)	200 m/s²
Shock resistance (DIN EN 60068-2-27)	2000 m/s² (6 ms)
Operating temperature	SSI, BiSS: -40 °C ... +100 °C CANopen, Analog: -40 °C ... +85 °C
Connection	Cable, radial M12 connector, radial

[1] 12 mm shaft on request

TECHNICAL DATA
electrical

Supply voltage	DC 10-30 V Analog: DC 17 - 30 V
EMC	EN 61326-1
Resolution singleturn	12 Bit
Resolution multiturn [1, 2]	12 Bit, 16 Bit
Absolute accuracy [3]	±1°
Repeatability	±0,2°
Control inputs	Preset, Direction

[1] Other resolution on request.
[2] Preset available for SSI, BiSS and Analogue interface.
Preset value: Zero (other on request).
Direction only for SSI.
[3] ±0,6° on request

Heavy Duty AR 62/63

Absolute

ELECTRICAL CONNECTIONS
BiSS/ SSI

Color	PIN (M12, 8 poles)	Signal
yellow	6	Clock
pink	5	Data
green	4	$\overline{\text{Clock}}$
grey	8	$\overline{\text{Data}}$
white	1	UB
brown	2	0 V
red	3	Preset (set to 0) [1]
blue	7	Direction [1]
Screen	Screen	Screen

Preset and Direction high active :
Signal level high: ≥ 66% Ub; low: ≤ 15% Ub or unconnected
Bounce time preset: >2s
Bounce time direction: < 1 ms (dynamic)

ELECTRICAL CONNECTIONS
CANopen

Color cable	PIN (M12, 8 poles)	Signal
yellow	6	CAN in+
green	4	CAN in-
pink	5	CAN out+
grey	8	CAN out-
blue	7	CAN GND in
black*	3	CAN GND out
white	1	UB
brown	2	0 V
Screen	Screen	Screen

* cable color red for extension cable

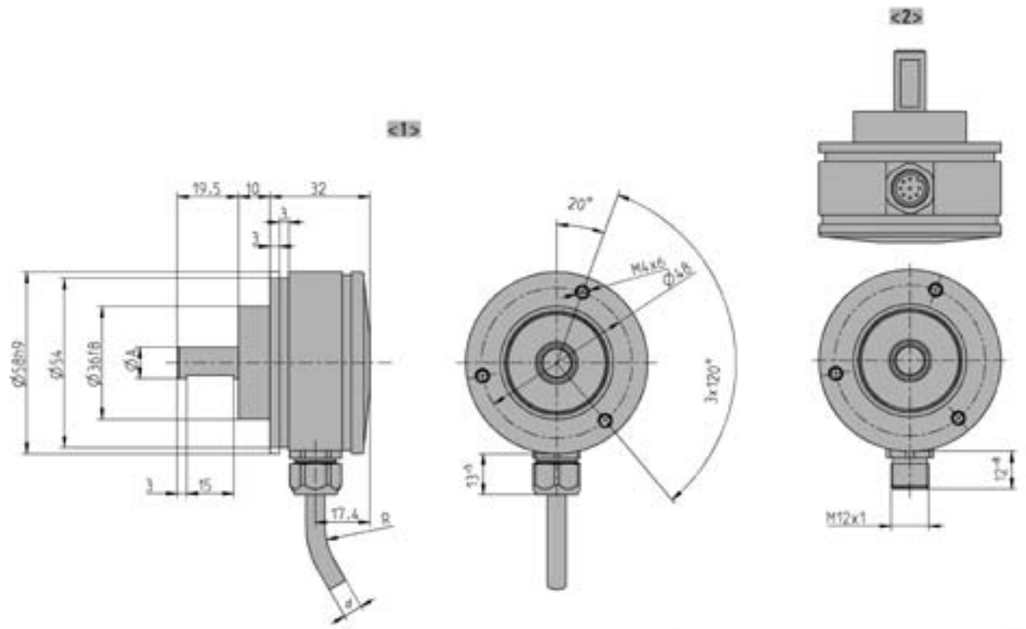
ELECTRICAL CONNECTIONS
Analog

Color Cable	PIN	Signal
pink	5	0 ... 10 V (Voltage output max. 5 mA)
blue	7	0 ... 20 mA or 4 ... 20 mA (current ouput)
grey	8	AGND
red [2]	3	preset (set to 0)
white	1	UB
brown	2	0 V
yellow [1]	6	
green [1]	4	
Screen	Screen	Screen

[1] Diagnostic signals only for service purposes. The cable wires have to be isolated.
[2] Preset low active :
Signal level high: ≤ DC 2 V

DIMENSIONED DRAWINGS

Clamping flange



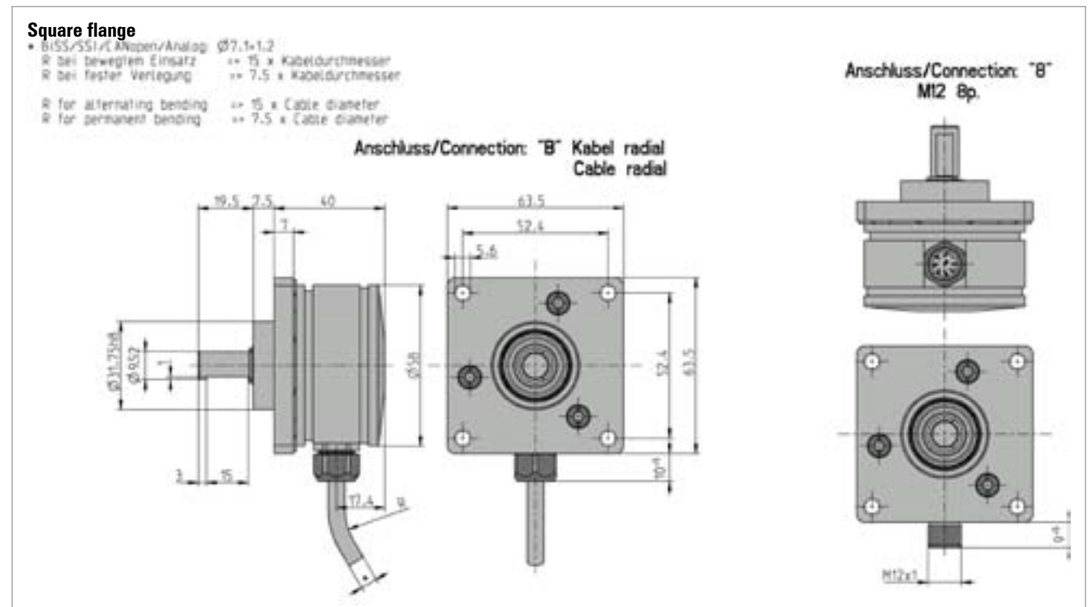
Mouting	
Flange, Protection, Shaft (see ordering information)	Shaft Ø A
L.72	10f8
L.92	10f8

<1> Connection "B": Cable radial
<2> Connection "8": M12, 8 pole
Cable Ø d BiSS/SSI: 7.1$^{+1,2}$
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter

Dimensions in mm

DIMENSIONED DRAWINGS (continued)

Square flange



Dimensions in mm

ORDERING INFORMATION

Type	Resolution [1]	Supply voltage [4]	Flange, Protection, Shaft	Interface [2]	Connection [3]
AR62 Aluminum **AR63** Stainless Steel	**0012** 12 Bit ST **1212** 12 Bit MT + 12 Bit ST **1612** 16 Bit MT + 12 Bit ST	**F** DC 17 - 30 V **E** DC 10 - 30 V	**Q.76** Square, IP67, 9.52 mm **Q.96** Square, IP69K, 9.52 mm **L.72** Synchro clamping, IP67, 10 mm **L.92** Synchro clamping, IP69k, 10 mm	**SG** SSI Gray **OL** CANopen **AV** Analog 0 ... 10 V **A4** Analog 4 ... 20 mA **BG** BiSS Gray	**B** Cable, radial **8** M12 connector, 8 pole, radial

[1] Other resolution on request. MT not available with analog interface (A4, AV) or BiSS interface (BI).
[2] Standard setting CANopen: Bus termination not activated. External bus terminal resistor required.
[3] M12 connector not available with stainless steel housing (AR63). IP67 and IP69k only guaranteed if mating plug connected correctly.
[4] Analog output (AV, A4) only available with DC 17 - 30 V (F).

Absolute

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

Incremental encoders are sensory capable of generating signals in response to rotary movement. In conjunction with mechanical conversion devices, such as rack-and-pinions, measuring wheels or spindles, incremental shaft encoders can also be used to measure linear movement. The shaft encoder generates a signal for each incremental change in position.

With the optical transformation, a line-coded disc made of metal, plastic or glass and positioned on a rotary bearing interrupts the infra red light ray emitted by gallium arsenid sender diode. The number of lines determines the resolution, i.e. the measuring points within a revolution. The interruptions of the light ray are sensed by the receptor element and electronically processed. The information is then made available as a rectangular signal at the encoder output.

Examples for typical applications of incremental encoders:

- Door closing devices
- Desktop robots
- Lens grinding machines
- Plotters
- Testing machines for optical waveguides
- Scattering machines
- Tampon printing machines
- Ultrasonic welding
- Screwing machines
- Labelling machines
- x/y indication
- Analysis devices
- Drilling machines
- Mixing machines

Incremental Solid shaft

- Miniature encoder for industrial use
- Low current consumption
- High noise interference immunity
- Cable lengths of up to 100 m
- Suitable for high pulse frequencies
- High protection class
- Applications: CNC machines, manipulators, motors, medical technology, textile machines

NUMBER OF PULSES

5 / 10 / 20 / 25 / 30 / 50 / 60 / 100 / 120 / 200 / 250 / 256 / 288 / 300 / 360 / 400 / **500** / **512** / 600 / 720 / **1000** / 1024 / 1250 / 1500
Other number of pulses on request
Preferably available versions are printed in bold type.

TECHNICAL DATA
mechanical

Housing diameter	30 mm
Shaft diameter	5 mm (Solid shaft)
Flange (Mounting of housing)	Synchro flange, Pilot flange
Protection class shaft input (EN 60529)	IP64
Protection class housing	IP64
Shaft load axial / radial	5 N / 10 N
Max. speed	max. 10 000 rpm
Starting torque typ.	≤ 0.2 Ncm
Moment of inertia	approx. 0.8 gcm²
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	-10 °C ... +70 °C
Storage temperature	-25 °C ... +85 °C
Material housing	Aluminum
Weight	approx. 60 g
Connection	Cable, axial or radial M16 (Binder), axial

TECHNICAL DATA
electrical

General design	as per DIN VDE 0160, protection class III, contamination level 2, overvoltage class II
Supply voltage	RS422 + Alarm (R), RS422 + Sense (T): DC 5 V ±10 % Push-pull (K): ± 10% DC 5 V or DC 10 - 30 V
Current w/o load typ.	40 mA (DC 5 V), 60 mA (DC 10 V), 30 mA (DC 24 V)
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz
Standard output versions [1, 2]	RS422 + Alarm (R): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$ RS422 + Sense (T): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, Sense Push-pull (K): A, B, N, $\overline{Alarm}$
Pulse width error	± max. 25° electrical
Number of pulses	5 ... 1500

Incremental Solid shaft

TECHNICAL DATA
electrical (continued)

Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Pulse duty factor	1:1

[1] With push-pull (K): pole protection
[2] Output description and technical data see chapter "Technical basics"

ELECTRICAL CONNECTIONS
Cable

Description (push-pull)	Description (RS422)	Lead ◻ mm [2]	Colour
DC 10 - 30 V	DC 5 V	0.5	red
	Sense V_{CC}	0.14	yellow/red
Channel A	Channel A	0.14	white
	Channel $\overline{A}$	0.14	white/brown
Channel B	Channel B	0.14	green
	Channel $\overline{B}$	0.14	green/brown
Channel N	Channel N	0.14	yellow
	Channel $\overline{N}$	0.14	yellow/brown
GND	GND	0.5	black
$\overline{Alarm}$	$\overline{Alarm}$/Sense GND [1]	0.14	yellow/black
screen [2]	screen [2]		screen [2]

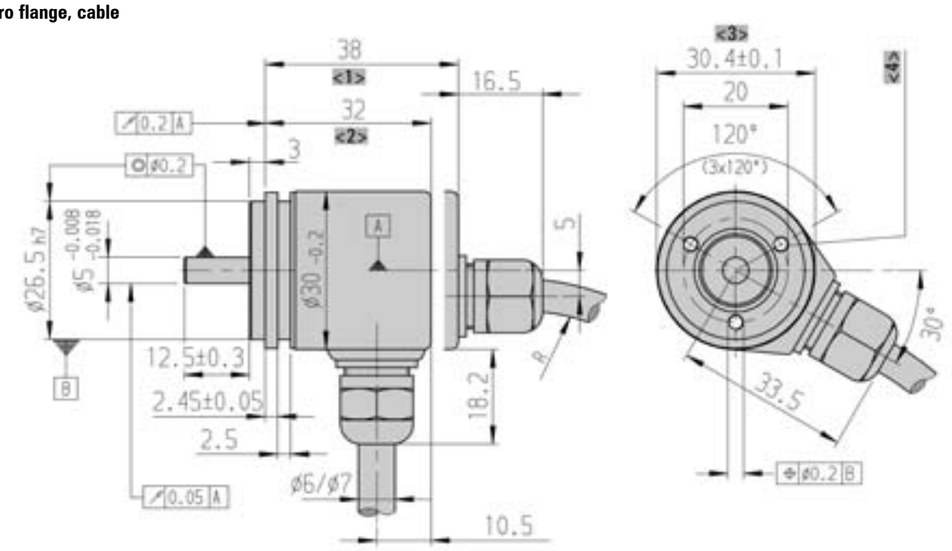
[1] depending on ordering code
[2] connected with encoder housing

ELECTRICAL CONNECTIONS
M16 connector (Binder), 6 pole

Description (push-pull)	Pin
DC 10 - 30 V	1
Channel A	2
Channel N	3
Channel B	4
$\overline{Alarm}$	5
GND	6

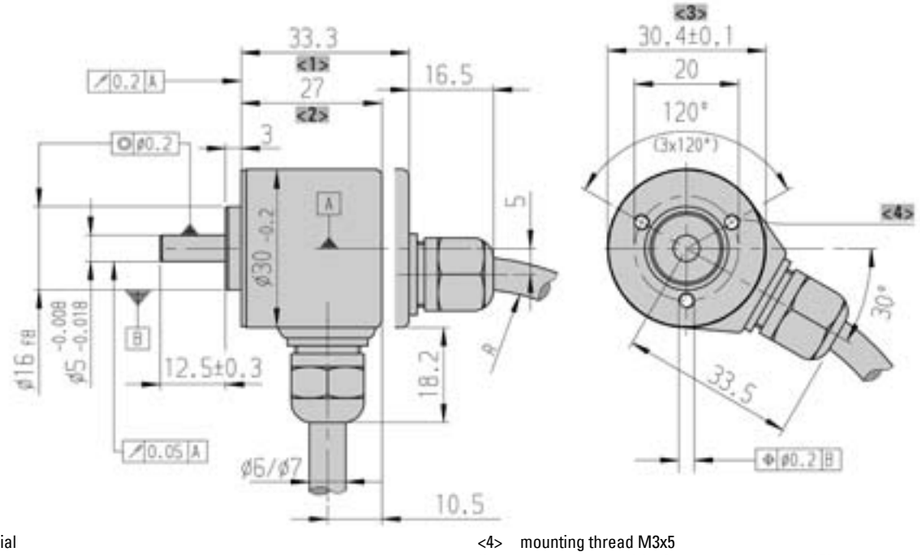
DIMENSIONED DRAWINGS

Synchro flange, cable



<1> axial
<2> radial
<3> Housing
<4> mounting thread M3x5
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm Dimensions in mm

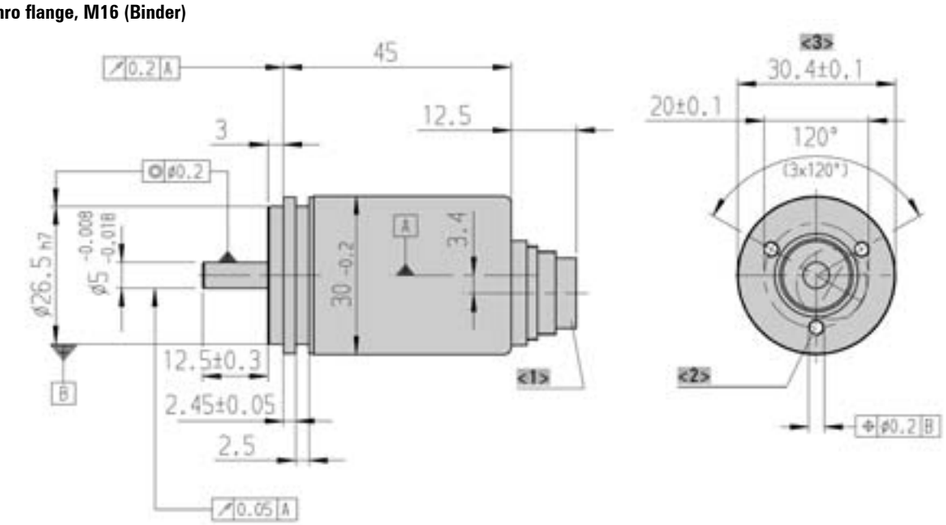
Pilot flange, cable



<1> axial
<2> radial
<3> Housing
<4> mounting thread M3x5
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm Dimensions in mm

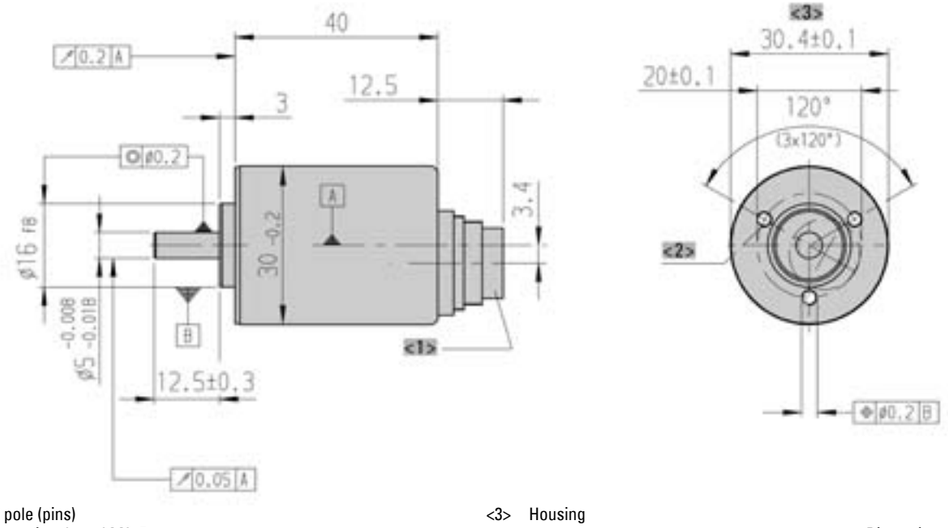
DIMENSIONED DRAWINGS (continued)

Synchro flange, M16 (Binder)



<1> 6 pole (pins)
<2> mounting thread M3x5
<3> Housing
Dimensions in mm

Pilot flange, M16 (Binder)



<1> 6 pole (pins)
<2> mounting thread M3x5
<3> Housing
Dimensions in mm

Incremental Solid shaft

ORDERING INFORMATION

Type	Number of pulses	Supply voltage [1]	Flange, Protection, Shaft	Output [2]	Connection [3]
☐	☐	☐	☐	☐	☐
RI30-O	**5 ... 1500**	**A** DC 5 V **E** DC 10 - 30 V	**S.34** Synchro, IP64, 5 mm **R.34** Pilot, IP64, 5 mm	**R** RS422 +Alarm **T** RS422 +Sense **K** Push-pull	**A** Cable, axial **B** Cable, radial **E-I** M23 connector (Conin) at 1 m TPE cable, cw **E-D** M23 connector (Conin) at 1 m TPE cable, ccw **N** M16 connector (Binder), 6 pole, axial

[1] DC 10 - 30 V only with push-pull
[2] Output code "K": short-circuit-proof
[3] For Output Code "N" (M16): only push-pull

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Incremental Solid shaft

- Miniature industry standard encoder for high numbers of pulses
- High reliability
- Applications: CNC axles, machine tools, robots, special purpose machines, high-speed winding machines

NUMBER OF PULSES

5 / 10 / 20 / 25 / 28 / 32 / 50 / 60 / 72 / 100 / 128 / 144 / 200 / 250 / 256 / 288 / 300 / 360 / 400 / 500 / 512 / 600 / 720 / 900 / 1000 / 1024 / 1250 / 1500 / 2000 / 2048 / 2500 / 3000 / 3600
Other number of pulses on request

TECHNICAL DATA
mechanical

Housing diameter	36 mm
Shaft diameter	6 mm / 6.35 mm (Solid shaft)
Flange (Mounting of housing)	Synchro flange, Pilot flange
Protection class shaft input (EN 60529)	IP64
Protection class housing (EN 60529)	IP64
Shaft load axial / radial	5 N / 10 N
Max. speed	max. 10 000 rpm
Starting torque typ.	≤ 0.3 Ncm
Moment of inertia	approx. 2.8 gcm²
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	-10 °C ... +70 °C
Storage temperature	-25 °C ... +85 °C
Material housing	Aluminum
Weight	approx. 80 g
Connection	Cable, axial or radial M16 (Binder), axial or radial

TECHNICAL DATA
electrical

General design	as per DIN VDE 0160, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	RS422 + Alarm (R), RS422 + Sense (T): DC 5 V ±10 % Push-pull (K), Push-pull antivalent (I): DC 10-30 V
Current w/o load typ.	40 mA (DC 5 V), 60 mA (DC 10 V), 30 mA (DC 24 V)
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz
Standard output versions [2]	RS422 + Sense (T): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, Sense RS422 + Alarm (R): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$ Push-pull (K): A, B, N, $\overline{Alarm}$ Push-pull complementary (I): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$
Pulse width error	± max. 25° electrical
Number of pulses	5 ... 3600
Alarm output	NPN-O.C., max. 5 mA

TECHNICAL DATA
electrical (continued)

Pulse shape	Square wave
Pulse duty factor	1:1

[1] With push-pull (K) and push-pull complementary (I): pole protection
[2] Output description and technical data see chapter "Technical basics"

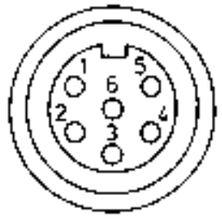
ELECTRICAL CONNECTIONS
Cable PVC

Cable PVC (A, B)		Output		
Colour	**Lead mm [2]**	**RS422 (R, T)**	**push-pull (K)**	**push-pull complementary (I)**
red	0.5	DC 5 V	DC 10 - 30 V	DC 10 - 30 V
yellow/red	0.14	Sense V_{CC}		Sense V_{CC}
white	0.14	Channel A	Channel A	Channel A
white/brown	0.14	Channel $\overline{A}$		Channel $\overline{A}$
green	0.14	Channel B	Channel B	Channel B
green/brown	0.14	Channel $\overline{B}$		Channel $\overline{B}$
yellow	0.14	Channel N	Channel N	Channel N
yellow/brown	0.14	Channel $\overline{N}$		Channel $\overline{N}$
black	0.5	GND	GND	GND
yellow/black	0.14	$\overline{Alarm}$/Sense GND [1]	$\overline{Alarm}$	$\overline{Alarm}$
screen [2]		screen [2]	screen [2]	screen [2]

[1] depending on ordering code
[2] connected with encoder housing

ELECTRICAL CONNECTIONS
M16 connector (Binder), 6 pole

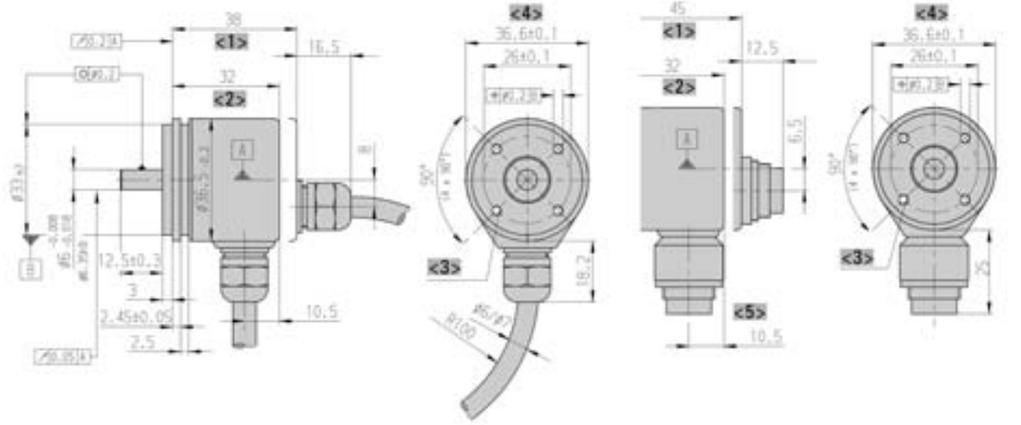
Description (push-pull)	Pin
DC 10 - 30 V	1
Channel A	2
Channel N	3
Channel B	4
$\overline{Alarm}$	5
GND	6



Standard Industrial types RI 36
Incremental Solid shaft

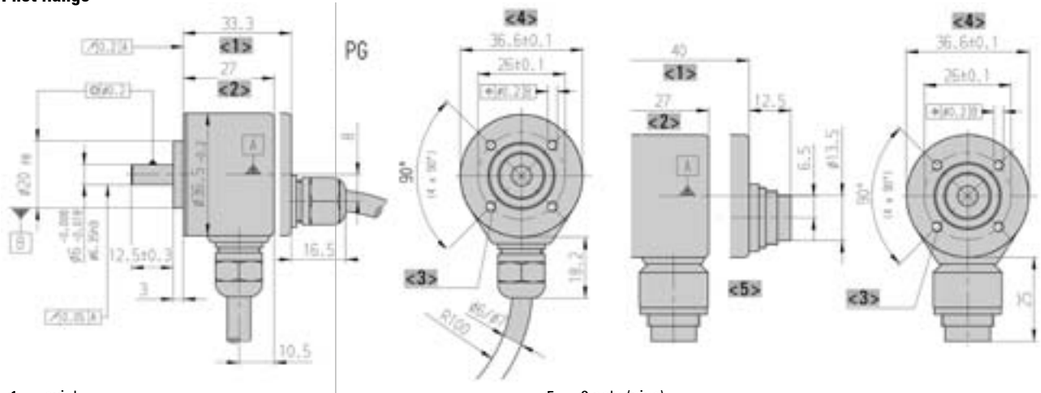
DIMENSIONED DRAWINGS

Synchro flange



<1> axial
<2> radial
<3> mounting thread M3x5
<4> Housing
<5> 6 pole (pins)
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm
Dimensions in mm

Pilot flange



<1> axial
<2> radial
<3> mounting thread M3x5
<4> Housing
<5> 6 pole (pins)
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm
Dimensions in mm

Incremental Solid shaft

ORDERING INFORMATION

Type	Number of pulses	Supply voltage [1]	Flange, Protection, Shaft	Output [2]	Connection [3]
☐	☐	☐	☐	☐	☐
RI36-O	**5 ... 3600**	**A** DC 5 V **E** DC 10 - 30 V	**S.31** Synchro, IP64, 6 mm **S.35** Synchro, IP64, 6.35 mm **R.31** Pilot, IP64, 6 mm **R.35** Pilot, IP64, 6,35 mm	**R** RS422 +Alarm **T** RS422 +Sense **K** Push-pull **I** Push-pull com-plementary	**A** Cable, axial **B** Cable, radial **E-I** M23 connector (Conin) at 1 m TPE cable, cw **E-D** M23 connector (Conin) at 1 m TPE cable, ccw **J** M16 connector (Binder), 6 pole, radial **N** M16 connector (Binder), 6 pole, axial

[1] DC 10 - 30 V only with output push-pull (K) and push-pull complementary (I)
[2] Output code "K" and "I": short-circuit-proof
[3] For Output Code "N" und "J" (M16): only push-pull

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Incremental Solid shaft

Synchro flange

Clamping flange

- Universal industry standard encoder
- Up to 40 000 steps with 10 000 pulses
- High signal accuracy
- Protection class up to IP67
- Flexible due to many flange and configuration variants
- Suitable for high shock ratings
- Applications: machine tools, CNC axles, packing machines, motors/ drives, injection moulding machines, sawing machines, textile machines
- For EX version, see RX 70-I
- Operating temperature up to 100 °C (RI 58-T)

NUMBER OF PULSES RI 58-O

1 / 2 / 3 / 4 / 5 / 10 / 15 / 20 / 25 / 30 / 35 / 40 / 45 / 50 / 60 / 64 / 70 / 72 / 80 / **100** / 125 / 128 / 144 / 150 / 180 / 200 / 230 / **250** / 256 / 300 / 314 / 350 / 360 / 375 / 400 / 460 / 480 / **500** / 512 / 600 / 625 / 635 / 720 / 750 / 900 / **1000** / **1024** / 1200 / **1250** / 1500 / 1600 / 1800 / 2000 / 2048 / **2500** / 3000 / 3480 / **3600** / 3750 / 4000 / **4096** / 4800 / **5000** / 5400 / 6000 / 7200 / 7680 / 8000 / 8192 / 9000 / 10000
Other number of pulses on request
Preferably available versions are printed in bold type.

NUMBER OF PULSES RI 58-T

4 / 5 / 10 / 15 / 20 / 25 / 30 / 35 / 40 / 45 / 50 / 60 / 64 / 70 / 72 / 80 / **100** / 125 / 128 / 144 / 150 / 180 / 200 / 230 / **250** / 256 / 300 / 314 / 350 / 360 / 375 / 400 / 460 / 480 / **500** / 512 / 600 / 625 / 635 / 720 / 750 / 900 / **1000** / **1024** / 1200 / **1250** / 1500 / 1600 / 1800 / 2000 / 2048 / **2500**
Other number of pulses on request
Preferably available versions are printed in bold type.

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	6 mm / 6.35 mm / 7 mm / 9.52 mm / 10 mm / 12 mm (Solid shaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Square flange, Synchro clamping flange
Protection class shaft input (EN 60529)	IP64 or IP67
Protection class housing (EN 60529)	IP65 or IP67
Shaft load axial / radial	Ø 6 mm / 6,35 mm: 20 N / 40 N Ø 7 ... 10 mm: 40 N / 60 N Ø 12 mm: 60 N / 80 N
Max. speed	max. 10 000 rpm
Starting torque typ.	≤ 0.5 Ncm ≤ 1 Ncm (IP67)

TECHNICAL DATA
mechanical (continued)

Moment of inertia	approx. 14 gcm² (Synchro flange) approx. 20 gcm² (Clamping flange)
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	RI 58-O: -10 °C ... +70 °C RI 58-T: -25 °C ... +100 °C
Storage temperature	RI 58-O: -25 °C ... +85 °C RI 58-T: -25 °C ... +100 °C
Material housing	Aluminum
Weight	approx. 360 g
Connection	PVC cable, axial or radial M23 connector (Conin), axial or radial TPE cable, axial or radial M16 (Binder), axial or radial MS, axial oder radial

TECHNICAL DATA
electrical

General design	as per DIN VDE 0160, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	RS422 + Sense (T): DC 5 V ±10 % RS422 + Alarm (R): ± 10% DC 5 V or DC 10 - 30 V Push-pull (K), Push-pull antivalent (I): DC 10-30 V
Current w/o load typ.	40 mA (DC 5 V), 60 mA (DC 10 V), 30 mA (DC 24 V)
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz
Standard output versions [2]	RS422 + Alarm (R): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, Alarm RS422 + Sense (T): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, Sense Push-pull (K): A, B, N, $\overline{Alarm}$ Push-pull complementary (I): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$
Pulse width error	± max. 25° electrical
Number of pulses	1 ... 10 000
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Pulse duty factor	1:1

[1] Pole protection with supply voltage DC 10 - 30 V
[2] Output description and technical data see chapter "Technical basics"

ELECTRICAL CONNECTIONS
Cable PVC

Cable PVC (A, B) Colour	Output RS422 (R, T)	push-pull (K)	push-pull complementary (I)
red	DC 5 / 10 - 30 V	DC 10 - 30 V	DC 10 - 30 V
yellow/red	Sense V_{CC}		Sense V_{CC}
white	Channel A	Channel A	Channel A
white/brown	Channel $\overline{A}$		Channel $\overline{A}$
green	Channel B	Channel B	Channel B
green/brown	Channel $\overline{B}$		Channel $\overline{B}$
yellow	Channel N	Channel N	Channel N
yellow/brown	Channel $\overline{N}$		Channel $\overline{N}$
black	GND	GND	GND
yellow/black	$\overline{Alarm}$/Sense GND [1]	$\overline{Alarm}$	$\overline{Alarm}$
screen [2]	screen [2]	screen [2]	screen [2]

[1] depending on ordering code
[2] connected with encoder housing

Standard Industrial types RI 58-O / RI 58-T
Incremental Solid shaft

ELECTRICAL CONNECTIONS
Cable TPE

Cable TPE (E, F) Colour	Output RS422 (R, T)	push-pull (K)	push-pull complementary (I)
brown/green	DC 5 / 10 - 30 V	DC 10 - 30 V	DC 10 - 30 V
blue	Sense V_{CC}		Sense V_{CC}
brown	Channel A	Channel A	Channel A
green	Channel $\overline{A}$		Channel $\overline{A}$
grey	Channel B	Channel B	Channel B
pink	Channel $\overline{B}$		Channel $\overline{B}$
red	Channel N	Channel N	Channel N
black	Channe $\overline{N}$		Channe $\overline{N}$
white/green	GND	GND	GND
violet (white) [1]	$\overline{Alarm}$/Sense GND [2]	$\overline{Alarm}$	$\overline{Alarm}$
screen [3]	screen [3]	screen [3]	screen [3]

[1] white with RS422 + Sense (T)
[2] depending on ordering code
[3] connected with encoder housing

ELECTRICAL CONNECTIONS
M23 connector (Conin), 12 pole

Pin	RS422 + Sense (T)	RS422 + Alarm (R)	push-pull (K)	push-pull complementary (I)
1	Channel $\overline{B}$	Channel $\overline{B}$	N.C.	Channel $\overline{B}$
2	Sense V_{CC}	Sense V_{CC}	N.C.	Sense V_{CC}
3	Channel N	Channel N	Channel N	Channel N
4	Channel $\overline{N}$	Channel $\overline{N}$	N.C.	Channel $\overline{N}$
5	Channel A	Channel A	Channel A	Channel A
6	Channel $\overline{A}$	Channel $\overline{A}$	N.C.	Channel $\overline{A}$
7	N.C.	$\overline{Alarm}$	$\overline{Alarm}$	$\overline{Alarm}$
8	Channel B	Channel B	Channel B	Channel B
9	N.C. [1]	N.C. [1]	N.C. [1]	N.C. [1]
10	GND	GND	GND	GND
11	Sense GND	N.C.	N.C.	N.C.
12	DC 5 V	DC 10 - 30 V	DC 10 - 30 V	DC 10 - 30 V

[1] screen for cable with CONIN connector

Pin-Adjustment
M23, cw

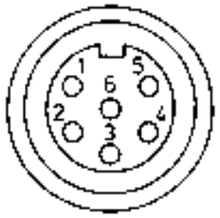
Pin-Adjustment
M23, ccw

ELECTRICAL CONNECTIONS
MS connector, 10 pole

Pin	Description RS422 / Euro-pinout (Connection codes O and K)	push-pull	push-pull complementary
1/A	Channel A	Channel A	Channel A
2/B	Channel B	Channel B	Channel B
3/C	Channel N	Channel N	Channel N
4/D	DC 5/10 - 30 V	DC 10 - 30 V	DC 10 - 30 V
5/E	$\overline{Alarm}$	$\overline{Alarm}$	$\overline{Alarm}$
6/F	GND	GND	GND
7/G	Channel $\overline{A}$	screen	Channel $\overline{A}$
8/H	Channel $\overline{B}$	N.C.	Channel $\overline{B}$
9/I	Channel $\overline{N}$	N.C.	Channel $\overline{N}$
10/J	screen	screen	screen

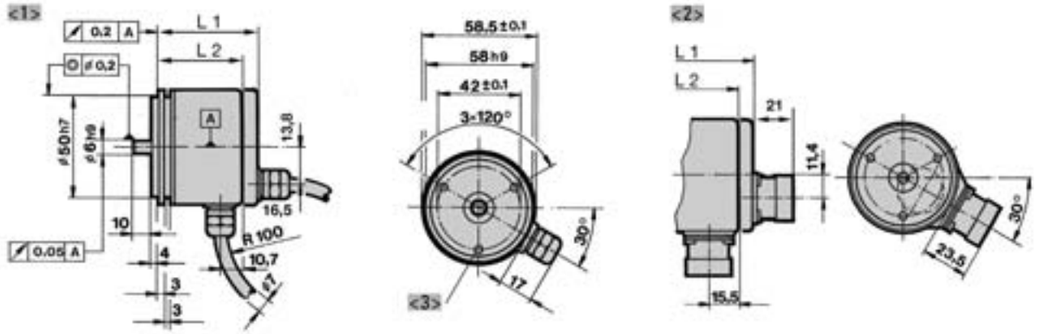
ELECTRICAL CONNECTIONS
M16 connector (Binder), 6 pole

Description (push-pull)	Pin
DC 10 - 30 V	1
Channel A	2
Channel N	3
Channel B	4
$\overline{\text{Alarm}}$	5
GND	6



DIMENSIONED DRAWINGS

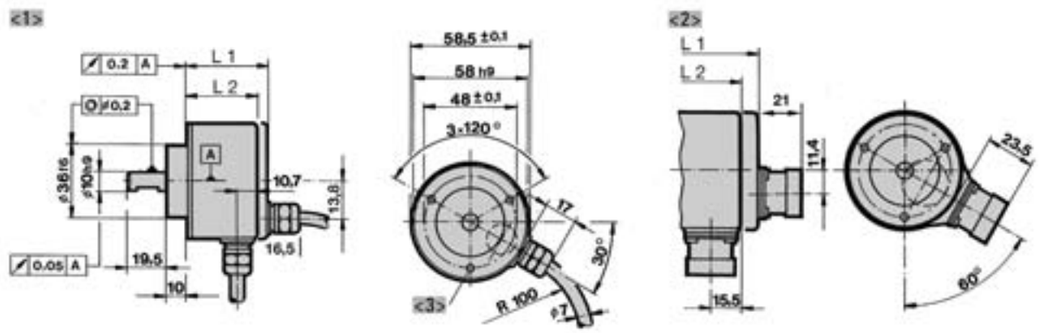
Synchro flange, 58 mm



<1> Connection cable, axial/radial
<2> M23, 12 pole, axial/ radial
<3> mounting thread M4x5

Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm
Dimensions in mm

Clamping flange, 58 mm

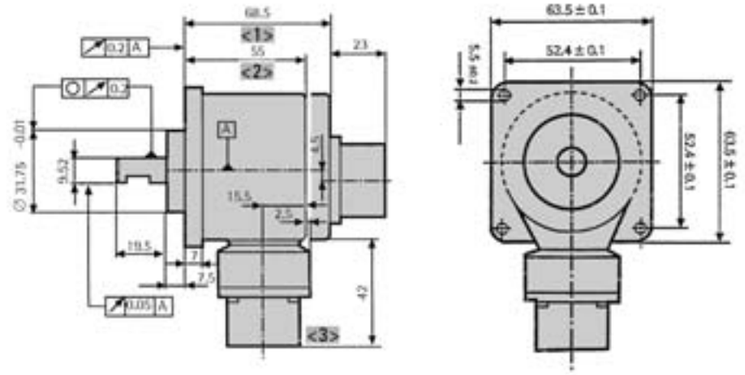


<1> Connection cable, axial/radial
<2> M23, 12 pole, axial/ radial
<3> mounting thread M3x5 (Option M4x5)

Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm
Dimensions in mm

DIMENSIONED DRAWINGS (continued)

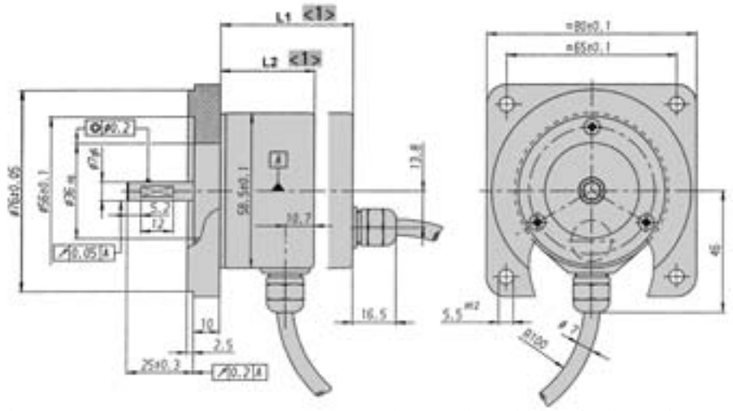
Square flange, 63,5 mm x 63,5 mm (2,5" x 2,5')



<1> axial
<2> radial
<3> MS 6 - 10 pole

Dimensions in mm

Square flange 80 x 80 mm

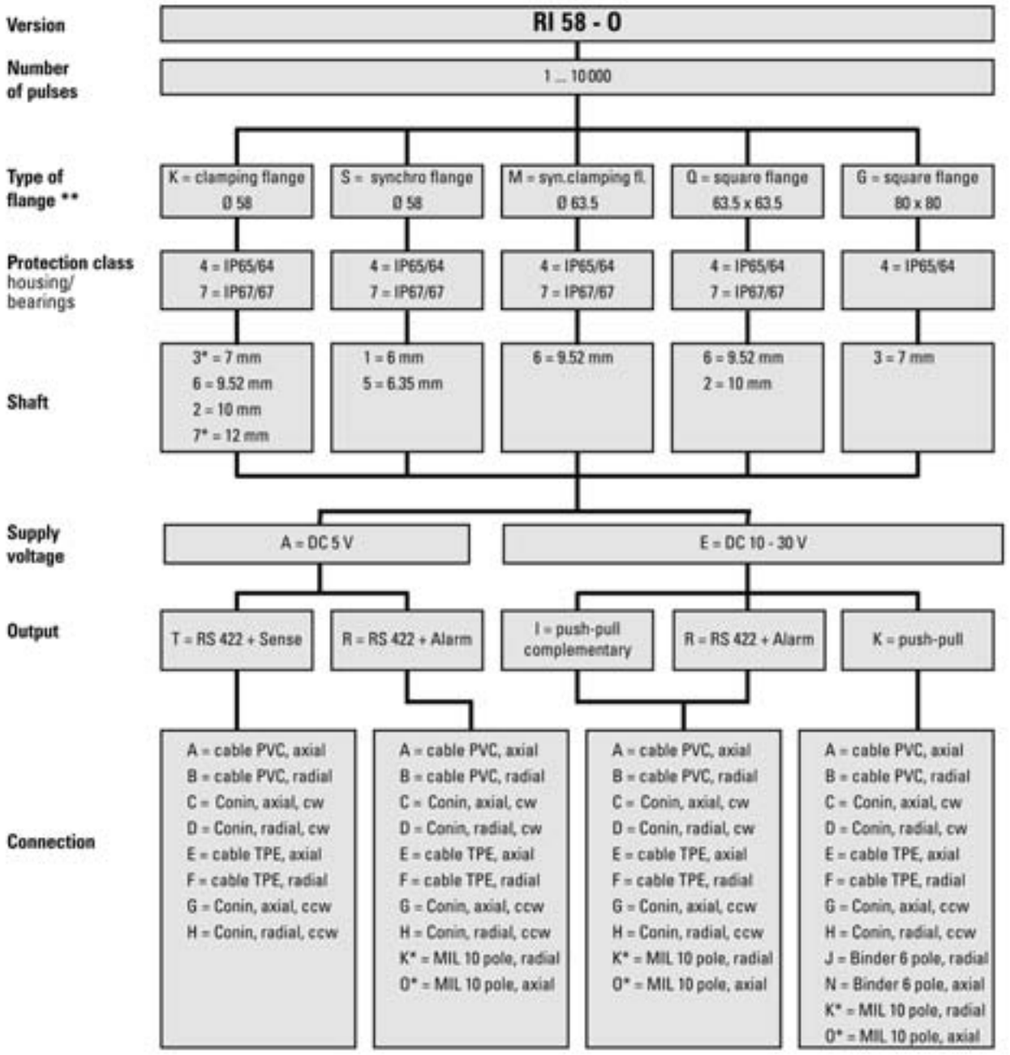


<1> L1, L2 see clamping flange
Cable bending radius R for fixed installation ≥ 40 mm
Cable bending radius R for flexible installation ≥ 100 mm
Dimensions in mm

DIMENSIONS

Typ	Connection	Output	axial L1 mm	radial L2 mm
Synchro flange, 58 mm	cable	R (with U_B = DC 5 V), T, K, I	51.5	41.5
		R (with U_B = DC 10 - 30 V)	56	56
	connector	R (with U_B = DC 5 V), T, K, I	57.5	51.5
		R (with U_B = DC 10 - 30 V)	57.5	56
Clamping flange, 58 mm	cable	R (with U_B = DC 5 V), T, K, I	45.5	35.5
		R (with U_B = DC 10 - 30 V)	50	50
	connector	R (with U_B = DC 5 V), T, K, I	51.5	45.5
		R (with U_B = DC 10 - 30 V)	51.5	50

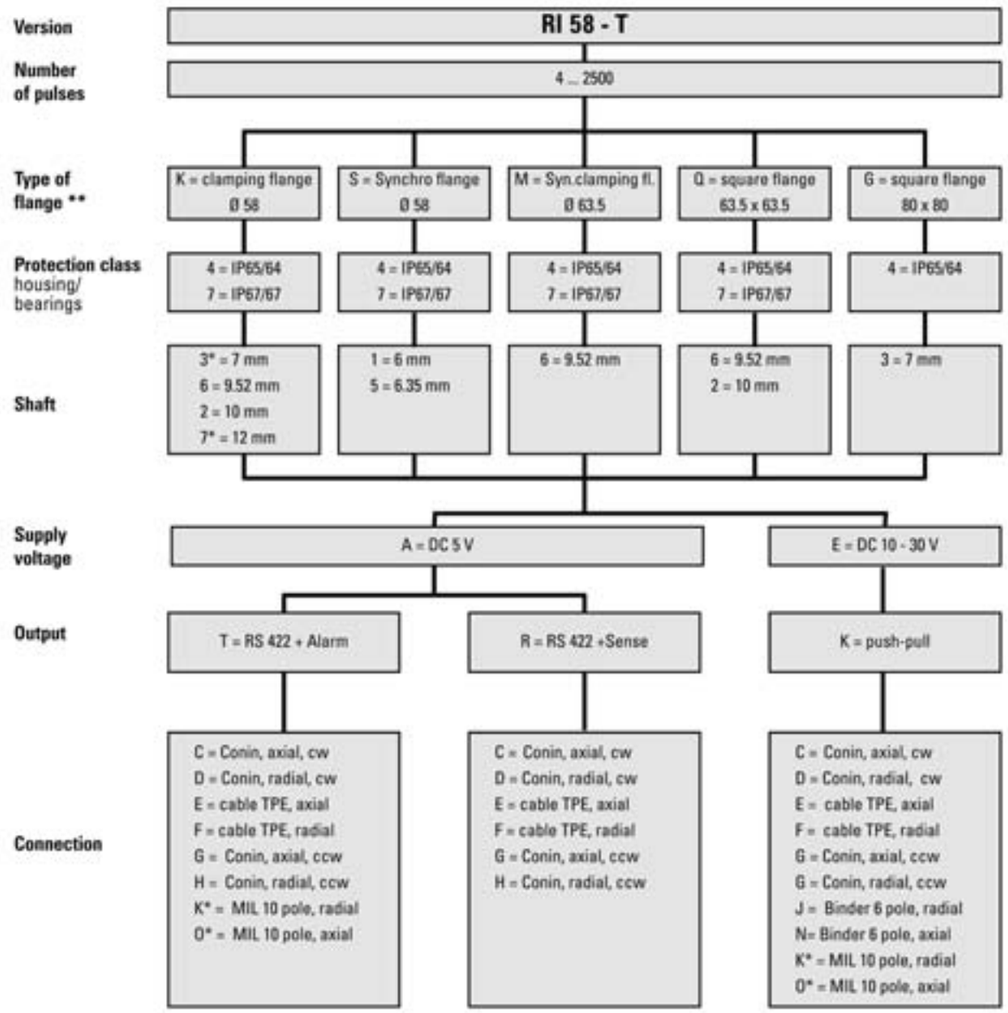
STANDARD VERSIONS



* not for IP67

** other flange versions can be realized by combination of clamping flange + flange adapter (see Accessories)
e.g. RI58 with synchro flange and 10 mm-shaft: version clamping flange with 10 mm-shaft + synchro flange adapter (1 522 328)

STANDARD VERSIONS (100 °C max. operating temperature)



* not for IP67

** other flange versions can be realized by combination of clamping flange + flange adapter (see Accessories)
e.g. RI58 with synchro flange and 10 mm-shaft: version clamping flange with 10 mm-shaft + synchro flange adapter (1 522 328)

Further versions on request

Incremental Solid shaft

ORDERING INFORMATION

Type	Number of pulses	Supply voltage [1]	Flange, Protection, Shaft [2,3]	Output [4]	Connection [5,6]
☐	☐	☐	☐	☐	☐
RI58-O **RI58-T**	RI 58-O: **1 ... 10000** RI 58-T: **4 ... 2500**	**A** DC 5 V **E** DC 10 - 30 V	**S.41** Synchro, IP64, 6 mm **S.45** Synchro, IP64, 6.35 mm **S.71** Synchro, IP67, 6 mm **S.75** Synchro, IP67, 6.35 mm **K.42** Clamping, IP64, 10 mm **K.47** Clamping, IP64, 12 mm **K.43** Clamping, IP64, 7 mm **K.46** Clamping, IP64, 9.52 mm **K.72** Clamping, IP67, 10 mm **K.76** Clamping, IP67, 9.52 mm **M.46** Syn.clamping, IP64, 9.52 mm **M.76** Syn.clamping, IP67, 9.52 mm **Q.46** Square, IP64, 9.52 mm **Q.42** Square, IP64, 10 mm **Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm **G.43** Square 80x80, IP64, 7 mm	**R** RS422 +Alarm **T** RS422 +Sense **K** Push-pull **I** Push-pull complementary	**A** PVC cable, axial **B** PVC cable, radial **E** TPE cable, axial **F** TPE cable, radial **C** M23 connector (Conin), 12 pole, axial, cw **D** M23 connector (Conin), 12 pole, radial, cw **G** M23 connector (Conin), 12 pole, axial, ccw **H** M23 connector (Conin), 12 pole, radial, ccw **J** M16 connector (Binder), 6 pole, radial **N** M16 connector (Binder), 6 pole, axial **O** MS connector, 10 pole (Insert arrangement 18-1), axial **K** MS connector, 10 pole (Insert arrangement 18-1), radial

[1] DC 10 - 30 V available with output K, I, R/ DC 5 V availalble with output R, T
[2] other flange versions can be realized by combination of clamping flange + flange adapter (see Accessories), e.g. RI58 with synchro flange and 10 mm-shaft: version clamping flange with 10 mm-shaft + synchro flange adapter (1 522 328)
[3] Output code "K" and "I": short-circuit-proof
[4] Connection code "O", "K": according to MIL-C-5015 (only RI 58-O)
[5] IP67 on cover with connector only if IP67 mating connector mounted properly.
[6] Connection code "O", "K": according to MIL-C-5016 (only RI 58-T)

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Incremental Hollow shaft

- Miniature industry encoder for high number of pulses
- Short mounting length
- Easy mounting procedure
- Applications: motors, machine tools, robots, automated SMD equipment

NUMBER OF PULSES

5 / 10 / 20 / 25 / 50 / 60 / 100 / 200 / 250 / 300 / 360 / 500 / 600 / 720 / 1000 / 1024 / 1250 / 1500 / 2000 / 2048 / 2500 / 3000 / 3600
Other number of pulses on request

TECHNICAL DATA
mechanical

Housing diameter	36 mm
Shaft diameter	4 mm / 6 mm / 8 mm / 10 mm (Hubshaft)
Flange (Mounting of housing)	Tether
Mounting of shaft	Front clamping ring
Protection class shaft input (EN 60529)	IP64
Protection class housing (EN 60529)	IP64
Axial endplay of mounting shaft (hubshaft)	± 0.5 mm
Radial runout of mating shaft (hubshaft)	± 0.15 mm
Max. speed	max. 10 000 rpm
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 3 gcm²
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	-10 °C ... +70 °C
Storage temperature	-25 °C ... +85 °C
Material housing	Aluminum
Weight	approx. 80 g
Connection	Cable, axial or radial

TECHNICAL DATA
electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	RS422 + Alarm (R), RS422 + Sense (T): DC 5 V ±10 % Push-pull (K), Push-pull antivalent (I): DC 10-30 V
Current w/o load typ.	40 mA (DC 5 V), 60 mA (DC 10 V), 30 mA (DC 24 V)
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz
Standard output versions [2]	RS422 + Sense (T): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, Sense RS422 + Alarm (R): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$ Push-pull (K): A, B, N, $\overline{Alarm}$ Push-pull complementary (I): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$
Pulse width error	± max. 25° electrical

TECHNICAL DATA
electrical (continued)

Number of pulses	5 ... 3600
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Pulse duty factor	1:1

[1] With push-pull (K) and push-pull complementary (I): pole protection
[2] Output description and technical data see chapter "Technical basics"

ELECTRICAL CONNECTIONS
Cable PVC

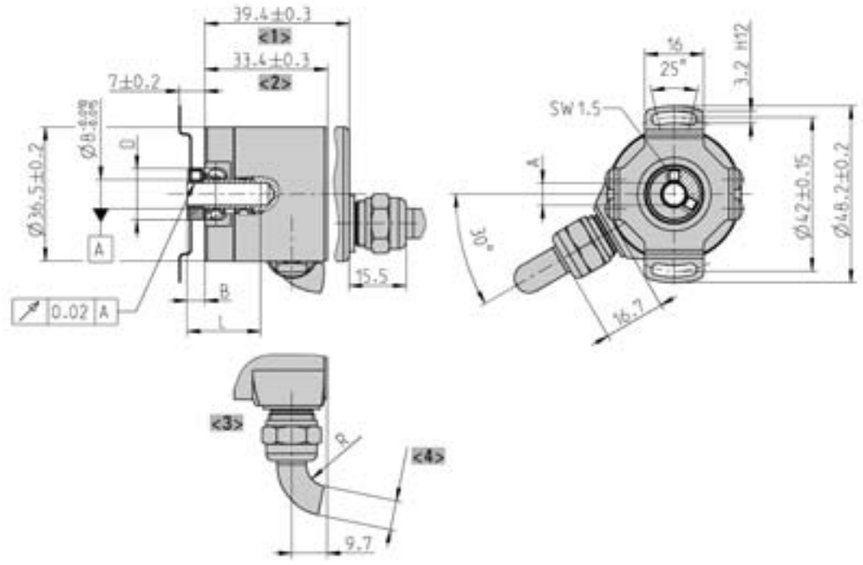
Cable PVC (A, B)		**Output**		
Colour	**Litze mm [2]**	**RS422 (R, T)**	**push-pull (K)**	**push-pull complementary (I)**
red	0.5	DC 5 V	DC 10 - 30 V	DC 10 - 30 V
yellow/red	0.14	Sense V_{CC}		Sense V_{CC}
white	0.14	Channel A	Channel A	Channel A
white/brown	0.14	Channel $\overline{A}$		Channel $\overline{A}$
green	0.14	Channel B	Channel B	Channel B
green/brown	0.14	Channel $\overline{B}$		Channel $\overline{B}$
yellow	0.14	Channel N	Channel N	Channel N
yellow/brown	0.14	Channel $\overline{N}$		Channel $\overline{N}$
black	0.5	GND	GND	GND
yellow/black	0.14	$\overline{Alarm}$/Sense GND [1]	$\overline{Alarm}$	$\overline{Alarm}$
screen [2]		screen [2]	screen [2]	screen [2]

[1] depending on ordering code
[2] connected with encoder housing

Standard Industrial types RI 36-H
Incremental Hollow shaft

DIMENSIONED DRAWINGS

Torque support "J"



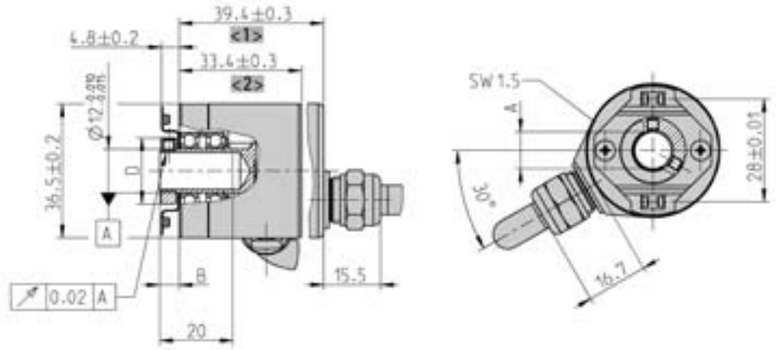
Dim.	Hollow shaft Ø				Unit
A	4 $^{+0.01}$	6 $^{+0.01}$	8 $^{+0.01}$	10 $^{+0.01}$	mm
A*	4 $_{g7}$	10 $_{g7}$	8 $_{g7}$	10 $_{g7}$	mm
B	4.8 ± 0.2	4.8 ± 0.2	4.8 ± 0.2	4.8 ± 0.2	mm
D	12	14	16	18	mm
L_{min}	6	9	12	15	mm
L_{max}	20	20	20	20	mm
A* = diameter of connection shaft					
B = space between housing and shaft					
D = diameter clamping ring					
L = length of connection shaft					

<1> axial
<2> radial
<3> Cable radial
<4> Ø 6 or Ø 8
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm
Tightening torque of set screw: 15 Ncm

Dimensions in mm

DIMENSIONED DRAWINGS (continued)

Torque support "F"



Dim.	Hollow shaft Ø				Unit
A	4 $^{+0.01}$	6 $^{+0.01}$	8 $^{+0.01}$	10 $^{+0.01}$	mm
A*	4 $_{g7}$	10 $_{g7}$	8 $_{g7}$	10 $_{g7}$	mm
B	4.8 ± 0.2	4.8 ± 0.2	4.8 ± 0.2	4.8 ± 0.2	mm
D	12	14	16	18	mm
L $_{min}$	6	9	12	15	mm
L $_{max}$	20	20	20	20	mm
A* = diameter of connection shaft					
B = space between housing and shaft					
D = diameter clamping ring					
L = length of connection shaft					

<1> axial
<2> radial
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm
Tightening torque of set screw: 15 Ncm
The hubshaft with tether (F) as torque supportmust be fixed by a cylindric pin (2.4 mm ◘) at the machine side.

Dimensions in mm

Standard Industrial types RI 36-H
Incremental Hollow shaft

ORDERING INFORMATION

Type	Number of pulses	Supply voltage [1]	Flange, Protection, Shaft [3,4]	Output [2]	Connection
☐	☐	☐	☐	☐	☐
RI36-H	**5 ... 3600**	**A** DC 5 V **E** DC 10 - 30 V	**F.30** Spring tether "F" with clamping ring front, IP64, 4 mm **F.31** Spring tether "F" with clamping ring front, IP64, 6 mm **F.3C** Spring tether "F" with clamping ring front, IP64, 8 mm **F.32** Spring tether "F" with clamping ring front, IP64, 10 mm **J.30** Spring tether "J" with clamping ring front, IP64, 4 mm **J.31** Spring tether "J" with clamping ring front, IP64, 6 mm **J.3C** Spring tether "J" with clamping ring front, IP64, 8 mm **J.32** Spring tether "J" with clamping ring front, IP64, 10 mm	**R** RS422 +Alarm **T** RS422 +Sense **K** Push-pull **I** Push-pull comple-mentary	**A** Cable, axial **B** Cable, radial **E-I** M23 connector (Conin) at 1 m TPE cable, cw **E-D** M23 connector (Conin) at 1 m TPE cable, ccw

[1] DC 10 - 30 V only with push-pull
[2] Output code "K" and "I": short-circuit-proof
[3] Fixing of hubshaft with tether by cylindrical pin
[4] Fixing of hubshaft with tether by oblong hole

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Incremental Hollow shaft

- Through hollow shaft
- High accuracy by means of integrated flexible coupling
- Safe shaft mounting
- Applications: textile machines, motors, drives, copiers

NUMBER OF PULSES

1 / 2 / 3 / 4 / 5 / 10 / 15 / 20 / 25 / 30 / 35 / 40 / 45 / 50 / 60 / 64 / 70 / 72 / 80 / **100** / 125 / 128 / 144 / 150 / 180 / 200 / **250** / 256 / 300 / 314 / 350 / 360 / 375 / 400 / 460 / 480 / **500** / 512 / 600 / 625 / 720 / 900 / **1000** / **1024** / **1250** / 1500 / 1600 / 1800 / 2000 / 2048 / **2500** / 3000 / 3480 / **3600** / 4000 / **4096** / **5000**
Other number of pulses on request
Preferably available versions are printed in bold type.

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	10 mm / 12 mm (Hubshaft)
Flange (Mounting of housing)	Synchro flange
Protection class shaft input (EN 60529)	IP64
Protection class housing (EN 60529)	IP64
Shaft tolerance	Ø 10 mm, tolerance g8 (-0.005 ... -0.027 mm), Ø 12 mm, tolerance g8 (-0.006 ... -0.033 mm)
Axial endplay of mounting shaft (hubshaft)	± 0.4 mm
Parallel endplay of mounting shaft	0.4 mm
Angular endplay of mounting shaft	1 °
Max. speed	max. 3000 rpm
Starting torque typ.	≤ 2 Ncm
Moment of inertia	approx. 65 gcm² (10 mm shaft) approx. 95 gcm² (12 mm shaft)
Vibration resistance (DIN EN 60068-2-6)	10 g = 100 m/s² (10 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	100 g = 1000 m/s² (6 ms)
Operating temperature	-10 °C ... +70 °C
Storage temperature	-25 °C ... +85 °C
Material housing	Aluminum
Weight	approx. 210 g
Connection	Cable, radial

TECHNICAL DATA
electrical

General design	as per DIN VDE 0160, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	RS422 + Sense (T): DC 5 V ±10 % RS422 + Alarm (R): ± 10% DC 5 V or DC 10 - 30 V Push-pull (K), Push-pull antivalent (I): DC 10-30 V
Current w/o load typ.	40 mA (DC 5 V), 60 mA (DC 10 V), 30 mA (DC 24 V)

Standard Industrial types RI 58-H

Incremental Hollow shaft

TECHNICAL DATA
electrical (continued)

Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz
Standard output versions [2]	RS422 + Alarm (R): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$ RS422 + Sense (T): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, Sense Push-pull (K): A, B, N, $\overline{Alarm}$ Push-pull complementary (I): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$
Pulse width error	± max. 25° electrical
Number of pulses	1 ... 5000
Pulse shape	Square wave
Pulse duty factor	1:1

[1] Pole protection with supply voltage DC 10 - 30 V
[2] Output description and technical data see chapter "Technical basics"

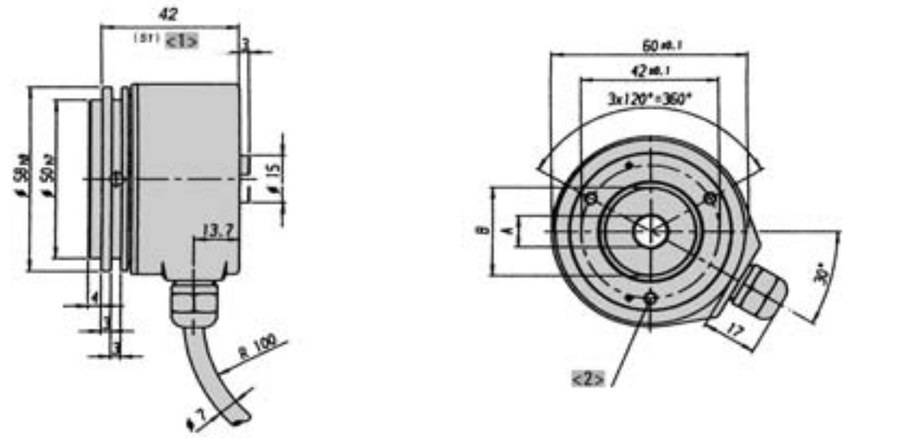
ELECTRICAL CONNECTIONS
Cable PVC

Connecting cable Colour	**Lead ◻**	**Output RS422 T and R**	**push-pull K and I**
red	0.5 mm [2]	DC 5/10 - 30 V	DC 10 - 30 V
red/yellow	0.14 mm [2]	Sense VCC	Sense VCC
white	0.14 mm [2]	Channel A	Channel A
white	0.14 mm [2]	Channel $\overline{A}$	Channel $\overline{A}$[1]
green/brown	0.14 mm [2]	Channel B	Channel B
green/brown	0.14 mm [2]	Channel $\overline{B}$	Channel $\overline{B}$ [1]
yellow	0.14 mm [2]	Channel N	Channel N
yellow/brown	0.14 mm [2]	Channel $\overline{N}$	Channel $\overline{N}$ [1]
black	0.5mm [2]	GND	GND
black/yellow	0.14 mm [2]	$\overline{Alarm}$/Sense GND [2]	$\overline{Alarm}$
screen [3]		screen [3]	screen [3]

[1] only push-pull complementary (I)
[2] depending on ordering code
[3] connected with encoder housing

DIMENSIONED DRAWINGS

Synchro flange



Required dimension of mounting shaft (g8)	Hollow shaft Ø (A)	B	Unit
-0.005 ... -0.027	10 *	28	mm
-0.006 ... -0.033	12 *	33	mm
* Tolerance H7 = 0 ... +0.018 mm			

<1> value in brackets with version DC 10 - 30 V, RS422
<2> mounting thread M4x5
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm

Dimensions in mm

ORDERING INFORMATION

Type	Number of pulses	Supply voltage [1, 2]	Flange, Protection, Shaft	Output	Connection
☐	☐	☐	☐	☐	☐
RI58-H	**1 ... 5000**	**A** DC 5 V **E** DC 10 - 30 V	**S.32** Synchro, IP64, 10 mm **S.37** Synchro, IP64, 12 mm	**R** RS422 +Alarm **T** RS422 +Sense **K** Push-pull **I** Push-pull complementary	**B** PVC cable, radial

[1] DC 5 V: only with output "T", "R" available
[2] DC 10 - 30 V: only with output "K", "I", "R" available

Standard Industrial types RI 58-H
Incremental Hollow shaft

ORDERING INFORMATION

Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Incremental Hollow shaft

Clamping shaft

Blind shaft

- Direct mounting without coupling
- Flexible hollow shaft design up to diameter 14 mm
- Through hollow shaft or as end shaft (blind shaft)
- Easy installation by means of clamping shaft or blind shaft
- Short overall length of 33 mm
- Fixing of flage by means of a stator coupling or set screw
- Various shaft versions
- Applications: actuators, motors
- Operating temperature up to 100 °C (RI 58TD)

NUMBER OF PULSES RI 58-D

1 / 2 / 3 / 4 / 5 / 10 / 20 / 25 / 30 / 35 / 40 / 45 / 50 / 60 / 64 / 70 / 72 / 80 / **100** / 125 / 128 / 144 / 150 / 180 / 200 / **250** / 256 / 300 / 314 / 350 / 360 / 375 / 400 / 460 / 480 / **500** / 512 / 600 / 625 / 720 / 900 / **1000** / **1024** / **1250** / 1500 / 1600 / 1800 / 2000 / 2048 / **2500** / 3000 / 3480 / **3600** / 4000 / **4096** / **5000**
Other number of pulses on request
Preferably available versions are printed in bold type.

NUMBER OF PULSES RI 58TD

4 / 5 / 10 / 20 / 25 / 30 / 35 / 40 / 45 / 50 / 60 / 64 / 70 / 72 / 80 / **100** / 125 / 128 / 144 / 150 / 180 / 200 / **250** / 256 / 300 / 314 / 350 / 360 / 375 / 400 / 460 / 480 / **500** / 512 / 600 / 625 / 720 / 900 / **1000** / **1024** / **1250** / 1500 / 1600 / 1800 / 2000 / 2048 / **2500**
Other number of pulses on request
Preferably available versions are printed in bold type.

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter [1]	10 mm / 12 mm (Through hollow shaft) 10 mm / 12 mm / 14 mm (Hubshaft)
Flange (Mounting of housing)	Synchro flange
Mounting of shaft	RI 58-D: Front clamping ring, Center bolt RI 58TD: Front clamping ring, Rear clamping ring, Center bolt
Protection class shaft input (EN 60529)	IP64
Protection class housing (EN 60529)	Through hollow shaft - D: IP64 Hubshaft - E,F: IP65

Standard Industrial types RI 58-D / RI 58TD

Incremental Hollow shaft

TECHNICAL DATA
mechanical (continued)

Shaft tolerance	Ø 10 mm, tolerance g8 (-0.005 ... -0.027 mm), Ø 12/ 14 mm, tolerance g8 (-0.006 ... -0.033 mm)
Max. speed	Hub shaft - E,F: max. 6000 rpm Through hollow shaft - D: max. 4000 rpm
Starting torque typ.	≤ 1 Ncm (Hub shaft - E,F) ≤ 2 Ncm (Through hollow shaft - D)
Moment of inertia	approx. 35 gcm² (Hub shaft with clamping ring front - F) approx. 20 gcm² (Hub shaft, mountig with set screw - E) approx. 60 gcm² (Through hollow shaft with clamping ring front - D)
Vibration resistance (DIN EN 60068-2-6)	10 g = 100 m/s² (10 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	100 g = 1000 m/s² (6 ms)
Operating temperature	RI 58-D: -10 °C ... +70 °C RI 58TD: -25 °C ... +100 °C
Storage temperature	-25 °C ... +85 °C
Material housing	Aluminum
Weight	approx. 170 g with hubshaft (E,F), approx. 190 g with trough hollow shaft (D)
Connection [2]	Cable, axial or radial M23 connector (Conin), radial

[1] Other shaft diameters on request
[2] Standard cable length: 1.5 m cable, other cable length on request (only RI 58TD)

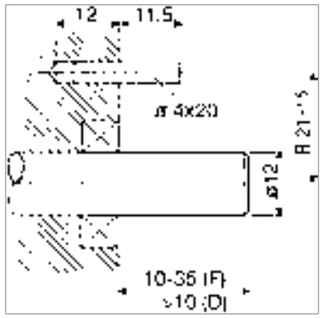
TECHNICAL DATA
electrical

General design	as per DIN VDE 0160, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	RS422 + Sense (T): DC 5 V ±10 % RS422 + Alarm (R): ± 10% DC 5 V or DC 10 - 30 V Push-pull (K), Push-pull antivalent (I): DC 10-30 V
Current w/o load typ.	40 mA (DC 5 V), 60 mA (DC 10 V), 30 mA (DC 24 V)
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz
Standard output versions [2]	RS422 + Alarm (R): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$ RS422 + Sense (T): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, Sense Push-pull (K): A, B, N, $\overline{Alarm}$ Push-pull complementary (I): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$
Pulse width error	± max. 25° electrical
Number of pulses	1 ... 5000
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Pulse duty factor	1:1

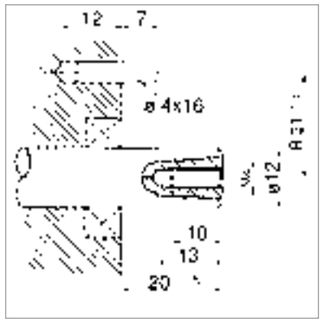
[1] With push-pull (K): pole protection
[2] Output description and technical data see chapter "Technical basics"

MOUNTING NECESSITIES

In order to be able to compensate an axial and radial misalignment of the shaft, the encoder flange must not be fixed rigidly. Fix the flanges by means of a stator coupling (e.g. hubshaft with tether) as torque support (see "Accessories") or by means of a cylindrical pin:



Dimensions in mm
also apply for shaft-Ø 10 or 14
Mounting = D, F (Clamping ring)
Preparation of the machine flange [1]
(all mounting versions):
In the machine flange a straight pin must be installed (diameter 4x16 resp. 4x20, DIN 6325).
This pin is required as a torque support.



Dimensions in mm
also apply for shaft-Ø 10 or 14
Mounting = E (mounting with center screw)
Preparation of the drive shaft
(only in mounting = E):
The drive shaft must be provided with a threaded bore M 4 x10:
This bore accepts the fastening screw of the shaft encoder.

1 Or as an option: stator coupling as torque support

ELECTRICAL CONNECTIONS Cable PVC

Cable PVC Colour	Output circuit RS422 + Sense (T)	RS422 + Alarm (R)	push-pull (K)	push-pull complementary (I)
white	Channel A	Channel A	Channel A	Channel A
white/brown	Channel $\overline{A}$	Channel $\overline{A}$		Channel $\overline{A}$
green	Channel B	Channel B	Channel B	Channel B
green/brown	Channel $\overline{B}$	Channel $\overline{B}$		Channel $\overline{B}$
yellow	Channel N	Channel N	Channel N	Channel N
yellow/brown	Channel $\overline{N}$	Channel $\overline{N}$		Channel $\overline{N}$
yellow/black	Sense GND	$\overline{Alarm}$	$\overline{Alarm}$	$\overline{Alarm}$
yellow/red	Sense V_{CC}	Sense V_{CC}		Sense V_{CC}
red	DC 5 V	DC 5 / 10 - 30 V	DC 10 - 30 V	DC 10 - 30 V
black	GND	GND	GND	GND
Cable screen [1]	Cable screen [1]	Cable screen [1]	Cable screen [1]	Cable screen [1]

[1] connected with encoder housing

Standard Industrial types RI 58-D / RI 58TD
Incremental Hollow shaft

ELECTRICAL CONNECTIONS Cable TPE

Cable TPE Colour	Output circuit RS422 + Sense (T)	RS422 + Alarm (R)	push-pull (K)	push-pull complementary (I)
brown	Channel A	Channel A	Channel A	Channel A
green	Channel $\overline{A}$	Channel $\overline{A}$		Channel $\overline{A}$
grey	Channel B	Channel B	Channel B	Channel B
pink	Channe $\overline{B}$	Channe $\overline{B}$		Channe $\overline{B}$
red	Channel N	Channel N	Channel N	Channel N
black	Channel $\overline{N}$	Channel $\overline{N}$		Channel $\overline{N}$
violet (white) [1]	Sense GND	$\overline{Alarm}$	$\overline{Alarm}$	$\overline{Alarm}$
blue	Sense V_{CC}	Sense V_{CC}		Sense V_{CC}
brown/green	DC 5 V	DC 5 / 10 - 30 V	DC 10 - 30 V	DC 10 - 30 V
white/green	GND	GND	GND	GND
Cable screen [2]	Cable screen [2]	Cable screen [2]	Cable screen [2]	Cable screen [2]

[1] white with RS422 + Sense (T)
[2] connected with encoder housing

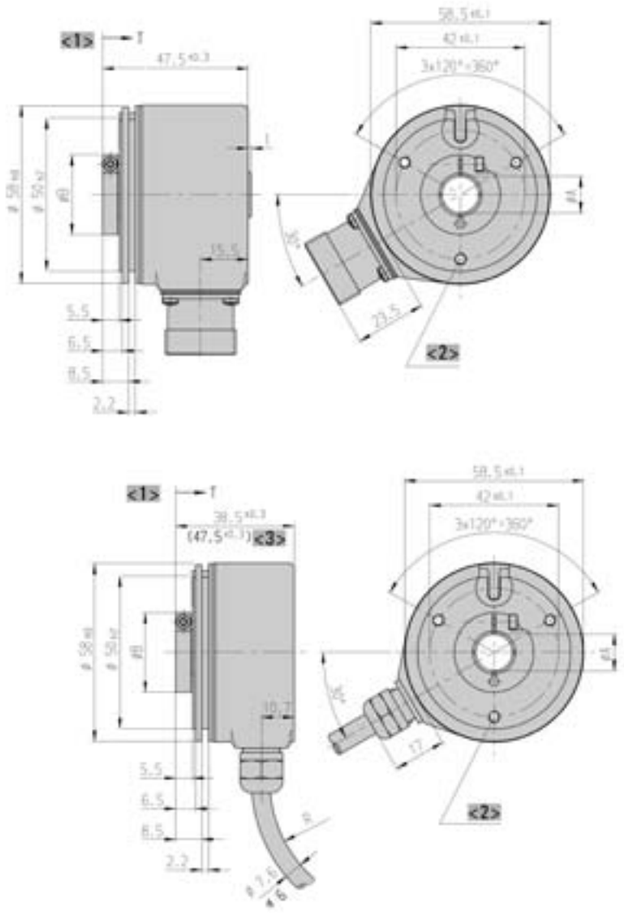
ELECTRICAL CONNECTIONS M23 connector (Conin), 12 pole

Pin	RS422 + Sense (T)	RS422 + Alarm (R)	push-pull (K)	push-pull complementary (I)
1	Channel $\overline{B}$	Channel $\overline{B}$	N.C.	Channel $\overline{B}$
2	Sense V_{CC}	Sense V_{CC}	N.C.	Sense V_{CC}
3	Channel N	Channel N	Channel N	Channel N
4	Channel $\overline{N}$	Channel $\overline{N}$	N.C.	Channel $\overline{N}$
5	Channel A	Channel A	Channel A	Channel A
6	Channel $\overline{A}$	Channel $\overline{A}$	N.C.	Channel $\overline{A}$
7	N.C.	$\overline{Alarm}$	$\overline{Alarm}$	$\overline{Alarm}$
8	Channel B	Channel B	Channel B	Channel B
9	N.C. [1]	N.C. [1]	N.C. [1]	N.C. [1]
10	GND	GND	GND	GND
11	Sense GND	N.C.	N.C.	N.C.
12	DC 5 V	DC 5/10 - 30 V	DC 10 - 30 V	DC 10 - 30 V

[1] screen for cable with CONIN connector

DIMENSIONED DRAWINGS

Mounting F: Hubshaft with clamping ring front



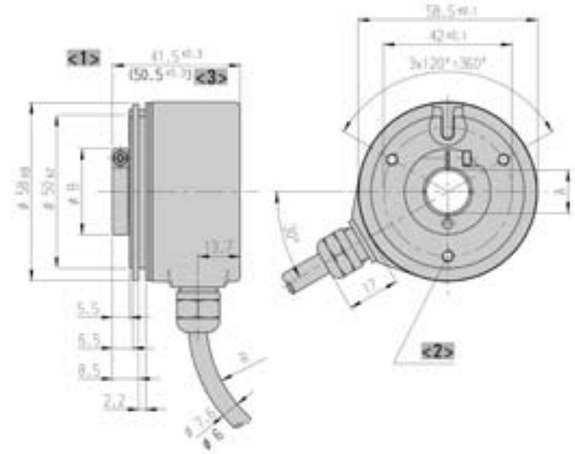
Dim.	Hollow shaft Ø			Unit
A	10 ^{H7}	12 ^{H7}	14 ^{H7}	mm
A*	10 $_{g8}$	12 $_{g8}$	14 $_{g8}$	mm
B	26	28	30	mm
T	33.5	33.5	22.5	mm
A* = diameter of connection shaft				

<1> View turned 60°
<2> mounting thread M4x5
<3> value in brackets with version DC 10 - 30 V, RS422
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm

Dimensions in mm

DIMENSIONED DRAWINGS (continued)

Mounting D: Through hollow shaft with clamping ring front

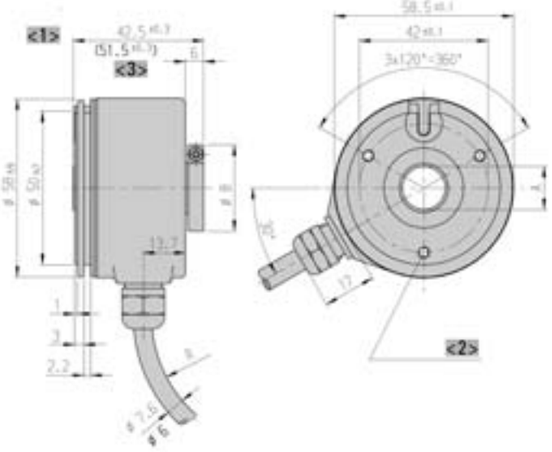


Dim.	Hollow shaft Ø		Unit
A	10 ^{H7}	12 ^{H7}	mm
A*	10 $_{g8}$	12 $_{g8}$	mm
B	26	28	mm
A* = diameter of connection shaft			

<1> View turned 60°
<2> mounting thread M4x5
<3> value in brackets with version DC 10 - 30 V, RS422
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm

Dimensions in mm

Mounting H optional: Through hollow shaft with clamping ring rear on request



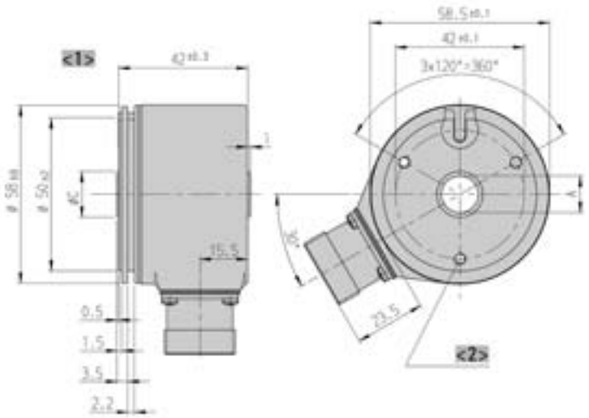
Dim.	Hollow shaft Ø		Unit
A	10 ^{H7}	12 ^{H7}	mm
A*	10 $_{g8}$	12 $_{g8}$	mm
B	26	28	mm
A* = diameter of connection shaft			

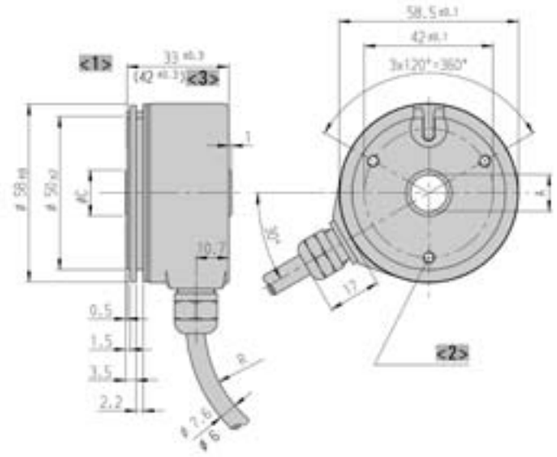
<1> View turned 60°
<2> mounting thread M4x5
<3> value in brackets with version DC 10 - 30 V, RS422
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm

Dimensions in mm

DIMENSIONED DRAWINGS (continued)

Mounting E: Hubshaft, mounting with center screw





Dim.	Hollow shaft Ø			Unit
A	10 ^{H7}	12 ^{H7}	14 ^{H7}	mm
A*	10 $_{g8}$	12 $_{g8}$	14 $_{g8}$	mm
C	15	15	17	mm
T	18±0.5	18±0.5	18±0.5	mm
A* = diameter of connection shaft T = length of custom shaft in encoder				

<1> View turned 60°
<2> mounting thread M4x5
<3> value in brackets with version DC 10 - 30 V, RS422
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm

Dimensions in mm

ORDERING INFORMATION

Type	Number of pulses	Supply voltage	Flange, Protection, Shaft [3]	Output	Connection
RI58-D **RI58TD**	**1 ... 5000**	**A** DC 5 V [1] **E** DC 10 - 30 V [2]	**D.32** Through hollow shaft with clamping ring front, IP64, 10 mm **D.37** Through hollow shaft with clamping ring front, IP64, 12 mm **E.42** Hubshaft, mounting with set screw, IP64, 10 mm **E.47** Hubshaft, mounting with set screw, IP64, 12 mm **E.49** Hubshaft, mounting with set screw, IP64, 14 mm **F.42** Hubshaft, mounting with clamping ring front, IP64, 10 mm **F.47** Hubshaft, mounting with clamping ring front, IP64, 12 mm **F.49** Hubshaft, mounting with clamping ring front, IP64, 14 mm	**R** RS422 +Alarm **T** RS422 +Sense **K** Push-pull **I** Push-pull complementary	**B** PVC cable, radial **F** TPE cable, radial **D** M23 connector (Conin), 12 pole, radial, cw **H** M23 connector (Conin), 12 pole, radial, ccw

[1] DC 5 V: only with output "T", "R" available
[2] DC 10 - 30 V: only with output "K", "I", "R" available
[3] Mounting (flange) code "D" only with connection code "B", "F" (cable)

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Incremental Hollow shaft


Clamping shaft

- Direct mounting without coupling
- Through hollow shaft Ø 14 mm and 15 mm
- Easy installation by means of clamping ring
- Fixing of flage by means of a stator coupling or set screw
- Applications: actuators, motors

NUMBER OF PULSES RI 58-G: 50 / 360 / 500 / 1000 / 1024 / 2000 / 2048 / 2500 / 3600 / 4096 / 5000

NUMBER OF PULSES RI 58TG: 50 / 360 / 500 / 1000 / 1024 / 2000 / 2048 / 2500

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	14 mm / 15 mm (Through hollow shaft)
Flange (Mounting of housing)	Synchro flange
Mounting of shaft	Front clamping ring, Rear clamping ring
Protection class shaft input (EN 60529)	IP64
Protection class housing (EN 60529)	IP64
Shaft tolerance	Ø 14/ 15 mm, tolerance g8
Max. speed	max. 4000 rpm
Starting torque typ.	≤ 2 Ncm
Moment of inertia	approx. 60 gcm²
Vibration resistance (DIN EN 60068-2-6)	10 g = 100 m/s² (10 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	100 g = 1000 m/s² (6 ms)
Operating temperature	RI 58-G: -10 °C ... +70 °C RI 58TG: -10 °C ... +100 °C
Storage temperature	-25 °C ... +85 °C
Material housing	Aluminum
Weight	approx. 210 g
Connection	Cable, radial

TECHNICAL DATA
electrical

General design	as per DIN VDE 0160, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	RS422 + Sense (T): DC 5 V ±10 % RS422 + Alarm (R): ± 10% DC 5 V or DC 10 - 30 V Push-pull (K), Push-pull antivalent (I): DC 10-30 V
Current w/o load typ.	40 mA (DC 5 V), 60 mA (DC 10 V), 30 mA (DC 24 V)
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz

Standard Industrial types RI 58-G / RI 58TG

Incremental Hollow shaft

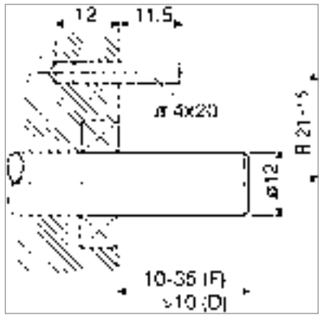
TECHNICAL DATA
electrical (continued)

Standard output versions [2]	RS422 + Alarm (R): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$ RS422 + Sense (T): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, Sense Push-pull (K): A, B, N, $\overline{Alarm}$ Push-pull complementary (I): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$
Pulse width error	± max. 25° electrical
Number of pulses	50 ... 2500
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Pulse duty factor	1:1

[1] With push-pull (K): pole protection
[2] Output description and technical data see chapter "Technical basics"

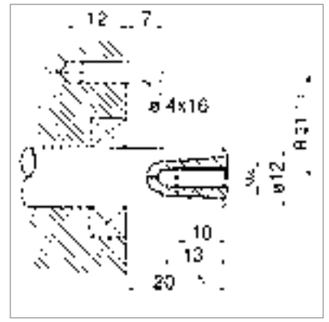
MOUNTING NECESSITIES

In order to be able to compensate an axial and radial misalignment of the shaft, the encoder flange must not be fixed rigidly. Fix the flanges by means of a stator coupling (e.g. hubshaft with tether) as torque support (see "Accessories") or by means of a cylindrical pin:



Dimensions in mm
also apply for shaft-Ø 10 or 14
Mounting = D, F (Clamping ring)
Preparation of the machine flange [1]
(all mounting versions):
In the machine flange a straight pin must be installed (diameter 4x16 resp. 4x20, DIN 6325).
This pin is required as a torque support.

1 Or as an option: stator coupling as torque support



Dimensions in mm
also apply for shaft-Ø 10 or 14
Mounting = E (mounting with center screw)
Preparation of the drive shaft
(only in mounting = E):
The drive shaft must be provided with a threaded bore M 4 x10:
This bore accepts the fastening screw of the shaft encoder.

ELECTRICAL CONNECTIONS
Cable PVC

Cable PVC Colour	Output circuit RS422 + Sense (T)	RS422 + Alarm (R)	push-pull (K)	push-pull complementary (I)
white	Channel A	Channel A	Channel A	Channel A
white/brown	Channel $\overline{A}$	Channel $\overline{A}$		Channel $\overline{A}$
green	Channel B	Channel B	Channel B	Channel B
green/brown	Channel $\overline{B}$	Channel $\overline{B}$		Channel $\overline{B}$
yellow	Channel N	Channel N	Channel N	Channel N
yellow/brown	Channel $\overline{N}$	Channel $\overline{N}$		Channel $\overline{N}$
yellow/black	Sense GND	$\overline{Alarm}$	$\overline{Alarm}$	$\overline{Alarm}$
yellow/red	Sense V_{CC}	Sense V_{CC}		Sense V_{CC}
red	DC 5 V	DC 5 / 10 - 30 V	DC 10 - 30 V	DC 10 - 30 V
black	GND	GND	GND	GND
Cable screen [1]	Cable screen [1]	Cable screen [1]	Cable screen [1]	Cable screen [1]

[1] connected with encoder housing

ELECTRICAL CONNECTIONS
Cable TPE

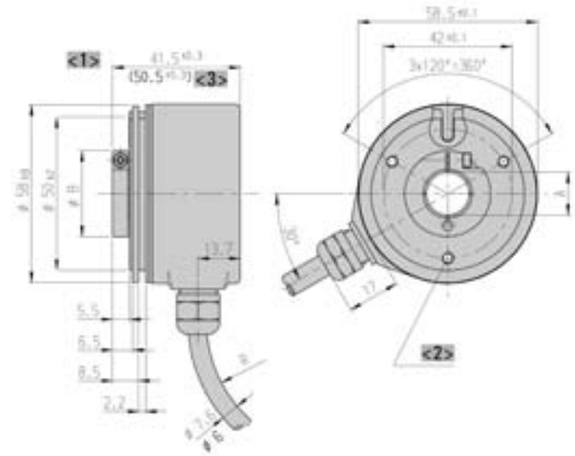
Cable TPE Colour	Output circuit RS422 + Sense (T)	RS422 + Alarm (R)	push-pull (K)	push-pull complementary (I)
brown	Channel A	Channel A	Channel A	Channel A
green	Channel $\overline{A}$	Channel $\overline{A}$		Channel $\overline{A}$
grey	Channel B	Channel B	Channel B	Channel B
pink	Channe $\overline{B}$	Channe $\overline{B}$		Channe $\overline{B}$
red	Channel N	Channel N	Channel N	Channel N
black	Channel $\overline{N}$	Channel $\overline{N}$		Channel $\overline{N}$
violet (white) [1]	Sense GND	$\overline{Alarm}$	$\overline{Alarm}$	$\overline{Alarm}$
blue	Sense V_{CC}	Sense V_{CC}		Sense V_{CC}
brown/green	DC 5 V	DC 5 / 10 - 30 V	DC 10 - 30 V	DC 10 - 30 V
white/green	GND	GND	GND	GND
Cable screen [2]	Cable screen [2]	Cable screen [2]	Cable screen [2]	Cable screen [2]

[1] white with RS422 + Sense (T)
[2] connected with encoder housing

Standard Industrial types RI 58-G / RI 58TG
Incremental Hollow shaft

DIMENSIONED DRAWINGS

Mounting D: Through hollow shaft with clamping ring front

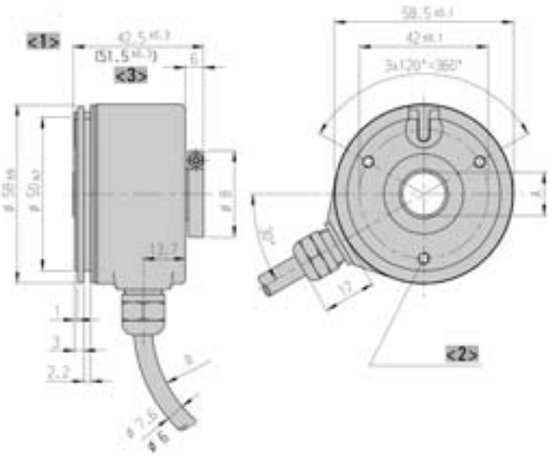


Dim.	Hollow shaft Ø		Unit
A	14 ^{H7}	15 ^{H7}	mm
A*	14 $_{g8}$	15 $_{g8}$	mm
B	30	30	mm
A* = diameter of connection shaft			

<1> View turned 60°
<2> mounting thread M4x5
<3> value in brackets with version DC 10 - 30 V, RS422
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm

Dimensions in mm

Mounting H optional: Through hollow shaft with clamping ring rear on request



Dim.	Hollow shaft Ø		Unit
A	14 ^{H7}	15 ^{H7}	mm
A*	14 $_{g8}$	15 $_{g8}$	mm
B	30	30	mm
A* = diameter of connection shaft			

<1> View turned 60°
<2> mounting thread M4x5
<3> value in brackets with version DC 10 - 30 V, RS422
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm

Dimensions in mm

Incremental Hollow shaft

ORDERING INFORMATION

Type	Number of pulses	Supply voltage [1,2]	Flange, Protection, Shaft [3]	Output	Connection
☐	☐	☐	☐	☐	☐
RI58-G **RI58TG**	RI 58-G: **50 ... 5000** RI 58TG: **50 ... 2500**	**A** DC 5 V **E** DC 10 - 30 V	**D.39** Through hollow shaft with clamping ring front, IP64, 14 mm **D.3D** Through hollow shaft with clamping ring front, IP64, 15 mm **H.39** Through hollow shaft with clamping ring rear, IP64, 14 mm **H.3D** Through hollow shaft with clamping ring rear, IP64, 15 mm	**R** RS422 +Alarm **T** RS422 +Sense **K** Push-pull **I** Push-pull complementary	**B** PVC cable, radial **F** TPE cable, radial

[1] DC 5 V: only with output "T", "R" available
[2] DC 10 - 30 V: only with output "K", "I", "R" available
[3] IP67 on cover with connector only if IP67 mating connector mounted properly.

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

Incremental Hollow shaft

- Incremental hollow shaft encoder
- Up to 10 000 ppr
- Through hollow shaft and hubshaft up to 12 mm (14 mm optional)
- Optimized stator coupling
- Applications: Feedback for asynchronous motors, industrial applications

NUMBER OF PULSES

1 / 2 / 3 / 4 / 10 / 20 / 25 / 30 / 40 / 45 / 50 / 60 / 64 / 70 / 72 / 80 / **100** / 125 / 128 / 144 / 150 / 180 / 200 / **250** / 256 / 300 / 314 / 350 / 360 / 375 / 400 / 460 / 480 / **500** / 512 / 600 / 625 / 720 / 900 / **1000** / **1024** / **1250** / 1500 / 1600 / 1800 / 2000 / 2048 / 2500 / 3000 / 3480 / **3600** / 4000 / **4096** / **5000** / **7854** / **10000**
Preferably available versions are printed in bold type.

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	6 mm / 10 mm / 12 mm (Hubshaft) 6 mm / 10 mm / 12 mm (Through hollow shaft)
Flange (Mounting of housing)	Tether
Mounting of shaft	Set screw, Front clamping ring, Rear clamping ring, Clamping ring with set screw
Protection class shaft input (EN 60529)	IP64
Protection class housing (EN 60529)	Through hollow shaft - D: IP64 Hubshaft - F: IP67
Axial endplay of mounting shaft (hubshaft)	± 1.5 mm
Radial runout of mating shaft (hubshaft)	± 0.2 mm
Max. speed	Hub shaft: max. 4000 rpm Through hollow shaft: max. 6000 rpm
Vibration resistance (DIN EN 60068-2-6)	100 m/s²
Shock resistance (DIN EN 60068-2-27)	1000 m/s²
Operating temperature	-10 °C ... +70 °C
Storage temperature	-25 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Aluminum
Weight	approx. 180 g
Connection	Cable, radial M23 connector (Conin), 12 pole, radial

TECHNICAL DATA
electrical

General design	as per DIN VDE 0160, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	RS422 + Sense (T): DC 5 V ±10 % RS422 + Alarm (R): ± 10% DC 5 V or DC 10 - 30 V Push-pull (K), Push-pull antivalent (I): DC 10-30 V
Current w/o load typ.	40 mA (DC 5 V), 60 mA (DC 10 V), 30 mA (DC 24 V)

TECHNICAL DATA
electrical (continued)

Standard output versions [2,3]	RS422 + Alarm (R): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$ RS422 + Sense (T): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, Sense Push-pull (K): A, B, N, $\overline{Alarm}$ Push-pull complementary (I): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$
Number of pulses	1 ... 10 000

[1] Pole protection with supply voltage DC 10 - 30 V
[2] Output code "K" and "I": short-circuit-proof
[3] Output description and technical data see chapter "Technical basics"

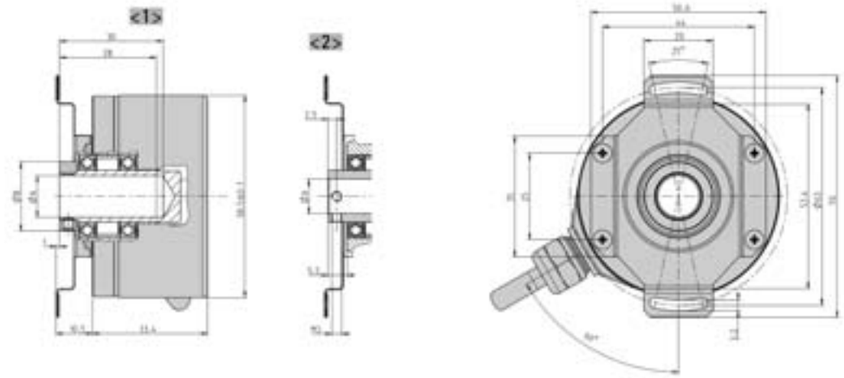
Electrical Connections
M23-Connector (conin), 12-pole / Cable

Colour TPE	Colour PVC	PIN	RS422 + Alarm (R)	Push-pull (K)	Push-pull antivalent (I)	RS422 + Sense (T)
brown	white	5	Channel A	Channel A	Channel A	Channel A
green	white/ brown	6	Channel $\overline{A}$		Channel $\overline{A}$	Channel $\overline{A}$
grew	green	8	Channel B	Channel B	Channel B	Channel B
pink	green/ brown	1	Channel $\overline{B}$		Channel $\overline{B}$	Channel $\overline{B}$
red	yellow	3	Channel N	Channel N	Channel N	Channel N
black	yellow/ brown	4	Channel $\overline{N}$		Channel $\overline{N}$	Channel $\overline{N}$
violet	yellow/ black	7	$\overline{Alarm}$	$\overline{Alarm}$	$\overline{Alarm}$	n.c.
white	yellow/ black	11	n.c.	n.c.	n.c.	Sense GND
blue	yellow/ red	2	Sense V_{cc}		Sense V_{cc}	Sense V_{cc}
brown/ green	red	12	DC 5 V / DC 10 - 30 V	DC 5 V / DC 10 - 30 V	DC 5 V / DC 10 - 30 V	DC 5 V / DC 10 - 30 V
white/ green	black	10	GND	GND	GND	GND
Screen	screen		screen	screen	screen	screen

Standard Industrial types RI 58-F
Incremental Hollow shaft

DIMENSIONED DRAWINGS

Hubshaft

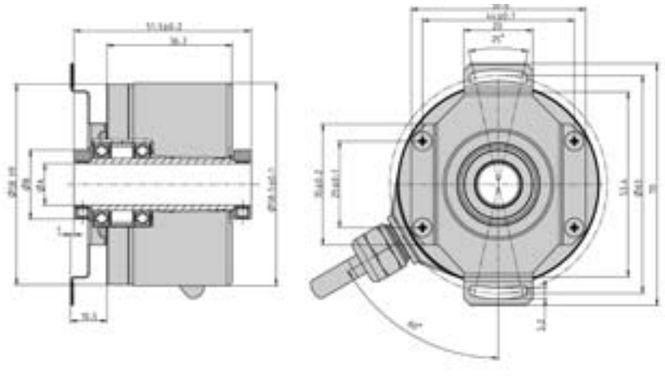


Dim.	Hollow shaft Ø		Unit
A	10 $^{-0.002/+0.008}$	12 $^{-0.002/+0.008}$	mm
A*	10 $_{g7}$	12 $_{g7}$	mm
B		20	mm
L_{min}	15.5	17.5	mm
L_{max}	28	28	mm
A* = diameter of connection shaft			
L = length of connection shaft			

<1> Ø A > 10 mm
<2> Ø A ≤ 10 mm
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm

Dimensions in mm

Through hollow shaft



Dim.	Hollow shaft Ø		Unit
A	10 $^{+0.012}$	12 $^{+0.012}$	mm
A*	10 $_{g7}$	12 $_{g7}$	mm
B	18	20	mm
A* = diameter of connection shaft			

Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm

Dimensions in mm

Incremental Hollow shaft

ORDERING INFORMATION

Type	Number of pulses	Supply voltage [1, 2]	Flange, Protection, Shaft [4]	Output	Connection [3]
☐	☐	☐	☐	☐	☐
RI58-F	**1 ... 10000**	**A** DC 5 V **E** DC 10 - 30 V	**B.32** Spring tether, IP64, through hollow shaft,10 mm, mounting with clamping ring front and rear **B.37** Spring tether, IP64, through hollow shaft,12 mm, mounting with clamping ring front and rear **F.41** Spring tether, IP64, hubshaft 6 mm, mounting with set screw **F.42** Spring tether, IP64, hubshaft 10 mm, mounting with set screw **F.47** Spring tether, IP64, hubshaft 12 mm, mounting with ring with clamping set screw	**R** RS422 +Alarm **T** RS422 +Sense **K** HTL **I** HTL complementary	**B** PVC cable, radial **F** TPE cable, radial **D** M23 connector (Conin), 12 pole, radial, cw **H** M23 connector (Conin), 12 pole, radial, ccw

[1] DC 5 V only with output T, R, K
[2] DC 10 - 30 V only with output K, I
[3] Connection code "D", "H" (M23 connector) only with hubshaft
[4] IP67 on cover with connector only if IP67 mating connector mounted properly.

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Incremental Hollow shaft

- Through hollow shaft and hubshaft up to 16 mm
- Robust design
- High shock and vibrations resistance
- PPR: Up to 5000
- Electrically insulated shaft: protection from shaft currents
- High temperature range: -40°C ... + 100°C
- Protection class IP67: also for through hollow shaft
- Applications: Feedback for asynchronous motors, industrial applications

NUMBER OF PULSES

360 /1000 / **1024** / 2000 / **2048** / 3600 / **4096** / **5000**

TECHNICAL DATA
mechanical

Housing diameter	63 mm
Mounting depth	54"
Shaft diameter	10 mm / 12 mm / 14 mm / 15 mm / 16 mm (Hubshaft) 12 mm / 14 mm / 15 mm / 16 mm (Through hollow shaft)
Flange (Mounting of housing)	Tether
Mounting of shaft	Front clamping ring, Rear clamping ring
Protection class shaft input (EN 60529)	IP64 or IP67
Axial endplay of mounting shaft (hubshaft)	± 0.8 mm
Radial runout of mating shaft (hubshaft)	± 0.2 mm
Max. speed	Hub shaft: max. 12 000 rpm Through hollow shaft: max. 6000 rpm
Vibration resistance (DIN EN 60068-2-6)	100 m/s²
Shock resistance (DIN EN 60068-2-27)	1000 m/s²
Operating temperature	-40 °C ... +100 °C
Material shaft	Aluminum, ceramic coating
Material housing	Aluminum
Weight	approx. 180 g
Connection	Cable, axial or radial Cable with M23 connector

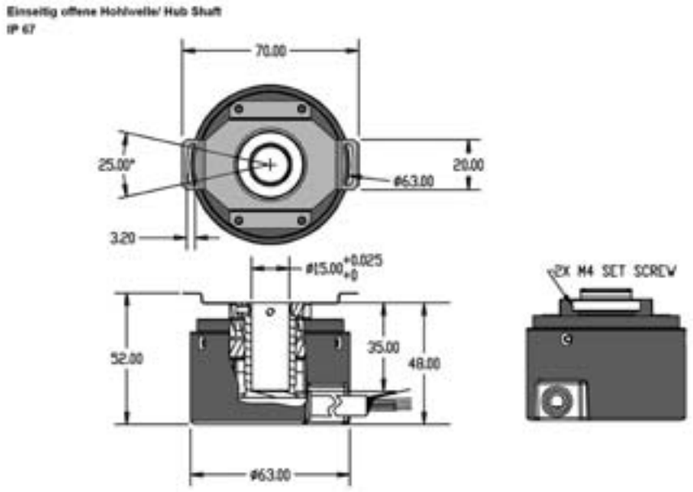
TECHNICAL DATA
electrical

Supply voltage	DC 5 V ±10 % DC 5 - 26 V
Max. pulse frequency	300 kHz
Index pulse width (N)	180° electrical
Number of pulses	1 ... 5000
Pulse shape	Square wave

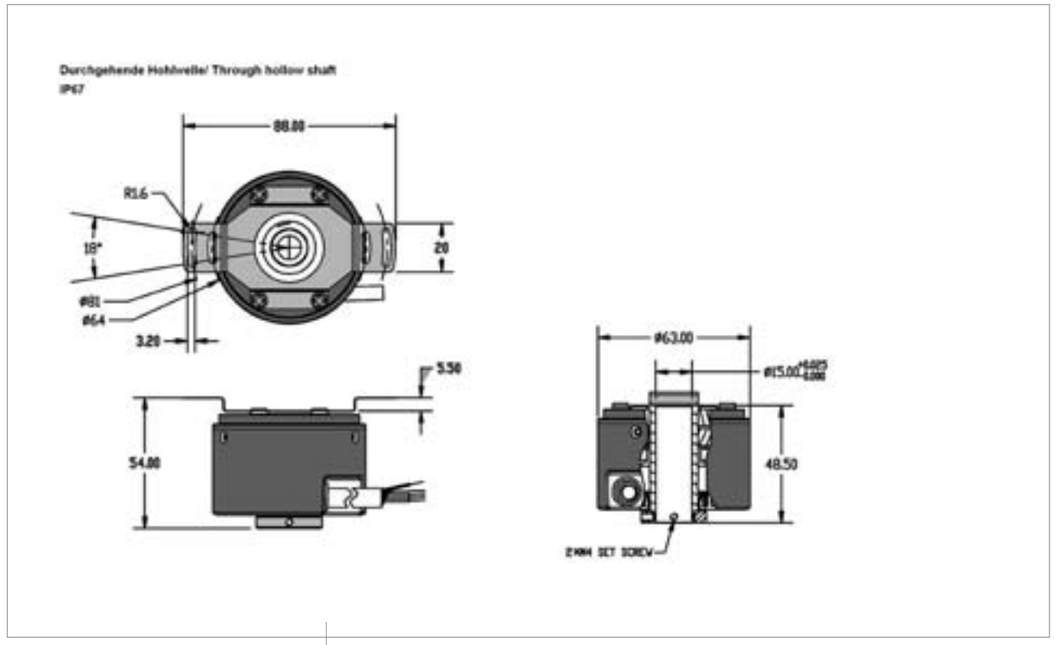
ELECTRICAL CONNECTIONS
M23 connector (Conin), 12 pole / cable

Colour	PIN	Signal
Red	12	DC 5/ 5 - 26 V
Black	10	GND
Blue	5	A
Green	8	B
Violet	3	N
Blue/ Black	6	$\overline{A}$
Green/ Black	1	$\overline{B}$
Violet/ Black	4	$\overline{Z}$
Screen	Screen	Screen

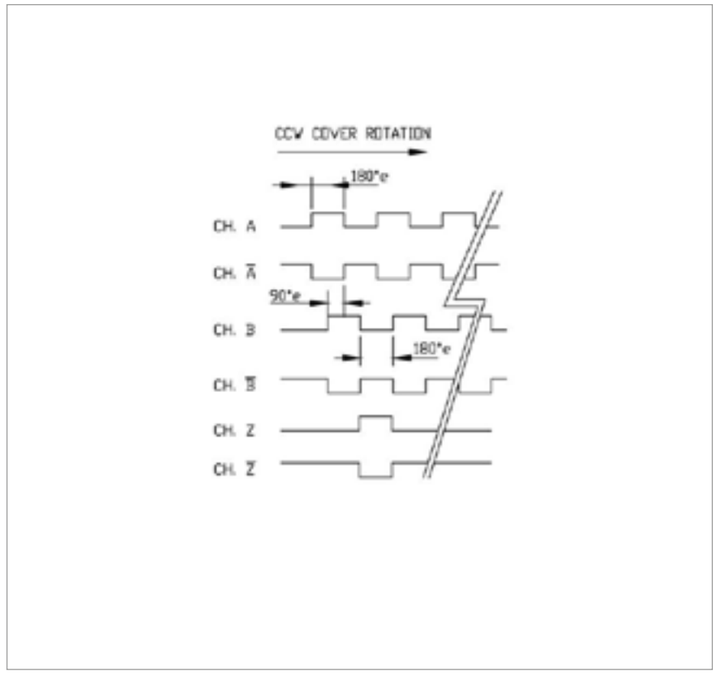
DIMENSIONED DRAWINGS



DIMENSIONED DRAWINGS (continued)



OUTPUT WAVEFORMS



ORDERING INFORMATION

ORDERING INFORMATION

Type	Number of pulses	Supply voltage [1, 2]	Spring tether	Protection	Shaft	Shaft Ø	Output	Connection [3]
RI64	**0360** **1000** **1024** **2000** **2048** **3600** **4096** **5000**	**A** DC 5 V **B** DC 5 - 30 V	**O** Without tether **V** 63 **W**81/64	**4** IP64 **7** IP67	**H** Clamping shaft with clamping ring rear **F** hub shaft with clamping ring front	**2** 10 mm **7** 12 mm **9** 14 mm **D** 15 mm **G** 16 mm	**I** Push-pull complementary **T** RS422	**B** PVC cable, radial **B-I** Cable with M23 connector, cw **B-D** Cable with M23-connector, ccw

[1] DC 5 V only with output T
[2] DC 5 - 26 V only with output I
[3] Standard cable lenght for variant with connector 1.5 m. For other cable length use chart below.

Standard Industrial types RI 64
Incremental Hollow shaft

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

Incremental Hollow shaft

- Through hollow shaft Ø 15 bis 42 mm
- Outside diameter only 76 mm
- Easy installation by means of clamping ring front or rear
- Operating temperature up to 100 °C
- Applications: motors, printing machines, lifts

NUMBER OF PULSES

50 / 100 / 250 / 300 / 314 / 360 / 500 / 600 / 720 / 900 / 1000 / 1024 / 1250 / 1500 / 2048 / 2500 / 3072 / 4096 / 5000 / 9000 / 10000
Other number of pulses on request

TECHNICAL DATA
mechanical

Housing diameter	76 mm
Shaft diameter	15 mm / 16 mm / 18 mm / 20 mm / 24 mm / 25 mm / 27 mm / 28 mm / 30 mm / 32 mm / 38 mm / 40 mm (Hub shaft)
Flange (Mounting of housing)	Tether
Mounting of shaft	Front clamping ring, Rear clamping ring
Protection class shaft input (EN 60529)	IP40 or IP64
Protection class housing (EN 60529)	IP50 (IP65 optional)
Minimum length of mountig shaft clamping ring front	32 mm with Ø 15 ... 30, 35 mm with Ø >30 ... 42
Mimimum length of mounting shaft clamping ring rear	corresponding to total length of encoder
Axial endplay of mounting shaft (hubshaft)	With stator coupling A (flexible): ± 2 mm With 1x stator coupling (torsionally rigid): ± 0.5 mm With 2x stator coupling (torsionally rigid): ± 0.3 mm
Radial runout of mating shaft (hubshaft)	With stator coupling A (flexible): ± 0.15 mm With 1x stator coupling (torsionally rigid): ± 0.3 mm With 2x stator coupling (torsionally rigid): ± 0.2 mm
Max. speed	for Ø 15 ... 25 mm at 70 °C and IP64: max. 3600 rpm for Ø >25 ... 42 mm bei 70 °C and IP64: max. 1800 rpm for Ø 15 ... 42 mm at 70 °C and IP40: max. 6000 rpm for Ø 15 ... 42 mm at 100 °C always: max. 1800 rpm
Starting torque typ.	3 ... 10 Ncm (depending on version)
Moment of inertia	approx. 140 ... 420 gcm² (depending on version)
Vibration resistance (DIN EN 60068-2-6)	10 g = 100 m/s² (10 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	100 g = 1000 m/s² (6 ms)
Operating temperature	-25 °C ... +100 °C
Storage temperature	-25 °C ... +100 °C
Material housing	Aluminum
Weight	approx. 320 ... 580 g (depending on version)
Connection	Cable, radial

TECHNICAL DATA
electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II

Incremental Hollow shaft

TECHNICAL DATA
electrical (continued)

Supply voltage [1]	RS422 + Sense (T): DC 5 V ±10 % RS422 + Alarm (R): ± 10% DC 5 V or DC 10 - 30 V Push-pull (K), Push-pull antivalent (I): DC 10-30 V
Current w/o load typ.	60 mA (DC 5 V), 60 mA (DC 10 V), 35 mA (DC 24 V)
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz
Standard output versions [2]	RS422 + Alarm (R): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$ RS422 + Sense (T): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, Sense Push-pull (K): A, B, N, $\overline{Alarm}$ Push-pull complementary (I): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$
Pulse width error	± max. 25° electrical
Number of pulses	1 ... 10 000
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Pulse duty factor	1:1

[1] Pole protection with supply voltage DC 10 - 30 V
[2] Output description and technical data see chapter "Technical basics"

SHAFT CONNECTION

Shaft fixing is done through a clamping ring either on the flange or cap side. As a rule, flange side clamping is better for smaller motors as the available shaft stub is correspondingly shorter.

On the other hand, cap side clamping is easier when there is sufficient shaft length available.

MOUNTING NECESSITIES

In order to compensate for axial and radial shaft eccentricity as well as any angle offset, the encoder flange must not be rigidly mounted. Please mount the flange with a flexible stator coupling (e.g. hubshaft with tether) as torque support

There are two flexible mounting plates:
- A flexible hubshaft with tether (A) for higher levels of play and lower requirements for accuracy.
- A rigid hubshaft with tether (N) for reduced play and rigid connection with reduced swing angle. This is suitable in the case of higher accuracy and dynamics requirments.

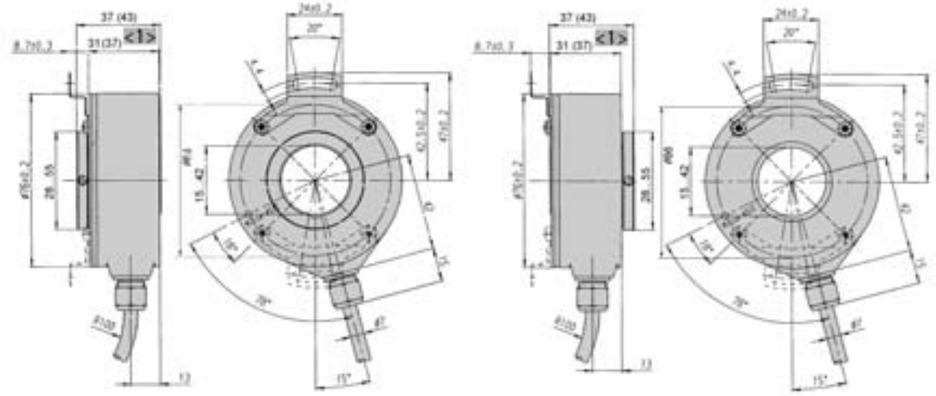
ELECTRICAL CONNECTIONS
Cable TPE

Colour (TPE)	**Output circuit**			
	RS422 + Sense (T)	**RS422 + Alarm (R)**	**push-pull (K)**	**push-pull complementary (I)**
brown	Channel A	Channel A	Channel A	Channel A
green	Channel $\overline{A}$	Channel $\overline{A}$		Channel $\overline{A}$
grey	Channel B	Channel B	Channel B	Channel B
pink	Channel $\overline{B}$	Channel $\overline{B}$		Channel $\overline{B}$
red	Channel N	Channel N	Channel N	Channel N
black	Channel $\overline{N}$	Channel $\overline{N}$		Channel $\overline{N}$
violet (white) [1]	Sense GND	$\overline{Alarm}$	$\overline{Alarm}$	$\overline{Alarm}$
blue	Sense V_{CC}	Sense V_{CC}		Sense V_{CC}
brown/green	DC 5 V	DC 5/10 - 30 V	DC 10 - 30 V	DC 10 - 30 V
white/green	GND	GND	GND	GND
Cable screen [2]	Cable screen [2]	Cable screen [2]	Cable screen [2]	Cable screen [2]

[1] white for version Sense (T)
[2] connected with encoder housing

DIMENSIONED DRAWINGS

With hubshaft with tether "rigid"

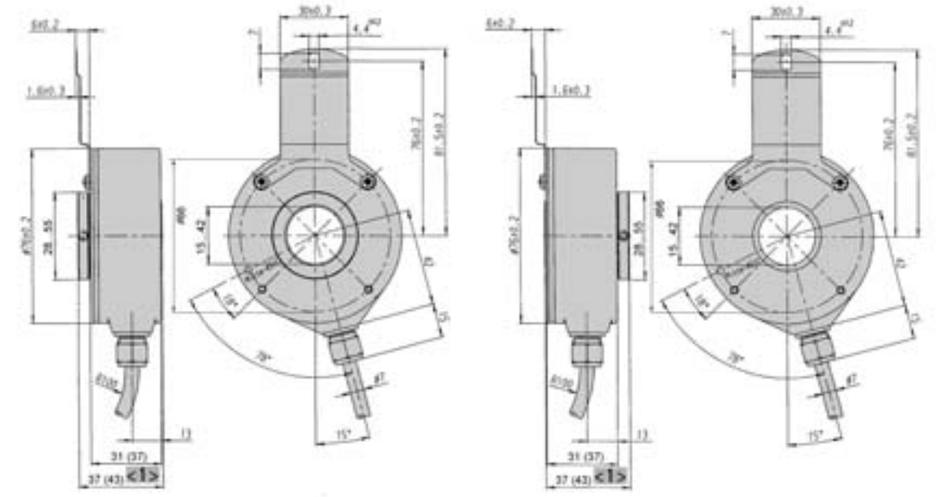


<1> Values in brackets for shaft diameter > 30, diameter of connection shaft 15^{g8} ... 42^{g8}

Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm

Dimensions in mm

With hubshaft with tether "flexible"



<1> Values in brackets for shaft diameter > 30, diameter of connection shaft 15^{g8} ... 42^{g8}

Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm

Dimensions in mm

ORDERING INFORMATION

Type	Number of pulses	Supply voltage [1, 2]	Shaft	Protection	Spring tether	Shaft Ø [3, 4, 5, 6]	Output	Connection
RI76TD	**1 ... 10000**	**A** DC 5 V **E** DC 10 - 30 V	**D** Clamping shaft with clamping ring front **H** Clamping shaft with clamping ring rear	**1** IP40 **4** IP64	**O** Without **A** Flexible **N** Rigid	**15 ... 42** 15 ... 42 mm **50 ... 99** 50 ... 99 inch **50** = 5/8" **51** = 1 5/8" **52** = 3/4"	**R** RS422 +Alarm **T** RS422 +Sense **K** Push-pull **I** Push-pull complementary	**F** TPE cable, radial

[1] DC 5 V: only with output "T", "R" available
[2] DC 10 - 30 V: only with output "K", "I", "R" available
[3] Available with front clamping ring and IP40: 15, 20, 24, 25, 27, 28, 30, 38, 40, 42, 50 (5/8"), 51 (1 5/8")
[4] Available with front clamping ring and IP64: 15, 16, 18, 20, 24, 25, 27, 28, 30, 32, 38, 40, 42, 50 (5/8"), 51 (1 5/8"), 52 (3/4")
[5] Available with rear clamping ring and IP40: 25, 28, 30, 32, 38, 40, 42
[6] Available with rear clamping ring and IP64: 20, 25, 30, 32, 38, 40, 42

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Incremental Hollow shaft

- Incremental
- 30 - 45 mm hollow shaft
- Rugged mechanical design
- Unbreakable disc
- Integrated diagnostic system
- Wide voltage range DC 5 - 30 V
- Option: Isolated shaft and spring tether

NUMBER OF PULSES

1024 / 2048 / 2500 / 4096 / 5000 / 10000
Other number of pulses on request

GENERAL INFORMATION

The central element of the RI80-E is the latest Hengstler OptoAsic technology, which offers the following key benefits:

- Highest EMC immunity
- Outstanding reliability by reduced number of components and integrated diagnostics system
- Aging compensation by integrated LED light regulation
- Integrated monitoring of pollution, disk damage, LED lifetime, temperature

A robust and generously dimensioned mechanical design ensures long maintenance free operation.

The RI80-E is ideally suited for applications like:
- Geared Elevators
- Asynchronous Motors
- Industrial Machinery

TECHNICAL DATA
mechanical

Housing diameter	100 mm
Shaft diameter	30 mm / 45 mm (Through hollow shaft)
Flange (Mounting of housing)	Tether
Mounting of shaft	Keyway, Set screw
Protection class shaft input (EN 60529)	IP50 or IP64
Protection class housing (EN 60529)	IP50 or IP64
Axial endplay of mounting shaft (hubshaft)	± 0.5 mm
Radial runout of mating shaft (hubshaft)	± 0.2 mm
Max. speed	IP50: max. 3600 rpm IP64: max. 1500 rpm
Vibration resistance (DIN EN 60068-2-6)	10 g (10 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	100 g (6 ms)
Operating temperature	-25 °C ... +85 °C
Storage temperature	-40 °C ... +70 °C
Material shaft	Aluminum, ceramic coating
Material housing	Aluminum / glass fiber-reinforced plastic

Standard Industrial types RI 80-E

Incremental Hollow shaft

TECHNICAL DATA
mechanical (continued)

TECHNICAL DATA
electrical

Weight	670 g
Connection	Sub-D connector Cable, radial
General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	DC 5 V ±10 % or DC 5 - 30 V
Current w/o load typ.	60 mA (DC 5 V), 60 mA (DC 10 V), 35 mA (DC 24 V)
Max. pulse frequency	RS422: 600 kHz Push-pull: 200 kHz
EMC	EN 61326 Class A
Standard output versions [2]	RS422 (R): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$, Sense Push-pull (K): A, B, N, $\overline{Alarm}$ Push-pull complementary (I): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$
Pulse width error	± max. 25° electrical
Number of pulses	1024, 2048, 2500, 4096, 5000, 10 000, (other number of pulses on request)
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Pulse duty factor	1:1

[1] Pole protection with supply voltage DC 5 - 30 V
[2] Output description and technical data see chapter "Technical basics"

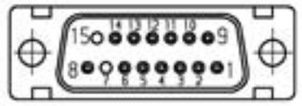
ELECTRICAL CONNECTIONS
Cable TPE

Color	RS422 + Alarm + Sense (R)	Push-pull (K)	Push-pull Complement. (I)
brown	Channel A	Channel A	Channel A
green	Channel $\overline{A}$		Channel $\overline{A}$
gray	Channel B	Channel B	Channel B
pink	Channel $\overline{B}$		Channel $\overline{B}$
red	Channel N	Channel N	Channel N
black	Channel $\overline{N}$		Channel $\overline{N}$
violet	$\overline{Alarm}$	$\overline{Alarm}$	$\overline{Alarm}$
white	Sense GND		Sense GND
blue	Sense V_{cc}		Sense V_{cc}
brown/green	DC 5 - 30 V	DC 5 - 30 V	DC 5 - 30 V
white/green	GND	GND	GND
screen [1]	screen [1]	screen [1]	screen [1]

[1] connected with encoder housing

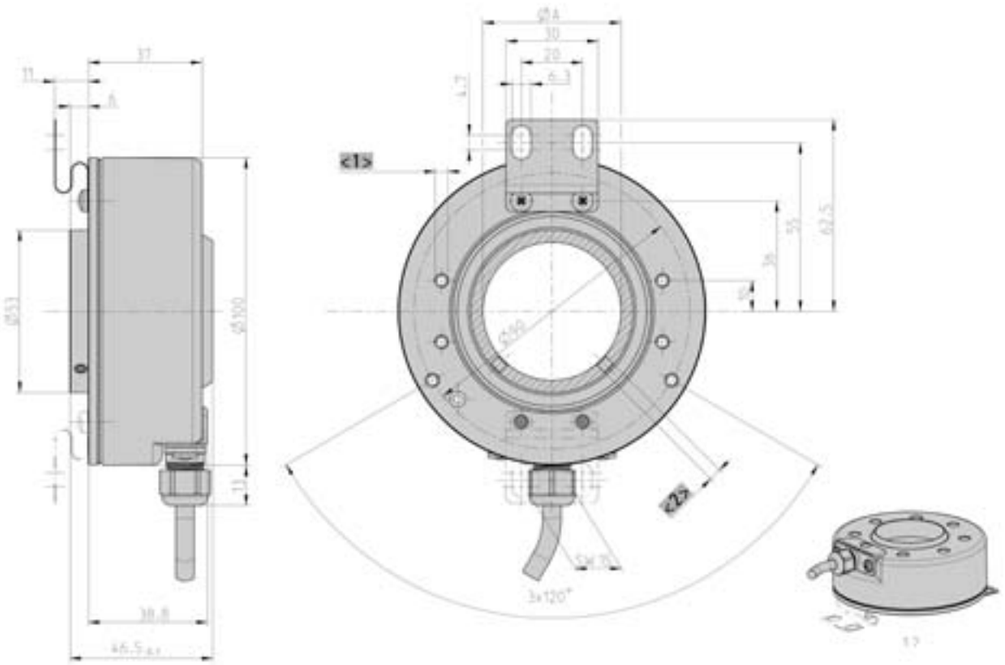
ELECTRICAL CONNECTIONS
Sub-D connector,15 pole/ 9 pole

Pin	Signal 15 pole	Signal 9 pole
1	$\overline{B}$	GND
2	B	+Ub
3	$\overline{A}$	A
4	A	B
5	GND	N
6	+Ub	$\overline{A}$
7	n.c.	$\overline{B}$
8	screen	$\overline{N}$
9	$\overline{N}$	
10	N	
11	n.c.	
12	n.c.	
13	n.c.	
14	n.c.	
15	n.c.	



DIMENSIONED DRAWINGS

Set screw

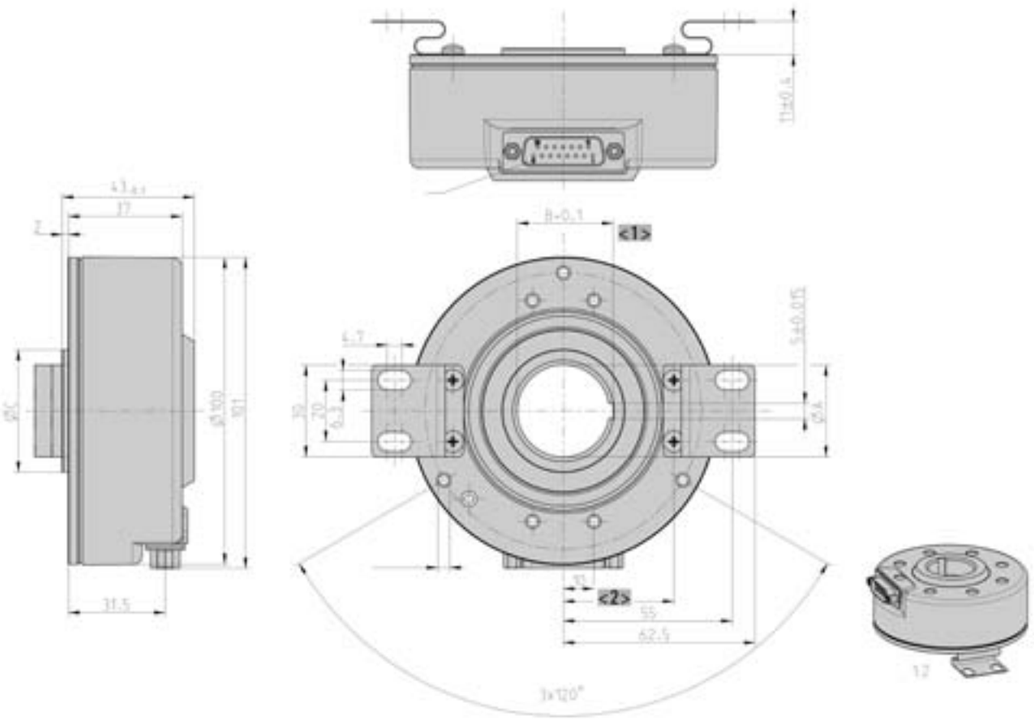


<1> M4 (depth 6) <2> M4 (2 x 90°) Dimensions in mm

Standard Industrial types RI 80-E
Incremental Hollow shaft

DIMENSIONED DRAWINGS (continued)

Keyway



<1> Connector SUB-D 15 pole <2> M4 (depth 6) Dimensions in mm

Standard Industrial types RI 80-E

Incremental Hollow shaft

ORDERING INFORMATION

Type	Number of pulses [2]	Supply voltage	Spring tether	Protection	Shaft	Output [1]	Connection
☐	☐	☐	☐	☐	☐	☐	☐
RI80-E	**1024** **2048** **2500** **4096** **10000** **5000**	**A** DC 5 V **B** DC 5 - 30 V	**0** Without tether **A** Spring tether single **B** Spring tether double **C** RI76 compatible (A)	**0** IP40 **1** IP50 **4** IP64	**G30** Set screw / 30 mm **G38** Set screw / 38 mm **G40** Set screw / 40 mm **G45** Set screw / 45 mm **K30** Keyway / 30 mm 1" isololated on request	**R** RS422 +Alarm +Sense **K** HTL **I** HTL complementary	**F** TPE cable, radial **E-I** M23 connector (Conin) at 1 m TPE cable, cw **E-D** M23 connector (Conin) at 1 m TPE cable, ccw **3** Sub-D connector, 9 pole **4** Sub-D connector, 15 pole

[1] Output code "K" and "I": Driver type DL, see < www.ichaus.de >
[2] Other number of pulses on request

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

HENGSTLER ACURO industry

HENGSTLER OPTOASIC

Standard Industrial Types Absolute

Absolute shaft encoders, also known as shaft-angle encoders, are by no means used only to detect angular positions. They are also suitable for linear movements that can be converted into rotary movements by a toothed belt, drive pinion, or wire winch.

The special feature of absolute shaft encoders is that they assign a unique, digitally encoded signal to each individual measured increment. The method of transducing prevents erroneous readings, whether by a power failure, or by a transient malfunction. After the encoder is switched on again, or power is restored, the position can be read out. It is not necessary to move to a reference position, as it is for shaft encoders of the incremental type.

Examples of application for absolute encoders:

- Overhead support robots
- Ventilation flaps
- Spinning machines
- Conveyor belts
- Cam controllers
- Injection moulding machines
- Packaging machinery
- Extruders
- Folding machines
- Printing machines
- High lift storage machines
- Stamping machines

Absolute + Incremental SSI

Clamping flange

- Positioning and Speed feedback in one Encoder
- MT Absolute encoder + Incremental output TTL or HTL
- Broad temperature range: -40 to + 100°C
- Control input: Preset and Direction
- Resolution: Up to 29 Bit; PPR: 512, 1024, 2048
- Compact design: 50 mm length
- High EMC - Resistance
- Appropriate for standard frequency converter and asynchron motors

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	10 mm (Solid shaft) 10 mm / 12 mm (Hubshaft)
Protection class shaft input (EN 60529)	IP64 or IP67
Protection class housing (EN 60529)	IP64 or IP67
Shaft load axial / radial	40 N / 60 N
Axial endplay of mounting shaft (hubshaft)	± 1.5 mm
Radial runout of mating	± 0.2 mm
Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Starting torque typ.	0.01 Nm
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	-40 °C ... +100 °C
Storage temperature [1]	-25 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Aluminum (option: stainless steel)
Weight	approx. 260 g (ST) / 310 g (MT)
Connection	M23 connector (Conin), 12 pole, axial or radial Cable, axial or radial

[1] due to packaging

TECHNICAL DATA
electrical

Supply voltage	DC 10-30 V
Current w/o load typ.	200 mA
Resolution singleturn	12 -17 Bit
Resolution multiturn	12 Bit
Output code	Gray
Drives	Clock and Data / RS422
Linearity	± ½ LSB
Incremental signals	Push pull, RS422
Number of pulses	512, 1024, 2048
Max. pulse frequency	200 kHz

Standard Industrial types AC 58-I

Absolute + Incremental SSI

TECHNICAL DATA
electrical (continued)

Absolute accuracy	±36"
Repeatability	±7"
Control inputs [1, 2, 3]	Preset, Direction

[1] Preset and Direction high active :
Signal level high: ≥ 70% Ub; low: ≤ 20% Ub or unconnected
[2] Bounce time preset: >2s
Bounce time direction: < 1 ms (dynamic)
[3] Preset-value: Zero
Other values on request

RECOMMENDED DATA TRANSFER RATE
bei SSI

The max. data transfer rate depends on the cable length. For Clock / $\overline{\text{Clock}}$ and Data / $\overline{\text{Data}}$ please use twisted pairs. Use shielded cable.

Cable length	Frequency
< 50 m	< 400 kHz
< 100 m	< 300 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz

DATA FORMAT SSI Multiturn

Resolution	Data bits									
	T1 ... T12	T13 ... T21	T22	T23	T24	T25				
24 Bit [1]	M11 ... M0	S11 ... S1	S0	0	W [2]					
25 Bit [1]	M11 ... M0	S12 ... S2	S1	S0	0	W [2]				
26 Bit [1]	M11 ... M0	S13 ... S3	S2	S1	S0	0	W [2]			
27 Bit [1]	M11 ... M0	S14 ... S4	S3	S2	S1	S0	0	0	0	W [2]
28 Bit [1]	M11 ... M0	S15 ... S5	S4	S3	S2	S1	S0	0	0	W [2]
29 Bit [1]	M11 ... M0	S16 ... S6	S5	S4	S3	S2	S1	S0	0	W [2]
Example for data format 24 Bit with the optional bits alarm and parity										
24 Bit + P [3]	M11 ... M0	S11 ... S2	S1	S0	P	0	W [2]			
24 Bit + A [4]	M11 ... M0	S11 ... S2	S1	S0	A	0	W [2]			
24 Bit + P [3] + A [4]	M11 ... M0	S11 ... S2	S1	S0	A	P	0	W [2]		

S0 ... S16 Data bits for resolution per revolution
M0 ... M11 Data bits for number of revolution (only for multiturn)
[1] Optionen (Parity bit, Alarm- and Parity bit, zero bit) on request
[2] W: from this data bit on the data iteration for multiplex starts
[3] Paritybit: Even Parity (Das Paritybit ergänzt die Datenbits auf eine gerade Anzahl von 1-Bits.) (Option)
[4] Alarm bit: is set to "1" when over temperature, under temperture, disc breakage and defect LED

Absolute + Incremental SSI

SYNCHRONOUS-SERAL TRANSFER (SSI)

Synchronous readout of the encoder data is according to the clock rate given by the SSI-counterpart.
The number of clock rates is determined by the type of encoder (singleturn resp. multiturn) and the configuration of the special Bits as defined.
For multiple transactions (the stored value is readout several times successively) a fixed clock rate per transaction must be kept (for singleturn 13 resp. 14 clocks, for multiturn 25 resp. 26 clocks).

- In the rest position, when the last clock brush has passed by more than 30µs, the data output is logically at "1".
- With the first descending clock edge the encoder data and the special bits are loaded in the shift register of the encoder interface.
- With each ascending clock edge the data bits are serially readout, beginning with the MSB.
- At the end of the data transfer the data output is set to logically "0" for approx. 20µs. If within these 20µs a further clock brush reaches the encoder interface, the already transferred data is readout once again. This multiple transfer of the same data makes it possible to recognize transfer errors.
- After the 20µs the data output goes to its rest position, logically "1". Subsequently new encoder data can be readout.

ELECTRICAL CONNECTIONS
Cable / Cable with M23 connector (Conin), 12 pole

PIN	Color	**Signal**
1	brown	0 V (supply)
2	pink	data
3	yellow	clock
4	white/ green	A+
5	blue	direction
6	red/ blue	B+
7	brown/ green	A-
8	white	DC 5/ 10-30 V
9	grey/ pink	B-
10	grey	$\overline{\text{data}}$
11	green	$\overline{\text{clock}}$
12	red	preset
screen	screen	screen

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 58-I, starting page 130

Standard Industrial types AC 58-I

Absolute + Incremental SSI

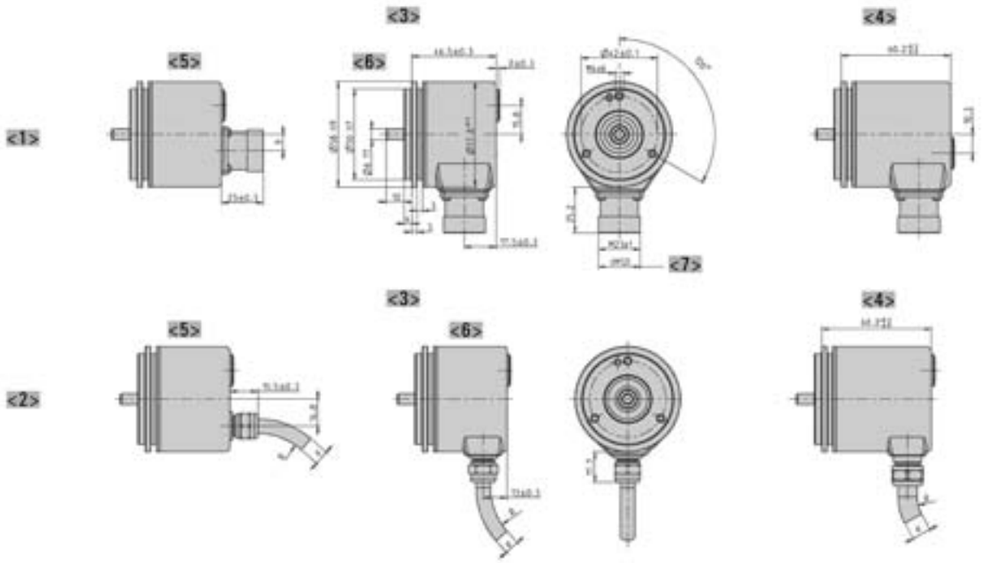
ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft [2]	Interface	Connection
☐	☐	☐	☐	☐	☐
AC58I	**1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST **1217** 12 Bit MT + 17 Bit ST	**E** DC 10 - 30 V	**K.42** Clamping, IP64, 10 mm **K.47** Clamping, IP64, 12 mm **F.42** Spring tether, IP64, hubshaft 10 mm, mounting with clamping ring front **F.47** Spring tether, IP64, hubshaft 12 mm, mounting with clamping ring front	**SM** SSI Gray + 512 ppr, push pull complementary **SN** SSI Gray + 1024 ppr, push pull complementary **SO** SSI Gray + 2048 ppr, push pull complementary	**C** M23 connector (Conin), 12 pole, axial, cw **D** M23 connector (Conin), 12 pole, radial, cw **G** M23 connector (Conin), 12 pole, axial, ccw **H** M23 connector (Conin), 12 pole, radial, ccw **A** Cable, axial, 1.5 m **B** Cable, radial, 1.5m

Absolute + Incremental Dimensioned Drawings

DIMENSIONED DRAWINGS

Synchro flange "S"



<1> Connection M23 (Conin)
<2> Connection cable
<3> Interface: BiSS, SSI, ST-Parallel
<4> Interface: MT-Parallel (only with cable), Fieldbus, SSI-P
<5> axial
<6> radial
<7> Value in brackets alternative at SSI

Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d BiSS/SSI/SSI-P: 7,1 $^{+1,2}$
Cable Ø d ST-P: 7,8 $^{+0,9}$
Cable Ø d MT-P: 9,3 +1,3
Cable Ø d Fieldbus: 7,1 $^{+1,2}$

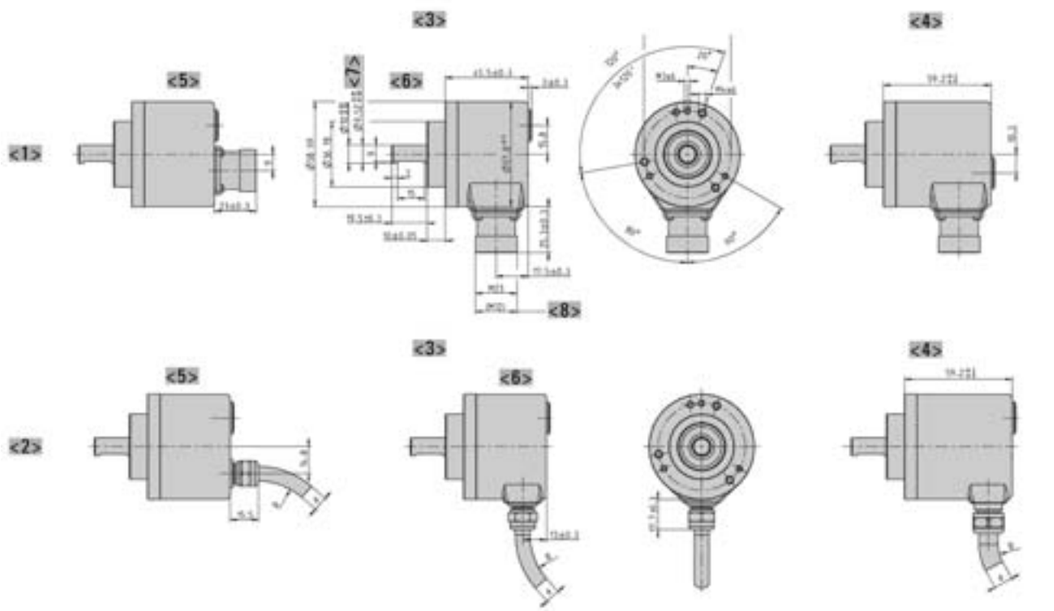
Dimensions in mm

Standard Industrial types AC 58

Absolute + Incremental Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

Clamping flange "K"



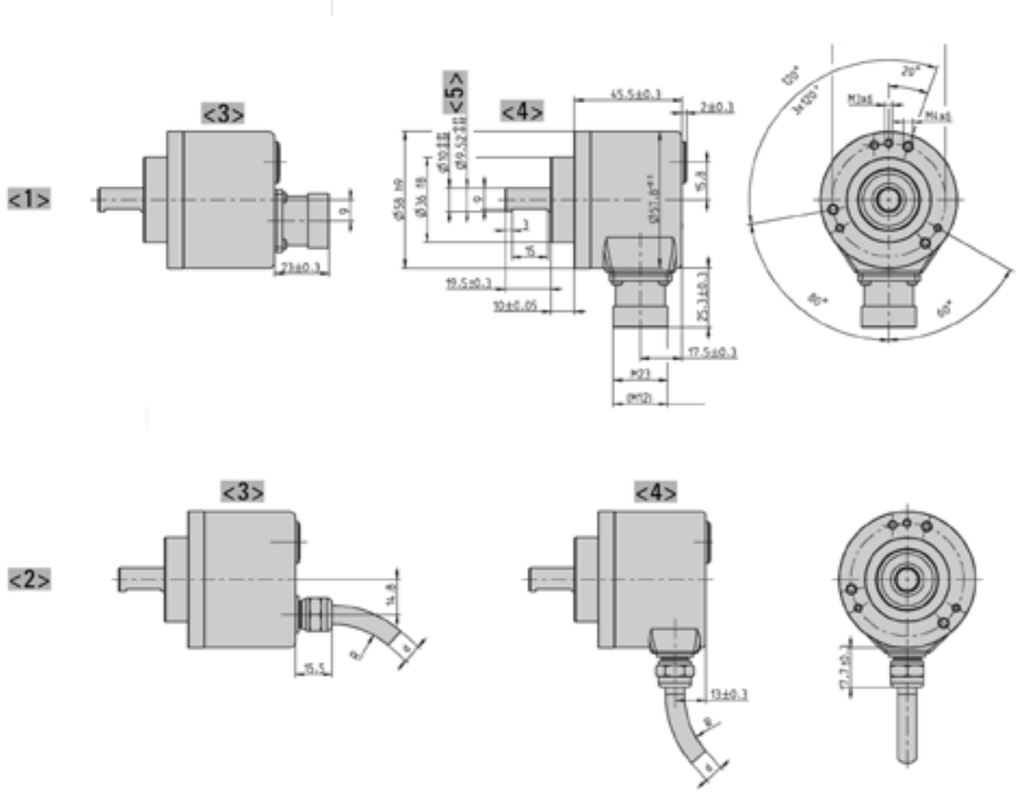
<1> Connection M23 (Conin)
<2> Connection cable
<3> Interface: BiSS, SSI, ST-Parallel
<4> Interface: MT-Parallel (only with cable), Fieldbus, SSI-P
<5> axial
<6> radial
<7> alternative

<8> Value in brackets alternative at SSI
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d BiSS/SSI/SSI-P: 7,1 $^{+1,2}$
Cable Ø d ST-P: 7,8 $^{+0,9}$
Cable Ø d MT-P: 9,3 +1,3
Cable Ø d Fieldbus: 7,1 $^{+1,2}$

Dimensions in mm

DIMENSIONED DRAWINGS (continued)

Clamping flange "K"

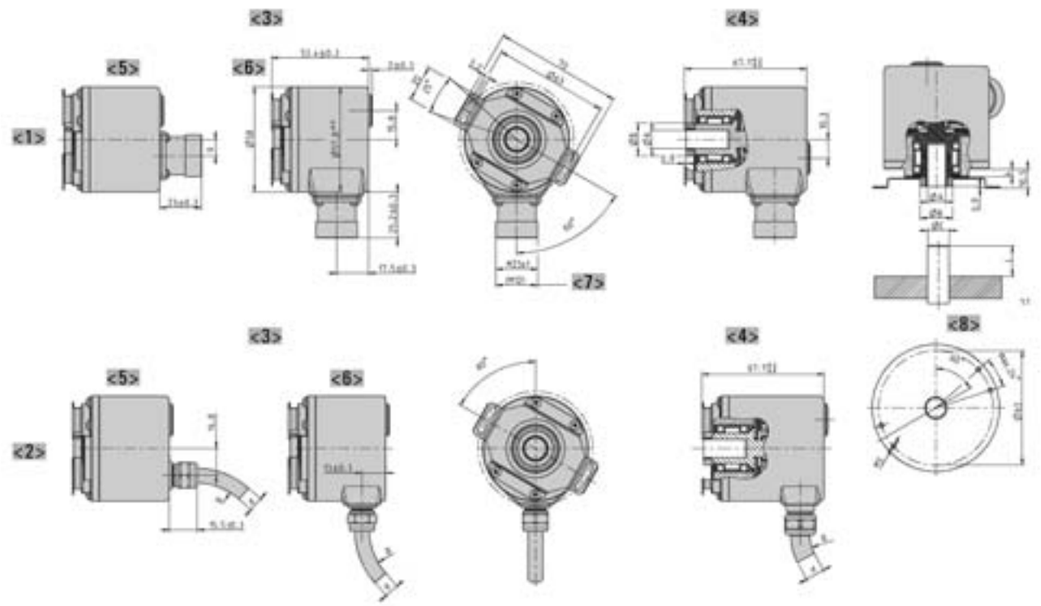


<1> Connection M23 (Conin)
<2> Connection cable
<3> axial
<4> radial
<5> alternative
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d : 7,1 $^{+1,2}$
Dimensions in mm

Absolute + Incremental Drawings — Dimensioned

DIMENSIONED DRAWINGS (continued)

Hollow shaft "F"



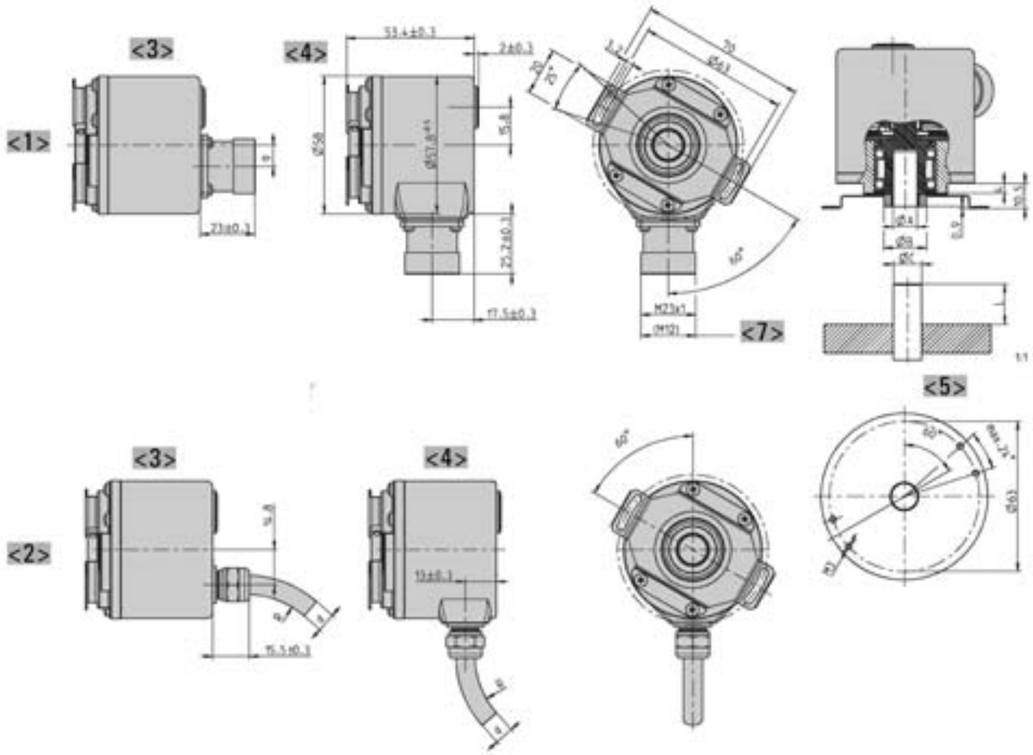
	Dim.				Unit
Hollow shaft Ø A	10 $^{+0.012}$	12 $^{+0.012}$	9,52 $^{+0.012}$	12,7 $^{+0.012}$	mm
Connecting shaft Ø C	10 $_{g7}$	12 $_{g7}$	9,52 $_{g7}$	12,7 $_{g7}$	mm
Clamping ring Ø B	18	20	18	22	mm
L_{min}	15	18	15	18	mm
L_{max}	20	20	20	20	mm
Shaft code	"2"	"7"	"6"	"E"	
L = Inside length of connection shaft					

<1> Connection M23 (Conin)
<2> Connection cable
<3> Interface: BiSS, SSI, ST-Parallel
<4> Interface: MT-Parallel (only with cable), Fieldbus, SSI-P
<5> axial
<6> radial
<7> Value in brackets alternative at SSI
<8> Customer side
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d BiSS/SSI/SSI-P: 7,1 $^{+1,2}$
Cable Ø d ST-P: 7,8 $^{+0,9}$
Cable Ø d MT-P: 9,3 +1,3
Cable Ø d Fieldbus: 7,1 $^{+1,2}$
Dimensions in mm

Absolute + Incremental Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

Hollow shaft "F"



<1> Connection M23 (Conin)
<2> Connection cable
<3> axial
<4> radial

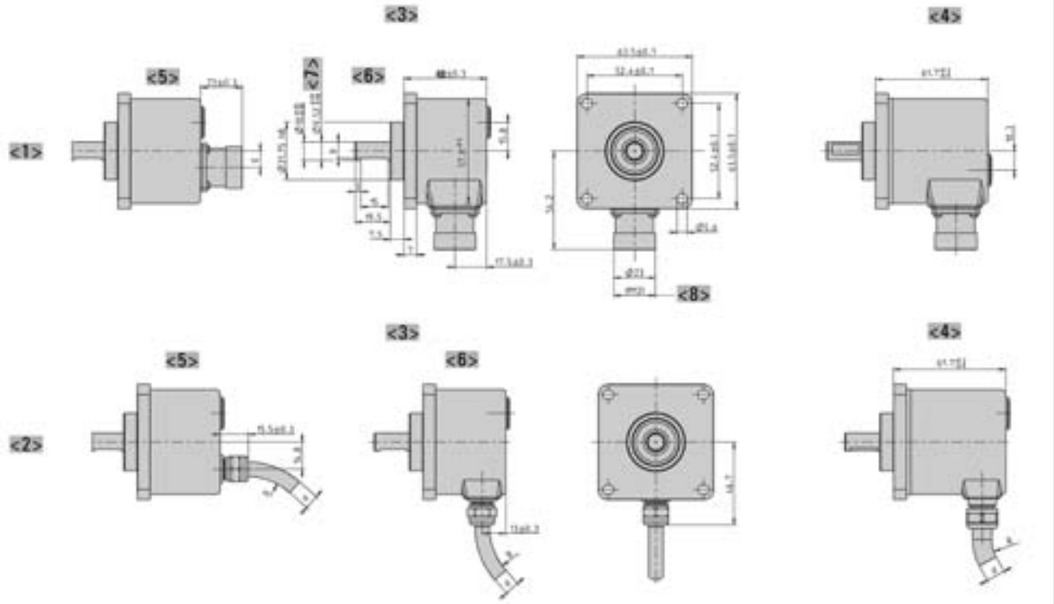
<5> Customer side
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d : 7,1 $^{+1,2}$

Dimensions in mm

Absolute + Incremental Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

Square flange "Q"



<1> Connection M23 (Conin)
<2> Connection cable
<3> Interface: BiSS, SSI, ST-Parallel
<4> Interface: MT-Parallel (only with cable), Fieldbus, SSI-P
<5> axial
<6> radial
<7> alternative

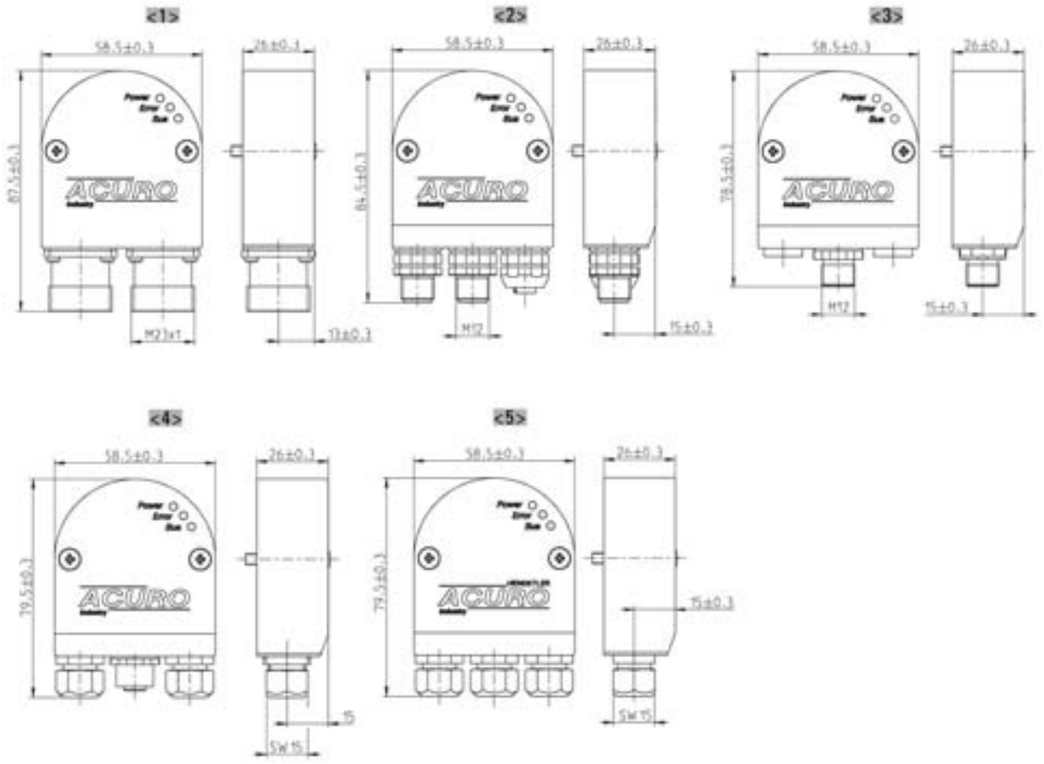
<8> Value in brackets alternative at SSI
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d BiSS/SSI/SSI-P: 7,1 $^{+1,2}$
Cable Ø d ST-P: 7,8 $^{+0,9}$
Cable Ø d MT-P: 9,3 +1,3
Cable Ø d Fieldbus: 7,1 $^{+1,2}$

Dimensions in mm

Absolute + Incremental Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

Bus covers



<1> Connection "I"
<2> Connection "R"
<3> Connection "S"
<4> Connection "T"
<5> Connection "Z"

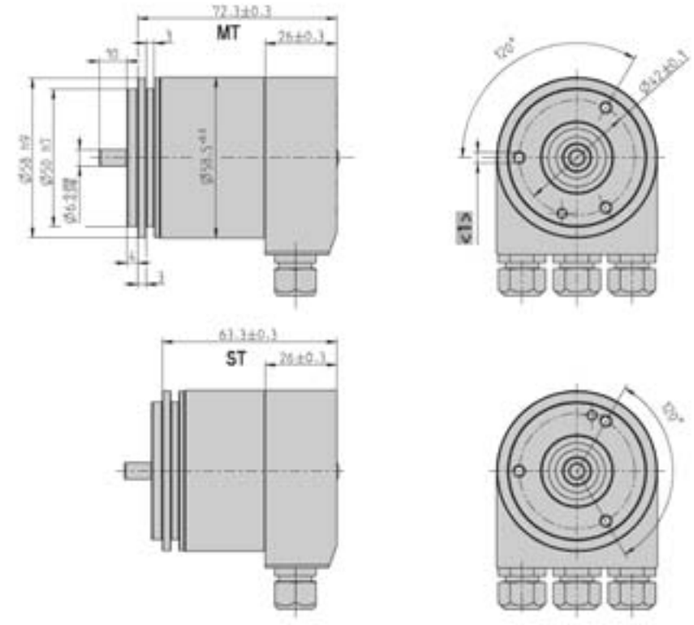
Dimensions in mm

Standard Industrial types AC 58

Absolute + Incremental Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

Synchro flange "S"



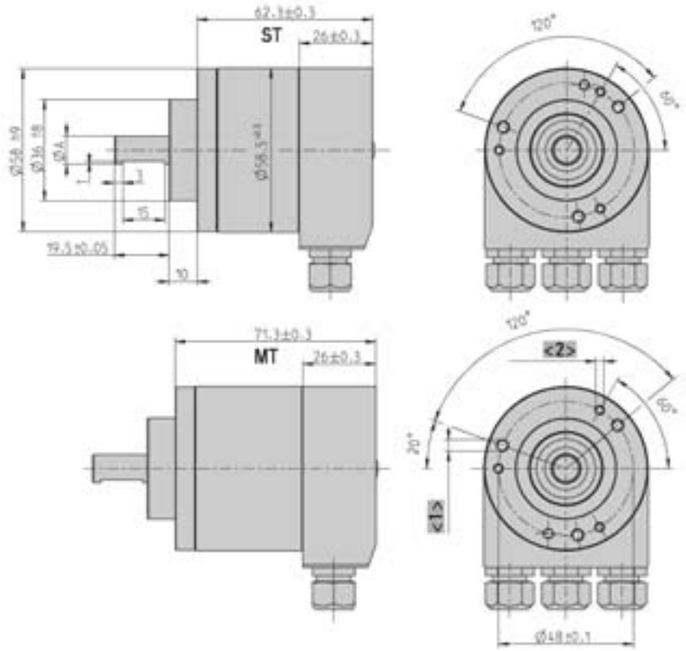
<1> 3xM4 (6 deep)

Dimensions in mm

Absolute + Incremental Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

Clamping flange "K"



	Dim.		Unit
Shaft Ø A	10 -0.01/-0.02	9.52 -0.01/-0.02	mm
Shaft code	"2"	"6"	

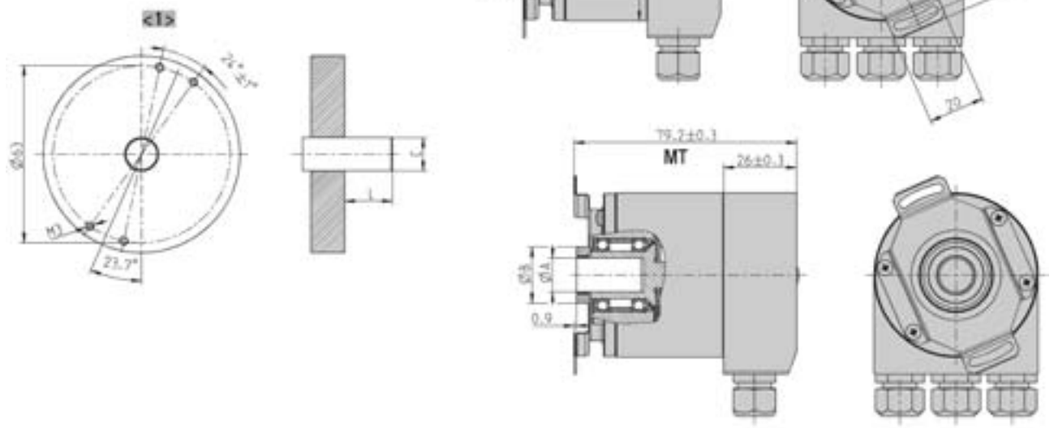
<1> 3xM4 (6 deep)
<2> 3xM3 (6 deep)

Dimensions in mm

Absolute + Incremental Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

Hollow shaft "F"



	Dim.				Unit
Hollow shaft Ø A	10 +0.012	12 +0.012	9,52 +0.012	12,7 +0.012	mm
Connecting shaft Ø C	10 g7	12 g7	9,52 g7	12,7 g7	mm
Clamping ring Ø B	18	20	18	22	mm
L min	15	18	15	18	mm
L max	20	20	20	20	mm
Shaft code	"2"	"7"	"6"	"E"	
L = Inside length of connection shaft					

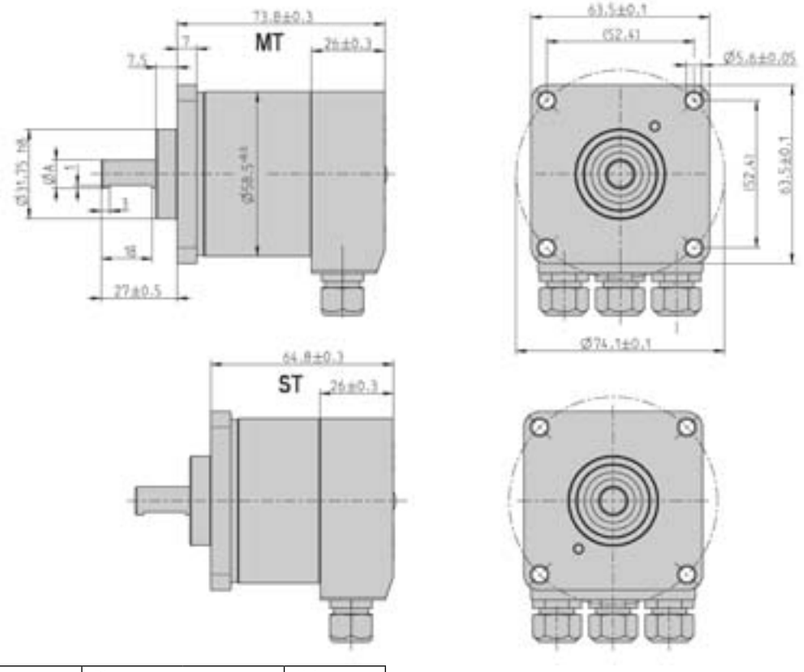
<1> Customer side

Dimensions in mm

Absolute + Incremental Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

Square flange "Q"



	Dim.		Unit
Shaft Ø A	10 $^{-0.01/-0.02}$	9.52 $^{-0.01/-0.02}$	mm
Shaft code	"2"	"6"	

Dimensions in mm

Absolute BiSS / SSI

- Overall length: 36 mm
- For equipment engineering and industry
- Up to 17 Bit Resolution Singleturn + 12 Bit Multiturn
- Solid shaft 6 mm (Hollow shaft version: AD 36)
- +100°C operating temperature
- 10,000 rpm (continuous)
- Optical encoder with a true geared multiturn
- BiSS or SSI interface
- Option Sinewave 1 Vpp
- Bandwidth 500 kHz

APPLICATIONS

The AC 36 is an absolute optical encoder with a true geared multiturn, optical sensing technology and 36 mm diameter. Equiped with a solid-shaft the AC 36 is mechanical compatible with all common inkremental encoders. The compact design allows to replace the adequate incremental encoders directly. As a result the technical facilities of absolute encoders can be used for the first time in equipment engineering and also in medical engineering. The mechanical design consists of two ball bearings supported mechanical shaft assembly. The AC 36 complements the **ACURO ®-industry** series with small frame sizes and the same performance as 58 mm versions.

BiSS-Interface
Unique within his class the AC 36 provides fully digital position data up to 17 Bit (singleturn) and 12 Bit (multi-turn) over the bidirectional synchronous interface with a variable clock rate up to 10 MHz. This corresponds a singleturn resolution of more than 130 000 mesured steps. Backward compatibility is realized through the SSI interface together with 2048 sine-cosine periods per revolution.

Integrated diagnostic system
The AC 36 is based on latest OptoAsic technology with an advanced diagnostic concept. A continous plausibility check controls the internal signal processing for each increment. A code check guarantees that the encoder signal represents bit by bit the mesured rotation. Also the operating temperature of the encoder can be measured, read out and monitored over warn and alarm bits with 8 bit resolution (1°C). Monitoring and controlling of the operating temperature ensures a maximum lifetime of the LED. Eventual failures are indicated early over warn bits.

TECHNICAL DATA
mechanical

Housing diameter	38.1 mm
Shaft diameter	6 mm (Solid shaft)
Flange (Mounting of housing)	Pilot flange
Protection class shaft input (EN 60529)	IP64
Protection class housing (EN 60529)	IP64
Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Starting torque typ.	≤ 1 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	-40 °C ... +100 °C
Storage temperature	-15 °C ... +85 °C
Weight	approx. 80 g (ST) / 130 g (MT)
Connection	Cable, axial or radial

TECHNICAL DATA
electrical

Supply voltage	-5%/ 10% DC 5 V DC 7-30 V
Current w/o load typ.	5 V: 100 mA (ST), 150 mA (MT) 10 - 30 V: 100 mA (ST), 150 mA (MT)
Allowable load	max. 30 mA
Resolution singleturn	12 -17 Bit
Resolution multiturn	12 Bit
Output code	Gray, Binary
Drives	Clock and Data / RS422
Incremental signals	Sinus-Cosinus 1 Vpp
Number of pulses	2048
3dB limiting frequency	500 kHz
Absolute accuracy	±35"
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)

ELECTRICAL CONNECTIONS
Cable

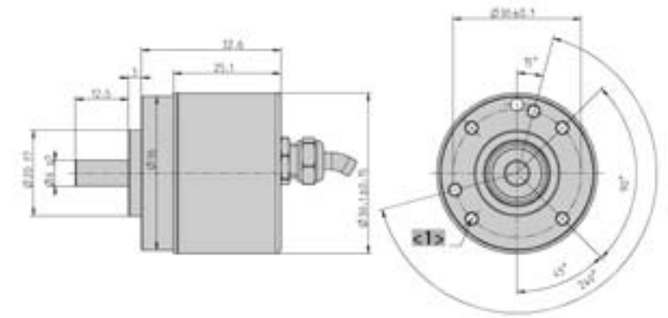
Signal	**Colour cable**
5 / 7-30 V (U_B)	white
0 V (U_N)	brown
Clock	yellow
$\overline{\text{Clock}}$	green
Data	pink
$\overline{\text{Data}}$	grey
A	white/green [1]
$\overline{\text{A}}$	brown/green [1]
B	red/blue [1]
$\overline{\text{B}}$	grey/pink [1]
5 V Sensor	violet [1]
0 V Sensor	black [1]

[1] only with "SC"

Standard Industrial types AC 36
Absolute BiSS / SSI

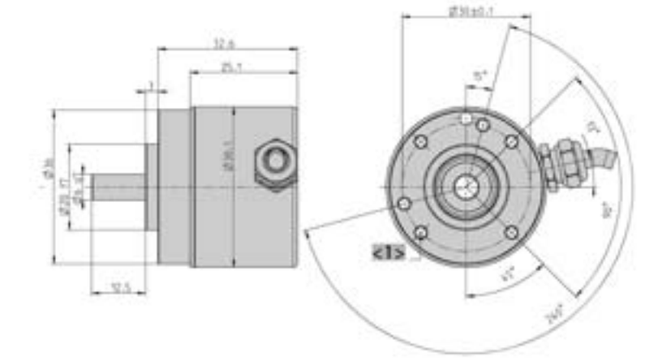
DIMENSIONED DRAWINGS

Connection axial



<1> M3 (depth 6) Dimensions in mm

Connection radial



<1> M3 (depth 6) Dimensions in mm

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AC36	**0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0017** 17 Bit ST **1213** 12 Bit MT + 13 Bit ST **1217** 12 Bit MT + 17 Bit ST (BiSS)	**A** DC 5 V **E** DC 7 - 30 V	**R.41** Pilot, IP64, 6 mm	**BI** BiSS **SB** SSI Binary **SG** SSI Gray **SC** SSI Gray (+SinCos 1Vpp)	**A** Cable, axial **B** Cable, radial

Absolute BiSS / SSI

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Clamping flange

TECHNICAL DATA
mechanical

Absolute BiSS / SSI

- Compact design: 50 mm length for single or multiturn
- Aids for start up and operation: diagnostic LED, preset key with optical response, status information
- Use of sine/ cosine signals for fast control task possible
- Control input: Direction
- Resolution up to 29 Bit

Housing diameter	58 mm
Shaft diameter	6 mm / 10 mm (Solid shaft) 10 mm / 12 mm (Hub shaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input (EN 60529)	IP64 or IP67
Protection class housing (EN 60529)	IP64 or IP67
Shaft load axial / radial	40 N / 60 N
Axial endplay of mounting shaft (hubshaft)	± 1.5 mm
Radial runout of mating shaft (hubshaft)	± 0.2 mm
Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Starting torque typ. [2]	≤ 0.01 Nm
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	-40 °C ... +100 °C
Storage temperature [1]	-25 °C ... +85 °C
Weight	approx. 260 g (ST) / 310 g (MT)
Connection	Cable, axial or radial M23 connector (Conin), 12 pole, axial or radial M12 connector, 8 pole, axial or radial

[1] due to packaging
[2] at 20°C

TECHNICAL DATA
electrical

Supply voltage	± 10% DC 5 V or DC 10 - 30 V
Current w/o load typ.	5 V: 100 mA (ST), 150 mA (MT) 10 - 30 V: 100 mA (ST), 150 mA (MT)
Allowable load	max. 30 mA
Resolution singleturn	10 - 17 Bit Gray Excess: 360, 720 increments
Resolution multiturn	12 Bit

TECHNICAL DATA
electrical (continued)

Output code	Binary, Gray
Drives	Clock and Data / RS422
Linearity	± ½ LSB (± 1 LSB for resolution > 13 Bit)
Incremental signals	Sinus-Cosinus 1 Vpp
Number of pulses	2048
3dB limiting frequency	500 kHz
Absolute accuracy	±35"
Parametrization	Code type, Direction, Warning, Alarm
Control inputs	$\overline{\text{Direction}}$
Reset key	Disable via parameterization
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)
Status LED	Green = ok, red = alarm

RECOMMENDED DATA TRANSFER RATE bei SSI

The max. data transfer rate depends on the cable length. For Clock / $\overline{\text{Clock}}$ and Data / $\overline{\text{Data}}$ please use twisted pairs. Use shielded cable.

Cable length	Frequency
< 50 m	< 400 kHz
< 100 m	< 300 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz

DATA FORMAT Singleturn

Resolution	**Data Bits**										
	T1 ... T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19
9 Bit [1]	S8 ... S0	0	0	0	0	0	W [2]				
10 Bit [1]	S9 ... S1	S0	0	0	0	0	W [2]				
11 Bit [1]	S10 ... S2	S1	S0	0	0	0	W [2]				
12 Bit [1]	S11... S3	S2	S1	S0	0	0	W [2]				
13 Bit [1]	S12 ... S4	S3	S2	S1	S0	0	W [2]				
14 Bit [1]	S13 ... S5	S4	S3	S2	S1	S0	0	W [2]			
15 Bit [1]	S14 ... S6	S5	S4	S3	S2	S1	S0	0	0	0	W [2]
16 Bit [1]	S15 ... S7	S6	S5	S4	S3	S2	S1	S0	0	0	W [2]
17 Bit [1]	S16 ... S8	S7	S6	S5	S4	S3	S2	S1	S0	0	W [2]

Examples for data format 9 Bit and 13 Bit with the optional bits alarm und parity

Resolution	**Data Bits**										
	T1 ... T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19
9 Bit + P [3]	S8 ... S0	0	0	0	P	0	W [2]				
9 Bit + A [4]	S8 ... S0	0	0	0	A	0	W [2]				
9 Bit + P [3] + A [4]	S8 ... S0	0	0	0	A	P	0	W [2]			
9 Bit + P [3]	S12 ... S4	S3	S2	S1	S0	P	0	W [2]			
9 Bit + A [4]	S12 ... S4	S3	S2	S1	S0	A	0	W [2]			
9 Bit + P [3] + A [4]	S12 ... S4	S3	S2	S1	S0	A	P	0	W [2]		

Standard Industrial types AC 58
Absolute BiSS / SSI

DATA FORMAT SSI Multiturn

Resolution	Data bits									
	T1 ... T12	T13 ... T21	T22	T23	T24	T25				
24 Bit [1]	M11 ... M0	S11 ... S1	S0	0	W [2]					
25 Bit [1]	M11 ... M0	S12 ... S2	S1	S0	0	W [2]				
26 Bit [1]	M11 ... M0	S13 ... S3	S2	S1	S0	0	W [2]			
27 Bit [1]	M11 ... M0	S14 ... S4	S3	S2	S1	S0	0	0	0	W [2]
28 Bit [1]	M11 ... M0	S15 ... S5	S4	S3	S2	S1	S0	0	0	W [2]
29 Bit [1]	M11 ... M0	S16 ... S6	S5	S4	S3	S2	S1	S0	0	W [2]
Example for data format 24 Bit with the optional bits alarm and parity										
24 Bit + P [3]	M11 ... M0	S11 ... S2	S1	S0	P	0	W [2]			
24 Bit + A [4]	M11 ... M0	S11 ... S2	S1	S0	A	0	W [2]			
24 Bit + P [3] + A [4]	M11 ... M0	S11 ... S2	S1	S0	A	P	0	W [2]		

S0 ... S16 Data bits for resolution per revolution

M0 ... M11 Data bits for number of revolution (only for multiturn)

[1] Optionen (Parity bit, Alarm- and Parity bit, zero bit) on request

[2] W: from this data bit on the data iteration for multiplex starts

[3] Paritybit: Even Parity (Das Paritybit ergänzt die Datenbits auf eine gerade Anzahl von 1-Bits.) (Option)

[4] Alarm bit: is set to "1" when over temperature, under temperture, disc breakage and defect LED

SYNCHRONOUS-SERAL TRANSFER (SSI)

Synchronous readout of the encoder data is according to the clock rate given by the SSI-counterpart.
The number of clock rates is determined by the type of encoder (singleturn resp. multiturn) and the configuration of the special Bits as defined.
For multiple transactions (the stored value is readout several times successively) a fixed clock rate per transaction must be kept (for singleturn 13 resp. 14 clocks, for multiturn 25 resp. 26 clocks).

- In the rest position, when the last clock brush has passed by more than 30µs, the data output is logically at "1".
- With the first descending clock edge the encoder data and the special bits are loaded in the shift register of the encoder interface.
- With each ascending clock edge the data bits are serially readout, beginning with the MSB.
- At the end of the data transfer the data output is set to logically "0" for approx. 20µs. If within these 20µs a further clock brush reaches the encoder interface, the already transferred data is readout once again. This multiple transfer of the same data makes it possible to recognize transfer errors.
- After the 20µs the data output goes to its rest position, logically "1". Subsequently new encoder data can be readout.

Absolute BiSS / SSI

ELECTRICAL CONNECTIONS
M23 connector (Conin), 12 pole / cable
Interface BI, SB, SG

Cable	M23 (Conin)	Signal
brown [3]	1	0 V (supply voltage)
pink	2	Data
yellow	3	Clock
	4	N.C.
blue	5	$\overline{\text{Direction}}$ [1]
red	6	N.C.
violet	7	N.C.
white [3]	8	DC 5/ 10 - 30 V
	9	N.C.
grey	10	$\overline{\text{Data}}$
green	11	$\overline{\text{Clock}}$
black	12	0 V-signal output [2]

[1] $\overline{\text{Direction}}$: U_B or unconnected = ascending code values with rotation cw
0 V = descending code values with rotation cw
[2] Connected with 0 V in the encoder.
Use this output to lay Direction on "0V" if required.
[3] use only thin wires (¤ = 0.14 mm)

ELECTRICAL CONNECTIONS
M23 connector (Conin), 12 pole / cable
Interface SC, BC

Cable	M23 (Conin)	Signal
brown [2]	1	0 V (supply voltage)
pink	2	Data
yellow	3	Clock
white/green	4	A+
blue	5	$\overline{\text{Direction}}$ [1]
red/blue	6	B+
brawn/green	7	A-
white [2]	8	DC 5/10 - 30 V
grey/pink	9	B-
grey	10	$\overline{\text{Data}}$
green	11	$\overline{\text{Clock}}$
black	12	Sense

[1] $\overline{\text{Direction}}$: +U_B or unconnected = ascending code values with rotation cw
0 V = descending code values with rotation cw
[2] use only thin wires (¤ = 0.14 mm)

ELECTRICAL CONNECTIONS
M12 connector, 8 pole

Colour	Pin	Signal
white	1	DC 10 - 30 V
brown	2	0 V
	3	N.C.
green	4	$\overline{\text{Clock}}$
pink	5	Data
yellow	6	Clock
blue	7	$\overline{\text{Direction}}$ [1]
grey	8	$\overline{\text{Data}}$

View on connector

[1] $\overline{\text{Direction}}$: + U_B or unconnected = ascending code values with rotation cw
0 V = descending code values with rotation cw

Absolute BiSS / SSI

ELECTRICAL CONNECTIONS
M23 connector (Conin), 12 pole / cable
Interface SR, SH

PIN	Cable	Signal
1	brown	0 V (supply voltage)
2	pink	Data
3	yellow	Clock
4	white/ green	-
5	blue	Direction [1]
6	red/ blue	-
7	brown/ green	-
8	white	DC10-30 V
9	grey/ pink	-
10	grey	$\overline{\text{Data}}$
11	green	$\overline{\text{Clock}}$
12	red	Preset [1]
Screen	Screen	Screen

[1] Preset and Direction high active :
Signal level high: ≥ 70% Ub; low: ≤ 20% Ub or unconnected
Bounce time preset: >2s
Bounce time direction: < 1 ms (dynamic)
Preset-value: Zero
Other values on request

CONNECTION

M12, View on connector

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 58, starting page 178

Absolute BiSS / SSI

ORDERING INFORMATION

Type	Resolution [1,2]	Supply voltage [3]	Flange, Protection, Shaft [4 8]	Interface [5,6]	Connection [7]
☐	☐	☐	☐	☐	☐
AC58	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0017** 17 Bit ST **0360** 360 increments ST **0720** 720 increments ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST **1217** 12 Bit MT + 17 Bit ST higher resolution on request	**A** DC 5 V **E** DC 10 - 30 V	**S.41 Synchro, IP64, 6 mm** **S.71 Synchro, IP67, 6 mm** **K.42 Clamping, IP64, 10 mm** **K.46** Clamping, IP64, 9.52 mm **K.72 Clamping, IP67, 10 mm** **K.76** Clamping, IP67, 9.52 mm **F.46** Spring tether, IP64, hubshaft 9.52 mm, mounting with clamping ring front **F.42 Spring tether, IP64, hubshaft 10 mm, mounting with clamping ring front** **F.47 Spring tether, IP64, hubshaft 12 mm, mounting with clamping ring front** **Q.46** Square, IP64, 9.52 mm **Q.42** Square, IP64, 10 mm **Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**BI** BiSS **BC** BiSS (+Sin-Cos 1Vpp) **SB** SSI Binary **SG** SSI Gray **SC** SSI Gray (+SinCos 1Vpp) **SR** SSI Binary + high active Preset **SH** SSI Gray + high active Preset	**A** Cable, axial **B** Cable, radial **C** M23 con-nector (Co-nin), 12 pole, axial, cw **D** M23 connector (Conin), 12 pole, radial, cw **G** M23 connector (Conin), 12 pole, axial, ccw **H** M23 connector (Conin), 12 pole, radial, ccw **7** M12 connec-tor, 8 pole, axial **8** M12 connec-tor, 8 pole, radial

[1] Resolution 360 increments ST with Offset 76 (value range 76...435)
[2] Resolution 720 increments ST with Offset 152 (value range 152...871)
[3] Max. cable length for DC 5 V: 10 m
[4] Protection class IP67 not available in combination with preset key and LED display
[5] Alarm- and/ or Parity-Bit on request.
[6] Interface SSI Gray (+SinCos 1Vpp): not with connection "7" and "8" (M12)
[7] Connection code "7" and "8" (M12) with square flange only for IP64 and 10x19,5 mm shaft
[8] IP67 on cover with connector only if IP67 mating connector mounted properly.

Preferably available versions are printed in bold type.

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Absolute Parallel

Synchro flange

- Compact design
- Aids for start up and operation: diagnostic LED, preset key with optical response (only with MT), status information
- Output Tristate short circuit-proof
- Gray or Binary code
- Encoder monitoring

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	6 mm / 10 mm (Solid shaft) 10 mm / 12 mm (Hub shaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input (EN 60529)	IP64 or IP67
Protection class housing (EN 60529)	IP64 or IP67
Shaft load axial / radial	40 N / 60 N
Axial endplay of mounting shaft (hubshaft)	± 1.5 mm
Radial runout of mating shaft (hubshaft)	± 0.2 mm
Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Starting torque typ. [3]	≤ 0.01 Nm
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	-40 °C ... +100 °C
Storage temperature	-40 °C ... +85 °C
Weight	approx. 350 g (ST) / 400 g (MT)
Connection [2]	Cable, axial or radial M23 connector (Conin), 17 pole, axial or radial Sub-D connector, 37 pole

TECHNICAL DATA
electrical

Supply voltage	DC 10-30 V On request: DC 5 V
Current w/o load typ.	5 V: 150 mA (ST), 300 mA (MT) 10 - 30 V: 200 mA (ST), 300 mA (MT)
Allowable load	max. 30 mA
Resolution singleturn	10 - 14 Bit Gray Excess: 360, 720 increments
Resolution multiturn	12 Bit
Output code	Binary, Gray, Gray Excess
Linearity	± ½ LSB
Output current	30 mA per Bit, short-circuit-proof

TECHNICAL DATA
electrical (continued)

Control inputs	Latch, Direction, Tristate with ST, Tristate with MT
Alarm output	NPN-O.C., max. 5 mA
Status LED	Green = ok, red = alarm

Data output level

Supply voltage U_B	DC 5 V - 5 % +10 % [1]	DC 10 - 30 V
Output level High	≥ 3.5 V (30 mA) ≥ 3.9 V (10 mA)	≥ U_B -2.2 V (30 mA) ≥ U_B -1.8 V (10 mA)
Output level Low	≤ 1.6 V (30 mA) ≤ 1.2 V (10 mA)	≤ 1.6 V (30 mA) ≤ 1.2 V (10 mA)
Rise time (1.5 m Cable)	≤ 0.1 µs	≤ 0.2 µs
Drop time (1.5 m Cable)	≤ 0.05 µs	≤ 0.1 µs

[1] on request

Control inputs

Input	Level logical (physical)	Function
Direction	1 (+ U_B or open) 0 (0 V)	ascending code values when turning clockwise (cw) descending code values when turning clockwise (cw)
Latch	1 (+ U_B or open) 0 (0 V)	encoder data continuously changing at output encoder data stored and constant at output
Tristate (with singleturn)	1 (+ U_B or open) 0 (0 V)	outputs active outputs at high impedance (Tristate mode)
Tristate (with multiturn)	1 (+ U_B) 0 (0 V or open)	outputs at high impedance (Tristate mode) outputs active

Typical actuating delay time 10 µs with push-pull selection; when selected via O.C., an external pull-down resistor (1 KΩ) is required

ELECTRICAL CONNECTIONS
Singleturn, cable

Colour (PVC)	9 Bit / 360 incr.	10 Bit / 720 incr.	12 Bit	13 Bit	14 Bit
grey/pink	N.C.	N.C.	N.C.	N.C.	S0 (LSB)
brown/yellow	N.C.	N.C.	N.C.	S0 (LSB)	S1
brown/grey	N.C.	N.C.	S0 (LSB)	S1	S2
red/blue	N.C.	N.C.	S1	S2	S3
violet	N.C.	S0 (LSB)	S2	S3	S4
white/brown	S0 (LSB)	S1	S3	S4	S5
white/green	S1	S2	S4	S5	S6
white/yellow	S2	S3	S5	S6	S7
white/grey	S3	S4	S6	S7	S8
white/pink	S4	S5	S7	S8	S9
white/blue	S5	S6	S8	S9	S10
white/red	S6	S7	S9	S10	S11
white/black	S7	S8	S10	S11	S12
brown/green	S8 (MSB)	S9 (MSB)	S11 (MSB)	S12 (MSB)	S13 (MSB)
yellow	Tristate S0...S8	Tristate S0...S9	Tristate S0...S11	Tristate S0...S12	Tristate S0...S13
pink	Latch	Latch	Latch	Latch	Latch
green	Direction	Direction	Direction	Direction	Direction
black	0 V	0 V	0 V	0 V	0 V
red	DC 5 V/ 10-30 V	DC 5 V/ 10-30 V	DC 5 V/ 10-30 V	DC 5 V/ 10-30 V	DC 5 V/ 10-30 V
brown	Alarm	Alarm	Alarm	Alarm	Alarm

ELECTRICAL CONNECTIONS
Singleturn, M23 connector (Conin), 17 pole

Pin	9 Bit / 360 incr.	10 Bit / 720 incr.	12 Bit	13 Bit	14 Bit
1	S0 (LSB)	S0 (LSB)	S0 (LSB)	S12 (MSB)	S13 (MSB)
2	S1	S1	S1	S11	S12
3	S2	S2	S2	S10	S11
4	S3	S3	S3	S9	S10
5	S4	S4	S4	S8	S9
6	S5	S5	S5	S7	S8
7	S6	S6	S6	S6	S7
8	S7	S7	S7	S5	S6
9	S8 (MSB)	S8	S8	S4	S5
10	N.C.	S9 (MSB)	S9	S3	S4
11	N.C.	N.C.	S10	S2	S3
12	Tristate S0...S8	Tristate S0...S9	S11 (MSB)	S1	S2
13	Latch	Latch	Latch	S0 (LSB)	S1
14	Direction	Direction	Direction	Direction	S0 (LSB)
15	0 V	0 V	0 V	0 V	0 V
16	DC 5 V/ 10-30 V	DC 5 V/ 10-30 V	DC 5 V/ 10-30 V	DC 5 V/ 10-30 V	DC 5 V/ 10-30 V
17	Alarm	Alarm	Alarm	Latch/Alarm	Latch/Alarm

ELECTRICAL CONNECTIONS
Multiturn, cable

Cable (TPE)	10 cm cable with Sub-D connector, 37 pole		Cable (TPE)	10 cm cable with Sub-D connector, 37 pole	
Colour	Pin	Connection	Colour	Pin	Connection
brown	2	S0	white/blue	14	M4 [1]
green	21	S1	brown/blue	33	M5 [1]
yellow	3	S2	white/red	15	M6 [1]
grey	22	S3	brown/red	34	M7 [1]
pink	4	S4	white/black	16	M8 [2]
violet	23	S5	brown/black	35	M9 [2]
grey/pink	5	S6	grey/green	17	M10 [2]
red/blue	24	S7	yellow/grey	36	M11 [2]
white/green	6	S8	pink/green	18	Alarm
brown/green	25	S9	yellow/pink	10	Direction
white/yellow	7	S10	green/blue	30	Latch
yellow/brown	26	S11	yellow/blue	12	Tristate
white/grey	8	M0	red (0.5mm [2])	13	DC 10-30 V
grey/brown	27	M1	white (0.5mm [2])	31	DC 10-30 V
white/pink	9	M2	blue (0.5mm [2])	1	0 V
pink/brown	28	M3	black (0.5mm [2])	20	0 V

[1] N. C. with resolution 16 Bit (4 Bit MT)
[2] N. C. with resolution 16 Bit or 20 Bit (4 or 8 Bit MT)

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 58, starting page 178

Absolute Parallel

ORDERING INFORMATION

Type	Resolution [1, 2]	Supply voltage	Flange, Protection, Shaft [3 7]	Interface	Connection [4, 5, 6]
☐	☐	☐	☐	☐	☐
AC58	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0360** 360 increments ST **0720** 720 increments ST **0412** 4 Bit MT + 12 Bit ST **0812** 8 Bit MT + 12 Bit ST **1212** 12 Bit MT + 12 Bit ST	**E** DC 10 - 30 V	**S.41 Synchro, IP64, 6 mm** **S.71 Synchro, IP67, 6 mm** **K.42 Clamping, IP64, 10 mm** **K.46** Clamping, IP64, 9.52 mm **K.72 Clamping, IP67, 10 mm** **K.76** Clamping, IP67, 9.52 mm **F.46** Spring tether, IP64, hubshaft 9.52 mm, mounting with clamping ring front **F.42 Spring tether, IP64, hubshaft 10 mm, mounting with clamping ring front** **F.47 Spring tether, IP64, hubshaft 12 mm, mounting with clamping ring front** **Q.46** Square, IP64, 9.52 mm **Q.42** Square, IP64, 10 mm **Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**PB** Parallel binary **PG** Parallel Gray	**A** Cable, axial **B** Cable, radial **U** M23 connector (Conin), 17 pole, axial, ccw **V** M23 connector (Conin), 17 pole, radial, ccw **W** M23 connector (Conin), 17 pole, axial, cw **Y** M23 connector (Conin), 17 pole, radial, cw **A-A1-F** 0,1 m cable with Sub-D connector, 37 pole, axial **B-A1-F** 0,1 m cable with Sub-D connector, 37 pole, radial

[1] Resolution 360 increments ST with Offset 76 (value range 76...435)
[2] Resolution 720 increments ST with Offset 152 (value range 152...871)
[3] Protection class IP67 not available in combination with preset key and LED display
[4] Connection code "A", "B" (cable): ST and MT
[5] Connection code "U", "V", "W", "Y" (M23 connector): only ST
[6] Connection code "A-A1-F" and "B-A1-F" (Sub-D connector): only MT
[7] IP67 on cover with connector only if IP67 mating connector mounted properly.

Preferably available versions are printed in bold type.

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

hubshaft with tether

TECHNICAL DATA
mechanical

Absolute Profibus

- Diagnostic LED
- Cable or M12 connector
- Output of speed, acceleration
- Programmable: Resolution, Preset, Direction, Operation time
- Option: Display "tico"
- Address via interface parameterizable (optional)

Housing diameter	58 mm
Shaft diameter	6 mm / 10 mm (Solid shaft) 10 mm / 12 mm (Hub shaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input (EN 60529)	IP64 or IP67
Protection class housing (EN 60529)	IP67
Shaft load axial / radial	40 N / 60 N
Axial endplay of mounting shaft (hubshaft)	± 1.5 mm
Radial runout of mating shaft (hubshaft)	± 0.2 mm
Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Starting torque typ. [1]	≤ 0.01 Nm
Moment of inertia	ca. 3.8 x 10^{-6} kgm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +85 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Aluminum
Weight	approx. 350 g (ST) / 400 g (MT)
Connection	Bus cover with 3 sealed cable exits Bus cover with 2x M23 connectors (Conin), 12 pole Bus cover with 3x M12 connector Bus cover with 2 sealed cable exits + 1 x M12 connector for "tico" display, 4 pole

[1] at 20°C

TECHNICAL DATA
electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage	DC 10-30 V
Current w/o load typ.	220 mA (ST), 250 mA (MT)
EMC	EN 61326: Class A
Resolution singleturn	10 - 14 Bit

TECHNICAL DATA
electrical (continued)

Resolution multiturn	12 Bit
Output code	Binary
Drives	RS 485
Linearity	± ½ LSB (± 1 LSB for resolution 13, 14, 25, 26 Bit)
Profile/ protocol	Profibus DP with encoder profile class C2 (parameterizable)
Programmable	Resolution, Preset, Direction
Integrated special functions	Speed, Acceleration, Operating time
Baud rate	is automatically set within a range of 9.6 KBaud through 12 MBaud
Device address	adjustable with DIP switches, via fieldbus (optional)
Bus termination resistor	set via DIP switches

STARTUP (The encoder can be easily and quickly installed and programmed with the GSD file.)

ELECTRICAL CONNECTIONS
Bus cover with 2x M23 connectors (Conin), 12 pole

Pin	IN (pins)	OUT (socket)	Description
1		GND [1]	Data Ground (M5V) [1]
2	A	A	Receive/Transmit Data-Negative (A)
3			
4	B	B	Receive/Transmit Data-Positive (B)
5			
6		VCC [1]	+5 V signal output (P5V) [1]
7	DC 10 - 30 V	DC 10 - 30 V	Supply voltage +U_B (P24)
8	0 V	0 V	Supply voltage Ground (M24)
9			
10			
11			
12			
screen	screen	screen	screen connected with encoder housing

[1] can be used as power supply for an external bus termination resistor

Standard Industrial types AC 58
Absolute Profibus

ELECTRICAL CONNECTIONS
Bus cover with 3x M12

Pin	Connector 1	Connector 2	Socket
1		UB in	+5 V signal output (P5V) [1]
2	A in		A out
3		0 V in	Data Ground (M5V) [1]
4	B in		B out
5	screen	screen	screen

[1] can be used as power supply for an external bus termination resistor

ELECTRICAL CONNECTIONS
Bus cover with 3 sealed cable exits

Connecting Terminal	Signal
1	UB in (DC 10 - 30V)
2	0 V in
3	UB out
4	0 V out
5	B in
6	A in
7	B out
8	A out

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 58, starting page 178

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AC58	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST	**E** DC 10 - 30 V	**S.41 Synchro, IP64, 6 mm** **S.71 Synchro, IP67, 6 mm** **K.42 Clamping, IP64, 10 mm** **K.46** Clamping, IP64, 9.52 mm **K.72 Clamping, IP67, 10 mm** **K.76** Clamping, IP67, 9.52 mm **F.46** Spring tether, IP64, hubshaft 9.52 mm, mounting with clamping ring front **F.42 Spring tether, IP64, hubshaft 10 mm, mounting with clamping ring front** **F.47 Spring tether, IP64, hubshaft 12 mm, mounting with clamping ring front** **Q.46** Square, IP64, 9.52 mm **Q.42** Square, IP64, 10 mm **Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**DP** Profibus	**I** Bus cover with 2x M23 connector (Conin), 12 pole, radial, cw **R** Bus cover with 3x M12 **T** Bus cover with 2 sealed cable exits + 1 x M12 connector for "tico" display, 4 pole **Z** Bus cover with 3 sealed cable exits

Preferably available versions are printed in bold type.

ACCESSORIES

see chapter "Accessories"

Absolute CANopen

Clamping flange

- Diagnostic LED
- Programmable: Resolution, Preset, Offset, Direction
- Output of speed, acceleration
- Operation timer
- Option: Display "tico"
- Address and baud rate via interface parameterizable (optional)

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	6 mm / 10 mm (Solid shaft) 10 mm / 12 mm (Hub shaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input (EN 60529)	IP64 or IP67
Protection class housing (EN 60529)	Connection bus cover: IP67 Connection cable or M23 (conin): IP64 (IP67 optional)
Shaft load axial / radial	40 N / 60 N
Axial endplay of mounting shaft (hubshaft)	± 1.5 mm
Radial runout of mating shaft (hubshaft)	± 0.2 mm
Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Starting torque typ. [1]	≤ 0.01 Nm
Moment of inertia	ca. 3.8 x 10^{-6} kgm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +85 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Aluminum
Weight	approx. 350 g (ST) / 400 g (MT)
Connection	Cable, axial or radial M23 connector (Conin), 12 pole, axial or radial Bus cover with 3 sealed cable exits Bus cover with 2x M23 connectors (Conin), 9 pole Bus cover with 2 sealed cable exits + 1 x M12 connector for "tico" display, 4 pole

[1] at 20°C

TECHNICAL DATA
electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage	DC 10-30 V
Current w/o load typ.	220 mA (ST), 250 mA (MT)
Resolution singleturn	10 - 16 Bit

Absolute CANopen

TECHNICAL DATA
electrical (continued)

Resolution multiturn	12 Bit
Output code	Binary
Linearity	± ½ LSB (± 1 LSB for resolution 13, 14, 25, 26 Bit)
Profile/ protocol	CANopen according to DS 301 with profile DSP 406, programmable encoder according class C2
Programmable	Resolution, Preset, Offset, Direction
Integrated special functions	Speed, Acceleration, Limit values, Operating time
Baud rate	set via DIP switches within a range of 10 through 1000 Kbit/s
Bus termination resistor	set via DIP switches
Updating of values	every millisecond (adjustable), on request
Basic identifier	set via DIP switches

ELECTRICAL CONNECTIONS
Bus cover with 2x M23 connectors (Conin), 9 pole

M23-PIN (Conin)	Pin insert (IN)	Socket insert (OUT)
1	CAN in +	CAN out +
2	CAN in -	CAN out-
3	CAN GND in	CAN GND out
4	N.C.	N.C.
5	N.C.	N.C.
6	N.C.	N.C.
7	UB in	UB out
8	0 V in	0 V out
9	N.C.	N.C.
screen	screen [1]	screen [1]

[1] screen connected with encoder housing

ELECTRICAL CONNECTIONS
M23 connector (Conin), 12 pole / cable

M23-Pin (Conin)	TPE cable	Cable pairs	Signal
7	yellow	Pair 1	CAN in+
2	green		CAN in -
4	pink	Pair 2	CAN out +
5	grey		CAN out -
3	blue		CAN GND in
11	brown		CAN GND out
12	white	Pair 3	UB in
10	brown		0 V in
screen	screen		screen

ELECTRICAL CONNECTIONS
Bus cover with 3 sealed cable exits

Connecting block KL 1 (10 pole)	
No.	**Signal name**
1	UB in (DC 10-30V)
2	0 V in
3	CAN in - (dominant L)
4	CAN in + (dominant H)
5	CAN GND in
6	CAN GND out
7	CAN out + (dominant H)
8	CAN out - (dominant L)
9	0 V out
10	UB out (DC 10-30V)

Absolute CANopen

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 58, starting page 178

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft [1]	Interface	Connection
AC58	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0016** 16 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST	**E** DC 10 - 30 V	**S.41 Synchro, IP64, 6 mm** **S.71 Synchro, IP67, 6 mm** **K.42 Clamping, IP64, 10 mm** **K.46** Clamping, IP64, 9.52 mm **K.72 Clamping, IP67, 10 mm** **K.76** Clamping, IP67, 9.52 mm **F.46** Spring tether, IP64, hubshaft 9.52 mm, mounting with clamping ring front **F.42 Spring tether, IP64, hubshaft 10 mm, mounting with clamping ring front** **F.47 Spring tether, IP64, hubshaft 12 mm, mounting with clamping ring front** **Q.46** Square, IP64, 9.52 mm **Q.42** Square, IP64, 10 mm **Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**OL** CANopen **OC** CANopen - on request -	**A Cable, axial** **B Cable, radial** **C M23 connector (Conin), 12 pole, axial, cw** **D M23 connector (Conin), 12 pole, radial, cw** **G** M23 connector (Conin), 12 pole, axial, ccw **H** M23 connector (Conin), 12 pole, radial, ccw **I** Bus cover with 2x M23 connector (Conin), 9 pole, radial, cw **T Bus cover with 2 sealed cable exits + 1 x M12 connector for "tico" display, 4 pole** **Z Bus cover with 2 sealed cable exits**

[1] Protection class IP67 in combination with connection "A" - "H": Version without DIP switches and LED. Setting over fieldbus

Preferably available versions are printed in bold type.

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Absolute CANlayer2

Clamping flange

- Diagnostic LED
- Poll and auto mode
- Programmable: Direction, limit values
- Option: Display "tico"

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	6 mm / 10 mm (Solid shaft) 10 mm / 12 mm (Hub shaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input (EN 60529)	IP64 or IP67
Protection class housing (EN 60529)	IP67 or IP64 (IP67 optional)
Shaft load axial / radial	40 N / 60 N
Axial endplay of mounting shaft (hubshaft)	± 1.5 mm
Radial runout of mating shaft (hubshaft)	± 0.2 mm
Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Starting torque typ. [1]	≤ 0.01 Nm
Moment of inertia	ca. 3.8 x 10^{-6} kgm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +85 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Aluminum
Weight	approx. 350 g (ST) / 400 g (MT)
Connection	Cable, axial or radial M23 connector (Conin), 12 pole, axial or radial Bus cover with 3 sealed cable exits Bus cover with 2x M23 connectors (Conin), 9 pole Bus cover with 2 sealed cable exits + 1 x M12 connector for "tico" display, 4 pole

[1] at 20°C

TECHNICAL DATA
electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage	DC 10-30 V
Current w/o load typ.	220 mA (ST), 250 mA (MT)
Resolution singleturn	10 - 14 Bit

TECHNICAL DATA
electrical (continued)

Resolution multiturn	12 Bit
Output code	Binary
Linearity	± ½ LSB (± 1 LSB for resolution 13, 14, 25, 26 Bit)
Profile/ protocol	CAN 2.0 A
Programmable	Direction, Limit values
Baud rate	set via DIP switches within a range of 10 through 1000 Kbit/s
Bus termination resistor	set via DIP switches
Updating of values	every millisecond
Basic identifier	set via DIP switches

ELECTRICAL CONNECTIONS
Bus cover with 2x M23 connectors (Conin), 9 pole

M23-PIN (Conin)	Pin insert (IN)	Socket insert (OUT)
1	CAN in +	CAN out +
2	CAN in -	CAN out-
3	CAN GND in	CAN GND out
4	N.C.	N.C.
5	N.C.	N.C.
6	N.C.	N.C.
7	UB in	UB out
8	0 V in	0 V out
9	N.C.	N.C.
screen	screen [1]	screen [1]

[1] screen connected with encoder housing

ELECTRICAL CONNECTIONS
M23 connector (Conin), 12 pole / cable

M23-Pin (Conin)	TPE cable	Cable pairs	Signal
7	yellow	Pair 1	CAN in+
2	green		CAN in -
4	pink	Pair 2	CAN out +
5	grey		CAN out -
3	blue		CAN GND in
11	brown		CAN GND out
12	white	Pair 3	UB in
10	brown		0 V in
screen	screen		screen

ELECTRICAL CONNECTIONS
Bus cover with 3 sealed cable exits

Connecting block KL 1 (10 pole)	
No.	**Signal name**
1	UB in (DC 10-30V)
2	0 V in
3	CAN in - (dominant L)
4	CAN in + (dominant H)
5	CAN GND in
6	CAN GND out
7	CAN out + (dominant H)
8	CAN out - (dominant L)
9	0 V out
10	UB out (DC 10-30V)

Standard Industrial types AC 58
Absolute CANlayer2

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 58, starting page 178

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft [1]	Interface	Connection
AC58	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST	**E** DC 10 - 30 V	**S.41 Synchro, IP64, 6 mm** **S.71 Synchro, IP67, 6 mm** **K.42 Clamping, IP64, 10 mm** **K.46** Clamping, IP64, 9.52 mm **K.72 Clamping, IP67, 10 mm** **K.76** Clamping, IP67, 9.52 mm **F.46** Spring tether, IP64, hubshaft 9.52 mm, mounting with clamping ring front **F.42 Spring tether, IP64, hubshaft 10 mm, mounting with clamping ring front** **F.47 Spring tether, IP64, hubshaft 12 mm, mounting with clamping ring front** **Q.46** Square, IP64, 9.52 mm **Q.42** Square, IP64, 10 mm **Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**CL** CANLayer2	**A Cable, axial** **B Cable, radial** **C M23 connector (Conin), 12 pole, axial, cw** **D M23 connector (Conin), 12 pole, radial, cw** **G** M23 connector (Conin), 12 pole, axial, ccw **H** M23 connector (Conin), 12 pole, radial, ccw **I** Bus cover with 2x M23 connector (Conin), 9 pole, radial, cw **T Bus cover with 2 sealed cable exits + 1 x M12 connector for "tico" display, 4 pole** **Z Bus cover with 2 sealed cable exits**

[1] Protection class IP67 not available in combination with cable and M23 connector (Conin) for connection code "A" - "H": Verion without DIP switches and LED. Setting over fieldbus.

Preferably available versions are printed in bold type.

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Absolute DeviceNet

Synchro flange

- Programmable: Resolution, Preset, Direction
- Allan-Bradley compatible
- Scalable
- Preset function
- Diagnostic LED
- Option: Display "tico"

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	6 mm / 10 mm (Solid shaft) 10 mm / 12 mm (Hub shaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input (EN 60529)	IP64 or IP67
Protection class housing (EN 60529)	IP67
Shaft load axial / radial	40 N / 60 N
Axial endplay of mounting shaft (hubshaft)	± 1.5 mm
Radial runout of mating shaft (hubshaft)	± 0.2 mm
Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Starting torque typ. [1]	≤ 0.01 Nm
Moment of inertia	ca. 3.8 x 10^{-6} kgm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +85 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Aluminum
Weight	approx. 350 g (ST) / 400 g (MT)
Connection	Bus cover with 2 sealed cable exits Bus cover with 2 sealed cable exits + 1 x M12 connector for "tico" display, 4 pole Bus cover with 1x M12 connectors (Conin), 5 pole

[1] at 20°C

TECHNICAL DATA
electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage	DC 10-30 V
Current w/o load typ.	220 mA (ST), 250 mA (MT)
EMC	Noise emission according to EN 50081-2 Immunity to interference according to EN 50082-2
Resolution singleturn	10 - 14 Bit

Absolute DeviceNet

TECHNICAL DATA
electrical (continued)

Resolution multiturn	12 Bit
Output code	Binary
Interface	CAN High-Speed according to ISO/DIS 11898 CAN specification 2.0 A (11-Bit-Identifier)
Linearity	± ½ LSB (± 1 LSB for resolution 13, 14, 25, 26 Bit)
Profile/ protocol	DeviceNet according to Rev. 2.0, progammable encoder
Programmable	Resolution, Preset, Direction
Baud rate	set via DIP switches to 125, 250, 500 KBaud
Bus termination resistor	set via DIP switches
Updating of values	every 5 Milliseconds
MAC-ID	set via DIP switches

RECOMMENDED DATA TRANSFER Lead type A

Shaft resistance	135...165 Ω (3...20MHz)
Operating capacity	< 30pF/m
Loop impedance	< 110 Ω/km
Strand diameter	> 0.64 mm
Strand cross section	> 0.34 mm²

Transfer speeds

Segment length	**kbit/s**
500 m	125
250 m	250
100 m	500

STARTUP (the encoder can be easily and quickly installed and programmed with the EDS file)

Absolute DeviceNet

ELECTRICAL CONNECTIONS
Bus cover with 2 sealed cable exits

Terminals	
No.	**Signal name**
1	UB in (DC 10 - 30V)
2	0 V in
3	CAN-L
4	CAN-H
5	DRAIN
6	DRAIN
7	DRAIN
8	CAN-L
9	0 V out
10	UB out (DC 10 - 30V)

ELECTRICAL CONNECTIONS
Bus cover with 1x M12, 5 pole

Pin	Connector	Colour
1	UB in (DC 10 - 30V)	white
2	0 V in	blue
3	CAN-L	green/yellow
4	CAN-H	black
5	DRAIN	brown

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 58, starting page 178

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AC58	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST	**E** DC 10 - 30 V	**S.41 Synchro, IP64, 6 mm** **S.71 Synchro, IP67, 6 mm** **K.42 Clamping, IP64, 10 mm** **K.46** Clamping, IP64, 9.52 mm **K.72 Clamping, IP67, 10 mm** **K.76** Clamping, IP67, 9.52 mm **F.46** Spring tether, IP64, hubshaft 9.52 mm, mounting with clamping ring front **F.42 Spring tether, IP64, hubshaft 10 mm, mounting with clamping ring front** **F.47 Spring tether, IP64, hubshaft 12 mm, mounting with clamping ring front** **Q.46** Square, IP64, 9.52 mm **Q.42** Square, IP64, 10 mm **Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**VD** DeviceNet	**S** Bushaube mit 1x M12-Stecker, 5-polig, radial **T** Bus cover with 2 sealed cable exits + 1 x M12 connector for "tico" display, 4 pole **Z** Bus cover with 2 sealed cable exits

Preferably available versions are printed in bold type.

ACCESSORIES

see chapter "Accessories"

Absolute Interbus

Hubshaft with tether

- Resolution programmable (K3)
- Resolution up to 24 Bit
- Preset (K3)
- Direction (K3)
- Diagnostic LED

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	6 mm / 10 mm (Solid shaft) 10 mm / 12 mm (Hub shaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input (EN 60529)	IP64 or IP67
Protection class housing (EN 60529)	Connection bus cover: IP67 Connection cable or M23 (conin): IP64 (IP67 optional)
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Starting torque typ. [1]	≤ 0.01 Nm
Moment of inertia	ca. 3.8 x 10^{-6} kgm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +70 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Aluminum
Weight	approx. 350 g (ST) / 400 g (MT)
Connection	Bus cover with 3 sealed cable exits Bus cover with 2x M23 connectors (Conin), 9 pole Cable 1.5 m with M23 connector (Conin), 12 pole, axial or radial

[1] at 20°C

TECHNICAL DATA
electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage	DC 10-30 V
Current w/o load typ.	220 mA (ST, recommended external fuse: T 0.25 A), 250 mA (MT, recommended external fuse: T 0.25 A)
EMC	Noise emission according to EN 50081-2 Immunity to interference according to EN 50082-2
Resolution singleturn	10 - 12 Bit
Resolution multiturn	12 Bit
Output code	32 Bit binary
Linearity	± ½ LSB

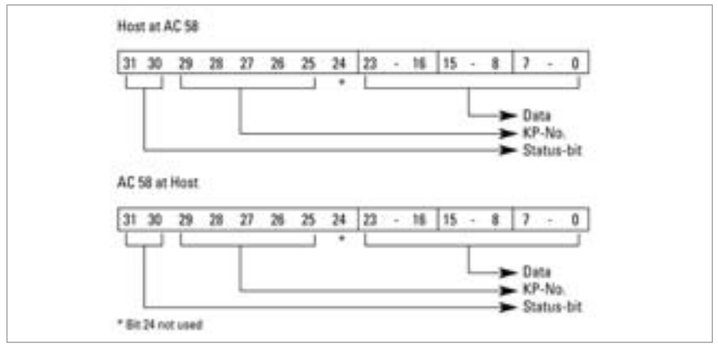
TECHNICAL DATA
electrical (continued)

Profile/ protocol	ENCOM-Profil K3 = ID-Code 37, K2 = ID-Code 36
Programmable	Resolution, Preset, Offset, Direction
Output current [1]	max. 4.5 A for bus cover with 2x M23 (recommended external fuse: T 4.5 A) max. 2 A for all other connections (recommended external fuse: T 2 A)
Baud rate	500 KBaud
Updating of values	every 600 µs

[1] Current with looped through voltage supply

DATA FORMAT Interbus K2/K3

	Differential signals (RS485) ENCOM profile K3, K2, 32 Bit, binary process data				
Data format	Sµpi-address	0	1	2	3
(as per Phoenix)	Byte-No.	3	2	1	0
ID-Code K2	36H (= 54 decimal)				
ID-Code K3	37H (= 55 decimal)				



PROGRAMMABLE FUNKTIONS
for Interbus K3

Function (Programming directly via the bus through transfer of configuration parameters)	**Preset values (manufacturer´s standard settings)**	**Customer-specific parameters**
Code sequence for clockwise (cw) rotation	ascending	
Offset (KP-No. 05)	0	
Preset value (KP-No. 04)	0	
Scaling faktor (KP-No. 08)	1 [1]	

[1] maximum resolution

Standard Industrial types AC 58
Absolute Interbus

ELECTRICAL CONNECTIONS
Cable with M23 connector (Conin), 12 pole
(Standard according to ENCOM for remote installation bus)

Plug pin	**Signal**
1	D02
2	$\overline{D02}$
3	DI 2
4	$\overline{DI}$ 2
5	D01
6	$\overline{D01}$
7	DI 1
8	$\overline{DI1}$
9	$\overline{RBST}$
10	GND- signal output [1]
11	0 V (supply voltage)
12	DC 10 - 30 V

[1] Due to electrical isolation not identical with 0 V (supply voltage) identisch; used by T-manifold to set the RBST input logical on "0"

ELECTRICAL CONNECTIONS
Bus cover with 2x M23 connector (Conin), 9 pole
(Standard according to ENCOM for remote installation bus)

Pin	**IN (9 pole pins)**	**OUT (9 pole socket)**
1	D01	D02
2	$\overline{D01}$	$\overline{D02}$
3	DI 1	DI 2
4	$\overline{DI1}$	$\overline{DI2}$
5	GND- signal output [1]	GND- signal output [1]
6	PE [2]	PE [2]
7	DC10 - 30 V (SELV)	DC10 - 30 V (SELV)
8	0 V (supply voltage)	0 V (supply voltage)
9	N.C.	$\overline{RBST}$

[1] Due to electrical isolation not identical with 0 V (supply voltage) identisch; used by T-manifold to set the RBST input logical on "0"
[2] Functional earthing; connected with the encoder housing

ELECTRICAL CONNECTIONS
Bus cover with 3 sealed cable exits

Connection clamp (12 pole)	
1	UB +
2	GND
3	DI1+
4	DI1-
5	D01+
6	D01-
7	D02+
8	D02-
9	DI2+
10	DI2-
11	RBST
12	GND

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 58, starting page 178

Absolute Interbus

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft [1]	Interface	Connection
AC58	**0010** 10 Bit ST **0012** 12 Bit ST **1212** 12 Bit MT + 12 Bit ST	**E** DC 10 - 30 V	**S.41 Synchro, IP64, 6 mm** **S.71 Synchro, IP67, 6 mm** **K.42 Clamping, IP64, 10 mm** **K.46** Clamping, IP64, 9.52 mm **K.72 Clamping, IP67, 10 mm** **K.76** Clamping, IP67, 9.52 mm **F.46** Spring tether, IP64, hubshaft 9.52 mm, mounting with clamping ring front **F.42 Spring tether, IP64, hubshaft 10 mm, mounting with clamping ring front** **F.47 Spring tether, IP64, hubshaft 12 mm, mounting with clamping ring front** **Q.46** Square, IP64, 9.52 mm **Q.42** Square, IP64, 10 mm **Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**I2** Interbus K2 **I3** Interbus K3	**I** Bus cover with 2x M23 connector (Conin), 9 pole, radial, cw **Z** Bus cover with 3 sealed cable exits **A-B5-C** 1.5 m cable with M23 connector (Conin), 12 pole, axial **B-B5-C** 1.5 m cable with M23 connector (Conin), 12 pole, radial

[1] Protection class IP67 not available in combination with LED display for connection with cable (connection code A-B5-C and B-B5-C)

Preferably available versions are printed in bold type.

ACCESSORIES

see chapter "Accessories"

Clamping flange

TECHNICAL DATA
mechanical

Absolute SUCOnet

- Compact design
- SUCOnet or Hengstler-G1-Protocol
- Parameterizable: preset, direction, scaling factor, resolution
- PC communication via RS 485 with Hengstler-G1-Protocol

Housing diameter	58 mm
Shaft diameter	6 mm / 10 mm (Solid shaft) 10 mm / 12 mm (Hubshaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input (EN 60529)	IP64 or IP67
Protection class housing (EN 60529)	IP64
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 6000 rpm (continuous), max. 12000 rpm (short term)
Starting torque typ. [1]	≤ 0.1 Nm
Vibration resistance (DIN EN 60068-2-6)	100 m/s²
Shock resistance (DIN EN 60068-2-27)	1000 m/s²
Operating temperature	-10 °C ... +60 °C
Storage temperature	-25 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Aluminum
Weight	approx. 260 g (ST) / 310 g (MT)
Connection	Cable, axial or radial

[1] at 20°C

TECHNICAL DATA
electrical

Supply voltage	DC 10-30 V
Current w/o load typ.	200 mA
Resolution singleturn	10 - 13 Bit
Resolution multiturn	12 Bit
Output code	Binary
Drives	RS485
Linearity	± ½ LSB (± 1 LSB for resolution 13 and 25 Bit)
Profile/ protocol	SUCOnet-K1 or Hengstler-G1
Programmable	Resolution, Direction
Address switch	set via DIP switches
Bus termination resistor	set via DIP switches

Absolute SUCOnet

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 58, starting page 178

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AC58	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **1210** 12 Bit MT + 10 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST	**E** DC 10 - 30 V	**S.41 Synchro, IP64, 6 mm** **K.42 Clamping, IP64, 10 mm** **K.46** Clamping, IP64, 9.52 mm **F.46** Spring tether, IP64, hubshaft 9.52 mm, mounting with clamping ring front **F.42 Spring tether, IP64, hubshaft 10 mm, mounting with clamping ring front** **F.47 Spring tether, IP64, hubshaft 12 mm, mounting with clamping ring front** **Q.46** Square, IP64, 9.52 mm **Q.42** Square, IP64, 10 mm	**RS** Hengstler-G1-Protocol **US** SUCOnet	**A** Cable, axial **B** Cable, radial

Preferably available versions are printed in bold type.

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Absolute SSI programmable

Clamping flange

- Compact design: 59 mm mounting depth for single or multiturn
- Aids for start up and operation: diagnostic LED, preset key with optical response
- Parameterization: Resolution, code type, direction, output format, warning, alarm
- Parameters can be stored in a non-volatile memory
- Integrated RS232 interface

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	6 mm / 10 mm (Solid shaft) 10 mm / 12 mm (Hub shaft)
Flange (Mounting of housing)	Synchro flange, Clamping flange, Tether, Square flange
Protection class shaft input (EN 60529)	IP64 or IP67
Protection class housing (EN 60529)	IP64 (IP67 optional)
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Starting torque typ. [1]	≤ 0.01 Nm
Moment of inertia	ca. 3.8 x 10^{-6} kgm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +100 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Aluminum
Weight	approx. 260 g (ST) / 310 g (MT)
Connection	Cable, axial or radial M23 connector (Conin), 12 pole, axial or radial

[1] at 20°C

TECHNICAL DATA
electrical

Supply voltage	DC 10-30 V
Current w/o load typ.	250 mA (ST / MT)
Resolution singleturn	10 - 17 Bit
Resolution multiturn	12 Bit
Output code	Binary, Gray
Drives	Clock and Data / RS422
Parametrization	Resolution, Code type, Direction, Output format, Warning, Alarm
Control inputs	Direction, Preset 1, Preset 2
Alarm output	Alarm bit
Status LED	Green = ok, red = alarm

RECOMMENDED DATA TRANSFER RATE bei SSI

The max. data transfer rate depends on the cable length. For Clock / $\overline{\text{Clock}}$ and Data / $\overline{\text{Data}}$ please use twisted pairs. Use shielded cable.

Cable length	Frequency
< 50 m	< 400 kHz
< 100 m	< 300 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz

SYNCHRONOUS-SERAL TRANSFER (SSI)

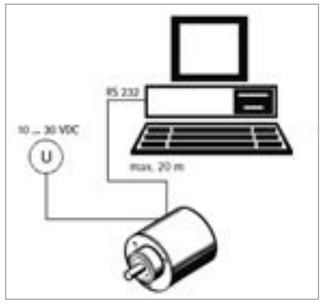
A clock brush is applied at the SSI interface, causing the encoder data to be serially clocked out. With each new clock brush (min. interval 30 ms) new data is readout. The following main parameters are programmable:

- Preset: Software-Preset and via input/ pushbutton settable presets (can be inactivated)
- Offset: Relative shifting of actual encoder value.
- Scaling: The actual value of the encoder is multiplied with the factor < 1(direct entry, increments per measuring distance or per revolution).
- Direction of rotation: Can be changed via software or input (can be inactivated)
- Output formats SSI: Tree format or standard format (MSB oriented)
- Output code: The choices are Gray or binary code, integer or two's complement representation. Selection of significant bit between 16 and 24 Bit.

In addition, programming of max. 7 status bits is possible:

- up to 4 warning positions
- overspeed
- encoder standstill
- parity
- encoder error
- direction of rotation

PROGRAMMING with SSI



To program the absolute encoder you require a PC, the software WinSSI and the adapter cable.
The encoder is connected to the power supply and the serial interface of your PC with the adapter cable. Using the menue-assisted programme you can then configure the encoder according to the parameters you require.

Standard Industrial types AC 58
Absolute SSI programmable

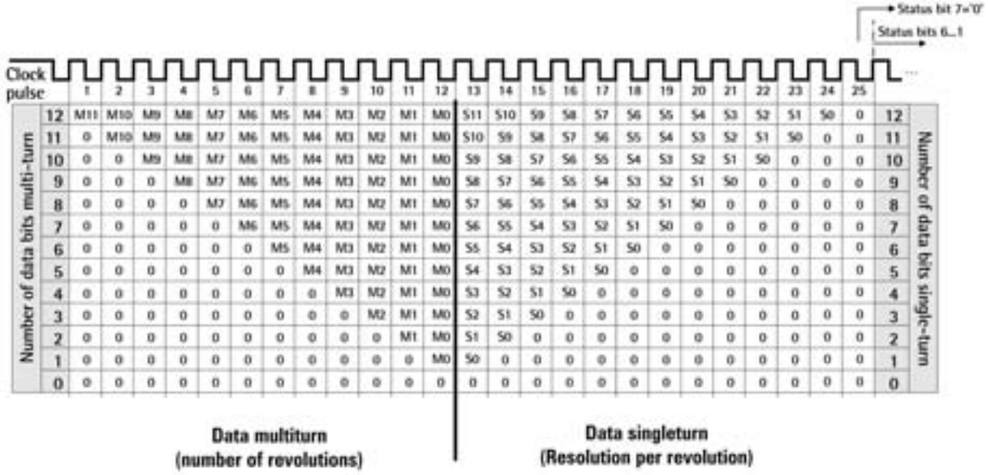
OUTPUT FORMAT SSI, MSB oriented, Multiturn

Clock pulse	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Number of data bits 24	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0
23	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0
22	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0
21	M8	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0
20	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0
19	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0
18	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0
17	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0
16	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0
15	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0
14	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0
13	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0
12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0
11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

OUTPUT FORMATS SSI, MSB oriented, Multiturn (not scaleable)

Clock pulse	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Number of data bits 32	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0
32	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0
32	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0
31	M8	M7	M6	M5	M4	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0
30	M7	M6	M5	M4	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0
29	M6	M5	M4	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0
28	M5	M4	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0
27	M4	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0
26	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0
25	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0
24	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0
23	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0
22	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0
21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0
20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0
19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

OUTPUT FORMAT SSI, tree format



ELECTRICAL CONNECTIONS
M23 connector (Conin), 12 pole / cable

Cable Colour	M23 (Conin) Pin	Signal
green	1	$\overline{\text{Clock}}$
yellow	2	Clock
pink	3	Data
grey	4	$\overline{\text{Data}}$
brown	5	RS 232 TxD
white	6	RS 232 RxD
black	7	0 V-signal output
blue	8	$\overline{\text{Direction}}$
red	9	Preset 1
violet	10	Preset 2
white [1]	11	DC 10 - 30 V
brown [1]	12	0 V (supply voltage)

[1] bigger cross section 0.5 mm [2]

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 58, starting page 178

Standard Industrial types AC 58
Absolute SSI programmable

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft [1,2]	Interface	Connection
AC58	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0017** 17 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST **1217** 12 Bit MT + 17 Bit ST higher resolution on request	**E** DC 10 - 30 V	**S.41 Synchro, IP64, 6 mm** **S.71 Synchro, IP67, 6 mm** **K.42 Clamping, IP64, 10 mm** **K.46** Clamping, IP64, 9.52 mm **K.72 Clamping, IP67, 10 mm** **K.76** Clamping, IP67, 9.52 mm **F.46** Spring tether, IP64, hubshaft 9.52 mm, mounting with clamping ring front **F.42 Spring tether, IP64, hubshaft 10 mm, mounting with clamping ring front** **F.47 Spring tether, IP64, hubshaft 12 mm, mounting with clamping ring front** **Q.46** Square, IP64, 9.52 mm **Q.42** Square, IP64, 10 mm **Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**SP** SSI programmable	**G** M23 connector (Conin), 12 pole, axial, ccw **H** M23 connector (Conin), 12 pole, radial, ccw

[1] Protection class IP67 not available in combination with preset key and LED display
[2] IP67 on cover with connector only if IP67 mating connector mounted properly.
Preferably available versions are printed in bold type.

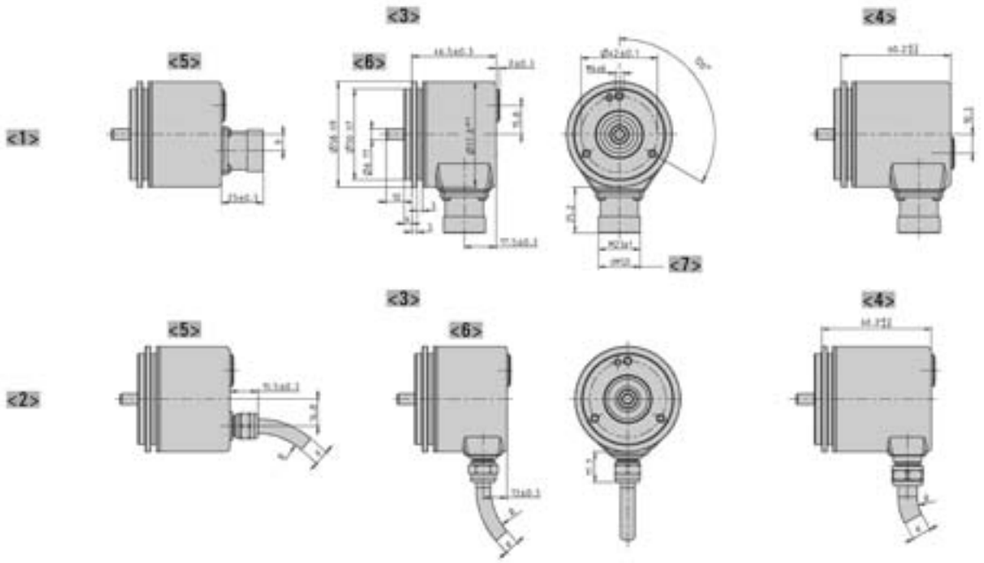
ACCESSORIES

see chapter "Accessories"

Absolute Dimensioned Drawings

DIMENSIONED DRAWINGS

Synchro flange "S"



<1> Connection M23 (Conin)
<2> Connection cable
<3> Interface: BiSS, SSI, ST-Parallel
<4> Interface: MT-Parallel (only with cable), Fieldbus, SSI-P
<5> axial
<6> radial
<7> Value in brackets alternative at SSI

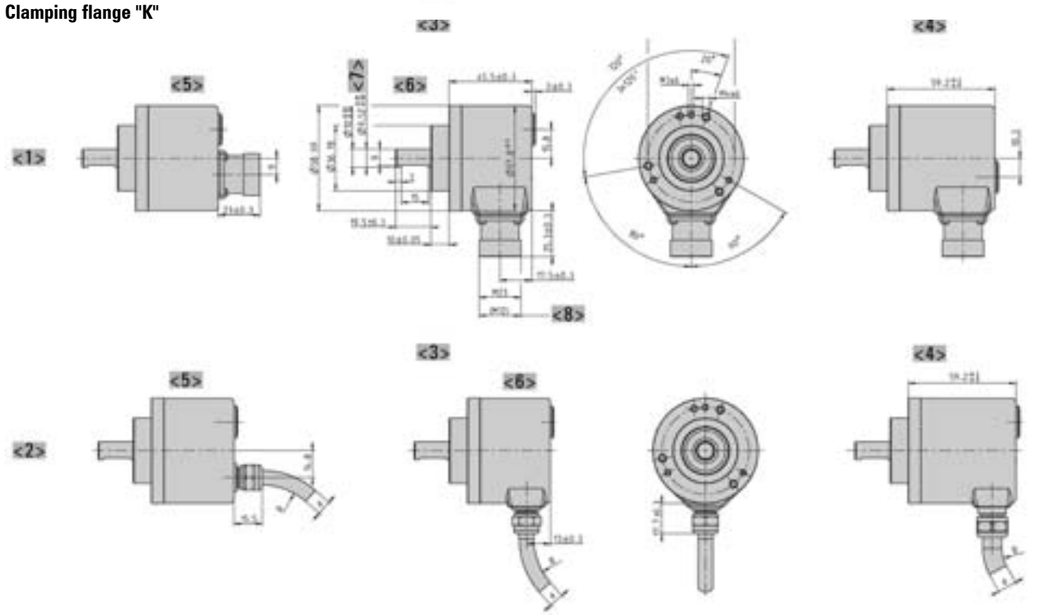
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d BiSS/SSI/SSI-P: 7,1 $^{+1,2}$
Cable Ø d ST-P: 7,8 $^{+0,9}$
Cable Ø d MT-P: 9,3 +1,3
Cable Ø d Fieldbus: 7,1 $^{+1,2}$

Dimensions in mm

Absolute Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

Clamping flange "K"



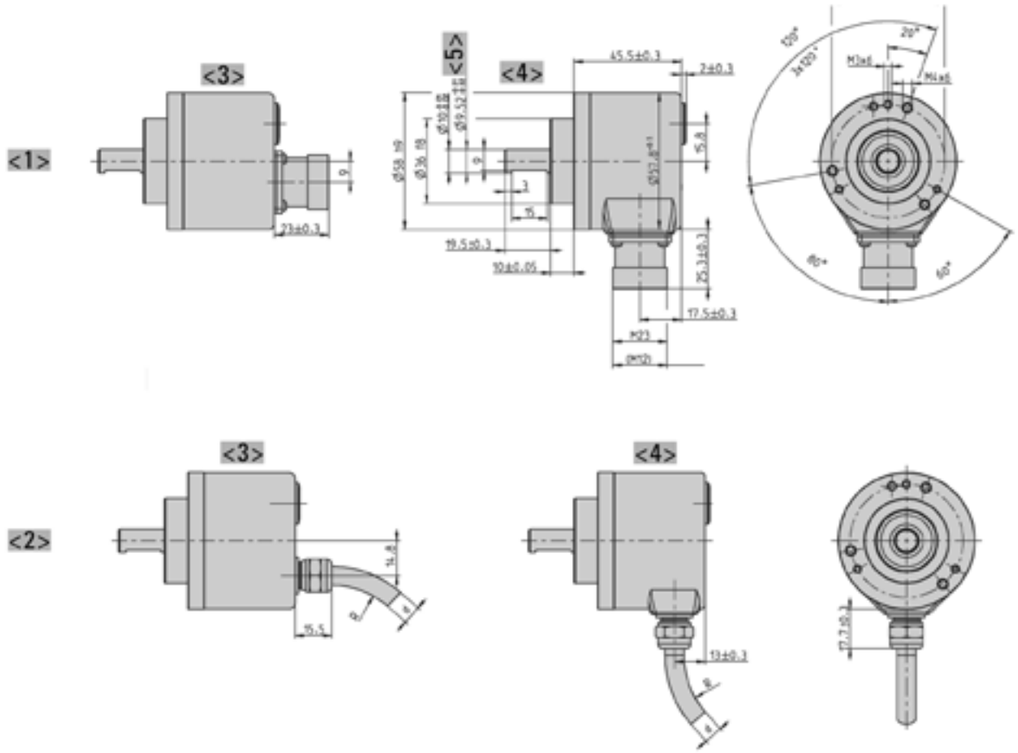
<1> Connection M23 (Conin)
<2> Connection cable
<3> Interface: BiSS, SSI, ST-Parallel
<4> Interface: MT-Parallel (only with cable), Fieldbus, SSI-P
<5> axial
<6> radial
<7> alternative

<8> Value in brackets alternative at SSI
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d BiSS/SSI/SSI-P: 7,1 $^{+1,2}$
Cable Ø d ST-P: 7,8 $^{+0,9}$
Cable Ø d MT-P: 9,3 +1,3
Cable Ø d Fieldbus: 7,1 $^{+1,2}$

Dimensions in mm

DIMENSIONED DRAWINGS (continued)

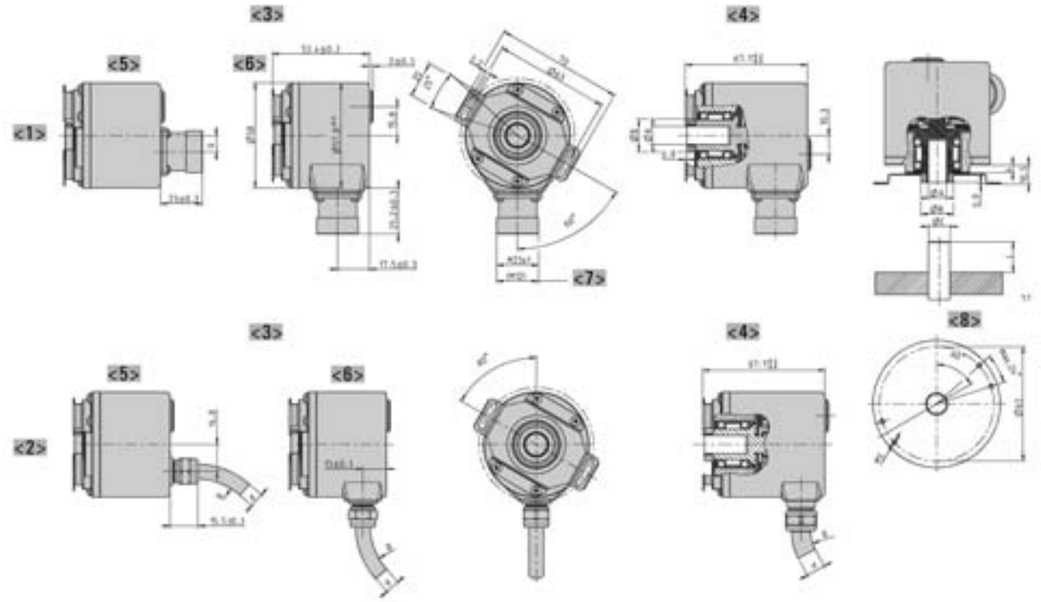
Clamping flange "K"



<1> Connection M23 (Conin)
<2> Connection cable
<3> axial
<4> radial
<5> alternative
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d : 7,1 $^{+1,2}$
Dimensions in mm

DIMENSIONED DRAWINGS (continued)

Hollow shaft "F"



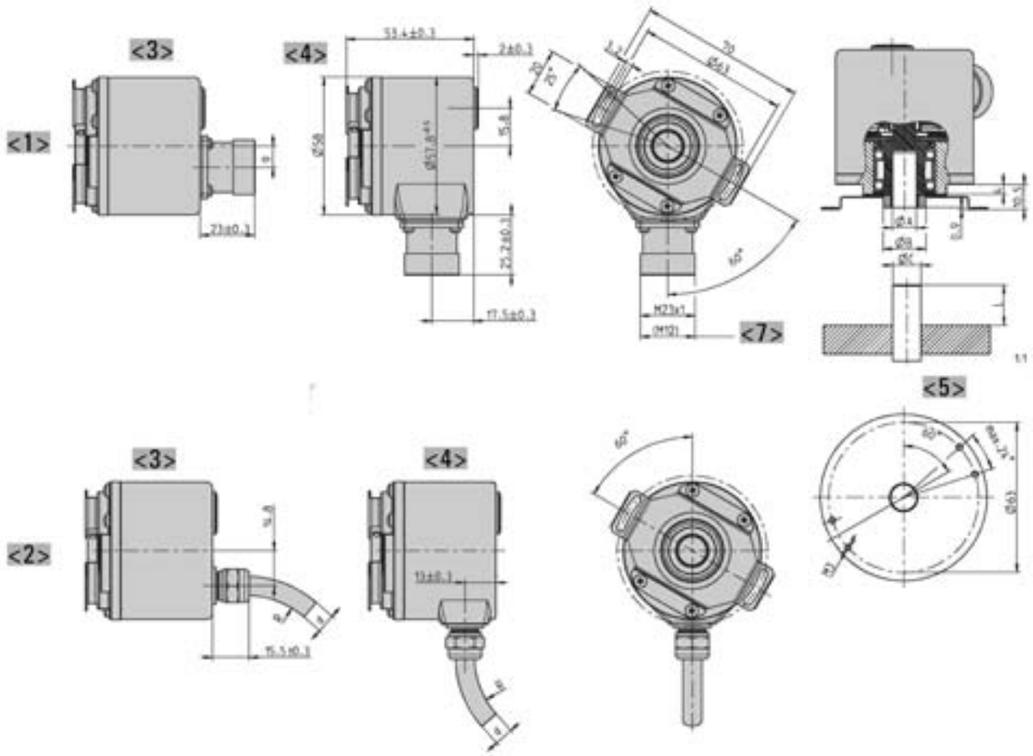
	Dim.				Unit
Hollow shaft Ø A	10 $^{+0.012}$	12 $^{+0.012}$	9,52 $^{+0.012}$	12,7 $^{+0.012}$	mm
Connecting shaft Ø C	10 $_{g7}$	12 $_{g7}$	9,52 $_{g7}$	12,7 $_{g7}$	mm
Clamping ring Ø B	18	20	18	22	mm
L_{min}	15	18	15	18	mm
L_{max}	20	20	20	20	mm
Shaft code	"2"	"7"	"6"	"E"	
L = Inside length of connection shaft					

<1> Connection M23 (Conin)
<2> Connection cable
<3> Interface: BiSS, SSI, ST-Parallel
<4> Interface: MT-Parallel (only with cable), Fieldbus, SSI-P
<5> axial
<6> radial
<7> Value in brackets alternative at SSI
<8> Customer side
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d BiSS/SSI/SSI-P: 7,1 $^{+1,2}$
Cable Ø d ST-P: 7,8 $^{+0,9}$
Cable Ø d MT-P: 9,3 +1,3
Cable Ø d Fieldbus: 7,1 $^{+1,2}$
Dimensions in mm

Absolute Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

Hollow shaft "F"

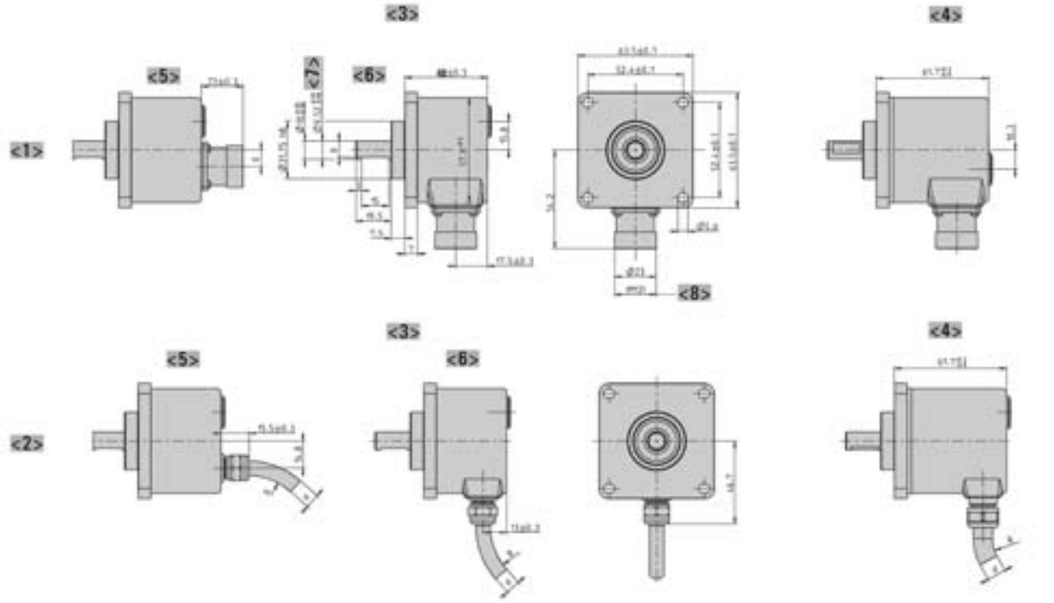


<1> Connection M23 (Conin)
<2> Connection cable
<3> axial
<4> radial
<5> Customer side
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d : 7,1 $^{+1,2}$
Dimensions in mm

Absolute Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

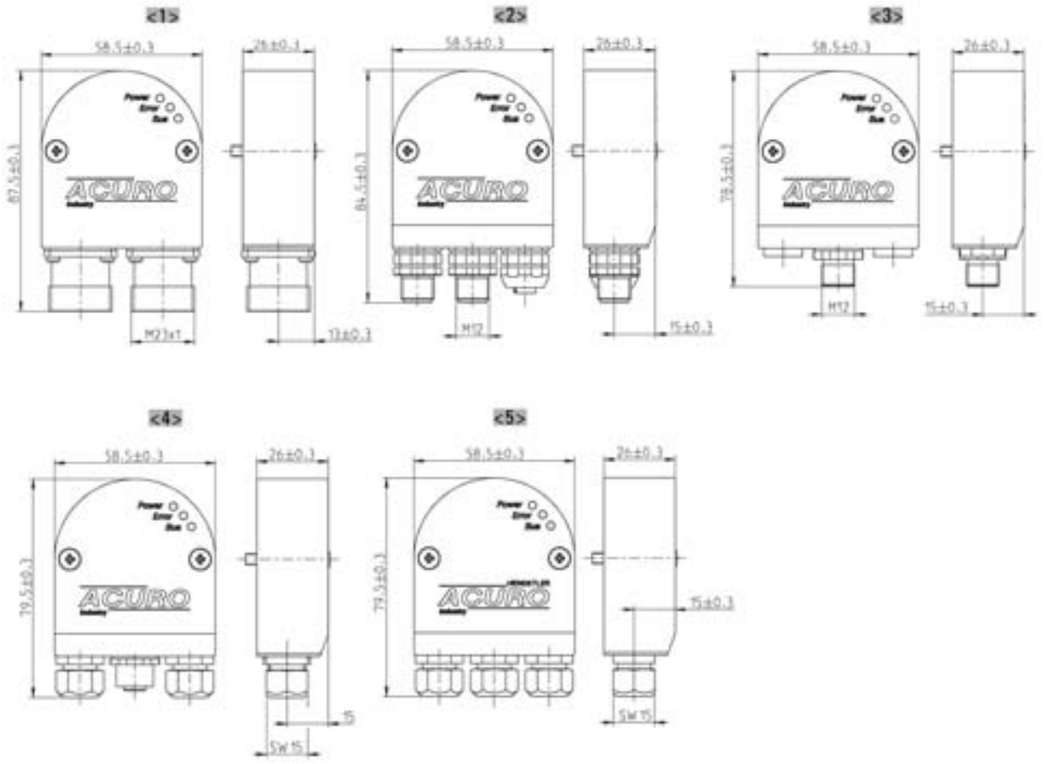
Square flange "Q"



<1> Connection M23 (Conin)
<2> Connection cable
<3> Interface: BiSS, SSI, ST-Parallel
<4> Interface: MT-Parallel (only with cable), Fieldbus, SSI-P
<5> axial
<6> radial
<7> alternative
<8> Value in brackets alternative at SSI
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d BiSS/SSI/SSI-P: 7,1 $^{+1,2}$
Cable Ø d ST-P: 7,8 $^{+0,9}$
Cable Ø d MT-P: 9,3 +1,3
Cable Ø d Fieldbus: 7,1 $^{+1,2}$
Dimensions in mm

DIMENSIONED DRAWINGS (continued)

Bus covers



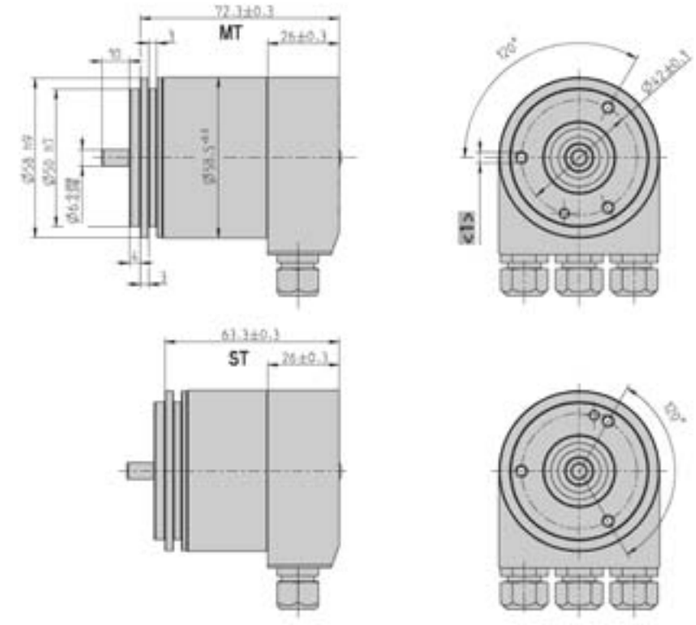
<1> Connection "I"
<2> Connection "R"
<3> Connection "S"
<4> Connection "T"
<5> Connection "Z"

Dimensions in mm

Standard Industrial types AC 58
Absolute Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

Synchro flange "S"

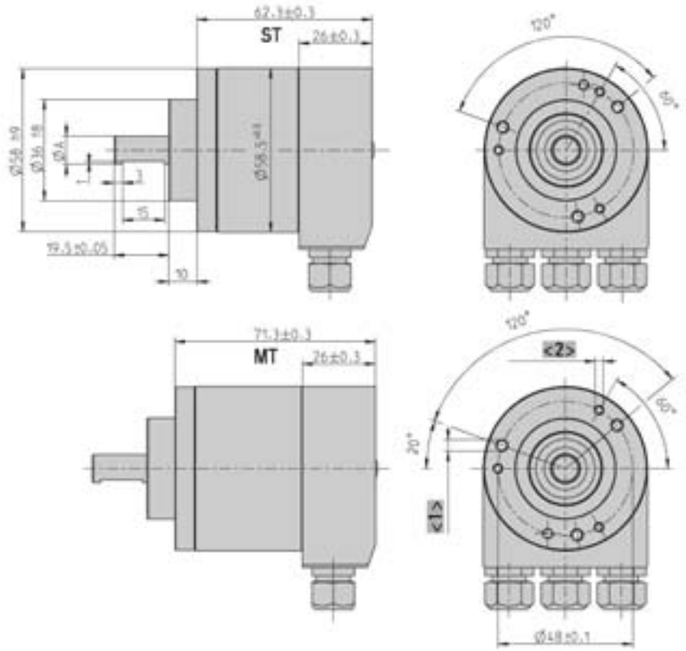


<1> 3xM4 (6 deep)

Dimensions in mm

DIMENSIONED DRAWINGS (continued)

Clamping flange "K"



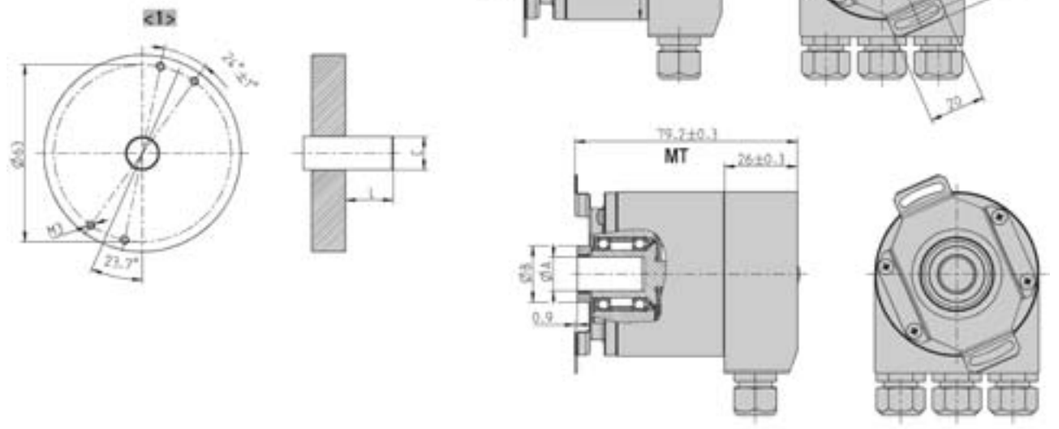
	Dim.		Unit
Shaft Ø A	10 $^{-0.01/-0.02}$	9.52 $^{-0.01/-0.02}$	mm
Shaft code	"2"	"6"	

<1> 3xM4 (6 deep)
<2> 3xM3 (6 deep)

Dimensions in mm

DIMENSIONED DRAWINGS (continued)

Hollow shaft "F"



	Dim.				Unit
Hollow shaft Ø A	10 $^{+0.012}$	12 $^{+0.012}$	9,52 $^{+0.012}$	12,7 $^{+0.012}$	mm
Connecting shaft Ø C	10 $_{g7}$	12 $_{g7}$	9,52 $_{g7}$	12,7 $_{g7}$	mm
Clamping ring Ø B	18	20	18	22	mm
L_{min}	15	18	15	18	mm
L_{max}	20	20	20	20	mm
Shaft code	"2"	"7"	"6"	"E"	
L = Inside length of connection shaft					

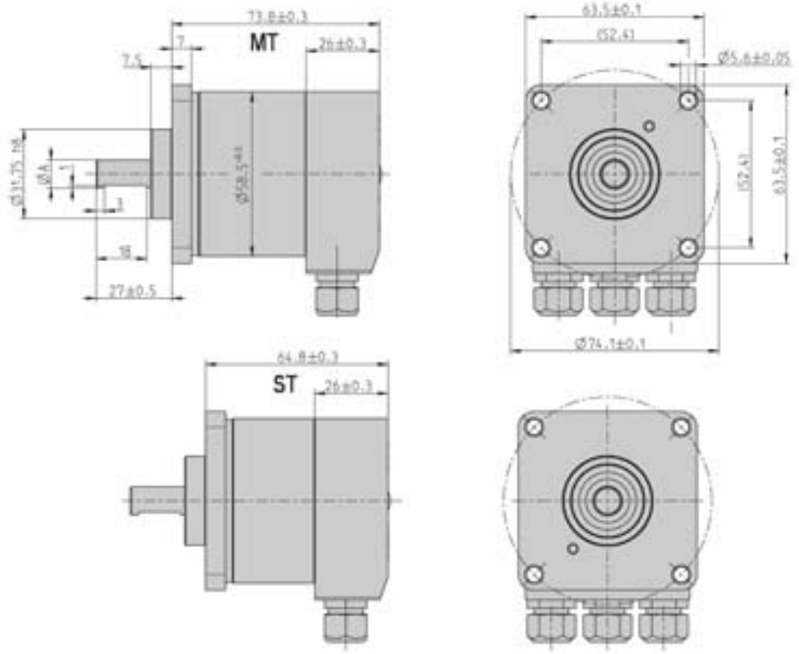
<1> Customer side

Dimensions in mm

Absolute Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

Square flange "Q"



	Dim.		Unit
Shaft Ø A	10 $^{-0.01/-0.02}$	9.52 $^{-0.01/-0.02}$	mm
Shaft code	"2"	"6"	

Dimensions in mm

Absolute BiSS / SSI

- Hollow shaft absolute encoder
- ST - Resolution up to 19 Bit
- Compact design: 50 mm
- Robust bearings for long life
- Hollow shaft up to 50 mm
- BiSS or SSI interface
- Optional: Sine-Cosine 4096 increments
- Integrated diagnostic system

GENERAL INFORMATION

HENGSTLER OPTOASIC Technology

The central Element of the ACURO AC110 is the latest Hengstler OptoAsic technology, which offers the following key benefits.

- Outstanding reliability by reduced number of components and integrated diagnostics systems
- Aging compensation by integrated LED light regulation
- Integrated monitoring of pollution, disk damage, LED lifetime and temperature

The ACURO AC110 is ideally suited for applications like:

- Gearless drive
- Gearless elevators
- Industrial Machinery

TECHNICAL DATA
mechanical

Housing diameter	110 mm
Shaft diameter	50 mm (Hub shaft)
Mounting of shaft	Keyway, Rear clamping ring
Protection class shaft input (EN 60529)	IP50 or IP64
Protection class housing (EN 60529)	IP40 or IP64
Axial endplay of mounting shaft (hubshaft)	± 0.5 mm
Radial runout of mating shaft (hubshaft)	± 0.05 mm
Max. speed	IP40: max. 3600 rpm IP50: max. 2000 rpm IP64: max. 1500 rpm
Starting torque typ.	25 Ncm
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-20 °C ... +70 °C
Storage temperature	-50 °C ... +80 °C
Material shaft	Stainless Steel / Aluminum, ceramic coated
Material housing	Aluminum

TECHNICAL DATA
mechanical (continued)

Weight	approx. 1000 g
Connection	Cable, radial Cable 1.5 m with M23 connector (Conin), 12 pole, axial or radial

TECHNICAL DATA
electrical

Supply voltage	-5%/ 10% DC 5 V DC 10-30 V
Current w/o load typ.	120 mA
Resolution singleturn	11 - 19 Bit (22 Bit on request)
Output code	Binary, Gray
Drives	Clock and Data / RS422
Incremental signals	Sinus-Cosinus 1 Vpp
Number of pulses	4096
3dB limiting frequency	500 kHz
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)

RECOMMENDED DATA TRANSFER RATE
bei SSI

The max. data transfer rate depends on the cable length. For Clock / $\overline{\text{Clock}}$ and Data / $\overline{\text{Data}}$ please use twisted pairs. Use shielded cable.

Cable length	Frequency
< 50 m	< 400 kHz
< 100 m	< 300 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz

ELECTRICAL CONNECTIONS
Cable / Cable with M23 connector (Conin), 12 pole

Colour cable	Cable connector	Signal
brown [4]	1	0 V (supply voltage)
pink	2	Data
yellow	3	Clock
	4	N.C.
blue	5	$\overline{\text{Direction}}$ [1]
	6	N.C.
	7	N.C.
white [4]	8	DC 5 V [3] / DC 10 - 30 V
	9	N.C.
grey	10	$\overline{\text{Data}}$
green	11	$\overline{\text{Clock}}$
black	12	0 V-signal output [2]
Screen		Shielded with housing

[1] $\overline{\text{Direction}}$: UB or unconnected = ascending code values with rotation cw
0 V = descending code values with rotation cw
When activating Direction only the rotation dirction for the absolute positon value is changed. For the optional version with SinCos - signals the direction is activated by changing A- and B- signal.

[2] Connected with 0 V in the encoder. Use this output to lay Direction on logical "0" if required.

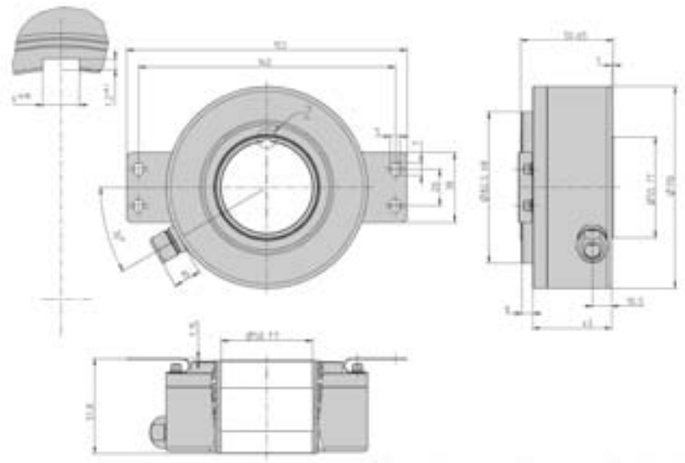
[3] Notice: when supply voltage = DC 5V ⇨ max. cable length 10 m

[4] Use only thin wires 0.14 mm ²

Standard Industrial types AC 110
Absolute BiSS / SSI

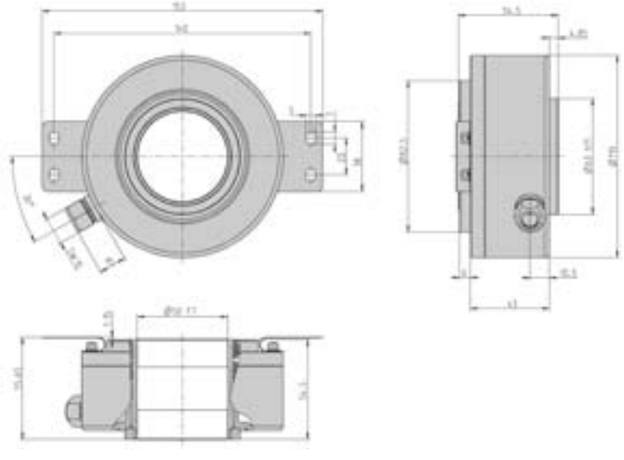
DIMENSIONED DRAWINGS

Keyway



Dimensions in mm

Clamping ring



Dimensions in mm

Absolute BiSS / SSI

ORDERING INFORMATION

Type	Resolution [1,2,3]	Supply voltage	Spring tether	Protec-tion	Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐	☐	☐
AC110	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0017** 17 Bit ST **0019** 19 Bit ST (BiSS)	**A** DC 5 V **E** DC 10 - 30 V	**0** Without tether **B** With tether	**0** IP40 **1** IP50 **4** IP64	**K50** Keyway (4x1,2) / 50 mm **H50** Clamping ring / 50 mm	**BI** BiSS **SB** SSI Binary **SG** SSI Gray	**B** Cable, radial **B-D** 1.5 m cable with M23 con-nector (Conin), 12 pole

[1] When SSI and resolution > 14 Bit: max. clock frequency 178 kHz
[2] higher resolutions on request
[3] Max. cable length for DC 5V: 10 m

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Stainless Industrial Types

The absolute encoder line ACURO® and incremental encoder line "RI" are available as stainless steel encoders under AC59 or AC 61 for absolute encoders and RI59 for incremental encoders.

The absolute stainless steel encoders are available in the versions AC59 and AC61:

- AC59: drawn stainless steel housing, together with cable outlet, no access to control elements
- AC61: machined housing, possible with cable or bus cover, access to control elements (DIP switch, reset switch)

Available interfaces: SSI, BiSS, SSI-P, Parallel, Profibus, CAN layer2, CANopen, DeviceNet, Interbus

The incremental stainless steel encoder is available in the version RI59:

- AC61: drawn stainless steel housing with cable outlet

Examples of applications for stainless steel encoders:

- Oil field applications
- Packaging machines
- Food & beverage
- Ship equipment
- Other offshore applications

Incremental

- Stainless steel encoder with high protection class
- High corrosion resistance
- Use in the area of food production
- Applications: packing machines, bottling machines, washing plants, mixers, cranes, hoists, marine outfitters

NUMBER OF PULSES

1 / 2 / 3 / 4 / 5 / 10 / 15 / 20 / 25 / 30 / 35 / 40 / 45 / 50 / 60 / 64 / 70 / 72 / 80 / **100** / 125 / 128 / 144 / 150 / 180 / 200 / 230 / **250** / 256 / 300 / 314 / 350 / 360 / 375 / 400 / 460 / 480 / **500** / 512 / 600 / 625 / 635 /720 / 900 / **1000** / **1024** / 1200 / **1250** / 1500 / 1600 / 1800 / 2000 / 2048 / **2500** / 3000 / 3480 / **3600** / 3750 / 3968 / 4000 / **4096** / 4800 / **5000** / 5400 / 6000 / 7200 / 7680 / 8000 / 8192 / 9000 / 10000
Other number of pulses on request
Preferably available versions are printed in bold type.

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	9.52 mm / 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange 63.5 mm
Protection class shaft input (EN 60529)	IP67
Protection class housing (EN 60529)	IP67
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 10 000 rpm
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²
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	-10 °C ... +70 °C
Storage temperature	-25 °C ... +85 °C
Material housing	Stainless Steel
Weight	approx. 620 g
Connection	Cable, axial or radial

TECHNICAL DATA
electrical

General design	as per DIN VDE 0160, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	RS422 + Sense (T): DC 5 V ±10 % RS422 + Alarm (R): ± 10% DC 5 V or DC 10 - 30 V Push-pull (K), Push-pull antivalent (I): DC 10-30 V
Current w/o load typ.	40 mA (DC 5 V), 60 mA (DC 10 V), 30 mA (DC 24 V)
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz
Standard output versions [2]	RS422 + Alarm (R): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$ RS422 + Sense (T): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, Sense Push-pull (K): A, B, N, $\overline{Alarm}$ Push-pull complementary (I): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$

Stainless Industrial types RI 59

Incremental

TECHNICAL DATA
electrical (continued)

Pulse width error	± max. 25° electrical
Number of pulses	1 ... 10 000
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Pulse duty factor	1:1

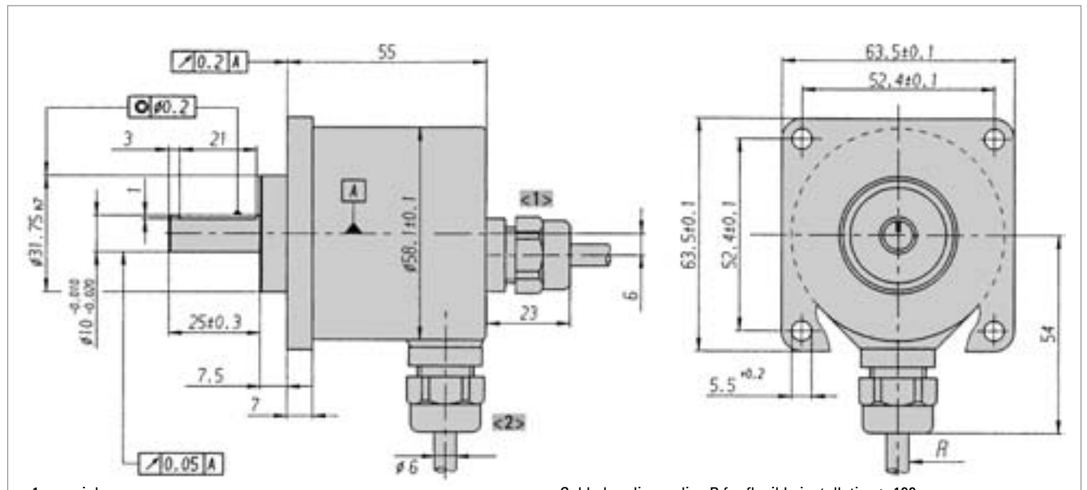
[1] Pole protection with supply voltage DC 10 - 30 V
[2] Output description and technical data see chapter "Technical basics"

ELECTRICAL CONNECTIONS
Cable PVC

Connecting cable Colour	Lead ◻	Output RS422 T and R	push-pull K and I
red	0.5 mm²	DC 5/10 - 30 V	DC 10 - 30 V
red/yellow	0.14 mm²	Sense V_{CC}	Sense V_{CC}
white	0.14 mm²	Channel A	Channel A
white/brown	0.14 mm²	Channel $\overline{A}$	Channel $\overline{A}$ [1]
green	0.14 mm²	Channel B	Channel B
green/brown	0.14 mm²	Channel $\overline{B}$	Channel $\overline{B}$ [1]
yellow	0.14 mm²	Channel N	Channel N
yellow/brown	0.14 mm²	Channel $\overline{N}$	Channel $\overline{N}$ [1]
black	0.5 mm²	GND	GND
black/yellow	0.14 mm²	$\overline{Alarm}$/Sense GND [2]	$\overline{Alarm}$
screen [3]		screen [3]	screen [3]

[1] only push-pull complementary (I)
[2] depending on ordering code
[3] connected with encoder housing

DIMENSIONED DRAWINGS



<1> axial
<2> radial

Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm
Dimensions in mm

Incremental

ORDERING INFORMATION

Type	Number of pulses	Supply voltage	Flange, Protection, Shaft	Output [1]	Connection
☐	☐	☐	☐	☐	☐
RI59-O	**1 ... 10000**	**A** DC 5 V **E** DC 10 - 30 V	**Q.76** Square, IP67, 9.52 mm x 19,5 mm **Q.72** Square, IP67, 10 mm x 19,5 mm **Q.7B** Square IP67, 9.52 x 25 mm **Q.7A** Square IP67, 10 x 25 mm	**R** RS422 +Alarm **T** RS422 +Sense **K** Push-pull **I** Push-pull complementary	**A** PVC cable, axial **B** PVC cable, radial

[1] Output code "K" and "I": short-circuit-proof

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

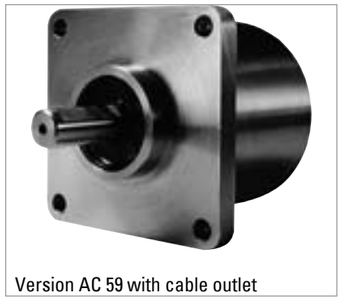
Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Absolute BiSS / SSI



Version AC 59 with cable outlet

- Compact design
- Protection class IP67
- High corrosion resistance
- Robust design
- Resolution up to 29 Bit (17 Bit ST, 12 Bit MT)
- Versions with cable
- Applications: packaging machine for food and beverage, ship equipment (e.g. cranes, winches, cable laying ships), offshore applications

GENERAL INFORMATION

The absolute stainless steel encoders are available in the Versions AC 59 and AC 61
- AC 59: drawn stainless steel housing, only together with cable outlet, no access to control elements
- AC 61: machined housing, possible with cable or bus cover, access to control elements (DIP switch, Reset switch)

TECHNICAL DATA
mechanical

Housing diameter	58 mm
Shaft diameter	9.52 mm / 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange 63.5 mm
Protection class shaft input (EN 60529)	IP67
Protection class housing (EN 60529)	IP67
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 6000 rpm (continuous), max. 10 000 rpm (short term)
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +100 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Stainless Steel
Weight	approx. 700 g with 1.5 m cable
Connection	Cable, axial or radial

TECHNICAL DATA
electrical

Supply voltage	± 10% DC 5 V or DC 10 - 30 V
Current w/o load typ.	5 V: 100 mA (ST), 150 mA (MT) 10 - 30 V: 100 mA (ST), 150 mA (MT)
Allowable load	max. 30 mA

TECHNICAL DATA electrical (continued)

Resolution singleturn	10 - 17 Bit Gray Excess: 360, 720 increments
Resolution multiturn	12 Bit
Output code	Binary, Gray
Drives	Clock and Data / RS422
Linearity	± ½ LSB (± 1 LSB for resolution > 13 Bit)
Incremental signals	Sinus-Cosinus 1 Vpp
Number of pulses	2048
3dB limiting frequency	500 kHz
Absolute accuracy	±35"
Parametrization	Code type, Direction, Warning, Alarm
Control inputs	$\overline{\text{Direction}}$
Reset key	Disable via parameterization
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)
Status LED	Green = ok, red = alarm

RECOMMENDED DATA TRANSFER RATE bei SSI

The max. data transfer rate depends on the cable length. For Clock / $\overline{\text{Clock}}$ and Data / $\overline{\text{Data}}$ please use twisted pairs. Use shielded cable.

Cable length	Frequency
< 50 m	< 400 kHz
< 100 m	< 300 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz

DATA FORMAT Singleturn

Resolution	**Data Bits**										
	T1 ... T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19
9 Bit [1]	S8 ... S0	0	0	0	0	0	W [2]				
10 Bit [1]	S9 ... S1	S0	0	0	0	0	W [2]				
11 Bit [1]	S10 ... S2	S1	S0	0	0	0	W [2]				
12 Bit [1]	S11... S3	S2	S1	S0	0	0	W [2]				
13 Bit [1]	S12 ... S4	S3	S2	S1	S0	0	W [2]				
14 Bit [1]	S13 ... S5	S4	S3	S2	S1	S0	0	W [2]			
15 Bit [1]	S14 ... S6	S5	S4	S3	S2	S1	S0	0	0	0	W [2]
16 Bit [1]	S15 ... S7	S6	S5	S4	S3	S2	S1	S0	0	0	W [2]
17 Bit [1]	S16 ... S8	S7	S6	S5	S4	S3	S2	S1	S0	0	W [2]

Examples for data format 9 Bit and 13 Bit with the optional bits alarm und parity

Resolution	**Data Bits**										
	T1 ... T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19
9 Bit + P [3]	S8 ... S0	0	0	0	P	0	W [2]				
9 Bit + A [4]	S8 ... S0	0	0	0	A	0	W [2]				
9 Bit + P [3] + A [4]	S8 ... S0	0	0	0	A	P	0	W [2]			
9 Bit + P [3]	S12 ... S4	S3	S2	S1	S0	P	0	W [2]			
9 Bit + A [4]	S12 ... S4	S3	S2	S1	S0	A	0	W [2]			
9 Bit + P [3] + A [4]	S12 ... S4	S3	S2	S1	S0	A	P	0	W [2]		

Stainless Industrial types AC 59
Absolute BiSS / SSI

DATA FORMAT SSI Multiturn

Resolution	Data bits									
	T1 ... T12	T13 ... T21	T22	T23	T24	T25				
24 Bit [1]	M11 ... M0	S11 ... S1	S0	0	W [2]					
25 Bit [1]	M11 ... M0	S12 ... S2	S1	S0	0	W [2]				
26 Bit [1]	M11 ... M0	S13 ... S3	S2	S1	S0	0	W [2]			
27 Bit [1]	M11 ... M0	S14 ... S4	S3	S2	S1	S0	0	0	0	W [2]
28 Bit [1]	M11 ... M0	S15 ... S5	S4	S3	S2	S1	S0	0	0	W [2]
29 Bit [1]	M11 ... M0	S16 ... S6	S5	S4	S3	S2	S1	S0	0	W [2]
Example for data format 24 Bit with the optional bits alarm and parity										
24 Bit + P [3]	M11 ... M0	S11 ... S2	S1	S0	P	0	W [2]			
24 Bit + A [4]	M11 ... M0	S11 ... S2	S1	S0	A	0	W [2]			
24 Bit + P [3] + A [4]	M11 ... M0	S11 ... S2	S1	S0	A	P	0	W [2]		

S0 ... S16 Data bits for resolution per revolution

M0 ... M11 Data bits for number of revolution (only for multiturn)

[1] Optionen (Parity bit, Alarm- and Parity bit, zero bit) on request

[2] W: from this data bit on the data iteration for multiplex starts

[3] Paritybit: Even Parity (Das Paritybit ergänzt die Datenbits auf eine gerade Anzahl von 1-Bits.) (Option)

[4] Alarm bit: is set to "1" when over temperature, under temperture, disc breakage and defect LED

SYNCHRONOUS-SERAL TRANSFER (SSI)

Synchronous readout of the encoder data is according to the clock rate given by the SSI-counterpart.
The number of clock rates is determined by the type of encoder (singleturn resp. multiturn) and the configuration of the special Bits as defined.
For multiple transactions (the stored value is readout several times successively) a fixed clock rate per transaction must be kept (for singleturn 13 resp. 14 clocks, for multiturn 25 resp. 26 clocks).

- In the rest position, when the last clock brush has passed by more than 30µs, the data output is logically at "1".
- With the first descending clock edge the encoder data and the special bits are loaded in the shift register of the encoder interface.
- With each ascending clock edge the data bits are serially readout, beginning with the MSB.
- At the end of the data transfer the data output is set to logically "0" for approx. 20µs. If within these 20µs a further clock brush reaches the encoder interface, the already transferred data is readout once again. This multiple transfer of the same data makes it possible to recognize transfer errors.
- After the 20µs the data output goes to its rest position, logically "1". Subsequently new encoder data can be readout.

ELECTRICAL CONNECTIONS
M23 connector (Conin), 12 pole / cable
Interface BI, SB, SG

Cable	M23 (Conin)	Signal
brown [3]	1	0 V (supply voltage)
pink	2	Data
yellow	3	Clock
	4	N.C.
blue	5	$\overline{\text{Direction}}$ [1]
red	6	N.C.
violet	7	N.C.
white [3]	8	DC 5/ 10 - 30 V
	9	N.C.
grey	10	$\overline{\text{Data}}$
green	11	$\overline{\text{Clock}}$
black	12	0 V-signal output [2]

[1] $\overline{\text{Direction}}$: U_B or unconnected = ascending code values with rotation cw
0 V = descending code values with rotation cw
[2] Connected with 0 V in the encoder.
Use this output to lay Direction on "0V" if required.
[3] use only thin wires (⌑ = 0.14 mm)

ELECTRICAL CONNECTIONS
12 pole / cable
Interface SC, BC

Cable	Signal
brown [2]	0 V (supply voltage)
pink	Data
yellow	Clock
white/green	A+
blue	$\overline{\text{Direction}}$ [1]
red/blue	B+
brown/green	A-
white [2]	DC 5/10 - 30 V
grey/pink	B-
grey	$\overline{\text{Data}}$
green	$\overline{\text{Clock}}$
black	Sense

[1] $\overline{\text{Direction}}$: +UB or unconnected = ascending code values with rotation cw
0 V = descending code values with rotation cw
[2] use only the thin wires (⌑ = 0,14 mm)

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 59, starting page 226

Stainless Industrial types AC 59
Absolute BiSS / SSI

ORDERING INFORMATION

Type	Resolution [1, 2]	Supply voltage	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AC59	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0017** 17 Bit ST **0360** 360 increments ST **0720** 720 increments ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST **1217** 12 Bit MT + 17 Bit ST	**A** DC 5 V **E** DC 10 - 30 V	**Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**BI** BiSS **BC** BiSS (+SinCos 1Vpp) **SB** SSI Binary **SG** SSI Gray **SC** SSI Gray (+SinCos 1Vpp)	**A** Cable, axial **B** Cable, radial

[1] Resolution 360 increments ST with Offset 76 (value range 76...435)
[2] Resolution 720 increments ST with Offset 152 (value range 152...871)

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Absolute Parallel

Version AC 59 with cable outlet

Version AC 61 with bus cover

- Compact design
- Protection class IP67
- High corrosion resistance
- Robust design
- Resolution up to 26 Bit (14 Bit ST, 12 Bit MT)
- Gray or Binary code
- Encoder monitoring
- Output Tristate short circuit-proof
- Applications: packaging machine for food and beverage, ship equipment (e.g. cranes, winches, cable laying ships), offshore applications

GENERAL INFORMATION

The absolute stainless steel encoders with parallel interface are available in the Versions AC 59 and AC 61.

- AC 59: drawn stainless steel housing, only together with Singleturn
- AC 61: machined housing

TECHNICAL DATA mechanical

Housing diameter	AC 59: 58 mm AC 61: 61.5 mm
Shaft diameter	9.52 mm / 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange 63.5 mm
Protection class shaft input (EN 60529)	IP67
Protection class housing (EN 60529)	IP67
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 6000 rpm (continuous), max. 10 000 rpm (short term)
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +100 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Stainless Steel
Weight	AC 59: approx. 700 g with 1.5 m cable AC 61: approx. 980 g with 1.5 m cable

Stainless Industrial types AC 59 / AC 61

Absolute Parallel

TECHNICAL DATA mechanical (continued)

Connection	Cable, axial or radial

TECHNICAL DATA electrical

Supply voltage	DC 10-30 V On request: DC 5 V
Current w/o load typ.	200 mA (ST), 300 mA (MT)
Resolution singleturn	10 - 14 Bit Gray Excess: 360, 720 increments
Resolution multiturn	12 Bit
Output code	Binary, Gray, Gray Excess
Linearity	± ½ LSB
Output current	30 mA per Bit, short-circuit-proof
Control inputs	$\overline{\text{Latch}}$, $\overline{\text{Direction}}$, $\overline{\text{Tristate}}$ with ST, Tristate with MT
Alarm output	NPN-O.C., max. 5 mA
Status LED	Green = ok, red = alarm

Note: preset key only with MT (IP64), preset value = 0

Data output level

Supply voltage U_B	DC 5 V - 5 % +10 % [1]	DC 10 - 30 V
Output level High	≥ 3.5 V (30 mA) ≥ 3.9 V (10 mA)	≥ U_B -2.2 V (30 mA) ≥ U_B -1.8 V (10 mA)
Output level Low	≤ 1.6 V (30 mA) ≤ 1.2 V (10 mA)	≤ 1.6 V (30 mA) ≤ 1.2 V (10 mA)
Rise time (1.5 m Cable)	≤ 0.1 µs	≤ 0.2 µs
Drop time (1.5 m Cable)	≤ 0.05 µs	≤ 0.1 µs

[1] on request

Control inputs

Input	Level logical (physical)	Function
$\overline{\text{Direction}}$	1 (+ U_B or open) 0 (0 V)	ascending code values when turning clockwise (cw) descending code values when turning clockwise (cw)
$\overline{\text{Latch}}$	1 (+ U_B or open) 0 (0 V)	encoder data continuously changing at output encoder data stored and constant at output
$\overline{\text{Tristate}}$ (with singleturn)	1 (+ U_B or open) 0 (0 V)	outputs active outputs at high impedance (Tristate mode)
Tristate (with multiturn)	1 (+ U_B) 0 (0 V or open)	outputs at high impedance (Tristate mode) outputs active

Typical actuating delay time 10 µs with push-pull selection; when selected via O.C., an external pull-down resistor (1 KΩ) is required

ELECTRICAL CONNECTIONS
Singleturn, cable

Colour (PVC)	9 Bit / 360 incr.	10 Bit / 720 incr.	12 Bit	13 Bit	14 Bit
grey/pink	N.C.	N.C.	N.C.	N.C.	S0 (LSB)
brown/yellow	N.C.	N.C.	N.C.	S0 (LSB)	S1
brown/grey	N.C.	N.C.	S0 (LSB)	S1	S2
red/blue	N.C.	N.C.	S1	S2	S3
violet	N.C.	S0 (LSB)	S2	S3	S4
white/brown	S0 (LSB)	S1	S3	S4	S5
white/green	S1	S2	S4	S5	S6
white/yellow	S2	S3	S5	S6	S7
white/grey	S3	S4	S6	S7	S8
white/pink	S4	S5	S7	S8	S9
white/blue	S5	S6	S8	S9	S10
white/red	S6	S7	S9	S10	S11
white/black	S7	S8	S10	S11	S12
brown/green	S8 (MSB)	S9 (MSB)	S11 (MSB)	S12 (MSB)	S13 (MSB)
yellow	Tristate S0...S8	Tristate S0...S9	Tristate S0...S11	Tristate S0...S12	Tristate S0...S13
pink	Latch	Latch	Latch	Latch	Latch
green	Direction	Direction	Direction	Direction	Direction
black	0 V	0 V	0 V	0 V	0 V
red	DC 5 V/ 10-30 V	DC 5 V/ 10-30 V	DC 5 V/ 10-30 V	DC 5 V/ 10-30 V	DC 5 V/ 10-30 V
brown	Alarm	Alarm	Alarm	Alarm	Alarm

ELECTRICAL CONNECTIONS (only AC 61 - Parallel)

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 59 / AC 61, starting page 226

Stainless Industrial types AC 59 / AC 61
Absolute Parallel

ORDERING INFORMATION

Type	Resolution [1,2,3]	Supply voltage	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AC59 **AC61**	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0017** 17 Bit ST **0360** 360 increments ST **0720** 720 increments ST **0412** 4 Bit MT + 12 Bit ST (AC 61) **0812** 8 Bit MT + 12 Bit ST (AC 61) **1212** 12 Bit MT + 12 Bit ST (AC 61)	**A** DC 5 V **E** DC 10 - 30 V	**Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**PB** Parallel binary **PG** Parallel Gray	**A** Cable, axial **B** Cable, radial

[1] Resolution 360 increments ST with Offset 76 (value range 76...435)
[2] Resolution 720 increments ST with Offset 152 (value range 152...871)
[3] AC59 only with ST (only AC 59)

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Absolute Profibus

Version AC 61 with bus cover

- Compact design
- Protection class IP67
- High corrosion resistance
- Robust design
- Resolution up to 26 Bit (14 Bit ST, 12 Bit MT)
- Bus cover
- Programmable: Resolution, Preset, Direction
- Output of speed, acceleration
- Applications: packaging machine for food and beverage, ship equipment (e.g. cranes, winches, cable laying ships), offshore applications

GENERAL INFORMATION

The absolute stainless steel encoders are available in the Versions AC 59 and AC 61.

- AC 59: drawn stainless steel housing, only together with cable outlet, no access to control elements
- AC 61: machined housing, possible with cable or bus cover, access to control elements (DIP switch, Reset switch)

TECHNICAL DATA
mechanical

Housing diameter	61.5 mm
Shaft diameter	9.52 mm / 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange 63.5 mm
Protection class shaft input (EN 60529)	IP67
Protection class housing (EN 60529)	IP67
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 6000 rpm (continuous), max. 10 000 rpm (short term)
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +85 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Stainless Steel
Weight	approx. 1180 g
Connection	Bus cover with 3 sealed cable exits

TECHNICAL DATA
electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage	DC 10-30 V
Current w/o load typ.	220 mA (ST), 250 mA (MT)
EMC	EN 61326: Class A
Resolution singleturn	10 - 14 Bit
Resolution multiturn	12 Bit

Absolute Profibus

TECHNICAL DATA
electrical (continued)

Output code	Binary
Drives	RS 485
Linearity	± ½ LSB (± 1 LSB for resolution 13, 14, 25, 26 Bit)
Profile/ protocol	Profibus DP with encoder profile class C2 (parameterizable)
Programmable	Resolution, Preset, Direction
Integrated special functions	Speed, Acceleration, Operating time
Baud rate	is automatically set within a range of 9.6 KBaud through 12 MBaud
Device address	adjustable with DIP switches, via fieldbus (optional)
Bus termination resistor	set via DIP switches

STARTUP (The encoder can be easily and quickly installed and programmed with the GSD file.)

ELECTRICAL CONNECTIONS
Bus cover with 3 sealed cable exits

Connecting Terminal	Signal
1	UB in (DC 10 - 30V)
2	0 V in
3	UB out
4	0 V out
5	B in
6	A in
7	B out
8	A out

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 61, starting page 226

Absolute Profibus

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft	Interface	Connection
AC61	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST	**E** DC 10 - 30 V	**Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**DP** Profibus	**Z** Bus cover with 3 sealed cable exits

ACCESSORIES

see chapter "Accessories"

Absolute CANopen

Version AC 61 with bus cover

- Compact design
- Protection class IP67
- High corrosion resistance
- Robust design
- Resolution up to 28 Bit (16 Bit ST, 12 Bit MT)
- Versions with cable or demountable bus cover
- Programmable: Resolution, Preset, Offset, Direction
- Output of speed, acceleration
- Applications: packaging machine for food and beverage, ship equipment (e.g. cranes, winches, cable laying ships), offshore applications

GENERAL INFORMATION

The absolute stainless steel encoders are available in the Versions AC 59 and AC 61.

- AC 59: drawn stainless steel housing, only together with cable outlet, no access to control elements
- AC 61: machined housing, possible with cable or bus cover, access to control elements (DIP switch, Reset switch)

TECHNICAL DATA
mechanical

Housing diameter	61.5 mm
Shaft diameter	9.52 mm / 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange 63.5 mm
Protection class shaft input (EN 60529)	IP67
Protection class housing (EN 60529)	IP67
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 6000 rpm (continuous), max. 10 000 rpm (short term)
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +85 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Stainless Steel
Weight	approx. 980 g with 1.5 m cable / 1180 g with bus cover
Connection	Cable, axial or radial Bus cover with 3 sealed cable exits

TECHNICAL DATA
electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage	DC 10-30 V
Current w/o load typ.	220 mA (ST), 250 mA (MT)
Resolution singleturn	10 - 16 Bit
Resolution multiturn	12 Bit
Output code	Binary

TECHNICAL DATA
electrical (continued)

Linearity	± ½ LSB (± 1 LSB for resolution 13, 14, 25, 26 Bit)
Profile/ protocol	CANopen according to DS 301 with profile DSP 406, programmable encoder according class C2
Programmable	Resolution, Preset, Offset, Direction
Integrated special functions	Speed, Acceleration, Limit values, Operating time
Baud rate	set via DIP switches within a range of 10 through 1000 Kbit/s
Bus termination resistor	set via DIP switches
Updating of values	every millisecond (adjustable), on request
Basic identifier	set via DIP switches

ELECTRICAL CONNECTIONS
12 pole / cable

TPE cable	Cable pairs	Signal
yellow	Pair 1	CAN in+
green		CAN in -
pink	Pair 2	CAN out+
grey		CAN out -
blue		CAN GND in
brown		CAN GND out
white	Pair 3	UB in
brown		0 V in
screen	screen	screen

ELECTRICAL CONNECTIONS
Bus cover with 3 sealed cable exits

Connecting block KL 1 (10 pole)	
No.	**Signal name**
1	UB in (DC 10-30V)
2	0 V in
3	CAN in - (dominant L)
4	CAN in + (dominant H)
5	CAN GND in
6	CAN GND out
7	CAN out + (dominant H)
8	CAN out - (dominant L)
9	0 V out
10	UB out (DC 10-30V)

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 61, starting page 226

Stainless Industrial types AC 61
Absolute CANopen

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AC61	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0016** 16 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST **1216** 12 Bit MT + 16 Bit ST	**E** DC 10 - 30 V	**Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**OL** CANopen	**A** Cable, axial **B** Cable, radial **Z** Bus cover with 3 sealed cable exits

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Absolute CANlayer2


Version AC 61 with bus cover

- Compact design
- Protection class IP67
- High corrosion resistance
- Robust design
- Resolution up to 26 Bit (14 Bit ST, 12 Bit MT)
- Versions with cable or demountable bus cover
- Applications: packaging machine for food and beverage, ship equipment (e.g. cranes, winches, cable laying ships), offshore applications

GENERAL INFORMATION

The absolute stainless steel encoders are available in the Versions AC 59 and AC 61.
- AC 59: drawn stainless steel housing, only together with cable outlet, no access to control elements
- AC 61: machined housing, possible with cable or bus cover, access to control elements (DIP switch, Reset switch)

TECHNICAL DATA mechanical

Housing diameter	61.5 mm
Shaft diameter	9.52 mm / 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange 63.5 mm
Protection class shaft input (EN 60529)	IP67
Protection class housing (EN 60529)	IP67
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 6000 rpm (continuous), max. 10 000 rpm (short term)
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +85 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Stainless Steel
Weight	approx. 980 g with 1.5 m cable / 1180 g with bus cover
Connection	Cable, axial or radial Bus cover with 3 sealed cable exits

TECHNICAL DATA electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage	DC 10-30 V
Current w/o load typ.	220 mA (ST), 250 mA (MT)
Resolution singleturn	10 - 14 Bit
Resolution multiturn	12 Bit
Output code	Binary
Linearity	± ½ LSB (± 1 LSB for resolution 13, 14, 25, 26 Bit)

Stainless Industrial types AC 61

Absolute CANlayer2

TECHNICAL DATA electrical (continued)

Profile/ protocol	CAN 2.0 A
Programmable	Direction, Limit values
Baud rate	set via DIP switches within a range of 10 through 1000 Kbit/s
Bus termination resistor	set via DIP switches
Updating of values	every millisecond
Basic identifier	set via DIP switches

ELECTRICAL CONNECTIONS 12 pole / cable

TPE cable	Cable pairs	Signal
yellow	Pair 1	CAN in+
green		CAN in -
pink	Pair 2	CAN out+
grey		CAN out -
blue		CAN GND in
brown		CAN GND out
white	Pair 3	UB in
brown		0 V in
screen	screen	screen

ELECTRICAL CONNECTIONS Bus cover with 3 sealed cable exits

Connecting block KL 1 (10 pole)	
No.	**Signal name**
1	UB in (DC 10-30V)
2	0 V in
3	CAN in - (dominant L)
4	CAN in + (dominant H)
5	CAN GND in
6	CAN GND out
7	CAN out + (dominant H)
8	CAN out - (dominant L)
9	0 V out
10	UB out (DC 10-30V)

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 61, starting page 226

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AC61	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST	**E** DC 10 - 30 V	**Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**CL** CANLayer2	**A** Cable, axial **B** Cable, radial **Z** Bus cover with 3 sealed cable exits

Absolute CANlayer2

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Absolute DeviceNet

Version AC 61 with bus cover

- Compact design
- Protection class IP67
- High corrosion resistance
- Robust design
- Resolution up to 26 Bit (14 Bit ST, 12 Bit MT)
- Bus cover
- Programmable: Resolution, Preset, Direction
- Allan-Bradley compatible
- Applications: packaging machine for food and beverage, ship equipment (e.g. cranes, winches, cable laying ships), offshore applications

GENERAL INFORMATION

The absolute stainless steel encoders are available in the Versions AC 59 and AC 61.
- AC 59: drawn stainless steel housing, only together with cable outlet, no access to control elements
- AC 61: machined housing, possible with cable or bus cover, access to control elements (DIP switch, Reset switch)

TECHNICAL DATA
mechanical

Housing diameter	61.5 mm
Shaft diameter	9.52 mm / 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange 63.5 mm
Protection class shaft input (EN 60529)	IP67
Protection class housing (EN 60529)	IP67
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 6000 rpm (continuous), max. 10 000 rpm (short term)
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +85 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Stainless Steel
Weight	approx. 1180 g
Connection	Bus cover with 2 sealed cable exits

TECHNICAL DATA
electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage	DC 10-30 V
Current w/o load typ.	220 mA (ST), 250 mA (MT)
EMC	Noise emission according to EN 50081-2 Immunity to interference according to EN 50082-2
Resolution singleturn	10 - 14 Bit
Resolution multiturn	12 Bit

TECHNICAL DATA
electrical (continued)

Output code	Binary
Interface	CAN High-Speed according to ISO/DIS 11898 CAN specification 2.0 A (11-Bit-Identifier)
Linearity	± ½ LSB (± 1 LSB for resolution 13, 14, 25, 26 Bit)
Profile/ protocol	DeviceNet according to Rev. 2.0, progammable encoder
Programmable	Resolution, Preset, Direction
Baud rate	set via DIP switches to 125, 250, 500 KBaud
Bus termination resistor	set via DIP switches
Updating of values	every 5 Milliseconds
MAC-ID	set via DIP switches

RECOMMENDED DATA TRANSFER Lead type A

Shaft resistance	135...165 Ω (3...20MHz)
Operating capacity	< 30pF/m
Loop impedance	< 110 Ω/km
Strand diameter	> 0.64 mm
Strand cross section	> 0.34 mm ²

Transfer speeds

Segment length	kbit/s
500 m	125
250 m	250
100 m	500

STARTUP (the encoder can be easily and quickly installed and programmed with the EDS file)

ELECTRICAL CONNECTIONS
Bus cover with 2 sealed cable exits

Terminals	
No.	**Signal name**
1	UB in (DC 10 - 30V)
2	0 V in
3	CAN-L
4	CAN-H
5	DRAIN
6	DRAIN
7	DRAIN
8	CAN-L
9	0 V out
10	UB out (DC 10 - 30V)

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 61, starting page 226

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AC61	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST	**E** DC 10 - 30 V	**Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**VD** DeviceNet	**Z** Bus cover with 2 sealed cable exits

ACCESSORIES

see chapter "Accessories"

Absolute Interbus

Version AC 61 with bus cover

- Compact design
- Protection class IP67
- High corrosion resistance
- Robust design
- Resolution up to 24 Bit (12 Bit ST, 12 Bit MT)
- Resolution programmable
- Preset (K3)
- Direction (K3)
- Bus cover
- Applications: packaging machine for food and beverage, ship equipment (e.g. cranes, winches, cable laying ships), offshore applications

GENERAL INFORMATION

The absolute stainless steel encoders are available in the Versions AC 59 and AC 61.

- AC 59: drawn stainless steel housing, only together with cable outlet, no access to control elements
- AC 61: machined housing, possible with cable or bus cover, access to control elements (DIP switch, Reset switch)

TECHNICAL DATA mechanical

Housing diameter	61.5 mm
Shaft diameter	9.52 mm / 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange 63.5 mm
Protection class shaft input (EN 60529)	IP67
Protection class housing (EN 60529)	IP67
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 6000 rpm (continuous), max. 10 000 rpm (short term)
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +70 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Stainless Steel
Weight	approx. 1180 g
Connection	Bus cover with 3 sealed cable exits

TECHNICAL DATA electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage	DC 10-30 V
Current w/o load typ.	220 mA (ST, recommended external fuse: T 0.25 A), 250 mA (MT, recommended external fuse: T 0.25 A)
EMC	Noise emission according to EN 50081-2 Immunity to interference according to EN 50082-2

Stainless Industrial types AC 61

Absolute Interbus

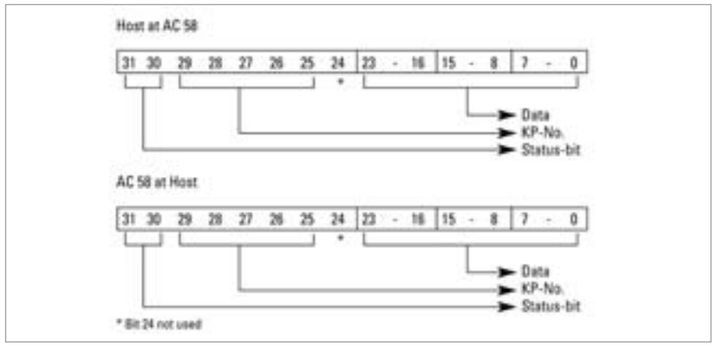
TECHNICAL DATA electrical (continued)

Resolution singleturn	10 - 12 Bit
Resolution multiturn	12 Bit
Output code	32 Bit binary
Linearity	± ½ LSB
Profile/ protocol	ENCOM-Profil K3 = ID-Code 37, K2 = ID-Code 36
Programmable	Resolution, Preset, Offset, Direction
Output current [1]	max. 4.5 A for bus cover with 2x M23 (recommended external fuse: T 4.5 A) max. 2 A for all other connections (recommended external fuse: T 2 A)
Baud rate	500 KBaud
Updating of values	every 600 µs

[1] Current with looped through voltage supply

DATA FORMAT Interbus K2/K3

	Differential signals (RS485) ENCOM profile K3, K2, 32 Bit, binary process data				
Data format	Sµpi-address	0	1	2	3
(as per Phoenix)	Byte-No.	3	2	1	0
ID-Code K2	36H (= 54 decimal)				
ID-Code K3	37H (= 55 decimal)				



PROGRAMMABLE FUNKTIONS for Interbus K3

Function (Programming directly via the bus through transfer of configuration parameters)	Preset values (manufacturer´s standard settings)	Customer-specific parameters
Code sequence for clockwise (cw) rotation	ascending	
Offset (KP-No. 05)	0	
Preset value (KP-No. 04)	0	
Scaling faktor (KP-No. 08)	1 [1]	

[1] maximum resolution

Absolute Interbus

ELECTRICAL CONNECTIONS
Bus cover with 3 sealed cable exits

Connection clamp (12 pole)	
1	UB +
2	GND
3	DI1+
4	DI1-
5	D01+
6	D01-
7	D02+
8	D02-
9	DI2+
10	DI2-
11	RBST
12	GND

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 61, starting page 226

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AC61	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST	**E** DC 10 - 30 V	**Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**I2** Interbus K2 **I3** Interbus K3	**Z** Bus cover with 3 sealed cable exits

ACCESSORIES

see chapter "Accessories"

Absolute SSI programmable

Version AC 61 with cable outlet

- Compact design
- Protection class IP67
- High corrosion resistance
- Robust design
- Resolution up to 29 Bit (17 Bit ST, 12 Bit MT)
- Versions with cable
- Parameterization: Resolution, code type, direction, output format, warning, alarm
- Applications: packaging machine for food and beverage, ship equipment (e.g. cranes, winches, cable laying ships), offshore applications

GENERAL INFORMATION

The absolute stainless steel encoders are available in the Versions AC 59 and AC 61.
- AC 59: drawn stainless steel housing, only together with cable outlet, no access to control elements
- AC 61: machined housing, possible with cable or bus cover, access to control elements (DIP switch, Reset switch)

TECHNICAL DATA
mechanical

Housing diameter	61.5 mm
Shaft diameter	9.52 mm / 10 mm (Solid shaft)
Flange (Mounting of housing)	Square flange 63.5 mm
Protection class shaft input (EN 60529)	IP67
Protection class housing (EN 60529)	IP67
Shaft load axial / radial	40 N / 60 N
Max. speed	max. 6000 rpm (continuous), max. 10 000 rpm (short term)
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Operating temperature	-40 °C ... +70 °C
Storage temperature	-40 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	Stainless Steel
Weight	approx. 980 g with 1.5 m cable
Connection	Cable, axial or radial

TECHNICAL DATA
electrical

Supply voltage	DC 10-30 V
Current w/o load typ.	250 mA (ST / MT)
Resolution singleturn	10 - 17 Bit
Resolution multiturn	12 Bit
Output code	Binary, Gray
Drives	Clock and Data / RS422
Parametrization	Resolution, Code type, Direction, Output format, Warning, Alarm

TECHNICAL DATA
electrical (continued)

Control inputs	Direction, Preset 1, Preset 2
Alarm output	Alarm bit
Status LED	Green = ok, red = alarm

RECOMMENDED DATA TRANSFER RATE bei SSI

The max. data transfer rate depends on the cable length. For Clock / $\overline{\text{Clock}}$ and Data / $\overline{\text{Data}}$ please use twisted pairs. Use shielded cable.

Cable length	Frequency
< 50 m	< 400 kHz
< 100 m	< 300 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz

SYNCHRONOUS-SERAL TRANSFER (SSI)

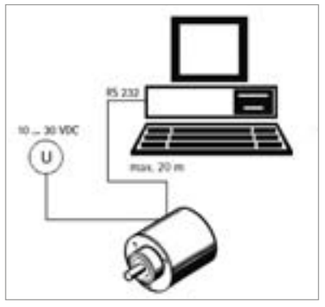
A clock brush is applied at the SSI interface, causing the encoder data to be serially clocked out. With each new clock brush (min. interval 30 ms) new data is readout. The following main parameters are programmable:

- Preset: Software-Preset and via input/ pushbutton settable presets (can be inactivated)
- Offset: Relative shifting of actual encoder value.
- Scaling: The actual value of the encoder is multiplied with the factor < 1(direct entry, increments per measuring distance or per revolution).
- Direction of rotation: Can be changed via software or input (can be inactivated)
- Output formats SSI: Tree format or standard format (MSB oriented)
- Output code: The choices are Gray or binary code, integer or two's complement representation. Selection of significant bit between 16 and 24 Bit.

In addition, programming of max. 7 status bits is possible:

- up to 4 warning positions
- overspeed
- encoder standstill
- parity
- encoder error
- direction of rotation

PROGRAMMING with SSI



To program the absolute encoder you require a PC, the software WinSSI and the adapter cable. The encoder is connected to the power supply and the serial interface of your PC with the adapter cable. Using the menue-assisted programme you can then configure the encoder according to the parameters you require.

Stainless Industrial types AC 61
Absolute SSI programmable

OUTPUT FORMAT SSI, MSB oriented, Multiturn

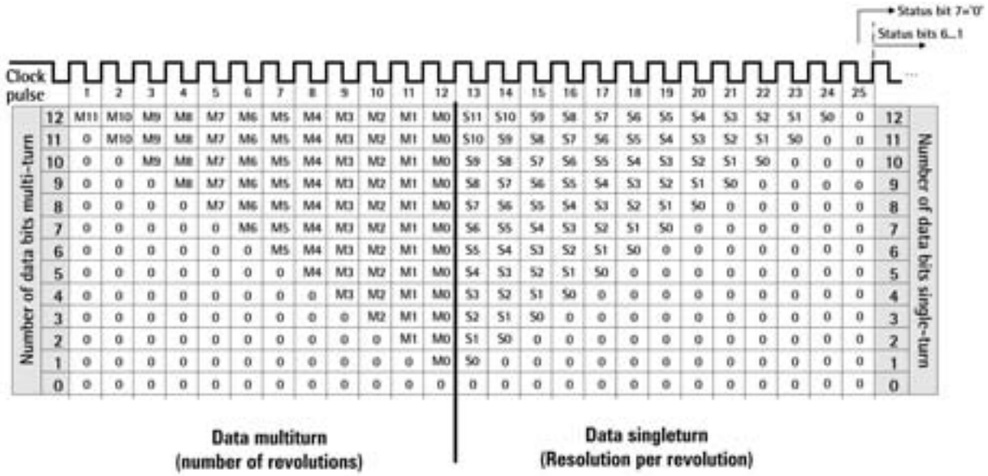
Clock pulse	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Number of data bits 24	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0
23	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0
22	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0
21	M8	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0
20	M7	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0
19	M6	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0
18	M5	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0
17	M4	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0
16	M3	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0
15	M2	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0
14	M1	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0
13	M0	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0
12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0
11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Status bits 1 ... 7

OUTPUT FORMATS SSI, MSB oriented, Multiturn (not scaleable)

Clock pulse	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Number of data bits 32	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0
32	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0
32	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0
31	M8	M7	M6	M5	M4	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0
30	M7	M6	M5	M4	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0
29	M6	M5	M4	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0
28	M5	M4	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0
27	M4	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0
26	M3	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0
25	M2	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0
24	M1	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0
23	M0	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0
22	S21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0
21	S20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0
20	S19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0
19	S18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	S17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	S16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	S15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	S14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	S13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	S8	S7	S6	S5	S4	S3	S2	S1	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

OUTPUT FORMAT SSI, tree format



ELECTRICAL CONNECTIONS
12 pole / cable

Cable Colour	Signal
green	Clock
yellow	Clock
pink	Data
grey	Data
brown	RS 232 TxD
white	RS 232 RxD
black	0 V signal output
blue	Direction
red	Preset 1
violet	Preset 2
white [1]	DC 10 - 30 V
brown [1]	0 V (supply voltage)

[1] bigger cross section 0.5 mm [2]

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AC 61, starting page 226

Stainless Industrial types AC 61
Absolute SSI programmable

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft	Interface	Connection
☐	☐	☐	☐	☐	☐
AC61	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST **1217** 12 Bit MT + 17 Bit ST higher resolution on request	**E** DC 10 - 30 V	**Q.76** Square, IP67, 9.52 mm **Q.72** Square, IP67, 10 mm	**SP** SSI programmable	**A** Cable, axial **B** Cable, radial

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

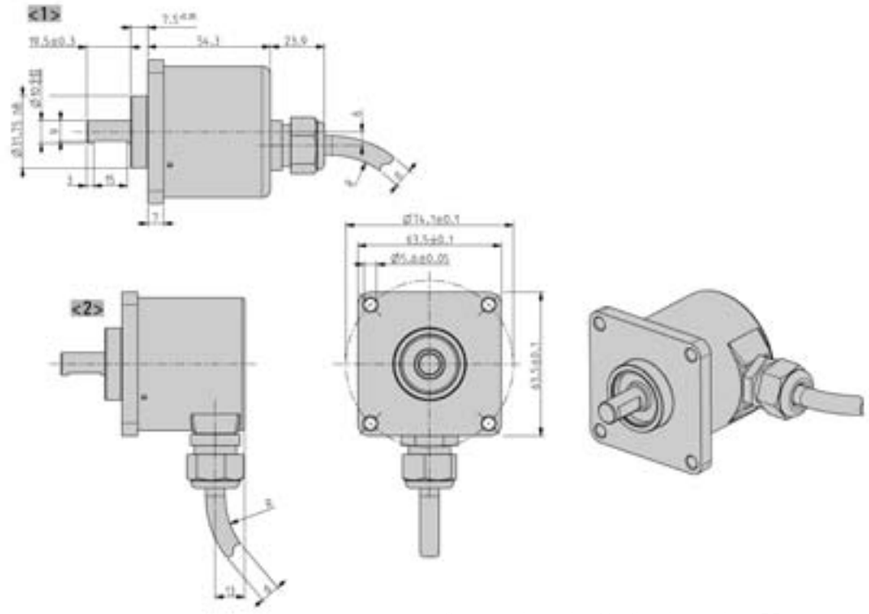
Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

DIMENSIONED DRAWINGS

AC 59 Connection cable "A"/ "B"
Dimensions in mm

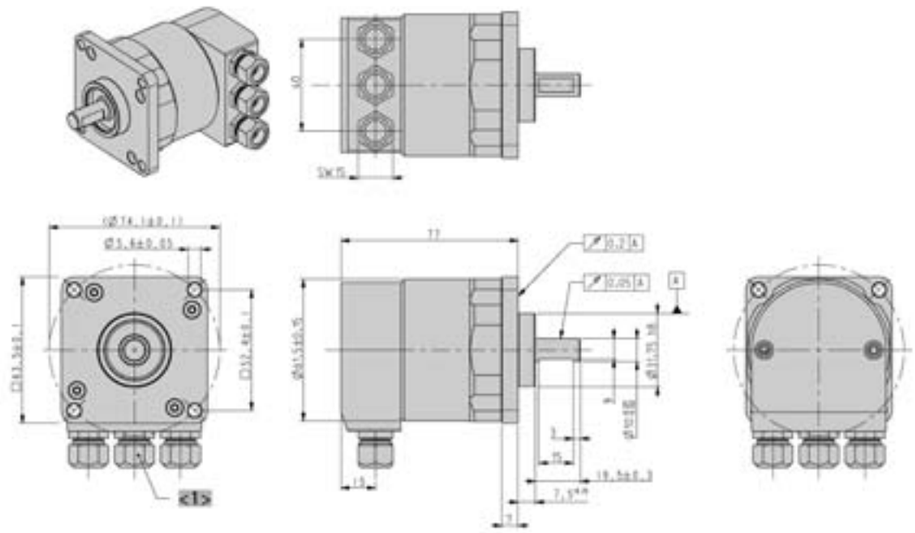


<1> Connection cable "A"
<2> Connection cable "B"
Cable bending radius R for flexible installation ≥ 15 x cable diameter

Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d BiSS/SSI/SSI-P: 7,1 $^{+1,2}$
Cable Ø d ST-P: 7,8 $^{+0,9}$

DIMENSIONED DRAWINGS (continued)

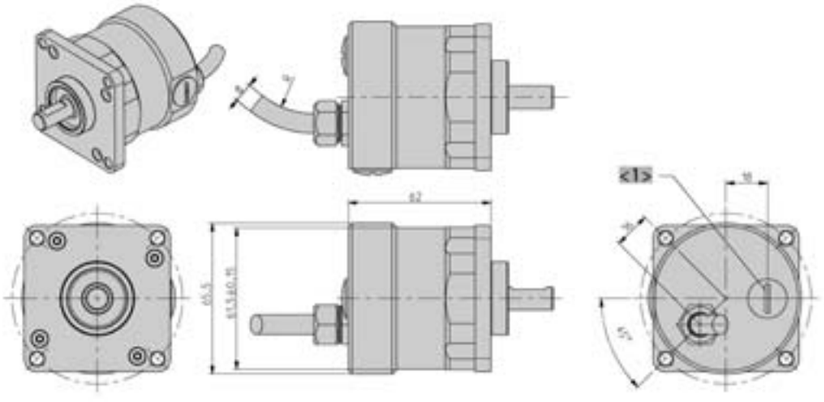
AC 61 Connection cable "Z"
Interface: Profibus. CANopen. CANlaver2. DeviceNet. Interbus



<1> Obsolete with DeviceNet

Dimensions in mm

AC 61 Connection cable "A"
Interface: BiSS. SSI. ST-/ MT-Parallel. SSI-P



<1> Preset
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d BiSS/SSI/SSI-P: 7,1 $^{+1,2}$

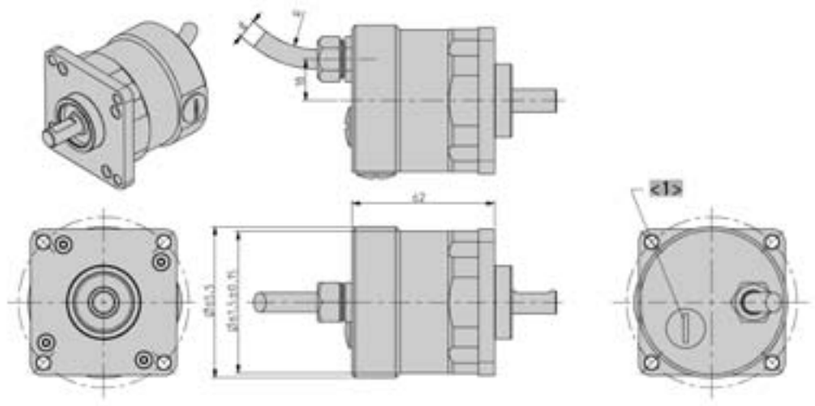
Cable Ø d ST-P: 7,8 $^{+0,9}$
Cable Ø d MT-P: 9,3 +1,3
Cable Ø d Fieldbus: 7,1 $^{+1,2}$

Dimensions in mm

Absolute Dimensioned Drawings

DIMENSIONED DRAWINGS (continued)

AC 61 Connection cable "A"
Interface: CANopen, CANlayer2

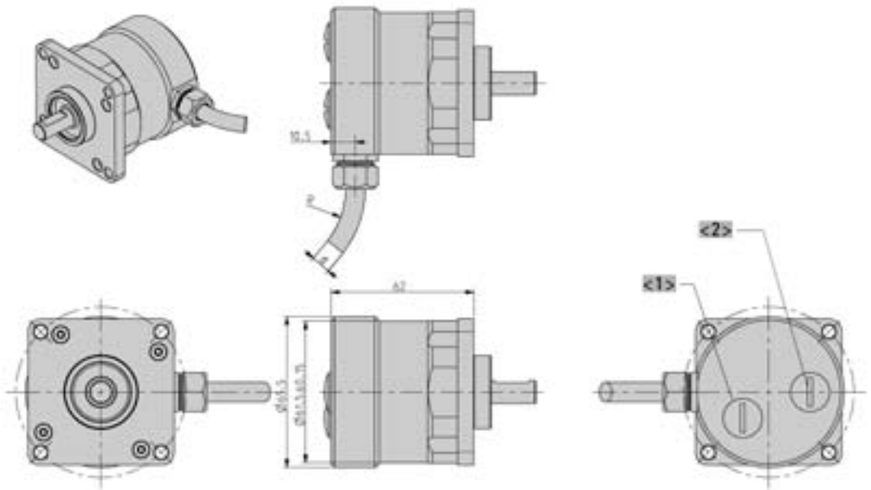


<1> Settings
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter
Cable Ø d BiSS/SSI/SSI-P: 7,1 +1,2

Cable Ø d ST-P: 7,8 +0,9
Cable Ø d MT-P: 9,3 +1,3
Cable Ø d Fieldbus: 7,1 +1,2

Dimensions in mm

AC 61 Connection cable "B"



<1> Settings CAN/ CANopen
<2> Preset BiSS, SSI, SSI-P, MT-Parallel
Cable bending radius R for flexible installation ≥ 15 x cable diameter
Cable bending radius R for fixed installation ≥ 7.5 x cable diameter

Cable Ø d BiSS/SSI/SSI-P: 7,1 +1,2
Cable Ø d ST-P: 7,8 +0,9
Cable Ø d MT-P: 9,3 +1,3
Cable Ø d Fieldbus: 7,1 +1,2

Dimensions in mm

EEx Industrial Types

The absolute encoder line ACURO® and incremental encoder line "RI" are available with explosion proof enclosure "d" under AX70 or AX71 (stainless steel) for absolute encoders and RX70 or RX71 (stainless steel) for incremental encoders.

They are approved by PTB and documented via "Declaration of Conformity" to meet the requirements of safety and health according to EN 60079-0:2006, EN 60079-1:2007, EN 61241-0:2006 and EN 61241-1:2004. Therefore it's usuage is permitted in explosive areas, code "Ex II 2 G EX d II C T6 resp.T4" and "Ex II 2 D tD A21 IP6X T85°C resp. T135°C".

For applications under tough environmental conditions and food industry the stainless steel version AX71 and RX71 are available.

Examples of applications for explosion proof encoders:

- Draw works
- Other Oil field applications
- Petro chemistry
- Enamelling production line
- Bottling machines
- Mixers
- Silo works

Incremental

RX 70 - Aluminium

RX 71 - Stainless steel

- Explosion proof class II according to EX II 2 G/D EEX d IIC T6/T4
- Highest working reliability
- Resolution up to 10.000 ppr (RX 70TI)
- Stainless steel version RX71 available (RX 70TI)
- Applications: enamelling production line, surfacing machines, bottling machines, mixers, silo works
- Stainless steel housing (RX 71TI)
- Resolution up to 10 000 ppr (RX 71TI)

NUMBER OF PULSES

1 / 2 / 3 / 4 / 5 / 10 / 15 / 20 / 25 / 30 / 35 / 40 / 45 / 50 / 60 / 64 / 70 / 72 / 80 / 100 / 125 / 128 / 144 / 150 / 180 / 200 / 230 / 250 / 256 / 300 / 314 / 350 / 360 / 375 / 400 / 460 / 480 / 500 / 512 / 600 / 625 / 635 / 720 / 750 / 900 / 1000 / 1024 / 1200 / 1250 / 1500 / 1600 / 1800 / 2000 / 2048 / 2500 / 3000 / 3480 / 3600 / 3750 / 3968 / 4000 / 4096 / 4800 / 5000 / 5400 / 6000 / 7200 / 7680 / 8000 / 8192 / 9000 / 10000
Other number of pulses on request

EX-CLASSIFICATION

The incremental shaft encoder is available in explosion proof design with explosion proof enclosure "d" under RX 70 and RX 71 (stainless steel).
The PTB has assured with the Declaration of Conformity that the RX 70 / 71 meets the requirements of safety and health according to EN 50014 and EN 50018. Therefore it is approved in explosive areas, code "Ex II 2 G/D E Ex d II C T4/T6 IP65/ IP66 135°C resp. 85°C".
For applications under tough environmental conditions and food industry the stainless steel version RX 71 is available.

TECHNICAL DATA
mechanical

Housing diameter	70 mm
Shaft diameter	10 mm (Solid shaft)
Flange (Mounting of housing)	Clamping flange
Protection class shaft input (EN 60529) [1]	T4: IP64 or IP67 T6: IP64
Protection class housing (EN 60529)	T4: IP65 or IP67 T6: IP65
Shaft load axial / radial	50 N / 100 N
Max. speed	T4: max. 10 000 rpm T6: max. 6000 rpm
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²

EEx Industrial types RX 70TI / RX 71TI

Incremental

TECHNICAL DATA
mechanical (continued)

Vibration resistance (DIN EN 60068-2-6)	10 g = 100 m/s² (10 ... 2000 Hz)
Shock resistance (DIN EN 60068-2-27)	100 g = 1000 m/s² (6 ms)
Ambient temperature	T4: -25 °C ... +60 °C T6: -25 °C ... +40 °C
Storage temperature	-25 °C ... +85 °C
Material shaft	Stainless Steel
Material housing	RX 70TI: Aluminum RX 71TI: Stainless Steel
Weight	RX 70TI: approx. 1.4 kg RX 71TI: approx. 4.8 kg
Connection [2, 3]	Cable, axial

[1] No dust explosion-proof certification for IP64
[2] Standard cable length: 5 m cable, other cable length on request
[3] Connection cable for fixed installation

TECHNICAL DATA
electrical

General design	as per DIN VDE 0160, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	RS422 + Sense (T): DC 5 V ±10 % RS422 + Alarm (R): ± 10% DC 5 V or DC 10 - 30 V Push-pull (K), Push-pull antivalent (I): DC 10-30 V
Current w/o load typ.	40 mA (DC 5 V), 60 mA (DC 10 V), 30 mA (DC 24 V)
Max. pulse frequency	RS422: 300 kHz Push-pull: 200 kHz
Standard output versions [2, 3]	RS422 + Alarm (R): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$ RS422 + Sense (T): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, Sense Push-pull (K): A, B, N, $\overline{Alarm}$ Push-pull complementary (I): A, B, N, $\overline{A}$, $\overline{B}$, $\overline{N}$, $\overline{Alarm}$
Pulse width error	± max. 25° electrical
Number of pulses	1 ... 10 000
Output current	RS 422: ±30 mA Push-pull with short-circuit protection: 30 mA (DC 10 - 30 V)
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Pulse duty factor	1:1

[1] Pole protection with supply voltage DC 10 - 30 V
[2] Output code "K" and "I": short-circuit-proof
[3] Output description and technical data see chapter "Technical basics"

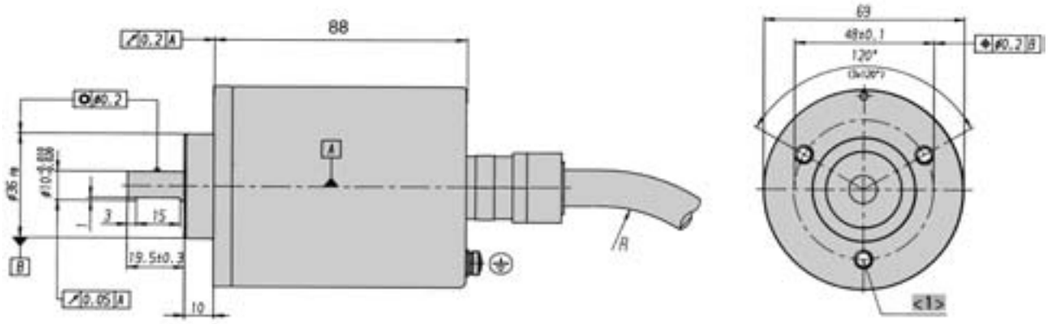
Incremental

ELECTRICAL CONNECTIONS
Cable TPE

Cable Colour	Cable No.	Output RS 422+ Sense (T)	RS 422+ Alarm (R)	push-pull (K)	push-pull complementary (I)
brown/green	12	DC 5 V	DC 5 / 10 - 30 V	DC 10 - 30 V	DC 10 - 30 V
white/green	11	GND	GND	GND	GND
blue	10	Sense V_{CC}			
white	9	Sense GND			
brown	1	Channel A	Channel A	Channel A	Channel A
green	2	Channel $\overline{A}$	Channel $\overline{A}$		Channel $\overline{A}$
grey	3	Channel B	Channel B	Channel B	Channel B
pink	4	Channel$\overline{B}$	Channel$\overline{B}$		Channel$\overline{B}$
red	5	Channel N	Channel N	Channel N	Channel N
black	6	Channel $\overline{N}$	Channel $\overline{N}$		Channel $\overline{N}$
violett	7		$\overline{Alarm}$	$\overline{Alarm}$	$\overline{Alarm}$
screen			Cable screen connected to housing		
Screw terminal			for additional connection of an earth conductor		

DIMENSIONED DRAWINGS

IP64

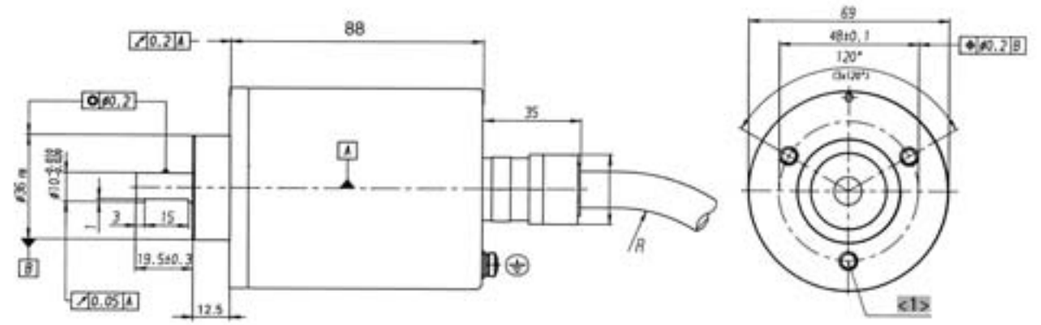


<1> mounting thread M6x12
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm
Dimensions in mm

Incremental

DIMENSIONED DRAWINGS (continued)

IP67



<1> mounting thread M6x12
Cable bending radius R for flexible installation ≥ 150 mm
Cable bending radius R for fixed installation ≥ 40 mm
Dimensions in mm

ORDERING INFORMATION

Type	Model	Number of pulses	Supply voltage [1,2]	Flange, Protection, Shaft [3]	Output	Connection
☐	☐	☐	☐	☐	☐	☐
RX70 **RX71** Stainless Steel	**TI** Incremental	**1 ... 10000**	**A** DC 5 V **E** DC 10 - 30 V	**K.42** Clamping, IP64, 10 mm **K.72** Clamping, IP67, 10 mm	**R** RS422 +Alarm **T** RS422 +Sense **K** Push-pull **I** Push-pull complementary	**E** TPE cable, axial

[1] DC 5 V: only with output "T", "R" available
[2] DC 10 - 30 V: only with output "K", "I", "R" available
[3] No dust explosion-proof certification (D) for IP64

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. Further cable lengths on request.

Code	Cable length
-F0 / without code	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

ACCESSORIES

see chapter "Accessories"

Absolute SSI

Version AX 70 - Aluminium

Version AX 71 - Stainless Steel

- ATEX certification for gas and dust explosion proof
- Same electrical performance as ACURO industry
- Protection class up to IP67
- Diameter only 70 mm
- Robust design
- Also available with stainless steel housing (AX 70 - SSI)
- Resolution up to 29 Bit (17 Bit ST, 12 Bit MT)
- Applications: enamelling production line, petro chemistry, bottling machines, mixers, silo works, mills

EX-CLASSIFICATION

The absolute shaft encoder line ACURO is available in explosion proof design with explosion proof enclosure "d" under AX 70 and AX 71 (stainless steel).
The PTB has assured with the Declaration of Conformity that the AX 70 / 71 meets the requirements of safety and health according to EN 50014 and EN 50018. Therefore it is approved in explosive areas, code "Ex II 2 G/D E Ex d II C T4/T6 IP65/ IP66 135°C resp. 85°C".
For applications under tough environmental conditions and food industry the stainless steel version AX 71 is available.

TECHNICAL DATA
mechanical

Housing diameter	70 mm
Shaft diameter	10 mm (Solid shaft)
Flange (Mounting of housing)	Clamping flange
Protection class shaft input (EN 60529) [1]	T4: IP64 or IP67 T6: IP64
Protection class housing (EN 60529)	T4: IP65 or IP67 T6: IP65
Shaft load axial / radial	40 N / 100 N
Max. speed	T4: max. 10 000 rpm T6: max. 6000 rpm
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Ambient temperature	T4: -40 °C ... +60 °C T6: -40 °C ... +40 °C
Storage temperature	-25 °C ... +85 °C

Absolute SSI

TECHNICAL DATA
mechanical (continued)

Material shaft	Stainless Steel
Material housing	AX 70: Aluminum AX 71: Stainless Steel
Weight	AX 70: approx. 1.4 kg AX 71: approx. 4.8 kg
Connection	Cable, axial

[1] No dust explosion-proof (D) for IP64

TECHNICAL DATA
electrical

Supply voltage	DC 10-30 V
Current w/o load typ.	220 mA (ST), 250 mA (MT)
Resolution singleturn	10 - 17 Bit
Resolution multiturn	12 Bit
Output code	Binary, Gray
Drives	Clock and Data / RS422
Control inputs	$\overline{\text{Direction}}$
Alarm output	Alarm bit (SSI Option)

RECOMMENDED DATA TRANSFER RATE
bei SSI

The max. data transfer rate depends on the cable length. For Clock / $\overline{\text{Clock}}$ and Data / $\overline{\text{Data}}$ please use twisted pairs. Use shielded cable.

Cable length	Frequency
< 50 m	< 400 kHz
< 100 m	< 300 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz

ELECTRICAL CONNECTIONS
Cable

Colour	No.	SSI
white 0.14 mm	12	DC 10 ... 30 V
brown 0.14 mm	11	0 V supply voltage
green	10	$\overline{\text{Clock}}$
yellow	9	Clock
grey	8	$\overline{\text{Data}}$
pink	7	Data
blue	3	$\overline{\text{Direction}}$
black	4	0 V signal output

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AX 70 / AX 71, starting page 246

Absolute SSI

ORDERING INFORMATION

Type	Resolution [1, 2, 3]	Supply voltage	Flange, Protection, Shaft [4, 5]	Interface	Connection
☐	☐	☐	☐	☐	☐
AX70 **AX71**	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0017** 17 Bit ST **0360** 360 increments ST **0720** 720 increments ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST higher resolution on request	**E** DC 10 - 30 V	**K.42** Clamping, IP64, 10 mm **K.72** Clamping, IP67, 10 mm	**SB** SSI Binary **SG** SSI Gray	**A** Cable, axial

[1] Resolution 360 increments ST with Offset 76 (value range 76...435)
[2] Resolution 720 increments ST with Offset 152 (value range 152...871)
[3] When resolution > 14 Bit: max. clock frequency 178´kHz
[4] Dust explosion-proof certification (D) only for IP67
[5] IP67 only with temperature class T4

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. Further cable lengths on request.

Code	Cable length
-F0 / without code	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

ACCESSORIES

see chapter "Accessories"

Absolute Profibus

Version AX 70 - Aluminium

Version AX 71 - Stainless Steel

- ATEX certification for gas and dust explosion proof
- Same electrical performance as ACURO industry
- Protection class up to IP67
- Diameter only 70 mm
- Robust design
- Also available with stainless steel housing (AX 70 - Profibus)
- Resolution up to 26 Bit (14 Bit ST, 12 Bit MT)
- Applications: enamelling production line, petro chemistry, bottling machines, mixers, silo works, mills

EX-CLASSIFICATION

The absolute shaft encoder line ACURO is available in explosion proof design with explosion proof enclosure "d" under AX 70 and AX 71 (stainless steel).
The PTB has assured with the Declaration of Conformity that the AX 70 / 71 meets the requirements of safety and health according to EN 50014 and EN 50018. Therefore it is approved in explosive areas, code "Ex II 2 G/D E Ex d II C T4/T6 IP65/ IP66 135°C resp. 85°C".
For applications under tough environmental conditions and food industry the stainless steel version AX 71 is available.

TECHNICAL DATA
mechanical

Housing diameter	70 mm
Shaft diameter	10 mm (Solid shaft)
Flange (Mounting of housing)	Clamping flange
Protection class shaft input (EN 60529) [1]	T4: IP64 or IP67 T6: IP64
Protection class housing (EN 60529)	T4: IP65 or IP67 T6: IP65
Shaft load axial / radial	40 N / 100 N
Max. speed	T4: max. 10 000 rpm T6: max. 6000 rpm
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Ambient temperature	T4: -40 °C ... +60 °C T6: -40 °C ... +40 °C
Storage temperature	-25 °C ... +85 °C

TECHNICAL DATA
mechanical (continued)

Material shaft	Stainless Steel
Material housing	AX 70: Aluminum AX 71: Stainless Steel
Weight	AX 70: approx. 1.4 kg AX 71: approx. 4.8 kg
Connection	Cable, axial

[1] No dust explosion-proof (D) for IP64

TECHNICAL DATA
electrical

Supply voltage	DC 10-30 V
Current w/o load typ.	220 mA (ST), 250 mA (MT)
Resolution singleturn	10 - 14 Bit
Resolution multiturn	12 Bit
Output code	Binary
Profile/ protocol	Profibus DP with encoder profile class C2 (parameterizable)
Parametrization	Resolution, Preset, Direction
Integrated special functions	Speed, Acceleration, Operating time
Baud rate	is automatically set within a range of 9.6 KBaud through 12 MBaud
Device address	set via Bus
Bus termination resistor	external mounting

ELECTRICAL CONNECTIONS
Cable

Color	Profibus
yellow	B in
green	A in
pink	B out
grey	A out
blue	GND1 (M5V [1])
brown	VCC1 (P5V [1])
white 0.5 mm	DC 10 ... 30 V
brown 0.5 mm	0 V
Screen	Screen connected to encoder housing

[1] used for power supply for an external bus termination resistor

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AX 70 / AX 71, starting page 246

EEx Industrial types AX 70 / AX 71
Absolute Profibus

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft [1, 2]	Interface	Connection
☐	☐	☐	☐	☐	☐
AX70 **AX71**	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST	**E** DC 10 - 30 V	**K.42** Clamping, IP64, 10 mm **K.72** Clamping, IP67, 10 mm	**DP** Profibus	**A** Cable, axial

[1] Dust explosion-proof certification (D) only for IP67
[2] IP67 only with temperature class T4

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. Further cable lengths on request.

Code	Cable length
-F0 / without code	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

ACCESSORIES

see chapter "Accessories"

Absolute CANopen

Version AX 70 - Aluminium

Version AX 71 - Stainless Steel

- ATEX certification for gas and dust explosion proof
- Same electrical performance as ACURO industry
- Protection class up to IP67
- Diameter only 70 mm
- Robust design
- Also available with stainless steel housing (AX 70 - CANopen)
- Resolution up to 26 Bit (14 Bit ST, 12 Bit MT)
- Applications: enamelling production line, petro chemistry, bottling machines, mixers, silo works, mills

EX-CLASSIFICATION

The absolute shaft encoder line ACURO is available in explosion proof design with explosion proof enclosure "d" under AX 70 and AX 71 (stainless steel).
The PTB has assured with the Declaration of Conformity that the AX 70 / 71 meets the requirements of safety and health according to EN 50014 and EN 50018. Therefore it is approved in explosive areas, code "Ex II 2 G/D E Ex d II C T4/T6 IP65/ IP66 135°C resp. 85°C".
For applications under tough environmental conditions and food industry the stainless steel version AX 71 is available.

TECHNICAL DATA
mechanical

Housing diameter	70 mm
Shaft diameter	10 mm (Solid shaft)
Flange (Mounting of housing)	Clamping flange
Protection class shaft input (EN 60529) [1]	T4: IP64 or IP67 T6: IP64
Protection class housing (EN 60529)	T4: IP65 or IP67 T6: IP65
Shaft load axial / radial	40 N / 100 N
Max. speed	T4: max. 10 000 rpm T6: max. 6000 rpm
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Ambient temperature	T4: -40 °C ... +60 °C T6: -40 °C ... +40 °C
Storage temperature	-25 °C ... +85 °C

Absolute CANopen

TECHNICAL DATA
mechanical (continued)

Material shaft	Stainless Steel
Material housing	AX 70: Aluminum AX 71: Stainless Steel
Weight	AX 70: approx. 1.4 kg AX 71: approx. 4.8 kg
Connection	Cable, axial

[1] No dust explosion-proof (D) for IP64

TECHNICAL DATA
electrical

Supply voltage	DC 10-30 V
Current w/o load typ.	250 mA (ST / MT)
Resolution singleturn	10 - 14 Bit
Resolution multiturn	12 Bit
Output code	Binary
Profile/ protocol	CANopen according to DS 301 with profile DSP 406, programmable encoder according class C2
Parametrization	Resolution, Preset, Offset, Direction
Integrated special functions	Speed, Acceleration, Rotery axis, Limit values, Operating time
Bus termination resistor	external mounting

ELECTRICAL CONNECTIONS
Cable

Farbe	CANopen
gelb	CAN in+
grün	CAN in-
rosa	CAN out+
grau	CAN out-
blau	CAN GND in
schwarz	CAN GND out
weiss 0.5 mm	UB in
braun 0.5 mm	0 V in
Schirm	Kabelschirm mit Gebergehäuse verbunden

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AX 70 / AX 71, starting page 246

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft [1,2]	Interface	Connection
☐	☐	☐	☐	☐	☐
AX70 **AX71**	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST	**E** DC 10 - 30 V	**K.42** Clamping, IP64, 10 mm **K.72** Clamping, IP67, 10 mm	**OL** CANopen	**A** Cable, axial

[1] Dust explosion-proof certification (D) only for IP67
[2] IP67 only with temperature class T4

Absolute CANopen

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. Further cable lengths on request.

Code	Cable length
-F0 / without code	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

ACCESSORIES

see chapter "Accessories"

Version AX 70 - Aluminium

Version AX 71 - Stainless Steel

EX-CLASSIFICATION

Absolute SSI programmable

- ATEX certification for gas and dust explosion proof
- Same electrical performance as ACURO industry
- Protection class up to IP67
- Diameter only 70 mm
- Robust design
- Also available with stainless steel housing (AX 70 - SSI-P)
- Resolution up to 29 Bit (17 Bit ST, 12 Bit MT)
- Applications: enamelling production line, petro chemistry, bottling machines, mixers, silo works, mills

The absolute shaft encoder line ACURO is available in explosion proof design with explosion proof enclosure "d" under AX 70 and AX 71 (stainless steel).
The PTB has assured with the Declaration of Conformity that the AX 70 / 71 meets the requirements of safety and health according to EN 50014 and EN 50018. Therefore it is approved in explosive areas, code "Ex II 2 G/D E Ex d II C T4/T6 IP65/ IP66 135°C resp. 85°C".
For applications under tough environmental conditions and food industry the stainless steel version AX 71 is available.

TECHNICAL DATA
mechanical

Housing diameter	70 mm
Shaft diameter	10 mm (Solid shaft)
Flange (Mounting of housing)	Clamping flange
Protection class shaft input (EN 60529) [1]	T4: IP64 or IP67 T6: IP64
Protection class housing (EN 60529)	T4: IP65 or IP67 T6: IP65
Shaft load axial / radial	40 N / 100 N
Max. speed	T4: max. 10 000 rpm T6: max. 6000 rpm
Starting torque typ.	≤ 1 Ncm
Moment of inertia	approx. 20 gcm²
Vibration resistance (DIN EN 60068-2-6)	100 m/s² (10 ... 500 Hz)
Shock resistance (DIN EN 60068-2-27)	1000 m/s² (6 ms)
Ambient temperature	T4: -40 °C ... +60 °C T6: -40 °C ... +40 °C
Storage temperature	-25 °C ... +85 °C

TECHNICAL DATA
mechanical (continued)

Material shaft	Stainless Steel
Material housing	AX 70: Aluminum AX 71: Stainless Steel
Weight	AX 70: approx. 1.4 kg AX 71: approx. 4.8 kg
Connection	Cable, axial

[1] No dust explosion-proof (D) for IP64

TECHNICAL DATA
electrical

Supply voltage	DC 10-30 V
Current w/o load typ.	250 mA (ST / MT)
Resolution singleturn	10 - 17 Bit
Resolution multiturn	12 Bit
Output code	Binary, Gray
Drives	Clock and Data / RS422
Parametrization	Resolution, Code type, Direction, Output format, Warning, Alarm, Preset values
Control inputs	Direction, Preset 1, Preset 2
Alarm output	Alarm bit

[1] Programmable with WIN SSI

RECOMMENDED DATA TRANSFER RATE
bei SSI

The max. data transfer rate depends on the cable length. For Clock / $\overline{\text{Clock}}$ and Data / $\overline{\text{Data}}$ please use twisted pairs. Use shielded cable.

Cable length	Frequency
< 50 m	< 400 kHz
< 100 m	< 300 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz

ELECTRICAL CONNECTIONS
Cable

Color	No.	SSI programmable
white 0.14 mm	6	RS232 RxD
brown 0.14 mm	5	RS232 TxD
green	10	$\overline{\text{Clock}}$
yellow	9	Clock
grey	8	$\overline{\text{Data}}$
pink	7	Data
blue	3	Direction
black	4	0 V signal output
red	1	Preset 1
violet	2	Preset 2
brown 0.5 mm	11	0 V supply voltage
white 0.5 mm	12	DC 10 ... 30 V
Screen		Screen connected to encoder housing

DIMENSIONED DRAWINGS

see chapter "Dimensioned drawings AX 70 / AX 71, starting page 246

EEx Industrial types AX 70 / AX 71
Absolute SSI programmable

ORDERING INFORMATION

Type	Resolution	Supply voltage	Flange, Protection, Shaft [1,2]	Interface	Connection
☐	☐	☐	☐	☐	☐
AX70 **AX71**	**0010** 10 Bit ST **0012** 12 Bit ST **0013** 13 Bit ST **0014** 14 Bit ST **0017** 17 Bit ST **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 Bit ST **1217** 12 Bit MT + 17 Bit ST higher resolution on request	**E** DC 10 - 30 V	**K.42** Clamping, IP64, 10 mm **K.72** Clamping, IP67, 10 mm	**SP** SSI program-mable	**A** Cable, axial

[1] Dust explosion-proof certification (D) only for IP67
[2] IP67 only with temperature class T4

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. Further cable lengths on request.

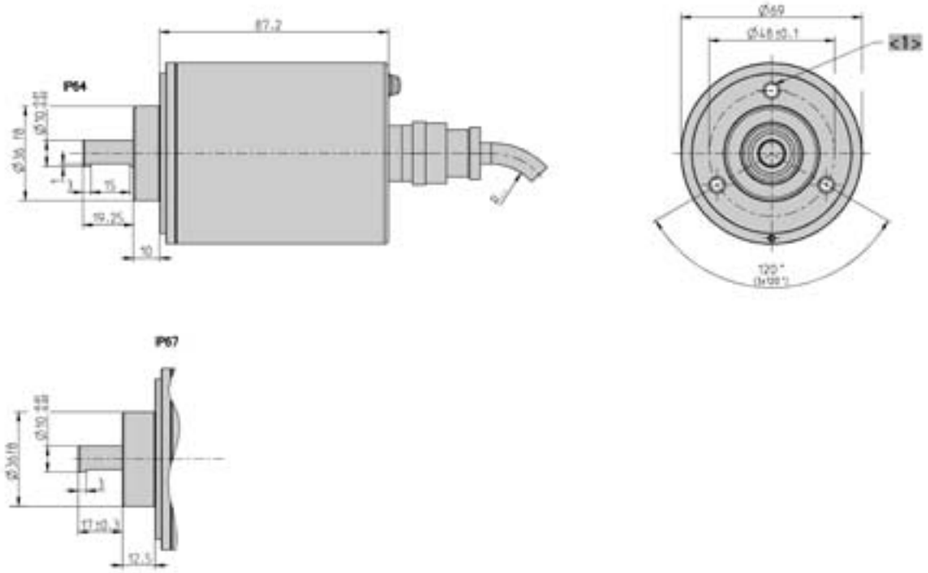
Code	Cable length
-F0 / without code	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

ACCESSORIES

see chapter "Accessories"

DIMENSIONED DRAWINGS

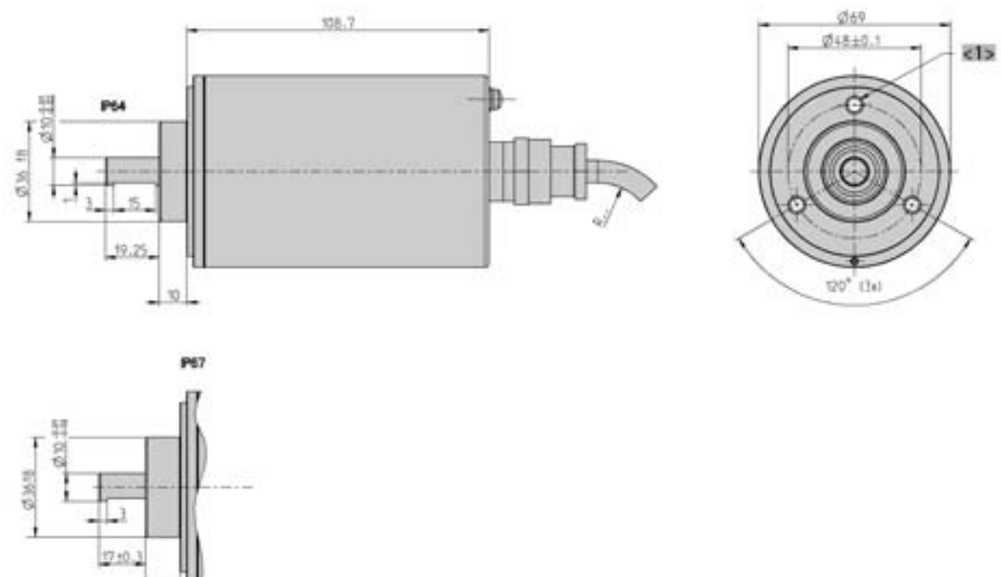
SSI



<1> mounting thread M6x12
Cable bending radius R for flexible installation ≥ 150 mm
Cable bending radius R for fixed installation ≥ 40 mm
Dimensions in mm

DIMENSIONED DRAWINGS (continued)

SSI-P, Profibus, CANopen



<1> mounting thread M6x12
Cable bending radius R for flexible installation ≥ 150 mm
Cable bending radius R for fixed installation ≥ 40 mm
Dimensions in mm

Light Duty Types

If you are looking for a compact, but high-resolution incremental encoder, then out light duty encoder line offers a broad selection to you.

With up to 3600 pulses per turn Hengstler's light duty encoder line is one of the most compact and ones in its class.

Despite its small frame size the encoders have two integrated precision ball bearings, which stand for a long life at high speed (up to 10.000 rpm). The electrical features are in no way inferior to the mechanical ones: The encoders are equipped with state-of-the-art optoasic technology, which increases the encoder's reliability by its high immunity to interference. It is also provided with monitoring electronics which in the event of failure fires an alarm output. If, for example, over temperature prevails, or the voltage range is fallen below the specified minimum, the alarm output will return a signal.

Examples of applications for Light Duty Encoders:

- Laboratory equipment
- Crimping machines
- Tampon printing machines
- Miniature grinding machines
- FHP motors
- Labelling machines
- Plotters
- Graphic machines
- Textile machinery

Incremental

- Provides digital control inputs from operators´s panel
- Bidirectional squarewave signal outputs
- Up to 512 increments
- Continuous and reversible rotation
- Non-contacting
- Operating temperature -40 ... 100 °C

NUMBER OF PULSES

100 ... 512

TECHNICAL DATA
mechanical

Housing diameter	PC 9: 22 mm PC 9S: 22.86 mm
Shaft diameter	1/8" / 0.25
Shaft load axial / radial	1/8" shaft: 4 N / 27 N 1/4" shaft: 4 N / 4 N
Moment of inertia	approx. 0.2 gcm²
Operating temperature	-40 °C ... +100 °C
Storage temperature	-50 °C ... +125 °C
Relative humidity	90 %, non-condensing
Connection	PC 9: 10 pole header (Accessory: 30 cm ribbon cable with connector, ordering code CA0040012) PC 9S: 5 pole header (Accessory: 30 cm ribbon cable with connector, ordering code CA0050012)
Recommended mating connector	PC 9: Thomas & Betts, ordering code 622-1030 (on request) PC 9S: AMP, ordering code 103675-4 (on request)

TECHNICAL DATA
electrical

Supply voltage	DC 5 V ±10 %
Standby current	50 µA
Code	Incremental, optical
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 (VOH), max. 0.5 V low (VOL)
Output current	PC 9: 3 mA sink/source (25 °C), 2 mA (100 °C) PC 9S: 6 mA sink/source (25 °C), 4 mA (100 °C)
Pulse shape	Square wave
Pulse duty factor	1:1

Incremental

OUTPUT WAVEFORMS (only PC 9)

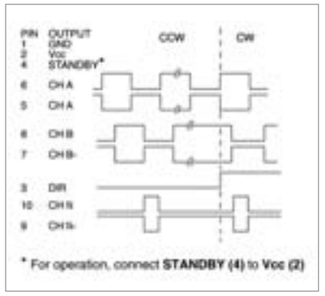


Figure 1: Code 2 (Output) = 01

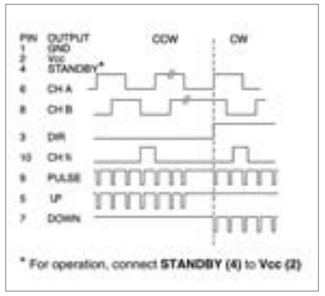
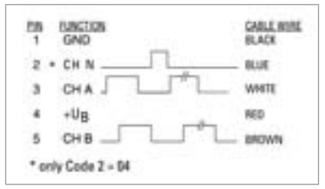


Figure 2: Code 2 (Output) = 02

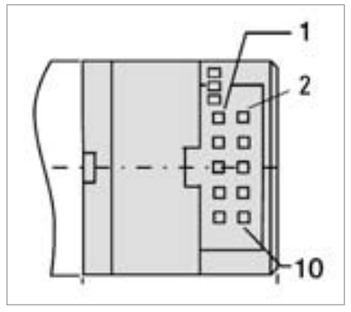
ELECTRICAL CONNECTIONS
OUTPUT WAVEFORMS (only PC 9S)



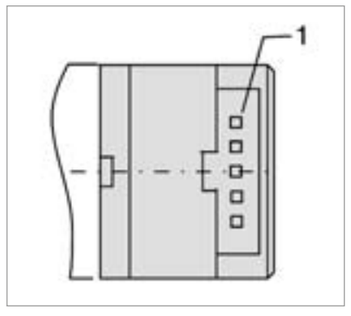
* only code 2 (output) = 04

Figure 3: Code 2 (Output) = 03/04

CONNECTION (only PC 9)



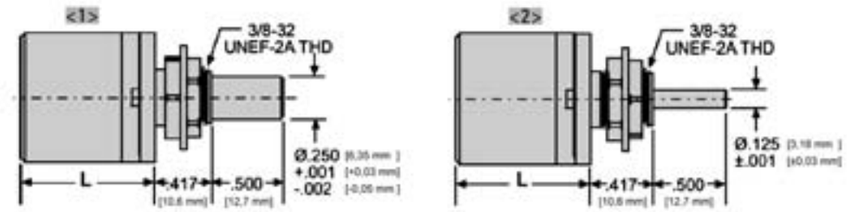
CONNECTION (only PC 9S)



Light Duty types PC 9 / PC 9S

Incremental

DIMENSIONED DRAWINGS



<1> Mounting Code 3 = M
<2> Mounting Code 3 = N

Body length (L) = 0,681'' / 17,3 mm (code 1 = PC9S)
Body length (L) = 0,894'' / 22,7 mm (code 2 = PC9)Dimensions in inch [mm]

ORDERING INFORMATION

Type	Number of pulses	Code 2: Output	Mounting
☐	☐	☐	☐
PC9 **PC9S**	**0100** **0144** **0200** **0256** **0300** **0360** **0500** **0512**	**01** see Fig. 1 (PC 9) **02** see Fig. 2 (PC 9) **03** see Fig. 3 (without index) (PC 9S) **04** see Fig. 3 (PC 9S)	**M** 1/4" shaft, sleeve bearings **N** 1/8" shaft, ball bearings

Incremental

- Replacement for type Typ RIS and RI 31
- The economical encoder for small appliances
- High efficiency by means of ball bearing
- Small torque
- Applications: laboratory equipment, training equipment, crimping machines, tampon printing machines, miniature grinding machines

NUMBER OF PULSES

5 / 10 / 20 / 25 / 30 / 50 / 60 / 100 / 120 / 128 / 200 / 250 / 256 / 288 / 300 / 360 / 400 / 500 / 512 / 600 / 720 / 900 / 1000 / 1024 / 1250 / 1500
Other number of pulses on request

TECHNICAL DATA
mechanical

Housing diameter	30 mm
Shaft diameter	5 mm / 6 mm (Solid shaft)
Flange (Mounting of housing)	Pilot flange
Protection class shaft input (EN 60529)	IP40
Protection class housing (EN 60529)	IP50
Shaft load axial / radial	5 N / 10 N
Max. speed	max. 6000 rpm
Starting torque typ.	≤ 0.05 Ncm
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	-10 °C ... +60 °C
Storage temperature	-25 °C ... +85 °C
Material shaft	Aluminum
Material housing	Plastic
Weight	approx. 50 g
Connection	Cable, axial or radial

TECHNICAL DATA
electrical

General design	as per DIN VDE 0160, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	Push-pull (D): DC 5 V ±10 % Push-pull (K): ± 10% DC 5 V or DC 10 - 30 V
Current w/o load typ.	40 mA (DC 5 V), 60 mA (DC 10 V), 30 mA (DC 24 V)
Max. pulse frequency	DC 5 V: 300 kHz DC 10 - 30 V: 200 kHz
Standard output versions [2,3]	Push-pull (K): A, B, N, $\overline{\text{Alarm}}$ Push-pull 5V, ± 30 mA (D): A, B, N, $\overline{\text{Alarm}}$
Pulse width error	± max. 25° electrical
Number of pulses	5 ... 1500
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Pulse duty factor	1:1

Incremental

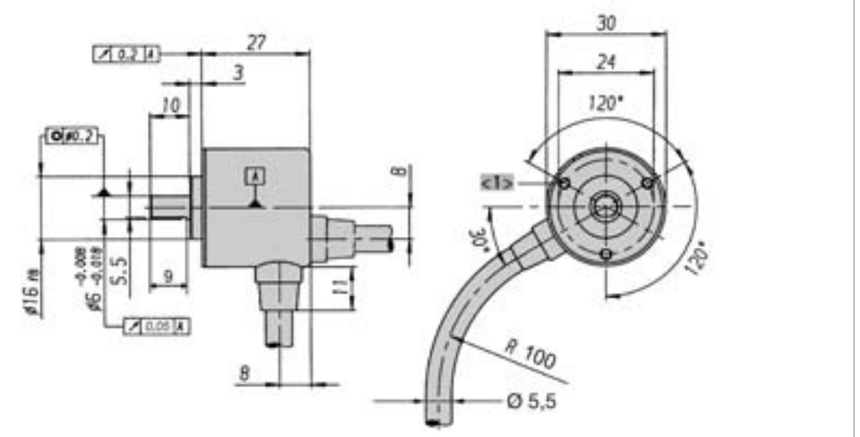
TECHNICAL DATA
electrical (continued)

[1] With push-pull (K): pole protection
[2] Output code "K": short-circuit-proof
[3] Output description and technical data see chapter "Technical basics"

ELECTRICAL CONNECTIONS
Cable

Description (push-pull)	Lead □ mm [2]	Colour
DC 5 V/ 10 - 30 V	0.5	red
Channel A	0.14	white
Channel B	0.14	green
Channel N	0.14	yellow
GND	0.5	black
$\overline{\text{Alarm}}$	0.14	yellow/black

DIMENSIONED DRAWINGS



<1> mounting thread M3x4
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm
Dimensions in mm

ORDERING INFORMATION

Type	Number of pulses	Supply voltage [1]	Flange, Protection, Shaft [2,3]	Output [4,5]	Connection
☐	☐	☐	☐	☐	☐
RI32-O	**5 ... 1500**	**A** DC 5 V **E** DC 10 - 30 V	**R.14** Pilot, IP40, 5 mm **R.11** Pilot, IP40, 6 mm	**K** Push-pull **D** Push-pull 5V, ± 30 mA	**A** Cable, axial **B** Cable, radial

[1] DC 10 - 30 V: only with output "K" available
[2] R.11: flattened, see dimensional drawing
[3] R.14: not flattened
[4] Output code "K": ±10 mA at DC 5 V, ±30 mA at DC 10 - 30 V
[5] Output code "K": short-circuit-proof

Incremental

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Incremental

- Replacement for type RI 39
- Encoder for universal installation by means of front/back panel mounting
- High efficiency by means of ball bearing
- Small torque
- Applications: FHP motors, laboratory equipment, labelling machines, plotters, length measuring machines

NUMBER OF PULSES

5 / 10 / 20 / 25 / 28 / 32 / 50 / 60 / 72 / 100 / 128 / 144 / 200 / 250 / 256 / 288 / 300 / 360 / 400 / 500 / 512 / 600 / 720 / 900 / 1000 / 1024
Other number of pulses on request

TECHNICAL DATA
mechanical

Housing diameter	39 mm
Shaft diameter	6 mm (Solid shaft)
Flange (Mounting of housing)	Square flange
Protection class shaft input (EN 60529)	IP40
Protection class housing (EN 60529)	IP50
Shaft load axial / radial	5 N / 10 N
Max. speed	max. 10 000 rpm
Starting torque typ.	≤ 0.2 Ncm
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	-10 °C ... +60 °C
Storage temperature	-25 °C ... +85 °C
Material housing	Glass fiber-reinforced plastic
Weight	approx. 60 g
Connection	Cable, radial

TECHNICAL DATA
electrical

General design	as per DIN VDE 0160, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	Push-pull (D): DC 5 V ±10 % Push-pull (K): ± 10% DC 5 V or DC 10 - 30 V
Current w/o load typ.	40 mA (DC 5 V), 60 mA (DC 10 V), 30 mA (DC 24 V)
Max. pulse frequency	DC 5 V: 300 kHz DC 10 - 30 V: 200 kHz
Standard output versions [2, 3]	Push-pull (K): A, B, N, $\overline{\text{Alarm}}$ Push-pull 5V, ± 30 mA (D): A, B, N, $\overline{\text{Alarm}}$
Pulse width error	± max. 25° electrical
Number of pulses	5 ... 1024
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Pulse duty factor	1:1

Incremental

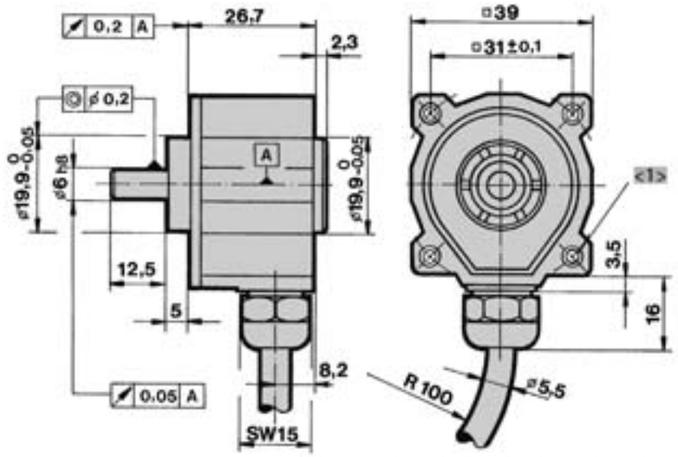
TECHNICAL DATA
electrical (continued)

[1] With push-pull (K): pole protection
[2] Output code "K": short-circuit-proof
[3] Output description and technical data see chapter "Technical basics"

ELECTRICAL CONNECTIONS
Cable

Description (push-pull)	Lead ¤ mm2	Colour
DC 5 V/ 10 - 30 V	0.5	red
Channel A	0.14	white
Channel B	0.14	green
Channel N	0.14	yellow
GND	0.5	black
$\overline{\text{Alarm}}$	0.14	yellow/black

DIMENSIONED DRAWINGS



<1> mounting thread M3x6
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm
Dimensions in mm

ORDERING INFORMATION

Type	Number of pulses	Supply voltage [1]	Flange, Protection, Shaft	Output [2,3]	Connection
☐	☐	☐	☐	☐	☐
RI38-O	**5 ... 1024**	**A** DC 5 V **E** DC 10 - 30 V	**Q.11** Square, IP40, 6 mm	**K** Push-pull **D** Push-pull 5V, ± 30 mA	**B** Cable, radial

[1] DC 10 - 30 V: only with output "K" available
[2] Output code "K": ±10 mA at DC 5 V, ±30 mA at DC 10 - 30 V
[3] Output code "K": short-circuit-proof

Light Duty types RI 38

Incremental

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Incremental

- Replacement for type RIM
- Economical miniature encoder
- Up to 14,400 steps with 3,600 pulses
- High mechanical efficiency
- Applications: wood working machines, FHP motors, graphic machines, table robots

NUMBER OF PULSES

5 / 10 / 20 / 25 / 28 / 32 / 50 / 60 / 72 / 100 / 128 / 144 / 200 / 250 / 256 / 288 / 300 / 360 / 400 / 500 / 512 / 600 / 720 / 900 / 1000 / 1024 / 1250 / 1500 / 2000 / 2048 / 2500 / 3000 / 3600
Other number of pulses on request

TECHNICAL DATA
mechanical

Housing diameter	40 mm
Shaft diameter	6 mm (Solid shaft)
Flange (Mounting of housing)	Pilot flange
Protection class shaft input (EN 60529)	IP40
Protection class housing (EN 60529)	IP50
Shaft load axial / radial	5 N / 10 N
Max. speed	max. 10 000 rpm
Starting torque typ.	≤ 0.2 Ncm
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	-10 °C ... +70 °C
Storage temperature	-25 °C ... +85 °C
Material housing	Aluminum
Weight	approx. 60 g
Connection	Cable, radial

TECHNICAL DATA
electrical

General design	as per DIN VDE 0160, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	Push-pull (D): DC 5 V ±10 % Push-pull (K): ± 10% DC 5 V or DC 10 - 30 V
Current w/o load typ.	40 mA (DC 5 V), 60 mA (DC 10 V), 30 mA (DC 24 V)
Max. pulse frequency	DC 5 V: 300 kHz DC 10 - 30 V: 200 kHz
Standard output versions [2,3]	Push-pull (K): A, B, N, $\overline{\text{Alarm}}$ Push-pull 5V, ± 30 mA (D): A, B, N, $\overline{\text{Alarm}}$
Pulse width error	± max. 25° electrical
Number of pulses	5 ... 3600
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Pulse duty factor	1:1

Incremental

TECHNICAL DATA
electrical (continued)

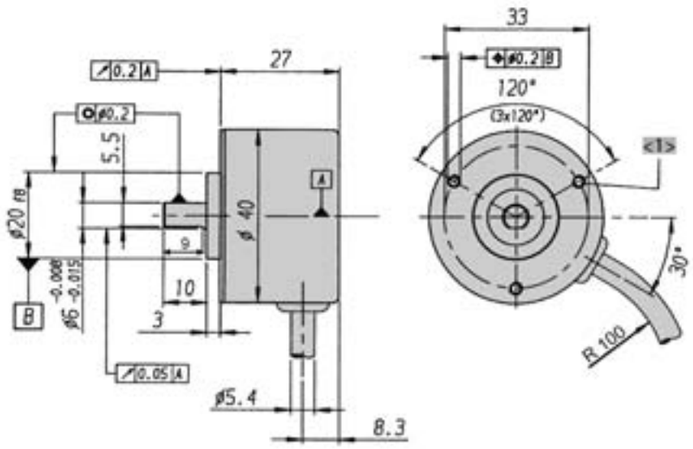
[1] With push-pull (K): pole protection
[2] Output code "K": short-circuit-proof
[3] Output description and technical data see chapter "Technical basics"

ELECTRICAL CONNECTIONS
Cable

Description (push-pull)	Lead □ mm [2]	Colour
DC 5 V/10 - 30 V	0.5	red
Channel A	0.14	white
Channel B	0.14	green
Channel N	0.14	yellow
GND	0.5	black
$\overline{\text{Alarm}}$	0.14	yellow/black
screen [1]		screen [1]

[1] not connected with encoder housing

DIMENSIONED DRAWINGS



<1> mounting thread M3x3
Cable bending radius R for fixed installation ≥ 40 mm
Cable bending radius R for flexible installation ≥ 100 mm
Dimensions in mm

ORDERING INFORMATION

Type	Number of pulses	Supply voltage [1]	Flange, Protection, Shaft	Output [2,3]	Connection
☐	☐	☐	☐	☐	☐
RI41-O	**5 ... 3600**	**A** DC 5 V **E** DC 10 - 30 V	**R.11** Pilot, IP40, 6 mm	**K** Push-pull **D** Push-pull 5V, ± 30 mA	**B** PVC cable, radial

[1] DC 10 - 30 V: only with output "K" available
[2] Output code "K": ±10 mA at DC 5 V, ±30 mA at DC 10 - 30 V
[3] Output code "K": short-circuit-proof

Incremental

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	Cable length
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

Incremental

- Economical miniature encoder
- High protection IP65
- Output Push-pull or NPN-O.C.
- High mechanical efficiency
- Applications: textile machinery

NUMBER OF PULSES

5 / 10 / 20 / 25 / 28 / 32 / 50 / 60 / 72 / 100 / 128 / 144 / 200 / 250 / 256 / 288 / 300 / 360 / 400 / 500 / 512 / 600 / 720 / 900 / 1000 / 1024
Other number of pulses on request

TECHNICAL DATA
mechanical

Housing diameter	40 mm
Shaft diameter	6 mm (Solid shaft)
Flange (Mounting of housing)	Pilot flange
Protection class shaft input (EN 60529)	IP64
Protection class housing (EN 60529)	IP65
Shaft load axial / radial	5 N / 10 N
Max. speed	max. 10 000 rpm
Starting torque typ.	≤ 1 Ncm
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	0 °C ... +60 °C
Storage temperature	-25 °C ... +85 °C
Material shaft	Aluminum
Material housing	Plastic
Weight	approx. 75 g
Connection	Cable, axial

TECHNICAL DATA
electrical

General design	as per DIN VDE 0160, protection class III, contamination level 2, overvoltage class II
Supply voltage [1]	Push-pull (D): DC 5 V ±10 % Push-pull (K): ± 10% DC 5 V or DC 10 - 30 V Push-pull antivalent (I): DC 10-30 V Open Collector NPN (S): DC 10-24 V
Current w/o load typ.	40 mA (DC 5 V), 30 mA (DC 24 V, with push-pull K, I), 40 mA (DC 24 V, NPN-O.C.)
Max. pulse frequency	DC 5 V: 300 kHz DC 10 - 30 V: 200 kHz DC 10 - 24 V: 50 kHz
Standard output versions [2, 3, 4]	Push-pull (K): A, B, N, $\overline{\text{Alarm}}$ Push-pull 5V, ± 30 mA (D): A, B, N, $\overline{\text{Alarm}}$ Push-pull complementary (I): A, B, N, $\overline{\text{A}}$, $\overline{\text{B}}$, $\overline{\text{N}}$, $\overline{\text{Alarm}}$ NPN-O.C. (S): A, B, N
Pulse width error	± max. 25° electrical

Incremental

TECHNICAL DATA
electrical (continued)

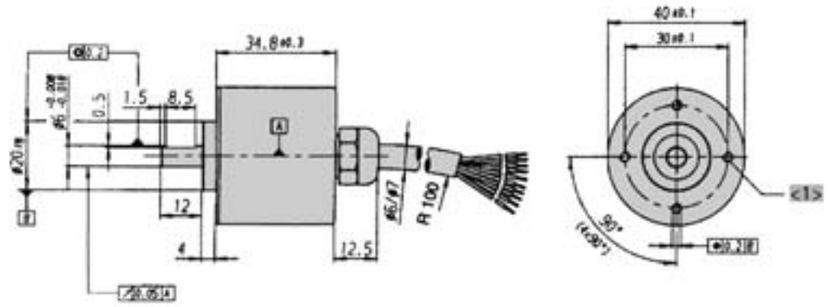
Number of pulses	5 ... 1024
Alarm output	NPN-O.C., max. 5 mA
Pulse shape	Square wave
Pulse duty factor	1:1

[1] With push-pull (K): pole protection
[2] Output code "K": short-circuit-proof
[3] NPN-O.C. with internal pull-up resistor = 10 KΩ , max. pulse frequency = 50 KHz, max. output lead = ± 30 mA, tolerance ≤ ± 30° electrical, delay time ≤ 4µs
[4] Output description and technical data see chapter "Technical basics"

ELECTRICAL CONNECTIONS
Cable

Colour (PVC)	**Output circuit**	
	push-pull (K, D), Open Collector (S)	**push-pull complementary (I)**
white	Channel A	Channel A
white/brown		Channel $\overline{A}$
green	Channel B	Channel B
green/brown		Channel $\overline{B}$
yellow	Channel N	Channel N
yellow/brown		Channel $\overline{N}$
yellow/black	$\overline{Alarm}$	$\overline{Alarm}$
yellow/red		Sense V_{CC}
red	DC 5/ 10 - 30/ 10 - 24 V	DC 10 - 30 V
black	GND	GND

DIMENSIONED DRAWINGS



<1> mounting thread M3x5
Cable bending radius R for flexible installation ≥ 100 mm
Cable bending radius R for fixed installation ≥ 40 mm
Dimensions in mm

Incremental

ORDERING INFORMATION

Type	Number of pulses	Supply voltage [1, 2, 3]	Flange, Protection, Shaft	Output [4, 5]	Connection
☐	☐	☐	☐	☐	☐
RI42-O	**5 ... 1024**	**A** DC 5 V **C** DC 10 - 24 V **E** DC 10 - 30 V	**R.41** Pilot, IP64, 6 mm	**K** Push-pull **I** Push-pull complementary **D** Push-pull 5V, ± 30 mA **S** Open Collector NPN	**A** Cable, axial

[1] DC 5 V: only with output "K", "D" available
[2] DC 10 - 30 V: only with output "K", "I" available
[3] DC 10 - 24 V: only with output "S" available
[4] Output code "K": ±10 mA at DC 5 V, ±30 mA at DC 10 - 30 V
[5] Output code "K" and "I": short-circuit-proof

ORDERING INFORMATION
Selection of cable length

Versions with cable outlet (connection A, B, E or F) are available with various lengths of cable. To order your desired cable length, please add the respective code to the end of your ordering code. For variants with connector on cable end please add cable length code in between. Further cable lengths on request.

Code	**Cable length**
without code	1.5 m
-D0	3 m
-F0	5 m
-K0	10 m
-P0	15 m
-U0	20 m
-V0	25 m

Example:
Cable 3 m length: ... B - D0
Cable mit 3 m length and M23 connectorr, cw: ... B - D0 - I

ACCESSORIES

see chapter "Accessories"

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 50 mm 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 comcodersfor direct block commutation ol BLDC motors in low cost modular version or with integrated bearings and resolutions up to 10 000 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 / 1/8" / 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 %
Current w/o load typ.	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)

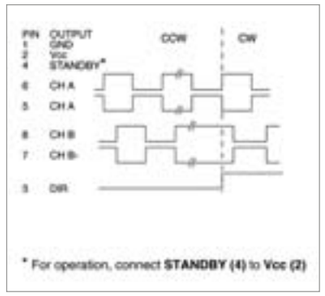


Figure 1

Code **00** for ordering information

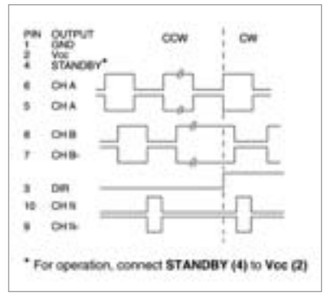


Figure 2

Code **01** for ordering information

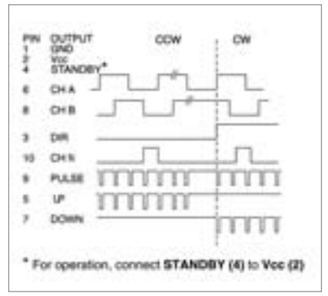
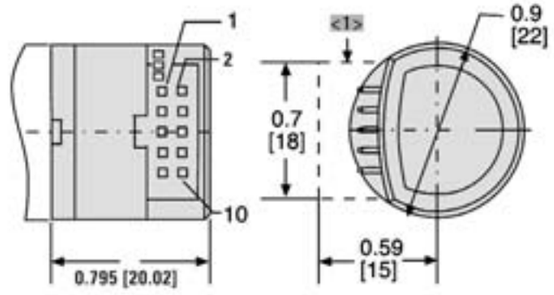


Figure 3

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** **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.

MK E9 ☐

Please designate hub shaft diameter.

Hub shaft
1.5 1.5 mm
2.0 2.0 mm
2.5 2.5 mm
3.0 3.0 mm
125 0.125 inch
156 0.156 inch

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

ACCESSORIES

see chapter "Accessories"

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 / 1/8" / 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. 12 000 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

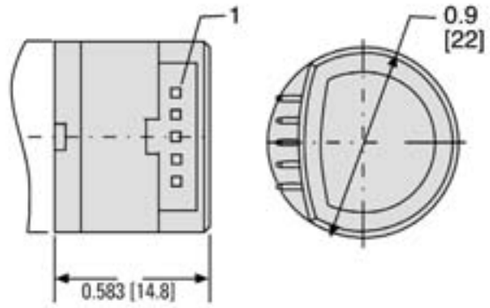
Supply voltage	DC 5 V ±10 %
Current w/o load typ.	10 mA

Miniature, DC & Stepper Motors Incremental

TECHNICAL DATA
electrical (continued)

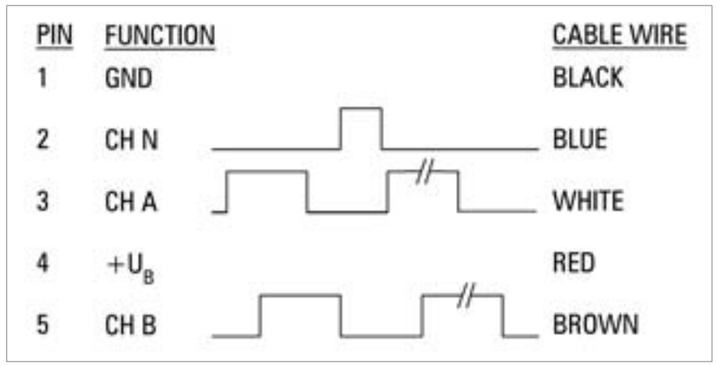
Code	Incremental, optical
Max. pulse frequency	200 kHz
Index pulse width (N)	90° ± 36° electrical
Phasing	90° ± 18° electrical
Symmetry	180° ± 18° electrical
Number of pulses	100 ... 512
Output signals	min. 2.5 V high, max. 0.5 V low
Output current	6 mA (25°C), 4 mA (100°C)

DIMENSIONED DRAWINGS



Dimensions in inch [mm]

OUTPUT WAVEFORMS AND CONNECTIONS (Direction viewing encoder cover)



Miniature, DC & Stepper Motors Incremental

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** **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.

MK M9 ☐

Please designate hub shaft diameter.

Hub shaft
1.5 1.5 mm
2.0 2.0 mm
2.5 2.5 mm
3.0 3.0 mm
125 0.125 inch
156 0.156 inch

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

ACCESSORIES

see chapter "Accessories"

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. 12 000 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)

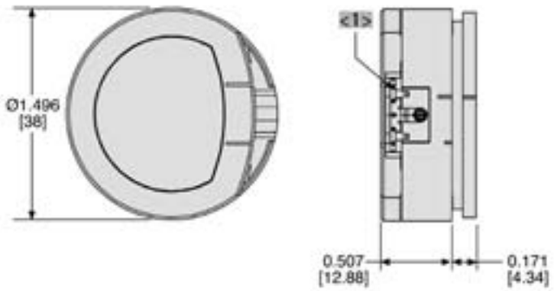
TECHNICAL DATA
electrical

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

TECHNICAL DATA
electrical (continued)

Phasing	90° ± 18° electrical
Symmetry	180° ± 18° electrical
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)

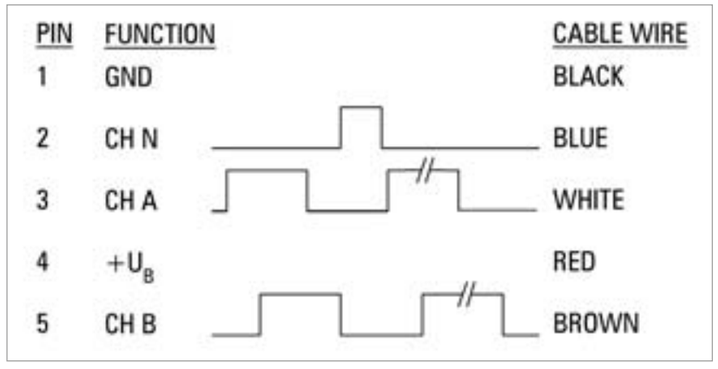
DIMENSIONED DRAWINGS



<1> Pin 1

Dimensions in inch [mm]

OUTPUT WAVEFORMS AND CONNECTIONS (Direction viewing encoder cover)



Motor Feedback M 14
Miniature, DC & Stepper Motors Incremental

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"

Asynchronous & DC Motors Incremental

OVERVIEW

Our hollow shaft encoder industry types are particularly suitable as a motor feedback product for asynchronous- and DC motors. Due ti 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 10 mm)
- Short overall length
- Easy and quick mounting procedure

There are two different spring tethers available.

Deteiled description: Page 85

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

- Flexible hollow shaft design up to diameter 14 mm (-D, TD), 15 mm 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 choise for all drive systems because of its high temperature option.

Detailed description of RI58-D, TD: Page 94
Detailed information of RI58-G, TG: Page 102

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 116

HOLLOW SHAFT ENCODER RI80-E

- Incremental Output
- 30 ... 45 mm hollow shaft
- Rugged machanical design
- 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 120

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.

Deteiled description: Page 145

ABSOLUTE HOLLOW SHAFT ENCODER AC110

- Robust absolute industry encoder with high resolution
- Hollow shaft (up to 50 mm)
- 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 189

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

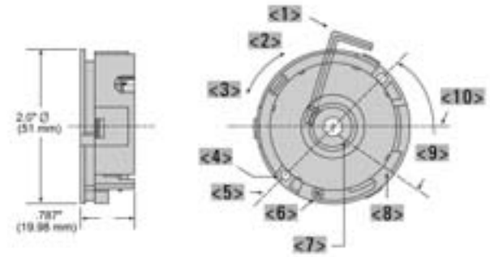
Supply voltage	DC 5 V or DC 12 V ±10 %
Current w/o load typ.	100 mA (Incremental: DC 5 or 12 V ± 10 % (excluding output load)), 75 mA (Commutation: DC 5 or 12 V ± 10 % (excluding output load))
Code	Incremental with commutation, optical
Accuracy	Incremental signals: ± arc-mins max. edge to edge Commutation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

AC-Synchronous & BLDC Motors Incremental

TECHNICAL DATA
electrical (continued)

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)
<10> 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** **1024** **2048** **2500**	**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. 12 000 rpm (short term)
Acceleration	100 000 rad/s²
Bearing life	[(3.6 x 109) / 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

Motor Feedback F 10

AC-Synchronous & BLDC Motors Incremental

TECHNICAL DATA
electrical

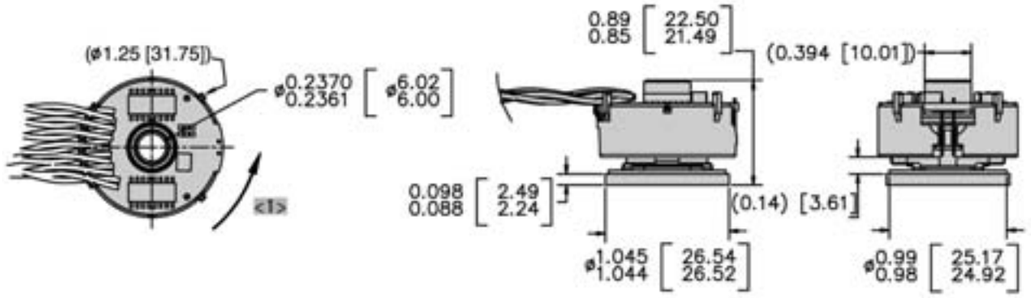
Supply voltage	DC 5 V ±10 %
Current w/o load typ.	100 mA (Incremental and Commutation, w/o load)
Code	Incremental with commutation, optical
Accuracy	Incremental signals: ±2.5 arc-mins. max. (edge to edge) Commutation signals: ±6 arc-mins. max.
Max. pulse frequency	300 kHz
Phasing	Incremental signals (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

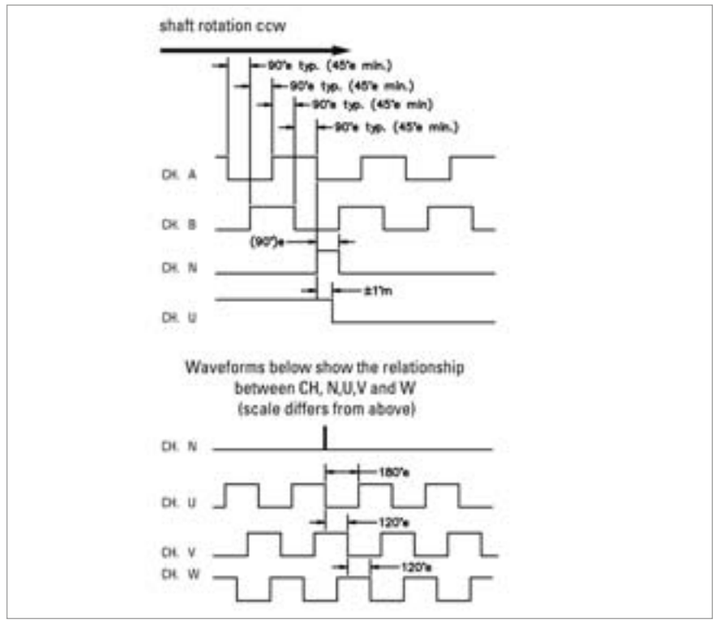
DIMENSIONED DRAWINGS



<1> ccw (counter clockwise)

Dimensions in inch [mm]

OUTPUT WAVEFORMS



Motor Feedback F 10
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. 12 000 rpm (short term)
Acceleration	100 000 rad/s²
Bearing life	[(3.6 x 109) / 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 %
Current w/o load typ.	100 mA (Incremental and Commutation, w/o load)

Motor Feedback F 15

AC-Synchronous & BLDC Motors Incremental

TECHNICAL DATA
electrical (continued)

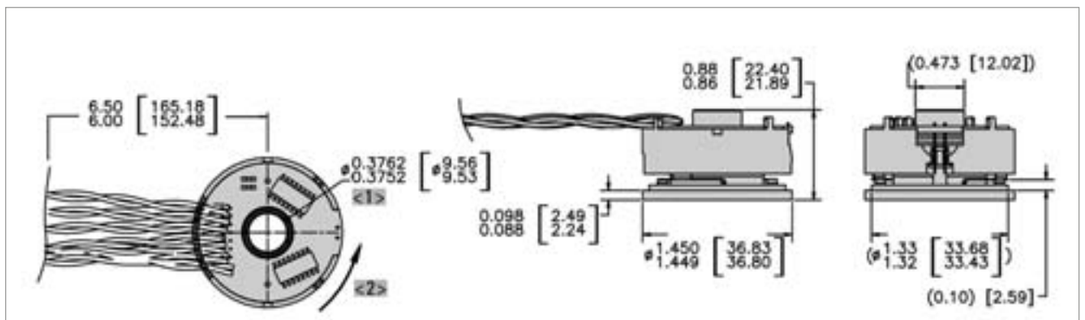
Code	Incremental with commutation, optical
Accuracy	Incremental signals: max. ±2,5 arc-mins. Incremental signals: max. ±6 arc-mins.
Max. pulse frequency	300 kHz
Phasing	Incremental signals (A leads B): A leads B by 90° for ccw shaft rotation viewing the shaft clamp end of the encoder Commutation signals (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

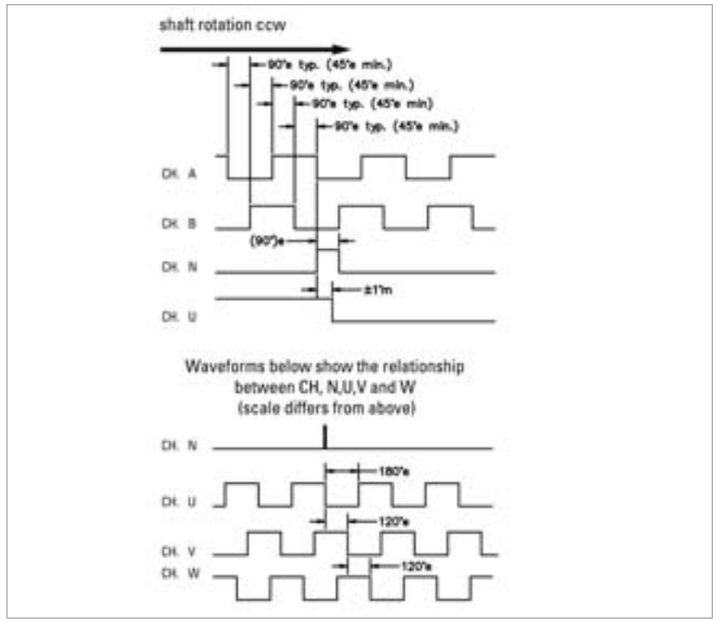
DIMENSIONED DRAWINGS



<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 109) / 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 %
Current w/o load typ.	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

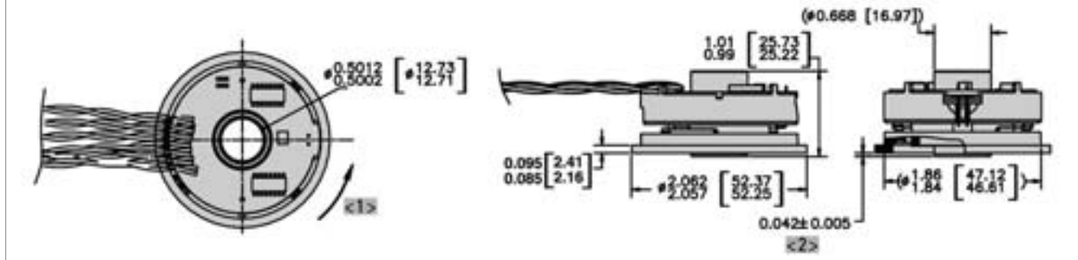
Function [1]	**Colour**
VCC	red
GND	black
$\overline{A}$	blue/black
A	blue
$\overline{B}$	green/black
B	green
$\overline{N}$	violet/black
N	violet
$\overline{U}$	brown/black
U	brown
$\overline{V}$	grey/black
V	grey
$\overline{W}$	white/black
W	white

[1] availability of function depends on version

Motor Feedback F 21

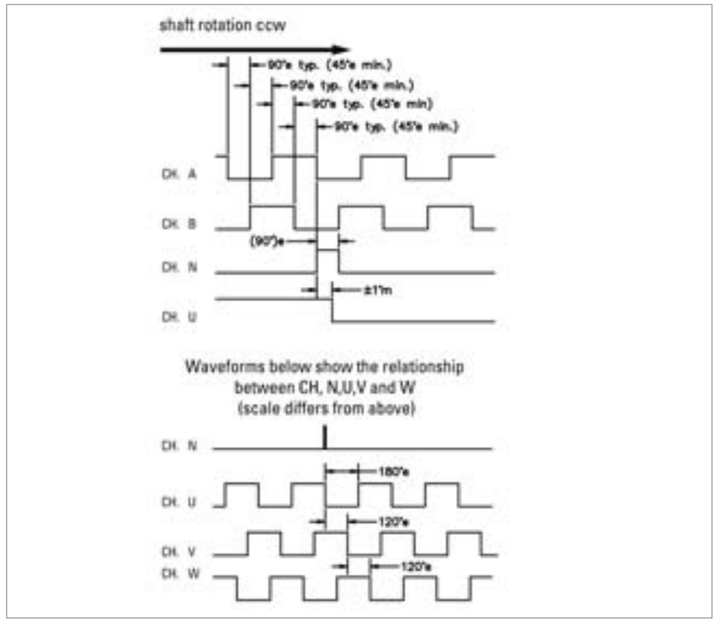
AC-Synchronous & BLDC Motors Incremental

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

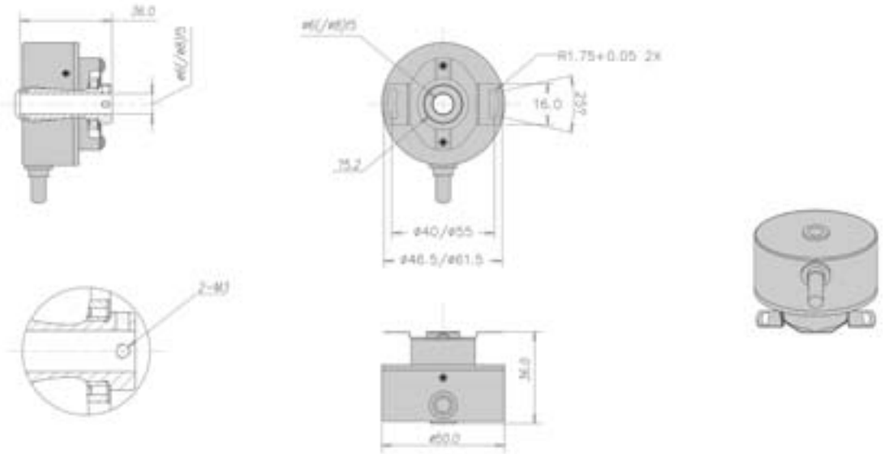
Supply voltage	DC 5 V ±10 %
Current w/o load typ.	150 mA (incremental), 175 mA (incremental + commutation)
Code	Incremental with commutation, optical
Accuracy	max. 40 arc-sec.
Max. pulse frequency	500 kHz

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

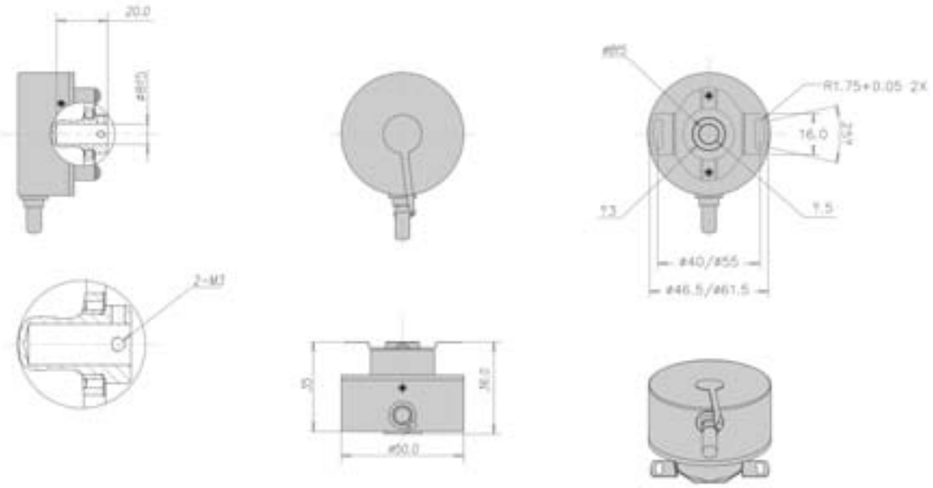
Hollow shaft



Dimensions in mm

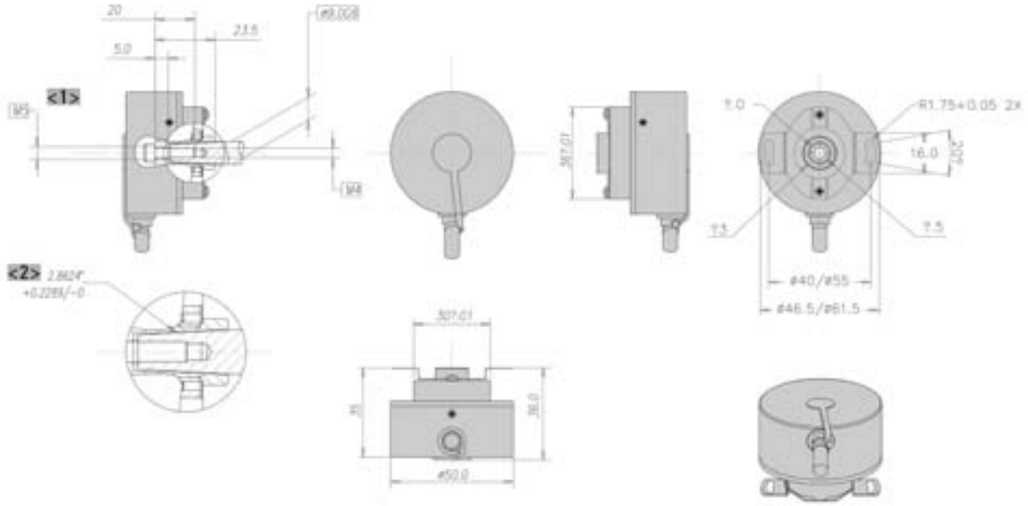
DIMENSIONED DRAWINGS (continued)

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 10000 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

TECHNICAL DATA
mechanical (continued)

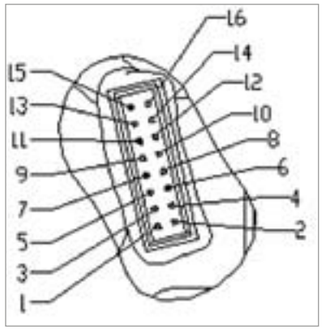
Connection	Cable Cable with Sub-D connector PCB connector

TECHNICAL DATA
electrical

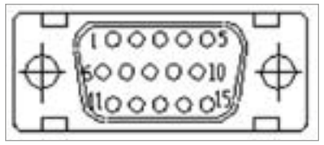
Supply voltage	DC 5 V ±10 %
Current w/o load typ.	100 mA
Code	Incremental with commutation, optical
Accuracy	Incremental signals: ±2.5 arc-mins. max. (edge to edge) Commutation signals: ±6 arc-mins. max.
Max. pulse frequency	100 kHz
Phasing	Incremental signals (A leads B): 90° Commutation signals (U 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



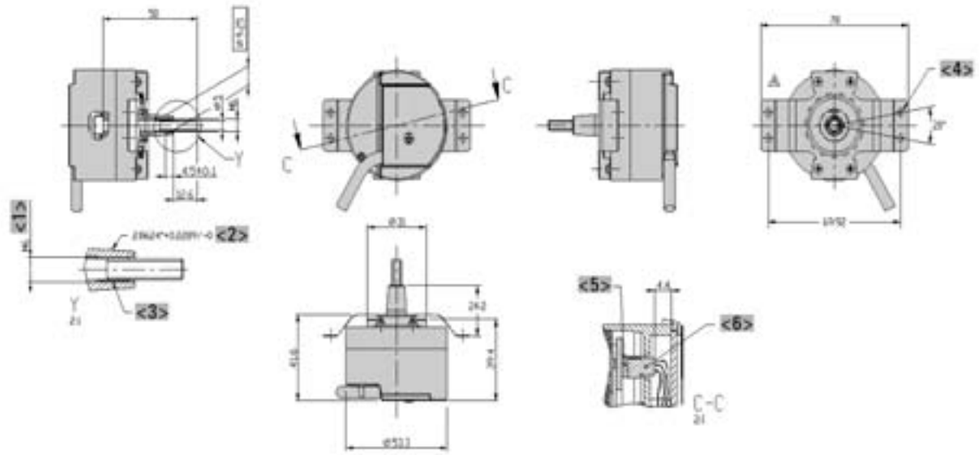
ELECTRICAL CONNECTIONS
Cable / Sub-D connector, 15 pole

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.		

Motor Feedback RF 53
AC-Synchronous & BLDC Motors Incremental

DIMENSIONED DRAWINGS

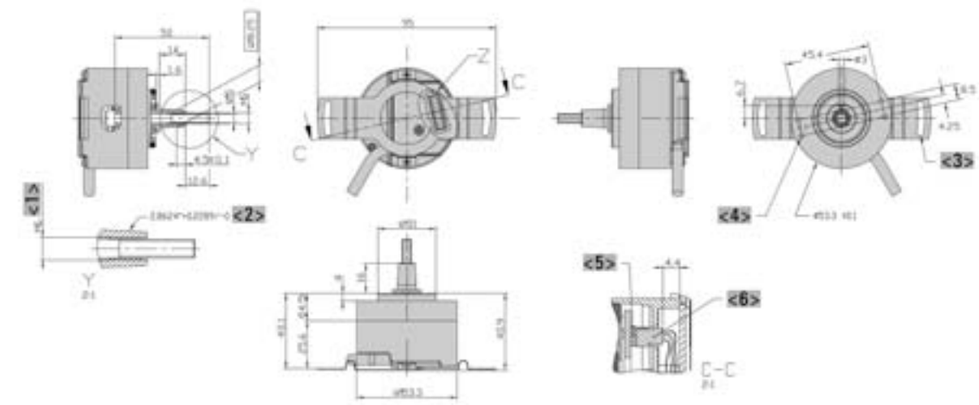
Front tether



<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

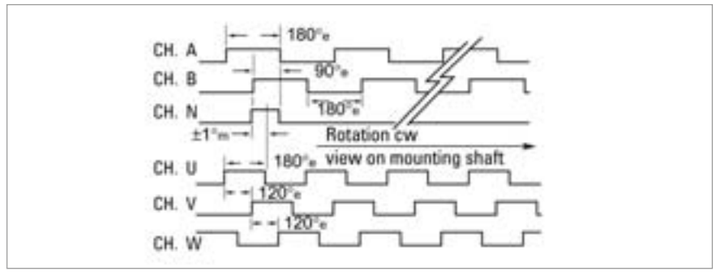


<1> M6 (used for dismounting)
<2> Taper
<3> 3.8 wide slot on a Ø 85 bolt circle (B.C.)
<4> M2.5 x 6 mm DP. (4x)
<5> Cable connector 1
<6> Cable connector 2

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]	Shaft	Connection
RF53	**0500** **0512** **1000** **1024** **2000** **2048** **2500** **4096** **5000** **8192** **10E3** = 10000	**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 front, 60 mm **2** Spring tether front, 69,92 mm **A** Spring tether rear, 85 mm	**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	**0** 10 mm Taped shaft	**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 =10000	X	X	X	X	X	X				

AC-Synchronous & BLDC Motors Absolute

- For brushless servo motors
- Light duty encoder
- Unique mounting concept: Save installation time and cost
- Mounting Depth: 25 mm (ST), 34 mm (MT)
- Up to 19 Bit ST - resolution + 12 Bit MT - 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 19 Bit Singleturn and 12 Bit Multiturn. 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 19 Bit per revolution 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

TECHNICAL DATA
mechanical (continued)

Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Starting torque typ.	0.01 Nm
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
Relative humidity	75%, non-condensing
Weight	approx. 80 g (ST)
Connection	Cable, radial PCB connector, 12 pole

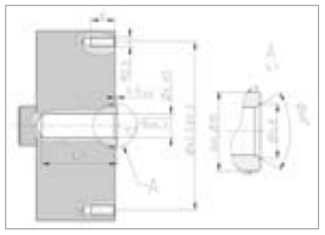
[1] due to packing

TECHNICAL DATA
electrical

Supply voltage	DC 5 V -5 %/+10 % or DC 7 - 30 V
Current w/o load typ.	5 V: 100 mA (ST), 150 mA (MT) 10 - 30 V: 100 mA (ST), 150 mA (MT)
Allowable load	max. 30 mA
Resolution singleturn	12 - 17 Bit (SSI) 12 - 19 Bit (BiSS)
Resolution multiturn	12 Bit
Output code	Gray
Drives	Clock and Data / RS422
Incremental signals	Sinus-Cosinus 1 Vpp
Number of pulses	2048
3dB limiting frequency	500 kHz
Absolute accuracy	±35"
Alarm output	Alarm bit (SSI Option), warning bit and alarm bit (BiSS)

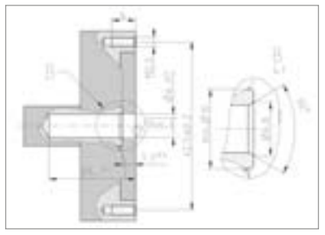
MOUNTING NECESSITIES

Spring tether "U"



Dimensions in mm

Spring tether "F"



Dimensions in mm

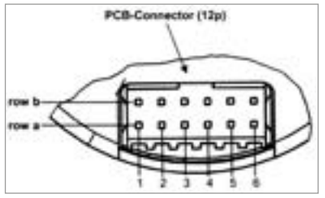
Motor Feedback AD 34
AC-Synchronous & BLDC Motors Absolute

ELECTRICAL CONNECTIONS
PCB connector, 12 pole

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

[1] Analog signals (1 Vpp) only available with interface SC (SSI Gray + 1 Vpp) and BC (BiSS + 1 Vpp).

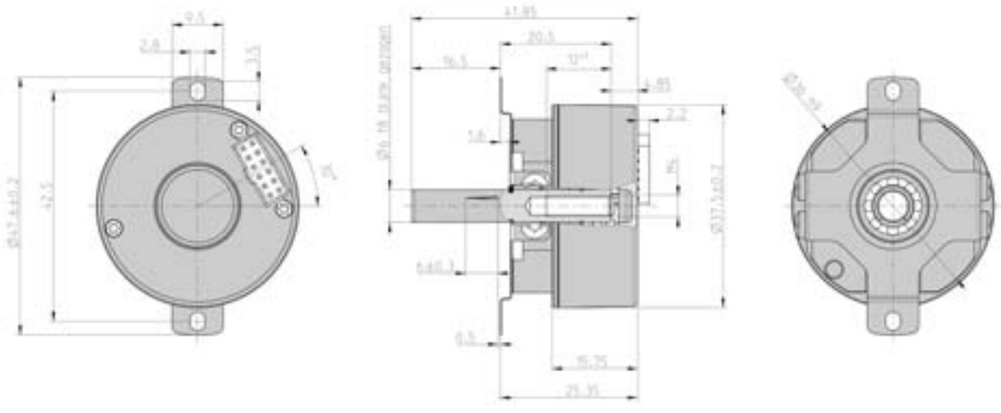
CONNECTION ENCODER SIDE



12 pin PCB connector
manufacture Berg, type Minitek

DIMENSIONED DRAWINGS

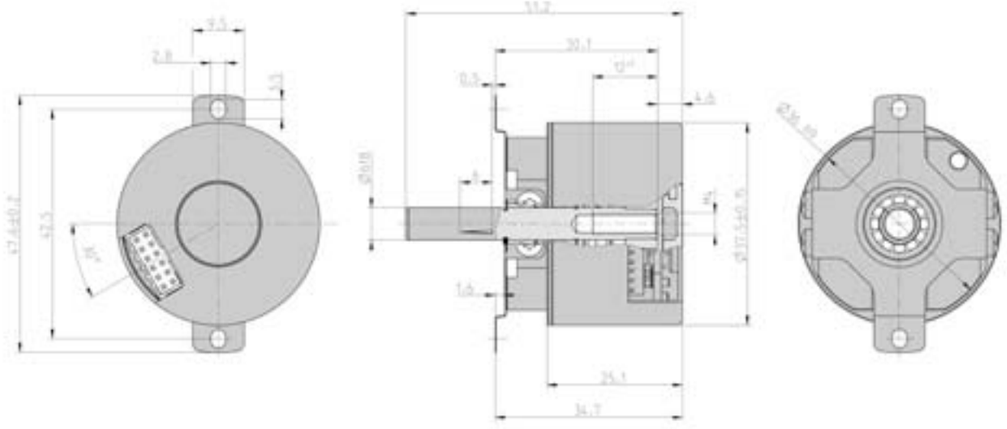
Singleturn, Spring tether "U"



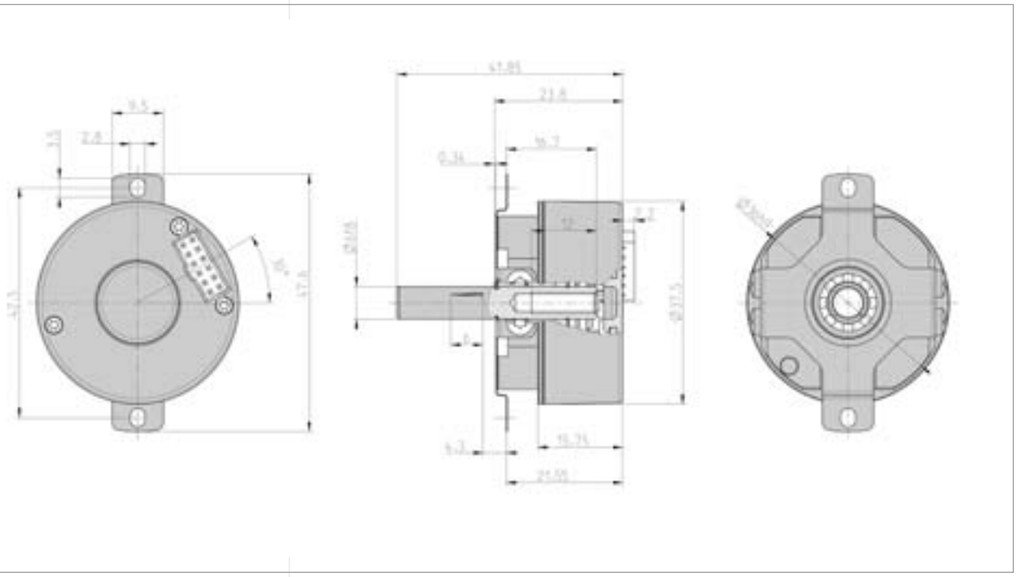
Dimensions in mm

DIMENSIONED DRAWINGS (continued)

Multiturn, Spring tether "U"

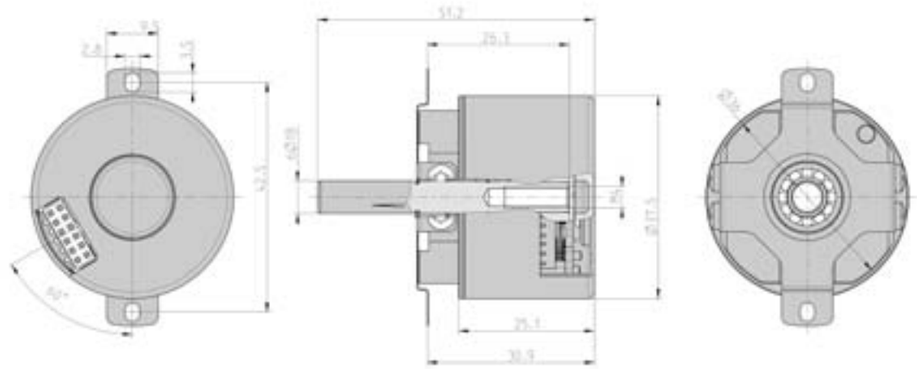


Dimensions in mm



DIMENSIONED DRAWINGS (continued)

Multiturn, Spring tether "F"



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 **0019** 19 Bit ST (BiSS) **1212** 12 Bit MT + 12 Bit ST **1213** 12 Bit MT + 13 Bit ST **1214** 12 Bit MT + 14 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.0N** Spring tether F, IP40, 6 mm notched shaft **U.0N** Spring tether U, IP40, 6mm Notched Shaft	**BI** BiSS **BC** BiSS (+SinCos 1Vpp) **SG** SSI Gray **SC** SSI Gray (+SinCos 1Vpp)	**0** PCB connector, axial, 12 pole **2** PCB connector, radial, 12 pole **A** PCB connector, axial, 12 pole with mating connector and 0.5 m cable **B** PCB connector, radial, 12 pole, with mating connector and 0.5 m cable

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

- 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
- BiSS or SSI interface
- Bandwidth 500kHz
- Bandwidth 500 kHz

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
Radial runout of mating shaft (hubshaft)	± 0.05 mm

Motor Feedback AD 35
AC-Synchronous & BLDC Motors Absolute

TECHNICAL DATA mechanical (continued)

Max. speed	max. 10 000 rpm (continuous), max. 12 000 rpm (short term)
Starting torque typ.	≤ 1 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
Current w/o load typ.	5 V: 100 mA (ST) 10 - 30 V: 100 mA (ST)
Allowable load	max. 30 mA
Resolution singleturn	12 - 22 Bit
Resolution multiturn	12 Bit
Output code	Gray
Drives	Clock and Data / RS422
Incremental signals	Sinus-Cosinus 1 Vpp
Number of pulses	2048
3dB limiting frequency	500 kHz
Absolute accuracy	±35"
Repeatability	±10"
Alarm output	Alarm bit (SSI Option), warning and alarm bit (BiSS)

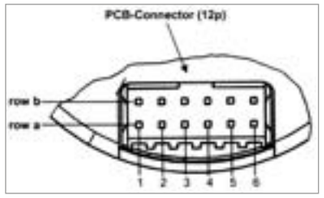
ELECTRICAL CONNECTIONS PCB connector, 12 pole

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

[1] Analog signals (1 Vpp) only available with interface SC (SSI Gray + 1 Vpp) and BC (BiSS + 1 Vpp).

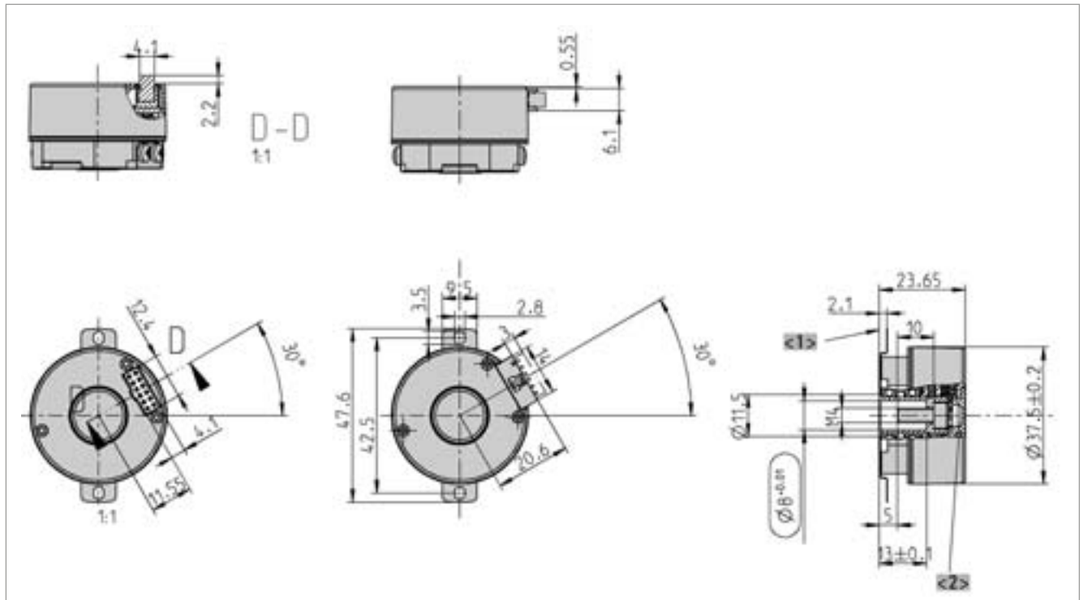
AC-Synchronous & BLDC Motors Absolute

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 **BC** BiSS (+Sin-Cos 1Vpp) **SG** SSI Gray **SC** SSI Gray (+SinCos 1Vpp)	**0** PCB connector, axial, 12 pole **2** PCB connector, radial, 12 pole **A** PCB connector, axial, 12 pole with mating connector and 0.5 m cable **B** PCB connector, radial, 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)
Starting torque typ.	≤ 1 Ncm
Moment of inertia	ca. 2.5 x 10^{-6} kgm²

TECHNICAL DATA
mechanical (continued)

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	-40 °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

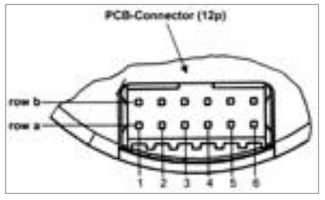
Supply voltage	DC 5 V -5 %/+10 % or DC 7 - 30 V
Current w/o load typ.	5 V: 100 mA (ST), 150 mA (MT) 10 - 30 V: 100 mA (ST), 150 mA (MT)
Allowable load	max. 30 mA
Resolution singleturn	12 - 19 Bit (BiSS) 12 - 17 Bit (SSI)
Resolution multiturn	12 Bit
Output code	Gray
Drives	Clock and Data / RS422
Incremental signals	Sinus-Cosinus 1 Vpp
Number of pulses	2048
3dB limiting frequency	500 kHz
Absolute accuracy	±35"
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 [1]	2a	A+
black [1]	3a	0 V sensor
red/ blue [1]	4a	B+
green	5a	$\overline{\text{Clock}}$
pink [1]	6a	5 V Sensor
white	1b	DC 5 V/ 7 - 30 V
yellow	2b	Clock
grey/ pink [1]	3b	B-
brown	4b	0 V (U_N)
brown/ green [1]	5b	A-
pink	6b	Data

[1] Analog signals (1 Vpp) only available with interface SC (SSI Gray + 1 Vpp) and BC (BiSS + 1 Vpp).

CONNECTION ENCODER SIDE

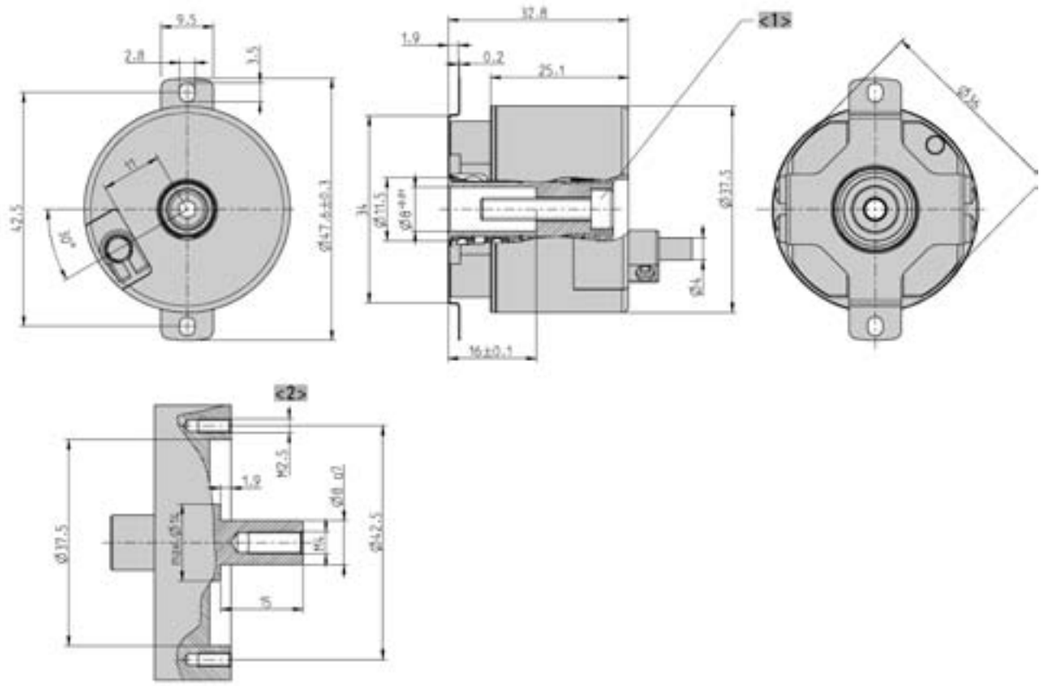


12 pin PCB connector
manufacture Berg, type Minitek

Motor Feedback AD 36
AC-Synchronous & BLDC Motors Absolute

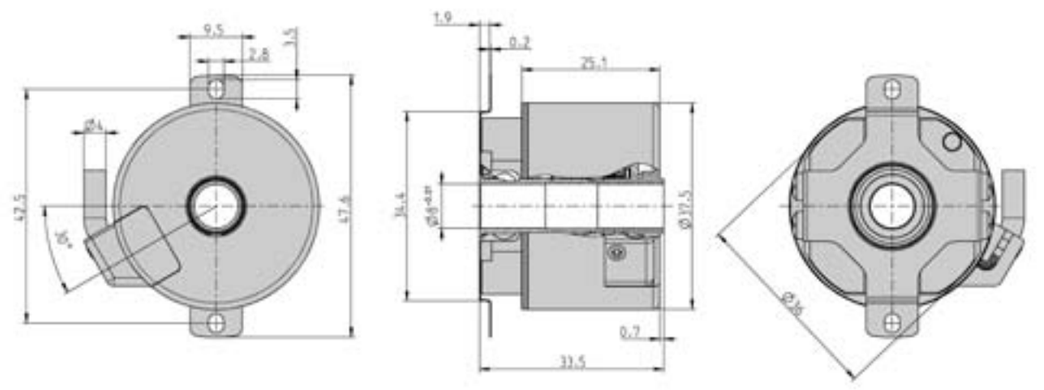
DIMENSIONED DRAWINGS

Hubshaft



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

Through hollow shaft



Dimensions in mm

AC-Synchronous & BLDC Motors Absolute

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 **BC** BiSS (+SinCos 1Vpp) **SG** SSI Gray **SC** SSI Gray (+SinCos 1Vpp)	**0** PCB connector, axial, 12 pole **2** PCB connector, radial, 12 pole **A** PCB connector, axial, 12 pole with mating connector and 0.5 m cable **B** PCB connector, radial, 12 pole, with mating connector and 0.5 m cable

ACCESSORIES

see chapter "Accessories"

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)
Starting torque typ.	≤ 1 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

[1] due to packing

TECHNICAL DATA
electrical (continued)

Supply voltage	± 10% DC 5 V or DC 10 - 30 V
Current w/o load typ.	5 V: 100 mA (ST), 150 mA (MT) 10 - 30 V: 100 mA (ST), 150 mA (MT)
Allowable load	max. 30 mA
Resolution singleturn	13 Bit (SSI) max. 22 Bit (BiSS)
Resolution multiturn	12 Bit
Output code	Binary, Gray
Incremental signals	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

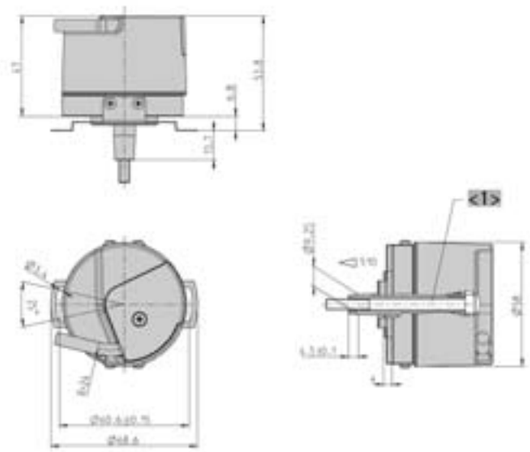
Colour	PIN	Signals
violet	1a	$\overline{\text{Data}}$
green	2a	A+
brown/green	3a	0 V Sensor
blue	4a	B+
brown	5a	$\overline{\text{Clock}}$
red//blue	6a	5 V Sensor
green/pink	1b	DC 5 V/ 7 -30 V
white	2b	Clock
red	3b	B-
white/green	4b	0 V (U_N)
yellow	5b	A-
black	6b	Data

CONNECTION ENCODER SIDE

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

Motor Feedback AD 58
AC-Synchronous & BLDC Motors Absolute

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, axial, 12 pole **B** PCB connector, radial, 12 pole, with mating connector and 0.5 m cable

ACCESSORIES

see chapter "Accessories"

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. 12 000 rpm (continuous), max. 15 000 rpm (short term)
Starting torque typ.	≤ 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

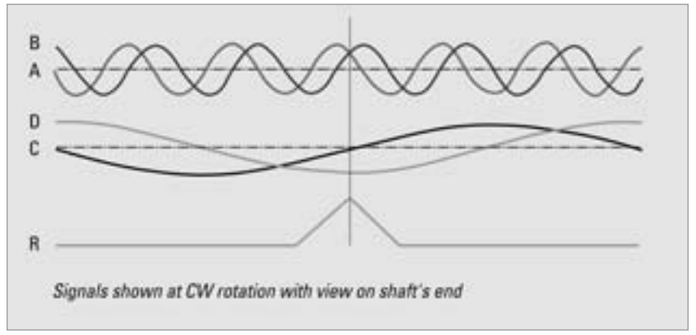
TECHNICAL DATA
electrical

General design	as per DIN EN 61010-1, protection class III, contamination level 2, overvoltage class II
Supply voltage	DC 5 V ±10 %
Current w/o load typ.	50 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	Sinus-Cosinus 1 Vpp
Number of pulses	2048
3dB limiting frequency	500 kHz
Absolute accuracy	±35"
Repeatability	±7"

Motor Feedback S 21

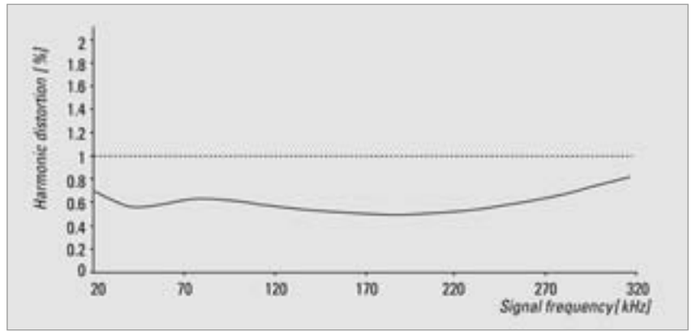
AC-Synchronous & BLDC Motors Sine-wave

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.

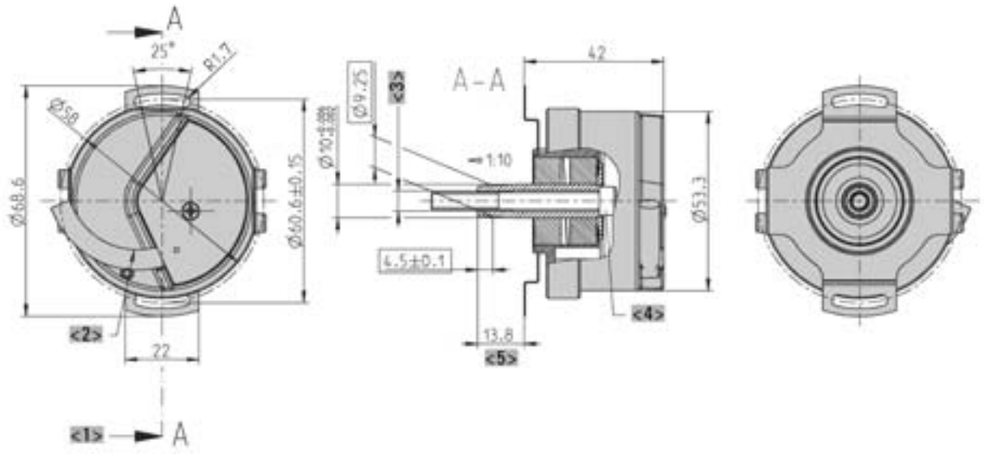
AC-Synchronous & BLDC Motors Sine-wave

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"

- 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

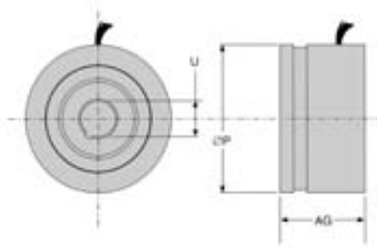
GENERAL INFORMATION

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.

TECHNICAL DATA
mechanical

Housing diameter	26.5 mm

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.

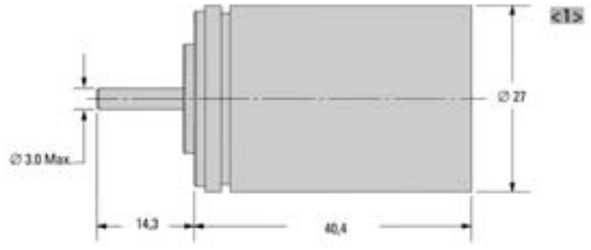
Housed Resolvers

- 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.

TECHNICAL DATA
mechanical
DIMENSIONED DRAWINGS

Housing diameter	27 mm



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

Dimensions in mm

Housed Resolvers Industry

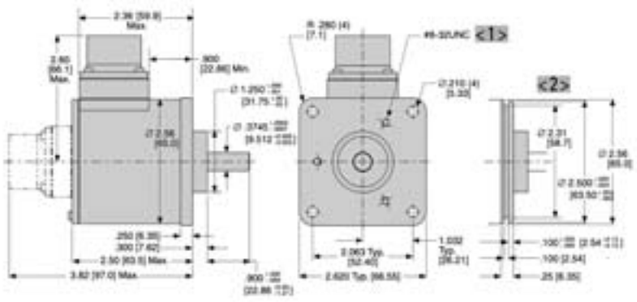
- Rugged housing with IP65
- Able to withstand high shock and vibration levels
- Insensitive to most industrial contaminant and temperature extremes
- High temperature up to 125°C
- Flange- and servo-mount styles

GENERAL INFORMATION

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.

TECHNICAL DATA
mechanical
DIMENSIONED DRAWINGS

Housing diameter	26.5 mm



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

Optional Servo Mounting

Dimensions in inch [mm]

Accesoires

Problem solutions from a single source.

Our wide range of accessory modules completes the encoder programme.

With these modules, we offer you an optimum means of meeting your application demands.

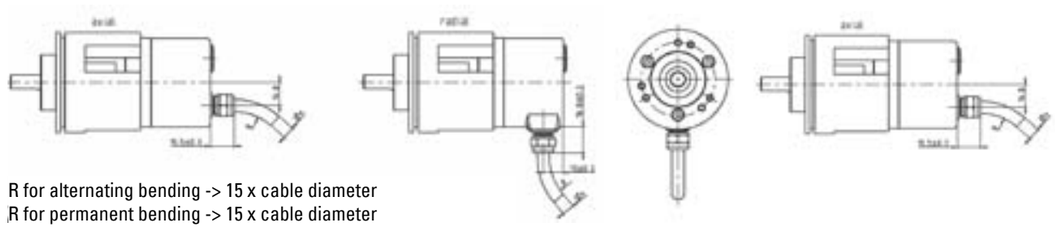
Encoder with Shock Module

AC58-S/M/P WITH OPTIONAL SHOCK MODULE

Applications with vibration rates of up to >100 m/s²and shock rates >1000 m/s²require the use of a shock module. By means of integrated attenuating elements, these encoder ratings are reduced.

Fixing	flange by means of clamping flange or clamping eccentric, shaft by means of flexible coupling
Absolute max. shaft load	axial 30 N, radial 100 N
Shaft diameter	10mm

DIMENSIONAL DRAWING ENCODER WITH SHOCK MODULE, CONNECTING CABLE



R for alternating bending -> 15 x cable diameter
R for permanent bending -> 15 x cable diameter

Dimensions in mm

DIMENSIONAL DRAWING ENCODER WITH SHOCK MODULE, FLANGE CONNECTOR

Dimensions in mm

ORDERING DATA

For the encoder option with shock module, please enquire by stating your desired encoder type.

(Accessories unit 1 540 239
Flange ordering code: L.42 for RI 58, K.42 for AC 58)

ENCODERS COUNTERS CONTROLLERS INDICATORS RELAYS PRINTERS CUTTERS HENGSTLER

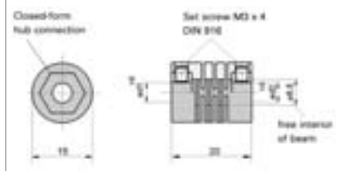
Flexible Couplings

Shaft encoders must be protected against excessive mechanical stresses, which occur whenever there are angular, axial, or radial misalignments between the machine and shaft encoder shafts.
Our flexible couplings can compensate for this within limits.

PLASTIC COUPLING

Max. speed	10000 min $^{-1}$
Torque max.	20 Ncm
Moment of inertia	1.1 gcm^2
Torsional spring constant	12 Nm/rad
Max. angular misalignment	±2.5°
Max. shaft misalignment radial / axial	±0.3 mm / ±0.2 mm
Max tightening torque of set screws	70 Ncm
Material	polyamide 6.6 glass-fibre reinforced
Weight approx.	6 g

Plastic coupling



Dimensions in mm

Hub diameter

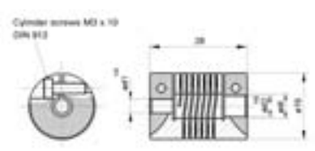
5/5 mm	**Ordering code 3 520 034**
5/6 mm	**Ordering code 3 520 033**
6/6 mm	**Ordering code 1 761 026**

Suitable for encoder type RI39
RI32,RI41,RI42for simple applications

HELICAL COUPLING

Max. speed	6000 min $^{-1}$
Torque max.	80 Ncm
Moment of inertia	8.7 gcm^2
Torsional spring constant	14 Ncm/degree
Max. angular misalignment	±4°
Max. shaft misalignment radial/axial	±0.25 mm / ±0.4 mm
Max tightening torque of set screws	80 Ncm
Material	AlCuMgPb, chromed
Weight	16 g

Helical coupling 19/28



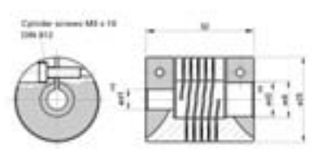
Dimensions in mm

Hub diameter

5/5 mm	**Ordering code 3 520 036**
5/6 mm	**Ordering code 3 520 035**
6/6 mm	**Ordering code 0 070 653**
6.35/6.35 mm	**Ordering code 3 520 057**

Suitable for encoder type RI 30, RI 32,
RI 36, RI 41, RI 42, RI 58, AC 58

Helical coupling 25/32



Dimensions in mm

Hub diameter

6/9.53 mm	**Ordering code 3 520 052**
6/10 mm	**Ordering code 3 520 066**
6.35/9.52 mm	**Ordering code 3 520 062**
10/12 mm	**Ordering code 3 520 065**
10/10 mm	**Ordering code 3 520 074**

Suitable for encoder type RI 58, AC 58

Flexible Couplings

ISOLATED DISK COUPLING

Max. speed		12000 min $^{-1}$
Torque max.		60 Ncm
Max. shaft misalignment	radial	±0.3 mm
	axial	±0.4 mm
	angular	±2.5°
Torsional spring constant		30 Nm/rad
Material	Flanges	aluminium, anodized
	Spring disc	plastic, glass-fibre reinforced

Hub diameter

5/6 mm	**Ordering code 3 520 080**
6/6 mm	**Ordering code 3 520 081**
6/10 mm	**Ordering code 3 520 082**
6/6.35 mm	**Ordering code 3 520 083**
6/9.53 mm	**Ordering code 3 520 084**
6.35/6.35 mm	**Ordering code 3 520 085**
7/7 mm	**Ordering code 3 520 086**
10/10 mm	**Ordering code 3 520 088**

Suitable for encoder type RI 30,
RI 32, RI 36, RI 41, RI 42, RI 58, AC 58

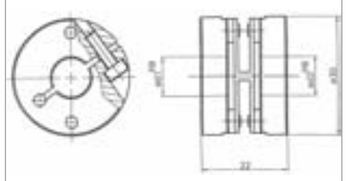
DISK COUPLING

Max. speed		12000 min $^{-1}$
Torque max.		80 Ncm
Moment of inertia		19 gcm ^{2}
Torsional spring constant		150 Nm/rad
Max. angular misalignment		±3.0°
Max. shaft misalignment radial		±0.4 mm
	axial	±0.4 mm
Max tightening torque of set screws		80 Ncm
Material	coupling body, flange	AlCuMgPb, anodized
Weight approx.		14.5 g

Ordering code 0 070 663 suitable for encoder type RI 36, RI 58, AC 58

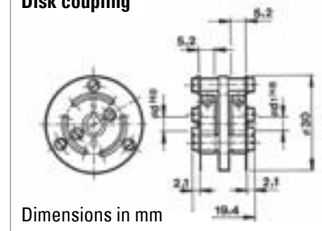
DIMENSIONAL DRAWINGS

Isolited disk coupling



Dimensions in mm

Disk coupling



Dimensions in mm

Flexible Couplings

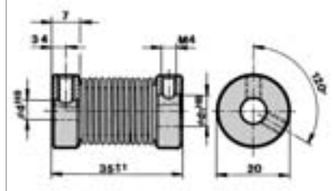
BELLOWS COUPLING

Max. speed		8000 min $^{-1}$
Torque max.		80 Ncm
Moment of inertia		9 gcm^2
Torsional spring constant		140 Nm/rad
Max. angular misalignment		±4.0°
Max. shaft misalignment radial		±0.3 mm
	axial	±0.5 mm
Max tightening torque of set screws		150 Ncm
Material	flange	aluminium
	bellows	stainless steel
Weight		16 g

Hub diameter

12/12 mm	**Ordering code 0 070 666**	Suitable for type RI 58, AC 58
10/10 mm	**Ordering code 3 520 037**	
9.53/9.53 mm	**Ordering code 3 520 038**	
6/6 mm	**Ordering code 3 520 068**	

Bellows coupling



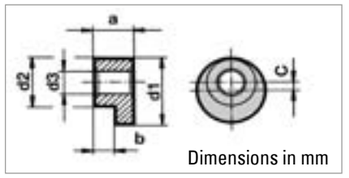
Dimensions in mm

Mounting

CLAMPING ECCENTRIC

Material CuZn39Pb3, surface nickel-plated
Set of three
Suitable for encoders with synchro flange type RI 30, RI 36, RI 58, AC 58

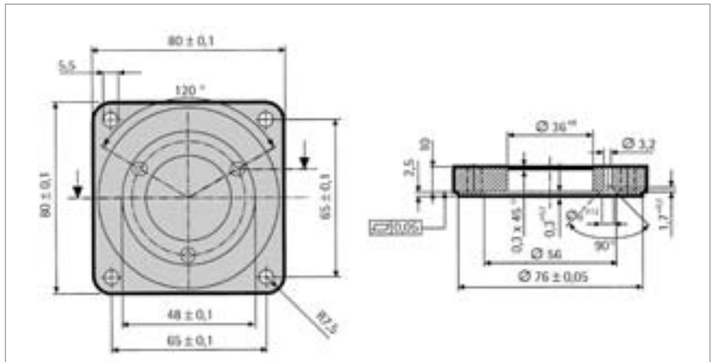
	ød$_1$	ød$_2$	ød$_3$	a	b	c
Ordering code **0 070 655** (RI 58, AC 58 Synchro flange for M3)	8.9$_{+0.1}$	6.5	3.2	4.9$_{-0.1}$	2.9$_{-0.1}$	1.2
Ordering code **0 070 657** (RI 58, AC 58 Synchro flange for M3)	12	9	3.5	4.9$_{-0.1}$	2.9$_{-0.1}$	1.5
Ordering code **0 070 654** (RI 30, RI 36 Synchro flange for M2.5)	6.8+$_{0.2}$	5	2.8	4.4$_{-0.1}$	2.4$_{-0.1}$	0.9



Dimensions in mm

SQUARE FLANGE ADAPTER
80 x 80 mm for clamping flange
RI 58, AC 58
(fastening material included)

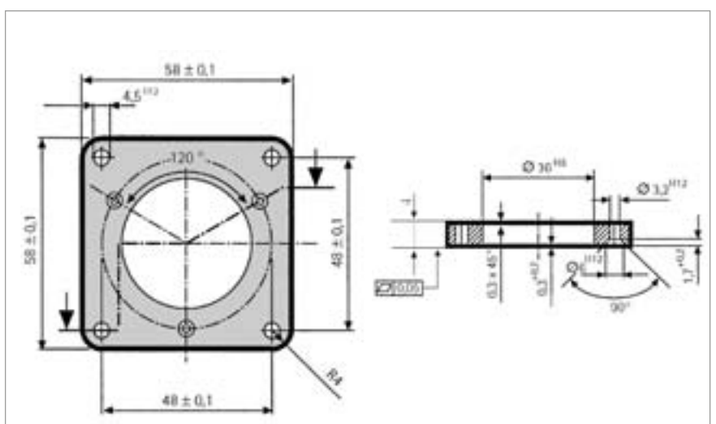
Ordering code 1 522 327



Dimensions in mm

SQUARE FLANGE ADAPTER
58 x 58 mm for clamping flange
RI 58, AC 58
(fastening material included)

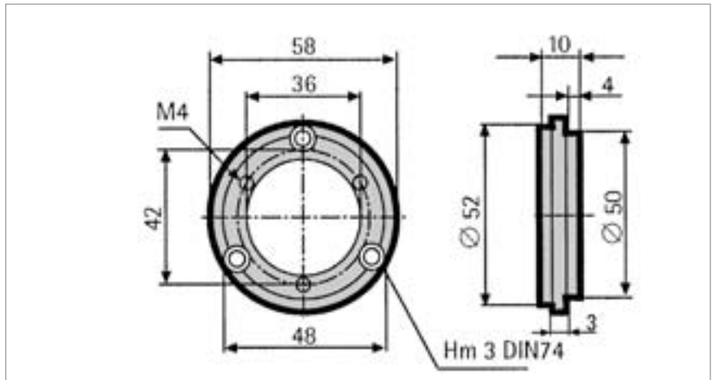
Ordering code 1 522 326



Dimensions in mm

SYNCHRO FLANGE ADAPTER
for clamping flange RI 58, AC 58 (fastening material included)

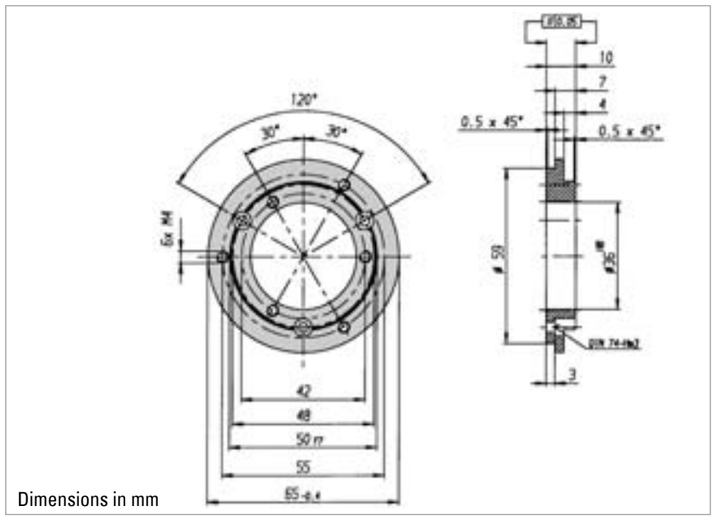
Ordering code 1 522 328



Dimensions in mm

SYNCHRO FLANGE ADAPTER
for clamping flange RI 58, same dimensions as TR HE 65 (fastening material included)

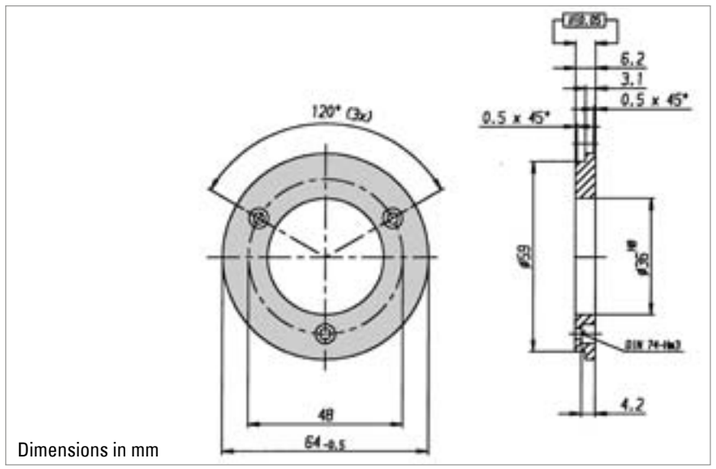
on request



Dimensions in mm

SYNCHRO FLANGE ADAPTER
for clamping flange RI 58, same dimensions as AG 661 (fastening material included)

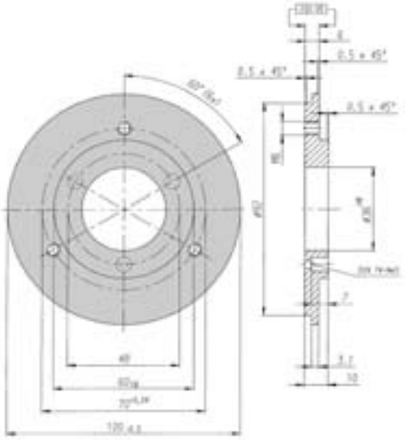
Ordering code 1 522 547



Dimensions in mm

SYNCHRO FLANGE ADAPTER
for clamping flange RI 58, same dimensions as AG 100/110 (fastening material included)

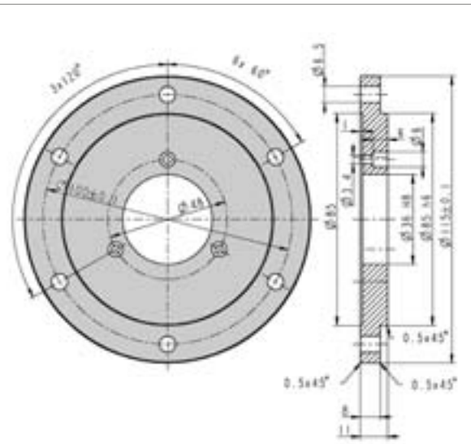
Ordering code 1 522 548



Dimensions in mm

FLANGE ADAPTER
for clamping flange AC 58, same dimensions as Gelma RAO 5 (fastening material included)

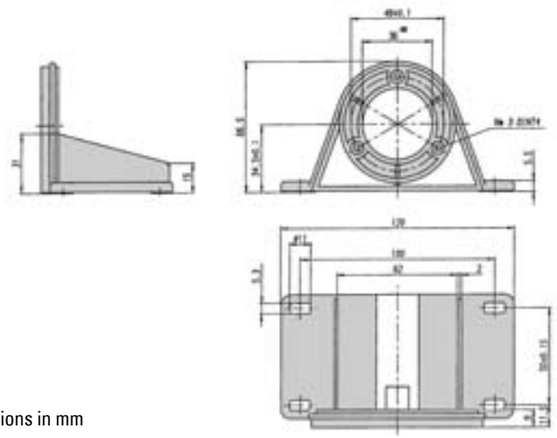
Ordering code 1 540 336



Dimensions in mm

FASTENING BRACKET (PLASTIC)
for clamping flange RI 58, AC 58 (fastening material included)

Ordering code 1 522 329

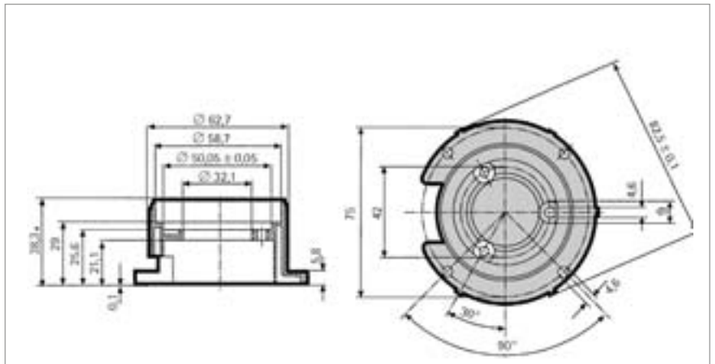


Dimensions in mm

Mounting

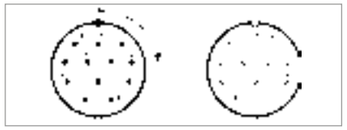
MOUNTING BELL (PLASTIC)
for synchro flange RI 58, AC 58 (clamping eccentric and fastening material included)

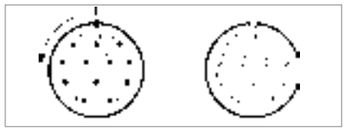
Ordering code 1 522 330



Dimensions in mm

Connectors





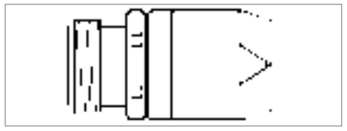
NUMBERING OF PINS

Clockwise system:
A connector with pin contacts, which is numbered clockwise, and the corresponding counter-plug connector with socket contacts (which consequently must be numbered counter-clockwise), is called right-turning.

Counter clockwise system:
A connector with pin contacts, which is numbered counter clockwise, and the corresponding counter-plug connector with socket contacts (which consequently must be numbered clockwise), is called left-turning.

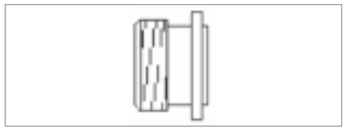
PLUG

A connector with coupling nut is called plug, without regard to its pin or socket contacts.



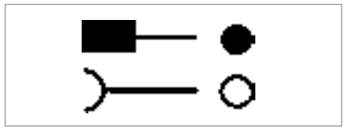
COUPLING

A connector with outer thread is called coupling without regard to its pin or socket contacts.



CONNECTOR

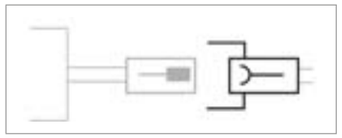
A connector is fastened to the encoder or the machine's housing, has an outer thread (like the coupling) and is available with pin or socket contacts.

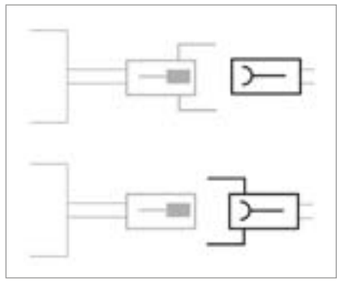


CONTACTS

Sign for pin contact

Sign for socket contact





CONNECTOR FOR MOUNTING IN ENCODER HOUSING (IDENTICALLY WITH ENCODER CONNECTOR CONIN 12 POLE)

Connector (pins) —■	Ordering code
M23 (Conin) 12 pole, clockwise	3 539 198
M23 (Conin) 12 pole, counter clockwise	3 539 230

CONNECTOR MATCHING WITH ENCODER CONNECTOR[1]

Encoder connector (pins) —■	Suitable plug (socket))—
M23 (Conin) 12 pole, clockwise (C, D)	3 539 202 (PG 9)
M23 (Conin) 12 pole, counter clockwise (G, H)	3 539 229 (PG 9)
M23 (Conin) 17 pole, counter clockwise (U, V)	3 539 256
M23 (Conin) 17 pole, clockwise (W, Y)	3 539 254
M23 (Conin) 21 pole, clockwise	1 540 232
Binder 6 pole (J, N)	3 539 472 (staight, IP67) 3 539 209 (bent, IP 40)
MS 7 pole (L, P)	3 539 262
MS 10 pole (K, O, R, T)	3 539 258
KPT 12 - 8P (1, 2)	3 539 333

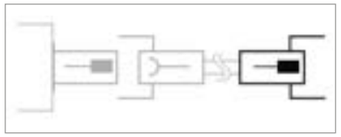
[1] Extension cables with plug refer to “Connecting cables”

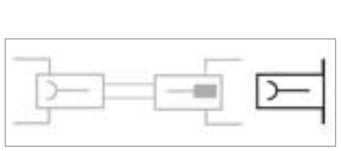
CONNECTOR MATCHING WITH ENCODER CABLE WITH CONNECTOR

Encoder plug (pins) —■	Suitable coupling (socket))—
Conin 12 pole, clockwise (-C) (3 539 186)	3 539 187
VDW[1], 12 pole, clockwise (-B) (3 539 252)	3 539 304
SUB-D, 37 pole (-F) (1 542 025)	1 542 024

Encoder coupling (pins) —■	Suitable plug (socket))—
M23 (Conin) 12 pole, counter clockwise (-D) (3 539 273)	3 539 229
VDW[1], 12 pole, counter clockwise (-E) (3 359 274)	3 539 305

[1] VDW corresponding to Conin plastic-coated





CONNECTOR ON CONNECTION CABLE SUITABLE FOR DOWNSTREAM LOGIC CIRCUIT

Plug (pins)	Ordering code
M23 Conin 12 pole, clockwise	3 539 186
M23 Conin 12 pole, counter clockwise	3 539 316
M23 Conin 9 pole, clockwise	3 539 293
VDW[1] 12 pole, clockwise	3 539 252
M23 Conin 17 pole, clockwise	3 539 317
M23 Conin 17 pole, counter clockwise	3 539 309

Coupling (pins)	Ordering code
M23 Conin 12 pole, clockwise	3 539 301
M23 Conin 12 pole, counter clockwise	3 539 273
VDW[1] 12 pole, counter clockwise	3 539 274
M23 Conin 17 pole, clockwise	3 539 302
M23 Conin 17 pole, counter clockwise	3 539 303

[1] VDW corresponding to Conin plastic-coated

CONNECTOR FOR MOUNTING INTO DOWNSTREAM LOGIC CIRCUIT HOUSING

Connector (socket)	Ordering code
M23 Conin 12 pole, clockwise	3 539 318
M23 Conin 12 pole, counter clockwise	3 539 319

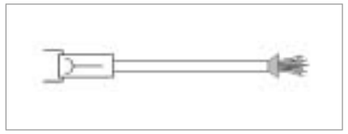
MOUNTING ACCESSORIES

	Ordering code
Mounting spanner for Conin connectors	3 539 318

OTHER CONNECTORS

	Ordering code
M23 Conin plug 9 pole, clockwise, socket	3 539 294
Binder 6 pole	3 539 472

CONNECTING CABLES
with plug (socket) on one end



M23 (CONIN), 12 POLE FOR RI 58 (TPE CABLE)

Pin	Colour[1]	Lead mm²
1	pink	0.14
2	blue	0.14
3	red	0.14
4	black	0.14
5	brown	0.14
6	green	0.14
7	violet	0.14
8	grey	0.14
9	Screen	0.14
10	white/green	0.5
11	white	0.14
12	brown/green	0.5
Housing	Screen	

[1] Cable version 3 280 112

Length	Matching with C/D, cw[1] Ordering code	Matching with G/H, ccw[2] Ordering code
3 m	**1 522 348**	**1 522 394**
5 m	**1 522 349**	**1 522 395**
10 m	**1 522 350**	**1 522 396**
15 m	**1 522 454**	**1 522 447**
20 m	**1 522 456**	**1 522 461**
25 m	**1 522 457**	**1 522 462**
30 m	**1 522 464**	**1 522 463**

[1] matching with encoder connector 12 pole, cw (C/D)
[2] matching with encoder connector 12 pole, ccw (G/H)

M16 (BINDER), 6 POLE FOR RI 30, RI 36, RI 58 (PVC CABLE)

Pin	Colour[1]	Lead mm²
1	red	0.5
2	white	0.14
3	yellow	0.14
4	green	0.14
5	yellow/black	0.14
6	black	0.5
Housing	Screen	

[1] Cable version 3 280 113

Length	Ordering code
3 m	**1 522 405**
5 m	**1 522 404**
10 m	**1 522 340**

matching with encoder connector (Binder) 6 pole (J, N)

M23 (CONIN), 12 POLE, FOR AC 58 WITH SSI-INTERFACE (TPE CABLE)

Pin	Colour[1]	Lead mm²
1	brown	0,5
2	pink	0,14
3	yellow	0,14
4		
5	blue	0,14
6		
7		
8	white	0,5
9		
10	grey	0,14
11	green	0,14
12	black	0,14
Gehäuse	Screen	

[1] Cable version 3 280 220

Length	Matching with C/D, cw[1] Ordering code	Matching with G/H, ccw[2] Ordering code
3 m	**1 542 003**	**1 542 010**
5 m	**1 542 004**	**1 542 011**
10 m	**1 542 005**	**1 542 012**
15 m	**1 542 006**	**1 542 013**
20 m	**1 542 007**	**1 542 014**
25 m	**1 542 008**	**1 542 015**
30 m	**1 542 009**	**1 542 016**
40 m	**1 542 026**	**1 542 028**
50 m	**1 542 027**	**1 542 029**

[1] matching with encoder connector 12 pole, cw (C/D)
[2] matching with encoder connector 12 pole, ccw (G/H)

M12, 8 POLE FOR AC 58 BISS/SSI (PUR CABLE)

Length	Ordering code	Length	Ordering code
3 m	**1 565 329**	15 m	**1 565 332**
5 m	**1 565 330**	20 m	**1 565 333**
10 m	**1 565 331**	25 m	**1 565 334**

CONNECTING CABLES
with plug (socket) on one end

MS, 10 POLE FOR RI 58 (TPE CABLE)

Pin	Colour[1]	Lead mm²
A	brown	0,14
B	grey	0,14
C	red	0,14
D	brown/green	0,5
E	violet	0,14
F	white/green	0,5
G	green	0,14
H	pink	0,14
I	black	0,14
J	Screen	0,14

[1] Cable version 3 280 112

Length	Ordering code
3 m	**1 522 610**

M23 (CONIN), 12 POLE FOR AC 58 SSI-P INTERFACE (TPE-CABLE)

Pin	Colour[1]	Lead mm²
1	green	0,14
2	yellow	0,14
3	pink	0,14
4	grey	0,14
5	brown	0,14
6	white	0,14
7	black	0,14
8	blue	0,14
9	red	0,14
10	violet	0,14
11	white	0,5
12	brown	0,5
Housing	Screen	

[1] Cable version 3 280 220

Length	ccw[1] Ordering code
3 m	1 543 002
5 m	1 543 003
10 m	1 543 004
15 m	1 543 005
20 m	1 543 006
25 m	1 543 007
30 m	1 543 008
40 m	1 543 015
50 m	1 543 016

[1] matching with encoder connector 12 pole, ccw (G/H)

M23 (CONIN) 12 POLE FOR AC 58 CANopen (TPE-Cable)

Pin	Colour[1]	Lead mm²
1		0,14
2	green	0,14
3	blue	0,14
4	pink	0,14
5	grey	0,14
6		0,14
7	yellow	0,14
8		0,14
9		0,14
10	brown	0,5
11	brown	0,14
12	white	0,5
Housing	Screen	

[1] Cable version 3 280 220

Length	ccw[1] Ordering code
1 m	1 542 236
3 m	1 542 237
5 m	1 542 238
10 m	1 542 288
15 m	1 542 289
20 m	1 542 290
25 m	1 542 291
30 m	1 542 292

[1] matching with encoder connector 12 pole, cw (C/D/-C/-I)

SUB-D 37 POLE FOR AC 58 WITH PARALLEL INTERFACE (TPE CABLE)

Colour [1]	Pin	Colour [1]	Pin
brown	2	white/blue	14
green	21	brown/blue	33
yellow	3	white/red	15
grey	22	brown/red	34
pink	4	white/black	16
violet	23	brown/black	35
grey/pink	5	grey/green	17
red/blue	24	yellow/grey	36

Colour [1]	Pin	Colour [1]	Pin
weiß/grün	6	pink/green	18
brown/green	25	yellow/pink	10
white/yellow	7	green/blue	30
yellow/brown	26	yellow/blue	12
white/grey	8	red	13
grey/brown	27	white	31
white/pink	9	blue	1
pink/brown	28	black	20

[1]Cable version 3 280 221

Length	Ordering code
1 m	**1 542 163**
3 m	**1 542 020**
5 m	**1 542 021**
10 m	**1 542 022**
15 m	**1 542 172**

Length	Ordering code
20 m	**1 542 173**
25 m	**1 542 174**
30 m	**1 542 175**
40 m	**1 542 176**
50 m	**1 542 177**

CONIN 17 POLE FOR AC 58 WITH PARALLEL INTERFACE (PVC-KABEL)

Pin	Colour [1]	Lead mm²
1	brown/grey	0,14
2	red/blue	0,14
3	violet	0,14
4	white/brown	0,14
5	white/green	0,14
6	white/yellow	0,14
7	white/grey	0,14
8	white/pink	0,14
9	white/blue	0,14
10	white/red	0,14
11	white/black	0,14
12	brown/green	0,14
13	pink	0,14
14	green	0,14
15	black	0,5
16	red	0,5
17	brown	0,14
Housing	Screen	

[1]Cable version 3 280 100

Length	Matching with C/D, cw [1] Ordering code	Matching with G/H, ccw [2] Ordering Code
3 m	**1 540 100**	**1 540 097**
5 m	**1 540 101**	**1 540 098**
10 m	**1 540 102**	**1 540 099**
15 m	**1 540 142**	**1 540 138**
20 m	**1 540 143**	**1 540 139**
25 m	**1 540 144**	**1 540 140**
30 m	**1 540 145**	**1 540 141**
40 m	**1 540 205**	**1 540 207**
50 m	**1 540 206**	**1 540 208**

[1]matching with encoder connector 17 pole, cw (W/Y)

[2]matching with encoder connector 17 pole, ccw (U/V)

Connection diagramm see AC 58, parallel interface with connector.

CONNECTING CABLES
with connector on both ends

CABLE NOT MADE UP WITH CONNECTORS

M23 (CONIN) 12 POLE FOR AC 58 WITH INTERBUS-INTERFACE (TPE-CABLE)

Length [1]	clockwise Ordering Code
3 m	**1 542 017**
5 m	**1 542 018**
10 m	**1 542 019**

[1]Cable version 3 280 220

	Ordering code
TPE cable for RI (12-core + screen)	**3 280 112 + length**
PVC cable for RI (10-core + screen)	**3 280 114 + length**
PVC cable for RI (6-core + screen)	**3 280 113 + length**
PVC cable for AC58 with parallel (20-core + screen)	**3 280 100 + length**
TPE cable for AC58 with SSI or IB-S (12-core + screen)	**3 280 220 + length**
TPE cable for AC58 with parallel (32-core + screen)	**3 280 221 + length**

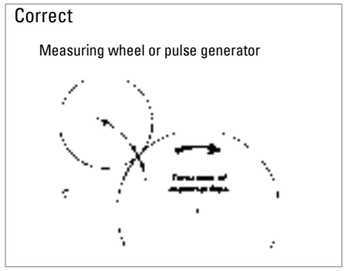
Measuring Wheels

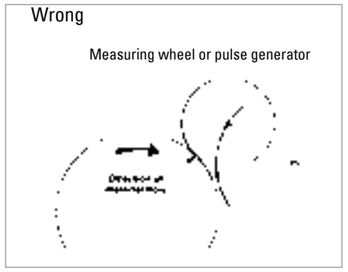
GENERAL ASPECTS

In order to prevent the result being distorted when the shaft encoder is driven by a measuring wheel make sure that the slip is as small as possible. When selecting the tread (surface), take into account the structure, stretchability, thickness, and resistance to being carried along of the material being measured.

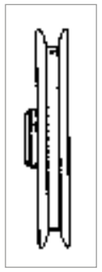
The slip is also affected by the width of the measuring wheel, the contact pressure, the tension in the material being measured, and the arc of contact. The arc of contact should be as large as possible. The wheel bodies are made of cast aluminium or plastic (as marked).

The position of the measuring wheel should be chosen so that the direction of movement of the material is away from the shaft encoder's bearing point.



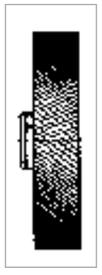


MEASURING WHEEL TREADS



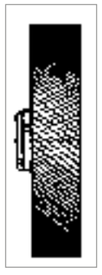
Tread 1
with rim and fine crosshatched knurl Material: aluminium

Applications such as threads and yarns



Tread 2
with glued-on rubber profile
A = soft specially clinging rubber surface (red)
B = low-wear rubber surface with good grip (white)

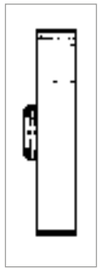
Applications such as paper and cardboard, measuring cables, nongreasy metals, fleece, undressed or surface-treated wood, soft and hard plastics.



Tread 3
vulcanized rubber surface with parallel knurl

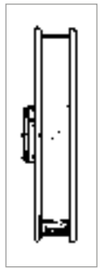
Applications such as rubber, leather, fabrics, flooring and glass.

Measuring Wheels



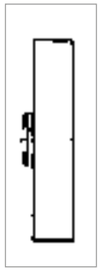
Tread 4
aluminium with parallel knurl

Applications such as rubber, soft plastics, wood with rough surface, and to a limited extent for fabrics.



Tread 5
with rim, aluminium with parallel knurl

Applications such as threads, yarns and bands.



Tread 6
plastic surface

Applications such as wire, greasy metals, and steel sections.

ORDERING DATA

Aluminium

Diameter	Circumference	Tread	Width of bearing surface mm	Bore diameter 4.0 mm	6.0 mm	7.00 mm	10.0 mm	12.0 mm
6.37 cm	0.2 m	1	4	0 601 014	—	0 601 017	—	—
		2 A	12	0 601 018	—	—	—	—
		2 B	12	0 601 118	0 601 048	—	0 601 049	—
		2 A	24	0 601 020	—	0 601 092	—	—
		2 B	24	—	—	0 601 192	—	—
		4	20,5	0 601 023	—	—	—	—
		4	20	—	—	0 601 093	—	—
		5	16,5	0 601 026	—	0 601 094	—	—
15.92 cm	0.5 m	2 A	25	—	—	0 601 050	—	—
		2 B	25	—	—	0 601 150	0 601 151	—
		3	25	—	—	0 601 059	0 601 156	0 601 159
		4	25	—	—	0 601 121[1]	0 601 157	—
		6	25	—	—	0 601 063[1]	0 601 163	0 601 165
5.73 cm	1/5 yd.	1	4	0 601 034	—	0 601 037	—	—
		2 A	24	0 601 042	—	—	—	—
		5	16,5	—	—	0 601 096	—	—
14.33 cm	1/2 yd.	4	25	—	—	0 601 061	—	—
9.70 cm	1 foot	2 A	25	—	—	0 601 071	—	—
		2 B	25	—	—	0 601 171	—	—

Plastic

6.37 cm	0.2 m	1	4	0 601 100	—	—	—	—
15.92 cm		4	25	—	—	0 601 301	—	—
		6	25	—	—	0 601 300	—	—

[1]PTB approved

Other measuring wheels available on request

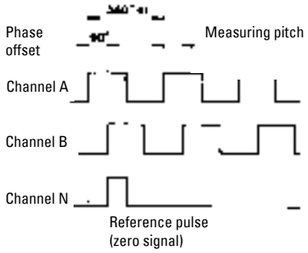
GENERAL INFORMATION

Incremental encoders are sensors capable of generating signals in response to **rotary movement**. In conjunction with mechanical conversion devices, such as rack-and-pinions, measuring wheels or spindles, incremental shaft encoders can also be used to **measure linear movement**. The shaft encoder generates a signal for each incremental change in position.

With the **optical transformation**, a line-coded disc made of metal, plastic or glass and positioned on a rotary bearing interrupts the infra red light ray emitted by gallium arsenid sender diode. The number of lines determines the resolution, i.e. the measuring points within a revolution. The interruptions of the light ray are sensed by the receptor element and electronically processed. The information is then made available as a rectangular signal at the encoder output.

Output Signals of Incremental Encoders

OUTPUT SIGNALS



Shaft turning clockwise (cw) seen from front of encoder

The shaft encoders supply two square wave pulses offset by 90° A and B, and a reference pulse N (zero signal) as well.

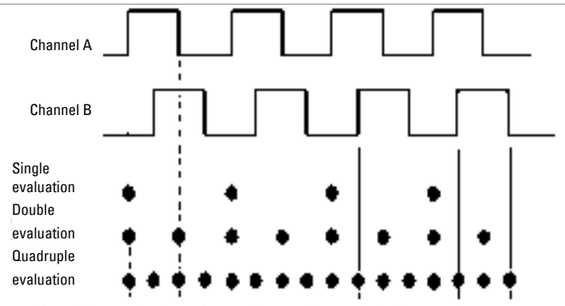
In order to suppress spurious pulses, certain output circuits (RS 422 and push-pull) generate inverted signals ($\overline{A}$, $\overline{B}$, $\overline{N}$) such as in models RI 30, RI 36, RI 58, RI 58-H, RI 76-TD and RI 58-D.

The measuring pitch is defined as the value of the distance between two pulse edges of A and B.

EVALUATION

The resolution of a two-channel shaft encoder can be doubled or quadrupled in the subsequent circuitry.

This enables the resolution of a two-channel encoder with 2500 lines per rev. to be increased electronically to 5,000 or 10,000 pulses per revolution (see diagram below).



Possible evaluation of two-/three-channel shaft encoders

Maximum Speed,Protection Class

SPEED

The maximum permissible speed of a shaft encoder is derived from:

- the mechanically permissible r.p.m,
- the minimum permissible pulse-edge spacing of the square-wave output signals of the shaft encoder for the subsequent circuitry, which depends on the tolerance of the phase offset,
- the functional speed, which is limited by the pulse frequency.

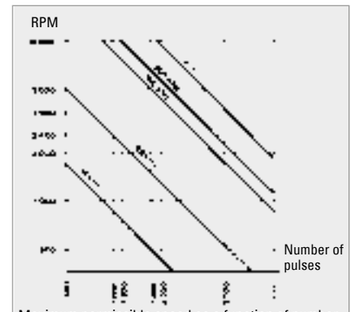
The mechanically permissible r.p.m. is specified for each shaft encoder among the mechanical characteristics.

In general, the control circuitry does not permit less than a certain minimum edge spacingbetween the square-wave output signal pulses. The minimum pulse-edge spacing is specified for each model of shaft encoder among the electrical characteristics.

The functional speedof an encoder is obtained by the equation:

$n_{max} = f_{max} \cdot 10^3 \cdot 60 / Z$

n_{max} = maximum functional speed [r.p.m.]
f_{max} = maximum pulse frequency of shaft encoder, or input frequency of downstream circuitry [kHz]
z = number of pulses of shaft encoder



Maximum permissible speed as a function of number of pulses and signal frequency of shaft encoder

PROTECTION CLASS

All encoders of the industrial types RI 30, RI 36, RI 58, RI 58-H, RI 58-D, RA 70-I as well as the absolute encoders ACURO, comply with protection class IP65 according to EN 60529 and IEC 529, unless otherwise stated.

These specifications are valid for the housing and the cable output and also for plugged in socket connectors. The shaft input complies with protection class IP64. If however the encoder is mounted vertically, there must be no standing water present at the shaft input and the ball bearings.

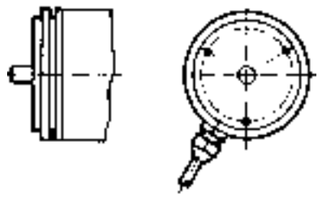
In case the standard protection class IP64 is not sufficient for the shaft input, e.g. with vertical mounting of the encoder, the encoders must be protected by additional labyrinth or pot-type seals.

On request our encoders are also available with protection class IP67 for the shaft input and for the housing.

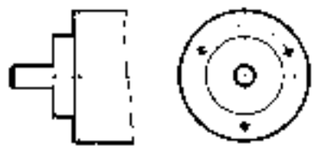
Examples of Flange Mounting

FLANGE TYPE OVERVIEW

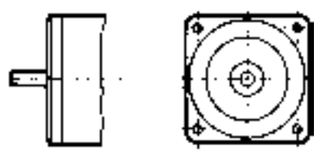
S = Synchro flange



K = Clamping flange



Q = Square flange

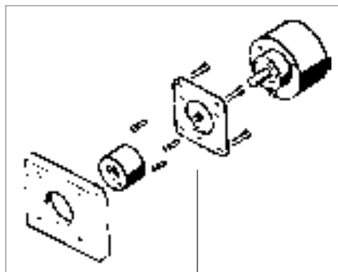


R = Pilot flange

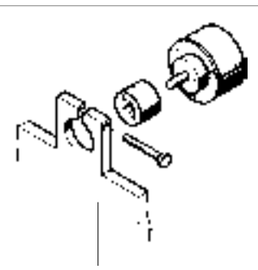
SHAFT ENCODERS WITH CLAMPING FLANGE

The shaft encoders with a clamping flange can be installed in following ways:
- by means of various flange adapters (see “Accessories”),
- by means of the clamping flange itself,
- by means of the fastening threads provided on the face,
- by means of an angle bracket (see Accessories”).

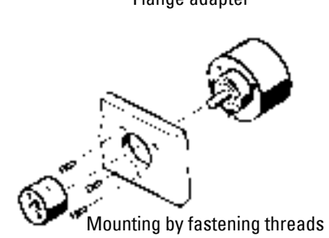
The encoder housing is centered by means of the clamping flange.



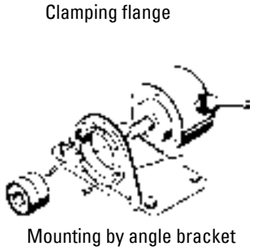
Flange adapter



Clamping flange



Mounting by fastening threads



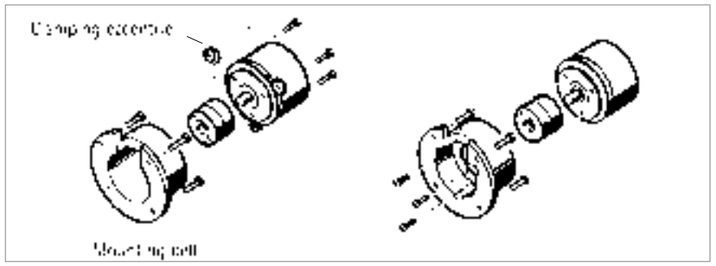
Mounting by angle bracket

Examples of Flange Mounting

SHAFT ENCODERS WITH SYNCHRO FLANGE

The shaft encoders with synchro flange can be installed in two ways:
- by means of the synchro flange and three clamping eccentrics (see “Accessories”),
- by means of the fastening threads provided on the face.

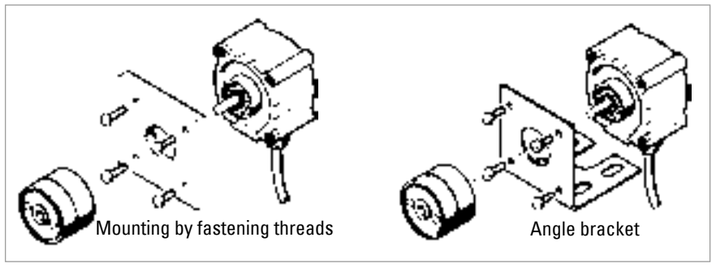
The encoder is centered by means of the centering collar on the flange.



SHAFT ENCODERS WITH SQUARE FLANGE

The shaft encoders with square flange can be installed in two ways:
- by means of the fastening threads provided on the face
- by means of an angle bracket.

The encoder is centered by means of the centering collar on the flange.



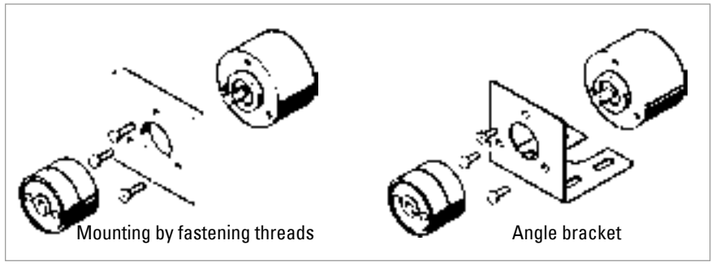
Mounting by fastening threads

Angle bracket

SHAFT ENCODERS WITH PILOT FLANGE

The shaft encoders with pilot flange can be installed in two ways:
- by means of the fastening threads provided on the face,
- by means of an angle bracket.

The encoder is centered by means of the centering collar on the flange.

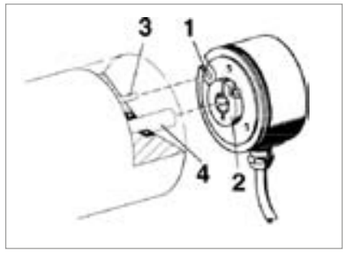


Mounting by fastening threads

Angle bracket

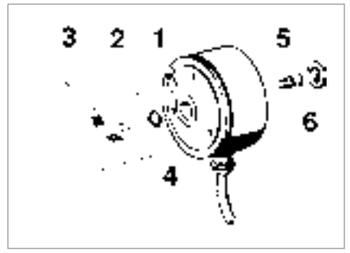
Examples of Flange Mounting

SHAFT ENCODERS WITH HOLLOW SHAFT (RI 58-D/G)



Mounting of version F, D (Clamping shaft)

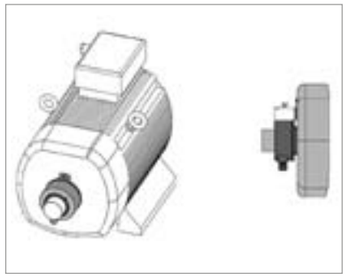
1 Torque support
2 Clamping ring with cross-recess screw
3 Straight pin
4 Actuating shaft



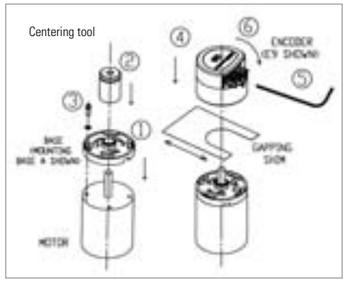
Mounting of version E (Blind shaft)

1 Torque support
2 O-ring
3 Straight pin
4 Actuating shaft with threaded bore
5 M4-screw with spring washer
6 Cap

SHAFT ENCODERS WITH HOLLOW SHAFT (RI 76)



MOTOR SHAFT ENCODERS WITH HOLLOW SHAFT (E9)



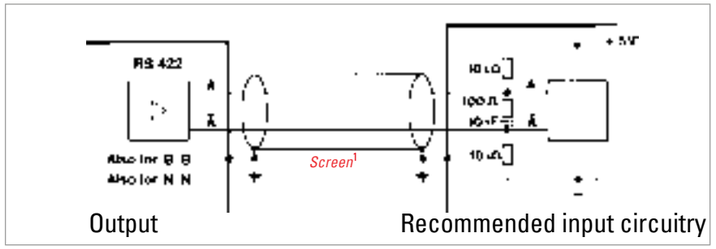
1. Place the base plate of encoder onto the motor rear end plate.
2. Install centering tool on motor shaft to center the base plate with respect to the shaft.
3. Install hardware supplied and tighten to secure the base plate. Remove centering tool.
4. Position and mount the encoder housing onto the base plate with its 3x120° bayonet snaps in their corresponding slots on the base plate. Slide the gapping shimbetween the base plate and the encoder from the side opposite the connector.
5. Place the hex wrench into the codewheel set screw. Tighten the set screw while pushing the codewheel down toward the gapping shim with the wrench.
6. Remove the gapping shim, push down and twist the encoder 30° clockwise to lock it in place.

SHAFT ENCODERS WITH SOLID SHAFT

Connection of solid-shaft encoders to the shaft is by means of a coupling. The coupling compensates for axial movements and lack of alignment between the shaft encoder and the drive shaft, thus preventing excessive bearing loads on the encoder shaft.
For further details please refer to chapter “Accessories”.

Outputs - RS 422 - TTL

OUTOUT CIRCUIT



[1]Cable sreen:
- not existing for RI 32, 38, 42
- connected to encoder housing for RI 30, 36, 58, 59, 76 and RX 70

TECHNICAL DATA

Code letter	R = RS 422 + Alarm[3](with U_B = DC 5 / 10 - 30 V) T = RS 422 + Sense[4](only with U_B= DC 5 V)
Output signals shaft turning clockwise (cw) seen from front of encoder	 Square wave pulses (TTL) for channels A, B, N and their inverted signals $\overline{A}$, $\overline{B}$, $\overline{N}$
Delay times at 1.5 m cable	≤100 ns ≤100 ns
Pulse shape	⎍
Pulse duty factor	1:1
Tolerance[1]	±25° electrical
Max. Output frequency	300 kHz
Output voltage	DC 0 - +5 V [2]
Output level	H ≥ DC 2,5 V / L ≤ DC 0,5 V (TTL-Pegel)
Output load max.	±30 mA
Short circuit protection	with U_B= DC 5 V: only 1 channel at a time for max. 1 s (Standard RS 422-Driver) with U_B= DC 10 - 30 V: short circuit proof for all channels due to integrated controller
Pole protection of U_B	with U_B= DC 5 V: no with U_B= DC 10 - 30 V: yes

[1]Distance A to B is at least 0.45 µs (at 300 kHz)
[2]also for U_B = DC 10 - 30 V
[3]Description - see Outputs Alarm
[4]Description - see Outputs Alarm

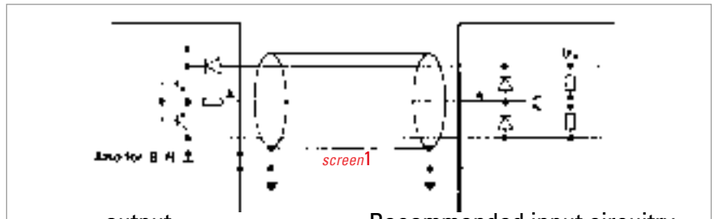
CABLE LENGTH

depending on voltage and frequency (at 25°C) [1]:	
Length	RS 422
10 m	DC 5 V, 300 kHz
50 m	DC 5 V, 300 kHz
100 m	DC 5 V, 300 kHz

[1]with Hengstler accessory cables

Outputs- Push-pull

OUTPUT CIRCUIT



[1]Cable screen:
- Not existing for RI 32, 38, 42
- Not ceonnected to encoder housing for RI 41
- Connected to encoder housing for RI 30, 36, 58, 59, 76 and RA 70

TECHNICAL DATA

Code letter	K = push-pull, 10 mA with U_B= DC 5 V or push-pull, 30 mA with U_B= DC 10 - 30 V D = push-pull, 30 mA with U_B= DC 5 V		
Output signals shaft turning clockwise (cw) seen from front of encoder	 Square wave pulses (TTL or HTL) for channels A,B,N		
Delay times at 1.5 m cable	 ≤ 100 ns (DC 5 V, push-pull D) ≤ 250 ns (DC 5 V, push-pull K) ≤ 2 µs (DC 10 - 30 V, push-pull K)		
Pulse shape	⎍		
Pulse duty factor	1:1		
Tolerance[1]	±25° electrical		
Max. Output frequency	300 kHz (see cable length)		
Output voltage	0... + U_B		
Outut level	K push-pull (10 - 30 V) H ≥ U_B-3V L ≤ 2 V	K push-pull (5 V) H ≥ 2,5 V L≤ 0,5 V	D push-pull (5 V) H ≥ 2,5 V L≤ 0,5 ç
Output load max.	±30 mA	±10 mA	±30 mA
Short circuit protection	all channels	all channels	1 channel [2]
Pole protection of U_B	yes	yes	no

[1]Distance A to B is at least 0,45 µs (at 300 kHz)
[2]only 1 channel at a time for max. 1 s

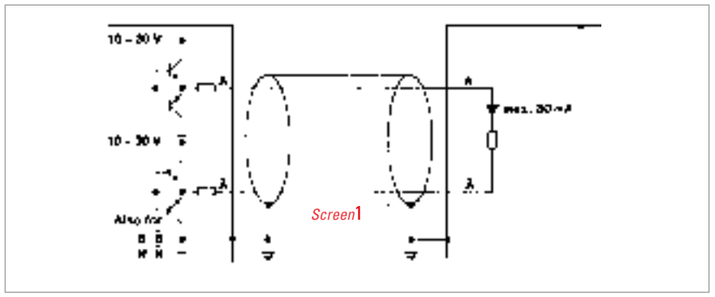
CABLE LENGTH

depending on voltage and frequency (at 25 °C) [1]:			
Length	push-pull (K) DC 5 V, 10 mA	push-pull (D) DC 5 V, 30 mA	push-pull (K) DC 10 - 30 V, 30 mA
10 m	300 kHz	300 kHz	DC 12 V, 200 kHz DC 24 V, 200 kHz DC 30 V, 200 kHz
50 m		300 kHz	DC 12 V, 200 kHz DC 24 V, 200 kHz DC 30 V, 100 kHz
100 m		300 kHz	DC 12 V, 200 kHz DC 24 V, 100 kHz DC 30 V, 50 kHz

[1]with Hengstler accessory cables

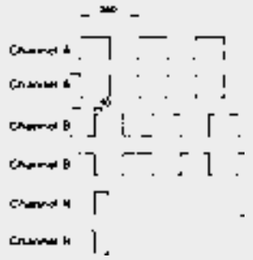
Outputs - push-pull complementary

OUTPUT CIRCUIT



[1]cable screen connected with encoder housing

TECHNICAL DATA

Code letter	I = push-pull complementary (bei U_B= 10 - 30 V)
Output signals shaft turning clockwise (cw) seen from front of encoder	 Square wave pulses (HTL) for channels A, B, N and their inverted signals $\overline{A}$, $\overline{B}$, $\overline{N}$
Delay times at 1.5 m cable	 ≤ 2 µs ≤ 2 µs
Pulse shape	⎍
Pulse duty factor	1:1
Tolerance[1]	±25° electical
Max. output frequency.	200 kHz (see cable length)
Output voltage	0 ... + U_B
Output level	H ≥ U_B-3 V / L ≤ 2V
Output load max.	±30 mA
Short circuit protection	short circuit proof for all channels due to integrated controller
Pole protection of U_B:	yes

[1]Distance from A to B is at least 0.7 µs (at 200 kHz)

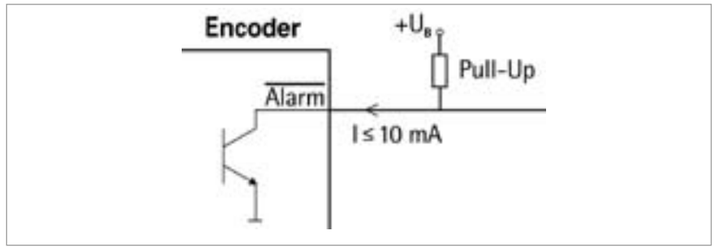
CABLE LENGTH

depending on voltage and frequency (at 25 °C) [1]:	
Length	push-pull complementary
10 m	DC12 V, 200 kHz
	DC24 V, 200 kHz
	DC30 V, 200 kHz
50 m	DC12 V, 200 kHz
	DC24 V, 50 kHz
	DC30 V, 25 kHz
100 m	DC12 V, 150 kHz
	DC24 V, 25 kHz
	DC30 V, 12 kHz

[1]with Hengstler accessory cables

Outputs - Alarm

OUTPUT CIRCUIT



TECHNICAL DATA

Output	NPN - Open collector
Output load max.	5 mA / 24 V at U_B= DC 5 V 5mA / 32 V at U_B= DC 10- 30 V
Output level	Output active (failure condition): L ≤ DC 0,7 V Output inactive: high impedance (if necessary: get H-level by an external pull-up resistor)
Malfunction indication time	≥ 20 ms

FUNCTION

The rotary encoders are equipped with an electronic monitoring system that reports potential malfunctions via a separate alarm output.

The alarm output can be used for selecting an optical display (LED; for circuit, see above) or the control system (SPC or similar).

Moreover, the alarm outputs of several encoders can be interconnected to a common „system alarm“ by means of a parallel connection.

The following errors are indicated:

Category I	Category II	Category III
- damaged disks	- overtemperature	- voltage range DC 1V < U < DC 4V
- defective LED	- overload e. g. due to chort circuit	- voltage drop on the supply lines
- contamination		

Category I malfunctions cannot be corrected; the encoder must be replaced.

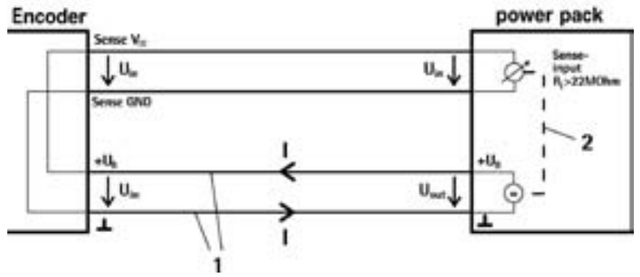
Category II malfunctions are detected by means of a thermal monitoring unit in the electronic system. The alarm message is cleared after the cause of temperature increase has been removed.

Category III malfunctions indicate insufficient supply voltage. Also included in this category are transients in the supply voltage, e.g. due to electrostatic discharge, which may distort the output signals. This is corrected by

- readjustment to the correct voltage
- eliminating the cause of disturbance, i.e. by careul arrangement of the cables.

Outputs- Sense at RS 422 (T)

OUTPUT CIRCUIT



[1]Voltage drop due to long cable lengths
[2]Automatic readjustment of the output voltage
(only for power packs with sense input)

FUNCTION

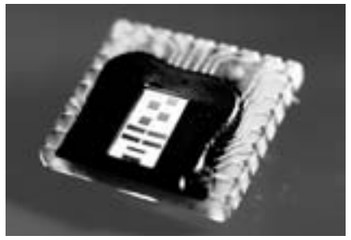
The sense wires enable measuring of the actual encoder supply voltage (compensates for voltage drops due to supply current and cable resistance).
Due to the voltage drop in the cables and the voltage supply, the encoder input voltage U_{in} is less than the power pack output voltage U_{out}.
The present input voltage U_{in} t is now output to the Sense V_{CC} and Sense GND cables and returns as data to the power pack.

The input resistance R_i on the power pack should amount to at least 22 MOhm so that no voltage drop occurs on these cables.

In case of power packs with sense input, it is now possible to readjust the output voltage U_{out} automatically.

Sine-wave OptoAsic technology

GENERAL INFORMATION



SINE-WAVE OPTOASIC TECHNOLOGY BURSTS THE LIMITS

Newest OptoAsic-Technology from Hengstler

With the introduction of the sine-wave encoder family, Hengstler has taken the opportunity to significantly rework its Opto-Asic technology.

The best features have been maintained and new improvements have been introduced. One major feature that has been retained of course, is the high level of EMC reliability which we have achieved by intergrating almost the complete encoder electronics into one component.

What is new is the integrated offset and amplitude control together with the in-chip optical system adjustment. In the past anybody wanting high quality, accurate sine-wave signals at low freuquencies had to trade in this for bandwith. We are now able to meet this apparently contradictory requirement with our in-built amplitude control. You can't fail to be convinced by a unit which delivers sine-wave signal with harmonic distortion better than 1% at low speed and 500 kHz max. frequency.

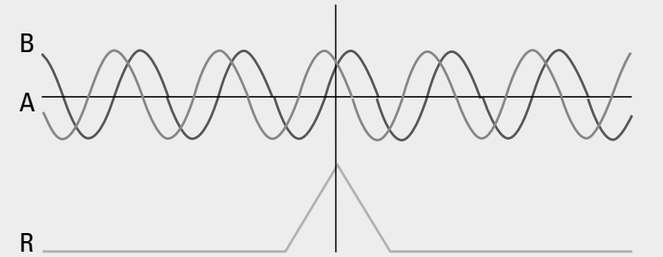
The advantages are crystal clear: If you need precision at slow speed you no longer have to compromise your productivity because the encoder limits the maximum speed of your machine e.g. for tool changing processes. You can have both - accuracy and speed.

APPLICATIONS

Typical applications:
- Machine tools
- Printing machines
- Gearless elevators
- Drives

Signals

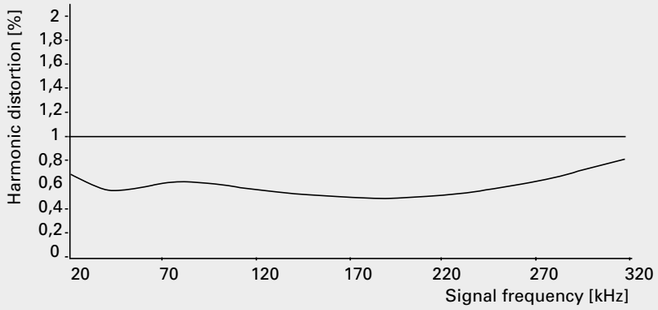
SIGNALS



Signals shown at CW rotation with view on shaft's end

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 with a peak of 0.4 V and reaches its maximum value at the angle where the amplitudes of the A and B signals are equal. All signals have a DC-offset of 2.5 V.

SIGNAL QUALITY



The quality of the servo loop is determined to a large extent by the abscene of harmonics in the encoder's sinewave signals, particulary at low speed. In order to achieve high interpolation factors in the sequencing control, the incremental sine 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.

ABSOLUTE EINCODERS FOLLOW THE LATEST TREND: CHANGE EASILY TO ACURO

Absolute encoders save costs and provide enhanced safety - facts that are obviously important in complex installations and multi-axis machinery: Time-consuming reference runs after powering-up the supply voltage have become a thing of the past for absolute encoders. Hazardous conditions caused by reference runs (which are always necessary with incremental encoders) can be prevented right from the start. Absolute encoders - too large, too expensive? A prejudice that is cleared up by ACURO. Even the multiturn version of ACURO is no larger than most incremental encoders and costs less than you would expect. And how about reliability? Due to their complexity, absolute encoders seem to be susceptible to faults. No problem with ACURO: once installed they will not cause trouble, due to the highest integration density and use of extremely reliable technologies to ensure safe and reliable long-term operation.

The platform concept

Hengstler's new ACURO absolute encoders feature innovative technology, simple operational and optimal functional safety. Their platform concept also allows especially compact dimensions with a modular design, which always ensures the right version for each individual application in the field of motor feedback and automation engineering. Equipped with the new open BiSS interface these encoders are a good and futore oriented investment. The mechanical construction of ACURO is rugged and precise. Double high-precision ball bearings guarantee reliable long-term operation even at speeds of up to 12 000 rpm. ACURO is equipped with the commercially available mechanical interfaces, including solid shaft or hub shaft, synchro-flange or clamping flange.

ABSOLUTE ENCODERS ARE DIFFERENTIATED ACCORDING TO:

Singleturn version

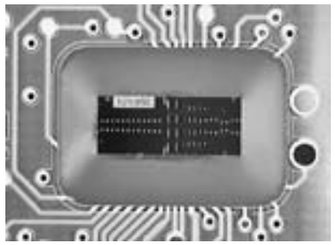
1 revolution (= 360°) is coded in n steps. After a rotation of over 360° the code is repeated.

Multiturn version

Apart from measuring 360° (1 revolution) further coded revolutions can be recorded e.g. for applications in combination with lead srews or timing belts. Hengstler is using the principle of a mechanical memory (gearbox, which is unmatched in reliability and EMC).

High-Tech Features in a Modular System

INNOVATIVE TECHNOLOGY



Hengstler's ACURO series comprises a complete range of absolute encoders, all in OPTOASIC technology. OPTOASIC units combine all required optical and electronic components in only one silicon chip.

This new technology is tailored to the user's needs and offers advantages perviously unknown in the field:

- **High degree of reliability** due to differential scanning and singlestep Gray code
- **Fail-safe** due to the elimination of more than a hundred components
- Long serviceable lifetime due to state-of-the-art semiconductor technology.
- High degree of **electromagnetic compatibility** due to elimination of macroscopic low-current paths.

Our new absolute shaft encoders have an excellent price/performance ratio. As a further feature the encoders are fully backward compatible due to identical mounting flanges and electrical interfaces.

This makes it easy for the user to switch from incremental to absolute shaft encoders.

PROGRAMMABLE ABSOLUTE SHAFT ENCODERS

All essential parameters are userprogrammable.
Additional advantages are uncomplicated subsequent data processing, electronic adjustment and add-on optimization of mechanical systems which are subject to tolerances.

Furthermore, storage and maintenance are more cost-efficient: the same encoder may be used for a variety of applications and assigned to its task at the place of installation.

APPLICATIONS

The new encoders are, for example, perfectly suited to determine angular positions in automated systems with reliable and precise operation.
Absolute encoding eliminates the need for a reference run after interruptions (such as power failures).

ACURO is the right match for a wide range of applications - from medical technology, elevators, all printing, paper processing or metal-processing machinery, such as presses and saws, right through to highly-dynamic drives.

INTERFACES

Of course, the user has a selection of the most advanced interface technology avialable:

- **Tristate parallel drivers**
  The symmetrical push-pull drivers are fully short circuit proof, overlaod protected in a range from 10 to 30 V.
  Parallel bus systems are easy to realize. So you have in cabling expenses.
- **CAN**
  Bus specifications according to CAN High-Speed ISO/DIS 11898 for transfer rates up to 1 MBaud.
- **Suconet K1**
  Klöckner-Moeller 2-Leiter fieldbus.
- **DeviceNet**
  - Based on CAN layer 2 (data link layer)
  - Up to 64 nodes and 500 KBaud speed
  - Configuration via network
- **INTERBUS**
  Interface including the potential-free power supply is already integrated in the housing with a diameter of only 58mm.
- **SSI**
  The encoders can also be supplied with synchronous-serial interface (SSI) which is available worldwide.
  This allows trouble-free connection to commercial processing components.
- **Profibus DP**
  Protocol according to encoder profile class C2 (programmable)
- **BiSS**
  - bidirectional and fully digital
  - synchronous serial data
  - licence-free
  - up to 8 slaves per master

Open Digital Sensor Interface (BiSS)

GENERAL INFORMATION

The bidirectional digital sensor interface BiSS safeguards communication between position encoders or measuring devices and industrial controls, such as a drive control, for example, and if necessary can transmit measurement values from up to 8 sensors simultaneously. For 1 to 8 subscribers the interface master provides a clock signal for the simultaneous capture of all position data and for the synchronous-serial data transmission which follows on from this. Just four unidirectional RS422 data lines are required; the slave electronics, kept to an absolute minimum, are incorporated on the sensor ICs.

When the master sends a clock pulse on line MA, the slave answers directly on return line SL with the recorded position data. Commands and parameters can be swapped on a PWM pulse form; this is, however, not necessary to start the BiSS protocol.

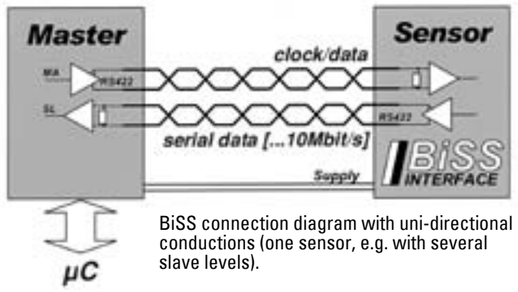
TRANSFER SEQUENCE

With each data cycle the master learns and compensates for line delays, thus permitting clock rates of up to 10 Mbit/s even for cable lengths of up to 100 m. Changes in line conditions which occur during cable drag, for example, are corrected. The precision of synchronization among several position encoders along various axes is less than 1 microsecond; the master also makes the signal delay it has recorded accessible to the control unit, allowing further optimization.

The BiSS protocol classifies each subscriber in one of the following data sections: sensor data, multi cycle data or register data. These data sections have various setups with regard to access and transmission performance so that a number of different sensor applications are catered for. Bidirectional parameter communication for device configuration - also applicable to what are known as OEM parameters - is usually consigned to the register data section. Data which alters gradually, such as revolution counts or drive temperatures, is allocated to the multi cycle data section, with rapidly changing angle data being assigned to the sensor data section.

Control cycle times of less than 10 µs are thus not a problem, even for data words of up to 64 bits in length. There is enough room in the protocol for redundancy; this space is normally used to implement a CRC (cyclic redundancy check). Framed by just one start and one stop bit, the sensor data is transmitted at the best-possible core data rate; a single multi cycle data bit is optional. Also captured when triggered, the multi cycle data bits make up a second in-band protocol which helps to increase the efficiency of the sensor data; permanent monitoring of the position and operation of the drive is possible without interfering with the control cycle.

Circuit diagram of an absolute encoder



BiSS connection diagram with uni-directional conductions (one sensor, e.g. with several slave levels).

Configuration

Specific product developments of individual users are not restricted or made unnecessarily expensive by a compulsory compatibility.

A BiSS subscriber is described with just a few parameters and the XML-descriptive file included with the delivery simplifies start up of the control system.

i For further informartion see: www.biss-interface.com

Synchromous-Serial Interface (SSI)

GENERAL INFORMATION

In many cases, absolute shaft encoders are subject to severe mechanical stresses and to electrical and magnetic fields that contaminate the site.
Therefore, special design measures are needed to combat dirt, dust and liquids in industrial environments.
Our absolute shaft encoders are of state-of-the-art rugged mechanical construction, and the electronic components are very compact.
A main consideration for immunity to interference is the data transfer from the shaft encoder to the control system. The control system must be able to read the readings from the shaft encoder without errors. Under no circumstances should undefined data be transmitted, for example at the changeover point.

The major differences between the concept of synchronous-serial data transfer for absolute shaft encoders described here and parallel and asynchronous serial forms of data transfer are:

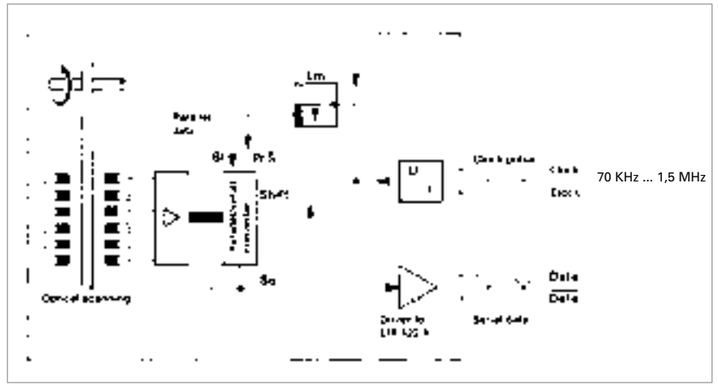
- less electronic components
- less cabling for data transfer
- the same interface hardware, regardless of the absolute shaft encoder's resolution (word length)
- electrical insulation of the shaft encoder from the control system by optocouplers
- open-circuit monitoring by constant current
- data transfer rates up to 1.5 megabits per second (depending on the length of line)
- ring-register operating possible.

TRANSFER SEQUENCE

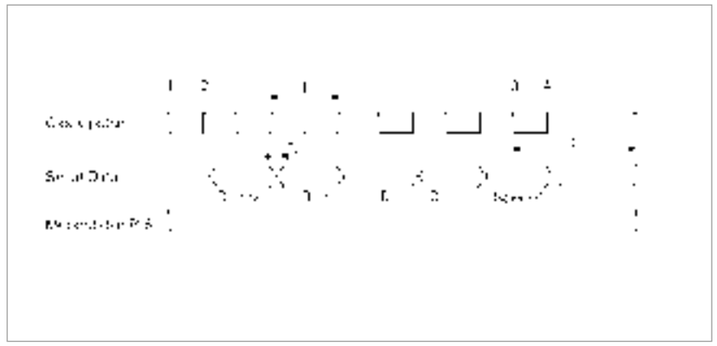
For correct transfer of the data a defined number of pulses (clock pulse brush) must be applied to the clock input of the absolute shaft encoder. Next, a pause TP must be observed. As long as no clock signal is applied to the shaft encoder, its internal parallel/serial shift register remains switched to parallel. The data change continuously, corresponding to the current position of the shaft encoder's shaft.

As soon as a clock pulse brush is applied to the clock input again, the instantaneous angular data is recorded.
The first shift of the clock signal from high to low ◘ actuates the shaft encoder's internal retriggerable mono-stable element, whose storage time tm must be greater than the clock signal's period T.
The output of the monostable element controls the parallel/serial register via terminal P/S (parallel/serial).

Block diagram of an absolute shaft encoder



Synchronous-Serial Interface (SSI)



T = clock pulse period
t_m = storage time of monostable element
t_m ranging from 10 µs und 30 µs
tv = 100 ns

The number of clock pulses necessary for data transfer is independent of the resolution of the absolute shaft encoder.

The clock signal can be interrupted at any point, or continued in ring-register mode for repeated polling.

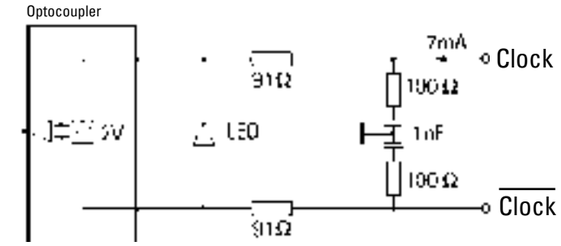
With the first shift of the clock signal from low to high ② the most significant bit (MSB) of the angular data is applied to the shaft encoder's serial output.
With each succeeding rising edge, the next less significant bit is shifted to the data output.
After transmission of the least significant bit (LSB) the Alarm bit or other special bits are transferred, depending on configuration. Then the data line switches to low ③ until the time tm has passed.

A further transfer of data cannot be started until the data line switches to high ④ again. If the clock pulse sequence is not interrupted at point ③, the ring-register mode is activated automatically. This means that the data stored at the first clock pulse transition ① are returned to the serial input Si via the terminal SO. As long as the clock pulse is not interrupted at ③, the data can be read out as often as wanted (multiple transfer).

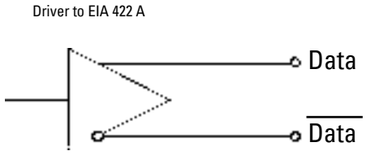
Basics of Absolute Encoders ACURO

Synchronous-Serial Interface (SSI)

Input circuit



Output circuit



RECOMMENDED DATA TRANSMISSION RATE

The maximum data transmission rate depends on the length of cable:.

Cable length	Baud rate
< 50 m	< 400 kHz
< 100 m	< 300 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz

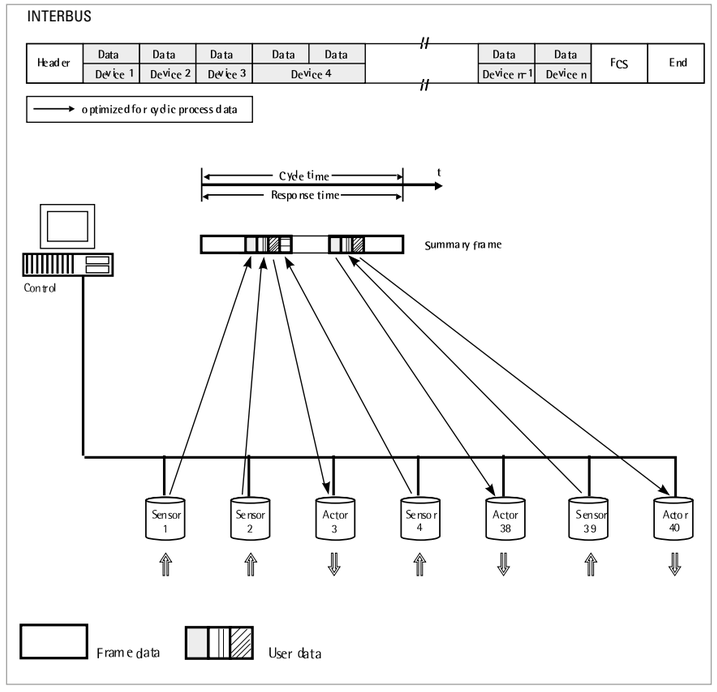
INTERBUS

GENERAL INFORMATION

INTERBUS is a real-time bus for the sensor-actor-level which is able to transfer data with a small overhead in a range of up to 4 bytes per subscriber for a maximum of 256 subscribers.

It is characterized by a circular transmission with a fixed message frame and a central master (e.g. SPC switching-in assembly).

TRANSFER SEQUENCE



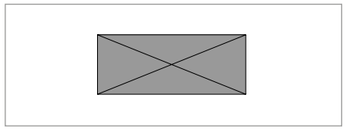
WHAT ARE THE BENEFITS OF INTERBUS COMPARED WITH A CONVENTIONAL SYSTEM WIRING?

- Lower costs for cables and wiring
- Lower noise sensitivity
- Many control signals which were analog before are now available as digital signals and directly transferable by INTERBUS
- Simple layout, installation and starting procedure
- High efficiency (net data rate): the percental share of the message header and of the terminating sequence decreases with a growing number of subscribers
- Data of all subscribers are stored at the same time and transferred sub-sequently
- Reaction time can easily be determined. It only depends on the system's total extension; this is important for controlling tasks
- Constant sampling rate for reference inputs and actual values; both are transferred in one bus cycle
- Considerations of priority are unnecessary since all subscribers have the same priority

Basics of Absolute Encoders ACURO

INTERBUS

ENCOM USER GROUP



- No system-parameter definition before starting procedure
- Data integrity is secured by 16-bit-CRC (according to CCITT polynomial) done for each transmission
- Sophisticated diagnostic software for the central bus controller: a point of error can specifically be isolated; in each case of malfunction there is a possibility to close the circular system in every single bus clip.

Devices with an INTERBUS interface for process control are now available from more than 200 manufacturers.

Encoder manufacturers are joined together in the ENCOM user group; drive manufacturers in DRIVECOM.

The user groups shall maximize the benefit for the customer by standardization of data transmission.

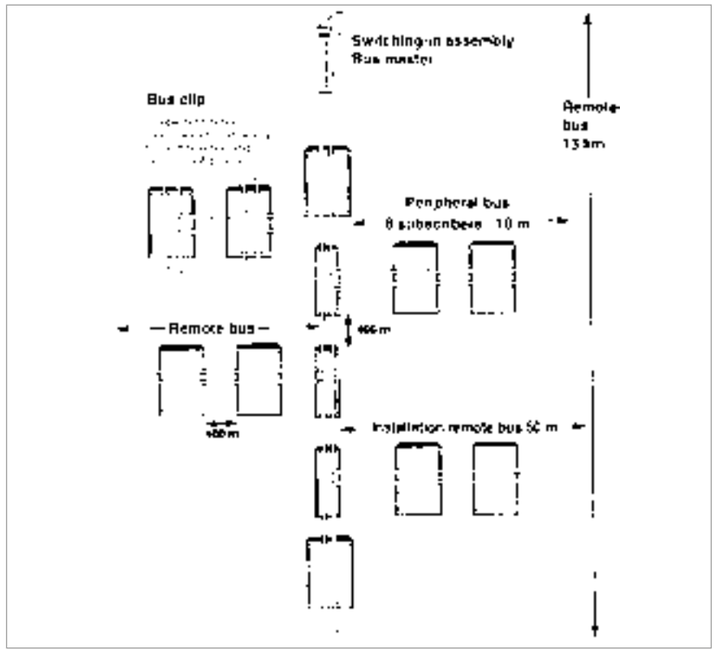
There is a high availability of devices with INTERBUS interface, and the bus mode has already been successful in industrial use.

The following device classes defined by ENCOM are used for absolute shaft encoders:

Class 2 (K2):
- 32-bit process data
- Binary
- Right-justified
- Readable only
- No control bits or status bits

Class 3 (K3):
- 32-bit process data
- Coded according to manufacturer specifications
- Right-justified
- 7 status bits and control bits

Basics of Absolute Encoders ACURO
INTERBUS



INTERBUS is physically divided into:

Remote bus
- Voltage difference transmission RS 485
- Max. cable length between two bus clips: 400 m
- Max. overall cable length of remote bus: 13 km
- A maximum of 64 bus clips/modules may be directly connected to the remote bus

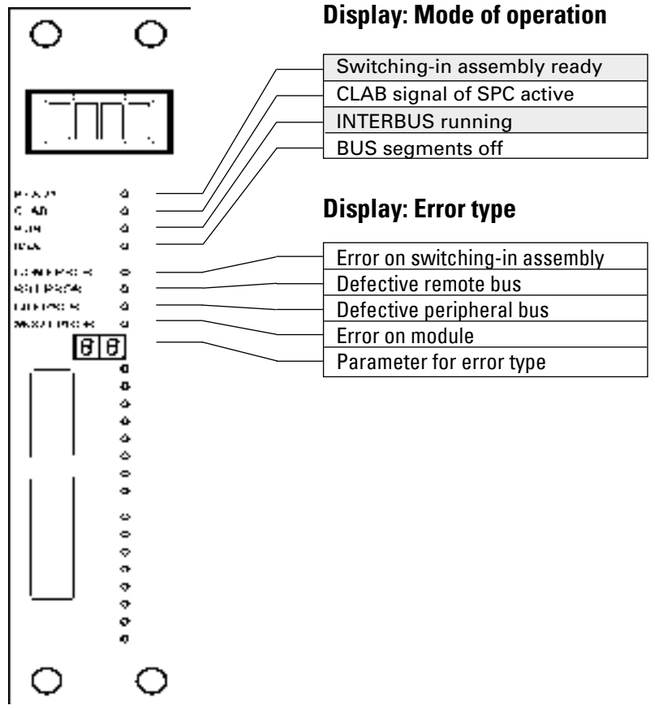
Peripheral bus
- 5 V voltage interface
- Max. overall cable length of peripheral bus: 10 m
- A maximum of 8 modules may be connected

Installation remote bus
- For modules with enclosure class IP65 (e.g. HENGSTLER absolute shaft encoders)
- Voltage difference transmission RS 485
- Max. overall cable length: 50 m
- Connection via bus clip or passive T-manifold
- Each subscriber has an electrically isolated voltage transformer
- 24 V supply may be led via the bus line or be connected to the T-manifold
- 8 modules may be connected.

The transmission speed is **500 kBit/s.**

Basics of Absolute Encoders ACURO
INTERBUS

Switching-in assembly



The diagnostic system is able to indicate peripheral and controller errors beside the selection of faults. Due to a row of LEDs comprising 16 bits, available on most switching-in assemblies, decentralized process states can be displayed centrally.

- Status display on control system for inputs and outputs without hand programming unit
- Self-acting fault detection and display with point and type of error without user programming
- Usual diagnosis by hand programming unit can be kept
- Diagnostic representation is always the same regardless of the control system.

For further information see:
www.interbusclub.com\de

CANopen

GENERAL INFORMATION

The AC 58 is an absolute shaft encoder (encoder, angle encoder). The version described in this technical manual sends its current position to another station via the „CAN-bus“ transmission medium (physically: screened and twisted two-wire line).

The serial bus system CAN (Controller Area Network), which had been originally developed by Bosch/ Intel for automotive uses, is gaining ground in industrial automation technology. The system is multimaster-compatible, i.e. several CAN- stations are able to request the bus at the same time. The message with the highest priority (determined by the identifier) will be received immediately.

The data transfer is regulated by the message's priority. Within the CAN system, there are no transport addresses, but message identifiers. The message which is being sent can be received by all stations at the same time (broadcast).

By means of a special filter methods, the station only accepts the relevant messages. The identifier transmitted with the message is the basis for the decision as to whether the message will be accepted or not.

The bus coupler is standardised according to the international standard ISO-DIS 11898 (CAN High Speed) standard and allows data to be transferred at a maximum rate of 1 MBit/ s. The most significant feature of the CAN-protocol is its high level of transmission reliability (Hamming distance = 6).

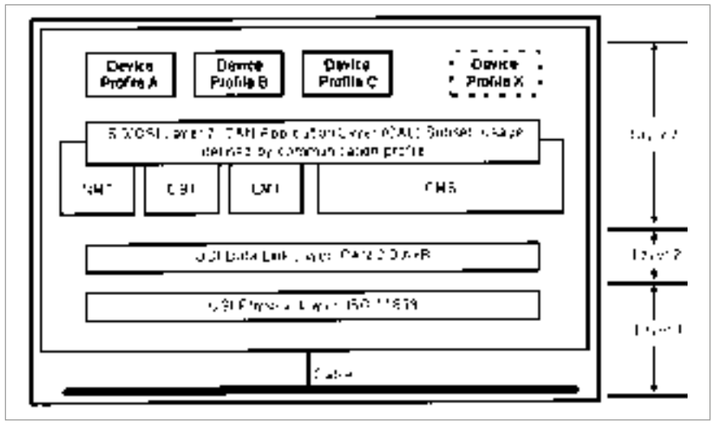
The CAN-Controller Intel 82527 used in the encoder is basic as well as full-CAN compatible and supports the CAN-specification 2.0 part B (standard protocol with 11-bit-identifier as well as extended protocol with 29-bit identifier). Up to now, only 11- bit identifiers have been used for CANopen.

FIELD OF APPLICATION

In systems, where the position of a drive or of any other part of a machine has to be recorded and signalled to the control system, the AC 58 can assume this function. The AC 58 can resolve, for instance, positioning tasks by sending the check-back signal concerning the present drive position via the CAN bus to the positioning unit.

CANopen

CANOPEN COMMUNICATION MODEL AND PROFILE



Schicht 1 (Physical Layer): ISO-DIS 11898 (CAN High Speed)

Schicht 2 (Data Link Layer): ISO-DIS 11898 (CAN High Speed)

Schicht 7 (Application Layer): CIA DS 301 (CANopen CAL-based Communication Profile) + Gerateprofile CiA DS 4xx (CANopen Device Profile for xx)

Für folgende Geräte existieren bereits Profile:

- CiA Draft Standard Proposal 401 for Input/Output Modules
- CiA Draft Standard Proposal 402 for Drives and Motion Control
- CiA Work Item 403 for Human Machine Interfaces
- CiA Work Draft 404 for Closed-Loop Controllers and Transformers
- CiA Work Item 405 for IEC-1 131 Interfaces
- **CIA Draft Standard Proposal 406 for Encoders**
- CiA Work Item 407 for Public Transport
- CiA Work Item 408 for Fork-Lifts

CANopen

THE CANOPEN PROFILE

About two and a half years after the CiA, the association of the user and manufacturer of CAN products, had adopted the CAN Application Layer (CAL), CANopen and the respective device profiles paved the way for the development of open systems.
CANopen has been developed under the technical direction of the Steinbeis Transfer Centre for Automation (STA Reutlingen; Germany) on the basis of the layer 7 CAL specification.
Compared with CAL, CANopen only provides the functions needed for this special purpose. CANopen is thus a part of CAL which has been optimised for application purposes and allows for a simpler system structure as well as for simpler devices.
CANopen has been optimised for a quick transfer of data in real-time systems and has been standardised for different device profiles.
The CAN in Automation (CiA) association of users and manufacturers is responsible for the establishing and the standardisation of the respective profiles.

The RA58 with CANopen meets the requirements laid down in the communication profile (CiA DS 301) and in the device profile for encoders.

CANopen allows for:
- auto configuration of the network,
- comfortable access to all device parameters.
- synchronisation of the devices,
- cyclical and event-controlled process data processing,
- simultaneous data input and output.

CANopen uses four communication objects (COB) with different features:
- Process Data Objects (PDO) for real-time data
- Service Data Objects (SDO) for the transfer of parameters and programs
- Network Management (NMT, Life-Guarding)
- predefined objects (for synchronisation, time stamp, emergency message)

All device parameters are stored in an object directory. The object directory contains the description, data type and structure of the parameters as well as their addresses (index).
The directory consists of three parts: communication profile parameters, device profile parameters and manufacturer specific parameters.

THE ENCODER DEVICE PROFILE (CIA DSP 406)

This profile describes a binding, but manufacturer independent definition of the interface for encoders. The profile not only defines which CANopen functions are to be used, but also how they are to be used. This standard permits an open and manufacturer independent bus system.

The device profile consists of two object categories
- the standard category C1 describes all the basic functions the shaft encoder must contain
- the extended category C2 contains a variety of additional functions which either have to be supported by category C2 shaft encoders (mandatory) or which are optional. Category C2 devices thus contain all C1 and C2 mandatory functions as well as, depending on the manufacturer, further optional functions.

Furthermore, an addressable area is defined in the profile, to which, depending on the manufacturer, different functions can be assigned.

CANopen

DATA TRANSFER

In CANopen, the data is transferred by means of two different communication types (COB = Communication Object) with different features:

- **Process Data Objects (PDO)**
- **Service Data Objects (SDO)**

The priority of the message objects is determined by the COB identifier.

The **process data objects (PDO)** serve the highly dynamic exchange of real-time data (e.g. position of the shaft encoder) with a maximum length of 8 Byte. This data is transferred with high priority (low COB identifier). PDOs are broadcast messages and put their information simultaneously at the disposal of all desired receivers.

The **service data objects (SDO)** form the communication channel for the transfer of device parameters (e.g. programming of the shaft encoders' resolution). Since these parameters are transferred acyclically (e.g. only once when running up the network), the SDO objects have a low priority (high COB identifier).

COB IDENTIFIER

For an easier administration of the identifiers, CANopen uses the „Predefined master/Slave Connection Set"). In this case, all identifiers with standard values are defined in the object directory. However, these identifiers can be modified according to the customers' needs via SDO access.

The 11-bit identifier consists of a 4 Bit function code and a 7 Bit node number.

Bit-No.	10	9	8	7	6	5	4	3	2	1	0
Type	Function code				Node number						
Assignment[1]	x	x	x	x	0	0	x	x	x	x	x

[1] x = binary value can be selected freely 0 or 1); 0 = 0 value is fixed

The higher the value of the COB identifier, the lower the identifier's priority!

NODE NUMBER

The 7-bit node number is set by means of the hardware via the 5 DIP switches on the encoder's back.

For further information see CAN user organisation:
www.can-cia.de

DeviceNet

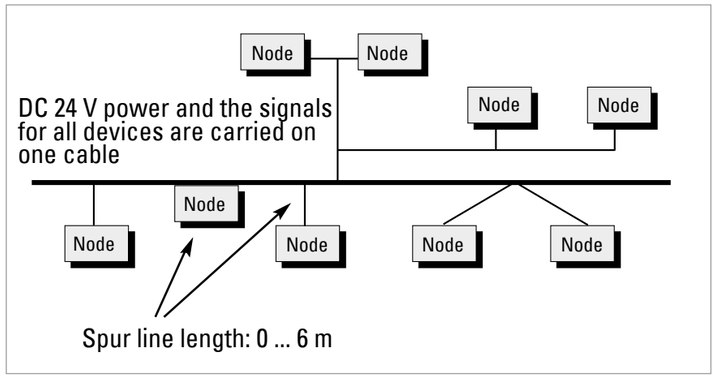
BACKGROUND AND TECHNOLOGY

Background
- The basic technology was developed by Allen-Bradley
- Introduced in March 1994
- The ODVA (Open DeviceNet Vendor Association) was founded in April 1995

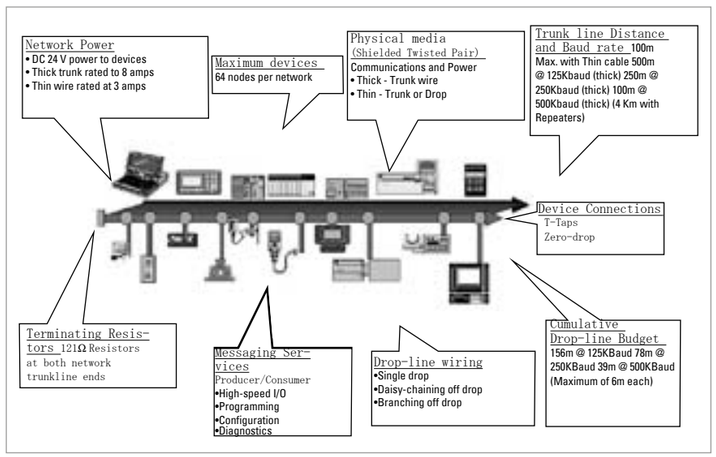
Technology
- CAN-Layer 2 (Data Link Layer) - ISO 11898 and 11519-1
- DeviceNet covers layer 7 (Application Layer) and layer 1 (Physical Layer), developed for industrial automation

Main benefits
- Reduced cabling and installation effort
- Reduced run-in time
- Reduced down-time
- Fast error elimination
- Devices can be removed, replaced and inserted without having to shut the network down
- Devices from various manufacturers can be exchanged
- Devices are configured over the network

LINEAR BUS TECHNOLOGY



NETWORK SPECIFICATIONS



For more information about deviceNet please contact:
http://www.odva.org
e-mail: odva@powerinternet.com

Profibus-DP

GENERAL INFORMATION

The basic functions of the PROFIBUS DP are here only described in extracts. For additional information, please refer to the standards on PROFIBUS DP, i.e. DIN 19245-3 and EN 50170 respectively.

DP-Encoder PROFIBUS Class 2 Zertifikat Nr. Z00381

INTRODUCTION

The AC 58 is an absolute shaft encoder (encoder, angle encoder). The version described in this manual sends its current position to another station via the transmission medium „PROFIBUS DP" (physically: screened and twisted pair line). The AC 58 supports all class 1 and 2 functions listed in the encoder profile. PROFIBUS-DP is manufacturer independent, open field bus standard for a variety of applications in the field of production, process and building services automation. The requirements of openness and independence from the manufacturer are stipulated in the European standard EN 50 170.

PROFIBUS-DP permits the communication of devices produced by different manufacturers without any particular adaptations of the interfaces.
PROFIBUS DP is a special standard version for a quick data exchange within the field level which has been optimised in terms of speed and low connection costs. Central control systems like, for example SPC/ PC communicate via a quick, serial connection with local field devices like drives, valves, or encoders. The data exchange between these devices is predominantly cyclical. The communication functions required for this exchange are determined by the basic functions of the PROFIBUS DP according to the EN 50 170 European standard.

FIELD OF APPLICATION

In systems, where the position of a drive or of any other part of a machine has to be recorded and signalled to the control system, the AC 58 can assume this function.

The AC 58 can resolve, for instance, positioning tasks by sending the checkback signal concerning the present drive position via the PROFIBUS DP to the positioning unit.

BASIC FUNCTIONS OF THE PROFIBUS-DP

The central control system (master) cyclically reads out the input information from the slaves and writes the output information to the slaves. For this purpose, the bus cycle time has to be shorter than the program cycle time of the central SPC, which amounts to approx. 10 ms for various applications.

Apart from the cyclical user data transfer, the PROFIBUS DP version also disposes of powerful functions for diagnosis and initial operation procedures. The data traffic is controlled by watchdog functions on both the slave and the master side. The following table summarises the basic functions of the PROFIBUS DP.

Profibus-DP

Transmission technlology:	• RS-485 twisted pair line • Baud rates ranging from 9.6 kbit/s up to 12 Mbit/s
Bus access:	• Token passing procedure between the masters and master-slave procedures for slaves • Monomaster or multimaster systems possible • Master and slave devices, max. of 126 stations at a single bus
Communication:	• Point-to-point (user data communication) or multicast (control commands) • cyclical master-slave user data communication and acyclical master-master data transfer
Operating state:	• Operate: cyclical transfer of input and output data • Clear: The input data are read, the output data remain in the safe status • Stop: only master-master data transfer is possible
Synchronisation:	• Control commands enable a synchronisation of the input and output data • Sync-Mode: Output data are being synchronised
Functionality:	• Cyclical user data transfer between DP master and DP slave(s) • Single DP slaves are dynamically activated or deactivated • Control of the DP slave's configuration. Powerful diagnostic functions, 3 stepped diagnostic message levels. • Synchronisation of in- and/or output • Address assignment for the DP slaves via the bus • Configuration of the DP masters (DPM1) via the bus • max. of 246 byte input and output data per DP slave possible
Protection functions:	• All messages are transferred with a hamming distance of HD=4 • Response control at the DP slaves • Access protection of the DP slaves' input/output • Monitoring of the user data communication with adjustable control timer at the master
Devices types:	• DP master class 2 (DPM2), e.g. programming/ project planning devices • DP master class 1 (DPM1), e.g. central automation devices like SPC, PC • DP slave e.g. devices with binary or analogue input/ output, drives, valves

ESSENTIAL FEATURES/ SPEED

The PROFIBUS DP only requires approx. 1 ms at a speed of 12 MBit/s in order to transfer 512 Bit input and 512 Bit output data by means of 32 stations.
The following diagram shows the usual PROFIBUS DP transfer time interval in relation to the number of stations as well as the transmission speed. The high speed can be above all explained by the fact that the input and output data within a message cycle are transferred by using the layer 2 SRD service (Send and Receive Data Service).

Diagnostic function:
The comprehensive diagnostic functions of PROFIBUS DP allow a quick localisation of the errors. The diagnostic messages are transferred by means of the bus and are assembled at the master. They are subdivided in three levels:

BASIC FEATURES/SPEED

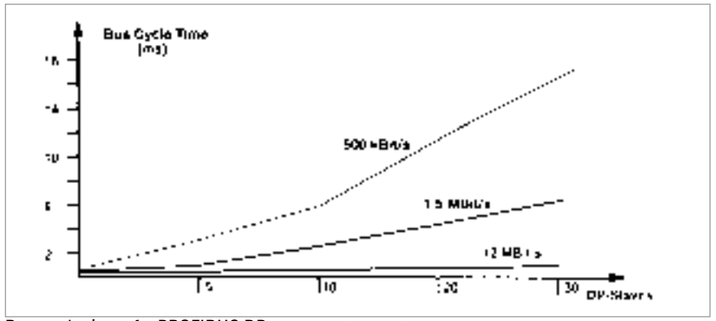
Basics of Absolute Encoders ACURO

Profibus-DP

Station-related diagnosis
Messages on the general readiness for service of a station, like for example, overtemperature or undervoltage.

Module-related diagnosis
Theses messages indicate that a diagnosis within a certain I/O part (e.g. 8 Bit output module) of a station is in hand.

Channel related diagnosis
The error cause in relation to a single input/ output bit (channel) is indicated here, like for example, a short-circuit at output line 7.



Bus cycle time of a PROFIBUS DP monomaster system
Boundary conditions: Each slave has 2 byte input and 2 yte output data; the minimum slave interval time amounts to 200 microseconds; TSDI = 37 Bit times, TSDR = 11 Bit times

CONFIGURATION OF THE SYSTEM AND DEVICE TYPES

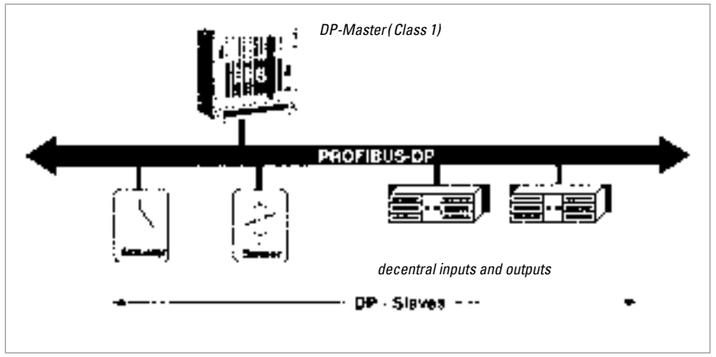
By means of PROFIBUS DP, mono- and multimaster systems can be realised. For this reason, a high level of flexibility in terms of the system configuration can be achieved. A maximum of 126 devices (master or slaves) may be connected to a bus. The definitions for the system configuration contain the number of stations, the assignment of the station address to the I/O addresses, the data consistency of the I/O data, the format of the diagnostic messages and the bus parameters used. Each PROFIBUS DP system consists of different device types. There are three device types to be distinguished:

DP master class 1 (DPM1)
These devices are central control systems exchanging information with the local stations (DP slaves) during a fixed message cycle. Typical devices of this kind are stored-program controllers (SPC), PC or VME systems.

DP master class 2 (DPM2)
Programming, configuration devices, and operator panels belong to this category. They are used for the initial operation procedures in order to establish the configuration of the DP system, or to operate the plants in the course of operation.

DP slave
A DP slave is a peripheral I/O rack (I/O, drives, HMI, valves) that reads the input information and sends output information to the peripheral equipment. Devices which provide only input or only output information might also be used.
The amount of input and output information is device specific and must not exceed 246 byte for the input and 246 byte for the output data.

Profibus-DP

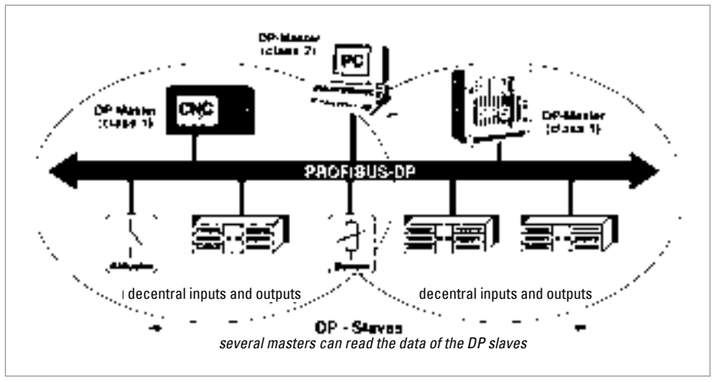


PROFIBUS DP monomaster system

In the case of monomaster bus systems, there is only one master active at bus during the on-line phase of the bus system. The above diagram shows the system configuration of a monomaster system.

The SPC based control system is the central control element. By means of the transmission medium, the DP slaves are locally linked to the SPC control system. By using this system configuration, the shortest bus cycle time can be obtained.

In the multimaster mode, several masters are linked to a single bus. They either form independent subsystems consisting of one DPM1 and its corresponding DP slaves each, or additional configuration and diagnostic devices (see diagram below).
The I/O maps of the DP slaves can be read by all DP masters, but only one DP master, the one which has been assigned DPM1 during project planning, is able to write the output information. Multimaster systems attain a medium bus cycle time.



several masters can read the data of the DP slaves

PROFIBUS-DP multimaster system

Profibus-DP

SYSTEM PERFORMANCE

In order to obtain a high level of exchange ability between the devices, the system performance of PROFIBUS DP has also been standardised. It is mainly determined by the operational status of the DPM1.

The **DPM1** can either be controlled locally or via the bus by the project planning device. The following three main states can be distinguished:

Stop
There is no data traffic between DPM1 and the DP slaves.

Clear
The DPM1 reads the input information of the DP alves and maintains the safe status of the DP slaves' output.

Operate
The DPM1 has entered the data transfer phase. In case of a Cyclical traffic, the input is read by the DP slaves while the output is transferred to the DP slaves.

CYCLICAL DATA TRANSFER BETWEEN DPM1 AND THE DP SLAVES

The data traffic between the DPM1 and the respective DP slaves is automatically handled by the DPM1 in a fixed, recurring order. When configuring the bus system, the user assigns a DP slave to the DPM1. In addition, the slaves to be included in- or excluded from the user data communication are defined.

The data traffic between the DPM1 and the DP slaves is subdivided in parametrisation, configuration, and data transfer phases. Before including a DP slave in the data transfer phase, the DPM1 checks during the parametrisation and configuration phase, whether the planned set configuration corresponds to the actual configuration of the device.

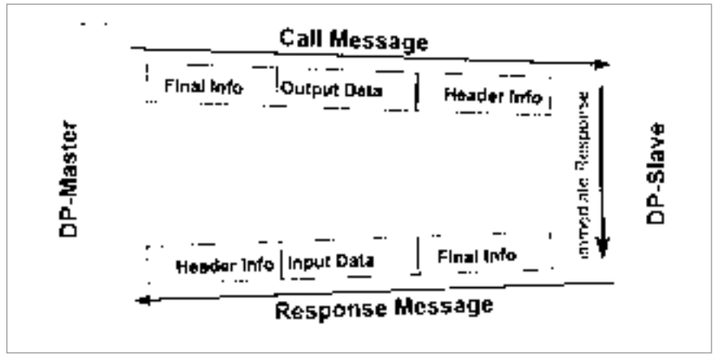
After an error has occurred during the data transfer phase of the DPM1, like for example, the failure of a DP slave, the response of the system is determined by the operating parameter „Auto Clear".

If this parameter has been set to true, the DPM1 will set the output of all the respective DP slaves to the safe status, as soon as a DP slave is no longer available for user data communication. Afterwards, the DPM1 changes to the clear status.

If this parameter is = false, the DPM1 remains, even if an error occurs, in the operate status, and the user can determine the response of the system at his own discretion.

For this check, the device type, the information on the format and the length as well as the number of input and output lines have to be correct. The user thus obtains a reliable protection against parametrisation errors. In addition to the user communication, which is automatically executed by the DPM1, the user may request the new parametrisation data to be sent to the DP slaves.

Profibus-DP



User data communication for PROFIBUS-DP

DATENVERKEHR ZWISCHEN DPM1 UND PROJEKTIERUNGSGERÄTEN

In addition to the functions between DP master and DP slaves, master-master communication functions are available, see table. They support the project planning and diagnostic devices in projecting the system via the bus.

Besides the upload and download functions, the master-master functions offer the opportunity to switch the user data transfer between the DPM1 and the single DP slaves dynamically on or off as well as to modify the operating status of the DPM1.

Function	Meaning	DPM1	DPM2
Get_master_Diag	reads the diagnostic data of the DPM1 or the collective diagnostics of the DP slaves	M	0
Download / Upload Gruppe (Start_Seq, Down- / Upload, End_Seq)	reads or writes the entire configuration data of a DPM1 and of the respective DP slaves.	0 0	0 0
Act_Para_Brct	activates the bus parameters for all operating DPM1 devices.		
Act_Param	activates parameters or modifies the operating status of the operating DPM1 device.	0	0

M: mandatory, 0: optional
Functional overview for the master-master functions for PROFIBUS DP

Profibus-DP

SYNC MODE

In addition to the station-related user data communication being automatically handled by the DPM1, the masters may send control commands to a single slave, a group of slaves or all slaves at the same time.
These control commands are transferred as multicast. It is only by means of this multicast that the sync and freeze operating modes for the event-controlled synchronisation of the DP slaves have been enabled.

The sync mode is started by the slaves, as soon as they receive a sync command form the respective master. The output lines of the addressed slaves will then be frozen in their current state. The output data will be stored at the slaves during the following user data transfers; the state of the output lines, however, will remain unchanged. Unless the next sync command has been received, the stored output data will not be connected to the output lines. By selecting unsync, the sync mode is terminated.

PROTECTIVE MECHANISMS

For reasons of safety, it is necessary to equip PROFIBUS DP with powerful protective functions against false parametrisation or failure of the transmission equipment. For this purpose, control mechanisms at the DP master and the DP slave have been realised, taking the form of time-out circuits. The monitoring interval is determined during project planning.

At the DP master
The DPM1 controls the data traffic of the slaves by means of the Data_Control_Timer. For each slave, a special timer is used. The time-out circuit will respond, if no proper user data transfer occurs during a control interval. In this case, the user will be informed. If the automatic response to an error (Auto_Clear = True) has been released, the DPM1 will quit the operate status, switch the output lines of the respective slaves to the safe status and change to the clear status.

At the DP slave
In order to recognise errors by the master or transmission errors, the slave executes the response control. If there is no data traffic during the response control interval, the slave will automatically switch the output lines to the safe status.
When operating in multimaster systems, a supplementary access protection for the I/O lines of the slaves will be necessary. This is to make sure that direct access can only be gained by an authorised master. For all the other masters, the slaves will provide an I/O map which can be also be read without access authorisation.

COMMUNICATION INTERFACE

The communication interface correponds to the PROFIBUS DP class 2 encoder profile.

Within this interface the class 1 functions are included.

i For further information see:
www.profibus.de

Glossary of Technical Terms

Absolute shaft encoder — Shaft encoder that transmits unique coded data for each increment.

Accuracy — The difference between the actual and measured position.

Alarm signal — Serves to monitor the shaft encoder for malfunctions, such as glass breakage, fouling, short circuit, short circuit of signal line, and supply voltage too low.

Amplitude regulation — Current or voltage amplitude is constant through regulation

Analogue signal — A signal whose level alters continuously

ASIC — Application specific integrated circuit

Axial loading — Maximum load on the shaft encoder's shaft in the axial direction

Bandwidth — Frequency range for output signals

Baud rate — Rate of data transfer (bits per second)

BCD — Binary-coded decimal; binary representation of a decimal number

Binary — Two logical states (yes/no); the basis of binary data-processing systems.

Binary code — Code using binary numbering; often udes for absolute measuring systems.

Bit — Abbreviation for „binary digit"; the smallest unit of information of a binary system, whose value can be 1 or 0 (yes-or-no decision).

Bus cycle — Time needed for polling every bus slave by the bus master.

Byte — Sequence of 8 Bits.

CAL — CAN application layer

CANopen — Layer 7 protocol based on CAN

CCW — Counter clockwise

Change of state — For CAN: Bus node (encoder) sends it's data automatically when position change occurs.

Channel — Signal track on which 1 or 0 is outputted

CiA — CAN in automation (CAN users and manufacturers group)

CiA DS — CAN in automation draft standard, communication profile

CiA DSP — CAN in automation draft standard proposal, communication profile

CIM — Computer Integrated Maufacturing; i.e. the linking of different computer-aided processes in production and related fields for general use of the data.

CMD — Software tool for configuration and diagnosis of Interbus networks

COB — Communication object

Code — Format in which data are transmitted

Code switching frequency — Number of position steps per second. For absolute shaft encoders with parallel interface: The maximum output frequency of the LSB output driver (fmax) also limits the maximum permissible code switching frequency:
Code switching frequency max. = $2 \cdot f_{max}$ for Binary code
Code switching frequency max. = $4 \cdot f_{max}$ for Gray code

Coefficient of thermal expansion — Material expansion under influence of temperature change [µm/°K m], relevant for linear scales.

Glossary of Technical Terms

Complementary — Output circuit for which also the inverted signals are outputted (e.g. Channel A and Channel A). Electrically, the 1/0 levels are transmitted as voltage differences between two lines. In this way the information signal (the difference) remains pure as in general interferences are interspersed equally on both lines.

CRC — Cyclic redundancy check. Bit error protection method for data communication.

CW — Clockwise

Data bus — System of lines over which data are transferred electronically in parallel or serially.

Data consistency — Intrinsic coherence of data in respect of timing and logical aspects.

Data integrity — Correspondence of data with the reality that they describe.

Datavalid — Output for checking the validity of data.

DC — Direct current (not alternating)

Demodulator — Device that filters the original information out of an altered signal again.

DeviceNet - conformity and interoperability — Confirmation of aggreement of a bus node with the DeviceNet specifications and correct interoperability with other DeviceNet nodes.

Differential line driver — Output circuit in which the difference between the two signals A and A is evaluated, thus providing high signal transmission reliability.

DIN — Deutsche Industrie Norm (German Industrial Standard).

Direction — Control input for determining the data sequence (whether ascending for clockwise or counterclockwise rotation).

Dual Code — Natural binary code.

EDS - File — Electronic data sheet. This is a file with the device specific parameter description and is provided by the manufacturer of a DeviceNet or CANopen device.

EEPROM — „Electrically Erasable Programmable Read-Only Memory" chip (see EPROM)

EIA — Electronic Industries Association; U.S. umbrella organization of manufacturers of electronic equipment and facilities. It is responsible for maintenance and development of the industrial standards for interfaces between data-processing devices and data communications equipment.

EMC — Electromagnetic compatibility

ENCOM — User group of manufacturers of INTERBUS-S absolute shaft encoders.

Encoder monitoring — See „Alarm signal)

Enable — Control input via which the data outputs can be activated.

Encoder power — Supply voltage to be provided for the shaft encoder.

EPROM — „Erasable Programmable Read-Only Memory" chip, which can be erased with ultraviolet light, after which new data can be written into it.

Gray code — A special binary code that changes only one data bit per measuring step at a time. It is used with absolute encoders.

Hamming distance — Measure for data security in a data transmission. The higher the number the better the ability to detect data errors.

Harmonic Distortion — Measure for the signal quality of sinewave encoder [%]. It describes the content of harmonics in analogue signals. The lower the number the better the signal.

Hysteresis error — Measurement deviation for a position approached from opposite directions.

Identifier

Address of a message in a CAN network.

IEC

International Electrotechnical Commission; organization promoting international standardization of electrical components.

Immunity to interference

Test procedure according to IEC 801, Part 4
- A test of susceptibility to fast electrical transients (bursts) causing interference on lines.

The test values are divided into 5 levels:

Level	Mains line	Data and control lines
1	0.5 kV	0.25 kV
2	1.0 kV	0.5 kV
3	2.0 kV	1.0 kV
4	4.0 kV	2.0 kV
X	special	special

- Test procedure according to IEC 801, Part 2
Discharge of static electricity on the surface and in the surroundings of the specimen. The test values are divided into 4 classes:

Class	test voltage
1	2 kV
2	4 kV
3	8 kV
4	15 kV

- Radio interference voltage test to VDE 0871

Incremental measuring system

Measuring method in which the variable is formed by counting increments (measuring steps).

Incremental shaft encoder

Shaft encoder which transmits an electrical signal (yes/no) for each increment, determined by the marked disc.

Integer

Integral values; range of values at n bit: 0 ... (2^n-1)

Integrated coupling

Flexible coupling built into shaft encoders.

INTERBUS

Real time bus for the sensor-actor-level

Interbus-Loop

Two wire version of Interbus, transmittind data over the power supply lines and using Phoenix Contact „Quickon" cable plugs.

Interface

Transfer point with certain terminals, signals, or signal sequences. The interface serves for communication of the shaft encoder with other systems.

IP

See „Protection class"

Jitter

Change in the phase angle between Channel A and B within one revolution (360°)

Latch

Control input for storing („freezing") the data before they are read out

Linearity

Deviation of the reading from the actual value within one revolution (360°).

Line driver

Output circuit that makes a larger current possible.

LSB

Least Significant Bit

Measuring wheel

A wheel thet, mounted on shaft encoder, converts a linear motion into a rotary motion.

MSB

Most Significant Bit

MTBF

„Meat Time Between Failures", a measure of average service life.

Multi-turn shaft encoder

Shaft encoder which transmits the number of shaft revolutions as well as the angular position of the shaft$_x$ for Gray code.

Nc machinery

Numerically Controlled machinery; their movements are programmed.

NPN input/output

Transistor input/output circuit implemented with an npn transistor, and thus negative switching.

Offset

For programmable absolute shaft encoders: the offset value is added to the value of physical position. As a result you get a relative shift of the output value
(output value = position value + offset value).

Parallel interface

Tranfer point at which the data are transferred in parallel over several lines.

Parity

Checkbit for error detection in data transfer.

PDO

Process data object (in CAN networks).

P.L.C.

Programmable Logic Controller: control system whose program is stored in a program memory and can be changed.

Phase discriminator

Sense-of-direction detector that functions by evaluation the phase angle betwenn Signal A and Signal B.

Phase tolerance

Deviation of the pulse-edge from Channel A to B, relative to the phase angle 90°.

PNP input/output

Transistor input/output circuit implemented with a pnp transistor, and thus positive switching.

Preset

For programmable absolute shaft encoders: The programmed numerical value is accepted as output value (output value = preset value)

Protection class

The enclosure class is designated according to DIN 40050, by IP and a two-figure code number.

1st digit	Degree of protection against ingress of solid bodies:
0	no special protection
1	solid bodies with dia. > 50 mm, no protection against intentional penetration
2	solid bodies with dia. > 12 mm, warding off fingers etc.
3	solid bodies with dia. > 2.5 mm, warding off tools, wires, etc. (thickness > 2.5 mm)
4	solid bodies with dia. > 1 mm, warding off tools, wires, etc. (thickness > 1 mm)
5	dust in harmful quantities, complete shock-hazard protection
6	dust /dust-tight), complete shock-hazard protection

2nd digit	Degree of protection against water:
0	no special protection
1	water dripping vertically
2	water dripping at angles up to 15° from vertical
3	water dripping at angles up to 60° from vertical (spraying water)
4	water from all directions (splashing water)
5	water from a nozzle from all directions (hose-water)
6	heavy seas or strong jet of water (flooding)
7	water, if the device is immersed in water under specified conditions of pressure and time (immersion)
8	water, if the device is submerged constantly. The manufacturer must describe the conditions (submersion)

Example: IP65
A device thus designated is dust-tight, and protected against hose-water.

PVC

Polyvinylchloride; plastic coating of device cable.

PTB approval

Approval for use by the Physikalisch-Technicsche Bundesanstalt, the German government materials testing institute.

Pulse (repetition) frequency, max. speed

The maximum signal frequency achievable by the shaft encoder, the product of rotary and number or markings.

Glossary of Technical Terms

Radial load, max.	Maximum loading of shaft encoder shaft in radial direction.
Quickon	Connector with self contacting cable cutting contacts from Phoenix Contact used with Interbus Loop.
RAM	„Random Access Memory“ chip; this memory can be read from, written to, and erased freely. When the power goeas off, it loses its information.
Reference mark	Irregular gradation pattern that generates a single peak, to provide an absolute reference for an incremental shaft encoder.
Reference pulse	Square-wave signal generated by a reference mark, usually only one increment wide, to provide an absolute reference for an incremental shaft encoder.
Repeatability	Degree of deviation for a point approached repeatedly under identical operating conditions.
Resolution	Number of increments per revolution (rotary) or distance between two increments (linear).
Resolver	Inductive angular measuring device that generates two alternating voltages, with amplitude a function of the angle.
Reversal error	Deviation in reading of a position when approached from different directions (hystersis).
ROM	„Read-Only-Memory“ chip, whose memory can be only read out.
RS 422	Standardized interface for undirectional point-to-point cennections (for description refer to „Complementary“); voltage difference 7 V DC max.
RS 422/485	Interfaces for serial data transfer with specifications to EIA standards.
RS 485	Like RS 422, however as a bidirectional bus interface
Sampling frequency	Number of signal periods per second. The maximum sampling frequency limits the speed of incremental measuring systems.
SDO	Service data object (in CAN networks)
Sense	The Sense lines (Sense VCC and Sense GND) enable measurement of the factual encoder voltage without adulteration by voltage drop due to supply current and cable resistivity. With that e.g. supply voltage can automatically be adjusted.
Scaling	For programmable absolute shaft encoders the encoder actual value is multiplied by a scaling factor. Thus the resolution (increments per measuring distance or increments per revolution) is adaptable to the respective application.
SSI	Synchronous-serial Interface; standardized interface for serial data transfer
TPE	Thermo-plastic polyester elastomer; plastic coating of device cable
Tristate	Control input; switches the outputs either to active or to high impedance.
Two's complement	Number format for the representation of negative numbers; range of values at n bit: $-(2^n-1)$ ... 0 ... $(2^{n-1}-1)$

GENERAL CONDITIONS
FOR THE SUPPLY OF PRODUCTS AND SERVICES OF THE ELECTRICAL AND ELECTRONICS INDUSTRY ("GL")*

for commercial transactions between businesses

ZVEI:

recommended by ZVEI - Zentralverband Elektrotechnik- und Elektronikindustrie e. V.

– as of June 2005 –

I. GENERAL PROVISIONS

1. Legal relations between Supplier and Purchaser in connection with supplies and/or services of the Supplier (hereinafter referred to as "Supplies") shall be solely governed by the present GL. The Purchaser's general terms and conditions shall apply only if expressly accepted by the Supplier in writing. The scope of delivery shall be determined by the congruent mutual written declarations.
2. The Supplier herewith reserves any industrial property rights and/or copyrights pertaining to its cost estimates, drawings and other documents (hereinafter referred to as "Documents"). The Documents shall not be made accessible to third parties without the Supplier's prior consent and shall, upon request, be returned without undue delay to the Supplier if the contract is not awarded to the Supplier. Sentences 1 and 2 shall apply mutatis mutandis to the Purchaser's Documents; these may, however, be made accessible to those third parties to whom the Supplier has rightfully subcontracted Supplies.
3. The Purchaser has the non-exclusive right to use standard software and firmware, provided that it remains unchanged, is used within the agreed performance parameters, and on the agreed equipment. Without express agreement the Purchaser may make one back-up copy of standard software.
4. Partial deliveries are allowed, unless they are unreasonable to accept for the Purchaser.
5. The term „claim for damages" used in the present GL also includes claims for indemnification for useless expenditure.

II. PRICES, TERMS OF PAYMENT, AND SET-OFF

1. Prices are ex works and excluding packaging; value added tax shall be added at the then applicable rate.
2. If the Supplier is also responsible for assembly or erection and unless otherwise agreed, the Purchaser shall pay the agreed remuneration and any incidental costs required, e. g. for traveling and transport as well as allowances.
3. Payments shall be made free Supplier's paying office.
4. The Purchaser may set off only those claims which are undisputed or non-appealable.

III. RETENTION OF TITLE

1. The items pertaining to the Supplies ("Retained Goods") shall remain the Supplier's property until each and every claim the Supplier has against the Purchaser on account of the business relationship has been fulfilled. If the combined value of the Supplier's security interests exceeds the value of all secured claims by more than 10 %, the Supplier shall release a corresponding part of the security interest if so requested by the Purchaser; the Supplier shall be entitled to choose which security interest it wishes to release.
2. For the duration of the retention of title, the Purchaser may not pledge the Retained Goods or use them as security, and resale shall be possible only for resellers in the ordinary course of their business and only on condition that the reseller receives payment from its customer or makes the transfer of property to the customer dependent upon the customer fulfilling its obligation to effect payment.
3. The Purchaser shall inform the Supplier forthwith of any seizure or other act of intervention by third parties.
4. Where the Purchaser fails to fulfil its duties, fails to make payment due, or otherwise violates its obligations the Supplier shall be entitled to rescind the contract and take back the Retained Goods in the case of continued failure following expiry of a reasonable remedy period set by the Supplier; the statutory provisions providing that a remedy period is not needed shall be unaffected. The Purchaser shall be obliged to return the Retained Goods. The fact that the Supplier takes back Retained Goods and/or exercises the retention of title, or has the Retained Goods seized, shall not be construed to constitute a rescission of the contract, unless the Supplier so expressly declares.

IV. TIME FOR SUPPLIES; DELAY

1. Times set for Supplies shall only be binding if all Documents to be furnished by the Purchaser, necessary permits and approvals, especially concerning plans, are received in time and if agreed terms of payment and other obligations of the Purchaser are fulfilled. If these conditions are not fulfilled in time, times set shall be extended reasonably; this shall not apply if the Supplier is responsible for the delay.
2. If non-observance of the times set is due to force majeure such as mobilization, war, rebellion or similar events, e. g. strike or lockout, such time shall be extended accordingly. The same shall apply if the Supplier does not receive its own supplies in due time or in due form.
3. If the Supplier is responsible for the delay (hereinafter referred to as "Delay") and the Purchaser has demonstrably suffered a loss therefrom, the Purchaser may claim a compensation as liquidated damages of 0.5 % for every completed week of Delay, but in no case more than a total of 5 % of the price of that part of the Supplies which due to the Delay could not be put to the intended use.
4. Purchaser's claims for damages due to delayed Supplies as well as claims for damages in lieu of performance exceeding the limits specified in No. 3 above are excluded in all cases of delayed Supplies, even upon expiry of a time set to the Supplier to effect the Supplies. This shall not apply in cases of mandatory liability based on intent, gross negligence, or due to loss of life, bodily injury or damage to health. Rescission of the contract by the Purchaser based on statute is limited to cases where the Supplier is responsible for the delay. The above provisions do not imply a change in the burden of proof to the detriment of the Purchaser.
5. At the Supplier's request, the Purchaser shall declare within a reasonable period of time whether it, due to the delayed Supplies, rescinds the contract or insists on the delivery of the Supplies.
6. If dispatch or delivery, due to Purchaser's request, is delayed by more than one month after notification of the readiness for dispatch was given, the Purchaser may be charged, for every additional month commenced, storage costs of 0.5 % of the price of the items of the Supplies, but in no case more than a total of 5 %. The parties to the contract may prove that higher or, as the case may be, lower storage costs have been incurred.

V. PASSING OF RISK

1. Even where delivery has been agreed freight free, the risk shall pass to the Purchaser as follows:
   a) If the Supplies do not include assembly or erection, at the time when the Supplies are shipped or picked up by the carrier. Upon the Purchaser's request, the Supplier shall insure the Supplies against the usual risks of transport at the Purchaser's expense;
   b) If the Supplies include assembly or erection, at the day of taking over in the Purchaser's own works or, if so agreed, after a fault-free trial run.
2. The risk shall pass to the Purchaser if dispatch, delivery, the start or performance of assembly or erection, the taking over in the Purchaser's own works, or the trial run is delayed for reasons for which the Purchaser is responsible or if the Purchaser has otherwise failed to accept the Supplies.

VI. ASSEMBLY AND ERECTION

Unless otherwise agreed in written form, assembly and erection shall be subject to the following provisions:

1. The Purchaser shall provide at its own expense and in due time:
   a) all earth and construction work and other ancillary work outside the Supplier's scope, including the necessary skilled and unskilled labor, construction materials and tools,
   b) the equipment and materials necessary for assembly and commissioning such as scaffolds, lifting equipment and other devices as well as fuels and lubricants,
   c) energy and water at the point of use including connections, heating and lighting,
   d) suitable dry and lockable rooms of sufficient size adjacent to the site for the storage of machine parts, apparatus, materials, tools, etc. and adequate working and recreation rooms for the erection personnel, including sanitary facilities as are appropriate in the specific circumstances; furthermore, the Purchaser shall take all measures it would take for the protection of its own possessions to protect the possessions of the Supplier and of the erection personnel at the site,
   e) protective clothing and protective devices needed due to particular conditions prevailing on the specific site.
2. Before the erection work starts, the Purchaser shall unsolicitedly make available any information required concerning the location of concealed electric power, gas and water lines or of similar installations as well as the necessary structural data.
3. Prior to assembly or erection, the materials and equipment necessary for the work to start must be available on the site of assembly or erection and any preparatory work must have advanced to such a degree that assembly or erection can be started as agreed and carried out without interruption. Access roads and the site of assembly or erection must be level and clear.

* **"Grüne Lieferbedingungen". The original German text shall be the governing version.**

4. If assembly, erection or commissioning is delayed due to circumstances for which the Supplier is not responsible, the Purchaser shall bear the reasonable costs incurred for idle times and any additional traveling expenditure of the Supplier or the erection personnel.
5. The Purchaser shall attest to the hours worked by the erection personnel towards the Supplier at weekly intervals and the Purchaser shall immediately confirm in written form if assembly, erection or commissioning has been completed.
6. If, after completion, the Supplier demands acceptance of the Supplies, the Purchaser shall comply therewith within a period of two weeks. In default thereof, acceptance is deemed to have taken place. Acceptance is also deemed to have been effected if the Supplies are put to use, after completion of an agreed test phase, if any.

VII. RECEIVING SUPPLIES

The Purchaser shall not refuse to receive Supplies due to minor defects.

VIII. DEFECTS AS TO QUALITY

The Supplier shall be liable for defects as to quality ("Sachmängel", hereinafter referred to as "Defects".) as follows:

1. Defective parts or defective services shall be, at the Supplier's discretion, repaired, replaced or provided again free of charge, provided that the reason for the Defect had already existed at the time when the risk passed.
2. Claims for repair or replacement are subject to a statute of limitations of 12 months calculated from the start of the statutory statute of limitations; the same shall apply mutatis mutandis in the case of rescission and reduction. This shall not apply where longer periods are prescribed by law according to Sec. 438 para. 1 No. 2 (buildings and things used for a building), Sec. 479 para. 1 (right of recourse), and Sec. 634a para. 1 No. 2 (defects of a building) German Civil Code ("BGB"), in the case of intent, fraudulent concealment of the Defect or non-compliance with guaranteed characteristics (Beschaffenheitsgarantie). The legal provisions regarding suspension of the statute of limitations ("Ablaufhemmung", "Hemmung") and recommencement of limitation periods shall be unaffected.
3. Notifications of Defect by the Purchaser shall be given in written form without undue delay.
4. In the case of notification of a Defect, the Purchaser may withhold payments to an amount that is in a reasonable proportion to the Defect. The Purchaser, however, may withhold payments only if the subject-matter of the notification of the Defect involved is justified and incontestable. The Purchaser has no right to withhold payments to the extent that its claim of a Defect is time-barred. Unjustified notifications of Defect shall entitle the Supplier to demand reimbursement of its expenses by the Purchaser.
5. The Supplier shall be given the opportunity to repair or to replace the defective good ("Nacherfüllung") within a reasonable period of time.
6. If repair or replacement is unsuccessful, the Purchaser is entitled to rescind the contract or reduce the remuneration; any claims for damages the Purchaser may have according to No. 10 shall be unaffected.
7. There shall be no claims based on Defect in cases of insignificant deviations from the agreed quality, of only minor impairment of usability, of natural wear and tear, or damage arising after the passing of risk from faulty or negligent handling, excessive strain, unsuitable equipment, defective civil works, inappropriate foundation soil, or claims based on particular external influences not assumed under the contract, or from non-reproducible software errors. Claims based on defects attributable to improper modifications or repair work carried out by the Purchaser or third parties and the consequences thereof are likewise excluded.
8. The Purchaser shall have no claim with respect to expenses incurred in the course of supplementary performance, including costs of travel, transport, labor, and material, to the extent that expenses are increased because the subject-matter of the Supplies has subsequently been brought to another location than the Purchaser's branch office, unless doing so complies with the normal use of the Supplies.
9. The Purchaser's right of recourse against the Supplier pursuant to Sec. 478 BGB is limited to cases where the Purchaser has not concluded an agreement with its customers exceeding the scope of the statutory provisions governing claims based on Defects. Moreover, No. 8 above shall apply mutatis mutandis to the scope of the right of recourse the Purchaser has against the Supplier pursuant to Sec. 478 para. 2 BGB.
10. The Purchaser shall have no claim for damages based on Defects. This shall not apply to the extent that a Defect has been fraudulently concealed, the guaranteed characteristics are not complied with, in the case of loss of life, bodily injury or damage to health, restrictions to liberty and/or intentionally or grossly negligent breach of contract on the part of the Supplier. The above provisions do not imply a change in the burden of proof to the detriment of the Purchaser. Any other or additional claims of the Purchaser exceeding the claims provided for in this Article VIII, based on a Defect, are excluded.

IX. INDUSTRIAL PROPERTY RIGHTS AND COPYRIGHT; DEFECTS IN TITLE

1. Unless otherwise agreed, the Supplier shall provide the Supplies free from third parties' industrial property rights and copyrights (hereinafter referred to as "IPR") with respect to the country of the place of delivery only. If a third party asserts a justified claim against the Purchaser based on an infringement of an IPR by the Supplies made by the Supplier and used in conformity with the contract, the Supplier shall be liable to the Purchaser within the time period stipulated in Article VIII No. 2 as follows:
   a) The Supplier shall choose whether to acquire, at its own expense, the right to use the IPR with respect to the Supplies concerned or whether to modify the Supplies such that they no longer infringe the IPR or replace them. If this would be impossible for the Supplier under reasonable conditions, the Purchaser may rescind the contract or reduce the remuneration pursuant to the applicable statutory provisions.
   b) The Supplier's liability to pay damages is governed by Article XI.
   c) The above obligations of the Supplier shall apply only if the Purchaser (i) immediately notifies the Supplier of any such claim asserted by the third party in written form, (ii) does not concede the existence of an infringement and (iii) leaves any protective measures and settlement negotiations to the Supplier's discretion. If the Purchaser stops using the Supplies in order to reduce the damage or for other good reason, it shall be obliged to point out to the third party that no acknowledgement of the alleged infringement may be inferred from the fact that the use has been discontinued.
2. Claims of the Purchaser shall be excluded if it is responsible for the infringement of an IPR.
3. Claims of the Purchaser are also excluded if the infringement of the IPR is caused by specifications made by the Purchaser, by a type of use not foreseeable by the Supplier or by the Supplies being modified by the Purchaser or being used together with products not provided by the Supplier.
4. In addition, with respect to claims by the Purchaser pursuant to No. 1 a) above, Article VIII Nos. 4, 5, and 9 shall apply mutatis mutandis in the event of an infringement of an IPR.
5. Where other defects in title occur, Article VIII shall apply mutatis mutandis.
6. Any other claims of the Purchaser against the Supplier or its agents or any such claims exceeding the claims provided for in this Article IX, based on a defect in title, are excluded.

X. IMPOSSIBILITY OF PERFORMANCE; ADAPTATION OF CONTRACT

1. To the extent that delivery is impossible, the Purchaser is entitled to claim damages, unless the Supplier is not responsible for the impossibility. The Purchaser's claim for damages is, however, limited to an amount of 10 % of the value of the part of the Supplies which, owing to the impossibility, cannot be put to the intended use. This limitation shall not apply in the case of mandatory liability based on intent, gross negligence or loss of life, bodily injury or damage to health; this does not imply a change in the burden of proof to the detriment of the Purchaser. The Purchaser's right to rescind the contract shall be unaffected.
2. Where unforeseeable events within the meaning of Article IV No. 2 substantially change the economic importance or the contents of the Supplies or considerably affect the Supplier's business, the contract shall be adapted taking into account the principles of reasonableness and good faith. To the extent this is not justifiable for economic reasons, the Supplier shall have the right to rescind the contract. If the Supplier intends to exercise its right to rescind the contract, it shall notify the Purchaser thereof without undue delay after having realized the repercussions of the event; this shall also apply even where an extension of the delivery period has previously been agreed with the Purchaser.

XI. OTHER CLAIMS FOR DAMAGES; STATUTE OF LIMITATIONS

1. The Purchaser has no claim for damages based on whatever legal reason, including infringement of duties arising in connection with the contract or tort.
2. The above shall not apply in the case of mandatory liability, e. g. under the German Product Liability Act ("Produkthaftungsgesetz"), in the case of intent, gross negligence, loss of life, bodily injury or damage to health, or breach of a condition which goes to the root of the contract ("wesentliche Vertragspflichten"). However, claims for damages arising from a breach of a condition which goes to the root of the contract shall be limited to the foreseeable damage which is intrinsic to the contract, unless caused by intent or gross negligence or based on liability for loss of life, bodily injury or damage to health. The above provision does not imply a change in the burden of proof to the detriment of the Purchaser.
3. To the extent that the Purchaser has a claim for damages, it shall be time-barred upon expiration of the statute of limitations pursuant to Article VIII No. 2. The same shall apply to the Purchaser's claims in connection with actions undertaken to avoid any damage (e. g. callback). In the case of claims for damages under the German Product Liability Act, the statutory statute of limitations shall apply.

XII. VENUE AND APPLICABLE LAW

1. If the Purchaser is a businessman, sole venue for all disputes arising directly or indirectly out of the contract shall be the Supplier's place of business. However, the Supplier may also bring an action at the Purchaser's place of business.
2. Legal relations existing in connection with this contract shall be governed by German substantive law, to the exclusion of the United Nations Convention on contracts for the International Sale of Goods (CISG).

XIII. SEVERABILITY CLAUSE

The legal invalidity of one or more provisions of this Agreement in no way affects the validity of the remaining provisions. This shall not apply if it would be unreasonable for one of the parties to be obligated to continue the contract.

In addition to the General Terms & Conditions for Products and Services supplied by the Electrical Industry the purchaser represents and warrants to Hengstler that he shall comply with Hengstlers' anti-corruption program provided on www.Hengstler.com. He represents and warrants that he shall comply with all local, national, and other laws of all jurisdictions globally relating to anti corruption, bribery, extortion, kickbacks, or similar matters which are applicable to purchasers' business activities in connection with all Hengstler products included in this order confirmation and that the purchaser will take no action that will cause himself or Hengstler to violate any such laws.

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